ROMTEC UTILITIES OPERATION & MAINTENANCE MANUAL

FOR:

BAY MEADOWS
(SAN MATEO, CA)

DATE: October 13, 2014

REVISION: 0

CUSTOMER CONTACT INFORMATION:

Customer Name
Company Name
111 Company Address
City, State Zip Code
(555) 555-5555
customername@companyname.com

ROMTEC UTILITIES
18240 North Bank Road ~ Roseburg ~ OR ~ 97470
541.496.9678(ph) / 541.496.0804(fx)
romtec3@romtecutilities.com

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1. INTRODUCTION

This section contains the necessary information and procedures for the understanding and use of this document by the client and other parties of interest.

This section is structured as follows:

1.01 ABOUT THIS DOCUMENT

1. Document Identification

The information in this document is the Operation & Maintenance Manual (O&M) provided by Romtec Utilities, Inc., herein referred to as Romtec Utilities for the project listed below:

Name (herein referred to as “the project”): Bay Meadows

Location (herein referred to as “the site”): San Mateo, California

Document Date: 10/13/2014

Revision #: 0

2. Document Description

This document contains all the as-built drawings, operation and maintenance manuals, and manufacturer warranties for the associated mechanical and electrical components of this project.

3. Document Delivery

The electronic copy of the Romtec Utilities Operation & Maintenance Manual will be provided to the customer at start-up of the system.

1.02 CONTACT INFORMATION

Pump Station Supplier:

Romtec Utilities, Inc.
18240 North Bank Rd.
Roseburg, OR 97470
541-496-3541; Fax: 541-496-0803
romtec3@romtec.com; www.romtecutilities.com

Wet Well:

Concrete:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Hatch:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Sealant:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Joint Tape:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

1.02 CONTACT INFORMATION

Pipe Boot:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Barrel Gasket:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Coupling:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Lining & Coating:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Pumps:

Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Level Sensors:

Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

1.02 CONTACT INFORMATION

Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Valve Vault:

Concrete:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Hatch:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Valves:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Coupling:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

1.02 CONTACT INFORMATION

Pressure Transducer:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Meter Vault:

Concrete:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Hatch:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Sealant:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Joint Tape:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

1.02 CONTACT INFORMATION

Pipe Boot:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Adapter:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Flow Tube:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Odor Control:

Concrete:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Fiberglass Shelter: Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

Blower:
Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

1.02 CONTACT INFORMATION

Generator:

Company Name
111 Company Address
(555) 555-5555
customername@companyname.co
m

Electrical:

Control Panel Supplier:
Romtec Utilities, Inc.
18240 North Bank Rd.
Roseburg, OR 97470
541-496-3541; Fax: 541-496-0803
romtec3@romtec.com; www.romtecutilities.com

1.03 ROMTEC UTILITIES LIMITED WARRANTY

Romtec Utilities Limited Warranty

Romtec Utilities, Inc. (herein referred to as “Romtec Utilities”) warrants that the equipment supplied will be free from defects in material and workmanship under normal use and service, when used in accordance with the Romtec Utilities procedures as set forth below for a period of one year from date of acceptance (acceptance is defined as the date Romtec Utilities’ “Start-Up” report is completed) or one year and six months from installation of the wet well (or delivery of the wet well or the date that the wet well was ready to deliver), whichever comes first. The obligation of Romtec Utilities under this warranty is limited to replacing or repairing any defective part (failure of other manufacturer supplied components will be addressed according to the individual manufacturer’s warranty, the periods of which, and the manufacturer’s obligations therein may differ from Romtec Utilities’ Warranty). This warranty extends only to Romtec Utilities’ direct customer (as named in the Romtec Utilities Purchase Order), herein called “customer”, and not to any person or entity with whom customer has business relationships, or any party other than customer.

Note: This warranty is in lieu of all other warranties, express or implied, including but not limited to the implied warranties of merchantability and fitness for purpose, which implied warranties are excluded. Romtec shall not be liable for consequential or incidental damages.

1. Components resold or supplied with Romtec Utilities materials

Certain components are warrantable directly by the original manufacturer for periods between 90 days and 5 years. Replacement for, repair or refund of defective workmanship or material under normal use shall be remunerated directly with the manufacturer of the component. Examples of components would be generators, manual cranes, pumps, pump controls, valves, etc.

2. Warranty voidable

Romtec Utilities’ representative must be on-site for oversight of assembly during installation of the wet well. Wet Well installation that is performed without the presence of a Romtec Utilities representative shall void all warranties related to the wet well structure and its performance.

Start-up that is performed without the presence of a Romtec Utilities representative shall void all warranties.

3. Claims of defective manufacture

Claims that the merchandise was incorrectly manufactured or that is defective in any way must be made directly to Romtec Utilities on a product-by-product basis. All claims must be made within 72 hours of the defective condition, or the time when the defect should have been discovered, whichever is earlier. All claims must include the following:

a. A detailed description of the specific problem, failure, or other event giving rise to the claim; and

b. Supporting photographs or videos; and

c. Specific location; and

d. Names and phone numbers of individuals who can substantiate the claim, but who do not work for contractor.

4. Failure of pump station

Romtec Utilities pump stations pump all types of water containing all kinds of materials. Sometimes pumps may clog or power may be lost and the pump station will fail to operate. If your station fails to operate, Romtec Utilities will suggest a local service company to evaluate the problem. If it is a warranty issue, Romtec Utilities will repair and/or replace per the terms of this warranty. If however, the pumps are simply “clogged” or the power is simply lost Romtec Utilities will advise you that it is not a warranty issue and you will simply pay for the service call and the associated services.

5. Action in event of established claim

In the event it is determined that goods have been incorrectly manufactured or are defective, the liability of Romtec Utilities shall be limited to, at its option, repair or replacement of the goods. Romtec Utilities also reserves the right to establish reasonable time limits for completion of any specific installation tasks resulting from the replacement of defective merchandise.

6. No third party claims

Under no circumstances shall Romtec Utilities be responsible for any damage claims by any party other than claims by Romtec Utilities direct customers.

7. Release and hold harmless

Contractor releases and agrees to defend, indemnify, and hold Romtec Utilities harmless from and against any and all claims, demands, actions, and causes of action for any matters arising out of or connected with the materials whereby the contractor is responsible for errors or omissions.

8. Specific limitations

Romtec Utilities’ liability under the foregoing warranty and under the transaction of which this document is a part is limited as follows:

a. Romtec Utilities has designed the lift station supplied under this project to meet a specific design standard and specific set of parameters as dictated to Romtec Utilities by its customer as set forth in the “Lift Station Design Form” located in the Romtec Utilities Scope of Supply and Design Submittal.

b. Romtec Utilities’ Scope of Supply & Design Submittal is a part of and limited by CUSTOMER’S site civil and electrical plans.

c. Romtec Utilities makes no guarantees that any of its supply will fit on customer’s site and/or building. However, at customer’s request,

1.03 ROMTEC UTILITIES LIMITED WARRANTY

Romtec Utilities will provide suggested layouts for the customer's project. Ultimately, the customer decides to accept or reject any given layout.

d. Romtec Utilities cannot make final layout or equipment placement judgments at the site (i.e. generator or control panel "fit" in or out of a building). It is the responsibility of customer's site engineer and contractor to check dimensions, etc. If customer has not accepted (or received) final dimensions, etc., please request further definition before approval. Romtec Utilities is not responsible for items that do not fit on the site.

e. It is Romtec Utilities' customer's responsibility and obligation to review the Romtec Utilities Scope of Supply & Design Submittal to insure it meets with customer approval relative to any customer third party agreements.

f. Romtec Utilities is not responsible for any aspect of the construction and installation of the Romtec Utilities lift station. The Contractor bears sole responsibility for installation of products manufactured by Romtec Utilities. The Romtec Utilities Scope of Supply and Design Submittal defines Romtec Utilities scope of supply relative to equipment, documentation, start-up services and warranty.

g. If Romtec Utilities is on site during the construction/installation of the Romtec Utilities lift station it is only as an advisor. Romtec Utilities is never on site to perform any construction and/or installation tasks.

h. Romtec Utilities designs and prefabricates its lift station system to enable contractors to install the Romtec Utilities system quickly and completely. However, Romtec Utilities has made no representation and/or claims as to "how long" it will take to construct/install the Romtec Utilities system.

Note: If any Romtec Utilities-supplied part is found to be defective and/or has been manufactured in error relative to this document, Romtec Utilities will repair and/or replace that part at Romtec Utilities' expense. Romtec Utilities does not offer, nor will Romtec Utilities accept, any charges and/or claims by anyone relative to the time it takes to install/construct the Romtec Utilities system and or claims for delays relative to a part that has to be repaired and/or replaced by Romtec Utilities.

i. Romtec Utilities' responsibility is to its direct customer. We want to help all parties, but we are ultimately responsible only to our direct customer. If Romtec Utilities' direct customer has hired a sub-contractor, Romtec Utilities will communicate with that sub-contractor through a representative of Romtec Utilities' direct customer. In other words, Romtec Utilities will not direct and/or advise any sub-contractor. Instead, Romtec Utilities will communicate directly with its "direct customer" and they will communicate with their sub-contractors, engineers, and/or owners.

j. The Romtec Utilities design reflects all elevations and/or orientations to an accuracy of +/- 0.10'. Romtec Utilities does not claim to manufacture any aspect of its lift station systems to absolute elevations. It is simply not possible in the general underground construction world to meet absolutes. Therefore, any owner and/or installer of a Romtec Utilities system is accepting the Romtec Utilities system proposed herein to the plus or minus 0.10' offered by Romtec Utilities.

9. Performance Characteristics and Start-Up.

Note: Start-up services are only supplied by Romtec Utilities if included in the proposal and subsequent purchase order.

a. The lift station is a sophisticated device that can be operated in many different ways. The Romtec Utilities Scope of Supply & Design Submittal defines Romtec Utilities' approach to the operation of the lift station.

Note: While there are many ways to vary and/or adjust "operational parameters" within the overall lift station, Romtec Utilities is only prepared to start-up per its own parameters (as specified in the customer's design criteria, see attached).

b. Romtec Utilities' obligation is to show that the station can run as designed to meet specific design criteria as shown in its Scope of Supply & Design Submittal. It is understood that the regulating agency may want to test many other scenarios. This will not be part of the standard Romtec Utilities start-up procedures and training. At start-up, Romtec Utilities will only prove that the station can run at the pre-specified design parameters.

c. Romtec Utilities is not an operator, installer or an electrical interconnector for the lift stations and equipment it supplies.

d. During start-up, Romtec Utilities is completely in charge. Romtec Utilities' start-up technician will start-up and "prove" the station per the approved Romtec Utilities Scope of Supply & Design Submittal. After the lift station is accepted other parties may choose to adjust and/or vary the operational parameters to suit their specific preference. However, Romtec Utilities will not be involved with these issues either during or after start-up, and is not responsible for problems arising from any adjustments or variations by such other parties.

1.03 ROMTEC UTILITIES LIMITED WARRANTY

10. Training (if included in the proposal).

<u>Note</u>: Training services are only supplied by Romtec Utilities if included in the proposal and subsequent purchase order.

a. Romtec Utilities will perform system training at no additional cost as part of its scope of supply if the training is scheduled for the day after start-up. If training is scheduled for any other time than the day after start-up, Romtec Utilities will require prepayment of the additional costs (incurred as a result of the need to reschedule) prior to confirming the alternate training schedule. If training is scheduled for any other time other than the day after start-up, Romtec Utilities will require prepayment of the additional costs incurred as a result of the need to reschedule.

2. PERMITS & REPORTS

Keep all permits and reports in this section for the project. Engineer or contractor to insert permits and reports related to this pump station. The Romtec Utilities start-up reports will be sent after the start-up is complete. Please insert in this section when received.

This section is structured as follows:

2.01 PERMITS

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(ENGINEER/CONTRACTOR TO INSERT PERMITS FOR THIS PUMP STATION)

2.02 START-UP REPORTS

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(THE ROMTEC UTILITIES START-UP REPORTS WILL BE SENT AFTER THE START-UP IS COMPLETE. PLEASE INSERT IN THIS SECTION)

2.03 INSPECTION REPORTS

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(ENGINEER/CONTRACTOR TO INSERT INSPECTION REPORTS FOR THIS PUMP STATION)

3. MECHANICAL

This section contains information pertaining to the mechanical design of this system. There is both technical information and related drawings necessary for the system construction.

This section is structured as follows:

3. MECHANICAL

3.01 ROMTEC UTILITIES SCOPE OF SUPPLY: PRODUCTS

COMPLETE PUMP STATION INCLUDES:

WET WELL & RELATED EQUIPMENT

QTY	ITEM
1	INTERIOR COATING - TNEMEC 61
1	EXTERIOR COATING - TNEMEC 61
1	BASE ASSEMBLY
1	GROUT RING - 10ft - 45 DEG
1	BASE - WW - 10ft - RU FLAT BASE - NO GROUT- 6in UPLIFT COLLAR
3	ANCHOR KIT - DISCHARGE ELBOW
3	DISCHARGE ELBOW - 4in - 540 13 05
3	COUPLING - ROMAC - RFCA - 6in FBEC - SS HARDWARE
3	REDUCER - 316 SS - ECCENTRIC - 6in X 4in
3	GASKET - FLANGE - 4in X 1/8in
1	BARREL - 10ft DIA X 3ft H
1	BARREL - 10ft DIA X 4ft H
2	BARREL - 10ft DIA X 5ft H
1	TOP SLAB ASSEMBLY
1	HATCH - WW - 10ft H20 - TRIPLEX - 54800 - 46 X 109
1	TOP SLAB - WW - 10ft H20 - TRIPLEX
4	CABLE HANGER ASSEMBLY
1	DEFLECTOR PANEL ASSEMBLY - 4ft
1	GUILLOTINE CABLE ASSEMBLY - 14ft
1	HDPE - 24in X 24in X 1/2in - BLACK - cut from 4ft x 8ft
2	BRACKET - SS GUILLOTINE SET
1	HDPE - 4ft X 8ft X 1-2in - BLACK
8	ANGLE - 316SS 11GA FORMED (10ftww)
2	DISCHARGE PIPE SUPPORT - WALL BRACKET SET
3	DISCHARGE CLAMP - U-BOLT - 6in 316SS
3	DISCHARGE CLAMP BOLT - 1-2 X 1 SS BOLT, WASHER, FIBER LOCK NUT
1	DISCHARGE PIPE SUPPORT - BOLT KIT
1	SHIPPING CRATE
5	BARREL GASKET
1	HATCH KEY
3	BRACKET - UPPER GUIDE BAR - 2in SS
4	LIFTING CLUTCH - 8 TON
3	BOLT & NUT KIT - UPPER GUIDE BAR BRACKET - 3-8in
3	BOW SHACKLE - 3-8in - SS W-SCREW PIN
3	BOW SHACKLE - 1-2in - SS W-SCREW PIN
1	GRIP EYE UNIT
3	CORD GRIP - 1.25in - 1.49 DIA SS
3	LIFTING SLING - .125in SS CABLE - 3 @ 20ft
6	CHAIN - S5 9-32in 316SS 3 @ 2ft

3.01 ROMTEC UTILITIES SCOPE OF SUPPLY: PRODUCTS

3	GASKET - FLANGE - 6in X 1/8in
196	TAPECOAT - 6in X .65mils X LFT
217.5	SEALANT - 1in X 1in X 14.5ft CS-202
1	NEVER SIEZE - TUBE
4	FLOAT - NOLTA - MS1 - 20m
1	ULTRASONIC TRANSDUCER - XPS-15
1	BRACKET - TRANSDUCER - HANGING
1	HANGING BRACKET - 16in - SS
1	DISCHARGE PIPE BRACKET - 10ft WW - 6in PIPE
3	PUMP - FLYGT - NP3171 HT 452 30HP
7	PIPE - 316SS - 6in SCH40 (1 @ 82in)
33	PIPE - 316SS - 6in SCH40 (3 @ 11ft)
15	PIPE - 316SS - 6in SCH40 (2 @ 86in)
114	PIPE - 316SS - 2in SCH40 (6 @ 19ft)
4	KOR-N-SEAL - 8in CORE -1.70 THRU 4.80 PIPE
3	KOR-N-SEAL - 12in CORE - 6in PIPE
6	FLANGE - 316SS - 6in - 150# WELD NECK
3	ELBOW - 316SS - 6in - 90 DEG - SHORT
2	COUPLING - 4in SCH40 - SLP X SLIP
20	PIPE - 4in PVC - SCH40 - 20ft TOTAL
1	JUNCTION BOX ASSEMBLY
1	BASE - VV - 444B X 30in TALL
1	HATCH - FLOODTIGHT - H20 - 24X30
1	TOP SLAB -VV - 444 - H20
21	SEALANT - .75in X .75in X 21ft CS-202
17	TAPECOAT - 6in X .65mils X LFT
1	ADALET ENCLOSURE - EXPLOSION PROOF
1	ADALET ENCLOSURE - LEVEL SENSING
1	JUNCTION BOX SUPPORT BRACKET
3	CONDUIT UNIONS - 1-1/2in
3	CABLE GLANDS FOR UNARMORED CABLES - 1-1/2inNPT, 1.16n - 1.5in
5	SEAL OFFS - 40% FILL - 1in NPT
2	PLASTIC BUSHING 1in
4	CABLE CONNECTORS NYLON 1/2in HUBS - .062 - .125
5	NIPPLE - GALV - 1in X 3in
1	CABLE CONNECTORS NYLON 1/2in HUBS - .250 - .375
4	SEALING LOCK NUT - 1in
5	LOCKNUT - 1-1/2in

VALVE VAULT & ASSOCIATED MECHANICAL

QTY	ITEM
1	REDUCER - CONCENTRIC - 12in X 6in - 150LB - 316SS
1	EXTERIOR COATING - TNEMEC 61
1	BASE - VV - 6ft X 8ft
2	RISER - VV - 6 x 8 - 1 FT
1	HATCH - VV - 687 - H20 - 44 X 68
1	TOP SLAB - 6 X 8 - H20

3.01 ROMTEC UTILITIES SCOPE OF SUPPLY: PRODUCTS

3	PIPE STAND - 6in - S89 FLG - NO BASE
3	PIPE STAND - 6in - S92 SAD - NO BASE
2	VALVE KEY BRACKET
1	VALVE KEY - SPECIAL SWIVEL
10	PIPE - 316SS - 2in SCH40
1	NIPPLE - BRASS - 1/2in X 2in
1	NIPPLE - 1-4in - BRASS - CLOSE
1	BUSHING - BRASS - 1-2in MALE X 1-4in FEMALE THD
1	VALVE - BALL - 1/2in BRASS - 1/4 TURN
3	MECHANICAL INDICATOR - 6in
1	CAM LOCK - 6in MIPTXM - 316SS
1	DUST CAP - 6in 316SS CAMLOCK
1	BACKFLOW ACTUATOR - 4in & 6in
1	VALVE - PLUG - 6in - WITH HANDWHEEL
3	VALVE - SWING CHECK - 6in - 506A
3	VALVE - PLUG - 6in - GEAR OP
6	COUPLING - ROMAC - RFCA - 6in FBEC - SS HARDWARE
6	KOR-N-SEAL - 12in CORE - 6in PIPE
1	FLANGE - 316SS - 6in - COMPANION W-6in TAP
2	SPOOL - FLG X PE - 6in X 26in - 316SS
1	SPOOL - FLG X PE - 6in X 36in - 316SS
1	SPOOL - FLG X FLG - 6in X 92.25in - 316SS
3	WYE - 316SS - 12in X 6in - FLG
3	ELBOW - 316SS - 6in - 45 DEG - FLG X FLG
2	ELBOW - 316SS - 6in - 90 DEG - FLG X FLG
3	GASKET - FLANGE - 12in X 1/8in
14	GASKET - FLANGE - 6in X 1/8in
130.5	SEALANT - 1in X 1in X 14.5ft CS-202
1	PRESSURE TRANSDUCER - ASHCROFT - 1/4in NPT
1	PRESSURE TRANSDUCER ISOLATOR

METER VAULT & ASSOCIATED MECHANICAL

QTY	ITEM
1	BASE - VV - 444B
4	RISER - VV - 444 - 1 FT
1	HATCH - FLOODTIGHT - H20 - 24X30
1	TOP SLAB -VV - 444 - H20
2	PIPE STAND - 12in - S92 SAD - NO BASE
1	PIPE - 316SS - 12in X 48 IN
1	FLOW TUBE - 12in - ABB WATER MASTER
2	MEGAFLANGE ADAPTER - 12in - SERIES2100
2	KOR-N-SEAL - 16in CORE - 12in PIPE
1	SPOOL - FLG X PE - 12in X 60in - SCH40 316SS
1	GASKET - FLANGE - 12in X 1/8in
105	SEALANT - .75in X .75in X 21ft CS-202
85	TAPECOAT - 6in X .65mils X LFT

3.01 ROMTEC UTILITIES SCOPE OF SUPPLY: PRODUCTS

1	NEVER SIEZE - TUBE
1	TRANSMITTER - ABB - IP68 RATED
1	SIGNAL CABLE - ABB - 100FT

GENERATOR

QTY	ITEM
1	100KW DIESEL GENERATOR W/ 24 HOUR FUEL TANK
1	AUTOMATIC TRANSFER SWITCH

ODOR CONTROL SYSTEM

QTY	ITEM
1	ENCLOSURE - INSULATED FIBERGLASS
1	BLOWER - EXPLOSION PROOF REGENERATIVE TYPE
2	NIPPLE - 316SS - 2in X 6in
2	NIPPLE - 316SS - 2in SCH40 X CLOSE
1	NIPPLE - 316SS - 2in SCH40 X 3.5in
2	NIPPLE - 316SS - 2in X CLOSE
1	BUSHING - 316SS - 2in FEMALE X 1in MALE THD
1	BUSHING - 316SS - 1in MALE THD X 1-8in FEMALE THD
2	HOSE FITTING - PUSH X MALE THD - 1-8in
1	HOSE - NYLON - 1-8in - 2ft
2	BUSHING - SS - 4inX2in
2	UNION - 316SS - 2in
2	FLANGE - PVC- 4in SCH40 - 150# - SOC
2	SPOOL - FLG X PE - 4in X 24in - 316SS - 4in FTHD X 4in FLG
4	ELBOW - 316SS - 2in - 90 DEG - - THREADED
1	TEE - 316SS - 2in - THREADED
2	GASKET - FLANGE - 4in X 1/8in
2	COUPLING - 4in SCH40 - SLP X SLIP
3	ELL; 4" PVC 90, SLIP X SLIP -SCH40
4	PIPE - 4in PVC - SCH40 - 1 @ 48in
1	PIPE - 4in PVC - SCH40 - 1 @ 12in
6	PIPE - 4in PVC - SCH40 - 1 @ 72in
1	PIPE - 4in PVC - SCH40 - 2 @ 6in
1	PRESSURE SWITCH
1	BASE - VAULT - PRECAST - 6ft6in X 10ft X 5ft10in - NO TOP SLAB
3	CAP - PVC - 4in SCH40
3	TEE - PVC - 4in SCH40 - SLIP
3	COUPLING - PVC - 4in SCH40 - 150# - SOC
5	ELBOW - PVC - 4in SCH40 - 90 DEG - SLIP X SLIP
3	4in PVC - SCH 40 X 24in
8	PIPE - 4in PVC - SCH80 X 2 @ 48in
9	PIPE - 4in PVC - SCH80 X 3 @ 36in

3.01 ROMTEC UTILITIES SCOPE OF SUPPLY: PRODUCTS

1	CROSS - PVC - 4in - SCH40
24	PIPE - 4in PVC - SCH40 X 3 @ 96in - PERFORATED
3	CAP - THREADED - PVC - 4in - SCH40

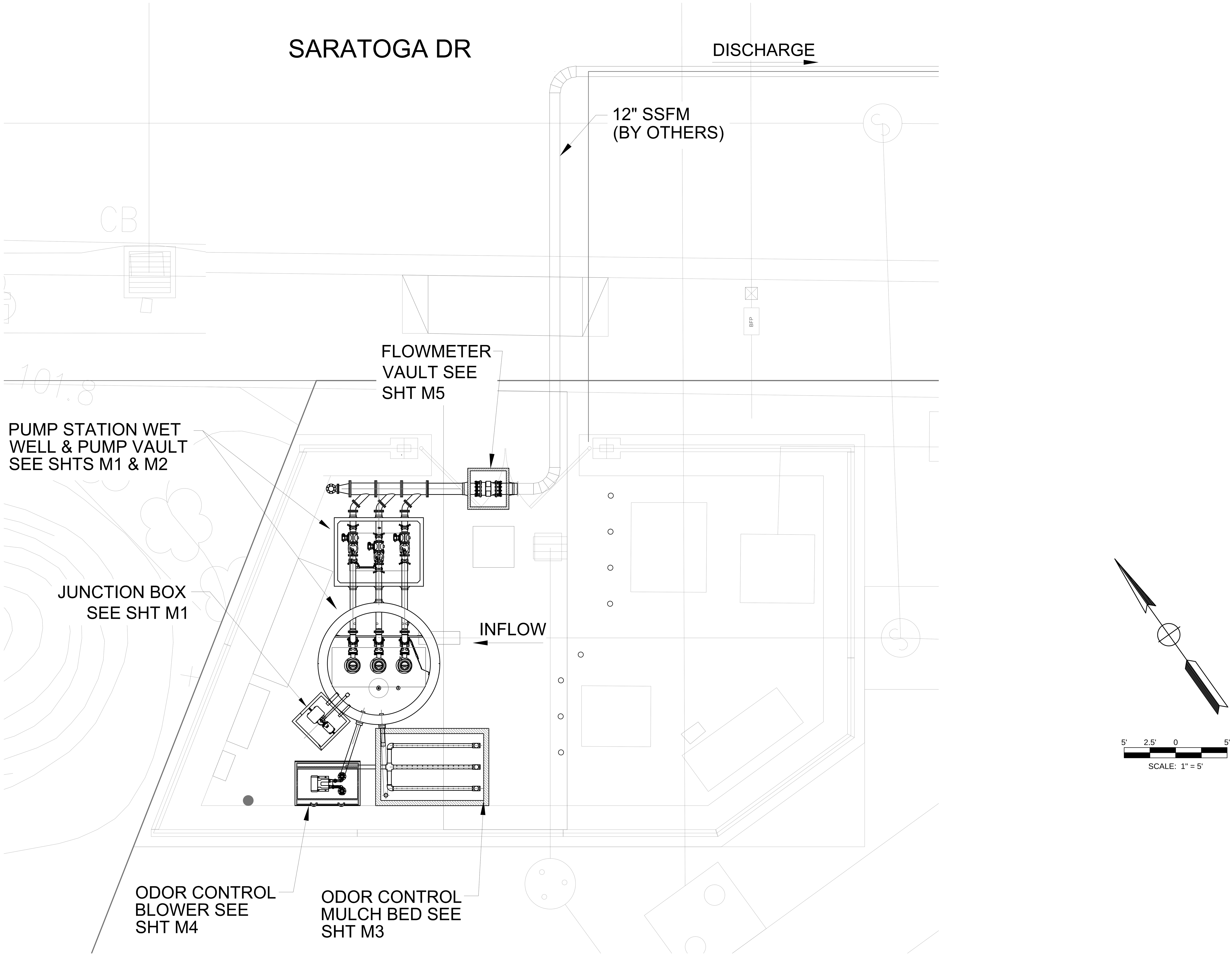
CONTROL PANEL/ELECTRICAL & COMMUNICATION

QTY	ITEM
1	Arc Armor Duplex PLC Control Panel w/VFD's and Flow Meter
1	Meltrics Generator Receptacle for connection to standby power.
1	Motorola ACE3600 PLC/RTU

3.02 WET WELL

This section contains information pertaining to the Wet Well. There is both technical information and related drawings necessary for the Wet Well construction.

This section is structured as follows:



Company Name
111 Company Address
(555) 555-5555
customername@companyname.com

NO.	REVISION	DATE

BAY MEADOWS
(SAN MATEO, CA.)

SITE PLAN

REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

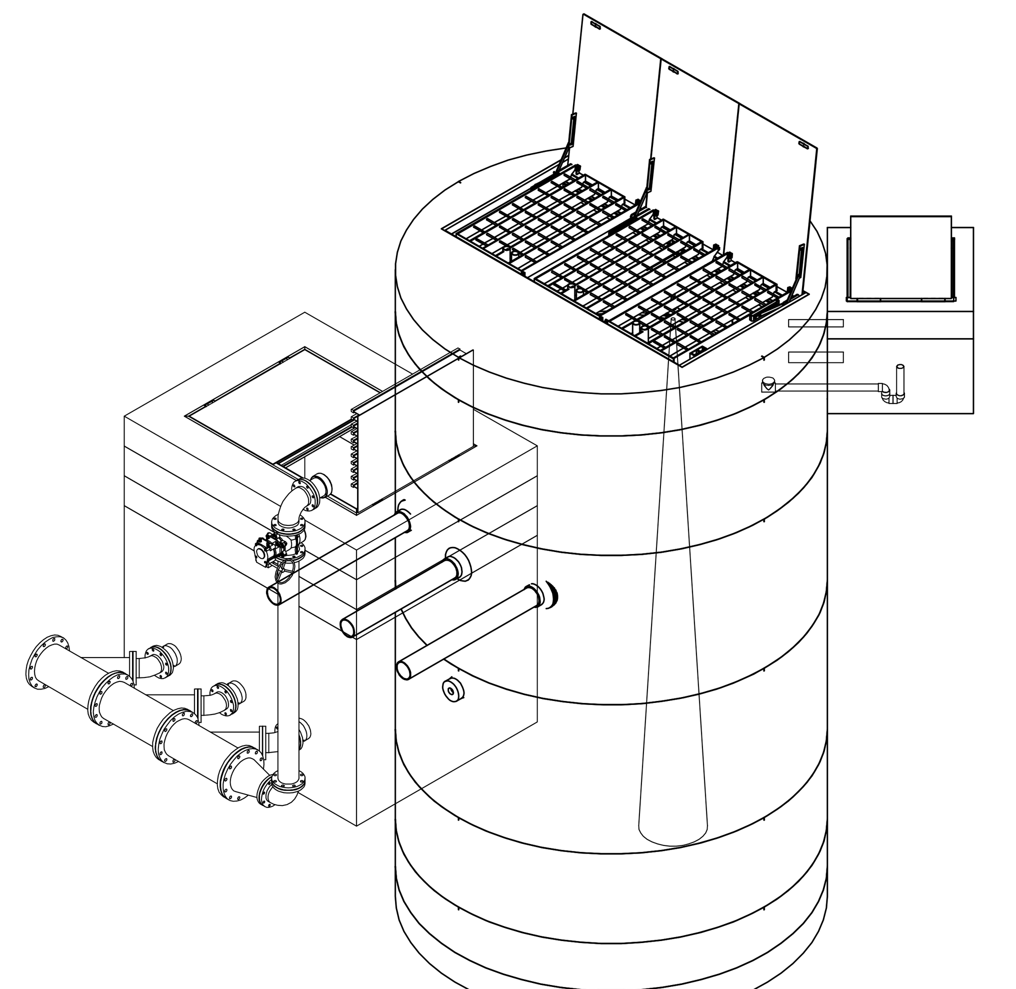
DRAWING
C1

Contact: John Doe
Project #:
File #: 000000

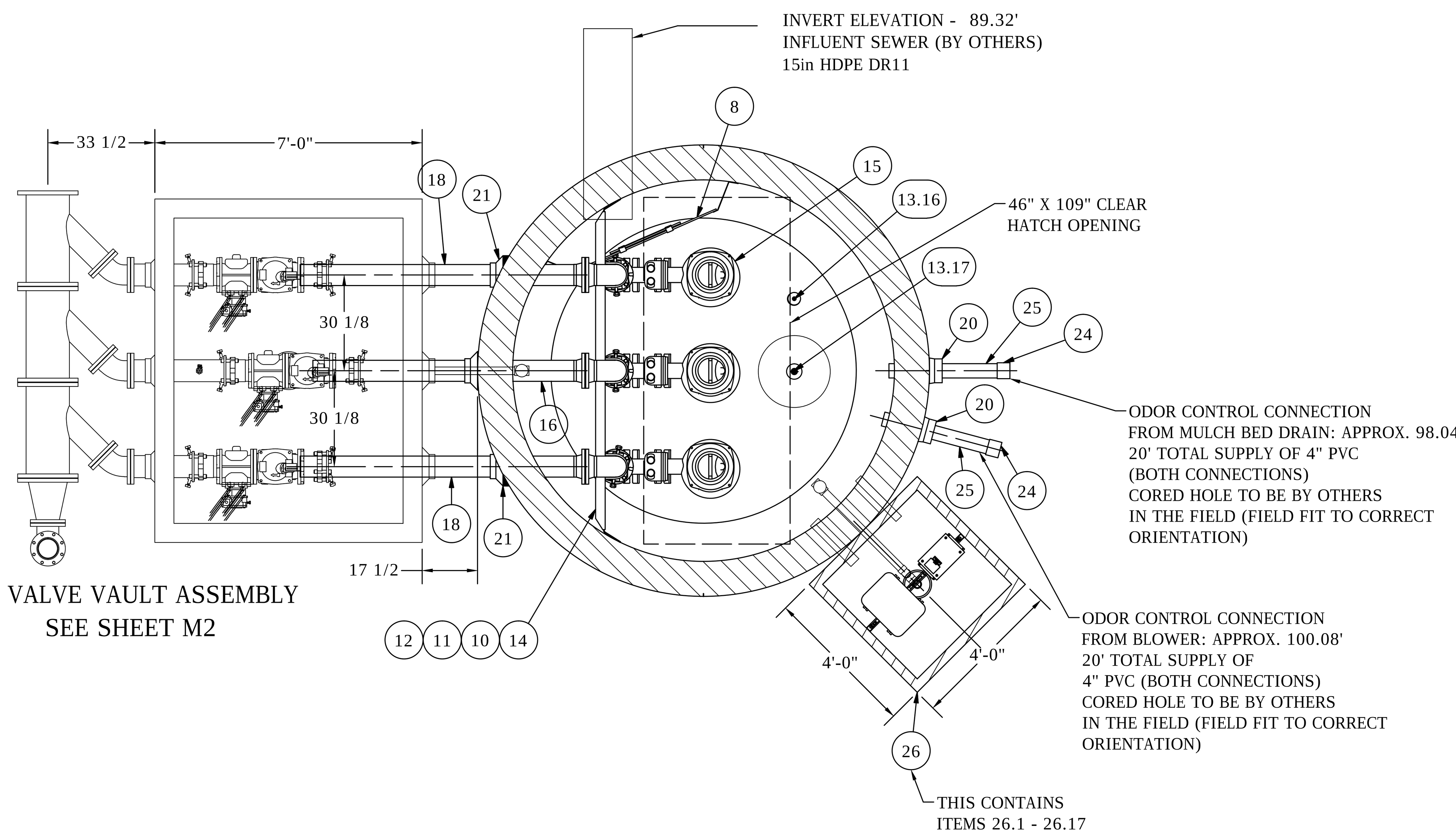
10-14-11

Two working days before you dig
CALL FOR THE BLUE STAKES
1-800-STAKE-IT
Blue Stake Center
1-800-782-5348

$USER$
$DATE$
$TIME$
$FILENAME$

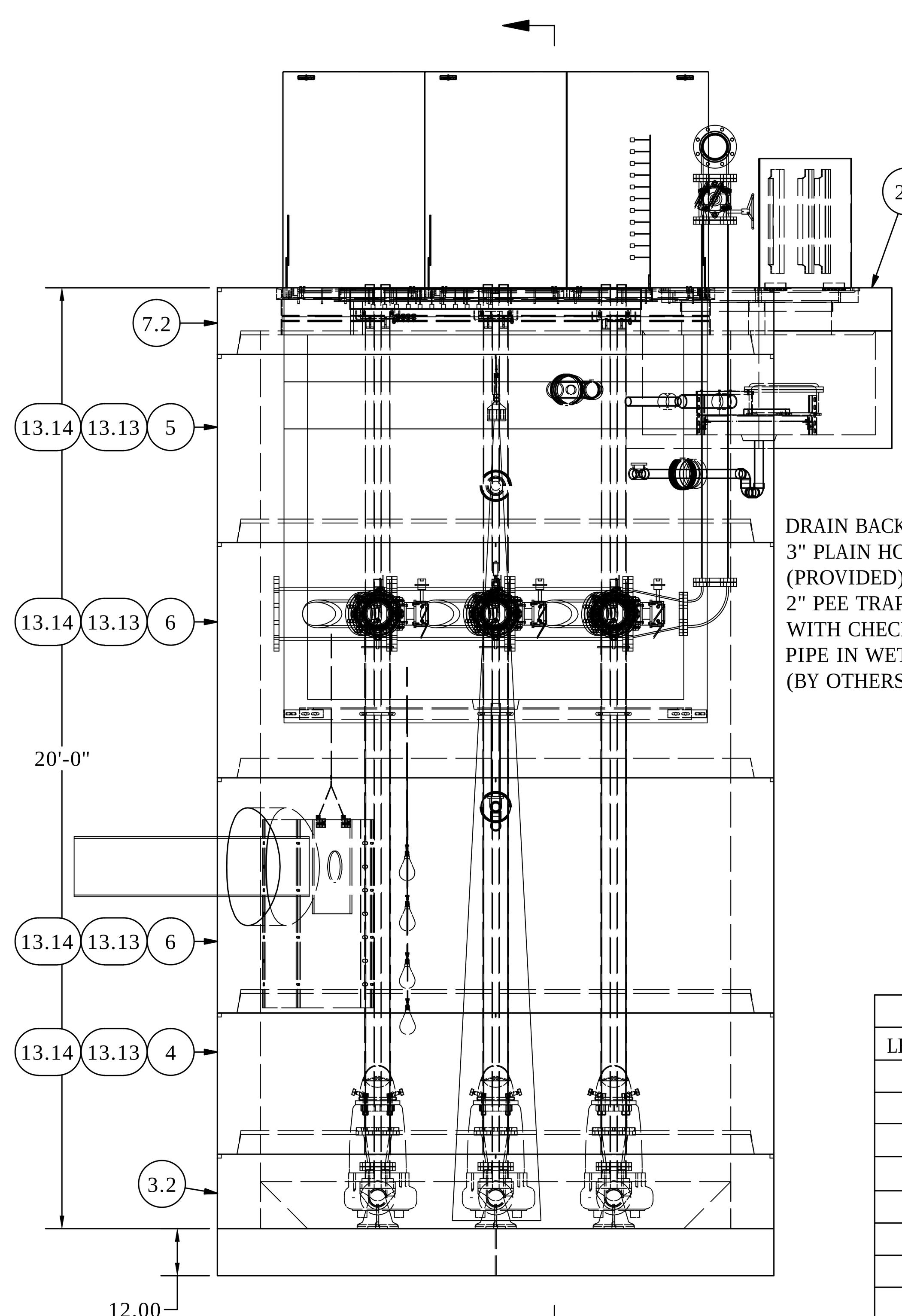


VALVE VAULT REFERENCE
DRAWING ONLY: SEE VALVE
VAULT COMPONENT
DRAWING (SECTION 10)
FOR VALVE VAULT DETAILS
AND PARTS LIST



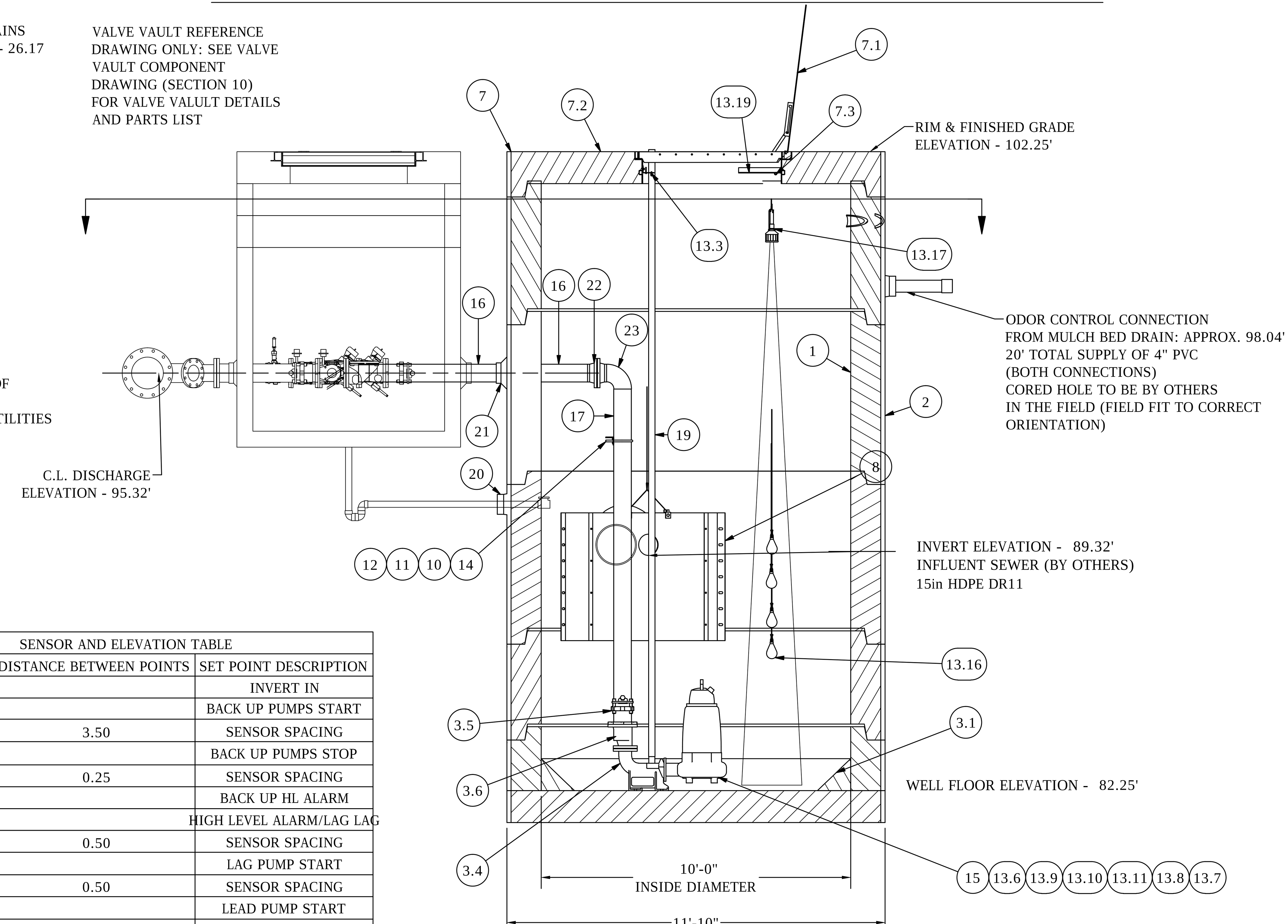
6' X 8' VALVE VAULT ASSEMBLY
SEE SHEET M2

NOTE: WET WELL TOP SLAB IS H-20 OCCASIONAL TRAFFIC RATED



DRAIN BACK TO WET WELL:
3" PLAIN HOLE IN VAULT
(PROVIDED)
2" PEE TRAP ON VAULT END
WITH CHECK VALVE AT END OF
PIPE IN WET WELL.
(BY OTHERS) NOT ROMTEC UTILITIES

VALVE VAULT REFERENCE
DRAWING ONLY: SEE VALVE
VAULT COMPONENT
DRAWING (SECTION 10)
FOR VALVE VALULT DETAILS
AND PARTS LIST



SENSOR AND ELEVATION TABLE		
LEVEL ELEVATION	DISTANCE BETWEEN POINTS	SET POINT DESCRIPTION
89.32		INVERT IN
93.75		BACK UP PUMPS START
	3.50	SENSOR SPACING
90.25		BACK UP PUMPS STOP
	0.25	SENSOR SPACING
90.00		BACK UP HL ALARM
89.75		HIGH LEVEL ALARM/LAG LAG
	0.50	SENSOR SPACING
89.25		LAG PUMP START
	0.50	SENSOR SPACING
88.75		LEAD PUMP START
	3.50	SENSOR SPACING
85.25		PUMP STOP
	3.00	DISTANCE TO FLOOR
82.25		FLOOR ELEVATION

NOTE: ALL DIMENSIONS AND ELEVATIONS SHOWN ARE NOMINAL DIMENSIONS. IT IS THE RESPONSIBILITY OF THE ON-SITE CONTRACTOR OR ROMTEC UTILITIES CUSTOMER (NOT ROMTEC UTILITIES) TO VERIFY THE ACCURACY OF ANY CRITICAL DIMENSIONS OR ELEVATIONS PRIOR TO SETTING OR INSTALLING ANY EQUIPMENT.

Parts List			
ITEM	QTY	STOCK NUMBER	DESCRIPTION
1	1	10-XXXX	INTERIOR COATING - TNEMEC 61
2	1	10-XXXX	EXTERIOR COATING - TNEMEC 61
3	1	10-XXXX	BASE ASSEMBLY
3.1	1	10-5364	GROUT RING - 10ft - 45 DEG
3.2	1	10-XXXX	BASE - WW - 10ft - RU FLAT BASE - NO GROUT- 6in UPLIFT COLLAR
3.3	3	31-6040	ANCHOR KIT - DISCHARGE ELBOW
3.4	3	31-6071	DISCHARGE ELBOW - 4in - 540 13 05
3.5	3	42-5247	COUPLING - ROMAC - RFCA - 6in FBEC - SS HARDWARE
3.6	3	44-XXXX	REDUCER - 316 SS - ECCENTRIC - 6in X 4in
3.7	3	47-6546	GASKET - FLANGE - 4in X 1/8in
4	1	12-4613	BARREL - 10ft DIA X 3ft H
5	1	12-4614	BARREL - 10ft DIA X 4ft H
6	2	12-5905	BARREL - 10ft DIA X 5ft H
7	1	14-XXXX	TOP SLAB ASSEMBLY
7.1	1	13-5380	HATCH - WW - 10ft H20 - TRIPLEX - 54800 - 46 X 109
7.2	1	14-5382	TOP SLAB - WW - 10ft H20 - TRIPLEX
7.3	4	18-6115	CABLE HANGER ASSEMBLY
8	1	15-4591	DEFLECTOR PANEL ASSEMBLY - 4ft
8.1	1	15-5365	GUILLOTINE CABLE ASSEMBLY - 14ft
8.2	1	15-6042	HDPE - 24in X 24in X 1/2in - BLACK - cut from 4ft x 8ft
8.3	2	15-6047	BRACKET - SS GUILLOTINE SET
8.4	1	50-6045	HDPE - 4ft X 8ft X 1-2in - BLACK
8.5	8	50-6139	ANGLE - 316SS 11GA FORMED (10ftww)
9	2	18-6009	DISCHARGE PIPE SUPPORT - WALL BRACKET SET
10	3	18-XXXX	DISCHARGE CLAMP - U-BOLT - 6in 316SS
11	3	18-FAST	DISCHARGE CLAMP BOLT - 1-2 X 1 SS BOLT, WASHER, FIBER LOCK NUT
12	1	18-FAST	DISCHARGE PIPE SUPPORT - BOLT KIT
13	1	18-XXXX	SHIPPING CRATE
13.1	5	12-ROM	BARREL GASKET
13.2	1	13-ROM	HATCH KEY
13.3	3	18-6015	BRACKET - UPPER GUIDE BAR - 2in SS
13.4	4	18-6020	LIFTING CLUTCH - 8 TON
13.5	3	18-6031	BOLT & NUT KIT - UPPER GUIDE BAR BRACKET - 3-8in
13.6	3	32-5942	BOW SHACKLE - 3-8in - SS W-SCREW PIN
13.7	3	32-5943	BOW SHACKLE - 1-2in - SS W-SCREW PIN
13.8	1	32-6016	GRIP EYE UNIT
13.9	3	32-6064	CORD GRIP - 1.25in - 1.49 DIA SS
13.10	3	32-6354	LIFTING SLING - .125in SS CABLE - 3 @ 20ft
13.11	6	32-6600	CHAIN - S5 9-32in 316SS 3 @ 2ft
13.12	3	47-6547	GASKET - FLANGE - 6in X 1/8in
13.13	196	51-5949	TAPECOAT - 6in X .65mils X LFT
13.14	217.5	51-6081	SEALANT - 1in X 1in X 14.5ft CS-202
13.15	1	51-ROM	NEVER SIEZE - TUBE
13.16	4	60-4574	FLOAT - NOLTA - MS1 - 20m
13.17	1	60-5044	ULTRASONIC TRANSDUCER - XPS-15
13.18	1	62-4561	BRACKET - TRANSDUCER - HANGING
13.19	1	62-4564	HANGING BRACKET - 16in - SS
14	1	18-XXXX	DISCHARGE PIPE BRACKET - 10ft WW - 6in PIPE
15	3	30-5500	PUMP - FLYGT - NP3171 HT 452 30HP
16	7	40-6049	PIPE - 316SS - 6in SCH40 (1 @ 82in)
17	33	40-6049	PIPE - 316SS - 6in SCH40 (3 @ 11ft)
18	15	40-6049	PIPE - 316SS - 6in SCH40 (2 @ 86in)
19	114	40-6253	PIPE - 316SS - 2in SCH40 (6 @ 19ft)
20	4	43-5186	KOR-N-SEAL - 8in CORE -1.70 THRU 4.80 PIPE
21	3	43-6113	KOR-N-SEAL - 12in CORE - 6in PIPE
22	6	44-6123	FLANGE - 316SS - 6in - 150# WELD NECK
23	3	46-XXXX	ELBOW - 316SS - 6in - 90 DEG - SHORT
24	2	48-4297	COUPLING - 4in SCH40 - SLP X SLIP
25	20	48-5464	PIPE - 4in PVC - SCH40 - 20ft TOTAL
26	1	65-XXXX	JUNCTION BOX ASSEMBLY
26.1	1	20-4875	BASE - VV - 444B X 30in TALL
26.2	1	23-4713	HATCH - FLOODTIGHT - H20 - 24X30
26.3	1	24-4716	TOP SLAB -VV - 444 - H20
26.4	21	51-5510	SEALANT - .75in X .75in X 21ft CS-202
26.5	17	51-5949	TAPECOAT - 6in X .65mils X LFT
26.6	1	61-4851	ADALET ENCLOSURE - EXPLOSION PROOF
26.7	1	61-4852	ADALET ENCLOSURE - LEVEL SENSING
26.8	1	62-XXXX	JUNCTION BOX SUPPORT BRACKET
26.9	3	62-XXXX	CONDUIT UNIONS - 1-1/2in
26.10	3	62-XXXX	CABLE GLANDS FOR UNARMORED CABLES - 1-1/2inNPT, 1.16n - 1.5in
26.11	5	62-5528	SEAL OFFS - 40% FILL - 1in NPT
26.12	2	62-XXXX	PLASTIC BUSHING 1in
26.13	4	62-XXXX	CABLE CONNECTORS NYLON 1/2in HUBS - .062 - .125
26.14	5	62-XXXX	NIPPLE - GALV - 1in X 3in
26.15	1	62-XXXX	CABLE CONNECTORS NYLON 1/2in HUBS - .250 - .375
26.16	4	62-XXXX	SEALING LOCK NUT - 1in
26.17	5	62-XXXX	LOCKNUT - 1-1/2in

10'DIAMETER WET WELL
6" DISCHARGE PIPING
NP3171 FLYGT PUMPS

ALL MATERIALS SHOWN ON THIS SHEET WILL BE SUPPLIED BY ROMTEC UTILITIES AND DELIVERED TO THE SITE AFTER THE HOLE HAS BEEN EXCAVATED AND SHORED. THE CONTRACTOR SHALL SUPPLY A CRANE OF SUFFICIENT SIZE TO LOWER ALL THE CONCRETE PIECES INTO THE HOLE SAFELY. THE THE CONTRACTOR SHALL INSTALL THE WET WELL (AND VALVE VAULT AND METERING VAULT IF APPLICABLE). ROMTEC UTILITIES WILL PROVIDE A REPRESENTATIVE FOR TECHNICAL ASSISTANCE ON THE DAY OF INSTALLATION TO ANSWER ANY QUESTIONS THAT MAY ARISE. THE CONTRACTOR IS RESPONSIBLE FOR ALL PLUMBING AND ELECTRICAL CONNECTIONS AND INSTALLATION. ITEMS NOTED AS "BY OTHERS" WILL BE PROVIDED AND INSTALLED BY THE CONTRACTOR. ROMTEC UTILITIES WILL NOT INSTALL ANY OF THE COMPONENTS SHOWN ON THIS PAGE.

DATE

REVISION

NO.

BAY MEADOWS
(SAN MATEO, CA.)

10' - WET WELL - 6" PIPING

REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

Two working days before you dig
CALL FOR THE BLUE STAKES
1-800-STAKE-IT
Blue Stake Center
1-800-782-5348

DRAWING
M1

Contact:
Project #:
CFile #:

10-14-11

$USER$
$DATE$
$TIME$
$FILENAME$

Bay Meadows - groundwater at 97.4ft **7/12/2013**

Romtec Utilities

Preliminary Bouyancy Calculation Spreadsheet — 10 ft wetwell

11/13/13 1:51 PM (last updated)

Design Criteria

ID	Wetwell Inside Diameter	**10**	ft	
Tts	Top Slab Thickness	12	inch	
	Top Slab Weight	**13,200**	lb calculated	xxxx lb (based on 08 CA Pipe estimates)
Tw	Wall Thickness	11	inch	
OD	Barrel Outside Diameter	11.8	ft	
	Barrel volume/ft based on OD	109.98	ft^3	
	Wall Volume/ft	31.44	ft^3	
	Wall Weight/ft	4,716	lb	
Tbs	Base Slab Thickness	12	inch	
Hbi	Base Inside Height	24.00	in (sump height)	
	Base Weight	**22,600**	lb calculated	xxxx lb (based on 08 CA Pipe estimates)
	Overhang type	RECTANGLE		
Elat	Base Overhang (lateral)	0	inch	
Elong	Base Overhang (long.)	0	inch	
	Overhang width	0.00	ft	
Ao	Overhang Area	0.00	ft^2	Uplift collar width in inches **0**
	Concrete Unit Weight	150	lb/ft^3	
	Soil Unit Weight (dry)	100	lb/ft^3	Assumed SG 2.50
	Equiv Soil Unit Wt (saturated)	60.0	lb/ft^3	

Bouyant Force: Assumes groundwater to 5.25ft below surface at 97.00'

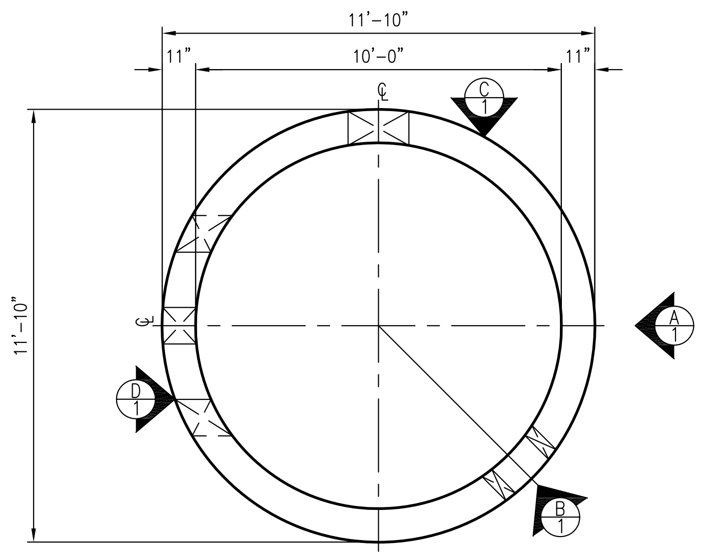
	Wetwell Depth (ground level to sump invert, assuming lid set flush)					
	10	15	**20**	25	30	35
Uplift Vol (ft^3), barrel + base	523.4	1,073.3	**1,623.2**	2,173.1	2,722.9	3,272.8
Uplift Force (lb), total	32,660	66,973	**101,286**	135,599	169,912	204,225

Downward Force:

	Wetwell Depth (ground level to sump invert, assuming lid set flush)					
	10	15	**20**	25	30	35
Barrel height, top of extended base to underside of top slab (ft)	7.00	12.00	**17.00**	22.00	27.00	32.00
Top Slab Weight (lb)	13,200	13,200	**13,200**	13,200	13,200	13,200
Barrel Weight (lb)	33,010	56,588	**80,166**	103,745	127,323	150,901
Base Slab Weight (lb)	22,600	22,600	**22,600**	22,600	22,600	22,600
Total Wetwell Weight (lb)	68,810	92,388	**115,966**	139,545	163,123	186,701
Soil Vol above Overhang (ft^3)	0.0	0.0	**0.0**	0.0	0.0	0.0
Soil Wt above Overhang (lb)	0	0	**0**	0	0	0
Total Downward Weight	68,810	92,388	**115,966**	139,545	163,123	186,701
SF w/out skin friction/soil shear	2.11	1.38	**1.14**	1.03	0.96	0.91

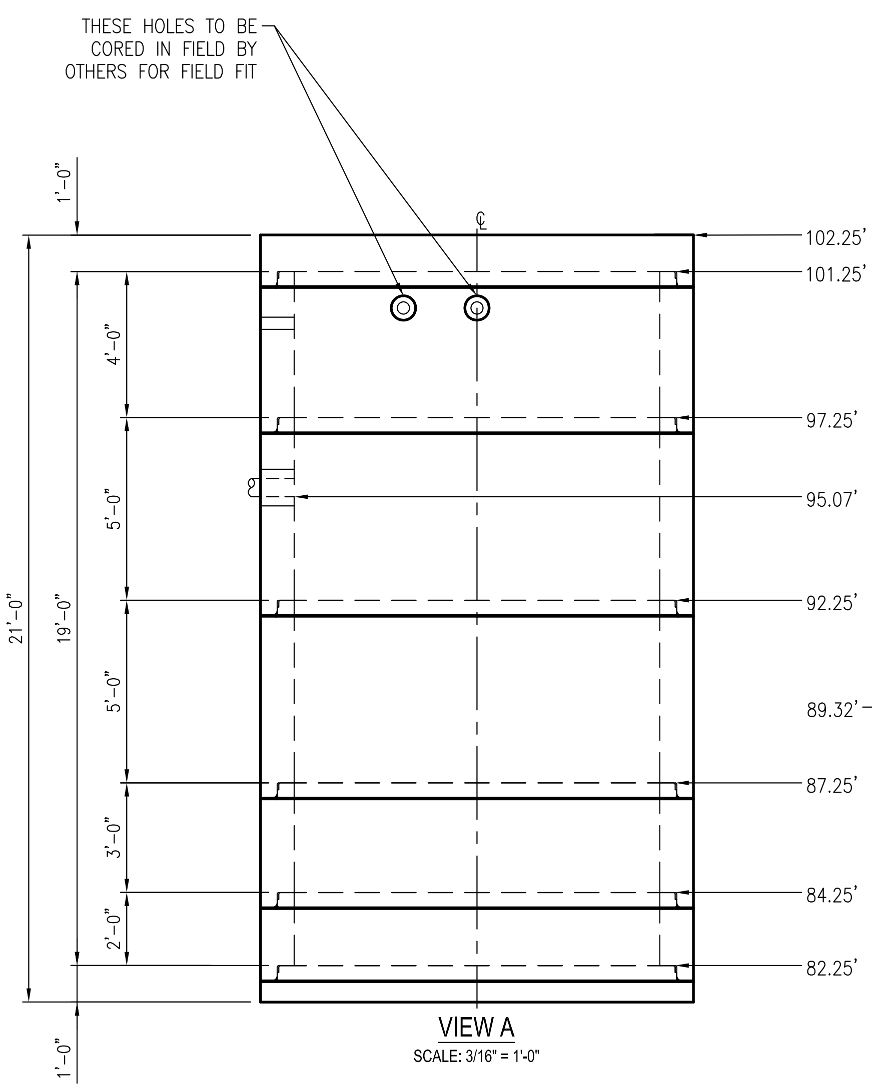
Top of wet well **102.25**

Inside floor of wet well **82.25**



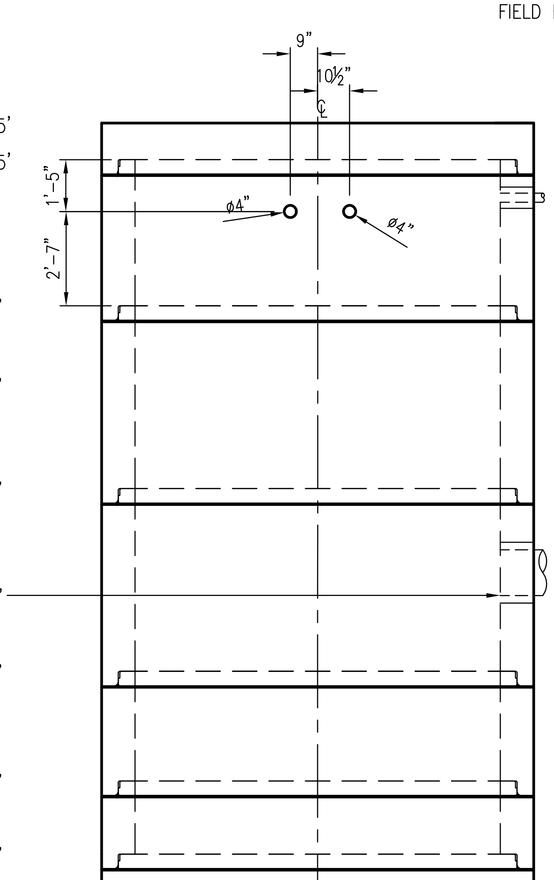
PLAN VIEW

SCALE: 3/16" = 1'-0"



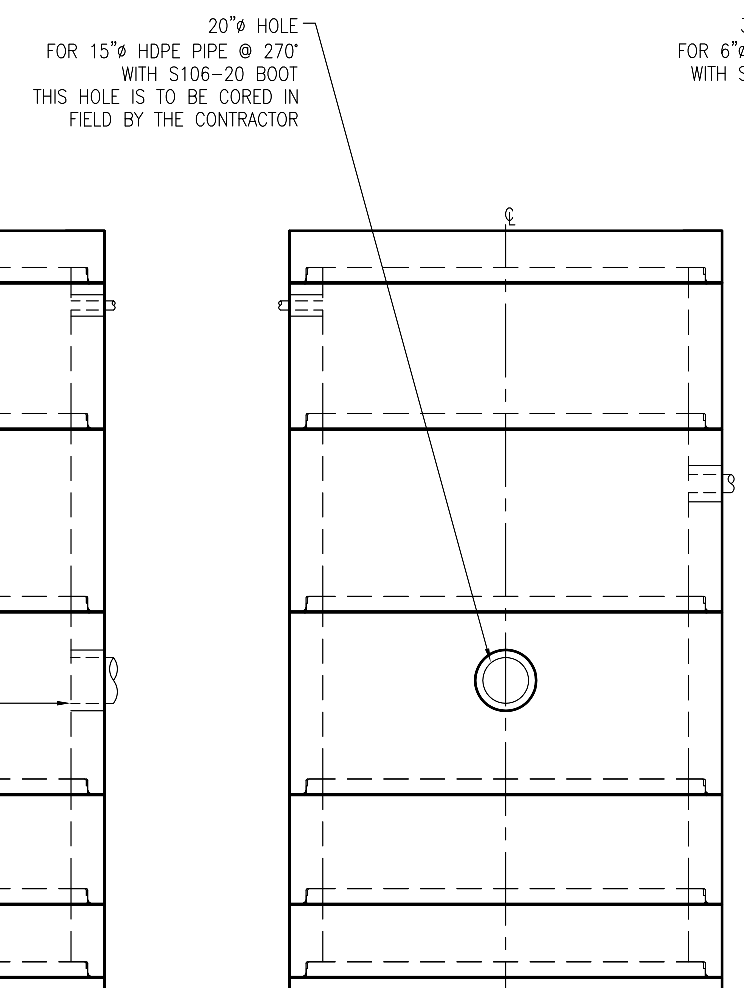
VIEW A

SCALE: 3/16" = 1'-0"



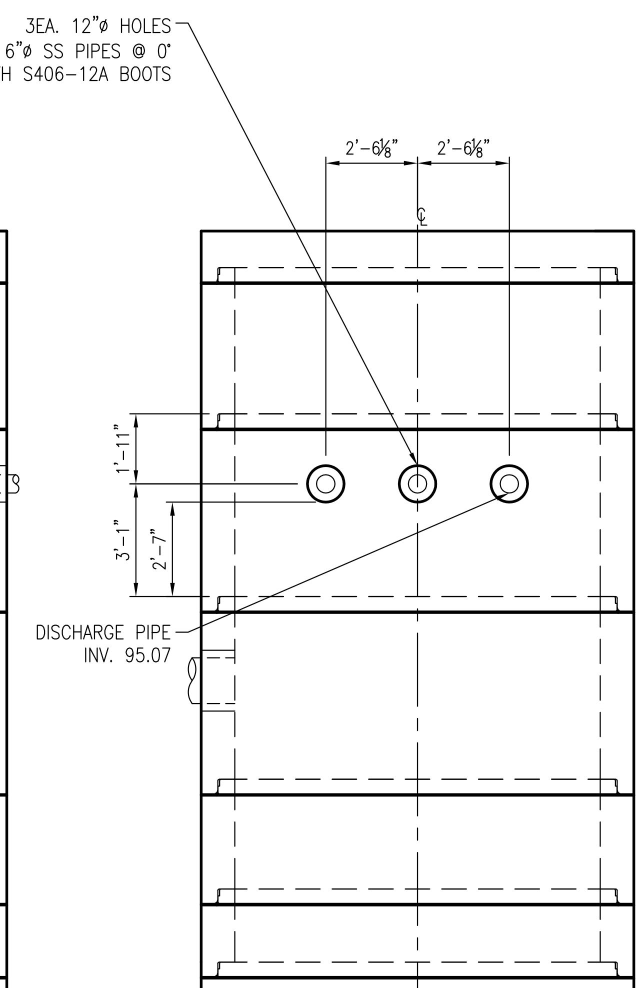
VIEW B

SCALE: 3/16" = 1'-0"



VIEW C

SCALE: 3/16" = 1'-0"



VIEW D

SCALE: 3/16" = 1'-0"

STRUCTURAL NOTES:

LOADS:
- H20 TRAFFIC
- 150 PCF CONCRETE DENSITY; 120 PCF SOIL DENSITY
- H20 SURCHARGE: 2 FT ABOVE FILL TO 8 FT BELOW GRADE
- DRY SOIL LATERAL LOAD - 40 PCF
- WET SOIL LATERAL LOAD - 80 PCF
- WATER TABLE - BELOW VAULT

DESIGN SPECIFICATIONS
- ACI-318-11 BUILDING CODE
- ASTM C 478 STANDARD SPECIFICATIONS FOR REINFORCED CONCRETE MANHOLE SECTIONS

MATERIALS:
- CONCRETE - 28 DAY COMPRESSIVE STRENGTH f'c =6000 PSI
- REBAR - ASTM A 706 GRADE 60
- CEMENT - ASTM C150
- FLYASH - ASTM C618

GENERAL NOTES:

1)CONTRACTOR TO:
  VERIFY ALL DIMENSIONS AND OPENING LOCATIONS
2)REBAR MAY BE TACK WELDED OR TIED
3)TOLERANCES PER ASTM C 478 STANDARD SPECIFICATIONS FOR REINFORCED CONCRETE MANHOLE SECTIONS

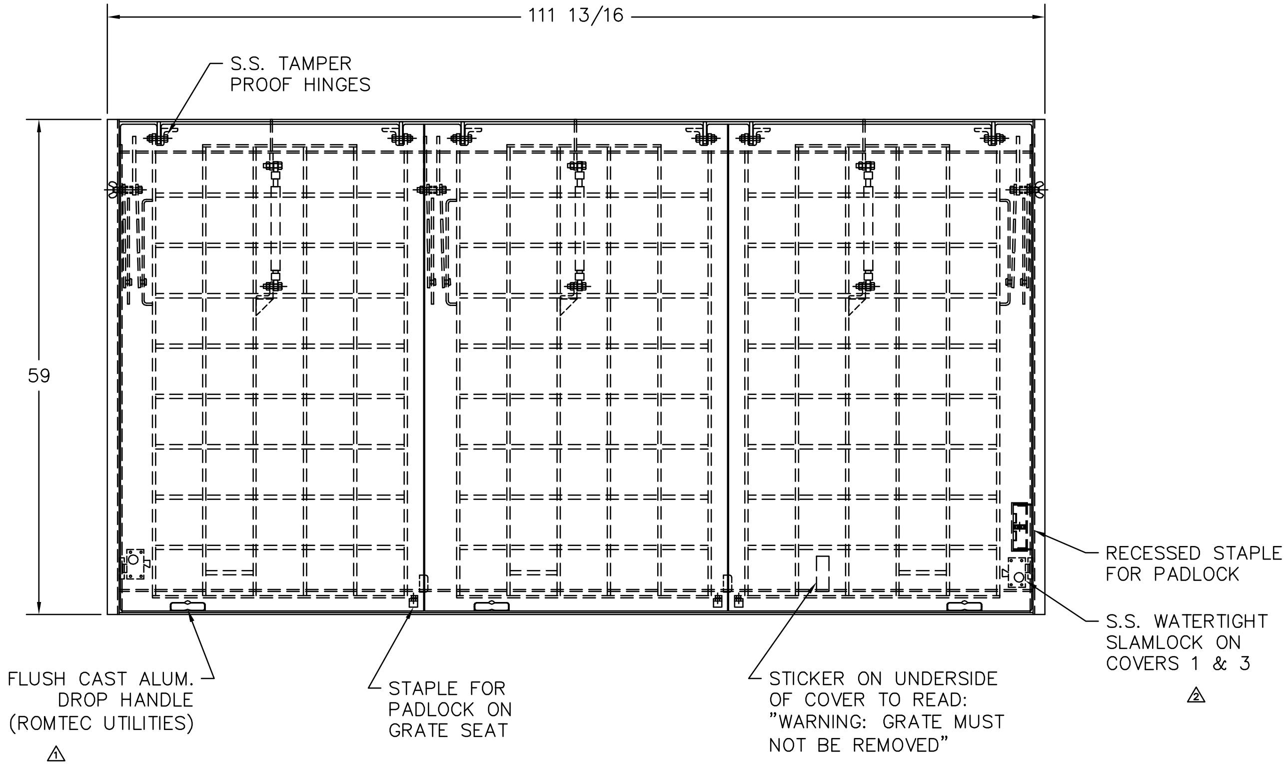
10'Ø X 19'-0" (I.D.)WET WELL

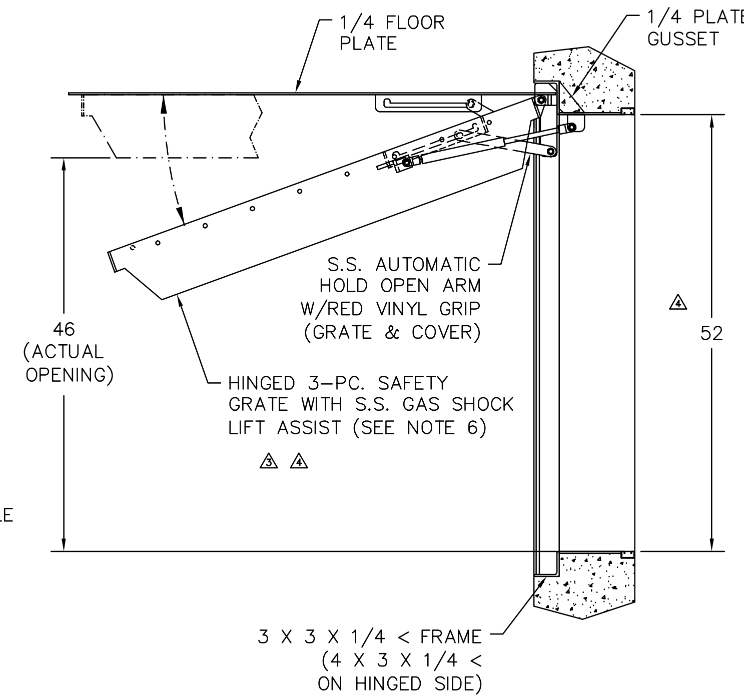
BAY MEADOWS
STOCKTON, CA

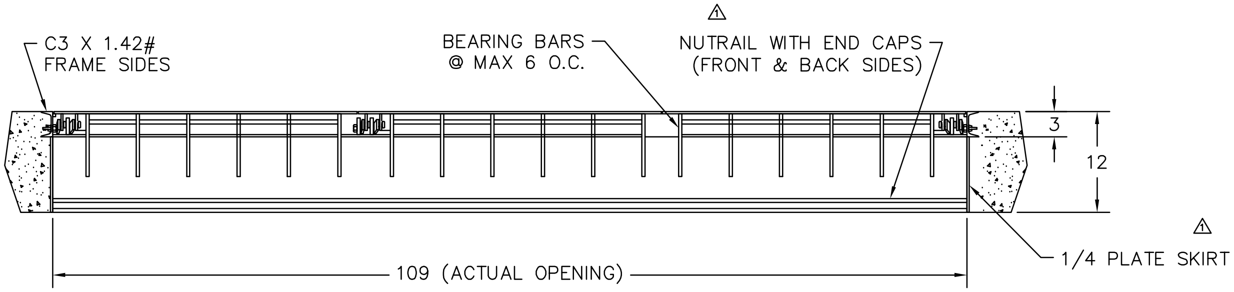
CUSTOMER
ROMTEC

DATE	SALES	DRAWN	ENGINEER	CHECKED	SALES ORDER
7/24/14	BD	VK	JM	JM	S18973

DRAWING NUMBER	REVISION	SHEET
030-S18973-085 - 7-24-14	1 REV DATE 07/10/14	1 OF 1







NOTES:
1- MATERIAL: ALUMINUM
2- LOADING: 16,000 LBS. WHEEL LOADS
3- 316 STAINLESS STEEL NUTS & BOLTS
4- AREA OF FRAME IN CONTACT WITH CONCRETE TO BE PAINTED WITH BITUMINOUS COATING
5- SAFETY GRATE TO BE PAINTED WITH SAFETY ORANGE POWDER COAT
6- LIFTING FORCE SHALL NOT EXCEED 15 LBS. TO LIFT SAFETY GRATE

REV.	DATE	BY	CHK.	DESCRIPTION
4	8/21/13	DAV	C.S.	UPDATED BEARING BARS PER 2013 SPECS. PER ECN# 0120 (52 WAS 50). S.S. SHOCKS WERE STD.
3	8/23/12	DAV		ADDED GAS SHOCKS & NOTE 6. UPDATED HINGE & REC. PADLOCK DESIGNS.
2	4/4/11	DAV		ADDED SLAMLOCK ON COVER 1.
1	7/6/09	DAV		SKIRT FOR 12" SLAB WAS FOR 8". ADDED NOTES.

INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M

BREAK ALL SHARP CORNERS & EDGES TO 0.01

TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONAL
1/16 = ±1/32
1/32 = ±1/64

ROMTEC 10 FT. DIA. WET WELL

, I

HATCH ASGT-16K 52 X 109 ALUMINUM
(46 X 109 ACTUAL OPENING)
WITH 2 SLAMLOCKS, RECESSED PADLOCK, NUTRAIL, SKIRT, BITUMINOUS PAINT & S.S. GAS SHOCKS

DWN. BY: DAV	SCALE: 1=12	QUOTE# 219027	DATE: 9/11/08
CHK. BY:	DWG. NO. 54800-R4	SHEET 1 OF 7	REV. 4

3.02.4 WET WELL DATA SHEETS

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Butyl Rubber Sealant

APPLICATIONS

For self-sealing joints in: Manholes, Concrete Vaults, Septic Tanks, Concrete Pipe, Box Culverts, Utility Vaults, Burial Vaults, and Vertical Panel Structures.

SEALING PROPERTIES

- Provides permanently flexible watertight joints.
- Low to high temperature workability: 0°F to 120°F (-12°C to 48°C)
- Rugged service temperature: -30°F to +200°F (-34°C to +93°C)
- Excellent chemical and mechanical adhesion to clean, dry surfaces.
- Sealed Joints will not shrink, harden or oxide upon aging.
- No priming normally necessary. When confronted with difficult installation conditions, such as wet concrete or temperatures below 40°F (4°C), priming the concrete will improve the bonding action. Consult Concrete Sealants for the proper primer to meet your application.

HYDROSTATIC STRENGTH

ConSeal CS-202 meets the hydrostatic performance requirement as set forth In ASTM C-990 section 10.1 (Performance requirement: 10psi for 10 minutes in straight alignment – in plant, quality control test for joint materials.)

SPECIFICATIONS

ConSeal CS-202 meets or exceeds the requirements of Federal Specification SS-S-210 (210-A), AASHTO M-198B, and ASTM C-990-91.

Butyl Rubber Sealant

PHYSICAL PROPERTIES

	Spec	Required*	CS-202
Hydrocarbon blend content % by weight	ASTM D4 (mod.)	50% min.	52%
Inert mineral filler % by weight	AASHTO T111	30% min.	35%
Volatile Matter % by weight	ASTM D6	2% max.	1.2
Specific Gravity, 77°F	ASTM D71	1.15-1.50	1.20
Ductility, 77°F	ASTM D113	5.0 min.	12
Penetration, cone 77°F, 150 gm. 5 sec.	ASTM D217	50-100	60-65
Penetration, cone 32°F, 150 gm. 5 sec.	ASTM D217	40 mm	50-55
Flash Point, C.O.C., °F	ASTM D92	350°F min.	425°F
Fire point, C.O.C., °F	ASTM D92	375°F min.	450°F

IMMERSION TESTING

• 30-Day Immersion Testing: No visible deterioration when tested in 5% Caustic Potash, 5% Hydrochloric Acid, 5% Sulfuric Acid, and 5% saturated Hydrogen Sulfide. *

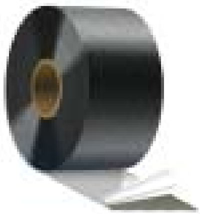
• One Year Immersion Testing: No visible deterioration when tested in 5% Formaldehyde, 5% Formic Acid, 5% Sulfuric Acid, 5% Hydrochloric Acid, 5% Sodium Hydroxide, 5% Hydrogen Sulfide and 5% Potassium Hydroxide.

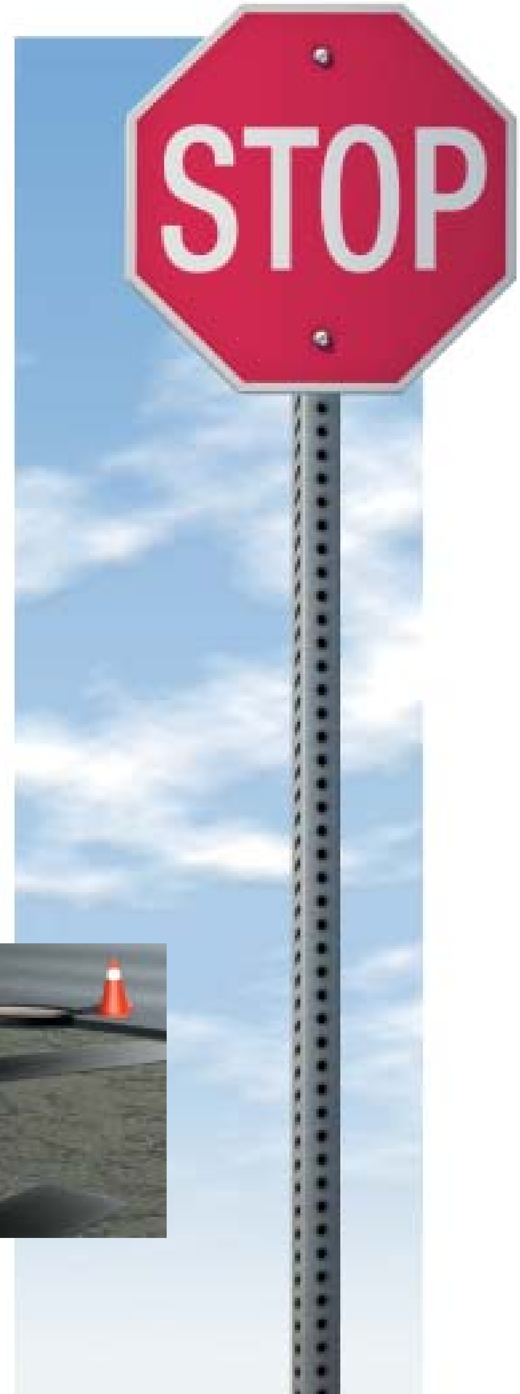
* Requirements of ASTM C-990 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.

ROMTEC UTILITIES RECOMMENDATION FOR USE AS JOINT TAPE

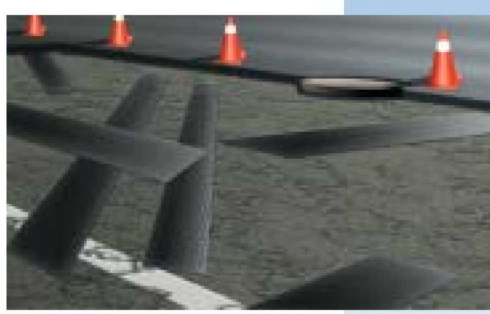
PAVEMENT REPAIR COATING

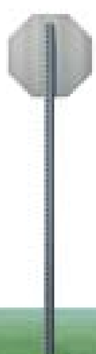
Protection for Concrete and Asphalt Surfaces





provides quick and easy repair of cracks in concrete and asphalt surfaces. This cold-applied, self-adhering tape is effective as a temporary patching material and also offers excellent bonding for repair of the substrate prior to a complete asphalt overlay. Tapecoat M860 solves maintenance problems in paving material on city streets, highways, and parking structures. This puncture-resistant coating can also protect transducer and sensor wiring from tire damage, prevent pavement deterioration due to deformation in heavy-traffic areas, and provide quick temporary repair to paved surfaces on bridges and airport runways and tarmacs. Tapecoat M860 retains its ability to bond under pressure at temperatures as low as 0° F, making this coating ideal for temporary repairs during the cold winter months.





Tapecoat can be used for manhole joint sealing tape.

Pavement Repair Coating

- *Excellent bond to concrete and asphalt surfaces*
- *Applies easily in long lengths or short pieces*
- *Cold-applied tape with quick release liner*
- *Impermeable to water and salt*
- *Puncture-resistant*
- *Prefabricated to provide uniform thickness*
- *Environment-friendly*

Features/Specifications/Application

A pre-formed, cold-applied, self-adhering material that is impermeable to water and salt.

Composition

Tapecoat M860 is a pre-formed, cold-applied coating. The adhesive is manufactured from specially formulated elastomer and resins bonded to a woven highly puncture-resistant polymer.

Technical Data

Color:	Black
Shelf life:	Rotate stock yearly
Low temp flex:	Excellent
Bacteria resistance:	Excellent
Thickness:	.060” Nominal
Water Vapor Transmission Rate, Permeance:	0.01 perms(grams/sq.ft.hr./in. Hg) Maximum
Tensile Strength:	50 lb.in. Minimum
Puncture Resistance: (Mesh)	200 lb. Minimum
Pliability-1/4” Mandrel 180° bend -30°F:	No cracks in mesh or adhesive

Surface Preparation

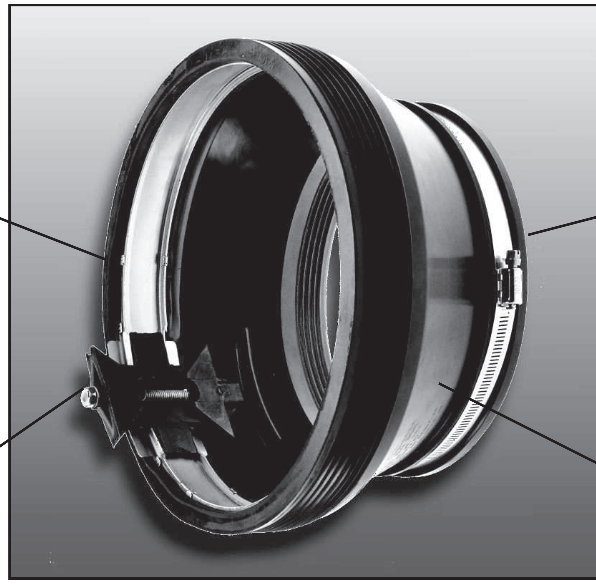
Tapecoat M860 should be applied over dry pavement that is free of dirt, debris or other foreign matter. Pavement cracks wider than 3/8” should be pre-filled with hot or cold crack material prior to applying Tapecoat M860 to assure longer protection of the crack filling material against surface wear.

Option

If the application is taking place in extreme cold (below 32°F/O°C) a liquid primer will enhance the immediate bond. TC Omniprime is the compatible primer for use with this product.

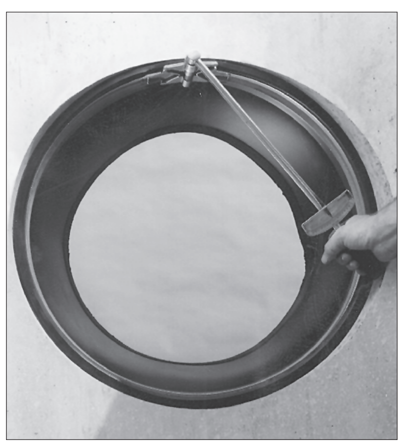
FLEXIBLE PIPE-TO-MANHOLE CONNECTORS

SPECIFICATION SHEET



WEDGE KORBAND CONNECTOR ASSEMBLY

Install - Wedge Korband with Socket Wrench & Torque Limiter



Install Wedge Korband with Standard Torque Wrench

Install Pipe Clamp(s) with T-Handle Torque Wrench

Flexible Pipe-to-Manhole Connectors

SPECIFICATION SHEET

PERFORMANCE

Test	ASTM Method	Test Requirements	Kor-N-Seal ® I & II
Head Pressure	C923 - 7.1	0° - 13 psi (30 ft) for 10 min. 7° - 10 psi (23 ft) for 10 min.	+13 psi for 10 min. +10 psi for 10 min.
Deflection Test	C923 - 7.2.2	7° in any direction	Over 7° in any direction
Load Test	C923 - 7.2.3	150 lbs/in. pipe dia.	Over 150 lbs/in. pipe dia.

Performed on all standard sizes of Kor-N-Seal Connectors.

RESILIENT EPDM OR POLYISOPRENE RUBBER

Conforms to ASTM C923

Test	ASTM Method	Test Requirements	TEST RESULTS Kor-N-Seal® I & II
Chemical Resistance	D543, at 22°C for 48 h		
1 *N* Sulfuric Acid		No weight loss	No weight loss
1 *N* Hydrochloric Acid		No weight loss	No weight loss
Tensile Strength	D412	1200 psi	1580 psi
Elongation at Break		350% min.	500%
Hardness	D2240 (shore A durometer)	± 5 from the manufacturer's specified hardness	48 ± 5
Accelerated Oven-Aging	D573 70 ± 1°C for 7 days	Decrease of 15%, max. of original tensile strength, decrease of 20% max. of elongation	10.1% tensile decrease 14.0% elongation decrease
Compression Set	D395, method B, at 70°C for 22 h	Decrease of 25%, max. of original deflection	13% decrease
Water Absorption	D471, immerse 0.75 by 2-in. specimen in distilled water at 70°C for 48 h	Increase of 10%, max. of original by weight	.8% increase
Ozone Resistance	D1171	Rating 0	Rating 0
Low-temperature Brittle Point	D746	No fracture at -40°C	No fracture at -40°C
Tear Resistance	D624, method B	200 lbf/in.	No tear at 210 lbf/in.

INTERNAL KORBAND

Conforms to ASTM C923, ASTM A666, and A240

– Korband Assembly is manufactured of 300 series stainless steel.
– Toggle Expander is made of 300 series stainless steel.
– The 106/406 series Wedge Expander is made from reinforced nylon or 300 series stainless steel.
– The 206/306 series Wedge Expander is made from 300 series stainless steel.

EXTERNAL PIPE CLAMP

Conforms to ASTM C923, ASTM A666, and A240

External take-up clamps are manufactured of 300 series stainless steel.

Pipe-to-Manhole Connector Technical Specification

Scope:

This specification describes the function of the NPC Kor-N-Seal pipe-to-manhole connector, its principle of operation, and the component materials that constitute the Kor-N-Seal connector, and their physical properties.

Product Application:

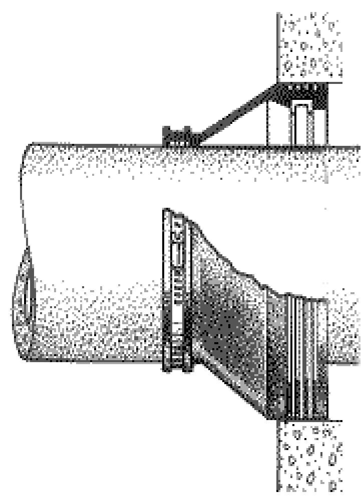
NPC Kor-N-Seal connectors are designed and manufactured to meet or exceed the requirements of ASTM C-923 "Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals". This specification requires the connector to provide a watertight seal under the following conditions:

- 10 PSI (23 feet head) of groundwater pressure
- Minimum 7 Degrees of pipe articulation in any direction
- Radial loading test of 150 pounds per inch diameter of pipe

Principle of Operation:

The connector creates a watertight seal between the pipe and manhole by first sealing to the inside of the cored or formed hole in the manhole and then sealing to the outside of the pipe. See illustration at right.

The seal at the inside of the manhole is created by the stainless steel Korband. The Korband is located inside of the end of the connector that fits into the manhole. Once the connector is located in the manhole, the diameter of the Korband is increased. This compresses the connector against the inside wall of the hole in the manhole creating a watertight seal at the manhole.



The seal at the outside of the pipe is created by the stainless steel pipe clamp(s). The pipe clamp is located on the outside of the connector. Once the pipe has been positioned in the connector the diameter of the pipe clamp is decreased. This compresses the connector against the outside wall of the pipe creating a watertight seal at the pipe.

Reference the [Recommeded Installation Instructions] for a detailed explanation of the preparation and installation of the connector.

STAINLESS STEEL WEDGE

Recommended Installation Procedure

Refer to reverse side *Kor-N-Seal I - Wedge Korband Installation Chart* for Hole Size Range, Connector Dimensions, and Suggested Pipe O.D. Range.

CONNECTOR INSTALLATION:

1. Check to be sure Korband is properly located in Connector groove. (Fig. 1)
2. Insert Connector Assembly into hole with Wedge Expander at top of hole. (Fig. 2)
3. Position Connector so it is square to manhole both vertically and horizontally. (Fig. 3)
4. Tighten Wedge Expander using 1/2" [13 mm] socket with a preset torque limiter for each. For each size connector use torque limiter preset to proper torque. (Fig. 4) Retorquing is not required prior to shipment.

CAUTION: DO NOT USE IMPACT WRENCH.

I M P O R T A N T

Recommended Torque		Torque Limiter
Connector Inches [mm]	Foot Pounds [Newton Meters]	P/N
10 – 24 [254 – 610]	12 [16]	91440-12

Fig. 4

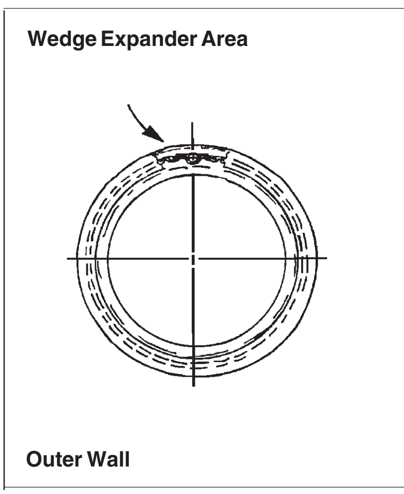


Fig. 1

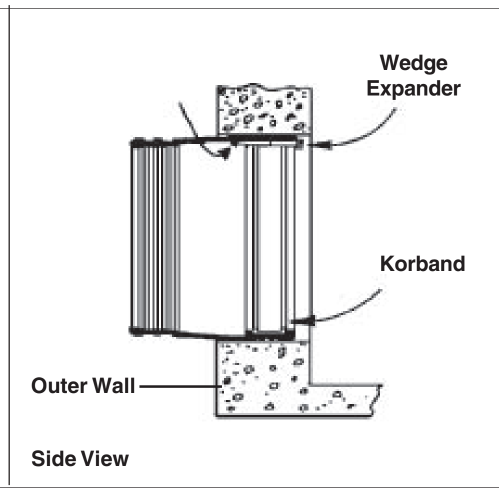


Fig. 2

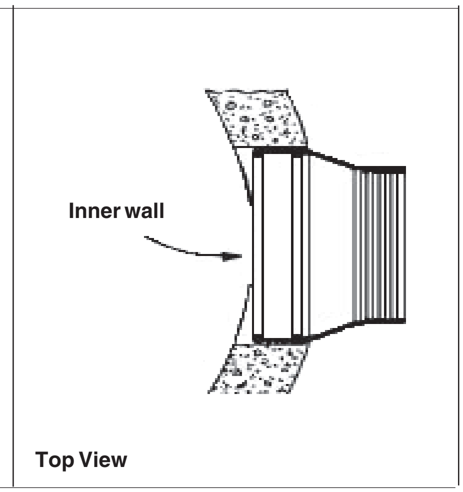


Fig. 3

PIPE INSTALLATION:

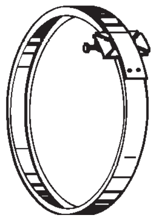
1. Center pipe in Connector opening.
2. On maximum pipe O.D. installations, use a pipe lubricant on the outside barrel of the pipe and/or the inside ridges of the Connector (under the Pipe Clamp area) to allow the pipe to slide into place more easily.
3. Position the Pipe Clamp in the Connector's Pipe Clamp groove with the screw at the top.
4. Tighten the Pipe Clamp screw to 60 inch pounds [7 Newton Meters] with a T-handle Torque Wrench, P/N 80090.
5. On minimum pipe O.D. installations, lift the rubber up underneath the Pipe Clamp screw so that the Connector contacts the bottom surface of the pipe while the Pipe Clamp screw is being tightened. Application of pipe lubrication on the underside of the clamp will also help assure that an even contraction of rubber is maintained throughout the clamping area.
6. After the Pipe Clamp has been tightened down firmly, move the pipe horizontally and/or vertically to bring it to grade.

Caution: Pipe must **NOT** rest on Connector Korband.

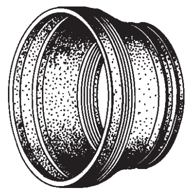
CAUTION:
All capped stubs awaiting pipe installation at a later date must be restrained. Assure that a proper backfill material is used in adverse conditions. Prior to any critical usage, contact NPC Customer service at 1-800-626-2180.

STAINLESS STEEL WEDGE

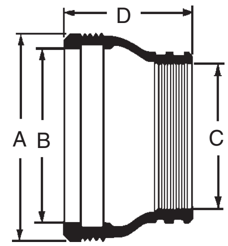
Recommended Installation Procedure

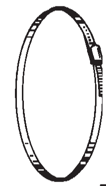


KORBAND
300 Series S.S., 16 Gauge



CONNECTOR
EPDM, Durometer 48





PIPE CLAMP
300 Series S.S., Quick Connect

S106 Series

Connector P/N	Suggested Pipe O.D. Range Inches	Hole Size Range Inches	Connector Dimensions Inches			Pipe Clamp P/N
		A	B	C	D	
S106-12BWS	5.75 — 7.00	12.00 — 12.20	10.30	6.50	8	I-128
S106-12AWS	7.00 — 8.50	12.00 — 12.20	10.30	8.00	8	I-180
S106-12WS	8.25 — 9.75	12.00 — 12.20	10.30	9.25	8	I-180
S106-14AWS	9.50 — 11.25	14.00 — 14.20	12.25	10.50	8	I-190
S106-16BWS	9.50 — 11.25	15.95 — 16.15	14.30	10.50	8	I-190
S106-16AWS	11.25 — 13.00	15.95 — 16.15	14.30	12.25	8	I-218
S106-16WS	13.00 — 14.20	15.95 — 16.15	14.30	14.00	8	I-242
S106-20BWS	14.00 — 15.50	19.95 — 20.10	18.25	15.00	8	I-306
S106-20AWS	15.50 — 17.00	19.95 — 20.10	18.25	16.50	8	I-306
S106-20WS	17.00 — 18.15	19.95 — 20.10	18.25	18.00	8	I-306
S106-22WS	17.75 — 19.25	21.95 — 22.10	20.25	18.75	8	I-318
S106-24WS	19.60 — 21.10	23.95 — 24.10	22.25	20.60	8	I-348

S406 Series

S406-10AWS	6.00 — 6.75	10.00 — 10.20	8.30	6.50	6	I-128
S406-10WS	7.50 — 8.20	10.00 — 10.20	8.30	8.50	6	I-180
S406-10.5AWS	6.00 — 6.75	10.50 — 10.70	8.80	6.50	6	I-128
S406-10.5WS	7.50 — 8.70	10.50 — 10.70	8.80	8.50	6	I-180
S406-11BWS	6.00 — 7.00	11.00 — 11.20	9.30	6.00	6	I-128
S406-11AWS	7.50 — 9.00	11.00 — 11.20	9.30	8.00	6	I-180
S406-12CWS	6.00 — 7.00	12.00 — 12.20	10.30	6.50	6	I-128
S406-12BWS	6.25 — 7.50	12.00 — 12.20	10.30	7.00	6	I-128
S406-12AWS	7.50 — 9.00	12.00 — 12.20	10.30	8.50	6	I-180
S406-12WS	9.00 — 10.20	12.00 — 12.20	10.30	10.00	6	I-180

Suggested pipe O.D. range comes from field experience. Refer to *Recommended Pipe Installation Procedure*.

CONNECTORS FOR SMALL DIAMETER PIPE			
S106 Series — 8” Long Connectors			
NOMINAL HOLE SIZE	**MODEL NUMBER**	**PIPE O.D. RANGE**	**HOLE SIZE RANGE**
7”	S106-7SWP	1.80 – 4.80	6.995 – 7.055
7”	S106-7WP	3.50 – 4.50	6.995 – 7.055
8”	S106-8ST	4.20 – 6.40	7.995 – 8.055
8”	S106-8T	4.10 – 5.90	7.995 – 8.055
8”	S106-8M	1.70 – 4.80	7.995 – 8.055
12”	S106-12BWP*	5.75 – 7.00	12.000 – 12.200
12”	S106-12AWP*	7.00 – 8.50	12.000 – 12.200
12”	S106-12WP*	8.25 – 9.75	12.000 – 12.200
12”	S106-12BT	5.75 – 7.00	12.040 – 12.130
12”	S106-12AT	7.00 – 8.50	12.040 – 12.130
12”	S106-12T	8.25 – 9.75	12.040 – 12.130
12”	S106-12BSL	5.75 – 7.00	12.000 – 12.250
12”	S106-12ASL	7.00 – 8.50	12.000 – 12.250
12”	S106-12SL	8.25 – 9.75	12.000 – 12.250
14”	S106-14AWP*	9.50 – 11.25	14.000 – 14.200
14”	S106-14AT	9.50 – 11.25	14.025 – 14.115
14”	S106-14ASL	9.50 – 11.25	14.500 – 14.250
16”	S106-16BWP*	9.50 – 11.25	15.950 – 16.150
16”	S106-16AWP*	11.25 – 13.00	15.950 – 16.150
16”	S106-16WP*	13.00 – 14.20	15.950 – 16.150
16”	S106-16BT	9.50 – 11.25	15.975 – 16.070
16”	S106-16AT	11.25 – 13.00	15.975 – 16.070
16”	S106-16T	13.00 – 14.50	15.975 – 16.070
16”	S106-16BSL	9.50 – 11.25	15.950 – 16.200
16”	S106-16ASL	11.25 – 13.00	15.950 – 16.200
16”	S106-16SL	13.00 – 14.20	15.950 – 16.200
20”	S106-20BWS	14.00 – 15.50	19.950 – 20.100
20”	S106-20AWS	15.50 – 17.00	19.950 – 20.100
20”	S106-20WS	17.00 – 18.15	19.950 – 20.100
22”	S106-22WS	17.75 – 19.25	21.950 – 22.100
24”	S106-24WS	19.60 – 21.10	23.950 – 24.100

* also available in Steel Wedge (WS)

MADE IN U.S.A

RFCA (Restrained Flanged Coupling Adapter)

Material Specifications

Flange Body: Ductile (nodular) iron, meeting or exceeding ASTM A 536, Grade 65-45-12. Flange meets the dimensional requirements of ANSI Class 125 and 150 bolt circles.

Gaskets: Compounded for water and sewer service in accordance with ASTM D 2000 (Sizes 3 - 12" have flange O-Ring gasket). Other compounds available for petroleum, chemical, or high temperature service.

Gland: Romac RomaGrip™. See page 7-6.

Restraining Bolts: 7/8 –9 roll thread, Ductile (nodular) iron, meeting or exceeding ASTM A 536.

Restraining Lugs: Ductile (nodular) iron, meeting or exceeding ASTM A 536. Heat treated using a proprietary process.

Lug Locators: Polyurethane, a thermal plastic.

T-bolts and Nuts: High strength low alloy steel T-head bolt. National coarse rolled thread and heavy hex nut. Steel meets AWWA C111 composition specifications. Stainless steel bolts and nuts available on request.

Coatings: Shop coat applied to cast parts for corrosion protection in transit. Fusion bonded epoxy available on request.

Use: Ductile Iron Pipe 3 - 24", cast iron pipe 3" - 24" (same OD's as ductile iron) and IPS size STD steel pipe 3 - 12".

To Order: Specify catalog number. **Example:** For a 12" RFCA Order: **RFCA - 13.20**

NOTE: 3" - 12" special Romac gasket works on both steel and D.I. ODs.

FM APPROVED

Not for use on PVC, HDPE pipe or plain-end mechanical joint fittings. For applications on PVC, please contact your Romac representative.

NOM. PIPE SIZE	GASKET RANGE	LENGTH	GLAND BOLTS QTY: SIZE	CATALOG NUMBER	LIST PRICE				WEIGHT (lbs.)
					Shopcoat w/Std. B&N	Shopcoat w/304 SS B&N	Fusion Epoxy w/Std. B&N	Fusion Epoxy w/304SS B&N	
3"	3.50-3.96	8.00"	4: 5/8" x 3"	RFCA - 3.96	$145.45	$157.56	$165.10	$177.20	21
4"	4.50-4.80	9.00"	4: 3/4" x 3 1/2"	RFCA -4.80	183.32	209.43	207.88	233.99	29
6"	6.63-6.90	9.25"	6: 3/4" x 4"	RFCA - 6.90	233.85	273.01	267.10	306.26	40
8"	8.63-9.05	9.25"	6: 3/4" x 4"	RFCA - 9.05	315.59	354.75	355.82	394.98	53
10"	10.75-11.10	10.25	8: 3/4" x 4"	RFCA - 11.10	581.96	634.17	669.69	721.91	83
12"	12.75-13.20	10.25"	8: 3/4" x 4"	RFCA - 13.20	632.13	684.34	739.86	792.07	110
14"	15.30	11.70"	10: 3/4" x 4 1/2"	RFCA -15.30	882.79	947.37	1,020.54	1,085.12	170
16"	17.40	11.70"	12: 3/4" x 4 1/2"	RFCA -17.40	1,225.93	1,302.91	1,410.23	1,487.21	200
18"	19.50	11.80"	12: 3/4" x 4 1/2"	RFCA -19.50	1,346.63	1,423.60	1,546.13	1,623.10	217
20"	21.60	11.80	14: 3/4" x 4 1/2"	RFCA - 21.60	1,521.19	1,611.94	1,772.94	1,863.69	256
24"	25.80	12.00"	16: 3/4" x 5"	RFCA - 25.80	1,845.38	1,959.61	2,130.38	2,244.61	305

Some initial axial movement may occur in lug style restraints as the lugs seat. Movement is directly related to the size of the piping system and the system pressure. In general terms movement of approximately 0.25" can be expected in restraints under 16”. For larger sizes, movement of approximately 0.4” may be seen. If this is critical to your application please contact Romac Engineering for additional information.

INSTALLATION INSTRUCTIONS

Read installation instructions first before installing. Check parts to ensure that no damage has occurred during transit and that no parts are missing. Also check the diameter of the pipe and the size marked on the coupling to ensure you have the proper size.

FM APPROVED

RFCA Restrained Flange Coupling Adapter

NOT FOR USE ON PVC PIPE OR PLAIN END MECHANICAL JOINT FITTINGS

NOTE: Not for use on polyethylene pipe, plain end mechanical joint fittings or PVC pipe.

The "Stab-Fit" installation technique may also be employed on 3"-10" sizes.

Step 1 • Check the RFCA parts to insure that no damage has occurred during transit and that no parts are missing.

Step 2 • Clean pipe end for a distance of 2" greater than length of the RFCA.

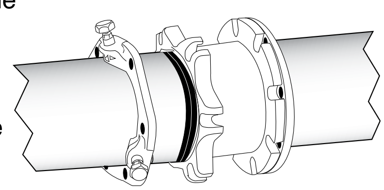
Step 3 • Place RomaGrip gland on pipe end.

Step 4 • Lubricate the gasket and pipe surface with soapy water or other suitable gasket lubricant.

Step 5 • Place gasket over pipe with beveled edge toward the flange adapter.

Step 6 • Slide the RFCA on to the pipe. Position the pipe and flanged coupling against the mating flange, inserting flange gasket (14" and larger) between the flange faces. Assemble the flange joint using flange bolts.

6



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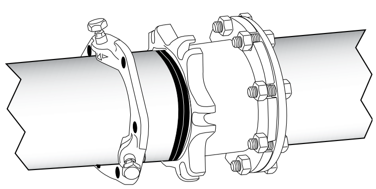
Step 7 • The pipe should be centered such that the space between the OD of the pipe and the ID of the RFCA is even all around the pipe. Slide the RFCA gasket into position with the beveled edge engaging the beveled end of the RFCA body.



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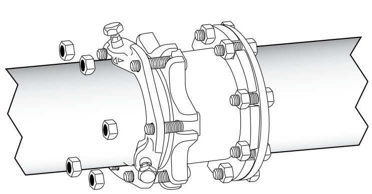
Step 8 • Slide the RomaGrip into position against the gasket, and insert T-bolts.



Step 9 • Tighten T-bolts evenly, alternating to diametrically opposite position at approximately 20 ft-lbs increments to the recommended torque for your size RFCA.

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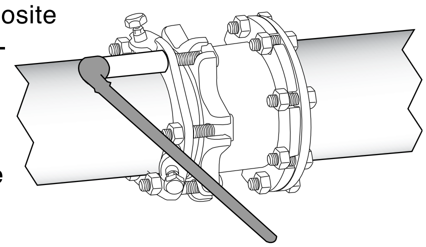


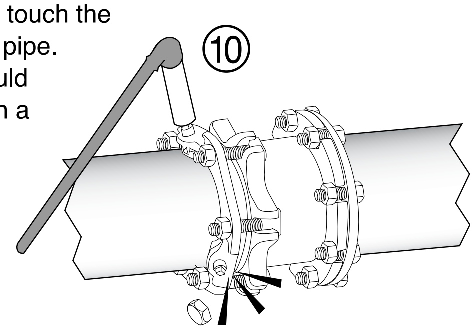
Recommended Torque:
3" RomaGrip - 45-65 ft-lbs.
4 - 24" RomaGrip - 75 - 90 ft-lbs.

Note:
90 ft-lbs. torque = 12" wrench w/90 lbs. force

For best results, wait 10 minutes and retighten bolts to proper torque.

Step 10 • Hand tighten the restrainer bolts until the restraining pads touch the surface of the pipe. The bolts should be tightened in a uniform criss-cross pattern, until the heads break off above the notch.

10



NOTE: Do not turn a bolt more than one turn before alternating to the next bolt.

Step 11 • Pressure test for leaks before backfilling.

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INSTALLATION INSTRUCTIONS

RFCA Restrained Flange Coupling Adapter

NOT FOR USE ON PVC PIPE OR PLAIN END MECHANICAL JOINT FITTINGS

PRECAUTIONS

1. Check flange to make sure the bolt holes match the RFCA.
2. Make sure a flange gasket is used between the mating flanges on sizes 14" and larger.
3. Check diameter of pipe to make sure you are using the correct size RFCA; also check gasket to make sure it is the size you think it is.
4. Be sure to clean pipe of as much dirt and corrosion as possible in the area that the gasket will seal.
5. Lubricate both the gasket and the pipe end with soapy water or approved pipe lubricant per ANSI/AWWA C111/ A21.11.
6. Make sure no foreign materials lodge between gasket and pipe.
7. Avoid loose fitting wrenches, or wrenches too short to achieve proper torque.
8. Keep threads free of foreign material to allow proper tightening.
9. Take extra care to follow proper bolt tightening procedures and torque recommendations. Bolts are often not tightened enough when a torque wrench is not used.
10. Be sure that the gland is centered around the pipe.
11. Pressure test for leaks before backfilling.
12. Backfill and compact carefully around pipe and fittings.
13. Some initial axial movement may occur in lug style restraints as the lugs seat. Movement is directly related to the size of the piping system and the system pressure. In general terms movement of approximately 0.25" can be expected in restraints under 16”. For larger sizes, movement of approximately 0.4” may be seen. If this is critical to your application please contact Romac Engineering for additional information.

COMMON INSTALLATION PROBLEMS

1. Flange gasket not installed on sizes 14" and larger.
2. T-Bolts are not tightened to the proper torque.
3. Rocks or debris between pipe and gasket.
4. Dirt or debris between pipe and restraining pad.
5. Dirt on threads of bolts or nuts.
6. Restraining bolt heads not snapped off.
7. Not enough pipe inserted into bell.
8. Using the RFCA on IPS size steel pipe with wall thickness thinner than schedule 40 steel pipe. (3-12 inch sizes)

IF RFCA MUST BE REMOVED

1. Make sure pipe is not pressurized. Removing the restrainer could cause the pipe joint to separate.
2. To remove the RFCA, use a 5/8" hex wrench or socket.
3. To reassemble, follow installation procedures. Tighten the restraining bolts using a 5/8" hex wrench to 75-ft-lbs minimum.

Pre-Lubricated Gasket

Say *Goodbye* to the lube bucket and brush …… Say *Hello* to fast, clean, simple installation

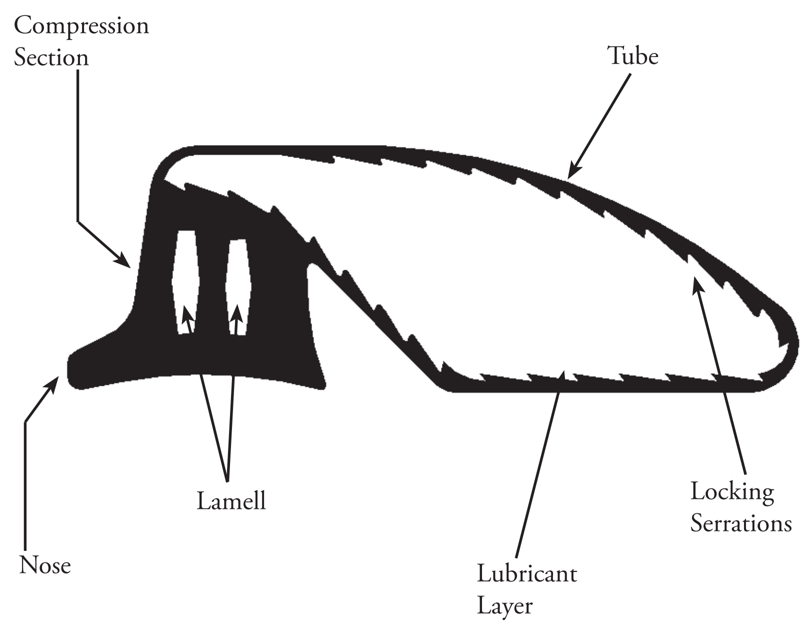
Requiring no field lubrication, the gasket* has a layer of silcone lubricant installed on the inner surface of the tube dur-ing the manufacturing process; sav-ing you time, and money, on the job-site.

Self-contained Lubricant. Sealed within the tube, the lube is impervious to mud, dirt and debris. If you drop it in the trench, simply wipe the gasket surface clean and you're ready to install. No special handling or packaging is required.

Easier installation, without equalization, is made possible due to the reduced gasket stretch required by the unique lamell/rolling tube design. Quick and easy to install means you save even more time.

No gasket "roll" or "twist" during coupling is another benefit of the unique lamell/rolling tube design, which reduces the insertion force required. Manual coupling of up to 36" pipe is possible.

For Single Offset Joints ...



… in Round or Elliptical Pipe, Man-Holes and Boxes

Self-Centering of the Spigot within the Bell is carried out as the tube rolls into the annular space during the homing process.

Elimination of Joint Kick Back, is caused by the rearward locking action of the serrations as the tube rolls forward

Bell and Spigot protection under deflection is accomplished by the cushioning effect of the tube, as it rests within the annular space.

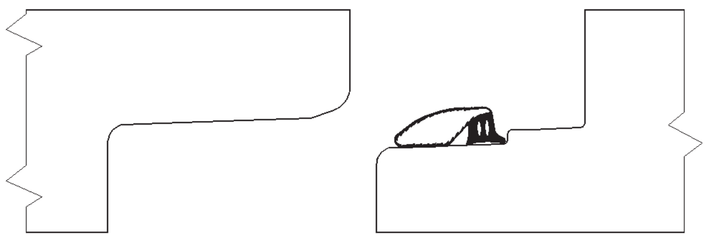
ASTM C361, ASTM C425, ASTM C443, AASHTO M198.4 and CSA A-257 material requirement compliance.

Pipe sizes to 144" can be accommodated.

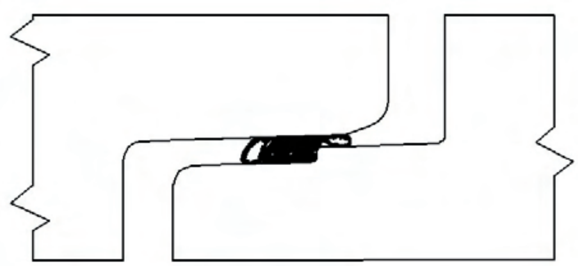
INSTALLATION

Ensure Bell, Spigot and Gasket are free from loose debris or foreign material.

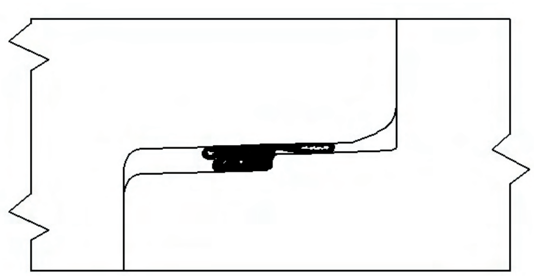
Stretch the gasket around the spigot, with the nose against the step, and the tube laying flat against the spigot. DO NOT LUBRICATE.



Align the spigot with the bell, and thrust the spigot home using suitable mechanical means. The homing process will cause the lubricated tube to "roll" over itself, above the compression section, allowing the pipe to slide forward.



Once fully homed, the compression section seals the total annular space; the rolling tube comes to rest within the small annular space - acting as a cushion against side loads, and the serrations act to resist pipe pull-out.



*

MATERIALS

Tylox® SuperSeal™ gaskets* are available in the following materials:

- •Isoprene

Optional Materials

- •Nitrile (Oil Resistant)
- •Isoprene / EPDM blend (Green Book & C425)
- •Neoprene (Oil and Ozone Resistant)

Other materials may be available as special order.
Consult your Hamilton Kent agent for your specific requirements.

SPECIFICATIONS

gaskets* are manufactured to meet the material requirements of the following speci-fications:

- •ASTM C361, C425, & C443
- •AASHTO M198.4
- •CSA A257
- •"Green Book"

Other specifications may be available as special order. Please consult your Hamilton Kent agent for your specific requirements.

CONTACT US

Customer Name
Company Name
111 Company Address
City, State Zip Code
(555) 555-5555
customername@companyname.com

PRODUCT DATA SHEET

SERIES 61

PRODUCT PROFILE

GENERIC DESCRIPTION Cycloaliphatic Amine Epoxy

COMMON USAGE Tightly cross-linked epoxy with excellent corrosion and chemical resistance. Principally used for immersion service, including fuel and crude oil storage, chemical containment and wastewater treatment.

COLORS 5001 Gray and 5002 Beige

FINISH Semi-gloss

SPECIAL QUALIFICATIONS A two-coat system of Series 61 at 4.0 to 6.0 dry mils (100-150 dry microns) per coat passes the performance requirements of **MIL-PRF-4556F.**

PERFORMANCE CRITERIA Extensive test data available. Contact your Tnemec representative for specific test results.

COATING SYSTEM

PRIMERS
Steel: Self-priming
Concrete: Self-priming or Series 215, 217, 218
CMU: Series 215, 218

TOPCOATS **Note:** Series 61 can be topcoated with select Tank Armor linings depending on service conditions. Contact Tnemec Technical Service for recommendations.

SURFACE PREPARATION

STEEL **Immersion Service:** SSPC-SP10/NACE 2 Near-White Blast Cleaning obtaining a minimum angular anchor profile of 2.0 mils (50 microns).

CONCRETE Allow new concrete to cure for 28 days. Abrasive blast referencing SSPC-SP13/NACE 6, ICRI-CSP3-5 Surface Preparation of Concrete and Tnemec's Surface Preparation and Application Guide.

ALL SURFACES Must be clean, dry and free of oil, grease and other contaminants.

TECHNICAL DATA

VOLUME SOLIDS 82.0 ± 2.0% (mixed) †

RECOMMENDED DFT
1. For JP-4, JP-5, JP-8, Aviation Gas and Jet A-1: 4.0 to 6.0 mils (100 to 150 microns) per coat (minimum of two coats).
2. Most Other Applications: 8.0 to 12.0 mils (205 to 305 microns) per coat (minimum of two coats). Contact your Tnemec representative for specific recommendations.

CURING TIME

Temperature	To Handle	To Recoat	Immersion
75°F (24°C) at 4.0 mils (100 microns)	6 hours	16-18 hours•	5 to 7 days
75°F (24°C) at 12.0 mils (305 microns)	11 hours	16-18 hours•	5 to 7 days

Curing time varies with surface temperature, air movement, humidity and film thickness.
• Maximum recoat time is 72 hours. If more than 72 hours have elapsed between coats, the coated surface must be scarified before topcoating.

VOLATILE ORGANIC COMPOUNDS
EPA Method 24
Unthinned: 0.36 lbs/gallon (45 grams/litre)
Thinned 6%: 0.71 lbs/gallon (85 grams/litre)
Thinned 10%: 1.21 lbs/gallon (145 grams/litre) †

HAPS
Unthinned: 1.53 lbs/gal solids
Thinned 10%: 2.42 lbs/gal solids

THEORETICAL COVERAGE 1,315 mil sq ft/gal (32.3 m²/L at 25 microns). See APPLICATION for coverage rates. †

NUMBER OF COMPONENTS Two: Part A (amine) and Part B (epoxy)

MIXING RATIO By volume: One (Part A) to one (Part B)

PACKAGING

	PART A	PART B	Yield (mixed)
Large Kit	5 gallon pail (18.9 L)	5 gallon pail (18.9 L)	10 gallons (37.85 L)
Small Kit	1 gallon can (3.79 L)	1 gallon can (3.79 L)	2 gallons (7.57 L)

NET WEIGHT PER GALLON 13.10 ± 0.25 lbs (5.94 ± .11 kg) †

STORAGE TEMPERATURE Minimum 20°F (-7°C) Maximum 110°F (43°C)
For optimum application properties, material temperature should be above 60°F (16°C) prior to application.

TEMPERATURE RESISTANCE (Dry) Continuous 250°F (121°C) Intermittent 275°F (135°C)
Performance in high temperature immersion applications depends on liquid media, temperature and substrate. Contact your Tnemec representative for more information.

SHELF LIFE 24 months at recommended storage temperature.

FLASH POINT - SETA Parts A & B: 81°F (27°C)

HEALTH & SAFETY Paint products contain chemical ingredients which are considered hazardous. Read container label warning and Material Safety Data Sheet for important health and safety information prior to the use of this product.
Keep out of the reach of children.

COVERAGE RATES

For JP-4, JP-5, JP-8
Aviation Gas, Jet A-1 Service

	Dry Mils (Microns)	Wet Mils (Microns)	Sq Ft/Gal (m²/Gal)
Suggested	5.0 (125)	6.0 (150)	263 (24.4)
Minimum	4.0 (100)	5.0 (125)	329 (30.6)
Maximum	6.0 (150)	7.5 (190)	219 (20.4)

Most Other Applications

	Dry Mils (Microns)	Wet Mils (Microns)	Sq Ft/Gal (m²/Gal)
Suggested	10.0 (255)	12.0 (305)	132 (12.2)
Minimum	8.0 (205)	10.0 (255)	164 (15.3)
Maximum	12.0 (305)	14.5 (355)	110 (10.2)

Allow for overspray and surface irregularities. Film thickness is rounded to the nearest 0.5 mil or 5 microns. Application of coating below minimum or above maximum recommended dry film thicknesses may adversely affect coating performance. †

MIXING

Power mix contents of each container, making sure no pigment remains on the bottom. Pour a measured amount of Part B into a clean container large enough to hold both components. Add an equal volume of Part A to Part B while under agitation. Continue agitation until the two components are thoroughly mixed. Do not use mixed material beyond pot life limits. **Note:** Both components must be above 60°F (16°C) prior to mixing. Mixing ratio is one to one by volume. A large volume of material will set up quickly if not applied or reduced in volume. **Caution: Do not reseal mixed material. An explosion hazard may be created.**

THINNING

Use No. 2 Thinner. For air spray, thin up to 10% or 12 oz (354 mL) per gallon. For airless spray or brush, thin up to 5% or 6 oz (177 mL) per gallon. **Note:** A maximum of 6% or 7 oz (207 mL) per gallon of No. 2 Thinner may be used to comply with VOC regulations.

POT LIFE

2 1/2 hours at 60°F (16°C) 1 1/2 hours at 77°F (25°C) 45 minutes at 100°F (38°C)

APPLICATION EQUIPMENT

Air Spray

Gun	Fluid Tip	Air Cap	Air Hose ID	Mat'l Hose ID	Atomizing Pressure	Pot Pressure
DeVilbiss JGA	E	765 or 704	5/16" or 3/8" (7.9 or 9.5 mm)	3/8" or 1/2" (9.5 or 12.7 mm)	60-90 psi (4.1-6.2 bar)	10-20 psi (0.7-1.4 bar)

Low temperatures or longer hoses require higher pot pressure.

Airless Spray

Tip Orifice	Atomizing Pressure	Mat'l Hose ID	Manifold Filter
0.015"-0.021" (380-535 microns)	3000-3800 psi (207-262 bar)	1/4" or 3/8" (6.4 or 9.5 mm)	60 mesh (250 microns)

Use appropriate tip/atomizing pressure for equipment, applicator technique and weather conditions.
Brush: Recommended for small areas only. Use high quality natural or synthetic bristle brushes. **Note:** Two or more coats may be required to obtain recommended film thicknesses.

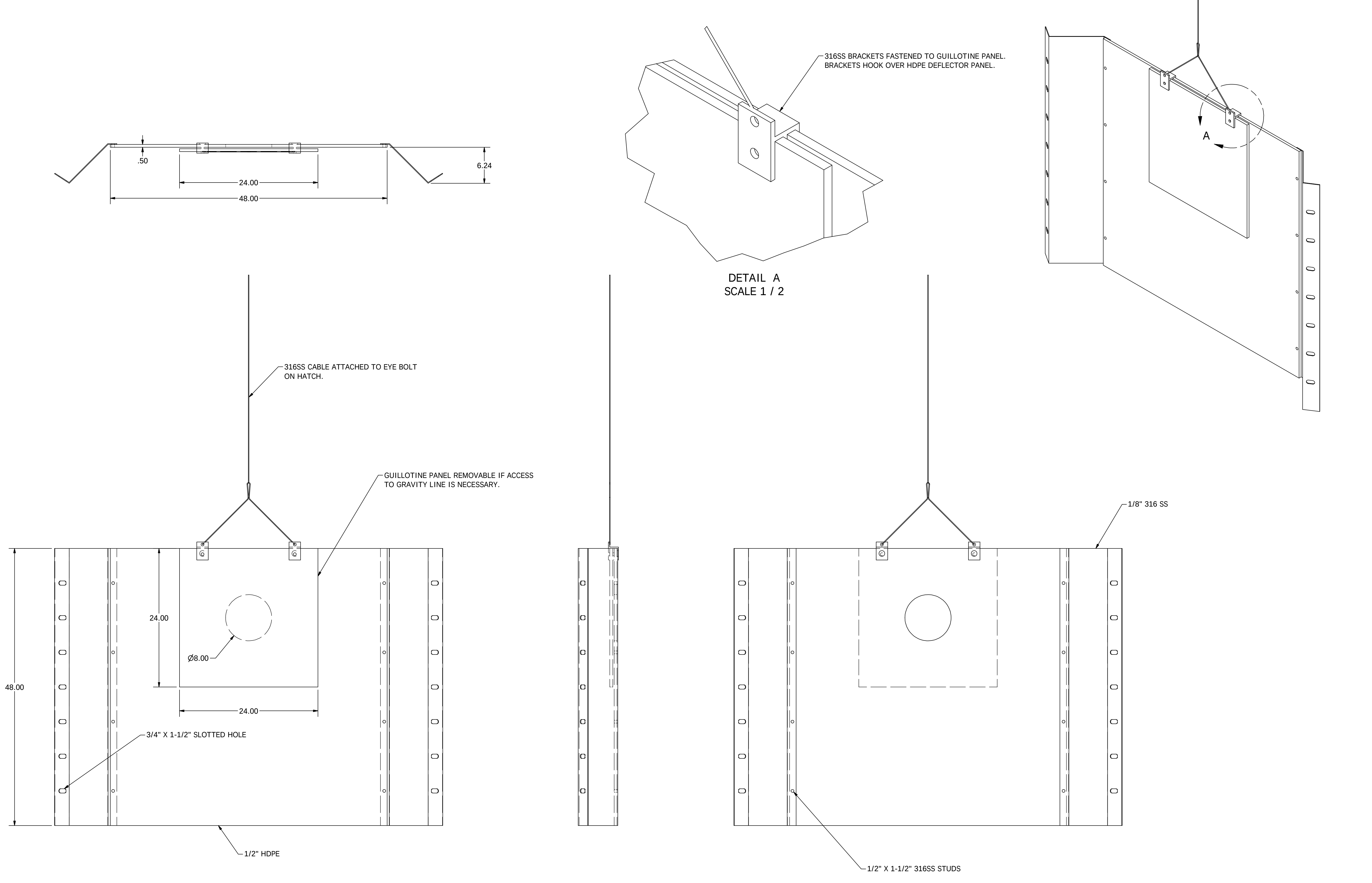
SURFACE TEMPERATURE

Minimum 60°F (16°C) Maximum 135°F (57°C)
The surface should be dry and at least 5°F (3°C) above the dew point. Coating will not cure below minimum surface temperature.

CLEANUP

Flush and clean all equipment immediately after use with the recommended thinner, xylol or MEK.

† Values may vary with color.



REV	DESCRIPTION	DATE	APPROV
1			

REVISION HISTORY

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
0 — 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

DSN - AD
DRN - AD
CKD - AD
DATE - 2-11-14

ROMTEC UTILITIES
18240 NORTH BANK ROAD
ROSEBURG, OREGON 97470
(541) 496-9678
FAX (541) 496-0804

10FT DEFLECTOR PANEL
DETAIL X 48" TALL

SHEET
1 OF 1

JOB NUMBER
RMTC
0000

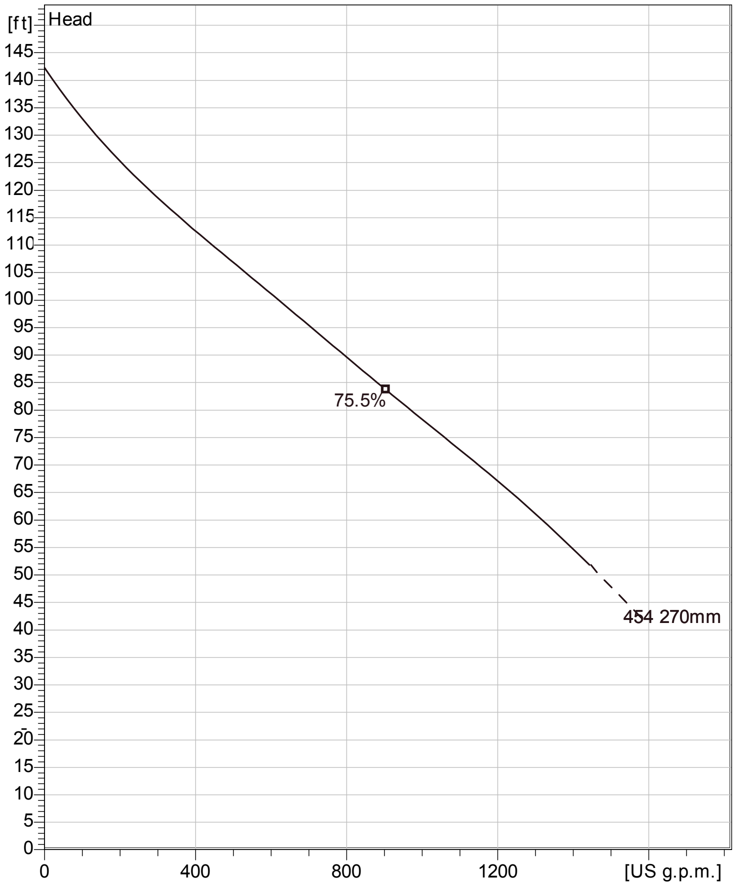
3.03 PUMPS

This section provides the information pertaining to the pumps for this project.

This section is structured as follows:

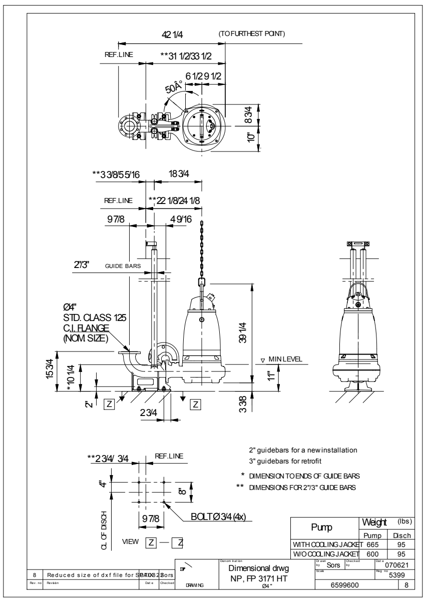
NP 3171 HT 3~ 454

Technical specification



Curve according to: ISO 9906 grade 2 annex 1 or 2

Installation: P - Semi permanent, Wet



Note: Picture might not correspond to the current configuration.

General

Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Possible to be upgraded with Guide-pin® for even better clogging resistance. Modular based design with high adaptation grade.

Impeller

Impeller material	Grey cast iron
Outlet width	3 15/16 inch
Inlet diameter	150 mm
Impeller diameter	270 mm
Number of blades	2
	0 inch

Motor

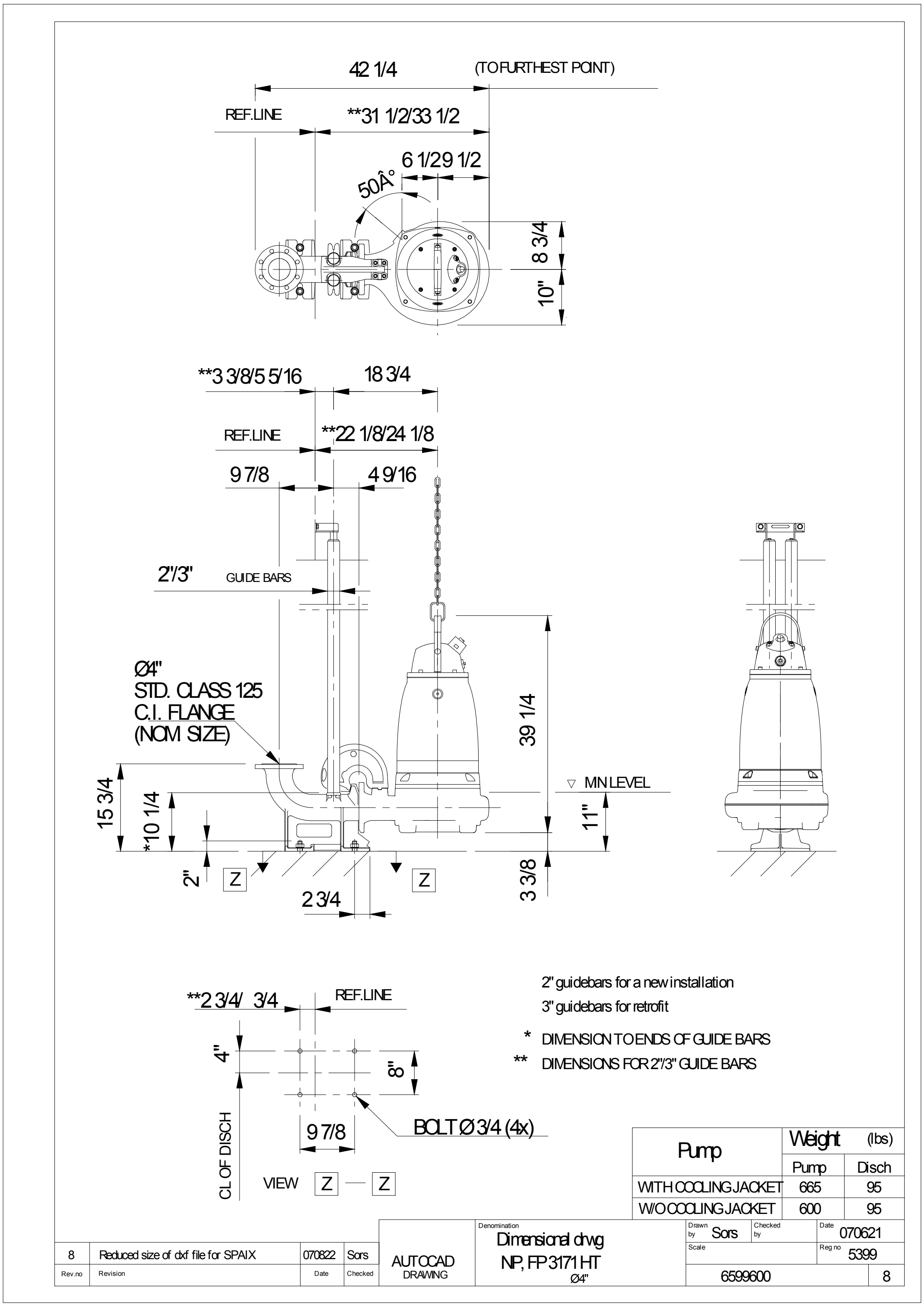
Motor #	N3171.181 25-17-4AA-W 30hp
Stator variant	1
Frequency	60 Hz
Rated voltage	460 V
Number of poles	4
Phases	3~
Rated power	30 hp
Rated current	36 A
Starting current	231 A
Rated speed	1755 rpm
Power factor	
1/1 Load	0.87
3/4 Load	0.83
1/2 Load	0.73
Efficiency	
1/1 Load	89.0 %
3/4 Load	90.0 %
1/2 Load	90.5 %

Configuration

Project	Project ID	Created by	Created on	Last update
			2013-07-19	

NP 3171 HT 3~ 454

Dimensional drawing



Project	Project ID	Created by	Created on	Last update
			2013-07-19	

NP 3171 HT 3~ 454

Performance curve

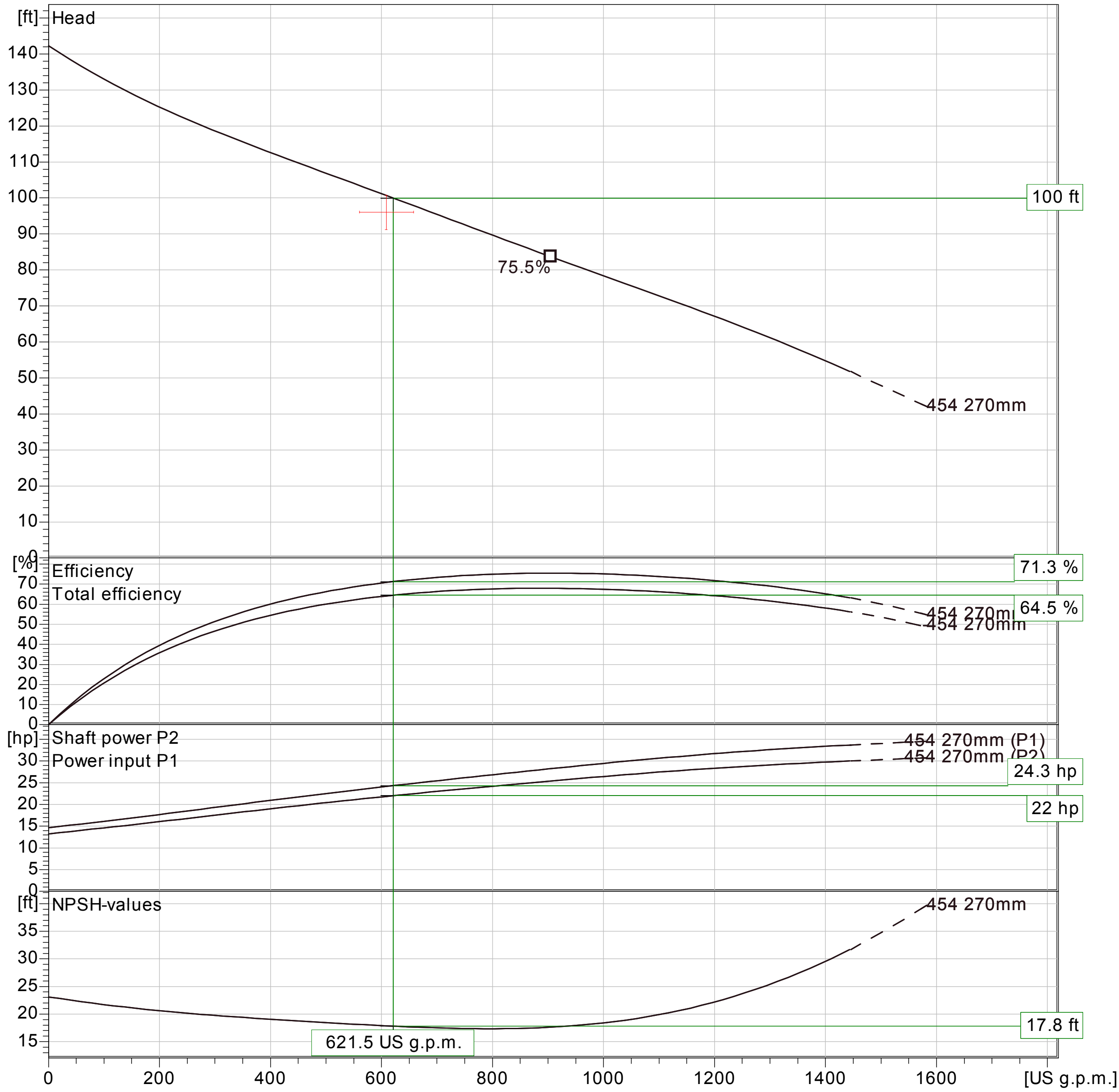
Pump

Outlet width	3 15/16 inch
Inlet diameter	150 mm
Impeller diameter	10⁵/₈"
Number of blades	2
	0 inch

Motor

Motor #	N3171.181 25-17-4AA-W 30hp
Stator variant	1
Frequency	60 Hz
Rated voltage	460 V
Number of poles	4
Phases	3~
Rated power	30 hp
Rated current	36 A
Starting current	231 A
Rated speed	1755 rpm

Power factor	
1/1 Load	0.87
3/4 Load	0.83
1/2 Load	0.73
Efficiency	
1/1 Load	89.0 %
3/4 Load	90.0 %
1/2 Load	90.5 %



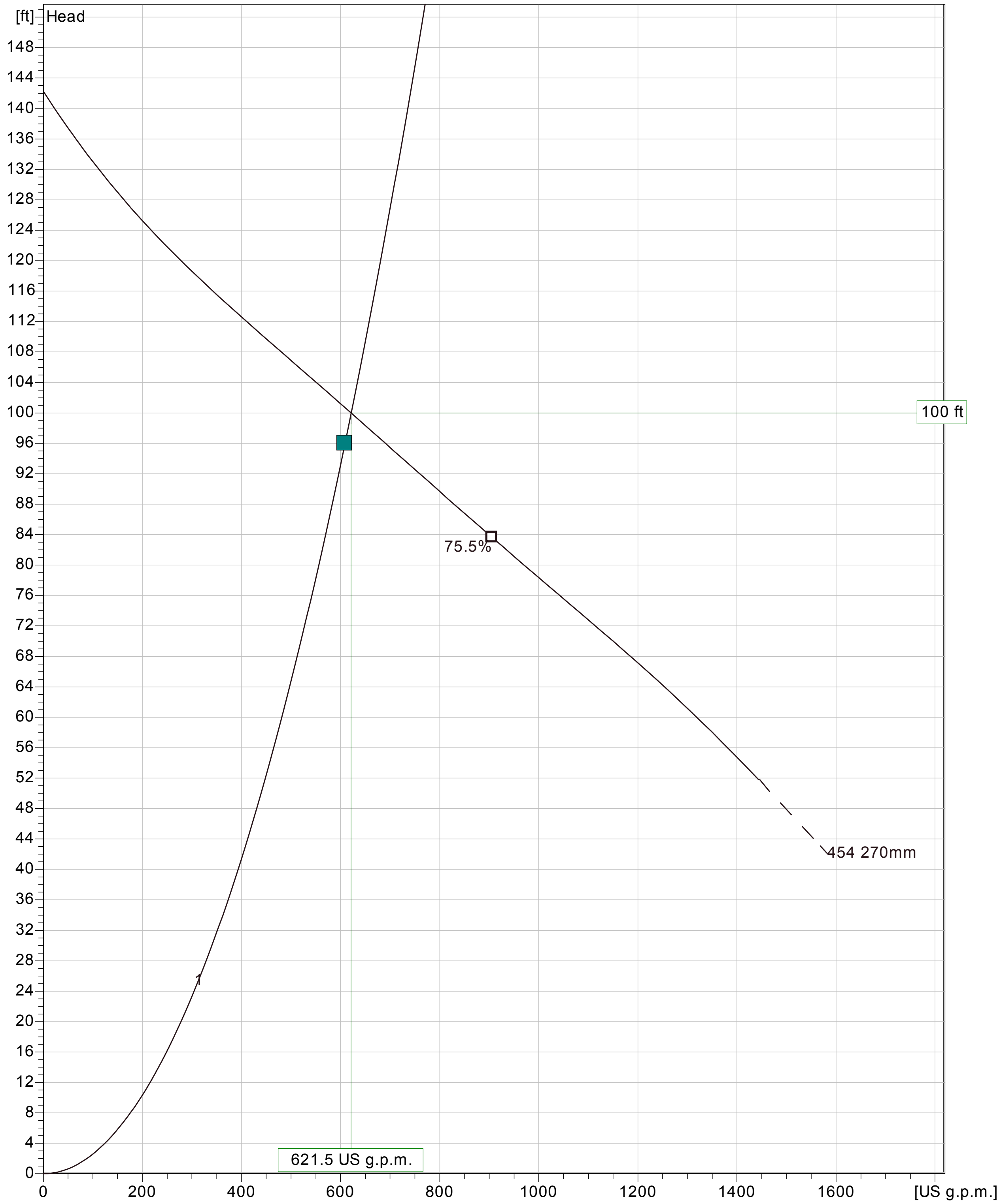
Curve according to: ISO 9906 grade 2 annex 1 or 2

Duty point					Guarantee
Flow	**Head**	**Shaft power**	**NPSHre**	**Hyd eff.**	**ISO_9906_Grade_2**
609 US g.p.m.	96 ft			%	No

Project	Project ID	Created by	Created on	Last update
			2013-07-19	

NP 3171 HT 3~ 454

Duty Analysis



Curve according to: ISO 9906 grade 2 annex 1 or 2

	Individual pump			Total					
Pumps running /System	Flow	Head	Shaft power	Flow	Head	Shaft power	Hyd eff.	Specific energy	NPSHre
1	621 US g.p.m.	100 ft	22 hp	621 US g.p.m.	100 ft	22 hp	71.3 %	487 kWh/US MG	17.8 ft

Project	Project ID	Created by	Created on	Last update
			2013-07-19	

Installation, Care and Maintenance

3171.091.181

895383/05

CONTENTS

SAFETY

This manual contains basic information on the installation, operating and maintenance and should be followed carefully. It is essential that these instructions are carefully read before installation or commissioning by both the installation crew as well as those responsible for operation or maintenance. The operating instructions should always be readily available at the location of the unit.

Identification of safety and warning symbols

General Danger:

Non-observance given to safety instructions in this manual, which could cause danger to life have been specifically highlighted with this general danger symbol.

High Voltage:

The presence of a dangerous voltage is identified with this safety symbol.

WARNING! Non-observance to this warning could damage the unit or affect its function

Qualifications of personnel

An authorized (certified) electrician and mechanic shall carry out all work.

Safety regulations for the owner/operator

All government regulations, local health and safety codes shall be complied with.

All dangers due to electricity must be avoided (for details consult the regulations of your local electricity supply company).

Unilateral modification and spare parts manufacturing

Modifications or changes to the unit/installation should only be carried out after consulting with Flygt.

Original spare parts and accessories authorized by the manufacturer are essential for compliance. The use of other parts can invalidate any claims for warranty or compensation.

Dismantling and re-assembly

If the pump has been used to pump hazardous media, care must be taken that, when draining the leakage, personnel and environment are not endangered.

All waste and emissions such as used coolant must be appropriately disposed of. Coolant spills must be cleaned up and emissions to the environment must be reported.

The pumping station must be kept in good order at all times.

All government regulations shall be observed.

NOTES FOR EX-PRODUCTS

- **Only Ex-approved pumps may be used in an explosive or flammable environment.**
- **Do not open the pump when an explosive gas atmosphere may be present.**
- **Before starting work on the pump, make sure that the pump and the control panel are isolated from the power supply and can not be energized. This applies to the control circuit as well.**
- **All mechanical work on the explosion-proof motor section must be performed by personnel authorized by Flygt.**
- **Electrical connection on the explosion-proof motor must be made by authorized personnel.**
- **Thermal contacts must be connected to protection circuit intended for that purpose according to the approval of the product.**
- **The pump may be used only in accordance with the approved motor data stated on the data plates.**
- **Intrinsically safe circuits are normally required (Ex i) for the automatic level control system by level regulator if mounted in zone 0.**
- **This equipment must be installed in conformity to prescriptions in international or national rules (IEC/EN 60079-14).**
- **The maintenance operation must be made in conformity to the international or national standards (IEC/EN 60079-17).**
- **The yield stress of fastener elements in the product must be in conformity with the value specified in the table for "Material of fastener" on the approval drawing or the parts specified in the part list for the product.**
- **According to the ATEX directive the Ex-pump must never run dry or snore. Permitted minimum water level, see dimensional drawing for the pump.**
  Dry running at service and inspection is only permitted outside the Ex area.
- **The user must know about the risks due the electric current and the chemical and physical characteristics of the gas and/or vapours present in hazardous areas.**
- **Flygt disclaims all responsibility for work done by untrained, unauthorized personnel.**

GUARANTEE

ITT Flygt undertakes to remedy faults in products sold by Flygt provided:

- that the fault is due to defects in design, materials or workmanship;
- that the faults are reported to Flygt or Flygt's representative during the guarantee period;
- that the product is used only under condition described in the Installation, Care and Maintenance manual and in applications for which it is intended;
- that the monitoring equipment incorporated in the product is correctly **connected** and **in use**;
- that all service and repair work is done by a work shop authorized by Flygt;
- that genuine Flygt parts are used.

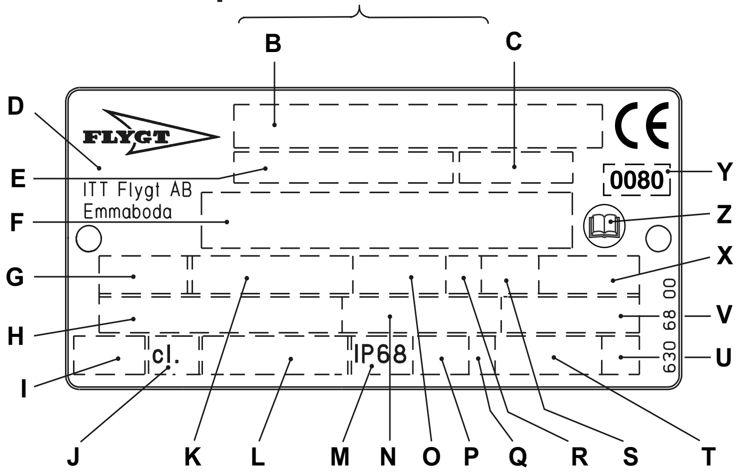
Hence, the guarantee does not cover faults caused by deficient maintenance, improper installation, incorrectly executed repair work or nomal wear and tear.

Flygt assumes no liability for either bodily injuries, material damages or economic losses beyond what is stated above.

Flygt guarantees that spare parts will be kept for 15 years after that the manufacture of this product has been discontinued.

DATA PLATE INTERPRETATION

General data plate

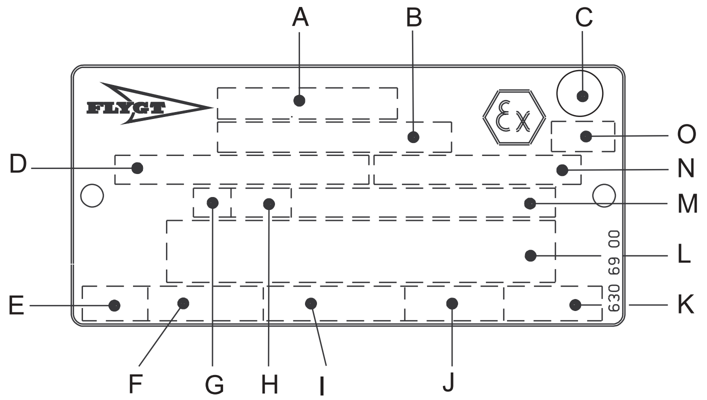


A Serial number
B Product code + Number
C Curve code / Propeller code
D Country of origin
E Product number
F Additional information
G Phase; Type of current; Frequency
H Rated voltage
I Thermal protection
J Thermal class
K Rated shaft power
L International standard
M Degree of protection
N Rated current
O Rated speed
P Max. submergence
Q Direction of rotation: L=left, R=right
R Duty class
S Duty factor
T Product weight
U Locked rotor code letter
V Power factor
X Max. ambient temperature
Y Notified body/ Only for EN-apparoved Ex-products
Z Read Installation Manual

Approval plates

These approval plates apply to an explosion-proof submersible Flygt pump. The plates are used together with the general data plate on the pump.

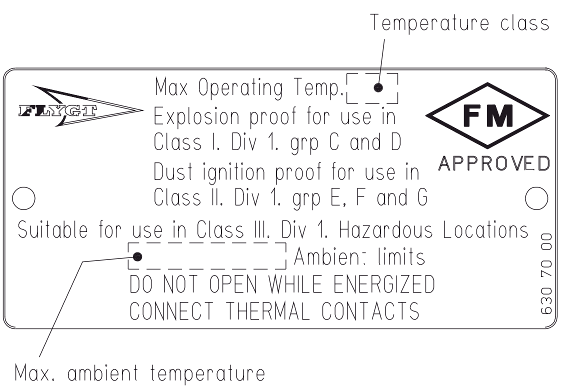
EN: European Norm
ATEX Directive
EN 50014, EN 50018, EN 1127-1
Ex II 2 G EEx dII B T3



A Approval
B Approval authority + Approval Number
C Approval for Class I
D Approved drive unit
E Stall time
F Starting current / Rated current
G Duty class
H Duty factor
I Input power
J Rated speed
K Controller
L Additional information
M Max. ambient temperature
N Serial number
O ATEX marking

EN approval for the Cable entry

Certificate number: INERIS 03ATEX9008 U
Ex II 2 G or IM2 EEx d IIC or EEx d I



PRODUCT DESCRIPTION

Introduction

Thank you for buying a submersible Flygt pump. In this Installation, Care and Maintenance manual you will find general information on how to install and service the 3171 pump to give it a long and reliable life.

Application

This Installation, Care and Maintenance manual applies to a submersible Flygt pump. If you have bought an Ex-approved pump (please see approval plate on your pump or Parts List) special handling instructions apply as described in this document.

The pump is intended to be used for;

— pumping of waste water

— pumping of raw or clean water

— pumping of sludge

Installation alternatives

P = semi permanent wet well arrangement with pump installed by means of twin guide bars with automatic connection to discharge.

S = transportable version with hose connection or flange for connection to discharge pipeline.

T = permanent dry well or in-line arrangement with flange connection to suction and discharge pipework; vertical mounting.

Z = permanent dry well or in-line arrangement with flange connection to suction and discharge pipework; horizontal mounting.

In **T, Z** and **S** installations the pump must be equipped with cooling jacket.

For further information on applications, contact your nearest Flygt representative.

Pump versions
LT = low head execution
MT = medium head execution
HT = high head execution
SH = super high head execution

Liquid temperature:max. 40°C (104°F)
also available in an execution for liquid temperature up to 70°C (158°F) only with cooling jacket. Higher temperatures than 40°C (104°F) are not permitted for Ex-approved pumps.

Liquid density: max. 1100 kg/m³ (9.2 lb per US gal.)

The pH of the pumped liquid: 5.5—14.

Lowest liquid level: See illustration page 8.

Depth of immersion: max. 20 m (65 ft).

Recycling
Local and/or private laws and regulations regarding recycling must be followed. If there are no laws or regulations, or the product is not accepted by an authorized recycling company, the product or it's parts can be returned to the nearest Flygt sales company or service workshop.

Weights

Weight including connections, but without motor cable in kg (lb).

Pump type	With cooling jacket	Without cooling jacket	Discharge connection
NP 3171 LT	410 (904)	381 (840)	98 (216)
NP 3171 MT	319 (703)	290 (640)	54 (119)
NP 3171 HT	297 (639)	268 (595)	42 (93)
NP 3171 SH	346 (763)	326 (719)	42 (43)
NS 3171 LT	460 (1014)		
NS 3171 MT	352 (776)		
NS 3171 HT	317 (699)		
NS 3171 SH	366 (807)		
NT 3171 LT	525 (1157)		*) 101 (223)
NT 3171 MT	406 (895)		*) 89 (196)
NT 3171 HT	366 (807)		*) 87 (191)
NT 3171 SH	415 (915)		*) 87 (191)
NZ 3171 LT	485 (1069)		
NZ 3171 MT	384 (846)		
NZ 3171 HT	357 (787)		
NZ 3171 SH	358 (789)		

*) Inlet elbow including stand

MOTOR DATA

50 Hz, 22.0 kW, 2925 r/min
3-phase, 2-pole

Voltage V	Rated current A	Starting current A
230 D	67	480
380 D	41	292
400 D	38	273
400 Y	39	280
415 D	38	285
440 D	37	305
500 D	31	227
660 Y	23	169
690 Y	22	157

50 Hz, 18.5 kW, 1460 r/min
3-phase, 4-pole

Voltage V	Rated current A	Starting current A
230 D	62	390
380 D	37	210
400 D	36	223
400 Y	36	225
415 D	34	210
440 D	34	225
500 D	29	179
660 Y	21	122
690 Y	21	128

50 Hz, 15.0 kW, 1460 r/min
3-phase, 4-pole

Voltage V	Rated current A	Starting current A
230 D	53	325
380 D	30	167
400 D	30	178
400 Y	31	189
415 D	29	170
440 D	29	182
500 D	24	142
660 Y	17	97
690 Y	17	102

50 Hz, 15.0 kW, 965 r/min
3-phase, 6-pole

Voltage V	Rated current A	Starting current A
230 D	52	278
380 D	31	157
400 D	30	167
400 Y	30	162
415 D	28	144
440 D	28	155
500 D	24	129
660 Y	18	91
690 Y	17	96

50 Hz, 22.0 kW, 1460 r/min
3-phase, 4-pole

Voltage V	Rated current A	Starting current A
230 D	73	470
380 D	42	236
400 D	41	248
400 Y	42	272
415 D	39	232
440 D	38	249
500 D	33	210
660 Y	24	137
690 Y	24	144

60 Hz, 35hp, (26 kW) 3525 r/min
3-phase, 2-pole

Voltage V	Rated current A	Starting current A
230 Y//	79	585
440 D	41	294
460 D	39	273
460 YSER	40	292
575 D	31	226
600 D	30	238

60 Hz, 30 hp, (22.0 kW) 1755 r/min
3-phase, 4-pole

Voltage V	Rated current A	Starting current A
230 Y//	75	515
380 D	45	300
460 D	36	231
460 YSER	38	257
575 D	29	175
600 D	29	194

60 Hz, 25 hp, (18.6 kW) 1755 r/min
3-phase, 4-pole

Voltage V	Rated current A	Starting current A
230 Y//	61	360
380 D	37	218
460 D	31	184
460 YSER	30	180
575 D	25	147
600 D	24	154

60 Hz, 25 hp, (18.6 kW) 1160 r/min
3-phase, 6-pole

Voltage V	Rated current A	Starting current A
230 Y//	64	355
380 D	38	215
460 D	31	174
460 YSER	32	177
575 D	25	134
600 D	24	141

60 Hz, 34 hp, (25 kW) 1755 r/min
3-phase, 4-pole

Voltage V	Rated current A	Starting current A
230 Y//	81	560
380 D	48	310
460 D	40	256
460 YSER	40	281
575 D	32	217
600 D	32	228

DESIGN OF THE PUMP

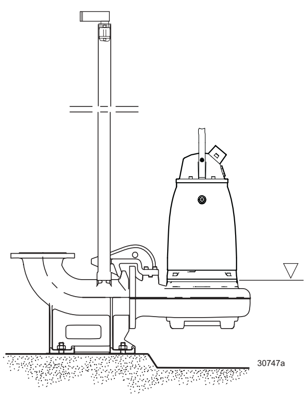
Motor
Squirrel-cage 3-phase induction motor for 50 Hz or 60 Hz.
The motor is started by means of direct on-line or star delta start.
The motor can be run continuously or intermittently with a maximum of 30 evenly spaced starts per hour.
Flygt motors are tested in accordance with IEC 34-1.
The stator is insulated in accordance with class H (180° C, 355° F). The motor is designed to supply its rated output at ± 10% variation of the rated voltage.
Without overheating the motor, ± 10% variation of the rated voltage can be accepted provided that the motor does not run continuously at full load.

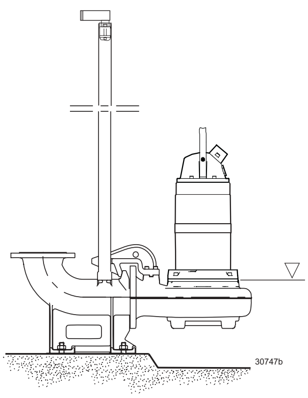
Bearings
The support bearing of the shaft is a double row ball bearing.
The main bearing of the shaft is a double row angular contact ball bearing.

Mechanical seal unit
The pump has one shaft mechanical seal unit consisting of two independently operating seals:

Alt I	Inner seal:	Corrosion resistant cemented carbide WCCR/WCCR
	Outer seal:	Corrosion resistant cemented carbide WCCR/WCCR
Alt II	Inner seal:	Corrosion resistant cemented carbide WCCR/WCCR
	Outer seal:	Silicon Carbide RSiC/RSiC

Lowest liquid level

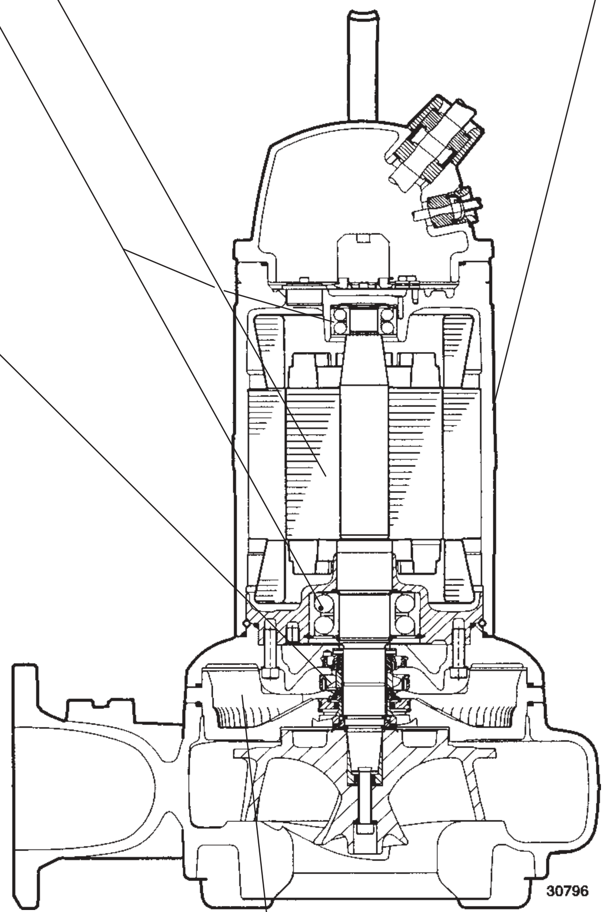




Monitoring equipment
The stator incorporates three thermal contacts connected in series that activate an alarm at overtemperature.
The thermal contacts: open at 140° C (285 F°). The sensors shall be connected to Flygt's monitoring unit MiniCAS II or equivalent unit.
The monitoring equipment shall be of a design that makes automatic restart impossible.
The 3171 is supplied with inspection sensor FLS10 for sensing the presence of any liquid in the inspection chamber.

Cooling
The pump is cooled by the ambient liquid. For lowest liquid level, see illustration below.

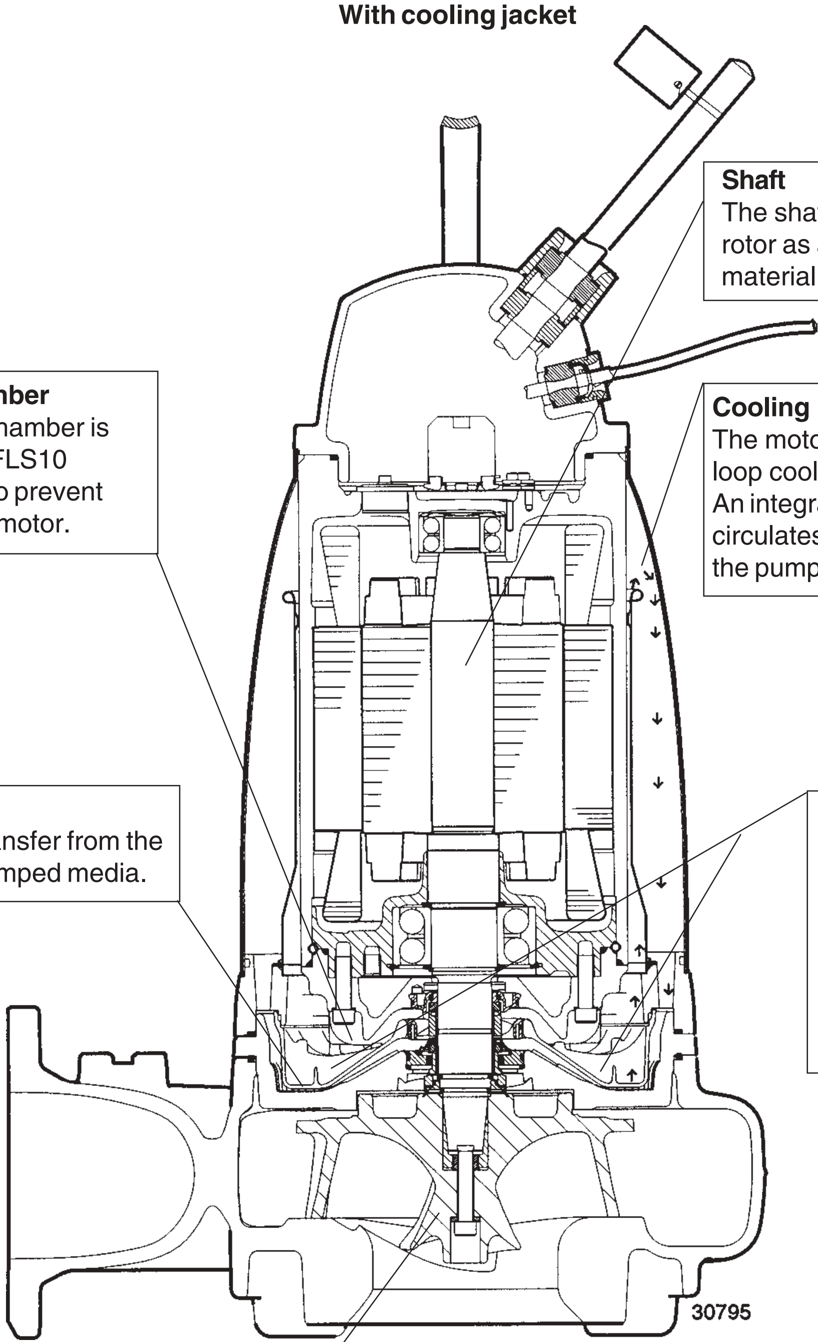
Without cooling jacket



Seal housing
A coolant fluid lubricates and cools the mechanical seal unit and acts as a buffer between the pumped media and the electric motor.

DESIGN OF THE PUMP

With cooling jacket



Shaft
The shaft is delivered with the rotor as an integral part. Shaft material; stainless steel.

Inspection chamber
The inspection chamber is equipped with a FLS10 leakage sensor to prevent damages on the motor.

Cooling
The motor is cooled by a closed loop cooling system.
An integrated coolant pump circulates the coolant whenever the pump is operated.

Flow diffusor
Provides heat transfer from the coolant to the pumped media.

Seal housing
The coolant lubricates and cools the mechanical seal unit and acts as a buffer between the pumped media and the electric motor.

Impeller
The pump is equipped with a N-impeller, a semi-open two-vane impeller.

TRANSPORTATION AND STORAGE

The pump may be transported and stored in a vertical or horizontal position. Make sure that the pump cannot roll or fall over.

WARNING!

Always lift the pump by its lifting handle never by the motor cable or the hose.

The pump is frostproof as long as it is operating or is immersed. If the pump is hoisted from the sump when the temperature is below the freezing point, the impeller and shaft seal may freeze.

A frozen impeller and shaft seal can be thawed by allowing the pump to stand immersed in the liquid for a short period before it is started. Never use a naked flame to thaw the pump. The pump should be run for a few seconds after being taken up in order to expel all remaining water from the hydraulic end.

For longer periods of storage, the pump must be protected against moisture and heat. The impeller should be rotated by hand occasionally (for example every other month) to prevent the shaft seals from sticking together. If the pump is stored for more than 6 months, this rotation is mandatory.

After a long period of storage, the pump should be inspected before it is put into operation. Pay special attention to the shaft seal and the cable entry.

Follow the instructions under the heading "Before starting".

INSTALLATION

Handling equipment

Always pay extra attention to safety aspects when working with lifting equipment.

Lifting equipment is required for handling the pump. The lifting chain and the schackle should be in stainless steel and inspected every year.

— **Stay clear of suspended loads.**

— **Always lift the pump by its lifting handle – never by the motor cable or the hose.**

The minimum height between the lifting hook and the floor shall be sufficient to lift the pump out of the sump.

The lifting equipment shall be able to hoist the pump straight up and down in the sump, preferably without the need for resetting the lifting hook.

Oversized lifting equipment could cause damage if the pump should stick when being lifted.

Make sure that the lifting equipment is securely anchored and in good condition.

Check that the lifting handle and chain are in good condition.

To ensure proper installation, please see the dimensions on the dimensional drawing.

WARNING! The end of the cable must not be submerged. It must be above flood level, as water could penetrate through the cable into the junction box or the motor.

For automatic operation of the pump (level control), it is recommended that the level regulators should be used at low voltage. The data sheet delivered with the regulators gives the permissible voltage.

Local rules may specify otherwise.

Clean out all debris from the sump before the pump is lowered down and the station is started.

— **NOTE for Ex version page 3.**

— **Minimum stop level should be according to the dimensional drawing.**

— **The pump must never run dry.**

INSTALLATION

Safety precautions

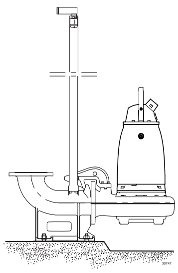
In order to minimize the risk of accidents in connection with service and installation work, the following rules should be followed:

1. Never work alone. Use a lifting harness, safety line and a respirator as required. Do not ignore the risk of drowning.
2. Make sure there are no dangerous gases within the work area.
3. Check the explosion risk before welding or using electric hand tools.
4. Before the pump is installed check that the cable and cable entry have not been damaged during the transportation.
5. Observe strict cleanliness. Do not ignore health hazards.
6. Bear in mind the risk of electrical accidents.
7. Make sure that the lifting equipment is in good condition and comply to local ordinances.
8. Provide a suitable barrier around the work area, e. a guard rail.
9. Make sure you have a clear path of retreat.
10. Use safety helmet, safety goggles and protective shoes.
11. All personnel who work with sewage systems must be vaccinated against diseases to which they may be exposed.
12. A first-aid kit must be close at hand.
13. Note that special rules apply to installation in explosive athmosphere.

Follow all health and safety rules and local codes and ordinances.

Installation alternatives

P- installation



In the P installation, the pump is installed on a stationary discharge connection and operates completely or partially submerged in the pumped liquid.
In addition to the pump the following items are required:

Guide bars consisting of two hot dip galvanized or stainless steel pipes.

Guidebar bracket for attaching the guide bars to the access frame or the upper part of the sump.

Level regulators or other control equipment for start, stop and alarm.

Cable holder for holding the cable and regulating the height of the level regulators.

Access frame (with covers) to which the upper guide bar bracket and cable holder can be attached.

Discharge connection for connecting the pump to the discharge line. The discharge connection has a flange which fits the pump casing flange and a bracket for attaching the guide equipment.

Bushings for vibration damping between the guide bars and the discharge connection.

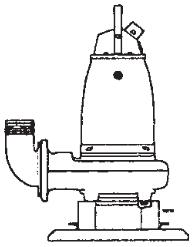
Instructions

- Provide a barrier around the pump pit, for example a guardrail.
- Arrange for a cable between the sump and the electric control box. Make sure that the cables are not sharply bent or pinched.
- Place the access frame in position.
- Align the frame so that it is horizontal and then grout it in place.
- Grout the anchor bolts in place. Be careful when aligning and positioning the discharge connection in relation to the access frame.
- Place the discharge connection in position and tighten the nuts.
- Secure the guide bars in the bracket.
- Check that the guide bars are placed vertically by using a level or a plumb line.
- Connect the discharge pipe to the discharge connection.
- Bolt the cable holder to the access frame. Thread the level regulator cables through the holes in the cable holder and adjust the height of the level regulators.
- Protect bolts and nuts with corrosion preventive compound.
- Lower the pump along the guide bars.
- Fasten the lifting chain (stainless steel) on the access frame and the cables on the cable holder. Make sure that the cables cannot be sucked into the inlet of the pump. Support straps are required for deep install-ations.
- Run the cables up to the electric control box.
- Clean out debris from the sump before starting up the station.
- The pump can be hoisted up along the guide bars for inspection without any connections having to be undone.

INSTALLATION

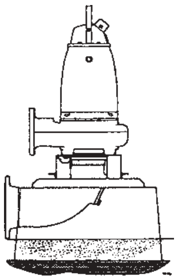
Installation alternatives

S- installation

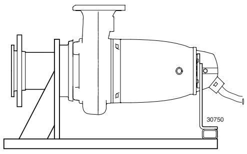


In the S- installation, the pump is transportable and intended to operate completely or partially submerged in the pumped liquid. The pump is equipped with a connection for hose or pipe, see "Parts list".
The pump stands on a base stand.

T- installation



T



Z

In the T- installation, the pump is installed in a stationary position in a dry well next to the wet sump.

In the Z- installation the pump is installed in a horizontal position on a support stand and a bell-mouth is connected to the inlet pipe.

The pump has a watertight motor and will therefore not be damaged in the event of flooding.

The pump is equipped with a cooling jacket.

In addition to the pump, the following items are required:

Support stand for anchoring the pump to a base.

Shut-off valves to permit the pump to be removed for service.

Level regulators or other control equipment for start, stop and alarm.

WARNING! The risk of freezing is particularly great at certain T or Z installations.

Instruction

Bolt the base stand to the concrete base by means of the anchor bolts. Bolt the pump to the base stand and the suction connection.

Connect the motor cable, suction line and discharge line.

Make sure that the weight of the pump does not bear on the system piping.

ELECTRICAL CONNECTIONS

- **Before starting work on the pump, make sure that the pump and the control panel are isolated from the power supply and cannot be energized.**
- **If the pump is equipped with automatic level control, there is a risk of sudden restart.**
- **If persons are likely to come into physical contact with the pump or pumped media (liquid), e.g on construction sites and farms, the earthed (grounded) socket must have an additional earth-(ground-) fault protection device (GFI) connected.**

All electrical work shall be carried out under the supervision of an authorized electrician. Local codes and regulations shall be complied with.

NOTE for Ex version page 3.

- **All electrical equipment must be earthed (grounded). This applies to both pump equipment and any monitoring equipment. Failure to heed this warning may cause a lethal accident. Make sure that the earth (ground) lead is correctly connected by testing it.**

Check the data plate to determine which voltage supply is valid for your pump.

Check that the main voltage and frequency agree with the specifications on the pump data plate.

If the pump can be connected to different voltages, the connected voltage is specified by a yellow sticker.

Connect the motor cable to the starter equipment as illustrated in the wiring diagrams.

When the pump is connected to the public mains it may cause flicker of incandescent lamps when starting. In this case the supply authority should be notified before installing the pump.

Leads that are not in use must be isolated.

The cable should be replaced if the outer sheath is damaged. Contact a Flygt service shop.
Make sure that the cable does not have any sharp bends and is not pinched.

Under no circumstances may the starter equipment be installed in the sump.

WARNING! For safety reasons, the earth (ground) lead should be approx. 100 mm (4.0") longer than the phase lead. If the motor cable is jerked loose by mistake, the earth (ground) lead should be the last lead to come loose from its terminal. This applies to both ends of the cable.

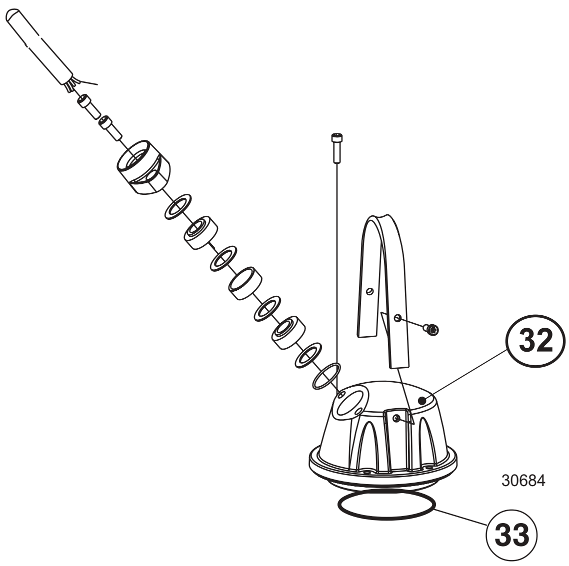
The motor is convertible between different voltages as stated on the data plate. This conversion is done on the terminal board or the contactor.

— **Bear in mind the risk of electrical shock and the risk of explosion if the electrical connections are not correctly carried out.**

When using a variable-frequency-drive (VFD) the shielded cable (type NSSHÖU.../3E+St) should be used in order to fulfil European CE requirements. Contact your Flygt representative and ask your VFD-supplier for electrical limitations. Also please see VFD-recommendation Flygt article no. 893472.

Connection of stator and motor leads

- Check on the data plate which connection, Y, D or YD, is valid for the voltage supply. Then, depending on voltage, arrange the connection on the terminal board in accordance with Y, D or YD. See figure.
- Connect the motor cable to the connection block, U1, V1, W1 and earth (ground). Connect the leads from the motor control circuit.
- If star-delta start is used, motor cables are connected as shown in the figure. Links (jumper strips) are not used with star-delta start.
- Make sure that the pump is correctly earthed (grounded).
- Install the O-ring (33) and connection cover (32).
- Tighten the screws and the gland nut so that the cable entry unit bottoms out.
- Connect the motor cable to the starter equipment.
- Check the direction of rotation, see "Before starting".
- If the direction of rotation is wrong, transpose two of the phase leads.
- Remember that the starting surge with the direct-on line start can be up to six times higher than the rated current. Make sure that the fuses and circuit breakers are of the proper amperage.
- The incorporated **thermal contacts** (motor protection breaker) must be connected and in use. It shall be set to the motor rated current as given on the dataplate.



CABLE CHART

SUBCAB® 7GX
2 parallel cores connected together
6-leads, Y
3171

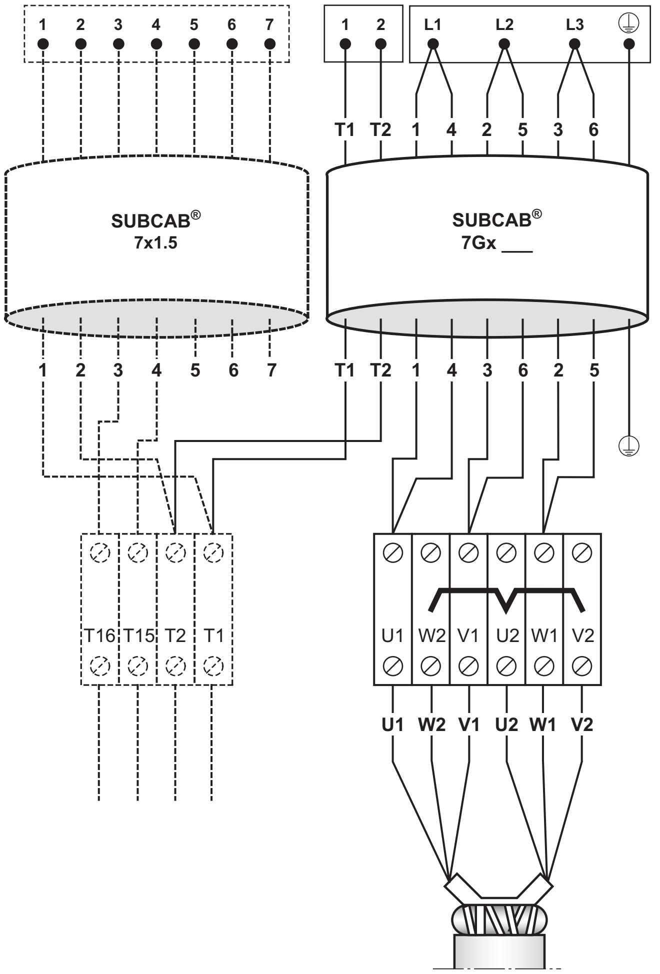


Bild 3

Mains	Lead	Terminal board
L1	1	U1
L1	4	U1
L2	2	W1
L2	5	W1
L3	3	V1
L3	6	V1
⏚	yellow/green	⏚
Control	**Cable lead**	**Terminal board**
T1	T1	T1
T2	T2	T2

Stator leads connection: Stator lead	Terminal board
U1, red	U1
W2, black	W2
V1, brown	V1
U2, green	U2
W1, yellow	W1
V2, blue	V2

SUBCAB® 7GX
2 parallel cores connected together
6-leads, D
3171

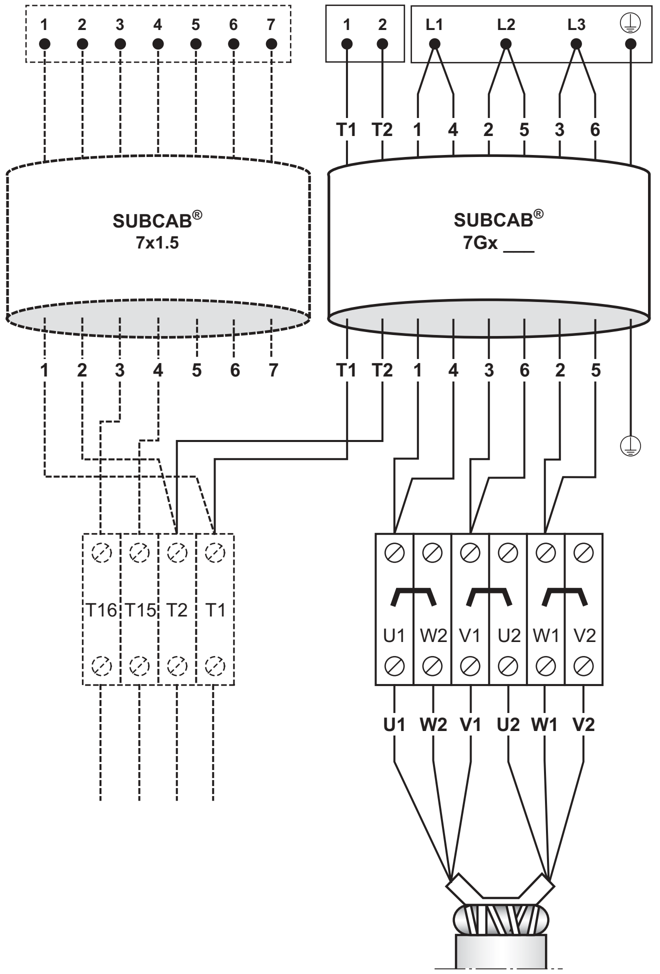


Bild 6

Mains	Lead	Terminal board
L1	1	U1
L1	4	U1
L2	2	W1
L2	5	W1
L3	3	V1
L3	6	V1
⏚	yellow/green	⏚
Control	**Cable lead**	**Terminal board**
T1	T1	T1
T2	T2	T2

Stator leads connection: Stator lead	Terminal board
U1, red	U1
W2, black	W2
V1, brown	V1
U2, green	U2
W1, yellow	W1
V2, blue	V2

CABLE CHART

SUBCAB® 4GX/SUBCAB® AWG, 6-leads, Y
3171

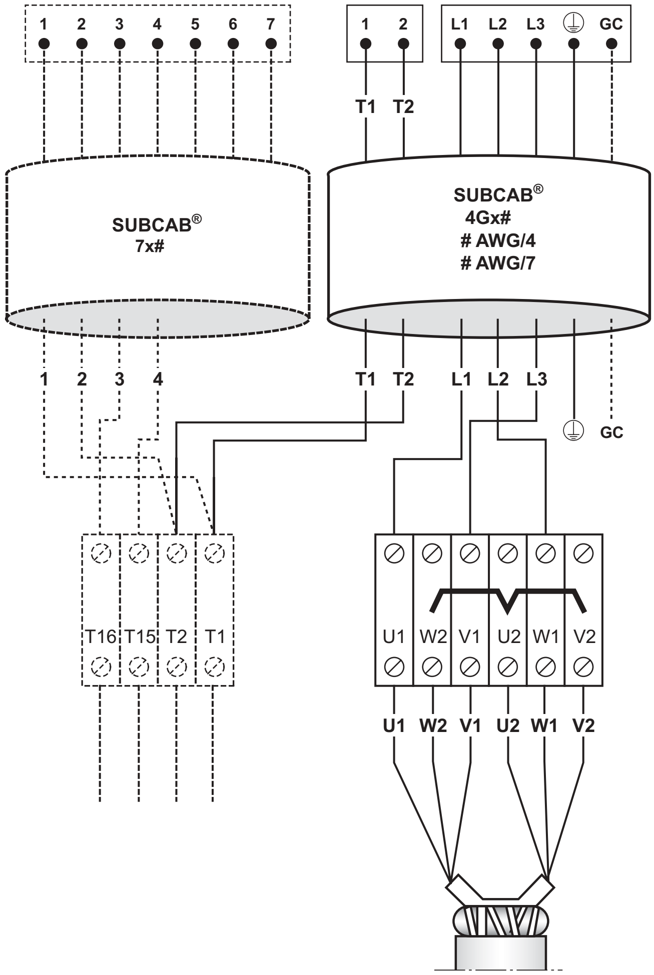


Bild 2

Mains	SUBCAB© Lead	SUBCAB© AWG Lead	Terminal board
L1	brown	red	U1
L2	black	black	W1
L3	grey	white	V1
⏚	yellow/green	yellow/green	⏚
Groundcheck GC		yellow	

Control	SUBCAB© Cable lead	SUBCAB© AWG Cable lead	Terminal board
T1	T1	orange	T1
T2	T2	blue	T2

Stator leads connection: Stator lead	Terminal board
U1, red	U1
W2, black	W2
V1, brown	V1
U2, green	U2
W1, yellow	W1
V2, blue	V2

SUBCAB® 4GX/SUBCAB® AWG, 6-leads, D
3171

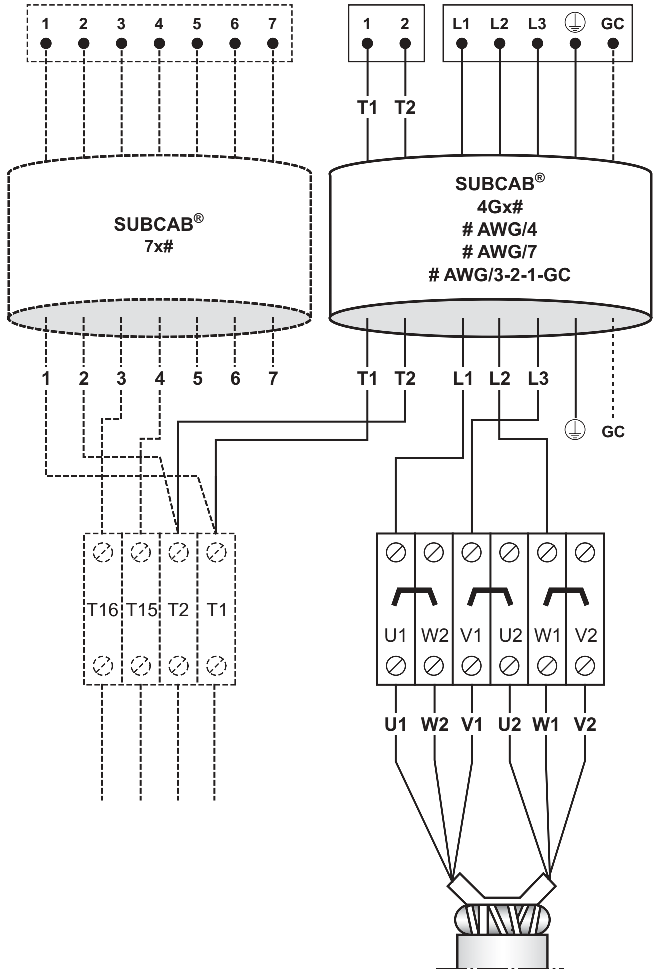


Bild 5

Mains	SUBCAB© Lead	SUBCAB© AWG Lead	Terminal board
L1	brown	red	U1
L2	black	black	W1
L3	grey	white	V1
⏚	yellow/green	yellow/green	⏚
Groundcheck GC		yellow	

Control	SUBCAB© Cable lead	SUBCAB© AWG Cable lead	Terminal board
T1	T1	orange	T1
T2	T2	blue	T2

Stator leads connection: Stator lead	Terminal board
U1, red	U1
W2, black	W2
V1, brown	V1
U2, green	U2
W1, yellow	W1
V2, blue	V2

CABLE CHART

SUBCAB® 4GX/SUBCAB® AWG, 60 Hz only, 9-leads, 460 V, Y ser.

3171

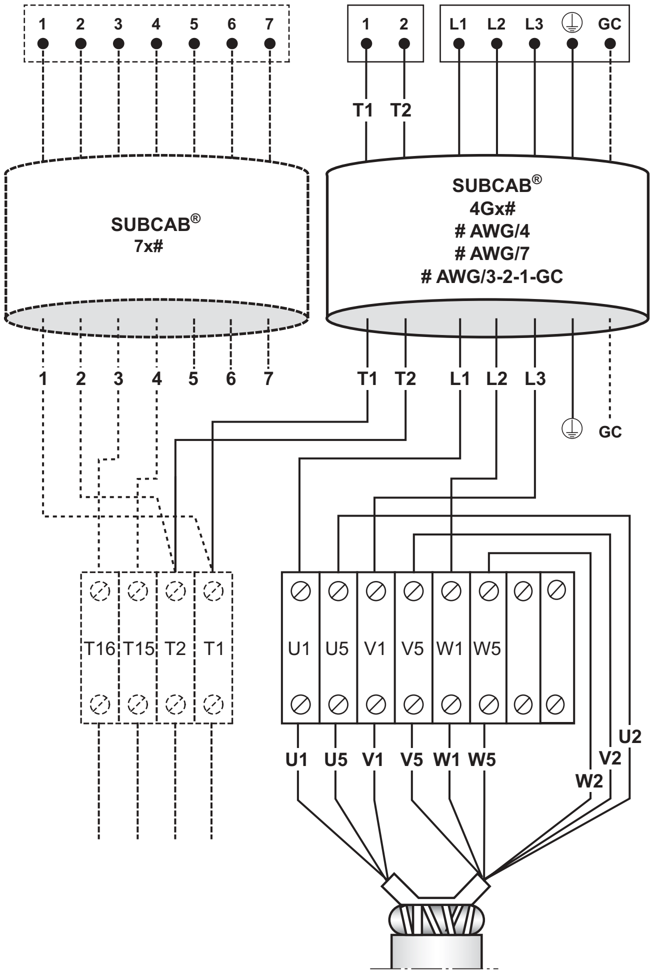


Bild 8

Mains	SUBCAB© Lead	SUBCAB© AWG Lead	Terminal board
L1	brown	red	U1
L2	black	black	W1
L3	grey	white	V1
⏚	yellow/green	yellow/green	⏚
Groundcheck GC		yellow	
Control	**SUBCAB© Cable lead**	**SUBCAB© AWG Cable lead**	**Terminal board**
T1	T1	orange	T1
T2	T2	blue	T2

Stator leads connection:

Stator lead	Terminal board
U1, red	U1
U5, red	U5
U2, green	U5
V1, brown	V1
V5, brown	V5
V2, blue	V5
W1, yellow	W1
W5, yellow	W5
W2, black	W5

SUBCAB® 4GX/SUBCAB® AWG, 60 Hz only, 9-leads, 230 V, Y //

3171

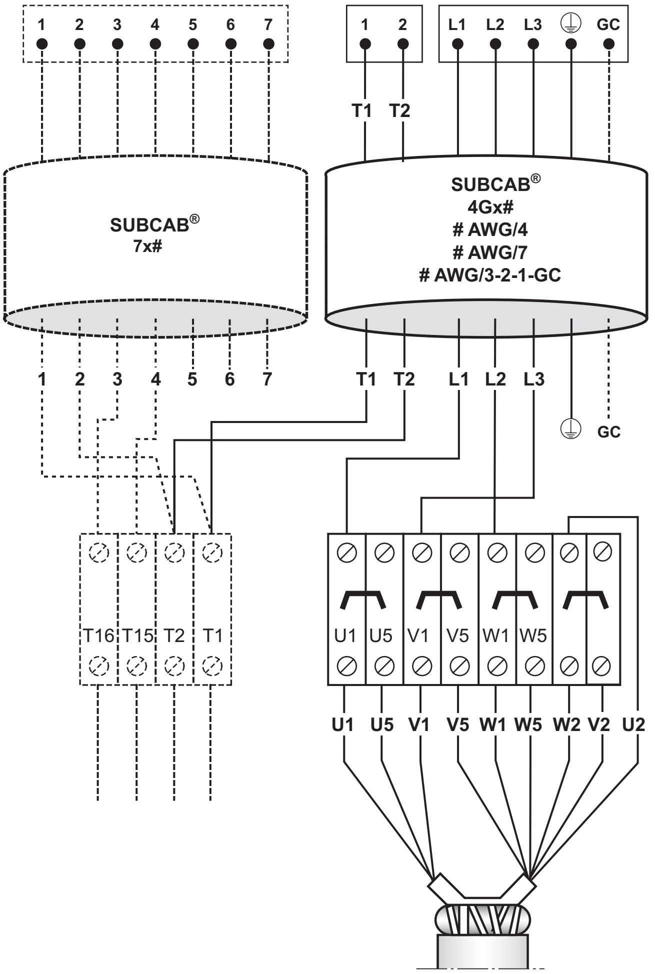


Bild 10

Mains	SUBCAB© Lead	SUBCAB© AWG Lead	Terminal board
L1	brown	red	U1
L2	black	black	W1
L3	grey	white	V1
⏚	yellow/green	yellow/green	⏚
Groundcheck GC		yellow	
Control	**SUBCAB© Cable lead**	**SUBCAB© AWG Cable lead**	**Terminal board**
T1	T1	orange	T1
T2	T2	blue	T2

Stator leads connection:

Stator lead	Terminal board
U1, red	U1
U5, red	U5
V1, brown	V1
V5, brown	V5
W1, yellow	W1
W5, yellow	W5
W2, black*	
V2, blue*	
U2, green*	

Connected together at terminal

CABLE CHART

SUBCAB® 7GX, 6-leads, Y/D

3171

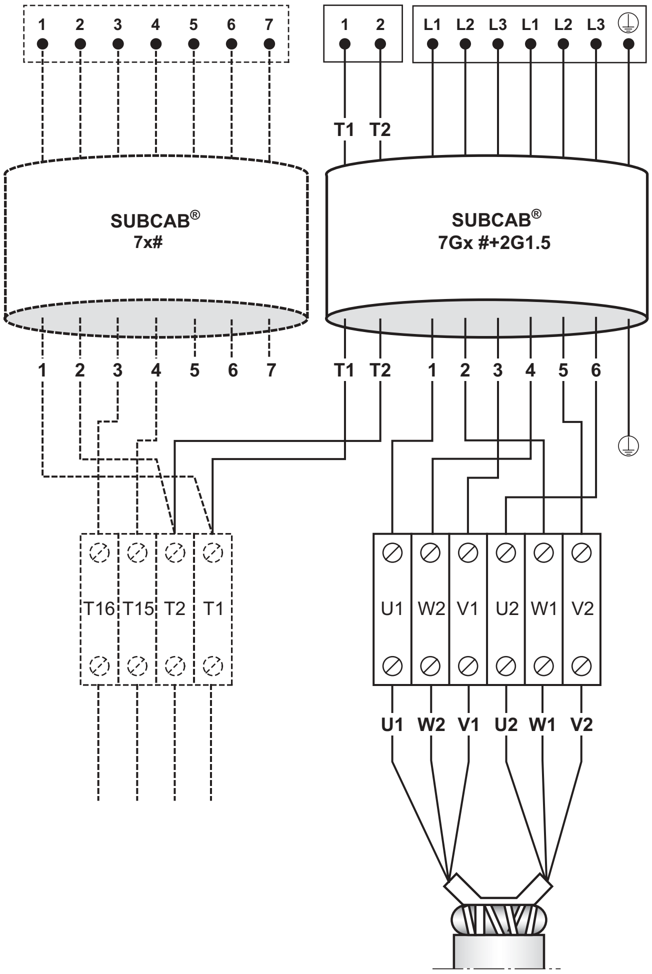


Bild 12

Mains	Lead	Lead
L1	1	U1
L2	2	W1
L3	3	V1
L1	4	W2
L2	5	V2
L3	6	U2
⏚	yellow/green	⏚
Control	**Cable lead**	**Terminal board**
T1	T1	T1
T2	T2	T2

Stator leads connection:

Stator lead	Terminal board
U1, red	U1
W2, black	W2
V1, brown	V1
U2, green	U2
W1, yellow	W1
V2, blue	V2

CABLE CHART

SUBCAB® Screened, 6-leads, Y

3171

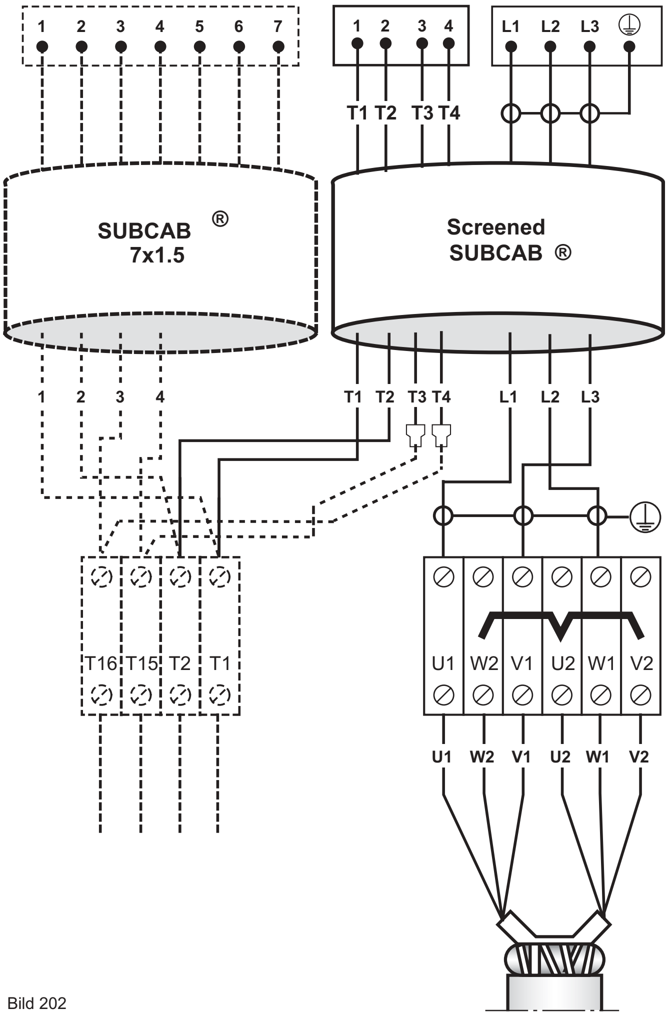


Bild 202

Mains	Lead	Lead
L1	Brown	U1
L2	Black	W1
L3	Grey	V1
⏚	Screen from leads	⏚
Control	**Cable lead**	**Terminal board**
T1	White T1	T1
T2	White T2	T2
T3	White T3	T15
T4	White T4	T16
Stator leads connection:		
Stator lead	**Terminal board**	
U1, red	U1	
W2, black	W2	
V1, brown	V1	
U2, green	U2	
W1, yellow	W1	
V2, blue	V2	

SUBCAB® Screened, 6-leads, D

3171

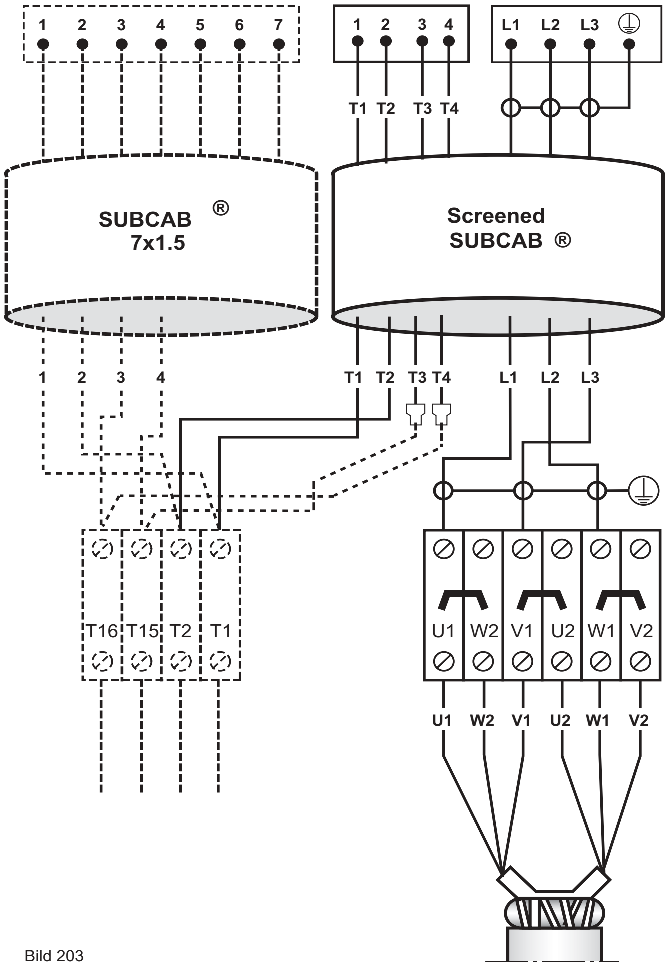


Bild 203

Mains	Lead	Lead
L1	Brown	U1
L2	Black	W1
L3	Grey	V1
⏚	Screen from leads	⏚
Control	**Cable lead**	**Terminal board**
T1	White T1	T1
T2	White T2	T2
T3	White T3	T15
T4	White T4	T16
Stator leads connection:		
Stator lead	**Terminal board**	
U1, red	U1	
W2, black	W2	
V1, brown	V1	
U2, green	U2	
W1, yellow	W1	
V2, blue	V2	

CABLE CHART

NSSHÖU ../3E+st, 6-leads, Y

3171

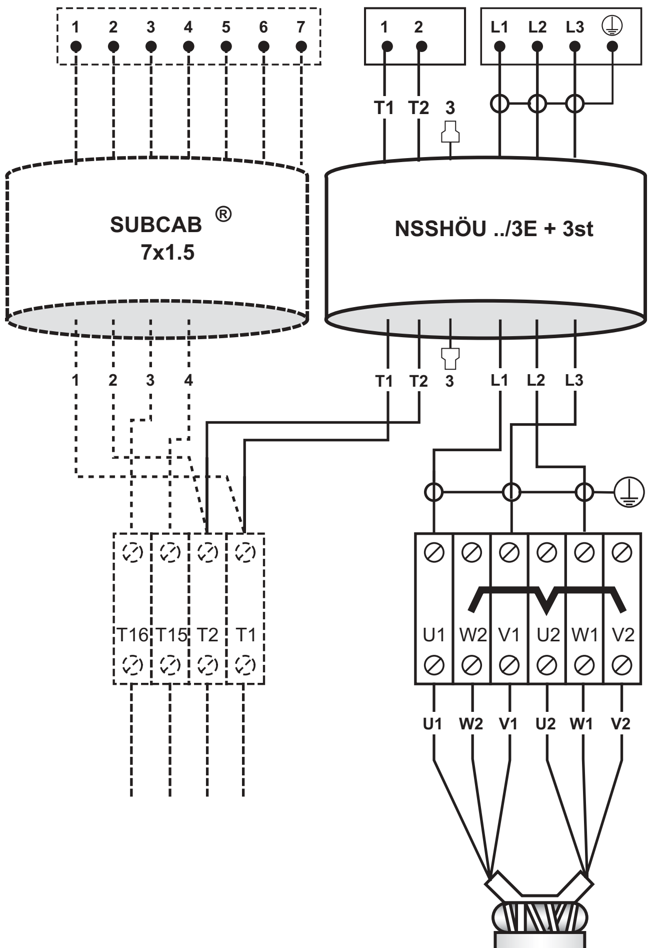


Bild 200

Mains	Lead	Lead
L1	Brown	U1
L2	Black	W1
L3	Grey	V1
⏚	Screen from leads	⏚
Control	**Cable lead**	**Terminal board**
T1	Black T1/1	T1
T2	Brown T2/2	T2
T3	Grey/3	Unused

Stator leads connection: Stator lead	 Terminal board
U1, red	U1
W2, black	W2
V1, brown	V1
U2, green	U2
W1, yellow	W1
V2, blue	V2

NSSHÖU ../3E+st, 6-leads, D

3171

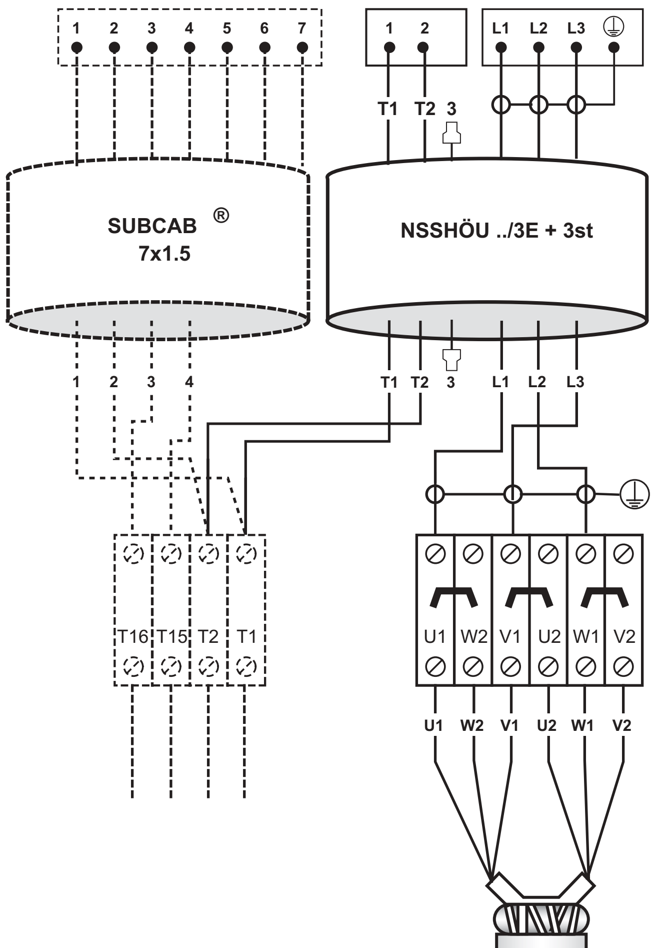


Bild 201

Mains	Lead	Lead
L1	Brown	U1
L2	Black	W1
L3	Grey	V1
⏚	Screen from leads	⏚
Control	**Cable lead**	**Terminal board**
T1	Black T1/1	T1
T2	Brown T2/2	T2
T3	Grey/3	Unused

Stator leads connection: Stator lead	 Terminal board
U1, red	U1
W2, black	W2
V1, brown	V1
U2, green	U2
W1, yellow	W1
V2, blue	V2

Sensor connections

Monitoring equipment

FLS10 is a small float switch and it is installed in the inspection chamber. FLS is connected to max 12 V.

Thermal switches are incorporated into the stator and are rated 250 V, 2,5 A (cos φ=1) / 1,6 A (cos φ=0,6).

The sensors are connected as standard to the Flygt monitoring relay MiniCAS II (see diagrams below).

In case optional sensors are used the more advanced monitoring relay MAS 711 can be used.

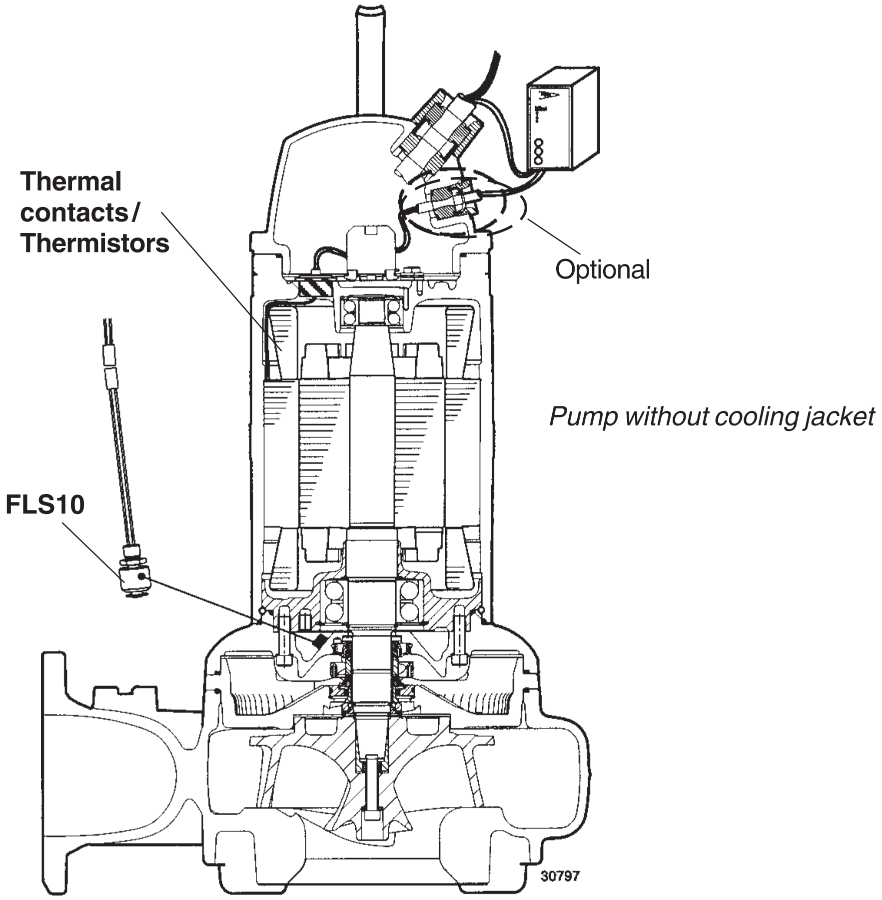
For a **PTC-thermistor** (PTC = Positive Temperature Coefficient), there is a significant increase in resistance at a certain temperature that can be utilized for monitoring the temperature.

PTC-thermistor

T= 25 °C	R $\leq$ 100 Ohm
T=135 °C (T_{REF} - 5 °C)	R $\leq$ 550 Ohm
T=145 °C (T_{REF} + 5 °C)	R $\geq$ 1330 Ohm

Three thermistors are connected in series and have a resistance of approx. 150-300 ohms at room temperature.

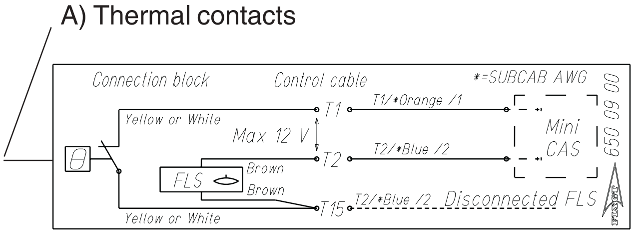
The label in the junction box shows if the pump is equipped with optional sensors.



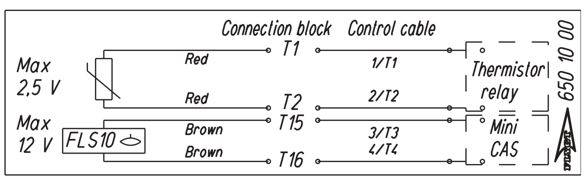
Sensor connection for standard configuration

The pump is as standard equipped with either thermal contacts or thermistors.

A) Thermal contacts



B)Thermistors



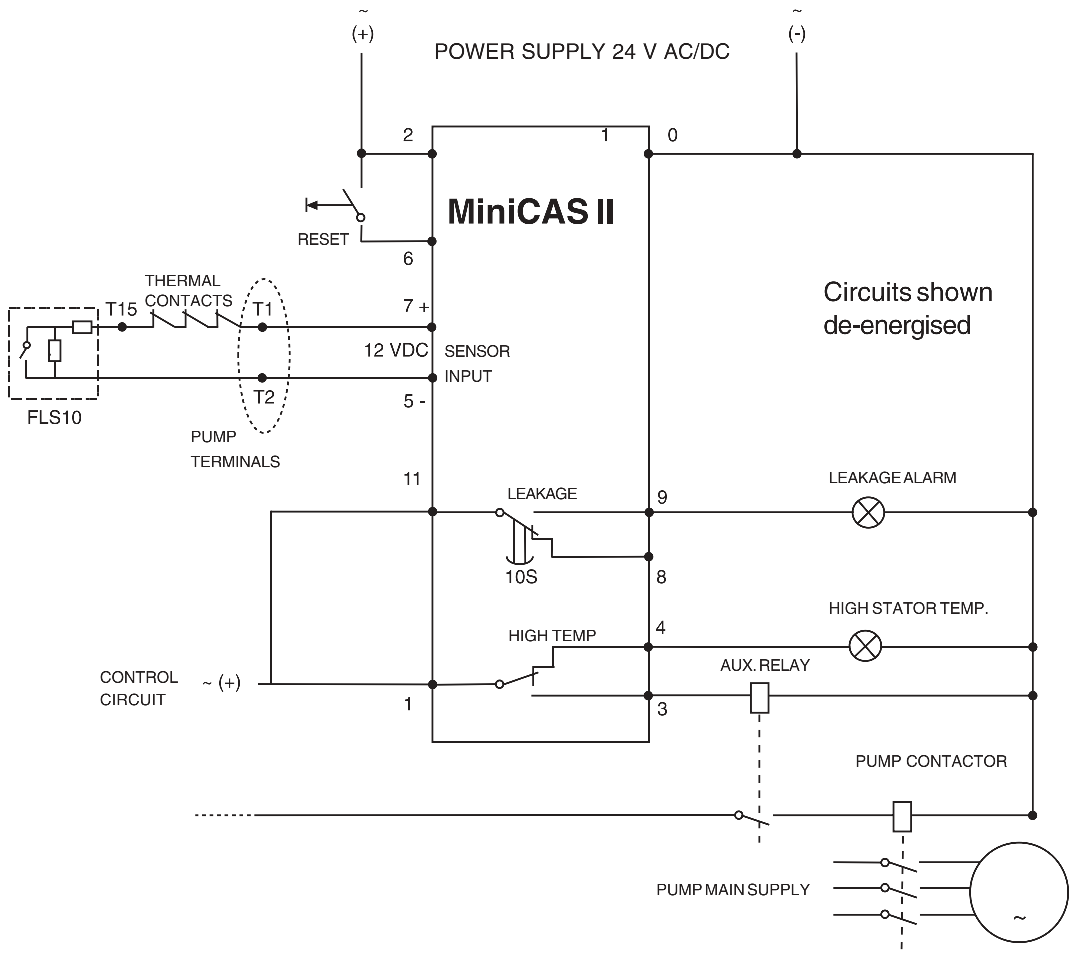
<u>FLS10 + thermal contacts</u>

0 mA = *Overtemperature*

10 mA = *OK*

28 mA = *Leakage*

Tolerance 10%



Sensor Connection Table

(For further information please contact Flygt representative.)

Sensor	Sensor lead	Thermal connection	Control cable	Connected to
Thermal contacts + FLS10	White Brown White+Brown	T1 T2 T15	T1/*Orange T2/*Blue = SubCab /* SubCabAWG	Mini CAS II Mini CAS II
Thermistors + FLS10	Red Red Brown Brown	T1 T2 T15 T16	1 2 3 4	Thermistor relay Thermistor relay Mini CAS II Mini CAS II

OPERATION

Before starting

- Check that the visible parts of the pump and installation are undamaged and in good condition.
- Remove the fuses or open the circuit breaker and check that the impeller can be rotated freely.
- Verify that the supply voltage matches the pump data plate voltage rating.
- Conduct insulation integrity check.
- Conduct phase to phase resistance check.
- Check that the monitoring equipment works.
- Check the direction of rotation. The impeller shall rotate clockwise, as viewed from above. When started, the pump will jerk in the opposite direction to the direction in which the impeller rotates. See figure. In case of dry installation, check the direction of rotation through the inlet elbow access cover. Transpose two phase leads if the impeller rotates in the wrong direction (3 ~).

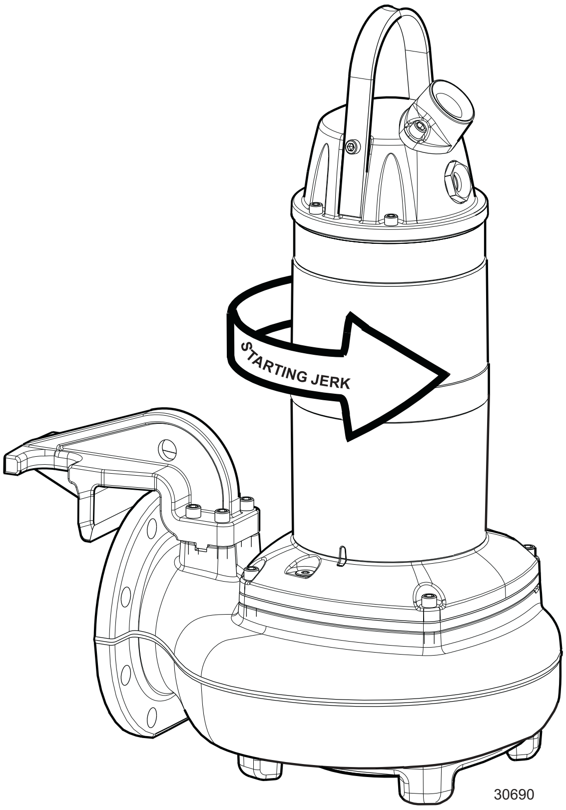
Note for Ex version page 3.

— **Before starting work on the pump, make sure that the pump is isolated from the power supply and cannot be energized.**

— **Make sure that the pump cannot roll or fall over and injure people or damage property.**

— **In some installations the pump surface and the surrounding liquid may be hot. Bear in mind the risk of burn injuries.**

— **In some installations and at certain operating points on the performance curve, the noise level of 70 dB or the noise level specified for the actual pump may be exceeded.**



Watch the starting jerk which can be powerful.

CARE AND MAINTENANCE

Service/Inspection

Flygt recommends a preventive maintenance program based on Intermediate and Major Services at regular intervals. For standard sewage applications where FLS10 is correctly connected and in use and the temperature of the pumped liquid is 40° C (104° F) or less an *Intermediate Service* should be performed every 8000 hours or every 2 years, whichever occurs first.

The time between *Major Service* could vary considerably depending on operating conditions and the need for a Major Service will be determind during the regular Intermediate Services.
However, a minimum of 20 000 hours of operation could be anticipated.

For applications other than sewage water or for specific operating conditions, other service intervals may be recommended.

Pump	**Intermediate Service running 8 000 h or 2 years**
Junction box	Check that it is clean and dry.
Terminal board	Check that the connections are properly tightened.
Insulation check	Check that the resistance between earth and phase lead is more than 5 M Ω. Conduct phase to phase resistance check.
Cable	Check that the rubber sheating (jacket) is undamaged.
Seal housing	Fill up with new coolant if necessary. Check freezing point (lower than –13°C, 9°F).
Inspection chamber	Drain all liquid if any. Check the resistance. Normal value approx.1200 Ω, alarm approx. 430 Ω.
O-rings	Always replace the O-rings of the filling plugs and at the junction cover. Always grease new O-rings.
Thermal contacts	Check the resistance. Normally closed circuit; interval 0 – 1 Ω.
Thermistor	Check the resistance 20 – 250 Ω, (measuring voltage max 2 V DC).
Impeller	Check impeller clearance and adjust if necessary.
Lifting handle	Check the screws and the status of the lifting handle.
Rotation direction	Check the rotation of the impeller.
Lifting device	Check that local safety regulations are followed.
Voltage and amperage	Check running values.

Pumpstation	**Intermediate Service running 8 000 h or 2 years**
Electrical cabinets/ panels	Check that they are clean and dry.
Connection to power	Check that the connections are properly tightened.
Overload and other protections	Check correct settings.
Personnel safety	Check guard rails, covers and other protections.
Level regulators	Check condition and function.

Pump	**Major Service**
Support and main bearing.	Replace with new bearings.
Mechanical seal unit.	Replace with new seal units.

Pumpstations same as Intermediate Service.

If any indication of alarm between inspections, please see instructions below.	Actions
FLS10	Drain the fluid in the inspection chamber. Fill with new coolant if necessary. Check freezing point (lower than –13° C (9° F)). Check the inspection chamber again after one week of operation. If leakage has occured, drain the fluid and change the mechanical seal unit and replace with new coolant.
Thermistor/Thermal-contact	Check coolant level. (pump with cooling jacket) Check start and stop levels.
Overload protection	Check that the impeller can rotate freely.

The following points are important in connection with work on the pump:

— Make sure that the pump cannot roll or fall over and injure people or damage property.

— Check every year that the lifting equipment is in good condition.

The pump is designed for use in liquids which can be a healthrisk. In order to prevent injury to the eyes and skin, observe the following points when working on the pump:

— Make sure that the pump has been thoroughly cleaned.

— Beware of the risk of infection.

— Follow local safety regulations.

— Always wear goggles and rubber gloves.

— Rinse the pump thoroughly with clean water before starting work.

— Rinse the components in water after dismantling.

— The coolant chamber may be under pressure. Hold a rag over the filling plug to prevent splatter.

Proceed as follows if fluids have splashed into your eyes:

— Rinse your eyes immediately in running water for 15 minutes. Hold your eyelids apart with your fingers.

— Contact an eye specialist.

On your skin:

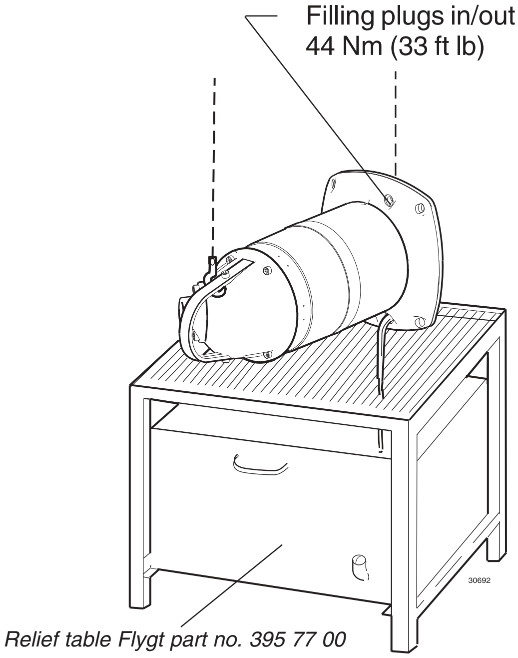
— Remove contaminated clothes.

— Wash your skin with soap and water.

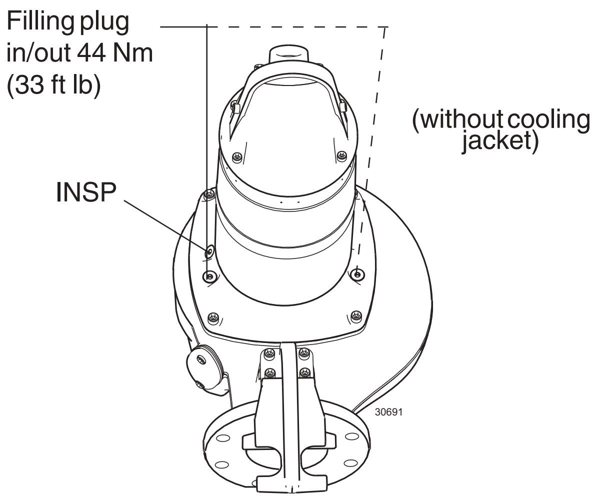
— Seek medical attention, if required.

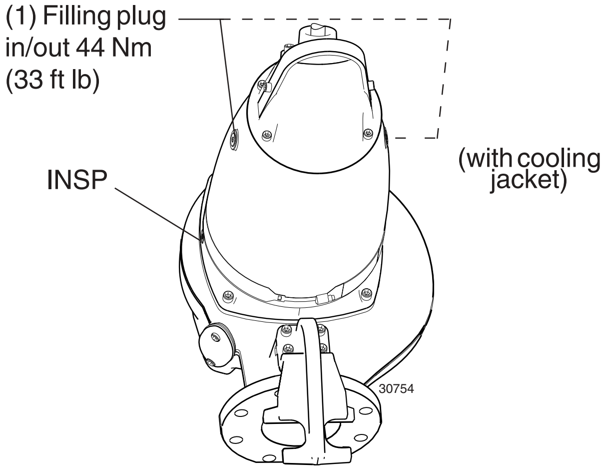
Changing the coolant

Emptying coolant
(without cooling jacket)

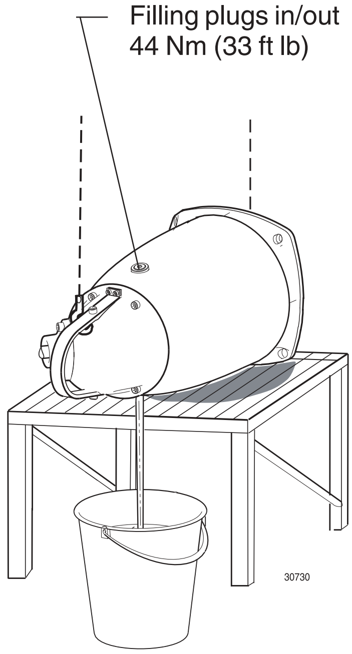


Filling coolant





Emptying coolant
(with cooling jacket)



1. Lift the pump horizontally with an overhead crane and place on a relief table.
2. Turn the pump so that one of the filling plugs holes faces downwards.
   WARNING! If the mechanical seal unit leaks, the seal housing may be under pressure. Hold a rag over the filling plug to prevent splatter.
3. Unscrew the filling plug. It is easier to drain the water-glycol if the other filling plug is also removed.
4. **Pump without cooling jacket.** Raise the pump to an upright position. Fill with coolant to the same level as the filling plugs; approx. 4,6 litres (4.9 US quarts).
   Pump with cooling jacket; approx. 16,7 litres (17.6 US quarts).
   Coolant: a mix of water and stabilized monopropyleneglycol in a mixture ratio of 70/30 % volume part.

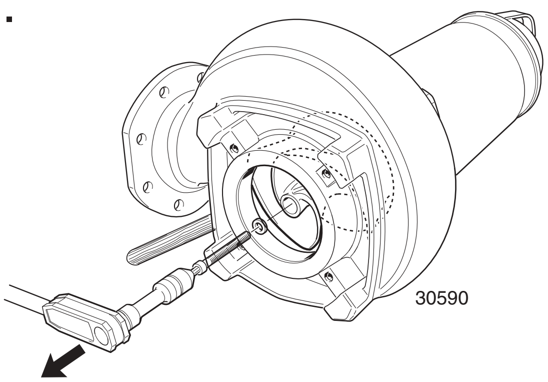
   Known trade marks of monopropyleneglycol are: Dowcal N (individual components are approved by FDA), Dowcal 20. These are non-poisonous, heat-and-cold resistant and inhibiting of corrosion.

   Use of other type of glycol jeopardize the function of the pump.

   If there is no risk of freezing even clean water with anti-corrosive is acceptable as coolant.
5. Always replace the O-rings of the filling plugs. Put the plugs back and tighten them.

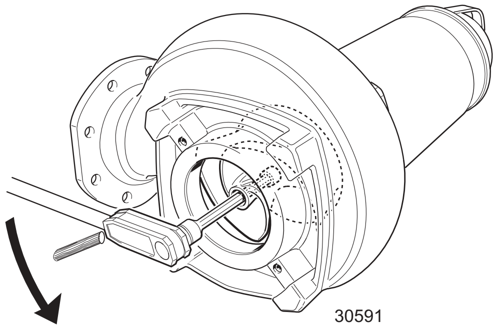
Removing the impeller

1.



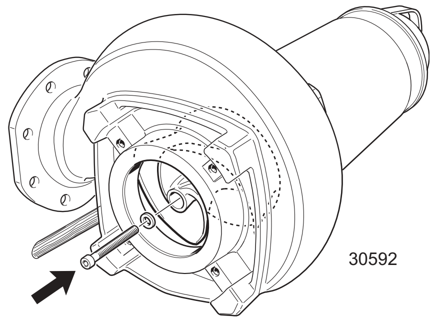
Place the pump horizontally. Remove the guide pin (if mounted). Remove the flush valve cover and it's O-ring. Insert a rod (wood or plastic) through the hole and lock the impeller in place. Remove the impeller screw.

2.



Using a 12 mm hexagon bit adaptor (allen socket) with a 100 mm (4") extension (minimum length) turn the gland screw counter clockwise until the impeller breaks free from the shaft.

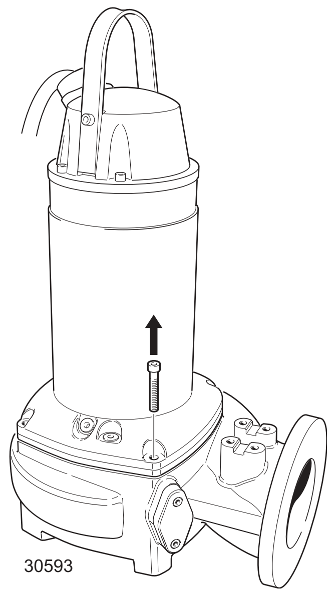
3.



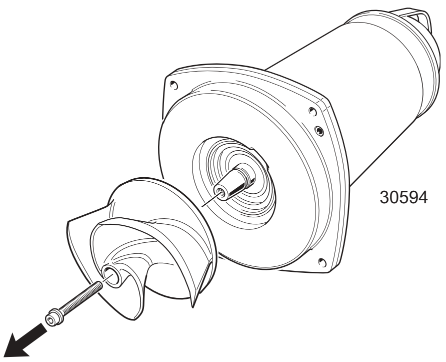
Install the impeller and screw. Tighten ligthly by hand, just to prevent the impeller from falling off.

4.

Remove the rod and raise the pump. Remove the pump housing. Using a crane, lift the drive unit off the pump housing.



5.



Place the drive unit horizontally. Remove the impeller screw.

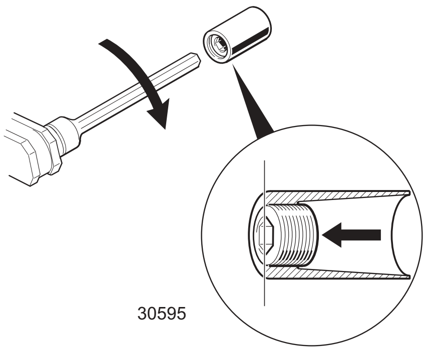
Worn impellers can have very sharp edges. Use protective gloves!

WARNING! When laying the pump on its side do not allow the weight of the pump to rest on any portion of the impeller. The impeller must not be allowed to make contact with the concrete floor or other hard and rough surfaces.

Installing and setting clearance

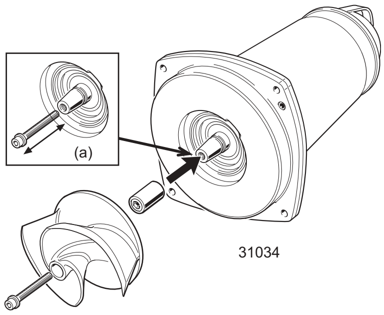
(If you fail with the impeller installation, you **must** start again from step 1)

1.



Make sure that the end of the shaft is clean and free from burrs. Polish off any flaws with fine emery cloth. Grease the end of the shaft, conical sleeve, the threads of the gland screw and the impeller screw. Align the edge of the gland screw with the edge of the conical sleeve so that they are flush.

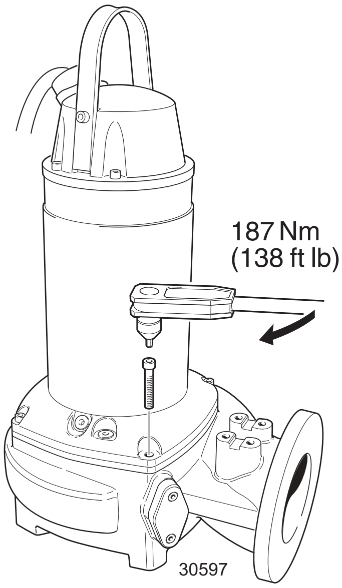
2.



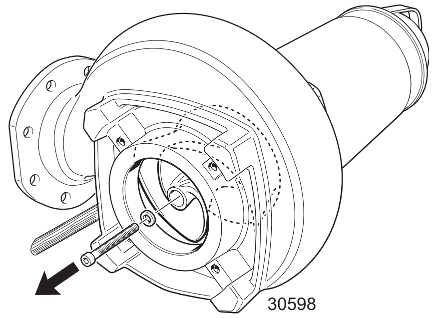
Before assembling, check that the impeller screw is clean and easy to screw into the shaft end (a). This is to prevent the shaft to rotate with the impeller Assemble the conical sleeve and the impeller onto the shaft. Fit the impeller screw onto the shaft. Tighten the impeller screw lightly by hand, just to prevent the impeller from falling off.

3.

Fit the drive unit to the pump housing. Adjust its position so that the inspection hole is on the same side as the hole for the flush valve. Tighten the screws in diagonally opposite pairs.

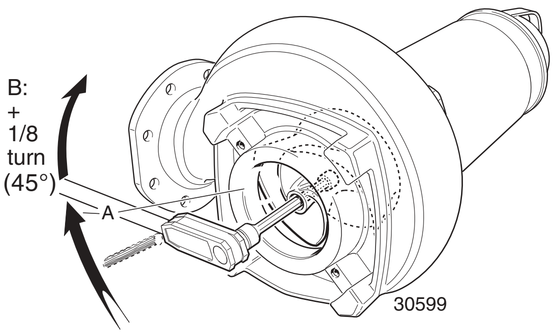


4.



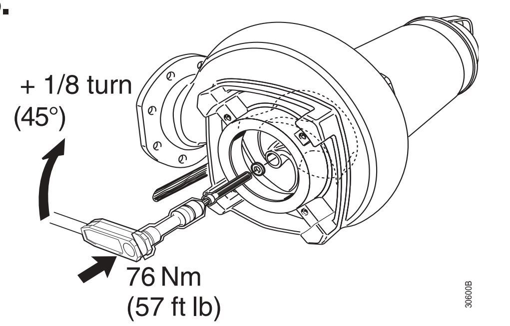
Place the pump horizontally. Remove the flush valve cover and it's O-ring. Insert a rod (wood or plastic) through the hole and lock the impeller in place. Remove the impeller screw.

5.



Turn the gland screw clockwise until the impeller makes contact with the pump housing. Tighten it a further 1/8 turn, 45°. This will insure the correct clearance between the impeller and the bottom of the pump housing in the next step.

6.

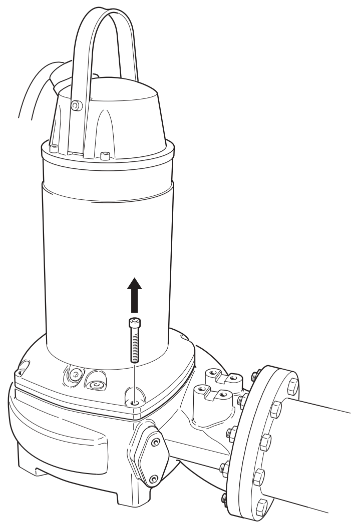


Fit the washer and the greased impeller screw and tighten, torque to 76 Nm (57 ft lb) + 1/8 turn (45°). Remove the rod used to lock the impeller. Fit the O-ring, flush valve cover and secure with screws, torque to 44 Nm (33 ft lb).

SH-version - if applicable: Fit the guide pin and adjust the clearance to 0,2 - 0,8 mm (0,008-0,032") between the guide pin and the impeller.

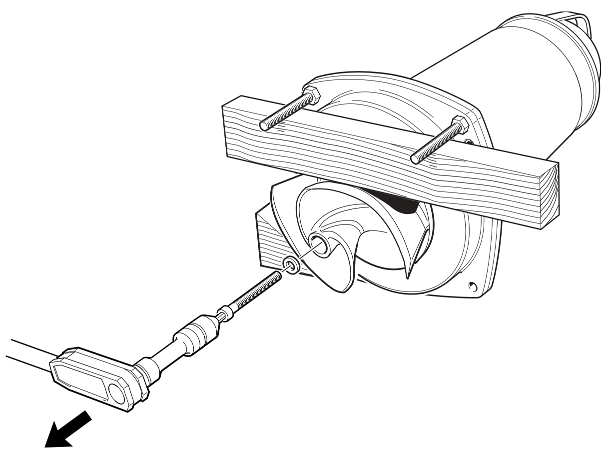
Removing the impeller - dry installation version, NT

1.



Remove the drive unit from the pump housing.

2.

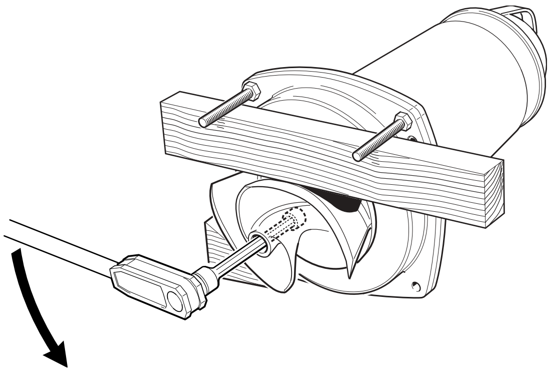


Place the drive unit horizontally. Lock the impeller in place and remove the impeller screw.

WARNING! When laying the pump on its side do not allow the weight of the pump to rest on any portion of the impeller. The impeller must not be allowed to make contact with the concrete floor or other hard and rough surfaces.

Worn impellers can have very sharp edges. Use protective gloves!

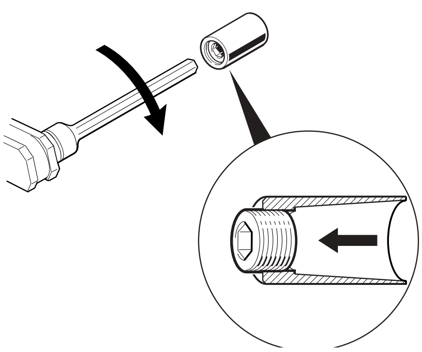
3.



Using a 12 mm hexagon bit adaptor (allen socket) with a 100 mm (4″) extension (minimum length) turn the gland screw counter clockwise until the impeller breaks free from the shaft. Remove the impeller.

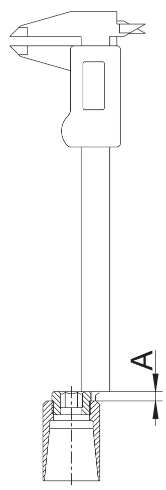
Installing and setting clearance

1.



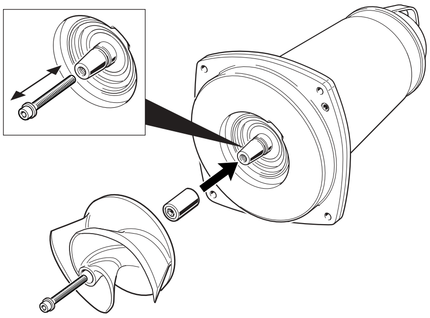
Make sure that the end of the shaft is clean and free from burrs. Polish off any flaws with fine emery cloth. Grease end of shaft, conical sleeve and the threads of the gland screw and the impeller screw. Unscrew the gland screw approximately 5 mm.

2.



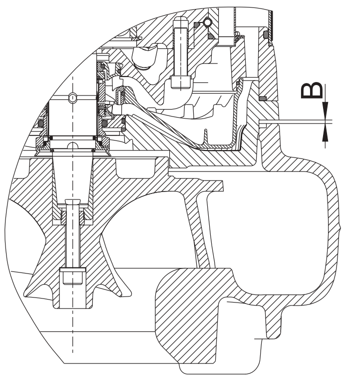
Measure and note the distance A.

3.



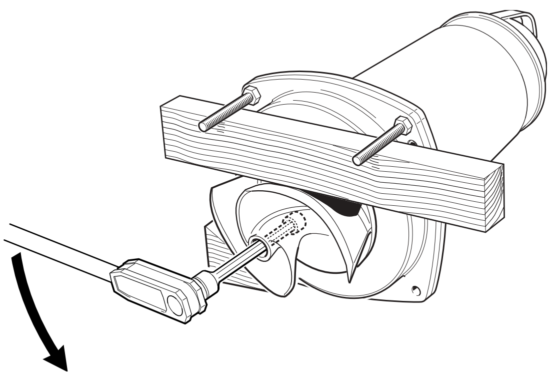
Before assembling, check that the impeller screw is clean and easy to screw into the shaft end (a). This to prevent the shaft to rotate with the impeller screw. Assemble the conical sleeve and the impeller onto the shaft. Fit the impeller screw with washer onto the shaft and tighten to 76 Nm (57 ft lb).

4.



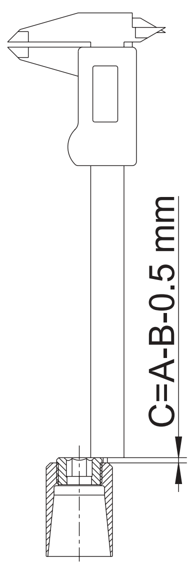
Make sure that the O-ring is removed from the seal housing cover. Place the drive unit in the pump housing. Check the distance between the seal housing cover and the pump housing with a feeler gauge. Check diametrically at four points.
Note the <u>largest</u> measured distance, B. See fig.

5.



Lift the drive unit out of the pump housing and remove the impeller and conical sleeve.

6.

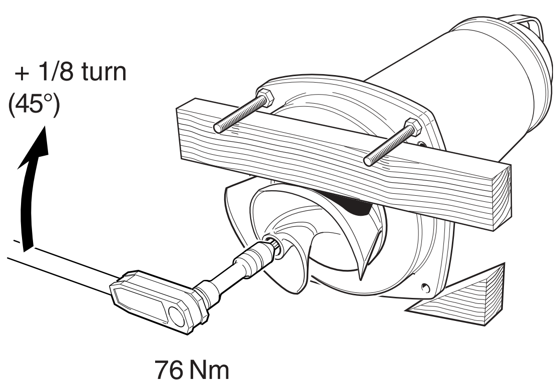


Calculate the measure C according to formula:

C = A - B - 0,5mm

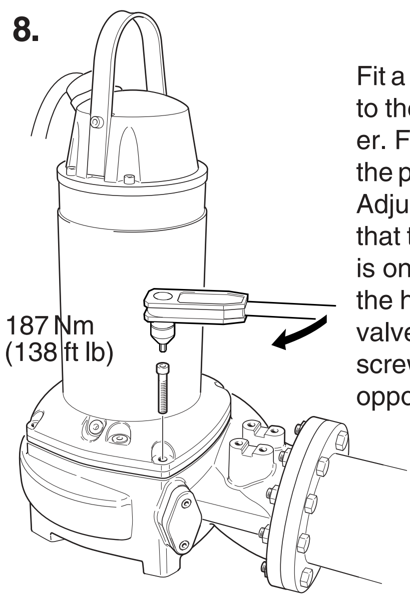
Unscrew the gland screw until C is reached.

7.



Fit the conical sleeve, impeller and impeller screw with washer and tighten to 76 Nm (57 ft lb) + 1/8 turn (45°).

8.



Fit a new greased O-ring to the seal housing cover. Fit the drive unit to the pump housing. Adjust its position so that the inspection hole is on the same side as the hole for the flush valve. Tighten the screws in diagonally opposite pairs.

FAULT TRACING (TROUBLESHOOTING)

A universal instrument multimeter (VOM), a test lamp (continuity tester) and wiring diagram are required in order to carry out fault tracing on the electrical equipment.

Fault tracing shall be done with the power supply disconnected and locked off, except for those checks which cannot be performed without voltage.

Always make sure that there is no one near the pump when the power supply is turned on.

Use the following checklist as an aid to fault tracing. It is assumed that the pump and installation have formerly functioned satisfactorily.

Electrical work shall be performed by an authorized electrician.

Follow local safety regulations and observe recommended safety precautions.

1. Pump fails to start

Is an alarm signal indicated on the control panel?

Yes →

Check the cause:
- If the stator temperature is high, check that the impeller rotates freely.
- If there is a fault in the thermistors/thermal contacts, contact a Flygt service shop.
- If the FLS10 indicates an alarm.
- Check that the overload protection is reset.

No ↓

Can the pump be started manually?

Yes →

a) Fault in level equipment (start level regulator). Clean or replace.

b) Fault in control equipment.

Check:
- that the thermal contacts have not opened.
- that all connections are intact.
- relay and contactor coils.
- that the control switch “Man/Auto” makes contact in both positions.

No ↓

Is the installation receiving voltage?

No →

Check:
- that the main power switch is on.
- that there is control voltage to the starter equipment and its fuses are intact.
- that there is voltage in each phase of the supply line.
- that all fuses have continuity and are tight.
- that the overload protection is reset.
- that there is no break in the motor cable.

Yes ↓

Is the impeller stuck? WARNING: disconnect power before checking the impeller.

Yes →

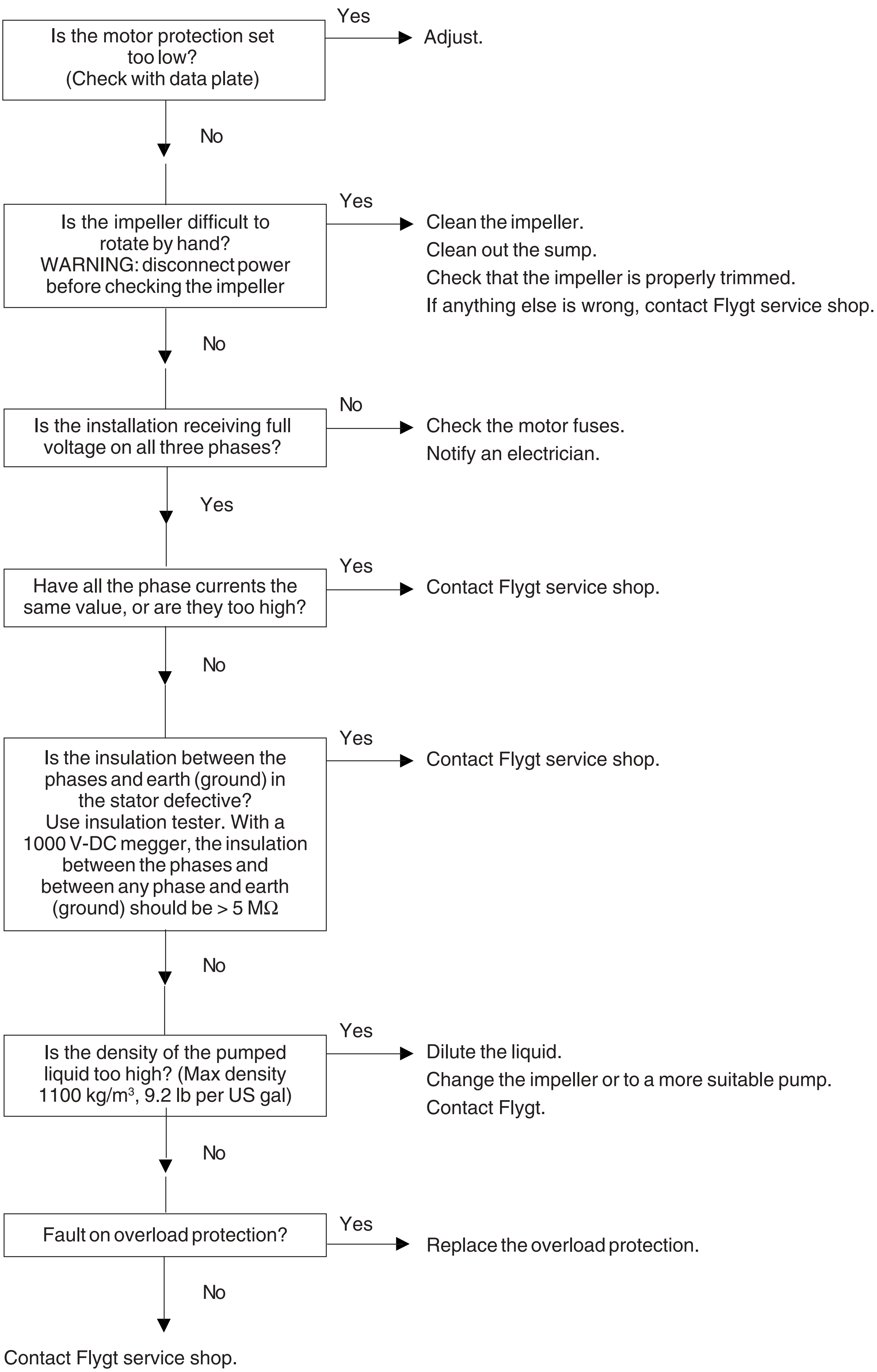
Clean.

Clean the sump.

No ↓

Contact Flygt service shop.

2. Pump starts but motor protection trips



3. The pump does not stop (when level control is used)

Is the pump able to empty the station to the stop level?

No → Check:
- — for leakage in pipe and/or discharge connection.
- — that the impeller is not clogged.
  WARNING: disconnect power before checking the impeller.
- — the non-return valve(s).
- — that the pump has adequate capacity. Contact Flygt.

Yes ↓

Fault in level sensing equipment?

Yes → Clean the level regulators.
Check the functioning of level regulators.
Check the contactor and control circuit.
Replace defective items.

No ↓

Stop level set too low?

Yes → Raise the stop level.

No ↓

Contact Flygt service shop.

4. The pump starts-stops-starts in rapid sequence

Does the pump start due to backflow which fills sump to start level again?

Yes → Check:
- — that the distance between the start and stop levels is not too small.
- — the non-return valve(s).
- — that the riser is not too long without a non-return valve.

No ↓

Does the contactor's self-holding function break?

Yes → Check:
- — contactor connections.
- — the voltage in the control circuit in relation to the rated voltages on the coil.
- — the functioning of stop level regulator.
- — the voltage drop in the line at the starting surge makes the contactor's self-holding break.

No ↓

Contact Flygt service shop.

5. Pump runs but delivers too little or no water

Check:
— direction of rotation of pump, see "Before starting".
— that valves are open and intact.
— that pipes and impeller are not clogged.
— that the impeller rotates freely.
— that the suction lift has not been altered.
— for leakage in the pump installation.
— for wear on the impeller, pump and casing/flange.

See also under "Inspection".

Do not override the motor protection repeatedly if it has tripped.

SERVICE LOG

Most recent service date	Pump No.	Hours of operation	Remarks	Sign.

3.03.5 RECOMMENDED MAINTENANCE

1. Safety precautions

a. Always disconnect the power and perform proper lockout/tag out procedures before servicing the unit.

b. Be aware of the risk of electrical accidents.

c. Do not ignore health hazards. Observe strict cleanliness.

d. Disconnecting power and/or performing electrical testing should be performed by a qualified person.

e. The pump must NOT be lifted out by the guide cable. Use the appropriate lifting eye and chain attached to the pump handle. The cable is only used for a guide to get the lifting eye to the chain.

2. Daily inspections

a. Check current – to be within the rated current. If ammeter fluctuation is great, even though within the limits of the pump rating, foreign matter may be clogging the pump. If the quantity of liquid discharged falls suddenly, foreign matter may be blocking the suction inlet. Document the current readings so there is a basis to compare to.

b. Check voltage – power supply voltage variation = within +- 10% of the rated voltage. Document the voltage readings so there is a basis to compare to.

c. Check for abnormal noise or vibration

d. Check and record pump runtime values if available.

e. Unusual readings or observations may indicate a problem requiring immediate service.

3. Regular inspections

a. Monthly

i. Measure the insulation resistance. Insulation resistance value should be more than 1 mega ohm (MΩ). If resistance starts to fall rapidly even with an initial indication of over 1 mega ohm, this may be an indication of trouble and repair work is required. Document what the reading is so it can be compared to the last reading.

ii. Make sure that the lifting equipment is in good condition and show no signs of abnormal wear or corrosion.

3.03.5 RECOMMENDED MAINTENANCE

- **iii.** Replace any worn or defective lifting equipment prior to further use.
- **iv.** Remove any foreign objects that might be attached to it.

b. Every 6 Months

- **i.** Inspect the pump cables for signs of wear and or deterioration.
- **ii.** Wash the pump with tap water. Pay particular attention to the impeller area, and completely remove any debris from the impeller.
- **iii.** Inspect the pump exterior; verify that there is no damage, and that the bolts and nuts have not loosened.
- **iv.** If the pump must be disassembled for repair due to damage or loose bolts or nuts, contact the local pump manufacturer's service office.
- **v.** Check the mechanical seal every six months. If you notice water mixed with the oil or cloudy texture of the oil, these may be indications of a defective mechanical seal requiring replacement.
- **vi.** CAUTION: Repair work on explosion proof motors may only be performed by approved workshops. Otherwise the "ex" approvals will no longer apply.

c. Yearly

- **i.** The service life of the mechanical seal can be prolonged by replacing the oil in the mechanical seal chamber once a year.
- **ii.** Refer to the actual O & M for the particular pump for addition yearly maintenance adjustments and directions.
- **iii.** Parts that need to be replaced:

  1. Mechanical Seal – Whenever oil in mechanical seal chamber is clouded.

  2. Oil filler plug gasket – Whenever oil is replaced or inspected.

  3. Lubricating oil – Whenever clouded or dirty

  4. O-ring – Whenever pump is overhauled.

See additional maintenance specific to the manufacturer in section 3.03.

3.03.6 PUMP DATA SHEETS

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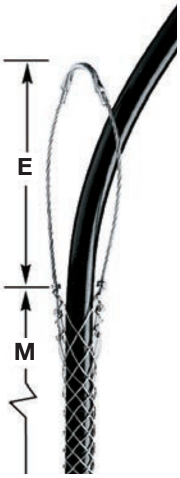
IMPORTANT

Read all breaking strength, safety and technical data relating to this product. Pages V-41 to V-45.

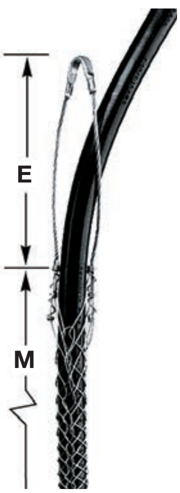
Single Eye, Closed Mesh



For permanent support when cable end is available to be installed through grip.

Cable Diameter Range Inches (cm)	Approx. Breaking Strength Lbs. (N) Tin-Coated Bronze	Stainless Steel	E Inches (cm)	M Inches (cm)	Tin-Coated Bronze	Stainless Steel
.50"-.62" (1.27-1.57)	530 (2,357)	1,370 (6,094)	7" (17.78)	10" (25.40)	**02201013**	**02401013**
.63"-.74" (1.60-1.88)	790 (3,514)	2,060 (9,163)	8" (20.32)	10" (25.40)	**02201014**	**02401014**
.75"-.99" (1.90-2.51)	1,020 (4,537)	2,060 (9,163)	8" (20.32)	13" (33.02)	**02201015**	**02401015**
1.00"-1.24" (2.54-3.15)	1,610 (7,161)	2,678 (11,912)	9" (22.86)	14" (35.56)	**02201017**	**02401017**
1.25"-1.49" (3.17-3.78)	1,610 (7,161)	4,490 (19,972)	10" (25.40)	15" (38.10)	**02201018**	**02401018**
1.50"-1.74" (3.81-4.42)	1,610 (7,161)	4,492 (19,981)	12" (30.48)	17" (43.18)	**02201019**	**02401019**
1.75"-1.99" (4.44-5.05)	2,150 (9,563)	5,000 (22,241)	14" (35.56)	19" (48.26)	**02201020**	**02401020**
2.00"-2.49" (5.08-6.32)	3,260 (14,500)	8,940 (39,767)	16" (40.64)	21" (53.34)	**02201021**	**02401021**
2.50"-2.99" (6.35-7.59)	3,260 (14,500)	8,947 (39,798)	18" (45.72)	23" (58.42)	**02201022**	**02401022**
3.00"-3.49" (7.62-8.86)	4,900 (21,795)	13,420 (59,695)	21" (53.34)	25" (63.50)	**02201023**	**02401023**
3.50"-3.99" (8.89-10.13)	4,900 (21,795)	—	24" (60.96)	27" (68.58)	**02201024**	**—**

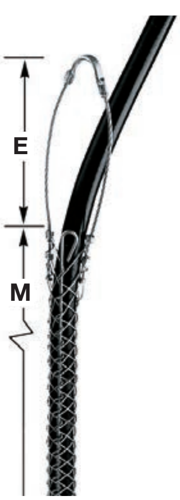
Single Eye, Split Mesh, Lace Closing



For permanent support when cable end is not available.

Cable Diameter Range Inches (cm)	Approx. Breaking Strength Lbs. (N) Tin-Coated Bronze	Stainless Steel	E Inches (cm)	M Inches (cm)	Tin-Coated Bronze	Stainless Steel
.50"-.62" (1.27-1.57)	530 (2,357)	1,370 (6,094)	7" (17.78)	10" (25.40)	**02202013**	**02402013**
.63"-.74" (1.60-1.88)	790 (3,514)	2,066 (9,190)	8" (20.32)	10" (25.40)	**02202014**	**02402014**
.75"-.99" (1.90-2.51)	1,020 (4,537)	2,060 (9,163)	8" (20.32)	13" (33.02)	**02202015**	**02402015**
1.00"-1.24" (2.54-3.15)	1,610 (7,161)	2,670 (11,876)	9" (22.86)	14" (35.56)	**02202017**	**02402017**
1.25"-1.49" (3.17-3.78)	1,610 (7,161)	4,490 (19,972)	10" (25.40)	15" (38.10)	**02202018**	**02402018**
1.50"-1.74" (3.81-4.42)	1,610 (7,161)	4,490 (19,972)	12" (30.48)	17" (43.18)	**02202019**	**02402019**
1.75"-1.99" (4.44-5.05)	2,150 (9,563)	4,375 (19,461)	14" (35.56)	19" (48.26)	**02202020**	**02402020**
2.00"-2.49" (5.08-6.32)	3,260 (14,500)	8,947 (39,798)	16" (40.64)	21" (53.34)	**02202021**	**02402021**
2.50"-2.99" (6.35-7.59)	3,260 (14,500)	8,940 (39,767)	18" (45.72)	23" (58.42)	**02202022**	**02402022**
3.00"-3.49" (7.62-8.86)	4,900 (21,795)	13,420 (59,695)	21" (53.34)	25" (63.50)	**02202023**	**02402023**
3.50"-3.99" (8.89-10.13)	4,900 (21,795)	13,420 (59,695)	24" (60.96)	27" (68.58)	**02202024**	**02402024**

Single Eye, Split Mesh, Rod Closing



For support when cable end is not available.

Cable Diameter Range Inches (cm)	Approx. Breaking Strength Lbs. (N) Tin-Coated Bronze	Stainless Steel	E Inches (cm)	M Inches (cm)	Tin-Coated Bronze	Stainless Steel
.50"-.62" (1.27-1.57)	790 (3,514)	1,050 (4,670)	7" (17.78)	8.5" (21.59)	**02203013**	**02403013**
.63"-.74" (1.60-1.88)	790 (3,514)	2,050 (9,119)	8" (20.32)	8.5" (21.59)	**02203014**	**02403014**
.75"-.99" (1.90-2.51)	1,020 (4,537)	2,050 (9,119)	8" (20.32)	10.5" (26.67)	**02203015**	**02403015**
1.00"-1.24" (2.54-3.15)	1,610 (7,161)	2,650 (11,788)	9" (22.86)	12.5" (31.75)	**02203017**	**02403017**
1.25"-1.49" (3.17-3.78)	1,610 (7,161)	4,500 (20,017)	10" (25.40)	14.5" (36.83)	**02203018**	**02403018**
1.50"-1.74" (3.81-4.42)	1,610 (7,161)	4,500 (20,017)	12" (30.48)	15.5" (39.37)	**02203019**	**02403019**
1.75"-1.99" (4.44-5.05)	2,150 (9,563)	6,000 (26,689)	14" (35.56)	16.5" (41.91)	**02203020**	**02403020**
2.00"-2.49" (5.08-6.32)	3,260 (14,500)	8,950 (39,812)	16" (40.64)	19.5" (49.53)	**02203021**	**02403021**
2.50"-2.99" (6.35-7.59)	3,260 (14,500)	7,750 (34,474)	18" (45.72)	21.5" (54.61)	**02203022**	**02403022**
3.00"-3.49" (7.62-8.86)	5,750 (25,576)	8,500 (37,810)	21" (53.34)	23.5" (59.69)	**02203023**	**02403023**
3.50"-3.99" (8.89-10.13)	5,750 (25,576)	—	24" (60.96)	25.5" (64.77)	**02203024**	**—**

Note: E-Eye length. M-Mesh length at nominal diameter.

Grip-Eye System

The normal method of lowering and raising a CP pump in and out of a lift station is by use of a chain or cable attached to the pump. The length of the chain or cable is dependent on the depth of the station. The average length would probably be between 18 to 20 ft. and in certain cases may be much longer. In many cases, depending on the lifting device (usually a hoist), the operator may have to take a second or third bite on the pump chain in order to lift the pump clear of the station.

An added accessory to the Flygt line is the pattented Flygt Grip-Eye System which consists of 33 ft. of nylon line, a short length of high tensile strength stainless steel chain and a forged “Grip-Eye” of wrought alloy steel.

The operation of this positive recovery system is as follows:

1. Connect the small eye of the grip-eye to the end of the hoist cable.

2. Slip the end of the nylon line through the large eye of the grip-eye. The nylon line simply acts as a guide for the grip-eye on its way down to the short length of the pump lifting chain.

3. While keeping the nylon line (guide line) taut, proceed to lower the grip-eye until it is well positioned over the pump lifting chain.

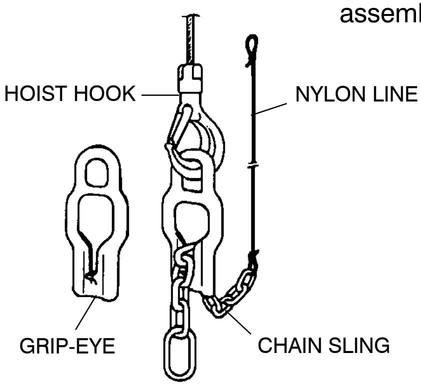
4. Release the tension on the nylon guide line. The lifting chain will now take a position to become engaged in the grip-eye.

5. Gradually take up tension on the hoist cable and the grip-eye will make a positive grip on the pump lifting chain. Continue hoisting until the pump is clear of the station.

Caution: The Grip-Eyes may only be used with the corresponding special Flygt Chain Sling Units.

Grip-Eyes are not warrantied if other chains are used.

Refer to the following pages for pump models and correct assembly.



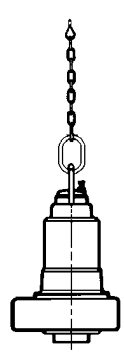


FIG. 1

(Standard) The end ring of the Chain Sling is slipped over the pump lifting handle.

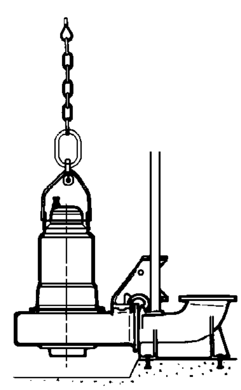


FIG. 2

(Customer to supply extra shackle) A shackle can be used in conjunction with the standard ring should customer choose not to remove and replace pump handle.

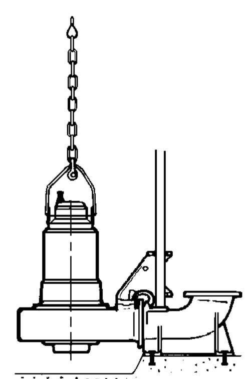


FIG. 3

(Standard) This type comes with a shackle as part of the Chain Sling for connecting to pump lifting handle.

3.04 LEVEL SENSORS

This section provides the information pertaining to the level sensing for this project.

This section is structured as follows:

Overview

transducers use ultrasonic technology to measure level in a wide range of liquids and solids.

Benefits

- Integral temperature compensation
- Low ringing effect reduces blanking distance
- Optional foam facing for dusty applications
- Self-cleaning and low-maintenance
- Chemically resistant
- Hermetically sealed

Application

The transducers can be fully immersed, are resistant to steam and corrosive chemicals, and can be installed without flanges.

The XPS series offers versions for various measuring ranges up to 40 m (130 ft) and up to a max. temperature of 95 °C (203 °F).

The XCT series can be used in applications at higher temperatures to measure level up to a distance of 12 m (40 ft) and at a max. temperature of 95 °C (203 °F).

During operation, the Echomax transducers emit acoustic pulses in a narrow beam. The level monitor measures the propagation time between pulse emission and its reflection (echo) to calculate the distance.

Echomax XPS and XCT

Technical specifications

Input	XPS-10 (standard and F models)	XPS-15 (standard and F models)	XPS-30	XPS-40	XCT-8 (standard and sanitary models)	XCT-12
Measuring range	0.3 ... 10 m (1 ... 33 ft)	Standard: 0.3 ... 15 m (1 ... 50 ft) Flanged: 0.45 ... 15 m (1.5 ... 50 ft)	0.6 ... 30 m (2 ... 100 ft)	0.9 ... 40 m (3 ... 130 ft)	0.6 ... 8 m (2 ... 26 ft)	0.6 ... 12 m (2 ... 40 ft)
Output						
Frequency	44 kHz	44 kHz	30 kHz	22 kHz	44 kHz	44 kHz
Beam angle	12°	6°	6°	6°	12°	6°
Environmental						
Location	Indoors/outdoors					
Ambient temperature	Standard: -40 ... +95 °C (-40 ... +203 °F) F: -20 ... +95 °C (-4 ... +203 °F)				Standard: -40 ... +145 °C (-40 ... +293 °F) Sanitary: -40 ... +125 °C (-40 ... +260 °F)	-40 ... +145 °C (-40 ... +293 °F)
Pollution degree	4					
Pressure	8 bar g (120 psi g) Flanged: 0.5 bar g (7.25 psi g)	8 bar g (120 psi g) Flanged: 0.5 bar g (7.25 psi g)	0.5 bar g (7.25 psi g) Flanged: 0.5 bar g (7.25 psi g)	0.5 bar g (7.25 psi g)	Standard: 4 bar g (60 psi g): -40 ... +138 °C (-40 ... +280 °F) Standard: 8 bar g (120 psi g): -40 ... +95 °C (-40 ... +203 °F) Flanged: 0.5 bar g (7.25 psi g) Sanitary: XCT-8: 0.5 bar g (7.25 psi g)	
Design						
Weight	0.8 kg (1.8 lbs)	1.3 kg (2.8 lbs) Flanged: 2 kg (4.4 lbs)	4.3 kg (9.5 lbs)	8 kg (18 lbs)	0.8 kg (1.7 lbs)	1.3 kg (2.8 lbs)
Power supply	Operation of transducer only with approved Siemens Milltronics controllers					
Material	Standard: PVDF Flanged: PVDF with CPVC flange Option: PTFE face with CPVC flange	Standard: PVDF Flanged: PVDF with CPVC flange Option: PTFE face with CPVC flange	Standard: PVDF Flanged: PVDF with CPVC flange Option: PTFE face with CPVC flange	PVDF	Standard: PVDF Options: DERAKANE flange; PTFE face with universal PVDF flange	
Color	Standard: blue F: gray	Standard: blue F: gray	blue	blue	white	
Process connection	Standard: 1" NPT or 1" BSPT F: 1" NPT	Standard: 1" NPT or 1" BSPT F: 1" NPT	1.5" universal thread (NPT or BSPT)		1" NPT or R 1" (BSPT), EN 10226	
Degree of protection	IP66/68	IP66/68	IP66/68	IP66/68	IP66/68	IP66/68
Cable	2 wire twisted pair/braided and foil shielded 0.5 mm² (20 AWG) PVC jacket				2 wire twisted pair/braided and foil shielded 0.5 mm² (20 AWG) silicone jacket	
Separation	Max. 365 m (1200 ft)					
Certificates and approvals	Standard: CE[1], CSA, FM, ATEX II 2GD F: FM Class I, Div 1, Groups A, B, C and D, Class II Div 1, Groups E, F and G, Class III	Standard: CE[1], CSA, FM, ATEX II 2GD F: FM Class I, Div 1, Groups A, B, C and D, Class II Div 1, Groups E, F and G, Class III	CE[1], CSA, FM, ATEX II 2G 1D	CE[1], CSA, FM, ATEX II 2G 1D	Standard: CE[1], CSA, FM, ATEX II 2GD Sanitary: CE, CTICK, $CSA_{US/C}$	CE[1], CSA, FM, ATEX II 2GD

1) EMC certificate available on request.

Selection and Ordering data		Order No.
Echomax XPS-15 ultrasonic transducer High-frequency ultrasonic transducer designed for a wide variety of liquid and solid applications, for use with approved controllers. Includes integral temperature sensor. Measuring range: min. 0.3 m, max. 15 m	C)	**7ML1118-** **■■■■0**
Mounting thread and facing		
1" NPT [(Taper), ANSI/ASME B1.20.1]		**0**
1" NPT [(Taper), ANSI/ASME B1.20.1] with foam facing[1]		**1**
1" NPT [(Taper), ANSI/ASME B1.20.1] with PTFE facing[2]		**2**
R 1" [(BSPT), EN 10226]		**3**
R 1" [(BSPT), EN 10226] with foam facing[1]		**4**
R 1" [(BSPT), EN 10226] with PTFE facing[2]		**5**
Cable length		
5 m (16.40 ft)		**B**
10 m (32.81 ft)		**C**
30 m (98.43 ft)		**E**
50 m (164.04 ft)		**F**
100 m (328.08 ft)		**K**
Mounting flange		
None		**A**
6" ASME, 150 lb, flat faced		**D**
8" ASME, 150 lb, flat faced		**E**
DN 150, PN 10/16, Type A, flat faced		**J**
DN 200, PN 10/16, Type A, flat faced		**K**
JIS10K 6B		**N**
JIS10K 8B (Note: Flange bolting patterns and facings dimensionally correspond to the applicable ASME B16.5 or EN 1092-1, or JIS B 2220 standard.)		**P**
Approvals		
ATEX II 2GD, FM Class I Div. 2, SAA Class I		**3**
CSA Class I Div. 1[3]		**4**

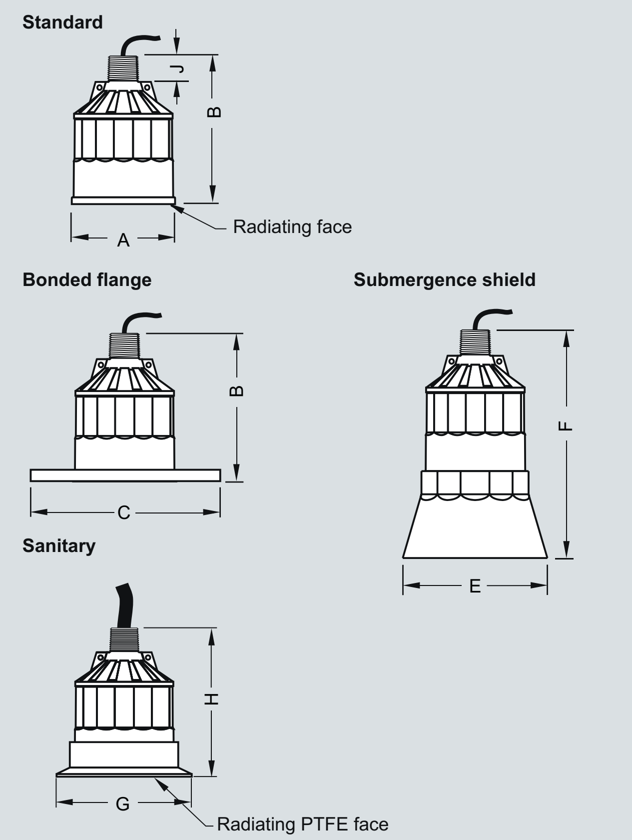
[1] Not available with flanged versions
[2] Available with flanged versions only
[3] Available with mounting options 0 to 2 only
C) Subject to export regulations AL: N, ECCN: EAR99.

Selection and Ordering data		Order code
Further designs Please add "**-Z**" to Order No. and specify Order code(s).		
Acrylic coated, stainless steel tag [13 x 45 mm Stainless steel tag [69 x 50 mm (2.71 x 1.97")]: Measuring-point number/identification (max. 27 characters) specify in plain text		**Y15**
Operating Instructions		Order No.
Quick Start guide, multi-language	C)	**7ML1998-5QM82**
Applications Guidelines, multi-language Note: The Applications Guidelines should be ordered as a separate line item on the order.	C)	**7ML1998-5HV61**
This device is shipped with the Siemens Milltronics manual CD containing the complete ATEX Quick Start and Operating Instructions library.		
Accessories		
Tag, stainless steel with hole, 12 x 45 mm (0.47 x 1.77"), one text line for fastening on sensors		**7ML1930-1BJ**
Submergence shield kit		**7ML1830-1BJ**
Universal box bracket, mounting kit		**7ML1830-1BK**
Channel bracket, wall mount		**7ML1830-1BL**
Extended channel bracket, wall mount		**7ML1830-1BM**
Channel bracket, floor mount		**7ML1830-1BN**
Extended channel bracket, floor mount		**7ML1830-1BP**
Bridge channel bracket, floor mount (see Mounting Brackets on page 5/198 for more information)		**7ML1830-1BQ**
1" NPT locknut, plastic		**7ML1830-1DS**
1" BSPT locknut, plastic		**7ML1830-1DR**
Easy Aimer 2, with ¾" x 1" NPT PVC coupling		**7ML1830-1AQ**
Easy Aimer 2, aluminum with M20 adapter and 1" and 1½" BSPT aluminum couplings		**7ML1830-1AX**
Easy Aimer 304 with stainless steel coupling		**7ML1830-1AU**
Easy Aimer 304, with M20 adapter and 1" and 1½" BSPT 304 SS couplings		**7ML1830-1GN**

C) Subject to export regulations AL: N, ECCN: EAR99.

5

Dimensional drawings

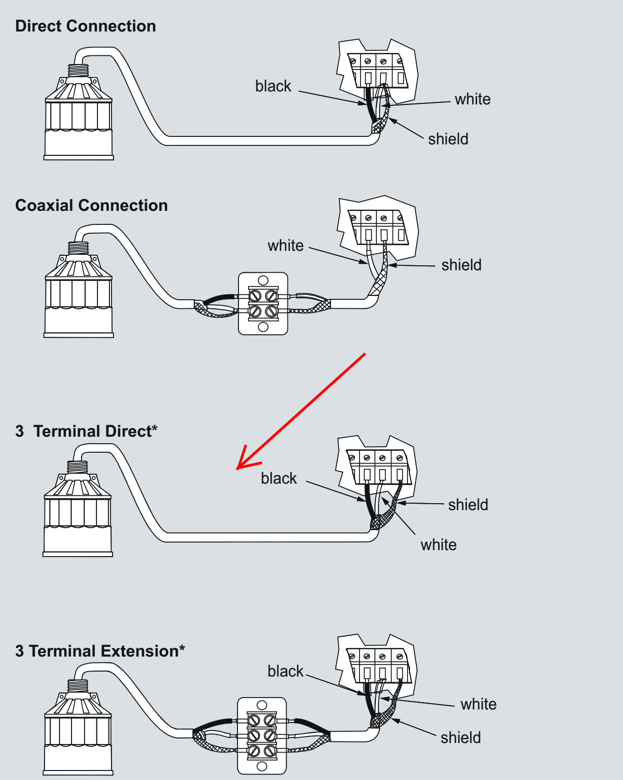


XPS and XCT ultrasonic transducer, dimensions, in mm (inch)

Version				
Dimension	**XPS-10**	**XPS-15**	**XPS-30**	**XPS-40**
A	88 mm (3.464")	121 mm (4.764")	175 mm (6.890")	206 mm (8.110")
B	122 mm (4.803")	132 mm (5.197")	198 mm (7.795")	229 mm (9.016")
C	According to ASME, DIN and JIS			n/a
E	124 mm (4.882")	158 mm (6.220")	n/a	n/a
F	152 mm (5.984")	198 mm (7.795")	n/a	n/a
J	28 mm (1.1")	28 mm (1.1")	28 mm (1.1")	28 mm (1.1")

Version		
Dimension	**XCT-8**	**XCT-12**
A	88 mm (3.464")	121 mm (4.764")
B	122 mm (4.803")	132 mm (5.197")
C	According to ASME, DIN and JIS	
E	n/a	n/a
F	n/a	n/a
G	Sanitary version: 119 mm (4.68")	n/a
H	Sanitary version: 122 mm (4.8")	n/a
J	28 mm (1.1")	28 mm (1.1")

Schematics



* For SITRANS LUC500, MultiRanger 100/200, HydroRanger 200

Mounting
Make particularly sure that the radiating face of the transducer is protected from damage. Mount the transducer so that it is above the maximum material level by at least the blanking value. On liquid applications, the transducer must be mounted so that the axis of transmission is perpendicular to the liquid surface. On solids alications, a Milltronics Easy Aimer should be used to facilitate aiming the transducer. Consider the optional temperature sensor when mounting the transducer.

Interconnection
Do not route cable openly or near high voltage or current runs, contactors and SCR control drives. For optimum isolation against electrical noise, run cable separately in a grounded metal conduit. Seal all thread connections to prevent ingress of moisture.

XPS and XCT ultrasonic transducer connections

MS 1

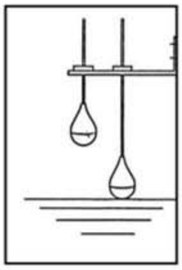
73/23/EEC

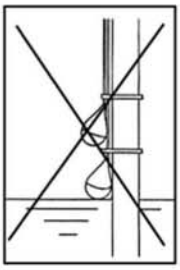
RoHS 2002/95/EC

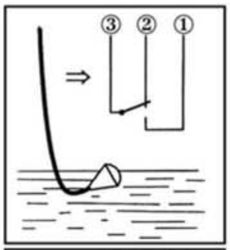
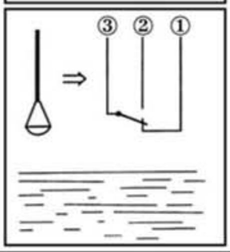
1mA/4V-5A/250V

⧈ ♦♦ ╫ μ T80

γ 0,95 - 1,05





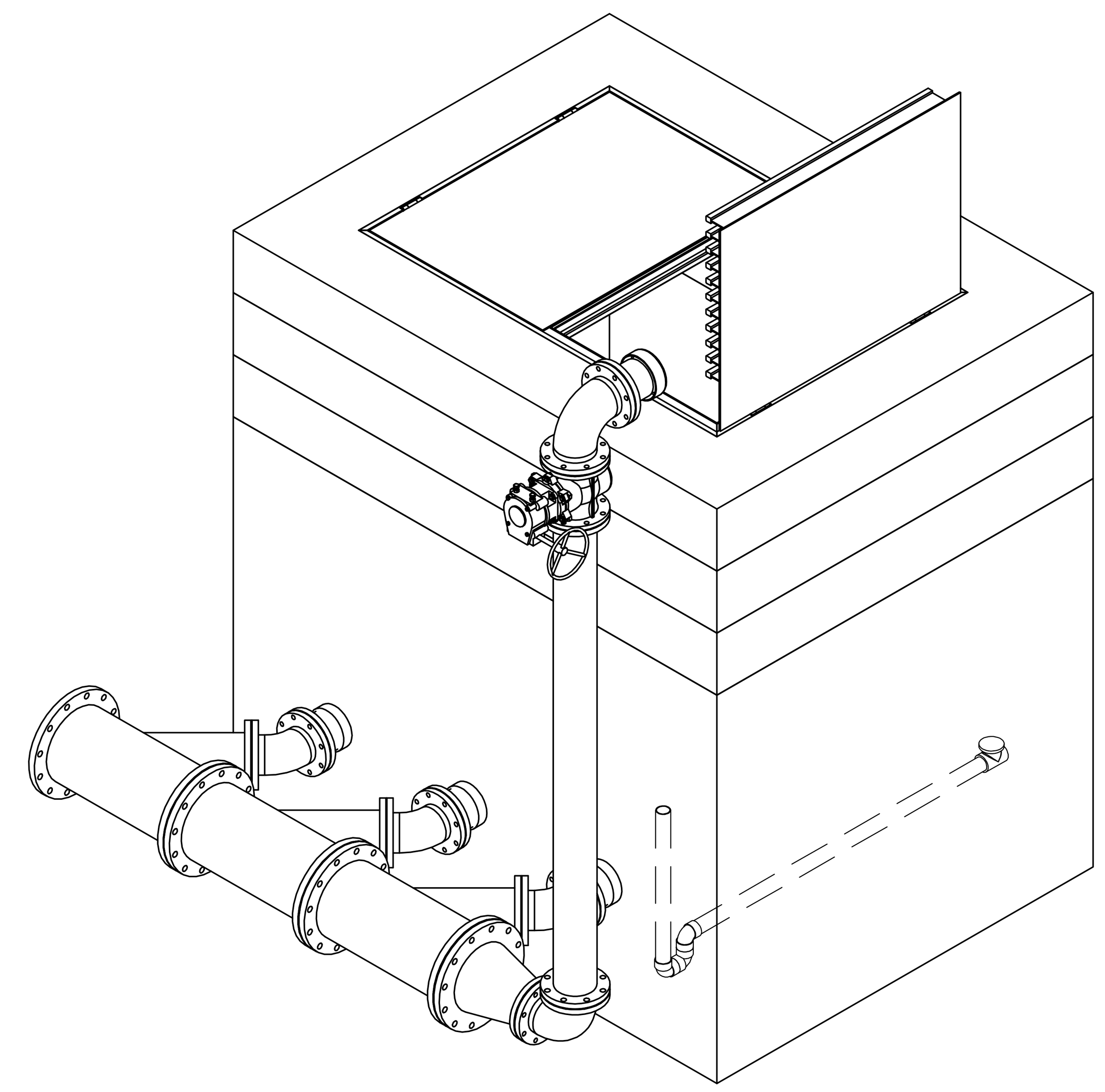
			①	②	③
GB	Connection of Level Regulators		grey	black	brown
D	Anschluss der Niveauregler		grau	schwarz	braun
F	Branchement des régulateurs de niveau		gris	noir	brun
I	Collegamento regolatori di livello		grigio	nero	marrone
E	Conexión de los reguladores de nivel		gris	negro	marrón
P	Conexão dos reguladores de nível		cinzento	preto	castanho
NL	Aansluiting van de niveauregelaar		grijs	zwart	bruin
DK	Tilslutning af niveauregulator		grå	sort	brun
S	Anslutning av nivåregulatorn		grå	svart	brun
N	Forbindelse til nivåregulatoren		grå	svart	brun
FIN	Pinnansäätimen liitäntä		harmaa	musta	ruskea
RUS	подсоединение регулятора уровня		серый	чёрный	коричневый
PL	Przyłącze regulatorów poziomu		kolor szary	kolor czarny	kolor brązowy
H	A szintszabályozók csatlakoztatása		szürke	fekete	barna
CZ	Přípoj regulátorů hladiny		šedý	černý	hnědý
SK	Prípoj regulátorov hladiny		sivý	čierny	hnedý
SLO	Priključitev regulatorjev nivoja		siv	črno	rjavo
HR	Cijev za regulator razine		sivo	crni	smeđi
SCG	Cev za spravu za regulisanje nivoa		sivo	crni	smeđi
GR	Σύνδεση ρυθμιστή στάθμης		γκρίζο	μαύρο	καφέ
TR	Seviye regülatörlerinin bağlantısı		gri	siyah	kahverengi
GB	For emptying a tank	Alarm high level	insulate	X	X
D	Zum Entleeren eines Behälters	Alarm bei hohem Flüssigkeitsstand	isolieren		
F	Pour vider un réservoir	Alarme au niveau supérieur	isoler		
I	Per lo svuotamento	Allarme di massimo livello	isolare		
E	Para vaciar un recipiente	Alarma con alto nivel de líquido	aislar		
P	Para esvaziar um reservatório	Alarme de nível máximo	isolar		
NL	Om een reservoir te legen	Alarm bij een hoog vloeistofpeil	isoleren		
DK	Til tømning af en beholder	Alarm ved høj væskeniveau	isoler		
S	För tömning av en behållare	Larm vid hög vätskenivå	isolera		
N	For å tømme en beholder	Alarm ved høyt væskenivå	isolere		
FIN	Säiliön tyhjennykseen	Ylärajahälytys	eristä		
RUS	для опорожнения резервуара	сигнал тревоги при высоком уровне жидкости	изолировать		
PL	Opróżnienie pojemnika	Alarm w przypadku wysokiego poziomu cieczy	zaizolować		
H	Egy tartály ürítéséhez	Riasztás túl magas töltésszint esetén	szigeteljük		
CZ	K vyprázdnění nádrže	Poplach při vysokém stavu kapaliny	izolovat		
SK	K vyprázdneniu nádrže	Poplach pri vysokom stave kvapaliny	izolovat'		
SLO	Za praznjenje posode	Alarm pri visokem nivoju tekočine	izolirati		
HR	Za pražnjenje nekog spremnika	Alarm kod visokog stanja tekućine	izolirati		
SCG	Za pražnjenje nekog rezervoara	Alarm kod visokog stanja tečnosti	izolovati		
GR	Γ ια την εκκένωση τον περιέκτη	Αλάρμ σε πολύ υψηλή στάθμη υγρού	μόνωση		
TR	Bir hazneyi/kabı boşaltmak için	Yüksek sıvı seviyesinde alarm	İzole etmek		
GB	For filling a tank	Alarm low level	X	insulate	X
D	Zum Füllen eines Behälters	Alarm bei niedrigem Flüssigkeitsstand		isolieren	
F	Pour remplir un réservoir	Alarme au niveau inférieur		isoler	
I	Per il riempimento	Allarme di minimo livello		isolare	
E	Para llenar un recipiente	Alarma con bajo nivel de líquido		aislar	
P	Para encher um reservatório	Alarme de nível mínimo		isolar	
NL	Om een reservoir te vullen	Alarm bij een laag vloeistofpeil		isoleren	
DK	Til fyldning af en beholder	Alarm ved lav væskeniveau		isoler	
S	För fyllning av en behållare	Larm vid låg vätskenivå		isolera	
N	For å fylle en beholder	Alarm ved lavt væskenivå		isolere	
FIN	Säiliön täyttämiseen	Alarajahälytys		eristä	
RUS	для наполнения резервуара	сигнал тревоги при низком уровне жидкости		изолировать	
PL	Napełnienie pojemnika	Alarm w przypadku niskiego poziomu cieczy		zaizolować	
H	Egy tartály töltéséhez	Riasztás túl alacsony töltésszint esetén		szigeteljük	
CZ	K naplnění nádrže	Poplach při nízkém stavu kapaliny		izolovat	
SK	K naplneniu nádrže	Poplach pri nízkom stave kvapaliny		izolovat'	
SLO	Za polnjenje posode	Alarm pri nizkem nivoju tekočine		izolirati	
HR	Za punjenje nekog spremnika	Alarm kod niskog stanja tekućine		izolirati	
SCG	Za punjenje nekog rezervoara	Alarm kod niskog stanja tečnosti		izolovati	
GR	Γ ια την πλήρωση τον περιέκτη	Αλάρμ σε πολύ χαμηλή στάθμη υγρού		μόνωση	
TR	Bir hayneyi/kabı doldurmak için	Düşük sıvı seviyesinde alarm		İzole etmek	

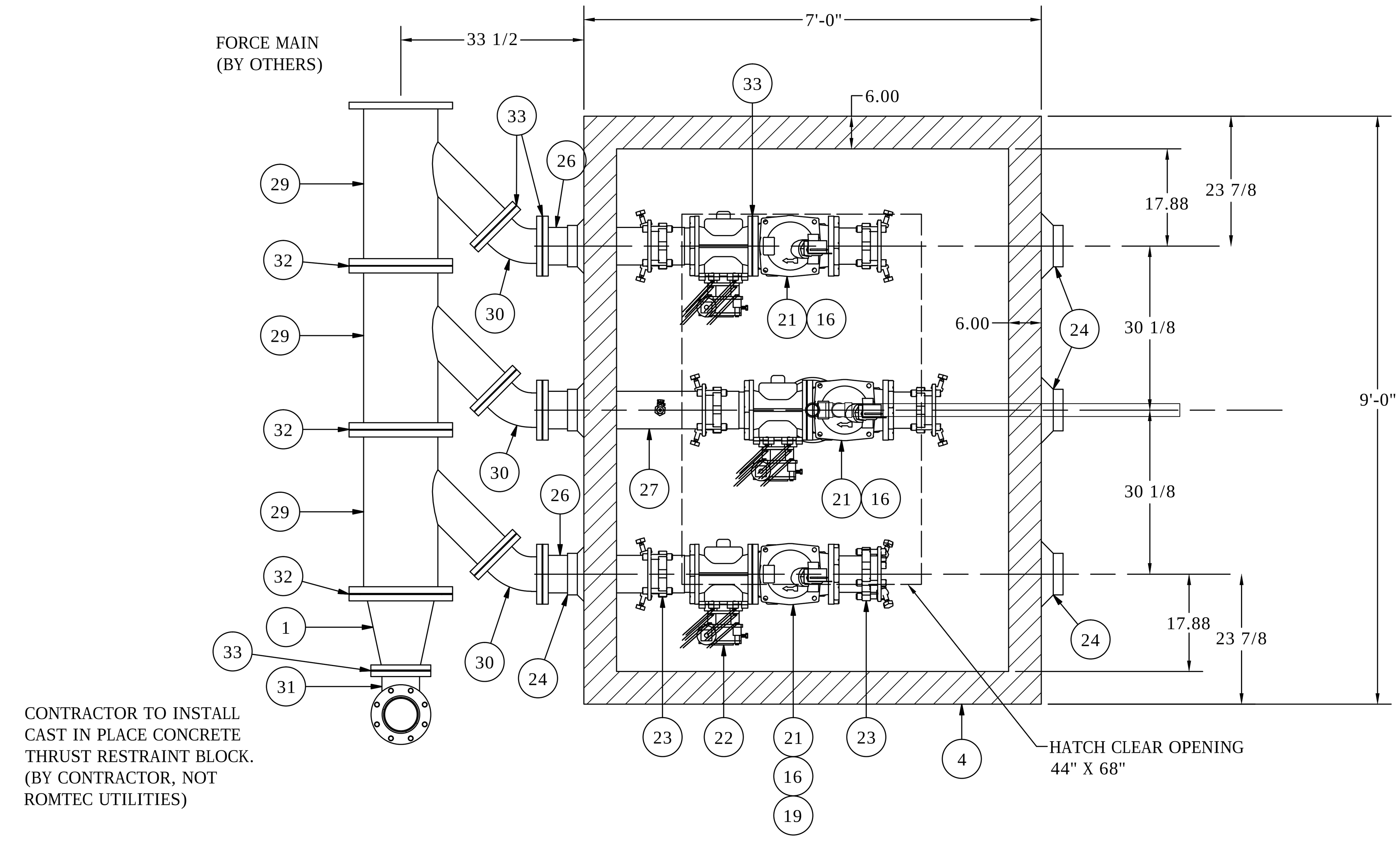
11 2126

3.05 VALVE VAULT

This section contains information pertaining to the valve vault. There is both technical information and related drawings necessary for the valve vault construction.

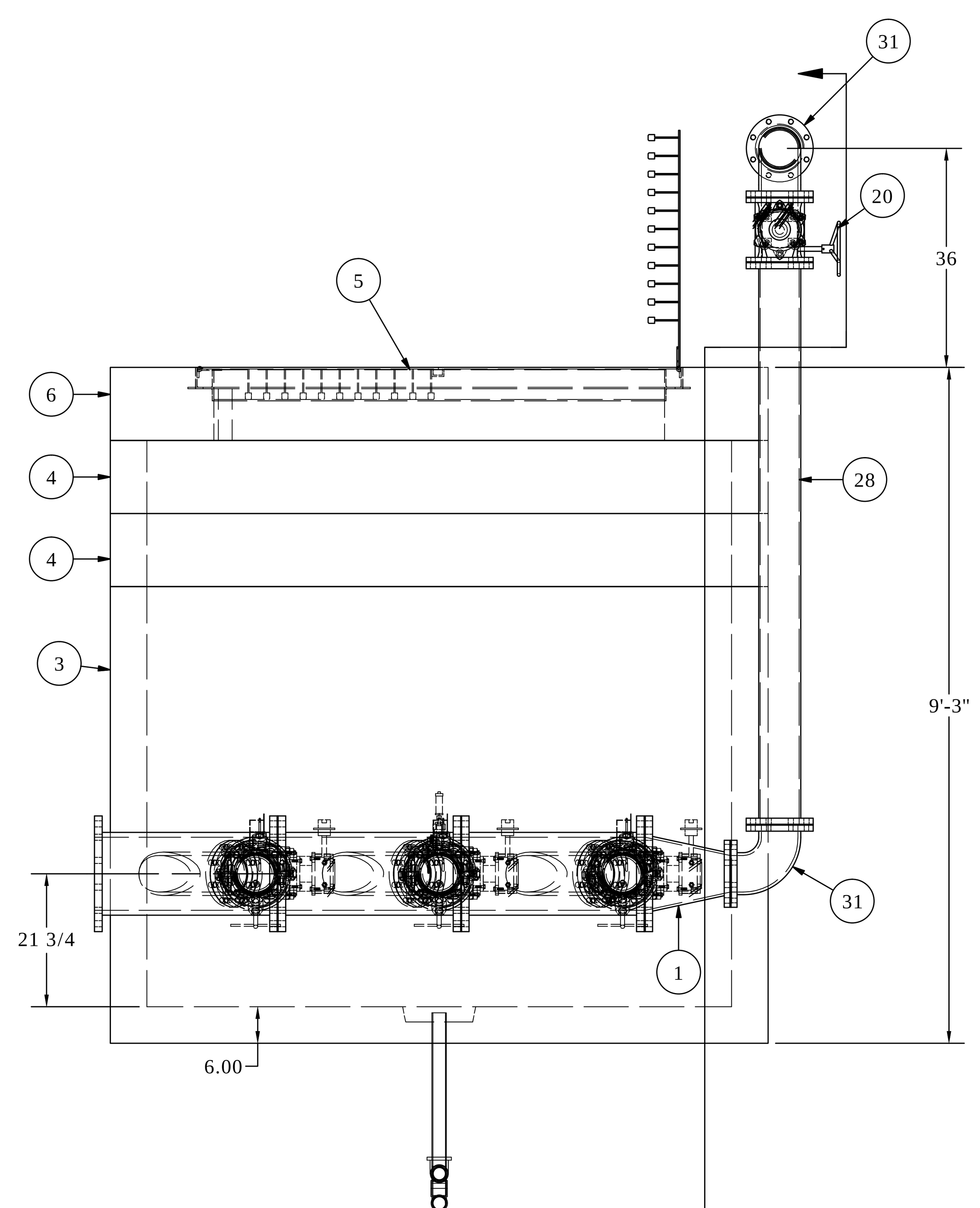
This section is structured as follows:

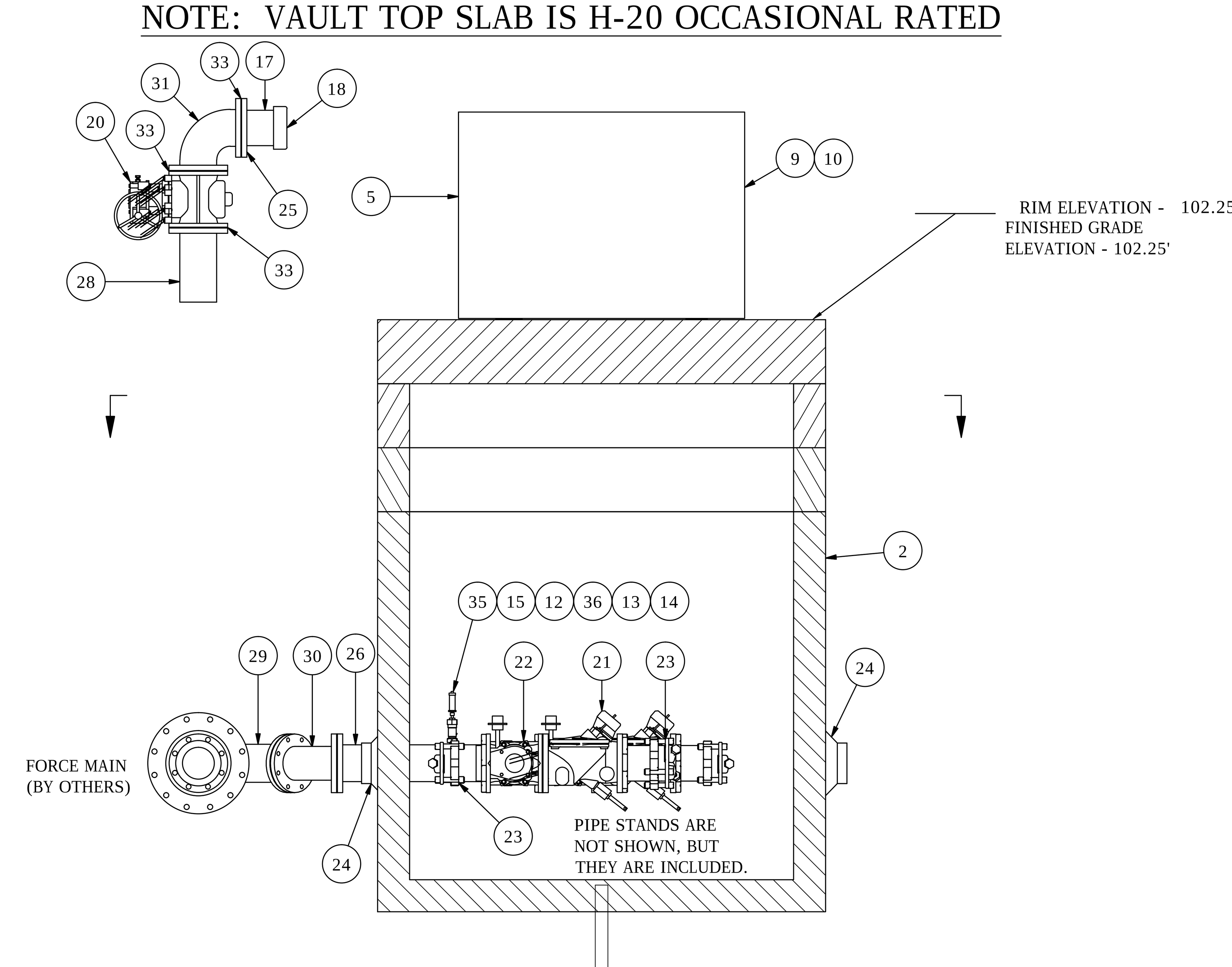




Parts List			
ITEM	QTY	STOCK NUMBER	DESCRIPTION
1	1	44-XXXX	REDUCER - CONCENTRIC - 12in X 6in - 150LB - 316SS
2	1	10-XXXX	EXTERIOR COATING - TNEMEC 61
3	1	20-XXXX	BASE - VV - 6ft X 8ft
4	2	22-XXXX	RISER - VV - 6 x 8 - 1 FT
5	1	23-5423	HATCH - VV - 687 - H20 - 44 X 68
6	1	24-XXXX	TOP SLAB - 6 X 8 - H20
7	3	25-6531	PIPE STAND - 6in - S89 FLG - NO BASE
8	3	25-6533	PIPE STAND - 6in - S92 SAD - NO BASE
9	2	25-6550	VALVE KEY BRACKET
10	1	25-6605	VALVE KEY - SPECIAL SWIVEL
11	10	40-6253	PIPE - 316SS - 2in SCH40
12	1	40-5095	NIPPLE - BRASS - 1/2in X 2in
13	1	40-XXXX	NIPPLE - 1-4in - BRASS - CLOSE
14	1	40-XXXX	BUSHING - BRASS - 1-2in MALE X 1-4in FEMALE THD
15	1	41-5093	VALVE - BALL - 1/2in BRASS - 1/4 TURN
16	3	41-5108	MECHANICAL INDICATOR - 6in
17	1	41-XXXX	CAM LOCK - 6in MIPTXM - 316SS
18	1	41-XXXX	DUST CAP - 6in 316SS CAMLOCK
19	1	41-6566	BACKFLOW ACTUATOR - 4in & 6in
20	1	41-6568	VALVE - PLUG - 6in - WITH HANDWHEEL
21	3	41-6569	VALVE - SWING CHECK - 6in - 506A
22	3	41-6583	VALVE - PLUG - 6in - GEAR OP
23	6	42-5247	COUPLING - ROMAC - RFCA - 6in FBEC - SS HARDWARE
24	6	43-6113	KOR-N-SEAL - 12in CORE - 6in PIPE
25	1	44-XXXX	FLANGE - 316SS - 6in - COMPANION W-6in TAP
26	2	45-4604	SPOOL - FLG X PE - 6in X 26in - 316SS
27	1	45-XXXX	SPOOL - FLG X PE - 6in X 36in - 316SS
28	1	45-XXXX	SPOOL - FLG X FLG - 6in X 92.25in - 316SS
29	3	46-XXXX	WYE - 316SS - 12in X 6in - FLG
30	3	46-XXXX	ELBOW - 316SS - 6in - 45 DEG - FLG X FLG
31	2	46-6521	ELBOW - 316SS - 6in - 90 DEG - FLG X FLG
32	3	47-5267	GASKET - FLANGE - 12in X 1/8in
33	14	47-6547	GASKET - FLANGE - 6in X 1/8in
34	130.5	51-6081	SEALANT - 1in X 1in X 14.5ft CS-202
35	1	60-XXXX	PRESSURE TRANSDUCER - ASHCROFT - 1/4in NPT
36	1	60-XXXX	PRESSURE TRANSDUCER ISOLATOR
37	1	45-XXXX	SPOOL - FLG X PE - 6in X 24in - 316SS

NOTE: VAULT TOP SLAB IS H-20 OCCASIONAL RATED





DRAIN BACK TO WET WELL:
3" PLAIN HOLE IN VAULT
(PROVIDED)
2" PEE TRAP ON VAULT END
WITH CHECK VALVE AT END OF
PIPE IN WET WELL.
(BY OTHERS) NOT ROMTEC UTILITIES

NOTE: ALL DIMENSIONS AND ELEVATIONS SHOWN ARE NOMINAL DIMENSIONS. IT IS THE RESPONSIBILITY OF THE ON-SITE CONTRACTOR OR ROMTEC UTILITIES CUSTOMER (NOT ROMTEC UTILITIES) TO VERIFY THE ACCURACY OF ANY CRITICAL DIMENSIONS OR ELEVATIONS PRIOR TO SETTING OR INSTALLING ANY EQUIPMENT.

6' X 8' VALVE VAULT
6" PIPING AND VALVES
12" PUMPING PORT

ALL MATERIALS SHOWN ON THIS SHEET WILL BE SUPPLIED BY ROMTEC UTILITIES AND DELIVERED TO THE SITE AFTER THE HOLE HAS BEEN EXCAVATED AND SHORED. THE CONTRACTOR SHALL SUPPLY A CRANE OF SUFFICIENT SIZE TO LOWER ALL THE CONCRETE PIECES INTO THE HOLE SAFELY. THE THE CONTRACTOR SHALL INSTALL THE WET WELL (AND VALVE VAULT AND METERING VAULT IF APPLICABLE). ROMTEC UTILITIES WILL PROVIDE A REPRESENTATIVE FOR TECHNICAL ASSISTANCE ON THE DAY OF INSTALLATION TO ANSWER ANY QUESTIONS THAT MAY ARISE. THE CONTRACTOR IS RESPONSIBLE FOR ALL PLUMBING AND ELECTRICAL CONNECTIONS AND INSTALLATION. ITEMS NOTED AS "BY OTHERS" WILL BE PROVIDED AND INSTALLED BY THE CONTRACTOR. ROMTEC UTILITIES WILL NOT INSTALL ANY OF THE COMPONENTS SHOWN ON THIS PAGE.

BAY MEADOWS
(SAN MATEO, CA.)

6' X 8' VALVE VAULT
6" PIPING

REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

DRAWING
M2

Contact:
Project #:
File #:

$USER$
$DATE$
$TIME$
$FILENAME$

Style "DTD-HD-AO" access hatch, as manufactured by Syracuse Castings, Tooele UT. Tel: 801-544-5728. Fax: 801-544-9571.

Material shall be 6061-T6 aluminum for bars, angles, and extrusions. 1/4" diamond plate shall be 5086 aluminum.

Unit designed heavy duty, for H-20 wheel loads, where not subject to high density traffic. Channel frame and bearing plate must be cast into and supported by concrete.

Each door shall be supplied with a heavy duty, stainless steel pneu-spring, for ease of operation when opening cover.

Each door shall be equipped with a grade 316 stainless steel hold open arm. Door shall lock open in the 90 degree position.

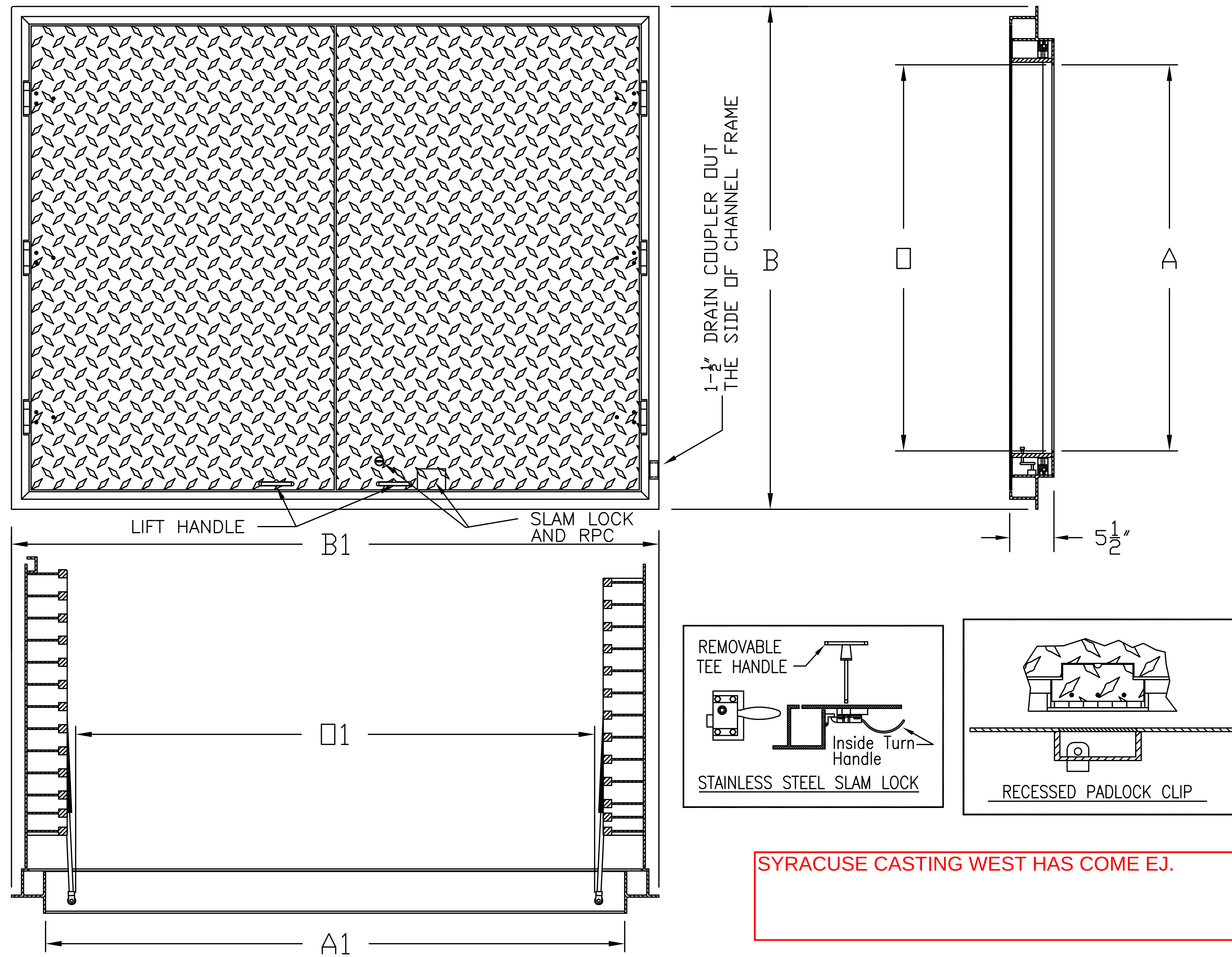
Channel frame shall be of extruded aluminum, with a continuous 1-1/4" anchor flange.

Each "DTD-HD-AO" style hatch is supplied with a 1-1/2" threaded drain coupler out the side of channel frame.

All hardware shall be stainless steel.

Each hatch shall be supplied with a grade 316 stainless steel slam lock and a recessed padlock clip.

Each hatch shall be equipped with a stainless steel lift handle. The lift handle shall be flush with the top of the 1/4" diamond plate.



SYRACUSE CASTING WEST HAS COME EJ.

687-VALVE VAULT-H20

"DTD-HD-AO" HEAVY DUTY H-20 ALUMINUM HATCH W/ RPC AND SLAM

DRAWN BY: C.M.A. | DATE: 07-10-09 | DRAW # DTDHD4468A

Syracuse Castings West
Better By Design
58 SOUTH 1200 WEST
P.O. BOX 488
TOELE, UT 84074-0488
www.syrcast.com
TEL: 801-544-5728 FAX: 801-544-9571

PATTERN NO.	DIMENSIONS IN INCHES		UNOBSTRUCTED CLEAR OPENING
ALUMINUM	A x A1	B x B1	O x O1
DTD-HD-44X68AO	44" X 74"	58-1/2" X 82-1/2"	44" X 68"

3.05.4 VALVE VAULT DATA SHEETS

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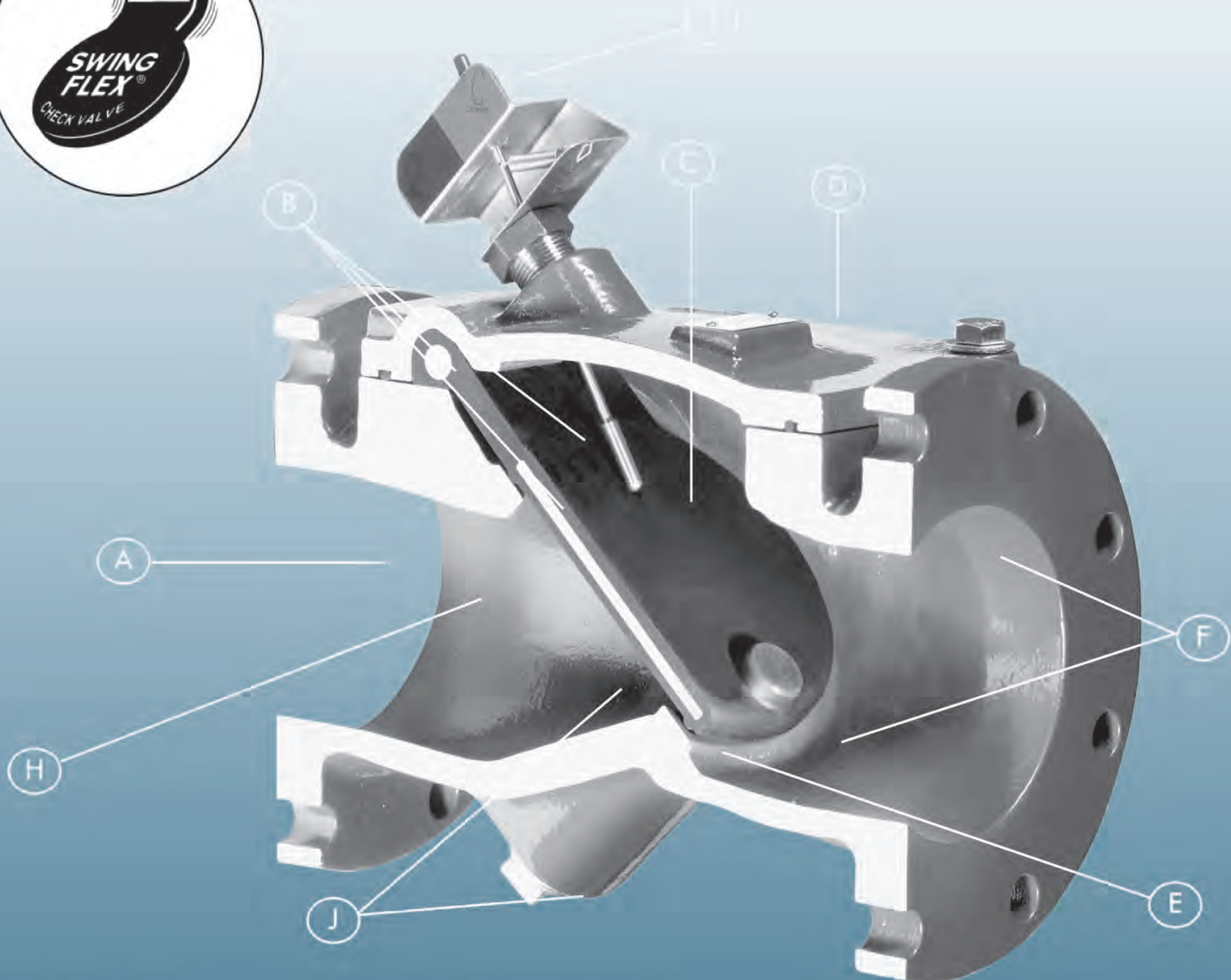
BULLETIN 500

VAL-MATIC®

SWING FLEX® CHECK VALVE

EFFICIENCY & RELIABILITY THROUGH SIMPLICITY OF DESIGN

Swing-Flex® Check Valve



A. 100% FLOW AREA
For improved flow characteristics and lower head loss, the Val-Matic Swing-Flex® Check Valve provides 100% unrestricted flow area.

B. REINFORCED DISC
The one piece precision molded disc is steel and nylon reinforced to provide years of trouble free performance. It is backed by a 25 year warranty for the flex portion of the disc. (Tested for proof of design - see page 5.)

C. ONE MOVING PART
The Memory-Flex™ disc, the only moving part, assures long life with minimal maintenance. No packing or O-rings, mechanical hinges, pivot pins or bearings to wear out.

D. DOMED ACCESS PORT
Full size top access port allows removal of disc without removing valve from line. Access cover includes a drilled and tapped port for installation of optional Disc Position Indicator.

E. DROP TIGHT SEATING
The synthetic reinforced disc, with its integral O-ring type seal design assures positive seating at high and low pressures.

F. NON-SLAM CLOSURE
"Short Disc Stroke" combined with Memory-Flex™ Disc Action reduces potentially destructive water hammer.

G. BACKFLOW ACTUATOR (Not Shown)
Body is drilled and tapped for installation of optional backflow actuator (see options).

H. NON-CLOG DESIGN
The unrestricted full flow area combined with smooth streamlined contouring allows passage of large solids minimizing the potential for clogging.

I. MECHANICAL DISC POSITION INDICATOR* (Optional)
Provides clear indication of the valve's disc position. Can also be provided with a SCADA compatible limit switch for off site monitoring (see options).

J. FUSION BONDED EPOXY
Fusion Bonded Epoxy (FBE) is provided standard on the interior and exterior of the valve. The FBE is ANSI/NSF 61 certified. Other coatings are available on request.

*US Patent 6,152,173 US Patent 6,050,294

EFFICIENCY..... RELIABILITY ......BY DESIGN!

Efficiency and reliability through simplicity of design is the key to the superior performance and long life of the Val-Matic ***Swing-Flex***® Check Valve.

ENERGY EFFICIENT BY DESIGN

The streamlined contour of the ***Swing-Flex***® body provides 100% flow area with no restrictions at any point through the valve (Figure 1.) Flow tests performed by an independent laboratory have shown that this unique body design produces minimal head loss through the valve. Flow and head loss charts, developed from the test data, are shown on Page 4.

DISC STABILIZATION BY DESIGN

In the full open position, the disc is stabilized by using body contouring to ease the direction of flow towards the disc assuring long disc life (Figure 1).

NON-CLOGGING BY DESIGN

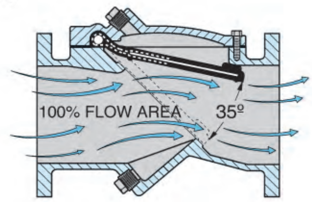
Clog resistant performance is achieved by maintaining an unobstructed 100% flow area, smooth streamlined body contouring and the simplicity of one moving part. The entrapment or hang-up of solids and stringy materials is minimized by the elimination of mechanical devices in the valve design. The standard 4" Swing-Flex® is designed to pass a 3" solid.

NON-SLAM CLOSING BY DESIGN

The non-slam closing characteristic of the ***Swing-Flex***® Check Valve is achieved by utilizing a "Short Disc Stroke" in conjunction with the unique "***Memory-Flex***™ action" of the valve's disc. The 35° stroke, a result of the angled seat, is less than half the typical 80° to 90° stroke of a conventional swing check valve. (Figures 1 & 2) The feature is similar to that found in high performance tilted disc check valves.

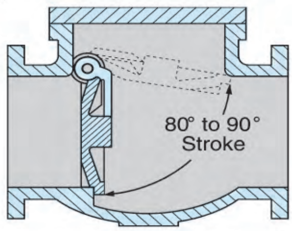
VAL-MATIC SWING-FLEX® VALVE

Figure 1



CONVENTIONAL SWING CHECK VALVE

Figure 2



The short disc stroke and "***Memory-Flex***™ action" (Figure 1) serve to reduce the closing time of the valve. This reduced closing time minimizes flow reversal and the resultant water hammer normally associated with the sudden stoppage of reverse flow.

RELIABILITY BY DESIGN

Operational reliability is achieved by utilizing just one moving part, the ***Memory-Flex***™disc. Extended life is -- designed into the disc by the inclusion of steel and nylon reinforcements. The steel and nylon are precision molded into the disc, providing a tough, durable disc with a 25-year warranty*. (Figure 3)

Unlike a conventional horizontal swing check valve, the ***Swing-Flex***® has no packing or O-rings, mechanical hinges, shafts, pivot pins, or bearings to wear out (Figure 3.) Upon conclusion of a 1,000,000 (one million) cycle test, an independent testing laboratory reported that the valve had no visible signs of wear and remained drop tight. (See Page 5.)

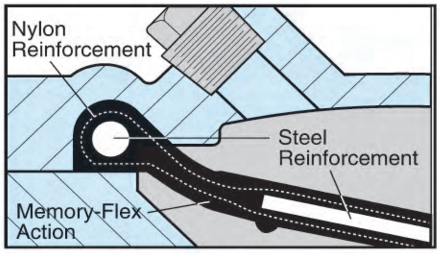


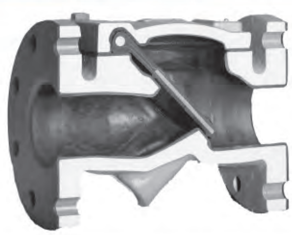
Figure 3

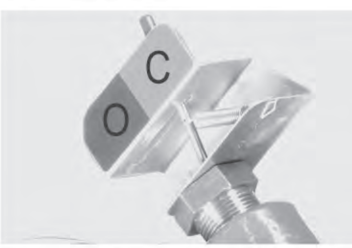
POSITIVE SHUT OFF BY DESIGN

The ***Memory-Flex***™ disc with its integral O-ring type seal design assures drop tight seating at both high and low working pressures. Each and every valve is tested to this standard. A certified report is available upon request.

OPTIONAL ACCESSORIES

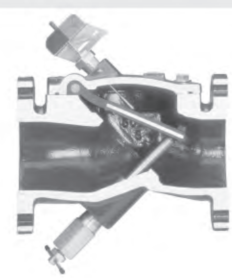
RUBBER LINING -- Unlike conventional swing check valves, the ***Swing-Flex***® Check Valve is designed to accept synthetic or natural rubber lining. Body lining coupled with synthetic ***Memory-Flex***™ discs makes the ***Swing-Flex***® ideally suited for systems containing abrasive or corrosive fluids.





DISC POSITION INDICATOR -- The cover mounted disc position indicator provides clear indication of the valve's disc position. A SCADA compatible limit switch can also be provided. Both can be provided at the time of valve purchase or for field installation at a later date.

BACKFLOW ACTUATOR -- Available for use when manual backflow operation is required. Most commonly used for priming pumps, back flushing, draining lines, and system testing. The Val-Matic Backflow Actuator can be provided at the time of valve purchase or for field installation at a later date.

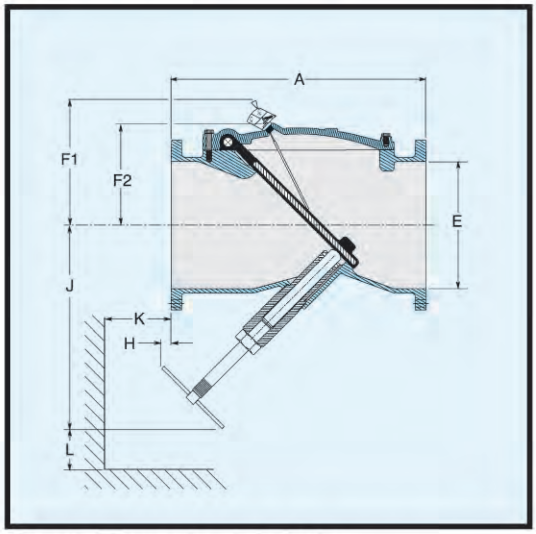


* The Val-Matic warranty and its remedies are available for 25 years covering the flex portion of the disc.

INSTALLATION DIMENSIONS AND CONSTRUCTION

VALVE SIZE	MODEL #	A	E	F1	F2	H	J	K	L
2	502A	8.00	2.00	N/A	3.38	-0.50	6.75	1.50	1.50
2 1/2	525A	8.50	2.50	N/A	3.38	-0.50	7.00	1.50	1.50
3	503A	9.50	3.00	8.69	5.12	-0.38	7.50	1.50	1.50
4	504A	11.50	4.00	10.63	5.75	3.38	10.75	2.50	2.50
6	506A	15.00	6.00	11.69	6.88	1.38	11.38	3.00	3.00
8	508A	19.50	8.00	13.25	8.38	2.00	15.75	5.75	5.75
10	510A	24.50	10.00	15.63	10.75	0.50	17.00	5.75	5.75
12	512A	27.50	12.00	17.19	12.50	3.50	22.50	6.50	6.50
14	514A	31.00	14.00	17.81	13.00	4.00	26.25	6.50	6.50
16	516A	32.00	16.00	19.06	14.25	4.63	30.00	6.50	6.50
18	518A	36.00	18.00	20.25	15.25	5.25	33.75	6.50	6.50
20	520A	40.00	20.00	21.69	16.88	5.88	37.50	8.00	8.00
24	524A	48.00	24.00	24.50	19.25	1.81	45.00	8.00	8.00
30	530A	56.00	30.00	27.81	23.00	-0.63	41.25	8.00	8.00
36	536A	63.00	36.00	32.63	27.38	-0.38	49.00	9.75	9.75
42	542A	70.00	42.00	39.63	36.88	-5.50	53.50	9.75	9.75
48	548A	76.00	48.00	43.41	40.66	-2.90	41.98	10.00	10.00

Dimensions "L" and "K" represent the clearance required to remove backflow actuator.



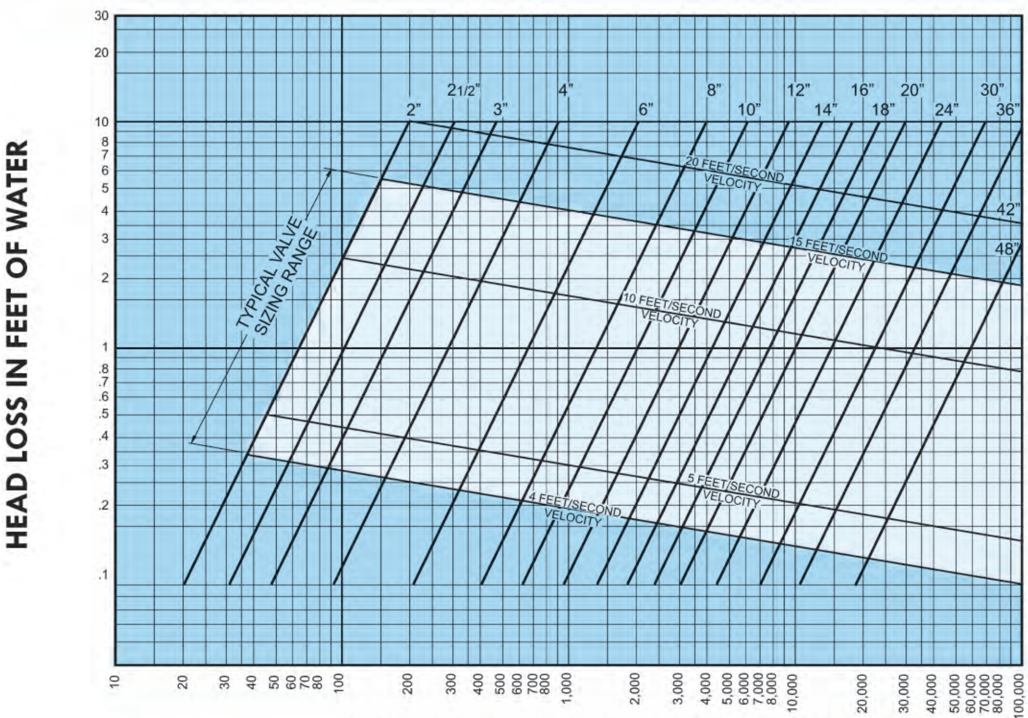
*Dimension "E" represents nominal valve size.
Note: Flanged ends conform to ANSI B16.1 Class 125.

MATERIALS OF CONSTRUCTION			
Component		Standard	Optional
Body and Cover		Ductile Iron ASTM A536 Grade 65-45-12	Stainless Steel, Bronze
Disc		Buna-N (NBR), ASTM D2000-BG	Viton (FKM), ASTM D2000-HK
Coatings	Interior	Fusion Bonded Epoxy*	Rubber Lining
	Exterior	Fusion Bonded Epoxy*	Consult Factory

Consult factory for additional material and coating options.
*ANSI/NSF 61 Certifications

ANSI MAXIMUM PRESSURE-TEMPERATURE RATING		
Maximum Non-Shock Working Pressure (P.S.I.) ANSI Class 125		
Temperature °F	2" - 48"	30" - 48"
100°	250	150
150°		
200°	235	135
Hydrostatic Test Pressures	500	300

HEAD LOSS CHART



FLOW OF WATER IN GALLONS PER MINUTE

Consult factory for Digester Gas Service

Flow Tests performed by the Utah Water Research Laboratory of Utah State University.

SAMPLE SPECIFICATIONS

The check valve shall be of the ***Swing-Flex***® full body flanged type, with a domed access cover and only one moving part - the valve disc.

The valve body shall have full flow equal to nominal pipe diameter at any point through the valve. The seating surface shall be on a 45° angle to minimize disc travel. The top access port shall be full size, allowing removal of the disc without removal of the valve from the pipeline and shall include a port for installation of an optional mechanical position indicator.

The disc shall be of one piece construction, precision molded with an integral O-ring type sealing surface and contain steel and nylon reinforcements in both the ***Memory Flex***™ and central disc areas. The flex portion of the disc shall be warranted for 25 years. Non-slam closing characteristic shall be provided through a short 35° disc stroke and a ***Memory-Flex***™ disc return action.

A mechanical indicator shall be provided when specified to provide disc position indication on valves 3" and larger. The indicator shall have continuous contact with the disc under all operating conditions to assure accurate disc position indication.

A limit switch will be provided when specified to indicate open/closed position to a remote location. The mechanical type limit switch shall be activated by the external position indicator. The switch shall be rated for NEMA 4, 6, or 6P and shall have U.L. rated 5 amp, 125, or 250 VAC contacts.

Backflow capabilities shall be available by means of an optional screw type backflow actuator. Both the disc position indicator and backflow actuator shall be capable of installation without special tools.

The valve body and cover shall be ASTM A536 Grade 65-45-12, Class B Ductile Iron. The disc shall be Buna-N (NBR), ASTM D2000-BG.

The interior and exterior of the valve shall be coated with an ANSI/NSF 61 approved Fusion Bonded Epoxy.

The valve shall be proof of design cycle tested 1,000,000 times with no signs of wear or distortion to the valve disc or seat and shall remain drop tight at both high and low pressures. The test results shall be independently certified.

The manufacturer shall have a minimum of five years experience in the manufacture of flexible disc type check valves.

The valve shall be Val-Matic ***Swing-Flex***® series 500 and shall be designed, manufactured and tested in accordance with ANSI/AWWA Standard C508.

INDEPENDENT PROOF OF DESIGN TEST

In the case of the Val-Matic ***Swing-Flex***® Check Valve, we have taken quality assurance one step further by having the valve cycle tested. Utilizing an eight-inch ***Swing-Flex***® with optional signal switch, the valve was cycled over 1,000,000 (one million) times.

To place one million cycles in perspective, it would take an average of 100 cycles per day for more than 27 years to equal the 1,000,000 cycles. Upon conclusion, PSI/Pittsburgh Testing Laboratory Division reported the following results:

1. After 1,000,000 cycles the valve's disc showed no signs of fatigue or stress cracks.

2. After 1,000,000 cycles the valve seating areas showed no signs of wear or distortion. The valve seating remained drop tight during the low and high pressure hydrostatic tests.

3. After 1,000,000 cycles the signal switch continued to function as designed.

Copies of the PSI/Pittsburgh Testing Laboratory Division report are available upon request.

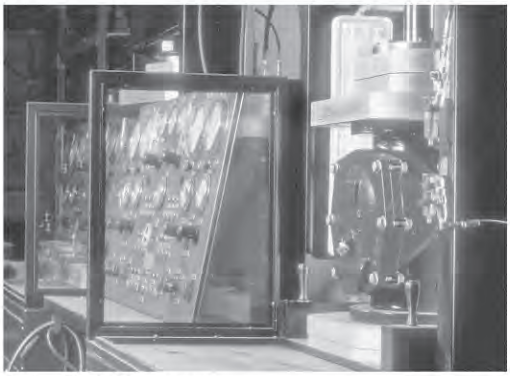
QUALITY ASSURANCE

Val-Matic's Quality Assurance is the sum of imaginative design, solid engineering, careful manufacturing and dedicated people.

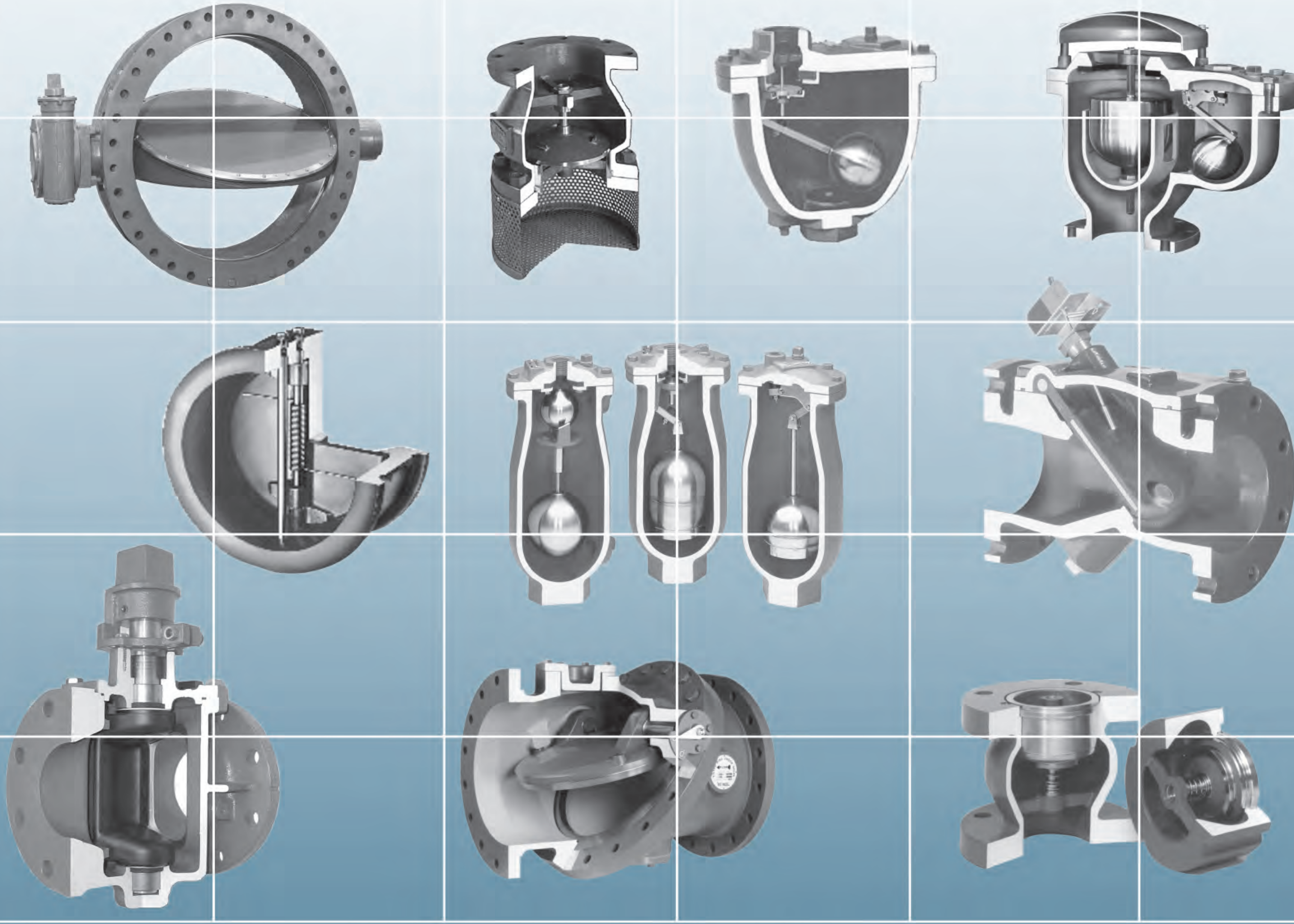
These all combine to ensure total customer satisfaction. We recognize the need for, and encourage, individual pride and the self-satisfaction, which is gained in producing reliable and quality valves.

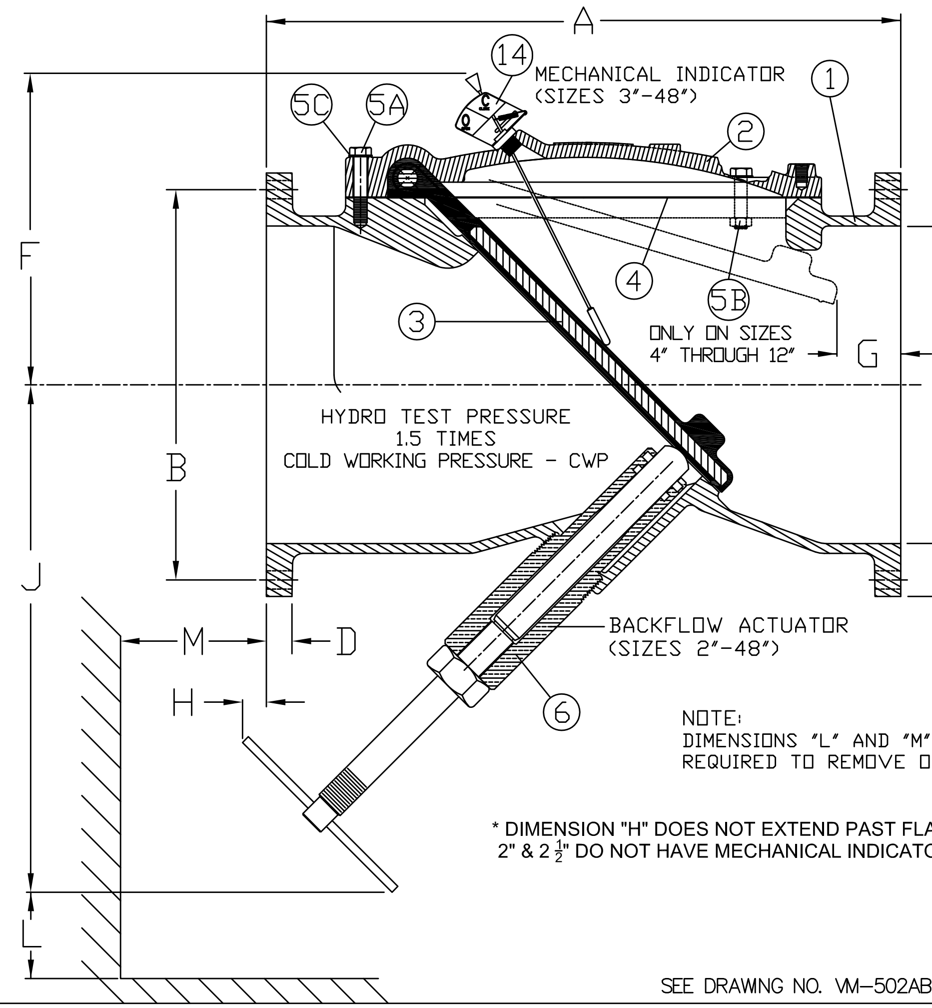
This quality attitude permeates through the corporation from the president to our newest employee.

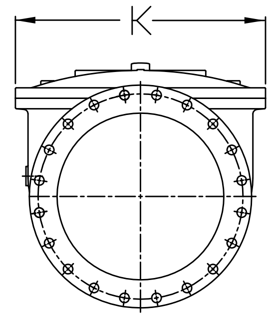
Testing (right) is the backbone of our quality assurance. Every Swing-Flex® Check Valve is 100% tested including a seat test to assure drop tight sealing and hydrostatic testing to assure the integrity of the casting.



Swing-Flex® Valve at test.







NSF/ANSI 61

NOTE:
DIMENSIONS "L" AND "M" REPRESENT THE MINIMUM CLEARANCE REQUIRED TO REMOVE OR INSTALL BACKFLOW ACTUATOR.

* DIMENSION "H" DOES NOT EXTEND PAST FLANGE ON VALVE SIZES 2" THRU 3", 30" THRU 48".
2" & 2 $\frac{1}{2}$" DO NOT HAVE MECHANICAL INDICATOR BOSS.

DRAWING DEPICTS 24" SIZE TO SCALE

SEE DRAWING NO. VM-502ABFMI-M FOR STANDARD MATERIALS OF CONSTRUCTION

ANSI CLASS 125

VALVE SIZE	MODEL NO.	CWP (PSI)	A	B	C	D	E	F	G	*H	J	K	L	M	BOLT SIZE	NO. OF BOLTS	SHPG. WT.
2	502ABF	250	8.00	4.75	6.00	0.63	2.00	N/A	1.63	–0.50	6.75	5.18	1.50	1.50	5/8	4	27
2 1/2	525ABF	250	8.50	5.50	7.00	0.68	2.50	N/A	1.63	–0.50	7.00	5.18	1.50	1.50	5/8	4	32
3	503ABFMI	250	9.50	6.00	7.50	0.75	3.00	8.69	1.63	–0.38	7.50	7.50	1.50	1.50	5/8	4	45
4	504ABFMI	250	11.50	7.50	9.00	0.75	4.00	10.63	2.12	3.38	10.75	8.25	2.50	2.50	5/8	8	70
6	506ABFMI	250	15.00	9.50	11.00	0.75	6.00	11.69	2.12	1.38	11.38	11.12	3.00	3.00	3/4	8	130
8	508ABFMI	250	19.50	11.75	13.50	0.88	8.00	13.25	2.88	2.00	15.75	16.00	5.75	5.75	3/4	8	250
10	510BAFMI	250	24.50	14.25	16.00	1.18	10.00	15.63	3.12	0.50	17.00	21.00	5.75	5.75	7/8	12	430
12	512ABFMI	250	27.50	17.00	19.00	1.25	12.00	17.19	3.43	3.50	22.50	24.00	6.50	6.50	7/8	12	660
14	514ABFMI	250	31.00	18.75	21.00	1.38	14.00	17.81	3.63	4.00	26.25	23.25	6.50	6.50	1	12	750
16	516ABFMI	250	32.00	21.25	23.50	1.43	16.00	19.06	3.25	4.63	30.00	25.25	6.50	6.50	1	16	900
18	518ABFMI	250	36.00	22.75	25.00	1.56	18.00	20.25	3.12	5.25	33.75	28.25	6.50	6.50	1 1/8	16	1230
20	520ABFMI	250	40.00	25.00	27.50	1.68	20.00	21.69	3.50	5.88	37.50	30.63	8.00	8.00	1 1/8	20	1750
24	52A4BFMI	250	48.00	29.50	32.00	1.88	24.00	24.50	5.00	1.81	45.00	36.00	8.00	8.00	1 1/4	20	2400
30	530BFMI	150	56.00	36.00	38.75	2.12	30.00	27.81	5.75	–0.63	41.25	45.88	8.00	8.00	1 1/4	28	4350
30	530ABFMI	250	56.00	36.00	38.75	2.12	30.00	27.81	5.75	–0.63	41.25	45.88	8.00	8.00	1 1/4	28	4350
36	536BFMI	150	63.00	42.75	46.00	2.38	36.00	32.63	3.88	–.38	49.00	55.00	9.75	9.75	1 1/2	32	7000
36	536ABFMI	250	63.00	42.75	46.00	2.38	36.00	32.63	3.88	–.38	49.00	55.00	9.75	9.75	1 1/2	32	7000
42	542BFMI	150	70.00	49.50	53.00	2.63	42.00	39.63	0.12	–5.50	53.50	60.18	9.75	9.75	1 1/2	36	9410
42	542ABFMI	250	70.00	49.50	53.00	2.63	42.00	39.63	0.12	–5.50	53.50	60.18	9.75	9.75	1 1/2	36	9410
48	548BFMI	150	76.00	56.00	59.50	2.75	48.00	43.41	0.12	–2.90	41.98	68.00	10.00	10.00	1 1/2	44	12700
48	548ABFMI	250	76.00	56.00	59.50	2.75	48.00	43.41	0.12	–2.90	41.98	68.00	10.00	10.00	1 1/2	44	12700

Revised 3-31-11

SWING-FLEX CHECK VALVE W/ BACKFLOW ACTUATOR AND MECHANICAL INDICATOR

DATE 6-9-09

DRWG. NO. VMC-502ABFMI

VAL-MATIC VALVE AND MANUFACTURING CORP.

Manual No.
SFCV-OM1-7

Swing-Flex® Check Valve

Operation, Maintenance and Installation Manual

VAL-MATIC

VAL-MATIC® VALVE AND MANUFACTURING CORP.

905 Riverside Dr. ● Elmhurst, IL 60126
Phone (630) 941-7600 ● Fax (630) 941-8042
www.valmatic.com

VAL-MATIC'S SWING-FLEX® CHECK VALVE OPERATION, MAINTENANCE AND INSTALLATION

INTRODUCTION

The Swing-Flex® Check Valve has been designed to give years of trouble-free operation. This manual will provide you with the information needed to properly install and maintain the valve and to ensure a long service life. The valve is opened by the fluid flow in one direction and closes automatically to prevent flow in the reverse direction.

An optional backflow actuator may be mounted on the bottom of the valve to allow manual backflow through the valve in the reverse direction.

Optional Mechanical Indicators and Limit Switches may be mounted on the valve cover to provide local and remote position indication.

An oil dashpot may be mounted on the bottom of 6" and larger valves to provide slow closure over the last 10% of travel.

The valve is of the swing check type utilizing an angled seat and fully encapsulated, resilient disc. It is capable of handling a wide range of fluids including flows containing suspended solids. The Size, Flow Direction, Maximum Working Pressure, and Series No. are stamped on the nameplate for reference.

CAUTION
Do not use valve for line testing at pressures higher than nameplate rating or damage to valve may occur

The "Maximum Working Pressure" is the non-shock pressure rating of the valve at 150°F. The valve is not intended as an isolation valve for line testing above the valve rating.

RECEIVING AND STORAGE

Inspect valves upon receipt for damage in shipment. Unload all valves carefully to the ground without dropping. Do not allow lifting slings or chains to come in contact with the seat area; use eyebolts or rods through the flange holes on large valves.

WARNING
Do not use threaded holes in cover for lifting the valve. Serious injury may result.

Valves should remain crated, clean and dry until installed to prevent weather related damage. For long term storage greater than six months, the rubber surfaces of the disc should be coated with a thin film of FDA approved grease such as Lubriko #CW-606. Do not expose disc to sunlight or ozone for any extended period.

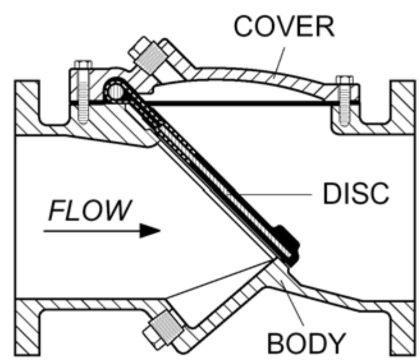


FIGURE 1. SWING FLEX® CHECK VALVE

DESCRIPTION OF VALVE OPERATION

The valve is designed to prevent reverse flow automatically. During system flow conditions, the movement of the fluid forces the disc to the open position allowing 100% un-restricted flow area through the valve. Under reverse flow conditions, the disc automatically returns to the closed position to prevent reverse flow.

Several optional features are a backflow actuator, mechanical indicator, limit switch and bottom oil dashpot. All of these options ship loose of the valve and require field installation.

INSTALLATION

Correct installation of the Swing-Flex® is important for proper operation. It may be installed in either horizontal or vertical flow-up applications. However, when horizontal, the valve must be installed with the nameplate facing up and the cover level. In all installations, the flow arrow cast in the valve cover must be pointed in the direction of flow during normal system operation.

> **WARNING**
> **Do not use threaded holes in cover for lifting the valve. Serious injury may result.**

FLANGED ENDS: Flanged valves should only be mated with flat-faced pipe flanges equipped with full-face resilient gaskets. The valve and adjacent piping must be supported and aligned to prevent cantilevered stress on the valve. Once the flange bolts or studs are lubricated and inserted around the flange, tighten them uniformly hand tight. The tightening of the bolts should then be done in graduated steps using the **crossover tightening** method. Recommended lubricated torque values for use with resilient gaskets (75 durometer) are given in Table 1. If leakage occurs, allow gaskets to absorb fluid and check torque and leakage after 24 hours. Do not exceed bolt rating or extrude gasket.

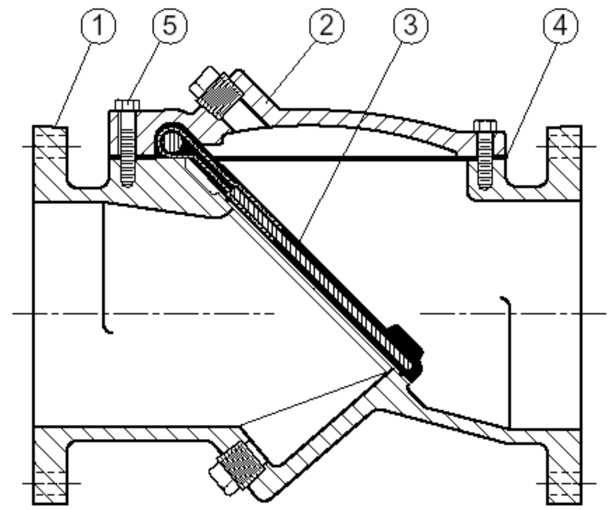
> **CAUTION**
> **The use of ring gaskets or excessive bolt torque may damage valve flanges.**

Table 1. Flange Bolt Torques

Valve Size (in)	Bolt Dia (in)	Recom. Torque (ft-lbs)	Max. Torque (ft-lbs)
3	5/8	25	90
4	5/8	25	90
6	3/4	30	150
8	3/4	40	150
10	7/8	45	205
12	7/8	65	205
14	1	80	300
16	1	80	300
18	1 1/8	100	425
20	1 1/8	100	425
24	1 1/4	150	600
30	1 1/4	160	600
36	1 1/2	300	900
42	1 1/2	300	900
48	1 1/2	300	1,000

VALVE CONSTRUCTION

The standard Swing-Flex® Check Valve is constructed of rugged cast iron with a rubber encapsulated disc. See the specific Materials List submitted for the order if other than standard cast iron construction. The disc is the only moving part assuring long life with minimal maintenance. The general details of construction are illustrated in Figure 2. The body (1) is flanged for connection to the pipeline with an open top sealed with a cast cover (2). The disc (3) is retained by the cover.



Item	Description	Material
1	Body	Ductile Iron – 250 psi Cast Iron – 150 psi
2	Cover	Ductile Iron – 250 psi Cast Iron – 150 psi
3	Disc*	Steel With Buna-N Facing
4	Cover Seal*	Buna-N or Non-Asbestos
5	Cover Bolt	Alloy Steel

*Recommended Spare Part

FIGURE 2. CHECK VALVE CONSTRUCTION

MAINTENANCE

The Swing Flex® Check Valve requires no scheduled lubrication or maintenance. For service or inspection, the valve can be serviced without removal from the line.

VALVE INSPECTION: If inspection of the valve is required, follow the Disassembly Instructions given on page 3.

TROUBLESHOOTING

Several problems and solutions are presented below to assist you in troubleshooting the valve assembly in an efficient manner.

- Leakage at Bottom Actuator: Remove line pressure and exercise actuator. If leak persists, replace seals in actuator; see the Backflow Actuator Seal Replacement Procedure on page 4.
- Leakage at Cover or Flanges: Tighten bolts, replace cover seal.
- Valve Leaks when Closed: Inspect disc for damage and replace. Inspect metal seating surface and clean if necessary.
- Valve Does not Open: Check for obstruction in valve or pipeline; see Disassembly procedure on page 4. Operating pressure may be less than cracking pressure. If less than 0.5 psig, review application with factory.

DISASSEMBLY

The valve can be disassembled without removing it from the pipeline. Or for convenience, the valve can be removed from the line. All work on the valve should be performed by a skilled mechanic with proper tools and a power hoist for larger valves. Disassembly may be required to inspect the disc for wear or the valve for deposits.

WARNING
The line must be drained before removing the cover or pressure may be released causing bodily harm.

1. Relieve pressure and drain the pipeline. Refer to Figure 2 on page 2. Remove the cover bolts (5) on the top cover.
2. Pry cover (2) loose and lift off valve body. 12” and larger valves have tapped holes in cover for lifting eyes.
3. Remove disc (3) and inspect for cracks, tears or damage in rubber sealing surface.
4. Clean and inspect parts. Replace worn parts as necessary and lubricate parts with FDA grease such as Lubriko #CW-606.

RE-ASSEMBLY

All parts must be cleaned. Gasket surfaces should be cleaned with a stiff wire brush in the direction of the serrations or machine marks. Worn parts, gaskets and seals should be replaced during reassembly.

1. Lay disc (3) over seat with beaded seating surface directed down.
2. Lay cover gasket (4) and cover (2) over bolt holes and disc hinge.
3. Insert lubricated bolts (5) noting that the bolts in the hinge area are longer than the other cover bolts.
4. Cover bolts should be tightened to the following specifications during assembly.

Table 2. Valve Cover Bolt Torques

Valve	Size	Torque (ft-lbs)
2”-2.5”	1/2"	75
3”	7/16"	50
4”	1/2"	75
6”	5/8"	150
8”	5/8"	150
10”	7/8"	250
12”-20”	7/8”	250
24”	1”	500
30”	1 1/8”	600
36”	1 1/4”	900
42”	1 1/2"	1,400
48”	1 1/2”	1,400

BACKFLOW ACTUATOR FIELD INSTALLATION AND MAINTENANCE (OPTIONAL)

BACKFLOW ACTUATOR OPERATION:
An optional **backflow actuator** assembly is available which can be easily installed in the field. The actuator is not designed to operate at the valve's Maximum Working Pressure rating. Therefore, prior to using the actuator, close the pump isolation valve and bleed off line pressure. To operate, turn the handle clockwise. This will open the valve disc allowing backflow through the valve. The handle should turn easily. When the actuator is fully extended into the valve, the disc will be partially open. Upon completion of the back flushing operation, turn the handle counter-clockwise and the valve will automatically return to the closed position. Lock the actuator in the closed position with the jam nut provided. The system is again ready for normal operation.

> **WARNING**
> **Relive line pressure before using backflow actuator or damage may occur.**

BACKFLOW ACTUATOR FIELD INSTALLATION:
The backflow actuator is supplied as an optional assembly from the factory, which is shipped loose with the valve.

> **WARNING**
> **Remove of the bottom plug while under pressure may cause bodily harm.**

1. Depressurize and drain the pipeline.
2. Score the coating around and remove the pipe plug in the bottom boss of the valve.
3. Inspect the backflow rod and place in the non-extended position. (The rod should extend about 1" past the end of the brass bushing.) Apply Teflon thread sealant to brass threads.
4. Insert the threaded end of the assembly into the valve boss. Slowly turn the assembly into the boss taking care not to cross-thread the bushing. Continue turning the assembly into the valve for a tight fit.

BACKFLOW ACTUATOR SEAL REPLACEMENT:
There are two parts (8 & 9) on the backflow actuator that are subject to wear. To replace the seals, the pipeline must first be depressurized and drained. Next, remove the backflow assembly from the valve by turning the brass bushing (6) counter-clockwise. Disassemble the actuator as follows:

1. Remove one of the vinyl caps (12).
2. Remove the T-Handle (10) and jam nut (11) from the rod (7).
3. Remove the rod (7) from the bushing (6) by screwing in the rod fully clockwise and pull the rod through the valve end of the bushing (6).
4. Lubricate new seals with FDA approved grease such as Lubriko #CW-606 and install in the bushing end grooves.
5. Clean, lubricate, and reinstall rod in bushing.
6. Re-install jam nut (11) and T-Handle (10).
7. Place vinyl cap (12) on handle (10).
8. Apply Teflon thread sealant to bushing and carefully thread into valve taking care not to cross-thread the bushing

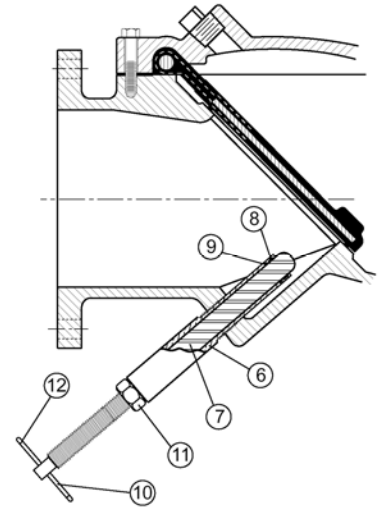


FIGURE 3. BACKFLOW ACTUATOR ASSEMBLY

Backflow Actuator Parts List

Item	Description	Material
6	Bushing	Lead-Free Brass
7	Rod	Stainless Steel
8	Rod Wiper*	Molythane
9	O-Ring*	Buna-N
10	Handle	Stainless Steel
11	Jam nut	Brass
12	Cap*	Vinyl

*Recommended Spare Part

MECHANICAL INDICATOR (OPTIONAL)

The mechanical indicator is an option that fits into the cover and can easily be installed in the field by going through the following steps. The mechanical indicator is used to visually indicate when the valve is opened or closed.

1. Remove line pressure and drain valve.

> **WARNING**
> **Removal of the pipe plug while under pressure may cause bodily harm.**

2. Score the coating around and remove the pipe plug from the cover.
3. Apply pipe joint compound to indicator body (21) threads.
4. Insert the indicator body (21), without the indicator plate (27), into the valve cover and tighten. Make sure that two of the tapped holes in the indicator body (21) are aligned with the valve and pipeline. This will ensure proper orientation of the indicator plate.
5. Remove the two socket head screws (31) from the indicator body (21).
6. Slide the indicator plate (27) over the indicator rod (23) and spring (28).
7. Align the indicator plate (27) as shown on the back of this card and secure with the 5mm socket head screws (31).
8. Connect the spring (28) to the indicator plate (27) notch.

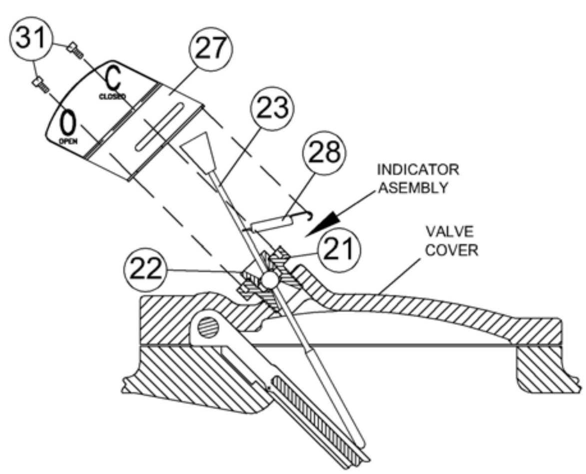


FIG. 4. MECHANICAL INDICATOR ASSEMBLY

Mechanical Indicator Parts List

Item	Description	Material
21	Body	Brass
22	Bushing	Brass
23	Rod	Stainless Steel T410
27	Plate	Stainless Steel T316
28	Spring	Stainless Steel T302
31	Screws	Stainless Steel T316

LIMIT SWITCH (OPTIONAL)

The limit switch is used in conjunction with the Mechanical Indicator. The standard limit switch is MICROSWITCH Model Number 914CE20-3. The limit switch is SCADA (Supervisory Control and Data Acquisition) compatible for applications requiring open/close indication.

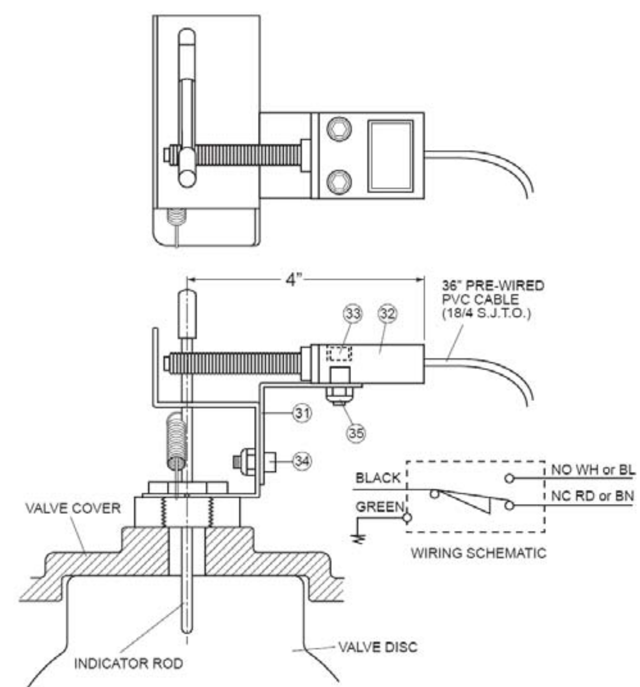
NEMA Ratings: 1, 2, 4, 6, 6P, 12, 13
UL Ratings: 5 AMPS, 1/10 HP, 125 or 250 VAC, SPDT

Installation:

1. Attach limit switch assembly to indicator using the supplied screws (34) and bracket (32).

2. Position the assembly so that the switch trips when the valve is closed.

3. Connect wiring to either the normally open or normally closed contact as shown in the schematic diagram.



BILL OF MATERIAL		
PART NO.	DESCRIPTION	QTY.
31	MOUNTING BRACKET	1
32	LIMIT SWITCH (SPDT) HONEYWELL 914CE20-3 ALLEN BRADLEY 802B-CSACXSXCE	1
33	SCREW	2
34	SCREW	2
35	NUT	4

FIGURE 5. LIMIT SWITCH ASSEMBLY

BOTTOM MOUNTED OIL DASHPOT FIELD INSTALLATION AND MAINTENANCE (OPTIONAL)

DASHPOT FIELD INSTALLATION: The bottom dashpot is supplied as an optional assembly from the factory. This unit provides control of the disc's final 10% travel to the closed position to reduce valve slam and water hammer. The 10% travel time is adjustable between 1 and 5 seconds.

1. Depressurize and drain the valve and pipeline.

WARNING
Removal of the bottom plug in the valve while under pressure may cause bodily harm.

2. Score the coating around and remove the pipe plug in the bottom boss of the valve. Apply Teflon thread sealant or tape to brass threads on the dashpot.

3. Insert the threaded end of the assembly into the valve boss. Slowly turn the assembly into the boss taking care not to cross-thread the bushing. Continue turning the assembly into the valve for a tight fit and so that the tank is upright.

4. Adjust the air pressure in the tank to be a minimum of 50 psi over the line pressure. Set the flow control valve in the mid position (i.e. 1 turn open). The dashpot rod should be extended and hold the disc open about 1 inch. The water line pressure will close the disc.

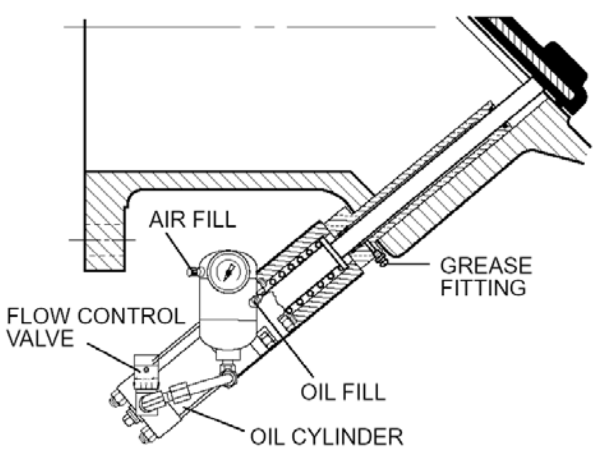


FIGURE 6. BOTTOM MOUNTED OIL DASHPOT

CHECKING OIL AND GREASE LEVELS:
1. The check valve should be closed.

2. The air in the oil reservoir must be bled from the reservoir, using the air fill valve mounted on the reservoir.

3. Remove the pipe plug from the oil reservoir fill port.

4. Add hydraulic fluid equal to Mobil #DTE 24 until fluid is up to level indicated on the reservoir. Replace pipe plug.

5. Recharge the reservoir with air pressure to a minimum of 10 psi over the water line pressure.

6. The grease level can not be checked but it is recommended that the grease fitting be charged with grease twice a year. Use a cartridge grease gun and pump grease into the fitting using two full strokes. An FDA approved grease such as Lubriko #CW-606 should be used (Master Lubricants Company, Philadelphia, PA)

DASHPOT SEAL REPLACEMENT: There are several seals in the unit that may require replacement.

1. Depressurize and drain the valve and pipeline.

2. Unscrew the dashpot from the valve and remove the 4 bolts holding the dashpot spacer.

3. Replace the (2) rod wipers and o-ring seal.

4. If the oil cylinder is leaking oil, tighten the tie rod nuts. The cylinder should be returned to the factory for rebuilding.

5. Reinstall the unit as listed above for a new unit.

PARTS AND SERVICE

Parts and service are available from your local representative or the factory. Make note of the valve Model No and Working Pressure located on the valve nameplate and contact:

Val-Matic Valve and Mfg. Corp.
905 Riverside Drive
Elmhurst, IL 60126
Phone: (630) 941-7600
Fax: (630) 941-8042
www.valmatic.com

A sales representative will quote prices for parts or arrange for service as needed.

LIMITED WARRANTY

All products are warranted to be free of defects in material and workmanship for a period of one year from the date of
shipment, subject to the limitations below.

If the purchaser believes a product is defective, the purchaser shall: (a) Notify the manufacturer, state the alleged defect and request permission to return the product; (b) if permission is given, return the product with transportation prepaid. If the product is accepted for return and found to be defective, the manufacturer will, at his discretion, either repair or replace the product, f.o.b. factory, within 60 days of receipt, or refund the purchase price. Other than to repair, replace or refund as described above, purchaser agrees that manufacturer shall not be liable for any loss, costs, expenses or damages of any kind arising out of the product, its use, installation or replacement, labeling, instructions, information or technical data of any kind, description of product use, sample or model, warnings or lack of any of the foregoing. NO OTHER WARRANTIES, WRITTEN OR ORAL, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY, ARE MADE OR AUTHORIZED. NO AFFIRMATION OF FACT, PROMISE, DESCRIPTION OF PRODUCT OF USE OR SAMPLE OR MODEL SHALL CREATE ANY WARRANTY FROM MANUFACTURER, UNLESS SIGNED BY THE PRESIDENT OF THE MANUFACTURER. These products are not manufactured, sold or intended for personal, family or household purposes.

Bulletin 5000

VAL-MATIC®

Proven Design

Preferred Features

Advanced Technology

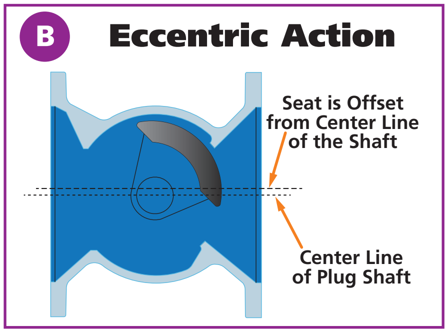
The Eccentric CAM-CENTRIC® Plug Valve

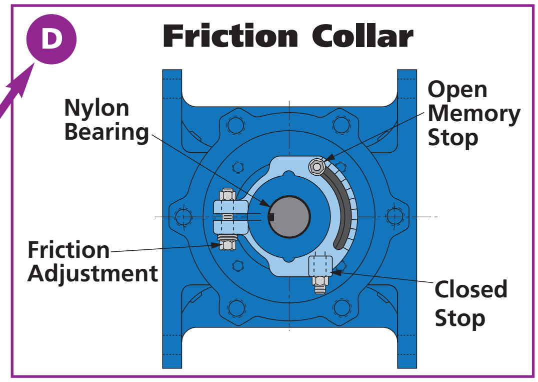
Cam-Centric® Plug Valves

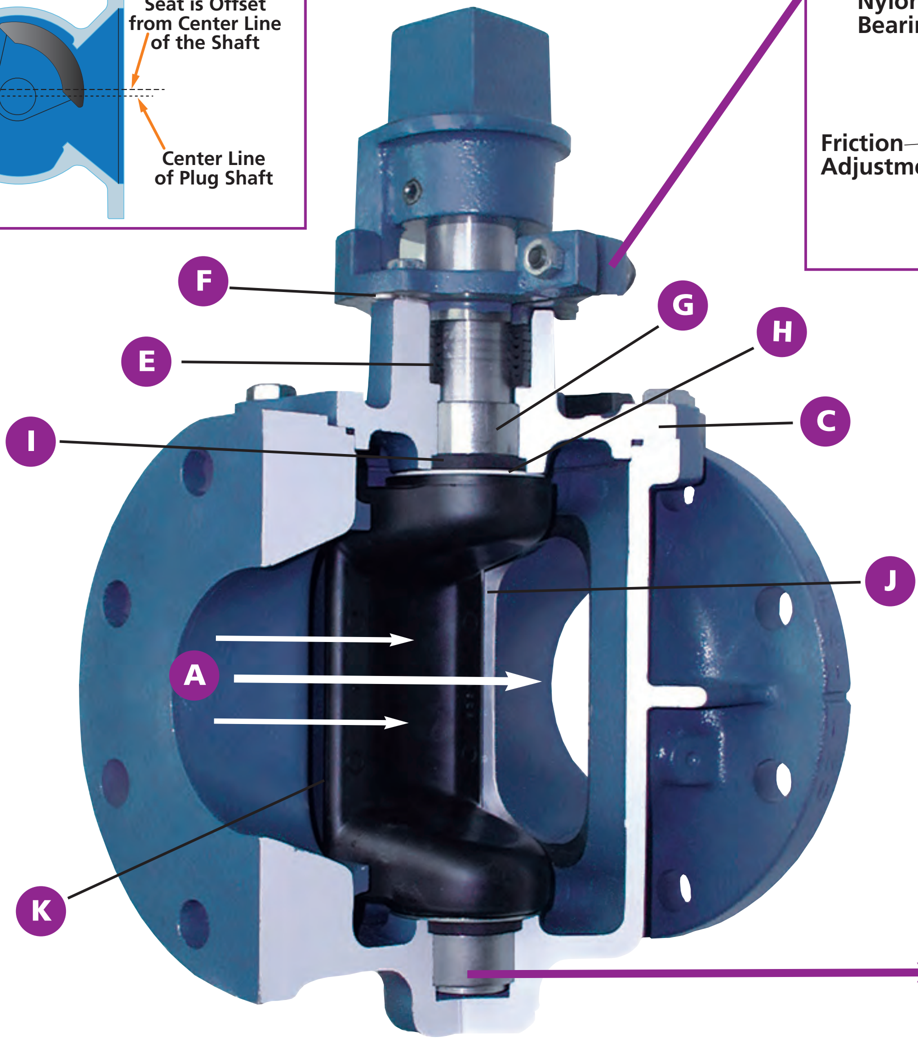
www.valmatic.com

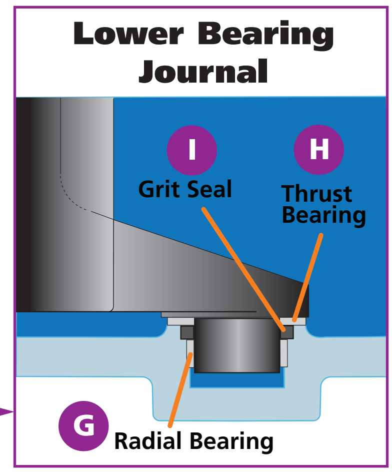
Meets AWWA C517
NSF/ANSI 372 Certified

Feature Highlights









A. Non-Clog Design

The unrestricted flow area combined with smooth streamline contouring allows passage of large solids to prevent potential clogging and provide low headloss.

B. Eccentric Action

Provides positive shut off with wear resistant action and low torque.

C. Full Top Access Cover

Provides accessibility for inspection without removal of the valve from the line.

D. Friction Collar with Memory Stop

Secures valve plug in any position and includes a nylon bearing for ease of operation.

E. V-Type Packing

Field adjustable and replaceable without removal of worm gear or motor actuators.

F. Removable POP™ Shims

Packing Overload Protection Shims protect packing by preventing overload during field adjustment.

G. Radial Bearings

Heavy Duty, T316 Stainless Steel, Permanently Lubricated.

H. Thrust Bearing

Upper: PTFE - Provides ease of actuation during operating conditions.
Lower: Stainless Steel - Prevents wear to plug and Grit-Guard.

I. Grit-Guard™ Shaft Seal

The *Val-Matic Exclusive* Grit-Guard™ shaft seal extends packing and bearing life by minimizing contact with abrasive line media.

J. Seat

Welded overlay of 95% pure nickel applied directly to the body using a state-of-the-art robotic welding system for a consistent, high quality weld. Machined and ground to a smooth finish.

K. Plug

Fully rubber encapsulated molded plug eliminates exposed surfaces preventing corrosion and delamination.

Proven Design

With installations worldwide, the Val-Matic Cam-Centric® Plug Valve has proven itself as the preferred valve for wastewater, industrial waste and process applications. The Cam-Centric® Plug Valve is a ¼ turn eccentric plug valve allowing cost effective, low torque actuation for pump control, shut-off and throttling service. The valve's eccentric action rotates the plug in and out of the seated position with minimal contact, thereby preventing high torque and wear to the valve seat and plug. The combination of the eccentric action, stainless steel bearings, Grit-Guard™ seals and heavy duty nickel seat assures long life with minimal maintenance.

Preferred Features

The Cam-Centric® Plug Valve features a shaft sealing system that utilizes V-Type packing, a packing follower and a Grit-Guard™ seal for ease of maintenance and to reduce wear. The Grit-Guard™ seals reduce wear by preventing grit and media from reaching the bearings and packing to prevent plug lock up. The seals are standard in both the upper and lower journals (Figures 1 & 2). To prevent the packing from being over tightened, the shaft seal incorporates POP™ (Packing Overload Protection) Shims. The packing is easily adjusted by removing the POP™ shims as necessary utilizing the pull tab feature (Figure 1). Adjustment or replacement of the V-Type packing can be done without removal of the gear, motor or cylinder actuator.

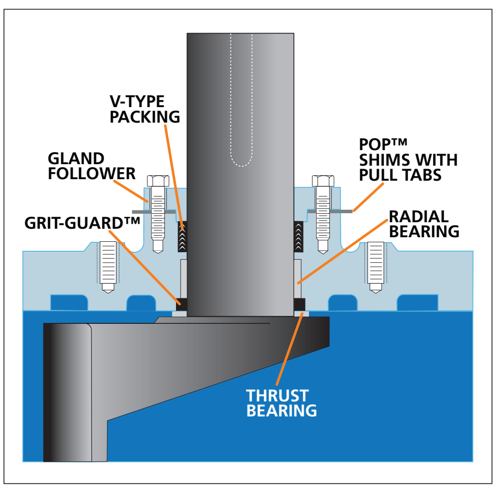


Figure 1. Upper Bearing Journal

The Cam-Centric® bearing package consists of permanently lubricated, T316 stainless steel radial bearings in both the upper and lower journals. The upper thrust bearing is made of Teflon and the lower thrust bearing is T316 stainless steel. The bearings are protected from grit related wear by the Grit-Guard™ seals (Figures 1 & 2).

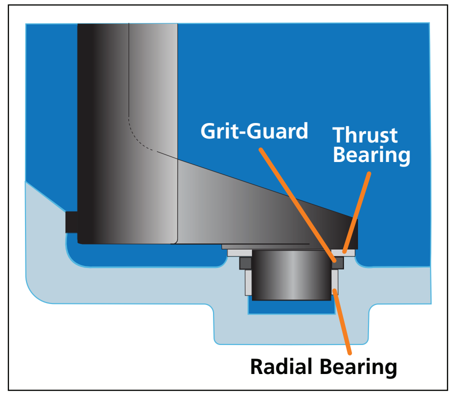


Figure 2. Lower Bearing Journal

The Cam-Centric® Plug Valve utilizes a totally encapsulated molded plug to protect exposure to corrosion and delamination in severe abrasive applications.

Figure 3. Robotic welding of nickel seat

The valve seat is a welded overlay of 95% pure nickel applied directly to the body on a machined surface using a state-of-the-art robotic welding system for a consistent, high quality weld (Figure 3).

Advanced Technology

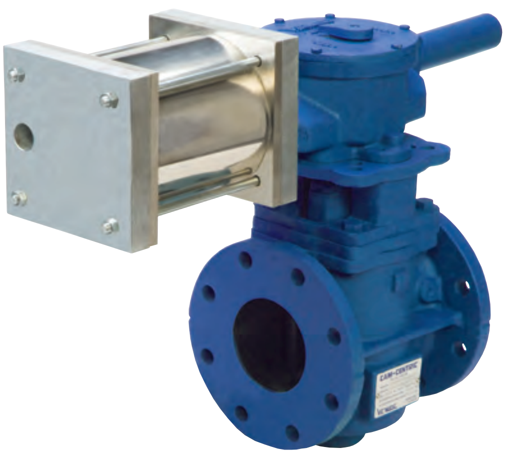
Incorporating the latest in valve technology assures a high-quality valve that will provide long service. The design process utilized solid Modeling and Finite Element Analysis (FEA) of the key structural components. Flow and torque data was derived from flow tests, mathematical models and Computational Fluid Dynamics (CFD). Manufacturing technology uses automated process control in the foundry and ISO 9001 controlled manufacturing processes. Every valve is tested in accordance with AWWA C517 and MSS SP-108 on automated hydraulic test rigs with gauges calibrated per ISO standards.

Actuation

The Cam-Centric® Plug Valve is available with a wide range of actuation options, from simple lever operation to advanced pump control systems. Options include 2" operator nuts, worm gears, chainwheels, electric motor and cylinder actuation. A wide variety of accessories such as floor stands and extended bonnets are also available (see accessories on page 7). Val-Matic Engineering personnel work closely with cylinder and electric actuation manufacturers to assure actuator/valve compatibility. This assures the actuator you specify will deliver the performance you expect when utilized with a Cam-Centric® Plug Valve.

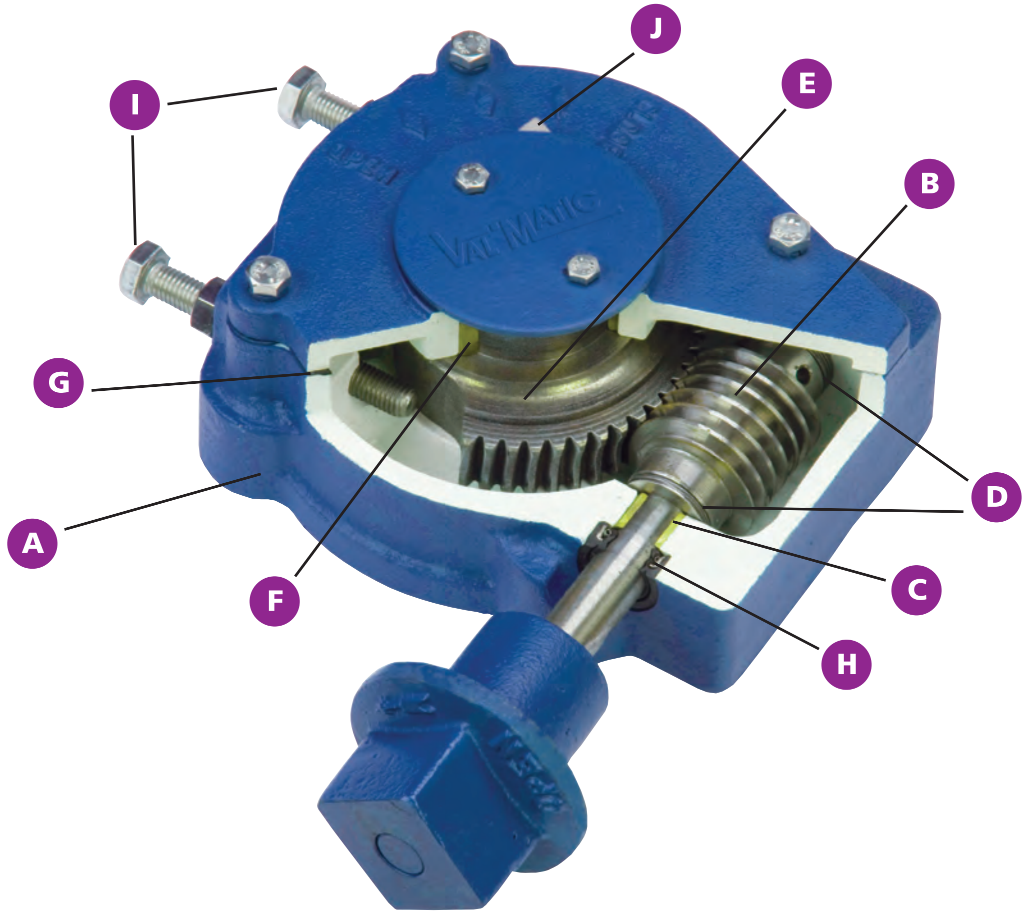
Direct Nut operated valve with memory stop:
- Adjustable open memory stop for system balancing
- Adjustable close stop
- Adjustable friction collar
- For use with lever accessories

Val-Matic Worm Gears:
- Heavy Duty, totally enclosed and sealed
- For above ground and buried service applications
- Bronze radial bearings and roller thrust bearings provide smooth operations and extended life



Val-Matic Cylinder Actuation:
- Compliance with AWWA C541 for Power Actuation
- Pneumatic/Hydraulic
- Single Acting or Double Acting
- Fail Open/Closed for power failure
- Modulating Service
- Throttling Service
- Limit Switches, Solenoid Valves, Positioners
- Manual Overrides
- Pump Control

Electric Actuation:
- 110 Single Phase, 230/460 Three Phase
- Compliance with AWWA C542 for Power Actuation
- Modulating Service
- Throttling Service
- Remote push button control and indication
- Torque Switches, Limit Switches
- De-clutchable handwheels
- Available from a wide variety of manufacturers



Val-Matic Worm Gear

A valve actuator must perform to the same level as the valve. The Val-Matic worm gear is designed and built to provide the same long term service as our Cam-Centric® Plug Valve. The exclusive bearing package in the worm gear includes four bronze sleeve bearings and two roller thrust bearings. This exclusive package assures smooth operation and long life regardless of the valve's orientation or application. The ductile iron segment gear coupled with the upper and lower bronze radial bearings exceed the requirements of AWWA C517 for strength and durability. All worm gears are designed to exceed, a rim pull of 200 pounds on handwheels and input torques of 300 foot pounds for operator nuts without damage. Buried service worm gears are grease packed, sealed and include stainless steel shafts. Worm gears can be provided with handwheels, chainwheels or 2" operator nuts.

A. Housing

Heavy duty, totally enclosed and sealed.

B. Worm

Hardened steel for durability and long life.

C. Radial Shaft Bearings

Bronze shaft bearings extend life and provide ease of operation (rear shaft bearing not visible).

D. Roller Thrust Bearings

Provides smooth operation and extends life.

E. Segment Gear

Heavy duty ductile iron for high strength. Provided with precision bore and keyway for connection to the valve shaft in multiple positions.

F. Segment Gear Radial Bearings

Upper and lower bronze bearings provide ease of operation and extend life (lower bearing not visible).

G. Cover Gasket

Seals housing and prevents foreign material from entering actuator and prevents loss of grease.

H. Shaft Seal

Prevents foreign material from entering the actuator.

I. External Stops

Both open and closed stops are external and easily adjustable.

J. Position Indicator

Displays precise plug position on above ground service.

PRESSURE RATINGS

MAXIMUM PRESSURE RATINGS			
SERIES	CONNECTION	SIZE RANGE	CWP (psig)
5400	ANSI Class 125 Flanged 4-Way	4″- 12″	175
5500	ANSI Class 125 Flanged 3-Way	4″- 12″	175
5600R	ANSI Class 125 Flanged 100% Port	4″- 10″	175
		12″- 48″	150
5700R	AWWA C111 Mechanical Joint 100% Port	4″- 10″	175
		12″- 48″	150
5800RTL	ASME NPT Threaded	1/2″- 2″	175
5800R	ANSI Class 125 Flanged	2″- 12″	175
		14″- 54″	150
5800HP	ANSI Class 125 Flanged High Pressure	3″- 24″	250
5900R	AWWA C111 Mechanical Joint	3″- 12″	175
		14″- 54″	150
5900HP	AWWA C111 Mechanical Joint High Pressure	3″- 48″	250

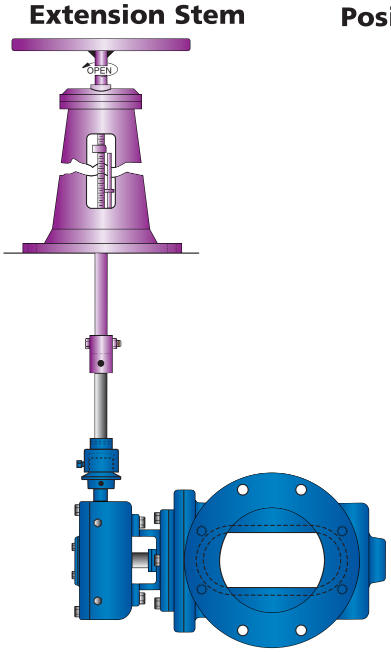
MATERIALS OF CONSTRUCTION

COMPONENT	STANDARD
Body (5600R, 5700R, 5800R, 5900R)	Cast Iron ASTM A126, Class B
Body (5400, 5500, 5800HP, 5900HP)	Ductile Iron ASTM A536, Grade 65-45-12
Plug (5600R, 5700R, 5800R, 5900R)	Cast Iron ASTM A126, Class B, Buna-N Encapsulated, ASTM D2000
Plug (5400, 5500, 5800HP, 5900HP)	Ductile Iron ASTM A536, Grade 65-45-12, Buna-N Encapsulated, ASTM D2000
Radial Shaft Bearings	T316 Stainless Steel
Top Thrust Bearing	Teflon
Bottom Thrust Bearing	T316 Stainless Steel
Available Coatings	Two-Part Epoxy, Fusion Bonded Epoxy, Glass Lining, Rubber Lining

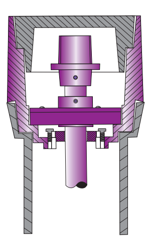
Accessories

Space limitations and application specifics often require special accessories. In addition to those shown below, Val-Matic offers a wide range of accessories to meet your application requirements.

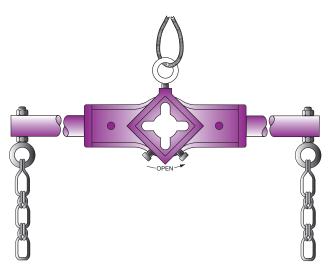
Floor Stand with Extension Stem



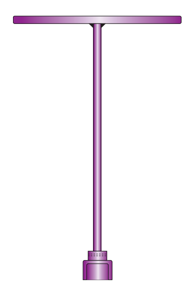
Ground Level Position Indicator



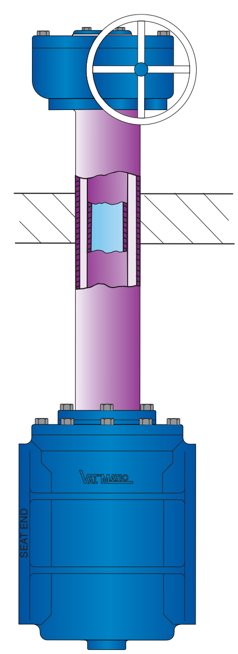
Chainlever

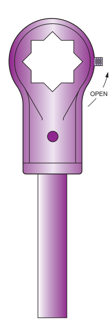


"T" Wrench

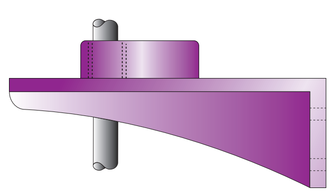


Extended Bonnet

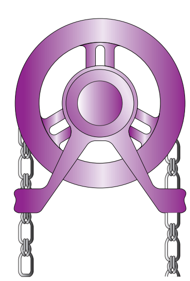




Lever

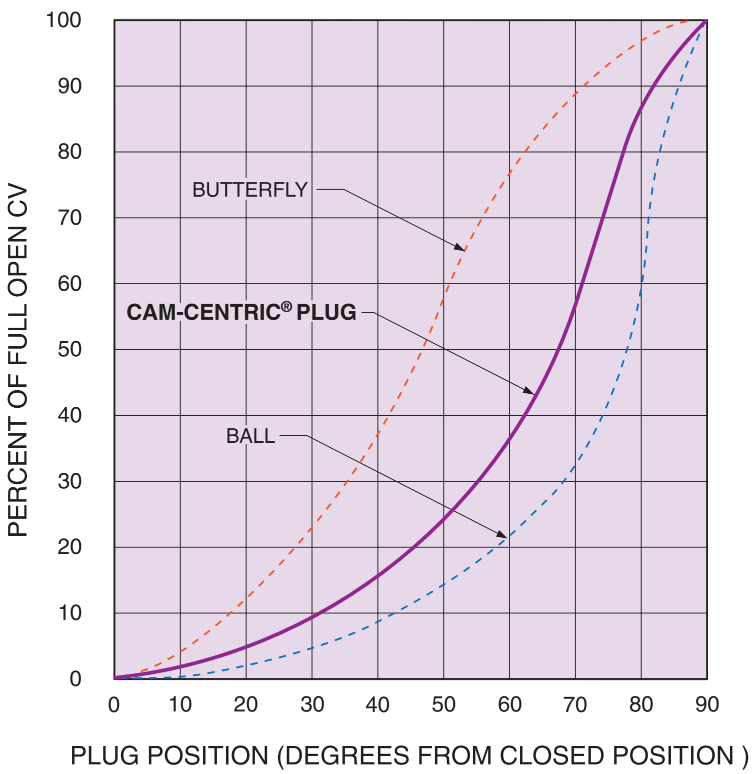


Stem Guide



Chainwheel

Flow Characteristics



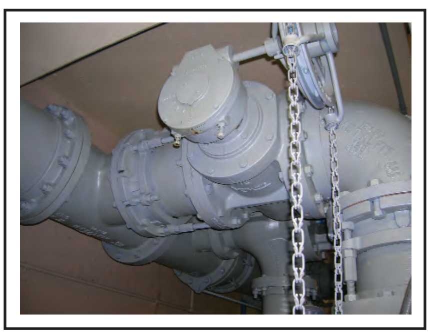
INHERENT PUMP CONTROL FLOW CHARACTERISTICS

To control pressure surges and provide good-controllability, the flow characteristics of valves should be considered.

The graph at left shows the inherent flow characteristics at a constant ΔP for various valves.

The Plug Valve has an inherent flow characteristic similar to a ball valve. When installed in a pipeline, the plug valve will approximate a linear flow characteristic because the piping system pressure losses will shift the flow curve to the left. A linear installed flow characteristic will help control surges and provide a wide range of controllability.

Installations



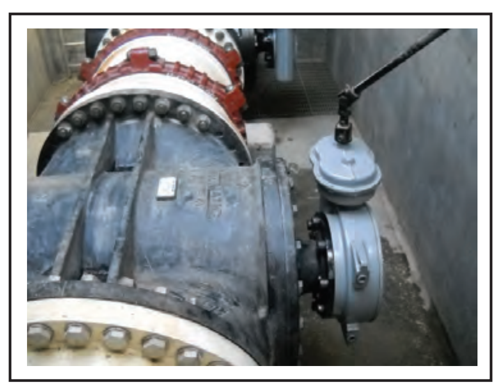
Cam-Centric® Plug Valve with worm gear actuator and chainwheel

Cam-Centric® Plug Valve with Val-Matic Swing-Flex®

3-Way Cam-Centric® Plug Valves with worm gear actuators

Cam-Centric® Plug Valve with motor actuator

Cam-Centric® Plug Valve with worm gear actuator



Cam-Centric® Plug Valve with worm gear actuator and extension stem

2-Way Specification

SCOPE

1.1 This specification covers the design, manufacture, and testing of 1/2 in. (15 mm) through 3 in. (80 mm) Threaded Eccentric Plug Valve, 2 ½ in. (60 mm) through 60 in. (1500 mm) Eccentric Plug Valve, and 4 in. (100 mm) through 60 in. (1500 mm) 100% Port Eccentric Plug Valve suitable for water or wastewater service with pressures up to 250 psig (1725 kPa).

1.2 Plug Valves shall be quarter-turn, non-lubricated with resilient encapsulated plug.

STANDARDS AND APPROVALS

2.1 2 ½ in. (60 mm) through 60 in. (1500 mm) plug valves shall be designed, manufactured and tested in accordance with American Water Works Association Standard ANSI/AWWA C517.

2.2 All Plug Valves shall be certified Lead-Free in accordance with NSF/ANSI 372.

2.3 Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

CONNECTIONS

3.1 Threaded valves shall have threaded NPT full size inlets. The connection shall be hexagonal for a wrench connection.

3.2 Flanged valves shall have flanges with drilling to ANSIB16.1, Class 125.

3.3 Mechanical Joint valves shall fully comply with ANSI/AWWA C111/A21.11.

DESIGN

4.1 Threaded and all other valves under 4” (100mm) shall have port areas of not less than 100% of pipe area. Port areas on other sizes are 85% on 16” (400 mm) and smaller, 80% on 18”-24” (150 mm- 600 mm), and 75% on 30” (800 mm) and larger.

4.2 Threaded valve seat shall be a machined seating surface.

4.3 2 ½ in. (60 mm) through 60 in. (1500 mm) plug valves shall have a valve seat that is a welded overlay of 95% pure nickel applied directly to the body on a pre-machined, cast seating surface and machined to a smooth finish.

4.4 Threaded valves shall have shaft seals which consist of V-type lip seal in a fixed gland with a resilient O-ring spring.

4.5 2 ½ in. (60 mm) through 60 in. (1500 mm) plug valves shall have shaft seals which consist of V-type packing in a fixed gland with an adjustable follower designed to prevent over compression of the packing and to meet design parameter of the packing manufacturer. Removable POP™ shims shall be provided under the follower flanges to provide for adjustment and prevent over tightening.

4.6 Permanently lubricated, radial shaft bearings shall be supplied in the upper and lower bearing journals. Thrust bearings shall be provided in the upper and lower journal areas, except for threaded type which only have upper thrust bearings.

4.7 Both the packing and bearings in the upper and lower journals shall be protected by a Grit-Guard™ “drip tight” Buna-N shaft seal located on the valve shaft to minimize the entrance of grit into the bearing journal and shaft seal areas.

4.8 The threaded valve body shall have 1/8” NPT upstream and downsteam pressure ports.

MATERIALS

5.1 Valve bodies and covers shall be constructed of ASTM A126 Class B cast iron for working pressures up to 175 psig (1200 kPa) and ASTM A536 Grade 65-45-12 for working pressures up to 250 psig (1725 kPa). The words “SEAT END” shall be cast on the exterior of the body seat end.

5.2 Threaded valve plugs in sizes 1/2 in. (15 mm) through 3 in. (80 mm) shall be of one-piece construction and made of ASTM A126 Class B cast iron fully encapsulated with a resilient facing per ASTM D2000-BG and ANSI/AWWA C517 requirements.

5.3 2 ½ in. (60 mm) through 60 in. (1500 mm) plugs shall be of one-piece construction and made of ASTM A126 Class B cast iron or ASTM A536 Grade 65-45-12 ductile iron and fully encapsulated with resilient facing per ASTM D2000-BG and ANSI/AWWA C517 requirements.

5.4 Threaded valves shall have radial shaft bearings constructed of self-lubricating Type 316 stainless steel. The top thrust bearing shall be Teflon.

5.5 2 ½ in. (60 mm) through 60 in. (1500 mm) plug valves shall have radial shaft bearings constructed of self-lubricating Type 316 stainless steel. The top thrust bearing shall be Teflon. The bottom thrust bearing shall be self-lubricating Type 316 stainless steel. Cover bolts shall be corrosion resistant with zinc plating.

ACTUATION

6.1 Threaded valves shall be equipped with a hand lever with a dial indicator and open memory stop.

6.2 Valves 2 ½ in. (60 mm) to 8 in. (200 mm) and 4 in. (100mm) to 6 in. (150 mm) 100% ported shall be equipped with a 2 inch square nut for direct quarter turn operation. The packing gland shall include a friction collar and an open position memory stop. The friction collar shall include a nylon sleeve to provide friction without exerting pressure on the valve packing.

6.3 When specified valves 4 in. (100 mm) and larger shall include a totally enclosed and sealed worm gear actuator with position indicator (above ground service only) and externally adjustable open and closed stops. The worm segment gear shall be ASTM A536 Grade 65-45-12 ductile iron with a precision bore and keyway for connection to the valve shaft. Bronze radial bearings shall be provided for the segment gear and worm shaft. Alloy steel roller thrust bearings shall be provided for the hardened worm.

6.4 All gear actuators shall be designed to withstand, without damage, a rim pull of 200 lb. on the hand wheel and an input torque or 300 ft-lbs. for nuts.

6.5 Buried service actuators shall be packed with grease and sealed for temporary submergence to 20 feet of water. Exposed worm shafts shall be stainless steel.

OPTIONS

7.1 When specified, the valve port area shall have not less than 100% of pipe area.

7.2 The interior and exterior of the valve shall be coated with an NSF/ANSI 61 approved fusion bonded epoxy.

7.3 The interior of the valve shall be coated with 8 mils SG-14 glass lining or 1/8” soft rubber lining.

MANUFACTURE

8.1 Manufacturer shall demonstrate a minimum of ten (10) years’ experience in the manufacture of plug valves. When requested, the manufacturer shall provide test certificates, dimensional drawings, parts list drawings and operation and maintenance manuals.

8.2 The exterior of the valve for above ground service shall be coated with a universal alkyd primer. Valve exterior for buried service shall be coated with an epoxy coating.

8.3 Valve shall be marked with the Serial Number, Manufacturer, Size, Cold Working Pressure (CWP) and the Direct and Reverse Actuator Pressure Ratings on a corrosion resistant nameplate.

8.4 Plug Valves shall be Series # 5600R (100% Port Flanged), 5700R (100% Port Mechanical Joint), 5800RTL (Threaded), 5800R (Flanged), 5800HP (Flanged), 5900R (Mechanical Joint) or 5900HP (Mechanical Joint) as manufactured by Val-Matic Valve and Mfg. Corporation, Elmhurst, IL. USA or approved equal.

VAL-MATIC®

Val-Matic's quality of design and meticulous workmanship has set the standards by which all others are measured. Quality design features such as the AWWA **Ener•G® Ball Valve** with its energy efficient design, fusion bonded epoxy and adjustable resilient seating....**Cam-Centric® Plug Valves** have more requested features than any other eccentric plug valve....**American-BFV® Butterfly Valves** include a field replaceable seat without the need for special tools....**Tilted Disc® Check Valves** with high strength and wear resistant aluminum bronze trim as standard....**Silent Check Valves** featuring combined resilient/metal-to-metal seating and are **NSF/ANSI 61 & 372 Certified**....**Sure Seal Foot Valves** provided with a heavy duty stainless steel screened inlet....**Swing-Flex® and Surgebuster® Check Valves** designed with an unrestricted full flow area....**Swing Check Valves** with field adjustable closure versatility....**Dual Disc® Check Valves** utilizing stabilized components to provide extended life....**Air Release, Air/Vacuum and Combination Air Valves** provided standard with Type 316 stainless steel trim....**VaultSafe®** family of products includes the **FloodSafe® Inflow Preventer**, **FrostSafe®** two-way damper and the **VentSafe®** vent pipe security cage. These features coupled with our attention to detail put Val-Matic Valves in a class by themselves. All products are WQA certified Lead-Free in accordance with NSF/ANSI 372.

Val-Matic is totally committed to providing the highest quality valves and outstanding service to our customers. Complete customer satisfaction is our goal.

Make the Change to Quality!

Specify VAL-MATIC®

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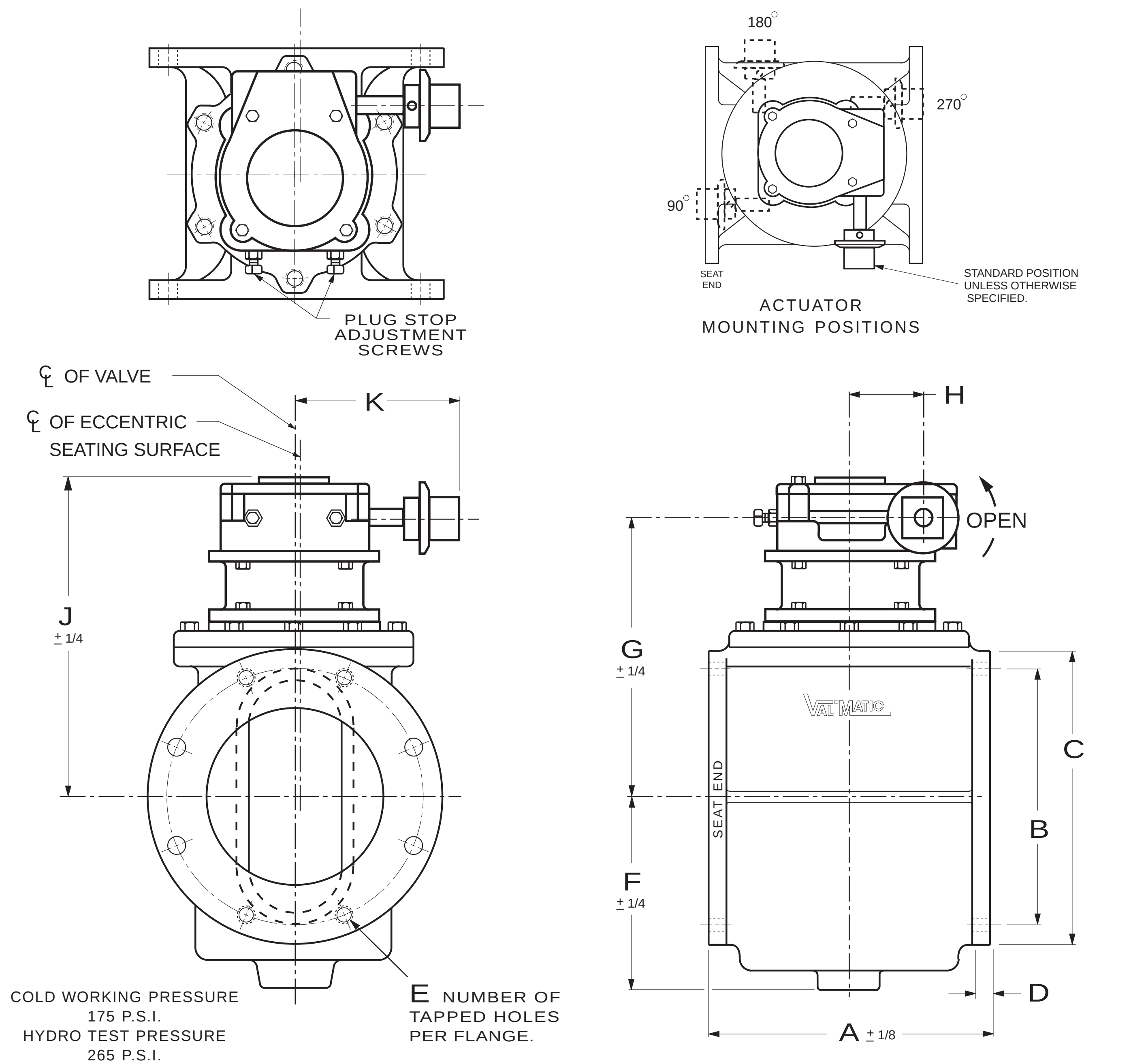
valves@valmatic.com



SEE DRAWING NO. VM-5804RN-M FOR STANDARD MATERIAL OF CONSTRUCTION.

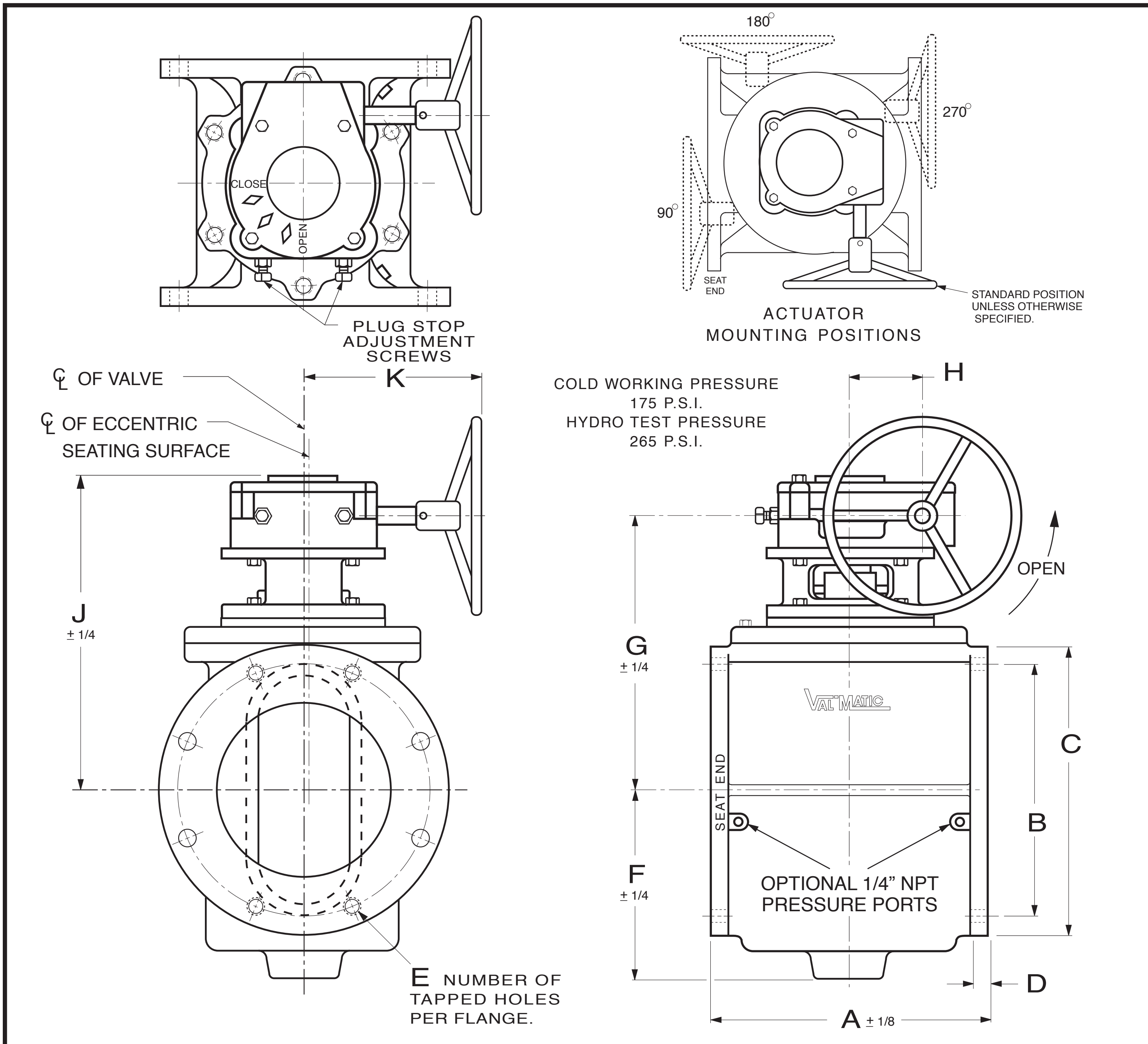
VALVE SIZE	MODEL NO.	RATING, P.S.I. REV	RATING, P.S.I. DIR	A	B	C	D	E QTY	E TAP	E DEEP	F	G	H	J	K	NO. OF TURNS	BOLT SIZE	NO. OF BOLTS
3	5803R/8A02	175	175	8.00	6.00	7.50	0.75	2	5/8-11	0.75	4.50	7.78	4.75	9.66	9.00	12.5	5/8	4
4	5804R/8A02	175	175	9.00	7.50	9.00	0.75	0	—	—	5.56	9.31	4.75	11.19	9.00	12.5	5/8	8
6	5806R/8A02	175	175	10.50	9.50	11.00	0.75	4	3/4-10	1.25	7.06	11.06	4.75	12.94	9.00	12.5	3/4	8
8	5808R/8A02	175	175	11.50	11.75	13.50	0.88	4	3/4-10	1.25	8.75	12.62	4.75	14.50	9.00	12.5	3/4	8
10	5810R/8C02	100	175	13.00	14.25	16.00	1.00	4	7/8-9	1.25	10.44	16.25	4.75	19.00	7.88	20	7/8	12
	5810R/8D02	175	175															
12	5812R/8C02	100	175	14.00	17.00	19.00	1.25	4	7/8-9	1.25	12.25	17.68	4.75	20.44	7.88	20	7/8	12
	5812R/8D02	175	175															

ANSI CLASS 125 CAM-CENTRIC® FLANGED PLUG VALVE WITH BURIED WORM GEAR ACTUATOR

DATE Revised 5-17-10
5-15-97

VAL-MATIC® **VALVE AND MANUFACTURING CORP.**

DRWG. NO.
VM-5804R/BWGA



SEE DRAWING NO. VM-5804RN-M FOR STANDARD MATERIALS OF CONSTRUCTION.

VALVE SIZE	MODEL NO.	PRESS. RATING P.S.I. REVERSE	PRESS. RATING P.S.I. DIRECT	A	B	C	D	E (Qty.)	E (Tap)	E (Deep)	F	G	H	J	K	BOLT SIZE	NO. OF BOLTS	NO. OF TURNS
2 1/2	5825R/7A08	175	175	7.50	5.50	7.00	0.69	4	5/8-11	0.69	4.50	7.50	3.06	10.00	9.50	5/8	4	12.5
3	5803R/7A08	175	175	8.00	6.00	7.50	0.75	4	5/8-11	1.00	4.50	7.50	3.06	10.00	9.50	5/8	4	12.5
4	5804R/7A08	175	175	9.00	7.50	9.00	0.75	0	—	—	5.56	9.31	3.06	11.18	9.50	5/8	8	12.5
6	5806R/7A08	175	175	10.50	9.50	11.00	0.75	4	3/4-10	1.25	7.06	11.06	3.06	12.94	9.50	3/4	8	12.5
8	5808R/7A12	100	175	11.50	11.75	13.50	0.88	4	3/4-10	1.25	8.75	12.62	3.06	14.50	11.50	3/4	8	12.5
	5808R/7B16	175	175												9.38			
10	5810R/7C12	100	175	13.00	14.25	16.00	1.00	4	7/8-9	1.25	10.44	16.25	4.75	19.00	13.13	7/8	12	20
	5810R/7D16	175	175												11.00			
12	5812R/7C16	100	175	14.00	17.00	19.00	1.25	4	7/8-9	1.25	12.50	17.69	4.75	20.44	11.00	7/8	12	20
	5812R/7D24	175	175												16.75			

ANSI CLASS 125 FLANGED CAM-CENTRIC® PLUG VALVE WITH WORM GEAR ACTUATOR

DATE Revised 7-6-12
3-21-96

VAL-MATIC® VALVE AND MANUFACTURING CORP.

DRWG. NO.
VM-5804R/WGA

Manual No.
CCPV-OM2-3

Val-Matic®
Cam-Centric® Plug Valve

Operation, Maintenance and Installation Manual

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VAL-MATIC'S CAM-CENTRIC PLUG VALVE OPERATION, MAINTENANCE AND INSTALLATION

INTRODUCTION

The Cam-Centric® Plug Valve has been designed to give years of trouble-free operation. This manual will provide you with the information to properly install and maintain the valve to ensure a long service life. The valve is an eccentric, resilient seated, quarter-turn plug valve capable of handling many types of fluids including fluids with suspended solids. The Size, Cold Working Pressure (CWP), Actuator Rating, and Model No. are stamped on the nameplate for reference.

CAUTION: Do not use valve for line testing at pressures higher than nameplate rating or leakage and damage to valve may occur.

The "Cold Working Pressure" is the non-shock pressure rating of the valve at 150°F. The valve is not intended as a block valve for line testing above the valve rating. The "Actuator Rating" is the pressure that was used to size the actuator for operating conditions and may be less than the "Cold Working Pressure". Because the valve is eccentric, the valve may have a different actuator rating for reverse and direct pressure. If the valve is operated at pressures higher than the actuator ratings, the valve may be difficult to operate or leak.

RECEIVING AND STORAGE

Inspect valves upon receipt for damage in shipment. Unload all valves carefully to the ground without dropping. Do not lift valves with slings or chains around the actuator or through the seat area.

Valves should remain crated, clean and dry until installed to prevent weather-related damage. For long term storage greater than six months, the valve must remain open and the rubber surfaces of the plug coated with a thin film of FDA approved grease such as Dow Corning # 7. Do not expose plug to sunlight or ozone for any extended period.

DESCRIPTION OF OPERATION

As shown in Figure 2, the valve consists of a body and quarter-turn plug that is offset from the seat centerline.

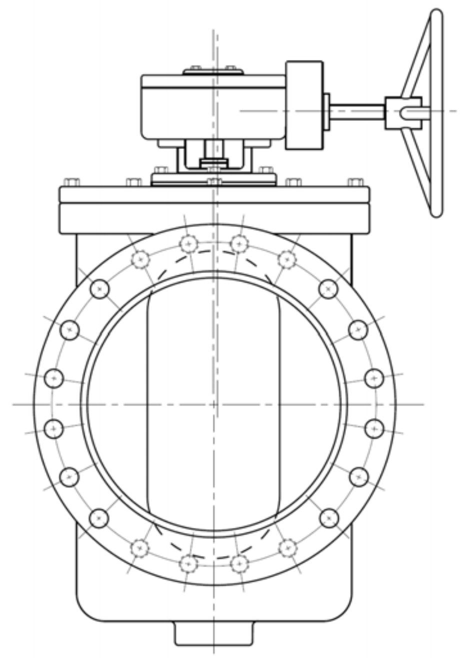


FIGURE 1. PLUG VALVE WITH GEAR ACTUATOR

The eccentric offset causes the plug to lift and rotate off the seat simultaneously to reduce seat friction and wear during operation. Direct Pressure pushes the plug into the seat and Reverse Pressure pushes the plug away from the seat. The valve can be operated with a direct nut, lever, or gear actuator. The gear actuator as shown in Figure 1 requires multi-turn input on a 2" square nut, handwheel, or chainwheel. The valve can also be automated with power actuators such as an electric motor or hydraulic cylinder.

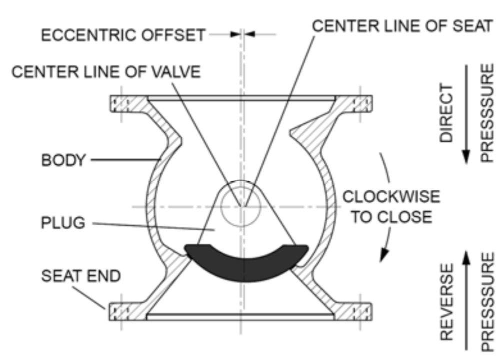


FIGURE 2. PLUG VALVE TERMS

VALVE CONSTRUCTION

The standard Cam-Centric® Plug Valve is constructed of rugged cast iron with a welded nickel seat and permanently lubricated bearings. See the specific Materials List submitted for the order if other than standard cast iron construction. The details of construction are illustrated in Figure 3.

The body (1) is available with flanged or mechanical joint ends for connection to the pipeline. The valve is designed to be serviced in-line by removing the cast cover (2). The quarter-turn plug (3) is guided by sleeve bearings (6) located in the cover and lower boss in the body. Grit-Guard seals (21) are located at the bottom of the bearings (6) to prevent abrasive material from wearing the bearing. Leak-tight closure is made when the rubber-coated plug (3) is rotated into the nickel seat on the "SEAT END" of the body.

ITEM	DESCRIPTION	MATERIAL
1	Body	Cast Iron with Overlay Welded Nickel Seat
2	Cover	Cast Iron
3	Plug*	Cast Iron with Resilient Facing
6	Bearings*	316 Stainless Steel
7	V-Type Packing*	Buna-N
8	Cover Seal*	Buna-N
15	Cover Bolt	Alloy Steel, Gr 5
18	Packing Follower	Cast Iron
19	Follower Bolt	Alloy Steel, Gr. 5
21	Grit-Guard*	Buna-N
22	Thrust Bearing*	Teflon
23	Thrust Bearing*	316 Stainless Steel
24	Key	Carbon Steel
29	Shims	304 Stainless Steel

*RECOMMENDED SPARE PART

TABLE 1. STANDARD PLUG VALVE PARTS LIST

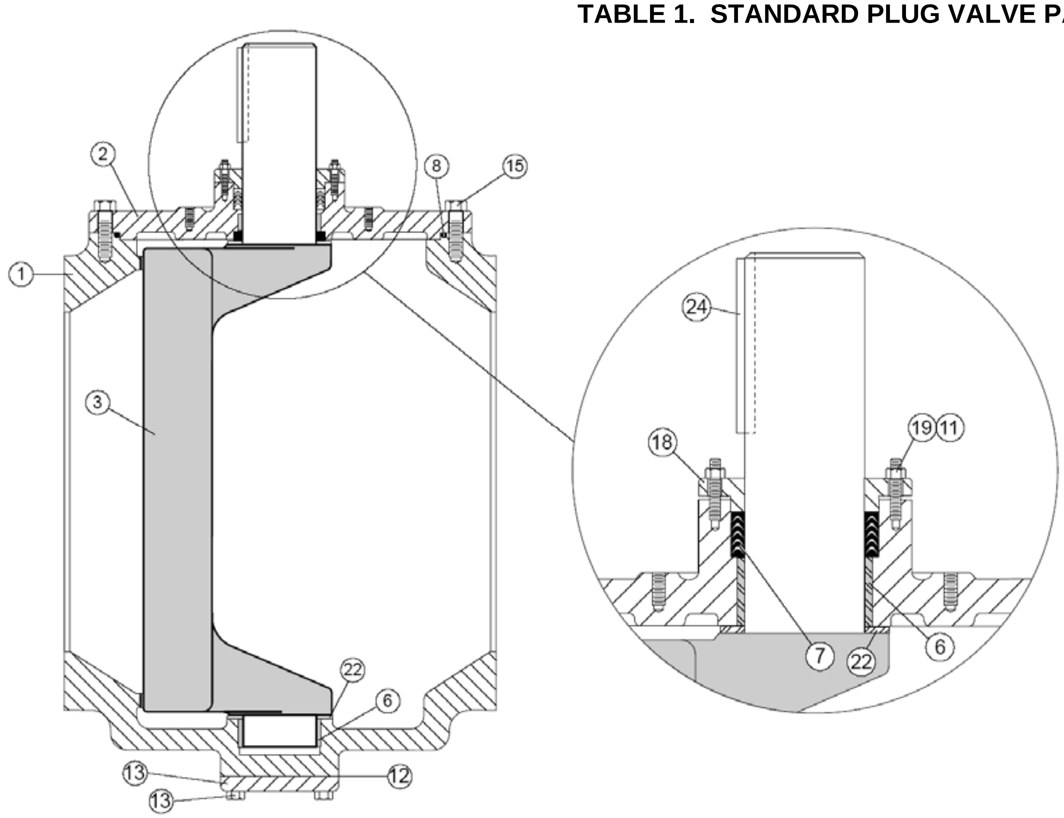


FIGURE 3. STANDARD PLUG VALVE CONSTRUCTION

INSTALLATION

The installation of the valve is important for its proper operation. The valve is capable of flow in either direction but the maximum operating pressure can vary with the location of the seat end. The words "SEAT END" are marked on the valve flange. Actuators are available for pressures up to the full rating in both direct and reverse pressure orientations. Actuator ratings will be indicated on the nameplate. Higher operating pressures may require adjustment of the closed position stop or a larger actuator; consult the factory.

SUSPENDED SOLIDS SERVICE: For fluids containing suspended solids, special orientations are needed to prevent debris from collecting in the valve. For horizontal installations (Figure 4), the valve should be installed with the flow entering the seat end of the valve and the shaft in a horizontal position with the plug up when open. For vertical installations (Figure 5), the valve must be installed with the seat end up regardless of flow direction.

CLEAN SERVICE: For both horizontal and vertical installations, install in the direct pressure orientation (pressure opposite the seat end).

AIR AND GAS SERVICE: Install valve in the direct pressure orientation (pressure opposite the seat end). Lubricate plug face with FDA approved silicone grease such as Dow Corning #7 before installation. Gear actuators are required for gas service applications.

PUMP DISCHARGE SERVICE: On all horizontal pump discharge applications (Figure 6), the seat end should be towards the pump.

BURIED SERVICE: Gear actuators are recommended for buried valves to hold the valve in position and provide multi-turn closure to prevent water hammer. The valve should be installed with the shaft horizontal and the actuator nut directed upwards. The valve box or extension pipe should be installed so that the actuator nut and extension stem turn freely.

NOTE: Adjust and test valve prior to backfill.

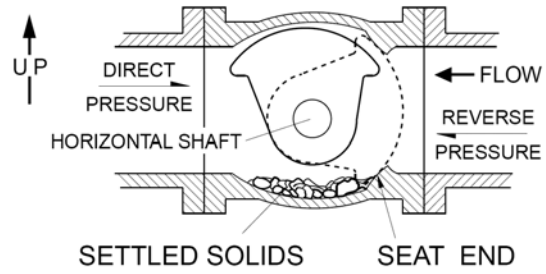


FIGURE 4. HORIZONTAL PIPE WITH SOLIDS

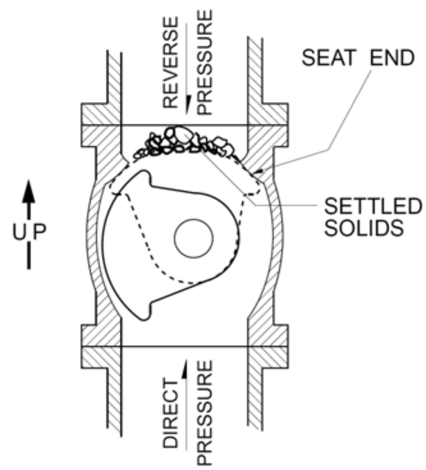


FIGURE 5. VERTICAL PIPE WITH SOLIDS

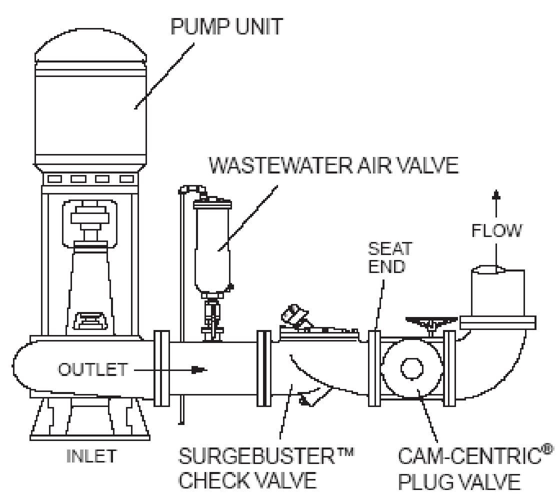


FIGURE 6. PUMP DISCHARGE SERVICE

FLANGED ENDS: Flanged valves should be mated with flat-faced pipe flanges equipped with resilient gaskets. When ring gaskets are used, the bolt material should be ASTM A307 Grade B of SAE Grade 2 Carbon Steel. Higher strength bolts may only be used with full-face gaskets.

The valve and adjacent piping must be supported and aligned to prevent cantilevered stress on the valve. Lower valve into line using slings or chains around the valve body. Lubricate the flange bolts or studs and insert them around the flange. Lightly turn bolts until gaps are eliminated.

The torquing of the bolts should then be done in graduated steps using the cross-over tightening method. Recommended lubricated torques for use with resilient gaskets (75 durometer) are given in Table 2. If leakage occurs, allow gaskets to absorb fluid and check torque and leakage after 24 hours. Do not exceed bolt rating or crush gasket more than 50 percent of its thickness.

VALVE SIZE (in)	BOLT DIA (in)	RECOM TORQUE (ft-lbs)	MAX TORQUE (ft-lbs)
3	5/8	25	90
4	5/8	30	90
6	3/4	30	150
8	3/4	40	150
10	7/8	45	205
12	7/8	65	205
14	1	80	300
16	1	90	300
18	1 1/8	100	425
20	1 1/8	120	425
24	1 1/4	150	600
30	1 1/4	175	600
36	1 1/2	175	1000
42	1 1/2	200	1000
48	1 1/2	250	1000

TABLE 2. FLANGE BOLT TORQUES

CAUTION: The use of raised-face flanges or excessive bolt torque may damage valve flanges.

MECHANICAL JOINT ENDS: Clean ends of mating pipe and valve sockets with soapy water (Figure 7). Place lubricated gasket and retainer gland over pipe end prior to installing valve. Install valve socket over pipe. Press gland and gasket toward valve until gasket is evenly set into valve socket.

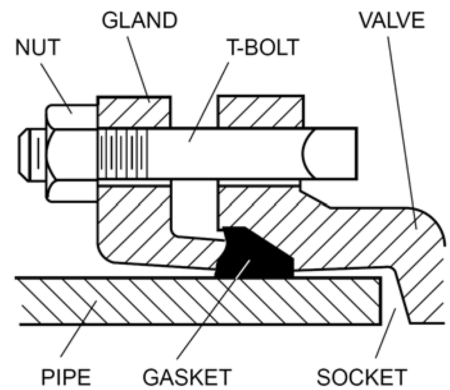


FIGURE 7. MECHANICAL JOINT INSTALLATION

Insert T-bolts in valve flange and hand tighten nuts. Torque nuts in four graduated steps using the cross-over tightening method without exceeding the torque listed in Table 3. Maintain an equal gap between the gland and the face of the valve at all points around the socket.

If a tight connection is not achieved, then the joint should be disassembled, thoroughly cleaned, and reassembled. Over-tightening may cause damage to the valve or gland.

VALVE SIZE (in)	T-BOLT DIA (in)	RECOM TORQUE (ft-lbs)	MAX TORQUE (ft-lbs)
3	5/8	45	60
4	3/4	75	90
6	3/4	75	90
8	3/4	75	90
10	3/4	75	90
12	3/4	75	90
14	3/4	75	90
16	3/4	75	90
18	3/4	75	90
20	3/4	75	90
24	3/4	75	90
30	1	100	120
36	1	100	120
42	1-1/4	75	150
48	1-1/4	75	150

TABLE 3. MECHANICAL JOINT NUT TORQUES

DIRECT NUT OPERATED VALVES: 8” and smaller valves may be equipped with a top-mounted nut for direct quarter-turn operation. The nut is 2” square to fit most valve wrenches and is mounted directly to the valve plug. To open the valve, slowly rotate the nut 90 degrees in the counter-clockwise (CCW) direction. The closed position is adjusted with a set screw and lock nut, see Figure 8. The open position can be adjusted by moving the bolt along the curved slot.

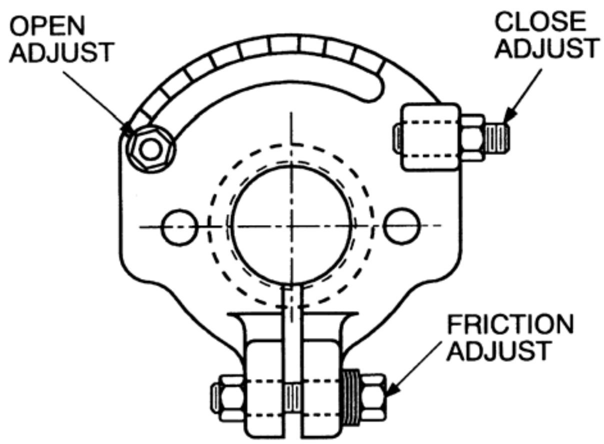


FIGURE 8. DIRECT NUT ADJUSTMENTS

DIRECT NUT FRICTION ADJUSTMENT: As shown in Figure 9, valves with direct nut actuators have a flanged packing follower (18) above the packing (7) to hold the valve in the open or closed position. If the valve is difficult to operate or does not maintain its set position, adjust the clamp bolt (17) to provide sufficient friction to hold the valve in position. IF the valve is equipped with a hand lever, the setting should allow the valve to be operated with about 80 pounds of force on the end of the pipe handle.

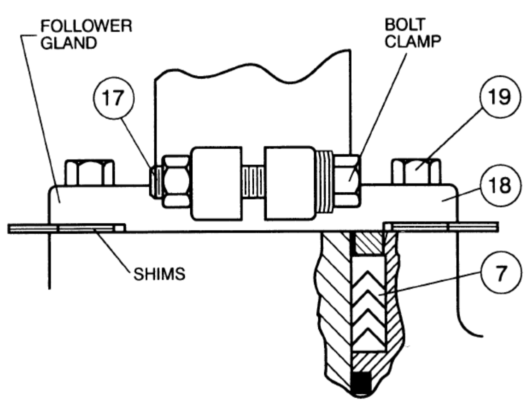


FIGURE 9. FRICTION ADJUSTMENT

LEVER OPERATED VALVES: A wrench head and lever (Figure 10) are available for use over the 2” nut for direct quarter-turn operation. Various lever lengths are available for specific direct and reverse pressure conditions as shown in Table 4.

WRENCH LENGTH, (Inches)				
VALVE	DIRECT PRES.		REVERSE PRES.	
SIZE	100 psi	175 psi	50 psi	175 psi
2 1/2	22	22	22	22
3	22	22	22	22
4	22	22	22	22
6	44	*	44	*
8	44	*	44	*

*Worm gear recommended due to operating torque

TABLE 4. APPLICATION OF LEVERS

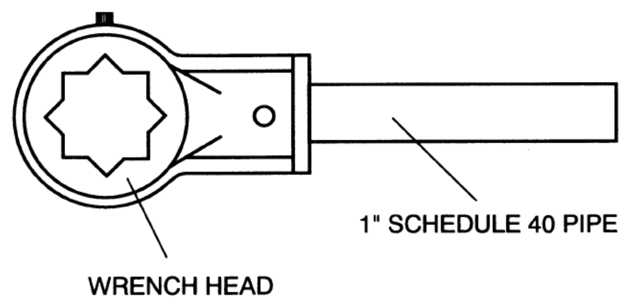


FIGURE 10. HANDLEVER

The wrench head is placed over the nut and can be secured with the set screw provided. To open the valve, rotate the lever 90 degrees in the CCW direction. The closed position is adjustable with a set screw and lock nut mounted below the nut, see Figure 8.

CAUTION: Open and close the valve slowly to prevent water hammer.

GEAR OPERATED VALVES: 4” and larger plug valves are available with a multi-turn manual gear actuator. The gear unit has a self-locking worm gear which multiplies the turning force on the handwheel or nut so that the valve can be operated with ease. A clamp-on chainwheel kit can also be used for installations high above the floor. An indicator on the top of the actuator housing indicates the position of the valve plug. The handwheel or nut must be rotated through 12-80 turns (depending on model) to open or close the plug valve. The direction of rotation to open the valve is indicated on the 2” square actuator nut.

GEAR ACTUATOR ADJUSTMENT: The standard gear actuator is provided with factory-set open and closed position stops. If the valve does not shut off tight, the stop bolt can be adjusted allowing the plug to rotate further into the seat. Loosen the locknut, and turn the closed stop bolt CCW 1 turn at a time (Figure 11). If the valve continues to leak after all of the adjustment is taken verify the orientation of the valve during installation. If a tight shut-off can not be achieved, a larger gear actuator may be required for the system operating pressure; consult the factory.

CAUTION:	**Adjust closed stop bolt for tight shut-off only. Over adjustment may cause high operating torques and damage to the plug.**

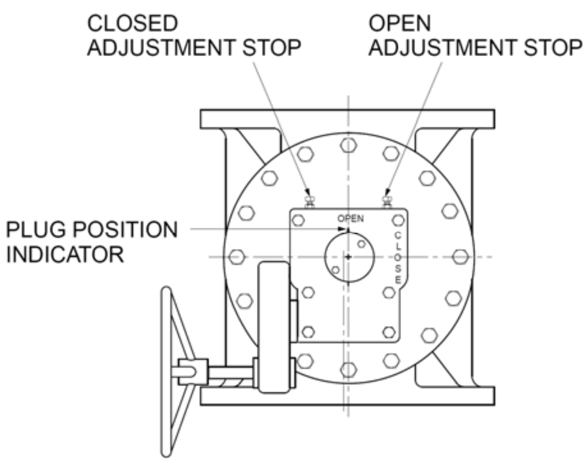


FIGURE 11: GEAR ACTUATOR ADJUSTMENT

MAINTENANCE

The Cam Centric® Plug Valve requires no scheduled lubrication or maintenance other than regular exercising and occasional inspection of the plug. The exercising is achieved by fully opening and closing the valve to verify smooth operation. If operation is difficult, it may be necessary to flush sediment from the valve by opening and closing the valve several times under flowing conditions.

CAUTION:	**Open and close the valve slowly to prevent water hammer.**

The recommended interval for exercising is every six months or annually if the valve is regularly operated. Over the life of the valve, inspection and some regular adjustments may be needed as given below.

CLOSED POSITION ADJUSTMENT: The standard valve is factory-set to seal at the “Actuator Pressure Ratings” shown on the nameplate for direct and reverse pressure directions (see Figure 2). Higher pressure applications may require adjustment of the closed position stop or a larger actuator; consult the factory.

If the valve is found to leak in the closed position due to wear, the plug can be adjusted by loosening the closed position stop on the actuator and rotating the plug further into the seat. Because of the eccentric action of the valve, further rotation will provide additional interference between the rubber plug surface and the body seat. Valves that have been in service for several years may require inspection of the plug for damage or wear. See the Disassembly Instructions of this manual.

PACKING ADJUSTMENT: V-type packing is pressure sensitive and therefore self-adjusting in nature. Over tightening will destroy both the pressure sensitive nature of the packing as well as its sealing capabilities. The packing configuration used in Cam-Centric Plug Valves follows the guidelines and recommendations of V-packing manufacturers.

Additional adjustment can be achieved by removing one or more shims found under the packing follower (18). If a leak develops, remove one shim (29) from the underside of the follower (18). An equal number of shims must be removed from both the left and right hand sides. Re-tighten the follower bolts (19) and check for leakage. If the leakage continues, remove additional shims or replace the packing.

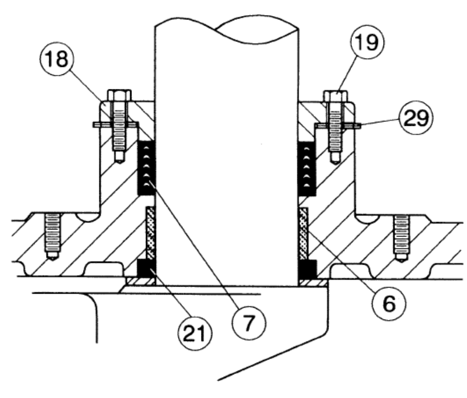


FIGURE 12. PACKING ASSEMBLY

PACKING REPLACEMENT: To replace the packing (7), it is recommended that the line be drained and the actuator removed. The valve can remain in the line. Te replace the packing, first open the valve and drain the line. Close the valve to hold it in position. For power actuators, turn off and lock out electrical and hydraulic supplies before proceeding.

<u>CAUTION:</u>	**Drain line and close valve before removing actuator or valve may rotate suddenly. Take precautions against exposure to toxic or hazardous fluids in the line.**

Remove the small round cover on actuator to expose shaft and key. Remove actuator mounting bolts and lift actuator from valve taking care not to lose square key. See Figure 12 and remove gland bolts (19) and lift follower (18) from the valve shaft. Remove old packing (7) with packing hook. Lubricate new packing with FDA grease and set in place one ring at a time taking care not to bend over the lips of the packing rings. Reinstall follower with 2 shims (29) per bolt (3 shims for 12" and larger valves). With valve in the closed position, place the actuator over valve and reinsert key (24). Finally, reinstall cover on actuator indicating "Closed".

<u>CAUTION:</u>	**If packing assembly contains clamp style follower as shown in Figure 8, do not lubricate shaft or sleeve.**

PACKING REPLACEMENT WITH ACTUATOR: The above procedure with removal of the actuator will result in the most reliable shaft seal. But if the actuator can not be removed, the following alternate procedure can be followed. To prevent the possibility of leakage during this procedure, open valve and drain the line.

<u>CAUTION:</u>	**Take precautions against exposure to toxic or hazardous fluids in the line.**

Referring to Figure 12, remove follower bolts (19) and side follower (18) up to actuator. Remove packing adapters and rings (7) with packing hook. Cut rings with knife to remove. New packing rings should be cut at a 45 degree slope to allow insertion around the shaft and provide some overlap. Install rings one at a time with the tips down toward the valve. Stagger all joints 180 degrees around the shaft. Pull down follower (18) and reinsert bolts (19) with 2 shims (29) under follower (18). V-packing is pressure assisted and only requires light compression.

GEAR ACTUATOR MAINTENANCE: A typical gear actuator is shown in Figure 13 and consists of a worm (3) mounted on an input shaft (9). The worm engages a worm wheel (2). When the worm is turned, it drives the wheel through 90° of rotation. The rotation of the valve plug is displayed by the top indicator (5). The open and closed positions of the segment gear are controlled by an end position stop bolts (20). The stops can be adjusted by loosening the lock nut (21) and rotating the bolts. The gears are lubricated with EP2 grease in a cast iron housing (1). Other parts are listed in Table 5.

The gear box is factory lubricated and sealed. No regular maintenance is required. If difficult operation is observed, the cover (4) can be removed and the unit inspected for wear. All moving parts should be coated with grease. The grease should have an even and smooth consistency. If needed, coat all moving parts with an lithium-based EP-2 grease such as Shell Alvania #2 or equal. Buried units should be packed 90% with grease.

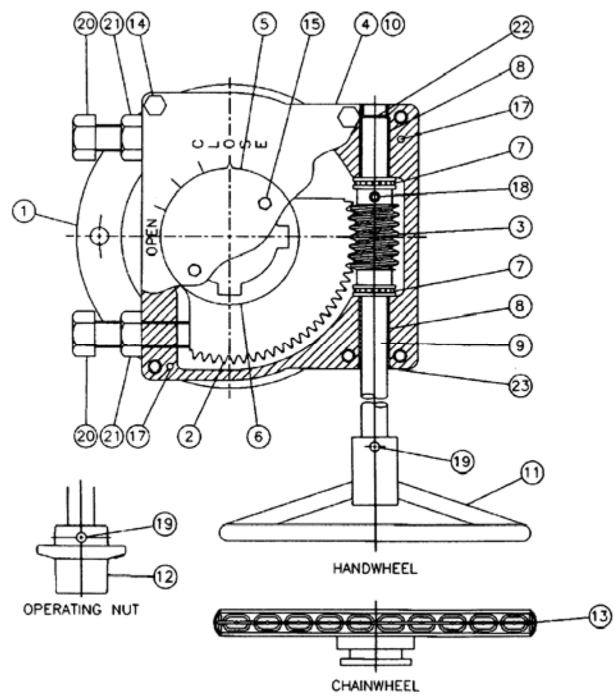


FIGURE 13. GEAR ACTUATOR CONSTRUCTION

ITEM	DESCRIPTION	MATERIAL
1	Housing	Cast Iron
2	Wormwheel	Ductile Iron
3	Worm	Steel
4	Cover	Cast Iron
5	Indicator	Cast Iron
6	O-Ring	Buna-N
7	Roller Bearing	Steel
8	Shaft Bearing	Bronze
9	Shaft	Steel
10	Gasket	Fiber
11	Handwheel	Steel or Iron
12	Operating Nut	Iron
13	Chainwheel	Iron
14	Cover Bolt	Steel
15	Indicator Bolt	Steel
16	Pipe Plug	Steel
17	Pin	Steel
18	Spirol Pin	Steel
19	Spring Pin	Steel
20	Screw	Steel
21	Jam Nut	Steel
22	Plug	Steel
23	U-Cup Seal	Buna-N

TABLE 5. GEAR ACTUATOR PARTS LIST

TROUBLESHOOTING

Several problems and solutions are presented below to assist you in troubleshooting the valve assembly in an efficient manner.

- Leakage at Valve Shaft: Adjust or replace packing.

- Leakage at Flanges: Tighten flange bolts, replace gasket.

- Valve Leaks when Closed: Pressure should be in the direction of pushing the plug into the seat. Adjust plug position by rotating the handwheel. Inspect plug for damage and replace.

- Hard to Open: Flush debris from valve. Check interior of valve for grit buildup or debris. On buried valves, check alignment of operating stem.

- Leaking Oil: Tighten actuator cover bolts. If leak persists, remove actuator cover, inspect grease, and replace actuator gasket.

- Noisy Operation: Flow noise is normal. Loud flow noise similar to hammering may be cavitation from dropping high pressures across valve; review application of valve. For gear actuator noise, inspect grease; add new grease if there are uncoated moving parts or grease has broken down into oil.

DISASSEMBLY

Disassembly may be required to inspect the plug for wear or remove debris and deposits from the valve. Work on the valve should be performed by a skilled mechanic with proper tools and a power hoist for large valves. The valve can be disassembled without removing the valve from the pipeline. Refer to Figure 14 for valve construction and parts.

WARNING: Open valve and drain line before removing cover bolts or pressure may be released causing injury. Place plug in lowest position before removing actuator or plug may rotate suddenly and jam or damage plug surface.

1. Open valve and drain the pipeline. Close valve until plug just touches the seat. Remove the small cover on the actuator to expose the shaft key.

2. Remove the actuator mounting bolts and lift actuator from valve taking care not to lose key (24).

3. Remove cover bolts (15). Matchmark cover (2) and body. Screw eye-bolts into actuator mounting holes and use hoist to lift cover (2) and plug assembly from valve. Use caution to prevent plug from dropping while lifting cover. To remove plug (3) from valve, use sling around top portion of plug.

4. Inspection of the bearings (6) is done by measuring diameter of shaft and inside diameter of bearing. Check for a normal running clearance of .005". Bearings are permanently lubricated.

5. Thrust bearing assembly (23) and packing gland (18) can be removed by removing all of the hex nuts (12).

REASSEMBLY

All parts must be cleaned and gasket surfaces should be cleaned with a stiff wire brush in the direction of the serrations or machine marks. Worn parts, gaskets and seals should be replaced during reassembly.

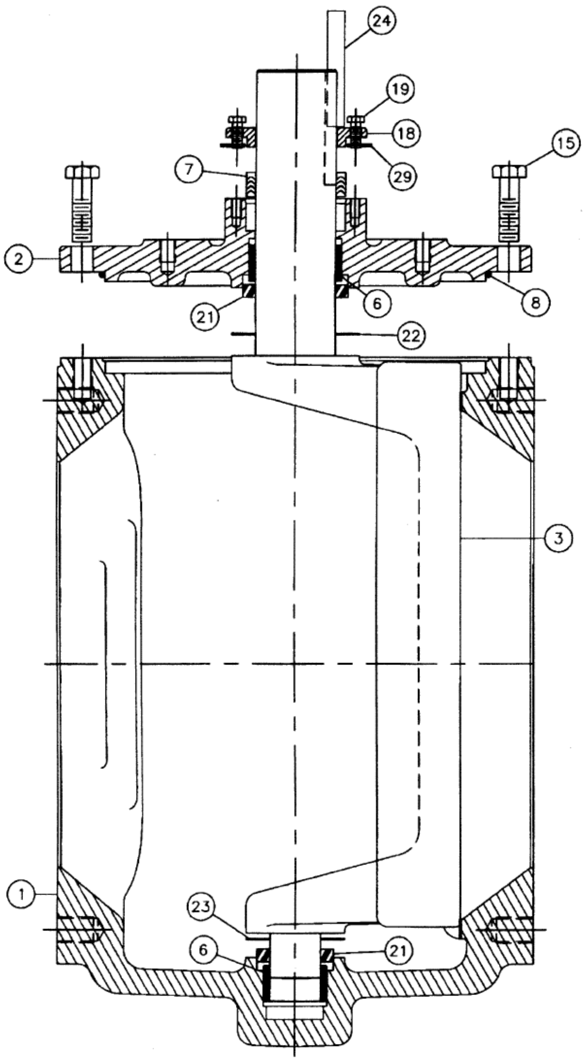


FIGURE 14. PLUG VALVE PARTS

1. Press new bearings (6) into cover and body with round, flat bar 1/4" below inside surfaces of body (1) and cover (2).

2. Install cover seal (8) over cover lip.

3. Apply thin film of FDA silicone grease such as Dow Corning #7 to plug rubber surface. Place stainless steel thrust bearing (23) over lower end of plug, Teflon bearing (22) over the upper end. Install grit seals (21) over the shafts of the plug.

4. Carefully place plug into the body (1) and insert lower plug shaft into bottom bearing (6). Plug (3) should be in the open position. Install cover (2) over plug shaft and into recess in body. Align match marks between body and cover (2). Torque cover bolts (15) per Table 6 in 3-4 increments using the cross-over tightening method.

SIZE	TORQUE (FT-LBS)
1/2"-13	45 - 75
5/8"-11	100 - 150
3/4"-10	150 - 250
7/8"-9	200 - 350
1"-8	300 - 500
1 1/8"-7	450 - 700
1 1/4"-7	650 - 1000
1 1/2"-6	750 - 1100

TABLE 6. TIGHTENING TORQUES

5. Lubricate ID and OD of packing set with FDA grease and install in packing bore one ring at a time taking care to keep lips pointing down toward plug. Reinstall follower, gland bolts, and 2 shims per bolt.

   NOTE: If valve has friction assembly with direct nut actuator, follow Friction Adjustment procedure on page 6.

6. Insert key (24) into shaft and place actuator over valve. Reinstall actuator mounting bolts and torque per Table 6. Install cover on actuator.

7. Apply power to actuator and cycle valve. Apply pressure to valve and check for cover and shaft leakage. Tighten bolts as necessary. Adjust packing if necessary.

8. If valve does not shut off tight, adjust the closed position stop as described on page 6 under "Closed Position Adjustment."

PARTS AND SERVICE

Parts and service are available from your local representative or the factory. Make note of the valve Size, Series No, and Serial No. located on the valve nameplate and contact:

Val-Matic Valve and Mfg. Corp.
905 Riverside Drive
Elmhurst, IL 60126
PH: 630/941-7600
FAX: 630/941-8042

A sales representative will quote prices for parts or arrange for service as needed.

LIMITED WARRANTY

All products are warranted to be free of defects in material and workmanship for a period of one year from the date of shipment, subject to the limitations below.

If the purchaser believes a product is defective, the purchaser shall: (a) Notify the manufacturer, state the alleged defect and request permission to return the product; (b) if permission is given, return the product with transportation prepaid. If the product is accepted for return and found to be defective, the manufacturer will, at his discretion, either repair or replace the product, f.o.b. factory, within 60 days of receipt, or refund the purchase price. Other than to repair, replace or refund as described above, purchaser agrees that manufacturer shall not be liable for any loss, costs, expenses or damages of any kind arising out of the product, its use, installation or replacement, labeling, instructions, information or technical data of any kind, description of product use, sample or model, warnings or lack of any of the foregoing. NO OTHER WARRANTIES, WRITTEN OR ORAL, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY, ARE MADE OR AUTHORIZED. NO AFFIRMATION OF FACT, PROMISE, DESCRIPTION OF PRODUCT OF USE OR SAMPLE OR MODEL SHALL CREATE ANY WARRANTY FROM MANUFACTURER, UNLESS SIGNED BY THE PRESIDENT OF THE MANUFACTURER. These products are not manufactured, sold or intended for personal, family or household purposes.

ROMAC INDUSTRIES, INC.
1-800-426-9341

MADE IN U.S.A

RFCA (Restrained Flanged Coupling Adapter)

Material Specifications

Flange Body: Ductile (nodular) iron, meeting or exceeding ASTM A 536, Grade 65-45-12. Flange meets the dimensional requirements of ANSI Class 125 and 150 bolt circles.

Gaskets: Compounded for water and sewer service in accordance with ASTM D 2000 (Sizes 3 - 12" have flange O-Ring gasket). Other compounds available for petroleum, chemical, or high temperature service.

Gland: Romac RomaGrip™. See page 7-6.

Restraining Bolts: 7/8 –9 roll thread, Ductile (nodular) iron, meeting or exceeding ASTM A 536.

Restraining Lugs: Ductile (nodular) iron, meeting or exceeding ASTM A 536. Heat treated using a proprietary process.

Lug Locators: Polyurethane, a thermal plastic.

T-bolts and Nuts: High strength low alloy steel T-head bolt. National coarse rolled thread and heavy hex nut. Steel meets AWWA C111 composition specifications. Stainless steel bolts and nuts available on request.

Coatings: Shop coat applied to cast parts for corrosion protection in transit. Fusion bonded epoxy available on request.

Use: Ductile Iron Pipe 3 - 24", cast iron pipe 3" - 24" (same OD's as ductile iron) and IPS size STD steel pipe 3 - 12".

Not for use on PVC, HDPE pipe or plain-end mechanical joint fittings. For applications on PVC, please contact your Romac representative.

To Order: Specify catalog number. **Example:** For a 12" RFCA Order: **RFCA - 13.20**

NOTE: 3" - 12" special Romac gasket works on both steel and D.I. ODs.

NOM. PIPE SIZE	GASKET RANGE	LENGTH	GLAND BOLTS QTY: SIZE	CATALOG NUMBER	LIST PRICE				WEIGHT (lbs.)
					Shopcoat w/Std. B&N	Shopcoat w/304 SS B&N	Fusion Epoxy w/Std. B&N	Fusion Epoxy w/304SS B&N	
3"	3.50-3.96	8.00"	4: 5/8" x 3"	RFCA - 3.96	$145.45	$157.56	$165.10	$177.20	21
4"	4.50-4.80	9.00"	4: 3/4" x 3 1/2"	RFCA -4.80	183.32	209.43	207.88	233.99	29
6"	6.63-6.90	9.25"	6: 3/4" x 4"	RFCA - 6.90	233.85	273.01	267.10	306.26	40
8"	8.63-9.05	9.25"	6: 3/4" x 4"	RFCA - 9.05	315.59	354.75	355.82	394.98	53
10"	10.75-11.10	10.25	8: 3/4" x 4"	RFCA - 11.10	581.96	634.17	669.69	721.91	83
12"	12.75-13.20	10.25"	8: 3/4" x 4"	RFCA - 13.20	632.13	684.34	739.86	792.07	110
14"	15.30	11.70"	10: 3/4" x 4 1/2"	RFCA -15.30	882.79	947.37	1,020.54	1,085.12	170
16"	17.40	11.70"	12: 3/4" x 4 1/2"	RFCA -17.40	1,225.93	1,302.91	1,410.23	1,487.21	200
18"	19.50	11.80"	12: 3/4" x 4 1/2"	RFCA -19.50	1,346.63	1,423.60	1,546.13	1,623.10	217
20"	21.60	11.80	14: 3/4" x 4 1/2"	RFCA - 21.60	1,521.19	1,611.94	1,772.94	1,863.69	256
24"	25.80	12.00"	16: 3/4" x 5"	RFCA - 25.80	1,845.38	1,959.61	2,130.38	2,244.61	305

Some initial axial movement may occur in lug style restraints as the lugs seat. Movement is directly related to the size of the piping system and the system pressure. In general terms movement of approximately 0.25" can be expected in restraints under 16". For larger sizes, movement of approximately 0.4" may be seen. If this is critical to your application please contact Romac Engineering for additional information.

ROMAC
INDUSTRIES,
INC.

INSTALLATION INSTRUCTIONS

Read installation instructions first before installing. Check parts to ensure that no damage has occurred during transit and that no parts are missing. Also check the diameter of the pipe and the size marked on the coupling to ensure you have the proper size.

FM APPROVED

RFCA Restrained Flange Coupling Adapter

NOT FOR USE ON PVC PIPE OR PLAIN END MECHANICAL JOINT FITTINGS

NOTE: Not for use on polyethylene pipe, plain end mechanical joint fittings or PVC pipe.

The "Stab-Fit" installation technique may also be employed on 3"-10" sizes.

Step 1 • Check the RFCA parts to insure that no damage has occurred during transit and that no parts are missing.

Step 2 • Clean pipe end for a distance of 2" greater than length of the RFCA.

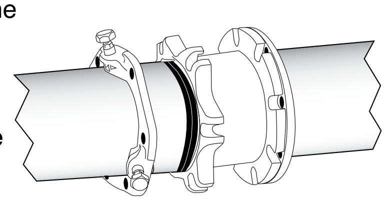
Step 3 • Place RomaGrip gland on pipe end.

Step 4 • Lubricate the gasket and pipe surface with soapy water or other suitable gasket lubricant.

Step 5 • Place gasket over pipe with beveled edge toward the flange adapter.

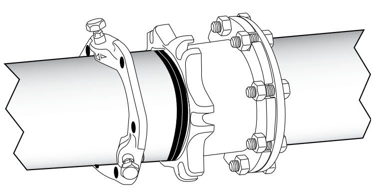
Step 6 • Slide the RFCA on to the pipe. Position the pipe and flanged coupling against the mating flange, inserting flange gasket (14" and larger) between the flange faces. Assemble the flange joint using flange bolts.

⑥



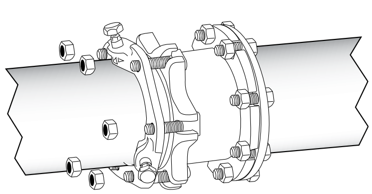
⑦

Step 7 • The pipe should be centered such that the space between the OD of the pipe and the ID of the RFCA is even all around the pipe. Slide the RFCA gasket into position with the beveled edge engaging the beveled end of the RFCA body.



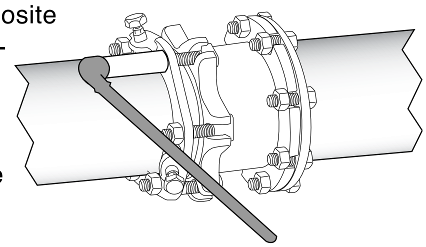
⑧

Step 8 • Slide the RomaGrip into position against the gasket, and insert T-bolts.



Step 9 • Tighten T-bolts evenly, alternating to diametrically opposite position at approximately 20 ft-lbs increments to the recommended torque for your size RFCA.

⑨



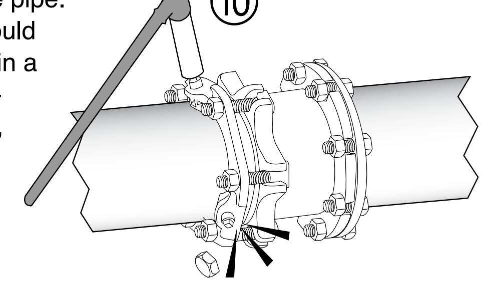
Recommended Torque:
3" RomaGrip - 45-65 ft-lbs.
4 - 24" RomaGrip - 75 - 90 ft-lbs.

Note:
90 ft-lbs. torque = 12" wrench w/90 lbs. force

For best results, wait 10 minutes and retighten bolts to proper torque.

Step 10 • Hand tighten the restrainer bolts until the restraining pads touch the surface of the pipe. The bolts should be tightened in a uniform criss-cross pattern, until the heads break off above the notch.

⑩



NOTE: Do not turn a bolt more than one turn before alternating to the next bolt.

Step 11 • Pressure test for leaks before backfilling.

Document # 20-9-0032 10/31/2007

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ROMAC
INDUSTRIES,
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INSTALLATION INSTRUCTIONS

RFCA Restrained Flange Coupling Adapter

NOT FOR USE ON PVC PIPE OR PLAIN END MECHANICAL JOINT FITTINGS

PRECAUTIONS

1. Check flange to make sure the bolt holes match the RFCA.
2. Make sure a flange gasket is used between the mating flanges on sizes 14" and larger.
3. Check diameter of pipe to make sure you are using the correct size RFCA; also check gasket to make sure it is the size you think it is.
4. Be sure to clean pipe of as much dirt and corrosion as possible in the area that the gasket will seal.
5. Lubricate both the gasket and the pipe end with soapy water or approved pipe lubricant per ANSI/AWWA C111/ A21.11.
6. Make sure no foreign materials lodge between gasket and pipe.
7. Avoid loose fitting wrenches, or wrenches too short to achieve proper torque.
8. Keep threads free of foreign material to allow proper tightening.
9. Take extra care to follow proper bolt tightening procedures and torque recommendations. Bolts are often not tightened enough when a torque wrench is not used.
10. Be sure that the gland is centered around the pipe.
11. Pressure test for leaks before backfilling.
12. Backfill and compact carefully around pipe and fittings.
13. Some initial axial movement may occur in lug style restraints as the lugs seat. Movement is directly related to the size of the piping system and the system pressure. In general terms movement of approximately 0.25" can be expected in restraints under 16”. For larger sizes, movement of approximately 0.4” may be seen. If this is critical to your application please contact Romac Engineering for additional information.

COMMON INSTALLATION PROBLEMS

1. Flange gasket not installed on sizes 14" and larger.
2. T-Bolts are not tightened to the proper torque.
3. Rocks or debris between pipe and gasket.
4. Dirt or debris between pipe and restraining pad.
5. Dirt on threads of bolts or nuts.
6. Restraining bolt heads not snapped off.
7. Not enough pipe inserted into bell.
8. Using the RFCA on IPS size steel pipe with wall thickness thinner than schedule 40 steel pipe. (3-12 inch sizes)

IF RFCA MUST BE REMOVED

1. Make sure pipe is not pressurized. Removing the restrainer could cause the pipe joint to separate.
2. To remove the RFCA, use a 5/8" hex wrench or socket.
3. To reassemble, follow installation procedures. Tighten the restraining bolts using a 5/8" hex wrench to 75-ft-lbs minimum.

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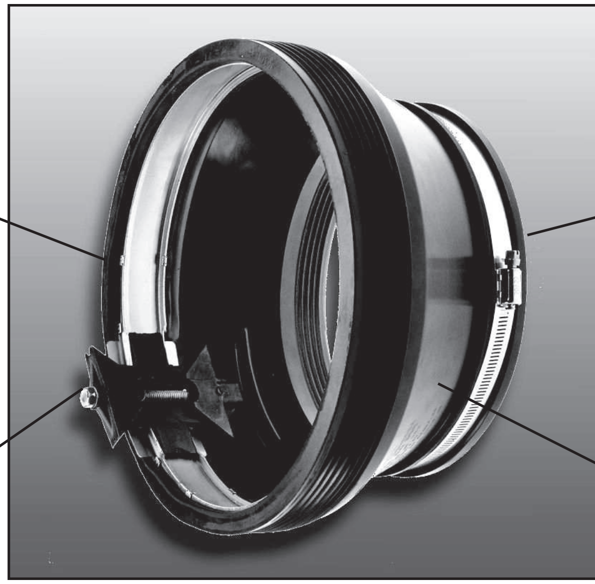
KOR-N-SEAL® I & II

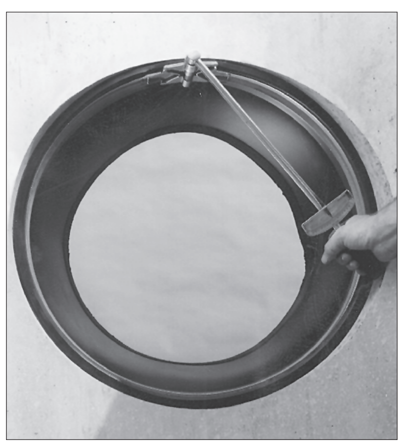
FLEXIBLE PIPE-TO-MANHOLE CONNECTORS

SPECIFICATION SHEET



KOR-N-SEAL I - WEDGE KORBAND CONNECTOR ASSEMBLY

Install Kor-N-Seal I - Wedge Korband with Socket Wrench & Torque Limiter



Install Kor-N-Seal II - Wedge Korband with Standard Torque Wrench

Install Pipe Clamp(s) with T-Handle Torque Wrench

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Milford, NH 03055, U.S.A.
Tel: 603-673-8680 • 800-626-2180 • Fax: 603-673-7271

KOR-N-SEAL® I & II

Flexible Pipe-to-Manhole Connectors

SPECIFICATION SHEET

PERFORMANCE

Test	ASTM Method	Test Requirements	Kor-N-Seal ® I & II
Head Pressure	C923 - 7.1	0° - 13 psi (30 ft) for 10 min. 7° - 10 psi (23 ft) for 10 min.	+13 psi for 10 min. +10 psi for 10 min.
Deflection Test	C923 - 7.2.2	7° in any direction	Over 7° in any direction
Load Test	C923 - 7.2.3	150 lbs/in. pipe dia.	Over 150 lbs/in. pipe dia.

Performed on all standard sizes of Kor-N-Seal Connectors.

RESILIENT EPDM OR POLYISOPRENE RUBBER

Conforms to ASTM C923

Test	ASTM Method	Test Requirements	TEST RESULTS Kor-N-Seal® I & II
Chemical Resistance	D543, at 22°C for 48 h		
1 *N* Sulfuric Acid		No weight loss	No weight loss
1 *N* Hydrochloric Acid		No weight loss	No weight loss
Tensile Strength	D412	1200 psi	1580 psi
Elongation at Break		350% min.	500%
Hardness	D2240 (shore A durometer)	± 5 from the manufacturer's specified hardness	48 ± 5
Accelerated Oven-Aging	D573 70 ± 1°C for 7 days	Decrease of 15%, max. of original tensile strength, decrease of 20% max. of elongation	10.1% tensile decrease 14.0% elongation decrease
Compression Set	D395, method B, at 70°C for 22 h	Decrease of 25%, max. of original deflection	13% decrease
Water Absorption	D471, immerse 0.75 by 2-in. specimen in distilled water at 70°C for 48 h	Increase of 10%, max. of original by weight	.8% increase
Ozone Resistance	D1171	Rating 0	Rating 0
Low-temperature Brittle Point	D746	No fracture at -40°C	No fracture at -40°C
Tear Resistance	D624, method B	200 lbf/in.	No tear at 210 lbf/in.

INTERNAL KORBAND

Conforms to ASTM C923, ASTM A666, and A240

– Korband Assembly is manufactured of 300 series stainless steel.
– Toggle Expander is made of 300 series stainless steel.
– The 106/406 series Wedge Expander is made from reinforced nylon or 300 series stainless steel.
– The 206/306 series Wedge Expander is made from 300 series stainless steel.

EXTERNAL PIPE CLAMP

Conforms to ASTM C923, ASTM A666, and A240

External take-up clamps are manufactured of 300 series stainless steel.

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NPC Kor-N-Seal Pipe-to-Manhole Connector

Technical Specification

Scope:

This specification describes the function of the NPC Kor-N-Seal pipe-to-manhole connector, its principle of operation, and the component materials that constitute the Kor-N-Seal connector, and their physical properties.

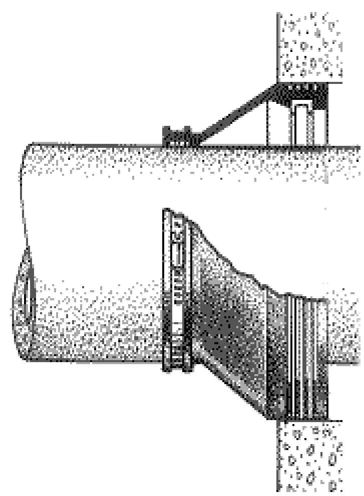
Product Application:

NPC Kor-N-Seal connectors are designed and manufactured to meet or exceed the requirements of ASTM C-923 "Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals". This specification requires the connector to provide a watertight seal under the following conditions:

- 10 PSI (23 feet head) of groundwater pressure
- Minimum 7 Degrees of pipe articulation in any direction
- Radial loading test of 150 pounds per inch diameter of pipe

Principle of Operation:

The Kor-N-Seal connector creates a watertight seal between the pipe and manhole by first sealing to the inside of the cored or formed hole in the manhole and then sealing to the outside of the pipe. See illustration at right.



The seal at the inside of the manhole is created by the stainless steel Korband. The Korband is located inside of the end of the Kor-N-Seal connector that fits into the manhole. Once the Kor-N-Seal connector is located in the manhole, the diameter of the Korband is increased. This compresses the Kor-N-Seal connector against the inside wall of the hole in the manhole creating a watertight seal at the manhole.

The seal at the outside of the pipe is created by the stainless steel pipe clamp(s). The pipe clamp is located on the outside of the Kor-N-Seal connector. Once the pipe has been positioned in the connector the diameter of the pipe clamp is decreased. This compresses the Kor-N-Seal connector against the outside wall of the pipe creating a watertight seal at the pipe.

Reference the Kor-N-Seal Recommeded Installation Instructions for a detailed explanation of the preparation and installation of the Kor-N-Seal connector.

KOR-N-SEALI – STAINLESS STEEL WEDGE

Recommended Installation Procedure

Refer to reverse side *Kor-N-Seal I - Wedge Korband Installation Chart* for Hole Size Range, Connector Dimensions, and Suggested Pipe O.D. Range.

CONNECTOR INSTALLATION:

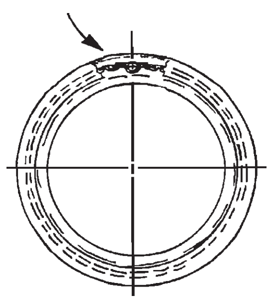
1. Check to be sure Korband is properly located in Connector groove. (Fig. 1)
2. Insert Connector Assembly into hole with Wedge Expander at top of hole. (Fig. 2)
3. Position Connector so it is square to manhole both vertically and horizontally. (Fig. 3)
4. Tighten Wedge Expander using 1/2" [13 mm] socket with a preset torque limiter for each. For each size connector use torque limiter preset to proper torque. (Fig. 4) Retorquing is not required prior to shipment.

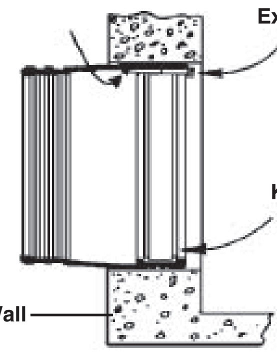
CAUTION: DO NOT USE IMPACT WRENCH.

IMPORTANT

RECOMMENDED TORQUE		TORQUE LIMITER
Connector Inches [mm]	Foot Pounds [Newton Meters]	P/N
10 – 24 [254 – 610]	12 [16]	91440-12

Fig. 4





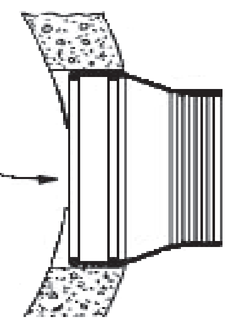


Fig. 1 **Fig. 2** **Fig. 3**

PIPE INSTALLATION:

1. Center pipe in Connector opening.
2. On maximum pipe O.D. installations, use a pipe lubricant on the outside barrel of the pipe and/or the inside ridges of the Connector (under the Pipe Clamp area) to allow the pipe to slide into place more easily.
3. Position the Pipe Clamp in the Connector's Pipe Clamp groove with the screw at the top.
4. Tighten the Pipe Clamp screw to 60 inch pounds [7 Newton Meters] with a T-handle Torque Wrench, P/N 80090.
5. On minimum pipe O.D. installations, lift the rubber up underneath the Pipe Clamp screw so that the Connector contacts the bottom surface of the pipe while the Pipe Clamp screw is being tightened. Application of pipe lubrication on the underside of the clamp will also help assure that an even contraction of rubber is maintained throughout the clamping area.
6. After the Pipe Clamp has been tightened down firmly, move the pipe horizontally and/or vertically to bring it to grade.

CAUTION: Pipe must **NOT** rest on Connector Korband.

CAUTION:
All capped stubs awaiting pipe installation at a later date must be restrained. Assure that a proper backfill material is used in adverse conditions. Prior to any critical usage, contact NPC Customer service at 1-800-626-2180.

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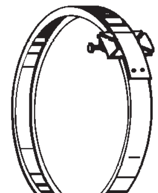
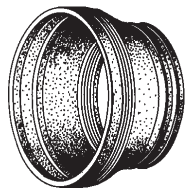
KOR-N-SEALI – STAINLESS STEEL WEDGE

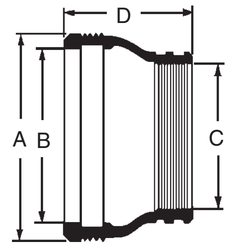
Recommended Installation Procedure

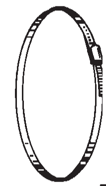


KORBAND
300 Series S.S., 16 Gauge



CONNECTOR
EPDM, Durometer 48





PIPE CLAMP
300 Series S.S., Quick Connect

Kor-N-Seal S106 Series

Connector P/N	Suggested Pipe O.D. Range Inches	Hole Size Range Inches	Connector Dimensions Inches			Pipe Clamp P/N
		A	B	C	D	
S106-12BWS	5.75 — 7.00	12.00 — 12.20	10.30	6.50	8	I-128
S106-12AWS	7.00 — 8.50	12.00 — 12.20	10.30	8.00	8	I-180
S106-12WS	8.25 — 9.75	12.00 — 12.20	10.30	9.25	8	I-180
S106-14AWS	9.50 — 11.25	14.00 — 14.20	12.25	10.50	8	I-190
S106-16BWS	9.50 — 11.25	15.95 — 16.15	14.30	10.50	8	I-190
S106-16AWS	11.25 — 13.00	15.95 — 16.15	14.30	12.25	8	I-218
S106-16WS	13.00 — 14.20	15.95 — 16.15	14.30	14.00	8	I-242
S106-20BWS	14.00 — 15.50	19.95 — 20.10	18.25	15.00	8	I-306
S106-20AWS	15.50 — 17.00	19.95 — 20.10	18.25	16.50	8	I-306
S106-20WS	17.00 — 18.15	19.95 — 20.10	18.25	18.00	8	I-306
S106-22WS	17.75 — 19.25	21.95 — 22.10	20.25	18.75	8	I-318
S106-24WS	19.60 — 21.10	23.95 — 24.10	22.25	20.60	8	I-348

Kor-N-Seal S406 Series

S406-10AWS	6.00 — 6.75	10.00 — 10.20	8.30	6.50	6	I-128
S406-10WS	7.50 — 8.20	10.00 — 10.20	8.30	8.50	6	I-180
S406-10.5AWS	6.00 — 6.75	10.50 — 10.70	8.80	6.50	6	I-128
S406-10.5WS	7.50 — 8.70	10.50 — 10.70	8.80	8.50	6	I-180
S406-11BWS	6.00 — 7.00	11.00 — 11.20	9.30	6.00	6	I-128
S406-11AWS	7.50 — 9.00	11.00 — 11.20	9.30	8.00	6	I-180
S406-12CWS	6.00 — 7.00	12.00 — 12.20	10.30	6.50	6	I-128
S406-12BWS	6.25 — 7.50	12.00 — 12.20	10.30	7.00	6	I-128
S406-12AWS	7.50 — 9.00	12.00 — 12.20	10.30	8.50	6	I-180
S406-12WS	9.00 — 10.20	12.00 — 12.20	10.30	10.00	6	I-180

Suggested pipe O.D. range comes from field experience. Refer to *Recommended Pipe Installation Procedure*.

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ConSeal™
Concrete Sealants INC.

CS-202

Butyl Rubber Sealant

APPLICATIONS

For self-sealing joints in: Manholes, Concrete Vaults, Septic Tanks, Concrete Pipe, Box Culverts, Utility Vaults, Burial Vaults, and Vertical Panel Structures.

SEALING PROPERTIES

- Provides permanently flexible watertight joints.
- Low to high temperature workability: 0°F to 120°F (-12°C to 48°C)
- Rugged service temperature: -30°F to +200°F (-34°C to +93°C)
- Excellent chemical and mechanical adhesion to clean, dry surfaces.
- Sealed Joints will not shrink, harden or oxide upon aging.
- No priming normally necessary. When confronted with difficult installation conditions, such as wet concrete or temperatures below 40°F (4°C), priming the concrete will improve the bonding action. Consult Concrete Sealants for the proper primer to meet your application.

HYDROSTATIC STRENGTH

ConSeal CS-202 meets the hydrostatic performance requirement as set forth In ASTM C-990 section 10.1 (Performance requirement: 10psi for 10 minutes in straight alignment – in plant, quality control test for joint materials.)

SPECIFICATIONS

ConSeal CS-202 meets or exceeds the requirements of Federal Specification SS-S-210 (210-A), AASHTO M-198B, and ASTM C-990-91.

P.O. Box 176, New Carlisle OH, 45344 • 937.845.8776 or 800.332.7325
FAX 937-845-3587 • www.conseal.com

CONSEAL™ Concrete Sealants INC.

CS-202

Butyl Rubber Sealant

PHYSICAL PROPERTIES

	Spec	Required*	CS-202
Hydrocarbon blend content % by weight	ASTM D4 (mod.)	50% min.	52%
Inert mineral filler % by weight	AASHTO T111	30% min.	35%
Volatile Matter % by weight	ASTM D6	2% max.	1.2
Specific Gravity, 77°F	ASTM D71	1.15-1.50	1.20
Ductility, 77°F	ASTM D113	5.0 min.	12
Penetration, cone 77°F, 150 gm. 5 sec.	ASTM D217	50-100	60-65
Penetration, cone 32°F, 150 gm. 5 sec.	ASTM D217	40 mm	50-55
Flash Point, C.O.C., °F	ASTM D92	350°F min.	425°F
Fire point, C.O.C., °F	ASTM D92	375°F min.	450°F

IMMERSION TESTING

• 30-Day Immersion Testing: No visible deterioration when tested in 5% Caustic Potash, 5% Hydrochloric Acid, 5% Sulfuric Acid, and 5% saturated Hydrogen Sulfide. *

• One Year Immersion Testing: No visible deterioration when tested in 5% Formaldehyde, 5% Formic Acid, 5% Sulfuric Acid, 5% Hydrochloric Acid, 5% Sodium Hydroxide, 5% Hydrogen Sulfide and 5% Potassium Hydroxide.

* Requirements of ASTM C-990 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.

P.O. Box 176, New Carlisle OH, 45344 • 937.845.8776 or 800.332.7325
FAX 937-845-3587 • www.conseal.com

TNEME-LINER

SERIES 61

PRODUCT PROFILE

GENERIC DESCRIPTION Cycloaliphatic Amine Epoxy

COMMON USAGE Tightly cross-linked epoxy with excellent corrosion and chemical resistance. Principally used for immersion service, including fuel and crude oil storage, chemical containment and wastewater treatment.

COLORS 5001 Gray and 5002 Beige

FINISH Semi-gloss

SPECIAL QUALIFICATIONS A two-coat system of Series 61 at 4.0 to 6.0 dry mils (100-150 dry microns) per coat passes the performance requirements of **MIL-PRF-4556F.**

PERFORMANCE CRITERIA Extensive test data available. Contact your Tnemec representative for specific test results.

COATING SYSTEM

PRIMERS
Steel: Self-priming
Concrete: Self-priming or Series 215, 217, 218
CMU: Series 215, 218

TOPCOATS **Note:** Series 61 can be topcoated with select Tank Armor linings depending on service conditions. Contact Tnemec Technical Service for recommendations.

SURFACE PREPARATION

STEEL **Immersion Service:** SSPC-SP10/NACE 2 Near-White Blast Cleaning obtaining a minimum angular anchor profile of 2.0 mils (50 microns).

CONCRETE Allow new concrete to cure for 28 days. Abrasive blast referencing SSPC-SP13/NACE 6, ICRI-CSP3-5 Surface Preparation of Concrete and Tnemec's Surface Preparation and Application Guide.

ALL SURFACES Must be clean, dry and free of oil, grease and other contaminants.

TECHNICAL DATA

VOLUME SOLIDS 82.0 ± 2.0% (mixed) †

RECOMMENDED DFT
1. For JP-4, JP-5, JP-8, Aviation Gas and Jet A-1: 4.0 to 6.0 mils (100 to 150 microns) per coat (minimum of two coats).
2. Most Other Applications: 8.0 to 12.0 mils (205 to 305 microns) per coat (minimum of two coats). Contact your Tnemec representative for specific recommendations.

CURING TIME

Temperature	To Handle	To Recoat	Immersion
75°F (24°C) at 4.0 mils (100 microns)	6 hours	16-18 hours•	5 to 7 days
75°F (24°C) at 12.0 mils (305 microns)	11 hours	16-18 hours•	5 to 7 days

Curing time varies with surface temperature, air movement, humidity and film thickness.
• Maximum recoat time is 72 hours. If more than 72 hours have elapsed between coats, the coated surface must be scarified before topcoating.

VOLATILE ORGANIC COMPOUNDS
EPA Method 24
Unthinned: 0.36 lbs/gallon (45 grams/litre)
Thinned 6%: 0.71 lbs/gallon (85 grams/litre)
Thinned 10%: 1.21 lbs/gallon (145 grams/litre) †

HAPS
Unthinned: 1.53 lbs/gal solids
Thinned 10%: 2.42 lbs/gal solids

THEORETICAL COVERAGE 1,315 mil sq ft/gal (32.3 m²/L at 25 microns). See APPLICATION for coverage rates. †

NUMBER OF COMPONENTS Two: Part A (amine) and Part B (epoxy)

MIXING RATIO By volume: One (Part A) to one (Part B)

PACKAGING

	PART A	PART B	Yield (mixed)
Large Kit	5 gallon pail (18.9 L)	5 gallon pail (18.9 L)	10 gallons (37.85 L)
Small Kit	1 gallon can (3.79 L)	1 gallon can (3.79 L)	2 gallons (7.57 L)

NET WEIGHT PER GALLON 13.10 ± 0.25 lbs (5.94 ± .11 kg) †

STORAGE TEMPERATURE Minimum 20°F (-7°C) Maximum 110°F (43°C)
For optimum application properties, material temperature should be above 60°F (16°C) prior to application.

TEMPERATURE RESISTANCE (Dry) Continuous 250°F (121°C) Intermittent 275°F (135°C)
Performance in high temperature immersion applications depends on liquid media, temperature and substrate. Contact your Tnemec representative for more information.

SHELF LIFE 24 months at recommended storage temperature.

FLASH POINT - SETA Parts A & B: 81°F (27°C)

HEALTH & SAFETY Paint products contain chemical ingredients which are considered hazardous. Read container label warning and Material Safety Data Sheet for important health and safety information prior to the use of this product.
Keep out of the reach of children.

APPLICATION

TNEME-LINER | SERIES 61

COVERAGE RATES

For JP-4, JP-5, JP-8
Aviation Gas, Jet A-1 Service

	Dry Mils (Microns)	Wet Mils (Microns)	Sq Ft/Gal (m²/Gal)
Suggested	5.0 (125)	6.0 (150)	263 (24.4)
Minimum	4.0 (100)	5.0 (125)	329 (30.6)
Maximum	6.0 (150)	7.5 (190)	219 (20.4)

Most Other Applications

	Dry Mils (Microns)	Wet Mils (Microns)	Sq Ft/Gal (m²/Gal)
Suggested	10.0 (255)	12.0 (305)	132 (12.2)
Minimum	8.0 (205)	10.0 (255)	164 (15.3)
Maximum	12.0 (305)	14.5 (355)	110 (10.2)

Allow for overspray and surface irregularities. Film thickness is rounded to the nearest 0.5 mil or 5 microns. Application of coating below minimum or above maximum recommended dry film thicknesses may adversely affect coating performance. †

MIXING

Power mix contents of each container, making sure no pigment remains on the bottom. Pour a measured amount of Part B into a clean container large enough to hold both components. Add an equal volume of Part A to Part B while under agitation. Continue agitation until the two components are thoroughly mixed. Do not use mixed material beyond pot life limits. **Note:** Both components must be above 60°F (16°C) prior to mixing. Mixing ratio is one to one by volume. A large volume of material will set up quickly if not applied or reduced in volume. **Caution: Do not reseal mixed material. An explosion hazard may be created.**

THINNING

Use No. 2 Thinner. For air spray, thin up to 10% or 12 oz (354 mL) per gallon. For airless spray or brush, thin up to 5% or 6 oz (177 mL) per gallon. **Note:** A maximum of 6% or 7 oz (207 mL) per gallon of No. 2 Thinner may be used to comply with VOC regulations.

POT LIFE

2 1/2 hours at 60°F (16°C) 1 1/2 hours at 77°F (25°C) 45 minutes at 100°F (38°C)

APPLICATION EQUIPMENT

Air Spray

Gun	Fluid Tip	Air Cap	Air Hose ID	Mat'l Hose ID	Atomizing Pressure	Pot Pressure
DeVilbiss JGA	E	765 or 704	5/16" or 3/8" (7.9 or 9.5 mm)	3/8" or 1/2" (9.5 or 12.7 mm)	60-90 psi (4.1-6.2 bar)	10-20 psi (0.7-1.4 bar)

Low temperatures or longer hoses require higher pot pressure.

Airless Spray

Tip Orifice	Atomizing Pressure	Mat'l Hose ID	Manifold Filter
0.015"-0.021" (380-535 microns)	3000-3800 psi (207-262 bar)	1/4" or 3/8" (6.4 or 9.5 mm)	60 mesh (250 microns)

Use appropriate tip/atomizing pressure for equipment, applicator technique and weather conditions.
Brush: Recommended for small areas only. Use high quality natural or synthetic bristle brushes. **Note:** Two or more coats may be required to obtain recommended film thicknesses.

SURFACE TEMPERATURE

Minimum 60°F (16°C) Maximum 135°F (57°C)
The surface should be dry and at least 5°F (3°C) above the dew point. Coating will not cure below minimum surface temperature.

CLEANUP

Flush and clean all equipment immediately after use with the recommended thinner, xylol or MEK.

† Values may vary with color.

Tnemec Company Incorporated 6800 Corporate Drive Kansas City, Missouri 64120-1372 1-800-TNEMEC1 Fax: 1-816-483-3969 www.tnemec.com

Figure 420
BRASS BODY BALL VALVES

2 PC FULL PORT 600 WOG

Features:

- 600 WOG
- 150 WSP
- Full Port
- Meets NSF-61 Standards (to 2”)
- Meets MSS SP-110 Standards
- Blow-out Proof Stem
- Adjustable Packing
- Threaded NPT Ends (ANSI B 1.20.1)
- Forged Brass Body & End Cap
- 100% Electronically Tested in Open and Closed Position at 80 PSI
- Optional Lock Lever
- Optional Stem Extension
- Optional Tee Handle (to 1”)
- Optional Oval Handle (to 2”)
- Optional SS Ball & Stem (to 2”)
- Optional Memory Stop (to 2”)

OPTIONS

Lock Lever

Stem Extension

Tee or Oval Handle

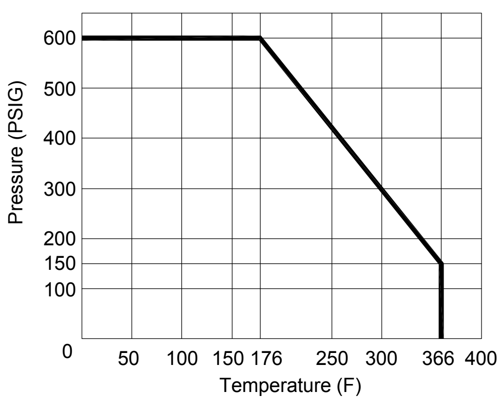
SS Ball & Stem

Memory Stop

Acc. to NSF 61
Up to 2”

Up to 2”

C US



Gas Approvals:

- CSA Class 3371-10, CGA 3.16, 125 PSIG, -40°F - 149°F, 1/2”-2”
- CSA Class 3371-88, ANSI Z21.15/CSA9.1, 1/2 PSIG, 32°F - 188.6°F, 1/2”-4”
- CSA Class 3371-90, ASME B16.33/b16.38, 125 PSIG, -40°F - 149°F, 1/4”-4”
- CSA Class 3371-92, ASME B16.44, 5 PSIG, -40°F - 149°F, 1/2”-2”
- CSA Class 3371-94, ASME B16.33, 125 PSIG, -40°F - 149°F, 1/2”-4”
- CSA Class 3371-97, UL-125, 250 PSIG, -40°F - 130°F, 1/4”-3/8”
- UL Class YRPV, ANSI/UL-842, 250 PSIG, -20°F - 125°F, 1/4”-4”
- UL Class YSDT, AMSI/UL-125, 250 PSIG, -40°F - 130°F, 1/4”-4”

Figure Number Matrix

FNW 420 Trim Lever Size

TRIM TYPES
BLANK = BRASS (CHROME BALL)
SS = SS BALL & STEM (INCL. LL)

LEVER TYPES
BLANK = STANDARD
LL = LOCK LEVER (STNDRD. w/SS)

SIZE CODES

1/4 = B	1 = G	2-1/2 = L
3/8 = C	1-1/4 = H	3 = M
1/2 = D	1-1/2 = J	4 = P
3/4 = F	2 = K	

Kit Codes (Order Separately)

LOCKING LEVER
1/4 - 1/2 = FNW420LHKBD
3/4 - 1 = FNW420LHKFG
1-1/4 - 1-1/2 = FNW420LHKHJ
2 = FNW420LHKK
2-1/2 = FNW420LHKL
3 = FNW420LHKM
4 = FNW420LHKP

TEE HANDLES
1/4 - 1/2 = FNW420THKBD
3/4 - 1 = FNW420THKFG

EXTENSIONS
1/4 - 1/2 = FNW420SEBD
3/4 - 1 = FNW420SEFG
1-1/4 - 1-1/2 = FNW420SEHJ
2 = FNW420SEK
2-1/2 - 3 = FNW420SELM
4 = FNW420SEP

OVAL HANDLES
1/4 - 1/2 = FNW420OHKBCD
3/4 - 1 = FNW420OHKFG
1-1/4 - 1-1/2 = FNW420OHKHJ
2 = FNW420OHKK

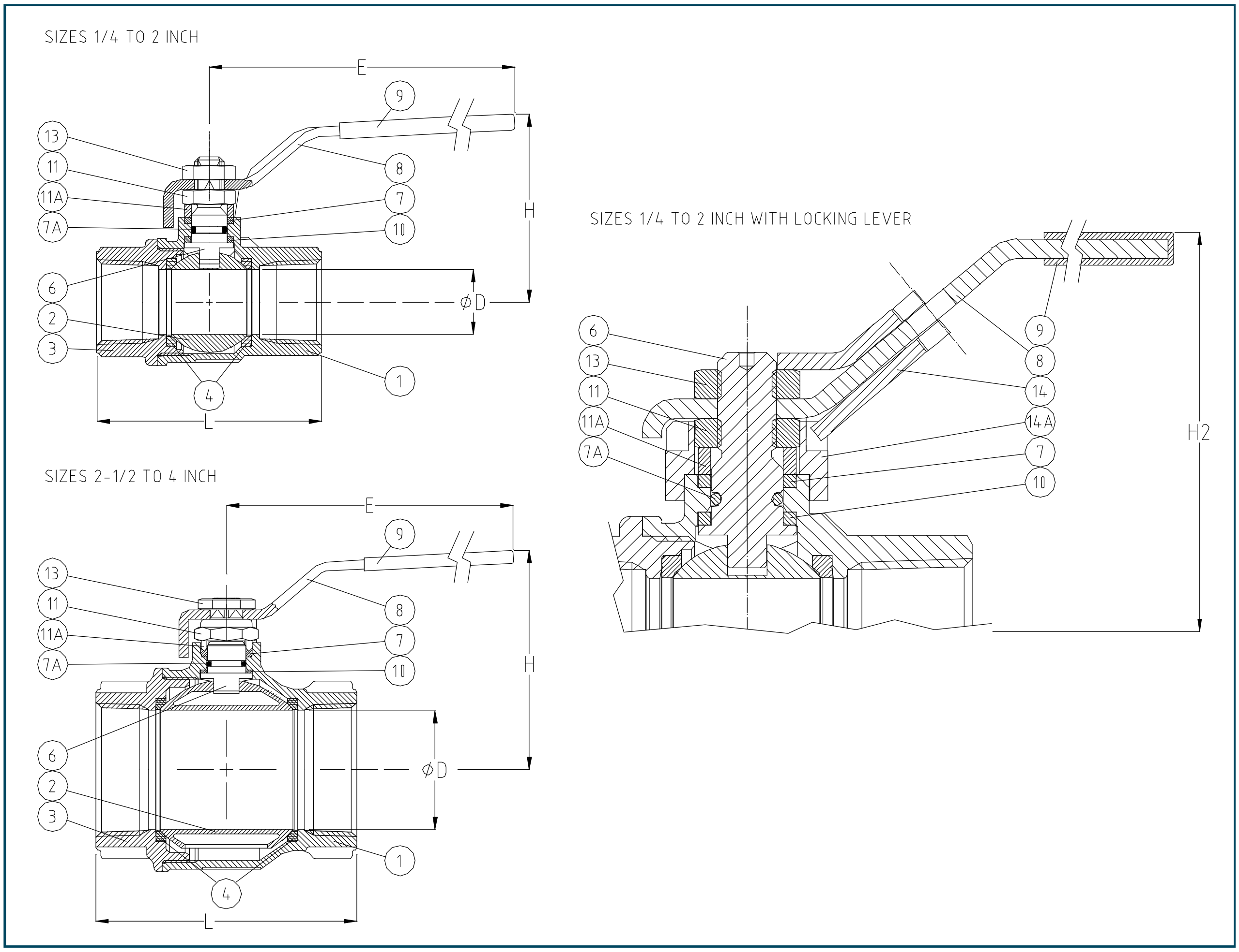
REPLACEMENT LEVER
1/4 - 1/2 = FNW420HKBD
3/4 - 1 = FNW420HKFG
1-1/4 - 1-1/2 = FNW420HKHJ
2 = FNW420HKK
2-1/2 - 3 = FNW420HKLM
4 = FNW420HKP

MEMORY STOPS
1/4 - 1/2 = FNW420MSKBD
3/4 - 1 = FNW420MSKFG
1-1/4 - 1-1/2 = FNW420MSKHJ
2 = FNW420MSKK

FNW™

Figure 420
BRASS BODY BALL VALVES

2 PC FULL PORT 600 WOG



Cv & Weights

Size	Cv	Wt. (Lbs)
1/4	6	0.3
3/8	7	0.3
1/2	19	0.5
3/4	34	0.7
1	50	1.1
1-1/4	104	2.0
1-1/2	268	3.1
2	309	4.2
2-1/2	629	8.0
3	1018	12.9
4	1622	22.0

Dimensions (Inches)

Size	ØD	E	L	H	H2
1/4	0.39	3.78	2.02	1.65	1.83
3/8	0.39	3.78	2.02	1.65	1.83
1/2	0.59	3.78	2.44	1.81	1.99
3/4	0.78	4.76	2.71	2.28	2.48
1	0.98	4.76	3.07	2.44	2.64
1-1/4	1.25	5.94	3.42	3.00	3.15
1-1/2	1.57	5.94	3.89	3.23	3.38
2	1.94	6.30	4.33	3.74	3.74
2-1/2	2.56	8.11	5.59	4.84	-
3	3.15	8.11	6.45	5.23	-
4	3.94	10.27	7.60	6.49	-

Standard Materials

Ref. No.	Description	Material	Qty
1	Body	Brass CW 617N UNI EN 12165	1
2	Ball	Brass CW 617N UNI EN 12165 (Nickel-Chrome Plated)	1
3	End Cap	Brass CW 617N UNI EN 12165	1
4	Seat	PTFE	2
6	Stem	Brass CW 614N UNI EN 12164	1
7	Stem Packing	PTFE	1
7A	Stem O-ring	NBR 75 Shore A	1
8	Handle	Fe P 11 UNI 5867	1
9	Handle Cover	Vinyl	1
10	Thrust Washer	PTFE	1
11	Gland Nut	Zinc Plated Steel 6S	1
11A	Packing Gland	Brass CW 614N UNI EN 12164	1
13	Handle Nut	Zinc Plated Steel 6S	1
14	Locking Pad	Fe P 11 UNI EN 10111	1
14A	Bushing	ZAMA G Zn A14 UNI EN1774	1

DOC: FNWBV420SSLL07 Ver. 7/09

ASHCROFT®

Model A4 Intrinsically Safe and Non-Incendive Pressure Transmitter

LOOK FOR THESE MARKS ON OUR PRODUCTS

APPLICATIONS:

Oil field equipment, upstream oil and gas production, natural gas compression and transfer control, alternative energy projects

FEATURES:

- ***FM and CSA listings***
- ***Choice of 0.25, 0.50 or 1.0% accuracy***
- ***Pressure ranges from 5 psi through 10,000 psi***
- ***CE mark***
- ***316L SS wetted materials, 17-4 PH optional***
- ***304 SS case in standard, welded or explosion proof construction***
- ***Optional absolute pressure ranges available***
- ***Zero and span access (Basic Enclosure)***

The Ashcroft® A4 pressure transmitter is ideal for a broad spectrum of pressure sensing requirements where Intrinsically Safe or Non-Incendive hazardous location ratings are required.

The Ashcroft® A4 is designed and manufactured to provide the user with accurate, reliable, and stable output data. This is accomplished through the use of an on board microprocessor, that is programmed during a unique digital compensation process, to provide extremely linear and precise performance over the entire specified pressure and temperature range.

PERFORMANCE SPECIFICATIONS

Reference temperature 70°F (21°C)

Accuracy, Three Classes (% Span): ±.25 ±0.5 ±1.0

Includes non-linearity (Terminal Point Method), hysteresis, non-repeatability, zero offset and span setting errors

Best Fit Straight Line* (BFSL): ±.20 ±.40 ±.50

Includes non-linearity hysteresis, non-repeatability errors

*Add ±.05% for ranges above 5000 psi

Stability:
≤ ±0.25% Span/year @ reference conditions

Durability: Greater than 10 million cycles

ENVIRONMENTAL SPECIFICATIONS

Temperature Limits:

Storage:	–40 to +125°C	(–40 to 257°F)
Process:	–40 to +125°C	(–40 to 257°F)
Operating:	–40 to +125°C	(–40 to 257°F)
Compensated*:	–20 to +85°C	(–4 to 185°F)

*Consult factory for other options

Temperature Effects: –20 to +85°C (–4 to 185°F)
- 1.0% of Span for .25% Accuracy Class
- 2.0% of Span for .50% and 1.0% Accuracy Classes

Humidity Effects: No performance effects from 0 to 95% relative humidity, non-condensing, 0-100% RH with "W" enclosure.

*Consult factory

FUNCTIONAL SPECIFICATIONS

Respone Time: <2ms

Pressure Ranges: Vacuum, gauge, compound and absolute pressure from 0-5 psi through 0-10,000. Equivalent ranges in bar available. See order guide section (reverse).

Vibration Effect:

Shock:	100g Peak, 11ms
Random:	10g RMS, 20-2000Hz
Sweep:	50-2000Hz, 5g peak

Position Effect: ±0.02% Typical

CE Mark (standard): EN 61326:1997 + A1: 1998 Annex A Heavy Industrial Immunity (Annex A, Table A.1) Light Industrial/Residential Emission (Table 4)

Overpressure (F.S.)*:	Proof	Burst
0#/vac. to 300 psi	1.5 x F.S.	min. 2 x F.S.
500-10,000 psi	1.2 x F.S.	1.5 x F.S.

*For higher overpressure ratings use XK8 option. See page 2 for additional option.

ELECTRICAL SPECIFICATIONS

Output Signal:		Supply Voltage: (unregulated) Minimum	Maximum
4-20mA*	(2 Wire)	12Vdc	30Vdc

*For Intrinsically Safe see entity parameters for supply voltage and load limits. Refer to Ashcroft A4 Installation & Maintenance document "I&M011-10166-A4."

Power Requirements:
See load chart page 2

Electrical Terminations: See To Order section (reverse.) for options

Circuit Protection: Reverse polarity and mis-wire protected

Insulation Resisance (Circuit to Case): 100Mohm @ 30Vdc

PHYSICAL SPECIFICATIONS

Case: Material 304SS

Wetted Materials: 316L SS diaphragm and presure port, optional 17-4PH SS diaphragm and 316L SS pressure port (see How to Order Section).

Ingress Protection Rating:

Enclosure	Code	Rating
Basic	(S)	IP65, NEMA 4X
All Welded (w/o Z/S)	(W)	IP67, NEMA 6

HAZARDOUS AREA CERTIFICATIONS

Intrinsically Safe – FM/CSA:

Intrinsic Safety:	Class I, II and III Div.1 and 2, Groups A, B, C, D, F and G per entity requirements see Ashcroft drawing # 825A022
Non-Incendive:	Class I, II and III Div.2, Groups A, B, C, D, F and G, no barriers needed

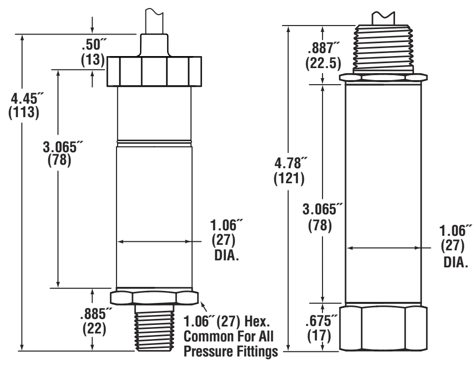
NOTE:
Refer to Ashcroft Model A2 for Heavy Industrial, non-hazardous rated configurations and Ashcroft Model A2X for Explosion/Flame Proof applications.

Ashcroft Inc., 250 East Main Street, Stratford, CT 06614 USA
Tel: 203-378-8281 • Fax: 203-385-0408
email: info@ashcroft.com • www.ashcroft.com

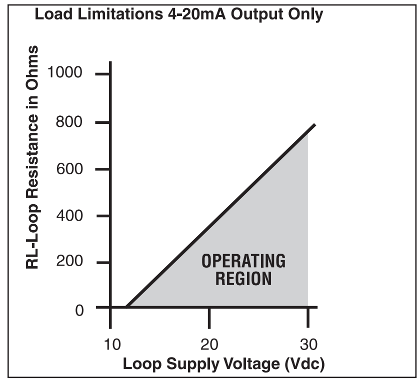
ASHCROFT®

Model A4 Intrinsically Safe and Non-Incendive Rated Pressure Transmitter

DIMENSIONS dimensions in ( ) are mm



INTRINSICALLY SAFE (ENCLOSURE S, W)



VdcMIN = 12V + (0.022A* X (RL))

$R_L = R_S + R_W$

R_L = Loop Resistance (ohms)

R_S = Sense Resistance (ohms)

R_W = Wiring Resistance (ohms)

* (Includes a 10% safety factor)

XK8 OVERPRESSURE (F.S.)

	Proof	Burst
0 to 2000 psi	200%	800%
3000 to 5000 psi	150%	300%
7500 to 10,000 psi	120%	150%

NOTE:

Refer to Ashcroft Model A2 for Heavy Industrial, non-hazardous rated configurations and Ashcroft Model A2X for Explosion / Flame Proof applications.

How To Order

A4 | S | A | M02 | 42 | D1 | 60# | G | X

Type Configuration
(A4)

Enclosure
(S) Basic
(W) Welded w/out Zero & Span Access

(See electrical termination coding for available selections)

Accuracy / Temp. EffectS
(A) 0.25%/≤1.0% (–20°C to +85°C)
(B) 0.50%/≤2.0% (–20°C to +85°C)
(C) 1.00%/≤2.0% (–20°C to +85°C)

Pressure Connection
(M01) ⅛ NPT-M
(M02) ¼ NPT-M
(F02) ¼ NPT-F
(MEK) 7⁄16-20 SAE-M
(F09) 9⁄16-18 (¼)-F (Aminco)
(M04) ½ NPT-M
(F04) ½ NPT-F
(MG4) G ½ M
(VM2) VCR inlet fitting ¼˝ VCR gland with 9⁄16-18 male nut
(VF2) VCR inlet fitting ¼˝ VCR gland with 9⁄16-18 female nut

(others avaiable upon request)

Output Signal
(42) 4-20mA

Electrical Termination

Integral Cable (Pigtail)
(F2) 3 shielded cable[1]
(P1) (specify length)[1]

Hirschmann Style Form A DIN 43650-A
(DN) w/o mating conn.[1]
(D0) with mate, no cable[1]
(D2) with mate, 3 cable[1]
(D1) with mate, (specify length)[1]

4-Pin Bendix Style
(B4) w/o mating conn.[2]
(H1) with mate, no cable[2]
(L1) with mate, 3 cable[2]
(P2) with mate, (specify length)[2]

½ NPT-M Conduit
(C1) 3 shielded cable[3]
(P7) (specify length)[3]

½ NPT-M Conduit
(C2) 3 flying leads[3]
(C4) 15 flying leads[3]

M12 Threaded
(EW) w/o mating conn.[1]
(E0) with male, no cable[1]
(E2) with male, 3 cable[1]
(E1) with male, (specify length)[1]

[1] Available with enclosure code (S)
[2] Available with enclosure code (S, W)
[3] Available with enclosure code (W)

Pressure Range

(1.5#) 1.5 psi[5],[6]	(750#) 750 psi
(5#) 5 psi[5],[6]	(1000#) 1000 psi
(10#) 10 psi[5],[6]	(1500#) 1500 psi
(15#) 15 psi[5]	(2000#) 2000 psi
(30#) 30 psi[5]	(3000#) 3000 psi
(50#) 50 psi	(5000#) 5000 psi
(60#) 60 psi	(7500#) 7500 psi
(75#) 75 psi	(10,000#) 10,000 psi[4]
(100#) 100 psi	(0# & vac.) 0 psi/vac.[5],[6]
(150#) 150 psi	(15# & vac.) Vac./15 psi[5],[6]
(200#) 200 psi	(30# & vac.) Vac./30 psi[5],[6]
(300#) 300 psi	(45# & vac.) Vac./45 psi[6]
(500#) 500 psi	(60# & vac.) Vac./60 psi[6]

[4] 17-4PH SS Sensor Required
[5] 17-4PH SS Sensor Not Available
[6] Gauge pressure only

Measurement Type
(G) Gauge Pressure Sensor
(A) Absolute Pressure Sensor

Optional X-Variations
(XCL) Non-standard[7] calibration
(XK8) 17-4PH SS Sensor Material
(X6B) Cleaned For Oxygen Service

[7] Minimum 10 pieces for non-standard pressure ranges

NOTE: All A4 pressure transmitters include a 9 pt. NIST traceable calibration certificate

Ashcroft Inc., 250 East Main Street, Stratford, CT 06614 USA
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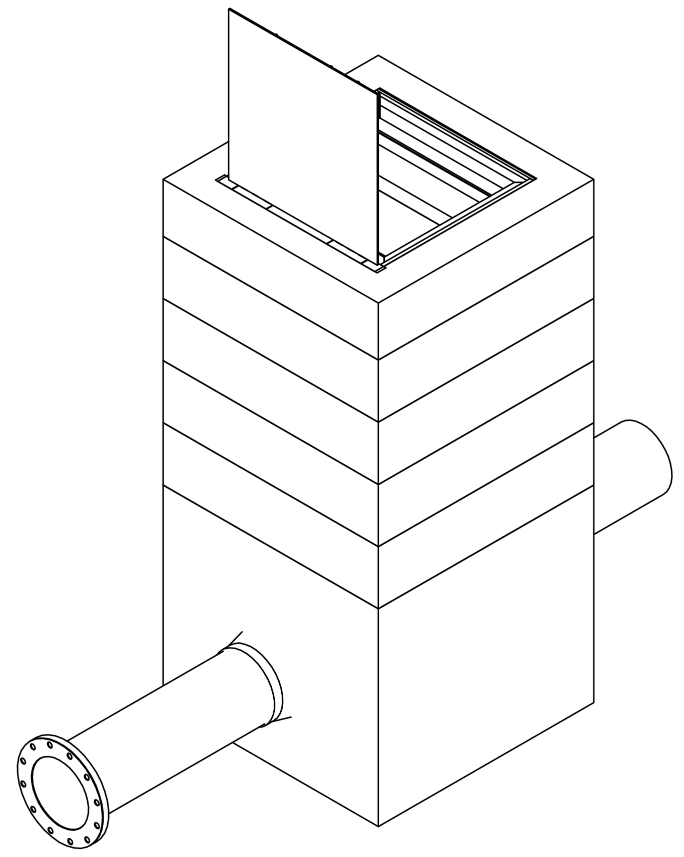
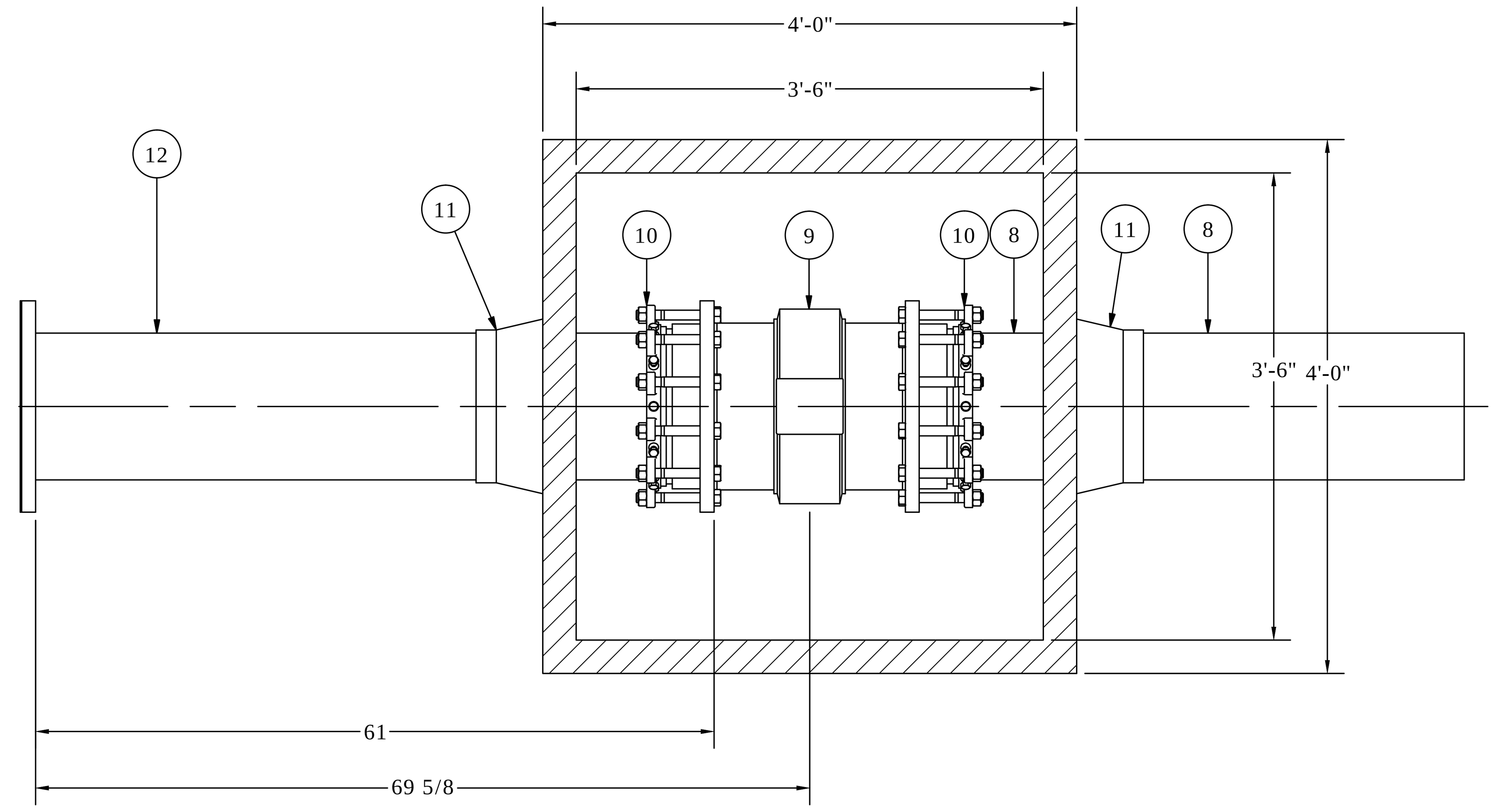
email: info@ashcroft.com • www.ashcroft.com

3.06 METER VAULT

This section contains information pertaining to the meter vault. There is both technical information and related drawings necessary for the meter vault construction.

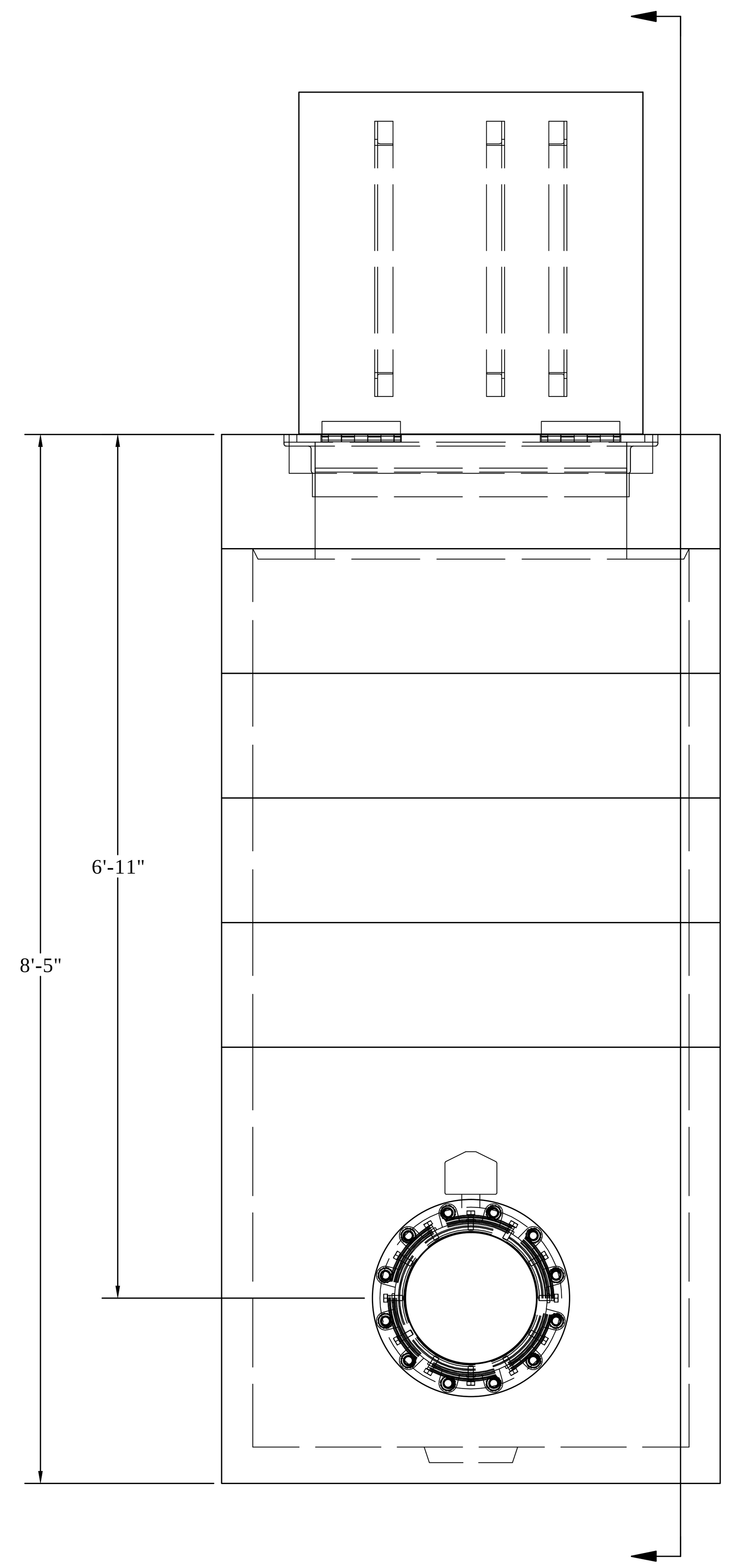
This section is structured as follows:

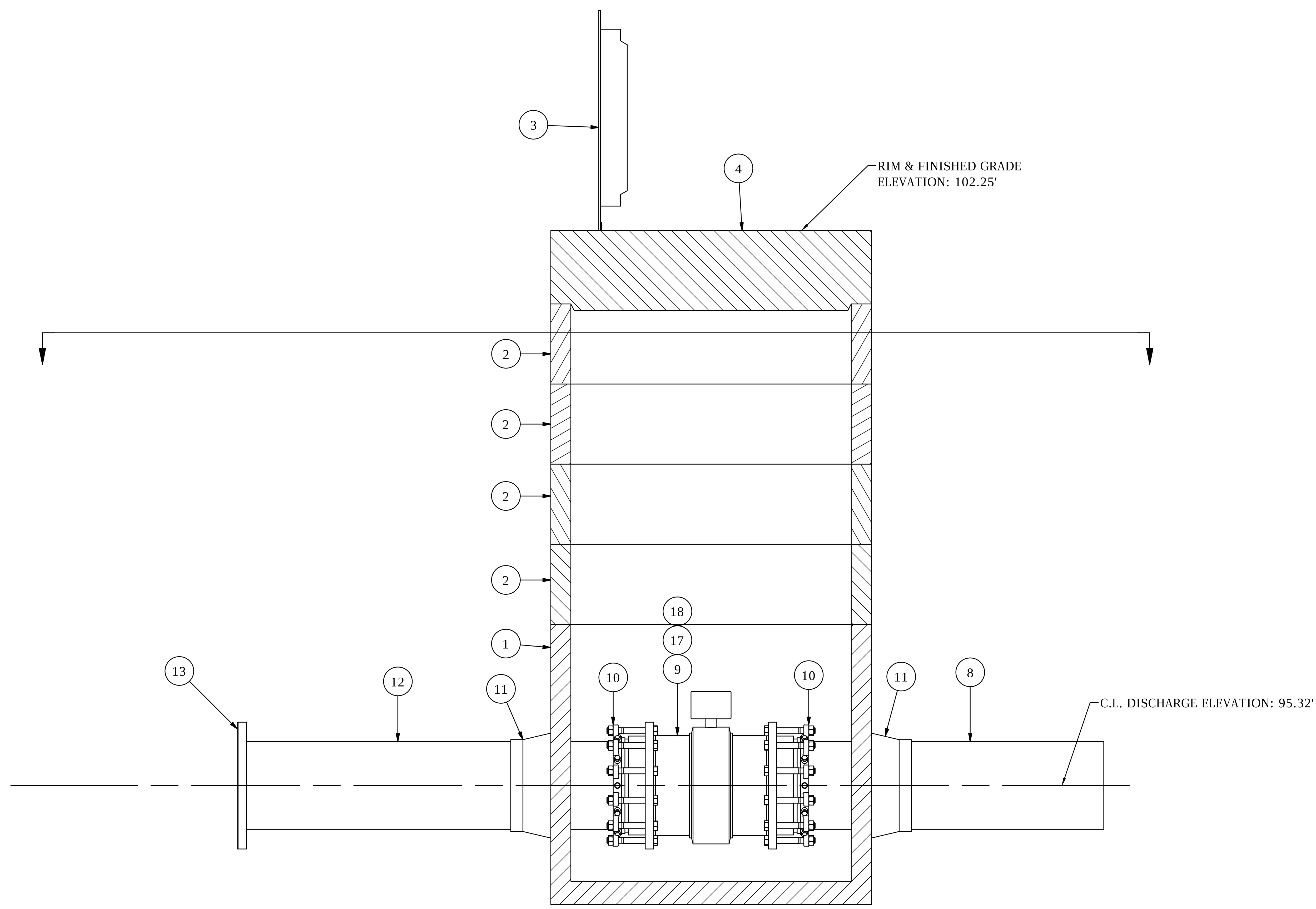




Parts List			
ITEM	QTY	STOCK NUMBER	DESCRIPTION
1	1	20-6221	BASE - VV - 444B
2	4	22-5245	RISER - VV - 444 - 1 FT
3	1	23-4713	HATCH - FLOODTIGHT - H20 - 24X30
4	1	24-4716	TOP SLAB -VV - 444 - H20
5	2	25-5158	PIPE STAND - 12in - S92 SAD - NO BASE
8	1	40-XXXX	PIPE - 316SS - 12in X 48 IN
9	1	41-XXXX	FLOW TUBE - 12in - ABB WATER MASTER
10	2	42-5271	MEGAFLANGE ADAPTER - 12in - SERIES2100
11	2	43-5193	KOR-N-SEAL - 16in CORE - 12in PIPE
12	1	45-5589	SPOOL - FLG X PE - 12in X 60in - SCH40 316SS
13	1	47-5267	GASKET - FLANGE - 12in X 1/8in
14	105	51-5510	SEALANT - .75in X .75in X 21ft CS-202
15	85	51-5949	TAPECOAT - 6in X .65mils X LFT
16	1	51-ROM	NEVER SIEZE - TUBE
17	1	62-XXXX	TRANSMITTER - ABB - IP68 RATED
18	1	62-XXXX	SIGNAL CABLE - ABB - 100FT

NOTE: METER VAULT TOP SLAB IS H20 OCCASIONAL TRAFFIC RATED





PIPING SUPPORT STAND
IS INCLUDED BUT NOT
SHOWN.

NOTE: ALL DIMENSIONS AND ELEVATIONS SHOWN ARE NOMINAL DIMENSIONS. IT IS THE RESPONSIBILITY OF THE ON-SITE CONTRACTOR OR ROMTEC UTILITIES CUSTOMER (NOT ROMTEC UTILITIES) TO VERIFY THE ACCURACY OF ANY CRITICAL DIMENSIONS OR ELEVATIONS PRIOR TO SETTING OR INSTALLING ANY EQUIPMENT.

ALL MATERIALS SHOWN ON THIS SHEET WILL BE SUPPLIED BY ROMTEC UTILITIES AND DELIVERED TO THE SITE AFTER THE HOLE HAS BEEN EXCAVATED AND SHORED. THE CONTRACTOR SHALL SUPPLY A CRANE OF SUFFICIENT SIZE TO LOWER ALL THE CONCRETE PIECES INTO THE HOLE SAFELY. THE THE CONTRACTOR SHALL INSTALL THE WET WELL (AND VALVE VAULT AND METERING VAULT IF APPLICABLE). ROMTEC UTILITIES WILL PROVIDE A REPRESENTATIVE FOR TECHNICAL ASSISTANCE ON THE DAY OF INSTALLATION TO ANSWER ANY QUESTIONS THAT MAY ARISE. THE CONTRACTOR IS RESPONSIBLE FOR ALL PLUMBING AND ELECTRICAL CONNECTIONS AND INSTALLATION. ITEMS NOTED AS "BY OTHERS" WILL BE PROVIDED AND INSTALLED BY THE CONTRACTOR. ROMTEC UTILITIES WILL NOT INSTALL ANY OF THE COMPONENTS SHOWN ON THIS PAGE.

Two working days before you dig
CALL FOR THE BLUE STAKES
1-800-STAKE-IT
Blue Stake Center
1-800-782-5348

CVL
4550 North 12th Street
Phoenix, Arizona 85014
Telephone 602-264-6831
http://www.cvlci.com

Coe & Van Loo Consultants, Inc.

NO.	REVISION	DATE

BAY MEADOWS
(SAN MATEO, CA.)

12" - METER VAULT

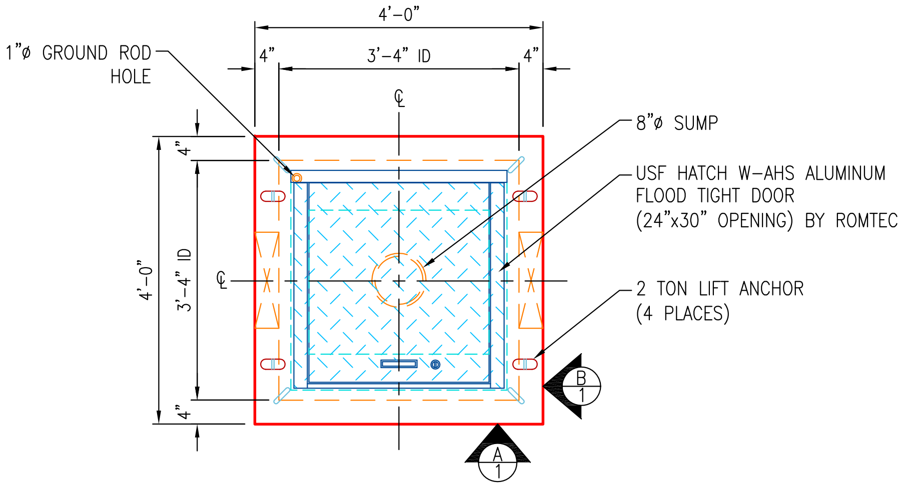
REGISTERED PROFESSIONAL ENGINEER
LES F. OLSON
No. C-30733
8-11-14
CIVIL
STATE OF CALIFORNIA

DRAWING
M5

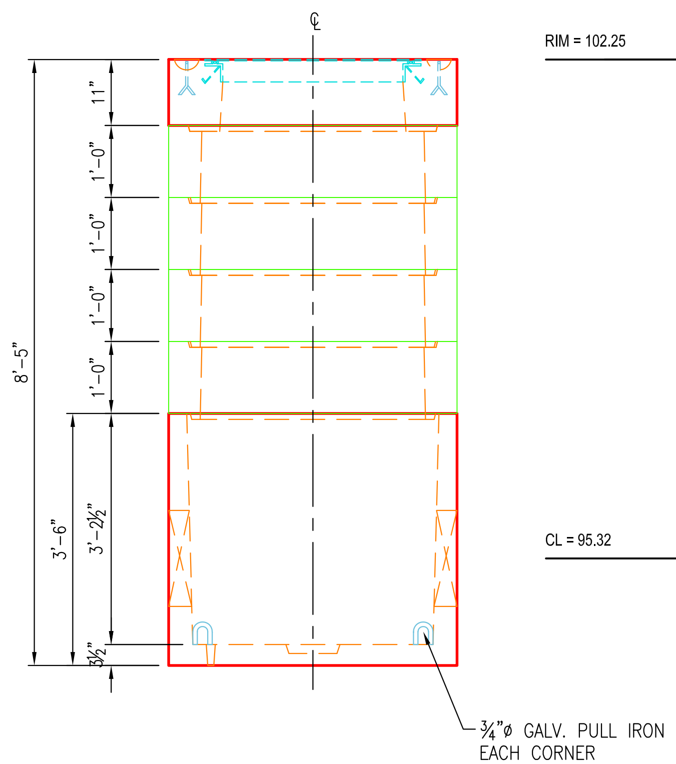
CVL Contact: ERIC LAURIN
CVL Project #: 1.01.0204801
CVL File #:

10-14-11

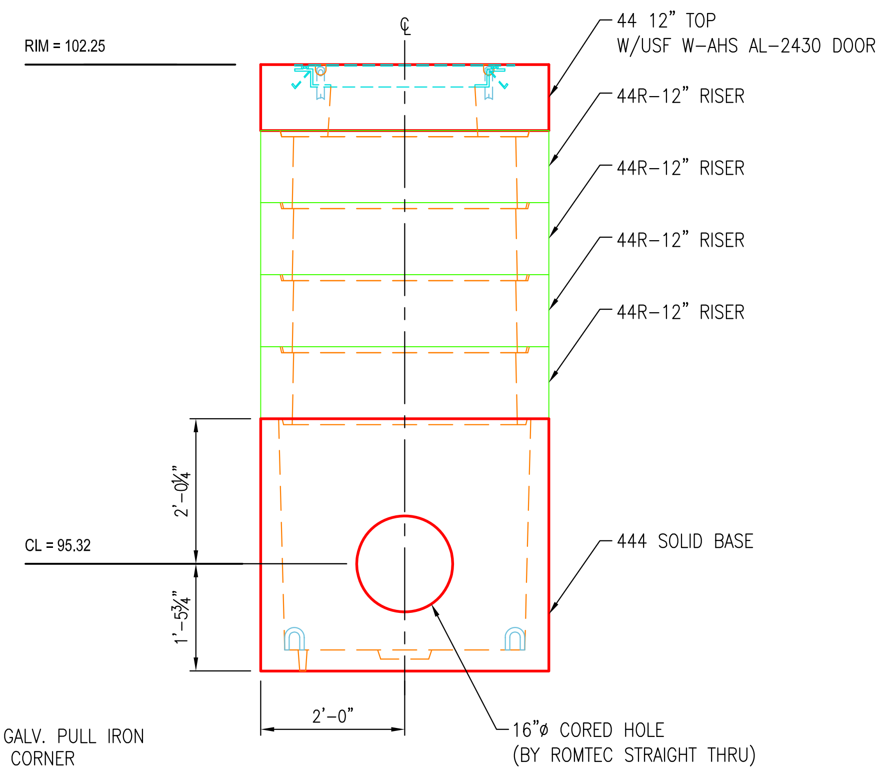
$USER$
$DATE$
$TIME$
$FILENAME$



PLAN VIEW
SCALE: 3/8" = 1'-0"



VIEW A
SCALE: 3/8" = 1'-0"



VIEW B
SCALE: 3/8" = 1'-0"

STRUCTURAL NOTES

1. CONCRETE: 28 DAY COMPRESSIVE STRENGTH f'c = 5,500 PSI
   STRIPPING STRENGTH f'c = 2,500 PSI
2. REBAR: ASTM A-615 GRADE 60
3. MESH: ASTM A-1064 GRADE 65
4. DESIGN: -ACI-318 BUILDING CODE
   -AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES
5. LOADS: -HS-20 TRUCK WHEEL LOAD W/ IMPACT
   -ASTM C-857 "MIN. STRUCTURAL DESIGN LOADING FOR UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURES"
   -ASTM C-890 "MIN. STRUCTURAL DESIGN LOADING FOR MONOLITHIC OR SECTIONAL PRECAST CONCRETE WATER AND WASTEWATER STRUCTURES"
   -40 PCF LATERAL SOIL PRESSURE ABOVE WATERTABLE
   -80 PCF LATERAL SOIL PRESSURE BELOW WATERTABLE

PRODUCT WEIGHTS

SECTION	WEIGHT
TOP W/DOOR	1,800 LBS.
1' RISER	816 LBS.
1' RISER	816 LBS.
1' RISER	816 LBS.
1' RISER	816 LBS.
BASE	2,650 LBS.
TOTAL	7,714 LBS.

Oldcastle Precast®
PO Box 323 Wilsonville, OR 97070
PHONE: 503 682-2844 FAX: 503 682-2657

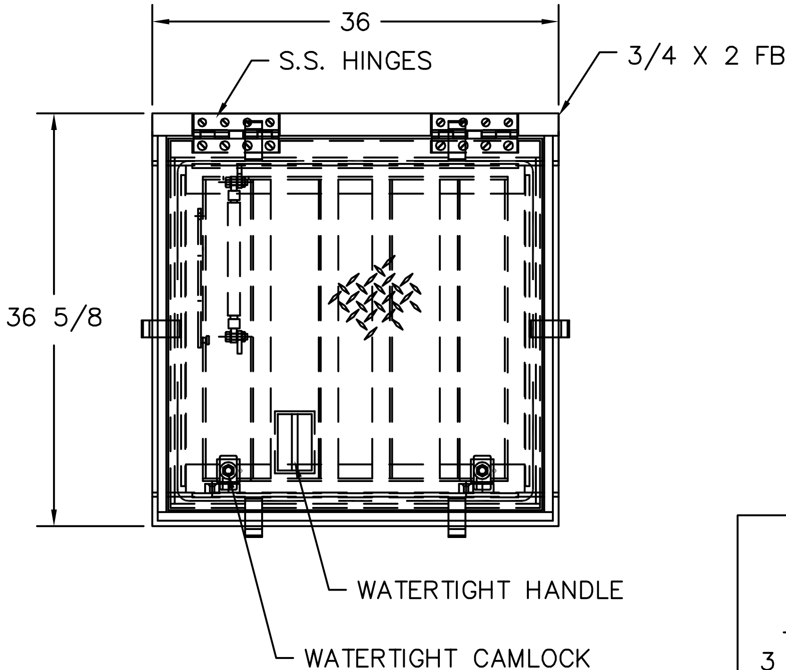
444 SOLID W/44 12" TOP USF-2430

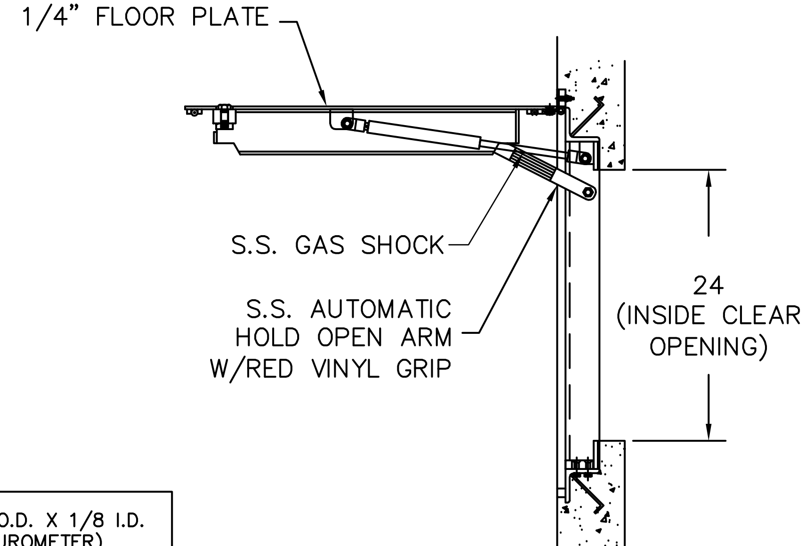
SUBMITTAL
BAY MEADOWS 12" METER VAULT
ROSEBURG, OR

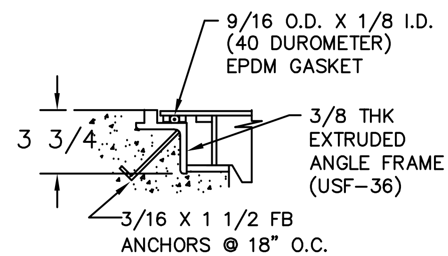
CUSTOMER
ROMTEC

DATE	SALES	DRAWN	ENGINEER	CHECKED	SALES ORDER	LN
7/11/14	TC	ML				

DRAWING NUMBER	REVISION	SHEET
444SLD-BAY MEADOWS	REV DATE	1 OF 1



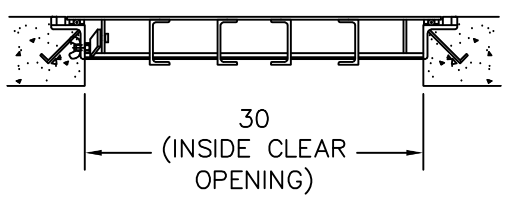




FRAME/COVER DETAIL

NOTES:

1– MATERIAL: ALUMINUM
2– LOADING: DESIGNED FOR OFF STREET LOCATIONS WHICH MAY OCCASIONALLY RECEIVE H–20 WHEEL LOADS. (CAPABLE OF HOLDING UP TO 25 FEET HEAD OF WATER)
3– 316 STAINLESS STEEL BOLTS & NUTS
4– APPROX. HATCH WEIGHT: 115 LBS.
5– AREA OF FRAME IN CONTACT WITH CONCRETE TO BE PAINTED WITH BITUMINOUS COATING



INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M

TOLERANCES UNLESS OTHERWISE SPECIFIED

FRACTIONAL
1/16 = ±1/32
1/32 = ±1/64

U.S.F. FABRICATION INC.
HIALEAH, FLORIDA

HATCH W–AHS 24 X 30 ALUMINUM
W/316.S.S.GAS SHOCKS & BIT. PAINT

DWN. BY: RT	SCALE: 1=12	QUOTE# 226818	DATE: 03/11/13
CHK. BY: A.Q.	DWG.# 78206	SHEET SIZE: B	SHEET NO: 1 OF 1	REV:

3.06.4 METER VAULT DATA SHEETS

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ConSeal™
Concrete Sealants INC.

CS-202

Butyl Rubber Sealant

APPLICATIONS

For self-sealing joints in: Manholes, Concrete Vaults, Septic Tanks, Concrete Pipe, Box Culverts, Utility Vaults, Burial Vaults, and Vertical Panel Structures.

SEALING PROPERTIES

- Provides permanently flexible watertight joints.
- Low to high temperature workability: 0°F to 120°F (-12°C to 48°C)
- Rugged service temperature: -30°F to +200°F (-34°C to +93°C)
- Excellent chemical and mechanical adhesion to clean, dry surfaces.
- Sealed Joints will not shrink, harden or oxide upon aging.
- No priming normally necessary. When confronted with difficult installation conditions, such as wet concrete or temperatures below 40°F (4°C), priming the concrete will improve the bonding action. Consult Concrete Sealants for the proper primer to meet your application.

HYDROSTATIC STRENGTH

ConSeal CS-202 meets the hydrostatic performance requirement as set forth In ASTM C-990 section 10.1 (Performance requirement: 10psi for 10 minutes in straight alignment – in plant, quality control test for joint materials.)

SPECIFICATIONS

ConSeal CS-202 meets or exceeds the requirements of Federal Specification SS-S-210 (210-A), AASHTO M-198B, and ASTM C-990-91.

P.O. Box 176, New Carlisle OH, 45344 • 937.845.8776 or 800.332.7325
FAX 937-845-3587 • www.conseal.com

ConSeal™ Concrete Sealants INC.

CS-202

Butyl Rubber Sealant

PHYSICAL PROPERTIES

	Spec	Required*	CS-202
Hydrocarbon blend content % by weight	ASTM D4 (mod.)	50% min.	52%
Inert mineral filler % by weight	AASHTO T111	30% min.	35%
Volatile Matter % by weight	ASTM D6	2% max.	1.2
Specific Gravity, 77°F	ASTM D71	1.15-1.50	1.20
Ductility, 77°F	ASTM D113	5.0 min.	12
Penetration, cone 77°F, 150 gm. 5 sec.	ASTM D217	50-100	60-65
Penetration, cone 32°F, 150 gm. 5 sec.	ASTM D217	40 mm	50-55
Flash Point, C.O.C., °F	ASTM D92	350°F min.	425°F
Fire point, C.O.C., °F	ASTM D92	375°F min.	450°F

IMMERSION TESTING

• 30-Day Immersion Testing: No visible deterioration when tested in 5% Caustic Potash, 5% Hydrochloric Acid, 5% Sulfuric Acid, and 5% saturated Hydrogen Sulfide. *

• One Year Immersion Testing: No visible deterioration when tested in 5% Formaldehyde, 5% Formic Acid, 5% Sulfuric Acid, 5% Hydrochloric Acid, 5% Sodium Hydroxide, 5% Hydrogen Sulfide and 5% Potassium Hydroxide.

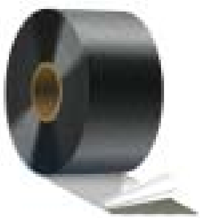
* Requirements of ASTM C-990 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.

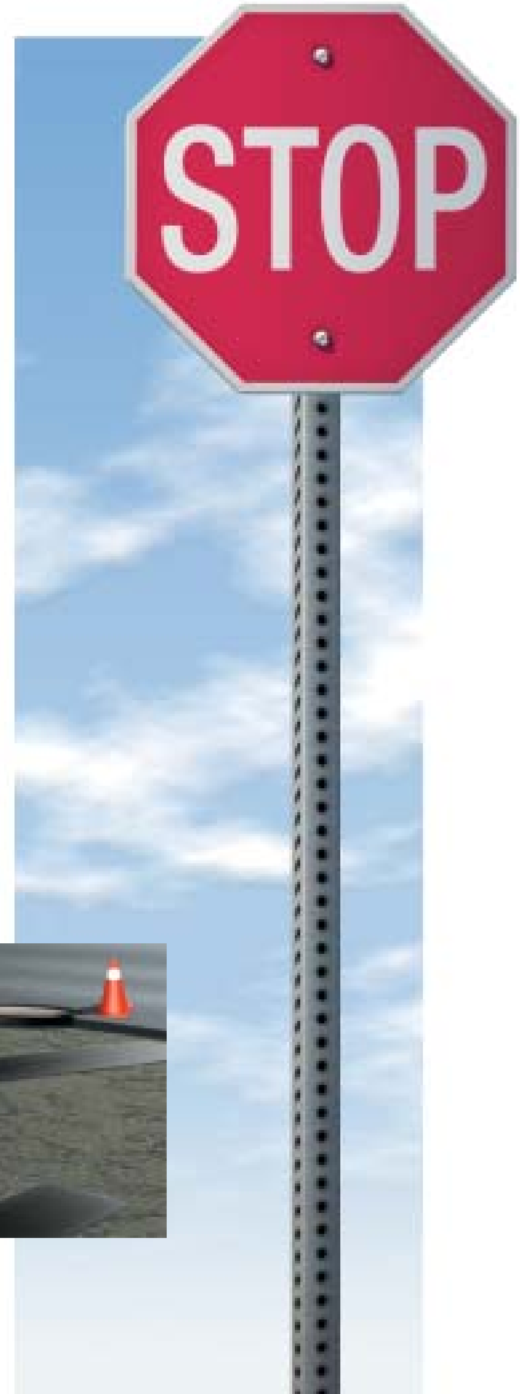
P.O. Box 176, New Carlisle OH, 45344 • 937.845.8776 or 800.332.7325
FAX 937-845-3587 • www.conseal.com

ROMTEC UTILITIES RECOMMENTATION FOR USE AS JOINT TAPE

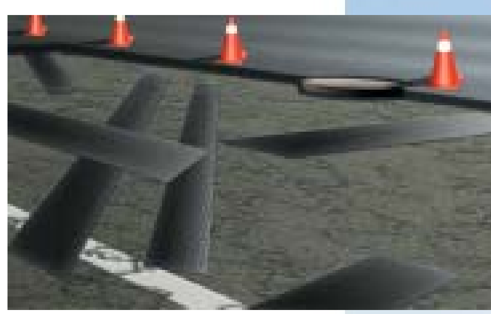
TAPECOAT® M860 PAVEMENT REPAIR COATING

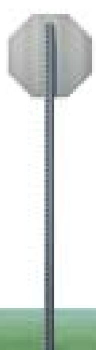
Protection for Concrete and Asphalt Surfaces





Tapecoat M860 provides quick and easy repair of cracks in concrete and asphalt surfaces. This cold-applied, self-adhering tape is effective as a temporary patching material and also offers excellent bonding for repair of the substrate prior to a complete asphalt overlay. Tapecoat M860 solves maintenance problems in paving material on city streets, highways, and parking structures. This puncture-resistant coating can also protect transducer and sensor wiring from tire damage, prevent pavement deterioration due to deformation in heavy-traffic areas, and provide quick temporary repair to paved surfaces on bridges and airport runways and tarmacs. Tapecoat M860 retains its ability to bond under pressure at temperatures as low as 0° F, making this coating ideal for temporary repairs during the cold winter months.





Tapecoat® M860 Pavement Repair Coating

- *Excellent bond to concrete and asphalt surfaces*
- *Applies easily in long lengths or short pieces*
- *Cold-applied tape with quick release liner*
- *Impermeable to water and salt*
- *Puncture-resistant*
- *Prefabricated to provide uniform thickness*
- *Environment-friendly*

Features/Specifications/Application

Tapecoat® M860

A pre-formed, cold-applied, self-adhering material that is impermeable to water and salt.

Composition

Tapecoat M860 is a pre-formed, cold-applied coating. The adhesive is manufactured from specially formulated elastomer and resins bonded to a woven highly puncture-resistant polymer.

Technical Data

Color:	Black
Shelf life:	Rotate stock yearly
Low temp flex:	Excellent
Bacteria resistance:	Excellent
Thickness:	.060" Nominal
Water Vapor Transmission Rate, Permeance:	0.01 perms(grams/sq.ft.hr./in. Hg) Maximum
Tensile Strength:	50 lb.in. Minimum
Puncture Resistance: (Mesh)	200 lb. Minimum
Pliability-1/4" Mandrel 180° bend -30°F:	No cracks in mesh or adhesive

Surface Preparation

Tapecoat M860 should be applied over dry pavement that is free of dirt, debris or other foreign matter. Pavement cracks wider than 3/8" should be pre-filled with hot or cold crack material prior to applying Tapecoat M860 to assure longer protection of the crack filling material against surface wear.

Option

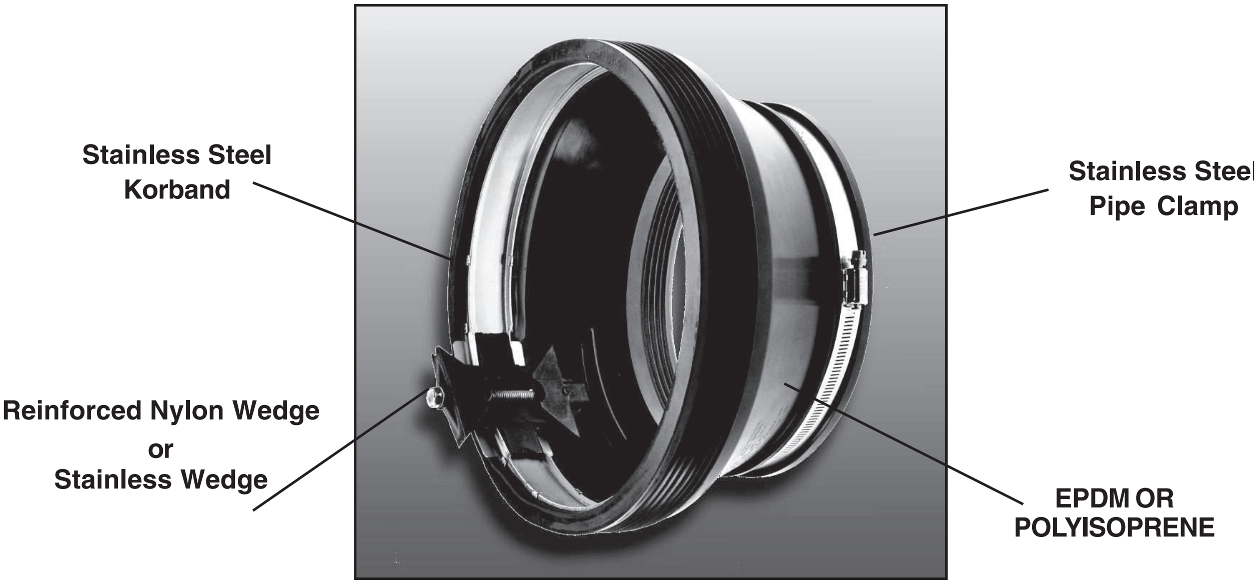
If the application is taking place in extreme cold (below 32°F/O°C) a liquid primer will enhance the immediate bond. TC Omniprime is the compatible primer for use with this product.

TAPECOAT®
PO Box 631, Evanston, IL 60204-0631 • 1527 Lyons St. Evanston, IL 60201-3551 USA
800/758-6041 847/866-8500 Fax: 800/332-8273 Fax: 847/866-8596 www.tapecoat.com

KOR-N-SEAL® I & II

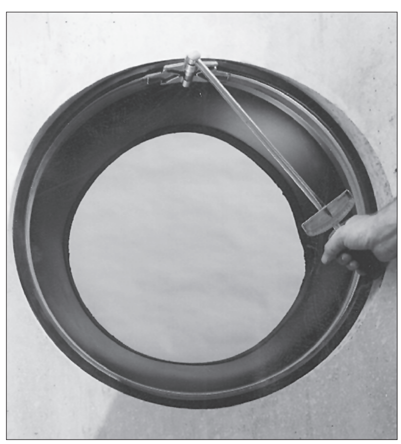
FLEXIBLE PIPE-TO-MANHOLE CONNECTORS

SPECIFICATION SHEET



KOR-N-SEAL I - WEDGE KORBAND CONNECTOR ASSEMBLY

Install Kor-N-Seal I - Wedge Korband with Socket Wrench & Torque Limiter



Install Kor-N-Seal II - Wedge Korband with Standard Torque Wrench

Install Pipe Clamp(s) with T-Handle Torque Wrench

www.npc.com
250 Elm Street • P.O. Box 301
Milford, NH 03055, U.S.A.
Tel: 603-673-8680 • 800-626-2180 • Fax: 603-673-7271

02/06

KOR-N-SEAL® I & II

Flexible Pipe-to-Manhole Connectors

SPECIFICATION SHEET

PERFORMANCE

Test	ASTM Method	Test Requirements	Kor-N-Seal ® I & II
Head Pressure	C923 - 7.1	0° - 13 psi (30 ft) for 10 min. 7° - 10 psi (23 ft) for 10 min.	+13 psi for 10 min. +10 psi for 10 min.
Deflection Test	C923 - 7.2.2	7° in any direction	Over 7° in any direction
Load Test	C923 - 7.2.3	150 lbs/in. pipe dia.	Over 150 lbs/in. pipe dia.

Performed on all standard sizes of Kor-N-Seal Connectors.

RESILIENT EPDM OR POLYISOPRENE RUBBER

Conforms to ASTM C923

Test	ASTM Method	Test Requirements	TEST RESULTS Kor-N-Seal® I & II
Chemical Resistance	D543, at 22°C for 48 h		
1 *N* Sulfuric Acid		No weight loss	No weight loss
1 *N* Hydrochloric Acid		No weight loss	No weight loss
Tensile Strength	D412	1200 psi	1580 psi
Elongation at Break		350% min.	500%
Hardness	D2240 (shore A durometer)	± 5 from the manufacturer's specified hardness	48 ± 5
Accelerated Oven-Aging	D573 70 ± 1°C for 7 days	Decrease of 15%, max. of original tensile strength, decrease of 20% max. of elongation	10.1% tensile decrease 14.0% elongation decrease
Compression Set	D395, method B, at 70°C for 22 h	Decrease of 25%, max. of original deflection	13% decrease
Water Absorption	D471, immerse 0.75 by 2-in. specimen in distilled water at 70°C for 48 h	Increase of 10%, max. of original by weight	.8% increase
Ozone Resistance	D1171	Rating 0	Rating 0
Low-temperature Brittle Point	D746	No fracture at -40°C	No fracture at -40°C
Tear Resistance	D624, method B	200 lbf/in.	No tear at 210 lbf/in.

INTERNAL KORBAND

Conforms to ASTM C923, ASTM A666, and A240

– Korband Assembly is manufactured of 300 series stainless steel.
– Toggle Expander is made of 300 series stainless steel.
– The 106/406 series Wedge Expander is made from reinforced nylon or 300 series stainless steel.
– The 206/306 series Wedge Expander is made from 300 series stainless steel.

EXTERNAL PIPE CLAMP

Conforms to ASTM C923, ASTM A666, and A240

External take-up clamps are manufactured of 300 series stainless steel.

www.npc.com
250 Elm Street • P.O. Box 301
Milford, NH 03055, U.S.A.
Tel: 603-673-8680 • 800-626-2180 • Fax: 603-673-7271

NPC Kor-N-Seal Pipe-to-Manhole Connector

Technical Specification

Scope:

This specification describes the function of the NPC Kor-N-Seal pipe-to-manhole connector, its principle of operation, and the component materials that constitute the Kor-N-Seal connector, and their physical properties.

Product Application:

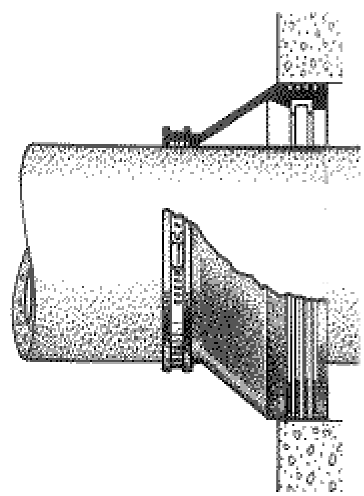
NPC Kor-N-Seal connectors are designed and manufactured to meet or exceed the requirements of ASTM C-923 "Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals". This specification requires the connector to provide a watertight seal under the following conditions:

- 10 PSI (23 feet head) of groundwater pressure
- Minimum 7 Degrees of pipe articulation in any direction
- Radial loading test of 150 pounds per inch diameter of pipe

Principle of Operation:

The Kor-N-Seal connector creates a watertight seal between the pipe and manhole by first sealing to the inside of the cored or formed hole in the manhole and then sealing to the outside of the pipe. See illustration at right.

The seal at the inside of the manhole is created by the stainless steel Korband. The Korband is located inside of the end of the Kor-N-Seal connector that fits into the manhole. Once the Kor-N-Seal connector is located in the manhole, the diameter of the Korband is increased. This compresses the Kor-N-Seal connector against the inside wall of the hole in the manhole creating a watertight seal at the manhole.



The seal at the outside of the pipe is created by the stainless steel pipe clamp(s). The pipe clamp is located on the outside of the Kor-N-Seal connector. Once the pipe has been positioned in the connector the diameter of the pipe clamp is decreased. This compresses the Kor-N-Seal connector against the outside wall of the pipe creating a watertight seal at the pipe.

Reference the Kor-N-Seal Recommeded Installation Instructions for a detailed explanation of the preparation and installation of the Kor-N-Seal connector.

KOR-N-SEAL I – STAINLESS STEEL WEDGE

Recommended Installation Procedure

Refer to reverse side *Kor-N-Seal I - Wedge Korband Installation Chart* for Hole Size Range, Connector Dimensions, and Suggested Pipe O.D. Range.

CONNECTOR INSTALLATION:

1. Check to be sure Korband is properly located in Connector groove. (Fig. 1)
2. Insert Connector Assembly into hole with Wedge Expander at top of hole. (Fig. 2)
3. Position Connector so it is square to manhole both vertically and horizontally. (Fig. 3)
4. Tighten Wedge Expander using 1/2" [13 mm] socket with a preset torque limiter for each. For each size connector use torque limiter preset to proper torque. (Fig. 4) Retorquing is not required prior to shipment.

CAUTION: DO NOT USE IMPACT WRENCH.

IMPORTANT

RECOMMENDED TORQUE		TORQUE LIMITER
Connector Inches [mm]	Foot Pounds [Newton Meters]	P/N
10 – 24 [254 – 610]	12 [16]	91440-12

Fig. 4

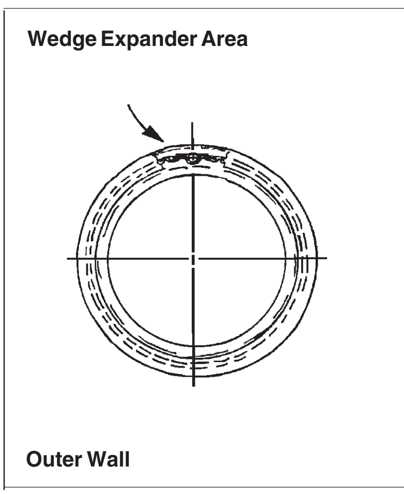


Fig. 1

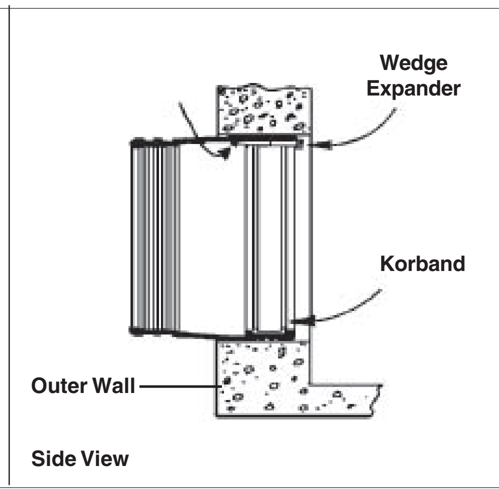


Fig. 2

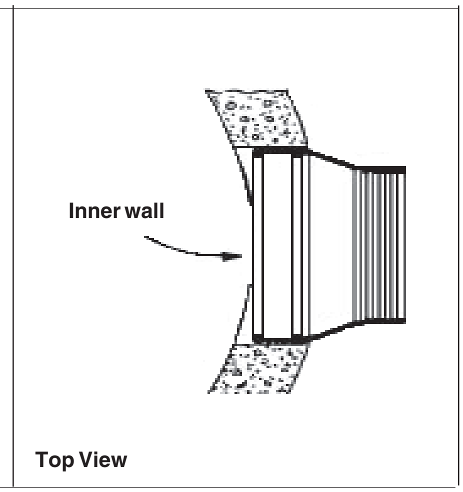


Fig. 3

PIPE INSTALLATION:

1. Center pipe in Connector opening.
2. On maximum pipe O.D. installations, use a pipe lubricant on the outside barrel of the pipe and/or the inside ridges of the Connector (under the Pipe Clamp area) to allow the pipe to slide into place more easily.
3. Position the Pipe Clamp in the Connector's Pipe Clamp groove with the screw at the top.
4. Tighten the Pipe Clamp screw to 60 inch pounds [7 Newton Meters] with a T-handle Torque Wrench, P/N 80090.
5. On minimum pipe O.D. installations, lift the rubber up underneath the Pipe Clamp screw so that the Connector contacts the bottom surface of the pipe while the Pipe Clamp screw is being tightened. Application of pipe lubrication on the underside of the clamp will also help assure that an even contraction of rubber is maintained throughout the clamping area.
6. After the Pipe Clamp has been tightened down firmly, move the pipe horizontally and/or vertically to bring it to grade.

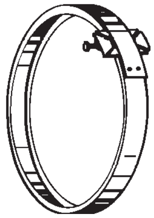
CAUTION: Pipe must **NOT** rest on Connector Korband.

CAUTION:
All capped stubs awaiting pipe installation at a later date must be restrained. Assure that a proper backfill material is used in adverse conditions. Prior to any critical usage, contact NPC Customer service at 1-800-626-2180.

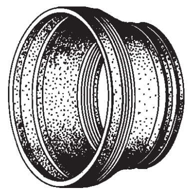
www.npc.com
250 Elm Street • P.O. Box 301
Milford, NH 03055, U.S.A.
Tel: 603-673-8680 • 800-626-2180 • Fax: 603-673-7271

KOR-N-SEAL I – STAINLESS STEEL WEDGE

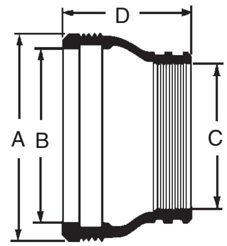
Recommended Installation Procedure

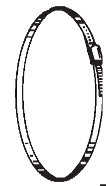


KORBAND
300 Series S.S., 16 Gauge



CONNECTOR
EPDM, Durometer 48





PIPE CLAMP
300 Series S.S., Quick Connect

Kor-N-Seal S106 Series

Connector P/N	Suggested Pipe O.D. Range Inches	Hole Size Range Inches	Connector Dimensions Inches			Pipe Clamp P/N
		A	B	C	D	
S106-12BWS	5.75 — 7.00	12.00 — 12.20	10.30	6.50	8	I-128
S106-12AWS	7.00 — 8.50	12.00 — 12.20	10.30	8.00	8	I-180
S106-12WS	8.25 — 9.75	12.00 — 12.20	10.30	9.25	8	I-180
S106-14AWS	9.50 — 11.25	14.00 — 14.20	12.25	10.50	8	I-190
S106-16BWS	9.50 — 11.25	15.95 — 16.15	14.30	10.50	8	I-190
S106-16AWS	11.25 — 13.00	15.95 — 16.15	14.30	12.25	8	I-218
S106-16WS	13.00 — 14.20	15.95 — 16.15	14.30	14.00	8	I-242
S106-20BWS	14.00 — 15.50	19.95 — 20.10	18.25	15.00	8	I-306
S106-20AWS	15.50 — 17.00	19.95 — 20.10	18.25	16.50	8	I-306
S106-20WS	17.00 — 18.15	19.95 — 20.10	18.25	18.00	8	I-306
S106-22WS	17.75 — 19.25	21.95 — 22.10	20.25	18.75	8	I-318
S106-24WS	19.60 — 21.10	23.95 — 24.10	22.25	20.60	8	I-348

Kor-N-Seal S406 Series

S406-10AWS	6.00 — 6.75	10.00 — 10.20	8.30	6.50	6	I-128
S406-10WS	7.50 — 8.20	10.00 — 10.20	8.30	8.50	6	I-180
S406-10.5AWS	6.00 — 6.75	10.50 — 10.70	8.80	6.50	6	I-128
S406-10.5WS	7.50 — 8.70	10.50 — 10.70	8.80	8.50	6	I-180
S406-11BWS	6.00 — 7.00	11.00 — 11.20	9.30	6.00	6	I-128
S406-11AWS	7.50 — 9.00	11.00 — 11.20	9.30	8.00	6	I-180
S406-12CWS	6.00 — 7.00	12.00 — 12.20	10.30	6.50	6	I-128
S406-12BWS	6.25 — 7.50	12.00 — 12.20	10.30	7.00	6	I-128
S406-12AWS	7.50 — 9.00	12.00 — 12.20	10.30	8.50	6	I-180
S406-12WS	9.00 — 10.20	12.00 — 12.20	10.30	10.00	6	I-180

Suggested pipe O.D. range comes from field experience. Refer to *Recommended Pipe Installation Procedure*.

www.npc.com
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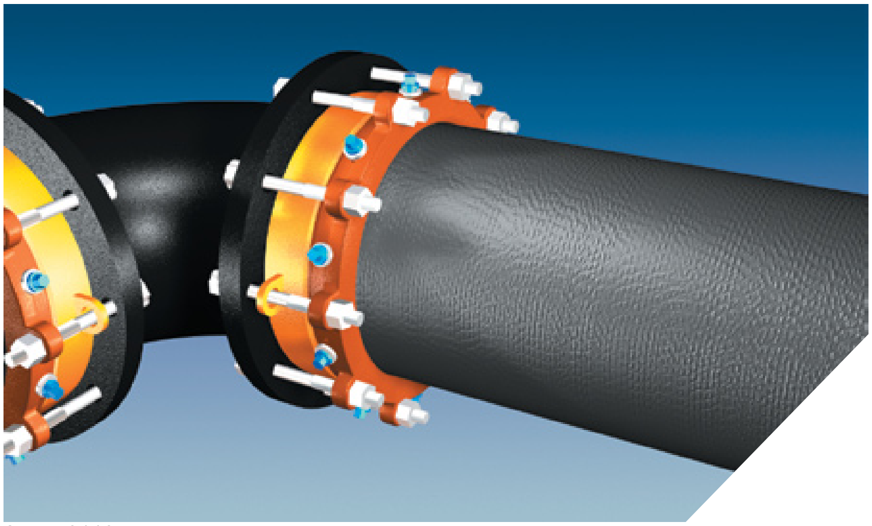
Milford, NH 03055, U.S.A.
Tel: 603-673-8680 • 800-626-2180 • Fax: 603-673-7271

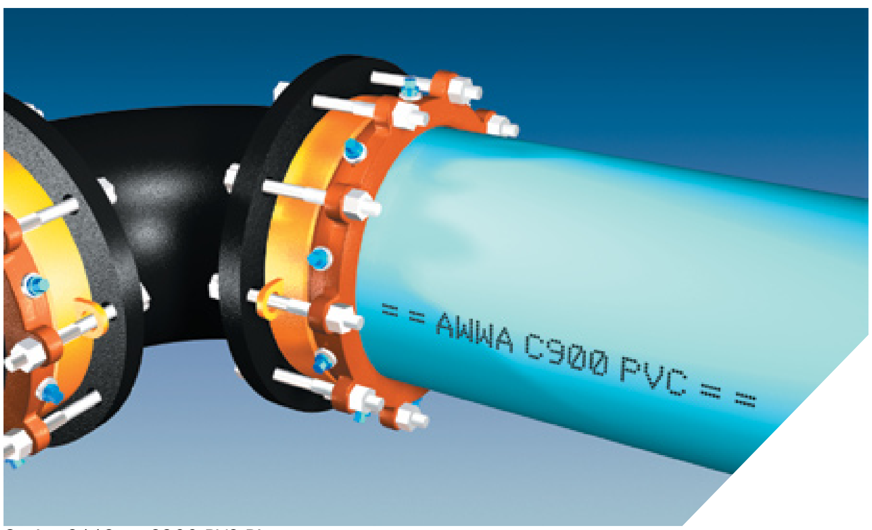
EBAA IRON INC
Your Connection to the Future™

Series 2100

MEGAFLANGE®
Restrained Flange Adapter
U.S. Patent Nos. 4627774 and 5071175



Series 2112 on Ductile Iron Pipe



Series 2112 on C900 PVC Pipe

Features and Applications:

- For adapting and restraining a plain end of ductile iron, PVC, or Steel pipe to a flange, conforming to ANSI/AWWA C110/A21.10. Not for use on plain end fittings.
- MEGA-BOND® Restraint Coating System
For more information regarding MEGA-BOND, refer to our web site @ www.ebaa.com
- Minimum 2 to 1 Safety Factor
- Fully Restrained
- Constructed of ASTM A536 Ductile Iron
- UL listed on sizes 3 inch through 12 inch
- FM approved on sizes 4 inch through 12 inch on C900 Class 150 and Class 200 PVC Pipe
- Pipe can be cut to length in the field
- Joint deflection up to 5°
- Easy dismantling allows fast removal of valves, meters or fittings for replacement or repair
- For use on water or wastewater pipelines subject to hydrostatic pressure and tested in accordance with either AWWA C600 or ASTM D2774.

UL

FM APPROVED

AWWA MEMBER

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AFS
AMERICAN FOUNDRY SOCIETY

Sample Specification

Restrained flange adapters shall be used in lieu of threaded or welded flanged spool pieces. Flanged adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with ANSI/AWWA C110/A21.10 (125#/Class 150 Bolt Pattern).

Restraint for flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.

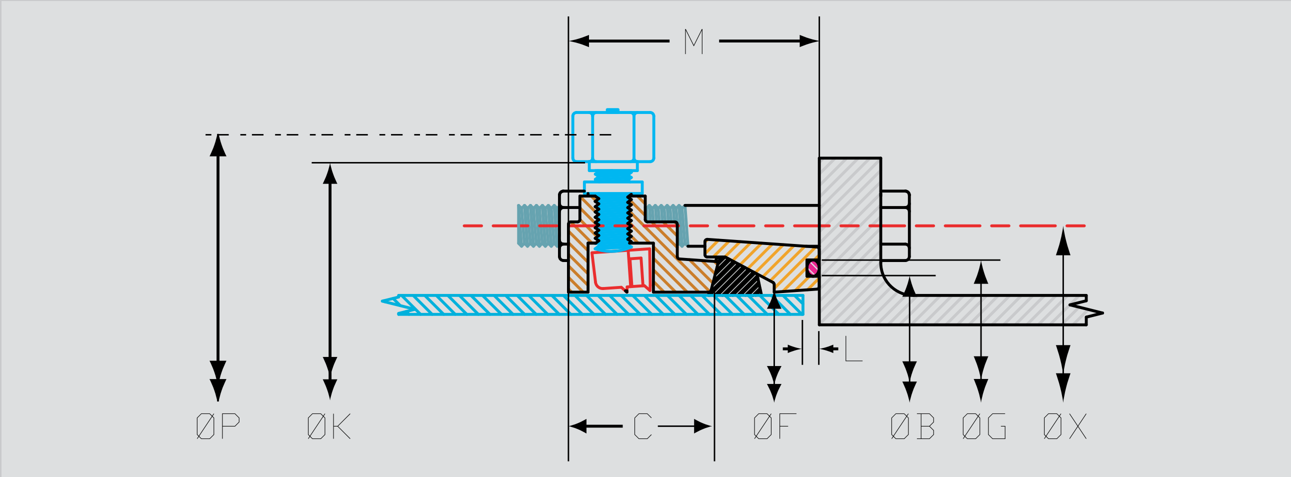
The flange adapters shall be capable of deflection during assembly or permit lengths of pipe to be field cut to allow a minimum 0.6 inch gap between the end of the pipe and the mating flange without affecting the integrity of the seal.

All internal surfaces of the gasket ring (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating and gaskets shall meet ANSI/NSF-61. Exterior surfaces of the gasket ring shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.

Pressure ratings shall be a minimum of those shown in the adjacent tables.

The flange adapter shall be the Series 2100 MEGAFLANGE® Restrained Flange Adapter as produced by EBAA Iron, Inc. or approved equal.

Series 2100 Submittal Reference Drawing



Nominal Pipe Size	Series Number	Restraint Ring K	Restraint Ring F	Restraint Ring C	Gasket Ring F	Gasket Ring B	Gasket Ring G	Bolts No.	Bolts Dia.	Bolts Length	Bolts X	L MAX.	Assembly Deflection	M	P*	Ship Weight (lbs.)
3	2103	7.5	4.1	2.2	4.1	4.3	4.9	4	⅝	5½	6.00	0.7	5.0	4.0	9.2	14
4	2104	9.0	4.9	2.2	4.9	5.4	6.0	8	⅝	5½	7.50	0.6	5.0	4.0	10.0	20
6	2106	11.0	7.0	2.3	7.0	7.5	8.1	8	¾	6	9.50	0.8	5.0	4.3	12.1	32
8	2108	13.5	9.2	2.4	9.2	9.8	10.4	8	¾	6	11.75	0.9	5.0	4.5	14.3	38
10	2110	16.0	11.2	2.5	11.2	11.8	12.4	12	⅞	7½	14.25	1.0	3.0	4.7	16.3	65
12	2112	19.0	13.3	2.5	13.3	13.8	14.4	12	⅞	7½	17.00	1.0	3.0	4.8	18.4	73
14	2114	21.0	15.5	2.5	15.5	16.1	16.9	12	1	8	18.75	1.3	2.0	5.0	20.6	89
16	2116	23.5	17.6	2.5	17.6	18.2	19.0	16	1	8	21.25	1.3	2.0	5.0	22.6	109
18	2118	25.0	19.7	2.6	19.7	20.2	21.0	16	1⅛	8½	22.75	1.3	1.5	5.1	24.7	134
20	2120	27.3	21.8	2.6	21.8	22.4	23.2	20	1⅛	8½	25.00	1.3	1.5	5.1	26.8	157
24	2124	32.0	26.0	2.6	26.0	26.7	27.5	20	1¼	8½	29.50	1.3	1.0	5.1	31.0	192
30	2130	38.5	32.2	3.3	32.2	32.9	34.1	28	1¼	10	36.00	2.0	3.0	6.0	38.8	296
36	2136	45.5	38.5	3.3	38.5	39.2	40.4	32	1½	10½	42.75	2.0	3.0	6.0	44.6	426
42	2142	52.3	44.7	4.1	44.7	45.8	47.0	36	1½	12	49.50	2.0	1.0	8.0	50.8	642
48	2148	58.8	51.0	4.1	51.0	52.1	53.3	44	1½	12	56.00	2.0	1.0	8.0	57.1	797

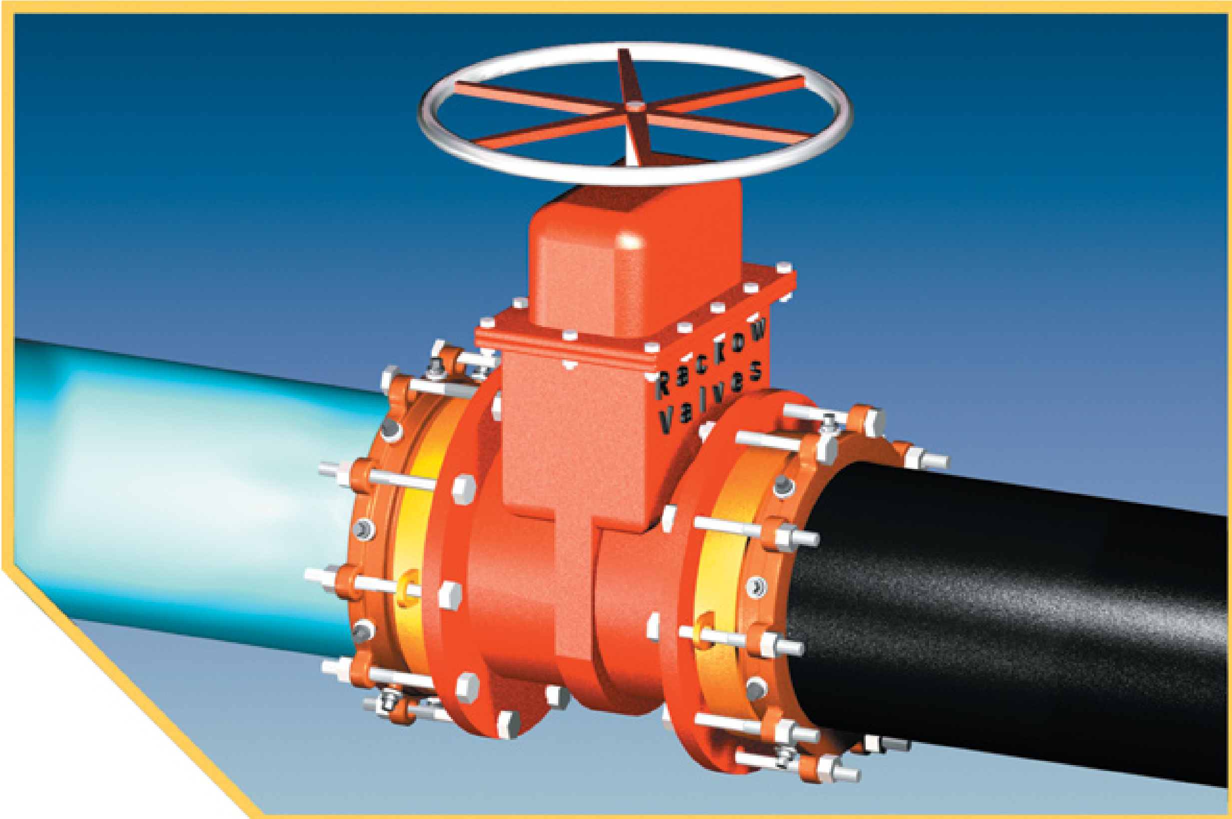
* The “P” dimensions is measured with torque-limiting nuts twisted off.
Note: Dimensions are in inches and are subject to change without notice.

MEGAFLANGE ADVANTAGES

- Fully Restrained
- Time Saving and Field Adaptable
- Pipe can be cut to length at the job site
- Can be used on Ductile Iron, PVC, and Steel (See pressure Rating chart for details)
- Wedges securely grip the pipe much better than set screws
- Easy disassembly allows fast removal of valves, meters, or fittings for replacement or repair

Pipe Size	Ductile Iron Pipe Pressure (PSI)	Steel Pipe* Pressure (PSI)	C900 PVC Pipe DR14 Pressure (PSI)	C900 PVC Pipe DR18 Pressure (PSI)	C900 PVC Pipe DR25 Pressure (PSI)	C900 PVC Pipe DR32.5 Pressure (PSI)	IPS PVC Pipe* SDR17 Pressure (PSI)	IPS PVC Pipe* SDR21 Pressure (PSI)	IPS PVC Pipe* SDR26 Pressure (PSI)
3	350	350	-	-	-	-	250	200	160
4	350	350	200	150	100	-	250	200	160
6	350	350	200	150	100	-	250	200	160
8	350	350	200	150	100	-	250	200	160
10	300	350	200	150	100	-	250	200	160
12	350	350	200	150	100	-	250	200	160
14	350	-	-	235	165	125	-	-	-
16	350	-	-	235	165	125	-	-	-
18	300	-	-	235	165	125	-	-	-
20	250	-	-	235	165	125	-	-	-
24	200	-	-	-	165	125	-	-	-
30	150	-	-	-	-	-	-	-	-
36	150	-	-	-	-	-	-	-	-
42	150	-	-	-	-	-	-	-	-
48	150	-	-	-	-	-	-	-	-

* Transition Gasket Required
NOTE: For Application on HDPE pipe see EBAA's HDPE Restraint Catalog Sheet.

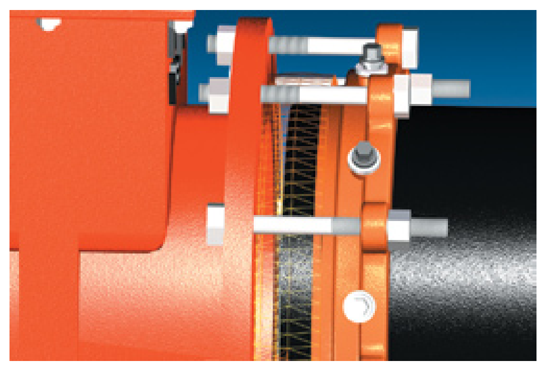


Two, Series 2112 connecting DI pipe and PVC pipe to a gate valve

Some flange adapters use a standard mechanical joint gasket for both the pipe and the flange seal and are prone to leaks.

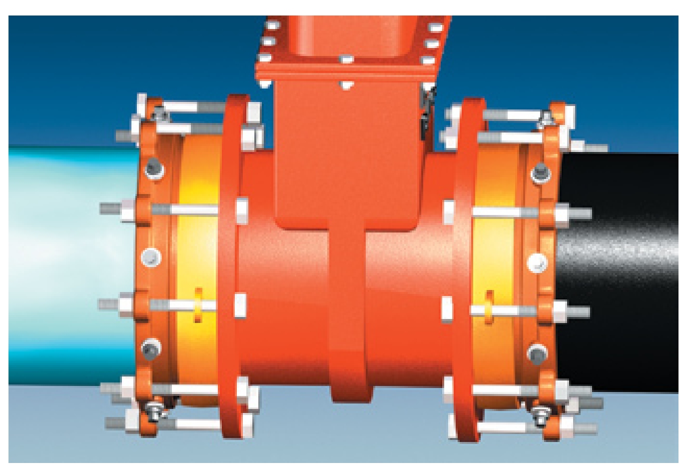
Other flanged coupling adapters separate the pipe seal from the flange seal but are not restrained, and require separate restraining devices.

Still some devices use “set screws’ to try to achieve restraint; but set screw restraints are ineffective when compared to the pull-out restraint strength of the standard flanged joint.



Depicting possible gap and deflection capabilities

THE SERIES 2100 MEGAFLANGE RESTRAINED FLANGE ADAPTER IS TOTALLY DIFFERENT!



Series 2100 MEGAFLANGE comes with all the necessary seals and bolts, for a complete and total install.

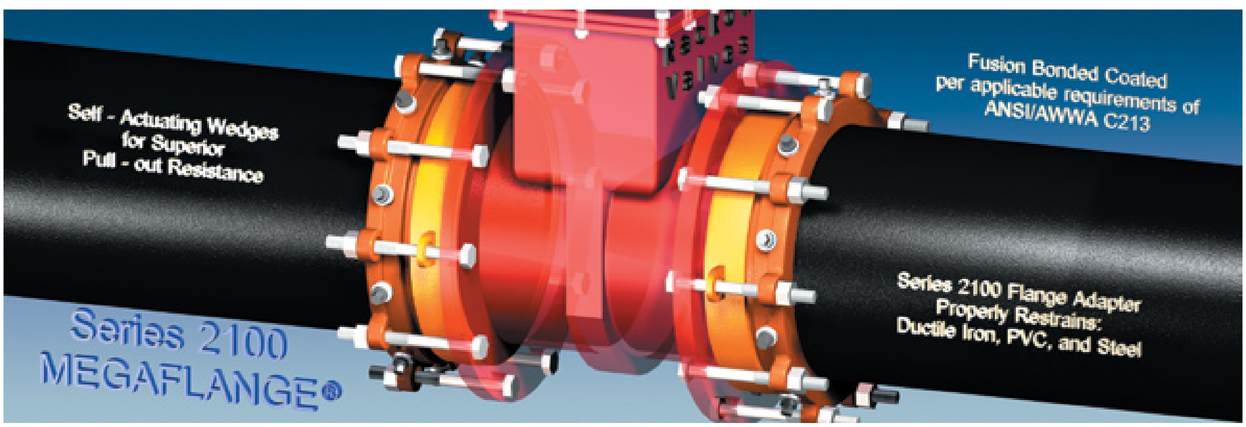
MEGAFLANGE TESTING RESULTS

PVC TESTING

- Quick Burst Test
- DR18 tested to 755 PSI
- DR14 tested to 985 PSI
- Long Term Pressure Test
- On DR18 PVC pipe at 615 PSI for 1000 hours without failure
- Cyclic Pressure Test
- DR18 tested from 94 to 188 PSI for over 1,000,000 cycles

DUCTILE IRON AND STEEL TESTING

- Leakage Test (one minute required)
- Tested to twice rated pressure without leakage
- Hydrostatic Test (one minute required)
- 3 inch though 6 inch sizes tested to 5 times rated pressure
- 8 inch and 10 inch sizes tested to 4 times rated pressure
- 12 inch size tested to 4 times rated pressure
- Flexural Test
- Tested to with stand a bending moment based on requirements of NFPA 12-1991 “Standard for Installation of Sprinkler Systems”



The Series 2100 MEGAFLANGE restrained flange adapter is comprised of two rings. The first is the restraint ring which incorporates wedges around the circumference of the ring to grip the pipe firmly and securely. The wedge style restraint offers enormous pullout strength when compared to set screw restraints. The resiliency of the wedge style restraint allows the Series 2100 to withstand severe moment loads.

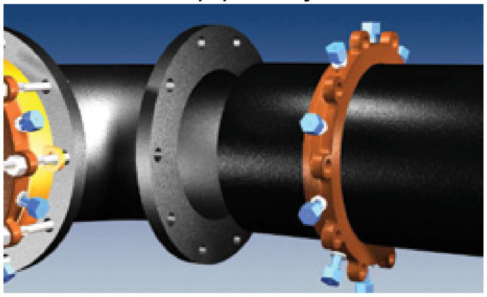
The second ring is the gasket ring which separates the seals dedicated to each sealing surface. This ring allows pipe to be cut to lengths in the field at a tolerance of 0.6 inch or more. In addition, the gasket ring also enables the joint to deflect during assembly.

DEFLECTION

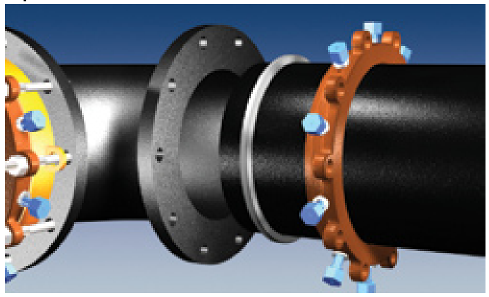
Traditional flanged joint connections require a tremendous amount of torque on the bolts to achieve a good seal. The pipe layout must be precisely planed to avoid misalignment errors due to deviations in appurtenances of pipe fabrication.

The Series 2100 MEGAFLANGE is a speedy, on-site fabrication tool which is generous in its deflection limits, from 0.5º to 5º depending on pipe size. The deflection capabilities provided by the gasket ring allow offset of almost nineteen inches of an eighteen foot length of pip through the eight inch size.

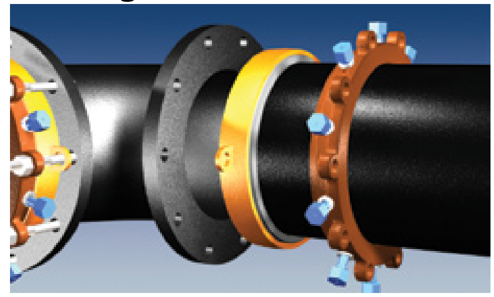
1. Identify the pipe. The MEGAFLANGE 2100 Flange Adapter, sizes 4 inch through 12 inch, is designed for use on ductile iron pipe, PVC (C900 & IPS O.D. (ASTM D2241)) pipe, and steel pipe. Check to see if the spacers under the screws are in place. If the pipe is ductile iron or C.I. O.D. PVC (C900) **DO NOT REMOVE THE SPACERS.** If the pipe is steel or IPS O.D. PVC, **REMOVE THE SPACERS** (sizes 4 inch through 12 inch). The 3 inch size is designed for use on ductile iron, IPS O.D. PVC pipe. Sizes 30 inch and larger are designed for ductile iron pipe only. There are no spacers on the 3 inch and the 14 inch and larger sizes.



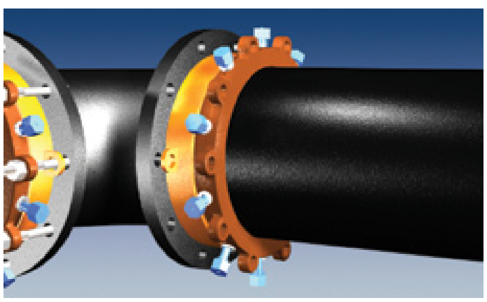
2. Cut the pipe to the required length. Clean the end of the pipe for a length approximately one foot using a wire brush if needed, removing all excess paint and foreign material. Also clean the opposing flange to be connected to the 2100. Place the 2100 restraint ring on the clean pipe with the lip facing the plain end.



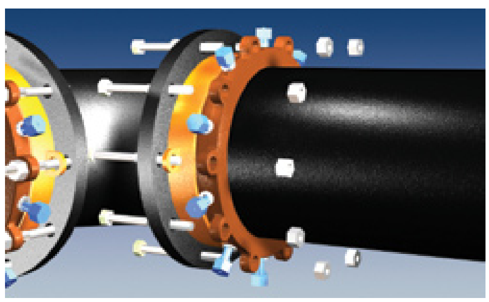
3. Lubricate and place the EBAA-Seal™ Gasket on the clean pipe following the restraint ring. **(USE A TRANSITION GASKET IN PLACE OF THE EBAA-SEAL GASKET FOR STEEL AND IPS. O.D. PVC PIPE.)**



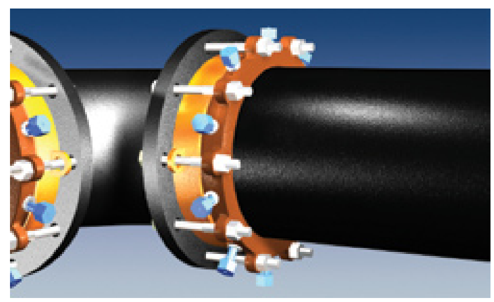
4. Place the O-ring into the groove of the 2100 gasket ring. (This step has already been completed in all sizes except 30 inch and larger.) Place the gasket ring on the pipe with the O-ring facing the pipe end and the gasket recess facing the EBAA-Seal (or transition) Gasket and restraint ring.



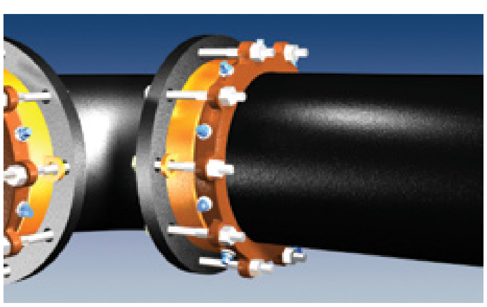
5. Bring the pipe and flanges together within the maximum assembled deflection and maximum allowable gap "L" to the flange face. Slide the gasket ring, gasket and restraint ring until contact is made with the opposing flange.



6. Insert and tighten all flange bolts. Torque all flange bolts an alternating manner to the value listed in Table 1.1. Be sure to make any necessary joint deflection before tightening the actuating screws. Joint deflection should not exceed the maximum allowable deflection. Be sure that deflection of the joint does not cause the end of the pipe to be separated from the opposing flange more than the maximum allowable gap "L".



7. Tighten the actuating screws in an alternating manner until all wedges touch the pipe. Continue tightening the nuts in an alternating pattern until all the torque-limiting nuts have been twisted off.



8. If removal is necessary, utilize the ⅝ inch hex head provided. For reinstallation, repeat steps 2 through 7, torquing the actuating screws to 70 ft-lbs or until the hex heads bottom out on the spacers or gland.

Table 1.1 Flange Bolt Torques

Nominal Pipe Size	Bolt Torque (ft-lbs.)
3	45 - 60
4 - 6	75 - 90
8 - 24	90 - 110
30 - 48	110 - 130

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Data sheet DS/WM–EN Rev. U

WaterMaster
Electromagnetic flowmeter

Measurement made easy

The perfect fit for all water industry applications

One solution for all your needs
— designed for use in all water and waste water applications, from sewage plants to distribution networks

State-of-the-art technology
— revolutionary data storage enables transmitter interchange and commissioning without the need for re-configuration
— self-calibrating transmitter with ultra-low temperature coefficient for highest accuracy

Versatile and simple configuration
— 'Through-the-Glass' (TTG) configuration eliminating the need to remove the cover
— smart key based functionality
— 'Easy Setup' function

VeriMaster in situ verification software option
— enables the customer to perform in situ verification of the flowmeter system

Unparalleled service ability
— fault-finding Help texts on the display
— minimized downtime with replaceable electronics cartridges

MID and OIML R49 approved with R49 self-checking
— Type-approved to accuracy Class 1 and Class 2 for any pipe orientation and bidirectional flows
— Type P-approved continuous self-checking of the sensor and transmitter to ensure the highest accuracy and long term performance

Innovative sensors for all applications
— optimized full-bore series for optimum turndown / low pressure drop, irrigation applications
— full-bore series for general-purpose water metering applications
— reduced-bore series for high turn down applications, for example, leakage
— buriable sensors eliminating the need for costly chamber construction

HART, PROFIBUS DP and MODBUS
— Full system and PLC integration

The Company

ABB is an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a world leader in process automation technology our worldwide presence, comprehensive service and application-oriented know-how make ABB a leading supplier of flow measurement products.

Introduction

Setting the standard for the Water Industry

The WaterMaster range, available in sizes 10 to 2400 mm ($^3/_8$ to 96 in.), is designed specifically for use on the many diverse applications encountered in the Water and Waste-water industry. The modular design concept offers flexibility, cost-saving operation and reliability while providing a long service life and exceptionally low maintenance.

Integration into ABB asset management systems and use of the self-monitoring and diagnostic functions increase the plant availability and reduce downtimes.

VeriMaster – the verification tool

An easy-to-use utility, available through the infra red service port, it uses the advanced self-calibration and diagnostic capability of WaterMaster, coupled with fingerprinting technology, to determine the accuracy status of the WaterMaster flowmeter to within ±1 % of its original factory calibration. VeriMaster also supports printing of calibration verification records for regulatory compliance.

Diagnostic functions

Using its diagnostic functions, the flowmeter monitors both its own operability and the process. Limit values for the diagnostic parameters can be set locally. When these limits are exceeded, an alarm is tripped. In the event of an error, diagnostic-dependent help text appears on the display and this considerably simplifies and accelerates the troubleshooting procedure.

In accordance with NAMUR NE107, alarms and warnings are classified with the status of 'Maintenance Required', 'Check Function', 'Failure' and 'Out of Specification'.

Flow performance

Utilizing its advanced filtering methods, the WaterMaster improves accuracy even under difficult conditions. WaterMaster has an operating flow range with ±0.4 % accuracy as standard (±0.2 % optional) in both forward and reverse flow directions.

Easy and quick commissioning

'Fit-and-Flow' data storage inside WaterMaster eliminates the need to match sensor and transmitter in the field. On initial installation, the self-configuration sequence automatically replicates into the transmitter all calibration factors, meter size and serial numbers, as well as customer site-specific settings, eliminating the potential for error.

Intuitive, convenient navigation

The 'Easy Setup' function reliably guides unpracticed users through the menu step by step. The smart key based functionality makes handling a breeze – it's just like using a cell phone. During configuration, the permissible range of each parameter is indicated on the display and invalid entries are rejected.

Universal transmitter – powerful and flexible

The backlit display can be rotated easily without the need for tools. The contrast is adjustable and the display fully-configurable. The character size, number of lines and display resolution (number of decimal points) can be set as required. In multiplex mode, several different display options can be pre-configured and invoked one after the other.

The smart modular design of the transmitter unit enables easy disassembly without the need to unscrew cables or unplug connectors. HART is used as the standard communications protocol. Optionally, the transmitter is available with PROFIBUS DP or MODBUS communication.

Assured quality

WaterMaster is designed and manufactured in accordance with international quality procedures (ISO 9001) and all flowmeters are calibrated on nationally-traceable calibration rigs to provide the end-user with complete assurance of both quality and performance of the flowmeter.

WaterMaster – always the first choice

WaterMaster sets the standard for the water industry. The specification, features and user benefits offered by this range are based on ABB's worldwide experience in this industry and they are all targeted specifically to the industry's requirements.

Submersible and buriable

WaterMaster sensors have a rugged, robust construction to ensure a long, maintenance-free life under the arduous conditions experienced in the Water and Waste Industry. The sensors are, as standard, inherently submersible (IP68, NEMA 6P), thus ensuring suitability for installation in chambers and metering pits that are susceptible to flooding.

A unique feature of the WaterMaster sensors is that sizes DN40 to DN2400 ($1^{1}/_{2}$ to 96 in. NB) are buriable; installation simply involves excavating to the underground pipe, fitting the sensor, cabling back to the transmitter and then backfilling the hole.

The WaterMaster family

Overview of the WaterMaster

A wide range of features and user benefits are built into WaterMaster as standard:

- bi-directional flow
- unique self-calibrating transmitter (patented) for the ultimate in stability and repeatability
- OIML-type continuous self-checking, with alarms, ensures both sensor and transmitter accuracy
- true electrode and coil impedance measurement
- comprehensive simulation mode
- universal switch-mode power supply (options are available for AC and DC supplies)
- comprehensive self-diagnostics compliant with NAMUR NE107
- programmable multiple-alarm capability
- bus options: HART (4 to 20 mA), PROFIBUS DP (RS485), MODBUS (RS485)
- 3 configurable pulse / frequency and alarm outputs
- advanced infrared service port supports remote HMI, HART, cyclic data out and parameter download
- VeriMaster in situ verification software available as option
- read-only switch and ultra-secure service password for total security

OIML / MID approved

WaterMaster has been type tested and Internationally approved to the highest accuracy class 1 and 2 for cold and hot potable water meters – OIML R49-1 (Organisation Internationale de Métrologie Légale). For full details, OIML R49 is available to download from www.oiml.org. Its requirements are very similar to other International standards, such as EN14154 and ISO4064.

WaterMaster has been assessed by type approval at the National Measurement Office (NMO) to OIML R49 and passed to the very highest accuracy designations for sizes DN40 to DN200 (1 1/2 to 8 in. NB).

The approval is for:

- Class 1 and Class 2 accuracy (calibration option)
- Environmental class T50 for water temperatures of 0.1 to 50 °C (32.18 to 122 °F)
- Electromagnetic Environment E2 (10 V/m)
- Any pipe orientation
- 5 Diameters upstream pipe
- 0 Diameters downstream pipe
- Pressure Loss Class <0.25 bar (3.62 psi)
- Integral or remote transmitter (<200 m [<656 ft.] cable)
- DN40 to DN200 (1 1/2 to 8 in. NB), bi-directional flow

A major advance in WaterMaster is the self-checking capabilities that meet and exceed the R49 requirements and is the first electromagnetic flowmeter to be approved to OIML Type P permanent self checking during normal operation (not just at startup) and alarm indication for:

- transmitter and sensor status, with an accuracy alarm
- program ROM and RAM status
- double, independent storage of totalizer values, in both the sensor and transmitter non-volatile memories
- display test

The OIML R49-1 certificate of conformity is available from:

http://www.abb.com/product/seitp330/b42ec2377d3293cdc12573de003db93b.aspx

WaterMaster is also approved under the EU Measuring Instruments Directive (MID) 2004/22/EC, that covers putting into use water flowmeters for certain applications. MID WaterMaster is secured against tamping and is available as an option, along with fingerprinting for ABB VeriMaster in situ verification product, with certificate printout to ±1 % accuracy.

WaterMaster certificates of EC type-examination of a measuring instrument are available from:

http://www.abb.com/product/seitp330/b42ec2377d3293cdc12573de003db93b.aspx

Superior control through advanced sensor design

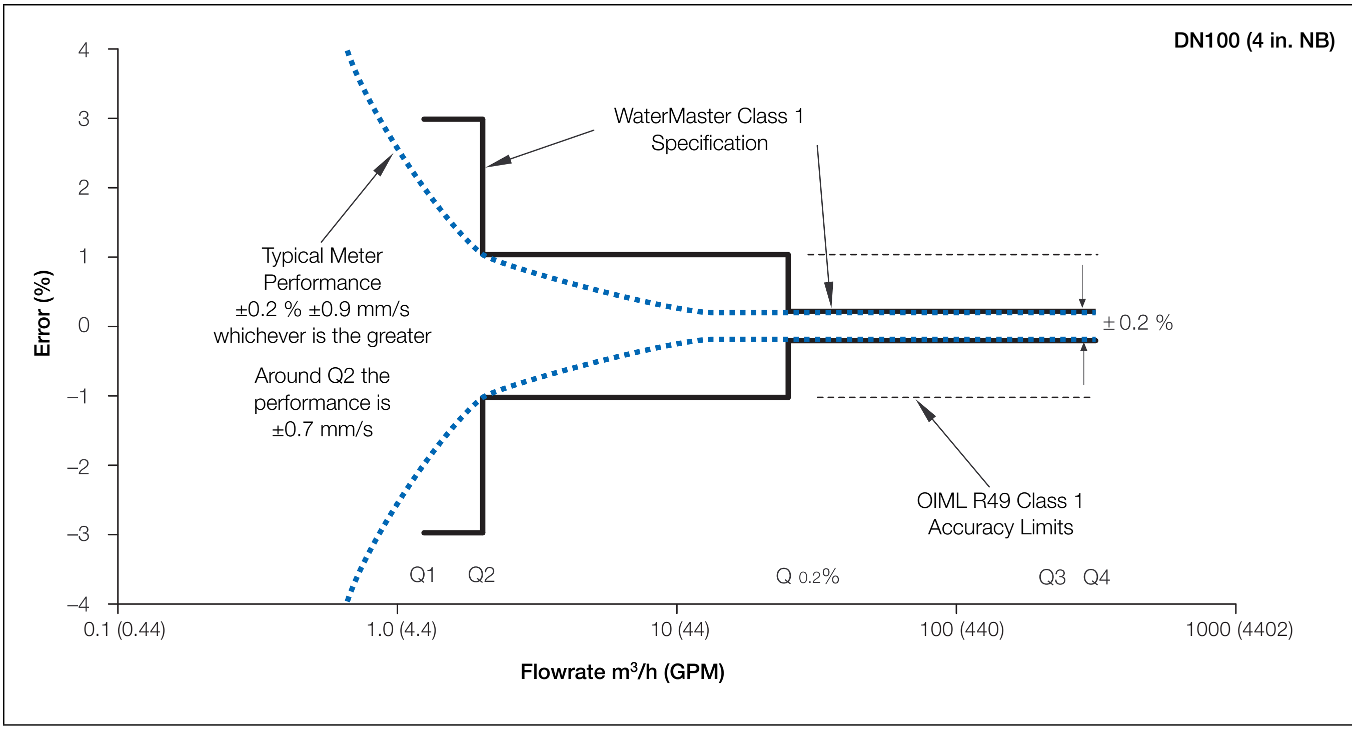
The innovative, patented octagonal sensor design improves flow profile and reduces up- and down-stream piping requirements for the most commonly used sizes of 40 to 200 mm (1 1/2 to 8 in.). This optimized full bore meter provides impressive results in the most difficult of installation requirements.

WaterMaster sensors are also available in reduced-bore geometries giving the ultimate in low-flow performance with a very high turn-down range.

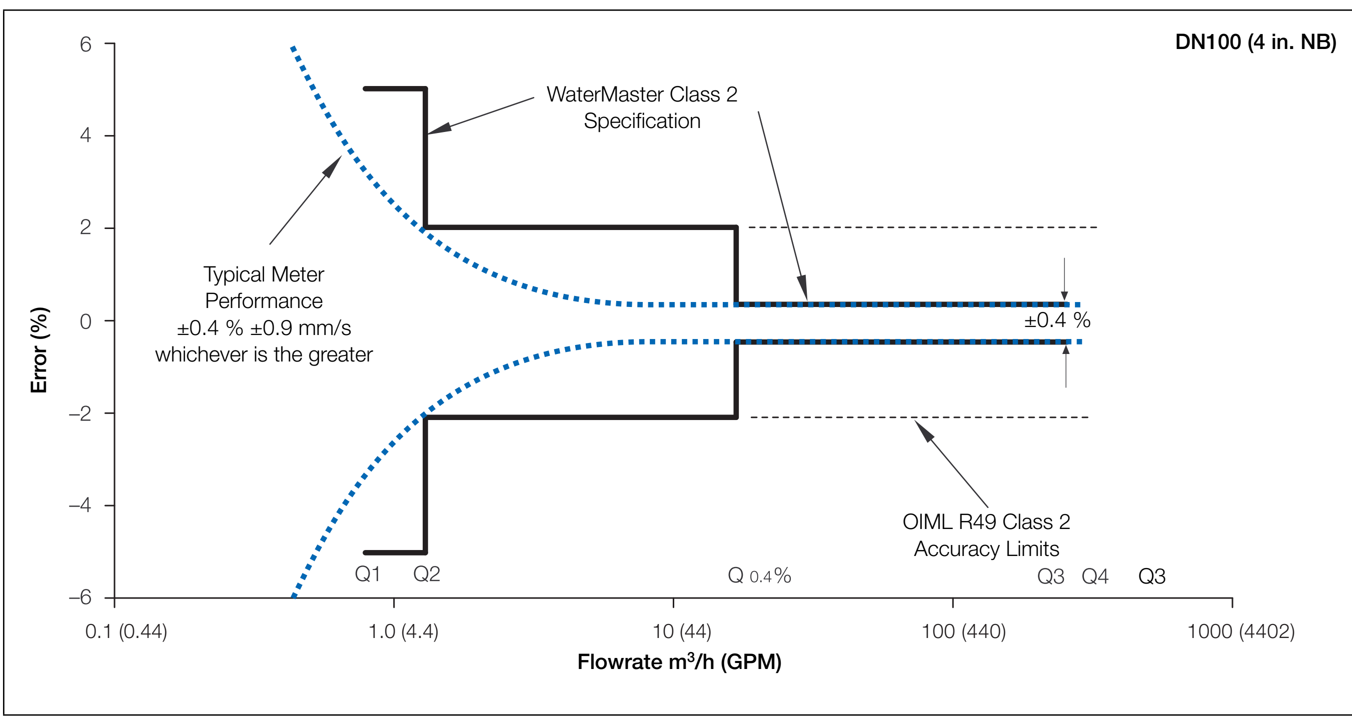
The unique design of the reduced-bore sensor conditions the flow profile in the measuring section so that distortions in the flow profile, either upstream or downstream, are flattened. The result is excellent in situ flowmeter performance, even with very bad hydraulic installation conditions.

Specification

WaterMaster specification to OIML R49 Class 1



WaterMaster specification to OIML R49 Class 2



Although OIML R49 does not define the flow accuracy below Q1, WaterMaster continues to measure flow at lower flow rates down to a cutoff velocity of ±5 mm/s (±0.2 in./s). The accuracy between cutoff and Q1 is typically ±0.9 mm/s (±0.04. in./s).

WaterMaster optimized full-bore meter (FEV) / full-bore meters (FEF, FEW) flow performance – gal/min

			Standard Calibration 0.4 % Class 2			High Accuracy Calibration 0.2 % Class 1		
NPS/NB (DN)	Q4	Q3	$Q_{0.4\%}$	Q2	Q1	$Q_{0.2\%}$	Q2	Q1
3/8 (10)	13.8	11	0.73	0.06	0.035	1.38	0.09	0.053
1/2 (15)	34.7	27.7	1.85	0.14	0.09	3.48	0.22	0.14
3/4 (20)	55	44	2.94	0.22	0.14	5.5	0.35	0.22
1 (25)	88	70.4	4.7	0.35	0.22	8.8	0.57	0.35
1 1/4 (32)	137.6	110	7.3	0.57	0.35	13.2	0.88	0.57
1 1/2 (40)	220	176	18.5	0.89	0.56	26.4	1.41	0.88
2 (50)	347	277	18.5	1.41	0.88	34.7	2.22	1.39
2 1/2 (65)	550	440	29.4	2.24	1.40	55.0	3.52	2.20
3 (80)	881	704	47.0	3.58	2.24	70.4	5.64	3.52
4 (100)	1,376	1,101	73.4	5.59	3.49	110	8.81	5.50
5 (125)	1,376	1,101	73.4	5.59	3.49	110	8.81	5.50
6 (150)	3,467	2,774	185	14.1	8.81	277	22.2	13.9
8 (200)	5,504	4,403	294	22.4	14.0	440	35.2	22.0
10 (250)	8,806	7,045	470	35.8	22.4	704	56.4	35.2
12 (300)	13,759	11,007	734	55.9	34.9	1,101	88.1	55.0
14 (350)	22,014	17,611	1,174	89.5	55.9	1,761	141	88.1
16 (400)	22,014	17,611	1,174	89.5	55.9	1,761	141	88.1
18 (450)	34,673	27,738	1,849	141	88.1	2,774	222	139
20 (500)	34,673	27,738	1,849	141	88.1	2,774	222	139
24 (600)	55,036	44,029	2,935	224	140	4,403	352	220
27/28* (700)	88,057	70,446	7,045	451	282	7,045	704	440
29 (750)	88,057	70,446	7,045	451	282	7,045	704	440
30 (760)	88,057	70,446	7,045	451	282	7,045	704	440
32 (800)	88,057	70,446	7,045	451	282	7,045	704	440
36 (900)	137,590	110,072	11,007	704	440	11,007	1,100	688
39/40* (1000)	137,590	110,072	11,007	704	440	11,007	1,100	688
42 (1050)	137,590	110,072	11,007	704	440	11,007	1,100	688
44 (1100)	137,590	110,072	11,007	704	440	11,007	1,100	688
48 (1200)	220,143	176,115	17,611	1,127	704	17,611	1,761	1,101
52 (1350)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
54 (1400)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
60 (1500)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
66 (1600)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
68 (1650)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
77 (1800)	550,358	440,287	44,029	2,818	1,761	44,029	4,403	2,752
77 (1950)	550,358	440,287	44,029	2,818	1,761	44,029	4,403	2,752
78 (2000)	550,358	440,287	44,029	2,818	1,761	44,029	4,403	2,752
78 (2000)	550,358	440,287	44,029	2,818	1,761	44,029	4,403	2,752
84 (2200)	880,573	704,459	70,446	4,509	2,818	70,446	7,045	4,403
96 (2400)	880,573	704,459	70,446	4,509	2,818	70,446	7,045	4,403

*Size is dependent on flange specification

WaterMaster reduced-bore meter (FER) flow performance – m^3/h (gal/min)

				Class 2 specification				Class 1 specification			
Size		Q_4	Q_3	$Q_{0.4\ \%}$	Q_2	Q_1	R	$Q_{0.2\ \%}$	Q_2	Q_1	R
mm	in.	m^3 / h (Ugal / min)	m^3 / h (Ugal / min)	m^3 / h (Ugal / min)	m^3 / h (Ugal / min)	m^3 / h (Ugal / min)		m^3 / h (Ugal / min)	m^3 / h (Ugal / min)	m^3 / h (Ugal / min)	
40	1 1/2	31 (138)	25 (110)	0.83 (1.05)	0.063 (0.28)	0.04 (0.18)	630	1.7 (7.48)	0.1 (0.44)	0.063 (0.28)	400
50	2	50 (220)	40 (176)	1.0 (4.40)	0.1 (0.44)	0.063 (0.28)	630	2.0 (8.8)	0.16 (0.7)	0.1 (0.44)	400
65	2 1/2	79 (347)	63 (277)	1.6 (7.04)	0.16 (0.7)	0.1 (0.44)	630	3.2 (10.56)	0.25 (1.1)	0.16 (0.7)	400
80	3	125 (550)	100 (440)	2.0 (8.80)	0.25 (1.1)	0.16 (0.7)	630	4.0 (17.6)	0.4 (1.76)	0.25 (1.1)	400
100	4	200 (880)	160 (704)	3.2 (10.56)	0.41 (1.8)	0.25 (1.1)	630	6.4 (28)	0.64 (2.8)	0.4 (1.76)	400
125	5	200 (880)	160 (704)	3.2 (10.56)	0.41 (1.8)	0.25 (1.1)	630	6.4 (28)	0.64 (2.8)	0.4 (1.76)	400
150	6	500 (2200)	400 (1760)	8.0 (35.20)	1.0 (4.4)	0.63 (2.77)	630	16 (70.4)	1.6 (7)	1.0 (4.4)	400
200	8	788 (3470)	630 (2770)	13.0 (57.2)	1.6 (7.04)	1.0 (4.4)	630	25 (110)	2.5 (11)	1.6 (7)	400
250	10	1250 (5500)	1000 (4400)	20 (88)	2.5 (11.01)	1.6 (7)	630	40 (176)	4.0 (17.6)	2.5 (11)	400
300	12	2000 (8810)	1600 (7045)	32 (140.8)	4.1 (18.05)	2.5 (11)	630	64 (281.6)	6.4 (28)	4.0 (17.6)	200
350	14	2000 (8810)	1600 (7045)	32 (140.8)	6.4 (28.18)	4.0 (17.6)	400	64 (281.6)	12.8 (56)	8.0 (35.2)	200
375	15	2000 (8810)	1600 (7045)	32 (140.8)	6.4 (28.18)	4.0 (17.6)	400	64 (281.6)	12.8 (56)	8.0 (35.2)	200
400	16	3125 (13760)	2500 (11007)	50 (220)	10 (44)	6.3 (27.7)	400	100 (440)	20 (88)	12.5 (55)	200
450	18	3125 (13760)	2500 (11007)	50 (220)	10 (44)	6.3 (27.7)	400	100 (440)	20 (88)	12.5 (55)	200
500	20	5000 (22014)	4000 (17610)	80 (352)	16 (70.45)	10 (44)	400	160 (70.4)	32 (141)	20 (88)	200
600	24	7875 (34670)	6300 (27740)	126 (554.4)	25.2 (110.9)	15.8 (70)	400	252 (1108)	50.4 (222)	31.5 (138.7)	200

Specification – sensor

Functional specification

Pressure limitations

As per flange rating – non approved
PN16 for OIML R49, MID Approved

Pressure equipment directive 97/23/EC

This product is applicable in networks for the supply, distribution and discharge of water and associated equipment and is therefore exempt.

Temperature limitations

Ambient temperature	
Remote transmitter	–20 to 70 °C (–4 to 158 °F)
Integral transmitter	–20 to 60 °C (–4 to 140 °F)
Process temperature	See table below. 0.1 to 50 °C (32.2 to 122 °F) – OIML R49 T50 Approved

			Medium temperature °C (°F)	
Code	**Lining**	**Flange material**	**Minimum**	**Maximum**
FEF, FEW3	Hard rubber	Carbon steel	–10 (14)	90 (194)
		Stainless steel	–10 (14)	90 (194)
FEW1	PTFE	Carbon steel	–10 (14)	130 (266)
		Stainless steel	–25 (–13)	130 (266)
FEW3	PTFE	Carbon steel	–10 (14)	130 (266)
		Stainless steel	–10 (14)	130 (266)
FEW3	Elastomer	Carbon steel	–5 (23)	80 (176)
		Stainless steel	–5 (23)	80 (176)
FEF, FER	Elastomer	Carbon steel	–6 (21)	70 (158)
FEV	Polypropylene		–6 (21)	70 (158)

IP rating

IP68 (NEMA 6) to 7 m (20 ft.) depth
Note. Not sizes DN10 to DN32 (3/8 – 1 1/4 in. NB)

IP67 (NEMA 4X) – DN10 to DN32 (3/8 – 1 1/4 in. NB)

Buriable (sensor only)

FEV, FEF and FEW – DN450 to 2400 (18 to 96 in. NB) to 5 m (16 ft.) depth

Conductivity

>5µS cm^{-1}

Transmitter mounting

Integral (not FEF) or remote

Electrical connections

20 mm glands

1/2 in. NPT
20 mm armored glands

Sensor cable

ABB WaterMaster cable available in two forms – standard and armored
Maximum length 200 m (660 ft.)

Physical specification

Wetted parts

Electrode material

Stainless steel 316 L / 316 Ti

Super-austenitic steel

Hastelloy® C-22 and Hastelloy C4

(other electrode materials available on request)

Potential equalizing rings

Minimum of 1 recommended

Lining material / potable water approvals

			Potable Water Approvals					
Code	**Size Range**	**Liner**	**WRAS**	**WRAS 60°C**	**ACS**	**DVGW**	**NSF**	**AZ/ NZS 4020**
FEW1	DN10 – 32 (3/8 – 1 1/4 in. NB)	PTFE	4					
FEW3	DN10 – 600 (3/8 – 24 in. NB)	PTFE						
FEW3	DN40 – 2400 (1 1/2 – 96 in. NB)	Elastomer	4					4
FEW3	DN40 – 2400 (1 1/2 – 96 in. NB)	Hard rubber	4	4		4	NSF approved material	
FEV	DN40 – 200 (1 1/2 – 8 in. NB)	Poly-propylene	4		4	4	NSF-61	4
FEF	DN250 – 600 (10 – 24 in. NB)	Elastomer	4		4	4	NSF-61	4
FEF	DN250 – 600 (10 – 24 in. NB)	Hard rubber	4	4		4	NSF approved material	
FER	DN40 – 600 (1 1/2 – 24 in. NB)	Elastomer	4		4	4		4

*Size is dependent on flange specification

Lining protection plates

Not required

Installation conditions (recommended)

	Straight pipe requirements	
	Upstream	Downstream
FEW / FEF	5 x DN	2 x DN
FEV	5x DN	0 x DN
FER	0 x DN	0 x DN

Pressure loss

Negligible at Q3	All full bore meters
<0.25 bar (<3.62 psi) at Q3	FEV (DN40 to 200 [1 1/2 to 8 in. NB])
<0.63 bar (<9.13 psi) at Q3	FER (DN40 to 600 [1 1/2 to 24in. NB])

Non-wetted parts

Flange material

Carbon steel	DN20 to DN2400 ($^3/_4$ to 96 in. NB)
Stainless steel	DN10 to DN2400 ($^3/_8$ to 96 in. NB)
SG iron	FEV – DN40 to DN150 [1 $^1/_2$ to 6 in. NB)
	FER – DN40 to DN150 [1 $^1/_2$ to 6 in. NB)

Housing material

Carbon steel	FEV – DN40 to 200 (1$^1/_2$ to 8 in. NB)
	FEW – DN450 to 2400 (18 to 96 in. NB)
Plastic	FEF – DN250 to 600 (10 to 24 in. NB)
Aluminium	FEW – DN10 to 400 ($^3/_8$ to 16 in. NB)

Terminal box material

Polycarbonate

Cable gland material

Plastic, brass

Paint specification

Paint coat ≥70 µm thick RAL 9002 (light grey)

Specification – transmitter

Functional specification

Power supply

Mains	85 to 265 V AC @ <7 VA
Low voltage	24 V AC +10 % /–30 % @ <7 VA
DC	24 V ±30 % @ <0.4 A

Supply voltage fluctuations within the specified range have no effect on accuracy

Digital Outputs (3)

Rating 30 V @ 220 mA, open collector, galvanically isolated *

Maximum output frequency 5250 Hz

1 off dedicated to Alarm / Logic, programmable function

2 off configurable to either Pulse / Frequency or Alarm/Logic function

Current output – HART FEX100 variant

4 to 20 mA or 4 to 12/20 mA, galvanically isolated *

Maximum loop resistance 750 Ω

HART protocol Version 5.7 (HART registered)

Signal levels compliant with NAMUR NE 43 (3.8 to 20.5 mA)

Low alarm 3.6 mA, High alarm 21.8 mA

Additional accuracy

±0.1 % of reading

Temperature coefficient: typically <±20 ppm/°C

RS485 Communications – PROFIBUS FEX100-DP variant

Registered name: FEX100-DP

RS485 (9.6kbps to 1.5Mbps), galvanically isolated

DPV0, DPV1

PA Profile 3.01

Standard idents: 9700, 9740, 9741

FEX100-DP specific ident: 3431

3 Concurrent MS2 master connections

RS485 Communications – MODBUS FEX100-MB variant

MODBUS RTU protocol

RS485 (9.6kbps to 115.2kbps), galvanically isolated

Electrical connections

20 mm glands 1/2 in. NPT, 20 mm armored glands

Temperature limitations

Ambient temperature	–20 to 60 °C (–4 to 140 °F)
Temperature coefficient	Typically <±10 ppm/°C @ Vel ≥0.5 mls

Environmental protection

Humidity: 0 to 100 %

Rating: IP67 (NEMA 4X) to 1m (3.3 ft.) depth

Tamper-proof security

Write access prevented by internal switch combined with external security seals for MID applications

Languages

English, French, German, Italian, Spanish, Polish

Infrared service port

USB adapter (accessory), USB 1.1. and 2.0 compatible

Driver software for Windows 2000, XP, 7 (32-bit) and Vista

Housing material

Powder-coated aluminium with glass window

Paint specification

Paint coat ≥70 µm thick RAL 9002 (light grey)

Transmitter vibration testing

Vibration level: 7 m/s^2

Frequency range: 20 to 150 Hz

No. of sweeps in 3 orthogonal planes: 20

Undetectable shift in transmitter span or zero performance

Hazardous approvals (HART variant only)

FM & FMc Class 1 Div 2

(FM listing NI / 1 / 2 / ABCD / T4, S / II, III / 2 / FG /T4,
Ta=60C; Type 4X, IP67 – for transmitter and integral mounting
Ta=70C, Type 6P, IP68 – for remote sensor type,
IP67 on DN10 to 32 [3/8 to 1 1/4 in.NB])

(FMc listing NI / 1 / 2 / ABCD / T4, DIP / II, III / 2 / FG /T4,
Ta=60C; Type 4X, IP67 – for transmitter and integral mounting
Ta=70C, Type 6P, IP68 – for remote sensor type, IP67 on
DN10 to 32 [3/8 to 1 1/4 in.NB])

FET, FEV, FEW and FEF DN700 to 2200 (27/28* to 84 in. NB) only

*Size is dependent on flange specification

ATEX* Zone 2, 21 & 22

II 3 G Ex nA IIC T5 Gc
II 2 D Ex tb IIIC T100°C Db
TA = –20°C to +60°C (integral transmitter)
TA = –20°C to +70°C (remote sensor)

IECEx* Zone 2, 21 & 22

Ex tb IIIC T100°C Db
Ex nA IIC T5 Gc
TA = –20°C to +60°C (integral transmitter)
TA = –20°C to +70°C (remote sensor)

*FEW, FEV, FET and FEF ≥700 (27/28 in. NB) only

Declaration of Conformance

Copies of CE certification will be available on request.

WaterMaster has OIML R49 Certificate of Conformity to accuracy class 1 and 2 (FEV DN40 to 200 [1 1/2 to 8 in.NB]). Copies of accuracy certification are available on request.

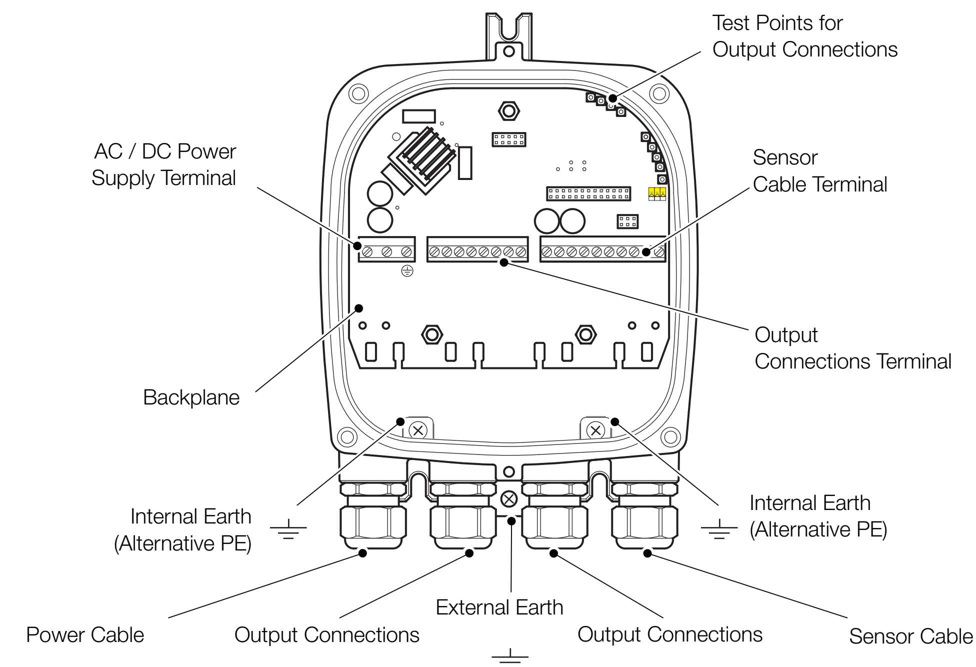
WaterMaster (FEV DN40 to 200 [1 1/2 to 8 in.NB]) has been type examined under directive MID 2004/22/EC, Annex MI-001. Copies of this certificate are available on request.

* When installed, do not leave galvanically isolated circuits (pulse and current) floating.

Transmitter connections

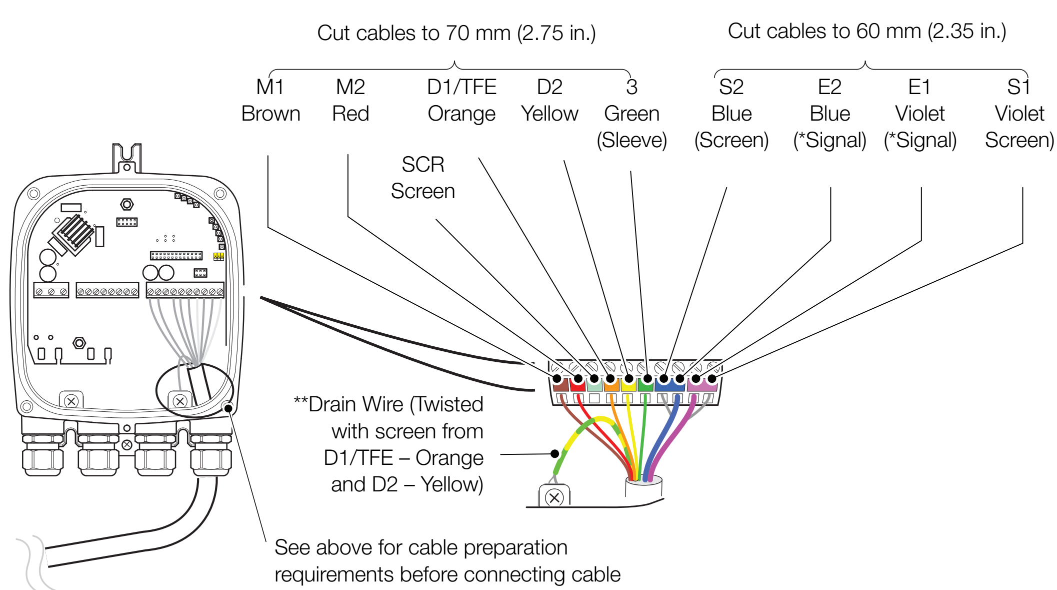
Transmitter terminal connections overview

This section is intended to give an overview of installation of a flowmeter. For Installation requirements, technical information and Health and safety precautions – refer to the User Guide OI/FET100–EN.



Cable gland / conduit entry (Remote transmitter shown)

Sensor cable terminal connections and recommended cable lengths



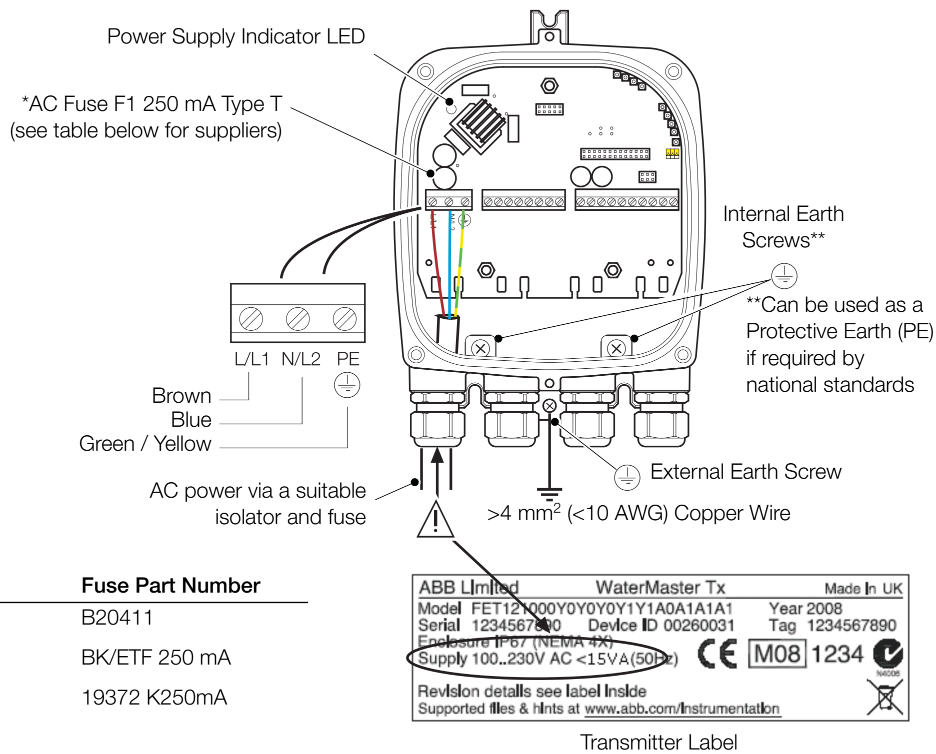
*Inner wire

**For cathodically-protected systems (or if the transmitter enclosure does not have an earth screw) connect the drain wire to terminal SCR.

Sensor cable connections at transmitter terminal block – remote transmitter

Power supply connections

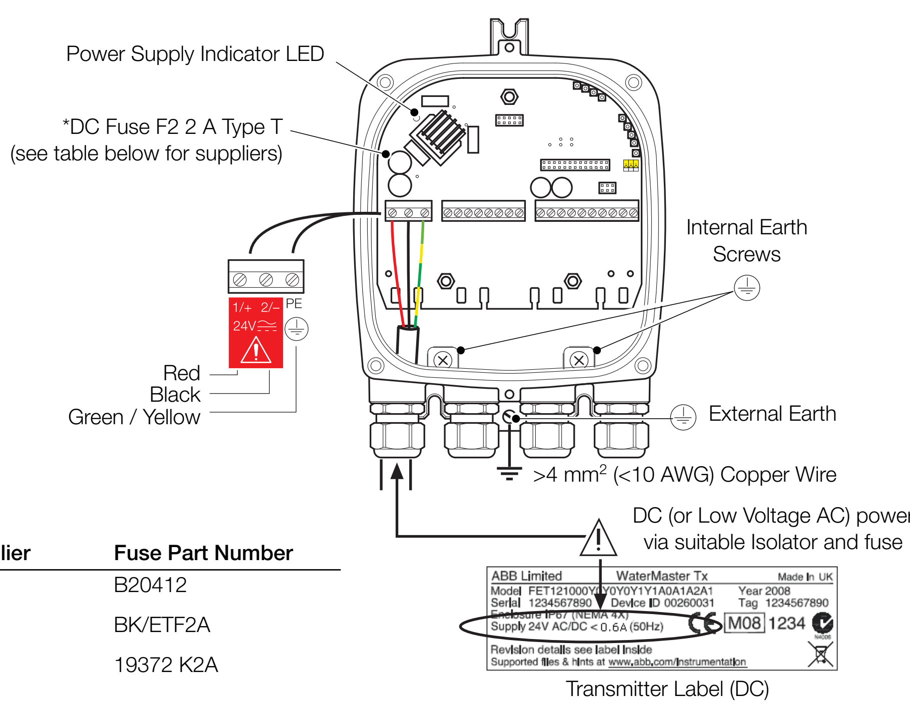
AC power supply



*Fuse Supplier	Fuse Part Number
ABB	B20411
Bussmann	BK/ETF 250 mA
Wickmann	19372 K250mA

AC power supply connections

DC (and low voltage AC) power supply



*Fuse Supplier	Fuse Part Number
ABB	B20412
Bussmann	BK/ETF2A
Wickmann	19372 K2A

DC (and low voltage AC) power supply connections

Configuration DIP switches

Three configuration DIP switches are mounted on the transmitter backplane board.

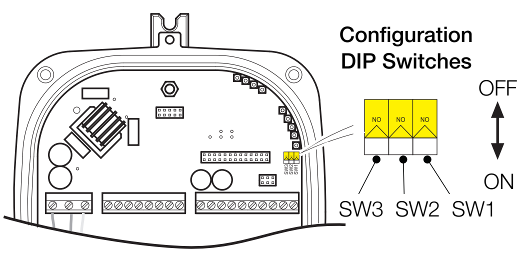
These are factory-set as follows:

- Remote transmitter – all OFF
- Integral transmitter – SW3 ON

For MID-compliant flowmeters the read-only / MID protection switch is set to 'ON' to ensure the meter is secure from tampering.

For HART software versions prior to 01.02.XX, this switch (set after commissioning) prevents login via the keypad or bus at any security level.

From HART software version 01.03.XX onwards and for all PROFIBUS software versions, on MID meters, all metrological-related parameters are locked and inaccessible at the Service level. Standard and Advanced user level parameters can still be modified via the HMI or bus.



DIP Switch Functions

SW1 – Read-only / MID Protection

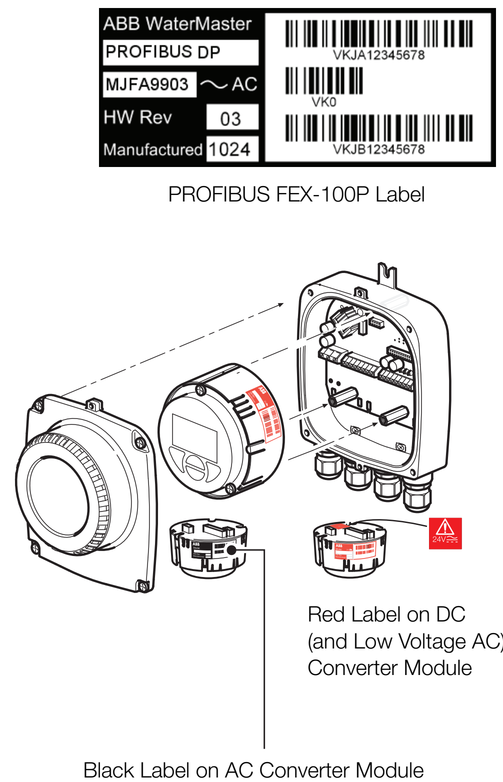
SW2 – (Future Product)

SW3 – Internal Sensor Memory

Configuration DIP switches

Transmitter module identification

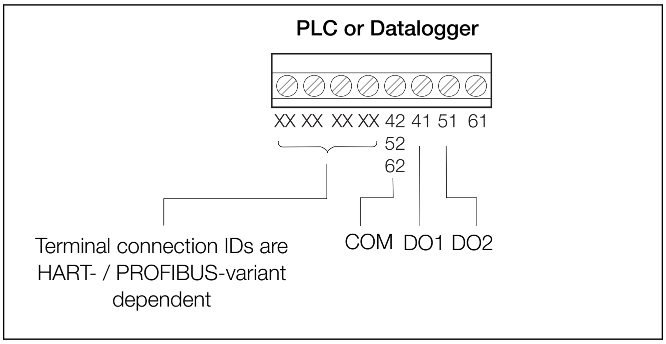
> **Note.** The communications bus type is HART FEX100 if not specified on the transmitter module label. An example of the PROFIBUS FEX100-DP variant transmitter module label is shown below.



Transmitter module identification

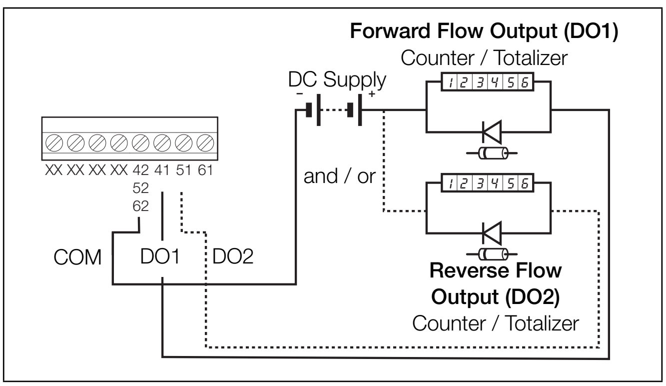
Output connections

Frequency outputs

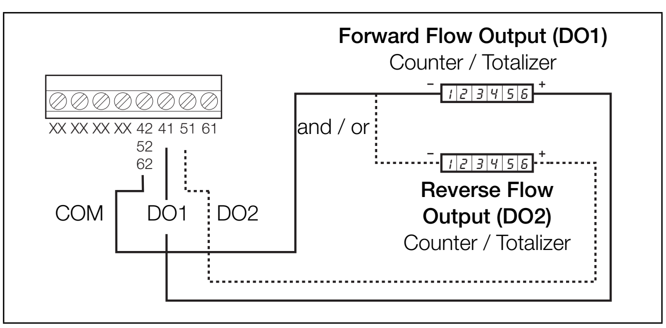


PLC / Datalogger connections

Note. Digital outputs DO1 and DO2 are polarity sensitive. The common (negative) connection for these outputs is designated 'COM'.

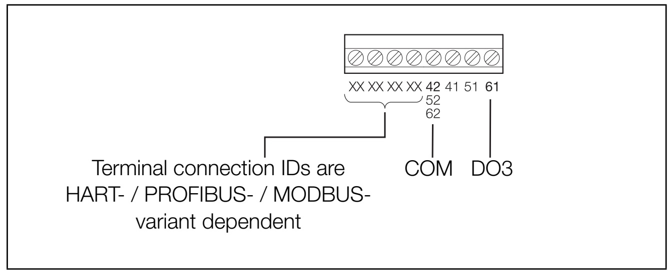


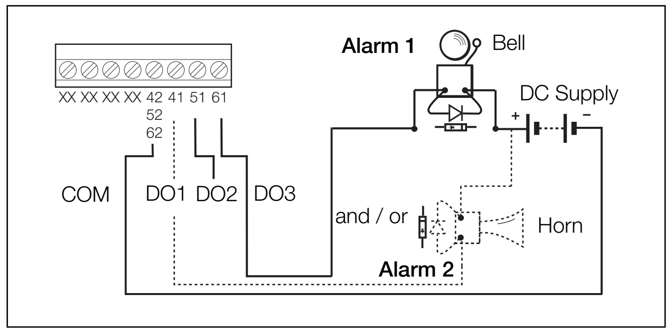
Electromechanical connections



Telemetry / Electronic counters connections

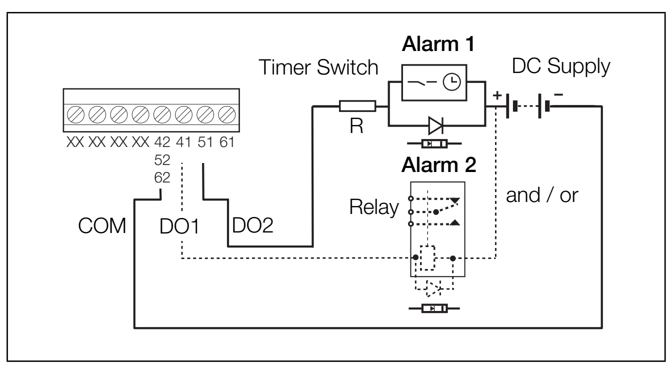
Alarm outputs





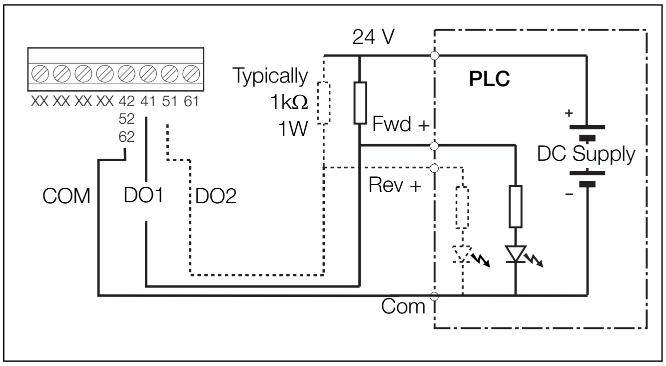
Note.

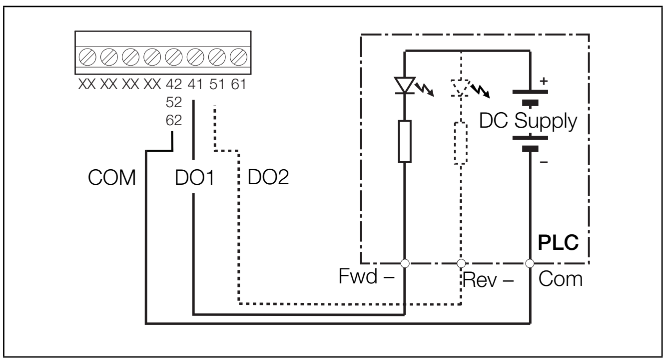
- Normal alarm / logic output is from DO3 (terminal 61). DO1 (41) and DO2 (51) can also be configured as alarms if required but are then NOT available as frequency / pulse outputs as shown in *Electromechanical connections* and *Telemetry / Electronic counters connections*, opposite.
- Bell and horn shown for example only. Any suitable alarm device may be used (for example, lamp, siren, buzzer etc.).



Note. Relay and timer switch shown for example only.

PLC interface

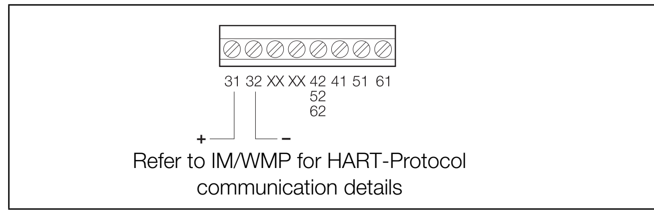




Note.

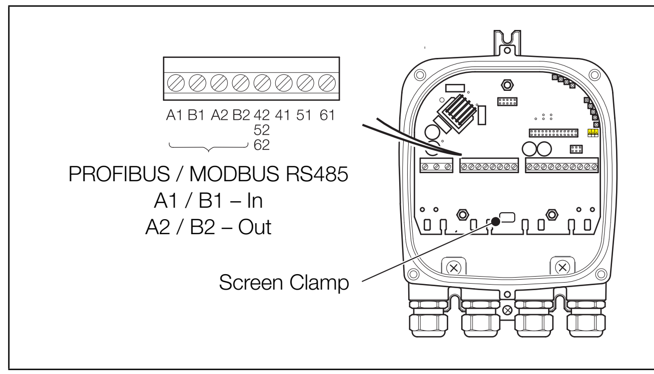
- WaterMaster digital outputs are NPN optocoupled transistors used as switches.
- Maximum allowed voltage at collector is 30 V DC
- Maximum allowed current across transistor is 220 mA.

Current output (4 to 20 ma) – HART (FEX100) variant



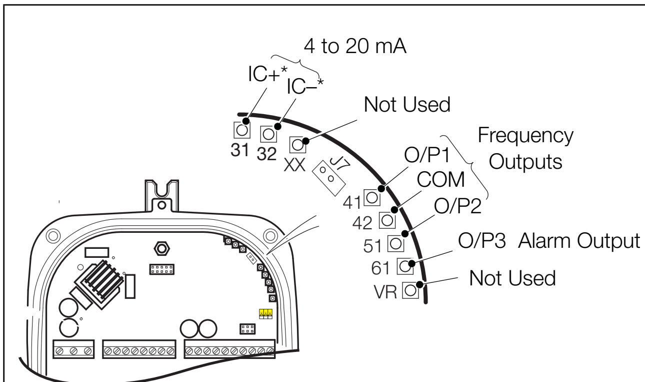
Current output (4 to 20 mA) – HART (FEX100) variant

RS485 communications – PROFIBUS (FEX100-DP) and MODBUS (FEX100-MB) variants



Test point access

Note. A typical DVM probe can access (fit) the PCB's test holes.



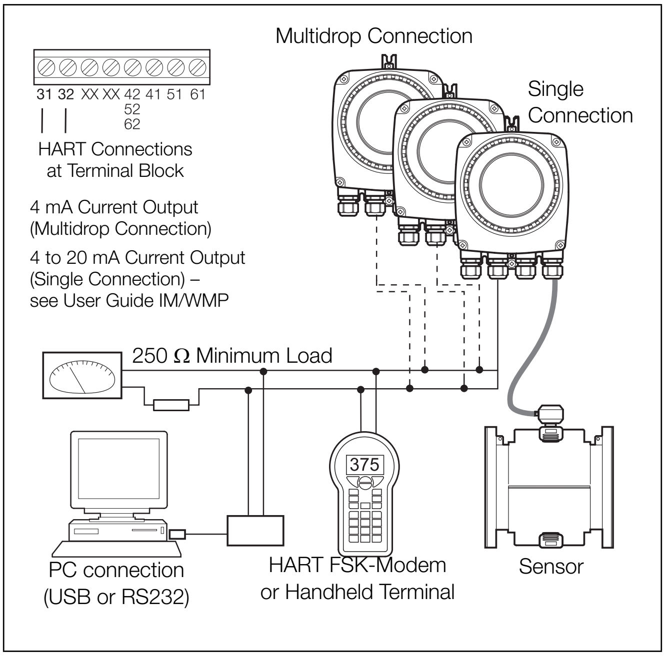
*These 2 test points are connected on the HART FEX100 backplane only (they are present on the PROFIBUS FEX100-DP / MODBUS FEX100-MB backplane but not connected)

Digital communication

The transmitter has the following options for digital communication.

HART protocol

The unit is registered with HART Communication Foundation.



HART protocol	
Configuration	Directly on the Device Software Asset Vision Basic (+ HART -DTM)
Transmission	Install a HART modem (FSK [Frequency Shift Keyed]-Modem) for HART-Communication when connecting to a PC. The HART-Modem converts the analog 4 to 20 mA signal into a digital output signal (Bell Standard 202) and connects to the PC using a USB (or RS232C) connector
Max. signal amplitude	1.2 mA
Current output load	Min. 250Ω, max. = 560Ω
Cable	AWG 24 twisted
Max. cable length	1500 m (4921 ft.)
Baud rate	1.200 baud

System integration

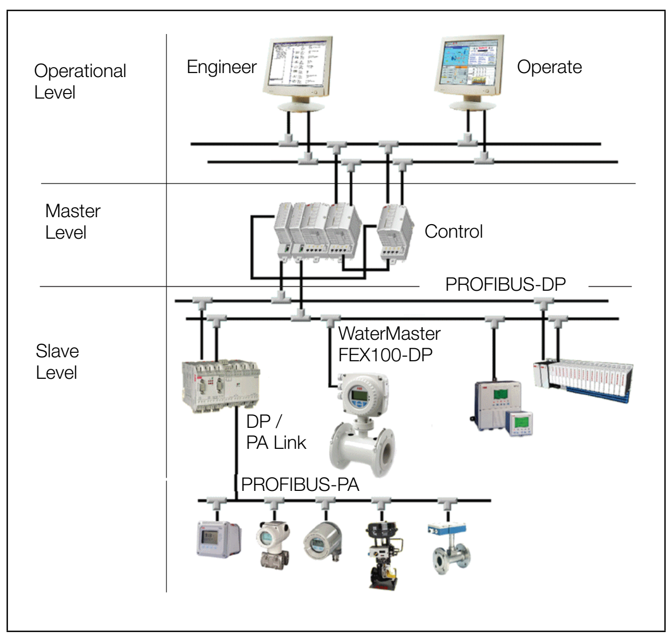
WaterMaster can be integrated into control systems and configuration devices using any Frame application, such as ABB AssetVision or similar third-party applications. ABB Device Type Managers (DTMs) for WaterMaster provide a unified structure for accessing device parameters, configuring and operating the devices and diagnosing problems. FDT (Field Device Tool) technology standardizes the communication and configuration interface between all field devices and host systems.

PROFIBUS DP protocol

PROFIBUS is a manufacturer-independent, open Fieldbus standard for a wide range of applications in manufacturing, process and building automation. Manufacturer independence and openness are ensured by the international standard EN 50170.

PROFIBUS DP ID no.	0x3431
Alternative standard ID no.	0x9701 or 0x9741
Configuration	Directly on the device Software Asset Vision Basic (+PROFIBUS DP-DTM)
Transmission signal	Accuracy to IEC 61158-2
Cable	Shielded, twisted cable (accurate to IEC 61158-2, types A or B)

All devices are connected in a bus structure ('line') as shown in below. Up to 32 stations (master or slaves) can be linked to create one 'segment', although it is recommended not to install more than 16 devices on a single segment. Each end of a segment must be terminated by an active bus terminating resistor. Both bus terminators must always be powered to ensure fault-free operation, therefore it is strongly recommended that they are connected to a back-up power supply. The use of bus amplifiers (repeaters) and segment couplers can be used to extend the network.



System integration

The GSD file for WaterMasters specifies the device-specific Ident No. 3431. It conforms to the PROFIBUS standard, providing a clear and comprehensive description of each instrument in a precisely defined format.

This enables the system configuration tool to use the information automatically when configuring a PROFIBUS bus system.

The ABB GSD file (Ident No. 3431) is divided into 2 sections:

- General specifications

  Identification of the device, together with hardware and software versions, baud rates supported and the possible time intervals for monitoring times.

- DP slave-related specifications

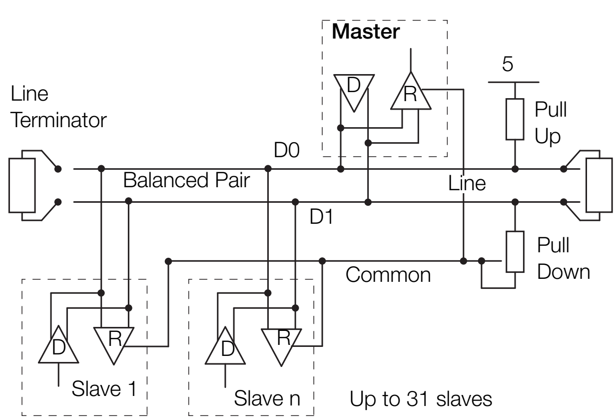
  Information about the user parameter block for device-specific configuration and modules containing details of the input and output data that can be exchanged cyclically with a PROFIBUS master.

The WaterMaster GSD file (ABB_3431.gsd) is available for download from the ABB website at: www.abb.com/fieldbus (follow the link for PROFIBUS DP field devices).

MODBUS protocol

MODBUS is an open standard that is owned and administered by an independent group of device manufacturers called the Modbus Organization (www.modbus.org).

Using the MODBUS protocol, devices from different manufacturers exchange information on the same communications bus without the need for special interface equipment. WaterMaster FEX100-MB follows the specification for Modbus Over Serial Line V1.02, using 2-wire TIA/EIA-485 (RS485) physical layer.



For example, WaterMaster FEX100–MOD

Cable Properties

The end-to-end length of the trunk cable must be limited. The maximum length depends on the Baud rate, the cable (gauge, capacitance or characteristic impedance), the number of loads on the daisy chain and the network configuration (2-wire or 4-wire).

For 9600 Baud rate and AWG26 (or wider) gauge, the maximum length is 1000 m (3280 ft.). Where 4-wire cabling is used as a 2-wire cabling system the maximum length must be divided by 2. The tap cables must be short, never more than 20 m (65.6 ft.). If a multi-port tap is used with n derivations, each one must have a maximum length of 40 m (131 ft.) divided by n.

The maximum serial data transmission line length for RS485 systems is 1200 m (3937 ft.). The lengths of cable that can be used are determined by the cable type, typically:

- Up to 6 m (19.7 ft.) – standard screened or twisted pair cable.
- Up to 300 m (984 ft.) – twin twisted pair with overall foil screen and an integral drain wire – for example, Belden 9502 or equivalent.
- Up to 1200 m (3937 ft.) – twin twisted pair with separate foil screens and integral drain wires – for example, Belden 9729 or equivalent.

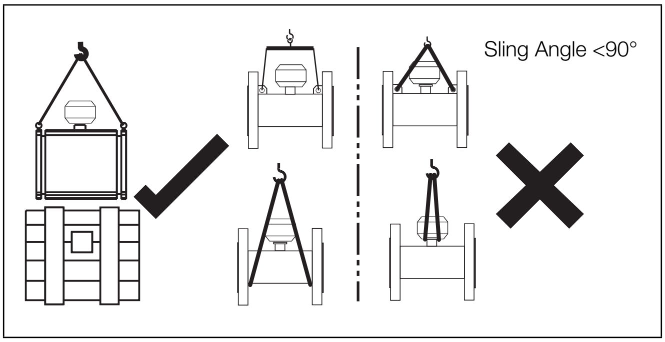
Category 5 cables may be used for RS485-MODBUS to a maximum length of 600 m (1968 ft.). For the balanced pairs used in an RS485-system, a characteristic impedance with value higher than 100Ω is preferred especially for 19200 and higher Baud rates.

Installation requirements

This section is intended to give an overview of installation of a flowmeter. For Installation requirements, technical information and Health and Safety precautions refer to User Guide OI/FEF/FEV/FEW–EN.

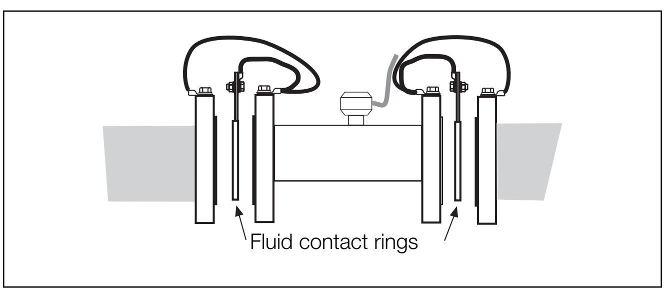
Unpacking the flowmeter

Care must be taken when lifting the flowmeter to use the lifting hooks provided or sling under the body of the meter. Never lift using the terminal connection box of the sensor cable as this will cause damage and invalidate warranty.



Grounding

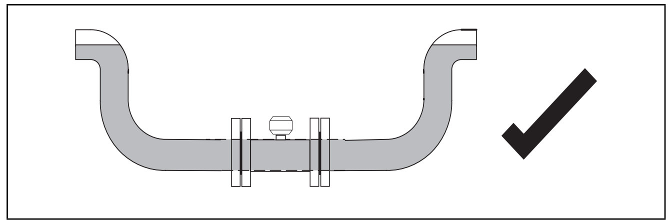
The flowmeter sensor must be cross-bonded to the upstream and downstream pipes and fluid. For technical reasons, this potential should be identical to the potential of the metering fluid. For plastic or insulated lined pipelines, the fluid is grounded by installing a minimum of 1 earthing rings. When there are stray potentials present in the pipeline, an earthing ring is recommended on both ends of the meter sensor.



Mounting

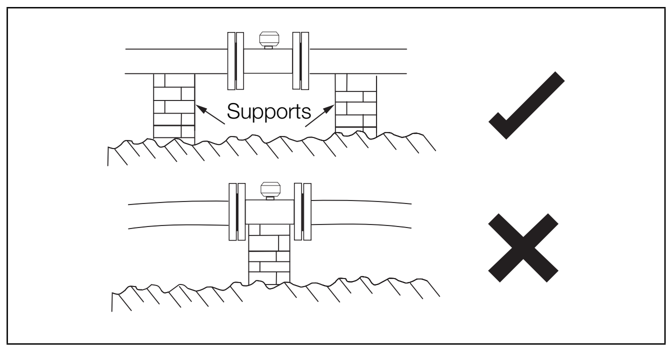
The installation conditions shown below must be observed to achieve the best operational results.

The sensor tube must always be completely full.

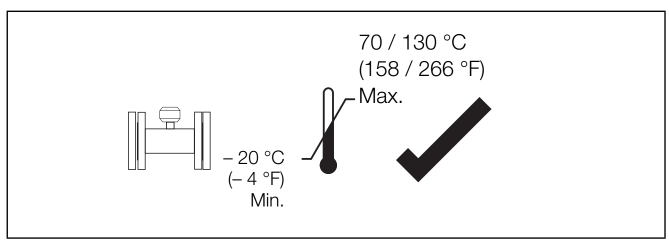


The flow direction must correspond to the identification plate. The device measures the flowrate in both directions. Forward flow is the factory setting.

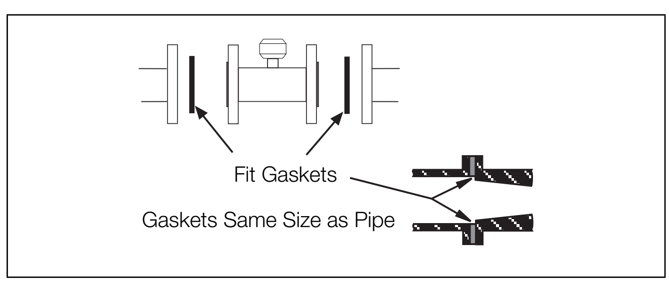
The devices must be installed without mechanical tension (torsion, bending). If required support the pipeline.



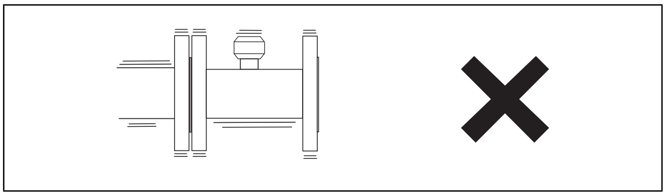
The flange seals must be made from a compatible material for the fluid and fluid temperatures if required.



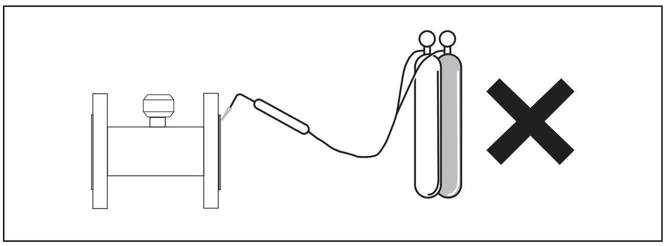
Seals must not extend into the flow area since possible turbulence could influence the device accuracy.



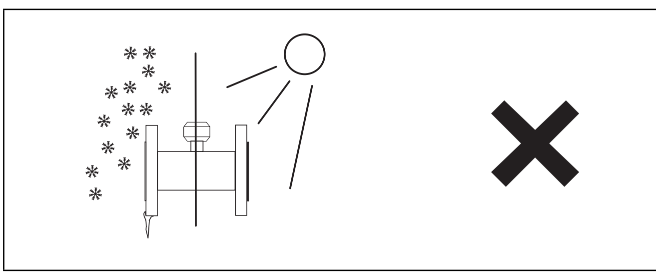
The pipeline may not exert any unallowable forces and torques on the device, such as vibration.



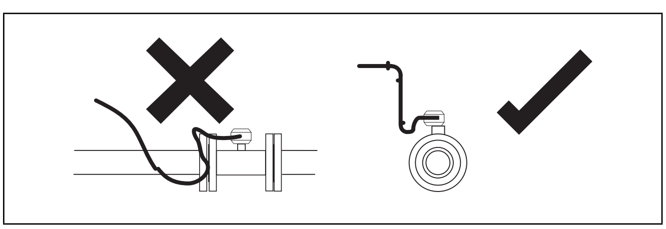
The flowmeter must not be submitted to any localized heat during installation; take care to remember this is a measuring instrument.



The flowmeter must not be exposed to direct sunlight or provide for appropriate sun protection where necessary.

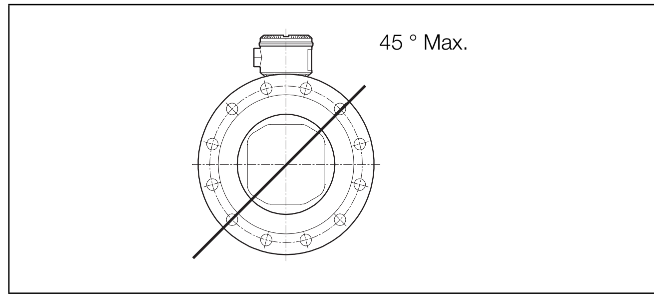


The cable to the flowmeter should be installed neatly or within a conduit, both loose or conduit should have a u shape below the terminal connection box height to allow any water run off to avoid any capillary action into the flowmeter sensor.



Electrode axis

Electrode axis should be horizontal if at all possible or no more than 45° from horizontal.



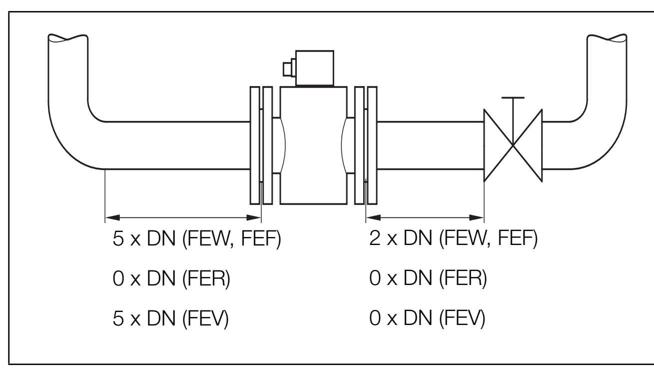
Upstream and Downstream pipe sections

The metering principle is tolerant of the flow profile.

- Wherever possible do not install fittings (for example, manifolds, valves) directly in front of the flowmeter sensor.
- Butterfly valves should be installed so that the valve plate does not extend into the flowmeter sensor.
- Valves or other turn-off components should be installed in the Downstream pipe section.

Experience has shown that, in most installations, straight upstream sections 3 x DN long and straight downstream sections 2 x DN long are normally sufficient. We would recommend conditions of 5 x DN straight upstream and 2 x DN straight downstream where possible.

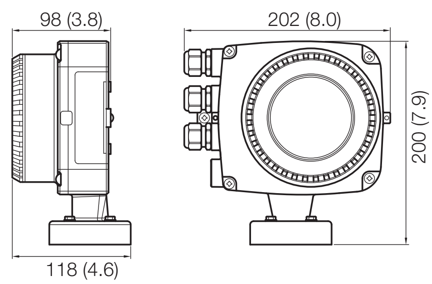
For reduced-bore meters (FER), these straight pipe sections are often not necessary.



Transmitter dimensions

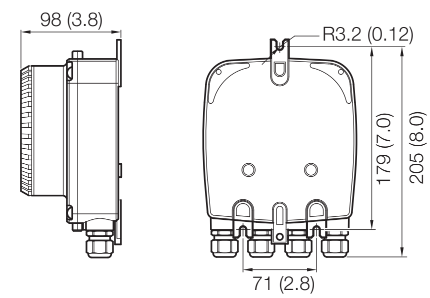
Integral transmitter

Dimensions in mm (in.)



Remote transmitter

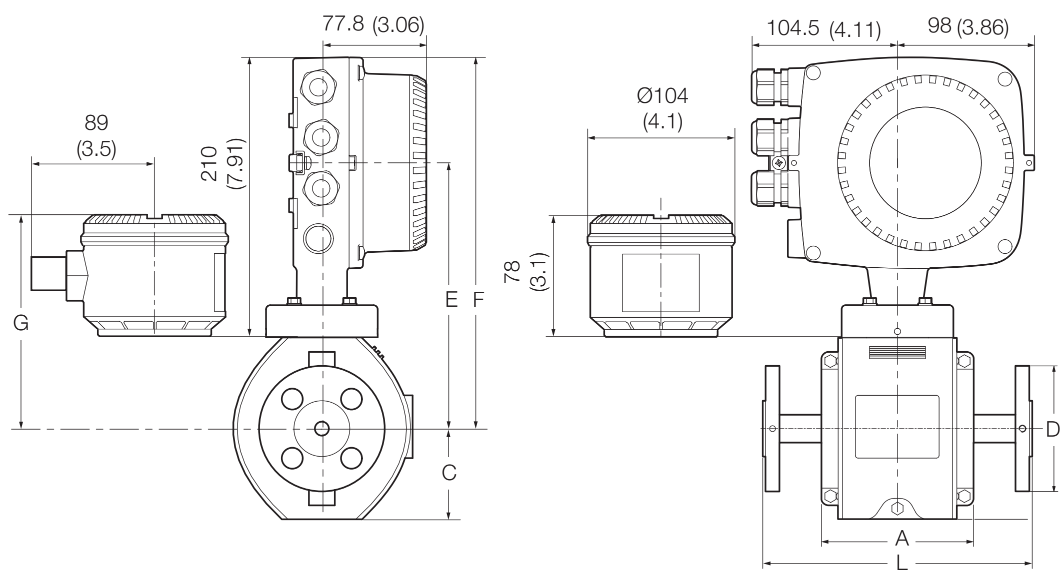
Dimensions in mm (in.)



Sensor dimensions

FEW – DN10 to 125 (3/8 to 5 in. NB)

Dimensions in mm (in.)

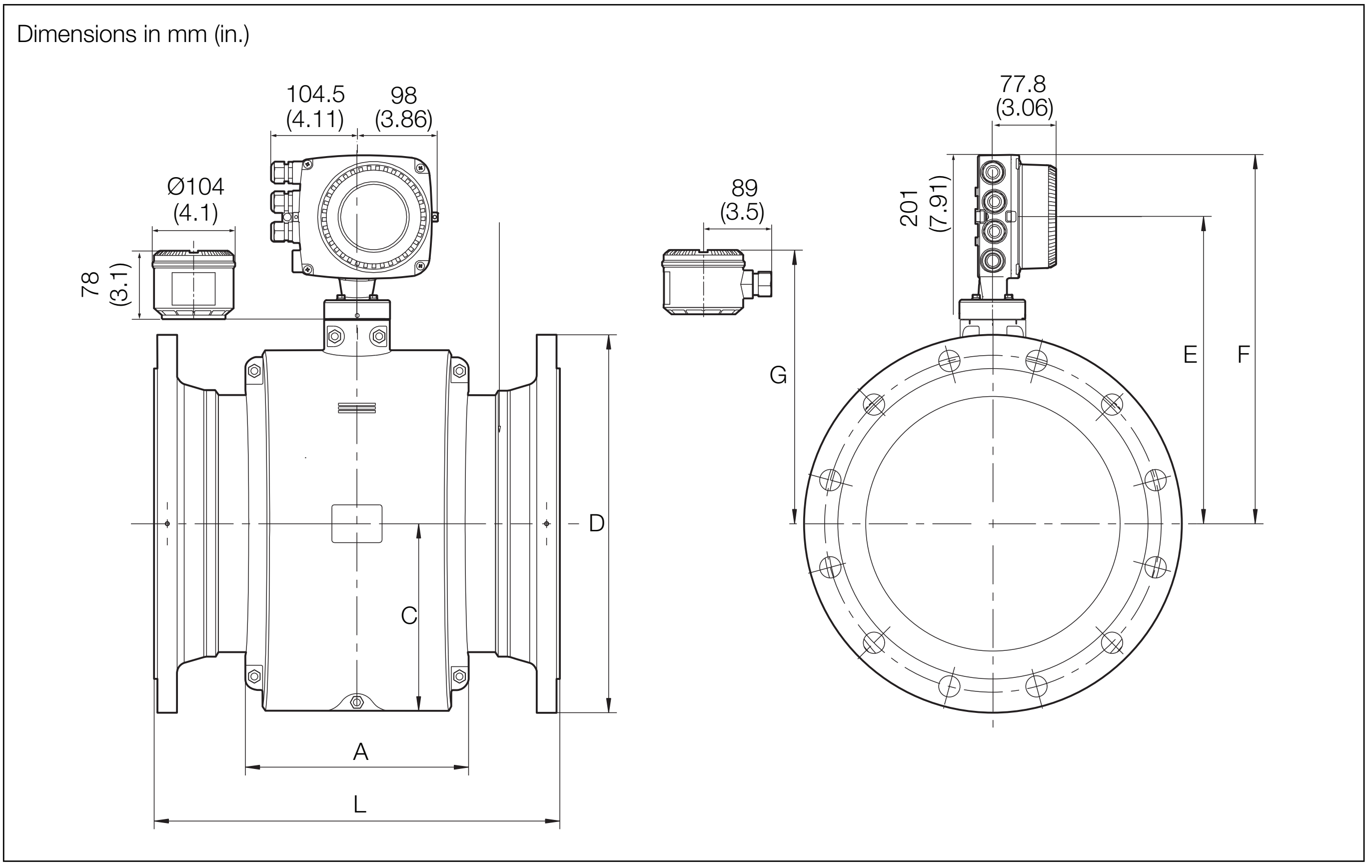


DN10 to 125 (3/8 to 5 in. NB) (FEW)

		Dimensions in mm (in.)							Approx. weight in kg (lb)	
DN	**Process connection type**	**D**	**L**	**F**	**C**	**E**	**G**	**A**	**Integral**	**Remote**
DN10 (3/8 in.)	JIS10K	90 (3.54)	200 (7.87)	268 (10.55)	82 (3.23)	193 (7.6)	148 (5.83)	113 (4.45)	6 (13)	4 (9)
	PN10 to 40	90 (3.54)								
	ASME B16.5 CL150	90 (3.54)								
	ASME B16.5 CL300	96 (3.78)								
DN15 (1/2 in.)	PN10 to 40	95 (3.74)								
	JIS5K	80 (3.15)								
	JIS10K	95 (3.74)								
	ASME B16.5 CL300	95 (3.74)								
	ASME B16.5 CL150	90 (3.54)								
DN20 (3/4 in.)	PN10 to 40	105 (4.13)							8 (18)	6 (13)
	JIS5K	85 (3.35)								
	JIS10K	100 (3.94)								
	ASME B16.5 CL300	115 (4.53)								
	ASME B16.5 CL150	98 (3.86)								
DN25 (1 in.)	PN10 to 40	115 (4.53)	200 (7.87)	268 (10.55)	82 (3.23)	193 (7.6)	148 (5.83)	113 (4.45)	9 (20)	7 (15)
	JIS5K	95 (3.74)								
	JIS10K	125 (4.88)								
	ASME B16.5 CL300	125 (4.88)								
	ASME B16.5 CL150	108 (4.25)								
DN32 (1 1/4 in.)	PN10 to 40	140 (5.51)		275 (10.83)	92 (3.62)	200 (7.87)	155 (6.10)	113 (4.45)	10 (22)	8 (18)
	JIS5K	115 (4.53)								
	JIS10K	135 (5.31)								
	ASME B16.5 CL300	135 (5.31)								
	ASME B16.5 CL150	117 (4.61)								
DN40 (1 1/2 in.)	PN10 to 40	150 (5.91)							11 (24)	9 (20)
	JIS5K	120 (4.72)								
	JIS10K	140 (5.51)								
	ASME B16.5 CL300	155 (6.10)								
	ASME B16.5 CL150	127 (5.00)								
DN50 (2 in.)	PN10 to 40	165 (6.5)		281 (11.06)	97 (3.82)	206 (8.11)	161 (6.34)	115 (4.53)	12 (26)	10 (22)
	JIS5K	130 (5.12)								
	JIS10K	155 (6.10)								
	AS4087 PN16	150 (5.91)								
	AS4087 PN35	165 (6.50)								
	ASME B16.5 CL150	152 (5.98)								
	ASME B16.5 CL300	165 (6.50)								
DN65 (2 1/2 in.)	PN10 to 40	185 (7.28)		292 (11.50)	108 (4.25)	217 (8.54)	172 (6.77)	104 (4.09)	13 (29)	11 (24)
	JIS5K	155 (6.10)								
	JIS10K	175 (6.89)								
	AS4087 PN16	165 (6.50)								
	AS4087 PN35	185 (7.28)								
	ASME B16.5 CL150	178 (7.01)								
	ASME B16.5 CL300	190 (7.48)							15 (33)	13 (29)
DN80 (3 in.)	PN10 to 40	200 (7.87)		292 (11.5)	108 (4.25)	217 (8.54)	172 (6.77)	104 (4.09)	17 (37)	15 (33)
	JIS5K	180 (7.09)								
	JIS10K	185 (7.28)								
	AS4087 PN16	185 (7.28)								
	AS4087 PN35	205 (8.07)								
	ASME B16.5 CL150	190 (7.48)								
	ASME B16.5 CL300	210 (8.28)							19 (42)	17 (37)
DN100 (4 in.)	PN10 to 16	220 (8.66)	250 (9.84)	314 (12.36)	122 (4.8)	239 (9.41)	194 (7.64)	125 (4.92)	19 (42)	17 (37)
	PN25 to 40	235 (9.25)							23 (51)	21 (46)
	JIS5K	200 (7.87)							19 (42)	17 (37)
	JIS10K	210 (8.27)								
	AS4087 PN16	215 (8.46)								
	AS4087 PN35	230 (9.06)							23 (51)	21 (46)
	ASME B16.5 CL300	255 (1.04)							30 (66)	28 (62)
	ASME B16.5 CL150	229 (9.00)							21 (51)	19 (42)
DN125 (5 in.)	PN10 to 16	250 (9.84)		324 (12.76)	130 (5.12)	249 (9.8)	204 (8.03)	125 (4.92)	22 (48)	20 (44)
	PN25 to 40	270 (10.63)							29 (64)	27 (59)
	JIS5K	235 (9.25)							22 (48)	20 (44)
	JIS10K	250 (9.84)								
	ASME B16.5 CL150	254 (10.00)								
	ASME B16.5 CL300	280 (11.02)							35 (77)	33 (73)

DN10 to 125 (3/8 to 5 in. NB) (FEW) dimensions / weights

FEW – DN150 to 400 (6 to 16 in. NB)



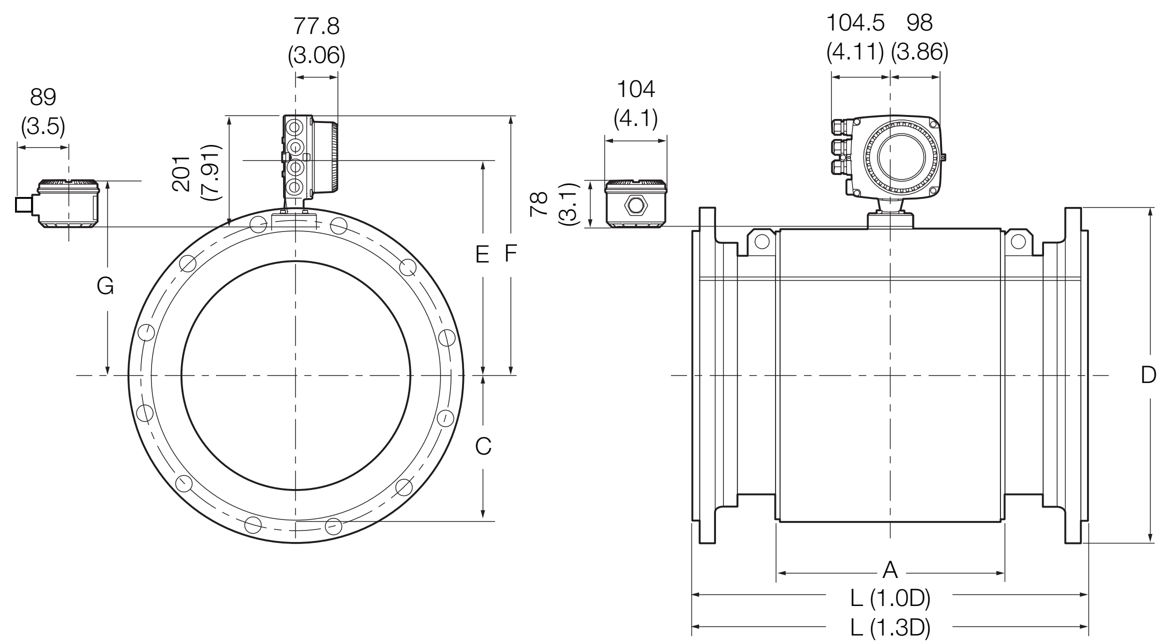
DN150 to 400 (6 to 16 in. NB) (FEW)

		Dimensions in mm (in.)							Approx. weight in kg (lb)	
DN	Process connection type	D	L	F	C	E	G	A	Integral	Remote
DN150 (6 in.)	PN10 to 16	285 (11.22)	300 (11.81)	371 (14.61)	146 (9.88)	296 (11.65)	251 (9.88)	166 (6.54)	33 (73)	31 (68)
	PN25 to 40	300 (11.81)							39 (86)	37 (81)
	JIS5K	265 (10.43)							33 (73)	31 (68)
	JIS10K	280 (11.02)								
	AS4087 PN16	280 (11.02)								
	AS4087 PN35	305 (11.81)							39 (86)	37 (81)
	ASME B16.5 CL300	320 (12.60)							47 (103)	45 (99)
	ASME B16.5 CL150	279 (10.98)							33 (73)	31 (68)
DN200 (8 in.)	PN10	340 (13.39)	350 (13.78)	411 (16.18)	170 (6.69)	336 (13.23)	291 (11.46)	200 (7.87)	41 (90)	39 (86)
	PN16	340 (13.39)								
	PN25	360 (14.17)							55 (121)	53 (117)
	PN40	375 (14.76)							65 (143)	63 (139)
	AS4087 PN16	335 (13.19)							41 (90)	39 (86)
	AS4087 PN35	370 (14.57)							65 (143)	63 (139)
	JIS5K	320 (12.60)							41 (90)	39 (86)
	JIS10K	330 (12.99)								
	ASME B16.5 CL300	380 (14.96)							72 (158)	70 (154)
	ASME B16.5 CL150	345 (13.58)							50 (110)	48 (106)
DN250 (10 in.)	PN10	395 (15.55)	450 (17.72)	426 (16.77)	198 (7.80)	351 (13.82)	306 (12.05)	235 (9.62)	61 (134)	59 (130)
	PN16	405 (15.94)							65 (143)	63 (139)
	PN25	425 (16.73)							84 (185)	82 (180)
	PN40	450 (17.72)							95 (209)	93 (205)
	AS4087 PN16	405 (15.94)							65 (143)	63 (139)
	AS4087 PN35	430 (16.93)							95 (209)	93 (205)
	JIS5K	385 (15.16)							65 (143)	63 (139)
	JIS10K	400 (15.75)								
	ASME B16.5 CL300	445 (17.52)							105 (231)	103 (227)
	ASME B16.5 CL150	405 (15.94)							70 (154)	68 (150)
DN300 (12 in.)	PN10	445 (17.52)	500 (19.69)	449 (17.68)	228 (8.98)	374 (14.72)	329 (12.95)	272 (10.71)	74 (163)	72 (158)
	PN16	460 (18.11)							80 (176)	78 (172)
	PN25	485 (19.09)							100 (220)	98 (216)
	JIS5K	430 (16.93)							80 (176)	78 (172)
	JIS10K	445 (17.52)								
	AS4087 PN16	455 (17.91)								
	AS4087 PN35	490 (19.29)							130 (286)	128 (282)
	ASME B16.5 CL300	520 (20.47)							150 (330)	148 (326)
	ASME B16.5 CL150	485 (19.09)							105 (231)	103 (227)
	PN40	515 (20.28)	600 (23.62)						130 (286)	128 (282)
DN350 (14 in.)	PN10	505 (19.88)	550 (21.65)	464 (18.27)	265 (10.43)	389 (15.31)	344 (13.54)	322 (12.68)	95 (209)	93 (205)
	PN16	520 (20.47)							110 (242)	108 (238)
	PN25	555 (21.85)							145 (319)	143 (315)
	JIS5K	480 (18.90)							95 (209)	93 (205)
	JIS10K	490 (19.29)								
	AS4087 PN16	525 (20.67)							130 (286)	128 (282)
	AS4087 PN35	550 (21.65)							185 (407)	183 (403)
	ASME B16.5 CL300	585 (23.03)							140 (308)	138 (304)
	ASME B16.5 CL150	535 (21.06)							105 (231)	103 (227)
	PN40	580 (22.83)	650 (25.59)						195 (429)	193 (425)
DN400 (16 in.)	PN10	565 (22.24)	600 (23.62)	506 (19.92)	265 (10.43)	431 (16.97)	386 (15.20)	322 (12.68)	103 (227)	101 (222)
	PN16	580 (22.83)							126 (277)	124 (273)
	PN25	620 (24.41)							170 (374)	168 (370)
	JIS5K	540 (21.26)							103 (227)	101 (223)
	JIS10K	560 (22.05)							116 (255)	114 (251)
	AS4087 PN16	580 (22.83)							154 (339)	152 (335)
	AS4087 PN35	610 (24.02)							302 (664)	300 (660)
	ASME B16.5 CL300	650 (25.59)							265 (583)	263 (578)
	ASME B16.5 CL150	600 (23.62)							175 (385)	173 (381)
	PN40	660 (25.98)	650 (25.59)						258 (568)	256 (564)

DN150 to 400 (6 to 5 in. NB) (FEW) dimensions / weights

FEW – DN450 to 2400 (18 to 96 in. NB)

Dimensions in mm (in.)



DN450 to 2400 (18 to 96 in. NB) (FEW)

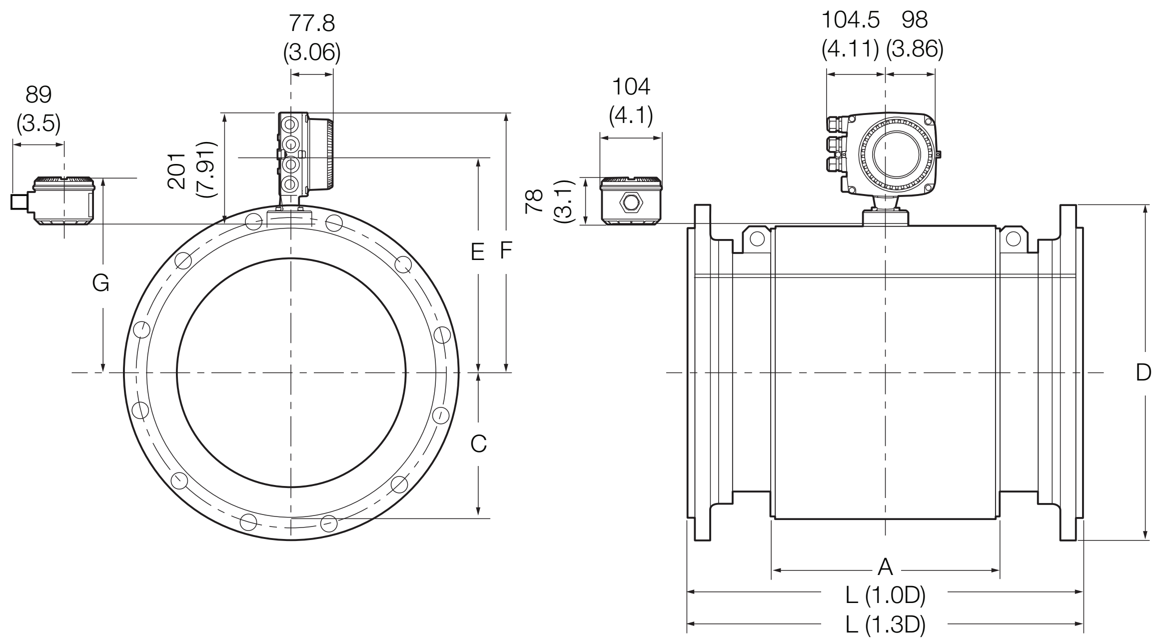
		Dimensions in mm (in.)								Approx. weight in kg (lb)	
DN	**Process connection type**	**D**	**L (1.0D)**	**L (1.3D)**	**F**	**C**	**E**	**G**	**A**	**Integral**	**Remote**
DN450 (18 in.)	PN10	615 (24.21)	N/A	600 (23.62)	514 (20.24)	310 (12.20)	439 (17.28)	394 (15.51)	328 (12.91)	173 (381)	171 (377)
	PN16	640 (25.20)								188 (414)	186 (410)
	JIS5K	605 (23.82)								165 (364)	163 (359)
	JIS10K	620 (24.41)								177 (390)	175 (386)
	AS4087 PN16	640 (25.20)								232 (511)	230 (507)
	AS4087 PN35	675 (26.57)								328 (723)	326 (718)
	ASME B16.5 CL300	710 (27.95)								368 (811)	366 (807)
	ASME B16.5 CL150	635 (25.00)								250 (551)	248 (547)
	PN25	670 (26.38)	N/A	686 (27.01)						245 (540)	243 (536)
	PN40	685 (26.97)								315 (694)	313 (690)
DN500 (20 in.)	PN10	670 (26.38)	N/A	600 (23.62)	514 (20.24)	310 (12.20)	439 (17.28)	394 (15.51)	367 (14.45)	190 (418)	188 (413)
	PN16	715 (28.15)								240 (528)	238 (524)
	JIS5K	655 (25.79)								190 (418)	188 (413)
	JIS10K	675 (26.57)									
	AS4087 PN16	705 (27.76)								290 (638)	288 (634)
	AS4087 PN35	735 (28.94)								435 (957)	433 (953)
	ASME B16.5 CL150	700 (27.56)								300 (660)	298 (656)
	ASME B16.5 CL300	775 (30.51)	N/A	762						490 (1080)	488 (1076)
	PN25	730 (28.74)	N/A	700						300 (661)	298 (657)
	PN40	755 (29.72)	N/A	762						392 (864)	390 (860)
DN600 (24 in.)	PN10	780 (30.71)	N/A	800 (31.50)	565 (22.24)	361 (14.21)	490 (19.29)	445 (17.52)	469 (18.46)	284 (626)	282 (622)
	PN16	840 (33.07)								318 (700)	316 (695)
	PN25	845 (33.27)								460 (1012)	458 (1008)
	JIS5K	770 (30.31)								275 (605)	273 (600)
	JIS10K	795 (31.30)								306 (673)	304 (668)
	AS4087 PN16	825 (32.48)								382 (840)	380 (835)
	AS4087 PN35	850 (33.46)								452 (994)	450 (990)
	ASME B16.5 CL300	915 (36.02)								550 (1210)	548 (1205)
	ASME B16.5 CL150	815 (32.09)								425 (935)	423 (930)
	PN40	890 (35.04)	N/A	890						600 (1320)	598 (1316)

DN450 to 2400 (18 to 96 in. NB) (FEW) dimensions / weights

		Dimensions in mm (in.)								Approx. weight in kg (lb)	
DN	Process connection type	D	L (1.0D)	L (1.3D)	F	C	E	G	A	Integral	Remote
DN700 (28 in.)	JIS 5K	875 (34.45)	700 (27.56)	910 (35.83)	604 (23.77)	403 (15.87)	528 (20.79)	488 (19.21)	444 (17.48)	216 (475)	214 (471)
	JIS 10K	905 (35.63)								282 (620)	280 (616)
	PN6	860 (33.86)								225 (495)	223 (491)
	PN10	895 (35.24)								303 (667)	301 (662)
	PN16	910 (35.83)								337 (741)	335 (737)
	AWWA C207 CLASS B	927 (36.50)								249 (548)	247 (543)
	AWWA C207 CLASS D	927 (36.50)								280 (616)	278 (612)
	AS4087 PN16	910 (35.83)								359 (790)	357 (785)
	AS2129 TABLE-D	910 (35.83)								263 (579)	261 (574)
	AS2129 TABLE-E	910 (35.83)								337 (741)	335 (737)
	PN25	960 (37.80)								471 (10.36)	469 (1032)
	PN40	995 (39.17)								586 (1289)	584 (1285)
	AWWA C207 CLASS E	927 (36.50)								472 (1038)	470 (1034)
	AWWA C207 CLASS F	1035 (40.75)								715 (1573)	713 (1569)
	AS4087 PN35	935 (36.80)								539 (1186)	537 (1181)
	ASME CL150 SERIES A	925 (36.42)								503 (1107)	501 (1102)
	ASME CL150 SERIES B	835 (32.87)								323 (711)	321 (706)
	ASME CL300 SERIES B	920 (36.22)								631 (1388)	629 (1384)
DN750 (30 in.)	JIS 5K	945 (37.20)	750 (29.52)	990 (38.98)	630 (24.79)	429 (16.89)	554 (21.81)	514 (20.23)	444 (17.48)	251 (552)	249 (548)
	JIS 10K	970 (38.19)								327 (719)	325 (715)
	AWWA C207 CLASS B	984 (38.74)								273 (601)	271 (596)
	AWWA C207 CLASS D	984 (38.74)								344 (757)	342 (752)
	AS4087 PN16	995 (39.17)								467 (1027)	465 (1023)
	AS2129 TABLE-D	995 (39.17)								340 (748)	338 (744)
	AS2129 TABLE-E	995 (39.17)								454 (999)	452 (994)
	AWWA C207 CLASS E	984 (38.74)								496 (1091)	494 (1087)
	AWWA C207 CLASS F	1092 (43.99)								790 (1738)	788 (1734)
	AS4087 PN35	1015 (39.96)								663 (1459)	661 (1454)
	ASME CL150 SERIES A	985 (38.78)								544 (1197)	542 (1192)
	ASME CL150 SERIES B	885 (34.84)								320 (704)	318 (700)
	ASME CL300 SERIES B	990 (38.98)								748 (1646)	746 (1641)
DN800 (32 in.)	JIS 5K	995 (39.17)	800 (31.49)	1040 (40.04)	654 (25.74)	453 (17.83)	578 (22.76)	538 (21.18)	542 (21.34)	280 (616)	278 (612)
	JIS 10K	1020 (40.16)								364 (801)	362 (796)
	PN6	975 (38.39)								294 (647)	292 (642)
	PN10	1015 (39.96)								406 (893)	404 (889)
	PN16	1025 (40.35)								469 (1032)	467 (1027)
	AWWA C207 CLASS B	1060 (41.73)								328 (722)	326 (717)
	AWWA C207 CLASS D	1060 (41.73)								408 (898)	406 (893)
	AS4087 PN16	1060 (41.73)								530 (1166)	528 (1162)
	AS2129 TABLE-D	1060 (41.73)								386 (849)	384 (845)
	AS2129 TABLE-E	1060 (41.73)								519 (1142)	517 (1137)
	PN25	1085 (42.72)								615 (1353)	613 (1349)
	PN40	1140 (44.88)								866 (1905)	864 (1901)
	AWWA C207 CLASS E	1060 (41.73)								634 (1395)	632 (1390)
	AWWA C207 CLASS F	1150 (45.28)								897 (1973)	895 (1969)
	AS4087 PN35	1060 (41.73)								751 (1652)	749 (1648)
	ASME CL150 SERIES A	1060 (41.73)								700 (1540)	698 (1536)
	ASME CL150 SERIES B	940 (37.01)								406 (893)	404 (889)
	ASME CL300 SERIES B	1055 (41.54)								933 (2053)	931 (2048
DN900 (36 in.)	JIS 5K	1095 (43.11)	900 (35.43)	1170 (46.06)	705 (27.7()	504 (19.84)	629 (24.76)	589 (23.19)	570 (22.44)	369 812)	367 (807)
	JIS 10K	1120 (44.09)								445 (979)	443 (975)
	PN6	1075 (42.32)								390 (858)	388 (854)
	PN10	1115 (43.90)								502 (1104)	500 (1100)
	PN16	1125 (44.29)								589 (1296)	587 (1291)
	AWWA C207 CLASS B	1168 (45.98)								417 (917)	415 (913)
	AWWA C207 CLASS D	1168 (45.98)								493 (1085)	491 (1080)
	AWWA C207 CLASS E	1168 (45.98)								827 (1819)	825 (1815)
	AWWA C207 CLASS F	1270 (50.00)								1150 (2530)	1148 (2526)
	AS4087 PN16	1175 (46.26)								706 (1553)	704 (1549)
	AS2129 TABLE-D	1175 (46.26)								514 (1131)	512 (1126)
	AS2129 TABLE-E	1175 (46.26)								694 (1527)	692 (1522)
	PN25	1185 (46.65)								819 (1802)	817 (1797)
	PN40	1250 (49.21)								1158 (2548)	1156 (2543)
	AS4087 PN35	1185 (46.65)								1044 (2297)	1042 (2292)
	ASME CL150 SERIES A	1170 (46.06)								961 (2114)	959 (2110)
	ASME CL150 SERIES B	1055 (41.54)								595 (1309)	593 (1305)
	ASME CL300 SERIES B	1170 (46.06)								1147 (2523)	1145 (2519)

DN450 to 2400 (18 to 96 in. NB) (FEW) dimensions / weights (Continued)

Dimensions in mm (in.)



…DN450 to 2400 (18 to 96 in. NB) (FEW)

		Dimensions in mm (in.)								Approx. weight in kg (lb)	
DN	**Process connection type**	**D**	**L (1.0D)**	**L (1.3D)**	**F**	**C**	**E**	**G**	**A**	**Integral**	**Remote**
DN1000 (40 in.)	JIS 5K	1195 (47.05)	1000 (39.37)	1300 (51.18)	755 (29.71)	554 (21.81)	679 (26.73)	639 (25.16)	624 (24.57)	441 (970)	439 (966)
	JIS 10K	1235 (48.62)								572 (1258)	570 (1254)
	PN6	1175 (46.26)								466 (1025)	464 (1021)
	PN10	1230 (48.43)								674 (1483)	672 (1478)
	PN16	1255 (49.41)								879 (1934)	877 (1929)
	AWWA C207 CLASS B	1289 (50.75)								503 (1107)	501 (1102)
	AWWA C207 CLASS D	1289 (50.75)								659 (1450)	657 (1445)
	AWWA C207 CLASS E	1289 (50.75)								1028 (2262)	1026 (2257)
	AWWA C207 CLASS F	1378 (54.25)								1367 (3007)	1365 (3003)
	AS4087 PN16	1255 (49.41)								831 (1828)	829 (1824)
	AS2129 TABLE-D	1255 (49.41)								610 (1342)	608 (1338)
	AS2129 TABLE-E	1255 (49.41)								833 (1833)	831 (1028)
	PN25	1320 (51.97)								1207 (2655)	1205 (2651)
	PN40	1360 (53.54)								1413 (3109)	1411 (3104)
	AS4087 PN35	1275 (50.20)								1244 (2737)	1242 (2732)
	ASME CL150 SERIES A	1290 (50.79)								1149 (2528)	1147 (2523)
	ASME CL300 SERIES A	1240 (48.82)								1349 (2968)	1347 (2963)
	ASME CL150 SERIES B	1175 (46.26)								738 (1624)	736 (1619)
	ASME CL300 SERIES B	1275 (50.20)								1487 (3271)	1485 (3267)
DN1050 (42 in.)	AWWA C207 CLASS B	1346 (5299)	1050 (41.33)	1365 (53.74)	808 (31.82)	608 (23.92)	733 (28.84)	693 (27.28)	624 (24.57)	564 (1241)	562 (1236)
	AWWA C207 CLASS D	1346 (5299)								669 (1472)	667 (1467)
	AWWA C207 CLASS E	1346 (5299)								1143 (2515)	1141 (2510)
	AWWA C207 CLASS F	1448 (57.01)								1568 (3450)	1566 (3445)
	ASME CL150 SERIES B	1225 (48.23)								809 (1780)	807 (1775)
	ASME CL150 SERIES A	1345 (52.95)								1289 (2836)	1287 (2831)
	ASME CL300 SERIES A	1290 (50.79)								1527 (3359)	1525 (3355)
	ASME CL300 SERIES B	1335 (52.56)								1704 (3749)	1702 (3744)
DN1100 (44 in.)	JIS 5K	1305 (51.38)	1100 (43.30)	1430 (56.30)						510 (1122)	508 (1118)
	JIS 10K	1345 (52.95)								689 (1516)	687 (1511)
	AWWA C207 CLASS B	1403 (55.24)								615 (1353)	613 (1349)
	AWWA C207 CLASS D	1403 (55.24)								807 (1775)	805 (1771)
	AWWA C207 CLASS E	1404 (55.26)								1205 (2651)	1203 (2647)
	AWWA C207 CLASS F	1505 (59.25)								1719 (3782)	1717 (3777)

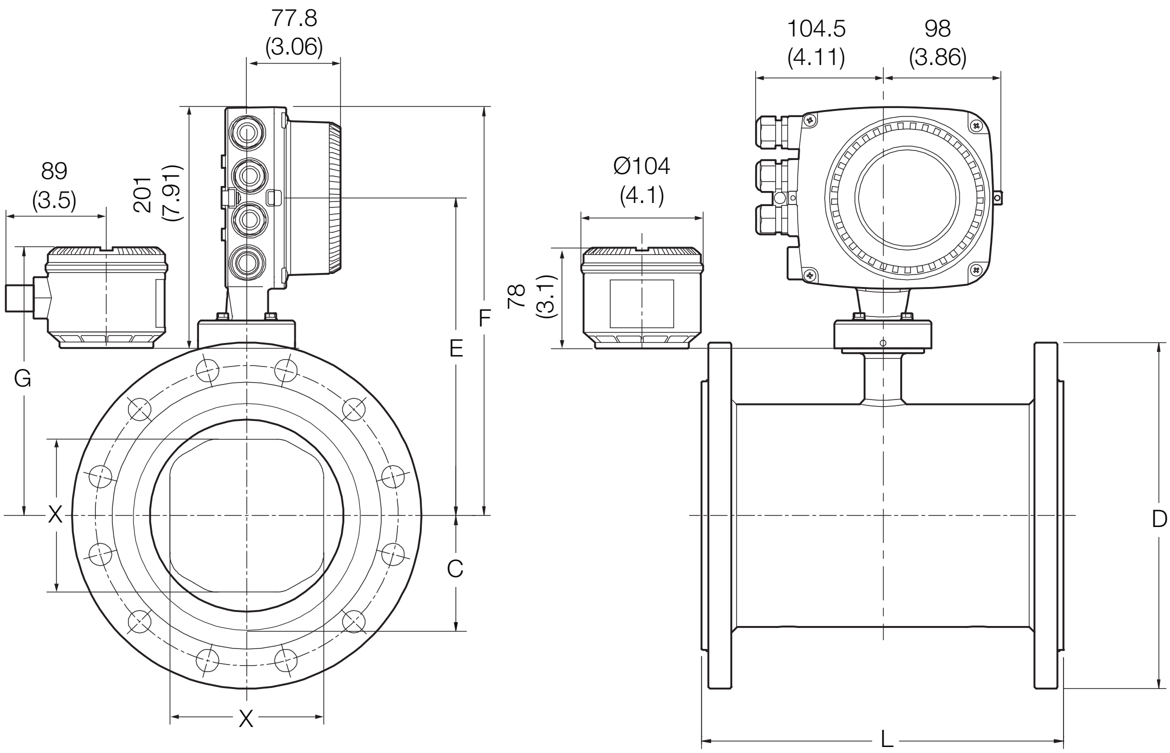
…DN450 to 2400 (18 to 96 in. NB) (FEW) dimensions / weights

		Dimensions in mm (in.)								Approx. weight in kg (lb)	
DN	Process connection type	D	L (1.0D)	L (1.3D)	F	C	E	G	A	Integral	Remote
DN1200 (48 in.)	JIS 5K	1420 (55.91)	1200 (47.24)	1560 (61.42)	860 (33.85)	659 (25.94)	784 (30.87)	744 (29.29)	802 (31.57)	651 (1432)	649 (1428)
	JIS 10K	1465 (57.68)								967 (2127)	965 (2123)
	PN6	1405 (55.31)								710 (1562)	708 (1558)
	PN10	1455 (57.28)								1107 (2435)	1105 (2431)
	PN16	1485 (58.46)								1363 (2999)	1361 (2994)
	AWWA C207 CLASS B	1511 (59.49)								772 (1698)	770 (1694)
	AWWA C207 CLASS D	1511 (59.49)								999 (2198)	997 (2193)
	AWWA C207 CLASS E	1511 (59.49)								1458 (3208)	1456 (3203)
	AWWA C207 CLASS F	1651 (65.00)								2400 (5280)	2398 (5276)
	AS4087 PN16	1490 (58.66)								1253 (2757)	1251 (2752)
	AS2129 TABLE-D	1490 (58.66)								1023 (2251)	1021 (2246)
	AS2129 TABLE-E	1490 (58.66)								1272 (2798)	1270 (2794)
	PN25	1530 (60.24)								1559 (3430)	1557 (3425)
	PN40	1575 (62.01)								2133 (4693)	2131 (4688)
	AS4087 PN35	1530 (60.24)								2115 (4653)	2113 (4649)
	ASME CL150 SERIES A	1510 (59.45)								1707 (3755)	1705 (3751)
	ASME CL300 SERIES A	1465 (57.68)								2163 (4759)	2161 (4754)
	ASME CL150 SERIES B	1390 (54.72)								1085 (2387)	1083 (2383)
	ASME CL300 SERIES B	1510 (59.45)								2352 (5174)	2350 (5170)
DN1350 (54 in.)	AWWA C207 CLASS B	1683 (66.26)	1350 (53.15)	1755 (69.09)	955 (37.59)	754 (29.69)	879 (34.61)	839 (33.03)	902 (35.51	981 (2158)	979 (2154)
	AWWA C207 CLASS D	1683 (66.26)								1213 (2669)	1211 (2664)
	AWWA C207 CLASS E	1683 (66.26)								1942 (4272)	1940 (4268)
DN1400 (56 in.)	PN6	1630 (64.17)	1400 (55.11)	1820 (71.65)						1085 (2387)	1083 (2383)
	PN10	1675 (65.94)								1731 (3808)	1729 (3804)
	PN16	1685 (66.34)								1770 (3894)	1768 (3890)
	ASME CL150 SERIES B	1600 (62.99)								1593 (3505)	1591 (3500)
	PN25	1755 (69.09)								2368 (5210)	2366 (5205)
	PN40	1795 (70.67)								3086 (6789)	3084 (6785)
	ASME CL150 SERIES A	1745 (68.70)								2556 (5623)	2554 (5619)
	ASME CL300 SERIES A	1710 (67.32)								3376 (7427)	3374 (7423)
	ASME CL300 SERIES B	1765 (69.49)								3758 (8268)	3756 (8263)
DN1500 (60 in.)	JIS 5K	1730 (68.11)	1500 (59.05)	1950 (76.77)	1065 (41.92)	864 (34.02)	989 (38.94)	949 (37.36)	910 (35.83)	1029 (2264)	1027 (2259)
	JIS 10K	1795 (70.67)								1504 (3309)	1502 (3304)
	ASME CL150 SERIES B	1725 (67.91)								2031 (4468)	2029 (4464)
	AWWA C207 CLASS B	1854 (72.99)								1229 (2704)	1227 (2699)
	AWWA C207 CLASS D	1854 (72.99)								1514 (3331)	1512 (3326)
	AWWA C207 CLASS E	1854 (72.99)								2544 (5597)	2542 (5592)
	ASME CL150 SERIES A	1855 (73.03)								3084 (6785)	3082 (6780)
	ASME CL300 SERIES A	1810 (71.26)								3875 (8525)	3873 (8521)
	ASME CL300 SERIES B	1880 (74.02								4181 (9198)	4179 (9194)
DN1600 (64 in.)	PN6	1830 (72.05)	1600 (62.99)	2080 (81.89)	1066 (41.96)	865 (34.06)	990 (38.98)	950 (37.4)	1000 (39.37)	1434 (3155)	1432 (3150)
	PN10	1915 (75.39)								2525 (5555)	2523 (5551)
	PN25	1975 (77.76)								3201 (7042)	3199 (7038)
	PN16	1930 (75.98)								2768 (6090)	2766 (6085)
	PN40	2025 (79.72)								4375 (9625)	4373 (9621)
DN1650 (66 in.)	AWWA C207 CLASS B	2032 (80.00)	N/A	2145 (84.45)	1116 (43.94)	915 (36.02)	1040 (40.94)	1000 (39.37)	1000 (39.37)	1504 (3309)	1502 (3304)
	AWWA C207 CLASS D	2032 (80.00)								2025 (4455)	2023 (4451)
DN1800 (72 in.)	PN6	2045 (80.51)	N/A	2340 (92.13)	1181 (46.50)	980 (38.58)	1105 (43.50)	1065 (41.93)	1100 (43.31)	1853 (4077)	1851 (4072)
	PN10	2115 (83.27)								3180 (6996)	3178 (6992)
	PN16	2130 (83.86)								3657 (8045)	3655 (8041)
	PN25	2195 (86.42)								4422 (9728)	4420 (9724)
	AWWA C207 CLASS B	2197 (86.50)								1773 (3901)	1771 (3896)
	AWWA C207 CLASS D	2197 (86.50)								2387 (5251)	2385 (5247)
DN1950 (78 in.)	AWWA C207 CLASS B	2362 (92.99)	N/A	2535 (99.80)	1291 (50.81)	1090 (42.91)	1215 (47.83)	1175 (46.26)	1180 (46.46)	2309 (5080)	2307 (5075)
	AWWA C207 CLASS D	2362 (92.99)								3037 (6681)	3035 (6677)
DN2000 (80 in.)	PN6	2265 (89.17)	N/A	2600 (102.36)						2581 (5678)	2579 (5674)
	PN10	2325 (91.54)								4254 (9359)	4252 (9354)
	PN16	2345 (92.32)								4556	4554
	PN25	2425 (95.47)								5896	5894
DN2100 (84 in.)	AWWA C207 CLASS B	2534 (99.76)	N/A	2730 (107.48)	1395 (54.91)	1194 (47.01)	1319 (51.93)	1279 (50.35)	1180 (46.46)	2641 (5810)	2639 (5806)
	AWWA C207 CLASS D	2534 (99.76)								3487 (7671)	3485 (7667)
DN2200 (88 in.)	PN6	2475 (97.44)	N/A	2860 (112.60)					1330 (52.36)	3363 (7399)	3361 (7394)
	PN10	2550 (100.39)								5795	5793
DN2400 (96 in.)	PN6	2685 (105.71	N/A	3120 (122.83)	1495 (58.85)	1294 (50.94)	1419 (55.87)	1379 (54.29)	1450 (57.09)	4100 (9020)	4098 (9016)
	PN10	2760 (108.66)								6968	6966

…DN450 to 2400 (18 to 96 in. NB) (FEW) dimensions / weights (Continued)

FEV – DN40 to 200 ($1^1/_2$ to 8 in. NB)

Dimensions in mm (in.)



DN40 to 200 ($1^1/_2$ to 8 in. NB) (FEV)

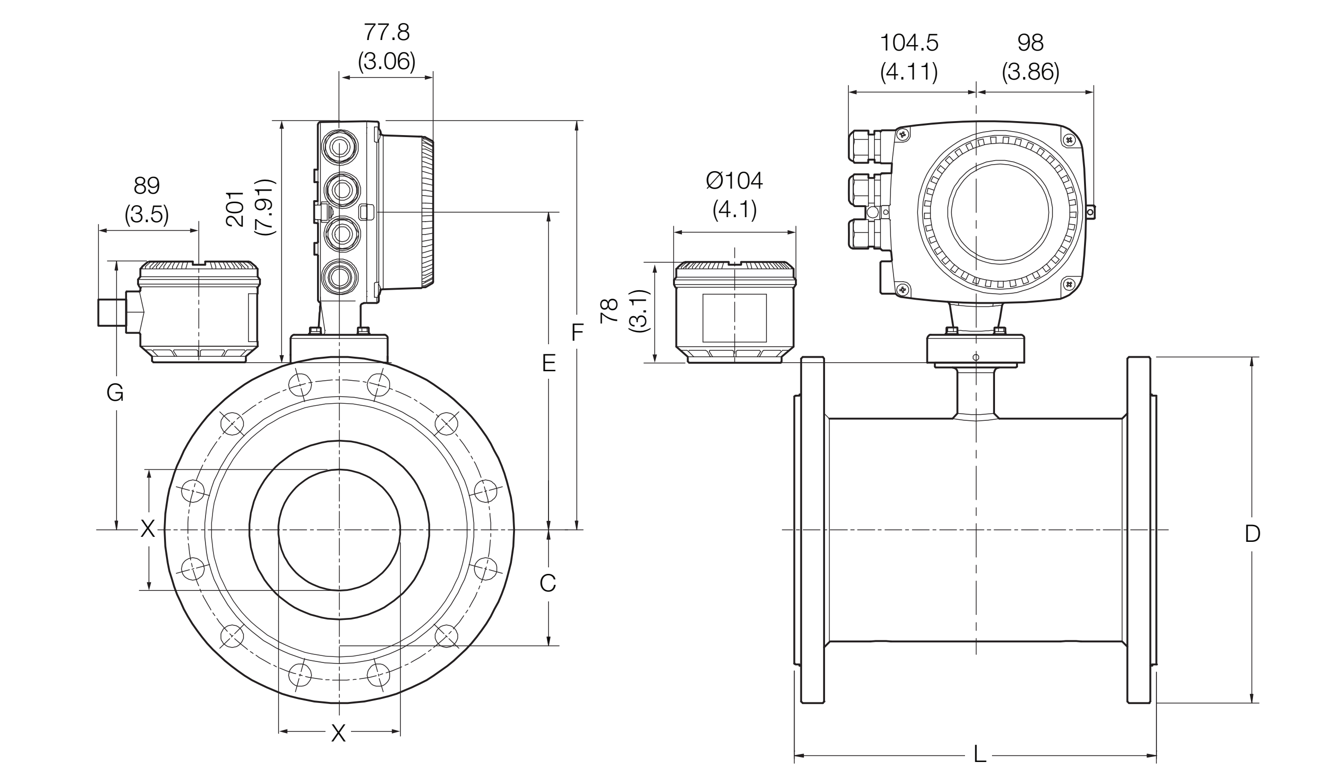
		Dimensions in mm (in.)						Approx. weight in kg (lb)	
DN	**Process connection type**	**D**	**L**	**F**	**E**	**G**	**X**	**Integral**	**Remote**
DN40 ($1^1/_2$ in.)	EN1092-1 PN10, 16, 25, 40	150 (5.91)	200 (7.87)	260 (10.24)	185 (7.28)	137 (5.39)	30 (1.18)	12.8 (28.16)	11.8 (25.96)
	ASME B16.5 CLASS 150								
	AS2129 TABLE D, E, F								
DN50 (2 in.)	EN1092-1 PN10, 16, 25, 40	165 (6.50)	200 (7.87)	261 (10.28)	186 (7.32)	138 (5.43)	38 (1.5)	13.75 (30.25)	12.75 (28.05)
	ASME B16.5 CLASS 150								
DN80 (3 in.)	EN1092-1 PN10, 16, 25, 40	200 (7.87)	200 (7.87)	280 (11.04)	205.5 (8.09)	157.5 (6.2)	61 (2.4)	17.2 (37.84)	16.2 (35.64)
	ASME B16.5 CLASS 150								
	AS4087 PN16, 21								
	AS2129 TABLE D, E, F								
DN100 (4 in.)	EN1092-1 PN10, 16, 25, 40	225 (8.86)	250 (9.84)	300.5 (11.83)	225.5 (8.88)	177.5 (6.98)	70 (2.76)	19.3 (42.5)	18.3 (40.3)
	ASME B16.5 CLASS 150								
	AS4087 PN16								
DN150 (6 in.)	EN1092-1 PN10, 16, 25, 40	300 (11.81)	300 (11.81)	333.5 (13.13)	258.5 (10.18)	210.5 (8.29)	103 (4.06)	35.1 (77.2)	34.1 (75)
	ASME B16.5 CLASS 150								
	AS4087 PN16								
DN200 (8 in.)	EN1092-1 PN10, 16	375 (11.76)	350 (13.78)	358.7 (14.12)	283.7 (11.17)	235.7 (9.28)	150 (5.91)	67 (147.4)	66 (145.2)
	ASME B16.5 CLASS 150								
	AS2129 TABLE C, D, E, F								
	AS4087 PN14, 16, 21								

WaterMaster integral / remote FEV – DN40 to 200 ($1^1/_2$ to 8 in.) cast iron sensor dimensions / weights

		Dimensions in mm (in.)							Approx. weight in kg (lb)	
DN	Process connection type	D	L	F	C	E	G	X	Integral	Remote
DN40 (1 1/2 in.)	EN1092-1 PN10, PN40	150 (5.91)	200 (7.87)	260 (10.24)	30.4 (1.20)	185 (7.28)	138 (5.43)	30 (1.18)	12 (27)	11 (24)
	ASME B16.5 CLASS 150	127 (5.00)								
	JIS 10K	140 (5.51)								
	AS2129 TABLE F	140 (5.51)								
	AS2129 TABLE C D E	135 (5.31)								
	AS4087 PN14	135 (5.31)								
DN50 (2 in.)	EN1092-1 PN10, PN16	165 (6.50)	200 (7.87)	270 (10.63)	38.3 (1.51)	195 (7.68)	146 (5.75)	38 (1.50)	13 (29)	12 (27)
	ASME B16.5 CLASS 150	152.4 (6.00)								
	JIS 10K	155 (6.10)								
	AS4087 PN21	165 (6.50)								
	AS2129 TABLE F	165 (6.50)								
	AS2129 TABLE C D E	150 (5.91)								
	AS4087 PN14, PN16	150 (5.91)								
DN65 (2 1/2 in.)	AS4087 PN14, PN16	165 (6.50)	200 (7.87)	275 (10.83)	45.2 (1.78)	200 (7.87)	152 (5.98)	48 (1.89)	15 (33)	14 (31)
	AS2129 TABLE C D E	165 (6.50)								
	EN1092-1 PN10	185 (7.28)								
	EN1092-1 PN16	185 (7.28)								
DN80 (3 in.)	EN1092-1 PN10, PN16	200 (7.87)	200 (7.87)	280 (11.02)	51.5 (2.03)	205 (8.07)	156 (6.14)	61 (2.40)	16 (36)	15 (33)
	ASME B16.5 CLASS 150	190 (7.48)								
	JIS 7.5K	211 (8.31)								
	JIS 10K	185 (7.28)								
	AS2129 TABLE C D E	185 (7.28)								
	AS4087 PN14, PN16	185 (7.28)								
	AS2129 TABLE F	205 (8.07)								
	AS4087 PN21	205 (8.07)								
DN100 (4 in.)	EN1092-1 PN10, PN16	220 (8.66)	250 (9.84)	320 (12.60)	63.75 (2.51)	245 (9.65)	196.8 (7.75)	70 (2.76)	19 (42)	18 (40)
	ASME B16.5 CLASS 150	228.6 (9.00)								
	JIS 7.5K	238 (9.37)								
	JIS 10K	210 (8.27)								
	AS2129 TABLE C D	215 (8.46)								
	AS4087 PN14, PN16	215 (8.46)								
	AS2129 TABLE E	215 (8.46)								
	AS4087 PN21	230 (9.06)								
	AS2129 TABLE F	230 (9.06)								
DN125 (5 in.)	EN1092-1 PN10, PN16	250 (9.84)	250 (9.84)	320 (12.60)	63.75 (2.51)	245 (9.65)	197 (7.76)	70 (2.76)	20 (44)	19 (42)
	ASME B16.5 CLASS 150	254 (10.00)								
	JIS 10K	250 (9.84)								
	AS2129 TABLE C D E	255 (10.04)								
	AS2129 TABLE F	280 (11.02)								
DN150 (6 in.)	EN1092 PN10, PN16	285 (11.22)	300 (11.81)	340 (13.39)	84.4 (3.32)	265 (10.43)	217 (8.54)	103 (4.06)	32 (70)	31 (68)
	ASME B16.5 CLASS 150	279 (10.98)								
	JIS 7.5k	290 (11.42)								
	JIS 10K	280 (11.02)								
	AS2129 TABLE C D	280 (11.02)								
	AS4087 PN14, PN16	280 (11.02)								
	AS2129 TABLE E	280 (11.02)								
	AS2129 TABLE F	305 (12.01)								
	AS4087 PN21	305 (12.01)								
DN200 (8 in.)	EN1092-1 PN10	340 (13.39)	350 (13.78)	365 (14.37)	109.8 (4.32)	290 (11.42)	243 (9.57)	150 (5.91)	49 (108)	48 (105)
	EN1092-1 PN16	340 (13.39)								
	ASME B16.5 CLASS 150	345 (13.58)								
	JIS 7.5K	342 (13.46)								
	JIS 10K	330 (12.99)								
	AS2129 TABLE C D	335 (13.19)								
	AS4087 PN14, PN 16	335 (13.19)								
	AS2129 TABLE E	335 (13.19)								
	AS2129 TABLE F	370 (14.57)								
	AS4087 PN21	370 (14.57)								

DN40 to 200 (1 1/2 to 8 in. NB) (FEV) dimensions / weights

FER – DN40 to 300 ($1^1/_2$ to 12 in. NB)



DN40 to 300 ($1^1/_2$ to 12 in. NB) (FER)

		Dimensions in mm (in.)						Approx. weight in kg (lb)	
DN	**Process connection type**	**D**	**L**	**F**	**E**	**G**	**X**	**Integral**	**Remote**
DN40 ($1^1/_2$ in.)	EN1092-1 PN10, 16, 25, 40	150 (5.91)	200 (7.87)	260 (10.24)	185 (7.28)	137 (5.39)	23.5 (0.93)	13.4 (29.5)	12.4 (27.3)
	ASME B16.5 CLASS 150								
	AS2129 TABLE D, E, F								
DN50 (2 in.)	EN1092-1 PN10, 16, 25, 40	165 (6.50)	200 (7.87)	261 (10.28)	186 (7.32)	138 (5.43)	29 (1.14)	14.75 (32.45)	13.75 (30.25)
	ASME B16.5 CLASS 150								
DN80 (3 in.)	EN1092-1 PN10, 16, 25, 40	200 (7.87)	200 (7.87)	280 (11.04)	205.5 (8.09)	157.5 (6.2)	47 (1.85)	21.2 (46.64)	20.2 (44.4)
	ASME B16.5 CLASS 150								
	AS4087 PN16, 21								
	AS2129 TABLE D, E, F								
DN100 (4 in.)	EN1092-1 PN10, 16, 25, 40	225 (8.86)	250 (9.84)	300.5 (11.83)	225.5 (8.88)	177.5 (6.98)	64 (2.52)	27.3 (60)	26.3 (58)
	ASME B16.5 CLASS 150								
	AS4087 PN16								
DN150 (6 in.)	EN1092-1 PN10, 16, 25, 40	300 (11.81)	300 (11.81)	333.5 (13.13)	258.5 (10.18)	210.5 (8.29)	100.2 (3.94)	27.3 (60)	26.3 (58)
	ASME B16.5 CLASS 150								
	AS4087 PN16								
DN200 (8 in.)	EN1092-1 PN10, 16	375 (11.76)	350 (13.78)	358.7 (14.12)	283.7 (11.17)	235.7 (9.28)	126.7 (5.00)	68 (150)	67 (147.4)
	ASME B16.5 CLASS 150								
	AS2129 TABLE C, D, E, F								
	AS4087 PN14, 16, 21								

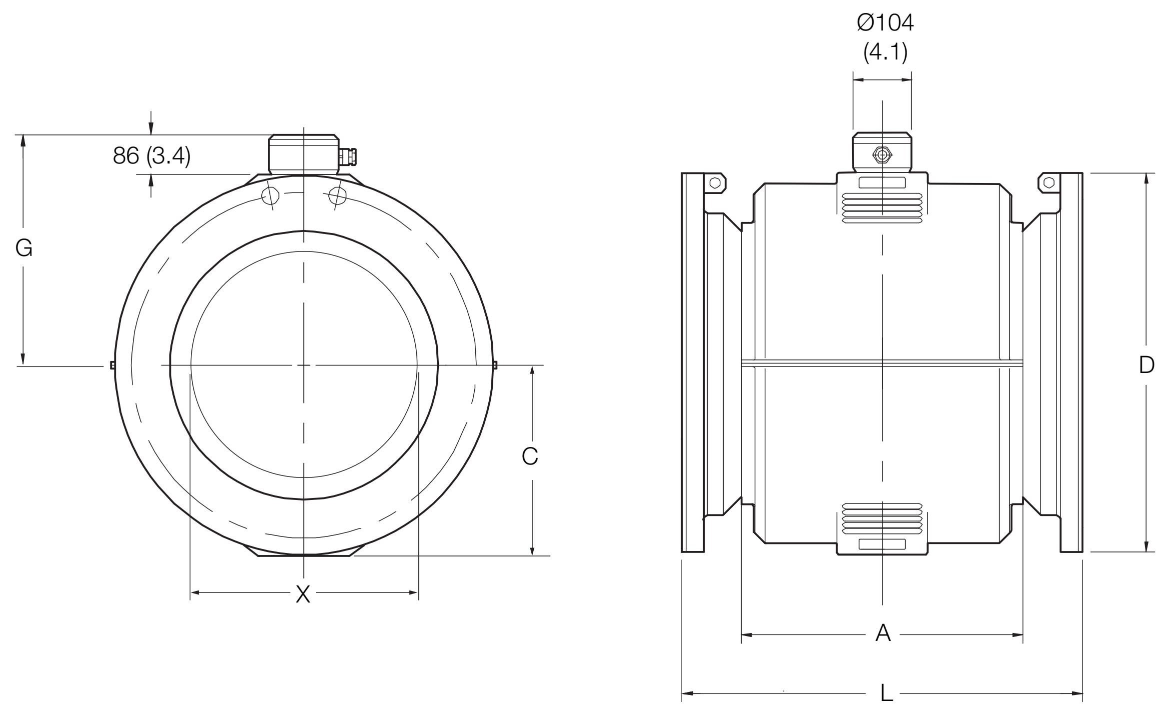
DN40 to 200 ($1^1/_2$ to 8 in.) (FER) cast iron sensor dimensions / weights

		Dimensions in mm (in.)							Approx. weight in kg (lb)	
DN	Process connection type	D	L	F	C	E	G	X	Integral	Remote
DN40	EN1092-1 PN10, 16, 25, 40	150 (5.91)	200 (7.87)	260 (10.24)	30.4 (1.20)	185 (7.28)	138 (5.43)	23.5 (0.93)	13 (29)	11 (24)
(1½ in.)	ASME B16.5 CLASS 150	127 (5.00)								
	JIS 10K	140 (5.51)								
	AS2129 TABLE C D E	135 (5.31)								
	AS2129 TABLE F	140 (5.51)								
	AS4087 PN14	135 (5.31)								
DN50	EN1092-1 PN10, 16, 25, 40	165 (6.50)	200 (7.87)	270 (10.63)	38.3 (1.51)	195 (7.68)	146 (5.75)	29 (1.14)	14 (31)	12 (27)
(2 in.)	ASME B16.5 CLASS 150	152.4 (6.00)								
	JIS 10K	155 (6.10)								
	AS4087 PN21	165 (6.50)								
	AS2129 TABLE F	165 (6.50)								
	AS2129 TABLE C D E	150 (5.91)								
	AS4087 PN14, PN16	150 (5.91)								
DN65	EN1092-1 PN10, 16, 25, 40	185 (7.28)	200 (7.87)	275 (10.83)	45.2 (1.78)	200 (7.87)	152 (5.98)	37 (1.46)	15 (33)	13 (29)
(2½ in.)	ASME B16.5 CLASS 150	178 (7.00)								
	JIS10K	175 (6.89)								
	AS2129 TABLE C D E	165 (6.50)								
	AS2129 TABLE F	185 (7.28)								
	AS4087 PN14, 16	165 (6.50)								
	AS4087 PN21	185 (7.28)								
DN80	EN1092-1 PN10, 16, 25, 40	200 (7.87)	200 (7.87)	280 (11.02)	51.5 (2.03)	205 (8.07)	156 (6.14)	47 (1.85)	20 (44)	18 (40)
(3 in.)	ASME B16.5 CLASS 150	190 (7.48)								
	JIS 10K	185 (7.28)								
	AS2129 TABLE C D E	185 (7.28)								
	AS4087 PN14, 16	185 (7.28)								
	AS2129 TABLE F	205 (8.07)								
	AS4087 PN21	205 (8.07)								
DN100	EN1092-1 PN10, 16	220 (8.66)	250 (9.84)	320 (12.60)	63.75 (2.51)	245 (9.65)	196.8 (7.75)	64 (2.52)	27 (59)	25 (55)
(4 in.)	EN1092-1 PN25, 40	235 (9.25)								
	ASME B16.5 CLASS 150	228.6 (9.00)								
	JIS 7.5K	238 (9.37)								
	JIS 10K	210 (8.27)								
	AS2129 TABLE C D	215 (8.46)								
	AS4087 PN14, 16	215 (8.46)								
	AS4087 PN21	230 (9.06)								
DN125	EN1092-1 PN10, 16	250 (9.84)	250 (9.84)	320 (12.60)	63.75 (2.51)	245 (9.65)	197 (7.76)	64 (2.52)	27 (59)	25 (55)
(5 in.)	EN1092-1 PN25, 40	270 (10.63)								
	ASME B16.5 CLASS 150	254 (10.00)								
	JIS 10K	250 (9.84)								
	AS2129 TABLE C D	255 (10.04)								
DN150	EN1092 PN10, 16	285 (11.22)	300 (11.81)	340 (13.39)	84.4 (3.32)	265 (10.43)	217 (8.54)	100.2 (3.94)	33 (72)	31 (68)
(6 in.)	EN1092 PN25, 40	300 (11.81)								
	ASME B16.5 CLASS 150	279 (10.98)								
	JIS 7.5k	290 (11.42)								
	JIS 10K	280 (11.02)								
	AS2129 TABLE C D	280 (11.02)								
	AS4087 PN14, 16	280 (11.02)								
	AS4087 PN21	305 (12.01)								
DN200	EN1092-1 PN10, 16	340 (13.39)	350 (13.78)	365 (14.37)	109.8 (4.32)	290 (11.42)	243 (9.57)	126.7 (4.99)	50 (110)	48 (106)
(8 in.)	EN1092-1 PN25, 40	360 (14.17)								
	ASME B16.5 CLASS 150	345 (13.58)								
	JIS 7.5K	342 (13.46)								
	JIS 10K	330 (12.99)								
	AS2129 TABLE C D	335 (13.19)								
	AS4087 PN14, 16	335 (13.19)								
	AS4087 PN21	370 (14.57)								
DN250	EN1092-1 PN10	395 (15.55)	450 (17.72)	389 (15.31)	136.8 (5.39)	313 (12.33)	268 (10.55)	153.5 (6.04)	77 (169)	75 (165)
(10 in.)	EN1092-1 PN16	405 (15.94)								
	EN1092-1 PN25	425 (16.73)								
	ASME B16.5 CLASS 150	405 (15.94)								
	JIS 7.5K	400 (15.75)								
	JIS 10K	400 (15.75)								
	AS2129 TABLE C D	405 (15.94)								
	AS4087 PN14, 16	405 (15.94)								
	AS4087 PN21	430 (16.93)								
DN300	EN1092-1 PN10	445 (17.52)	500 (19.69)	414 (16.30)	162.2 (6.39)	338.6 (13.33)	294 (1157)	203.5 (8.01)	114 (251)	112 (247)
(12 in.)	EN1092-1 PN16	460 (18.11)								
	EN1092-1 PN25	485 (19.09)								
	ASME B16.5 CLASS 150	485 (19.09)								
	JIS 10K	445 (17.52)								
	AS2129 TABLE C D	455 (17.91)								
	AS4087 PN14, 16	455 (17.91)								
	AS4087 PN21	490 (19.29)								

DN40 to 300 (1½ to 12 in. NB) (FER) dimensions / weights

FER – DN350 to 600 (14 to 24 in. NB) remote sensor

Dimensions in mm (in.)



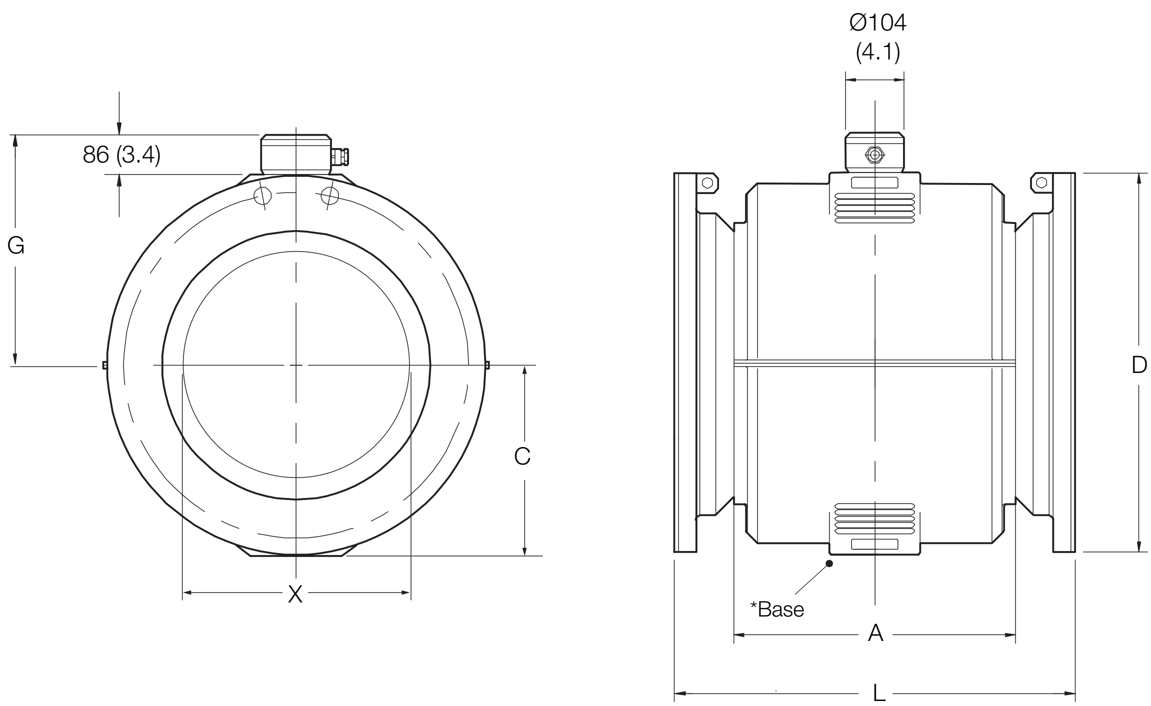
DN350 to 600 (14 to 24 in. NB) (FER) remote sensor

		Dimensions in mm (in.)								Approx. weight in kg (lb)
DN	Process connection type	D	L	F	C	E	G	A	X	Remote
DN350 (14 in.)	EN1092-1 PN10	505 (19.88)	550 (21.65)	472 (18.58)	231 (9.09)	402 (15.83)	325 (12.80)	376 (14.80)	340 (13.39)	100 (220)
	EN1092-1 PN16	520 (20.47)								
	EN1092-1 PN25	555 (21.85)								
	EN1092-1 PN40	580 (22.83)								
	JIS 5K	480 (18.90)								
	JIS 10K	490 (19.29)								
	AS2129 TABLE C D E	525 (20.67)								
	AS2129 TABLE F	550 (21.65)								
	AS4087 PN14, PN16	525 (20.67)								
	AS4087 PN21	550 (21.65)								
DN400 (16 in.)	EN1092-1 PN10	565 (22.24)	600 (23.62)	502 (19.76)	257.5 (10.14)	432 (17.01)	355 (13.98)	420 (16.54)	390 (15.35)	115 (253)
	EN1092-1 PN16	580 (22.83)								
	EN1092-1 PN25	620 (24.41)								
	EN1092-1 PN40	660 (25.98)								
	JIS 5K	540 (21.26)								
	JIS 10K	560 (22.05)								
	AS2129 TABLE C D E	580 (22.83)								
	AS2129 TABLE F	610 (24.02)								
	AS4087 PN14, PN16	580 (22.83)								
	AS4087 PN21	610 (24.02)								
DN450 (18 in.)	EN1092-1 PN10	615 (24.21)	700 (27.56)	537 (21.14)	285 (11.22)	467 (18.39)	390 (15.35)	480 (18.90)	440 (17.32)	160 (352)
	EN1092-1 PN16	640 (25.20)								
	EN1092-1 PN25	670 (26.38)								
	EN1092-1 PN40	685 (26.97)								
	JIS 5K	605 (23.82)								
	JIS 10K	620 (24.41)								
	AS2129 TABLE C D E	640 (25.20)								
	AS2129 TABLE F	675 (26.57)								
	AS4087 PN14, PN16	640 (25.20)								
	AS4087 PN21	675 (26.57)								
DN500 (20 in.)	EN1092-1 PN10	670 (26.38)	770 (30.31)	557 (21.93)	317.5 (12.50)	487 (19.17)	410 (16.14)	520 (20.47)	490 (19.29)	217 (477)
	EN1092-1 PN16	715 (28.15)								
	EN1092-1 PN25	730 (28.74)								
	EN1092-1 PN40	755 (29.72)								
	JIS 5K	655 (25.79)								
	JIS 10K	675 (26.57)								
	AS2129 TABLE C D E	705 (27.76)								
	AS2129 TABLE F	735 (28.94)								
	AS4087 PN14, PN16	705 (27.76)								
	AS4087 PN21	735 (28.94)								
DN600 (24 in.)	EN1092-1 PN10	780 (30.71)	920 (36.22)	602 (23.70)	345 (13.58)	532 (20.94)	455 (17.91)	610 (24.02)	591 (23.27)	315 (693)
	EN1092-1 PN16	840 (33.07)								
	EN1092-1 PN25	845 (33.27)								
	EN1092-1 PN40	890 (35.04)								
	JIS 5K	770 (30.31)								
	JIS 10K	795 (31.30)								
	AS2129 TABLE C D E	825 (32.48)								
	AS2129 TABLE F	850 (33.46)								
	AS4087 PN14, PN16	825 (32.48)								
	AS4087 PN21	850 (33.46)								

DN350 to 600 (14 to 24 in. NB) (FER) remote sensor dimensions / weights

FEF – DN250 to 600 (10 to 24 in. NB)

Dimensions in mm (in.)



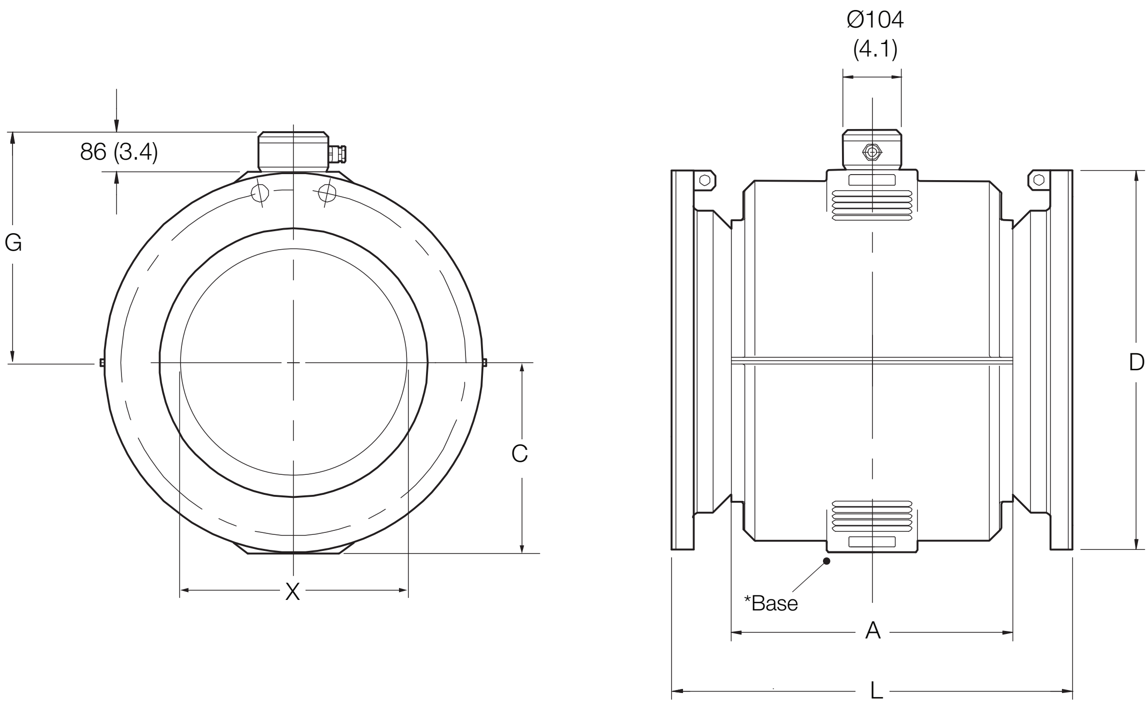
*Dimension C = centre line to base of flowmeter body

DN250 to 600 (10 to 24 in. NB) (FEF)

		Dimensions in mm (in.)						
DN	Process connection type	D	L	C	G	A	X	Approx. weight in kg (lb)
DN250 (10 in.)	ASME B16.5 CLASS 150	405 (15.94)	450 (17.72)	215 (8.46)	301 (11.85)	300 (11.81)	250 (9.84)	88 (194)
	ASME B16.5 CLASS 300	445 (17.52)	490 (19.29)					
	EN1092 -1 PN10	395 (15.55)	450 (17.72)					
	EN1092 – 1 PN16	405 (15.94)						
	EN1092 – 1 PN25	425 (16.73)	490 (19.29)					
	EN1092 – 1 PN40	450 (17.72)						
	JIS 5K	385 (15.16)	450 (17.72)					
	JIS 10K	400 (15.75)						
	AS4087 PN14, PN16	405 (15.94)						
	AS2129 TABLE C D							
	AS2129 TABLE E							
	AS4087 PN21	430 (16.93)						
	AS2129 TABLE F							
DN300 (12 in.)	ASME B16.5 CLASS 150	485 (19.09)	500 (19.69)	231 (9.09)	317 (12.48)	352 (13.86)	300 (11.81)	128 (282)
	ASME B16.5 CLASS 300	520 (20.47)	540 (21.26)					
	EN1092 – 1 PN10	445 (17.52)	500 (19.69)					
	EN1092 – 1 PN16	460 (18.11)	500 (19.69)					
	EN1092 – 1 PN25	485 (19.09)	540 (21.26)					
	EN1092 – 1 PN40	515 (20.28)	540 (21.26)					
	JIS 5K	430 (16.93)	500 (19.69)					
	JIS 10K	445 (17.52)	500 (19.69)					
	AS4087 PN14, PN16	455 (17.91)	500 (19.69)					
	AS2129 TABLE TABLE C D	455 (17.91)	500 (19.69)					
	AS2129 TABLE E	455 (17.91)	500 (19.69)					
	AS4087 PN21	490 (19.29)	500 (19.69)					
	AS2129 TABLE F	490 (19.29)	500 (19.69)					
DN350 (14 in.)	ASME B16.5 CLASS 150	535 (21.06)	550 (21.65)	257.5 (10.14)	346 (13.62)	376 (14.80)	350 (13.78)	100 (220)
	ASME B16.5 CLASS 300	585 (23.03)	570 (22.44)					
	EN1092 – 1 PN10	505 (19.88)	550 (21.65)					
	EN1092 – 1 PN16	520 (20.47)	550 (21.65)					
	EN1092 – 1 PN25	555 (21.85)	570 (22.44)					
	EN1092 – 1 PN40	580 (22.83)	570 (22.44)					
	JIS 5K	480 (18.90)	550 (21.65)					
	JIS 7.5K	530 (20.87)	550 (21.65)					
	JIS 10K	490 (19.29)	550 (21.65)					
	AS4087 PN14, PN16	525 (20.67)	550 (21.65)					
	AS2129 TABLE C D E	525 (20.67)	550 (21.65)					
	AS4087 PN21	550 (21.65)	550 (21.65)					
	AS2129 TABLE F	550 (21.65)	550 (21.65)					
	AS4087 PN35	550 (21.65)	570 (22.44)					
	AS2129 TABLE H	550 (21.65)	570 (22.44)					
DN375 (15 in.)	AS4087 PN14, PN16	550 (21.65)	550 (21.65)	257.5 (10.14)	346 (13.62)	376 (14.80)	350 (13.78)	115 (253)
	AS2129 TABLE C	550 (21.65)	550 (21.65)					
	AS4087 PN35	580 (22.83)	570 (22.44)					
DN400 (16 in.)	ASME B16.5 CLASS 150	600 (23.62)	600 (23.62)	285 (11.22)	371 (14.61)	420 (16.54)	400 (15.75)	115 (253)
	ASME B16.5 CLASS 300	650 (25.59)	620 (24.41)					
	EN1092 – 1 PN10	565 (22.24)	600 (23.62)					
	EN1092 – 1 PN16	580 (22.83)	600 (23.62)					
	EN1092 – 1 PN25	620 (24.41)	620 (24.41)					
	EN1092 – 1 PN40	660 (25.98)	620 (24.41)					
	JIS 5K	540 (21.26)	600 (23.62)					
	JIS 7.5K	582 (22.91)	600 (23.62)					
	JIS 10K	560 (22.05)	600 (23.62)					
	AS4087 PN14, PN16	580 (22.83)	600 (23.62)					
	AS2129 TABLE C D E	580 (22.83)	600 (23.62)					
	AS4087 PN21	610 (24.02)	600 (23.62)					
	AS2129 TABLE F	610 (24.02)	600 (23.62)					
	AS4087 PN35	610 (24.02)	620 (24.41)					
	AS2129 TABLE H	610 (24.02)	620 (24.41)					

DN250 to 600 (10 to 24 in. NB) (FEF) dimensions / weights

Dimensions in mm (in.)



*Dimension C = centre line to base of flowmeter body

…DN250 to 600 (10 to 24 in. NB) (FEF)

DN	Process connection type	Dimensions in mm (in.) D	L	C	G	A	X	Approx. weight in kg (lb)
DN450 (18 in.)	ASME B16.5 CLASS 150	635 (25.00)	700 (27.56)	317.5 (12.50)	402 (15.83)	480 (18.90)	450 (17.72)	160 (352)
	ASME B16.5 CLASS 300	710 (27.95)						
	EN1092 – 1 PN10	615 (24.21)						
	EN1092 – 1 PN16	640 (25.20)						
	EN1092 – 1 PN25	670 (26.38)						
	EN1092 – 1 PN40	685 (26.97)						
	JIS 5K	605 (23.82)						
	JIS 7.5K	652 (25.67)						
	JIS 10K	620 (24.41)						
	AS4087 PN14, PN16	640 (25.20)						
	AS2129 TABLE C D	640 (25.20)						
	AS2129 TABLE E	640 (25.20)						
	AS4087 PN21	675 (26.57)						
	AS2129 TABLE F	675 (26.57)						
	AS4087 PN35	675 (26.57)						
	AS2129 TABLE H	675 (26.57)						
DN500 (20 in.)	ASME B16.5 CLASS 150	700 (27.56)	770 (30.31)	345 (13.58)	429 (16.89)	520 (20.47)	500 (19.69)	217 (455)
	ASME B16.5 CLASS 300	775 (30.51)						
	EN1092 – 1 PN10	670 (26.38)						
	EN1092 – 1 PN16	715 (28.15)						
	EN1092 – 1 PN25	730 (28.74)						
	EN1092 – 1 PN40	755 (29.72)						
	JIS 5K	655 (25.79)						
	JIS 7.5K	706 (27.80)						
	JIS 10K	675 (26.57)						
	AS4087 PN 14, PN16	705 (27.76)						
	AS2129 TABLE C D E	705 (27.76)						
	AS4087 PN21	735 (28.94)						
	AS2129 TABLE F	735 (28.94)						
	AS4087 PN35	735 (28.94)						
	AS2129 TABLE H	735 (28.94)						
DN600 (24 in.)	ASME B16.5 CLASS 150	815 (32.09)	920 (36.22)	387.5 (15.25)	472 (18.58)	610 (24.02)	600 (23.62)	315 (693)
	ASME B16.5 CLASS 300	915 (36.02)						
	EN1092 – 1 PN10	780 (30.71)						
	EN1092 – 1 PN16	840 (33.07)						
	EN1092 – 1 PN25	845 (33.27)						
	EN1092 – 1 PN40	890 (35.04)						
	JIS 5K	770 (30.31)						
	JIS 7.5K	810 (31.89)						
	JIS 10K	795 (31.30)						
	AS4087 PN14, PN16	825 (32.48)						
	AS2129 TABLE C D	825 (32.48)						
	AS2129 TABLE E	825 (32.48)						
	AS4087 PN21	850 (33.46)						
	AS2129 TABLE F	850 (33.46)						
	AS4087 PN35	850 (33.46)						
	AS2129 TABLE H	850 (33.46)						

…DN250 to 600 (10 to 24 in. NB) (FEF) dimensions / weights

Electromagnetic flowmeter WaterMaster FEF12 and FEF18

Product coding field number	1 … 5	6	7 … 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options
Flowmeter system, full bore, remote mount	**FEF12**	X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	
Full bore sensor only, for use with WaterMaster transmitter / remote	**FEF18**																				

Design (field 6)

Non-hazardous areas	1
Hazardous areas (DN≥700 [27 in. NB])	5

Bore diameter (fields 7 … 9)

DN250 (10 in.)	250
DN300 (12 in.)	300
DN350 (14 in.)	350
DN375 (15 in.)	375
DN400 (16 in.)	400
DN450 (18 in.)	450
DN500 (20 in.)	500
DN600 (24 in.)	600
Others	999

Liner material (field 10)

Elastomer – DN250 to 600 (10 to 24 in. NB)	K
Hard rubber – DN250 to 600 (10 to 24 in. NB)	H
Other	Z

Electrode design (field 11)

Standard	1
Others	9

Measuring electrodes material (field 12)

Stainless steel 316	S
Hastelloy® C-22	C
Super-austenitic steel (DN250 to 600 [10 to 24 in. NB])	U
Others	Z

Grounding accessories (field 13)

Standard	1
One potential equalizing ring (stainless steel)	3
Two potential equalizing rings (stainless steel)	4
Others	9

Process connection type (refer to pages 35 to 33) (fields 14, 15)

Flanges ASME B16.5 class 150	A1
Flanges ASME B16.5 class 300	A3
Flanges AWWA C207 class B	C1
Flanges AWWA C207 class D	C2
Flanges AS 4087 PN21	E0
Flanges AS 4087 PN16	E1
Flanges AS 4087 PN14	E2
Flanges AS 2129 Table F	E3
Flanges AS 2129 Table E	E4
Flanges AS 2129 Table D	E5
Flanges AS 2129 Table C	E6
Flanges AS 2129 Table H	E7
Flanges AS 4087 PN35	E8
Flanges JIS G5527 7.5K	J0
Flanges JIS B2220 10K	J1
Flanges JIS B2220 5K	J2
Flanges ISO / EN PN6	S0
Flanges ISO / EN PN10	S1
Flanges ISO / EN PN16	S2
Flanges ISO / EN PN25	S3
Flanges ISO / EN PN40	S4
Others	Z9

Note. DN80 to 200 (3 to 10 in. NB) available only with PN16

Process connection material (field 16)

Carbon steel flanges	B
Others	Z

Usage certifications (field 17)

Standard	1

Calibration type (field 18)

Class 2 calibration – standard accuracy 0.4 %	A
Class 1 calibration – high accuracy 0.2 %	B
Extended range, class 1 calibration – high accuracy 0.2 %	N
Extended range, class 2 calibration – standard accuracy 0.4 %	P

Continued on next page …

Product coding field number	1 … 5	6	7 … 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options
Flowmeter system, full bore, remote mount	FEF12	X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	
Full bore sensor only, for use with WaterMaster transmitter / remote	FEF18																				

Temperature range installation / ambient temperature range

Standard design / –20 … 60 °C (–4 … 140 °F)	1

Nameplate

Adhesive	A

Signal cable length and type*

Without signal cable	0
5 m (15 ft.) cable	1
10 m (30 ft.) cable	2
20 m (60 ft.) cable	3
30 m (100 ft.) cable	4
50 m (165 ft.) cable	5
80 m (260 ft.) cable	6
100 m (325 ft.) cable	7
150 m (490 ft.) cable	8
Special Length > 150 m (> 490 ft.) (and / or armored cable)	9

Explosion protection certification

General purpose (non-Ex design)	A

Protection class transmitter / protection class sensor

IP67 (NEMA 4X) / IP68 (NEMA 6P) – cable not fitted and not potted	2
IP67 (NEMA 4X) / IP68 (NEMA 6P) – cable fitted and potted	3

Cable conduits**

M20 x 1.5 (plastic)	A
NPT 1/2 in. (blanked when cable not fitted)	B
M20 SWA (armored)	D
M20 SWA sensor, M20 x 1.5 (plastic) power / output	F
Without	Y

Power supply

Without	0
100… 230 V AC (50 Hz)	1
24 V AC or 24 V DC (50 Hz)	2
100… 230 V AC (60 Hz)	3
24 V AC or 24 V DC (60 Hz)	4

Input and output signal type

HART + 20 mA + pulse + contact output	A
PROFIBUS DP RS485 physical layer + pulse + contact output (general-purpose design only)	G
MODBUS RTU RS485 physical layer + pulse + contact output (general-purpose design only)	M
Without	Y

Configuration type / diagnostics type

Without	0
Factory defaults / standard diagnostics	1

Options***

Accessories

Configuration lead	AC

Documentation language

German	M1	Chinese	M6
Italian	M2	Swedish	M7
Spanish	M3	Finnish	M8
French	M4	Portuguese	MA
English	M5 (default)	Danish	MF
		Norwegian	MN

Verification type

Without fingerprint	V0
VeriMaster	V3

Potable water approvals

WRAS cold water approval	CWA
NSF 61 meter approval	CWC
DVGW	CWD
ACS	CWF
WRAS 60 °C (140 °F) water approval	CWK
Without	CWY

Power supply frequency (sensor FEF 18 only)

50 Hz	F5
60 Hz	F6

Number of testpoints

1 Point	T1
3 Points	T3

*Size is dependent on flange specification
**The type of signal cable supplied (standard or armored) depends on the type of cable conduit (variant digit number 24) ordered – for FM or FMC Approved versions, NPT only permitted.
***Add codes for options.

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3KXF211101R1001

Sales

Service

Software

DS/WM–EN Rev. U 10.2013

Power and productivity
for a better world™

Specification – sensor

Functional specification

Pressure limitations

As per flange rating – non approved
PN16 for OIML R49 Approved

Temperature limitations

Ambient temperature	
Remote transmitter	–20 to 70 °C (–4 to 158 °F)
Integral transmitter	–20 to 60 °C (–4 to 140 °F)
Process temperature	–6 to 70 °C (21 to 158 °F) – non approved 0.1 to 50 °C (32.2 to 122 °F) – OIML R49 T50 Approved

Environmental protection

Rating:

IP68 (NEMA 6) to 10m (33 ft) depth with fully-potted terminal box – not DN10 to DN32

IP67 (NEMA 4X) – DN10 to DN32

Buriable (sensor only)

FEWNo

FEV and FEFYes

Conductivity

>5µS cm^{-1}

Transmitter mounting

Integral or remote

Electrical connections

20 mm glands

1/2 in NPT
20 mm armored glands

Sensor cable

ABB WaterMaster cable available in two forms – standard and armored
Maximum length 200 m (660 ft)

Physical specification

Wetted parts

Lining material

PTFE	(sizes DN10 to DN32 [3/8 to 1 1/4 NB])
Polypropylene	(sizes DN40 to 200 [1 1/2 to 8 NB])
Elastomer	(sizes DN250 to 2200 [10 to 84 NB])
WRAS listed – NSF61 approved	(sizes DN40 to 200 [1 1/2 to 8 NB])
NSF	(FEW DN350 to 600) (FEW DN350 to 600) (FEV40 to 200 and FEF250 to 2200)

Electrode material

Stainless steel 316 L

Hastelloy® C-22 (Hastelloy C4 on DN10 to DN32)
(Other electrode materials available on request)

Potential equalizing rings

Optional (recommended)

Lining protection plates

Not required

Installation conditions (recommended)

Upstream ≥ 5D

Downstream ≥ 0D

Pressure loss

<0.25 bar at Q3	(sizes DN40 to 200 [1 1/2 to 8 NB])
Negligible at Q3	(sizes DN10 to 32 [3/8 to 1 1/4 NB], DN250 to 2200 [10 to 84 NB])

Non-wetted parts

Flange material

Carbon steel	(sizes DN20 to DN2200 [3/4 to 84 NB])
Stainless steel	(sizes DN10 to DN15 [3/8 to 1/2 NB])

Housing material

Carbon steel	(sizes DN40 to 200 [1 1/2 to 8 NB] and DN700 to 2200 [28 to 84 NB])
Plastic	(sizes DN250 to 600 [10 to 24 NB])
Aluminium	(FEW, sizes DN10 to DN32 [3/8 to 1 1/4 NB]) (FEW, sizes DN350 to DN400 [14 to 16 NB])
Carbon steel	(FEW, sizes DN450 to DN600 [18 to 24 NB])

Terminal box material

Polycarbonate

Cable gland material

Plastic or brass

Specification – transmitter

Functional specification

Power supply

Mains	85 to 265 V AC @ <7 VA
Low voltage	24 V AC +10 %/–30 % @ <7 VA
DC	24 V ±30 % @ <0.4 A

Supply voltage fluctuations within the specified range have no effect on accuracy

Digital Outputs (3 off)

Rating 30 V @ 220 mA, open collector, galvanically isolated

Maximum output frequency 5250 Hz

1 off dedicated to Alarm / Logic, programmable function

2 off configurable to either Pulse / Frequency or Alarm/Logic function

Current output – HART FEX100 variant

4 to 20 mA or 4 to 12/20 mA, galvanically isolated

Maximum loop resistance 750 Ω

HART protocol Version 5.7 (HART registered)

Signal levels compliant with NAMUR NE 43 (3.8 to 20.5 mA)

Low alarm 3.6 mA, High alarm 21.8 mA

Additional accuracy

±0.1 % of reading
Temperature coefficient: typically <±20 ppm/°C

RS485 Communications – PROFIBUS FEX100-DP variant

Registered name: FEX100-DP

RS485 (9.6kbps to 1.5Mbps), galvanically isolated

DPV0, DPV1

PA Profile 3.01

Standard idents: 9700, 9740, 9741

FEX100-DP specific ident: 3431

3 Concurrent MS2 master connections

Electrical connections

20 mm glands· 1/2 in NPT, 20 mm armored glands

Temperature limitations

Ambient temperature	–20 to 60 °C (–4 to 140 °F)
Temperature coefficient	Typically <±10 ppm/°C @ Vel ≥0.5 mls

Environmental protection

Humidity: 0 to 100 %

Rating: IP67 (NEMA 4X) to 1m (3.3 ft) depth

Tamper-proof security

Write access prevented by internal switch combined with external security seals for MID applications

Languages

English, French, German, Italian, Spanish, Polish

Infrared service port

USB adapter (accessory), USB 1.1. and 2.0 compatible

Driver software for Windows 2000, XP, 7 and Vista

Housing material

Powder-coated aluminium with glass window

Hazardous approvals (HART variant only)

FM & FMc Class 1 Div 2

(FM listing NI / 1 / 2 / ABCD / T4, S / II, III / 2 / FG /T4,
Ta=60C; Type 4X, IP67 - for transmitter and integral mounting
Ta=70C, Type 6P, IP68 - for remote sensor type)
(FMc listing NI / 1 / 2 / ABCD / T4, DIP / II, III / 2 / FG /T4,
Ta=60C; Type 4X, IP67 - for transmitter and integral mounting
Ta=70C, Type 6P, IP68 - for remote sensor type)

FET, FEV, FEW and FEF DN700 to 2200 (27/28* to 84) only

*Size is dependent on flange specification

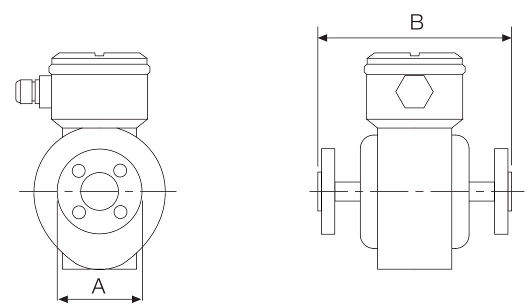
Declaration of Conformance

Copies of CE and PED certification will be available on request.

WaterMaster has OIMLR49 Certificate of Conformity to accuracy class 1 and 2. Copies of accuracy certification are available on request.

WaterMaster has been type examined under directive MID 2004/22/EC, Annex MI-001. Copies of this certificate are available on request.

Sensor dimensions

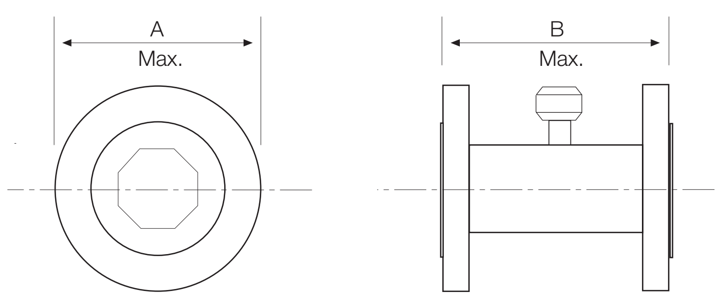


DN10 to 32 ($^3/_8$ to $1^1/_4$ NB) full-bore

Meter Size		Dimensions mm (in)		Approximate Weight	
DN	NPS/NB	A*	B	kg	lb
10	$^3/_8$	93 (3.7)	200 (7.9)	6	13.2
15	$^1/_2$	95 (3.7)	200 (7.9)	7	15.4
20	$^3/_4$	111 (4.4)	200 (7.9)	7	15.4
25	1	120 (4.7)	200 (7.9)	8	17.6
32	$1^1/_4$	137 (5.4)	200 (7.9)	10	22

*Dimensions are approximate and vary depending on flange type

DN10 to 32 ($^3/_8$ to $1^1/_4$ NB) full-bore

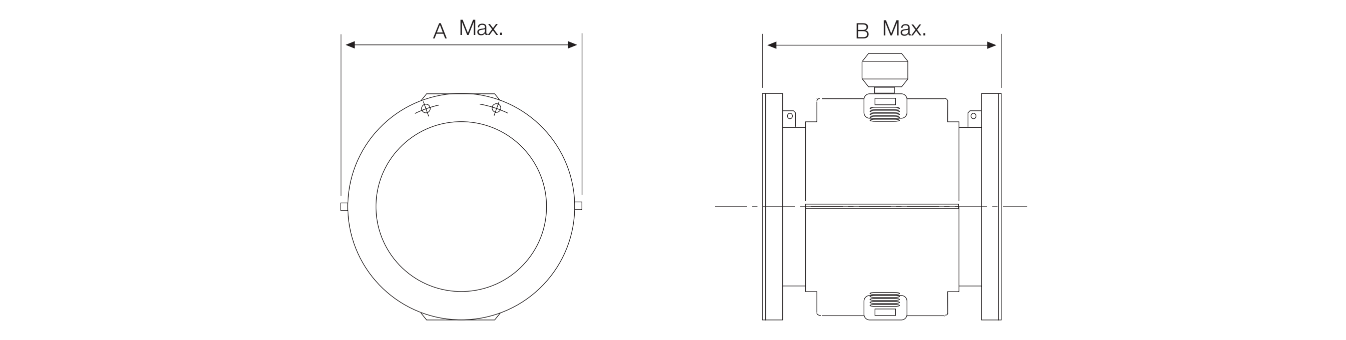


DN40 to 300 ($1^1/_2$ to 12 NB) full-bore

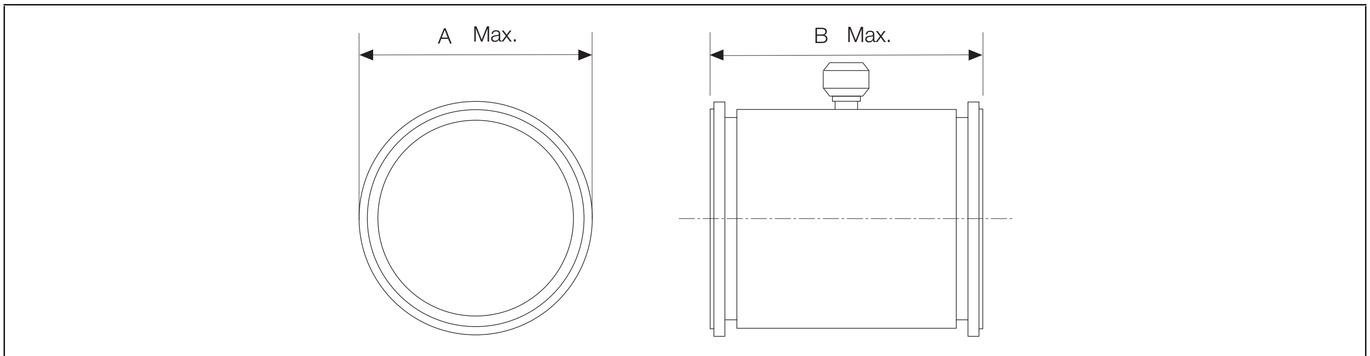
Meter Size		Dimensions mm (in)		Approximate Weight	
DN	NPS/NB	A*	B	kg	lb
40	$1^1/_2$	150 (5.9)	200 (7.9)	11	24
50	2	165 (6.5)	200 (7.9)	12	27
80	3	200 (7.9)	200 (7.9)	15	33
100	4	230 (9.1)	250 (9.8)	18	40
150	6	280 (11.0)	300 (11.8)	31	68
200	8	345 (13.6)	350 (13.8)	48	106
250	10	405 (15.9)	450 (17.7)	75	165
300	12	460 (18.1)	500 (19.7)	112	247

*Dimensions are approximate and vary depending on flange type

DN40 to 300 ($1^1/_2$ to 12 NB) full-bore



DN250 to 600 (10 to 24 NB) full-bore



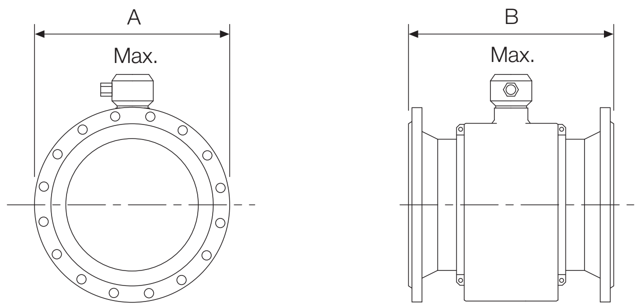
DN700 to 2200 (28 to 84 NB) full-bore

Meter Size		Dimensions in mm (in)			Approximate Weight	
DN	NPS/NB	A	B (<PN25)	B (PN25, PN40, ASME, CL300)	kg	lb
250	10	405 (15.99)	450 (17.7)**	488 (19.2)	88	194
300	12	460 (18.1)	500 (19.7)**	538 (21.2)	128	282
350	14	535 (21.1)	550 (21.7)**	568 (22.3)	100	220
400	16	600 (23.6)	600 (23.6)**	618 (24.3)	115	253
450	18	640 (25.2)	698 (27.5)**	698 (27.5)	160	352
500	20	715 (28.1)	768 (30.2)**	768 (30.2)	217	455
600	24	840 (33.1)	918 (36.1)**	918 (36.1)	315	693
700	27/28*	927 (36.5)	700 (27.6)***	–	430	945
760	30	985 (38.8)	762 (30)***	–	430	945
800	32	1060 (41.7)	800 (31.5)***	–	430	945
900	36	1170 (46.1)	900 (35.4)***	–	540	1190
1000	39/40*	1290 (50.8)	1000 (39.4)***	–	720	1585
1050	42	1405 (55.3)	1067 (42)***	–	880	1930
1100	44	1405 (55.3)	1067 (42)***	–	880	1930
1200	48	1511 (59.5)	1200 (47.2)***	–	1000	2160
1400	54	1745 (68.7)	1400 (55.1)***	–	1450	3190
1500	60	1855 (73.0)	1524 (59)***	–	1370	3000
1600	66	2032 (80.0)	1600 (63)***	–	2000	4400
1800	72	2197 (86.5)	2250 (88.6)***	–	2400	5280
2000	78	2362 (93.0)	2500 (98.4)***	–	3200	7040
2200	84	2534 (100.0)	2750 (110)***	–	4200	9300

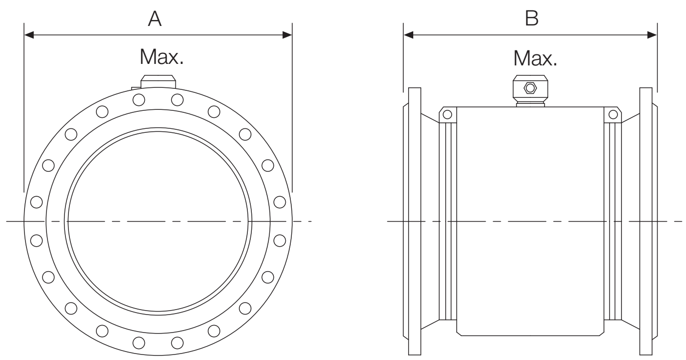
* Size is dependent on flange specification

Typical tolerances:
** +0/–10 mm (0.40 in) *** +0/–20 mm (1.0 in)

DN250 to 2200 (10 to 84 NB) full-bore



DN350 and DN400



DN450 to DN600

DN350 to 600 (14 to 24 NB) FM – approved version

Meter Size		Dimensions in mm (in)*		Approximate Weight**	
DN	**NPS/NB**	**A**	**B**	**kg**	**lb**
350	14	585 (23.0)	550 (21.7)	145	319
400	16	690 (27.2)	600 (23.6)	179	394
450	18	711 (28.0)	686 (27.0)	189	417
500	20	775 (30.5)	752 (29.6)	195	430
600	24	914 (36.0)	914 (36.0)	275	606

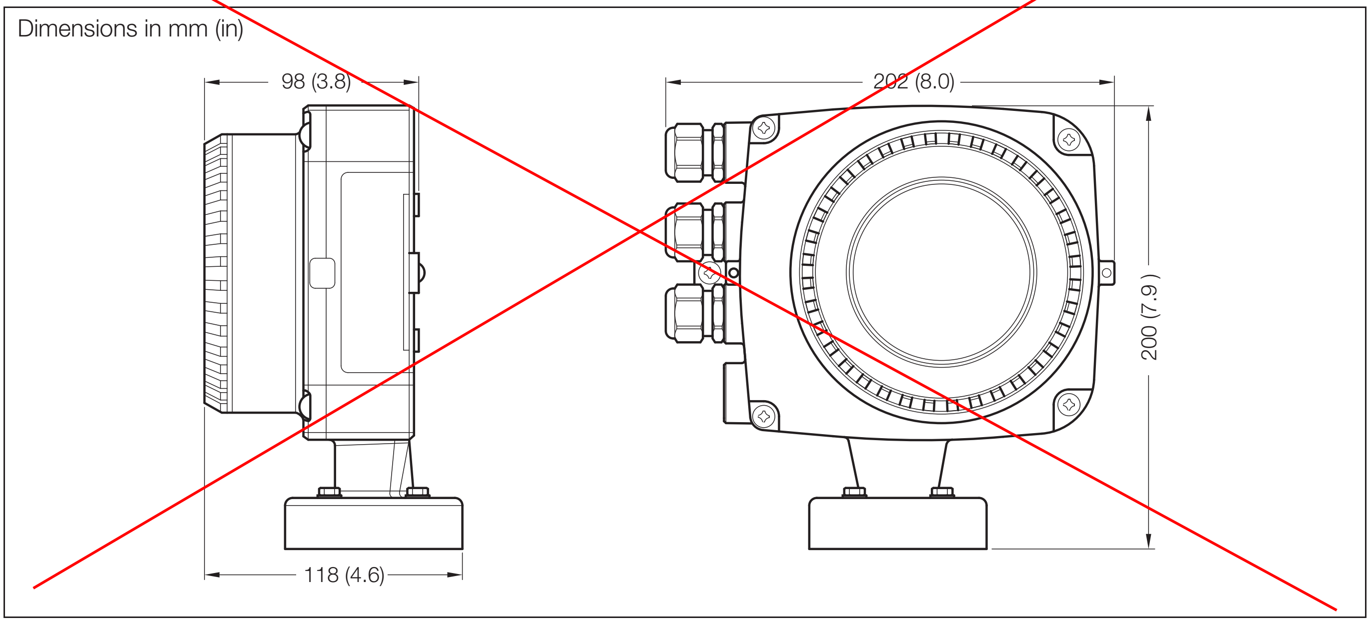
* Sizes are approximate and dependent on flange specification

**Approximate weight for Class 150 flanges

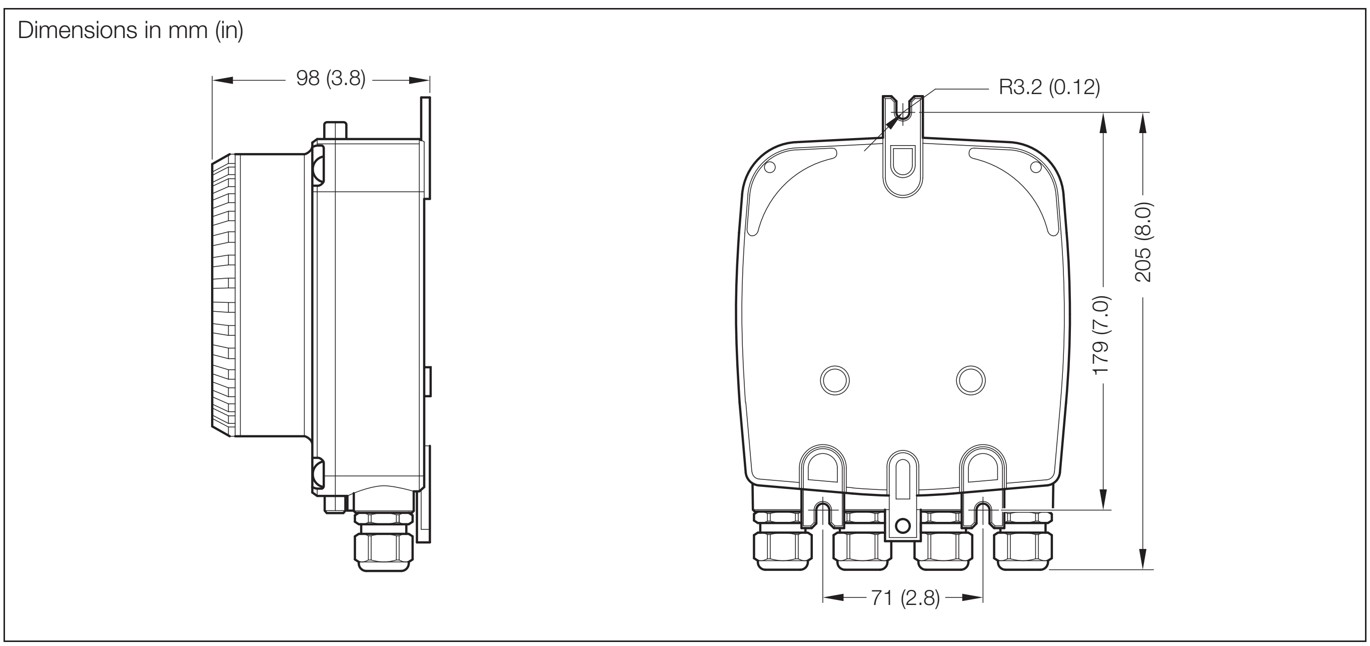
DN350 to 600 (14 to 24 NB) FM – approved version

Transmitter dimensions

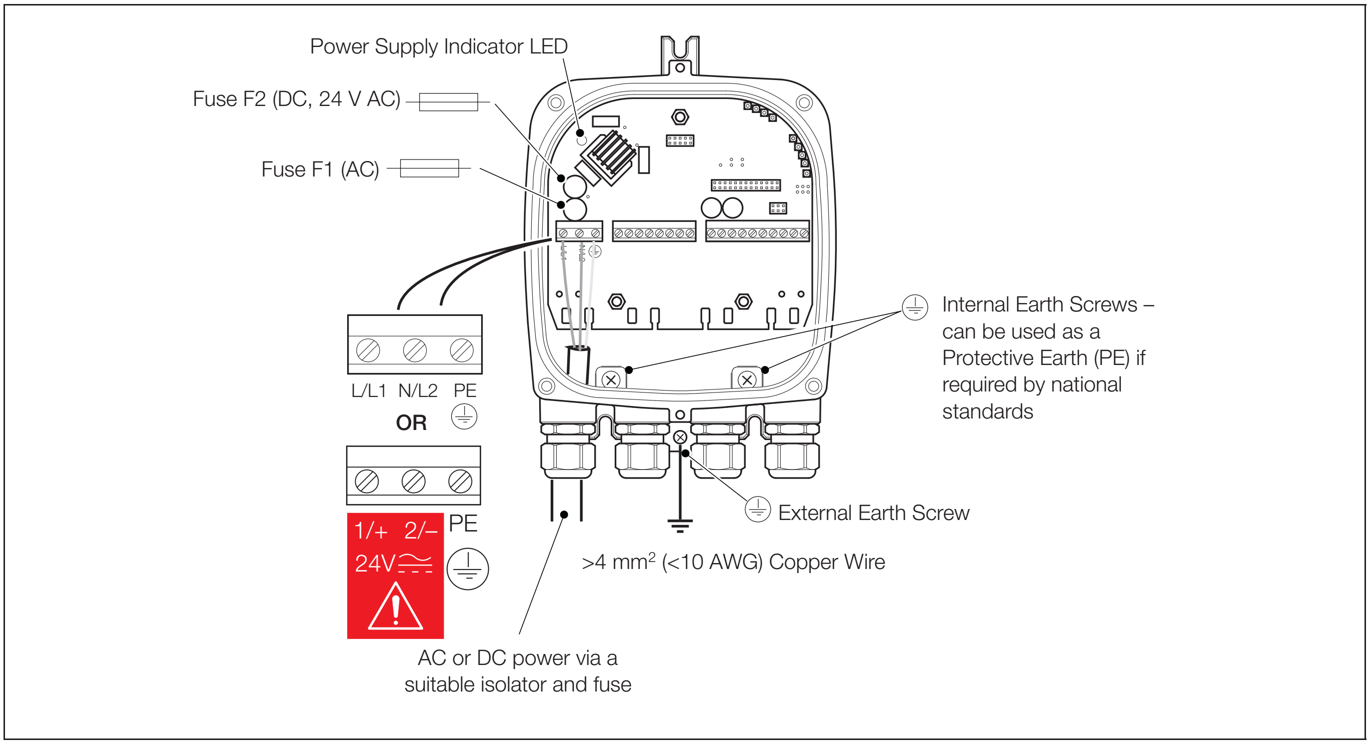
Integral transmitter



Remote transmitter



Electrical connections



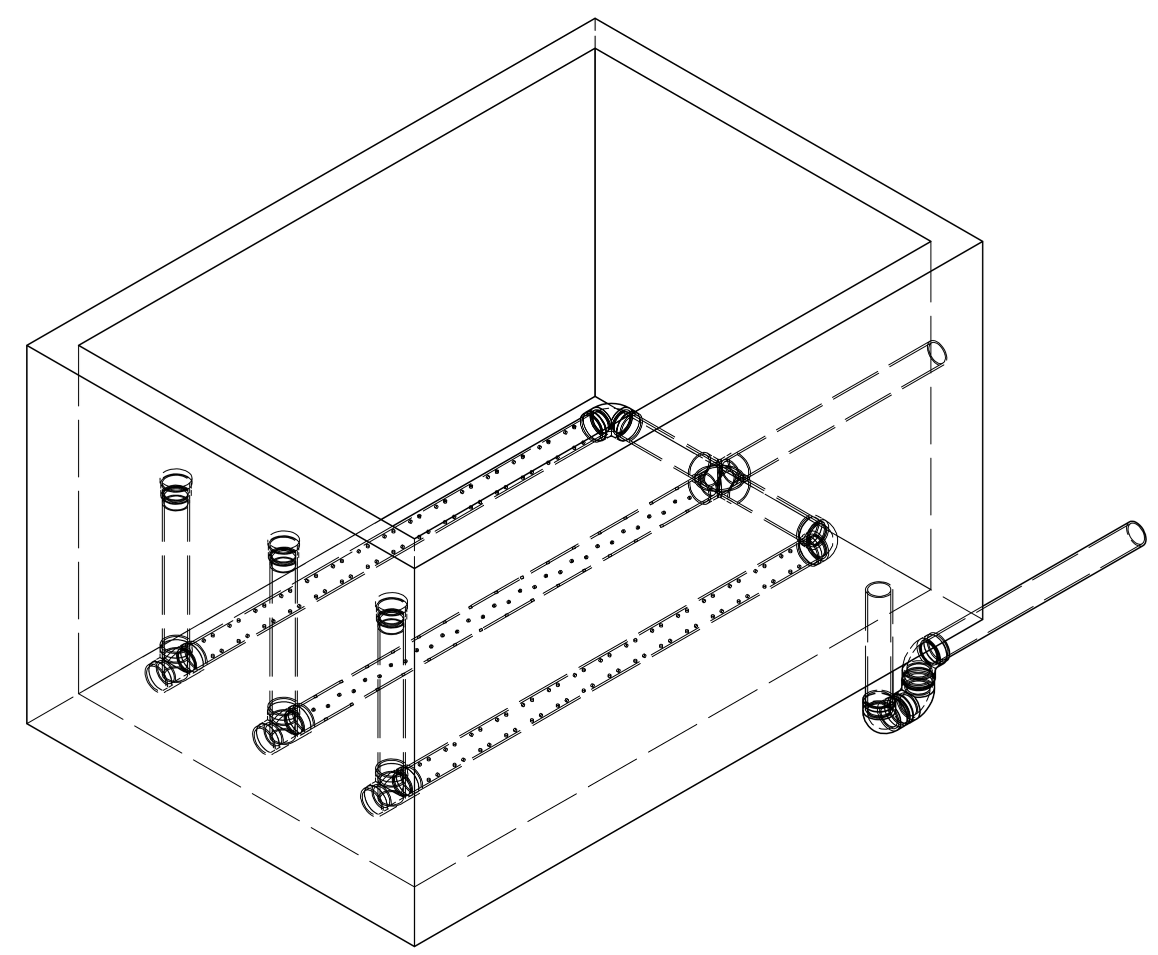
AC and DC power supply connections

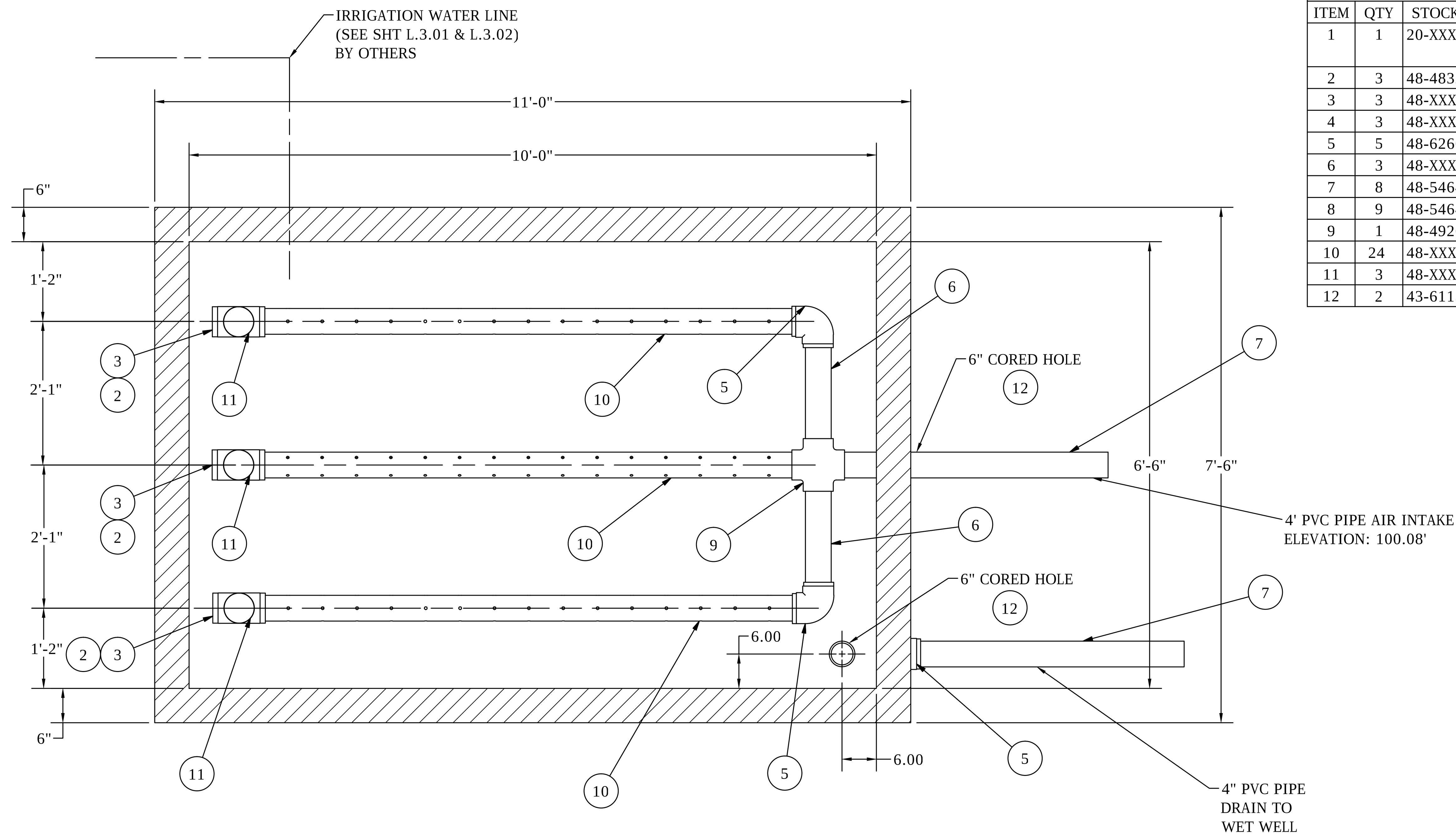
3.07 ODOR CONTROL

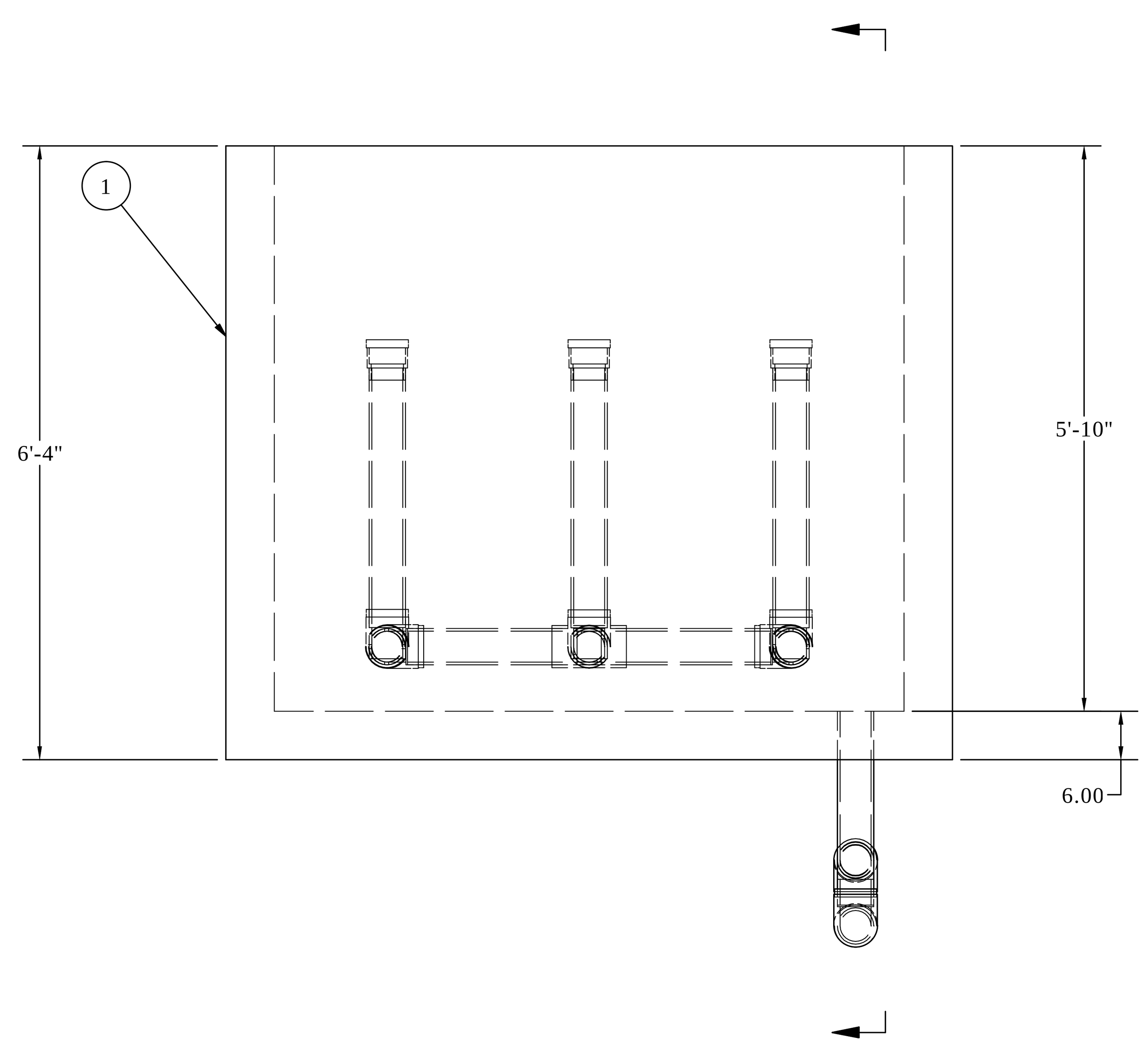
This section provides the information pertaining to the odor control system for this project.

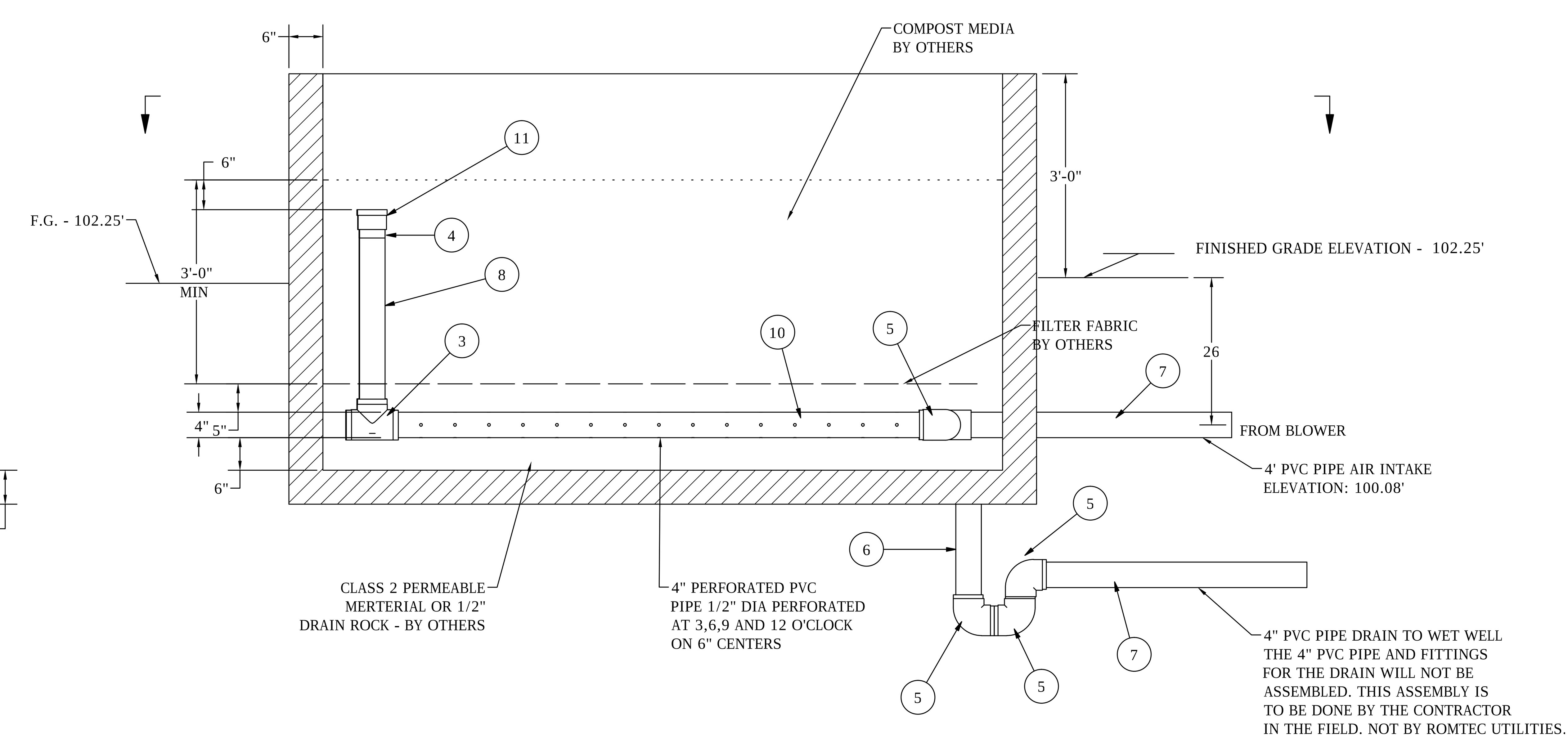
This section is structured as follows:

Parts List			
ITEM	QTY	STOCK NUMBER	DESCRIPTION
1	1	20-XXXX	BASE - VAULT - PRECAST - 6ft6in X 10ft X 5ft10in - NO TOP SLAB
2	3	48-4832	CAP - PVC - 4in SCH40
3	3	48-XXXX	TEE - PVC - 4in SCH40 - SLIP
4	3	48-XXXX	COUPLING - PVC - 4in SCH40 - 150# - SOC
5	5	48-6266	ELBOW - PVC - 4in SCH40 - 90 DEG - SLIP X SLIP
6	3	48-XXXX	4in PVC - SCH 40 X 24in
7	8	48-5464	PIPE - 4in PVC - SCH80 X 2 @ 48in
8	9	48-5464	PIPE - 4in PVC - SCH80 X 3 @ 36in
9	1	48-4926	CROSS - PVC - 4in - SCH40
10	24	48-XXXX	PIPE - 4in PVC - SCH40 X 3 @ 96in - PERFORATED
11	3	48-XXXX	CAP - THREADED - PVC - 4in - SCH40
12	2	43-6113	KOR-N-SEAL - 6" CORE - 4" PIPE









NOTE: ALL DIMENSIONS AND ELEVATIONS SHOWN ARE NOMINAL DIMENSIONS. IT IS THE RESPONSIBILITY OF THE ON-SITE CONTRACTOR OR ROMTEC UTILITIES CUSTOMER (NOT ROMTEC UTILITIES) TO VERIFY THE ACCURACY OF ANY CRITICAL DIMENSIONS OR ELEVATIONS PRIOR TO SETTING OR INSTALLING ANY EQUIPMENT.

$USER$
$DATE$
$TIME$
$FILENAME$

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http://www.cvlci.com
Coe & Van Loo Consultants, Inc.

NO.	REVISION	DATE

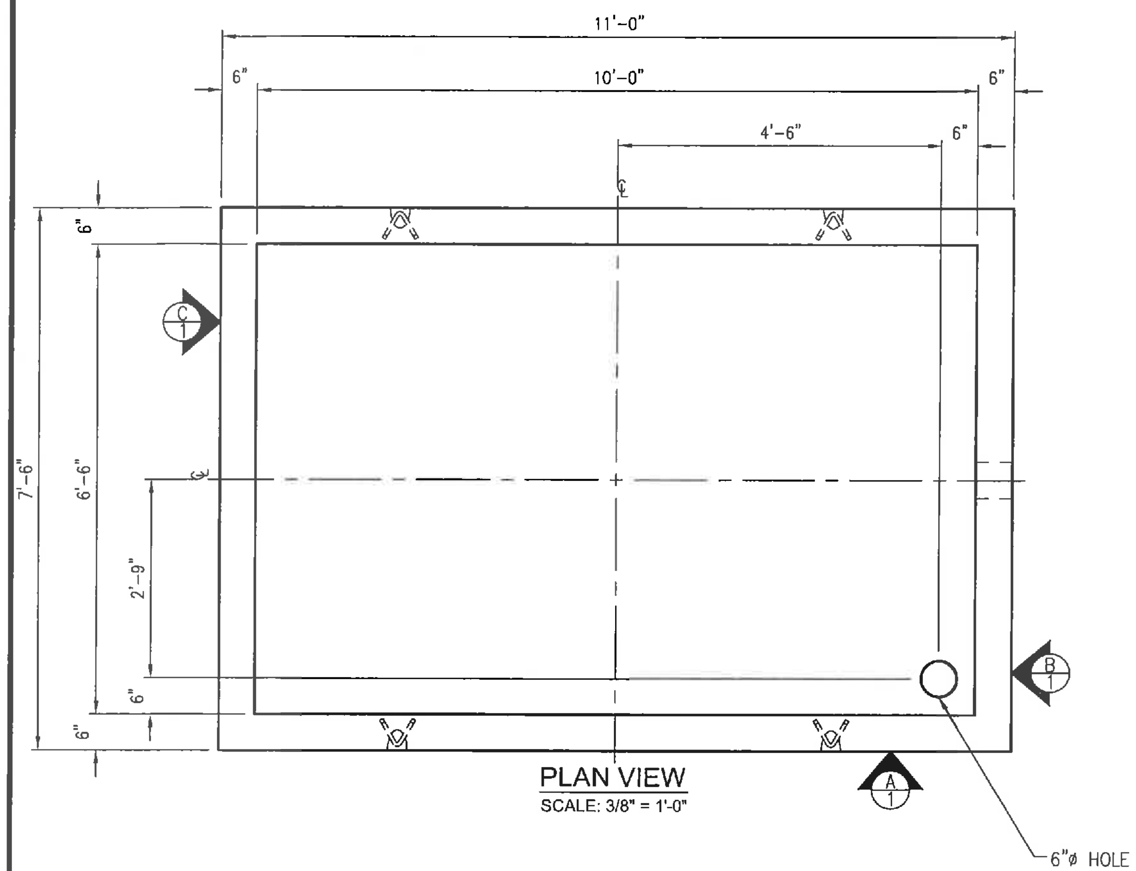
BAY MEADOWS
(SAN MATEO, CA.)
ODOR CONTROL VAULT

REGISTERED PROFESSIONAL ENGINEER
LES F. OLSON
No. C-30733
8-11-14
CIVIL
STATE OF CALIFORNIA

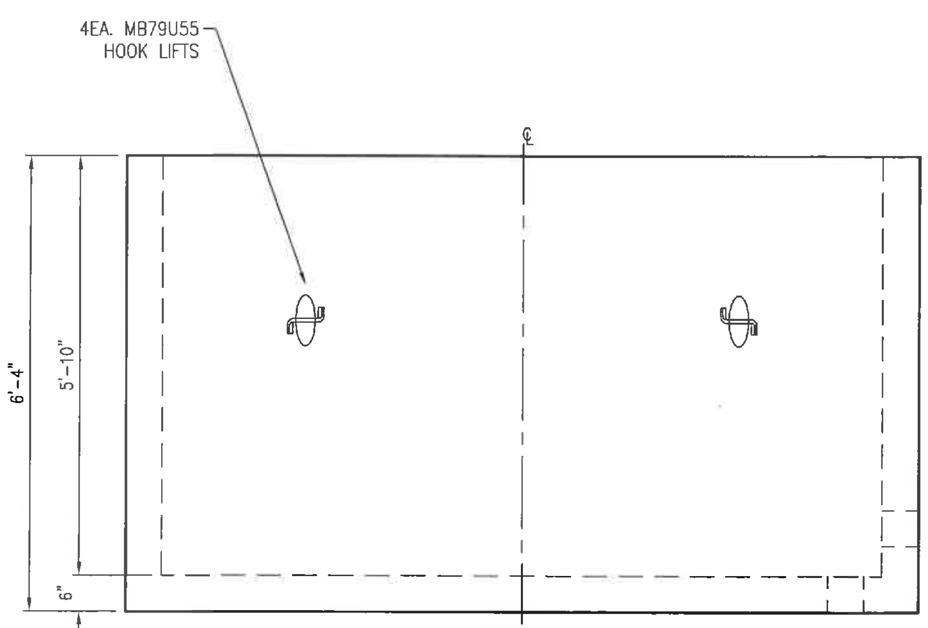
Two working days before you dig
CALL FOR THE BLUE STAKES
1-800-STAKE-IT
Blue Stake Center
1-800-782-5348

DRAWING
M3
CVL Contact: ERIC LAURIN
CVL Project #: 1.01.0204801
CVL File #:

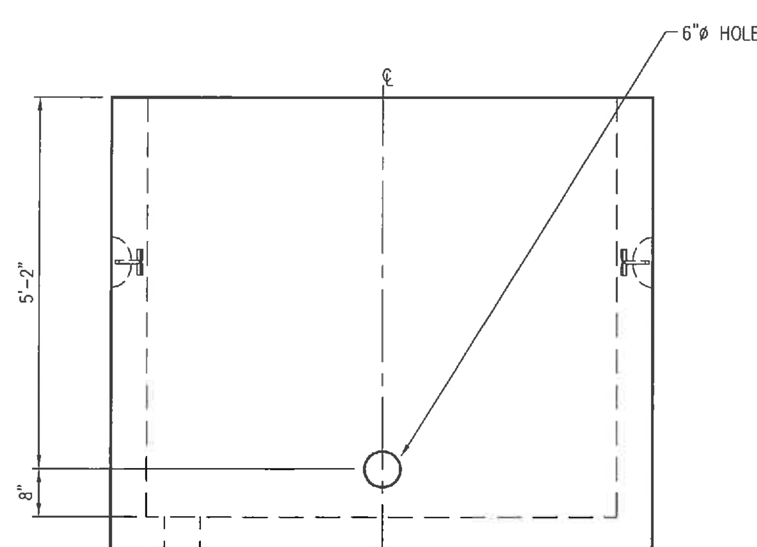
10-14-11



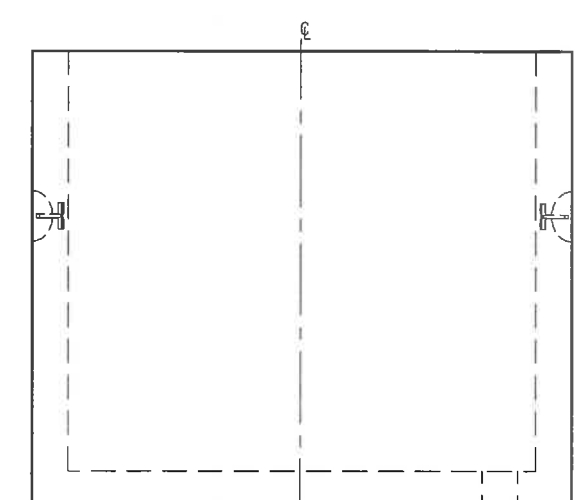
PLAN VIEW
SCALE: 3/8" = 1'-0"



VIEW A
SCALE: 3/8" = 1'-0"



VIEW B
SCALE: 3/8" = 1'-0"



VIEW C
SCALE: 3/8" = 1'-0"

STRUCTURAL NOTES:
LOADS:
- H20 TRAFFIC
- MAXIMUM SOIL COVER: O FT
- 150 PCF CONCRETE DENSITY; 120 PCF SOIL DENSITY
- H20 SURCHARGE: 128 PSF TO 8 FT BELOW GRADE
- DRY SOIL LATERAL LOAD - 40 PCF
- WET SOIL LATERAL LOAD - 80 PCF
- WATER TABLE - BELOW VAULT

DESIGN SPECIFICATIONS
- AASHTO "STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES"
- ACI-318-05 BUILDING CODE
- ASTM C 857 MINIMUM STRUCTURAL DESIGN LOADING FOR UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURES.

MATERIALS:
- CONCRETE - 28 DAY COMPRESSIVE STRENGTH f'c =6000 PSI
- REBAR - ASTM A 706 GRADE 60
- CEMENT - ASTM C150
- FLYASH - ASTM C618

GENERAL NOTES:
1)CONTRACTOR TO:
VERIFY ALL DIMENSIONS AND OPENING LOCATIONS
2)REBAR MAY BE TACK WELDED OR TIED
3)TOLERANCES PER ASTM C-858
STANDARD SPECIFICATION FOR UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURES

WEIGHTS / CONCRETE YD³

SECTION	WEIGHT
BASE	22,950 LBS / 5.555 CYD
TOTAL LBS	22,950 LBS
TOTAL CYD	5.555 CYD

Oldcastle Precast®

P.O. BOX 727 PLEASANTON, CA 94566
PHONE: 800-248-8183 FAX: 925-846-4904

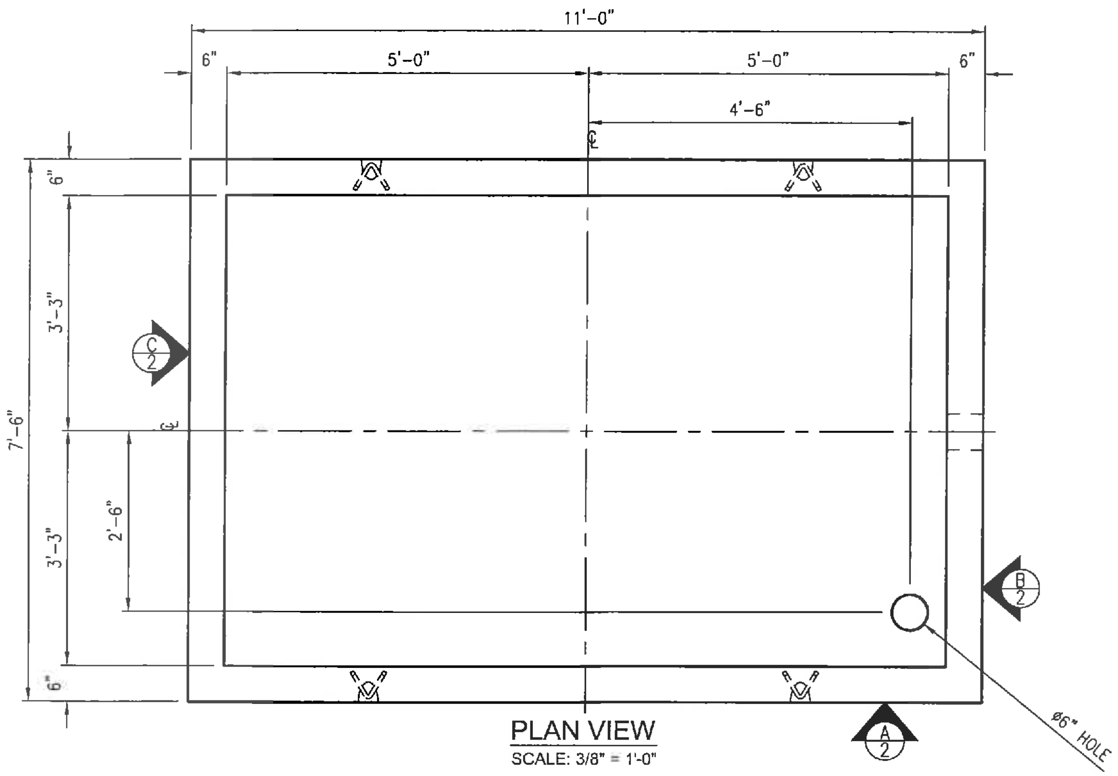
6'-6"X10'-0"X5'-10" (I.D.) PRECAST VAULT

BAY MEADOWS ORDER CONTROL VAULT
PLEASANTON, CA

CUSTOMER
ROMTEC UTILITIES

DATE	SALES	DRAWN	ENGINEER	CHECKED	SALES ORDER
7/18/13	JG	VK	JM	JM	S166318

DRAWING NUMBER	REVISION	SHEET
030-S166318-001	— REV DATE —	1 OF 3



PLAN VIEW
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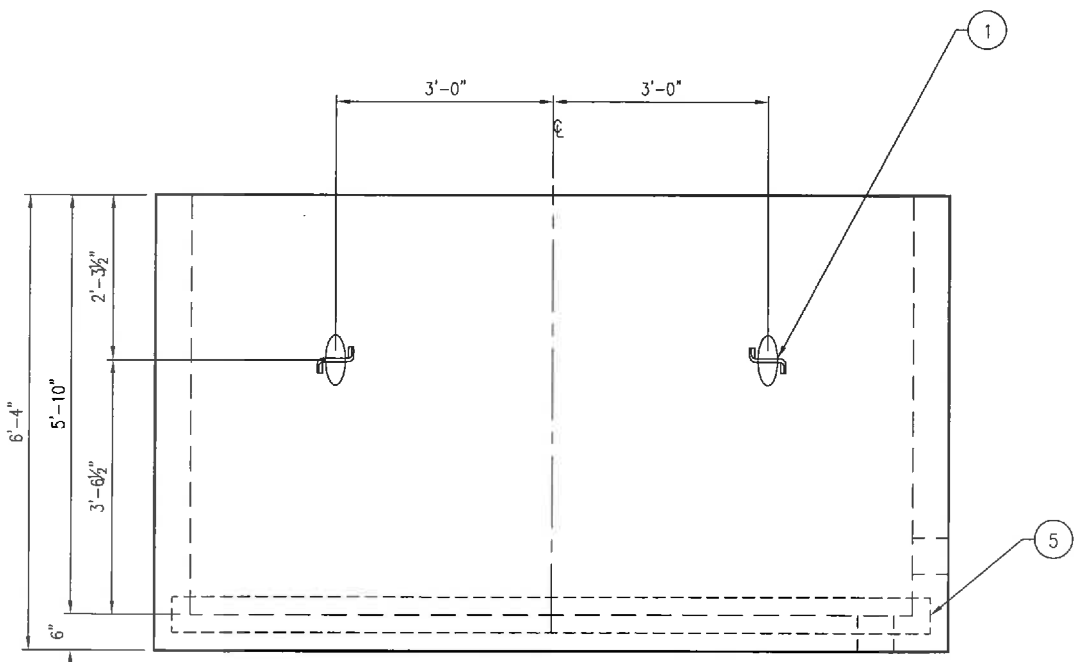
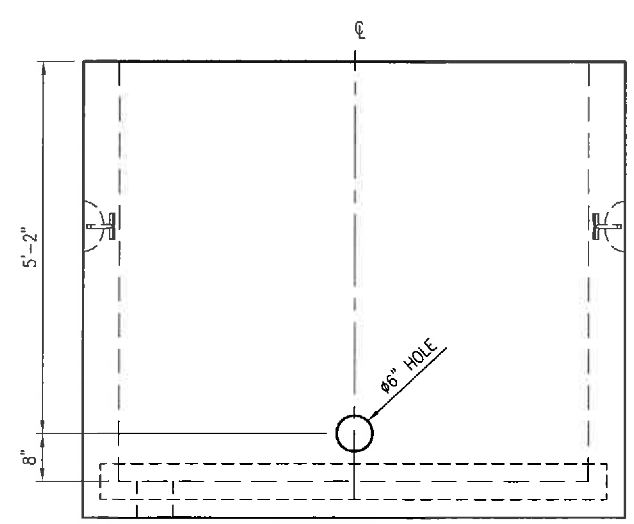
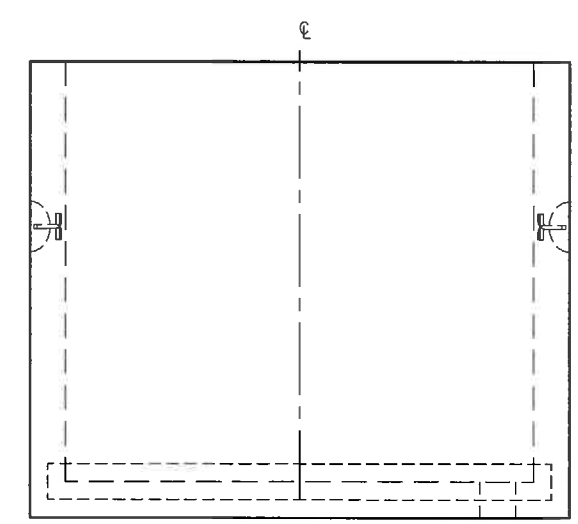


VIEW A
SCALE: 3/8" = 1'-0"



VIEW B
SCALE: 3/8" = 1'-0"



VIEW C
SCALE: 3/8" = 1'-0"

BOM

#	QTY.	DESCRIPTION	ITEM #
1	4 EA	MB79U55 HOOK LIFT	5100052
2		A 706 #4x40' REBAR	5510035
3		A 706 #5x40' REBAR	5510055
4		6,000psi STD CONCRETE	5010050

CUT LIST

#	QTY	LENGTH	DESCRIPTION	ITEM #
5	1	35'-0"	4" WATER STOP	5130000

WEIGHTS / CONCRETE YD³

SECTION	WEIGHT
VAULT	22,950 LBS / 5.555 CYD

Oldcastle Precast®
P.O. BOX 727 PLEASANTON, CA 94566
PHONE: 800-248-8183 FAX: 925-846-4904

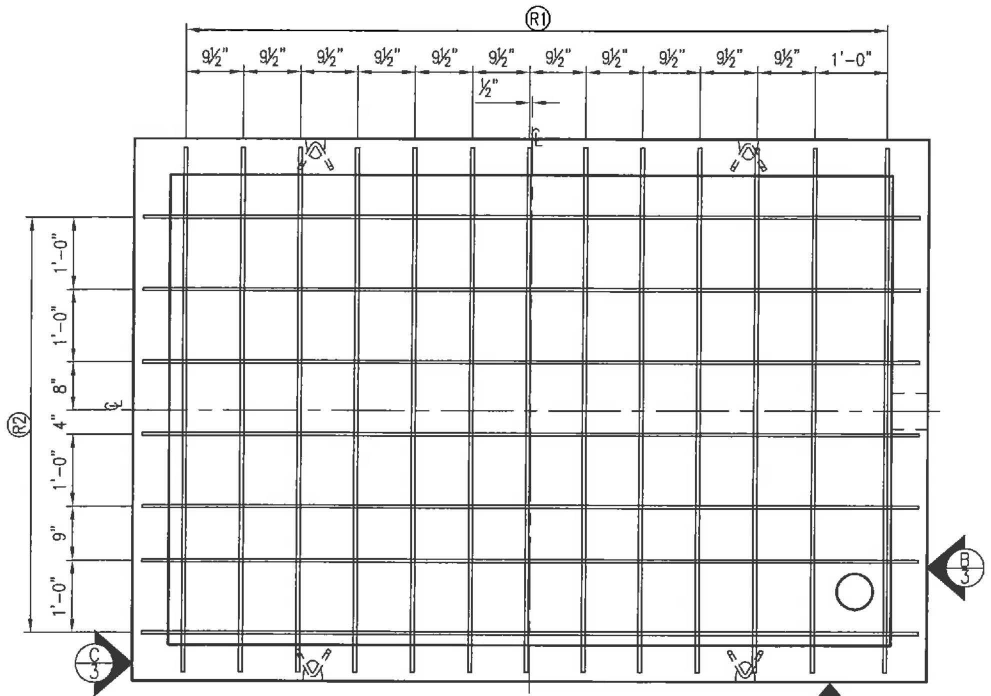
6'-6"X10'-0"X5'-10" (I.D.) PRECAST VAULT

VAULT #3
BAY MEADOWS ORDER CONTROL VAULT
PLEASANTON, CA

CUSTOMER
ROMTEC UTILITIES

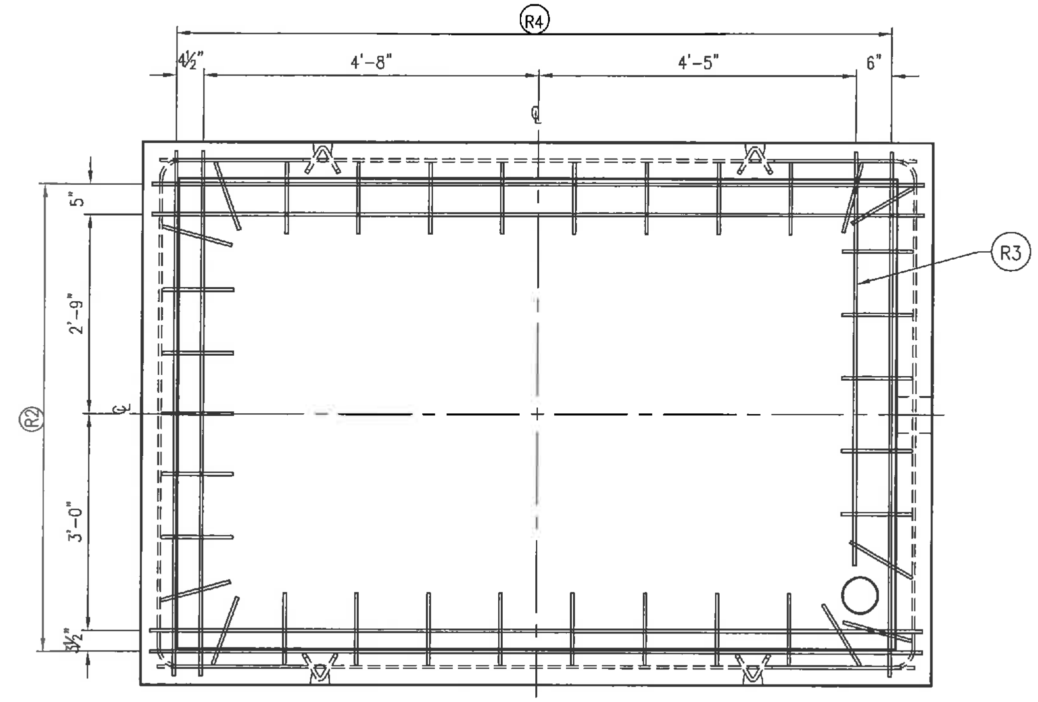
DATE	SALES	DRAWN	ENGINEER	CHECKED	SALES ORDER
7/18/13	JG	VK	JM	JM	S166318

DRAWING NUMBER	REVISION	SHEET
030-S166318-001	— REV DATE —	2 OF 3



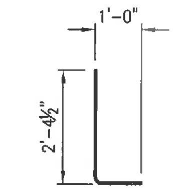
PLAN VIEW

SCALE: 3/8" = 1'-0"



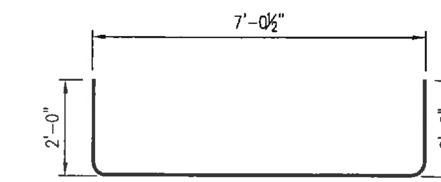
L BAR DETAIL

SCALE: 3/8" = 1'-0"



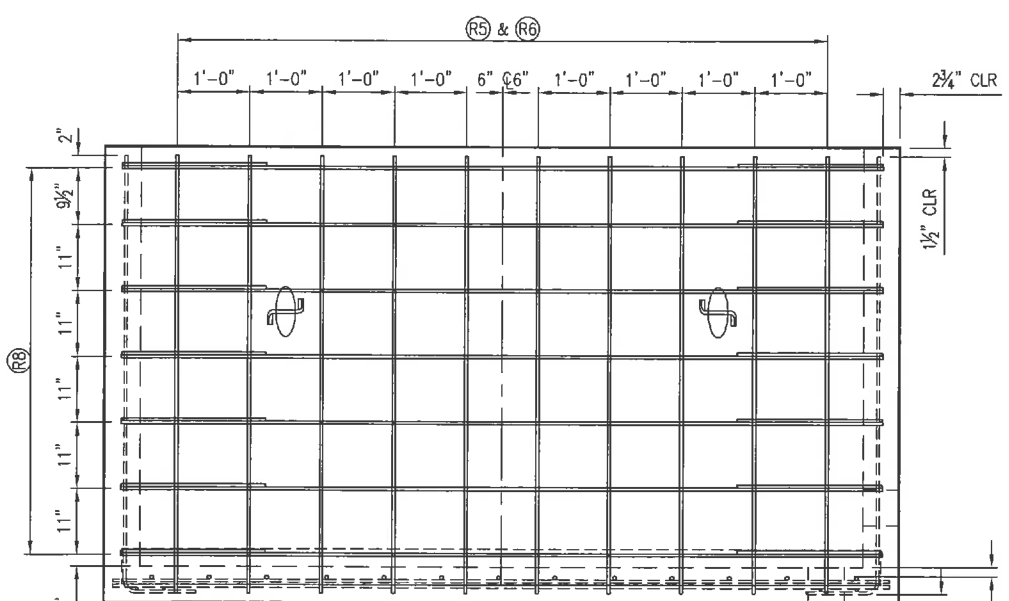
R5 DETAIL

SCALE: 1/4" = 1'-0"



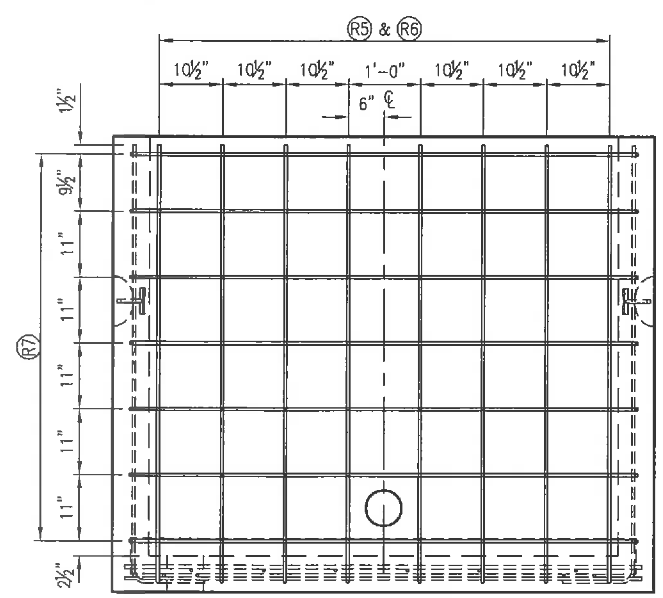
R7 DETAIL

SCALE: 1/4" = 1'-0"



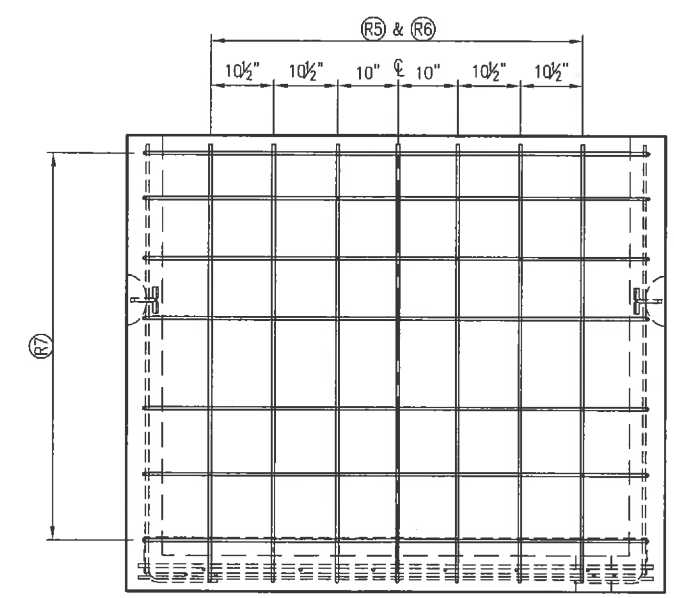
VIEW A

SCALE: 3/8" = 1'-0"



VIEW B

SCALE: 3/8" = 1'-0"



VIEW C

SCALE: 3/8" = 1'-0"

REBAR CUT LIST

R#	QTY.	MATERIAL	LENGTH
R1	13	#5 REBAR	7'-3"
R2	11	#5 REBAR	10'-9"
R3	1	#4 REBAR	5'-8½"
R4	3	#4 REBAR	7'-3"
R5	35	#4 REBAR	3'-3½"
R6	35	#4 REBAR	5'-8½"
R7	14	#4 REBAR	10'-10½"
R8	14	#4 REBAR	10'-6½"

BAR SIZE	WEIGHT
#4	429 LBS
#5	222 LBS

Oldcastle Precast®

P.O. BOX 727 PLEASANTON, CA 94566

PHONE: 800-248-8183 FAX: 925-846-4904

6'-6"X10'-0"X5'-10" (I.D.) PRECAST VAULT

VAULT #3

BAY MEADOWS ORDER CONTROL VAULT

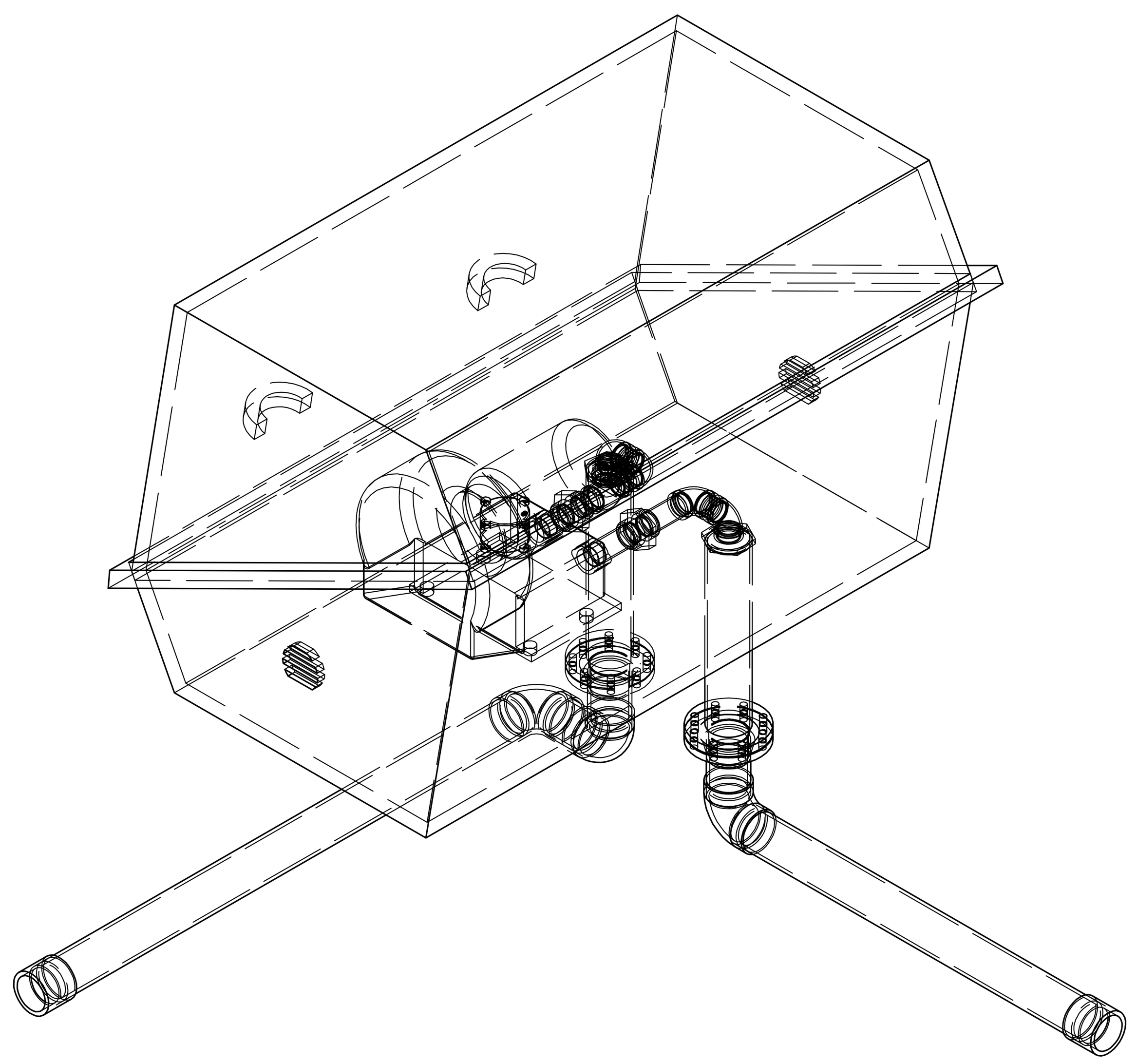
PLEASANTON, CA

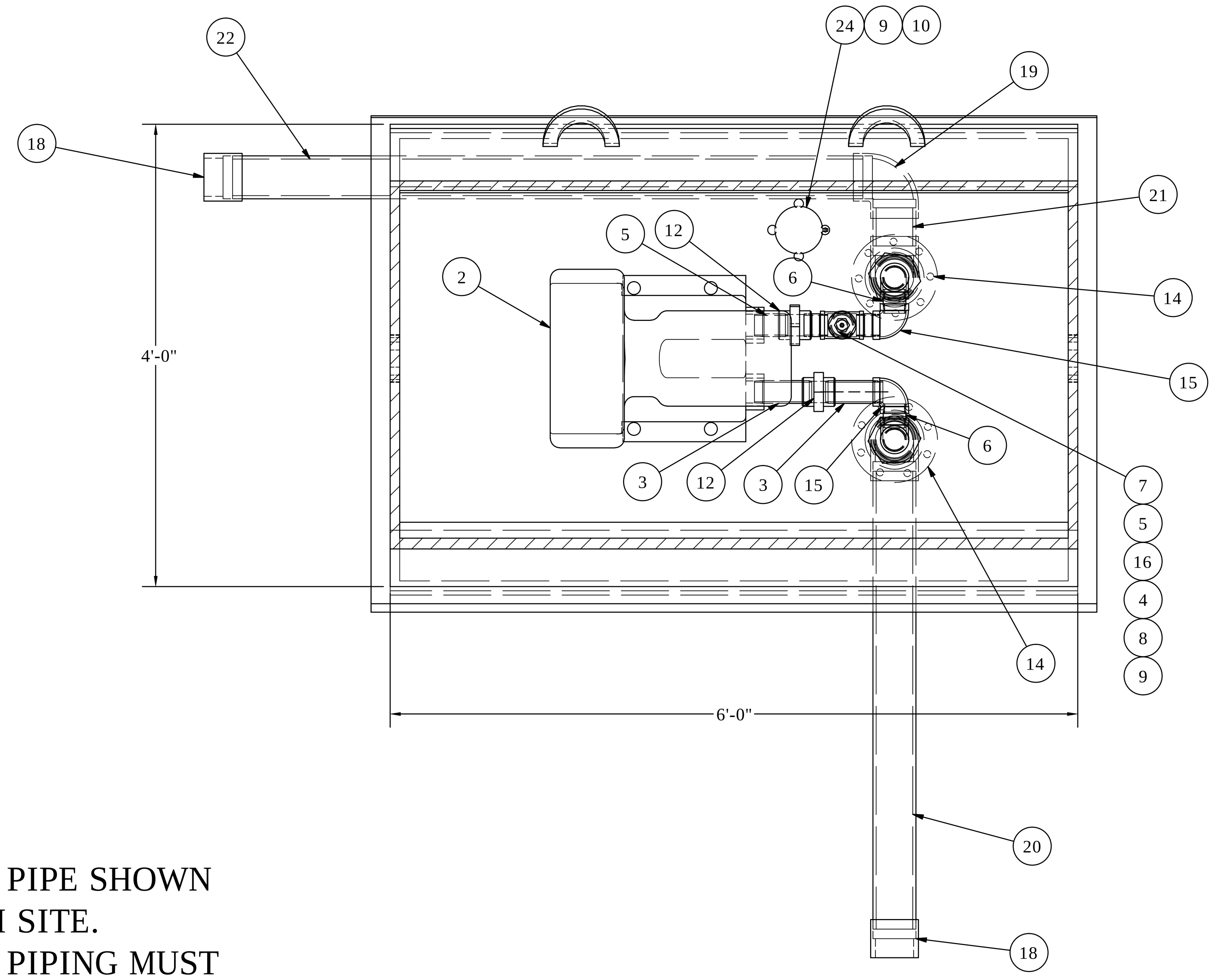
CUSTOMER

ROMTEC UTILITIES

DATE	SALES	DRAWN	ENGINEER	CHECKED	SALES ORDER
7/10/14	JG	VK	JM	JM	S166318

DRAWING NUMBER	REVISION	SHEET
030-S166318-001	— REV DATE —	3 OF 3

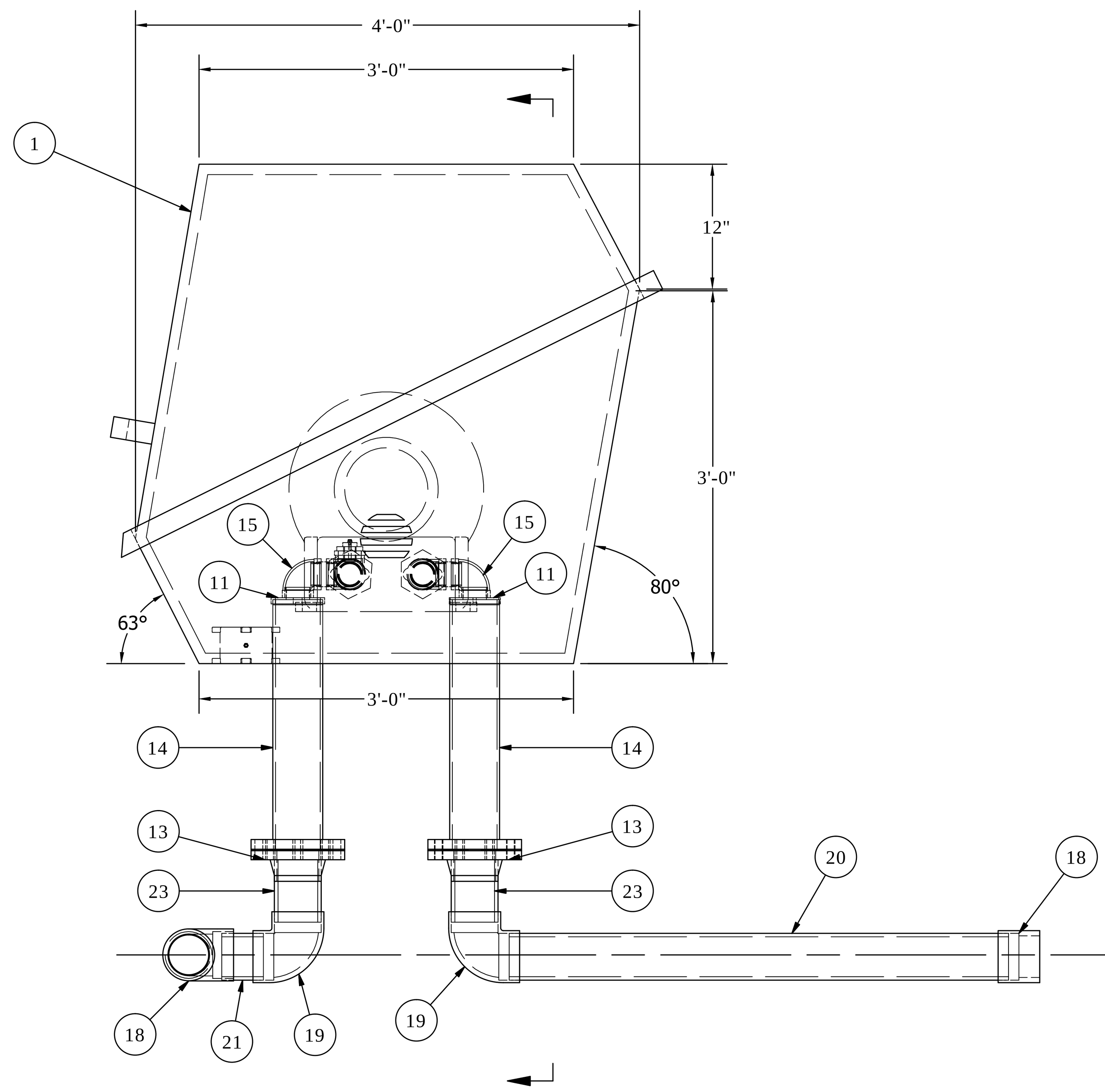


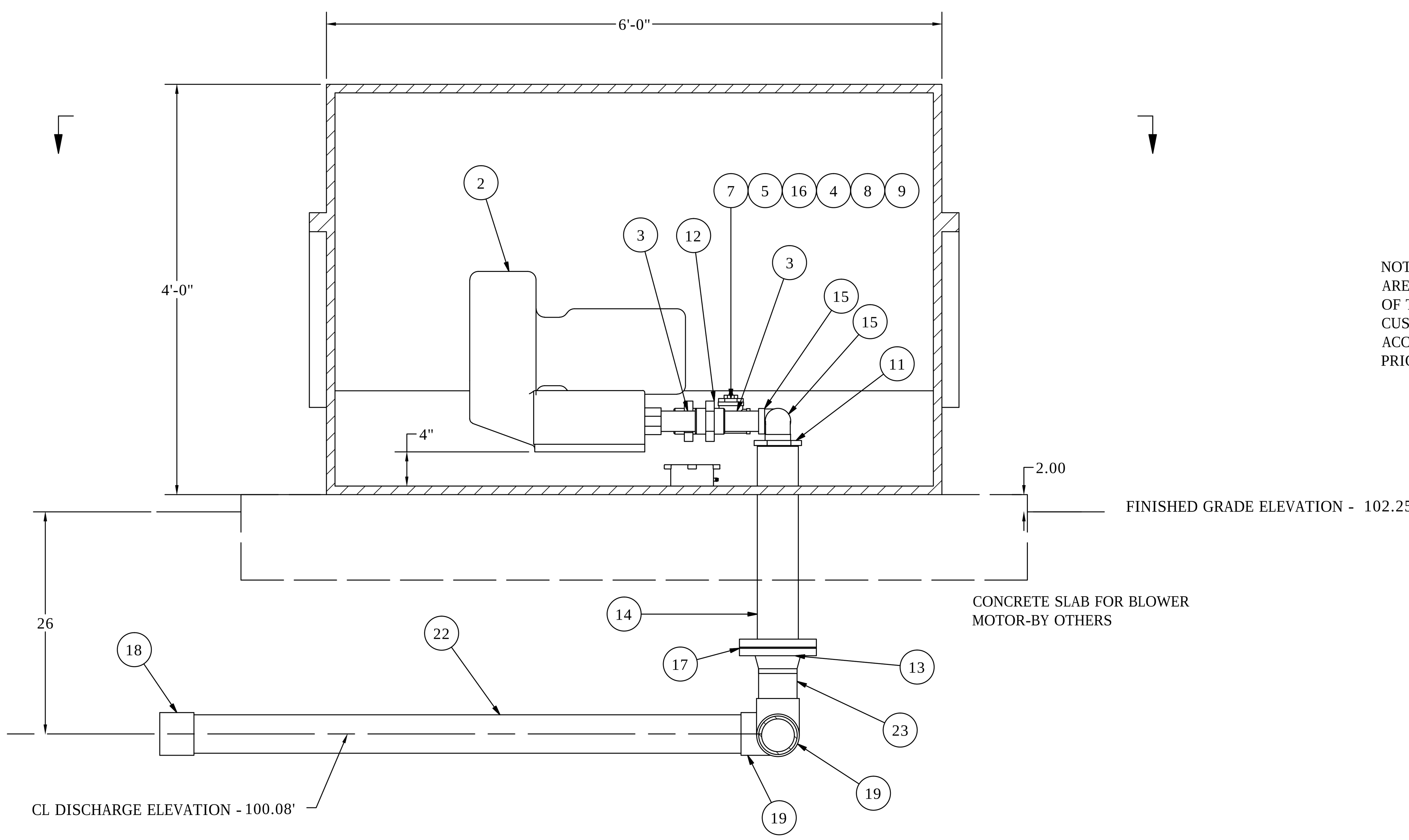


Parts List			
ITEM	QTY	STOCK NUMBER	DESCRIPTION
1	1	10-XXXX	ENCLOSURE - INSULATED FIBERGLASS
2	1	30-5500	BLOWER - EXPLOSION PROOF REGENERATIVE TYPE
3	2	40-XXXX	NIPPLE - 316SS - 2in X 6in
4	2	40-4111	NIPPLE - 316SS - 2in SCH40 X CLOSE
5	1	40-6458	NIPPLE - 316SS - 2in SCH40 X 3.5in
6	2	40-XXXX	NIPPLE - 316SS - 2in X CLOSE
7	1	40-XXXX	BUSHING - 316SS - 2in FEMALE X 1in MALE THD
8	1	40-XXXX	BUSHING - 316SS - 1in MALE THD X 1-8in FEMALE THD
9	2	40-XXXX	HOSE FITTING - PUSH X MALE THD - 1-8in
10	1	40-XXXX	HOSE - NYLONE - 1-8in - 2ft
11	2	42-4928	BUSHING - SS - 4inX2in
12	2	42-XXXX	UNION - 316SS - 2in
13	2	44-XXXX	FLANGE - PVC- 4in SCH40 - 150# - SOC
14	2	45-XXXX	SPOOL - FLG X PE - 4in X 24in - 316SS - 4in FTHD X 4in FLG
15	4	46-XXXX	ELBOW - 316SS - 2in - 90 DEG - - THREADED
16	1	46-XXXX	TEE - 316SS - 2in - THREADED
17	2	47-6546	GASKET - FLANGE - 4in X 1/8in
18	2	48-XXXX	COUPLING - 4in SCH40 - SLP X SLIP
19	3	48-5460	ELL; 4" PVC 90, SLIP X SLIP -SCH40
20	4	48-XXXX	PIPE - 4in PVC - SCH40 - 1 @ 48in
21	1	48-XXXX	PIPE - 4in PVC - SCH40 - 1 @ 12in
22	6	48-XXXX	PIPE - 4in PVC - SCH40 - 1 @ 72in
23	1	48-XXXX	PIPE - 4in PVC - SCH40 - 2 @ 6in
24	1	62-XXXX	PRESSURE SWITCH

ORIENTATION OF PIPE SHOWN
DOES NOT MATCH SITE.
ORIENTATION OF PIPING MUST
BE FIELD ADJUSTED.

BLOWER ASSEMBLY
FOR ODOR CONTROL
2" SS TO 4" PVC PIPING





NOTE: ALL DIMENSIONS AND ELEVATIONS SHOWN ARE NOMINAL DIMENSIONS. IT IS THE RESPONSIBILITY OF THE ON-SITE CONTRACTOR OR ROMTEC UTILITIES CUSTOMER (NOT ROMTEC UTILITIES) TO VERIFY THE ACCURACY OF ANY CRITICAL DIMENSIONS OR ELEVATIONS PRIOR TO SETTING OR INSTALLING ANY EQUIPMENT.

4in PVC FITTINGS WILL NOT BE INSTALLED. THE 4in PVC PIPE AND FITTING ARE TO BE FIELD FIT. ROMTEC UTILITIES WILL SUPPLY THE FITTINGS AND PIPE. THE PIPE WILL NOT BE CUT TO LENGTH.

Two working days before you dig
CALL FOR THE BLUE STAKES
1-800-STAKE-IT
Blue Stake Center
1-800-782-5348

CVL
4550 North 12th Street
Phoenix, Arizona 85014
Telephone 602-264-6831
http://www.cvlci.com

Coe & Van Loo Consultants, Inc.

NO. | REVISION | DATE

BAY MEADOWS
(SAN MATEO, CA.)

ODOR CONTROL BLOWER ASSEMBLY

REGISTERED PROFESSIONAL ENGINEER
LES P. OLSON
No. C-30733
8-11-14
CIVIL
STATE OF CALIFORNIA

DRAWING
M4

CVL Contact: ERIC LAURIN
CVL Project #: 1.01.0204801
CVL File #:

10-14-11

$USER$
$DATE$
$TIME$
$FILENAME$

SHELTER WORKS

Built for Life.

SUBMITTAL PACKAGE

Romtec Utilities

3897 - Bay Meadows #436

Big Mouth Cabinet- Hinged w/ Lift Assistance

Tuesday, July 29, 2014

PLEASE REVIEW CAREFULLY

☐ APPROVED AS SUBMITTED

☐ REVISE & RESUBMIT

______________________________ ______________

SIGNATURE DATE

ONSITE/SHIPPING CONTACT: ______________________________

PHONE/EMAIL:______________________________

PREFERRED DELIVERY DATE:______________________________

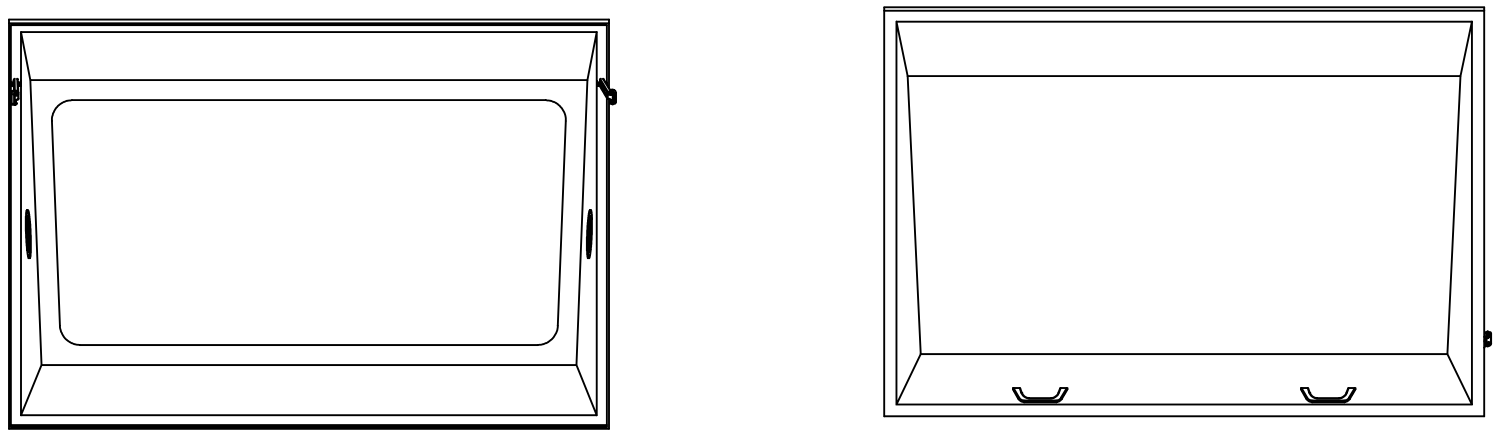
FAX TO: 314•664•9301
OR
EMAIL TO: submittals@shelterworks.com

PROUDLY MADE IN AMERICA

INTERIOR COLOR:	WHITE	EXTERIOR COLOR:	Polar White

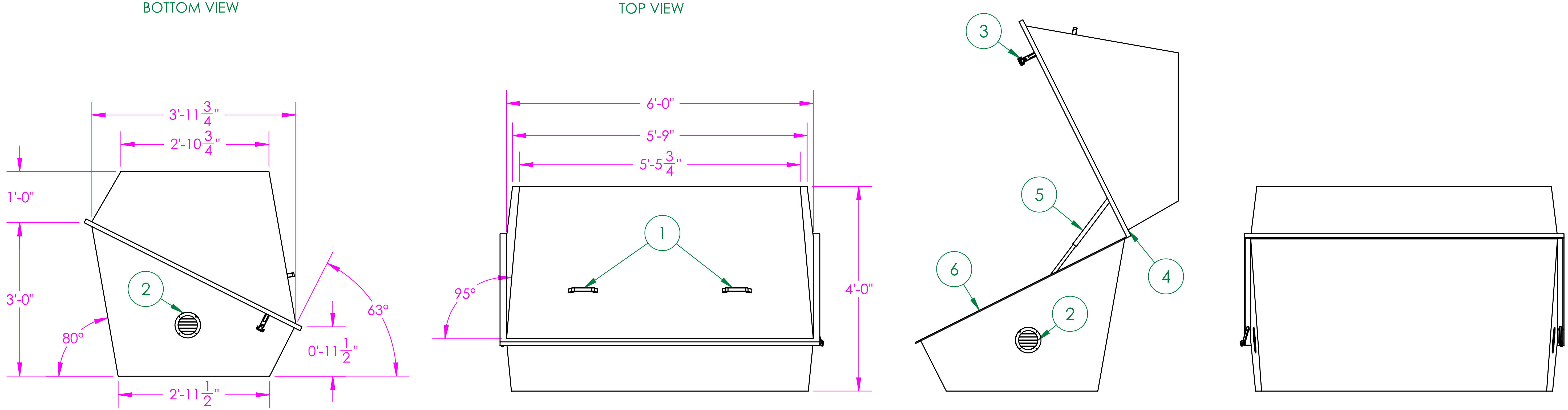
ITEMS LIST

ITEM	QTY	PART NUMBER	DESCRIPTION	NOTES	SHIPPED LOOSE
1	2	30357	PLASTIC GRAB HANDLE	MOLDED POLYPROPYLENE	-
2	2	281140	5" ROUND VENT	304 STAINLESS STEEL	-
3	2	12065A63	RUBBER DRAW DOWN LATCH	W/ NYLON STRIKE	-
4	1	1658A867	CONTINUOUS PIANO HINGE	TYPE 304 SS	-
5	2	AC-10150	GAS SPRING	LIFT ASSISTANCE	-
6	-	X119HT	GASKET	SPONGE RUBBER	-
7	1	CS-102B	SEALANT	14'-6" PER ROLL	X



BOTTOM VIEW

TOP VIEW



LEFT VIEW CLOSED

FRONT VIEW CLOSED

RIGHT VIEW OPENED

BACK VIEW CLOSED

REV.	DESCRIPTION	DATE	APPROVED
-	-	-	-
-	-	-	-

RATINGS:

20 PSF SNOW LOAD
90 MPH WIND LOAD
500 LBS APPROX. WEIGHT

INTERIOR & PLAN VIEWS

MODEL: 3897 Assembly

PLOT SCALE: 1:48 BY: MP DATE: 07/29/2014

PROPRIETARY TO SHELTER WORKS

This document is confidential and proprietary to Shelter Works and cannot be used, disclosed, copied, or duplicated in any manner without the prior written consent of Shelter Works

SHELTER WORKS Built for Life.

SHELTER WORKS
2616 South Third Street, St. Louis, MO 63118
Phone: (800)794-8037 Fax: (314) 664-9301
www.shelterworks.com

CUSTOMER:	Romtec Utilities	ORDER #:	3897
PROJECT:	Bay Meadows #436	SIZE:	B
TITLE:	Big Mouth Cabinet- Hinged w/ Lift Assistance		
SCALE: 1:48	DWG #: 3897 Assembly	SHEET:	1 OF 3

INTERIOR COLOR: WHITE				EXTERIOR COLOR: POLAR WHITE	
3897 ITEMS LIST					
ITEM	QTY	PART NUMBER	DESCRIPTION	NOTES	SHIPPED LOOSE
1	2	30357	PLASTIC GRAB HANDLE	MOLDED POLYPROPYLENE	-
2	2	281140	5" ROUND VENT	304 STAINLESS STEEL	-
3	2	12065A63	RUBBER DRAW DOWN LATCH	W/ NYLON STRIKE	-
4	1	1658A867	CONTINUOUS PIANO HINGE	TYPE 304 SS	-
5	2	AC-10150	GAS SPRING	LIFT ASSISTANCE	-
6	-	X119HT	GASKET	SPONGE RUBBER	-
7	1	CS-102B	SEALANT	14'-6" PER ROLL	X

SHELTER WORKS ASSUMES NO RESPONSIBILITY FOR ACTUAL FOUNDATION DESIGN AND CONSTRUCTION. THE SITE CONTRACTOR IS TO VERIFY THE FINAL DIMENSIONS BASED UPON ACTUAL SITE CONDITIONS AND REQUIREMENTS. CONCRETE SLAB SHALL BE TRUE AND LEVEL TO A TOLERANCE OF NOT MORE THAN 3/16" WHERE THE BUILDING IS TO ATTACH. ALL PAVED OR GRADED SURFACES SURROUNDING THE SHELTER SHALL BE PITCHED TO PROMOTE PROPER DRAINAGE OF PRECIPITATION. SOME ITEMS MAY SHIP LOOSE FOR SHIPPING EFFICIENCY.

Building Summary

Order #	3897
Width	4'
Length	6'
Height	4'
Wall Foam	- (-)
Wall Wood	- A B C D
Roof Foam	- (-)
Roof Wood	-
Door Wood	-
Resin Type	General Purpose
Interior Color	White
Exterior Color	Polar White
Fastener Spacing	-
Floor	-
Gasket	CS-102B
Pre-Drill Base Flange	-
Roof Truss	-
Approximate Weight	500 LBS

Electrical Summary

Conduit	None
Termination Point	-
Wiring	-

•Conduit shall be run at the top of the walls with conduit drops to individual electrical devices.
•All wiring will be done by a licensed electrician in compliance with the NEC.
•Short lengths of code-compliant, flexible conduit shall be permitted when necessary.

Special Notes

-

FIBERGLASS REINFORCED POLYMER (FRP)

FRP

PROPERTY	PANEL
Tensile Strength (psi) similar to ASTM D638	
Average	12,458
Standard Deviation	1,806
Tensile Elongation (%) similar to ASTM D638	
Average	1.35
Standard Deviation	0.22
Tensile Modulus (psi) similar to ASTM D638	
Average	1,277,218
Standard Deviation	98,158
Flexural Strength (psi) similar to ASTM D790	
Average	20,386
Standard Deviation	1,182
Flexural Modulus (psi) similar to ASTM D790	
Average	920,271
Standard Deviation	39,102
Izod Impact ((ft-lbs)/in) similar to ASTM D256	Notched
Average	16.30
Standard Deviation	2.20
Izod Impact ((ft-lbs)/in) similar to ASTM D256	Un-Notched
Average	21.79
Standard Deviation	1.74
	* Results not certified to ASTM
Fiberglass Laminate	
Burning Characteristics (ASTM E48)	< 150 Flame Spread
	< 1000 Smoke Density
Foam Core	
Burning Characteristics (ASTM E48)	< 75 Flame Spread
	< 450 Smoke Development

Manufactured by: Cook Composites

Molded Grab Handle

30357

Specifications

- Strong light weight molded polypropylene
- 6.8" overall length
- Snap-shut panels conceal two mounting holes
- Mounting holes measure 5.5" C.C.
- 1.25 " hand clearance
- Textured black finish

5” Stainless Steel Vent

281140

Specifications

- Air flow: Straight-through
- Material: 304 Stainless steel
- Dimensions: 5” diameter
- Mounting: Drilled for (4) #6 screws

Rubber Draw Latch

12065A63

Draw latch stretches to fit the strike and "gives" a little to compensate for misalignment. Rubber won't scratch painted surfaces and resists weather, oil, chemicals, and dirt.

Specifications

- Length: 4 13/16”
- Width: 1 13/16”
- Height: 1 15/64”
- Reach distance: 1 11/16”
- Material: Synthetic rubber
- Color: Black
- Screws: Exposed, drilled for #10 screws

Stainless Steel Piano Hinge

1658A867

Specifications

- Mounting Type: Surface-Mounted
- Type: Piano Hinge
- Base Material: Stainless Steel
- Stainless Steel Material: 300 Series Stainless Steel
- Finish: Unfinished
- Open Width: 3”
- Knuckle Length: ½”
- Length: 6’

<u>Gas Spring™</u>

SHELTER WORKS

Built for Life.

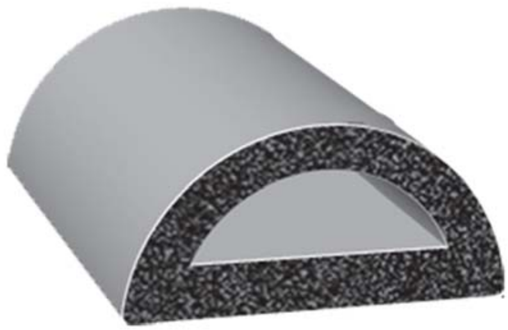
AC10150

Durable, long lasting design. Metal ends are constructed with heavy gauge steel and is used in conjunction with metal safety clips. Teflon back up ring provides superior seal stability. Body is made of heavy gauge steel with black heat cured paint. Shaft is made of chromium plated steel.

<u>Specifications:</u>

- Force (lbs.): 150
- Ext. Length: 27.80”
- Stroke: 10.00”
- Comp Length: 17.80”
- Rod Diameter: 393”
- BBL Diameter:0.866”

SPONGE RUBBER



X119HT

.75" D-Shaped Sponge Rubber
Made from a custom formulated sponge rubber compound
Recommended operating temp range: -40° to +212°F
Maximum compression of 50% recommended for max performance
Roll size: 500'
Uses standard bond adhesive

Width: .750"
Height: .530"
Length: 500'

ConSeal - Bituman Blended Sealant

CS-102B

Butyl base gasket for sealing joints between the enclosure and concrete.

Specifications

- Provides permanently flexible watertight joints.
- Low to high temperature workability: 30°F to 120°F (-1°C to 48°C)
- Rugged service temperature: -30°F to +200°F (-34°C to +93°C)
- Excellent chemical and mechanical adhesion to clean and dry surfaces.
- Greater cohesive and adhesive strengths.
- Sealed Joints will not shrink, harden or oxidize upon aging.
- Controlled flow resistance for application ease.
- No priming normally necessary. When confronted with difficult installation
- conditions, such as wet concrete or temperatures below 40°F (4°C), priming the concrete will improve the bonding action. Consult Concrete Sealants for the proper primer to meet your application

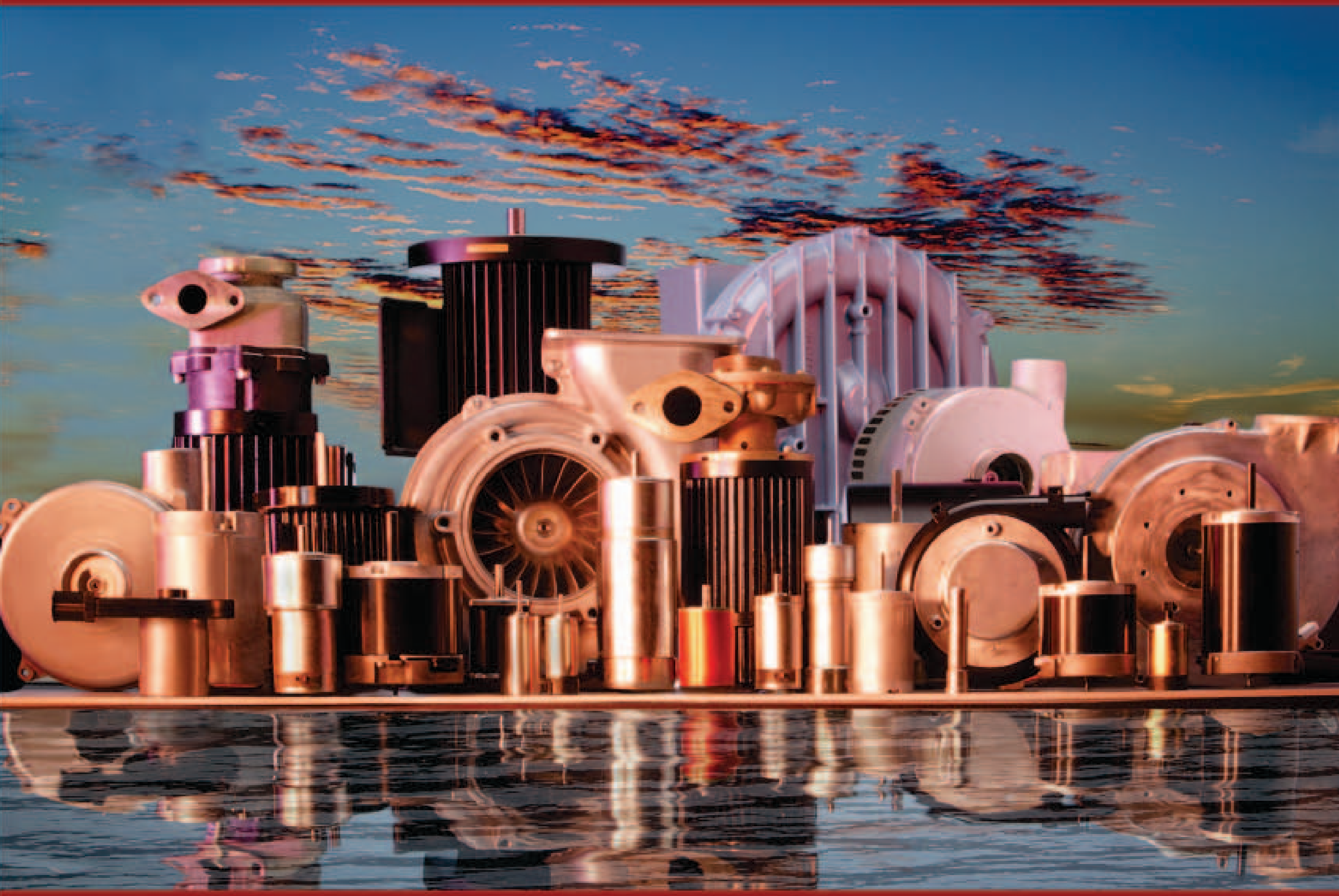
Prepared on July 10, 2013

PRODUCT CATALOG

AMETEK®
TECHNICAL & INDUSTRIAL PRODUCTS

T3M Equipment
541-447-5660
541-950-6035 Cell
541-447-6101 Fax
t3m@crestviewcable.com

CP808
Romtec

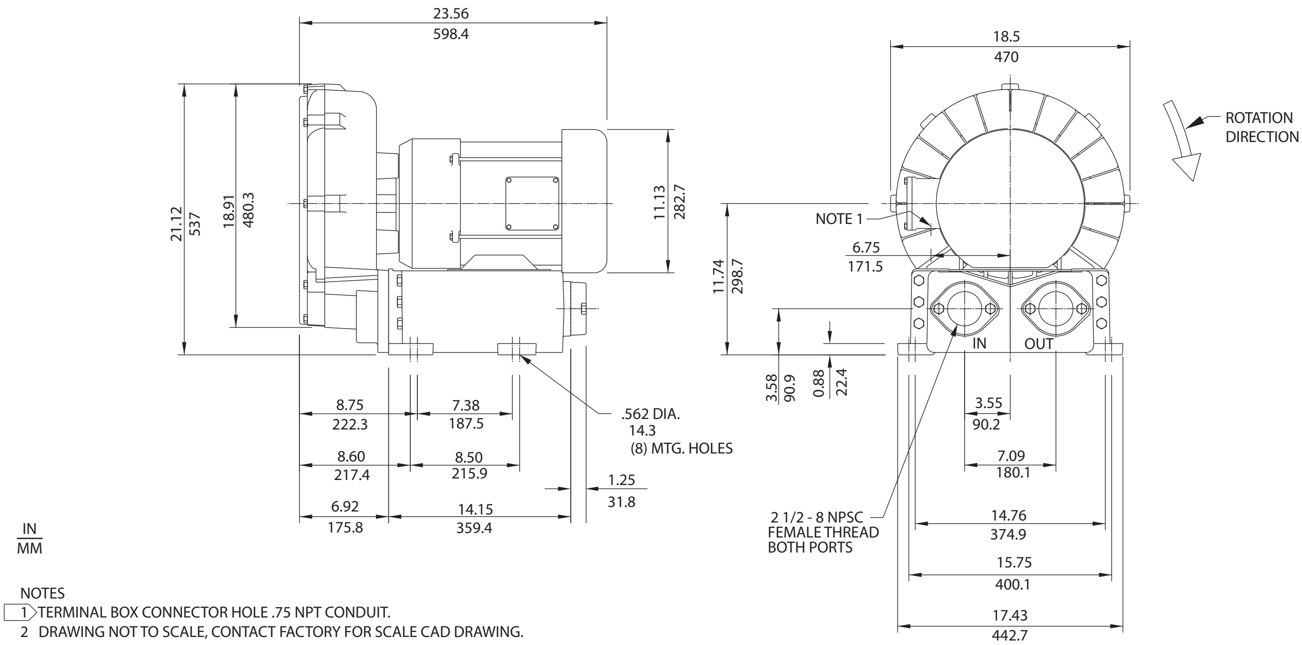


WELCOME TO SOLUTION CITY®

ROTRON®

EN 808 & CP 808 Three-Phase

Sealed Regenerative Blower w/Explosion-proof Motor



NOTES
1 TERMINAL BOX CONNECTOR HOLE .75 NPT CONDUIT.
2 DRAWING NOT TO SCALE, CONTACT FACTORY FOR SCALE CAD DRAWING.
3 CONTACT FACTORY FOR BLOWER MODEL LENGTHS NOT SHOWN.

		Part/ Model Number		
		EN808BA72MXL	EN808BA86MXL	CP808FY72MXLR
Specification	Units	081229	081230	081234
Motor Enclosure - Shaft Mtl.	-	Explosion-proof-CS	Explosion-proof-CS	Chem XP-SS
Horsepower	-	7.5	7.5	7.5
Phase - Frequency	-	Three-60 hz	Three-60 hz	Three-60 hz
Voltage	AC	230/460	575	230/460
Motor Nameplate Amps	Amps (A)	18.6/9.3	7.4	18.6/9.3
Max. Blower Amps	Amps (A)	22.0/11.0	8.1	22.0/11.0
Inrush Amps	Amps (A)	126/63	56	126/63
Service Factor	-	1.0	1.0	1.0
Starter Size	-	1/1	1	1/1
Thermal Protection	-	Class B - Pilot Duty	Class B - Pilot Duty	Class B - Pilot Duty
XP Motor Class - Group	-	I-D, II-F&G	I-D, II-F&G	I-D, II-F&G
Shipping Weight	Lbs	287	287	287
	Kg	130.2	130.2	130.2

Voltage - ROTRON motors are designed to handle a broad range of world voltages and power supply variations. Our dual voltage 3 phase motors are factory tested and certified to operate on both: **208-230/415-460 VAC-3 ph-60 Hz** and **190-208/380-415 VAC-3 ph-50 Hz**. Our dual voltage 1 phase motors are factory tested and certified to operate on both: **104-115/208-230 VAC-1 ph-60 Hz** and **100-110/200-220 VAC-1 ph-50 Hz**. All voltages above can handle a ±10% voltage fluctuation. Special wound motors can be ordered for voltages outside our certified range.

Operating Temperatures - Maximum operating temperature: Motor winding temperature (winding rise plus ambient) should not exceed 140°C for Class F rated motors or 120°C for Class B rated motors. Blower outlet air temperature should not exceed 140°C (air temperature rise plus inlet temperature). Performance curve maximum pressure and suction points are based on a 40°C inlet and ambient temperature. Consult factory for inlet or ambient temperatures above 40°C.

Maximum Blower Amps - Corresponds to the performance point at which the motor or blower temperature rise with a 40°C inlet and/or ambient temperature reaches the maximum operating temperature.

XP Motor Class - Group - See Explosive Atmosphere Classification Chart in Section I

Environmental / Chemical Processing Blowers

ROTRON®

EN 808 & CP 808 Three-Phase

Sealed Regenerative Blower w/Explosion-proof Motor

FEATURES

- Manufactured in the USA - ISO 9001 and NAFTA compliant
- Maximum flow: 360 SCFM
- Maximum pressure: 85 IWG
- Maximum vacuum: 90 IWG
- Standard motor: 7.5 HP, explosion-proof
- Cast aluminum blower housing, impeller , cover & manifold; cast iron flanges (threaded); teflon® lip seal
- UL & CSA approved motor with permanently sealed ball bearings for explosive gas atmospheres Class I Group D minimum
- Sealed blower assembly
- Quiet operation within OSHA standards

MOTOR OPTIONS

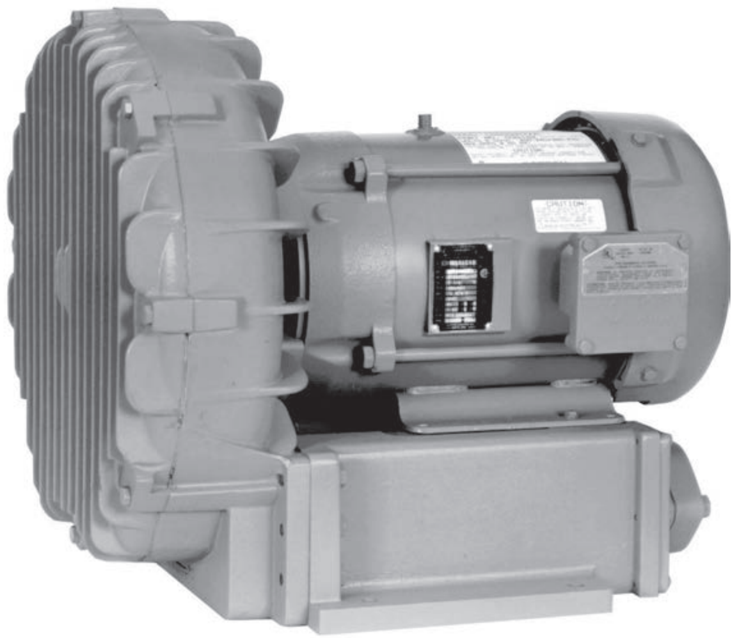
- International voltage & frequency (Hz)
- Chemical duty, high efficiency, inverter duty or industry-specific designs
- Various horsepowers for application-specific needs

BLOWER OPTIONS

- Corrosion resistant surface treatments & sealing options
- Remote drive (motorless) models
- Slip-on or face flanges for application-specific needs

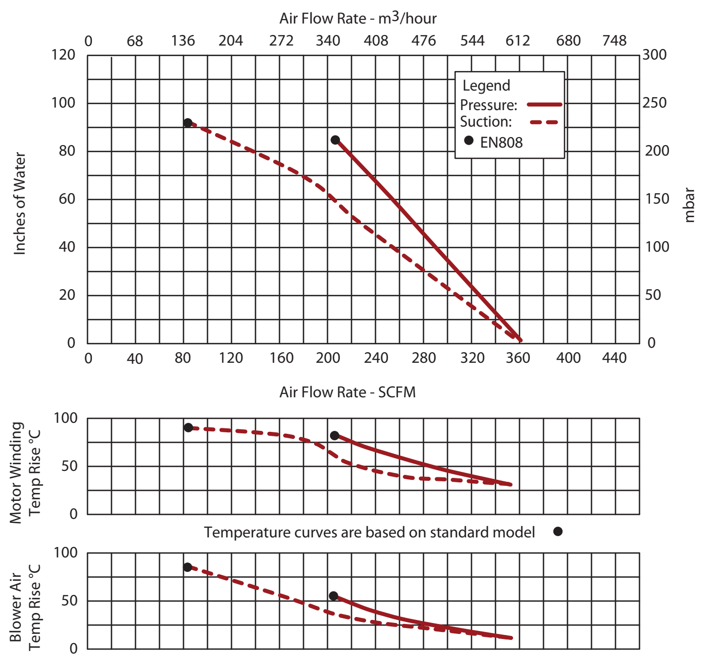
ACCESSORIES

- Flowmeters reading in SCFM
- Filters & moisture separators
- Pressure gauges, vacuum gauges, & relief valves
- Switches - air flow, pressure, vacuum, or temperature
- External mufflers for additional silencing
- Air knives (used on blow-off applications)
- Variable frequency drive package

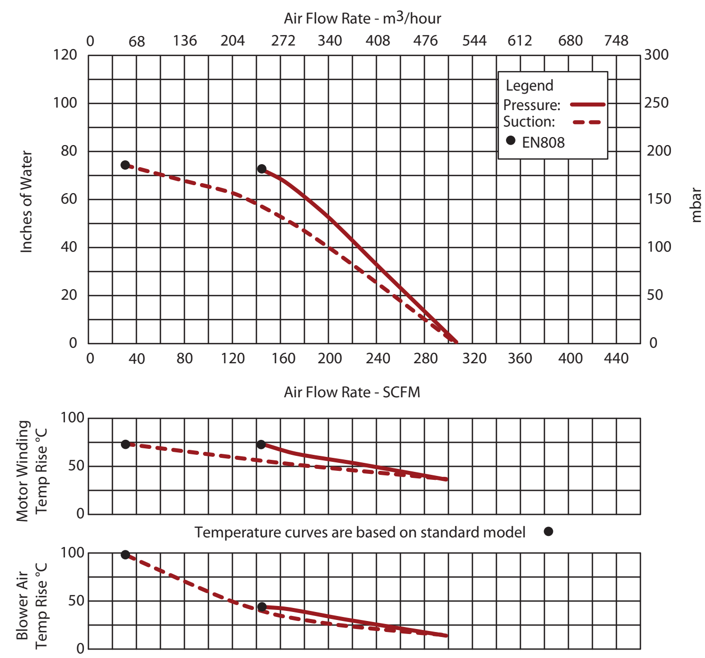


Blower Performance at Standard Conditions

60 Hz



50 Hz



This document is for informational purposes only and should not be considered as a binding description of the products or their performance in all applications. The performance data on this page depicts typical performance under controlled laboratory conditions. AMETEK is not responsible for blowers driven beyond factory specified speed, temperature, pressure, flow or without proper alignment. Actual performance will vary depending on the operating environment and application. AMETEK products are not designed for and should not be used in medical life support applications. AMETEK reserves the right to revise its products without notification. The above characteristics represent standard products. For product designed to meet specific applications, contact AMETEK Technical & Industrial Products Sales department.

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75 North Street, Saugerties, NY 12477
USA: +1 215-256-6601 - Europe: +44 (0) 845 366 9664 - Asia: +86 21 5763 1258
Customer Service Fax: +1 215.256.1338
www.ametektip.com

AMETEK® TECHNICAL & INDUSTRIAL PRODUCTS

Explosion Proof Diaphragm Switch *D1X, D2X Series*

Features

- Hermetically sealed
- Explosion proof housing for hazardous location
- Tamper proof setpoint adjustment
- Ideal for pressure or vacuum

Applications

- Pump & compressor monitoring
- Hydraulic power units
- Oil & gas
- Food & beverage
- Utility & power generation
- Mining

General Specifications*

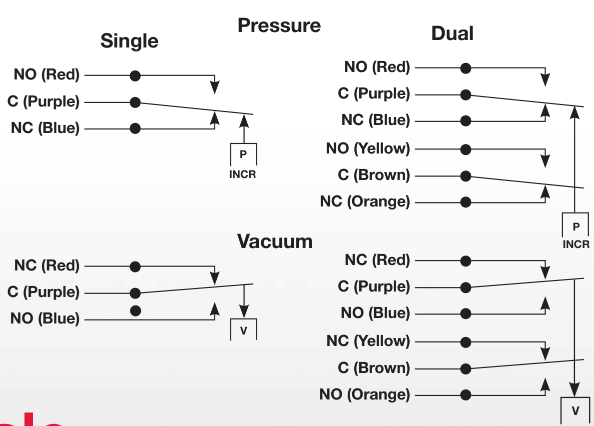
Accuracy:	± 0.5% of the adjustable range
Switch: Type: Rating:	 Single pole double throw (SPDT) Snap Action; single circuit 10 amps @ 125/250 VAC; 3 amps @ 480 VAC (Class A or H limit switch). Consult sales drawing for ratings of optional limit switches.
Wetted Parts: Process Fitting: Diaphragm: Enclosure:	 303 stainless steel 17-7 PH stainless steel Die-cast aluminum, anodized and painted
Electrical Connection:	Screw terminals on covered terminal strip via 1/2” NPT (D1X) and 3/4” NPT (D2X) conduit fittings.
Enclosure Ratings:	NEMA 4, 7, 9
Pressure Connection:	1/4” NPT Female
Approvals: UL (standard):	 All models are UL approved for use in hazardous locations Class I, Groups B, C, & D; Class II, Groups E, F, & G. UL File No. E37043
Approvals (cont.): CSA (standard): ATEX (optional):	 All models are CSA approved for use in hazardous locations Class I, Groups B, C & D; Class II, Groups E, F, & G. CSA File No. LR22354 EX models are ATEX marked as follows: CE 0081, ISSeP 08 ATEX024X Ex II 2G D, Ex d IIC T6 Ex tD A21 IP65 T80°C -40°C ≤ Tamb ≤ +75°C
Temperature Range: Operating: Storage:	 -65° to +165°F (-54° to +74°C) -65° to +200°F (-54° to 93°C)
Adjustment Instructions: Pressure: Vacuum:	 Turn adjustment screw counterclockwise to raise actuation point. Turn adjustment screw clockwise to increase setpoint (higher vacuum).
Options:	- Factory pre-set
Shipping Weight:	7.0 lbs. approximate

* See product configurator for additional options.

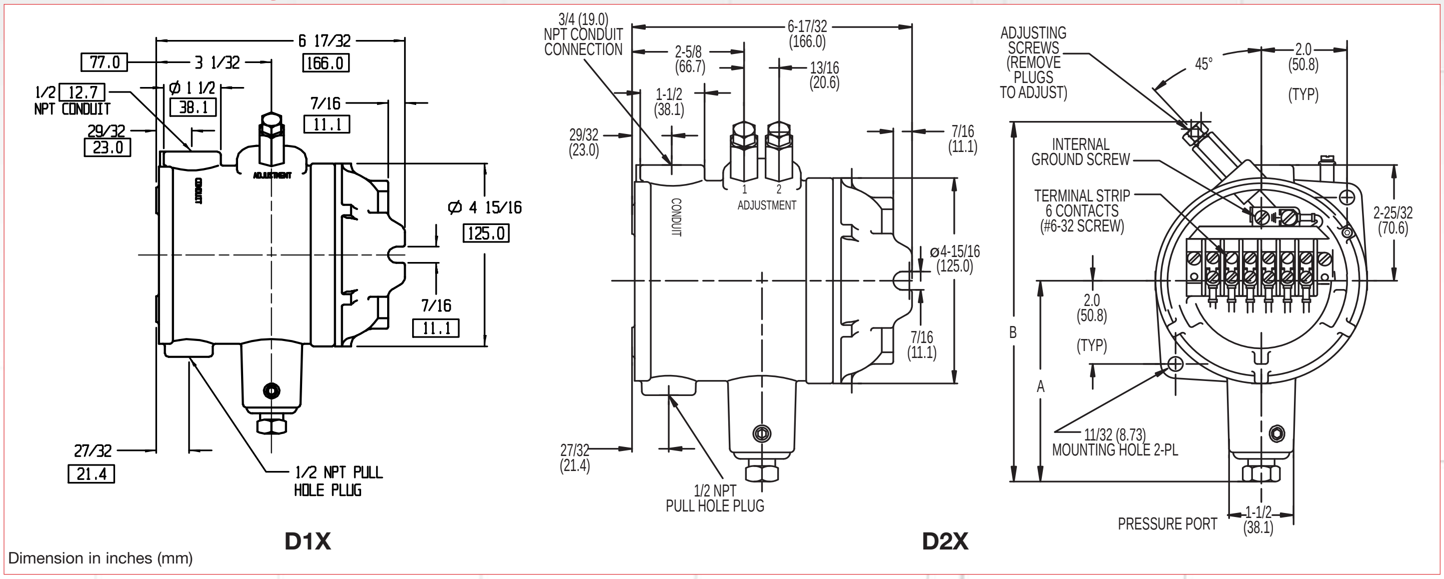
Wiring Code

Lead	Circuit #1		Circuit #2	
	Pressure	**Vacuum**	**Pressure**	**Vacuum**
Normally Closed	Blue	Red	Orange	Yellow
Common	Purple	Purple	Brown	Brown
Normally Open	Red	Blue	Yellow	Orange

Wiring Diagram



Technical Drawing



Product Configurator

Example		D1X	-A	3SS		-UL

H	Hermetically sealed limit switch option - Class I, Division II (requires AA, CC or HH limit switch)

Base Configuration

D1X	Single setpoint housed version
D2X	Dual setpoint housed version

Limit Switch[1]

-A	10 amps @ 125/250 VAC; 3 amps @ 480 VAC; (standard for pressure range 3SS, 80SS or 150SS)
-H	10 amps @ 125/250 VAC; 3 amps @ 480 VAC; (standard for pressure range 18SS)
-J	10 amps @ 125/250 VAC; 3 amps @ 480 VAC; (comes with an elastomer boot)
-M	10 amps @ 125/250 VAC; 3 amps @ 480 VAC; 0.5 amps @ 125 VDC; 0.25 amps @ 250 VDC
-GH	1 amp @ 125 VAC; 1 amp @ 24 VDC with Gold Contacts
-AA	Hermetically sealed; 4 amps @ 125/250 VAC (not available on vacuum models)
-CC	Hermetically sealed; 10 amps @ 125/250 VAC (not available on vacuum models)
-HH	Hermetically sealed; 5 amps @ 125/250 VAC (not available on vacuum models)

Options

-UL	UL & CSA Approval
-EX	ATEX Certified, -EX in place of UL for ATEX only
-Sxxx	Factory pre-set (consult factory)

Pressure Connection

Blank	Std 1/4” NPT female pressure connection
-P2	1/2” NPT female pressure connection

Adjustable Pressure Range

	Adjustable Range (PRESSURE)				Approx. Deadband[2] (Actuation Value) psi-(bar)	Proof Pressure psi (bar)
	Decreasing - psi (bar)		Increasing - psi (bar)			
	Min	Max	Min	Max		
3SS	.03 (.00)	2.85 (.2)	.18 (.01)	3 (.2)	.07 - .15 (0 - .01)	10 (.7)
18SS	.4 (.03)	17.74 (1.2)	.66 (.04)	18 (1.2)	.12 - .26 (.01 - .02)	60 (4.1)
80SS	.5 (.03)	76.6 (5.2)	3.9 (.3)	80 (5.4)	1.6 - 3.4 (.1 - .2)	160 (10.9)
150SS	1.5 (.10)	144 (9.8)	7.5 (.5)	150 (10.2)	2.3 - 6.0 (.2 - .4)	300 (20.4)

	Adjustable Range (VACUUM)				Approx. Deadband[2] (Actuation Value) In. Hg	Proof Pressure In. Hg
	Decreasing - In. Hg		Increasing - In. Hg			
	Min	Max	Min	Max		
3SS	0.06	5.72	0.34	6	.14 - .28	6
18SS	0.8	29.2	1.6	30	.4 - .8	30

NOTES:
[1] Consult Supplemental Guide for specific deadband values
[2] Deadband values indicated when used with the “standard” limit switch

4. ELECTRICAL

This section includes all drawings, schematics, data sheets, and user manuals related to the control panel and electrical components.

This section is structured as follows:

4.01 CONTROL PANEL DRAWING

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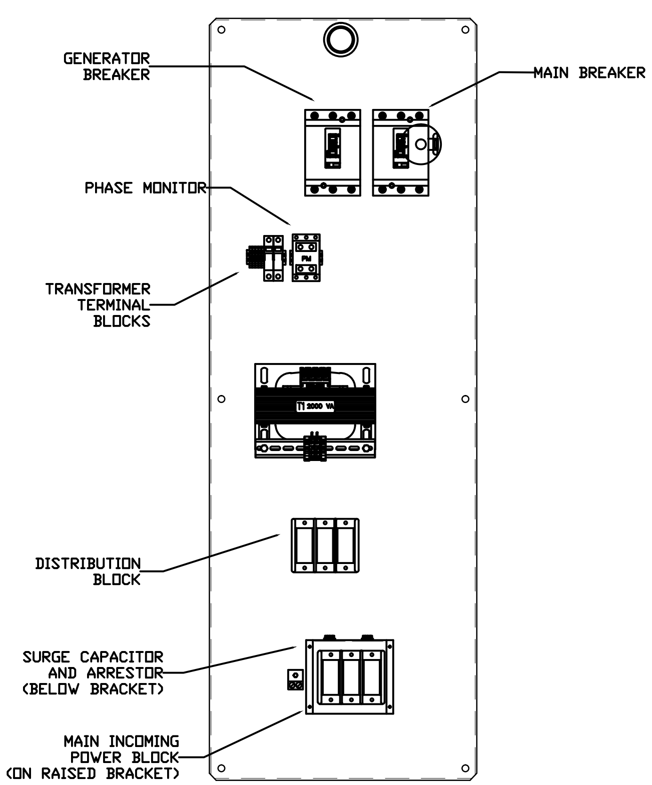
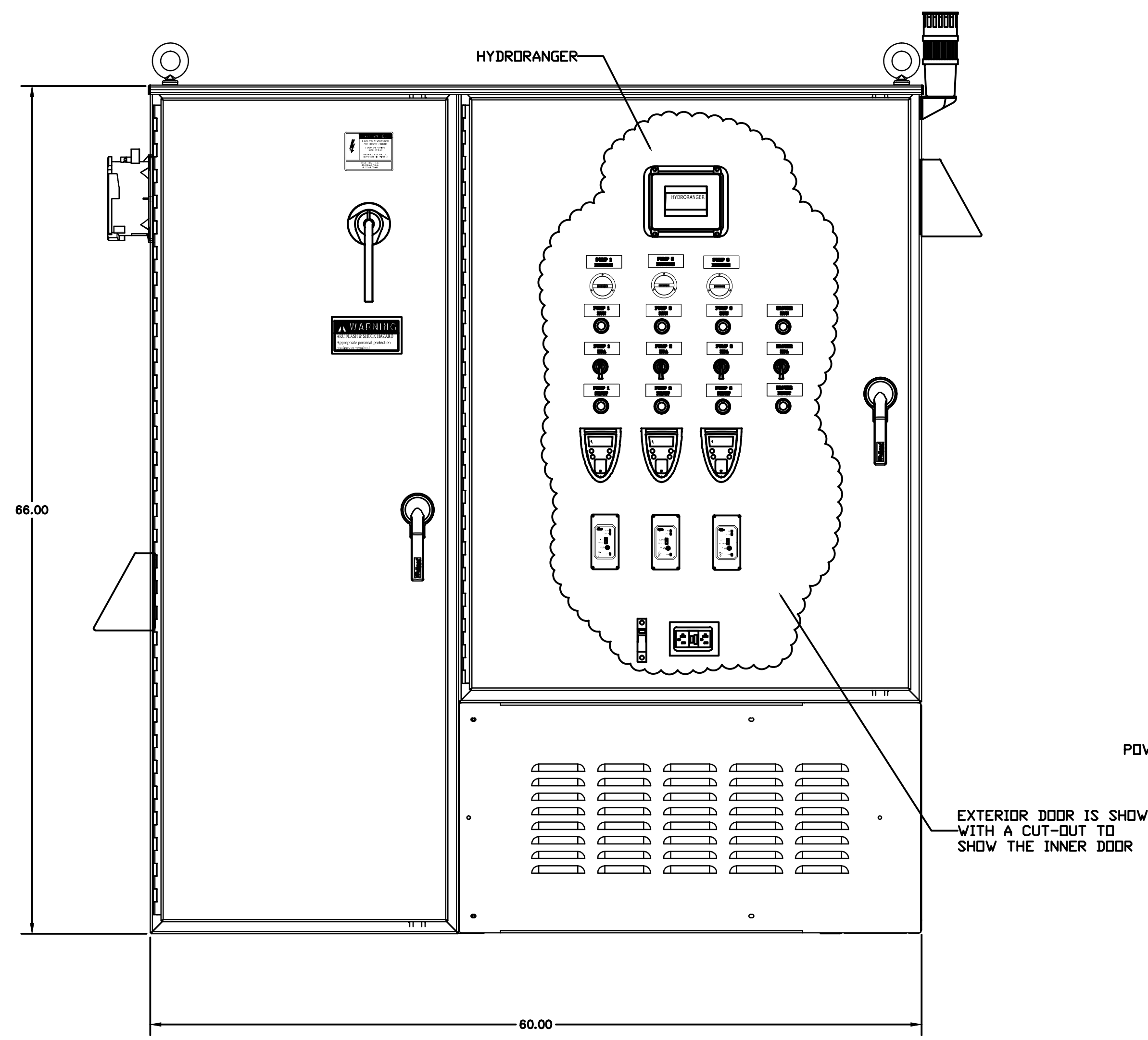
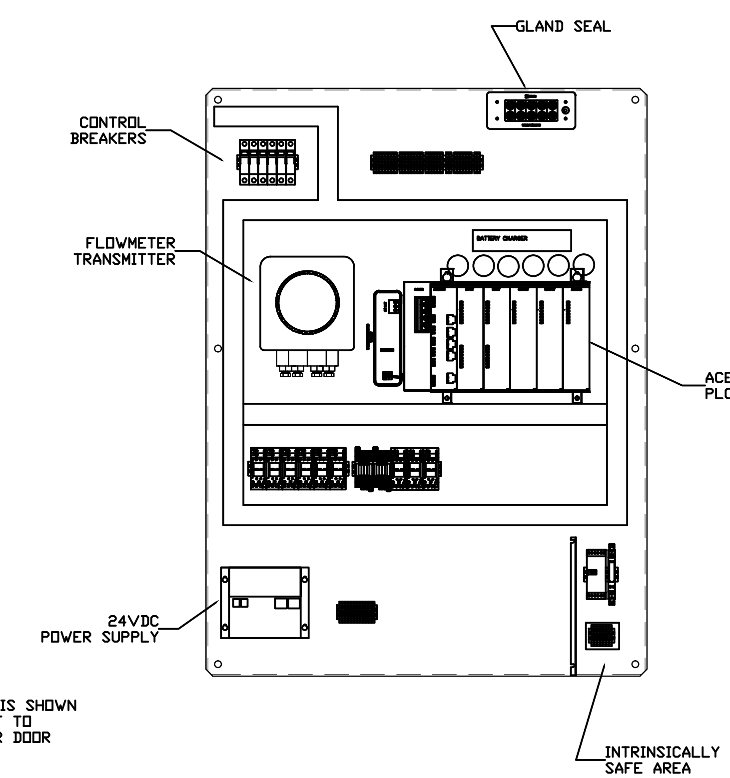


SERVICE ENTRANCE COMPARTMENT BACKPANEL LAYOUT





CONTROL COMPARTMENT BACKPANEL LAYOUT

THE ENCLOSURE SHOWN REPRESENTS THE INTENT OF THE DESIGN. OFTEN THE ENCLOSURE SIZE AND LAYOUT MUST CHANGE TO ACCOMMODATE THE REQUIRED COMPONENTS AND FINAL DESIGN. PLEASE CONTACT ROMTEC UTILITIES TO OBTAIN ACTUAL AS-BUILT DRAWINGS BEFORE INSTALLATION.

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BAY MEADOWS

CONTROL PANEL LAYOUT DRAWING

SHEET 1 OF 4

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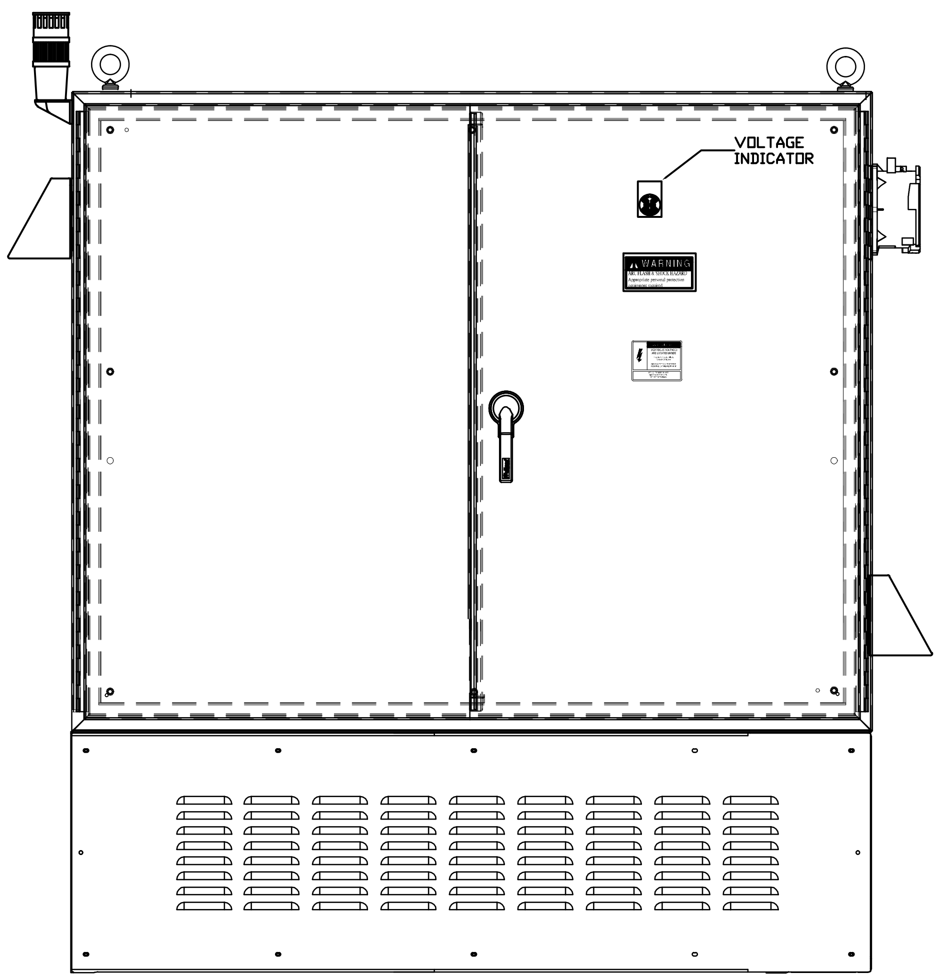

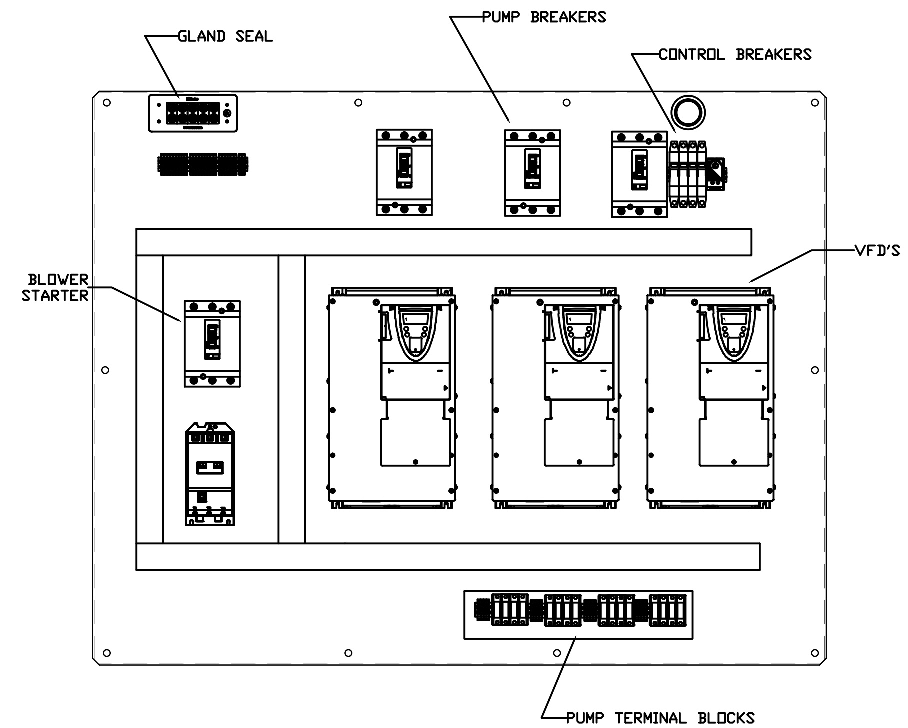

MCC COMPARTMENT
BACKPANEL LAYOUT

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CONTROL PANEL
LAYOUT DRAWING

SHEET
2 OF 4

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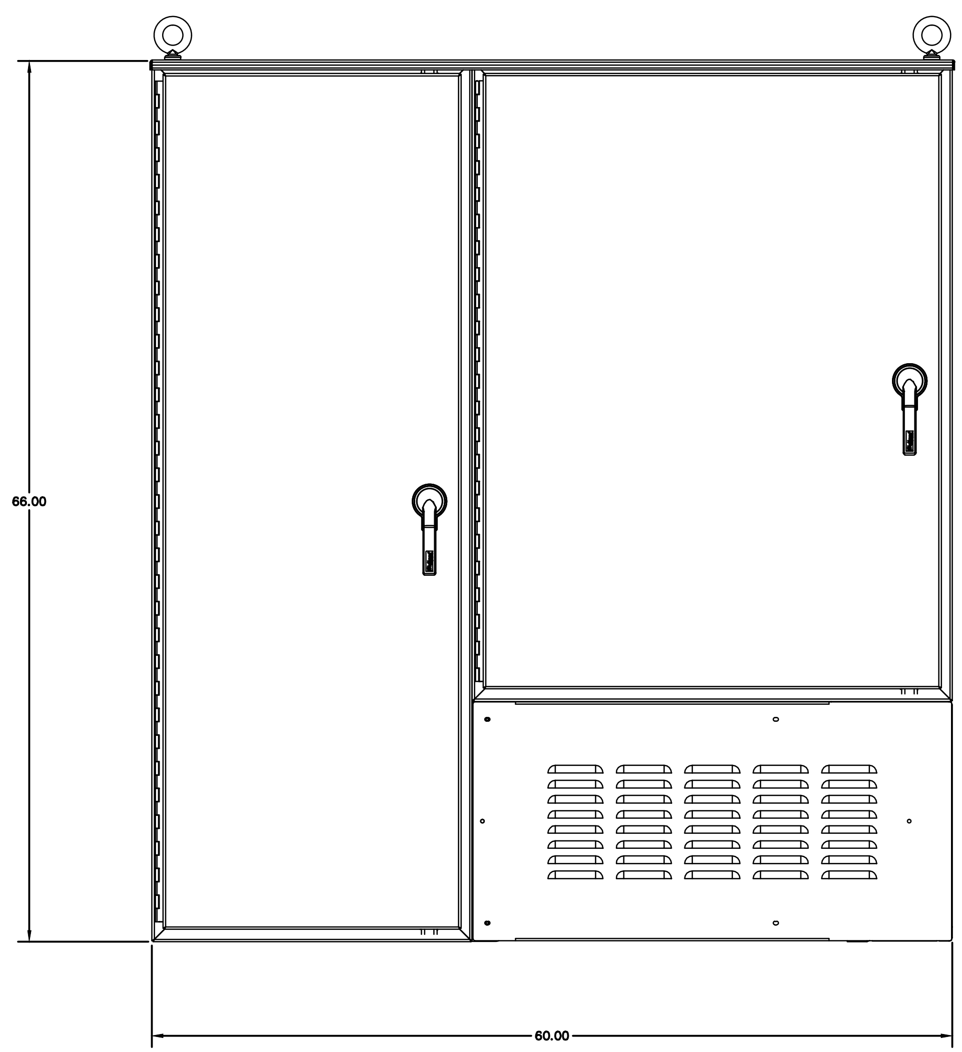

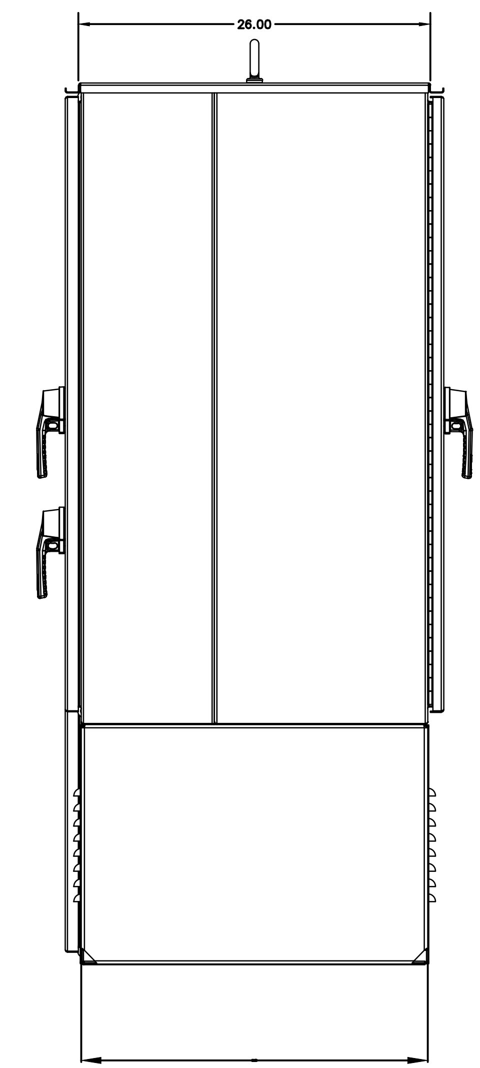

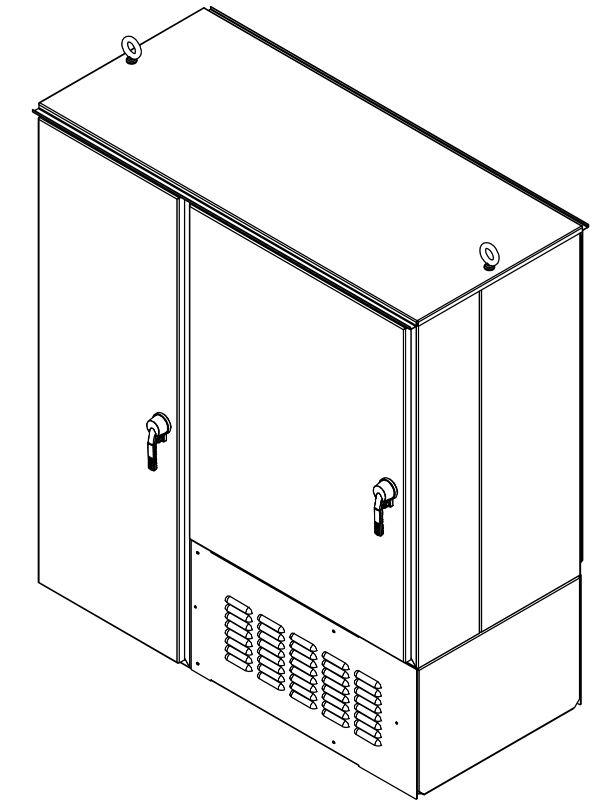

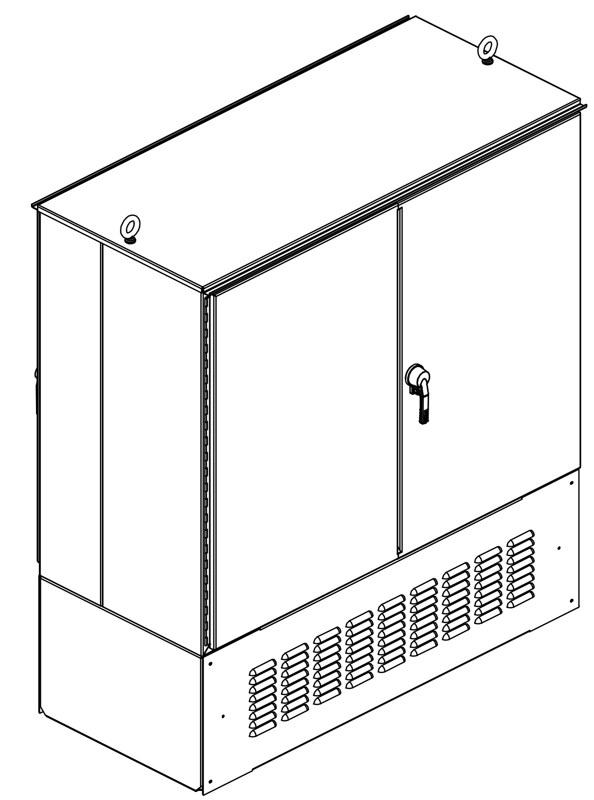

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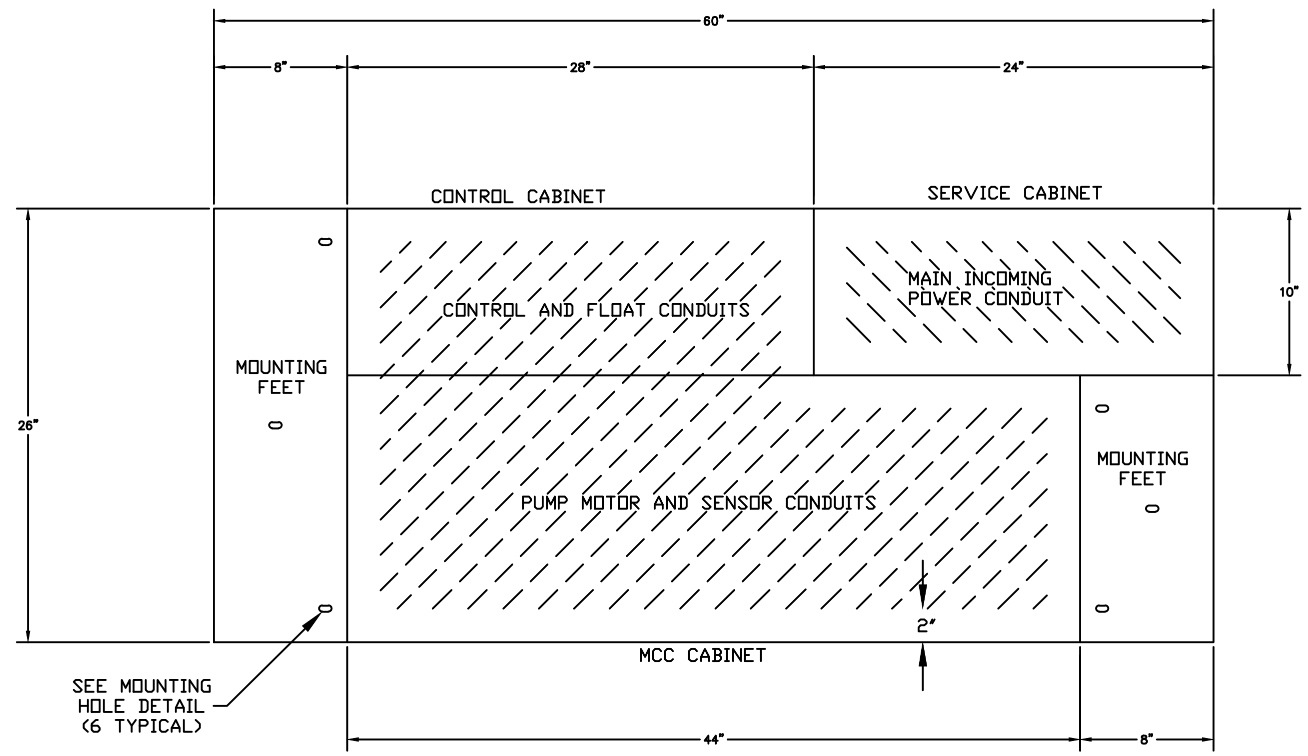
BAY MEADOWS

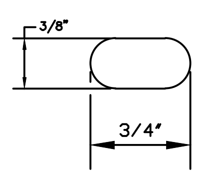
CONTROL PANEL
LAYOUT DRAWING

SHEET
3 OF 4

JOB NUMBER



ARC-ARMOR, SIZE 2 CONDUIT LAYOUT



MOUNTING HOLE
DETAIL

NOTE:
- PLACE CONDUITS WITHIN HATCHED AREA SHOWN ON THE DRAWING.
- DO NOT PLACE CONDUITS WITHIN 2" OF EDGE OF THE ENCLOSURE.

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BAY MEADOWS

CONTROL PANEL
CONDUIT LAYOUT

SHEET
4 OF 4

JOB NUMBER

4.02 ELECTRICAL SCHEMATICS

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ROMTEC UTILITIES, INC.

ELECTRICAL DRAWING SET
FOR
BAY MEADOWS

SAN MATEO, CA

TRIPLEX LIFT STATION

DRAWINGS LIST REPORT

SHEET	DRAWING DESCRIPTION
1	MAIN SERVICE COMPARTMENT
2	PUMP 1 VFD
3	PUMP 2 VFD
4	PUMP 3 VFD
5	BLOWER MOTOR & CONTROL POWER
6	HYDRORANGER CONTROLLER - PLC & FLOW METER POWER
7	HOA'S - BACKUP LEVEL CONTROL - MINICAS RELAYS
8	MIXED MODULE I/O SLOT 1
9	MIXED MODULE I/O SLOT 2
10	ANALOG OUTPUT MODULE SLOT 3
11	DIGITAL OUTPUT MODULES SLOT 4 & 5
12	FIELD TERMINAL CONNECTIONS

FIELD INSTALLATION AND WIRING:

GENERAL:

THE SCHEMATIC DRAWINGS AID IN UNDERSTANDING AND INSTALLING THE CONTROL SYSTEM. COMPLETE FIELD WIRING INSTALLATION INSTRUCTIONS ARE NOT INCLUDED HERE AND THE CORRECT INSTALLATION AND CONFORMANCE TO APPLICABLE CODES IS THE RESPONSIBILITY OF THE INSTALLER.

FIELD WIRING INSIDE ENCLOSURES:

1: CONNECTIONS WILL BE ONLY TO TERMINALS PROVIDED.

2: WIRE LENGTH FROM ENTRY POINT TO TERMINAL BOARD TO BE AS SHORT AS POSSIBLE.

3: SIGNAL WIRE MUST NOT BE PLACED OR RUN WITH NON-SIGNAL WIRE ENTRY INTO THE ENCLOSURE.

4: INCOMING WIRE MUST NOT BE ROUTED IN WIRE CHANNELS OR THROUGH AREAS OF POWER AND CONTROL COMPONENTS WIRING.

5: WHEN UNLIKE SIGNAL LEVELS MUST CROSS THEY SHOULD CROSS AT 90 DEGREE ANGLES AT A MAXIMUM SPACING.

FIELD CONNECTION NOTES:

1: ALL WIRING TO BE: THWN COPPER, UNLESS OTHERWISE SPECIFIED.

2: SHIELDED CABLES ARE #18GA. FOIL SHIELDED TYPE. 2 CONDUCTOR CABLE TO BE BELDEN #9318 OR EQUIVALENT, 3 CONDUCTOR CABLE TO BE BELDEN #9365 OR EQUIVALENT, AND 4 CONDUCTOR CABLE TO BE BELDEN #9368 OR EQUIVALENT UNLESS OTHERWISE SPECIFIED. NOTE: SHIELDS ARE ONLY CONNECTED AT THE SIGNAL SOURCE, OTHER END OF THE SHIELD IS UNCONNECTED AND SHOULD BE CUTOFF.

DRAWING STANDARDS:

WIRE COLOR STANDARD

USE	COLOR	SYM
POWER AC	BLACK	<BK>
CONTROL POWER (H)	RED	<RD>
CONTROL POWER (N)	WHITE	<WH>
UPS CONTROL POWER (H)	ORANGE	<OR>
UPS CONTROL POWER (N)	WHITE/ORANGE	<WO>
DC POWER (+)	BLUE	<BL>
DC POWER (-)	WHITE/BLUE	<WB>
EXTERNAL POWER	YELLOW	<YL>
INTRINSICALLY SAFE WIRING	BLUE/WHITE	<BW>
GROUND	GREEN	<GN>

WIRE SPECS :

-ALL WIRING TO BE: COPPER STRANDED, UNLESS OTHERWISE SPECIFIED.

-ALL WIRES SHALL BE NUMBERED AT BOTH ENDS OF EACH SEGMENT, I.E. TERMINATION POINTS.

-ALL TERMINALS SHALL BE LEGIBLY NUMBERED AND SHALL MATCH THE CONNECTED WIRE NUMBER AS PER DRAWING.

WIRE NUMBERING CONVENTION

1 01 A (STANDARD)

SEQUENTIAL LETTER

PAGE ROW NUMBER

PAGE NUMBER

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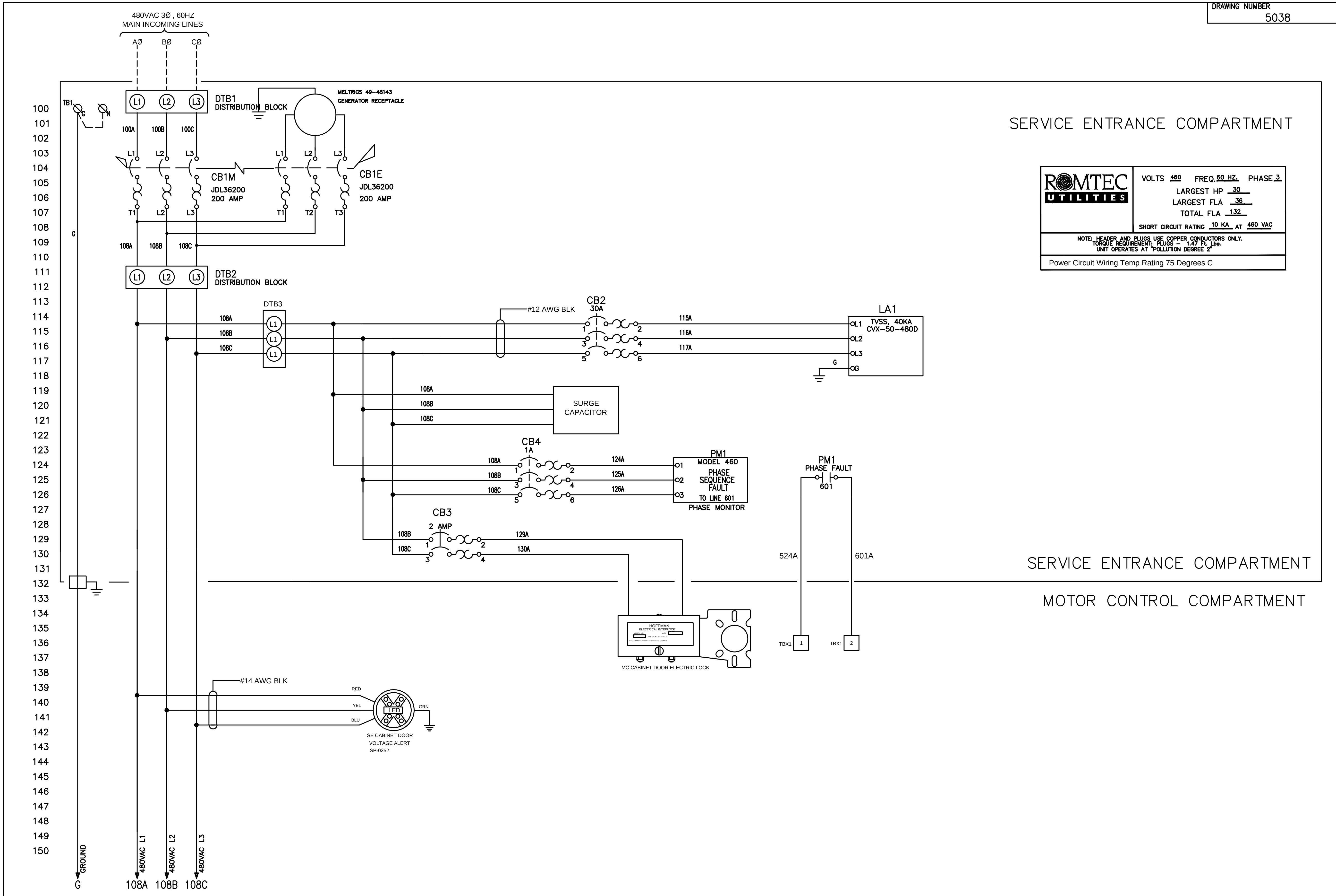
CHK'D
APPR'D
SHEET 1 OF 1

REV. 1
HP 30
SIZE C

PROJECT NAME: BAY MEADOWS
FILE NO:
CONFIG NO:
ADDER NO:
PROJECT NUMBER
DRAWING NUMBER TITLE BLOCK

DRAWING NUMBER 5038



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SHEET 1 OF 12

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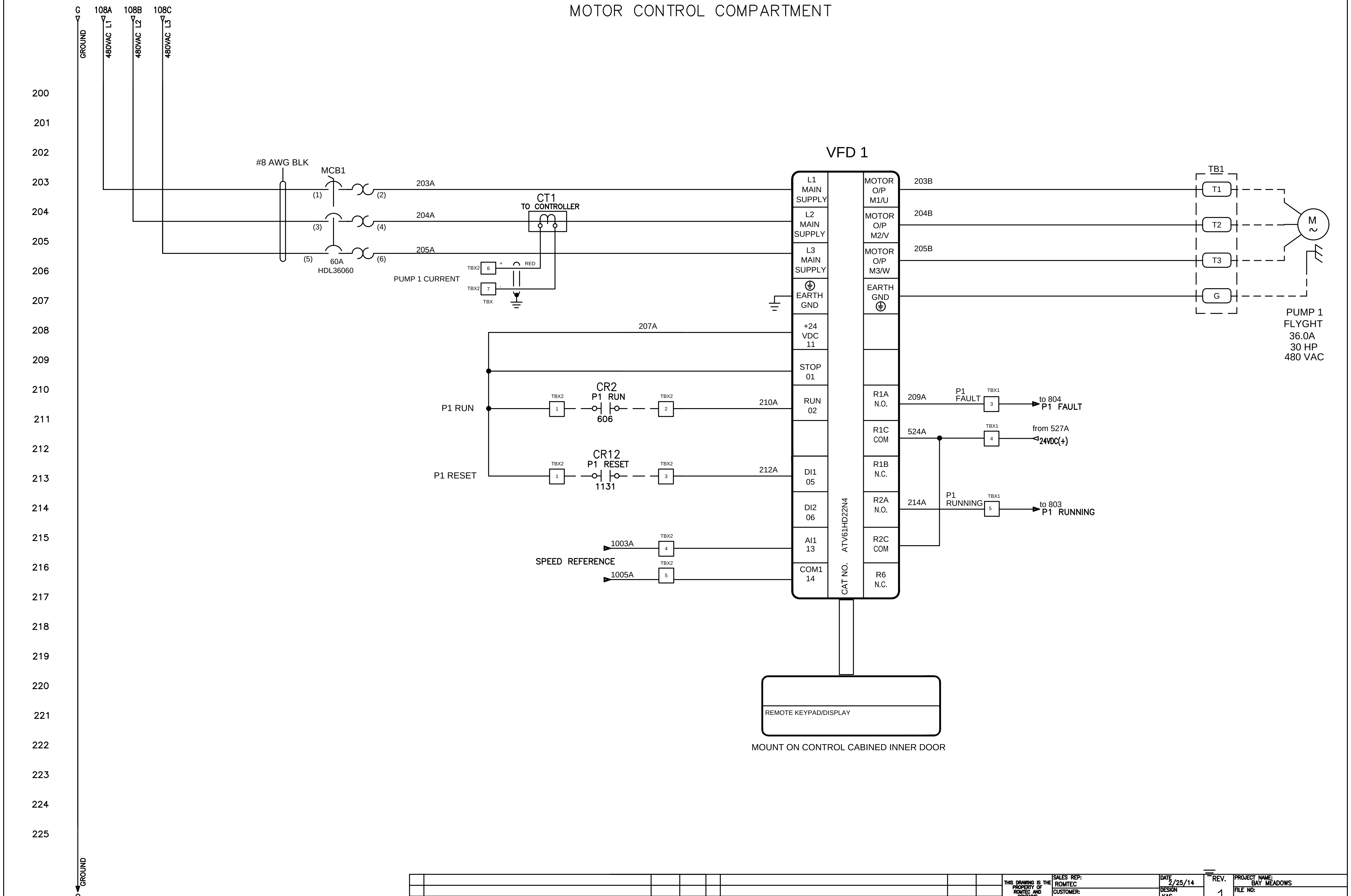
HP 30
SIZE C

PROJECT NAME: BAY MEADOWS
FILE NO:
CONFIG NO:
ADDER NO:
PROJECT NUMBER
DRAWING NUMBER 5038

DRAWING NUMBER P5038

DRAWING NUMBER 5038

MOTOR CONTROL COMPARTMENT



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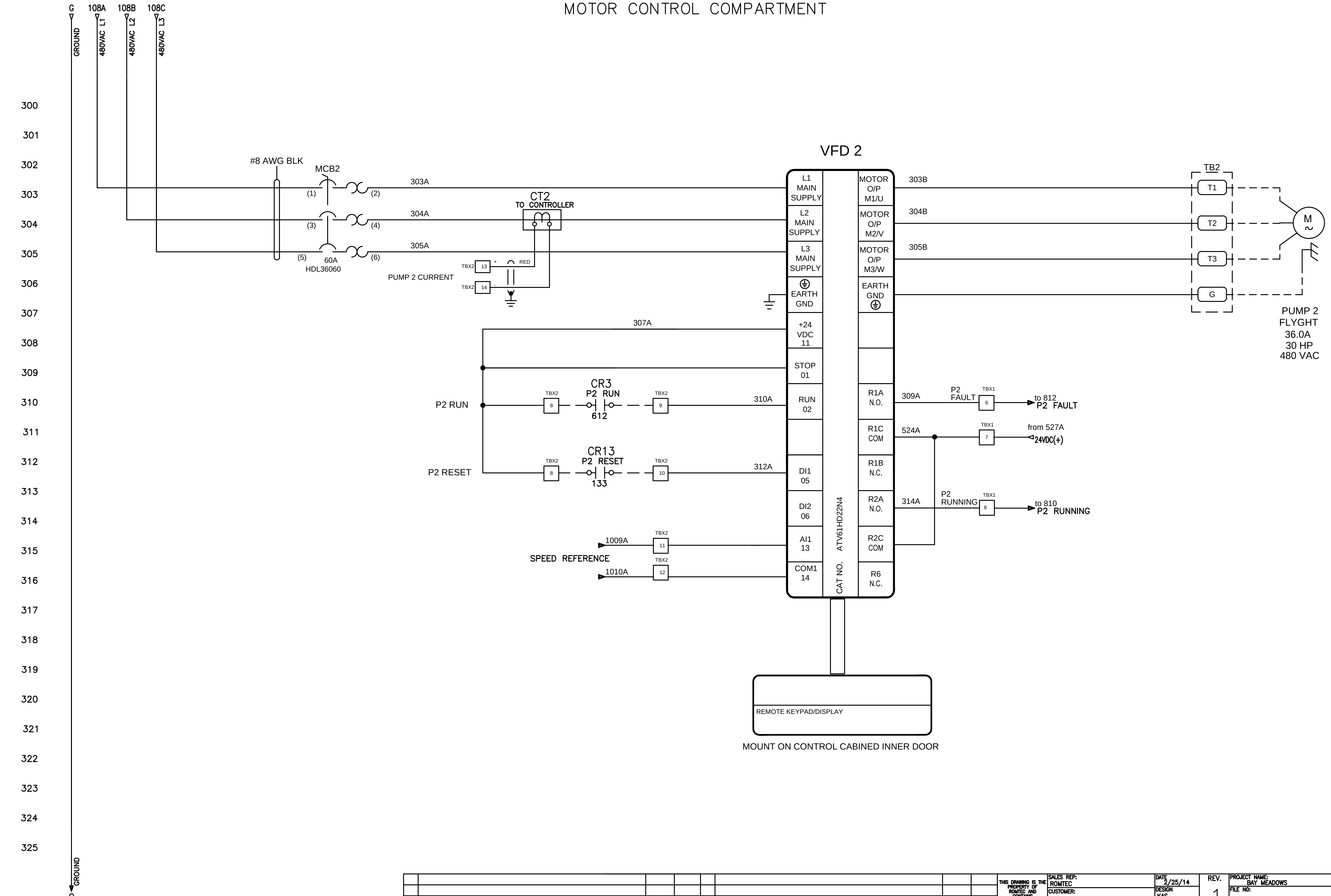
	APPR'D	SIZE C	PROJECT NUMBER
ROMTEC UTILITIES, INC. ROSEBURG, OREGON	SHEET 2 OF 12		DRAWING NUMBER 5038

MOTOR CONTROL COMPARTMENT



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DESIGN KAS
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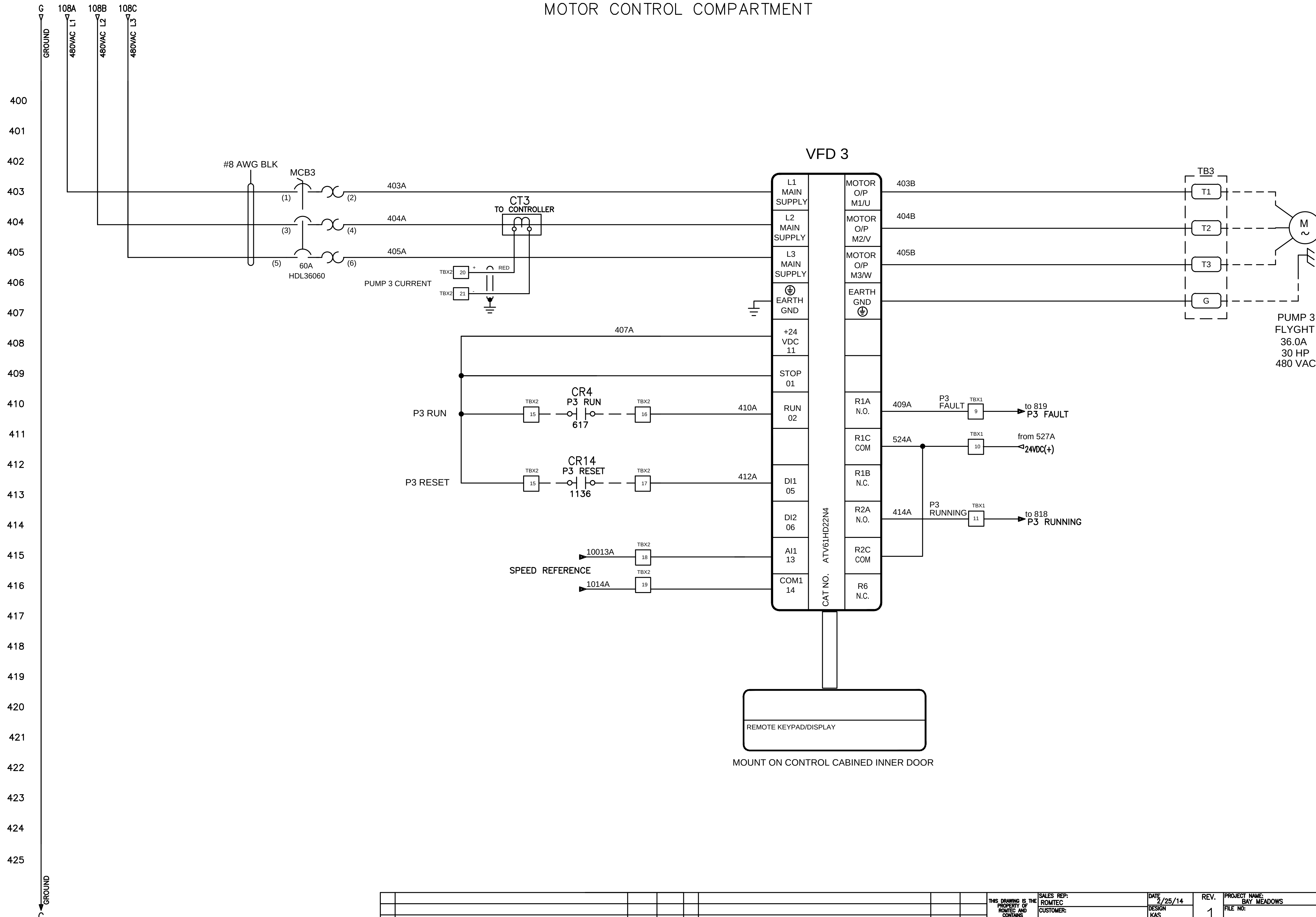
APPR'D
SHEET 3 OF 12

REV. 1
HP 30
SIZE C

PROJECT NAME: BAY MEADOWS
FILE NO:
CONFIG NO:
ADDER NO:
PROJECT NUMBER
DRAWING NUMBER P5038

MOTOR CONTROL COMPARTMENT



DRAWING NUMBER P5038

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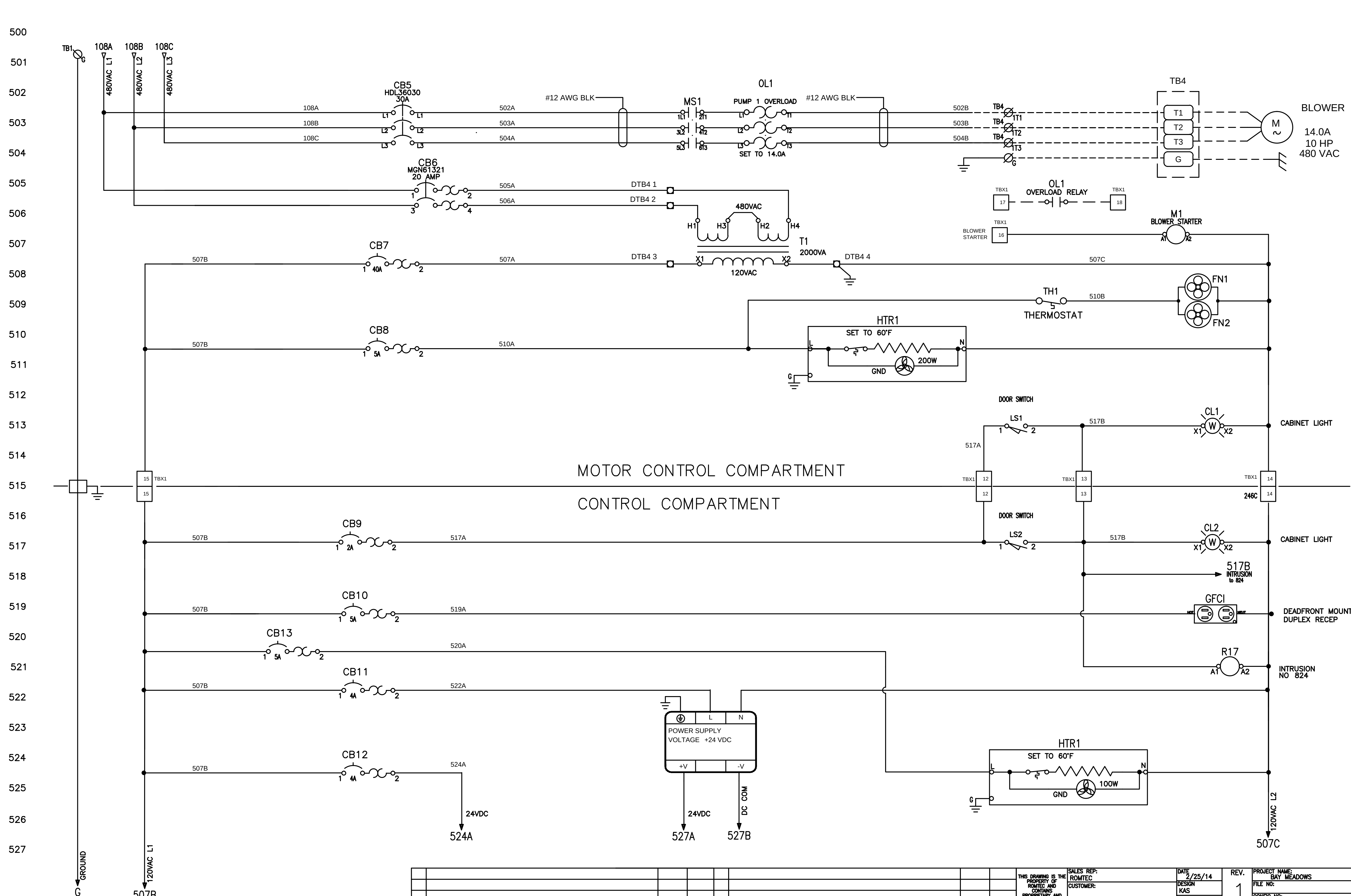
SALES REP: ROMTEC	DATE 2/25/14	REV. 1	PROJECT NAME: BAY MEADOWS
CUSTOMER:	DESIGN KAS		FILE NO:
PHONE: 541-496-9678 FAX: 541-496-0804	DRAWN KAS		CONFIG NO:
ROMTEC UTILITIES, INC.	CHK'D	HP 30	ADDER NO:
	APPR'D	SIZE C	PROJECT NUMBER
ROMTEC UTILITIES, INC. ROSEBURG, OREGON	SHEET 4 OF 12		DRAWING NUMBER P5038

MOTOR CONTROL COMPARTMENT



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SALES REP: ROMTEC
CUSTOMER:
PHONE: 541-496-9678
FAX: 541-496-0804

ROMTEC UTILITIES, INC.

ROMTEC UTILITIES, INC. ROSEBURG, OREGON

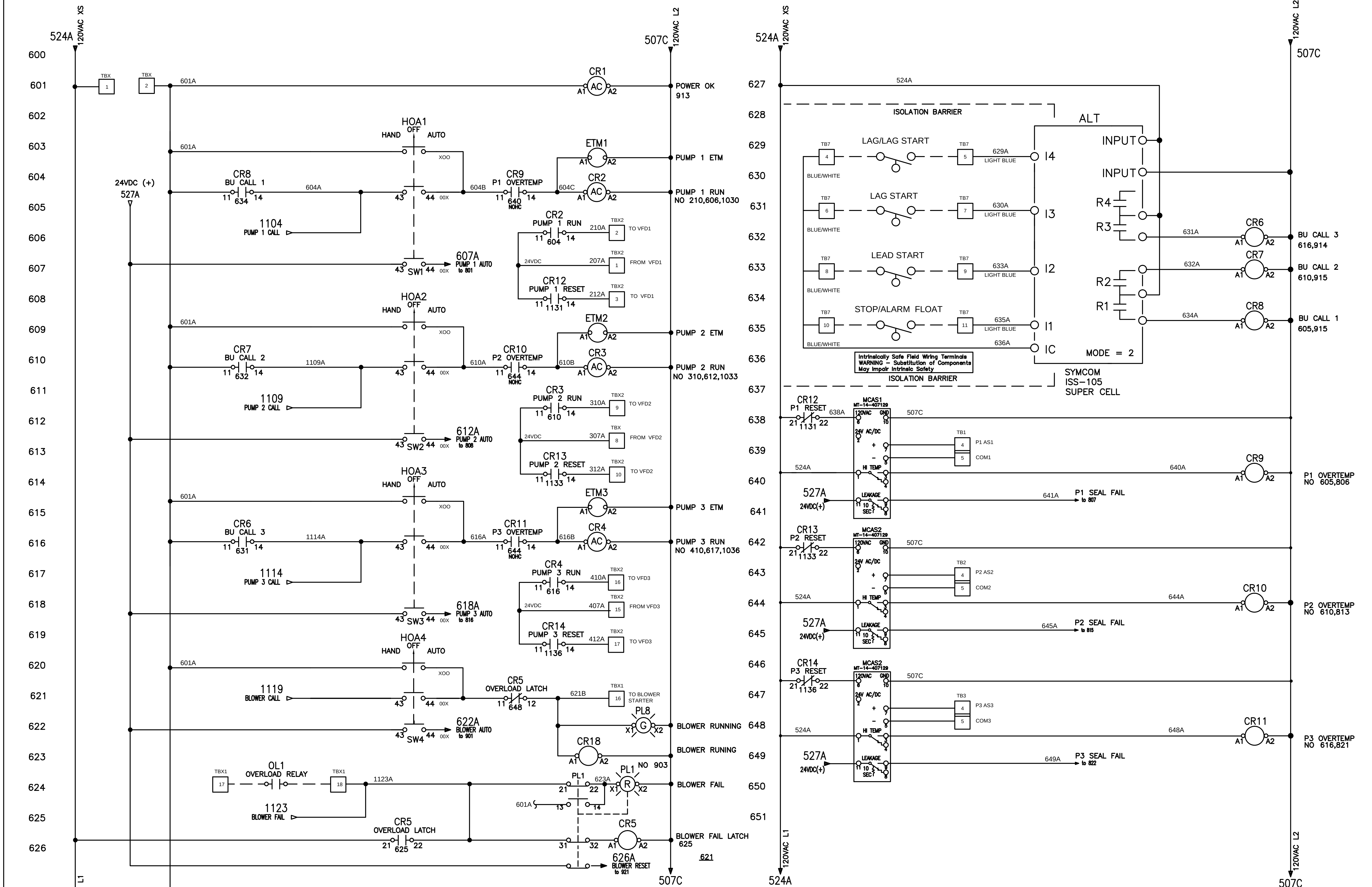
DATE 2/25/14
DESIGN KAS
DRAWN KAS
CHK'D
APPR'D
SHEET 5 OF 12

REV. 1
HP
SIZE C

PROJECT NAME: BAY MEADOWS
FILE NO:
CONFIG NO:
ADDER NO:
PROJECT NUMBER
DRAWING NUMBER P5038

CONTROL COMPARTMENT

DRAWING NUMBER P5038



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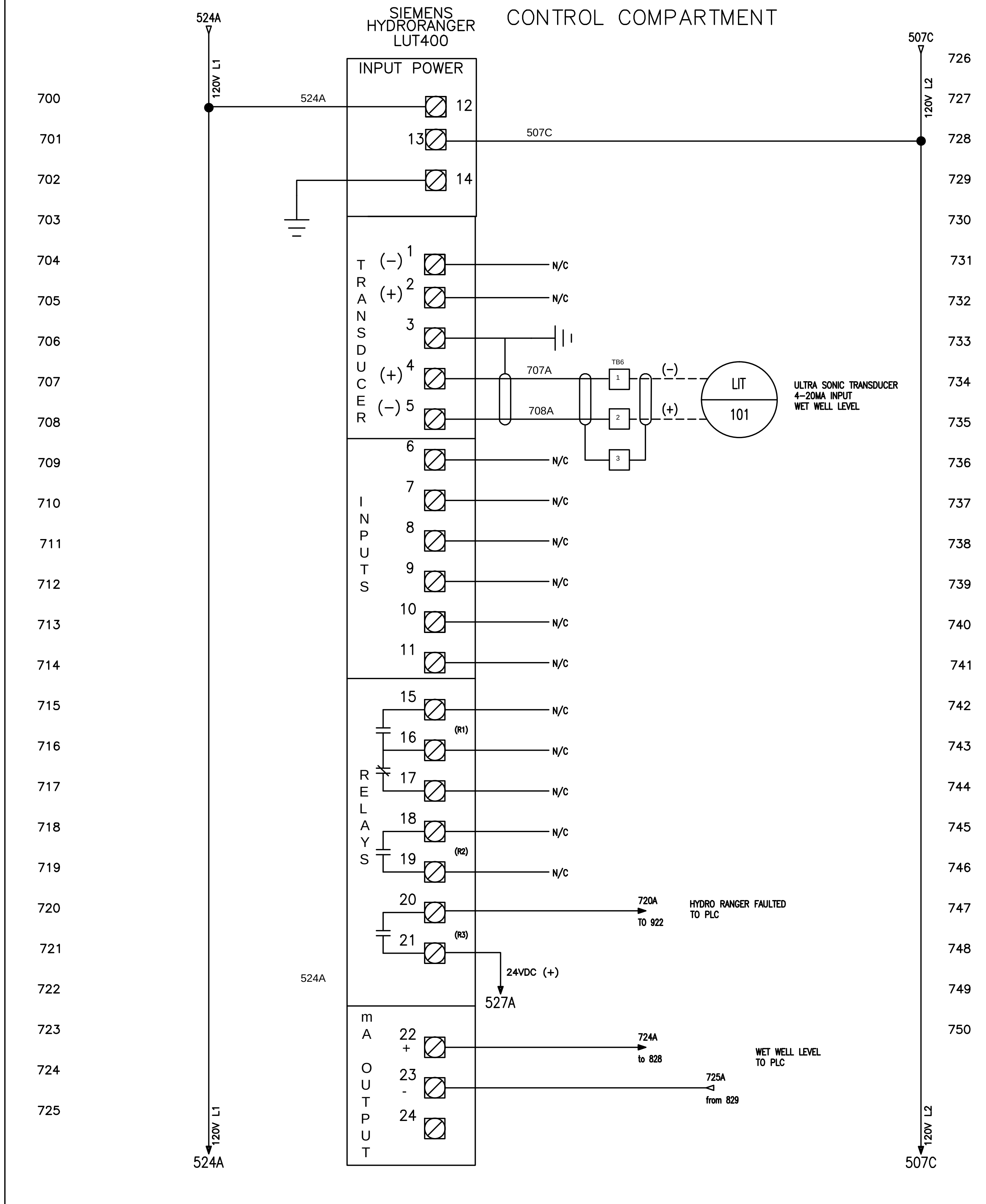
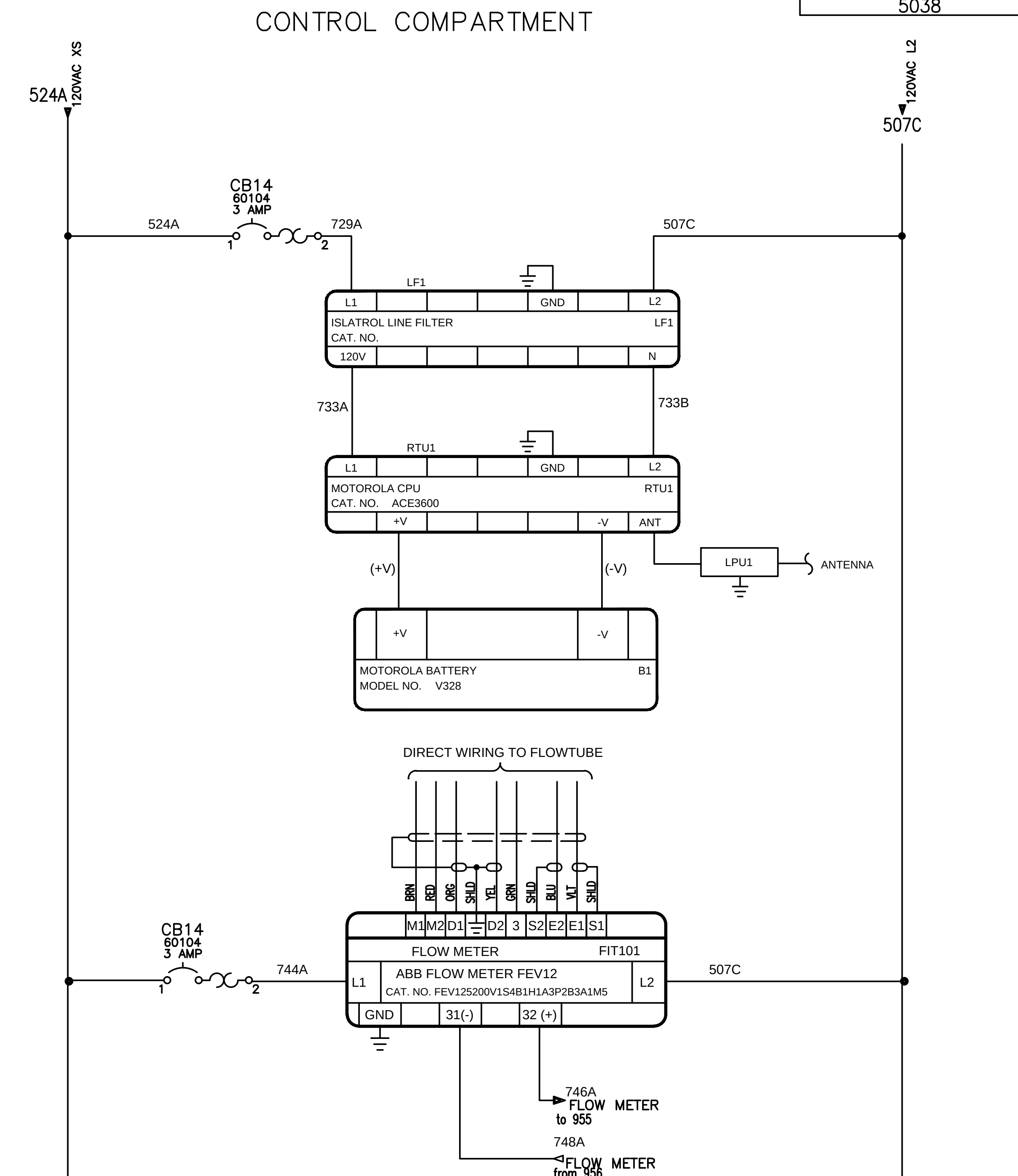




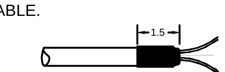
HYDRORANGER NOTES:

1. ROUTE SIGNAL CABLE IN GROUNDED METAL CONDUIT, SEPARATE FROM OTHER CABLES.

2. CONNECT ALL CABLE SHIELDS TO THE HYDRORANGER 400 SHIELD CONNECTIONS. AVOID DIFFERENTIAL GROUND POTENTIALS BY NOT CONNECTING CABLES SHIELDS TO GROUND (EARTH) ANYWHERE ELSE.

3. KEEP EXPOSED CONDUCTORS ON SHIELDED CABLES AS SHORT AS POSSIBLE TO REDUCE NOISE ON THE LINE CAUSED BY STRAY TRANSMISSIONS AND NOISE PICKUP.

4. COVER END OF CABLE WITH 1.5 IN. SHRINK WRAP. COVERING COVERING PART OF THE EXPOSED CONDUCTORS AND PART OF THE INSULATED CABLE.



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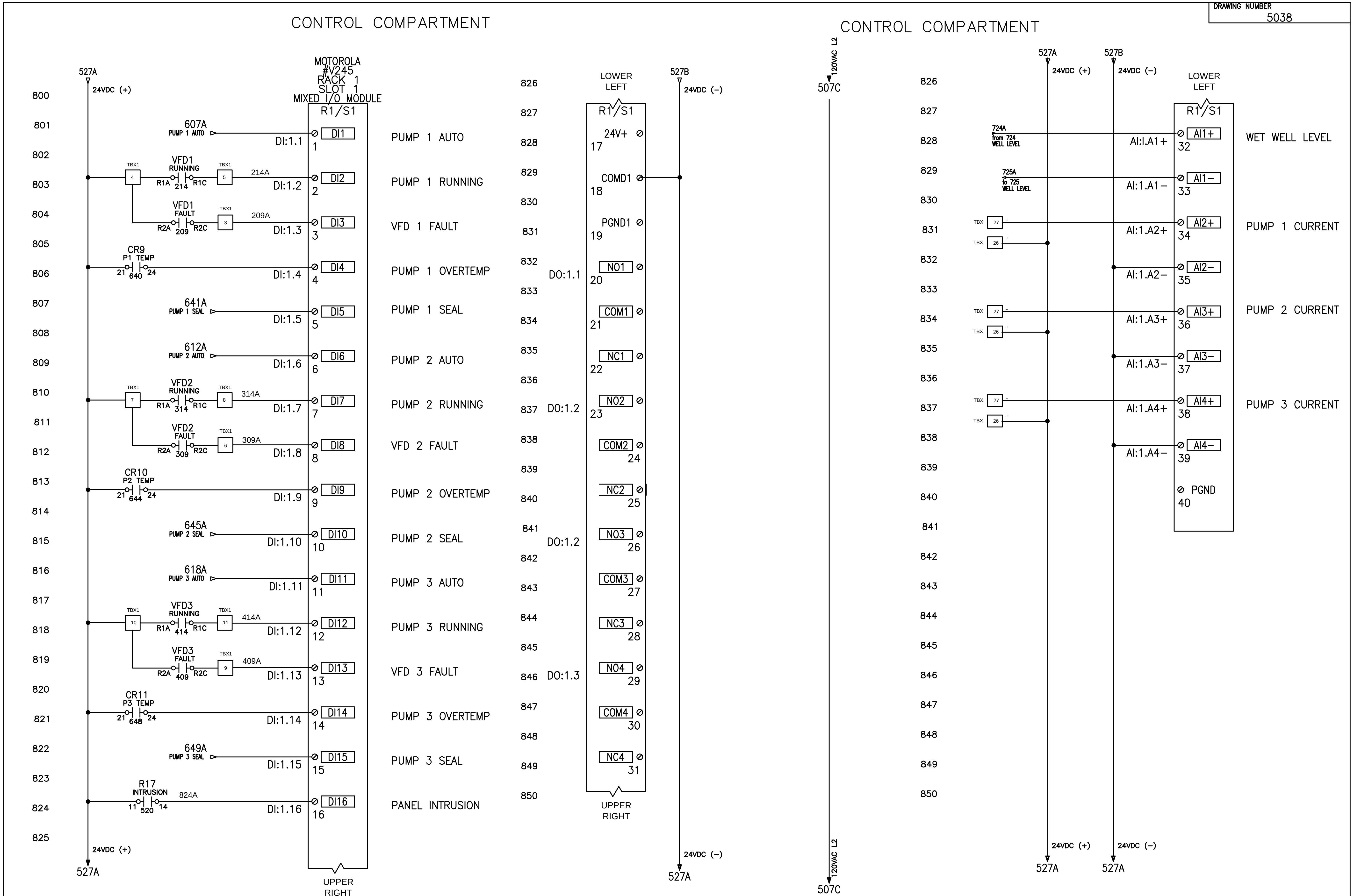

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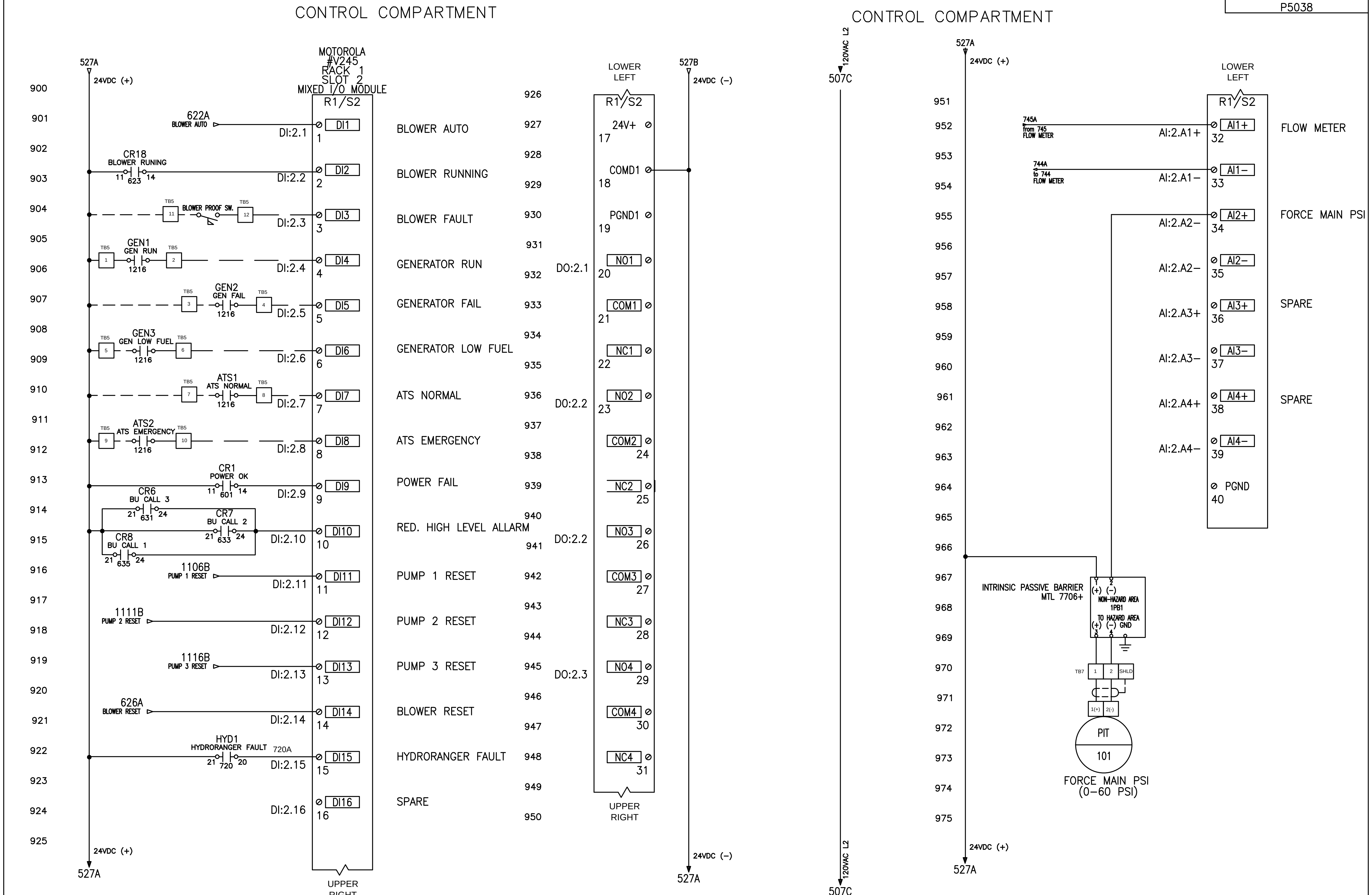

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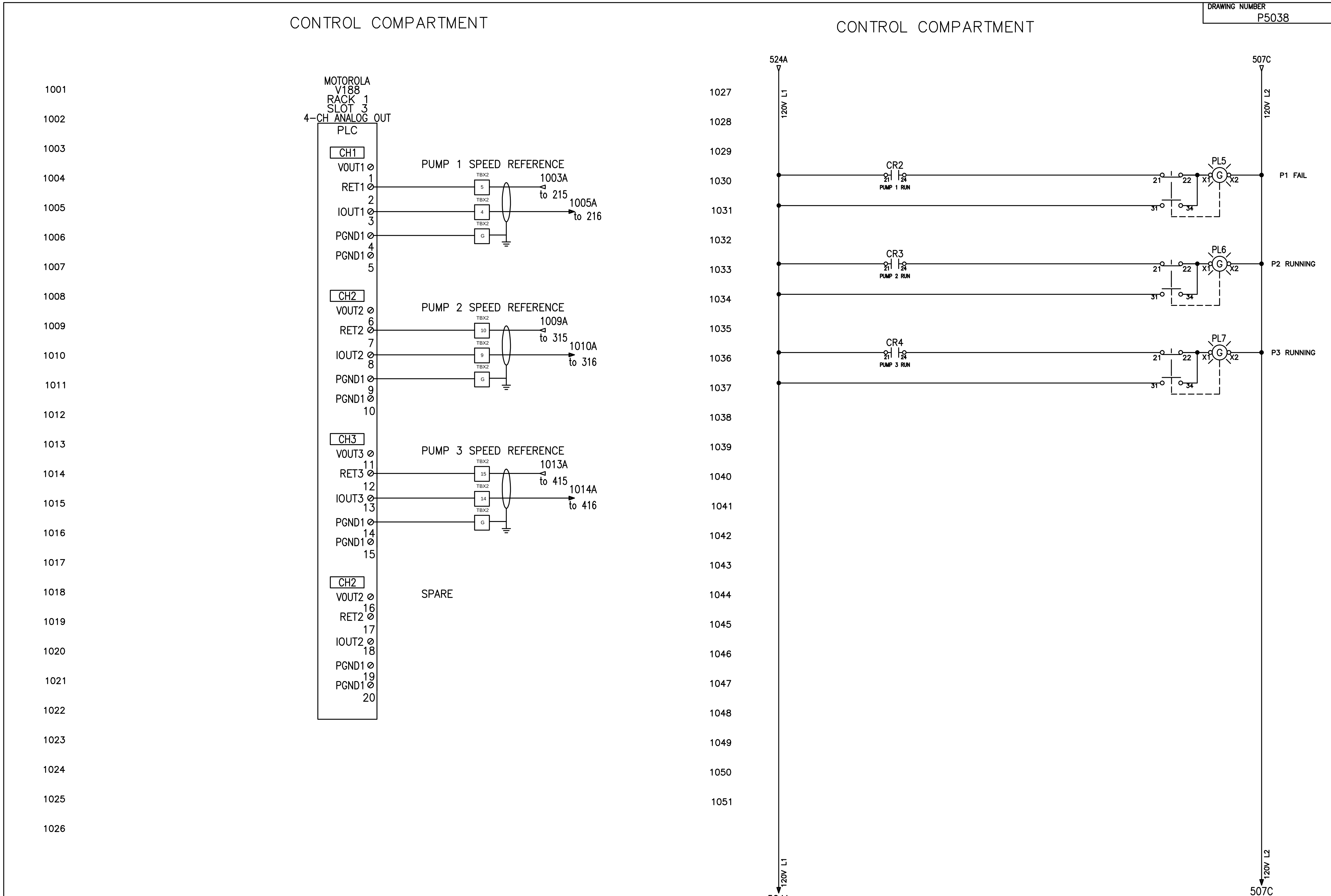

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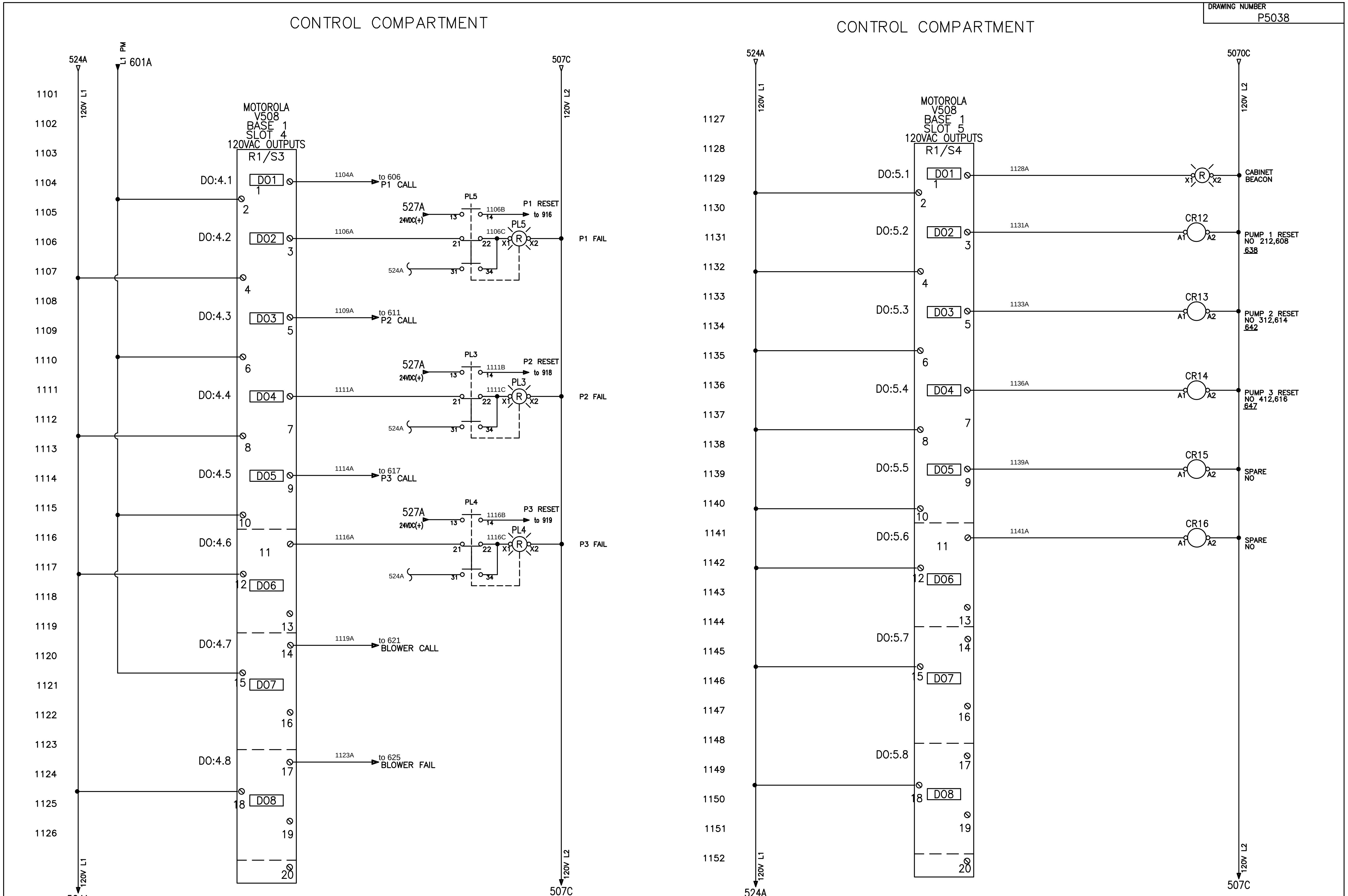

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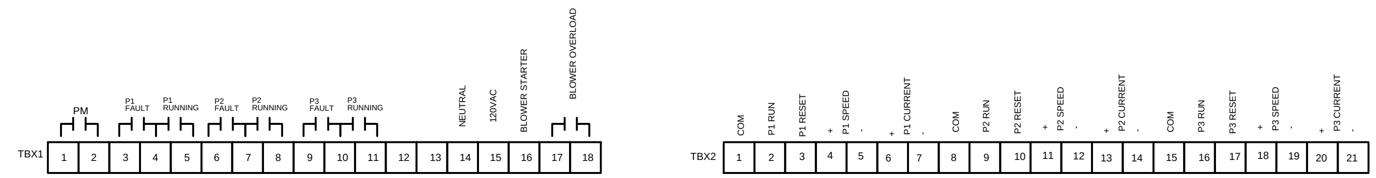
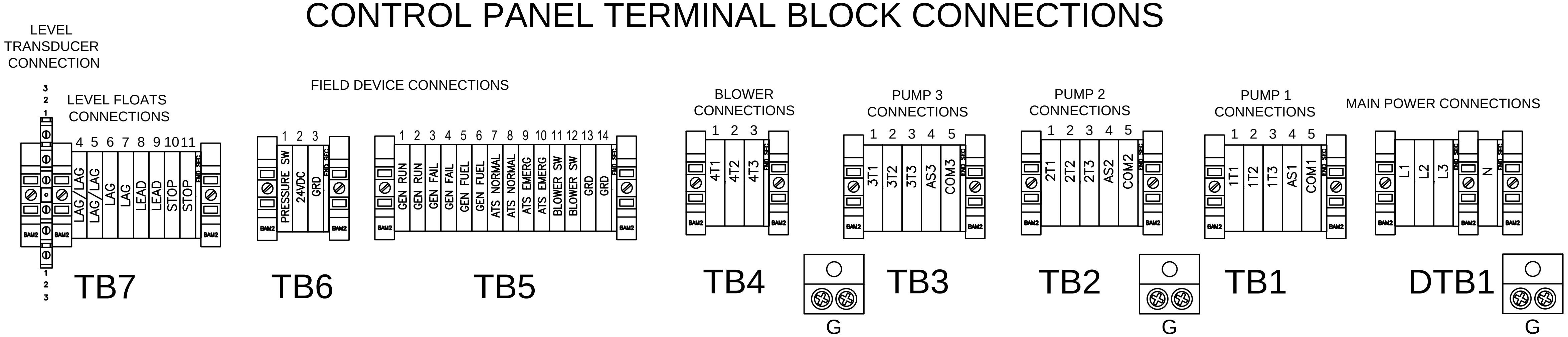


CONNECTIONS BETWEEN MCP AND CONTROL COMPARTIMENT

CONTROL PANEL TERMINAL BLOCK CONNECTIONS



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DESIGN KAS
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CHK'D
APPR'D
SHEET 12 OF 12
REV. 1
HP 7.5
SIZE C
PROJECT NAME: BAE ACETIC ACID PLANT
FILE NO:
CONFIG NO:
ADDER NO:
PROJECT NUMBER
DRAWING NUMBER P5038

4.03 CONTROL PANEL DATA SHEETS

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BILL OF MATERIAL

QUOTE # :				
140708JG5			MODEL # :	P5038
BY :			JOB NAME :	BAY MEADOWS LIFT STATION, SAN MATEO, CA.
WDB			DESCRIPTION :	460/3/60 30HP 36FLA Triplex, VFDs - Arc Armor

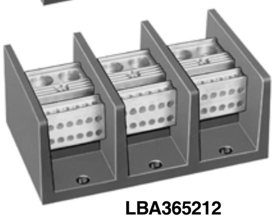
QTY.	NOTES		PART #	DESCRIPTION
			MINI DIST. BLOCK	**SQUARE D**
4			9080LBA361101	(1)#14-2 (1)#14-2 3 POLE - 115A/115A
			DIST. BLOCK	**SQUARE D**
1			9080LBA363106	(1)#6-400 (6)#14-2 3 POLE - 335A/115A
1			9080LBA365208	(2)#4-500 (8)#4-2/0 3 POLE - 760/175A
1			9080LBA363101	(1)#6-350 (1)#6-350 3 POLE - 310A/310A
			NEUTRAL BLOCKS	**SQUARE D**
3			9080LBA161101	(1)#14-2 (1)#14-2 1 POLE - 115A/115A
			NEUTRAL BLOCKS	**SQUARE D**
1			9080LBA163101	(1)#6-350 (1)#6-350 1 POLE - 310A/310A
			GROUND BLOCKS	**BURNDY**
6			K2A25U	1/0 DOUBLE LUG
1			K2A31U	250 MCM DOUBLE LUG
			CIRCUIT BREAKERS	**SQUARE D**
1			HDL36030	30A 600V 3 POLE
3			HDL36060	60A 600V 3 POLE
2			JDL36200	200A 600V 3 POLE
			CIRCUIT BREAKER INTERLC	**SQUARE D**
1			S29369	ROTARY HANDLE INTERLOCK
2			S29338	ROTARY HANDLE ADAPTER
			MINIATURE CIRCUIT BREAKERS	**SQUARED**
1			60103	MINIATURE CB 1P 120V 2A
2			60104	MINIATURE CB 1P 120V 3A
2			60105	MINIATURE CB 1P 120V 4A
2			60106	MINIATURE CB 1P 120V 5A
1			60113	MINIATURE CB 1P 120V 20A
1			MGN61313	MINIATURE CB 2P 480Y/277V 2A
1			MGN61318	MINIATURE CB 2P 480Y/277V 8A
1			MGN61321	MINIATURE CB 2P 480Y/277V 20A
1			MGN61323	MINIATURE CB 3P 480Y/277V 1A

			GENERATOR RECEPTACLE	**MELTRIC**
1			**49-48143**	**400A 600V**
			CONTACTORS	**SQUARE D NEMA**
1			**8536SCO3V02SB**	**NEMA 1 3P W/ AUTO RESET ON OVERLOADS (BIMETALLIC)**
			OVERLOADS	**SQUARE D NEMA**
6			AR23.0	THERMAL UNIT - BI-METALLIC 13.4-15.2A
			VARIABLE FREQUENCY DRI	**SQUARE-D**
3			**VW3A1102**	**REMOTE MOUNT KIT**
3			**VW3A1104R10**	**INTERFACE CABLE**
3			**ATV61HD22N4**	**ATV61, 30HP, 460V, 3PH 48A 16.54x9.45x9.29**
			TRANSFORMERS (CONTROL)	**SQUARE D**
1			9070T2000D1	2000VA 240-480VAC/120VAC
			SELECTORS	**SQUARE D 30MM**
4			9001SKS43BH2	3 POS CAM "C" - 2 NO 2 NC
			PUSH BUTTON	**SQUARE D 30 MM**
4			9001SKR1BH5	1NO CONTACT (KA2) BLACK
1			9001SKR1BH6	1NC CONTACT (KA3) BLACK
			CONTACT BLOCKS	**SQUARE D**
4			9001KA1	CONTACT BLOCK 1 NO 1NC 30MM
			PILOT LIGHT	**SQUARE D 30MM**
4			9001SKT1R31	115V PUSH TO TEST RED
4			9001SKT1G31	115V PUSH TO TEST GREEN
4			9001SKT1A31	115V PUSH TO TEST AMBER
			RELAY SOCKETS 300V	**IDEC**
2			SR2P-06	8 PIN TUBE-TYPE SOCKET 300V
			RELAY SOCKET 600V	**IDEC**
1			OT08	600V 8-PIN TUBE-TYPE SOCKET
			RELAYS	**SQUARE-D**
22			RXM4AB1F7	ZELIO RELAY 120VAC 4PDT
22			RXZ400	HOLD DOWN CLIPS
22			RXZE2M114M	RELAY SOCKET 4PDT
7			RXM041FU7	RELAY R/C PROTECTION MODULE 110-240VAC
			INTRINSICALLY SAFE CONTROLLER	**SYMCOM**
1			ISS-105-SUPER CELL	4 CHANNEL CONSTROLLER 120VAC W/ SOCKET
			INTRINSICALLY SAFE BARRIER	**ALLEN BRADLEY**
1			897H-S214	SINGLE CHANNEL 4-20 ma
			PHASE MONITOR	**MACROMATIC**
1			PMPU	208-480V ADJUSTABLE PHASE MONITOR
			LIGHTNING ARRESTOR	**SQUARE-D**
1			SDSA3650	3 PH
			SURGE CAPACITORS	**Delta Lightning Arrestors**
1			CA 603R	600V 3 Phase

			TIMERS	**IDEC**
2			GT3A-3AF20	120V 0-10 SEC/MIN/HR
			ELAPSED TIME METERS	**CONTROL DYNAMICS**
3			HMA470	120VAC 60HZ
			GROUND FAULT INTERRUPTER	**HUBBELL**
1			GF15WLA	15 AMP GFCI
			HEATER	**HOFFMAN**
1			DAH2001A	HEATER 200W 120VAC
			THERMOSTAT	**PFANNENBERG**
1			FLZ 530	ADJ THERMOSTAT FOR COOLER
			LEVEL TRANSMITTER	**SIEMENS**
1			**7ML5050-0AA11-1DA0**	**SITRANS LUT400 LEVEL TRANSMITTER**
1			**7ML1118-0CA30**	**ECHOMAX XPS-15 TRANSDUCER**
			RTU/PLC	**MOTOROLA (BY CUSTOMER)**
	1		**F7574A**	**ACE3600 CPU W/ RADIO**
	1		**V056**	**CHASSIS**
	1		**V261**	**DC POWER SUPPLY**
	1		**V328**	**10AH BACKUP BATTERY**
	2		**V245**	**16 DI, 4 DO, 4 AI COMBO MODULE**
	2		**V508**	**8 POINT DIGITAL OUTPUT MODULE**
	1		**V188**	**4 POINT ANALOG OUTPUT MODULE**
	1		**V20**	**BLANK I/O MODULE (SLOT FILLER)**
	4		**V253**	**20 CONDUCTOR I/O MODULE CABLE**
	2		**V202**	**30 CONDUCTOR I/O MODULE CABLE**
			FLOW TRANSMITTER	**ABB (BY OTHERS)**
	1		**SEE CUT SHEET IN QUOTE F**	**FLOW TRANSMITTER AC POWERED**
			CURRENT TRANSMITTER	**INGRAM PRODUCTS**
3			FCS521-SP-420E	CURRENT,SENS,LOOP,4-20mA TRANSMITTER INGRAM
			POWER SUPPLY	**IDEC**
1			PS5R-SF24	24VDC @ 5A
			OUTSIDE ALARM LIGHT	**INGRAM**
1			SBN120AC-R	SUNLIGHT VISIBLE LED ALARM LIGHT - 120V RED
			TERMINAL BLOCKS	**SQUARE D**
	134		9080GR6	TERMINAL WHITE
	24		9080GM6B	END BARRIERS
	50		BAM-2	END CLAMP ENTRELEC
			TERMINAL BLOCKS	**SQUARE D (TELEMECHANIQUE IEC)**
	120		AB1ET3235U	TERMINAL GRAY (6mm IEC) (THREE LEVEL)
	2		AB1PS4	END BARRIER FOR AB1ET3235U
			ENCLOSURE LIGHTS	
2			TXFLEDDUCL18WH30	18" LED UNDER-CABINET LIGHT
			MINICAS PUMP MONITOR RELAY	**FLYGT**
3			14-407129	FLYGT MINICAS II PUMP MONITOR RELAY

			MINICAS / PMR SOCKET	**MPE**
3			P3GA-11	MPE / MINICAS RELAY SOCKET
			FINGERSAFE COVER	**OMRON**
3			Y92A-48G	P3GA-11 SOCKET COVER / MINICAS & PMR1
			ENCLOSURES	**ARC ARMOR**
1			**1030423**	**SIZE 2 (947SY) ENCLOSURE 66X60X26**
1			**1030996**	**INNER DOOR FOR LARGE ARC ARMOR**
1			**1030997**	**BACK PANEL FOR LARGE ARC ARMOR CNTL**
1			**6000993**	**BACK PANEL FOR LARGE ARC ARMOR MCC**
1			**1030998**	**BACK PANEL FOR LARGE ARC ARMOR SRVC**
			DOOR INTERLOCK ARC ARM	**HOFFMAN**
1			**AEK460**	**ENCL, INTERLOCK ELEC, 460V HOFFMAN**
			VOLTAGE IND - ARC ARMOR	**DIVERSIFIED**
1			**UPA-100**	**POWER ALERT WARNING INDICATOR**
1			**UPA-WP100**	**WARNING INDICATOR LABEL**
			CORD GRIP	
6			**69915K55**	**CORD GRIP, MC MASTER CARR**
			ARC ARMOR ACCESSORIES	**HOFFMAN/BEST CONTROLS/CSI**
1			**1030163**	**LBL, ARC ARMOR**
1			**1030154**	**LBL, ARC FLASH**
2			**1033548**	**LBL, RH, INTERLOCK WRNG, ECOSMART**
2			**6002019**	**ENCL, KIT, DOOR STOP LRG ENCL HOFF**
2			**1030149**	**FAN, SHROUD KIT, SS WHT 4 INCH HOFF**
2			**1021631**	**FAN, AXIAL, 120V 120MM 117CFM**
4			**1021632**	**FAN, FINGER GUARD, 120MM**
4			**1021633**	**FAN, GUARD/FILTER, 120MM**
1			**1021635**	**FAN, FILTER, REPLACEMENT (5/PKG)**
1			**1031082**	**CLOSE NIPPLE NIP-GRC200X300**
2			**1031083**	**CONDUIT BUSHING 2" PLASTIC PD 600-ID**
			INTRUSION SWITCH	**HOFFMAN**
2			ALFSWD	DOOR ACTIVATED SWITCH
			LABELS	**EMEDCO**
3			**QS3743**	**ARC FLASH AND SHOCK HAZARD LABEL**
1			**QS3647**	**DANGER 460 VOLTS LABEL**
1			**QS3569**	**DANGER BACK UP POWER SUPPLY LABEL**
			MISC PARTS	**CUSTOMER SUPPLIED**
1			CUSTOMER SUPPLIED PARTS	MOTROROLA RTU/PLC AND FLOWMETER
			SCHEMATICS	**PRIMEX CONTROLS**
1			LITERATURE, SCHEMS, CLW	MATCHES PANEL NUMBER

LBC165212



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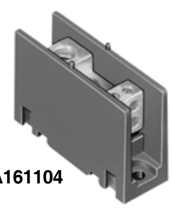
LBA361104



LBA161104

22 TERMINAL BLOCKS

Standard Power Distribution Blocks

Lug WireRange▲		Aluminum■						Dim. Type
Main	Branch	One Pole		Two Pole		Three Pole		
		Type ★	Price	Type ★	Price	Type ★	Price	
(1) #14–2/0	(1) #14–2/0	LBA162101	**$ 6.90**	LBA262101	**$ 14.70**	LBA362101	**$ 17.10**	2
(1) #6–350 kcmil	(1) #6–350 kcmil	LBA163101	**35.60**	LBA263101	**54.00**	LBA363101	**71.00**	3
(1) #4–600 kcmil	(1) #4–600 kcmil	LBA164101	**63.00**	N/A	. . .	LBA364101	**122.00**	4
(2) #4–350 kcmil	(2) #4–350 kcmil	LBA165202	**65.00**	LBA265202	**98.00**	LBA365202	**126.00**	5
(2) #4–500 kcmil	(2) #4–500 kcmil	LBA1652021	**60.00**	LBA2652021	**137.00**	LBA3652021	**162.00**	5
(1) #14–2/0	(4) #14–4	LBA162104	**20.30**	LBA262104	**30.50**	LBA362104	**45.60**	2
(1) #14–2/0	(6) #14–4	N/A	. . .	N/A	. . .	LBA362106	**87.00**	...▼
(1) #6–400 kcmil	(4) #14–2	LBA163104	**37.20**	LBA263104	**56.00**	LBA363104	**75.00**	3
(1) #6–400 kcmil	(6) #14–2	LBA163106	**39.30**	LBA263106	**59.00**	LBA363106	**81.00**	3
(1) #6–400 kcmil	(8) #14–2	LBA164108	**51.00**	LBA264108	**77.00**	LBA364108	**107.00**	4
(1) #4–500 kcmil	(6) #14–2/0	LBA165106	**84.00**	LBA265106	**126.00**	LBA365106	**155.00**	5
(1) #4–500 kcmil	(12) #14–2	LBA165112	**89.00**	LBA265112	**134.00**	LBA365112	**174.00**	5
(2) #14–2/0	(6) #14–4	LBA163206	**39.80**	LBA263206	**60.00**	LBA363206	**81.00**	3
(2) #4–500 kcmil	(8) #14–2/0	LBA165208	**84.00**	LBA265208	**126.00**	LBA365208	**167.00**	5
(2) #4–500 kcmil	(12) #14–4	LBA165212	**90.00**	LBA265212	**137.00**	LBA365212	**174.00**	5

Miniature Power Distribution Blocks

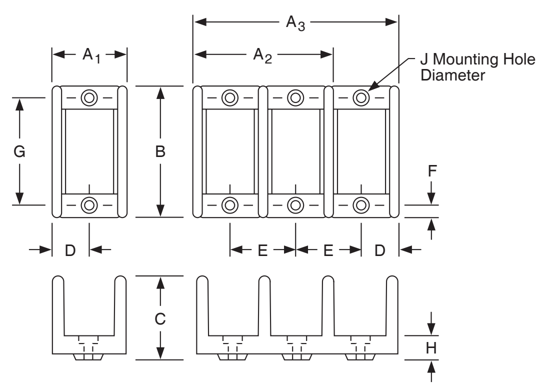
Lug Wire Range▲		Aluminum■						Dim. Type
Main	Branch	One Pole		Two Pole		Three Pole		
		Type ★	Price	Type ★	Price	Type ★	Price	
(1) #14–2	(1) #14–2	LBA161101	**$ 8.90**	N/A	. . .	LBA361101	**$ 16.60**	1
(1) #14–2	(4) #18–10	LBA161104	**17.60**	LBA261104	**$20.40**	LBA361104	**38.70**	1

Copper Power Distribution Blocks

Lug Wire Range▲		Copper						Dim. Type
Main	Branch	One Pole		Two Pole		Three Pole		
		Type ★	Price	Type ★	Price	Type ★	Price	
(1) #18–1/0	(1) #18–1/0	LBC162101	**$ 66.00**	N/A	. . .	LBC362101	**$134.00**	2
(1) #6–250 kcmil	(1) #6–250 kcmil	LBC163101	**83.00**	N/A	. . .	LBC363101	**155.00**	3
(1) #14–2/0	(4) #14–4	LBC162104	**66.00**	LBC262104	**$ 98.00**	LBC362104	**165.00**	2
(1) #4–500 kcmil	(6) #14–2	LBC163106	**102.00**	LBC263106	**156.00**	LBC363106	**236.00**	3
(2) #14–2/0	(6) #14–4	LBC163206	**89.00**	LBC263206	**134.00**	LBC363206	**179.00**	3
(2) #4–500 kcmil	(8) #14–2/0	LBC165208	**181.00**	N/A	. . .	LBC365208	**395.00**	5
(2) #4–500 kcmil	(12) #14–2	LBC165212	**189.00**	N/A	. . .	LBC365212	**378.00**	5

▲ Lugs suitable for use with 75°C conductors. (#) indicates number of conductors.
■ Aluminum blocks will accept either Al or Cu conductors.
♦ Cu blocks will accept copper conductors only.
★ CE Marked.
▼ Refer to catalog for dimensions.

Dimensions



Dimensions (Inches)

Type	A1	A2	A3	B	C	D	E	F	G	H	J
1	.76	1.40	2.03	2.29	1.62	.38	.64	.19	1.93	.32	.201
2	1.13	1.94	2.75	2.88	1.78	.56	.81	.31	2.25	.24	.205
3	1.94	3.47	5.00	4.00	2.61	.97	1.53	.31	3.38	.40	.203
4	2.28	4.16	6.04	4.75	2.92	1.14	1.88	.31	4.13	.51	.20
5	3.17	5.88	8.54	5.50	3.12	1.58	2.69	.38	4.75	.50	.265

Clear Plastic Covers (0.045 in. thick)

Note: There are no covers for miniature blocks.

For LBA Type	Type	Price △	Dim. A	Dim. B
LBA162..., LBC162	LB21	**$ 7.50**	1.062	2.750
LBA262..., LBC262	LB22	**9.00**	1.875	2.750
LBA362..., LBC362 □	LB23	**10.50**	2.688	2.750
LBA163..., LBC163	LB31	**8.30**	1.782	3.813
LBA263..., LBC263	LB32	**9.80**	3.313	3.813
LBA363..., LBC363	LB33	**11.30**	4.844	3.813
LBA164...	LB41	**9.00**	2.125	4.563
LBA264...	LB42	**10.50**	4.000	4.563
LBA364...	LB43	**12.00**	5.875	4.563
LBA165..., LBC165	LB51	**9.80**	2.719	5.313
LBA265..., LBC265	LB52	**11.30**	5.656	5.313
LBA365..., LBC365	LB53	**12.80**	8.375	5.313

△ Above covers must be ordered in multiples of 5 covers.
Above covers are supplied with two self tapping screws per cover.
□ Will not work on a 9080LBA362106 block.

Application Data

UL component recognized (File E60616 CCN XCFR2).
CSA certified (File LR70361).
Voltage Rating—Class B & C—600 V
Blocks are rated based on NEC Table 310-16 using 75°C wire.
Aluminum blocks are tin plated high conductive aluminum.
Copper blocks are tin plated high conductive copper.
Housing material:
- Miniature Blocks are made from high impact thermoplastic rated at 125°C. max. & -40°C. min.
- Full Size Blocks are made from general purpose phenolic rated at 150°C. max. & -40°C. min.

All blocks have a flammability rating of UL 94V-0.

For additional information, reference Catalog # 9080CT9603.

New!

HD and HG 2P

H-frame

J-frame

Table 7.37: H-frame 150 A and J-frame 250 A Thermal-magnetic Circuit Breakers (600 Vac, 250 Vdc) With Factory Sealed Trip Unit Suitable for Reverse Connection▲

Current Rating @ 40°C	Fixed AC Magnetic Trip		Cat. No.■♦	Interrupting Rating (2nd Letter of Catalog Number)								Terminal Wire Range
				D		G		J		L		
				$ Price								
	Hold	Trip		80% Rated	100% Rated	80% Rated	100% Rated	80% Rated	100% Rated	80% Rated	100% Rated	
H-frame, 150A 2P, 600 Vac 50/60 Hz, 250 Vdc												
15 A	350 A	750 A	H( )L26015(C)	**580.00**	**696.00**	**846.00**	**1015.00**	**1039.00**	**1247.00**	**1576.00**	**1891.00**	
20 A	350 A	750 A	H( )L26020(C)	**580.00**	**696.00**	**846.00**	**1015.00**	**1039.00**	**1247.00**	**1576.00**	**1891.00**	
25 A	350 A	750 A	H( )L26025(C)	**580.00**	**696.00**	**846.00**	**1015.00**	**1039.00**	**1247.00**	**1576.00**	**1891.00**	
30 A	350 A	750 A	H( )L26030(C)	**580.00**	**696.00**	**846.00**	**1015.00**	**1039.00**	**1247.00**	**1576.00**	**1891.00**	
35 A	400 A	850 A	H( )L26035(C)	**580.00**	**696.00**	**846.00**	**1015.00**	**1039.00**	**1247.00**	**1576.00**	**1891.00**	
40 A	400 A	850 A	H( )L26040(C)	**580.00**	**696.00**	**846.00**	**1015.00**	**1039.00**	**1247.00**	**1576.00**	**1891.00**	
45 A	400 A	850 A	H( )L26045(C)	**580.00**	**696.00**	**846.00**	**1015.00**	**1039.00**	**1247.00**	**1576.00**	**1891.00**	
50 A	400 A	850 A	H( )L26050(C)	**580.00**	**696.00**	**846.00**	**1015.00**	**1039.00**	**1247.00**	**1576.00**	**1891.00**	AL150HD 14–3/0 AWG Al or Cu
60 A	800 A	1450 A	H( )L26060(C)	**580.00**	**696.00**	**846.00**	**1015.00**	**1039.00**	**1247.00**	**1576.00**	**1891.00**	
70 A	800 A	1450 A	H( )L26070(C)	**708.00**	**849.00**	**998.00**	**1198.00**	**1147.00**	**1377.00**	**1742.00**	**2091.00**	
80 A	800 A	1450 A	H( )L26080(C)	**708.00**	**849.00**	**998.00**	**1198.00**	**1147.00**	**1377.00**	**1742.00**	**2091.00**	
90 A	800 A	1450 A	H( )L26090(C)	**708.00**	**849.00**	**998.00**	**1198.00**	**1147.00**	**1377.00**	**1742.00**	**2091.00**	
100 A	900 A	1700 A	H( )L26100(C)	**708.00**	**849.00**	**998.00**	**1198.00**	**1147.00**	**1377.00**	**1742.00**	**2091.00**	
110 A	900 A	1700 A	H( )L26110(C)	**1381.00**	**1657.00**	**2039.00**	**2447.00**	**2966.00**	**3559.00**	**3689.00**	**4427.00**	
125 A	900 A	1700 A	H( )L26125(C)	**1381.00**	**1657.00**	**2039.00**	**2447.00**	**2966.00**	**3559.00**	**3689.00**	**4427.00**	
150 A	900 A	1700 A	H( )L26150(C)	**1381.00**	**1657.00**	**2039.00**	**2447.00**	**2966.00**	**3559.00**	**3689.00**	**4427.00**	
H-frame 150A 3P, 600 Vac 50/60 Hz, 250 Vdc												
15 A	350 A	750 A	H( )L36015(C)	**725.00**	**870.00**	**995.00**	**1194.00**	**1299.00**	**1559.00**	**1899.00**	**2279.00**	
20 A	350 A	750 A	H( )L36020(C)	**725.00**	**870.00**	**995.00**	**1194.00**	**1299.00**	**1559.00**	**1899.00**	**2279.00**	
25 A	350 A	750 A	H( )L36025(C)	**725.00**	**870.00**	**995.00**	**1194.00**	**1299.00**	**1559.00**	**1899.00**	**2279.00**	
30 A	350 A	750 A	H( )L36030(C)	**725.00**	**870.00**	**995.00**	**1194.00**	**1299.00**	**1559.00**	**1899.00**	**2279.00**	
35 A	400 A	850 A	H( )L36035(C)	**725.00**	**870.00**	**995.00**	**1194.00**	**1299.00**	**1559.00**	**1899.00**	**2279.00**	
40 A	400 A	850 A	H( )L36040(C)	**725.00**	**870.00**	**995.00**	**1194.00**	**1299.00**	**1559.00**	**1899.00**	**2279.00**	
45 A	400 A	850 A	H( )L36045(C)	**725.00**	**870.00**	**995.00**	**1194.00**	**1299.00**	**1559.00**	**1899.00**	**2279.00**	
50 A	400 A	850 A	H( )L36050(C)	**725.00**	**870.00**	**995.00**	**1194.00**	**1299.00**	**1559.00**	**1899.00**	**2279.00**	AL150HD 14–3/0 AWG Al or Cu
60 A	800 A	1450 A	H( )L36060(C)	**725.00**	**870.00**	**995.00**	**1194.00**	**1299.00**	**1559.00**	**1899.00**	**2279.00**	
70 A	800 A	1450 A	H( )L36070(C)	**885.00**	**1061.00**	**1134.00**	**1361.00**	**1399.00**	**1679.00**	**2099.00**	**2519.00**	
80 A	800 A	1450 A	H( )L36080(C)	**885.00**	**1061.00**	**1134.00**	**1361.00**	**1399.00**	**1679.00**	**2099.00**	**2519.00**	
90 A	800 A	1450 A	H( )L36090(C)	**885.00**	**1061.00**	**1134.00**	**1361.00**	**1399.00**	**1679.00**	**2099.00**	**2519.00**	
100 A	900 A	1700 A	H( )L36100(C)	**885.00**	**1061.00**	**1134.00**	**1361.00**	**1399.00**	**1679.00**	**2099.00**	**2519.00**	
110 A	900 A	1700 A	H( )L36110(C)	**1733.00**	**2080.00**	**2399.00**	**2879.00**	**3449.00**	**4139.00**	**4499.00**	**5399.00**	
125 A	900 A	1700 A	H( )L36125(C)	**1733.00**	**2080.00**	**2399.00**	**2879.00**	**3449.00**	**4139.00**	**4499.00**	**5399.00**	
150 A	900 A	1700 A	H( )L36150(C)	**1733.00**	**2080.00**	**2399.00**	**2879.00**	**3449.00**	**4139.00**	**4499.00**	**5399.00**	
Current Rating @ 40°C	**Adjustable AC Magnetic Trip**		**Cat. No.■♦**	**Interrupting Rating (2nd Letter of Catalog Number)**								**Terminal Wire Range**
				D		**G**		**J**		**L**		
				$ Price								
	Low	**High**		**80% Rated**	**100% Rated**	**80% Rated**	**100% Rated**	**80% Rated**	**100% Rated**	**80% Rated**	**100% Rated**	
J-frame 250A 2P, 600 Vac 50/60 Hz, 250 Vdc												
150 A	750 A	1500 A	J( )L26150(C)	**1450.00**	**1740.00**	**2141.00**	**2569.00**	**3114.00**	**3737.00**	**3874.00**	**4648.00**	AL175JD 4–4/0 AWG Al or Cu
175 A	875 A	1750 A	J( )L26175(C)	**1450.00**	**1740.00**	**2141.00**	**2569.00**	**3114.00**	**3737.00**	**3874.00**	**4648.00**	
200 A	1000 A	2000 A	J( )L26200(C)	**1450.00**	**1740.00**	**2141.00**	**2569.00**	**3114.00**	**3737.00**	**3874.00**	**4648.00**	AL250JD 3/0 AWG–350 kcmil Al or Cu
225 A	1125 A	2250 A	J( )L26225(C)	**1450.00**	**1740.00**	**2141.00**	**2569.00**	**3114.00**	**3737.00**	**3874.00**	**4648.00**	
250 A	1250 A	2500 A	J( )L26250(C)	**1992.00**	**2390.00**	**2834.00**	**3401.00**	**4150.00**	**4979.00**	**4796.00**	**5755.00**	
J-frame 250A 3P, 600 Vac 50/60 Hz, 250 Vdc												
150 A	750 A	1500 A	J( )L36150(C)	**1820.00**	**2184.00**	**2519.00**	**3023.00**	**3621.00**	**4346.00**	**4724.00**	**5669.00**	AL175JD 4–4/0 AWG Al or Cu
175 A	875 A	1750 A	J( )L36175(C)	**1820.00**	**2184.00**	**2519.00**	**3023.00**	**3621.00**	**4346.00**	**4724.00**	**5669.00**	
200 A	1000 A	2000 A	J( )L36200(C)	**1820.00**	**2184.00**	**2519.00**	**3023.00**	**3621.00**	**4346.00**	**4724.00**	**5669.00**	AL250JD 3/0 AWG–350 kcmil Al or Cu
225 A	1125 A	2250 A	J( )L36225(C)	**1820.00**	**2184.00**	**2519.00**	**3023.00**	**3621.00**	**4346.00**	**4724.00**	**5669.00**	
250 A	1250 A	2500 A	J( )L36250(C)	**2499.00**	**2999.00**	**3334.00**	**4001.00**	**4825.00**	**5790.00**	**5995.00**	**7194.00**	

▲ See page 7-23 for circuit breakers with field interchangeable trip units.
■ To complete catalog number, replace the blank with the appropriate rating (D, G, J, L).
♦ For 100% rated circuit breakers add a "C" in the 9th character place (for example, HDL26015**C** or JDL26150**C**).

Table 7.38: H- and J-frame Termination Options

Termination Letter
A - I-Line (See Section 9)
F = No Lugs (includes terminal nut kit on both ends)★
L = Lugs both ends
M = Lugs ON end Terminal Nut Kit OFF end
P = Lugs OFF end Terminal Nut Kit ON end
N = Plug-in ▼
D = Drawout ▼
S = Rear Connected ▼

For factory-installed termination, place termination letter in the third block of the circuit breaker catalog number.

H G L 3 6 1 0 0

└Termination Letter

Plug-in

Drawout

Rear Connected

★ Add TS suffix for circuit breaker without terminal nut kit.
▼ For N and D pricing, add termination pricing on page 7-41 to price. For S pricing, add termination pricing on page 7-37 to price.

Table 7.39: H- and J-frame Interrupting Ratings

Voltage	Interrupting Rating			
	D	G	J	L
240 Vac	25 kA	65 kA	100 kA	125 kA
480 Vac	18 kA	35 kA	65 kA	100 kA
600 Vac	14 kA	18 kA	25 kA	50 kA

Product Data Sheet

S29369

CB MECH INTERLOCK FOR ROTARY HANDLE

List Price	$494.00 USD
Availability	**Non-Stock Item: This item is not normally stocked in our distribution facility.**

Technical Characteristics

Shipping and Ordering

Category	01103 - Circuit Breakers, Accessories for Type Compact NS, UL/IEC
Discount Schedule	DE2
GTIN	00785901499312
Package Quantity	1
Weight	1 lbs.
Availability Code	Non-Stock Item: This item is not normally stocked in our distribution facility.
Returnability	Y
Country of Origin	FR

As standards, specifications, and designs change from time to time, please ask for confirmation of the information given in this document.

Product Data Sheet

S29338

CIRCUIT BREAKER ROTARY HANDLE

List Price	$383.00 USD
Availability	**Stock Item: This item is normally stocked in our distribution facility.**

Technical Characteristics

Circuit Breaker Type	Standard
Specifications	Door Mounted - Standard Black Handle

Shipping and Ordering

Category	01103 - Circuit Breakers, Accessories for Type Compact NS, UL/IEC
Discount Schedule	DE2
GTIN	00785901435877
Package Quantity	1
Weight	1.64 lbs.
Availability Code	Stock Item: This item is normally stocked in our distribution facility.
Returnability	Y
Country of Origin	CN

As standards, specifications, and designs change from time to time, please ask for confirmation of the information given in this document.

UL 489 Listed 240 Vac C60 Circuit Breakers (AC)

A selected range of Multi-9 circuit breakers rated 240 V are UL 489 Listed. Unlike UL 1077 Supplementary Protectors, these UL 489 circuit breakers can be used for branch circuit protection as required by the National Electrical Code.

As shown in tables Table 5 and Table 6, the UL 489 Listed products are available in C and D curves. They include devices ranging from 0.5 to 35 A.

UL 489 Listed Multi 9 C60 Circuit Breakers

08603

1P

08603

2P

08603

3P

Table 4: Specifications for UL 489 240 V Listed C60N Circuit Breakers

High Voltage Withstand	6 kV	
Connector: Box Lug	Rating	UL 486A File No. E216919 (Use with Copper Wire Only)
	Connection	0.5–25 A: 14–4 AWG (2–25 mm^2) Cables Torque to 22 lb-in. (2.48 N•m) 30–35 A: 14–2 AWG (1–35 mm^2) Cables Torque to 31 lb-in. (3.52 N•m)
Connector: Ring Tongue	Use Single UL Listed or CSA Certified Insulated Ring Tongue Only	Screw dia. 0.2 in. (5 mm) Torque to 18 lb-in. (2.03 N•m)
	Max Ring Terminal Width	0.54 in. (14 mm)
Mounting	35 mm DIN rail	
Degree of Protection	Case	IP40 as per IEC 529
	Terminals	IP20
Temperatures	Calibration	25°C (77°F)
	Storage	-40 to 80°C (-40 to 176°F)
	Operating	-30 to 70°C (-22 to 158°F)
Plug-On Auxiliary Modules with Mechanical Linkage:	MN Undervoltage Trip MX + OF Shunt Trip/Auxiliary Switch OF Auxiliary Switch SD Alarm Switch	
Tropicalization	Treatment 2	Relative Humidity: 95% at 131°F (55°C)
Number of Operating Cycles	Electrical (O-C)	6,000 load, 4,000 no-load
See specifications Table 2 for dimensions, weights and interrupting ratings		

Standard Features

- Fast closing: Allows increased withstand to the high inrush currents of some loads.
- Trip-free mechanism: Contacts cannot be held in the I-ON position when the C60 circuit breaker is tripped automatically.
- Positive indication of contact disconnect. Green mechanical indication on front face of circuit breaker shows that all poles are open.
- C curve: Overcurrent protection for all application types. Magnetic release operates from 7 to 10 times ampere rating (7 to 14 for DC applications).

- D curve: Overcurrent protection for loads with high inrush currents (motors, transformers). Magnetic release operates between 10 and 14 times ampere rating (no dc rating for D curve).
- Suitable for reverse feeding.
- Allows locking in O-OFF position using padlock attachment.

Connections

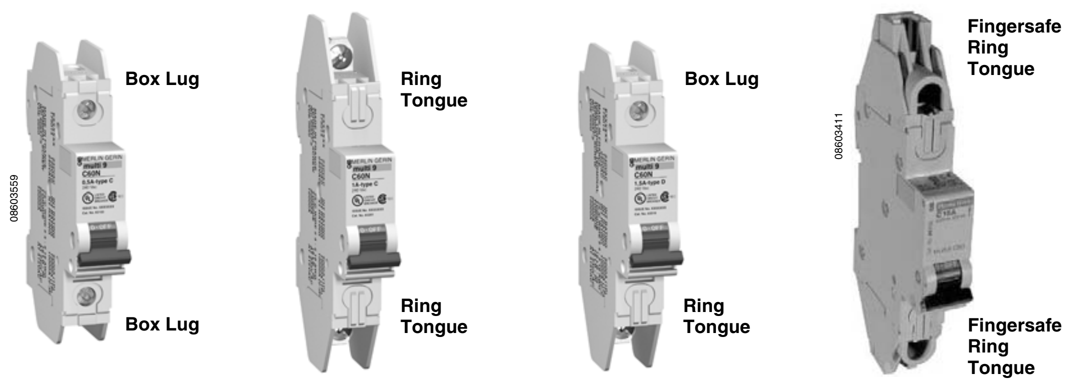
Three versions of field wiring connectors are available for the 240 Vac UL 489 Listed devices:

- Box lug, meeting UL 486A requirements
- Ring tongue terminal with 5 mm screw
- Ring Tongue terminals with Fingersafe (IP20) shrouds

The circuit breakers can be ordered with the following combinations of connectors:

- Line terminal box lug/load terminal box lug
- Line terminal ring tongue/load terminal ring tongue (for fingersafe version, add -F suffix to catalog number)
- Line terminal box lug/load terminal ring tongue

Figure 5: Connection Options for 240 Vac UL 489 Listed Devices



Standards

- UL 489 Circuit Breaker: File No. E215117
- Single pole 15–20 A is UL Listed as SWD (switching duty).
- 1-, 2-, and 3-pole 15–35 A are HID (high intensity discharge) rated.
- CSA C22.2 No. 5.1 Circuit Breakers: File No. 179014
- IEC 60947-2
- CE Marked

Catalog Numbers

Table 5: Catalog Numbers for C Curve, UL 489 Listed 240 Vac C60 Miniature Circuit Breakers (Box Lug and Ring Tongue Terminal Combinations)

Rating	1P			2P			3P		
	Box/Box	Ring/Ring[1]	Box/Ring	Box/Box	Ring/Ring[1]	Box/Ring	Box/Box	Ring/Ring[1]	Box/Ring
0.5 A	60100	60200	60300	60134	60234	60334	—	—	—
1 A	60101	60201	60301	60135	60235	60335	60168	60268	60368
1.5 A	60102	60202	60302	60136	60236	60336	60169	60269	60369
2 A	60103	60203	60303	60137	60237	60337	60170	60270	60370
3 A	60104	60204	60304	60138	60238	60338	60171	60271	60371
4 A	60105	60205	60305	60139	60239	60339	60172	60272	60372
5 A	60106	60206	60306	60140	60240	60340	60173	60273	60373
6 A	60107	60207	60307	60141	60241	60341	60174	60274	60374
7 A	60108	60208	60308	60142	60242	60342	60175	60275	60375
8 A	60109	60209	60309	60143	60243	60343	60176	60276	60376
10 A	60110	60210	60310	60144	60244	60344	60177	60277	60377
13 A	60111	60211	60311	60145	60245	60345	60178	60278	60378
15 A	60112	60212	60312	60146	60246	60346	60179	60279	60379
20 A	60113	60213	60313	60147	60247	60347	60180	60280	60380
25 A	60114	60214	60314	60148	60248	60348	60181	60281	60381
30 A	60115	60215	60315	60149	60249	60349	60182	60282	60382
35 A	60116	60216	60316	60150	60250	60350	60183	60283	60383

[1] IP-20 Fingersafe ring tongue terminals may be ordered with an F suffix (example: 60210F)

Table 6: Catalog Numbers for D Curve, UL 489 Listed 240 Vac C60 Miniature Circuit Breakers (Line/Load as Box Lug or Ring Tongue Terminals)

Rating	1P			2P			3P		
	Box/Box	Ring/Ring[1]	Box/Ring	Box/Box	Ring/Ring[1]	Box/Ring	Box/Box	Ring/Ring[1]	Box/Ring
0.5 A	60117	60217	60317	60151	60251	60351	—	—	—
1 A	60118	60218	60318	60152	60252	60352	60184	60284	60384
1.5 A	60119	60219	60319	60153	60253	60353	60185	60285	60385
2 A	60120	60220	60320	60154	60254	60354	60186	60286	60386
3 A	60121	60221	60321	60155	60255	60355	60187	60287	60387
4 A	60122	60222	60322	60156	60256	60356	60188	60288	60388
5 A	60123	60223	60323	60157	60257	60357	60189	60289	60389
6 A	60124	60224	60324	60158	60258	60358	60190	60290	60390
7 A	60125	60225	60325	60159	60259	60359	60191	60291	60391
8 A	60126	60226	60326	60160	60260	60360	60192	60292	60392
10 A	60127	60227	60327	60161	60261	60361	60193	60293	60393
13 A	60128	60228	60328	60162	60262	60362	60194	60294	60394
15 A	60129	60229	60329	60163	60263	60363	60195	60295	60395
20 A	60130	60230	60330	60164	60264	60364	60196	60296	60396
25 A	60131	60231	60331	60165	60265	60365	60197	60297	60397
30 A	60132	60232	60332	60166	60266	60366	60198	60298	60398
35 A	60133	60233	60333	60167	60267	60367	60199	60299	60399

[1] IP-20 Fingersafe ring tongue terminals may be ordered with an F suffix (example: 60210F)

NOTE: UL 489 Listed Multi 9 circuit breakers are calibrated at 25°C (77°F). Please refer to the rating tables (page 80) for applications at temperatures greater than 25°C (77°F).

NOTE: The NEC requires that the continuous load applied to the circuit breaker shall not exceed 80% of the circuit breaker ampere rating.

UL 489 Listed 480Y/277 Vac C60 Circuit Breakers (AC)

08603411

The UL 489 Listed 480Y/277 Vac Multi 9 C60 miniature circuit breakers can be used in 480Y/277 Vac systems. With amperages from 0.5 A to 20 A, they are ideal for fuse replacement, yet carry the UL 489 Listing that is required for branch circuit applications. See specifications on Table 2 for dimensions, weights, and interrupting ratings.

Table 7: Specifications for UL 489 Listed 480Y/277 Vac C60 Circuit Breakers

Interruption Rating	2P and 3P	480Y/277 V @ 10kA
	1P	277 Vac @ 10kA
Amperage	0.5 A through 20 A	
Construction	1P, 2P and 3P	
Magnetic Trip Curves	C-curve	7 to 10 Times Ampere Rating
	D-curve	10 to 14 Times Ampere Rating
UL 486E Listed 2-Barrel Lug	18–16 AWG (1–1.5 mm^2), Cu Only Stranded Wire:	Torque to 7 lb-in (0.68 N•m)
	14–10 AWG (2–5 mm^2), Cu Only Solid or Stranded Wire	Torque to 14 lb-in (1.6 N•m)
Ring Tongue Screw	5 mm	Torque to 18 lb-in (2 N•m)
Plug-On Auxiliary Modules With Mechanical Linkage:	MN Undervoltage Trip MX + OF Shunt Trip/Auxiliary Switch OF Auxiliary Switch SD Alarm Switch	
Mounting	35 mm DIN Rail	
See selection Table 2 for dimensions, weights, and interrupting ratings.		

Benefits

- Satisfies customer's preferences to use circuit breakers instead of fuses.
- Eliminates costs of spare fuses, blown fuse indicators, additional wiring, etc.
- Reduces concerns and uncertainty of misapplying a UL 1077 supplementary protector where a UL 489 branch circuit breaker is required.
- Facilitates one common design for UL 489, CSA and IEC applications.
- Simplifies installation with a compact, DIN-mounted circuit breaker that accepts a wide range of accessories.
- Offers alternative terminations for ring terminals or cable.

Standard Features

- Fast closing: Allows increased withstand to the high inrush currents of some loads.
- Trip-free mechanism: Contacts cannot be held in the I-ON position when the circuit breaker is tripped automatically.
- Positive indication of contact disconnect. Green mechanical indication on front face of device shows that all poles are open.
- C curve: Overcurrent protection for all application types. Magnetic release operates from 7 to 10 times ampere rating. (7 to 14 for dc)
- D curve: Overcurrent protection for loads with high inrush currents (motors, transformers). Magnetic release operates between 10 and 14 times ampere rating (no dc rating for D curve).
- Suitable for reverse feeding
- Allows locking in O-OFF position using padlock attachment.

Connections

Two versions of field wiring connectors are available:

- Two-barrel lug with binding screws for two 18–10 AWG wires.
- Crimp-type ring tongue terminal for up to 8 AWG wire

Both of these terminals provide fingersafe ingress protection per IP20 of IEC EN60529. This feature reduces the potential of incidental contact with live circuit breaker components.

Standards

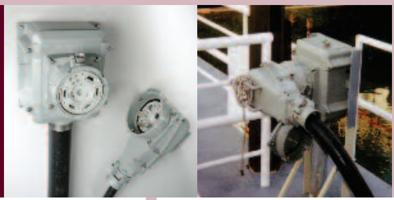
- UL 489 Listed
- CSA C22.2 No. 5.1
- IEC 60947-2
- CE Marked

Catalog Numbers

Table 8: Catalog Numbers for UL 489 Listed 480Y/277 V C60 Miniature Circuit Breakers (AC)

Rating	2-Barrel Wire Lug			Ring-Tongue Terminal		
	1P	2P	3P	1P	2P	3P
C-curve, 7–10 Times Ampere Rating						
0.5 A	MGN61300	—	—	MGN61366	—	—
1 A	MGN61301	MGN61312	MGN61323	MGN61367	MGN61378	MGN61389
2 A	MGN61302	MGN61313	MGN61324	MGN61368	MGN61379	MGN61390
3 A	MGN61303	MGN61314	MGN61325	MGN61369	MGN61380	MGN61391
4 A	MGN61304	MGN61315	MGN61326	MGN61370	MGN61381	MGN61392
5 A	MGN61305	MGN61316	MGN61327	MGN61371	MGN61382	MGN61393
6 A	MGN61306	MGN61317	MGN61328	MGN61372	MGN61383	MGN61394
8 A	MGN61307	MGN61318	MGN61329	MGN61373	MGN61384	MGN61395
10 A	MGN61308	MGN61319	MGN61330	MGN61374	MGN61385	MGN61396
15 A	MGN61309	MGN61320	MGN61331	MGN61375	MGN61386	MGN61397
20 A	MGN61310	MGN61321	MGN61332	MGN61376	MGN61387	MGN61398
D-curve, 10–14 Times Ampere Rating						
0.5 A	MGN61333	—	—	MGN61399	—	—
1 A	MGN61334	MGN61345	MGN61356	MGN61400	MGN61411	MGN61422
2 A	MGN61335	MGN61346	MGN61357	MGN61401	MGN61412	MGN61423
3 A	MGN61336	MGN61347	MGN61358	MGN61402	MGN61413	MGN61424
4 A	MGN61337	MGN61348	MGN61359	MGN61403	MGN61414	MGN61425
5 A	MGN61338	MGN61349	MGN61360	MGN61404	MGN61415	MGN61426
6 A	MGN61339	MGN61350	MGN61361	MGN61405	MGN61416	MGN61427
8 A	MGN61340	MGN61351	MGN61362	MGN61406	MGN61417	MGN61428
10 A	MGN61341	MGN61352	MGN61363	MGN61407	MGN61418	MGN61429
15 A	MGN61342	MGN61353	MGN61364	MGN61408	MGN61419	MGN61430
20 A	MGN61343	MGN61354	MGN61365	MGN61409	MGN61420	MGN61431

RFI Response #001



PF/PFQ – 300A - 600A
High Ampacity Plugs & Receptacles

Ratings

- **Voltage**
  PF = 1000 VAC*, 250 VDC
  PFQ = 600 VAC, 250 VDC
- **Current Interruption Capability**
  Not for current interrupting
- **Environmental Ratings**
  IP66+IP67
- **Temperature Range**
  Min -40°F/Max 140°F
  See pg 210 for temps below -15°F.
- **Wiring Capacity**
  PFQ = 4/0 AWG to 350 MCM
  PF = 250 MCM to 600 MCM
- **Pilot Contacts**
  PFQ = 8
  PF = 4
- **Listings**
  UL*, CSA*

* Listings apply only to 300A & 400A devices at 600V or less

Receptacle / Cap (female)
300A

Don't forget to add installation accessories to your order

Voltage	Polarity	Part # PFQ300**	Part # PF300
277V	1P+N+G	47-34045	49-34045
347V	1P+N+G	47-34145	49-34145
480V	2P+G	47-34042	49-34042
480V	2P+N+G	47-34046	49-34046
480V	3P+G	47-34043	49-34043
480V	3P+N+G	47-34047	49-34047
600V	2P+G	47-34142	49-34142
600V	2P+N+G	47-34146	49-34146
600V	3P+G	47-34143	49-34143
600V	3P+N+G	47-34147	49-34147

Inlet / Cap (male)
300A

Voltage	Polarity	Part # PFQ300**	Part # PF300
277V	1P+N+G	47-38045	49-38045
347V	1P+N+G	47-38145	49-38145
480V	2P+G	47-38042	49-38042
480V	2P+N+G	47-38046	49-38046
480V	3P+G	47-38043	49-38043
480V	3P+N+G	47-38047	49-38047
600V	2P+G	47-38142	49-38142
600V	2P+N+G	47-38146	49-38146
600V	3P+G	47-38143	49-38143
600V	3P+N+G	47-38147	49-38147

Other voltage configurations are available – contact customer service at 800.433.7642.

*** PFQ300 devices are differentiated from similarly rated PF300 devices in their smaller size, lighter weight and different pilot contacts.*

Main Options

Receptacle with no cap

With no cap — Recept # - 48

Inlet with no cap

With no cap — Inlet # - 48

Notes: *• Metal caps are provided as standard with male and female devices.*

• Heat shrink wrap is provided with each inlet and receptacle to provide insulation between terminals.

PF/PFQ devices are not intended for connection or disconnection under load. To prevent live making or breaking electrical interlocking is required.

Receptacle / Cap (female)
400A / 600A

Voltage	Polarity	Part # PF400	Part # PF600
277V	1P+N+G	49-44045	49-64045
347V	1P+N+G	49-44145	49-64145
480V	2P+G	49-44042	49-64042
480V	2P+N+G	49-44046	49-64046
480V	3P+G	49-44043	49-64043
480V	3P+N+G	49-44047	49-64047
600V	2P+G	49-44142	49-64142
600V	2P+N+G	49-44146	49-64146
600V	3P+G	49-44143	49-64143
600V	3P+N+G	49-44147	49-64147

Inlet / Cap (male)
400A / 600A

For applications above 400A, please consult factory regarding NEC recommended conductor sizing.

Voltage	Polarity	Part # PF400	Part # PF600
277V	1P+N+G	49-48045	49-68045
347V	1P+N+G	49-48145	49-68145
480V	2P+G	49-48042	49-68042
480V	2P+N+G	49-48046	49-68046
480V	3P+G	49-48043	49-68043
480V	3P+N+G	49-48047	49-68047
600V	2P+G	49-48142	49-68142
600V	2P+N+G	49-48146	49-68146
600V	3P+G	49-48143	49-68143
600V	3P+N+G	49-48147	49-68147

Full Voltage Starters—NEMA Rated
Class 8536

Type SCO3
Size 1, 3-Pole Starter

General Information

Type S magnetic starters are used for full-voltage starting and stopping of AC squirrel cage motors. Motor overload protection is provided via melting alloy type thermal overload relays. Type S starters are available in NEMA Sizes 00 through 7, and are designed for operation at 600 Vac, 50 to 60 Hz.

Solid State Overload Relay Protection (MOTOR LOGIC®)

These ambient insensitive overload relays are available on Sizes 00 through 6 and standard on size 7. They provide phase loss, phase unbalance protection and a power LED indication. To order, add Form **H10** (for Class 10), **H20** (for Class 20), or **H30** (for selectable trip class protection). For more information about MOTOR LOGIC, see page 14-97 and page 14-111.

3-Pole Polyphase—600 Vac Maximum—50–60 Hz

Note that prices shown do not include thermal units. Devices require 3 thermal units (Sizes 00–6). Standard trip thermal units are **$14.30** each. See page 14-129 for selection information.

NEMA Size	Continuous Current Ratings	Motor Voltage	Max. Hp	Open Type		NEMA 1 General Purpose Enclosure		NEMA 4 & 4X Watertight, Dusttight Brushed Stainless Steel Enclosure (Size 0-5)▲		NEMA 4X Watertight, Dusttight, Corrosion-Resistant Glass-Polyester Enclosure	
				Type	Price	Type	Price	Type	Price	Type	Price
00	9	Separate Control ■ 200 230 460 575	 1 1/2 1 1/2 2 2	SAO12♦	**$ 257.**	SAG12♦	**$ 279.**	Use Size 0		Use Size 0	
0	18	Separate Control ■ 200 230 460 575	 3 3 5 5	SBO2♦	**323.**	SBG2♦	**345.**	SBW12♦	**$ 678.**	SBW22♦	**$ 678.**
1	27	Separate Control ■ 200 230 460 575	 7 1/2 7 1/2 10 10	SCO3♦	**371.**	SCG3♦	**393.**	SCW13♦	**735.**	SCW23♦	**735.**
2	45	Separate Control ■ 200 230 460 575	 10 15 25 25	SDO1♦	**674.**	SDG1♦	**773.**	SDW11♦	**1457.**	SDW21♦	**1457.**
3	90	Separate Control ■ 200 230 460 575	 25 30 50 50	SEO1♦	**1092.**	SEG1♦	**1286.**	SEW11♦	**2253.**	SEW21♦	**2817.**
4	135	Separate Control ■ 200 230 460 575	 40 50 100 100	SFO1♦	**2498.**	SFG1♦	**2900.**	SFW11♦	**4551.**	SFW21♦	**5690.**
5	270	Separate Control ■ 200 230 460 575	 75 100 200 200	SGO1♦	**6101.**	SGG1♦	**6836.**	SGW11♦	**8924.**	…	…
6	540	Separate Control ■ 200 230 460 575	 150 200 400 400	SHO2♦	**14504.**	SHG2♦	**19254.**	SHW2♦	**24002.**	…	…
7	810	Separate Control ■ 200 230 460 575	 … 300 600 600	SJO2♦	**20837.**	SJG2♦	**25587.**	SJW2♦	**30335.**	…	…

▲ Size 6 and 7 are rated NEMA 4 only.
■ 120 Volt Polyphase starters are wired for separate control and must be ordered with Form S (i.e., 8502SCO2V02S).
♦ Coil voltage code must be specified to order this product. Refer to standard coil voltage codes shown below.

Coil Voltage Codes

Voltage		Code	Price Adder
60 Hz	50 Hz		
24★	…	V01	No Charge
120▼	110	V02	No Charge
208	…	V08	No Charge
240	220	V03	No Charge
480	440	V06	No Charge
600	550	V07	No Charge
Specify	Specify	V99	**$23.70**

★ 24 V coils are not available on Sizes 4–7. On Sizes 00-3, where 24 V coils are available, **Form S** (separate control) must be specified (i.e., order as 8502SBO2V01S).
▼ 120 Volt Polyphase contactors are wired for separate control (i.e., order as 8502SCO2V02S).
Note: For voltage codes used with control transformers, see page 14-110.
Form S (separate control) is used when a separate source of power is available for the control (coil) voltage. Form S is supplied at no charge.

Dimensions . . . . page 14-21
Factory Modifications (Forms) . . . . page 14-109
Separate Enclosures (Class 9991) . . . . page 14-102
Replacement Parts (Class 9998) . . . . page 14-118
Type S Accessories (Class 9999) . . . . page 14-121

For additional information, reference Catalog #8502CT9701.

Altivar® 61 Drives

The *leading edge!*

This new generation of AC drives demonstrates the expertise and know-how of Schneider Electric with respect to AC drives. Exceptional flexibility, advanced functions and a high level of customization...while always keeping the emphasis on simplicity. Open to many communication networks, the Altivar 61 drive provides ingenious solutions for all your HVAC fan and pump requirements.

Simply Smart!

Leverage **ingenuity** and intelligence for **ease** of use

A *powerful* fleet

- 1 to 900 HP
  3-phase 380 to 480V
- 1 to 125 HP
  3-phase 200 to 240V
- Integrated EMC level A filters
- Worldwide offer:
  UL, CSA, CE, C-Tick, GOST, UL1995 Plenum rated, SEMI-F47

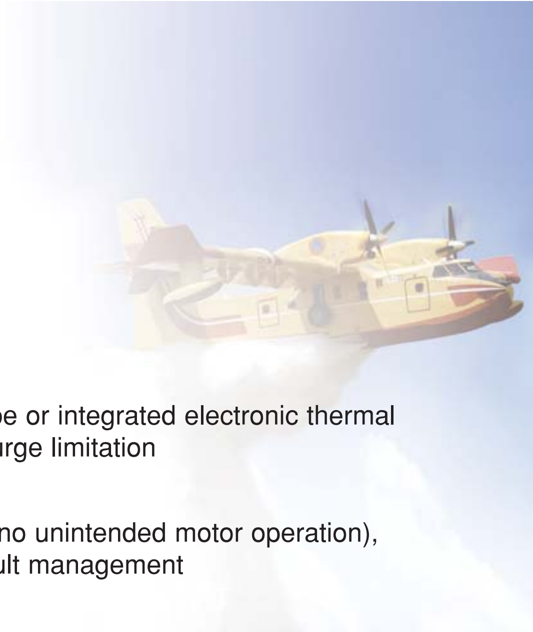
Remarkable performance for fan and pump applications

- Under voltage ride-thru qualified to SEMI-F47 standard
- Catch on the fly restart
- Up to 110% overcurrent
- Energy economizer motor algorithm to maximize energy savings, or select two point or five point Volts/Hz profile
- Three skip frequency bands
- Bump-less transfer from automatic to hand control

Expandable capabilities

The drive is equipped with a wealth of features, application functions, inputs/outputs and communication capabilities. These can be further extended by:

- input/output extension cards
- communication cards
- a Controller Inside programmable card
- a Multipump application card



Protection at all levels

- **Of the Motor:**
  Thermal protection by PTC probe or integrated electronic thermal overload, voltage and current surge limitation

- **Of the Machine:**
  Power removal safety function (no unintended motor operation), alarm management, external fault management

- **Of the Drive:**
  Protection in the event of overheating, current limitation using hardware and software, protection against corrosive environments

- **Of the Installation:**
  The intelligent design of the Altivar 61 drive power system architecture optimizes the balance between inductance and capacitance to achieve effective harmonic mitigation with 3% equivalent impedance without requiring additional panel space. This unique design minimizes dc bus ripple, reduces input currents and lowers harmonic currents. This eliminates the need to oversize power wiring, disconnect means, and short circuit protection devices. This also improves the efficiency of the drive and allows operation at higher ambient temperature than other AC drives.

- **Of the Environment:**
  Developed in accordance with the Eco-Design principle. Materials used have been selected for their minimal impact on the environment and conform to the RoHS directive (Restriction of Hazardous Substances) that prohibits certain levels of materials. Also, 88% of the parts used for the Altivar 61 drive are recyclable, conforming to the directive WEEE (Waste Electrical & Electronic Equipment).

Easy to control...

- Graphic screen with customizable display
- Plain text with six languages (English, Chinese, German, Spanish, French and Italian)
- Navigation wheel for easily “surfing” through the menus
- “Simply Start” menu for quick start-up and immediate benefit of the full performance of the Altivar 61 drive
- Function keys for short-cuts, on-line help or configurable for some applications
- Continuous display of the operating parameters of the motor
- Hand/auto function key provides one button bumpless transfer between terminal strip control and control with the keypad, or between communication network control and control with the keypad

Altivar® 61 Drives

Evolutionary design

Unrivalled basic equipment

With the many functions already integrated in the Altivar 61 drive, you reduce the cost of solutions for your installation. The most economical solution is offered without compromise!

Interface with the typical HVAC and Pump I/O

requirements such as:

- run command: Input to VFD by remote dry contact from the BAS
- speed command: Input to VFD from the BAS
- run status: Output contact from VFD to the BAS
- speed feedback: Analog output from VFD to the BAS
- fault output: Form-C contact from VFD to the BAS
- fire/safety interlock: 24Vdc supplied by VFD, Use N.C. contacts

Fans optimized for long life and serviceability

The cooling fans on the Altivar 61 drive are designed to be easily removed for cleaning and servicing. These fans can be removed without removing the drive from the wall or its enclosure and are intelligently cycled on only when required to cool the drive, maximizing the life of the fan.

With more than 100 fan and pump functions available, you benefit from:

- increased flexibility
- high level of customization
- high level of integration

Integrated Modbus® and CANopen Port

With these two standard networks, you achieve:

- simplified installation
- savings in panel space
- direct connection to building network systems

Dialogue

The graphic terminal can be multipoint connected to several drives. The Altivar 61 drive is also available with a 7-segment display for ratings up to and including 20 HP @230Vac and 100 HP @460Vac for the most economical solution.

EMC mastered

Incorporating level A conducted and radiated EMC filters, the Altivar 61 drive simplifies installation and establishes conformity of the machine for CE marking, without additional costs.

"Power Removal" function

Conforming to the machine standard EN 954-1 category 3 and the standard for electrical installations IEC/EN 61508-1 SIL2, and certified by a competent body (INERIS), it enables:

- easier machine certification
- elimination of electromechanical relays
- reduced wiring and installation times
- space savings in enclosures

Altivar® 61 Drives

Eco-Design:
thinking of the future

Within its sustainable development policy, Schneider Electric is committed to environmental friendliness:

"Our products safeguard life, make goods safer and optimize the consumption of energy and natural resources. We are actively involved in design, production, distribution and recycling processes that are environmentally friendly. Protection of the environment forms an integral part of our strategic decision making."

ISO 14 001 certified sites for their manufacturing operations:

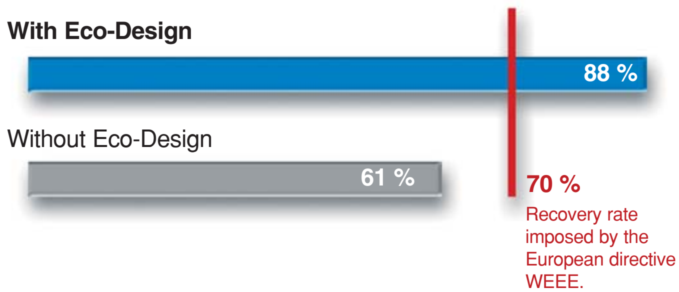
- Pacy-sur-Eure/France
- Houston TX/USA
- Mie/Japan

and certified for their Eco-Design cycles

The new generation of **Altivar 61 drives** benefits from an Eco-Design approach. The same importance has been given to the "environment" criterion as that for other criteria, such as: performance, quality, ergonomics...and this applies to each stage of the life cycle of the product* (manufacture, distribution, usage and end of life).

Exemplary end of life recovery ...

88% of the parts used for the Altivar 61 drive are recyclable. They enable the recuperation of energy (incineration with energy recuperation) or of material (recycling, composting) conforming to the European directive WEEE (Waste Electrical & Electronic Equipment).



... due to a strict selection and ideal combination of materials

Materials used for the **Altivar 61 drive** have been selected for their minimal impact on the environment. Conformity to the European directive ROHS (Restriction Of Hazardous Substances) that prohibits the use of materials such as lead, codmium, mercury and hexavelent chromium.

*For the complete "Product Environmental Profile" document relating to the entire range, please contact Schneider Electric.
Analysis carried out using EIME (Environmental Information and Management Explorer) software and based on international averages.

The *green building* movement is on!

The Altivar 61 drive can help create green buildings. The U.S. Green Building Council® (USGBC) developed and administered the LEED® (Leadership in Energy and Environmental Design) Green Building Rating System™, to define green buildings. One of the prerequisites of the LEED-NC Energy and Atmosphere component is meeting both the mandatory provisions and prescriptive/performance requirements of ASHRAE 90.1-2004. This standard sets minimum requirements to promote the principles of effective, energy-conserving design for buildings and building systems. More specifically, the ASHRAE prescriptive strongly recommends that HVAC systems with total fan power greater than 5 hp have variable air volume fan control and that individual variable air volume fans with motors greater than or equal to 15 hp have variable speed drives.

For government buildings, government regulations such as the Energy Policy Act of 2005 (EPAct) mandate energy monitoring and energy efficiency improvements. LEED certification alone has its benefits. In addition to saving energy costs, it also allows the building owner to take advantage of state and local government incentives and makes the building project more marketable to tenants who are seeking more energy-efficient/sustainable facilities.

The Altivar 61 drive can help create green buildings by providing gains in energy efficiency, easier commissioning and monitoring of the building, and by its Eco-Design.

Altivar® 61 Drives Electrical Specifications

Input Voltage	200 -15% to 240 +10%, 380 -15% to 480 +10%
Displacement Power Factor	98% through speed range
Input Frequency	50 Hz -5% to 60 Hz +5%
Drive Input Section	Six pulse bridge rectifier
Drive Output Section	Three Phase, IGBT Inverter with Pulse Width Modulated (PWM) output Maximum voltage equal to input voltage
Galvanic Isolation	Galvanic isolation between power and control (inputs, outputs and power supplies)
Frequency Range of Power Converter	0.5 to 500 Hz
Torque/overtorque	110% of nominal motor torque for 60 s, minimum
Current (transient)	110% of controller rated current for 60 s, minimum
Switching Frequency	Selectable from 1 to 16 kHz, 12 kHz nominal rating for 1-60 hp @ 200/240 V, 1-100 hp @ 380/480 V. Selectable: 2.5 to 8 kHz, 2.5 kHz nominal rating for 75-125 hp @ 200/240 V125-900 hp @ 380/480 V.
Speed Reference Inputs	AI: 0 to +10 V, Impedance = 30 kOhms Used for Speed potentiometer, 1-10 kOhms AI2: Factory setting = 4 to 20mA, software configurable for current, (0-20mA, X-Y) or voltage
Analog Reference Resolution	0.1 for 100 Hz (11 bits)
I/O Sampling Time	2 ms +/- 0.5 ms on analog inputs & outputs, & logic inputs, 7 ms +/- 0.5 ms on relay outputs
Power Removal/Run Permissive Input	24Vdc input, for use to prohibit unitended equipment operation
Efficiency	98% at full load typical
Acceleration and Deceleration Ramps	0.1 to 999.9 seconds (definition in 0.1 s increments)
Skip Frequencies	Three configurable skip frequency/jump frequency bands
Motor Control Profiles	Energy economizer (flux optimization) motor algorithm to maximize energy savings. (Automatically optimizes voltage based on load.) or select from 2 point or 5 point volts/hertz profile or SLFV (sensorless flux vector)
Speed Range	1 to 100, open loop
Motor Protection	Class 10 electronic overload protection or PTC probe
Graphic Display Terminal	Simply Start menu, PID set-up menu, network set-up menu, Logic I/O & Analog I/O mapping and status, Monitoring and self diagnostics with fault messages and status such as; Power on time, elapsed time, motor run time, line voltage, motor current, ready to run, running, motor speed
Compliance	RoHS and WEEE (Waste Electrical & Electronic Equipment compliant
Codes and Standards	UL, CSA, NOM 117, DNV, CE, C-Tick, GOST, UL 1995 Plenum rated, SEMI-F47 certified for voltage dip ride-through

Altivar® 61 Drives Environmental Specifications

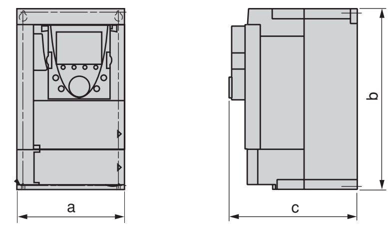
Temperature	Operation:+14 to + 122˚ F (-10 to +50˚ C) Storage:-13 to +158˚ F (-25 to +70˚ C)
Humidity	95% with no condensation or dripping water, conforming to IEC 600068-2-3.
Altitude	3,300 ft. (1,000 m) without derating; 3,300- 9850 ft (1,000-3,000 m) derate output current by 1% for each additional 330 ft. (100 m). 6560 ft (2000m) maximum for corner grounded distribution system.
Enclosure Rating	*1-60 hp @ 200/240 V, 1-100 hp @ 380/480 V:* IP 41 on top IP21 on all other surfaces, Type 1 with optional conduit kit. *75-125 hp @ 200/240 V, 125-500 hp @ 380/480 V:* IP 41 on top, IP30 sides & front IP00 on bottom, Type 1 w/ optional conduit kit. 600 -900 hp @ 380/480 V. IP 41 on top, IP30 sides and front, IP00 on bottom
Pollution Degree	*1-20 hp @ 200/240 V, 1-25 hp @ 380/480 V:* Pollution degree 2 per IEC/EN 61800-5-1, Option S337 provides protection per IEC 60721-3-3 Class 3C2 *25-60 hp @ 200/240 V, 30-100 hp @ 380/480V:* Pollution degree 3 per IEC/EN 61800-5-1, Option S337 provides protection per IEC 60721-3-3 Class 3C2 *60-125hp @ 200/240 V, 125-900 hp @ 380/480V:* Pollution degree 3 per IEC/EN 61800-5-1 and protection per IEC 60721-3-3 Class 3C2
Vibration Resistance	1-60hp @ 200/240V 1-100 hp @ 380/480 V Conforming to IEC/EN 60068-2-6 1.5mm peak to peak from 3 to 13 Hz, 1gn from 13 to 200 Hz. 75-125 hp @ 200/240V, 125-900 hp @ 380/480V: Conforming to IEC/EN 60068-2-6 1.5mm peak to peak from 3 to 10 Hz, 0.6gn from 10 to 200 Hz.
Shock Resistance	1-60 hp @ 200/240 V, 1-100 hp @ 380/480 V: 15gn for 11ms conforming to IEC/EN 600068-2-27 75-125 hp @ 200/240 V, 125-500 hp @ 380/480 V: 7gn for 11ms conforming to IEC/EN 600068-2-27 600-900 hp @ 380/480 V. 4gn for 11ms conforming to IEC/EN 600068-2-27

Altivar® 61 Drives Dimensions and Weights

With LCD Graphic Display Terminal

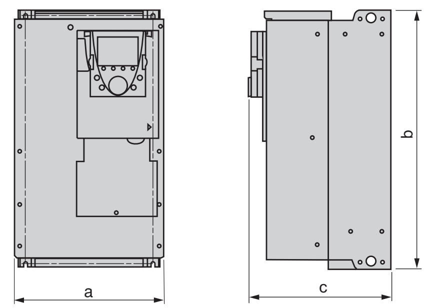
Frame Size	a Width		b Height		c Depth		Weight		b Height with Type 1 Kit	
	mm	In.	mm	In.	mm	In.	kg.	lbs.	mm	In.
1	130	5.12	230	9.06	175	6.89	3	6.61	357	14.05
2	155	6.10	260	10.24	187	7.36	4	8.82	387	15.23
3	175	6.89	295	11.61	187	7.36	5.5	12.13	422	16.61
4	210	8.27	295	11.61	213	8.39	7	15.43	396	15.61
5	230	9.06	400	15.75	213	8.39	9	19.84	502	19.75

For a drive without a graphic display terminal, the depth is reduced by 26mm (1.02 in)
For a drive with one option card installed, the depth is increases 23mm (0.91 in)
For a drive with two option cards installed, the depth is increases 46mm (1.81 in)



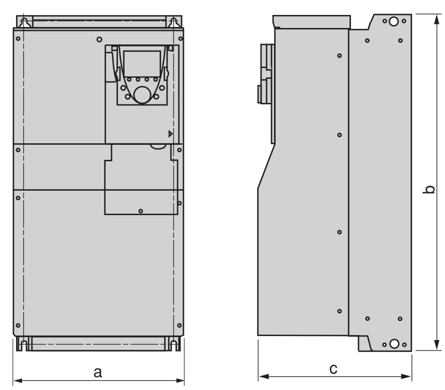
Frame Size	a Width		b Height		c Depth		Weight		b Height with Type 1 Kit	
	mm	In.	mm	In.	mm	In.	kg.	lbs.	mm	In.
6	240	9.45	420	16.54	236	9.29	30	66.14	547	21.54
7	240	9.45	550	21.65	266	10.47	37	81.57	677	26.65
8	320	12.60	550	21.65	266	10.47	37	81.87	753	29.65
9	320	12.60	630	24.80	290	11.42	45	99.21	833	32.80

For a drive without a graphic display terminal, the depth is reduced by 26mm (1.02 in)
For a drive with one option card installed, the depth is increases 23mm (0.91 in)
For a drive with two option cards installed, the depth is increases 46mm (1.81 in)



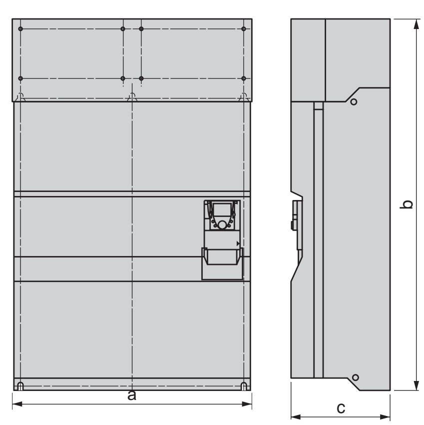
Frame Size	a Width		b Height		c Depth		Weight		b Height with Type 1 Kit	
	mm	In.	mm	In.	mm	In.	kg.	lbs.	mm	In.
10	320	12.60	920	36.22	377	14.84	74	163	985	38.77
11	360	14.17	1022	40.24	377	14.84	80	176	1188	46.79
12	340	13.39	1190	46.85	377	14.84	110	242	1471	57.90
13	440	17.32	1190	46.85	377	14.84	140	309	1407	55.40
14	595	23.43	1190	46.85	377	14.84	215	474	1458	57.40

For a drive with one option card installed, the depth remains the same
For a drive with two option cards installed, the depth is increases 15mm (0.59 in)



Frame Size	a Width		b Height		c Depth		Weight	
	mm	In.	mm	In.	mm	In.	kg.	lbs.
15	890	35.04	1390	54.72	377	14.84	225	496
16	1120	44.09	1390	54.72	377	14.84	300	661

For a drive with one option card installed, the depth remains the same
For a drive with two option cards installed, the depth is increases 15mm (0.59 in)



Altivar® 61 Drives Selection guide

Supply voltage: 3-phase 200...240V

Motor kW	HP	Amps	Drive References (LCD keypad included)	Frame size
0.75	1	4.8	ATV61H075M3[1]	1
1.5	2	8	ATV61HU15M3[1]	1
2.2	3	11	ATV61HU22M3[1]	2
3	–	13.7	ATV61HU30M3[1]	2
4	5	17.5	ATV61HU40M3[2]	2
5.5	7.5	27.5	ATV61HU55M3[2]	3
7.5	10	33	ATV61HU75M3[2]	4
11	15	54	ATV61HD11M3X[3]	5
15	20	66	ATV61HD15M3X[3]	5
18.5	25	75	ATV61HD18M3X[3]	6
22	30	88	ATV61HD22M3X[3]	6
30	40	120	ATV61HD30M3X[3]	8
37	50	144	ATV61HD37M3X[3]	8
45	60	176	ATV61HD45M3X[3]	8
55	75	221	ATV61HD55M3X[3][4]	10
75	100	285	ATV61HD75M3X[3][4]	10
90	125	359	ATV61HD90M3X[3][4]	11

For 20 HP and smaller, add the letter "Z" to the end of the reference for an Altivar 61 to receive the drive with an LED keypad in place of the LCD keypad.

(1) For single-phase 0.75 to 7.5 kW range, select the next rating up (example: 2.2 kW - reference = ATV61HU30M3).

(2) For single-phase operation, select the next rating up and add a line choke.

(3) Without EMC filter.
(4) With integrated DC bus inductance.

Supply voltage: 3-phase 380...480V

Motor kW	HP	Amps	Drive References (LCD keypad included)	Frame size
0.75	1	2.3	ATV61H075N4[4]	1
1.5	2	4.1	ATV61HU15N4[4]	1
2.2	3	5.8	ATV61HU22N4[4]	1
3	–	7.8	ATV61HU30N4[4]	2
4	5	10.5	ATV61HU40N4[4]	2
5.5	7.5	14.3	ATV61HU55N4[4]	3
7.5	10	17.6	ATV61HU75N4[4]	3
11	15	27.7	ATV61HD11N4[4]	4
15	20	33	ATV61HD15N4[4]	5
18.5	25	41	ATV61HD18N4	5
22	30	48	ATV61HD22N4	6
30	40	66	ATV61HD30N4	7
37	50	79	ATV61HD37N4	7
45	60	94	ATV61HD45N4	9
55	75	116	ATV61HD55N4	9
75	100	160	ATV61HD75N4	9
90	125	179	ATV61HD90N4[5]	10
110	150	215	ATV61HC11N4[5]	10
132	200	259	ATV61HC13N4[5]	11
160	250	314	ATV61HC16N4[5]	12
220	350	427	ATV61HC22N4[5]	13
250	400	481	ATV61HC25N4[5]	14
315	500	616	ATV61HC31N4[5]	14
400	600	759	ATV61HC40N4[5]	15
500	700	941	ATV61HC50N4[5]	15
630	900	1188	ATV61HC63N4[5]	16

(4) For 100 HP and smaller, add the letter "Z" to the end of the reference for an Altivar 61 to receive the drive with an LED keypad in place of the LCD keypad.
(5) With integrated DC bus inductance.

Inputs/outputs on board

Analog input #1: +/- 10Vdc bipolar input, 1 bits + 1 sign resolution, 2ms +/- .5ms sample time

Analog input #2: software selectable for 1-10Vdc or x-y mA x-y selectable from 0-20mA, 11 bits resolution, 2ms +/- .5ms sample time

Analog output #1: software selectable for 1-10Vdc or x-y mA x-y selectable from 0-20mA, 10 bits resolution, 2ms +/- .5ms sample time

Relay output #1: one NO (normally open) one NC (normally closed)

Relay output #2: one NO (normally open)

6 logic inputs: 24Vdc, 2ms +/- .5ms sample time Multiple function assignment possible Positive logic (source) or Negative logic (sink) choice LI6 offers PTC probe assignment

Power Removal input: 1 input for interlocking function (run permissive)

RJ45 port: Modbus or CANopen (selectable)

Power*Suite* software workshop

PowerSuite CD-ROM for PC __________ VW3 A 8104

Connection kit

for PC __________ VW3 A 8106

Adaptor for wireless link

Modbus-Bluetooth® __________ VW3 A 8114

Input/output cards

Logic inputs/outputs

1 voltage output, 24V
1 voltage output, -10V
1 logic output, relay
4 programmable logic inputs
2 assignable logic outputs with open collector
1 input for 6 PTC probes max. __________ VW3 A 3201

Extended inputs/outputs

Same as logic inputs/outputs card +
2 analog inputs
2 analog outputs
1 pulse input __________ VW3 A 3202

Communication cards

Modbus Plus __________ VW3 A 3302
Uni-Telway __________ VW3 A 3303
InterBus __________ VW3 A 3304
Profibus DP __________ VW3 A 3307
DeviceNet __________ VW3 A 3309
Ethernet __________ VW3 A 3310
Fipio __________ VW3 A 3311
LonWorks __________ VW3 A 3312
METASYS N2 __________ VW3 A 3313
APOGEE FLN __________ VW3 A 3314
BACnet __________ VW3 A 3315

Controller Inside programmable card

__________ VW3 A 3501

Pump application card __________ VW3 A 3503

Altivar 61

Variable speed drives for synchronous and asynchronous motors

Programming Manual

Sofware V2.1

12/2009

1760649

www.schneider-electric.com

Contents

Read and understand these instructions before performing any procedure with this drive.

⚠ DANGER

HAZARDOUS VOLTAGE

- Read and understand the Installation Manual in full before installing or operating the ATV61 drive. Installation, adjustment, repair, and maintenance must be performed by qualified personnel.
- The user is responsible for compliance with all international and national electrical standards in force concerning protective grounding of all equipment.
- Many parts in this variable speed drive, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.
- DO NOT touch unshielded components or terminal strip screw connections with voltage present.
- DO NOT short across terminals PA and PC or across the DC bus capacitors.
- Install and close all the covers before applying power or starting and stopping the drive.
- Before servicing the variable speed drive
  - Disconnect all power.
  - Place a “DO NOT TURN ON” label on the variable speed drive disconnect.
  - Lock the disconnect in the open position.
- Disconnect all power including external control power that may be present before servicing the drive. WAIT 15 MINUTES for the DC bus capacitors to discharge. Then follow the DC bus voltage measurement procedure given in the Installation Manual to verify that the DC voltage is less than 42 V. The drive LEDs are not accurate indicators of the absence of DC bus voltage.

Failure to follow these instructions can result in death or serious injury

⚠ CAUTION

DAMAGED EQUIPMENT

Do not operate or install any drive that appears damaged.
Failure to follow this instruction can result in equipment damage.

Documentation structure

The following Altivar 61 technical documents are available on the Schneider Electric website (www.schneider-electric.com) as well as on the CD-ROM supplied with the drive.

Installation Manual

This bulletin contains complete mounting and wiring instructions.

Programming Manual

This describes the functions, parameters and use of the drive terminal (integrated display terminal and graphic display terminal).
The communication functions are not described in this manual, but in the manual for the bus or network used.

Communication Parameters Manual

This manual describes:

- The drive parameters with specific information for use via a bus or communication network.
- The operating modes specific to communication (state chart).
- The interaction between communication and local control.

Manuals for Modbus, CANopen, Ethernet, Profibus, INTERBUS, Uni-Telway, FIPIO and Modbus Plus, etc.

These manuals describe the assembly, connection to the bus or network, signaling, diagnostics, and configuration of the communication-specific parameters via the integrated display terminal or the graphic display terminal.
They also describe the communication services of the protocols.

ATV 38/ATV 61 Migration Manual

This manual describes the differences between the Altivar 61 and the Altivar 38 and explains how to replace an Altivar 38, including how to replace drives communicating on a bus or a network.

ATV 78/ATV 61/71 Migration Manual

This manual describes the differences between the Altivar 61/71 and Altivar 78 and explains how to replace an Altivar 78.

Software enhancements

Since the Altivar ATV 61 was first launched, it has benefited from the addition of several new functions. The software version is now V2.1. The old versions can be replaced by this new one without any modifications.
Although this documentation relates to version V2.1, it can still be used with earlier versions, as the updates merely involve the addition of new values and parameters, and none of the parameters of the previous versions have been modified or removed.
The software version is indicated on the nameplate attached to the body of the drive.

Enhancements made to version V1.2 in comparison to V1.1

New parameters and functions

Option of operating with a BACnet communication card

[1.8 FAULT MANAGEMENT] (FLt-) menu

- The external fault [EXTERNAL FAULT] (EtF-) page 197 can now be configured in positive or negative logic via [External fault config.] (LEt).

Enhancements made to version V1.4 in comparison to V1.2

Factory setting

Note: In versions V1.1 and V1.2, analog output AO1 was assigned to the motor frequency. In the new version, this output is not assigned.
With the exception of this parameter, the factory setting of versions V1.1 and V1.2 remain the same in the new version. The new functions are inactive in the factory setting.

New parameters and functions

[1.2 MONITORING] (SUP-) menu

Addition of states and internal values relating to the new functions described below.

[1.3 SETTINGS] (SEt-) menu

- [High torque thd.] (ttH) page 59
- [Low torque thd.] (ttL) page 59
- [Pulse warning thd.] (FqL) page 59
- [Freewheel stop Thd] (FFt) page 60

[1.4 MOTOR CONTROL] (drC-) menu

- Extension of the following configurations to all drive ratings (previously limited *to* 45 kW (60 HP) for ATV61●●●M3X and to 75 kW (100 HP) for ATV61●●●N4): synchronous motor [Sync. mot.] (SYn) page 67, sinus filter [Sinus filter] (OFI) page 75, noise reduction [Noise reduction] (nrd) page 76, braking balance [Braking balance] (bbA) page 78.

[1.5 INPUTS / OUTPUTS CFG] (I-O-) menu

- [AI net. channel] (AIC1) *page* 89
- New options for assigning relays and logic outputs, page 94: torque greater than high threshold, torque less than low threshold, motor in forward rotation, motor in reverse rotation, measured speed threshold attained.
- Analog output AO1 can now be used as a logic output and assigned to relay functions and logic outputs, page 100.
- New option of modifying the scale of analog outputs, page 102, using the parameters [Scaling AOx min] (ASLx) and [Scaling AOx max] (ASHx).
- New options for assigning analog outputs page 103: signed motor torque and measured motor speed.
- New options for assigning alarm groups page 107: torque greater than high threshold, torque less than low threshold, measured speed threshold attained.

[1.7 APPLICATION FUNCT.] (Fun-) menu

- The summing, subtraction and multiplication reference functions can now be assigned to virtual input [Network AI] (AIU1) page 128.
- New parameter [Freewheel stop Thd] (FFt) page 133 used to adjust a threshold for switching to freewheel at the end of a stop on ramp or fast stop.
- The torque limitation [TORQUE LIMITATION] (tOL-) page 164 can now be configured in whole % or in 0.1% increments using [Torque increment] (IntP) and assigned to virtual input [Network AI] (AIU1).
- New Damper control function using the [DAMPER MANAGEMENT] (dAM-) menu, page 172.
- Parameter switching [PARAM. SET SWITCHING] (MLP-) page 174 can now be assigned to attained frequency thresholds [Freq. Th. attain.] (FtA) and [Freq. Th. 2 attain.] (F2A).

[1.8 FAULT MANAGEMENT] (FLt-) menu

- Option to reinitialize the drive without turning it off, via [Product reset] (rP) page 190.
- Option to reinitialize the drive via a logic input without turning it off, using [Product reset assig.] (rPA) page 190.
- The option to configure the "output phase loss" fault [Output Phase Loss] (OPL) page 194 to [Output cut] (OAC) has been extended to all drive ratings (previously limited *to* 45 kW (60 HP) for ATV61●●●M3X and 75 kW (100 HP) for ATV61●●●N4).
- New monitoring function based on speed measurement using "Pulse input" input page 204, via the [FREQUENCY METER] (FqF-) menu.
- The braking unit short-circuit fault can now be configured using [Brake res. fault Mgt] bUb) page 206.
- The [Damper stuck] (Fd1) fault in the Damper control function can be configured via [DAMPER FAULT MGT.] (FdL-) page 211.

[7 DISPLAY CONFIG.] menu

- Addition, in [7.4 KEYPAD PARAMETERS] page 237, of the [Keypad contrast] and [Keypad stand-by] parameters to adjust the contrast and stand-by mode of the graphic display unit.

Enhancements made to version V1.5 in comparison to V1.4

Extension of the range with the addition of **ATV61●●●●Y** drives for 500 to 690 V supplies.
There are no new parameters, but the adjustment ranges and factory settings of some parameters have been adapted to the new voltages.

[1.5 INPUTS / OUTPUTS CFG] (I-O-) menu

Increased adjustment range for the relay and logic output delay parameters: 0 to 60000 ms instead of 0 to 9999 ms.

[1.7 APPLICATION FUNCT.] (Fun-) menu

- New parameter [Conf.sensor flow] (LnS) page 181, used to configure the zero flow sensor for positive or negative logic.

Enhancements made to version V1.6 in comparison to V1.5

The communication option card APOGEE FLN P1 (VW3 A3 314) is fully supported with the version V1.6 and above of the Altivar 61 software.

Enhancements made to version V1.8 in comparison to V1.6

[7 DISPLAY CONFIG.] menu

- Addition in [7.4 KEYPAD PARAMETERS] page 233 of [Power up menu].This parameter allows to choose the menu which displays on the drive on power up.

Enhancements made to version V2.1 in comparison to V1.8

[1.7 APPLICATION FUNCT.] (Fun-) menu

New parameters and functions

- New parameter [REGEN CONNECTION] (AFE) page 185. With this parameter it is possible to retun the braking energy to the mains and reduce the harmonics.

INSTALLATION

☐ **1 Consult the Installation Manual**

PROGRAMMING

Procedure applicable if the factory configuration, page 9, and use of the [SIMPLY START] (SIM-) menu only are sufficient for the application.

■ **2 Power up without run command**

- ☐ **If you are using a separate power supply for the control section, follow the instructions on page 10.**

■ **3 Select the language, if the drive has a graphic display terminal**

■ **4 Configure the [SIMPLY START] (SIM-) menu**

- ☐ **2-wire or 3-wire control**
- ☐ **Macro configuration**
- ☐ **Motor parameters**
  - ☞ ***Perform an auto-tuning operation***
- ☐ **Motor thermal current**
- ☐ **Acceleration and deceleration ramps**
- ☐ **Speed variation range**

■ **5 Start**

Tips:

- **Before you start programming, complete the user setting tables, page 246.**
- **Perform an auto-tuning operation to optimize performance, page 36.**
- **If you get lost, return to the factory settings, page 222.**

☞ ***Note: Check that the wiring of the drive is compatible with its configuration.***

Drive factory settings

The Altivar 61 is factory-set for the most common operating conditions:

- Macro-configuration: Pumps/fans
- **Motor** frequency: 50 Hz
- Energy-saving variable torque applications
- Normal stop mode on deceleration ramp
- Stop mode in the event of a fault: freewheel
- Linear, acceleration and deceleration ramps: 3 seconds
- Low speed: 0 Hz
- High speed: 50 Hz
- Motor thermal current = rated drive current
- Standstill injection braking current = 0.7 x rated drive current, for 0.5 seconds
- No automatic starts after a fault
- Switching frequency 2.5 kHz or 12 kHz depending on drive rating
- Logic inputs:
  - LI1: forward (1 operating direction), 2-wire control on transition
  - LI2: inactive (not assigned)
  - LI3: switching of 2nd speed reference
  - LI4: fault reset
  - LI5, LI6: inactive (not assigned)
- Analog inputs:
  - AI1: 1st speed reference 0 +10 V
  - AI2: 2nd speed reference 0-20 mA
- Relay R1: The contact opens in the event of a fault (or drive off)
- Relay R2: The contact closes when the drive is in operation
- Analog output AO1: 0-20 mA, inactive (not assigned)

If the above values are compatible with the application, the drive can be used without changing the settings.

Option card factory settings

The option card inputs/outputs are not factory-set.

Turning on and configuring the drive

⚠ DANGER

UNINTENDED EQUIPMENT OPERATION

- Before turning on and configuring the Altivar 61, check that the PWR (POWER REMOVAL) input is deactivated (at state 0) in order to prevent unintended operation.
- Before turning on or on exiting the configuration menus, check that the inputs assigned to the run command are deactivated (at state 0) since they can cause the motor to start immediately.

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

INCOMPATIBLE LINE VOLTAGE

Before turning on and configuring the drive, ensure that the line voltage is compatible with the supply voltage range shown on the drive nameplate. The drive may be damaged if the line voltage is not compatible.

Failure to follow these instructions can result in equipment damage.

Separate control section power supply

Only supply power to the power section the next time the drive is powered up when:
A) The drive control section is powered independently of the power section (P24 and 0V terminals).
B) Whenever an option card is added or replaced.

Power switching via line contactor

⚠ CAUTION

RISK OF EQUIPMENT DAMAGE

- Avoid operating the contactor frequently (premature ageing of the filter capacitors).
- Cycle times < 60 s may result in damage to the pre-charge resistor.

Failure to follow these instructions can result in equipment damage.

User adjustment and extension of functions

- The display unit and buttons can be used to modify the settings and to extend the functions described in the following pages.
- **Return to factory settings** is made easy by the [1.12 FACTORY SETTINGS] (FCS-) menu, see page 220.
- There are three types of parameter:
  - Display: Values displayed by the drive
  - Adjustment: Can be changed during operation or when stopped
  - Configuration: Can only be modified when stopped and no braking is taking place. Can be displayed during operation

⚠ DANGER

UNINTENDED EQUIPMENT OPERATION

- Check that changes made to the settings during operation do not present any danger.
- We recommend stopping the drive before making any changes.

Failure to follow these instructions will result in death or serious injury.

Starting

Important:
- In factory settings mode, the motor can only be supplied with power once the “forward”, “reverse” and “DC injection stop” commands have been reset:
  - On power-up or a manual fault reset or after a stop command

  If they have not been reset, the drive will display “nSt” but will not start.
- If the automatic restart function has been configured ([Automatic restart] (Atr) parameter in the [1.8-FAULT MANAGEMENT] (FLt-) menu, see page 191), these commands are taken into account without a reset being necessary.

Test on a low power motor or without a motor

- In factory settings mode, [Output Phase Loss] detection (OPL) page 194 is active (OPL = YES). To check the drive in a test or maintenance environment without having to switch to a motor with the same rating as the drive (particularly useful in the case of high power drives), deactivate [Output Phase Loss] (OPL = no).
- Set [Motor control type] (Ctt) = [V/F 2pts] (UF2) or [V/F 5pts] (UF5) or [U/F Quad.] (UFq) ([1.4-MOTOR CONTROL] (drC-) menu, see page 67)

⚠ CAUTION
UNINTENDED EQUIPMENT OPERATION
Motor thermal protection will not be provided by the drive if the motor current is less than 0.2 times the rated drive current. Provide an alternative means of thermal protection.
Failure to follow these instructions can result in equipment damage.

Using motors in parallel

- Set [Motor control type] (Ctt) = [V/F 2pts] (UF2) or [V/F 5pts] (UF5) or [U/F Quad.] (UFq) ([1.4-MOTOR CONTROL] (drC-) menu, see page 67)

⚠ CAUTION
UNINTENDED EQUIPMENT OPERATION
Motor thermal protection is no longer provided by the drive. Provide an alternative means of thermal protection on every motor.
Failure to follow these instructions can result in equipment damage.

ATV61●●●Y - Network which presents often under voltage

To assure an optimal running of an ATV61●●●Y used on network which presents often under voltage (network voltage contained between 425 V and 446 V), it is necessary to adjust [Prevention level] (UPL) = 383 V ([1.8-FAULT MANAGEMENT] (FLt-) menu, see page 199).

Using motor with nominal voltage lower than drive supply voltage

- Configure [Vector Control 2pt] (UC2) = [Yes] (YES) ([1.4-MOTOR CONTROL] (drC-) menu, see page 69)

CAUTION

UNINTENDED EQUIPMENT OPERATION

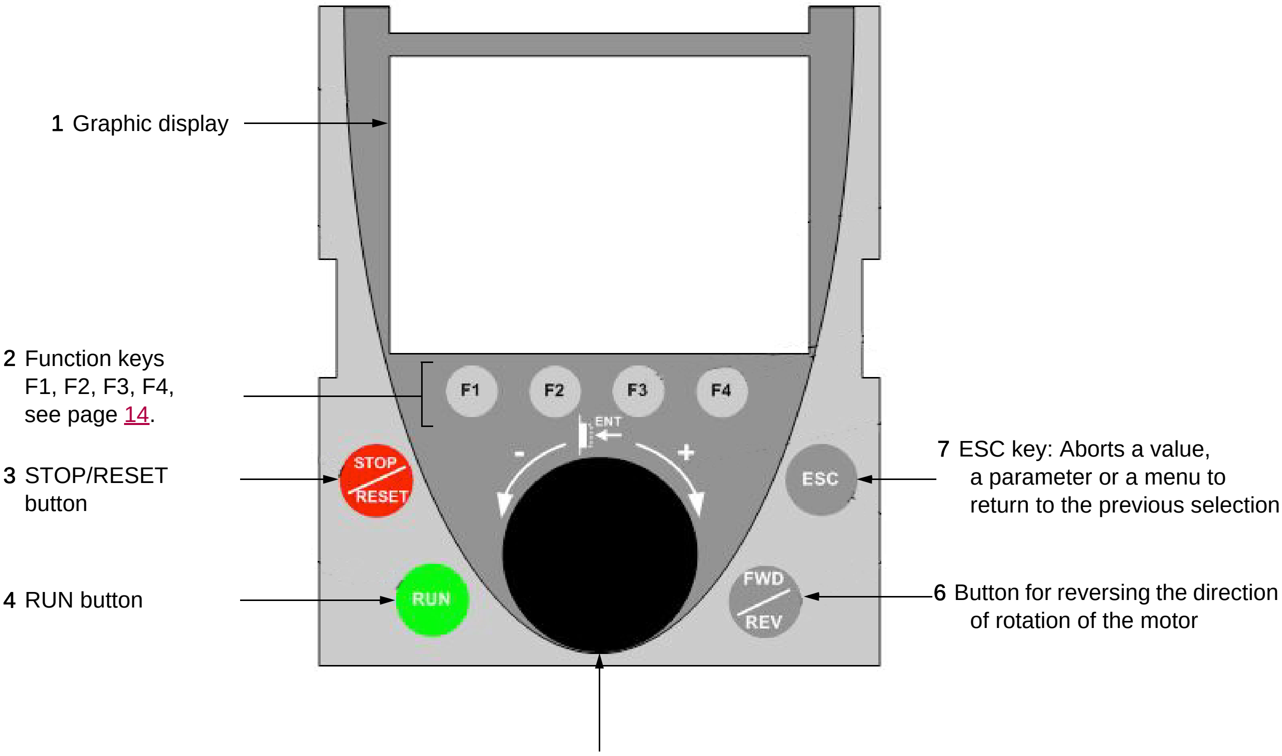
- To protect a motor which has a nominal voltage lower than drive supply voltage, it is mandatory to use [Vector Control 2pt] (UC2) function in order to limit maximal voltage of the motor lower than network voltage.
- Nevertheless, it is necessary to check that instantaneous voltage applied to the motor (link to DC bus voltage) are compatible with characteristics of this one.

Failure to follow these instructions can result in equipment damage.

Graphic display terminal

Although the graphic display terminal is optional for low-power drives, it is a standard component on high-power drives (see catalog). The graphic display terminal can be disconnected and connected remotely (on the door of an enclosure for example) using the cables and accessories available as options (see catalog).

Description of the terminal



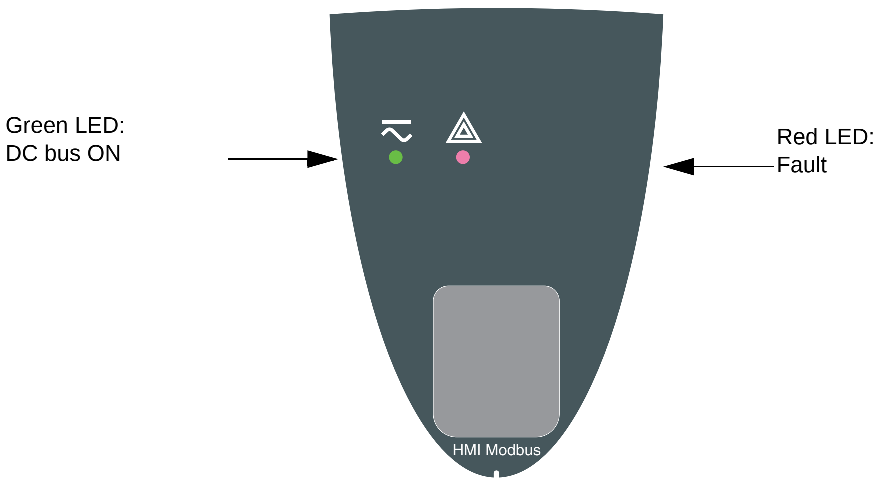
5 Navigation button:

- Press (ENT):
  - To save the current value
  - To enter the selected menu or parameter
- Turn CW/ CCW:
  - To increment or decrement a value
  - To go to the next or previous line
  - To increase or decrease the reference if control via the terminal is activated

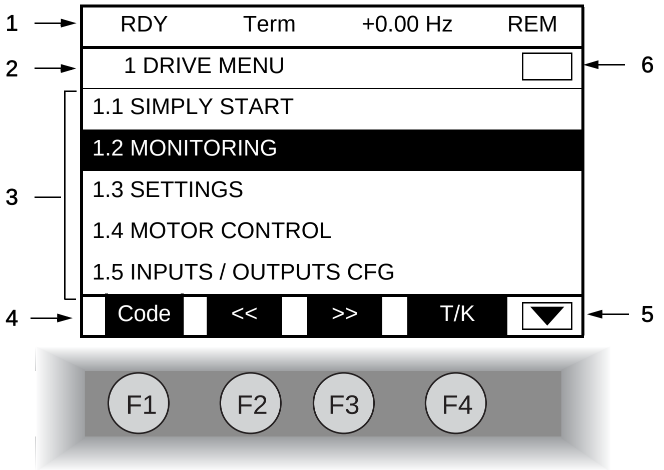
Note: Buttons **3**, **4**, **5** and **6** can be used to control the drive directly, if control via the terminal is activated.

Disconnected terminal

When the terminal is disconnected, two LEDs become visible:



Description of the graphic screen



1. Display line. Its content can be configured; the factory settings show:
   - The drive state (see page 15)
   - The active control channel:
     - Term: Terminals
     - HMI: Graphic display terminal
     - MDB: Integrated Modbus
     - CAN: Integrated CANopen
     - NET: Communication card
     - APP: Controller Inside card
   - Frequency reference
   - LOC/REM: “LOC” appears if the command and reference are set via the graphic display terminal; otherwise, “REM” appears. This corresponds to the state selected by the [T/K] function key.

2. Menu line. Indicates the name of the current menu or submenu.

3. Menus, submenus, parameters, values, bar charts, etc., are displayed in drop-down window format on a maximum of 5 lines. The line or value selected by the navigation button is displayed in reverse video.

4. Section displaying the functions assigned to the keys F1 to F4 and aligned with them, for example:

   - Code F1 : Displays the code of the selected parameter, i.e., the code corresponding to the 7-segment display.
   - HELP F1 : Contextual help.
   - << F2 : Navigate horizontally to the left, or go to previous menu/submenu or, for a value, go to the next digit up, displayed in reverse video (see the example on page 16).
   - >> F3 : Navigate horizontally to the right or go to next menu/submenu (going to the [2 ACCESS LEVEL] menu in this example) or, for a value, go to the next digit down, displayed in reverse video (see the example on page 16).
   - T/K F4 : Command and reference via the terminal, see page 120.

The function keys are dynamic and contextual.
Other functions (application functions) can be assigned to these keys via the [1.6 COMMAND] menu.
If a preset speed is assigned to a function key and if the function key is pressed, the motor will run at this preset speed until another preset speed or JOG is pressed, speed reference is changed, or Stop key is pressed.

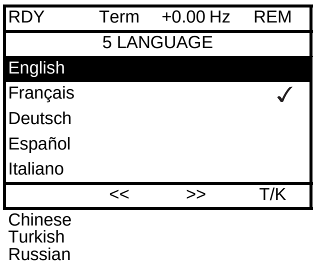
5. Indicates that there are no more levels below this display window.
   Indicates that there are more levels below this display window.

6. Indicates that there are no more levels above this display window.
   Indicates that there are more levels above this display window.

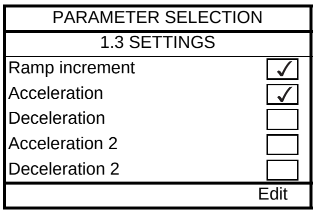
Drive state codes:

- ACC: Acceleration
- CLI: Current limit
- CTL: Controlled stop on input phase loss
- DCB: DC injection braking in progress
- DEC: Deceleration
- FLU: Motor fluxing in progress
- FRF: Drive at fallback speed
- FST: Fast stop
- NLP: No line power (no line supply on L1, L2, L3)
- NST: Freewheel stop
- OBR: Auto-adapted deceleration
- PRA: Power Removal function active (drive locked)
- RDY: Drive ready
- RUN: Drive running
- SOC: Controlled output cut in progress
- TUN: Auto-tuning in progress
- USA: Undervoltage alarm

Example configuration windows:

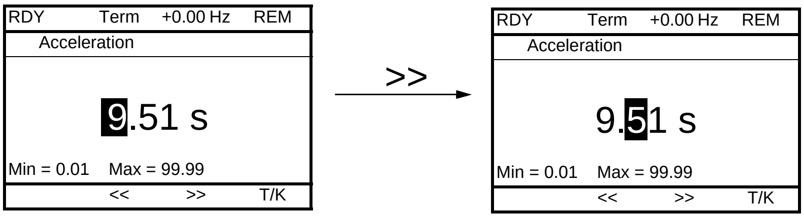


When only one possible selection can be made, the selection made is indicated by ✓
Example: Only one language can be chosen.



When multiple selection is possible, the selections made are indicated by ☑
Example: A number of parameters can be chosen to form the [USER MENU].

Example configuration window for one value:



The << and >> arrows (keys F2 and F3) are used to select the digit to be modified, and the navigation button is rotated to increase or decrease this number.

First power-up – [5. LANGUAGE] menu

The first time the drive is powered up, the user will automatically be guided through the menus as far as [1. DRIVE MENU].
The parameters in the [1.1 SIMPLY START] submenu must be configured and auto-tuning performed before the motor is started up.

Display	
Schneider Electric **ATV61HU22N4** 2.2kW/3HP 380/480V Config. n°1	Display for 3 seconds following power-up

3 seconds ↓

Display	
5 LANGUAGE **English** Français ✓ Deutsch Español Italiano Chinese Turkish Russian	Switches to [5 LANGUAGE] menu automatically. Select the language and press ENT.

↓

Display	
RDY Term +0.00 Hz REM 2 ACCESS LEVEL **Basic** Standard ✓ Advanced Expert	Switches to [2 ACCESS LEVEL] menu (see page 26) Select the access level and press ENT.

↓

Display	
RDY Term +0.00 Hz REM 1 DRIVE MENU **1.1 SIMPLY START** 1.2. MONITORING 1.3. SETTINGS 1.4. MOTOR CONTROL 1.5. INPUTS / OUTPUTS CFG Code << >> T/K	Switches to [1 DRIVE MENU] (see page 22)

ESC ↓

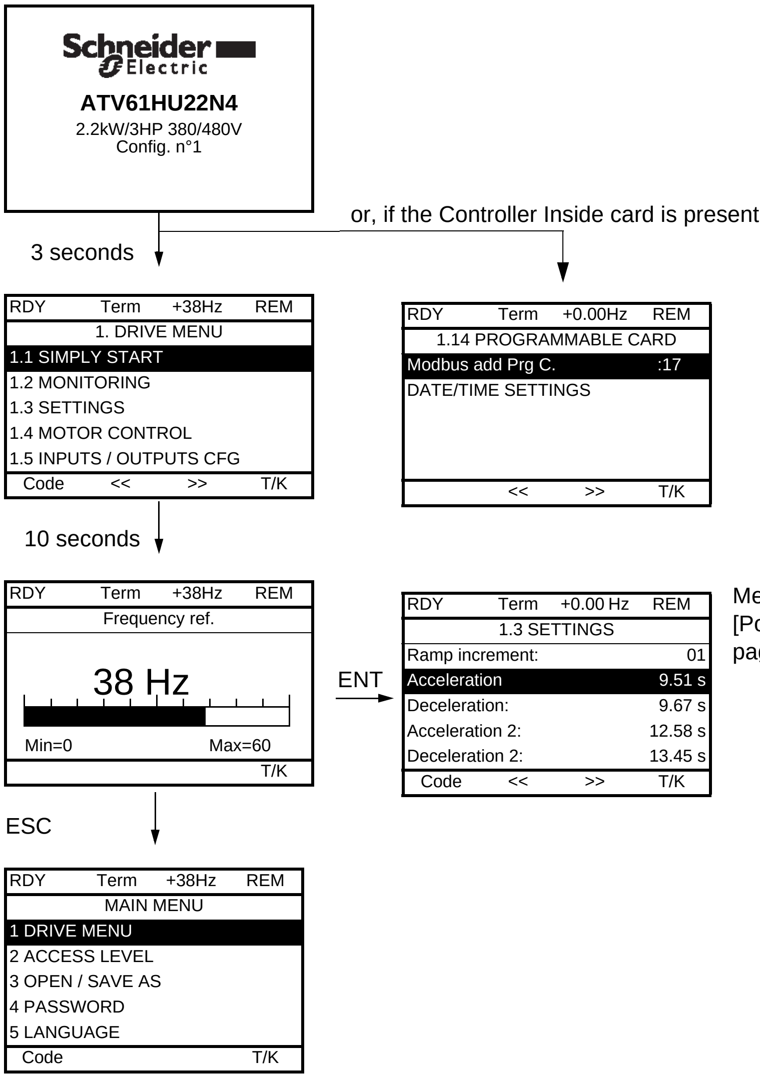
Display	
RDY Term +0.00 Hz REM MAIN MENU **1 DRIVE MENU** 2 ACCESS LEVEL 3 OPEN / SAVE AS 4 PASSWORD 5 LANGUAGE Code T/K	Press ESC to return to [MAIN MENU]

Subsequent power ups

3 seconds later, switches to [1. DRIVE MENU] or to [1.14 PROGRAMMABLE CARD].

If no operator inputs are made, switches to "Display" automatically 10 seconds later (the display will vary depending on the selected configuration).

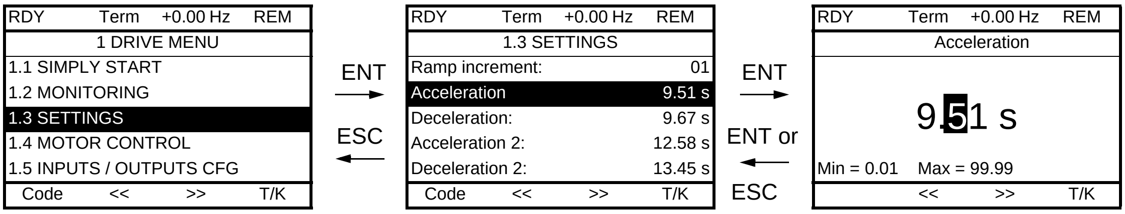
Users can return to [MAIN MENU] by pressing ENT or ESC.



Menu selected in [Power up menu] page 237

Programming: Example of accessing a parameter

Accessing the acceleration ramp



Note:

- To select a parameter:
  - Turn the navigation button to scroll vertically.

- To modify a parameter:
  - Use the << and >> keys (F2 and F3) to scroll horizontally and select the digit to be modified (the selected digit changes to white on a black background).
  - Turn the navigation button to modify the digit.

- To cancel the modification:
  - Press ESC.

- To save the modification:
  - Press the navigation button (ENT).

Quick navigation

In order to access this function you must first reassign the F4 key, which is assigned by default to control via the terminal (T/K) (see page 120).
If the "Quick" function is displayed above the F4 key, you can gain quick access to a parameter from any screen.

Example:

RDY	Term	+0.00 Hz	REM
1.4 MOTOR CONTROL			
Standard mot. freq:			5 0 Hz IEC
Rated motor power:			0.37 kW (0.5 HP)
Rated motor volt.:			206 V
Rated mot. current:			1.0 A
Rated motor freq.:			50.0 Hz
Code	<<	>>	Quick

Press F4 to access the Quick screen, which contains 4 selection options.

RDY	Term	+0.00 Hz	REM
QUICK NAVIGATION			
RETURN TO MAIN MENU			
DIRECT ACCESS TO...			
10 LAST MODIFICATIONS			
GOTO MULTIPOINT SCREEN			
Code			

ENT

See page 238

- [HOME]: Return to [MAIN MENU].

RDY	Term	+0.00 Hz	REM
MAIN MENU			
1 DRIVE MENU			
2 ACCESS LEVEL			
3 OPEN / SAVE AS			
4 PASSWORD			
5 LANGUAGE			
Code			Quick

- [DIRECT ACCESS TO...]: Opens the direct access window, which will contain the text "1". The function keys << and >> (F2 and F3) can be used to select each of the numbers and the navigation button to increment or decrement the numbers: 1.3 in the example below.

RDY	Term	+0.00 Hz	REM
DIRECT ACCESS TO...			
1.3			
SETTINGS			
<<	>>		

ENT

RDY	Term	+0.00 Hz	REM
1.3 SETTINGS			
Ramp increment:			01
Acceleration			9.51 s
Deceleration:			9.67 s
Acceleration 2:			12.58 s
Deceleration 2:			13.45 s
Code	<<	>>	Quick

- [10 LAST MODIFICATIONS]: Opens a window in which the last 10 parameters modified can be accessed directly.

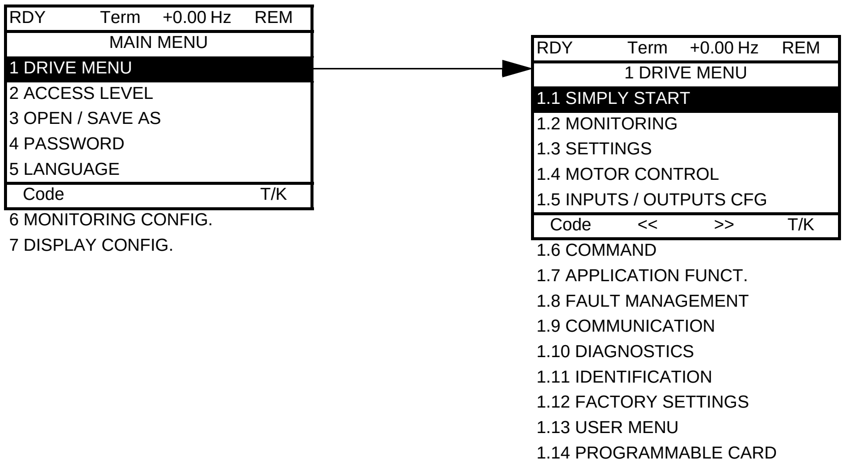
RDY	Term	+0.00 Hz	REM
10 LAST MODIFICATIONS			
Acceleration:			10 s
Speed prop. gain:			25%
Rated mot. current:			15 A
Preset speed 4:		20 Hz	
Preset speed 5:		30 Hz	
Code			

ENT

ESC

RDY	Term	+0.00 Hz	REM
Rated mot. current			
15.0 A			
<<	>>		

[MAIN MENU] – Menu mapping



Content of [MAIN MENU] menus

[1 DRIVE MENU]	See next page
[2 ACCESS LEVEL]	Defines which menus can be accessed (level of complexity)
[3 OPEN / SAVE AS]	Can be used to save and recover drive configuration files
[4 PASSWORD]	Provides password protection for the configuration
[5 LANGUAGE]	Language selection
[6 MONITORING CONFIG.]	Customization of information displayed on the graphic display terminal during operation
[7 DISPLAY CONFIG.]	• Customization of parameters • Creation of a customized user menu • Customization of the visibility and protection mechanisms for menus and parameters

[1 DRIVE MENU]

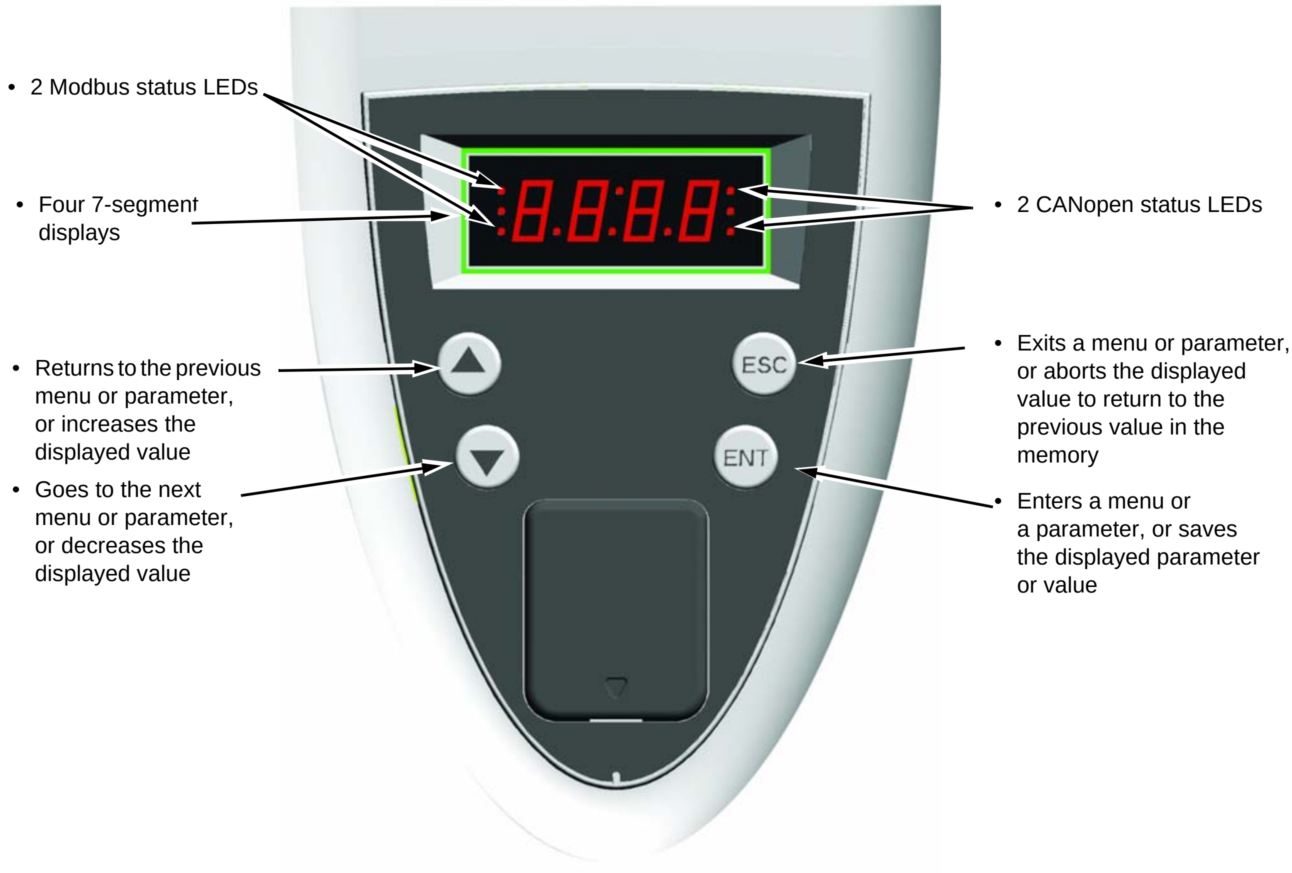
```
RDY          Term     +0.00 Hz     REM
            1 DRIVE MENU
1.1 SIMPLY START
1.2 MONITORING
1.3 SETTINGS
1.4 MOTOR CONTROL
1.5 INPUTS / OUTPUTS CFG
  Code       <<        >>        T/K
1.6 COMMAND
1.7 APPLICATION FUNCT.
1.8 FAULT MANAGEMENT
1.9 COMMUNICATION
1.10 DIAGNOSTICS
1.11 IDENTIFICATION
1.12 FACTORY SETTINGS
1.13 USER MENU
1.14 PROGRAMMABLE CARD
```

Content of [1. DRIVE MENU] menus:

[1.1 SIMPLY START]:	Simplified menu for fast startup
[1.2 MONITORING]:	Visualization of current, motor and input/output values
[1.3 SETTINGS]:	Accesses the adjustment parameters, which can be modified during operation
[1.4 MOTOR CONTROL]:	Motor parameters (motor nameplate, auto-tuning, switching frequency, control algorithms, etc.)
[1.5 INPUTS / OUTPUTS CFG]:	I/O configuration (scaling, filtering, 2-wire control, 3-wire control, etc.)
[1.6 COMMAND]:	Configuration of command and reference channels (graphic display terminal, terminals, bus, etc.)
[1.7 APPLICATION FUNCT.]:	Configuration of application functions (e.g., preset speeds, PID, etc.)
[1.8 FAULT MANAGEMENT]:	Configuration of fault management
[1.9 COMMUNICATION]:	Communication parameters (fieldbus)
[1.10 DIAGNOSTICS]:	Motor/drive diagnostics
[1.11 IDENTIFICATION]:	Identification of the drive and internal options
[1.12 FACTORY SETTINGS]:	Access to configuration files and return to factory settings
[1.13 USER MENU]:	Specific menu set up by the user in the [7. DISPLAY CONFIG.] menu
[1.14 CONTROL. INSIDE CARD]:	Configuration of optional Controller Inside card

Low-power Altivar 61 drives (see catalog) feature an integrated display terminal with a 7-segment 4-digit display. The graphic display terminal described on the previous pages can also be connected to these drives as an option.

Functions of the display and the keys



Note: **• Pressing ▲ or ▼ does not store the selection.**

• Press and hold down (>2 s) ▲ or ▼ to scroll through the data quickly.

Save and store the selection: ENT

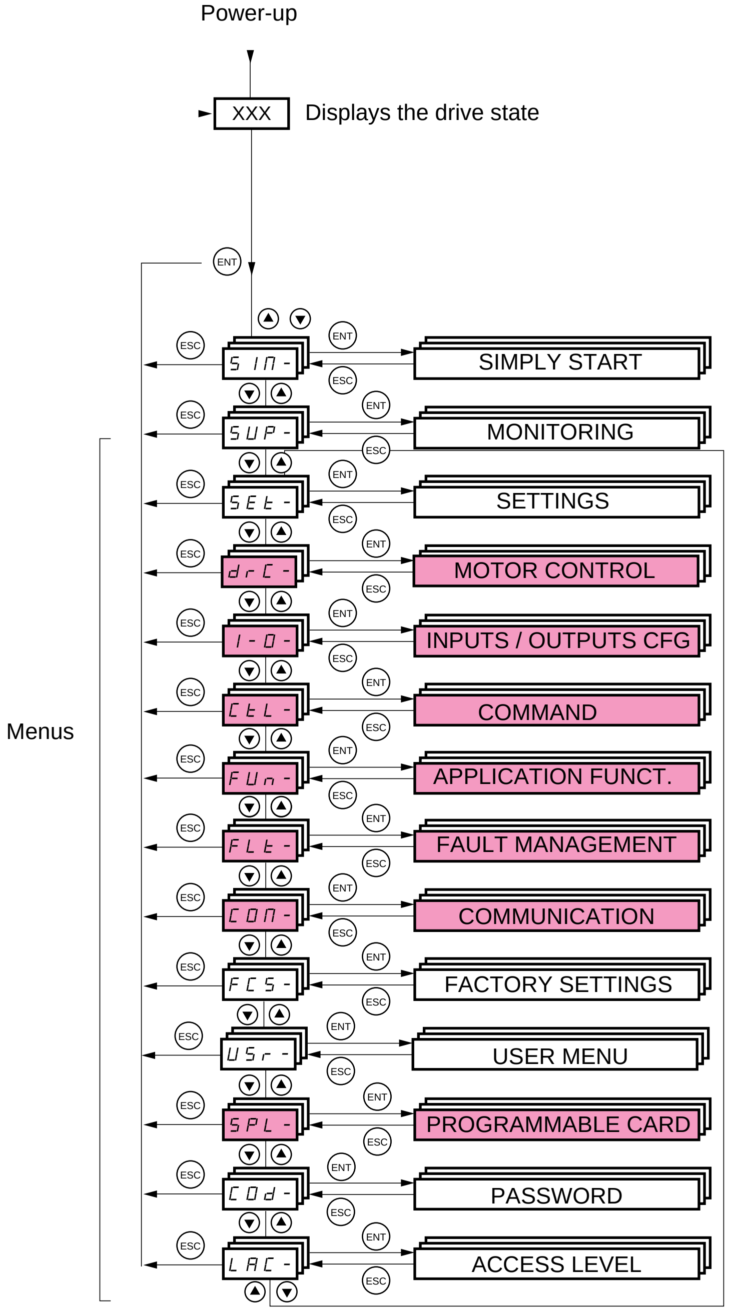
The display flashes when a value is stored.

Normal display, with no fault present and no startup:

- 43.0: Display of the parameter selected in the SUP menu (default selection: motor frequency)
- CLI: Current limit
- CtL: Controlled stop on input phase loss
- dCb: DC injection braking in progress
- FLU: Motor fluxing in progress
- FRF: Drive at fallback speed
- FSt: Fast stop
- nLP: No line power (no line supply on L1, L2, L3)
- nSt: Freewheel stop
- Obr: Auto-adapted deceleration
- PrA: Power Removal function active (drive locked)
- rdY: Drive ready
- SOC: Controlled output cut in progress
- tUn: Auto-tuning in progress
- USA: Undervoltage alarm

The display flashes to indicate the presence of a fault.

Accessing menus



(page 32) Simplified menu for fast startup

(page 38) Visualization of current, motor and input/output values

(page 47) Adjustment parameters, can be modified during operation

(page 66) Motor parameters (motor nameplate, auto-tuning, switching frequency, control algorithms, etc.)

(page 79) I/O configuration (scaling, filtering, 2-wire control, 3-wire control, etc.)

(page 108) Configuration of command and reference channels (graphic display terminal, terminals, bus, etc.)

(page 121) Configuration of application functions (e.g., preset speeds, PID, etc.)

(page 187) Configuration of fault management

(page 213) Communication parameters (fieldbus)

(page 220) Access to configuration files and return to factory settings

(page 223) Specific menu, set up by the user using the graphic display terminal.

(page 224) Menu for the Controller Inside card, if present.

(page 227)

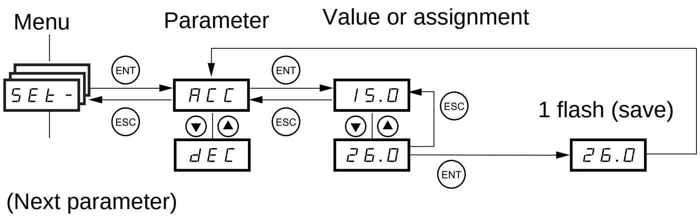
(page 26)

A dash appears after menu and submenu codes to differentiate them from parameter codes.
Examples: FUn- menu, ACC parameter.

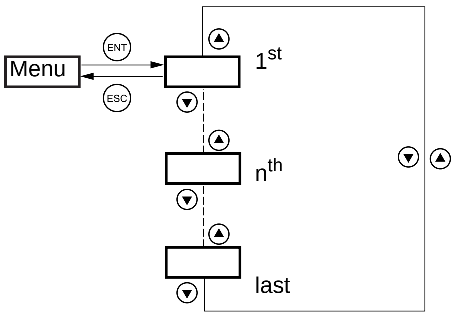
The grayed-out menus may not be accessible depending on the control access (LAC) configuration.

Accessing menu parameters

Save and store the displayed selection: ENT

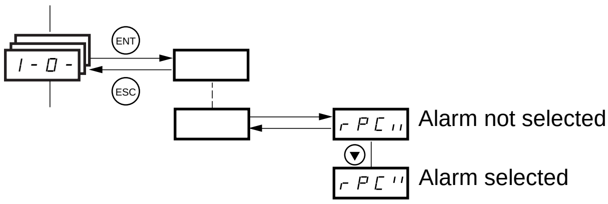


The display flashes when a value is stored.



All the menus are “drop-down scrolling” menus, which means that after the last parameter, if you continue to press ▼, you will return to the first parameter and, conversely, you can switch from the first parameter to the last parameter by pressing ▲.

Selection of multiple assignments for one parameter



Example: List of group 1 alarms in [INPUTS / OUTPUTS CFG] menu (I-O-)
A number of alarms can be selected by “checking” them as follows.

The digit on the right indicates:  selected

 not selected

The same principle is used for all multiple selections.

With graphic display terminal

RDY	Term	+0.00 Hz	REM
2 ACCESS LEVEL			
Basic			
Standard ✓			
Advanced			
Expert			
	<<	>>	T/K

Basic
Access to 5 menus only, and access to 6 submenus only in the [1. DRIVE MENU] menu.
A single function can be assigned to each input.

RDY	Term	+0.00 Hz	REM
MAIN MENU			
1 DRIVE MENU			
2 ACCESS LEVEL			
3 OPEN / SAVE AS			
4 PASSWORD			
5 LANGUAGE			
Code	<<	>>	T/K

RDY	Term	+0.00 Hz	REM
1. DRIVE MENU			
1.1 SIMPLY START			
1.2. MONITORING			
1.3. SETTINGS			
1.11. IDENTIFICATION			
1.12. FACTORY SETTINGS			
Code	<<	>>	T/K

1.13 USER MENU

Standard
This is the factory-set level. Access to 6 menus only, and access to all submenus in the [1. DRIVE MENU] menu.
A single function can be assigned to each input.

RDY	Term	+0.00 Hz	REM
MAIN MENU			
1 DRIVE MENU			
2 ACCESS LEVEL			
3 OPEN / SAVE AS			
4 PASSWORD			
5 LANGUAGE			
Code			T/K

6 MONITORING CONFIG.

RDY	Term	+0.00 Hz	REM
1 DRIVE MENU			
1.1 SIMPLY START			
1.2 MONITORING			
1.3 SETTINGS			
1.4 MOTOR CONTROL			
1.5 INPUTS / OUTPUTS CFG			
Code	<<	>>	T/K

1.6 COMMAND
1.7 APPLICATION FUNCT.
1.8 FAULT MANAGEMENT
1.9 COMMUNICATION
1.10 DIAGNOSTICS
1.11 IDENTIFICATION
1.12 FACTORY SETTINGS
1.13 USER MENU
1.14 PROGRAMMABLE CARD

Advanced
Access to all menus and submenus.
Several functions can be assigned to each input.

RDY	Term	+0.00 Hz	REM
MAIN MENU			
1 DRIVE MENU			
2 ACCESS LEVEL			
3 OPEN / SAVE AS			
4 PASSWORD			
5 LANGUAGE			
Code			T/K

6 MONITORING CONFIG.
7 DISPLAY CONFIG.

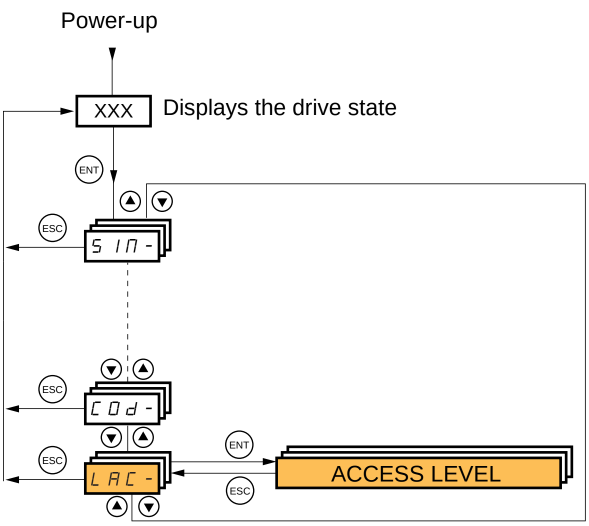
Expert
Access to all menus and submenus as for [Advanced] level, and access to additional parameters.
Several functions can be assigned to each input.

RDY	Term	+0.00 Hz	REM
MAIN MENU			
1 DRIVE MENU			
2 ACCESS LEVEL			
3 OPEN / SAVE AS			
4 PASSWORD			
5 LANGUAGE			
Code			T/K

6 MONITORING CONFIG.
7 DISPLAY CONFIG.

[2. ACCESS LEVEL] (LAC-)

With integrated display terminal:



Code	Name/Description	Factory setting
LAC-		Std
bAS	• bAS: Limited access to SIM, SUP, SEt, FCS, USr, COd and LAC menus. A single function can be assigned to each input.	
Std	• Std: Access to all menus on the integrated display terminal. A single function can be assigned to each input.	
AdU	• AdU: Access to all menus on the integrated display terminal. Several functions can be assigned to each input.	
EPr	• EPr: Access to all menus on the integrated display terminal and access to additional parameters. Several functions can be assigned to each input.	

[2. ACCESS LEVEL] (LAC-)

Comparison of the menus that can be accessed on the graphic display terminal/ integrated display terminal

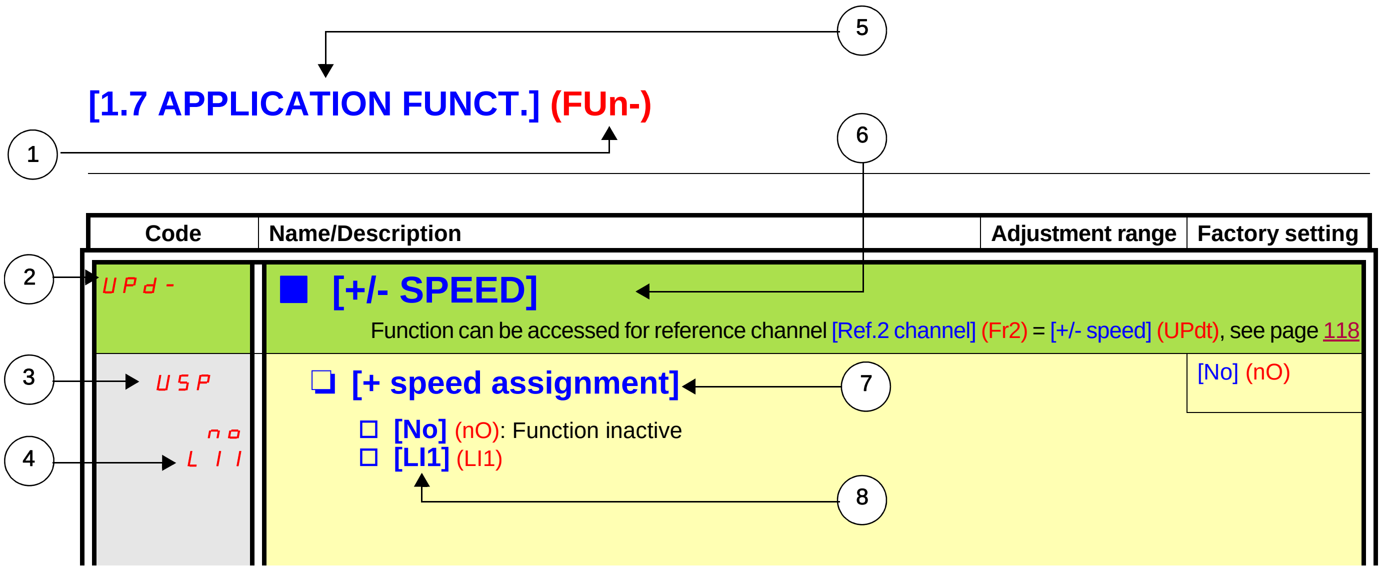
Graphic display terminal		Integrated display terminal	Access level
[2 ACCESS LEVEL]		LAC- (Access level)	
[3. OPEN / SAVE AS]		-	
[4 PASSWORD]		COd- (Password)	
[5 LANGUAGE]		-	
[1 DRIVE MENU]	[1.1 SIMPLY START]	SIM- (Simply start)	
	[1.2 MONITORING]	SUP- (Monitoring)	Basic bAS
	[1.3 SETTINGS]	SEt- (Settings)	
	[1.11 IDENTIFICATION]	-	
	[1.12 FACTORY SETTINGS]	FCS- (Factory settings)	
	[1.13 USER MENU]	USr- (User menu)	
A single function can be assigned to each input.		A single function can be assigned to each input.	
	[1.4 MOTOR CONTROL]	drC- (Motor control)	
	[1.5 INPUTS / OUTPUTS CFG]	I-O- (I/O configuration)	Standard Std (factory setting)
	[1.6 COMMAND]	CtL- (Command)	Advanced AdU
	[1.7 APPLICATION FUNCT.]	FUn- (Application functions)	Expert EPr
	[1.8 FAULT MANAGEMENT]	FLt- (Fault management)	
	[1.9 COMMUNICATION]	COM- (Communication)	
	[1.10 DIAGNOSTICS]	-	
	[1.14 PROGRAMMABLE CARD] (1)	PLC- (Controller Inside card) (1)	
[6 MONITORING CONFIG.]		-	
A single function can be assigned to each input.		A single function can be assigned to each input.	
[7 DISPLAY CONFIG.]		-	
Several functions can be assigned to each input.		Several functions can be assigned to each input.	
Expert parameters		Expert parameters	
Several functions can be assigned to each input.		Several functions can be assigned to each input.	

(1) Can be accessed if the Controller Inside card is present.

Structure of parameter tables

The parameter tables in the descriptions of the various menus can be used with both the graphic display terminal and the integrated display terminal. They, therefore, contain information for these two terminals in accordance with the description below.

Example:



1. Name of menu on 4-digit 7-segment display
2. Submenu code on 4-digit 7-segment display
3. Parameter code on 4-digit 7-segment display
4. Parameter value on 4-digit 7-segment display
5. Name of menu on graphic display terminal
6. Name of submenu on graphic display terminal
7. Name of parameter on graphic display terminal
8. Value of parameter on graphic display terminal

Note:
- The text in square brackets [ ] indicates what you will see on the graphic display terminal.
- The factory settings correspond to [Macro configuration] (CFG) = [Pumps.Fans] (PnF). This is the macro configuration set at the factory.

Interdependence of parameter values

The configuration of certain parameters modifies the adjustment range of other parameters, in order to reduce the risk of errors. **This may result in the modification of a factory setting or a value you have already selected.**

Example 1:

1. [Switching freq.] (SFr) page 75 set to 16 kHz.
2. [Sinus filter] (OFI), see page 75, set to [Yes] (YES) (and confirmed with “ENT”) limits [Switching freq.] (SFr) to 8 kHz.

If you set [Sinus filter] (OFI) to [No] (nO), [Switching freq.] (SFr) will no longer be limited **but will remain at 8 kHz**. If you require 16 kHz, you must **reset** [Switching freq.] (SFr).

Example 2:

1. The factory setting of [Switching freq.] (SFr) page 75 remains unchanged at 2.5 kHz.
2. Setting [Sinus filter] (OFI) page 75 to [Yes] (YES) (and confirming with “ENT”) changes the factory setting of [Switching freq.] (SFr) to 4 kHz.
3. If you set [Sinus filter] (OFI) to [No] (nO), [Switching freq.] (SFr) **will remain at 4 kHz**. If you require 2.5 kHz, you must **reset** [Switching freq.] (SFr).

Finding a parameter in this document

The following assistance with finding explanations on a parameter is provided:

- **With the integrated display terminal:** Direct use of the parameter code index, page 249, to find the page giving details of the displayed parameter.

- **With the graphic display terminal:** Select the required parameter and press F1 : [Code]. The parameter code is displayed instead of its name while the key is held down.

  Example: ACC

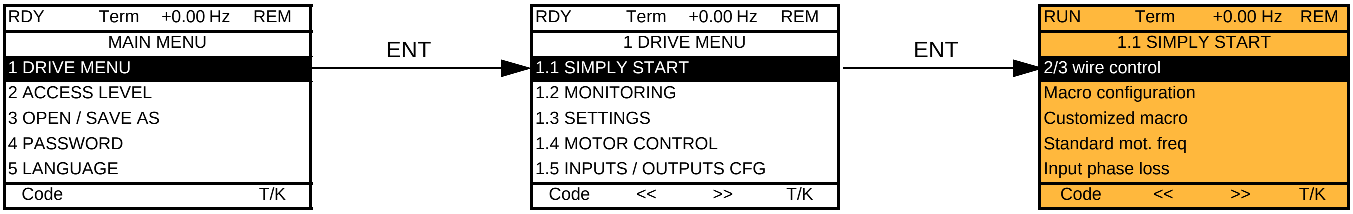
RDY	Term	+0.00 Hz	REM
	1.3 SETTINGS		
Ramp increment:			01
Acceleration			9.51 s
Deceleration:			9.67 s
Acceleration 2:			12.58 s
Deceleration 2:			13.45 s
Code	<<	>>	T/K

Code →

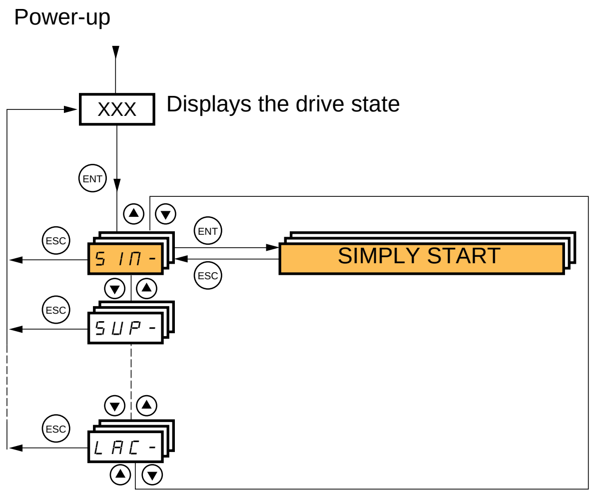
RDY	Term	+0.00 Hz	REM
	1.3 SETTINGS		
Ramp increment:			01
ACC			9.51 s
Deceleration:			9.67 s
Acceleration 2:			12.58 s
Deceleration 2:			13.45 s
Code	<<	>>	T/K

Then use the parameter code index, page 249, to find the page giving details of the displayed parameter.

With graphic display terminal:



With integrated display terminal:



The [1.1-SIMPLY START] (SIM-) menu can be used for fast startup, which is sufficient for the majority of applications.

The parameters in this menu can only be modified when the drive is stopped and no run command is present, with the following exceptions:

- Auto-tuning, which causes the motor to start up
- The adjustment parameters on page 37

Note: The parameters of the [1.1 SIMPLY START] (SIM-) menu must be entered in the order in which they appear, as the later ones are dependent on the first ones.
For example [2/3 wire control] (tCC) must be configured before any other parameters.

The [1.1 SIMPLY START] (SIM-) menu should be configured **on its own or before the other drive configuration menus**. If a modification has previously been made to any of them, in particular in [1.4 MOTOR CONTROL] (drC-), some [1.1 SIMPLY START] (SIM-) parameters may be changed, for example, the motor parameters, if a synchronous motor has been selected. Returning to the [1.1 SIMPLY START] (SIM-) menu after modifying another drive configuration menu **is unnecessary** but does not pose any risk. Changes following modification of another configuration menu **are not described**, to avoid unnecessary complication in this section.

Macro configuration

Macro configuration provides a means of speeding up the configuration of functions for a specific field of application.
5 macro configurations are available:

- Start/stop
- General use
- PID regulator
- Communication bus
- Pumps/fans (factory configuration)

Selecting a macro configuration assigns the parameters in this macro configuration.

Each macro configuration can still be modified in the other menus.

Macro configuration parameters

Assignment of the inputs/outputs

Input/ output	[Start/Stop]	[Gen. Use]	[PID regul.]	[Network C.]	[Pumps.Fans]
AI1	[Ref.1 channel]	[Ref.1 channel]	[Ref.1 channel] (PID reference)	[Ref.2 channel] ([Ref.1 channel] = integrated Modbus) (1)	[Ref.1 channel]
AI2	[No]	[Summing ref. 2]	[PID feedback]	[No]	[Ref.1B channel]
AO1	[No]	[No]	[No]	[No]	[No]
R1	[No drive flt]	[No drive flt]	[No drive flt]	[No drive flt]	[No drive flt]
R2	[No]	[No]	[No]	[No]	[Drv running]
LI1 (2-wire)	[Forward]	[Forward]	[Forward]	[Forward]	[Forward]
LI2 (2-wire)	[Fault reset]	[Reverse]	[Fault reset]	[Fault reset]	[No]
LI3 (2-wire)	[No]	[Jog]	[PID integral reset]	[Ref. 2 switching]	[Ref 1B switching]
LI4 (2-wire)	[No]	[Fault reset]	[2 preset PID ref.]	[Forced local]	[Fault reset]
LI5 (2-wire)	[No]	[Torque limitation]	[4 preset PID ref.]	[No]	[No]
LI6 (2-wire)	[No]	[No]	[No]	[No]	[No]
LI1 (3-wire)	Stop	Stop	Stop	Stop	Stop
LI2 (3-wire)	[Forward]	[Forward]	[Forward]	[Forward]	[Forward]
LI3 (3-wire)	[Fault reset]	[Reverse]	[Fault reset]	[Fault reset]	[No]
LI4 (3-wire)	[No]	[Jog]	[PID integral reset]	[Ref. 2 switching]	[Ref 1B switching]
LI5 (3-wire)	[No]	[Fault reset]	[2 preset PID ref.]	[Forced local]	[Fault reset]
LI6 (3-wire)	[No]	[Torque limitation]	[4 preset PID ref.]	[No]	[No]
Option cards					
LI7 to LI14	[No]	[No]	[No]	[No]	[No]
LO1 to LO4	[No]	[No]	[No]	[No]	[No]
R3/R4	[No]	[No]	[No]	[No]	[No]
AI3, AI4	[No]	[No]	[No]	[No]	[No]
RP	[No]	[No]	[No]	[No]	[No]
AO2	[I motor]	[I motor]	[I motor]	[I motor]	[I motor]
AO3	[No]	[No]	[PID Output]	[No]	[No]
Graphic display terminal keys					
F1 key	[No]	[No]	[No]	[No]	[No]
F2, F3 keys	[No]	[No]	[No]	[No]	[No]
F4 key	[T/K] (Control via graphic display terminal)	[T/K] (Control via graphic display terminal)	[T/K] (Control via graphic display terminal)	[T/K] (Control via graphic display terminal)	[T/K] (Control via graphic display terminal)

In 3-wire control, the assignment of inputs LI1 to LI7 shifts.

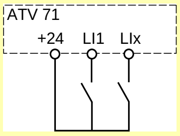
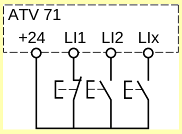
(1) To start up with integrated Modbus, [Modbus Address] (Add) must first be configured, page 215.

Note: These assignments are reinitialized every time the macro configuration changes.

Return to factory settings:
Returning to factory settings with [Config. source] (FCSI) = [Macro-Conf] (InI) page 222 will restore the selected macro configuration. The [Macro configuration] (CFG) parameter does not change, although [Customized macro] (CCFG) disappears.

Note:

- The factory settings in the parameter tables correspond to [Macro configuration] (CFG) = [Pumps.Fans] (PnF). This is the macro configuration set at the factory.

Code	Name/Description	Adjustment range	Factory setting
tCC 2C 3C	❑ **[2/3 wire control]** ☐ **[2 wire]** (2C) ☐ **[3 wire]** (3C) 2-wire control: This is the input state (0 or 1) or edge (0 to 1 or 1 to 0), which controls running or stopping. Example of “source” wiring:  LI1: forward LIx: reverse 3-wire control (pulse control): A “forward” or “reverse” pulse is sufficient to command starting, a “stop” pulse is sufficient to command stopping. Example of “source” wiring:  LI1: stop LI2: forward LIx: reverse **WARNING** **UNINTENDED EQUIPMENT OPERATION** To change the assignment of [2/3 wire control] (tCC) press the “ENT” key for 2 s. The following function will be returned to factory settings: [2 wire type] (tCt) page 80 as will all functions which assign logic inputs. The macro configuration selected will also be reset if it has been customized (loss of custom settings). Check that this change is compatible with the wiring diagram used. **Failure to follow these instructions can result in death or serious injury.**		[2 wire] (2C)
CFG StS GEn PId nEt PnF	❑ **[Macro configuration]** ☐ **[Start/Stop]** (StS): Start/stop ☐ **[Gen. Use]** (GEn): General use ☐ **[PID regul.]** (PId): PID regulation ☐ **[Network C.]** (nEt): Communication bus ☐ **[Pumps.Fans]** (PnF): Pumps/fans **WARNING** **UNINTENDED EQUIPMENT OPERATION** To change the assignment of [Macro configuration] (CFG) press the “ENT” key for 2 s. Check that the selected macro configuration is compatible with the wiring diagram used. **Failure to follow these instructions can result in death or serious injury.**		[Pumps.Fans] (PnF)
CCFG YES	❑ **[Customized macro]** Read-only parameter, only visible if at least one macro configuration parameter has been modified. ☐ **[Yes]** (YES)		

Code	Name/Description	Adjustment range	Factory setting
bFr	❑ **[Standard mot. freq]**		[50Hz IEC] (50)
50 60	☐ **[50Hz IEC]** (50): IEC. ☐ **[60Hz NEMA]** (60): NEMA. This parameter modifies the presets of the following parameters: [Rated motor power] (nPr), [Rated motor volt.] (UnS), [Rated drive current] (nCr), [Rated motor freq.] (FrS), [Rated motor speed] (nSP), and [Max frequency] (tFr) below, [Mot. therm. current] (ItH) page 37, [High speed] (HSP) page 37.		
IPL	❑ **[Input phase loss]**		According to drive rating
nO YES	☐ **[Ignore]** (nO): Fault ignored, to be used when the drive is supplied via a single-phase supply or by the DC bus. ☐ **[Freewheel]** (YES): Fault, with freewheel stop. If one phase disappears, the drive switches to fault mode [Input phase loss] (IPL) but if 2 or 3 phases disappear, the drive continues to operate until it trips on an undervoltage fault. This parameter is only accessible in this menu on ATV61H037M3 to HU75M3 drives (used with a single phase supply).		
nPr	❑ **[Rated motor power]** Rated motor power given on the nameplate, in kW if [Standard mot. freq] (bFr) = [50 Hz IEC] (50), in HP if [Standard mot. freq] (bFr) = [60 Hz NEMA] (60).	According to drive rating	According to drive rating
UnS	❑ **[Rated motor volt.]** Rated motor voltage given on the nameplate. ATV61●●●M3: 100 to 240 V - ATV61●●●N4: 200 to 480 V - ATV61●●●S6X: 400 to 600 V - ATV61●●●Y: 400 to 690 V.	According to drive rating	According to drive rating and [Standard mot. freq] (bFr)
nCr	❑ **[Rated mot. current]** Rated motor current given on the nameplate.	0.25 to 1.1 or 1.2 Hz according to rating (1)	According to drive rating and [Standard mot. freq] (bFr)
FrS	❑ **[Rated motor freq.]** Rated motor frequency given on the nameplate. The factory setting is 50 Hz, or preset to 60 Hz if [Standard mot. freq] (bFr) is set to 60 Hz.	10 to 500 or 1,000 Hz according to rating	50 Hz
nSP	❑ **[Rated motor speed]** Rated motor speed given on the nameplate. 0 to 9,999 rpm then 10.00 to 60.00 krpm on the integrated display terminal. If, rather than the rated speed, the nameplate indicates the synchronous speed and the slip in Hz or as a %, calculate the rated speed as follows: • Nominal speed = Synchronous speed x $\frac{100 - \text{slip as a \%}}{100}$ or • Nominal speed = Synchronous speed x $\frac{50 - \text{slip in Hz}}{50}$ (50 Hz motors) or • Nominal speed = Synchronous speed x $\frac{60 - \text{slip in Hz}}{60}$ (60 Hz motors)	0 to 60,000 rpm	According to drive rating
tFr	❑ **[Max frequency]** The factory setting is 60 Hz, or preset to 72 Hz if [Standard mot. freq] (bFr) is set to 60 Hz. The maximum value is limited by the following conditions: • It must not exceed 10 times the value of [Rated motor freq.] (FrS) • Values between 500 Hz and 1000 Hz are not possible for ATV61H●●●Y (500 to 690 V) • Values between 500 Hz and 1,000 Hz are only possible in V/F control and for powers limited to 37 kW (50 HP) for ATV61H ●●● and 45 kW (60 HP) for ATV61W●●●. In this case, configure [Motor control type] (Ctt) before [Max frequency] (tFr).	10 to 500 or 1,000 Hz according to rating	60 Hz

(1) In corresponds to the rated drive current indicated in the Installation Manual and on the drive nameplate.

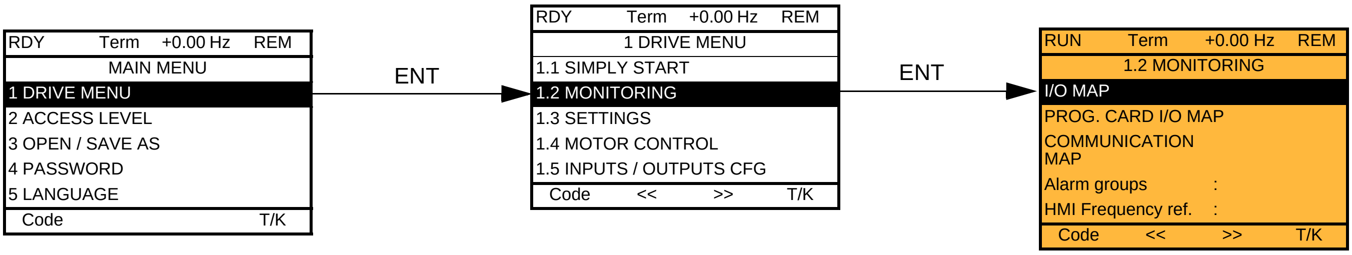
Code	Name/Description	Factory setting
tUn	❑ **[Auto tuning]**	[No] (nO)
nO	☐ **[No]** (nO): Auto-tuning not performed.	
YES	☐ **[Yes]** (YES): Auto-tuning is performed as soon as possible, then the parameter automatically changes to [Done] (dOnE).	
dOnE	☐ **[Done]** (dOnE): Use of the values given the last time auto-tuning was performed. **Caution:** • It is essential that all motor parameters ([Rated motor volt.] (UnS), [Rated motor freq.] (FrS), [Rated mot. current] (nCr), [Rated motor speed] (nSP), [Rated motor power] (nPr)) are configured correctly before starting auto-tuning. If one or more of these parameters is modified after auto-tuning has been performed, [Auto tuning] (tUn) will return to [No] (nO) and the procedure must be repeated. • Auto-tuning is only performed if no stop command has been activated. If a "freewheel stop" or "fast stop" function has been assigned to a logic input, this input must be set to 1 (active at 0). • Auto-tuning takes priority over any run or prefluxing commands, which will be taken into account after the auto-tuning sequence. • If auto-tuning fails, the drive displays [No] (nO) and, depending on the configuration of [Autotune fault mgt] (tnL) page 206, may switch to [Auto-tuning] (tnF) fault mode. • Auto-tuning may last for 1 to 2 seconds. Do not interrupt the process. Wait for the display to change to "[Done] (dOnE)" or "[No] (nO)". **Note:** During auto-tuning the motor operates at rated current.	
tUS	❑ **[Auto tuning status]** (for information only, cannot be modified)	[Not done] (tAb)
tAb	☐ **[Not done]** (tAb): The default stator resistance value is used to control the motor.	
PEnd	☐ **[Pending]** (PEnd): Auto-tuning has been requested but not yet performed.	
PrOG	☐ **[In Progress]** (PrOG): Auto-tuning in progress.	
FAIL	☐ **[Failed]** (FAIL): Auto-tuning has failed.	
dOnE	☐ **[Done]** (dOnE): The stator resistance measured by the auto-tuning function is used to control the motor.	
PHr	❑ **[Output Ph rotation]**	[ABC] (AbC)
AbC	☐ **[ABC]** (AbC): Forward	
ACb	☐ **[ACB]** (ACb): Reverse This parameter can be used to reverse the direction of rotation of the motor without reversing the wiring.	

Parameters that can be changed during operation or when stopped

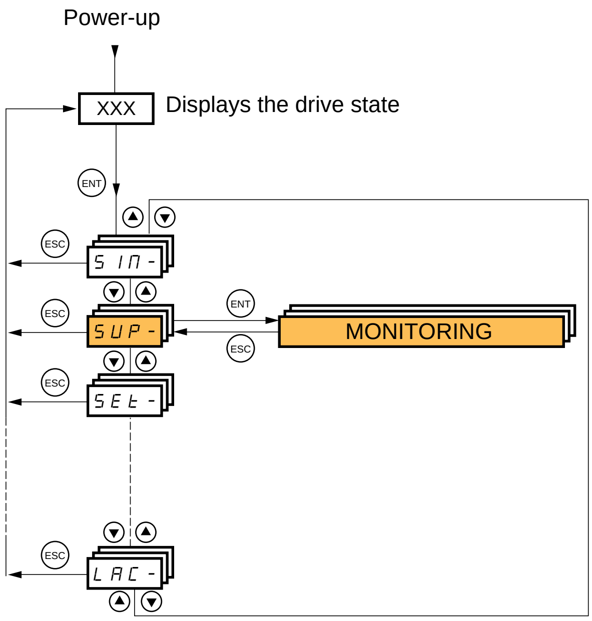
Code	Name/Description	Adjustment range	Factory setting
ItH	❑ **[Mot. therm. current]**	0 to 1.1 or 1.2 In (1) according to rating	According to drive rating
	Motor thermal protection current, to be set to the rated current indicated on the nameplate.		
ACC	❑ **[Acceleration]**	0.1 to 999.9 s	3.0 s
	Time to accelerate from 0 to the [Rated motor freq.] (FrS) (page 35). Make sure that this value is compatible with the inertia being driven.		
dEC	❑ **[Deceleration]**	0.1 to 999.9 s	3.0 s
	Time to decelerate from the [Rated motor freq.] (FrS) (page 35) to 0. Make sure that this value is compatible with the inertia being driven.		
LSP	❑ **[Low speed]**		0
	Motor frequency at minimum reference, can be set between 0 and [High speed] (HSP).		
HSP	❑ **[High speed]**		50 Hz
	Motor frequency at maximum reference, can be set between [Low speed] (LSP) and [Max frequency] (tFr). The factory setting changes to 60 Hz if [Standard mot. freq] (bFr) = [60Hz NEMA] (60).		

(1) In corresponds to the rated drive current indicated in the Installation Manual and on the drive nameplate.

With graphic display terminal:



With integrated display terminal:



With graphic display terminal

This menu can be used to display the inputs/outputs, the drive internal states and values, and the communication data and values.

```
RUN        Term     +50.00 Hz   REM
         1.2 MONITORING
I/O MAP
PROG. CARD I/O MAP
COMMUNICATION MAP
Alarm groups:
HMI Frequency ref.:
   Code        <<        >>       T/K
```

- I/O MAP → I/O
- PROG. CARD I/O MAP → I/O of the Controller Inside card if it is present
- COMMUNICATION MAP → Communication data and values
- Alarm groups / HMI Frequency ref. → Drive internal drive states and values (see page 44)

I/O

```
RUN        Term     +50.00 Hz   REM
             I/O MAP
LOGIC INPUT MAP
ANALOG INPUTS IMAGE
LOGIC OUTPUT MAP
ANALOG OUTPUTS IMAGE
FREQ. SIGNAL IMAGE
   Code                           T/K
```

Move from one screen to another
(from LOGIC INPUT MAP
to FREQ. SIGNAL IMAGE)
by turning the navigation button

State 0

State 1

```
RUN      Term-{}-   +50.00 Hz   REM
          LOGIC INPUT MAP
   PR  LI1  LI2  LI3  LI4  LI5  LI6  LI7
 1
 0
   LI8  LI9  LI10 LI11 LI12 LI13 LI14
 1
 0
               <<        >>       T/K
```

Access to the selected input
or output configuration:
Press ENT.

```
RUN        Term     +50.00 Hz   REM
           LI1 assignment
Forward
Pre Fluxing
LI1 On Delay         :          0 ms
               <<        >>       T/K
```

```
RUN        Term     +50.00 Hz   REM
        ANALOG INPUTS IMAGE
AI1                :          9.87 V
AI2                :         2.35 mA
   Code        <<        >>       T/K
```

ENT

```
RUN        Term     +50.00 Hz   REM
           AI1 assignment
Ref.1 channel
Forced local
Torque reference
AI1 min value      :           0.0 V
AI1 max value      :          10.0 V
                                  T/K
```

State 0

State 1

```
RUN        Term     +50.00 Hz   REM
          LOGIC OUTPUT MAP
  R1   R2   LO

LOA:              0000000000000010b
               <<        >>       T/K
```

ENT

```
RUN        Term     +50.00 Hz   REM
           LO1 assignment
No
LO1 delay time      :          0 ms
LO1 active at       :          1
LO1 holding time    :          0 ms
               <<        >>       T/K
```

```
RUN        Term     +50.00 Hz   REM
       ANALOG OUTPUTS IMAGE
AO1                :          9.87 V
   Code        <<        >>       T/K
```

ENT

```
RUN        Term     +50.00 Hz   REM
           AO1 assignment
Motor freq.
AO1 min output      :          4 mA
AO1 max output      :         20 mA
AO1 Filter          :         10 ms
                                  T/K
```

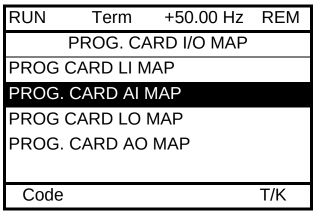
```
RUN        Term     +50.00 Hz   REM
        FREQ. SIGNAL IMAGE
RP input           :       25.45 kHz
Encoder            :         225 kHz
   Code        <<        >>       T/K
```

ENT

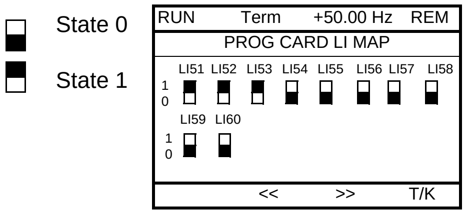
```
RUN        Term     +50.00 Hz   REM
           RP assignment
Frequency ref.
RP min value        :          2 kHz
RP max value        :         50 kHz
RP filter           :          0 ms
                                  T/K
```

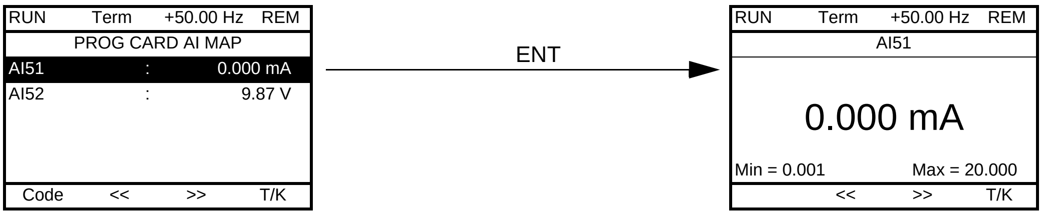
With graphic display terminal

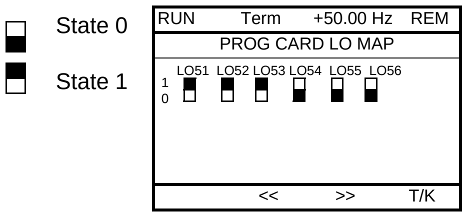
Controller Inside card I/O

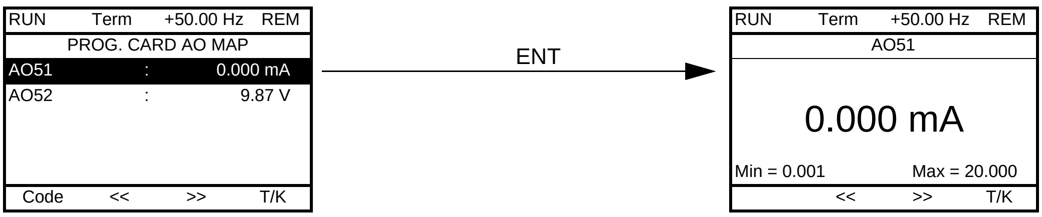


Move from one screen to another
(from PROG CARD LI MAP
to PROG. CARD AO MAP)
by turning the navigation button









With graphic display terminal

Communication

[COMMUNICATION MAP] indicates the types of bus used for control or reference, the corresponding command and reference values, the status word, the words selected in the [DISPLAY CONFIG] menu, etc.
The display format (hexadecimal or decimal) can be configured in the [DISPLAY CONFIG.] menu.

RUN Term +50.00 Hz REM	
COMMUNICATION MAP	
Command Channel:	Modbus
Cmd value:	ABCD Hex
Active ref. channel:	CANopen
Frequency ref.:	- 12.5 Hz
ETA status word:	2153 Hex
Code	T/K

W3141: F230 Hex
W2050: F230 Hex
W4325: F230 Hex
W0894: F230 Hex
COM. SCANNER INPUT MAP
COM SCAN OUTPUT MAP
CMD. WORD IMAGE
FREQ. REF. WORD MAP
MODBUS NETWORK DIAG
MODBUS HMI DIAG
CANopen MAP
PROG. CARD SCANNER

RUN Term +50.00 Hz REM	
COM. SCANNER INPUT MAP	
Com Scan In1 val.:	0
Com Scan In2 val.:	0
Com Scan In3 val.:	0
Com Scan In4 val.:	0
Com Scan In5 val.:	0
Code	T/K

Com Scan In6 val.: 0
Com Scan In7 val.: 0
Com Scan In8 val.: 0

RUN Term +50.00 Hz REM	
COM SCAN OUTPUT MAP	
Com Scan Out1 val.:	0
Com Scan Out2 val.:	0
Com Scan Out3 val.:	0
Com Scan Out4 val.:	0
Com Scan Out5 val.:	0
Code	T/K

Com Scan Out6 val.: 0
Com Scan Out7 val.: 0
Com Scan Out8 val.: 0

RUN Term +50.00 Hz REM	
CMD. WORD IMAGE	
Modbus cmd.:	0000 Hex.
CANopen cmd.:	0000 Hex.
COM. card cmd.:	0000 Hex.
Prog. card cmd:	0000 Hex.
Code	T/K

RUN Term +50.00 Hz REM	
FREQ. REF. WORD MAP	
Modbus ref.:	0.0 Hz
CANopen ref.:	0.0 Hz
Ref. Com. card:	0.0 Hz
Prog. Card ref:	0.0 Hz
Code	T/K

[COM. SCANNER INPUT MAP] and [COM SCAN OUTPUT MAP]:
Visualization of registers exchanged periodically (8 input and 8 output) for integrated Modbus and for fieldbus cards.

With graphic display terminal

Communication (continued)

```
RUN        Term      +50.00 Hz    REM
          COMMUNICATION MAP
Command Channel:          Modbus
Cmd value:                ABCD Hex
Active ref. channel:      CANopen
Frequency ref.:           - 12.5 Hz
ETA status word:          2153 Hex
  Code                           T/K
W3141      :   F230 Hex
W2050      :   F230 Hex
W4325      :   F230 Hex
W0894      :   F230 Hex
COM. SCANNER INPUT MAP
COM SCAN OUTPUT MAP
CMD. WORD IMAGE
FREQ. REF. WORD MAP
MODBUS NETWORK DIAG
MODBUS HMI DIAG
CANopen MAP
PROG. CARD SCANNER
```

The state of the LEDs, the periodic data, the address, the speed, and the format, etc,. is given for each bus.

⊗ LED off

LED on

Communication via Modbus

```
RUN        Term      +50.00 Hz    REM
         MODBUS NETWORK DIAG
COM LED            :          ⊗
Mb NET frames nb.
Mb NET CRC errors

  Code                           T/K
```

Communication via the graphic display terminal

```
RUN        Term      +50.00 Hz    REM
           MODBUS HMI DIAG
COM LED            :
Mb HMI frames nb.
Mb HMI CRC errors

  Code                           T/K
```

Communication via CANopen

```
RUN        Term      +50.00 Hz    REM
             CANopen MAP
RUN LED            :          ⊗
ERR LED            :          ⊗
PDO1 IMAGE
PDO2 IMAGE
PDO3 IMAGE
  Code                           T/K
Canopen NMT state
Number of TX PDO              0
Number of RX PDO              0
Error codes                   0
RX Error Counter              0
TX Error Counter              0
```

PDO images are only visible if CANopen has been enabled (address other than OFF) and if the PDOs are active.

PDO configuration using the network tool.
Some PDOs cannot be used.

```
RUN        Term      +50.00 Hz    REM
              PDO1 IMAGE
Received PDO1-1            : FDBA Hex
Received PDO1-2
Received PDO1-3
Received PDO1-4
Transmit PDO1-1            : FDBA Hex
  Code                           T/K
Transmit PDO1-2
Transmit PDO1-3
Transmit PDO1-4
```

```
RUN        Term      +50.00 Hz    REM
              PDO2 IMAGE
Received PDO2-1            : FDBA Hex
Received PDO2-2
Received PDO2-3
Received PDO2-4
Transmit PDO2-1            : FDBA Hex
  Code                           T/K
Transmit PDO2-2
Transmit PDO2-3
Transmit PDO2-4
```

```
RUN        Term      +50.00 Hz    REM
              PDO3 IMAGE
Received PDO3-1            : FDBA Hex
Received PDO3-2
Received PDO3-3
Received PDO3-4
Transmit PDO3-1            : FDBA Hex
  Code                           T/K
Transmit PDO3-2
Transmit PDO3-3
Transmit PDO3-4
```

With graphic display terminal

Communication (continued)

RUN	Term	+50.00 Hz	REM
COMMUNICATION MAP			
Command Channel:		Modbus	
Cmd value:		ABCD Hex	
Active ref. channel:		CANopen	
Frequency ref.:		- 12.5 Hz	
ETA status word:		2153 Hex	
Code			T/K
W3141	: F230 Hex		
W2050	: F230 Hex		
W4325	: F230 Hex		
W0894	: F230 Hex		
COM. SCANNER INPUT MAP			
COM SCAN OUTPUT MAP			
CMD. WORD IMAGE			
FREQ. REF. WORD MAP			
MODBUS NETWORK DIAG			
MODBUS HMI DIAG			
CANopen MAP			
PROG. CARD SCANNER			

Controller Inside card

RUN	Term	+50.00 Hz	REM
PROG. CARD SCANNER			
Input scanner			
Output scanner			
Code			T/K

RUN	Term	+50.00 Hz	REM
Input scanner			
Prg.card. scan in 1:			0
Prg.card. scan in 2:			0
Prg.card. scan in 3:			0
Prg.card. scan in 4:			0
Prg.card. scan in 5:			0
Code			T/K
Prg.card. scan in 6:			0
Prg.card. scan in 7:			0
Prg.card. scan in 8:			0

RUN	Term	+50.00 Hz	REM
Output scanner			
Prog.card.scan Out1:			0
Prog.card.scan Out2:			0
Prog.card.scan Out3:			0
Prog.card.scan Out4:			0
Prog.card.scan Out5:			0
Code			T/K
Prog.card.scan Out6:			0
Prog.card.scan Out7:			0
Prog.card.scan Out8:			0

[Input scanner] and [Output scanner]:
Visualization of registers exchanged periodically (8 input and 8 output).

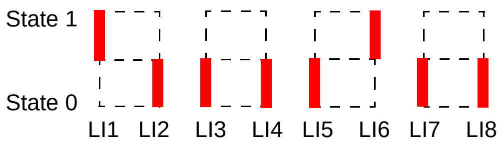
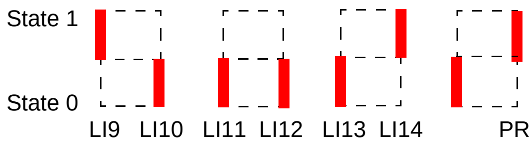
With graphic display terminal: Drive internal states and values

Name/Description	
[Alarm groups] (ALGr)	Current alarm group numbers
[HMI Frequency ref.] (LFr)	in Hz. Frequency reference via the graphic display terminal (can be accessed if the function has been configured)
[Internal PID ref.] (rPI)	as a process value. PID reference via graphic display terminal (can be accessed if the function has been configured)
[Multiplying coeff.] (MFr)	as a % (can be accessed if [Multiplier ref. -] (MA2,MA3) page 128 has been assigned)
[Frequency ref.] (FrH)	in Hz
[Output frequency] (rFr)	in Hz
[Measured output fr.] (MMF)	in Hz: The measured motor speed is displayed if an encoder card has been inserted, otherwise 0 appears.
[Pulse in. work. freq.] (FqS)	in Hz: Frequency of the "Pulse input" input used by the [FREQUENCY METER] (FqF-) function, page 205
[Motor current] (LCr)	in A
[Motor speed] (SPd)	in rpm
[Motor voltage] (UOP)	in V
[Motor power] (OPr)	as a % of the rated power
[Motor torque] (Otr)	as a % of the rated torque
[Mains voltage] (ULn)	in V. Line voltage from the point of view of the DC bus, motor running or stopped
[Motor thermal state] (tHr)	as a %
[Drv. thermal state] (tHd)	as a %
[DBR thermal state] (tHb)	as a % (can only be accessed on high rating drives)
[Input Power] (IPr)	in kW (electrical power consumed by the drive)
[Consumption] (IPHr)	in Wh, kWh or MWh (accumulated electrical consumption of drive)
[Run time] (rtH)	in seconds, minutes or hours (length of time the motor has been switched on)
[Power on time] (PtH)	in seconds, minutes or hours (length of time the drive has been switched on)
[Proc. Operat. Time] (PEt)	in hours (length of time the process has been switched on) This parameter can be initialized by the user if the drive is replaced, in order to maintain a record of previous times.
[IGBT alarm counter] (tAC)	in seconds (length of time the "IGBT temperature" alarm has been active)
[PID reference] (rPC)	as a process value (can be accessed if the PID function has been configured)
[PID feedback] (rPF)	as a process value (can be accessed if the PID function has been configured)
[PID error] (rPE)	as a process value (can be accessed if the PID function has been configured)
[PID Output] (rPO)	in Hz (can be accessed if the PID function has been configured)
[Date/Time] (CLO)	Current date and time generated by the Controller Inside card (can be accessed if the card has been inserted)
[- - - - 2] (o02) to [- - - - 6] (o06)	Words generated by the Controller Inside card (can be accessed if the card has been inserted)
[Config. active] (CnFS)	Active configuration [Config. n°0, 1 or 2]
[Utilised param. set] (CFPS)	[Set n°1, 2 or 3] (can be accessed if parameter switching has been enabled, see page 174)
[ALARMS] (ALr-)	List of current alarms. If an alarm is present, a ✓ appears.
[OTHER STATUS] (SSt-)	List of secondary states:

- [In motor fluxing] (FLX): In motor fluxing
- [PTC1 alarm] (PtC1): Probe alarm 1
- [PTC2 alarm] (PtC2): Probe alarm 2
- [LI6=PTC alarm] (PtC3): LI6 = PTC probe alarm
- [Fast stop in prog.] (FSt): Fast stop in progress
- [Current Th. attained] (CtA): Current threshold attained ([Current threshold] (Ctd) page 59)
- [Freq. Th. attained] (FtA): Frequency threshold attained ([Freq. threshold] (Ftd) page 59)
- [Freq. Th. 2 attained] (F2A): 2nd frequency threshold attained ([Freq. threshold 2] (F2d) page 59)
- [Frequency ref. att.] (SrA): Frequency reference attained
- [Motor th. state att.] (tSA): Motor 1 thermal state attained
- [External fault alarm] (EtF): External fault alarm
- [Auto restart] (AUtO): Automatic restart in progress
- [Remote] (FtL): Line mode control
- [Auto-tuning] (tUn): Performing auto-tuning
- [Undervoltage] (USA): Undervoltage alarm
- [Cnfg.1 act.] (CnF1): Configuration 1 active
- [Cnfg.2 act.] (CnF2): Configuration 2 active
- [HSP attained] (FLA): High speed attained
- [Set 1 active] (CFP1): Parameter set 1 active
- [Set 2 active] (CFP2): Parameter set 2 active
- [Set 3 active] (CFP3): Parameter set 3 active
- [In braking] (brS): Drive braking
- [DC bus loading] (dbL): DC bus loading
- [Forward] (MFrd): Motor running forward
- [Reverse] (MrrS): Motor running in reverse
- [High torque alarm] (ttHA): Motor torque greater than high threshold [High torque thd.] (ttH) page 59.
- [Low torque alarm] (ttLA): Motor torque less than low threshold [Low torque thd.] (ttL) page 59.
- [Freq. meter Alarm] (FqLA): Measured speed threshold attained: [Pulse warning thd.] (FqL) page 59.

With integrated display terminal

This menu can be used to display the drive inputs, states and internal values.

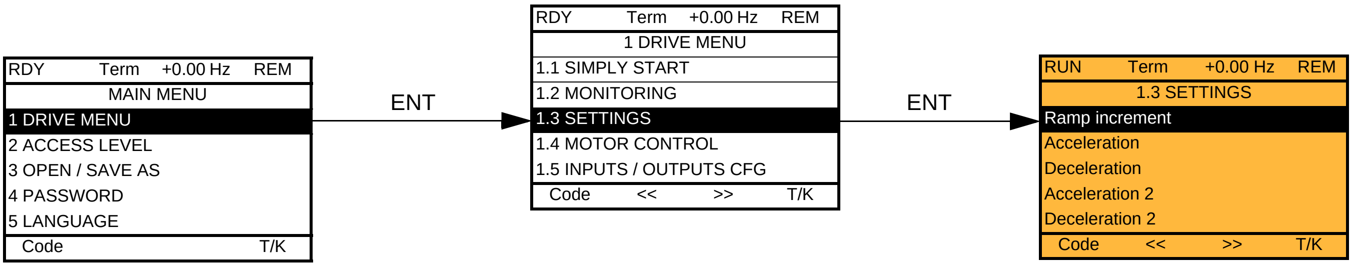
Code	Name/Description	Adjustment range	Factory setting
IOM-	**I/O MAP**		
LIA-	**■ Logic input functions**		
L1A to L14A	Can be used to display the functions assigned to each input. If no functions have been assigned, nO is displayed. Use the ▲ and ▼ arrows to scroll through the functions. If a number of functions have been assigned to the same input, check that they are compatible.		
LIS1	**■ State of logic inputs LI1 to LI8**		
	Can be used to visualize the state of logic inputs LI1 to LI8 (display segment assignment: high = 1, low = 0)  Example above: LI1 and LI6 are at 1; LI2 to LI5, LI7 and LI8 are at 0.		
LIS2	**■ State of logic inputs LI9 to LI14 and Power Removal**		
	Can be used to visualize the state of logic inputs LI19to LI14 and PR (Power Removal) (display segment assignment: high = 1, low = 0)  Example above: LI9 and LI14 are at 1, LI10 to LI13 are at 0 and PR (Power Removal) is at 1.		
AIA-	**■ Analog input functions**		
AI1A AI2A AI3A AI4A	Can be used to display the functions assigned to each input. If no functions have been assigned, nO is displayed. Use the ▲ and ▼ arrows to scroll through the functions. If a number of functions have been assigned to the same input, check that they are compatible.		

With integrated display terminal: Drive internal states and values

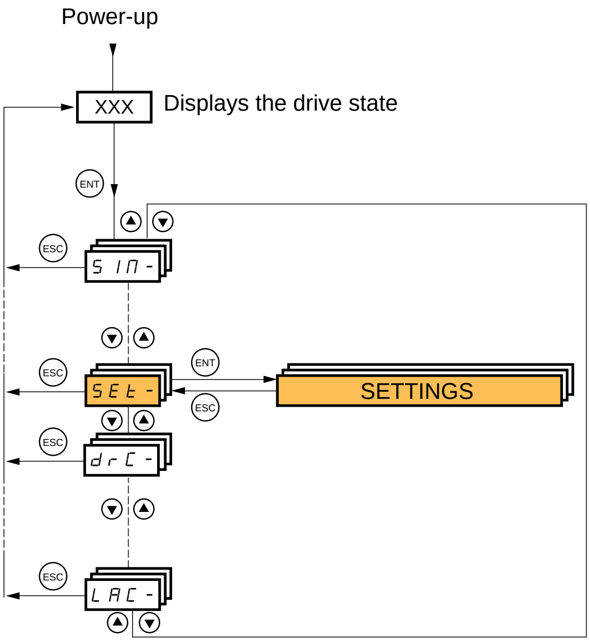
Code	Name/Description	Unit
ALGr	**Alarm groups:** Current alarm group numbers	
rPI	**Internal PID reference:** PID reference via graphic display terminal (can be accessed if the function has been configured).	as a process value
MFr	**Multiplication coefficient** (can be accessed if [Multiplier ref. -] (MA2,MA3) page 128 has been assigned)	%
FrH	**Frequency ref.**	Hz
rFr	**Output frequency**	Hz
MMF	**The measured motor speed is displayed** if an encoder card has been inserted, otherwise 0 appears.	Hz
FqS	**Frequency of the "Pulse input"** used by the **[FREQUENCY METER] (FqF-)** function, page 205	Hz
LCr	**Motor current**	A
SPd	**Motor speed**	rpm
UOP	**Motor voltage**	V
OPr	**Motor power**	%
Otr	**Motor torque**	%
ULn	**Line voltage:** Line voltage from the point of view of the DC bus, motor running or stopped.	V
tHr	**Motor thermal state**	%
tHd	**Drive thermal state**	%
tHb	**DBR thermal state:** Accessible on high rating drives only.	%
IPr	**Electrical power consumed by the drive**	W or kW
IPHr	**Accumulated electrical consumption of drive**	Wh, kWh or MWh
rtH	**Run time:** Length of time the motor has been turned on	seconds, minutes or hours
PtH	**Power on time:** Length of time the drive has been turned on	
PEt	**Length of time the process has been turned on:** in hours. This parameter can be initialized by the user if the drive is replaced, in order to maintain a record of previous times.	hours
tAC	**IGBT alarm counter:** Length of time the "IGBT temperature" alarm has been active	seconds
rPC	**PID reference:** Can be accessed if the PID function has been configured	as a process value
rPF	**PID feedback:** Can be accessed if the PID function has been configured	
rPE	**PID error:** Can be accessed if the PID function has been configured	
rPO	**PID Output:** Can be accessed if the PID function has been configured	Hz
CLO-	**tIME, dAY:** Current date and time generated by the Controller Inside card (can be accessed if the card has been inserted)	
o02	**- - - - 2:** Word generated by the Controller Inside card (can be accessed if the card has been inserted)	
o03	**- - - - 3:** Word generated by the Controller Inside card (can be accessed if the card has been inserted)	
o04	**- - - - 4:** Word generated by the Controller Inside card (can be accessed if the card has been inserted)	
o05	**- - - - 5:** Word generated by the Controller Inside card (can be accessed if the card has been inserted)	
o06	**- - - - 6:** Word generated by the Controller Inside card (can be accessed if the card has been inserted)	
CnFS	**Config. active:** CnF0, 1 or 2 (can be accessed if motor or configuration switching has been enabled, see page 179)	
CFPS	**Utilised param. set:** CFP1, 2 or 3 (can be accessed if parameter switching has been enabled, see page 174)	

[1.3 SETTINGS] (SEt-)

With graphic display terminal:



With integrated display terminal:



The adjustment parameters can be modified with the drive running or stopped.

⚠ DANGER

UNINTENDED EQUIPMENT OPERATION

- Check that changes made to the settings during operation do not present any danger.
- We recommend stopping the drive before making any changes.

Failure to follow these instructions will result in death or serious injury.

Code	Name/Description	Adjustment range	Factory setting
Inr 0.01 0.1 1	❑ **[Ramp increment]** ☐ **[0.01]**: Ramp up to 99.99 seconds ☐ **[0.1]**: Ramp up to 999.9 seconds ☐ **[1]**: Ramp up to 9,000 seconds This parameter is valid for [Acceleration] (ACC), [Deceleration] (dEC), [Acceleration 2] (AC2) and [Deceleration 2] (dE2).	0.01 - 0.1 - 1	0.1
ACC	❑ **[Acceleration]** Time to accelerate from 0 to the [Rated motor freq.] (FrS) (page 64). Make sure that this value is compatible with the inertia being driven.	0.01 to 9,000 s (1)	3.0 s
dEC	❑ **[Deceleration]** Time to decelerate from the [Rated motor freq.] (FrS) (page 64) to 0. Make sure that this value is compatible with the inertia being driven.	0.01 to 9,000 s (1)	3.0 s
AC2 ★	❑ **[Acceleration 2]** See page 131 Time to accelerate from 0 to the [Rated motor freq.] (FrS). Make sure that this value is compatible with the inertia being driven.	0.01 to 9,000 s (1)	5.0 s
dE2 ★	❑ **[Deceleration 2]** See page 131 Time to decelerate from the [Rated motor freq.] (FrS) to 0. Make sure that this value is compatible with the inertia being driven.	0.01 to 9,000 s (1)	5.0 s
tA1 ★	❑ **[Begin Acc round]** See page 130 Rounding of start of acceleration ramp as a % of the [Acceleration] (ACC) or [Acceleration 2] (AC2) ramp time.	0 to 100%	10%
tA2 ★	❑ **[End Acc round]** See page 130 - Rounding of end of acceleration ramp as a % of the [Acceleration] (ACC) or [Acceleration 2] (AC2) ramp time. - Can be set between 0 and (100% – [Begin Acc round] (tA1))		10%
tA3 ★	❑ **[Begin Dec round]** See page 130 Rounding of start of deceleration ramp as a % of the [Deceleration] (dEC) or [Deceleration 2] (dE2) ramp time.	0 to 100%	10%

(1) Range 0.01 to 99.99 s or 0.1 to 999.9 s or 1 to 9,000 s according to [Ramp increment] (Inr).

★ These parameters only appear if the corresponding function has been selected in another menu. When the parameters can also be accessed and adjusted from within the configuration menu for the corresponding function, their description is detailed in these menus, on the pages indicated, to aid programming.

Code	Name/Description	Adjustment range	Factory setting
tA4 ★	❑ **[End Dec round]** See page 130 - Rounding of end of deceleration ramp as a % of the [Deceleration] (dEC) or [Deceleration 2] (dE2) ramp time. - Can be set between 0 and (100% – [Begin Dec round] (tA3))		10%
LSP	❑ **[Low speed]** Motor frequency at minimum reference, can be set between 0 and [High speed] (HSP).		0 Hz
HSP	❑ **[High speed]** Motor frequency at maximum reference, can be set between [Low speed] (LSP) and [Max frequency] (tFr). The factory setting changes to 60 Hz if [Standard mot. freq] (bFr) = [60 Hz NEMA] (60).		50 Hz
ItH	❑ **[Mot. therm. current]** Motor thermal protection current, to be set to the rated current indicated on the nameplate.	0 to 1.1 or 1.2 In (1) according to rating	According to drive rating
SPG	❑ **[Speed prop. gain]** Speed loop proportional gain	0 to 1,000%	40%
SIt	❑ **[Speed time integral]** Speed loop integral time constant.	1 to 1,000%	100%
SFC	❑ **[K speed loop filter]** Speed loop filter coefficient.	0 to 100	0

(1) In corresponds to the rated drive current indicated in the Installation Manual or on the drive nameplate.

★	These parameters only appear if the corresponding function has been selected in another menu. When the parameters can also be accessed and adjusted from within the configuration menu for the corresponding function, their description is detailed in these menus, on the pages indicated, to aid programming.

Adjusting the [K speed loop filter] (SFC), [Speed prop. gain] (SPG), and [Speed time integral] (SIt) parameters

- The following parameters can only be accessed in vector control profiles: [Motor control type] (Ctt) page 67 = [SVC V] (UUC), [Energy Sav.] (nLd) and [Sync. mot.] (SYn).
- The factory settings are suitable for most applications.

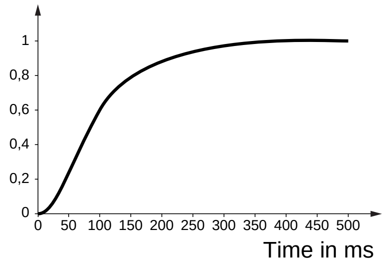
General case: Setting with [K speed loop filter] (SFC) = 0

The regulator is an “IP” type with filtering of the speed reference, for applications requiring flexibility and stability (high inertia, for example).

- [Speed prop. gain] (SPG) affects excessive speed.
- [Speed prop. gain] (SIt) affects the passband and response time.

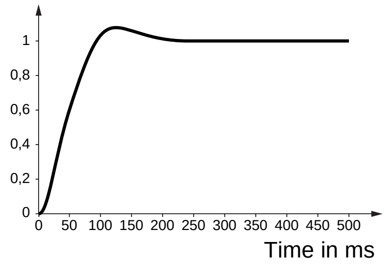
Initial response

Reference division



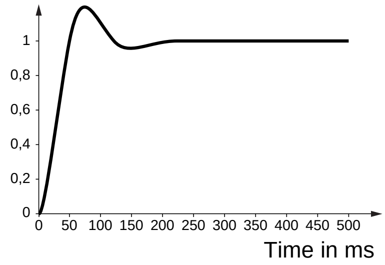
Reduction in SIT ↘

Reference division



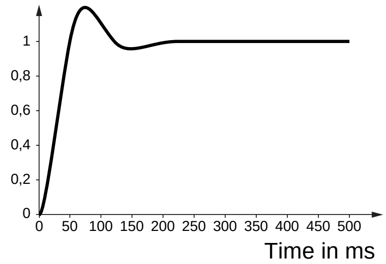
Reduction in SIT ↘↘

Reference division



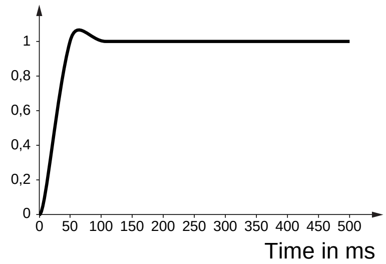
Initial response

Reference division



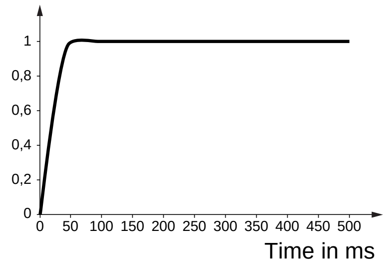
Increase in SPG ↗

Reference division



Increase in SPG ↗↗

Reference division



Special case: Parameter [K speed loop filter] (SFC) not 0

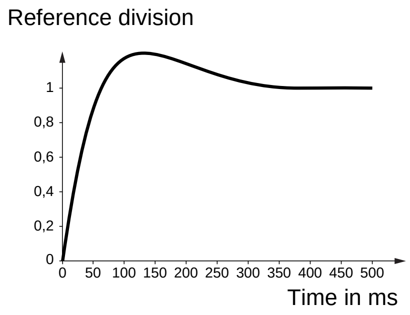
This parameter must be reserved for specific applications that require a short response time (trajectory positioning or servo control).

- When set to 100 as described above the regulator is a “PI” type, without filtering of the speed reference.
- Settings between 0 and 100 will obtain an intermediate function between the settings below and those on the previous page.

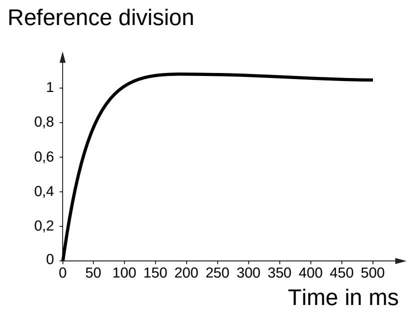
Example: Setting with [K speed loop filter] (SFC) = 100

- [Speed prop. gain] (SPG) affects the passband and response time.
- [Speed time integral] (SIt) affects excessive speed.

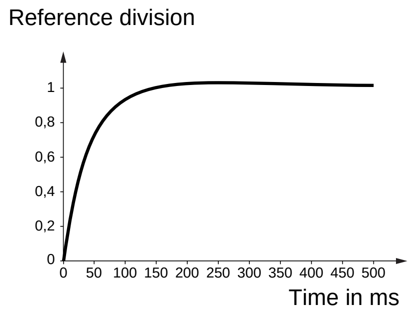
Initial response



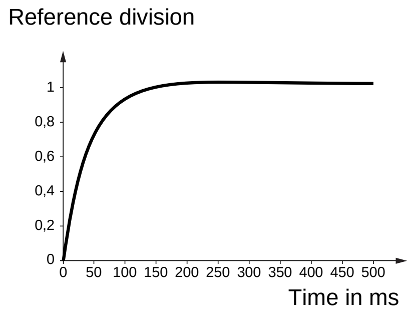
Reduction in SIT ↘



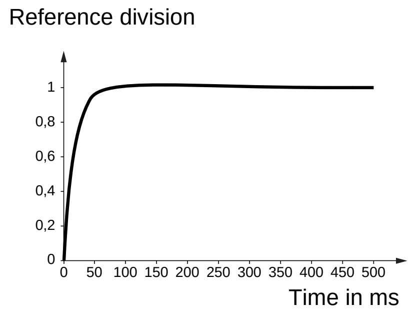
Reduction in SIT ↘↘



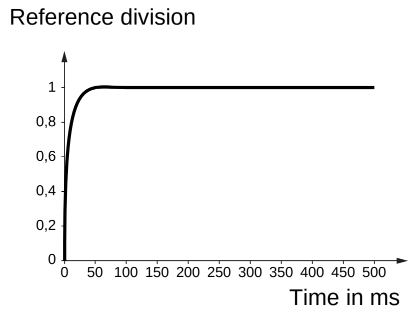
Initial response



Increase in SPG ↗



Increase in SPG ↗↗



<table>
<tr><th>Code</th><th>Name/Description</th><th>Adjustment range</th><th>Factory setting</th></tr>
<tr><td>UFr
★</td><td>❑ [IR compensation]
See page 71</td><td>25 to 200%</td><td>100%</td></tr>
<tr><td>SLP
★</td><td>❑ [Slip compensation]
See page 71</td><td>0 to 300%</td><td>100%</td></tr>
<tr><td>dCF
★</td><td>❑ [Ramp divider]
See page 133</td><td>0 to 10</td><td>4</td></tr>
<tr><td>IdC
★</td><td>❑ [DC inject. level 1]
See page 134
Level of DC injection braking current activated via logic input or selected as stop mode.

CAUTION
Check that the motor will withstand this current without overheating.
Failure to follow these instructions can result in equipment damage.</td><td>0.1 to 1.1 or 1.2 In (1) according to rating</td><td>0.64 In (1)</td></tr>
<tr><td>tdI
★</td><td>❑ [DC injection time 1]
See page 134
Maximum current injection time [DC inject. level 1] (IdC). After this time the injection current becomes [DC inject. level 2] (IdC2).</td><td>0.1 to 30 s</td><td>0.5 s</td></tr>
<tr><td>IdC2
★</td><td>❑ [DC inject. level 2]
See page 134
Injection current activated by logic input or selected as stop mode, once period of time [DC injection time 1] (tdI) has elapsed.

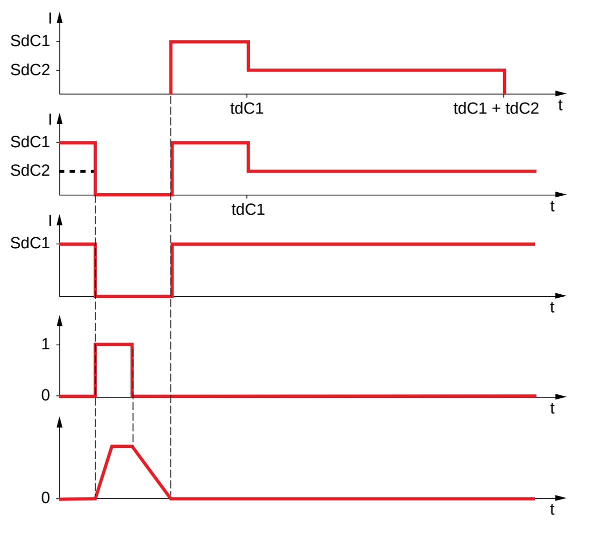
CAUTION
Check that the motor will withstand this current without overheating.
Failure to follow these instructions can result in equipment damage.</td><td>0.1 In (1) to [DC inject. level 1] (IdC)</td><td>0.5 In (1)</td></tr>
<tr><td>tdC
★</td><td>❑ [DC injection time 2]
See page 134
Maximum injection time [DC inject. level 2] (IdC2) for injection selected as stop mode only.</td><td>0.1 to 30 s</td><td>0.5 s</td></tr>
</table>

(1) In corresponds to the rated drive current indicated in the Installation Manual or on the drive nameplate.

★ These parameters only appear if the corresponding function has been selected in another menu. When the parameters can also be accessed and adjusted from within the configuration menu for the corresponding function, their description is detailed in these menus, on the pages indicated, to aid programming.

Code	Name/Description	Adjustment range	Factory setting
SdC1 ★	❑ **[Auto DC inj. level 1]** Level of standstill DC injection current. This parameter can be accessed if [Auto DC injection] (AdC) page 135 is not [No] (nO). This parameter is forced to 0 if [Motor control type] (Ctt) page 67 = [Sync. mot.] (SYn). **CAUTION** Check that the motor will withstand this current without overheating. **Failure to follow these instructions can result in equipment damage.**	0 to 1.1 or 1.2 In (1) according to rating	0.7 In (1)
tdC1 ★	❑ **[Auto DC inj. time 1]** Standstill injection time. This parameter can be accessed if [Auto DC injection] (AdC) page 135 is not [No] (nO) If [Motor control type] (Ctt) page 67 = [Sync. mot.] (SYn) this time corresponds to the zero speed maintenance time.	0.1 to 30 s	0.5 s
SdC2 ★	❑ **[Auto DC inj. level 2]** 2nd level of standstill DC injection current. This parameter can be accessed if [Auto DC injection] (AdC) page 135 is not [No] (nO). This parameter is forced to 0 if [Motor control type] (Ctt) page 67 = [Sync. mot.] (SYn). **CAUTION** Check that the motor will withstand this current without overheating. **Failure to follow these instructions can result in equipment damage.**	0 to 1.1 or 1.2 In (1) according to rating	0.5 In (1)
tdC2 ★	❑ **[Auto DC inj. time 2]** 2nd standstill injection time. This parameter can be accessed if [Auto DC injection] (AdC) page 135 = [Yes] (YES).	0 to 30 s	0 s

AdC	SdC2	Operation
YES	x	
Ct	≠ 0	
Ct	= 0	
Run command		
Speed		



(1) In corresponds to the rated drive current indicated in the Installation Manual or on the drive nameplate.

★ These parameters only appear if the corresponding function has been selected in another menu. When the parameters can also be accessed and adjusted from within the configuration menu for the corresponding function, their description is detailed in these menus, on the pages indicated, to aid programming.

Code	Name/Description	Adjustment range	Factory setting
SFr	❑ **[Switching freq.]**	According to rating	According to rating

Switching frequency setting.

Adjustment range: It can vary between 1 and 16 kHz, but the minimum and maximum values, as well as the factory setting, can be limited in accordance with the type of drive (ATV61H or W), the rating (power and voltage) and the configuration of the [Sinus filter] (OFI) and [Motor surge limit.] (SUL) parameters, page 75.

Adjustment with drive running:
- If the initial value is less than 2 kHz, it is not possible to increase it above 1.9 kHz while running.
- If the initial value is greater than or equal to 2 kHz, a minimum of 2 kHz must be maintained while running.

Adjustment with the drive stopped: No restrictions.

Note: In the event of excessive temperature rise, the drive will automatically reduce the switching frequency and reset it once the temperature returns to normal.

.

CAUTION

On ATV61●075N4 to U40N4 drives, if the RFI filters are disconnected (operation on an IT system), the switching frequency of the drive must not exceed 4 kHz.
Failure to follow this instruction can result in equipment damage.

Code	Name/Description	Adjustment range	Factory setting
CLI	❑ **[Current Limitation]**	0 to 1.1 or 1.2 In (1) according to rating	1.1 or 1.2 In (1) according to rating

Used to limit the motor current.

Note: If the setting is less than 0.25 In, the drive may lock in [Output Phase Loss] (OPF) fault mode if this has been enabled (see page 194). If it is less than the no-load motor current, the limitation no longer has any effect.

.

CAUTION

Check that the motor will withstand this current, particularly in the case of permanent magnet synchronous motors, which are susceptible to demagnetization.
Failure to follow this instruction can result in equipment damage.

Code	Name/Description	Adjustment range	Factory setting
CL2 ★	❑ **[I Limit. 2 value]**	0 to 1.1 or 1.2 In (1) according to rating	1.1 or 1.2 In (1) according to rating

See page 166

Note: If the setting is less than 0.25 In, the drive may lock in [Output Phase Loss] (OPF) fault mode if this has been enabled (see page 194). If it is less than the no-load motor current, the limitation no longer has any effect.

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CAUTION

Check that the motor will withstand this current, particularly in the case of permanent magnet synchronous motors, which are susceptible to demagnetization.
Failure to follow this instruction can result in equipment damage.

(1) In corresponds to the rated drive current indicated in the Installation Manual or on the drive nameplate.

★ These parameters only appear if the corresponding function has been selected in another menu. When the parameters can also be accessed and adjusted from within the configuration menu for the corresponding function, their description is detailed in these menus, on the pages indicated, to aid programming.

Code	Name/Description	Adjustment range	Factory setting
FLU FnC FCt FnO	❑ **[Motor fluxing]** ☐ **[Not cont.]** (FnC): Non-continuous mode ☐ **[Continuous]** (FCt): Continuous mode. This option is not possible if [Auto DC injection] (AdC) page 135 is [Yes] (YES) or if [Type of stop] (Stt) page 133 is [Freewheel] (nSt). ☐ **[No]** (FnO): Function inactive. At and above ATV61HD55M3X, ATV61HD90N4 and ATV61HC11Y, if [Motor control type] (Ctt) page 67 = [SVC V] (UUC) or [Energy Sav.] (nLd), this selection cannot be made and the factory setting is replaced by [Not cont.] (FnC). If [Motor control type] (Ctt) = [Sync. mot.] (SYn) the factory setting is replaced by [Not cont.] (FnC). In order to obtain rapid high torque on startup, magnetic flux needs to already have been established in the motor. • In [Continuous] (FCt) mode, the drive automatically builds up flux when it is powered up. • In [Not cont.] (FnC) mode, fluxing occurs when the motor starts up. The flux current is greater than nCr (configured rated motor current) when the flux is established and is then adjusted to the motor magnetizing current... **CAUTION** Check that the motor will withstand this current without overheating. **Failure to follow these instructions can result in equipment damage.** If [Motor control type] (Ctt) page 67 = [Sync. mot.] (SYn), the [Motor fluxing] (FLU) parameter causes the alignment of the rotor and not the fluxing.		[No] (FnO)
tLS	❑ **[Low speed time out]** Maximum operating time at [Low speed] (LSP) (see page 37) Following operation at LSP + SLE for a defined period, a motor stop is requested automatically. The motor restarts if the reference is greater than LSP + SLE and if a run command is still present. Caution: Value 0 corresponds to an unlimited period. **Note:** If [Low speed time out] (tLS) is not 0, [Type of stop] (Stt) page 133 is forced to [Ramp stop] (rMP) (only if a ramp stop can be configured).	0 to 999.9 s	0 s
SLE	❑ **[Sleep Offset Thres.]** Adjustable restart threshold (offset) following a stop after prolonged operation at [Low speed] (LSP) + [Sleep Offset Thres.] (SLE), in Hz. The motor restarts if the reference rises above (LSP + SLE) and if a run command is still present.	0 to 500 or 1,000 according to rating	1 Hz
JGF ★	❑ **[Jog frequency]** See page 137 Reference in jog operation	0 to 10 Hz	10 Hz
JGt ★	❑ **[Jog delay]** See page 137 Anti-repeat delay between 2 consecutive jog operations.	0 to 2.0 s	0.5 s

★ These parameters only appear if the corresponding function has been selected in another menu. When the parameters can also be accessed and adjusted from within the configuration menu for the corresponding function, their description is detailed in these menus, on the pages indicated, to aid programming.

Code	Name/Description	Adjustment range	Factory setting
SP2 ★	❑ **[Preset speed 2]** See page 140 Preset speed 2	0 to 500 or 1,000 Hz according to rating	10 Hz
SP3 ★	❑ **[Preset speed 3]** See page 140 Preset speed 3	0 to 500 or 1,000 Hz according to rating	15 Hz
SP4 ★	❑ **[Preset speed 4]** See page 140 Preset speed 4	0 to 500 or 1,000 Hz according to rating	20 Hz
SP5 ★	❑ **[Preset speed 5]** See page 140 Preset speed 5	0 to 500 or 1,000 Hz according to rating	25 Hz
SP6 ★	❑ **[Preset speed 6]** See page 140 Preset speed 6	0 to 500 or 1,000 Hz according to rating	30 Hz
SP7 ★	❑ **[Preset speed 7]** See page 140 Preset speed 7	0 to 500 or 1,000 Hz according to rating	35 Hz
SP8 ★	❑ **[Preset speed 8]** See page 140 Preset speed 8 The factory setting changes to 60 Hz if [Standard mot. freq] (bFr) = [60 Hz NEMA] (60).	0 to 500 or 1,000 Hz according to rating	50 Hz

★ These parameters only appear if the corresponding function has been selected in another menu. When the parameters can also be accessed and adjusted from within the configuration menu for the corresponding function, their description is detailed in these menus, on the pages indicated, to aid programming.

Code	Name/Description	Adjustment range	Factory setting
SrP ★	❑ **[+/-Speed limitation]** See page 144 Limitation of +/- speed variation	0 to 50%	10%
rPG ★	❑ **[PID prop. gain]** See page 151 Proportional gain	0.01 to 100	1
rIG ★	❑ **[PID integral gain]** See page 152 Integral gain	0.01 to 100	1
rdG ★	❑ **[PID derivative gain]** See page 152 Derivative gain	0.00 to 100	0
PrP ★	❑ **[PID ramp]** See page 152 PID acceleration/deceleration ramp, defined to go from [Min PID reference] (PIP1) to [Max PID reference] (PIP2) and vice versa.	0 to 99.9 s	3.0 s
POL ★	❑ **[Min PID output]** See page 152 Minimum value of regulator output in Hz	-500 to 500 or -1,000 to 1,000 according to rating	0 Hz
POH ★	❑ **[Max PID output]** See page 152 Maximum value of regulator output in Hz	0 to 500 or 1,000 according to rating	60 Hz
PAL ★	❑ **[Min fbk alarm]** See page 152 Minimum monitoring threshold for regulator feedback	See page 152 (1)	100
PAH ★	❑ **[Max fbk alarm]** See page 152 Maximum monitoring threshold for regulator feedback	See page 152 (1)	1,000

(1) If a graphic display terminal is not in use, values greater than 9,999 will be displayed on the 4-digit display with a period mark after the thousand digit, e.g. 15.65 for 15,650.

★	These parameters only appear if the corresponding function has been selected in another menu. When the parameters can also be accessed and adjusted from within the configuration menu for the corresponding function, their description is detailed in these menus, on the pages indicated, to aid programming.

Code	Name/Description	Adjustment range	Factory setting
PEr ★	❑ **[PID error Alarm]** See page 152 Regulator error monitoring threshold.	0 to 65,535 (1)	100
PSr ★	❑ **[Speed input%]** See page 153 Multiplying coefficient for predictive speed input.	1 to 100%	100%
rP2 ★	❑ **[Preset ref. PID 2]** See page 156 Preset PID reference	See page 156 (1)	300
rP3 ★	❑ **[Preset ref. PID 3]** See page 156 Preset PID reference	See page 156 (1)	600
rP4 ★	❑ **[Preset ref. PID 4]** See page 156 Preset PID reference	See page 156 (1)	900
LPI ★ nO -	❑ **[PID Threshold]** See page 155 PID regulator feedback supervision threshold (alarm can be assigned to a relay or a logic output, page 94). Adjustment range: ❑ **[No]** (nO): Function inactive ❑ between [Min PID feedback] (PIF1) and [Max PID feedback] (PIF2) (2).		100
tPI ★	❑ **[PID Ctrl. time delay]** See page 155 PID regulator feedback supervision time delay	0 to 600 s	0 s

(1) If a graphic display terminal is not in use, values greater than 9,999 will be displayed on the 4-digit display with a period mark after the thousand digit, e.g. 15.65 for 15,650.

★ These parameters only appear if the corresponding function has been selected in another menu. When the parameters can also be accessed and adjusted from within the configuration menu for the corresponding function, their description is detailed in these menus, on the pages indicated, to aid programming.

Code	Name/Description	Adjustment range	Factory setting
tLIM ★	❑ **[Motoring torque lim]** See page 164 Torque limitation in motor mode, as a whole % or in 0.1% increments of the rated torque in accordance with the [Torque increment] (IntP) parameter, page 164.	0 to 300%	100%
tLIG ★	❑ **[Gen. torque lim]** See page 164 Torque limitation in generator mode, as a whole % or in 0.1% increments of the rated torque in accordance with the [Torque increment] (IntP) parameter, page 164.	0 to 300%	100%
Ctd	❑ **[Current threshold]** Upper current threshold for [I attained] (CtA) function assigned to a relay or a logic output (see page 94).	0 to 1.1 or 1.2 In (1) according to rating	In (1)
CtdL	❑ **[Low I Threshold]** Lower current threshold for [Low I Th.At.] (CtAL) function assigned to a relay or a logic output (see page 94).	0 to 1.1 or 1.2 In (1) according to rating	0
ttH	❑ **[High torque thd.]** High current threshold for [High tq. att.] (ttHA) function assigned to a relay or a logic output (see page 94), as a % of the rated motor torque.	-300% to +300%	100%
ttL	❑ **[Low torque thd.]** Low current threshold for [Low tq. att.] (ttLA) function assigned to a relay or a logic output (see page 94), as a % of the rated motor torque.	-300% to +300%	50%
FqL ★	❑ **[Pulse warning thd.]** Speed threshold measured by the [FREQUENCY METER] (FqF-) function, page 205, assigned to a relay or a logic output (see page 95).	0 Hz to 30.00 kHz	0 Hz
Ftd	❑ **[Freq. threshold]** High frequency threshold for the [Freq.Th.att.] (FtA) function assigned to a relay or a logic output (see page 94), or used by the [PARAM. SET SWITCHING] (MLP-) function, page 174.	0 to 500 or 1,000 Hz according to rating	[Standard mot. freq] (bFr)
FtdL	❑ **[Low Freq.Threshold]** Lower frequency threshold for [Low Frq. Th. Attain.] (FtAL) function assigned to a relay or a logic output (see page 94).	0 to 500 or 1,000 Hz according to rating	0
F2d	❑ **[Frequency 2 threshold]** Frequency threshold for [Freq. Th. 2 attain.] (F2A) function assigned to a relay or a logic output (see page 94), or used by the [PARAM. SET SWITCHING] (MLP-) function, page 174.	0 to 500 or 1,000 Hz according to rating	[Standard mot. freq] (bFr)
F2dL	❑ **[2 Freq. Threshold]** Lower frequency threshold for [2Low F.Thld] (F2AL) function assigned to a relay or a logic output (see page 94).	0 to 500 or 1,000 Hz according to rating	0

(1) In corresponds to the rated drive current indicated in the Installation Manual or on the drive nameplate.

★	These parameters only appear if the corresponding function has been selected in another menu. When the parameters can also be accessed and adjusted from within the configuration menu for the corresponding function, their description is detailed in these menus, on the pages indicated, to aid programming.

Code	Name/Description	Adjustment range	Factory setting
FFt	❑ **[Freewheel stop Thd]** See page 133 This parameter supports switching from a ramp stop or a fast stop to a freewheel stop below a low speed threshold. It can be accessed if [Type of stop] (Stt) = [Fast stop] (FSt) or [Ramp stop] (rMP). ☐ 0.0: Does not switch to freewheel stop. ☐ 0.1 to 1000 Hz: Speed threshold below which the motor will switch to freewheel stop.	0.0 to 1000 Hz	0.0
ttd ★	❑ **[Motor therm. level]** See page 194 Trip threshold for motor thermal alarm (logic output or relay)	0 to 118%	100%
rtd	❑ **[High Freq. Ref. Thr.]** Upper frequency reference threshold for [High Ref.] (rtAH) function assigned to a relay or a logic output (see page 94).	0 to 500 or 1,000 Hz according to rating	0
rtdL	❑ **[Low Freq. Ref. Thr.]** Lower frequency reference threshold for [Low Ref.] (rtAL) function assigned to a relay or a logic output (see page 94).	0 to 500 or 1,000 Hz according to rating	0

(1) In corresponds to the rated drive current indicated in the Installation Manual or on the drive nameplate.

★	These parameters only appear if the corresponding function has been selected in another menu. When the parameters can also be accessed and adjusted from within the configuration menu for the corresponding function, their description is detailed in these menus, on the pages indicated, to aid programming.

Code	Name/Description	Adjustment range	Factory setting
JPF	❑ **[Skip Freq.]** Skip frequency. This parameter prevents prolonged operation within an adjustable range around the regulated frequency. This function can be used to prevent a critical speed, which would cause resonance, being reached. Setting the function to 0 renders it inactive.	0 to 500 or 1,000 Hz according to rating	0 Hz
JF2	❑ **[Skip Freq. 2]** 2nd skip frequency. This parameter prevents prolonged operation within an adjustable range around the regulated frequency. This function can be used to prevent a critical speed, which would cause resonance, being reached. Setting the function to 0 renders it inactive.	0 to 500 or 1,000 Hz according to rating	0 Hz
JF3	❑ **[3rd Skip Frequency]** 3rd skip frequency. This parameter prevents prolonged operation within an adjustable range around the regulated frequency. This function can be used to prevent a critical speed, which would cause resonance, being reached. Setting the function to 0 renders it inactive.	0 to 500 or 1,000 Hz according to rating	0 Hz
JFH	❑ **[Skip.Freq.Hysteresis]** Parameter visible if at least one skip frequency [Skip Frequency] (JPF), [Skip Frequency 2] (JF2) or [3rd Skip Frequency] (JF3) is different from 0. Skip frequency range: between (JPF – JFH) and (JPF + JFH), for example. This adjustment is common to all 3 frequencies (JPF, JF2 and JF3).	0.1 to 10 Hz	1 Hz
LUn ★	❑ **[Unld.Thr.Nom.Speed]** See page 209. Underload threshold at rated motor frequency ([Rated motor freq.] (FrS) page 35), as a % of the rated motor torque.	20 to 100%	60%
LUL ★	❑ **[Unld.Thr.0.Speed]** See page 209. Underload threshold at zero frequency, as a % of the rated motor torque.	0 to [Unld.Thr.Nom.Speed] (LUn)	0%
rMUd ★	❑ **[Unld. Freq.Thr. Det.]** See page 209. Underload detection minimum frequency threshold	0 to 500 or 1,000 Hz according to rating	0 Hz
Srb ★	❑ **[Hysteresis Freq.Att.]** See pages 209 and 210. Maximum deviation between the frequency reference and the motor frequency, which defines steady state operation.	0.3 to 500 or 1,000 Hz according to rating	0.3 Hz
FtU ★	❑ **[Underload T.B.Rest.]** See page 209. Minimum time permitted between an underload being detected and any automatic restart. In order for an automatic restart to be possible, the value of [Max. restart time] (tAr) page 191 must exceed that of this parameter by at least one minute.	0 to 6 min	0 min

★ These parameters only appear if the corresponding function has been selected in another menu. When the parameters can also be accessed and adjusted from within the configuration menu for the corresponding function, their description is detailed in these menus, on the pages indicated, to aid programming.

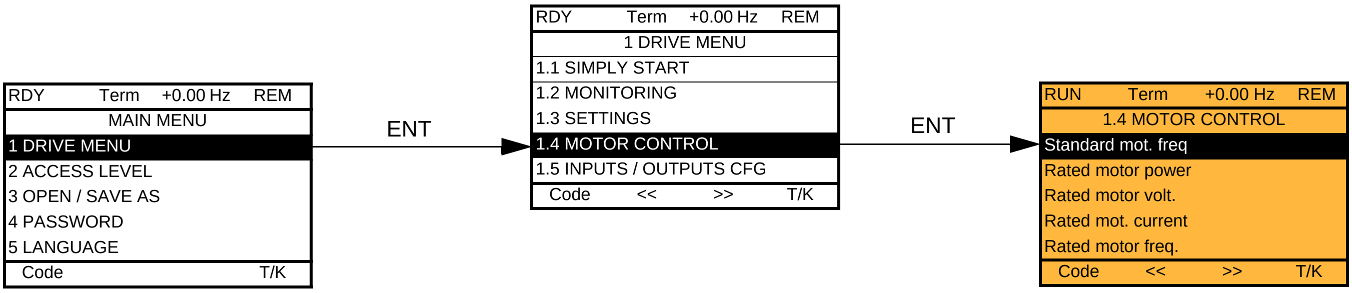
Code	Name/Description	Adjustment range	Factory setting
LOC ★	❑ **[Ovld Detection Thr.]** See page 210. Overload detection threshold, as a % of the rated motor current [Rated mot. current] (nCr). This value must be less than the limit current in order for the function to work.	70 to 150%	110%
FtO ★	❑ **[Overload T.B.Rest.]** See page 210. Minimum time permitted between an overload being detected and any automatic restart. In order for an automatic restart to be possible, the value of [Max. restart time] (tAr) page 191 must exceed that of this parameter by at least one minute.	0 to 6 min	0 min
FFd ★	❑ **[NoFlo.Freq.Thres.Ac.]** See page 181. Zero flow detection activation threshold The parameter can be accessed if [PID feedback ass.] (PIF) is not [No] (nO) and if [No Flow Period Det.] (nFd) is not 0.	0 to 500 or 1,000 Hz according to rating	0 Hz
LFd ★	❑ **[No Flow Offset]** See page 181. Zero flow detection offset The parameter can be accessed if [PID feedback ass.] (PIF) is not [No] (nO) and if [No Flow Period Det.] (nFd) is not 0.	0 to 500 or 1,000 Hz according to rating	0 Hz
nFFt ★	❑ **[Freq.Th.Sensor. Act.]** See page 181. Zero fluid detection activation threshold The parameter can be accessed if [No Flow Sensor] (nFS) is not [No] (nO).	0 to 500 or 1,000 Hz according to rating	0 Hz
nFSt ★	❑ **[Flow Times Ctrl]** See page 181. Zero fluid detection activation time delay The parameter can be accessed if [No Flow Sensor] (nFS) is not [No] (nO).	0 to 999 s	10 s
CHt ★	❑ **[Flow.Lim.Th.Active]** See page 183. Function activation threshold, as a % of the max. signal of the assigned input The parameter can be accessed if [Flow.Sen.Inf] (CHI) is not [No] (nO).	0 to 100%	0%
rCHt ★	❑ **[Flo.Lim.Thres. Inact.]** See page 183. Function deactivation threshold, as a % of the max. signal of the assigned input The parameter can be accessed if [Flow.Sen.Inf] (CHI) is not [No] (nO).	0 to 100%	0%
dFL ★	❑ **[Dec. Flow. limit]** See page 183. The parameter can be accessed if [Flow.Sen.Inf] (CHI) is not [No] (nO). Time to decelerate from [Rated motor freq.] (FrS) to 0. Make sure that this value is compatible with the inertia being driven.	0.01 to 9,000 s (1)	5.0 s

(1) Range 0.01 to 99.99 s or 0.1 to 999.9 s or 1 to 9,000 s according to [Ramp increment] (Inr).

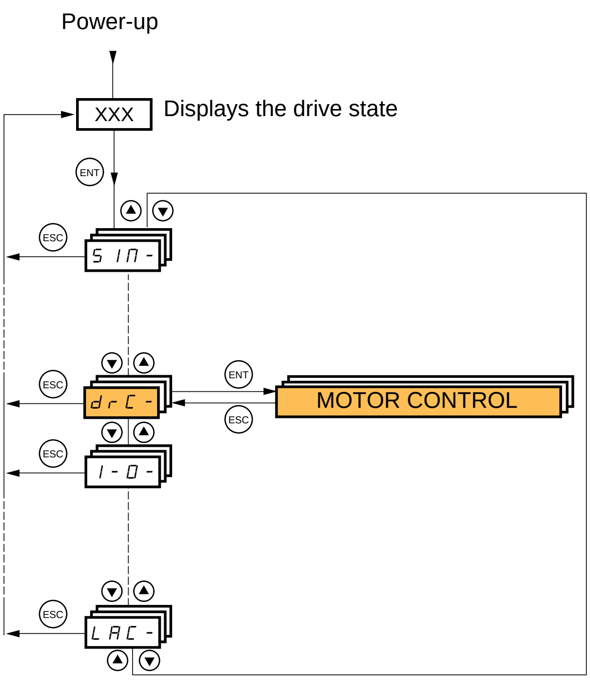
★	These parameters only appear if the corresponding function has been selected in another menu. When the parameters can also be accessed and adjusted from within the configuration menu for the corresponding function, their description is detailed in these menus, on the pages indicated, to aid programming.

[1.4 MOTOR CONTROL] (drC-)

With graphic display terminal:



With integrated display terminal:



The parameters in the [1.4 MOTOR CONTROL] (drC-) menu can only be modified when the drive is stopped and no run command is present, with the following exceptions:

- [Auto tuning] (tUn) page 66, which causes the motor to start up.
- Parameters containing the sign () in the code column, which can be modified with the drive running or stopped.

Code	Name/Description	Adjustment range	Factory setting
bFr	**[Standard mot. freq]**		[50Hz IEC] (50)
50 60	**[50Hz IEC]** (50): IEC. **[60Hz NEMA]** (60): NEMA. This parameter modifies the presets of parameters [Rated motor power] (nPr), [Rated motor volt.] (UnS), [Rated mot. current] (nCr), [Rated motor freq.] (FrS), [Rated motor speed] (nSP) and [Max frequency] (tFr) below, [Mot. therm. current] (ItH) page 49, [High speed] (HSP) page 49, [Freq. threshold] (Ftd) page 59, [Freq. threshold 2] (F2d) page 59, [V. constant power] (UCP) page 69, [Freq. Const Power] (FCP) page 69, [Nominal freq sync.] (FrSS) page 70, [Preset speed 8] (SP8) page 140, [Forced Run Ref.] (InHr) page 201.		
nPr	**[Rated motor power]**	According to drive rating	According to drive rating
	The parameter cannot be accessed if [Motor control type] (Ctt) page 67 = [Sync. mot.] (SYn) Rated motor power given on the nameplate, in kW if [Standard mot. freq] (bFr) = [50 Hz IEC] (50), in HP if [Standard mot. freq] (bFr) = [60 Hz NEMA] (60).		
UnS	**[Rated motor volt.]**	According to drive rating	According to drive rating and [Standard mot. freq] (bFr)
	The parameter cannot be accessed if [Motor control type] (Ctt) page 67 = [Sync. mot.] (SYn) Rated motor voltage given on the nameplate. ATV61●●●M3X: 100 to 240 V ATV61●●●N4: 200 to 480 V ATV61●●●Y: 400 to 690 V		
nCr	**[Rated mot. current]**	0.25 to 1.1 or 1.2 In (1) according to rating	According to drive rating and [Standard mot. freq] (bFr)
	The parameter cannot be accessed if [Motor control type] (Ctt) page 67 = [Sync. mot.] (SYn) Rated motor current given on the nameplate.		
FrS	**[Rated motor freq.]**	10 to 500 or 1,000 Hz according to rating	50 Hz
	The parameter cannot be accessed if [Motor control type] (Ctt) page 67 = [Sync. mot.] (SYn) Rated motor frequency given on the nameplate. The factory setting is 50 Hz, or preset to 60 Hz if [Standard mot. freq] (bFr) is set to 60 Hz. The maximum value is limited to 500 Hz if [Motor control type] (Ctt) (page 67) is not V/F or if the drive rating is higher than ATV61HD37● or ATV61WD45● or if the drive is an ATV61●●●Y (500 to 690 V). Values between 500 Hz and 1000 Hz are only possible in V/F control and for powers limited to 37 kW (50 HP) for the ATV61H ●●● and 45 kW (60 HP) for ATV61W●●●. In this case, configure [Motor control type] (Ctt) before [Rated motor freq.] (FrS).		

(1) In corresponds to the rated drive current indicated in the Installation Manual and on the drive nameplate.

Code	Name/Description	Adjustment range	Factory setting
nSP	❑ **[Rated motor speed]**	0 to 60,000 rpm	According to drive rating
	The parameter cannot be accessed if [Motor control type] (Ctt) page 67 = [Sync. mot.] (SYn) Rated motor speed given on the nameplate. 0 to 9,999 rpm then 10.00 to 60.00 krpm on the integrated display terminal. If, rather than the rated speed, the nameplate indicates the synchronous speed and the slip in Hz or as a %, calculate the rated speed as follows: • Nominal speed = Synchronous speed x $\frac{100 - \text{slip as a }\%}{100}$ or • Nominal speed = Synchronous speed x $\frac{50 - \text{slip in Hz}}{50}$ (50 Hz motors) or • Nominal speed = Synchronous speed x $\frac{60 - \text{slip in Hz}}{60}$ (60 Hz motors)		
tFr	❑ **[Max frequency]**	10 to 500 or 1,000 Hz according to rating	60 Hz
	The factory setting is 60 Hz, or preset to 72 Hz if [Standard mot. freq] (bFr) is set to 60 Hz. The maximum value is limited by the following conditions: • It must not exceed 10 times the value of de [Rated motor freq.] (FrS) • It cannot exceed 500 Hz if the [Motor control type] (Ctt) (page 67) is not V/F or if the drive rating is higher than ATV61HD37● or ATV61WD45●, or if the drive is an ATV61●●●Y (500 to 690 V). Values between 500 Hz and 1000 Hz are only possible in V/F control and for powers limited to 37 kW (50 HP) for the ATV61H ●●● and 45 kW (60 HP) for ATV61W●●●. In this case, configure [Motor control type] (Ctt) before [Max frequency] (tFr).		

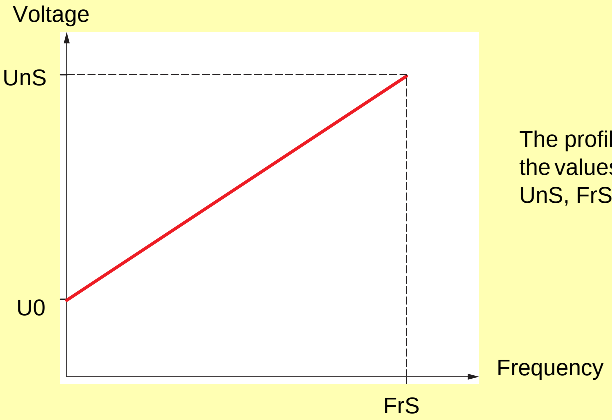
Code	Name/Description	Factory setting
tUn nO YES dOnE	❑ **[Auto tuning]** ☐ **[No]** (nO): Auto-tuning not performed. ☐ **[Yes]** (YES): Auto-tuning is performed as soon as possible, then the parameter automatically changes to [Done] (dOnE). ☐ **[Done]** (dOnE): Use of the values given the last time auto-tuning was performed. **Caution:** • It is essential that all the motor parameters are correctly configured before starting auto-tuning. - Asynchronous motor: [Rated motor volt.] (UnS), [Rated motor freq.] (FrS), [Rated mot. current] (nCr), [Rated motor speed] (nSP), [Rated motor power] (nPr) - Synchronous motor: [Nominal I sync.] (nCrS), [Nom motor spdsync] (nSPS), [Pole pairs] (PPnS), [Syn. EMF constant] (PHS), [Autotune L d-axis] (LdS), [Autotune L q-axis] (LqS) If one or more of these parameters is modified after auto-tuning has been performed, [Auto tuning] (tUn) will return to [No] (nO) and the procedure must be repeated. • Auto-tuning is only performed if no stop command has been activated. If a "freewheel stop" or "fast stop" function has been assigned to a logic input, this input must be set to 1 (active at 0). • Auto-tuning takes priority over any run or prefluxing commands, which will be taken into account after the auto-tuning sequence. • If auto-tuning fails, the drive displays [No] (nO) and, depending on the configuration of [Autotune fault mgt] (tnL) page 206, may switch to [Auto-tuning] (tnF) fault mode. • Auto-tuning may last for 1 to 2 seconds. Do not interrupt the process. Wait for the display to change to "[Done] (dOnE)" or "[No] (nO)". **Note:** During auto-tuning the motor operates at rated current.	[No] (nO)
AUt nO YES	❑ **[Automatic autotune]** ☐ **[No]** (nO): Function inactive ☐ **[Yes]** (YES): Auto-tuning is performed on every power-up. **Caution:** Same comments as for [Auto tuning] (tUn) above. If [Profile] (CHCF) = [8 serie] (SE8), then [Automatic autotune] (AUt) is fixed to [No] (nO).	[No] (nO)
tUS tAb PEnd PrOG FAIL dOnE CUS	❑ **[Auto tuning status]** For information only, cannot be modified. ☐ **[Not done]** (tAb): The default stator resistance value is used to control the motor. ☐ **[Pending]** (PEnd): Auto-tuning has been requested but not yet performed. ☐ **[In Progress]** (PrOG): Auto-tuning in progress ☐ **[Failed]** (FAIL): Auto-tuning has failed. ☐ **[Done]** (dOnE): The stator resistance measured by the auto-tuning function is used to control the motor. ☐ **[Customized]** (CUS): Auto-tuning has been performed, but at least one parameter set by this auto-tuning operation has subsequently been modified. The [Auto tuning] (tUn) parameter then returns to [No] (nO). The following auto-tuning parameters are concerned: [Cust. stator R syn] (rSAS) page 70, [R1w] (rSA), [Idw] (IdA), [LFw] (LFA) and [T2w] (trA) page 72.	[Not done] (tAb)
PHr AbC ACb	❑ **[Output Ph rotation]** ☐ **[ABC]** (AbC): Forward ☐ **[ACB]** (ACb): Reverse This parameter can be used to reverse the direction of rotation of the motor without reversing the wiring.	ABC

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.

Code	Name/Description	Adjustment range	Factory setting
Ctt	❑ **[Motor control type]**		[Energy Sav.] (nLd)

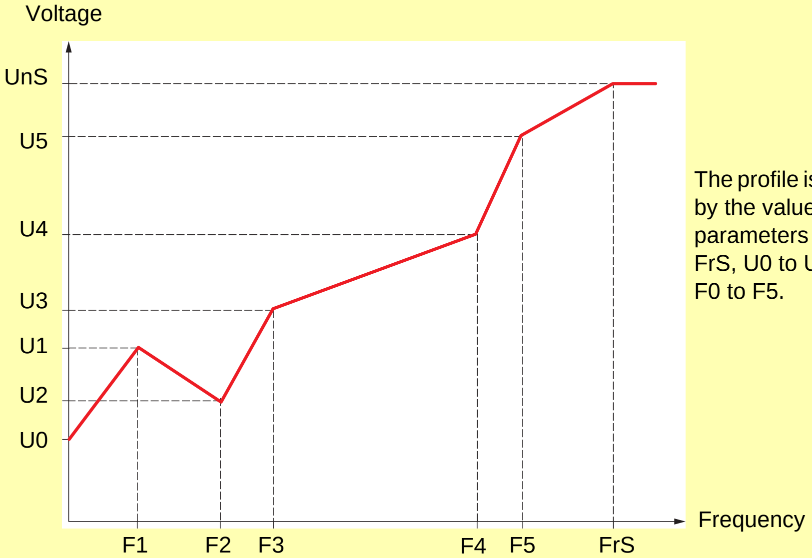
UUC — ☐ **[SVC V]** (UUC): Open-loop voltage flux vector control with automatic slip compensation according to the load. It supports operation with a number of motors connected in parallel on the same drive (if the motors are identical).

UF2 — ☐ **[V/F 2pts]** (UF2): Simple V/F profile without slip compensation. It supports operation with:
- Special motors (wound rotor, tapered rotor, etc.)
- A number of motors in parallel on the same drive
- High-speed motors
- Motors with a low power rating in comparison to that of the drive



The profile is defined by the values of parameters UnS, FrS and U0.

UF5 — ☐ **[V/F 5pts]** (UF5): 5-segment V/F profile: As V/F 2 pts profile but also supports the avoidance of resonance (saturation).



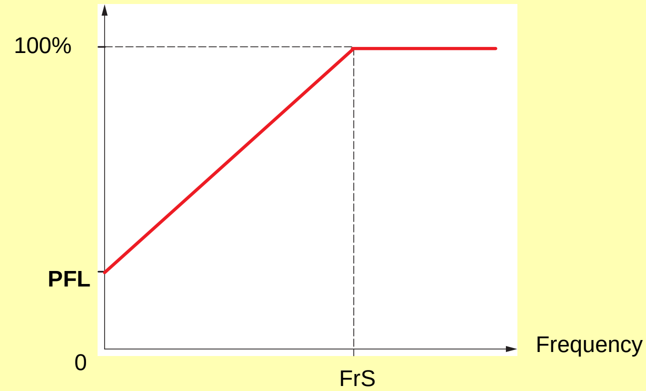
The profile is defined by the values of parameters UnS, FrS, U0 to U5 and F0 to F5.

FrS > F5 > F4 > F3 > F2 > F1

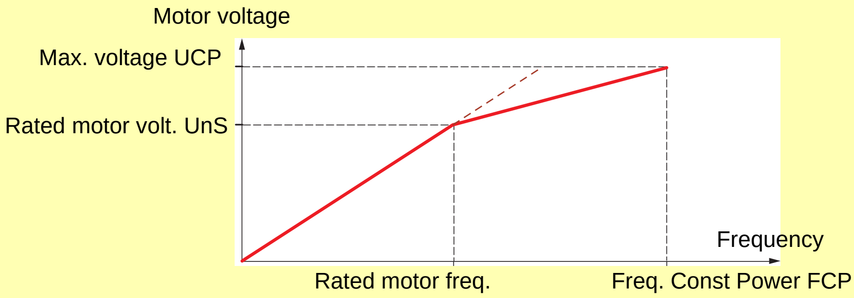
SYn — ☐ **[Sync. mot.]** (SYn): For synchronous permanent magnet motors with sinusoidal electromotive force (EMF) only. This selection is prohibited with ATV61●●●●Y (500 to 690 V).
This selection makes the asynchronous motor parameters inaccessible, and the synchronous motor parameters accessible.

UFq — ☐ **[U/F Quad.]** (UFq): Variable torque. For pump and fan applications.

nLd — ☐ **[Energy Sav.]** (nLd): Energy saving. For applications that do not require high dynamics. This type of control is recommended when replacing an ATV38.

Code	Name/Description	Adjustment range	Factory setting
PFL	❑ **[U/F Profile]** Adjustment of the [U/F Quad.] (UFq) ratio. The parameter can be accessed if [Motor control type] (Ctt) = [U/F Quad.] (UFq). It defines the magnetizing current at zero frequency, as a % of the rated magnetizing current.  	0 to 100%	20
U0	❑ **[U0]** V/f ratio The parameter can be accessed if [Motor control type] (Ctt) = [V/F 2pts] (UF2) or [V/F 5pts] (UF5) or [U/F Quad.] (UFq).	0 to 600 or 1,000 V according to rating	0
U1	❑ **[U1]** V/F profile setting. The parameter can be accessed if [Motor control type] (Ctt) = [V/F 5pts] (UF5)	0 to 600 or 1,000 V according to rating	0
F1	❑ **[F1]** V/F profile setting. The parameter can be accessed if [Motor control type] (Ctt) = [V/F 5pts] (UF5)	0 to 1,000 Hz	0
U2	❑ **[U2]** V/F profile setting. The parameter can be accessed if [Motor control type] (Ctt) = [V/F 5pts] (UF5)	0 to 600 or 1,000 V according to rating	0
F2	❑ **[F2]** V/F profile setting. The parameter can be accessed if [Motor control type] (Ctt) = [V/F 5pts] (UF5)	0 to 1,000 Hz	0
U3	❑ **[U3]** V/F profile setting. The parameter can be accessed if [Motor control type] (Ctt) = [V/F 5pts] (UF5)	0 to 600 or 1,000 V according to rating	0
F3	❑ **[F3]** V/F profile setting. The parameter can be accessed if [Motor control type] (Ctt) = [V/F 5pts] (UF5)	0 to 1,000 Hz	0

Parameter that can be modified during operation or when stopped.

Code	Name/Description	Adjustment range	Factory setting
UY	❑ [U4]	0 to 600 or 1,000 V according to rating	0
	V/F profile setting. The parameter can be accessed if [Motor control type] (Ctt) = [V/F 5pts] (UF5)		
FY	❑ [F4]	0 to 1,000 Hz	0
	V/F profile setting. The parameter can be accessed if [Motor control type] (Ctt) = [V/F 5pts] (UF5)		
U5	❑ [U5]	0 to 600 or 1,000 V according to rating	0
	V/F profile setting. The parameter can be accessed if [Motor control type] (Ctt) = [V/F 5pts] (UF5)		
F5	❑ [F5]	0 to 1,000 Hz	0
	V/F profile setting. The parameter can be accessed if [Motor control type] (Ctt) = [V/F 5pts] (UF5)		
UC2	❑ [Vector Control 2pt]		[No] (nO)
	The parameter can be accessed if [Motor control type] (Ctt) is not [Sync. mot.] (SYn).		
nO	❑ [No] (nO): Function inactive		
YES	❑ [Yes] (YES): Function active. Used in applications in which the motor rated speed and frequency need to be exceeded in order to optimize operation at constant power, or when the maximum voltage of the motor needs to be limited to a value below the line voltage. The voltage/frequency profile must then be adapted in accordance with the motor's capabilities to operate at maximum voltage UCP and maximum frequency FCP. 		
UCP	❑ [V. constant power]	According to drive rating	According to drive rating and [Standard mot. freq] (bFr)
	The parameter can be accessed if [Vector Control 2pt] (UC2) = [Yes] (YES)		
FCP	❑ [Freq. Const Power]	According to drive rating and [Rated motor freq.] (FrS)	= [Standard mot. freq] (bFr)
	The parameter can be accessed if [Vector Control 2pt] (UC2) = [Yes] (YES)		

Synchronous motor parameters

These parameters can be accessed if [Motor control type] (Ctt) page 67 = [Sync. mot.] (SYn). In this case, the asynchronous motor parameters cannot be accessed.

Code	Name/Description	Adjustment range	Factory setting
nCrS	❑ **[Nominal I sync.]** Rated synchronous motor current given on the nameplate.	0.25 to 1.1 or 1.2 Hz according to rating (1)	According to drive rating
nSPS	❑ **[Nom motor spdsync]** Rated motor speed given on the nameplate. On the integrated display unit: 0 to 9,999 rpm then 10.00 to 60.00 krpm.	0 to 60,000 rpm	According to drive rating
PPnS	❑ **[Pole pairs]** Number of pairs of poles on the synchronous motor.	1 to 50	According to drive rating
PHS	❑ **[Syn. EMF constant]** Synchronous motor EMF constant, in mV per rpm.	0 to 6,553.5	According to drive rating
LdS	❑ **[Autotune L d-axis]** Axis "d" stator inductance in mH. On motors with smooth poles [Autotune L d-axis] (LdS) = [Autotune L q-axis] (LqS) = Stator inductance L.	0 to 655.3	According to drive rating
LqS	❑ **[Autotune L q-axis]** Axis "q" stator inductance in mH. On motors with smooth poles [Autotune L d-axis] (LdS) = [Autotune L q-axis] (LqS) = Stator inductance L.	0 to 655.3	According to drive rating
rSAS	❑ **[Cust. stator R syn]** Cold state stator resistance (per winding) The factory setting is replaced by the result of the auto-tuning operation, if it has been performed. The value can be entered by the user, if he knows it. Value in milliohms (mΩ) up to 75 kW (100 HP), in hundredths of milliohms (mΩ/100) above 75 kW (100 HP). On the integrated display unit: 0 to 9,999 then 10.00 to 65.53 (10,000 to 65,536).	According to drive rating	According to drive rating

(1) In corresponds to the rated drive current indicated in the Installation Manual and on the drive nameplate.

Synchronous motor parameters that can be accessed in [Expert] mode

Code	Name/Description
rSMS	❑ **[R1rS]** Cold state stator resistance (per winding), in read-only mode. This is the drive factory setting or the result of the auto-tuning operation, if it has been performed. Value in milliohms (mΩ) up to 75 kW (100 HP), in hundredths of milliohms (mΩ/100) above 75 kW (100 HP). On the integrated display unit: 0 to 9,999 then 10.00 to 65.53 (10,000 to 65,536).
FrSS	❑ **[Nominal freq sync.]** Motor frequency at rated speed in Hz, calculated by the drive (rated motor frequency), in read-only mode.

Code	Name/Description	Adjustment range	Factory setting
UFr	❑ **[IR compensation]** (1) The parameter can be accessed if [Motor control type] (Ctt) is not [V/F 2pts] (UF2), [V/F 5pts] (UF5) or [U/F Quad.] (UFq). Used to optimize the torque at very low speed (increase [IR compensation] (UFr) if the torque is insufficient). Check that the [IR compensation] (UFr) value is not too high when the motor is warm (risk of instability).	25 to 200%	100%
SLP	❑ **[Slip compensation]** (1) The parameter can be accessed if [Motor control type] (Ctt) is not [V/F 2pts] (UF2), [V/F 5pts] (UF5), [U/F Quad.] (UFq) or [Sync. mot.] (SYn). Adjusts the slip compensation around the value set by the rated motor speed. The speeds given on motor nameplates are not necessarily exact. • If slip setting < actual slip: The motor is not rotating at the correct speed in steady state, but at a speed lower than the reference. • If slip setting > actual slip: The motor is overcompensated and the speed is unstable.	0 to 300%	100%

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.

Parameter that can be modified during operation or when stopped.

Parameter can be accessed in [Expert] mode.

Code	Name/Description
PrT	**[Power Ident]** Parameter reserved for Schneider Electric product support. **Do not modify.** To modify this parameter with the integrated terminal, press and hold down the "ENT" key for 2 s.

Asynchronous motor parameters that can be accessed in [Expert] mode

These parameters can be accessed if [Motor control type] (Ctt) page 67 is not [Sync. mot.] (SYn).
These include:

- Parameters calculated by the drive during auto-tuning, in read-only mode. For example, R1r, calculated cold stator resistance.
- The possibility of replacing some of these calculated parameters by other values, if necessary. For example, R1w, measured cold stator resistance.

When a parameter Xyw is modified by the user, the drive uses it in place of the calculated parameter Xyr.

If auto-tuning is performed or if one of the motor parameters on which auto-tuning depends is modified ([Rated motor volt.] (UnS), [Rated motor freq.] (FrS), [Rated mot. current] (nCr), [Rated motor speed] (nSP), [Rated motor power] (nPr)), parameters Xyw return to their factory settings.

Code	Name/Description
rSM	**[Stator R measured]** Cold stator resistance, calculated by the drive, in read-only mode. Value in milliohms (mΩ) up to 75 kW (100 HP), in hundredths of milliohms (mΩ/100) above 75 kW (100 HP).
IdM	**[Idr]** Magnetizing current in A, calculated by the drive, in read-only mode.
LFM	**[Lfr]** Leakage inductance in mH, calculated by the drive, in read-only mode.
trM	**[T2r]** Rotor time constant in mS, calculated by the drive, in read-only mode.
nSL	**[Nominal motor slip]** Rated slip in Hz, calculated by the drive, in read-only mode. To modify the rated slip, modify the [Rated motor speed] (nSP) (page 65).
PPn	**[Pr]** Number of pairs of poles, calculated by the drive, in read-only mode.
rSA	**[R1w]** Cold state stator resistance (per winding), modifiable value. In milliohms (mΩ) up to 75 kW (100 HP), in hundredths of milliohms (mΩ/100) above 75 kW (100 HP). On the integrated display unit: 0 to 9,999 then 10.00 to 65.53 (10,000 to 65,536).
IdA	**[Idw]** Magnetizing current in A, modifiable value.
LFA	**[Lfw]** Leakage inductance in mH, modifiable value.
trA	**[T2w]** Rotor time constant in mS, modifiable value.

Selecting the encoder

Follow the recommendations in the catalog and the Installation Manual.

Code	Name/Description	Adjustment range	Factory setting
EnS	❑ **[Encoder type]**		[AABB] (AAbb)
	To be configured in accordance with the type of card and encoder used (1).		
nO	☐ **[----]** (nO): Card missing.		
AAbb	☐ **[AABB]** (AAbb): For signals A, A-, B, B-.		
Ab	☐ **[AB]** (Ab): For signals A, B.		
A	☐ **[A]** (A): For signal A. Value cannot be accessed if [Encoder usage] (EnU) page 74 = [Spd fdk reg.] (rEG).		
PGI	❑ **[Number of pulses]**	100 to 5,000	1,024
	Number of pulses per encoder revolution. The parameter can be accessed if an encoder card has been inserted (1).		

(1) The encoder parameters can only be accessed if the encoder card has been inserted, and the available selections will depend on the type of encoder card used. The encoder configuration can also be accessed in the [1.5- INPUTS / OUTPUTS CFG] (I/O) menu.

Encoder check procedure

1. Set up in open-loop mode, following the recommendations on page 8.
2. Set [Encoder usage] (EnU) = [No] (nO).
3. Set [Encoder type] (EnS) and [Number of pulses] (PGI) accordingly for the encoder used.
4. Set [Encoder check] (EnC) = [Yes] (YES)
5. Check that the rotation of the motor is safe.
6. Set the motor rotating at stabilized speed ≈ 15% of the rated speed for at least 3 seconds, and use the [1.2-MONITORING] (SUP-) menu to monitor its behavior.
7. If it trips on an [Encoder fault] (EnF), [Encoder check] (EnC) returns to [No] (nO).
   - Check [Number of pulses] (PGI) and [Encoder type] (EnS).
   - Check that the mechanical and electrical operation of the encoder, its power supply and connections are all correct.
   - Reverse the direction of rotation of the motor ([Output Ph rotation] (PHr) parameter page 66) or the encoder signals.
8. Repeat the operations from 5 onwards until [Encoder check] (EnC) changes to [Done] (dOnE).

Code	Name/Description	Adjustment range	Factory setting
EnC	❑ **[Encoder check]**		[Not done] (nO)
	Encoder feedback check See the procedure below. The parameter can be accessed if an encoder card has been inserted (1).		
nO	☐ **[Not done]** (nO) Check not performed.		
YES	☐ **[Yes]** (YES): Activates monitoring of the encoder.		
dOnE	☐ **[Done]** (dOnE): Check performed successfully. The check procedure checks: - The direction of rotation of the encoder/motor - The presence of signals (wiring continuity) - The number of pulses/revolution If a fault is detected, the drive locks in [Encoder fault] (EnF) fault mode.		
EnU	❑ **[Encoder usage]**		[No] (nO)
	The parameter can be accessed if an encoder card has been inserted (1).		
nO	☐ **[No]** (nO): Function inactive		
SEC	☐ **[Fdbk monit.]** (SEC): The encoder provides speed feedback for monitoring only.		
rEG	☐ **[Spd fdk reg.]** (rEG): The encoder provides speed feedback for regulation and monitoring. If [Motor control type] (Ctt) = [SVC U] (UUC) the encoder operates in speed feedback mode and enables static correction of the speed to be performed. This configuration is not accessible for other [Motor control type] (Ctt) values.		
PGr	☐ **[Speed ref.]** (PGr): The encoder provides a reference.		

(1) The encoder parameters can only be accessed if the encoder card has been inserted, and the available selections will depend on the type of encoder card used. The encoder configuration can also be accessed in the [1.5- INPUTS / OUTPUTS CFG] (I/O) menu.

Code	Name/Description	Adjustment range	Factory setting
OFI nO YES	❑ **[Sinus filter]** ☐ **[No]** (nO): No sinus filter ☐ **[Yes]** (YES): Use of a sinus filter, to limit overvoltages on the motor and reduce the ground fault leakage current. [Sinus filter] (OFI) is forced to [No] (nO) for ATV61●075●● ratings and all ATV61●●●●Y. . **CAUTION** If [Sinus filter] (OFI) = [Yes] (YES), [Max frequency] (tFr) **must not exceed 100 Hz and** [Motor control type] (Ctt) page 67 **must not be:** • [Sync. mot.] (SYn), irrespective of the drive rating • [SVC V] (UUC) or [Energy Sav.] (nLd) at and above 55 kW (75 HP) for ATV61H●●●M3X and at and above 90 kW (120 HP) for ATV61H●●●N4 **Failure to follow this instruction can result in equipment damage.**		[No] (nO)
SFr ( )	❑ **[Switching freq.]** (1) Switching frequency setting. **Note:** In the event of excessive temperature rise, the drive will automatically reduce the switching frequency and reset it once the temperature returns to normal. **Adjustment range:** It can vary between 1 and 16 kHz, but the minimum and maximum values, as well as the factory setting, can be limited in accordance with the type of drive (ATV61H or W), the rating (power and voltage) and the configuration of the [Sinus filter] (OFI) parameter above and [Motor surge limit.] (SUL) parameter page 76. **Adjustment with drive running:** - If the initial value is less than 2 kHz, it is not possible to increase it above 1.9 kHz while running. - If the initial value is greater than or equal to 2 kHz, a minimum of 2 kHz must be maintained while running. **Adjustment with the drive stopped:** No restrictions. **CAUTION** On ATV61●075N4 to U40N4 drives, if the RFI filters are disconnected (operation on an IT system), the switching frequency of the drive must not exceed 4 kHz. **Failure to follow this instruction can result in equipment damage.**	According to rating	According to rating
CLI ( )	❑ **[Current Limitation]** (1) Used to limit the motor current. **Note:** If the setting is less than 0.25 In, the drive may lock in [Output Phase Loss] (OPF) fault mode if this has been enabled (see page 194). If it is less than the no-load motor current, the limitation no longer has any effect. **CAUTION** Check that the motor will withstand this current, particularly in the case of permanent magnet synchronous motors, which are susceptible to demagnetization. **Failure to follow this instruction can result in equipment damage.**	0 to 1.1 or 1.2 In (2) according to rating	1.1 or 1.2 In (2) according to rating

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.
(2) In corresponds to the rated drive current indicated in the Installation Manual and on the drive nameplate.

( ) Parameter that can be modified during operation or when stopped.

Code	Name/Description	Adjustment range	Factory setting
nrd	❑ **[Noise reduction]**		According to rating
nO	☐ **[No]** (nO): Fixed frequency. Factory setting at and above ATV61HD55M3X, ATV61HD90N4 and ATV61HC11Y.		
YES	☐ **[Yes]** (YES): Frequency with random modulation. Factory setting up to ATV61HD45M3X, ATV61HD75N4 and ATV61HD90Y. Random frequency modulation prevents any resonance, which may occur at a fixed frequency.		
SUL	❑ **[Motor surge limit.]** This function limits motor overvoltages and is useful in the following applications: - NEMA motors - Japanese motors - Spindle motors - Rewound motors		[No] (nO)
nO	☐ **[No]** (nO): Function inactive		
YES	☐ **[Yes]** (YES): Function active This parameter is forced to [No] (nO) if a sinus filter is used. This parameter can remain = [No] (nO) for 230/400 V motors used at 230 V, or if the length of cable between the drive and the motor does not exceed: - 4 m with unshielded cables - 10 m with shielded cables		
SOP	❑ **[Volt surge limit. opt]** Optimization parameter for transient overvoltages at the motor terminals. Accessible if [Motor surge limit.] (SUL) = [Yes] (YES). Set to 6, 8, or 10 (µs), according to the following table.		10 (µs)

The value of the “SOP” parameter corresponds to the attenuation time of the cable used. It is defined to prevent the superimposition of voltage wave reflections resulting from long cable lengths. It limits overvoltages to twice the DC bus rated voltage.
The tables on the following page give examples of correspondence between the “SOP” parameter and the length of the cable between the drive and the motor. For longer cable lengths, a sinus filter or a dV/dt protection filter must be used.

- For motors in parallel, the sum of all the cable lengths must be taken into consideration. Compare the length given in the line corresponding to the power for one motor with that corresponding to the total power, and select the shorter length. Example: Two 7.5 kW (10 HP) motors – take the lengths on the 15 kW (20 HP) line, which are shorter than those on the 7.5 kW (10 HP) line, and divide by the number of motors to obtain the length per motor (with unshielded “GORSE” cable and SOP = 6, the result is 40/2 = 20 m maximum for each 7.5 kW (10 HP) motor).

In special cases (for example, different types of cable, different motor powers in parallel, different cable lengths in parallel, etc.), we recommend using an oscilloscope to check the overvoltage values obtained at the motor terminals.

To retain the overall drive performance, do not increase the SOP value unnecessarily.

Tables giving the correspondence between the SOP parameter and the cable length, for 400 V line supply

Altivar 61	Motor		Cable cross-section		Maximum cable length in meters					
reference	Power				Unshielded "GORSE" cable Type H07 RN-F 4Gxx			Shielded "GORSE" cable Type GVCSTV-LS/LH		
	kW	HP	in mm^2	AWG	SOP = 10	SOP = 8	SOP = 6	SOP = 10	SOP = 8	SOP = 6
ATV61H075N4	0.75	1	1.5	14	100 m	70 m	45 m	105 m	85 m	65 m
ATV61HU15N4	1.5	2	1.5	14	100 m	70 m	45 m	105 m	85 m	65 m
ATV61HU22N4	2.2	3	1.5	14	110 m	65 m	45 m	105 m	85 m	65 m
ATV61HU30N4	3	-	1.5	14	110 m	65 m	45 m	105 m	85 m	65 m
ATV61HU40N4	4	5	1.5	14	110 m	65 m	45 m	105 m	85 m	65 m
ATV61HU55N4	5.5	7.5	2.5	14	120 m	65 m	45 m	105 m	85 m	65 m
ATV61HU75N4	7.5	10	2.5	14	120 m	65 m	45 m	105 m	85 m	65 m
ATV61HD11N4	11	15	6	10	115 m	60 m	45 m	100 m	75 m	55 m
ATV61HD15N4	15	20	10	8	105 m	60 m	40 m	100 m	70 m	50 m
ATV61HD18N4	18.5	25	10	8	115 m	60 m	35 m	150 m	75 m	50 m
ATV61HD22N4	22	30	16	6	150 m	60 m	40 m	150 m	70 m	50 m
ATV61HD30N4	30	40	25	4	150 m	55 m	35 m	150 m	70 m	50 m
ATV61HD37N4	37	50	35	5	200 m	65 m	50 m	150 m	70 m	50 m
ATV61HD45N4	45	60	50	0	200 m	55 m	30 m	150 m	60 m	40 m
ATV61HD55N4	55	75	70	2/0	200 m	50 m	25 m	150 m	55 m	30 m
ATV61HD75N4	75	100	95	4/0	200 m	45 m	25 m	150 m	55 m	30 m

Altivar 61	Motor		Cable cross-section		Maximum cable length in meters					
reference	Power				Shielded "BELDEN" cable Type 2950x			Shielded "PROTOFLEX" cable Type EMV 2YSLCY-J		
	kW	HP	in mm^2	AWG	SOP = 10	SOP = 8	SOP = 6	SOP = 10	SOP = 8	SOP = 6
ATV61H075N4	0.75	1	1.5	14	50 m	40 m	30 m			
ATV61HU15N4	1.5	2	1.5	14	50 m	40 m	30 m			
ATV61HU22N4	2.2	3	1.5	14	50 m	40 m	30 m			
ATV61HU30N4	3	-	1.5	14	50 m	40 m	30 m			
ATV61HU40N4	4	5	1.5	14	50 m	40 m	30 m			
ATV61HU55N4	5.5	7.5	2.5	14	50 m	40 m	30 m			
ATV61HU75N4	7.5	10	2.5	14	50 m	40 m	30 m			
ATV61HD11N4	11	15	6	10	50 m	40 m	30 m			
ATV61HD15N4	15	20	10	8	50 m	40 m	30 m			
ATV61HD18N4	18.5	25	10	8	50 m	40 m	30 m			
ATV61HD22N4	22	30	16	6				75 m	40 m	25 m
ATV61HD30N4	30	40	25	4				75 m	40 m	25 m
ATV61HD37N4	37	50	35	5				75 m	40 m	25 m
ATV61HD45N4	45	60	50	0				75 m	40 m	25 m
ATV61HD55N4	55	75	70	2/0				75 m	30 m	15 m
ATV61HD75N4	75	100	95	4/0				75 m	30 m	15 m

Note: For 230/400 V used at 230 V, the [Motor surge limit.] (SUL) parameter can remain = [No] (nO).

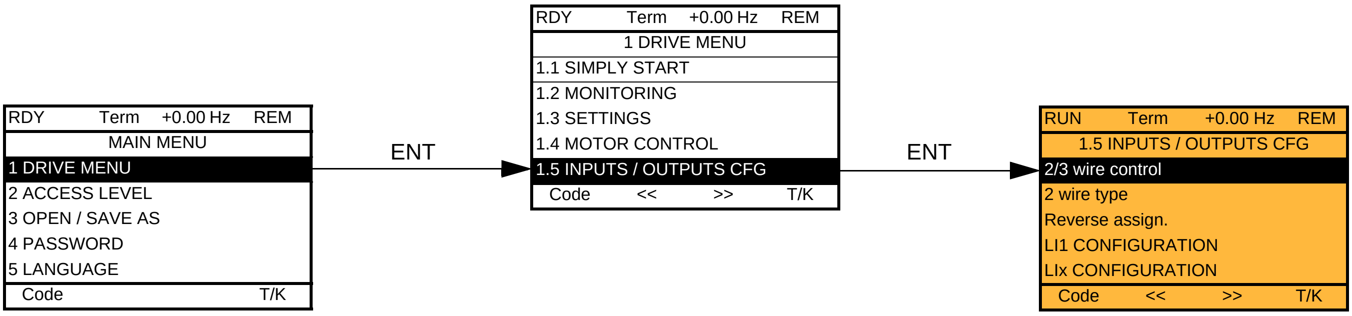
Code	Name/Description	Adjustment range	Factory setting
UbR	**[Braking level]** DC bus voltage threshold above which the braking transistor cuts in to limit this voltage. ATV61●●●●M3●: factory setting 395 V. ATV61●●●●N4: factory setting 785 V. ATV61●●●●S6Y: factory setting 980 V. ATV61●●●●Y: factory setting 1127 V or 1080 V according to rating. The adjustment range depends on the voltage rating of the drive and the [Mains voltage] (UrES) parameter, page 198.		According to drive voltage rating
bbA nO YES	**[Braking balance]** **[No]** (nO): Function inactive **[Yes]** (YES): Function active, to be used on drives connected in parallel via their DC bus. Used to balance the braking power between the drives. The [Braking level] (Ubr) parameter, page 78, must be set to the same value on the various drives. The value [Yes] (YES) is only possible if [Dec ramp adapt.] (brA) = [No] (nO) (see page 132).		[No] (nO)

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.

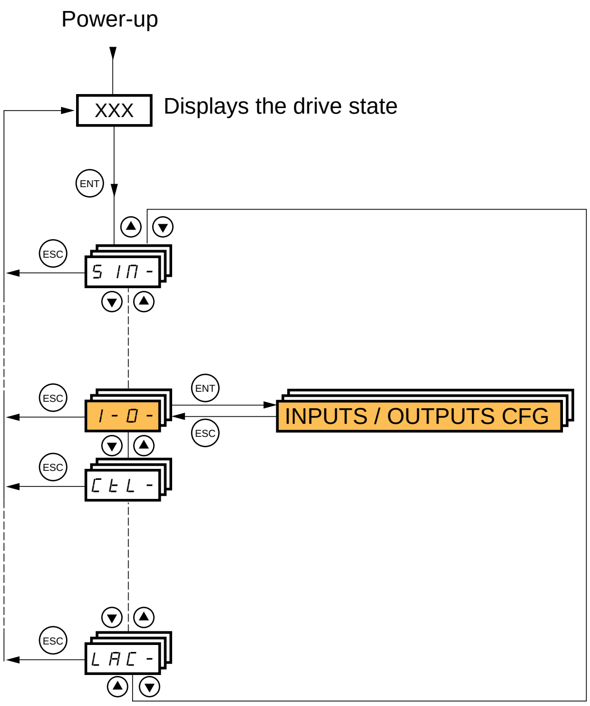
Parameter that can be modified during operation or when stopped.

[1.5 INPUTS / OUTPUTS CFG] (I-O-)

With graphic display terminal:

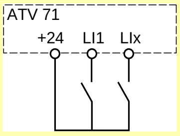
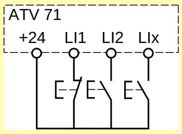


With integrated display terminal:



[1.5 INPUTS / OUTPUTS CFG] (I-O-)

The parameters in the [1.5 INPUTS / OUTPUTS CFG] (I-O-) menu can only be modified when the drive is stopped and no run command is present.

Code	Name/Description	Adjustment range	Factory setting
tCC 2C 3C	**❑ [2/3 wire control]** ☐ **[2 wire]** (2C) ☐ **[3 wire]** (3C) 2-wire control: This is the input state (0 or 1) or edge (0 to 1 or 1 to 0), which controls running or stopping. Example of "source" wiring:  LI1: forward LIx: reverse 3-wire control (pulse control): A "forward" or "reverse" pulse is sufficient to command starting, a "stop" pulse is sufficient to command stopping. Example of "source" wiring:  LI1: stop LI2: forward LIx: reverse **WARNING** **UNINTENDED EQUIPMENT OPERATION** To change the assignment of [2/3 wire control] (tCC) press the "ENT" key for 2 s. It causes the following functions to return to factory setting: [2 wire type] (tCt) and [Reverse assign.] (rrS) below, and all functions which assign logic inputs and analog inputs. The macro configuration selected will also be reset if it has been customized (loss of custom settings). It is advisable to configure this parameter before configuring the [1.6 COMMAND] (CtL-) and [1.7 APPLICATION FUNCT.] (FUn-) menus. Check that this change is compatible with the wiring diagram used. **Failure to follow these instructions can result in death or serious injury.**		[2 wire] (2C)
tCt LEL trn PFO	**❑ [2 wire type]** ☐ **[Level]** (LEL): State 0 or 1 is taken into account for run (1) or stop (0). ☐ **[Transition]** (trn): A change of state (transition or edge) is necessary to initiate operation, in order to prevent accidental restarts after a break in the power supply. ☐ **[Fwd priority]** (PFO): State 0 or 1 is taken into account for run or stop, but the "forward" input always takes priority over the "reverse" input.		[Transition] (trn)
rrS nO LI1 - - C101 - - - Cd00 -	**❑ [Reverse assign.]** ☐ **[No]** (nO): Not assigned ☐ **[LI1]** (LI1) to **[LI6]** (LI6) ☐ **[LI7]** (LI7) to **[LI10]** (LI10): If VW3A3201 logic I/O card has been inserted ☐ **[LI11]** (LI11) to **[LI14]** (LI14): If VW3A3202 extended I/O card has been inserted ☐ **[C101]** (C101) to **[C115]** (C115): With integrated Modbus in [I/O profile] (IO) ☐ **[C201]** (C201) to **[C215]** (C215): With integrated CANopen in [I/O profile] (IO) ☐ **[C301]** (C301) to **[C315]** (C315): With a communication card in [I/O profile] (IO) ☐ **[C401]** (C401) to **[C415]** (C415): With a Controller Inside card in [I/O profile] (IO) ☐ **[CD00]** (Cd00) to **[CD13]** (Cd13): In [I/O profile] (IO) can be switched with possible logic inputs ☐ **[CD14]** (Cd14) to **[CD15]** (Cd15): In [I/O profile] (IO) can be switched without logic inputs Assignment of the reverse direction command.		[No] (nO)

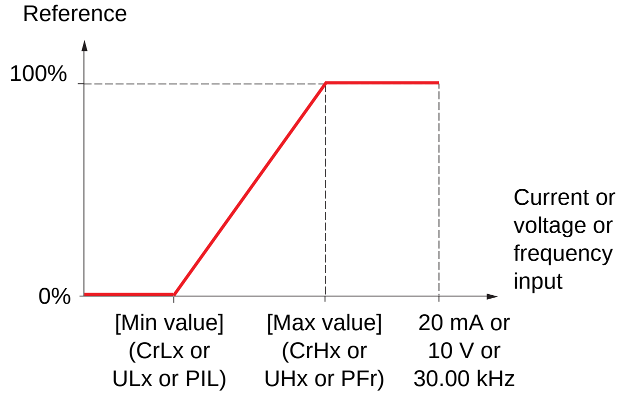
Code	Name/Description	Adjustment range	Factory setting
L1-	■ [LI1 CONFIGURATION]		
L1A	❑ [LI1 assignment] Read-only parameter, cannot be configured. It displays all the functions that are assigned to input LI1 in order to check multiple assignments.		
L1d	❑ [LI1 On Delay] This parameter is used to take account of the change of the logic input to state 1 with a delay that can be adjusted between 0 and 200 milliseconds, in order to filter out possible interference. The change to state 0 is taken into account without delay. **WARNING** **UNINTENDED EQUIPMENT OPERATION** Check that the delay set does not pose a risk or lead to undesired operation. The relative order in which these inputs are taken into account may be modified according to the delay values of the various logic inputs, and thus lead to unintended operation. **Failure to follow these instructions can result in death or serious injury.**	0 to 200 ms	0
L--	■ [LIx CONFIGURATION] All the logic inputs available on the drive are processed as in the example for LI1 above, up to LI6, LI10 or LI14, depending on whether or not option cards have been inserted.		

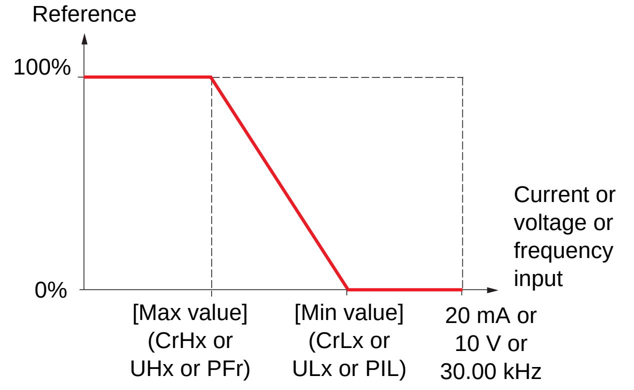
Configuration of analog inputs and Pulse input

The minimum and maximum input values (in volts, mA, etc.) are converted to% in order to adapt the references to the application.

Minimum and maximum input values:

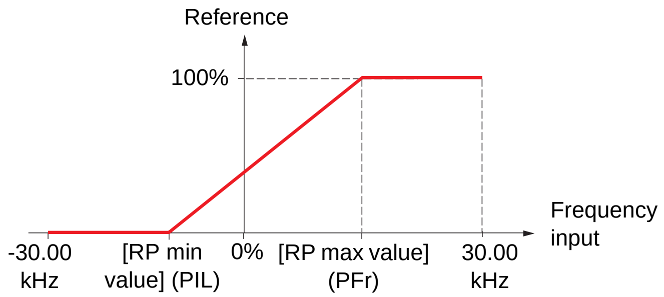
The minimum value corresponds to a reference of 0% and the maximum value to a reference of 100%. The minimum value may be greater than the maximum value:





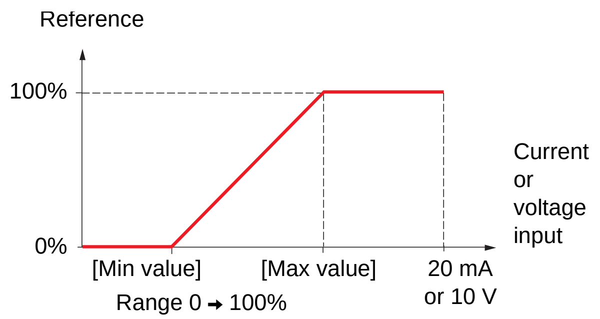
For +/- bidirectional inputs, the min. and max. are relative to the absolute value, for example, +/- 2 to 8 V.

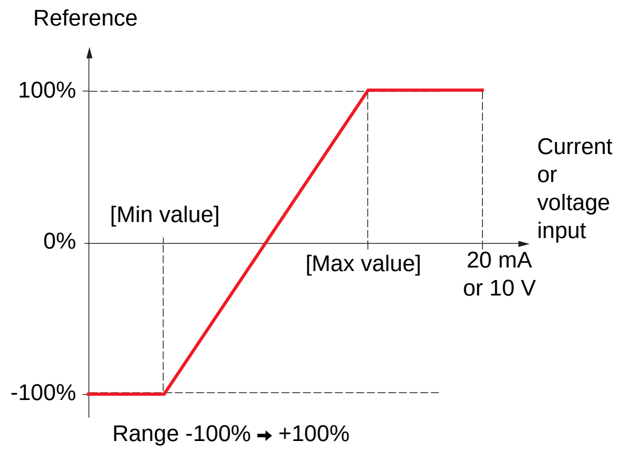
Negative min. value of Pulse input:



Range (output values): For analog inputs only

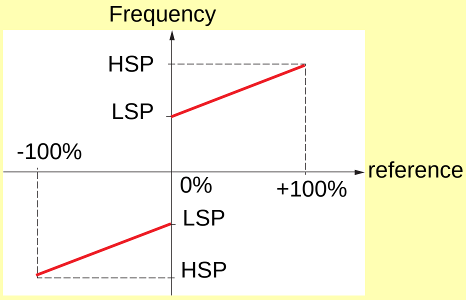
This parameter is used to configure the reference range to [0% → 100%] or [-100% → +100%] in order to obtain a bidirectional output from a unidirectional input.





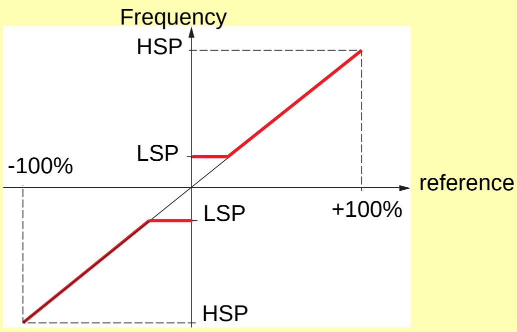
Code	Name/Description	Adjustment range	Factory setting
bSP	❑ **[Reference template]**		[Standard] (bSd)

bSd ☐ **[Standard]** (bSd)



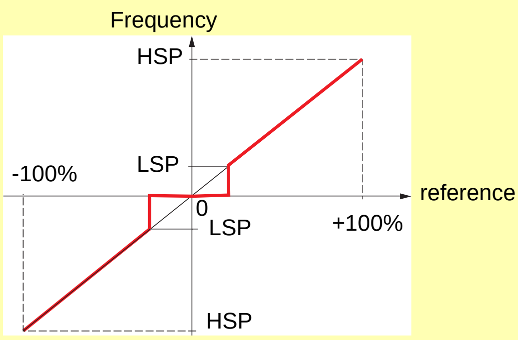
At zero reference the frequency = LSP

bLS ☐ **[Pedestal]** (bLS)



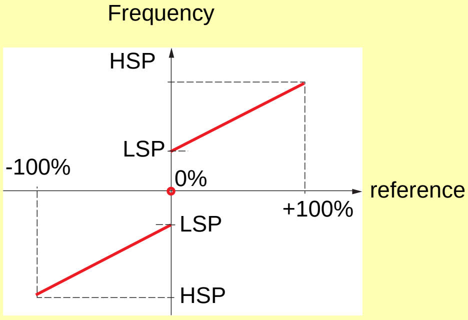
At reference = 0 to LSP the frequency = LSP

bnS ☐ **[Deadband]** (bnS)



At reference = 0 to LSP the frequency = 0

bnS0 ☐ **[Deadband 0]** (bnS0)



This operation is the same as [Standard] (bSd), except that in the following cases at zero reference, the frequency = 0:
• The signal is less than [Min value], which is greater than 0 (example 1 V on a 2 - 10 V input)
• The signal is greater than [Min value], which is greater than [Max value] (example 11 V on a 10 - 0 V input).

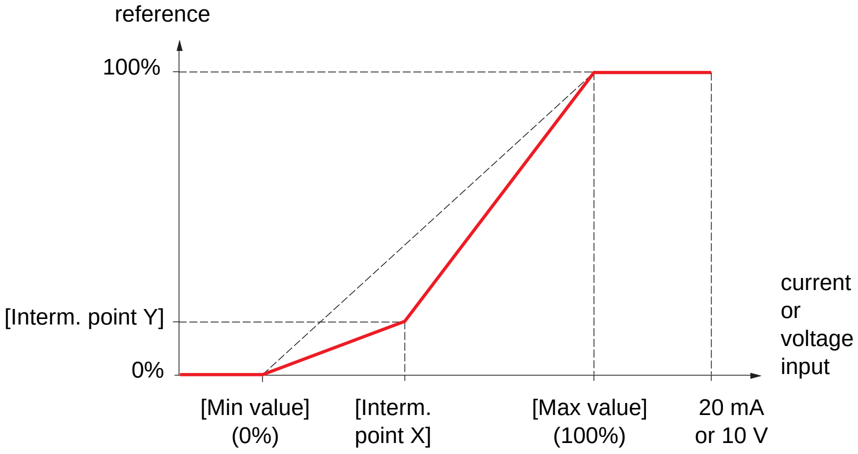
If the input range is configured as “bidirectional”, operation remains identical to [Standard] (bSd).

This parameter defines how the speed reference is taken into account, for analog inputs and Pulse input only. In the case of the PID regulator, this is the PID output reference.
The limits are set by the [Low speed] (LSP) and [High speed] (HSP) parameters, page 37

Delinearization: For analog inputs only

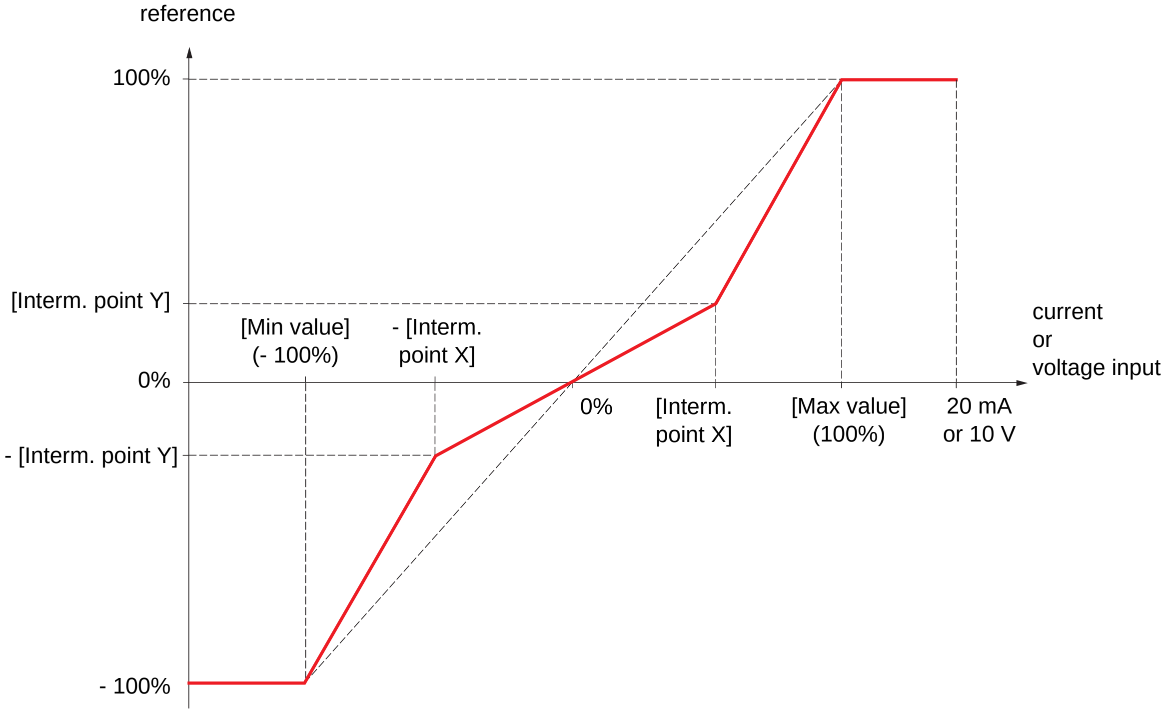
The input can be delinearized by configuring an intermediate point on the input/output curve of this input:

For range 0 → 100%



Note: For [Interm. point X], 0% corresponds to [Min value] and 100% to [Max value]

For range -100% → 100%



Code	Name/Description	Adjustment range	Factory setting
AI1-	■ **[AI1 CONFIGURATION]**		
AI1A	❑ **[AI1 assignment]** Read-only parameter, cannot be configured. It displays all the functions associated with input AI1 in order to check, for example, for compatibility problems.		
AI1t	❑ **[AI1 Type]**		[Voltage] (10U)
10U	☐ **[Voltage]** (10U): Positive voltage input (negative values are considered as zero: the input is unidirectional).		
n10U	☐ **[Voltage +/-]** (n10U): Positive and negative voltage input (the input is bidirectional).		
UIL1	❑ **[AI1 min value]**	0 to 10.0 V	0 V
UIH1	❑ **[AI1 max value]**	0 to 10.0 V	10.0 V
AI1F	❑ **[AI1 filter]** Interference filtering.	0 to 10.00 s	0 s
AI1E	❑ **[AI1 Interm. point X]** Input delinearization point coordinate. • 0% corresponds to [AI1 min value] (UIL1). • 100% corresponds to [AI1 max value] (UIH1).	0 to 100%	0%
AI1S	❑ **[AI1 Interm. point Y]** Output delinearization point coordinate (frequency reference).	0 to 100%	0%

Code	Name/Description	Adjustment range	Factory setting
AI2-	**[AI2 CONFIGURATION]**		
AI2A	**[AI2 assignment]** Read-only parameter, cannot be configured. It displays all the functions associated with input AI2 in order to check, for example, for compatibility problems.		
AI2t 10U 0A	**[AI2 Type]** **[Voltage]** (10U): Voltage input **[Current]** (0 A): Current input		[Current] (0 A)
CrL2	**[AI2 min. value]** The parameter can be accessed if [AI2 Type] (AI2t) = [Current] (0 A)	0 to 20.0 mA	0 mA
UIL2	**[AI2 min. value]** The parameter can be accessed if [AI2 Type] (AI2t) = [Voltage] (10U)	0 to 10.0 V	0 V
CrH2	**[AI2 max. value]** The parameter can be accessed if [AI2 Type] (AI2t) = [Current] (0 A)	0 to 20.0 mA	20.0 mA
UIH2	**[AI2 max. value]** The parameter can be accessed if [AI2 Type] (AI2t) = [Voltage] (10U)	0 to 10.0 V	10.0 V
AI2F	**[AI2 filter]** Interference filtering.	0 to 10.00 s	0 s
AI2L POS nEG	**[AI2 range]** **[0 – 100%]** (POS): Unidirectional input **[+/- 100%]** (nEG): Bidirectional input Example: On a 0/10 V input - 0 V corresponds to reference -100% - 5 V corresponds to reference 0% - 10 V corresponds to reference +100%		[0 – 100%] (POS)
AI2E	**[AI2 Interm. point X]** Input delinearization point coordinate. • 0% corresponds to [Min value] if the range is 0 → 100%. • 0% corresponds to $\frac{\text{[Max value] + [Min value]}}{2}$ if the range is -100% → +100%. • 100% corresponds to [Max value].	0 to 100%	0%
AI2S	**[AI2 Interm. point Y]** Output delinearization point coordinate (frequency reference).	0 to 100%	0%

Code	Name/Description	Adjustment range	Factory setting
AI3-	**[AI3 CONFIGURATION]** Can be accessed if a VW3A3202 option card has been inserted		
AI3A	**[AI3 assignment]** Read-only parameter, cannot be configured. It displays all the functions associated with input AI3 in order to check, for example, for compatibility problems.		
AI3t 0A	**[AI3 Type]** Read-only parameter, cannot be configured. ☐ **[Current]** (0 A): Current input		[Current] (0 A)
CrL3	**[AI3 min. value]**	0 to 20.0 mA	0 mA
CrH3	**[AI3 max. value]**	0 to 20.0 mA	20.0 mA
AI3F	**[AI3 filter]** Interference filtering.	0 to 10.00 s	0 s
AI3L POS nEG	**[AI3 range]** ☐ **[0 – 100%]** (POS): Unidirectional input ☐ **[+/- 100%]** (nEG): Bidirectional input Example: On a 4 – 20 mA input - 4 mA corresponds to reference -100% - 12 mA corresponds to reference 0% - 20 mA corresponds to reference +100% Since AI3 is, in physical terms, a bidirectional input, the [+/- 100%] (nEG) configuration must only be used if the signal applied is unidirectional. A bidirectional signal is not compatible with a bidirectional configuration.		[0 – 100%] (POS)
AI3E	**[AI3 Interm. point X]** Input delinearization point coordinate. • 0% corresponds to [Min value] (CrL3) if the range is 0 → 100%. • 0% corresponds to $\frac{\text{[AI3 max. value] (CrH3) - [AI3 min. value] (CrL3)}}{2}$ if the range is -100% → +100%. • 100% corresponds to [AI3 max. value] (CrH3).	0 to 100%	0%
AI3S	**[AI3 Interm. point Y]** Output delinearization point coordinate (frequency reference).	0 to 100%	0%

Code	Name/Description	Adjustment range	Factory setting
AI4-	**[AI4 CONFIGURATION]** Can be accessed if a VW3A3202 option card has been inserted		
AI4A	**[AI4 assignment]** Read-only parameter, cannot be configured. It displays all the functions associated with input AI4 in order to check, for example, for compatibility problems.		
AI4t 10U 0A	**[AI4 Type]** ☐ **[Voltage]** (10U): Voltage input ☐ **[Current]** (0 A): Current input		[Voltage] (10U)
CrL4	**[AI4 min value]** The parameter can be accessed if [AI4 Type] (AI4t) = [Current] (0 A)	0 to 20.0 mA	0 mA
UIL4	**[AI4 min value]** The parameter can be accessed if [AI4 Type] (AI4t) = [Voltage] (10U)	0 to 10.0 V	0 V
CrH4	**[AI4 max value]** The parameter can be accessed if [AI4 Type] (AI4t) = [Current] (0 A)	0 to 20.0 mA	20.0 mA
UIH4	**[AI4 max value]** The parameter can be accessed if [AI4 Type] (AI4t) = [Voltage] (10U)	0 to 10.0 V	10.0 V
AI4F	**[AI4 filter]** Interference filtering.	0 to 10.00 s	0 s
AI4L POS nEG	**[AI4 range]** ☐ **[0 – 100%]** (POS): Unidirectional input ☐ **[+/- 100%]** (nEG): Bidirectional input Example: On a 0/10 V input - 0 V corresponds to reference -100% - 5 V corresponds to reference 0% - 10 V corresponds to reference +100%		[0 – 100%] (POS)
AI4E	**[AI4 Interm.point X]** Input delinearization point coordinate. • 0% corresponds to [Min value] if the range is 0 → 100%. • 0% corresponds to $\frac{\text{[Max value] + [Min value]}}{2}$ if the range is -100% → + 100%. • 100% corresponds to [Max value].	0 to 100%	0%
AI4S	**[AI4 Interm.point Y]** Output delinearization point coordinate (frequency reference).	0 to 100%	0%

Code	Name/Description	Adjustment range	Factory setting
AU1-	■ **[VIRTUAL AI1]**		
AIC1	❑ **[AI net. channel]**		[No] (nO)
	Virtual input. This parameter can also be accessed in the [PID REGULATOR] (PId-) submenu, page 151.		
nO	**[Non]** (nO): Not assigned (in this case, the virtual input does not appear in the analog input assignment parameters for the functions)		
Mdb	❑ **[Modbus]** (Mdb): Integrated Modbus		
CAn	❑ **[CANopen]** (CAn): Integrated CANopen		
nEt	❑ **[Com. card]** (nEt): Communication card (if inserted)		
APP	❑ **[C.Insid. card]** (APP): Controller Inside card (if inserted)		
	Scale: The value 8192 transmitted by this input is equivalent to 10 V on a 10 V input.		

WARNING

UNINTENDED EQUIPMENT OPERATION

If the equipment switches to forced local mode (see page 216), the virtual input remains frozen at the last value transmitted.
Do not use the virtual input and forced local mode in the same configuration.
Failure to follow this instruction can result in death or serious injury.

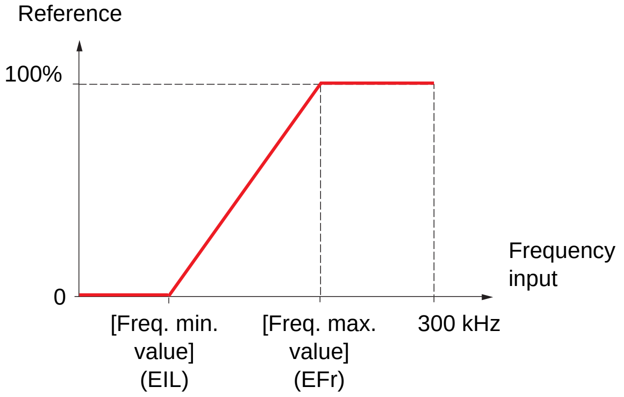
Code	Name/Description	Adjustment range	Factory setting
PL I-	■ **[RP CONFIGURATION]** Can be accessed if a VW3A3202 option card has been inserted		
P IA	❑ **[RP assignment]** Read-only parameter, cannot be configured. It displays all the functions associated with the Pulse In input in order to check, for example, for compatibility problems.		
P IL	❑ **[RP min value]** Frequency corresponding to the minimum speed	- 30.00 to 30.00 kHz	0
PFr	❑ **[RP max value]** Frequency corresponding to the maximum speed	0 to 30.00 kHz	30.00 kHz
PF I	❑ **[RP filter]** Interference filtering.	0 to 1,000 ms	0

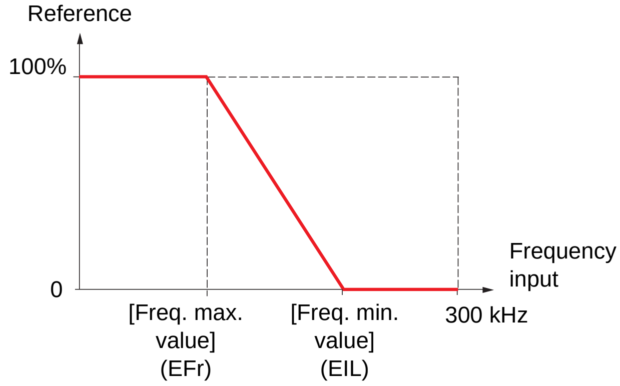
Configuration of the encoder input serving as a reference, with a frequency generator

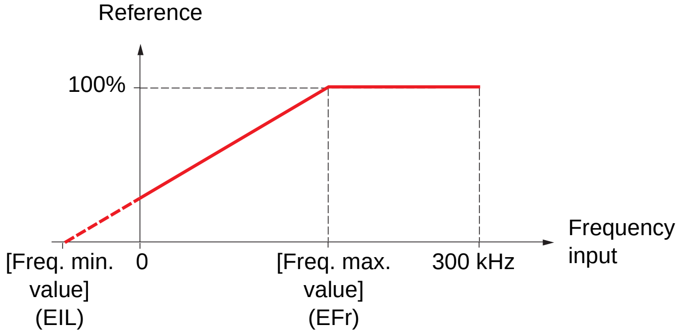
This reference is not signed, therefore the directions of operation must be given via the control channel (logic inputs, for example).

Minimum and maximum values (input values):

The minimum value corresponds to a minimum reference of 0% and the maximum value to a maximum reference of 100%. The minimum value may be greater than the maximum value. It may also be negative.







A reference can be obtained at zero frequency by assigning a negative value to the minimum value.

The encoder configuration can also be accessed in the [1.4 MOTOR CONTROL] (drC-) menu.

Code	Name/Description	Adjustment range	Factory setting
IEn-	**[ENCODER CONFIGURATION]** The encoder parameters can only be accessed if the encoder card has been inserted, and the available selections will depend on the type of encoder card used.		
EnS	**[Encoder type]** The parameter can be accessed if an encoder card has been inserted. To be configured in accordance with the type of encoder used.		[AABB] (AAbb)
AAbb	**[AABB]** (AAbb): For signals A, A-, B, B-.		
Ab	**[AB]** (Ab): For signals A, B.		
A	**[A]** (A): For signal A. Value cannot be accessed if [Encoder usage] (EnU) page 93 = [Spd fdk reg.] (rEG).		
EnC	**[Encoder check]** Encoder feedback check See procedure page 74. The parameter can be accessed if an encoder card has been inserted and if [Encoder usage] (EnU) page 93 is not [Speed ref.] (PGr).		[Not done] (nO)
nO	**[Not done]** (nO) Check not performed.		
YES	**[Yes]** (YES): Activates monitoring of the encoder.		
dOnE	**[Done]** (dOnE): Check performed successfully. The check procedure checks: - The direction of rotation of the encoder/motor - The presence of signals (wiring continuity) - The number of pulses/revolution If a fault is detected, the drive locks in [Encoder fault] (EnF) fault mode.		

Code	Name/Description	Adjustment range	Factory setting
	[ENCODER CONFIGURATION] (continued)		
EnU	**[Encoder usage]**		[No] (nO)
	The parameter can be accessed if an encoder card has been inserted.		
nO	**[No]** (nO): Function inactive, In this case, the other parameters cannot be accessed.		
SEC	**[Fdbk monit.]** (SEC): The encoder provides speed feedback for monitoring only.		
rEG	**[Spd fdk reg.]** (rEG): The encoder provides speed feedback for regulation and monitoring. If [Motor control type] (Ctt) = [SVC U] (UUC) the encoder operates in speed feedback mode and enables static correction of the speed to be performed. This configuration is not accessible for other [Motor control type] (Ctt) values.		
PGr	**[Speed ref.]** (PGr): The encoder provides a reference.		
PGI	**[Number of pulses]**	100 to 5,000	1,024
	Number of pulses per encoder revolution. The parameter can be accessed if an encoder card has been inserted.		
PGA	**[Reference type]**		[Encoder] (EnC)
	The parameter can be accessed if [Encoder usage] (EnU) = [Speed ref.] (PGr).		
EnC	**[Encoder]** (EnC): Use of an encoder.		
PtG	**[Freq. gen.]** (PtG): Use of a frequency generator (unsigned reference).		
EIL	**[Freq. min. value]**	- 300 to 300 kHz	0
	The parameter can be accessed if [Encoder usage] (EnU) = [Speed ref.] (PGr) and if [Reference type] (PGA) = [Freq. gen.] (PtG). Frequency corresponding to the minimum speed		
EFr	**[Freq. max value]**	0.00 to 300 kHz	300 kHz
	The parameter can be accessed if [Encoder usage] (EnU) = [Speed ref.] (PGr) and if [Reference type] (PGA) = [Freq. gen.] (PtG). Frequency corresponding to the maximum speed		
EFI	**[Freq. signal filter]**	0 to 1,000 ms	0
	The parameter can be accessed if [Encoder usage] (EnU) = [Speed ref.] (PGr). Interference filtering.		

Code	Name/Description	Adjustment range	Factory setting
r1-	■ **[R1 CONFIGURATION]**		
r1	❑ **[R1 Assignment]**		[No drive flt] (FLt)
nO	☐ **[No]** (nO): Not assigned		
FLt	☐ **[No drive flt]** (FLt): Drive not faulty (relay normally energized, and de-energized if there is a fault)		
rUn	☐ **[Drv running]** (rUn): Drive running		
FtA	☐ **[Freq. Th. attain.]** (FtA): The relay is closed if the frequency is greater than [Freq. threshold] (Ftd) page 59.		
FLA	☐ **[HSP attain.]** (FLA): High speed reached		
CtA	☐ **[Current Th. attained]** (CtA): The relay is closed if the current is greater than [Current threshold] (Ctd) page 59.		
SrA	☐ **[Freq.ref.att]** (SrA): Frequency reference reached		
tSA	☐ **[Th.mot. att.]** (tSA): Motor 1 thermal state reached		
PEE	☐ **[PID error al]** (PEE): PID error alarm		
PFA	☐ **[PID fdbk al.]** (PFA): PID feedback alarm (greater than [Max fbk alarm] (PAH) page 152 or less than [Min fbk alarm] (PAL) page 152)		
AP2	☐ **[AI2 Al. 4-20]** (AP2): Alarm indicating absence of 4-20 mA signal on input AI2		
F2A	☐ **[Freq. Th. 2 attain.]** (F2A): The relay is closed if the frequency is greater than [Freq. threshold 2] (F2d) page 59.		
tAd	☐ **[Th.drv.att.]** (tAd): Drive thermal state reached		
ttHA	☐ **[High tq. att.]** (ttHA): Motor torque greater than high threshold [High torque thd.] (ttH) page 59		
ttLA	☐ **[Low tq. att.]** (ttLA): Motor torque less than low threshold [Low torque thd.] (ttL) page 59		
MFrd	☐ **[Forward]** (MFrd): Motor running forward		
MrrS	☐ **[Reverse]** (MrrS): Motor running in reverse		
rtAH	☐ **[High Reference Att.]** (rtAH): The relay is closed if the frequency reference is greater than [High Freq. Ref. Thr.] (rtd) page 60.		
rtAL	☐ **[Low Reference Att.]** (rtAL): The relay is closed if the frequency reference is less than [Low Freq. Ref. Thr.] (rtdL) page 60.		
FtAL	☐ **[Low Frq. Th. Attain.]** (FtAL): The relay is closed if the frequency is less than [Low Freq.Threshold] (FtdL) page 59.		
F2AL	☐ **[2Low F.Thld]** (F2AL): The relay is closed if the frequency is less than [2 Freq. Threshold] (F2dL) page 59.		
CtAL	☐ **[Low I Th.At.]** (CtAL): The relay is closed if the current is less than [Low I Threshold] (CtdL) page 59.		
ULA	☐ **[Pro.Undload]** (ULA): Process underload (see page 208)		
OLA	☐ **[Ovld.P.Alrm]** (OLA): Process overload (see page 210)		
PFAH	☐ **[PID high Al.]** (PFAH): PID feedback alarm (greater than [Max fbk alarm] (PAH) page 152).		
PFAL	☐ **[PID low Alarm]** (PFAL): PID feedback alarm (less than [Min fbk alarm] (PAL) page 152).		
PISH	☐ **[Regul.Alarm]** (PISH): PID regulator feedback supervision fault page 155.		
Ern	☐ **[Emerg. Run]** (Ern): The relay is closed if the drive is in emergency run. See [Forced Run] (InHS) page 201.		
tS2	☐ **[Th.mot2 att.]** (tS2): Motor 2 thermal state reached		
tS3	☐ **[Th.mot3 att]** (tS3): Motor 3 thermal state reached		
bMP	☐ **[Rem.Cmd]** (bMP): Control via the graphic display terminal is activated via a function key on the terminal.		

Code	Name/Description	Adjustment range	Factory setting
r1-	■ **[R1 CONFIGURATION]** (continued)		
r1	❑ **[R1 Assignment]** (continued)		
AtS	☐ **[Neg Torque]** (AtS): Negative torque (braking)		
CnF0	☐ **[Cnfg.0 act.]** (CnF0): Configuration 0 active		
CnF1	☐ **[Cnfg.1 act.]** (CnF1): Configuration 1 active		
CnF2	☐ **[Cnfg.2 act.]** (CnF2): Configuration 2 active		
CFP1	☐ **[Set 1 active]** (CFP1): Parameter set 1 active		
CFP2	☐ **[Set 2 active]** (CFP2): Parameter set 2 active		
CFP3	☐ **[Set 3 active]** (CFP3): Parameter set 3 active		
dbL	☐ **[DC charged]** (dbL): DC bus loading		
brS	☐ **[In braking]** (brS): Drive braking		
PrM	☐ **[P. removed]** (PRM): Drive locked by “Power removal” input		
FqLA	☐ **[Fr.met. alar.]** (FqLA): Measured speed threshold attained: [Pulse warning thd.] (FqL) page 59		
MCP	☐ **[I present]** (MCP): Motor current present		
AG1	☐ **[Alarm Grp 1]** (AGI): Alarm group 1		
AG2	☐ **[Alarm Grp 2]** (AG2): Alarm group 2		
AG3	☐ **[Alarm Grp 3]** (AG3): Alarm group 3		
P1A	☐ **[PTC1 alarm]** (P1A): Probe alarm 1		
P2A	☐ **[PTC2 alarm]** (P2A): Probe alarm 2		
PLA	☐ **[LI6=PTC al.]** (PLA): LI6 = PTC probe alarms		
EFA	☐ **[Ext. fault al]** (EFA): External fault alarm		
USA	☐ **[Under V. al.]** (USA): Undervoltage alarm		
UPA	☐ **[Uvolt warn]** (UPA): Undervoltage warning		
tHA	☐ **[Al. °C drv]** (tHA): Drive overheating		
SSA	☐ **[Lim T/I att.]** (SSA): Torque limit alarm		
tJA	☐ **[IGBT al.]** (tJA): IGBT alarm		
bOA	☐ **[Brake R. al.]** (bOA): Braking resistor temperature alarm		
APA	☐ **[Option al.]** (APA): Alarm generated by the Controller Inside card		
AP3	☐ **[AI3 Al. 4-20]** (AP3): Alarm indicating absence of 4-20 mA signal on input AI3		
AP4	☐ **[AI4 Al. 4-20]** (AP4): Alarm indicating absence of 4-20 mA signal on input AI4		
FSA	☐ **[Flow Limit.]** (FSA): Flow rate limiting active (see page 182)		
rdY	☐ **[Ready]** (rdY): Drive ready		

Code	Name/Description	Adjustment range	Factory setting
	■ **[R1 CONFIGURATION]** (continued)		
r1d	❑ **[R1 Delay time]** The change in state only takes effect once the configured time has elapsed, when the information becomes true. The delay cannot be set for the [No drive flt] (FLt) assignment, and remains at 0.	0 to 60000 ms (1)	0
r1S POS nEG	❑ **[R1 Active at]** Configuration of the operating logic: ☐ **[1]**: State 1 when the information is true ☐ **[0]**: State 0 when the information is true Configuration [1] (POS) cannot be modified for the [No drive flt] (FLt), assignment.		[1] (POS)
r1H	❑ **[R1 Holding time]** The change in state only takes effect once the configured time has elapsed, when the information becomes false. The holding time cannot be set for the [No drive flt] (FLt) assignment, and remains at 0.	0 to 9,999 ms	0
r2-	■ **[R2 CONFIGURATION]**		
r2 LLC OCC dCO dAM	❑ **[R2 Assignment]** Identical to R1 (see page 94) with the addition of (shown for information only as these selections can only be configured in the [APPLICATION FUNCT.] (Fun-)) menu: ☐ **[Input cont.]** (LLC): Line contactor control ☐ **[Output cont]** (OCC): Output contactor control ☐ **[DC charging]** (dCO): DC bus precharging contactor control ☐ **[Damper]** (dAM): Damper control		[Drv running] (rUn)
r2d	❑ **[R2 Delay time]** The delay cannot be set for the [No drive flt] (FLt), [Output cont] (OCC), [DC charging] (dCO), and [Input cont.] (LLC) assignments, and remains at 0. The change in state only takes effect once the configured time has elapsed, when the information becomes true.	0 to 60000 ms (1)	0
r2S POS nEG	❑ **[R2 Active at]** Configuration of the operating logic: ☐ **[1]**: State 1 when the information is true ☐ **[0]**: State 0 when the information is true The [1] (POS) configuration cannot be modified for the[No drive flt] (FLt), [DC charging] (dCO) and [Input cont.] (LLC), assignments.		[1] (POS)
r2H	❑ **[R2 Holding time]** The holding time cannot be set for the [No drive flt] (FLt), [DC charging] (dCO) and [Input cont.] (LLC) assignments, and remains at 0. The change in state only takes effect once the configured time has elapsed, when the information becomes false.	0 to 9,999 ms	0

(1) 0 to 9999 ms then 10.00 to 60.00 s on the integrated display terminal.

Code	Name/Description	Adjustment range	Factory setting
r3-	**[R3 CONFIGURATION]** Can be accessed if a VW3A3201 option card has been inserted		
r3	**[R3 Assignment]** Identical to R2		[No] (nO)
r3d	**[R3 Delay time]** The delay cannot be set for the [No drive flt] (FLt), [Output cont] (OCC), [DC charging] (dCO), and [Input cont.] (LLC) assignments, and remains at 0. The change in state only takes effect once the configured time has elapsed, when the information becomes true.	0 to 60000 ms (1)	0
r3S POS nEG	**[R3 Active at]** Configuration of the operating logic: **[1]**: State 1 when the information is true **[0]**: State 0 when the information is true The [1] (POS) configuration cannot be modified for the[No drive flt] (FLt), [DC charging] (dCO) and [Input cont.] (LLC), assignments.		[1] (POS)
r3H	**[R3 Holding time]** The holding time cannot be set for the [No drive flt] (FLt), [DC charging] (dCO) and [Input cont.] (LLC) assignments, and remains at 0. The change in state only takes effect once the configured time has elapsed, when the information becomes false.	0 to 9,999 ms	0
r4-	**[R4 CONFIGURATION]** Can be accessed if a VW3A3202 option card has been inserted		
r4	**[R4 Assignment]** Identical to R2 (see page 96).		[No] (nO)
r4d	**[R4 Delay time]** The delay cannot be set for the [No drive flt] (FLt), [Output cont] (OCC), [DC charging] (dCO), and [Input cont.] (LLC) assignments, and remains at 0. The change in state only takes effect once the configured time has elapsed, when the information becomes true.	0 to 60000 ms (1)	0
r4S POS nEG	**[R4 Active at]** Configuration of the operating logic: **[1]**: State 1 when the information is true **[0]**: State 0 when the information is true The [1] (POS) configuration cannot be modified for the[No drive flt] (FLt), [DC charging] (dCO) and [Input cont.] (LLC), assignments.		[1] (POS)
r4H	**[R4 Holding time]** The holding time cannot be set for the [No drive flt] (FLt), [DC charging] (dCO) and [Input cont.] (LLC) assignments, and remains at 0. The change in state only takes effect once the configured time has elapsed, when the information becomes false.	0 to 9,999 ms	0

(1) 0 to 9999 ms then 10.00 to 60.00 s on the integrated display terminal.

Code	Name/Description	Adjustment range	Factory setting
LO1-	**[LO1 CONFIGURATION]** Can be accessed if a VW3A3201 option card has been inserted		
LO1 LLC OCC dCO dAM	**[LO1 assignment]** Identical to R1 (see page 94) with the addition of (shown for information only as these selections can only be configured in the [APPLICATION FUNCT.] (Fun-)) menu: ☐ **[Input cont.]** (LLC): Line contactor control ☐ **[Output cont]** (OCC): Output contactor control ☐ **[[DC charging]** (dCO): DC bus precharging contactor control ☐ **[Damper]** (dAM): Damper control		[No] (nO)
LO1d	**[LO1 delay time]** The delay cannot be set for the [No drive flt] (FLt), [Output cont] (OCC), [DC charging] (dCO), and [Input cont.] (LLC) assignments, and remains at 0. The change in state only takes effect once the configured time has elapsed, when the information becomes true.	0 to 60000 ms (1)	0
LO1S POS nEG	**[LO1 active at]** Configuration of the operating logic: ☐ **[1]**: State 1 when the information is true ☐ **[0]**: State 0 when the information is true The [1] (POS) configuration cannot be modified for the[No drive flt] (FLt), [DC charging] (dCO) and [Input cont.] (LLC), assignments.		[1] (POS)
LO1H	**[LO1 holding time]** The holding time cannot be set for the [No drive flt] (FLt), [DC charging] (dCO) and [Input cont.] (LLC) assignments, and remains at 0. The change in state only takes effect once the configured time has elapsed, when the information becomes false.	0 to 9,999 ms	0
LO2-	**[LO2 CONFIGURATION]** Can be accessed if a VW3A3201 option card has been inserted		
LO2	**[LO2 assignment]** Identical to LO1.		[No] (nO)
LO2d	**[LO2 delay time]** The delay cannot be set for the [No drive flt] (FLt), [Output cont] (OCC), [DC charging] (dCO), and [Input cont.] (LLC) assignments, and remains at 0. The change in state only takes effect once the configured time has elapsed, when the information becomes true.	0 to 60000 ms (1)	0
LO2S POS nEG	**[LO2 active at]** Configuration of the operating logic: ☐ **[1]**: State 1 when the information is true ☐ **[0]**: State 0 when the information is true The [1] (POS) configuration cannot be modified for the[No drive flt] (FLt), [DC charging] (dCO) and [Input cont.] (LLC), assignments.		[1] (POS)
LO2H	**[LO2 holding time]** The holding time cannot be set for the [No drive flt] (FLt), [DC charging] (dCO) and [Input cont.] (LLC) assignments, and remains at 0. The change in state only takes effect once the configured time has elapsed, when the information becomes false.	0 to 9,999 ms	0

(1) 0 to 9999 ms then 10.00 to 60.00 s on the integrated display terminal.

Code	Name/Description	Adjustment range	Factory setting
LO3-	■ **[LO3 CONFIGURATION]** Can be accessed if a VW3A3202 option card has been inserted		
LO3	❑ **[LO3 assignment]** Identical to LO1 (see page 98).		[No] (nO)
LO3d	❑ **[LO3 delay time]** The delay cannot be set for the [No drive flt] (FLt), [Output cont] (OCC), [DC charging] (dCO), and [Input cont.] (LLC) assignments, and remains at 0. The change in state only takes effect once the configured time has elapsed, when the information becomes true.	0 to 60000 ms (1)	0
LO3S POS nEG	❑ **[LO3 active at]** Configuration of the operating logic: ☐ **[1]**: State 1 when the information is true ☐ **[0]**: State 0 when the information is true The [1] (POS) configuration cannot be modified for the[No drive flt] (FLt), [DC charging] (dCO) and [Input cont.] (LLC), assignments.		[1] (POS)
LO3H	❑ **[LO3 holding time]** The holding time cannot be set for the [No drive flt] (FLt), [DC charging] (dCO) and [Input cont.] (LLC) assignments, and remains at 0. The change in state only takes effect once the configured time has elapsed, when the information becomes false.	0 to 9,999 ms	0
LO4-	■ **[LO4 CONFIGURATION]** Can be accessed if a VW3A3202 option card has been inserted		
LO4	❑ **[LO4 assignment]** Identical to LO1 (see page 98).		[No] (nO)
LO4d	❑ **[LO4 delay time]** The delay cannot be set for the [No drive flt] (FLt), [Output cont] (OCC), [DC charging] (dCO), and [Input cont.] (LLC) assignments, and remains at 0. The change in state only takes effect once the configured time has elapsed, when the information becomes true.	0 to 60000 ms (1)	0
LO4S POS nEG	❑ **[LO4 active at]** Configuration of the operating logic: ☐ **[1]**: State 1 when the information is true ☐ **[0]**: State 0 when the information is true The [1] (POS) configuration cannot be modified for the[No drive flt] (FLt), [DC charging] (dCO) and [Input cont.] (LLC), assignments.		[1] (POS)
LO4H	❑ **[LO4 holding time]** The holding time cannot be set for the [No drive flt] (FLt), [DC charging] (dCO) and [Input cont.] (LLC) assignments, and remains at 0. The change in state only takes effect once the configured time has elapsed, when the information becomes false.	0 to 9,999 ms	0

(1) 0 to 9999 ms then 10.00 to 60.00 s on the integrated display terminal.

Use of analog output AO1 as a logic output

Analog output AO1 can be used as a logic output, by assigning DO1. In this case, state 0 of this output corresponds to the minimum value of AO1 (0 V or 0 mA, for example), and state 1 corresponds to the maxium value of AO1 (10 V or 20 mA, for example).
The electrical characteristics of this analog output remain unchanged. As they differ from logic output characteristics, it is important to ensure that they are compatible with the intended application.

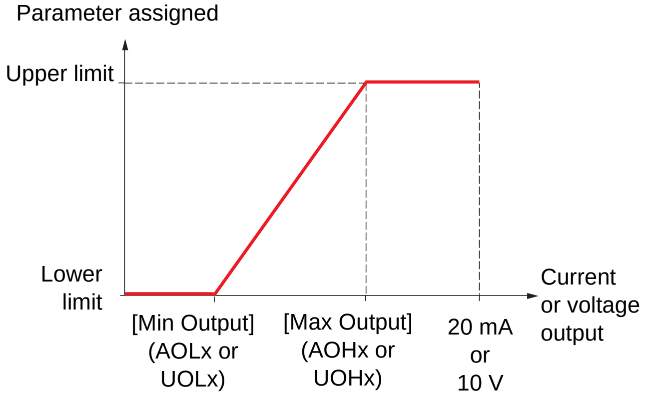
Code	Name/Description	Adjustment range	Factory setting
dO1-	■ **[DO1 CONFIGURATION]**		
dO1	❑ **[DO1 assignment]**		[No] (nO)
	Identical to R1 (see page 94) with the addition of (shown for information only as these selections can only be configured in the [1.7 APPLICATION FUNCT.] (Fun-) menu):		
LLC	□ **[Input cont.]** (LLC): Line contactor control		
OCC	□ **[Output cont]** (OCC): Output contactor control		
dCO	□ **[DC charging]** (dCO): DC bus precharging contactor control		
dAM	□ **[Damper]** (dAM): Damper control		
dO1d	❑ **[DO1 delay time]**	0 to 60000 ms (1)	0
	The delay cannot be set for the [No drive flt] (FLt), [Output cont] (OCC), [DC charging] (dCO), and [Input cont.] (LLC) assignments, and remains at 0. The change in state only takes effect once the configured time has elapsed, when the information becomes true.		
dO1S	❑ **[DO1 active at]**		[1] (POS)
	Configuration of the operating logic:		
POS	□ **[1]** (POS): State 1 when the information is true		
nEG	□ **[0]** (nEG): State 0 when the information is true The [1] (POS) configuration cannot be modified for the [No drive flt] (FLt), [DC charging] (dCO) and [Input cont.] (LLC) assignments.		
dO1H	❑ **[DO1 holding time]**	0 to 9999 ms	0
	The holding time cannot be set for the [No drive flt] (FLt), [DC charging] (dCO) and [Input cont.] (LLC) assignments, and remains at 0. The change in state only takes effect once the configured time has elapsed, when the information becomes false.		

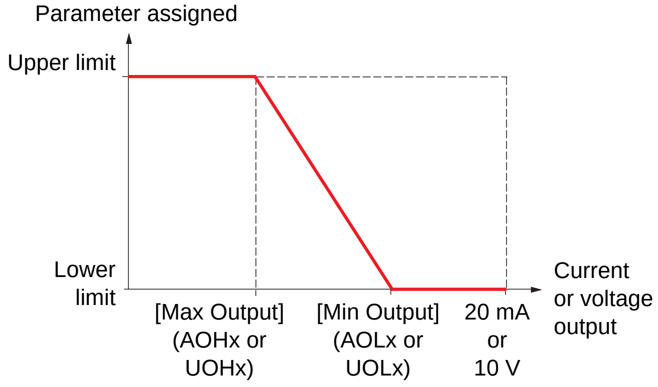
(1) 0 to 9999 ms then 10.00 to 60.00 s on the integrated display terminal.

Configuration of analog outputs

Minimum and maximum values (output values):

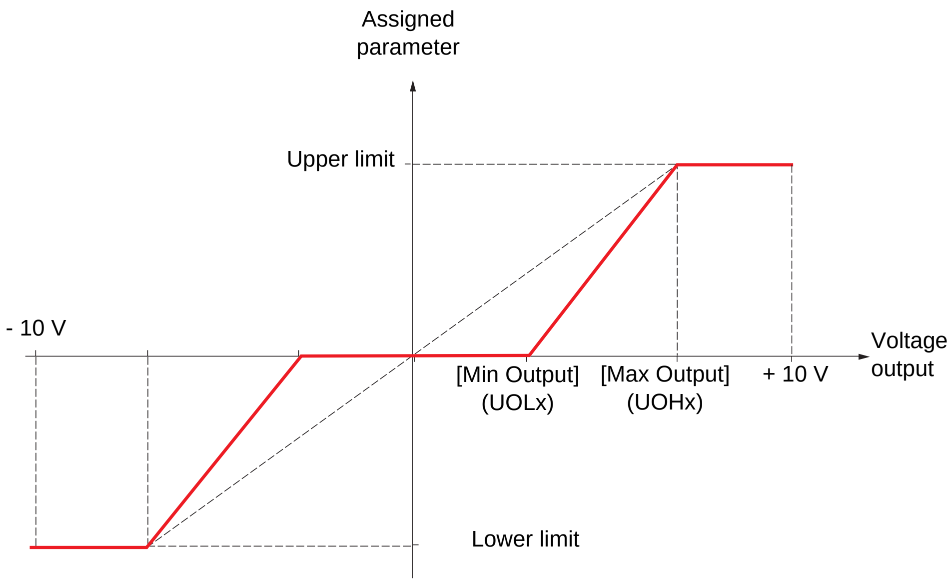
The minimum output value, in volts or mA, corresponds to the lower limit of the assigned parameter and the maximum value corresponds to its upper limit. The minimum value may be greater than the maximum value:





Outputs AO2 and AO3 configured as bipolar outputs (strongly recommended for signed parameters):

The [min Output] (UOLx) and [max Output] (UOHx) parameters are absolute values, although they function symmetrically. In the case of bipolar outputs, always set the maximum value higher than the minimum value.
The [max Output] (UOHx) corresponds to the upper limit of the assigned parameter, and the [min Output] (UOLx) corresponds to an average value between the upper and lower limits (0 for a signed and symmetrical parameter such as in the example below).

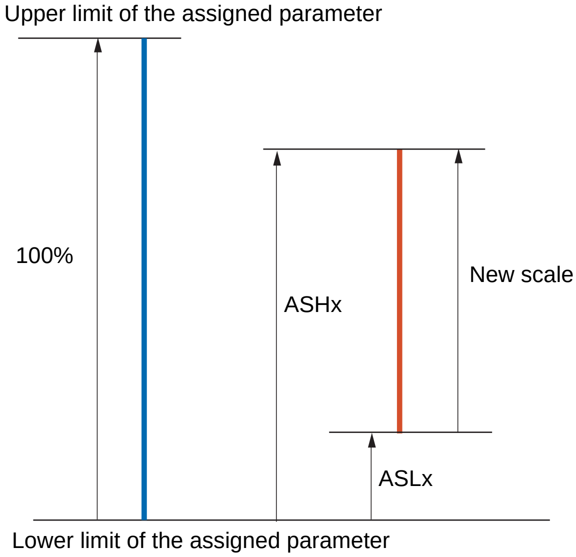


Scaling of the assigned parameter

The scale of the assigned parameter can be adapted in accordance with requirements by modifying the values of the lower and upper limits by means of two parameters for each analog output.
These parameters are given as a %; 100% corresponds to the total variation range of the configured parameter, so:

- 100% = upper limit - lower limit. For example, for [Sign. torque] (Stq), which varies between -3 and +3 times the rated torque, 100% corresponds to 6 times the rated torque.

- The parameter [Scaling AOx min] (ASLx) modifies the lower limit: new value = lower limit + (range x ASLx). The value 0% (factory setting) does not modify the lower limit.
- The [Scaling AOx max] (ASHx) parameter modifies the upper limit: new value = lower limit + (range x ASHx). The value 100% (factory setting) does not modify the upper limit.
- [Scaling AOx min] (ASLx) must always be lower than [Scaling AOx max] (ASHx).



Application example 1

The value of the signed motor torque at the AO2 output is to be transferred with +/- 10 V, with a range of -2 Tr to +2 Tr

The parameter [Sign. torque.] (Stq) varies between -3 and +3 times the rated torque, or a range of 6 times the rated torque.

[Scaling AO2 min] (ASL2) must modify the lower limit by 1x the rated torque, or 100/6 = 16.7% (new value = lower limit + (range x ASL2).

[Scaling AO2 max] (ASH2) must modify the upper limit by 1x the rated torque, or 100 - 100/6 = 83.3% (new value = lower limit + (range x ASH2).

Application example 2

The value of the motor current at the AO2 output is to be transferred with 0 - 20 mA, with a range of 2 In motor, In motor being the equivalent of a 0.8 In drive.

The parameter [I motor] (OCr) varies between 0 and 2 times the rated drive current, or a range of 2.5 times the rated drive current.

[Scaling AO2 min] (ASL2) must not modify the lower limit, which therefore remains at its factory setting of 0%.

[Scaling AO2 max] (ASH2) must modify the upper limit by 0.5x the rated motor torque, or 100 - 100/5 = 80% (new value = lower limit + (range x ASH2).

Code	Name/Description	Adjustment range	Factory setting
AO1-	**[AO1 CONFIGURATION]**		
AO1	**[AO1 assignment]**		[No] (nO)
nO	**[No]** (nO): Not assigned		
OCr	**[I motor]** (OCr): Current in the motor, between 0 and 2 In (In = rated drive current indicated in the Installation Manual and on the drive nameplate).		
OFr	**[Motor freq.]** (OFr): Output frequency, between 0 and [Max frequency] (tFr)		
OrP	**[Ramp out.]** (OrP): Between 0 and [Max frequency] (tFr)		
trq	**[Motor torq.]** (trq): Motor torque, between 0 and 3 times the rated motor torque		
Stq	**[Sign. torque]** (Stq): Signed motor torque, between -3 and +3 times the rated motor torque. The + sign corresponds to motor mode and the - sign to generator mode (braking).		
OrS	**[sign ramp]** (OrS): Signed ramp output, between – [Max frequency] (tFr) and + [Max frequency] (tFr)		
OPS	**[PID ref.]** (OPS): PID regulator reference between [Min PID reference] (PIP1) and [Max PID reference] (PIP2)		
OPF	**[PID feedback]** (OPF): PID regulator feedback between [Min PID feedback] (PIF1) and [Max PID feedback] (PIF2)		
OPE	**[PID error]** (OPE): PID regulator error between -5% and +5% of ([Max PID feedback] (PIF2) – [Min PID feedback] (PIF1))		
OPI	**[PID output]** (OPI): PID regulator output between [Low speed] (LSP) and [High speed] (HSP)		
OPr	**[Mot. power]** (OPr): Motor power, between 0 and 2.5 times [Rated motor power] (nPr)		
tHr	**[Mot thermal]** (tHr): Motor thermal state, between 0 and 200% of the rated thermal state		
tHd	**[Drv thermal]** (tHd): Drive thermal state, between 0 and 200% of the rated thermal state		
tqMS	**[Torque 4Q]** (tqMS): Signed motor torque, between -3 and +3 times the rated motor torque. The + sign and the - sign correspond to the physical direction of the torque, regardless of mode (motor or generator).		
OFrr	**[Meas.mot.fr]** (OFrr): Measured motor speed if an encoder card has been inserted, otherwise 0 appears.		
OFS	**[Sig. o/p frq.]** (OFS): Signed output frequency, between – [Max frequency] (tFr) and + [Max frequency] (tFr)		
tHr2	**[Mot therm2]** (tHr2): Thermal state of motor 2, between 0 and 200% of the rated thermal state		
tHr3	**[Mot therm3]** (tHr3): Thermal state of motor 3, between 0 and 200% of the rated thermal state		
Utr	**[Uns.TrqRef]** (Utr): Torque reference, between 0 and 3 times the rated motor torque		
Str	**[Sign trq ref.]** (Str): Signed torque reference, between -3 and +3 times the rated motor torque		
tqL	**[Torque lim.]** (tqL): Torque limit, between 0 and 3 times the rated motor torque		
UOP	**[Motor volt.]** (UOP): Voltage applied to the motor, between 0 and [Rated motor volt.] (UnS)		
dO1	**dO1]** (dO1): Assigned as logic output. This assignment can only appear if [DO1 assignment] (dO1) page 100 has been assigned. This is the only possible choice in this case, and is displayed for information purposes only.		
AO1t	**[AO1 Type]**		[Current] (0 A)
10U	**[Voltage]** (10U): **Voltage output**		
0A	**[Current]** (0 A): Current output		
AOL1	**[AO1 min Output]** The parameter can be accessed if [AO1 Type] (AO1t) = [Current] (0 A)	0 to 20.0 mA	0 mA
AOH1	**[AO1 max Output]** The parameter can be accessed if [AO1 Type] (AO1t) = [Current] (0 A)	0 to 20.0 mA	20.0 mA
UOL1	**[AO1 min Output]** The parameter can be accessed if [AO1 Type] (AO1t) = [Voltage] (10U)	0 to 10.0 V	0 V
UOH1	**[AO1 max Output]** The parameter can be accessed if [AO1 Type] (AO1t) = [Voltage] (10U)	0 to 10.0 V	10.0 V

Code	Name/Description	Adjustment range	Factory setting
AO1-	■ **[AO1 CONFIGURATION]** (continued)		
ASL1	❑ **[Scaling AO1 min]**	0 to 100.0%	0%
	Scaling of the lower limit of the assigned parameter, as a % of the maximum possible variation.		
ASH1	❑ **[Scaling AO1 max]**	0 to 100.0%	100.0%
	Scaling of the upper limit of the assigned parameter, as a % of the maximum possible variation.		
AO1F	❑ **[AO1 Filter]**	0 to 10.00 s	0 s
	Interference filtering. This parameter is forced to 0 if [AO1 assignment] (AO1) = [dO1] (dO1).		

Code	Name/Description	Adjustment range	Factory setting
AO2-	■ **[AO2 CONFIGURATION]** Can be accessed if a VW3A3202 option card has been inserted		
AO2	❑ **[AO2 assignment]** Same assignments as AO1, without [dO1] (dO1)		[No] (nO)
AO2t 10U 0A n10U	❑ **[AO2 Type]** ☐ **[Voltage]** (10U): Voltage output ☐ **[Current]** (0 A): Current output ☐ **[Voltage +/-]** (n10U): Bipolar voltage output		[Current] (0 A)
AOL2	❑ **[AO2 min Output]** The parameter can be accessed if [AO2 Type] (AO2t) = [Current] (0 A)	0 to 20.0 mA	0 mA
AOH2	❑ **[AO2 max Output]** The parameter can be accessed if [AO2 Type] (AO2t) = [Current] (0 A)	0 to 20.0 mA	20.0 mA
UOL2	❑ **[AO2 min Output]** The parameter can be accessed if [AO2 Type] (AO2t) = [Voltage] (10U) or [Voltage +/-] (n10U)	0 to 10.0 V	0 V
UOH2	❑ **[AO2 max Output]** The parameter can be accessed if [AO2 Type] (AO2t) = [Voltage] (10U) or [Voltage +/-] (n10U)	0 to 10.0 V	10.0 V
ASL2	❑ **[Scaling AO2 min]** Scaling of the lower limit of the assigned parameter, as a % of the maximum possible variation.	0 to 100.0%	0%
ASH2	❑ **[Scaling AO2 max]** Scaling of the upper limit of the assigned parameter, as a % of the maximum possible variation.	0 to 100.0%	100.0%
AO2F	❑ **[AO2 Filter]** Interference filtering.	0 to 10.00 s	0 s

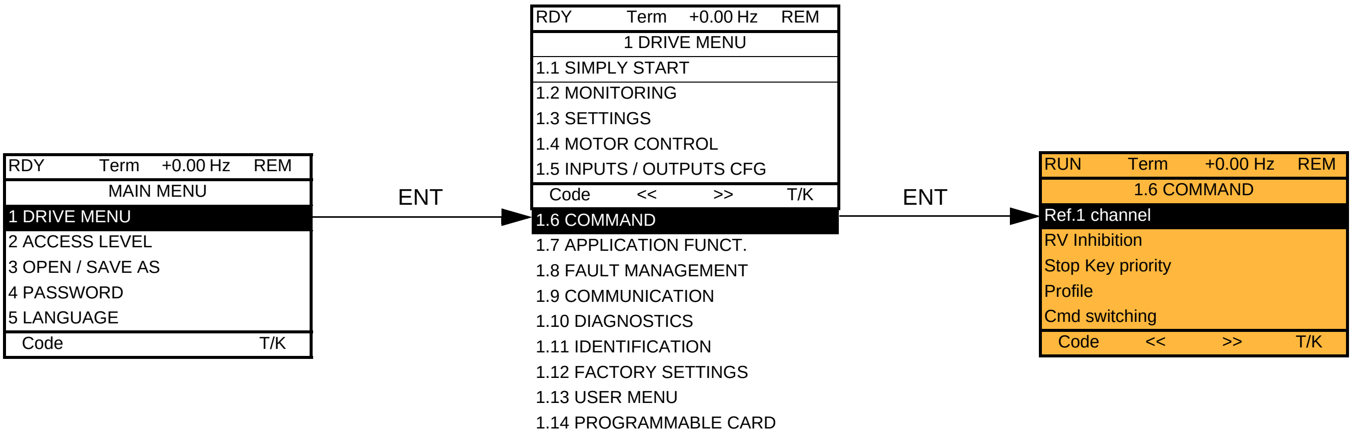
Code	Name/Description	Adjustment range	Factory setting
AO3-	■ **[AO3 CONFIGURATION]** Can be accessed if a VW3A3202 option card has been inserted		
AO3	❑ **[AO3 assignment]** Same assignments as AO1, without [dO1] (dO1)		[No] (nO)
AO3t 10U 0A n10U	❑ **[AO3 Type]** ☐ **[Voltage]** (10U): Voltage output ☐ **[Current]** (0 A): Current output ☐ **[Voltage +/-]** (n10U): Bipolar voltage output		[Current] (0 A)
AOL3	❑ **[AO3 min Output]** The parameter can be accessed if [AO3 Type] (AO3t) = [Current] (0 A)	0 to 20.0 mA	0 mA
AOH3	❑ **[AO3 max Output]** The parameter can be accessed if [AO3 Type] (AO3t) = [Current] (0 A)	0 to 20.0 mA	20.0 mA
UOL3	❑ **[AO3 min Output]** The parameter can be accessed if [AO3 Type] (AO3t) = [Voltage] (10U) or [Voltage +/-] (n10U)	0 to 10.0 V	0 V
UOH3	❑ **[AO3 max Output]** The parameter can be accessed if [AO3 Type] (AO3t) = [Voltage] (10U) or [Voltage +/-] (n10U)	0 to 10.0 V	10.0 V
ASL3	❑ **[Scaling AO3 min]** Scaling of the lower limit of the assigned parameter, as a % of the maximum possible variation.	0 to 100.0%	0%
ASH3	❑ **[Scaling AO3 max]** Scaling of the upper limit of the assigned parameter, as a % of the maximum possible variation.	0 to 100.0%	100.0%
AO3F	❑ **[AO3 Filter]** Interference filtering.	0 to 10.00 s	0 s

The following submenus group the alarms into 1 to 3 groups, each of which can be assigned to a relay or a logic output for remote signaling. These groups can also be displayed on the graphic display terminal (see [6 MONITORING CONFIG.] menu) and viewed via the [1.2 MONITORING] (SUP) menu.
When one or a number of alarms selected in a group occurs, this alarm group is activated.

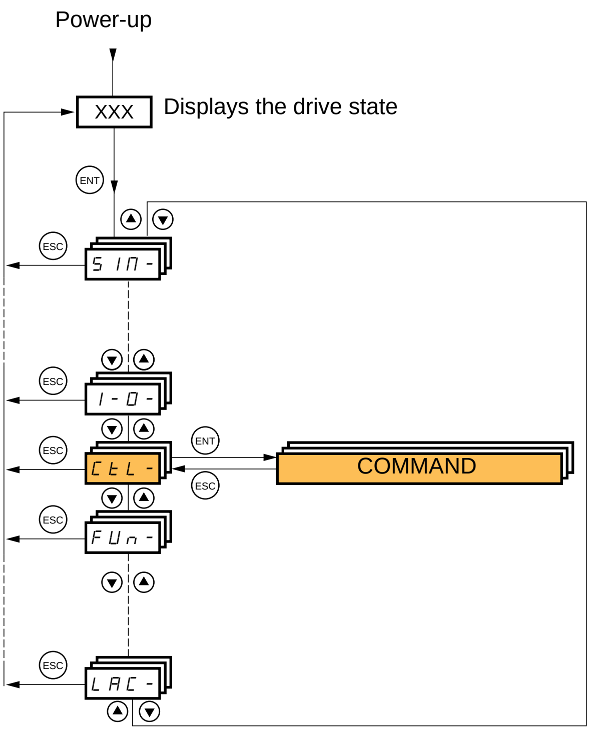
Code	Name/Description	Adjustment range	Factory setting
A1C-	■ **[ALARM GRP1 DEFINITION]**		
	Selection to be made from the following list:		
PLA	☐ **[LI6=PTC al.]** (PLA): LI6 = PTC probe alarms		
P1A	☐ **[PTC1 alarm]** (P1A): Probe alarm 1		
P2A	☐ **[PTC2 alarm]** (P2A): Probe alarm 2		
EFA	☐ **[Ext. fault al]** (EFA): External fault alarm		
USA	☐ **[Under V. al.]** (USA): Undervoltage alarm		
CtA	☐ **[I attained]** (CtA): The current is greater than [Current threshold] (Ctd) page 59.		
CtAL	☐ **[Low I Thres. Attain.]** (CtAL): The current is less than [Low I Threshold] (CtdL) page 59.		
FtA	☐ **[Freq. Th. attain.]** (FtA): The frequency is greater than [Freq. threshold] (Ftd) page 59.		
FtAL	☐ **[Low Frq. Th. Attain.]** (FtAL): The frequency is less than [Low Freq.Threshold] (FtdL) page 59.		
F2A	☐ **[Freq. Th. 2 attain.]** (F2A): The frequency is greater than [Freq. threshold 2] (F2d) page 59.		
F2AL	☐ **[Fq. Low Th. 2 attain]** (F2AL): The frequency is less than [2 Freq. Threshold] (F2dL) page 59.		
SrA	☐ **[Freq.ref.att]** (SrA): Frequency reference reached		
tSA	☐ **[Th.mot. att.]** (tSA): Motor 1 thermal state reached		
tS2	☐ **[Th.mot2 att.]** (tS2): Motor 2 thermal state reached		
tS3	☐ **[Th.mot3 att]** (tS3): Motor 3 thermal state reached		
UPA	☐ **[Uvolt warn]** (UPA): Undervoltage warning		
FLA	☐ **[HSP attain.]** (FLA): High speed reached		
tHA	☐ **[Al. °C drv]** (tHA): Drive overheating		
PEE	☐ **[PID error al]** (PEE): PID error alarm		
PFA	☐ **[PID fdbk al.]** (PFA): PID feedback alarm (greater than [Max fbk alarm] (PAH) page 152 or less than [Min fbk alarm] (PAL) page 152)		
PFAH	☐ **[PID high Alarm]** (PFAH): PID feedback alarm (greater than [Max fbk alarm] (PAH) page 152).		
PFAL	☐ **[PID low Alarm]** (PFAL): PID feedback alarm (less than [Min fbk alarm] (PAL) page 152).		
PISH	☐ **[Regulation Alarm]** (PISH): PID regulator feedback supervision fault page 155.		
AP2	☐ **[AI2 Al. 4-20]** (AP2): Alarm indicating absence of 4-20 mA signal on input AI2		
AP3	☐ **[AI3 Al. 4-20]** (AP3): Alarm indicating absence of 4-20 mA signal on input AI3		
AP4	☐ **[AI4 Al. 4-20]** (AP4): Alarm indicating absence of 4-20 mA signal on input AI4		
SSA	☐ **[Lim T/I att.]** (SSA): Torque limit alarm		
tAd	☐ **[Th.drv.att.]** (tAd): Drive thermal state reached		
tJA	☐ **[IGBT alarm]** (tJA): IGBT alarm		
bOA	☐ **[Brake R. al.]** (bOA): Braking resistor temperature alarm		
APA	☐ **[Option alarm]** (APA): Alarm generated by an option card.		
UrA	☐ **[Regen. underV. al.]** (UrA): Reserved.		
rtAH	☐ **[High Reference Att.]** (rtAH): The frequency reference is greater than [High Freq. Ref. Thr.] (rtd) page 60.		
rtAL	☐ **[Low Reference Att.]** (rtAL): The frequency reference is less than [Low Freq. Ref. Thr.] (rtdL) page 60.		
ULA	☐ **[Underload. Proc. Al.]** (ULA): Process underload (see page 208)		
OLA	☐ **[Overload. Proc. Al.]** (OLA): Process overload (see page 210)		
FSA	☐ **[Flow Limit. active]** (FSA): Flow rate limiting active (see page 182)		
Ern	☐ **[Emerg. Run]** (Ern): Emergency run in progress (see page 201)		
ttHA	☐ **[High torque alarm]** (ttHA): Motor torque greater than high threshold [High torque thd.] (ttH) page 59		
ttLA	☐ **[Low torque alarm]** (ttLA): Motor torque less than low threshold [Low torque thd.] (ttL) page 59		
FqLA	☐ **[Freq. meter Alarm]** (FqLA): Measured speed threshold attained: [Pulse warning thd.] (FqL) page 59		
	See the multiple selection procedure on page 25 for the integrated display terminal, and page 16 for the graphic display terminal.		
A2C-	■ **[ALARM GRP2 DEFINITION]**		
	Identical to [ALARM GRP1 DEFINITION] (A1C-)		
A3C-	■ **[ALARM GRP3 DEFINITION]**		
	Identical to [ALARM GRP1 DEFINITION] (A1C-)		

[1.6 COMMAND] (CtL-)

With graphic display terminal:



With integrated display terminal:



[1.6 COMMAND] (CtL-)

The parameters in the [1.6 COMMAND] (CtL) menu can only be modified when the drive is stopped and no run command is present.

Command and reference channels

Run commands (forward, reverse, stop, etc.) and references can be sent using the following channels:

Command	Reference
• Terminals: Logic inputs LI • Graphic display terminal • Integrated Modbus • Integrated CANopen • Communication card • Controller Inside card	• Terminals: Analog inputs AI, frequency input, encoder • Graphic display terminal • Integrated Modbus • Integrated CANopen • Communication card • Controller Inside card • +/- speed via the terminals • +/- speed via the graphic display terminal

The behavior of the Altivar 61 can be adapted according to requirements:

- [8 serie] (SE8): To replace an Altivar 58. See the Migration Manual.
- [Not separ.] (SIM): Command and reference are sent via the same channel.
- [Separate] (SEP): Command and reference may be sent via different channels.

In these configurations, control via the communication bus is performed in accordance with the DRIVECOM standard with only 5 freely-assignable bits (see Communication Parameters Manual). The application functions cannot be accessed via the communication interface.

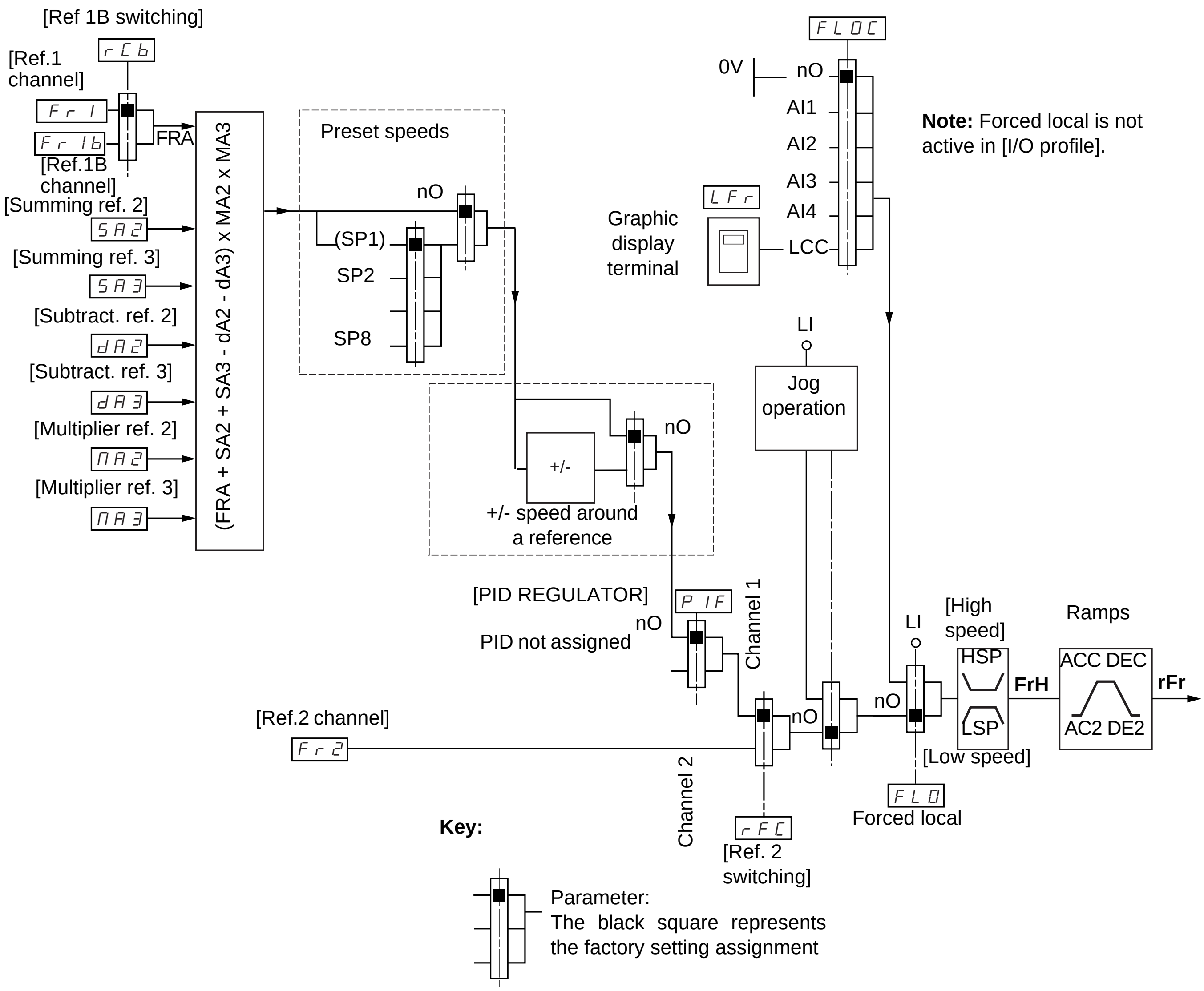
- [I/O profile] (IO): Command and reference may be sent via different channels. This configuration both simplifies and extends use via the communication interface.
  Commands may be sent via the logic inputs on the terminals or via the communication bus.
  When commands are sent via a bus, they are available on a word, which acts as virtual terminals containing only logic inputs.
  Application functions can be assigned to the bits in this word. More than one function can be assigned to the same bit.

Note: Stop commands from the terminals remain active even if the terminals are not the active command channel.

Note: The integrated Modbus channel has 2 physical communication ports:
- The Modbus network port
- The Modbus HMI port

The drive does not differentiate between these two ports, but recognizes the graphic display terminal irrespective of the port to which it is connected.

Reference channel for [Not separ.] (SIM), [Separate] (SEP) and [I/O profile] (IO) configurations, PID not configured



References

Fr1, SA2, SA3, dA2, dA3, MA2, MA3:

- Terminals, graphic display terminal, integrated Modbus, integrated CANopen, communication card, Controller Inside card

Fr1b, for SEP and IO:

- Terminals, graphic display terminal, integrated Modbus, integrated CANopen, communication card, Controller Inside card

Fr1b, for SIM:

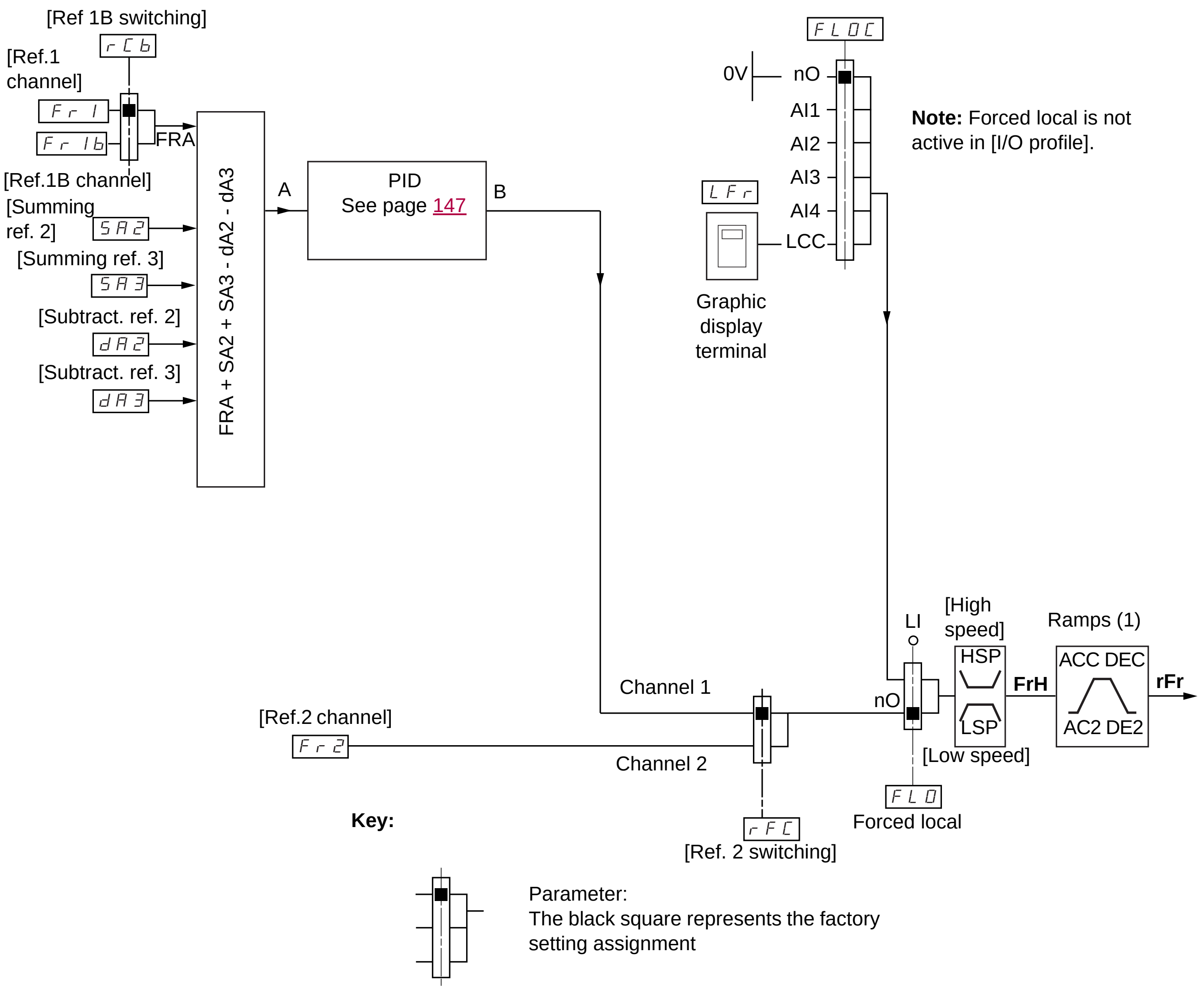
- Terminals, only accessible if Fr1 = terminals

Fr2:

- Terminals, graphic display terminal, integrated Modbus, integrated CANopen, communication card, Controller Inside card, **and +/-speed**

Note: [Ref.1B channel] (Fr1b) and [Ref 1B switching] (rCb) must be configured in the [APPLICATION FUNCT.] (Fun-) menu.

Reference channel for [Not separ.] (SIM), [Separate] (SEP) and [I/O profile] (IO) configurations, PID configured with PID references at the terminals



References

Fr1:

- Terminals, graphic display terminal, integrated Modbus, integrated CANopen, communication card, Controller Inside card

Fr1b, for SEP and IO:

- Terminals, graphic display terminal, integrated Modbus, integrated CANopen, communication card, Controller Inside card

Fr1b, for SIM:

- Terminals, only accessible if Fr1 = terminals

SA2, SA3, dA2, dA3:

- Terminals only

Fr2:

- Terminals, graphic display terminal, integrated Modbus, integrated CANopen, communication card, Controller Inside card, **and +/- speed**

(1) Ramps not active if the PID function is active in automatic mode.

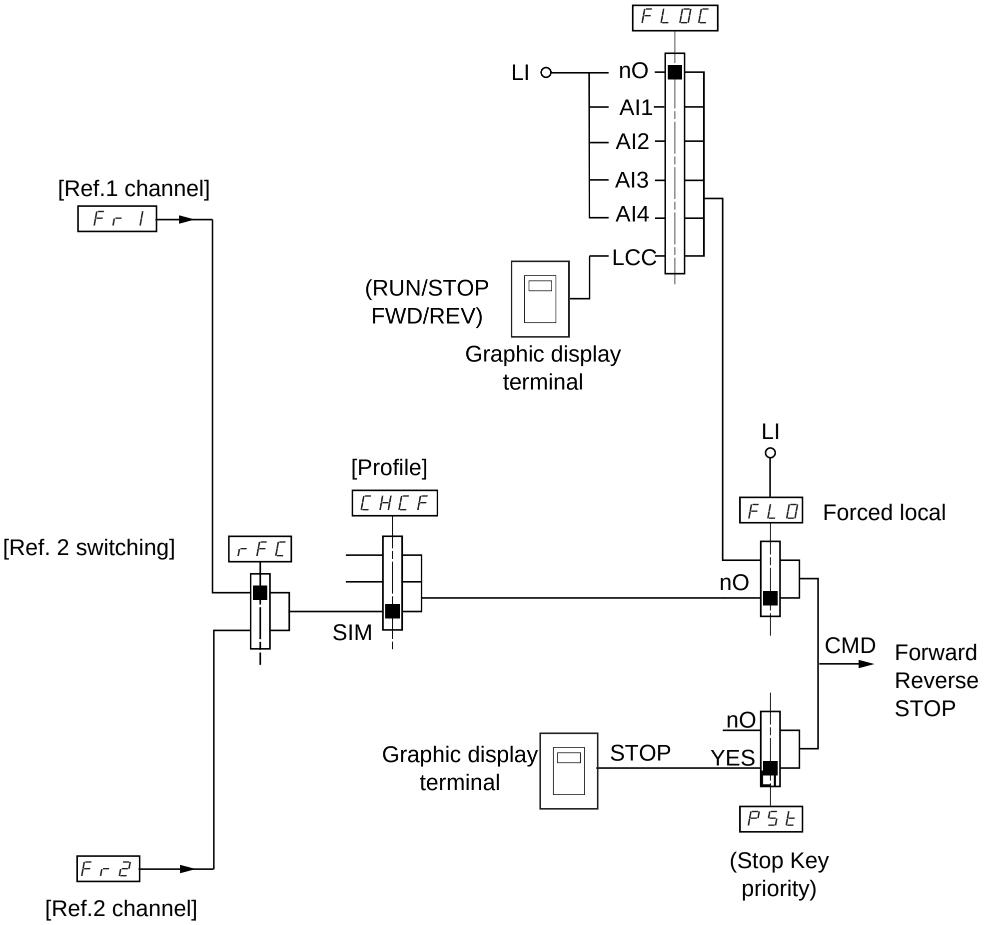
Note: [Ref.1B channel] (Fr1b) and [Ref 1B switching] (rCb) must be configured in the [APPLICATION FUNCT.] (Fun-) menu.

Command channel for [Not separ.] (SIM) configuration

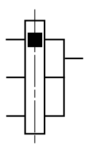
Reference and command, not separate

The command channel is determined by the reference channel. Parameters Fr1, Fr2, rFC, FLO and FLOC are common to reference and command.

Example: If the reference is Fr1 = AI1 (analog input at the terminals), control is via LI (logic input at the terminals).



Key:



Parameter:
The black square represents
the factory setting assignment.

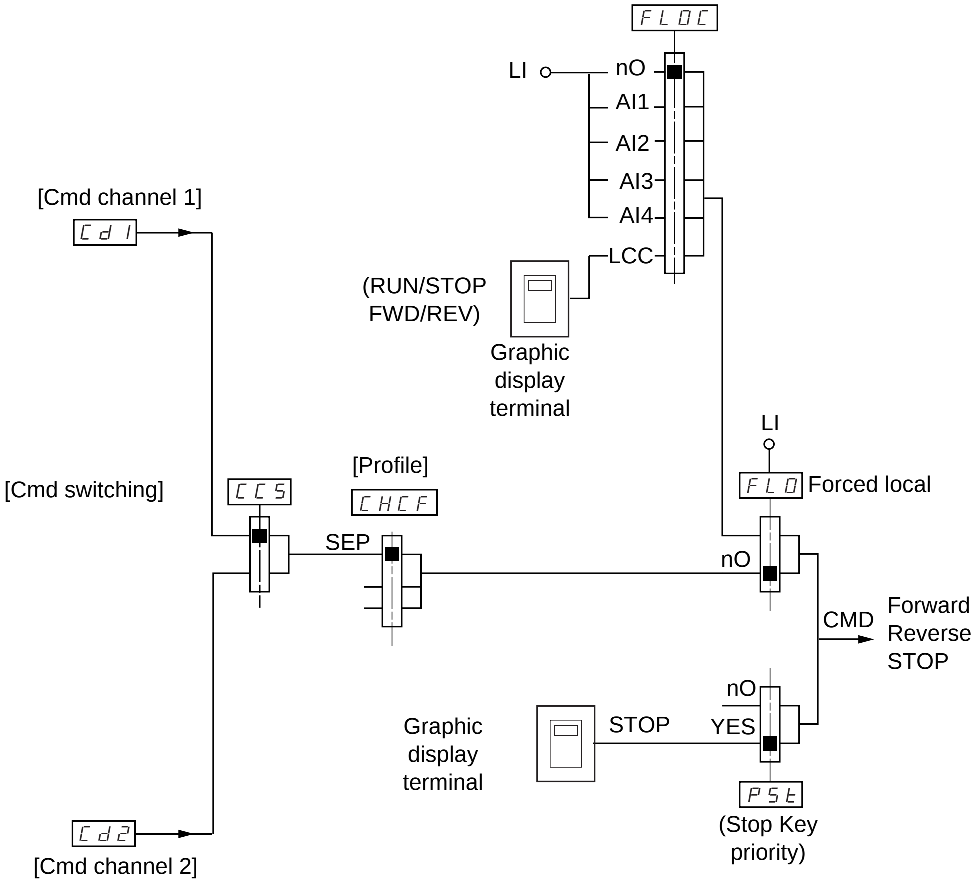
Command channel for [Separate] (SEP) configuration

Separate reference and command

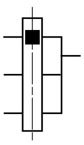
Parameters FLO and FLOC are common to reference and command.

Example: If the reference is in forced local mode via AI1 (analog input at the terminals), command in forced local mode is via LI (logic input at the terminals).

The command channels Cd1 and Cd2 are independent of the reference channels Fr1, Fr1b and Fr2.



Key:



Parameter:
The black rectangle represents the factory setting assignment, except for [Profile].

Commands

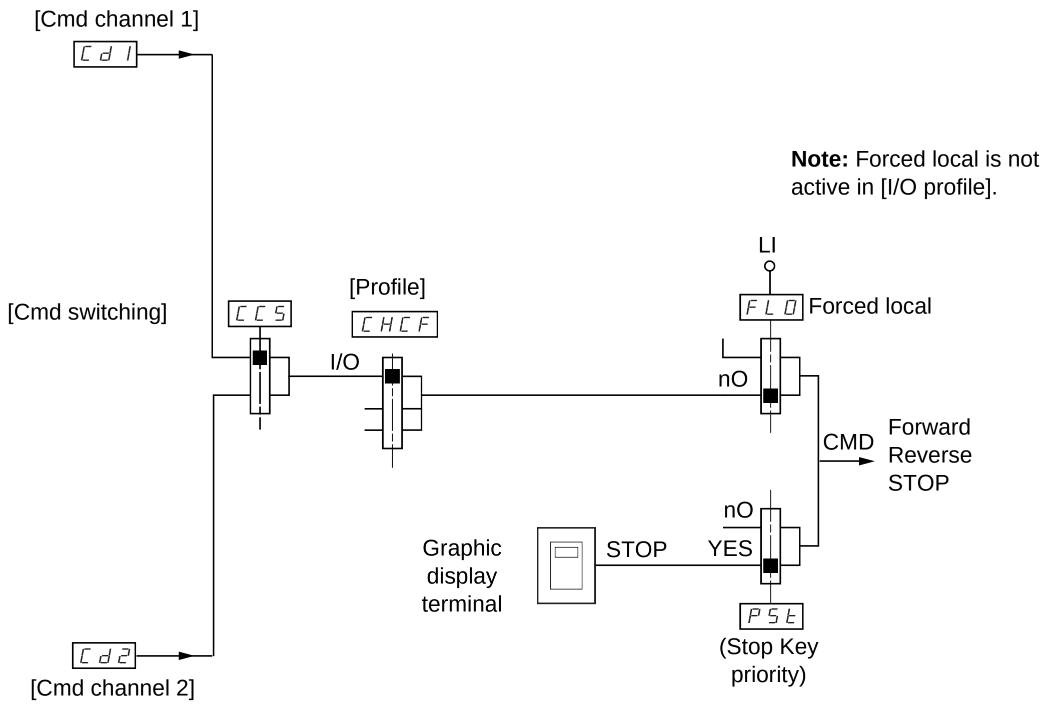
Cd1, Cd2:

- Terminals, graphic display terminal, integrated Modbus, integrated CANopen, communication card, Controller Inside card

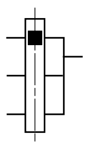
Command channel for [I/O profile] (IO) configuration

Separate reference and command, as in [Separate] (SEP) configuration

The command channels Cd1 and Cd2 are independent of the reference channels Fr1, Fr1b and Fr2.



Key:



Parameter:
The black rectangle represents the factory setting assignment, except for [Profile].

Commands

Cd1, Cd2:

- Terminals, graphic display terminal, integrated Modbus, integrated CANopen, communication card, Controller Inside card

Command channel for [I/O profile] (IO) configuration

Selection of a command channel:

A command or an action can be assigned:

- To a fixed channel by selecting an LI input or a Cxxx bit:
  - By selecting e.g., LI3, this action will always be triggered by LI3 regardless of which command channel is switched.
  - By selecting e.g., C214, this action will always be triggered by integrated CANopen with bit 14 regardless of which command channel is switched.

- To a switchable channel by selecting a CDxx bit:
  - By selecting, e.g., CD11, this action will be triggered by
    LI12 if the terminals channel is active
    C111 if the integrated Modbus channel is active
    C211 if the integrated CANopen channel is active
    C311 if the communication card channel is active
    C411 if the Controller Inside card channel is active

If the active channel is the graphic display terminal, the functions and commands assigned to CDxx switchable internal bits are inactive.

Note:

- CD14 and CD15 can only be used for switching between 2 networks. They do not have equivalent logic inputs.

Terminals	Integrated Modbus	Integrated CANopen	Communication card	Controller Inside card	Internal bit, can be switched
					CD00
LI2 (1)	C101 (1)	C201 (1)	C301 (1)	C401 (1)	CD01
LI3	C102	C202	C302	C402	CD02
LI4	C103	C203	C303	C403	CD03
LI5	C104	C204	C304	C404	CD04
LI6	C105	C205	C305	C405	CD05
LI7	C106	C206	C306	C406	CD06
LI8	C107	C207	C307	C407	CD07
LI9	C108	C208	C308	C408	CD08
LI10	C109	C209	C309	C409	CD09
LI11	C110	C210	C310	C410	CD10
LI12	C111	C211	C311	C411	CD11
LI13	C112	C212	C312	C412	CD12
LI14	C113	C213	C313	C413	CD13
-	C114	C214	C314	C414	CD14
-	C115	C215	C315	C415	CD15

(1) If [2/3 wire control] (tCC) page 80 = [3 wire] (3C), LI2, C101, C201, C301, and C401 cannot be accessed.

Assignment conditions for logic inputs and control bits

The following elements are available for every command or function that can be assigned to a logic input or a control bit:

[LI1] (LI1) to [LI6] (LI6)	Drive with or without option
[LI7] (LI7) to [LI10] (LI10)	With VW3A3201 logic I/O card
[LI11] (LI11) to [LI14] (LI14)	With VW3A3202 extended I/O card
[C101] (C101) to [C110] (C110)	With integrated Modbus in [I/O profile] (IO) configuration
[C111] (C111) to [C115] (C115)	With integrated Modbus regardless of configuration
[C201] (C201) to [C210] (C210)	With integrated CANopen in [I/O profile] (IO) configuration
[C211] (C211) to [C215] (C215)	With integrated CANopen regardless of configuration
[C301] (C301) to [C310] (C310)	With a communication card in [I/O profile] (IO) configuration
[C311] (C311) to [C315] (C315)	With a communication card regardless of configuration
[C401] (C401) to [C410] (C410)	With Controller Inside card in [I/O profile] (IO) configuration
[C411] (C411) to [C415] (C415)	With Controller Inside card regardless of configuration
[CD00] (Cd00) to [CD10] (Cd10)	In [I/O profile] (IO) configuration
[CD11] (Cd11) to [CD15] (Cd15)	Regardless of configuration

Note: In [I/O profile] (IO) configuration, LI1 cannot be accessed and if [2/3 wire control] (tCC) page 80 = [3 wire] (3C), LI2, C101, C201, C301, and C401 cannot be accessed either.

WARNING

UNINTENDED EQUIPMENT OPERATION

Inactive communication channels are not monitored (no lock following malfunction in the event of a communication bus failure). Make sure that the commands and functions assigned to bits C101 to C415 will not pose a risk in the event of the failure of the associated communication bus.

Failure to follow these instructions can result in death or serious injury.

Code	Name/Description	Adjustment range	Factory setting
Fr1	❑ **[Ref.1 channel]**		[AI1] (AI1)
AI1	❑ **[AI1]** (AI1): Analog input		
AI2	❑ **[AI2]** (AI2): Analog input		
AI3	❑ **[AI3]** (AI3): Analog input, if VW3A3202 extension card has been inserted		
AI4	❑ **[AI4]** (AI4): Analog input, if VW3A3202 extension card has been inserted		
LCC	❑ **[HMI]** (LCC): Graphic display terminal		
Mdb	❑ **[Modbus]** (Mdb): Integrated Modbus		
CAn	❑ **[CANopen]** (CAn): Integrated CANopen		
nEt	❑ **[Com. card]** (nEt): Communication card (if inserted)		
APP	❑ **[Prog. card]** (APP): Controller Inside card (if inserted)		
PI	❑ **[RP]** (PI): Frequency input, if VW3A3202 extension card has been inserted		
PG	❑ **[Encoder]** (PG): Encoder input, if encoder card has been inserted		
rIn	❑ **[RV Inhibition]**		[No] (nO)
nO	❑ **[No]** (nO)		
YES	❑ **[Yes]** (YES) Inhibition of movement in reverse direction, does not apply to direction requests sent by logic inputs. - Reverse direction requests sent by logic inputs are taken into account. - Reverse direction requests sent by the graphic display terminal are not taken into account. - Reverse direction requests sent by the line are not taken into account. - Any reverse speed reference originating from the PID, summing input, etc., is interpreted as a zero reference (0 Hz).		
PSt	❑ **[Stop Key priority]**		[Yes] (YES)
nO	❑ **[No]** (nO)		
YES	❑ **[Yes]** (YES): Gives priority to the STOP key on the graphic display terminal when the graphic display terminal is not enabled as the command channel. Press and hold down ENT for 2 seconds in order for any change in the assignment of [Stop Key priority] (PSt) to be taken into account. This will be a freewheel stop. If the active command channel is the graphic display terminal, the stop will be performed according to the [Type of stop] (Stt) page 133 irrespective of the configuration of [Stop Key priority] (PSt).		
CHCF	❑ **[Profile]**		[Not separ.] (SIM)
SE8	❑ **[8 serie]** (SE8): ATV38 interchangeability (see Migration Manual). The [8 serie] (SE8) configuration is used to load, via PowerSuite, for example, an ATV38 drive configuration in an ATV61 that has already been set to this configuration. This assignment cannot be accessed if a Controller Inside card has been inserted. **Note:** Modifications to the configuration of the ATV61 must only be made using PowerSuite when it is in this configuration, otherwise operation cannot be guaranteed.		
SIM	❑ **[Not separ.]** (SIM): Reference and command, not separate		
SEP	❑ **[Separate]** (SEP): Separate reference and command This assignment cannot be accessed in [I/O profile] (IO).		
IO	❑ **[I/O profile]** (IO): I/O profile When [8 serie] (SE8) is selected and [I/O profile] (IO) is deselected, the drive automatically returns to the factory setting (this is mandatory). This factory setting only affects the [1 DRIVE MENU] menu. It does not affect either [1.9 COMMUNICATION] or [1.14 PROGRAMMABLE CARD]. - With the graphic display terminal, a screen appears to perform this operation. Follow the instructions on the screen. - With the integrated display terminal, press ENT and hold it down (for 2 s). This will save the selection and return to the factory setting.		

Code	Name/Description	Adjustment range	Factory setting
CCS	❑ **[Cmd switching]**		[ch1 active] (Cd1)
	The parameter can be accessed if [Profile] (CHCF) = [Separate] (SEP) or [I/O profile] (IO)		
Cd1	☐ **[ch1 active]** (Cd1): [Cmd channel 1] (Cd1) active (no switching)		
Cd2	☐ **[ch2 active]** (Cd2): [Cmd channel 2] (Cd2) active (no switching)		
LI1	☐ **[LI1]** (LI1)		
-	:		
-	:		
-	☐ **[...]** (...): See the assignment conditions on page 116 (not CDOO to CD14).		
	If the assigned input or bit is at 0, channel [Cmd channel 1] (Cd1) is active. If the assigned input or bit is at 1, channel [Cmd channel 2] (Cd2) is active.		
Cd1	❑ **[Cmd channel 1]**		[Terminals] (tEr)
tEr	☐ **[Terminals]** (tEr): Terminals		
LCC	☐ **[HMI]** (LCC): Graphic display terminal		
Mdb	☐ **[Modbus]** (Mdb): Integrated Modbus		
CAn	☐ **[CANopen]** (CAn): Integrated CANopen		
nEt	☐ **[Com. card]** (nEt): Communication card (if inserted)		
APP	☐ **[Prog. card]** (APP): Controller Inside card (if inserted) The parameter is available if [Profile] (CHCF) = [Separate] (SEP) or [I/O profile] (IO).		
Cd2	❑ **[Cmd channel 2]**		[Modbus] (Mdb)
tEr	☐ **[Terminals]** (tEr): Terminals		
LCC	☐ **[HMI]** (LCC): Graphic display terminal		
Mdb	☐ **[Modbus]** (Mdb): Integrated Modbus		
CAn	☐ **[CANopen]** (CAn): Integrated CANopen		
nEt	☐ **[Com. card]** (nEt): Communication card (if inserted)		
APP	☐ **[Prog. card]** (APP): Controller Inside card (if inserted) The parameter is available if [Profile] (CHCF) = [Separate] (SEP) or [I/O profile] (IO).		
rFC	❑ **[Ref. 2 switching]**		[ch1 active] (Fr1)
Fr1	☐ **[ch1 active]** (Fr1): No switching, [Ref.1 channel] (Fr1) active		
Fr2	☐ **[ch2 active]** (Fr2): No switching, [Ref.2 channel] (Fr2) active		
LI1	☐ **[LI1]** (LI1)		
-	:		
-	:		
-	☐ **[...]** (...): See the assignment conditions on page 116 (not CDOO to CD14).		
	If the assigned input or bit is at 0, channel [Ref.1 channel] (Fr1) is active. If the assigned bit or input is at 1, channel [Ref.2 channel] (Fr2) is active.		
Fr2	❑ **[Ref.2 channel]**		[No] (nO)
nO	☐ **[No]** (nO): Not assigned If [Profile] (CHCF) = [Not separ.] (SIM), command is at the terminals with a zero reference. If [Profile] (CHCF) = [Separate] (SEP) or [I/O profile] (IO), the reference is zero.		
AI1	☐ **[AI1]** (AI1): Analog input		
AI2	☐ **[AI2]** (AI2): Analog input		
AI3	☐ **[AI3]** (AI3): Analog input, if VW3A3202 extension card has been inserted		
AI4	☐ **[AI4]** (AI4): Analog input, if VW3A3202 extension card has been inserted		
UPdt	☐ **[+/- Speed]** (UPdt): +/-Speed command		
LCC	☐ **[HMI]** (LCC): Graphic display terminal		
Mdb	☐ **[Modbus]** (Mdb): Integrated Modbus		
CAn	☐ **[CANopen]** (CAn): Integrated CANopen		
nEt	☐ **[Com. card]** (nEt): Communication card (if inserted)		
APP	☐ **[Prog. card]** (APP): Controller Inside card (if inserted)		
PI	☐ **[RP]** (PI): Frequency input, if VW3A3202 extension card has been inserted		
PG	☐ **[Encoder]** (PG): Encoder input, if encoder card has been inserted		

Code	Name/Description	Adjustment range	Factory setting
COP	❑ **[Copy channel 1 <> 2]**		[No] (nO)
	Can be used to copy the current reference and/or the command by means of switching, in order to avoid speed surges, for example. If [Profile] (CHCF) page 117 = [Not separ.] (SIM) or [Separate] (SEP), copying will only be possible from channel 1 to channel 2. If [Profile] (CHCF) = [I/O profile] (IO), copying will be possible in both directions.		
nO	❑ **[No]** (nO): No copy		
SP	❑ **[Reference]** (SP): Copy reference		
Cd	❑ **[Command]** (Cd): Copy command		
ALL	❑ **[Cmd + ref.]** (ALL): Copy command and reference - A reference or a command cannot be copied to a channel on the terminals. - The reference copied is FrH (before ramp) unless the destination channel reference is set via +/- speed. In this case, the reference copied is rFr (after ramp).		
	! WARNING **UNINTENDED EQUIPMENT OPERATION** Copying the command and/or reference can change the direction of rotation. Check that this is safe. **Failure to follow these instructions can result in death or serious injury.**		

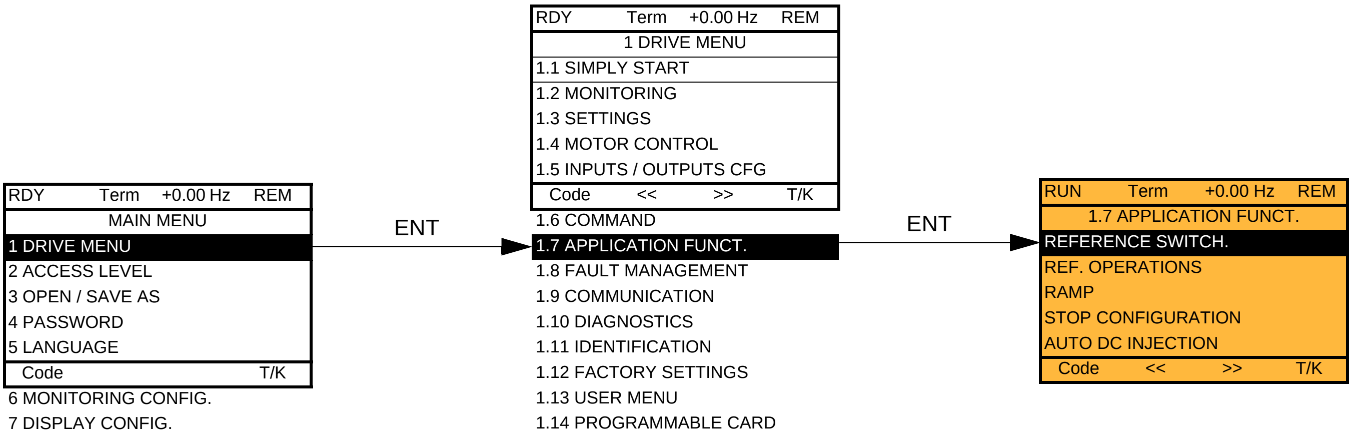
As the graphic display terminal may be selected as the command and/or reference channel, its action modes can be configured.
The parameters on this page can only be accessed on the graphic display terminal, and not on the integrated display terminal.

Notes:

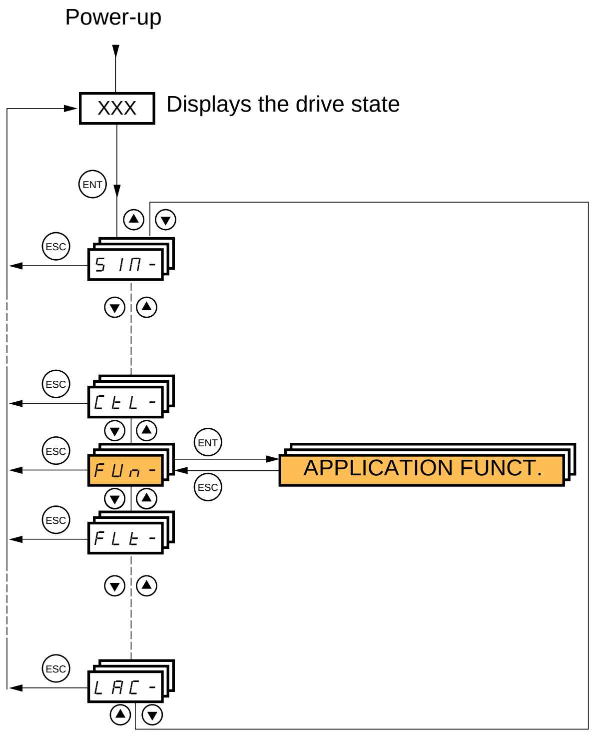
- The display terminal command/reference is only active if the command and/or reference channels from the terminal are active, with the exception of [T/K] (command and reference via the display terminal), which takes priority over these channels. Press [T/K] again or turn off the drive to revert control to the selected channel.
  - **•Note:** The channel selected by pressing [T/K] remains active after a return to factory settings, until [T/K] is pressed again or the drive is turned off.
- Command and reference via the display terminal are impossible if the latter is connected to more than one drive.
- The JOG, preset speed and +/- speed functions can only be accessed if [Profile] (CHCF) = [Not separ.] (SIM).
- The preset PID reference functions can only be accessed if [Profile] (CHCF) = [Not separ.] (SIM) or [Separate] (SEP).
- The [T/K] function (command and reference via the display terminal) can be accessed regardless of the [Profile] (CHCF).

Name/Description	Adjustment range	Factory setting
❑ **[F1 key assignment]** ☐ **[No]**: Not assigned ☐ **[Jog]**: JOG operation ☐ **[Preset spd2]**: Press the key to run the drive at the 2nd preset speed [Preset speed 2] (SP2) page 140. Press STOP to stop the drive. ☐ **[Preset spd3]**: Press the key to run the drive at the 3rd preset speed [Preset speed 3] (SP3) page 140. Press STOP to stop the drive. ☐ **[PID ref. 2]**: Sets a PID reference equal to the 2nd preset PID reference [Preset ref. PID 2] (rP2) page 156 without sending a run command. Only operates if [Ref.1 channel] (Fr1) = [HMI] (LCC). Does not operate with the [T/K] function. ☐ **[PID ref. 3]**: Sets a PID reference equal to the 3rd preset PID reference [Preset ref. PID 3] (rP3) page 156 without sending a run command. Only operates if [Ref.1 channel] (Fr1) = [HMI] (LCC). Does not operate with the [T/K] function. ☐ **[+Speed]**: Faster, only operates if [Ref.2 channel] (Fr2) = [HMI] (LCC). Press the key to run the drive and increase the speed. Press STOP to stop the drive. ☐ **[-Speed]**: Slower, only operates if [Ref.2 channel] (Fr2) = [HMI] (LCC) and if a different key is assigned to [+Speed]. Press the key to run the drive and decrease the speed. Press STOP to stop the drive. ☐ **[T/K]**: Command and reference via the display terminal: Takes priority over [Cmd switching] (CCS) and over [Ref. 2 switching] (rFC).		[No]
❑ **[F2 key assignment]** Identical to [F1 key assignment].		[No]
❑ **[F3 key assignment]** Identical to [F1 key assignment].		[No]
❑ **[F4 key assignment]** Identical to [F1 key assignment].		[T/K]
❑ **[HMI cmd.]** When the [T/K] function is assigned to a key and that function is active, this parameter defines the behavior at the moment when control returns to the graphic display terminal. ☐ **[Stop]**: Stops the drive (although the controlled direction of operation and reference of the previous channel are copied (to be taken into account on the next RUN command)). ☐ **[Bumpless]**: Does not stop the drive (the controlled direction of operation and the reference of the previous channel are copied).		[Bumpless]

With graphic display terminal:



With integrated display terminal:



Summary of functions:

Code	Name	Page
rEF-	[REFERENCE SWITCH.]	127
OA1-	[REF. OPERATIONS]	128
rPt-	[RAMP]	129
Stt-	[STOP CONFIGURATION]	133
AdC-	[AUTO DC INJECTION]	135
JOG-	[JOG]	137
PSS-	[PRESET SPEEDS]	139
UPd-	[+/-Speed]	142
SrE-	[+/-SPEED AROUND REF.]	144
SPM-	[MEMO REFERENCE]	145
FL1-	[FLUXING BY LI]	146
PId-	[PID REGULATOR]	151
Pr1-	[PID PRESET REFERENCES]	156
SrM-	[SLEEPING / WAKE UP]	158
tOL-	[TORQUE LIMITATION]	164
CL1-	[2nd CURRENT LIMIT.]	166
LLC-	[LINE CONTACTOR COMMAND]	168
OCC-	[OUTPUT CONTACTOR CMD]	170
dAM-	[DAMPER MANAGEMENT]	172
MLP-	[PARAM. SET SWITCHING]	174
MMC-	[MULTIMOTORS/CONFIG.]	179
tnL-	[AUTO TUNING BY LI]	179
nFS-	[NO FLOW DETECTION]	181
FLL-	[FLOW LIMITATION]	183
dCO-	[DC BUS SUPPLY]	184
OIr-	[REGEN CONNECTION]	185

[1.7 APPLICATION FUNCT.] (FUn-)

The parameters in the [1.7 APPLICATION FUNCT.] (FUn-) menu can only be modified when the drive is stopped and there is no run command, except for parameters with a ⟲ symbol in the code column, which can be modified with the drive running or stopped.

☞ **Note: Compatibility of functions**
The choice of application functions may be limited by the number of I/O and by the fact that some functions are incompatible with one another. Functions that are not listed in the table below are fully compatible.
If there is an incompatibility between functions, the first function configured will prevent the others being configured.

Each of the functions on the following pages can be assigned to one of the inputs or outputs.
A single input can activate several functions at the same time (reverse and 2nd ramp, for example). **The user must therefore ensure that these functions can be used at the same time**. It is only possible to assign one input to several functions at [Advanced] (AdU) and [Expert] (EPr) level.

Before assigning a command, reference or function to an input or output, the user must make sure that this input or output has not already been assigned and that another input or output has not been assigned to an incompatible or undesirable function.
The drive factory setting or macro configurations automatically configure functions, **which may prevent other functions being assigned. It may be necessary to unconfigure one or more functions in order to be able to enable another.** Check the compatibility table below.

Compatibility table

	Ref. operations (page 128)	+/- speed (2) (page 142)	Preset speeds (page 139)	PID regulator (page 151)	JOG operation (page 137)	DC injection stop (page 133)	Fast stop (page 133)	Freewheel stop (page 133)	+/- speed around a reference (page 144)	Synchronous motor (page 67)
Ref. operations (page 128)			↑	●(3)	↑					
+/- speed (2) (page 142)					●					
Preset speeds (page 139)	←				↑					
PID regulator (page 151)	●(3)				●				●	
JOG operation (page 137)	←	●	←	●					●	
DC injection stop (page 133)							●(1)	↑		●
Fast stop (page 133)						●(1)		↑		
Freewheel stop (page 133)						←	←			
+/- speed around a reference (page 144)				●	●					
Synchronous motor (page 67)						●				

(1) Priority is given to the first of these two stop modes to be activated.
(2) Excluding special application with reference channel Fr2 (see diagrams on pages 110 and 111).
(3) Only the multiplier reference is incompatible with the PID regulator.

● Incompatible functions

☐ Compatible functions

N/A (grey)

Priority functions (functions, which cannot be active at the same time):

← ↑ The function marked with the arrow takes priority over the other.

Stop functions have priority over run commands.
Speed references via logic command have priority over analog references.

Note: This compatibility table does not affect commands that can be assigned to the keys of the graphic display terminal (see page 120).

Incompatible functions

The following functions will be inaccessible or deactivated in the cases described below:

Automatic restart

This is only possible for control type [2/3 wire control] (tCC) = [2 wire] (2C) and [2 wire type] (tCt) = [Level] (LEL) or [Fwd priority] (PFO).
See page 80.

Catch on the fly

This is only possible for control type [2/3 wire control] (tCC) = [2 wire] (2C) and [2 wire type] (tCt) = [Level] (LEL) or [Fwd priority] (PFO).
See page 80.
This function is locked if automatic injection on stop [Auto DC injection] (AdC) = [Continuous] (Ct). See page 135.

The SUP- monitoring menu (page 38) can be used to display the functions assigned to each input in order to check their compatibility.

When a function is assigned, a ✓ appears on the graphic display terminal, as illustrated in the example below:

RDY	Term	+0.00 Hz	REM
1.7 APPLICATION FUNCT.			
REFERENCE SWITCH.			
REF. OPERATIONS			
RAMP			✓
STOP CONFIGURATION			
AUTO DC INJECTION			
Code	<<	>>	T/K

JOG

If you attempt to assign a function that is incompatible with another function that has already been assigned, an alarm message will appear:

With the graphic display terminal

RDY	Term	+0.00 Hz	REM
INCOMPATIBILITY			
The function can't be assigned because an incompatible function is already selected. See programming book.			
ENT or ESC to continue			

With the integrated display terminal:
COMP flashes until ENT or ESC is pressed.

When you assign a logic input, an analog input, a reference channel or a bit to a function, pressing the HELP button will display the functions that may already have been activated by this input, bit or channel.

When a logic input, an analog input, a reference channel or a bit that has already been assigned is assigned to another function, the following screens appear:

With the graphic display terminal

RUN +50.00 Hz 1250A +50.00 Hz
WARNING - ASSIGNED TO
Reference switch. 2
ENT->Continue ESC->Cancel

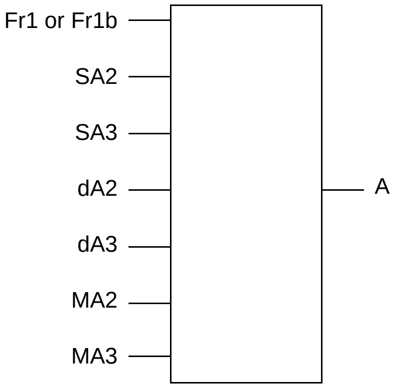
If the access level permits this new assignment, pressing ENT confirms the assignment.
If the access level does not permit this new assignment, pressing ENT results in the following display.

RUN +50.00 Hz 1250A +50.00 Hz
ASSIGNMENT FORBIDDEN
Un-assign the present functions, or select Advanced access level

With the integrated display terminal:

The code for the first function, which is already assigned, is displayed flashing.
If the access level permits this new assignment, pressing ENT confirms the assignment.
If the access level does not permit this new assignment, pressing ENT has no effect, and the message continues to flash. It is only possible to exit by pressing ESC.

Summing input/Subtracting input/Multiplier

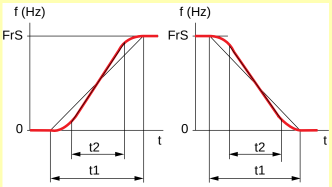
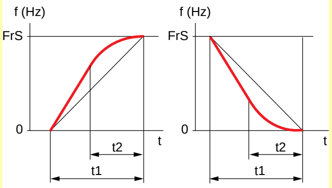
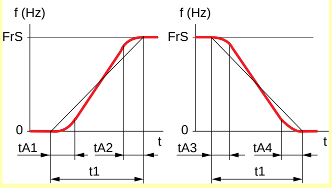


A = (Fr1 or Fr1b + SA2 + SA3 - dA2 - dA3) x MA2 x MA3

- If SA2, SA3, dA2, dA3 are not assigned, they are set to 0.
- If MA2, MA3 are not assigned, they are set to 1.
- A is limited by the minimum LSP and maximum HSP parameters.
- For multiplication, the signal on MA2 or MA3 is interpreted as a %; 100% corresponds to the maximum value of the corresponding input. If MA2 or MA3 is sent via the communication bus or graphic display terminal, an MFr multiplication variable (see page 44) must be sent via the bus or graphic display terminal.
- Reversal of the direction of operation in the event of a negative result can be inhibited (see page 117).

Code	Name/Description	Adjustment range	Factory setting
rEF-	**[REFERENCE SWITCH.]**		
rCb	**[Ref 1B switching]** See the diagrams on pages 110 and 111.		[LI3] (LI3)
Fr1 Fr1b	**[ch1 active]** (Fr1): No switching, [Ref.1 channel] (Fr1) active **[ch1B active]** (Fr1b): No switching, [Ref.1B channel] (Fr1b) active		
LI1 - - -	**[LI1]** (LI1) : : **[...]** (...): See the assignment conditions on page 116 (not CDOO to CD14). • If the assigned input or bit is at 0, [Ref.1 channel] (Fr1) is active (see page 117). • If the assigned input or bit is at 1, [Ref.1B channel] (Fr1b) is active. [Ref 1B switching] (rCb) is forced to [ch1 active] (Fr1) if [Profile] (CHCF) = [Not separ.] (SIM) with [Ref.1 channel] (Fr1) assigned via the terminals (analog inputs, encoder, pulse input); see page 117.		
Fr1b	**[Ref.1B channel]**		[AI2] (AI2)
nO	**[No]** (nO): Not assigned		
AI1	**[AI1]** (AI1): Analog input		
AI2	**[AI2]** (AI2): Analog input		
AI3	**[AI3]** (AI3): Analog input, if VW3A3202 extension card has been inserted		
AI4	**[AI4]** (AI4): Analog input, if VW3A3202 extension card has been inserted		
LCC	**[HMI]** (LCC): Graphic display terminal		
Mdb	**[Modbus]** (Mdb): Integrated Modbus		
CAn	**[CANopen]** (CAn): Integrated CANopen		
nEt	**[Com. card]** (nEt): Communication card (if inserted)		
APP	**[Prog. card]** (APP): Controller Inside card (if inserted)		
PI	**[RP]** (PI): Frequency input, if VW3A3202 extension card has been inserted		
PG	**[Encoder]** (PG): Encoder input, if encoder card has been inserted **Note**: In the following instances, only assignments via the terminals are possible: - [Profile] (CHCF) = [Not separ.] (SIM) with [Ref.1 channel] (Fr1) assigned via the terminals (analog inputs, encoder, pulse input); see page 117. - PID configured with PID references via the terminals		

Code	Name/Description	Adjustment range	Factory setting
OAI-	■ **[REF. OPERATIONS]** Reference = (Fr1 or Fr1b + SA2 + SA3 - dA2 - dA3) x MA2 x MA3. See the diagrams on pages 110 and 111. **Note:** This function cannot be used with certain other functions. Follow the instructions on page 122.		
SA2 nO AI1 AI2 AI3 AI4 LCC Mdb CAn nEt APP PI PG AIU1	❑ **[Summing ref. 2]** Selection of a reference to be added to [Ref.1 channel] (Fr1) or [Ref.1B channel] (Fr1b). ☐ **[No]** (nO): No source assigned ☐ **[AI1]** (AI1): Analog input ☐ **[AI2]** (AI2): Analog input ☐ **[AI3]** (AI3): Analog input, if VW3A3202 extension card has been inserted ☐ **[AI4]** (AI4): Analog input, if VW3A3202 extension card has been inserted ☐ **[HMI]** (LCC): Graphic display terminal ☐ **[Modbus]** (Mdb): Integrated Modbus ☐ **[CANopen]** (CAn): Integrated CANopen ☐ **[Com. card]** (nEt): Communication card (if inserted) ☐ **[Prog. card]** (APP): Controller Inside card (if inserted) ☐ **[RP]** (PI): Frequency input, if VW3A3202 extension card has been inserted ☐ **[Encoder]** (PG): Encoder input, if encoder card has been inserted ☐ **[Network AI]** (AIU1): Virtual input via communication bus, to be configured via [AI net. channel] (AIC1) page 89 **WARNING** **UNINTENDED EQUIPMENT OPERATION** If the equipment switches to forced local mode (see page 216), the virtual input remains frozen at the last value transmitted. Do not use the virtual input and forced local mode in the same configuration. **Failure to follow this instruction can result in death or serious injury.**		[No] (nO)
SA3	❑ **[Summing ref. 3]** Selection of a reference to be added to [Ref.1 channel] (Fr1) or [Ref.1B channel] (Fr1b). • Possible assignments are identical to [Summing ref. 2] (SA2) above.		[No] (nO)
dA2	❑ **[Subtract. ref. 2]** Selection of a reference to be subtracted from [Ref.1 channel] (Fr1) or [Ref.1B channel] (Fr1b). • Possible assignments are identical to [Summing ref. 2] (SA2) above.		[No] (nO)
dA3	❑ **[Subtract. ref. 3]** Selection of a reference to be subtracted from [Ref.1 channel] (Fr1) or [Ref.1B channel] (Fr1b). • Possible assignments are identical to [Summing ref. 2] (SA2) above.		[No] (nO)
MA2	❑ **[Multiplier ref. 2]** Selection of a multiplier reference [Ref.1 channel] (Fr1) or [Ref.1B channel] (Fr1b). • Possible assignments are identical to [Summing ref. 2] (SA2) above.		[No] (nO)
MA3	❑ **[Multiplier ref. 3]** Selection of a multiplier reference [Ref.1 channel] (Fr1) or [Ref.1B channel] (Fr1b). • Possible assignments are identical to [Summing ref. 2] (SA2) above.		[No] (nO)

Code	Name/Description	Adjustment range	Factory setting
rPt-	■ **[RAMP]**		
rPt LIn S U CUS	❑ **[Ramp type]** ☐ **[Linear]** (LIn) ☐ **[S ramp]** (S) ☐ **[U ramp]** (U) ☐ **[Customized]** (CUS) S ramps  The rounding coefficient is fixed, where t2 = 0.6 x t1 and t1 = set ramp time. U ramps  The rounding coefficient is fixed, where t2 = 0.5 x t1 and t1 = set ramp time. Customized ramps  tA1: adjustable from 0 to 100% tA2: adjustable from 0 to (100% – tA1) tA3: adjustable from 0 to 100% tA4: adjustable from 0 to (100% – tA3) As a % of t1, where t1 = set ramp time		[Linear] (LIn)
Inr () 0.01 0.1 1	❑ **[Ramp increment]** (1) ☐ **[0.01]**: Ramp up to 99.99 seconds ☐ **[0.1]**: Ramp up to 999.9 seconds ☐ **[1]**: Ramp up to 9,000 seconds This parameter is valid for [Acceleration] (ACC), [Deceleration] (dEC), [Acceleration 2] (AC2) and [Deceleration 2] (dE2).		[0.1] (0.1)
ACC ()	❑ **[Acceleration]** (1) Time to accelerate from 0 to the [Rated motor freq.] (FrS) (page 64). Make sure that this value is compatible with the inertia being driven.	0.01 to 9,000 s (2)	3.0 s
dEC ()	❑ **[Deceleration]** (1) Time to decelerate from the [Rated motor freq.] (FrS) (page 64) to 0. Make sure that this value is compatible with the inertia being driven.	0.01 to 9,000 s (2)	3.0 s

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.
(2) Range 0.01 to 99.99 s or 0.1 to 999.9 s or 1 to 9,000 s according to [Ramp increment] (Inr).

()	Parameter that can be modified during operation or when stopped.

Code	Name/Description	Adjustment range	Factory setting
	■ **[RAMP]** (continued)		
tA1	❑ **[Begin Acc round]** (1) - Rounding of start of acceleration ramp as a % of the [Acceleration] (ACC) or [Acceleration 2] (AC2) ramp time. - Can be set between 0 and 100% - The parameter can be accessed if the [Ramp type] (rPt) is [Customized] (CUS).	0 to 100%	10%
tA2	❑ **[End Acc round]** (1) - Rounding of end of acceleration ramp as a % of the [Acceleration] (ACC) or [Acceleration 2] (AC2) ramp time. - Can be set between 0 and (100% – [Begin Acc round] (tA1)) - The parameter can be accessed if the [Ramp type] (rPt) is [Customized] (CUS).		10%
tA3	❑ **[Begin Dec round]** (1) - Rounding of start of deceleration ramp as a % of the [Deceleration] (dEC) or [Deceleration 2] (dE2) ramp time. - Can be set between 0 and 100% - The parameter can be accessed if the [Ramp type] (rPt) is [Customized] (CUS).	0 to 100%	10%
tA4	❑ **[End Dec round]** (1) - Rounding of end of deceleration ramp as a % of the [Deceleration] (dEC) or [Deceleration 2] (dE2) ramp time. - Can be set between 0 and (100% – [Begin Dec round] (tA3)) - The parameter can be accessed if the [Ramp type] (rPt) is [Customized] (CUS).		10%

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.

Parameter that can be modified during operation or when stopped.

Code	Name/Description	Adjustment range	Factory setting
	[RAMP] (continued)		
FrT	**[Ramp 2 threshold]**	0 to 500 or 1,000 Hz according to rating	0 Hz

Ramp switching threshold
The 2nd ramp is switched if the value of Frt is not 0 (0 deactivates the function) and the output frequency is greater than Frt.
Threshold ramp switching can be combined with [Ramp switch ass.] (rPS) switching as follows:

LI or bit	Frequency	Ramp
0	<Frt	ACC, dEC
0	>Frt	AC2, dE2
1	<Frt	AC2, dE2
1	>Frt	AC2, dE2

Code	Name/Description	Adjustment range	Factory setting
rPS	**[Ramp switch ass.]**		[No] (nO)
nO	**[No]** (nO): Not assigned.		
LI1	**[LI1]** (LI1)		
-	:		
-	:		
-	**[...]** (...): See the assignment conditions on page 116.		

- ACC and dEC are enabled when the assigned input or bit is at 0.
- AC2 and dE2 are enabled when the assigned input or bit is at 1.

Code	Name/Description	Adjustment range	Factory setting
AC2	**[Acceleration 2]** (1)	0.01 to 9,000 s (2)	5.0 s
	Time to accelerate from 0 to the [Rated motor freq.] (FrS). Make sure that this value is compatible with the inertia being driven. The parameter can be accessed if [Ramp 2 threshold] (Frt) > 0 or if [Ramp switch ass.] (rPS) is assigned.		
dE2	**[Deceleration 2]** (1)	0.01 to 9,000 s (2)	5.0 s
	Time to decelerate from [Rated motor freq.] (FrS) to 0. Make sure that this value is compatible with the inertia being driven. The parameter can be accessed if [Ramp 2 threshold] (Frt) > 0 or if [Ramp switch ass.] (rPS) is assigned.		

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.
(2) Range 0.01 to 99.99 s or 0.1 to 999.9 s or 1 to 9,000 s according to [Ramp increment] (Inr) page 129.

Parameter that can be modified during operation or when stopped.

Code	Name/Description	Adjustment range	Factory setting
brA	❑ **[Dec ramp adapt.]**		[Yes] (YES)
	Activating this function automatically adapts the deceleration ramp, if this has been set at too low a value for the inertia of the load, which can cause an overvoltage fault.		
nO	☐ **[No]** (nO): Function inactive		
YES	☐ **[Yes]** (YES): Function active, for applications that do not require strong deceleration. The following selections appear depending on the rating of the drive and [Motor control type] (Ctt) page 67. They enable stronger deceleration to be obtained than with [Yes] (YES). Use comparative testing to determine your selection. When [Dec ramp adapt.] (brA) is configured on [High torq. x] (dYnx), the dynamic performances for braking are improved by the addition of a current flow component. The aim is to increase the iron loss and magnetic energy stored in the motor.		
dYnA	☐ **[High torq. A]** (dYnA): Addition of a constant current flow component.		
dYnb	☐ **[High torq. B]** (dYnb): Addition of a current flow component oscillating at 100 Hz.		
dYnC	☐ **[High torq. C]** (dYnC): Addition of a current flow component oscillating at 200 Hz but with a greater amplitude. [Dec ramp adapt.] (brA) is forced to [No] (nO) if [Braking balance] (bbA) page 78 = [Yes] (YES). The function is incompatible with applications requiring: - Positioning on a ramp - The use of a braking resistor (the resistor would not operate correctly).		

CAUTION

Do not use [High torq. A] (dYnA), [High torq. B] (dYnB) or [High torq. C] (dYnC) configurations if the motor is a permanent magnet synchronous motor, as it will be demagnetized.

Failure to follow this instruction can result in equipment damage.

[1.7 APPLICATION FUNCT.] (FUn-)

Code	Name/Description	Adjustment range	Factory setting
StT-	■ **[STOP CONFIGURATION]** **Note:** Some types of stop cannot be used with all other functions. Follow the instructions on page 122.		
Stt rMP FSt nSt dCI	❑ **[Type of stop]** Stop mode on disappearance of the run command or appearance of a stop command. ☐ **[Ramp stop]** (rMP): On ramp ☐ **[Fast stop]** (FSt): Fast stop ☐ **[Freewheel]** (nSt): Freewheel stop This selection will not appear if [Motor fluxing] (FLU) page 146 = [Continuous] (FCt). ☐ **[DC injection]** (dCI): DC injection stop If the [Low speed time out] (tLS) parameter page 55 or 158 is not 0, [Type of stop] (Stt) is forced to [Ramp stop] (rMP).		[Ramp stop] (rMP)
FFt	❑ **[Freewheel stop Thd]** (1) This parameter supports switching from a ramp stop or a fast stop to a freewheel stop below a low speed threshold. It can be accessed if [Type of stop] (Stt) = [Fast stop] (FSt) or [Ramp stop] (rMP). ☐ 0.0: Does not switch to freewheel stop ☐ 0.1 to 1000 Hz: Speed threshold below which the motor will switch to freewheel stop	0.0 to 1000 Hz	0.0
nSt nO LI1 - - C101 - - - Cd00 -	❑ **[Freewheel stop ass.]** ☐ **[No]** (nO): Not assigned ☐ **[LI1]** (LI1) to **[LI6]** (LI6) ☐ **[LI7]** (LI7) to **[LI10]** (LI10): If VW3A3201 logic I/O card has been inserted ☐ **[LI11]** (LI11) to **[LI14]** (LI14s): If VW3A3202 extended I/O card has been inserted ☐ **[C101]** (C101) to **[C115]** (C115): With integrated Modbus in [I/O profile] (IO) ☐ **[C201]** (C201) to **[C215]** (C215): With integrated CANopen in [I/O profile] (IO) ☐ **[C301]** (C301) to **[C315]** (C315): With a communication card in [I/O profile] (IO) ☐ **[C401]** (C401) to **[C415]** (C415): With a Controller Inside card in [I/O profile] (IO) ☐ **[CD00]** (Cd00) to **[CD13]** (Cd13): In [I/O profile] (IO) can be switched with possible logic inputs ☐ **[CD14]** (Cd14) to **[CD15]** (Cd15): In [I/O profile] (IO) can be switched without logic inputs The stop is activated when the input or bit is at 0. If the input returns to state 1 and the run command is still active, the motor will only restart if [2/3 wire control] (tCC) page 80 = [2 wire] (2C) and [2 wire type] (tCt) = [Level] (LEL) or [Fwd priority] (PFO). If not, a new run command must be sent.		[No] (nO)
FSt nO LI1 - - -	❑ **[Fast stop assign.]** **Note:** This function cannot be used with certain other functions. Follow the instructions on page 122. ☐ **[No]** (nO): Not assigned ☐ **[LI1]** (LI1) : : ☐ **[...]** (...): See the assignment conditions on page 116. The stop is activated when the input changes to 0 or the bit changes to 1(bit in [I/O profile] (IO) at 0). If the input returns to state 1 and the run command is still active, the motor will only restart if [2/3 wire control] (tCC) page 80 = [2 wire] (2C) and [2 wire type] (tCt) = [Level] (LEL) or [Fwd priority] (PFO). If not, a new run command must be sent.		[No] (nO)
dCF	❑ **[Ramp divider]** (1) The parameter can be accessed if [Type of stop] (Stt) = [Fast stop] (FSt) and if [Fast stop assign.] (FSt) is not [No] (nO). The ramp that is enabled (dEC or dE2) is then divided by this coefficient when stop requests are sent. Value 0 corresponds to a minimum ramp time.	0 to 10	4

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.

Parameter that can be modified during operation or when stopped.

Code	Name/Description	Adjustment range	Factory setting
	■ **[STOP CONFIGURATION]** (continued)		
dCI	❑ **[DC injection assign.]** Note: This function cannot be used with certain other functions. Follow the instructions on page 122.		[No] (nO)
nO LI1 - - -	☐ **[No]** (nO): Not assigned ☐ **[LI1]** (LI1) : : ☐ **[...]** (...): See the assignment conditions on page 116. DC injection braking is initiated when the assigned input or bit changes to state 1. If the input returns to state 1 and the run command is still active, the motor will only restart if [2/3 wire control] (tCC) page 80 = [2 wire] (2C) and [2 wire type] (tCt) = [Level] (LEL) or [Fwd priority] (PFO). If not, a new run command must be sent.		
IdC ()	❑ **[DC inject. level 1]** (1) (3) Level of DC injection braking current activated via logic input or selected as stop mode. The parameter can be accessed if [Type of stop] (Stt) = [DC injection] (dCI) or if [DC injection assign.] (dCI) is not [No] (nO). **CAUTION** Check that the motor will withstand this current without overheating. **Failure to follow these instructions can result in equipment damage.**	0.1 to 1.1 or 1.2 In (2) according to rating	0.64 In (2)
tdI ()	❑ **[DC injection time 1]** (1) (3) Maximum current injection time [DC inject. level 1] (IdC). After this time the injection current becomes [DC inject. level 2] (IdC2). The parameter can be accessed if [Type of stop] (Stt) = [DC injection] (dCI) or if [DC injection assign.] (dCI) is not [No] (nO).	0.1 to 30 s	0.5 s
IdC2 ()	❑ **[DC inject. level 2]** (1) (3) Injection current activated by logic input or selected as stop mode, once period of time [DC injection time 1] (tdI) has elapsed. The parameter can be accessed if [Type of stop] (Stt) = [DC injection] (dCI) or if [DC injection assign.] (dCI) is not [No] (nO). **CAUTION** Check that the motor will withstand this current without overheating. **Failure to follow these instructions can result in equipment damage.**	0.1 In (2) to [DC inject. level 1] (IdC)	0.5 In (2)
tdC ()	❑ **[DC injection time 2]** (1) (3) Maximum injection time [DC inject. level 2] (IdC2) for injection, selected as stop mode only. The parameter can be accessed if [Type of stop] (Stt) = [DC injection] (dCI).	0.1 to 30 s	0.5 s

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.
(2) In corresponds to the rated drive current indicated in the Installation Manual and on the drive nameplate.
(3) Warning: These settings are independent of the [AUTO DC INJECTION] (AdC-) function.

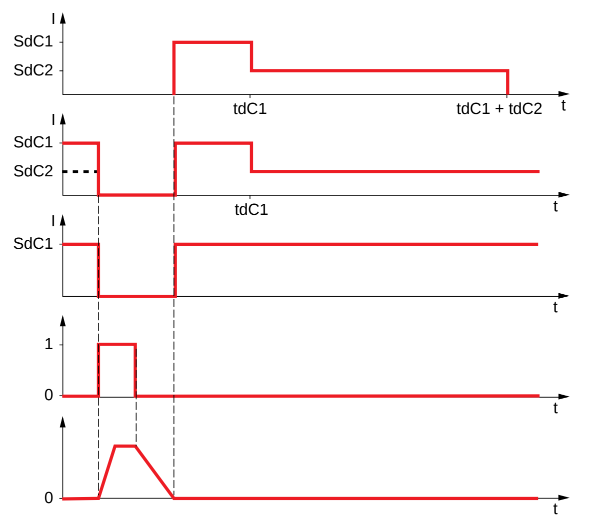
()	Parameter that can be modified during operation or when stopped.

Code	Name/Description	Adjustment range	Factory setting
AdC-	**[AUTO DC INJECTION]**		
AdC	**[Auto DC injection]** Automatic current injection on stopping (at the end of the ramp)		[Yes] (YES)
nO YES Ct	**[No]** (nO): No injection **[Yes]** (YES): Adjustable injection time **[Continuous]** (Ct): Continuous standstill injection **Warning**: There is an interlock between this function and [Motor fluxing] (FLU) page 146. If [Motor fluxing] (FLU) = [Continuous] (FCt), [Auto DC injection] (Adc) must be [No] (nO). **Note:** This parameter gives rise to the injection of current even if a run command has not been sent. It can be accessed with the drive running.		
SdC1	**[Auto DC inj. level 1]** (1) Level of standstill DC injection current. The parameter can be accessed if [Auto DC injection] (AdC) is not [No] (nO). This parameter is forced to 0 if [Motor control type] (Ctt) page 67 = [Sync. mot.] (SYn). **CAUTION** Check that the motor will withstand this current without overheating. **Failure to follow these instructions can result in equipment damage.**	0 to 1.1 or 1.2 In (2) according to rating	0.7 In (2)
tdC1	**[Auto DC inj. time 1]** (1) Standstill injection time. The parameter can be accessed if [Auto DC injection] (AdC) is not [No] (nO). If [Motor control type] (Ctt) page 67 = [Sync. mot.] (SYn) this time corresponds to the zero speed maintenance time.	0.1 to 30 s	0.5 s
SdC2	**[Auto DC inj. level 2]** (1) 2nd level of standstill DC injection current. The parameter can be accessed if [Auto DC injection] (AdC) is not [No] (nO). This parameter is forced to 0 if [Motor control type] (Ctt) page 67 = [Sync. mot.] (SYn). **CAUTION** Check that the motor will withstand this current without overheating. **Failure to follow these instructions can result in equipment damage.**	0 to 1.1 or 1.2 In (2) according to rating	0.5 In (2)

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.
(2) In corresponds to the rated drive current indicated in the Installation Manual and on the drive nameplate.

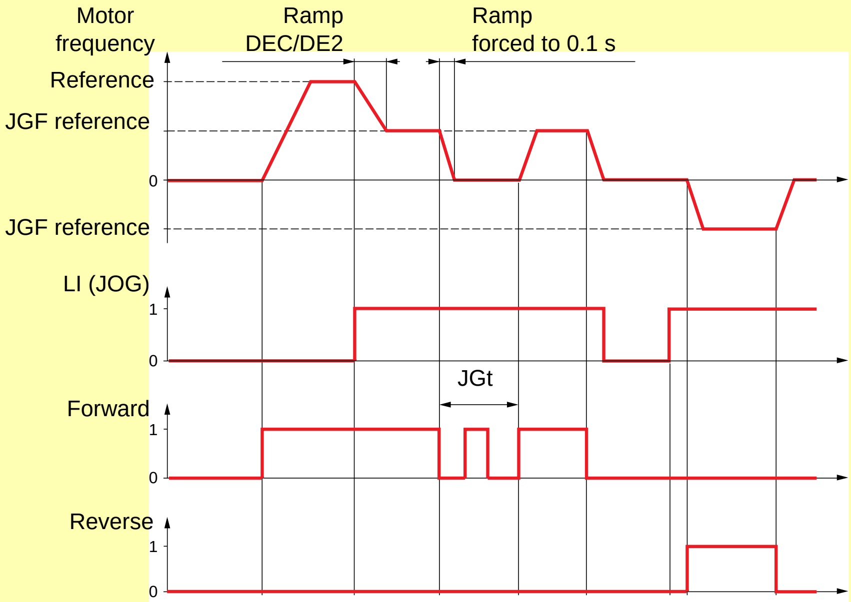
Parameter that can be modified during operation or when stopped.

Code	Name/Description		Adjustment range	Factory setting
	[AUTO DC INJECTION] (continued)			
tdC2	**[Auto DC inj. time 2]**	(1)	0 to 30 s	0 s
	2nd standstill injection time. The parameter can be accessed if [Auto DC injection] (AdC) = [Yes] (YES.)			

AdC	SdC2	Operation
YES	x	
Ct	≠ 0	
Ct	= 0	
Run command		
Speed		

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.

Parameter that can be modified during operation or when stopped.

Code	Name/Description		Adjustment range	Factory setting
JOG-	■ **[JOG]** **Note:** This function cannot be used with certain other functions. Follow the instructions on page 122.			
JOG	❑ **[JOG]** Pulse operation. **The JOG function is only active if the command channel and the reference channels are on the terminals.** Selecting the assigned logic input or bit activates the function.			[No] (nO)
nO	☐ **[No]** (nO): Not assigned			
LI1 - -	☐ **[LI1]** (LI1) to **[LI6]** (LI6) ☐ **[LI7]** (LI7) to **[LI10]** (LI10): If VW3A3201 logic I/O card has been inserted ☐ **[LI11]** (LI11) to **[LI14]** (LI14): If VW3A3202 extended I/O card has been inserted			
C101 - - -	☐ **[C101]** (C101) to **[C115]** (C115): With integrated Modbus in [I/O profile] (IO) configuration ☐ **[C201]** (C201) to **[C215]** (C215): With integrated CANopen in [I/O profile] (IO) configuration ☐ **[C301]** (C301) to **[C315]** (C315): With a communication card in [I/O profile] (IO) configuration ☐ **[C401]** (C401) to **[C415]** (C415): With a Controller Inside card in [I/O profile] (IO) configuration			
Cd00 -	☐ **[CD00]** (Cd00) to **[CD13]** (Cd13): In [I/O profile] (IO) configuration can be switched with possible logic inputs ☐ **[CD14]** (Cd14) to **[CD15]** (Cd15): In [I/O profile] (IO) configuration can be switched without logic inputs The function is active when the assigned input or bit is at 1. Example: 2-wire control operation (tCC = 2C) 			
JGF ()	❑ **[Jog frequency]** The parameter can be accessed if [JOG] (JOG) is not [No] (nO) or if a function key has been assigned to JOG (see page 120). Reference in jog operation	(1)	0 to 10 Hz	10 Hz
JGt ()	❑ **[Jog delay]** The parameter can be accessed if [JOG] (JOG) is not [No] (nO) or if a function key has been assigned to JOG (see page 120). Anti-repeat delay between 2 consecutive jog operations.	(1)	0 to 2.0 s	0.5 s

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.

()	Parameter that can be modified during operation or when stopped.

Preset speeds

2, 4 or 8 speeds can be preset, requiring 1, 2 or 3 logic inputs respectively.

Note: **You must configure 2 and 4 speeds in order to obtain 4 speeds.**
You must configure 2, 4 and 8 speeds in order to obtain 8 speeds.

Combination table for preset speed inputs

8 speeds LI (PS8)	4 speeds LI (PS4)	2 speeds LI (PS2)	Speed reference
0	0	0	Reference (1)
0	0	1	SP2
0	1	0	SP3
0	1	1	SP4
1	0	0	SP5
1	0	1	SP6
1	1	0	SP7
1	1	1	SP8

(1) See the diagram on page 110: Reference 1 = (SP1).

Code	Name/Description	Adjustment range	Factory setting
PSS-	■ **[PRESET SPEEDS]** **Note:** This function cannot be used with certain other functions. Follow the instructions on page 122.		
PS2	❑ **[2 preset speeds]**		[No] (nO)
nO	☐ **[No]** (nO): Function inactive		
LI1 - - -	☐ **[LI1]** (LI1) : : ☐ **[...]** (...): See the assignment conditions on page 116.		
PS4	❑ **[4 preset speeds]**		[No] (nO)
nO	☐ **[No]** (nO): Function inactive		
LI1 - - -	☐ **[LI1]** (LI1) : : ☐ **[...]** (...): See the assignment conditions on page 116. To obtain 4 speeds you must also configure 2 speeds.		
PS8	❑ **[8 preset speeds]**		[No] (nO)
nO	☐ **[No]** (nO): Function inactive		
LI1 - - -	☐ **[LI1]** (LI1) : : ☐ **[...]** (...): See the assignment conditions on page 116. To obtain 8 speeds you must also configure 2 and 4 speeds.		

Code	Name/Description	Adjustment range	Factory setting
	■ **[PRESET SPEEDS]** (continued) The appearance of these [Preset speed x] (SPx) parameters is determined by the number of speeds configured.		
SP2	❑ **[Preset speed 2]** (1)	0 to 500 or 1,000 Hz according to rating	10 Hz
SP3	❑ **[Preset speed 3]** (1)		15 Hz
SP4	❑ **[Preset speed 4]** (1)		20 Hz
SP5	❑ **[Preset speed 5]** (1)		25 Hz
SP6	❑ **[Preset speed 6]** (1)		30 Hz
SP7	❑ **[Preset speed 7]** (1)		35 Hz
SP8	❑ **[Preset speed 8]** (1) The factory setting changes to 60 Hz if [Standard mot. freq] (bFr) = [60Hz NEMA] (60).		50 Hz

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.

Parameter that can be modified during operation or when stopped.

+/- speed

Two types of operation are available.

1. **Use of single-press buttons:** Two logic inputs are required in addition to the operating direction(s).
   The input assigned to the "+ speed" command increases the speed, the input assigned to the "- speed" command decreases the speed.

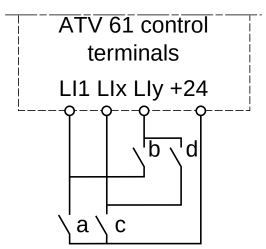
2. **Use of double-press buttons:** Only one logic input assigned to "+ speed" is required.

+/- speed with double-press buttons:

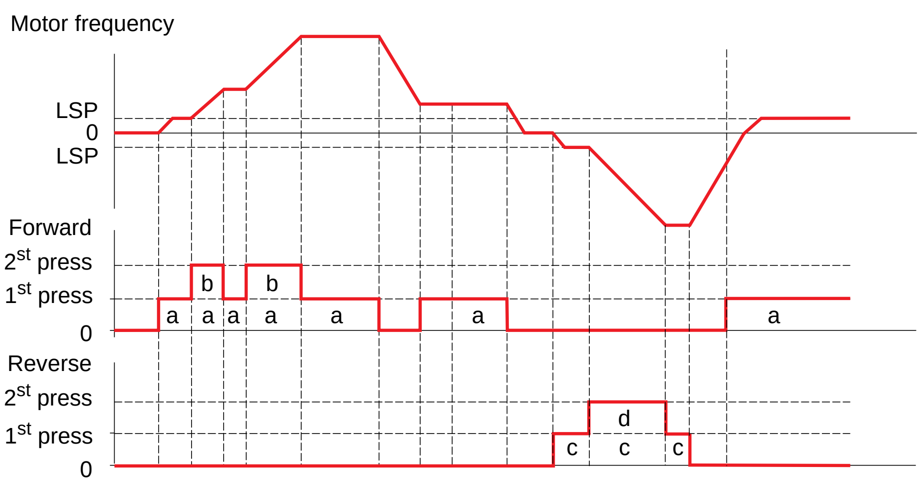
Description: 1 button pressed twice (2 steps) for each direction of rotation. A contact closes each time the button is pressed.

	Released (- speed)	1st press (speed maintained)	2nd press (faster)
Forward button	–	a	a and b
Reverse button	–	c	c and d

Example of wiring:



LI1: forward
LIx: reverse
LIy: + speed



Do not use this +/-speed type with 3-wire control.

Whichever type of operation is selected, the max. speed is set by [High speed] (HSP) (see page 37).

Note:
If the reference is switched via rFC (see page 118) from any one reference channel to another reference channel with "+/- speed", the value of reference rFr (after ramp) may be copied at the same time in accordance with the [Copy channel 1 --> 2] (COP) parameter, see page 119.
If the reference is switched via rFC (see page 118) from one reference channel to any other reference channel with "+/- speed", the value of reference rFr (after ramp) is always copied at the same time.

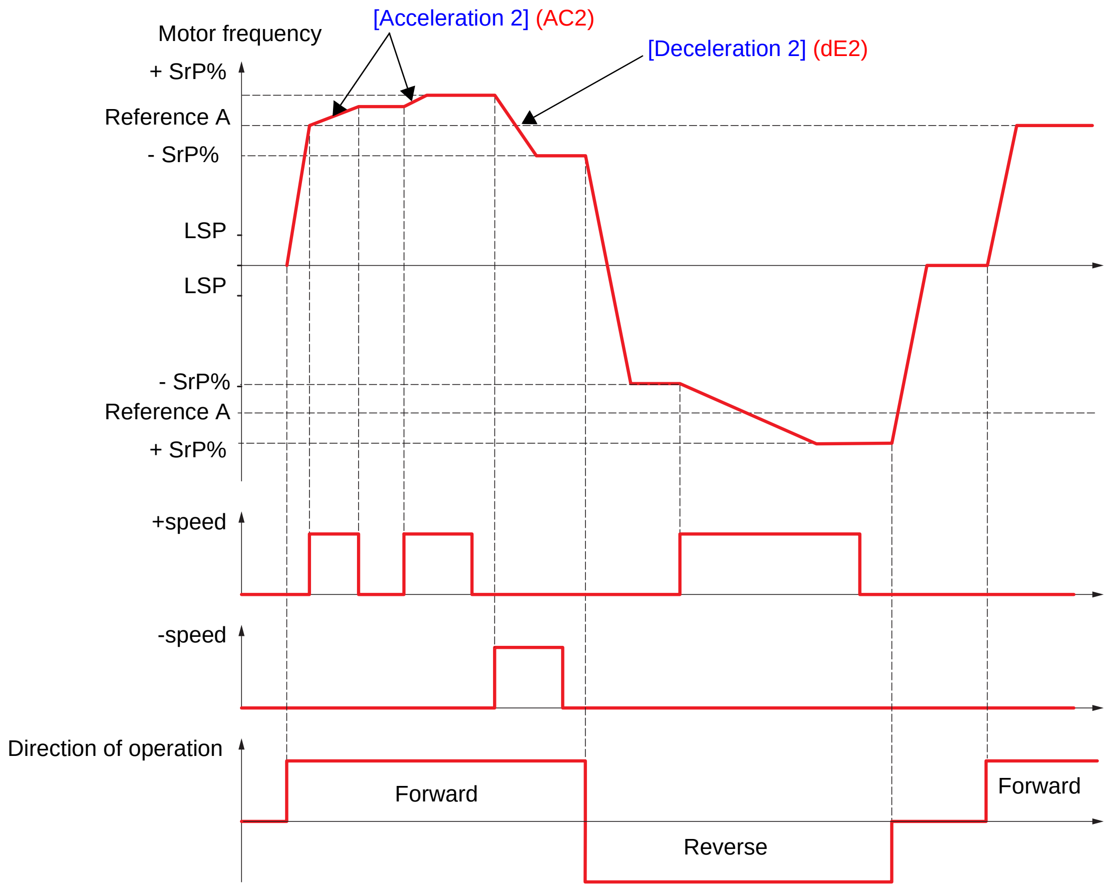
This prevents the speed being incorrectly reset to zero when switching takes place.

Code	Name/Description	Adjustment range	Factory setting
UPd-	■ **[+/-Speed]** Function can be accessed if reference channel [Ref.2 channel] (Fr2) = [+/-Speed] (UPdt) see page 118. **Note:** This function cannot be used with certain other functions. Follow the instructions on page 122.		
USP nO LI1 - - C101 - - - Cd00 -	❑ **[+ speed assignment]** ☐ **[No]** (nO): Function inactive ☐ **[LI1]** (LI1) to **[LI6]** (LI6) ☐ **[LI7]** (LI7) to **[LI10]** (LI10): If VW3A3201 logic I/O card has been inserted ☐ **[LI11]** (LI11) to **[LI14]** (LI14): If VW3A3202 extended I/O card has been inserted ☐ **[C101]** (C101) to **[C115]** (C115): With integrated Modbus in [I/O profile] (IO) ☐ **[C201]** (C201) to **[C215]** (C215): With integrated CANopen in [I/O profile] (IO) ☐ **[C301]** (C301) to **[C315]** (C315): With a communication card in [I/O profile] (IO) ☐ **[C401]** (C401) to **[C415]** (C415): With a Controller Inside card in [I/O profile] (IO) ☐ **[CD00]** (Cd00) to **[CD13]** (Cd13): In [I/O profile] (IO) can be switched with possible logic inputs ☐ **[CD14]** (Cd14) to **[CD15]** (Cd15): In [I/O profile] (IO) can be switched without logic inputs Function active if the assigned input or bit is at 1.		[No] (nO)
dSP nO LI1 - - C101 - - - Cd00 -	❑ **[-Speed assignment]** ☐ **[No]** (nO): Function inactive ☐ **[LI1]** (LI1) to **[LI6]** (LI6) ☐ **[LI7]** (LI7) to **[LI10]** (LI10): If VW3A3201 logic I/O card has been inserted ☐ **[LI11]** (LI11) to **[LI14]** (LI14): If VW3A3202 extended I/O card has been inserted ☐ **[C101]** (C101) to **[C115]** (C115): With integrated Modbus in [I/O profile] (IO) ☐ **[C201]** (C201) to **[C215]** (C215): With integrated CANopen in [I/O profile] (IO) ☐ **[C301]** (C301) to **[C315]** (C315): With a communication card in [I/O profile] (IO) ☐ **[C401]** (C401) to **[C415]** (C415): With a Controller Inside card in [I/O profile] (IO) ☐ **[CD00]** (Cd00) to **[CD13]** (Cd13): In [I/O profile] (IO) can be switched with possible logic inputs ☐ **[CD14]** (Cd14) to **[CD15]** (Cd15): In [I/O profile] (IO) can be switched without logic inputs Function active if the assigned input or bit is at 1.		[No] (nO)
Str nO rAM EEP	❑ **[Reference saved]** Associated with the "+/- speed" function, this parameter can be used to save the reference: • When the run commands disappear (saved to RAM) • When the line supply or the run commands disappear (saved to EEPROM) Therefore, the next time the drive starts up, the speed reference is the last reference saved. ☐ **[No]** (nO): No save (the next time the drive starts up, the speed reference is [Low speed] (LSP), see page 37) ☐ **[RAM]** (rAM): Save to RAM ☐ **[EEprom]** (EEP): Save to EEPROM		[No] (nO)

+/- speed around a reference

The reference is given by Fr1 or Fr1b with summing/subtraction/multiplication functions and preset speeds if relevant (see the diagram on page 110). For improved clarity, we will call this reference A. The action of the +speed and -speed buttons can be set as a % of this reference A. On stopping, the reference (A +/- speed) is not saved, so the drive restarts with reference A only.
The maximum total reference is always limited by [High speed] (HSP) and the minimum reference by [Low speed] (LSP), see page 37.

Example of 2-wire control:



Code	Name/Description	Adjustment range	Factory setting
SrE-	**[+/-SPEED AROUND REF.]** The function can be accessed for reference channel [Ref.1 channel] (Fr1). **Note:** This function cannot be used with certain other functions. Follow the instructions on page 122.		
US1	**[+ speed assignment]**		[No] (nO)
nO	[No] (nO): Function inactive		
LI1 - - -	[LI1] (LI1) : : [...] (...): See the assignment conditions on page 116. Function active if the assigned input or bit is at 1.		
dS1	**[-Speed assignment]**		[No] (nO)
nO	[No] (nO): Function inactive		
LI1 - - -	[LI1] (LI1) : : [...] (...): See the assignment conditions on page 116. Function active if the assigned input or bit is at 1.		
SrP ()	**[+/-Speed limitation]** This parameter limits the variation range with +/- speed as a % of the reference. The ramps used in this function are [Acceleration 2] (AC2) and [Deceleration 2] (dE2). The parameter can be accessed if +/- speed is assigned.	0 to 50%	10%
AC2 ()	**[Acceleration 2]** (1) Time to accelerate from 0 to the [Rated motor freq.] (FrS). Make sure that this value is compatible with the inertia being driven. The parameter can be accessed if +/- speed is assigned.	0.01 to 9,000 s (2)	5.0 s
dE2 ()	**[Deceleration 2]** (1) Time to decelerate from the [Rated motor freq.] (FrS) to 0. Make sure that this value is compatible with the inertia being driven. The parameter can be accessed if +/- speed is assigned.	0.01 to 9,000 s (2)	5.0 s

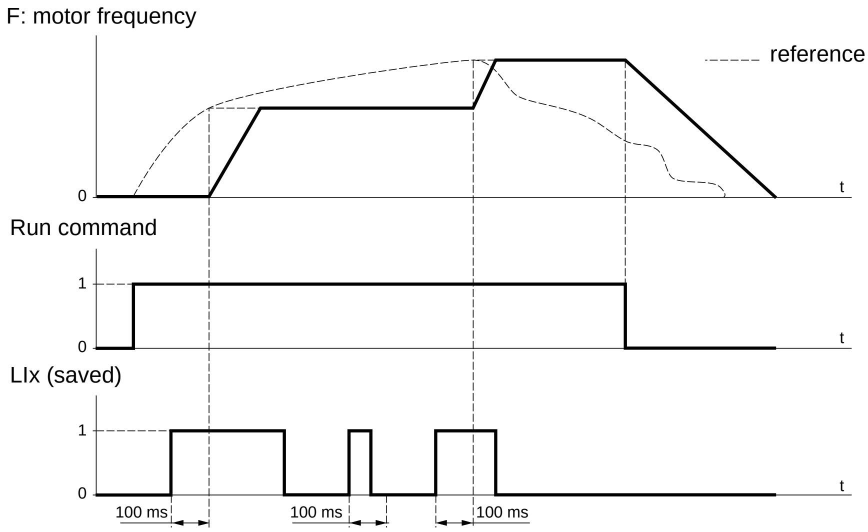
(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.
(2) Range 0.01 to 99.99 s or 0.1 to 999.9 s or 1 to 9,000 s according to [Ramp increment] (Inr) page 129.

() Parameter that can be modified during operation or when stopped.

Reference saving:

Saving a speed reference value using a logic input command lasting longer than 0.1 s.

- This function is used to control the speed of several drives alternately via a single analog reference and one logic input for each drive.
- It is also used to confirm a line reference (communication bus or network) on several drives via a logic input. This allows movements to be synchronized by getting rid of variations when the reference is sent.
- The reference is acquired 100 ms after the rising edge of the request. A new reference is not then acquired until a new request is made.



Code	Name/Description	Adjustment range	Factory setting
SPM-	■ **[MEMO REFERENCE]**		
SPM	❑ **[Ref. memo ass.]**		[No] (nO)
nO LI1 - LI14	☐ **[No]** (nO): Function inactive ☐ **[LI1]** (LI1) to **[LI6]** (LI6) ☐ **[LI7]** (LI7) to **[LI10]** (LI10): If VW3A3201 logic I/O card has been inserted ☐ **[LI11]** (LI11) to **[LI14]** (LI14): If VW3A3202 extended I/O card has been inserted Assignment to a logic input. Function active if the assigned input is at 1.		

Code	Name/Description	Adjustment range	Factory setting
FLI-	**[FLUXING BY LI]**		
FLU	**[Motor fluxing]**	(1)	[No] (FnO)
FnC	**[Not cont.]** (FnC): Non-continuous mode		
FCt	**[Continuous]** (FCt): Continuous mode. This option is not possible if [Auto DC injection] (AdC) page 135 is [Yes] (YES) or if [Type of stop] (Stt) page 133 is [Freewheel] (nSt).		
FnO	**[No]** (FnO): Function inactive At and above ATV61HD55M3X, ATV61HD90N4 and ATV61HC11Y, if [Motor control type] (Ctt) page 67 = [SVC V] (UUC) or [Energy Sav.] (nLd), this selection cannot be made and the factory setting is replaced by [Not cont.] (FnC). If [Motor control type] (Ctt) = [Sync. mot.] (SYn) the factory setting is replaced by [Not cont.] (FnC). In order to obtain rapid high torque on startup, magnetic flux needs to already have been established in the motor. • In [Continuous] (FCt) mode, the drive automatically builds up flux when it is powered up. • In [Not cont.] (FnC) mode, fluxing occurs when the motor starts up. The flux current is greater than nCr (configured rated motor current) when the flux is established and is then adjusted to the motor magnetizing current... **CAUTION** Check that the motor will withstand this current without overheating. **Failure to follow these instructions can result in equipment damage.** If [Motor control type] (Ctt) page 67 = [Sync. mot.] (SYn), the [Motor fluxing] (FLU) parameter causes the alignment of the motor and not the fluxing.		
FLI	**[Fluxing assignment]**		[No] (nO)
nO	**[No]** (nO): Function inactive		
LI1	**[LI1]** (LI1)		
-	:		
-	:		
-	**[...]** (...): See the assignment conditions on page 116. Assignment is only possible if [Motor fluxing] (FLU) is not [Continuous] (FCt). • In [Not cont.] (FnC) mode: - If an LI or a bit is assigned to the motor fluxing command, flux is built up when the assigned input or bit is at 1. - If an LI or a bit has not been assigned, or if the LI or bit assigned is at 0 when a run command is sent, fluxing occurs when the motor starts. • In [No] (FnO) mode: - If an LI or a bit is assigned to the motor fluxing command, flux is built up when the assigned input or bit is at 1 and is suppressed when the assigned input or bit is at 0.		

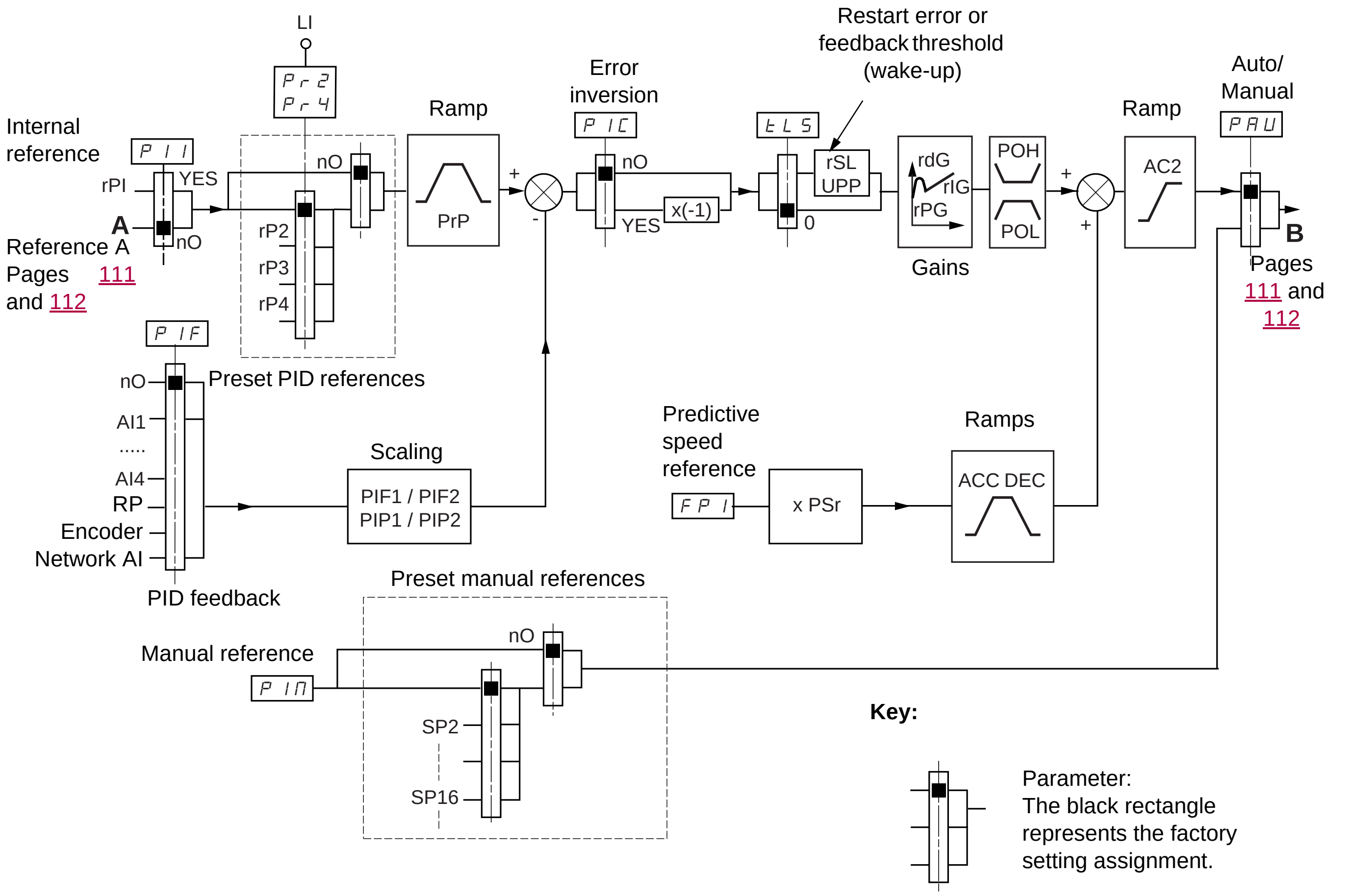
(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.

Parameter that can be modified during operation or when stopped.

PID regulator

Block diagram

The function is activated by assigning an analog input to the PID feedback (measurement).



PID feedback:
The PID feedback must be assigned to one of the analog inputs AI1 to AI4, to the frequency input or the encoder, according to whether any extension cards have been inserted.

PID reference:
The PID reference must be assigned to the following parameters:
- Preset references via logic inputs (rP2, rP3, rP4)
- In accordance with the configuration of [Act. internal PID ref.] (PII) pages 151:
  - Internal reference (rPI) or
  - Reference A (Fr1 or Fr1b, see page 111)

Combination table for preset PID references

LI (Pr4)	LI (Pr2)	Pr2 = nO	reference
			rPI or A
0	0		rPI or A
0	1		rP2
1	0		rP3
1	1		rP4

A predictive speed reference can be used to initialize the speed on restarting the process.

How the various ramps work:
- ACC and dEC are only active in the event of changes in the predictive reference and not on starting PID regulation.
- AC2 affects the PID output on starting PID regulation and on PID "wake-ups" only.
- PrP is only active in the event of changes in the PID reference.

Scaling of feedback and references:

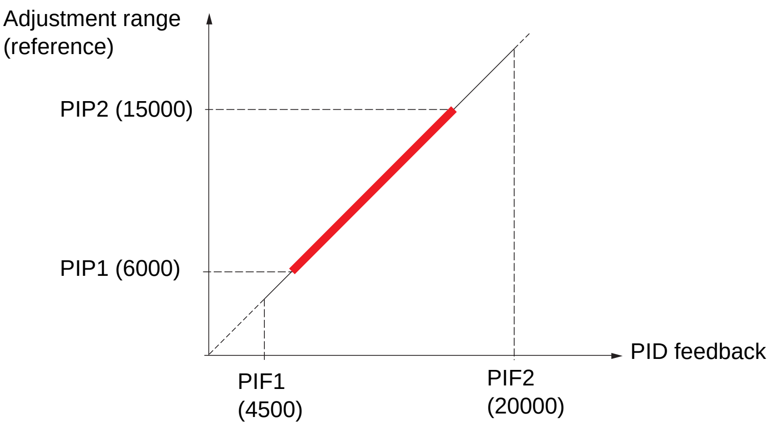
- PIF1, PIF2 parameters
  Can be used to scale the PID feedback (sensor range).
  This scale MUST be maintained for all other parameters.

- PIP1, PIP2 parameters
  Can be used to scale the adjustment range, i.e., the reference. **The adjustment range MUST be within the sensor range.**

  The scaling parameters must not exceed a value of 32767. To simplify setup, we recommend that you use values as close as possible to this maximum limit but remain within powers of 10 in respect of the actual values.

  Example (see the graph below): Adjustment of the volume in a tank, between 6 m^3 and 15 m^3.
  - Sensor used 4-20 mA, 4.5 m^3 for 4 mA, 20 m^3 for 20 mA, with the result that PIF1 = 4500 and PIF2 = 20000.
  - Adjustment range 6 to 15 m^3, with the result that PIP1 = 6000 (min. reference) and PIP2 = 15000 (max. reference).
  - Example references:
    - rP1 (internal reference) = 9,500
    - rp2 (preset reference) = 6,500
    - rP3 (preset reference) = 8,000
    - rP4 (preset reference) = 11,200

The [DISPLAY CONFIG.] menu can be used to customize the name of the unit displayed and its format.



Other parameters:

- rSL parameter:
  Can be used to set the PID error threshold, above which the PID regulator will be reactivated (wake-up) after a stop due to the max. time threshold being exceeded at low speed (tLS).

- Reversal of the direction of correction (PIC): If PIC = nO, the speed of the motor will increase when the error is positive, for example: pressure control with a compressor. If PIC = YES, the speed of the motor will decrease when the error is positive, for example: temperature control using a cooling fan.

- UPP parameter:
  If PIC = nO, can be used to set the PID feedback threshold, above which the PID regulator will be reactivated (wake-up) after a stop due to the max. time threshold being exceeded at low speed (tLS).
  If PIC = YES, can be used to set the PID feedback threshold, below which the PID regulator will be reactivated (wake-up) after a stop due to the max. time threshold being exceeded at low speed (tLS).

- The integral gain may be short-circuited by a logic input.

- An alarm on the PID feedback may be configured and indicated by a logic output.

- An alarm on the PID error may be configured and indicated by a logic output.

"Manual – Automatic" operation with PID

This function combines the PID regulator, the preset speeds and a manual reference. Depending on the state of the logic input, the speed reference is given by the preset speeds or by a manual reference input via the PID function.

Manual reference (PIM)
- Analog inputs AI1 to AI4
- Frequency input
- Encoder

Predictive speed reference (FPI)

- [AI1] (AI1): Analog input
- [AI2] (AI2): Analog input
- [AI3] (AI3): Analog input, if VW3A3202 extension card has been inserted
- [AI4] (AI4): Analog input, if VW3A3202 extension card has been inserted
- [RP] (PI): Frequency input, if VW3A3202 extension card has been inserted
- [Encoder] (PG): Encoder input, if encoder card has been inserted
- [HMI] (LCC): Graphic display terminal
- [Modbus] (Mdb): Integrated Modbus
- [CANopen] (CAn): Integrated CANopen
- [Com. card] (nEt): Communication card (if inserted)
- [Prog. card] (APP): Controller Inside card (if inserted)

Setting up the PID regulator

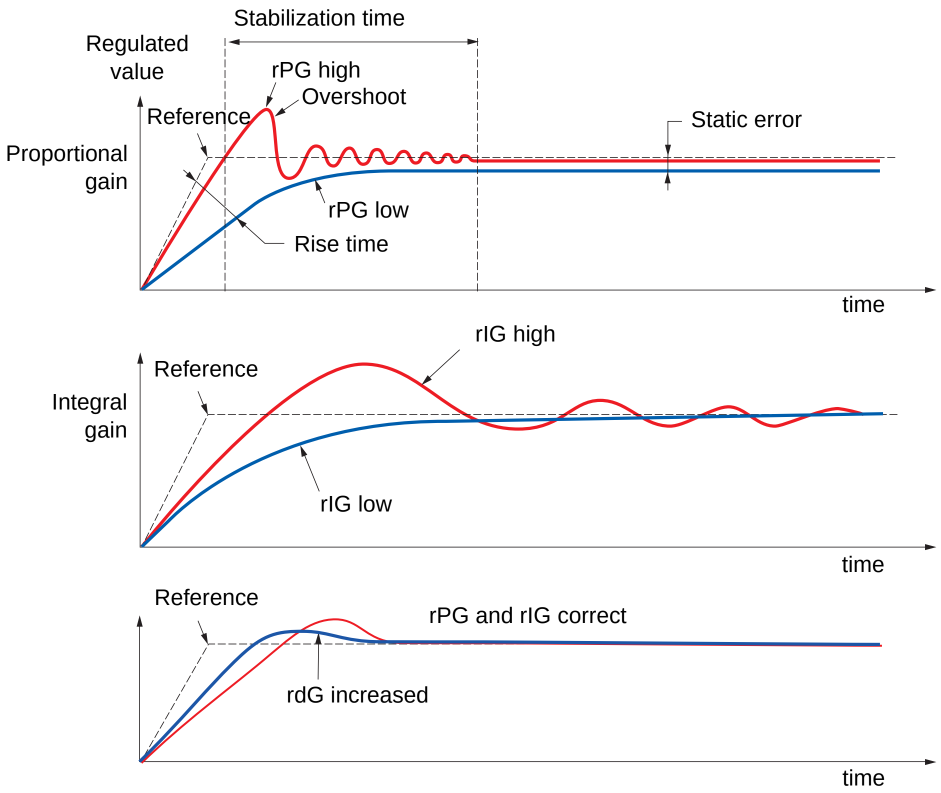
1. **Configuration in PID mode**
   See the diagram on page 147.

2. **Perform a test in factory settings mode (in most cases, this will be sufficient).**
   To optimize the drive, adjust rPG or rIG gradually and independently and observe the effect on the PID feedback in relation to the reference.

3. **If the factory settings are unstable or the reference is incorrect**

- Perform a test with a speed reference in Manual mode (without PID regulator) and with the drive on load for the speed range of the system:
  - In steady state, the speed must be stable and comply with the reference and the PID feedback signal must be stable.
  - In transient state, the speed must follow the ramp and stabilize quickly, and the PID feedback must follow the speed.
  If this is not the case, see the settings for the drive and/or sensor signal and wiring.

- Switch to PID mode.
- Set brA to no (no auto-adaptation of the ramp).
- Set the PID ramp (PrP) to the minimum permitted by the mechanism without triggering an ObF fault.
- Set the integral gain (rIG) to minimum.
- Leave the derivative gain (rdG) at 0.
- Observe the PID feedback and the reference.
- Switch the drive ON/OFF a number of times or vary the load or reference rapidly a number of times.
- Set the proportional gain (rPG) in order to ascertain the best compromise between response time and stability in transient phases (slight overshoot and 1 to 2 oscillations before stabilizing).
- If the reference varies from the preset value in steady state, gradually increase the integral gain (rIG), reduce the proportional gain (rPG) in the event of instability (pump applications), find a compromise between response time and static precision (see diagram).
- Lastly, the derivative gain may permit the overshoot to be reduced and the response time to be improved, although this will make it more difficult to obtain a compromise in terms of stability, as it depends on 3 gains.
- Perform in-production tests over the whole reference range.



The oscillation frequency depends on the system kinematics.

Parameter	Rise time	Overshoot	Stabilization time	Static error
rPG ↗	↘↘	↗	=	↘
rIG ↗	↘	↗↗	↗	↘↘
rdG ↗	=	↘	↘	=

Code	Name/Description	Adjustment range	Factory setting
PId-	■ **[PID REGULATOR]** **Note:** This function cannot be used with certain other functions. Follow the instructions on page 122.		
PIF	❑ **[PID feedback ass.]**		[No] (nO)
nO AI1 AI2 AI3 AI4 PI PG AIU1	☐ **[No]** (nO): Not assigned (function inactive) In this case, none of the function parameters can be accessed. ☐ **[AI1]** (AI1): Analog input ☐ **[AI2]** (AI2): Analog input ☐ **[AI3]** (AI3): Analog input, if VW3A3202 extension card has been inserted ☐ **[AI4]** (AI4): Analog input, if VW3A3202 extension card has been inserted ☐ **[RP]** (PI): Frequency input, if VW3A3202 extension card has been inserted ☐ **[Encoder]** (PG): Encoder input, if encoder card has been inserted ☐ **[Network AI]** (AIU1): Virtual input via communication bus. **Note :** If the equipment switches to forced local mode (see page 216), the virtual input remains frozen at the last value transmitted.		
AIC1	❑ **[AI net. channel]**		[No] (nO)
nO Mdb CAn nEt APP	The parameter can be accessed if [PID feedback ass.] (PIF) = [Network AI] (AIU1). This parameter can also be accessed in the [1.5 INPUTS / OUTPUTS CFG] (I-O-) menu. ☐ **[No]** (nO): Not assigned ☐ **[Modbus]** (Mdb): Integrated Modbus ☐ **[CANopen]** (CAn): Integrated CANopen ☐ **[Com. card]** (nEt): Communication card (if inserted) ☐ **[Prog. card]** (APP): Controller Inside card (if inserted)		
PIF1 ◯	❑ **[Min PID feedback]** (1) Value for minimum feedback. Adjustment range from 0 to [Max PID feedback] (PIF2) - 1 (2).		100
PIF2 ◯	❑ **[Max PID feedback]** (1) Value for maximum feedback Adjustment range from [Min PID feedback] (PIF1) + 1 to 32,767 (2).		1,000
PIP1 ◯	❑ **[Min PID reference]** (1) Minimum process value. Adjustment range between [Min PID feedback] (PIF1) and [Max PID feedback] (PIP2) - 1 (2).		150
PIP2 ◯	❑ **[Max PID reference]** (1) Maximum process value Adjustment range between [Min PID reference] (PIP1) + 1 to [Max PID reference] (PIF2) (2).		900
PII	❑ **[Act. internal PID ref.]**		[No] (nO)
nO YES	Internal PID regulator reference ☐ **[No]** (nO): The PID regulator reference is given by Fr1 or Fr1b with summing/subtraction/multiplication functions (see the diagram on page 110). ☐ **[Yes]** (YES): The PID regulator reference is internal via parameter rPI.		
rPI ◯	❑ **[Internal PID ref.]** Internal PID regulator reference This parameter can also be accessed in the [1.2 MONITORING] (SUP-) menu. Adjustment range between [Min PID reference] (PIP1) and [Max PID reference] (PIP2) (2).		150
rPG ◯	❑ **[PID prop. gain]** Proportional gain	0.01 to 100	1

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.
(2) If a graphic display terminal is not in use, values greater than 9,999 will be displayed on the 4-digit display with a period mark after the thousand digit, e.g., 15.65 for 15,650.

◯ Parameter that can be modified during operation or when stopped.

Code	Name/Description	Adjustment range	Factory setting
	■ **[PID REGULATOR]** (continued)		
rIG	❑ **[PID integral gain]** Integral gain	0.01 to 100	1
rdG	❑ **[PID derivative gain]** Derivative gain	0.00 to 100	0
PrP	❑ **[PID ramp]** (1) PID acceleration/deceleration ramp, defined to go from [Min PID reference] (PIP1) to [Max PID reference] (PIP2) and vice versa.	0 to 99.9 s	0 s
PIC nO YES	❑ **[PID correct. reverse]** ☐ **[No]** (nO) ☐ **[Yes]** (YES) Reversal of the direction of correction (PIC): If PIC = nO, the speed of the motor will increase when the error is positive. Example: pressure control with a compressor. If PIC = YES, the speed of the motor will decrease when the error is positive. Example: temperature control using a cooling fan.		[No] (nO)
POL	❑ **[Min PID output]** (1) Minimum value of regulator output in Hz	- 500 to 500 or -1,000 to 1,000 Hz according to rating	0 Hz
POH	❑ **[Max PID output]** (1) Maximum value of regulator output in Hz	0 to 500 or 1,000 Hz according to rating	60 Hz
PAL	❑ **[Min fbk alarm]** (1) Minimum regulator feedback monitoring threshold (alarm can be assigned to a relay or a logic output, page 94). Adjustment range from [Min PID feedback] (PIF1) to [Max PID feedback] (PIF2) (2).		100
PAH	❑ **[Max fbk alarm]** (1) Maximum regulator feedback monitoring threshold (alarm can be assigned to a relay or a logic output, page 94). Adjustment range from [Min PID feedback] (PIF1) to [Max PID feedback] (PIF2) (2).		1,000
PEr	❑ **[PID error Alarm]** (1) Regulator error monitoring threshold.	0 to 65,535 (2)	100
PIS nO LI1 - - -	❑ **[PID integral reset]** ☐ **[No]** (nO): Function inactive ☐ **[LI1]** (LI1) : : ☐ **[...]** (...): See the assignment conditions on page 116. If the assigned input or bit is at 0, the function is inactive (the PID integral is enabled). If the assigned input or bit is at 1, the function is active (the PID integral is disabled).		[No] (nO)

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.
(2) If a graphic display terminal is not in use, values greater than 9,999 will be displayed on the 4-digit display with a period mark after the thousand digit, e.g., 15.65 for 15,650.

Parameter that can be modified during operation or when stopped.

Code	Name/Description	Adjustment range	Factory setting
	■ **[PID REGULATOR]** (continued)		
FPI	❑ **[Speed ref. assign.]**		[No] (nO)
	PID regulator predictive speed input		
nO	❑ **[No]** (nO): Not assigned (function inactive)		
AI1	❑ **[AI1]** (AI1): Analog input		
AI2	❑ **[AI2]** (AI2): Analog input		
AI3	❑ **[AI3]** (AI3): Analog input, if VW3A3202 extension card has been inserted		
AI4	❑ **[AI4]** (AI4): Analog input, if VW3A3202 extension card has been inserted		
LCC	❑ **[HMI]** (LCC): Graphic display terminal		
Mdb	❑ **[Modbus]** (Mdb): Integrated Modbus		
CAn	❑ **[CANopen]** (CAn): Integrated CANopen		
nEt	❑ **[Com. card]** (nEt): Communication card (if inserted)		
APP	❑ **[Prog. card]** (APP): Controller Inside card (if inserted)		
PI	❑ **[RP]** (PI): Frequency input, if VW3A3202 extension card has been inserted		
PG	❑ **[Encoder]** (PG): Encoder input, if encoder card has been inserted		
PSr ⟳	❑ **[Speed input%]** (1)	1 to 100%	100%
	Multiplying coefficient for predictive speed input. The parameter cannot be accessed if [Speed ref. assign.] (FPI) = [No] (nO).		
PAU	❑ **[Auto/Manual assign.]**		[No] (nO)
nO	❑ **[No]** (nO): The PID is always active.		
LI1	❑ **[LI1]** (LI1)		
-	:		
-	:		
-	❑ **[...]** (...): See the assignment conditions on page 116. If the assigned input or bit is at 0, the PID is active. If the assigned input or bit is at 1, manual operation is active.		
AC2 ⟳	❑ **[Acceleration 2]** (1)	0.01 to 9000 s (2)	5.0 s
	Time to accelerate from 0 to the [Rated motor freq.] (FrS). Make sure that this value is compatible with the inertia being driven. Ramp AC2 is only active when the PID function is starting up and in the event of PID "wake-ups".		
PIM	❑ **[Manual reference]**		[No] (nO)
	Manual speed input. The parameter can be accessed if [Auto/Manual assign.] (PAU) is not [No] (nO).		
nO	❑ **[No]** (nO): Not assigned (function inactive)		
AI1	❑ **[AI1]** (AI1): Analog input		
AI2	❑ **[AI2]** (AI2): Analog input		
AI3	❑ **[AI3]** (AI3): Analog input, if VW3A3202 extension card has been inserted		
AI4	❑ **[AI4]** (AI4): Analog input, if VW3A3202 extension card has been inserted		
PI	❑ **[RP]** (PI): Frequency input, if VW3A3202 extension card has been inserted		
PG	❑ **[Encoder]** (PG): Encoder input, if encoder card has been inserted The preset speeds are active on the manual reference if they have been configured.		

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.
(2) Range 0.01 to 99.99 s or 0.1 to 999.9 s or 1 to 9000 s according to [Ramp increment] (Inr) page 129.

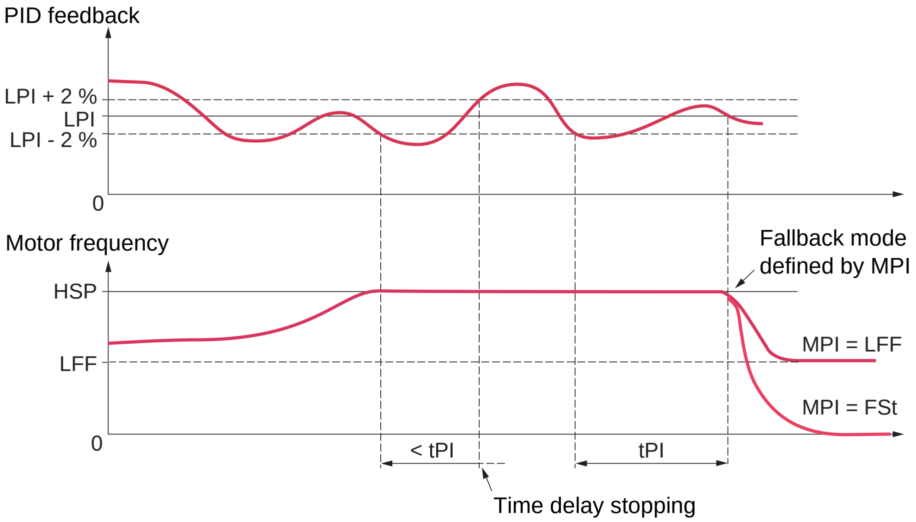
⟳ Parameter that can be modified during operation or when stopped.

PID feedback supervision

Used to define the operating mode in the event of detection of a PI feedback:

- Lower than the limit set if [PID correct. reverse] (PIC) = [No] (nO)
- Higher than the limit set if [PID correct. reverse] (PIC) = [Yes] (YES)

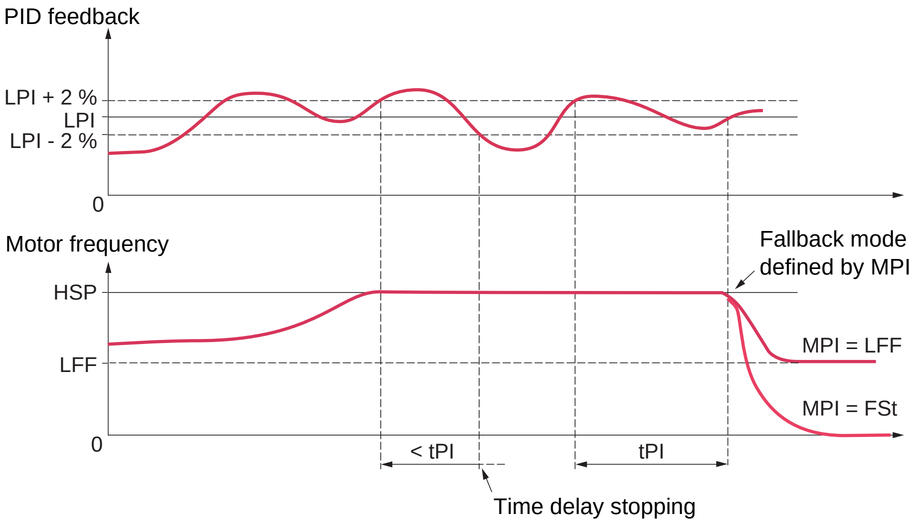
Where [PID correct. reverse] (PIC) = [No] (nO)



If, once maximum speed has been reached ([High speed] (HSP)), the PID feedback is lower than the supervision threshold [PID Threshold] (LPI) -2%, a time delay tPI is launched. If at the end of this time delay the value of the PID feedback is still lower than the supervision threshold [PID Threshold] (LPI) + 2%, the drive switches to fallback mode as defined by parameter MPI.

In all cases the drive reverts to PID regulation mode as soon as the PID feedback exceeds the supervision threshold [PID Threshold] (LPI) +2%.

Where [PID correct. reverse] (PIC) = [Yes] (YES)



If, once maximum speed has been reached ([High speed] (HSP)), the PID feedback is higher than the supervision threshold [PID Threshold] (LPI) +2%, a time delay tPI is launched. If at the end of this time delay the value of the PID feedback is still higher than the supervision threshold [PID Threshold] (LPI) -2%, the drive switches to fallback mode as defined by parameter MPI.

In all cases the drive reverts to PID regulation mode as soon as the PID feedback undershoots the supervision threshold [PID Threshold] (LPI) -2%.

Code	Name/Description	Adjustment range	Factory setting
	■ **[PID REGULATOR]** (continued)		
LPI	❑ **[PID Threshold]** (1) PID regulator feedback supervision threshold (alarm can be assigned to a relay or a logic output, page 94). Adjustment range:		100
nO	☐ **[No]** (nO): Function inactive (it will not be possible to access the other function parameters)		
-	☐ between [Min PID feedback] (PIF1) and [Max PID feedback] (PIF2) (2).		
tPI	❑ **[PID Ctrl. time delay]** (1) PID regulator feedback supervision time delay	0 to 600 s	0 s
MPI	❑ **[PID Control Mngmt]** Type of stop for PID regulator feedback supervision fault.		[Ignore] (nO)
nO	☐ **[Ignore]** (nO): Fault ignored		
YES	☐ **[Freewheel]** (YES): Freewheel stop.		
LFF	☐ **[fallback spd]** (LFF): Switch to fallback speed, maintained as long as the fault is present and the run command is not disabled (3).		
rMP	☐ **[Ramp stop]** (rMP): Stop on ramp		
FSt	☐ **[Fast stop]** (FSt): Fast stop		
LFF	❑ **[Fallback speed]** Fallback speed for PID regulator feedback supervision fault.	0 to 500 or 1,000 Hz according to rating	0 Hz

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.
(2) If a graphic display terminal is not in use, values greater than 9,999 will be displayed on the 4-digit display with a period mark after the thousand digit, e.g., 15.65 for 15,650.
(3) Because, in this case, the fault does not trigger a stop, it is essential to assign a relay or logic output to its indication.

Parameter that can be modified during operation or when stopped.

Code	Name/Description	Adjustment range	Factory setting
Pr I-	**[PID PRESET REFERENCES]** Function can be accessed if [PID feedback ass.] (PIF) is assigned.		
Pr2	**[2 preset PID ref.]**		[No] (nO)
nO LI1 - - -	**[No]** (nO): Function inactive **[LI1]** (LI1) : : **[...]** (...): See the assignment conditions on page 116. If the assigned input or bit is at 0, the function is inactive. If the assigned input or bit is at 1, the function is active.		
Pr4	**[4 preset PID ref.]**		[No] (nO)
nO LI1 - - -	Make sure that [2 preset PID ref.] (Pr2) has been assigned before assigning this function. **[No]** (nO): Function inactive **[LI1]** (LI1) : : **[...]** (...): See the assignment conditions on page 116. If the assigned input or bit is at 0, the function is inactive. If the assigned input or bit is at 1, the function is active.		
rP2 ()	**[Preset ref. PID 2]** (1) The parameter can be accessed if [2 preset PID ref.] (Pr2) has been assigned. Adjustment range between [Min PID reference] (PIP1) and [Max PID reference] (PIP2) (2).		300
rP3 ()	**[Preset ref. PID 3]** (1) The parameter can be accessed if [2 preset PID ref.] (Pr2) and [4 preset PID ref.] (Pr4) have been assigned. Adjustment range between [Min PID reference] (PIP1) and [Max PID reference] (PIP2) (2).		600
rP4 ()	**[Preset ref. PID 4]** (1) The parameter can be accessed if [2 preset PID ref.] (Pr2) and [4 preset PID ref.] (Pr4) have been assigned. Adjustment range between [Min PID reference] (PIP1) and [Max PID reference] (PIP2) (2).		900

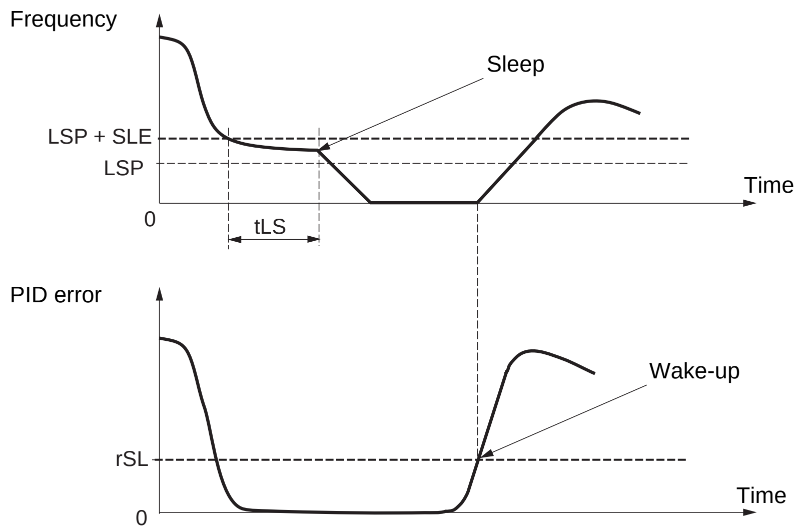
(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.
(2) If a graphic display terminal is not in use, values greater than 9,999 will be displayed on the 4-digit display with a period mark after the thousand digit, e.g., 15.65 for 15,650.

()	Parameter that can be modified during operation or when stopped.

Sleep/Wake-up

This function supplements the PID regulator, in order to avoid prolonged operation at excessively low speeds when neither useful nor desirable.

- It stops the motor after a period of operation at reduced speed. This time and speed can be adjusted.
- It restarts the motor if the PID error or feedback exceeds an adjustable threshold.



Sleep:

Following operation at a speed less than [Low speed] (LSP) + [Sleep Offset Thres.] (SLE) for a period of time greater than or equal to [Low speed time out] (tLS), the motor is stopped on a ramp.

Wake-up:

If the PID error exceeds [PID wake up thresh.] (rSL) (see the example opposite) or if the PID feedback exceeds [PID Wakeup Thres.] (UPP), the PID regulator is reactivated.

Code	Name/Description	Adjustment range	Factory setting
SrM-	**[SLEEPING / WAKE UP]**		
tLS	**[Low speed time out]** (1) Maximum operating time at [Low speed] (LSP). Following operation at LSP + SLE for a defined period, a motor stop is requested automatically. The motor restarts if the reference exceeds (LSP + SLE) and if a run command is still present. Caution: Value 0 corresponds to an unlimited period. **Note:** If [Low speed time out] (tLS) is not 0, [Type of stop] (Stt) page 133 is forced to [Ramp stop] (rMP) (only if a ramp stop can be configured).	0 to 999.9 s	0 s
LSP	**[Low speed]** (1) Motor frequency at minimum reference, can be set between 0 and [High speed] (HSP) (see page 49).		0 Hz
SLE	**[Sleep Offset Thres.]** (1) Adjustable restart threshold (offset) following a stop after prolonged operation at [Low speed] (LSP) + [Sleep Offset Thres.] (SLE), in Hz. The motor restarts if the reference rises above (LSP + SLE) and if a run command is still present.	0 to 500 or 1,000 Hz according to rating	1 Hz
rSL	**[PID wake up thresh.]** If the "PID" and "Low speed operating time" tLS functions are configured at the same time, the PID regulator may attempt to set a speed lower than LSP. This results in unsatisfactory operation, which consists of starting, operating at low speed then stopping, and so on… Parameter rSL (restart error threshold) can be used to set a minimum PID error threshold for restarting after a stop at prolonged LSP. The function is inactive if the PID function has not been configured or if tLS = 0 or if rSL = 0. **WARNING** **UNINTENDED EQUIPMENT OPERATION** Check that unintended restarts will not present any danger. **Failure to follow these instructions can result in death or serious injury.** Adjustment range from 0.0 to [Max PID feedback] (PIF2) (2).		0

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.
(2) If a graphic display terminal is not in use, values greater than 9,999 will be displayed on the 4-digit display with a period mark after the thousand digit, e.g., 15.65 for 15,650.

Parameter that can be modified during operation or when stopped.

Code	Name/Description	Adjustment range	Factory setting
UPP	❑ **[PID Wakeup Thres.]**		[No] (nO)
	If the “PID” and “Low speed operating time” tLS functions are configured at the same time, the PID regulator may attempt to set a speed lower than LSP. This results in unsatisfactory operation, which consists of starting, operating at low speed then stopping, and so on… Parameter UPP (restart feedback threshold) can be used to set a PID feedback threshold for restarting after a stop due to prolonged LSP. This threshold is minimum if [PID correct. reverse] (PIC) = [No] (nO) and maximum if [PID correct. reverse] (PIC) = [Yes] (YES) The function is inactive if the PID function has not been configured or if tLS = 0 or if UPP = [No] (nO) or if rSL is active (not 0). **⚠ WARNING** **UNINTENDED EQUIPMENT OPERATION** Check that unintended restarts will not present any danger. **Failure to follow these instructions can result in death or serious injury.** Adjustment range: [No] (nO) or between [Min PID feedback] (PIF1) and [Max PID feedback] (PIF2) (2).		

(1) If a graphic display terminal is not in use, values greater than 9,999 will be displayed on the 4-digit display with a period mark after the thousand digit, e.g., 15.65 for 15,650.

Sleeping on the basis of flow detection

Parameters can be accessed in [Expert] mode.

This function is only active when the motor frequency is less than [NoFlo.Freq.Thres.Ac.] (FFd).
This function is used in applications where zero flow cannot be detected by the sleep function alone. At periodic intervals (based on time [No Flow Period Det.] (nFd)), it forces the drive's frequency reference to [Low speed] (LSP) + [No Flow Offset] (LFd) in order to test for zero flow.

Set the sleep function so that the drive switches to sleep mode when zero flow is detected ([No Flow Offset] (LFd) ⩽ [Sleep Offset Thres.] (SLE) page 158).

The test can be carried out at underpressure or overpressure as appropriate for the type of installation.

Test at underpressure: (LSP + LFd) < FFd

- If the request is still present, the PID regulator error increases (at underpressure), causing the drive to restart at its previous speed above the sleep threshold.

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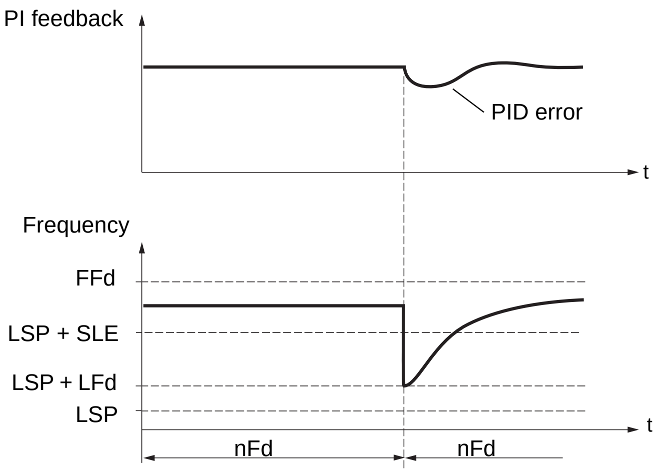

- If the request is no longer present (zero flow), the PID regulator error will not increase, and the speed will remain below the sleep threshold, thereby inducing a stop.

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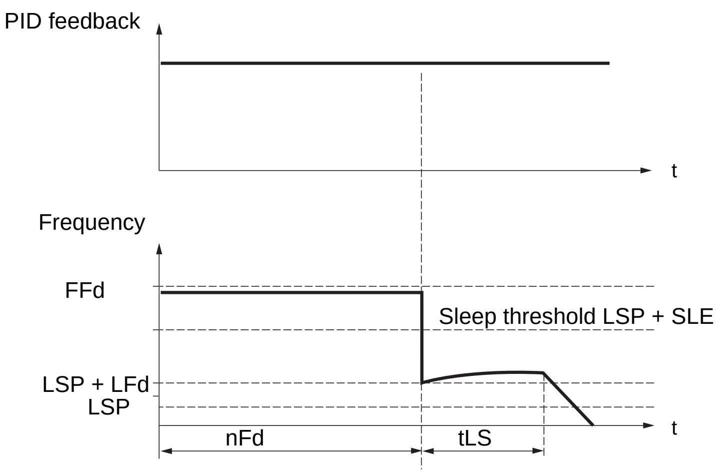

Test at overpressure: (LSP + LFd) > FFd

- If the request is still present, the PID regulator error increases (at overpressure), causing the drive to decelerate. If flow is detected, the speed will stabilize at its previous level, above the sleep threshold.

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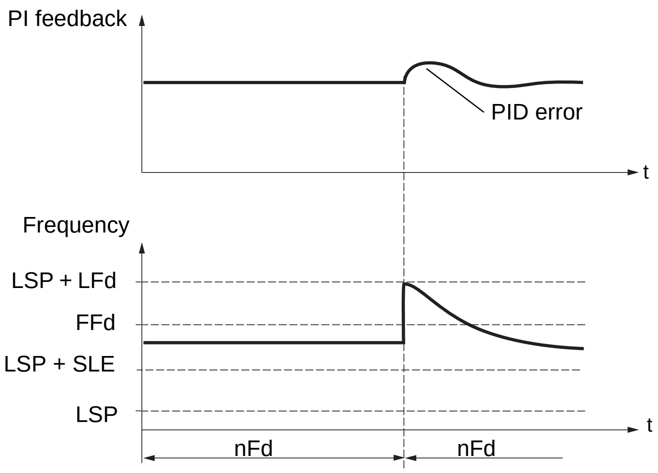

- If the request is no longer present (zero flow), the PID regulator error increases (at overpressure), causing the drive to decelerate. The absence of flow maintains the overpressure and the speed falls below the sleep threshold, causing the drive to stop.

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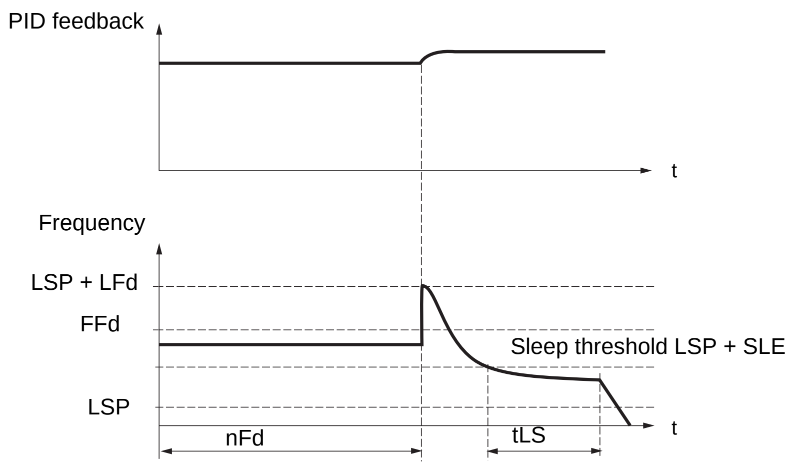


Parameters can be accessed in [Expert] mode.

Code	Name/Description	Adjustment range	Factory setting
	[SLEEPING / WAKE UP] (continued)		
nFd	**[No Flow Period Det.]** Zero flow detection interval, in minutes. The parameter can be accessed if [PID feedback ass.] (PIF) is not [No] (nO).	0 to 20 min	0 min
FFd ()	**[NoFlo.Freq.Thres.Ac.]** (1) Zero flow detection activation threshold The parameter can be accessed if [PID feedback ass.] (PIF) is not [No] (nO) and if [No Flow Period Det.] (nFd) is not 0.	0 to 500 or 1,000 Hz according to rating	0 Hz
LFd ()	**[No Flow Offset]** (1) Zero flow detection offset The parameter can be accessed if [PID feedback ass.] (PIF) is not [No] (nO) and if [No Flow Period Det.] (nFd) is not 0.	0 to 500 or 1,000 Hz according to rating	0 Hz

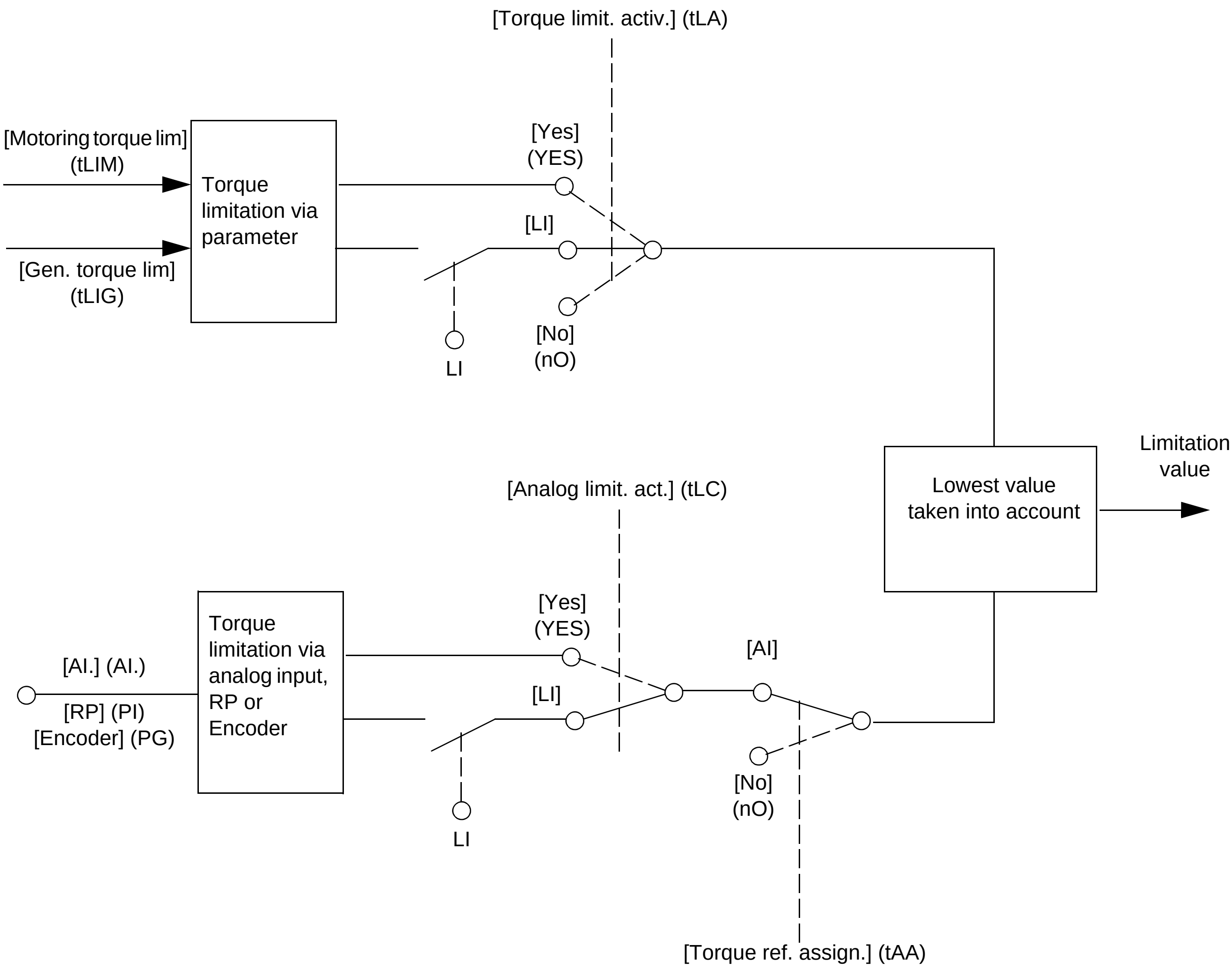
(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.

() Parameter that can be modified during operation or when stopped.

Torque limitation

There are two types of torque limitation:
- With a value that is fixed by a parameter
- With a value that is set by an analog input (AI, pulse or encoder)

If both types are enabled, the lowest value is taken into account. The two types of limitation can be configured or switched remotely using a logic input or via the communication bus.



Code	Name/Description	Adjustment range	Factory setting
tOL-	■ **[TORQUE LIMITATION]** This function cannot be accessed in V/F profile mode.		
tLA nO YES LI1 - - -	❑ **[Torque limit. activ.]** ☐ **[No]** (nO): Function inactive ☐ **[Yes]** (YES): Function always active ☐ **[LI1]** (LI1) : : ☐ **[...]** (...): See the assignment conditions on page 116. If the assigned input or bit is at 0, the function is inactive. If the assigned input or bit is at 1, the function is active.		[No] (nO)
IntP 0.1 1	❑ **[Torque increment]** The parameter cannot be accessed if [Torque limit. activ.] (tLA) = [No] (nO). Selection of units for the [Motoring torque lim] (tLIM) and [Gen. torque lim] (tLIG) parameters ☐ **[0.1%]** (0.1): 0.1% unit ☐ **[1%]** (1): 1% unit		[1%] (1)
tLIM	❑ **[Motoring torque lim]** (1) The parameter cannot be accessed if [Torque limit. activ.] (tLA) = [No] (nO) Torque limitation in motor mode, as a whole % or in 0.1% increments of the rated torque in accordance with the [Torque increment] (IntP) parameter.	0 to 300%	100%
tLIG	❑ **[Gen. torque lim]** (1) The parameter cannot be accessed if [Torque limit. activ.] (tLA) = [No] (nO) Torque limitation in generator mode, as a whole % or in 0.1% increments of the rated torque in accordance with the [Torque increment] (IntP) parameter.	0 to 300%	100%
tAA nO AI1 - AI4 PI PG AIU1	❑ **[Torque ref. assign.]** If the function is assigned, the limitation varies between 0% and 300% of the rated torque on the basis of the 0% to 100% signal applied to the assigned input. Examples: - 12 mA on a 4-20 mA input results in limitation to 150% of the rated torque. - 2.5 V on a 10 V input results in 75% of the rated torque. ☐ **[No]** (nO): Not assigned (function inactive) ☐ **[AI1]** (AI1) to **[AI4]** (AI4): Analog input, if VW3A3202 I/O card has been inserted ☐ **[RP]** (PI): Frequency input, if VW3A3202 I/O card has been inserted ☐ **[Encoder]** (PG): Encoder input, if encoder card has been inserted ☐ **[Network AI]** (AIU1): Virtual input via communication bus, to be configured via [AI net. channel] (AIC1) page 89 **⚠ WARNING** **UNINTENDED EQUIPMENT OPERATION** If the equipment switches to forced local mode (see page 216), the virtual input remains frozen at the last value transmitted. Do not use the virtual input and forced local mode in the same configuration. **Failure to follow this instruction can result in death or serious injury.**		[No] (nO)

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.

Parameter that can be modified during operation or when stopped.

Code	Name/Description	Adjustment range	Factory setting
tLC	❑ **[Analog limit. act.]**		[Yes] (YES)
	The parameter can be accessed if [Torque ref. assign.] (tAA) is not [No] (nO).		
YES	☐ **[Yes]** (YES): The limitation depends on the input assigned by [Torque ref. assign.] (tAA).		
LI1	☐ **[LI1]** (LI1)		
-	:		
-	:		
-	☐ **[...]** (...): See the assignment conditions on page 116. If the assigned input or bit is at 0: • The limit is specified by the [Motoring torque lim] (tLIM) and [Gen. torque lim] (tLIG) parameters if [Torque limit. activ.] (tLA) is not [No] (nO). • No limitation if [Torque limit. activ.] (tLA) = [No] (nO). If the assigned input or bit is at 1: • The limitation depends on the input assigned by [Torque ref. assign.] (tAA). **Note:** If [Torque limitation] (tLA) and [Torque ref. assign.] (tAA) are enabled at the same time, the lowest value will be taken into account.		

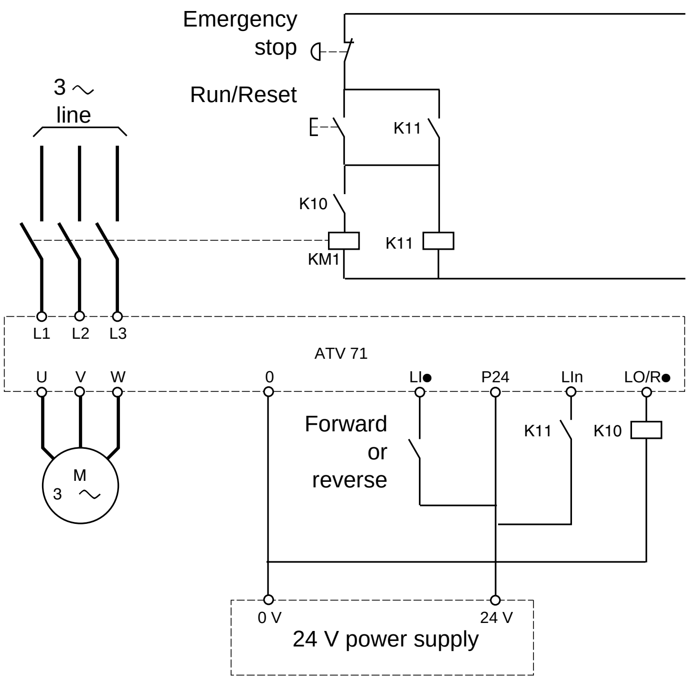
Code	Name/Description	Adjustment range	Factory setting
CLI-	**[2nd CURRENT LIMIT.]**		
LC2	**[Current limit 2]**		[No] (nO)
nO LI1 - - -	**[No]** (nO): Function inactive. **[LI1]** (LI1) : : **[...]** (...): See the assignment conditions on page 116. If the assigned input or bit is at 0, the first current limitation is active. If the assigned input or bit is at 1, the second current limitation is active.		
CL2	**[I Limit. 2 value]** (1)	0 to 1.1 or 1.2 In (2) according to rating	1.1 or 1.2 In (2) according to rating
	Second current limitation The parameter can be accessed if [Current limit 2] (LC2) is not [No] (nO). **Note:** If the setting is less than 0.25 In, the drive may lock in [Output Phase Loss] (OPF) fault mode if this has been enabled (see page 194). If it is less than the no-load motor current, the limitation no longer has any effect. **CAUTION** Check that the motor will withstand this current, particularly in the case of permanent magnet synchronous motors, which are susceptible to demagnetization. **Failure to follow this instruction can result in equipment damage.**		
CLI	**[Current Limitation]** (1)	0 to 1.1 or 1.2 In (2) according to rating	1.1 or 1.2 In (2) according to rating
	First current limitation **Note:** If the setting is less than 0.25 In, the drive may lock in [Output Phase Loss] (OPF) fault mode if this has been enabled (see page 194). If it is less than the no-load motor current, the limitation no longer has any effect. **CAUTION** Check that the motor will withstand this current, particularly in the case of permanent magnet synchronous motors, which are susceptible to demagnetization. **Failure to follow this instruction can result in equipment damage.**		

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.
(2) In corresponds to the rated drive current indicated in the Installation Manual and on the drive nameplate.

Parameter that can be modified during operation or when stopped.

Line contactor command

Example circuit:



Note: The "Run/Reset" button must be pressed once the "Emergency stop" button has been released.

The drive control power supply must be provided via an external 24 V source.

CAUTION
This function can only be used for a small number of consecutive operations with a cycle time longer than 60 s (in order to avoid premature aging of the filter capacitor charging circuit). **Failure to follow these instructions can result in equipment damage.**

Note: The line contactor closes every time a run command (forward or reverse) is sent and opens after every stop.

Code	Name/Description	Adjustment range	Factory setting
LLC-	■ [LINE CONTACTOR COMMAND]		
LLC	❑ [Line contactor ass.] Logic output or control relay		[No] (nO)
nO	☐ [No] (nO): Function not assigned (in this case, none of the function parameters can be accessed).		
LO1 - LO4	☐ [LO1] (LO1) to [LO4] (LO4): Logic output (if one or two I/O cards have been inserted, LO1 to LO2 or LO4 can be selected).		
r2 - r4	☐ [R2] (r2) to [R4] (r4): Relay (selection of R2 extended to R3 or R4 if one or two I/O cards have been inserted).		
dO1	☐ [dO1] (dO1): Analog output AO1 functioning as a logic output. Selection can be made if [AO1 assignment] (AO1) page 103 = [No] (nO).		
LES	❑ [Drive lock]		[No] (nO)
nO	☐ [No] (nO): Function inactive.		
LI1 - - -	☐ [LI1] (LI1) : : ☐ [...] (...): See the assignment conditions on page 116. The drive locks when the assigned input or bit changes to 0.		
LCt	❑ [Mains V. time out] Monitoring time for closing of line contactor. If, once this time has elapsed, there is no voltage on the drive power circuit, the drive will lock with an [input contactor] (LCF) fault.	5 to 999 s	5 s

Output contactor command

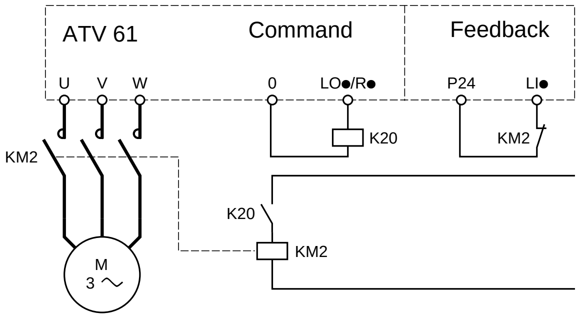
This allows the drive to control a contactor located between the drive and the motor. The request for the contactor to close is made when a run command is sent. The request for the contactor to open is made when there is no longer any current in the motor.

CAUTION
If a DC injection braking function has been configured it should not be left operating too long in stop mode, as the contactor only opens at the end of braking. **Failure to follow these instructions can result in equipment damage.**

Output contactor feedback

The corresponding logic input should be at 1 when there is no run command and at 0 during operation.
In the event of an inconsistency, the drive trips on an FCF2 fault if the output contactor fails to close (LIx at 1) and on an FCF1 fault if it is stuck (LIx at 0).
The parameter [Time to motor run] (dbS) can be used to delay tripping in fault mode when a run command is sent and the parameter [Time to open cont.] (dAS) delays the fault when a stop command is set.

Note:
Fault FCF2 (contactor failing to close) can be reset by the run command changing state from 1 to 0 (0 --> 1 --> 0 in 3-wire control).



The [Out. contactor ass.] (OCC) and [Output contact. fdbk] (rCA) functions can be used individually or together.

Code	Name/Description	Adjustment range	Factory setting
OCC-	**[OUTPUT CONTACTOR CMD]**		
OCC nO LO1 - LO4 r2 - r4 dO1	**[Out. contactor ass.]** Logic output or control relay □ **[No]** (nO): Function not assigned (in this case, none of the function parameters can be accessed). □ **[LO1]** (LO1) to **[LO4]** (LO4): Logic output (if one or two I/O cards have been inserted, LO1 to LO2 or LO4 can be selected). □ **[R2]** (r2) to **[R4]** (r4): Relay (selection of R2 extended to R3 or R4 if one or two I/O cards have been inserted) □ **[dO1]** (dO1): Analog output AO1 functioning as a logic output. Selection can be made if [AO1 assignment] (AO1) page 103 = [No] (nO).		[No] (nO)
rCA nO LI1 - - -	**[Output contact. fdbk]** □ **[No]** (nO): Function inactive □ **[LI1]** (LI1) : : □ **[...]** (...): See the assignment conditions on page 116. The motor starts up when the assigned input or bit changes to 0.		[No] (nO)
dbS	**[Time to motor run]** Time delay for: • Motor control following the sending of a run command • Output contactor fault monitoring, if the feedback is assigned. If the contactor fails to close at the end of the set time, the drive will lock in FCF2 fault mode. This parameter can be accessed if [Output cont.] (OCC) is assigned or if [Output contact. fdbk] (rCA) is assigned. The time delay must be greater than the closing time of the output contactor.	0.05 to 60 s	0.15
dAS	**[Time to open cont.]** Time delay for output contactor opening command following motor stop. This parameter can be accessed if [Output contact. fdbk] (rCA) is assigned. The time delay must be greater than the opening time of the output contactor. If it is set to 0, the fault will not be monitored. If the contactor fails to open at the end of the set time, the drive will lock in FCF1 fault mode.	0 to 5.00 s	0.10

Parameter that can be modified during operation or when stopped.

Damper control

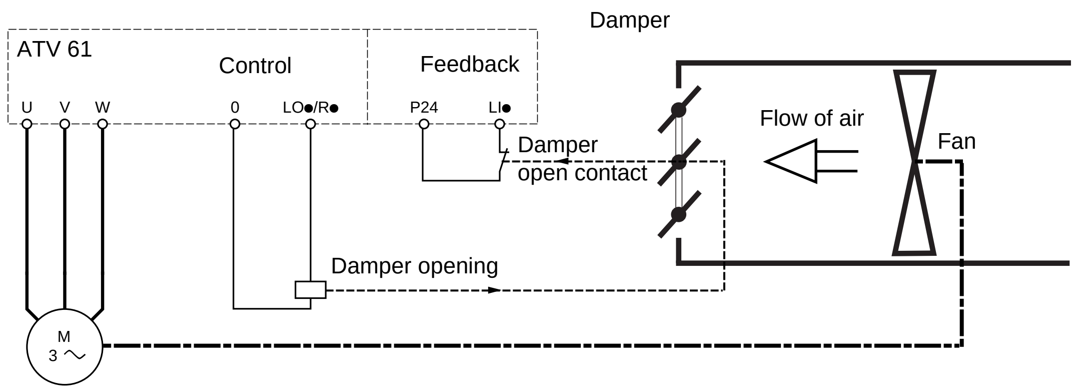
This function applies to the ventilation ducts. The aim is to control the opening of the duct (shutter device called a "damper") when the fan starts up.

Damper opening command

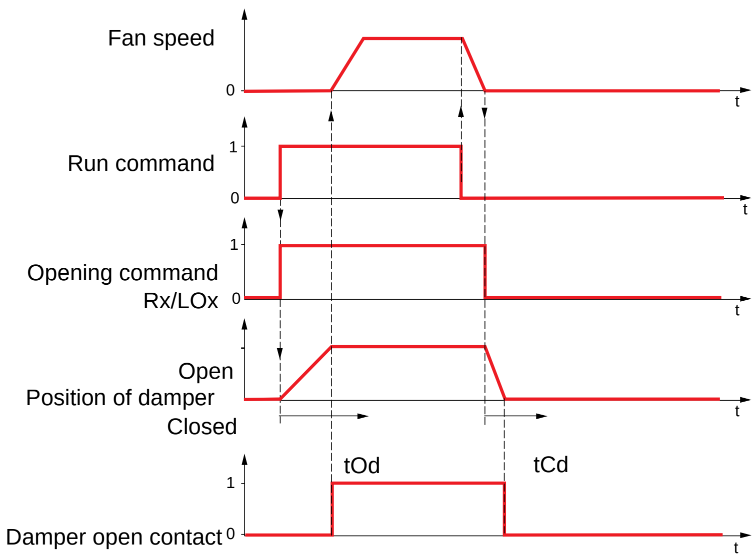
The opening command can be assigned to a logic output or a relay via the [Damper assignment] (dAM)parameter. The damper is closed automatically when there is no longer an opening command.

Damper opening feedback

Opening is controlled by a bit or a logic input that can be assigned via the [Damper feedback] (dFb) parameter. The corresponding logic input or bit can be configured (state 0 or 1 for damper open) via the parameter [F.back dam. contact](Fbtd).
When there is an inconsistency, the drive trips on a [Damper stuck] (Fd1) fault if the damper does not open and on a [Damper open] (Fd2) fault if it does not close.
The parameter [Time to open damp.] (tOd) can be used to delay tripping on an opening fault when a run command is sent and the parameter [Time to close damp.] (tCd) delays the closing fault when a stop command is sent.



Example of operation with feedback at state 1 for damper open



Code	Name/Description	Adjustment range	Factory setting
dAM-	■ **[DAMPER MANAGEMENT]**		
dAM	❑ **[Damper assignment]**		[No] (nO)
	Logic output or opening control relay		
nO	☐ **[No]** (nO): Function not assigned (in this case, none of the function's parameters can be accessed)		
LO1	☐ **[LO1]** (LO1)		
-	to		
LO4	**[LO4]** (LO4): Logic output (if one or two I/O cards have been inserted, LO1 to LO2 or LO4 can be selected)		
r2	**[R2]** (r2)		
-	to		
r4	**[R4]** (r4): Relay (selection of R2 extended to R3 or R4 if one or two I/O cards have been inserted)		
dO1	☐ **[dO1]** (dO1): Analog output AO1 functioning as a logic output. Selection can be made if [AO1 assignment] (AO1) page 103 = [No] (nO).		
dFb	❑ **[Damper feedback]**		[No] (nO)
	Feedback of the "damper open" information		
nO	☐ **[No]** (nO): Function inactive		
LI1	☐ **[LI1]** (LI1)		
-	:		
-	:		
-	☐ **[...]** (...) : See the assignment conditions on page 116.		
	Note: Before assigning damper feedback, check that the input wiring or the state of the assigned bit corresponds to the configuration of parameter [F.back dam. contact] (Fbtd) below. If it does not, the drive may immediately switch to fault mode.		
tOd ()	❑ **[Time to open damp.]**	0.05 to 300 s	60
	Opening fault monitoring time delay. If the damper does not open at the end of the set time, the drive will lock in [Damper stuck] (Fd1) fault mode. The time delay must be greater than the normal opening time of the damper.		
tCd ()	❑ **[Time to close damp.]**	0.00 to 300 s	60
	Closing fault monitoring time delay. If the damper does not close at the end of the set time, the drive will lock in [Damper open.] (Fd1) fault mode. If this parameter is at 0.00, the [Damper open.] (Fd2) fault is monitored only at the run command before activation of the relay or the control logic output. The time delay must be greater than the normal closing time of the damper.		
Fbtd	❑ **[F.back dam. contact]**		[Active at 0] (SHUt)
	This parameter defines the positive or negative logic of the input or bit assigned by [Damper feedback] (dFb).		
SHUt	☐ **[Active at 0]** (SHUt): The motor starts up when the assigned input or bit changes to 0.		
OPEn	☐ **[Active at 1]** (OPEn): The motor starts up when the assigned input or bit changes to 1.		

() Parameter that can be modified during operation or when stopped

Parameter set switching [PARAM. SET SWITCHING]

A set of 1 to 15 parameters from the [1.3 SETTINGS] (SEt-) menu on page 47 can be selected and 2 or 3 different values assigned. These 2 or 3 sets of values can then be switched using 1 or 2 logic inputs or control word bits. This switching can be performed during operation (motor running).
It can also be controlled on the basis of one or two frequency thresholds, whereby each threshold acts as a logic input (0 = threshold not attained, 1 = threshold attained).

	Values 1	Values 2	Values 3
Parameter 1 Parameter 2 Parameter 3 Parameter 4 Parameter 5 Parameter 6 Parameter 7 Parameter 8 Parameter 9 Parameter 10 Parameter 11 Parameter 12 Parameter 13 Parameter 14 Parameter 15	Parameter 1 Parameter 2 Parameter 3 Parameter 4 Parameter 5 Parameter 6 Parameter 7 Parameter 8 Parameter 9 Parameter 10 Parameter 11 Parameter 12 Parameter 13 Parameter 14 Parameter 15	Parameter 1 Parameter 2 Parameter 3 Parameter 4 Parameter 5 Parameter 6 Parameter 7 Parameter 8 Parameter 9 Parameter 10 Parameter 11 Parameter 12 Parameter 13 Parameter 14 Parameter 15	Parameter 1 Parameter 2 Parameter 3 Parameter 4 Parameter 5 Parameter 6 Parameter 7 Parameter 8 Parameter 9 Parameter 10 Parameter 11 Parameter 12 Parameter 13 Parameter 14 Parameter 15
Input LI or bit or frequency threshold 2 values	0	1	0 or 1
Input LI or bit or frequency threshold 3 values	0	0	1

Note: Do not modify the parameters in the [1.3 SETTINGS] (SEt-) menu, because any modifications made in this menu will be lost on the next power-up. The parameters can be adjusted during operation in the [PARAM. SET SWITCHING] (MLP-) menu, on the active configuration.

Note: Parameter set switching cannot be configured from the integrated display terminal.
Parameters can only be adjusted on the integrated display terminal if the function has been configured previously via the graphic display terminal, by PowerSuite or via the bus or communication network. If the function has not been configured, the **MLP-** menu and the **PS1-**, **PS2-**, **PS3-** submenus do not appear.

Code	Name/Description	Adjustment range	Factory setting
MLP-	■ **[PARAM. SET SWITCHING]**		
CHA1 nO FtA F2A LI1 - - -	❑ **[2 Parameter sets]** ☐ **[No]** (nO): Function inactive. ☐ **[Freq.Th.att.]** (FtA): Switching via [Freq. threshold] (Ftd) page 59 ☐ **[Freq. Th. 2 attain.]** (F2A): Switching via [Freq. threshold 2] (Ftd) page 59 ☐ **[LI1]** (LI1) ☐ **[...]** (...): See the assignment conditions on page 116. Switching 2 parameter sets		[No] (nO)
CHA2 nO FtA F2A LI1 - - -	❑ **[3 Parameter sets]** ☐ **[No]** (nO): Function inactive. ☐ **[Freq.Th.att.]** (FtA): Switching via [Freq. threshold] (Ftd) page 59 ☐ **[Freq. Th. 2 attain.]** (F2A): Switching via [Freq. threshold 2] (Ftd) page 59 ☐ **[LI1]** (LI1) ☐ **[...]** (...): See the assignment conditions on page 116. Switching 3 parameter sets **Note:** In order to obtain 3 parameter sets, [2 Parameter sets] must also be configured.		[No] (nO)
	❑ **[PARAMETER SELECTION]** The parameter can only be accessed on the graphic display terminal if [2 Parameter sets] is not [No]. Making an entry in this parameter opens a window containing all the adjustment parameters that can be accessed. Select 1 to 15 parameters using ENT (a tick then appears next to the parameter). Parameter(s) can also be deselected using ENT. Example: PARAMETER SELECTION 1.3 SETTINGS Ramp increment ✓ - ✓		
PS1-	❑ **[SET 1]** The parameter can be accessed if one or more parameters have been selected in [PARAMETER SELECTION]. Making an entry in this parameter opens a settings window containing the selected parameters **in the order in which they were selected**. With the graphic display terminal: RDY Term +0.00 Hz REM SET1 Acceleration : 9.51 s Deceleration : 9.67 s Acceleration 2 : 12.58 s Deceleration 2 : 13.45 s Begin Acc round : 2.3 s Code T/K ENT → RDY Term +0.00 Hz REM Acceleration 9.51 s Min = 0.1 Max = 999.9 << >> T/K With the integrated display terminal: Proceed as in the Settings menu using the parameters that appear.		

Code	Name/Description	Adjustment range	Factory setting
	■ **[PARAM. SET SWITCHING]** (continued)		
PS2-	❑ **[SET 2]** The parameter can be accessed if one or more parameters have been selected in [PARAMETER SELECTION]. Procedure identical to [SET 1] (PS1-).		
PS3-	❑ **[SET 3]** The parameter can be accessed if [3 parameter sets] is not [No] and if one or more parameters have been selected in [PARAMETER SELECTION]. Procedure identical to [SET 1] (PS1-).		

Note: We recommend that a parameter set switching test is carried out on stopping and a check is made to ensure that it has been performed correctly.
Some parameters are interdependent and in this case may be restricted at the time of switching.

Interdependencies between parameters must be respected, even between different sets.

Example: The highest [Low speed] (LSP) must be below the lowest [High speed] (HSP).

Motor or configuration switching [MULTIMOTORS/CONFIG.]

The drive may contain up to 3 configurations, which can be saved using the [1.12 FACTORY SETTINGS] (FCS-) menu, page 220.
Each of these configurations can be activated remotely, enabling adaptation to:

- 2 or 3 different motors or mechanisms (multimotor mode)
- 2 or 3 different configurations for a single motor (multiconfiguration mode)

The two switching modes cannot be combined.

Note: The following conditions MUST be observed:

- Switching may only take place when stopped (drive locked). If a switching request is sent during operation, it will not be executed until the next stop.
- In the event of motor switching, the following additional conditions apply:
  - When the motors are switched, the power and control terminals concerned must also be switched as appropriate.
  - The maximum power of the drive must not be exceeded by any of the motors.
- All the configurations to be switched must be set and saved in advance in the same hardware configuration, this being the definitive configuration (option and communication cards). Failure to follow this instruction can cause the drive to lock on an [Incorrect config.] (CFF) fault.

Menu and parameters switched in multimotor mode

- [1.3 SETTINGS] (SEt-)
- [1.4 MOTOR CONTROL] (drC-)
- [1.5 INPUTS / OUTPUTS CFG] (I-O-)
- [1.6 COMMAND] (CtL-)
- [1.7 APPLICATION FUNCT.] (FUn-) with the exception of the [MULTIMOTORS/CONFIG.] function (to be configured once only)
- [1.8 FAULT MANAGEMENT] (FLt)
- [1.13 USER MENU]
- [USER CONFIG.]: The name of the configuration specified by the user in the [1.12 FACTORY SETTINGS] (FCS-) menu

Menu and parameters switched in multiconfiguration mode

As in multimotor mode, except for the motor parameters that are common to the three configurations:

- Rated current
- Thermal current
- Rated voltage
- Rated frequency
- Rated speed
- Rated power
- Magnetizing current at zero frequency
- IR compensation
- Slip compensation
- Synchronous motor parameters
- Type of thermal protection
- Thermal state
- The auto-tuning parameters and motor parameters that can be accessed in expert mode
- Type of motor control

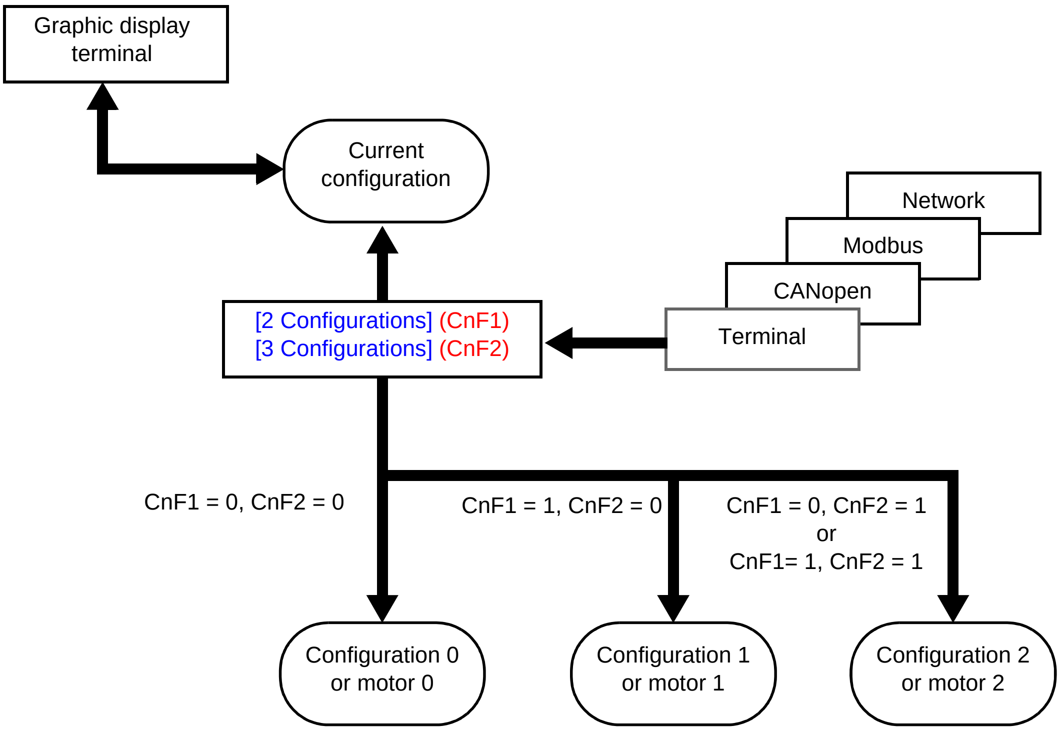
Note: No other menus or parameters can be switched.

Transfer of a drive configuration to another one, with graphic display terminal, when the drive uses [MULTIMOTORS/CONFIG.] function

Let A be the source drive and B the drive addressed. In this example, switching are controled by logic input.

1. Connect graphic display terminal to the drive A.
2. Put logic input LI ([2 Configurations] (CnF1)) and LI ([3 Configurations] (CnF2)) to 0.
3. Download configuration 0 in a file of graphic display terminal (example : file 1 of the graphic display terminal).
4. Put logic input LI ([2 Configurations] (CnF1)) to 1 and leave logic input LI ([3 Configurations] (CnF2)) to 0.
5. Download configuration 1 in a file of graphic display terminal (example : file 2 of the graphic display terminal).
6. Put logic input LI ([3 Configurations] (CnF2)) to 1 and leave logic input LI ([2 Configurations] (CnF1)) to 1.
7. Download configuration 2 in a file of graphic display terminal (example : file 3 of the graphic display terminal).
8. Connect graphic display terminal to the drive B.
9. Put logic input LI ([2 Configurations] (CnF1)) and LI ([3 Configurations] (CnF2)) to 0.
10. Make a factory setting of the drive B.
11. Download the configuration file 0 in the drive (file 1 of graphic display terminal in this example).
12. Put logic input LI ([2 Configurations] (CnF1)) to 1 and leave logic input LI ([3 Configurations] (CnF2)) to 0.
13. Download the configuration file 1 in the drive (file 2 of graphic display terminal in this example).
14. Put logic input LI ([3 Configurations] (CnF2)) to 1 and leave logic input LI ([2 Configurations] (CnF1)) to 1.
15. Download the configuration file 2 in the drive (file 3 of graphic display terminal in this example).

Nota: Steps 6, 7, 14 et 15 are necessary only if [MULTIMOTORS/CONFIG.] function is used with 3 configurations or 3 motors.

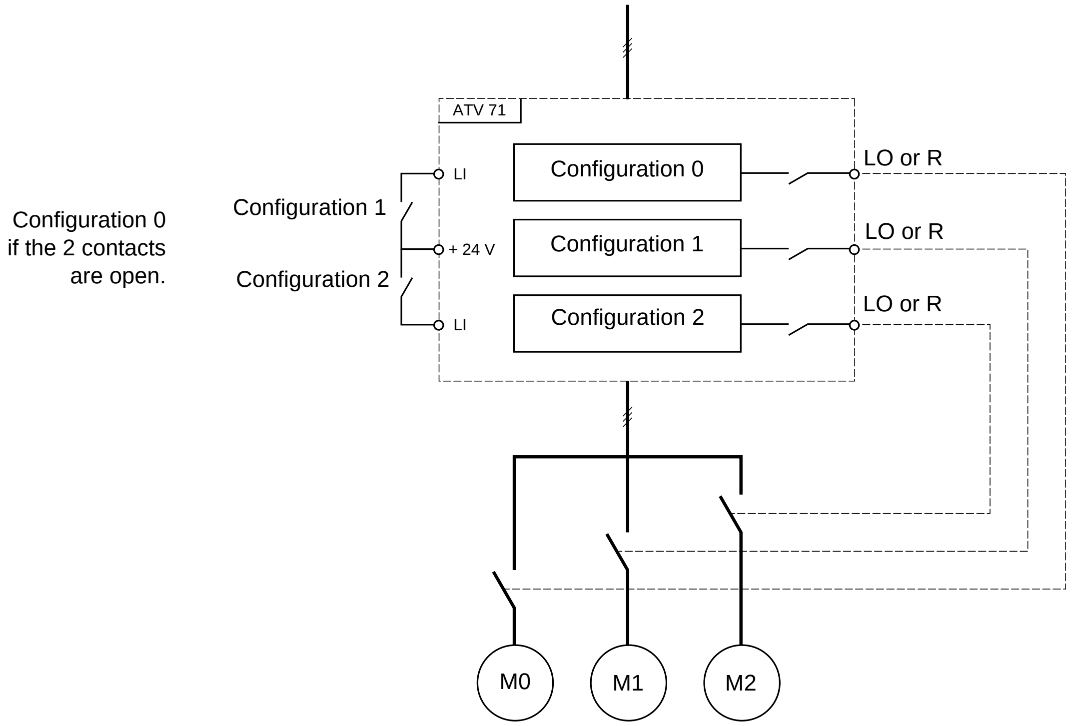


Switching command

Depending on the number of motors or selected configuration (2 or 3), the switching command is sent using one or two logic inputs. The table below lists the possible combinations.

LI 2 motors or configurations	LI 3 motors or configurations	Number of configuration or active motor
0	0	0
1	0	1
0	1	2
1	1	2

Schematic diagram for multimotor mode



Auto-tuning in multimotor mode

This auto-tuning can be performed:
- Manually using a logic input when the motor changes
- Automatically each time the motor is activated for the 1st time after switching on the drive, if the [Automatic autotune] (AUt) parameter on page 66 = [Yes] (YES).

Motor thermal states in multimotor mode:

The drive protects the three motors individually. Each thermal state takes into account all stop times, including drive shutdowns.
It is therefore not necessary to perform auto-tuning every time the power is switched on. It is sufficient to auto-tune each motor at least once.

Configuration information output

In the [1.5 INPUTS / OUTPUTS CFG] (I-O-) menu, a logic output can be assigned to each configuration or motor (2 or 3) for remote information transmission.

Note: As the [1.5 INPUTS / OUTPUTS CFG] (I-O-) menu is switched, these outputs must be assigned in all configurations in which information is required.

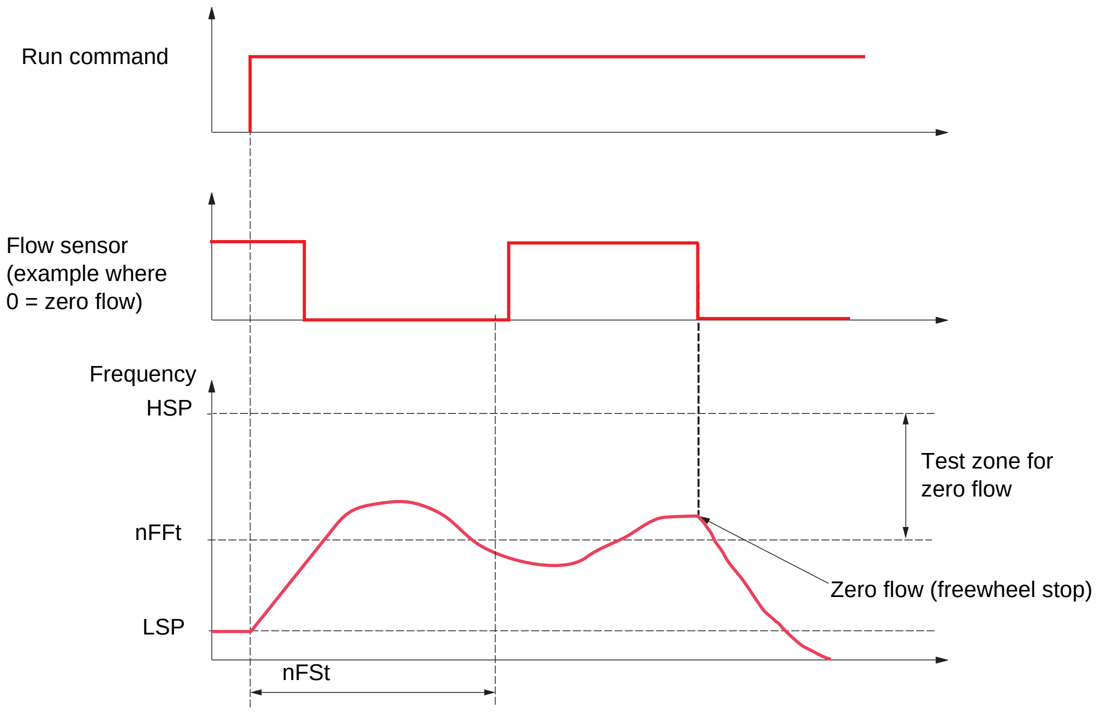
Code	Name/Description	Adjustment range	Factory setting
MMC-	**[MULTIMOTORS/CONFIG.]**		
CHM nO YES	**[Multimotors]** **[No]** (nO): Multiconfiguration possible **[Yes]** (YES): Multimotor possible		[No] (nO)
CnF1 nO LI1 - - C111 - - -	**[2 Configurations]** **[No]** (nO): No switching. **[LI1]** (LI1) to **[LI6]** (LI6) **[LI7]** (LI7) to **[LI10]** (LI10): If VW3A3201 logic I/O card has been inserted **[LI11]** (LI11) to **[LI14]** (LI14): If VW3A3202 extended I/O card has been inserted **[C111]** (C111) to **[C115]** (C115): With integrated Modbus **[C211]** (C211) to **[C215]** (C215): With integrated CANopen **[C311]** (C311) to **[C315]** (C315): With a communication card **[C411]** (C411) to **[C415]** (C415): With a Controller Inside card Switching of 2 motors or 2 configurations		[No] (nO)
CnF2 nO LI1 - - C111 - - -	**[3 Configurations]** **[No]** (nO): No switching **[LI1]** (LI1) to **[LI6]** (LI6) **[LI7]** (LI7) to **[LI10]** (LI10): If VW3A3201 logic I/O card has been inserted **[LI11]** (LI11) to **[LI14]** (LI14): If VW3A3202 extended I/O card has been inserted **[C111]** (C111) to **[C115]** (C115): With integrated Modbus **[C211]** (C211) to **[C215]** (C215): With integrated CANopen **[C311]** (C311) to **[C315]** (C315): With a communication card **[C411]** (C411) to **[C415]** (C415): With a Controller Inside card Switching of 3 motors or 3 configurations **Note:** In order to obtain 3 motors or 3 configurations, [2 Configurations] (CnF1) must also be configured.		[No] (nO)
tnL-	**[AUTO TUNING BY LI]**		
tUL nO LI1 - - -	**[Auto-tune assign.]** **[No]** (nO): Not assigned **[LI1]** (LI1) : : **[...]** (...): See the assignment conditions on page 116. Auto-tuning is performed when the assigned input or bit changes to 1. **Note:** Auto-tuning causes the motor to start up.		[No] (nO)

Zero fluid or zero flow detection via sensor

In the case of a pump, for example, this function can be used to avoid operation when there is no fluid or if the conduits are blocked. Although this function is independent of the "[1.7 APPLICATION FUNCT.] (FUn-)" function on page 160, the two can be used in tandem.

The function uses a fluid sensor assigned to a logic input or a bit, which can be configured for positive or negative logic by [Conf.sensor flow] (LnS).
The fault is triggered if the frequency exceeds an adjustable threshold [Freq.Th.Sensor. Act.] (nFFt) and the input or bit assigned to the sensor changes to 0 or 1 depending on its configuration.
The fault is ignored on startup for an adjustably time delay [Flow Times Ctrl] (nFSt) in order to avoid untimely triggering due to a transient state.

This fault triggers a freewheel stop.



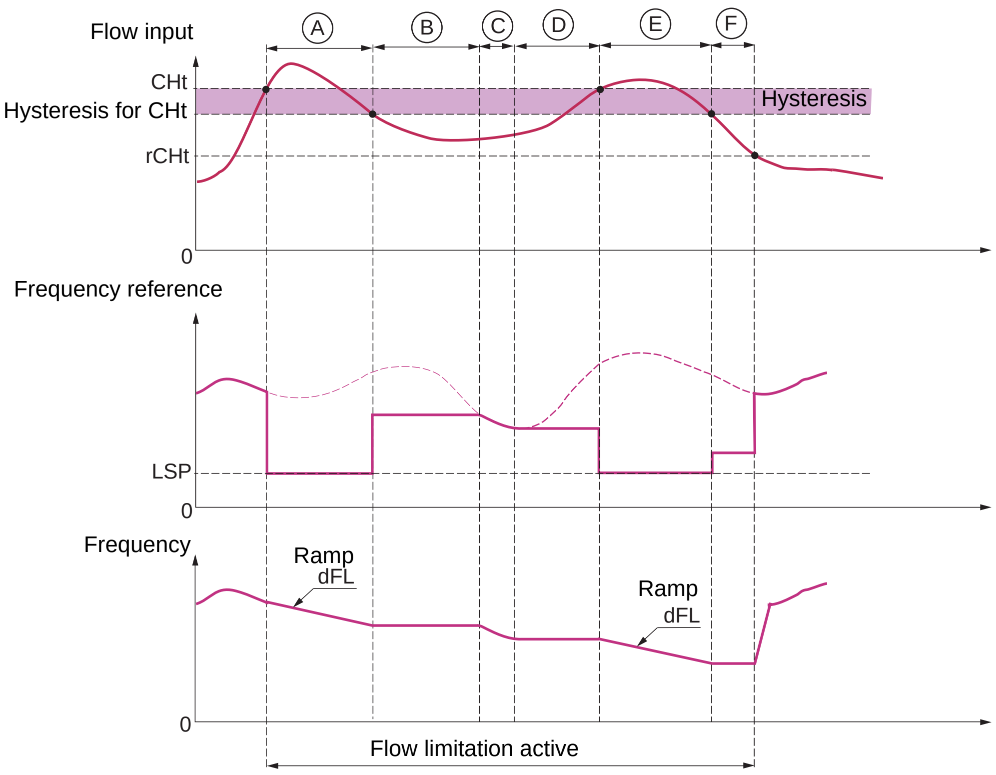
Code	Name/Description	Adjustment range	Factory setting
nFS-	**[NO FLOW DETECTION]**		
nFS	**[No Flow Sensor]** Assignment of the zero fluid sensor.		[No] (nO)
nO	**[No]** (nO): Function inactive		
LI1 - -	**[LI1]** (LI1) to **[LI6]** (LI6) **[LI7]** (LI7) to **[LI10]** (LI10): If VW3A3201 logic I/O card has been inserted **[LI11]** (LI11) to **[LI14]** (LI14): If VW3A3202 extended I/O card has been inserted		
C101 - - -	**[C101]** (C101) to **[C115]** (C115): With integrated Modbus in [I/O profile] (IO) **[C201]** (C201) to **[C215]** (C215): With integrated CANopen in [I/O profile] (IO) **[C301]** (C301) to **[C315]** (C315): With a communication card in [I/O profile] (IO) **[C401]** (C401) to **[C415]** (C415): With a Controller Inside card in [I/O profile] (IO)		
Cd00 -	**[CD00]** (Cd00) to **[CD13]** (Cd13): In [I/O profile] (IO) can be switched with possible logic inputs **[CD14]** (Cd14) to **[CD15]** (Cd15): In [I/O profile] (IO) can be switched without logic inputs		
LnS	**[Conf.sensor flow]** This parameter can be accessed if zero flow detection has been assigned to a logic input or a bit. It defines the positive or negative logic of the input or bit assigned to this detection.		[Active low] (LO)
LO	**[Active low]** (LO): Detection on falling edge (change from 1 to 0) of the assigned input or bit.		
HIG	**[Active high]** (HIG): Detection on rising edge (change from 0 to 1) of the assigned input or bit.		
nFFt ()	**[Freq.Th.Sensor. Act.]** (1) Zero fluid detection activation threshold The parameter can be accessed if [No Flow Sensor] (nFS) is not [No] (nO).	0 to 500 or 1,000 Hz according to rating	0 Hz
nFSt ()	**[Flow Times Ctrl]** (1) Zero fluid detection activation time delay The parameter can be accessed if [No Flow Sensor] (nFS) is not [No] (nO).	0 to 999 s	10 s

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.

() Parameter that can be modified during operation or when stopped.

Flow limitation

This function can be used to limit the flow of a fluid, in the case of a pump, for example.
The function uses a flow sensor assigned to an analog input, the "pulse in" input or the encoder input. It limits the frequency reference. In the case of regulation with PID, it affects the PID regulator output reference.



- **Before A** – The signal on the input assigned to the flow measurement has not reached the activation threshold [Flow.Lim.Th.Active] (CHt): Flow limitation is not activated and the input reference is applied.
- **A –** The signal on the input assigned to the flow measurement has reached the threshold [Flow.Lim.Th.Active] (CHt): Flow limitation is activated, the reference is limited to [Low speed] (LSP) and the frequency decelerates along the ramp [Dec. Flow. limit] (dFL).
- **B** – The signal on the input assigned to the flow measurement has fallen below the hysteresis of the threshold [Flow.Lim.Th.Active] (CHt): The current frequency is copied and applied as the reference.
- **C** – The input reference has fallen below the reference **B** and is continuing to fall: It is applied.
- **D** – The input reference starts to rise again: The current frequency is copied and applied as the reference.
- **E** – The signal on the input assigned to the flow measurement has reached the threshold [Flow.Lim.Th.Active] (CHt): The reference is limited to [Low speed] (LSP) and the frequency decelerates along the ramp [Dec. Flow. limit] (dFL).
- **F** – The signal on the input assigned to the flow measurement has fallen below the hysteresis of the threshold [Flow.Lim.Th.Active] (CHt): The current frequency is copied and applied as the reference.
- **After F** – The signal on the input assigned to the flow measurement has fallen below the deactivation threshold [Flo.Lim.Thres. Inact.] (rCHt): Flow limitation is no longer active and the input reference is applied.

Code	Name/Description	Adjustment range	Factory setting
FLL-	■ **[FLOW LIMITATION]**		
CHI	❑ **[Flow.Sen.Inf]**		[No] (nO)
nO AI1 - AI4 PI PG	□ **[No]** (nO): Not assigned (function inactive) □ **[AI1]** (AI1) to **[AI4]** (AI4): Analog input, if VW3A3202 I/O card has been inserted □ **[RP]** (PI): Frequency input, if VW3A3202 I/O card has been inserted □ **[Encoder]** (PG): Encoder input, if encoder card has been inserted		
CHt	❑ **[Flow.Lim.Th.Active]** (1)	0 to 100%	0%
	The parameter can be accessed if [Flow.Sen.Inf] (CHI) is not [No] (nO). Function activation threshold, as a % of the max. signal of the assigned input		
rCHt	❑ **[Flo.Lim.Thres. Inact.]** (1)	0 to 100%	0%
	The parameter can be accessed if [Flow.Sen.Inf] (CHI) is not [No] (nO). Function deactivation threshold, as a % of the max. signal of the assigned input		
dFL	❑ **[Dec. Flow. limit]** (1)	0.01 to 9,000 s (2)	5.0 s
	The parameter can be accessed if [Flow.Sen.Inf] (CHI) is not [No] (nO). Time to decelerate from the [Rated motor freq.] (FrS) to 0. Make sure that this value is compatible with the inertia being driven.		

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.
(2) Range 0.01 to 99.99 s or 0.1 to 999.9 s or 1 to 9,000 s according to [Ramp increment] (Inr) page 129.

Parameter that can be modified during operation or when stopped.

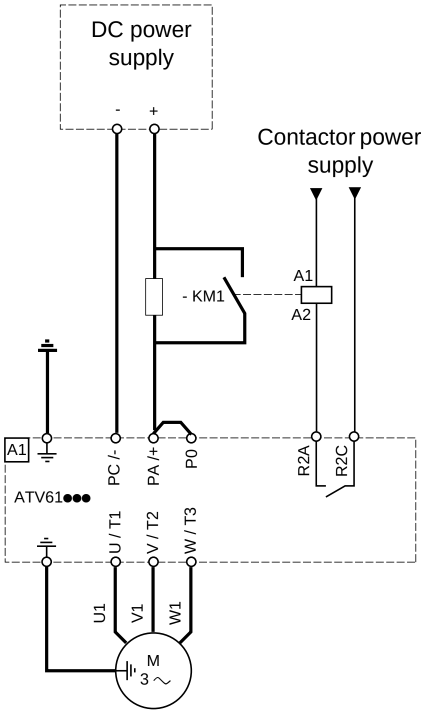
Direct power supply via DC bus

This function is only accessible for ATV61H●●●M3 ⩾ 18.5 kW, ATV61H●●●N4 ⩾ 18.5 kW, ATV61W●●●N4 ⩾ 22 kW drives and all ratings of ATV61H●●●Y drives.

Direct power supply via the DC bus requires a protected direct current source with adequate power and voltage as well as a suitably dimensioned resistor and capacitor precharging contactor. Consult Schneider Electric for information about dimensioning these components.

The “direct power supply via DC bus” function can be used to control the precharging contactor via a relay or a logic input on the drive.

Example circuit using R2 relay:



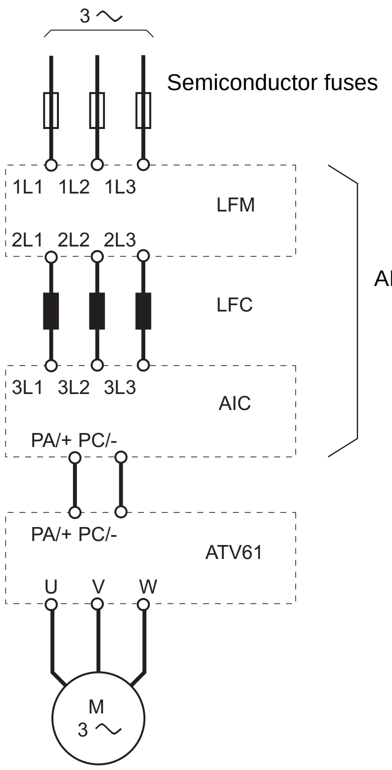
Code	Name/Description	Adjustment range	Factory setting
dCO-	■ **[DC BUS SUPPLY]** This function is only accessible for ATV61H●●●M3 ⩾ 18.5 kW, ATV61H●●●N4 ⩾ 18.5 kW, ATV61W●●●N4 ⩾ 22 kW drives and all ratings of ATV61H●●●Y drives.		
dCO	❑ **[Precharge cont. ass.]**		[No] (nO)
	Logic output or control relay		
nO	☐ **[No]** (nO): Function not assigned.		
LO1 - LO4	☐ **[LO1]** (LO1) to **[LO4]** (LO4): Logic output (if one or two I/O cards have been inserted, LO1 to LO2 or LO4 can be selected).		
r2 - r4	☐ **[R2]** (r2) to **[R4]** (r4): Relay (selection of R2 extended to R3 or R4 if one or two I/O cards have been inserted).		
dO1	☐ **[dO1]** (dO1): Analog output AO1 functioning as a logic output. Selection can be made if [AO1 assignment] (AO1) page 103 = [No] (nO).		

Active Front End connection

This function is not accessible for ATV61H●●●S6X ⩾ and for ATV61H●●●Y ⩾ 110 kW (150 HP). (HHP range)

Direct power supply via Active Front End (AFE) reduces the mains current harmonics to less than 4% and gives enables the drive to feedback the generative energy to the mains supply.

Example circuit using one AFE for one ATV61



AFE (Active Front End)

- LFM (Line Filter Module)
- LFC (Line Filter Choke)
- AIC (Active Infeed Converter)

Code	Name/Description	Adjustment range	Factory setting
O1r-	■ [REGEN CONNECTION]		
AFE	❑ [Regen. Connection]		[No] (nO)
nO	☐ [No] (nO): Not assigned		
YES	☐ [Yes] (YES): Function always active		
LI1	☐ [LI1] (LI1) to [LI6] (LI6)		
-	☐ [LI7] (LI7) to [LI10] (LI10): If VW3A3201 logic I/O card has been inserted		
-	☐ [LI11] (LI11) to [LI14] (LI14): If VW3A3202 extended I/O card has been inserted		
C101	☐ [C101] (C101) to [C115] (C115): With integrated Modbus in [I/O profile] (IO)		
-	☐ [C201] (C201) to [C215] (C215): With integrated CANopen in [I/O profile] (IO)		
-	☐ [C301] (C301) to [C315] (C315): With a communication card in [I/O profile] (IO)		
-	☐ [C401] (C401) to [C415] (C415): With a Controller Inside card in [I/O profile] (IO)		
Cd00	☐ [CD00] (Cd00) to [CD13] (Cd15): In [I/O profile] (IO) it can be switched with possible logic inputs		
-	☐ [CD14] (Cd14) to [CD15] (Cd15): In [I/O profile] (IO) it can be switched without logic inputs		
	If [Profile] (CHCF) = [8 serie] (SE8), then only [Yes] (YES) and [LIx] (LIx) are available		

⚠ CAUTION

DAMAGED EQUIPMENT

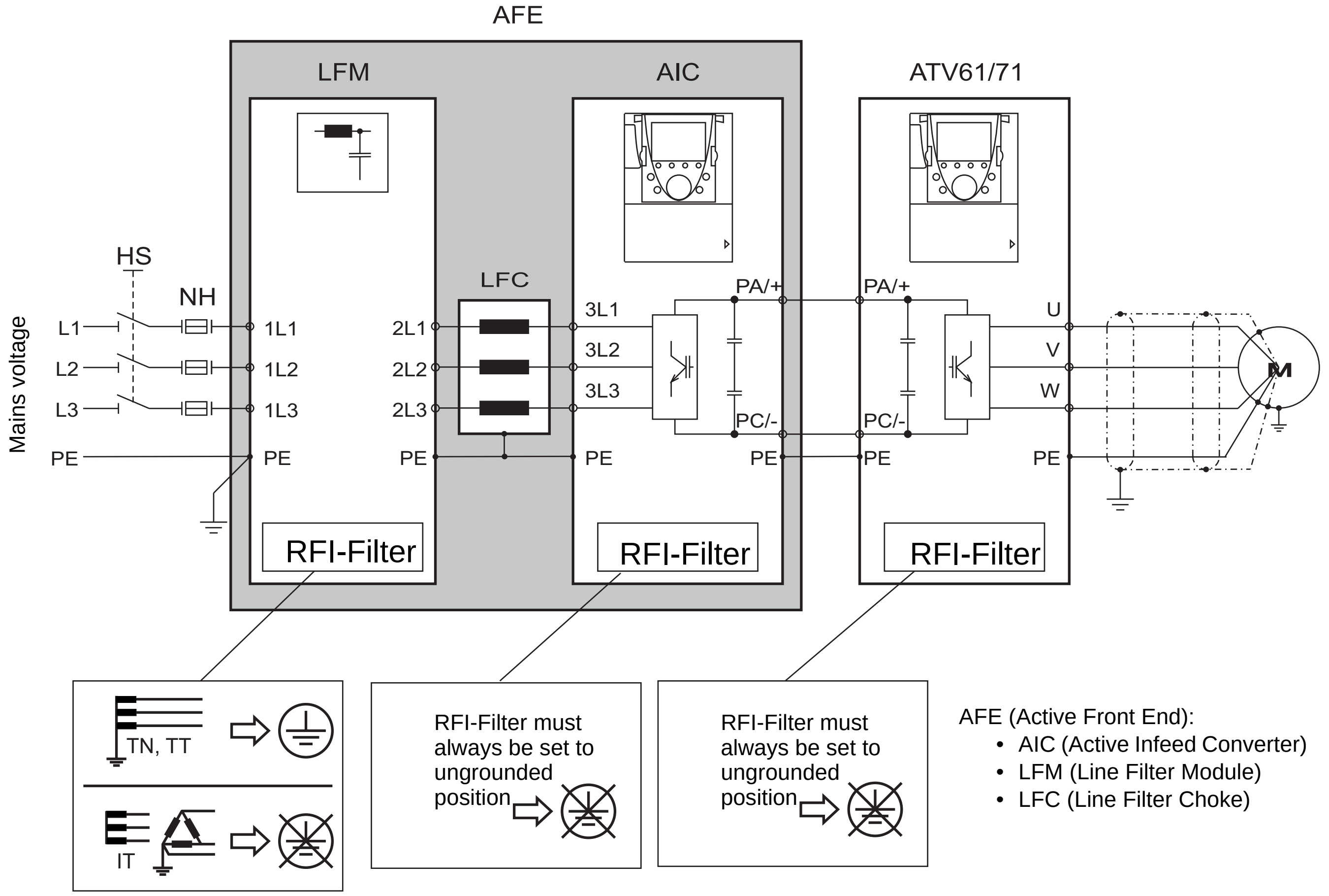
It is absolutely necessary to carry out further parameter setting on all ATV61 drive connnected to Active Front End (AFE). Check the list of parameter on next page.

Failure to follow this instruction can result in equipment damage.

Active Front End connection

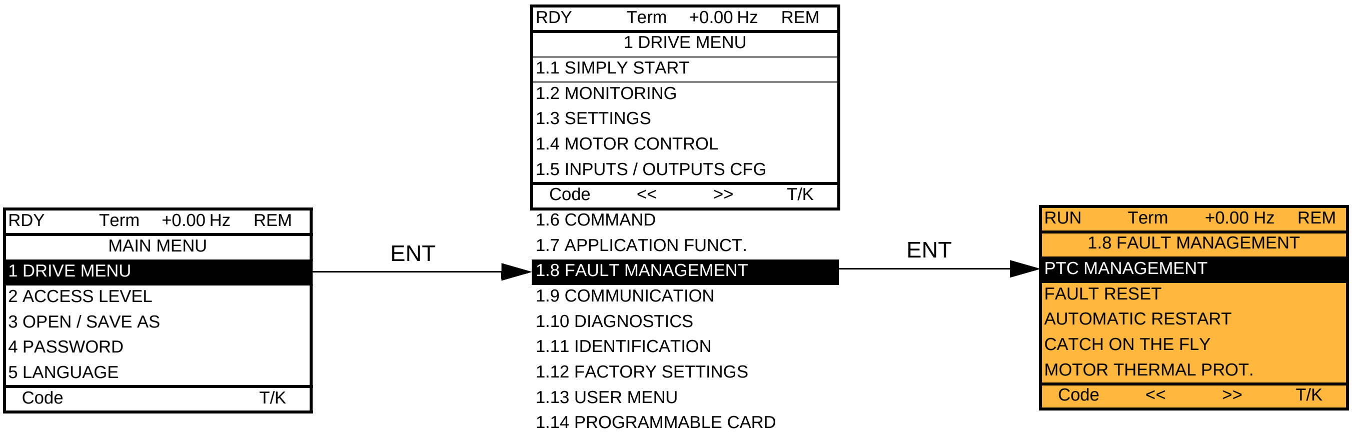
It is necessary to carry out the following settings for all frequency inverters connected to an active front end:

- Parameter [Mains voltage] (UrES) : Same setting as the active front end (Thereby the internal voltage levels of the frequency inverter are adapted).
- Parameter [Input phase loss] (IPL) has to be set to [Ignore] (nO).
- Parameter for operation with active front end [Regen. Connection] (AFE) has to be set to [Yes] (YES) (Thereby the undervoltage level of the frequency inverter is adapted to the operation with the active front end).
- Parameter [Dec ramp adapt.] (brA) is set to [nO] to inactivate this function.
- Parameter [Brake res. fault Mgt] (bUb) has to be set to [ignore] (nO) (for HHP range only).
- Parameter [Deceleration] (dEC) has to be increased for applications with high inertia to avoid overload of Active Front End. This can be prevented also by rounding the deceleration ramp with parameter [Begin Dec round] (tA3).
- Parameter [2 wire type] (tCt) has to be set on [Level] (LEL) to ensure an automatic restart after undervoltage detection of the Active Front End. An automatic restart is only possible on 2 wire control.
- The integrated RFI filter has to be always deactivated (position IT, non-grounded mains) for all ATV 61 inverter and also for the Active Infeed Converter (AIC) because there exists no direct mains connection.

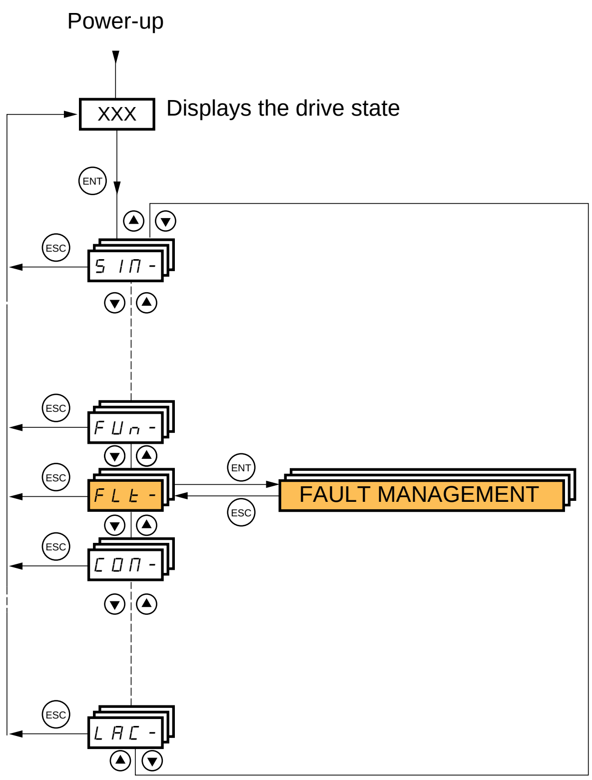


AFE (Active Front End):
- AIC (Active Infeed Converter)
- LFM (Line Filter Module)
- LFC (Line Filter Choke)

With graphic display terminal:



With integrated display terminal:



Summary of functions:

Code	Name	Page
PtC-	[PTC MANAGEMENT]	189
rSt-	[FAULT RESET]	190
Atr-	[AUTOMATIC RESTART]	191
FLr-	[CATCH ON THE FLY]	192
tHt-	[MOTOR THERMAL PROT.]	194
OPL-	[OUTPUT PHASE LOSS]	194
IPL-	[INPUT PHASE LOSS]	195
OHL-	[DRIVE OVERHEAT]	195
SAt-	[THERMAL ALARM STOP]	196
EtF-	[EXTERNAL FAULT]	197
USb-	[UNDERVOLTAGE MGT]	198
tIt-	[IGBT TESTS]	199
LFL-	[4-20mA LOSS]	200
InH-	[FAULT INHIBITION]	201
CLL-	[COM. FAULT MANAGEMENT]	202
tId-	[TORQUE OR I LIM. DETECT.]	203
FqF-	[FREQUENCY METER]	205
brP-	[DB RES. PROTECTION]	206
bUF-	[BU PROTECTION]	206
tnF-	[AUTO TUNING FAULT]	206
PPI-	[CARDS PAIRING]	207
ULd-	[PROCESS UNDERLOAD]	209
OLd-	[PROCESS OVERLOAD]	210
FdL-	[DAMPER FAULT MGT.]	211
LFF-	[FALLBACK SPEED]	212
FSt-	[RAMP DIVIDER]	212
dCI-	[DC INJECTION]	212

The parameters in the [1.8 FAULT MANAGEMENT] (FLt-) menu can only be modified when the drive is stopped and there is no run command, except for parameters with a symbol in the code column, which can be modified with the drive running or stopped.

PTC probes

3 sets of PTC probes can be managed by the drive in order to protect the motors:

- 1 on logic input LI6 converted for this use by switch "**SW2**" on the control card.
- 1 on each of the 2 option cards VW3A3201 and VW3A3202.

Each of these sets of PTC probes is monitored for the following faults:

- Motor overheating
- Sensor break fault
- Sensor short-circuit fault

Protection via PTC probes does not disable protection via I^2t calculation performed by the drive (the two types of protection can be combined).

Code	Name/Description	Adjustment range	Factory setting
PtC-	■ **[PTC MANAGEMENT]**		
PtCL	❑ **[LI6 = PTC probe]**		[No] (nO)
	Can be accessed if switch **SW2** on the control card is set to PTC.		
nO	☐ **[No]** (nO): Not used		
AS	☐ **[Always]** (AS): “PTC probe” faults are monitored permanently, even if the power supply is not connected (as long as the control remains connected to the power supply).		
rdS	☐ **[Power ON]** (rdS): “PTC probe” faults are monitored while the drive power supply is connected.		
rS	☐ **[Motor ON]** (rS): “PTC probe” faults are monitored while the motor power supply is connected.		
PtC1	❑ **[PTC1 probe]**		[No] (nO)
	Can be accessed if a VW3A3201 option card has been inserted.		
nO	☐ **[No]** (nO): Not used		
AS	☐ **[Always]** (AS): “PTC probe” faults are monitored permanently, even if the power supply is not connected (as long as the control remains connected to the power supply).		
rdS	☐ **[Power ON]** (rdS): “PTC probe” faults are monitored while the drive power supply is connected.		
rS	☐ **[Motor ON]** (rS): “PTC probe” faults are monitored while the motor power supply is connected.		
PtC2	❑ **[PTC2 probe]**		[No] (nO)
	Can be accessed if a VW3A3202 option card has been inserted.		
nO	☐ **[No]** (nO): Not used		
AS	☐ **[Always]** (AS): “PTC probe” faults are monitored permanently, even if the power supply is not connected (as long as the control remains connected to the power supply).		
rdS	☐ **[Power ON]** (rdS): “PTC probe” faults are monitored while the drive power supply is connected.		
rS	☐ **[Motor ON]** (rS): “PTC probe” faults are monitored while the motor power supply is connected.		

Code	Name/Description	Adjustment range	Factory setting
rSt-	■ **[FAULT RESET]**		
rSF	❑ **[Fault reset]** Manual fault reset		[LI4] (LI4)
nO LI1 - - C101 - - - Cd00 -	☐ **[No]** (nO): Function inactive ☐ **[LI1]** (LI1) to **[LI6]** (LI6) ☐ **[LI7]** (LI7) to **[LI10]** (LI10): If VW3A3201 logic I/O card has been inserted ☐ **[LI11]** (LI11) to **[LI14]** (LI14): If VW3A3202 extended I/O card has been inserted ☐ **[C101]** (C101) to **[C115]** (C115): With integrated Modbus in [I/O profile] (IO) ☐ **[C201]** (C201) to **[C215]** (C215): With integrated CANopen in [I/O profile] (IO) ☐ **[C301]** (C301) to **[C315]** (C315): With a communication card in [I/O profile] (IO) ☐ **[C401]** (C401) to **[C415]** (C415): With a Controller Inside card in [I/O profile] (IO) ☐ **[CD00]** (Cd00) to **[CD13]** (Cd13): In [I/O profile] (IO) can be switched with possible logic inputs ☐ **[CD14]** (Cd14) to **[CD15]** (Cd15): In [I/O profile] (IO) can be switched without logic inputs Faults are reset when the assigned input or bit changes to 1, if the cause of the fault has disappeared. The STOP/RESET button on the graphic display terminal performs the same function. See pages 240 to 244 for the list of faults that can be reset manually.		
rP	❑ **[Product reset]** Parameter can only be accessed in [ACCESS LEVEL] = [Expert] mode. Drive reinitialization. Can be used to reset all faults without having to disconnect the drive from the power supply.		[No] (nO)
nO YES	☐ **[No]** (nO): Function inactive ☐ **[Yes]** (YES): Reinitialization. Press and hold down the "ENT" key for 2 s. The parameter changes back to [No] (nO) automatically as soon as the operation is complete. The drive can only be reinitialized when locked. **CAUTION** Make sure that the cause of the fault that led to the drive locking has been removed before reinitializing. **Failure to follow this instruction can result in equipment damage.**		
rPA	❑ **[Product reset assig.]** Parameter can only be modified in [ACCESS LEVEL] = [Expert] mode. Drive reinitialization via logic input. Can be used to reset all faults without having to disconnect the drive from the power supply. The drive is reinitialized on a rising edge (change from 0 to 1) of the assigned input. The drive can only be reinitialized when locked.		[No] (nO)
nO LI1 - LI14	☐ **[No]** (nO): Function inactive ☐ **[LI1]** (LI1) to **[LI6]** (LI6) ☐ **[LI7]** (LI7) to **[LI10]** (LI10): If VW3A3201 logic I/O card has been inserted ☐ **[LI11]** (LI11) to **[LI14]** (LI14): If VW3A3202 extended I/O card has been inserted To assign reinitialization, press and hold down the "ENT" key for 2 s. **CAUTION** Make sure that the cause of the fault that led to the drive locking has been removed before reinitializing. **Failure to follow this instruction can result in equipment damage.**		

Code	Name/Description	Adjustment range	Factory setting
AtR-	■ **[AUTOMATIC RESTART]**		
Atr	❑ **[Automatic restart]**		[No] (nO)
nO	❑ **[No]** (nO): Function inactive		
YES	❑ **[Yes]** (YES): Automatic restart, after locking on a fault, if the fault has disappeared and the other operating conditions permit the restart. The restart is performed by a series of automatic attempts separated by increasingly longer waiting periods: 1 s, 5 s, 10 s, then 1 mn for the following attempts. The drive fault relay remains activated if this function is active. The speed reference and the operating direction must be maintained. Use 2-wire control ([2/3 wire control] (tCC) = [2 wire] (2C) and [2 wire type] (tCt) = [Level] (LEL) see page 80). ⚠ **WARNING** **UNINTENDED EQUIPMENT OPERATION** **Check that an automatic restart will not endanger personnel or equipment in any way.** **Failure to follow these instructions can result in death or serious injury.** If the restart has not taken place once the configurable time tAr has elapsed, the procedure is aborted and the drive remains locked until it is turned off and then on again. The faults which permit this function are listed on page 243:		
tAr	❑ **[Max. restart time]**		[5 minutes] (5)
5	❑ **[5 minutes]** (5): 5 minutes		
10	❑ **[10 minutes]** (10): 10 minutes		
30	❑ **[30 minutes]** (30): 30 minutes		
1h	❑ **[1 hour]** (1h): 1 hour		
2h	❑ **[2 hours]** (2h): 2 hours		
3h	❑ **[3 hours]** (3h): 3 hours		
Ct	❑ **[Unlimited]** (Ct): Unlimited Max. duration of restart attempts. This parameter appears if [Automatic restart] (Atr) = [Yes] (YES). It can be used to limit the number of consecutive restarts on a recurrent fault.		

Code	Name/Description	Adjustment range	Factory setting
FLr-	**[CATCH ON THE FLY]**		
FLr	**[Catch on the fly]**		[Yes] (YES)
	Used to enable a smooth restart if the run command is maintained after the following events: • Loss of line supply or disconnection • Reset of current fault or automatic restart • Freewheel stop The speed given by the drive resumes from the estimated speed of the motor at the time of the restart, then follows the ramp to the reference speed. This function requires 2-wire level control.		
nO	**[No]** (nO): Function inactive		
YES	**[Yes]** (YES): Function active When the function is operational, it activates at each run command, resulting in a slight delay of the current (0.5 s max.). [Catch on the fly] (FLr) is forced to [No] (nO) if [Auto DC injection] (AdC) page 135 = [Continuous] (Ct)		
UCb ()	**[Sensitivity]** Parameter accessible at and above ATV61HD55M3X, ATV61HD90N4 and ATV61HC11Y. Adjusts the catch-on-the-fly sensitivity around the zero speed. Decrease the value if the drive is not able to perform the catch on the fly, and increase it if the drive locks on a fault as it performs the catch on the fly.	0.4 to 15%	0.6%

() Parameter that can be modified during operation or when stopped.

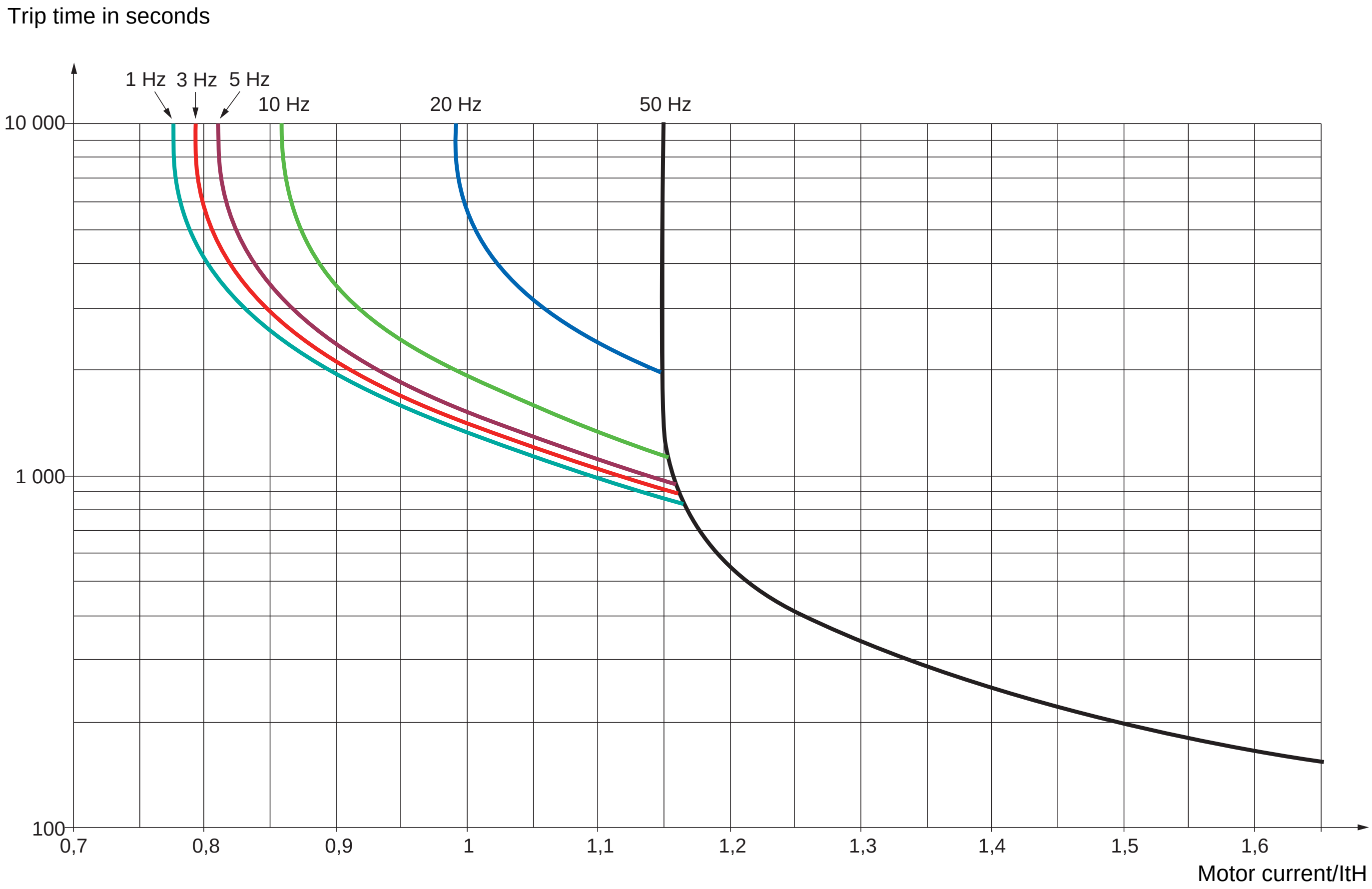
Motor thermal protection

Function:

Thermal protection by calculating the I^2t.

☞ **Note:** The memory of the motor thermal state is saved when the drive is switched off. The power-off time is used to recalculate the thermal state the next time the drive is switched on.

- Naturally-cooled motors:
  The tripping curves depend on the motor frequency.
- Force-cooled motors:
  Only the 50 Hz tripping curve needs to be considered, regardless of the motor frequency.



Code	Name/Description	Adjustment range	Factory setting
tHt-	■ **[MOTOR THERMAL PROT.]**		
tHt nO ACL FCL	❑ **[Motor protect. type]** ☐ **[No]** (nO): No protection. ☐ **[Self cooled]** (ACL): For self-cooled motors ☐ **[Force-cool]** (FCL): For force-cooled motors **Note:** A fault trip will occur when the thermal state reaches 118% of the rated state and reactivation will occur when the state falls back below 100%.		[Self cooled] (ACL)
ttd	❑ **[Motor therm. level]** (1) Trip threshold for motor thermal alarm (logic output or relay)	0 to 118%	100%
ttd2	❑ **[Motor2 therm. level]** Trip threshold for motor 2 thermal alarm (logic output or relay)	0 to 118%	100%
ttd3	❑ **[Motor3 therm. level]** Trip threshold for motor 3 thermal alarm (logic output or relay)	0 to 118%	100%
OLL nO YES Stt LFF rLS rMP FSt dCI	❑ **[Overload fault mgt]** Type of stop in the event of a motor thermal fault ☐ **[Ignore]** (nO): Fault ignored ☐ **[Freewheel]** (YES): Freewheel stop. ☐ **[Per STT]** (Stt): Stop according to configuration of [Type of stop] (Stt) page 133, without fault tripping. In this case the fault relay does not open and the drive is ready to restart as soon as the fault disappears, according to the restart conditions of the active command channel (e.g., according to [2/3 wire control] (tCC) and [2 wire type] (tCt) page 80 if control is via the terminals). Configuring an alarm for this fault is recommended (assigned to a logic output, for example) in order to indicate the cause of the stop. ☐ **[fallback spd]** (LFF): Switch to fallback speed, maintained as long as the fault is present and the run command is not disabled (2). ☐ **[Spd maint.]** (rLS): The drive maintains the speed being applied when the fault occurred, as long as the fault is present and the run command is not disabled (2). ☐ **[Ramp stop]** (rMP): Stop on ramp ☐ **[Fast stop]** (FSt): Fast stop ☐ **[DC injection]** (dCI): DC injection stop. This type of stop cannot be used with certain other functions. See table on page 122.		[Freewheel] (YES)
OPL-	■ **[OUTPUT PHASE LOSS]**		
OPL nO YES OAC	❑ **[Output Phase Loss]** ☐ **[No]** (nO): Function inactive ☐ **[Yes]** (YES): Tripping on OPF fault with freewheel stop. ☐ **[Output cut]** (OAC): No fault triggered, but management of the output voltage in order to avoid an overcurrent when the link with the motor is re-established and catch on the fly performed (even if this function has not been configured). This selection cannot be made at and above 55 kW (75 HP) for the ATV61●●●M3X and at and above 90 kW (120 HP) for the ATV61●●●N4.		[Yes] (YES)
Odt	❑ **[OutPh time detect]** Time delay for taking the [Output Phase Loss] (OPL) fault into account, or for taking management of the output voltage into account if [Output Phase Loss] (OPL) = [Ouptut cut] (OAC).	0.5 to 10 s	0.5 s

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.
(2) Because, in this case, the fault does not trigger a stop, it is essential to assign a relay or logic output to its indication.

Parameter that can be modified during operation or when stopped.

IPL-	**[INPUT PHASE LOSS]**		
IPL	**[Input phase loss]**		According to drive rating
nO YES	☐ **[Ignore]** (nO): Fault ignored, to be used when the drive is supplied via a single-phase supply or by the DC bus. ☐ **[Freewheel]** (YES): Fault, with freewheel stop. If one phase disappears, the drive switches to fault mode [Input phase loss] (IPL), but if 2 or 3 phases disappear, the drive continues to operate until it trips on an undervoltage fault.		
OHL-	**[DRIVE OVERHEAT]**		
OHL	**[Overtemp fault mgt]**		[Freewheel] (YES)
	CAUTION **RISK OF EQUIPMENT DAMAGE** Inhibiting faults results in the drive not being protected. This invalidates the warranty. Check that the possible consequences do not present any risk. **Failure to follow these instructions can result in equipment damage.**		
nO YES Stt LFF rLS rMP FSt dCI	Behavior in the event of the drive overheating ☐ **[Ignore]** (nO): Fault ignored ☐ **[Freewheel]** (YES): Freewheel stop. ☐ **[Per STT]** (Stt): Stop according to configuration of [Type of stop] (Stt) page 133, without fault tripping. In this case the fault relay does not open and the drive is ready to restart as soon as the fault disappears, according to the restart conditions of the active command channel (e.g., according to [2/3 wire control] (tCC) and [2 wire type] (tCt) page 80 if control is via the terminals). Configuring an alarm for this fault is recommended (assigned to a logic output, for example) in order to indicate the cause of the stop. ☐ **[fallback spd]** (LFF): Switch to fallback speed, maintained as long as the fault is present and the run command is not disabled (1). ☐ **[Spd maint.]** (rLS): The drive maintains the speed being applied when the fault occurred, as long as the fault is present and the run command is not disabled (1). ☐ **[Ramp stop]** (rMP): Stop on ramp ☐ **[Fast stop]** (FSt): Fast stop ☐ **[DC injection]** (dCI): DC injection stop. This type of stop cannot be used with certain other functions. See table on page 122. **Note:** A fault trip will occur when the thermal state reaches 118% of the rated state and reactivation will occur when the state falls back below 90%.		
tHA ()	**[Drv therm. state al]** Trip threshold for drive thermal alarm (logic output or relay).	0 to 118%	100%

(1) Because, in this case, the fault does not trigger a stop, it is essential to assign a relay or logic output to its indication.

()	Parameter that can be modified during operation or when stopped.

Deferred stop on thermal alarm

This function can be used in intermittent applications, where it is desirable to avoid any stops for which no command has been given.
It prevents untimely stopping if the drive or motor overheats, by authorizing operation until the next stop for which a command is given. At the next stop, the drive is locked until the thermal state falls back to a value which undershoots the set threshold by 20%. Example: A trip threshold set at 80% enables reactivation at 60%.
One thermal state threshold must be defined for the drive, and one thermal state threshold for the motor(s), which will trip the deferred stop.

Code	Name/Description	Adjustment range	Factory setting
SAt-	■ [THERMAL ALARM STOP]		
SAt	❑ [Thermal alarm stop]		[No] (nO)
nO YES	☐ [No] (nO): Function inactive (in this case, the following parameters cannot be accessed) ☐ [Yes] (YES): Freewheel stop on drive or motor thermal alarm **CAUTION** **The drive and motor are no longer protected in the event of thermal alarm stops. This invalidates the warranty.** **Check that the possible consequences do not present any risk.** **Failure to follow these instructions can result in equipment damage.**		
tHA	❑ [Drv therm. state al] Thermal state threshold of the drive tripping the deferred stop.	0 to 118%	100%
ttd	❑ [Motor therm. level] Thermal state threshold of the motor tripping the deferred stop.	0 to 118%	100%
ttd2	❑ [Motor2 therm. level] Thermal state threshold of the motor 2 tripping the deferred stop.	0 to 118%	100%
ttd3	❑ [Motor3 therm. level] Thermal state threshold of the motor 3 tripping the deferred stop.	0 to 118%	100%

Parameter that can be modified during operation or when stopped.

Code	Name/Description	Adjustment range	Factory setting
EtF-	**[EXTERNAL FAULT]**		
EtF	**[External fault ass.]**		[No] (nO)
nO	[No] (nO): Function inactive		
LI1	[LI1] (LI1)		
-	:		
-	:		
-	[...] (...): See the assignment conditions on page 116. If the assigned bit is at 0, there is no external fault. If the assigned bit is at 1, there is an external fault. Logic can be configured via [External fault config] (LEt) if a logic input has been assigned.		
LEt	**[External fault config]**		[Active high] (HIG)
	Parameter can be accessed if the external fault has been assigned to a logic input. It defines the positive or negative logic of the input assigned to the fault.		
LO	[Active low] (LO): Fault on falling edge (change from 1 to 0) of the assigned input		
HIG	[Active high] (HIG): Fault on rising edge (change from 0 to 1) of the assigned input		
EPL	**[External fault mgt]**		[Freewheel] (YES)
	Type of stop in the event of an external fault		
nO	[Ignore] (nO): Fault ignored		
YES	[Freewheel] (YES): Freewheel stop.		
Stt	[Per STT] (Stt): Stop according to configuration of [Type of stop] (Stt) page 133, without fault tripping. In this case the fault relay does not open and the drive is ready to restart as soon as the fault disappears, according to the restart conditions of the active command channel (e.g., according to [2/3 wire control] (tCC) and [2 wire type] (tCt) page 80 if control is via the terminals). Configuring an alarm for this fault is recommended (assigned to a logic output, for example) in order to indicate the cause of the stop.		
LFF	[fallback spd] (LFF): Switch to fallback speed, maintained as long as the fault is present and the run command is not disabled (1).		
rLS	[Spd maint.] (rLS): The drive maintains the speed being applied when the fault occurred, as long as the fault is present and the run command is not disabled (1).		
rMP	[Ramp stop] (rMP): Stop on ramp		
FSt	[Fast stop] (FSt): Fast stop		
dCI	[DC injection] (dCI): DC injection stop. This type of stop cannot be used with certain other functions. See table on page 122.		

(1) Because, in this case, the fault does not trigger a stop, it is essential to assign a relay or logic output to its indication.

Code	Name/Description	Adjustment range	Factory setting
USb-	**[UNDERVOLTAGE MGT]**		
USb	**[UnderV. fault mgt]**		[Flt&R1open] (0)
	Behavior of the drive in the event of an undervoltage		
0	**[Flt&R1open]** (0): Fault and fault relay open.		
1	**[Flt&R1close]** (1): Fault and fault relay closed.		
2	**[Alarm]** (2): Alarm and fault relay remains closed. The alarm may be assigned to a logic output or a relay.		
UrES	**[Mains voltage]**	According to drive voltage rating	According to drive voltage rating
	Rated voltage of the line supply in V.		
	For ATV61●●●M3:		
200	**[200Vac]** (200): 200 Volts AC		
220	**[220Vac]** (220): 220 Volts AC		
240	**[240Vac]** (240): 240 Volts AC		
260	**[260Vac]** (260): 260 Volts AC (factory setting)		
	For ATV61●●●N4:		
380	**[380Vac]** (380): 380 Volts AC		
400	**[400Vac]** (400): 400 Volts AC		
440	**[440Vac]** (440): 440 Volts AC		
460	**[460Vac]** (460): 460 Volts AC		
480	**[480Vac]** (480): 480 Volts AC (factory setting)		
	For ATV61●●●S6X:		
500	**[500 Vac]** (500): 500 Volts AC		
600	**[600 Vac]** (600): 600 Volts AC (factory setting)		
	For ATV61●●●Y:		
500	**[500 Vac]** (500): 500 Volts AC		
600	**[600 Vac]** (600): 600 Volts AC		
690	**[690 Vac]** (690): 690 Volts AC (factory setting)		
USL	**[Undervoltage level]**		
	Undervoltage fault trip level setting in V. The adjustment range and factory setting are determined by the drive voltage rating and the [Mains voltage] (UrES) value.		
USt	**[Undervolt. time out]**	0.2 s to 999.9 s	0.2 s
	Time delay for taking undervoltage fault into account		
StP	**[UnderV. prevention]**		[No] (nO)
	Behavior in the event of the undervoltage fault prevention level being reached		
nO	**[No]** (nO): No action		
MMS	**[DC Maintain]** (MMS): This stop mode uses the inertia to maintain the DC bus voltage as long as possible.		
rMP	**[Ramp stop]** (rMP): Stop following an adjustable ramp [Max stop time] (StM).		
LnF	**[Lock-out]** (LnF): Lock (freewheel stop) without fault		

Parameter that can be modified during operation or when stopped.

[1.8 FAULT MANAGEMENT] (FLt-)

Code	Name/Description	Adjustment range	Factory setting
USb-	■ **[UNDERVOLTAGE MGT]**		
tSM	❑ **[UnderV. restart tm]** Time delay before authorizing the restart after a complete stop for [UnderV. prevention] (StP) = [Ramp stop] (rMP), if the voltage has returned to normal.	1.0 s to 999.9 s	1.0 s
UPL	❑ **[Prevention level]** Undervoltage fault prevention level setting in V, which can be accessed if [UnderV. prevention] (StP) is not [No] (nO). The adjustment range and factory setting are determined by the drive voltage rating and the [Mains voltage] (UrES) value.		
StM	❑ **[Max stop time]** Ramp time if [UnderV. prevention] (StP) = [Ramp stop] (rMP).	0.01 to 60.00 s	1.00 s
tbS	❑ **[DC bus maintain tm]** DC bus maintain time if [UnderV. prevention] (StP) = [DC Maintain] (MMS).	1 to 9,999 s	9,999 s
tIt-	■ **[IGBT TESTS]**		
Strt	❑ **[IGBT test]**		[No] (nO)
nO	☐ **[No]** (nO): No test		
YES	☐ **[Yes]** (YES): The IGBTs are tested on power up and every time a run command is sent. These tests cause a slight delay (a few ms). In the event of a fault, the drive will lock. The following faults can be detected: - Drive output short-circuit (terminals U-V-W): SCF display - IGBT faulty: xtF, where x indicates the number of the IGBT concerned - IGBT short-circuited: x2F, where x indicates the number of the IGBT concerned		

Parameter that can be modified during operation or when stopped.

Code	Name/Description	Adjustment range	Factory setting
LFL-	**[4-20mA LOSS]**		
LFL2	**[AI2 4-20mA loss]**		[Ignore] (nO)
nO	**[Ignore]** (nO): Fault ignored. This configuration is the only one possible if [AI2 min. value] (CrL2) page 86 is not greater than 3 mA or if [AI2 Type] (AI2t) page 86 = [Voltage] (10U).		
YES	**[Freewheel]** (YES): Freewheel stop.		
Stt	**[Per STT]** (Stt): Stop according to configuration of [Type of stop] (Stt) page 133, without fault tripping. In this case the fault relay does not open and the drive is ready to restart as soon as the fault disappears, according to the restart conditions of the active command channel (e.g., according to [2/3 wire control] (tCC) and [2 wire type] (tCt) page 80 if control is via the terminals). Configuring an alarm for this fault is recommended (assigned to a logic output, for example) in order to indicate the cause of the stop.		
LFF	**[fallback spd]** (LFF): Switch to fallback speed, maintained as long as the fault is present and the run command is not disabled (1).		
rLS	**[Spd maint.]** (rLS): The drive maintains the speed being applied when the fault occurred, as long as the fault is present and the run command is not disabled (1).		
rMP	**[Ramp stop]** (rMP): Stop on ramp		
FSt	**[Fast stop]** (FSt): Fast stop		
dCI	**[DC injection]** (dCI): DC injection stop. This type of stop cannot be used with certain other functions. See table on page 122.		
LFL3	**[AI3 4-20mA loss]** Can be accessed if a VW3A3202 option card has been inserted.		[Ignore] (nO)
nO	**[Ignore]** (nO): Fault ignored. This configuration is the only one possible if [AI3 min. value] (CrL3) page 87 is not greater than 3 mA.		
YES	**[Freewheel]** (YES): Freewheel stop.		
Stt	**[Per STT]** (Stt): Stop according to configuration of [Type of stop] (Stt) page 133, without fault tripping. In this case the fault relay does not open and the drive is ready to restart as soon as the fault disappears, according to the restart conditions of the active command channel (e.g., according to [2/3 wire control] (tCC) and [2 wire type] (tCt) page 80 if control is via the terminals). Configuring an alarm for this fault is recommended (assigned to a logic output, for example) in order to indicate the cause of the stop.		
LFF	**[fallback spd]** (LFF): Switch to fallback speed, maintained as long as the fault is present and the run command is not disabled (1).		
rLS	**[Spd maint.]** (rLS): The drive maintains the speed being applied when the fault occurred, as long as the fault is present and the run command is not disabled (1).		
rMP	**[Ramp stop]** (rMP): Stop on ramp		
FSt	**[Fast stop]** (FSt): Fast stop		
dCI	**[DC injection]** (dCI): DC injection stop. This type of stop cannot be used with certain other functions. See table on page 122.		
LFL4	**[AI4 4-20mA loss]** Can be accessed if a VW3A3202 option card has been inserted.		[Ignore] (nO)
nO	**[Ignore]** (nO): Fault ignored. This configuration is the only one possible if [AI4 min. value] (CrL4) page 88 is not greater than 3 mA or if [AI4 Type] (AI4t) page 88 = [Voltage] (10U).		
YES	**[Freewheel]** (YES): Freewheel stop.		
Stt	**[Per STT]** (Stt): Stop according to configuration of [Type of stop] (Stt) page 133, without fault tripping. In this case the fault relay does not open and the drive is ready to restart as soon as the fault disappears, according to the restart conditions of the active command channel (e.g., according to [2/3 wire control] (tCC) and [2 wire type] (tCt) page 80 if control is via the terminals). Configuring an alarm for this fault is recommended (assigned to a logic output, for example) in order to indicate the cause of the stop.		
LFF	**[fallback spd]** (LFF): Switch to fallback speed, maintained as long as the fault is present and the run command is not disabled (1).		
rLS	**[Spd maint.]** (rLS): The drive maintains the speed being applied when the fault occurred, as long as the fault is present and the run command is not disabled (1).		
rMP	**[Ramp stop]** (rMP): Stop on ramp		
FSt	**[Fast stop]** (FSt): Fast stop		
dCI	**[DC injection]** (dCI): DC injection stop. This type of stop cannot be used with certain other functions. See table on page 122.		

(1) Because, in this case, the fault does not trigger a stop, it is essential to assign a relay or logic output to its indication.

Parameter can be accessed in [Expert] mode.

Code	Name/Description	Adjustment range	Factory setting
InH-	■ **[FAULT INHIBITION]**		
InH	❑ **[Fault inhibit assign.]** To assign fault inhibit, press the "ENT" key for 2 s. **CAUTION** **Inhibiting faults results in the drive not being protected. This invalidates the warranty.** **Check that the possible consequences do not present any risk.** **Failure to follow these instructions can result in equipment damage.**		[No] (nO)
nO LI1 - - -	☐ **[No]** (nO): Function inactive, thereby preventing access to other function parameters. ☐ **[LI1]** (LI1) : : ☐ **[...]** (...): See the assignment conditions on page 116. If the assigned input or bit is at 0, fault monitoring is active. If the assigned input or bit is at 1, fault monitoring is inactive. Active faults are reset on a rising edge (change from 0 to 1) of the assigned input or bit. **Note:** The "Power Removal" function and any faults that prevent any form of operation are not affected by this function. A list of faults affected by this function appears on pages 240 to 245.		
InHS	❑ **[Forced Run]** This parameter causes the run command to be forced in a specific direction when the input or bit for fault inhibition is at 1, with priority over all other commands with the exception of "Power Removal". To assign forced run, press and hold down the "ENT" key for 2 s.		[No] (nO)
nO Frd rrS	☐ **[No]** (nO): Function inactive ☐ **[Fw.For.Run]** (Frd): Forced forward run. ☐ **[Rev.For.Run]** (rrS): Forced reverse run. **DANGER** **UNINTENDED EQUIPMENT OPERATION** • Check that it is safe to force the run command. **Failure to follow these instructions will result in death or serious injury.**		
InHr	❑ **[Forced Run Ref.]** The parameter can be accessed if [Forced Run] (InHS) is not [No] (nO) This parameter causes the reference to be forced to the configured value when the input or bit for fault inhibition is at 1, with priority over all other references. Value 0 = function inactive. The factory setting changes to 60 Hz if [Standard mot. freq] (bFr) = [60 Hz NEMA] (60).	0 to 500 or 1,000 Hz according to rating	50 Hz

Code	Name/Description	Adjustment range	Factory setting
CLL-	■ [COM. FAULT MANAGEMENT]		
CLL	❑ [Network fault mgt]		[Freewheel] (YES)
	Behavior of the drive in the event of a communication fault with a communication card		
nO	☐ [Ignore] (nO): Fault ignored		
YES	☐ [Freewheel] (YES): Freewheel stop.		
Stt	☐ [Per STT] (Stt): Stop according to configuration of [Type of stop] (Stt) page 133, without fault tripping. In this case the fault relay does not open and the drive is ready to restart as soon as the fault disappears, according to the restart conditions of the active command channel (e.g., according to [2/3 wire control] (tCC) and [2 wire type] (tCt) page 80 if control is via the terminals). Configuring an alarm for this fault is recommended (assigned to a logic output, for example) in order to indicate the cause of the stop.		
LFF	☐ [fallback spd] (LFF): Switch to fallback speed, maintained as long as the fault is present and the run command is not disabled (1).		
rLS	☐ [Spd maint.] (rLS): The drive maintains the speed being applied when the fault occurred, as long as the fault is present and the run command is not disabled (1).		
rMP	☐ [Ramp stop] (rMP): Stop on ramp		
FSt	☐ [Fast stop] (FSt): Fast stop		
dCI	☐ [DC injection] (dCI): DC injection stop. This type of stop cannot be used with certain other functions. See table on page 122.		
COL	❑ [CANopen fault mgt]		[Freewheel] (YES)
	Behavior of the drive in the event of a communication fault with integrated CANopen		
nO	☐ [Ignore] (nO): Fault ignored		
YES	☐ [Freewheel] (YES): Freewheel stop.		
Stt	☐ [Per STT] (Stt): Stop according to configuration of [Type of stop] (Stt) page 133, without fault tripping. In this case the fault relay does not open and the drive is ready to restart as soon as the fault disappears, according to the restart conditions of the active command channel (e.g., according to [2/3 wire control] (tCC) and [2 wire type] (tCt) page 80 if control is via the terminals). Configuring an alarm for this fault is recommended (assigned to a logic output, for example) in order to indicate the cause of the stop.		
LFF	☐ [fallback spd] (LFF): Switch to fallback speed, maintained as long as the fault is present and the run command is not disabled (1).		
rLS	☐ [Spd maint.] (rLS): The drive maintains the speed being applied when the fault occurred, as long as the fault is present and the run command is not disabled (1).		
rMP	☐ [Ramp stop] (rMP): Stop on ramp		
FSt	☐ [Fast stop] (FSt): Fast stop		
dCI	☐ [DC injection] (dCI): DC injection stop. This type of stop cannot be used with certain other functions. See table on page 122.		
SLL	❑ [Modbus fault mgt]		[Freewheel] (YES)
	Behavior of the drive in the event of a communication fault with integrated Modbus		
nO	☐ [Ignore] (nO): Fault ignored		
YES	☐ [Freewheel] (YES): Freewheel stop.		
Stt	☐ [Per STT] (Stt): Stop according to configuration of [Type of stop] (Stt) page 133, without fault tripping. In this case the fault relay does not open and the drive is ready to restart as soon as the fault disappears, according to the restart conditions of the active command channel (e.g., according to [2/3 wire control] (tCC) and [2 wire type] (tCt) page 80 if control is via the terminals). Configuring an alarm for this fault is recommended (assigned to a logic output, for example) in order to indicate the cause of the stop.		
LFF	☐ [fallback spd] (LFF): Switch to fallback speed, maintained as long as the fault is present and the run command is not disabled (1).		
rLS	☐ [Spd maint.] (rLS): The drive maintains the speed being applied when the fault occurred, as long as the fault is present and the run command is not disabled (1).		
rMP	☐ [Ramp stop] (rMP): Stop on ramp		
FSt	☐ [Fast stop] (FSt): Fast stop		
dCI	☐ [DC injection] (dCI): DC injection stop. This type of stop cannot be used with certain other functions. See table on page 122.		

(1) Because, in this case, the fault does not trigger a stop, it is essential to assign a relay or logic output to its indication.

Code	Name/Description	Adjustment range	Factory setting
tId-	■ **[TORQUE OR I LIM. DETECT.]**		
SSb	❑ **[Trq/I limit. Stop]** Behavior in the event of switching to torque or current limitation		[Ignore] (nO)
nO	☐ **[Ignore]** (nO): Fault ignored		
YES	☐ **[Freewheel]** (YES): Freewheel stop.		
Stt	☐ **[Per STT]** (Stt): Stop according to configuration of [Type of stop] (Stt) page 133, without fault tripping. In this case the fault relay does not open and the drive is ready to restart as soon as the fault disappears, according to the restart conditions of the active command channel (e.g., according to [2/3 wire control] (tCC) and [2 wire type] (tCt) page 80 if control is via the terminals). Configuring an alarm for this fault is recommended (assigned to a logic output, for example) in order to indicate the cause of the stop.		
LFF	☐ **[fallback spd]** (LFF): Switch to fallback speed, maintained as long as the fault is present and the run command is not disabled (1).		
rLS	☐ **[Spd maint.]** (rLS): The drive maintains the speed being applied when the fault occurred, as long as the fault is present and the run command is not disabled (1).		
rMP	☐ **[Ramp stop]** (rMP): Stop on ramp		
FSt	☐ **[Fast stop]** (FSt): Fast stop		
dCI	☐ **[DC injection]** (dCI): DC injection stop. This type of stop cannot be used with certain other functions. See table on page 122.		
StO ()	❑ **[Trq/I limit. time out]** (If fault has been configured) Time delay for taking SSF “Limitation” fault into account	0 to 9,999 ms	1,000 ms

(1) Because, in this case, the fault does not trigger a stop, it is essential to assign a relay or logic output to its indication.

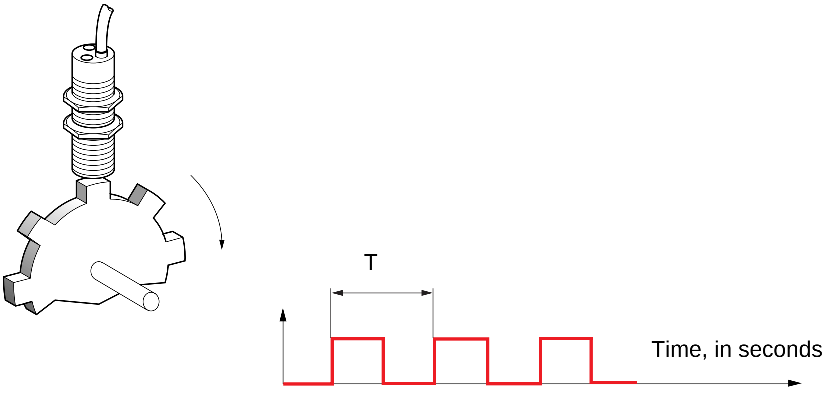
()	Parameter that can be modified during operation or when stopped.

Use of the "Pulse input" to measure the speed of rotation of the motor

This function uses the "Pulse input" from the VW3A3202 extension card and can, therefore, only be used if this card has been inserted and if the "Pulse input" is not being used for another function.

Example of use

A notched disc driven by the motor and connected to a proximity sensor can be used to generate a frequency signal that is proportional to the speed of rotation of the motor.



When applied to the "Pulse input", this signal supports:

- Measurement and display of the motor speed: signal frequency = 1/T. This frequency is displayed by means of the [Pulse in. work. freq.] (FqS) parameter, page 44 or 46.
- Overspeed detection (if the measured speed exceeds a preset threshold, the drive will trip on a fault).
- Detection of a speed threshold that can be adjusted using [Pulse warning thd.] (FqL) page 59 and is assignable to a relay or logic output, see page 94.

Code	Name/Description	Adjustment range	Factory setting
FqF-	**[FREQUENCY METER]** Can be accessed if a VW3A3202 option card has been inserted		
FqF	**[Frequency meter]**		[No] (nO)
	Activation of the speed measurement function.		
nO	[No] (nO): Function inactive		
YES	[Yes] (YES): Function active, assignment only possible if no other functions have been assigned to the "Pulse input".		
FqC	**[Pulse scal. divisor]**	1.0 to 100.0	1.0
	Scaling factor for the "Pulse input" (divisor). The frequency measured is displayed by means of the [Pulse in. work. freq.] (FqS) parameter, page 44 or 46.		
FqA	**[Overspd. pulse thd.]**		[No] (nO)
	Activation and adjustment of overspeed monitoring: [Overspeed] (SOF) fault.		
nO	[No] (nO): No overspeed monitoring		
-	**1 Hz to 30.00 Hz**: Adjustment of the frequency tripping threshold on the "Pulse input" divided by [Pulse scal. divisor] (FqC)		
tdS	**[Pulse overspd delay]**	0.0 s to 10.0 s	0.0 s
	Time delay for taking overspeed fault into account		
Fdt	**[Level fr. pulse ctrl]**		[No] (nO)
	Activation and adjustment of monitoring for the Pulse input (speed feedback): [Speed fdback loss] (SPF) fault		
nO	[No] (nO): No monitoring of speed feedback		
-	**0.1 Hz to 500.0 Hz**: Adjustment of the motor frequency threshold for tripping a speed feedback fault (difference between the estimated frequency and the measured speed)		

Code	Name/Description	Adjustment range	Factory setting
brP-	**[DB RES. PROTECTION]**		
brO	**[DB res. protection]**		[No] (nO)
nO	□ **[No]** (nO): No braking resistor protection (thereby preventing access to the other function parameters).		
YES	□ **[Alarm]** (YES): Alarm. The alarm may be assigned to a logic output or a relay (see page 94).		
FLt	□ **[Fault]** (FLt) : Switch to fault (bOF) with locking of drive (freewheel stop).		
	Note: The thermal state of the resistor can be displayed on the graphic display terminal. It is calculated for as long as the drive control remains connected to the power supply.		
brP	**[DB Resistor Power]**	0.1 kW (0.13 HP) to 1,000 kW (1,333 HP)	0.1 kW (0.13 HP)
	The parameter can be accessed if [DB res. protection] (brO) is not [No] (nO). Rated power of the resistor used.		
brU	**[DB Resistor value]**	0.1 to 200 Ohms	0.1 Ohm
	The parameter can be accessed if [DB res. protection] (brO) is not [No] (nO). Rated value of the braking resistor in Ohms.		
bUF-	**[BU PROTECTION]** Parameter accessible at and above ATV61HD55M3X, ATV61HD90N4 and ATV61HC11Y.		
bUb	**[Brake res. fault Mgt]**		[Freewheel] (YES)
	Management of short-circuit [DB unit sh. circuit] (bUF) and overheating [Internal- th. sensor] (InFb) faults in the braking unit.		
nO	□ **[Ignore]** (nO): Fault ignored. **Configuration to be used if there is no braking unit or resistor connected to the drive.**		
YES	□ **[Freewheel]** (YES): Freewheel stop		
tnF-	**[AUTO TUNING FAULT]**		
tnL	**[Autotune fault mgt]**		[Freewheel] (YES)
nO	□ **[Ignore]** (nO): Fault ignored.		
YES	□ **[Freewheel]** (YES): Freewheel stop.		

Parameter that can be modified during operation or when stopped.

Card pairing

Function can only be accessed in [Expert] mode.

This function is used to detect whenever a card has been replaced or the software has been modified in any way.
When a pairing password is entered, the parameters of the cards currently inserted are stored. On every subsequent power-up these parameters are verified and in the event of a discrepancy the drive locks in HCF fault mode. Before the drive can be restarted you must revert to the original situation or re-enter the pairing password.

The following parameters are verified:
- The type of card for: all cards
- The software version for: the two control cards, the VW3A3202 extension card, the Controller Inside card and the communication cards
- The serial number for: both control cards

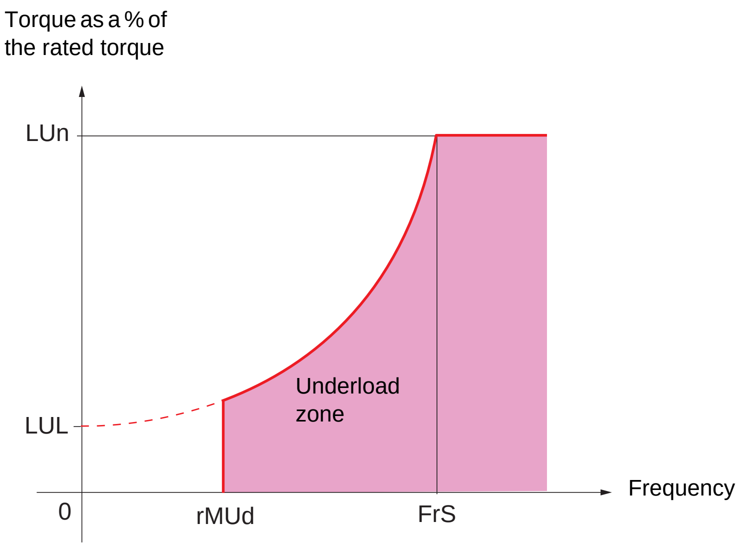
Code	Name/Description	Adjustment range	Factory setting
PPI-	■ [CARDS PAIRING]		
PPI	❑ [Pairing password]	OFF to 9,999	[OFF] (OFF)
	The [OFF] (OFF) value signifies that the card pairing function is inactive. The [ON] (On) value signifies that card pairing is active and that an access code must be entered in order to start the drive in the event of a card pairing fault. As soon as the code has been entered the drive is unlocked and the code changes to [ON] (On). - The PPI code is an unlock code known only to Schneider Electric Product Support.		

Process underload fault

A process underload is detected when the next event occurs and remains pending for a minimum time (ULt), which is configurable:

- The motor is in steady state and the torque is below the set underload limit (LUL, LUn, rMUd parameters).

The motor is in steady state when the offset between the frequency reference and motor frequency falls below the configurable threshold (Srb).



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Between zero frequency and the rated frequency, the curve reflects the following equation:

$$\text{torque} = \text{LUL} + \frac{(\text{LUn - LUL}) \times (\text{frequency})^2}{(\text{rated frequency})^2}$$

The underload function is not active for frequencies below rMUd.

A relay or a logic output can be assigned to the signaling of this fault in the [1.5 INPUTS / OUTPUTS CFG] (I-O-) menu.

Code	Name/Description	Adjustment range	Factory setting
ULd-	■ **[PROCESS UNDERLOAD]**		
ULt	❑ **[Unld T. Del. Detect]** Underload detection time delay. A value of 0 deactivates the function and renders the other parameters inaccessible.	0 to 100 s	0 s
LUn	❑ **[Unld.Thr.Nom.Speed]** (1) Underload threshold at rated motor frequency ([Rated motor freq.] (FrS) page 35), as a % of the rated motor torque.	20 to 100%	60%
LUL	❑ **[Unld.Thr.0.Speed]** (1) Underload threshold at zero frequency, as a % of the rated motor torque.	0 to [Unld.Thr.Nom.Speed] (LUn)	0%
rMUd	❑ **[Unld. Freq.Thr. Det.]** (1) Minimum frequency underload detection threshold	0 to 500 or 1,000 Hz according to rating	0 Hz
Srb	❑ **[Hysteresis Freq.Att.]** (1) Maximum deviation between the frequency reference and the motor frequency, which defines steady state operation.	0.3 to 500 or 1,000 Hz according to rating	0.3 Hz
UdL nO YES rMP FSt	❑ **[Underload Mangmt.]** Behavior on switching to underload detection. ☐ **[Ignore]** (nO): Fault ignored ☐ **[Freewheel]** (YES): Freewheel stop ☐ **[Ramp stop]** (rMP): Stop on ramp ☐ **[Fast stop]** (FSt): Fast stop		[Freewheel] (YES)
FtU	❑ **[Underload T.B.Rest.]** (1) This parameter cannot be accessed if [Underload Mangmt.] (UdL) = [Ignore] (nO). Minimum time permitted between an underload being detected and any automatic restart. In order for an automatic restart to be possible, the value of [Max. restart time] (tAr) page 191 must exceed that of this parameter by at least one minute.	0 to 6 min	0 min

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.

Parameter that can be modified during operation or when stopped.

Process overload fault

A process overload is detected when the next event occurs and remains pending for a minimum time (tOL), which is configurable:

- The drive is in current limitation mode.
- The motor is in steady state and the current is above the set overload threshold (LOC).

The motor is in steady state when the offset between the frequency reference and motor frequency falls below the configurable threshold (Srb).
A relay or a logic output can be assigned to the signaling of this fault in the [1.5 INPUTS / OUTPUTS CFG] (I-O-) menu.

Code	Name/Description	Adjustment range	Factory setting
OLd-	■ **[PROCESS OVERLOAD]**		
tOL	❑ **[Unld Time Detect.]**	0 to 100 s	0 s
	Overload detection time delay. A value of 0 deactivates the function and renders the other parameters inaccessible.		
LOC	❑ **[Ovld Detection Thr.]** (1)	70 to 150%	110%
	Overload detection threshold, as a % of the rated motor current [Rated mot. current] (nCr). This value must be less than the limit current in order for the function to work.		
Srb	❑ **[Hysteresis Freq.Att.]** (1)	0.3 to 500 or 1,000 Hz according to rating	0.3 Hz
	Maximum deviation between the frequency reference and the motor frequency, which defines steady state operation.		
OdL	❑ **[Ovld.Proces.Mngmt]**		[Freewheel] (YES)
	Behavior on switching to overload detection.		
nO	☐ **[Ignore]** (nO): Fault ignored		
YES	☐ **[Freewheel]** (YES): Freewheel stop		
rMP	☐ **[Ramp stop]** (rMP): Stop on ramp		
FSt	☐ **[Fast stop]** (FSt): Fast stop		
FtO	❑ **[Overload T.B.Rest.]** (1)	0 to 6 min	0 min
	This parameter cannot be accessed if [Ovld.Proces.Mngmt] (OdL) = [Ignore] (nO). Minimum time permitted between an overload being detected and any automatic restart. In order for an automatic restart to be possible, the value of [Max. restart time] (tAr) page 191 must exceed that of this parameter by at least one minute.		

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) menu.

Parameter that can be modified during operation or when stopped.

Code	Name/Description	Adjustment range	Factory setting
FdL-	■ **[DAMPER FAULT MGT.]**		
FdL	❑ **[Damper fault mgt.]**		[Freewheel] (YES)
	Type of stop in the event of a damper fault: [Damper stuck] (Fd1)		
nO	☐ **[Ignore]** (nO): Fault ignored		
YES	☐ **[Freewheel]** (YES): Freewheel stop		
Stt	☐ **[Per STT]** (Stt): Stop according to configuration of [Type of stop] (Stt) page 133, without fault tripping. In this case the fault relay does not open and the drive is ready to restart as soon as the fault disappears, according to the restart conditions of the active command channel (e.g. according to [2/3 wire control] (tCC) and [2 wire type] (tCt) page 80 if control is via the terminals). It is advisable to configure an alarm for this fault (assigned to a logic output, for example) in order to indicate the cause of the stop.		
LFF	☐ **[fallback spd]** (LFF): Change to fallback speed, maintained as long as the fault persists and the run command has not been removed (1).		
rLS	☐ **[Spd maint.]** (rLS): The drive maintains the speed being applied when the fault occurred, as long as the fault is present and the run command has not been removed (1).		
rMP	☐ **[Ramp stop]** (rMP): Stop on ramp		
FSt	☐ **[Fast stop]** (FSt): Fast stop		
dCI	☐ **[DC injection]** (dCI): DC injection stop. This type of stop cannot be used with certain other functions. See table on page 122.		

(1) Because, in this case, the fault does not trigger a stop, it is essential to assign a relay or logic output to its indication.

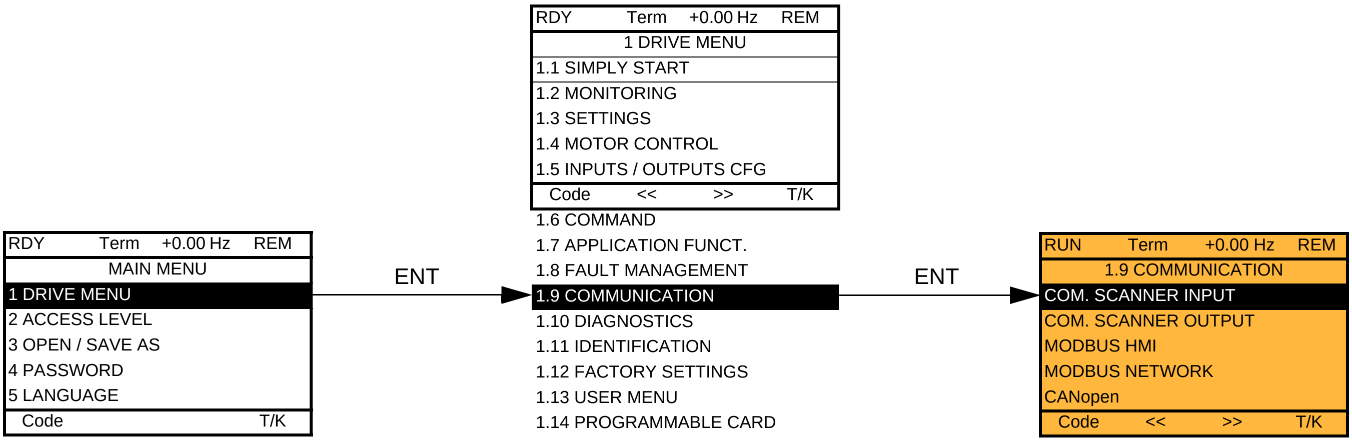
Code	Name/Description		Adjustment range	Factory setting
LFF-	■ [FALLBACK SPEED]			
LFF	❑ [Fallback speed] Selection of the fallback speed		0 to 500 or 1,000 Hz according to rating	0 Hz
FSt-	■ [RAMP DIVIDER]			
dCF	❑ [Ramp divider] The ramp that is enabled (dEC or dE2) is then divided by this coefficient when stop requests are sent. Value 0 corresponds to a minimum ramp time.	(1)	0 to 10	4
dCI-	■ [DC INJECTION]			
IdC	❑ [DC inject. level 1] Level of DC injection braking current activated via logic input or selected as stop mode. **CAUTION** Check that the motor will withstand this current without overheating. **Failure to follow these instructions can result in equipment damage.**	(1) (3)	0.1 to 1.1 or 1.2 In (2) according to rating	0.64 In (2)
tdI	❑ [DC injection time 1] Maximum current injection time [DC inject. level 1] (IdC). After this time the injection current becomes [DC inject. level 2] (IdC2).	(1) (3)	0.1 to 30 s	0.5 s
IdC2	❑ [DC inject. level 2] Injection current activated by logic input or selected as stop mode, once period of time [DC injection time 1] (tdI) has elapsed. **CAUTION** Check that the motor will withstand this current without overheating. **Failure to follow these instructions can result in equipment damage.**	(1) (3)	0.1 In (2) to [DC inject. level 1] (IdC)	0.5 In (2)
tdC	❑ [DC injection time 2] Maximum injection time [DC inject. level 2] (IdC2) for injection, selected as stop mode only. (Can be accessed if [Type of stop] (Stt) = [DC injection] (dCI)).	(1) (3)	0.1 to 30 s	0.5 s

(1) The parameter can also be accessed in the [1.3 SETTINGS] (SEt-) and [1.7 APPLICATION FUNCT.] (FUn-) menus.
(2) In corresponds to the rated drive current indicated in the Installation Manual and on the drive nameplate.
(3) Warning: These settings are independent of the [AUTO DC INJECTION] (AdC-) function.

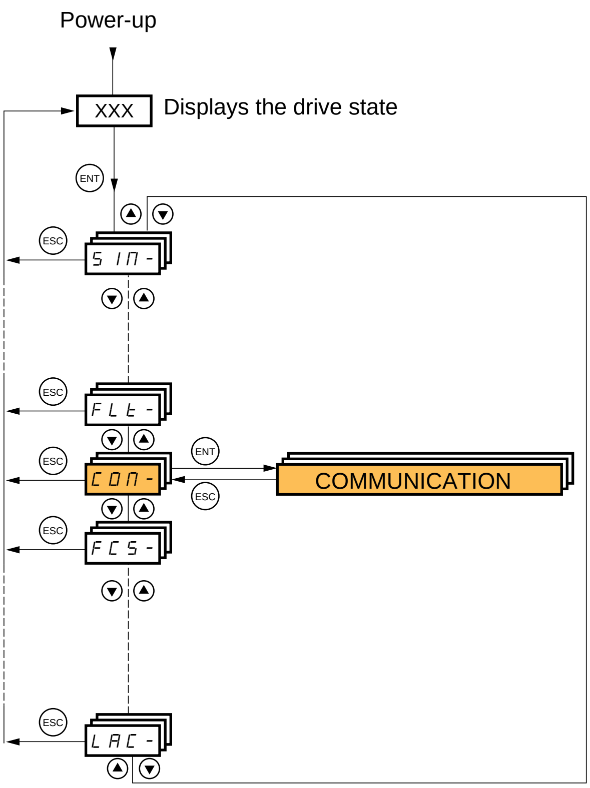
Parameter that can be modified during operation or when stopped.

[1.9 COMMUNICATION] (COM-)

With graphic display terminal:



With integrated display terminal:



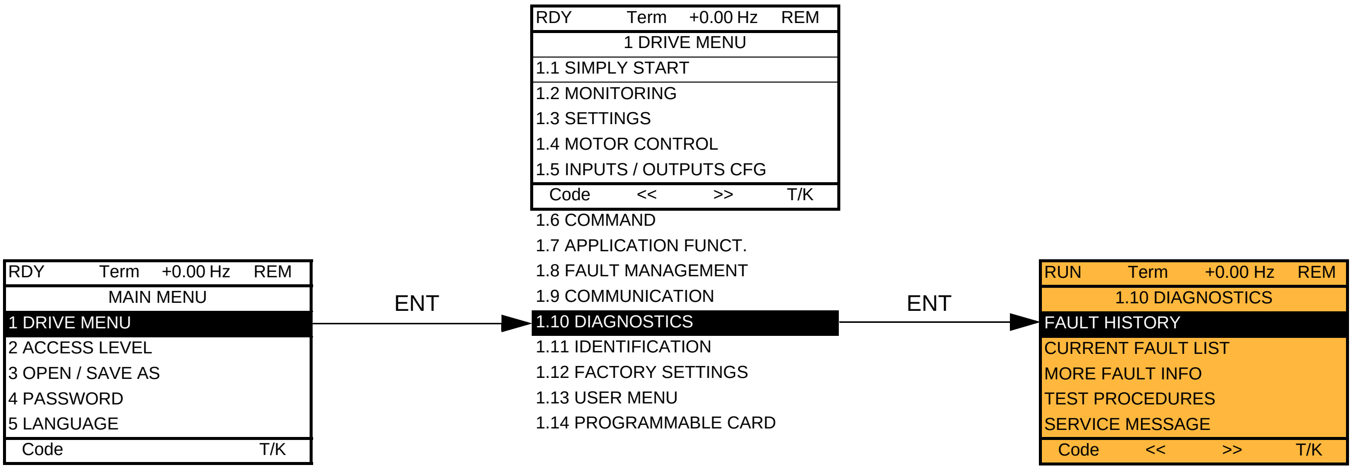
Code	Name/Description	Adjustment range	Factory setting
	[COM. SCANNER INPUT] **Only accessible via graphic display terminal**		
nMA1	**[Scan. IN1 address]** Address of the 1st input word		3201
nMA2	**[Scan. IN2 address]** Address of the 2nd input word		8604
nMA3	**[Scan. IN3 address]** Address of the 3rd input word		0
nMA4	**[Scan. IN4 address]** Address of the 4th input word		0
nMA5	**[Scan. IN5 address]** Address of the 5th input word		0
nMA6	**[Scan. IN6 address]** Address of the 6th input word		0
nMA7	**[Scan. IN7 address]** Address of the 7th input word		0
nMA8	**[Scan. IN8 address]** Address of the 8th input word		0
	[COM. SCANNER OUTPUT] **Only accessible via graphic display terminal**		
nCA1	**[Scan.Out1 address]** Address of the 1st output word		8501
nCA2	**[Scan.Out2 address]** Address of the 2nd output word		8602
nCA3	**[Scan.Out3 address]** Address of the 3rd output word		0
nCA4	**[Scan.Out4 address]** Address of the 4th output word		0
nCA5	**[Scan.Out5 address]** Address of the 5th output word		0
nCA6	**[Scan.Out6 address]** Address of the 6th output word		0
nCA7	**[Scan.Out7 address]** Address of the 7th output word		0
nCA8	**[Scan.Out8 address]** Address of the 8th output word		0

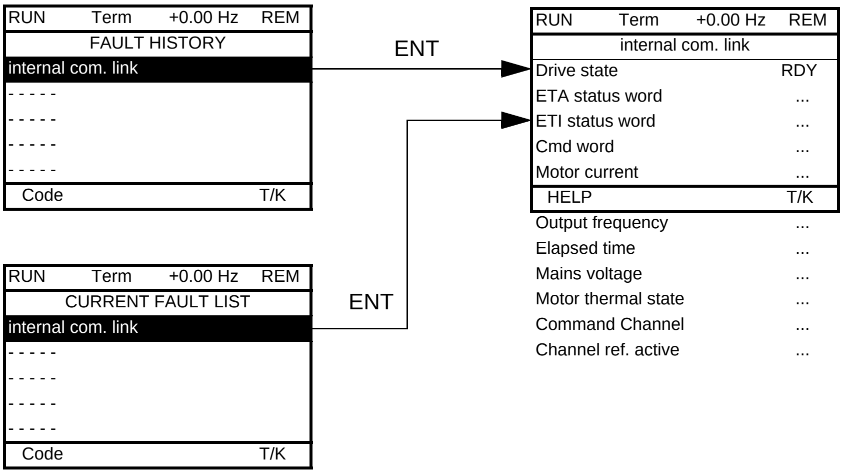
Code	Name/Description	Adjustment range	Factory setting
Md2-	■ **[MODBUS HMI]** Communication with the graphic display terminal		
tbr2	❑ **[HMI baud rate]** 9.6 or 19.2 kbps via the integrated display terminal. 9,600 or 19,200 bauds via the graphic display terminal. The graphic display terminal only operates if [HMI baud rate] (tbr2) = 19,200 bauds (19.2 kbps). In order for any change in the assignment of [HMI baud rate] (tbr2) to be taken into account you must: - Provide confirmation in a confirmation window if using the graphic display terminal - Press the ENT key for 2 s if using the integrated display terminal		19.2 kbps
tFO2	❑ **[HMI format]** Read-only parameter, cannot be modified.		8E1
Md1-	■ **[MODBUS NETWORK]**		
Add	❑ **[Modbus Address]** OFF to 247		OFF
AMOA	❑ **[Modbus add Prg C.]** Modbus address of the Controller Inside card OFF at 247 The parameter can be accessed if the Controller Inside card has been inserted and depending on its configuration (please consult the specific documentation).		OFF
AMOC	❑ **[Modbus add Com.C.]** Modbus address of the communication card OFF to 247 The parameter can be accessed if a communication card has been inserted and depending on its configuration (please consult the specific documentation).		OFF
tbr	❑ **[Modbus baud rate]** 4.8 – 9.6 – 19.2 – 38.4 kbps on the integrated display terminal. 4,800, 9,600, 19,200 or 38,400 bauds on the graphic display terminal.		19.2 kbps
tFO	❑ **[Modbus format]** 8O1 – 8E1 – 8n1, 8n2		8E1
ttO	❑ **[Modbus time out]** 0.1 to 30 s		10.0 s
CnO-	■ **[CANopen]**		
AdCO	❑ **[CANopen address]** OFF to 127		OFF
bdCO	❑ **[CANopen bit rate]** 50 – 125 – 250 – 500 kbps – 1 Mbps		125 kbps
ErCO	❑ **[Error code]** Read-only parameter, cannot be modified.		

Code	Name / Description	Factory setting
-	**[COMMUNICATION CARD]**	
	See the specific documentation for the card used.	
LCF-	**[FORCED LOCAL]**	
FLO	**[Forced local assign.]**	[No] (nO)
nO	[No] (nO): Function inactive	
LI1 - LI14	[LI1] (LI1) to [LI6] (LI6) [LI7] (LI7) to [LI10] (LI10): If VW3A3201 logic I/O card has been inserted [LI11] (LI11) to [LI14] (LI14): If VW3A3202 extended I/O card has been inserted Forcing to local is active when the input is at state 1. [Forced local assign.] (FLO) is forced to [No] (nO) if [Profile] (CHCF) page 117 = [I/O profile] (IO).	
FLOC	**[Forced local Ref.]**	[No] (nO)
nO	[No] (nO): Not assigned (control via the terminals with zero reference).	
AI1	[AI1] (AI1): Analog input	
AI2	[AI2] (AI2): Analog input	
AI3	[AI3] (AI3): Analog input, if VW3A3202 extension card has been inserted	
AI4	[AI4] (AI4): Analog input, if VW3A3202 extension card has been inserted	
LCC	[HMI] (LCC): Assignment of the reference and command to the graphic display terminal. Reference: [HMI Frequency ref.] (LFr), page 44, control: RUN/STOP/FWD/REV buttons.	
PI	[RP] (PI): Frequency input, if VW3A3202 card has been inserted If the reference is assigned to an analog input, or [RP] (PI), the command is automatically assigned to the terminals as well (logic inputs).	
FLOt	**[Time-out forc. local]**	10.0 s
	0.1 to 30 s The parameter can be accessed if [Forced local assign.] (FLO) is not [No] (nO). Time delay before communication monitoring is resumed on leaving forced local mode.	

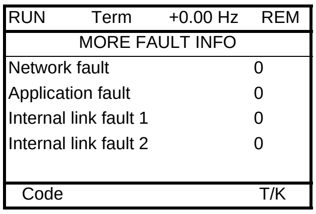
[1.10 DIAGNOSTICS]

This menu can only be accessed with the graphic display terminal:



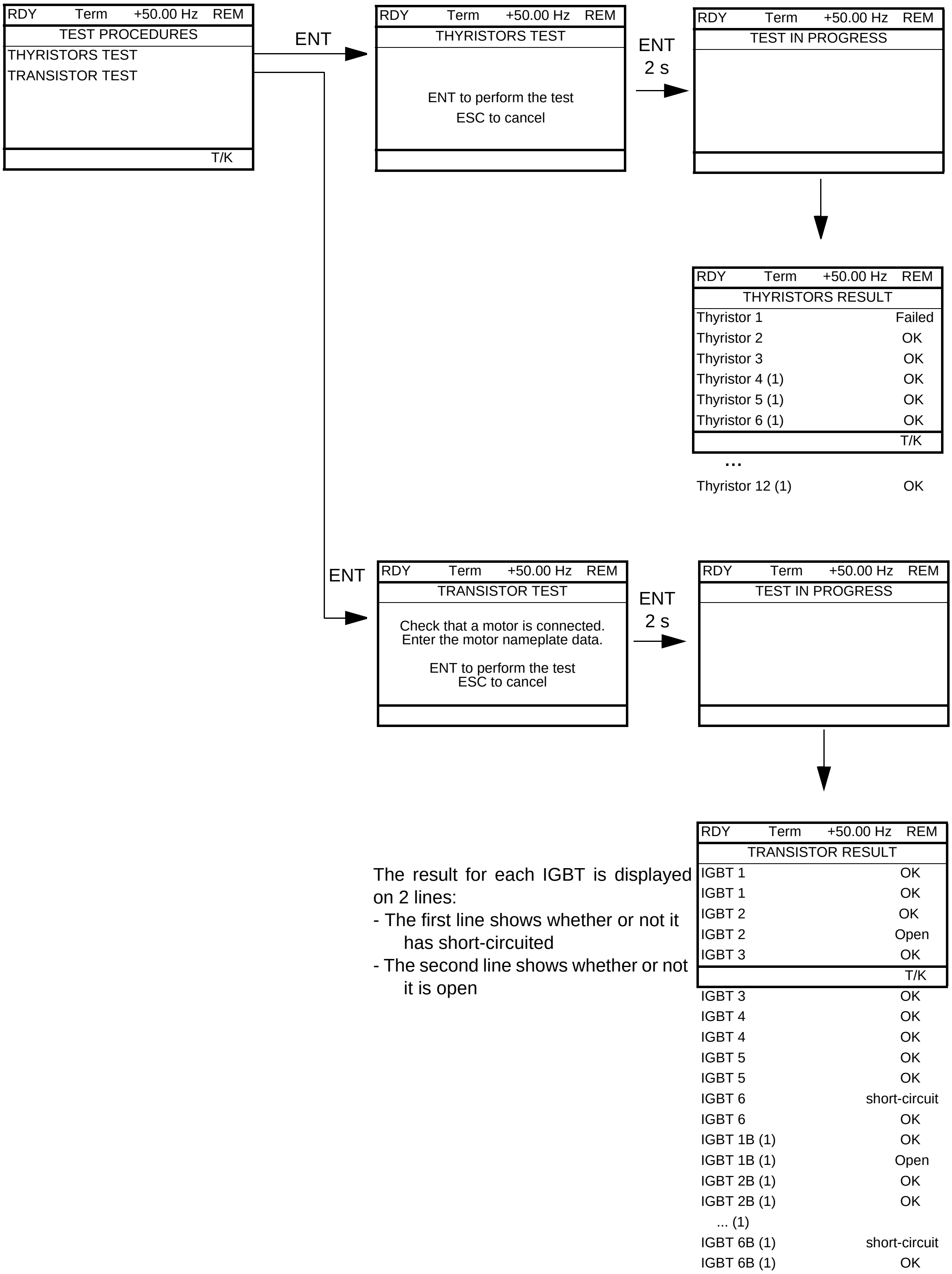


This screen indicates the state of the drive at the moment the selected fault occurred.



This screen indicates the number of communication faults, for example, with the option cards.
Number: 0 to 65,535

[TEST THYRISTORS] is only accessible for ATV61●●●M3 ≥ 18.5 kW, ATV61●●●N4 drives > 18.5 kW, and all ratings of ATV61●●●Y drives.

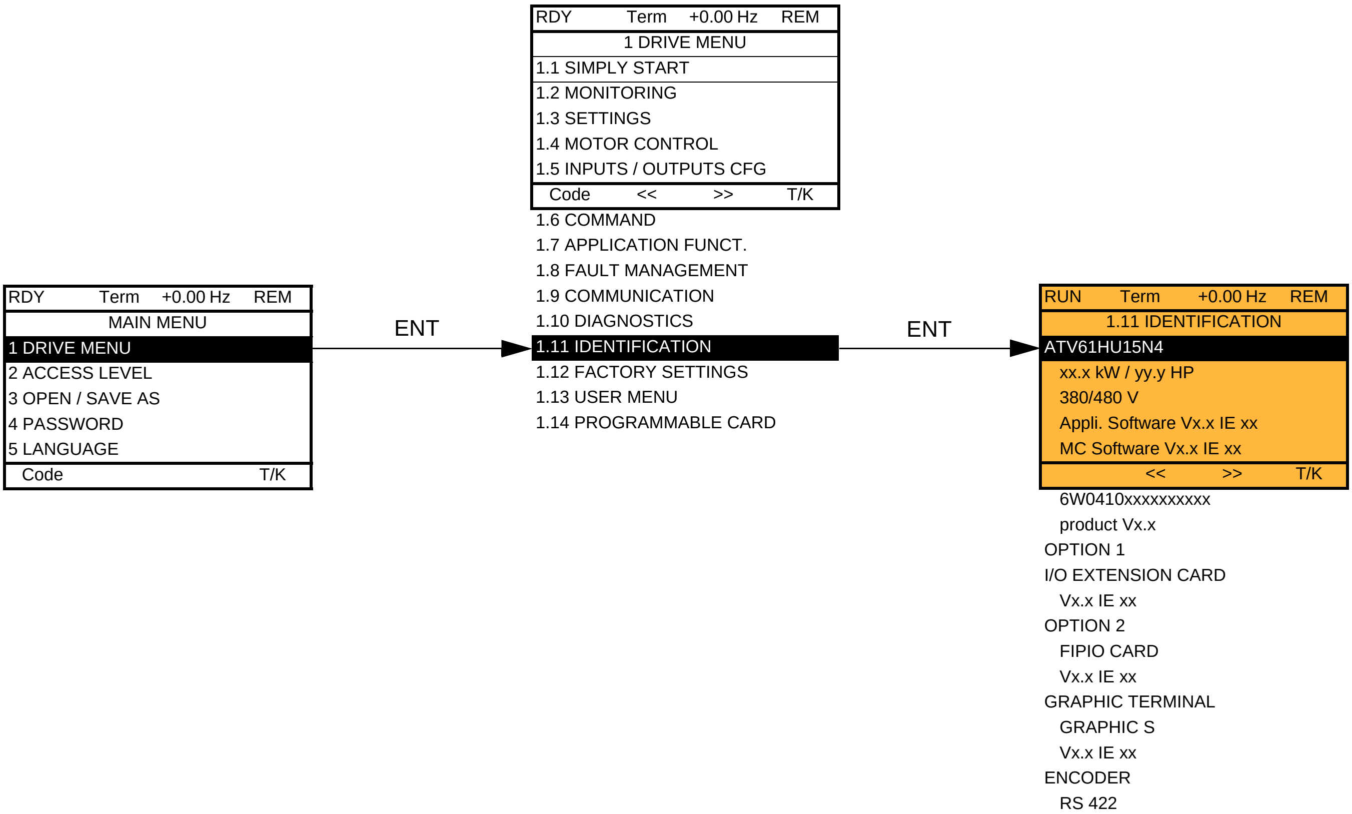


The result for each IGBT is displayed on 2 lines:
- The first line shows whether or not it has short-circuited
- The second line shows whether or not it is open

Note: To start the tests, press and hold down (2 s) the ENT key.

(1) Test results for Thyristor 4...12 and IGBT 1B ... 6B are only accessible for ATV61EC90N4 to M14N4 and ATV61EM15Y to M24Y

[1.11 IDENTIFICATION]

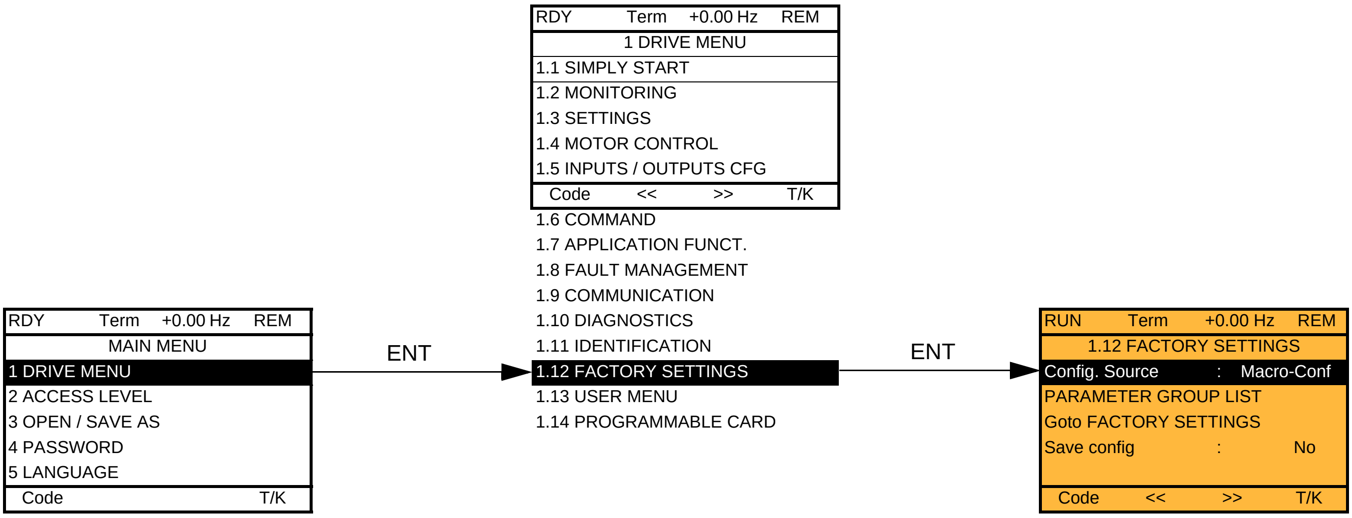


The [1.11 IDENTIFICATION] menu can only be accessed on the graphic display terminal.
This is a read-only menu that cannot be configured. It enables the following information to be displayed:

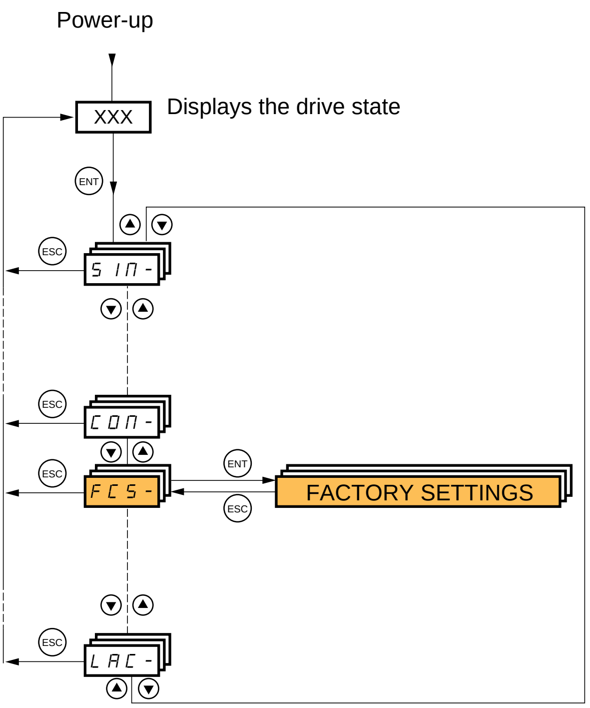
- Drive reference, power rating and voltage
- Drive software version
- Drive serial number
- Type of options present, with their software version

[1.12 FACTORY SETTINGS] (FCS-)

With graphic display terminal:



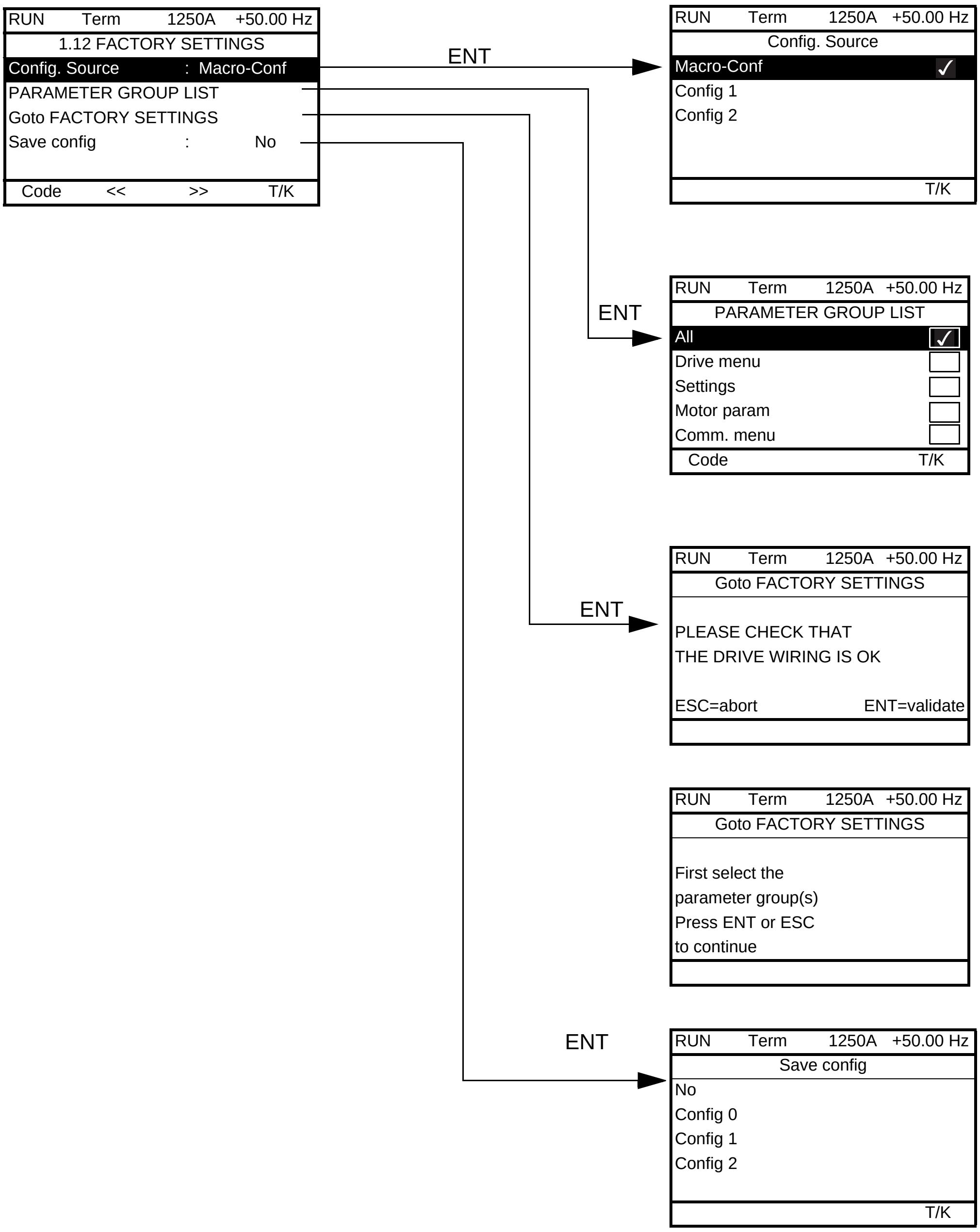
With integrated display terminal:



The [1.12 FACTORY SETTINGS] (FCS-) menu is used to:

- Replace the current configuration with the factory configuration or a configuration saved previously.
  All or part of the current configuration can be replaced: Select a group of parameters in order to select the menus you wish to load with the selected source configuration.

- Save the current configuration to a file.



Selection of source configuration

Selection of the menus to be replaced

Note: In factory configuration and after a return to “factory settings”, [PARAMETER GROUP LIST] will be empty.

Command to return to “factory settings”

This window appears if no group of parameters is selected.

Code	Name/Description
FCSI	**❑ [Config. Source]**
	Choice of source configuration. The parameter cannot be accessed if the drive has locked on an [Incorrect config.] (CFF) fault.
InI	❑ **[Macro-Conf]** (InI) Factory configuration, return to selected macro configuration.
CFG1	❑ **[Config 1]** (CFG1)
CFG2	❑ **[Config 2]** (CFG2) If the configuration switching function is configured, it will not be possible to access [Config 1] (CFG1) and [Config 2] (CFG2).
FrY-	**❑ [PARAMETER GROUP LIST]**
	Selection of menus to be loaded
ALL	❑ **[All]** (ALL) : All parameters.
drM	❑ **[Drive menu]** (drM): The [1 DRIVE MENU] menu without [1.9 COMMUNICATION] and [1.14 PROGRAMMABLE CARD]. In the [7 DISPLAY CONFIG.] menu, [Return std name] page 234 returns to [No].
SEt	❑ **[Settings]** (SEt): The [1.3 SETTINGS] menu without the [IR compensation] (UFr), [Slip compensation] (SLP) and [Mot. therm. current] (ItH) parameters.
MOt	❑ **[Motor param]** (MOt): Motor parameters, see list below. The following selections can only be accessed if [Config. Source] (FCSI) = [Macro-Conf.] (InI):
COM	❑ **[Comm. menu]** (COM): The [1.9 COMMUNICATION] menu without either [Scan. IN1 address] (nMA1) to [Scan. IN8 address] (nMA8) or [Scan.Out1 address] (nCA1) to [Scan.Out8 address] (nCA8).
PLC	❑ **[Prog. card menu]** (PLC): the [1.14 PROGRAMMABLE CARD] menu.
MOn	❑ **[Monitor config.]** (MOn): The [6 MONITORING CONFIG.] menu.
dIS	❑ **[Display config.]** (dIS): the [7 DISPLAY CONFIG.] menu. See the multiple selection procedure on page 25 for the integrated display terminal and page 16 for the graphic display terminal. **Note:** In factory configuration and after a return to "factory settings", [PARAMETER GROUP LIST] will be empty.
GFS	**❑ [Goto FACTORY SETTINGS]**
	It is only possible to revert to the factory settings if at least one group of parameters has previously been selected. With the integrated display terminal:
nO	- No
YES	- Yes: The parameter changes back to nO automatically as soon as the operation is complete. With the graphic display terminal: See the previous page.
SCSI	**❑ [Save config]**
nO	❑ **[No]** (nO):
Str0	❑ **[Config 0]** (Str0): Press the "ENT" key for 2 s.
Str1	❑ **[Config 1]** (Str1): Press the "ENT" key for 2 s.
Str2	❑ **[Config 2]** (Str2): Press the "ENT" key for 2 s. The active configuration to be saved does not appear for selection. For example, if the active configuration is [Config 0] (Str0), only [Config 1] (Str1) and [Config 2] (Str2) appear. The parameter changes back to [No] (nO) automatically as soon as the operation is complete.

List of motor parameters

[1.4 MOTOR CONTROL] (drC-) menu:

[Rated motor power] (nPr) – [Rated motor volt.] (UnS) – [Rated mot. current] (nCr) – [Rated motor freq.] (FrS) – [Rated motor speed] (nSP) – [Auto tuning] (tUn) – [Auto tuning status] (tUS) – [U/F Profile] (PFL) – [U0] (U0) to [U5] (U5) – [F1] (F1) to [F5] (F5) – [V. constant power] (UCP) - [Freq. Const Power] (FCP) – [Nominal I sync.] (nCrS) – [Nom motor spdsync] (nSPS) – [Pole pairs] (PPnS) – [Syn. EMF constant] (PHS) – [Autotune L d-axis] (LdS) – [Autotune L q-axis] (LqS) – [Cust. stator R syn] (rSAS) – [IR compensation] (UFr) – [Slip compensation] (SLP) – motor parameters that can be accessed in [Expert] mode, page 72.

[1.3 SETTINGS] (SEt-) menu:

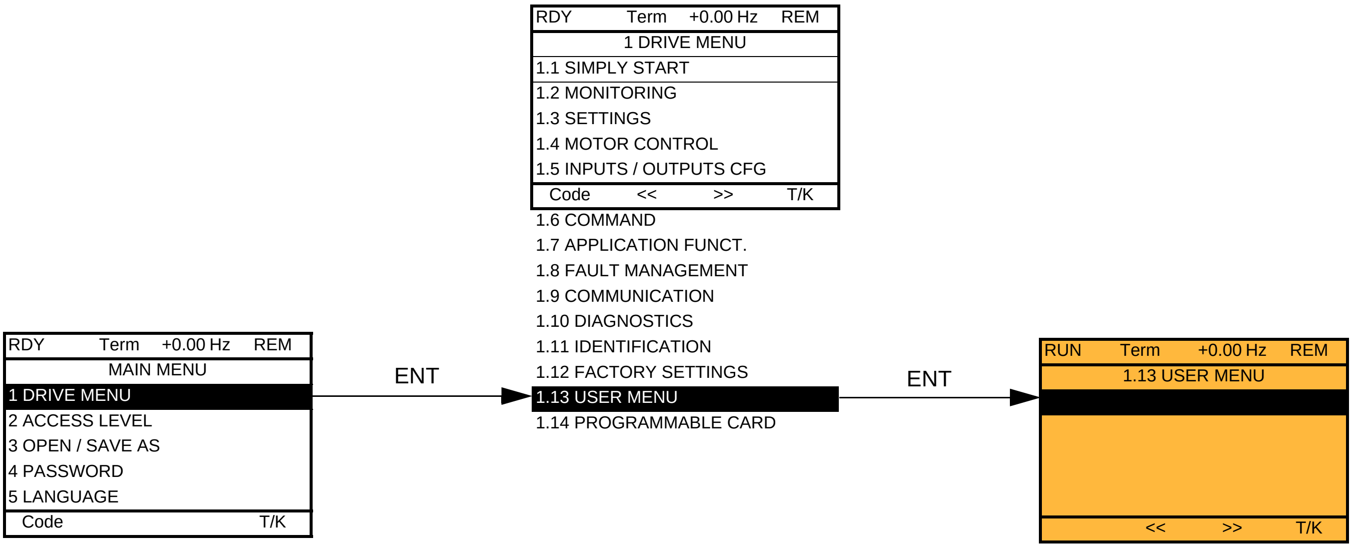
[Mot. therm. current] (ItH)

Example of total return to factory settings

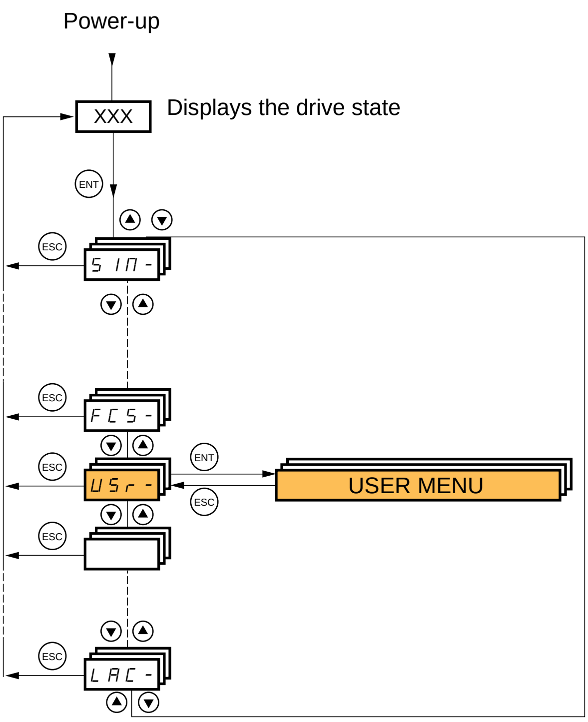
1. [Config. Source] (FCSI) = [Macro-Conf] (InI)
2. [PARAMETER GROUP LIST] (FrY-) = [All] (ALL)
3. [Goto FACTORY SETTINGS] (GFS = YES)

This menu contains the parameters selected in the [7 DISPLAY CONFIG.] menu on page 233.

With graphic display terminal:



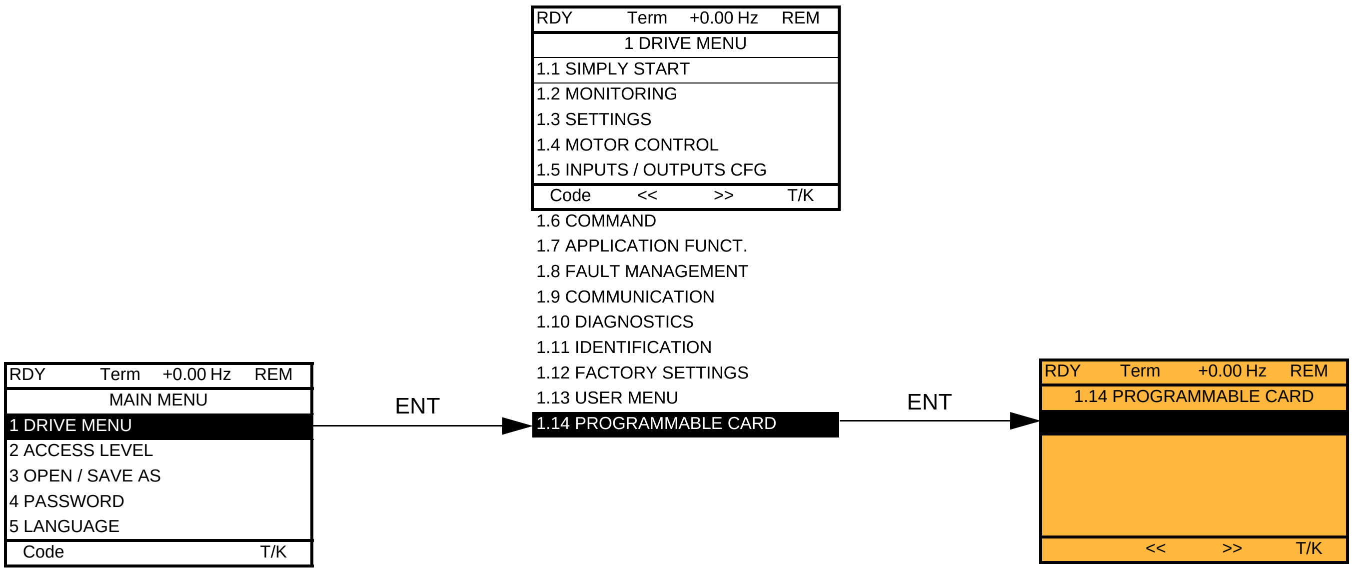
With integrated display terminal:



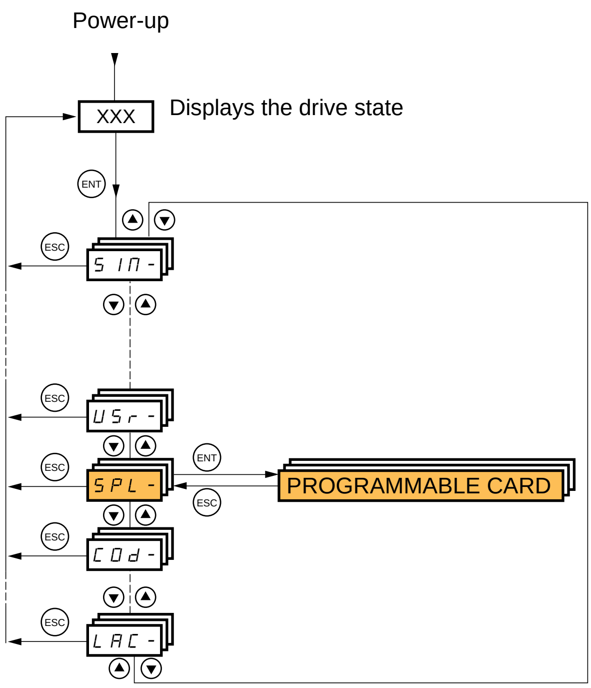
[1.14 PROGRAMMABLE CARD] (PLC-)

This menu can only be accessed if a Controller Inside card has been inserted. Please refer to the documentation specific to this card.

With graphic display terminal:

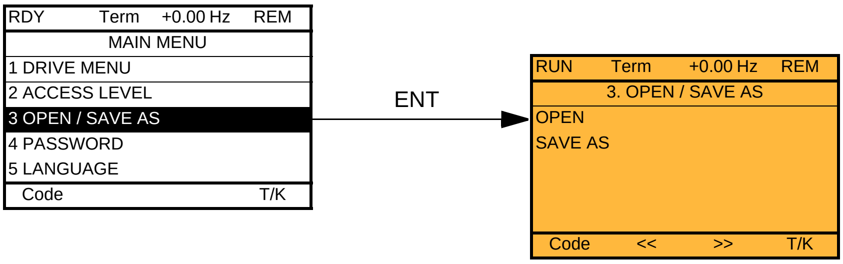


With integrated display terminal:

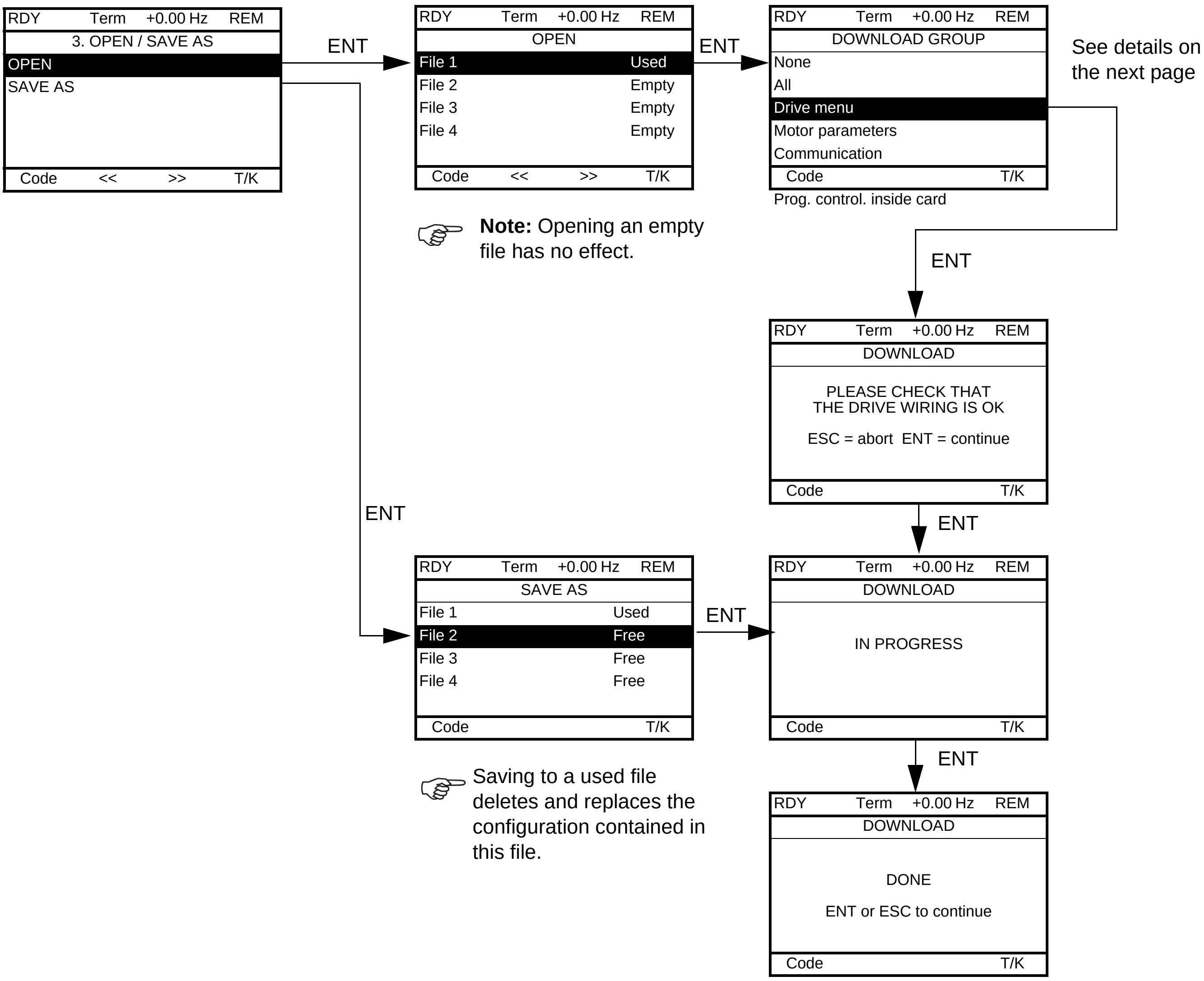


[3. OPEN / SAVE AS]

This menu can only be accessed with the graphic display terminal.



[OPEN]: To download one of the 4 files from the graphic display terminal to the drive.
[SAVE AS]: To download the current configuration from the drive to the graphic display terminal.



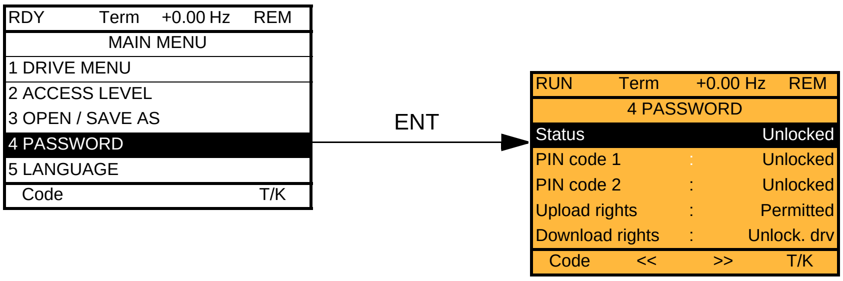
Various messages may appear when the download is requested:

- [IN PROGRESS]
- [DONE]
- Error messages if download not possible
- [Motor parameters are NOT COMPATIBLE. Do you want to continue?]: In this case the download is possible, but the parameters will be restricted.

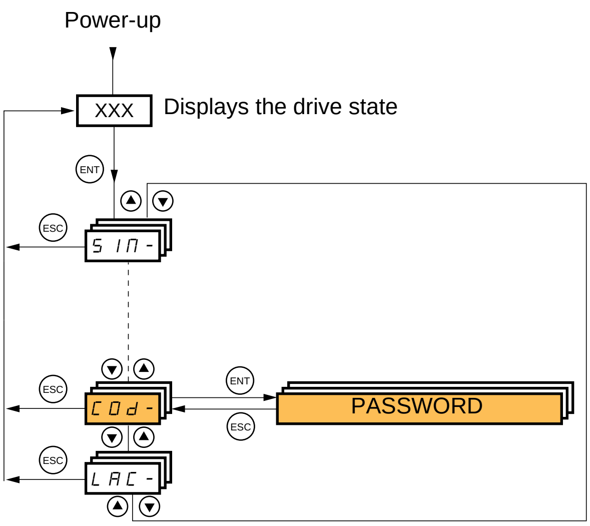
[DOWNLOAD GROUP]

[None]:		No parameters
[All]:		All parameters in all menus
[Drive menu]:		The entire [1 DRIVE MENU] without [1.9 COMMUNICATION] and [1.14 PROGRAMMABLE CARD].
[Motor parameters]:	[Rated motor power] (nPr)	in the [1.4 MOTOR CONTROL] (drC-) menu
	[Rated motor volt.] (UnS)	
	[Rated mot. current] (nCr)	
	[Rated motor freq.] (FrS)	
	[Rated motor speed] (nSP)	
	[Auto tuning] (tUn)	
	[Auto tuning status] (tUS)	
	[U/F Profile] (PFL)	
	[U0] (U0) to [U5] (U5)	
	[F1] (F1) to [F5] (F5)	
	[V. constant power] (UCP)	
	[Freq. Const Power] (FCP)	
	[Nominal I sync.] (nCrS)	
	[Nom motor spdsync] (nSPS)	
	[Pole pairs] (PPnS)	
	[Syn. EMF constant] (PHS)	
	[Autotune L d-axis] (LdS)	
	[Autotune L q-axis] (LqS)	
	[Cust. stator R syn] (rSAS)	
	[IR compensation] (UFr)	
	[Slip compensation] (SLP)	
	The motor parameters that can be accessed in [Expert] mode, page 72	
	[Mot. therm. current] (ItH)	in the [1.3 SETTINGS] (SEt-) menu
[Communication]:		All the parameters in the [1.9 COMMUNICATION] menu
[Prog. control. inside card]:		All the parameters in the [1.14 PROGRAMMABLE CARD] menu

With graphic display terminal:

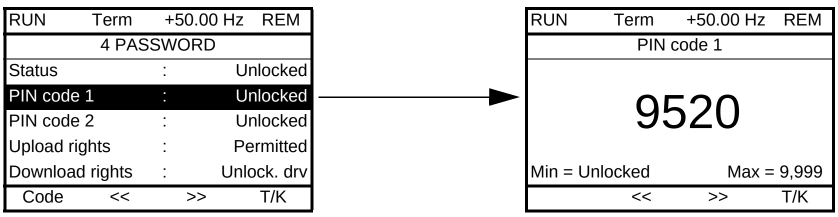


With integrated display terminal:



Enables the configuration to be protected with an access code or a password to be entered in order to access a protected configuration.

Example with graphic display terminal:



- The drive is unlocked when the PIN codes are set to [Unlocked] (OFF) (no password) or when the correct code has been entered. All menus are visible.
- Before protecting the configuration with an access code, you must:
  - Define the [Upload rights] (ULr) and [Download rights] (dLr).
  - Make a careful note of the code and keep it in a safe place where you will always be able to find it.
- The drive has 2 access codes, enabling 2 access levels to be set up.
  - PIN code 1 is a public unlock code: 6969.
  - PIN code 2 is an unlock code known only to Schneider Electric Product Support. It can only be accessed in [Expert] mode.
  - Only one PIN1 or PIN2 code can be used – the other must remain set to [OFF] (OFF).

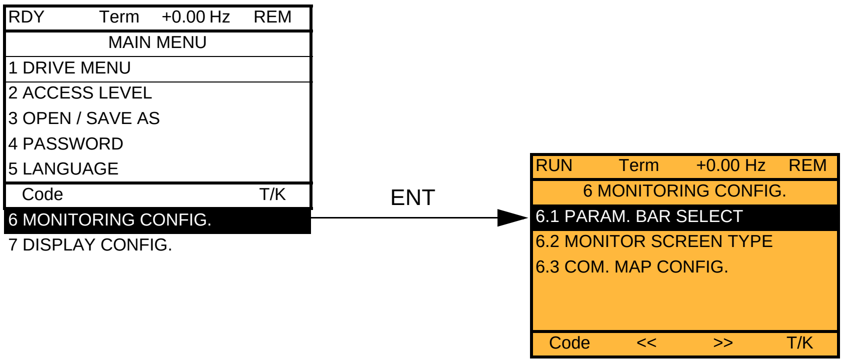
Note: When the unlock code is entered, the user access code appears.

The following items are access-protected:
- Return to factory settings ([1.12 FACTORY SETTINGS] (FCS-) menu.
- The channels and parameters protected by the [1.13 USER MENU] as well as the menu itself.
- The custom display settings ([7 DISPLAY CONFIG.] menu).

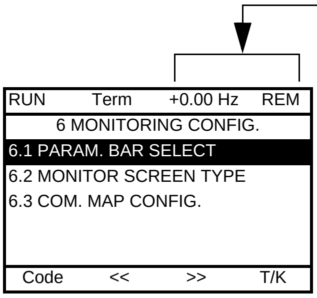
Code	Name/Description	Adjustment range	Factory setting
CSt LC ULC	❑ **[Status]** Information parameter, cannot be modified. ☐ **[Locked]** (LC): The drive is locked by a password. ☐ **[Unlocked]** (ULC): The drive is not locked by a password.		[Unlocked] (ULC)
COd	❑ **[PIN code 1]** 1st access code. The value [OFF] (OFF) indicates that no password has been set [Unlocked]. The value [ON] (On) indicates that the drive is protected and an access code must be entered in order to unlock it. Once the correct code has been entered, it remains on the display and the drive is unlocked until the next time the power supply is disconnected. - PIN code 1 is a public unlock code: 6969.	OFF to 9,999	[OFF] (OFF)
COd2	❑ **[PIN code 2]** Parameter can only be accessed in [Expert] mode. 2nd access code. The value [OFF] (OFF) indicates that no password has been set [Unlocked]. The value [ON] (On) indicates that the drive is protected and an access code must be entered in order to unlock it. Once the correct code has been entered, it remains on the display and the drive is unlocked until the next time the power supply is disconnected. - PIN code 2 is an unlock code known only to Schneider Electric Product Support. When [PIN code 2] (COd2) is not set to OFF, the [1.2 MONITORING] (SUP-) menu is the only one visible. Then if [PIN code 2] (COd2) is set to OFF (drive unlocked), all menus are visible. If the display settings are modified in [7 DISPLAY CONFIG.] menu, and if [PIN code 2] (COd2) is not set to OFF, the visibility configured is kept. Then if [PIN code 2] (COd2) is set to OFF (drive unlocked), the visibility configured in [7 DISPLAY CONFIG.] menu is kept.	OFF to 9,999	[OFF] (OFF)
ULr ULr0 ULr1	❑ **[Upload rights]** Read or copy the current configuration to the drive ☐ **[Permitted]** (ULr0): The current drive configuration can always be uploaded to the graphic display terminal or PowerSuite. ☐ **[Not allowed]** (ULr1): The current drive configuration can only be uploaded to the graphic display terminal or PowerSuite if the drive is not protected by an access code or if the correct code has been entered.		[Permitted] (ULr0)
dLr dLr0 dLr1 dLr2 dLr3	❑ **[Download rights]** Writes the current configuration to the drive or downloads a configuration to the drive ☐ **[Locked drv]** (dLr0): A configuration file can only be downloaded to the drive if the drive is protected by an access code, which is the same as the access code for the configuration to be downloaded. ☐ **[Unlock. drv]** (dLr1): A configuration file can be downloaded to the drive or a configuration in the drive can be modified if the drive is unlocked (access code entered) or is not protected by an access code. ☐ **[not allowed]** (dLr2): Download not authorized. ☐ **[Lock/unlock]** (dLr3): Combination of [Locked drv] (dLr0) and [Unlock. drv] (dLr1).		[Unlock. drv] (dLr1)

[6 MONITORING CONFIG.]

This menu can only be accessed with the graphic display terminal.



This can be used to configure the information displayed on the graphic display screen during operation.



[6.1 PARAM. BAR SELECT]: Selection of 1 to 2 parameters displayed on the top line (the first 2 cannot be modified).

[6.2. MONITOR SCREEN TYPE]: Selection of parameters displayed in the centre of the screen and the display mode (values in digita or bar graph format).

[6.3. COM. MAP CONFIG.]: Selection of the words displayed and their format.

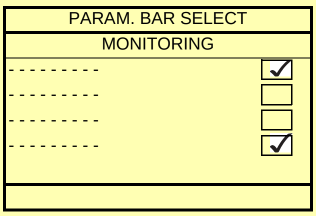
Name/Description

[6.1 PARAM. BAR SELECT]

☐ [Alarm groups]	
☐ [Frequency ref.]	in Hz: parameter displayed in factory configuration
☐ [Output frequency]	in Hz
☐ [Motor current]	in A
☐ [Motor speed]	in rpm
☐ [Motor voltage]	in V
☐ [Motor power]	in W
☐ [Motor torque]	as a %
☐ [Mains voltage]	in V
☐ [Motor thermal state]	as a %
☐ [Drv. thermal state]	as a %
☐ [DBR thermal state]	as a %
☐ [Input Power]	in W or kW depending on drive rating
☐ [Consumption]	in Wh or kWh depending on drive rating
☐ [Run time]	in hours (length of time the motor has been switched on)
☐ [Power on time]	in hours (length of time the drive has been switched on)
☐ [IGBT alarm counter]	in seconds (total time of IGBT overheating alarms)
☐ [PID reference]	as a %
☐ [PID feedback]	as a %
☐ [PID error]	as a %
☐ [PID Output]	in Hz
☐ [- - - - 2]	Word generated by the Controller Inside card (can be accessed if the card has been inserted)
to	
☐ [- - - - 6]	Word generated by the Controller Inside card (can be accessed if the card has been inserted)
☐ [Config. active]	CNFO, 1 or 2 (see page 176)
☐ [Utilised param. set]	SET1, 2 or 3 (see page 174)
☐ [Local / Remote]	Display factory configuration. “LOC” appears if the command and reference are set via the graphic display terminal; otherwise, “REM” appears. This corresponds to the state selected by the [T/K] function key, page 120.

Select the parameter using ENT (a ☑ then appears next to the parameter). Parameter(s) can also be deselected using ENT.
1 or 2 parameters can be selected.

Example:



Name/Description

[6.2. MONITOR SCREEN TYPE]

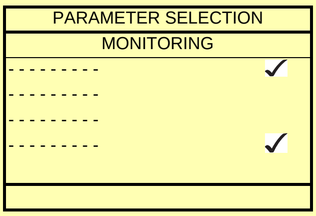
❑ [Display value type]

- ☐ **[Digital]**: Display of one or two digital values on the screen (factory configuration).
- ☐ **[Bar graph]**: Display of one or two bar graphs on the screen.
- ☐ **[List]**: Display a list of between one and five values on the screen.

❑ [PARAMETER SELECTION]

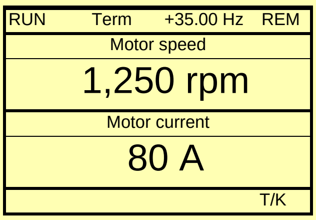
☐ **[Alarm groups]**	can only be accessed if [Display value type] = [List]
☐ **[Frequency ref.]**	in Hz: parameter displayed in factory configuration
☐ **[Output frequency]**	in Hz
☐ **[Motor current]**	in A
☐ **[Motor speed]**	in rpm
☐ **[Motor voltage]**	in V
☐ **[Motor power]**	in W
☐ **[Motor torque]**	as a %
☐ **[Mains voltage]**	in V
☐ **[Motor thermal state]**	as a %
☐ **[Drv. thermal state]**	as a %
☐ **[DBR thermal state]**	as a %
☐ **[Input Power]**	in W or kW depending on drive rating
☐ **[Consumption]**	in Wh or kWh depending on drive rating
☐ **[Run time]**	in hours (length of time the motor has been switched on)
☐ **[Power on time]**	in hours (length of time the drive has been switched on)
☐ **[IGBT alarm counter]**	in seconds (total time of IGBT overheating alarms)
☐ **[PID reference]**	as a %
☐ **[PID feedback]**	as a %
☐ **[PID error]**	as a %
☐ **[PID Output]**	in Hz
☐ **[- - - - 2]**	Word generated by the Controller Inside card (can be accessed if the card has been inserted)
to	
☐ **[- - - - 6]**	Word generated by the Controller Inside card (can be accessed if the card has been inserted)
☐ **[Config. active]**	CNFO, 1 or 2 (see page 176), can only be accessed if [Display value type] = [List]
☐ **[Utilised param. set]**	SET1, 2 or 3 (see page 174), can only be accessed if [Display value type] = [List]

Select the parameter(s) using ENT (a ✓ then appears next to the parameter). Parameter(s) can also be deselected using ENT.

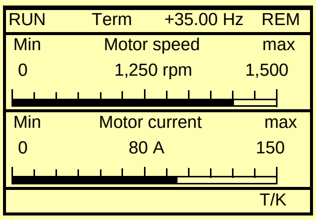


Examples:

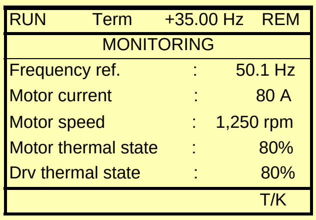
Display of 2 digital values



Display of 2 bar graphs



Display of a list of 5 values



Name/Description

[6.3. COM. MAP CONFIG.]

[Word 1 add. select.]

Select the address of the word to be displayed by pressing the <<, >> (F2 and F3) keys and rotating the navigation button.

[Format word 1]

Format of word 1.
- **[Hex]**: Hexadecimal
- **[Signed]**: Decimal with sign
- **[Unsigned]**: Decimal without sign

[Word 2 add. select.]

Select the address of the word to be displayed by pressing the <<, >> (F2 and F3) keys and rotating the navigation button.

[Format word 2]

Format of word 2.
- **[Hex]**: Hexadecimal
- **[Signed]**: Decimal with sign
- **[Unsigned]**: Decimal without sign

[Word 3 add. select.]

Select the address of the word to be displayed by pressing the <<, >> (F2 and F3) keys and rotating the navigation button.

[Format word 3]

Format of word 3.
- **[Hex]**: Hexadecimal
- **[Signed]**: Decimal with sign
- **[Unsigned]**: Decimal without sign

[Word 4 add. select.]

Select the address of the word to be displayed by pressing the <<, >> (F2 and F3) keys and rotating the navigation button.

[Format word 4]

Format of word 4.
- **[Hex]**: Hexadecimal
- **[Signed]**: Decimal with sign
- **[Unsigned]**: Decimal without sign

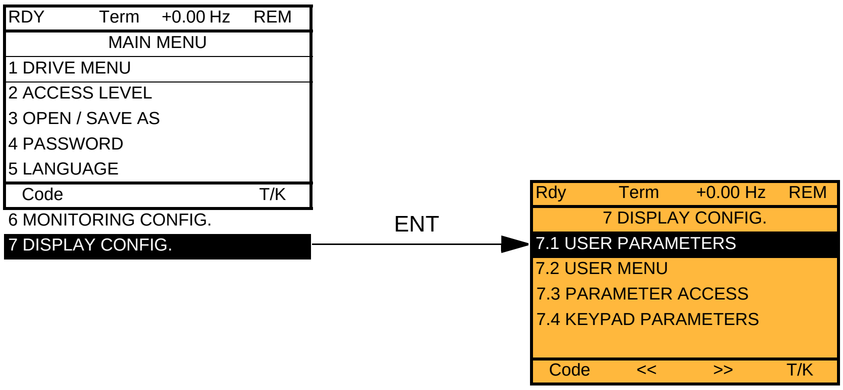
It will then be possible to view the selected words in the [COMMUNICATION MAP] submenu of the [1.2 MONITORING] menu.
Example:

```
RUN      Term     +35.00 Hz   REM
       COMMUNICATION MAP
- - - - - - - -- -
- - - - -- - - - -
W3141        :   F230 Hex

            <<        >>        T/K
```

[7 DISPLAY CONFIG.]

This menu can only be accessed with the graphic display terminal. It can be used to customize parameters or a menu and to access parameters.



7.1 USER PARAMETERS: Customization of 1 to 15 parameters.

7.2 USER MENU: Creation of a customized menu.

7.3 PARAMETER ACCESS: Customization of the visibility and protection mechanisms of menus and parameters.

7.4 KEYPAD PARAMETERS: Adjustment of the contrast and stand-by mode of the graphic display terminal (parameters stored in the terminal rather than in the drive). Choice of the menu displayed on power up.

If [Return std name] = [Yes] the display reverts to standard but the custom settings remain stored.

RDY Term +0.00 Hz REM
7.1 USER PARAMETERS
Return std name : No
PARAMETER SELECTION
CUSTOMIZED SELECTION
USER MENU NAME
DEVICE NAME
Code << >> T/K

SERVICE MESSAGE
CONFIGURATION 0
CONFIGURATION 1
CONFIGURATION 2
ATV SERIAL NUMBER

ENT

PARAMETER SELECTION
1 DRIVE MENU
1.1 SIMPLY START
1.2 MONITORING
1.3 SETTINGS
1.4 MOTOR CONTROL
1.5 INPUTS / OUTPUTS CFG
Code << >> T/K

ENT

PARAMETER SELECTION
1.3 SETTINGS
Ramp increment ✓
Acceleration
Deceleration
Acceleration 2
Deceleration 2
List

Selection of 1 to 15 parameters to be customized

List

Note: The 1st line is [PARAMETER SELECTION] or [RDY Term +0.00 Hz REM] depending on the path (ENT or List).

ENT

RDY Term +0.00 Hz REM
CUSTOMIZED SELECTION
Ramp increment
Acceleration
Speed prop. gain
Delete

List of customized parameters

ENT

RDY Term +0.00 Hz REM
Ramp increment
User name
Unit
Multiplier
Divisor
Offset

ENT

RDY Term +0.00 Hz REM
User name
FLOW REFERENCE
Nb characters max. 13
ABC << >>

If no custom settings have been made, the standard value appears (names, units, etc.).

Display on 1 or 2 lines of characters

Offsets and coefficients are numerical values. Do not use too high a multiplier (99,999 – max display).

Use F1 to change to ABC, abc, 123, *[-.
Use the navigation selector button to increment the character (alphabetical order) and << and >> (F2 and F3) to switch to the next or previous character respectively.

ENT

- Standard: use of the factory set unit
- Customized: customization of the unit
-%, mA, etc.: select from drop-down list

RDY Term +0.00 Hz REM
Unit
Standard ✓
Customized
%
mA
T/K

RDY Term +0.00 Hz REM
Customized
LBS
Nb characters max. 3
ABC << >>

Once you have entered the unit, if you press ENT, the Ramp increment screen will re-appear in order to display the name. Press ESC to return to Unit.

RDY Term +0.00 Hz REM
SERVICE MESSAGE
LINE 1
LINE 2
LINE 3
LINE 4
LINE 5
View T/K

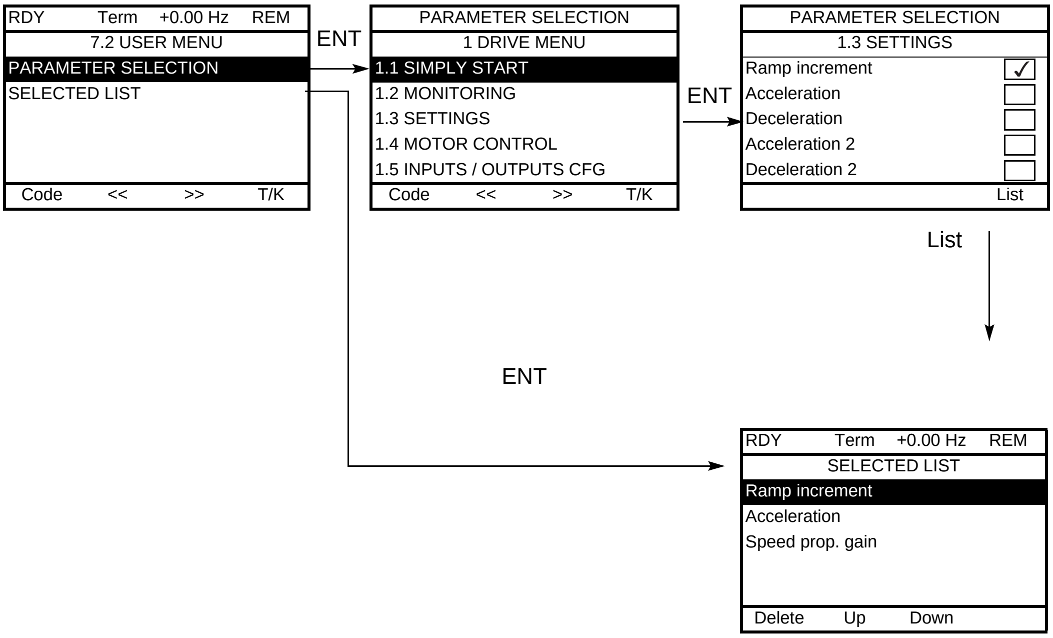
The message entered appears while the "View" button is pressed.

ENT

RDY Term +0.00 Hz REM
LINE 2
For any service, dial:
Nb characters max. 23
ABC << >> T/K

RDY Term +0.00 Hz REM
USER MENU NAME
FLOW REFERENCE
Nb characters max. 18
ABC << >> T/K

Names (USER MENU NAME, DRIVE NAME, configuration, serial no., lines of messages, names of units, etc.) are customized as in the example of the parameter name shown opposite.
If no custom settings have been made, the standard value appears (names, units, etc.).
Display on 1 or 2 lines of characters.
Use F1 to change to ABC, abc, 123, *[-.
Use the navigation selector button to increment the character (alphabetical order) and << and >> (F2 and F3) to switch to the next or previous character respectively.

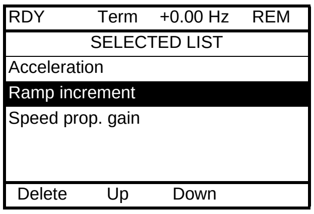


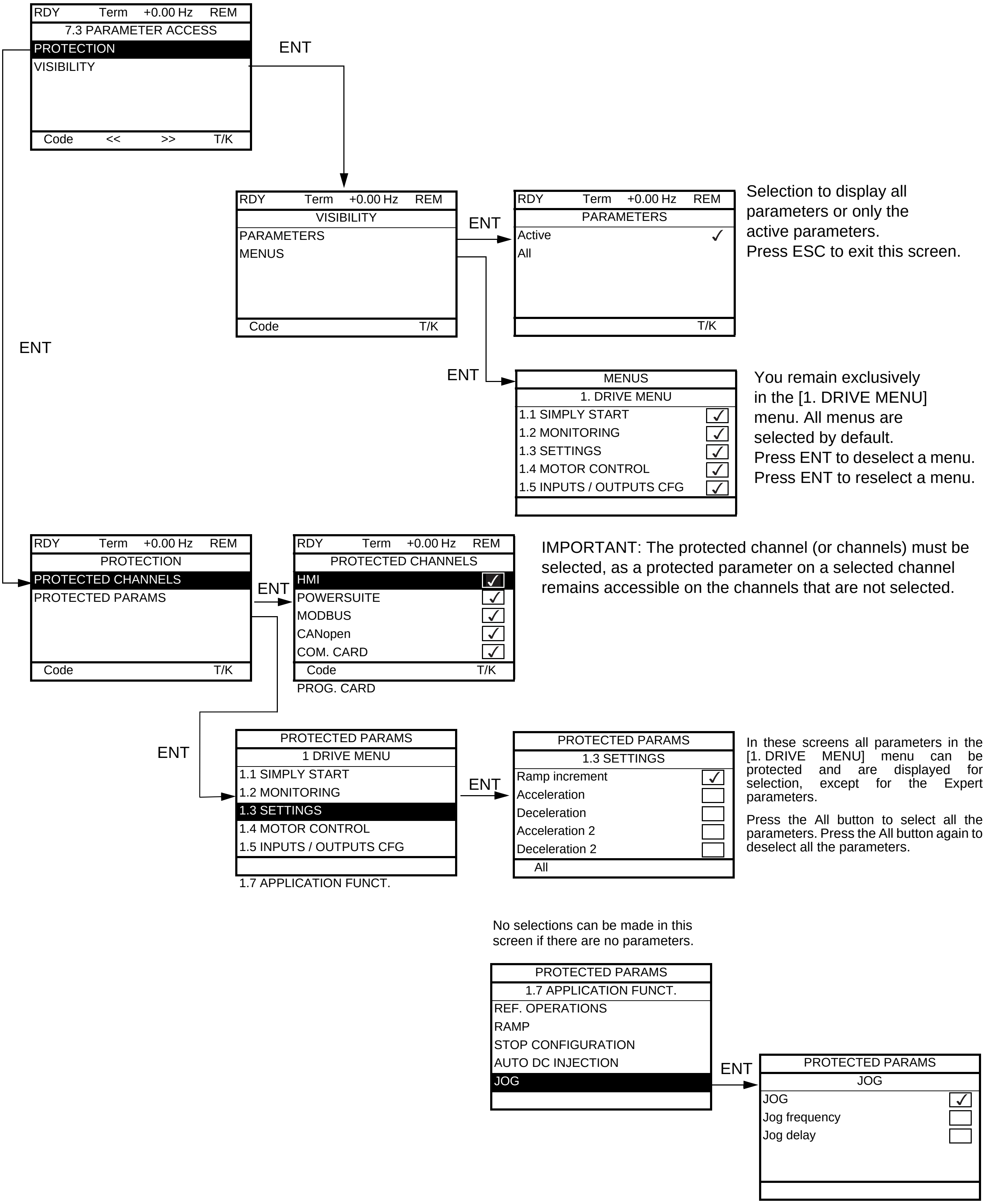
Selection of parameters included in the user menu

Note: The 1st line is [PARAMETER SELECTION] or [RDY Term +0.00 Hz REM] depending on the path (ENT or List).

Parameter list making up the user menu.

Use the F2 and F3 keys to arrange the parameters in the list (example below using F3).





Selection to display all parameters or only the active parameters.
Press ESC to exit this screen.

You remain exclusively in the [1. DRIVE MENU] menu. All menus are selected by default.
Press ENT to deselect a menu.
Press ENT to reselect a menu.

IMPORTANT: The protected channel (or channels) must be selected, as a protected parameter on a selected channel remains accessible on the channels that are not selected.

In these screens all parameters in the [1. DRIVE MENU] menu can be protected and are displayed for selection, except for the Expert parameters.

Press the All button to select all the parameters. Press the All button again to deselect all the parameters.

No selections can be made in this screen if there are no parameters.

Note: The protected parameters are no longer accessible and are not, therefore, displayed for the selected channels.

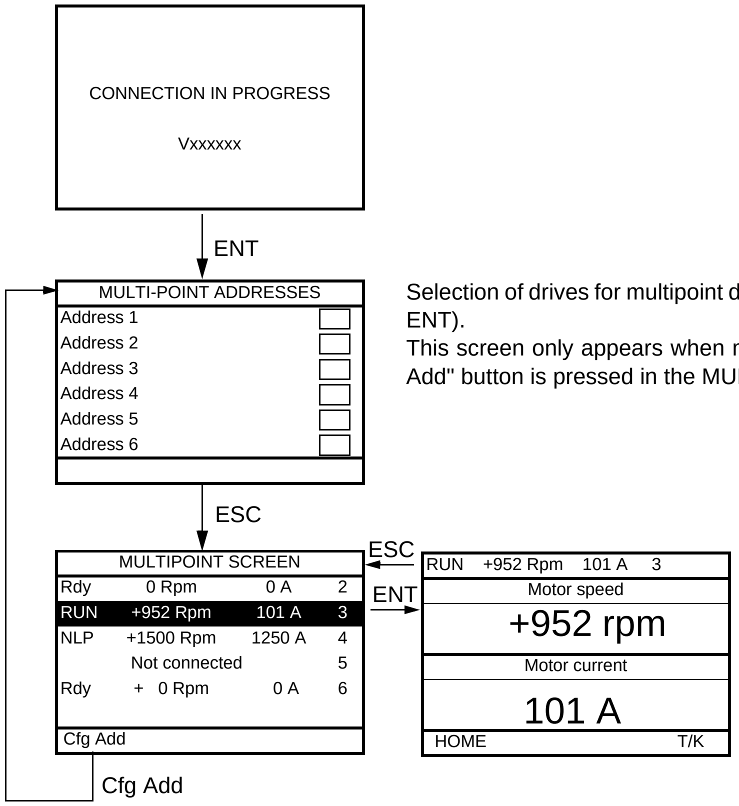
RDY	Term	+0.00Hz	REM
7.4 KEYPAD PARAMETERS			
Keypad contrast			
Keypad stand-by			
Power up menu			
Code	<<	>>	T/K

Name/Description	Adjustment range	Factory setting
❑ **[Keypad contrast]**	0 to 100%	50%
Adjustment of contrast on the graphic display unit		
❑ **[Keypad stand-by]**		[5]
Configures and adjusts the stand-by mode of the graphic display unit. ☐ **[No]**: No stand-by mode. ☐ **[1]** to **[10]**: Adjusts the time during which the terminal is to remain idle before stand-by mode is triggered, in minutes. After this idle time, the display backlight turns off and the contrast is reduced. The screen returns to normal operation when a key or the navigation button is pressed. It also returns to normal operation if the terminal exits the normal display mode, for example, if a fault occurs.		
❑ **[Power up menu]**		[Main menu]
Choice of menu which appears on the product on power-up ☐ **[Drive menu]**: Displays the drive menu. ☐ **[Sim. start]**: Displays the simply start menu. ☐ **[Monitoring]**: Displays the monitoring menu. ☐ **[Settings]**: Displays the settings menu. ☐ **[Mot. Ctrl]**: Displays the control motor menu. ☐ **[I/O Conf.]**: Displays the inputs / outputs configuration menu. ☐ **[Command]**: Displays the command menu. ☐ **[Appli. fun.]**: Displays the application function menu. ☐ **[Fault mgt]**: Displays the fault management menu. ☐ **[Com.]**: Displays the communication menu. ☐ **[Diagnostics]**: Displays the diagnostics menu. ☐ **[Ident.]**: Displays the identification menu. ☐ **[Factory Set.]**: Displays the factory settings menu. ☐ **[User menu]**: Displays the user menu. ☐ **[CI menu]**: Displays the card CI menu. ☐ **[Main menu]**: Displays the main menu.		

[MULTIPOINT SCREEN]

Communication is possible between a graphic display terminal and a number of drives connected on the same bus. The addresses of the drives must be configured in advance in the [1.9 COMMUNICATION] menu using the [Modbus Address] (Add) parameter, page 215.

When a number of drives are connected to the same display terminal, the terminal automatically displays the following screens:



Selection of drives for multipoint dialog (select each address and check it by pressing ENT).
This screen only appears when making a connection for the first time or if the "Cfg Add" button is pressed in the MULTIPOINT SCREEN below.

Selection of a drive for multipoint dialog.

In multipoint mode, the command channel is not displayed. The state, then the 2 selected parameters and the drive address appear from left to right.

All menus can be accessed in multipoint mode. Only drive control via the graphic display terminal is not authorized, apart from the Stop key, which locks all the drives.
If there is a fault on a drive, this drive is displayed.

Servicing

The Altivar 61 does not require any preventive maintenance. It is nevertheless advisable to perform the following regularly:

- Check the condition and tightness of the connections.
- Ensure that the temperature around the unit remains at an acceptable level and that ventilation is effective (average service life of fans: 3 to 5 years depending on the operating conditions).
- Remove any dust from the drive.

Assistance with maintenance, fault display

If a problem arises during setup or operation, first check that the recommendations relating to the environment, mounting and connections have been observed.

The first fault detected is saved and displayed, and the drive locks.
The drive switching to fault mode can be indicated remotely via a logic output or a relay, which can be configured in the [1.5 INPUTS / OUTPUTS CFG] (I-O-) menu, see, for example, [R1 CONFIGURATION] (r1-) page 94.

[1.10 DIAGNOSTICS] menu

This menu can only be accessed with the graphic display terminal. It displays faults and their cause in plain text and can be used to carry out tests, see page 217.

Clearing the fault

Disconnect the drive power supply in the event of a non-resettable fault.
Wait for the display to disappear completely.
Find the cause of the fault in order to correct it.

The drive is unlocked after a fault:

- By switching off the drive until the display disappears completely, then switching on again
- Automatically in the scenarios described for the [AUTOMATIC RESTART] (Atr-) function, page 191
- By means of a logic input or control bit assigned to the [FAULT RESET] (rSt-) function, page 190
- By pressing the STOP/RESET button on the graphic display terminal

[1.2 MONITORING] (SUP-) menu:

This is used to prevent and find the causes of faults by displaying the drive state and its current values.
It can be accessed with the integrated display terminal.

Spares and repairs:

Consult Schneider Electric product support.

Starter does not start, no fault displayed

- If the display does not light up, check the power supply to the drive.
- The assignment of the “Fast stop” or “Freewheel” functions will prevent the drive starting if the corresponding logic inputs are not powered up. The ATV61 then displays [Freewheel] (nSt) in freewheel stop and [Fast stop] (FSt) in fast stop. This is normal since these functions are active at zero so that the drive will be stopped safely if there is a wire break.
- Make sure that the run command input or inputs are activated in accordance with the selected control mode ([2/3 wire control] (tCC) and [2 wire type] (tCt) parameters, page 80).
- If the reference channel or command channel is assigned to a communication bus, when the power supply is connected, the drive will display [Freewheel] (nSt) and remain in stop mode until the communication bus sends a command.

Faults, which cannot be reset automatically

The cause of the fault must be removed before resetting by turning off and then back on.
AI2F, EnF, SOF, SPF, and tnF faults can also be reset remotely by means of a logic input or control bit ([Fault reset] (rSF) parameter, page 190).
EnF, InFA, InFb, SOF, SPF, and tnF faults can be inhibited and cleared remotely by means of a logic input or control bit ([Fault inhibit assign.] (InH) parameter, page 201).

Fault	Name	Probable cause	Remedy
AI2F	[AI2 input]	• Non-conforming signal on analog input AI2	• Check the wiring of analog input AI2 and the value of the signal • If necessary, modify the fault configuration via [AI2 4-20mA loss] (LFL2), page 200
bOF	[DBR overload]	• The braking resistor is under excessive stress	• Check the size of the resistor and wait for it to cool down • Check the [DB Resistor Power] (brP) and [DB Resistor value] (brU) parameters, page 206.
bUF	[DB unit sh. Circuit]	• Short-circuit output from braking unit • Braking unit not connected	• Check the wiring of the braking unit and the resistor • Check the braking resistor • The monitoring of this fault must be disabled by the [Brake res. fault Mgt] (bUb) parameter, page 206 if there is no braking unit or resistor connected to the drive, at and above 55 kW (75 HP) for ATV61H●●●M3X and at and above 90 kW (120 HP) for ATV61H●●●N4.
CrF1	[Precharge]	• Load relay control fault or charging resistor damaged	• Switch the drive off and then back on again • Check the internal connections • Inspect/repair the drive
CrF2	[Thyr. soft charge]	• DC bus charging fault (thyristors)	
dCF	[Differential curent Fault]	• Current difference between power block A and B (ATV61EC60 ... M14N4 or ATVEM15...M24Y only)	• Check thyristor with [TEST THYRISTORS] • Check IGBT with [TRANSISTOR TEST] • Check current transformer
EEF1	[Control Eeprom]	• Internal memory fault, control card	• Check the environment (electromagnetic compatibility) • Turn off, reset, return to factory settings • Inspect/repair the drive
EEF2	[Power Eeprom]	• Internal memory fault, power card	
EnF	[Encoder]	• Encoder feedback fault	• Check [Number of pulses] (PGI) and [Encoder type] (EnS) page 73 • Check that the encoder's mechanical and electrical operation, its power supply and connections are all correct • If necessary, reverse the direction of rotation of the motor ([Output Ph rotation] (PHr) parameter, page 66) or the encoder signals
FCF1	[Out. contact. stuck]	• The output contactor remains closed although the opening conditions have been met	• Check the contactor and its wiring • Check the feedback circuit
Fd2	[Damper open]	• The damper remains open although the closing conditions have been met	• Check the damper and its wiring • Check the feedback circuit • Check the time delay for the function, page 172
HdF	[IGBT desaturation]	• Short-circuit or grounding at the drive output	• Check the cables connecting the drive to the motor, and the insulation of the motor • Perform the diagnostic tests via the [1.10 DIAGNOSTICS] menu.

Faults, which cannot be reset automatically (continued)

Fault	Name	Probable cause	Remedy
ILF	[internal com. link]	• Communication fault between option card and drive	• Check the environment (electromagnetic compatibility) • Check the connections • Check that no more than 2 option cards (max. permitted) have been installed on the drive • Replace the option card • Inspect/repair the drive
InF1	[Rating error]	• The power card is different from the card stored	• Check the reference of the power card
InF2	[Incompatible PB]	• The power card is incompatible with the control card	• Check the reference of the power card and its compatibility
InF3	[Internal serial link]	• Communication fault between the internal cards	• Check the internal connections • Inspect/repair the drive
InF4	[Internal MFG area]	• Internal data inconsistent	• Recalibrate the drive (performed by Schneider Electric Product Support)
InF6	[Internal-option]	• The option installed in the drive is not recognized	• Check the reference and compatibility of the option
InF7	[Internal-hard init.]	• Initialization of the drive is incomplete	• Turn off and reset
InF8	[Internal-ctrl supply]	• The control power supply is incorrect	• Check the control section power supply
InF9	[Internal- I measure]	• The current measurements are incorrect	• Replace the current sensors or the power card • Inspect/repair the drive
InFA	[Internal-mains circuit]	• The input stage is not operating correctly	• Perform the diagnostic tests via the [1.10 DIAGNOSTICS] menu. • Inspect/repair the drive
InFb	[Internal- th. sensor]	• The drive temperature sensor is not operating correctly • The braking unit's temperature sensor is not operating correctly	• Replace the temperature sensor • Inspect/repair the drive • Replace the braking unit's temperature sensor • Inspect/repair the braking unit • The monitoring of this fault must be disabled by the [Brake res. fault Mgt] (bUb) parameter, page 206 if there is no braking unit connected to the drive
InFC	[Internal-time meas.]	• Fault on the electronic time measurement component	• Inspect/repair the drive
InFE	[internal- CPU]	• Internal microprocessor fault	• Turn off and reset. Inspect/repair the drive
OCF	[Overcurrent]	• Parameters in the [SETTINGS] (SEt-) and [1.4 MOTOR CONTROL] (drC-) menus are not correct • Inertia or load too high • Mechanical locking	• Check the parameters • Check the size of the motor/drive/load • Check the state of the mechanism
PrF	[Power removal]	• Fault with the drive's "Power removal" safety function	• Inspect/repair the drive
SCF1	[Motor short circuit]	• Short-circuit or grounding at the drive output	• Check the cables connecting the drive to the motor, and the insulation of the motor • Perform the diagnostic tests via the [1.10 DIAGNOSTICS] menu. • Reduce the switching frequency • Connect chokes in series with the motor • Check the adjustment of speed loop and brake
SCF2	[Impedant sh. circuit]		
SCF3	[Ground short circuit]	• Significant earth leakage current at the drive output if several motors are connected in parallel	
SOF	[Overspeed]	• Instability or driving load too high	• Check the motor, gain and stability parameters • Add a braking resistor • Check the size of the motor/drive/load • Check the parameter settings for the [FREQUENCY METER] (FqF-) function, page 205, if it is configured

Faults, which cannot be reset automatically (continued)

Fault	Name	Probable cause	Remedy
SPF	[Speed fdback loss]	• Encoder feedback signal missing • No signal on "Pulse input", if the input is used for speed measurement	• Check the wiring between the encoder and the drive • Check the encoder • Check the wiring of the input and the detector used
tnF	[Auto-tuning]	• Special motor or motor whose power is not suitable for the drive • Motor not connected to the drive	• Check that the motor/drive are compatible • • Check that the motor is present during auto-tuning • If an output contactor is being used, close it during auto-tuning

Faults that can be reset with the automatic restart function, after the cause has disappeared

These faults can also be reset by turning on and off or by means of a logic input or control bit ([Fault reset] (rSF) parameter, page 190).
APF, CnF, COF, EPF1, EPF2, FCF2, Fd1, LFF2, LFF3, LFF4, nFF, ObF, OHF, OLC, OLF, OPF1, OPF2, OSF, OtF1, OtF2, OtFL, PHF, PtF1, PtF2, PtFL, SLF1, SLF2, SLF3, SPIF, SSF, tJF, and ULF faults can be inhibited and cleared remotely by means of a logic input or control bit ([Fault inhibit assign.] (InH) parameter, page 201).

Fault	Name	Probable cause	Remedy
APF	[Application fault]	• Controller Inside card fault	• Please refer to the card documentation
CnF	[Com. network]	• Communication fault on communication card	• Check the environment (electromagnetic compatibility) • Check the wiring • Check the time-out • Replace the option card • Inspect/repair the drive
COF	[CAN com.]	• Interruption in communication on the CANopen bus	• Check the communication bus • Check the time-out • Refer to the CANopen User's Manual
EPF1	[External flt-LI/Bit]	• Fault triggered by an external device, depending on user	• Check the device, which caused the fault, and reset
EPF2	[External fault com.]	• Fault triggered by a communication network	• Check for the cause of the fault and reset
FCF2	[Out. contact. open.]	• The output contactor remains open although the closing conditions have been met.	• Check the contactor and its wiring • Check the feedback circuit
Fd1	[Damper stuck]	• The damper remains closed although the opening conditions have been met	• Check the damper and its wiring • Check the feedback circuit • Check the time delay for the function, page 172
LCF	[input contactor]	• The drive is not turned on even though [Mains V. time out] (LCt) has elapsed.	• Check the contactor and its wiring • Check the time-out • Check the line/contactor/drive connection
LFF2 LFF3 LFF4	[AI2 4-20mA loss] [AI3 4-20mA loss] [AI4 4-20mA loss]	• Loss of the 4-20 mA reference on analog input AI2, AI3 or AI4	• Check the connection on the analog inputs • If necessary, modify the fault configuration via [AIx 4-20mA loss] (LFLx), page 200
nFF	[No Flow Fault]	• Zero fluid	• Check and rectify the cause of the fault. • Check the zero fluid detection parameters page 181.
ObF	[Overbraking]	• Braking too sudden or driving load	• Increase the deceleration time • Install a braking resistor if necessary • Activate the [Dec ramp adapt.] (brA) function, page 132, if it is compatible with the application.
OHF	[Drive overheat]	• Power board -PCB over temperature • Braking unit over temperature • Phase module over temperature • Rectifier over temperature	• Check the motor load, the drive ventilation and the ambient temperature. Wait for the drive to cool down before restarting
OLC	[Proc. Overload Flt]	• Process overload	• Check and remove the cause of the overload. • Check the parameters of the [PROCESS UNDERLOAD] (OLd-) function, page 210.
OLF	[Motor overload]	• Triggered by excessive motor current	• Check the setting of the motor thermal protection, check the motor load. Wait for the drive to cool down before restarting
OPF1	[1 motor phase loss]	• Loss of one phase at drive output	• Check the connections from the drive to the motor

Faults that can be reset with the automatic restart function, after the cause has disappeared (continued)

Fault	Name	Probable cause	Remedy
OPF2	[3 motor phase loss]	• Motor not connected or motor power too low • Output contactor open • Instantaneous instability in the motor current	• Check the connections from the drive to the motor • If an output contactor is being used, parameterize [Output Phase Loss] (OPL) = [Output cut] (OAC), page 194 • Test on a low power motor or without a motor: In factory settings mode, motor phase loss detection is active [Output Phase Loss] (OPL) = [Yes] (YES). To check the drive in a test or maintenance environment, without having to use a motor with the same rating as the drive (in particular for high power drives), deactivate motor phase loss detection [Output Phase Loss] (OPL) = [No] (nO) • Check and optimize the [IR compensation] (UFr) page 71, [Rated motor volt.] (UnS) and [Rated mot. current] (nCr) parameters, page 64, and perform [Auto tuning] (tUn), page 66.
OSF	[Mains overvoltage]	• Line voltage too high • Disturbed line supply	• Check the line voltage
OtF1	[PTC1 overheat]	• Overheating of the PTC1 probes detected	• Check the motor load and motor size • Check the motor ventilation • Wait for the motor to cool before restarting • Check the type and state of the PTC probes
OtF2	[PTC2 overheat]	• Overheating of the PTC2 probes detected	
OtFL	[LI6=PTC overheat]	• Overheating of PTC probes detected on input LI6	
PtF1	[PTC1 probe]	• PTC1 probes open or short-circuited	• Check the PTC probes and the wiring between them and the motor/drive
PtF2	[PTC2 probe]	• PTC2 probes open or short-circuited	
PtFL	[LI6=PTC probe]	• PTC probes on input LI6 open or short-circuited	
SCF4	[IGBT short circuit]	• Power component fault	• Perform a test via the [1.10 DIAGNOSTICS] menu. • Inspect/repair the drive
SCF5	[Motor short circuit]	• Short-circuit at drive output	• Check the cables connecting the drive to the motor, and the motor's insulation • Perform tests via the [1.10 DIAGNOSTICS] menu. • Inspect/repair the drive
SLF1	[Modbus com.]	• Interruption in communication on the Modbus bus	• Check the communication bus • Check the time-out • Refer to the Modbus User's Manual
SLF2	[PowerSuite com.]	• Fault communicating with PowerSuite	• Check the PowerSuite connecting cable • Check the time-out
SLF3	[HMI com.]	• Fault communicating with the graphic display terminal	• Check the terminal connection • Check the time-out
SPIF	[PI Feedback]	• PID feedback below lower limit	• Check the PID function feedback. • Check the PID feedback supervision threshold and time delay, page 155.
SSF	[Torque/current lim]	• Switch to torque limitation	• Check if there are any mechanical problems • Check the parameters of [TORQUE LIMITATION] (tLA-) page 164 and the parameters of the [TORQUE OR I LIM. DETECT.] (tId-) fault, page 203).
tJF	[IGBT overheat]	• Drive overheated	• Check the size of the load/motor/drive • Reduce the switching frequency • Wait for the motor to cool before restarting
ULF	[Proc. Underload Flt]	• Process underload	• Check and remove the cause of the underload. • Check the parameters of the [PROCESS OVERLOAD] (ULd-) function, page 209.

Faults that can be reset as soon as their causes disappear

The USF fault can be inhibited and cleared remotely by means of a logic input or control bit ([Fault inhibit assign.] (InH) parameter, page 201).

Fault	Name	Probable cause	Remedy
CFF	[Incorrect config.]	• changed or removed • The current configuration is inconsistent	• Check that there are no card errors. • In the event of the option card being changed/removed deliberately, see the remarks below • Return to factory settings or retrieve the backup configuration, if it is valid (see page 222)
CFI	[Invalid config.]	• Invalid configuration The configuration loaded in the drive via the bus or communication network is inconsistent.	• Check the configuration loaded previously • Load a compatible configuration
HCF	[Cards pairing]	• The [CARDS PAIRING] (PPI-) function, page 207, has been configured and a drive card has been changed	• In the event of a card error, reinsert the original card • Confirm the configuration by entering the [Pairing password] (PPI) if the card was changed deliberately
PHF	[Input phase loss]	• Drive incorrectly supplied or a fuse blown • Failure of one phase • 3-phase ATV61 used on a single-phase line supply • Unbalanced load This protection only operates with the drive on load	• Check the power connection and the fuses. • Use a 3-phase line. • Disable the fault by [Input phase loss] (IPL) = [No] (nO). (page 195)
PrtF	[Power Ident]	• The [Power Identification] (Prt) parameter, page 72, is incorrect. • Control card replaced by a control card configured on a drive with a different rating	• Enter the correct parameter (reserved for Schneider Electric product support). • Check that there are no card errors. • In the event of the control card being changed deliberately, see the remarks below
USF	[Undervoltage]	• Line supply too low • Transient voltage dip • Damaged pre-charge resistor	• Check the voltage and the parameters of [UNDERVOLTAGE MGT] (USb-), page 198 • Replace the pre-charge resistor • Inspect/repair the drive

Option card changed or removed

When an option card is removed or replaced by another, the drive locks in [Incorrect config.] (CFF) fault mode on power-up. If the card has been deliberately changed or removed, the fault can be cleared by pressing the ENT key twice, which **causes the factory settings to be restored** (see page 222) for the parameter groups affected by the card. These are as follows:

Card replaced by a card of the same type
- I/O cards: [Drive menu] (drM)
- Encoder cards: [Drive menu] (drM)
- Communication cards: Only the parameters that are specific to communication cards
- Controller Inside cards: [Prog. card menu] (PLC)

Card removed (or replaced by a different type of card)
- I/O card: [Drive menu] (drM)
- Encoder card: [Drive menu] (drM)
- Communication card: [Drive menu] (drM) and parameters specific to communication cards
- Controller Inside card: [Drive menu] (drM) and [Prog. card menu] (PLC)

Control card changed

When a control card is replaced by a control card configured on a drive with a different rating, the drive locks in [Power Ident] (PrtF) fault mode on power-up. If the card has been deliberately changed, the fault can be cleared by modifying the [Power Identification] (Prt) parameter, page 72, which **causes all the factory settings to be restored.**

[1.1 SIMPLY START] (SIM-) menu

Code	Name	Factory setting	Customer setting
tCC	**[2/3 wire control]**	[2 wire] (2C)	
CFG	**[Macro configuration]**	[Start/Stop] (StS)	
bFr	**[Standard mot. freq]**	[50 Hz] (50)	
IPL	**[Input phase loss]**	According to drive rating	
nPr	**[Rated motor power]**	According to drive rating	
UnS	**[Rated motor volt.]**	According to drive rating	
nCr	**[Rated mot. current]**	According to drive rating	
FrS	**[Rated motor freq.]**	50 Hz	
nSP	**[Rated motor speed]**	According to drive rating	
tFr	**[Max frequency]**	60 Hz	
PHr	**[Output Ph rotation]**	ABC	
ItH	**[Mot. therm. current]**	According to drive rating	
ACC	**[Acceleration]**	3.0 s	
dEC	**[Deceleration]**	3.0 s	
LSP	**[Low speed]**	0	
HSP	**[High speed]**	50 Hz	

Functions assigned to I/O

Inputs Outputs	Functions assigned
LI1	
LI2	
LI3	
LI4	
LI5	
LI6	
LI7	
LI8	
LI9	
LI10	
LI11	
LI12	
LI13	
LI14	

Inputs Outputs	Functions assigned
LO1	
LO2	
LO3	
LO4	
AI1	
AI2	
AI3	
AI4	
R1	
R2	
R3	
R4	
RP	
Encoder	

Other parameters (table to be created by the user)

Code	Name	Customer setting

Code	Name	Customer setting

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A1C-					107						
A2C-					107						
A3C-					107						
AC2			48				131 144 153				
ACC	37		48				129				
AdC							135				
AdCO									215		
Add									215		
AI1A		45			85						
AI1E					85						
AI1F					85						
AI1S					85						
AI1t					85						
AI2A		45			86						
AI2E					86						
AI2F					86						
AI2L					86						
AI2S					86						
AI2t					86						
AI3A		45			87						
AI3E					87						
AI3F					87						
AI3L					87						
AI3S					87						
AI3t					87						
AI4A		45			88						
AI4E					88						
AI4F					88						
AI4L					88						
AI4S					88						
AI4t					88						
AIC1					89		151				
AFE							185				
ALGr		46									
AMOA									215		

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AMOC									215		
AO1					103						
AO1F					104						
AO1t					103						
AO2					105						
AO2F					105						
AO2t					105						
AO3					106						
AO3F					106						
AO3t					106						
AOH1					103						
AOH2					105						
AOH3					106						
AOL1					103						
AOL2					105						
AOL3					106						
ASH1					104						
ASH2					105						
ASH3					106						
ASL1					104						
ASL2					105						
ASL3					106						
Atr								191			
AUt				66							
bbA				78							
bdCO									215		
bFr	35		64								
brA							132				
brO								206			
brP								206			
brU								206			
bSP					83						
bUb								206			
CCFG	34										
CCS						118					
Cd1						118					

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Cd2						118					
CFG	34										
CFPS		46									
CHA1							174				
CHA2							174				
CHCF						117					
CH1							183				
CHM							179				
CHt			62				183				
CL2			54				166				
CL1			54	75			166				
CLL								202			
CLO-		46									
CnF1							179				
CnF2							179				
CnFS		46									
COd											228
COd2											228
COL								202			
COP						119					
CrH2					86						
CrH3					87						
CrH4					88						
CrL2					86						
CrL3					87						
CrL4					88						
CSt											228
Ctd			59								
CtdL			59								
Ctt				67							
dA2							128				
dA3							128				
dAM							172				
dAS							170				
dbS							170				
dCF			52				133	212			

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FFt			60				133				
FLI							146				
FLO									216		
FLOC									216		
FLOt									216		
FLr								192			
FLU			55				146				
FPI							153				
FqA								205			
FqC								205			
FqF								205			
FqL			59								
FqS		44, 46									
Fr1						117					
Fr1b							127				
Fr2						118					
FrH		46									
FrS	35		64								
FrSS				70							
Frt							131				
FrY-										222	
FSt							133				
Ftd			59								
FtdL			59								
FtO			62					210			
FtU			61					209			
GFS										222	
HSP	37		49								
IdA				72							
IdC			52				134	212			
IdC2			52				134	212			
IdM				72							
InH								201			
InHr								201			
InHS								201			
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	[1.1 SIMPLY START] (SIM-)	[1.2 MONITORING] (SUP-)	[1.3 SETTINGS] (SEt-)	[1.4 MOTOR CONTROL] (drC-)	[1.5 INPUTS / OUTPUTS CFG] (I-O-)	[1.6 COMMAND] (CtL-)	[1.7 APPLICATION FUNCT.] (FUn-)	[1.8 FAULT MANAGEMENT] (FLt-)	[1.9 COMMUNICATION] (COM-)	[1.12 FACTORY SETTINGS] (FCS-)	[4 PASSWORD] (COd-)
IntP							164				
IPHr		46									
IPL	35							195			
IPr		46									
ItH	37		49								
JF2			61								
JF3			61								
JFH			61								
JGF			55				137				
JGt			55				137				
JOG							137				
JPF			61								
L1A to L14A		45			81						
L1d to L14d					81						
LC2							166				
LCr		46									
LCt							168				
LdS				70							
LES							168				
LEt								197			
LFA				72							
LFd			62				162				
LFF							155	212			
LFL2 LFL3 LFL4								200			
LFM				72							
LIS1		45									
LIS2		45									
LLC							168				
LnS							181				
LO1					98						
LO1d					98						
LO1H					98						
LO1S					98						
LO2					98						

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Code	Page										
	[1.1 SIMPLY START] (SIM-)	[1.2 MONITORING] (SUP-)	[1.3 SETTINGS] (SEt-)	[1.4 MOTOR CONTROL] (drC-)	[1.5 INPUTS / OUTPUTS CFG] (I-O-)	[1.6 COMMAND] (CtL-)	[1.7 APPLICATION FUNCT.] (FUn-)	[1.8 FAULT MANAGEMENT] (FLt-)	[1.9 COMMUNICATION] (COM-)	[1.12 FACTORY SETTINGS] (FCS-)	[4 PASSWORD] (COd-)
LO2d					98						
LO2H					98						
LO2S					98						
LO3					99						
LO3d					99						
LO3H					99						
LO3S					99						
LO4					99						
LO4d					99						
LO4H					99						
LO4S					99						
LOC			62					210			
LPI			58				155				
LqS				70							
LSP	37		49				158				
LUL			61					209			
LUn			61					209			
MA2							128				
MA3							128				
MFr		46									
MMF		44, 46									
MPI							155				
nCA1									214		
nCA2									214		
nCA3									214		
nCA4									214		
nCA5									214		
nCA6									214		
nCA7									214		
nCA8									214		
nCr	35		64								
nCrS				70							
nFd							162				
nFFt			62				181				
nFS							181				
nFSt			62				181				

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Code	Page										
	[1.1 SIMPLY START] (SIM-)	[1.2 MONITORING] (SUP-)	[1.3 SETTINGS] (SEt-)	[1.4 MOTOR CONTROL] (drC-)	[1.5 INPUTS / OUTPUTS CFG] (I-O-)	[1.6 COMMAND] (CtL-)	[1.7 APPLICATION FUNCT.] (FUn-)	[1.8 FAULT MANAGEMENT] (FLt-)	[1.9 COMMUNICATION] (COM-)	[1.12 FACTORY SETTINGS] (FCS-)	[4 PASSWORD] (COd-)
nMA1									214		
nMA2									214		
nMA3									214		
nMA4									214		
nMA5									214		
nMA6									214		
nMA7									214		
nMA8									214		
nPr	35		64								
nrd				76							
nSL				72							
nSP	35		65								
nSPS				70							
nSt							133				
o06		46									
o02		46									
o03		46									
o04		46									
o05		46									
OCC							170				
OdL								210			
Odt								194			
OF1				75							
OHL								195			
OLL								194			
OPL								194			
OPr		46									
Otr		46									
PAH			57				152				
PAL			57				152				
PAU							153				
PEr			58				152				
PEt		46									
PF1					90						
PFL				68							
PFr					90						

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Code	Page										
	[1.1 SIMPLY START] (SIM-)	[1.2 MONITORING] (SUP-)	[1.3 SETTINGS] (SEt-)	[1.4 MOTOR CONTROL] (drC-)	[1.5 INPUTS / OUTPUTS CFG] (I-O-)	[1.6 COMMAND] (CtL-)	[1.7 APPLICATION FUNCT.] (FUn-)	[1.8 FAULT MANAGEMENT] (FLt-)	[1.9 COMMUNICATION] (COM-)	[1.12 FACTORY SETTINGS] (FCS-)	[4 PASSWORD] (COd-)
rPS							131				
rPt							129				
rrS					80						
rSA				72							
rSAS				70							
rSF								190			
rSL							158				
rSM				72							
rSMS				70							
rtd			60								
rtdL			60								
rtH		46									
SA2							128				
SA3							128				
SAt								196			
SCS1										222	
SdC1			53				135				
SdC2			53				135				
SFC			49								
SFr			54	75							
SIt			49								
SLE			55				158				
SLL								202			
SLP			52	71							
SOP				76							
SP2			56				140				
SP3			56				140				
SP4			56				140				
SP5			56				140				
SP6			56				140				
SP7			56				140				
SP8			56				140				
SPd		46									
SPG			49								
SPM							145				

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Code	Page										
	[1.1 SIMPLY START] (SIM-)	[1.2 MONITORING] (SUP-)	[1.3 SETTINGS] (SEt-)	[1.4 MOTOR CONTROL] (drC-)	[1.5 INPUTS / OUTPUTS CFG] (I-O-)	[1.6 COMMAND] (CtL-)	[1.7 APPLICATION FUNCT.] (FUn-)	[1.8 FAULT MANAGEMENT] (FLt-)	[1.9 COMMUNICATION] (COM-)	[1.12 FACTORY SETTINGS] (FCS-)	[4 PASSWORD] (COd-)
tHr		46									
tHt								194			
tLA							164				
tLC							165				
tLIG			59				164				
tLIM			59				164				
tLS			55				158				
tOd							172				
tOL								210			
tPI			58				155				
trA				72							
trM				72							
tSM								199			
ttd			60					194, 196			
ttd2								194, 196			
ttd3								194, 196			
ttH			59								
ttL			59								
ttO								215			
tUL							179				
tUn	36			66							
tUS	36			66							
U0				68							
U1				68							
U2				68							
U3				68							
U4				69							
U5				69							
Ubr				78							
UC2				69							
UCb								192			
UdL								209			
UCP				69							
UFr			52	71							

Index of parameter codes

Code	Page										
	[1.1 SIMPLY START] (SIM-)	[1.2 MONITORING] (SUP-)	[1.3 SETTINGS] (SEt-)	[1.4 MOTOR CONTROL] (drC-)	[1.5 INPUTS / OUTPUTS CFG] (I-O-)	[1.6 COMMAND] (CtL-)	[1.7 APPLICATION FUNCT.] (FUn-)	[1.8 FAULT MANAGEMENT] (FLt-)	[1.9 COMMUNICATION] (COM-)	[1.12 FACTORY SETTINGS] (FCS-)	[4 PASSWORD] (COd-)
UIH1					85						
UIH2					86						
UIH4					88						
UIL1					85						
UIL2					86						
UIL4					88						
ULn		46									
ULr											228
ULt								209			
UnS	35		64								
UOH1					103						
UOH2					105						
UOH3					106						
UOL1					103						
UOL2					105						
UOL3					106						
UOP		46									
UPL								199			
UPP							159				
UrES								198			
USb								198			
USI							144				
USL								198			
USP							142				
USt								198			

ATV61_programming_manual_EN_1760649_07

1760649   12/2009

Product Data Sheet

VW3A1102

REMOTE MOUNTING KIT FOR LCD KEYPAD:ATV61/71

List Price	$55.00 USD
Availability	**Stock Item: This item is normally stocked in our distribution facility.**

Technical Characteristics

Shipping and Ordering

Category	22135 -
Discount Schedule	CP4C
GTIN	00785901684985
Package Quantity	1
Weight	0.52 lbs.
Availability Code	Stock Item: This item is normally stocked in our distribution facility.
Returnability	Y
Country of Origin	FR

As standards, specifications, and designs change from time to time, please ask for confirmation of the information given in this document.

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The Type T units are designed for the global market and are the best choice when size and cost are of concern. This is our most popular and complete offering of industrial control transformers, and includes the following features:

- 50/60 Hz rated
  Customer installed accessories (finger-safe covers, fuse blocks, fuse clips)
- Type T transformers are designed with the various temperature classes:
  50–150 VA with a 55° C temperature rise, 105° C insulation
  200–350 VA with a 80° C temperature rise, 130° C insulation
  500–5000 VA with a 115° C temperature rise, 180° C insulation

Square D manufactures a wide variety of voltage combinations for control transformers. The voltage combinations are expressed as “Voltage Codes” and these codes are embedded within the catalog number of the transformer. Standard codes are listed, if the voltage combination you require is not listed, call your Square D Distributor for assistance.

Key to Price Column Headings

Voltage Code
Primary Voltages
Secondary Voltages
Key for Dimensions & Accessory

Type T

UL/CSA/ NOM VA	CE VA	Type	D1 240 x 480 120 I	D31 240 x 480 120/240 I	D5 600 120 I	D37 600 120/240 I	D24 120 120 I	D55 120 x 240 120/240 I	D3 208 120 I	D4 277 120 I	D51 208/277 120 I	D60 277 120/240 I
25	25	T25	$ 34.70	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
50	50	T50	36.50	$ 59.00	$ 42.40	$147.00	$147.00	$147.00	$ 42.40	$ 42.40	$147.00	$147.00
75	75	T75	43.30	62.00	51.00	153.00	153.00	153.00	51.00	51.00	153.00	153.00
100	100	T100	48.50	65.00	57.00	154.00	154.00	154.00	57.00	57.00	154.00	154.00
150	150	T150	52.00	86.00	72.00	164.00	164.00	164.00	72.00	72.00	164.00	164.00
200	200	T200	64.00	111.00	92.00	224.00	224.00	224.00	92.00	92.00	224.00	224.00
250	160	T250	75.00	117.00	114.00	225.00	225.00	225.00	114.00	114.00	225.00	225.00
300	200	T300	83.00	137.00	117.00	227.00	227.00	227.00	117.00	117.00	227.00	227.00
350	250	T350	88.00	143.00	136.00	228.00	228.00	228.00	136.00	136.00	228.00	228.00
500	300	T500	110.00	160.00	148.00	235.00	235.00	235.00	148.00	148.00	235.00	235.00
750	500	T750	152.00	223.00	209.00	264.00	264.00	264.00	209.00	209.00	264.00	264.00
1000	630	T1000	184.00	263.00	263.00	280.00	280.00	280.00	263.00	263.00	280.00	280.00
1500	1000	T1500	263.00	385.00	368.00	404.00	404.00	404.00	368.00	368.00	404.00	404.00
2000	1500	T2000	320.00	427.00	427.00	438.00	438.00	438.00	427.00	427.00	438.00	438.00
3000	2000	T3000	444.00	701.00	602.00	749.00	749.00	749.00	602.00	602.00	749.00	749.00
5000	3000	T5000	746.00	948.00	948.00	948.00	948.00	948.00	948.00	948.00	948.00	948.00

Type T

UL/CSA/ NOM VA	CE VA	Type	D2 240 x 480 24 I	D59 240 x 480 12/24 I	D13 120 12/24 I	D23 120/240 24 I	D54 120/240 12/24 I	D14 208 24 I	D25 277 24 I	D36 600 12/24 I
50	50	T50	$ 42.40	$147.00	$ 42.40	$ 42.40	$147.00	$ 42.40	$147.00	$147.00
75	75	T75	51.00	153.00	51.00	51.00	153.00	51.00	153.00	153.00
100	100	T100	57.00	154.00	57.00	57.00	154.00	57.00	154.00	154.00
150	150	T150	72.00	164.00	72.00	72.00	164.00	72.00	164.00	164.00
200	200	T200	92.00	224.00	92.00	92.00	224.00	92.00	224.00	224.00
250	160	T250	114.00	225.00	114.00	114.00	225.00	114.00	225.00	225.00
300	200	T300	117.00	227.00	117.00	117.00	227.00	117.00	227.00	227.00
350	250	T350	136.00	228.00	136.00	136.00	228.00	136.00	228.00	228.00
500	300	T500	148.00	235.00	148.00	148.00	235.00	148.00	235.00	235.00
750	500	T750 ▲	209.00	264.00	209.00	209.00	264.00	209.00	264.00	264.00
1000	630	T1000 ▲	263.00	280.00	263.00	263.00	280.00	263.00	280.00	280.00

Type T

UL/CSA/NOM VA	CE VA	Type	D15 240 x 480 24/120 I	D12 480 240 I	D22 480 277 I	D62 600 240 I
50	50	T50	$ 42.40	$ 42.40	$147.00	$147.00
75	75	T75	51.00	153.00	153.00	153.00
100	100	T100	65.00	57.00	154.00	154.00
150	150	T150	72.00	72.00	164.00	164.00
200	200	T200	92.00	92.00	224.00	224.00
250	160	T250	117.00	114.00	225.00	225.00
300	200	T300	137.00	117.00	227.00	227.00
350	250	T350	143.00	136.00	228.00	228.00
500	300	T500	160.00	148.00	235.00	235.00
750	500	T750	223.00	209.00	264.00	264.00
1000	630	T1000	263.00	263.00	280.00	280.00
1500	1000	T1500	385.00	368.00	404.00	404.00
2000	1500	T2000	427.00	427.00	438.00	438.00
3000	2000	T3000	701.00	602.00	749.00	749.00
5000	3000	T5000	948.00	948.00	948.00	948.00

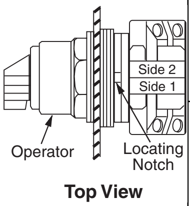
Listing	File	Type
UL	E61239	T25–T1000
CSA	LR37055, Guide 184-N-90, C22.2	T25–T1000
cULus	E61239	T1500–T5000
EN (CE)	947923, EN-61558-1 (TUV ref: 00941-RAG/sg E9371495E01)	T25–T200
	9579078, EN-61558-1 (TUV ref: 00941-RAG/sg E9471921.02E01)	T250–T1000
	9579078, EN-61558-1 (TUV ref: 00941-RAG/sg E9471921.02E01)	T1500–T5000

▲ See Control Transformer Catalog: 9070CT9901 for dimensions different than Digest.

CP8 | Discount Schedule

Non-Illuminated 3 Position Selector Switch Operators—UL Types 4, 4X, 13/NEMA 4, 4X, 13

For use in hazardous locations—See page 17-79.
Legend plate and contact block not included unless noted.

CONTACT BLOCK REQUIRED					1 — Contact Closed 0 — Contact Open								
Contact Block Position	Quantity and Type		Mount on Side		Center Left Right	Center Left Right	Center Left Right	Center Left Right	Center Left Right	Center Left Right	Center Left Right	Center Left Right	Center Left Right
 Operator, Locating Notch, Side 2, Side 1, Top View	KA1 or	KA3	KA1 #2 or	KA3 #2	1 0 0	1 0 0	0 0 1	1 0 0	1 0 0	1 0 0	1 0 0	0 1 0	1 1 0
		KA2		KA2 #2	0 1 1	0 0 1	0 1 0	0 1 0	0 0 1	0 1 1	0 1 1	1 0 0	0 0 1
	KA1 or	KA3	KA1 #1 or	KA3 #1	0 0 1	1 0 0	0 0 1	1 0 0	0 1 0	0 0 1	1 0 1	0 0 1	0 1 1
		KA2		KA2 #1	1 1 0	0 0 1	0 1 0	0 1 0	0 0 1	1 0 0	0 1 0	0 1 0	1 0 0
Cam (see page 17-64)					B	C	D	E	F	G	J	L	M

Non-Illuminated Operators	Type	Type	Type	Type	Type	Type	Type	Type	Type	Price
Manual Return										
Operator Only ▲										
Without Knob	SKS42	SKS43	SKS44	SKS45	SKS46	SKS47	SKS49	SKS401	SKS402	$28.50
With Standard Black Knob	SKS42B	SKS43B	SKS44B	SKS45B	SKS46B	SKS47B	SKS49B	SKS401B	SKS402B	35.10
With Other Color Knob (See Knob Table) ■	SKS42■	SKS43■	SKS44■	SKS45■	SKS46■	SKS47■	SKS49■	SKS401■	SKS402■	35.10
With Contact Block(s)										
With Standard Black Knob (From Table for Other Colors, Replace B in Type Number with Color Code)										
With 1 KA1 on side #2	SKS42BH13	SKS43BH13	SKS44BH13	SKS45BH13	SKS46BH13	SKS47BH13	SKS49BH13	SKS401BH13	SKS402BH13	64.00
With 1 KA1 on side #1	SKS42BH1	SKS43BH1	SKS44BH1	SKS45BH1	SKS46BH1	SKS47BH1	SKS49BH1	SKS401BH1	SKS402BH1	64.00
With 1 KA1 on side #1 and 1 KA1 on side #2 (H2)	SKS42BH2	SKS43BH2	SKS44BH2	SKS45BH2	SKS46BH2	SKS47BH2	SKS49BH2	SKS401BH2	SKS402BH2	92.00
Spring Return from Left to Center										
Operator Only ▲										
Without Knob	SKS62	SKS63	SKS64	SKS65	SKS66	SKS67	SKS69	SKS601	SKS602	47.60
With Standard Black Knob	SKS62B	SKS63B	SKS64B	SKS65B	SKS66B	SKS67B	SKS69B	SKS601B	SKS602B	54.00
With Other Color Knob (See Knob Table) ■	SKS62■	SKS63■	SKS64■	SKS65■	SKS66■	SKS67■	SKS69■	SKS601■	SKS602■	54.00
Spring Return From Right to Center										
Operator Only ▲										
Without Knob	SKS72	SKS73	SKS74	SKS75	SKS76	SKS77	SKS79	SKS701	SKS702	47.60
With Standard Black Knob	SKS72B	SKS73B	SKS74B	SKS75B	SKS76B	SKS77B	SKS79B	SKS701B	SKS702B	54.00
With Other Color Knob (See Knob Table) ■	SKS72■	SKS73■	SKS74■	SKS75■	SKS76■	SKS77■	SKS79■	SKS701■	SKS702■	54.00
Spring Return Both Sides to Center										
Operator Only ▲										
Without Knob	SKS52	SKS53	SKS54	SKS55	SKS56	SKS57	SKS59	SKS501	SKS502	47.60
With Standard Black Knob	SKS52B	SKS53B	SKS54B	SKS55B	SKS56B	SKS57B	SKS59B	SKS501B	SKS502B	54.00
With Other Color Knob (See Knob Table) ■	SKS52■	SKS53■	SKS54■	SKS55■	SKS56■	SKS57■	SKS59■	SKS501■	SKS502■	54.00

▲ These operators can be ordered complete with contact blocks. For maximum block usage, see page 17-85. Add the "H" number chosen from page 17-80 to the end of the operator type number and add the cost of the "H" number to the operator cost.
■ Add the color code as chosen from knob color table below.
EXAMPLE: SKS43■ with a green gloved-hand knob = SKS43FG.

Selector Switch Knobs

Standard Knob

Gloved-Hand Knob

Coin Operated

Color	■ Knob Code	Type	■ Knob Code	Type	■ Knob Code	Type	Price
Black	B	B11	FB	B25	TB	B18	$6.60
Red	R	R8	FR	R24	TR	R16	
Green	G	G8	FG	G24	TG	G16	
Yellow	Y	Y8	FY	Y24	TY	Y16	
Orange	S	S11	FS	S25	. . .	. . .	
Blue	L	L8	FL	L24	TL	L16	
White	W	W8	FW	W24	. . .	. . .	
Amber	A	A8	FA	A24	. . .	. . .	
Clear	C	C8	FC	C24	TC	C16	

For additional information, reference Catalog #9001CT0301.

Non-Illuminated Momentary Push Button Operators—UL Types 4, 4X, 13/NEMA 4, 4X, 13

For use in hazardous locations—See page 17-79.
Contact blocks and legend plate not included unless otherwise noted.

Description	Color	Operator with 1 N.O. and 1 N.C. Contact (KA1)	Price	Operator with 1 N.O. Contact (KA2)	Operator with 1 N.C. Contact (KA3)	Price	Operator Only No Contacts ▼	Price
	Black	SKR1BH13	$54.00	SKR1BH5	SKR1BH6	$39.90	SKR1B	$25.70
	Red	SKR1RH13	54.00	SKR1RH5	SKR1RH6	39.90	SKR1R	25.70
	Green	SKR1GH13	54.00	SKR1GH5	SKR1GH6	39.90	SKR1G	25.70
	Universal ▲	SKR1UH13	54.00	SKR1UH5	SKR1UH6	39.90	SKR1U	25.70
9001SKR1B Full Guard	Other ■	SKR1■H13	54.00	SKR1■H5	SKR1■H6	39.90	SKR1■	25.70
	Black	SKR3BH13	54.00	SKR3BH5	SKR3BH6	39.90	SKR3B	25.70
	Red	SKR3RH13	54.00	SKR3RH5	SKR3RH6	39.90	SKR3R	25.70
	Green	SKR3GH13	54.00	SKR3GH5	SKR3GH6	39.90	SKR3G	25.70
	Universal ▲	SKR3UH13	54.00	SKR3UH5	SKR3UH6	39.90	SKR3U	25.70
9001SKR3B No Guard	Other ■	SKR3■H13	54.00	SKR3■H5	SKR3■H6	39.90	SKR3■	25.70
	Black	SKR2BH13	54.00	SKR2BH5	SKR2BH6	39.90	SKR2B	25.70
	Red	SKR2RH13	54.00	SKR2RH5	SKR2RH6	39.90	SKR2R	25.70
	Green	SKR2GH13	54.00	SKR2GH5	SKR2GH6	39.90	SKR2G	25.70
	Universal ▲	SKR2UH13	54.00	SKR2UH5	SKR2UH6	39.90	SKR2U	25.70
9001SKR2B Extended Guard	Other ■	SKR2■	54.00	SKR2■H5	SKR2■H6	39.90	SKR2■	25.70

▲ The universal push button operators include one each of the following color inserts: black, red, green, yellow, orange, blue and white.
■ See table below.

Description	Color	Operator with 1 N.O. and 1 N.C. Contact (KA1)	Price	Operator with 1 N.O. Contact (KA2)	Operator with 1 N.C. Contact (KA3)	Price	Operator Only No Contacts ▼	Price
	Snap-In Mushroom Button							
	Black	SKR4BH13	$83.00	SKR4BH5	SKR4BH6	$68.00	SKR4B	$54.00
	Red	SKR4RH13	83.00	SKR4RH5	SKR4RH6	68.00	SKR4R	54.00
	Red ♦	SKR4R05H13	86.00	SKR4R05H5	SKR4R05H6	72.00	SKR4R05	57.00
	Green	SKR4GH13	83.00	SKR4GH5	SKR4GH6	68.00	SKR4G	54.00
	Other ★	SKR4★H13	83.00	SKR4★H5	SKR4★H6	68.00	SKR4★	54.00
9001SKR4B	**Screw-On Mushroom Button with Set Screw Security**							
1 3/8 Mushroom Button	Black	SKR24BH13	83.00	SKR24BH5	SKR24BH6	68.00	SKR24B	54.00
	Red	SKR24RH13	83.00	SKR24RH5	SKR24RH6	68.00	SKR24R	54.00
	Green	SKR24GH13	83.00	SKR24GH5	SKR24GH6	68.00	SKR24G	54.00
	Other ★	SKR24★H13	83.00	SKR24★H5	SKR24★H6	68.00	SKR24★	54.00
	Snap-In Mushroom Button							
	Black	SKR5BH13	83.00	SKR5BH5	SKR5BH6	68.00	SKR5B	54.00
	Red	SKR5RH13	83.00	SKR5RH5	SKR5RH6	68.00	SKR5R	54.00
	Red ♦	SKR5R05H13	86.00	SKR5R05H5	SKR5R05H6	72.00	SKR5R05	57.00
	Green	SKR5GH13	83.00	SKR5GH5	SKR5GH6	68.00	SKR5G	54.00
	Other ★	SKR5★H13	83.00	SKR5★H5	SKR5★H6	68.00	SKR5★	54.00
9001SKR5B	**Screw-On Mushroom Button with Set Screw Security**							
2 1/4 Mushroom Button	Black	SKR25BH13	83.00	SKR25BH5	SKR25BH6	68.00	SKR25B	54.00
	Red	SKR25RH13	83.00	SKR25RH5	SKR25RH6	68.00	SKR25R	54.00
	Green	SKR25GH13	83.00	SKR25GH5	SKR25GH6	68.00	SKR25G	54.00
	Other ★	SKR25★H13	83.00	SKR25★H5	SKR25★H6	68.00	SKR25★	54.00

♦ Knob has the words “Emergency Stop” in raised letters highlighted in white for readability.
★ See table below.
▼ These operators can be ordered complete with contact blocks. For maximum block usage, see page 17-85. Add the “H” number chosen from page 17-80 to the end of the operator type number and add the cost of the “H” number to the operator cost.

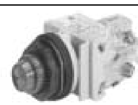
Color	■ SKR1, 2, 3 Place Color Code in Type Number	★ SKR4, 5, 24, 25 Place Color Code in Type Number
Blue	L	L
Yellow	Y	Y
White	W	. . .
Orange	S	S
Gray	E	. . .

For additional information, reference Catalog #9001CT0301.

CP1 | Discount Schedule

Pilot Lights—UL Types 4, 4X, 13/NEMA 4, 4X, 13

For use in hazardous locations—See page 17-79.
Legend plate not included.

Description		Voltage	Style	With Red Fresnel Color Cap	With Green Fresnel Color Cap	With Other Color Cap	Price	Without Color Cap	Price
 9001SKP1	Standard Pilot Light (Non-metallic fresnel color cap shown)	110–120 V, 50–60 Hz	Transformer	SKP1R31	SKP1G31	SKP1■	$102.	SKP1	$95.
		220–240 V, 50–60 Hz	Transformer	SKP7R31	SKP7G31	SKP7■	102.	SKP7	95.
		24–28 Vac/dc	Full Voltage	SKP35R31	SKP35G31	SKP35■	83.	SKP35	77.
		For other voltages see Table ▲	Transformer, Flashing or LED♦	SKP▲R31	SKP▲G31	SKP▲■	102.	SKP▲	95.
			Full Voltage, Neon or Resistor★	SKP▲R31	SKP▲G31	SKP▲■	83.	SKP▲	77.
 9001SKT1	Push-To-Test Pilot Light (Non-metallic fresnel color cap shown)	110–120 V, 50–60 Hz	Transformer	SKT1R31	SKT1G31	SKT1■	131.	SKT1	123.
		220–240 V, 50–60 Hz	Transformer	SKT7R31	SKT7G31	SKT7■	131.	SKT7	123.
		24–28 Vac/dc	Full Voltage	SKT35R31	SKT35G31	SKT35■	111.	SKT35	105.
		For other voltages see Table ▲	Transformer, Flashing or LED♦	SKT▲R31	SKT▲G31	SKT▲■	131.	SKT▲	123.
			Full Voltage, Neon or Resistor★	SKT▲R31	SKT▲G31	SKT▲■	111.	SKT▲	105.
 9001SKTR38	Remote Test Pilot Light (Non-metallic fresnel color cap shown)	120 Vac Only	Resistor	SKTR38R31	SKTR38G31	SKTR38■	131.	SKTR38	123.
		24–28 Vac Only	Full Voltage	SKTR35R31	SKTR35G31	SKTR35■	131.	SKTR35	123.
		For other voltages see Tables ▲■▼	Full Voltage or Resistor ▼	SKTR▲R31	SKTR▲G31	SKTR▲■	131.	SKTR▲	123.
 Pilot Light For Intrinsically Safe Circuits (NEMA 4X)	Intrinsically safe equipment must not release electrical or thermal energy capable of igniting certain explosive or combustible hazardous atmospheres, for which the equipment has been tested. These pilot lights are intrinsically safe when used with suitable approved barrier or barrier relay. These pilot lights are Factory Mutual (FM) approved. Consult your local Square D sales office for further details. These pilot lights are fully encapsulated—there are no replaceable parts—except for the SK40 ring nut. Use KN100 series plastic legend plates as shown on Pages 17-81 and 17-82.			KP44R	KP44G	KP44Y (Yellow Color Cap)	119.	. . .	. . .

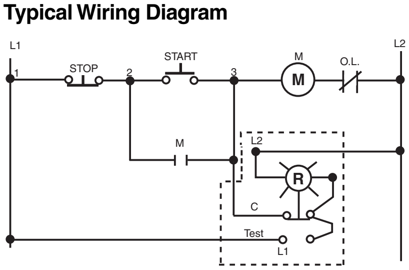
Operating Voltage Range	Nominal Current	
20–30 Vac/dc	25 mA	V max = 32 V I max = 165 mA

▲ Add the voltage assembly code as chosen from table, page 17-77.
EXAMPLE: SKT▲R31 with 60 Vac red LED voltage = SKT37LRR31.
■ Add the color code as chosen from the color cap table below.
EXAMPLE: SKP1■ with a blue fresnel cap = SKP1L31.
♦ The cap must be the same color as the LED light module chosen, e.g., for green LED, use green color cap.
★ On neon light modules, use clear color caps only.
▼ Use only full voltage or resistor voltage assembly codes on remote test pilot lights. Do not choose LED, neon or transformer codes. For AC use only.

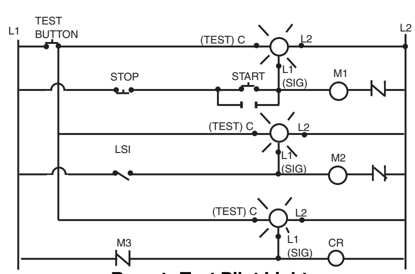
Color Caps

Color	■ Plastic Fresnel 	■ Plastic Domed 
Amber	A31	A9
Blue	L31	L9
Clear	C31	C9
Green	G31	G9
Red	R31	R9
White	W31	W9
Yellow	Y31	Y9

Typical Wiring Diagram



Push-To-Test Pilot Light



Remote Test Pilot Light

For additional information, reference Catalog #9001CT0301.

CP1 | Discount Schedule

RXZ E2M114M with relay RXM4AB2P7TQ

RXZ E2S114M with relay RXM4AB2F7TQ

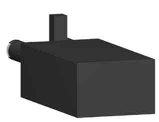
Miniature relays with lockable test button, without LED (sold in lots of 100)

	Number and type of contacts - Thermal current (Ith)					
	DPDT - 12 A			4PDT - 6 A		
Coil Voltage	Catalog Number	Weight lb.	Weight kg	Catalog Number	Weight lb.	Weight kg
12 Vdc	—	—	—	**RXM4AB1JDTQ**	0.080	0.036
24 Vdc	**RXM2AB1BDTQ**	0.082	0.037	**RXM4AB1BDTQ**	0.080	0.036
48 Vdc	—	—	—	**RXM4AB1EDTQ**	0.080	0.036
110 Vdc	—	—	—	**RXM4AB1FDTQ**	0.080	0.036
220 Vdc	—	—	—	**RXM4AB1MDTQ**	0.080	0.036
24 Vac	**RXM2AB1B7TQ**	0.082	0.037	**RXM4AB1B7TQ**	0.080	0.036
48 Vac	—	—	—	**RXM4AB1E7TQ**	0.080	0.036
120 Vac	**RXM2AB1F7TQ**	0.082	0.037	**RXM4AB1F7TQ**	0.080	0.036
230 Vac	**RXM2AB1P7TQ**	0.082	0.037	**RXM4AB1P7TQ**	0.080	0.036
Miniature relays with LED (sold in lots of 100)						
24 Vdc	—	—	—	**RXM4AB2BDTQ**	0.080	0.036
24 Vac	**RXM2AB2B7TQ**	0.082	0.037	**RXM4AB2B7TQ**	0.080	0.036
230 Vac	**RXM2AB2P7TQ**	0.082	0.037	**RXM4AB2P7TQ**	0.080	0.036

Sockets (sold in lots of 10)

Contact terminal arrangement	Connection	Relay type	Catalog Number	Weight lb.	Weight kg
Mixed	Screw clamp terminals	RXM2●●●● [1] RXM4●●●●	**RXZE2M114** [2]	0.11	0.048
	Box lug connector	RXM2●●●● [1] RXM4●●●●	**RXZE2M114M** [2]	0.12	0.056
Separate	Box lug connector	RXM2●●●●	**RXZE2S108M** [3]	0.13	0.058
		RXM3●●●●	**RXZE2S111M** [2]	0.15	0.066
		RXM4●●●●	**RXZE2S114M** [2]	0.15	0.070

1 When mounting relay RXM2●●●●● on socket RXZE2M●●●●, the thermal current must not exceed 10 A.
2 Thermal current Ith: 10 A
3 Thermal current Ith: 12 A



RXM 041●●7

Protection modules (sold in lots of 20)

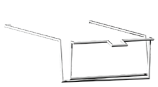
Description	Voltage	For use with	Catalog Number	Weight oz.	Weight g
Diode	6–250 Vdc	All sockets	**RXM040W**	0.11	3.0
RC circuit	24–60 Vac	All sockets	**RXM041BN7**	0.35	10.0
	110–240 Vac	All sockets	**RXM041FU7**	0.35	10.0
Varistor	6–24 Vac/Vdc	All sockets	**RXM021RB**	1.06	30.0
	24–60 Vac/Vdc	All sockets	**RXM021BN**	1.06	30.0
	110–240 Vac/Vdc	All sockets	**RXM021FP**	1.06	30.0

REXL4●●

Timing relays

Description	For use with	Catalog Number	Weight lb.	Weight kg
2 timed DPDT contacts (function A—On-delay)	Sockets RXZ E●●●●●	**REXL2●●** [4]	0.09	0.042
4 timed 4PDT contacts (function A—On-delay)		**REXL4●●** [4]	0.09	0.042

4 Please refer to the *Zelio® Time - Timers* catalog (9050CT0001R2/05).



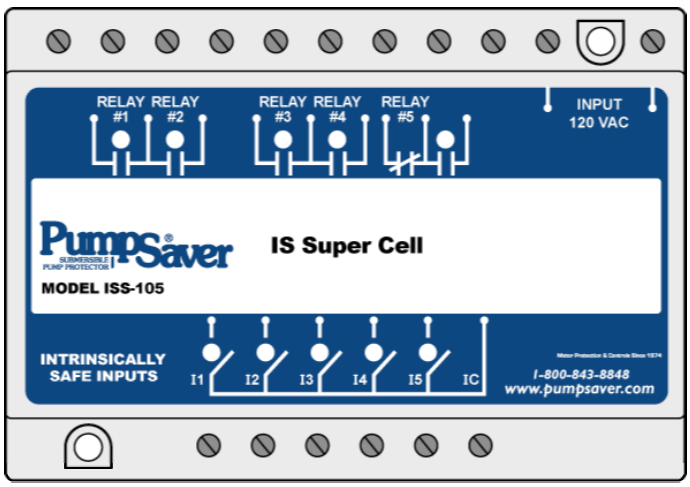
RXZ400

Accessories (sold in lots of 10)

Description	For use with	Catalog Number	Weight oz.	Weight g
Metal hold-down clip	All sockets	**RXZ400**	0.04	1.0
Plastic hold-down clip	All sockets	**RXZR335**	0.18	5.0
Bus jumper, 2-pole (Ith: 5 A)	All sockets with separate contacts	**RXZS2**	0.18	5.0
Mounting adapter for DIN rail [5]	All relays	**RXZE2DA**	0.14	4.0
Mounting adapter for mounting directly to a panel	All relays	**RXZE2FA**	0.07	2.0
Clip-in markers	All relays (sheet of 108 markers)	**RXZL520**	2.82	80.0
	All sockets except RXZE2M114	**RXZL420**	0.04	1.0

5 Test button becomes inaccessible.

PumpSaver® ISS-105
IS Super Cell
Installation Guide



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Introduction

The PumpSaver® ISS-105 IS Super Cell is a smart, five-channel, intrinsically safe relay and pump controller. It has a long list of features that are needed for multiple pump applications. The IS Super Cell can indicate low, high and out-of-sequence alarms. It can do alternating pump control, non-alternating pump control, or alternating control with one non-alternating pump. The non-alternating pump can be used as either a jockey or emergency pump and can optionally start the non-alternating pump after every 50 cycles of the lead pump, to keep it working freely. Using the built-in DIP switches, individual pumps can be disabled when taken out of service for repair or maintenance.

The IS Super Cell has the following features and capabilities:

- High, Low and Out-Of-Sequence Alarms
- Variable Time Delay/Lag Pump Delay
- Separate Pump Stop
- Pump Alternation w/ or w/o Non-Alternating Pump
- Jockey or Emergency Pump
- Duplex, Triplex or Quadplex Pump Modes
- Pump Up or Pump Down Functions
- External Silence, Reset and Alternation Configuration
- Five-Channel Relay

Quick Start

The IS Super Cell can operate as an intrinsically safe pump control for eight different pumping configurations. Duplex, Triplex, Quadplex and Duplex SPS (Separate Pump Stop) pumping modes are possible for either Pump Up or Pump Down applications. Refer to page 21 for the full description of five-channel relay operation.

Read **1. Pumping Modes**, page 6, for details of the features and mode descriptions of the unit.

1. If the desired pump configuration is known, follow Table 1 to the page showing the typical wiring diagram and setup for each mode.

2. If further description is needed in choosing which mode to use, see Table 2 and Table 3 to view the capabilities of each pumping mode and look at the typical wiring diagrams of the eight different pumping modes starting on page 11.

3. Once the desired configuration is determined, punch out and slide the correct card into the slot on the front of the IS Super Cell to display the input and output connections.

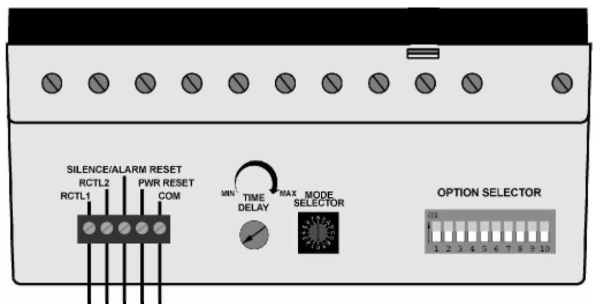
Mode Selector Switch Position	Mode Description	Page
0	5-Channel Relay – Mode 0	22
1	Duplex Pump Down – Mode 1	11
2	Triplex Pump Down – Mode 2	12
3	Quadplex Pump Down – Mode 3	13
4	Duplex SPS Pump Down – Mode 4	14
5	Duplex Pump Up – Mode 5	15
6	Triplex Pump Up – Mode 6	16
7	Quadplex Pump Up – Mode 7	17
8	Duplex SPS Pump Up – Mode 8	18

Table 1. Mode Selector

Model Description

The ISS-105 has three adjustable controls to set the mode of operation:

1. Mode Selector
2. Option Selector
3. Time Delay



WARNING! **To ensure proper initialization and operation, set the mode and option selectors before applying power to the unit.**

Time Delay

The Time Delay can be set from 2–255 seconds and is the Lag Pump delay in each of the pumping modes. When the Lead Float opens/closes, the Time Delay starts and once it expires, the Lag Pump is ready to turn on. After the Lag Pump turns on, any necessary pumps will turn on successively after a two-second time delay each.

Mode Selector

This dial is used to select the operation mode. A description of each mode is shown in Table 1. The capabilities of each pumping mode and the Non-Alternating Pump designations are shown in Table 2 below.

	Duplex	Triplex	Quadplex	Duplex SPS
# Pumps	2	3	4	2
High Alarm	Yes	*Yes	No	**Yes
Low Alarm	Yes	*Yes	No	**Yes
Out-of-Sequence Alarm	Yes	Yes	Yes	Yes
# Stop Floats	1	1	1	2
Pump Direction	Up/Down	Up/Down	Up/Down	Up/Down
Non-Alternating Start Float	Lag 1	Lag 2	Lag 3	N/A
Non-Alternation Pump	Pump 2	Pump 3	Pump 4	N/A
Alternator	Yes	Yes	Yes	Yes

Table 2. Mode Capabilities

* On a Triplex pump system, either a High or Low Alarm is available, but not both. See Triplex Mode description for more details.

** On a Duplex SPS system, a High Alarm is typical on a Pump Down application and a Low Alarm is typical on a Pump Up.

Option Selector

Table 2 describes the Option Selector for all pumping modes.
(· Indicates the function is available for the pump mode)

Option Selector Position	Function Description	Duplex	Triplex	Quadplex	Duplex SPS (Separate Pump Stop)
1	High Alarm	·	* ·		·
2	Low Alarm	·	* ·		·
3	Pump 1	·	·	·	·
4	Pump 2	·	·	·	·
5	Pump 3		·	·	
6	Pump 4			·	
7	Audible Alarm Relay State/Fail Safe	·	·	·	·
8	Alternator Select 0, (ALS-0, see Table 4)	·	·	·	·
9	Alternator Select 1, (ALS-1, see Table 4)	·	·	·	·
10	Alternator Select 2, (ALS-2, see Table 4)	·	·	·	·

Table 3. Option Selector

* On a Triplex pump system, either a High or Low Alarm is available, but not both. See Triplex Mode description for more details.

1. Pumping Modes

Duplex

In a Duplex mode, two pumps are used with one Stop Float and High and Low Alarms.

Triplex: High/Low Alarm

In a Triplex mode, three pumps are used with one Stop Float.

In a **Triplex Pump Down** mode, a High Alarm is the typical configuration with the Option Selector switches 1=ON (High Alarm) and 2=OFF (Low Alarm).

If a Low Alarm is desired, the alarm float must be moved to the position in the tank below the Stop Float and Option Selector switches must be 1=OFF and 2=ON.

In a **Triplex Pump Up** mode, a Low Alarm is the typical configuration with the Option Selector switches 1=OFF (High Alarm) and 2=ON (Low Alarm).

If a High Alarm is desired, the alarm float must be moved to the position in the tank above the Stop Float and Option Selector switches must be 1=ON and 2=OFF

Quadplex

In a Quadplex mode, four pumps are used with one Stop Float and no alarms floats.

Separate Pump Stop (SPS)

In the Duplex SPS mode, both the Lead and Lag pumps have their own stop floats.

In an **SPS Pump Down** mode, a **High Alarm** is the typical configuration with Option Selector switches 1=ON (High Alarm) and 2=OFF (Low Alarm).

If a **Low Alarm** is desired, the alarm float must be moved to the position in the tank below the Lead Stop Float, and Option Selector switches must be 1=OFF, and 2=ON.

In an **SPS Pump Up** mode, a **Low Alarm** is the typical configuration with Option Selector switches 1=OFF (High Alarm) and 2=ON (Low Alarm).

If a **High Alarm** is desired, the alarm float must be moved to the position in the tank above the Lead Stop Float, and Option Selector switches must be 1=ON and 2=OFF.

2. IS Super Cell Functions

High Alarm

The **High Alarm** is activated when the High Alarm Float closes, indicating the pumps are unable to keep the water level down on a **Pump Down** application. If the High Alarm Float closes at any time, all pumps will turn on, bypassing the 10-second out-of-sequence trip delay, and the adjustable Time Delay.

If a **High Alarm** is used on a **Pump Up** application, the alarm will be activated when the High Alarm Float closes indicating the water level has been pumped too high, possibly due to a defective Stop Float, and will turn off all pumps.

During a High or Low Alarm, the Alarm LED and Audible Alarm LED will be on. If the High or Low Alarm condition ends, the Audible Alarm will turn off and the Alarm LED will flash indicating the alarm had occurred, but is not present now. If the High or Low Alarm occurs again, the Audible Alarm LED will turn on again, but the Alarm LED will remain flashing.
The unit must be silenced or reset to clear the flashing alarm LEDs.

Low Alarm

The **Low Alarm** is activated when the Low Alarm Float opens indicating the pumps are unable to keep the water level up on a **Pump Up** application. If the Pump Up Low Alarm Float opens at any time, except if a High Alarm is activated, all pumps will turn on.

If a **Low Alarm** is used on a **Pump Down** application, the alarm will be activated when the Low Alarm Float opens indicating the water level has been pumped too low. This may be a result of a defective stop float. The Low Alarm will not turn off the pumps though, but will activate the low alarm relay; another form of pump-dry protection such as the SymCom Model 777 may be required.

Out-of-Sequence Alarm

When a float in the series does not open or close in sequence, the Audible Alarm will be activated and input LED(s) will flash until the unit is reset or power is cycled. An out-of-sequence condition has to exist for 10 seconds before the ISS-105 will alarm. When the stop float fails open in pump down mode or closed in pump up mode, an Out-of-Sequence Alarm will NOT occur and pumps will not turn on with floats. In this case, all pumps will turn on when the High/Low Alarm is activated. Thus, in Quadplex mode, pumps will never turn on if the Stop Float malfunctions.

Audible Alarm

The Audible Alarm is activated when a High, Low or Out-of Sequence Alarm occurs. The Audible Alarm will turn off when there is no longer high or low alarms or if the unit is silenced.

Audible Alarm Logic/Fail-Safe

The Audible Alarm relay can be configured to operate in either a Fail-Safe mode (position 7=ON), or a Non Fail-Safe mode (position 7=OFF). In Fail-Safe mode, the NC (Normally Closed) contacts will be **open** during normal operation and closed during an alarm. In Non Fail-Safe mode, the NC contacts will be **closed** during normal operation and open during an alarm.

Clearing Alarms

The external Silence / Alarm Reset button will clear the Audible Alarm. The Reset button or cycling power will clear Out-of-Sequence Alarms.

Alternation

The ISS-105 is equipped with a built-in alternator that determines which pump will start each pumping cycle. This alternator is configured using switches ALS-0, ALS-1 and ALS-2 of the Option Selector.

Function	ALS-0 Position 8	ALS-1 Position 9	ALS-2 Position 10
Alternation On	ON	ON	ON
Alternation On	OFF	ON	ON
Alternation On, Non-Alternating Pump Enabled (1)	*ON	OFF	OFF
Alternation On, Non-Alternating Pump Enabled (1)	**OFF	OFF	OFF
Alternation Off, Force Pump 1 as Lead	OFF	ON	OFF
Alternation Off, Force Pump 2 as Lead	OFF	OFF	ON
Alternation Off, Force Pump 3 as Lead (2)	ON	ON	OFF
Alternation Off, Force Pump 4 as Lead (3)	ON	OFF	ON

Table 4. Alternator Options

Note (1) In Duplex Mode, this setting is the same as Alternation On.
Note (2) In Duplex Mode, this will force Pump 1 as lead and will cycle Pump 2 every 50 cycles of the lead pump
Note (3) In Duplex Mode, this will force Pump 2 as lead and will cycle Pump 1 every 50 cycles of the lead pump

* If ALS-0 is ON in this mode, the Non-Alternating Pump will cycle when the Non-Alternating Float changes state, or after 50 cycles of the Lead Float.

** If ALS-0 is OFF the Non-Alternating Pump will cycle only when the Non-Alternating Float changes state.

Alternation On

When the alternator is on, each pump will be alternated as the Lead Pump (see Table 5).

	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 5
Pump 1	Lead	Lag 3	Lag 2	Lag 1	Lead
Pump 2	Lag 1	Lead	Lag 3	Lag 2	Lag 1
Pump 3	Lag 2	Lag 1	Lead	Lag 3	Lag 2
Pump 4	Lag 3	Lag 2	Lag 1	Lead	Lag 3

Table 5. Pump Sequence

Alternation On, Non-Alternating Pump Enabled

The Triplex and Quadplex pump modes are equipped with an optional Non-Alternating Pump. This pump will **not** be included in the normal pump alternation sequence when ALS-1 and ALS-2 (positions 9 and 10) are both OFF. If ALS-0 (position 8) is ON, the Non-Alternating Pump will cycle when the Non-Alternating Float changes state or after every 50 cycles of the Lead Float. If ALS-0 is OFF, the Non-Alternating Pump will only cycle if the Non-Alternating Float changes state.

The last pump in the float sequence (highest #) is the Non-Alternating Pump and can be used as either a jockey or emergency pump. (See Table 2, page 5 for Non-Alternating Pump and Float details for each pumping mode.)

A **Jockey Pump** is typically a smaller pump that will always be used first in the pump sequence. In order to implement a jockey pump; the Non-Alternating Pump Float must be moved in the tank to just above the Stop Float in a Pump Down system, and to just below the Stop Float in a Pump Up system. See Figure 9 (page 19), an example wiring diagram using a Jockey Pump in a Duplex Pump Down system.

An **Emergency Pump** is usually a larger pump that is always used last. In order to implement an emergency pump; the Non-Alternating Pump is already the last pump in the sequence so there is no need to move the float. See Figure 10 (page 20), an example wiring diagram using an Emergency Pump in a Duplex Pump Down system.

Alternation Off

When the alternator is off, a Lead Pump can be forced by setting ALS-0, 1 & 2 (see Table 4). The remaining pumps will start in a sequential order as each float opens/closes.

Disabling Pumps

Using the built-in DIP switches, individual pumps can be disabled, when taken out of service for repair or maintenance.

WARNING !

UNEXPECTED OUTPUT ACTUATION CAN OCCUR.
Use hard-wired safety interlocks where personnel and/or equipment hazards exist.
Failure to follow this instruction can result in death, injury or equipment damage.

External Inputs

A five-pin connector is provided for optional external inputs.

· **External Silence / Alarm Reset**

This input allows for an external NO (Normally Open) pushbutton that will silence audible alarms and clear flashing alarm lights.

· **External Power Reset**

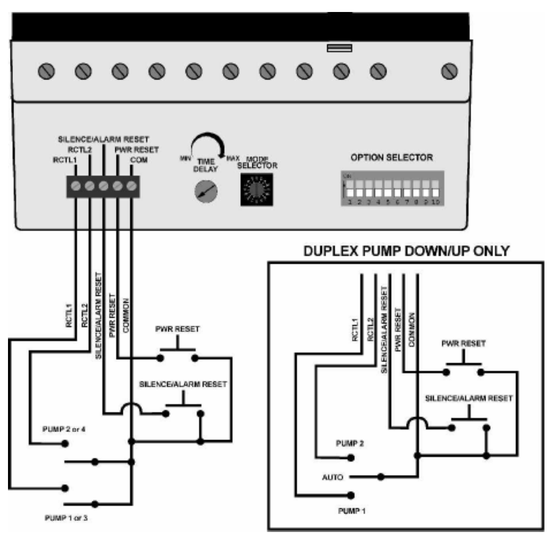
This input allows for an external NO pushbutton to reset the IS Super Cell, causing the same effect as a power cycle.

· **External Alternation Configuration**

For Duplex Mode, a SPDT (Single Pole Double Throw) switch can be connected to close RTCL1 or RTCL2 (remote controls) to force Pump 1 or 2 as the Lead Pump. **Option Selector Positions 8, 9 & 10 must be OFF.** If the switch is in the middle position, pumps will be in alternation mode.

For Triplex and Quadplex Modes two SPST (Single Pole Single Throw) switches can be connected to force Pump 1,2,3 or 4 to be the Lead Pump. **Option Selector Positions 9 & 10 must be OFF.**

To force Pump 1 or 2 as Lead, **Position 8 must be OFF.**
To force Pump 3 or 4 as Lead, **Position 8 must be ON.**
For alternation mode, close both RTCL1 and RTCL2.



3. Wiring Diagrams

The following Figures 1-10, show typical wiring diagrams for all pumping modes available for the IS Super Cell.

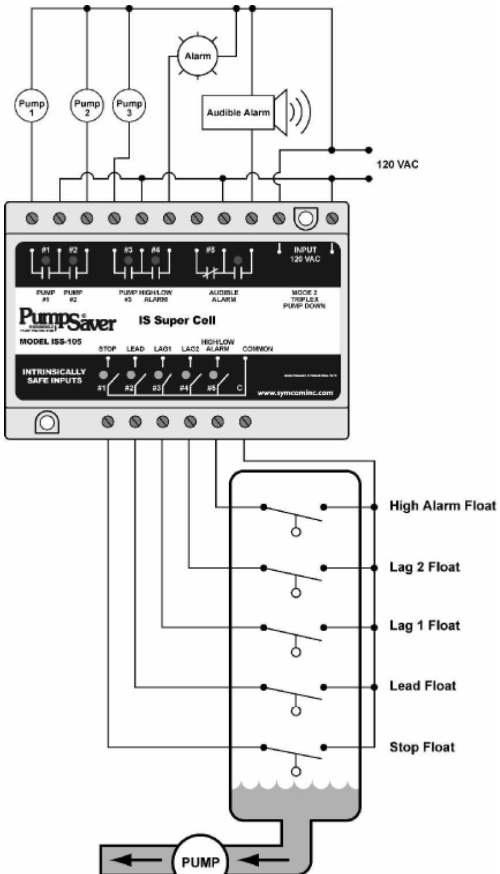


Figure 2. Typical Wiring for Triplex Pump Down - Mode 2

		Switch State
Mode Selector Switch		2
Time Delay Adjustment		MIN
Option Selector Switch		
1	High Alarm	ON
2	Low Alarm	OFF
3	Pump 1	ON
4	Pump 2	ON
5	Pump 3	ON
6	Pump 4	NA
7	Fail-Safe	OFF
8	ALS-0	ON
9	ALS-1	ON
10	ALS-2	ON

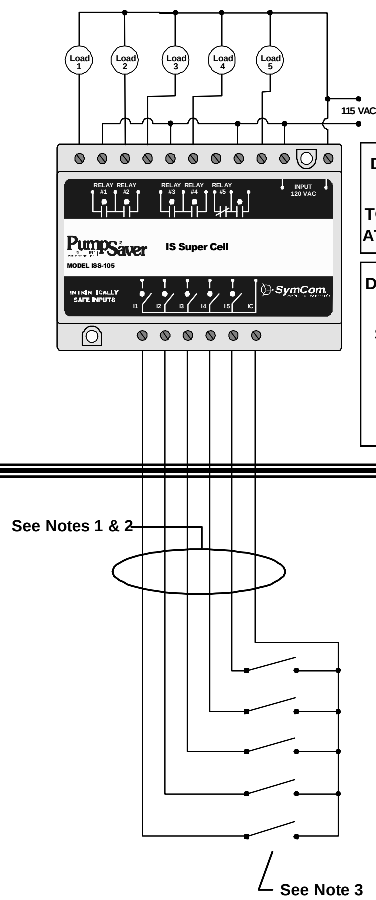
Table 7. Typical Triplex Pump Down Setup

Model ISS-105 Specifications	
Control Voltage	108–132VAC
Frequency	50/60 Hz
Power	4 Watts (max.)
Adjustments	
Time Delay/Lag Pump Delay	2–255 sec.
Mode Selector	0–8 (9–F: force mode 0)
Option Selector	1–10, ON/OFF
Silence Button	dry input only / non IS
Reset Button	dry input only / non IS
External Alternation Configuration	ALS-1
External Alternation Configuration	ALS-2
Pumping Modes Available	
Duplex Pump Down	2 pumps w/ high and low alarms
Triplex Pump Down	3 pumps w/ high alarm (typical)
Quadplex Pump Down	4 pumps
Duplex Pump Down SPS (Separate Pump Stop)	2 pumps w/ high alarm (typical) 2 stop floats
Duplex Pump Up	2 pumps w/ high and low alarms
Triplex Pump Up	3 pumps w/ low alarm (typical)
Quadplex Pump Up	4 pumps
Duplex Pump Up SPS (Separate Pump Stop)	2 pumps w/ low alarm (typical) 2 stop floats
5-Channel Relay Mode	
5-Channel	1 relay latched / time delay output
Operating Temperature	-20 to 55°C
Terminals	
Wire AWG	12–20 AWG
Torque	6 in.-lbs.
Relay Contacts	
	B 300 or 480VA @ 240VAC, Pilot Duty
	240 VAC, 7A (max.), General Purpose
Pump Inrush Delay	2 sec.
Entity Parameters	
	Voc=16.8 V
	Isc=1.2 mA
	La=100mH
	Ca=0.39μF
	$Po = \frac{Voc * Isc}{4}$
Provides Intrinsically Safe Circuits in the Following Locations:	Class I, Divisions I & II, Groups A, B, C & D; Class II, Divisions I & II, Groups E, F & G; and Class III locations
Standards Passed	
Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6 kv contact, 8 kv air
Radio Frequency Immunity (RFI)	IEC 61000-4-2, Level 3, 10V/m
Fast Transients	IEC 61000-4-4, Level 3, 4 kv input power 2 kV inputs/outputs

CONTROL DRAWING ISS-105

ASSOCIATED APPARATUS / APPAREILLAGE CONNEXE

Non-Hazardous Location



Supply Voltage
120VAC

Relay Output Rating
7 Amps @ 240VAC General Purpose
Pilot Duty 480VA @ 240VAC, B300

Maximum Ambient Temperature Rating
55°C

DEVICE MUST BE INSTALLED IN A SUITABLE ENCLOSURE

WARNING!

TO PREVENT IGNITION OF FLAMMABLE OR COMBUSTABLE ATMOSPHERES, DISCONNECT POWER BEFORE SERVICING.

DEVICE MAY ONLY BE REPAIRED BY THE MANUFACTURER

WARNING!

SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.

AVERTISSEMENT!

LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA SÉCURITÉ INTRINSÈQUE.

Hazardous Location

Class I, Divisions I & II, Groups A, B, C & D;
Class II, Divisions I & II, Groups E, F & G; and
Class III locations

NOTES:

1. Maximum distance between unit and switch contact is 10,000 feet.
2. All non-intrinsically safe wiring shall be separated from intrinsically safe wiring. Description of special wiring methods can be found in the National Electrical Code ANSI/NFPA 70, Article 504 Intrinsically Safe Systems. Check your state and local codes for additional requirements.
3. All switch contacts shall be non-energy storing, containing no inductance or capacitance.
4. Entity Parameters:

$V_{oc} = 16.8V$	$C_a = 0.39\mu F$
$I_{sc} = 1.2mA$	$P_o = \dfrac{V_{oc} * I_{sc}}{4}$
$L_a = 100mH$	

5. Entity Parameter Relationships:

IS Equipment		Associated Apparatus
Vmax (or Ui)	≥	Voc or Vt (or Uo)
Imax (or Ii)	≥	Isc or It (or Io)
Pmax, Pi	≥	Po
Ci + Ccable	≤	Ca (or Co)
Li + Lcable	≤	La (or Lo)

Capacitance and inductance of the field wiring from the intrinsically safe equipment to the associated apparatus shall be calculated and must be included in the system calculations as shown in the table above. Cable capacitance, Ccable, plus intrinsically safe equipment capacitance, Ci, must be less than the marked capacitance, Ca (or Co), shown on any associated apparatus used. The same applies for inductance (Lcable, Li and La or Lo, respectively). Where the cable capacitance and inductance per foot are not known, the following values shall be used: Ccable = 60pF/ft., Lcable = 0.2μH/ft.

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Barriers and Isolators

Intrinsically Safe Zener Diode Barriers

Intrinsically Safe Galvanic Isolators

Description

For applications involving sensor use in hazardous locations,
Rockwell Automation offers a line of Intrinsic Safety Zener Diode Barriers and Galvanic Isolators. Both are economical solutions for instrumentation and control systems in hazardous locations as defined by NEC article 500 and CEC Part I, Section 18.

Zener diode barriers are *passive* protective interface assemblies that limit the amount of energy (voltage and current) that enters a hazardous area in the event of a fault (i.e., overvoltage, shorted field wiring). The energy is limited to an amount that would not be sufficient to ignite the potentially explosive atmosphere. Designed in a slim 1/2 inch wide housing, each barrier contains zener diodes that limit the voltage while a resistor prevents excessive current from being transferred to the hazardous area. In the barriers offered by Rockwell Automation, a replaceable fuse is used to protect the barrier from miswiring and transients.

The principle of a keyed fuse assembly has been employed. In case of a fault due to overvoltage, polarity misconnection or transients, only the protective keyed fuse assembly needs to be replaced.

The replacement of the fuse assembly can be done by the user at the job site. The barriers do not have to be returned to the manufacturer for replacement.

Intrinsically Safe or Galvanic Isolators are *active* protective interface assemblies that limit the amount of energy allowed to enter a hazardous area under fault conditions. Sometimes called Transformer Isolated Barriers, they separate intrinsically safe wiring from non-intrinsically safe wiring through the use of the same isolation coils found in power transformers. Galvanic isolators, unlike zener diode barriers, do not require grounding—therefore they may reduce ground loop problems as well as installation and maintenance costs. The slim 3/4 inch wide housing on DC models also conserves valuable mounting space. DIP switches provide convenient programming of output and diagnostic functions while multiple LEDs provide visual indication of module and circuit status.

Rockwell Automation zener diode barriers and galvanic isolators are DIN Rail mountable and designed primarily for use with intrinsically safe proximity sensors and photoelectrics. All Rockwell Automation barriers and isolators are UL Listed, FM Certified, CSA and CE Marked for all applicable directives.

Features

- Replaceable fuse
- Low internal resistance
- Short-circuit protected
- Reverse polarity protection
- Slim 1/2 inch wide housing
- UL Listed, FM, CSA and PTB Certified, and CE Marked for all applicable Directives

Specifications

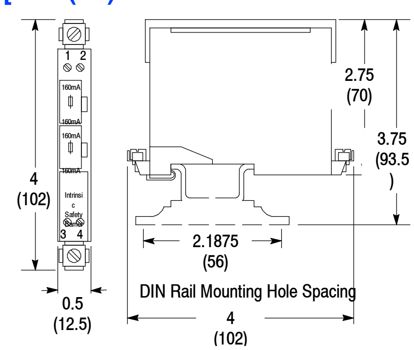
Environmental	
Certifications	UL, FM, CSA PTB, and CE Marked for all applicable directives
Operating Temperature [C (F)]	+20…+60° (-4…+140°)
Vibration	55 Hz (1.5 mm amplitude)
Shock	20 g
Relative Humidity	0…95% (noncondensation)
Electrical	
Leakage Current	≤1 μA
Protection Type	Reverse polarity (protected by replaceable fuse), over-voltage (protected by replaceable fuse), and short-circuit (incorporated)
Replaceable Fuse Rating	160 A
Operating Frequency	≤100 kHz @ Isc > 50 mA; ≤50 kHz @ Isc ≤0.50 mA
Short Circuit Protection	Incorporated
Mechanical	
Material	Polyamide
Mounting Location	Nonhazardous or Class 1, Division 2 or Zone 2/Zone 22 locations
I.S. Connections for	Class I, II, III; Div 1 and 2; Groups A-G and Zones 0, 1, 2, 20, 21, 22; Group IIC and IIB
Enclosure Rating	IP40 (IEC529)

Compatible Sensors

Photoelectrics

Sensor Style	Sensing Mode	Connection Type	Cat. No. — Sensor	Cat. No. — Barriers Used†
9000 Through Beam Photoelectric	Emitter	2 m Cable	42GRL-9540	897H-S120
		4-Pin Micro	42GRL-9540-QD	
		4-Pin Mini	42GRL-9540-QD1	
	Receiver	2 m Cable	42GRR-9500	897H-S214 or 897H-S150
		4-Pin Micro	42GRR-9500-QD	
		4-Pin Mini	42GRR-9500-QD1	
5000 Photoelectric	Retroreflective	Screw Terminals	42DRU-5500	897H-S120 or 897H-S140 or 897H-S150
	Polarized Retroreflective		42DRU-5700	
	Standard Diffuse		42DRP-5500	
	Fiber Optic		42DRA-5500	

Approximate Dimensions [mm (in.)]



Proximities

Sensor Style	Barrel Diameter	Shielding	Cat. No. — Sensor	Cat. No. — Barriers Used†
Stainless Steel Face and Barrel Proximity Sensor	12 mm	Shielded	871TM-DR2ENE12-⊗	897H-S214 or 897H-S120
		Unshielded	871TM-DR4ENE12-⊗	
	18 mm	Shielded	871TM-DR2ENE18-⊗	
		Unshielded	871TM-DR4ENE18-⊗	
	30 mm	Shielded	871TM-DR2ENE30-⊗	
		Unshielded	871TM-DR4ENE30-⊗	

⊗ Replace symbol with desired termination. A2 for 2 meter PVC cable and D4 for 4-pin micro QD.

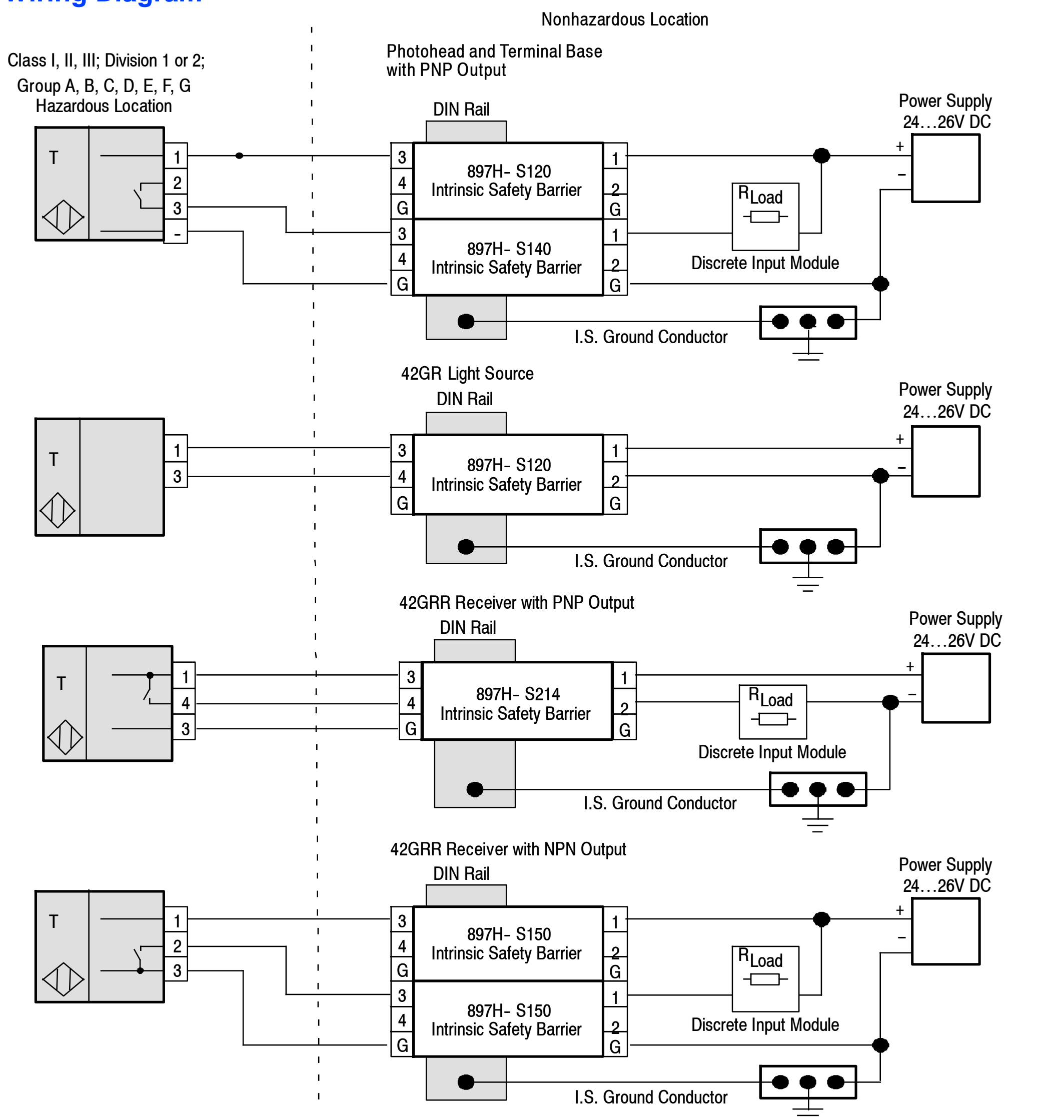
Intrinsically Safe Zener Diode Barriers

Product Selection

Rated Voltage	Internal Resistance	Classification	FM Entity Parameters					ATEX Certified Stahl Part No.	Cat. No.
			Supply Voltage, Max.	Current, Max.	Power, Max.	Permissible External Capacity	Permissible External Inductance, Max.		
24V DC	286…319 ohms	A, B, E	28V	100 mA	700 Mw	0.083 µF	1.6 mH	9001/01-280-100-101	**897H-S120**
		D, F, G				0.65 µF	11 mH		
	0 ohms	A, B, E				0.083 µF	1.6 mH	9001/03-280-000-101	**897H-S140**
		D, F, G				0.65 µF	230 mH		
	599…666 ohms	A, B, E				0.083 µF	1.6 mH	9001/01-280-050-101	**897H-S150**
		D, F, G				0.65 µF	230 mH		
	269…290 ohms	A, B,E				0.083 µF	1.6 mH	9002/13-280-110-001	**897H-S214**
		D, F, G				0.65 µF	230 mH		
	321…356 ohms	A, B				0.083 µF	1.6 mH	9002/11-280-186-001	**897H-S233**
		D, F, G				0.65 µF	230 mH		
Replacement Fuse Assembly									**897H-F160**

Note: Safety Parameters stated above are per input.

Typical Wiring Diagram



PHASE MONITOR RELAYS

Phase Loss, Phase Reversal, Phase Unbalance, and Under/Over Voltage
PMP Series Plug-in

- Universal voltage range of 208-480V on PMPU provides the flexibility to cover a variety of applications with one unit
- Protects against phase loss, phase reversal, phase unbalance, undervoltage and overvoltage
- Variety of user-selectable and adjustable settings for the ultimate in three-phase protection
- Automatic & Manual Reset in Same Unit
- Multi-Color LED indicates normal condition and provides specific fault indication to simplify troubleshooting
- Compact plug-in case utilizing industry-standard 8 pin octal socket
- 10A SPDT output contacts
- c UR us CE UL LISTED (with appropriate socket)

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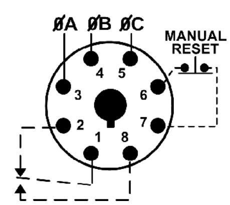
The PMP Series Phase Monitor Relays utilize a microprocessor-based design to provide protection against phase loss, phase reversal, phase unbalance, undervoltage and overvoltage. The PMPU is a universal voltage product that works on any three-phase system voltage from 208-480V (a separate 120V version is available). These devices are designed to be compatible with most Wye or Delta systems with no connection to Neutral required. PMP Series products protect against unbalanced voltages or single phasing regardless of any regenerative voltages.

The relay is energized when the phase sequence and all voltages are correct. Any one of five fault conditions will de-energize the relay. As standard, re-energization is automatic upon correction of the fault condition. Manual reset is available if a momentary N.C. switch is wired to the appropriate terminals. A multi-color LED indicates normal condition and also provides specific fault indication to simplify troubleshooting.

The PMP Series offers a variety of user-adjustable settings. The percent phase unbalance is adjustable from 2-10%, and also has a “Disable” setting for those applications where poor voltage conditions could cause nuisance tripping. The undervoltage drop-out can be set at 80-95% of operating voltage (overvoltage setting is fixed at 110% of nominal). The adjustable time delay drop-out on undervoltage (0.1-20 seconds) eliminates nuisance tripping caused by momentary voltage fluctuations. There is also an adjustable time delay (1-300 seconds) on both power up and restart after a fault has been cleared.

PROTECTS AGAINST	NOMINAL VOLTAGE▲ 50/60 Hz	PRODUCT NUMBER	WIRING/SOCKET ■
Phase Loss, Phase Reversal, Phase Unbalance, Undervoltage & Overvoltage	120V 208-480V	PMP120 PMPU *	8 Pin Octal **70169-D**  **DIAGRAM 104**

▲ Phase-to-Phase (Line-to-Line).
* Requires a 600V-rated socket when used on system voltages above 300V.
■ See Pages 80 & 81 for **Sockets & Accessories**.

8/11

PHASE MONITOR RELAYS

Phase Loss, Phase Reversal, Phase Unbalance, and Under/Over Voltage
PMP Series Plug-in
Application Data & Dimensions

Application Data

Phase Loss:
Unit trips on loss of any Phase A, B or C.

Phase Reversal:
Unit trips if rotation (sequence) of the three phases is anything other than A-B-C.

Undervoltage:
Adjustable from 80-95% of nominal voltage. Unit trips when the average of all three lines is less than the adjusted set point for a period longer than the adjustable time delay drop-out.

Overvoltage:
Fixed at 110% of nominal voltage. Unit trips when the average of all three lines is greater than the fixed set point for a period longer than the time delay drop-out.

Phase Unbalance:
Adjustable from 2 - 10% unbalance. Unit trips when any one of the three lines deviates from the average of all three lines by more than the adjusted set point. There is also a "Disable" setting adjustment that will turn off the Phase Unbalance Protection if nuisance tripping is a problem.

Output Contacts:
SPDT: 10A @ 240V AC/30V DC, 1/2HP @ 240V AC

Life:
Mechanical: 10,000,000 operations
Full Load: 100,000 operations

Response Times:

Power Up & Restart After Fault:		1 - 300 seconds adjustable
Drop-out Due to Fault:		
	Phase Loss & Reversal	100ms fixed
	Phase Unbalance	2 seconds fixed
	Undervoltage	0.1 - 20 seconds adjustable
	Overvoltage	Fixed Time Based on Inverse Time Curve

Hysteresis: 2 - 3%

Load (Burden): Less than 3VA

Temperature: -28° to 65°C (-18° to 149°F)

Mounting:
Uses an 8 pin octal socket. Requires a 600V-rated socket when used on system voltages greater than 300V (Macromatic Product Number 70169-D--see Page 80).

Indicator LED:

LED Status	Indicator
Green Steady	Normal / Relay ON
Green Flashing	Power Up / Restart Delay
Red Steady	Unbalance
Red Flashing	Undervoltage / Overvoltage
Amber Steady	Reversal
Amber Flashing	Loss
Green / Red Alternating	Undervoltage / Overvoltage Trip Pending
Red / Amber Alternating*	Nominal Voltage Set Error

* Applies to 208-480V units only.

Reset:
As standard, reset is automatic upon correction of fault. When a momentary-contact N.C. switch is wired across the Manual Reset terminals (6 & 7), the unit switches to manual reset mode and remote manual reset is available.

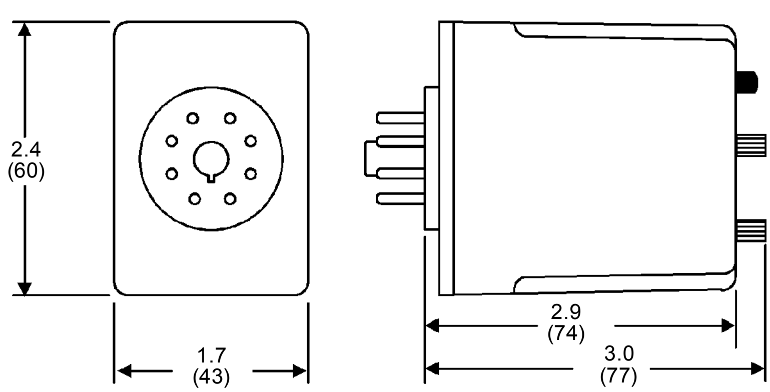
Approvals:

c UR us File #E109466

UL LISTED IND. CONT. EQUIP. 50U7 with appropriate socket File #E109466

CE Low Voltage & EMC Directives EN60947-1, EN60947-5-1

Dimensions



All Dimensions in Inches (Millimeters)

SDSA3650 SPDs

Square D Type 1 Surge Protective Devices

Square D™ brand Surgelogic™ SDSA3650 products are compact and affordable Surge Protective Devices (SPDs). SDSA3650 SPDs offer a simple means to bring down initial surges to manageable levels and can offer addtional value in a cascaded SPD system. Their compact design allows surge suppression to be installed adjacent to power panels or directly on sensitive equipment.

SQUARE D™
by Schneider Electric

SDSA3650 SPDs
Features

Superior Performance

Square D brand Surgelogic SDSA3650 SPDs utilize high-energy suppression circuitry that can be located at any point in the electrical system. As a Type 1 rated device, they have the flexibility to be used with or without an Overcurrent Protection Device (OCPD).

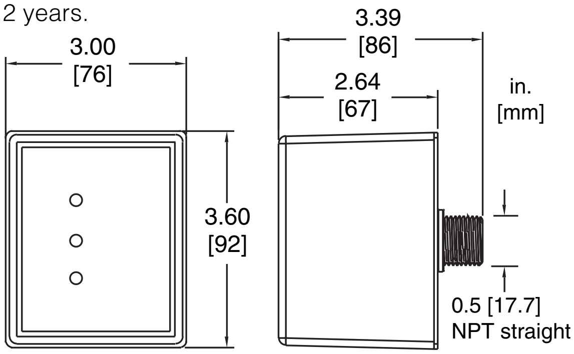
SDSA3650 SPDs provide surge suppression for equipment from severe transient activity. Each metal oxide varistor (MOV) is individually fused and the products carry a NEMA Type 4X rating suitable for installing indoors, outdoors, or in other harsh environments.

Easy Installation

Surgelogic SDSA3650 SPDs are some of the most versatile, yet compact devices available on the market today. This compact package can be mounted on an electrical panel, meter socket, or inside electrical control cabinets.

Warranty

The SDSA3650 and SDSA3650D warranty is 2 years.



SDSA3650 SPDs

Performance

Surge Current Rating per Phase	40kA
Short Circuit Current Rating	200kA
Modes of Protection	6
Fusing	Individually fused MOVs
Thermal Fusing	Yes
Overcurrent Fusing	Yes
Operating Frequency	50/60 Hz

Mechanical Description

Enclosure	Plastic
NEMA Rating	NEMA Type 4X
Connection Method	#12 AWG
Weight	1.8 lbs
Mounting Method	Close Nippled, Back Mounted
Operating Altitude	Sea Level-12,000' (3,658 m)
Storage Temperature	-40˚ F to +149˚ F (-40˚ C to +65˚ C)
Operating Temperature	-40˚ F to +149˚ F (-40˚ C to +65˚ C)

Diagnostics

Green status LED

Listings and Performance

cULus Listed per UL 1449 3rd edition Type 1 SPD, UL 1283, CSA C22.2 No. 8-M1986, C233.1-87
CE marked (IEC 61643-11)

The SDSA3650 is a four-wire surge suppressor designed for use on all solidly grounded systems up to 600Y/347 Vac. The SDSA3650D is a three-wire surge suppressor designed for delta applications up to 600 Vac.

Voltage	Surge Current per Phase	Modes of Protection	Configuration	Model Number	MCOV	SCCR	I_n	VPR			
								L-N	L-G	L-L	N-G
600Y/347V[1]	40kA	6	3 Ø, 4-wire	SDSA3650	750V L-N 1500V L-L	200kA	10kA	2500V	N/A	4000V	N/A
600V Delta[2]	40kA	3	3 Ø, 3-wire	SDSA3650D	1500V L-L	200kA	10kA	N/A	N/A	4000V	N/A

1 Applicable voltages: 120/240V, 208Y/120V, 380Y/220V, 400Y/230V, 480Y/277V, 600Y/347V
2 Applicable voltages: 240V Delta, 480V Delta, 600V Delta

Schneider Electric USA, Inc. 1751 S. 4800 W., Salt Lake City, UT 84104, USA Telephone: (801)-977-9009 Fax: (801)-977-0200 www.surgelogic.com

Document Number 9990-0120B March 2011 bw

idec

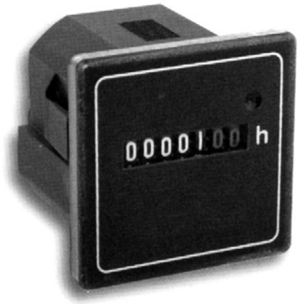
Timer Selection Guide

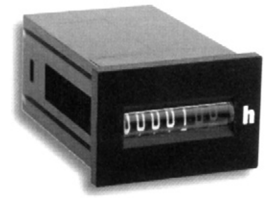
Series Model	RTE	GT3A	GT3D	GT3F
Appearance				
Mode of Operation	ON-delay Interval OFF-delay One-shot Cycle Signal OFF delay Signal ON/OFF delay	ON-delay Interval OFF-delay One-shot Cycle (off first) Cycle (on first) Signal OFF delay Signal ON/OFF delay	ON-delay Interval One-shot One-shot ON delay Cycle Signal OFF delay Signal ON/OFF delay	True OFF-delay
Time Range	0.1 second to 600 hrs	0.05 second to 180 hrs	0.01 second to 99.9 hrs	0.05 to 600 seconds
Contact Configuration	DPDT	SPDT, DPDT	SPDT, DPDT	SPDT, DPDT
Repeat Accuracy	±0.25% maximum	±0.2% maximum	±0.3% maximum	±0.4% maximum
Contact Load Rating (resistive)	10A, 240V AC	SPDT: 3A, 250V AC DPDT: 5A, 240V AC	SPDT: 3A, 250V AC DPDT: 5A, 240V AC	5A, 250V AC
Available Operating Voltage	120-240V AC 12V DC 24V AC/DC	100 to 240V AC 12V DC 24V AC/DC	100 to 240V AC 12V DC 24V AC/DC	100 to 240V AC 24V AC/DC
Approvals	UL Listed TUV CSA CE	UL recognized TUV CSA CE	UL recognized TUV CSA CE	UL recognized TUV CSA CE

Series Model	GT3S	GT3W	GE1A	GT5P	GT5Y
Appearance					
Mode of Operation	Star-Delta	Sequential start ON-delay Recycler & instantaneous Recycler OFF start Recycler ON start Interval Interval ON delay Sequential interval	ON-delay	ON-delay	ON-delay
Time Range	Star side: 0.05s to 100s Star-delta Switching Time: 0.05, 0.1, 0.25, 0.5 seconds	0.1s to 6 hrs	0.1s to 10 hrs	0.1s to 10 minutes	0.1s to 1 hour
Contact Configuration	SPST-NO	DPDT	SPDT, DPDT	SPDT	DPDT, 4PDT
Repeat Accuracy	±0.2% maximum	±0.2% maximum	±0.2% maximum	±0.2% maximum	±0.2% maximum
Contact Load Rating (resistive)	5A, 250V AC/30VDC	3A, 250V AC 5A, 120V AC/30V DC	5A, 240V AC	5A, 250V AC	5A, DPDT: 250V AC 3A, 4PDT: 250V AC
Available Operating Voltage	100 to 240V AC	100 to 240V AC 12V DC 24V AC/DC	24V AC/DC 110 to 120V AC 220 to 240V AC	100 to 120V AC 200 to 240V AC 12V DC 24V DC	100 to 120V AC 200 to 240V AC 12V DC 24V DC 24V AC
Approvals	UL recognized TUV CSA CE	UL Listed cUL TUV CE	UL Listed cUL TUV Rheinland CE	UL recognized TUV CSA CE	UL recognized TUV CSA CE

AC and DC Hour Meters

Hour meters show run time of machines, equipment, and other devices. When you need accurate information for testing, maintenance or warranty purposes, choose from a wide range of Control Dynamics AC, DC or Vibration hour meters.





	AC Models DC Models	HMA 460 HMD 460	HMA 470 HMD 470	HMA 300 HMD 300
AC	Voltages	24, 120, 240, 400VAC	24, 120, 240, 400VAC	24, 120, 240VAC
AC	Frequency	50Hz, 60Hz	50Hz, 60Hz	50Hz, 60Hz
AC	Counting Range	99,999.99 hours	99,999.99 hours	99,999.99 hours
AC	Number of Digits	5 integers, 2 decimals	5 integers, 2 decimals	5 integers, 2 decimals
AC	Operating Temperature	–12° to 176°F (–25° to 80°C)	–12° to 176°F (–25° to 80°C)	–12° to 158°F (–25° to 70°C)
AC	Power Consumption	8mA	8mA	8mA
DC	Voltages	6-30VDC, 10-80VDC	6-30VDC, 10-80VDC	6-12VDC, 12-36VDC, 36-80VDC
DC	Counting Range	999,999.9 hours	999,999.9 hours	999,999.9 hours
DC	Number of Digits	6 integers, 1 decimal	6 integers, 1 decimal	6 integers, 1 decimal
DC	Operating Temperature	–2° to 158°F (–20° to 70°C)	–2° to 158°F (–20° to 70°C)	12° to 131°F (–10° to 55°C)
DC	Power Consumption	9mA	9mA	9mA
AC & DC	Protection	IP 40 front side IP 20 terminals	IP 65 front side IP 00 terminals	IP 40 front side IP 00 terminals
AC & DC	Front Dimensions	1.89”x1.89” (48x48mm)	Ø2.28” (Ø58mm) Ø2.83” (Ø72mm)	1.42”x0.95” (36x24mm)
AC & DC	Front Bezels	2.05”x2.05”, 2.17”x2.17”, 2.83”x2.83” (52x52, 55x55, 72x72, Ø80mm)	Ø2.87” & 3.14” (Ø72 & Ø80mm)	1.89”x0.95”, 2.13”x1.14”, 1.89”x1.89” (48x24, 54x29, 48x48mm)
AC & DC	Special Protection	IP 65 front side IP 20 terminals	IP 67 front side IP 00 terminals	IP 65 front side (transp. housing) IP 00 terminals
AC & DC	Approval	CE mark, UL recognized	CE mark, UL recognized	CE mark, UL recognized
AC & DC	Connection	1/4” spade, screw clamp	1/4” spade, screw clamp	1/4” spade, screw clamp
AC & DC	Mounting Options	Flush with retainer bracket or metal clamp DIN rail	Flush with metal clamp or 3 screw front Ø2.83” and Ø3.14” (Ø72 and 80mm)	Flush with retainer clamp Cutout 1/3”x0.84” (33x22mm) or 3 screw front Ø2.83” (Ø72mm)

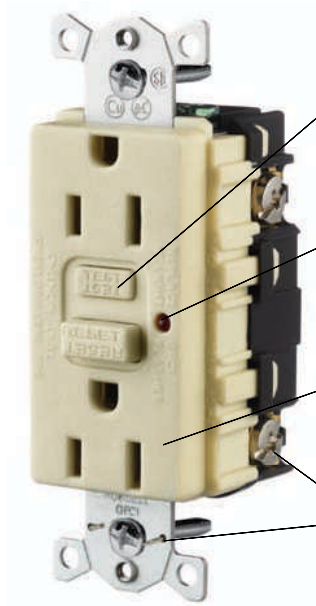
Control Dynamics LLC
www.controldynamicsllc.com
(551) 206-4517 • (914) 263-8970 • info@controldynamicsllc.com

Ground Fault Products

Heavy Duty Commercial and Hospital Grade GFCI Receptacles with Auto Grounding

15 and 20 Ampere, 125 Volts AC
2 Pole, 3 Wire Grounding

Meets UL Standard 943 Class A GFCI



GF15ILA

10kA Short Circuit Current Rating

Comprehensive diagnostics
- When test button is actuated, both the electronic components and mechanical trip mechanism are functionally tested

Ground fault indicator
- Flashing **RED** indicates device has lost capability to provide protection

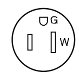
No power at face if reverse wired
- Open circuit condition eliminates false assumption of protection at face

Installation ease
- Internal back wiring
- Automatic grounding feature
- Captive mounting screws

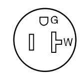
GF15ILA

GF20WLA

GFR8200HOWLA



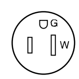
15A 125V NEMA 5-15R



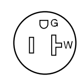
20A 125V NEMA 5-20R

Circuit Guard® GFCI Receptacles

Description	Rating	Color	Catalog Number	
Flush, nylon face, back and side wired, multiple drive screws, automatic grounding clip.	15 and 20A 125V AC	Almond	**GF15ALLA**	**GF20ALLA**
		Black	**GF15BKLA**	**GF20BKLA**
		Brown	**GF15LA**	**GF20LA**
		Gray	**GF15GYLA**	**GF20GYLA**
		Ivory	**GF15ILA**	**GF20ILA**
		Light Almond	**GF15LALA**	**GF20LALA**
		Office White	**GF15OWLA**	**GF20OWLA**
		Red	**GF15RLA**	**GF20RLA**
		White	**GF15WLA**	**GF20WLA**



15A 125V NEMA 5-15R



20A 125V NEMA 5-20R

Hospital Grade ● Circuit Guard® GFCI Receptacles

Description	Rating	Color	Catalog Number	
Flush, nylon face, back and side wired, multiple drive screws, automatic grounding clip.	15 and 20A 125V AC	Almond	**GFR8200HALLA**	**GFR8300HALLA**
		Black	**GFR8200HBKLA**	**GFR8300HBKLA**
		Brown	**GFR8200HLA**	**GFR8300HLA**
		Gray	**GFR8200HGYLA**	**GFR8300HGYLA**
		Ivory	**GFR8200HILA**	**GFR8300HILA**
		Light Almond	**GFR8200HLAA**	**GFR8300HLAA**
		Office White	**GFR8200HOWLA**	**GFR8300HOWLA**
		Red	**GFR8200HRLA**	**GFR8300HRLA**
		White	**GFR8200HWLA**	**GFR8300HWLA**

Note: GFCI type receptacles should not be used in critical care patient areas or for electrical life support equipment applications because of the possibility of power interruption. All GFCI receptacles listed above are furnished with a matching color nylon wallplate. 20 amp feed-through capability.

Electric Heaters

Application

Designed to protect sensitive mechanical, electrical, and electronic equipment from the harmful effects of condensation, corrosion, and low temperatures. Thermostatically controlled fan-driven heater units maintain a stable temperature within enclosures so critical components can perform more reliably over a longer period of time.

Construction

- Attractive and durable housing is brushed aluminum
- Thermostat, standard on all units, is adjustable from 0°F to 100°F (-18°C to 38°C)
- Fan draws cool air from the bottom of the enclosure and passes this air across the thermostat and heating elements before being released into enclosure cavity
- Heated air is discharged through the top of the heater unit
- Four 10-32 x self-tapping screws are included with each heater
- Ball bearing fan runs continuously for even temperature distribution
- Terminal strip with clamp connector that accepts both solid and stranded wire

Finish

Brushed aluminum.

Industry Standards

UL Component Recognized
CSA Listed
CE

Installation

CAUTION

These electric heaters are not designed for use in dusty, dirty, corrosive, or hazardous locations.

Portions of the heater can get hot. Adequate protection must be taken to protect people from potential burns, and to protect other components from this heat.

This heater can only be installed in a totally enclosed metal enclosure.

Hoffman electric heaters should be centered as low as possible on an interior enclosure panel. This permits the unit to heat the cool air located at the bottom of the enclosure. For maximum efficiency and longevity, the heater should be mounted in a vertical position with the terminal block to the bottom and the air outlet openings at the top in a sealed enclosure free from dust or debris. However, the unit will also effectively distribute heat if turned 90 degrees with the terminal block out the bottom and the air outlet at the side. Although enclosure panels are preferable, heaters may be installed on any flat sheet metal surface. Do not install heaters on wood panels.

Heat sensitive components should not be placed near the heater discharge area since this air can be quite warm. The clearance range defines the space that must be kept free of these components for proper and safe operation of the heater.

Standard Sizes Electric Heaters

Catalog Number	Watts	Voltage	Hz	Amps	Weight lb.	(kg.)
DAH1001A	100	115	50/60	0.9	4.00	(1.81)
DAH1002A	100	230	50/60	0.6	4.00	(1.81)
DAH2001A	200	115	50/60	1.7	4.00	(1.81)
DAH2002A	200	230	50/60	0.9	4.00	(1.81)
DAH4001B	400	115	50/60	3.3	6.00	(2.72)
DAH4002B	400	230	50/60	1.7	6.00	(2.72)
DAH8001B	800	115	50/60	6.5	6.00	(2.72)
DAH8002B	800	230	50/60	3.3	6.00	(2.72)

Thermostat Serie FLZ

Pfannenberg
ELECTRO-TECHNOLOGY FOR INDUSTRY

Mechanical bi-metallic thermostat for temperature in enclosures. Suitable for Pfannenberg Filterfans® and heaters and also for monitoring temperature.

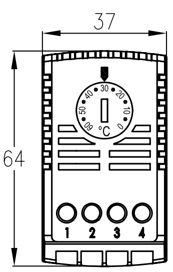
Different models available fitted with either change-over contact with neutral position, NCC or NOC. Function at increasing temperature. AS-i slave module also available.

Level of protection

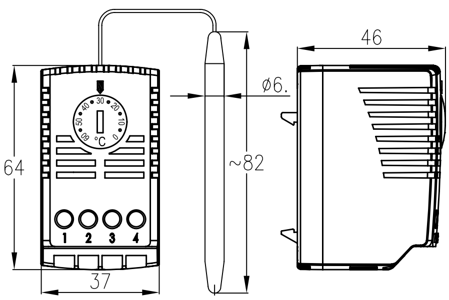
suitable for both 50 Hz and 60 Hz

Technical data:	FLZ 510	FLZ 520	FLZ 530	FLZ 550 AS-i
Type of contact	change over switch with spring contact	NCC with spring contact	NOC with spring contact	integrated AS-i bus slave
Available setting ranges	- 20 °C (- 4 °F) ... + 40 °C (+ 104 °F) 0 °C (+32 °F) ... + 60 °C (+ 140 °F) + 20 °C (+ 68 °F) ... + 80 °C (+ 176 °F)			-10°C (+14°F) ... +60°C (+140°F)
Max. breaking capacity, value in brackets inductive load at cos(phi) = 0,6	NCC: 100-250V AC/10(2)A NOC: 100-250V AC/5(2)A DC: max. 30W	240V AC / 10(2) A 120V AC / 15(2) A DC: max. 30W		< 20 mA 26,5 V ... 31,6 V AS-i profile: S-BA
Breaking temperature difference	1K: thermal return 3K: without thermal return 7K: capillary sensor	< 7K		1 - 4K
Tolerance for switching point	+/- 3K	+/- 4K		+/- 2K
Sensor	bimetal or remote sensor with 1,5 m capillary	bimetal		NTC
Connection	0,5 - 2,5 mm² screw clamps			1,3 mm DC Jack
Colour	RAL 7035 - light grey			
Weight	75 g	50 g	50 g	55 g
System of protection	IP20			
Working / storage temperature range	– 20 °C (- 4 °F) ... + 80 °C (+ 176 °F)			-25°C (-13°F) ... +80°C (+176°F)
Mounting method	snap fastening for 35 mm profile bars in accordance with EN 60715 (FLZ 520/530: for Pfannenberg Exhaust Filter PFA 3000 too) FLZ 550 AS-i not for headfirst mounting			
Approvals	UL approval applied for	UL approval		AS-i

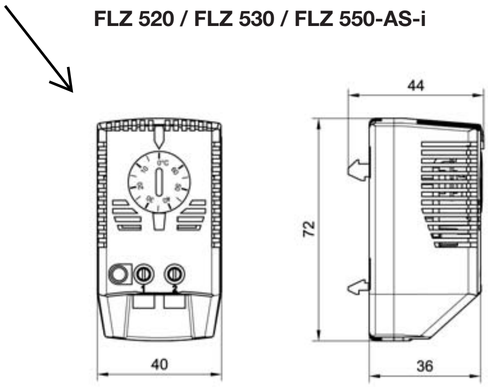
FLZ 510



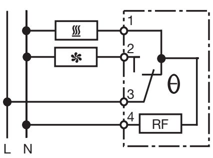
FLZ 510
capillary sensor



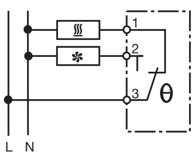
FLZ 520 / FLZ 530 / FLZ 550-AS-i



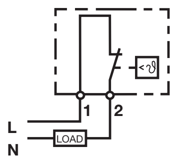
FLZ 510 1K



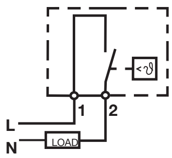
FLZ 510 3K / 7K



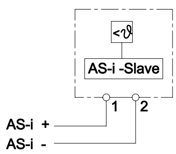
FLZ 520
NCC



FLZ 530
NOC



FLZ 550 AS-i



SITRANS LUT400
The world's most accurate ultrasonic level controller

- 1 mm accuracy within 3 meters for precise open channel flow monitoring
- 1 mm + 0.17% of measured distance up to 60 meters!

Three models to match your application needs

- **LUT420** Level and Volume Controller
- **LUT430** Level, Volume, Pump, and Flow controller
- **LUT440** High Accuracy Open Channel Monitor (OCM)

Accuracy means greater control of your process.

SITRANS LUT400
Features

SIEMENS

- Compact ½ DIN Enclosure (146 x 146 x 147mm) for installation in tight locations
- Advanced pump, alarm, and flow control features with three relays
- Digital input for back-up level override from point level devices
- Compatible with Siemens full line of Echomax transducers

SITRANS LUT400
Installation simplicity

SIEMENS

Standard offering includes:

Wall

Pipe

(vertical & horizontal)

DIN Rail

(35mm-7/15)

Optional: Panel Mount allows for remote display up to five meters from the electronics

SITRANS LUT400
Easy to use

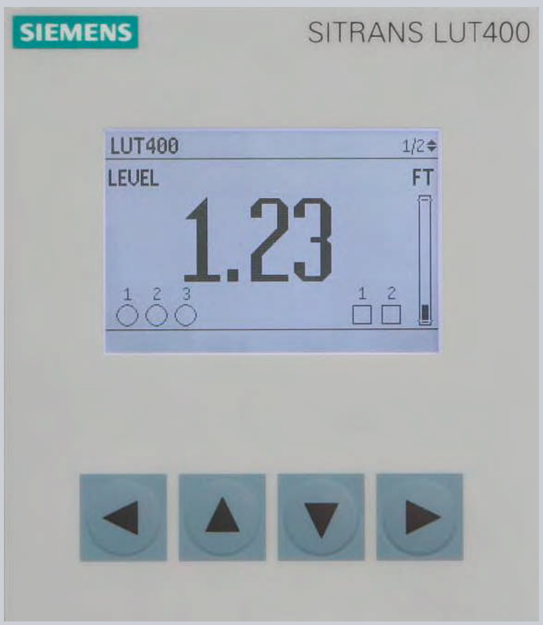
SIEMENS

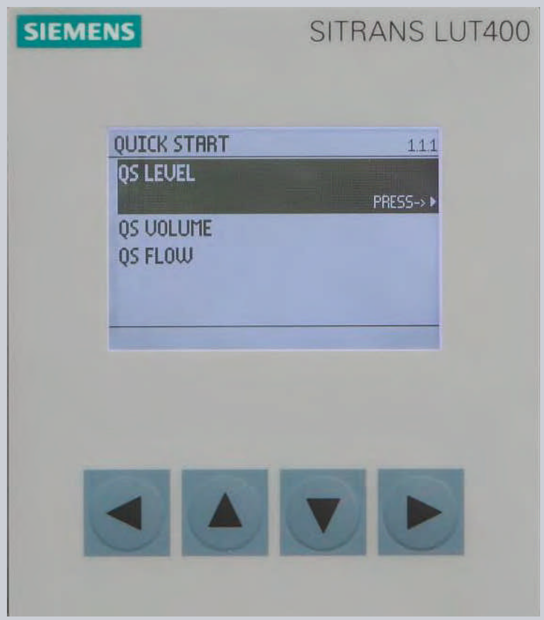
Level measurement in less than a minute!
Local programming has never be easier or faster!

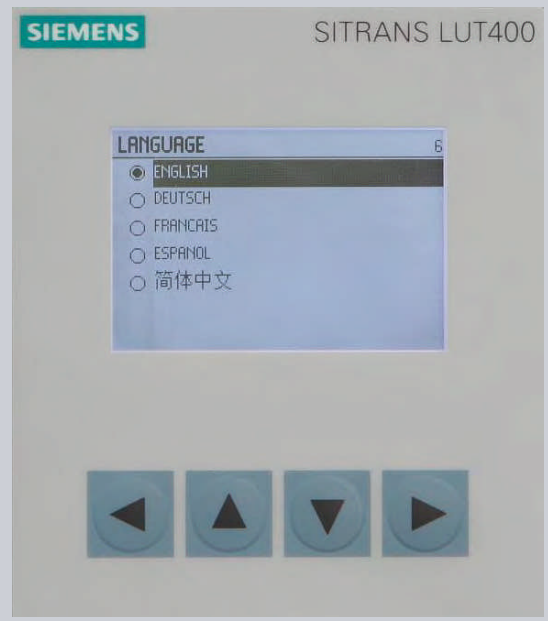
Four button Local User Interface with backlit Display

Quick Start Wizards guide you through the programming process

Multi-language, text based, menu driven programming







SITRANS LUT400
Next Generation Sonic Intelligence

SIEMENS

Patented digital receiver

- High measurement resolution, extensive signal detail, low noise, world's best ultrasonic accuracy

Enhanced filters

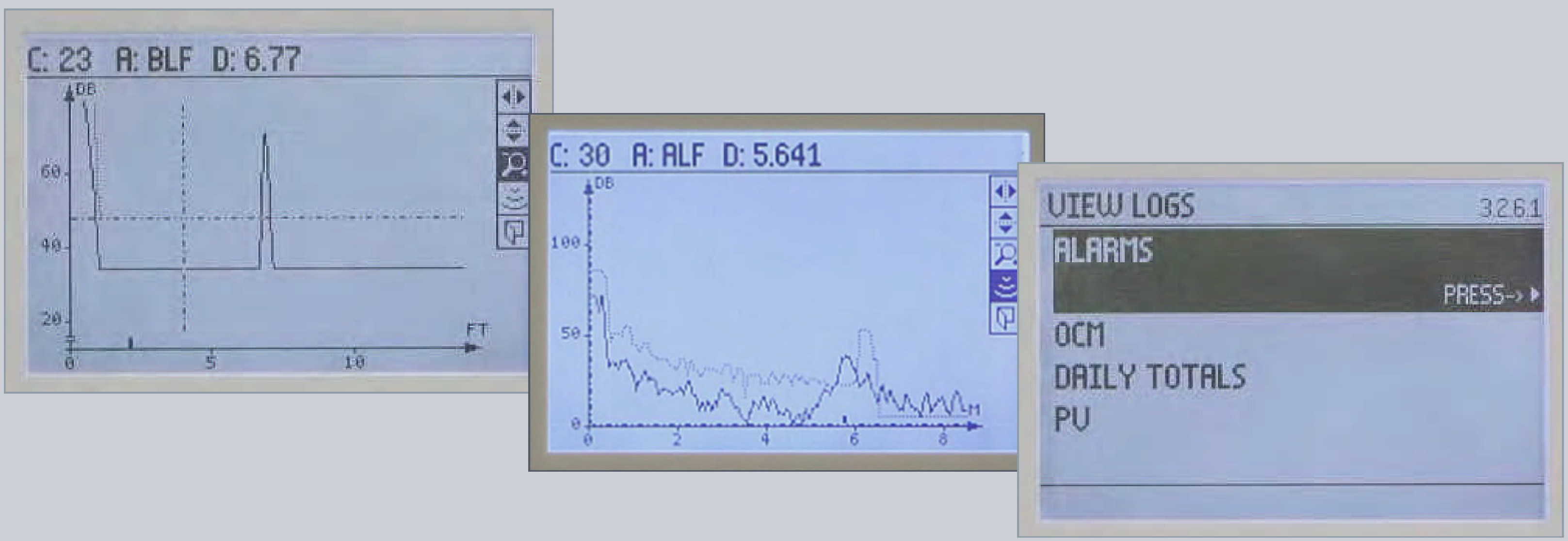
- Excellent performance reliability in the toughest applications
    - Adapts to changing process conditions
    - Continuously evaluates and adjusts for:
        - Noise level and noise characteristics
        - Echo strength
        - Confidence

SITRANS LUT400 reacts to changing process conditions, ensuring the best performance

SITRANS LUT400
Next Generation Sonic Intelligence

Advanced Diagnostics

- Echo profile and trend views on the display
- New Figure of Merit (FOM) parameter evaluates extended performance, not just point in time
- False Echo Suppression tunes echo thresholds to ignore obstructions
- Integrated datalogger allows you to review historic performance



SITRANS LUT400
Communications convenience

SIEMENS

The controller with HART

- Full set of Electronic Device Descriptors (EDDs)
    - PDM 6.0.5
    - SITRANS DTM 3.1 (for FDTs like PACTware 4.0)
    - FC375/475
    - AMS 10.5
    - Browser for IE8
- Graphical Wizard support on LUI and most communications tools

SITRANS LUT400
Saves you money

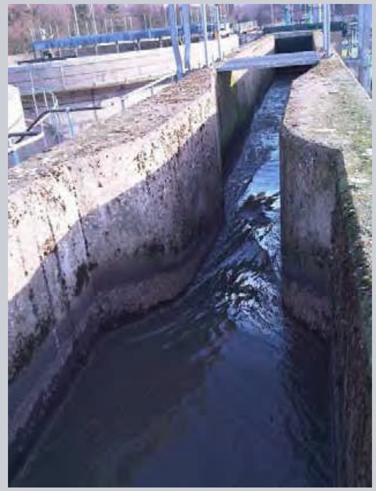
Reduce operating costs by minimizing pump operation during peak energy periods with SITRANS LUT400's energy saving algorithms

- Immediate return on investment
- Significant operational cost savings

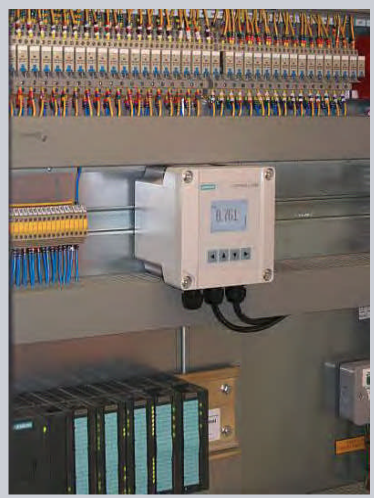
Quick commissioning and ease of use means low start-up and operating costs

- Low to no maintenance – set it and forget it
- Once installed, the SITANS LUT400 demands no maintenance, calibration or service, just access the functionality you need

SITRANS LUT400 Applications



Level, volume, open channel flow, pump control, storage vessels, processes, liquids, solids, slurries…



One device: Endless applications

SITRANS LUT400
Features by model

SIEMENS

		SITRANS LUT420	SITRANS LUT430	SITRANS LUT440
Category	**Feature**	**Level controller**	**Level, pump and flow controller**	**High accuracy OCM controller**
Operations	Level, space, and distance measurement	✓	✓	✓
	Open channel flow measurement		✓	✓
	Volume conversion	✓	✓	✓
Specifications	Compatible with Echomax and ST-H transducers	✓	✓	✓
	Standard accuracy: ± 1 mm +0.17 % of measured distance	✓	✓	✓
	High accuracy: ± 1 mm within 3 meters			✓
	Mounting options: wall or panel, pipe, DIN-rail	✓	✓	✓
Data logging and communications	HART communications	✓	✓	✓
	4 ... 20 mA output (active and passive)	✓	✓	✓
	Integrated datalogger for measurement value and alarms	✓	✓	✓
	Integrated datalogger for fixed rate flow logging		✓	✓
	Integrated datalogger for variable rate flow logging			✓
	Daily data logging for maximum, minimum and average flow, daily totalized volume, and minimum and maximum temperature			✓

SITRANS LUT400
Features by model

SIEMENS

		SITRANS LUT420	SITRANS LUT430	SITRANS LUT440
Category	**Feature**	**Level controller**	**Level, pump and flow controller**	**High accuracy OCM controller**
Flow monitoring	High accuracy open channel flow measurement			✓
	9 digit daily and running flow totalizers		✓	✓
	MCerts			✓
	High and low flowrate alarms		✓	✓
	External totalizer and sampler control		✓	✓
Pump control	Energy saving algorithms for pump control		✓	✓
	Wall cling reduction	✓	✓	✓
	Pump run-on functionality		✓	✓
	Pump start and power resumption delays		✓	✓
	Alternate duty pump routines	✓	✓	✓
	Fixed duty and service ratio pump routines		✓	✓
	Pumped volume totalizer		✓	✓
	Submergence detection	✓	✓	✓
	Discrete input pump inter-locks		✓	✓
	Time to spill calculation		✓	✓

SITRANS LUT400
The world's most accurate ultrasonic level controller

SIEMENS

Three models to match your application needs:

- **LUT420** Level and Volume Controller
  - **LUT430** Level, Volume, Pump, and Flow controller
    - **LUT440** High Accuracy Open Channel Monitor (OCM)

Featuring:

- **Industry leading accuracy** - 1 mm (0.04") accuracy
- **Installation simplicity** – 4 variations for installation
- **Easy to use** – four buttons, Wizard support
- **Quick to configure** - Quick Start Wizards
- **Next Generation Sonic Intelligence** – patented digital receiver and enhanced diagnostics
- **Communications convenience**
- **Saves money** – energy saving algorithms and low to no maintenance

Ultrasonic Controllers

SITRANS LUT400 (HART)

Operating Instructions • 08/2012

SITRANS

SIEMENS

Safety Guidelines: Warning notices must be observed to ensure personal safety as well as that of others, and to protect the product and the connected equipment. These warning notices are accompanied by a clarification of the level of caution to be observed.

Qualified Personnel: This device/system may only be set up and operated in conjunction with this manual. Qualified personnel are only authorized to install and operate this equipment in accordance with established safety practices and standards.

Unit Repair and Excluded Liability:

- The user is responsible for all changes and repairs made to the device by the user or the user's agent.
- All new components are to be provided by Siemens Milltronics Process Instruments.
- Restrict repair to faulty components only.
- Do not reuse faulty components.

Warning: Cardboard shipping package provides limited humidity and moisture protection. This product can only function properly and safely if it is correctly transported, stored, installed, set up, operated, and maintained.
This product is intended for use in industrial areas. Operation of this equipment in a residential area may cause interference to several frequency based communications.

Note: Always use product in accordance with specifications.

Contact SMPI Technical Publications at the following address:
Technical Publications
Siemens AG
Siemens Milltronics Process Instruments
1954 Technology Drive, P.O. Box 4225
Peterborough, Ontario, Canada, K9J 7B1
Email: techpubs.smpi@siemens.com

European Authorized Representative

Siemens AG
Industry Sector
76181 Karlsruhe
Deutschland

- For a selection of Siemens Milltronics level measurement manuals, go to: **www. siemens.com/processautomation**. Under Process Instrumentation, select *Level Measurement* and then go to the manual archive listed under the product family.
- For a selection of Siemens Milltronics weighing manuals, go to: **www. siemens.com/processautomation**. Under Weighing Technology, select *Continuous Weighing Systems* and then go to the manual archive listed under the product family.

Table of Contents

Introduction

The Manual

Notes:
- This product is intended for use in industrial areas. Operation of this equipment in a residential area may cause interference to several frequency based communications.
- Please follow the installation and operating procedures for a quick, trouble-free installation and to ensure the maximum accuracy and reliability of your SITRANS LUT400.
- This manual applies to the SITRANS LUT400 series only.

This manual will help you set up your SITRANS LUT400 for optimum performance. We always welcome suggestions and comments about manual content, design, and accessibility. Please direct your comments to techpubs.smpi@siemens.com.

For other Siemens level measurement manuals, go to: www.siemens.com/level, and look under **Level Measurement.**

Manual symbols

Please note their use carefully.

~	Alternating Current
⎓	Direct Current
⏚	Earth (ground) Terminal
	Protective Conductor Terminal
⚠	Caution (refer to instructions)
	No co-axial cable connections

Application examples

The application examples used in this manual illustrate typical installations using SITRANS LUT400. As there is often a range of ways to approach an application, other configurations may also apply.

In all examples, substitute your own application details. If the examples do not apply to your application, check the applicable parameter reference for the available options.

Change History

Sensor node

Firmware Rev.	PDM EDD Rev.	Date	Changes
1.00.00	1.00.00	August 3, 2012	• Initial release.

LUI

Firmware Rev.	Date	Changes
1.00.00	August 3, 2012	• Initial release.

Safety Notes

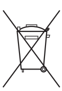
Special attention must be paid to warnings and notes highlighted from the rest of the text by grey boxes.

⚠ **WARNING: relates to a caution symbol on the product, and means that failure to observe the necessary precautions can result in death, serious injury, and/or considerable material damage.**

! **WARNING[1]: means that failure to observe the necessary precautions can result in death, serious injury, and/or considerable material damage.**

Note: means important information about the product or that part of the operating manual.

Safety marking symbols

In manual	On product	Description
⏚	⏚	Earth (ground) Terminal (shield)
		Protective Conductor Terminal
		Dispose of in an environmentally safe manner, and according to local regulations.
⚠	⚠	WARNING: refer to accompanying documents (manual) for details.
		CAUTION: Observe electrostatic discharge precautions prior to handling electronic components within the wiring compartment.

1. This symbol is used when there is no corresponding caution symbol on the product.

FCC Conformity

US Installations only: Federal Communications Commission (FCC) rules

WARNING: Changes or modifications not expressly approved by Siemens could void the user's authority to operate the equipment.

Notes:

- This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.
- This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference to radio communications, in which case the user will be required to correct the interference at his own expense.

CE Electromagnetic Compatibility (EMC) Conformity

This equipment has been tested and found to comply with the following EMC Standards:

EMC Standard	Title
CISPR 11:2004/EN 55011: 2009, CLASS A	Limits and methods of measurements of radio disturbance characteristics of industrial, scientific, and medical (ISM) radio-frequency equipment.
EN 61326-1: 2006 IEC 61326-1: 2005	Electrical Equipment for Measurement, Control and Laboratory Use – Electromagnetic Compatibility.
EN61000-3-2: 2006	Electromagnetic Compatibility (EMC) Part 3-2: Limits for harmonic current emissions (equipment input current $\leq$ 16A per phase).
EN61000-3-3: 2008 A1: 2001 + A2: 2005	Electromagnetic Compatibility (EMC) Part 3-3: Limitation of voltage changes, voltage fluctuations, and flicker in public low voltage supply systems, for equipment with rated current $\leq$ 16A per phase and not subject to conditional connection.
EN61000-4-2:2009	Electromagnetic Compatibility (EMC) Part 4-2:Testing and measurement techniques – Electrostatic discharge immunity test.
EN61000-4-3:2006	Electromagnetic Compatibility (EMC) Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test.
EN61000-4-4:2004	Electromagnetic Compatibility (EMC) Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test.
EN61000-4-5:2006	Electromagnetic Compatibility (EMC) Part 4-5: Testing and measurement techniques – Surge immunity test.

EMC Standard	Title
EN61000-4-6:2009	Electromagnetic Compatibility (EMC) Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields.
EN61000-4-8:2010	Electromagnetic Compatibility (EMC) Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test.
EN61000-4-11: 2004	Electromagnetic Compatibility (EMC) Part 4-11: Testing and measurement techniques - voltage clips, short interruptions and voltage variations immunity tests.

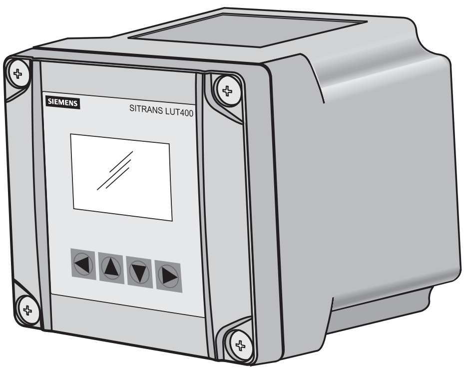
Notes

Description

Overview

The Siemens SITRANS LUT400 series controllers are compact, single point, long-range ultrasonic controllers for continuous level measurement of liquids, slurries, and solids, and high accuracy monitoring of open channel flow.

The series is compatible with Siemens full line of EchoMax® Transducers, allowing an operating range of 0.3 to 60 meters (dependent on transducer). The SITRANS LUT400 has been coupled with a backlit Local User Interface (LUI) display featuring menu driven programming and a host of wizards for plug and play performance. The LUT400 also features our next generation of Sonic Intelligence®, further strengthening our industry leading measurement performance while improving ease of use. With a number of advanced pump, alarm, and flow control features, plus a real time clock and an integrated datalogger, the LUT400 is a powerful and comprehensive solution for your Ultrasonic applications.



Features

- Small 1/2 DIN enclosure footprint with standard universal mounting bracket for wall, pipe, and DIN rail, plus an optional panel mount
- Easy to use LUI display with local four-button programming, menu-driven parameters, and Wizard support for key applications
- Level, Volume, High Accuracy OCM Flow monitoring
- Three relays combined with a suite of pump, alarm, and relay control features
- HART Communications
- EDDs for SIMATIC PDM, AMS Device Manager, and Field Communicator 375/475, plus DTMs for FDTs (Field Device Tools)
- Integrated web browser for local programming from an intuitive web-based interface
- Two discrete inputs for backup level override and pump interlock functions
- Echo profile and trend views from the local display
- Patented digital receiver for improved performance in electrically noisy applications (close proximity to VSDs)
- Real time clock with daylight savings time supporting an integrated datalogger and energy saving algorithms for minimizing pump operation during high cost energy periods
- Removable terminal blocks for ease of wiring

Models

The SITRANS LUT400 comes in three different models, depending on the application, level of performance and functionality required:

- SITRANS LUT420 Level Controller - Level or volume measurement, basic pump control functions, and basic data logging capability
- SITRANS LUT430 Pump and Flow Controller - Full suite of advanced control functionality, open channel flow monitoring, and basic data logging capability
- SITRANS LUT440 High Accuracy OCM - Best performance (rated at 1 mm accuracy up to 3 meters), full suite of advanced control functionality, and enhanced data logging capability

Applications

- Liquids, solids and slurry monitoring in small to large process and storage vessels or outdoor applications (open air)
- Environmental, Mining/Aggregates/Cement, Food & Beverage, and Chemical market applications primarily
- Key sample applications include: wet wells, reservoirs, flumes/weirs, chemical storage, liquid storage, hoppers, crusher bins, dry solids storage

Approvals and Certificates

The SITRANS LUT400 is available with General Purpose and Hazardous Area approvals. It also has a number of approvals for specialized applications. For details, see chart below.

Note: The device nameplate lists the approvals that apply to your device.

Application Type		Approval Rating	Valid for:
Non-hazardous	General Purpose	$CSA_{US/C}$, CE, FM, UL listed, C-TICK	N. America, Europe, Australia
Hazardous	Non-incendive	CSA Class I, Div. 2, Groups A, B, C, D; Class II, Div 2, Groups F, G; Class III[a]	Canada

a. Not available for devices with remote display.

Installing and Mounting

Installing

Notes:

- Installation must only be performed by qualified personnel, and in accordance with local governing regulations.
- This product is susceptible to electrostatic shock. Follow proper grounding procedures.

⚠ **All field wiring must have insulation suitable for at least 250V.**

⚠ **Hazardous voltages present on transducer terminals during operation.**

⚠ **DC input terminals shall be supplied from a source providing electrical isolation between the input and output, in order to meet applicable safety requirements of IEC 61010-1.**

- Relay contact terminals are for use with equipment that has no accessible live parts and wiring that has insulation suitable for at least 250 V. The maximum allowable working voltage between adjacent relay contacts shall be 250 V.
- The non-metallic enclosure does not provide grounding between conduit connections. Use grounding type bushings and jumpers.

Mounting locations

Recommended

- Ambient temperature is always within -20 to +50 °C (-4 to +122 °F)
- SITRANS LUT400 display window is at shoulder level, unless most interaction is through a SCADA system
- Easy access to local push buttons is provided
- Cable length requirements are minimized
- Mounting surface is free from vibration
- Sufficient room to swing device lid open and have clear access.
- A place for a laptop computer is provided for on-site configuration (optional, as laptop not required for configuration).

Avoid

- Exposure to direct sunlight. (Provide a sun shield to avoid direct sunlight.)
- Proximity to high voltage/current runs, contactors, SCR or variable frequency motor speed controllers

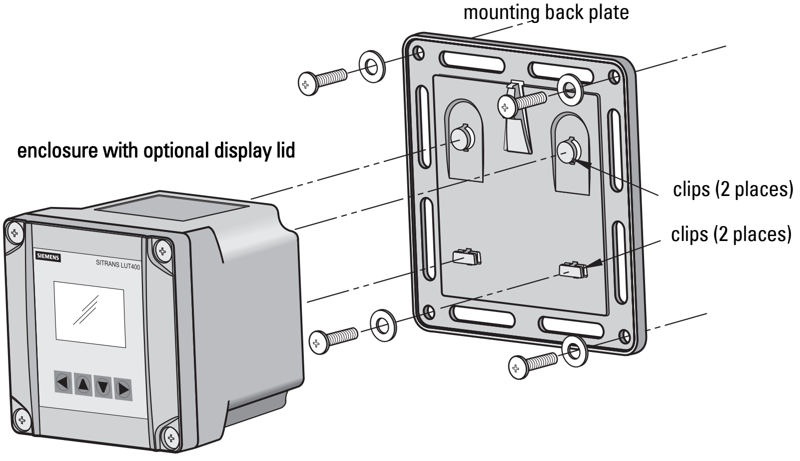
Mounting instructions

Mounting instructions differ for wall, pipe, DIN-rail, and remote display panel mount devices. Please follow the specific instructions for your device.

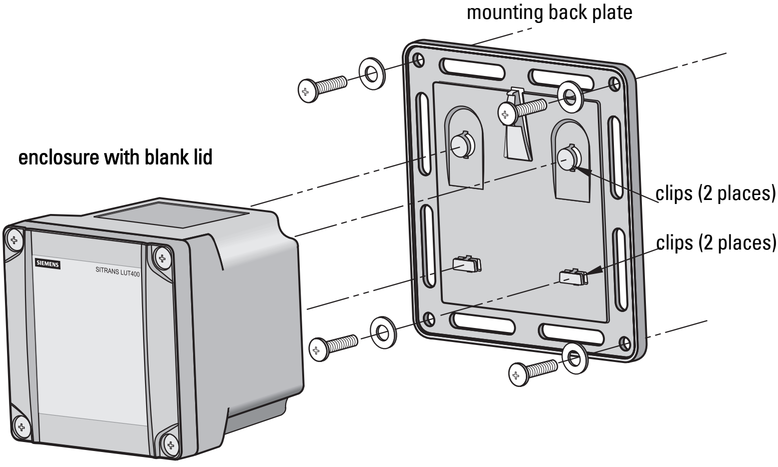
Note: When routing cable through a conduit, please follow the Cable Routing instructions on page 16 before mounting the SITRANS LUT400.

Wall or panel mount

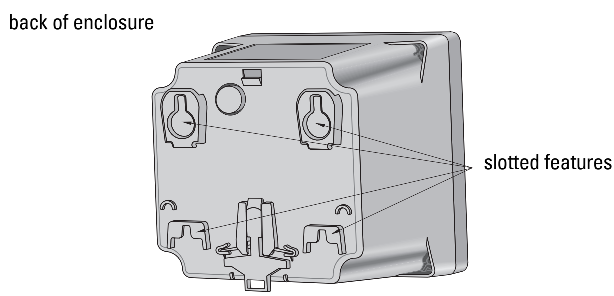
All configurations of the SITRANS LUT400 are shipped with a mounting back plate. SITRANS LUT400 has the option of a lid with a Local User Interface (LUI) display, a remote display for panel mount configuration, or a blank lid. The panel mount model comes with both a LUI display and a blank lid.



Note: Wall mount fasteners not included.



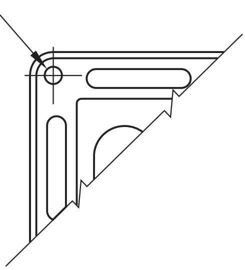
Note: Wall mount fasteners not included.



For a more detailed dimension drawing, see *SITRANS LUT400 Dimensions* **on page 253**.

Wall mounting of the enclosure

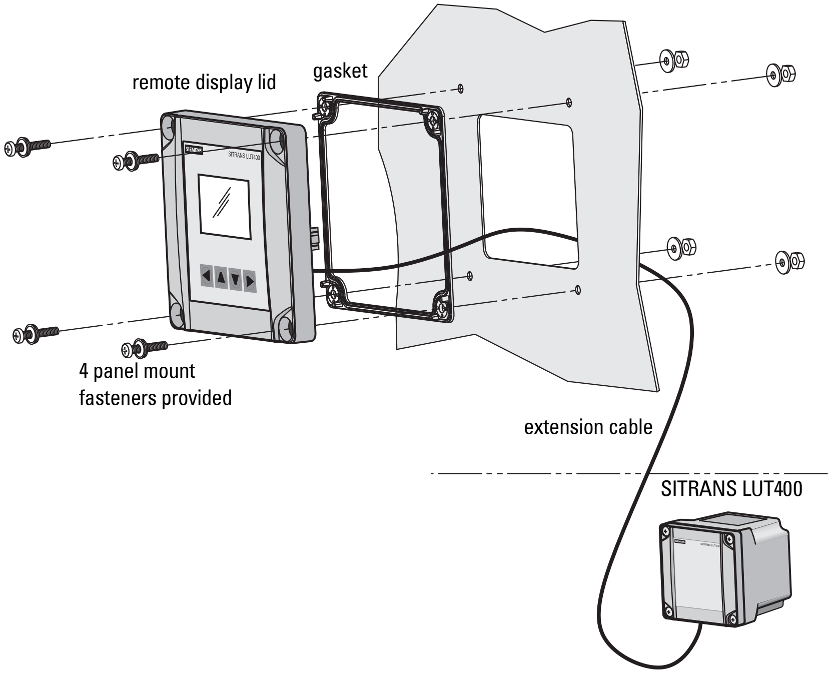
1. Mark and drill four holes in the mounting surface for the four screws (customer supplied).
2. Fasten with a screwdriver.
3. Line up slotted features on back of device with clips on mounting back plate. Press the LUT400 flush against the back plate and slide downward to fasten in place.



Please note:

- Recommended fastener size: M8 or 5/16 " screw with washer of maximum 17 mm or 5/8 " outside diameter
- Recommended mounting: mount directly to wall. If alternate mounting surface is used, it MUST be able to support four times the weight of the device.

Remote mounted lid



For a more detailed dimension drawing, see *SITRANS LUT400 Dimensions* on page 253 and *Cutout Dimensions (for Remote Panel Mount)* on page 254.

Mounting the remote lid

Note: Remote mounted lid can be mounted up to 5 m from the device using two optional cable extensions (each 2.5 m in length). For instructions on how to connect an extension cable, see *Remote mounted lid with extension cable* on page 29.

1. Using the template provided, cut out the necessary hole for the remote LUI display lid. Place the gasket inside the lid, aligning the mounting holes. Align the back of the remote display lid with the panel hole cut-out. Mark and drill four holes in the mounting surface for the four screws (provided).
2. Fasten with a screwdriver and wrench.

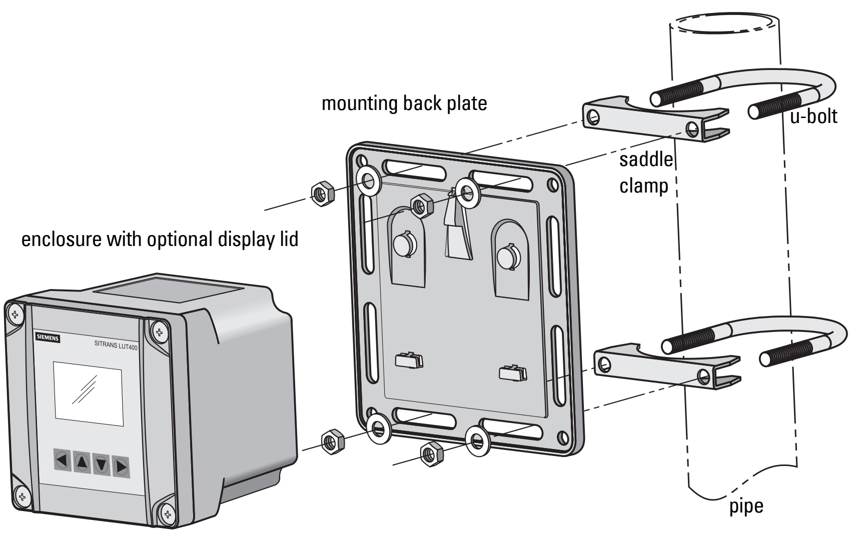
Note: Recommended torque on fastening screws for good seal:
- 1.1 N m
- 10 in-lbs

Please note:

- Recommended mounting: mount to panel, up to 5 m from the device. If alternate mounting surface is used, it **MUST** be able to support four times the weight of the device.

Note: Fasteners included: M5 screw, seal washer, M5 flat washer and nut. These fasteners are required to maintain IP65 rating on remote lid.

Pipe mount



Note: Pipe mount fasteners not included.

For a more detailed dimension drawing, see *SITRANS LUT400 Dimensions* on page 253.

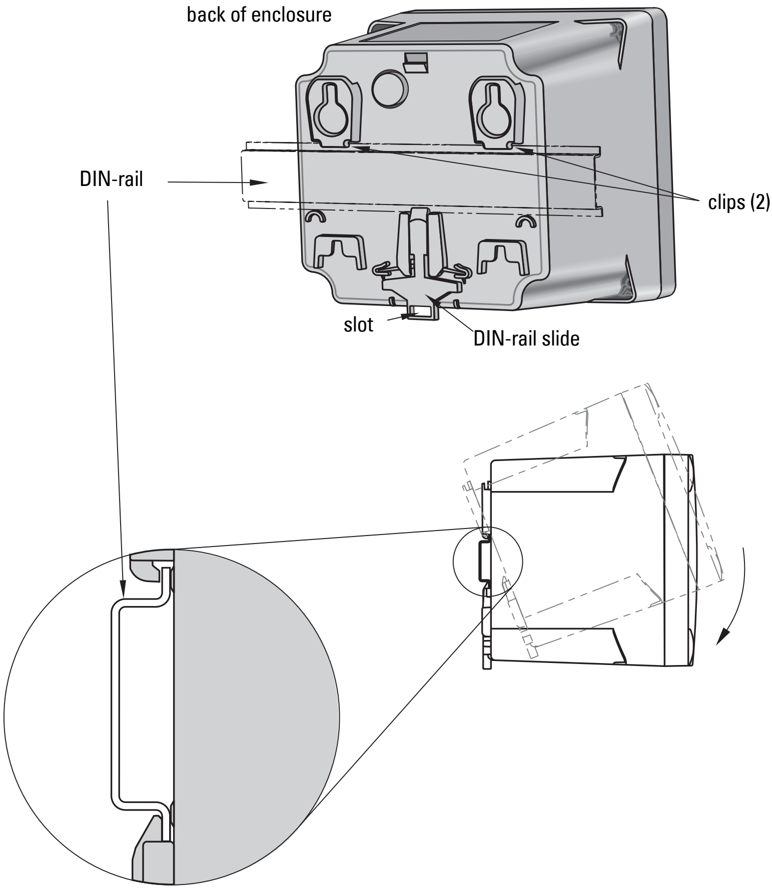
Mounting the enclosure

1. Fasten the mounting back plate to the pipe using u-bolts, saddle clamps, (customer supplied) suitable to pipe diameter.
2. Fasten bolts with a wrench. Do not over-tighten so that plate becomes twisted or bent. This may hinder ability to clip the LUT400 to the back plate.
3. Fasten device to mounting back plate (as described in step 3 of *Wall mounting of the enclosure* on page 11).

Please note:

- Recommended mounting: directly to horizontal or vertical pipe. If alternate mounting surface is used, it MUST be able to support four times the weight of the device.
- Recommended pipe dimensions: maximum: 3" pipe, minimum: 3/4" pipe
- Recommended fastener sizes:
  - U-Bolts:
    maximum: 3" pipe size with M8 or 3/8" thread
    minimum: 3/4" pipe size with M6 or 1/4" thread
  - Hex Nuts:
    M6 or 1/4" to M8 or 3/8"
  - Washer:
    maximum: 16 mm or 13/16" outside diameter.

DIN-rail mount



For a more detailed dimension drawing, see *SITRANS LUT400 Dimensions* on page 253.

Mounting the enclosure

1. Angle top of enclosure toward DIN-rail, and position slightly above top of rail.
2. Move enclosure downward against DIN-rail to hook clips on back of enclosure to top of DIN-rail.
3. Press device flush against DIN-rail to engage DIN-rail slide, which will fasten enclosure securely to DIN-rail.

Please note:

- Recommended mounting: directly to horizontal DIN-rail.
- Required DIN-rail dimensions: TH 35-7.5 or TH 35-15 per standard IEC 60715.
- The DIN-rail MUST be able to support four times the weight of the SITRANS LUT400.

Removing the enclosure

1. From the front of the device, place screwdriver in slot at bottom of DIN-rail slide and pry downward. This will unclip slide from bottom of DIN-rail.
2. While holding slide down, push upward on enclosure to release clips from top of DIN-rail.

Preparation for cable entry

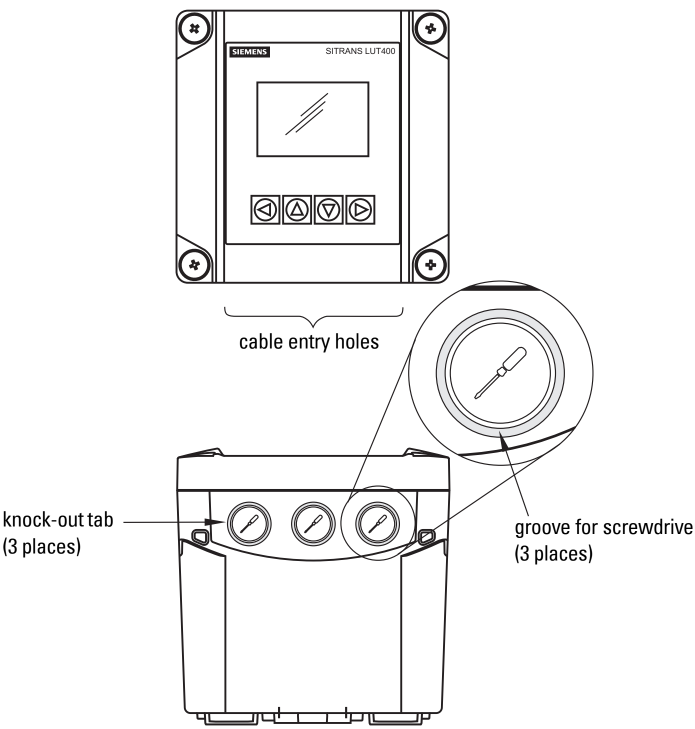
Cables can be routed through conduit or enter the enclosure through cable glands. Follow steps 1 to 5 below to first uncover cable entry holes, then complete steps for use with conduit, or with cable glands.

1. Ensure enclosure lid is closed and fastener screws are locked.
2. Place tip of screwdriver into groove on the outer diameter of the knock-out tab (see illustration that follows).
3. Hit the end of the screwdriver with palm of hand to knock out entry hole.
4. Loosen screws and remove enclosure lid.
5. Remove plastic piece(s) that covered entry holes from enclosure. Be careful not to damage the electronics with static electricity, or the tools used to knock out entry holes.

Cable routed through conduit

(continued from steps 1 to 5 above)

6. After preparing for cable entry in steps 1 to 5 above, attach the conduit to the enclosure using only suitable size fittings approved for water-tight applications. (Conduit size is 1/2" NPT.)
7. Replace enclosure lid and tighten screws.



For a more detailed dimension drawing, see *SITRANS LUT400 Dimensions* on page 253.

Cable exposed and entering through the cable glands

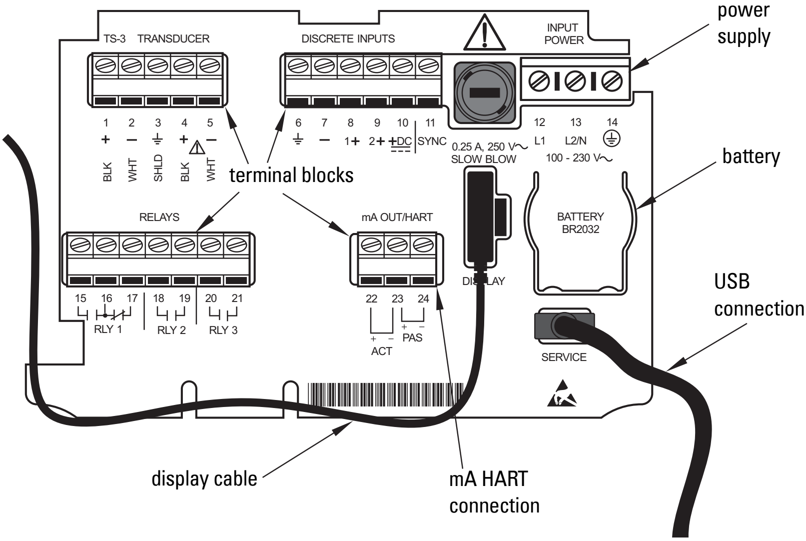
(continued from steps 1 to 5 on previous page)

6. After preparing for cable entry in steps 1 to 5 above, unscrew the glands and attach them firmly to the enclosure.
7. Thread the cables through the glands. Ensure the power cable is kept separated from the signal cables and then wire the cables to the terminal blocks.
8. Tighten the glands to form a good seal.
9. Replace enclosure lid and tighten screws.

Notes:

- When cable entry hole knock-out tabs have been removed, the entry hole is 21.4 mm to 21.6 mm in diameter.
- M20 cable glands (20 mm in diameter), and 1/2" NPT conduit (21.3 mm in diameter) fit this entry hole.
- Caution should be taken when selecting appropriate seal for entry holes. Flat gasket is recommended (instead of O-ring). If alternate cable glands are used, it is the customer's responsibility to maintain IP65 rating of entry holes.

SITRANS LUT400 wiring compartment



The Battery

The SITRANS LUT400 is supplied with one battery installed. The battery (BR2032) has a life expectancy of ten years, and is affected by ambient temperature. If the LUT400 loses input power, the battery will maintain operation of the device's real time clock until power has been restored.

When the battery reaches its end of life, refer to *Replacing the Battery* on page 226.

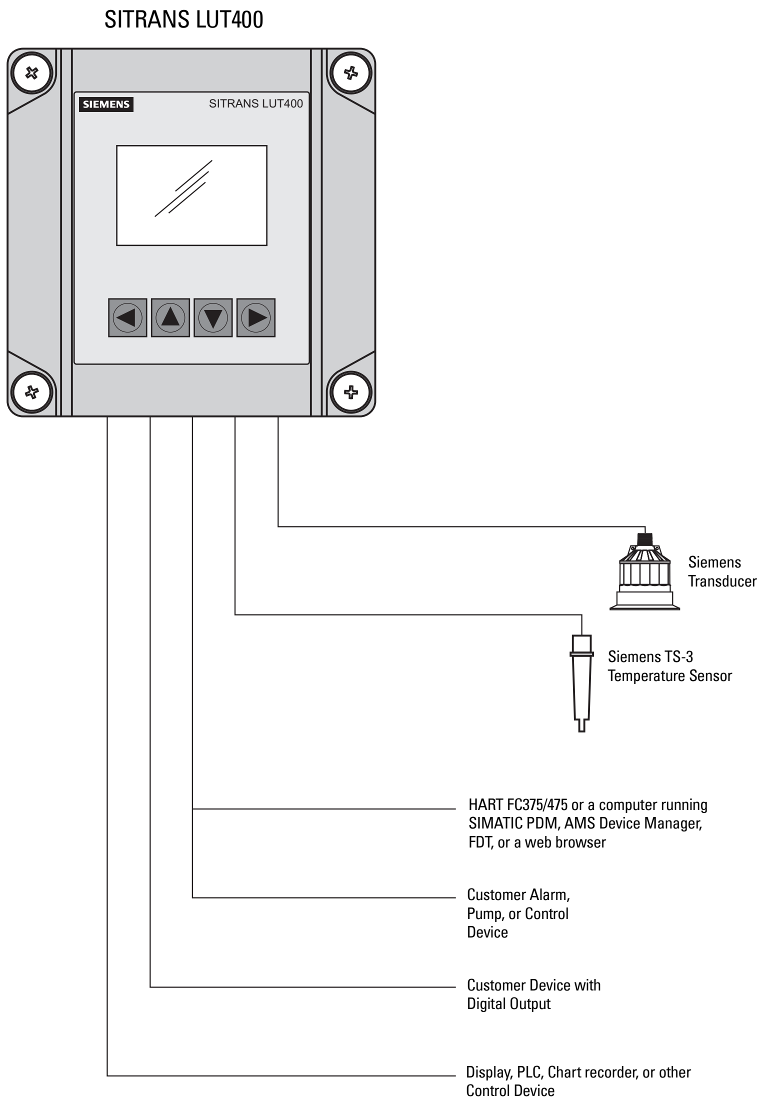
Disconnect power before replacing the battery.

Notes

Connecting

Safety notes for connection

- Verify that all system components are installed in accordance with instructions.
- Connect all cable shields to the LUT400 shield terminals (denoted on device with symbol ⏚). To avoid differential ground potentials ensure cable shields are properly connected to ground.
- Keep exposed conductors on shielded cables as short as possible to reduce noise on the line caused by stray transmissions and noise pickup.



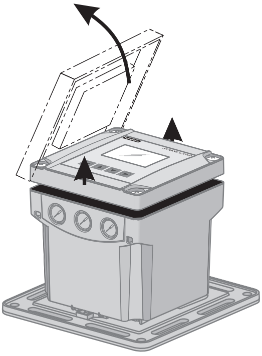
Connecting SITRANS LUT400

WARNINGS:
- **Check the device label on your instrument, to verify the approval rating.**
- **Use appropriate conduit seals to maintain IP or NEMA rating.**

Notes:
- Separate cables and conduits may be required to conform to standard instrumentation wiring practices or electrical codes.

To access the wiring compartment:

1. Loosen 1/4 turn locking screws.
2. Lift lid up and to the left on its hinges.
3. The lid can remain open connected by hinges, or it can be unclipped from the hinges and set to one side, to access wiring compartment.



4. Make all connections as per instructions that follow.
5. When wiring complete, replace device lid.
6. Tighten locking screws.

Wiring compartment

The terminal board on the LUT400 allows all inputs and outputs to be connected simultaneously. Terminal strips can be removed to improve ease of wiring.

CAUTION: Ensure the terminal strips are terminated to the correct location during re-installation. Failure to do so may result in damage to the device, or external equipment that is attached.

Note: Recommended torque on terminal clamping screws.
- 0.56 - 0.79 N m
- 5 - 7 in-lbs

Please do not overtighten the screws.

Power

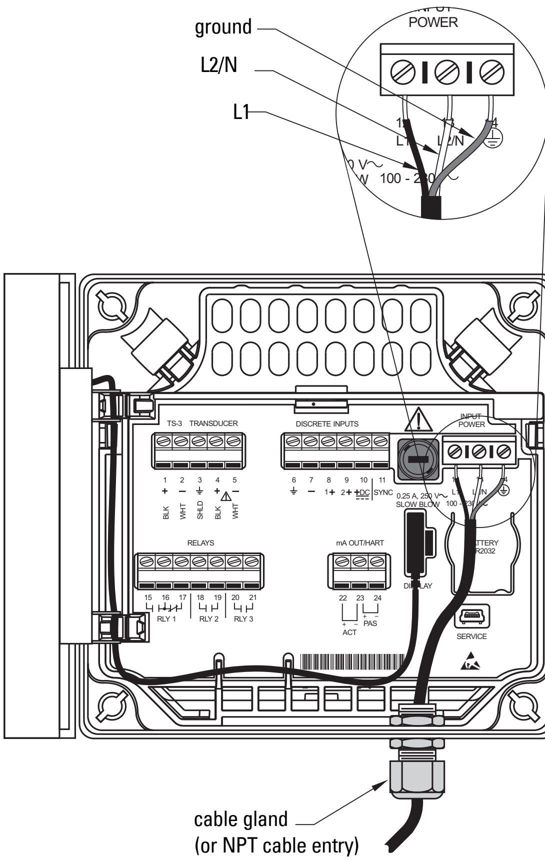
WARNINGS:

The DC input terminals shall be supplied from a source providing electrical isolation between the input and output, in order to meet the applicable safety requirements of IEC 61010-1.

All field wiring must have insulation ratings suitable for the application.

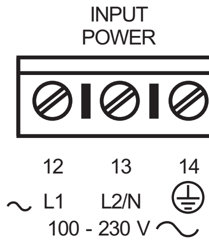
Important!

Before applying power to the SITRANS LUT400 for the first time, ensure any connected alarm/control equipment is disabled until satisfactory system operation and performance is verified.

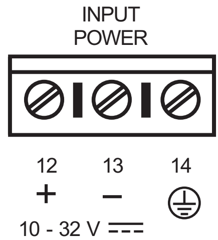


The SITRANS LUT400 is available in AC or DC power models.

AC Power



DC Power



AC: 100-230 V AC ±15%, 50/60 Hz, 36 VA (10W)

DC: 10-32 V DC, 10W

Note: Make sure device is connected to a reliable ground.

1. To wire for power, strip the cable jacket for approximately 70 mm (2.75") from the end of the cable, and thread the wires through the gland[1].
2. Connect the wires to the terminals as shown: the polarity is identified below the terminal block.
3. Ground the device according to local regulations.

Notes for AC power connections:

- The equipment must be protected by a 15 A fuse, or circuit breaker on all current-carrying conductors in the building installation.
- A circuit breaker or switch in the building installation, marked as the disconnect switch, must be in close proximity to the equipment and within easy reach of the operator, and must disconnect all current-carrying conductors.

Cables

The SITRANS LUT400 is designed to work with two conductor shielded transducer cables.

Connection	Cable Type
mA output, sync, Temperature sensor, discrete input	2 copper conductors, twisted, with shield[a]/drain wire, 300V 0.324 - 0.823 mm^2 (22 - 18 AWG). **Maximum length**: 365 m
Transducer	Shielded two-wire.
	**Warning:** Do not use a coaxial transducer cable extension with the SITRANS LUT400. High voltage transmitted on shield of coaxial cable could result in personal injury, damage to equipment, or poor device performance.
Relay output AC input	Copper conductors per local requirements.

a. Preferred shielding is braided shield.

1. If cable is routed through conduit, use only approved suitable-size hubs for waterproof applications.

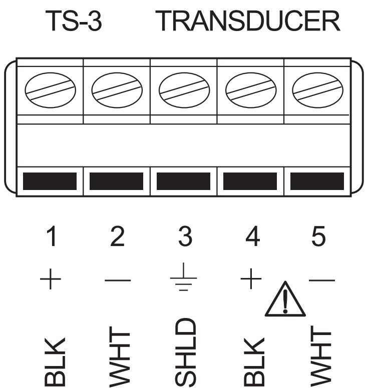
Transducers

Warning: Hazardous voltage present on transducer terminals during operation.

Run the transducer cable in a grounded metal conduit, separate from other wiring (except TS-3 temperature sensor wiring, if applicable).

Notes:

- Do not use coaxial cable with SITRANS LUT400 due to high voltage transmitted on shield of coaxial cable
- Do not connect the LUT400 shield and white transducer wires together; wire to separate terminals



Temperature sensor

The speed of sound changes as temperature changes. To ensure accurate level measurement, the SITRANS LUT400 compensates via an external temperature input. All Siemens EchoMax transducers have an internal temperature sensor for this purpose, and for the fastest temperature response, Siemens also offers a dedicated temperature sensor, the TS-3.

If the following conditions apply, a separate TS-3 temperature sensor will ensure optimum accuracy:

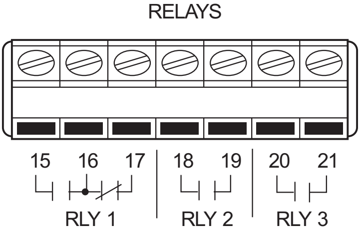
- the transducer is exposed to direct sunlight (or other radiant heat source)
- the temperature of the atmosphere between the transducer face and monitored surface differs from the temperature of the transducer
- faster response to temperature changes is required.

To achieve the best performance of temperature measurement in a typical open channel flow application, the temperature sensor should be shielded from direct sunlight and mounted half way between the ultrasonic transducer face and the maximum head achievable in the application. Care should be taken to not obstruct the direct sound path of the ultrasonic transducer.

Note: Use a TS-3 Temperature Sensor only. Leave terminals open (unused) if TS-3 is not deployed.

Relays

Relay contacts are shown in the de-energized position. All relays can be configured as positive or negative logic (see 2.8.11. Relay Logic).



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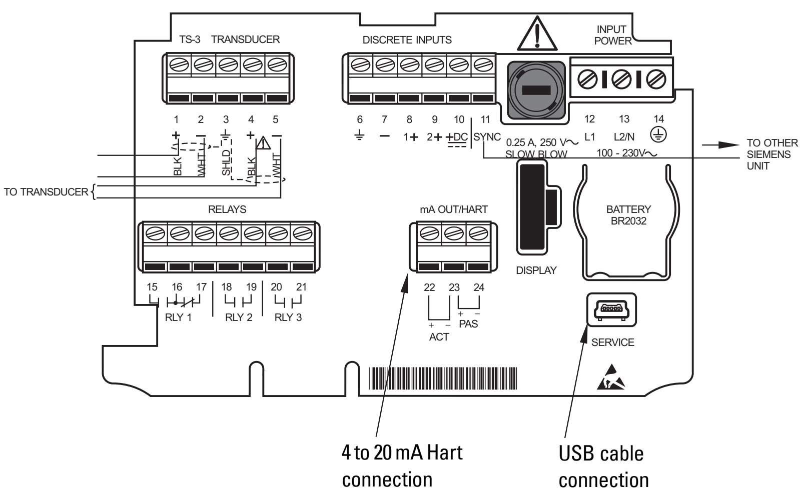
Power Failure
Relays 2, 3 are normally open. Relay 1 can be wired either normally open or normally closed. In the event of loss of input power, relays will revert to their normal states.

Relay Ratings

- one Form **C** (NO or NC) relay (relay 1), 1A at 250 V AC, non-inductive, 3A at 30 V DC
- two Form **A** (NO) relays (relays 2,3), 5A at 250 V AC, non-inductive, 3A at 30 V DC

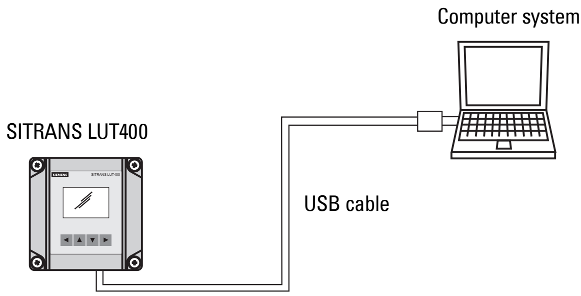
Communications

The USB port and the 4 to 20 mA HART terminal block (terminal numbers 22, 23, and 24) are located inside the enclosure of the device.

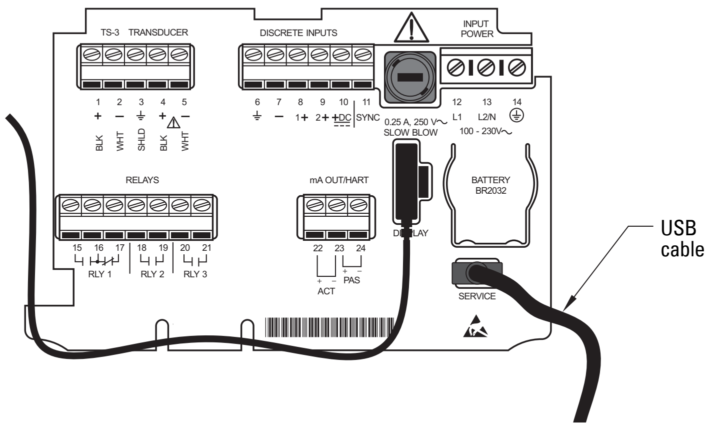


Connecting via USB

Typical USB configuration



USB connection



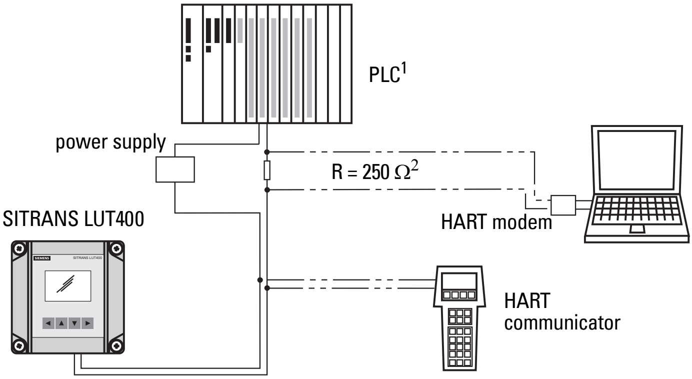
Use 5-pin USB Mini-B cable. The cable should not exceed 3 m (9.8 ft.).

Notes:

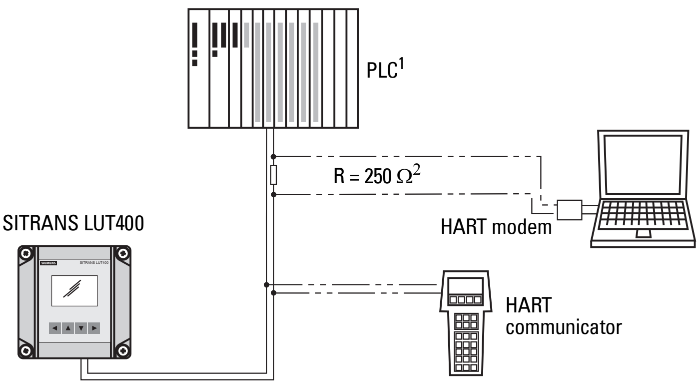
- No data logs are written while device is connected to a PC via USB. (See **2.10. Data Logging on page 173** and **3.2.6. View Logs on page 201.)** Connect USB cable for device configuration, and when configuration is complete, disconnect the USB cable to allow Data Logging to occur. (It is good practice to use MS Windows *Safely Remove Hardware* feature before unplugging any USB cable from your computer.)
- Do not use a USB *extension* cable with the LUT400. Data Logging may not occur, even after extension cable has been disconnected. (If a USB extension cable has been used in error, a power reset of the device is required to restart Data Logging.)

Connecting HART

Typical PLC/mA configuration with Passive HART connection

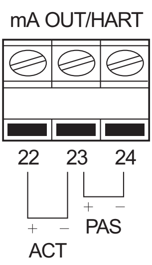


Typical PLC/mA configuration with Active HART connection



mA Output (HART)

For **ACTIVE** HART connection (using LUT400 integral power supply), connect terminals 22 and 23.



For **PASSIVE** HART connection (using external power supply), connect terminals 23 and 24.

For more information, consult the mA output parameters (2.5. Current Output) in the parameter reference section.

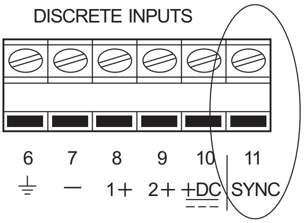
1. Depending on the system design, the power supply may be separate from the PLC, or integral to it.
2. The nominal value for the HART resistor is 250 Ohm. For more information see application guide *Working with HART*, which can be downloaded from the product page of our website. Go to: www.siemens.com/sitransLUT400 under **Support** and click on **Application Guides**.

Level system synchronization

Note: The SITRANS LUT400 CANNOT be synchronized with the MultiRanger Plus, the original HydroRanger, or the OCMIII.

When using multiple ultrasonic level monitors, be sure to run the transducer cables in separate grounded metal conduits.

When separate conduits are not possible, synchronize the level monitors so that no device transmits while another is waiting for echo reception. If more than one ultrasonic device is being installed in the same application, the devices must be synchronized to prevent cross-talk.



Synchronizing with another SITRANS LUT400, or other Siemens devices

Other Siemens devices that can be synchronized with the SITRANS LUT400:

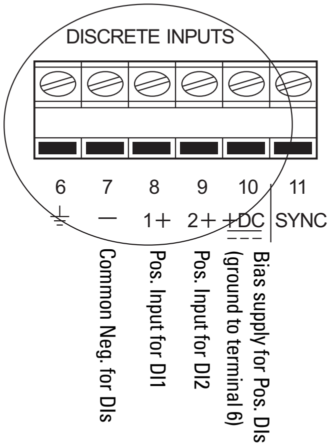
DPL+, SPL, XPL+, LU01, LU02, LU10, LUC500, DPS300, HydroRanger 200, HydroRanger Plus, EnviroRanger, MiniRanger, MultiRanger 100/200

- Mount the level monitors together in one cabinet
- Use a common power (mains) supply and ground (earth) for all devices
- Interconnect the SYNC terminals of all level monitors.

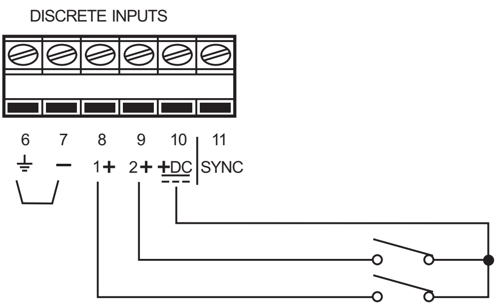
For more information or assistance, contact Siemens or your local distributor. Go to: www.siemens.com/processautomation.

Discrete inputs

The SITRANS LUT400 has a 24V power bias (terminal 10) for use with the discrete inputs, or the discrete inputs can be wired using external power.

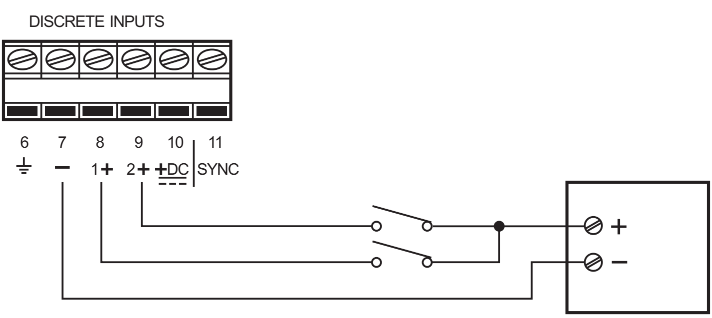


Discrete Inputs used with internal bias supply



Note: terminals 6 and 7 must be connected together.

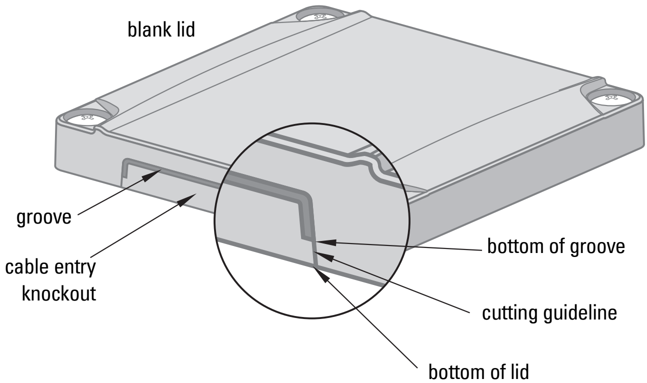
Discrete Inputs used with external bias voltage



Remote mounted lid with extension cable

The optional display lid can be mounted remotely up to 5 m from the device. The optional extension cable can be used for such an installation.

1. Remove display lid from the enclosure.
2. Carefully disconnect the existing display cable from the terminal board.
3. Separate from the device, knock out cable entry tab on blank lid:
   a. With gasket in place, use snips to cut into lid on both sides of the cable entry knockout. Use cutting guideline to cut from bottom of lid, up to bottom of groove (as shown below).
   b. Once both sides of knockout have been cut through all layers of the lid (including the gasket), pry upward with pliers on knockout to snap off plastic and uncover cable entry hole.



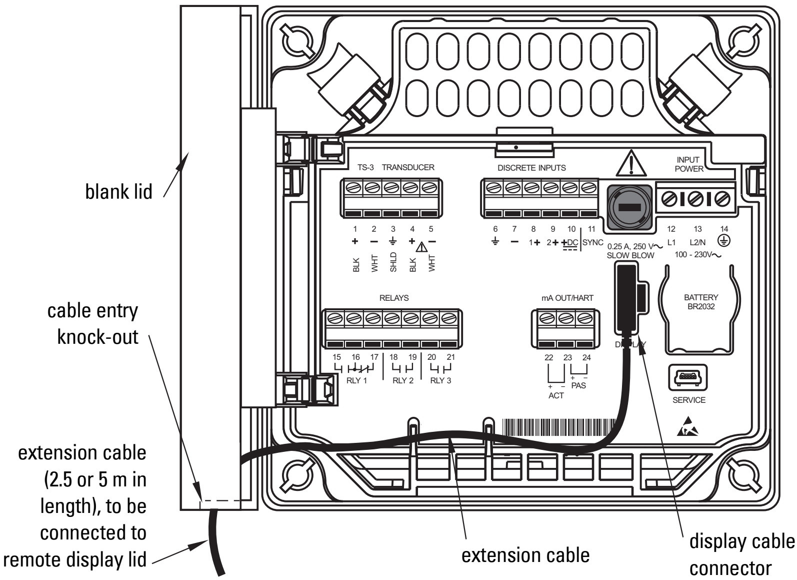
   c. Use sand paper if necessary to smooth any sharp edges.
   d. Replace the blank lid on the enclosure.

WARNINGS:

- **Ingress protection of the enclosure is reduced to IP20, and Type 4X / NEMA 4X rating is void when cable entry knock-out in the blank lid is removed.**
- **An enclosure reduced to an IP20 rating and intended for use in non-hazardous locations must be installed in an indoor location free of dust and moisture, or be installed in a suitably rated field enclosure IP54 or better.**

4. Connect the extension cable to the display connector on the terminal board. (If desired, attach second extension cable to the other end of the first extension cable.)
5. Feed the free end of the extension cable through cable entry hole on blank lid.
6. Connect extension cable to display cable on remote lid.

7. Secure blank lid on device and mount display lid remotely. See *Remote mounted lid* on page 12 for mounting instructions.



Extension cable

Optional extension cables (2.5 m cables) are available to be used with remote mounted lid. Two cables can be connected together for an extension of up to 5 meters.

Note: It is recommended that the exposed extension cable be secured along a wall, or run through conduit to prevent damage to device, should cable be accidentally subjected to stress.

Connecting in hazardous area installations

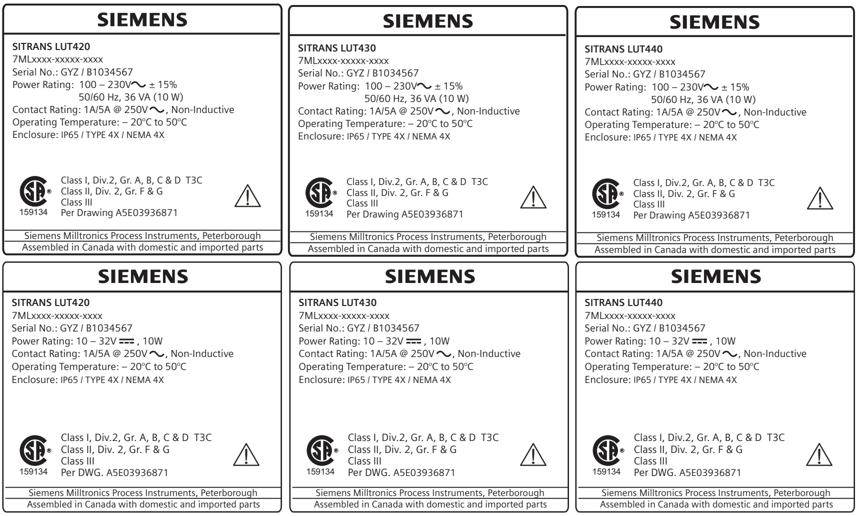
Wiring setups for hazardous area installations

The following wiring options are available for hazardous area installations:

- Non-incendive wiring (Canada)

In all cases, check the device label on your instrument, and confirm the approval rating.

1. Non-incendive wiring (Canada)

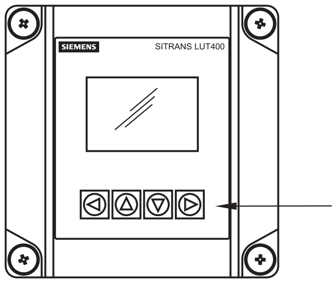


CSA Class I, Div 2 connection drawing number A5E03936871 can be downloaded from the product page of our website at www.siemens.com/sitransLUT400.

Notes

Local Commissioning

SITRANS LUT400 is an easy to use, and quick to commission device, with its numerous wizards, and menu driven parameters. The parameters can be modified locally using the LCD and the local push buttons, also known as the Local User Interface (LUI).



A Quick Start Wizard provides an easy step-by-step procedure to help you configure the device for a simple application. We recommend that you configure your application in the following order:

- First, run the appropriate Quick Start Wizard for your application (Level, Volume, Flow).
- Next, setup pumps via the Pump Control Wizard (if applicable).
- Lastly, configure alarms, or other controls, totalizers and samplers, referencing the respective parameters [see *Parameter reference (LUI)* on page 137]. It is important that alarms, and other controls are configured last to avoid pump relay assignments being overridden by the Quick Start Wizard.

There are two ways to access the Quick Start wizards:

- locally (see *Quick Start Wizards via LUI* on page 38)
- from a remote location (see *Other Quick Start Wizards (QSW):* on page 38)

See *Level Application Example* on page 58, or *Flow application example* on page 59 for illustrations, and for the complete range of parameters, see *Parameter reference (LUI)* on page 137.

Activating SITRANS LUT400

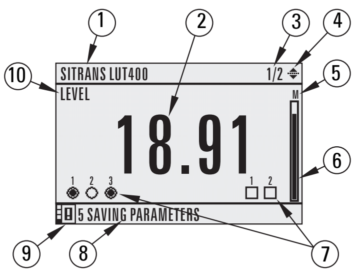
Notes:
- Program Mode and Measurement mode refer to the display only. While the device is in Program mode, the output remains active and continues to respond to changes in the device.
- To enter Program mode using the device local push buttons, press ▶. Press ◀ to return to Measurement mode.
- The display will return to Measurement mode after ten minutes of inactivity (from last button press), when in Program Mode and from within a Wizard. Pressing ▶ will then take you to the main navigation menu. (It will not return to the screen from which the timeout occurred.)

1. Power up the device. SITRANS LUT400 automatically starts up in Measurement mode. A transition screen showing first the Siemens logo and then the current firmware revision of the LUI is displayed while the first measurement is being processed.
2. The first time the device is configured, you will be prompted to select a language (English, German, French, Spanish or Chinese). To change the language again (after initial setup), see *Language* on page 217.
3. Device time is set to Eastern Standard Time (EST) at the factory. To modify, see *Date and Time* on page 187. The correct date and time should be set prior to configuring the device.

The LCD Display

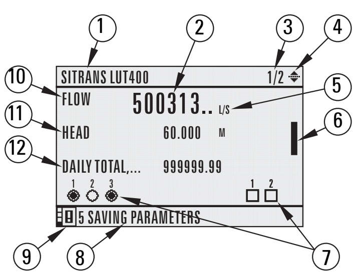
Measurement mode display: Normal operation

Level



1 – tag
2 – measured value (level, space, distance, volume, flow, or head)
3 – value being displayed [Primary Variable (PV)=1 of 2, Secondary Variable (SV)=2 of 2]
4 – toggle indicator[1] for PV or SV
5 – units
6 – bar graph indicates level
7 – secondary region indicates configured relays (left) and discrete inputs (right)
8 – text area displays status messages
9 – device status indicator
10 – selected (primary) sensor mode: level, space, distance, volume, head, or flow
11 – secondary sensor mode = head when primary sensor mode = flow
12 – totalizer values: display alternates between daily totalizer and running totalizer

Flow



Fault present

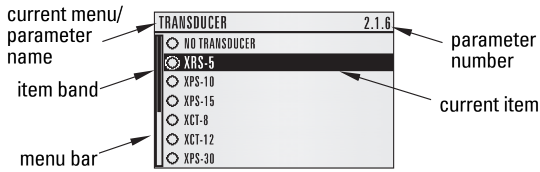
8 – text area displays a fault code and an error message
9 – service required icon appears

1. Press UP or DOWN arrow to switch

PROGRAM mode display

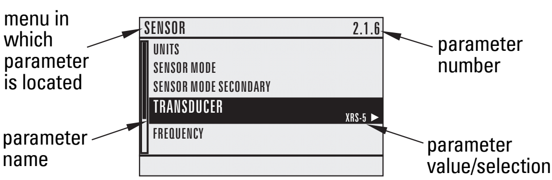
Navigation view

- A visible menu bar indicates the menu list is too long to display all items.
- The depth of the item band on the menu bar indicates the length of the menu list: a deeper band indicates fewer items.

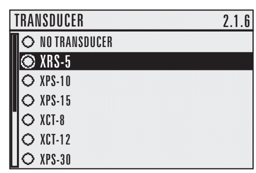


- The position of the item band indicates the approximate position of the current item in the list. A band filled halfway down the menu bar indicates the current item is halfway down the list.

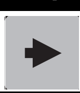
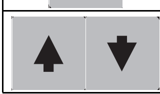
Parameter view



Edit view



Key functions in Measurement mode

Key	Function	Result
	**RIGHT arrow** opens PROGRAM mode.	Opens the top level menu.
	**UP** or **DOWN arrow** toggles between PV and SV.	LCD displays primary or secondary value.

Programming SITRANS LUT400

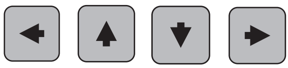
Notes:
- To enter Program mode using the device local push buttons, press ▶. Press ◀ to return to Measurement mode.
- While the device is in Program mode, the output remains active and continues to respond to changes in the device.

Change parameter settings and set operating conditions to suit your specific application. (For remote operation, see *Operation via SIMATIC PDM 6 (HART)* on page 127 or *Operation via AMS Device Manager (HART)* on page 131.)

Parameter menus

> **Note:** For the complete list of parameters with instructions, see *Parameter reference (LUI)* on page 137.

Parameters are identified by name and organized into function groups, then arranged in a 5-level menu structure, as in the example below. (For full menu see *LCD Menu Structure* on page 273.)



- **1. WIZARDS**
- 2. SETUP
  - 2.1 SENSOR
  - ......
  - **2.7 PUMPS**
    - 2.7.1 BASIC SETUP
    - **2.7.2 MODIFIERS**
      - **2.7.2.1 WALL CLING REDUCTION**
        - **2.7.2.1.1 ENABLE**

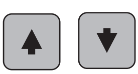
1. Enter PROGRAM mode

Using local push buttons:

- RIGHT arrow ▶ activates PROGRAM mode and opens menu level 1.

2. Navigating: key functions in Navigation view

> **Notes:**
> - In Navigation view, **ARROW keys** move to the next menu item in the direction of the arrow.
> - Press and hold any arrow key to scroll through a list of options or menus (in the direction of the arrow).

Key	Name	Menu level	Function
	UP or DOWN arrow	menu or parameter	Scroll to previous or next menu or parameter.
	RIGHT arrow	menu	Go to first parameter in the selected menu, or open next menu.
		parameter	Open **Edit** mode.
	LEFT arrow	menu or parameter	Open parent menu.

3. Editing in PROGRAM mode

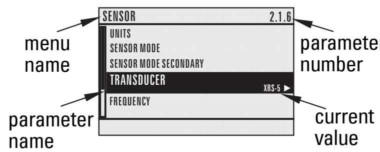
Selecting a listed option

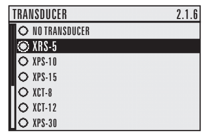
a. Navigate to the desired parameter.

b. Press **RIGHT arrow** ▶ to open **Edit** mode. The current selection is highlighted.

c. Scroll to a new selection.

d. Press **RIGHT arrow** ▶ to accept it. The LCD returns to parameter view and displays the new selection.





Changing a numeric value

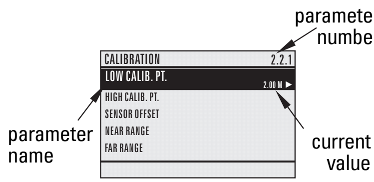
a. Navigate to the desired parameter.

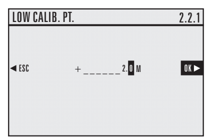
b. When selected, the current value is displayed.

c. Press **RIGHT arrow** ▶ to open **Edit** mode. The cursor position is highlighted.

d. Use **LEFT** ◀ and **RIGHT arrow** ▶ to move cursor to digit position you wish to change.

e. As each digit is highlighted (selected), use the **UP** ▲ and **DOWN arrow** ▼ to increase or decrease the digit respectively.





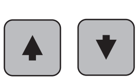
f. While decimal point is selected, use **UP** ▲ and **DOWN arrow** ▼ to shift decimal position.

g. To escape without saving your changes, press **LEFT arrow** ◀ continually until **ESC** is highlighted. Press **LEFT arrow** ◀ again to escape without saving changes.

Otherwise, when new parameter value is correct, press **RIGHT arrow** ▶ continually until **OK** is highlighted.

h. Press **RIGHT arrow** ▶ to accept the new value. The LCD returns to parameter view and displays the new selection. Review for accuracy.

Key functions in Edit mode

Key	Name	Function	
	**UP** or **DOWN arrow**	Selecting options	Scrolls to item.
		Alpha-numeric editing	- Increments or decrements digits - Toggles plus and minus sign

Key	Name	Function (Continued)	
	RIGHT arrow	Selecting options	- Accepts the data (writes the parameter) - Changes from **Edit** to **Navigation** mode
		Numeric editing	- Moves cursor one space to the right - or with selection highlighted, accepts the data and changes from **Edit** to **Navigation** mode
	LEFT arrow:	Selecting options	Cancels **Edit** mode without changing the parameter
		Numeric editing	- Moves cursor to plus/minus sign if this is the first key pressed - or moves cursor one space to the left. - or with cursor on Enter sign, cancels the entry

Quick Start Wizards

A Wizard provides an easy step-by-step Quick Start (QS) procedure that configures the device for a simple application. To configure the SITRANS LUT400 for applications of level, volume (standard vessel shapes), or flow, use the *Quick Start Wizards via LUI* on page 38 of this chapter.

Wizards for applications employing more complex vessel shapes are available via SIMATIC PDM. See *Quick Start (Volume - Linearization)* in the LUT400 Communications manual[1].

Other Quick Start Wizards (QSW):

Other Quick Start Wizards using various software packages are also available:

- SIMATIC PDM (HART) (see page 127)
- AMS (HART) (see page 131)
- FC375/475 (HART) (see page 133)
- FDTs (HART) (see page 135)

Before initiating a Quick Start Wizard to configure the device, you may wish to gather the necessary parameter values. Parameter Configuration Charts that list all parameters and available options for each application type are available on our website. Go to www.siemens.com/sitransLUT400 > **Support > Application Guides**. You can record data and select from options on the chart that apply to your application, then with this data on hand, complete the *Quick Start Wizards via LUI* below, or via another Quick Start Wizard, as referenced above.

Quick Start Wizards via LUI

1) Press ► to enter Program mode.

Note: Device continues to measure while in Program Mode. If you wish to disable the device while it is configured, see *3.3.1. Transducer Enable* on page 203.

1. Communications for SITRANS LUT400 (HART) Manual (7ML19985NE01). (See DVD shipped with device or download manual from our website.)

2) Choose Wizards (1.), Quick Start (1.1), and then the appropriate quick start: QS Level (1.1.1.), QS Volume (1.1.2.), or QS Flow (1.1.3.).
[The QS Flow wizard will display on LUI for LUT430 (Pump and Flow), and LUT440 (OCM) configured models only.]

3) Follow the steps then choose **Finish** to save Quick Start parameter changes and return to Program menu, then press ◀ three times to return to Measurement mode.

Notes:
- The Quick Start Wizard settings are inter-related and changes apply only after you choose Finish in the final step.
- Perform customization for your application only after the Quick Start has been completed.

1. Wizards

1.1. Quick Start

1.1.1. QS Level

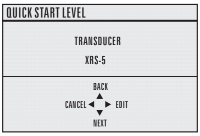
Use this wizard to configure simple level applications.

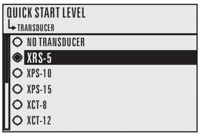
a. Press **RIGHT arrow** ▶ to activate PROGRAM mode and open menu level 1: MAIN MENU.

b. Press **RIGHT arrow** ▶ two times to navigate to menu item 1.1.1.

c. Press **RIGHT arrow** ▶ to open QS Level.

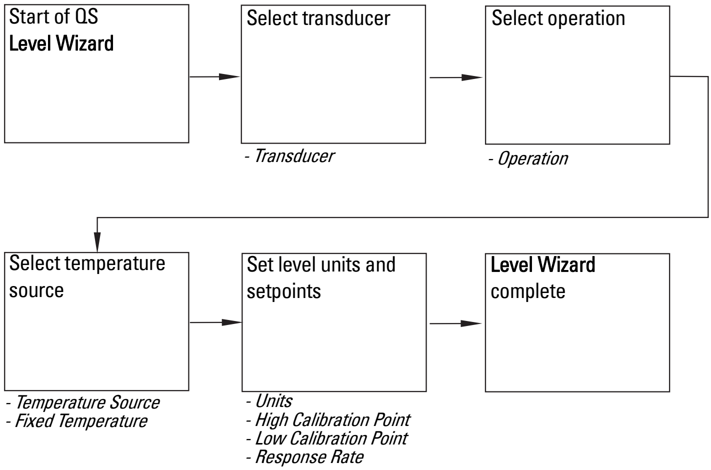
d. At each step, press **DOWN arrow** ▼ to accept default values and move directly to the next item,
or **RIGHT arrow** ▶ to open Edit mode: the current selection is highlighted.





e. Scroll to desired item and press **RIGHT arrow** ▶ to store the change, then press **DOWN arrow** ▼ to continue.

f. At any time, you can press **UP arrow** ▲ to go back, or **LEFT arrow** ◀ to cancel the wizard.



Start of QS Level Wizard

> **Note:** The introduction screen is displayed only on the device when using the local push buttons. This screen is not part of the Quick Start when using SIMATIC PDM.

Shows the type of Wizard to be executed.

Options	CANCEL, START

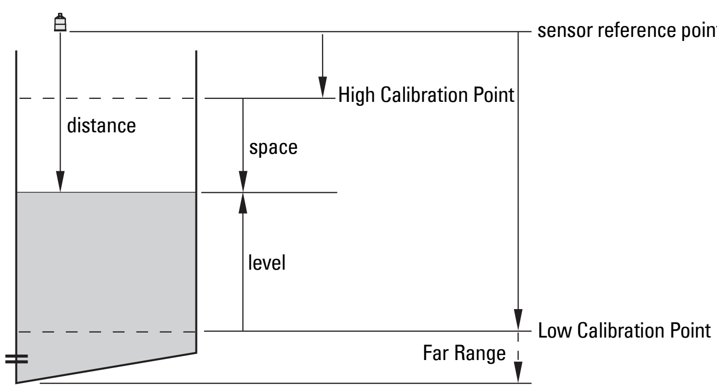
Transducer

Specifies the Siemens transducer connected to the device.

Options	NO TRANSDUCER, XRS-5, XPS-10, XPS-15, XCT-8, XCT-12, XPS-30, XPS-40, XLT-30, XLT-60, STH
	Default: NO TRANSDUCER

Operation

Sets the type of measurement (and the corresponding mA output) required for the application.



Mode		Description	Reference point
LEVEL	*	Height of material	Low Calibration Point (process empty level)
SPACE		Distance to material surface	High Calibration Point (process full level)
DISTANCE			Sensor Reference Point
OTHER		Do NOT select. If Operation value displays as OTHER, the device is configured as a level controller, but has been set previously to a mode other than LEVEL, SPACE, or DISTANCE. The operation mode must be set to LEVEL, SPACE, or DISTANCE to proceed with the QS Level Wizard.	

Temperature Source

Source of the temperature reading used to adjust the speed of sound.

Options	TRANSDUCER, FIXED TEMPERATURE, EXTERNAL TS-3, AVERAGE OF SENSORS
	Default: TRANSDUCER

See *Temperature Source* on page 180 for more details.

Fixed Temperature

Use this feature if a temperature sensing device is not used.

Value	Range: -100.0 to +150.0 °C
	Default: +20.0 °C

This parameter is only displayed if **FIXED TEMPERATURE** selected for Temperature Source.

Units

Sensor measurement units.

Options	M, CM, MM, FT, IN
	Default: M

Note: For the purpose of this example, all values are assumed to be in meters (m).

High Calibration Point

Distance from Sensor Reference Point to High Calibration Point: usually process full level.

Value	Range: 0.000 to 60.000
	Default: 0.000

Commissioning

Low Calibration Point

Distance from Sensor Reference Point to Low Calibration Point: usually process empty level.

Value	Range: 0.000 to 60.000
	Default: 60.000

Response Rate

Sets the reaction speed of the device to measurement changes in the target range.

Notes:
- Response Rate can only be set through the Quick Start Wizard, and any changes made to Fill Rate per Minute (2.3.1.), Empty Rate per Minute (2.3.2.), or Damping Filter (2.3.3.) parameters following the completion of the wizard will supersede the Response Rate setting.
- **Response Rate** always displays in m/minute.

Options	SLOW (0.1 M/MIN)
	MEDIUM (1.0 M/MIN)
	FAST (10 M/MIN)
	Default: SLOW (0.1 M/MIN)

Use a setting just faster than the maximum filling or emptying rate (whichever is greater). Slower settings provide higher accuracy, faster settings allow for more rapid level fluctuations.

End of QS Level Wizard

For QS to be successful, all changes must be applied.

Options	BACK, CANCEL, FINISH (Display returns to 1.1 Quick Start menu when Quick Start is successfully completed or cancelled. If CANCEL is selected, no changes are written to the device.)

To transfer Quick Start values to the device and return to Program menu, press **DOWN arrow** ▼ **(Finish)**. Then press **LEFT arrow** ◀ three times to return to Measurement mode.

1.1.2. QS Volume

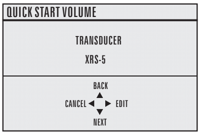
Use this wizard to configure volume applications employing standard vessel shapes.

a. Press **RIGHT arrow** ▶ to activate PROGRAM mode and open menu level 1: MAIN MENU.

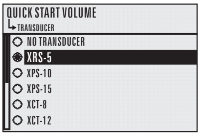
b. Press **RIGHT arrow** ▶ two times to navigate to menu item 1.1.1.

c. Press **DOWN arrow** ▼ and **RIGHT arrow** ▶ to open QS Volume.

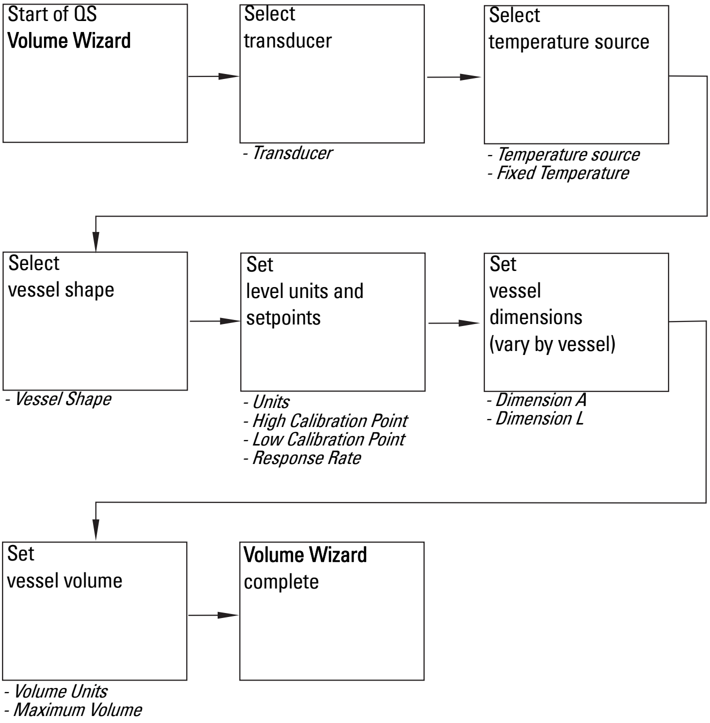
d. At each step, press **DOWN arrow** ▼ to accept default values and move directly to the next item, or **RIGHT arrow** ▶ to open Edit mode: the current selection is highlighted.



e. Scroll to desired item and press **RIGHT arrow** ▶ to store the change, then press **DOWN arrow** ▼ to continue.



f. At any time, you can press **UP arrow** ▲ to go back, or **LEFT arrow** ◀ to cancel the wizard.



Commissioning

Start of QS Volume Wizard

Note: The introduction screen is displayed only on the device when using the local push buttons. This screen is not part of the Quick Start when using SIMATIC PDM.

Shows the type of Wizard to be executed.

Options	CANCEL, START

Transducer

Specifies the Siemens transducer connected to the device.

Options	NO TRANSDUCER, XRS-5, XPS-10, XPS-15, XCT-8, XCT-12, XPS-30, XPS-40, XLT-30, XLT-60, STH
	Default: NO TRANSDUCER

Temperature Source

Source of the temperature reading used to adjust the speed of sound.

Options	TRANSDUCER, FIXED TEMPERATURE, EXTERNAL TS-3, AVGERAGE OF SENSORS
	Default: TRANSDUCER

See *Temperature Source* on page 180 for more details.

Fixed Temperature

Use this feature if a temperature sensing device is not used.

Value	Range: -100.0 to +150.0 °C
	Default: +20.0 °C

This parameter is only displayed if **FIXED TEMPERATURE** selected for Temperature Source.

Vessel Shape

*Defines the vessel shape and allows the SITRANS LUT400 to calculate volume instead of level. If **NONE** is selected, no volume conversion is performed. Select the vessel shape matching the monitored vessel or reservoir.*

Options	NONE, LINEAR, CYLINDER, PARABOLIC BOTTOM, HALF SPHERE BOTTOM, FLAT SLOPED BOTTOM, PARABOLIC ENDS, SPHERE, CONICAL BOTTOM, CURVE TABLE, LINEAR TABLE
	Default: LINEAR

See *Vessel Shape* on page 147 for illustration. If CURVE TABLE or LINEAR TABLE selected, enter values for level and volume breakpoints after completing the wizard (see *2.6.7. Table 1-8* on page 150).

Units

Sensor measurement units.

Options	M, CM, MM, FT, IN
	Default: M

Note: For the purpose of this example, all values are assumed to be in meters (m).

High Calibration Point

Distance from Sensor Reference Point to High Calibration Point: usually process full level.

Value	Range: 0.000 to 60.000
	Default: 0.000

Low Calibration Point

Distance from Sensor Reference Point to Low Calibration Point: usually process empty level.

Value	Range: 0.000 to 60.000
	Default: 60.000

Response Rate

Sets the reaction speed of the device to measurement changes in the target range.

Notes:
- Response Rate can only be set through the Quick Start Wizard, and any changes made to Fill Rate per Minute (2.3.1.) or Empty Rate per Minute (2.3.2.) parameters following the completion of the wizard will supersede the Response Rate setting.
- **Response Rate** always displays in m/minute.

Options	SLOW (0.1 M/MIN)
	MEDIUM (1.0 M/MIN)
	FAST (10 M/MIN)
	Default: SLOW (0.1 M/MIN)

Use a setting just faster than the maximum filling or emptying rate (whichever is greater). Slower settings provide higher accuracy, faster settings allow for more level fluctuations.

Dimension A

The height of the vessel bottom when the bottom is conical, pyramidal, parabolic, spherical, or flat -sloped..

Value	Range: 0.000 to 99.999
	Default: 0.000

Dimension L

Length of the cylindrical section of a horizontal parabolic end vessel.

Value	Range: 0.000 to 99.999
	Default: 0.000

Volume Units

Determines volume measurement units.

Options	L, USGAL, IMPGAL, CUM, USER DEFINED *
	Default: L

* If **USER DEFINED** option selected, the value must be set after completing the wizard. See *2.6.6. User Defined Unit* on page 149.

Commissioning

Commissioning

Maximum Volume

The maximum volume of the vessel. Enter the vessel volume corresponding to the High Calibration Point. For example, if your maximum vessel volume is 8000 L, enter a value of 8000.

Value	Range: 0.0 to 9999999
	Default: 100.0

End of QS Volume Wizard

For QS to be successful, all changes must be applied.

Options	BACK, CANCEL, FINISH (Display returns to 1.1 Quick Start menu when Quick Start is successfully completed or cancelled. If CANCEL is selected, no changes are written to the device.)

To transfer Quick Start values to the device and return to Program menu, press **DOWN arrow** ▼ **(Finish)**. Then press **LEFT arrow** ◀ three times to return to Measurement mode.

1.1.3. QS Flow

Use this wizard to configure simple flow applications.
(Visible on LUT430 (Pump and Flow), and LUT440 (OCM) configured models only.

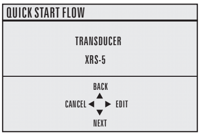
a. Press **RIGHT arrow** ▶ to activate PROGRAM mode and open menu level 1: MAIN MENU.

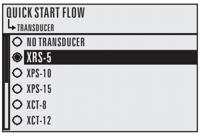
b. Press **RIGHT arrow** ▶ two times to navigate to menu item 1.1.1.

c. Press **DOWN arrow** ▼ two times and **RIGHT arrow** ▶ to open QS Flow.

d. At each step, press **DOWN arrow** ▼ to accept default values and move directly to the next item,

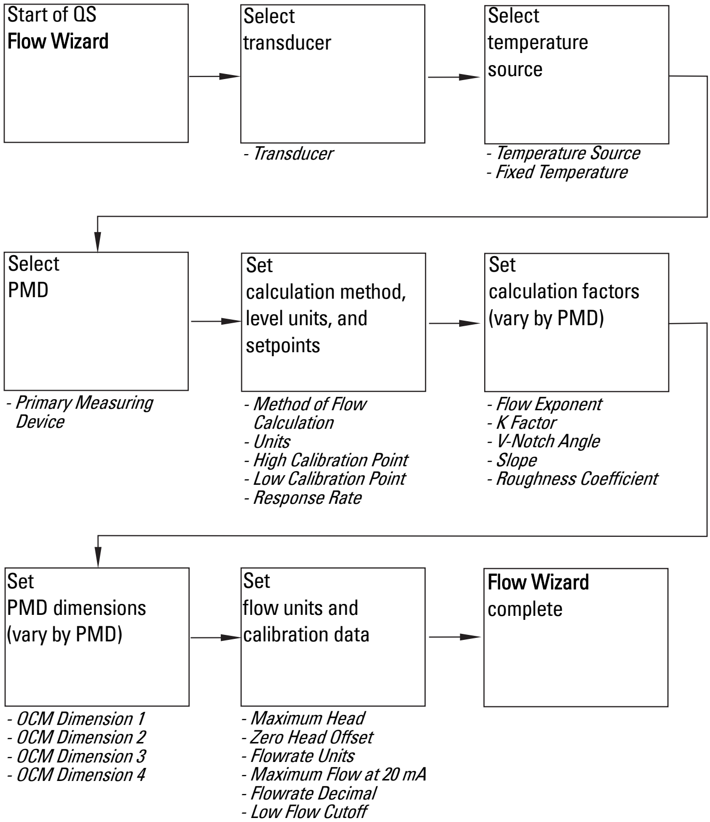
   or **RIGHT arrow** ▶ to open Edit mode: the current selection is highlighted.





e. Scroll to desired item and press **RIGHT arrow** ▶ to store the change, then press **DOWN arrow** ▼ to continue.

f. At any time, you can press **UP arrow** ▲ to go back, or **LEFT arrow** ◀ to cancel the wizard.



Start of QS Flow Wizard

> **Note:** The introduction screen is displayed only on the device when using the local push buttons. This screen is not part of the Quick Start when using SIMATIC PDM.

Shows the type of Wizard to be executed.

Options	CANCEL, START

Transducer

Specifies the Siemens transducer connected to the device.

Options	NO TRANSDUCER, XRS-5, XPS-10, XPS-15, XCT-8, XCT-12, XPS-30, XPS-40, XLT-30, XLT-60, STH
	Default: NO TRANSDUCER

Commissioning

Temperature Source

Source of the temperature reading used to adjust the speed of sound.

Options	TRANSDUCER, FIXED TEMPERATURE, EXTERNAL TS-3, AVGERAGE OF SENSORS
	Default: TRANSDUCER

See *Temperature Source* on page 180 for more details.

Fixed Temperature

Source of the temperature reading used to adjust the speed of sound.

Value	Range: -100.0 to +150.0 °C
	Default: +20.0 °C

This parameter is only displayed if **FIXED TEMPERATURE** selected for Temperature Source.

Primary Measuring Device

Defines the primary measuring device (PMD) to be used in the application.

Options	EXPONENTIAL DEVICES, RECTANGULAR FLUME BS-3680, ROUND NOSE HORIZONTAL CR. BS-3680, TRAPEZOIDAL FLUME BS-3680, U-FLUME BS-3680, FINITE CREST WEIR BS-3680, THIN PLATE RECT. WEIR BS-3680, THIN PLATE V-NOTCH WEIR BS-3680, RECT. WEIR CONTRACTED, ROUND PIPE, PALMER BOWLUS FLUME, H-FLUME, OTHER*
	Default: EXPONENTIAL DEVICES

* Option will be set to **OTHER** if the wizard was run previously via HART software tool (such as SIMATIC PDM), and the device was set to **OFF** or **UNIVERSAL HEAD VS. FLOW.** If this is initial configuration, the PMD can only be set for no calculation (OFF), or for linearization (UNIVERSAL HEAD VS. FLOW) via HART software tools (SIMATIC PDM, AMS, FC375/475).

Method of Flow Calculation

Sets the method of flow calculation.

Options	ABSOLUTE, RATIOMETRIC
	Default: ABSOLUTE

Units

Sensor measurement units.

Options	M, CM, MM, FT, IN
	Default: M

Note: For the purpose of this example, all values are assumed to be in meters (m).

High Calibration Point

Distance from Sensor Reference Point to High Calibration Point: usually process full level.

Value	Range: 0.000 to 60.000
	Default: 0.000

Low Calibration Point

Distance from Sensor Reference Point to Low Calibration Point: usually process empty level.

Value	Range: 0.000 to 60.000
	Default: 60.000

Response Rate

Sets the reaction speed of the device to measurement changes in the target range.

Notes:
- Response Rate can only be set through the Quick Start Wizard, and any changes made to Fill Rate per Minute (2.3.1.) or Empty Rate per Minute (2.3.2.) parameters following the completion of the wizard will supersede the Response Rate setting.
- Response Rate always displays in m/minute.

Options	SLOW (0.1 M/MIN)
	MEDIUM (1.0 M/MIN)
	FAST (10 M/MIN)
	Default: SLOW (0.1 M/MIN)

Use a setting just faster than the maximum filling or emptying rate (whichever is greater). Slower settings provide higher accuracy, faster settings allow for more level fluctuations.

Calculation factors:

Notes:
- **The following five parameters will display in the wizard based on the PMD selected above.**
- These parameters are used in the flow calculation formula (see *Method of Flow Calculation* on page 266).

Flow Exponent

(PMD = EXPONENTIAL DEVICES)

The exponent for the flow calculation formula. (See Method of Flow Calculation on page 266.)

Value	Range: -999.000 to 9999.000
	Default: 1.550

K Factor

(PMD = EXPONENTIAL DEVICES)

The constant used in the flow calculation formula for absolute calculation of an exponential device only.

Value	Range: -999.000 to 9999.000
	Default: 1.000

V-Notch Angle

(PMD = THIN PLATE V-NOTCH WEIR)

The V-Notch angle used in the flow calculation formula.

Value	Range: 25.000 to 95.000
	Default: 25.000

Slope

(PMD = TRAPEZOIDAL FLUME or ROUND PIPE)

The Flow Slope used in the flow calculation formula.

Value	Range: -999.000 to 9999.000
	Default: 0.000

Roughness Coefficient

(PMD = ROUND PIPE)

The Flow Roughness Coefficient used in the flow calculation formula.

Value	Range: -999.000 to 9999.000
	Default: 0.000

PMD Dimensions

Notes:
- For each PMD excluding *Exponential Devices*, and *Other*, you must enter up to four dimensions.
- In the wizard, you will be prompted for each dimension required for the PMD selected, and the respective PMD dimension name will be displayed.

PMD selected	Wizard dimension name (parameter menu reference)
Rectangular Flume BS-3680	
	APPROACH WIDTH B (*2.15.4.5. OCM Dimension 1*)
	THROAT WIDTH B (*2.15.4.6. OCM Dimension 2*)
	HUMP HEIGHT P (*2.15.4.7. OCM Dimension 3*)
	THROAT LENGTH L (*2.15.4.8. OCM Dimension 4*)
Round Nose Horizontal Crest Weir BS-3680	
	CREST WIDTH B (*2.15.4.5. OCM Dimension 1*)
	CREST HEIGHT P (*2.15.4.6. OCM Dimension 2*)
	CREST LENGTH L (*2.15.4.7. OCM Dimension 3*)
Trapezoidal Flume **BS-3680**	
	APPROACH WIDTH B (*2.15.4.5. OCM Dimension 1*)
	THROAT WIDTH B (*2.15.4.6. OCM Dimension 2*)
	HUMP HEIGHT P (*2.15.4.7. OCM Dimension 3*)
	THROAT LENGTH L (*2.15.4.8. OCM Dimension 4*)
U-Flume BS-3680	
	APPROACH DIAMETER DA (*2.15.4.5. OCM Dimension 1*)
	THROAT DIAMETER D (*2.15.4.6. OCM Dimension 2*)
	HUMP HEIGHT P (*2.15.4.7. OCM Dimension 3*)
	THROAT LENGTH L (*2.15.4.8. OCM Dimension 4*)
Finite Crest Weir BS-3680	
	CREST WIDTH B (*2.15.4.5. OCM Dimension 1*)
	CREST HEIGHT P (*2.15.4.6. OCM Dimension 2*)
	CREST LENGTH L (*2.15.4.7. OCM Dimension 3*)
Thin Plate Rectangular Weir BS-3680	
	APPROACH WIDTH B (*2.15.4.5. OCM Dimension 1*)
	CREST WIDTH B (*2.15.4.6. OCM Dimension 2*)
	CREST HEIGHT P (*2.15.4.7. OCM Dimension 3*)
Rectangular Weir Contracted	
	CREST WIDTH B (*2.15.4.5. OCM Dimension 1*)
Round Pipe	
	PIPE INSIDE DIAMETER D (*2.15.4.5. OCM Dimension 1*)

PMD selected (cont'd)	Wizard dimension name (parameter menu reference)
Palmer Bowlus Flume	
	MAXIMUM FLUME WIDTH HMAX (*2.15.4.5. OCM Dimension 1*)
H-Flume	
	MAXIMUM LISTED HEAD HMAX (*2.15.4.5. OCM Dimension 1*)

Maximum Head

The maximum level value associated with the PMD.

Value	Range: 0.000 to 60.000
	Default: 60.000

Zero Head Offset

The difference (positive or negative) between Low Calibration Point and zero head (level at zero flow).

Value	Range: -60.000 to 60.000
	Default: 0.000

Flowrate Units

The volume units used to display total flow.

Options	L/S, L/MIN, CUFT/S, CUFT/D, GAL/MIN, GAL/D, IMPGAL/MIN, IMPGAL/D, CUM/H, CUM/D, USER DEFINED *
	Default: L/S

* If USER DEFINED option selected, the value must be set after completing the wizard. See *2.15.3.8. User Defined Unit* on page 193.

Maximum Flow at 20 mA

The maximum flowrate.

Value	Range: -999 to 9999999
	Default: 100

Flowrate Decimal

The maximum number of decimal units to be displayed.

Options	NO DIGITS, 1 DIGIT, 2 DIGITS, 3 DIGITS
	Default: NO DIGITS

Low Flow Cutoff

Eliminates totalizer activity for head levels at or below the cutoff value.

Value	Range: 0.000 to 60.000
	Default: 0.000

End of QS Flow Wizard

For QS to be successful, all changes must be applied.

Options	BACK, CANCEL, FINISH (Display returns to 1.1.1 Quick Start menu when Quick Start is successfully completed or cancelled. If CANCEL is selected, no changes are written to the device.)

To transfer Quick Start values to the device and return to Program menu, press **DOWN arrow** ▼ **(Finish)**. Then press **LEFT arrow** ◀ three times to return to Measurement mode.

Note: It is strongly recommended that an *Auto Zero Head* be performed after completion of the wizard to ensure best accuracy. See *2.15.2. Auto Zero Head* on page 190.

Commissioning

Commissioning

1.2. Pump Control

Use this wizard to configure pumps if they will be used in your application. Be sure to first complete the applicable Quick Start Wizard.

a. Press **RIGHT arrow** ▶ to activate PROGRAM mode and open menu level 1: MAIN MENU.

b. Press **RIGHT arrow** ▶ to navigate to menu item 1.1.

c. Press **DOWN arrow** ▼ and **RIGHT arrow** ▶ to open Pump Control.

d. At each step, press **DOWN arrow** ▼ to accept default values and move directly to the next item,

or **RIGHT arrow** ▶ to open Edit mode: the current selection is highlighted.

e. Scroll to desired item and press **RIGHT arrow** ▶ to store the change, then press **DOWN arrow** ▼ to continue.

f. At any time, you can press **UP arrow** ▲ to go back, or **LEFT arrow** ◀ to cancel the wizard.

Start of Wizard - Pump Control

Note: The introduction screen is displayed only on the device when using the local push buttons. This screen is not part of the Quick Start when using SIMATIC PDM.

Shows the type of Wizard to be executed.

Options	CANCEL, START

Number of Pumps

Select the number of pumps to be used with pump control.

Options	NONE, 2
	Default: NONE

If set to NONE, pump control is disabled.

Relay Pump 1

Selects the relay assigned to Pump 1.

Options	RELAY 2, RELAY 3
	Default: RELAY 2

Relay Pump 2

View only. Automatically sets the relay assigned to Pump 2 based on relay selected for Pump 1 in previous step.

Options (view only)	If Relay Pump 1 = RELAY 2, then Relay Pump 2 = RELAY 3
	If Relay Pump 1 = RELAY 3, then Relay Pump 2 = RELAY 2

Pump Control Mode

Sets the control algorithm used to trip the relay.

Options supported per model	**LUT420 Level Controller:** ALTERNATE DUTY ASSIST, ALTERNATE DUTY BACKUP
	LUT430 Pump and Flow Controller: ALTERNATE DUTY ASSIST, ALTERNATE DUTY BACKUP, SERVICE RATIO DUTY ASSIST, SERVICE RATIO DUTY BACKUP, FIXED DUTY ASSIST, FIXED DUTY BACKUP
	LUT440 High Accuracy OCM: ALTERNATE DUTY ASSIST, ALTERNATE DUTY BACKUP, SERVICE RATIO DUTY ASSIST, SERVICE RATIO DUTY BACKUP, FIXED DUTY ASSIST, FIXED DUTY BACKUP
	Default (all models): ALTERNATE DUTY ASSIST

See *Pump Control Mode 2.7.1.4.* on page 151 for descriptions of each.

Service Ratio Pump 1

Selects pump usage based on the RUN time ratio rather than last used.

Value	Range: 0 to 255
	Default: 1

This parameter displays only if a Service Ratio algorithm is selected for Pump Control Mode.

Service Ratio Pump 2

Selects pump usage based on the RUN time ratio rather than last used.

Value	Range: 0 to 255
	Default: 1

This parameter displays only if a Service Ratio algorithm is selected for Pump Control Mode.

Run Time Relay 2

Set the amount of time that pump Relay 2 has run, defined in hours.

Value	Range: 0 to 999999
	Default: 0

Use the default value for new pumps, or set this value for existing pumps with accumulated run time. (This parameter displays only if a Service Ratio algorithm is selected for Pump Control Mode.)

Run Time Relay 3

Set the amount of time that pump Relay 3 has run, defined in hours.

Value	Range: 0 to 999999
	Default: 0

Use the default value for new pumps, or set this value for existing pumps with accumulated run time. (This parameter displays only if a Service Ratio algorithm is selected for Pump Control Mode.)

Commissioning

ON Setpoint Pump 1

The level at which Pump 1 turns ON, defined in 2.1.1. Units.

Value	Range: 0.000 to 99999.000
	Default: 0.000

ON Setpoint Pump 2

The level at which Pump 2 turns ON, defined in 2.1.1. Units.

Value	Range: 0.000 to 99999.000
	Default: 0.000

OFF Setpoint Pump 1

The level at which Pump 1 turns OFF, defined in 2.1.1. Units.

Value	Range: 0.000 to 99999.000
	Default: 0.000

OFF Setpoint Pump 2

The level at which Pump 2 turns OFF, defined in 2.1.1. Units.

Value	Range: 0.000 to 99999.000
	Default: 0.000

End of Wizard - Pump Control

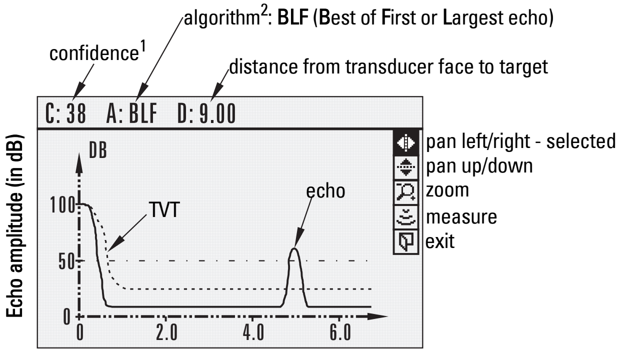
For Wizard to be successful, all changes must be applied.

Options	BACK, CANCEL, FINISH (Display returns to Pump Control menu when Wizard is successfully completed or cancelled. If CANCEL is selected, no changes are written to the device.)

To transfer values to the device and return to Program menu, press DOWN arrow ▼ (Finish). Then press LEFT arrow ◀ two times to return to Measurement mode.

Requesting an Echo Profile

- In PROGRAM mode, navigate to: **Main Menu** > **Diagnostics (3.2.)** > Echo Profile (3.2.1.).
- Press **RIGHT arrow** ▶ to request a profile.



1. See Confidence (3.2.9.2.) on page 202.
2. See Algorithm (2.12.2.1.) on page 181.

- Use **UP** ▲ or **DOWN arrow** ▼ to scroll to an icon. When an icon is highlighted, that feature becomes active.
- To move a cross-hair, press **RIGHT arrow** ▶ to increase the value, **LEFT arrow** ◀ to decrease.
- To Zoom into an area, position the intersection of the cross-hairs at the center of that area, select **Zoom**, and press **RIGHT arrow** ▶ . Press **LEFT arrow** ◀ to Zoom out.
- To update the profile, select **Measure** and press **RIGHT arrow** ▶ .
- To return to the previous menu, select **Exit** then press **RIGHT arrow** ▶ .

Device Address

Setting a device address is not necessary for local operation, but must be set if configuring the SITRANS LUT400 for use on a HART network. See *Device Address 4.1.* on page 215.

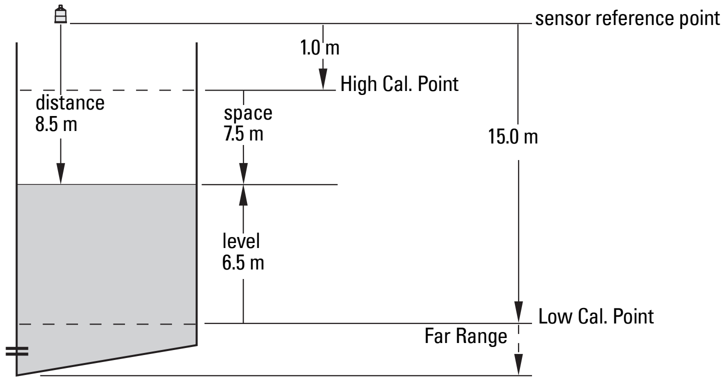
Testing the configuration

After programming the device, it is recommended that you test the device to ensure that it performs to your specifications. This test can be run in simulation mode or by varying the actual level in the application. The latter is preferred as it more accurately represents running conditions. However, if it is not possible to do a physical test, a simulation will ensure that control programming is correct. For further details, see *Simulation* on page 120, and *Application test* on page 123.

Application examples

In the examples that follow, substitute your own application details. If the examples do not apply to your application, check the applicable parameter reference for the available options.

Level Application Example



Quick Start Parameter	Setting	Description
Transducer	XPS-15	Transducer to be used with the LUT400.
Operation	LEVEL	Material level referenced from Low Cal. Point.
Temperature Source	TS-3	Temperature source.
Units	M	Sensor measurement units.
High Calibration Point	1.0	Process full level.
Low Calibration Point	15.0	Process empty level.
Response Rate	SLOW	Sets Fill Rate[a]/ Empty Rate to 0.1 m/minute.

a. See *Fill Rate per Minute 2.3.1.* on page 142.

The application is a vessel that takes an average 3 hours (180 minutes) to fill and 3 weeks to empty.

Fill rate = (Low Cal Pt. – High Cal Pt.) / fastest of fill or empty time
= (15.5 m – 1 m) / 180 min.
= 14.5 m /180 min. = 0.08 m/min.

Flow application example

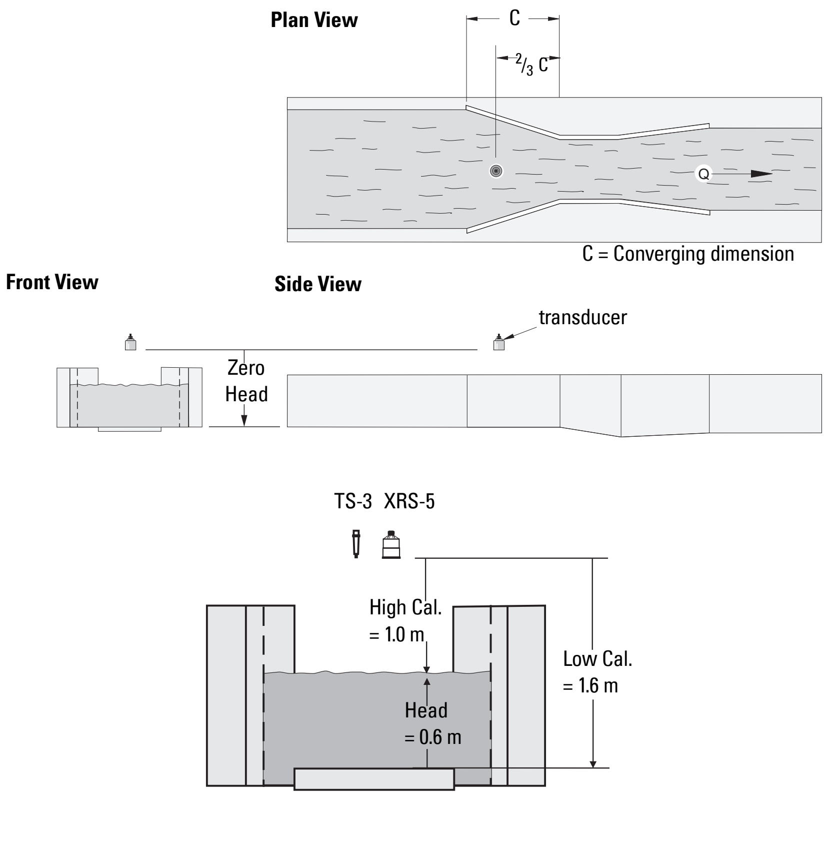
Parshall Flume

In this example, a 12 inch (0.305 m) Parshall Flume has been installed in an open channel. As per the supplier's data sheet, the device has been rated for a maximum flow of 1143 m^3 per hour at a maximum head of 0.6 m.

The Parshall Flume is considered an exponential device, therefore the supplier's data sheet includes a flow exponent value of 1.522.

The SITRANS LUT400, and the XRS-5 transducer have been installed 1.6 m above the channel beside the TS-3 external temperature sensor.

During intermittent peak flow times, the head level can be expected to rise at a rate of approximately 0.12 m/minute. The application also calls for a flow sampler to be activated every 1000 m^3, or 24 hours (whichever comes first), and for a fail-safe alarm to activate in the event of a loss of echo or cable fault.



Commissioning

Initial device setup

Quick Start Parameter	Setting/ Value	Description
Transducer	XRS-5	For best accuracy, an XRS-5 transducer should be used in conjunction with the High Accuracy SITRANS LUT440.
Temperature Source	TS-3	For best accuracy, a TS-3 external temperature sensor is required.
Primary Measuring Device (PMD)	Exponential	Parshall Flumes are a type of exponential device.
Flow Exponent	1.522	Available from the PMD supplier data sheet.
Units	m	Units corresponding to the head measurement.
Low Calibration Point	1.6	The distance to the empty point or bottom of the flume. This sets the 4 mA setpoint.
High Calibration Point	1.0	The distance to the Max. Head. This sets the 20 mA setpoint.
Response Rate	Medium (1.0 m/min)	Response rate is set to be faster than the fastest rise in material level under typical operating conditions. In this example, the rate is faster than the Peak Time rate provided by the end user.
Method of Flow Calculation	Ratiometric	Used when the Max. Head and Max. Flow values are provided.
Maximum Head	0.6 m	Available from the PMD supplier data sheet.
Flowrate Units	Cum/hr	Set per end user requirements.
Maximum Flow at 20 mA	1143	Available from the PMD supplier data sheet.
Flowrate Decimal	No Digits	For the purpose of this example, decimals are not required.
Low Flow Cutoff	0.00	This parameter stops the LUT440 from totalizing if the head value corresponding to low flow is reached. This prevents flow from being totalized when the head level reaches the ineffective point of the PMD. Refer to the PMD data sheets for ratings.

Continue with alarm setup below.

Fail-safe Alarm setup

Parameter	Setting/ Value	Description
Enable (2.8.8.1.)	Enabled	By selecting Enabled, the fail-safe alarm is now activated.
Assigned Relay (2.8.8.2.)	Relay 1	Select relay to be used for fail-safe alarm. Relay 1 is the dedicated alarm relay for the LUT400.

Continue with sampler setup on next page.

External Sampler setup

Parameter	Setting/ Value	Description
Enable (2.11.4.1.)	Enabled	By selecting Enabled, the external sampler is now activated.
Multiplier (2.11.4.2.)	1000	In this example, the LUT440 will activate the external sampler every 1000 flow units (*Flowrate Units* defined above during initial application setup).
Interval (2.11.4.3.)	24	In low flow conditions where the sampler may not activate for extended periods of time, a relay interval can be programmed to allow for sampler activation after a defined number of hours. In this example, activation should occur every 24 hours.
Relay Duration (2.11.4.4.)	0.2	Duration of time in seconds that the relay will energize or "tick".
Assigned Relay (2.11.4.5.)	Relay 2	Relay 2 has been selected for control in this example as relay 1 has been allocated to the Fail-safe alarm.
Relay Logic (2.11.4.6.)	Normally Open	Default for control relay functions is Normally Open. In this example, relay 2's coil will be Normally Open, and will close for 0.2 seconds.

Notes

Commissioning

General Operation

This chapter provides details on the general operation and functionality of the SITRANS LUT400. For instructions on the use of the device LCD and local push buttons, refer to *The LCD Display* on page 34.

Starting measurement

The SITRANS LUT400 is a single point device. The device starts in LEVEL mode with a preset of no transducer and a low calibration point of 60 meters. Change the following common parameters to reflect your application.

Parameter	Sample Value
2.1.2. Sensor Mode	LEVEL
Response Rate (set via *QS Level* on page 39)	MEDIUM
2.1.6. Transducer	XPS-15
2.1.1. Units	M
2.2.1. Low Calibration Point	12
2.2.2. High Calibration Point	2

Measurement conditions

The following information will help you configure your SITRANS LUT400 for optimal performance and reliability.

Response Rate

The response rate of the device influences the measurement reliability. Use the slowest rate possible with the application requirements.

Note: Changes to fill and empty rate parameters can override Response Rate setting. See "Response Rate" on page 42.

Dimensions

Dimensions of the vessel, wet well, or reservoir (other than low and high calibration points) are only important if you require volume readings. In this case, all dimensions are used to calculate the volume value in terms of level. They are also used to calculate pumped volume.

Fail-safe

The fail-safe parameters ensure that the devices controlled by the SITRANS LUT400 default to an appropriate state when a valid level reading is not available. (See list of faults that result in fail-safe in *General Fault Codes* on page 231.)

- *2.4.2. LOE Timer* activates if an error condition is detected. Upon expiration of the timer, the mA output value and the relay status default to values based on *2.4.1. Material Level*.
- The fail-safe *2.4.1. Material Level* determines the mA output if the *2.4.2. LOE Timer* expires and the device is still in an error condition.

If fail-safe operation activates frequently, see *Diagnosing and Troubleshooting* on page 229.

Relays

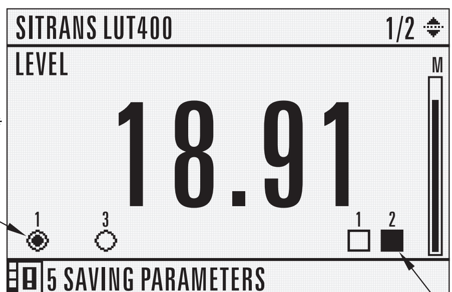
Relays are the primary controls of external devices such as pumps or alarms. The SITRANS LUT400 comes with extensive control and alarm functions described below.

General introduction

Three relays are provided on the SITRANS LUT400. Each relay may be independently assigned to one function (one or more functions for alarms), and has a corresponding status icon on the LCD.

Relay icons:
Relay 1, 3 programmed
Relay 2 not programmed*

Relay 1 active
Relay 3 inactive



Discrete Input icons:
DI 1, 2 programmed
DI 1 off
DI 2 on

*Icon will not display for relay or DI that is not programmed.

Mode	Function (in normal state)
alarm	alarm ON = LCD icon ON = relay coil de-energized
pump	pump ON = LCD icon ON = relay coil energized
miscellaneous	contact closed = LCD icon ON = relay coil energized

Relay contact operation is NORMALLY CLOSED for alarms and NORMALLY OPEN for controls.

	Default	Alarm Contact	Pump or Control Contact
Options	*	Normally Closed	Normally Open
		Normally Open	Normally Closed

In software, all relays are programmed the same way, with ON setpoints indicating when to change the relay contact state (open or closed). Some parameters allow the reversal of the operation so that relay contacts can be NORMALLY CLOSED or NORMALLY OPEN (for example, when assigned to an alarm).

Relay function

Alarm

Level

In high alarm, the alarm state becomes active when the level rises to High Level Value ON and inactive when it falls below High Level Value OFF. In low alarm, the alarm state becomes active when the level falls to Low Level Value ON and inactive when the level rises above Low Level Value OFF.

In-bounds

The relay alarm becomes active if the level is inside a user-defined range.

Out-of-bounds

The relay alarm becomes active if the level is outside a user-defined range.

Temperature

In high alarm, the alarm state becomes active when the temperature rises to High Temperature Value ON and inactive when the temperature falls below High Temperature Value OFF. In low alarm, the alarm state becomes active when the temperature falls to Low Temperature Value ON and inactive when the temperature rises above Low Temperature Value OFF.

Switch (Discrete Input)

The relay alarm state associated with the discrete input becomes active when the discrete input is in a user-defined state.

Fail-safe fault

The relay alarm state becomes active when a fault that has caused a fail-safe condition is present. The relay alarm state becomes inactive when no faults that cause fail-safe are present.

Flowrate

Available for LUT440 (OCM) model only.
In high alarm, the alarm state becomes active when the flowrate exceeds High Flowrate Value ON and inactive when the flowrate falls below High Flowrate Value OFF. In low alarm, the alarm state becomes active when the flowrate falls below Low Flowrate Value ON and inactive when the flowrate rises above Low Flowrate Value OFF.

Pump

Setpoint - ON / OFF

If the ON setpoint is higher than the OFF setpoint, the relay operates as:

- pump down control

If the ON setpoint is lower than the OFF setpoint, the relay operates as:

- pump up control

Miscellaneous

Totalizer and samplers

Refer to *Other Pump Controls* on page 87. Relays are normally de-energized, contact closure is approximately 200 ms duration.

Relay behaviour under fail-safe conditions

A fail-safe condition generally indicates that the level reading is not reliable or is unknown. In such a situation, pumps will not run and alarms (that are based on level or a derivative reading) will not activate. The following describes this behaviour in detail, by relay function.

Alarm relays

Any alarm that is based on level, or a reading derived from level such as flow rate, will not activate if there is a fail-safe condition. If the fail-safe condition occurs and the alarm is already active, the alarm will de-activate.

The following alarm types will de-activate during a fail-safe condition:

- *High Level*
- *Low Level*
- *In-bounds Level*
- *Out-of-bounds Level*
- *High Flow Rate*
- *Low Flow Rate.*

> **Note**: A dedicated alarm exists for fail-safe condition as described above. See *Fail-safe fault* on page 65.

Pump relays

If a pump cycle is in progress at the time the fail-safe condition occurs, then the pump cycle will end prematurely (as if the 'off' setpoints were reached). This has the effect of turning off all pumps immediately. If a pump run-on occurrence was scheduled for the pump cycle, *it will not occur.* However, if a pump run-on occurrence has already begun at the time the fail-safe condition occurs, then the run-on will complete.

If no pump cycle is in progress at the time the fail-safe condition occurs, then subsequent pump cycles will not occur (the fail-safe condition will prevent pumps from starting), until the fail-safe condition is cleared.

Miscellaneous relays

<u>External Totalizer relay</u>

If the external totalizer is in the process of recording volume (i.e. the relay is clicking) when a fail-safe condition occurs, then the current series of clicks will be allowed to complete.

When totalizing volume:
Since pumps do not run when in fail-safe, then the external totalizer will in general not operate either. If a fail-safe condition occurs during a pump cycle then the volume pumped for that cycle will *not* be totalized.

General Operation

When totalizing OCM flow:

The flow totalizers continue to operate during a fail-safe condition, thus the external totalizer relay will also continue to operate.

<u>External Sampler relay</u>

The External Sampler relay operates the same as the External Totalizer relay described above. The periodic timeout-click will also continue to occur in fail-safe.

<u>Communications relays</u>

Relays controlled by communications (HART) are not affected by a fail-safe condition.

Relay states

The relays on the SITRANS LUT400 are programmable, allowing for many control schemes.

Relay Types
Relay 1 – NO / NC (Form C)
Relay 2,3 – NO (Form A)

Relay output logic

Affects relay reaction. Reverses the logic (normally-open to normally-closed or vice versa). Relay logic can be modified separately for alarms, and controls. (Logic for pumps cannot be reversed.)

Function		Parameter
2.8.11. Relay Logic for *2.8. Alarms*		*2.8.11.1. Relay 1 Logic* *2.8.11.2. Relay 2 Logic* *2.8.11.3. Relay 3 Logic*
2.11. Other Control	*2.11.1. Elapsed Time Relay*	*2.11.1.5. Relay Logic*
	2.11.2. Time of Day Relay	*2.11.2.5. Relay Logic*
	2.11.3. External Totalizer	*2.11.3.5. Relay Logic*
	2.11.4. External Sampler	*2.11.4.6. Relay Logic*

Relay related parameters

Some parameters affect how relays react during normal conditions:

Setpoints

When a setpoint is reached, the corresponding action is taken. The setpoint can be an ON or OFF setpoint related to a process variable, or a timed setpoint based on interval and duration.

1. ON and OFF Setpoints

Sets the process point at which the relay is activated (ON setpoint) then reset (OFF setpoint). These setpoints are set separately for each pump within each pump control, and for each alarm type:

Function		Parameter
2.7. Pumps	*2.7.1. Basic Setup*	*2.7.1.6. ON Setpoint Pump 1* *2.7.1.7. OFF Setpoint Pump 1* *2.7.1.8. ON Setpoint Pump 2* *2.7.1.9. OFF Setpoint Pump 2*
2.7.2. Modifiers (for *2.7. Pumps*)	*2.7.2.2. Energy Savings*	*2.7.2.2.13. Peak ON Setpoint Pump 1* *2.7.2.2.14. Peak OFF Setpoint Pump 1* *2.7.2.2.15. Peak ON Setpoint Pump 2* *2.7.2.2.16. Peak OFF Setpoint Pump 2*
2.8. Alarms	*2.8.1. High Level Alarm*	*2.8.1.2. High Level Value ON* *2.8.1.3. High Level Value OFF*
	2.8.2. Low Level Alarm	*2.8.2.2. Low Level Value ON* *2.8.2.3. Low Level Value OFF*
	2.8.4. In-bounds Level Alarm	*2.8.4.2. High Level Value* *2.8.4.3. Low Level Value*
	2.8.5. Out-of-bounds Level Alarm	*2.8.5.2. High Level Value* *2.8.5.3. Low Level Value*
	2.8.6. Low Temperature Alarm	*2.8.6.2. Low Temperature Value ON* *2.8.6.3. Low Temperature Value OFF*
	2.8.7. High Tempera-ture Alarm	*2.8.7.2. High Temperature Value ON* *2.8.7.3. High Temperature Value OFF*
	2.8.9. High Flowrate Alarm	*2.8.9.2. High Flowrate Value ON* *2.8.9.3. High Flowrate Value OFF*
	2.8.10. Low Flowrate Alarm	*2.8.10.2. Low Flowrate Value ON* *2.8.10.3. Low Flowrate Value OFF*

2. Timed Setpoints

Timed setpoints are based on interval, duration, or time of day. These setpoints are set separately for each pump within each pump control, and for each non-pump control function:

Function		Parameter
2.7.2. Modifiers (for *2.7. Pumps*)	*2.7.2.3. Pump Run-On*	*2.7.2.3.2. Run-On Interval* *2.7.2.3.3. Run-On Duration Pump 1* *2.7.2.3.4. Run-On Duration Pump 2*
	2.7.2.4. Pump Start Delays	*2.7.2.4.1. Delay Between Starts* *2.7.2.4.2. Power Resumption Delay*
2.11. Other Control	*2.11.1. Elapsed Time Relay*	*2.11.1.2. Interval* *2.11.1.3. Relay Duration*
	2.11.2. Time of Day Relay	*2.11.2.2. Activation Time* *2.11.2.3. Relay Duration*
	2.11.3. External Totalizer	*2.11.3.3. Relay Duration*
	2.11.4. External Sampler	*2.11.4.3. Interval* *2.11.4.4. Relay Duration*

Relays controlled by HART Communications

A relay can be controlled directly by a remote system through communications. HART commands can be used for this purpose. An expert knowledge of HART, and the use of HART commands is recommended. For further details on configuring relays controlled by HART, contact your Siemens representative.

Discrete Inputs

SITRANS LUT400 has two discrete inputs to trigger or alter the way SITRANS LUT400 controls devices. A Backup Level Override, Pump Interlock, or a Switch (DI) Alarm can be configured using discrete inputs, and discrete input logic can be reversed if necessary for the application.

Backup Level Override

Backup level override provides the option of overriding the ultrasonic input (signal from a transducer) with another contacting point level device, such as the Pointek CLS200, to determine the level output.

The material reading is fixed at the programmed switch level until the discrete input is released. The LUT400 makes its decisions based on the override value.

Note: A backup level override will prevent a fail-safe condition from occurring.

Backup Level Override functionality is particularly useful in wet-wells and reservoirs that use pumps:

- place a backup level switch high in a vessel to indicate when it is about to overflow
- place a backup level switch low in a vessel, to indicate when it is almost empty.

Basic operation

Configuring Backup Level Override involves three steps (see *2.9.1. Backup Level Override*).

1. Select a level override value. This will be the Level output produced by the instrument when the backup level override condition is present.
2. Select the discrete input that is connected to the point-level device.
3. Enable the Backup Level Override function.

It may also be necessary to invert the logic of the discrete input, which is possible through the LUT400 discrete input logic parameters (see *2.9.2. Discrete Input Logic*).

Backup Level Override parameters

Example:

SITRANS LUT400 is configured for a level measurement. In the same application, Discrete Input 2 is connected to a Hi Level Backup switch at a level value of 4.3 m.

Settings

Parameter	Sample Value
2.9.1.2. Level Override Value	4.3
2.9.1.3. Discrete Input Number	DISCRETE INPUT 2
2.9.1.1. Enable	ENABLED

When the level rises to 4.3 m and the switch is activated, the reading is forced to 4.3 m where it stays until the switch is de-activated.

Level Override conditions

When the discrete input activates, the level output will immediately take on the value chosen in step 1 above. The LUT400 LCD will indicate that the discrete input has been activated.

When a Backup Level Override condition clears (the discrete input is deactivated), the level will return to the value determined from the ultrasonic transducer or, if no echo is available, the device will enter the fail-safe condition.

Affect of Backup Level Override

The level produced by a Backup Level Override condition completely replaces the level that would otherwise be produced by normal echo processing algorithms. This means that the Backup Level will:

- drive all readings that depend on Level (for example: space, distance, and flow)
- drive level alarms
- appear in system logs
- affect pump control
- affect totalizers (OCM and Pumped Volume)

Additional considerations

A Backup Level Override condition will prevent a fail-safe condition from occurring: when a backup level override condition is present, a fail-safe response will never occur. This allows pumps and other controls such as level alarms to be active even during the backup level override condition.

Pump Interlocks

Discrete inputs can be used to supply pump information to the SITRANS LUT400 to set actions that will occur when a pump is determined to be in a failed state.

For an example of how to configure a pump interlock, see *Pump Control Interlocks* on page 87.

Switch (DI) Alarm

An alarm can be set to activate based on the state of a discrete input. See *Switch (DI) Alarm* on page 70 for an example.

Discrete Input Logic

Discrete input logic affects the reaction of the discrete input. Normal state is standard operation, with the SITRANS LUT400 sensing the material level and controlling the pumps.

The contacts of the signalling device connected to the discrete inputs may be **normally-open** or **normally closed.**

Example:

Normal state for a backup high level switch is **open**, and the contacts on the discrete input are wired as **normally open**.

This logic can also be reversed (NORMALLY OPEN to NORMALLY CLOSED or vice versa).

Use the Discrete Input logic parameters to set the state of each discrete input.

Function		Parameter
2.9. Discrete Inputs	*2.9.2. Discrete Input Logic*	*2.9.2.1. Discrete Input 1 Logic*
		2.9.2.3. Discrete Input 2 Logic

Read the current state of discrete input 1 in *2.9.2.2. Discrete Input 1 Scaled State* and the current state of discrete input 2 in *2.9.2.4. Discrete Input 2 Scaled State*.

See *Discrete inputs* on page 28 for complete details on wiring the discrete inputs. To override a level using a discrete input, see *2.9.1. Backup Level Override* on page 171.

mA Control

mA output

The SITRANS LUT400 has one mA output, used for communications with other devices.

Example:

Configuring the mA output to send a 4 to 20 mA signal corresponding to a scaled value of 10% to 90% of maximum process level on a 60 m transducer:

Parameter	Sample Value	Description
2.5.1. Current Output Function or *2.5.2. Current Output Function*	LEVEL	send mA proportional to level reading
2.5.3. 4 mA Setpoint	6	set 4 mA at process level equal to 10% of maximum (Low Cal minus High Cal)[a]
2.5.4. 20 mA Setpoint	54	set 20 mA at process level equal to 90% of maximum (Low Cal minus High Cal)[b]
2.5.5. Minimum mA Limit	3.5	set minimum mA level below 4 mA
2.5.6. Maximum mA Limit	22.8	set maximum mA level above 20 mA

a. If the level reading drops below 6 m, the mA output drops below 4 mA.

b. If the level reading rises above 54 m, the mA output rises above 20 mA.

Note: If default values (4 and 20 mA) are used for the minimum and maximum mA limits, the mA output (shown in *2.5.8. Current Output Value*) will remain at the set mA limit, even if the level reading falls below/rises above the mA setpoints.

Verifying the mA range

Checks that the external device can track the entire 4 to 20 mA range sent by the SITRANS LUT400. Follow the steps below if actual mA readings differ between the LUT400 (shown in *2.5.8. Current Output Value*) and an external device (such as a PLC).

1. To test the loop current, set *2.5.1. Current Output Function* to **Manual**, then set the value to use in *2.5.7. Manual Value*.
2. Check that the external device displays the same mA reading as the mA value set above.
3. If external device reading differs from the set manual value on the LUT400, adjust the reading on the external device to match the reading on the LUT400.

Volume

Volume is used in two situations:

1. Calculate and display volume instead of level.
2. Calculate pumped volume to accomplish the following:
    - Totalize the volume of material that is pumped out of the wet well

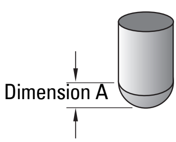
Readings

When using volume, readings are given in units specified in *2.6.2. Volume Units*.

Vessel Shape and Dimensions

There are many common vessel shapes to select from. (See *2.6.1. Vessel Shape*. If possible, use one of these.) Each vessel shape uses the *2.2.1. Low Calibration Point* in its calculations of volume.

Some vessel shapes also require extra dimensions to calculate the volume. Do not estimate these values. They must be correct to ensure the accuracy of your volume calculations.



Example:

To configure volume for a vessel with a half-sphere bottom, set the following:

Parameter	Sample Value	Description
2.6.1. Vessel Shape	HALF SPHERE BOTTOM	selects the correct vessel shape
2.6.3. Maximum Volume	100	sets maximum volume at 100 (defined in *2.6.2. Volume Units*)
2.6.4. Dimension A	1.3	sets dimension A to 1.3 m

Notes:
- The default reading changes to a range from 0 to 100
- The process empty value is still measured to the bottom of the vessel (*2.2.1. Low Calibration Point* plus any *2.2.5. Far Range* value), not the top of **Dimension A**.

Characterization chart

If you cannot use a pre-defined vessel, then use one of the universal vessel shapes and program the characterization curve.

1. Plot a volume to height chart. Usually a vessel supplier will provide this chart. However, if you have a custom-built vessel, then you will need access to complete drawings of the well or accurate measurements.

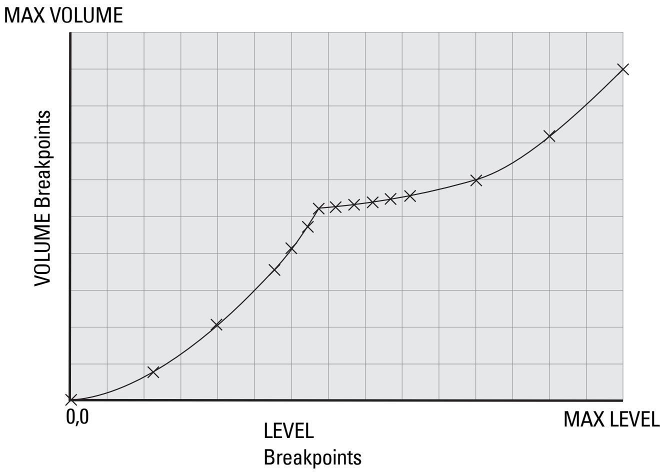
2. Enter the curve values from this chart into level and volume breakpoint tables (see *2.6.7. Table 1-8*).

> **Note:** If breakpoints are entered via LUI, then an upload is performed via PDM, a second upload via PDM may be necessary to transfer the breakpoint values.

3. Ensure extra points are added around sharp transitions in the vessel volume (e.g: steps in a well wall).

> **Note:** The end points in the curve are 0,0 (fixed) and the point defined by Maximum Level and Maximum Volume.

Example chart (with 15 of possible 32 Level and Volume breakpoints defined):

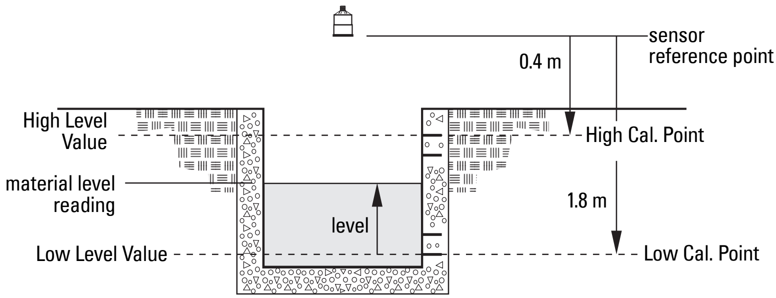


Parameter	Value	Description
2.6.7.1. Level 1	0.0	Determines the Level breakpoints at which the volumes are known.
Level 2	0.8	
Level 3	2.0	
Level 4	3.5	
Level 5	4.1	
Level 6	4.7	
Level 7	5.1	
Level 8	5.2	
Level 9	5.3	
Level 10	5.4	
Level 11	5.5	
Level 12	5.6	
Level 13	6.0	
Level 14	7.2	
Level 15	9.0	

Parameter	Value	Description
2.6.7.2. Volume 1	0.0	Determines the volumes which correspond to the level breakpoints. The universal calculations interpret between the breakpoints to produce an accurate model of the volume at all level readings. Settings *2.6.1. Vessel Shape* = LINEAR TABLE for linear approximation *2.6.1. Vessel Shape* = CURVE TABLE for curved approximation Linear approximation uses a linear algorithm; curved approximation uses a cubic spline algorithm.
Volume 2	2.1	
Volume 3	4.0	
Volume 4	5.6	
Volume 5	5.9	
Volume 6	6.3	
Volume 7	6.7	
Volume 8	7.1	
Volume 9	7.8	
Volume 10	8.2	
Volume 11	8.8	
Volume 12	9.2	
Volume 13	10.9	
Volume 14	13.0	
Volume 15	15.0	

Alarms

Set the common parameters



Prerequisite: You must know the details of your application and substitute the values for the sample values provided. If you are bench testing the device, then set your test values to be the same as the sample values.

Parameter	Sample Value
2.1.2. Sensor Mode (for Level) or *2.1.3. Sensor Mode* (for Flow)	LEVEL FLOW
Response Rate	MEDIUM
2.1.6. Transducer	XPS-10
2.1.1. Units (for Level Alarms) *2.15.3.7. Flowrate Units* (for Flowrate Alarms)	M L/S
2.2.1. Low Calibration Point	1.8
2.2.2. High Calibration Point	0.4

Note: When configuring alarms, more than one alarm can be assigned to the same relay.

Level

The level alarm is the most common. Use this alarm to warn you when your process is in danger of being upset due to high or low levels.

High level and low level alarms can be set to activate when the material level rises above or falls below a set level. (See *2.8.1. High Level Alarm*, *2.8.2. Low Level Alarm*.)

Example: Setting a High Level Alarm

To assign Relay 3 to a high level alarm that activates when the level rises above 10 m:

1. Enable the High Level Alarm (set *2.8.1.1. Enable* = **Enabled**)
2. Set *2.8.1.2. High Level Value ON* = **10** m

General Operation

3. Set *2.8.1.3. High Level Value OFF* = **9** m
4. Set *2.8.1.4. Assigned Relay* to **Relay 3**

Use the High Level alarm in conjunction with *2.8.12. Time To Spill* feature. See page 170.

Example: Setting a Low Level Alarm

To assign Relay 3 to a low level alarm that activates when the level falls below 2 m:

1. Enable the Low Level Alarm (set *2.8.2.1. Enable* = **Enabled**)
2. Set *2.8.2.2. Low Level Value ON* = **2**
3. Set *2.8.2.3. Low Level Value OFF* = **3**
4. Set *2.8.2.4. Assigned Relay* to **Relay 3**

In-bounds/ Out-of-bounds Range

Use the bounded range alarms to detect when the level is inside or outside of the range.

Example: Setting an In-bounds Level Alarm

To assign Relay 3 to an in-bounds level alarm do the following:

1. Enable the In-bounds Level Alarm (set *2.8.4.1. Enable* = **Enabled**)
2. Set *2.8.4.2. High Level Value* = **1.30** m
3. Set *2.8.4.3. Low Level Value* = **0.30** m
4. Set *2.8.4.4. Assigned Relay* to **Relay 3.**

Results:

- Activates alarm assigned to relay 3 when level is within range 0.3 to 1.3 m
- Resets alarm above 1.3 m or below 0.3 m

Use *2.8.4.5. Alarm State* to view the current state of the In-bounds Level Alarm.

Example: Setting an Out-of-bounds Level Alarm

To assign Relay 3 to an out-of-bounds level alarm do the following:

1. Enable the Out-of-bounds Level Alarm (set *2.8.5.1. Enable* = **Enabled**)
2. Set *2.8.5.2. High Level Value* = **1.30** m
3. Set *2.8.5.3. Low Level Value* = **0.30** m
4. Set *2.8.5.4. Assigned Relay* to **Relay 3.**

Results:

- Activates alarm assigned to relay 3 when level is outside range 0.3 to 1.3 m
- Resets alarm below 1.30 m or above 0.30 m

Use *2.8.5.5. Alarm State* to view the current state of the Out-of-bounds Level Alarm.

Temperature

Activates an alarm when the process temperature reaches a certain value (Low Temperature Value ON for Low Temperature Alarm or High Temperature Value ON for a High Temperature Alarm).

The temperature source can be the temperature sensor built into the transducer or an external TS-3, as set by *Temperature Source*. (Temperature Source is set in the Quick Start Wizard, see page 39.)

Example: Setting a High Temperature Alarm

To assign Relay 3 to a high temperature alarm that activates when the temperature goes above 30 °C do the following:

1. Enable the High Temperature Alarm (set *2.8.7.1. Enable* = **Enabled**)
2. Set *2.8.7.2. High Temperature Value ON* = **30**
3. Set *2.8.7.3. High Temperature Value OFF* = **28**
4. Set *2.8.7.4. Assigned Relay* to **Relay 3.**

The high temperature alarm will not de-activate until the temperature falls to 28 °C.
Use *2.8.7.5. Alarm State* to view the current state of the High Temperature Alarm.

Example: Setting a Low Temperature Alarm

To assign Relay 3 to a low level alarm that activates when the temperature falls below -10 °C do the following:

1. Enable the Low Level Alarm (set *2.8.6.1. Enable* = **Enabled**)
2. Set *2.8.6.2. Low Temperature Value ON* = **-10**
3. Set *2.8.6.3. Low Temperature Value OFF* = **- 8**
4. Set *2.8.6.4. Assigned Relay* to **Relay 3.**

Use *2.8.6.5. Alarm State* to view the current state of the Low Temperature Alarm.

Switch (Discrete Input) Alarm

Activates an alarm when a discrete input is in a pre-defined state.

Example: Setting a Switch Alarm

To assign Relay 3 to a switch alarm that is activated when DI 1 turns ON do the following:

1. Enable the Switch (Discrete Input) Alarm (set *2.8.3.1. Enable* = **Enabled**)
2. Set the *2.8.3.2. Discrete Input Number* = **1**
3. Set *2.8.3.3. Discrete Input State* to **ON**.
4. Set *2.8.3.4. Assigned Relay* to **Relay 3.**

Use *2.8.3.5. Alarm State* to view the current state of the Switch Alarm.

Fail-safe Fault Alarm

Activates an alarm when a fault that has caused a fail-safe condition is present.

Example: Setting a Fail-safe Fault Alarm

To assign a fail-safe fault alarm to Relay 3 do the following:

1. Enable the Fail-safe Fault Alarm (set *2.8.8.1. Enable* = **Enabled**)
2. Set *2.8.8.2. Assigned Relay* to **Relay 3.**

Use *2.8.8.3. Alarm State* to view the current state of the Fail-safe Alarm.

Flowrate

Flowrate alarms are available on LUT440 (OCM) model only. They can activate an alarm if the OCM flowrate is above or below a given setpoint.

Example: Setting a High Flowrate Alarm

To assign Relay 3 to a high flowrate alarm that activates when the flowrate rises above 10 l/s:

1. Enable the High Flowrate Alarm (set *2.8.9.1. Enable* = **Enabled**).
2. Set *2.8.9.2. High Flowrate Value ON* = **10**
3. Set *2.8.9.3. High Flowrate Value OFF* = **8**
4. Set *2.8.9.4. Assigned Relay* to **Relay 3**

Example: Setting a Low Flowrate Alarm

To assign Relay 3 to a low level alarm that activates when the flowrate falls below 2 l/s:

1. Enable the Low Flowrate Alarm (set *2.8.10.1. Enable* = **Enabled**)
2. Set *2.8.10.2. Low Flowrate Value ON* = **2**
3. Set *2.8.10.3. Low Flowrate Value OFF* = **4**
4. Set *2.8.10.4. Assigned Relay* to **Relay 3**

Pump Control

The SITRANS LUT400 has the pump control functionality to solve nearly any water / wastewater application.

To set up pump control for simple applications, see *Pump Control Wizard* in LUT400 Communications manual[1].

General Operation

1. Communications for SITRANS LUT400 (HART) Manual (7ML19985NE01)

Pump Control options

Methods of pump control are dependent on two variables:

Pump start method indicates in what sequence pumps are started; using Fixed, Alternate, or Service Ratio setpoints.

Pump duty indicates whether new pumps start and run with any currently running pumps (most common) or whether new pumps start and shut off currently running pumps; using Assist or Backup duty.

Pump Control algorithms

Algorithms are used to provide six modes of pump control. They can be used to start multiple pumps (assist) or one pump at a time (backup). These six modes can be grouped into three main methods of pump control used by the SITRANS LUT400: Fixed, Alternate, and Service Ratio. The LUT420 (Level) model operates with Alternate pump control only.

Fixed: Starts pumps based on individual setpoints and always starts the same pumps in the same sequence [Fixed Duty Assist (FDA), and Fixed Duty Backup (FDB)].

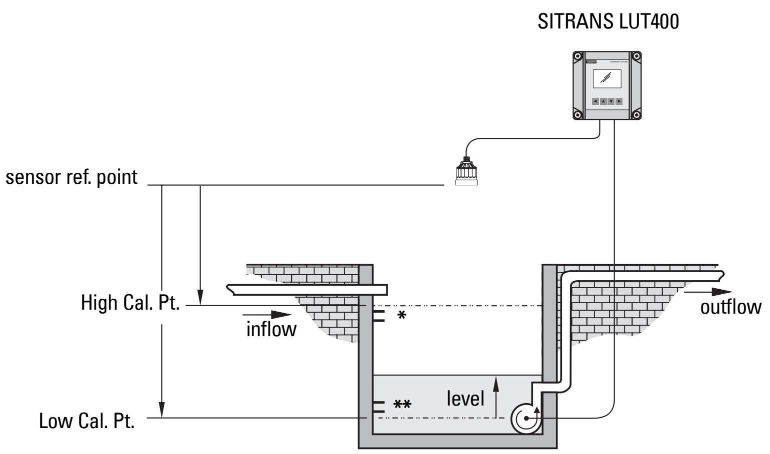
Alternate: Starts pumps based on the duty schedule and always leads with a new pump [Alternate Duty Assist (ADA), and Alternate Duty Backup (ADB)].

Service Ratio: Starts pumps based on user-defined ratio of running time [Service Ratio Duty Assist (SRA), and Service Ratio Duty Backup (SRB)].

Alternate Duty Assist (ADA) is set as the default.

Setting a pump down (wet well) group

Setting a group of two pumps to pump down a wet well.



Setpoint sample values: (see tables below)

* ON Setpoint Pump 1 / Pump 2
** OFF Setpoint Pump 1 / Pump 2

Set the common parameters

Prerequisite: Substitute the details of your application in place of the sample values provided. If you are bench testing the device, set your test values to be the same as the sample values.

Parameter	Sample Value
2.1.2. Sensor Mode	Level
Response Rate	Medium
2.1.6. Transducer	XPS-10
2.1.1. Units	M
2.2.1. Low Calibration Point	1.8
2.2.2. High Calibration Point	0.4

Set Relays to ALTERNATE DUTY ASSIST (ADA)

Parameter	Value	Description
2.7.1.4. Pump Control Mode or *2.7.1.5. Pump Control Mode*	ADA	Sets the control algorithm used to trip the pump relay to **ALTERNATE DUTY ASSIST.** Multiple pumps can run simultaneously.

Set the ON Setpoints

Parameter	Sample Value[a]	Description
2.7.1.6. ON Setpoint Pump 1	1.0 m *	Sets the level at which pump 1 turns on. The first cycle will use this setpoint. Subsequent cycles rotate the setpoint among the pumps. For example: In cycle 1, pump 1 turns on at 1 m. In the next cycle, pump 2 will turn on at 1 m.
2.7.1.8. ON Setpoint Pump 2	1.1 m *	Sets the level at which pump 2 turns on.

a. Sample values denoted by asterisks in illustration on page 80.

Set the OFF Setpoints

Parameter	Sample Value[a]	Description
2.7.1.7. OFF Setpoint Pump 1	0.5 m **	Sets the level at which pump 1 turns off. The first cycle will use this setpoint. Subsequent cycles rotate the setpoint among the pumps. For example: In cycle 1, pump 1 turns off at 0.5 m. In the next cycle, pump 2 will turn off at 0.5 m.
2.7.1.9. OFF Setpoint Pump 2	0.6 m **	Sets the level at which pump 2 turns off.

a. Sample values denoted by asterisks in illustration on page 80.

Other Pump Control algorithms

Set Relays to ALTERNATE DUTY BACKUP (ADB)

Parameter	Value	Description
2.7.1.4. Pump Control Mode or *2.7.1.5. Pump Control Mode*	ADB	Sets the control algorithm used to trip the pump relay to **ALTERNATE DUTY BACKUP.** Only one pump can run at a time.

Set the ON Setpoints

Parameter	Sample Value	Description
2.7.1.6. ON Setpoint Pump 1	1.3 m	Sets the level at which pump 1 turns on. The first cycle will use this setpoint. Subsequent cycles rotate the setpoint among the pumps.
2.7.1.8. ON Setpoint Pump 2	1.2 m	Sets the level at which pump 2 turns on.

Set the OFF Setpoints

Parameter	Sample Value	Description
2.7.1.7. OFF Setpoint Pump 1	0.4 m	Sets the level at which pump 1 turns off. The first cycle will use this setpoint. Subsequent cycles rotate the setpoint among the pumps.
2.7.1.9. OFF Setpoint Pump 2	0.3 m	Sets the level at which pump 2 turns off.

Set Relays to FIXED DUTY ASSIST (FDA)

Parameter	Value	Description
2.7.1.5. Pump Control Mode	FDA	Sets the control algorithm used to trip the pump relay to **FIXED DUTY ASSIST.** Multiple pumps can run simultaneously.

Set the ON Setpoints

Parameter	Sample Value	Description
2.7.1.6. ON Setpoint Pump 1	1.3 m	Sets the level at which pump 1 turns on.
2.7.1.8. ON Setpoint Pump 2	1.2 m	Sets the level at which pump 2 turns on.

Set the OFF Setpoints

Parameter	Sample Value	Description
2.7.1.7. OFF Setpoint Pump 1	0.4 m	Sets the level at which pump 1 turns off.
2.7.1.9. OFF Setpoint Pump 2	0.3 m	Sets the level at which pump 2 turns off.

Set Relays to FIXED DUTY BACKUP (FDB)

Parameter	Value	Description
2.7.1.5. Pump Control Mode	FDB	Sets the control algorithm used to trip the pump relay to FIXED DUTY BACKUP. Only one pump can run at a time.

Set the ON Setpoints

Parameter	Sample Value	Description
2.7.1.6. ON Setpoint Pump 1	1.3 m	Sets the level at which pump 1 turns on.
2.7.1.8. ON Setpoint Pump 2	1.2 m	Sets the level at which pump 2 turns on.

Set the OFF Setpoints

Parameter	Sample Value	Description
2.7.1.7. OFF Setpoint Pump 1	0.4 m	Sets the level at which pump 1 turns off.
2.7.1.9. OFF Setpoint Pump 2	0.3 m	Sets the level at which pump 2 turns off.

Set Relays to SERVICE RATIO DUTY ASSIST (SRA)

Parameter	Value	Description
2.7.1.5. Pump Control Mode	SRA	Sets the control algorithm used to trip the pump relay to SERVICE RATIO DUTY ASSIST. Multiple pumps can run simultaneously. Pump usage is based on RUN time rather than last used.
2.7.1.10. Service Ratio Pump 1	25	Sets the ratio to: 25% for pump 1, i.e. pump 1 will run 25% of the time.
2.7.1.11. Service Ratio Pump 2	75	Sets the ratio to: 75% for pump 2, i.e pump 2 will run 75% of the time

Set the ON Setpoints

Parameter	Sample Value	Description
2.7.1.6. ON Setpoint Pump 1	1.3 m	Sets the level at which the first pump turns on.
2.7.1.8. ON Setpoint Pump 2	1.2 m	Sets the level at which the second pump turns on.

Set the OFF Setpoints

Parameter	Sample Value	Description
2.7.1.7. OFF Setpoint Pump 1	0.4 m	Sets the level at which the first pump turns off.
2.7.1.9. OFF Setpoint Pump 2	0.3 m	Sets the level at which the second pump turns off.

Set Relays to SERVICE RATIO DUTY BACKUP (SRB)

Parameter	Value	Description
2.7.1.5. Pump Control Mode	SRB	Sets the control algorithm used to trip the pump relay to SERVICE RATIO DUTY BACKUP. Only one pump can run at a time. Pump usage is based on RUN time rather than last used.

Set the Service Ratio for each pump

Parameter	Sample Value	Description
2.7.1.10. Service Ratio Pump 1	25	Sets the ratio to: 25% for pump 1, i.e. pump 1 will run 25% of the time.
2.7.1.11. Service Ratio Pump 2	75	Sets the ratio to: 75% for pump 2, i.e pump 2 will run 75% of the time

Set the ON Setpoints

Parameter	Sample Value	Description
2.7.1.6. ON Setpoint Pump 1	1.3 m	Sets the level at which the first pump turns on.
2.7.1.8. ON Setpoint Pump 2	1.2 m	Sets the level at which the second pump turns on.

Set the OFF Setpoints

Parameter	Sample Value	Description
2.7.1.7. OFF Setpoint Pump 1	0.4 m	Sets the level at which the first pump turns off.
2.7.1.9. OFF Setpoint Pump 2	0.3 m	Sets the level at which the second pump turns off.

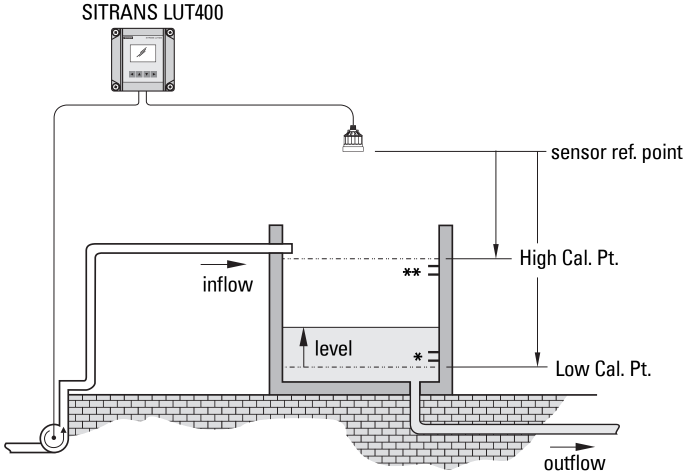
Notes:
- The SITRANS LUT400 will not sacrifice other pumping strategies to ensure that the service ratio is held true
- If the pump ratios are set to the same value, then the ratio equals 1:1 and all pumps are used equally (default)

When a pump start is required (ON Setpoint), the pump with the fewest running hours (with respect to the assigned ratio values) starts.

Conversely, when a pump stop is required (OFF Setpoint), if multiple pumps are running simultaneously, the pump with the most running hours (as compared to the assigned ratio values) stops.

Setting a pump up (reservoir) group

Sets a group of two pumps to pump up a reservoir.



Setpoint sample values: (see tables below)

* ON Setpoint Pump 1 / Pump 2
** OFF Setpoint Pump 1 / Pump 2

Set the common parameters

Prerequisite: Substitute the details of your application in place of the sample values provided. If you are bench testing the device, set your test values to be the same as the sample values.

Parameter	Sample Value
2.1.2. Sensor Mode or *2.1.3. Sensor Mode*	Level
Response Rate	Medium
2.1.6. Transducer	XPS-10
2.1.1. Units	M
2.2.1. Low Calibration Point	1.8
2.2.2. High Calibration Point	0.4

Set Relays to ALTERNATE DUTY ASSIST (ADA)

Parameter	Value	Description
2.7.1.4. Pump Control Mode or *2.7.1.5. Pump Control Mode*	ADA	Sets the control algorithm used to trip the pump relay to **ALTERNATE DUTY ASSIST**.

Set the ON Setpoints

Parameter	Sample Value[a]	Description
2.7.1.6. ON Setpoint Pump 1	0.4 m*	Sets the level at which pump 1 turns on. The first cycle will use this setpoint. Subsequent cycles rotate the setpoint among the pumps. For example: In cycle 1, pump 1 turns on at 0.4 m. In the next cycle, pump 2 will turn on at 0.4 m.
2.7.1.8. ON Setpoint Pump 2	0.3 m*	Sets the level at which pump 2 turns on.

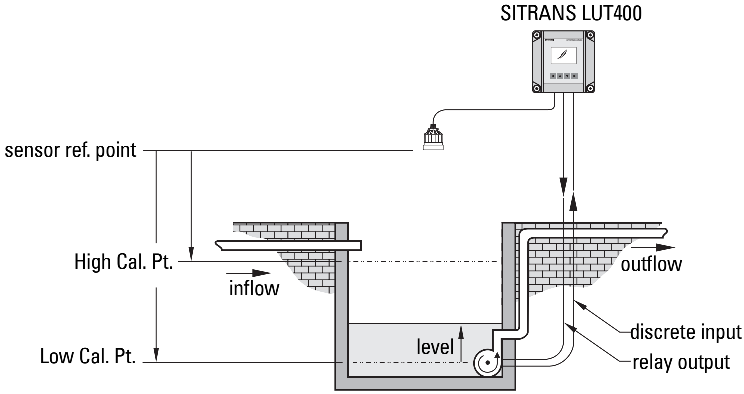
a. Sample values denoted by asterisks in illustration on page 85.

Set the OFF Setpoints

Parameter	Sample Value[a]	Description
2.7.1.7. OFF Setpoint Pump 1	1.3 m**	Sets the level at which pump 1 turns off. The first cycle will use this setpoint. Subsequent cycles rotate the setpoint among the pumps. For example: In cycle 1, pump 1 turns off at 1.3 m. In the next cycle, pump 2 will turn off at 1.3 m.
2.7.1.9. OFF Setpoint Pump 2	1.2 m**	Sets the level at which pump 2 turns off.

a. Sample values denoted by asterisks in illustration on page 85.

Pump Control Interlocks



Parameter	Sample Value	Description
2.7.1.4. Pump Control Mode or *2.7.1.5. Pump Control Mode*	ADA	Sets the control algorithm used to trip the pump relay to **ALTERNATE DUTY ASSIST**.
2.9.3.1. Enable Pump 1	ON	Enables pump start interlock for Pump 1.
2.9.3.2. Pump 1 Discrete Input	Discrete Input 1	Sets the discrete input to use for pump start interlock on Pump 1.
2.9.3.3. Enable Pump 2	ON	Enables pump start interlock for Pump 2.
2.9.3.4. Pump 2 Discrete Input	Discrete Input 2	Sets the discrete input to use for pump start interlock on Pump 2.
2.9.2.1. Discrete Input 1 Logic	Normally Closed	Use if necessary to reverse logic for Discrete Input 1.
2.9.2.3. Discrete Input 2 Logic	Normally Closed	Use if necessary to reverse logic for Discrete Input 2.

These values will ensure that any pump reporting a failure is removed from the pumping rotation. For more information on pump interlocks and discrete inputs, see *Discrete Inputs* on page 69.

Other Pump Controls

Prerequisite: Common parameters must first be set for each pump control below:

Parameter	Sample Value
2.1.2. Sensor Mode or *2.1.3. Sensor Mode*	Volume
Response Rate	Medium
2.1.6. Transducer	XPS-10
2.1.1. Units	M
2.2.1. Low Calibration Point	1.8
2.2.2. High Calibration Point	0.4

General Operation

Totalizing pumped volume

Available only on LUT430 (Pump and Flow model), and LUT440 (OCM model).

Prerequisite: The volume of the vessel must be known.

Parameter	Sample Value	Description
2.6.1. Vessel Shape	LINEAR	Vessel shape is linear (flat bottom)
2.6.3. Maximum Volume	17.6	Max volume is 17.6m^3 or 17,600 liters.
2.7.1.4. Pump Control Mode or *2.7.1.5. Pump Control Mode*	ADA	Sets the control algorithm used to trip the pump relay to **ALTERNATE DUTY ASSIST**.
2.7.1.6. ON Setpoint Pump 1	1.0 m	Sets the level at which pump 1 turns on. The first cycle will use this setpoint. Subsequent cycles rotate the setpoint among the pumps.
2.7.1.8. ON Setpoint Pump 2	1.2 m	Sets the level at which pump 2 turns on.
2.7.1.7. OFF Setpoint Pump 1	0.2 m	Sets the level at which pump 1 turns off. The first cycle will use this setpoint. Subsequent cycles rotate the setpoint among the pumps.
2.7.1.9. OFF Setpoint Pump 2	0.3 m	Sets the level at which pump 2 turns off.
2.7.3.2. Totalizer Decimal Position	2 DIGITS	Sets the totalizer display to 2 digits.
2.7.3.3. Totalizer Multiplier	1000	Actual volume is divided by 1000, prior to display on LCD.
2.7.3.4. Inflow/Discharge Adjust	RATE ESTIMATE	The inflow rate measured just prior to the start of the pump cycle is used to estimate the inflow for the duration of the cycle.

1. Display vessel volume on the LCD (set parameter *2.1.2. Sensor Mode* to **VOLUME**).
2. Toggle to SV on LCD to display current level (set parameter *2.1.4. Sensor Mode Secondary* to **LEVEL**).
3. See *2.7.3.1. Running Totalizer* to view pumped volume.

Setting a pump to run-on

This functionality is used to reduce sludge and sediment from building up at the bottom of a wet well, thereby reducing maintenance. This is achieved by running the pumps below the normal OFF setpoint and requires you to set a run-on duration and interval to control this event.

Example:

Pump 1 is set to pump for an extra 60 seconds every 5 hours, pump 2 should not run-on.

Parameter	Sample Value	Description
2.7.2.3.2. Run-On Interval	5	Five hours between pump run-on occurrences.
2.7.2.3.3. Run-On Duration Pump 1	60	The pump will run-on for 60 seconds.
2.7.2.3.4. Run-On Duration Pump 2	0	Pump 2 will never run-on.

Setting the pump start delays

In the event that power to the SITRANS LUT400 has been lost, the pump start delay ensures that all of the pumps do not start at once to avoid power surges. There are two parameters used here: Pump Start Delay and Power Resumption Delay.

Example:

The delay between pumps is set to 20 seconds and the delay of the first pump is set to 30 seconds.

Parameter	Sample Value	Description
2.7.2.4.1. Delay Between Starts	20	Wait at least 20 seconds between pump starts.
2.7.2.4.2. Power Resumption Delay	60	Wait for 60 seconds when power is restored for the first pump to activate.

Reducing wall cling

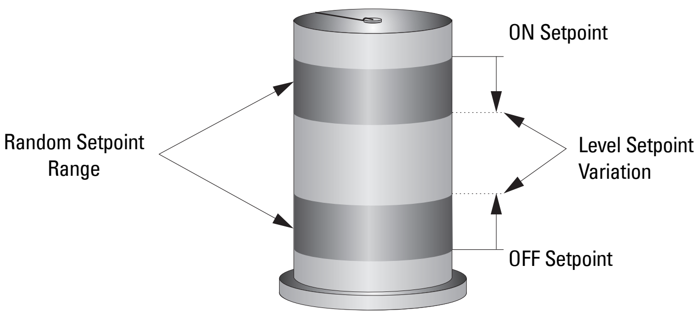
Use the Wall Cling Reduction function to randomly alter the ON and OFF setpoints over a range. This eliminates the ridge of material that builds up at the setpoint that can give false echoes.

This setting may increase the number of days between trips to clean the wet well.

Enable Wall Cling Reduction by setting *2.7.2.1.1. Enable* = **Enabled**. Then set the range in *2.7.2.1.2. Level Setpoint Variation*. The pump ON and OFF setpoints are randomly varied inside this range so the material level does not stop at the same point each time.

Example:

A range of 0.5 meters is used to vary the setpoint. The randomly-selected setpoints are always **inside** the ON and OFF setpoints.



General Operation

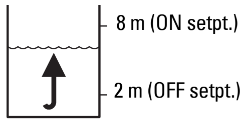
Saving energy

Pumps can use different setpoints at different times of the day to account for variable energy costs.

The following example illustrates high energy cost usage reduction and/or elimination by using the SITRANS LUT400 Energy Savings function on a wet well (pump down application) using pump 1.

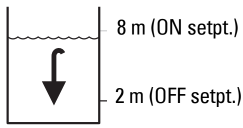
Pre-requisite: enable Energy Savings function (set *2.7.2.2.1. Enable* = **Enabled**)

15:30
(3:30 pm)



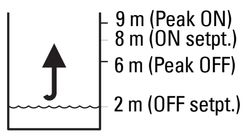
Normal Operation
Uses the standard ON and OFF setpoints (*2.7.1.6. ON Setpoint Pump 1* | *2.7.1.7. OFF Setpoint Pump 1*).
Energy cost is at minimum.

16:30
(4:30 pm)



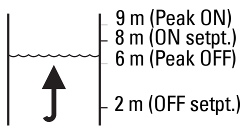
2.7.2.2.2. Peak Lead Time = 60 minutes.
Pumps down the wet well regardless of the pump ON Setpoints. This ensures that the wet well starts the high cost period at the *2.7.1.7. OFF Setpoint Pump 1*. Energy cost is at minimum.

17:30
(5:30 pm)



2.7.2.2.3. Peak 1 Start Time = 17:30.
Starts using the energy savings setpoints (*2.7.2.2.13. Peak ON Setpoint Pump 1* and *2.7.2.2.14. Peak OFF Setpoint Pump 1*).
Energy cost is at maximum.

21:30
(9:30 pm)



2.7.2.2.4. Peak 1 End Time = 21:30.
Returns to normal setpoints (*2.7.1.6. ON Setpoint Pump 1* | *2.7.1.7. OFF Setpoint Pump 1*).
Energy cost returns to minimum.

Generally, you would cascade the timing of the pump downs so that the wells farthest from the treatment facility would begin first and the entire system would push material through during the low cost period.

> **Note:** When the Peak ON Setpoint is not reached, no energy is used during the **high cost** period. If the Peak ON Setpoint is reached, the Wet Well is only pumped down to 6 m, thereby minimizing **high cost** energy usage.

Parameter	Value	Description
2.7.2.2.1. Enable	Enabled	Enables Energy Savings function
2.7.2.2.3. Peak 1 Start Time	17:30	Starts the first high cost period at 5:30 pm
2.7.2.2.4. Peak 1 End Time	21:30	Ends the first high cost period at 9:30 pm
2.7.2.2.2. Peak Lead Time	00:60	Sets the pump down to happen 60 minutes before the high cost period
2.7.2.2.13. Peak ON Setpoint Pump 1	9	Sets the high cost ON setpoint at process level of 9 m
2.7.2.2.14. Peak OFF Setpoint Pump 1	6	Sets the high cost OFF setpoint at process level of 6 m

Tracking pump usage

You can find out how much an individual pump has been used by viewing the pump record parameters.

Information Available	Parameter Access
Total running hours for a relay assigned to a pump.	*3.2.7.1. Run Time Relay 2* *3.2.7.2. Run Time Relay 3*

Other controls

Relays controlled by time

A relay can be controlled by time setpoints using Time of Day or Elapsed Time.

Set Time of Day Relay

Parameter	Value	Description
2.11.2.1. Enable	Enabled	Enables Time of Day Relay
2.11.2.2. Activation Time	17:30	Activates the relay at 5:30 pm
2.11.2.3. Relay Duration	60	Activates the relay for 60 seconds
2.11.2.4. Assigned Relay	Relay 1	Sets relay 1 to be controlled by time of day
2.11.2.5. Relay Logic	Normally Closed	Use (if necessary) to change the behaviour of the relay assigned to the time of day control. Default: Normally Open

Set Elapsed Time Relay

Parameter	Value	Description
2.11.1.1. Enable	Enabled	Enables elapsed time relay
2.11.1.2. Interval	24	Activates the relay every 24 hours
2.11.1.3. Relay Duration	60	Activates the relay for 60 seconds
2.11.1.4. Assigned Relay	Relay 1	Sets relay 1 to be controlled by elapsed time
2.11.1.5. Relay Logic	Normally Closed	Use (if necessary) to change the behaviour of the relay assigned to the elapsed time control. Default: Normally Open

Flow

Flow calculation

The SITRANS LUT400 provides numerous open channel flow calculation features (see *2.15. Flow*).

The device can be configured to select the flow calculation specific to the primary measuring device (PMD), such as a flume or weir. If the PMD does not match any of the eleven preset PMD calculations, a universal flow calculation can be used (PMD = Universal Head Flow). See *Flow Calculation* on page 265 for more details.

The SITRANS LUT400 converts the head measurement into flow rate. The flow rate is totalized and stored in a comprehensive data log to facilitate detailed flow analysis.

Totalizing flow

Totalizing of the calculated flow is ongoing. Daily and running totalizers can be viewed in *2.16. Totalizers*. The daily totalizer resets automatically every 24 hours at 23:59:59, and both can be reset by the user.

In order to adjust the rate of filling of the totalizer, the *2.7.3.3. Totalizer Multiplier* can be set to an appropriate value. Totalizing that is specific to a time and date can be viewed under View Logs for flow (see *3.2.6.2. OCM* on page 201).

The SITRANS LUT400 can be programmed to operate a remote totalizer by assigning any of the relays to act as a totalizer contact. Under this function, the maximum rate of contact closure is 5/s with a closure duration of 100 ms.[1]

External Totalizers and Flow Samplers

External totalizers are simple counters which count the number of relay clicks produced by the SITRANS LUT400. This is generally used to keep track of OCM or pumped volume totals. Note that both of these values are also stored in the SITRANS LUT400 and are available through communications.

Flow samplers are devices which take a sample of liquid when triggered by a relay click. These samples are used to monitor water quality over time. Flow samplers can be driven by OCM volume, pumped volume, or by time depending on the application requirements.

1. Typically the totalizer should be set for 300 to 3000 counts per day at maximum flow.

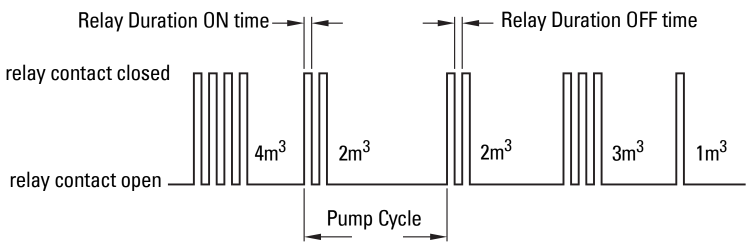
Relay contacts

Pumped volume is calculated at the end of the pump cycle. Totalized volume when *External Totalizer* function is enabled will be given in bursts at the end of the pump cycle, not throughout the pump cycle.

Use *2.11.3.3. Relay Duration* to set the time in seconds from one change of state in the relay to the next. This parameter sets both the open and closed times for the relay contact and is preset to 0.2 seconds. Partial units are added to the next pump cycle.

Example:

Shows a relay set up to make one contact for every cubic metre (m^3) of liquid.



The following parameters describe how to setup a Totalizer or Sampler.

Totalizer

Use the *2.11.3. External Totalizer* function to set the totalizer to provide relay contact to an external counter.

Counter Formula	
1 contact every x units, where *x* = value set in *2.11.3.2. Multiplier* Example: To click once every 4310 units, set *2.11.3.2. Multiplier* to 4310.	*2.11.3.2. Multiplier* is preset to **1** so the default number of contacts is one contact per unit of volume.

The totalizer source, and units depend on the volume configuration:

Volume Configuration	Totalizer Source	Units Source
2.6.1. Vessel Shape = NONE	*2.16. Totalizers* (OCM flow totalizer)	*2.15.3.7. Flowrate Units*
2.6.1. Vessel Shape = any setting other than NONE	*2.7.3. Totalizers* (pumped volume totalizer)	*2.6.2. Volume Units*

Parameter	Sample Value	Description
2.11.3.1. Enable	Enabled	Enables External Totalizer Relay
2.11.3.2. Multiplier	4310	Click once every 4310 units
2.11.3.3. Relay Duration	0.2	Activates the relay for 0.2 seconds
2.11.3.4. Assigned Relay	Relay 1	Sets relay 1 to be controlled by external totalizer
2.11.3.5. Relay Logic	Normally Closed	Use (if necessary) to change the behaviour of the relay assigned to the totalizer. Default: Normally Open

Flow Sampler

Use the *2.11.4. External Sampler* function to activate the flow sampler relay based on volume and time.

Counter Formula	
1 contact every x units, where *x* = value set in *2.11.4.2. Multiplier* Example: To click once every 4310 units, set *2.11.4.2. Multiplier* to 4310.	*2.11.4.2. Multiplier* is preset to **1** so the default number of contacts for a pumped volume cycle is one contact per unit of volume.

The totalizer source, and units depend on the volume configuration:

Volume Configuration	Totalizer Source	Units Source
2.6.1. Vessel Shape = NONE	*2.16. Totalizers* (OCM flow totalizer)	*2.15.3.7. Flowrate Units*
2.6.1. Vessel Shape = any setting other than NONE	*2.7.3. Totalizers* (pumped volume totalizer)	*2.6.2. Volume Units*

By using *2.11.4.2. Multiplier*, the relay contacts can be based on a volume other than a multiple of ten.

Parameter	Sample Value	Description
2.11.4.1. Enable	Enabled	Enables Flow Sampler Relay
2.11.4.2. Multiplier	4310	Click once every 4310 units
2.11.4.3. Interval	2	Sets the INTERVAL (in hours) of the relay contact, usually long.
2.11.4.4. Relay Duration	0.2	Sets the DURATION (in seconds) of the relay contact, usually short.
2.11.4.5. Assigned Relay	Relay 1	Sets relay 1 to be controlled by flow sampler
2.11.4.6. Relay Logic	Normally Closed	Use (if necessary) to change the behaviour of the relay assigned to the sampler. Default: Normally Open

During the periods of low flow, the sampler may be idle for lengths of time. Program *2.11.4.3. Interval* time in hours to drive the sampler. The sampler will operate based on the volume of flow or the time interval, whichever comes first.

Open Channel Monitoring (OCM)

An OCM installation is defined one of three ways, based on the Primary Measuring Device (PMD):

1. Dimensional

For some common weir and flume types. PMD dimensions (*2.15.4. PMD Dimensions*) are entered directly.

Vessel Type	See page:
BS- 3680 Rectangular Flume	105
BS- 3680 Round Nose Horizontal Crest Weir	106
BS- 3680 Trapezoidal Flume	107
BS- 3680 U-Flume	108
BS- 3680 Finite Crest Weir	109
BS- 3680 Thin Plate Rectangular Weir	110
BS- 3680 Thin Plate V-Notch Weir	111
Rectangular Weir Contracted	112
Round Pipe	113
Palmer Bowlus Flume	114
H-Flume	115

2. Exponential

For most other weir and flume types. PMD exponents provided by the manufacturer are entered. Flow is calculated using the exponent (*2.15.3.2. Flow Exponent*) and the maximum values (*2.15.3.3. Maximum Head* and *2.15.3.4. Maximum Flow at 20 mA*).

Vessel Type	See page:
Standard Weirs	116
Parshall Flume	101
Leopold Lagco Flume	102
Cut Throat Flume	103

3. Universal

For all other PMDs, the head-to-flow curve can be plotted based on known breakpoints, usually supplied by the PMD manufacturer.

Vessel Type	See page:
Typical flow characterization	116
Example flumes	117
Example weirs	118

Method of Flow Calculation

When using the SITRANS LUT400 in a flow application, the **Method of Flow Calculation (2.15.3.1.)** must be selected. There are two possible methods for calculating flow with the SITRANS LUT400: absolute or ratiometric, and different information must be entered for the device to carry out the calculation. For more details, and an example, see *Method of Flow Calculation* on page 266.

Common parameters

These common parameters are required for all installations.

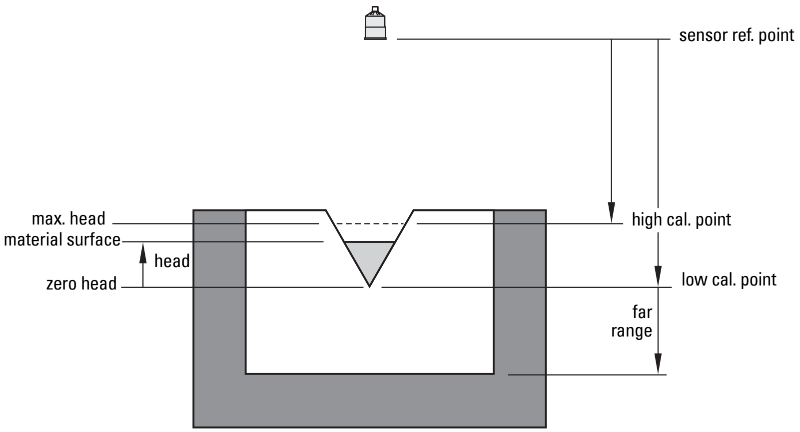
Parameter	Sample Value
	Flow
Response Rate	MEDIUM
2.1.6. Transducer	XRS-5
2.1.1. Units	M
2.2.1. Low Calibration Point	1.8
2.2.2. High Calibration Point	0.4
2.2.5. Far Range	0.8

Setting Zero Head

Many PMDs start flowing higher than the traditional empty distance of the application. You can account for the flow in one of two ways:

1. Use *2.15.3.5. Zero Head Offset* to have OCM calculations ignore levels below that value. Possible head = *2.2.1. Low Calibration Point* minus *2.2.2. High Calibration Point*.

Note: *2.15.3.3. Maximum Head* is preset to *2.2.1. Low Calibration Point* minus *2.2.2. High Calibration Point* and is not updated when *2.15.3.5. Zero Head Offset* is used. Make sure you set *2.15.3.3. Maximum Head* to the correct value when using *2.15.3.5. Zero Head Offset*. (Refer to PMD supplier documentation for Maximum Head.).



2. Use *2.2.5. Far Range* where the empty level is set to the bottom of the weir, and above the bottom of the channel. It should be used if the surface monitored can fall past the *2.2.1. Low Calibration Point* level in normal operation without reporting an LOE. The value is added to *2.2.1. Low Calibration Point* and can be greater than the range of the transducer.

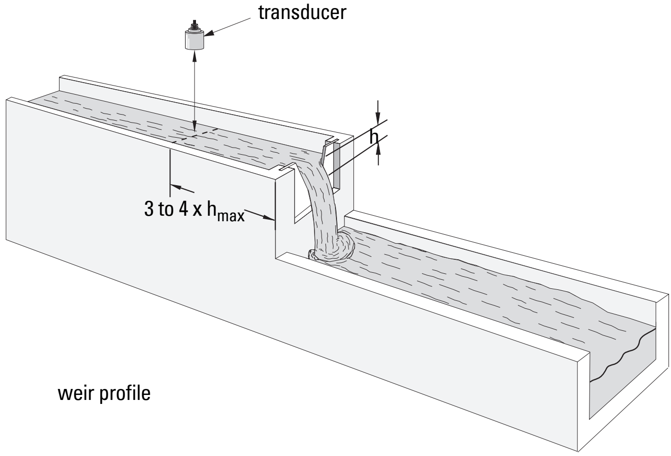
The examples on the following pages show both methods.

General Operation

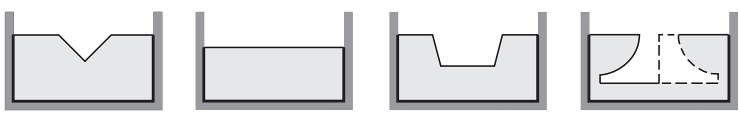
PMDs with Exponential Flow to Head function

For Primary Measuring Devices (PMDs) that measure flow by an exponential equation, use these parameters. Ensure that you use the correct exponent for your PMD; the values below are samples only.

Standard Weirs



Applicable weir profiles



V-notch or triangular | **suppressed rectangular** | **cipolletti or trapezoidal** | **sutro or proportional**

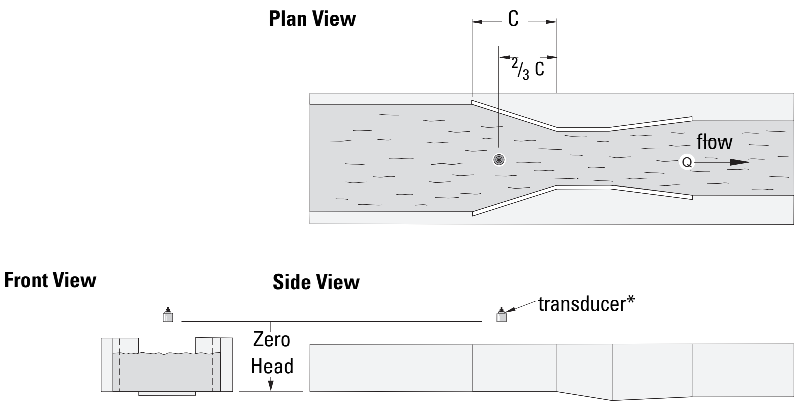
Parameter	Value	
2.15.1. Primary Measuring Device (PMD)	Exponential Devices	
2.15.3.2. Flow Exponent	**Weir Type**	**Value[a]**
	V-notch	2.50
	Suppressed rectangular	1.50
	Cipolletti or trapezoidal	1.50
	Sutro or proportional	1.00
2.15.3.3. Maximum Head		
2.15.3.4. Maximum Flow at 20 mA		
2.15.3.7. Flowrate Units		
2.2.5. Far Range		
2.15.4.1. K Factor[b]		

a. Values are samples only. Consult weir manufacturer's documentation for correct flow exponent.

b. Required for exponential device absolute calculation only.

Parshall Flume

> **Note**: C = Converging Dimension.



* The transducer must be above the maximum head by at least the blanking value (see *2.2.4. Near Range*).

Application information

- Sized by throat width
- Set on solid foundation
- For rated flows under free flow conditions, the head is measured at $^2/_3$ the length of the converging section from the beginning of the throat section

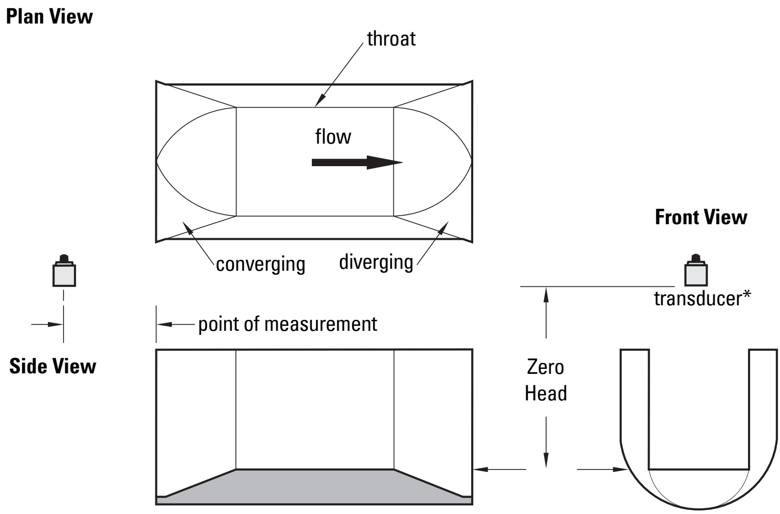
Parameter	Value
2.15.1. Primary Measuring Device (PMD)	Exponential Devices
2.15.3.2. Flow Exponent	1.522–1.607[a]
2.15.3.3. Maximum Head	
2.15.3.4. Maximum Flow at 20 mA	
2.15.4.1. K Factor[b]	

a. Typical Flow Exponent range for Parshall Flume; consult your flume documentation.

b. Required for exponential device absolute calculation only.

General Operation

Leopold Lagco Flume



* The transducer must be above the maximum head by at least the blanking value (see *2.2.4. Near Range*).

Parameter	Value
2.15.1. Primary Measuring Device (PMD)	Exponential Devices
2.15.3.2. Flow Exponent	1.547[a]
2.15.3.3. Maximum Head	
2.15.3.4. Maximum Flow at 20 mA	
2.15.3.5. Zero Head Offset	
2.15.3.7. Flowrate Units	
2.15.4.1. K Factor[b]	

a. Typical Flow Exponent for Leopold Lagco Flume; consult your flume documentation.

b. Required for exponential device absolute calculation only.

Application information

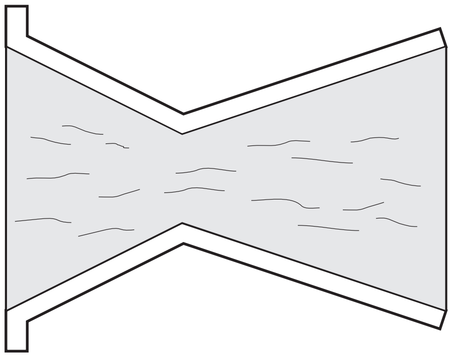
- Designed to be installed directly into pipelines and manholes
- Leopold Lagco may be classed as a rectangular Palmer-Bowlus flume
- Sized by pipe (sewer) diameter
- For rated flows under free flow conditions, the head is measured at a point upstream referenced to the beginning of the converging section. Refer to the following table:

Flume Size (pipe diameter in inches)	Point of Measurement cm	inches
4-12	2.5	1
15	3.2	1.25
18	4.4	1.75
21	5.1	2

Flume Size (pipe diameter in inches)	Point of Measurement cm	inches
24	6.4	2.5
30	7.6	3
42	8.9	3.5
48	10.2	4
54	11.4	4.5
60	12.7	5
66	14.0	5.5
72	15.2	6

Cut Throat Flume

Plan View



Application information

- Similar to Parshall flume except that the floor is flat bottomed and throat has no virtual length.
- Refer to manufacturer's specifications for flow equation and point of head measurement.

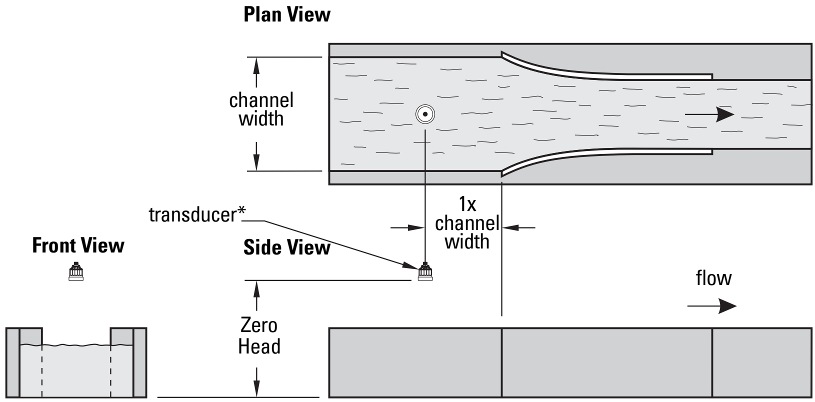
Parameter	Value
2.15.1. Primary Measuring Device (PMD)	Exponential Devices
2.15.3.2. Flow Exponent	1.56 - 2.00[a]
2.15.3.3. Maximum Head	
2.15.3.4. Maximum Flow at 20 mA	
2.15.3.7. Flowrate Units	
2.15.4.1. K Factor[b]	

a. Typical Flow Exponent range for Cut Throat Flume; consult your flume documentation.

b. Required for exponential device absolute calculation only.

General Operation

Khafagi Venturi



* The transducer must be above the maximum head by at least the blanking value (see *2.2.4. Near Range*).

Application information

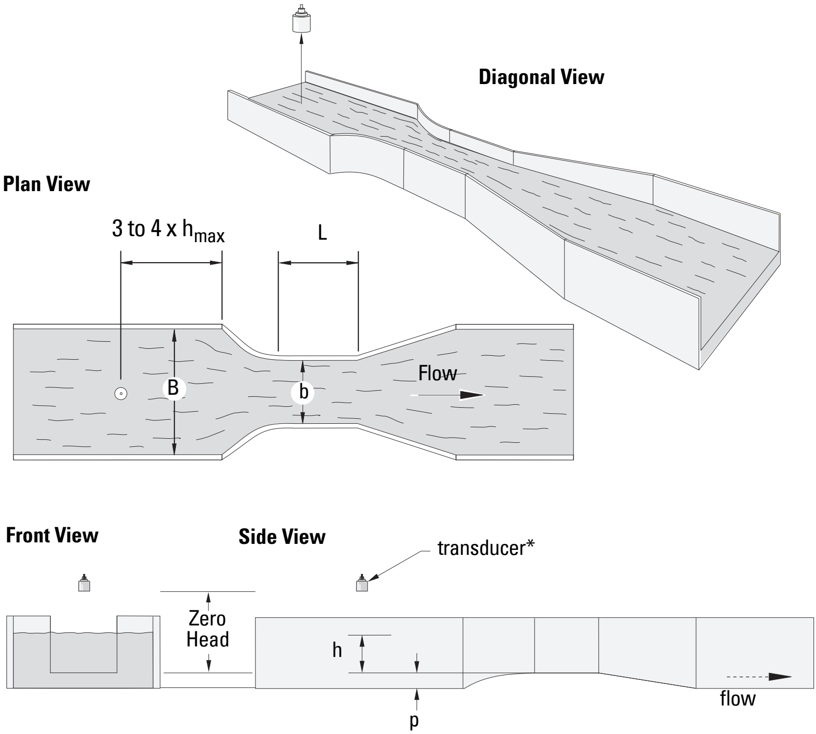
- Similar to Parshall flume except that the floor is flat bottomed and the sidewalls are curved.
- For rated flows under free flow conditions, the head is measured 1 x (channel width) upstream from the beginning of the converging section.

Parameter	Value
2.15.1. Primary Measuring Device (PMD)	Exponential Devices
2.15.3.2. Flow Exponent	1.55 (Consult your flume documentation.)
2.15.3.3. Maximum Head	
2.15.3.4. Maximum Flow at 20 mA	
2.15.3.7. Flowrate Units	
2.15.4.1. K Factor[a]	

a. Required for exponential device absolute calculation only.

Applications supported by SITRANS LUT400

BS- 3680 Rectangular Flume



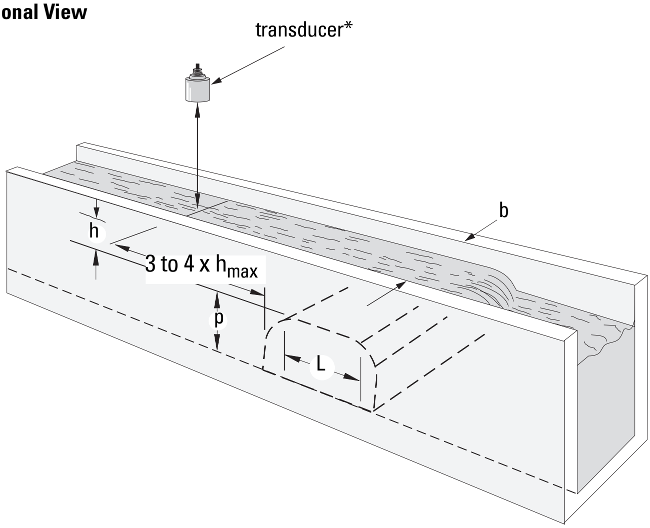
* The transducer must be above the maximum head by at least the blanking value (see *2.2.4. Near Range*).

Parameter	Value
2.15.1. Primary Measuring Device (PMD)	BS-3680 Rectangular Flume
2.15.4. PMD Dimensions	Approach width (B)
	Throat width (b)
	Hump Height (p)
	Throat length (L)
2.15.3.5. Zero Head Offset	
2.15.3.7. Flowrate Units	
2.15.3.1. Method of Flow Calculation	
2.15.3.4. Maximum Flow at 20 mA	

General Operation

BS- 3680 Round Nose Horizontal Crest Weir

Diagonal View

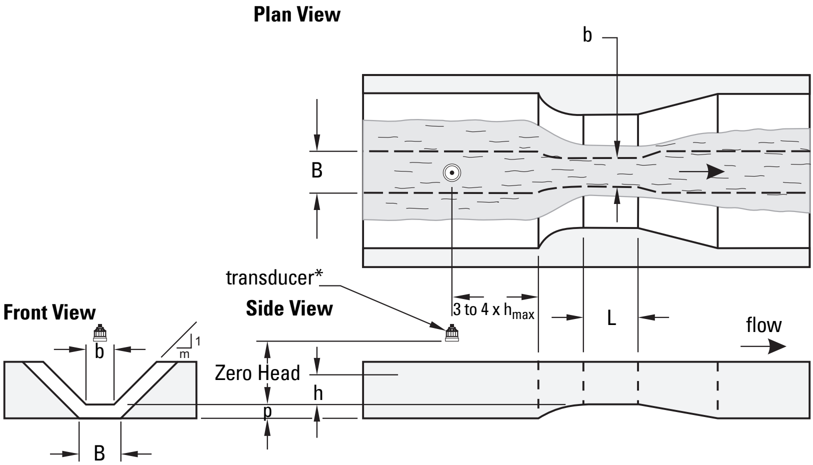


* The transducer must be above the maximum head by at least the blanking value (see *2.2.4. Near Range*).

Parameter	Value
2.15.1. Primary Measuring Device (PMD)	BS-3680 Round Nose Horizontal Crest Weir
2.15.4. PMD Dimensions	Crest Width b
	Crest Height p
	Crest Length L
2.15.3.3. Maximum Head	
2.2.5. Far Range	
2.15.3.7. Flowrate Units	
2.15.3.1. Method of Flow Calculation	
2.15.3.4. Maximum Flow at 20 mA	

General Operation

BS- 3680 Trapezoidal Flume



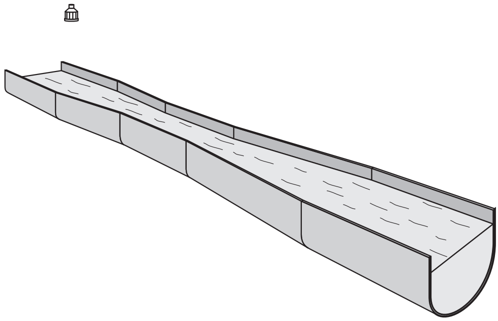
* The transducer must be above the maximum head by at least the blanking value (see *2.2.4. Near Range*).

Parameter	Value
2.15.1. Primary Measuring Device (PMD)	BS-3680 Trapezoidal Flume
2.15.4. PMD Dimensions	Slope m
	Approach Width B
	Throat Width b
	Hump Height p
	Throat length L
2.15.3.3. Maximum Head	
2.2.5. Far Range	
2.15.3.7. Flowrate Units	
2.15.3.1. Method of Flow Calculation	
2.15.3.4. Maximum Flow at 20 mA	

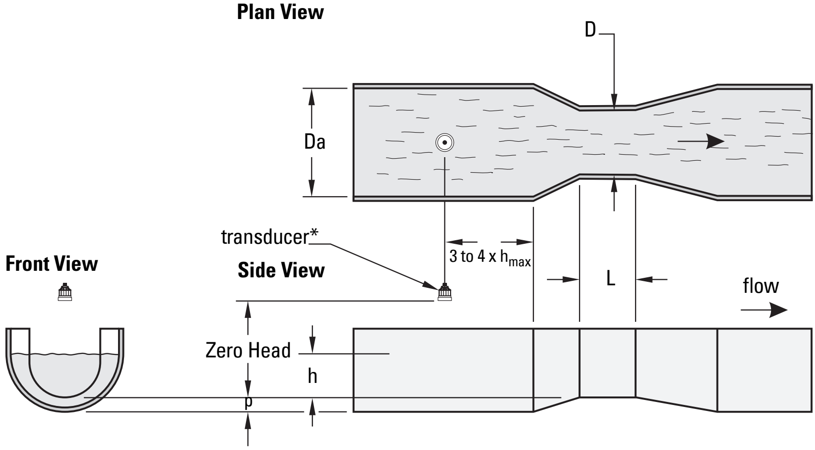
General Operation

BS- 3680 U-Flume

Diagonal View



Plan View

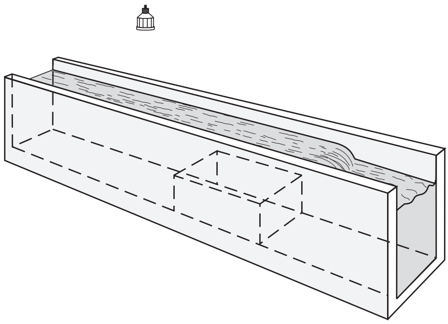


* The transducer must be above the maximum head by at least the blanking value (see *2.2.4. Near Range*).

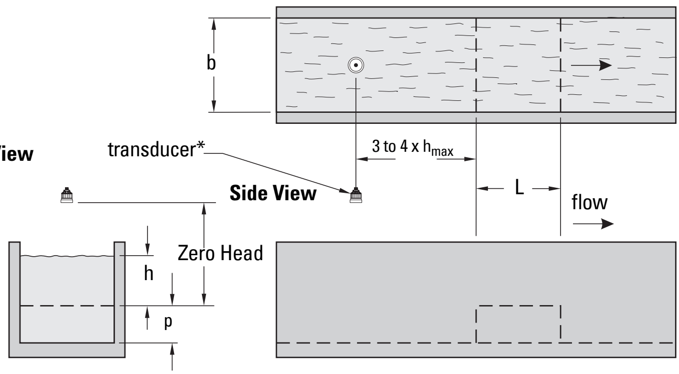
Parameter	Value
2.15.1. Primary Measuring Device (PMD)	BS-3680 U-Flume
2.15.4. PMD Dimensions	Approach Diameter Da
	Throat Diameter D
	Hump Height p
	Throat Length L
2.15.3.3. Maximum Head	
2.2.5. Far Range	
2.15.3.7. Flowrate Units	
2.15.3.1. Method of Flow Calculation	
2.15.3.4. Maximum Flow at 20 mA	

BS- 3680 Finite Crest Weir

Diagonal View



Front View

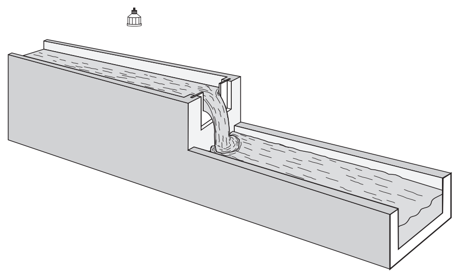


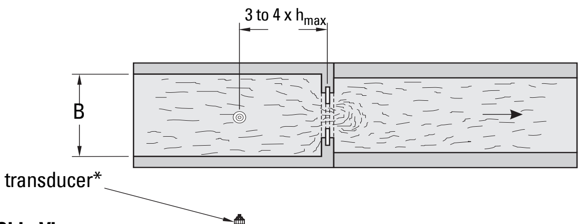
* The transducer must be above the maximum head by at least the blanking value (see *2.2.4. Near Range*).

Parameter	Value
2.15.1. Primary Measuring Device (PMD)	BS-3680 Finite Crest Weir
2.15.4. PMD Dimensions	Crest Width b
	Crest Height p
	Crest Length L
2.15.3.3. Maximum Head	
2.2.5. Far Range	
2.15.3.7. Flowrate Units	
2.15.3.1. Method of Flow Calculation	
2.15.3.4. Maximum Flow at 20 mA	

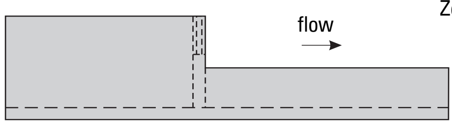
BS- 3680 Thin Plate Rectangular Weir

Diagonal View

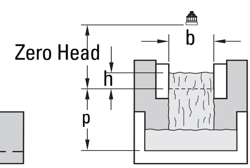




Side View



Front View

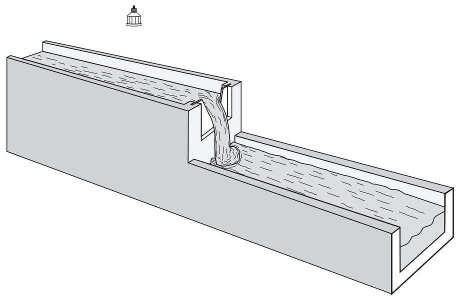


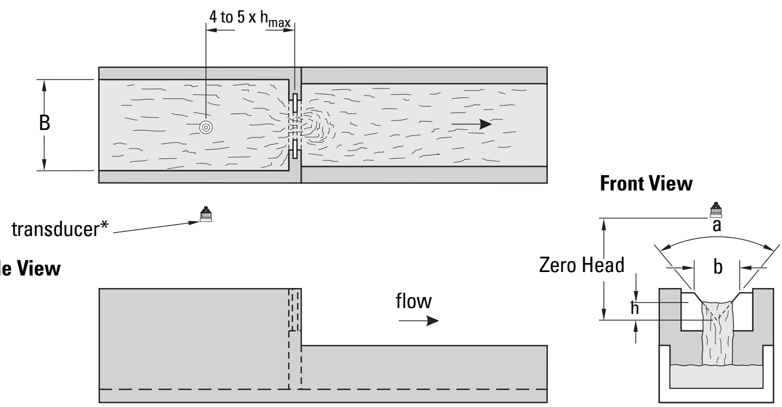
* The transducer must be above the maximum head by at least the blanking value (see *2.2.4. Near Range*).

Parameter	Value
2.15.1. Primary Measuring Device (PMD)	BS-3680 Thin Plate Rectangular Weir
2.15.4. PMD Dimensions	Approach Width B
	Crest Width b
	Crest Height p
2.15.3.3. Maximum Head	
2.2.5. Far Range	
2.15.3.7. Flowrate Units	
2.15.3.1. Method of Flow Calculation	
2.15.3.4. Maximum Flow at 20 mA	

BS- 3680 Thin Plate V-Notch Weir

Diagonal View



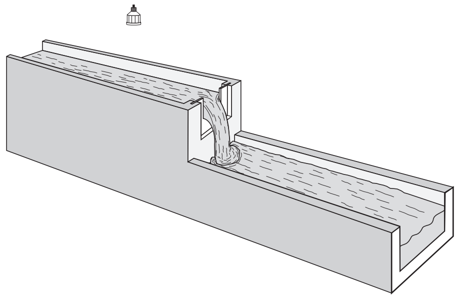


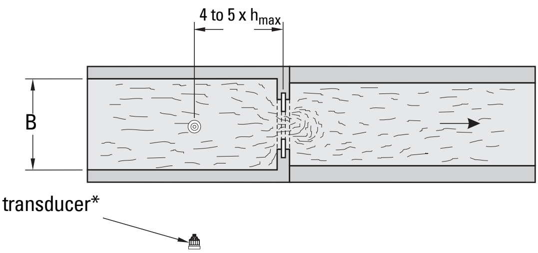
* The transducer must be above the maximum head by at least the blanking value (see *2.2.4. Near Range*).

Parameter	Value
2.15.1. Primary Measuring Device (PMD)	BS-3680 Thin Plate V-Notch Weir
2.15.4. PMD Dimensions	Notch angle (a)
2.15.3.3. Maximum Head	
2.2.5. Far Range	
2.15.3.7. Flowrate Units	
2.15.3.1. Method of Flow Calculation	
2.15.3.4. Maximum Flow at 20 mA	

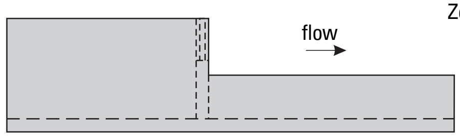
Rectangular Weir Contracted

Diagonal View

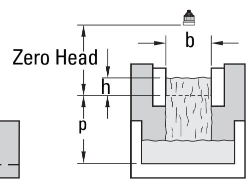




Side View



Front View



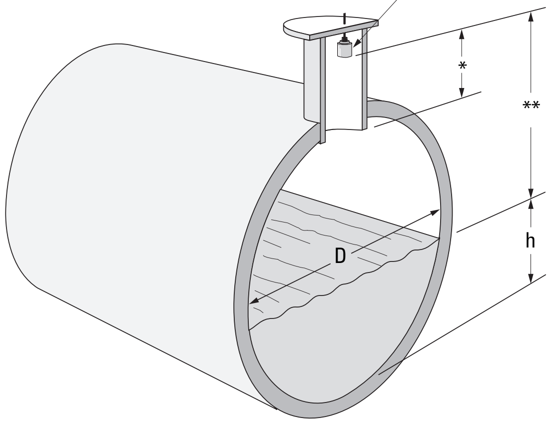
* The transducer must be above the maximum head by at least the blanking value (see *2.2.4. Near Range*).

Parameter	Value
2.15.1. Primary Measuring Device (PMD)	Rectangular Weir Contracted
2.15.4. PMD Dimensions	Crest Width b
2.15.3.3. Maximum Head	
2.2.5. Far Range	
2.15.3.7. Flowrate Units	
2.15.3.1. Method of Flow Calculation	
2.15.3.4. Maximum Flow at 20 mA	

General Operation

Round Pipe

Diagonal View



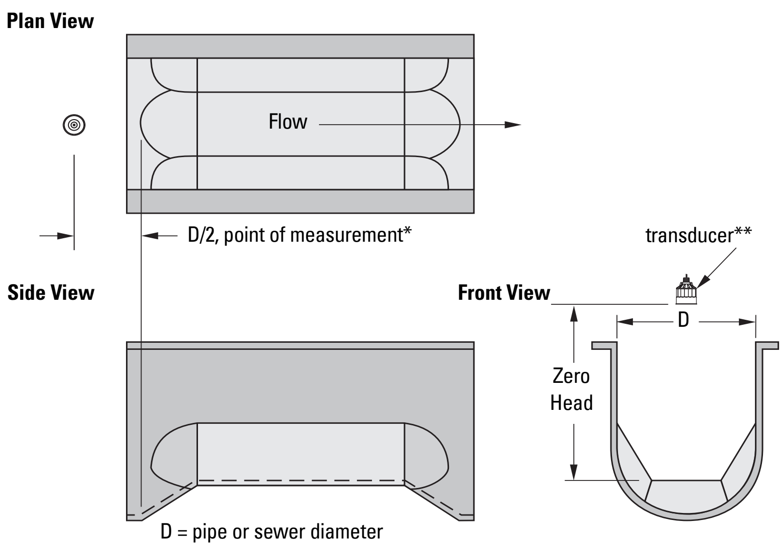
* This dimension should be at least 15 cm (6") shorter than the blanking value (see *2.2.4. Near Range*).

** The transducer must be above the maximum head by at least the blanking value.

Parameter	Value
2.15.1. Primary Measuring Device (PMD)	Round Pipe
2.15.4. PMD Dimensions	Pipe Inside Diameter D
	Slope (fall/run) s
	Roughness Coefficient n
2.15.3.3. Maximum Head	
2.2.5. Far Range	
2.15.3.7. Flowrate Units	
2.15.3.1. Method of Flow Calculation	
2.15.3.4. Maximum Flow at 20 mA	

General Operation

Palmer Bowlus Flume



* for rated flows under free flow conditions

** The transducer must be above the maximum head by at least the blanking value (see *2.2.4. Near Range*).

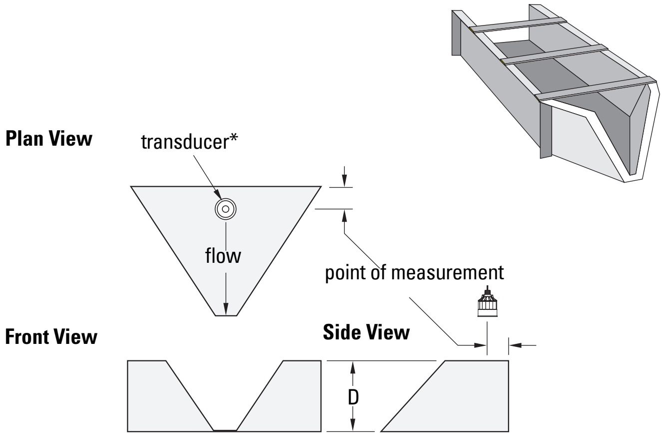
Parameter	Value
2.15.1. Primary Measuring Device (PMD)	Palmer Bowlus Flume
2.15.4. PMD Dimensions	Maximum Flume width h_{max}
2.15.3.3. Maximum Head	
2.15.3.4. Maximum Flow at 20 mA	
2.15.3.5. Zero Head Offset	
2.15.3.7. Flowrate Units	
2.15.3.1. Method of Flow Calculation	Ratiometric

Note: Palmer Bowlus Flume can only be setup using ratiometric calculations

Application information

- Sized by pipe diameter D
- Flume relief is trapezoidal
- Designed to install directly into pipelines and manholes
- Head is referenced to bottom of the throat, not bottom of the pipe
- For rated flows under free flow conditions, the head is measured at a distance of D/2 upstream from the beginning of the converging section

H-Flume



* The transducer must be above the maximum head by at least the blanking value (see *2.2.4. Near Range*).

Parameter	Value
2.15.1. Primary Measuring Device (PMD)	H-Flume
2.15.4. PMD Dimensions	Flume height (D)
2.15.3.3. Maximum Head	
2.15.3.4. Maximum Flow at 20 mA	
2.15.3.7. Flowrate Units	
2.15.3.1. Method of Flow Calculation	Ratiometric

Note: H-Flume can only be setup using ratiometric calculations

- Sized by maximum depth of flume
- Approach is preferably rectangular, matching width and depth for distance 3 to 5 times the depth of the flume
- May be installed in channels under partial submergence (ratio of downstream level to head). Typical errors are:
  - 1% @ 30% submergence
  - 3% @ 50% submergence
- For rated flows under free flow conditions, the head is measured at a point downstream from the flume entrance. Refer to the following table.

Flume Size (Diameter in feet)	Point of Measurement cm	inches
0.5	5	1.75
0.75	7	2.75
1.0	9	3.75
1.5	14	5.5

continued on next page

General Operation

Flume Size (Diameter in feet)	Point of Measurement cm	inches
2.0	18	7.25
2.5	23	9
3.0	28	10.75
4.5	41	16.25

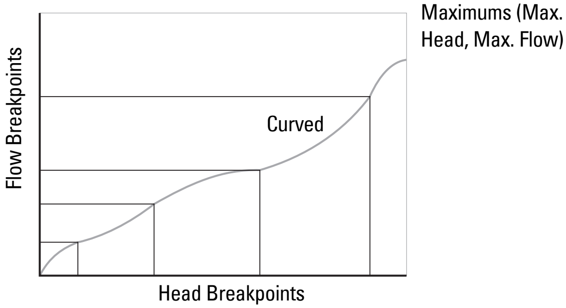
- H-flumes come with a flat or sloping floor. The same flow table can be used because error is less than 1%.

Universal calculation support

When the primary measuring device (PMD) doesn’t fit one of the standard types, it can be programmed using a universal characterization. When Universal is selected as the PMD type [*2.15.1. Primary Measuring Device (PMD)*], then both head and flow breakpoints (*2.15.5. Universal Head vs. Flow*) must be entered to define the flow.

SITRANS LUT400 supports Universal curved (cubic spline) flow calculation shown in the following chart. (The *2.15.3.1. Method of Flow Calculation* for universal support can be Ratiometric or Absolute. Refer to your PMD manufacturer’s documentation.)

Typical flow characterization

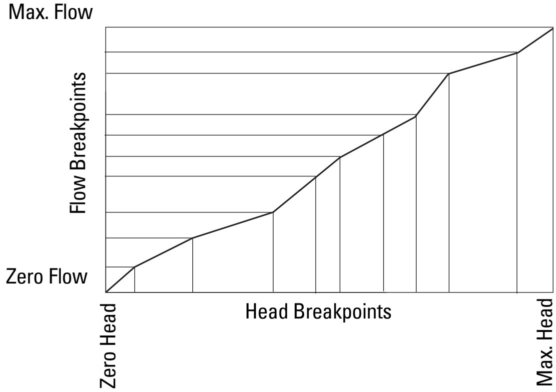


Characterization is achieved by entering the head and corresponding flow breakpoints, either from empirical measurement or from the manufacturer's specification. Increasing the number of defined breakpoints will increase the accuracy of the flow measurement.

Breakpoints should be concentrated in areas exhibiting the higher degrees of non linear flow. A maximum of 32 breakpoints can be defined, with a minimum of four required. The curve’s end point is always specified by the parameters *2.15.3.3. Maximum Head* and *2.15.3.4. Maximum Flow at 20 mA*. These two parameter values are in addition to the 32 breakpoints available for definition.

Use as many breakpoints as required by the complexity of your PMD.

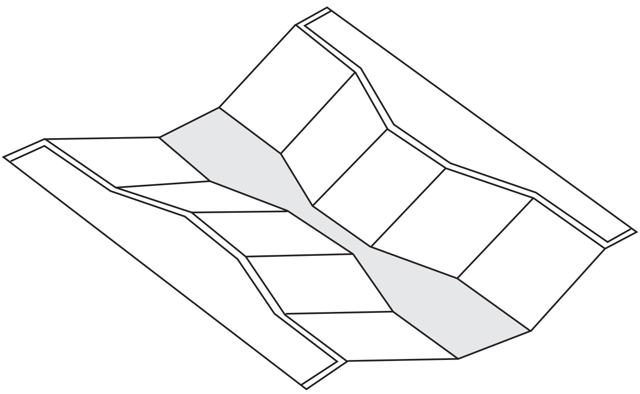
See *Volume* on page 73 for more information and parameter *2.15.5. Universal Head vs. Flow* for characterization.



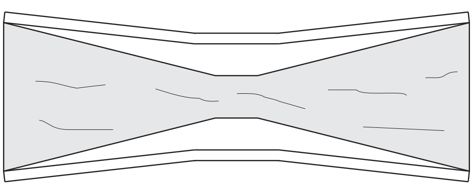
Example flumes

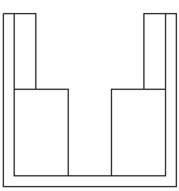
These example flumes would both require a universal calculation.

Trapezoidal



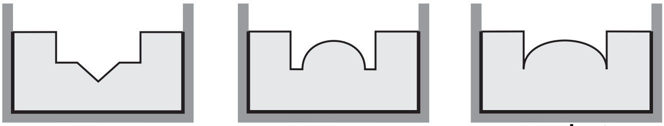
Dual Range (nested) Parshall





Example weirs

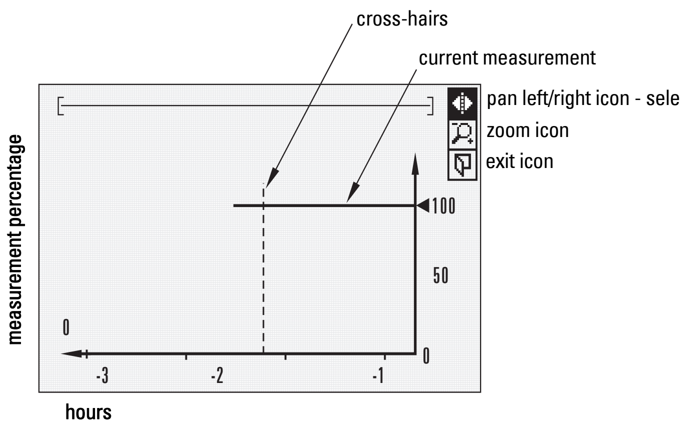
These weirs could require universal calculation.



Trends

To view trend lines, navigate to ***3. Maintenance and Diagnostics* > *3.2. Diagnostics* > *3.2.2. Trend***. The PV (in percentage) is logged at five minute intervals and trend displays up to 3000 data points since last power up.

- Press **RIGHT arrow** ▶ to request a trend.



- Use **UP** ▲ or **DOWN arrow** ▼ to scroll to an icon. When an icon is highlighted, that feature becomes active.
- To move the cross-hair, press **RIGHT arrow** ▶ to increase the value, **LEFT arrow** ◀ to decrease.
- To Zoom into an area, position the cross-hairs at the center of that area, select **Zoom** icon, and press **RIGHT arrow** ▶. Press **LEFT arrow** ◀ to Zoom out.
- To return to the previous menu, select **Exit** icon then press **RIGHT arrow** ▶.

Notes:
- When a fail-safe condition has occurred, it will appear as a gap in the Trend line.
- Trend view will *not* timeout. This view will display on LUI until the exit icon is selected.

General Operation

Data logging

The SITRANS LUT400 provides an extensive logging feature which can be viewed on the local display or retrieved via USB port.

Enable data logging for a Process Value, an Alarm, or for Flow (see *2.10. Data Logging* on page 173).

For flow, the logging rate can be fixed or variable. The latter being useful in conserving logging space. The condition for variable logging is determined when selecting the logging rate.

Variable logging rate conditions are categorized as: percent change of flow per minute, percent change of maximum flow or percent change of maximum head. Logging occurs at the normal (slower) rate while the condition is less than the setpoint (*2.10.3.6. Rapid Flow Log Setpoint*). If the condition exceeds the rapid flow log setpoint, the rapid rate of logging takes effect until the condition falls below the standard flow log setpoint (*2.10.3.4. Standard Flow Log Setpoint*).

The setpoints represent the absolute value of the rate of change; that is, for either increasing or decreasing flowrate. The SITRANS LUT400 does not recognize negative entries for standard or rapid flow log setpoints.

Flow data is logged in flowrate units (with full resolution of flow measurement value) from 0 to 110% of maximum flow. Flows above 110% are logged at the 110% value (in flowrate units). Truncation of flows to 110% does not apply to daily totalization.

Viewing the Data Log

To view the data log, navigate to ***3. Maintenance and Diagnostics* > *3.2. Diagnostics* > *3.2.6. View Logs*** and select the desired log; Alarms, OCM, PV, or Daily Totals.

The log can be examined locally via LUI, or via USB. On LUI, viewing of the log is done by task and by method. The viewing tasks are: Alarms, OCM, Daily Totals, or Primary Variable (PV). The viewing methods are: by first entry, by last entry and by specified date. The scrolling keys are used to maneuver through the tasks, methods and time of day.

Log Capacity vs. Rates

Rate	Capacity
1 min.	7 days
5	1 month
15	3.5 months
30	7 months
60	1.2 years
24 hr	27.8 years

e.g. rate = 15 / 5, capacity = 3.5 months max / 1 month min

Log files written to a local computer drive via USB, are comma-delimited files. For a list of field names, see *Data Logging* on page 267.

General Operation

Fault code 129 is displayed on the device when the data log memory becomes full. To clear entries when memory is full:

1. Disable all logging functions that are active (PV log: *2.10.1.1.*, Alarm log: *2.10.2.1.*, Flow log: *2.10.3.1.* or *2.10.3.2.*)
2. Browse to the USB drive on your computer and delete log files (or *move* files from the USB drive to another local computer drive). (If a file is deleted or moved without first disabling the associated logging function, the fault code will not clear.)
3. Re-enable logging functions that were disabled in step 1.

Simulation

The SITRANS LUT400 supports simulation from the LUI. Level and discrete inputs can be simulated, separately or concurrently.

Level simulation

In level simulation, the LCD reacts to the simulated level changes, and activates relays based on the setpoints programmed. The material level can be set to continuously sweep through the measurement range, from Low Calibration Point to High Calibration Point and back again (using *3.4.1.3. Ramp*, *3.4.1.4. Ramp Rate*), or the material level can be held at a specific value (using *3.4.1.2. Level Value*).

Discrete Input simulation

When discrete inputs are simulated, the DI icon on the LCD will show the simulated states of the discrete inputs. Any programming that uses the discrete inputs, such as the backup level override, will use the simulated values.

In simulation mode, some of the LUT400's configured functionality will respond to the simulated value, including:

- **Readings that are based on Level** - The LUT400 supports simulation of Level values only. Other simulated values cannot be entered, however, these values will be calculated correctly when Level is simulated. Space, Distance, Volume, Flow, and Head will be calculated [see Sensor Mode (2.1.2.) on page 138].
- **The milliamp output -** The current loop output will also track the corresponding reading (Level, Space, Distance, Volume, Flow, or Head depending on which of these it is configured to track). [See Current Output Function (2.5.1.) on page 144.]
- **Alarms -** Any alarms that have been configured, including any relays configured for alarms, will activate based on the simulated value. [See Alarms (2.8.) on page 162.]
- **Relays configured for pumps -** If the device is configured for a pump application then the corresponding relay indicators on the LCD will also show when the pumps would activate. By default the relay contacts themselves will not activate in simulation mode, but this behaviour can be changed if desired (see *Pump relay behaviour during simulation* on page 121).
- **Logging -** Log files will reflect the simulated values. This includes logging simulated high-flow/low-flow conditions, and any alarms.

The following functions will not respond to the simulated value when in simulation mode:

- **Fault Conditions -** The LUT400 will never enter the Fail-safe state when in simulation mode. For further details see *Fail-safe and Simulation* on page 122.
- **Backup Level Override -** If a Backup Level Override switch is configured and it lies within the simulated Level range, it will not be simulated. To simulate a Backup Level Override, simulate the discrete input. See *Simulating Discrete Inputs* on page 123.
- **Totalizing of OCM Flow -** Totalizing of flow (OCM applications) does not occur during simulation. The OCM Daily Totalizer (*2.16.1.*) and Running Totalizer (*2.16.2.*) will not increase in value during simulation.
- **Totalizing of Pumped Volume -** Totalizing of pumped volume does not occur during simulation if *3.4.3. Pump Activations* is set to **Disabled**. If pumps are set to run during simulation, the material pumped will be totalized (*2.7.3.1. Running Totalizer*).
- **External Sampler** - The external sampler, if configured, will click at its timeout interval when in simulation mode (see *2.11.4.3. Interval*).

Pump relay behaviour during simulation

The *3.4.3. Pump Activations* parameter allows you to choose how the physical relays that are assigned to pumps will behave when in simulation mode.
This parameter has two possible values:

Disabled: Pump relays are not activated in simulation (default value)

Enabled: Pump relays are activated in simulation

If *3.4.3. Pump Activations* is **Disabled**, only the LCD indicators are affected (the corresponding relay icons will turn ON, but the relays will not energize). If *3.4.3. Pump Activations* is **Enabled**, the relay icons will turn ON, and the relays will energize.

! **WARNING:** Select **Enabled** only when there is no possibility of the pumps being damaged during simulation, or if the pumps have been locally disabled through some other means.

Notes:
- If the pump relays are configured to physically activate in simulation mode, then any time activated will be recorded in the pump Run Time parameter (see *Pump Records* on page 202.).
- If a pump start delay has been programmed for the device (*2.7.2.4.1. Delay Between Starts*), it will be respected in Simulation mode.

General Operation

Fail-safe and Simulation

When simulating Level or Discrete Inputs, the LUT400 will never enter the Fail-safe state. Faults that would normally cause a fail-safe condition (such as a broken cable or LOE) may still occur, but a fail-safe condition will not be reported on the device during simulation.

> **Note**: As fail-safe will not be reported during simulation, a bench simulation of the LUT400 can be run without a transducer connected.

HART status

When using HART communications via software tools such as PDM, AMS, FDT, and FC375/475, the Level value and the readings derived from level will display simulated values (when level or discrete input simulation is enabled on LUI). (See *Process Variables* within PDM, AMS, FDT, and FC375/475.) Device status conditions within each tool will also indicate that the device is in simulation mode (see *Diagnostics*).

Simulation process

Simulation is an iterative process whereby parameters are adjusted and corresponding results are viewed in Measurement Mode. Level and Discrete Inputs can be simulated separately, or concurrently. When either simulation is enabled, the LCD displays *Simulation Enabled* in the text area for status messages (see *Measurement mode display: Normal operation* on page 34).

> **Note:** *Simulation Enabled* status will display on LCD even if other faults are present.

To stop simulation at any time, set the parameter for the function being simulated (*3.4.1.1. Level Simulation Enable*, *3.4.2.1. Discrete Input 1*, *3.4.2.2. Discrete Input 2*) to **Disabled**.

In general, to run a simulation:

1. Select the function to be simulated: Level or Discrete Input (can be simulated concurrently).
2. Set simulation parameters if performing a Level simulation.
3. Decide if pumps will be active during simulation (see *Pump relay behaviour during simulation* on page 121).
4. Start simulation.

Simulating a fixed level

1. Set the desired fixed level value in *3.4.1.2. Level Value*.
2. Set *3.4.1.3. Ramp* to **Disabled**.
3. **Enable** *3.4.3. Pump Activations* if desired (see *Pump relay behaviour during simulation* on page 121).
4. Set *3.4.1.1. Level Simulation Enable* to **Enabled** to start level simulation.

Set *3.4.1.1. Level Simulation Enable* to **Disabled** when you wish to stop level simulation.

Simulating a changing level

1. Set the desired starting level value in *3.4.1.2. Level Value*.
2. Set *3.4.1.3. Ramp* to **Enabled**.
3. Set *3.4.1.4. Ramp Rate* to the desired speed, e.g. **Medium**.
4. **Enable** *3.4.3. Pump Activations* if desired (see *Pump relay behaviour during simulation* on page 121).
5. Set *3.4.1.1. Level Simulation Enable* to **Enabled** to start level simulation.

The simulated level will initially begin ramping up from *Level Value* (increasing level). When the level rises to 100% or falls to 0%, it reverses direction at the same rate.

Set *3.4.1.1. Level Simulation Enable* to **Disabled** when you wish to stop level simulation.

Simulating Discrete Inputs

1. Enable *3.4.3. Pump Activations* if desired (see *Pump relay behaviour during simulation* on page 121).
2. Set the discrete input to be simulated (*3.4.2.1. Discrete Input 1*, *3.4.2.2. Discrete Input 2* or both) to one of the following:
   - **ON**: the discrete input is simulated to be on
   - **OFF**: the discrete input is simulated to be off.

Set parameter(s) for DI to be simulated (*3.4.2.1. Discrete Input 1* and/or *3.4.2.2. Discrete Input 2*) to **Disabled** if you do not wish to simulate a discrete input, or to stop DI simulation that is currently running.

Simulation timeout

Simulation will automatically be disabled and the LUT400 will return to normal measurement and control ten minutes after changing (editing) any simulation parameter (except *Level Value*). When the timeout occurs, parameters used to enable simulation (*Level Simulation Enable* , *Discrete Input 1* , *Discrete Input 2*), as well as *Pump Activations* will switch to **Disabled**, and the message ***Simulation Enabled*** will no longer display on the LCD. (Device status conditions will also reset in PDM, AMS, FDT, and FC375/475.)

Application test

You can test the application by varying the actual material level (the preferred test method), or by simulating level changes.

If you are testing the application via simulation mode, decide if control devices, such as pumps, are to be operational during simulation by setting the *Pump Activations* parameter (see *Pump relay behaviour during simulation* on page 121).

> **!** **WARNING:** Only enable *Pump Activations* when there is no possibility of the pumps being damaged during simulation, or if the pumps have been locally disabled through some other means.

While the level is being cycled, check the results of the discrete inputs either by closing the circuit externally (preferred), or by setting DI simulation parameter to force the input **ON** or **OFF**. Try all possible combinations to thoroughly test the setup. When simulating a changing level, run a complete cycle (from Low Calibration Point to High Calibration Point and back again) to verify that the relays operate as expected.

Monitor system performance carefully, under all anticipated operating conditions.

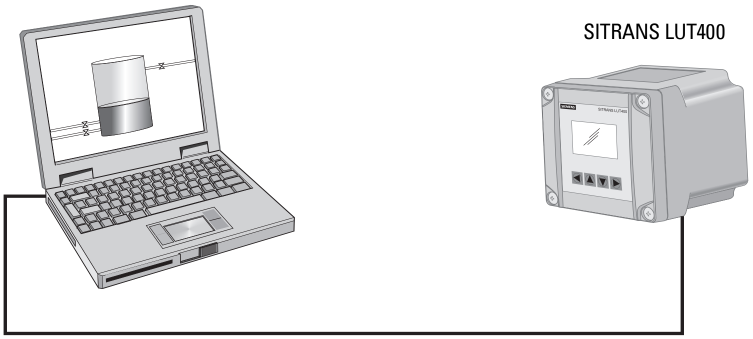
1. When the LUT400 performs exactly as required, programming is complete.
2. If alternate reading units, fail-safe action, or relay operation is desired, update the parameters for the new functionality.
3. If you experience problems with system performance, see *Diagnosing and Troubleshooting* on page 229.

If you cannot observe all possible operating conditions by varying the material level, use *Simulation process* on page 122 to verify programming.

Retest the system each time you adjust any control parameters.

SITRANS LUT400 Communication Systems

The SITRANS LUT400 is an integrated level controller capable of communicating process information to a Supervisory Control and Data Acquisition (SCADA) system, via a HART modem.



Connection via HART modem.

LUT400 Communications (HART)

Highway Addressable Remote Transducer, HART, is an industrial protocol that is superimposed on the 4-20 mA signal. It is an open standard, and full details about HART can be obtained from the HART Communication Foundation at www.hartcomm.org

SITRANS LUT400 can be configured over the HART network using the HART Communicator 375/475 by Emerson (see *Operation via Field Communicator 375/475 (FC375/FC475) (HART)* on page 133), or a software package. The recommended software package is the SIMATIC Process Device Manager (PDM) by Siemens.

HART Version

SITRANS LUT400 conforms to HART rev. 7.2.

Burst mode

SITRANS LUT400 does not support burst mode.

HART multi-drop mode

HART Multi-drop Mode allows the connection of multiple field devices via HART. To setup a device in Multi-drop Mode, see *Device Address* on page 126. Details on the use of Multi-drop Mode are outlined in an application guide *Working with HART*, which can be downloaded from the product page of our website. Go to: www.siemens.com/sitransLUT400 under **Support** and click on **Application Guides**.

SIMATIC PDM

This software package is designed to permit easy configuration, monitoring, and troubleshooting of HART devices. The HART EDD for SITRANS LUT400 was written with SIMATIC PDM in mind and has been extensively tested with this software.

For more information, see *Operation via SIMATIC PDM 6 (HART)* on page 127.

HART Electronic Device Description (EDD)

In order to configure a HART device, the configuration software requires the HART Electronic Device Description for the instrument in question.

You can download the HART EDD for SITRANS LUT400 from the product page of our website. Go to: www.siemens.com/sitransLUT400 and click on **Support>Software Downloads**.

Older versions of the library will have to be updated in order to use all the features of SITRANS LUT400.

HART Status

Information on HART Status is outlined in an application guide *Working with HART*, which can be downloaded from the product page of our website. Go to: www.siemens.com/sitransLUT400 under **Support** and click on **Application Guides**.

LUT400 Communication connections

The SITRANS LUT400 can be connected to a computer system via a HART modem (connected to the mA OUT/HART terminal block), or directly connected via a Universal Serial Bus (USB) cable (for use with the Web Browser interface). A HART network requires a device address be configured. For communications via USB, connect SITRANS LUT400 to your computer via the USB cable.

Configuring communication ports

HART modem

Note: It is recommended that only HCF registered modems be used.

Device Address

The unique identifier of the SITRANS LUT400 on a HART network.

Values	Range: **0 to 63** (Set within range of 0 to 15 if HART 5 master used.)
	Default: **0**

Set the device address or poll ID on a HART network.

Prior to HART 6, the device address was set to 0 for point to point operation. For HART Multi-drop mode, the device was set to any value other than 0 within the range. (Setting a non-zero address forced the device into fixed current mode.)

With HART 6 and above (version 7.2 supported by LUT400), Multi-drop mode no longer depends on the device address. (However, it is recommended that a non-zero address be set to avoid confusion based on previous HART requirements).

To set the LUT400 in Multi-drop mode, **disable** *Loop current mode* via one of the HART communication software tools (such as SIMATIC PDM). When *Loop current mode* is disabled, a low fixed current is used, allowing for multiple devices to be connected.

Note: Loop current mode can not be disabled via LUI or Web Browser.

See *4.1. Device Address* on page 215.

USB cable

See *Communications* on page 24 for typical setup via USB, then follow instructions under *Installing the USB driver* in the LUT400 Communications manual[1].

Communication troubleshooting

See *Communication Troubleshooting* on page 229 of *Diagnosing and Troubleshooting*.

1. Communications for SITRANS LUT400 (HART) Manual (7ML19985NE01).

Remote operation

SITRANS LUT400 supports several software tools for operation via remote communications:

- PC running SIMATIC PDM
- PC running Emerson AMS Device Manager
- PC running a web browser
- PC running a Field Device Tool (FDT)
- Field Communicator 375/475 (FC375/FC475).

This section of the manual covers basic information required to use these tools with your SITRANS LUT400. Further details for each are available in the Communications for SITRANS LUT400 (HART) Manual (7ML19985NE01). (See DVD shipped with device or download manual from product page of our website: Go to www.siemens.com/sitransLUT400 > Technical Info > Manuals/Operating instructions.)

Operation via SIMATIC PDM 6 (HART)

(SITRANS LUT400 compatible with PDM version 6.1)

Features and Functions

SIMATIC PDM is a software package used to commission and maintain SITRANS LUT400 and other process devices. PDM monitors the process values, alarms and status signals of the device. It allows you to display, compare, adjust, verify, and simulate process device data; also to set schedules for calibration and maintenance. Please consult the LUT400 online help for details on using SIMATIC PDM. (You can find more information at: www.siemens.com/simatic-pdm.)

SIMATIC PDM features four Quick Start Wizards (Level, Volume, Volume-Linearization, and Flow) to easily configure the SITRANS LUT400. A Pump Control Wizard is also available. Other features include Echo Profile Utilities, Manual TVT Shaper adjustment, Auto False Echo Suppression screening, Process Variables monitoring, and Maintenance scheduling.

Parameters are identified by name and organized into function groups. The menu structure for SIMATIC PDM is almost identical to that of the LCD. See *LCD Menu Structure* on page 273 for a chart. For a complete list of parameters, see *Parameter reference (LUI)* on page 137.

Startup and Configuration

To startup the SITRANS LUT400 using SIMATIC PDM, check that you have the latest version of PDM installed (update your installation if necessary - see *SIMATIC PDM version* below), then install the EDD. Next, configure the device using the Quick Start Wizards in PDM.

For more information on SIMATIC PDM functions, and details on how to configure the device using PDM, refer to the LUT400 Communications manual[1].

1. Communications for SITRANS LUT400 (HART) Manual (7ML19985NE01).

SIMATIC PDM version

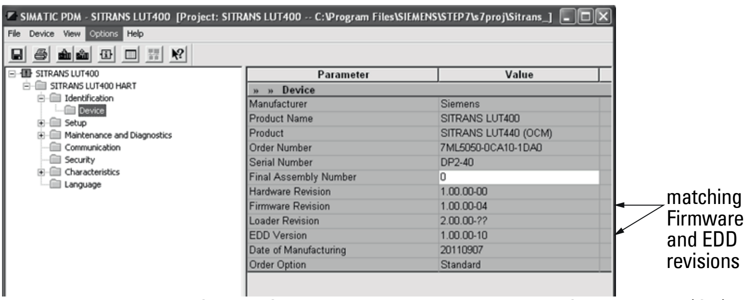
Check the support page of our website to make sure you have the latest version of SIMATIC PDM, the most recent Service Pack (SP) and the most recent hot fix (HF). Go to:

http://support.automation.siemens.com/WW/llisapi.dll?func=cslib.csinfo&lang=en&objiD=10806857&subtype=133100

Electronic Device Description (EDD)

You can locate the EDD in Device Catalog, under **Sensors/Level/Echo/Siemens AG/SITRANS LUT400**. (The EDD is written for forward compatibility.)
As a guideline to locate the correct EDD, the major and minor numbers should match between the EDD revision and the Firmware revision in the device (e.g. major and minor numbers in bold text: **1.00**.00-04).

To check it in PDM, go to **SITRANS LUT400 HART > Identification > Device**.



Installing a new version of SIMATIC PDM requires the most recent Service Pack (SP) and the most recent hot fix (HF).

To install a new EDD

- Go to www.siemens.com/sitransLUT400 > **Support > Software Downloads** to download the most up-to-date EDD from the product page of our website.
- Save the files to your computer and extract the zipped file to an easily accessed location.
- Launch **SIMATIC PDM – Manage Device Catalog**, browse to and select the folder which contains the unzipped EDD file.

Operation via Web Browser (USB)

Features and Functions

The web browser interface in SITRANS LUT400, designed to work with Windows XP, makes monitoring and adjustments easy. Internet Explorer installed on a computer can be used to configure the SITRANS LUT400, and the Web Server *Abyss* is supplied for your convenience. The web browser is available in English only.

SITRANS LUT400 parameters, organized into six main function groups, allow you to configure and monitor the device:

- Identification
- Setup
- Maintenance and Diagnostics
- Communication
- Security
- Language

Startup and Configuration

To startup the SITRANS LUT400 using the Web Browser, you must first install the USB driver and web browser interface. On the small DVD shipped with the device you will find the driver and installation software[1]. Once installed, the communication port (COMPORT) must be set, then you can configure the device via the browser menu parameters.

The menu structure for the web browser interface is almost identical to that of the LCD. See *Browser Menu Parameter Function Groups* in the LUT400 Communications manual[2] for a complete list of parameters that can be configured via the web browser.

For installation instructions and details on how to configure the device via the Web Browser, refer to the LUT400 Communications manual[1].

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1. Also available from the product page of our website. Go to: www.siemens.com/sitransLUT400 and click on **Support>Software Downloads**.
2. Communications for SITRANS LUT400 (HART) Manual (7ML19985NE01).

Notes

Operation via AMS Device Manager (HART)

(SITRANS LUT400 compatible with AMS version 10.5 and higher)

Features and Functions

AMS Device Manager is a software package used to commission and maintain SITRANS LUT400 and other process devices. AMS Device Manager monitors the process values, alarms and status signals of the device. It allows you to display, compare, adjust, verify, and simulate process device data. The graphic interface in SITRANS LUT400 makes monitoring and adjustments easy. Please consult the operating instructions or online help for details on using AMS Device Manager. (You can find more information at: http://www.emersonprocess.com/AMS/.)

AMS Device Manager features four Quick Start Wizards (Level, Volume, Volume-Linearization, and Flow) to easily configure the SITRANS LUT400. A Pump Control Wizard is also available. Other features include Echo Profile viewing, TVT setup, Process Variables monitoring, and Security.

Parameters organized into three main function groups allow you to configure and monitor the device:

- Configure/Setup
- Device Diagnostics (read only)
- Process Variables (read only)

For a chart[1] of the *AMS Menu Structure* , see LUT400 Communications manual[2].

Startup and Configuration

To startup the SITRANS LUT400 using AMS Device Manager, you must first install the EDD (see below). You can then configure the device using the Quick Start Wizards in AMS.

For more information on AMS functions, and details on how to configure the device using AMS, refer to the LUT400 Communications manual[2].

Electronic Device Description (EDD)

SITRANS LUT400 requires the EDD for AMS Device Manager version 10.5.

You can locate the EDD in Device Catalog, under **Sensors/Level/Echo/Siemens/SITRANS LUT400**. Check the product page of our website at www.siemens.com/sitransLUT400, under **Support->Software Downloads**, to make sure you have the latest version of the EDD for AMS Device Manager.

1. The menu structure for AMS Device Manager is almost identical to that of the LCD.
2. Communications for SITRANS LUT400 (HART) Manual (7ML19985NE01).

Notes

Operation via Field Communicator 375/475 (FC375/FC475) (HART)

Features and Functions

The FC375/FC475 HART Communicator is a handheld communication device that is easy to use, and provides universal support for other HART devices, such as the SITRANS LUT400.

For a list of parameters available with the Field Communicator, see *HART FC375/FC475 Menu Structure* in the LUT400 Communications manual[1]. This menu structure is very similar to that of AMS Device Manager.

Startup and Configuration

In order to configure this HART device, just as with AMS, the configuration software requires the HART Electronic Device Description (EDD) for the instrument. Once the EDD is installed, you can configure the device using the Quick Start Wizards within FC375/475.

For instructions on how to install the EDD, and how to configure a new device using FC375/475, refer to the LUT400 Communications manual[2].

Operation - FC375

1. Communications for SITRANS LUT400 (HART) Manual (7ML19985NE01).

Notes

Operation via FDT (Field Device Tool)

Features and Functions

FDT is a standard used in several software packages designed to commission and maintain field devices such as SITRANS LUT400. Two commercially available FDTs are PACTware and Fieldcare.

FDT is very similar to PDM [see *Operation via SIMATIC PDM 6 (HART)* in the LUT400 Communications manual[1] for more detail].

- To configure a field device via FDT, you need the DTM (Device Type Manager) for the device.
- To configure a field device via SIMATIC PDM, you need the EDD (Electronic Data Description) for the device.

Startup and Configuration

To startup the SITRANS LUT400 using an FDT, you must first install the DTM (see below). You can then configure the device using the parameters available with the FDT.

The full process to configure a field device via FDT is outlined in an application guide for *SITRANS DTM*, which can be downloaded from the product page of our website. Go to: www.siemens.com/sitransLUT400 under **Support** and click on **Application Guides**.

Device Type Manager (DTM)

A DTM is a type of software that 'plugs into' FDT. It contains the same information as an EDD but an EDD is independent of the operating system.

SITRANS DTM version 3.1

- SITRANS DTM is an EDDL interpreter developed by Siemens to interpret the EDD for that device.
- To use SITRANS DTM to connect to a device, you must first install SITRANS DTM on your system and then install the instrument EDD written for SITRANS DTM.
- You can download SITRANS DTM from our website at: http://www.siemens.com/sitransdtm.
  Click on **Support** then go to **Software downloads**.

Electronic Device Description (EDD)

The SITRANS LUT400 HART EDD for SITRANS DTM can be downloaded from the product page of our website.

Go to www.siemens.com/sitransLUT400 under **Support** and click on **Software Downloads.**

Operation - FDT (DTM)

1. Communications for SITRANS LUT400 (HART) Manual (7ML19985NE01).

Notes

Parameter reference (LUI)

Notes:

- Parameter names and menu structure are almost identical for SIMATIC PDM and the local user interface (LUI). Access is described below for some parameters that do not appear in the SIMATIC PDM menu structure.
  (For further details on using these parameters within SIMATIC PDM, see the LUT400 Communications manual[a].)
- Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.
- Parameter range values are displayed in the default of the defined unit of measure. For example, if a parameter description states that it is *defined in Units (2.1.1.)*, the range for that parameter will be shown in meters [as meters (M) is the default for Units (2.1.1.)].
- The number of decimals displayed for a parameter value will depend on the unit of measure, unless decimal places can be set by the user (e.g. Totalizers - *2.7.3.2.Totalizer Decimal Position*).
  For example:
  Values defined in default *2.1.1.Units* will display 3 decimal places; default *2.6.2.Volume Units* - 1 decimal place, default *2.15.3.7.Flowrate Units* - 0 decimal places.
- To enter Program mode using the local push buttons, press ▶. Press ◀ to return to Measurement mode.

a. Communications for SITRANS LUT400 (HART) Manual (7ML19985NE01)

Parameters are identified by name and organized into function groups. See **LCD Menu Structure** on page 273 for a chart.

Parameters accessible via the local push buttons are preceded by a number. Parameters not preceded by a number are accessible only via remote operation.

Based on model configuration (LUT420, LUT430, LUT440), some parameters will not appear on LUI. Exceptions are noted by parameter.

Where the same parameter exists for more than one model, but is represented by a different menu number, both parameters are listed together (separated by "OR"), and the details are noted under the second of the two parameters.

For more details see:

- **Operation via SIMATIC PDM 6 (HART)** on page 127
- **Operation via AMS Device Manager (HART)** on page 131

1. Wizards

Several Wizards are available with the SITRANS LUT400. Wizards group together all the settings needed for a particular feature. All Wizards are available via the local push buttons, and many are also available via SIMATIC PDM under the Device menu.

For details on the Wizards listed below, see **Quick Start Wizards** on page 38 of *Commissioning*.

1.1. Quick Start

1.1.1. QS Level

1.1.2. QS Volume

1.1.3. QS Flow

Available only on LUT430 (Pump and Flow), and LUT440 (OCM) configured models.

1.2. Pump Control

2. Setup

Notes:
- See **Local Commissioning** on page 33 or **Operation via SIMATIC PDM 6 (HART)** on page 127 for instructions.
- Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.
- Values shown in the following tables can be entered via the local push buttons.

2.1. Sensor

2.1.1. Units

Determines sensor measurement units used when 2.1.2.Sensor Mode set to Level, Space, Distance, or Head.

Options	M, CM, MM, FT, IN
	Default: M

2.1.2. Sensor Mode

Menu number *2.1.2.* visible on LUT420 (Level model).

OR

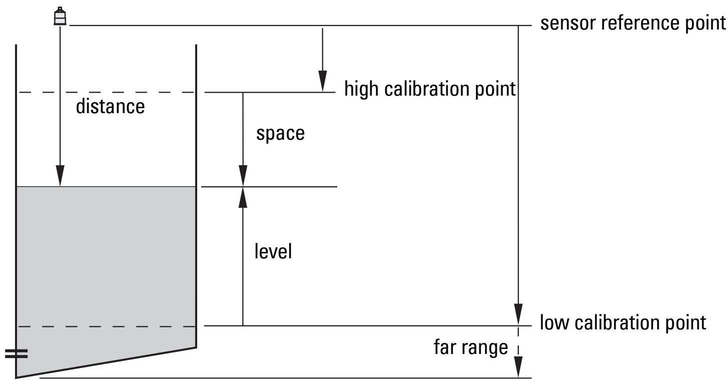
2.1.3. Sensor Mode

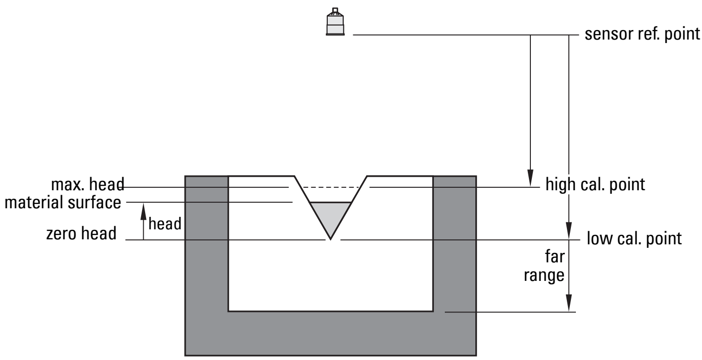
Menu number *2.1.3.* visible on LUT430 (Pump and Flow model), and LUT440 (OCM model).

Sets the type of measurement required for the application.

Options (Mode)		**Description**	**Reference point**
*	LEVEL	Distance to material surface	Low Calibration Point (process empty level)
	SPACE		High Calibration Point (process full level)
	DISTANCE		Sensor Reference Point
	VOLUME	Volume of material in volumetric units (based on level)	Low Calibration Point
	HEAD [a]	Distance to material surface	Zero Head
	FLOW [a]	Flowrate in an open channel in Flowrate Units	Zero Head (zero flow level)

a. Option available only on LUT430, LUT440.





2.1.4. Sensor Mode Secondary

Menu number *2.1.4.* visible on LUT420 (Level model).

OR

2.1.5. Sensor Mode Secondary

Menu number *2.1.5.* visible on LUT430 (Pump and Flow model), and LUT440 (OCM model).

Sets the secondary measurement type to be used in the application.

See **Sensor Mode (2.1.3.)** for illustration.

Parameters

2.1.6. Transducer

Specifies the Siemens transducer connected to the device.

Options	*	NO TRANSDUCER
		XRS-5
		XPS-10
		XPS-15
		XCT-8
		XCT-12
		XPS-30
		XPS-40
		XLT-30
		XLT-60
		STH

Notes:
- When **Transducer (2.1.6.)** is set to NO TRANSDUCER, the LOE fault will display immediately.
- An **Echo Profile (3.2.1.)** cannot be requested from LUI when **Transducer (2.1.6.)** is set to NO TRANSDUCER. The local push button will not operate.

2.1.7. Frequency

Adjust the shot transmit pulse frequency (in kHz).

Values	Range: **10.000 to 52.000**
	Default: Depends on transducer selected in Transducer (2.1.6.).

2.1.8. Long Shot Duration

Adjust the duration of the long shot transmit pulse (in µs).

Values	Range: **100.000 to 2000.000**
	Default: Depends on transducer selected in Transducer (2.1.6.).

2.1.9. Short Shot Duration

Adjust the duration of the short shot transmit pulse (in µs).

Values	Range: **100.000 to 2000.000**
	Default: Depends on transducer selected in Transducer (2.1.6.).

2.2. Calibration

2.2.1. Low Calibration Point

Distance from sensor reference point[1] to Low Calibration Point defined in ***Units (2.1.1.)***.

Values	Range: **0.000 to 60.000**
	Default: 60.000

1. The point from which level measurement is referenced (see **Sensor Mode on page 138** for illustration).

Parameters

2.2.2. High Calibration Point

Distance from sensor reference point[1] to High Calibration Point defined in ***Units (2.1.1.)***.

Values	Range: **0.000 to 60.000**
	Default: 0.000

When setting the High Calibration Point value, note that echoes are ignored within *2.2.4.Near Range*.

2.2.3. Sensor Offset

The value altered when an ***Auto Sensor Offset (2.2.6.)*** *is performed, defined in* ***Units (2.1.1.)***.

Values	Range: **-99.999 to 99.999**
	Default: 0.000

Alternatively, if amount of Sensor Offset is known, enter the constant that can be added to or subtracted from sensor value[1] to compensate if the sensor reference point has shifted.

2.2.4. Near Range

The range in front of the device (measured from the sensor reference point) within which any echoes will be ignored. This is sometimes referred to as blanking or a dead zone. Defined in ***Units (2.1.1.)***.

Values	Range: **0.000 to 60.000**
	Default: 0.300

2.2.5. Far Range

Note: Far Range can extend beyond the bottom of the vessel.

Allows the material level to drop below Low Calibration Point without generating a Loss of Echo (LOE) state. See ***Sensor Mode (2.1.2.)*** *on page 138 for an illustration. Defined in* ***Units (2.1.1.)***.

Values	Range: Min. = Low Calibration Point Max. = 61.000 M (200.13 FT)
	Default: Value for Low Calibration Pt. + 1 m (3.281 ft.)

Use this feature if the measured surface can drop below the Low Calibration Point in normal operation.

1. The value produced by the echo processing which represents the distance from sensor reference point to the target (see **Sensor Mode on page 138** for illustration).

Parameters

2.2.6. Auto Sensor Offset

> **Note:** Auto Sensor Offset supports adjustments to distance value only.

*Calibrates actual distance if reported value is consistently high or low by a fixed amount. (Adjusts distance measurement by a fixed amount.) Defined in **Units (2.1.1.)**.*

Values	Range: **0.000 to 60.000**

Before using this feature, verify the following parameters are correct:

- *2.2.1.Low Calibration Point* (or *2.15.3.5.Zero Head Offset*, if using OCM)
- *2.12.1.2.Process Temperature*
- *2.2.3.Sensor Offset*

A correction to any one of these parameters may resolve the issue and an Auto Sensor Offset calibration may not be necessary.

Using Auto Sensor Offset:

Begin with a steady distance at a known low distance value (low distance value equates to a high level value).

1. Review the distance measurement via LUI for approximately 30 seconds to verify repeatability.

2. Measure the actual distance (for example, with a tape measure).

3. Enter the actual distance, defined in ***Units (2.1.1.)***

The deviation between the calculated and the actual distance value is stored in *2.2.3.Sensor Offset*.

2.3. Rate

> **Note:** Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

> **Notes:**
> - The following three rate parameters work in conjunction, and are affected by **Response Rate** (set in the Quick Start wizard).
> - **Fill Rate per Minute**, **Empty Rate per Minute**, and **Damping Filter** automatically update when **Response Rate** is altered, but any change to these parameters will supersede a Response Rate set previously through the wizard.
> - For more information, see **Measurement Response** on page 260.

2.3.1. Fill Rate per Minute

Defines the maximum rate at which the reported level is allowed to increase. Allows you to adjust the SITRANS LUT400 response to increases in the actual material level.

Values	Range: **0.000 to 99999.000** m/min
	Default: 0.100 m/min

Enter a value slightly greater than the vessel's maximum filling rate, in units per minute.

2.3.2. Empty Rate per Minute

Defines the maximum rate at which the reported level is allowed to decrease. Adjusts the SITRANS LUT400 response to decreases in the actual material level.

Values	Range: **0.000 to 99999.000** m/min
	Default: 0.100 m/min

Enter a value slightly greater than the vessel's maximum emptying rate, in units per minute.

2.3.3. Damping Filter

Use this to stabilize the reported level (displayed and analog output), due to level fluctuations (such as a rippling or splashing liquid surface), defined in seconds.

Values	Range: **0.0 to 7200.0**
	Default: **100.0**

2.4. Fail-Safe

*The fail-safe parameters ensure that the devices controlled by the SITRANS LUT400 default to an appropriate state when a valid level reading is not available. The PV region on LUI will display dashes (– – – – – – –) until the fail-safe fault has been cleared. (See **General Fault Codes** on page 231 for a list of faults that will cause fail-safe.)*

Note: When a Loss of Echo occurs **Material Level (2.4.1.)** determines the material level to be reported when the Fail-safe timer expires. See **Loss of Echo (LOE)** on page 261 for more detail.

2.4.1. Material Level

Note: The default is a factory setting and depends whether or not your device was ordered as NAMUR NE43-compliant for Fail-safe.

*Defines the mA output to use (shown in **Current Output Value**) when the Fail-safe Timer expires and the device is still in an error condition.*

Options	HI	**20.0 mA** (max. mA Limit)
	LO	**4.0 mA** (min. mA Limit)
	HOLD	Last valid reading
	VALUE	User-selected value [defined in **Fail-Safe mA Value (2.4.3.)**: default 3.58 mA]
Default	VALUE (if ordered with NAMUR NE43 compliant fail-safe preset) HOLD (if ordered without NAMUR NE43 compliant fail-safe preset)	

Parameters

2.4.2. LOE Timer

Sets the time to elapse since the last valid reading, before the Fail-safe Material Level is reported (defined in seconds).

Values	Range: **0 to 7200**
	Default: 100

2.4.3. Fail-Safe mA Value

Note: Material Level (2.4.1.) must be set to **Value** for the **Material Level** value to be reported.

Allows the user to define the mA value to be reported when the Fail-safe timer expires.

Values	Range	**3.50 to 22.80 mA**
	Default	3.58

2.5. Current Output

Note: Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

2.5.1. Current Output Function

Menu number *2.5.1.* visible on LUT420 (Level model).

OR

2.5.2. Current Output Function

Menu number *2.5.2.* visible on LUT430 (Pump and Flow model), and LUT440 (OCM model).

Alters the mA output/measurement relationship.

Notes:
- The various options have different reference points.
- Use caution when changing Current Output Function while the device is connected to a HART network. Current Output Function controls the primary value and the loop current for the device.

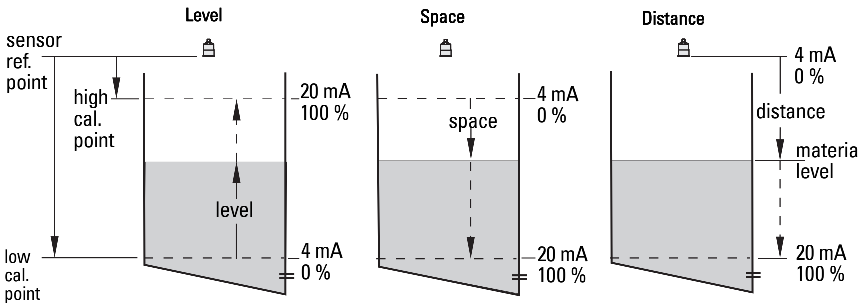
Options		**Reference point**	**Description**
	MANUAL [a]	n/a	user can enter mA value for loop current.
*	LEVEL	Low Calibration Point	measured as difference between the material level and *2.2.1.Low Calibration Point*, defined in *2.1.1.Units*
	SPACE	High Calibration Point	measured as difference between the material level and *2.2.2.High Calibration Point*, defined in *2.1.1.Units*
	DISTANCE	Sensor reference point	measured as difference between the material level and sensor reference point, defined in *2.1.1.Units*

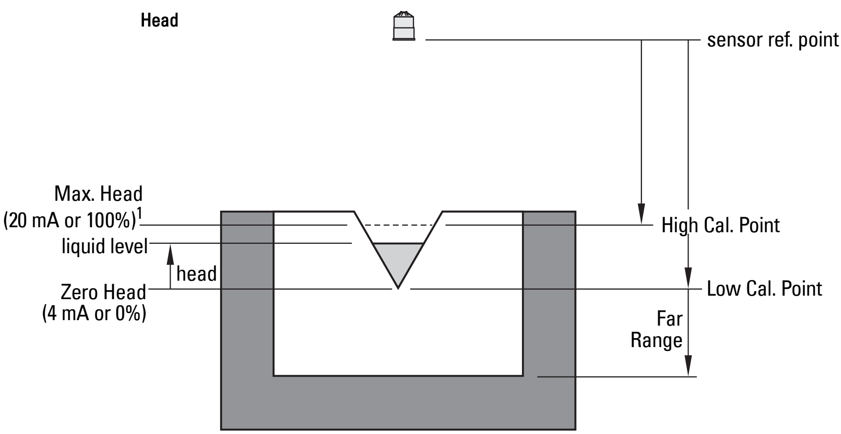
Parameters

	VOLUME	Low Calibration Point	converted from Level, defined in *Length of the cylindrical section of a horizontal parabolic end vessel. See Vessel Shape (2.6.1.) for an illustration.*
	HEAD [b]	Zero Head	measured as difference between the liquid level and Zero Head, defined in *2.1.1.Units*
	FLOW [b]	Zero Head	converted from Head, defined in *2.15.3.7.Flowrate Units*

a. When Current Output Function is set to **Manual**, a power cycle will reset this parameter to its previous value.

b. Option available only on LUT430, LUT440.





1. Refer to PMD supplier documentation for maximum head.

To modify Current Output Function via SIMATIC PDM:

Open the menu **Device – Select Analog Output.**

Parameters

2.5.3. 4 mA Setpoint

*Sets the process level corresponding to the 4 mA value. 4 mA always defaults to **0 m**, and **Current Output Function (2.5.1.)** determines the type of measurement. [See **Current Output Function (2.5.1.)** for an illustration.]*

Values	Range: Level, Space, Distance, Head: 0.000 to 60.000 m Volume: 0.0 to Max. Volume Flow: 0 to Max. Flow
	Default: **0** (set to value corresponding to 0% as defined by Current Output Function and associated units)

- Enter the reading that is to correspond to a 4 mA output.
- Units are defined in **Units (2.1.1.)** for Level, Space, Distance, or Head, and in **Flowrate Units (2.15.3.7.)** for Flow. Volume units are converted from a level value.

2.5.4. 20 mA Setpoint

*Sets the process level corresponding to the 20 mA value. 20 mA always defaults to **60 m**, and **Current Output Function (2.5.1.)** determines the type of measurement. [See **Current Output Function (2.5.1.)** for an illustration.]*

Values	Range: Level, Space, Distance, Head: 0.000 to 60.000 m Volume: 0.0 to Max. Volume Flow: 0 to Max. Flow
	Default: Level, Space, Distance, Head: **60.000** Volume: **Max. Volume** Flow: **Max Flow** (set to value corresponding to 100% as defined by Current Output Function and associated units)

- Enter the reading that is to correspond to a 20 mA output.
- Units are defined in **Units (2.1.1.)** for Level, Space, or Distance, or Head, and in **Flowrate Units (2.15.3.7.)** for Flow. Volume units are converted from a level value.

2.5.5. Minimum mA Limit

Prevents the mA output from dropping below this minimum level for a measurement value. This does not restrict the Fail-safe or Manual settings.

Values	Range: **3.5 to 22.8** mA
	Default: 4.0

2.5.6. Maximum mA Limit

Prevents the mA output from rising above this maximum level for a measurement value. This does not restrict the Fail-safe or Manual settings

Values	Range: **3.5 to 22.8** mA
	Default: 20.0

2.5.7. Manual Value

*The mA value to use when **Current Output Function (2.5.1.)** is set to **Manual**. Allows you to use a simulated value to test the functioning of the loop. You can enter 4 mA, 20 mA, or any other user-defined value within the range.*

Values	Range: **3.5 to 22.8** mA
	Default: 3.58

a) First set **Current Output Function (2.5.1.)** to **Manual**.
b) Set this parameter to the desired mA value.
c) After completing the test, remember to reset **Current Output Function (2.5.1.)** to the previous setting.

Via SIMATIC PDM:

Open the menu **Device – Loop Test**.

2.5.8. Current Output Value

Read only. Displays the current mA value, including a simulated value entered to test the functioning of the loop.

Values	Range: **3.5 to 22.8** mA

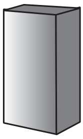
2.6. Volume

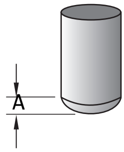
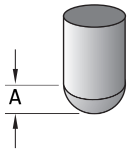
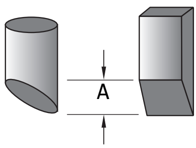
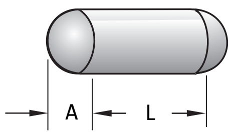
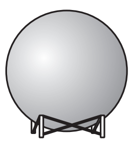
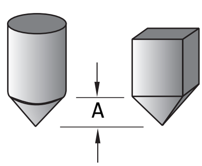
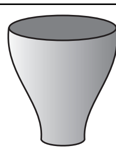
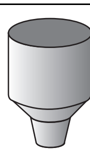
Carries out a volume conversion from a level value.

Note: Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

2.6.1. Vessel Shape

*89Defines the vessel shape and allows the LUT400 to calculate volume instead of level. If **None** is selected, no volume conversion is performed. Select the vessel shape matching the monitored vessel or reservoir.*

	Vessel Shape	LCD DISPLAY/ Description	Also required
*	None	NONE/ No volume calculation required	N/A
	 	LINEAR/ Upright, linear (flat bottom)	maximum volume
		CYLINDER/ Flat end horizontal cylinder	maximum volume

	Vessel Shape (cont'd)	LCD DISPLAY/ Description	Also required
		PARABOLIC BOTTOM	maximum volume, dimension A
		HALF SPHERE BOTTOM	maximum volume, dimension A
		FLAT SLOPED BOTTOM	maximum volume, dimension A
		PARABOLIC ENDS/ Parabolic end horizontal cylinder	maximum volume, dimension A, dimension L
		SPHERE	maximum volume
		CONICAL BOTTOM/ Conical or pyramidal bottom	maximum volume, dimension A
		CURVE TABLE[a]/ Linearization table (level/volume breakpoints)	maximum volume, tables 1-32 level and volume breakpoints
		LINEAR TABLE[a]/ Linearization table (level/volume breakpoints)	maximum volume, tables 1-32 level and volume breakpoints

a. Linearization Table must be selected in order for level/volume values [see **Table 1-8 (2.6.7.)**] to be transferred.

Parameters

2.6.2. Volume Units

Determines volume measurement units used when 2.1.2.Sensor Mode set to VOLUME.

Options	*	L (Litres)
		USGAL (US Gallons)
		IMPGAL (Imperial Gallons)
		CUM (Cubic Meters)
		USER DEFINED (units defined in *2.6.6.User Defined Unit*)

2.6.3. Maximum Volume

The maximum volume of the vessel. Enter the vessel volume corresponding to High Calibration Point. For example, if your maximum vessel volume is 8000 L, enter a value of 8000.

Values	Range: **0.0 to 9999999**
	Default: 100.0

2.6.4. Dimension A

The height of the vessel bottom when the bottom is conical, pyramidal, parabolic, spherical, or flat -sloped. If the vessel is horizontal with parabolic ends, the depth of the end. See ***Vessel Shape (2.6.1.)*** *for an illustration.*

Values	Range: **0.000 to 99.999**
	Default: 0.000

Defined in *2.1.1.Units*.

2.6.5. Dimension L

Length of the cylindrical section of a horizontal parabolic end vessel. See ***Vessel Shape (2.6.1.)*** *for an illustration.*

Values	Range: **0.000 to 99.999**
	Default: 0.000

Defined in *2.1.1.Units*.

2.6.6. User Defined Unit

Set the unit text to display for current volume when 2.6.2.Volume Units set to ***user-defined.*** *Limited to 16 ASCII characters.*

Note: The text entered is simply for display purposes. No unit conversion occurs.

Parameters

2.6.7. Table 1-8

If your vessel shape is more complex than any of the preconfigured shapes, you can define the shape as a series of segments. A value is assigned to each level breakpoint and a corresponding value is assigned to each volume breakpoint. Level values are defined in ***Units (2.1.1.)****. Volume values are defined in* ***Volume Units (2.6.2.)****..*

Level Values	Range: **0.000 to 60.000**
	Default: 0.000
Volume Values	Range: **0.0 to 9999999.0**
	Default: 0.0

Enter up to 32 level breakpoints, where the corresponding volume is known. The values corresponding to 0% and 100% levels must be entered, and breakpoints can be ordered from top to bottom, or the reverse.

Breakpoints are grouped into four tables: Table 1-8, Table 9-16, Table 17-24, and Table 25-32.

Entering breakpoints via SIMATIC PDM:

- See *Using Linearization via the Quick Start wizard* in the LUT400 Communications manual[1].

Entering breakpoints via the local push buttons:

a) The default unit for level values is **m**: to change it navigate to **Setup (2.) > Sensor (2.1.) > Units (2.1.1.),** and select the desired unit.
b) Navigate to **Setup (2.) > Volume (2.6.) > Table 1-8 (2.6.7.)**, and enter the value.
c) Go to the appropriate table for the particular breakpoint you wish to adjust: for example, go to Table 1-8 for breakpoint 1.
d) Under Table 1-8, go to **Level 1 (2.6.7.1.)** to enter the level value for the breakpoint 1.
e) Under Table 1-8, go to **Volume 1 (2.6.7.2.)** to enter the volume value for the breakpoint 1.
f) Repeat steps c) to e), until values have been entered for all required breakpoints.

2.6.7.1. Level 1

a) Press **RIGHT arrow** to open Edit mode.
b) Enter level value and press **RIGHT arrow** to accept it.
c) Press **Down ARROW** to move to corresponding volume breakpoint.

2.6.7.2. Volume 1

a) Press **RIGHT arrow** to open Edit mode.
b) Enter volume value and press **RIGHT arrow** to accept it.
c) Press **Down ARROW** to move to next level breakpoint.

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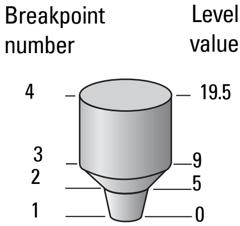
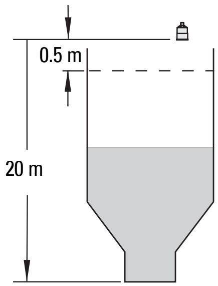
Example (values are for example purposes only)



Breakpoint Number	Level value (m)	Volume value (l)
1	0	0
2	5	500
3	9	3000
4	19.5	8000



2.6.8. Table 9-16

2.6.9. Table 17-24

2.6.10. Table 25-32

2.7. Pumps

Note: Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

For details on relay behaviour under fail-safe conditions, see ***Pump relays*** *on page 66.*

2.7.1. Basic Setup

2.7.1.1. Pump Control Enable

Enables/disables pump control.

Options		ENABLED
	*	DISABLED

2.7.1.2. Relay Pump 1

Selects the relay assigned to Pump 1.

Options	*	RELAY 2
		RELAY 3

2.7.1.3. Relay Pump 2

Selects the relay assigned to Pump 2.

Options		RELAY 2
	*	RELAY 3

2.7.1.4. Pump Control Mode

Menu number *2.7.1.4.* visible on LUT420 (Level model).

OR

2.7.1.5. Pump Control Mode

Menu number *2.7.1.5.* visible on LUT430 (Pump and Flow model), and LUT440 (OCM model).

Sets the control algorithm used to trip the relay.

Options	*	ALTERNATE DUTY ASSIST (ADA)	At rotating ON and OFF setpoints and allows multiple pumps to run
		ALTERNATE DUTY BACKUP (ADB)	At rotating ON and OFF setpoints and allows only one pump to run
		SERVICE RATIO DUTY ASSIST (SRA) [a]	On service ratio at ON and OFF setpoints and allows multiple pumps to run
		SERVICE RATIO DUTY BACKUP (SRB) [a]	On service ratio at ON and OFF setpoints and allows only one pump to run
		FIXED DUTY ASSIST (FDA) [a]	At fixed ON and OFF setpoints and allows multiple pumps to run
		FIXED DUTY BACKUP (FDB) [a]	At fixed ON and OFF setpoints and allows only one pump to run

a. Option available only on LUT430, LUT440.

Each algorithm defines a pump duty and pump start method.

2.7.1.6. ON Setpoint Pump 1

The level at which Pump 1 turns ON, defined in 2.1.1. Units.

Values	Range: **0.000 to 99999.000**
	Default: 0.000

This parameter is set according to level even when another reading, such as volume, is shown on the LCD.

2.7.1.7. OFF Setpoint Pump 1

The level at which Pump 1 turns OFF, defined in 2.1.1. Units.

Values	Range: **0.000 to 99999.000**
	Default: 0.000

This parameter is set according to level even when another reading, such as volume, is shown on the LCD.

2.7.1.8. ON Setpoint Pump 2

The level at which Pump 2 turns ON, defined in 2.1.1. Units.

Values	Range: **0.000 to 99999.000**
	Default: 0.000

This parameter is set according to level even when another reading, such as volume, is shown on the LCD.

2.7.1.9. OFF Setpoint Pump 2

The level at which Pump 2 turns OFF, defined in 2.1.1. Units.

Values	Range: **0.000 to 99999.000**
	Default: 0.000

This parameter is set according to level even when another reading, such as volume, is shown on the LCD.

2.7.1.10. Service Ratio Pump 1

Selects pump usage based on the RUN time ratio rather than last used. (See 3.2.7.1.Run Time Relay 2.)

Values	Range: **0 to 255**
	Default: 1

This parameter only relates to relays with **Pump Control Mode (2.7.1.4.)** set to Service Ratio Duty Assist or Service Ratio Duty Backup.

The number assigned to each pump relay represents the ratio applied to decide the next pump to start or stop.

Notes:
- The SITRANS LUT400 will not sacrifice other pumping strategies to ensure that the ratio is held true.
- If the pump relays are set to the same value then the ratio equals 1:1 and all pumps are used equally (default).

2.7.1.11. Service Ratio Pump 2

Selects pump usage based on the RUN time ratio rather than last used. (See 3.2.7.2.Run Time Relay 3.)

Values	Range: **0 to 255**
	Default: 1

This parameter only relates to relays with **Pump Control Mode (2.7.1.4.)** set to Service Ratio Duty Assist or Service Ratio Duty Backup.

The number assigned to each pump relay represents the ratio applied to decide the next pump to start or stop.

Notes:
- The SITRANS LUT400 will not sacrifice other pumping strategies to ensure that the ratio is held true.
- If the pump relays are set to the same value then the ratio equals 1:1 and all pumps are used equally (default).

2.7.2. Modifiers

Note: Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

2.7.2.1. Wall Cling Reduction

2.7.2.1.1. Enable

Enables/disables 2.7.2.1.2.Level Setpoint Variation.

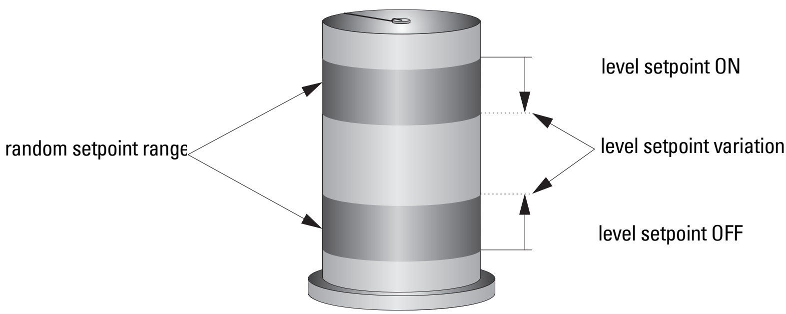
Options		ENABLED
	*	DISABLED

2.7.2.1.2. Level Setpoint Variation

Varies the ON and OFF setpoints to reduce material buildup on the walls (defined in 2.1.1. Units).

Values	Range: **0.000 to 99999.000**
	Default: 0.000

This value is the range in which the setpoints are allowed to deviate. The pump ON and OFF Setpoint values are randomly varied inside the range to ensure that the material level does not consistently stop at the same point.



Parameters

2.7.2.2. Energy Savings

Available only on LUT430 (Pump and Flow model), and LUT440 (OCM model).

Use these parameters to maximize your device's operation during periods of low energy cost and minimize its operation during periods of high cost.

The methods used to achieve this are:

- Emptying the wet well just prior to the high cost period, regardless of material level (*2.7.2.2.2.Peak Lead Time*).
- Changing setpoints for high cost and low cost periods (*2.7.2.2.13.Peak ON Setpoint Pump 1*, *2.7.2.2.14.Peak OFF Setpoint Pump 1*, *2.7.2.2.3.Peak 1 Start Time*, *2.7.2.2.4.Peak 1 End Time*).

One peak lead time is shared by all five peak zones. When one zone's peak time interval (difference between peak start time and peak end time) overlaps another zone's peak lead time, the lead time is chosen over the interval. If a zone's start time matches its end time, the zone is treated as not configured.

2.7.2.2.1. Enable

Enables/disables the Energy Savings feature. The Energy Savings feature is used to minimize the pumping that occurs during periods of high energy cost.

Options	*	DISABLED
		ENABLED

2.7.2.2.2. Peak Lead Time

The time in minutes before the Peak Start Time that the SITRANS LUT400 will begin pumping.

Values	Range: **0 to 65535**
	Default: 60

This value determines when pumping should start to ensure the level is as far as possible from the *2.7.1.6.ON Setpoint Pump 1* level. If level is already within 5% of *2.7.1.7.OFF Setpoint Pump 1*, no action occurs. If multiple pump stations are series linked, ensure the Peak Lead Time entered is sufficient to attain the desired level in all stations before the high-energy cost period occurs.

2.7.2.2.3. Peak 1 Start Time

Sets the start time of the high energy cost period 1.

Values	Range: **00:00 to 23:59**
	Format: HH:MM (24 hour format, e.g. for 5:30pm, set parameter to **17:30**)
	Default: 00:00

Used in conjunction with *2.7.2.2.4.Peak 1 End Time* to define the high cost period.

For instructions on how to edit parameters with a string editor, see **Using the string editor:** on page 187.

Parameters

2.7.2.2.4. Peak 1 End Time

Sets the end time of the high energy cost period 1.

Values	Range: **00:00 to 23:59**
	Format: HH:MM (24 hour format, e.g. for 5:30pm, set parameter to **17:30**)
	Default: 00:00

Used in conjunction with *2.7.2.2.3.Peak 1 Start Time* to define the high cost period.

For instructions on how to edit parameters with a string editor, see **Using the string editor:** on page 187.

2.7.2.2.5. Peak 2 Start Time

Sets the start time of the high energy cost period 2.

Values	Range: **00:00 to 23:59**
	Format: HH:MM (24 hour format, e.g. for 5:30pm, set parameter to **17:30**)
	Default: 00:00

Used in conjunction with *2.7.2.2.6.Peak 2 End Time* to define the high cost period.

2.7.2.2.6. Peak 2 End Time

Sets the end time of the high energy cost period 2.

Values	Range: **00:00 to 23:59**
	Format: HH:MM (24 hour format, e.g. for 5:30pm, set parameter to **17:30**)
	Default: 00:00

Used in conjunction with *2.7.2.2.5.Peak 2 Start Time* to define the high cost period.

2.7.2.2.7. Peak 3 Start Time

Sets the start time of the high energy cost period 3.

Values	Range: **00:00 to 23:59**
	Format: HH:MM (24 hour format, e.g. for 5:30pm, set parameter to **17:30**)
	Default: 00:00

Used in conjunction with *2.7.2.2.8.Peak 3 End Time* to define the high cost period.

2.7.2.2.8. Peak 3 End Time

Sets the end time of the high energy cost period 3.

Values	Range: **00:00 to 23:59**
	Format: HH:MM (24 hour format, e.g. for 5:30pm, set parameter to **17:30**)
	Default: 00:00

Used in conjunction with *2.7.2.2.7.Peak 3 Start Time* to define the high cost period.

2.7.2.2.9. Peak 4 Start Time

Sets the start time of the high energy cost period 4.

Values	Range: **00:00 to 23:59**
	Format: HH:MM (24 hour format, e.g. for 5:30pm, set parameter to **17:30**)
	Default: 00:00

Used in conjunction with *2.7.2.2.10.Peak 4 End Time* to define the high cost period.

2.7.2.2.10. Peak 4 End Time

Sets the end time of the high energy cost period 4.

Values	Range: **00:00 to 23:59**
	Format: HH:MM (24 hour format, e.g. for 5:30pm, set parameter to **17:30**)
	Default: 00:00

Used in conjunction with *2.7.2.2.9.Peak 4 Start Time* to define the high cost period.

2.7.2.2.11. Peak 5 Start Time

Sets the start time of the high energy cost period 5.

Values	Range: **00:00 to 23:59**
	Format: HH:MM (24 hour format, e.g. for 5:30pm, set parameter to **17:30**)
	Default: 00:00

Used in conjunction with *2.7.2.2.12.Peak 5 End Time* to define the high cost period.

2.7.2.2.12. Peak 5 End Time

Sets the end time of the high energy cost period 5.

Values	Range: **00:00 to 23:59**
	Format: HH:MM (24 hour format, e.g. for 5:30pm, set parameter to **17:30**)
	Default: 00:00

Used in conjunction with *2.7.2.2.11.Peak 5 Start Time* to define the high cost period.

2.7.2.2.13. Peak ON Setpoint Pump 1

Sets the process point at which Pump 1 will turn on when in a peak period.

Values	Range: **0.000 to 99999.000**
	Default: 0.000

To allow the level to go beyond the normal Relay ON Setpoint before a pump is started, enter the value to be used for the high-energy cost period.

2.7.2.2.14. Peak OFF Setpoint Pump 1

Sets the process point at which Pump 1 will turn off when in a peak period.

Values	Range: **0.000 to 99999.000**
	Default: 0.000

To stop the pump(s) before the normal relay OFF Setpoint and reduce pump-running time. Enter the value to be used for the high cost period.

2.7.2.2.15. Peak ON Setpoint Pump 2

Sets the process point at which Pump 2 will turn on when in a peak period.

Values	Range: **0.000 to 99999.000**
	Default: 0.000

To allow the level to go beyond the normal Relay ON Setpoint before a pump is started, enter the value to be used for the high-energy cost period.

2.7.2.2.16. Peak OFF Setpoint Pump 2

Sets the process point at which Pump 2 will turn off when in a peak period.

Values	Range: **0.000 to 99999.000**
	Default: 0.000

To stop the pump(s) before the normal relay OFF Setpoint and reduce pump-running time. Enter the value to be used for the high cost period.

2.7.2.3. Pump Run-On

Available only on LUT430 (Pump and Flow model) and LUT440 (OCM model).

*For details on relay behaviour under fail-safe conditions, see **Pump relays** on page 66.*

2.7.2.3.1. Enable

Enables/disables Pump Run-On.

Options		ENABLED
	*	DISABLED

2.7.2.3.2. Run-On Interval

The number of hours between pump run-on occurrences.

Values	Range: **0.00 to 1000.00**
	Default: 0.00

To clear sediment in a pump-down wet well, run the pump after the normal OFF setpoint is reached to force some solid material through. This parameter sets the time between such events. Only the last pump running can run-on.

2.7.2.3.3. Run-On Duration Pump 1

The number of seconds that the pump will run-on.

Values	Range: **0 to 65535**
	Default: 0

Each pump capacity will determine the amount of material that can be removed. Choose a value long enough to clean out the vessel bottom, yet short enough not to run the pump dry. Also be sure that this value does not overlap with **Run-On Interval (2.7.2.3.2.)**.

2.7.2.3.4. Run-On Duration Pump 2

The number of seconds that the pump will run-on.

Values	Range: **0 to 65535**
	Default: 0

Each pump capacity will determine the amount of material that can be removed. Choose a value long enough to clean out the vessel bottom, yet short enough not to run the pump dry. Also be sure that this value does not overlap with **Run-On Interval (2.7.2.3.2.)**.

2.7.2.4. Pump Start Delays

Available only on LUT430 (Pump and Flow model), and LUT440 (OCM model).

2.7.2.4.1. Delay Between Starts

The minimum delay (in seconds) between pump starts.

Values	Range: **0 to 65535**
	Default: 10

Use this feature to reduce a power surge from all pumps starting at the same time. This delay determines when the next pump is permitted to start.

Note: If a delay is configured, it will be respected when in simulation mode (see **Pump relay behaviour during simulation** on page 121).

2.7.2.4.2. Power Resumption Delay

The minimum delay (in seconds) before the first pump restart after a power failure.

Values	Range: **0 to 65535**
	Default: 60

This reduces the power surge from multiple instruments starting their pumps immediately on power resumption. When this delay expires, other pumps will start as per *2.7.2.4.1.Delay Between Starts*.

2.7.3. Totalizers

Available only on LUT430 (Pump and Flow model), and LUT440 (OCM model).

Note: Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

2.7.3.1. Running Totalizer

Current pumped volume totalizer value in 2.6.2.Volume Units.

Values	Range: **0.00 to 999999999**
	Default: 0.00

Pumped volume is automatically calculated whenever both Volume and Pumps are configured.

2.7.3.2. Totalizer Decimal Position

Sets the maximum number of decimal places to be displayed on the LCD.

Options		NO DIGITS	No digits after the decimal position
		1 DIGIT	1 digit after the decimal point
	*	2 DIGITS	2 digits after the decimal point
		3 DIGITS	3 digits after the decimal point

Parameters

2.7.3.3. Totalizer Multiplier

Use this feature if the LCD Total increments by an amount that is too large (or too small).

Options		.001
		.01
		.1
	*	1
		10
		100
		1000
		10,000
		100,000
		1,000,000
		10,000,000

Enter the factor by which actual volume is divided, prior to display on LCD. Use a value such that the nine-digit totalizer doesn't roll over between readings.

Example:

*For an LCD Total display in 1000s of volume units, enter **1000**. In this example, **10,000** volume units would display as **10**.*

2.7.3.4. Inflow/Discharge Adjust

Determines how inflow (or discharge) adjustment is made.

Options	*	BASED ON RATE ESTIMATION	The inflow rate measured just prior to the start of the pump cycle is used to estimate the inflow for the duration of the cycle.
		BASED ON PUMP CYCLE	The inflow is calculated using the change of volume between the end of the last pump cycle and the start of the next one, and the time period between the last cycle and the current one.
		NO ADJUSTMENT	No inflow adjustment is made (assumes an inflow of zero).

For an illustration, see Pump Totalizers on page 264.

2.7.3.5. Reset Running Totalizer

*Select **YES** to reset pumped volume totalizer value to zero.*

Options	*	NO
		YES

2.8. Alarms

The SITRANS LUT400 supports eight alarm types. Any alarm can be assigned to any available relay.
It is possible to assign more than one alarm to the same relay. In this case, the relay will activate if any one of the alarms is activated. If no alarms are activated, the relay will become inactive.
For details on relay behaviour under fail-safe conditions, see ***Alarm relays*** *on page 66.*

Note: Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

2.8.1. High Level Alarm

Reported when material level is within a user-defined range (see 2.8.1.2.High Level Value ON and 2.8.1.3.High Level Value OFF).
Can be used in conjunction with 2.8.12.Time To Spill feature.

2.8.1.1. Enable

Enables/disables High Level Alarm.

Options		ENABLED
	*	DISABLED

2.8.1.2. High Level Value ON

Sets the material level (defined in 2.1.1.Units) at which the High Level Alarm will activate.

Values	Range: **0.000 to 99999.000**
	Default: 0.000

Value must be lower than Level To Spill (2.8.12.1.) if Time to Spill feature is used.

2.8.1.3. High Level Value OFF

Sets the material level (defined in 2.1.1.Units) at which the High Level Alarm will de-activate.

Values	Range: **0.000 to 99999.000**
	Default: 0.000

2.8.1.4. Assigned Relay

Determines which relay (if any) will be activated when the High Level Alarm activates.

Options	*	NO RELAY
		RELAY 1
		RELAY 2
		RELAY 3

2.8.1.5. Alarm State

Read only. Used to view the current state of the High Level Alarm.

Options	ACTIVE
	INACTIVE

Parameters

2.8.2. Low Level Alarm

Reported when material level is within a user-defined range (see 2.8.2.2.Low Level Value ON and 2.8.2.3.Low Level Value OFF).

2.8.2.1. Enable

Enables/disables Low Level Alarm.

Options		ENABLED
	*	DISABLED

2.8.2.2. Low Level Value ON

Sets the material level (defined in 2.1.1.Units) at which the Low Level Alarm will activate.

Values	Range: **0.000 to 99999.000**
	Default: 0.000

2.8.2.3. Low Level Value OFF

Sets the material level (defined in 2.1.1.Units) at which the Low Level Alarm will de-activate.

Values	Range: **0.000 to 99999.000**
	Default: 0.000

2.8.2.4. Assigned Relay

Determines which relay (if any) will be activated when the Low Level Alarm activates.

Options	*	NO RELAY
		RELAY 1
		RELAY 2
		RELAY 3

2.8.2.5. Alarm State

Read only. Used to view the current state of the Low Level Alarm.

Options	ACTIVE
	INACTIVE

2.8.3. Switch (Discrete Input) Alarm

Reported when Discrete Input (2.8.3.2.Discrete Input Number) is in a pre-defined state (2.8.3.3.Discrete Input State).

2.8.3.1. Enable

Enables/disables Switch Alarm.

Options		ENABLED
	*	DISABLED

2.8.3.2. Discrete Input Number

Determines which discrete input to monitor for Switch Alarm.

Options	*	DISCRETE INPUT 1
		DISCRETE INPUT 2

2.8.3.3. Discrete Input State

Sets the state of the discrete input (2.8.3.2.Discrete Input Number) that will cause the Switch Alarm to activate.

Options	*	ON
		OFF

2.8.3.4. Assigned Relay

Determines which relay (if any) will be activated when the Switch Alarm activates.

Options	*	NO RELAY
		RELAY 1
		RELAY 2
		RELAY 3

2.8.3.5. Alarm State

Read only. Used to view the current state of the Switch Alarm.

Options	ACTIVE
	INACTIVE

2.8.4. In-bounds Level Alarm

Reported when material level is within a user-defined range (see 2.8.4.2.High Level Value and 2.8.4.3.Low Level Value).

2.8.4.1. Enable

Enables/disables In-bounds Level Alarm.

Options		ENABLED
	*	DISABLED

2.8.4.2. High Level Value

Sets the upper level value for range within which the In-bounds Level Alarm will activate.

Values	Range: **0.000 to 99999.000**
	Default: 0.000

2.8.4.3. Low Level Value

Sets the lower level value for range within which the In-bounds Level Alarm will activate.

Values	Range: **0.000 to 99999.000**
	Default: 0.000

Parameters

2.8.4.4. Assigned Relay

Determines which relay (if any) will be activated when the In-bounds Level Alarm activates.

Options	*	NO RELAY
		RELAY 1
		RELAY 2
		RELAY 3

2.8.4.5. Alarm State

Read only. Used to view the current state of the In-bounds Level Alarm.

Options	ACTIVE
	INACTIVE

2.8.5. Out-of-bounds Level Alarm

Reported when material level is outside a user-defined range (see 2.8.5.2.High Level Value or *2.8.5.3.Low Level Value*).

2.8.5.1. Enable

Enables/disables Out-of-bounds Level Alarm.

Options		ENALBED
	*	DISABLED

2.8.5.2. High Level Value

Sets the upper level value for range outside of which the Out-of-bounds Level Alarm will activate.

Values	Range: **0.000 to 99999.000**
	Default: 0.000

2.8.5.3. Low Level Value

Sets the lower level value for range outside of which the Out-of-bounds Level Alarm will activate.

Values	Range: **0.000 to 99999.000**
	Default: 0.000

2.8.5.4. Assigned Relay

Determines which relay (if any) will be activated when the Out-of-bounds Level Alarm activates.

Options	*	NO RELAY
		RELAY 1
		RELAY 2
		RELAY 3

Parameters

2.8.5.5. Alarm State

Read only. Used to view the current state of the Out-of-bounds Level Alarm.

Options	ACTIVE
	INACTIVE

2.8.6. Low Temperature Alarm

Reported when process temperature is within a user-defined range (see 2.8.6.2.Low Temperature Value ON and 2.8.6.3.Low Temperature Value OFF).

2.8.6.1. Enable

Enables/disables Low Temperature Alarm.

Options		ENABLED
	*	DISABLED

2.8.6.2. Low Temperature Value ON

Sets the temperature value (defined in ° C) at which the Low Temperature Alarm will activate.

Values	Range: **-273.0 to +273.0** °C (-459.0 to +523.0 °F)
	Default: 0.0 °C

2.8.6.3. Low Temperature Value OFF

Sets the material level (defined in ° C) at which the Low Temperature Alarm will de-activate.

Values	Range: **-273.0 to +273.0** °C (-459.0 to +523.0 °F)
	Default: 0.0 °C

2.8.6.4. Assigned Relay

Determines which relay (if any) will be activated when the Low Temperature Alarm activates.

Options	*	NO RELAY
		RELAY 1
		RELAY 2
		RELAY 3

2.8.6.5. Alarm State

Read only. Used to view the current state of the Low Temperature Alarm.

Options	ACTIVE
	INACTIVE

2.8.7. High Temperature Alarm

Reported when process temperature is within a user-defined range (see 2.8.7.2.High Temperature Value ON and 2.8.7.3.High Temperature Value OFF).

The temperature used for the alarm is the same temperature used for sound velocity compensation (see 2.12.1.3.Temperature Source).

2.8.7.1. Enable

Enables/disables High Temperature Alarm.

Options		ENABLED
	*	DISABLED

2.8.7.2. High Temperature Value ON

Sets the temperature value (defined in ° C) at which the High Temperature Alarm will activate.

Values	Range: **-273.0 to +273.0** °C (-459.0 to +523.0 °F)
	Default: 100.0 °C

2.8.7.3. High Temperature Value OFF

Sets the material level (defined in ° C) at which the High Temperature Alarm will de-activate.

Values	Range: **-273.0 to +273.0** °C (-459.0 to +523.0 °F)
	Default: 100.0 °C

2.8.7.4. Assigned Relay

Determines which relay (if any) will be activated when the High Temperature Alarm activates.

Options	*	NO RELAY
		RELAY 1
		RELAY 2
		RELAY 3

2.8.7.5. Alarm State

Read only. Used to view the current state of the High Temperature Alarm.

Options	ACTIVE
	INACTIVE

2.8.8. Fail-safe Fault Alarm

Reported when fault that has caused a fail-safe condition is present.

2.8.8.1. Enable

Enables/disables Fail-safe Alarm.

Options		ENABLED
	*	DISABLED

Parameters

2.8.8.2. Assigned Relay

Determines which relay (if any) will be activated when the Fail-safe Alarm activates.

Options	*	NO RELAY
		RELAY 1
		RELAY 2
		RELAY 3

2.8.8.3. Alarm State

Read only. Use to view the current state of the Fail-safe Alarm.

Options	ACTIVE
	INACTIVE

2.8.9. High Flowrate Alarm

Available only on LUT440 (OCM model).

Reported when the OCM flowrate is within a user-defined range (see 2.8.9.2.High Flowrate Value ON and 2.8.9.3.High Flowrate Value OFF).

2.8.9.1. Enable

Enables/disables High Flowrate Alarm.

Options		ENABLED
	*	DISABLED

2.8.9.2. High Flowrate Value ON

Sets the flowrate value (defined in 2.15.3.7.Flowrate Units) at which the High Flowrate Alarm will activate.

Values	Range: **0 to 9999999**
	Default: 0

2.8.9.3. High Flowrate Value OFF

Sets the material level (defined in 2.15.3.7.Flowrate Units) at which the High Flowrate Alarm will de-activate.

Values	Range: **0 to 9999999**
	Default: 0

2.8.9.4. Assigned Relay

Determines which relay (if any) will be activated when the High Flowrate Alarm activates.

Options	*	NO RELAY
		RELAY 1
		RELAY 2
		RELAY 3

2.8.9.5. Alarm State

Read only. Used to view the current state of the High Flowrate Alarm.

Options	ACTIVE
	INACTIVE

2.8.10. Low Flowrate Alarm

Available only on LUT440 (OCM model).

Reported when the OCM flowrate is within a user-defined range (see 2.8.10.2.Low Flowrate Value ON and 2.8.10.3.Low Flowrate Value OFF).

2.8.10.1. Enable

Enables/disables Low Flowrate Alarm.

Options		ENABLED
	*	DISABLED

2.8.10.2. Low Flowrate Value ON

Sets the flowrate value (defined in 2.15.3.7.Flowrate Units) at which the Low Flowrate Alarm will activate.

Values	Range: **0 to 9999999**
	Default: 0

2.8.10.3. Low Flowrate Value OFF

Sets the material level (defined in 2.15.3.7.Flowrate Units) at which the Low Flowrate Alarm will de-activate.

Values	Range: **0 to 9999999**
	Default: 0

2.8.10.4. Assigned Relay

Determines which relay (if any) will be activated when the Low Flowrate Alarm activates.

Options	*	NO RELAY
		RELAY 1
		RELAY 2
		RELAY 3

2.8.10.5. Alarm State

Read only. Used to view the current state of the Low Flowrate Alarm.

Options	ACTIVE
	INACTIVE

2.8.11. Relay Logic

Relay contact operation is NORMALLY CLOSED for alarms and NORMALLY OPEN for controls.

By default an alarm contact is **Normally Closed**. When an alarm activates, the corresponding relay coil is de-energized. By setting this parameter to **Normally Open**, the relay coil will be energized when an alarm assigned to the relay activates.

2.8.11.1. Relay 1 Logic

Use to change the behaviour of Relay 1 when assigned to an alarm.

Options		NORMALLY OPEN
	*	NORMALLY CLOSED

2.8.11.2. Relay 2 Logic

Use to change the behaviour of Relay 2 when assigned to an alarm.

Options		NORMALLY OPEN
	*	NORMALLY CLOSED

2.8.11.3. Relay 3 Logic

Use to change the behaviour of Relay 3 when assigned to an alarm.

Options		NORMALLY OPEN
	*	NORMALLY CLOSED

2.8.12. Time To Spill

Used to predict when an overflow (spill) condition may occur. This feature works in conjunction with the 2.8.1.High Level Alarm.

2.8.12.1. Level To Spill

Value (defined in 2.1.1.Units) representing material level at which a spill will occur.

Options	**-999999.000 to 999999.000**
	Default: 0.000

This value must be greater than high level alarm ON setpoint [High Level Value ON (2.8.1.2.)].

2.8.12.2. Minutes Left To Spill

Read only. Calculated value representing minutes remaining before a spill will occur.

Enter the level at which a spill condition will occur in *2.8.12.1.Level To Spill*. When the High Level Alarm is tripped, the estimated time to spill is displayed in *2.8.12.2.Minutes Left To Spill*. The estimated time is calculated by the LUT400 based on the material level and the rate of change of the material level. If the High Level alarm is not tripped, or the material level is falling, then the estimated time to spill will display as zero.

2.9. Discrete Inputs

Discrete inputs are used to trigger or alter the way SITRANS LUT400 controls devices such as pumps and alarms. Discrete inputs can be used for the following:

- as a backup level override
- allowing the device to be more flexible by interlocking control functions with external conditions.

For more detail see Discrete Inputs on page 69.

Note: Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

2.9.1. Backup Level Override

Use this feature to override the material reading by a discrete input such as a contacting point device. The material reading will be fixed at the programmed switch level until the discrete input is released. The LUT400 makes decisions based on the override values.

2.9.1.1. Enable

Enables/disables the Backup Level Override function.

Options		ENABLED
	*	DISABLED

2.9.1.2. Level Override Value

This value is substituted for the current reading when the selected discrete input is enabled and ON.

Values	Range: **0.000 to 60.000**
	Default: 0.000

Value is defined in current *2.1.1.Units*, and is valid only for level (and head when *2.1.2.Sensor Mode* set to Flow). (Volume is calculated based on the Backup level.)

2.9.1.3. Discrete Input Number

Sets the discrete input to act as the source for a level reading override when enabled.

Options	*	DISCRETE INPUT 1
		DISCRETE INPUT 2

2.9.2. Discrete Input Logic

Use the following parameters to configure the discrete input itself.

Normal state is standard operation, with the SITRANS LUT400 sensing the material level and controlling the pumps, and no faults or alarms present. The discrete input contacts are either NORMALLY OPEN or NORMALLY CLOSED when the system state is normal.

Discrete Input Logic	Terminal Block	Discrete Input Scaled State
Normally Open	Voltage applied	ON
	No voltage applied	OFF
Normally Closed	Voltage applied	OFF
	No voltage applied	ON

For example:

When discrete input logic is set to Normally Open and discrete input has no voltage applied on the terminal block, the discrete input will be inactive (OFF).

2.9.2.1. Discrete Input 1 Logic

Use to change the behaviour of the Discrete Input 1.

Options	*	NORMALLY OPEN
		NORMALLY CLOSED

2.9.2.2. Discrete Input 1 Scaled State

Read only. Indicates the current state of Discrete Input 1.

Options		ON
	*	OFF

2.9.2.3. Discrete Input 2 Logic

Use to change the behaviour of Discrete Input 2.

Options	*	NORMALLY OPEN
		NORMALLY CLOSED

2.9.2.4. Discrete Input 2 Scaled State

Read only. Indicates the current state of Discrete Input 2.

Options		ON
	*	OFF

2.9.3. Pump Interlock

Available only on LUT430 (Pump and Flow model), and LUT440 (OCM model). Discrete inputs allow you to supply pump information to the SITRANS LUT400 so that it can modify pump algorithms. The following parameters are used to program actions that should take place when a pump is determined to be in a failed state. For example, a pump interlock can be used to ensure that any pump reporting a failure is removed from the pumping rotation.

2.9.3.1. Enable Pump 1

Enables/disables the pump start interlock. If ON, then Pump 1 will not start if the corresponding discrete input [Pump 1 Discrete Input (2.9.3.2.)] is active.

Options		ENABLED
	*	DISABLED

2.9.3.2. Pump 1 Discrete Input

Sets the discrete input to use for pump start interlock on Pump 1.

Options	*	DISCRETE INPUT 1
		DISCRETE INPUT 2

2.9.3.3. Enable Pump 2

Enables/disables the pump start interlock. If ON, then Pump 2 will not start if the corresponding discrete input [Pump 2 Discrete Input (2.9.3.4.)] is active.

Options		ENABLED
	*	DISABLED

2.9.3.4. Pump 2 Discrete Input

Sets the discrete input to use for pump start interlock on Pump 2.

Options	*	DISCRETE INPUT 1
		DISCRETE INPUT 2

2.10. Data Logging

Use data logging to keep track of a parameter value on regular intervals or when an event is triggered. Up to 3 data logs can be configured, and collectively the logs can hold approximately 30,000 entries. [To view these data logs, see View Logs (3.2.6.).]

Notes:

- No data logs are written while device is connected to a PC via USB.
- Always disable Data Logging before removing log files (when log memory becomes full). See **Viewing the Data Log** on page 119.

Parameters

2.10.1. Process Value Log

2.10.1.1. Enable

Enables/disables Process Value (PV) Logging.

Options		ENABLED
	*	DISABLED

2.10.1.2. Process Values Log Rate

Sets Process Value (PV) Logging rate in minutes.

Values	Range: **1 to 1440**
	Default: 1

2.10.2. Alarm Log

2.10.2.1. Enable

Enables/disables Alarm Logging.

Options		ENABLED
	*	DISABLED

2.10.3. Flow Log

Available only on LUT430 (Pump and Flow model), and LUT440 (OCM model).

Note: Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

2.10.3.1. Flow Log Mode

Menu number *2.10.3.1.* visible on LUT430 (Pump and Flow model).

OR

2.10.3.2. Flow Log Mode

Menu number *2.10.3.2.* visible on LUT440 (OCM model).

Sets flow log mode.

Options	*	OFF
		FIXED RATE
		VARIABLE PERCENTAGE MAX FLOW / MIN [a]
		VARIABLE PERCENTAGE MAX FLOW [a]
		VARIABLE PERCENTAGE MAX HEAD [a]

[a] Option available only for LUT440.

2.10.3.3. Standard Flow Log Interval

Sets standard flow log interval in minutes, when 2.10.3.1.Flow Log Mode set to a fixed or variable rate.

Values	Range: **1 to 1440**
	Default: 1

Parameters

2.10.3.4. Standard Flow Log Setpoint

Sets standard flow setpoint as a percent based on flow log mode, when 2.10.3.1.Flow Log Mode set to a variable rate.

Values	Range: **0.000 to 110.000**
	Default: 0.000

2.10.3.5. Rapid Flow Log Interval

Sets rapid flow log interval in minutes, when 2.10.3.1.Flow Log Mode set to a variable rate.

Values	Range: **1 to 1440**
	Default: 1

2.10.3.6. Rapid Flow Log Setpoint

Sets rapid flow setpoint as a percent based on flow logger mode, when 2.10.3.1.Flow Log Mode set to a variable rate.

Values	Range: **0.000 to 110.000**
	Default: 0.000

2.11. Other Control

Note: Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

2.11.1. Elapsed Time Relay

This function drives a relay based on an interval and duration of time. The relay toggles on and off at a rate set by the parameters below. (This relay is not affected by LOE, faults, alarms, or any other condition within the device.)

2.11.1.1. Enable

Enables/disables elapsed time relay control.

Options		ENABLED
	*	DISABLED

2.11.1.2. Interval

The interval in minutes from the activation of the relay until the next activation.

Values	Range: **0.1 to 99999** [a]
	Default: 60.0

a. Fractional values are allowed, such as 0.5 for 30 seconds

This value must be greater than the *2.11.1.3.Relay Duration* or the relay will never reset. The first activation occurs when the device is powered on.

2.11.1.3. Relay Duration

The time in seconds from one change of state in the relay to the next.

Values	Range: **1 to 9999**
	Default: 10

This value must be less than the *2.11.1.2.Interval* or the relay will never reset.

Parameters

2.11.1.4. Assigned Relay

Determines the relay assigned to elapsed time control.

Options	*	RELAY 1
		RELAY 2
		RELAY 3

2.11.1.5. Relay Logic

Use to change the behaviour of the relay assigned to elapsed time control.

Options	*	NORMALLY OPEN
		NORMALLY CLOSED

Relay contact operation is NORMALLY CLOSED for alarms and NORMALLY OPEN for controls.

By default a control contact is **Normally Open**. For *2.11.1.3.Relay Duration* the corresponding relay coil is energized. By setting this parameter to **Normally Closed**, the relay coil will be de-energized for the duration phase.

2.11.2. Time of Day Relay

This function drives a relay based on time of day. The relay toggles on and off at a rate set by the parameters below. This relay is not affected by LOE, faults, alarms, or any other condition within the device.

2.11.2.1. Enable

Enables/disables time of day relay control.

Options		ENABLED
	*	DISABLED

2.11.2.2. Activation Time

Sets time of day, using a 24-hour clock, at which the relay should activate.

Values	Range: **00:00 to 23:59**
	Format: HH:MM (24 hour format, e.g. for 5:30 pm, set parameter to **17:30**)
	Default: 00:00

For instructions on how to edit parameters with a string editor, see **Using the string editor:** on page 187.

2.11.2.3. Relay Duration

The time in seconds from one change of state in the relay to the next.

Values	Range: **1 to 9999**
	Default: 10

2.11.2.4. Assigned Relay

Determines the relay assigned to time of day control.

Options	*	RELAY 1
		RELAY 2
		RELAY 3

2.11.2.5. Relay Logic

Use to change the behaviour of the relay assigned to time of day control.

Options	*	NORMALLY OPEN
		NORMALLY CLOSED

Relay contact operation is NORMALLY CLOSED for alarms and NORMALLY OPEN for controls.

By default a control contact is **Normally Open**. For *2.11.2.3.Relay Duration* the corresponding relay coil is energized. By setting this parameter to **Normally Closed**, the relay coil will be de-energized for the duration phase.

2.11.3. External Totalizer

Available only on LUT430 (Pump and Flow model), and LUT440 (OCM model).

This function tracks the volume of material that passes through a system. The external totalizer controls a relay to signal an external totalizing device. The relay toggles on and off at a rate set by the parameters below. (For details on relay behaviour under fail-safe conditions, see ***Miscellaneous relays*** *on page 66.)*

Note: Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

2.11.3.1. Enable

Enables/disables external totalizer relay control.

Options		ENABLED
	*	DISABLED

2.11.3.2. Multiplier

Use to scale the external totalizer up or down as required.

Values	Range: **0.0000001 to 99999.000**
	Default: 1.000

This allows the totalizer relay to click for different values of volume.

Example:

To click once every 4310 units, set *2.11.3.2. Multiplier* to 4310.

2.11.3.3. Relay Duration

The time in seconds from one change of state in the relay to the next.

Values	Range: **0.1 to 1024.0**
	Default: 0.2

2.11.3.4. Assigned Relay

Determines the relay assigned to external totalizer control.

Options	*	RELAY 1
		RELAY 2
		RELAY 3

2.11.3.5. Relay Logic

Use to change the behaviour of the relay assigned to external totalizer control.

Options	*	NORMALLY OPEN
		NORMALLY CLOSED

Relay contact operation is NORMALLY CLOSED for alarms and NORMALLY OPEN for controls.

By default a control contact is **Normally Open**. For *2.11.3.3.Relay Duration* the corresponding relay coil is energized. By setting this parameter to **Normally Closed**, the relay coil will be de-energized for the activation phase.

2.11.4. External Sampler

Available only on LUT430 (Pump and Flow model), and LUT440 (OCM model).

This function uses a relay to signal a flow sampling device when a certain volume of material has passed through a system (set by the Multiplier), or after a defined period of time (set by the Interval). The relay toggles on and off at a rate set by the parameters below. (For details on relay behaviour under fail-safe conditions, see ***Miscellaneous relays*** *on page 66.)*

Note: Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

2.11.4.1. Enable

Enables/disables flow sampler relay control.

Options		ENABLED
	*	DISABLED

2.11.4.2. Multiplier

Use to scale the external sampler up or down as required.

Values	Range: **0.0000001 to 99999.000**
	Default: 1.000

This allows the sampler relay to click for different values of volume.

Example:

To click once every 4310 flow units, set *2.11.4.2. Multiplier* to 4310.

2.11.4.3. Interval

The time in hours from the activation of the relay until the next activation.

Values	Range: **0.10 to 99999.00**
	Default: 1.00

Set the time to activate the relay during low-flow conditions.

2.11.4.4. Relay Duration

The time in seconds from one change of state in the relay to the next.

Values	Range: **0.1 to 1024.0**
	Default: 0.2

This value must be less than the *2.11.4.3.Interval* or the relay will never reset.

2.11.4.5. Assigned Relay

Determines the relay assigned to flow sampler control.

Options	*	RELAY 1
		RELAY 2
		RELAY 3

2.11.4.6. Relay Logic

Use to change the behaviour of the relay assigned to flow sampler control.

Options	*	NORMALLY OPEN
		NORMALLY CLOSED

Relay contact operation is NORMALLY CLOSED for alarms and NORMALLY OPEN for controls.

By default a control contact is **Normally Open**. For *2.11.4.3.Interval* the corresponding relay coil is energized. By setting this parameter to **Normally Closed**, the relay coil will be de-energized for the activation phase.

2.12. Signal Processing

Note: Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

2.12.1. Temperature and Velocity

2.12.1.1. Sound Velocity

*The value adjusted based on the **Sound Velocity at 20 degrees C (2.12.1.5.)** vs. **Process Temperature (2.12.1.2.)** characteristics of air.*

Values	Range: **125.000 to 20000.000** m/s
	Default: 344.130 m/s

Alternatively, enter the current sound velocity (if known), or perform an *2.12.1.6.Auto Sound Velocity* calibration. Value is always reported in m/s.

2.12.1.2. Process Temperature

View the transducer temperature in °C.

If **Temperature Source (2.12.1.3.)** is set to any value other than **Fixed Temperature (2.12.1.4.)**, the value displayed is the temperature measured. If Temperature Source is set to **Temp Fixed**, the **Fixed Temperature (2.12.1.4.)** value is displayed.

2.12.1.3. Temperature Source

Source of the temperature reading used to adjust the speed of sound.

Options	*	TRANSDUCER
		FIXED TEMPERATURE
		EXTERNAL TS-3
		AVERAGE OF SENSORS (Transducer and TS-3)

With this default, the SITRANS LUT400 uses the transducer's internal temperature sensor (standard in all Siemens EchoMax Transducers).

If the transducer does not have an internal temperature sensor, Fixed Temperature value, or an External TS-3 temperature sensor can be used.

If the acoustic beam atmosphere temperature varies with distance from the transducer, connect a TS-3 Temperature Sensor and Ultrasonic/ Temperature Transducer, and select Average of Sensors (Transducer and TS-3).

In gasses other than air, the temperature variation may not correspond with the speed of sound variation. In these cases, turn off the temperature sensor, select value Fixed Temperature, and set a fixed temperature [see **Fixed Temperature (2.12.1.4.)**].

If Ultrasonic/Temperature Transducer, TS-3 Temperature Sensor, or Average of Sensors value is selected, faults on the temperature sensors will be displayed if the sensor appears open or short.

When a transducer temperature sensor fault occurs, Temperature Source can be set to FIXED. This allows the device to continue measuring (and no cable fault will display), until the transducer is replaced. Once replaced, set Temperature Source back to its original setting.

2.12.1.4. Fixed Temperature

Use this feature if a temperature sensing device is not used.

Values	Range: **-100.0 to +150.0** °C
	Default: +20.0 °C

Enter the temperature (in °C) of the atmosphere within the transducer acoustic beam. If the temperature varies with distance from the transducer, enter the average temperature.

2.12.1.5. Sound Velocity at 20 degrees C

This value is used to automatically calculate sound velocity.

Values	Range: **125.000 to 20000.000** m/s
	Default: 344.13 m/s

If the acoustic beam atmosphere sound velocity at 20°C (68 °F) is known, and the sound velocity vs. temperature characteristics are similar to that of **air** (344.1 m/s), enter the sound velocity. Units displayed in meters per second (m/s).

2.12.1.6. Auto Sound Velocity

> **Note:** Auto Sound Velocity supports adjustments to distance value only.

Adjusts the speed of sound and changes the distance measurement calculations. Defined in 2.1.1.Units.

Values	Range: **0.000 to 60.000**

Condition for use of this feature:

- The acoustic beam atmosphere is other than air
- The acoustic beam atmosphere temperature is unknown
- The Reading accuracy is acceptable at higher material levels only

For best results, calibrate with the level at a known value near Low Calibration Point.

Using Auto Sound Velocity:

Start with a steady distance at a known high distance value (high distance value equates to a low level value).

1. Review the distance measurement via LUI for approximately 30 seconds to verify repeatability.

2. Measure the actual distance (for example, with a tape measure).

3. Enter the actual distance, defined in *2.1.1.Units*.

Repeat this procedure if the atmosphere type, concentration, or temperature conditions are different from when the last sound velocity calibration was performed.

> **Note:** In gasses other than air, the temperature variation may not correspond with the speed of sound variation. Turn off temperature sensor and use a fixed temperature.

2.12.2. Echo Select

2.12.2.1. Algorithm

Selects the algorithm to be applied to the echo profile to extract the true echo.

Options		TF	TRUE FIRST	**T**rue **F**irst echo
		TR	TRACKER	**TR**acker
		L	LARGEST ECHO	**L**argest echo
	*	BLF	BEST F-L	**B**est of **F**irst and **L**argest echo
		ALF	AREA LARGEST FIRST	**A**rea, **L**argest and **F**irst

For more details, see **Algorithm** on page 257.

Parameters

2.12.2.2. Echo Threshold

*Sets the minimum echo confidence that the echo must meet in order to prevent a Loss of Echo condition and the expiration of the Fail-safe (LOE) timer. When **Confidence (3.2.9.2.)** exceeds **Echo Threshold (2.12.2.2.)**, the echo is accepted as a valid echo and is evaluated.*

Values	Range: **-20 to 128**
	Default: 5

Use this feature when an incorrect material level is reported.

2.12.2.3. Reform Echo

Smooth jagged peaks in the echo profile.

Values	Range: **0 to 50** intervals[a] (greater = wider)
	Default: 0

a. one interval = span of 24.5 micro seconds

Use this feature when monitoring solids if the reported level fluctuates slightly though the monitored surface is still. Enter the amount (in ms) of Echo Profile smoothing required. When a value is keyed in, the nearest acceptable value is entered.

2.12.2.4. Narrow Echo Filter

Filters out echoes of a specific width.

Values	Range: **0 to 14** intervals[a] (greater = wider)
	Default: 2

a. one interval = span of 24.5 micro seconds

Use this for transducer acoustic beam interference (e.g. ladder rungs). Enter the width of false echoes (in groups of 25 ms), to be removed from the Echo Profile. [For example, select value of 3 to remove 75 ms (3 x 25 ms) of false echos from the profile.]

When a value is keyed in, the nearest acceptable value is entered.

2.12.2.5. Submergence Detection

Enables/disables submergence detection.

Values		Enabled
	*	Disabled

(Submergence Detection Shield must first be installed on transducer.)
When this parameter is enabled and the transducer becomes submerged:

- fault code 26 is displayed (see **General Fault Codes** on page 231),
- mA output immediately advances to **Minimum mA Limit (2.5.5.)** or **Maximum mA Limit (2.5.6.)**, as defined by the application,
- DISTANCE is set to zero (corresponding to a high level),
- pumps and alarms operate normally (according to level), therefore they remain ON (or activate if not already ON).

The submergence condition remains in effect until the transducer is no longer submerged. A valid echo must then be detected before the LOE Timer expires or the device will enter fail-safe condition (see *2.4. Fail-Safe*).

2.12.3. TVT Setup

Note: Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

2.12.3.1. Auto False Echo Suppression

*Used together with **Auto False Echo Suppression Range (2.12.3.2.)** to screen out false echoes in a vessel with known obstructions. A 'learned TVT' (time varying threshold) replaces the default TVT over a specified range. See **Shaper Mode and Auto False Echo Suppression** on page 258 for a more detailed explanation.*

Notes:
- Make sure material level is below all known obstructions when Auto False Echo Suppression is used to learn the echo profile. (An empty or almost empty vessel is recommended.)
- Note the distance to material level when Auto False Echo learns the environment. Set Auto False Echo Suppression Range to a shorter distance to avoid the material echo being screened out.
- Set Auto False Echo Suppression and Auto False Echo Suppression Range during startup, if possible.
- All other tuning and filter adjustments (such as *2.12.2.4. Narrow Echo Filter*, *2.12.2.3. Reform Echo*, *2.12.3.3. Hover Level*, etc.) should be completed prior to using Auto False Echo Suppression to ensure that the learned profile is representative.

a) Determine Auto False Echo Suppression Range. Measure the actual distance from the sensor reference point to the material surface using a rope or tape measure.

b) Subtract 0.5 m (20") from this distance, and use the resulting value.

To set Auto False Echo Suppression via SIMATIC PDM:

Open the menu **Device – Echo Profile Utilities** and click on the tab **Auto False Echo Suppression.**

(For more detailed instructions see *Auto False Echo Suppression* in LUT400 Communications manual[1].)

Parameters

1. Communications for SITRANS LUT400 (HART) Manual (7ML19985NE01)

To set Auto False Echo Suppression via the local push buttons:

Options		OFF	Default TVT will be used.
	*	ON	'Learned' TVT will be used.
		LEARN	'Learn' the TVT.

c) Navigate to **Setup (2.) > Signal Processing (2.12.) > TVT Setup (2.12.3.) > Auto False Echo Suppression Range (2.12.3.2.)**, and enter the value calculated in step b).

d) Navigate to **Setup (2.) > Signal Processing (2.12.) > TVT Setup (2.12.3.) > Auto False Echo Suppression (2.12.3.1.)**, and press **RIGHT arrow** to open Edit Mode

e) Select **Learn.** The device will automatically revert to **On** (Use Learned TVT) after a few seconds.

2.12.3.2. Auto False Echo Suppression Range

*Specifies the range within which Learned TVT is used (see **Auto False Echo Suppression** on page 183 for more detail).*

Values	Range: **0.000** to **60.000 m**
	Default: 1.000

a) Calculate range according to **Auto False Echo Suppression (2.12.3.1.)** steps a) and b).

b) Press **RIGHT arrow** to open Edit mode.

c) Enter the new value and press **RIGHT arrow** to accept it.

d) Navigate to **Setup (2.) > Signal Processing (2.12.) > TVT Setup (2.12.3.) > Auto False Echo Suppression (2.12.3.1.)**, and set value.

2.12.3.3. Hover Level

*Defines how high the TVT (Time Varying Threshold) is placed above the noise floor of the echo profile, as a percentage of the difference between the peak of the largest echo in the profile and the noise floor. See **Example before Auto False Echo Suppression** on page 259 for an illustration.*

Values	Range: **0** to **100**
	Default: **40**

When the device is located in the center of the vessel, the TVT hover level may be lowered to increase the confidence level of the largest echo.

2.12.3.4. Shaper Mode

Enables/disables the TVT shaper.

Options		ON
	*	OFF

Turn TVT Shaper Mode ON before using *2.12.4.TVT Shaper*. Turn the TVT Shaper **ON** and **OFF** while monitoring the effect to pick up the true echo.

2.12.4. TVT Shaper

Adjusts the TVT (Time Varying Threshold) at a specified range (breakpoint on the TVT). This allows you to reshape the TVT to avoid unwanted echoes. There are 40 breakpoints arranged in 5 groups. (We recommend using SIMATIC PDM to access this feature.)

To use TVT shaper via SIMATIC PDM:

a) Open the menu **Device – Echo Profile Utilities** and click on **TVT Shaper.** (For more details see *TVT Shaper* in LUT400 Communications manual[1].)

To use TVT shaper via local push buttons:

a) Navigate to **Setup (2.) > Signal Processing (2.12.) > TVT Setup (2.12.3.) > Shaper Mode (2.12.3.4.),** and select **ON**.
b) From the TVT Setup menu, **LEFT ARROW** to the Signal Processing menu, and **DOWN ARROW** to TVT Shaper. **RIGHT ARROW** to enter the TVT Shaper menu and **RIGHT ARROW** to edit **Breakpoint 1-8 (2.12.4.1.)**.
c) Open TVT Breakpoint 1 enter the TVT Offset value (between –50 and 50).
d) Go to the next TVT Breakpoint and repeat steps c) and d) till all desired breakpoint values have been entered.

2.12.4.1. Breakpoint 1-8

Values	Range: –**50** to **50** dB
	Default: **0** dB

2.12.4.2. Breakpoint 9-16

Values	Range: –**50** to **50** dB
	Default: **0** dB

2.12.4.3. Breakpoint 17-24

Values	Range: –**50** to **50** dB
	Default: **0** dB

2.12.4.4. Breakpoint 25-32

Values	Range: –**50** to **50** dB
	Default: **0** dB

2.12.4.5. Breakpoint 33-40

Values	Range: –**50** to **50** dB
	Default: **0** dB

Parameters

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2.12.5. Measured Values

Read only. Allows you to view measured values for diagnostic purposes.

To access measured values via SIMATIC PDM:

Open the menu **View – Process Variables.**

> **Note:** These parameters will display the simulated value when in simulation mode (see **Simulation process** on page 122).

2.12.5.1. Level Measurement

*The distance to monitored surface referenced from **Low Calibration Point (2.2.1.)**, defined in **Units (2.1.1.)**.*

2.12.5.2. Space Measurement

*The distance to monitored surface referenced from **High Calibration Point (2.2.2.)**, defined in **Units (2.1.1.)**.*

2.12.5.3. Distance Measurement

*The distance to monitored surface referenced from the transducer face (sensor reference point), defined in **Units (2.1.1.)**.*

2.12.5.4. Volume Measurement

*The calculated vessel volume (calculated from level and scaled according to vessel shape) in **Volume Units (2.6.2.)**.*

2.12.5.5. Head Measurement

Available only on LUT430 (Pump and Flow model), and LUT440 (OCM model).
*Corresponds to Head [the distance from **Zero Head Offset (2.15.3.5.)** to the monitored surface in **Units (2.1.1.)**].*

2.12.5.6. Flow Measurement

Available only on LUT430 (Pump and Flow model) and LUT440 (OCM model).

*The calculated flowrate, defined in **Flowrate Units (2.15.3.7.)**.*

2.13. Display

> **Note:** Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

2.13.1. Local Display Backlight

Time the backlight remains on.

Options		OFF
	*	ON
		TIMED (on for five minutes after key press - takes effect in Measurement View only)

Available only via LUI.

Parameters

2.13.2. LCD Contrast

The factory setting is for optimum visibility at room temperature and in average light conditions. Extremes of temperature will lessen the contrast.

Values	Range: **0** (Low contrast) to **20** (High contrast)
	Default: **10**

Adjust the value to improve visibility in different temperatures and luminosity. Available only via LUI and web browser.

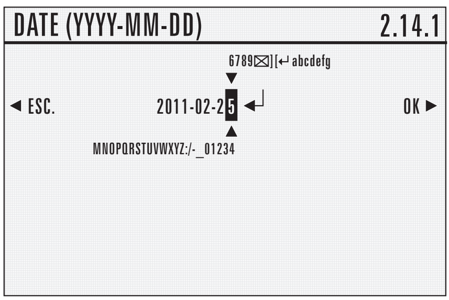
2.14. Date and Time

Enter the current date and time using the local push buttons.

Parameter **Edit** mode displays a string editor.

Using the string editor:

a) Use **RIGHT/LEFT arrow** to select the character position in the parameter field to be edited.



b) As each character is highlighted (selected), use the **UP/DOWN arrow** to change the character.
- Use the **DOWN arrow** to select a character from the string *above* the parameter value.
- Use the **UP arrow** to select a character from the string *below* the parameter value.

c) To escape without saving your changes, press **LEFT arrow** continually until **ESC** is highlighted. Press **LEFT arrow** again to escape without saving changes. Otherwise, when new parameter value is correct, press **RIGHT arrow** continually until **OK** is highlighted.

d) Press **RIGHT arrow** to accept the new value. The LCD returns to parameter view and displays the new selection. Review for accuracy.

Special Characters:

Character	Description	Function
:	colon	enters colon in text string
	space	enters space in text string
/	slash	enters slash in text string
-	hyphen	enters hyphen in text string
_	underscore	enters underscore in text string

Character	Description	Function
⊠	'x' in box	deletes highlighted character in text string
][	square brackets	inserts space between two characters in text string (limited to one space between characters)
↵	return arrow key	deletes characters (including currently highlighted character) to end of text string

2.14.1. Date

Date is the current date in the format: YYYY-MM-DD.

Values	Range: **1900-01-01 to 2155-12-31**

2.14.2. Time

Time is the current time in 24-hour format: HH:MM[:SS].

Values	Range: **00:00:00 to 23:59:59**

A value for seconds [:SS] is optional. If a value is not entered, the clock will default to 0 seconds.

2.14.3. Daylight Saving

Use the following parameters to enable and define start/end dates for daylight saving. (Start/end time of day is always 2:00am.)

Example:

Set the start of daylight saving to the second Sunday in February, and the end of daylight saving to the first Sunday in November:

Starting Ordinal = Second
Starting Day = Sunday
Starting Month = February
Ending Ordinal = First
Ending Day = Sunday
Ending Month = November

2.14.3.1. Enable

Enables/disables daylight saving.

Options		ENABLED
	*	DISABLED

2.14.3.2. Starting Ordinal

The order of the day within the month when daylight saving will begin.

Options		FIRST, SECOND, THIRD, FOURTH
	*	FIRST

Parameters

2.14.3.3. Starting Day

The day of the week on which daylight saving will begin.

Options		SUNDAY, MONDAY, TUESDAY, WEDNESDAY, THURSDAY, FRIDAY, SATURDAY
	*	SUNDAY

2.14.3.4. Starting Month

The month in which daylight saving will begin.

Options		JANUARY, FEBRUARY, MARCH, APRIL, MAY, JUNE, JULY, AUGUST, SEPTEMBER, OCTOBER, NOVEMBER, DECEMBER
	*	JANUARY

2.14.3.5. Ending Ordinal

The order of the day within the month when daylight saving will end.

Options		FIRST, SECOND, THIRD, FOURTH
	*	FIRST

2.14.3.6. Ending Day

The day of the week on which daylight saving will end.

Options		SUNDAY, MONDAY, TUESDAY, WEDNESDAY, THURSDAY, FRIDAY, SATURDAY
	*	SUNDAY

2.14.3.7. Ending Month

The month in which daylight saving will end.

Options		JANUARY, FEBRUARY, MARCH, APRIL, MAY, JUNE, JULY, AUGUST, SEPTEMBER, OCTOBER, NOVEMBER, DECEMBER
	*	JANUARY

2.15. Flow

Available only on LUT430 (Pump and Flow model) and LUT440 (OCM model).

Note: Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

2.15.1. Primary Measuring Device (PMD)

The type of primary measuring device (PMD) used.

Values	*	OFF (no calculation)
		EXPONENTIAL DEVICES
		RECTANGULAR FLUME BS-3680
		ROUND NOSE HORIZONTAL CR. BS-3680
		TRAPEZOIDAL FLUME BS-3680
		U-FLUME BS-3680
		FINITE CREST WEIR BS-3680
		THIN PLATE RECT. WEIR BS-3680
		THIN PLATE V-NOTCH WEIR BS-3680
		RECT. WEIR CONTRACTED
		ROUND PIPE
		PALMER BOWLUS FLUME
		H-FLUME
		UNIVERSAL HEAD FLOW

The LUT400 is pre-programmed for common PMD flow calculations. If your PMD is not listed, use a Universal Flow calculation. See**Universal calculation support** on page 116.

2.15.2. Auto Zero Head

Calibrates 2.15.3.5.Zero Head Offset (defined in 2.1.1.Units) based on actual head measurements.

Values	Range: **-60.000 to 60.000**
	Default: 0.000

Use this parameter when the reported head is consistently high or low by a fixed amount.

Before using this feature, verify the following parameters are correct:

- *2.2.1.Low Calibration Point*
- *2.12.1.2.Process Temperature*

With HEAD steady...

a) Measure the actual head (e.g. with a tape measure or solid rule)
b) Enter the actual head value

The deviation between the entered head value and the calibrated value, is stored in *2.15.3.5.Zero Head Offset*.

Parameters

2.15.3. Basic Setup

2.15.3.1. Method of Flow Calculation

Sets the method of flow calculation.

Options	*	ABSOLUTE
		RATIOMETRIC

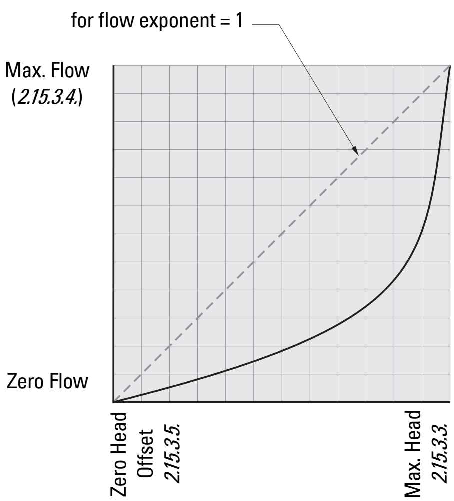
Set this parameter to **Ratiometric** only if the primary measuring device (PMD) supports ratiometric calculations. (Note that Palmer Bowlus Flume and H-Flume support ratiometric calculations only.) For more details on Absolute and Ratiometric calculations, see **Method of Flow Calculation** on page 266.

2.15.3.2. Flow Exponent

The exponent for the flow calculation formula.

Values	Range: **-999.000 to 9999.000**
	Default: 1.550

Use this parameter if the PMD is set to **Exponential devices**. It creates an exponential curve with end points set by *2.15.3.3.Maximum Head* and *2.15.3.5.Zero Head Offset* and with the curve based on the specified exponent.



Exponents

The exponential equation is:

$Q = KH^{\text{Flow Exponent (2.15.3.2.)}}$

Where:

Q = flow
K = constant factor
H = head

Use the exponent specified by the PMD manufacturer, if available, or relevant Open Channel Monitoring reference material.

2.15.3.3. Maximum Head

The maximum level value associated with the PMD and works in conjunction with 2.15.3.4.Maximum Flow at 20 mA for Ratiometric calculations. (Defined in 2.1.1.Units.)

Values	Range: **0.000 to 60.000**
	Default: 60.000

This represents the highest head level supported by the Primary Measuring Device (PMD) and works in conjunction with *2.15.3.4.Maximum Flow at 20 mA* to define the highest point in the exponential curve. Use it when the PMD requires a maximum head and flow reference point. Maximum Head must be set for all Absolute and Ratiometic PMDs.

2.15.3.4. Maximum Flow at 20 mA

The maximum flowrate associated with 2.15.3.3.Maximum Head shown in 2.15.3.7.Flowrate Units.

Values	Range: **0 to 9999999**
	Default: 100

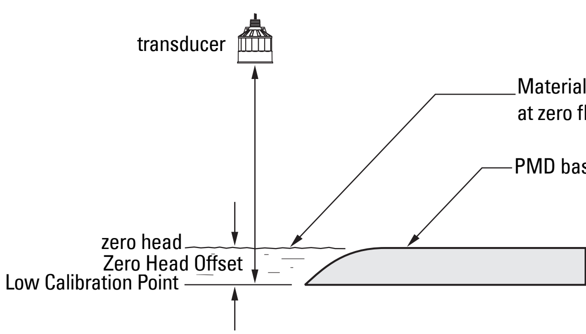
This represents the flow at the highest head level supported by the Primary Measuring Device (PMD) and works in conjunction with *2.15.3.3.Maximum Head* to define the highest point in the exponential curve. Use it when the PMD requires a maximum head and flow reference point. Maximum Flow must be set for all Absolute and Ratiometic PMDs.

2.15.3.5. Zero Head Offset

The difference (positive or negative) between Low Calibration Point and zero head (level at zero flow), defined in 2.1.1.Units.

Values	Range: **-60.000 to 60.000**
	Default: 0.000

This feature can be used for most weirs and some flumes (e.g. Palmer Bowlus) where the zero reference is at a higher elevation than the channel bottom.



2.15.3.6. Flowrate Decimal

The maximum number of decimal places to be displayed.

Options	*	NO DIGITS	no digits after the decimal point
		1 DIGIT	1 digit after the decimal point
		2 DIGITS	2 digits after the decimal point
		3 DIGITS	3 digits after the decimal point

2.15.3.7. Flowrate Units

The volume units used to display total flow.

Options	*	L/S (Litres per second)
		L/MIN (Litres per minute)
		CUFT/S (Cubic feet per second)
		CUFT/D (Cubic feet per day)
		GAL/MIN (US Gallons per minute)
		GAL/D (US Gallons per day)
		IMPGAL/MIN (Imperial Gallons per minute)
		IMPGAL/D (Imperial Gallons per day)
		CUM/H (Cubic meters per hour)
		CUM/D (Cubic meters per day)
		USER DEFINED (units defined in *2.15.3.8.User Defined Unit*)

2.15.3.8. User Defined Unit

*Set the unit text to display for current flow when 2.15.3.7.Flowrate Units set to **user-defined.** Limited to 16 ASCII characters.*

Notes: The text entered is simply for display purposes. No unit conversion occurs.

2.15.3.9. Low Flow Cutoff

Eliminates totalizer activity for head levels at or below the cutoff value.

Values	Range: **0.000 to 60.000**
	Default: 0.000

Enter the minimum head in *2.1.1.Units* where totalizer activity should cease.

2.15.4. PMD Dimensions

The dimensions of the Primary Measuring Device (PMD). (The dimensions of the vessel, wet well, or reservoir are only important if you require volume.)

Parameters

The following table is a reference to the parameters that must be set for each PMD. Parameter definitions follow the table.

Supported PMD	Dimensions required
Exponential Devices	
	2.15.3.2. Flow Exponent
	2.15.4.1. K Factor
Rectangular Flume BS-3680	
	2.15.4.5. OCM Dimension 1 - approach width B
	2.15.4.6. OCM Dimension 2 - throat width b
	2.15.4.7. OCM Dimension 3 - hump height p
	2.15.4.8. OCM Dimension 4 - throat length L
Round Nose Horizontal Crest Weir BS-3680	
	2.15.4.5. OCM Dimension 1 - crest width b
	2.15.4.6. OCM Dimension 2 - crest height p
	2.15.4.7. OCM Dimension 3 - crest length L
Trapezoidal Flume **BS-3680**	
	2.15.4.5. OCM Dimension 1 - approach width B
	2.15.4.6. OCM Dimension 2 - throat width b
	2.15.4.7. OCM Dimension 3 - hump height p
	2.15.4.8. OCM Dimension 4 - throat length L
	2.15.4.3. Slope
U-Flume BS-3680	
	2.15.4.5. OCM Dimension 1 - approach diameter Da
	2.15.4.6. OCM Dimension 2 - throat diameter D
	2.15.4.7. OCM Dimension 3 - hump height p
	2.15.4.8. OCM Dimension 4 - throat length L
Finite Crest Weir BS-3680	
	2.15.4.5. OCM Dimension 1 - crest width b
	2.15.4.6. OCM Dimension 2 - crest height p
	2.15.4.7. OCM Dimension 3 - crest length L

Supported PMDs (cont'd)	
Thin Plate Rectangular Weir BS-3680	
	2.15.4.5. OCM Dimension 1 - approach width B
	2.15.4.6. OCM Dimension 2 - crest width b
	2.15.4.7. OCM Dimension 3 - crest height p
Thin Plate V-Notch Weir BS-3680	
	2.15.4.2. V-Notch Angle
Rectangular Weir Contracted	
	2.15.4.5. OCM Dimension 1 - crest width b
Round Pipe	
	2.15.4.5. OCM Dimension 1 - pipe inside diameter D
	2.15.4.3. Slope
	2.15.4.4. Roughness Coefficient
Palmer Bowlus Flume	
	2.15.4.5. OCM Dimension 1 - maximum flume width hmax
H-Flume	
	2.15.4.5. OCM Dimension 1 - maximum listed head hmax
Universal Head Flow	
	2.15.5.1.1. Head 1 (up to 32)
	2.15.5.1.2. Flow 1 (up to 32)

2.15.4.1. K Factor

The constant used in the flow calculation formula for absolute calculation of an exponential device only.

Values	Range: **-999.000 to 9999.000**
	Default: 1.000

Use this parameter if the PMD is set to **Exponential devices**. The Constant Factor is used to create an exponential curve with end points set by *2.15.3.3. Maximum Head* and *2.15.3.5. Zero Head Offset*, and with the curve based on the specified exponent.

Parameters

2.15.4.2. V-Notch Angle

The V-Notch angle used in the flow calculation formula.

Values	Range: **25.000 to 95.000**
	Default: 25.000

Use when PMD is set to Thin Plate V-Notch Weir.

2.15.4.3. Slope

The Flow Slope used in the flow calculation formula.

Values	Range: **-999.000 to 9999.000**
	Default: 0.000

Use when PMD is set to Trapezoidal Flume or Round Pipe.

2.15.4.4. Roughness Coefficient

The Flow Roughness Coefficient used in the flow calculation formula.

Values	Range: **-999.000 to 9999.000**
	Default: 0.000

Use when PMD is set to Round Pipe.

2.15.4.5. OCM Dimension 1

2.15.4.6. OCM Dimension 2

2.15.4.7. OCM Dimension 3

2.15.4.8. OCM Dimension 4

See table under **PMD Dimensions (2.15.4.)** to relate OCM Dimension 1-4 above to a specific dimension for each directly supported Primary Measuring Device. For PMDs that are not directly supported (*Universal Head Flow*), use a Universal Flow calculation. See **Universal calculation support** on page 116.

For more information on PMD, see **Open Channel Monitoring (OCM)** on page 97.

2.15.5. Universal Head vs. Flow

In the following table, enter Head and Flow Breakpoints for universal PMDs.

*Head Breakpoints: The head breakpoints for which flowrate is known, defined in **Units (2.1.1.)**.*

*Flowrate Breakpoints: The flowrate corresponding to each Head Breakpoint entered, defined in **Flowrate Units (2.15.3.7.)**.*

Head Values	Range: **0.000 to 60.000**
	Default: 0.000
Flowrate Values	Range: **0 to 9999999**
	Default: 0

See **Universal calculation support** on page 116 for details on how to specify universal flows.

Parameters

Entering breakpoints via SIMATIC PDM:

See *Quick Start (Flow)* in the LUT400 Communications manual[1].

2.15.5.1. Table 1-8

2.15.5.1.1. Head 1

2.15.5.1.2. Flow 1

2.15.5.2. Table 9-16

2.15.5.2.1. Head 9

2.15.5.2.2. Flow 9

2.15.5.3. Table 17-24

2.15.5.3.1. Head 17

2.15.5.3.2. Flow 17

2.15.5.4. Table 25-32

2.15.5.4.1. Head 25

2.15.5.4.2. Flow 25

2.16. Totalizers

Available only on LUT430 (Pump and Flow model) and LUT440 (OCM model).

Note: Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

2.16.1. Daily Totalizer

Read only. Current daily totalizer value. (Automatically resets daily and can be reset by user.)

Values	Range: **0.00 to 999999999**
	Default: **0.00**

2.16.2. Running Totalizer

Read only. Current running totalizer value. (Reset only by user.)

Values	Range: **0.00 to 999999999**
	Default: **0.00**

2.16.3. Totalizer Decimal Position

Sets the maximum number of decimal places to be displayed.

Options		NO DIGITS	no digits after the decimal point
		1 DIGIT	1 digit after the decimal point
	*	2 DIGITS	2 digits after the decimal point
		3 DIGITS	3 digits after the decimal point

Parameters

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2.16.4. Totalizer Multiplier

Use this feature if the LCD Total increments by an amount that is too large (or too small).

Options		.001
		.01
		.1
	*	1
		10
		100
		1000
		10,000
		100,000
		1,000,000
		10,000,000

Enter the factor (powers of 10 only) by which actual flow is divided, prior to display on LCD. Use a value such that the eight-digit totalizer doesn't roll over between readings.

Example: For an LCD Total display in 1000s of flow units, enter 1000.

2.16.5. Reset Daily Totalizer

*Select **YES** to reset daily totalizer value to zero.*

Options	*	NO
		YES

2.16.6. Reset Running Totalizer

*Select **YES** to reset running totalizer value to zero.*

Options	*	NO
		YES

Parameters

3. Maintenance and Diagnostics

Note: Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

3.1. Identification

To edit parameters with a string editor (*3.1.1.* to *3.1.5.*), see **Using the string editor:** on page 187.

3.1.1. TAG

*Text that can be used in any way. A recommended use is as a unique label for a field device in a plant. Limited to 32 alphanumeric characters (8 characters via HART). Appears in top left corner of display in measurement mode (see **The LCD Display** on page 34).*

3.1.2. Long TAG

Text that can be used in any way. A recommended use is as a unique label for a field device in a plant. Limited to 32 alphanumeric characters.

3.1.3. Descriptor

Text that can be used in any way. Limited to 32 ASCII characters (16 ASCII characters via HART). No specific recommended use.

3.1.4. Message

Text that can be used in any way. Limited to 32 ASCII characters. No specific recommended use.

3.1.5. Installation Date

Date the device was first commissioned (YYYY-MM-DD).

Manufacturer

Read only. The device manufacturer (e.g. Siemens).

Product Name

Read only. Identifies the product by name (e.g. SITRANS LUT400).

3.1.6. Product

Read only. Identifies the product by name and capability:

SITRANS LUT420 (Level)

SITRANS LUT430 (Pump and Flow)

SITRANS LUT440 (OCM)

3.1.7. Order No. (Order Number in PDM)

Read only. Order number for the current device configuration (e.g. 7ML5050-0CA10-1DA0).

3.1.8. Serial Number

Read only. Unique factory set serial number of the device.

3.1.9. Final Assembly Number

Integer used to identify the device on site, e.g. enter '2' to denote second SITRANS LUT400 in application.

3.1.10. Hardware Revision

Read only. Corresponds to the electronics hardware of the Field Device.

3.1.11. Firmware Revision

Read only. Corresponds to the software or firmware that is embedded in the Field Device.

3.1.12. Loader Revision

Read only. Corresponds to the software used to update the Field Device.

EDD Version

Read only. Corresponds to the Electronics Device Description (EDD) installed with the device.

3.1.13. Manufacture Date (Date of Manufacturing in PDM)

The date of manufacture of the SITRANS LUT400 (YYYY-MM-DD).

3.1.14. Order Option

Read only. Displays the device type: Standard or NAMUR 43-compliant.

3.2. Diagnostics

Note: Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

3.2.1. Echo Profile

Allows you to request the current echo profile either locally via the local push buttons, or remotely via SIMATIC PDM.

To request a profile via the local push buttons:

a) In PROGRAM mode, navigate to **MAIN MENU > DIAGNOSTICS (3) > ECHO PROFILE (3.1)**

b) Press **RIGHT arrow** to request a profile.

Note: An **Echo Profile (3.2.1.)** cannot be requested from LUI when:
- **Transducer Enable (3.3.1.)** is set to DISABLED,
  or when
- **Transducer (2.1.6.)** is set to NO TRANSDUCER.
  In either case, the local push button will not operate.

For more detail see **Requesting an Echo Profile** on page 57.

For more details on how to interpret an Echo Profile, see **Echo Processing** on page 255.

To request a profile via SIMATIC PDM:

a) Open the menu **Device – Echo Profile Utilities**. (For more details see *Echo Profile Utilities* in LUT400 Communications manual.[1])

3.2.2. Trend

Read only. Display of level trends. Captures last 3000 PV values (logged at five minute intervals) in percentage of range (defined in 2.1.1.Units). For more information, see ***Trends*** *on page 118.*

3.2.3. Master Reset

Note: Following a reset to **Factory Defaults**, complete reprogramming is required.

Resets all parameter to factory defaults, with the following exceptions:

- Tag, Long Tag, Description, Message, Assembly Number
- **Device Address (4.1.)** and **Language (6.)** remain unchanged
- **Write Protection (5.1.)** value is not reset
- **Auto False Echo Suppression (2.12.3.1.)** learned TVT is not lost
- **Shaper Mode (2.12.3.4.)**, and breakpoints for **TVT Shaper (2.12.4.)** are not lost
- **Totalizers (2.7.3.)** values are not reset

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- **Date (2.14.1.)** and **Time (2.14.2.)** values are not reset

Options	*	DO NOTHING (Return to previous menu)
		FACTORY DEFAULTS

To perform a reset to factory defaults via SIMATIC PDM, open the menu **Device – Master Reset.**

3.2.4. Power-on Resets

The number of power cycles that have occurred since manufacture.

In SIMATIC PDM, open the menu **Device – Wear**.

3.2.5. Power-on Time

Displays the number of days the device has been powered on since manufacture.

In SIMATIC PDM, open the menu **Device – Wear**.

3.2.6. View Logs

View various log types with entries (to a collective maximum of approximately 30,000) listed by day. For a list of field names that coincide with the comma delimited log file on the PC, see ***Data Logging*** *on page 267.*

Notes:
- No data logs are written while device is connected to a PC via USB.
- To clear entries when log memory becomes full, see **Viewing the Data Log** on page 119.

3.2.6.1. Alarms

History of alarms. Displays type of alarm, value at which alarm triggered, state of alarm.

3.2.6.2. OCM

Flow logs. Displays head and flow values.

3.2.6.3. Daily Totals

Daily totals for both totalizers. Displays maximum and minimum values for flow and temperature, average flow, and daily totalizer (DT) and running totalizer (RT) values.

3.2.6.4. PV

Primary Variable. Displays PV type (e.g. Level), PV value and temperature.

Note: PV is controlled by the mA function (see *2.5.1. Current Output Function*). Therefore, the LUI operation can be changed (via *2.1.2. Sensor Mode*) without affecting the process being controlled.

3.2.7. Pump Records

Relay usage.

3.2.7.1. Run Time Relay 2

Read or set the total running time of Relay 2 in hours.

Values	Range: **0 to 999999**

3.2.7.2. Run Time Relay 3

Read or set the total running time of Relay 3 in hours.

Values	Range: **0 to 999999**

3.2.7.3. Relay Pump 1

Read only. Relay assigned to Pump 1.

To change the relay assignment, see *2.7.1.2. Relay Pump 1*.

3.2.7.4. Relay Pump 2

Read only. Relay assigned to Pump 2.

To change the relay assignment, see *2.7.1.3. Relay Pump 2*.

3.2.8. Temperature Peak Values

This feature displays the high and low process temperatures in °C.

If the device is powered up without a temperature sensor connected, the default fixed temperature value 20 °C is displayed [see **Fixed Temperature (2.12.1.4.)**]. This information can help trace problems with both built in and external temperature sensors.

3.2.8.1. Highest Value

View the highest process temperature encountered, as measured by the transducer in ° C.

3.2.8.2. Lowest Value

View the lowest process temperature encountered, as measured by the transducer in ° C.

3.2.9. Echo Quality

3.2.9.1. Figure of Merit

*This value measures the quality of the reported echo value: higher values represent better quality. This measure combines the noise level, quality of tracking, and signal strength. (For more details see **Echo Processing** on page 255.)*

Values (view only)	Range: **0 to 100 %**

3.2.9.2. Confidence

*Indicates echo reliability: higher values represent better echo quality. The display shows the echo confidence of the last measurement. **Echo Threshold (2.12.2.2.)** defines the minimum criterion for echo confidence.*

Values (view only)	Range: **-20 to 128**

In SIMATIC PDM, open the menu **Device – Echo Profile Utilities** and click on the tab **Echo Profile**.

Parameters

3.2.9.3. Echo Strength

Displays the absolute strength (in dB above 1 μV rms) of the echo selected as the measurement echo.

Values (view only)	Range: **-20 to 128 dB**

In SIMATIC PDM, open the menu **Device – Echo Profile Utilities** and click on the tab **Echo Profile**.

3.2.9.4. Noise Average

Displays the average ambient noise (in dB above 1 μV rms) of a noise profile after each measurement.

The noise level is a combination of transient acoustic noise and electrical noise (induced into the transducer cable or receiving circuitry). See **Noise Problems** on page 240.

3.2.9.5. Noise Peak

Displays the peak ambient noise (in dB above 1 μV rms) of a noise profile after each measurement.

3.3. Maintenance

Note: Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

3.3.1. Transducer Enable

Enables/disables transducer from taking measurements.

Options	*	ENABLED
		DISABLED

Set parameter to Disabled to stop transducer from measuring while calibration or maintenance work is performed. Set to Enabled to restart measurements after calibration or maintenance complete.

Notes:
- An **Echo Profile (3.2.1.)** cannot be requested from LUI when **Transducer Enable (3.3.1.)** is set to DISABLED. The local push button will not operate.
- When **Transducer Enable (3.3.1.)** is set to DISABLED, the LOE fault will display immediately.
- If **Transducer Enable (3.3.1.)** is set to DISABLED and power to the device is turned off, **Transducer Enable (3.3.1.)** will be reset to ENABLED when power is restored.

3.3.2. Backup Control

LUI only. Determine source of configuration recovery file when sensor has been replaced.

Options	*	DONE	No change required (no fault displayed), or operation is complete
		FROM SENSOR	Sensor parameters will be used as is, and LUI will receive these parameters as backup.
		FROM LUI	Recovery of sensor parameters will come from LUI backup.

When sensor unit has been replaced, fault code 132 is displayed to note that LUI backup file does not match configuration file in sensor. To clear fault, set Backup Control option to location from where parameter configuration should be read; from the LUI backup file or from the new sensor.

3.3.3. Remaining Device Life

Notes:
- Four sets of parameters allow you to monitor the Device/Sensor Lifetimes and set up Maintenance/Service schedules, based on operating hours instead of a calendar-based schedule. See also **Remaining Sensor Life (3.3.4.)**, **Service Schedule (3.3.5.)**, and **Calibration Schedule (3.3.6.)**.
- Performing a reset to **Factory Defaults** will reset all the Maintenance Schedule parameters to their factory defaults.
- The device operates in years. To view Remaining Device Lifetime parameters in hours or days (only via SIMATIC PDM, PACTware FDT, and AMS) see **Lifetime Expected (3.3.3.1.)**.

The device tracks itself based on operating hours and monitors its predicted lifetime. You can modify the expected device lifetime, set up schedules for maintenance reminders, and acknowledge them.

The maintenance warnings and reminders are available through HART communications. This information can be integrated into an Asset Management system. For optimal use, we recommend that you use SIMATIC PCS7 Asset Management Software in conjunction with SIMATIC PDM.

To access these parameters via SIMATIC PDM:

- Open the menu **Device – Maintenance** and select the **Remaining Device Lifetime** tab. (For more details see *Maintenance* in LUT400 Communications manual.[1])

Parameters

1. Communications for SITRANS LUT400 (HART) Manual (7ML19985NE01)

Time Units

Allows you to set the desired units.

Options[a]		HOURS
		DAYS
	*	YEARS

a. Units are selectable only via SIMATIC PDM, PACTware FDT, and AMS.

3.3.3.1. Lifetime Expected

> **Note:** The device always operates in years. Changing the Time Units affects only the parameter view of the Remaining Device Lifetime parameters in SIMATIC PDM, PACTware FDT, and AMS.

Allows you to override the factory default.

Values	Units[a]: hours, days, years
	Range: **0.000 to 20.000** years
	Default: **10.000** years

a. Units are selectable only via SIMATIC PDM, PACTware FDT, and AMS.

3.3.3.2. Time in Operation

Read only. The amount of time the device has been operating.

3.3.3.3. Remaining Lifetime

Read only. ***Lifetime Expected (3.3.3.1.)*** *less* ***Time in Operation (3.3.3.2.)****.*

3.3.3.4. Reminder Activation

> **Note:** To modify this parameter via SIMATIC PDM it must be accessed via the pull-down menu **Device – Maintenance**.

Allows you to enable a maintenance reminder.

Options		REMINDER 1 (MAINTENANCE REQUIRED)
		REMINDER 2 (MAINTENANCE DEMANDED)
		REMINDERS 1 AND 2
	*	OFF

a) First set the values in **Reminder 1 before Lifetime (Required) (3.3.3.5.)/Reminder 2 before Lifetime (Demanded) (3.3.3.6.)**.

b) Select the desired **Reminder Activation** option.

3.3.3.5. Reminder 1 before Lifetime (Required)

If ***Remaining Lifetime (3.3.3.3.)*** *is equal to or less than this value, the device generates a Maintenance Required reminder.*

Values	Range: **0.000 to 20.000** years
	Default: **0.164** years (8 weeks)

a) Modify values as required.

b) Set **Reminder Activation (3.3.3.4.)** to the desired option.

Parameters

3.3.3.6. Reminder 2 before Lifetime (Demanded)

*If **Remaining Lifetime (3.3.3.3.)** is equal to or less than this value, the device generates a Maintenance Demanded reminder.*

Values	Range: **0.000 to 20.000** years
	Default: **0.019** years (1 week)

a) Modify values as required.
b) Set **Reminder Activation (3.3.3.4.)** to the desired option.

3.3.3.7. Maintenance Status

Indicates which level of maintenance reminder is active.

In SIMATIC PDM, open the menu **View – Device Status**, click on the **Maintenance** tab, and check the **Device Lifetime Status** window.

3.3.3.8. Acknowledged Status

Indicates which level of maintenance reminder has been acknowledged.

In SIMATIC PDM, open the menu **View – Device Status**, click on the **Maintenance** tab, and check the **Device Lifetime Status** window.

3.3.3.9. Acknowledged

Acknowledges the current maintenance reminder.

To acknowledge a reminder via SIMATIC PDM:

a) Open the menu **View – Device Status** and click on the tab **Maintenance**.
b) In the **Device Lifetime** section, click on **Acknowledge Warnings.**

To acknowledge a reminder via the local push buttons:

a) Navigate to **Maintenance and Diagnostics (3.) > Maintenance (3.3.) > Remaining Device Life (3.3.3.) > Acknowledged (3.3.3.9.),** and **RIGHT arrow** ▶ to acknowledge the reminder.

3.3.4. Remaining Sensor Life

Notes:
- Four sets of parameters allow you to monitor the Device/Sensor Lifetimes and set up Maintenance/Service schedules, based on operating hours instead of a calendar-based schedule. See also **Remaining Device Life (3.3.3.)**, **Service Schedule (3.3.5.)**, and **Calibration Schedule (3.3.6.)**.
- Performing a reset to **Factory Defaults** will reset all the Maintenance Schedule parameters to their factory defaults.
- The device operates in years. To view Remaining Sensor Lifetime parameters in hours or days (only via SIMATIC PDM, PACTware FDT, and AMS) see **Lifetime Expected (3.3.4.1.)**.

The device monitors the predicted lifetime of the sensor (the components exposed to the vessel environment). You can modify the expected sensor lifetime, set up schedules for maintenance reminders, and acknowledge them.

To access these parameters via SIMATIC PDM:

- Open the menu **Device – Maintenance** and select the **Remaining Sensor Lifetime** tab. (For more details see *Maintenance* in LUT400 Communications manual.[1])

Time Units

Allows you to set the desired units.

Options[a]		HOURS
		DAYS
	*	YEARS

a. Units are selectable only via SIMATIC PDM, PACTware FDT, and AMS.

3.3.4.1. Lifetime Expected

Note: The device always operates in years. Changing the Time Units affects only the parameter view of Remaining Sensor Life parameters in SIMATIC PDM, PACTware FDT, and AMS.

Allows you to override the factory default.

Values	Units[a]: hours, days, years
	Range: **0.000 to 20.000** years
	Default: **10.000** years

a. Units are selectable only via SIMATIC PDM, PACTware FDT, and AMS.

3.3.4.2. Time in Operation

The amount of time the sensor has been operating. Can be reset to zero after performing a service or replacing the sensor.

To reset to zero:

- In SIMATIC PDM, open the menu **Device – Maintenance**, click on the **Remaining Sensor Lifetime** tab, and click on **Sensor Replaced** to re-start the timer and clear any fault messages.
- Via the local push buttons, navigate to **Maintenance and Diagnostics (3.) > Maintenance (3.3.) > Remaining Sensor Life (3.3.4.) > Time in Operation (3.3.4.2.)**, and **set** to zero.

3.3.4.3. Remaining Lifetime

*Read only. **Lifetime Expected (3.3.4.1.)** less **Time in Operation (3.3.4.2.)**.*

Parameters

1. Communications for SITRANS LUT400 (HART) Manual (7ML19985NE01)

3.3.4.4. Reminder Activation

Note: To modify this parameter via SIMATIC PDM it must be accessed via the pull-down menu **Device – Maintenance**.

Allows you to enable a maintenance reminder.

Options		REMINDER 1 (MAINTENANCE REQUIRED)
		REMINDER 2 (MAINTENANCE DEMANDED)
		REMINDERS 1 AND 2
	*	OFF

a) First set the values in **Reminder 1 before Lifetime (Required) (3.3.4.5.)/Reminder 2 before Lifetime (Demanded) (3.3.4.6.)**.

b) Select the desired Reminder Activation option.

3.3.4.5. Reminder 1 before Lifetime (Required)

*If **Remaining Lifetime (3.3.4.3.)** is equal to or less than this value, the device generates a **Maintenance Required** reminder.*

Values	Range: **0.000 to 20.000** years
	Default: **0.164** years (8 weeks)

a) Modify values as required.

b) Set **Reminder Activation (3.3.4.4.)** to the desired option.

3.3.4.6. Reminder 2 before Lifetime (Demanded)

*If **Remaining Lifetime (3.3.4.3.)** is equal to or less than this value, the device generates a **Maintenance Demanded** reminder.*

Values	Range: **0.000 to 20.000** years
	Default: **0.019** years (1 week)

a) Modify values as required.

b) Set **Reminder Activation (3.3.4.4.)** to the desired option.

3.3.4.7. Maintenance Status

Indicates which level of maintenance reminder is active.

In SIMATIC PDM, open the menu **View – Device Status**, click on the **Maintenance** tab, and check the **Sensor Lifetime Status** window.

3.3.4.8. Acknowledged Status

Indicates which level of maintenance reminder has been acknowledged.

In SIMATIC PDM, open the menu **View – Device Status,** click on the **Maintenance** tab and check the **Sensor Lifetime Status** window.

3.3.4.9. Acknowledged

Acknowledges the current maintenance reminder.

To acknowledge a reminder via SIMATIC PDM:

a) Open the menu **View – Device Status** and click on the **Maintenance** tab.

b) In the **Sensor Lifetime** section click on **Acknowledge Warnings.**

To acknowledge a reminder via the local push buttons:

a) Navigate to **Maintenance and Diagnostics (3.)** > **Maintenance (3.3.)** > **Remaining Sensor Life (3.3.4.)** > **Acknowledged (3.3.3.9.),** and **RIGHT arrow** ▶ to acknowledge the reminder.

3.3.5. Service Schedule

Notes:
- Four sets of parameters allow you to monitor the Device/Sensor Lifetimes and set up Maintenance/Service schedules, based on operating hours instead of a calendar-based schedule. See also **Remaining Device Life (3.3.3.)**, **Remaining Sensor Life (3.3.4.)**, and **Calibration Schedule (3.3.6.)**.
- Performing a reset to **Factory Defaults** will reset all the Maintenance Schedule parameters to their factory defaults.
- The device operates in years. To view Service Interval parameters in hours or days (only via SIMATIC PDM, PACTware FDT, and AMS) see **Service Interval (3.3.5.1.)**.

The device tracks service intervals based on operating hours and monitors the predicted lifetime to the next service. You can modify the Total Service Interval, set schedules for maintenance reminders, and acknowledge them.

The maintenance warnings and reminders are communicated to the end user through status information. This information can be integrated into any Asset Management system. For optimal use, we recommend that you use SIMATIC PCS7 Asset Management Software in conjunction with SIMATIC PDM.

To access these parameters via SIMATIC PDM:

- Open the menu **Device – Maintenance** and select the **Service Schedule** tab. (For more details see *Maintenance* in LUT400 Communications manual.[1])

Time Units

Allows you to set the desired units.

Options[a]		HOURS
		DAYS
	*	YEARS

a. Units are selectable only via SIMATIC PDM, PACTware FDT, and AMS.

Parameters

1. Communications for SITRANS LUT400 (HART) Manual (7ML19985NE01)

3.3.5.1. Service Interval

Note: The device always operates in years. Changing the Time Units affects only the parameter view of the Service Interval parameters in SIMATIC PDM, PACTware FDT, and AMS.

*User-configurable recommended time between product inspections***.**

Values	Units[a]: hours, days, years
	Range: **0.000 to 20.000** years
	Default: **1.000** year

a. Units are selectable only via SIMATIC PDM, PACTware FDT, and AMS.

3.3.5.2. Time Last Service

Time elapsed since last service. Can be reset to zero after performing a service.

To reset to zero:

- In SIMATIC PDM, open the menu **Device – Maintenance**, click on the **Service Schedule** tab, and click on **Service Performed** to restart the timer and clear any fault messages.
- Navigate to **Maintenance and Diagnostics (3.) > Maintenance (3.3.) > Service Schedule (3.3.5.) > Time Last Service (3.3.5.2.)**, and **set** to zero.

3.3.5.3. Time Next Service

*Read only. **Time Next Service (3.3.5.3.)** less **Time Last Service (3.3.5.2.)**.*

3.3.5.4. Reminder Activation

Note: To modify this parameter via SIMATIC PDM it must be accessed via the pull-down menu **Device – Maintenance**.

Allows you to enable a maintenance reminder.

Values	*	TIMER OFF
		ON NO LIMITS - no reminders checked
		ON REMINDER 1 (MAINTENANCE REQUIRED) checked
		ON REMINDER 1 AND 2 checked
		ON REMINDER 2 (MAINTENANCE DEMANDED) checked

a) First set the values in **Reminder 1 before Service (Required) (3.3.5.5.)/ Reminder 2 before Service (Demanded) (3.3.5.6.)**.

b) Select the desired **Reminder Activation** option.

3.3.5.5. Reminder 1 before Service (Required)

*If **Time Next Service (3.3.5.3.)** is equal to or less than this value, the device generates a **Maintenance Required** reminder.*

Values	Range: **0.000 to 20.000** years
	Default: **0.164** years (8 weeks)

a) Modify values as required.

b) Set **Reminder Activation (3.3.5.4.)** to the desired option.

3.3.5.6. Reminder 2 before Service (Demanded)

If ***Time Next Service (3.3.5.3.)*** *is equal to or less than this value, the device generates a* ***Maintenance Demanded*** *reminder.*

Values	Range: **0.000 to 20.000** years	
	Default: **0.019** years (1 week)	

a) Modify values as required.
b) Set **Reminder Activation (3.3.5.4.)** to the desired option.

3.3.5.7. Maintenance Status

Indicates which level of maintenance reminder is active.

In PDM, open the menu **View – Device Status,** click on the **Maintenance** tab and check the **Service Schedule Status** window.

3.3.5.8. Acknowledged Status

Indicates which level of maintenance reminder has been acknowledged.

In PDM, open the menu **View – Device Status,** click on the **Maintenance** tab and check the **Service Schedule Status** window.

3.3.5.9. Acknowledged

Acknowledges the current maintenance reminder.

To acknowledge a reminder via SIMATIC PDM:

a) Open the menu **View – Device Status** and click on the **Maintenance** tab.
b) In the **Service Schedule Status** section click on **Acknowledge Warnings.**

To acknowledge a reminder via the local push buttons:

Navigate to **Maintenance and Diagnostics (3.) > Maintenance (3.3.) >**

Service Schedule (3.3.5.) > Acknowledged (3.3.5.9.), and **RIGHT arrow** ▶ to acknowledge the reminder.

3.3.6. Calibration Schedule

Notes:
- Four sets of parameters allow you to monitor the Device/Sensor Lifetimes and set up Maintenance/Service schedules, based on operating hours instead of a calendar-based schedule. See also **Remaining Device Life (3.3.3.), Remaining Sensor Life (3.3.4.)**, and **Service Schedule (3.3.5.)**.
- Performing a reset to **Factory Defaults** will reset all the Maintenance Schedule parameters to their factory defaults.
- The device operates in years. To view Calibration Interval parameters in hours or days (only via SIMATIC PDM, PACTware FDT, and AMS) see **Calibration Interval (3.3.6.1.)**.

The device tracks calibration intervals based on operating hours and monitors the predicted lifetime to the next calibration. You can modify the Total Calibration Interval, set schedules for maintenance reminders, and acknowledge them.

Parameters

To access these parameters via SIMATIC PDM:

- Open the menu **Device – Maintenance** and select the **Calibration Schedule** tab. (For more details see *Maintenance* in LUT400 Communications manual.[1])

Time Units

Allows you to set the desired units.

Options[a]		HOURS
		DAYS
	*	YEARS

a. Units are selectable only via SIMATIC PDM, PACTware FDT, and AMS.

3.3.6.1. Calibration Interval

Note: The device always operates in years. Changing the units affects only the parameter view of the Calibration Interval parameters in SIMATIC PDM, PACTware FDT, and AMS.

User-configurable recommended time between product calibrations.

Values	Units[a]: hours, days, years
	Range: **0.000 to 20.000** years
	Default: **1.000** year

a. Units are selectable only via SIMATIC PDM, PACTware FDT, and AMS.

3.3.6.2. Time Last Calibration

Time elapsed since last calibration. Can be reset to zero after performing a calibration.

To reset to zero:

- In SIMATIC PDM, open the menu **Device – Maintenance**, click on the **Calibration Schedule** tab, and click on **Calibration Performed** to re-start the timer and clear any fault messages.
- Via the local push buttons, navigate to **Maintenance and Diagnostics (3.) > Maintenance (3.3.) > Calibration Schedule (3.3.6.) > Time Last Calibration (3.3.6.2.)**, and **set** to zero.

3.3.6.3. Time Next Calibration

*Read only. **Calibration Interval (3.3.6.1.)** less **Time Last Calibration (3.3.6.2.)***

Parameters

1. Communications for SITRANS LUT400 (HART) Manual (7ML19985NE01)

3.3.6.4. Reminder Activation

> **Note:** To modify this parameter via SIMATIC PDM it must be accessed via the pull-down menu **Device – Maintenance**.

Allows you to enable a maintenance reminder.

Values	*	TIMER OFF
		ON NO LIMITS - no reminders checked
		ON REMINDER 1 (MAINTENANCE REQUIRED) checked
		ON REMINDER 1 AND 2 checked
		ON REMINDER 2 (MAINTENANCE DEMANDED) checked

a) First set the values in **Reminder 1 before Calibration (Required) (3.3.6.5.)/Reminder 2 before Calibration (Demanded) (3.3.6.6.)**.
b) Select the desired **Reminder Activation** option.

3.3.6.5. Reminder 1 before Calibration (Required)

*If **Time Next Calibration (3.3.6.3.)** is equal to or less than this value, the device generates a **Maintenance Required** reminder.*

Values	Range: **0.000 to 20.000** years
	Default: **0.164** years (8 weeks)

a) Modify values as required.
b) Set **Reminder Activation (3.3.6.4.)** to the desired option.

3.3.6.6. Reminder 2 before Calibration (Demanded)

*If **Time Next Calibration (3.3.6.3.)** is equal to or less than this value, the device generates a **Maintenance Demanded** reminder.*

Values	Range: **0.000 to 20.000** years
	Default: **0.019** years (1 week)

a) Modify values as required.
b) Set **Reminder Activation (3.3.6.4.)** to the desired option.

3.3.6.7. Maintenance Status

Indicates which level of maintenance reminder is active.

In SIMATIC PDM, open the menu **View – Device Status,** click on the **Maintenance** tab and check the **Calibration Schedule Status** window.

3.3.6.8. Acknowledged Status

Indicates which level of maintenance reminder has been acknowledged.

In SIMATIC PDM, open the menu **View – Device Status,** click on the **Maintenance** tab and check the **Calibration Schedule Status** window.

3.3.6.9. Acknowledged

Acknowledges the current maintenance reminder.

To acknowledge a reminder via SIMATIC PDM:

a) Open the menu **View – Device Status** and click on the **Maintenance** tab.
b) In the **Calibration Schedule Status** section click on **Acknowledge Warnings.**

To acknowledge a reminder via the local push buttons:

Navigate to **Maintenance and Diagnostics (3.) > Maintenance (3.3.) > Calibration Schedule (3.3.6.) > Acknowledged (3.3.6.9.)**, and **RIGHT arrow** ▶ to acknowledge the reminder.

3.4. Simulation

Use simulation to test your application. For further details, see ***Application examples*** *on page 58.*

3.4.1. Level

Simulates level changes, and activates relays based on the setpoints programmed.

3.4.1.1. Level Simulation Enable

Enables/disables level simulation.

Options	*	DISABLED
		ENABLED

3.4.1.2. Level Value

Sets the level for a fixed level simulation, or the starting level for a ramped simulation.

Values	Range: **Low Calibration Point to High Calibration Point**
	Default: 0.000

3.4.1.3. Ramp

Enables/disables ramped simulation.

Options	*	DISABLED
		ENABLED

3.4.1.4. Ramp Rate

Sets the rate at which the simulated level will change in a ramp simulation.

Options		SLOW	1% of span[a] per second
	*	MEDIUM	2% of span[a] per second
		FAST	4% of span[a] per second

a. Low Calibration Point to High Calibration Point

Parameters

3.4.2. Discrete Inputs

Simulates behaviour of external contacts connected to a discrete input.

3.4.2.1. Discrete Input 1

Disables simulation of Discrete Input 1, or sets behaviour of DI during simulation.

Options	*	DISABLED	DI is not simulated
		ON	DI is simulated to be ON
		OFF	DI is simulated to be OFF

3.4.2.2. Discrete Input 2

Disables simulation of Discrete Input 2, or sets behaviour of DI during simulation.

Options	*	DISABLED	DI is not simulated
		ON	DI is simulated to be ON
		OFF	DI is simulated to be OFF

3.4.3. Pump Activations

Sets how physical relays (that are assigned to pumps) will behave in simulation mode.

Options	*	DISABLED	Pump relays are not activated in simulation
		ENABLED	Pump relays are activated in simulation

4. Communication

4.1. Device Address

Sets the device address or poll ID on a HART network.

Values	Range: **0 to 63** (Set within range of 0 to 15 if HART 5 master used.)
	Default: **0**

To reset Device Address via SIMATIC PDM:

- Open the project in **Process Device Network View** then right-click on the device.
- Go to **Object Properties** and open the **Connection** tab to access the field **Short Address**.

Note: The following list of parameters are available in PDM. Unless otherwise stated, the options are displayed in integer format (as required by HART communications).

Manufacturer's ID

Read only. Numerical code that refers to the manufacturer of the device (e.g. 42, which refers to Siemens).

Device Id

Read only. Unique identification of the device by manufacturer and device type.

Product Id

Read only. Unique identification of the product by model number.

Device Revision

Read only. Device revision associated with a specific EDD.

EDD Revision

Read only. Revision of a specific EDD associated with the device.

Universal Command Revision

Read only. Revision of the Universal Device Description associated with the device.

Protocol

Read only. The communication protocol supported by the device.

Common Practice Command Revision

Read only. Revision of the set of HART common practice commands supported by the device.

Configuration Change Counter

Read only. Indicates the number of times the device's configuration or calibration has been changed by a host application or from a local operator interface.

5. Security

Note: Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

5.1. Write Protection

A public password to prevent any changes to parameters via local push buttons, remote communication, or Windows-based web browser.

Values		Range: 0 to 65535	
	*	Unlock value **(2457)**	Lock Off
		Any other value	Lock On

- To turn Lock On, key in any value other than the Unlock Value.
- To turn Lock Off, key in the Unlock Value (2457).

6. Language

Note: Default settings in the parameter tables are indicated with an asterisk (*) unless explicitly stated.

Selects the language to be used on the LCD.

Options	*	ENGLISH
		DEUTSCH
		FRANCAIS
		ESPANOL
		简体中文

Characteristics

Certificates & Approvals

Device Certification

The approvals certificates applicable to the device.

Parameters

Alphabetical parameter list

Note: Maintenance Parameters are not listed below. See **Remaining Device Life** on page 204, **Remaining Sensor Life** on page 206, **Service Schedule** on page 209, and **Calibration Schedule** on page 211 for these parameters.

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Parameters

Parameters

Service and Maintenance

SITRANS LUT400 requires no maintenance or cleaning under normal operating conditions.

Firmware updates

To update the LUT400 firmware, please contact your Siemens representative to obtain the installer (self-executable .exe file). For a complete list of representatives, go to www.siemens.com/processautomation.

Two installers are available: one to update the firmware in the Local User Interface (LUI) node, and one for the sensor node. One or both may be required, depending on the reason for the update.
To complete an update, follow steps in the installer:

1. Connect your computer to the SITRANS LUT400 USB port.
2. Before running the .exe installer received from your Siemens representative, note the computer COM port to which the LUT400 is connected.
3. From your computer, double-click the .exe, and follow the installer steps. The first step will prompt for Communication Options. These options are set to factory defaults. Ensure the COM Port is set to that noted in step 2 above. No other changes are required.
4. Follow remaining installer steps.
5. Once complete, verify the update was successful by checking the current firmware revision:
   - If updating the **LUI node**, recycle the power on the LUT400. On power-up, you will see the current LUI firmware revision on the LUT400 display.
   - If updating the **sensor node**, view parameter Firmware Revision (3.1.11.) to see the current sensor node firmware revision.

Complete a Master Reset (3.2.3.) to factory defaults after a successful upgrade of the sensor node, before re-entering parameters.

Transferring parameters using LUT400 display lid

If necessary to transfer parameters from one LUT400 to another, the LUI display maintains a backup file of the parameters on the device. With this backup file, it is possible to connect the remote lid to a second LUT400 to transfer parameters.

When the remote lid is connected to a second device, a fault code is displayed to note that the LUI backup file does not match the configuration file in the sensor. You can then use the Backup Control parameter to specify that sensor parameters be copied from the LUI backup to the device [see Backup Control (3.3.2.) on page 204].

Replacing the Battery

The battery (BR2032) has a life expectancy of ten years, and is affected by ambient temperature. If the device loses external power the battery will maintain the SITRANS LUT400's Real Time Clock (date and time) until power is restored.

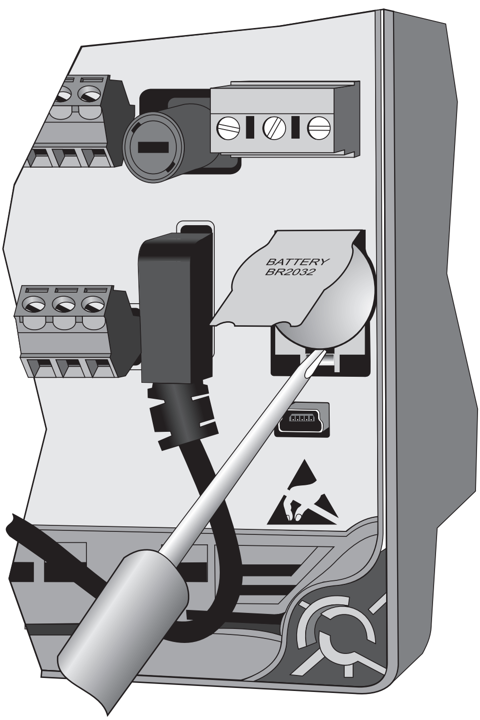
The flash memory is updated constantly. Therefore, data logs are unaffected by the loss of power.

WARNING: Disconnect power before replacing the battery.

Notes:

- To replace, remove the existing battery from the holder as shown below, and reinstall replacement battery (BR2032).
- Battery Type: Lithium metal coin cell
  Battery Chemistry: solid-cathode Carbon Monofluoride

Dispose of battery in an environmentally safe manner, and according to local regulations.



1. Open the enclosure lid.
2. Slide the end of a screwdriver under the lip of the plastic battery cover, and lift cover with fingers. (Do not press back on fold.)
3. While holding cover in raised position, place end of screwdriver at an angle into slot below battery, and pry upward.
4. Lift out battery.
5. Insert new battery and press down on face of battery to secure in holder.
6. Press down on plastic battery cover to secure in place.
7. Close enclosure lid and tighten screws.
8. Reset the Real Time Clock (See **Date and Time (2.14.)** on page 187.)

Maintenance

Decontamination Declaration

Any device returned to Siemens for repair must be accompanied by a Declaration of Decontamination. With this declaration you certify *that the returned products/spare parts have been carefully cleaned and are free from any residues*.

If the device has been operated together with toxic, caustic, flammable or water-damaging products, clean the device before return by rinsing or neutralizing. Ensure that all cavities are free from dangerous substances. Then, double-check the device to ensure the cleaning is completed.

Siemens will not service a device or spare part unless the declaration of decontamination confirms proper decontamination of the device or spare part.

Shipments received without a declaration of decontamination will be cleaned professionally at your expense before further processing.

Decontamination Declaration form can be found on the internet at www.siemens.com/processinstrumentation, under Service – Decontamination Declaration.

Notes

Maintenance

Diagnosing and Troubleshooting

Notes:
- Many of the parameters referenced and techniques described here require a good understanding of ultrasonic technologies and Siemens echo processing software. Use this information with caution.
- If the setup becomes too confusing do a *3.2.3. Master Reset* and start again.
- As a further resource, ***Understanding Ultrasonic Level Measurement*** is available on our website. Go to www.siemens.com/level.

Communication Troubleshooting

Generally

1. Check the following:
   - There is power at the device
   - The optional LCD is showing the relevant data
   - The device can be programmed using the local push buttons.
   - If any fault codes are being displayed, see "General Fault Codes" on page 231 for a detailed list.
2. Verify that the wiring connections are correct.

Specifically

1. The SITRANS LUT400 is set to communicate via a HART modem but no communication is returning to the master.
   - Check that the device address is set correctly for the HART network.
2. A SITRANS LUT400 parameter is set via remote communications, but the parameter remains unchanged.
   - Try setting the parameter from the local push buttons. If it can not be set using the buttons, ensure *5.1. Write Protection* is set to the unlock value.

If you continue to experience problems, go to our website at: www.siemens.com/sitransLUT400, and check the FAQs for SITRANS LUT400, or contact your Siemens representative.

Device Status Icons

LUI Icon	PDM Icon	Priority Level[a]	Meaning
		1	• Maintenance alarm • Measurement values are not valid
		2	• Maintenance warning: maintenance demanded immediately • Measured signal still valid
		3	• Maintenance required • Measured signal still valid
		1	• Process value has reached an alarm limit
		2	• Process value has reached a warning limit
		3	• Process value has reached a tolerance limit
	 (red)	1	• Configuration error • Device will not work because one or more parameters/components is incorrectly configured
	 (yellow)	2	• Configuration warning • Device can work but one or more parameters/components is incorrectly configured
	 (green)	3	• Configuration changed • Device parameterization not consistent with parameterization in project. Look for info text.
		1	• Manual operation (local override) • Communication is good; device is in manual mode.
		2	• Simulation or substitute value • Communication is good; device is in simulation mode or works with substitute values.
		3	• Out of operation • Communication is good; device is out of action.

LUI Icon	PDM Icon	Priority Level[a]	Meaning (Continued)
			• Data exchanged
			• No data exchange
			• Write access enabled
			• Write access disabled

a. Lowest priority number equals highest fault severity.

General Fault Codes

Notes:
- If two faults are present at the same time, the device status indicator and text for the highest priority fault will display.
- Certain faults exist, such as with a loss of echo (LOE) or a broken cable, that when triggered cause the mA output to go to a fail-safe reading (see “Fail-Safe” on page 143) and LUI to display dashes (– – – – – – –) until fault is cleared. These faults are indicated with an asterisk (*) in the table below.

General Fault Codes				
Code / LUI Icon	**Code / PDM Icon**		**Meaning**	**Corrective Action**
0	0	*	Loss of echo (LOE). The device was unable to get a measurement within the Fail-safe LOE Timer period. Possible causes: faulty installation, foaming/other adverse process conditions, invalid calibration range.	• Ensure installation details are correct. • Adjust process conditions to minimize adverse conditions. • Correct range calibration. • If fault persists, contact your local Siemens representative.
1	1	*	Cable fault. Broken cable.	Inspect attached cabling and any termination points to ensure no disconnection or damage; repair/replace if necessary. If no issue with cabling, contact your local Siemens representative.
3	3		Device is nearing its lifetime limit according to the value set in Maintenance Required Limit.	Replacement is recommended.

General Fault Codes (Continued)

Code / LUI Icon	Code / PDM Icon		Meaning	Corrective Action
4	4		Device is nearing its lifetime limit according to the value set in Maintenance Demanded Limit.	Replacement is recommended.
5			Saving Parameters. (LUI fault only.) Saving is in progress. Do not turn off the device.	Wait for completion.
6	6		Sensor is nearing its lifetime limit according to the value set in Maintenance Required Limit.	Replacement is recommended.
7	7		Sensor is nearing its lifetime limit according to the value set in Maintenance Demanded Limit.	Replacement is recommended.
8	8		Service interval as defined in Maintenance Required Limit has expired.	Perform service.
9	9		Service interval as defined in Maintenance Demanded Limit has expired.	Perform service.
10	10 (red)		Configuration parameters are incorrect. The following conditions will cause this fault: • Far Range < Low Cal. Pt. • Near Range > Far Range • Low Cal. Pt - High Cal. Pt. < 10 cm • Far Range - Near Range < 10 cm • Max. mA Limit ≤ Min. mA Limit • Current Output Function set to *Volume*, but Vessel Shape set to *None* • Current Output Function set to *Volume*, but Max. Volume has not been set.	Check device configuration.
17	17		Calibration interval as defined in Maintenance Required Limit has expired.	Perform calibration.
18	18		Calibration interval as defined in Maintenance Demanded Limit has expired.	Perform calibration.
25	25		Internal device error.	Reset power. If fault persists, contact your local Siemens representative.

General Fault Codes (Continued)				
Code / LUI Icon	**Code / PDM Icon**		**Meaning**	**Corrective Action**
26	26	*	Submergence detected. The transducer appears submerged.	Correct the installation.
27	27 (red)		Incorrect product model. Basic model does not support flow and advanced pump control features	Only configure the supported features.
39	39	*	Transducer temperature sensor has failed.	Inspect attached cabling and any termination points to ensure no disconnection or damage; repair/ replace if necessary. If no issue with cabling, contact your local Siemens representative.
46	46	*	The TS-3 temperature sensor failed.	Inspect attached cabling and any termination points to ensure no disconnection or damage; repair/ replace if necessary. If no issue with cabling, contact your local Siemens representative.
47	47		Poor signal from the application. Poor installation or high noise level.	Verify installation.
121	121 (red)		Flow calculations are not configured properly. Incorrect parameter settings.	Reconfigure the unit. Check the configuration. If fault persists, do a master reset.
122	122		Flow calculations encountered an error.	Reconfigure the unit. Check the breakpoints. If fault persists, do a master reset.
123	123		Flow log could not restore the settings.	Reconfigure the unit. Check the flow log settings. If fault persists, do a master reset.
124	124 (red)		Flow log is not configured properly.	Reconfigure the unit. Check the flow log settings. If fault persists, do a master reset.
125	125		Flow log error. Log failed.	Verify that the drive where the log file resides is not full. Copy the log file to a computer and delete it from the device.
126	126		Failed to open log file.	Verify that the drive where the log file resides is not full. Copy the log file to a computer and delete it from the device.

General Fault Codes (Continued) Code / LUI Icon	Code / PDM Icon	Meaning	Corrective Action
127	127	Failed to close log file.	Verify that the drive where the log file resides is not full. Copy the log file to a computer and delete it from the device.
128	128	Log file read error. Error reading file. Unexpected error.	Verify that the drive where the log file resides is not full. Copy the log file to a computer and delete it from the device.
129	129	Log file write error. Error writing file. The file could not be written; the disk is full.	Copy the log file to a computer and delete it from the device.
130	130 (red)	Configuration error. One or more settings invalid.	Adjust/correct relay assignments or setpoints.
131	131	Parameter backup did not succeed. Communication or file system problems.	Repair required. Contact your local Siemens representative.
132	132 (red)	User input required. Serial numbers mismatch.	Manually force recovery. (Set parameter *3.3.2. Backup Control*.)
133	133	Simulation Enabled.	Simulation is active. Enable or disable simulation via LUI (*3.4.1.1. Level Simulation Enable*, *3.4.2.1. Discrete Input 1*, *3.4.2.2. Discrete Input 2*).

Common Problems Chart

Symptom	Possible Cause	Action
Display blank, transducer not pulsing	No power, incorrect power	Check mains voltage at terminals; Check fuse; Check wiring connections; Check wiring.
Display blank, transducer is pulsing	Loose or disconnected display cable	Reconnect display cable.
Display active, transducer not pulsing	Incorrect transducer connections or wiring; Incorrect transducer selection (or set to **NO Transducer**); Transducer has been disabled through the software	Verify terminal connections; Check transducer field wiring; Check any junction box connections; Check that transducer is enabled (see **Transducer Enable (3.3.1.)** on page 203)

Symptom	Cause	Action
Reading fluctuates while material level is still	Material level is changing	Visually verify, if possible.
	Strong false echoes	Determine source of false echoes; Relocate transducer to avoid source.
	Incorrect damping	Adjust damping. See **Damping Filter (2.3.3.)** on page 143.
	Improper echo Algorithm selection	Set algorithm to default. If no improvement, try a different algorithm. See **Algorithm (2.12.2.1.)** on page 181.
	High noise levels	Verify source and minimize. See “Noise Problems” on page 240.
	Weak echo	Determine cause; Check noise, confidence, FOM, and echo strength. See **Echo Quality (3.2.9.)** on page 202.
	Foam on surface of material	Eliminate source of foaming; Use stilling well.
	Rapid temperature changes	Use an external temperature sensor. See **Temperature Source (2.12.1.3.)** on page 180.
	Faulty temperature sensor	Verify operation; Replace if required, or use fixed temperature. See **Temperature Source (2.12.1.3.)** on page 180.
	Vapours	If fluctuation is unacceptable, consider an alternative technology. Contact your Siemens representative.

Symptom	Cause	Action
Reading is fixed, but material level changes or reading does not follow material level	Incorrect speed of response	Verify response speed setting is adequate for process. See *Response Rate* (set in the Quick Start Wizard).
	Loss of Echo condition (LOE)	Check Noise, Echo Strength, Confidence. See **Echo Quality (3.2.9.)** on page 202. Check LOE Timer is not set too short. See **LOE Timer (2.4.2.)** on page 144.
	Agitator blade stopped in front of transducer (false echo)	Ensure agitator is running.
	Foam on surface of material	Eliminate source of foaming. Use stilling well
	Incorrect Algorithm used	Set algorithm to default. If no improvement, try a different algorithm. See **Algorithm (2.12.2.1.)** on page 181.
	Transducer mounting: wrong location or incorrectly mounted	Ensure beam has a clear path to material surface; Verify transducer is not too tight; Use an isolation coupling.
	Incorrect transducer used for the application	Use correct transducer. Contact your Siemens representative.
	Unavoidable false echoes from obstructions	Relocate transducer to ensure beam has a clear path to material surface; Use manual TVT shaping or Auto False Echo Suppression. See **TVT Shaper (2.12.4.)** on page 184 or **Auto False Echo Suppression (2.12.3.1.)** on page 183.

Symptom	Cause	Action
Accuracy Varies	Faulty temperature sensor	Verify operation; Replace if required, or use fixed temperature. See **Temperature Source (2.12.1.3.)** on page 180.
	Vapours present in varying concentrations	Eliminate vapours or consider a different technology. Contact your Siemens representative.
	Thermal gradients	Insulate vessel; Consider external temperature sensor.
	Calibration required	If accuracy is better when level is close to transducer, and worse when level is far from transducer, perform calibration [see **Auto Sound Velocity (2.12.1.6.)** on page 181]. If accuracy is consistently incorrect, use **Sensor Offset (2.2.3.)** on page 141 or perform calibration [see **Auto Sensor Offset (2.2.6.)** on page 142].
Reading erratic	Transducer mounting: wrong location or incorrectly mounted	Ensure beam has a clear path to material surface; Verify transducer is not too tight; Use an isolation coupling.
	Unavoidable false echoes from obstructions	Use Auto False Echo Suppression. See **Auto False Echo Suppression (2.12.3.1.)** on page 183.
	Confidence too low	Check Noise, Echo Strength, Confidence. See **Echo Quality (3.2.9.)** on page 202. Check LOE Timer is not set too short. See **LOE Timer (2.4.2.)** on page 144.
	Multiple echoes	Check mounting location; Verify material is not entering Near Range zone. See **Near Range (2.2.4.)** on page 141.
	Noise in the application	Verify source and minimize. See “Noise Problems” on page 240.

Symptom	Cause	Action
Incorrect reading (mA output and/or displayed value)	mA function not assigned to correct measurement	Check mA assignment. See **Current Output Function (2.5.1.)** on page 144.
	When device configured for flow: exponent or breakpoint not correctly selected	Check configuration: if *2.1.2. Sensor Mode* set to **FLOW**, verify correct exponent [**Flow Exponent (2.15.3.2.)** on page 191] and breakpoints [**Universal Head vs. Flow (2.15.5.)** on page 196].
	Incorrect vessel or PMD dimensions	For volume application: Verify vessel dimensions. See **Vessel Shape (2.6.1.)** on page 147. For flow application: Verify PMD dimensions. See **PMD Dimensions (2.15.4.)** on page 193
Relay not activating	Relay not programmed	Program relay.
	Relay incorrectly assigned	Verify with simulation. See **Simulation (3.4.)** on page 214.
	Incorrect relay function selected	Verify with simulation. See **Simulation (3.4.)** on page 214.
	Incorrect relay setpoints	Verify setpoints.
Relay not activating correctly	Relay incorrectly assigned	Verify with simulation. See **Simulation (3.4.)** on page 214.
	Incorrect relay function selected	Verify with simulation. See **Simulation (3.4.)** on page 214.
	Incorrect relay setpoints	Verify setpoints.

Symptom	Cause	Action
No response when echo profile requested via LUI (*3.2.1. Echo Profile*)	Transducer is disabled.	Set **Transducer Enable (3.3.1.)** on page 203 to ENABLED, then request an echo profile.
Configuration error 130 displayed	Relay/pump configuration errors - possible causes include: • A relay is assigned to more than one function (e.g. relay 2 is assigned to both an external totalizer and a pump). • Pump setpoints are out of order. • Wall Cling adjustment range is too large.	• Verify that each relay is assigned to one function only. Review relay assignments under **Pump Control** (page 151) and **Other Control** functions (page 175). • Verify that all 'ON' setpoints are greater than their respective 'OFF' setpoints for pump down applications (or vica versa for pump up applications). • Ensure range set in **Level Setpoint Variation (2.7.2.1.2.)** on page 154 has not caused 'ON' or 'OFF' setpoints to overlap.
Echo profile request results in an error icon that displays for 5 seconds before returning to the echo profile request menu.	Another external communication is trying to access an echo profile at the same time.	Wait for several seconds and then retry the echo profile request, or disconnect / disable any external communications that may be requesting an echo profile.
Data log files are empty or logging has stopped.	• Data Logging is not enabled. • USB cable is connected. • USB **extension** cable has been used (although may not currently be connected).	• Verify that Data Logging is enabled. See **Data Logging (2.10.)** on page 173. • Disconnect USB cable, as no data logs are written while device is connected to a PC via USB. • If a USB **extension** cable has been used (remove if currently connected), a power reset of the device is required to restart Data Logging.

Noise Problems

Incorrect readings can be the result of noise problems, either acoustic or electrical, in the application.

The noise present at the input to the ultrasonic receiver can be determined by viewing the echo profile locally via the LUI, or alternatively, using remote software such as SIMATIC PDM, AMS Device Manager, FC375/475, or DTM. View also parameters *3.2.9.4. Noise Average* and *3.2.9.5. Noise Peak*. In general, the most useful value is the average noise.

With no transducer attached the noise is under 5 dB. This is often called the noise floor. If the value with a transducer attached is greater than 5 dB, signal processing problems can occur. High noise decreases the maximum distance that can be measured. The exact relationship between noise and maximum distance is dependent on the transducer type and the material being measured. An average noise level greater than 30 dB may be cause for concern if the installed transducers maximum operation range matches the range of the application (e.g. 8 m application using an 8 m XRS-5). Using a larger transducer with greater transmitted energy should help to improve performance in a noise condition.

Determine the Noise Source

Disconnect the transducer from the SITRANS LUT400. If the measured noise is below 5 dB, then continue here. If the measured noise is above 5 dB go to *Non-Transducer Noise Sources* below.

1. Connect only the shield wire of the transducer to the SITRANS LUT400. If the measured noise is below 5 dB, continue with the next step. If the noise is above 5 dB, go to *Common Wiring Problems* below.
2. Connect the white and black transducer wires to the SITRANS LUT400. Record the average noise.
3. Remove the positive wire of the transducer. Record the average noise.
4. Re-connect the positive wire and remove the negative wire. Record the average noise.

Using the table below, determine the appropriate next step. The terms higher, lower and unchanged refer to the noise recorded in the previous steps.

These are guidelines only. If the suggested solution does not solve the problem, try the other options also.

	- removed	+ removed	Go to:
noise	higher	higher	*Reducing Electrical Noise*
		unchanged	*Common Wiring Problems*
		lower	*Reducing Acoustical Noise*
	unchanged	higher	*Reducing Electrical Noise*
		unchanged	Contact Siemens representative.
		lower	*Reducing Acoustical Noise*
	lower	higher	*Common Wiring Problems*
		unchanged	*Common Wiring Problems*
		lower	*Reducing Acoustical Noise*

Acoustical Noise

To confirm that the problem is acoustical, place several layers of cardboard over the face of the transducer. If the noise is reduced, the noise is definitely acoustical.

Non-Transducer Noise Sources

Remove all input and output cables from the SITRANS LUT400 individually while monitoring the noise. If removing a cable reduces the noise, that cable may be picking up noise from adjacent electrical equipment. Check that low voltage cables are not being run adjacent to high voltage cables or near to electrical noise generators such as variable speed drives.

Filtering cables is an option but is not recommended unless all other options have been exhausted.

The SITRANS LUT400 is designed to work near heavy industrial equipment such as variable speed drives. Even so, it should not be located near high voltage wires or switch gear.

Try moving the electronics to a different location. Often moving the electronics a few meters farther from the source of noise will fix the problem. Shielding the electronics is also an option, but it should be a last resort. Proper shielding is expensive and is difficult to install properly–the shielding box must enclose the SITRANS LUT400 electronics completely, and all wires must be brought to the box through grounded metal conduit.

Common Wiring Problems

- Make sure that the transducer shield wire is connected at the electronics end only. Do not ground it at any other location.
- Do not connect the transducer shield wire to the white wire.
- The exposed transducer shield wire must be as short as possible.
- Connections between the wire supplied with the transducer, and any customer installed extension wire should only be grounded at the LUT400.

On Siemens transducers the white wire is negative and the black wire is positive. If the extension wire is colored differently, make sure that it is wired consistently.

Extension wire must be shielded twisted pair. See the installation section for specifications.

Reducing Electrical Noise

- Ensure that the transducer cable does not run parallel to other cables carrying high voltage or current.
- Move the transducer cable away from noise generators like variable speed drives.
- Put the transducer cable in grounded metal conduit.
- Filter the noise source.
- Check grounding.

Reducing Acoustical Noise

- Move the transducer away from the noise source.
- Use a stilling well.
- Install a rubber or foam bushing or gasket between the transducer and the mounting surface.
- Relocate or insulate the noise source.
- Change the frequency of the noise. Ultrasonic devices are sensitive to noise in the frequency range of the transducer employed.
- Check that transducer is not mounted too tightly; only hand-tight.

Measurement Difficulties

If the *2.4.2. LOE Timer* expires due to a measurement difficulty, the *2.4.3. Fail-Safe mA Value* displays. In rare cases, the SITRANS LUT400 may lock on to a false echo and report a fixed or wrong reading.

Loss of Echo (LOE)

The *2.4.3. Fail-Safe mA Value* displays (seen in *2.5.8. Current Output Value*) when the echo confidence is below the threshold value set in *2.12.2.2. Echo Threshold*.

LOE occurs when:

- The echo is lost and no echo is shown above the ambient noise (see low *3.2.9.2. Confidence* and low *3.2.9.3. Echo Strength*)
- Two echoes are too similar to differentiate (when BLF algorithm used) (see low *3.2.9.2. Confidence* and low *3.2.9.3. Echo Strength*)
- No echo can be detected within the programmed range (see *2.2.5. Far Range*).

If *2.4.3. Fail-Safe mA Value* is displayed, check the following:

- Surface monitored is within the transducer maximum range
- *2.1.6. Transducer* model matches the transducer used
- Transducer is located and aimed properly
- Transducer (that is installed without a submergence shield) is not submerged

Adjust Transducer Aiming

See the transducer manual for range, mounting, and aiming details. For optimum performance, adjust transducer aiming to provide the best *3.2.9.2. Confidence* and *3.2.9.3. Echo Strength* for all material levels within the measurement range.

Displaying Echoes

The most efficient method of checking echoes is locally via the LUI, or remotely using SIMATIC PDM, AMS, FC375/475, or DTM software.

Use LUI or remote software to graphically display the echo profile at the installation. Interpret the echo profile and change relevant parameters. For LUI, see “Requesting an Echo Profile” on page 57, and for details on how to interpret an Echo Profile, see “Echo Processing” on page 255.

Increase Fail-safe Timer Value

Increase the *2.4.2. LOE Timer* value, if fail-safe operation will not be compromised by the larger value.

Try this only if LOE exists for short periods of time.

Install a Transducer with a Narrower Beam

A consistent, incorrect level reading may result due to interference echoes from the sides of a vessel. If this occurs, try installing a longer range (narrower beam) transducer, enter the new *2.1.6. Transducer* model, and (if necessary) optimize aiming and frequency again.

Always contact Siemens service personnel before selecting a transducer to solve this type of problem.

Fixed Reading

If the Reading is a fixed value, regardless of the transducer to material surface distance, ensure the:

1. Transducer acoustic beam is free from obstruction.
2. Transducer is properly aimed
3. Transducer is not in contact with any metal object.
4. Material mixer (if used) is operating while the SITRANS LUT400 is operating. If it is stopped, ensure that the mixer blade is not stopped under the transducer.

Obstructions in the Sound Beam

Check for (and remove if present) any acoustic beam obstruction, or relocate the transducer.

If an obstruction cannot be removed or avoided, adjust the Time Varying Threshold (TVT) curve to reduce the Echo Confidence derived from the sound reflected by the obstruction. Use SIMATIC PDM to adjust the TVT curve. (See *TVT Shaper* under *Echo Profile Utilities* in LUT400 Communications manual[1].)

Nozzle Mountings

If the transducer is mounted on or in a nozzle, grind smooth any burrs or welds on the inside or open end (the end that opens into the vessel). If the problem persists, install a larger diameter or shorter length nozzle, bevel the inside of the bottom end, or cut the open end of the nozzle at a 45° angle.

See the transducer manual for complete mounting instructions.

If the mounting hardware is over tightened, loosen it. Over tightening changes the resonance characteristics of the transducer and can cause problems.

1. Communications for SITRANS LUT400 (HART) Manual (7ML19985NE01)

Set the SITRANS LUT400 to Ignore the Bad Echo

If the preceding remedies have not fixed the problem, the false echo has to be ignored.

If the Echo is Close to the Transducer

If there is a static, incorrect, high level reading from the SITRANS LUT400 there is probably something reflecting a strong echo back to the transducer. If the material level never reaches that point extend the *2.2.4. Near Range* to a distance to just past the obstruction.

Adjust the TVT to Ignore the Echo

Use *2.12.3.1. Auto False Echo Suppression*. If this does not correct the problem, use *2.12.4. TVT Shaper* to manually shape around false echoes.

Wrong Reading

If the Reading is erratic, or jumps to some incorrect value periodically, ensure the:

1. Surface monitored is not beyond the SITRANS LUT400's programmed range or the transducer's maximum range.
2. Material is not falling into the transducer's acoustic beam.
3. Material is not inside the blanking distance (near range) of the transducer.

Types of Wrong Readings

If a periodic wrong Reading is always the same value, see "Fixed Reading" on page 243.

If the wrong Reading is random, ensure the distance from the transducer to the material surface is less than *2.2.5. Far Range* value plus one meter (i.e. ensure you are still within the measurement range programmed in the device). If the material/object monitored is outside this range, increase *2.2.5. Far Range* as required. This error is most common in OCM applications using weirs.

Liquid Splashing

If the material monitored is a liquid, check for splashing in the vessel. Enter a lower *Response Rate* value (see page 42) to stabilize the Reading, or install a stilling well. (Contact Siemens representative.)

Adjust the Echo Algorithm

Use SIMATIC PDM to view echo profiles and make adjustments to the *Algorithm* parameter. See *2.12.2.1. Algorithm* on page 181 for details.

If the "TRACKER" algorithm is used and narrow noise spikes are evident on the Echo Profile, widen the *2.12.2.4. Narrow Echo Filter*. Also, if the true echo has jagged peaks, use *2.12.2.3. Reform Echo*.

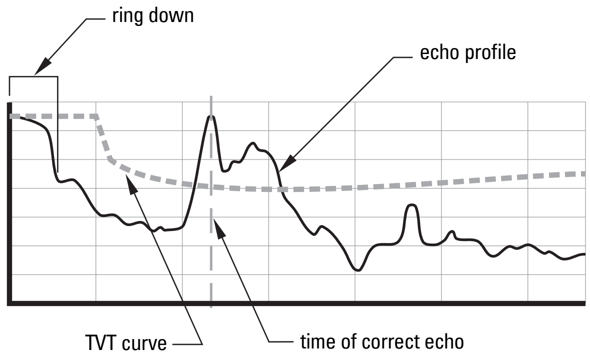
If multiple echoes appear on the Echo Profile, typical of a flat material profile (especially if the vessel top is domed), use the "TF " (True First) algorithm.

Should a stable measurement still not be attainable, contact Siemens representative.

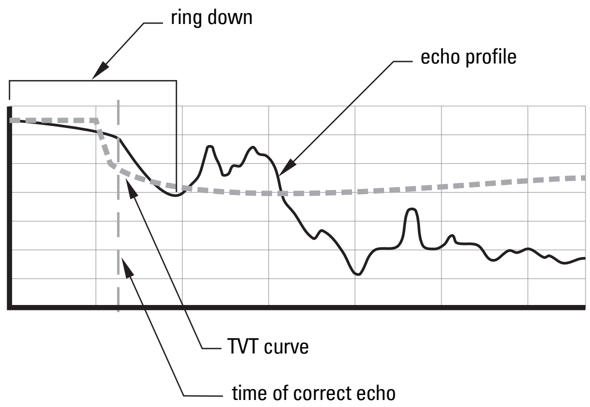
Transducer Ringing

If the transducer is mounted too tightly, or if it is mounted so that its side touches something (such as a vessel wall, or standpipe), its resonance characteristics change and this can cause problems. Hand tighten only. PTFE tape is not recommended as it reduces friction resulting in a tighter connection that can lead to ringing.

Normal Ring Down



Poor Ring Down



Ring down times that extend past the near range area can be interpreted by the SITRANS LUT400 as the material level and are characterized by a steady high level being reported.

Echo Profile Display

To assist in troubleshooting echo profiles, **pan** and **zoom** options are available. See “Requesting an Echo Profile” on page 57.

Trend Display

A trend display is available with pan and zoom options. See “Trends” on page 118.

Notes

Technical Data

Power

AC model

- 100-230 V AC ±15%, 50 / 60 Hz, 36 VA (10W)[1]
- Fuse: 5 x 20 mm, Slow Blow, 0.25A, 250V

DC model

- 10-32 V DC, 10W [1]
- Fuse: 5 x 20 mm, Slow Blow, 1.6A, 125V

Performance

Range

- 0.3 to 60 m (1 to 196 ft), dependent on transducer

Accuracy (measured under Reference Conditions similar to IEC 60770-1)

- Standard operation: ±1 mm (0.04") plus 0.17 % of distance
- High accuracy OCM [2]: ±1 mm (0.04"), within 3 m (9.84 ft) range

Resolution (measured under Reference Conditions similar to IEC 60770-1)

- Standard operation: 0.1 % of range or 2 mm (0.08”), whichever is greater
- High accuracy OCM [2]: 0.6 mm (0.02"), within 3 m (9.84 ft) range

Reference operating conditions according to IEC 60770-1

- ambient temperature: +15 to +25 °C (+59 to +77 °F)
- humidity: 45% to 75% relative humidity
- ambient pressure: 860 to 1060 mbar g (86 000 to 106 000 N/m^2 g)

Temperature Compensation

- Range: -40 to +150 °C (-40 to +300 °F)

1. Power consumption is listed at maximum.
2. A high accuracy configuration consists of the LUT440 (OCM) model using XRS-5 transducer, TS-3 temperature sensor, and a Low Calibration Point of 3 m or less.
Under severe EMI/EMC environments per IEC 61326-1 the DC powered device may have an additional error increase of up to 0.5 mm.

Source

- Integral transducer sensor
- TS-3 temperature sensor
- Average (integral transducer and TS-3)
- Programmable fixed temperature

Temperature Error

Fixed

- 0.17 % per °C deviation from programmed value

Memory

- 512 kB flash EPROM
- 1.5 MB flash for data logging

Interface

Outputs

Transducer drive

- 315 V peak

mA Analog

- 4-20 mA
- 600 ohms maximum in ACTIVE mode, 750 ohms maximum in PASSIVE mode
- Resolution of 0.1%
- Isolated

Relays[1] (3)

- 2 control
- 1 alarm control

Control Relays

- 2 Form A (SPST), NO relays
- Rated 5A at 250 V AC, non-inductive
- Rated 3A at 30 V DC

1. All relays are certified only for use with equipment that fails in a state at or under the rated maximums of the relays.

Alarm Relay

- 1 Form C (SPDT), NO or NC relay
- Rated 1A at 250 V AC, non-inductive
- Rated 3A at 30 V DC

Inputs

Discrete (2)

- 0-50 V DC maximum switching level
- Logical 0 = < 10 V DC
- Logical 1 = 10 to 50 V DC
- 3 mA maximum draw

Programming

Primary

- Local push buttons

Secondary

- PC running SIMATIC PDM
- PC running Emerson AMS Device Manager
- PC running a web browser
- PC running a Field Device Tool (FDT)
- Field Communicator 375/475 (FC375/FC475)

Compatible Transducers

- EchoMax series and STH series

Transducer Frequency

- 10 to 52 kHz

Communication

- HART 7.0
- USB

Display

- Back-lit LCD
- Dimensions:
  - 60 x 40 mm (2.36 x 1.57")
- Resolution:
  - 240 x 160 pixels
- Removable display, operational up to 5 m from enclosure base

Mechanical

Enclosure

- 144 mm (5.7") x 144 mm (5.7") x 146 mm (5.75")
- IP65 / Type 4X / NEMA 4X
- Polycarbonate

Note: Use only approved, suitable size hubs in the enclosure's conduit holes that maintain the applicable IP / Type / NEMA rating.

Remote Display Lid

- 144 mm (5.7") x 144 mm (5.7") x 22 mm (0.87")
- IP65 / Type 3 / NEMA 3
- Polycarbonate
- Operational up to 5 m from enclosure base

Blank Lid

- 144 mm (5.7") x 144 mm (5.7") x 22 mm (0.87")
- IP65 / Type 4X / NEMA 4X
- Polycarbonate

WARNINGS:

- Ingress protection of the enclosure is reduced to IP20, and Type 4X / NEMA 4X rating is void when cable entry knock-out in the blank lid is removed.
- An enclosure reduced to an IP20 rating and intended for use in non-hazardous locations must be installed in an indoor location free of dust and moisture, or be installed in a suitably rated field enclosure IP54 or better.

Back Mount Bracket

- 190 mm (7.5") x 190 mm (7.5") x 9 mm (0.35")
- Polycarbonate

Weight

- Enclosure with display lid: 1.3 kg (2.87 lbs)
- Enclosure with blank lid: 1.2 kg (2.65 lbs)

Environmental

Location

- Indoor / outdoor
(only suitable for outdoor use with IP65 / Type 4X / NEMA 4X Enclosure)

Altitude

- 2000 m max.

Ambient temperature

- -20 to +50 °C (-4 to +122 °F)

Relative humidity

- Suitable for outdoors
  (only with IP65 / Type 4X / NEMA 4X Enclosure)

Installation category

- II

Pollution degree

- 4

Approvals

Note: The device nameplate lists the approvals that apply to your device.

- General
  $CSA_{US/C}$, CE, FM, UL listed, C-TICK
- Hazardous

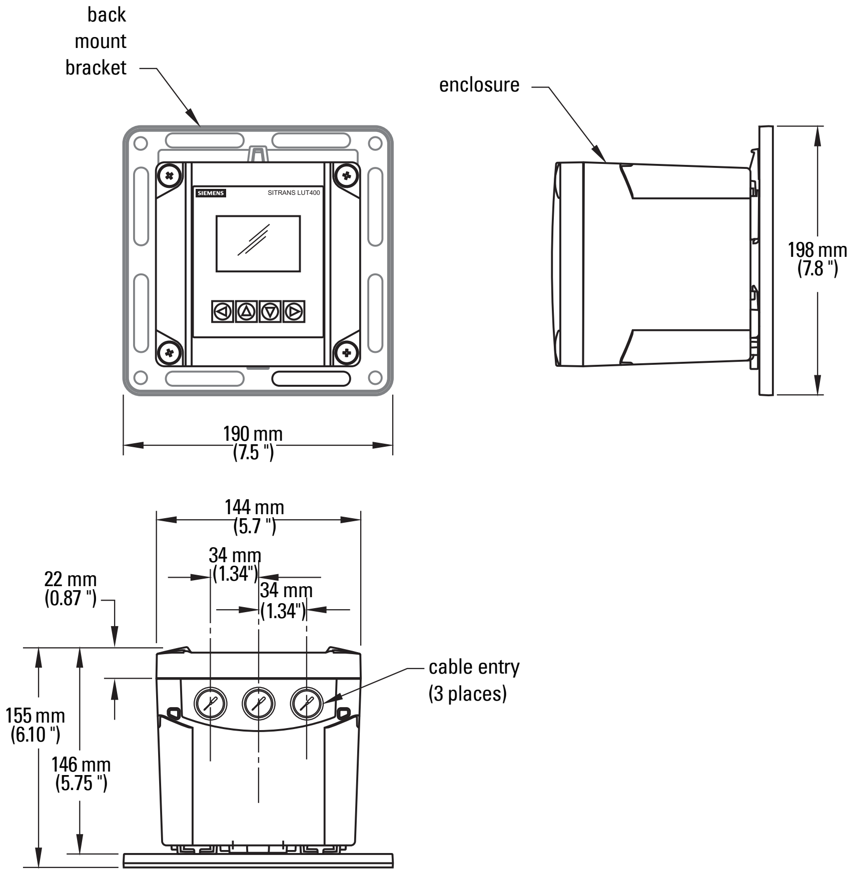
Non-incendive (Canada)	CSA Class I, Div. 2, Groups A, B, C, D; Class II, Div 2, Groups F, G; Class III

Technical Data

Notes

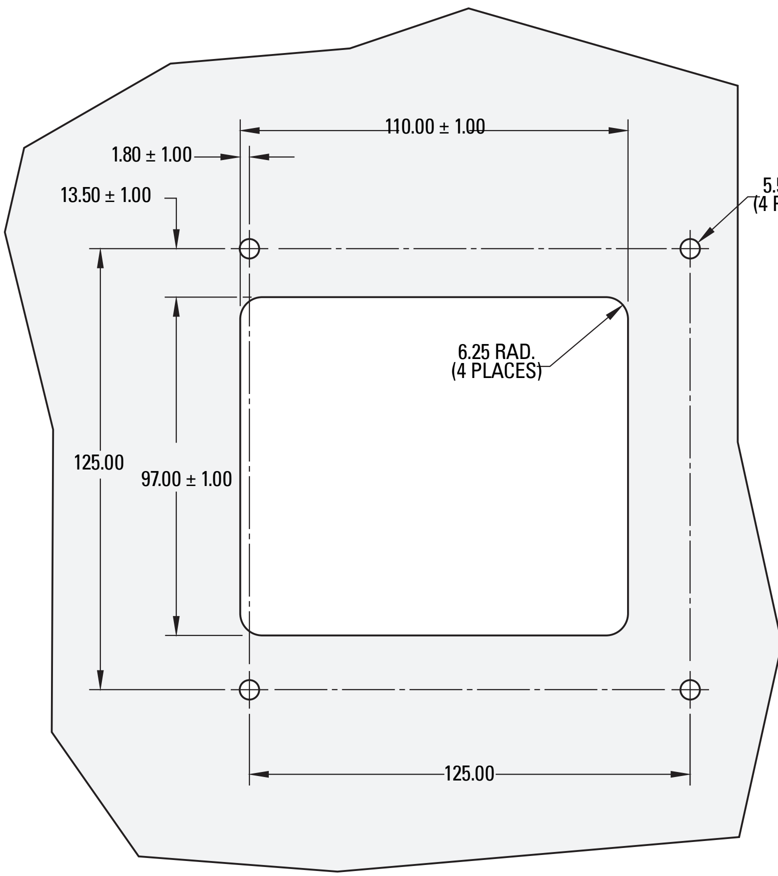
Dimension Drawings

SITRANS LUT400 Dimensions



Dimensions

Cutout Dimensions (for Remote Panel Mount)



DIMENSIONS ARE IN MILLIMETERS.

Note: Cut-out template (printed to scale) shipped with remote panel mount model.

Dimensions

Appendix A - Technical Reference

> **Note:** Where a number precedes a parameter name (for example, *2.12.2.4. Narrow Echo Filter*) this is the parameter access number via the local display. See *Parameter reference (LUI)* on page 137 for a complete list of parameters.

Principles of Operation

The SITRANS LUT400 is a high quality ultrasonic controller, configured to meet the needs of different applications, from medium range solids applications to liquids management with open channel measurement capability. The LUT400 features our next generation of Sonic Intelligence® advanced echo-processing software for increased reading reliability.

Process Variables

The Primary Variable (PV) is one of six process variables, and is set in *2.5.1.Current Output Function*.

- Level (difference between material level and Low Calibration Point),
- Space (difference between material level and High Calibration Point),
- Distance (difference between material level and sensor reference point),
- Head (difference between liquid level and Zero Head),
- Volume (volume of material based on level),
- Flow (flowrate in an open channel, based on head).

Transmit Pulse

The transmit pulse consists of one or more electrical “shot” pulses, which are supplied to the transducer connected to the SITRANS LUT400 terminals. The transducer fires an acoustic “shot” for each electrical pulse supplied. After each shot is fired, sufficient time is provided for echo (shot reflection) reception before the next (if applicable) shot is fired. After all shots of the transmit pulse are fired, the resultant echoes are processed. The transmit pulse frequency, duration, delay, and associated measurement range are defined by parameters in the Setup menu (see *Setup* on page 138.)

Echo Processing

SITRANS LUT400 uses next generation Sonic Intelligence® for echo processing.

Next generation Sonic Intelligence provides adaptive digital filtering of the transducer signal. For example, when noise levels are high, filters are adjusted to maximize the signal to noise ratio. This advanced Sonic Intelligence not only allows for better filtering, but provides improved tracking of echos, and more sophisticated echo positioning algorithms.

Echo processing consists of echo enhancement, true echo selection, and selected echo verification.

Echo enhancement is achieved by filtering (*2.12.2.4. Narrow Echo Filter*) and reforming (*2.12.2.3. Reform Echo*) the echo profile.

True echo selection (selection of echo reflected by the intended target) occurs when that portion of the echo profile meets the evaluation criteria of Sonic Intelligence.

Insignificant portions of the echo profile outside of the measurement range (*2.2.1. Low Calibration Point*), below the TVT curve (*2.12.4. TVT Shaper*) are automatically disregarded. The remaining portions of the Echo Profile are evaluated using the echo select algorithm (*2.12.2.1. Algorithm*), and the Echo Profile portion providing the best echo confidence (*3.2.9.2. Confidence*) is selected.

A confidence value is a static test of a single snapshot profile so to maintain a valid reading, it imposes that each individual profile show its peak above the threshold. The window may be locked on the profile for hours or days so if the profile drops below the TVT curve just once, a loss of echo may occur.

The SITRANS LUT400, with it's advanced tracking ability, can find and track the real echo amongst stationary clutter echoes. Therefore, even if the echo drops below the tvt curve, it can be identified with near certainty for approximately 30 seconds. This capability is measured by the FOM (*3.2.9.1. Figure of Merit*).

Selected echo verification is automatic. The position (relation in time after transmit) of the new echo is compared to that of the previously accepted echo. When the new echo is within the Echo Lock Window, it is accepted and displays, outputs, and relays are updated. If the new echo is outside of the Window, it is not accepted until Echo Lock requirements are satisfied.

Echo Selection

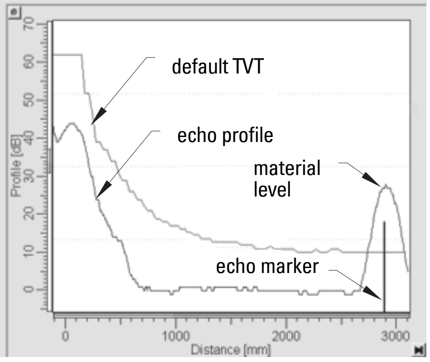
Time Varying Threshold (TVT)

A TVT curve describes a threshold below which any echoes will be ignored. The default TVT curve is used, until *2.12.3.1. Auto False Echo Suppression* and *2.12.3.2. Auto False Echo Suppression Range* are used to create a new 'learned TVT curve'.

A TVT hovers above the echo profile to screen out unwanted reflections (false echoes).

In most cases the material echo is the only one which rises above the default TVT.

In a vessel with obstructions, a false echo may occur. See *Shaper Mode and Auto False Echo Suppression* below for more details.



The device characterizes all echoes that rise above the TVT as potential good echoes. Each peak is assigned a rating based on its strength, area, height above the TVT, and reliability, amongst other characteristics.

App. A - Technical Ref.

Algorithm

The true echo is selected based on the setting for the Echo selection algorithm. For a list of options see **Algorithm (2.12.2.1.)** on page 181. All algorithms ultimately use confidence to select the true echo. However, when applications report a low confidence value, the **TR** algorithm (which tracks the moving echo) can be used to predict the primary variable.

Algorithm		Echo Determination	Suggested Usage
TF	**T**rue **F**irst echo	Selects the first echo that crosses TVT curve.	Use in liquids applications free of obstructions when confidence of first echo is high.
TR	**TR**acker	Selects the echo that is closest to the transducer, and is moving. (If echo location is steady, BLF algorithm should be used.)	Only use **TR** algorithm in process applications with continuous level changes, and a risk of fixed obstructions that could interfere with true level, resulting in low confidence.
L	**L**argest echo	Selects the largest echo above the TVT curve.	Use in long range liquids applications with large (tall) material return echoes.
BLF	**B**est of **F**irst and **L**argest echo	Selects the echo (first and highest) with the highest confidence value.	Default and most commonly used. Use in all short to mid range general liquids and solids applications where there is a relatively large (tall), sharp echo.
ALF	**A**rea, **L**argest, and **F**irst	Selects the echo with the highest confidence value based on the three criterion (widest, highest, and first).	Use in mid to long range solids applications where the material return echo is wide and large, and where competing smaller echoes challenge **BLF**.

Confidence

Confidence (3.2.9.2.) describes the quality of an echo. Higher values represent higher quality.

Echo Threshold

Echo Threshold (2.12.2.2.) defines the minimum confidence value required for an echo to be accepted as valid and evaluated.

Figure of Merit

Figure of Merit (3.2.9.1.) measures the quality of the reported process value: higher values represent better quality. Even when a low confidence value exists, a high FOM will ensure the true echo has been selected. Approximately 20 readings are used to support the FOM value.

Example:

FOM greater than 75% = good quality,
FOM less than 50% = poor quality.

Various things contribute to the FOM:

- success of the tracking (how closely can the next level vs. the actual next level be predicted)
- level of noise
- confidence of the last echo
- time interval since last valid echo
- speed at which the process is moving
- quality of the echo shape and how it helps the calculation of the echo position

If FOM is low, reduce the noise in the process, or check the installation to increase signal quality.

Shaper Mode and Auto False Echo Suppression

Notes:
- For detailed instructions on using this feature via PDM, see Auto False Echo Suppression in LUT400 Communications manual[a].
- For detailed instructions on using this feature via the local push buttons, see **Shaper Mode (2.12.3.4.)** on page 184.

a. Communications for SITRANS LUT400 (HART) Manual (7ML19985NE01)

False echoes can be caused by an obstruction in the transducer shot path (such as pipes, ladders, chains). Such false echoes may rise above the default TVT curve.

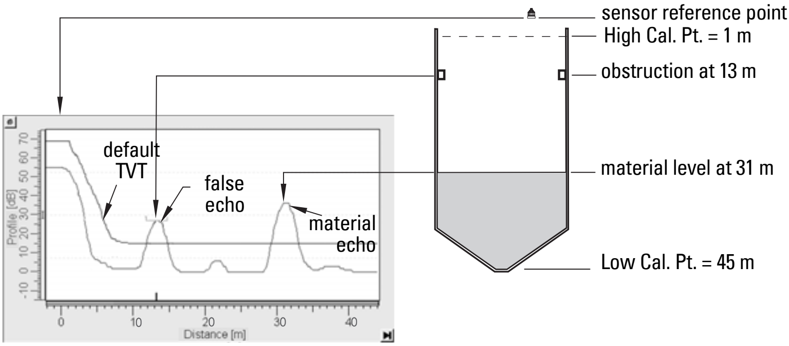
Auto False Echo Suppression Range (2.12.3.2.) specifies the range within which the learned TVT is applied. Default TVT is applied over the remainder of the range.

The material level should be below all known obstructions at the moment when Auto False Echo Suppression learns the echo profile. Ideally the vessel should be empty or almost empty.

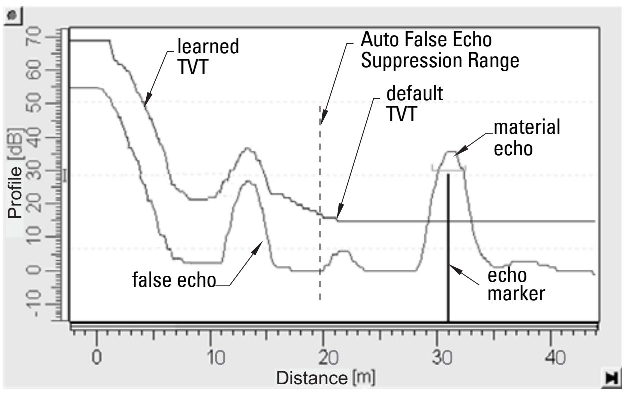
The device learns the echo profile over the whole measurement range and the TVT is shaped around all echoes present at that moment.

Auto False Echo Suppression Range must be set to a distance shorter than the distance to the material level when the environment was learned, to avoid the material echo being screened out.

Example before Auto False Echo Suppression



Example after Auto False Echo Suppression



Auto False Echo Suppression Range set to 20 m

Measurement Range

Near Range

Near Range (2.2.4.) programs SITRANS LUT400 to ignore the area in front of the transducer. The default blanking distance is 27.8 cm (0.91 ft) from the sensor reference point.

Near Range allows you to increase the blanking value from its factory default. But Shaper Mode (2.12.3.4.) is generally recommended in preference to extending the blanking distance from factory values.

Far Range

Far Range (2.2.5.) can be used in applications where the base of the vessel is conical or parabolic. A reliable echo may be available below the vessel empty distance, due to an indirect reflection path.

Increasing Far Range by 30% or 40% can provide stable empty vessel readings.

Measurement Response

Note: Units are defined in **Quick Start (1.1.)** and are in meters by default.

Response Rate limits the maximum rate at which the display and output respond to changes in the measurement. There are three preset options: slow, medium, and fast.

Once the real process fill/empty rate (m/min by default) is established, a response rate can be selected that is slightly higher than the application rate. Response Rate automatically adjusts the three rate parameters that affect the output response rate.

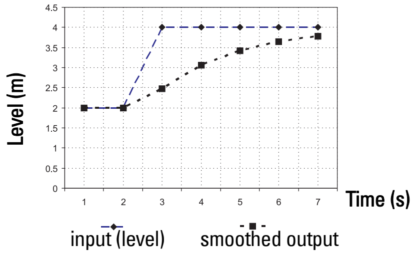
When Response Rate set to:		Fill Rate per Minute (2.3.1.)/ Empty Rate per Minute (2.3.2.) automatically adjust to:	Damping Filter (2.3.3.) automatically adjusts to:
*	Slow	0.1 m/min	100.0 s
	Medium	1.0 m/min	10.0 s
	Fast	10.0 m/min	0.0 s

Damping

Damping Filter (2.2.3.) smooths out the response to a sudden change in level. This is an exponential filter and the engineering unit is always in seconds.

In 5 time constants, the output rises exponentially: from 63.2% of the change in the first time constant, to almost 100% of the change by the end of the 5th time constant.

Damping example
time constant = 2 seconds
input (level) change = 2 m



Note: Damping Filter can be set to 0 in order to display measurement readings as fast as fill/empty rates permit. Fill Rate per Minute, and Empty Rate per Minute work in conjunction with Damping Filter, therefore, if readings are slow to respond to changes, check that Fill and Empty Rates are set to values greater than or equal to the desired Response Rate.

App. A - Technical Ref.

Analog Output

The mA output (current output) is proportional to material level in the range 4 to 20 mA. 0% and 100% are percentages of the full-scale reading (m, cm, mm, ft, in). Typically mA output is set so that 4 mA equals 0% and 20 mA equals 100%.

Current Output Function (2.6.1.)

Current Output Function (2.6.1.) controls the mA output and applies any relevant scaling. By default it is set to **LEVEL**. Other options are Space, Distance, Volume, Head, Flow, or Manual. A MANUAL setting allows you to test the functioning of the loop.

You can also set the mA output to report when the device is in an error condition and the fail-safe timer has expired. By default, the reported value depends on the device type. A standard device reports the last valid reading, and a NAMUR NE43 compliant device reports the user-defined value for **Material Level** (3.58 mA by default).

Loss of Echo (LOE)

A loss of echo (LOE) occurs when the calculated measurement is judged to be unreliable because the echo confidence value has dropped below the echo confidence threshold.

If the LOE condition persists beyond the time limit set in **LOE Timer (2.4.2.)** the LCD displays the Service Required icon, and the text region displays the fault code 0 and the text LOE.

If two faults are present at the same time, the device status indicator and text for the highest priority fault will display. For example, if both Loss of Echo and Broken cable faults are present, the Broken cable fault will display.

 1 Broken cable

Fail-safe Mode

The purpose of the Fail-safe setting is to put the process into a safe mode of operation in the event of a fault or failure. The value to be reported in the event of a fault (as displayed in *2.5.8. Current Output Value*) is selected so that a loss of power or loss of signal triggers the same response as an unsafe level.

LOE Timer (2.4.2.) determines the length of time a Loss of Echo (LOE) condition will persist before a Fail-safe state is activated. The default setting is 100 seconds.

Material Level (2.4.1.) determines the mA value (corresponding to the selected PV) to be reported when **LOE Timer (2.4.2.)** expires. The default setting is device dependent (standard or NAMUR NE 43-compliant).

Upon receiving a reliable echo, the loss of echo condition is aborted, the Maintenance Required icon and error message are cleared, and the mA output return to the current material level. [The PV region on the LUI display will show dashes (– – – – – – –) when a fault that causes fail-safe is present, and will return to the current reading when the fault is cleared.]

Distance Calculation

To calculate the transducer to material level (object) distance, the transmission medium (atmosphere) *2.12.1.1. Sound Velocity* is multiplied by the acoustic transmission to reception time period. This result is divided by 2 to calculate the one way distance.

Distance = Sound Velocity x Time / 2

The Reading displayed is the result of performing any additional modification to the calculated distance as determined by:

- *2.1.2. Sensor Mode*,
- *2.1.1. Units*,
- Volume conversion parameters - *2.6. Volume*, *2.2.3. Sensor Offset*,
- Flow parameters - *2.15. Flow*,
- and/or Totalizer parameters - *2.16. Totalizers*.

Sound Velocity

The sound velocity of the transmission medium is affected by the type, temperature, and vapor pressure of the gas or vapor present. As preset, the SITRANS LUT400 assumes the vessel atmosphere is air at +20 °C (+68 °F). Unless altered, the sound velocity used for the distance calculation is 344.1 m / s (1129 ft / s).

Variable air temperature is automatically compensated when a Siemens ultrasonic / temperature transducer is used. If the transducer is exposed to direct sunlight, use a sunshield or a separate TS-3 temperature sensor.

Also, if the temperature varies between the transducer face and the liquid monitored, use a TS-3 temperature sensor in combination with an ultrasonic / temperature transducer. The TS-3 must be installed as close to the material as possible to ensure best performance. It is acceptable to submerge the TS-3 if necessary. Set *2.12.1.3. Temperature Source* for **Average of Sensors**, to average the transducer and TS-3 measurements.

Atmosphere composition other than air can pose a challenge for ultrasonic level measurement. However, excellent results may be obtained if the atmosphere is homogeneous (well mixed), at a fixed temperature, and consistent vapour pressure, by performing a *2.12.1.6. Auto Sound Velocity*.

The SITRANS LUT400 automatic temperature compensation is based on the sound velocity / temperature characteristics of “air” and may not be suitable for the atmosphere present. If the atmosphere temperature is variable, perform frequent sound velocity calibrations to optimize measurement accuracy.

Sound velocity calibration frequency may be determined with experience. If the sound velocity in two or more vessels is always similar, future calibrations may be performed on one vessel and the resultant *2.12.1.1. Sound Velocity* entered directly for the other vessel(s).

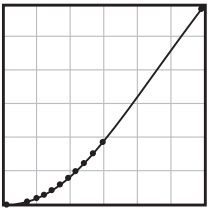
If the sound velocity of a vessel atmosphere is found to be repeatable at specific temperatures, a chart or curve may be developed. Then rather than performing a sound velocity calibration each time the vessel temperature changes significantly, the anticipated *2.12.1.1. Sound Velocity* may be entered directly.

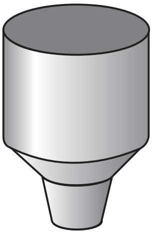
Volume Calculation

The SITRANS LUT400 provides a variety of volume calculation features (see *2.6.Volume*).

If the vessel does not match any of the eight preset vessel shape calculations, a Universal Volume calculation may be used. Use the level/volume graph or chart provided by the vessel fabricator (or create one based on the vessel dimensions). Based on the graph, choose the Universal Volume calculation, and select the level vs. volume breakpoints to be entered (32 max). Generally, the more breakpoints entered, the greater the accuracy.

2.6.1.Vessel Shape set to Universal, Linear





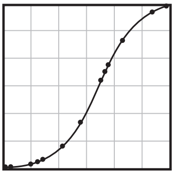
This volume calculation creates a piece-wise linear approximation of the level/volume curve. This option provides best results if the curve has sharp angles joining relatively linear sections.

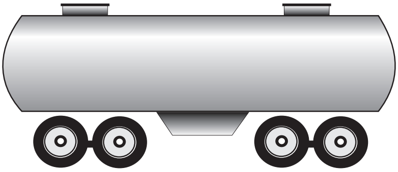
Enter a Level Breakpoint at each point where the level/volume curve bends sharply (2 minimum).

For combination curves (mostly linear but include one or more arcs), enter numerous breakpoints along the arc, for best volume calculation accuracy.

2.6.1.Vessel Shape set to Universal, Curved

This calculation creates a cubic spline approximation of the level/volume curve, providing best results if the curve is non-linear, and there are no sharp angles.





Select at least enough breakpoints from the curve to satisfy the following:

- two breakpoints very near the minimum level
- one breakpoint at the tangent points of each arc
- one breakpoint at each arc apex
- two breakpoints very near the maximum level

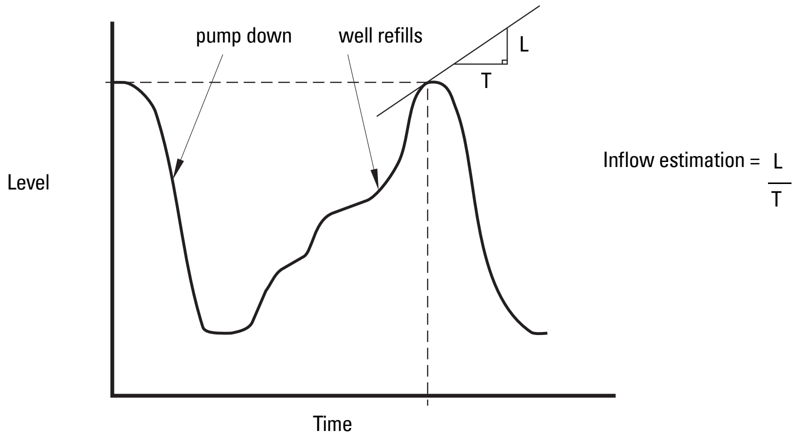
For combination curves, enter at least two breakpoints immediately before and after any sharp angle (as well as one breakpoint exactly at the angle) on the curve.

Pump Totalizers

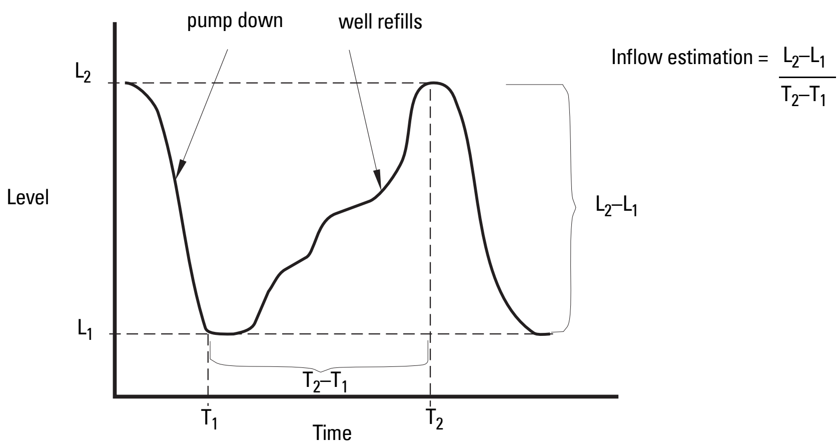
Inflow/Discharge Adjust

Pumped volume totals are affected by the inflow (or discharge) rate. This rate can be calculated based on rate of change estimation, or pump cycle timing.

Using **Inflow/Discharge Adjust (2.7.3.4.)**, set option **Based on rate estimation** to have the inflow rate measured just prior to the start of the pump cycle.



Set option **Based on pump cycle** to calculate the inflow based on the change of volume between the end of the last pump cycle and the start of the next one, and the time period between the last cycle and the current one.



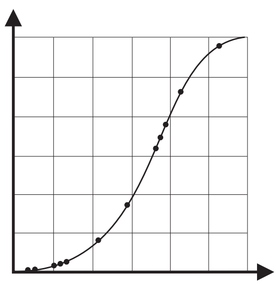
Flow Calculation

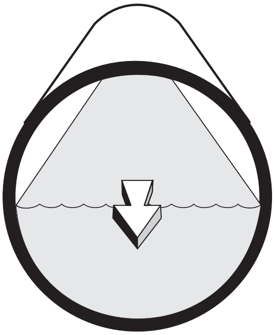
Special emphasis has been placed on providing the most accurate flow calculations possible. To this end, specific routines have been written to comply with the British Standards Institute's Specifications BS-3680. These routines calculate correction factors taking into account second order effects such as approach velocity and boundary layer.

If the PMD does not match any of the eleven preset PMD calculations, or if a PMD is not used, select a Universal flow calculation (PMD = Universal Head Flow). Use the head/flow graph or chart provided by the PMD fabricator (or create one based on the PMD or channel dimensions).

The SITRANS LUT400 supports Universal curved flow calculation. This calculation creates a cubic spline approximation of the head/flow curve, providing best results if the curve is non-linear, and there are no sharp angles.

Select the head versus flow breakpoints to be entered (32 max). Generally, the more breakpoints entered, the greater the flow calculation accuracy.





Select at least enough breakpoints from the curve to satisfy the following:

- two breakpoints very near the minimum head
- one breakpoint at the tangent points of each arc
- one breakpoint at each arc apex
- two breakpoints very near the maximum head

For combination curves, enter at least 2 breakpoints immediately before and after any sharp angle (as well as 1 breakpoint exactly at the angle) on the curve.

Method of Flow Calculation

The SITRANS LUT400 can be programmed to use either of two methods for calculating flow from the head measurement: absolute or ratiometric. The result is the same regardless of the method used. The main difference is the information that must be entered in order for the device to carry out the calculation. Refer to *2.15.1.Primary Measuring Device (PMD)*, and *2.15.4.PMD Dimensions* for list of information required.

For the ratiometric method, it is usually sufficient that the user know the flow rate (Q_{cal}) which occurs at maximum head (h_{cal}).

On the other hand, absolute calculations require that the user enter information such as: the physical dimensions of the PMD and the constant relating to units of measure for both linear dimensions and flow rates.

Example:

the general formula for flow through a single exponent PMD is:

$Q = KH^{x}$

the specific formula for flow through a 45 ° V-notch weir is:

$cfs = 1.03H^{2.5}$

thus: Q = flow in cubic feet per second

K = constant of 1.03

H = head in feet

The absolute method is not applicable to the following:

- Palmer Bowlus Flume
- H-Flume

Data Logging

Data logs are available for Alarms, OCM flow, Daily Totals, and Primary Variable. The logs can be examined locally via LUI (see **View Logs (3.2.6.)**, or via USB on a computer.

After connecting the USB cable, browse to the USB drive on the computer. Logs can be viewed on the USB drive, or can be copied from the USB drive to another local computer drive.

Note: No data logs are written while device is connected to a PC via USB.

Log files written to a local computer drive via USB, are comma-delimited files, and a list of file headings for each type of log is shown below.

Log type	Headings
Alarms	Current Date (YYYY/MM/DD)
	Current Time (HH:MM:SS)
	Alarm Name
	Alarm Value
	Alarm State
OCM	Current Date (YYYY/MM/DD)
	Current Time (HH:MM:SS)
	Current Head Value (in level units)
	Current Flow Value (in flowrate units)
Daily Totals	Current Date (YYYY/MM/DD)
	Maximum Daily Flow (in flowrate units)
	Minimum Daily Flow (in flowrate units)
	Daily Average Flow (in flowrate units)
	Daily Totalized Volume (in volume units)
	Daily Running Totalized Volume (in volume units)
	Daily Maximum Temperature (in temperature units)
	Daily Minimum Temperature (in temperature units)
PV	Current Date (YYYY/MM/DD)
	Current Time (HH:MM:SS)
	PV (in Device Variable Code) 0 = Level 1 = Space 2 = Distance 3 = Volume 4 = Flow 5 = Head
	PV Value (in PV units)
	Temperature Value (in temperature units)

To clear entries when log memory becomes full, see *Viewing the Data Log* on page 119.

Notes

Appendix B - Certificates and Support

Certificates

Certificates can be downloaded from the product page of our website at: www.siemens.com/sitransLUT400.

Technical Support

If you have any technical questions about the device described in these Operating Instructions and do not find the answers, you can contact Customer Support:

- Via the Internet using the Support Request:

Support request (http://www.siemens.com/automation/support-request)

- Via Phone:
  - Europe: +49 (0) 911 895 7222
  - America: +1 423 262 5710
  - Asia-Pacific: +86 10 6475 7575

Further information about our technical support is available on the Internet at Technical support (http://support.automation.siemens.com/WW/view/en/16604318)

Service & Support on the Internet

In addition to our documentation, we offer a comprehensive knowledge base online on the Internet at:

Service & Support (http://www.siemens.com/automation/service&support)

There you will find:

- The latest product information, FAQs, downloads, tips and tricks.
- Our newsletter, providing you with the latest information about our products.
- Our bulletin board, where users and specialists share their knowledge worldwide.
- Your local contact partner for Industry Automation and Drives Technologies in our partner database.
- Information about field service, repairs, spare parts and lots more under "Services".

Additional Support

Please contact your local Siemens representative and offices if you have additional questions about the device.

Find your contact partner at:

Local contact person (http://www.siemens.com/automation/partner)

Notes

List of Abbreviations

Short form	Long Form	Description	Units
AC	Alternating Current	power source	
AFES	Auto False Echo Suppression		
CE / FM / CSA	Conformité Européene / Factory Mutual / Canadian Standards Association	safety approval	
BS-3680	Flow standard from the British Standards Institute		
DC	Direct Current	power source	
DTM	Device Type Manager		
EDD	Electronic Device Description		
EMC	Electromagnetic Compatibility		
ESD	Electrostatic Discharge		
FCC	Federal Communications Commission		
FDT	Field Device Tool		
FOM	Figure of Merit	measurement of echo quality	
HART	Highway Addressable Remote Transducer		
HCF	Hart Communication Foundation		
IEC	International Electrotechnical Commission		
IP	Ingress Protection		
IS	Intrinsically Safe	safety approval	
LCD	Liquid Crystal Display		
LOE	Loss of Echo		
LUI	Local User Interface	view outputs via LCD display; make modifications via local push buttons	
μs	microsecond	10^{-6}	Second
μV	microvolt	10^{-6}	Volt
mA	Milliamp	unit of electric current	
N m	Newton meter	unit of torque	

Short form	Long Form	Description	Units
NEMA	National Electrical Manufacturer's Association		
PDM	Process Device Manager		
PLC	Programmable Logic Controller		
PV	Primary Variable	measured value	
RC	Resistance Capacitance	resistance x capacitance	µs
SCADA	Supervisory Control and Data Acquisition		
SCR	Silicon-controlled rectifier	switching device	
SPDT	Single Pole Double Throw	relay configuration	
SPST	Single Pole Single Throw	relay configuration	
SV	Secondary Variable	equivalent value	
TVT	Time Varying Threshold	sensitivity threshold	
USB	Universal Serial Bus		
VSDs	Variable Speed Drives		

LCD Menu Structure

LCD Menu Structure

Notes:
- In Navigation mode **ARROW keys** navigate the menu in the direction of the arrow.
- See *Parameter reference (LUI)* on page 137 for detailed information and instructions.

MAIN MENU

1. WIZARDS

1.1 QUICK START
- 1.1.1 QS LEVEL
  - INTRODUCTION
  - TRANSDUCER
  - OPERATION
  - TEMPERATURE SOURCE
  - FIXED TEMPERATURE
  - UNITS
  - HIGH CALIB. PT.
  - LOW CALIB. PT.
  - RESPONSE RATE
  - APPLY?
- 1.1.2 QS VOLUME
  - INTRODUCTION
  - TRANSDUCER
  - TEMPERATURE SOURCE
  - FIXED TEMPERATURE
  - VESSEL SHAPE
  - UNITS
  - HIGH CALIB. PT.
  - LOW CALIB. PT.
  - RESPONSE RATE
  - DIMENS. A
  - DIMENS. L
  - VOLUME UNITS
  - MAX. VOLUME
  - APPLY?
- 1.1.3 QS FLOW (LUT430, 440 only)
  - INTRODUCTION
  - TRANSDUCER
  - TEMPERATURE SOURCE
  - FIXED TEMPERATURE
  - PRIMARY MEASURING DEVICE
  - METHOD OF FLOW CALCULATION
  - UNITS
  - HIGH CALIB. PT.
  - LOW CALIB. PT.
  - RESPONSE RATE
  - Calculation factors (vary per PMD)
  - PMD dimensions (vary per PMD)
  - MAXIMUM HEAD
  - ZERO HEAD OFFSET
  - FLOWRATE UNITS
  - MAXIMUM FLOW AT 20MA
  - FLOWRATE DECIMAL
  - LOW FLOW CUTOFF
  - APPLY?

1. WIZARDS (cont'd)

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- INTRODUCTION
- NUMBER OF PUMPS
- RELAY PUMP 1
- RELAY PUMP 2
- PUMP CONTROL MODE
- SERVICE RATIO PUMP 1
- SERVICE RATIO PUMP 2
- RUN TIME PUMP 1
- RUN TIME PUMP 2
- ON SETPOINT PUMP 1
- ON SETPOINT PUMP 2
- OFF SETPOINT PUMP 1
- OFF SETPOINT PUMP 2

2. SETUP

2.1 SENSOR
- 2.1.1 UNITS
- 2.1.2 SENSOR MODE (LUT420)
- 2.1.3 SENSOR MODE (LUT430, 440)
- 2.1.4 SENSOR MODE SECONDARY (LUT420)
- 2.1.5 SENSOR MODE SECONDARY (LUT430, 440)
- 2.1.6 TRANSDUCER
- 2.1.7 FREQUENCY
- 2.1.8 LONG SHOT DURATION
- 2.1.9 SHORT SHOT DURATION

2.2 CALIBRATION
- 2.2.1 LOW CALIB. PT.
- 2.2.2 HIGH CALIB. PT.
- 2.2.3 SENSOR OFFSET
- 2.2.4 NEAR RANGE
- 2.2.5 FAR RANGE
- 2.2.6 AUTO SENSOR OFFSET

2.3 RATE
- 2.3.1 FILL RATE/MIN
- 2.3.2 EMPTY RATE/MIN
- 2.3.3 DAMPING FILTER

2.4 FAIL-SAFE
- 2.4.1 MATERIAL LEVEL
- 2.4.2 LOE TIMER
- 2.4.3 FAIL-SAFE MA VALUE

2.5 CURRENT OUTPUT
- 2.5.1 CURR. OUT. FUNC. (LUT420)
- 2.5.2 CURR. OUT. FUNC. (LUT430, 440)
- 2.5.3 4 MA SETPOINT
- 2.5.4 20 MA SETPOINT
- 2.5.5 MIN. MA LIMIT
- 2.5.6 MAX. MA LIMIT
- 2.5.7 MANUAL VALUE
- 2.5.8 CURRENT OUTPUT VALUE

2.6 VOLUME
- 2.6.1 VESSEL SHAPE
- 2.6.2 VOLUME UNITS
- 2.6.3 MAX. VOLUME
- 2.6.4 DIMENS. A
- 2.6.5 DIMENS. L
- 2.6.6 USER DEFINED UNIT

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- 2.6.8 TABLE 9-16
- 2.6.9 TABLE 17-24
- 2.6.10 TABLE 25-32
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    - 2.7.1.2 RELAY PUMP 1
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    - 2.7.1.4 PUMP CONTROL MODE (LUT420)
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    - 2.7.1.7 OFF SETPOINT PUMP 1
    - 2.7.1.8 ON SETPOINT PUMP 2
    - 2.7.1.9 OFF SETPOINT PUMP 2
    - 2.7.1.10 SERVICE RATIO PUMP 1
    - 2.7.1.11 SERVICE RATIO PUMP 2
  - 2.7.2 MODIFIERS
    - 2.7.2.1 WALL CLING REDUCTION
      - 2.7.2.1.1 ENABLE
      - 2.7.2.1.2 LEVEL SETPOINT VARIATION
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      - 2.7.2.2.5 PEAK 2 START TIME
      - 2.7.2.2.6 PEAK 2 END TIME
      - 2.7.2.2.7 PEAK 3 START TIME
      - 2.7.2.2.8 PEAK 3 END TIME
      - 2.7.2.2.9 PEAK 4 START TIME
      - 2.7.2.2.10 PEAK 4 END TIME
      - 2.7.2.2.11 PEAK 5 START TIME
      - 2.7.2.2.12 PEAK 5 END TIME
      - 2.7.2.2.13 PEAK ON SETPOINT PUMP 1
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      - 2.7.2.4.1 DELAY BETWEEN STARTS
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    - 2.7.3.2 TOTALIZER DECIMAL POSITION
    - 2.7.3.3 TOTALIZER MULTIPLIER
    - 2.7.3.4 INFLOW/DISCHARGE ADJUST
    - 2.7.3.5 RESET RUNNING TOTALIZER

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    - 2.8.1.3 HIGH LEVEL VALUE OFF
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    - 2.8.2.4 ASSIGNED RELAY
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    - 2.8.3.2 DISCRETE INPUT NUMBER
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- 2.12.2 ECHO SELECT
  - 2.12.2.1 ALGORITHM
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Glossary

accuracy: degree of conformity of a measure to a standard or a true value.

algorithm: a prescribed set of well-defined rules or processes for the solution of a problem in a finite number of steps.

ambient temperature: the temperature of the surrounding air that comes in contact with the enclosure of the device.

Auto False-Echo Suppression: a technique used to adjust the level of a TVT curve to avoid the reading of false echoes. (See TVT.)

Auto False-Echo Suppression Range: defines the endpoint of the TVT distance. (See TVT.) This is used in conjunction with auto false echo suppression.

blanking: a blind zone extending away from the reference point plus any additional shield length.The device is programmed to ignore this zone.

confidence: describes the quality of an echo. HIgher values represent higher quality. Confidence threshold defines the minimum value.

damping: term applied to the performance of a device to denote the manner in which the measurement settles to its steady indication after a change in the value of the level.

dB (decibel): a unit used to measure the amplitude of signals.

derating: to decrease a rating suitable for normal conditions according to guidelines specified for different conditions.

echo: a signal that has been reflected with sufficient magnitude and delay to be perceived in some manner as a signal distinct from that directly transmitted. Echoes are frequently measured in decibels relative to the directly transmitted signal.

echo confidence: the recognition of the validity of the echo. A measure of echo reliability.

echo lock window: a window centered on an echo in order to locate and display the echo's position and true reading. Echoes outside the window are not immediately processed.

Echo marker: a marker that points to the processed echo.

Echo Processing: the process by which the device determines echoes.

Echo Strength: describes the strength of the selected echo in dB referred to 1 μV rms.

Echo Profile: a graphical display of a processed echo.

false echo: any echo which is not the echo from the desired target. Generally, false echoes are created by vessel obstructions.

far range: the distance below the zero percent or empty point in a vessel.

figure of merit: combines noise level, tracking quality, and signal strength to measure the quality of the reported echo value.

frequency: the number of periods occurring per unit time. Frequency may be stated in cycles per second.

Hertz (Hz): unit of frequency, one cycle per second. 1 Gigahertz (GHz) is equal to 10^9 Hz.

HART: **H**ighway **A**ddressable **R**emote **T**ransducer. An open communication protocol used to address field devices.

multiple echoes: secondary echoes that appear as double, triple, or quadruple echoes in the distance from the target echo.

parameters: in programming, variables that are given constant values for specific purposes or processes.

range: distance between a transducer and a target.

shot: one transmit pulse or measurement.

speed of sound: the speed at which sound is propagated through some medium under specified conditions.

stillpipe: a pipe that is mounted inside a vessel parallel to the vessel wall, and is open to the vessel at the bottom.

stilling well: see **stillpipe**.

TVT (time varying threshold): a time-varying curve that determines the threshold level above which echoes are determined to be valid.

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Notes

For more information

www.siemens.com/level

www.siemens.com/continuous-weighing

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System Planner

ACE3600 RTU

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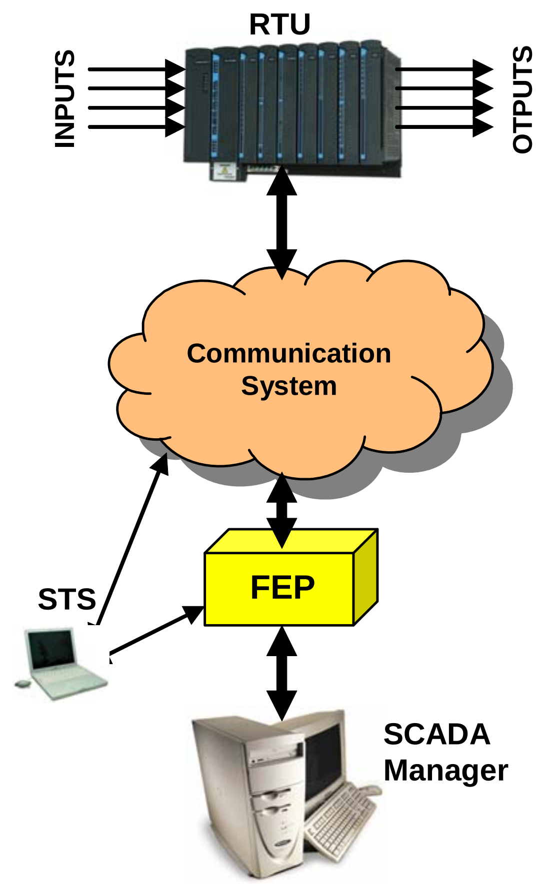
ACE3600 System Overview

The purpose of ACE3600 system is typically to provide some degree of automatic operation to a new or existing customer process. The process may be found in water pump stations, sewage lift stations, communication system monitoring, security, public notification control, electrical substation monitoring, distribution automation, demand-side management, automated meter reading, or other applications. This automation is provided by a combination of hardware.

- Remote Terminal Unit (RTU):



The field sites are equipped with ACE3600 RTUs that collect data from on-site sensors, add data from off-site sources, and use this data aggregate to make decisions regarding how the process is operating. Changes to the local process may be made; messages may be initiated that send data elsewhere to influence the operation of off-site equipment or to advise the SCADA Manager of some important change.

- Communications:

The multiple sites in the system may communicate among themselves by utilizing a variety of communication choices: IP networks, two-way conventional, trunked, or data radio or any other communication network. MDLC, the main communication protocol employed by ACE3600, is based on the seven-layer OSI recommendation, and is designed to be totally functional on variety of communication media.
MDLC includes a *store-&-forward* capability that permits different communication media links to be incorporated into the total system, i.e. conventional radio *and* trunked radio *and* microwave radio *and* LAN all interconnected by ACE3600 into a single communication system. Data may be passed from any site to any other site in the system (peer-to-peer) either directly or by multiple hops through intermediate ACE3600 sites. This peer-to-peer communication capability enables system designs that use a distributed-intelligence operating philosophy; central-intelligence-only systems may also be implemented if the load on the communication system permits it.

- The Front End Processor (FEP):

The Front End Processor is used at the central site(s) to provide a two-way path to the communication system and the distant RTUs from the SCADA Manager hardware and software. The FEP converts MDLC protocol data from the RTUs to a protocol used by the SCADA Manager vendor: when the OPC or ModBus protocol is used, the FEP will maintain a local database of all the data from the multiple in-field sites; when TCP/IP gateway is used, the FEP is simply a gateway between the two different protocols. The FEP always acknowledges all RTU-initiated messages. The FEP can also provide a two-way path between the ACE3600 STS and the field RTUs for those functions unique to ACE3600 that are not provided by the SCADA Manager software (over-the-air programming download, diagnostics upload, and more.)

- SCADA Manager:

The SCADA Manager provides the operator with the display and report tools necessary to view and manage the associated process(es). The SCADA Manager obtains data from the FEP according to its needs and typically presents that data on custom-created display formats; control messages may also be initiated from these custom screens. Security is typically implemented via permission levels activated by the operator's sign-on password. Microsoft Windows is becoming the operating system of choice because it easily supports the desired graphic symbols used on the custom screens. The report capability may be provided by the SCADA software or a data export to Microsoft Excel or equivalent may be utilized. The end result is an easy to use pictorially-described representation of the field status of key equipment items plus the means to make changes in how those pieces of equipment operate.

- System Tools Suite (STS):

The ACE3600 STS is a software program that allows the system engineer to set up and maintain the ACE3600 system in accordance with system-specific requirements. The STS computer (PC) may be connected to any RTU/FEP or to the other network points in the system and have connectivity established with any other site through the store-&-forward capability of the MDLC protocol; all the capabilities available during a local connection may then be enjoyed by the remotely-connected system engineer: the communication network topography may be defined; the application(s) for each site may be created and downloaded into the RTUs; run-time and diagnostic data may be uploaded.

ACE3600 RTU Construction

The ACE3600 RTU is a universal device that may serve as an RTU, a Programmable Logic Controller (PLC), or as the system FEP. It is placed at the system's field sites to collect data from on-site sensors, add data from off-site sources, and use this data aggregate to make decisions regarding how some process is operating. The RTU may make changes to the local process; messages may be initiated that send data elsewhere to influence the operation of off-site equipment or to advise the SCADA Manager of some important change.

The ACE3600 is available in various structures:

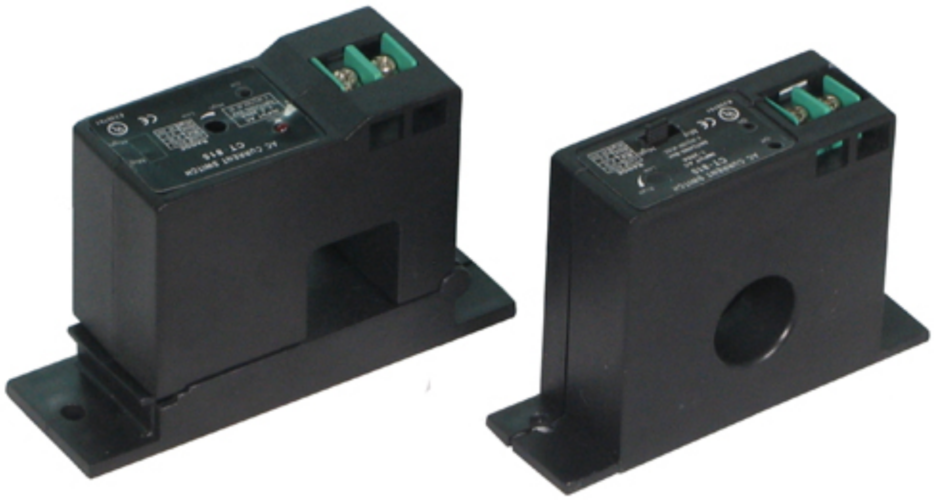
- Frame which can accommodate a varied number and type of modules
- Metal chassis which accommodates the frame, and optional radios, backup battery and communication interfaces
- Protective housing which accommodates the frame, and optional radios, backup battery and communication interfaces (suitable for outdoor installation)



The ACE3600 frame consists of the following elements:

- Plastic slots which accommodate the power supply, CPU and I/O modules, and backplane bus motherboard
- Mounting plate for attaching the plastic slots together and mounting the frame on a wall
- Backplane bus motherboard which connects the modules to each other via the signal buses and connects the modules with operating voltages
- Power junction box for AC or DC power source and ground connections

A frame can be mounted on the wall or installed in a 19" rack or customer enclosure.



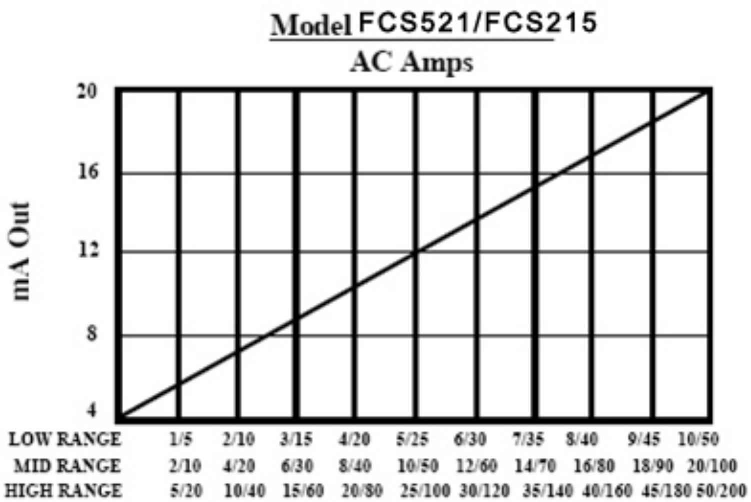
Application of Current transducer:
Current transducer measure power and monitor filling and pumping operations as well as monitoring changing process variables.

Feature of current transducer:
Three ranges per unit reduces inventory by select jumper or none.
No field adjustment necessary, factory calibrated
Average measurement is equivalent to True RMS for pure sine waves for the 0-5V,0-10V no need power supply,4-20mA series
True RMS measurement for sine waves or variable frequency drives for the 420T series
Input / Output isolation via current transformer
Solid-state reliability

Specifications:
FCS521/FCS2151

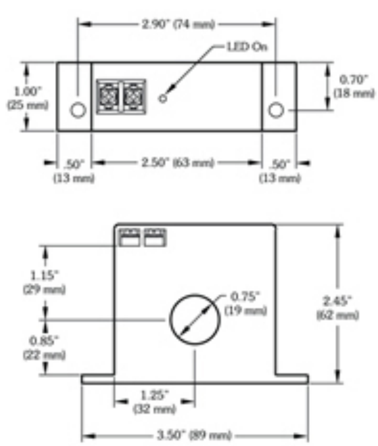
Power Supply15-42 Vdc at sensor (loop powered) Operating Temperature -30C to +70°C(32 to 104 ° F)
Input Current RangesThree field selectable ranges, 0-10/0-20/0-50 Amps or 0-50/0-100/0-200 Amps
Operating Humidity0 to 95% RH, non-condensing
Maximum Input Current

10/20/50 Amp ranges – 80/120/200 Amps continuous
50/100/200 Amp ranges – 175/300/400 Amps continuous
Protection Circuitry: Reverse voltage protected and output limited
Response Time: 250mS (0-90%)
WiringSolid Core – Barrier strip
AC Conductor Hole: Split Core
Enclosure Material: UL 94 V-0 flammability rated ABS
Enclosure Size: below dimension.
(H x W x D) 2.45" x 3.5" x 1"
Output Signal & Accuracy: 4 to 20 mA represents 0 to 100% of current span. Better than ±1% FS on all three ranges

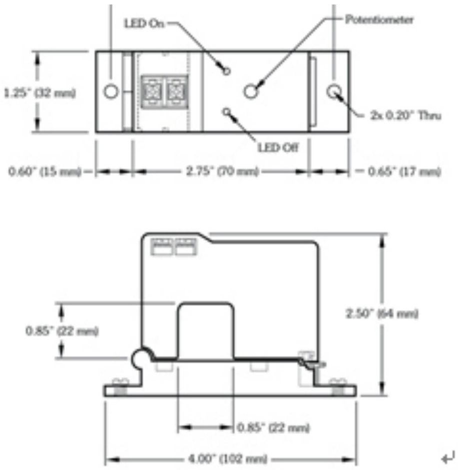


UL E320368,CE compliant,Rohs compliant

FCS521/FCS2151

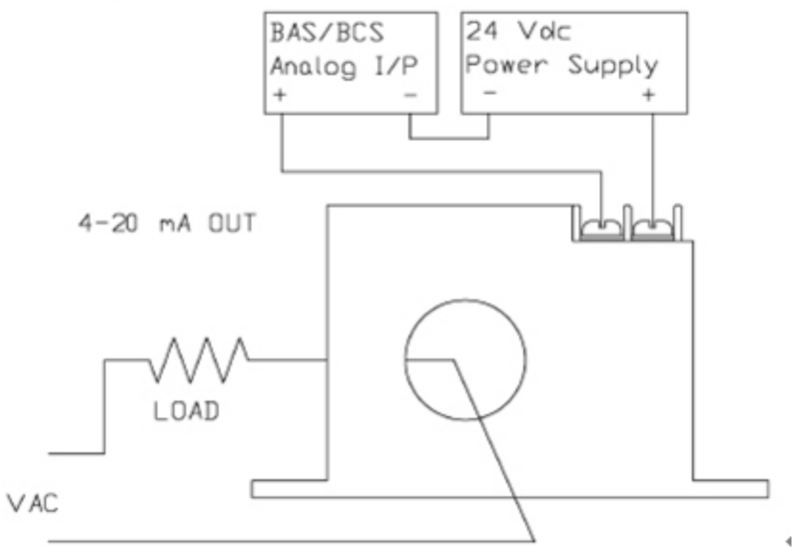


FCS521/FCS2151



Installation:

Wiring



Attention:0-5V,0-10V output are do not need power supply.
Disconnect and lock-out all power sources during installation as severe injury or death can result from electrical shock due to contact with high voltage conductors. Ensure all installations are in compliance with applicable electrical codes and that the installation is completed by qualified installers familiar with the standards and proper safety procedures for high-voltage installation. Never rely on status indicating devices only to determine if power is present in a conductor.
Insure the range selection jumper is installed in the correct position for the current being monitored. Excessive current can damage the sensor. See below for information on setting the jumpers.
Install the Split-Core over the conductor to be monitored and close the sensor until it latches, ensuring that the two halves are properly aligned. Operation of the sensor will be impaired if any dirt particles prevents good contact between the core pieces when the device is closed, keep the sensor clean when it is opened.
Mount the switch in a suitable location using the two mounting holes in the base of the unit.
The conductor may be looped more than once through the sensor to multiply the sensitivity but this also divides the maximum
currents. For example, on the 0-200 amp scale, if the conductor is looped through twice, the maximum current will now be 100 amps.
Connect the output circuit to the two screw terminals using ring or fork type terminals. Typical connections are shown in the wiring examples. Note polarity as indicated on the device label.
To allow field calibration, all devices have easily accessible calibration pots.

Owner's Manual

ACE3600 RTU

6802979C35-B

MOTOROLA

COMPUTER SOFTWARE COPYRIGHTS

EUROPEAN UNION DIRECTIVE 2002/95/EC CONFORMANCE STATEMENT

Hereby, Motorola declares that these products comply with RoHS European Directive no. 2002/95/EC (Restriction of the use of Hazardous Substances) and WEEE Directive no. 2002/96/EC (Strategy of Waste management), with the exception of models listed in Appendix B.

Motorola, Inc.
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CONTENTS

GLOSSARY

ACE	Advanced Control Equipment
AI	Analog Input
AO	Analog Output
AWG	American Wire Gauge
DCD	Data Carrier Detect
DFM	Direct Frequency Modulation
DI	Digital (Discrete) Input
DNP	Distributed Network Protocol
DO	Digital (Discrete) Output
DPSK	Differential Phase Shift Keying
EPP	Environmentally Preferred Product
ESD	Electrostatic Discharge
EU	European Union
FCC	Federal Communication Commission
FEP	Front End Processor (MCP-M, MCP-T, or FIU)
FET	Field Effect Transistor
FPGA	Field Programmable Gate Array
FSK	Phase Shift Keying
FIU	Field Interface Unit
GND	Ground
GPRS	General Packet Radio Service
GPS	Global Positioning Satellite
GSM	Global System for Mobile Communications
HW	Hardware
IEC	International Electrotechnical Commission
IO (I/O)	Inputs Outputs
IP	Internet Protocol
IPGW	MOSCAD IP gateway
LAN	Local Area Network
LED	Light Emitting Diode
MCC	Master Control Center

MCP-M	Motorola Communication Processor – MODBUS
MDLC	Motorola Data Link Communication
MODBUS	MODICON BUS Protocol
MOSCAD	Motorola SCADA
MOSCAD-L	Motorola SCADA-Light
NEMA	National Electrical Manufacturers Association (issues enclosure standards)
NTP	Network Time Protocol
OPC	Open Connectivity
OVF	Overflow
PC	Personal Computer
PLC	Programmable Logic Controller
PPC	Power PC
PPH	Pulse per Hour
PPM	Particle Per Million
PPP	Point-to-Point Protocol
PPS	Pulse per Second
PSTN	Public Switched Telephone Network
RAM	Random Access Memory
RF	Radio Frequency
ROM	Read Only Memory
RST	Reset
RTS	Request to Send
RTU	Remote Terminal Unit (can be MOSCAD or MOSCAD-L)
RX	Receive
SCADA	Supervisory Control and Data Acquisition
SBO	Select Before Operate
SDRAM	Synchronous Dynamic Random Access Memory
SNMP	Simple Network Management Protocol
SNTP	Simple Network Time Protocol
SPDT	Single Pole Double Trigger
SPST	Single Pole Single Trigger
STS	System Tools Suite
SW	Software
TB	Terminal Block

TCP	Transmission Control Protocol
TDPSK	Trunked Differential Phase Shift Keying
TX	Transmit
UDF	Underflow
UDP	User Datagram Protocol
USB	Universal Serial Bus
WAN	Wide Area Network
WB	Wire Break

DESCRIPTION

Product Overview

The ACE3600 is a programmable Remote Terminal Unit (RTU). Almost any automation task can be implemented with a suitable choice of ACE3600 components. Typically the RTU monitors and controls local equipment and communicates with a control center and with other RTUs in the system. The ACE3600 is the newest Motorola SCADA (MOSCAD) RTU, a member of MOSCAD family of RTUs and Control Center Front End Processors.

The ACE3600 System Tools Suite (STS) can be run on a local or remote PC to perform all the setup, programming and monitoring operations such as RTU configuration, system/application, download, monitoring, etc.

Features of the ACE3600

The ACE3600 combines all the advantages of the legacy MOSCAD and MOSCAD-L RTUs with those of modern hardware and software technologies.

Among these are:

- A modern CPU platform with powerful microprocessor
- Real-time operating system based on Wind Rivers VxWorks OS
- Enhanced communication and networking capabilities
- Rugged modular design
- Extended operating temperature range
- Improved power supply/charger
- Modules with a high component density
- System building tools
- Interoperability with legacy MOSCAD family RTUs

General Description

The ACE3600 RTU is a modular unit, comprised of removable modules installed in a multi-slot frame. These modules include

- Power supply
- CPU
- I/O modules

The basic (default) model includes one power supply and one CPU module. The number of I/O modules is selected as an option of the base model.

Figure 1-1 provides a general view of the ACE3600 RTU with five I/O modules.

Figure 1-1 ACE3600 RTU – General View

I/O Module Options

The following types of I/O modules are available:

- Digital Inputs (DI)
- Digital Outputs (DO)
- Analog Inputs (AI)
- Analog Outputs (AO)
- Mixed I/O
- Mixed Analog

Communication Interfaces

The ACE3600 CPU includes the following serial ports:

- Configurable RS232 or RS485 serial port
- Configurable RS232 with GPS receiver support (for time sync)
- Ethernet 10/100 Mb/s (ACE3640 models)

Two additional plug-in ports can be added to the CPU. The following types of communication modules are available for the plug-in ports:

- RS232
- RS485
- General radio interface (Conventional or Trunking, DPSK 1200, FSK 2400, DFM 4800, Duo-binary 9600)
- Ethernet 10 Mb/s
- Ethernet 10/100 Mb/s (on plug-in Port 1 only)

ACE3600 RTU Construction

The ACE3600 is available in various structures:

- Frame which can accommodate a varied number and type of modules
- Metal chassis which accommodates the frame, and optional radios, backup battery and communication interfaces
- Protective housing which accommodates the frame, and optional radios, backup battery and communication interfaces (suitable for outdoor installation)

The ACE3600 frame consists of the following elements:

- Plastic slots which accommodate the power supply, CPU and I/O modules, and backplane bus motherboard
- Mounting plate for attaching the plastic slots together and mounting the frame on a wall
- Backplane bus motherboard which connect the modules to each other via the signal buses and connects the modules with operating voltages
- Power junction box for AC or DC power source and ground connections

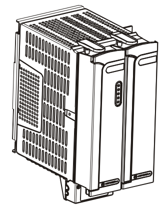
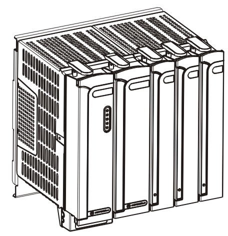
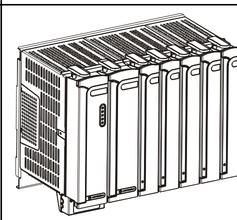
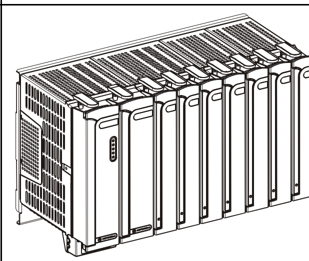
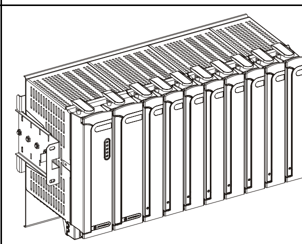
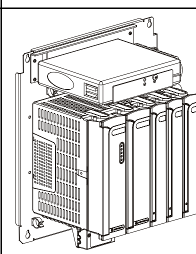
A frame can be mounted on the wall or installed in a 19” rack or customer enclosure. For more information, see the Installation chapter below

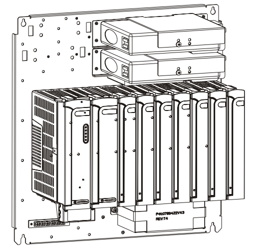
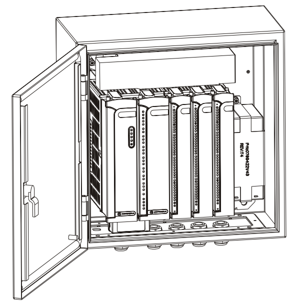
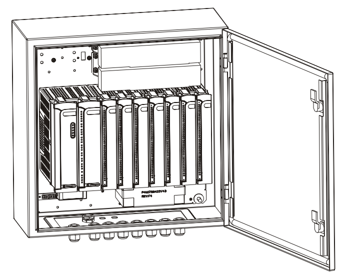
The ACE3600 frame can include wide or narrow plastic slot units:

- Wide slot unit - can hold a power supply and a CPU or up to three I/O modules
- Narrow slot unit - can hold up to two I/O modules

RTU Options

Each RTU can include a number of options, including portable and mobile radios, and plastic boxes with interface card for communication, etc.

Housing/Mounting Type	Capacity/Options	Illustration
No I/O slot frame Basic (default) model. Can be installed on a wall.	Power supply and CPU Can be ordered with metal chassis or housing options.	
3 I/O slot frame Can be installed on a wall.	Power supply and CPU, up to 3 I/Os Can be ordered with metal chassis or housing.	
5 I/O slot frame Can be installed on a wall.	Power supply and CPU, up to 5 I/Os Can be ordered with large metal chassis or housing.	
7 I/O slot frame Can be installed on a wall.	Power supply and CPU, up to 7 I/Os Can be ordered with large metal chassis or housing.	
8 I/O slot frame Can be installed on a wall or in 19" rack/enclosure.	Power supply and CPU, up to 8 I/Os Can be ordered with metal chassis option for accessories: 6.5 or 10 Ah Lead-Acid backup battery up to 2 radios; up to four plastic boxes.	
Small metal chassis Enables installation of radio, backup battery and other accessories. Can be installed on a wall or in housing.	Power supply and CPU, up to 3 I/Os, 1 mobile/portable radio, 1 plastic interface box, 6.5 Ah Lead-Acid backup battery	

Housing/Mounting Type	Capacity/Options	Illustration
Large painted metal chassis Enables installation of radio, backup battery and other accessories. Can be installed on a wall or in housing.	Power supply and CPU, up to 7 I/Os, 1 plastic interface box, up to 2 mobile/portable radios, 6.5 or 10 Ah Lead-Acid backup battery	
Small NEMA 4X/IP65 housing Enables installation of radio, backup battery and other accessories. Can be installed on a wall.	Power supply and CPU, up to 3 I/Os, 1 mobile/portable radio, 1 plastic interface box, 6.5 Ah Lead-Acid backup battery	
Large metal NEMA 4X/IP65 housing Enables installation of radio, backup battery and other accessories. Can be installed on a wall.	Power supply and CPU, up to 7 I/Os, 1 plastic interface box, up to 2 mobile/portable radios, 6.5 or 10 Ah Lead-Acid backup battery	

For installation instructions of each housing/mounting type, see the Installation chapter.

For the dimensions and weight of each combination, see Appendix A: General Specifications.

For a detailed list of all ACE3600 options, see the ACE3600 price pages and ordering information.

For a detailed description of the individual modules, see the appropriate chapter below.

RTU Components

The ACE3600 RTU can include the following components.

Component	Function	Notes
Power supply module	Converts the main AC or DC power source to the voltages required by the modules, radio/modems and accessories. Charges the backup battery and switches to the battery voltage when the main power fails (in models with charger.)	See Power Supply Module and Backup Battery chapter.
CPU module	Stores and runs the user application program, stores data collected by the I/O modules and communicates with the control center, RTUs and other devices via the communication ports.	See CPU Module chapter.
CPU plug-in port	Enables adding various communication ports to the CPU modules.	See CPU Module chapter.
CPU plug-in SRAM	Provides static RAM.	See CPU Module chapter.
I/O module	Matches between the ACE3600 and signals of various types/levels. Interfaces between the ACE3600 and the process signals.	See I/O Modules chapter.
Terminal blocks (TB)	Connects the signals to the I/O modules.	See I/O Modules chapter.
Plug-in 24V DC power supply	Enables adding 24 V floating power supplies to I/O modules for contact “wetting” and sensor operation.	See I/O Modules chapter.
TB holder kit	Holds Module TBs.	See I/O Modules chapter.
Cable with TB holder	A cable to connect signals to the I/O modules.	See I/O Modules chapter.
Backup battery	Enables backup RTU operation when main power fails.	See Power Supply Module and Backup Battery chapter.

Component	Function	Notes
Radio installation kit	Mechanical support and cables that enable installation of radio.	See Radio Types and Installation Kits chapter.
RS485 Connection Box	Enables connection of up to 6 devices to the RS485 port on the CPU (2W multi-drop).	See the RS485 Connection Box chapter.
RTU to PC RS232 cable	Enables connection of the RTU to a PC via the RS232 port.	For use of the ACE3600 Software Tools Suite (STS) to perform operations such as RTU configuration, system/application, download, monitoring, etc. See the ACE3600 STS User Guide.
RTU to PC Ethernet cable	Enables connection of the RTU to a PC via the Ethernet port.	For use of the ACE3600 Software Tools Suite (STS) to perform operations such as RTU configuration, system/application, download, monitoring, etc. See the ACE3600 STS User Guide.

Model Options and Accessories

F7500 - ACE3600 System Tools Suite Software

F7600 - ACE3600 ‘C’ Toolkit Software

The full list of ACE3600 options and accessories are listed in the ACE3600 System Planner.

Product Safety and RF Exposure

Before using an ACE3600 RTU model with a radio installed, read the operating instructions and RF exposure booklet for the specific radio contained in the product.

INSTALLATION

General

The ACE3600 RTU is shipped from the factory with the modules and plug-in ports assembled. The RTU frame is ready for mounting directly on a wall or in a customer's enclosure. The eight I/O frame can be installed on a 19" rack.

Modules can be added to the slots in a frame before or after mounting the RTU on a wall/enclosure.

WARNING

Installation of the ACE3600 should be done only by authorized and qualified service personnel in accordance with the US National Electrical Code. Only UL Listed parts and components will be used for installation. Use UL Listed devices having an environmental rating equal to or better than the enclosure rating to close all unfilled openings.

If the installation involves high-voltage connections, technicians must be specifically qualified to handle high voltage.

If the I/O connections are powered by a hazardous voltage (>60VDC or >42Vpeak), all inputs should be defined as hazardous and the unit must be installed in a restricted access area for service personnel only.

If the I/O connections are powered by a safety extra low voltage (SELV) (<60VDC or <42Vpeak), all inputs should be defined SELV.

INSTALLATION CODES

This device must be installed according to the latest version of the country's national electrical codes. For North America, equipment must be installed in accordance to the applicable requirements in the US National Electrical Code and the Canadian Electrical Code.

INTERCONNECTION OF UNITS

Cables for connecting RS232 and Ethernet Interfaces to the unit must be UL-certified type DP-1 or DP-2. (Note- when residing in a non LPS circuit.)

OVERCURRENT PROTECTION

A readily accessible Listed branch circuit overcurrent protective device rated 20 A must be incorporated in the building wiring.

CAUTION

External wiring which connects an I/O module to instruments/devices may not exceed 42.67m (140 feet).
If the ACE3600 is subject to high levels of shock or vibration, you must take suitable measures to reduce the acceleration or amplitude. We recommend that you install the ACE3600 on vibration-damping materials (for example, rubber-metal anti-vibration mountings).

METAL PARTS OF THE POWER SUPPLY MAY BE VERY HOT.

After removing the power supply module, allow the metal parts to cool down before servicing the unit.

NOTE

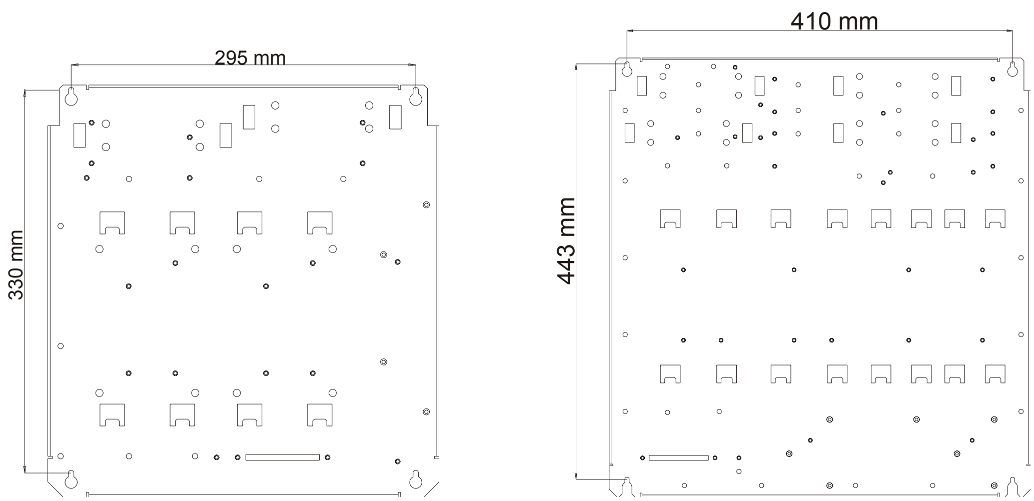
A TORX screwdriver is required for installation.

Mounting the ACE3600 Frame on a Wall

WARNING

Before drilling holes for mounting the frame, make sure there are no electrical wires installed inside the wall at the holes' location.

Four holes are provided, one in each corner of the RTU frame, for wall mounting the RTU. Figure 2-1, Figure 2-2, and Figure 2-3 show the dimensions of the various frames/metal chassis and the distances between the holes. For convenient installation of the ACE3600 RTU on a wall, allow an additional 6 cm (2.4") (in W, H) and 7 cm (2.75") (in D) around the plate.



Small Metal Chassis **Large Metal Chassis**

Figure 2-1 Small/Large Metal Chassis Installation Dimensions and Screw Holes for Installation

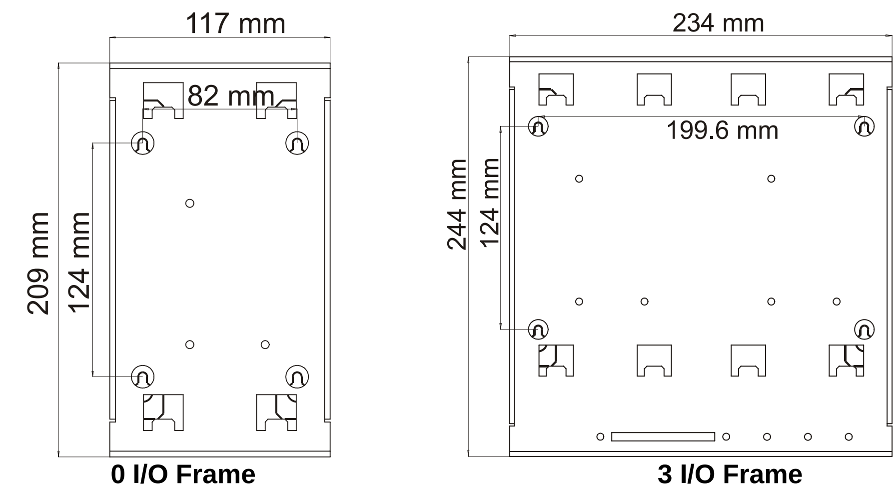


Figure 2-2 No I/O and 3 I/O Frame Installation Dimensions and Screw Holes for Installation

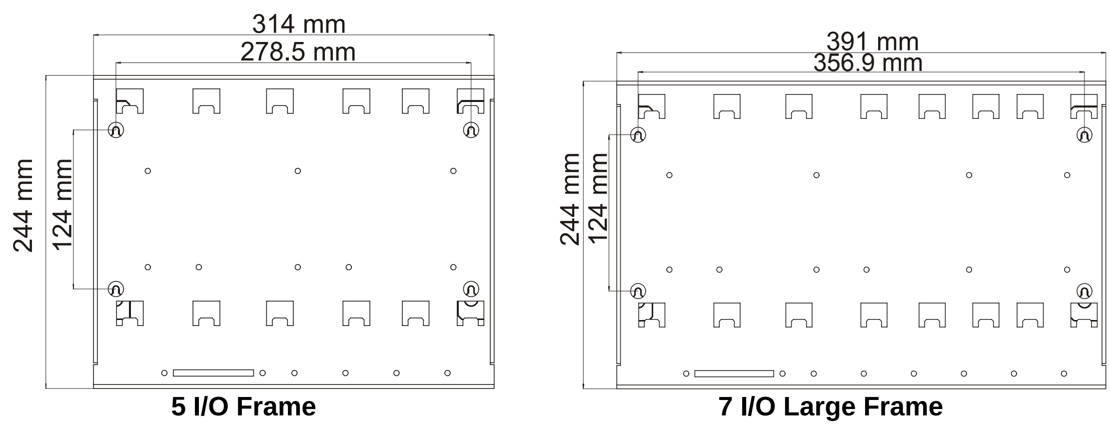


Figure 2-3 5 I/O and 7 I/O Frame Installation Dimensions and Screw Holes for Installation

The following screw mount installation procedure should be used to install all ACE3600 frames (with or without a metal chassis) on a wall, except the 8 I/O (19") frames.

Procedure 2-1 How to Mount the RTU Frame on a Wall

1) Drill four holes in the wall at the horizontal and vertical distances shown in Figure 2-1 and Figure 2-2.

2) Insert M4 screws (not supplied) with head size DIN 7981C/ST4, 2x38mm into the holes.

3) Remove the modules from the frame.

4) Lift the RTU frame and hang over the four screws.

5) Remove the outermost modules in order to access the screws.

6) Tighten all four screws with a screwdriver to secure the frame firmly against the wall.

7) Replace the removed modules in their slots.

Installing the ACE3600 in a 19" Rack

The following screw mount installation procedure should be used to install the ACE3600 8 I/O (19") frame in a 19" rack.

Note: The brackets for 19" rack installation are not provided with the RTU and should be ordered separately.

Procedure 2-2 How to Mount the RTU in a 19" Rack Unit

1) Press the small metal bracket into the slot of the larger bracket. See Figure 2-4.

2) Secure the two brackets together with two M5 screws (supplied), according to the desired depth of the unit on the rack. See Figure 2-4.

3) Repeat steps 1-2 for the other pair of brackets.

4) Using the supplied two screws, attach the combined brackets to the metal pole of a 19" rack unit. See Figure 2-4. Repeat on other side.

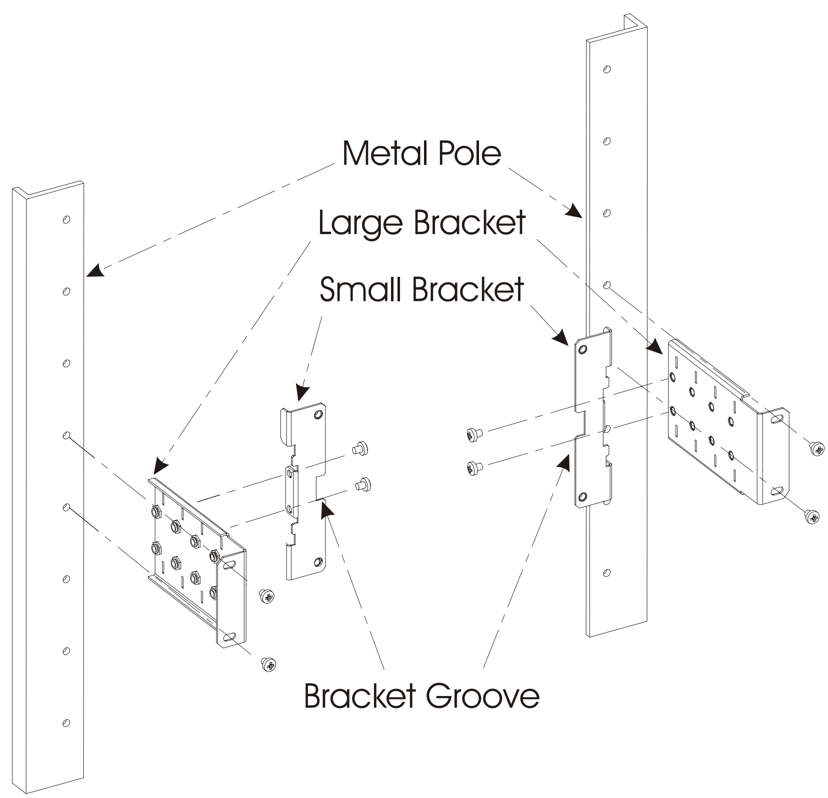


Figure 2-4 Installation of Brackets for 19" Rack Units

5) Hang the 19" metal chassis on the brackets, so that the two teeth on the back of the metal chassis hook onto the groove of the larger bracket.

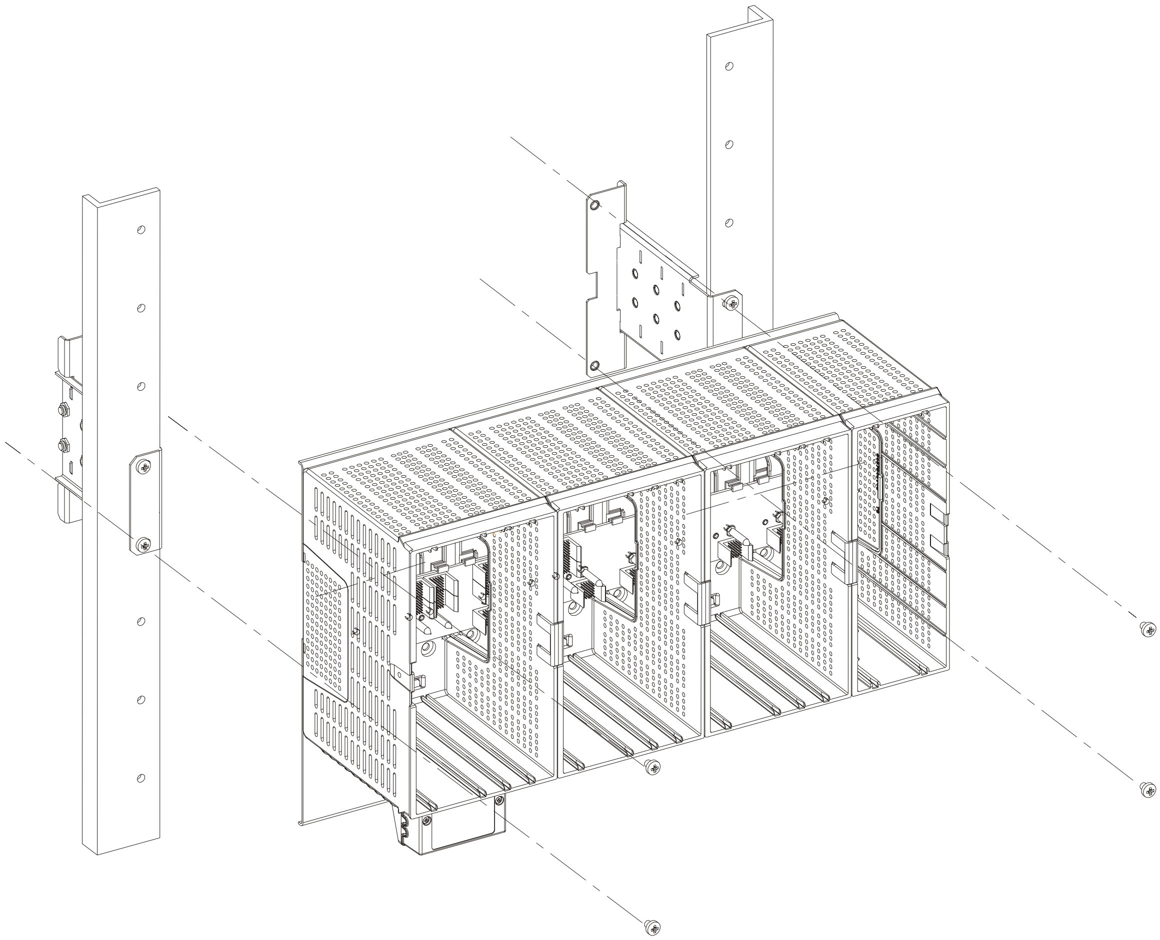


Figure 2-5 Installation of ACE3600 RTU 19" Rack- Exploded View

6) From the standard rack unit, remove the two modules from the leftmost slots and the two modules from the rightmost slots. For the 19" accessories metal chassis, no accessories need to be removed. (See Figure 2-6.)

7) Using two supplied M5 (X6) screws and a 16 cm (6.3") long screwdriver, from inside the slot secure the 19" metal chassis to the small bracket. Repeat on the second side. See Figure 2-5.

8) Replace any removed modules to their slots.

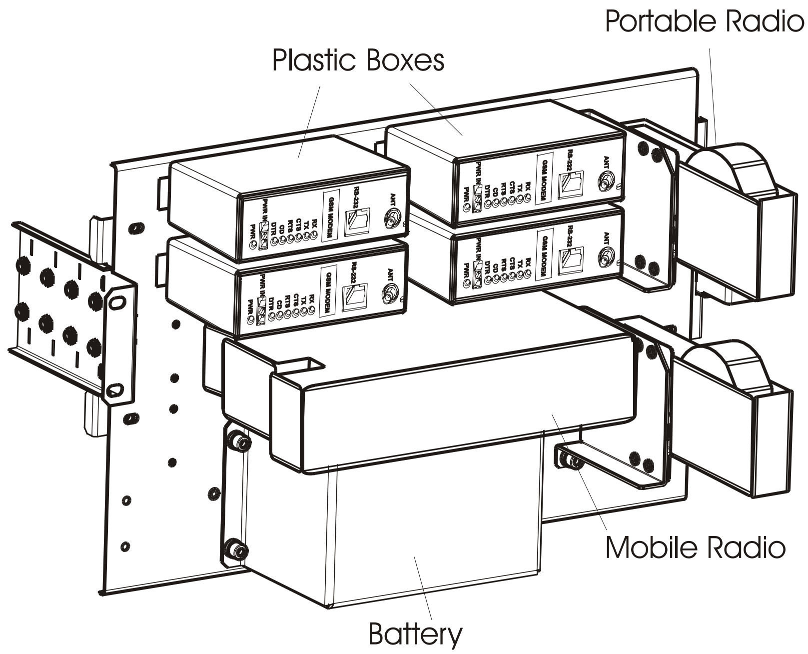


Figure 2-6 Installation of ACE3600 RTU 19" Rack Accessories - General View

Mounting the ACE3600 8 I/O Frame on a Wall

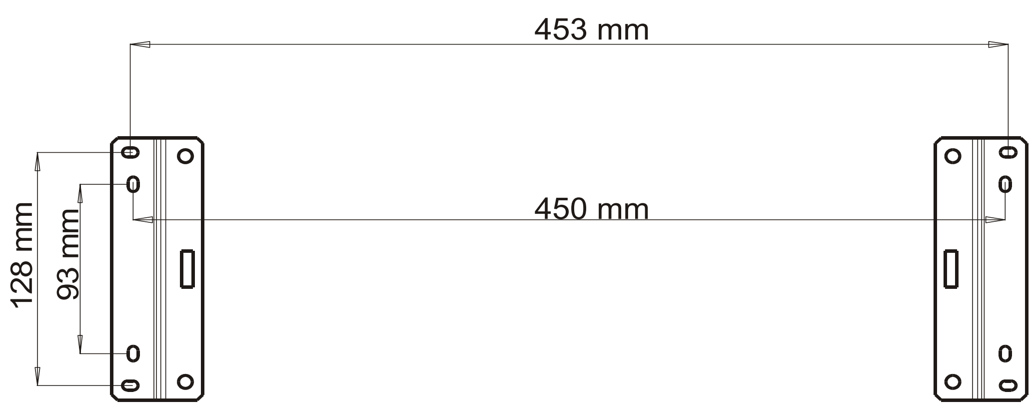


Figure 2-7 RTU Metal Chassis Installation Dimensions

Procedure 2-3 How to Mount the RTU 19" Metal Chassis on a Wall

The following installation procedure should be used to install the 8 I/O (19'') frame on a wall, using the special wall mount brackets provided with the RTU.

1) Remove the CPU, Power Supply and I/O modules from the RTU rack.

2) Drill four holes into the wall at the horizontal and vertical distances shown in Figure 2-7.

3) Using two supplied screws, secure the rectangular wall mounting bracket to the wall. Repeat for the second bracket.

4) Hang the metal chassis on brackets so that the 2 teeth of the metal chassis hook onto the groove of the brackets. (See Figure 2-8.)

5) Using two M4 screws (not supplied) with head size DIN 7981C/ST4, 2x38mm screws, secure the top and bottom of the rack to the left bracket. Repeat for the right bracket.

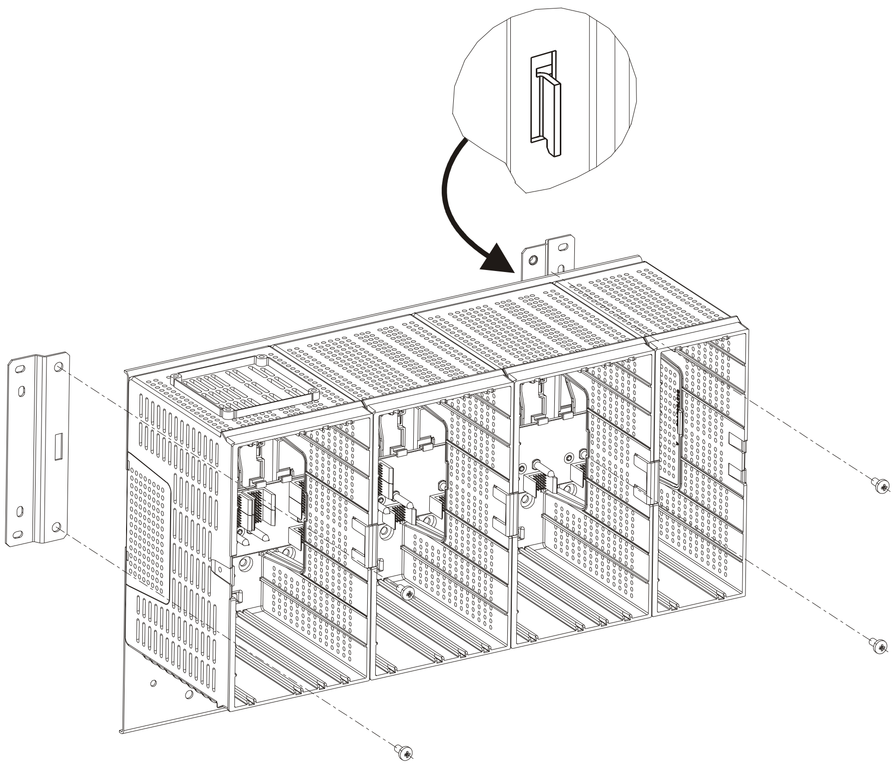


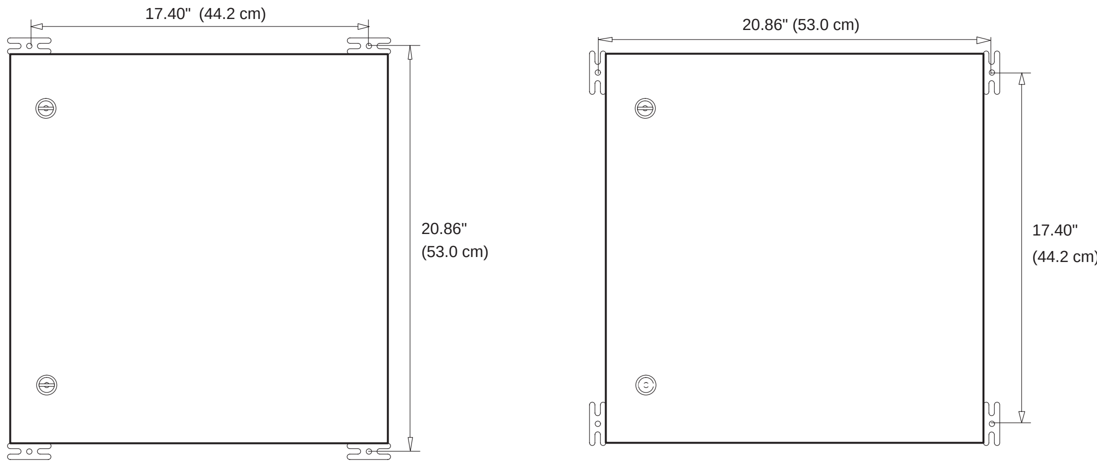
Figure 2-8 RTU Metal Chassis Installation

Mounting the ACE3600 NEMA4 Housing on a Wall

The following screw mount installation procedure should be used to install ACE3600 frames in NEMA4 housing on a wall.

For convenient installation of the ACE3600 RTU with the NEMA4 housing, allow an additional 6 cm (2.4") (in W, H) and 7 cm (2.75") (in D) around the housing.

Four mounting brackets are provided, one in each corner of the RTU, for wall mounting the RTU housing (see Figure 2-9 through Figure 2-11). Figure 2-9 and Figure 2-10 show the distances between the bracket holes.



Horizontal Bracket Installation **Vertical Bracket Installation**

Figure 2-9 Large NEMA 4 Housing - Installation Dimensions

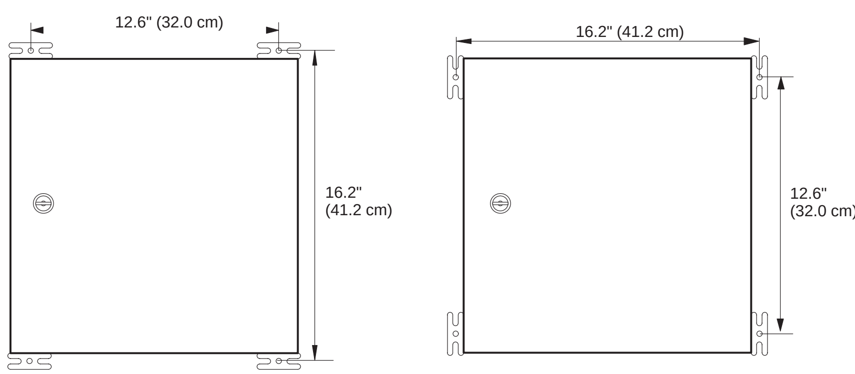


Figure 2-10 Small NEMA 4 Housing - Installation Dimensions

Procedure 2-4 How to Mount the RTU NEMA4 Housing

1) Drill four holes in the wall at the horizontal and vertical distances shown in Figure 2-9 (for the large housing) and in Figure 2-10 (for the small housing.)

2) Using the brackets and the screws supplied in the plastic bag, fasten the mounting brackets, either horizontally or vertically, onto the four back corners of the housing. See Figure 2-11.

3) Mount the RTU onto the wall and secure with M4 screws (not supplied) with head size DIN 7981C/ST4, 2x38mm through the bracket hole. See Figure 2-11.

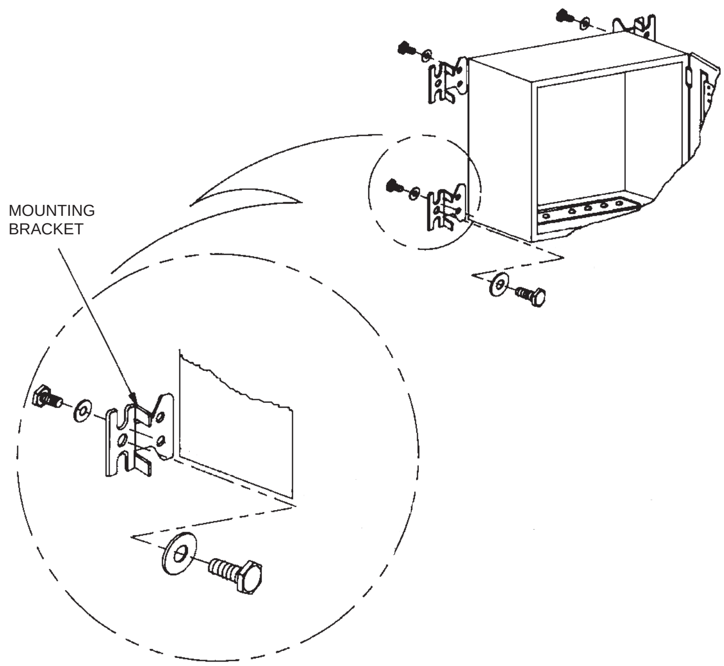


Figure 2-11 Mounting the NEMA 4 Housing

Connecting Power and Ground

All internal electrical connections except for the main power, ground and battery are performed in the factory and supplied with the RTU. The electrical interconnection diagrams are provided in the Break-Fix Procedures chapter.

The procedures for the main power, ground and battery connections are provided below.

The power and ground connections should be performed only by qualified and authorized service personnel. All power and ground connections must be in accordance with local standards and laws.

Per UL 60950 / EN 60950, install an external circuit breaker rated at 6 A between the power source and the ACE3600 Power supply.

Per UL 60950 / EN 60950, for all I/O modules connections, the maximum voltage should not exceed 60V DC or 30 V AC unless it is specifically written otherwise.

To maintain Overvoltage (Installation) Category II, install a suitable surge suppressor device in the branch circuit to limit expected transients to over voltage Category II values. The limits are based on IEC60664 and are also located in Table 2H of UL60950 (for mains = 150V, the transient rating is 1500V; for 150V < mains = 300V, the transient rating is 2500V; and for 300V < mains = 600V, the transient rating is 4000V).

NOTE

Make sure that the ground wire on the user cable is long enough to reach the grounding strip.

Connecting AC/DC Main Power

The power connection to all the ACE3600 power supply types is via the power junction box located on the frame beneath the power supply slot.

IMPORTANT

Safety standards require that the power cable be attached to the unit at two anchor points:

- Anchor point 1 for all units is inside the power junction box. (See Figure 2-12 below.)
- Anchor point 2 for the basic model (No I/O Slots Frame) is located on the right of the power junction box. (See Figure 2-12 below.)
  Anchor point 2 for all units with housing (other than No I/O Slots) is in the housing power cable gland. (See Figure 2-16 below.)
  Anchor point 2 for all other units without housing (other than No I/O Slots) is near the unit's ground strip. (See Figure 2-13 below.)

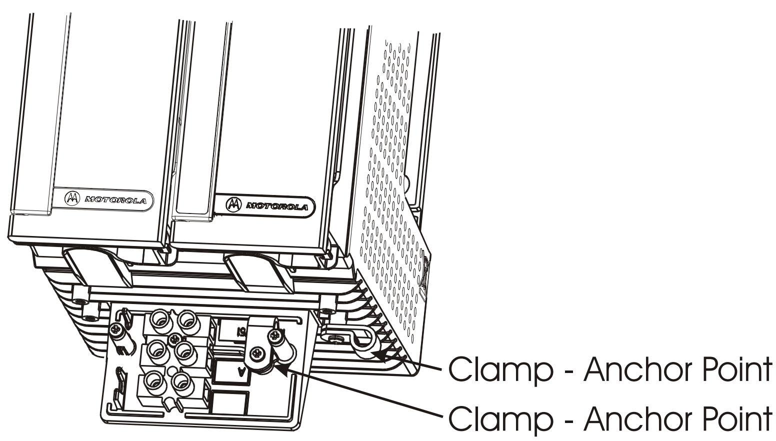


Figure 2-12 RTU on No I/O Frame – Cable Anchor Points 1 and 2

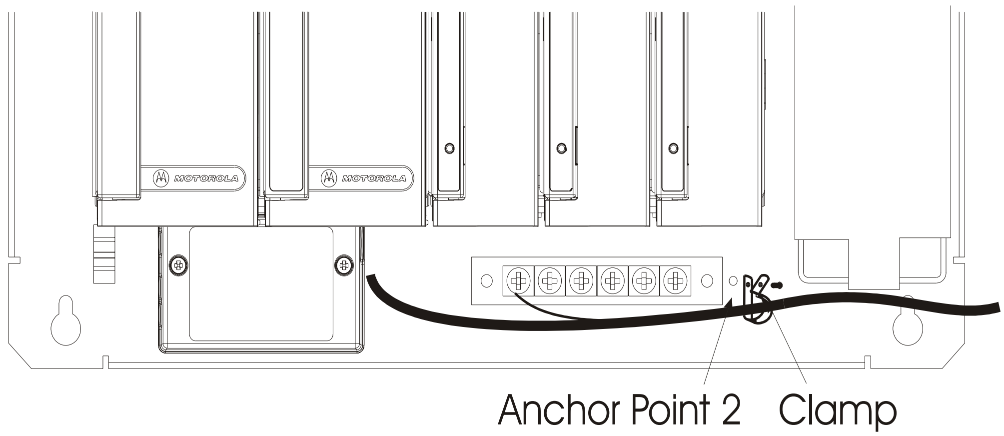


Figure 2-13 RTU on Metal Chassis – Cable Anchor Point 2

Procedure 2-5 How to Connect the RTU to Main Power Source (Units with Frames and Metal Chassis)

1) Using a screwdriver, open the power junction box cover (save the screws) and unscrew the power terminals screws inside the power junction box.

2) Thread the user's main power cable through the two supplied clamps.

3) Attach the wires of the user cable, according to the labels (~/0 for AC and +/- for DC.) For the No I/O Frame, connect the ground cable to the lower wire terminals (third pair). Figure 2-14 and Figure 2-15.

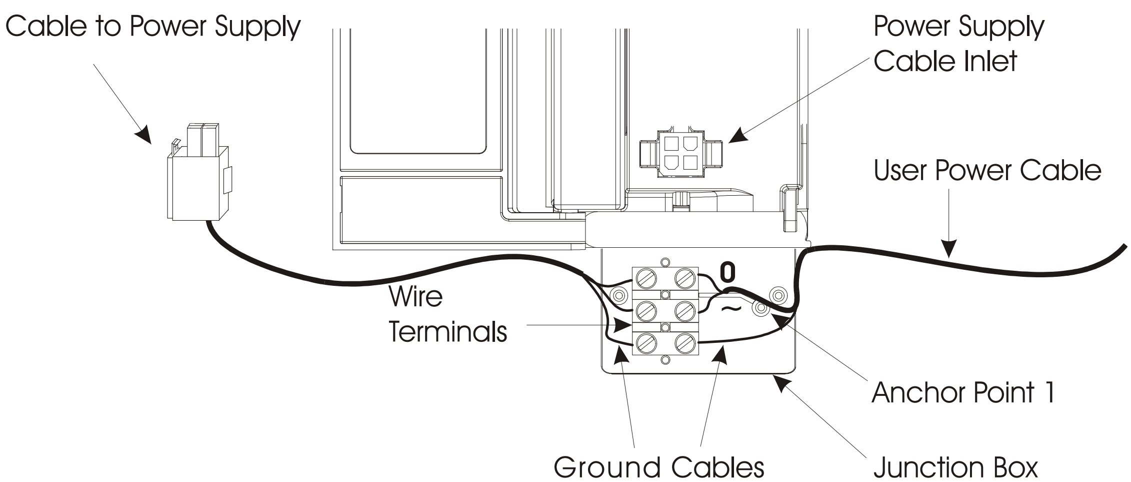


Figure 2-14 RTU Power and Ground Connections - No I/O Frame Installation

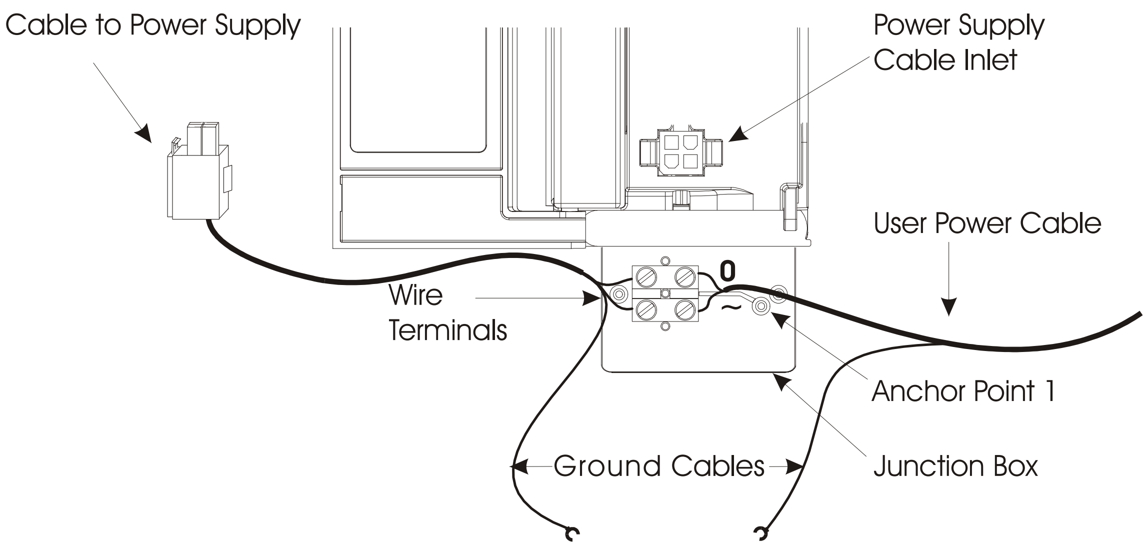


Figure 2-15 RTU Power and Ground Connections – All Other Installations

4) Pass the power cable to the right of the wire terminals inside the junction box, over the horizontal ridge.

5) Close the first clamp around the user cable and screw it onto the junction box, into the hole next to wire terminals (anchor point #1).

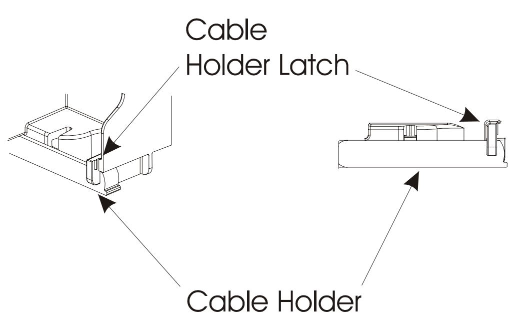
6) Close the second clamp and screw it onto the anchor point near the grounding strip (or on the bottom of the plastic to the right of the junction box in case of the No I/O Slots frame.)

7) Replace the junction box cover over the junction box.

8) Secure the junction box cover with two saved screws.

9) For all installations except the No I/O frame, loosen the two screws on the grounding strip at the bottom of the metal chassis/housing and connect the ground cable to the protective ground. Tighten the screws firmly.

10) Open the door of the power supply module and press in the cable holder downwards.



11) Plug the connector of the power supply cable (3089004V64 for DC, 3089004V65 for AC) into the cable inlet on the power supply module (on the bottom of the front panel.) and rotate the cable holder upwards to secure.

Procedure 2-6 How to Connect the RTU to Main Power Source (Units with Housing)

1) Using a screwdriver, open the power junction box cover (save the screws) and unscrew the power terminals screws inside the power junction box.

2) Insert the rubber grommet (supplied) into the threaded plastic cable gland, and place it into the hole on the bottom of the housing (from the outside.) (See Figure 2-16.)

3) Place the nut into the same hole from inside the housing and screw the nut onto the cable gland. (See Figure 2-16.)

4) Thread the user's main power cable (110/220VAC or 24-48VDC) through the cable gland cover from below, through the cable gland, and into the housing. (See Figure 2-16.)

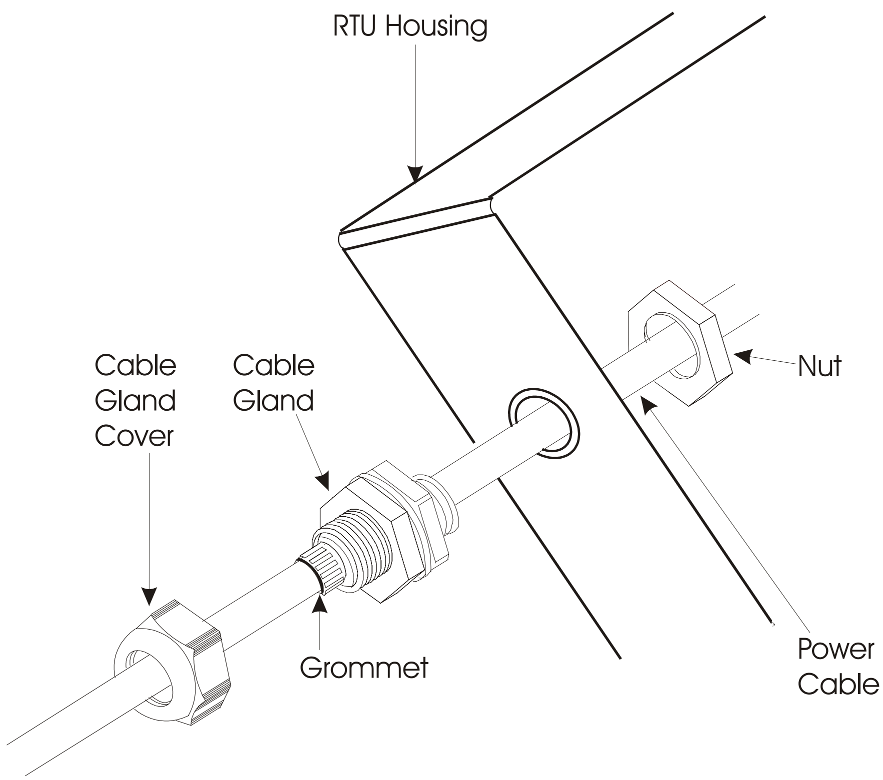


Figure 2-16 RTU in NEMA4 Housing – Cable Gland Anchor Point 2

5) Attach the wires of the user cable, according to labels (~/0 for AC and +/- for DC.) See Figure 2-14 and Figure 2-15. For the No I/O frame, connect the ground cable to the lower wire terminals (third pair).

6) Tighten the screws of the wire terminals and screw the wire terminals onto the junction box.

7) Pass the power cable into the right side of the junction box, over the horizontal ridge.

8) Place the user cable into the clamp, close the clamp and screw it onto the junction box, into the hole next to wire terminals (anchor point #1).

9) Replace the junction box cover over the junction box.

10) Secure the junction box cover with the two saved screws.

11) For all installations except the No I/O frame, loosen two screws on the grounding strip at the bottom of the metal chassis/housing and connect the ground cable to the protective ground. Tighten the screws firmly.

12) Screw the top of the cable gland tightly to the cable gland to secure the cable (anchor point #2).

13) Open the door of the power supply module and release the cable holder (press downward).

14) Plug the connector of the power supply cable (3089004V64 for DC, 3089004V65 for AC) into the cable inlet on the power supply module (on the bottom of the front panel.) and close the cable holder.

Connecting the Backup Battery

The backup battery of ACE3600 is shipped from factory disconnected. Use this procedure to connect the battery cable to the power supply charger.

IMPORTANT

Before using the Lead Acid backup battery, it is strongly recommended to read the information on the battery provided in the Power Supply Module and Backup Battery chapter.

Lead acid batteries will self-discharge if they are stored without charging. Self-discharge below the manufacturer's recommended voltage will result in internal permanent damage to the battery rendering it inoperable. When this occurs, if connected to a power supply/charger, the battery may produce excessive internal heat and therefore deform and/or leak.

WARNING

A battery contains diluted sulfuric acid, a toxic and corrosive substance. Avoid any bodily contact with the leaking liquid when handling leaking batteries and affected parts. If the battery leaks and the liquid inside touch the skin or clothing, immediately wash it off with plenty of clean water. If the liquid splashes into eyes, immediately flush the eyes with plenty of clean water and consult a doctor. Sulfuric acid in the eyes may cause loss of eyesight and acid on the skin will cause burns.

Procedure 2-7 How to Connect the Backup Battery

1) Check the battery visually. If the battery looks deformed and / or you notice corrosion on the battery terminals and / or the battery leaks, DO NOT use the battery and replace it with a new battery.

2) Check the battery terminal voltage level before connecting it. If the battery voltage is less than 10V DC, DO NOT use the battery and replace it with a charged battery that measures at least 10V DC.

3) If the battery passes a visual inspection and the terminal voltage is correct, plug the battery cable (3089927V10) into the Battery In/Out connector on the power supply module.

4) Fully charge the battery prior to initial use (~10 hours).

Connecting I/O Modules to Ground

Before operating the I/Os in the ACE3600, the I/O modules must be connected to ground.

Procedure 2-8 How to Connect an I/O Module to Ground

1) Identify the PGND pin(s) on the I/O module using the Module Block Diagram or Connection Charts in the relevant chapter for the I/O module type. See the symbol next to the Protective Ground in the Module Block Diagrams.

2) If user-supplied cables are used, connect the ground wire(s) to the PGND pin(s) on the I/O module and to the grounding strip at the bottom of the RTU. (See grounding strip in Figure 2-13 above.)

3) If the wired cable braid is used, identify the ground wire(s) based on the pin number printed on the wire label.
Connect the ground wire(s) from the cable braid to the PGND pin(s) on the I/O module and to the grounding strip at the bottom of the RTU. (See grounding strip in Figure 2-13 above.)

4) Repeat steps 1-3 for the PGND wires on all I/O modules.

Connecting the Radio

A radio which is shipped in the ACE3600 is fully connected. To add a radio to the ACE3600, use the appropriate radio installation kit. For information on radio types, radio installation kits and connections, see the Radio Types and Installation Kits chapter.

Opening/Closing the Housing Door

The door to the small ACE3600 NEMA4 housing is equipped with a latch or with an optional padlock accessory. See Figure 2-17. The door to the large ACE3600 NEMA4 housing is equipped with two door latches or with an optional padlock accessory plus a latch. See Figure 2-18.

Procedure 2-9 How to Open and Close the Housing Door

1) To open a small RTU housing equipped with a door latch, turn the latch clockwise. The door will open.
To open a small RTU housing equipped with the padlock accessory, remove the user-supplied padlock (if one exists) and turn the padlock accessory clockwise. The door will open.

To open a large RTU housing equipped with two door latches, turn both latches clockwise. The door will open.
To open a large RTU housing equipped with the padlock accessory and a latch, remove the user-supplied padlock (if one exists) and turn the padlock accessory and latch clockwise. The door will open.

2) To close a small RTU housing equipped with a door latch, turn the latch counterclockwise and push the door closed until the latch clicks.
To close a small RTU housing equipped with the padlock accessory, turn the padlock accessory counterclockwise and push the door closed until the latch clicks. Add the user-supplied padlock (if one exists) to lock the door.
To close a large RTU housing equipped with two door latches, turn both latches counterclockwise and push the door closed until the latch clicks.
To close a large RTU housing equipped with the padlock accessory and a latch, turn the padlock accessory and latch counterclockwise and push the door closed until the latch clicks. Add the user-supplied padlock (if one exists) to the padlock accessory to lock the door.

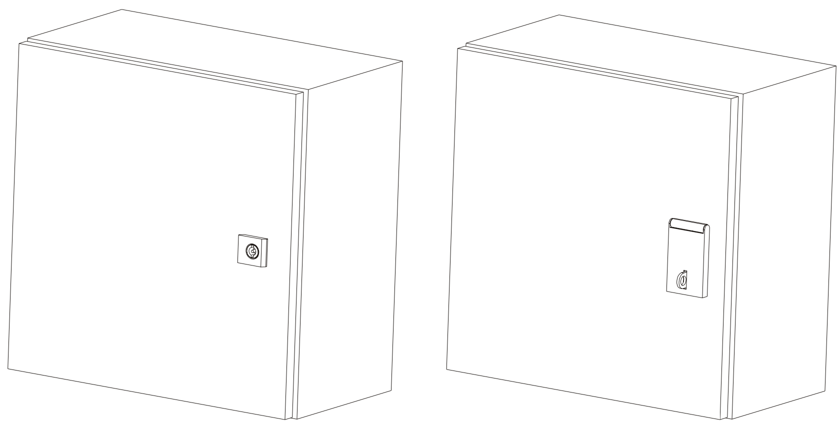


Figure 2-17 Small ACE3600 NEMA4 Housing/Housing with Padlock

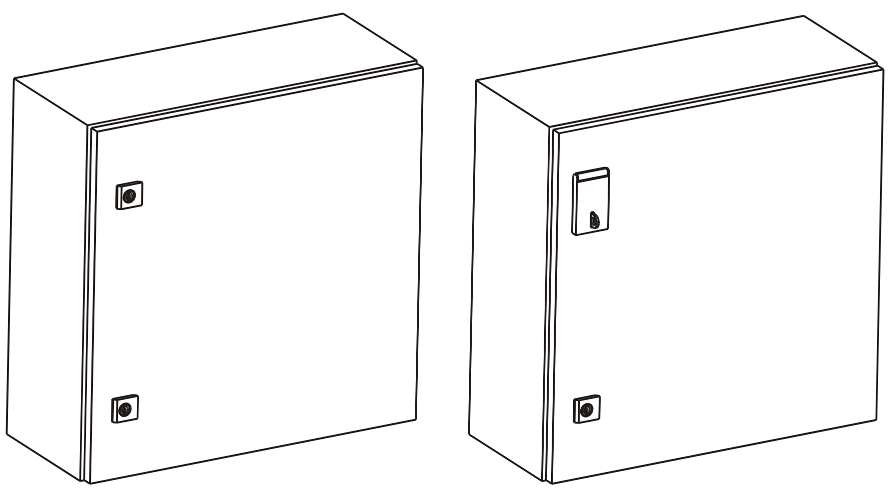


Figure 2-18 Large ACE3600 NEMA4 Housing/Housing with Padlock

Installing Plastic Box Interfaces

Cards such as RS485 interface card can be attached to the ACE3600 RTU using a plastic box. The plastic box can be attached to the 19" accessories metal chassis, small/large metal chassis, or small/large NEMA housing.

Procedure 2-10 How to Install the Plastic Box Interface on the Metal Chassis

1) To connect the plastic box interface to the metal chassis, place the box on the metal plate and click the two pegs on the back of the plastic box into the desired holes on the metal chassis. See Figure 2-19.
Note: This figure is for illustration purposes only. It is not possible to install all accessories on the same metal chassis.

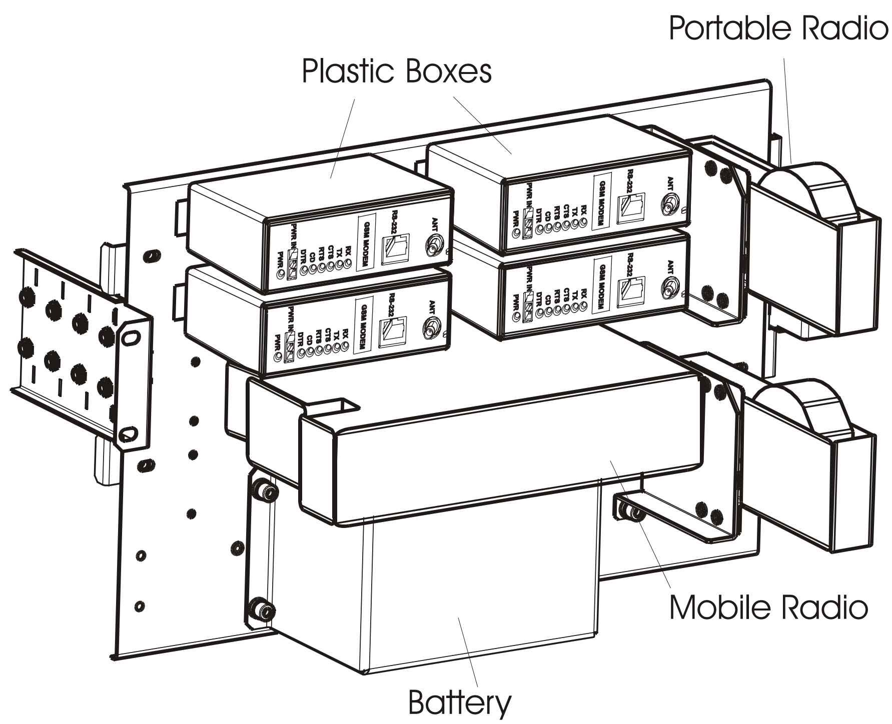


Figure 2-19 Accessories Installed on a Metal Chassis

2) To remove the plastic box interface from the metal chassis, insert a screwdriver into the notch located in the snap securing the unit to the chassis. Slightly bend the snap outwards to release it from the slot, and carefully pull out the unit.

POWER SUPPLY MODULE AND BACKUP BATTERY

General Description/Module Overview

The ACE3600 power supply module provides the other modules in the RTU with their operating voltages via the motherboard bus.

The following power supply options are available:

- DC power supply low-tier (10.8-16V)
- DC power supply (10.8-16V) - provided by default with the ACE3600 RTU
- DC power supply (18-72V)
- DC power supply (18-72V) with battery charger
- AC power supply- 90-264V
- AC power supply- 90-264V with battery charger

Common characteristics of all power supply modules (not including the DC power supply low-tier):

- On/Off switch on the front panel
- Controlled auxiliary voltage outputs
- Heat convection cooling (no need for fans)
- Short protection outputs
- Over heating protection
- Status LEDs in the front panel
- PS located on the leftmost slot of the frame
- Input current protection fuse
- Controlled power line enables centralized disabling of Electrically Energized relay outputs in selectable DO modules.

Note: The DC power supply low-tier does not support radios that require input power other than 10.8-16V. Do not use portable radios which require 7.5V input with this option.

Note: The low limit of the DC power supply (10.8-16V) can be configured to 10.5V. The default is 10.8.

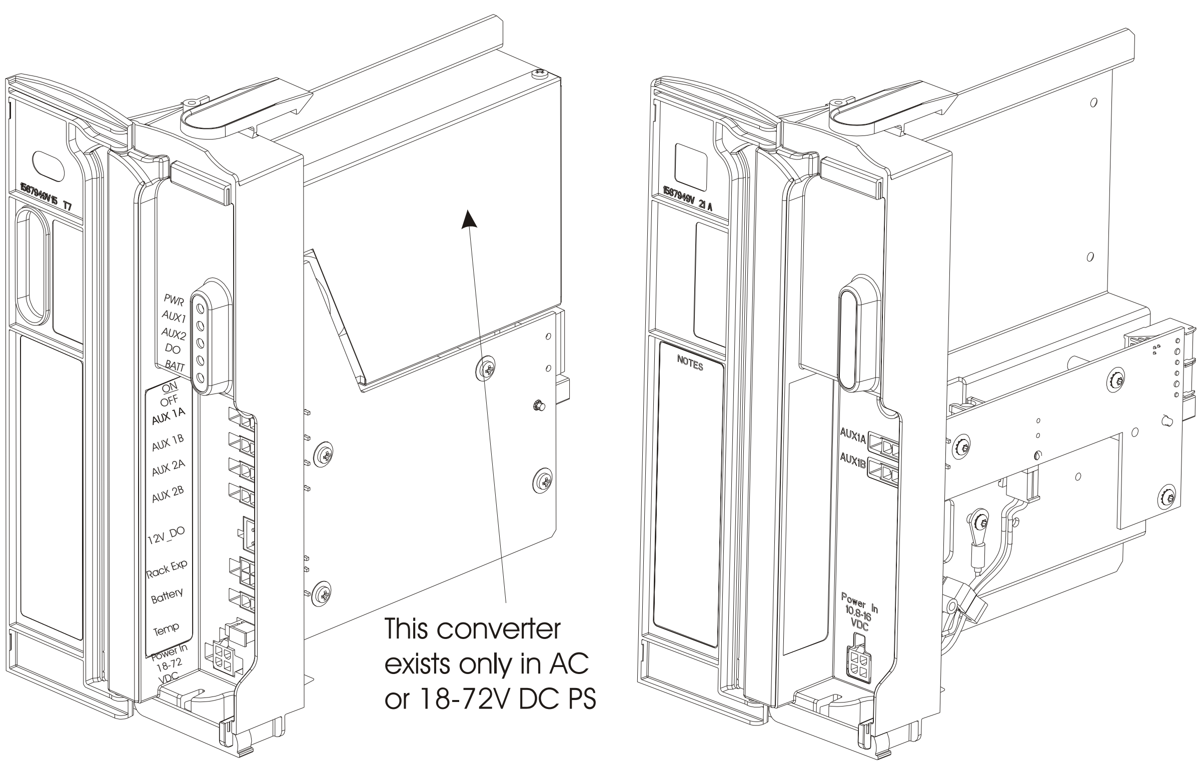
Common characteristics of power supply modules with battery charger:

- Automatic switchover to battery on power fail
- Automatic switchover to main power on power return
- Temperature compensated charging
- Over-charging protection
- Over-discharge protection
- Battery test and diagnostics, including battery controlled discharge

Characteristics of the DC power supply low-tier:

- Two auxiliary voltage outputs
- Short circuit protection outputs
- PS located on the leftmost slot of the frame
- Overvoltage protection for CPU and I/Os
- Reverse voltage protection

Figure 3-1 below depicts a general view of the power supply.



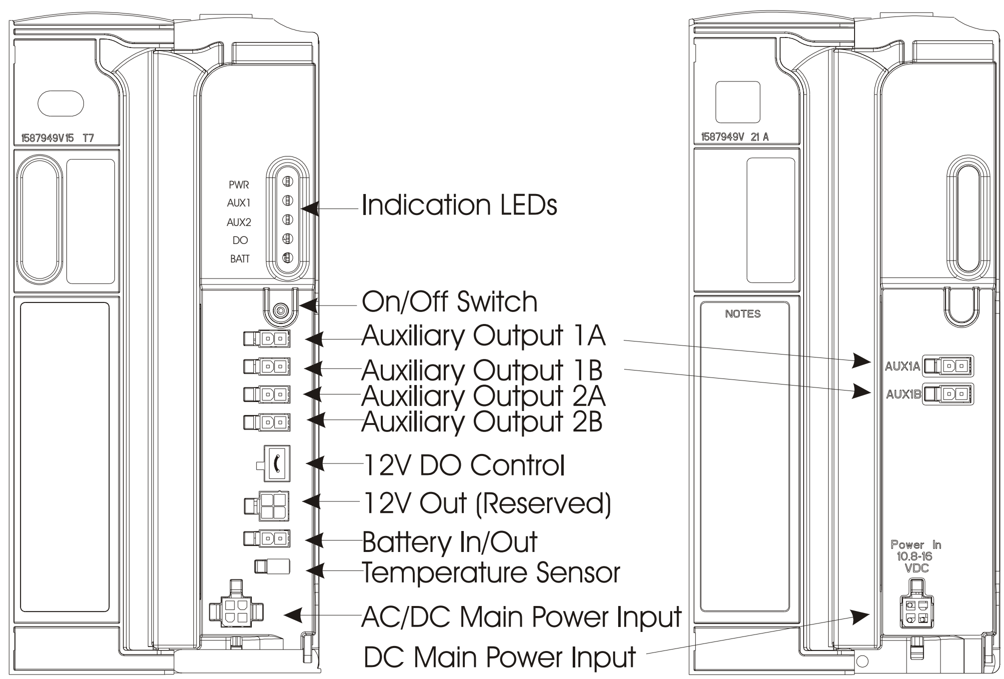
Power Supply **DC Power Supply Low-Tier**

Figure 3-1 ACE3600 Power Supply – General View

CAUTION

METAL PARTS OF THE POWER SUPPLY MAY BE VERY HOT.
After removing the power supply module, allow the metal parts to cool down before servicing the unit.

Figure 3-2 below depicts a detailed view of the power supply front panel.



Power Supply **DC Power Supply Low-Tier**

Figure 3-2 ACE3600 Power Supply – Front Panel

ON/OFF Switch

The front panel of the power supply module includes an ON/OFF switch for the module. In the OFF (down) position, all the power outputs except Battery In/Out are disabled. A mechanism is provided to prevent accidentally changing the switch position.

NOTE

In power supply modules equipped with a battery charger, if the ON/OFF switch is in the OFF position, and the RTU main power is connected, the Battery In/Out is not disabled to ensure battery charging.

Input/Output Connectors

The front panel of the power supply module (not including DC power supply low-tier) includes the following connectors.

Connector Name	Description	Notes
Auxiliary Output 1A	13.8V DC (±5%) @ 20°C User controlled power output. Short protected.	This output is used for powering radios, modems, etc. The output can be switched ON/OFF either by the user application program or using the STS hardware test. (Default = ON) For more information, see the Performing Hardware Tests section or Application Programmer section of ACE3600 STS User Guide.
Auxiliary Output 1B	Same as Auxiliary Output 1A	Same as Auxiliary Output 1A
Caution: Auxiliary Output 1A and 1B are ON by default with 13.8V DC. Do NOT plug in a radio which requires less voltage or the radio may be damaged.		
Auxiliary Output 2A	DC Power Output Selectable/programmable 3.3 to 9V DC or 13.8V DC (±5%) @ 20°C. User controlled power output. Short protected.	This output is used for powering radios, modems, etc. The output voltage can be set by the user using the STS site configuration. The output can be switched ON/OFF either using the STS hardware test or by the user application program. (Default = OFF) If both 2A and 2B are ON, they must have the same output level. The voltage levels of AUX2A and AUX2B are the same.
Auxiliary Output 2B	Same as Auxiliary Output 2A	Note: Auxiliary Output 2B can be ON independently of 2A. The voltage levels of AUX2A and AUX2B are the same.
Caution: If both 2A and 2B are ON, they must have the same output level. If cables are connected to Auxiliary Output 2A and 2B, they must use the same voltage.		

Connector Name	Description	Notes
12V DO Control	Control input that enables centralized disabling of Electrically Energized (EE) relay outputs in selectable DO modules. Input open = Relays are disabled. (ML relays do not change state) Input shorted = Relays are enabled.	This input controls a dedicated 12V power line that is available to all the slots in the frame. In each relay DO module, the user can mechanically select to power the relay coils from this dedicated 12V power line. For details on setting this control, see the Module Configuration section of the DO Relay Module chapter.
12V Out	(Reserved)	Pin 1- PGND Pin 2- 12V DO Pin 3- GND Pin 4- MAIN (12V)
Battery In/Out (only in power supply with charger)	Battery charger output when the main power exists. Backup power input from battery when the main power fails.	The charging voltage level is controlled by the battery charger and is a function of the temperature.
Temperature Sensor	Sensor for battery temperature to control charging level.	(In modules with power supply and charger only) For more information, see the Backup Battery section below.
AC/DC Main Power Input	Cable inlet for main power cable (AC or DC)	The cable is part of the RTU frame (connected to the power junction box. Note: When the cable male connected is place in this input, it locks the power supply module in its slot. To remove the power supply module, first unplug the power input cable.

The front panel of the DC power supply low-tier includes the following connectors.

Connector Name	Description	Notes
Auxiliary Output 1A	Vin=Vout Shorted to Power IN.	This output is used for powering radios, modems, etc.
Auxiliary Output 1B	Vin=Vout Shorted to Power IN.	This output is used for powering radios, modems, etc.

Connector Name	Description	Notes
10.8-16V DC Main Power Input	Cable inlet for main power cable (DC)	The cable is part of the RTU frame (connected to the power junction box. Note: When the cable male connected is place in this input, it locks the power supply module in its slot. To remove the power supply module, first unplug the power input cable.

LEDs

The front panel of the power supply module (not including the DC power supply low-tier) includes five indication LEDs.

LED Name	Description	Status
PWR	Power LED	Indicates the existence of AC or DC main power in the Main Power input. When the ON/OFF switch is in ON position - the LED is lit in Green. When the ON/OFF switch is in OFF position, but there is AC or DC input or battery- the LED is lit in Red. When the ON/OFF switch is in ON position and the unit is powered from the battery - the LED is lit in Orange. When there is no AC or DC input or battery connected - the LED is OFF.
AUX1	Auxiliary Output 1 LED	AUX1A is ON - Green AUX1B is ON - Red AUX1A and AUX1B are ON – Orange
AUX2	Auxiliary Output 2 LED	AUX2A is ON - Green AUX2B is ON - Red AUX2A and AUX2B are ON – Orange
DO	Digital Output Control LED	Relays enabled – LED ON – Green Relays disabled – LED OFF

LED Name	Description	Status
BATT	Battery LED	No battery/thermistor - LED OFF Battery is fully charged (charging current <20mA) - LED ON - Green Battery is being charged (charging current >20mA and <600mA)- LED ON – Green/Yellow Blinking Battery is being charged (charging current >600mA)- LED ON – Yellow Battery is discharging (battery voltage is higher than voltage of power supply) - LED ON – Red. Battery charging current is stabilizing - LED ON – Yellow Blinking. When battery capacity test is being performed - the LED is lit in Green Blinking. Battery tests are performed using the STS Hardware Test function or the user application program.

Battery Charger

Power supply modules with a battery option support a 6.5 or 10 Ah Lead-Acid battery. The power supply automatically switches to the backup battery as a 12V DC power source for the RTU and communications when the main AC or DC power source fails.

Power supply modules with a 12 VDC smart battery charger option charge the backup battery when not in use, and protect the battery from over-discharge. The charger performs battery tests/diagnostics, including controlled battery discharge, when requested by the user. If the battery is failed, the charger will not charge it and will send a failed status signal to the CPU. If the battery is remotely located, long battery cables can be used.

The DC power supply low-tier does not include a battery option.

Charging the Battery

The charging voltage of the Lead-Acid battery is controlled by the charger as a function of the battery temperature. The charging profile is set to comply with the temperature-compensated float-voltage of the ACE3600 battery.

Diagnostics

A battery test can be performed on the Lead-Acid battery, either from the ACE3600 STS Hardware Test utility or from the user application program. The battery test includes disabling the battery charger, discharging the battery and measuring the capacitance. For more information, see the Hardware Test section or the Creating a User Application section of the ACE3600 STS User Guide.

NOTE

It is recommended to run a battery capacity test once per month (for more exact results perform at +10˚ to +30˚C), and a charge level test once per day. The capacity test discharges the battery for 20 seconds and then measures the output. If the capacity is below the manufacturer recommended level, the battery should be replaced with a new one. (See Replacing the Backup Battery below.) Note that the capacity test is only available for the battery types supplied by Motorola.

The results of the battery capacity test can be:

- Battery OK
- Battery needs to be replaced
- Test blocked - bad environment

The battery capacity test will be blocked under the following conditions:

1. If the battery is discharging (battery is main power source of RTU),
2. If the battery or thermistor is disconnected,
3. If the battery temperature is outside the specified range (-30˚ to 60˚C),
4. If the battery is not fully loaded.

Connecting the Power Supply to a Power Source

The power supply can be connected to an AC or DC power source. The DC power supply low-tier can be connected to a DC power source only.

For instructions on connecting the power supply to a power source, see the Power and Ground Connections section of the Installation chapter above.

IMPORTANT

All power and ground connections must be in accordance with local standards and laws.

Power Supply Module Detailed Specifications

The following four charts detail the specifications of the various power supply modules.

12V DC Power Supply Module (Default)	
Input Voltage	DC 10.8-16 V The low limit of the DC power supply (10.8-16V) can be configured to 10.5V. The default is 10.8.
Outputs	Motherboard connector (to CPU and I/O modules): equal to input voltage, max. 4 A AUX1A/AUX1B: equal to input voltage, max. 8 A, on/off controlled by user program AUX2A/AUX2B (configurable): equal to input voltage (default), max. 8A, or 3.3, 5, 7.5, 9 V DC ±10%, max. 2.5A, on/off controlled by user program Note: max. 8 A total current consumption from all outputs
No Load Power Consumption	Max. 50 mA
Diagnostic LEDs	Status LED for: input voltage, AUX1 and AUX2 outputs, 12V control for DO modules
Input Protection	Internal Line Fuse, replaceable
Output Protection	AUX2A/B short circuit, automatic recovery on 3.3, 5, 7.5, 9 V
Dimensions	56 mm W x 225 mm H x 180 mm D (2.2" W x 8.7" H x 7.1" D)
Weight	Approx. 0.43Kg (0.95 Lb)

12V DC Low-Tier Power Supply Module	
Input voltage	10.8-16 V DC
Outputs	Motherboard connector (to CPU and I/O modules): The same as input voltage / max. 4 A AUX1A/AUX1B: equal to input voltage max. 8A Note: max. 8 A total current consumption from all outputs
Input Protection	Internal Line Fuse, replaceable
Dimensions	56 mm W x 225 mm H x 180 mm D (2.2" W x 8.7" H x 7.1" D)
Weight	Approx. 0.43Kg (0.95 Lb)

Specifications subject to change without notice.

18-72V DC Power Supply Modules	
Input Voltage	18-72 V DC
Total Power	18-72 V DC Max. 60 W continuous; max. 105 W peak @ 25% duty cycle
Outputs	Motherboard connector (to CPU and I/O modules): 13.2 V DC ±20%, max. 4 A AUX1A/AUX1B: equal to input voltage, max. 8 A, on/off controlled by user program AUX2A/AUX2B (configurable): equal to input voltage (default), max. 8 A, or 3.3, 5, 7.5, 9 V DC ±10%, max. 2.5A, on/off controlled by user program Note: max. 8 A total current consumption from all outputs
Battery Charger	12 V Lead Acid battery charger (in PS model with charger) Automatic charging of 6.5 or 10 Ah backup battery, battery temperature sensing, overcharging protection, battery capacity test and diagnostics, automatic battery switch-over
Diagnostic LEDs	Status LED for: input voltage, AUX1 and AUX2 outputs, 12 V Control DO for DO modules, and battery
No Load Power Consumption	Max. 250 mA
Efficiency	80% typical, 76% with full load
Inrush Current	10 A maximum, for 2 mSec. Max, cold start at 25°C
Protection	Internal line input fuse (replaceable), short circuit automatic recover
Output Protection	AUX2A/B short circuit, automatic recovery on 3.3, 5, 7.5, 9 V
Insulation	Input to case: 500 V DC, input to output 500 V DC
Dimensions	56 mm W x 225 mm H x 180 mm D (2.2" W x 8.7" H x 7.1" D)
Weight	Approx. 1Kg (2.2 Lb)

Specifications subject to change without notice.

AC Power Supply Module	
Input voltage	90-264 V AC, 50/60 Hz 90-264 V AC, 50/60 Hz with 12V smart battery charger
Total Power	Maximum 60 W continuous; maximum 105 W peak @ 25% duty cycle
Outputs	Motherboard connector (to CPU and I/O modules): 13.2 V DC ±20%, max. 4 A AUX1A/AUX1B: 13.2 V DC ±20%, max. 8 A, on/off controlled by user program AUX2A/AUX2B (configurable): equal to input voltage (default), max. 8 A, or 3.3, 5, 7.5, 9 V DC ±10%, max. 2.5A, on/off controlled by user program Note: max. 8 A total current consumption from all outputs
Battery Charger	12 V Lead Acid battery charger (in PS with charger) Automatic charging of 6.5 or 10 Ah backup battery, battery temperature sensing, overcharging protection, battery capacity test and diagnostics, automatic battery switch-over
Diagnostic LEDs	Status LED for: input voltage, AUX1 and AUX2 outputs, 12V Control for DO modules, and battery
No Load Power Consumption	130 mA @ 220 V AC
Efficiency	80% typical @230 V AC, 76% typical @115 V AC (full load)
Inrush Current	25 A maximum, for 2 mSec. Max, cold start at 25°C
Power Factor	0.98 typical at 230 V AC, 0.99 typical at 115 V AC
Protection	Internal Line Fuse, replaceable
Output Protection	AUX2A/B short circuit, automatic recovery on 3.3, 5, 7.5, 9 V
Insulation	Input to case: 1500 V AC, input to output: 3000 V AC
Dimensions	56 mm W x 225 mm H x 180 mm D (2.2" W x 8.7" H x 7.1" D)
Weight	Approx. 1kg (2.2 lb)

Specifications subject to change without notice.

Backup Battery

Overview

The ACE3600 backup 12V Lead-Acid battery provides backup for the main input power. The battery is available in two capacities: 6.5 Ah and 10 Ah. Switching from main input power to the battery and charging of the battery is performed by the ACE3600 power supply module.

Sealed Lead Acid technology batteries can be recharged and discharged at a temperature range of -30º to +60ºC. Storage and operating temperatures affect the battery capacity and lifespan. ACE3600 power supply modules include a special charging power supply designed to fit the specific temperature-compensated float-voltage-charging curve of the battery.

CAUTION

Lead Acid batteries will self-discharge if they are stored without charging. Self-discharge below the manufacturer's recommended voltage will result in internal permanent damage to the battery rendering it inoperable. When this occurs, if connected to a power supply/charger, the battery may produce excessive internal heat and therefore deform and / or leak.

The batteries are shipped disconnected from the power supply/charger. To ensure that there are no battery problems on your ACE3600 project, each Lead Acid battery MUST be fully charged and checked before connecting it to the ACE3600 power supply/charger. To verify that the battery is fit for use, measure the BATTERY OPEN CIRCUIT voltage (when the battery is not connected to the power supply/charger) with a digital voltmeter. If the battery voltage is less than 12.5 V DC, DO NOT use the battery and replace it with a new ACE3600 battery that measures more than 12.5 V DC.

Before transporting the battery, read and follow all safety information located on the battery case.

IMPORTANT

ACE3600 batteries are shipped from the factory tested, fully charged and with a label stating the next time it should be recharged when stored at temperatures of 30ºC or less.

Motorola battery warranty is valid only when the battery is charged with the original Motorola ACE3600 charging power supplies. Use of any other power supply/charger will void the battery warranty.

Under various state or local laws, the batteries must be recycled or disposed of properly and cannot be disposed of in landfills or incinerators. Environmental protection regulations classify used Lead Acid batteries as hazardous waste, unless certain exemptions apply. Consideration should be given to the methods of collecting, labeling, handling and shipping used Lead Acid batteries. Please consult the environmental protection authority for specific legal requirements and for recycling options in your country/area.

Backup Battery Storage, Lifespan, Inspection and Replacement

The manufacturer's recommendations for handling during each of the battery's life stages are:

- Transportation:

  Batteries must be handled with care to prevent falls, impact, short circuit or exposure to high temperatures and fire.

- Battery Storage:

  Storage of batteries in a warehouse requires a periodic recharge. The time between these recharge cycles depends upon the storage temperature. The minimum open circuit voltage allowed on the battery before recharging is 12.42 V, which represents remaining capacity of approximately 30%. Therefore it is recommended to perform a full charging cycle every few months depending upon the storage temperature of the battery. Please refer to Table 3-1 to determine the suggested maximal period between recharge cycles that suits the actual storage conditions. Improper storage may cause deep discharge of the battery, which might cause degradation of the battery operating life and lower the actual delivered capacity. Motorola performs a periodic full charge cycle procedure on stored batteries and a final full charge operation prior to shipment.

- Lifespan:

  The average temperature of the battery environment affects the lifespan of batteries installed in the field. Please refer to the battery vendor information at the following website:

  · (Sonnenschein A512/6.5S and A512/10S): http://www.sonnenschein.org/A500.htm

- Inspection and Replacement:

  It is important to inspect the batteries periodically (recommended every 6-12 month) and replace any battery that has corrosion on the leads or it is deformed or leaks. Such a battery should be disposed according to the local environmental laws. To assure the battery availability and proper operation, the battery should be replaced at the end of its lifespan (approximately 30% capacity) even if it is still functional. Measure the battery open circuit voltage using a digital voltmeter as described above. Please note that using a battery beyond its lifespan period may cause a battery heating, leakage and/or deformation.

Table 3-1: Recommended Time between Periodic Battery Recharge vs. Storage Temperature

Average Storage Temp (°C)	Recharge Interval (Months)
25	12
45	4
60	1

Replacing the Backup Battery

WARNING

A battery contains diluted sulfuric acid, a toxic and corrosive substance. Avoid any bodily contact with the leaking liquid when handling leaking batteries and affected parts. If the battery leaks and the liquid inside touch the skin or clothing, immediately wash it off with plenty of clean water. If the liquid splashes into eyes, immediately flush the eyes with plenty of clean water and consult a doctor. Sulfuric acid in the eyes may cause loss of eyesight and acid on the skin will cause burns.

Procedure 3-1 How to Replace the Lead Acid Backup Battery

To replace the Lead-Acid backup battery, follow the procedure below.

1) Disconnect the battery cable from the Battery connector of the power supply (see Figure 3-2) and from the battery.

2) Unscrew the battery holders (two screws in the small battery and four screws in the large battery) with the attached battery temperature sensor. (See Figure 3-3 below.)

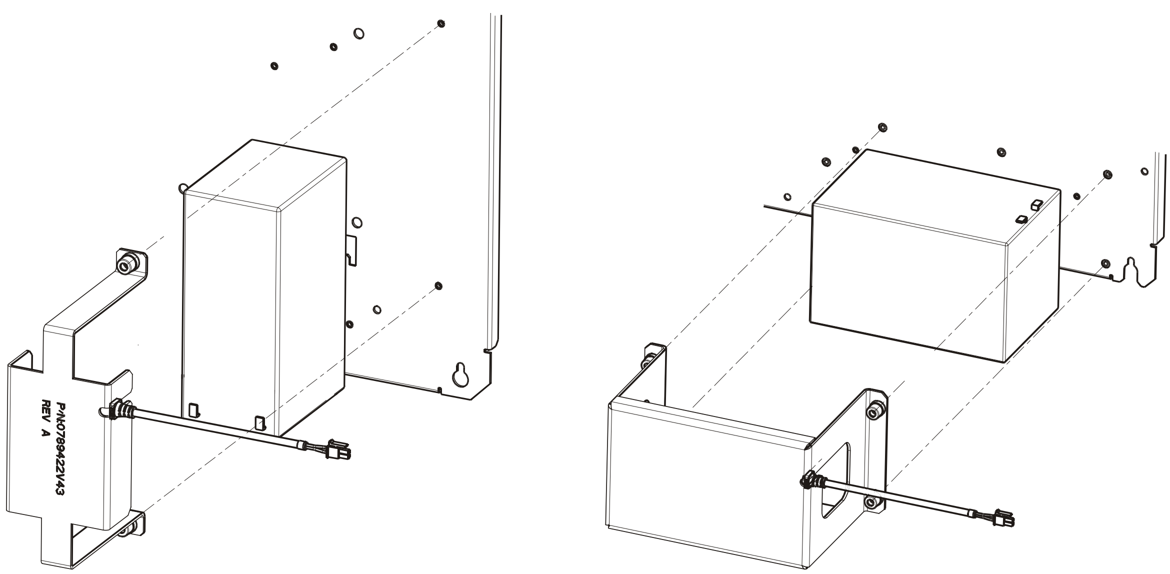


Figure 3-3 Backup Batteries – Exploded View

3) Remove the old battery from the RTU.

4) Check the replacement battery visually. If the battery looks deformed, if you notice corrosion on the battery terminals, or the battery leaks, DO NOT use the replacement battery; get another replacement battery.

5) Check the replacement battery terminal voltage level before connecting it. If the battery voltage is less than 12.42V DC, DO NOT use the battery and replace it.

6) If the replacement battery passed the visual inspection and the terminal voltage is satisfactory, put the battery into place on the RTU and screw in the battery holders.

7) Connect the battery cable to the battery terminals in the correct polarity.

8) Connect the battery cable to the Battery In/Out connector on the front panel of the power supply module.

9) Recharge the replacement battery for 10 hours to be fully charged.

CPU MODULE

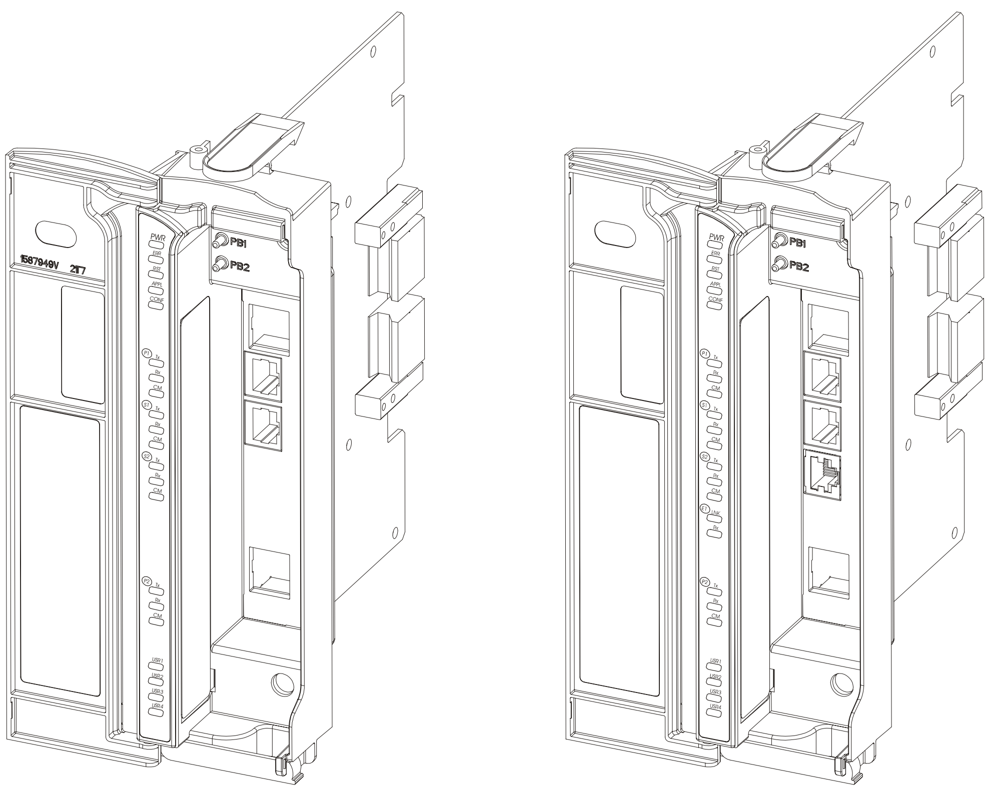
General Description

The main element of the ACE3600 is the CPU module. It controls the I/O modules, processes the gathered data and communicates with the outside world.

The core of the module is Freescale's MPC8270 32-bit microprocessor which has extended communication capabilities, high speed core, DMA and floating point calculation support. The module includes on-board memory, communication ports, I/O bus interface and other circuits. The firmware is based on Wind River's VxWorks operating system.

Module Location: The CPU is a removable module located in a dedicated slot in the RTU rack. The CPU module must be plugged into the wide slot to the right of the Power Supply module. (Inserting the module in the wrong slot will not cause any damage to the CPU.)

Figure 4-1 provides a general view of the ACE3600 CPU (Models 3610 and 3640).



Model 3610 **Model 3640**

Figure 4-1 ACE3600 CPU – General View

The CPU panel includes status LEDs, user LEDs, communication port LEDs, two pushbuttons, and communication ports. The panel is covered by the module door.

Figure 4-2 provides a detailed view of the CPU front panel.

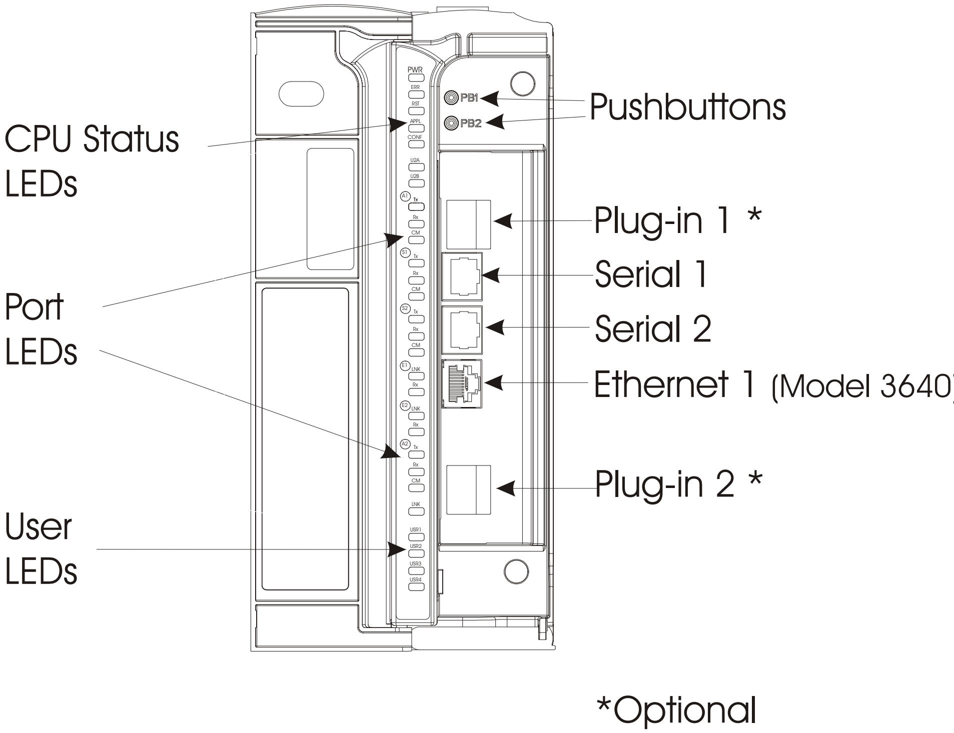


Figure 4-2 ACE3600 CPU (Model 3610/3640) – Front Panel

Front Panel

Communication Ports

The CPU module includes several communication ports:

<u>On Board ports:</u>

- Serial 1 (SI1) – RS232/RS485 serial port (configurable)
- Serial 2 (SI2) – RS232 serial port
- Eth1 (E1) - 10/100BaseT Ethernet port (CPU 3640 only)

<u>Plug-in ports bays, where different types of ports can be installed:</u>

- Plug-in 1 (PI1) – fits RS232, RS485, 10 MB Ethernet, 10/100 MB Ethernet, or Radio Modem Plug-in option
- Plug-in 2 (PI2) – fits RS232, RS485, 10 MB Ethernet, or Radio Modem Plug-in port option.

For the detailed specifications of each port, see CPU 3610/CPU 3640 Module Specifications below. For information on the cables and connectors, see Appendix C.

Buzzer

The CPU module includes a buzzer (audio indication), which is used to indicate task completion (such as end of download/upload, restart etc.) and can also be controlled from the user application program.

Pushbuttons

The CPU includes two pushbuttons on the front panel, PB1 and PB2.

These pushbuttons are used for activating and testing the modules LED, restarting the unit, erasing the user Flash memory and activating memory test. Table 4-2 describes the pushbuttons functionality.

The pushbuttons can also be monitored by the user application program (when it is running) for the application purposes.

LEDs

The CPU includes CPU status LEDs, port status LEDs, and user LEDs. Some of the LEDs are single color (green) and some are bicolor LEDs (red, green or orange).

Status LEDS indicate the CPU status in startup (boot), run-time or when there is a failure. The communication LEDs are used to indicate the communication port status. The user LEDs can be used by the user application program. Note that during startup or failure, the communication and user LEDs are used to indicate various situations. Table 4-4 details the LEDs functionality.

CPU Memory

The ACE3600 CPU includes Flash, SDRAM, and optional SRAM Plug-in memory.

The Flash stores the firmware, the user application program, and the user data.

The SDRAM memory stores the temporary data.

The optional SRAM memory expansion is used for logging user data. The SRAM data is retained using an on-board rechargeable lithium battery. See Backup Battery for SRAM and RTC for more information.

The size of the CPU memory is determined by the model as shown in the table below.

Table 4-1 ACE3600 CPU Memory

	Model 3610	Model 3640
Flash memory	16 MB	16 MB
SDRAM memory:	32 MB	32 MB
User Flash:	3 MB	3 MB
User SDRAM:	10 MB	10 MB
SRAM Plug-In	4 MB	4 MB

Real Time Clock (RTC)

The CPU includes a low drift RTC. The date and time are retained using an on-board rechargeable lithium battery.

The CPU date and time can be set using the ACE3600 STS. The CPU can also be synchronized with other RTUs in the system, using the system clock. For more information, see the Setting/Getting a Site's Date and Time section or the Creating a User Application section of the ACE3600 STS User Guide.

Backup Battery for SRAM and RTC

The CPU module includes a rechargeable lithium battery that provides backup power and data retention for the SRAM and RTC.

The lithium battery is located on the CPU board and cannot be replaced.

Typically, the battery will retain the SRAM data and RTC for 60 continuous days without power and no Lead-Acid backup battery. When the SRAM option is not used, the Lithium battery will keep the Real Time Clock running for a longer period of time.

CPU Firmware and Operation Modes

The CPU firmware is a real-time multitasking operating system, based on the Wind River VxWorks OS. The CPU shipped from the factory with the most recent firmware version, and it can be updated/replaced using a remote or local connection. Downloading firmware updates is performed using the STS. (See Downloading to a Site in the ACE3600 STS manual.) If the new firmware download stops or fails, the CPU will restart with the existing firmware.

Power-up and Restart

The CPU requires DC voltage provided by the power supply module via the motherboard (when the PS switch is ON). The CPU will power-up and restart in the range of 10.8V to 16V DC. During power-up, the processor performs fast memory tests, initiates the RTU and starts the user program (if one was downloaded). The end of the power-up sequence is indicated by the buzzer. The length of time from the beginning of CPU power-up until the user program starts running is approximately 10-15 seconds.

It is possible to perform a comprehensive memory test during power-up by pressing push-button PB1 for few seconds while switching the power supply from OFF to ON. In this case the power-up period is about 30-35 seconds long.

If the startup fails, the RTU will freeze (boot sequence stops), the PWR LED will blink and the four indicator LEDs (see LEDs Location in Table 4-3) will blink seven times. The four LEDs will then display the failure error in binary code, as described in Table 4-3.

Restart after Firmware Download

The RTU will restart after downloading system firmware. If the firmware is faulty or the firmware download failed, the RTU, if protected by the Safe Firmware Download feature, will restart and roll back to the previous firmware version. A failure message will appear in the STS Downloader screen. For information on using the Safe Firmware Download feature, see the Safe Firmware Download section of the ACE3600 STS Advanced Features manual.

Restart after Configuration Download

The RTU will restart after downloading a site configuration. For information on downloading to the RTU, see the Operation chapter of the ACE3600 STS User Guide.

If the RTU fails to restart after the user-defined site configuration was downloaded, a unique LED display (in the range of the PI1-TX and SI2-RX LEDs) and a series of buzzer tones will follow. The RST LED will turn RED and the RTU will restart itself with the previous "good" configuration. The following message will appear in the RTU Error Logger "Configuration file was deleted due to failure in startup. Rolling back to the last configuration file". Errors can be retrieved from the RTU using the ACE3600 STS Error Logger utility.

If the startup succeeds after configuration download but has errors, these errors are reported in the RTU Error Logger. It is, therefore, recommended to check for errors after downloading a configuration file to the RTU. Errors can be retrieved from the RTU using the ACE3600 STS Error Logger utility.

For information on retrieving errors from the RTU Error Logger, see the Operation chapter of the ACE3600 STS User Guide.

Restart after Erase Flash

After the User Flash is erased, the RTU will restart successfully with the default site configuration.

Power-down

When the voltage provided to the CPU module drops below the minimum level, the CPU will shut down in an orderly fashion. This level is configurable for all power supply modules other than the 12V DC power supply low-tier. See the ‘Minimum DC operation voltage’ parameter in Appendix A: Site Configuration Parameters of the ACE3600 STS User Guide.

CPU Status and Diagnostics

The CPU status is indicated on the front panel LED. Detailed CPU status and diagnostics information can be retrieved from the module using the CPU Hardware Test utility. For more details, see the Hardware Test section of the ACE3600 STS User Guide.

CPU Warnings and Errors

CPU warnings and errors are logged in the CPU memory to indicate issues or errors during power-up, restart, user application program execution and other modes of CPU operation. The existence of CPU warnings and errors are indicated in the ERR LED on the front panel of the module. Green indicates a message, orange indicates a warning and red indicates an error.

The CPU error logger information can be retrieved using the STS Error Logger utility. For more details, see the Error Logger section of the ACE3600 STS User Guide.

CPU Serial Number

Each CPU has a unique serial number. This number is printed on a label on the side of the CPU module front panel. The serial number can be read using the STS Hardware Test and is also available to the user application program. For more information, see the Hardware Test section or the Creating a User Application section of the ACE3600 STS User Guide.

Connecting Plug-In Ports to the CPU Module

In general, the plug-in ports are ordered as options with the RTU and are installed in the factory. However, it is also possible to add plug-in ports to the CPU after it is shipped from the factory. Several plug-in ports are available. See Communication Ports above.

Note: A TORX screwdriver is required for installation of the plug-in ports.

Figure 4-3 depicts a plug-in port board attached to the ACE3600 CPU module.

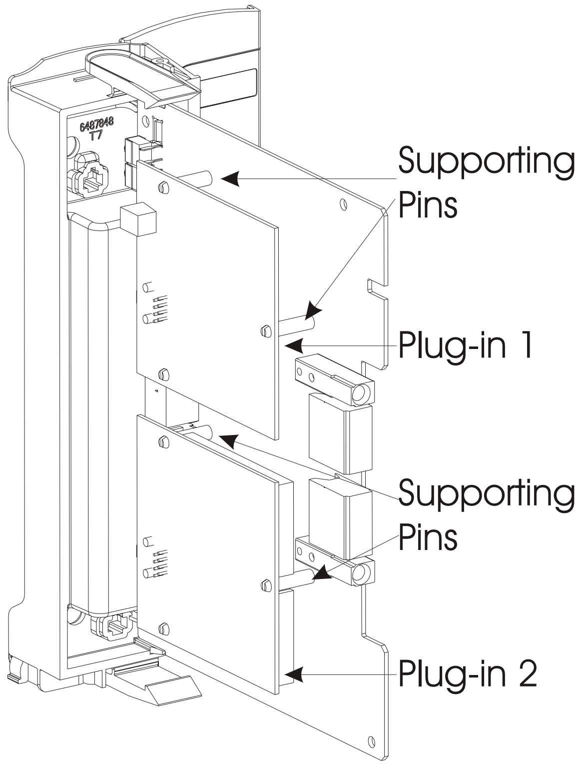


Figure 4-3 Plug-In Port in CPU Module

Procedure 4-1 describes how to connect a plug-in port to the CPU.

Procedure 4-1 How to Connect a Plug-in Port to the CPU

1) Remove the CPU module from the RTU.

2) Remove the cover from the desired opening on the front panel.

3) Connect two supporting pins with screws to the plug-in port.

4) Place the plug-in board with the RJ-45 connector facing the panel. Carefully insert the plug-in board connector into the appropriate connector on the CPU board.
For Ethernet 10/100 MB, use the J14 connector on the CPU (Plug-in 1 only.)
For all other plug-in ports, use the J5 (Plug-in 1) or J6 (plug-in 2) connector.

5) Connect the two supporting pins with screws to the other side of the CPU board.

6) Replace the CPU module in the slot.

Connecting SRAM Expansion Memory to the CPU Module

In general the plug-in SRAM is ordered as an option with the RTU and is installed in the factory. However, it is also possible to add plug-in SRAM to the CPU after it is shipped from the factory.

Note: A TORX screwdriver is required for installation of the SRAM.

Figure 4-4 depicts the user SRAM Plug-in memory in the ACE3600 CPU module.

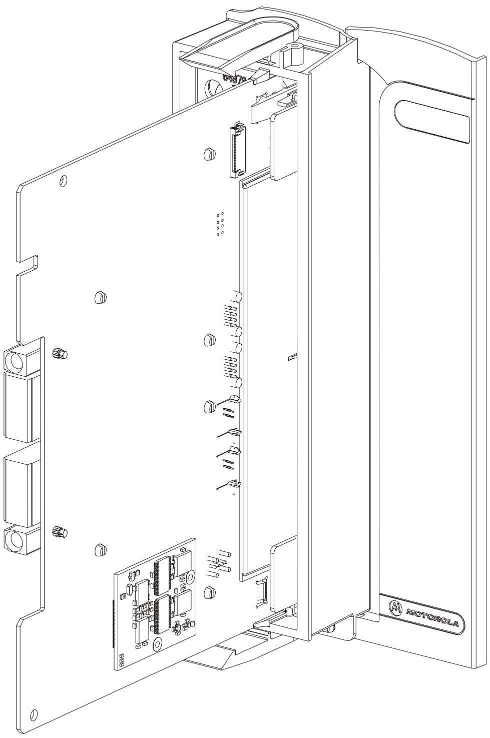


Figure 4-4 SRAM Expansion in CPU Module

Procedure 4-3 describes how to connect a plug-in SRAM memory card to the CPU.

Procedure 4-2 How to Connect a Plug-in SRAM Memory Card to the CPU

1) Remove the CPU module from the RTU.
2) Remove the cover from the connector marked P12 on the CPU board.
3) Place the plug-in SRAM memory card with the connector facing the panel. Carefully insert the plug-in board connector into the connector on the CPU board.
4) Secure the memory card to the CPU board with the supplied screw.
5) Replace the CPU module in the slot.

Pushbutton Functionality

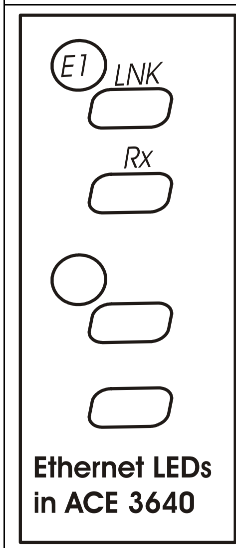
The table below describes the use of the two pushbuttons in various scenarios, during power-up and run-time. To press a pushbutton during startup, first press the pushbutton(s), then turn on the RTU using the On/Off switch on the front panel. Keep the pushbutton(s) depressed for the required number of seconds, as specified in the scenarios below.

Table 4-2 ACE3600 Pushbutton Functionality

Scenario	Trigger	Action
LEDs Test	During run-time, press PB1 for five or more consecutive seconds (but less than 30).	All the LEDS on the CPU and I/O modules will be lit until let go of PB1 and then returned to their previous states.
RTU Restart	During run-time, press PB1 for 30 consecutive seconds.	All the LEDs will be lit. Then all the LEDs will blink once. The buzzer will buzz several short beeps. (If PB1 is released during this time the restart will not be performed.) At the long beep, release PB1 and the RTU will restart (and the buzzer will buzz.)
Turn LEDs ON	During run-time, press PB1 for one second.	Those LEDs which are currently active will be turned on for a period of time (configured in the RTU configuration using the STS.)
RAM Test	During startup, press PB1.	A detailed memory test of SDRAM and SRAM plug-in is performed. - At the beginning of the RAM test, the four indicator LEDs (see LEDs Location in Table 4-3) will blink three times. During the RAM test, the LEDs may blink or be lit. If the RAM test succeeds, the four LEDs will blink three times and turn off and the restart sequence will continue. If the RAM test fails, the RTU will freeze (restart sequence stops), the PWR LED will blink and the four LEDs will blink seven times. The failure error code will then be displayed on the LEDs, in binary code, as described in Table 4-3. - To exit/abort the RAM test in the middle, restart the RTU using the On/Off switch on the front panel.

Scenario	Trigger	Action
Erase User Flash	During startup, press both PB1 and PB2 simultaneously until the buzzer buzzes five times quickly, then continuously for three seconds.	All the user Flash memory content excluding logging files (files tagged as data logging files) is erased, including the site configuration, user application programs, user tables, etc.
Bootstrap	During startup, press PB2 continuously for five seconds.	The RTU will start up in diagnostic mode. Communication with the RTU is for diagnostic purposes only (Error Logger/ SW Diagnostics.) You cannot download to the RTU and no application will run. If the bootstrap fails, the four indicator LEDs (see LEDs Location in Table 4-3) will display the failure error in binary code, as described in Table 4-3.

Table 4-3 ACE3600 Failure - Error Code Display on LEDs

LEDs Location	LED Error Code	Description
 On CPU 3640, the four LEDs begin with the group marked E1, as above. On CPU 3610, the four LEDs are unmarked, but can be found after the S2 group.	ERR Code 1 OFF OFF OFF ON ERR Code 2 OFF OFF ON OFF ERR Code 3 OFF OFF ON ON ERR Code 4 OFF ON OFF OFF ERR Code 6 OFF ON ON OFF	ERR Code 1 = Error in Flash ERR Code 2 = Error in SDRAM ERR Code 3 = Error in SRAM ERR Code 4 = Unable to boot. Corrupted bootstrap. -ERR Code 6 = Low voltage under 12V Where OFF LED = '0'; ON LED = '1' (very fast blink, almost continuous); The highest LED is the most significant.

CPU LEDs Behavior

The table below describes the behavior of the LEDs on the CPU module.

Table 4-4 ACE3600 CPU LEDs Behavior

LED Name	Description	Status
PWR	Power LED Bicolor LED (Red, Green)	Flashing Red – Power exists; CPU FPGA not loaded. Green – Power exists; CPU is running from a recognized power supply (one of the six power supply options.) Red – Failure on power-up. CPU is running without power supply.
ERR	Error Logger Status LED Bicolor LED (Red, Green)	OFF – No new errors or warnings. Green – New message logged. Orange – New warning logged. Red – New error logged.
RST	Reset LED Bicolor LED (Red, Green)	Green – On startup OFF – Successful power-up or restart. Red – Power-up or restart failed.
APPL	Application LED Bicolor LED (Red, Green)	OFF - No user application program in the Flash memory. Green - User application program is running. Orange - User application program was paused by user (during Hardware Test.)
CONF	Configuration LED Bicolor LED (Red, Green)	OFF – Configuration was not loaded. Green - Configuration was loaded. Red - Configuration error.
PI1 TX	Plug-in Port 1 – TX (transmit) Green LED	ON- Transmitting Data
PI1 RX	Plug-in Port 1– RX (receive) Green LED	ON – Receiving Data
PI1 CM	Plug-in Port 1 – CM (channel monitor) Green LED	ON – Channel Busy (if port is in use by radio, RS485, or RS232) – Network Connected (if an IP plug-in is used)

LED Name	Description	Status
SI1 TX	Serial Port 1 – TX (transmit) Green LED	ON – Transmitting Data
SI1 RX	Serial Port 1 – RX (receive) Green LED	ON – Receiving Data
SI1 CM	Serial Port 1 – CM (channel monitor) Green LED	ON – Channel Monitor is ON.
S2 TX	Serial Port 2 – TX (transmit) Green LED	ON – Transmitting Data
S2 RX	Serial Port 2 – RX (receive) Green LED	ON – Receiving Data
S2 CM	Serial Port 2 – CM (channel monitor) Green LED	ON – Channel Monitor is ON
E1 LNK*	Ethernet Port 1 (link) Green LED	ON – Network Connected In case of RAM test and startup failure, see Table 4-2 and Table 4-3.
E1 RX*	Ethernet Port 1 (receive) Green LED	ON – Receiving Data In case of RAM test and startup failure, see Table 4-2 and Table 4-3.
PI2 TX	Plug-in Port 2 – TX (transmit) Green LED	ON – Transmitting Data
PI2 RX	Plug-in Port 2 – RX (receive) Green LED	ON – Receiving Data
PI2 CM	Plug-in Port 2 – CM (channel monitor) Green LED	ON – Channel Busy (if port is in use by radio, RS485, or RS232) – Network Connected (if an IP plug-in is used)
USR1-USR4	User application program LEDs Green LED	Controlled by the user application program. Light consecutively and repeatedly one after the other when entering boot mode.

* The LED names E1 LNK and RX appear only in CPU 3640.

CPU 3610/CPU 3640 Module Specifications

Microprocessor	Freescale – Power PC II MPC8720, 32-bit, extended communication capability, DMA and floating point calculation support
Microprocessor Clock	200 MHz
Memory	Flash: 16 MB/3 MB free for user DRAM: 32 MB/10 MB free for user SRAM plug-in (Optional): 4 MB total, all free for user
Real-Time Clock	Full calendar with leap year support (year, month, day, hours, minutes, seconds). Time drift: max. 2.5 Seconds per day (when power is on)
SRAM and RTC Retention	3 V Rechargeable lithium backup battery
Serial Port 1	Configurable RS232 or RS485 port: - RS232: Asynch, Full Flow Control, up to 230.4 kb/s, GPS receiver interface - RS485, multi-drop 2-Wire up to 460.8 kb/s
Serial Port 2	RS232, Asynch, Full Flow Control, up to 230.4 kb/s, GPS receiver interface
Plug-In Port 1	Supports the following Plug-In ports: - Radio Modem, DPSK 1.2 kb/s, FSK 1.2/1.8/2.4 kb/s, DFM 2.4/3.6/4.8 kb/s - RS232, Sync/Asynch, Full Flow Control, up to 230.4 kb/s, GPS receiver interface - RS485, multi-drop 2-Wire up to 460.8 kb/s - Ethernet 10/100 Mb/s
Plug-In Port 2	Supports the following Plug-In ports: - Radio Modem, DPSK 1.2 kb/s, FSK 1.2/1.8/2.4 kb/s, DFM 2.4/3.6/4.8 kb/s - RS232, Sync/Asynch, Full Flow Control, up to 230.4 kb/s, GPS receiver interface - RS485, multi-drop 2-Wire up to 460.8 kb/s - Ethernet 10 Mb/s
Ethernet Port 1	10/100 Mb/s (on CPU 3640 only)
LEDs Display	4 CPU diagnostic LEDS, Port status LEDs and user application LEDs
Power Consumption (measured at power supply in)	Typical: 4W (280 mA @ 13.8VDC); LEDs on: 4.4W (320mA @ 13.8VDC)
Operating Voltage	10.8-16 V DC (from the motherboard connector)
Dimensions	56 mm W x 225 mm H x 180 mm D (2.2" W x 8.7" H x 7.1" D)
Weight	Approx. 0.38 Kg (0.84 Lb)

Specifications subject to change without notice.

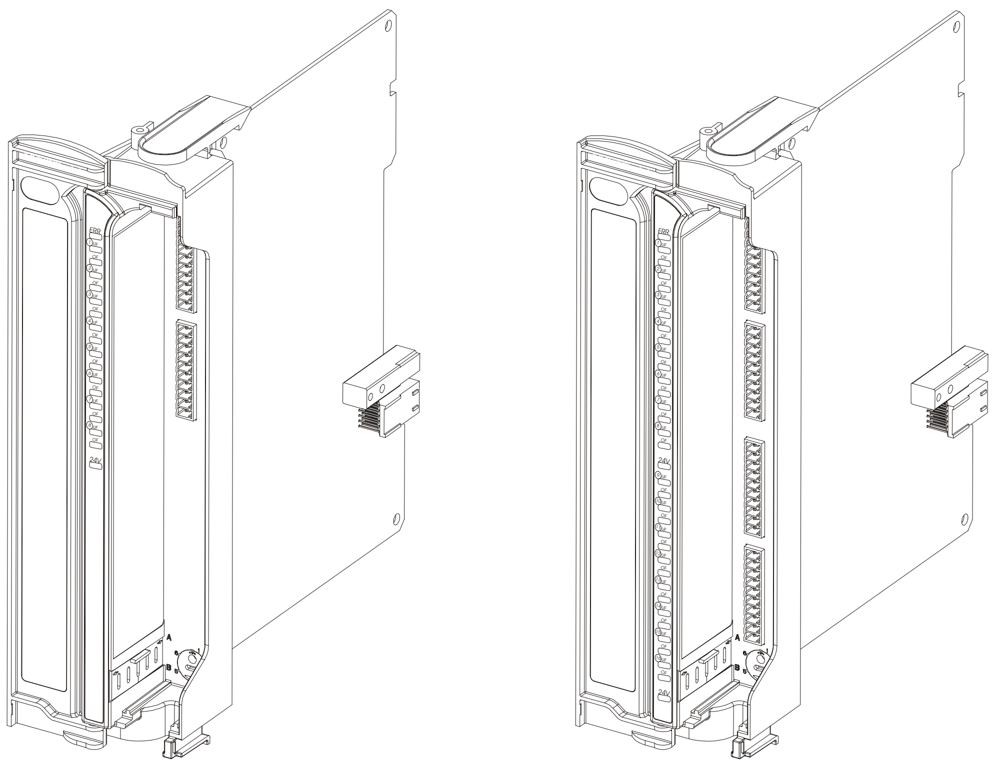
I/O MODULES

General Description

The ACE3600 RTU can include up to eight I/O modules, depending on the frame size. A variety of I/O modules are available.

The I/O modules can be positioned in the slots to the right of the CPU. As with all ACE3600 modules, the I/O modules can be replaced while the power is on (hot swap.)

Figure 5-1 provides a general view of an ACE3600 I/O module.



I/O Module with Two TBs **I/O Module with Expanded TBs**

Figure 5-1 ACE3600 I/O Module – General View

Each I/O module includes an ERR status LED, individual I/O status LEDs, an array of I/O connectors, and a coding mechanism for the terminal cable connector or TB holder option.

Figure 5-2 provides a detailed view of the I/O front panel.

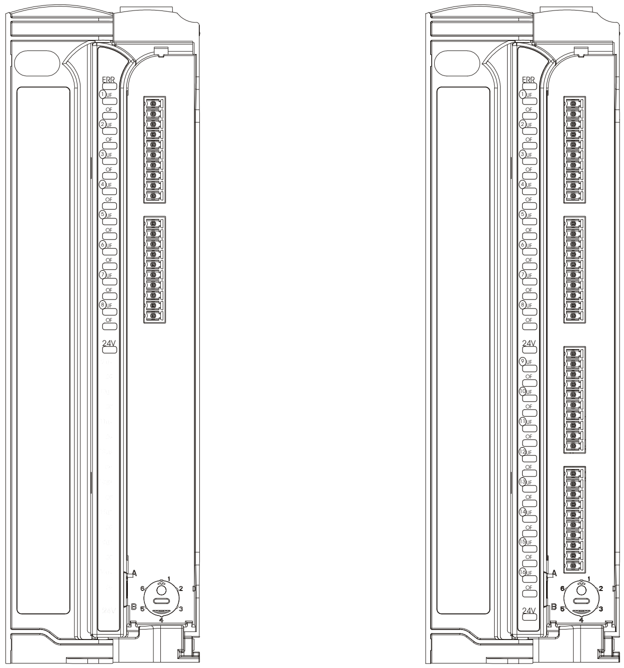


Figure 5-2 ACE3600 I/O Module – Front Panel (without TB Holder)

I/O Module LEDs

The ERR LED indicates an I/O module fault and errors. It will remain lit until all the errors have been eliminated. Diagnostic and error messages can be retrieved from the module using the ACE3600 STS Error Logger or SW Diagnostics. For more information, see the ACE3600 STS User Guide.

The I/O status LEDs in Digital Input (DI) and Digital Output (DO) modules indicate ON and OFF (LED lit when the I/O is ON.) In Analog Input (AI) modules, each input has two LEDs, indicating Overflow (OF) and Underflow (UF). In Analog Output (AO) modules, each output has three LEDs, indicating voltage output (Vout), current output (Iout), and calibration (Cal).

I/O Module Test

The I/O modules can be tested using the STS Hardware Test utility. For more information, see the ACE3600 STS User Guide.

The I/O module LEDs can be tested using the STS Hardware Test utility– all the LEDS are lit for a number of seconds, and then turned back to their previous state.

Panel Terminal Block (TB) Connectors

Each I/O module can be ordered either with a set of two/four TB connectors or a TB holder. (See *TB Holder and Cables* below.) Each TB connector has a fixed female side on the module and a male plug for the sensor/device wire connection. The TB male side in all modules is screw type for up to 1mm (18 AWG) wire. A TB extractor (FHN7063A) is available for easy removal of TBs.

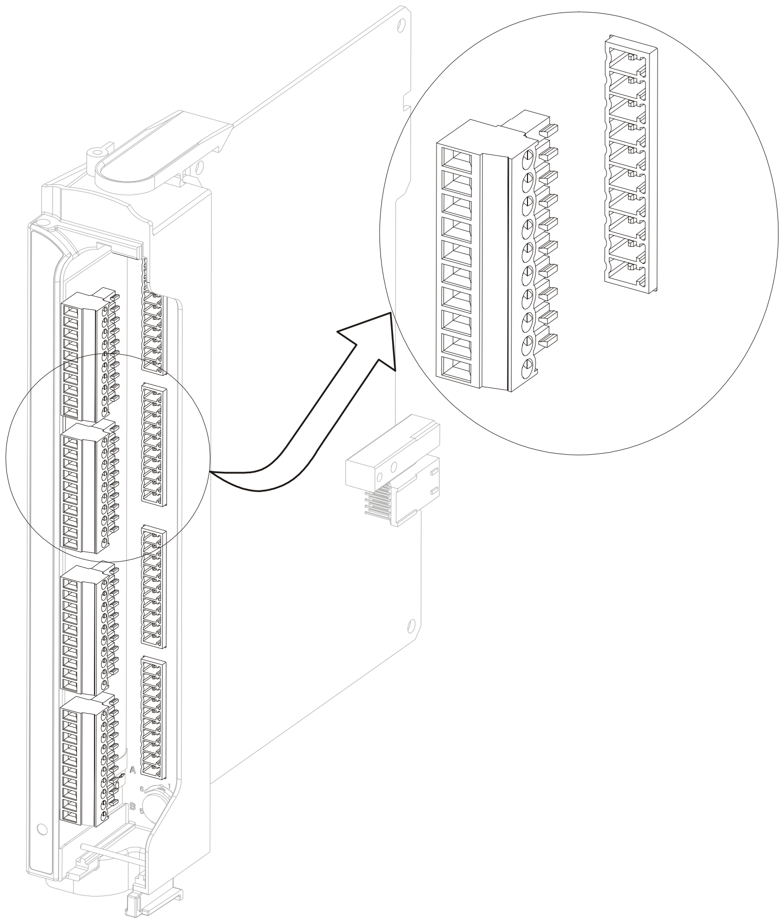


Figure 5-3 TB Connector-Male/Female

Procedure 5-1 Extracting the TB Connector from the I/O Module

1) Open the door of the I/O module to expose the TB connectors (2-4).

2) Position the TB extractor over the desired TB connector, with the small notch facing to the right. (See Figure 5-4.)

3) Press the center of the TB extractor from both sides to open the two sides of the clamp end.

4) Clamp the open TB extractor over the desired TB connector and pull on the back handle to extract the TB connector from the I/O module.

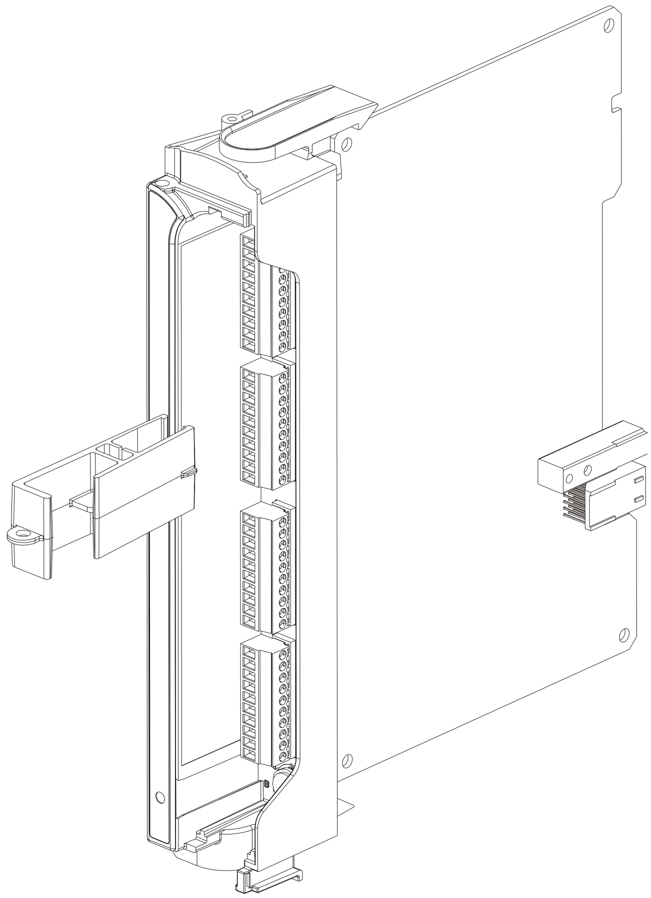


Figure 5-4 TB Extractor

TB Holder and Cables

The TB holder secures the male TBs neatly in place and forms a single connector plug per module. The wires connected to the TBs are concealed in the holder. The module and the TB holder provide a coding mechanism to prevent cabling errors. Ejector handles enable easy release of the TB holder connector from the module. An optional three-meter cable braid, completely wired with holder and cable, is available.

A TB holder kit is available to enable self-assembly of cables. User assembled cables should use wires of up to 0.4mm (26 AWG). The TB holder kit does not include a cable.

Note that a TORX screwdriver is required for assembling the TB holder and a flat screwdriver is required for setting the code key pin.

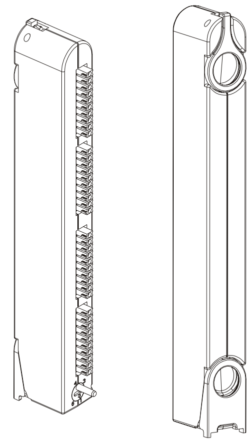


Figure 5-5 Terminal Block (TB) Holder-Front and Back View

Assembling the TB Holder Parts

Procedure 5-1 Assembling the TB Holder Parts

If the TB holder kit is ordered, follow the procedure below: (See Figure 5-6)

1) Prepare the cable by cutting the wires to fit the TBs. Connect the wires of the user-assembled cables to the TBs, following the pin descriptions on the module panel label (where pin 1 is at the top of first TB and so on downwards.)

2) Place the TBs onto the left part of the TB holder plastic.

3) Add the top ejector handle, the code key and the positioner.

4) Close the right side of the plastic TB holder over the left side.

5) Screw together the assembly using the three screws provided in the kit.
   Note the lower screw holds the positioner into place.)

6) Insert the lower ejector handle at the bottom of the TB holder.

7) Slide the metal axis into lower ejector handle from the side.

Once the TB holder is assembled, it can be connected to the I/O module.

Figure 5-6 provides an exploded view of the TB holder assembly.

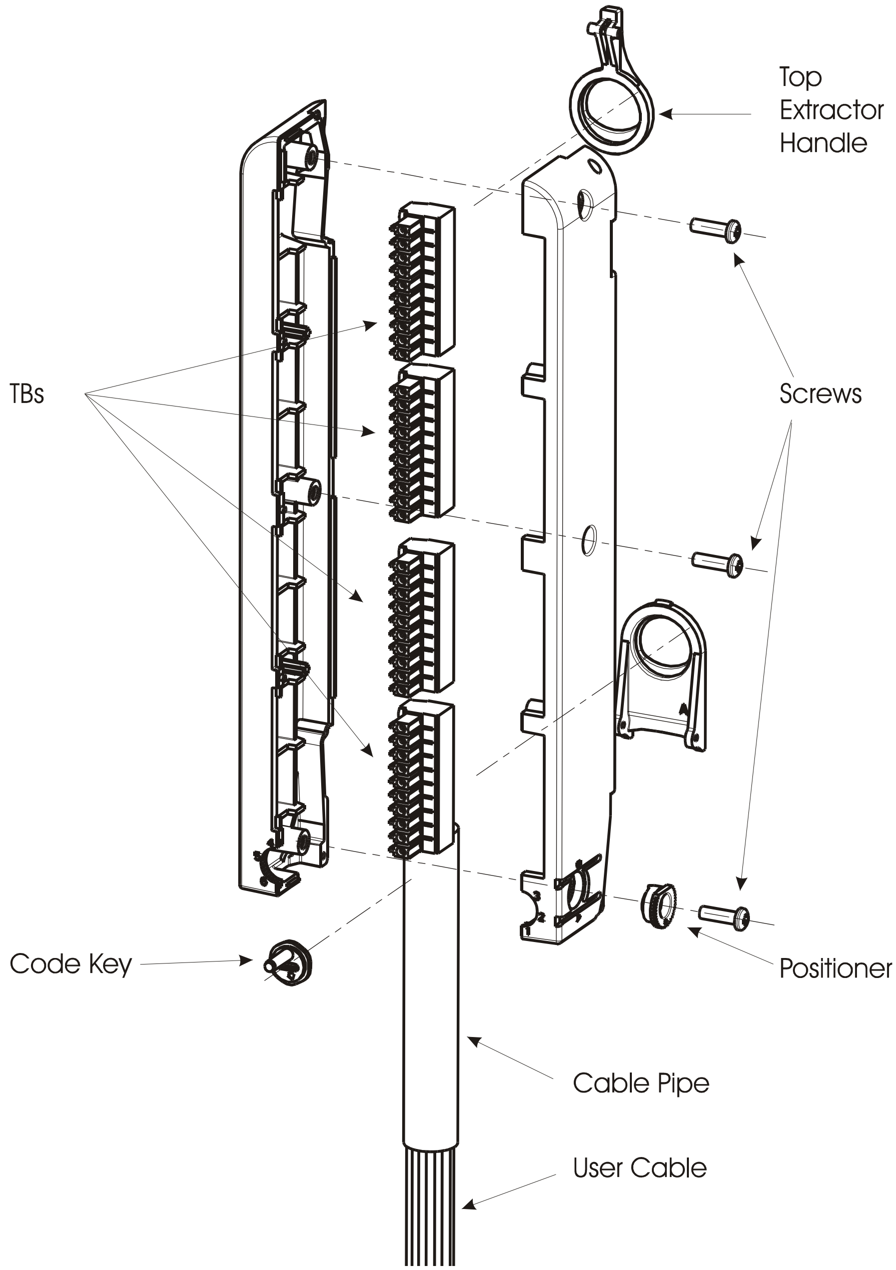


Figure 5-6 Terminal Block (TB) Holder Assembly – Exploded View with Coding

Attaching the TB Holder Clip to the I/O Module

An optional TB holder clip can be added to the I/O module to secure the cable.

Procedure 5-2 Attaching the TB Holder Clip to the I/O Module

1) Remove the I/O module from the ACE3600 RTU.

2) Using the supplied screw, attach the TB holder clip to the bottom of the I/O module. (see Figure 5-7)

3) Replace the I/O module in the RTU slot.

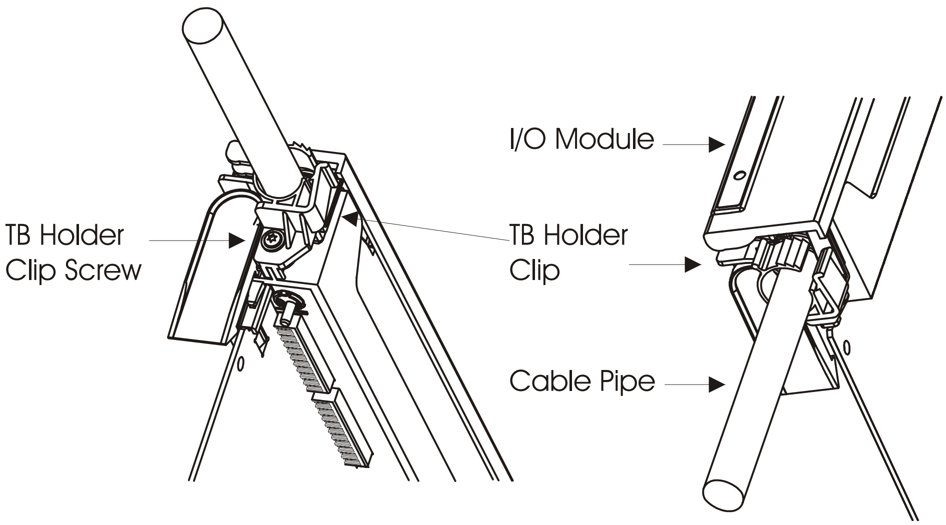


Figure 5-7 I/O Module with Terminal Block (TB) Holder Clip

Connecting the TB Holder to the I/O Module

Procedure 5-3 Connecting the TB Holder to the I/O Module

1) Open the door of the I/O module.

2) On the TB holder, loosen the screw and turn the positioner so that the arrow points to either A or B.

3) Tighten the screw.

4) With a flat screwdriver, set the code key pin to a number from 1 to 6.

5) On the I/O module, using a flat screwdriver, set the pin to the same number (from 1 to 6.) This ensures that the TB holder will not be accidentally connected to the wrong I/O module.

6) Slide the plastic lip on the bottom of the I/O module to either A (up) or B (down) (as in Step 2).

7) Align the plastic lip with the flat edge of positioner on the TB holder and snap the TB holder into the I/O module, (see Figure 5-8), fitting the code key pin into the code key.

8) If the ejector handles are extended, push them inwards, against the TB holder (see Figure 5-8.)

9) If a TB holder clip was attached to the I/O module, slide the cable between the two edges of the clip, and press the clip closed to secure the TB holder to the module. See Figure 5-7.

10) Label the TBs wires with any desired user notes. The wires are numbered 1-20 or 1-40 depending on the model. The wire numbers correspond to the module pins.

11) To extract the TB holder from the I/O module front panel, extend the ejector handles outward away from the module and pull on the handles.

Figure 5-8 provides a general view of the TB holder and an I/O module.

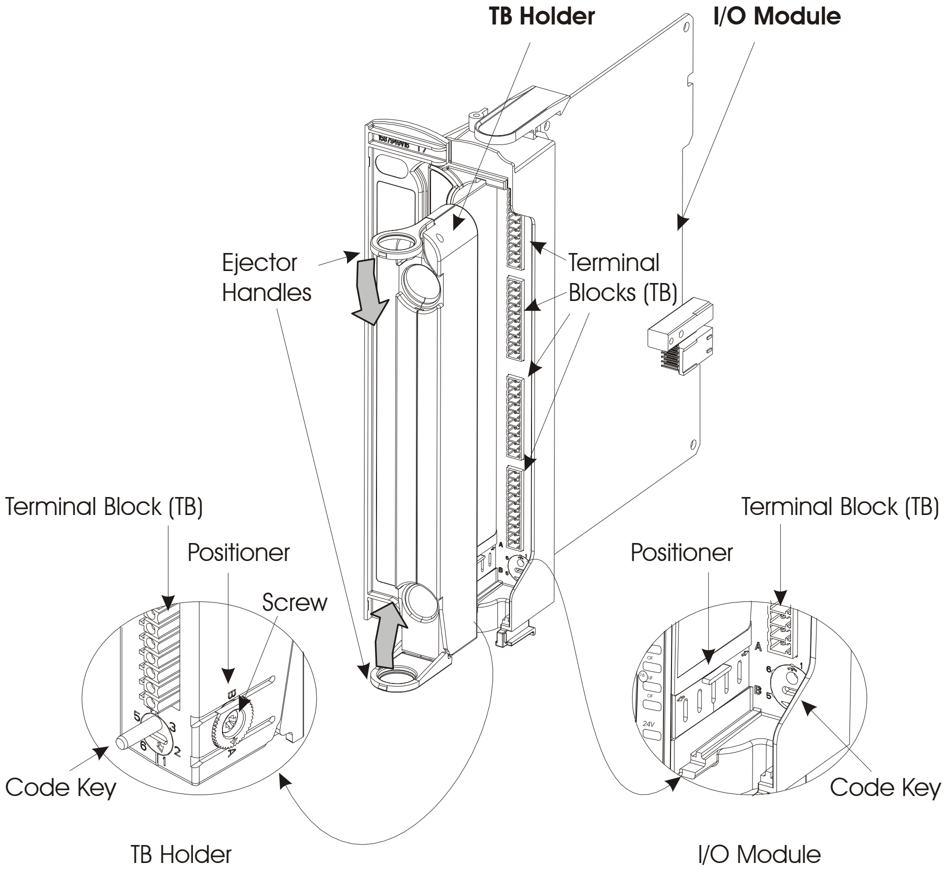


Figure 5-8 Terminal Block (TB) Holder on I/O Module – General View with Coding

Wired Cable Braid

The optional three-meter cable braid is completely wired with a TB holder and either 20-wire or 40 wire cable. Each wire in the cable is labeled with the corresponding pin number. This information is useful when connecting the PGND to the grounding strip. See the Connecting I/O Modules to Ground section of the Installation chapter.

User Label

Each I/O module is provided with a blank label on the module door for user notes.

Inserting/Removing an I/O Module from the Rack

I/O modules support hot-swap and can be inserted and extracted while the system is powered up. For instructions on removing/inserting an I/O module from/into a rack, see the Replacing an I/O Module section of the Break-Fix Procedures chapter below.

Automatic Module ID

Each I/O module has a unique module type ID number. When the RTU is powered up or when an I/O module is inserted into a slot (hot-swap), the CPU automatically identifies the module type.

The module ID can be viewed from the STS Hardware Test utility. For more information, see the Hardware Test section of the ACE STS User Guide.

24V DC Floating Plug-In Power Supply

Up to two 24V DC floating plug-in power supplies can be added to certain I/O modules, as detailed in the table below. Up to four 24V DC floating plug-in power supplies can be added per rack. (For guidelines on remaining within the maximum system power consumption, see Appendix D: ACE3600 Maximum Power Ratings below.)

Table 5-1 Number of Plug-In Power Supplies in ACE3600 I/O Modules

Module Type	Number of Power Supplies
32 DI	2
16 DI	1
16 AI	1
8 AI	1
Mixed I/O	1
Mixed Analog	1

The plug-in power supply is ordered separately.

Before installing the 24V DC floating plug-in power supply card on the I/O module, please verify that the FPGA version of the I/O module is as follows:

I/O Module Type	**FPGA Version**
AI module (all types)	Version 1.5.002 or higher.
DI module (all types)	Version 2.1.004 or higher.
Mixed I/O module (all types)	Version 1.5.004 or higher.

Use the ACE36000 STS Hardware Test utility to retrieve the FPGA version from the unit. If the FPGA version listed in the Module Diagnostics is lower than the version in the chart above, you must upgrade the I/O version by downloading a higher version FPGA file using the STS. Contact your local support team for the updated FPGA file.

Procedure 5-4 Attaching the Power Supply to the I/O Module

Attach the power supply to the I/O module using the following procedure. Note that a TORX screwdriver is required.

1) Remove the cap from the 40-pin connector on the power supply plug-in.
2) Place the plug-in onto the board with the connector attached and the spacers over the holes on the board.
3) Screw the four supplied metals screws into the spacers to secure the plug-in.
   The RTU will automatically recognize the 24V power supply.

Each plug-in power supply output is controlled by the CPU module. By default, the plug-in power supply is ON and can supply up to 150mA. The power supply plug-in can be turned ON/OFF via the user application program or Hardware Test utility.

Figure 5-9 provides a general view of an I/O module with one plug-in.

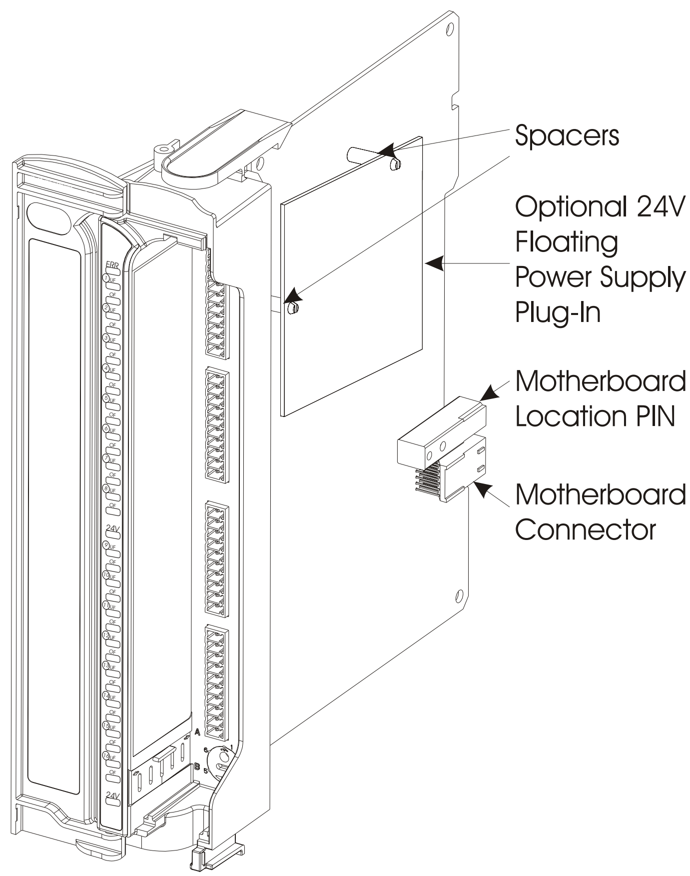


Figure 5-9 ACE3600 I/O Module with a 24V Floating Power Supply Plug-In

24V DC Floating Plug-In Power Supply Module Detailed Specifications

Input Voltage	10.8-16 V (from I/O module)
Outputs	24V floating, max. 150 mA
Efficiency	75% typical
Protection	Automatic output shut down on over-voltage and over-current
Insulation	Input to output: 1500 V AC
Dimensions	78 mm W x 15 mm H x 68 mm D (3.1" W x 0.6" H x 2.7" D)
Weight	Approx. 0.04Kg (0.09 Lb)

Specifications subject to change without notice.

DIGITAL INPUT MODULE

General Description

The ACE3600 Digital Input (DI) module can have 16 or 32 inputs.

The following DI modules are available.

- 16 DI Fast 24V
- 32 DI Fast 24V
- 16 DI Fast 24V IEC TYPE 2
- 32 DI Fast 24V IEC TYPE 2

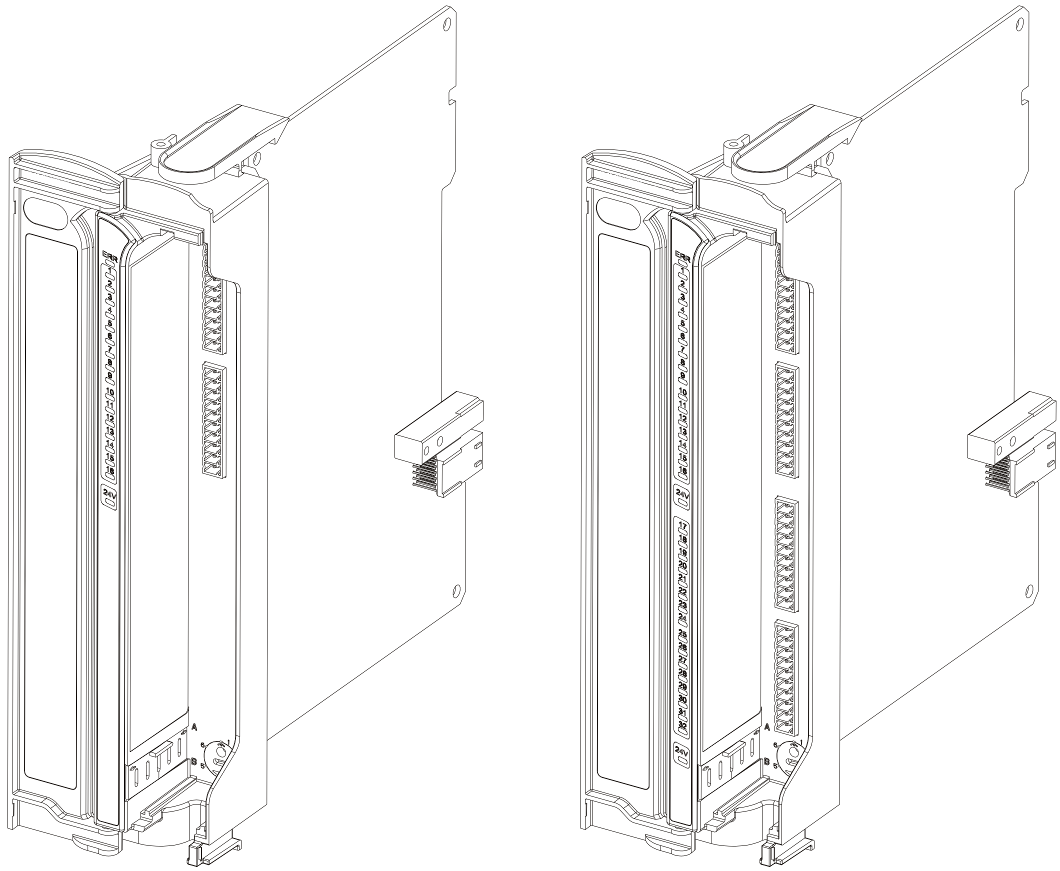
Two types of voltage (“wet”) inputs are supported, IEC 61131-2 Type II compliant inputs and 24V “MOSCAD compatible” inputs. In the 32 DI module, the first 20 inputs can function as fast counters. In the 16 DI module, all inputs can function as fast counters. A counter's maximum rate is dependent on the module type (see the specifications below.)

All the inputs are optically isolated. The DI modules support optional 24V DC floating plug-in power supplies (for contact “wetting” or other purposes).

Each DI can be an event trigger (interrupt-driven) to a high priority fast process. The high priority fast process enables very fast activation of an output in response to an input trigger and logical conditions. This high priority fast process is not dependent on the I/O scan (refer to the STS Application Programmer manual.)

For a description of I/O module construction, location, LEDs, TBs, and other common I/O module features, see the I/O Modules chapter above.

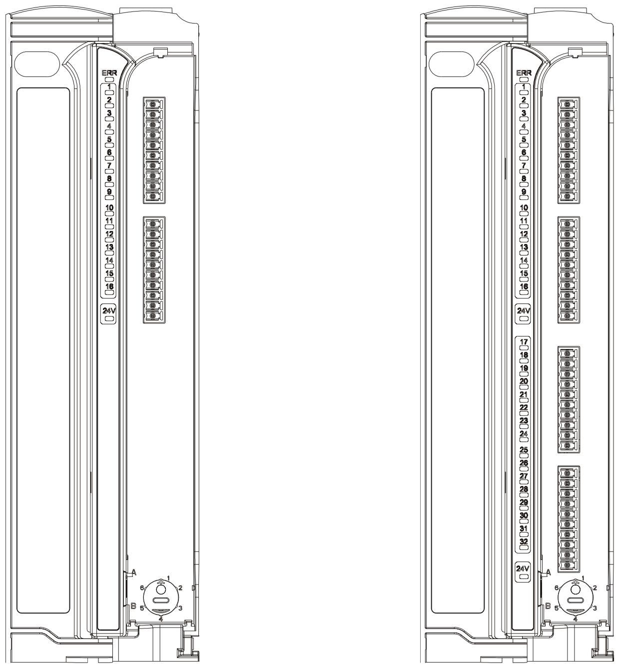
Figure 6-1 provides a general view of the ACE3600 DI module.



16 DI Module **32 DI Module**

Figure 6-1 ACE3600 DI Module – General View

Figure 6-2 provides a detailed view of the ACE3600 DI module front panel.



16 DI Module **32 DI Module**

Figure 6-2 ACE3600 DI Module – Front Panel

DI Module Configuration

The 16 DI Fast 24V and 32 DI Fast 24V modules can handle AC and DC input signals. The user can select DC or AC operation per module. When AC configuration is selected, the Fast Capture, Counter Function and Input Filters (see below) are disabled.

Fast Capture (DC Configuration)

When the DI module is in DC mode, each DI can be configured as a Fast Capture DI. Fast capture causes the SCAN ladder output operation to get the first change that occurred since the previous scan. When fast capture is disabled, the scan gets the current value of the DI (in this case, any DI changes between scans are missed.)

Input Filters (DC Configuration)

When the DI module is in DC mode, each input has a HW input filter to make sure that the input reading is stable. The range of the HW DI filter is 0 to 50.8 millisecond (in 0.2 mS steps). The Fast Counter DI filter range is 0 to 12.75 millisecond (in 0.05 mS steps).

Event Time Tagging

Each DI can be set in the user application program's I/O link table to trigger recording of time tagged events upon any input change of state. The time tagged events are recorded in the CPU memory and can be retrieved for various purposes.

Keep Last Value (KLV) and Predefined Value (PDV)

Each input can be configured to KLV or to a PDV (0, 1). This value is shown to the user application program in the event of DI module failure. The PDV can also be used during normal operation to force a value that masks the actual input value. In this case the user program will get the PDV instead of the actual input value.

DI Module Configuration Options

The DI module features which can be configured are listed in the table below. Some parameters are per module and some are per input.

Table 6-1 ACE3600 DI Module Configurable Features

Feature	Parameter Settings	Default Setting	Per Module / Input	Parameter Setup Location
DC or AC operation*	AC / DC	DC	Module	STS site configuration
Fast Capture	Disabled /Enabled	Disabled	Input	STS site configuration
DI Filter (DC)	0-254 (x 0.2 mS)	50 * 0.2 mS (=10 mS)	Module	STS site configuration; 'C' User Program
Counter Filter (DC)	0-255 (x 0.05 mS)	20 * 0.2 mS (= 1 ms)	Module	STS site configuration 'C' User Program
Event Time Tagging	Disabled/ Enabled	Disabled	Input	User Program I/O link table
Keep Last Value and Predefined Value	KLV/PDV PDV=0/1	KLV	Input	User Program I/O link table
Mask	No /Yes	No	Input	User Program I/O link table

Sleep Mode

Each DI module can be switched by the user application program to Sleep Mode. In Sleep Mode, the module does not function and the power consumption is minimized. During Sleep mode, the user application program will get the predefined values (PDV) for each I/O.

* in Fast 24V IEC TYPE II modules –only DC

Module Status and Diagnostics

In the event of DI Module failure, the I/O module ERR LED will be lit. This event is registered by the CPU in the Error Logger. DI Module failure status is also visible to the user application program.

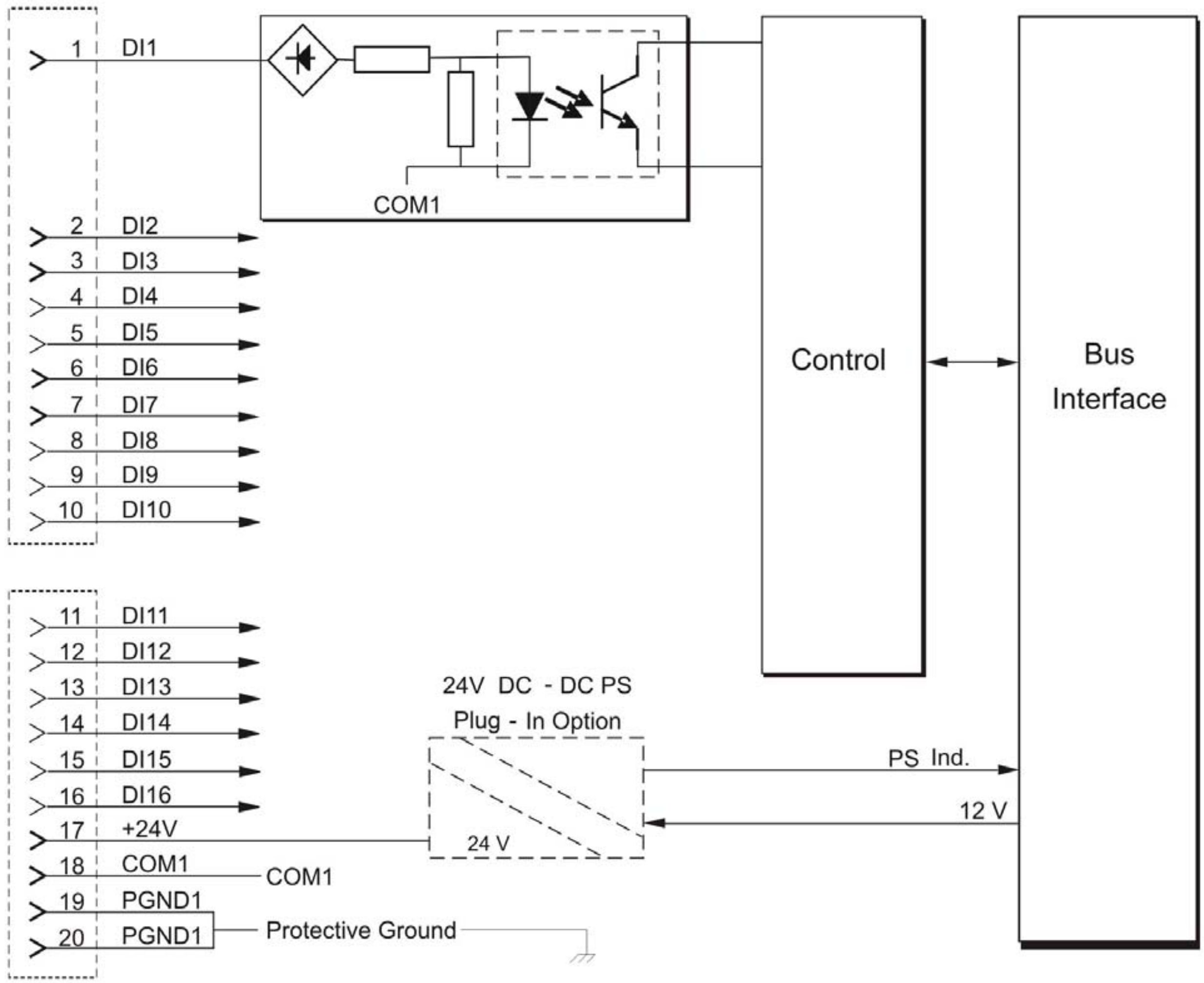
The DI module can be diagnosed and monitored using the STS Hardware Test utility. This test verifies that the module is operational, presents the module configuration and shows the actual value of each input. It is also possible to change the input filter setup temporarily for the duration of the Hardware Test.

In the Hardware Test utility, it is possible to set the DI module to Freeze Mode. In this mode the user application program will get the predefined value of each input in the module, instead of the actual input value. Freeze mode enables testing the inputs while the user application program is running.

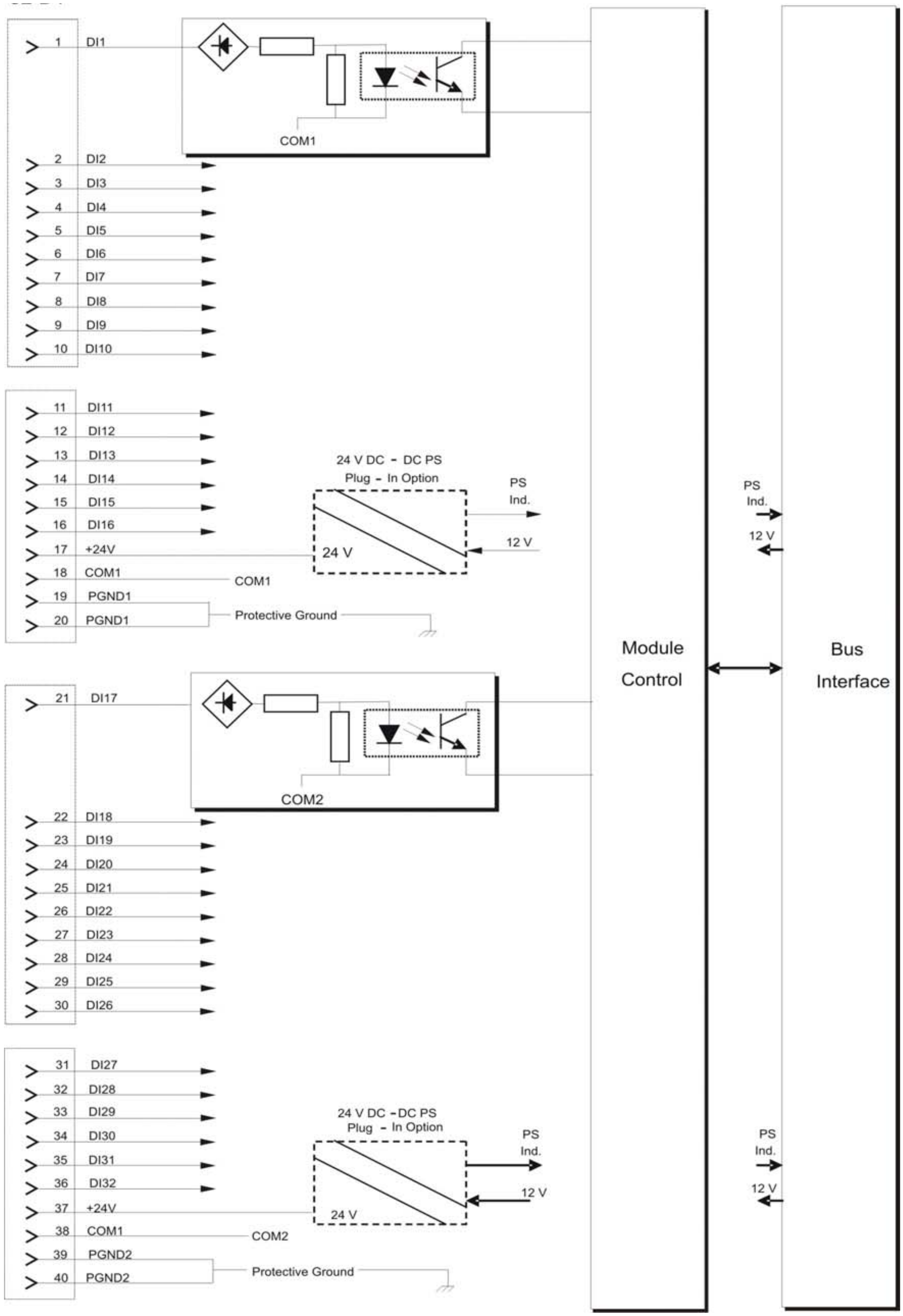
For details on configuring the DI modules, see the Site Configuration section, and the Application Programming section of the STS User Guide.

Module Block Diagram

16 DI



32 DI



1 DI1
COM1
2 DI2
3 DI3
4 DI4
5 DI5
6 DI6
7 DI7
8 DI8
9 DI9
10 DI10
11 DI11
12 DI12
13 DI13
14 DI14
15 DI15
16 DI16
17 +24V
18 COM1
19 PGND1
20 PGND1
24 V DC - DC PS
Plug - In Option
PS Ind.
12 V
24 V
COM1
Protective Ground
21 DI17
COM2
22 DI18
23 DI19
24 DI20
25 DI21
26 DI22
27 DI23
28 DI24
29 DI25
30 DI26
31 DI27
32 DI28
33 DI29
34 DI30
35 DI31
36 DI32
37 +24V
38 COM1
39 PGND2
40 PGND2
24 V DC -DC PS
Plug - In Option
PS Ind.
12 V
24 V
COM2
Protective Ground
Module Control
Bus Interface
PS Ind.
12 V
PS Ind.
12 V

Connection Charts

16 DI

Pin	Function	Pin	Function
1	DI1	11	DI11
2	DI2	12	DI12
3	DI3	13	DI13
4	DI4	14	DI14
5	DI5	15	DI15
6	DI6	16	DI16
7	DI7	17	+24V
8	DI8	18	COM1
9	DI9	19	PGND1
10	DI10	20	PGND1

32 DI

Pin	Function	Pin	Function
1	DI1	21	DI17
2	DI2	22	DI18
3	DI3	23	DI19
4	DI4	24	DI20
5	DI5	25	DI21
6	DI6	26	DI22
7	DI7	27	DI23
8	DI8	28	DI24
9	DI9	29	DI25
10	DI10	30	DI26
11	DI11	31	DI27
12	DI12	32	DI28
13	DI13	33	DI29
14	DI14	34	DI30
15	DI15	35	DI31
16	DI16	36	DI32
17	+24V	37	+24V
18	COM1	38	COM2
19	PGND1	39	PGND2
20	PGND1	40	PGND2

DI Module Specifications

16/32 DI FAST 24V Module	
Total Number of Inputs	16 DI; 32 DI
Input Arrangement	Isolated groups of 16 inputs with shared common
Fast Counter Inputs	Inputs that can be used as fast counters: - All inputs in 16 DI module; - First 20 inputs in 32 DI module
AC Input Frequency	45 – 65 Hz
AC Input Delay	Maximum 0.2 mS
Fast Counter Input Frequency	0 - 12.5 KHz, minimum pulse width 40 µS
Max. DC Input Voltage	Max. ±40 V DC (relative to input common)
“ON” DC Voltage Range	+9 to +30 V DC, -30 to -9 V DC
“OFF” DC Voltage Range	-3 to +3 V DC
“ON” AC Voltage Range	10 to 27 V AC (RMS)
“OFF” AC Voltage Range	0 to 5 V AC (RMS)
Input Current	Max. 2.5 mA
Fast Capture Resolution	1 mS (Interrupt upon change of state)
Event Time Tagging Resolution	1 mS (Interrupt upon change of state)
Input Filtering	0 to 50.8 mS (DC, programmable in 0.2 mSec steps)
Counter Input Filtering	0 to 12.75 mS (programmable in 0.05 mSec steps for inputs configured as high speed counters)
24 V DC Output	Supports optional isolated 24 V plug-in “Wetting” Power Supply (one in 16 DI, two in 32 DI)
Diagnostic LEDs	Status LED per each input, module error LED, 24V plug-in status LED
User Connection	2 or 4 Terminal Blocks (3.5mm pitch), Maximum 18 AWG
Cable and TB Holder	20 or 40 Wire Cable with TB Holder connector, 26 AWG wires
Module Replacement	Hot swap replacement – module extraction/insertion under voltage
Input Isolation	2.5 kV DC/AC between input and module logic per IEC255-5
Input Insulation	Insulation resistance 100 MΩ @ 500 V DC, Insulation impulse 5 kV per IEC255-5
Operating Voltage	10.8-16 V DC and 3.3 V DC (from the motherboard connector)
Power Consumption (measured at power supply in)	16 DI: 0.32 W typical with all LEDs on (23 mA @ 13.8 VDC) 32 DI: 0.55 W typical with all LEDs on (40 mA @ 13.8 VDC) (Not including 24 V DC Plug-in Power Supply power consumption)
Dimensions	37 mm W x 225 mm H x 180 mm D, (1.5“ W x 8.7“ H x 7.1“ D)
Weight	16 DI: approx. 0.28 Kg (0.62 Lb); 32 DI: approx. 0.29 Kg (0.63 Lb)

16/32 DI FAST 24V IEC 61131-2 TYPE II Module	
Total Number of Inputs	16 DI 32 DI
Input Arrangement	Isolated groups of 16 inputs with shared common
Fast Counter Inputs	Inputs that can be used as fast counter: - All inputs in 16 DI module - First 20 inputs in 32 DI module
Fast Counter Input Frequency	0 - 10 KHz, minimum pulse width 50 µS
Max. DC Input Voltage	Max. ±40 V DC (relative to input common)
"ON" DC Voltage Range	+11 to +30 V DC, -30 to -11 V DC
"OFF" DC Voltage Range	-5 to +5 V DC
Input Current	6-10 mA
Fast Capture Resolution	1 mS (Interrupt upon change of state)
Event Time Tagging Resolution	1 mS (Interrupt upon change of state)
Input Filtering	0 to 50.8 mS (DC, programmable in 0.2 mSec steps)
Counter Input Filtering	0 to 12.75 mS (programmable in 0.05 mSec steps for inputs configured as high speed counter)
24V DC Output	Supports optional isolated 24 V plug-in "Wetting" Power Supply (one in 16 DI, two in 32 DI)
Diagnostic LEDs	Status LED per each input, module error LED, 24V Plug-in status LED
User Connection	2 or 4 Terminal Blocks (3.5mm pitch), Maximum 18 AWG
Cable and TB Holder	20 or 40 Wire Cable with Terminal Block Holder connector, 26 AWG wires
Module Replacement	Hot swap replacement – module extraction/insertion under voltage
Input Isolation	2.5 kV DC/AC between input and module logic per IEC255-5
Input Insulation	Insulation resistance 100 MΩ @ 500 V DC, Insulation impulse 5 kV per IEC255-5
Operating Voltage	10.8-16 V DC and 3.3 V DC (from the motherboard connector)
Power Consumption (measured at power supply in)	16 DI: 0.32 W typical with all LEDs on (23 mA @ 13.8 VDC) 32 DI: 0.55 W typical with all LEDs on (40 mA @ 13.8 VDC) (Not including 24 V DC Plug-in Power Supply power consumption)
Dimensions	37 mm W x 225 mm H x 180 mm D, (1.5" W x 8.7" H x 7.1" D)
Weight	16 DI: approx. 0.28 Kg (0.62 lb) 32 DI: approx. 0.29 Kg (0.63 lb)

Specifications subject to change without notice.

DIGITAL OUTPUT/DIGITAL INPUT FET MODULE

General Description

The Digital Output/Digital Input (DO/DI) FET module has 16 or 32 configurable user connections, organized in four groups. Each group can be configured as an 8 DO group or as an 8 DI group.

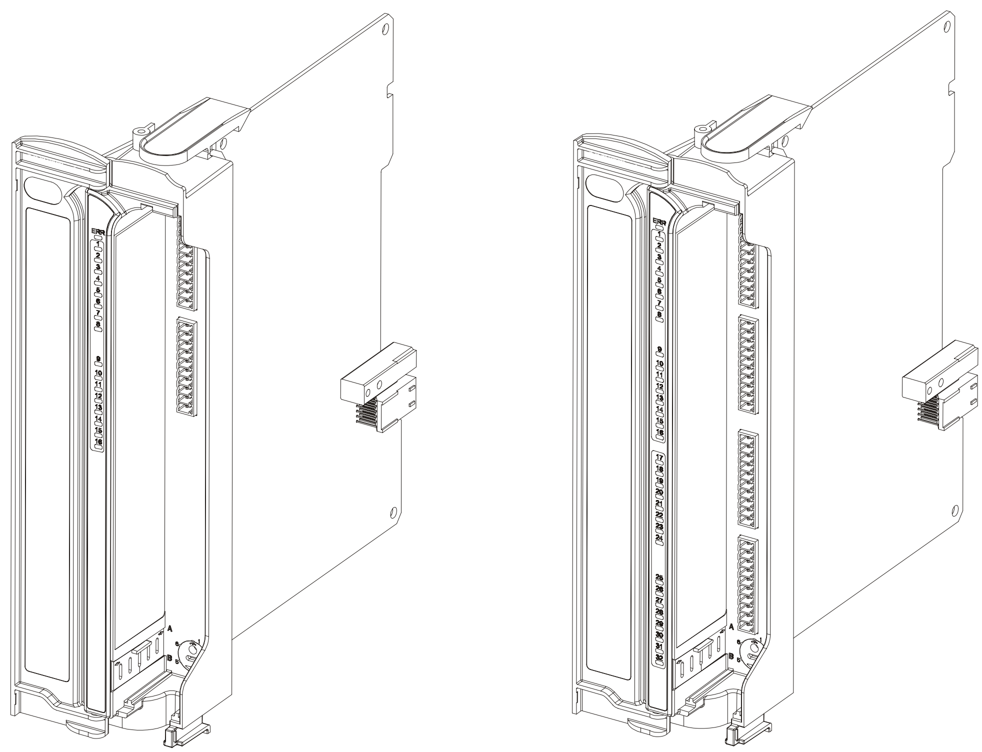
The following Digital Output/Digital Input (DO/DI) FET modules are available.

- 16 (DO/DI) FET
- 32 (DO/DI) FET

The outputs are optically isolated current sink FET type with back indication. The inputs are optically isolated Dry Contact type with internal “wetting” voltage.

For a description of I/O module construction, location, LEDs, TBs, and other common I/O module features, see the I/O Modules chapter above.

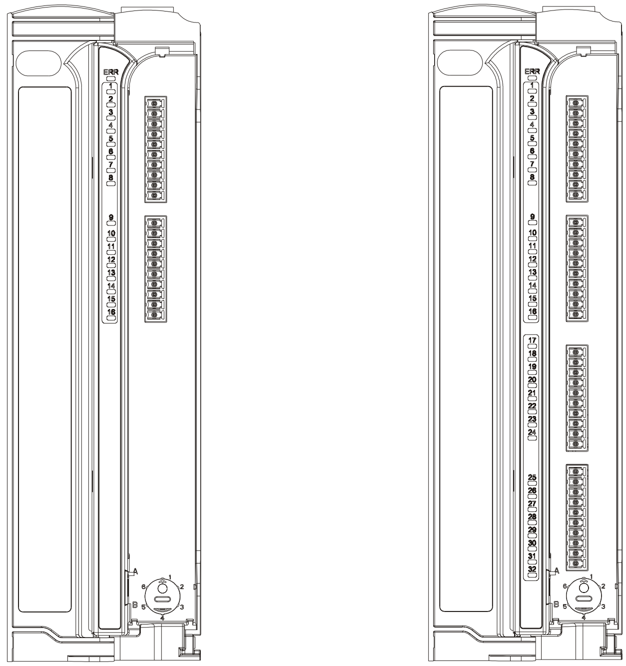
Figure 7-1 provides a general view of the ACE3600 DO/DI FET module.



16 DO/DI FET Module **32 DO/DI FET Module**

Figure 7-1 ACE3600 DO/DI FET Module – General View

Figure 7-2 provides a detailed view of the ACE3600 DO/DI FET module front panel.



16 DO/DI FET Module **32 DO/DI FET Module**

Figure 7-2 ACE3600 DO/DI FET Module – Front Panel

Module Configuration

Input/Output

The following combinations can be configured in the STS site configuration (16 DO/DI).

I/O combination	DI location	DO location
16DO	-	1-16
8DI + 8DO	1-8	9-16
16DI	1-16	-

The following combinations can be configured in the STS site configuration (32 DO/DI).

I/O combination	DI location	DO location
32DO	-	1-32
8DI + 24DO	1-8	9-32
16DI + 16DO	1-16	17-32
24DI + 8DO	1-24	25-32
32DI	1-32	-

The appropriate combination is selected as the I/O module type, when configuring the I/Os in the ACE3600 STS site configuration.

DI Fast Capture

Each DI can be configured as Fast Capture DI in the STS advanced I/O configuration. Fast capture causes the SCAN ladder output operation to get the first change that occurred since the previous scan. When fast capture is disabled (default), the scan gets the current value of the DI (in this case DI changes between scans are missed).

DI Input Filters

Each inputs has a hardware input filter to make sure that the input reading is stable. The hardware DI filter range is 0 to 50.8 mS (in 0.2 mS steps). Counter DI filter range is 0 to 12.75 mS (in 0.05 mS steps). The DI filter can be set in the STS advanced I/O configuration.

DI Event Time Tagging

Each DI can be set in the Application Programmer I/O link table to trigger recording of time tagged events upon any input change of state. The time tagged events are recorded in the CPU memory and can be retrieved for various purposes.

DI Keep Last Value (KLV) and Predefined Value (PDV)

Each input can be configured to KLV or to a PDV (0, 1) in the Application Programmer I/O link table. This value is shown to the user application program in the event of DI module failure. Also, the predefined value can be used during normal operation to force a value that masks the actual input value. In this case the user application program will get the PDV instead of the actual input value.

DO Keep Last Value (KLV) and Predefined Value (PDV)

Each output can be configured to KLV or to a PDV (0, 1). This value is executed when the user application program stops or when the module has no communication with the CPU module. Also, the predefined value can be used during normal operation to force a value on the output by ignoring the user application program value.

DO/DI FET Module Configuration Options

The DO/DI FET module features which can be configured are listed in the table below. Some parameters are per module and some are per input.

Table 7-1 ACE3600 DO/DI FET Module Configurable Features

Parameter	Selection	Default Setup	Per Module/ Input	Parameter Setup Location
DI Fast Capture	Disabled /Enabled	Disabled	Input	RTU configuration
DI Filter	0-254 (x 0.2 mS)	50 * 0.2 mS (=10 mS)	Module	RTU configuration; 'C' Program
DI Counter Filter	0-255 (x 0.05 mS)	20 * 0.2 mS (= 1 ms)	Module	RTU configuration; 'C' Program
DI Event Time Tagging	Disabled /Enabled	Disabled	Input	Application Programmer I/O link table
DI Keep Last Value & Predefined Value	KLV/PDV PDV = 0/1	KLV	Input	Application Programmer I/O link table
DI Mask	No /Yes	No	Input	Application Programmer I/O link table
DO Keep Last Value & Predefined Value	KLV/PDV PDV = 0/1	KLV	Output	Application Programmer I/O link table
DO Mask	No /Yes	No	Output	Application Programmer I/O link table

Sleep Mode

Each DO/DI module can be switched by the user application program to Sleep Mode. In Sleep Mode, the module does not function and the power consumption is minimized. During Sleep mode, the user application program will get the KLV or PDV per each DI.

Module Status and Diagnostics

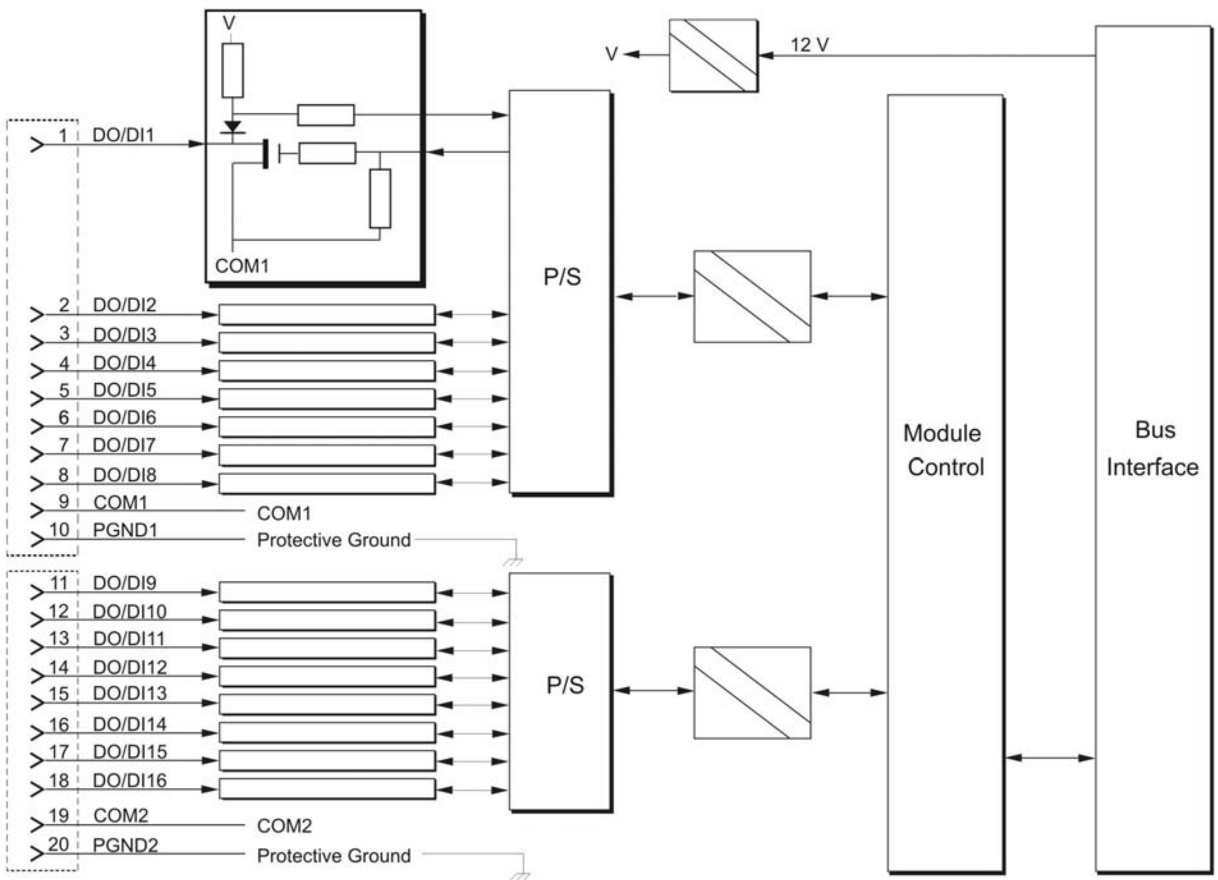
In the event of a DO/DI module failure, the ERR LED on the module will be lit. This event is registered by the CPU in the Error Logger. DO/DI module failure status is also visible to the user application program.

The DO/DI module can be diagnosed and monitored using the STS Hardware Test utility. The Hardware Test verifies that the module is operational, presents the module configuration and shows the actual value of each input and output. It is also possible to change the input filter setup for the duration of the Hardware test and change the value of the DOs.

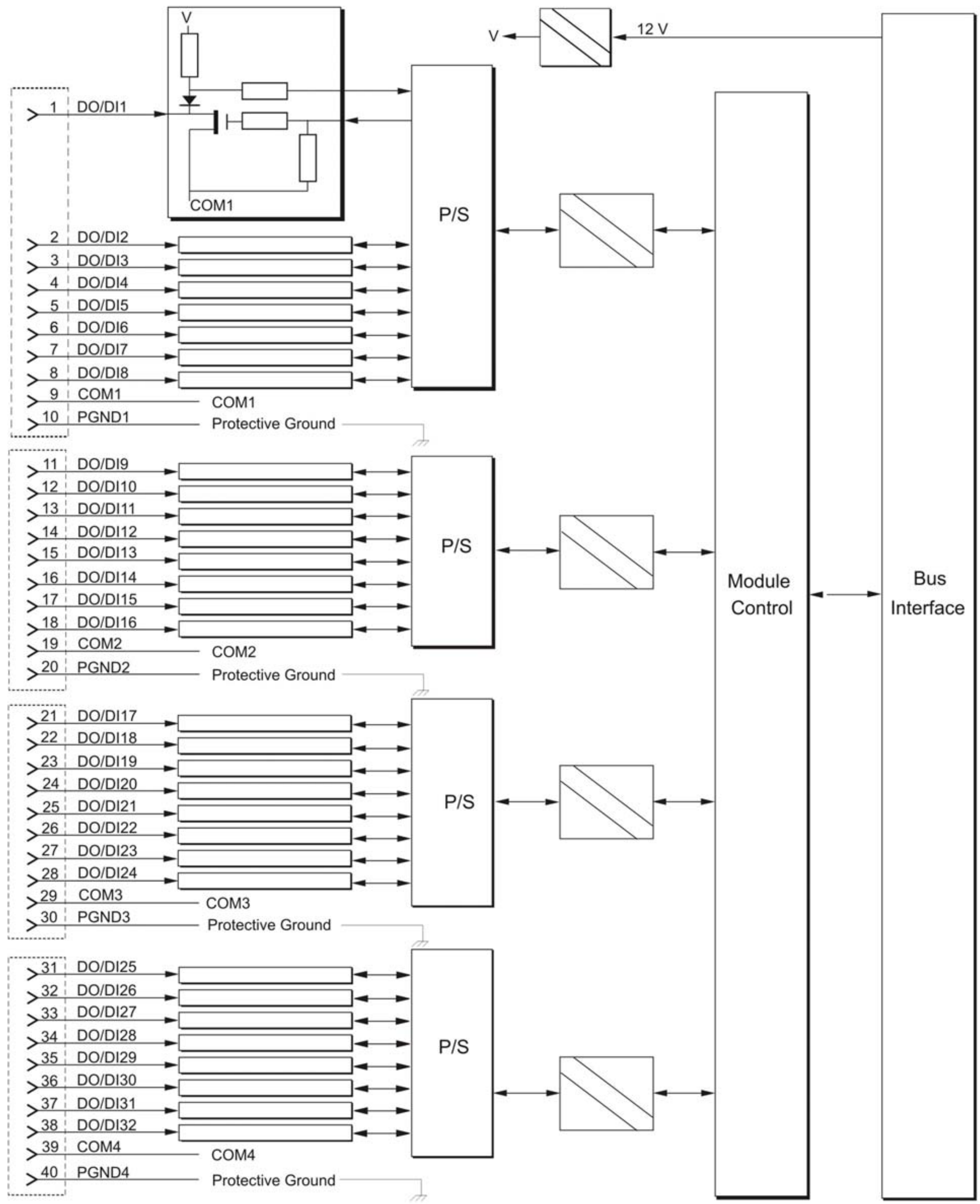
In the Hardware Test utility, it is possible to set the module to Freeze Mode. In this mode the user application program will get the KLV/PDV of each input in the module instead of the actual input value. The DO values will keep the last value they had when the module was switched to Freeze Mode. Freeze mode enables testing the inputs and outputs while the user application program is running.

Module Block Diagram

16 DO/DI FET



32 DO/DI FET



V
V
12 V
1 DO/DI1
COM1
P/S
2 DO/DI2
3 DO/DI3
4 DO/DI4
5 DO/DI5
6 DO/DI6
7 DO/DI7
8 DO/DI8
9 COM1
COM1
10 PGND1
Protective Ground
11 DO/DI9
12 DO/DI10
13 DO/DI11
14 DO/DI12
15 DO/DI13
16 DO/DI14
17 DO/DI15
18 DO/DI16
19 COM2
COM2
20 PGND2
Protective Ground
P/S
Module
Control
Bus
Interface
21 DO/DI17
22 DO/DI18
23 DO/DI19
24 DO/DI20
25 DO/DI21
26 DO/DI22
27 DO/DI23
28 DO/DI24
29 COM3
COM3
30 PGND3
Protective Ground
P/S
31 DO/DI25
32 DO/DI26
33 DO/DI27
34 DO/DI28
35 DO/DI29
36 DO/DI30
37 DO/DI31
38 DO/DI32
39 COM4
COM4
40 PGND4
Protective Ground
P/S

Connection Charts

16 DO/DI FET

Pin	Function	Pin	Function
1	DO/DI1	11	DO/DI9
2	DO/DI2	12	DO/DI10
3	DO/DI3	13	DO/DI11
4	DO/DI4	14	DO/DI12
5	DO/DI5	15	DO/DI13
6	DO/DI6	16	DO/DI14
7	DO/DI7	17	DO/DI15
8	DO/DI8	18	DO/DI16
9	COM1	19	COM2
10	PGND1	20	PGND2

32 DO/DI FET

Pin	Function	Pin	Function
1	DO/DI1	21	DO/DI17
2	DO/DI2	22	DO/DI18
3	DO/DI3	23	DO/DI19
4	DO/DI4	24	DO/DI20
5	DO/DI5	25	DO/DI21
6	DO/DI6	26	DO/DI22
7	DO/DI7	27	DO/DI23
8	DO/DI8	28	DO/DI24
9	COM1	29	COM3
10	PGND1	30	PGND3
11	DO/DI9	31	DO/DI25
12	DO/DI10	32	DO/DI26
13	DO/DI11	33	DO/DI27
14	DO/DI12	34	DO/DI28
15	DO/DI13	35	DO/DI29
16	DO/DI14	36	DO/DI30
17	DO/DI15	37	DO/DI31
18	DO/DI16	38	DO/DI32
19	COM2	39	COM4
20	PGND2	40	PGND4

DO/DI FET Module Specifications

Total Number of I/Os	16; 32
I/O Arrangement	Two or four group of 8 I/Os with shared common Each group can be configured as FET DO or dry contact DI. Selectable combinations (32 DO/DI): 32 DO/8 DI+24 DO/ 16 DI+16 DO/24 DI+8 DO/32 DI Selectable combinations (16 DO/DI): 16 DO/8 DI+8 DO/16 DI+16 DI
Counter Inputs	20 first inputs can be used as counter inputs
Counter Input Frequency	0 - 1 KHz, minimum pulse width 500 µS. Note: Although filters are defined in steps of 0.2mSec and 0.05mSec, it is relevant only from 1mSec and above.
Max. DC Input Voltage	Max. 30 V DC (relative to input common)
Input "ON" Resistance	0-4 kΩ
Input "OFF" Resistance	≥50 kΩ
Fast Capture Resolution	1 mS (Interrupt upon change of state)
Event Time Tagging Resolution	1 mS (Interrupt upon change of state)
Input Current	Max. 0.3 mA (when the input is shorted)
Input Filtering	0 to 50.8 mS (programmable in 0.2 mSec steps), relevant only from 1mSec
Counter Input Filtering	0 to 12.75 mS (programmable in 0.05 mSec steps), relevant only from 1mSec
Output Type	MOSFET
Output Voltage Range	5-30 V DC (user supplied voltage)
DO Frequency	Max. 1 KHz (resistive load)
DO Output Current	Max. 500 mA sink current (resistive load)
Output Fail State	Configurable output state on CPU fail: On, Off or 'last value'
Diagnostic LEDs	LED per each input / output status, module error LED
User Connection	4 Terminal Blocks (3.5mm pitch), Maximum 18 AWG
Cable and TB Holder	20 or 40 Wire Cable with Terminal Block Holder connector, 26 AWG
Module Replacement	Hot swap replacement– module extraction / insertion under voltage
Input / Output Isolation	2.5 kV between input/output and module logic
Input Insulation	Insulation resistance 100 MΩ @ 500 V DC per IEC255-5
Operating Voltage	10.8-16 V DC and 3.3 V DC (from the motherboard connector)
Power Consumption (measured at power supply in)	16 DO/DI: 0.55 W typical with all LEDs/all outputs on (40 mA @ 13.8 VDC) 32 DO/DI: 1 W typical with all LEDs/all outputs on (72 mA @ 13.8 VDC)
Dimensions	37 mm W x 225 mm H x 180 mm D (1.5" W x 8.7" H x 7.1" D)

Weight	Approx. 0.25 Kg (0.55 Lb)

Specifications subject to change without notice.

DIGITAL OUTPUT RELAY MODULE

General Description

The DO Relay modules have 8 or 16 outputs.

There are two types of DO relays:

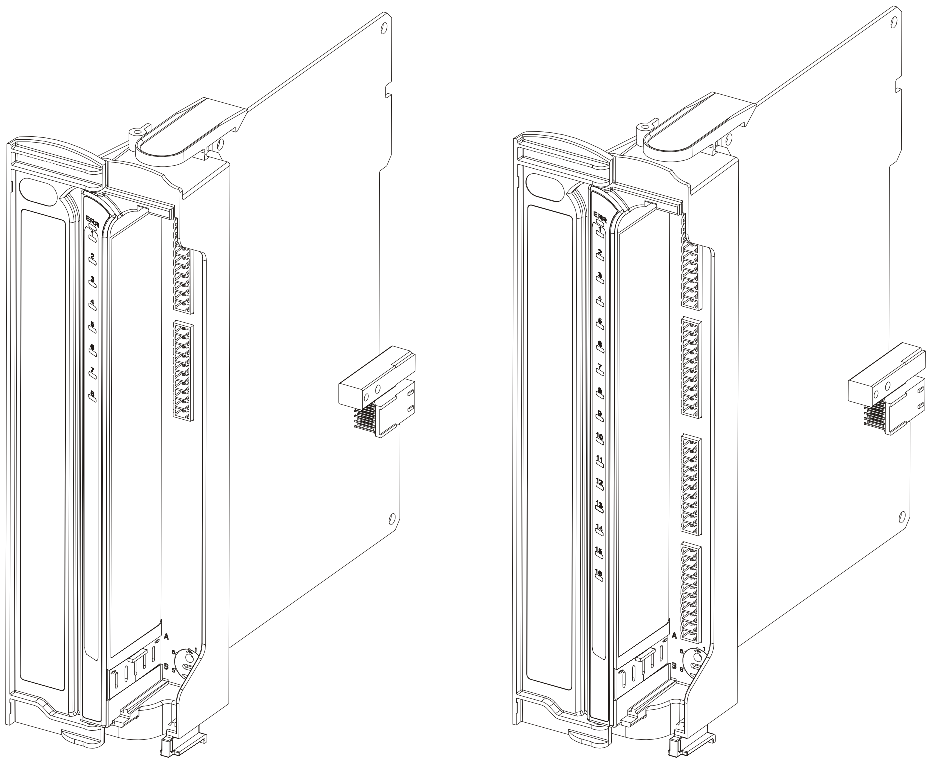
- Electrically Energized (EE) - the outputs return to the non-energized state in case of power off or module failure.
- Magnetically Latched (ML) - Relay outputs are magnetically latched, the outputs maintain their state in case of power off or module failure.

The following DO relays modules are available:

- 8 DO EE Relay 2A
- 16 DO EE Relay 2A
- 8 DO ML Relay 2A
- 16 DO ML Relay 2A

For a description of I/O module construction, location, LEDs, TBs, and other common I/O module features, see the I/O Modules chapter above.

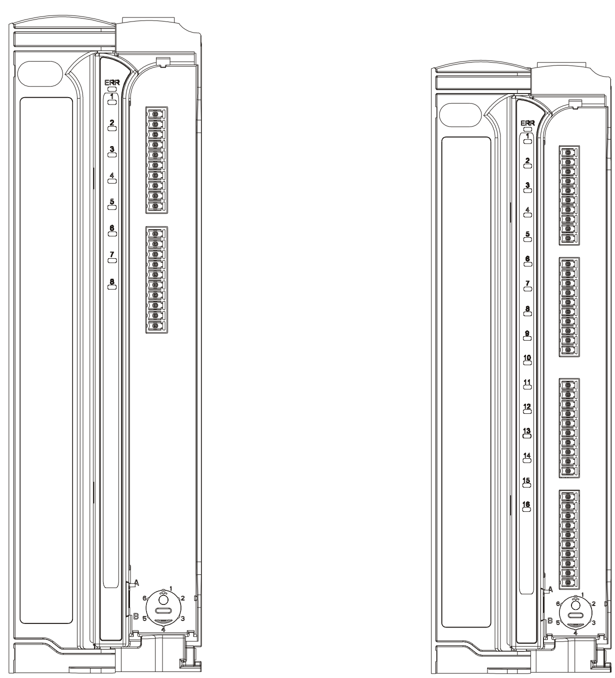
Figure 8-1 provides a general view of the ACE3600 DO Relay Module.



8DO Relay **16 DO Relay**

Figure 8-1 ACE3600 DO Relay Module – General View

Figure 8-2 provides a detailed view of the ACE3600 DO Relay Module front panel.



8DO Relay **16DO Relay**

Figure 8-2 ACE3600 I/O Module – Front Panel

In the 8 DO modules, the relays of outputs 1 through 5 are Single Pole Single Throw (SPST) normally open (NO) and are referred to as the “Form A” relays. The relays of outputs 6 through 8 are Single Pole Double Throw (SPDT) and are referred to as the “Form C” relays.

In the 16 DO modules, the relays of outputs 1 through 5 and 9 through 13 are Single Pole Single Throw (SPST) normally open (NO) “Form A” relays. The relays of outputs 6 through 8 and 14 through 16 are Single Pole Double Throw (SPDT) “Form C” relays.

The physical position of each relay is monitored by the module logic, using a back indication signal which is connected to the relay’s second contact set. Any contradiction between the required position and the back indication signal is reported to the CPU and is available to the user program.

In some applications it is necessary to inhibit relay output operation when attending the site for safety reasons. In all DO relay modules, it is possible to inhibit all relays per DO module. When a module is configured to enable relay inhibiting, the power to the relays is provided from the power supply via a dedicated power line (12V DO), controlled from the “12V DO” input (TB located on the power supply module panel). When the input’s terminals are shorted, the relays are operational. When the input’s terminals are open, the relays are inhibited (EE relays in 0 position and ML relays do not change state.)

The user program can monitor the relay inhibiting status and act accordingly. Also, when the module’s relays are inhibited, any mismatch between the relay position and the output logical state is ignored.

Module Configuration

Relay Inhibiting

NOTE

When the dipswitch is set to 12V DO, the position of the 2-pin 12V DO Control connector on the front panel of the power supply module (see Power Supply Module chapter above) acts as a safety mechanism. When the 2-pin TB is unplugged from the 12V DO Control (e.g. for maintenance), power is not supplied via the motherboard to the relays and the relays are disabled. The 12V DO affects all relays in the system that are programmed to work from the 12V DO and not the (default) 12V Main.

EE relays that are programmed for 12V DO operation will disconnect when 12V DO power is shut down and cannot be changed in this state.
ML relays that are programmed for 12V DO operation will freeze in their current state when 12V DO power is shut down and cannot be changed. Therefore, setting the dipswitch for ML will not necessarily inhibit them.

A dual selector dipswitch (S3) on the DO Relay module has 4 selectable positions as described in the following table:

Table 8-1 DO Relay Module- Dipswitch Settings

S3 SW 1	**S3 SW 2**	**Configuration mode**
OFF	OFF	12V_DO – Relay inhibiting enabled
ON	OFF	Software selectable – inhibiting is set in site configuration
OFF	ON	12V_DO – Relay inhibiting enabled
ON	ON	12 V – (factory default) Relay inhibiting disabled

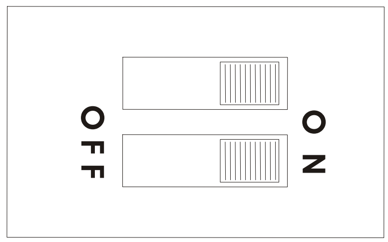


Figure 8-3 12V DO Dipswitch

When S3 is set to Software Selectable mode, the inhibiting configuration is set using the module configuration in the STS Site Configuration (see Table 8-2 below).

Procedure 8-1 describes how to set the 12V DO dipswitch to enable relay inhibiting.

Procedure 8-1 How to Set the 12V DO Dipswitch to Enable Relay Inhibiting.

1) If the 2-pin TB is plugged into the 12V DO Control on the front panel of the power supply module, unplug it.
2) Remove the DO module from the slot in the rack.
3) Carefully remove the plastic wrap covering from the S3 dipswitch (see Figure 8-3) on the DO module board. Note: Ignore text on the board that OFF/OFF is the factory default.
4) Set the S3 dipswitch to the desired position, according to the legend in Table 8-1.
5) Replace the DO module in the rack.
6) If the new dipswitch position causes DO relay power to be drawn from the 12VDO, plug the 2-pin TB back into the 12V DO Control on the front panel of the power supply module.

DO Keep Last Value (KLV) and Predefined Value (PDV)

Each output can be configured to KLV or to a PDV (0, 1). This value is executed when the user program stops or when the module has no communication with the CPU module. Also, the PDV can be used during normal operation to force a value on the output by ignoring the user program value (mask).

Reset DO at Startup

It is possible to configure the module to reset all the ML relays positions on startup. This is set in the STS site configuration.

Table 8-2 ACE3600 DO Relay Module Configurable Features

Parameter	Selection	Default Setup	Per Module/ Input	Parameter Setup Location
DO Keep Last Value & Pre Defined Value	KLV/PDV PDV = 0/1	KLV	Output	Application Programmer I/O link table
DO Mask	No /Yes	No	Output	Application Programmer I/O link table
Reset DO at Startup	Disable/Enable	Disable	Module	Site configuration
Relay Inhibiting (SW selectable)	Disable/Enable	Disable	Module	Site configuration

Sleep Mode

Each DO module can be switched by the user program to Sleep Mode. In Sleep Mode, the module is not functioning and the power consumption is minimized.

Module Status and Diagnostics

In the event of module failure, the module's ERR LED will be lit. This event is registered by the CPU in the Error Logger. Module failure status is also visible to the user program.

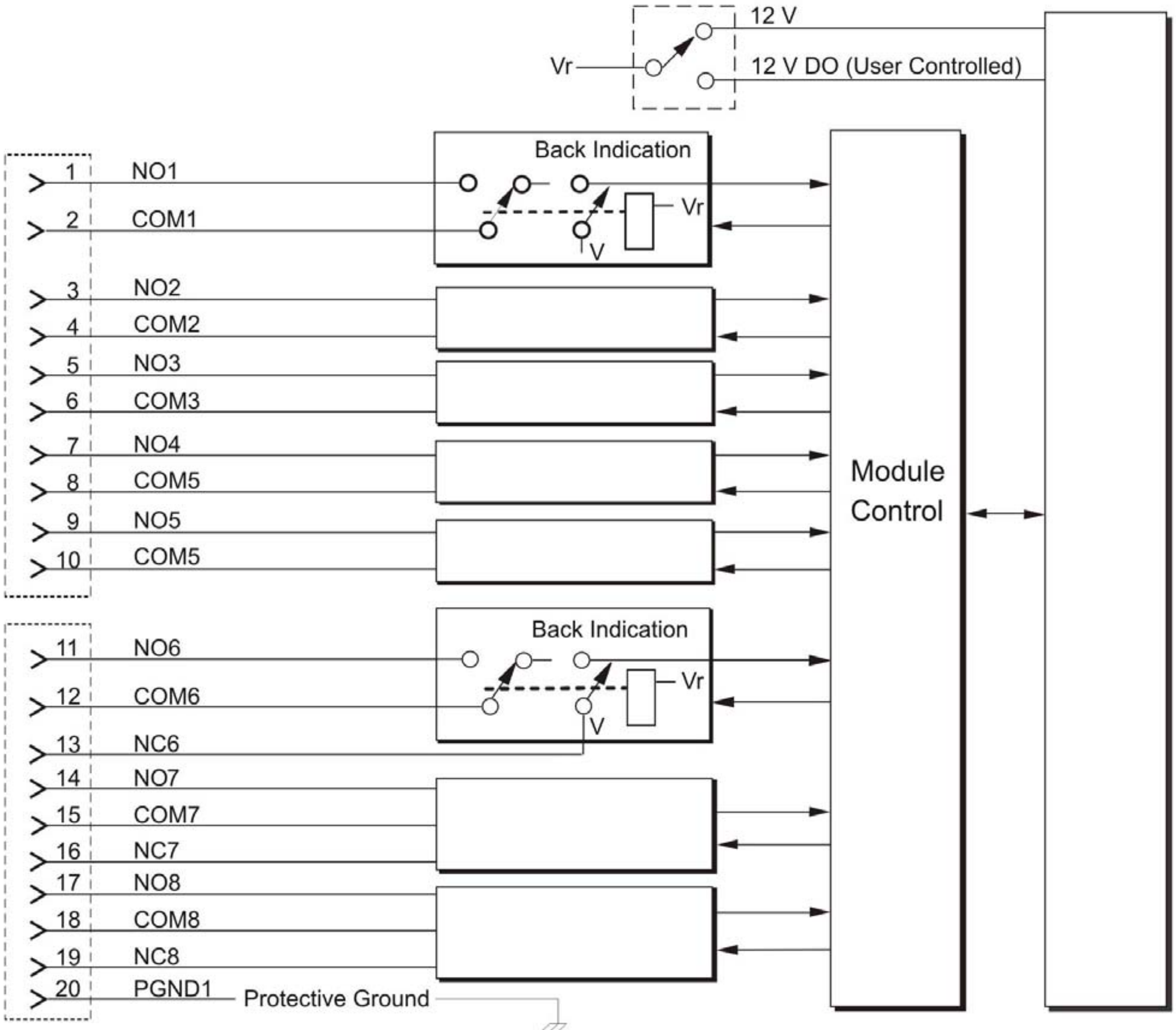
The DO module can be diagnosed and monitored using the STS Hardware Test utility. This test verifies that the module is operational, presents the module configuration and shows the actual value of each output. It is also possible to change the DO's value.

In the Hardware Test utility, it is possible to set the module to Freeze Mode. In this mode, the DOs will keep the last value they had at the time they were frozen. Freeze mode enables testing the inputs and outputs while the user program is running.

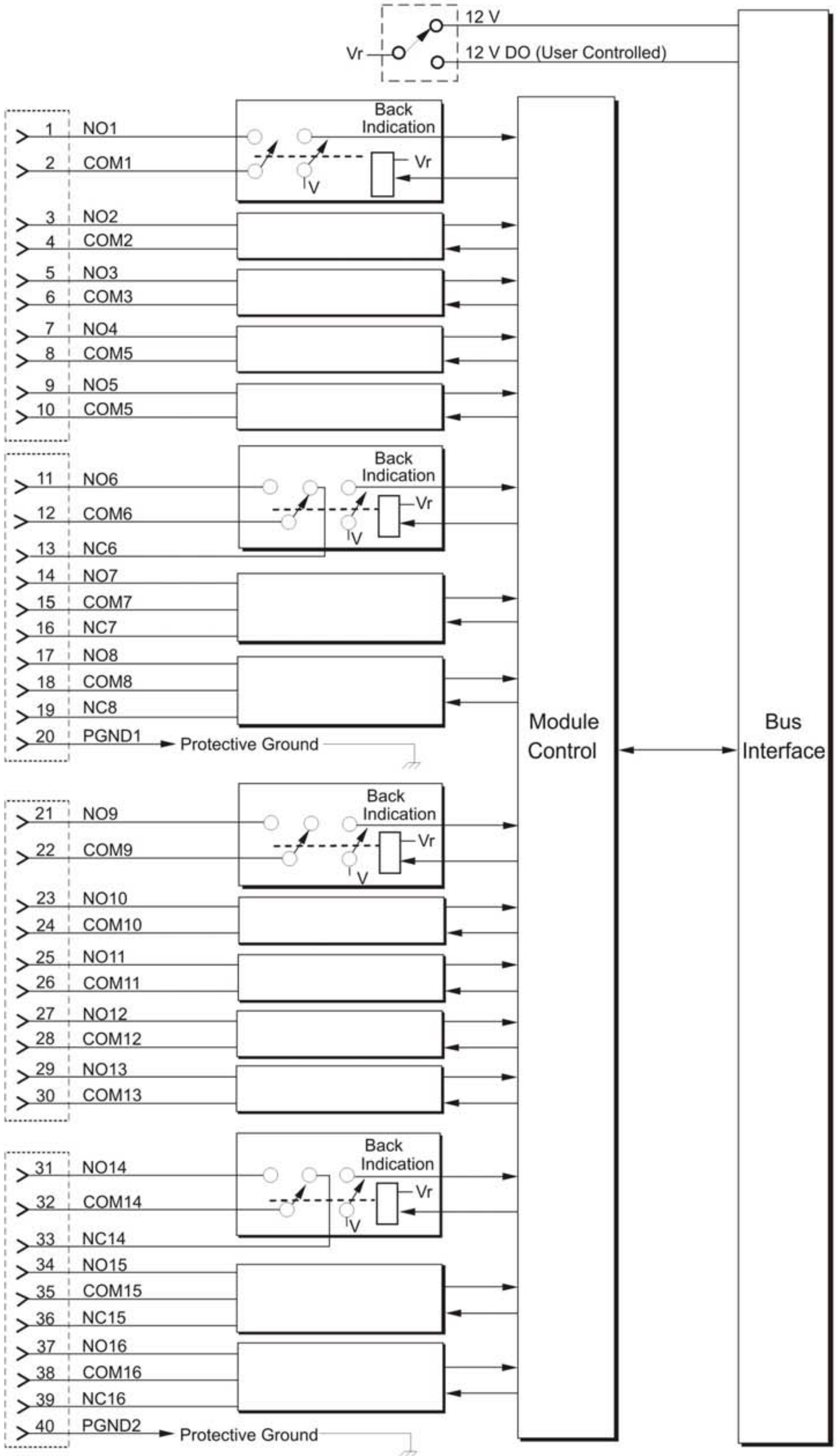
For details on configuring the DO modules, see the Configuring a Site section and the Application Programmer section of the ACE3600 STS User Guide.

Module Block Diagram

8 DO



16 DO


12 V
Vr
12 V DO (User Controlled)
Back Indication
Vr
V
1 NO1
2 COM1
3 NO2
4 COM2
5 NO3
6 COM3
7 NO4
8 COM5
9 NO5
10 COM5
11 NO6
12 COM6
13 NC6
14 NO7
15 COM7
16 NC7
17 NO8
18 COM8
19 NC8
20 PGND1
Protective Ground
21 NO9
22 COM9
23 NO10
24 COM10
25 NO11
26 COM11
27 NO12
28 COM12
29 NO13
30 COM13
31 NO14
32 COM14
33 NC14
34 NO15
35 COM15
36 NC15
37 NO16
38 COM16
39 NC16
40 PGND2
Protective Ground
Module Control
Bus Interface

Connection Charts

8 DO

Pin	Function	Pin	Function
1	NO1	11	NO6
2	COM1	12	COM6
3	NO2	13	NC6
4	COM2	14	NO7
5	NO3	15	COM7
6	COM3	16	NC7
7	NO4	17	NO8
8	COM4	18	COM8
9	NO5	19	NC8
10	COM5	20	PGND1

16 DO

Pin	Function	Pin	Function
1	NO1	21	NO9
2	COM1	22	COM9
3	NO2	23	NO10
4	COM2	24	COM10
5	NO3	25	NO11
6	COM3	26	COM11
7	NO4	27	NO12
8	COM4	28	COM12
9	NO5	29	NO13
10	COM5	30	COM13
11	NO6	31	NO14
12	COM6	32	COM14
13	NC6	33	NC14
14	NO7	34	NO15
15	COM7	35	COM15
16	NC7	36	NC15
17	NO8	37	NO16
18	COM8	38	COM16
19	NC8	39	NC16
20	PGND1	40	PGND2

DO Relay Module Specifications

Total Number of Outputs	8 EE relay outputs 16 EE relay outputs 8 ML relay outputs 16 ML relay outputs
Output Arrangement	8 DO : 3 X Form C (SPDT) and 5 X Form A (SPST) 16 DO: 6 X Form C (SPDT) and 10 X Form A (SPST)
Contact Voltage Ratings	Max. 60 V DC or 30 V AC RMS (42.4 V peak).
Contact Power Ratings	2A @ 30 V DC, 0.6A @ 60V DC or 0.6A @ 30V AC (resistive load)
Relay Back Indication	Contact position - hardware back indication
DO Frequency	Max. 10 Hz
Diagnostic LEDs	LED per each output status, module error LED
User Connection	2 or 4 Terminal Blocks (3.5mm pitch), Maximum 18 AWG
Cable and TB Holder	20 or 40 Wire Cable with Terminal Block Holder connector, 26 AWG
Fail State	Configurable relay state on CPU fail: On, Off or 'last value'
All Relays Disable/Enable	Selectable per module, controlled from the power supply
Module Replacement	Hot swap replacement – module extraction/insertion under voltage
Output Isolation	Between open contacts: 1kV, Between contact and coil: 1.5 kV, Between contact sets: 1.5 kV
Insulation	Insulation resistance 100 MΩ @ 500 V DC per IEC255-5, Insulation impulse 1.5 kV between input and logic
Operating Voltage	10.8-16 V DC and 3.3 V DC (from the motherboard connector)
Power Consumption (measured at power supply in)	8 DO: 0.2 W typical when all LEDs on/all relays off (14 mA @ 13.8 VDC) 16 DO: 0.3 W typical when all LEDs on/all relays off (22 mA @ 13.8 VDC) For each EE Relay on: 0.2 W typical (15 mA @ 13.8 VDC)
Dimensions	37 mm W x 225 mm H x 180 mm D (1.5" W x 8.7" H x 7.1" D)
Weight	8 DO : approx. 0.29 Kg (0.64 Lb) 16 DO: approx. 0.32 Kg (0.7 Lb)

Specifications subject to change without notice.

ANALOG INPUT MODULE

General Description

The Analog Input (AI) modules have 8 or 16 inputs. The modules sample and convert analog data into digital format and transfer the digital data to the CPU module.

The following modules are available:

- 8 AI ±20 mA (supports 4-20 mA)
- 16 AI ±20 mA (supports 4-20 mA)
- 8 AI ±5 V (supports 0-5 V and 1-5 V)
- 16 AI ±5 V (supports 0-5 V and 1-5 V)

The module’s analog-to-digital conversion resolution is 16 bit (including sign). Each input is fully isolated from the other inputs on the module and also optically isolated from the module internal circuits. The modules are fully calibrated and can be tested and recalibrated in the field.

The measured values are digitally filtered to reduce the 50 or 60 Hz noise. The user can select the filtering frequency per module.

The measured values can be smoothed by digital filtering. Smoothing is accomplished by calculating the running average values of a defined number of converted analog values (samples). The user can select the level of smoothing per module. The higher the smoothing level chosen, the more stable is the smoothed analog value and the longer it takes until the smoothed analog signal is applied after a step response.

The user can select how the analog values are represented to the user application program as unit-less numeric values or as scaled values that represent certain Engineering Units (EGU).

Each AI module can include an optional plug-in floating 24V DC power supply to power external devices.

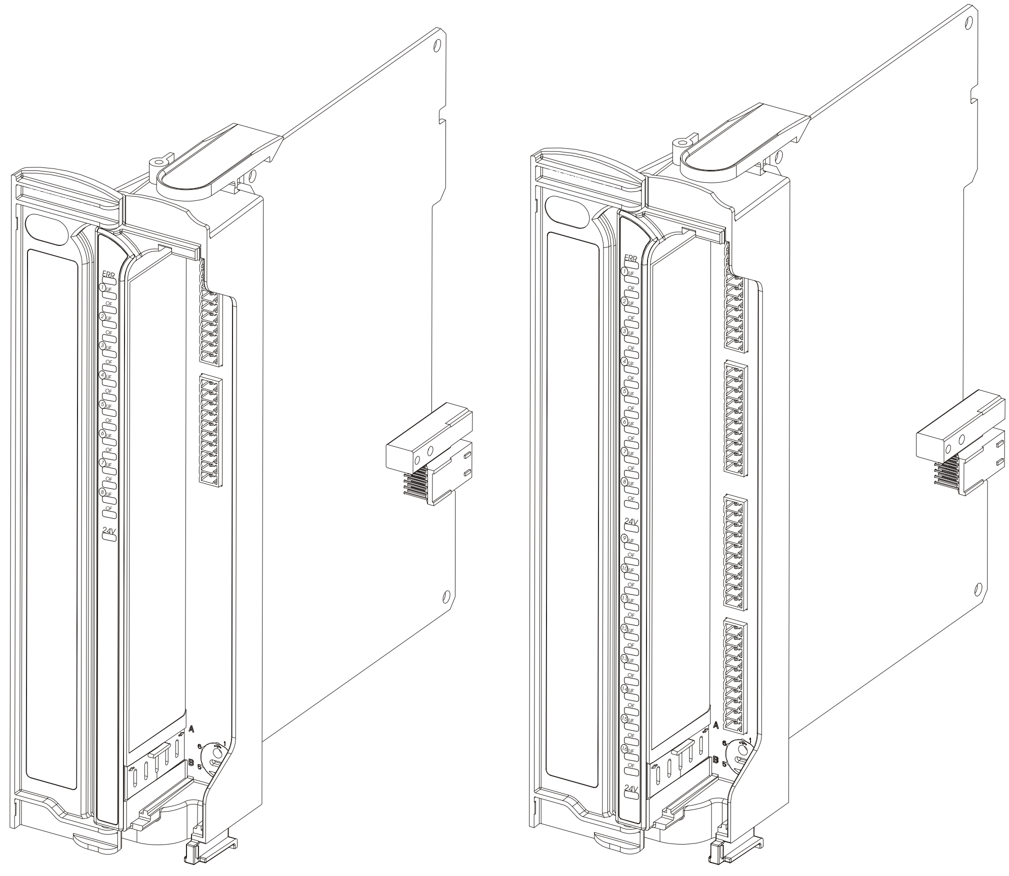
Each analog input has two status LEDs:

- UF - indicates Underflow when lit
- OF - indicates Overflow when lit

For a description of I/O module construction, location, LEDs, TB holder, and other common I/O module features, see the I/O Modules chapter above.

For details on specific AI parameters and configuration, see AI Module Configuration below.

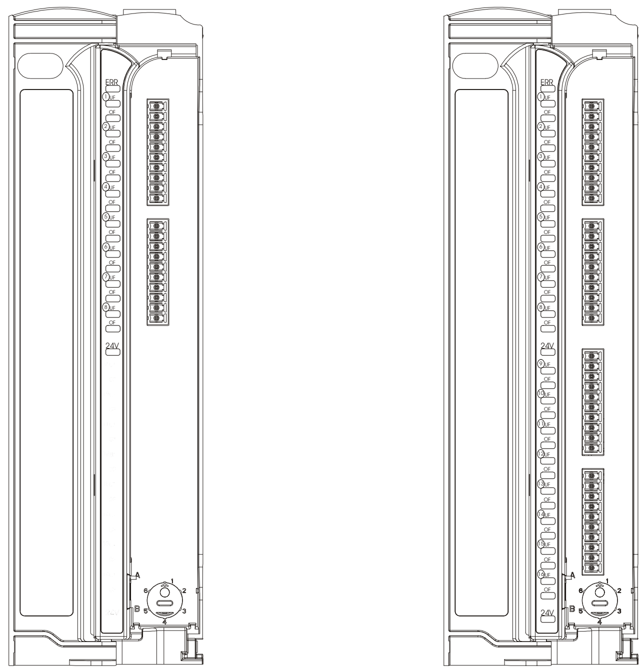
Figure 9-1 provides a general view of the ACE3600 AI module.



8 AI Module 16 AI Module

Figure 9-1 ACE3600 AI Module – General View

Figure 9-2 provides a detailed view of the AI module front panel.



8 AI Module **16 AI Module**

Figure 9-2 ACE3600 AI Module – Front Panel

AI Module Configuration

50/60 Hz Filtering

This parameter enables the user to configure the module to use 50 or 60 Hz filter on all inputs.

AI Filter (Smoothing)

This parameter enables the user to configure the level smoothing (averaging) on all inputs. It can be set to 1, 2, 4, 8, 16, 32, 64,128 samples.

Change Of State (COS) Delta

This parameter sets a delta value to each input. This enables the user application program to get an indication when the input value change is more than ± delta value.

Input Range

This parameter sets the overflow and underflow limits (refer to AI Module value representation below.)

In the current input modules, the ranges that can be selected are: ±20 mA (default) and 4-20 mA.

In voltage input modules, the ranges that can be selected are ± 5V (default), 0-5 V and 1-5 V.

Keep Last Value (KLV) and Predefined Value (PDV)

Each input can be configured to KLV or to a PDV. This value is shown to the user application program in the event of AI module failure. The predefined value can also be used during normal operation to force a value that masks the actual input value. In this case the user application program will get the PDV instead of the actual input value.

I/O Legacy Resolution Parameter

In systems with both ACE3600 RTUs and legacy (MOSCAD/MOSCAD-L) RTUs, some MOSCAD/MOSCAD-L applications can be upgraded to ACE3600 without modifying the references to analog values in the applications ('C' or ladder). The I/O Legacy Resolution STS advanced parameter sets the Analog I/O bit resolution to either Actual (ACE3600) or Legacy (MOSCAD/MOSCAD-L).

For values and restrictions, see Appendix A: Site Configuration Parameters in the ACE3600 STS User Guide.

AI Module Configuration Options

The AI module features which can be configured are listed in the table below. Some parameters are per module and some are per input.

Table 9-1 ACE3600 AI Module Configurable Parameters

Parameter	Selection	Default setup	Per Module / Input	Parameter Setup location
50/60 Hz Filtering	50/60	50 Hz	Module	STS Site configuration
AI Filter (Smoothing)	1/2/4/8/16/32/64/128 (x10 mS)	32	Module	STS Site configuration
Input Range	Current: ±20 mA/ 4-20 mA Voltage: ±5 V/0-5V/ 1-5V	Current: ±20 mA Voltage: ±5 V	Module	STS Site configuration
COS Delta	value	0 (disabled)	Input	Application Programmer I/O link table
KLV & PDV	KLV/PDV PDV=value	KLV	Input	Application Programmer I/O link table

Parameter	Selection	Default setup	Per Module / Input	Parameter Setup location
Mask	No /Yes	No	Input	Application Programmer I/O link table

Sleep Mode

Each AI module can be switched by the user application program to Sleep Mode. In Sleep Mode, the module does not function and the power consumption is minimized. During Sleep mode the user application program will get the predefined values for each I/O.

Module Status and Diagnostics

In the event of AI Module failure, the I/O module ERR LED will be lit. The event is registered by the CPU in the Error Logger. AI Module failure status is also visible to the user application program.

In addition to the ERR LED, the module includes an Underflow (UDF) and Overflow (OVF) LED for each input.

• When the UDF LED is lit, it indicates that the signal level in the corresponding input is below the nominal range.

• When the OVF LED is lit, this indicates that the signal level in the corresponding AI is above the nominal range.

• If both the UDF and OVF LEDs of the same channel are lit, the channel is uncalibrated.

The AI module can be diagnosed and monitored using the STS Hardware Test utility. The Hardware Test verifies that the module is operational, presents the module configuration and shows the actual value of each input, including overflow and underflow. It is also possible to change the input filter setup for the duration of the Hardware test.

In the HW Test utility, it is possible to set the AI module to Freeze Mode. In this mode the program user will get the KLV or PDV of each input in the module instead of the actual input value. Freeze mode enables testing the inputs while the user application program is running.

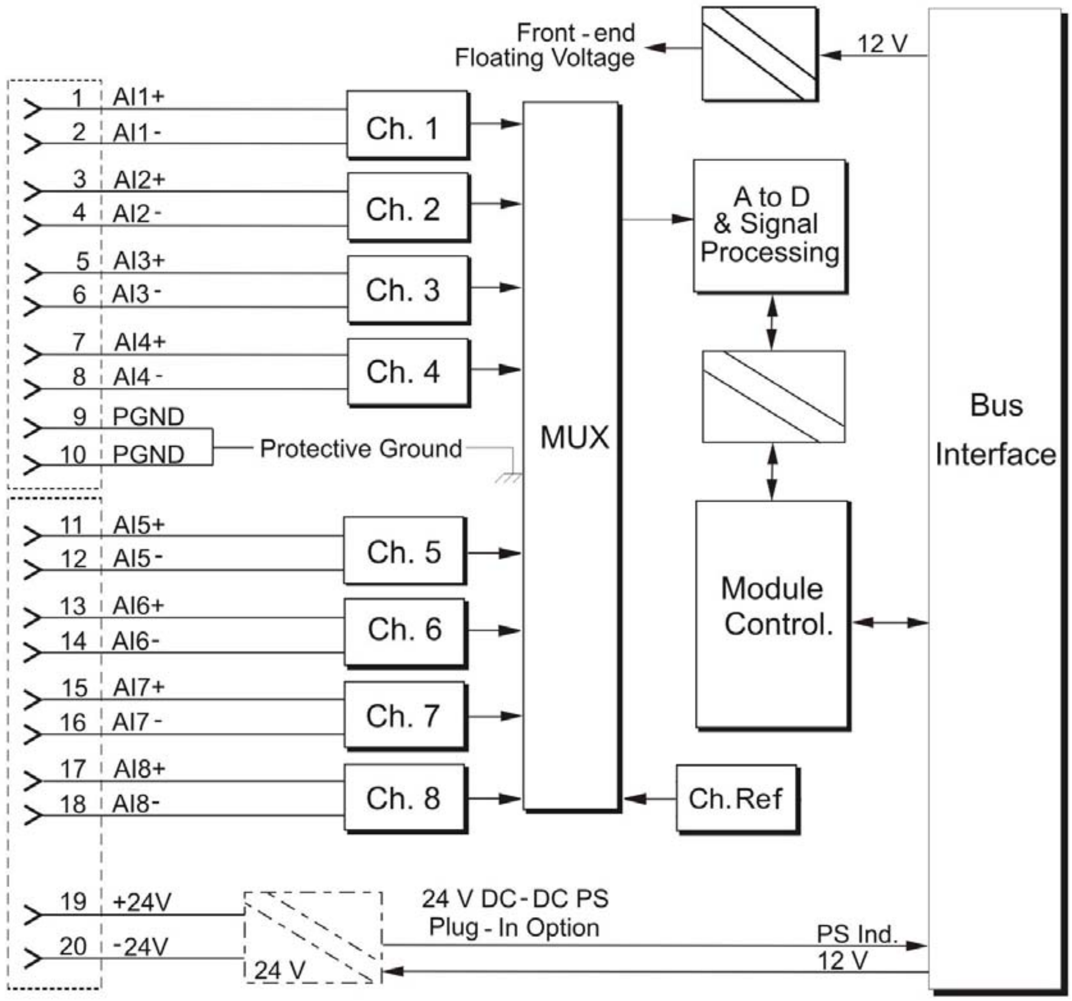
AI Module Value Representation

In ± 20 mA current inputs	Decimal Value	Input Current	Indication
	< -32256	< -20.16 mA	Underflow LED ON
	-32000	-20 mA	
	0	0 mA	Rated range (no LED active)
	32000	+20 mA	
	> 32256	> +20.16 mA	Overflow LED ON
In 4 - 20 mA current inputs	**Decimal Value**	**Input Current**	**Indication**
	< 6144	< 3.84 mA	Underflow LED ON
	6400	+4 mA	
	0	0 mA	Rated range (no LED active)
	32000	+20 mA	
	> 32256	> +20.16 mA	Overflow LED ON
In ± 5 V current inputs	**Decimal Value**	**Input Voltage**	**Indication**
	< -32256	<-5.04V	Underflow LED ON
	-32000	-5 V	
	0	0 V	Rated range (no LED active)
	32000	+5 V	
	> 32256	> +5.04 V	Overflow LED ON
In 0 - 5 V current inputs	**Decimal Value**	**Input Voltage**	**Indication**
	< -256	< -0.04 V	Underflow LED ON
	0	0 V	Rated range (no LED active)
	32000	+5 V	
	> 32256	> +5.04 V	Overflow LED ON

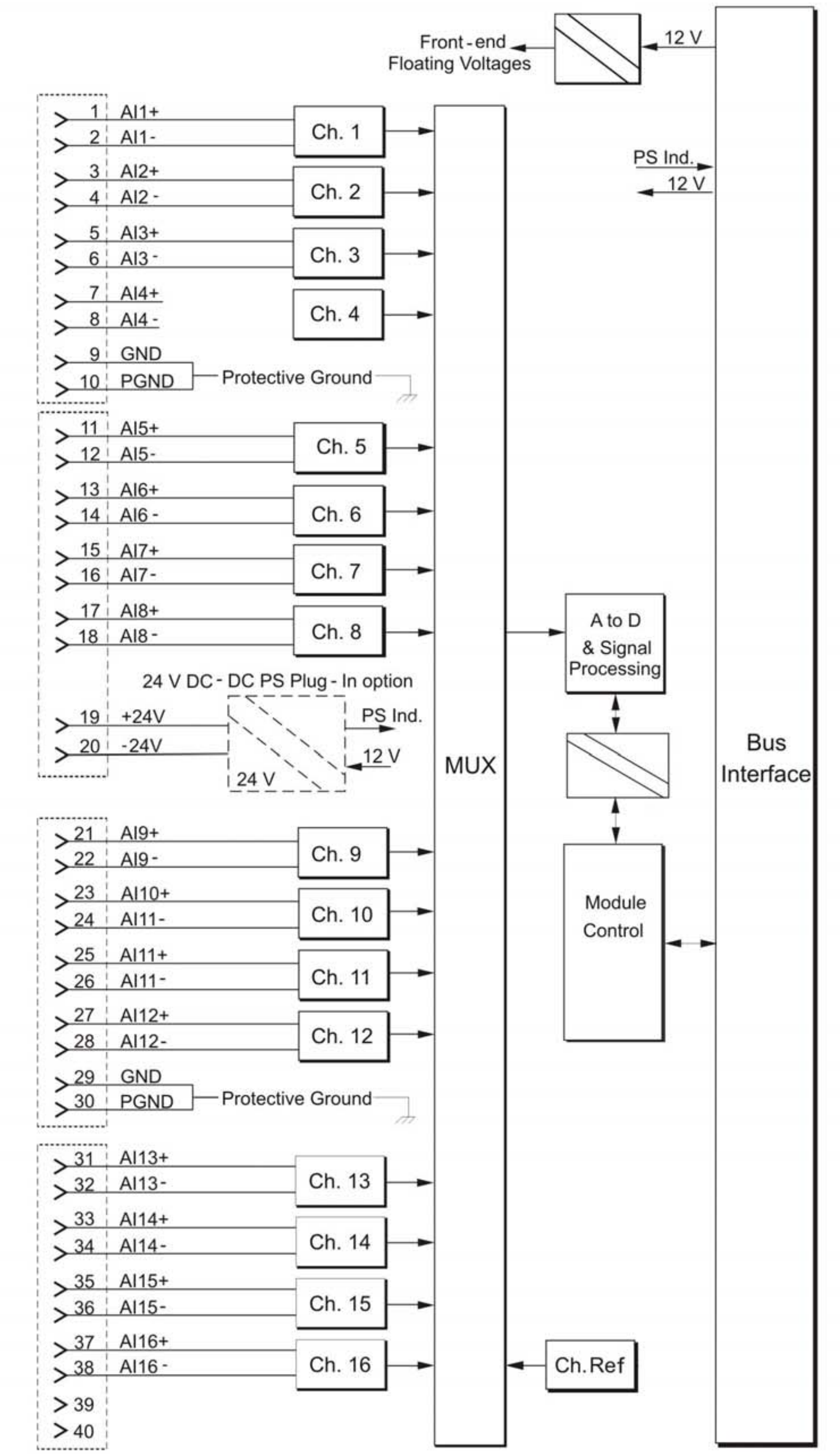
In 1 - 5 V current inputs	Decimal Value	Input Voltage	Indication
	< 6144	< 0.96 V	Underflow LED ON
	6400	1 V	Rated range (no LED active)
	32000	+5 V	
	> 32256	> 5.04 V	Overflow LED ON

Module Block Diagram

8 AI



16 AI


Front-end
Floating Voltages
12 V
PS Ind.
12 V
1 AI1+
2 AI1-
3 AI2+
4 AI2 -
5 AI3+
6 AI3 -
7 AI4+
8 AI4 -
9 GND
10 PGND
Protective Ground
11 AI5+
12 AI5-
13 AI6+
14 AI6 -
15 AI7+
16 AI7-
17 AI8+
18 AI8 -
24 V DC - DC PS Plug - In option
19 +24V
20 -24V
PS Ind.
12 V
24 V
21 AI9+
22 AI9 -
23 AI10+
24 AI11-
25 AI11+
26 AI11-
27 AI12+
28 AI12-
29 GND
30 PGND
Protective Ground
31 AI13+
32 AI13-
33 AI14+
34 AI14-
35 AI15+
36 AI15-
37 AI16+
38 AI16 -
39
40
Ch. 1
Ch. 2
Ch. 3
Ch. 4
Ch. 5
Ch. 6
Ch. 7
Ch. 8
Ch. 9
Ch. 10
Ch. 11
Ch. 12
Ch. 13
Ch. 14
Ch. 15
Ch. 16
MUX
A to D
& Signal
Processing
Module
Control
Ch.Ref
Bus
Interface

Connection Charts

8 AI

Pin	Function	Pin	Function
1	AI1+	11	AI5+
2	AI1-	12	AI5-
3	AI2+	13	AI6+
4	AI2-	14	AI6-
5	AI3+	15	AI7+
6	AI3-	16	AI7-
7	AI4+	17	AI8+
8	AI4-	18	AI8-
9	PGND	19	+24V
10	PGND	20	-24V

16 AI

Pin	Function	Pin	Function
1	AI1+	21	AI9+
2	AI1-	22	AI9-
3	AI2+	23	AI10+
4	AI2-	24	AI10-
5	AI3+	25	AI11+
6	AI3-	26	AI11-
7	AI4+	27	AI12+
8	AI4-	28	AI12-
9	PGND	29	GND
10	PGND	30	PGND
11	AI5+	31	AI13+
12	AI5-	32	AI13-
13	AI6+	33	AI14+
14	AI6-	34	AI14-
15	AI7+	35	AI15+
16	AI7-	36	AI15-
17	AI8+	37	AI16+
18	AI8-	38	AI16-
19	+24V	39	
20	-24V	40	

AI Module Specifications

Total Number of Inputs	8 AI ±20 mA (4-20 mA) 16 AI ±20 mA (4-20 mA) 8 AI ±5 V (0-5 V, 1-5 V) 16 AI ±5 V (0-5 V, 1-5 V)
Input Configuration	Isolated (floating) analog inputs
A to D Resolution	16 bit (including sign)
Input Accuracy	±0.1% of full scale @ -40ºC to +70ºC
Input Sampling Time	10 mSec @ 50 Hz filtering; 8.33 mSec @ 60 Hz filtering
Smoothing	Selectable input averaging:1,2,4,8,16,32,64,128 samples (x10 mS)
Permitted Potential Between Inputs	75 V DC, 60 V AC (RMS)
Input Impedance	±20 mA input: Rin < 250 Ω ±5 V input: Rin > 1 MΩ
Crosstalk Rejection	Better than 80 dB between any pair of inputs
Temperature Stability	25 PPM/ºC
Interference Suppression	Selectable 50 or 60 Hz filtering, Common mode rejection > 80 dB, Differential mode rejection > 50 dB
24 V DC Output	Supports optional isolated 24V Plug-in Power Supply (one in 16 DI, two in 32 DI)
Diagnostic LEDs	Overflow and Underflow LED per each input status, Module error LED, 24V Plug-in status LED The module Overflow and Underflow levels can be configured to: Current inputs: ±20mA / 4-20 mA Voltage inputs: ±5 V / 0-5 V /1-5 V
User Connection	2 or 4 Terminal Blocks (3.5mm pitch), Maximum 18 AWG
Cable and TB Holder	20 or 40 Wire Cable with TB Holder connector, 26 AWG
Module Replacement	Hot swap replacement– module extraction/insertion under voltage
Input Isolation	1.5 kV between input and module logic
Input Insulation	Insulation resistance 100 MΩ @ 500 V DC, per IEC255-5
Operating Voltage	10.8-16 V DC and 3.3 V DC (from the motherboard connector)
Power Consumption (measured at power supply in)	8 AI: 0.9 W typical with all LEDs on (65 mA @ 13.8 VDC) 16 AI: 1.3W typical with all LEDs on (95 mA @ 13.8 VDC) (Not including 24 V Plug-in Power Supply)
Dimensions	37 mm W x 225 mm H x 180 mm D, (1.5" W x 8.7" H x 7.1" D)
Weight	8 AI : approx.032 Kg (0.71 Lb) 16 AI: approx. 0.34 Kg (0.75 Lb)

Specifications subject to change without notice.

ANALOG OUTPUT MODULE

General Description

The Analog Output (AO) modules have four optically-isolated analog output channels for controlling user devices (see Figure 10-1). Each channel has two possible outputs: 0-20 mA Interface industry standard current output and 0-10 V Interface industry standard voltage output. Only one of the outputs can be enabled in a particular channel - either current or voltage.

The module's digital to analog converter resolution is 14 bit. The Analog Output channels are optically isolated from the module internal logic circuits. The modules are fully calibrated and can be tested and recalibrated in the field.

Each analog output has three status LEDs, Vout, Iout, and CAL which represent the calibration status of each output for voltage/current. See Module Status and Diagnostics below for the LEDs behavior.

For a description of I/O module construction, location, LEDs, TBs, and other common I/O module features, see the I/O Modules chapter above.

For details on specific AO parameters and configuration, see AO Module Configuration below.

Figure 10-1 provides a general view of the ACE3600 AO module.

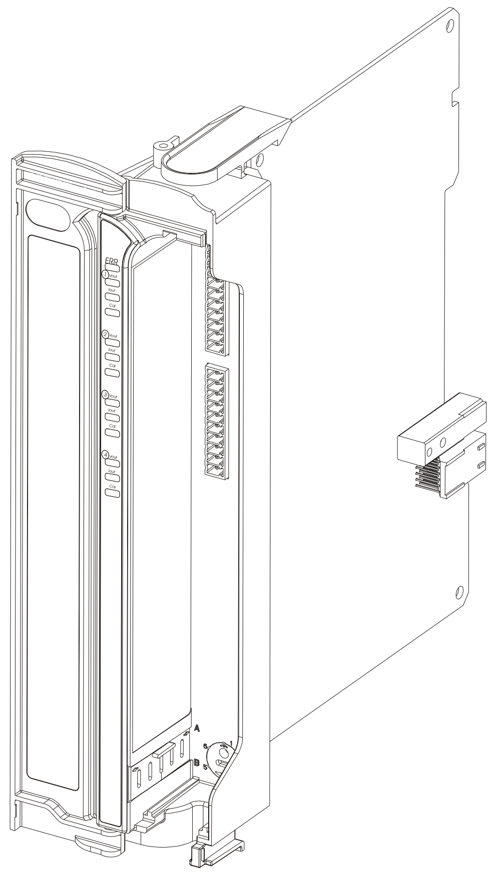


Figure 10-1 ACE3600 AO Module – General View

Figure 10-2 provides a detailed view of the AO module front panel.

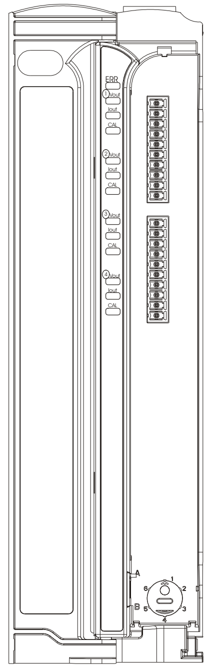


Figure 10-2 ACE3600 AO Module – Front Panel

AO Module Configuration

AO Type

The analog outputs can be set to voltage, current, or raw data. See Module Status and Diagnostics for details.

AO Value

The analog outputs can be set to a numeric value (in the range of 0 to 16000) or either in voltage or current according to the output type. The values for voltage are 0 to 10 V and the values for current are 0 to 20 mA. See Module Status and Diagnostics for details.

The AO module value representation is as follows:

In 0-20 mA current outputs	**Decimal Value**	**Output Current**
	0	0
	4000	5 mA
	8000	10 mA
	16000	20 mA
In 0- 10 V voltage outputs	**Decimal Value**	**Output Voltage**
	0	0 V
	4000	2.5 V
	8000	5 V
	16000	10 V

AO Calibration

The upper and lower limits of analog outputs can be calibrated - either as current (20mA upper limit and 4mA lower limit) or voltage (10V upper limit and 2V lower limit). Default upper and lower calibration limits are provided from the factory. See Module Status and Diagnostics for details.

Keep Last Value (KLV) and Predefined Value (PDV)

Each output can be configured to KLV or to a PDV. This value is maintained in the event of AO module failure or communication failure with the CPU.

The predefined value can also be used during normal operation to force a value that masks the actual output value.

I/O Legacy Resolution Parameter

In systems with both ACE3600 RTUs and legacy (MOSCAD/MOSCAD-L) RTUs, some MOSCAD/MOSCAD-L applications can be upgraded to ACE3600 without modifying the references to analog values in the applications ('C' or ladder). The I/O Legacy Resolution STS advanced parameter sets the Analog I/O bit resolution to either Actual (ACE3600) or Legacy (MOSCAD/MOSCAD-L).

For values and restrictions, see Appendix A: Site Configuration Parameters in the ACE3600 STS User Guide.

AO Module Configuration Options

The AO module features which can be configured are listed in the table below. Some parameters are per module and some are per output.

Table 10-1 ACE3600 AO Module Configurable Parameters

Parameter	Selection	Default setup	Per Module / Output	Parameter Setup location
AO Type	Voltage/Current	User Defined	Output	STS HW Test/User application program
AO Value	Voltage - 0 to 10 V Current - 0 to 20 mA	User Defined	Output	STS HW Test/User application program
AO Calibration	Voltage - 2 to 10 V Current - 4 to 20 mA	Voltage - 2 to 10 V Current - 4 to 20 mA	Output	STS HW Test
KLV & PDV	KLV/PDV PDV=value	KLV	Output	Application Programmer I/O link table
Mask	No /Yes	No	Output	Application Programmer I/O link table

Sleep Mode

Each AO module can be switched by the user application program to Sleep Mode. In Sleep Mode, the module does not function and the power consumption is minimized. During Sleep mode the user application program will get the predefined values for each output.

Module Status and Diagnostics

In the event of AO Module failure, the I/O module ERR LED will be lit. The event is registered by the CPU in the Error Logger. AO Module failure status is also visible to the user application program.

In addition to the ERR LED, the module includes a voltage output (Vout), current output (Iout), and calibration (CAL) LED for each output.

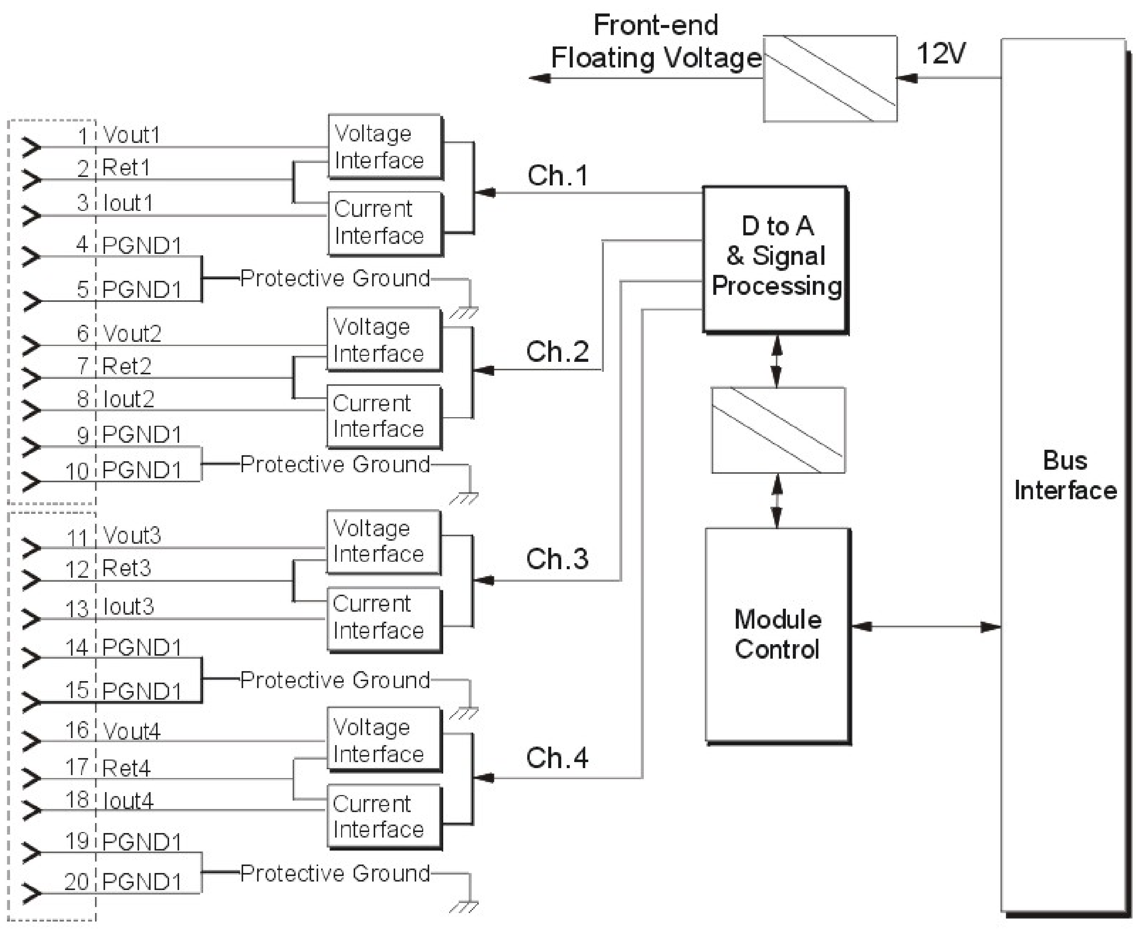
CAL	Vout	Iout	Indication
On	On	On	Neither output is calibrated.
On	Off	On	Iout is uncalibrated.
On	On	Off	Vout is uncalibrated.
Off	On	On	Row value for testing purpose is defined by the user, either using HW test or user application program to send raw data.
Off	On	Off	Vout is defined by the user, either using HW test or user application program.
Off	Off	On	Iout is defined by the user, either using HW test or user application program.

The AO module can be diagnosed and monitored using the STS Hardware Test utility. The Hardware Test verifies that the module is operational, shows the type and actual value of each output, enables calibration, and presents the ROM data calibration factors. The AO type can be set either in the user application program or in the Hardware Test. To set the output value in the Hardware test, the user application program must be stopped or the AO module frozen. To calibrate the output in the Hardware test, the user application program must be stopped or the AO module frozen.

In the Hardware Test utility, it is possible to set the AO module to Freeze Mode. In this mode, the AOs will keep the last value they had at the time they were frozen. Freeze mode enables testing the inputs and outputs while the user program is running.

Module Block Diagram

4 AO



Connection Charts

4 AO

Pin	Function	Pin	Function
1	Vout1	11	Vout3
2	Ret1	12	Ret3
3	Iout1	13	Iout3
4	PGND1	14	PGND1
5	PGND1	15	PGND1
6	Vout2	16	Vout4
7	Ret2	17	Ret4
8	Iout2	18	Iout4
9	PGND1	19	PGND1
10	PGND1	20	PGND1

AO Module Specifications

Total Number of Outputs	4 AO current (0-20 mA) or voltage (0-10 V)
Output Arrangement	Isolated floating channels, each channel can be connected as 0-20 mA or 0-10 V DC voltage
D to A Resolution	14 bit
Output Accuracy	±0.1% full scale @ 25ºC
Temperature Stability	25 PPM/ºC
Internal Settling Time	Max. 1.0 msec
Output Load	Voltage: > 1.0 kΩ, < 1.0 µf Current: < 750 Ω (internal power source)
Crosstalk Rejection	Better than 50 dB between any pair of outputs
Interference Suppression	Common mode rejection > 60 dB
Output Protection	Voltage output: short circuit current, max. 30 mA Current output: No-load voltage max. 22 V DC
Diagnostic LEDs	Module error LED, Voltage mode LED, Current mode LED, Calibration LED per channel
User Connection	2 Terminal Blocks (3.5mm pitch), Maximum 18 AWG
Cable and TB Holder	20 Wire Cable with TB Holder connector, 26 AWG
Module Replacement	Hot swap replacement– module extraction/insertion under voltage
Isolation	1.5 kV between output and module logic
Insulation	Insulation resistance 100 MΩ @ 500 V DC, per IEC255-5
Operating Voltage	10.8-16 V DC and 3.3 V DC (from the motherboard connector)
Power Consumption (measured at power supply in)	1.8 W typical with all LEDs on/all outputs off (130 mA @ 13.8 VDC) 3.4 W typical with all LEDs on/all outputs 20 mA (250 mA @ 13.8 VDC)
Dimensions	37 mm W x 225 mm H x 180 mm D, (1.5" W x 8.7" H x 7.1" D)
Weight	Approx. 0.29 Kg (0.64 Lb)

Specifications subject to change without notice.

MIXED I/O MODULE

General Description

The ACE3600 Mixed I/O modules include a mixture of Digital Inputs, Relay Outputs and Analog Inputs on the same module.

The available Mixed I/O modules are:

- 16 Digital Inputs + 4 EE DO Relay Outputs + 4 Analog Inputs (±20 mA)
- 16 Digital Inputs + 4 ML DO Relay Outputs + 4 Analog Inputs (±20 mA)

Figure 11-1 provides a general view of the ACE3600 Mixed I/O module.

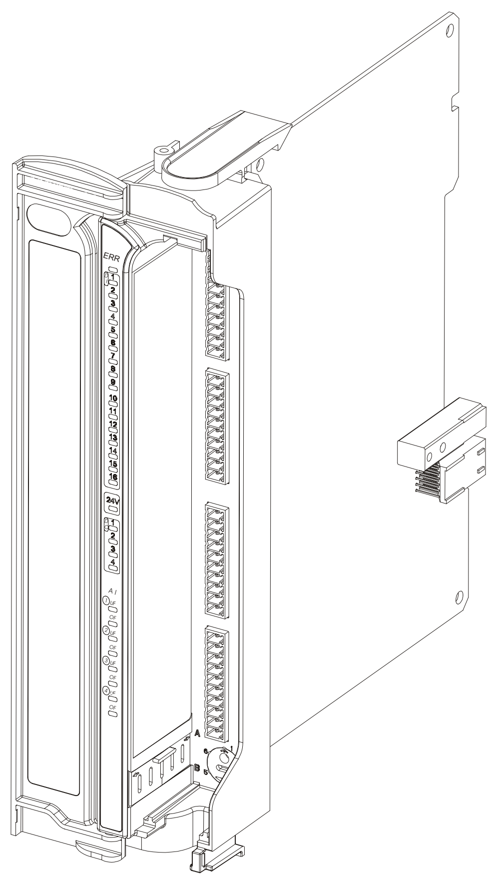


Figure 11-1 ACE3600 Mixed I/O Module – General View

Another type of mixed I/O is found on the Digital Output/Digital Input (DO/DI) FET module. See the Digital Output/Digital Input (DO/DI) FET module chapter above for more information.

Figure 11-2 provides a detailed view of the Mixed I/O module front panel.

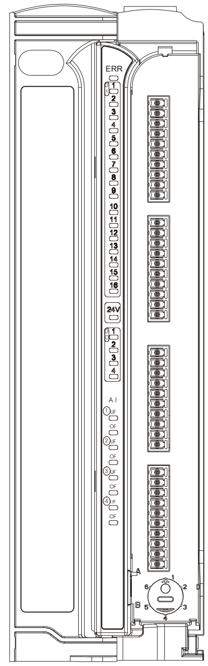


Figure 11-2 ACE3600 Mixed I/O Module – Front Panel

The Digital Input (DIs) on the Mixed I/O modules are voltage ("wet") inputs IEC 61131-2 Type II compliant. All DIs can function as fast counters. All DIs are optically isolated.

Each DI can be an event trigger (by interrupt) to a high priority fast process. A high priority fast process enables very fast activation of an output in response to an input trigger and logical conditions. This high priority fast process is independent of the I/O scan (refer to the STS Application Programmer manual).

All four relay outputs are Single Pole Double Throw (SPDT) and are referred to as the "Form C" relays. The physical position of each relay is monitored by the module logic, by using a back indication signal which is connected to the relay's second contact set. Any contradiction between the required position and the back indication signal, is reported to the CPU and is available to the user application program.

In some applications, it is necessary to inhibit relay output operation when attending the site for safety reasons. In all DO relay modules; it is possible to inhibit all relays per DO module. When a module is configured to enable relay inhibiting, the power to the relays is provided from the power supply via a dedicated power line (12V DO), controlled from the "12V DO" input (TB located on the power supply module panel). When the input's terminals are shorted, the relays are operational. When the input's terminals are open, the relays are inhibited (EE relays in the OFF (0) position and ML relays do not change state.)

The user application program can monitor the relay inhibiting status and act accordingly. Also, when the module's relays are inhibited, any mismatch between the relay position and the output logical state is ignored.

The Mixed I/O modules Analog-to-Digital conversion resolution is 16 Bit (including sign). Each input is fully isolated from the other inputs on the module and also optically isolated from the module internal circuits. The modules are fully calibrated. It is possible to test and re-calibrate the module in the field.

The measured values are digitally filtered to reduce the 50 or 60 Hz noise. The user can select the filtering frequency per module.

The measured values can be smoothed by digital filtering. Smoothing is accomplished by calculating the running average values of a defined number of converted analog values (samples). The user can select the level of smoothing per module. The higher the smoothing level chosen, the more stable is the smoothed analog value and the longer it takes until the smoothed analog signal is applied after a step response.

The user can select how the analog values are represented to the user application program, as unitless numeric values or as scaled values that represent certain Engineering Units (EGU).

Each AI module can include an optional plug-in floating 24V DC power supply to power external devices.

Each analog input has two Status LEDs:

- UF - indicates Underflow when lit
- OF - indicates Overflow when lit

The Mixed I/O modules support an optional 24V DC floating plug-in power supply (for contact "wetting" or other purposes).

For a description of I/O module construction, location, LEDs, TB holder, and other common I/O module features, see the I/O Modules chapter above. For details on Mixed I/O Module specific parameters and configuration, see the Mixed I/O Module Configuration section below.

Mixed I/O Module Configuration

For configuration of the DIs, refer to the DI Module chapter.

For configuration of the DOs, refer to the DO/DI FET Module or DO Relay Module chapter.

For configuration of the AIs, refer to the AI Module chapter.

Sleep Mode

Each Mixed I/O module can be switched by the user application program to Sleep Mode. In Sleep Mode, the module does not function and the power consumption is minimized. During Sleep mode the user application program will get the predefined values per each I/O.

Module Status and Diagnostics

In the event of Mixed I/O Module failure, the ERR LED will be lit. This event is registered by the CPU in the Error Logger. DI Module failure status is also visible to the user application program.

The Mixed I/O module can be diagnosed and monitored using the STS Hardware Test utility.

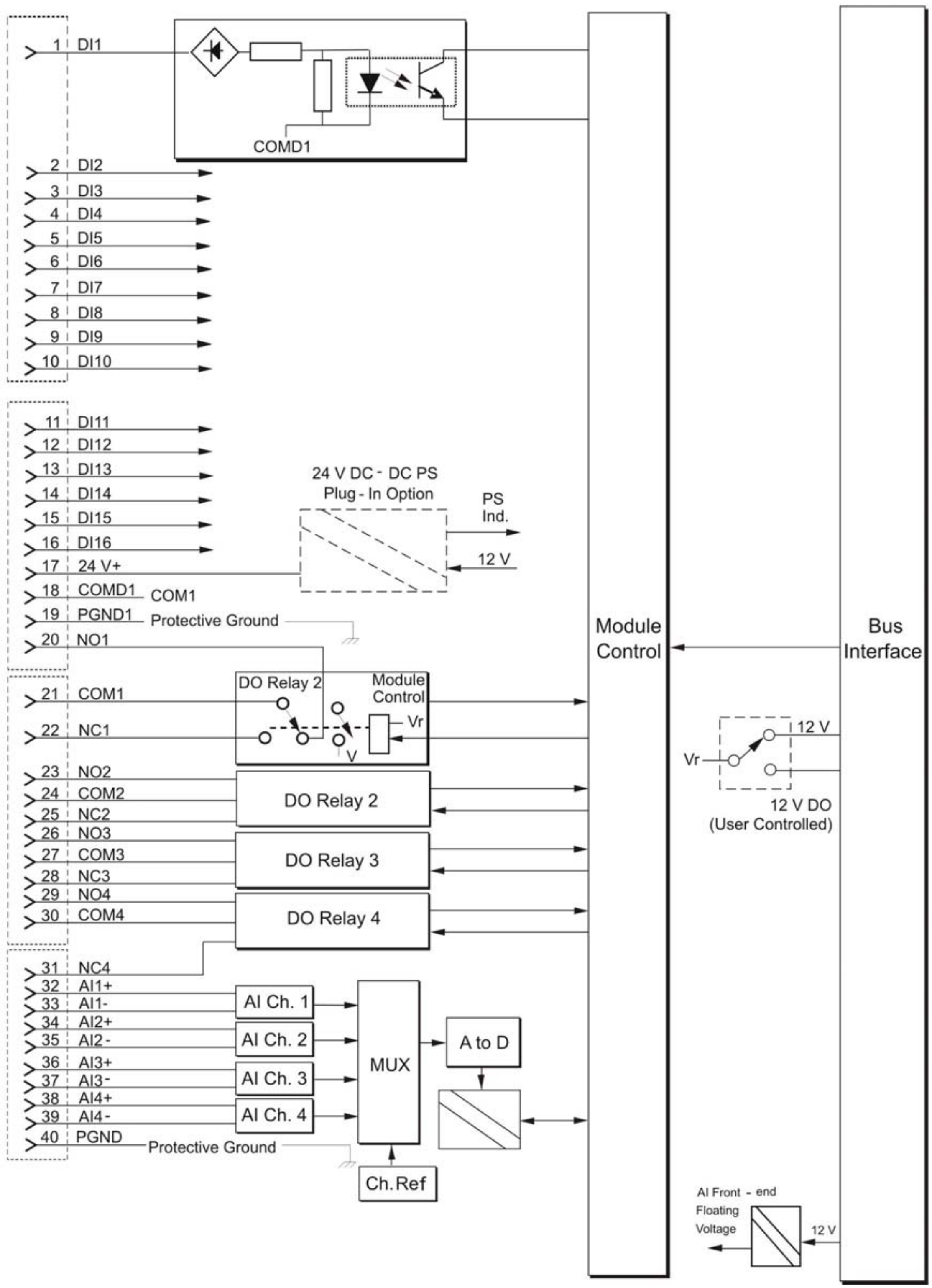
For Hardware Test of the DIs, refer to the DI Module chapter.

For Hardware Test of the DOs, refer to the DO/DI FET Module or DO Relay Module chapter.

For Hardware Test of the AIs, refer to the AI Module chapter.

Module Block Diagram

Mixed I/O



Connection Charts

Mixed I/O

Pin	Function	Pin	Function
1	DI1	21	COM1
2	DI2	22	NC1
3	DI3	23	NO2
4	DI4	24	COM2
5	DI5	25	NC2
6	DI6	26	NO3
7	DI7	27	COM3
8	DI8	28	NC3
9	DI9	29	NO4
10	DI10	30	COM4
11	DI11	31	NC4
12	DI12	32	AI1+
13	DI13	33	AI1-
14	DI14	34	AI2+
15	DI15	35	AI2-
16	DI16	36	AI3+
17	24V+	37	AI3-
18	COM1	38	AI4+
19	PGND1	39	AI4-
20	NO1	40	PGND

Mixed I/O Module Specifications

Total Number of Inputs / Outputs	16 Digital Inputs + 4 EE Relay Outputs + 4 Analog Inputs (±20 mA) 16 Digital Inputs + 4 ML Relay Outputs + 4 Analog Inputs (±20 mA)
I/O Arrangement	1 group of 16 DIs with shared common 4 relay outputs - Form C 4 isolated analog inputs
DI Counter Inputs	All inputs can be configured as fast counters
DI Frequency	0 - 1 KHz
DI Fast Counter Frequency	0 - 5 KHz, minimum pulse width 100 µS
DI Max. DC Voltage	Max. 40 V DC
DI “ON” DC Voltage Range	+11 to +30 V DC, -30 to -11 V DC
DI “OFF” DC Voltage Range	-5 to +5 V DC
DI Current	6-10 mA
Fast Capture Resolution	1 mS (Interrupt upon change of state)
Event Time Tagging Resolution	1 mS (Interrupt upon change of state)
DI Filtering	0 to 255 mSec (DC, programmable in 1 mSec steps)
DI Counter Filtering	0 to 6.375 mSec (programmable in 0.025 mSec steps for inputs configured as high speed counter)
DO Contact Voltage Ratings	Max. 60 V DC or 30 V AC RMS (42.4 V peak).
DO Contact Power Ratings	2A @ 30 V DC, 0.6A @ 60V DC or 0.6A @ 30V AC (resistive load)
DO Relay Back Indication	Contact position - hardware back indication
DO Fail State	Configurable relay state on CPU fail: On, Off or ‘last value’
AI Resolution	16 Bit (including sign)
AI Accuracy	±0.1% of full scale @ -40ºC to +70ºC
AI Sampling Time	10 mSec @ 50 Hz filtering 8.33 mSec @ 60 Hz filtering
AI Smoothing	Selectable input averaging: 1, 2, 4, 8, 16, 32, 64 or 128 samples (x10 mS)
AI max. Potential between AIs	75 V DC, 60 V AC (RMS)
AI Impedance	Rin < 250 Ω
AI Crosstalk Rejection	Better than 80 dB between any pair of inputs

AI Temperature Stability	25 PPM/ºC
AI Interference Suppression	Selectable 50 or 60 Hz filtering, common mode rejection > 80 dB, differential mode rejection > 50 dB
Diagnostic LEDs	Module error LED, Status LED per each DO and DI. Overflow and Underflow LED per each AI, 24V Plug-in status LED (AI) AI Overflow and Underflow levels can be configured to: Current inputs: ±20mA / 4-20 mA Voltage inputs: ±5 V / 0-5 V /1-5 V
24 V DC Output	Supports one isolated 24V A plug-in "wetting" power supply
User Connection	4 Terminal Blocks (3.5mm pitch), Maximum 18 AWG
Cable and TB Holder	40 wire cable with Terminal Block Holder connector, 26 AWG
Module Replacement	Hot swap replacement– module extraction/insertion under voltage
Input / Output Isolation	DI: 2.5 kV DC/AC between input and module logic per IEC255-5 DO: Between open contacts: 1kV, between contact and coil: 1.5 kV, between contact sets: 1.5 kV AI: 1.5 kV between input and module logic
Input Insulation	Insulation resistance 100 MΩ @ 500 V DC per IEC255-5
Operating Voltage	10.8-16 V DC and 3.3 V DC (from the motherboard connector)
Power Consumption (measured at power supply in)	1.5 W typical with all LEDs on and outputs off (110 mA @ 13.8 V DC) For each EE Relay on: 0.2 W typical (15 mA @ 13.8 VDC) (Not including 24 V Plug-in Power Supply)
Dimensions	37 mm W x 225 mm H x 180 mm D (1.5" W x 8.7" H x 7.1" D)
Weight	Approx. 0.31 Kg (0.68 Lb)

Specifications subject to change without notice.

MIXED ANALOG MODULE

General Description

The ACE3600 Mixed Analog modules include a mixture of Analog Inputs and Analog Outputs on the same module.

The available Mixed Analog modules are:

- 4 Analog Outputs + 8 Analog Inputs (±20 mA) (supports 4-20 mA)
- 4 Analog Outputs + 8 Analog Inputs (±5V) (supports 0-5 V and 1-5V)

Figure 12-1 provides a general view of the ACE3600 Mixed Analog module.

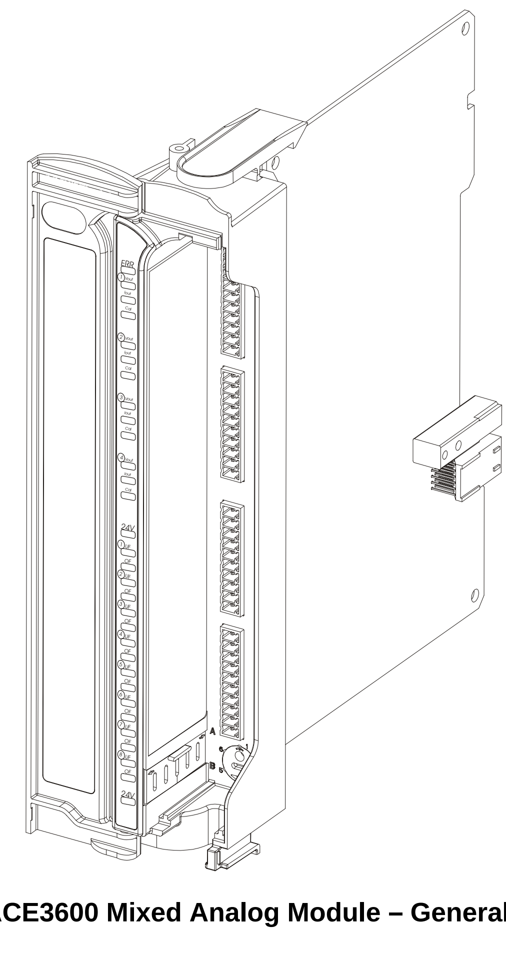


Figure 12-1 ACE3600 Mixed Analog Module – General View

Figure 12-2 provides a detailed view of the Mixed Analog module front panel.

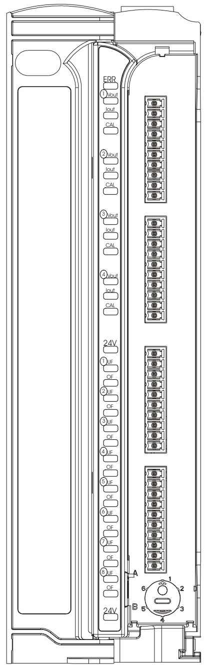


Figure 12-2 ACE3600 Mixed Analog Module – Front Panel

For a description of the AIs in the Mixed Analog modules, see the Analog Input Module chapter. For a description of the AOs in the Mixed Analog modules, see the Analog Output Module chapter.

The Mixed Analog modules support an optional 24V DC floating plug-in power supply to power external devices.

For a description of I/O module construction, location, LEDs, TB holder, and other common I/O module features, see the I/O Modules chapter above. For details on Mixed Analog Module specific parameters and configuration, see the Mixed Analog Module Configuration section below.

Mixed Analog Module Configuration

For configuration of the AIs, refer to the AI Module chapter.

For configuration of the AOs, refer to the AO Module chapter.

Sleep Mode

Each Mixed Analog module can be switched by the user application program to Sleep Mode. In Sleep Mode, the module does not function and the power consumption is minimized. During Sleep mode the user application program will get/set the predefined values per each I/O.

Module Status and Diagnostics

In the event of Mixed Analog Module failure, the ERR LED will be lit. This event is registered by the CPU in the Error Logger. AI Module failure status is also visible to the user application program.

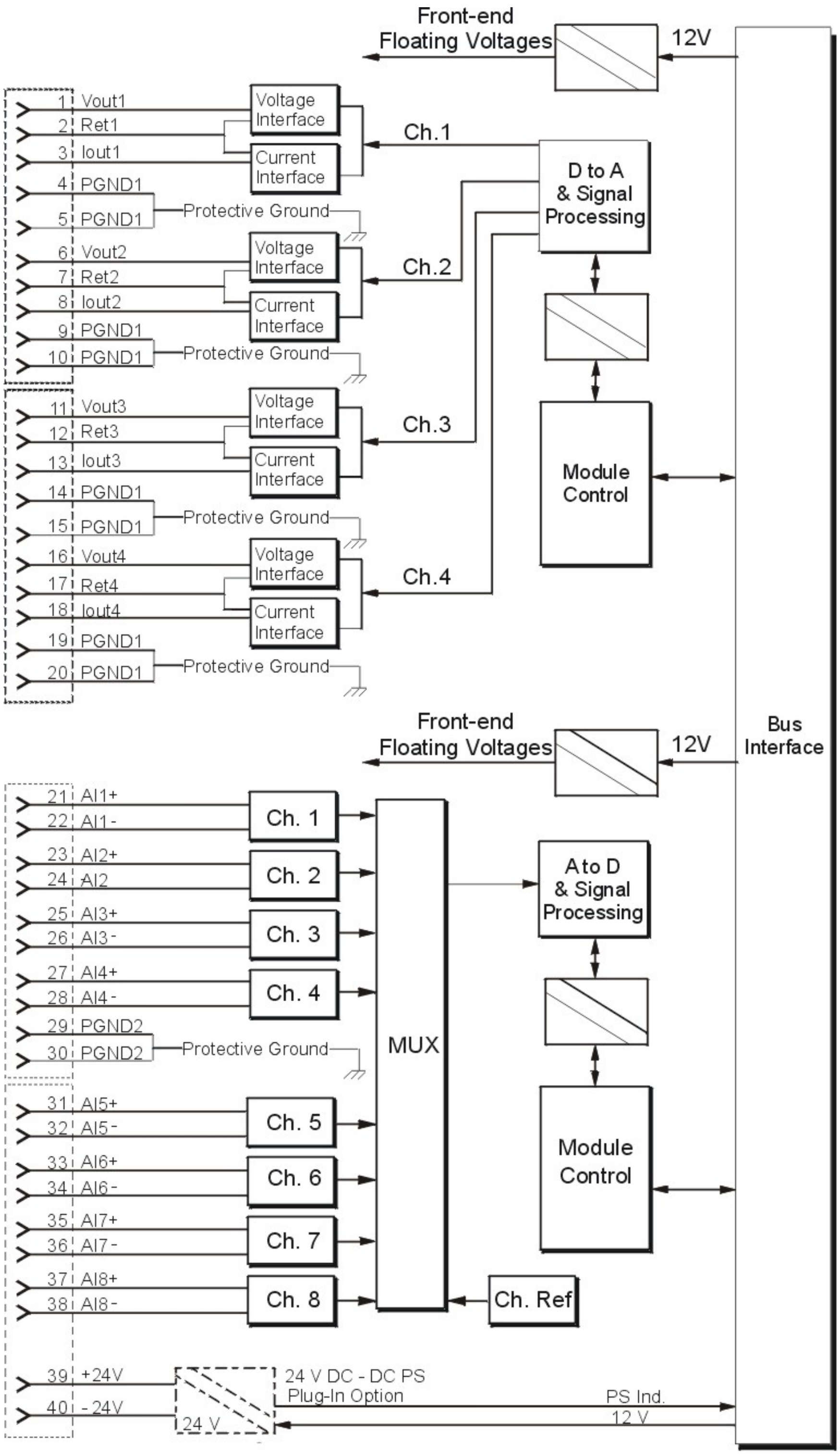
The Mixed Analog module can be diagnosed and monitored using the STS Hardware Test utility.

For Hardware Test of the AIs, refer to the AI Module chapter.

For Hardware Test of the AOs, refer to the AO Module chapter.

Module Block Diagram

Mixed Analog



Connection Charts

4AO/8AI

Pin	Function	Pin	Function
1	Vout1	21	AI1+
2	Ret1	22	AI1-
3	Iout1+	23	AI2+
4	PGND1	24	AI2-
5	PGND1	25	AI3+
6	Vout2	26	AI3-
7	Ret2	27	AI4+
8	Iout2	28	AI4-
9	PGND1	29	PGND2
10	PGND1	30	PGND2
11	Vout3	31	AI5+
12	Ret3	32	AI5-
13	Iout3	33	AI6+
14	PGND1	34	AI6-
15	PGND1	35	AI7+
16	Vout4	36	AI7-
17	Ret4	37	AI8+
18	Iout4	38	AI8-
19	PGND1	39	+24V
20	PGND1	40	-24V

Mixed Analog Module Specifications

Total Number of I/Os	4 Analog Outputs + 8 Analog Inputs (±20 mA) or 4 Analog Outputs + 8 Analog Inputs (±5V DC)
I/O Arrangement	AO - each channel can be connected as 0-20 mA or 0-10 V, AI - Isolated (floating) analog inputs
AO D to A Resolution	14 bit
AO Accuracy	±0.1% full scale @ 25ºC
AO Temperature Stability	25 PPM/ºC
AO Internal Settling Time	Max. 1.0 msec
AO Load	Voltage: > 1.0 kΩ, < 1.0 µf Current: < 750 Ω (with internal power supply)
AO Crosstalk Rejection	Better than 50 dB between any pair of outputs
AO Interference Suppression	Common mode rejection > 60 dB
AO Voltage Output Protection	Short circuit protection, max. 30 mA (all other operating channels remain fully functional)
AO Current Output No-load Voltage	Max. 22.0 V DC
AO Isolation	1.5 kV between output and module logic
AO Insulation	Insulation resistance 100 MΩ @ 500 V DC per IEC255-5
AI A to D Resolution	16 Bit (including sign)
AI Accuracy	±0.1% full scale
AI Sampling Time	10 mSec @ 50 Hz filtering 8.33 mSec @ 60 Hz filtering
AI Smoothing	Selectable input averaging: 1, 2, 4, 8, 16, 32, 64 or 128 samples (x10 mS)
Permitted. Potential between Inputs	75 V DC, 60 V AC (RMS)
AI Input Impedance	±20 mA input: Rin < 250 Ω ±5 V input: Rin > 1 MΩ
AI Crosstalk Rejection	Better than 80 dB between any pair of inputs
AI Temperature Stability	25 PPM/ºC
AI Interference Suppression	Selectable 50 or 60 Hz filtering, common mode rejection > 80 dB, differential mode rejection > 50 dB
24 V DC Output	Supports one isolated 24V Plug-in “wetting” power supply

Diagnostic LEDs	AO - Voltage mode LED, Current mode LED, Calibration LED per channel AI - Overflow and Underflow LED per each input, 24V Plug-in status LED The module Overflow and Underflow levels can be configured to: Current inputs: ±20mA / 4-20 mA Voltage inputs: ±5 V / 0-5 V /1-5 V General - Module error LED
AI Input Isolation	1.5 kV between input and module logic
AI Input Insulation	Insulation resistance 100 MΩ @ 500 V DC per IEC255-5
User Connection	4 Terminal Blocks (3.5mm pitch), Maximum 18 AWG
Cable and TB Holder	40 wire cable with Terminal Block Holder connector, 26 AWG
Module Replacement	Hot swap replacement– module extraction/insertion under voltage
Operating Voltage	10.8-16 V DC and 3.3 V DC (from the motherboard connector)
Power Consumption (measured at power supply in)	1.9 W typical with all LEDs on/outputs off (140 mA @ 13.8 VDC) 3.4 W typical with all LEDs on/all outputs 20 mA (250 mA @ 13.8 VDC)
Dimensions	37 mm W x 225 mm H x 180 mm D (1.5" W x 8.7" H x 7.1" D)
Weight	Approx. 0.34 Kg (0.75 Lb)

Specifications subject to change without notice.

RADIO TYPES AND INSTALLATION KITS

ACE3600 Radio Types

CAUTION

In order to prevent overheating of the radio and degradation of radio performance, the radio should not exceed operating duty factors of 30% transmission and 70% receive mode.

Note that the operating temperature range of ACE3600 RTU models that include a radio is from -30 ºC to +60 ºC (-22 ºF to +140 ºF). (The operating temperature range of the ACE3600 RTU models without a radio is from -40 ºC to +70 ºC (-40 ºF to +158 ºF)).

The ACE3600 RTU supports conventional, analog trunked radios and digital trunked radios. It also supports data radios and various wireless modems. Conventional and analog trunked radios are connected to a plug-in radio modem port. Digital trunked radios and wireless modems are connected to an RS232 port. For information on configuring CPU ports for various radios/modems, see the ACE3600 STS User Guide. For information on IP communications over such modems, see the ACE3600 STS Advanced Features manual.

The following conventional/trunked mobile analog and digital radios and conventional portable analog and digital radios can be used with the ACE3600 RTU:

	Analog Motorola Radios	Digital Motorola Radios	Third Party Radios
Trunked	XTL5000/XTL2500	XTL5000/XTL2500	
		XTS2500	
Conventional	CM200/CM140/EM200/ GM3188		MDS 9810/MDS 4710/ MDS 9710
	GP320/GP328/HT750/ PRO5150		TransNET 900™* OEM
	CDM750		iNET 900™

For complete radio specifications such as modulations, standards, Tx power output, Rx sensitivity, supply voltage, and power consumption, see the specific radio owner's manual. Please note that third party radios are not provided with the RTUs.

The following table lists all the ACE3600 models that include radios.

* TransNET 900 and iNET 900 are trademarks of GE MDS.

Conventional VHF Radio	ACE3600 Model
ACE3600 for CM200/CM140/EM200/GM3188 VHF	F7573A
ACE3600 with CDM750 136-174 MHz	F7563A
ACE3600 for HT750/GP320/GP328 /PRO5150 VHF	F7553A
Conventional UHF Radio	
ACE3600 for CM200/CM140/EM200/GM3188 UHF	F7574A
ACE3600 with CDM750 403-512 MHz	F7564A
ACE3600 for HT750/GP320/GP328 /PRO5150 UHF	F7554A
Trunked VHF Radio	
ACE3600 with XTL5000 136-174 MHz Analog	F7523A
ACE3600 with XTL5000 136-174 MHz Digital	F7513A
ACE3600 with XTL2500 136-174 MHz Analog	F7533A
ACE3600 with XTL2500 136-174 MHz Digital	F7593A
ACE3600 with XTS2500 136-174 MHz Digital	F7543A
Trunked UHF Radio	
ACE3600 with XTL5000 380-520 MHz Analog	F7524A
ACE3600 with XTL5000 380-520 MHz Digital	F7514A
ACE3600 with XTL2500 380-520 MHz Analog	F7534A
ACE3600 with XTL2500 380-520 MHz Digital	F7594A
ACE3600 with XTS2500 380-520 MHz Digital	F7544A
Trunked 800MHz Radio	
ACE3600 with XTL5000 800MHz Analog	F7585A
ACE3600 with XTL5000 800MHz Digital	F7586A
ACE3600 with XTL2500 800MHz Analog	F7538A
ACE3600 with XTL2500 800MHz Digital	F7598A
ACE3600 with XTS2500 800 MHz Digital	F7548A

For a list of the radio models and regional options for the CM/EM/GM radios, see CM/EM/GM Radio Models and Regional Options for ACE3600 below. For a list of the radio models and regional options for the GP/HT/PRO radios, see GP/HT/PRO Radio Models and Regional Options for ACE3600 below.

IMPORTANT: Only model F7509A and all its options, including radio installation kits, may be shipped to European Union (EU) countries. The installer must confirm that there are no emissions or harmful interference to the spectrum due integrating the radio into this model.

The radios in the models listed in the table above are installed on the RTU using the installation radio kits described below.

Radio Installation Kits

The following radio installation kits enable the user to install a radio in the ACE3600 RTU.

					Option/Kit
Conventional Mobile Radios	CDM750				V143AH/ FLN3638A
	MDS 9810, MDS 4710, MDS 9710				V152AK/ FLN3853A
	TransNET 900 OEM				VA00225AA/ FLN3852A
	iNET 900				V680AH/ FLN3854A
	NA	**EMEA**	**APAC**	**LA**	
	CM200	CM140	GM3188	EM200	V148AC/ FLN3635A
Conventional Portable Radios	**NA**	**EMEA**	**APAC**	**LA**	
	HT750	GP320	GP328	PRO5150	V154AE/ FLN3637A
Analog Trunking Mobile Radios	XTL5000/XTL2500				V157AB/ FLN3640A
Digital Trunking Mobile Radios	XTL5000/XTL2500				V681AT/ FLN3649A
	XTS2500				V156AG/ FLN3814A

For instructions on mounting the radio on the ACE3600 frame, see the desired installation instructions below.

For general instructions on mounting a radio on the wall, see Mounting the ACE3600 Radios on a Wall below.

Note: A TORX screwdriver is required for the installation kits.

XTL5000/XTL2500 Radio Installation Kit

The XTL5000/XTL2500 radio installation kit (ACE3600 option V681AT or V157AB) enables the user to install the XTL5000/XTL2500 radio in ACE3600 Remote Terminal Units (RTU). The ACE3600 can use the XTL5000/XTL2500 in two operation modes, depending on the system used.

- Digital mode (ACE3600 option V681AT) - suitable for Astro 6.x/7.x system trunked ASTRO IV&D only
- Analog mode (ACE3600 option V157AB) - suitable for SmartNet 3.x system or Astro 4.x system (on the analog part only)

The following hardware and firmware are required:

- Radio firmware version 6.3E and above for digital trunked ASTRO IV&D. (For 6.3E, HOST R04.51.01 DSP R04.50.00; for 6.5 HOST R05.00.00 and DSP R05.00.00)
- Radio firmware version 6.5E and above for analog trunked system (DSP version R06.00.00 for radio firmware R06.01.00)
- ASTRO Infrastructure version SR6.3 and above for trunked ASTRO IV&D
- Smartnet version 3.x or Astro version 4.x for analog trunked system
- ACE3600 firmware 10.00 and above
- ACE3600 System Tools Suite (STS) version 10.50 and above

The FLN3649A/FLN3640A installation kits include a bracket, cables, and screws.

IMPORTANT: The XTL5000/XTL2500 radio control head must be radio option O5 for revolving power button control head.

Installation

The XTL5000/XTL2500 radio can be mounted on the ACE3600 RTU using the metal bracket and cables as follows:

Procedure 13-1 How to Install the XTL5000/XTL2500 Radio on the Metal Chassis

1. Attach the radio plug-in port from the installation kit (FLN3696A) to the desired opening on the ACE3600 CPU module. For instructions on attaching plug-in ports, see Connecting Plug-In Ports to the CPU Module in the CPU Module chapter above.
2. Attach the XTL5000/XTL2500 radio to the metal bracket (#0789422V41 from FHN6895A) using the four supplied radio screws (#0310906A67), two on each side. (See Figure 13-1.) The wider side of the bracket should be on the right side of the radio (closer to the knobs.)
3. Connect the 26-pin connector of the signal cable (FKN8432A for digital mode or FKN8438A for analog mode) to the Accessory connector on the radio. In analog mode only, place one Fair-Rite soft ferrite (#7683477X01 from the supplied ferrite kit

FHN7007A) on the signal cable (FKN8438A) near the bottom of the CPU door, loop the cable one turn around it, and clamp the ferrite on the cable.
Connect the other end of the communication cable to the ACE3600 CPU module port configured for the radio. (See Figure 13-2 and Figure 13-4.) For digital mode use any of the serial on-board or plug-in ports. For analog mode only the plug-in ports may be used. See RTU Port Configuration for the Astro IV&D Digital Radio and RTU Port Configuration for the Astro IV&D Analog Trunked Radio below.

4. Connect the DC power cable (FKN8436A) to the Power connector on the radio and the free red wire to the ignition pin on the FKN8432A/FKN8438A cable. Connect the opposite end of the power cable to the AUX2A or AUX2B connector on the ACE3600 power supply unit. (See Figure 13-2 and Figure 13-4.)

Figure 13-1 XTL5000/XTL2500 Radio and Metal Bracket

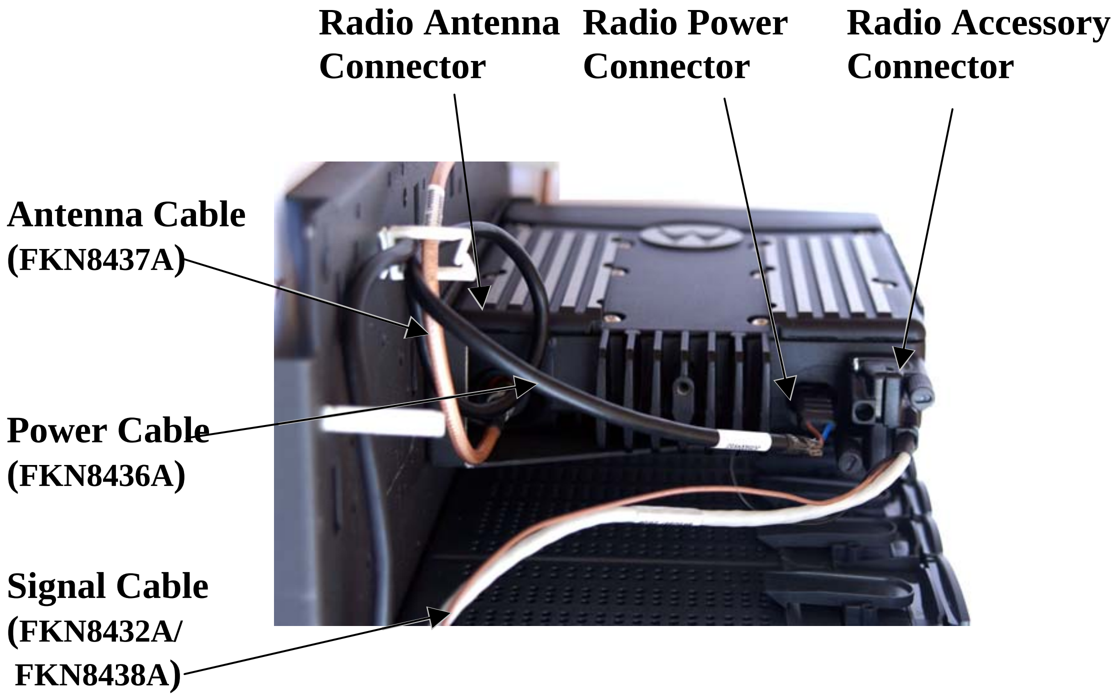


Figure 13-2 XTL5000/XTL2500 Radio Cable Connections- Rear View

5. Mount the bracket on the RTU chassis above the CPU and I/O modules, using the four built-in screws. (See Figure 13-4.) The wider side of the bracket is attached to the chassis.

6. Connect the antenna cable (FKN8437A) to the Antenna connector on the radio. Run the cable through the small white clips along the edge of the chassis and attach the connector to the opening on the bottom of the ACE3600 RTU housing. (See Figure 13-2 and Figure 13-4.)

Figure 13-3 XTL5000/XTL2500 Radio Bracket with Four Bracket Mounting Screws

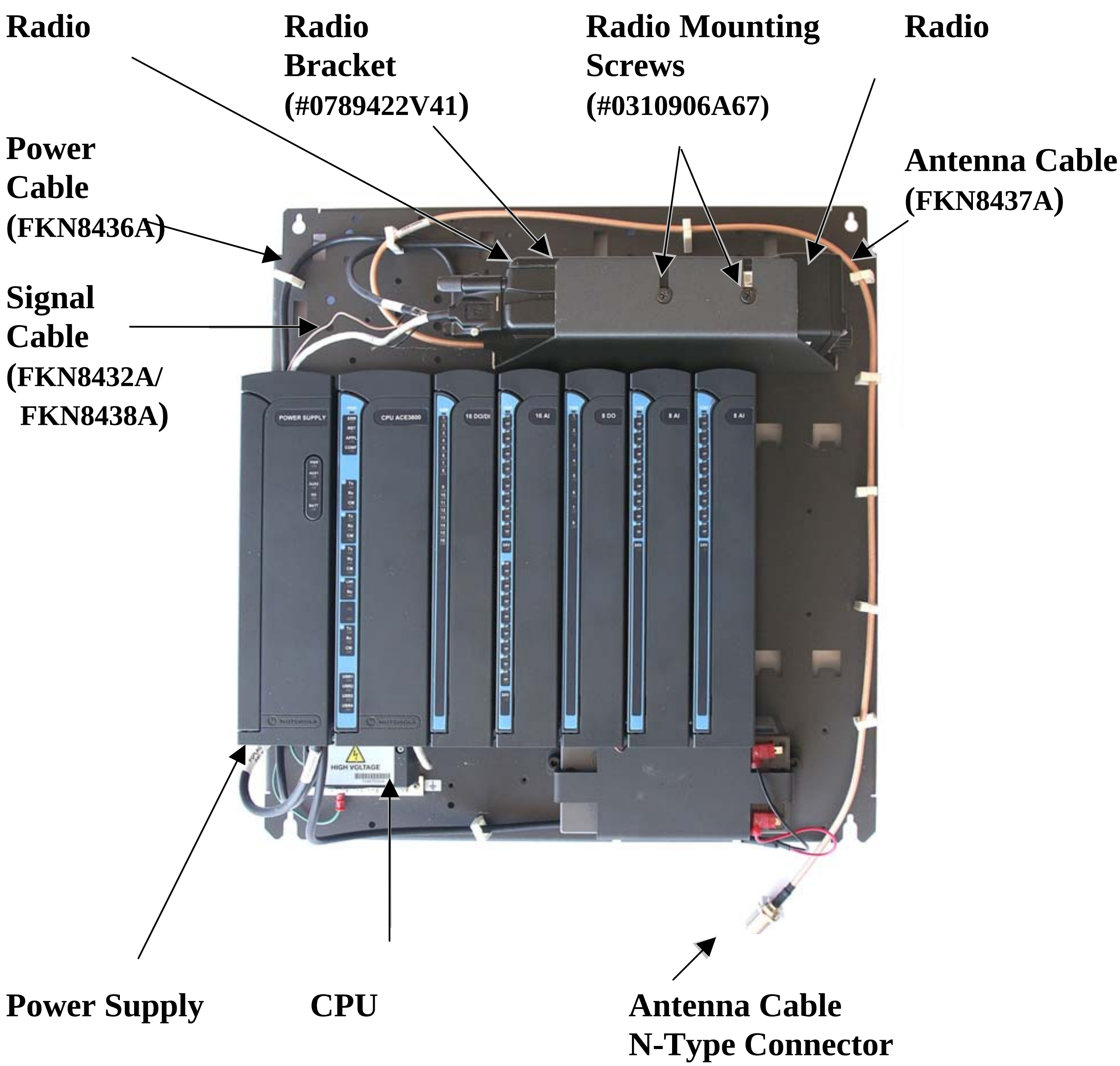


Figure 13-4 XTL5000/XTL2500 Radio Installed on ACE3600 Chassis

RTU Port Configuration for the Astro IV&D Digital Radio

To enable MDLC communication using Astro XTL5000/XTL2500 radios, use the ACE3600 STS site configuration utility to configure the ACE3600 RTU port connected to the radio. For more information, refer to the IP Communications chapter of the ACE3600 STS Advanced Features manual.

The following figures show the port configuration and advanced parameter configuration. Although these show Port SI1, the same values can be applied to other ports, where relevant.

Port Type (for Astro IV&D Digital Radio)

Procedure 13-2 How to Configure the ACE3600 Port for the Astro IV&D Digital Radio

1. In the ACE3600 STS click on the desired site, and open the site view.
2. In the Port Tab, click on the on-board or plug-in port through which the RTU will communicate with the XTL5000/XTL2500 radio.
3. Confirm that the port parameters and data speed are as shown in the screen below.
4. Define desired links.
5. If you plan to synchronize the RTU time from the Front End Processor (FEP) in the Customer Enterprise Network (CEN), specify the IP address of the FEP in the NTP field. This IP address information is provided by your ASTRO IV&D system operator.
6. Save the changes.

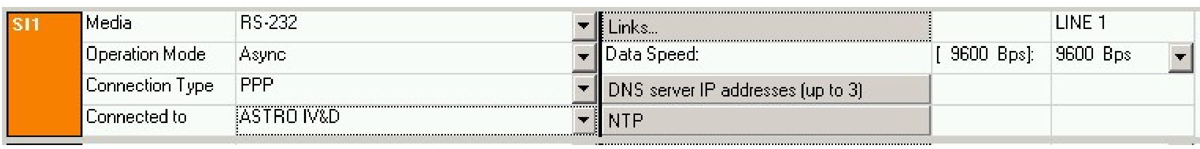


Figure 13-5 RTU Site Configuration for MDLC over ASTRO IV&D – Port Type Parameters

Advanced Parameter Configuration (for Astro IV&D Digital Radio)

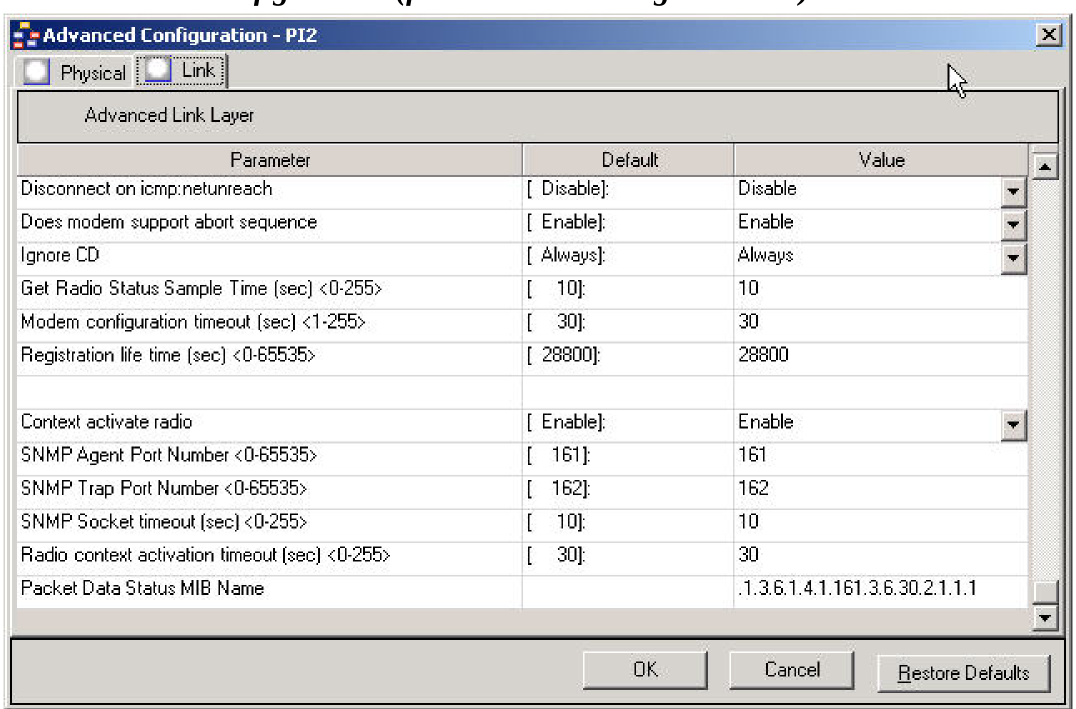


Figure 13-6 RTU Site Configuration for MDLC over ASTRO IV&D – Advanced Parameters

Generally no other changes are required to Advanced Physical or Link Layer parameters. For information on these parameters, see the MDLC over IP chapter of the ACE3600 STS Advanced Features manual.

Procedure 13-3 How to Configure the Advanced Parameters of the ACE3600 Port for the Astro IV&D Digital Radio

1. (ASTRO System 6.3-6.5 only) Make sure that the Advanced Link parameter Registration life time to 28800 seconds (default) in order to restart the radio periodically.

2. If any changes are required, click on the appropriate screen in the Port Tab.

3. Change the settings as necessary.
   Note: The Default Group ID Address should be left 000.000.000. The actual values will be read by the RTU from the radio upon connection.

4. Save any changes.

5. Save the project.

6. Download the site configuration to the ACE3600 RTU.

IP Conversion Table (for Astro IV&D Digital Radio)

Prepare an IP conversion table if the RTU must communicate with another RTU or an IP Gateway. In the IP conversion table, specify the IP address of each RTU port (site ID + link ID). This IP address is assigned by the infrastructure operator.

Note that an IP address is obtained from the radio once it is connected to the RTU port over PPP. The IP address obtained from the radio is not the real IP address set by the infrastructure, but rather a dummy address. This dummy is configured in the radio via the CPS Mobile Computer IP address parameter (by default 192.168.128.2).

When device LINxL level 0 is retrieved using the ACE3600 STS Software Diagnostics tool, the IP Address displayed is this dummy address and not the actual IP address assigned by the infrastructure operator.

It is recommended to create two IP conversion tables:

1. The first is downloaded to the FIU or IP Gateway on the LAN and includes the site and IP information for each RTU.

2. The second is downloaded to all RTUs which are connected to the infrastructure with ASTRO IV&D radios, and includes the site and IP information for the FIU and IP Gateway.

For detailed instructions on preparing the IP conversion table, refer to the IP Communications chapter of the ACE3600 STS Advanced Features manual.

Radio Programming using CPS for the Astro IV&D Digital

The XTL5000/XTL2500 radio is programmed for ACE3600 in the factory and is ready for ASTRO IV&D communication. For user programming of site-specific parameters, the radio should be brought to the Motorola Service Center.

Radio Connections

To program the XTL5000/XTL2500 radio with Customer Programming Software (CPS), the radio must be connected to a PC.

Procedure 13-4 How to Connect the XTL5000/XTL2500 Radio to the CPS

1. Connect one end of the programming cable (HKN6155) to the microphone connector on the front of the radio. This cable is not supplied and must be ordered separately.
2. Connect the other end to the serial port of a PC on which the ASTRO CPS software (RVN4185) is installed.

Radio Disassembly

If the XTL5000/XTL2500 radio is to be programmed outside of the ACE3600 housing, disassemble the radio as follows:

Procedure 13-5 How to Disassemble the XTL5000/XTL2500 Radio from the ACE3600 Metal Chassis

1. Disconnect the antenna cable (FKN8437A) from the Antenna connector on the radio.
2. Remove the radio/bracket unit from the RTU chassis by unscrewing the four built-in screws.
3. Disconnect the DC power cable (FKN8436A) from the Power connector on the radio.
4. Disconnect the 26-pin connector of the signal cable (FKN8432A/FKN8438A) from the Accessory connector on the radio.
5. Detach the metal bracket (#0789422V41 from FHN6895A) by unscrewing the four radio screws (#0310906A67), two on each side. (See Figure 13-1.)
6. Take the radio to a laboratory for programming, as described in CPS Programming Settings below.

CPS Programming Settings

Before programming the radio, read the codeplug file from the radio and save it to your PC using the File >Read Device command in the CPS (R04.01.01 for radio firmware 6.3E; R05.00.00 for firmware 6.5). Open the codeplug file in the CPS and set the parameters as follows.

Procedure 13-6 How to Program the XTL5000/XTL2500 Digital Radio

1. In the CPS, click on the codeplug in the tree view to view and select the items below or select them from the Feature menu.
2. Under Radio Configuration, double-click on Radio Wide.
    a. In the Transmit Power Levels tab, reduce the radio power level to low: Change TX Power Level Low for Freq. Range A from 16.5 to 10. (Range A 700Mhz UHF and VHF).
        1) Change TX Power Level Low for Freq. Range B from 19.0 to 10. (Range B 800Mhz and UHFR2 (470-520Mhz).

2) Change TX Power Level High for Freq. Range A from 33.0 to 15.

3) Change TX Power Level High for Freq. Range B from 38.5 to 15.

b. In the General tab, set the Out of Range Indicator and Imbalanced Coverage Indicator to Alert & Display.

c. (Recommended) In the Data tab, enable SNMP Traps. (You can disable it, but the RTU will only detect a loss of context activation the next time it polls the radio (every 10 seconds by default).

d. (Optional) Specify the Mobile Computer IP address. This is the dummy IP address assigned to the RTU by the radio (by default it is 192.168.128.2). For each radio, it is recommended to change the last digit in the Mobile Computer IP address (e.g. to the Unit ID in Trunking systems.)

e. (CPS R05.00.00 only) In the Advanced tab, make sure that "MOSCAD Data Enable" is not enabled (not checked.) (For IV&D only. For communication over analog ASTRO Trunking, leave it enabled.) Set Extended DEK to Enable and Ignition Switch to Soft Power Off.

3. Double-click on NAT List -> NAT List Entry 1.

a. Add an entry to the NAT List:

1) WAN port = MDLC over IP port number (e.g. 2002)

2) LAN port = MDLC over IP port number (e.g. 2002)

3) Static NAT IP Address = Mobile Computer IP Address (e.g. 192.168.128.2).

4) The Mobile Computer address should match the Mobile Computer IP Address assigned on the Radio Configuration>Radio Wide>Data tab in Step 2 above.

4. Double-click on Trunking ->Trunking System ->Trunking System 1.

a. In the General tab, set the Type to ASTRO 25. If the proper system key was loaded, the System Key field should already be enabled.

b. Set the ASTRO 25 Home System ID, Home WACN ID and Unit ID to values obtained from the radio system administrator.

c. Under Coverage Type, set the type to SmartZone.

d. In the Astro 25 Channel ID tab, enable the first channel.

e. In the 700/800 Astro 25 Control Channels tab (700_800 or OBT depending on the band), enter the control channels with which the data subscriber should be able to affiliate. Consult your radio system administrator for the list of control channels.

f. In the Data tab, enable Packet Data Capable System (PDS), and Terminal Data and disable (uncheck) Rx Voice Interrupts Data.

5. Double-click on Trunking ->Trunking Personality ->Trunking Personality 1.

a. In the General tab, set the Protocol Type to ASTRO 25 and set the System & ID to 1.

b. In the 700/800 Failsoft tab, data only subscribers should set Failsoft Type to disabled. (There is no data service unless the subscriber is affiliated to a wide-area trunking site.)

c. In the Talkgroup tab, set the radio talkgroup value in hexadecimal. Consult your radio system administrator for the talkgroup information.

d. (Recommended) In the Preferred Sites tab, set the status of the first record to None. (This means that data only subscribers are not locked into preferred sites.)

6. Double-click on Zone Channel Assignment ->Zone Channel Assignment.

a. In the Zone tab, set the Zone to the desired zone name (e.g. ZONE1).

b. In the Channels tab, set the Channel to the name which will be displayed on the radio screen (if the radio is Model II or III).

c. Select the Personality type of that channel.

d. Specify the Personality # of that channel.

e. Specify the Talkgroup # of that channel.

7. From the Tools menu, select the Change Control Head command. Make sure the Control Head Type is set to O5(M5) for new models and to W4 for old models, and click OK.

8. From the File Menu, select Save to save changes to the radio.

9. From the File Menu, select Write Device to download the configuration to the radio.

Infrastructure Configuration for the Astro IV&D Digital Radio

In order for the ACE3600 RTU to communicate over the ASTRO IV&D infrastructure (6.4 or later) using the XTL5000/XTL2500 digital radio, the infrastructure must be properly configured using the UCM (User Configuration Manager) tool.

Note: If configuring a border router or any firewall within the CEN (Customer Enterprise network), make sure that the ACE3600's MDLC over IP UDP port number 2002 is enabled for inbound and outbound messages.

Note: In the UCM Radio User Data Settings tab, be sure to set the IP address as Static, to enable Generate ICMP and Source Address Checking, and the Ready timer set to 10 seconds.

RTU Port Configuration for the Astro IV&D Analog Trunked Radio

To enable MDLC communication using Astro XTL5000/XTL2500 radios, use the ACE3600 STS site configuration utility to configure the ACE3600 RTU port (either on-board serial or plug-in port) connected to the radio. For more information, refer to the IP Communications chapter of the ACE3600 STS Advanced Features manual.

Port Type (for Analog Trunked Radio)

Procedure 13-7 How to Configure the ACE3600 Port for the Astro IV&D Analog Radio

1. In the ACE3600 STS click on the desired site, and open the site view.
2. In the Port Tab, click on the plug-in port through which the RTU will communicate with the XTL5000/XTL2500 radio.
3. Set the port parameters as shown in the screen below. The Trunk system parameter should reflect the type of trunking system (e.g. SmartNet, SmartZone.)
4. Save the changes.

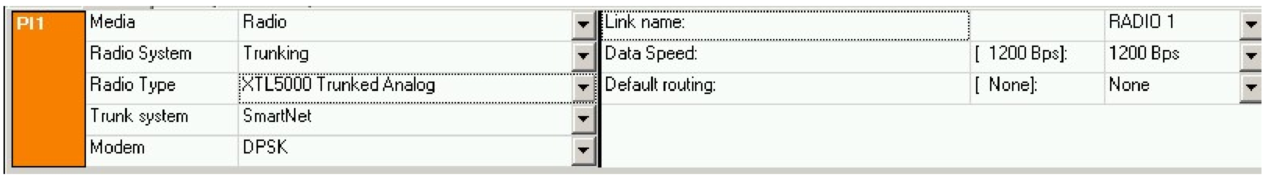


Figure 13-7 RTU Site Configuration for MDLC over Analog Trunked System – Port Type Parameters

Programming the XTL5000/XTL2500 Analog Trunked Radio using CPS

The XTL5000/XTL2500 radio is programmed for ACE3600 in the factory and is ready for analog trunked communication. For user programming of site-specific parameters, the radio should be brought to the Motorola Service Center.

Radio Connections

Follow the Radio Connections instructions described under Radio Programming using CPS for the Astro IV&D Digital above.

Radio Disassembly

Follow the Radio Disassembly instructions described under Radio Programming using CPS for the Astro IV&D Digital above.

CPS Programming Settings

Before programming the radio, read the codeplug file from the radio and save it to your PC using the File >Read Device command in the CPS (DSP version R06.00.00 for radio firmware R06.01.00.) Open the codeplug file in the CPS and set the parameters as follows.

Procedure 13-8 How to Program the XTL5000/XTL2500 Analog Radio

1. In the CPS, click on the codeplug in the tree view to view and select the items below or select them from the Feature menu.
2. Under Radio Configuration, double-click on Radio Wide.
   a. In the Transmit Power Levels tab, reduce the radio power level to low: Change TX Power Level Low for Freq. Range A from 28.0 to 10.
      1) Change TX Power Level High for Freq. Range A from 53.5 to 15.

b. In the Advanced tab, make sure that "MOSCAD Data Enable" is enabled. Set Extended DEK to Enable and Ignition Switch to Soft Power Off.

c. In the Time Out Timer tab, make sure the Time # is set to 3 (for 60 sec).

3. Double-click on Controls.

   a. Click on Control Head.

   b. Make sure the Control Head is O5(M5) for new models and W4 for old models.

   c. Click on Radio VIP.

      1) Set VIP In for VIP 1, VIP 2, and VIP 3 to Blank.

      2) Set VIP Out for VIP 1 to MOSCAD CG.

      3) Set VIP Out for VIP 2 to MOSCAD TXE/CM.

      4) Set VIP Out for VIP 3 to NULL.

4. Double-click on Conventional ->Conventional Personality -> Conventional Personality 1.

   a. In the Rx Options tab, set Unmute/Mute Type to UnMute, Or Mute.

   b. Set Rx Voice/Signal Type to Non-Astro.

   c. Enable (check) Rx Emphasis and Busy LED.

   d. In the Tx Options tab, make sure that the Time Out Timer is set to 3 (for 60 sec).

   e. Set Tx Voice/Signal Type to Non-Astro.

   f. Set Transmit Power Level to High.

5. Double-click on Trunking ->Trunking System ->Trunking System 1.

   a. In the General tab, if the proper system key was loaded, the System Key field should already be enabled.

   b. Set the Type to II.

   c. Set the Type II System ID, and Connect Tone to values obtained from the radio system administrator for the site.

   d. Under Coverage Type, set the type to Disabled.

   e. In the Type II tab, set the Individual ID to the value obtained from the radio system administrator for the site.

   f. Set the Affiliation type to Automatic.

   g. In the Channel Assignment tab, enter the Rx and Tx channel ranges. Consult your radio system administrator for the list of values.

h. In the OBT Control Channels tab, set the RX Frequency and TX Frequency of each control channel with which the data subscriber should be able to affiliate. Consult your radio system administrator for the list of control channels.

6. Double-click on Trunking ->Trunking Personality ->Trunking Personality 1.

   a. In the General tab, set the Protocol Type to II and set the System ID to the value obtained from the radio system administrator for the site. Make sure that the Time Out Timer is set to 3 (for 60 sec). Check that the Type II Individual ID is set to the value obtained from the radio system administrator for the site.

   b. In the Talkgroup tab, set the radio talkgroup value in hexadecimal. Consult your radio system administrator for the talkgroup information. (Note: Talkgroup for voice in analog trunking is the same for voice and data on analog trunk.

7. From the File Menu, select Save to save changes to the radio.

8. From the File Menu, select Write Device to download the configuration to the radio.

XTL5000/XTL2500 Radio Models and Options for ACE3600

The XTL5000/XTL2500 radio installation kit is used with one of the following XTL5000/XTL2500 radio:

Description	Nomenclature	Band
XTL5000 Mobile 10-35 W, 764-870MH	M20URS9PW1 N	764 - 870 MHz
XTL5000 UHF R1 Mobile 10-40 W 380-470	M20QSS9PW1 N	380 - 470Mhz
XTL5000 UHF R2 450-520 MHZ 10-45 W	M20SSS9PW1 N	450 - 520Mhz
XTL5000 VHF Mobile 10-50 W 136-174 MHZ	M20KSS9PW1 N	136 - 174Mhz
XTL2500 Mobile 10-35 W, 764-870MHz	M21URM9PW1N	764-870 MHz
XTL2500 Mobile 10-40 W, 380-470MHz	M21QSM9PW1 N	380-470MHz
XTL2500 Mobile 10-45 W, 450-520MHz	M21SSM9PW1 N	450-520 MHz
XTL2500 Mobile 10-50 W, 136-174MHz	M21KSM9PW1 N	136-174 MHz

All of the following options may be ordered with the XTL5000/XTL2500 radio:

Option Name	Option Number
ADD: O5 CONTROL HEAD	G442
ADD: NO MICROPHONE NEEDED	G90
ENH: SOFTWARE ASTRO DIGITAL CAI OPERATION	G806
ENH: ASTRO PROJECT 25 TRUNKING SOFTWARE	G361
ADD: CONTROL HEAD SOFTWARE, O5	G444
ENH: SMARTZONE OPERATION	G51
ENH: RS232 PACKET DATA INTERFACE	W947

Option Name	Option Number
ADD: DASH MOUNT	G66
ADD: NO SPEAKER	G142
ADD: NO ANTENNA	G89

XTS2500 Radio Installation Kit

The XTS2500 radio installation kit (ACE3600 option V156AG or kit FLN3814A) enables the user to install the XTS2500 radio in ACE3600 Remote Terminal Units (RTU). The RTU can use the XTS2500 in digital mode to communicate over the ASTRO 6.x/7.x system. The following hardware and firmware are required:

- Radio firmware version 6.4 and above for trunked IV&D
- ASTRO Infrastructure version SR6.5 and above for trunked IV&D
- ACE3600 firmware 10.00 and above
- ACE3600 System Tools Suite (STS) version 10.50 and above

The installation kit includes brackets, cables, screws and installation instructions.

After the XTS2500 radio is installed in the RTU, the RTU port is configured, the IP address information is downloaded, the radio is context activated and finally, communication from the RTU over the air is verified. For more information on MDLC over ASTRO IV&D (Integrated Voice & Data), refer to the MDLC over IP chapter of the ACE3600 STS Advanced Features Manual.

Installation

CAUTION

Before installing the XTS2500 radio on the RTU, configure the power supply AUX2A/B connector to 7.5V DC in the ACE3600 STS site configuration (using the Power Supply <n> Auxiliary 2 voltage parameter.) Download the updated site configuration to the RTU. Failure to do so might damage the radio.

The installation kit includes a radio bracket, metal bracket with built-in screws, power cables, communication cable, antenna cable and plastic strips. The XTS2500 can be mounted on the ACE3600 RTU using the kit as follows:

Procedure 13-9 How to Install the XTS2500 Radio on the Metal Chassis

1. Attach the XTS 2500 radio to the radio bracket (from FHN6674A). (See Figure 13-8.)

2. Connect the programming cable (RKN4106A) provided with the radio to the Accessory connector on the radio. (See Figure 13-10.) Connect the other end of the programming cable to the 9-pin D-type (Radio) connector on the communication cable (FKN8516A) and tighten the screws attached to the programming cable. Do not use the 25-pin connector; it is for programming only.

3. Connect the other end of the communication cable (RJ45 connector) to the plug-in port of the ACE3600 CPU.

4. Connect the 7.5V DC power cable (FKN8515A) to the AUX2A or AUX2B auxiliary power output connector on the RTU power supply. Connect the other end of the power cable to the DC adapter on the radio bracket (FHN6674A). (See Figure 13-9 and Figure 13-10.)

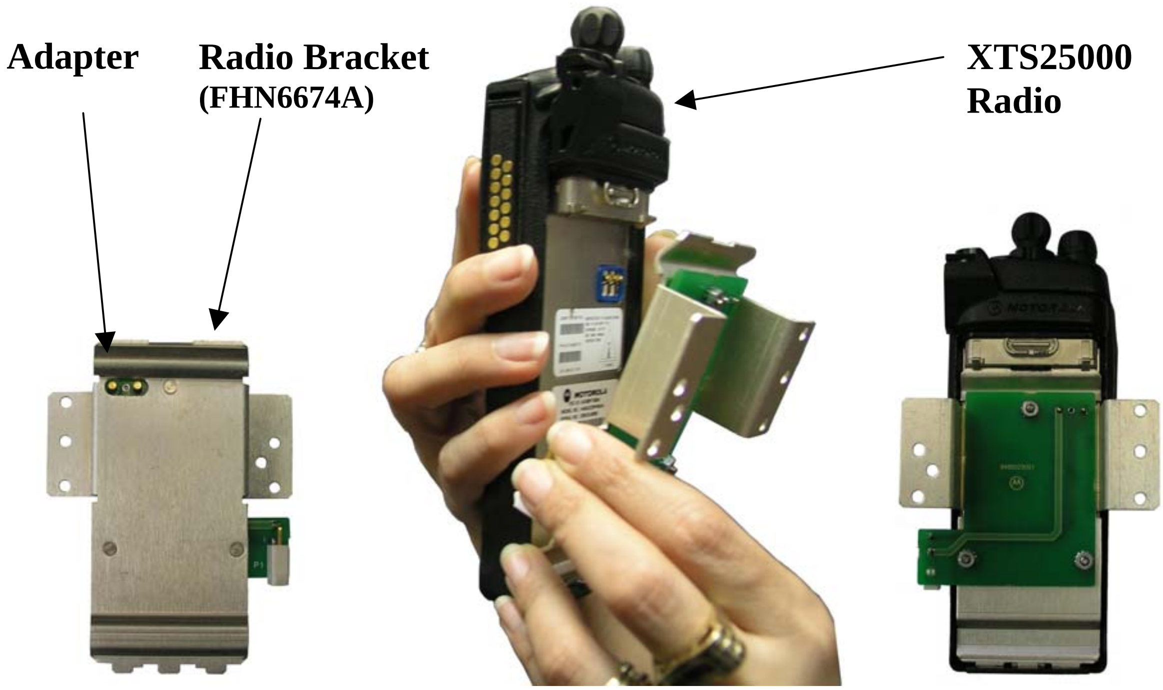


Figure 13-8 XTS2500 Radio and Metal Bracket

5. Add the BNC adapter (#5871143Y04) to the XTS2500 radio antenna connector. (See Figure 13-9.)

6. Attach the BNC connector of the antenna cable (FKN8434A) to the radio's BNC adapter. Route the antenna cable through the small wire clamps along the left side edge of the RTU chassis, according to the placement of the radio on the chassis. Attach the N-type connector at the other end to the opening on the bottom of the RTU housing using the supplied locking washer and nut. (See Figure 13-9.)

7. Mount the radio/bracket unit on the metal bracket (#0789422V40 from FHN6674A) using the four supplied screws.

8. Mount the metal bracket on the RTU chassis above the I/O modules, using the three built-in screws, with the bottom of the radio towards the chassis. (See Figure 13-9.)

9. Attach all cables to the chassis using the supplied wire clamps.

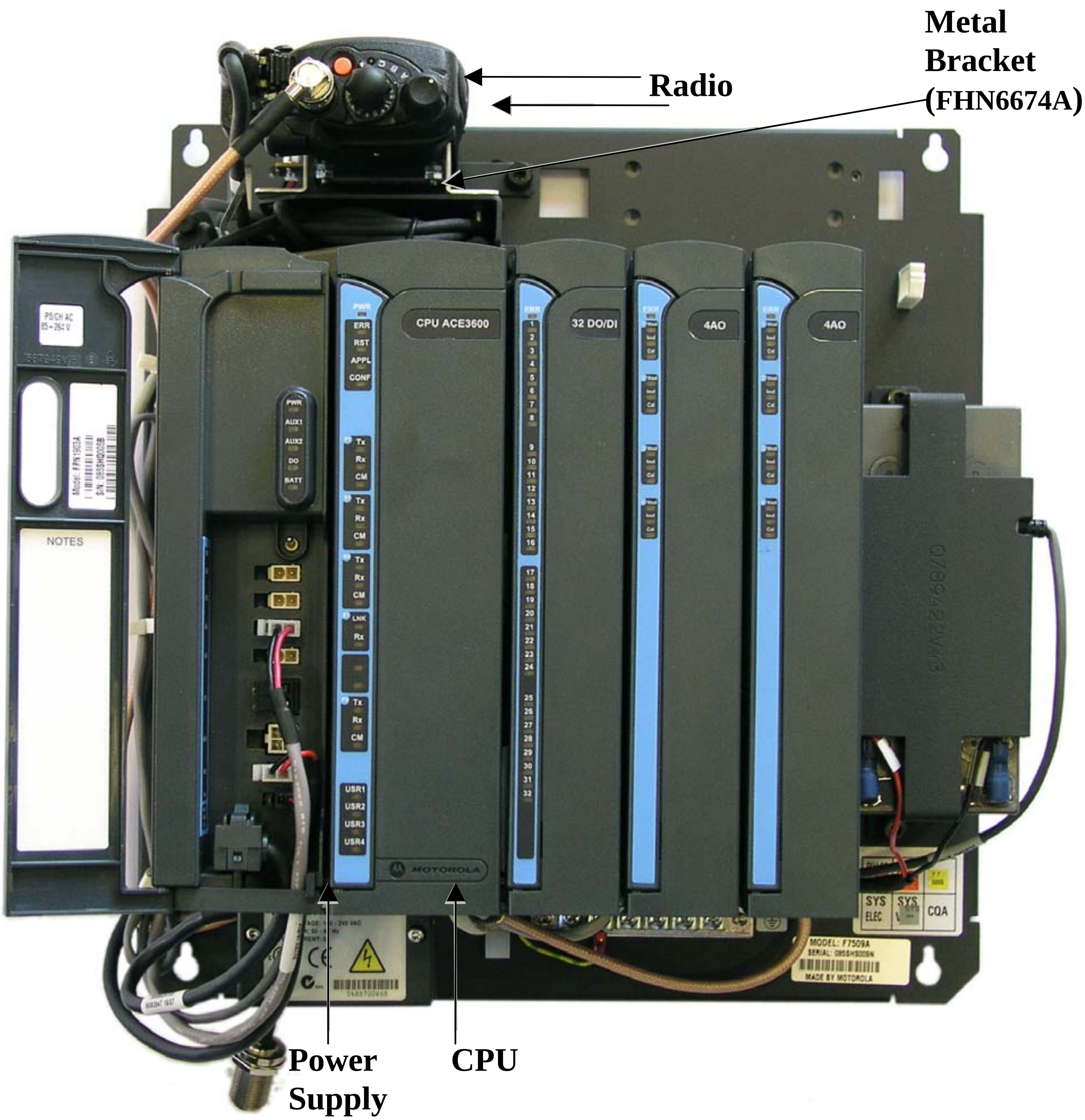


Figure 13-9 XTS2500 Radio Installed on ACE3600 Chassis

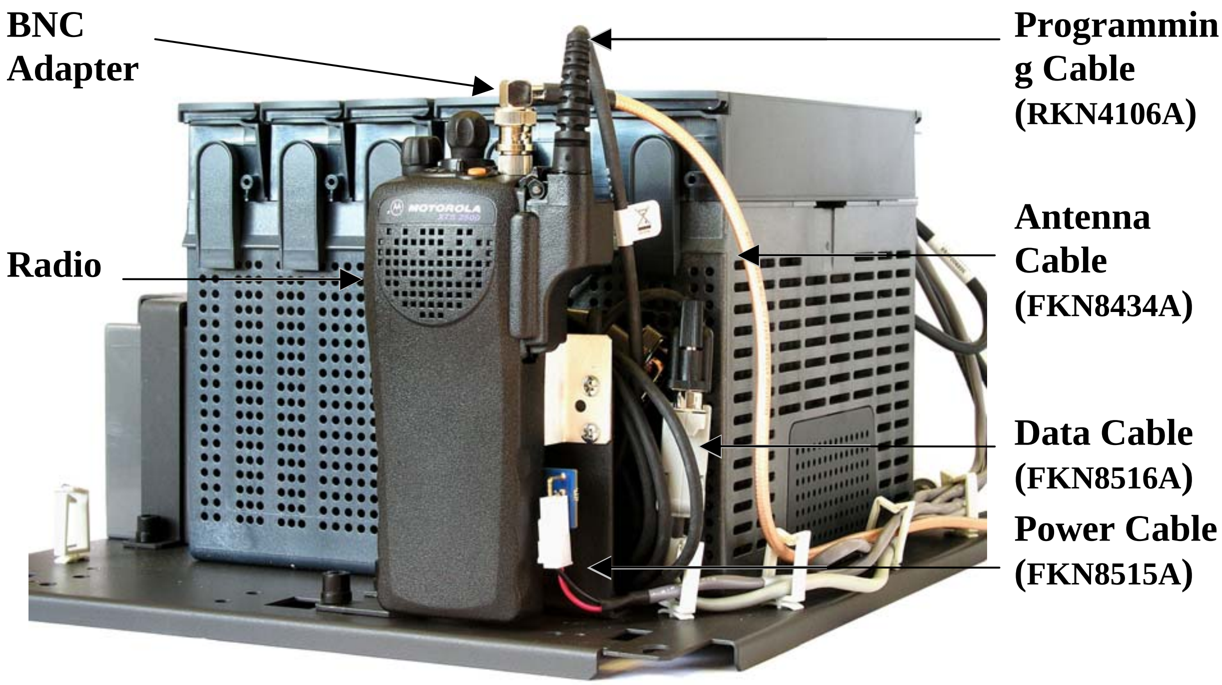


Figure 13-10 XTS2500 Radio Installed on ACE3600 Chassis - Cable Connections

RTU Port Configuration

To enable MDLC communication over ASTRO IV&D, use the ACE3600 STS (≥V10.50) to configure the RTU port connected to the XTS25000 radio. For more information, refer to the MDLC over IP chapter of the ACE3600 STS Advanced Features manual.

The following figures show the port configuration and advanced parameter configuration. Although these show Port SI1, the same values can be applied to other ports, where relevant.

Port Type

Procedure 13-10 How to Configure the ACE3600 Port for the Astro XTS2500 Digital Radio

1. In the ACE3600 STS click on the desired site, and open the site view.
2. In the Port Tab, click on the on-board or plug-in port through which the RTU will communicate with the XTS2500 radio.
3. Confirm that the port parameters and data speed are as shown in the screen below.
4. Define desired links.
5. If you plan to synchronize the RTU time from the Front End Processor (FEP) in the Customer Enterprise Network (CEN), specify the IP address of the FEP in the NTP field. This IP address information is provided by your ASTRO IV&D system operator.
6. Save the changes.

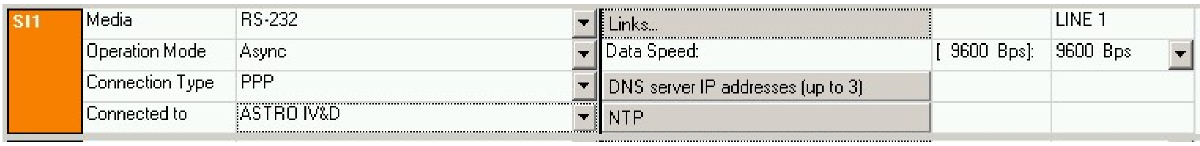


Figure 13-11 RTU Site Configuration for MDLC over ASTRO IV&D – Port Type Parameters

Advanced Parameter Configuration

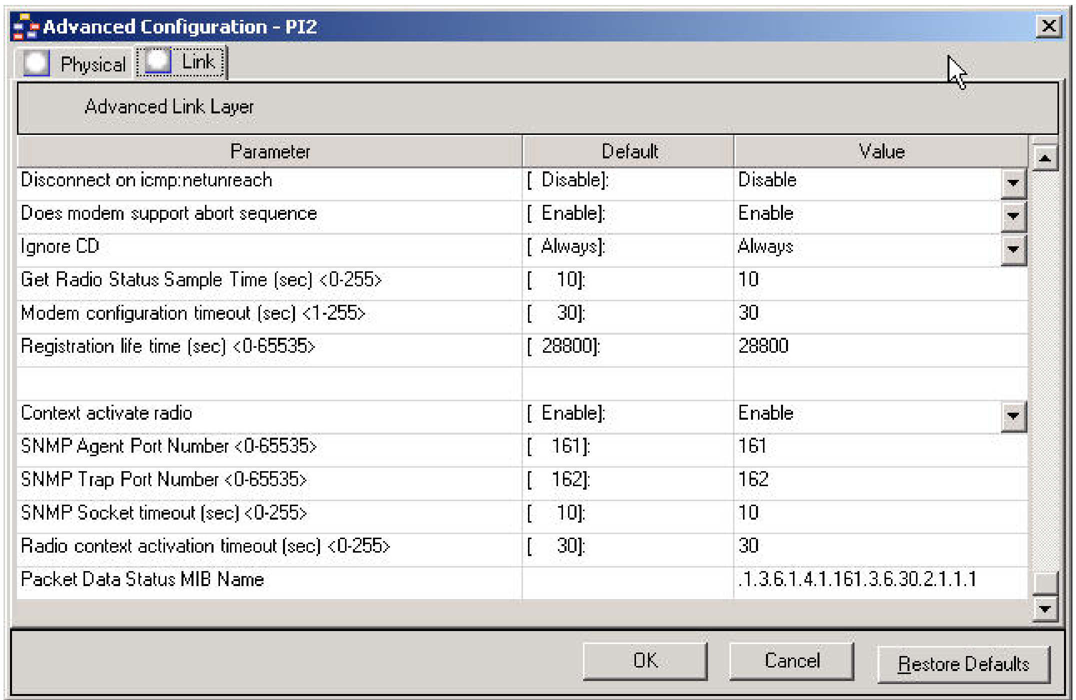


Figure 13-12 RTU Site Configuration for MDLC over ASTRO IV&D – Advanced Parameters

Generally no other changes are required to Advanced Physical or Link Layer parameters. For information on these parameters, see the MDLC over IP chapter of the ACE3600 STS Advanced Features manual.

Procedure 13-11 How to Configure the Advanced Parameters of the ACE3600 Port for the Astro XTS2500 IV&D Digital Radio

1. (ASTRO System 6.3-6.5 only) Make sure that the Advanced Link parameter Registration life time to 28800 seconds (default) in order to restart the radio periodically.

2. If any changes are required, click on the appropriate screen in the Port Tab.

3. Change the settings as necessary.
   Note: The Default Group ID Address should be left 000.000.000. The actual values will be read by the RTU from the radio upon connection.

4. Save any changes.

5. Save the project.

6. Download the site configuration to the ACE3600 RTU.

IP Conversion Table (for Astro XTS2500 IV&D Digital Radio)

Prepare an IP conversion table if the RTU must communicate with another RTU or an IP Gateway. In the IP conversion table, specify the IP address of each RTU port (site ID + link ID). This IP address is assigned by the infrastructure operator.

Note that an IP address is obtained from the radio once it is connected to the RTU port over PPP. The IP address obtained from the radio is not the real IP address set by the infrastructure, but rather a dummy address. This dummy is configured in the radio via the CPS Mobile Computer IP address parameter (by default 192.168.128.2).

When device LINxL level 0 is retrieved using the ACE3600 STS Software Diagnostics tool, the IP Address displayed is this dummy address and not the actual IP address assigned by the infrastructure operator.

It is recommended to create two IP conversion tables:

1. The first is downloaded to the FIU or IP Gateway on the LAN and includes the site and IP information for each RTU.
2. The second is downloaded to all RTUs which are connected to the infrastructure with ASTRO IV&D radios, and includes the site and IP information for the FIU and IP Gateway.

For detailed instructions on preparing the IP conversion table, refer to the IP Communications chapter of the ACE3600 STS Advanced Features manual.

Radio Programming using CPS for the Astro XTS2500 IV&D Digital

The XTS2500 radio is programmed for ACE3600 in the factory and is ready for ASTRO IV&D communication. For user programming of site-specific parameters, the radio should be brought to the Motorola Service Center.

Radio Connections

To program the XTS2500 radio with Customer Programming Software (CPS), the radio must be connected to a PC.

Procedure 13-12 How to Connect the XTS2500 Radio to the CPS

1. Power on the radio.
2. Disconnect the programming cable (RKN4106A) from the 9-pin D-type (Radio) connector on the data cable (FKN8516A).
3. Connect the D-type connector of the programming cable (RKN4106A) to the serial port of a PC on which the ASTRO CPS software is installed.
4. Program the radio using the CPS, as described in CPS Programming Settings below.
5. After radio programming, reconnect the communication and programming cables as described in the Installation section above.

Radio Disassembly

If the XTS2500 radio is to be programmed outside of the ACE3600 housing, disassemble the radio as follows:

Procedure 13-13 How to Disassemble the XTS2500 Radio from the ACE3600 Metal Chassis

1. Disconnect the antenna cable (FKN8434A) from the Antenna connector on the radio.
2. Remove the radio/bracket unit from the RTU chassis by unscrewing the three built-in screws.
3. Disconnect the DC power cable (FKN8515A) from the Power connector on the radio.
4. Disconnect the 13-pin connector of the programming cable (RKN4106A) from the Accessory connector on the radio.
5. Detach the metal bracket (#0789422V40 from FHN6674A) by unscrewing the four radio screws (#0310906A67), two on each side. (See Figure 13-9.)
6. Take the radio to a laboratory for programming, as described in CPS Programming Settings below.

CPS Programming Settings

Before programming the radio, read the codeplug file from the radio and save it to your PC using the File->Read command in the CPS (R05.00.00 or above). Open the codeplug file in the CPS and set the parameters as follows.

Procedure 13-14 How to Program the XTS2500 Digital Radio

1. In the CPS, click on the codeplug in the tree view to open the items below.
2. Under Radio Configuration, double-click on Radio Wide.
    a. In the General tab, set the Out of Range Indicator and Imbalanced Coverage Indicator to Alert & Display.
    b. (Recommended) In the Data tab, enable SNMP Traps. (You can disable it, but the RTU will only detect a loss of context activation the next time it polls the radio (every 10 seconds by default).
    c. (Optional) Specify the Mobile Computer IP address. This is the dummy IP address assigned to the RTU by the radio (by default it is 192.168.128.2). For each radio, it is recommended to change the last digit in the Mobile Computer IP address (e.g. to the Unit ID in Trunking systems.)
3. Double-click on NAT List -> NAT List Entry 1.
    a. Add an entry to the NAT List:

        1) WAN port = MDLC over IP port number (e.g. 2002)

        2) LAN port = MDLC over IP port number (e.g. 2002)

        3) Static NAT IP Address = Mobile Computer IP Address (e.g. 192.168.128.2).

The Mobile Computer address should match the Mobile Computer IP Address assigned on the Radio Configuration>Radio Wide>Data tab in Step 2 above.

4. Double-click on Trunking ->Trunking System ->Trunking System 1.

    a. In the General tab, set the Type to ASTRO 25. If the proper system key was loaded, the System Key field should already be enabled.

    b. Set the ASTRO 25 Home System ID, Home WACN ID and Unit ID to values obtained from the radio system administrator.

    c. Under Coverage Type, set the type to SmartZone.

    d. In the Astro 25 Channel ID tab, enable the first channel.

    e. In the 700/800 Astro 25 Control Channels tab (700_800 or OBT depending on the band), enter the control channels with which the data subscriber should be able to affiliate. Consult your radio system administrator for the list of control channels.

    f. In the Data tab, enable Packet Data Capable System (PDS), and Terminal Data and disable (uncheck) Rx Voice Interrupts Data.

5. Double-click on Trunking ->Trunking Personality ->Trunking Personality 1.

    a. In the General tab, set the Protocol Type to ASTRO 25 and set the System & ID to 1.

    b. In the 700/800 Failsoft tab, data only subscribers should set Failsoft Type to disabled. (There is no data service unless the subscriber is affiliated to a wide-area trunking site.)

    c. In the Talkgroup tab, set the radio talkgroup value in hexadecimal. Consult your radio system administrator for the talkgroup information.

    d. (Recommended) In the Preferred Sites tab, set the status of the first record to None. (This means that data only subscribers are not locked into preferred sites.)

6. Double-click on Zone Channel Assignment ->Zone Channel Assignment.

    a. In the Zone tab, set the Zone to the desired zone name (e.g. ZONE1).

    b. In the Channels tab, set the Channel to the name which will be displayed on the radio screen (if the radio is Model II or III).

    c. Select the Personality type of that channel.

    d. Specify the Personality # of that channel.

    e. Specify the Talkgroup # of that channel.

7. From the File Menu, select Save to save changes to the radio.

8. From the File Menu, select Write Device to download the configuration to the radio.

Infrastructure Configuration for the Astro IV&D XTS2500Digital Radio

In order for the ACE3600 RTU to communicate over the ASTRO IV&D infrastructure (6.4 or later) using the XTS2500 digital radio, the infrastructure must be properly configured using the UCM (User Configuration Manager) tool.

Note: If configuring a border router or any firewall within the CEN (Customer Enterprise network), make sure that the ACE3600's MDLC over IP UDP port number 2002 is enabled for inbound and outbound messages.

Note: In the UCM Radio User Data Settings tab, be sure to set the IP address as Static, to enable Generate ICMP and Source Address Checking, and the Ready timer set to 10 seconds.

XTS2500 Radio Models and Options for ACE3600

The XTS2500 radio installation kit is used with one of the following XTS2500 radio:

Description	Nomenclature	Band
XTS2500 PORTABLE 1-3 WATTS, 764-870MH	H46UCC9PW5 N	764-870 MHz
XTS2500 VHF PORTABLE 1-5 WATTS 136-174	H46KDC9PW5 N	136-174 MHz
XTS2500 UHF R1 PORTABLE 1-5 WATTS 380-470	H46QDC9PW5 N	380-470 MHz
XTS2500 UHF R1 PORTABLE 1-5 WATTS 450-520	H46SDC9PW5 N	450-520 MHz

All of the following options may be ordered with the XTS2500 radio:

Option Name	Option Number
ENH: SOFTWARE TRUNKING 9600 BAUD Includes: 9600 Baud, Wide Area SmartZone, OmniLink, ASTRO Digital CAI, & PTT-ID Display	Q574
ENH: RADIO PACKET DATA	Q947
DEL: ANTENNA	H112
DEL: BATTERY ALL TOGETHER	H207
DEL: BELT CLIP	H301
ADD: DATA CABLE	Q157

CDM750 Radio Installation Kit

The CDM750 radio installation kit (ACE3600 option V143AH/kit FLN3638A) enables the user to install the CDM750 radio series in ACE3600 Remote Terminal Units (RTU). The FLN3638A installation kit includes a bracket, adapter, and cables.

Installation

The CDM750 radio can be mounted on the ACE3600 RTU as follows:

Procedure 13-15 How to Install the CDM750 Radio on the Metal Chassis

1. Attach the radio plug-in port from the installation kit (FLN3696A) to the desired opening on the ACE3600 CPU module. For instructions on attaching plug-in ports, see Connecting Plug-In Ports to the CPU Module in the CPU Module chapter above.

2. Connect the radio adapter (FLN3639A) 16-pin connector to the radio Accessory connector (See Figure 13-13.)

3. Connect the power cable (FKN8436A) to the radio power connector, and the opposite end of the cable to the AUX1A or AUX1B connector on the ACE3600 power supply module.

4. Connect the communication cable (FKN8427A) to the rear connector (8-pin RJ45 connector) of FLN3639A. Place one Fair-Rite soft ferrite (#7683477X01 from the supplied ferrite kit FHN7007A) on the cable near the bottom of the CPU door, loop the cable one turn around it, and clamp the ferrite on the cable.
   Connect the other end of the communication cable to the plug-in port of the ACE3600 CPU module.

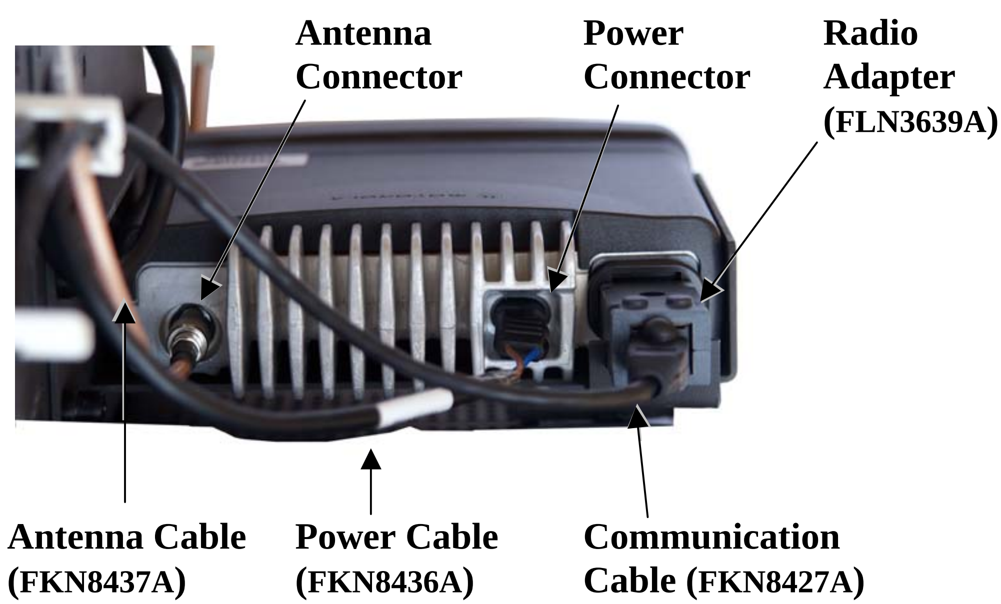


Figure 13-13 CDM750 Antenna, Power and Communication Cable Connections

4. Connect the antenna cable (FKN8437A) to the Antenna connector on the radio and to the opening on the bottom of the ACE3600 RTU housing, using the four supplied screws. See Figure 13-13 and Figure 13-15.)

5. Attach the radio to the bracket (0789422V45 from FHN6898A) by using screws and washers from kit FHN6898A. See Figure 13-14 below.

Figure 13-14 CDM750 Radio and Metal Bracket

6. Attach the complex (radio + bracket) using the four supplied screws to the ACE3600 chassis. See Figure 13-15 below.

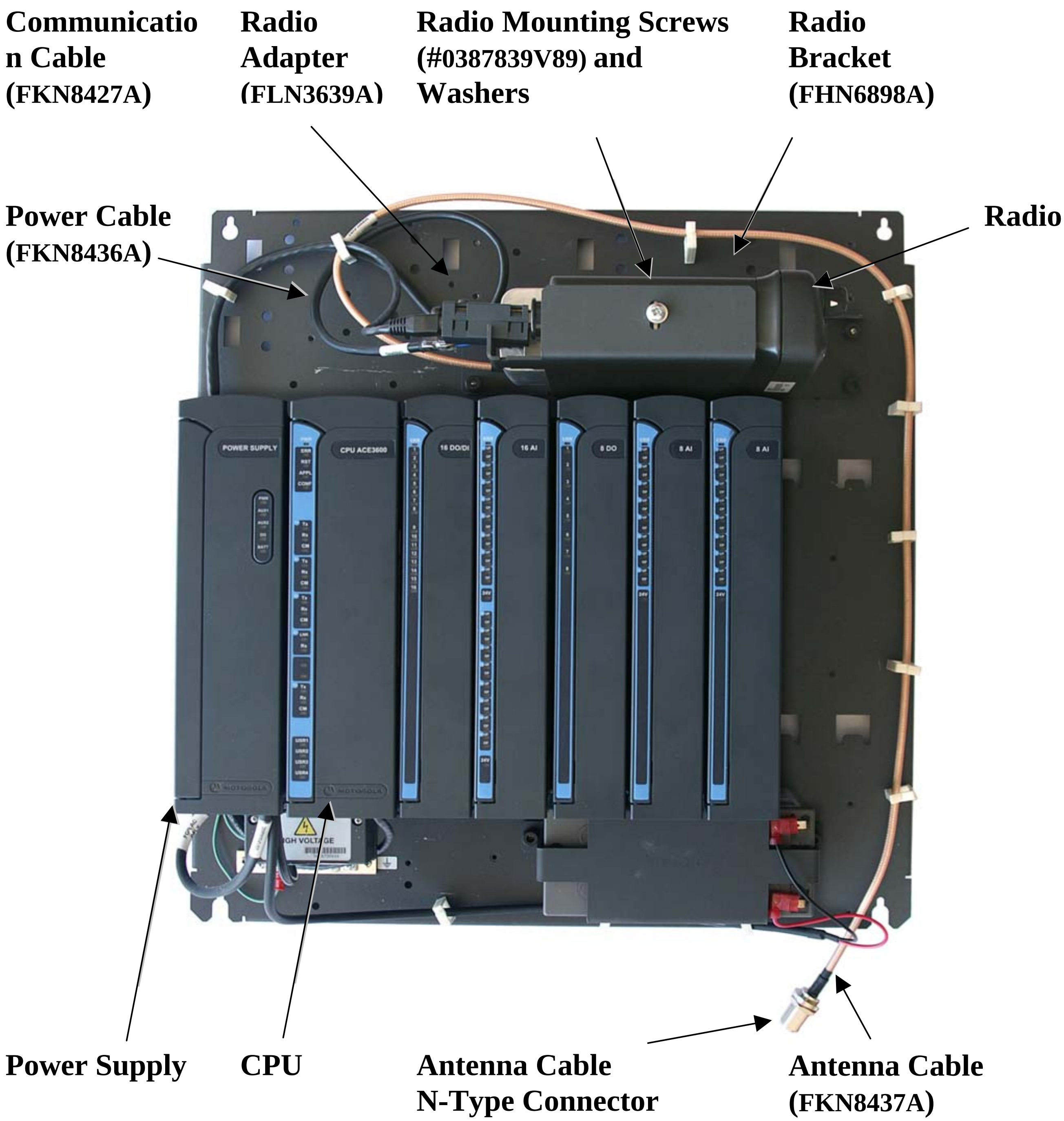


Figure 13-15 CDM750 Radio Installed on ACE3600 Chassis

RTU Port Configuration for the CDM750 Radio

To enable MDLC communication using CDM750 radios, use the ACE3600 STS site configuration utility to configure the ACE3600 RTU plug-in port connected to the radio.

The following figures show the port configuration and advanced parameter configuration. Although these show Port PI1, the same values can be applied to port PI2 as well, where relevant.

Port Type

Procedure 13-16 How to Configure the ACE3600 Port for the CDM750 Radio

1. In the ACE3600 STS click on the desired site, and open the site view.
2. In the Port Tab, click on the plug-in port through which the RTU will communicate with the radio.
3. Confirm that the port parameters and data speed are as shown in the screen below.
4. Define desired radio links and zones if necessary.
5. Save the changes. Generally no other changes are required to Advanced Physical or Link Layer parameters.

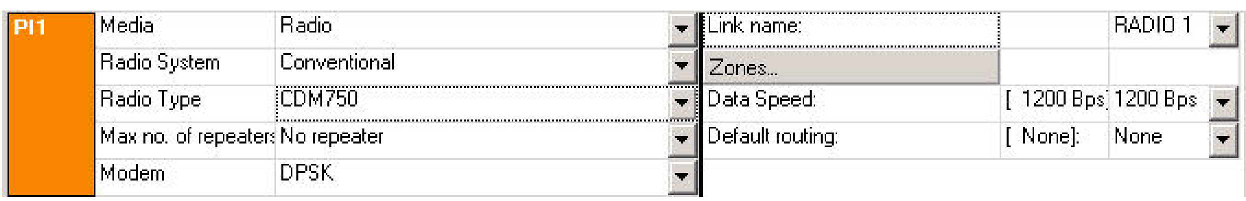


Figure 13-16 RTU Site Configuration for MDLC over CDM750 Radio – Port Type Parameters

Programming the CDM750 Radio using CPS

The CDM750 radio is programmed for ACE3600 in the factory and is ready for communication. For user programming of site-specific parameters, follow the instructions below.

Radio Connections

To program the CDM750 radio with Customer Programming Software (CPS), the radio is connected to a PC using the standard Radio Interface Box (RIB).

Procedure 13-17 How to Connect the CDM750 Radio to the CPS

1. Connect one end of the programming cable (PMKN4004) to the radio Accessory connector and the other end to the 25-pin connector on the RIB (RLN4008). The RIB and cable are not supplied and must be ordered separately.
2. Using the 9-pin interface cable (3080369B72), connect the RIB to the serial port of a PC on which the CDM750 CPS software (HVN9025) is installed.
3. Connect the RIB to a power RIB power supply or 9V battery.

Radio Disassembly

If the CDM750 radio is to be programmed outside of the ACE3600 housing, disassemble the radio as follows:

Procedure 13-18 How to Disassemble the CDM750 Radio from the ACE3600 Metal Chassis

1. Disconnect the antenna cable (FKN8437A) to the radio Antenna connector.
2. Remove the radio/bracket unit from the RTU chassis by unscrewing the four built-in screws.
3. Disconnect the DC power cable (FKN8436A) from the radio Power connector.
4. Disconnect the radio adapter (FLN3639A) 16-pin connector from the radio Accessory connector.
5. Detach the metal bracket (FHN6898A) by unscrewing the two radio screws (#0387839V89), one on each side. (See Figure 13-14.)

CPS Programming Settings

The following programming instructions must be performed before connecting a CDM750 radio to the ACE3600 family Remote Terminal Units (RTU). These instructions define miscellaneous settings and the function of each pin in the radio's general purpose I/O connector.

Procedure 13-19 How to Program the CDM750 Radio

1. Before programming the radio, read the codeplug file from the radio and save it to your PC using the File >Read Device command in the CPS.
2. Open the codeplug file in the CPS. Click on the codeplug in the tree view to view and select the items below or select them from the Feature menu.
3. Under Radio Configuration, change the settings on the Basic, Tx Power, Accessory Configuration, and Accessory Pins tabs, as shown in the screens below.
4. Under Controls and Menus->Conventional Buttons, change the settings to the Mobile Key Buttons and Programmable Buttons tabs, as shown in the screens below.
5. Under Conventional Personality 1, change the settings to the Basic, Options and Advanced tabs, as shown in the screens below.
6. Under Personality Assignment to Zone 1, make sure that the desired channel(s) appear on the list on the Channels tab. If not all the assigned channels are required, remove them from the assignment list.
7. From the File Menu, select Save to save changes to the radio.
8. From the File Menu, select Write Device to download the configuration to the radio.

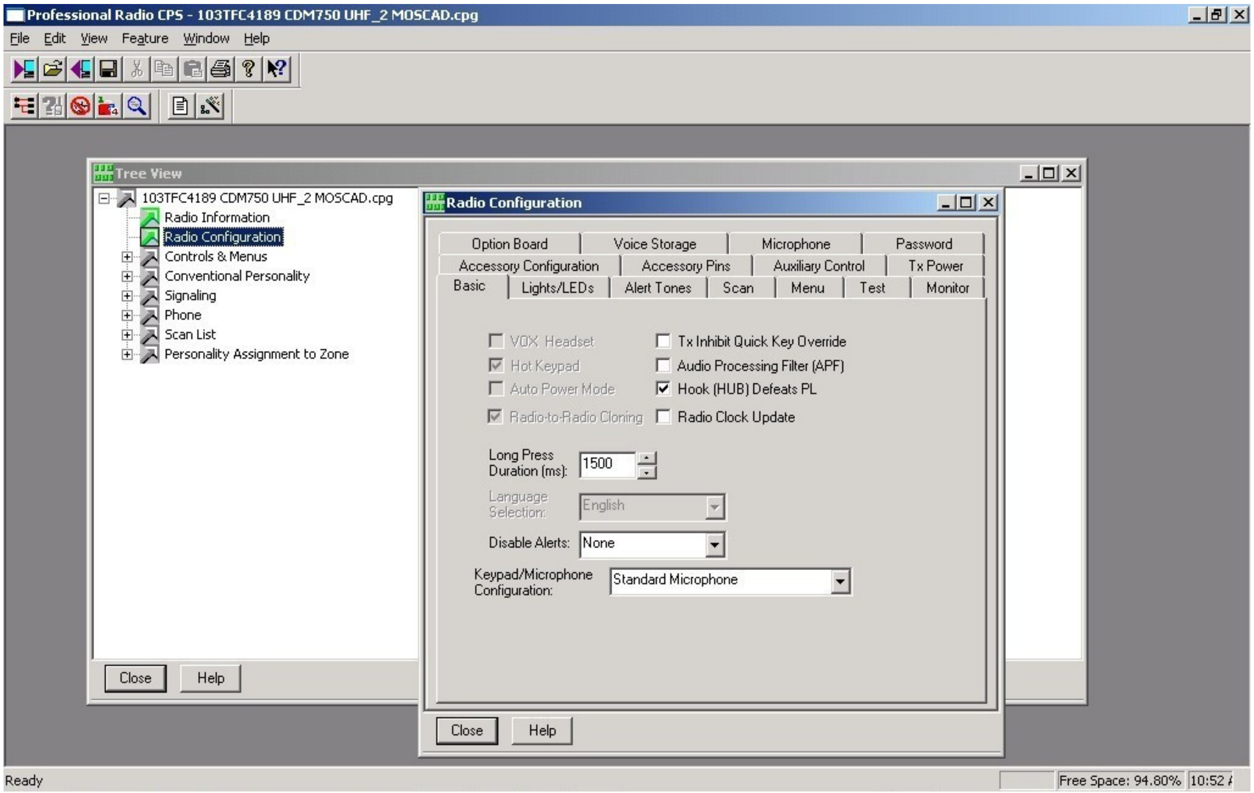


Figure 13-17 Radio Configuration- Basic Settings

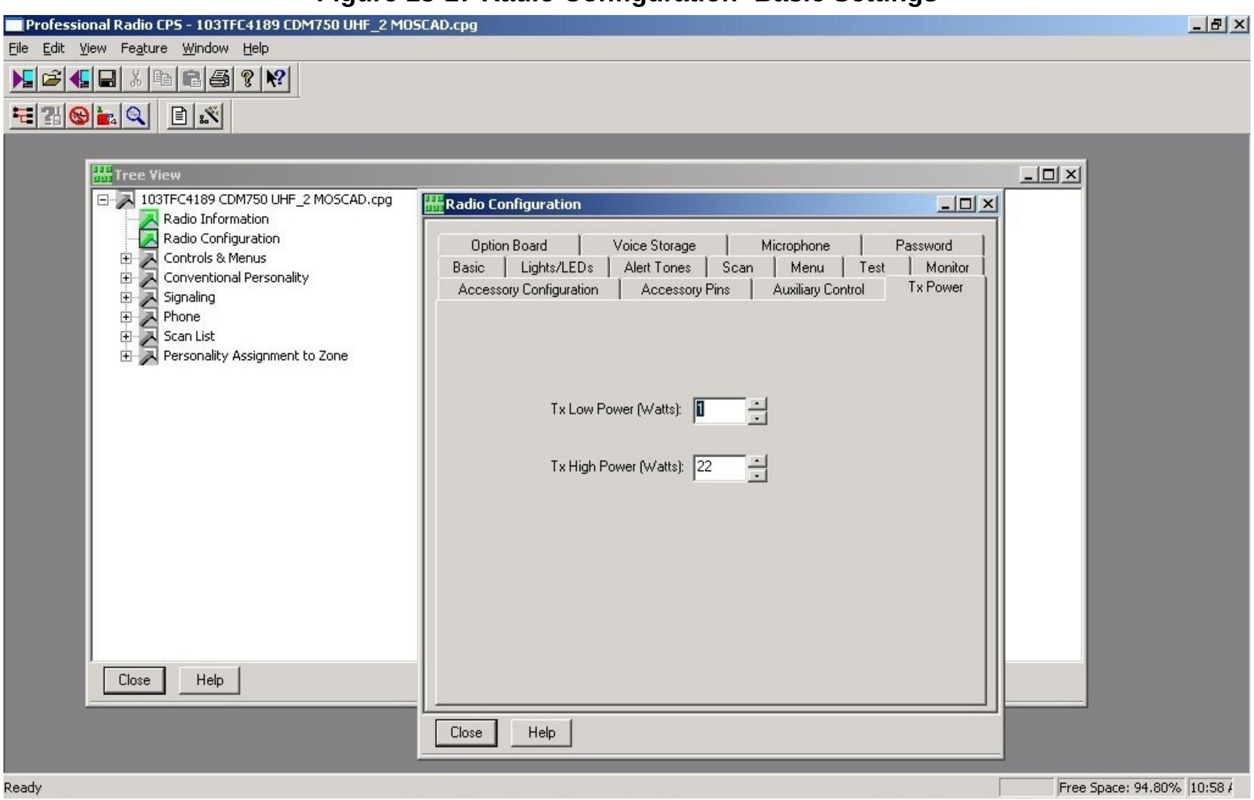


Figure 13-18 Radio Configuration- Tx Power

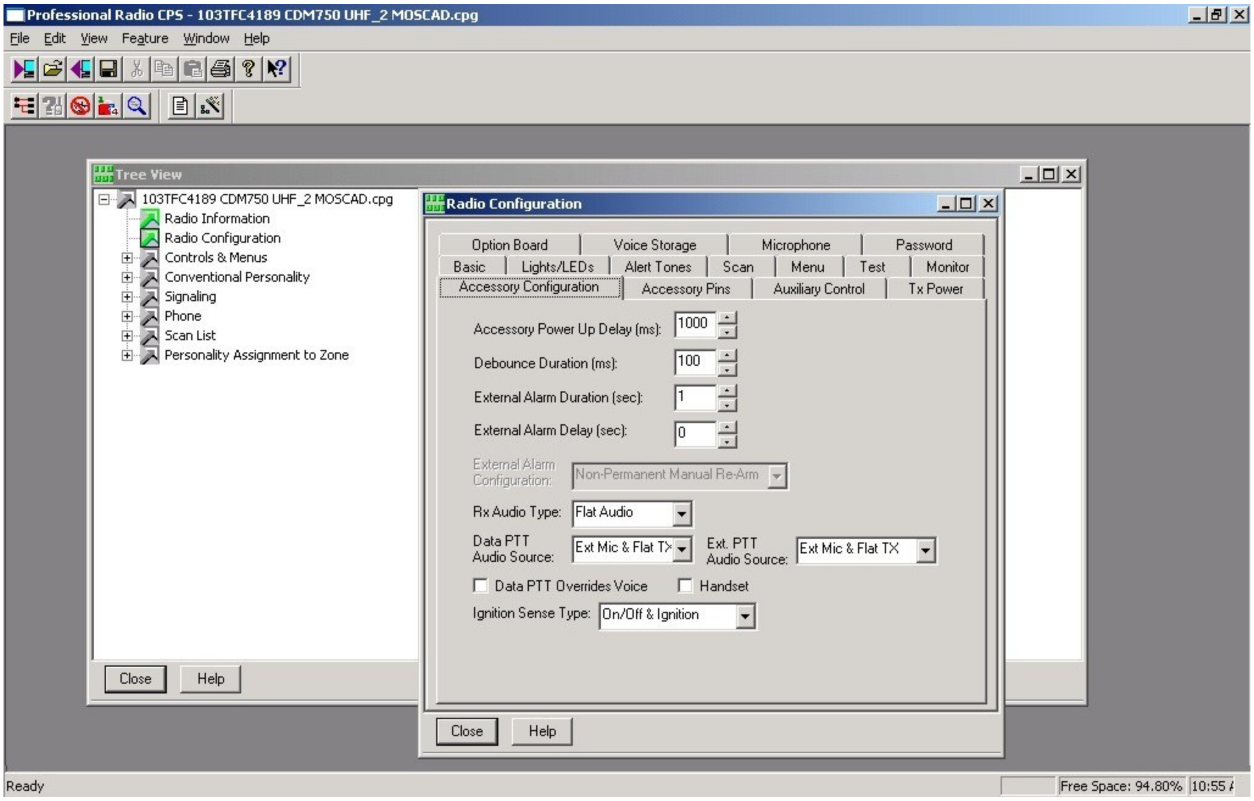


Figure 13-19 Radio Configuration - Accessory Connector Configuration

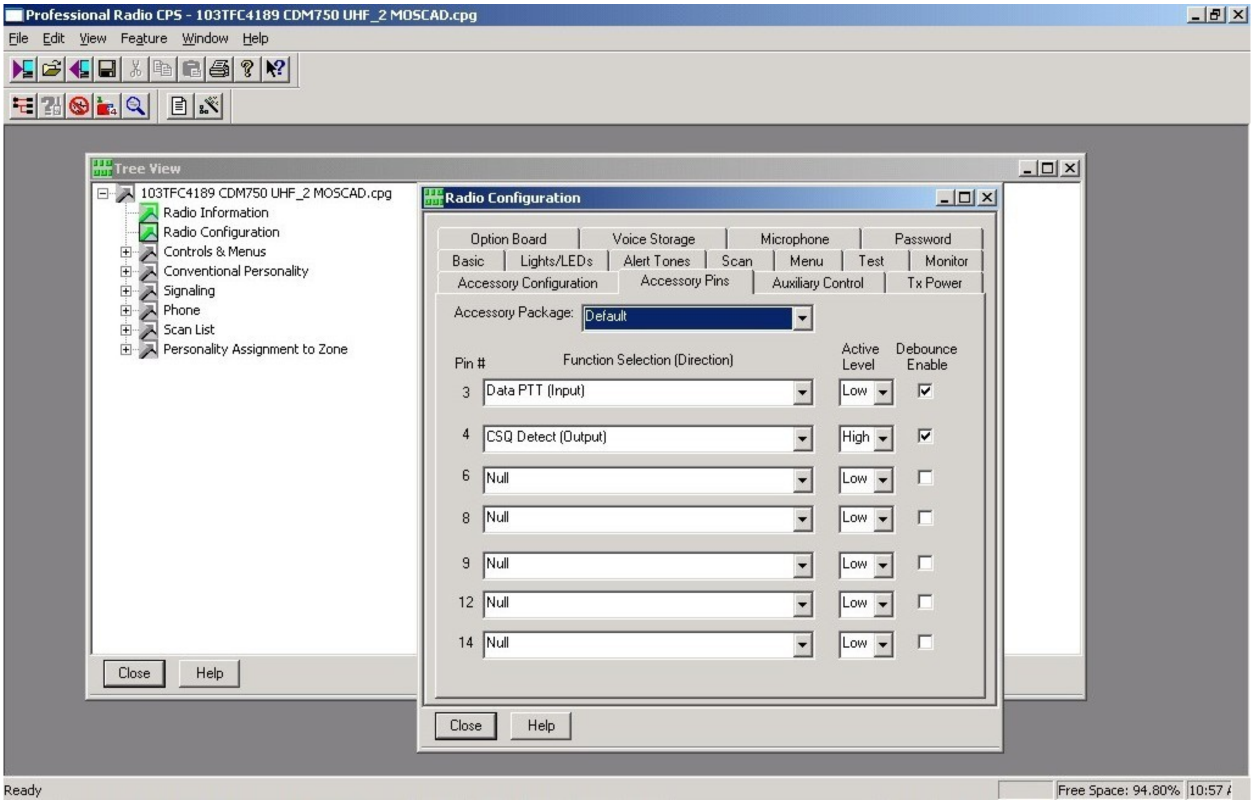


Figure 13-20 Radio Configuration - Accessory Pins Definition

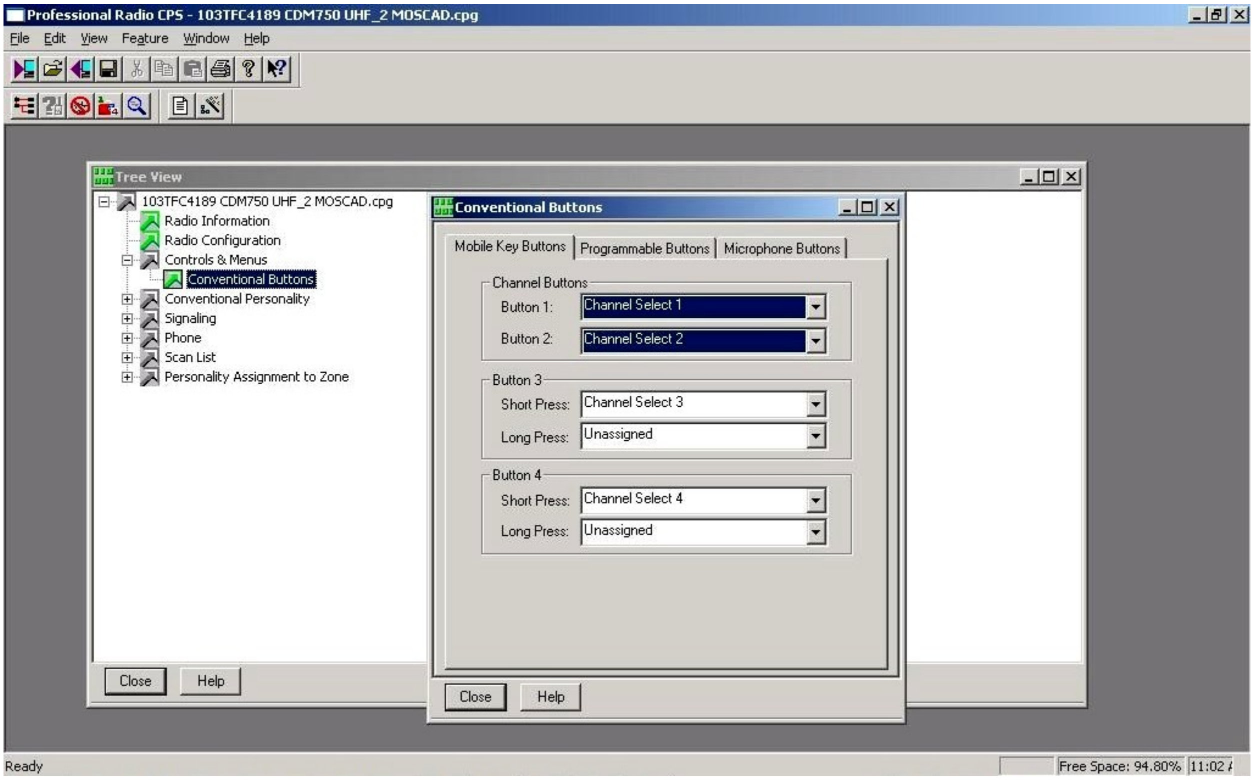


Figure 13-21 Conventional Buttons Configuration – Mobile Key Buttons

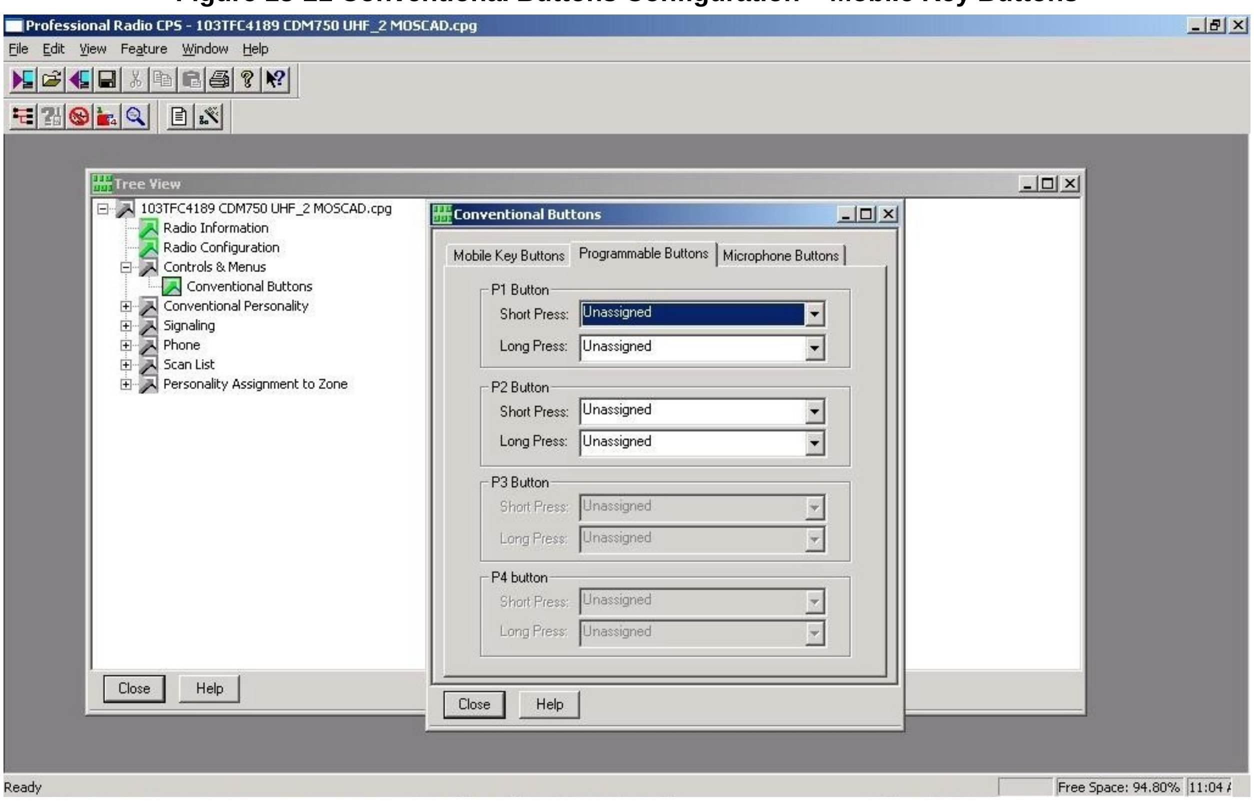


Figure 13-22 Conventional Buttons Configuration – Programmable Buttons

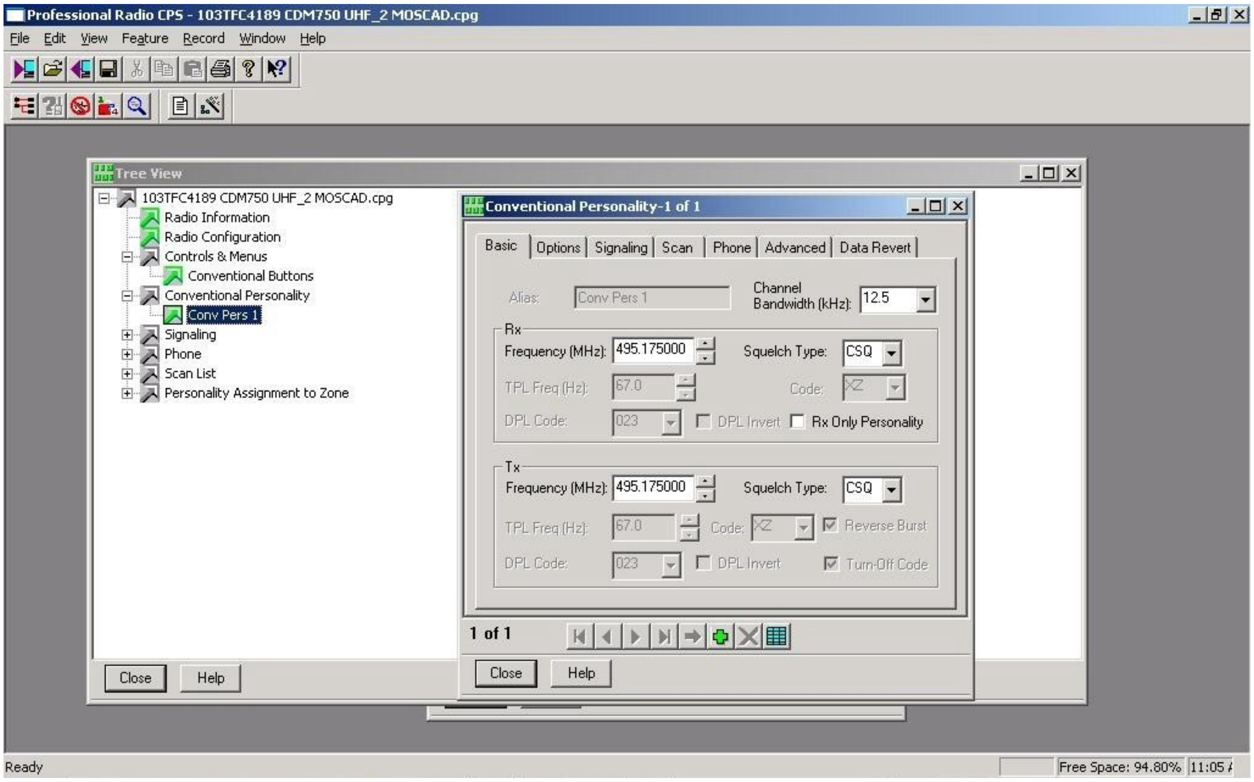


Figure 13-23 Conventional Personality Configuration – Basic Settings

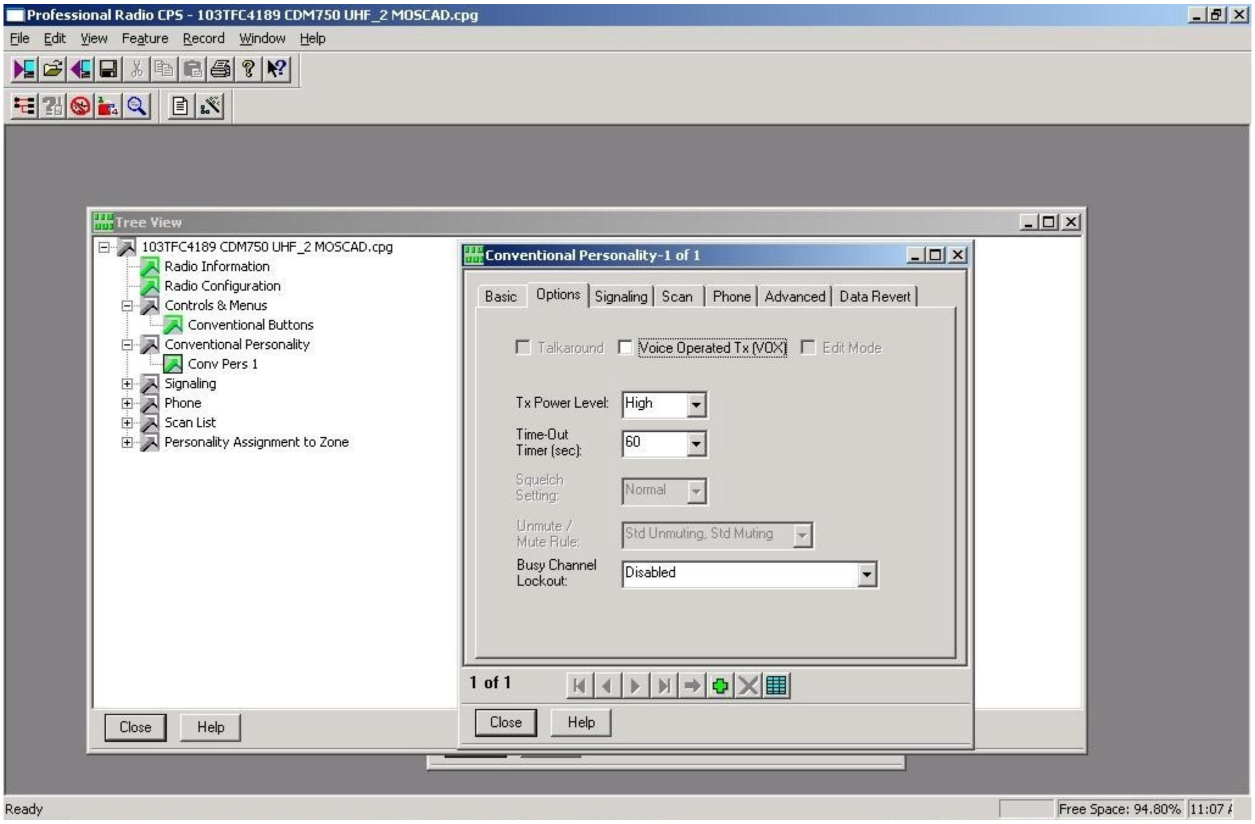


Figure 13-24 Conventional Personality Configuration – Options

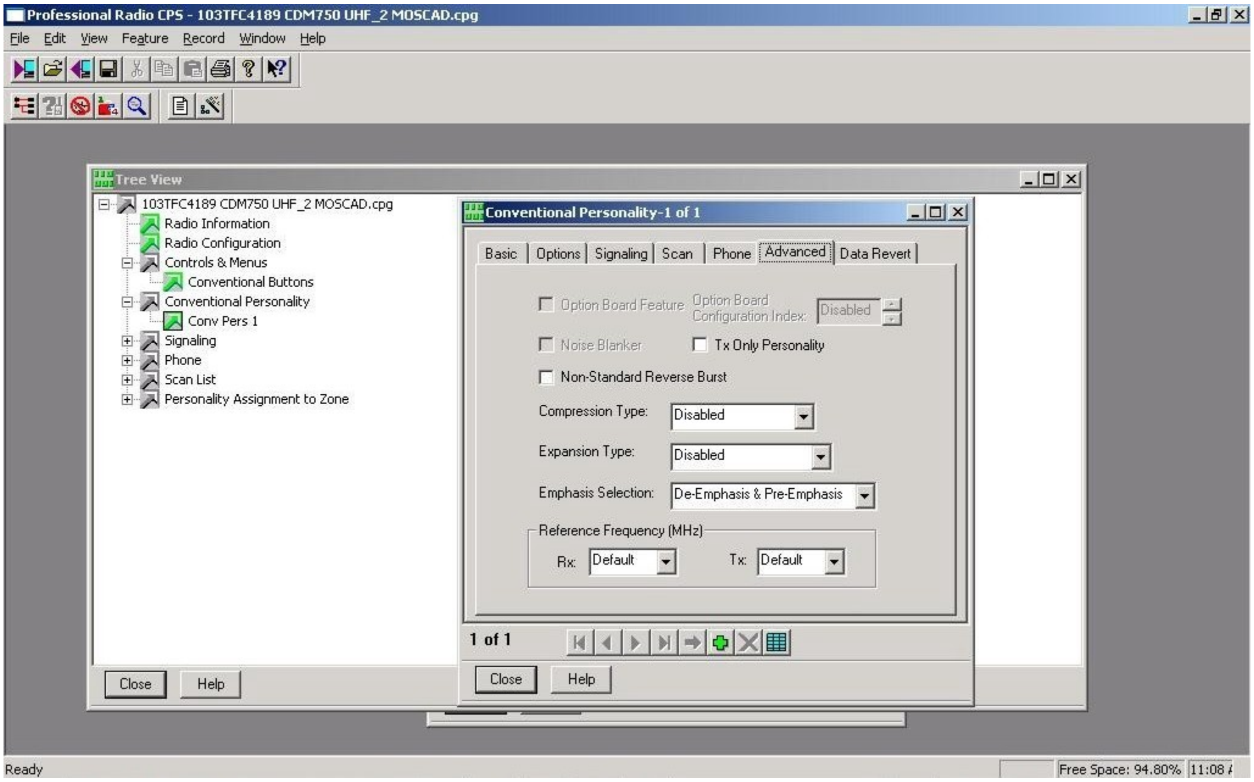


Figure 13-25 Conventional Personality Configuration – Advanced Settings

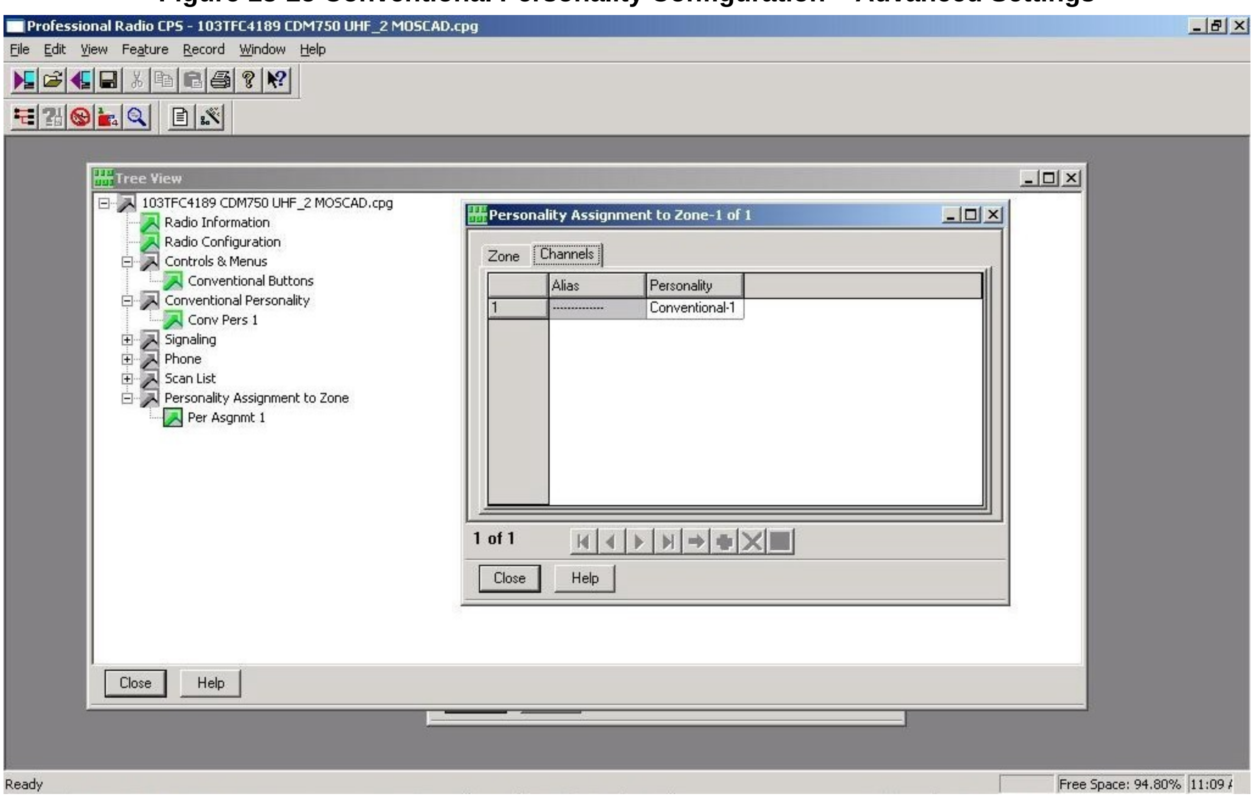


Figure 13-26 Radio Channel Assignment - Personality Assignment to Zone

GP/HT/PRO Radio Installation Kit

The GP/HT/PRO Radio Installation Kit for ACE3600 (V154AE, FLN3637A) enables the user to install the GP320/GP328/HT750/PRO5150 portable radios in ACE3600 Remote Terminal Units (RTU). Each kit includes a bracket, radio interface, adapters, and cables.

Volume Knob Retainer

The volume knob retainer sets a fixed position for the volume knob on the GP/HT/PRO radios, for optimal operation in an ACE3600 RTU installation. To implement this option, follow the procedure below.

Procedure 13-20 How to Attach the Volume Knob Retainer for the GP/HT/PRO Radio

1. Remove the original plastic volume knob cover from the radio by pulling it out with pliers, as shown in Figure 13-27.

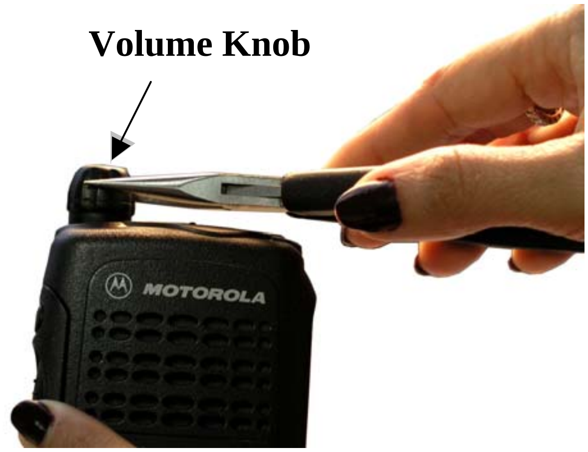


Figure 13-27 Removing the Volume Knob

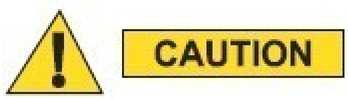
2. Place the hole of the volume knob retainer (shown in Figure 13-28) over the exposed metal volume rod on the radio (shown in Figure 13-29.)

Figure 13-28 Volume Knob Retainer

3. Fasten the bottom of the volume knob retainer to the radio body. (See Figure 13-29.)

Figure 13-29 Attach Retainer to Radio

Installation



Before installing the GP/HT/PRO radio on the RTU, configure the power supply AUX2A/B connector to 7.5V DC in the ACE3600 STS site configuration (using the Power Supply <n> Auxiliary 2 voltage parameter.) Download the updated site configuration to the RTU. Failure to do this might damage the radio.

The GP/HT/PRO radio can be mounted on the ACE3600 RTU as follows:

1. Attach the radio plug-in port from the installation kit (FLN3696A) to the desired opening on the ACE3600 CPU module. For instructions on attaching plug-in ports, see Connecting Plug-In Ports to the CPU Module in the CPU Module chapter above.
2. Connect the audio accessory adapter (HLN9716) (Item 1) to the radio. See Figure 13-30.
3. Insert the communication cable (FKN8431A) (Item 2) into the audio accessory adapter.
4. Insert the BNC antenna adapter (FTN6045B) into the radio antenna connector (Item 3).
5. Snap the radio into the DC adapter (FCN5516B) (Item 4).
6. Insert the 7.5V DC power cable (FKN8515A) into the DC connector of the DC adapter (Item 5).

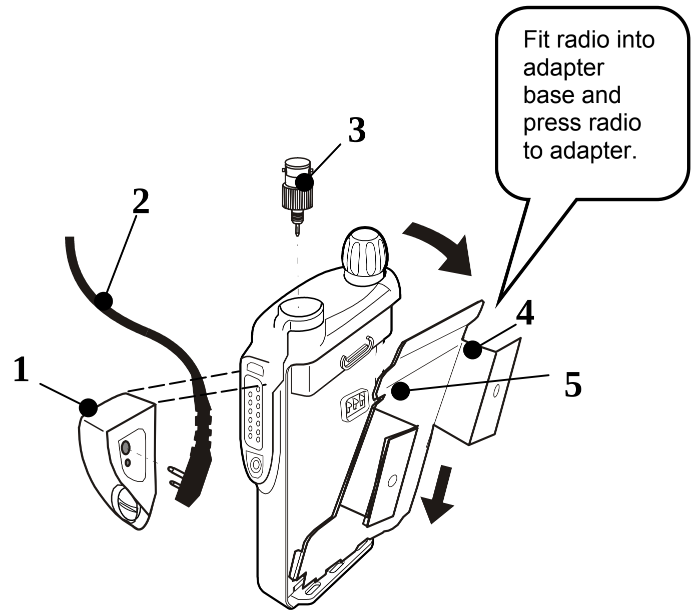


Figure 13-30 GP/HT/PRO Radio Installation

7. Using the two screws, attach the radio assembly to the radio bracket (FHN6899A).

8. Using the three screws on the bracket, attach the bracket with the radio to the chassis of the ACE3600. (See Figure 13-31.)

9. Connect the audio communication cable (FKN8431A) to the audio adapter (attached to the radio). Place one Fair-Rite soft ferrite (#7683477X01 from the supplied ferrite kit FHN7007A) on the cable near the bottom of the CPU door, loop the cable one turn around it, and clamp the ferrite on the cable. Connect the other end of the communication cable to the plug-in port on the front panel of the CPU module.

10. Connect the DC power cable (FKN8515A) from the DC adapter (attached to the radio) to the AUX2A or AUX2B connector of the power supply module.

11. Route the antenna cable (FKN8434A) from the bottom of the RTU box to the BNC adapter on the radio.

12. Use the clamps provided in the kit to route and secure the audio communication and DC power cables. (See Figure 13-31.)

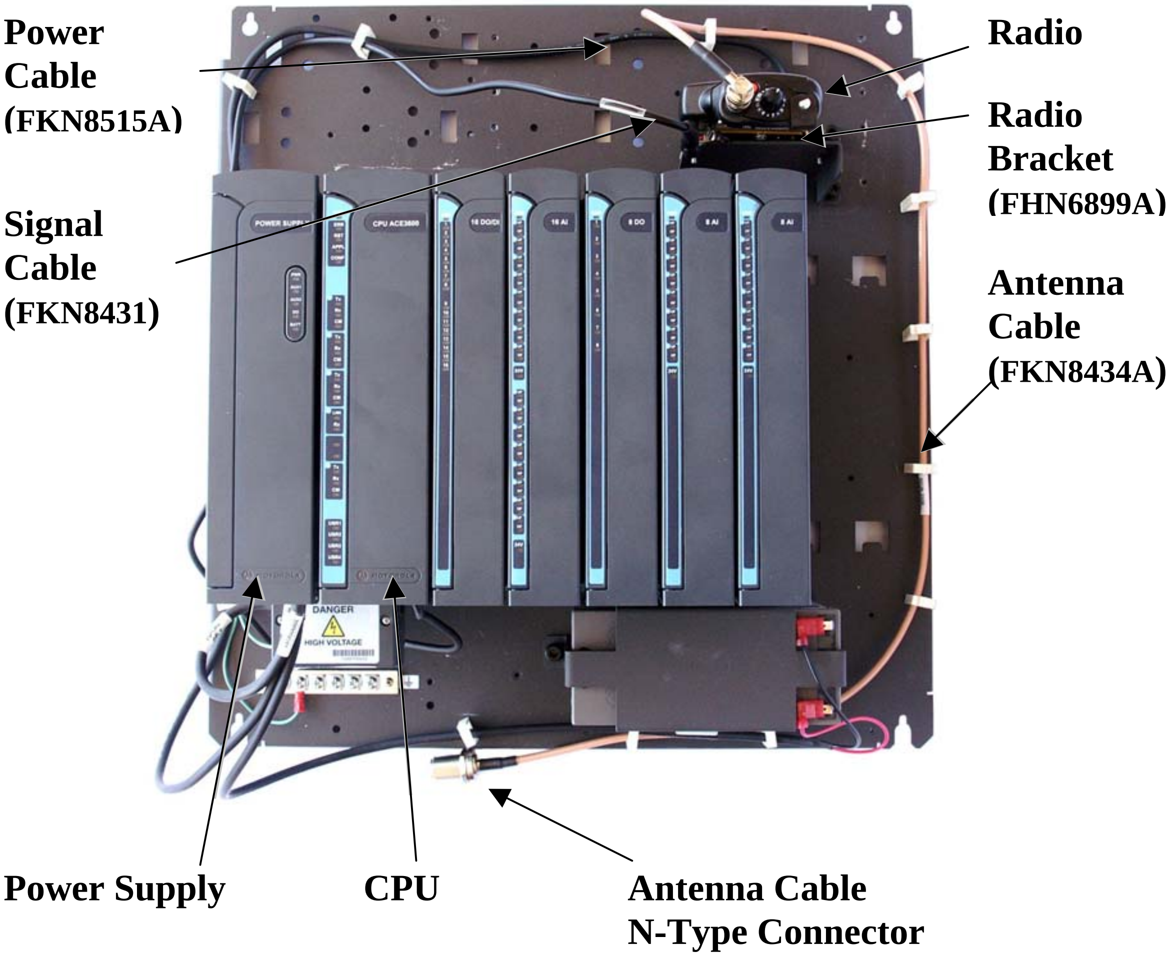


Figure 13-31 GP/HT/PRO Radio Installed on ACE3600 Chassis

RTU Port Configuration for the GP320/GP328/HT750/PRO5150 Radio

To enable MDLC communication using GP320/GP328/HT750/PRO5150 radios, use the ACE3600 STS site configuration utility to configure the ACE3600 RTU plug-in port connected to the radio.

The following figures show the port configuration and advanced parameter configuration. Although these show Port PI1, the same values can be applied to port PI2 as well, where relevant.

Port Type

Procedure 13-21 How to Configure the ACE3600 Port for the GP/HT/PRO Radio

1. In the ACE3600 STS click on the desired site, and open the site view.
2. In the Port Tab, click on the plug-in port through which the RTU will communicate with the radio.
3. Confirm that the port parameters and data speed are as shown in the screen below.

4. Define desired radio links and zones if necessary.

5. Save the changes. Generally no other changes are required to Advanced Physical or Link Layer parameters.

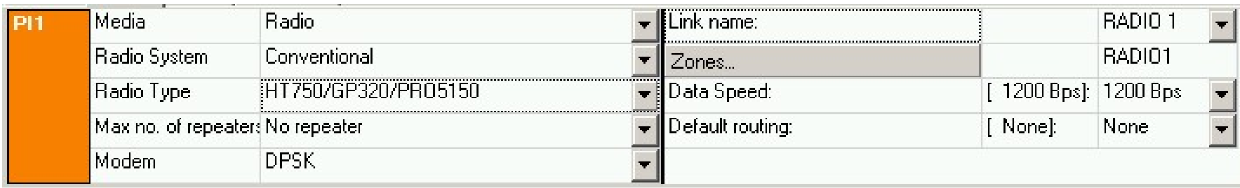


Figure 13-32 RTU Site Configuration for MDLC over GP320/GP328/HT750/PRO5150 Radio – Port Type Parameters

GP/HT/PRO Radio Models and Regional Options for ACE3600

The GP/HT/PRO models of the ACE3600 RTU, F7553A (VHF) and F7554A (UHF) include the following regional options:

Option	Region	Radio
V951	North America (NA)	HT750
V952	EMEA	GP320
V953	Asia	GP328
V954	Latin America (LA)	PRO5150
V154AE	GP/HT/PRO INSTALL KIT	
FLN3637A	GP/HT/PRO INSTALL KIT	

Note:

1. When ordering ACE3600 model with a GP/HT/PRO radio, a V95x option must be added.
2. For models/options availability, see the latest sales price list.
3. Orders to EMEA should be placed as model without radio and radio as a kit

CM/EM/GM Radio Installation Kit

The CM/EM/GM Installation Kit for ACE3600 (V148AC/FLN3635A) enables the user to install the CM/EM/GM mobile radio (CM200, CM140, EM200, GM3188) in ACE3600 Remote Terminal Units (RTU). Each kit includes a bracket, adapter, and cables.

Installation

The CM/EM/GM can be mounted on the ACE3600 RTU as follows:

Procedure 13-22 How to Install the CM/EM/GM Radio on the Metal Chassis

1. Attach the radio plug-in port from the installation kit (FLN3696A) to the desired opening on the ACE3600 CPU module. For instructions on attaching plug-in ports, see Connecting Plug-In Ports to the CPU Module in the CPU Module chapter above.

2. Connect the 16-pin connector radio adapter (FLN3636A) to the accessory connector on the radio. (See Figure 13-33.)

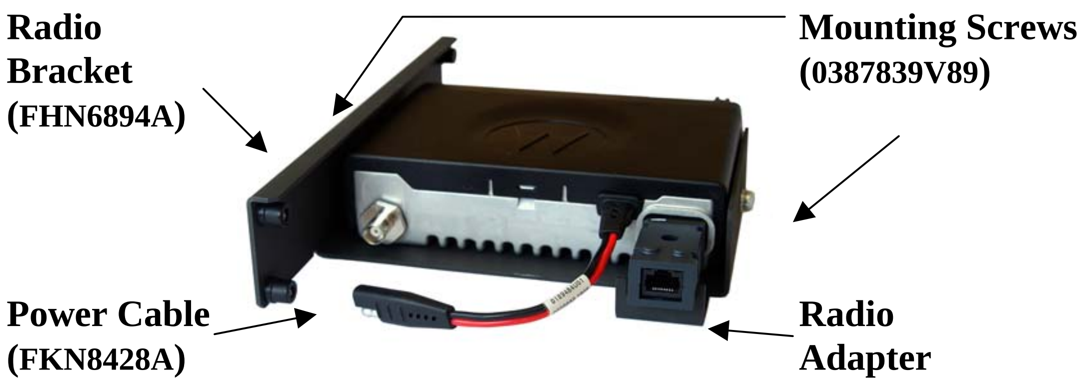


Figure 13-33 CM/EM/GM Radio, Adapter and Power Cable

3. Connect the power cable (FKN8428A) to the radio's power connector. (See Figure 13-33 and Figure 13-34.) Connect the other end of the power cable to the AUX1A or AUX1B connector on the ACE3600 RTU Power Supply unit. (See Figure 13-35.)

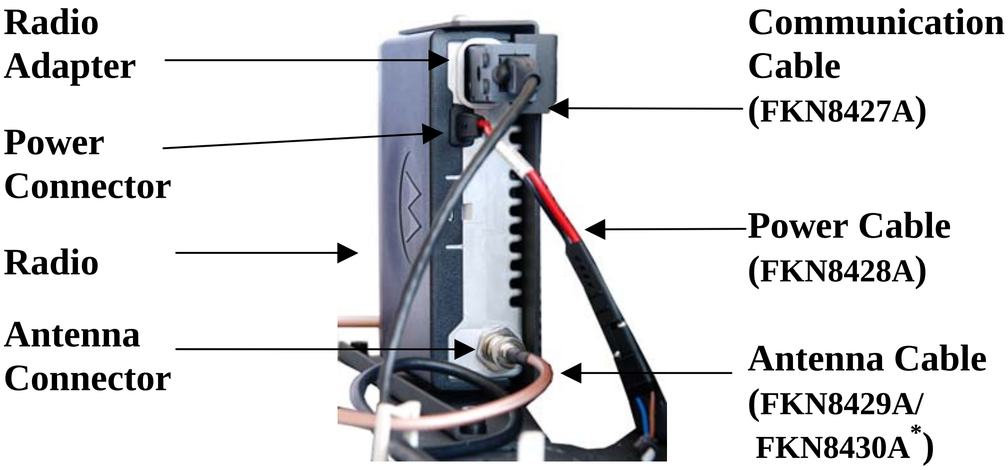


Figure 13-34 CM/EM/GM Radio Cable Connections

4. Connect the communication cable (FKN8427A) to the back of the radio adapter (FLN3636A) connector (10-pin RJ45 connector). (See Figure 13-34.) Place one Fair-Rite soft ferrite (#7683477X01 from the supplied ferrite kit FHN7007A) on the cable near the bottom of the CPU door, loop the cable one turn around it, and clamp the ferrite on the cable. Connect the other end of the communication cable to the plug-in port of the ACE3600 CPU.

5. Mount the CM/EM/GM radio onto the metal bracket (#0789422V45) using the two supplied radio mounting screws from kit FHN6894A, # 0387839V89 on the top and bottom of the radio. (See Figure 13-33, Figure 13-34 and Figure 13-35.)

6. Connect the antenna cable (FKN8429A/FKN8430A*) to the antenna connector on the radio and to the opening on the bottom of the ACE3600 housing using the four supplied screws. (See Figure 13-34 and.) Mount the complex (bracket and radio) on the RTU chassis above the CPU and I/O modules, using the four built-in screws. (See Figure 13-35.)

---

* Antenna Cable FKN8429A with UHF connector is for Latin and North America.
Antenna Cable FKN8430A with BNC connector is for Asia and Europe.

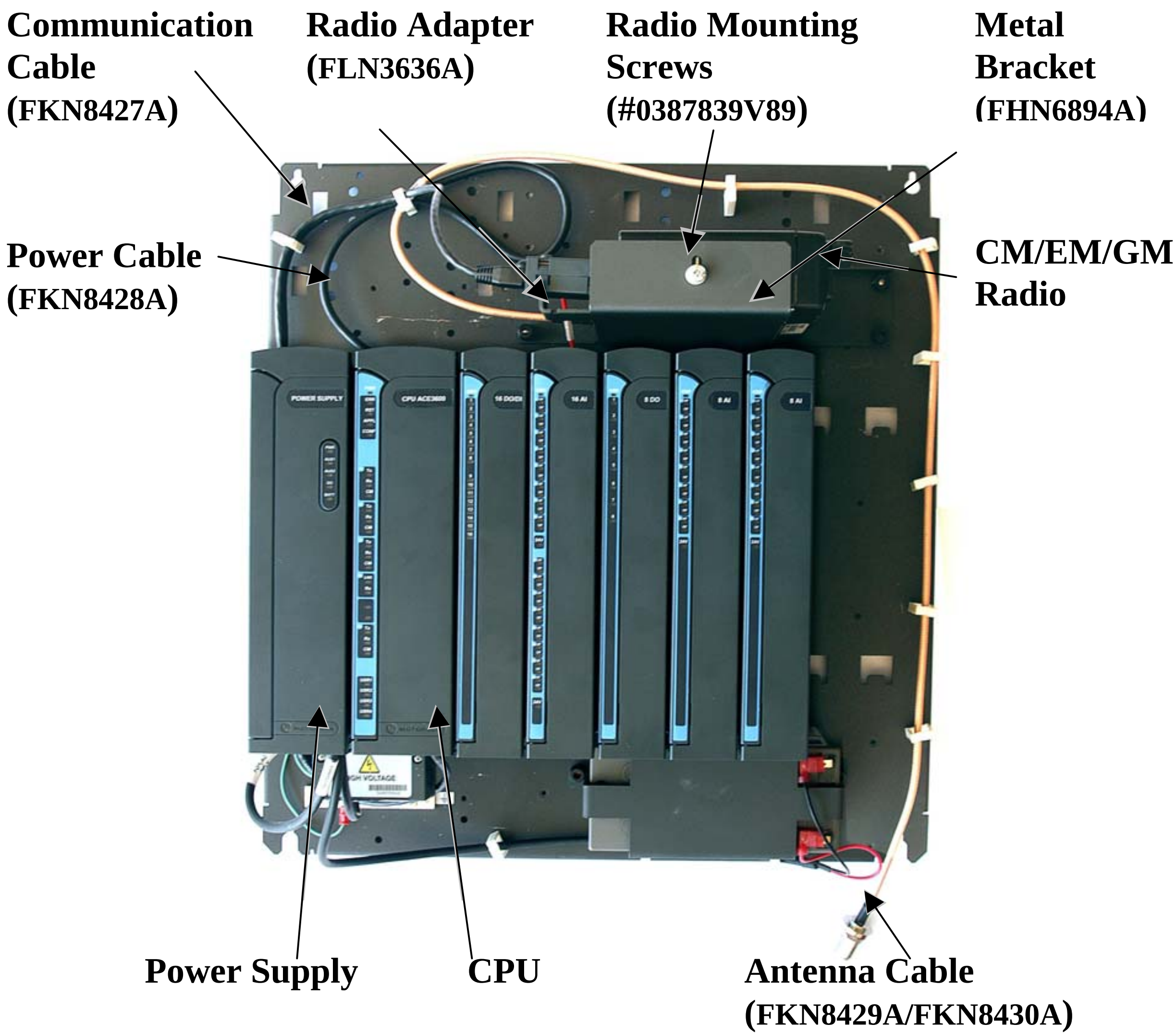


Figure 13-35 CM/EM/GM Radio Installed on ACE3600 Chassis

RTU Port Configuration for the CM/EM/GM Radio

To enable MDLC communication using CM/EM/GM radios, use the ACE3600 STS site configuration utility to configure the ACE3600 RTU plug-in port connected to the radio.

Follow the instructions for RTU Port Configuration for the CDM750 Radio above.

Programming the CM/EM/GM Radio using CPS

The following programming instructions must be performed before connecting a CM/EM/GM radio to an ACE3600 RTU. These steps define miscellaneous settings and the function of each pin in the radio's general purpose I/O connector.

Radio Information

The picture below shows the radio model information screen in the CPS.

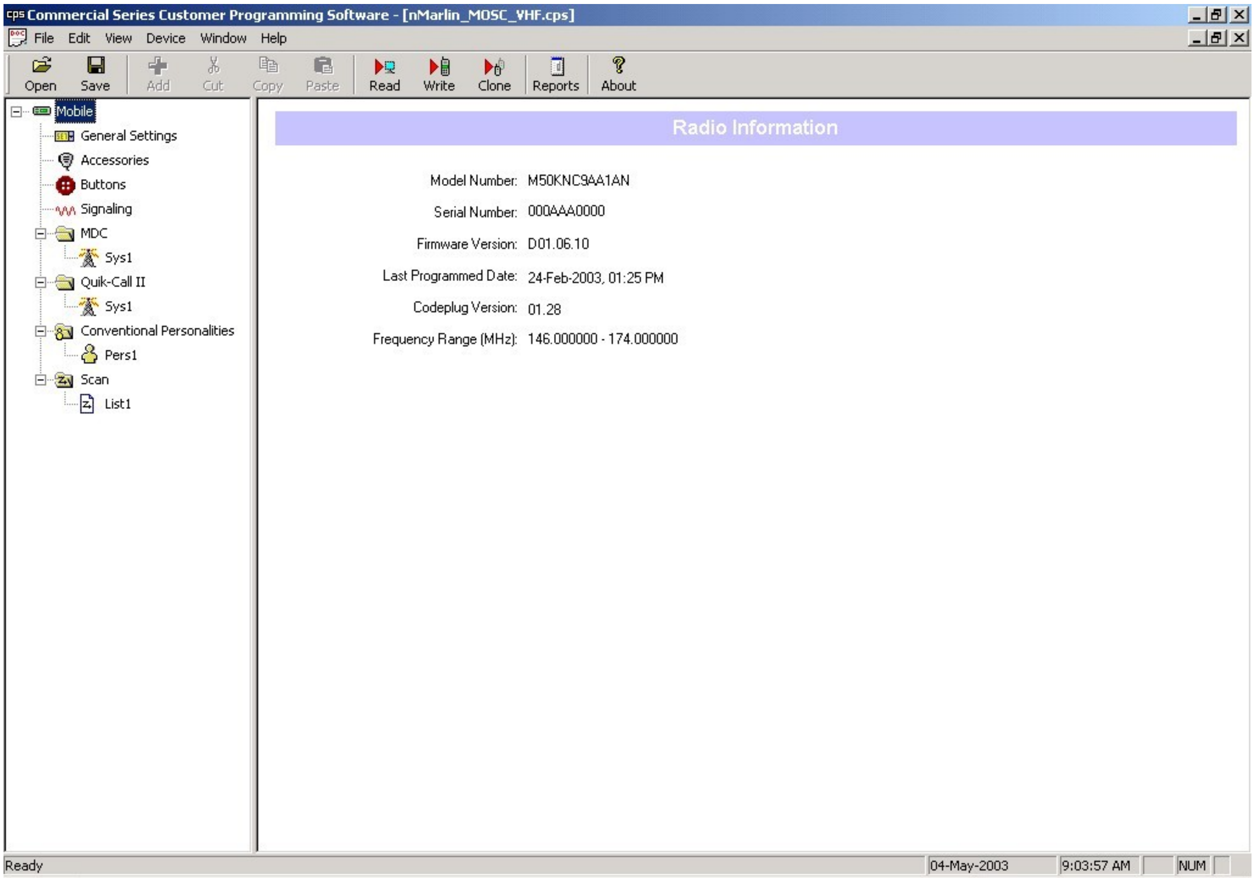


Figure 13-36 CM/EM/GM CPS Radio Information Screen

Radio Power Settings

The picture below shows the TX power setting (1-25 W) in CPS.

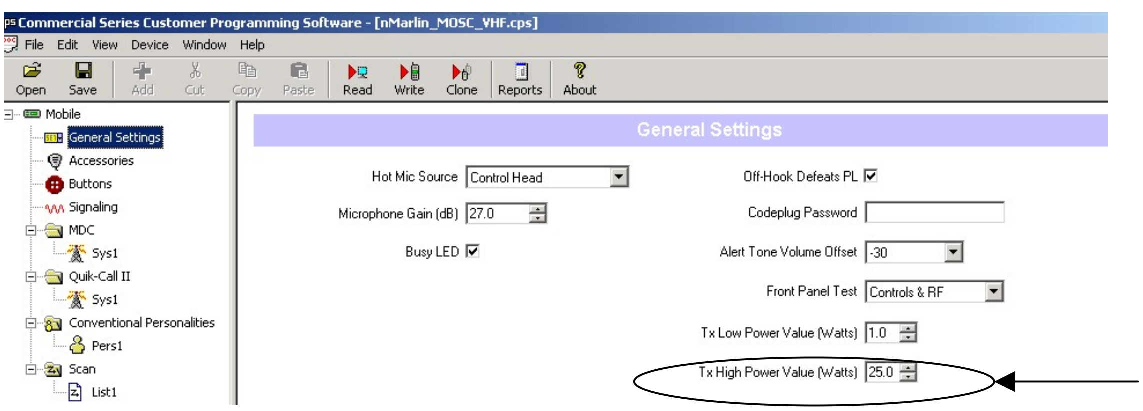


Figure 13-37 CM/EM/GM CPS General Settings Screen

Radio Accessory Connector Pins Definition

The picture below shows the setting of the radio's accessories pins required for interfacing with the ACE3600.

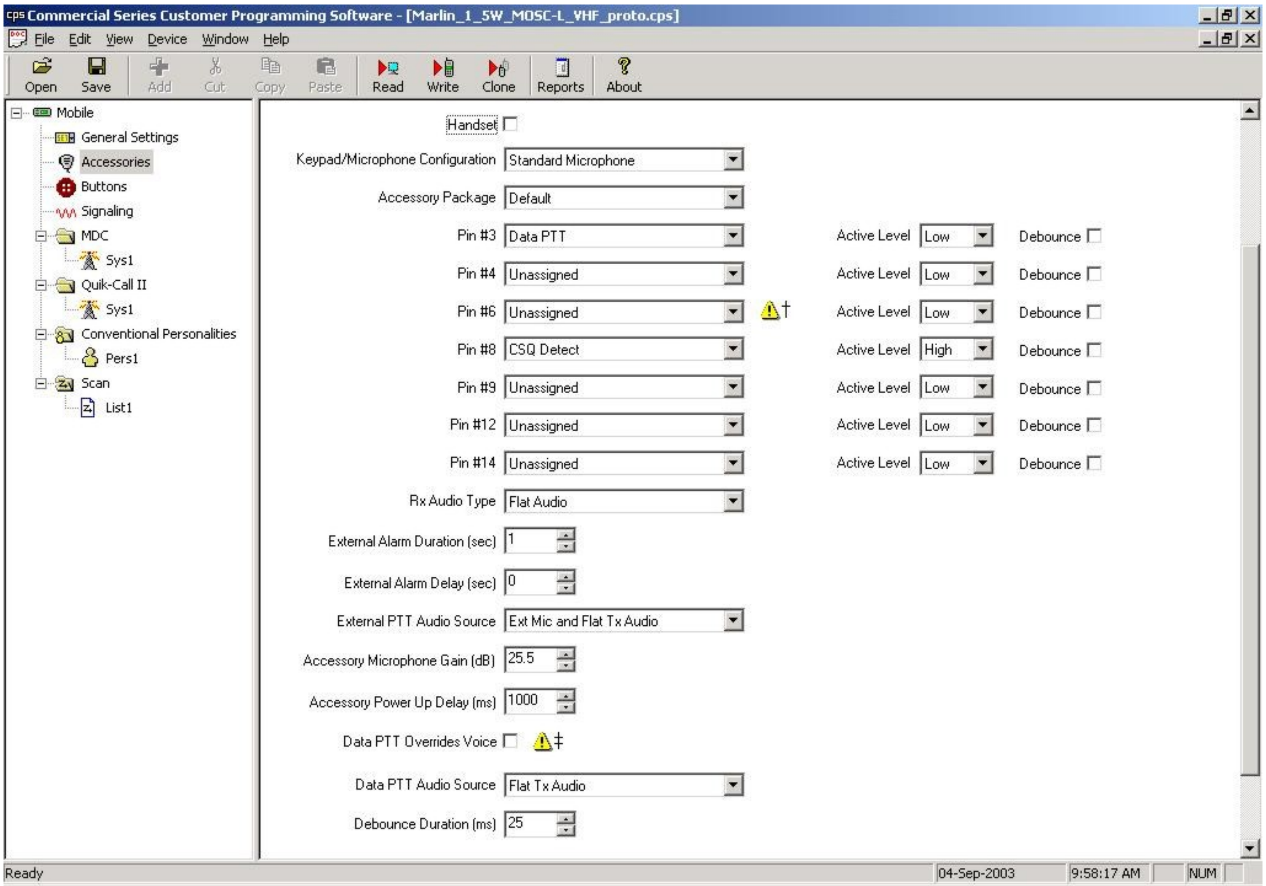


Figure 13-38 CM/EM/GM CPS Radio Accessories Screen

Frequency and Bandwidth Settings

The picture below shows the setting of the radio's frequency, bandwidth and power level.

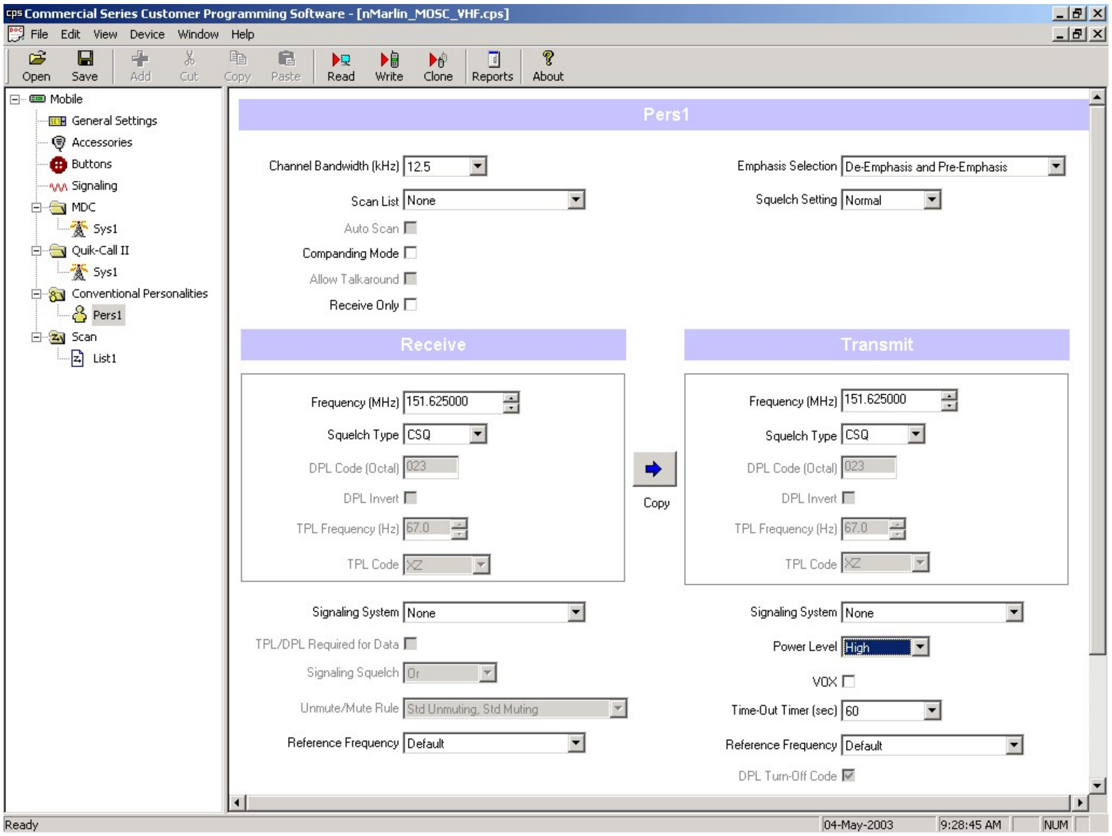


Figure 13-39 CM/EM/GM CPS Radio Personality Tx/Rx Screen

Note: The Power Level should be set according to the power output.

CM/EM/GM Radio Models and Regional Options for ACE3600

The CM/EM/GM models of the ACE3600 RTU, F7573A (VHF) and F7574A (UHF) include the following regional options:

Option	Region	Radio
V851	North America (NA)	CM200, 1-25W
V852	EMEA*	CM140, 1-25W
V853	Asia*	GM3188, 1-25W
V854	Latin America (LA)	EM200, 1-25W
V148AC	CM/EM/GM INSTALL KIT	
FLN3635A	CM/EM/GM INSTALL KIT	

Note:

1. When ordering an ACE3600 model with a CM/EM/GM radio, a V95x option must be added.
2. For models/options availability, see the latest sales price list.

* Antenna Cable FKN8429A with UHF connector is for Latin and North America.
Antenna Cable FKN8430A with BNC connector is for Asia and Europe.

TransNET 900 OEM Radio Installation Kit

The TransNET™ 900 OEM radio installation kit (VA00225AA/FLN3852A) enables the user to install MDS TransNET 900 OEM (board version) radio modems in ACE3600 Remote Terminal Units (RTU). Each kit includes a bracket, adapter, and cables.

Installation

The TransNET 900 radio modem is housed in a plastic housing, as shown below:

Figure 13-40 TransNET 900 Radio Modem and Connectors

The TransNET 900 can be mounted on the ACE3600 RTU as follows:

Procedure 13-23 How to Install the TransNET 900 Radio on the Metal Chassis

1. Attach the TransNET 900 radio modem to the metal bracket (#0789971V39 from FHN7067A) using the four supplied screws, inserting the screws from above. (See Figure 13-41 below.)

Figure 13-41 TransNET 900 Radio Modem Mounted on Metal Bracket - Front and Rear View

2. Mount the bracket on the RTU chassis above the I/O modules, using the four built-in screws. (See Figure 13-42 and Figure 13-43 below.)

3. Connect one end of the power cable (FKN8508A) to the TransNET's PWR (9-30VDC) connector and tighten the attached screws. Connect the other end of the cable to the AUX1A connector on the RTU's power supply module.

4. Connect one end of the data cable (FKN8514A) to the TransNET's DATA connector using the attached screws. Connect the other end of the communication cable to the ACE3600 CPU module port configured for the radio.

5. Connect the small end of the antenna cable (FKN8511A) to the TransNET's ANT (Antenna) connector.
   Unscrew the nut and locking washer from the other end of the antenna cable.
   If the RTU is inside an enclosure, thread the end of the cable through the opening on the bottom of the enclosure and screw on the nut and locking washer from outside the enclosure.

6. Connect the antenna cable to an external antenna.

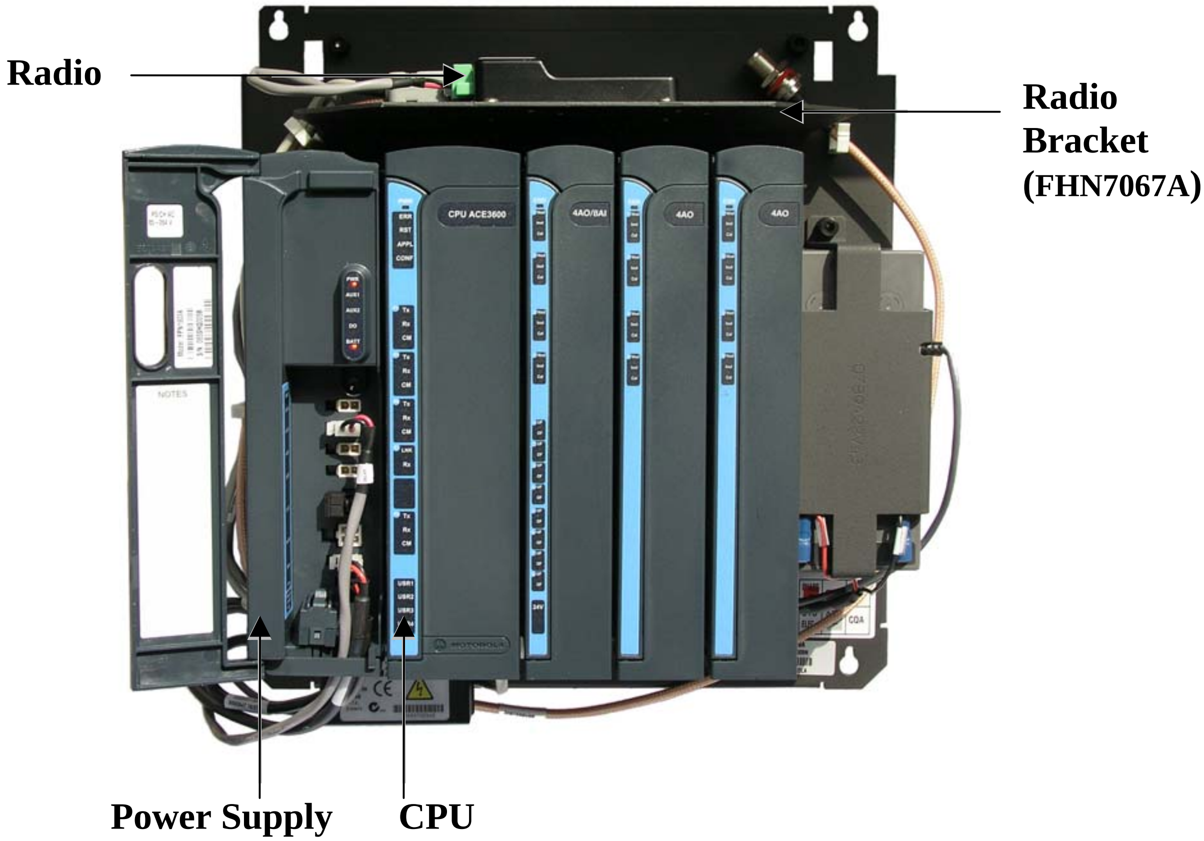


Figure 13-42 TransNET 900 Radio Modem Installed on ACE3600 Chassis

Figure 13-43 TransNET 900 Radio Modem Installed on ACE3600 Chassis – Cable Connections

Setting Radio Parameters

The TransNET 900 radio has certain parameters which are set in the MDS factory.

- The radio address ADDR = xx, where xx is the same number for all radios in the system The address appears on the radio itself.
- Mode - either MASTER or REMOTE (Slave). The mode setting appears on the radio itself.
- Baud rate (factory default = 9600 8N1)

These radio settings are determined in the MDS factory and are not generally changed by the user. If it is necessary to change these settings, refer to the TransNET 900 radio documentation.

RTU Configuration

The RTU port is configured using the ACE3600 STS as follows:

Procedure 13-24 How to Configure the ACE3600 Port for the TransNET 900 Radio

1. In the ACE3600 STS click on the desired site, and open the site view.
2. In the Port Tab, click on the on-board or plug-in port through which the RTU will communicate with the TransNET radio.
3. Confirm that the port parameters and data speed are as shown in the screen below. Note: If the baud rate of the radio is not the default value (9600), the baud rate of the port should be configured accordingly.
4. Define desired links.
5. Save the changes.

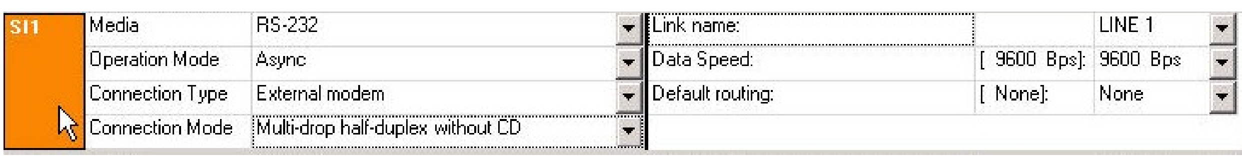


Figure 13-44 RTU Site Configuration for TransNET Radio– Port Type Parameters

iNET 900 Radio Installation Kit

The iNET™ 900 installation kit (V680AH/FLN3854A) enables the user to install MDS iNET 900 (board version) radio modems in ACE3600 Remote Terminal Units (RTU). Each kit includes a bracket, adapter, and cables.

Installation

The iNET 900 radio modem is housed in a plastic housing, as shown below:

Figure 13-45 iNET 900 Radio Modem

The iNET 900 can be mounted on the ACE3600 RTU as follows:

Procedure 13-25 How to Install the iNET 900 Radio on the Metal Chassis

1. Attach the iNET 900 radio modem to the metal bracket (#0789971V39 from FHN7067A) using the four supplied screws, inserting the screws from below. (See Figure 13-46 below.) Note: The radio must be placed in the bracket with the connectors to the left side, so that the bracket can be mounted on the RTU chassis and the cables can reach the CPU.

Figure 13-46 iNET 900 Radio Modem Mounted on Metal Bracket – Front and Rear View

2. Mount the bracket on the RTU chassis above the I/O modules, using the four built-in screws. (See Figure 13-47 below.)

3. Connect one end of the power cable (FKN8508A) to the iNET's PWR connector and tighten the attached screws. Connect the other end of the cable to the AUX1A connector on the RTU's power supply module. See Figure 13-47 and Figure 13-48 below.)

4. Connect one end of the data cable (FKN8512A) to the iNET's COM2 connector using the attached screws. Connect the other end of the communication cable to the ACE3600 CPU module port configured for the radio.

5. Connect the small end of the antenna cable (FKN8511A) to the iNET's ANT (Antenna) connector.
   Unscrew the nut and locking washer from the other end of the antenna cable.
   If the RTU is inside an enclosure, thread the end of the cable through the opening on the bottom of the enclosure and screw on the nut and locking washer from outside the enclosure.

6. Connect the antenna cable to an external antenna.

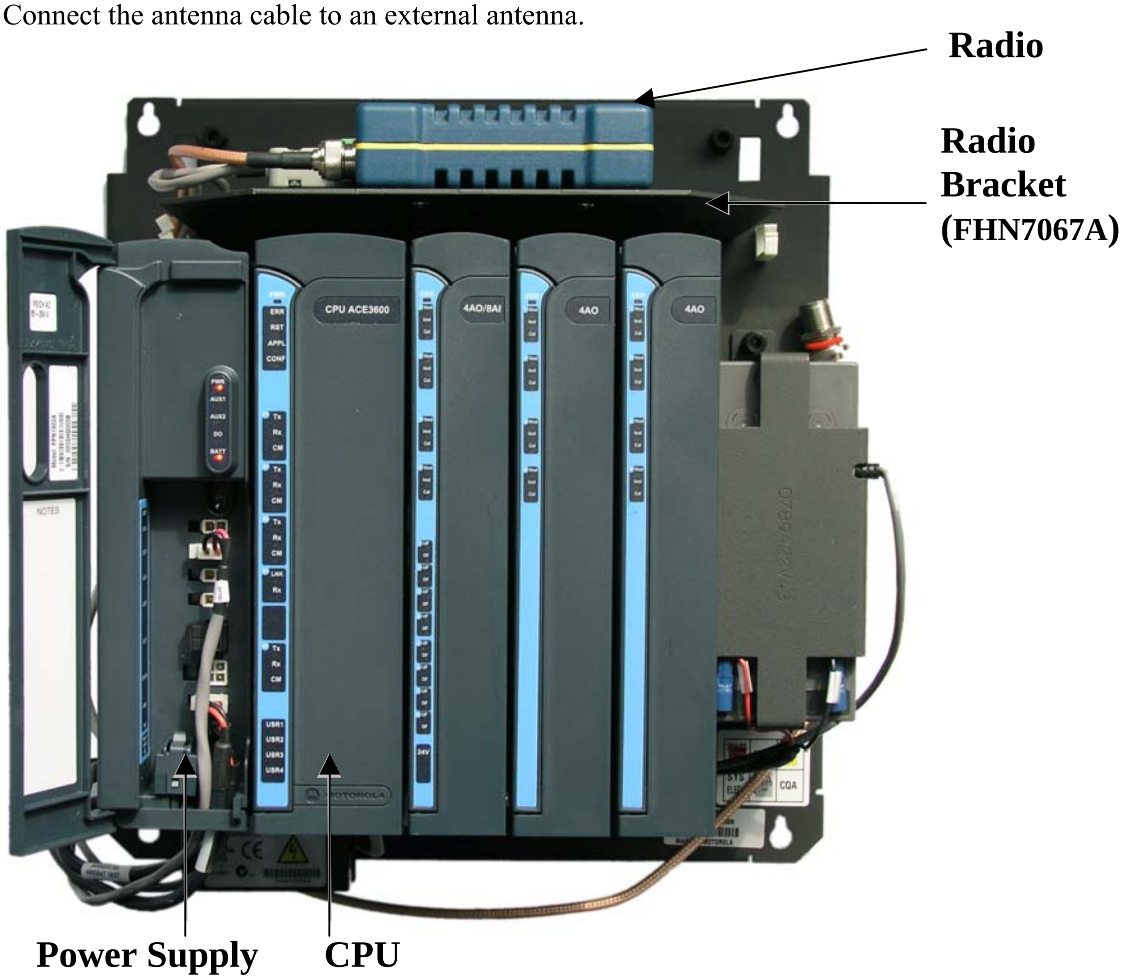


Figure 13-47 iNET 900 Radio Modem Installed on ACE3600 Chassis

Figure 13-48 iNET 900 Radio Modem Installed on ACE3600 Chassis – Cable Connections

Configuring the iNET 900 to Work with ACE3600

The iNET 900 radio modem can be configured to work with ACE3600 RTUs in several ways as described below. Configurations 1-3 below represent External Modem configurations. Configurations 4-7 represent MDLC over IP configurations.

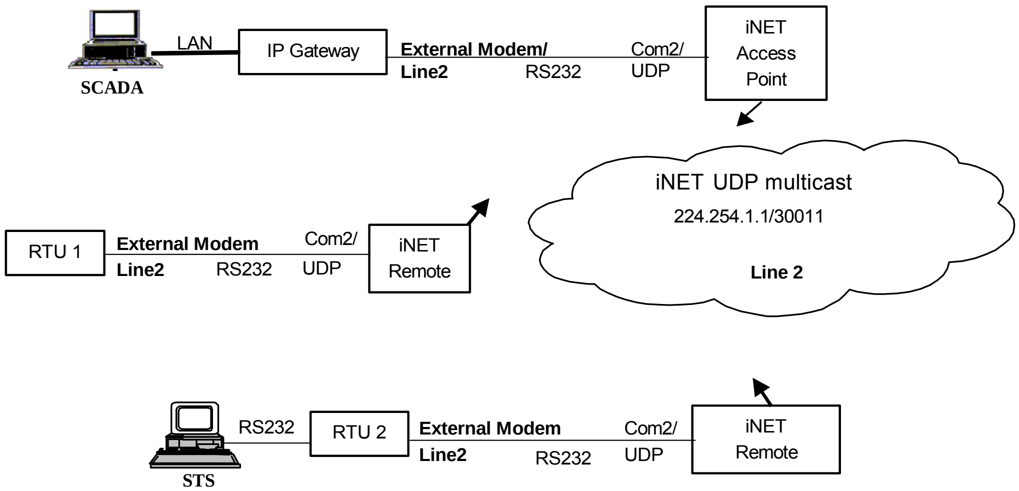
With iNET radios (firmware version ≥ V4.4.0) any remote can communicate with any other remote. An MDLC network (with zones) is no longer needed. The iNET should be set in Multipoint to Multipoint topology, in order to enable communication between RTUs with no zones.

Notes:

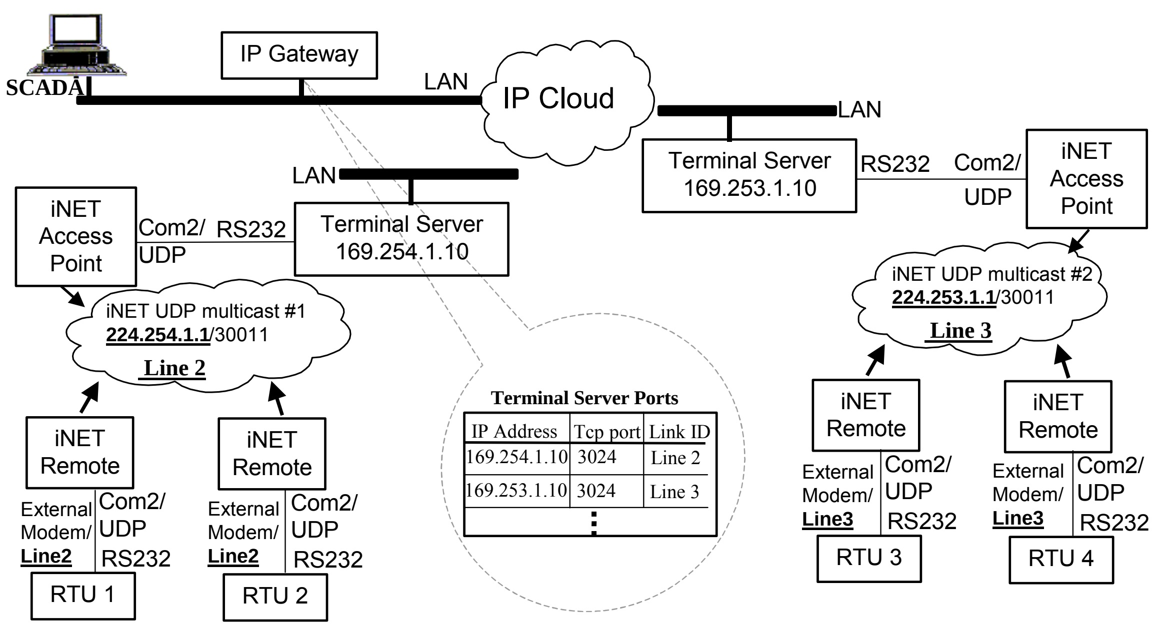
- It is recommended to enable flow control on the RS232 serial port.
- An RTU configured for MDLC over IP cannot communicate with an RTU configured for External Modem over the iNET network. If both exist, they should be allocated different Link IDs.

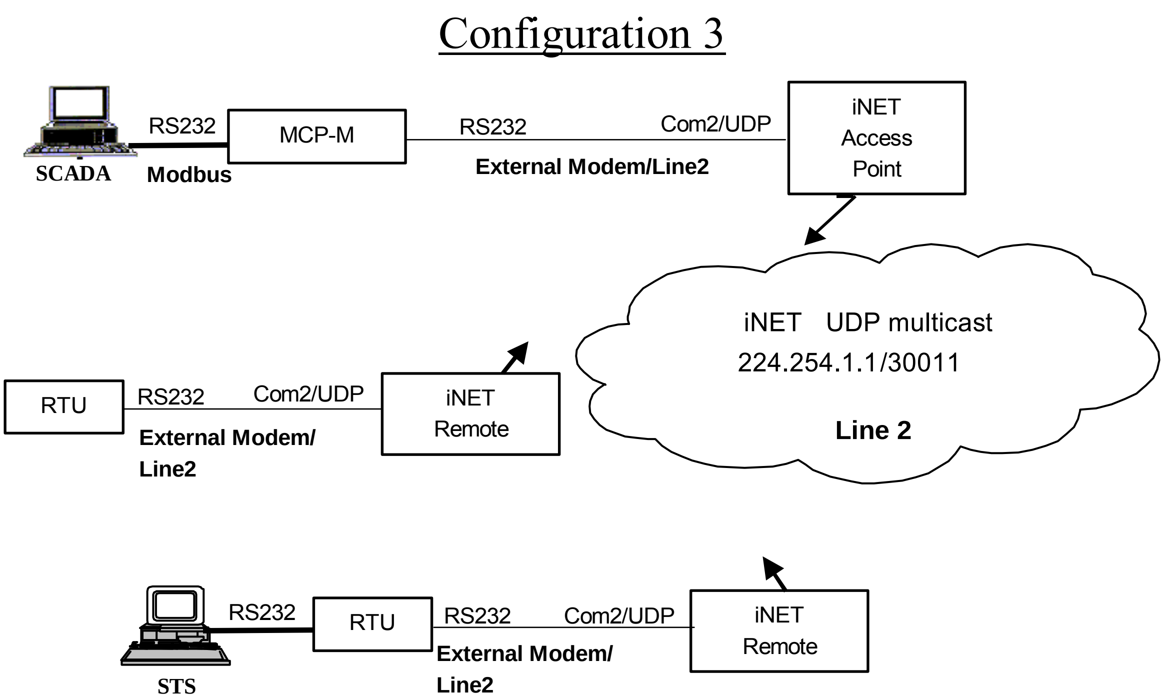
External Modem Port Configurations

Configuration 1

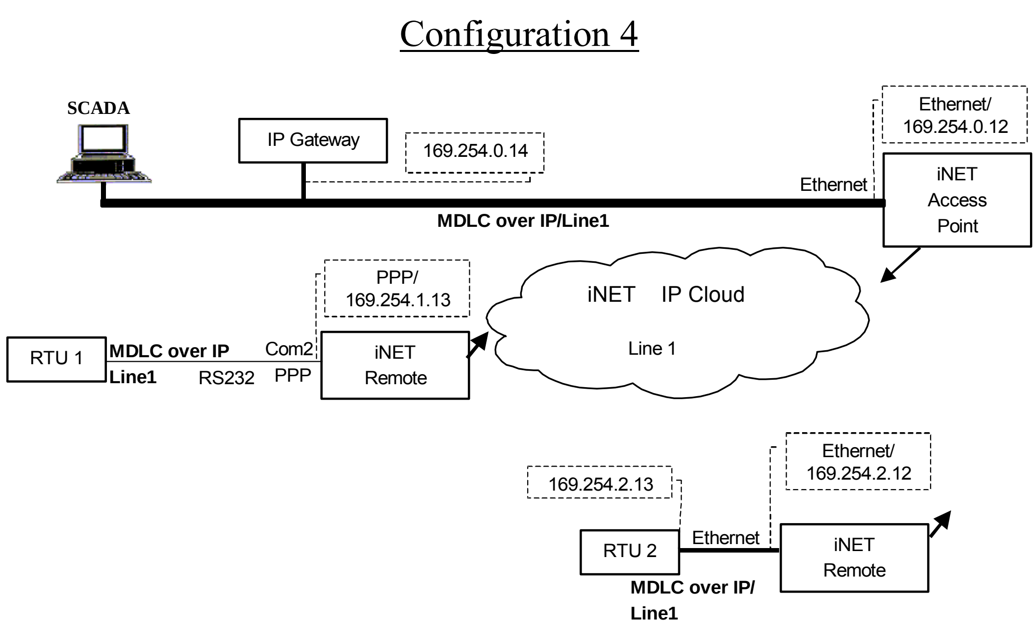


Configuration 2

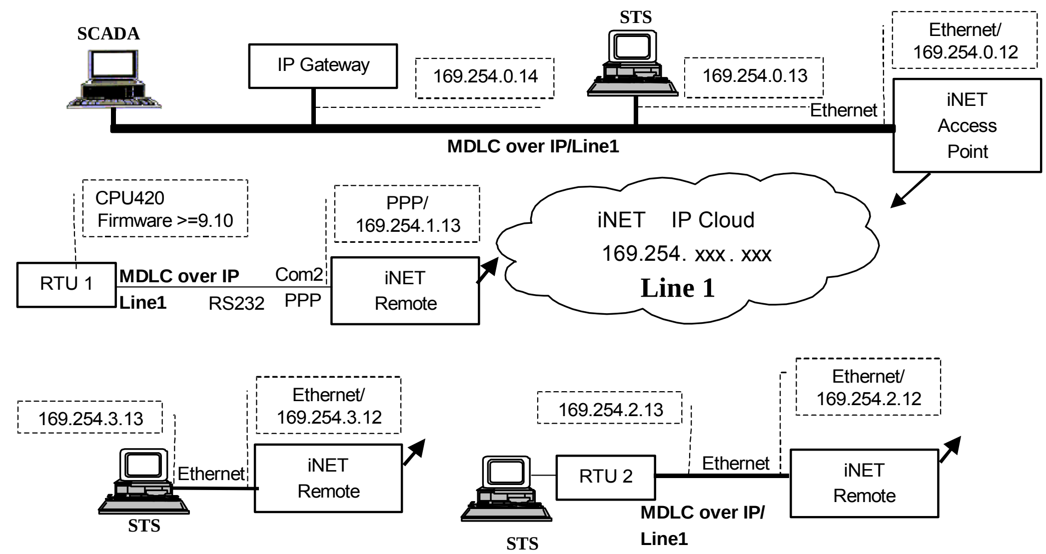




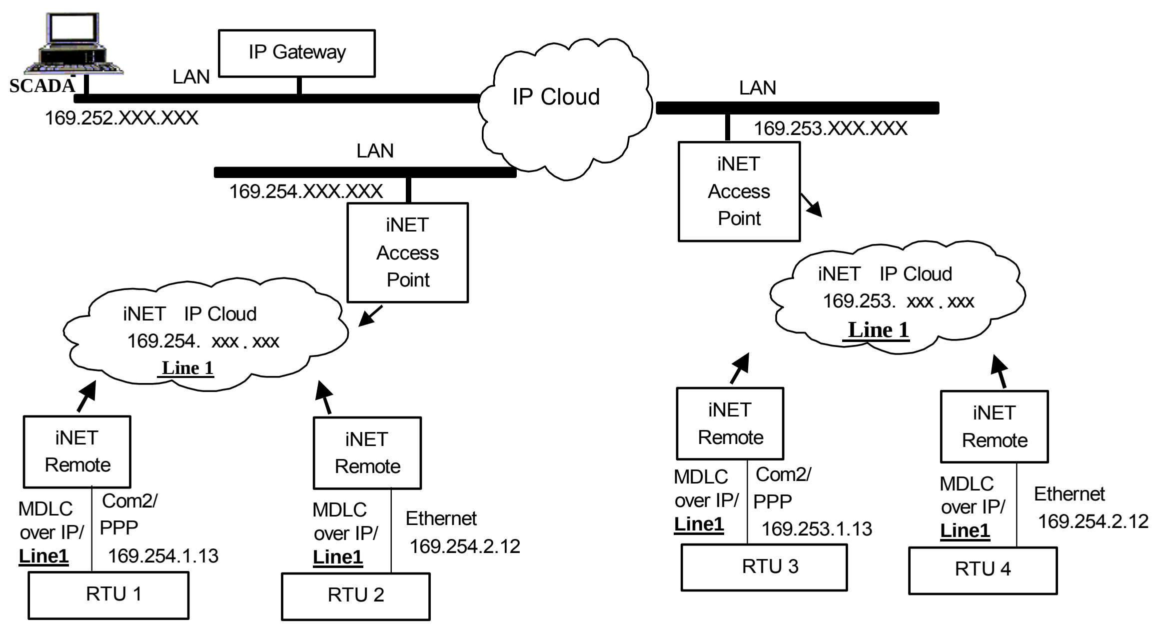
MDLC over IP Port Configurations



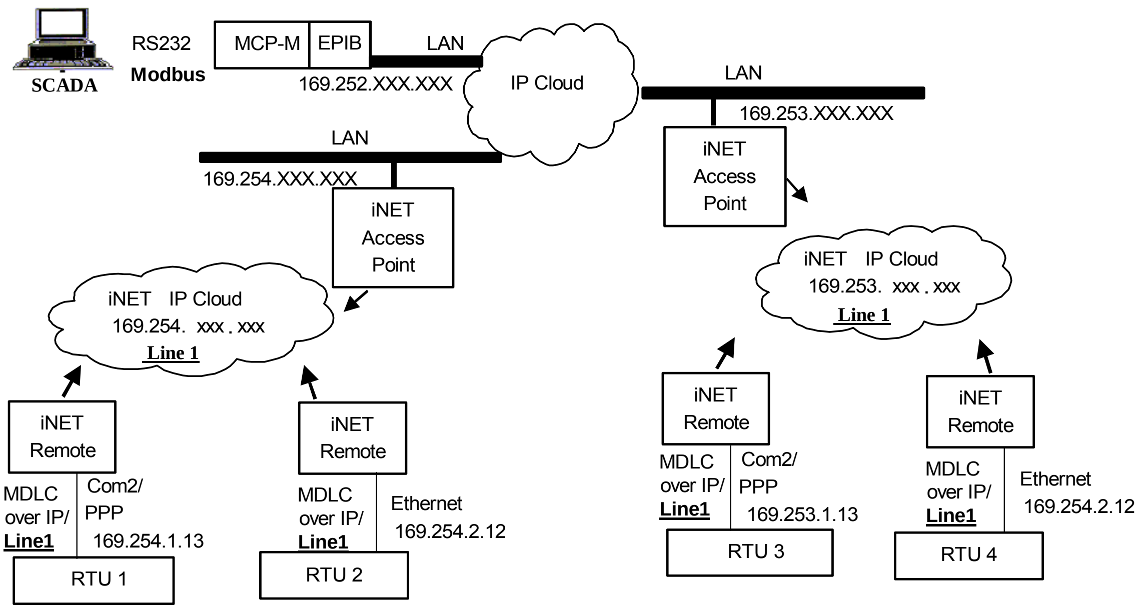
Configuration 5



Configuration 6



Configuration 7



Radio Configuration

External Modem Port

iNET radios can be configured to work with the External Modem port on ACE3600 RTUs (see Configurations 1, 2 and 3 above.)

Use the iNET radio programming software to program the AP (Access Point) and then the remote with the following settings.

Note:

- Radio firmware should be 4.4.0 or above.
- IP Address refers to the Ethernet port IP and not the "over the air" IP.

The initial screen is as follows:

```
MDS iNET 900
 Starting Information Screen
 -=====================================================================-

       Device Mode:          Access Point

       Device Name:          AP Demo Set I

       Network Name:         Demo Set l

       IP Address:           169.254.0.12

       Device Status:        Operational

       Uptime:               01 hrs, 51 min

       Firmware Version:     4.4.0

       Hardware Version:     1.0.3

       Serial Number:        1069975


                  Press 'G' to go to Main Menu
```

1. Press 'G' and the Main Menu will be displayed.
2. Press 'D' and the Serial Gateway Configuration Menu will be displayed.
3. Press 'D' to enable COM2 (if it is not enabled). Use the SPACE bar to cycle between Enabled and Disabled. COM2 should be Enabled and COM1 Disabled. Press ENTER once Enabled is shown.
4. Press 'E' and the Serial Configuration Wizard will be displayed. This wizard will assist you in the configuration of your available Serial Data Ports.

5. Press 'A' and the IP Protocol selection menu will appear.

6. Select the IP Protocol you would like to use. The following modes are supported:

   - TCP – Cannot be used for ACE3600.
   - UDP – to be used as ACE3600external modem.
   - PPP – to be used for MDLC over IP (Not relevant for External Modem.)

   Press 'B' to select the UDP port.

7. If you selected UDP above, you will be prompted to select the Topology. You have the following choices:

   - Point to Point is used if you have a single AP and a single remote unit.
   - Point to MultiPoint is used if you transmit to a single radio. This radio is the point, and all radios are the multipoint. For example: An FNE is a point, and all other RTUs are multipoint. No RTU to RTU is provided.
   - MultiPoint to MultiPoint works like a real radio where any radio (RTU) can communicate with another.

   Press 'C' (Multipoint to MultiPoint) to enable routing between any RTU to any RTU.

8. Next, set the values for the Multicast IP Address and Multicast Port. These are the addresses used when transmitting and receiving. They should be the same on all radios. Press 'A' and enter "224.254.1.1" for the Multicast IP Address.

9. Press 'B' and enter "30011" for the Multicast Port.

10. Press 'C' to continue the wizard until the final screen, or abort it by pressing 'Q'.

11. When the final wizard screen appears prompting you to "Change values (if necessary) for UDP Data Connection Settings", do not change any values. Press 'Q' to quit wizard.

12. The COM2 Serial Data Port values will be displayed. Press 'G' and set the appropriate Baud Rate (from 1200 bps to 115200 bps.)

13. The Hardware Configuration values will be displayed. Press 'G' to select the 8N1 hardware configuration for the port.

14. It is recommended to have Hardware Flow Control on the serial port enabled. When prompted, press 'A' to enable Hardware Flow Control.

15. When prompted to select the Serial Packet Mode, press 'A' to use the default value (Seamless Mode.) Press Q to exit wizard.

The settings for the COM2 Serial Data Port should appear as follows:

```
AP Demo Set I
 Serial Configuration Wizard
 -==================================================================-

   COM2 Serial Data Port

 A) Status              enabled
 B) IP Protocol         UDP Multipoint to Multipoint
 C) Multicast IP Address      224.254.1.1
 D) Multicast Port      30011
 E) Time to Live        1
 F) Packet Redundancy Mode          Single Packet Mode
 G) Data Baud Rate            9600
 H) Configuration       8N1
 I) Flow Control        enabled
 J) Serial Mode         Seamless
 K) Seamless Inter-Frame Delay       4

 X) Commit Changes and Exit Wizard


  These changes will take effect immediately...
    Are you sure (y/n)?
 Select a letter to choose an item, <ESC> for the prev menu, 'Q' to quit wizard
```

16. Press 'X' to save the changes and exit the wizard. When prompted with "These changes will take effect immediately... Are you sure (y/n)?", press 'y' and ENTER. There is no need to power up the iNET radio. Note that these settings are saved and you do not need to reset them when powering up the radio unit again.

17. Press ESC to return to the Main Menu.

18. From the Main Menu, press 'B' to select Network Configuration. This is needed if you want to set an IP connection to the radio unit (recommended). Ethernet port is needed if you are using an IP Interface on RTUs and Ethernet port on IP Gateway (MDLC over IP). In any case, it is recommended that you set it.

19. Next press 'G' for IP Address configuration.

20. In the IP Address Configuration Menu, press 'B' to set the Static IP Address to 169.254.0.12.

21. Next press 'C' to set the Static IP subnet mask to 255.255.0.0. It is recommended that all units having the same AP (Access Point) be on the same subnet mask.

22. Press ESC to return to the Network Configuration Menu.

23. Finally press 'D' and enter the maximum number of remotes. By default this value is 50. If the AP has more than that, you must change the value.

24. Your configuration of the AP is complete. Return to the Starting Information screen (Step 1 above) and repeat all steps with the remote unit. All of the settings/values are the same.

MDLC over IP Port

iNET radios can be configured to work with the MDLC over IP port on ACE3600 RTUs (see Configurations 4-7 above.)

MDLC over IP supports:

- IP Gateway 4.xx configured with MDLC over IP over Ethernet port.
- ACE3600 RTU Ethernet port
- ACE3600 RTU RS232 port configured as MDLC over IP over PPP connected to Standard modem.

When using an RTU with EP Ethernet port, connect the RTU Ethernet port to the iNET Ethernet port. The IP Port should be on the same subnet as the iNET. Its Subnet mask and IP Gateway should be the same. The rest of the configuration should be the same as an MDLC over IP port (i.e. configuring the port and setting the appropriate baud rate and Link ID, and downloading the IP Conversion Table.) The P Conversion Table is needed to communicate with other RTUs connected over PPP or Ethernet.

The rest of the configuration should be the same as an MDLC over IP port (as above). All IP settings are obtained dynamically from the modem when connecting to it. The RTU PPP port should be connected to COM2 on the iNET radio using a computer adapter. The following describes how to configure iNET COM2 modem for PPP.

After configuring the IP Gateway, EPIB for Ethernet, and RTU (for PPP) with MDLC over IP port, they can all communicate on the iNET network as if they all reside on a LAN. All routing between them is done via the iNET network, and if a LAN is involved, using other routers as well. Any RTU can communicate with any other RTU or IP Gateway. A single Link ID should be set for all RTUs/ IP Gateways on these ports.

Note however, that if the MDS radio was connected via External Modem port (serial), or via a Terminal Server (e.g. Equinox) over serial port, it is a completely different MDLC link/protocol. A different Link ID should be set in the RTU/IP Gateway when using this configuration. If both coexist on the same iNET network, each should have its own Link ID with MDLC network configuration downloaded to all units.

Use the iNET radio programming software to program the AP (Access Point) and then the remote with the following settings.

Note:

- Radio firmware should be 4.4.0 or above.
- IP Address refers to the Ethernet port IP and not the “over the air” IP.

The following shows Access point configuration for MDLC over IP but it is exactly the same for Remote.

The initial screen is as follows:

```
MDS iNET 900
 Starting Information Screen
 -=====================================================================-

        Device Mode:           Access Point

        Device Name:           AP Demo Set I

        Network Name:          Demo Set l

        IP Address:            169.254.0.12

        Device Status:         Operational

        Uptime:                01 hrs, 51 min

        Firmware Version:      4.4.0

        Hardware Version:      1.0.3

        Serial Number:         1069975

                 Press 'G' to go to Main Menu
```

1. Press 'G' and the Main Menu will be displayed.
2. Press 'B' and the Network Configuration Menu will be displayed.
3. Press 'G' for IP Address configuration.
4. In the IP Address Configuration Menu, press 'B' to set the Static IP Address to 169.254.0.12.
5. Next press 'C' to set the Static IP subnet mask to 255.255.0.0. It is recommended that all units having the same AP (Access Point) be on the same subnet mask.

   Note that the Static (sub)Net Mask and Static IP Gateway addresses should be the same as those of the IP Gateway and EPIB. Their IP Address should be on the same subnet. For example 169.254.0.100 for an IP Gateway address of 169.254.0.012 is suitable.

   Also note that when using PPP it is recommended to have the IP Address of PPP on the same subnet, for example 169.254.0.13. See Configuring for PPP below.
6. Press 'E' to commit changes. Press ESC to return to the Network Configuration Menu.
7. Finally press 'D' and enter the maximum number of remotes. By default this value is 50. If the AP has more than that, you must change the value.

8. Your configuration of the AP is complete. Return to the Starting Information screen (Step 1 above) and repeat all steps with the remote unit. All of the settings/values are the same.

Configuring for PPP

9. From the Main Menu, press 'D' and the Serial Gateway Configuration Menu will be displayed.

10. Press 'D' to enable COM2 (if not enabled). SPACE to cycle between Enabled and Disabled. COM2 should be Enabled and COM1 Disabled. Press ENTER once Enabled is shown.

11. Press 'E' and the Serial Configuration Wizard will be displayed. This wizard will assist you in the configuration of your available Serial Data Ports.

12. Press 'A' to begin the Wizard and the IP Protocol selection menu will appear.

13. Select the IP Protocol you would like to use. The following modes are supported:

    - TCP - to be used as a Terminal Server. (IP Gateway does not support this option.)
    - UDP - to be used as External Modem.
    - PPP - to be used as PPP port (same as Ethernet).

    Press 'C' to select PPP.

14. The wizard will prompt you to change the value of the IP Address. Press 'A' and enter the Remote IP Address. This is the address that is uniquely assigned to the RTU. It should be different from the other addresses used in the iNET network and in the LAN (if connected to LAN).

    A good scheme is to add 1 to the Static IP Address set in the Network Configuration screen above. For example, if the address 169.254.0.12 was assigned to the iNET Ethernet port, the PPP would be assigned 169.254.0.13. Both addresses reside in the same subnet 255.255.0.0 as was set in the Network Configuration. When using a PPP port, two IP addresses are set for iNET, one for the Ethernet port, and another (on the same subnet) for PPP. It is recommended to make those addresses consecutive where possible.

15. Press 'B' and the Data Baud Rate screen is displayed.

16. Select the baud rate according to the RTU, e.g. 'D' for 9600.

17. Next press 'G' to select the 8N1 hardware configuration.

18. It is recommended to have Hardware Flow Control on the serial port enabled. When prompted, press 'A' to enable Hardware Flow Control.

19. When prompted to select the Serial Packet Mode, press 'A' to use the default value (Seamless Mode.)

The settings for the COM2 Serial Data Port should appear as follows:

```
Serial Configuration Wizard
-==========================================================================-
  COM2 Serial Data Port

A) Status                      enabled
B) IP Protocol                 Point to Point Protocol (PPP)
C) Device IP Address                   169.254.0.13
D) Data Baud Rate                      9600
E) Configuration                       8N1
F) Flow Control                enabled
G) Serial Mode                 Custom
H) Custom Inter-Frame Delay            4
I) Custom Data Buffer Size             64




Select a letter to choose item, <ESC> for the prev menu, 'Q' to quit wizard
```

20. Press 'X' to save the changes and exit the wizard. There is no need to power up the iNET radio. Note that these settings are saved and you do not need to reset them when powering up the radio unit again.

21. From the Serial Gateway Configuration, press ESC to return to the Main Menu.

Your configuration of the PPP is complete.

RTU Configuration

The RTU port is configured using the ACE3600 STS.

Site Configuration

Procedure 13-26 How to Configure the ACE3600 Port for the iNET 900 Radio

In the ACE3600 STS click on the desired site, and open the site view.

2. In the Port Tab, click on the on-board or plug-in port through which the RTU will communicate with the iNET radio.

3. Confirm that the port parameters and data speed are as shown in the screen below.
   Note: If the baud rate of the radio is not the default value (9600), the baud rate of the port should be configured accordingly.

4. Define desired links.

5. Save the changes.

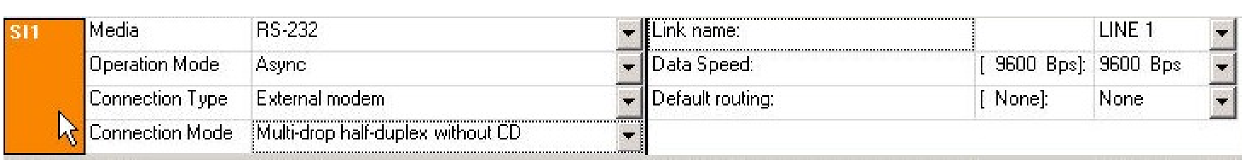


Figure 13-49 RTU Site Configuration for iNET Radio– External Modem Port Port Type Parameters

SI1	Media	RS-232	Links...		LINE 1
	Operation Mode	Async	Data Speed:	[9600 Bps]	9600 Bps
	Connection Type	PPP	DNS Servers		
	Connected to	Null modem	NTP Servers		

Figure 13-50 RTU Site Configuration for iNET Radio– MDLC over IP Port Port Type Parameters

Physical | Link

Advanced Link Layer

Parameter	Default	Value
TX to failed RTU every <0:DISABLE 0-30> min	[3]:	3
Periodic check of failed RTU	[Disable]:	Disable
Default group IP address:	[0.0.0.0]:	0.0.0.0
Get host by name using DNS	[Enable]:	Enable
MDLC over IP port number:	[2002]:	2002
Enable sync	[Disable]:	Disable
Enable routing on MDLC over IP port	[Disable]:	Disable
Notify IP address when connecting	[Enable]:	Enable
Check alive timeout (sec) <0-65535>	[35]:	300
Poll interval (sec) <0-255>	[10]:	10
Maximum number of polls <0-255>	[3]:	3
Disconnect on icmp:netunreach	[Disable]:	Disable
Disconnect on idle timeout (sec) <0-65535>	[0]:	0
Does modem support abort sequence	[Enable]:	Enable
Ignore CD	[Never]:	When connect
Modem configuration timeout (sec) <1-255>	[30]:	30
Registration life time (sec) <0-65535>	[0]:	0

Figure 13-51 RTU Site Configuration for iNET Radio– MDLC over IP Port Advanced Link Layer Parameters

IP Conversion Table

Prepare an IP Conversion Table and download it to the RTU. The IP Address of the RTU is the one assigned by the iNET 900 to the RTU, referred to as Remote IP Address in Configuring for PPP above. This IP address can be retrieved using the ACE3600 STS SW Diagnostics & Loggers utility in Device LIN1L, level 0.

Verify that the connection succeeded using the SW Diagnostics & Loggers utility. In Device LIN1L, level 101, make sure that the "State of configuration task" field is set to "connected and registered". This may take between 30-60 seconds.

MDS Radio Installation Kit

The MDS installation kit (V152AK/FLN3853A) enables the user to install the 9810 Spread Spectrum, 9710A- 900 MHz and 4710 UHF Transceiver radio modems in ACE3600 Remote Terminal Units (RTU). The kit includes a bracket and cables.

Installation

The MDS radio can be mounted on the ACE3600 RTU as follows:

Procedure 13-27 How to Install the MDS 900 Radio on the Metal Chassis

1. Connect the radio to the bracket provided in the Hardware Kit (#0789971V39 from FHN7066A) using the four screws, supplied with the bracket. (See Figure 13-52 below.)

Figure 13-52 MDS Radio Mounted on Metal Bracket - Front and Rear View

2. Connect the communication cable (FKN8513A) to the 25-pin connector on the side of the radio and tighten the screws.

3. Insert the DC power cable (FKN8510A) connector into the DC power connector on the radio.

4. If the RTU is to be installed inside an enclosure, screw the antenna cable (FKN8509A) into the antenna connector on the radio. Otherwise, an external antenna can be connected directly to the antenna connector on the radio.

5. Mount the bracket (#0789971V39 from FHN7066A) on the RTU chassis above the I/O modules, using the four built-in screws. (See Figure 13-53 below.)

6. Route the antenna cable (FKN8509A) cable through the small wire clamps along the left side edge of the RTU chassis, according to the placement of the radio on the chassis, as in Figure 13-53 and Figure 13-54.

7. Unscrew the nut and locking washer from the N-type connector at the other end of the antenna cable. Thread the end of the cable through the opening on the bottom of the enclosure and screw on the nut and locking washer from outside the enclosure.

8. Connect the other end of the DC power cable (FKN8510A) to the AUX1A/B connector on the RTU's power supply module.

9. Connect the other end of the communication cable (FKN8513A) to the ACE3600 CPU module port configured for the radio. See RTU Configuration below.

10. Connect the antenna cable to an external antenna.

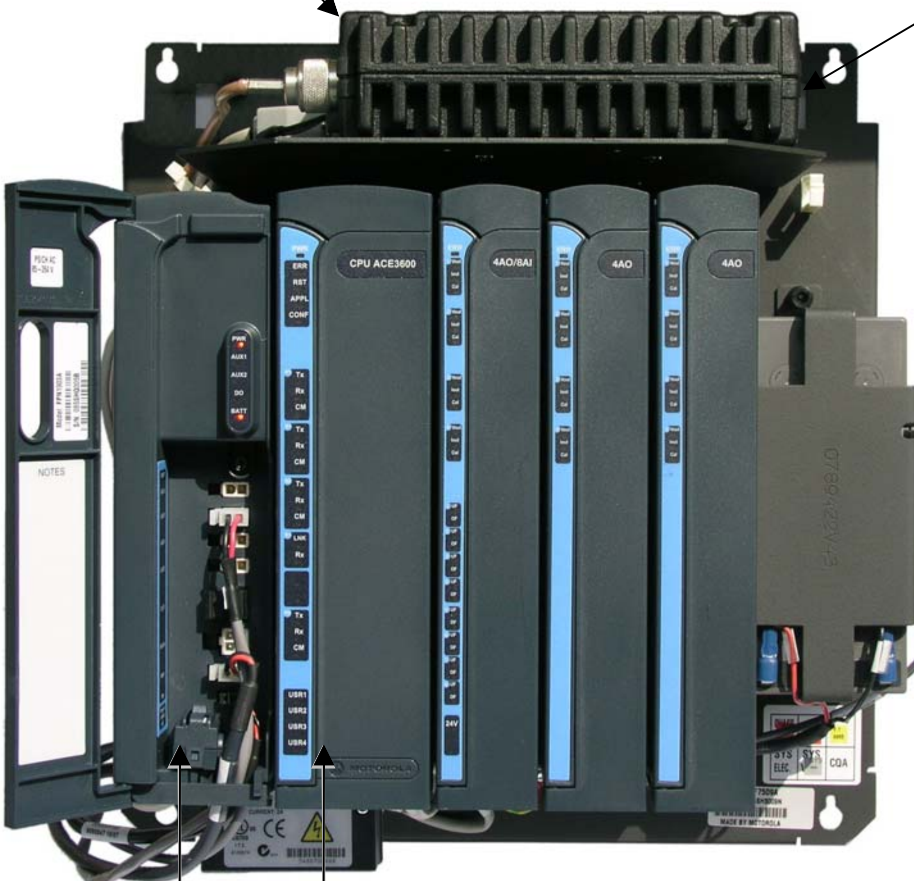


Figure 13-53 MDS Radio Modem Installed on ACE3600 Chassis

Figure 13-54 MDS Radio Modem Installed on ACE3600 Chassis – Cable Connections

RTU Configuration

The RTU port is configured using the ACE3600 STS as follows:

Procedure 13-28 How to Configure the ACE3600 Port for the MDS Radio

1. In the ACE3600 STS click on the desired site, and open the site view.

2. In the Port Tab, click on the on-board or plug-in port through which the RTU will communicate with the MDS radio.

3. Confirm that the port parameters and data speed are as shown in the relevant screen below.
Note: If the baud rate of the radio is not the default value (9600), the baud rate of the port should be configured accordingly.

4. Define desired links.

5. Save the changes.

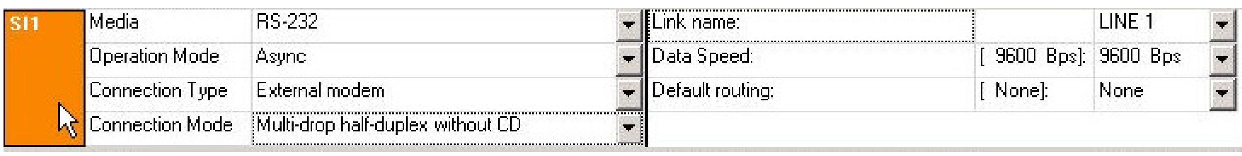


Figure 13-55 RTU Site Configuration for MDS 9810 Spread Spectrum/4710 UHF Transceiver Radio– Port Type Parameters

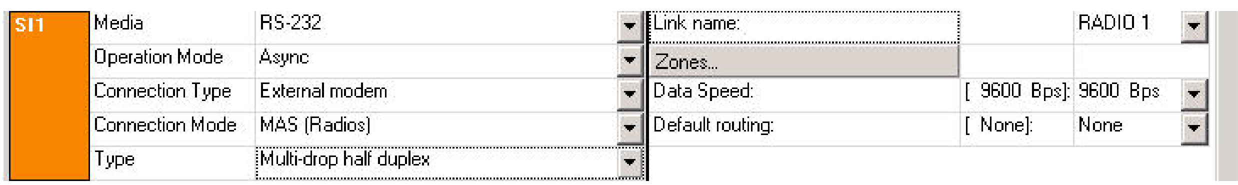
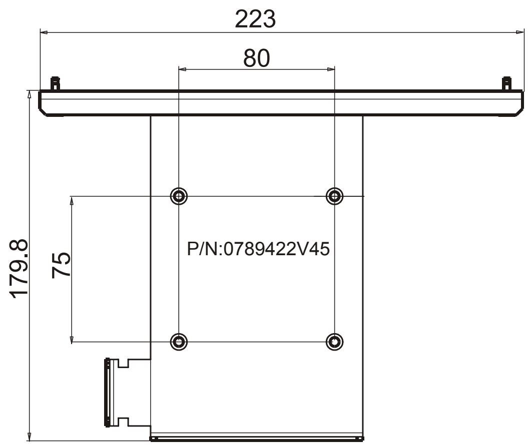


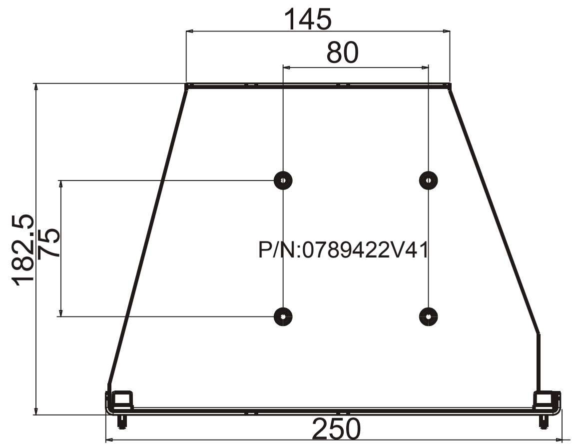
Figure 13-56 RTU Site Configuration for MDS 9710A- 900 MHz Radio– Port Type Parameters

Mounting the ACE3600 Radios on a Wall

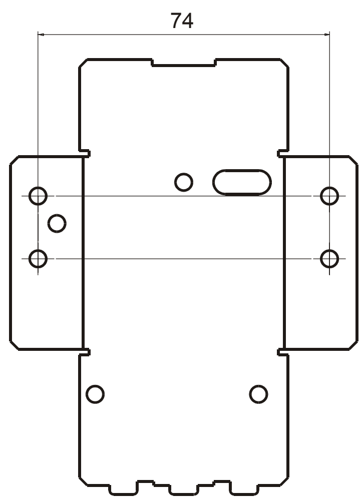
ACE3600 radios can be mounted on a wall near the ACE3600 frame/housing, using a special metal bracket. This bracket is part of the specific radio installation kit and must be ordered.



CM/EM/GM/CDM750 Bracket



XTL5000/XTL2500 Bracket



GP/HT/PRO Bracket

Figure 13-57 Radio Wall Mount Brackets

Procedure 13-29 How to Mount a Radio on a Wall

The following installation procedure should be followed to install radios on a wall near the ACE36000 frame. A special wall mount bracket is provided with the radio installation kit, which can be ordered separately from the frame. Allow extra space around the bracket for the radio and wires.

1. Drill four holes in the wall at the horizontal and vertical distances (in mm) shown in Figure 13-57 for the desired radio wall mount bracket, at the desired angle/orientation.

2. Place the bracket on the wall, lining up the bracket holes with the drilled holes.

3. Insert four M3 Phillips 10mm screws (not supplied) into the holes and tighten with a screwdriver to secure the bracket firmly against the wall.
4. Attach the radio to the bracket using the supplied screws.

RS485 CONNECTION BOX

General Description

The RS485 Connection Box (V186AD/FLN3641A) provides an interface to up to seven RS485 connections. (See Figure 14-1.)

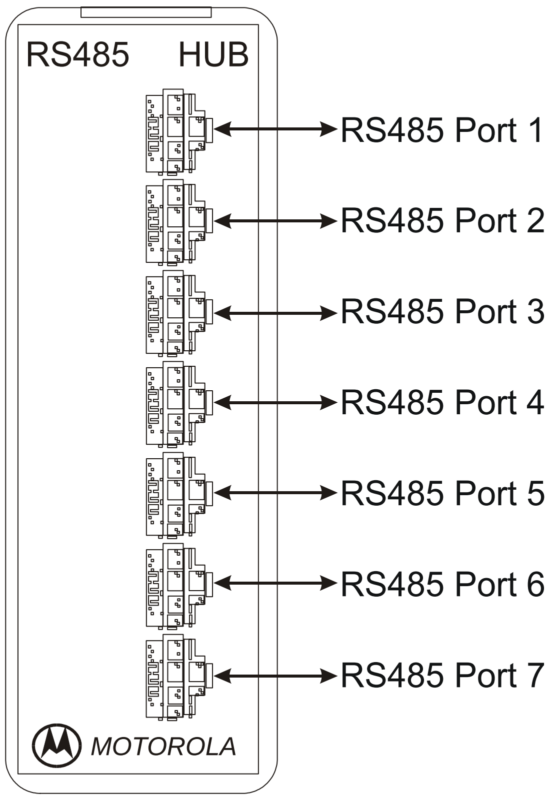


Figure 14-1 RS485 Connection Box – Front Panel

Installation

The RS485 Connection Box can be easily installed on the RTU chassis.

Mounting the RS485 Connection Box on the RTU Chassis

1) To connect the plastic box interface to the metal chassis, place the box on the metal plate and click the two pegs on the back of the plastic box into the desired holes on the metal chassis.

Wire Connections

1) To interface to an RTU, connect the communication cable (FKN8427A) between the connection box input port and the ACE3600 RS485 port.

2) To interface to an external device, connect the communication cable (FKN8427A) between the connnection box port and an external RS485 modem with an RJ45 connector.

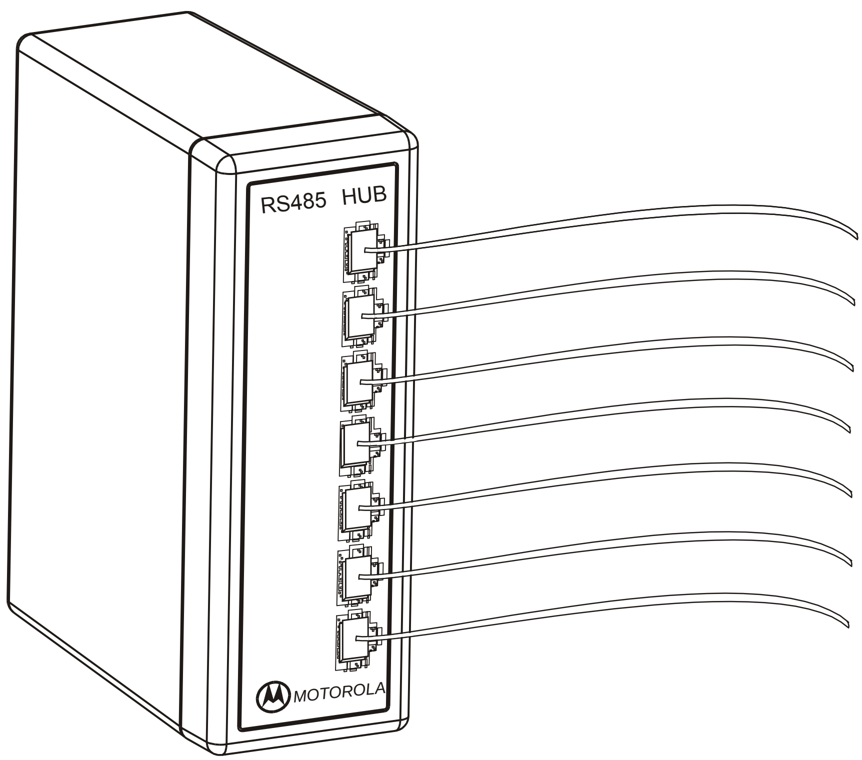


Figure 14-2 RS485 Connection Box – Wire Connections

AUDIO CONTROL AND TONE (ACT) MODULE

Introduction

The Audio Control and Tone (ACT) module (V155AE/FLN3851A) serves as a player of recorded voice and alarm sounds in ACE3600 based alert systems. The ACT module also routes low-level sound signals to high-level amplifiers. The high-level sound can be directed to specified alert speakers in a set of six speakers, mounted in different locations.

The ACT module contains an internal audio memory that allows custom tones or audio sounds to be recorded and stored in the ACT module. Recording of audio may be done directly from a low-level output source (tape recorder, laptop or radio output).

Front Panel Description

The ACT module is enclosed in a compact plastic box. See the ACT module below.

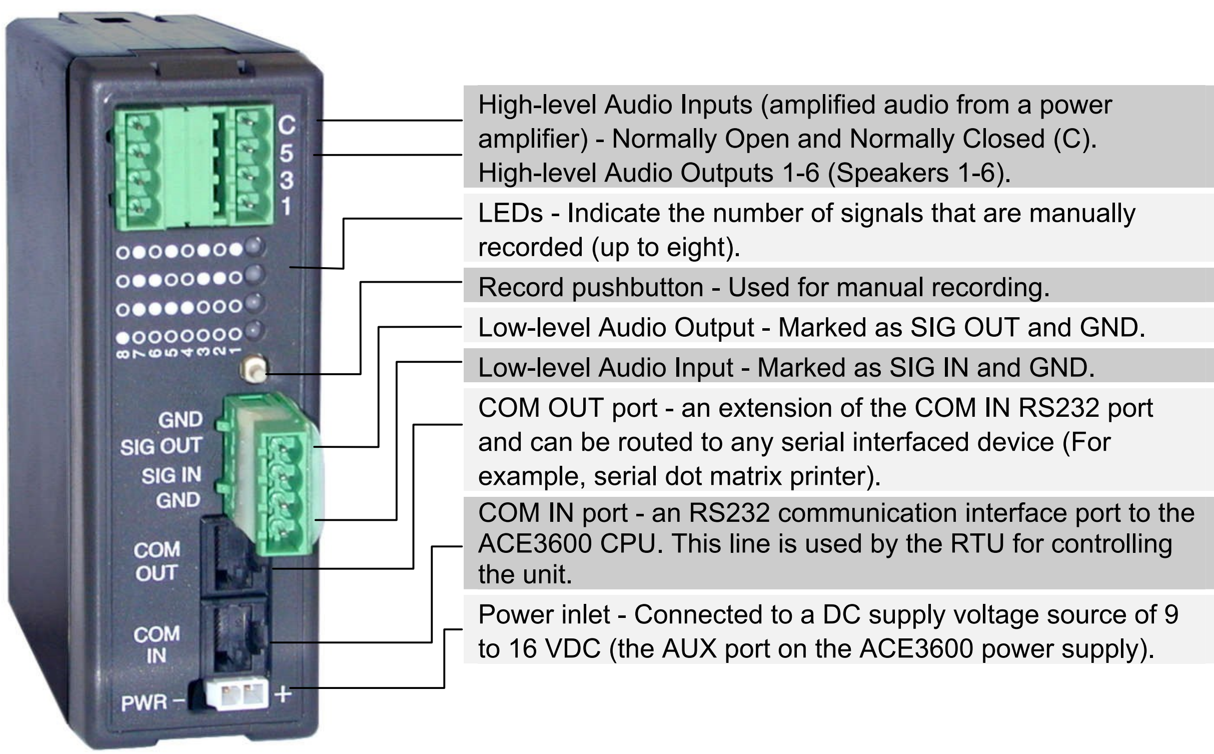


Figure 15-1 ACT Module – Front Panel

ACT Module Features

The ACT module features are described below:

- Controlled by the RTU via an RS232 serial port using a simple instruction set.
- Digitally records audio signals (alarm tones, voice announcements, etc).
- Plays stored audio signal.
- Interface to an external low-level audio signal source (microphone, radio audio out, etc.).
- Interface to input of one audio amplifier and up to two outputs of audio amplifiers.
- Connects to up to six speakers.
- Selective output to any combination of six speakers.
- Routes the audio signals from the amplifier(s) output to selected speakers.
- Routes data coming from the RTU to a serial printer to allow printing of information by alternative use of the RTU serial port.

The ACT module block diagram is shown below:

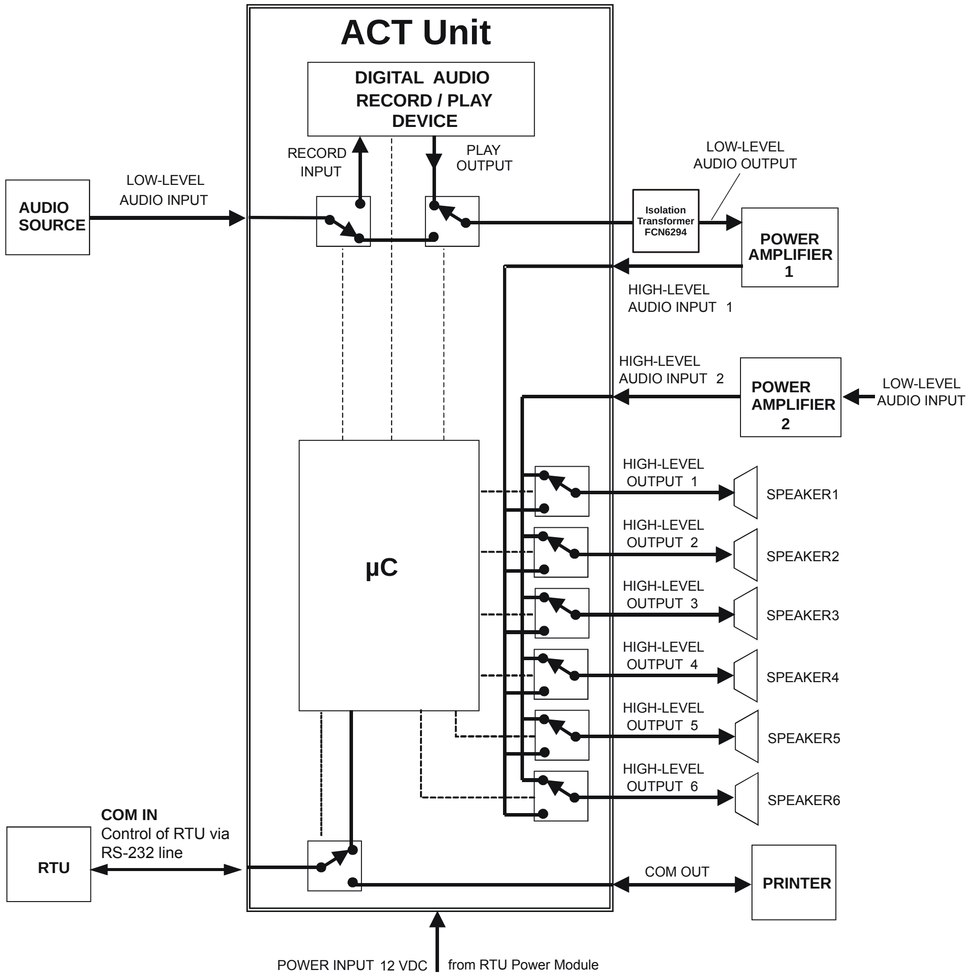


Figure 15-2 ACT Module – Simplified Block Diagram

Audio Handling Capabilities

The ACT module has built-in hardware which records and stores audio signals by digitizing the signal from an audio source connected directly to the module's low-level audio input. The module can play these pre-recorded audio signals once or repeatedly.

To facilitate the recording process, audio signals may be formed or saved in "WAV" file format on a PC (or on any other audio format provided it can be played by a PC) and then downloaded to the module through the PC audio out.

The module's total recording capacity is 240 seconds. As default, the recording space is divided into eight "cells" (each of which holds up to 30 seconds). The number of cells is configurable and can be set to 1, 2, 4, 8, 16, 30 and 60.

NOTE: Recording will automatically terminate 2 seconds after the module detects silence. Recording will also be stopped when the "cell" has run out of recording capacity.

The module's low-level audio input also enables the connection of an external low-level audio source (such as a radio audio output) for direct routing to an audio amplifier. Thus the audio routed to this output can be either a pre-recorded audio signal or an external source, connected to the low-level audio input.

Two high-level audio inputs are used to route amplified audio signals into the module. The ACT module has six high-level audio outputs that can be routed to selected speakers.

Interface to the RTU

The ACT module interfaces to the RTU via an RS232 port, marked as COM IN. The communication with the RTU is based on an 8-bit code protocol.

The ACT module also enables the RTU to have more than one use for its RS232 port. The application on board the RTU may select its serial port connected to COM IN to control the ACT module or to send data to COM OUT. This is very useful for connecting a dot matrix printer to the RTU without requiring an additional serial port which could necessitate the another CPU.

The destination of the serial data sent to the COM IN port is selected via the following mechanism:

- Set DTR signal "Off" – Data is routed to COM OUT.
- Set DTR signal "On" – Data protocol controlling the ACT.

The ACT module operates on 9 to 16 VDC, usually supplied by the RTU's auxiliary power supply.

An RTU application program controls the ACT module via a user port using an 8-bit instruction set.

The ACT module returns simple 8-bit codes as a response to instructions.

The instruction set is comprised of the following set of operations:

- Play
- Repeat Play # times
- Stop - Play
- Enable low-level Audio Output
- Disable low-level Audio Output
- Configure the number of recorded signals (cells)
- Record
- Report Status
- Connect/Disconnect Speakers

For the ACT module instruction set, see *ACT Instruction Set* below.

Installation and Wiring

The ACT can be installed in various locations on the RTU chassis (mounted on holes prepared for installation).

Note: Connect the ACT to the High Power Audio Amplifier only via the Isolation Board - FCN6294A (connected to the SIG IN/SIG OUT connector).

Procedure 15-1 How to Install the ACT Module

1) Place the ACT module on the metal plate and click the two pegs on the back of the plastic box into the desired holes on the metal chassis.

2) Connect one end of the power cable (FKN8433A) to the PWR connector on the ACT module. Connect the other end of the cable to the one of the AUX connectors (configured to 12V) on the ACE3600 power supply module.

3) Connect one end of the communication cable (FKN8427A) to the COM IN port on the ACT module. Connect the other end of the cable to the RS232 port on the ACE3600 CPU.

4) To use high-level audio speakers, connect up to six speakers to the High-Level Audio Out (1-6) relays on the top of the ACT module front panel. See Figure 15-3 below.

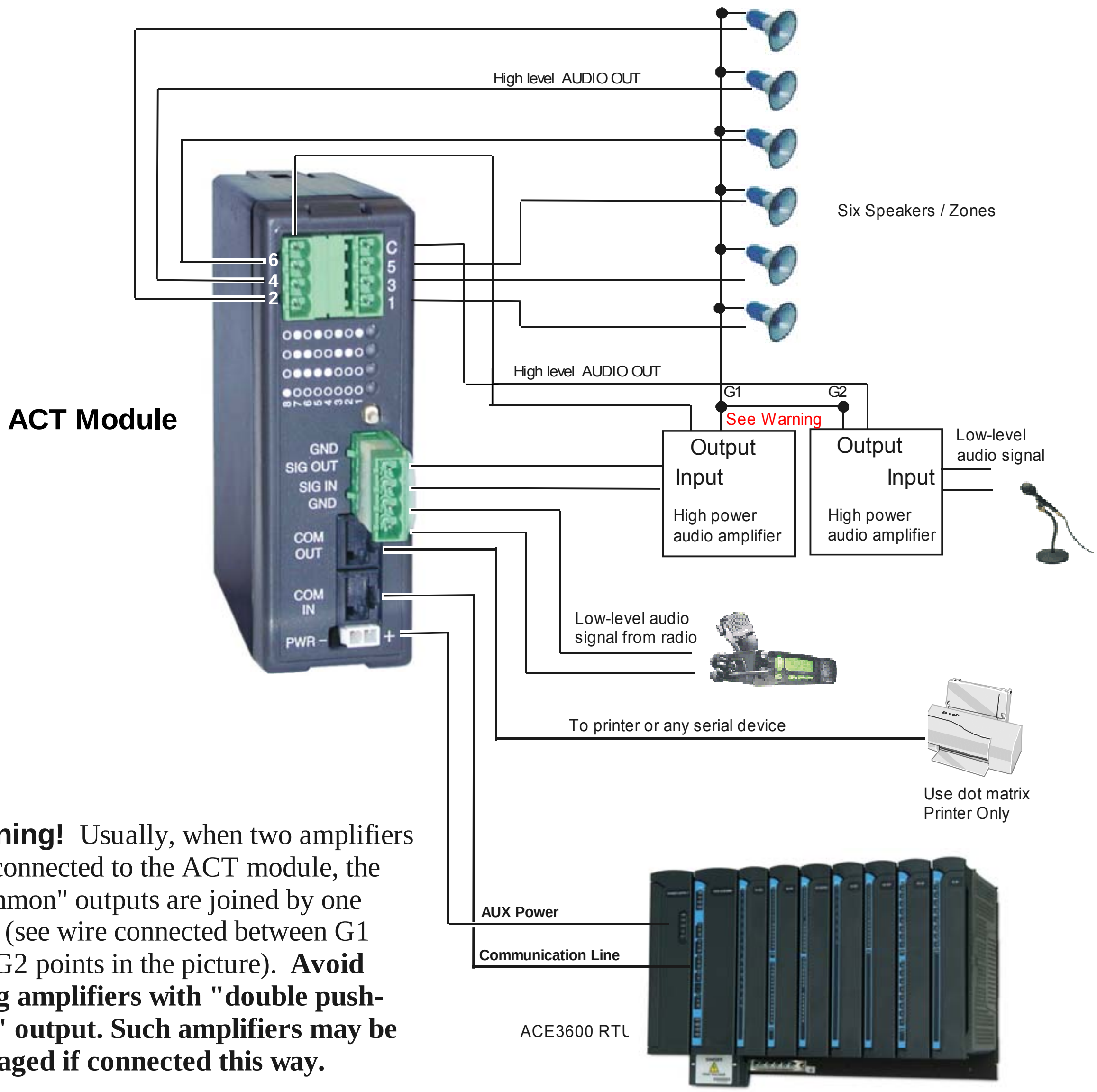
5) To enable playing prerecorded tones, connect the input of the first high power audio amplifier to the SIG OUT/GND connectors, using the Isolation Board (FCN6294A). Connect the output of the amplifier to the Normally Open connector on the top left corner of the ACT module front panel. See Figure 15-3 below.

6) To enable radio voice channel audio (low level signal), connect the external speaker of the voice radio to the SIG IN/GND connectors, using a simple wire cable (can be shielded). See Figure 15-3 below.

7) To add a second high power audio amplifier for local microphone, connect the output of the second amplifier Normally Closed (C) connector on the top of the ACT module front panel. Also connect the output of the second amplifier to the output of the first amplifier. See the warning in Figure 15-3 below.

8) To use a local microphone (low-level audio signal), connect the microphone to the second amplifier.

9) To attach a dot matrix printer or other serial device, connect the device to the COM OUT connector on the ACT module using a data cable (with connector adaptors as necessary.) See Figure 15-3 below.



Warning! Usually, when two amplifiers are connected to the ACT module, the "common" outputs are joined by one wire (see wire connected between G1 and G2 points in the picture). **Avoid using amplifiers with "double push-pull" output. Such amplifiers may be damaged if connected this way.**

Figure 15-3 ACT Module – Wiring Diagram

Table 15-1 ACT Module Communication Ports Connection Chart

COM IN		COM OUT
RxD - In	1	TxD
TxD - Out	2	RxD
DTR - Out	3	CTS
GND	4	GND
RTS - Out	5	CD

CD - In	6	RTS
Not Used	7	Not Used
CTS - In	8	DTR

RTU Port Configuration

Before using the ACT module with the RTU, configure the communication port to which the ACT module is connected.

Procedure 15-2 How to Configure the ACE3600 Port for the ACT Module

1) In the ACE3600 STS click on the desired site, and open the site view.
2) In the Port Tab, click on the on-board or plug-in port through which the RTU will communicate with the ACT Module.
3) Set Media to RS-232, Operation Mode to Async, Connection Type to User Port (Ladder Controlled).
4) Save the changes.

Generally no other changes are required to Advanced Physical or Link Layer parameters. For information on the RTU port parameters, see Appendix A: Site Configuration Parameters of the ACE3600 STS User Guide.

Controlling the Module

The RTU (or PC) is interfaced to the ACT via the RS232 port. The communication parameters of the RTU (or PC) port must be set to: 9600 BPS, 1 stop bit, no parity.

The ACT is operated using a simple instruction set. Each instruction must be sent twice. If the second instruction sent does not correspond to the first, that instruction is rejected. When the ACT recognizes a valid instruction, it echoes an acknowledgement. While the module is playing a stored audio signal, the instructions should be sent only once.

ACT Instruction Set

Instruction	**Code**	**Description**
Play Signal #	"01XXXXXX" (XXXXXX=1 - 60)	Plays recorded audio signal number #. The recorded audio is played into the low-level Output. The low-level Output is disabled. *Example: Play signal 6 = "01000110"*
Record Signal #	10XXXXXX (XXXXXX=1-60)	Records audio signal number #. *Example: Record signal 6 = "10000110"*
Connect/Disconnect Speakers	$11X_5X_4X_3X_2X_1X_0$ X_n= Speaker n (n=0-5) 0= disconnect 1= connect	Connects or disconnects speakers.
Repeat the Played Signal # times	001XXXXX XXXXX=1-31	Repeats playing the audio signal # times. Note: *This command can be instructed and performed only while the unit plays a signal*. *Example: Repeat playing the played signal 4 times = "00100100"*
Stop Play	"00011111"	Stops the played signal.
Enable Low-level Audio Output	"00100000"	Low-level Audio Input is routed to Low- Audio Output
Disable Low-level Audio Output	"00000000"	Low-level Audio Output is disabled (no audio is routed to the output). Played signal is stopped.
Configure the number of recorded signals	"000XXXXX" XXXXX=1,2,4,8,15, 30 N=2*(XXXXX)	Configures the number of different signals that can be recorded to n= 2, 4, 8, 16, 30, 60 *Example: Set to 16 signals = "00001000"*
One signal	"00000011"	Configures the number of recorded signals to only one.
Report Status	"01000000"	Use this command to interrogate the ACT. The ACT then returns the following 4 byte sequence with the

		module status: Byte 1: Instruction Echo (“01000000”) Byte 2: Bit 0-5 = Speaker status (0=disconnect) Bit 6 = Play status (1 = play) Bit 7 = Low-level Audio Output status (1= Low-level Input routed to Low-level Out) Byte 3: Possible number of recorded signals Byte 4: The number of recorded audio signal that is currently playing (will be reported only when a signal is played.)

Response to Instructions

The ACT acknowledgements are the 8-bit codes described below:

Response	Code	Description
Record completed	“01111110”	Recording has been completed.
Play started	“10000000”	Signal is currently being played.
Play completed	“01111101”	Signal play has been completed.
Instruction inconsistency	“01111111”	Instruction was not the same as the first one (when not playing); the instruction is not performed.
Instruction time out	”01000000”	Instruction received only once, (when not playing); the instruction is not performed.

Recording Audio Signals

Manual recording enables the recording of up to eight audio signals using the pushbutton (PB) and LEDs on the ACT unit front panel. Follow the steps below to record audio from PC/Laptop/Recorder:

Procedure 15-3 How to Manually Record Audio Signals

1) Connect the "Speaker Out” of the PC/Laptop/Recorder to the "Audio In” port (Use Mono adapter if needed).

2) Pause the audio and tune the volume to approximately ¾ of full scale.

3) Press the PB for more than two seconds; all four LEDs will light up.

4) Press the PB to select the audio cell (from a selection of eight) to which you want to record. (The audio signal number is displayed as a binary number represented by four LEDs).

5) Start playing the audio. The unit will identify the input as audio and start recording. The LEDs will start to blink and will stop when audio input ceases (or when the maximum recording time has elapsed).

6) Repeat steps 4 and 5 to record additional audio signals (up to eight).

7) When recording is completed, all the LEDs will turn off.

ACT Module* Specifications

General	
Operation Voltage	9 to 16VDC
Power Consumption	140 mA max (when all relays energized) 35 mA max (when all relays non energized)
Dimensions (H x W x L)	25mm x 95mm x 115mm (1" x 3.6" x 4.5")
Operating Temperature	-30º to +60º C (-22º to +140ºF)
Relative Humidity	0-95% @ 50° C without condensation
User Connection	
Power connector	Molex 2 pin with polarity
COM IN RS232	Phone 8-pin
COM OUT RS232	Phone 8-pin
Low-level Audio In/Out	4 screw TB connector
High-level In/Out	8 screw TB
Audio	
Low-level Audio Input	0.8 to 1.5 Vp-p, 300-3300 Hz, Minimum 50 kW ±10% input impedance – 4.6KV isolated.
Low-level Audio Output	1Vp-p ±60% - 4.6KV isolated, via Isolation Board.
High-level Audio Input	Maximum 30 VAC RMS, 0.5A RMS Maximum 0.05 W-output Impedance Minimum signal: 100 mV, 100 µA.
High-level Audio Output	30 V RMS, 0.5 A RMS maximum per one output
EMC	
Electrostatic Discharge	IEC 1000-4-2, level 3
Radiated Electromagnetic Field	IEC 1000-4-3, level 3
Electrical Fast Transient / Burst	IEC 1000-4-4, level 3
Radiated Emission	EN55022

Specifications subject to change without notice.

* The ACT module is not compliant with ROHS European Directive no. 2002/95/EC.

CONFIGURATION

General

For information on setting the 12V DO dipswitch in the DO relay module board, see the Digital Output Relay chapter above.

OPTIMIZATION

General

No optimization is required for the ACE3600 units.

OPERATION

General

The operational functions of the ACE3600 unit are performed using the ACE3600 System Tools Suite (STS). These are administrative and diagnostic tasks, generally performed by technicians and administrators. The functions available depend on the specific software applications installed in the unit.

Opening/Closing the Housing Door

For instructions on opening and closing the housing door and locking the door with the optional padlock accessory, see the Opening/Closing the Housing Door section in the Installation chapter.

MAINTENANCE

General

The following maintenance procedures are recommended for the ACE3600 RTU.

Lead Acid Battery Maintenance

It is recommended to perform the following maintenance procedures for the lead acid battery using the ACE STS Hardware Test utility or the user application program:

- Once per month - run a full battery test (battery capacity) of the lead acid battery.
- Once per day - read the charge level of the lead acid battery.

If the capacity is below the manufacturer recommended level, replace the battery. See the Power Supply Module and Backup Battery chapter above.

TROUBLESHOOTING

Symptom	Action
The PWR LED on the CPU module front panel is not lit.	Check power connections to the unit. If all connections are correct, check cables.
The Power LED on the CPU module front panel is red.	The CPU has received an error from the power supply (AC fail, Bat Error etc.) Check the AC power supply, backup battery, etc.
The ERR LED on the CPU module front panel is red.	The unit has a problem. Check the Error Logger to read error message.
The ERR LED on the CPU module front panel is orange.	The unit has a warning. Check the Error Logger to read warning.
The ERR LED on the CPU module front panel is green.	The unit has a message. Check the Error Logger to read message.
The APPL LED on the CPU module front panel is red.	The user application is not running. Check the Error Logger to read error.
The CONF LED on the CPU module front panel is red.	There is a configuration error (such as an incompatible plug-in.) Check the Error Logger to read error.
The PWR LED on the CPU module front panel is flashing red.	The boot did not complete and the FPGA is not loaded. Download a new system to the unit.
The PWR LED on the CPU module front panel is flashing red.	The boot did not complete and the FPGA is not loaded. Download a new system to the unit.
The power supply is connected to power sources and there is no power in AUX1 and/or AUX2.	Check if the AUX connectors are off due to STS Hardware Test. If not, check if the fuse associated with the AUX is burned out and should be replaced. (One fuse for AUX 1A/1B and another fuse for AUX 2A/2B.) See Break-Fix Procedures chapter.
No communication with WAN, IP Gateway.	Check the unit's connection to the Ethernet.

BREAK-FIX PROCEDURES

General

IMPORTANT

This chapter refers only to replacement of removable modules, plug-ins, motherboard, power supply fuses, and backup battery. If any other components in the unit require replacement, contact your local service center.

Before replacing modules or plug-ins, see safety issues/warnings in the Installation chapter above.

Note: A TORX screwdriver is required for component replacement.

For information on installation of the frame/housing on the wall, see the Installation chapter above.

The ACE3600 has a hot swap capability, which means that the modules can be removed from their slots and inserted without powering down the unit. The only exception to this rule is the main power supply module, which cannot be removed during normal operation. See Replacing a Power Supply Module below for details.

If a module is inserted once the system is running, the system will recognize the module, but will not operate it using the application until the unit has been rebooted.

Replacing a CPU Module

Procedure 21-1 How to Replace a CPU Module

1. To replace a CPU module, open the door of the CPU module and press the cable holder downward.
2. Disconnect all cables from the connectors.
3. Simultaneously press on the tabs on the top and bottom of the plastic front of the old module, and pull the module from its slot. See Figure 21-1.

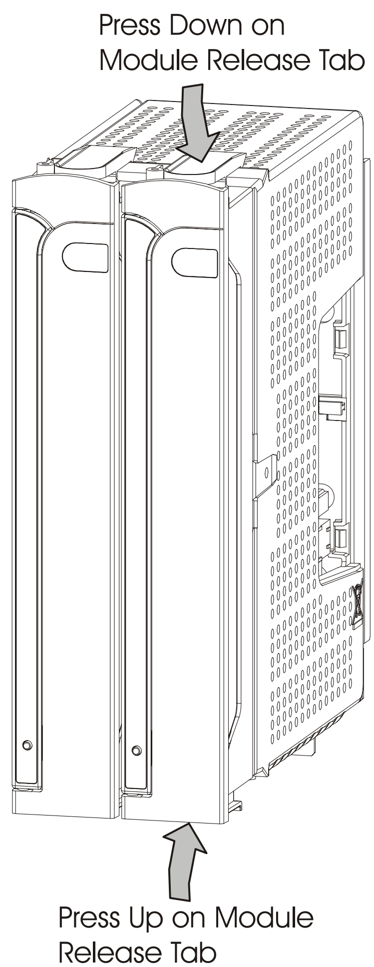


Figure 21-1 ACE3600 Module Release Tabs

4. Remove any SRAM plug-in memory from the old CPU module and plug in to the new CPU module.
5. Slide the new module all the way into the slot until the tabs click into place.
6. Reconnect the cables and press the cable holder back up into place.

Replacing a Power Supply Module

METAL PARTS OF THE POWER SUPPLY MAY BE VERY HOT.
After removing the power supply module, allow the metal parts to cool down before servicing the unit.

Procedure 21-2 How to Replace a Redundant Power Supply Module

1. To replace the second power supply module in a site with redundant power supplies, open the door of the power supply module and press the cable holder downward.
2. Disconnect the cables from the connectors.
3. Simultaneously press on the tabs on the top and bottom of the plastic front of the old module, and pull the module from its slot.
4. Slide the new module all the way into the slot until the tabs click into place.
5. Reconnect the cables and press the cable holder back up into place.

The main power supply cannot be removed under power and a safeguard is added in order to prevent unplanned removal.

Procedure 21-3 How to Replace the Main Power Supply Module

1. To replace the main power supply module, open the door of the power supply module.
2. Press down on the top of the main power cable connector to disconnect the user's main power cable from the cable inlet on the bottom of the power supply module front panel.
3. Follow steps 1-5 in Procedure 21-2 to replace the power supply.

Replacing an I/O Module

To replace an I/O module, follow the procedure below.

Procedure 21-4 How to Replace an I/O Module

1. If the I/O module includes a TB holder, remove TB holder by pulling on the extractor handles.
   If the I/O module does not include a TB holder, remove the TBs by hand or using the TB extractor.
2. Simultaneously press on the tabs on the top and bottom of the plastic front of the old module, and pull the module from its slot.
3. Remove any plug-in 24V power supplies from the old I/O module and plug-in to the new I/O module.
4. For DO relay modules, reset the 12VDO dipswitch, if necessary. See the Configuration chapter.
5. Slide the new module all the way into the slot until the tabs click into place.
6. If the I/O module includes a TB holder, reconnect the TB holder as described in the I/O Module section.
   If the I/O module does not include a TB holder, replace the TBs on the connectors on the front of the I/O module by hand.

Replacing a Plug-in Port on the CPU Module

Procedure 21-5 How to Replace a Plug-in Port on the CPU Module

1. To replace a plug-in port on the CPU module, remove the CPU module from the RTU.
2. Unscrew the two supporting pins on the other side of the CPU board. Save the screws.
3. Unscrew the two supporting pins on the plug-in port. Save the screws.
4. Connect the two supporting pins with screws to the new plug-in port.
5. Replace the plug-in board with the RJ-45 connector facing the panel. Carefully insert the plug-in board connector into the appropriate connector on the CPU board.
   For Ethernet 10/100 MB, use the J14 connector on the CPU (Plug-in 1 only.)
   For all other plug-in ports, use the J5 (Plug-in 1) or J6 (plug-in 2) connector.
6. Connect the two supporting pins with screws to the other side of the CPU board.
7. Replace the CPU module in the slot.

Replacing a Plug-in SRAM Memory Card in the CPU Module

Procedure 21-6 How to Replace a Plug-in SRAM Memory Card in the CPU Module

1. To replace an SRAM memory card on the CPU module, remove the CPU module from the RTU.
2. Remove the old plug-in SRAM memory card from the board.
3. Place the new plug-in SRAM memory card with the connector facing the panel. Carefully insert the plug-in board connector into the connector marked P12 on the CPU board.
4. Secure the memory card to the CPU board with the supplied screw.
5. Replace the CPU module in the slot.

For more information, see Connecting SRAM Expansion Memory to the CPU Module in the CPU Module chapter.

Replacing the Motherboard

To replace the motherboard of the ACE3600 RTU, follow the procedure below.

Procedure 21-7 How to Replace the Motherboard

1. If the unit is installed in a NEMA4 housing, unscrew the four large screws and remove the metal chassis from the housing.
2. Remove all modules from the outermost slots, generally the power supply module from the leftmost slot and I/O module from the rightmost slot.
3. Unscrew the M5 screws on each side which secure the motherboard to the metal chassis. Save the screws. See Figure 21-2.

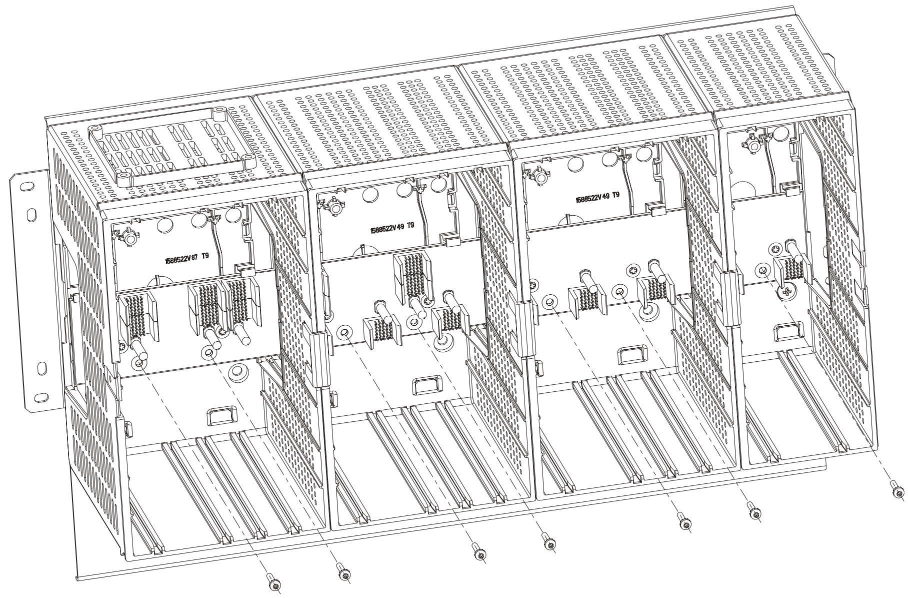


Figure 21-2 ACE3600 Motherboard on Metal Chassis

4. From inside the cage, push out the small cover on the side of the RTU rack/cage. Save the cover.
5. Slide the damaged motherboard out of the cage, through the opening on the side of the RTU rack/cage.
6. Slide the new motherboard into the rack, through the opening on the side of the RTU rack/cage.
7. Secure the motherboard to the rack/cage and metal chassis using the M5 screws saved in step 3.
8. Replace the cover on the cage.
9. If the unit was installed in a NEMA4 housing, replace the metal chassis in the housing and screw the four large screws from the metal chassis into the housing.
10. Replace the modules in their respective slots.
11. Make sure that the ground is reconnected.

Replacing the Fuses on the Power Supply Module for AUX1/AUX2

Procedure 21-8 How to Replace the Fuse for AUX1 1A/1B or AUX2 2A/2B

1. To replace a fuse for AUX1 1A/1B or AUX2 2A/2B on the power supply module,
2. Disconnect cables … from the connectors. If the faulty fuses are attached to the main power supply, press down on the top of the main power cable connector to disconnect the user’s main power cable from the cable inlet on the bottom of the power supply module front panel.
3. Simultaneously press on the tabs on the top and bottom of the plastic front of the old module, and pull the module from its slot.

4. Using narrow pliers, remove the faulty fuse from its groove on the board.
5. Press the new fuse into the groove on the board.
6. Slide the power supply module all the way into the slot until the tabs click into place.
7. Reconnect cables as in installation…

Replacing the Backup Battery on the RTU

For instructions on replacing the backup battery on the RTU, see Replacing the Backup Battery in the Power Supply and Backup Battery chapter above.

Interconnection Diagrams

All internal electrical connections except for the main power, ground and battery are performed in the factory and supplied with the RTU. The electrical interconnection diagrams are provided below.

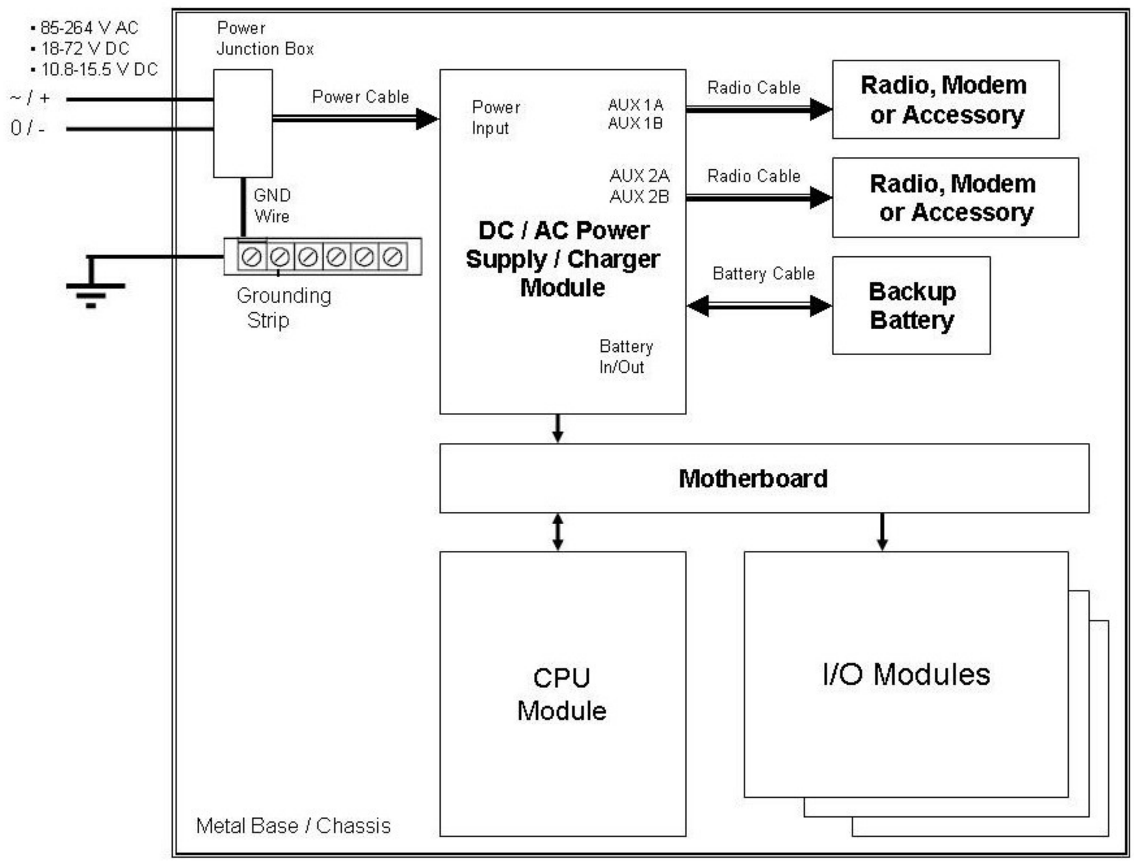


Figure 21-3 Electrical Interconnection (RTUs with I/O slots)

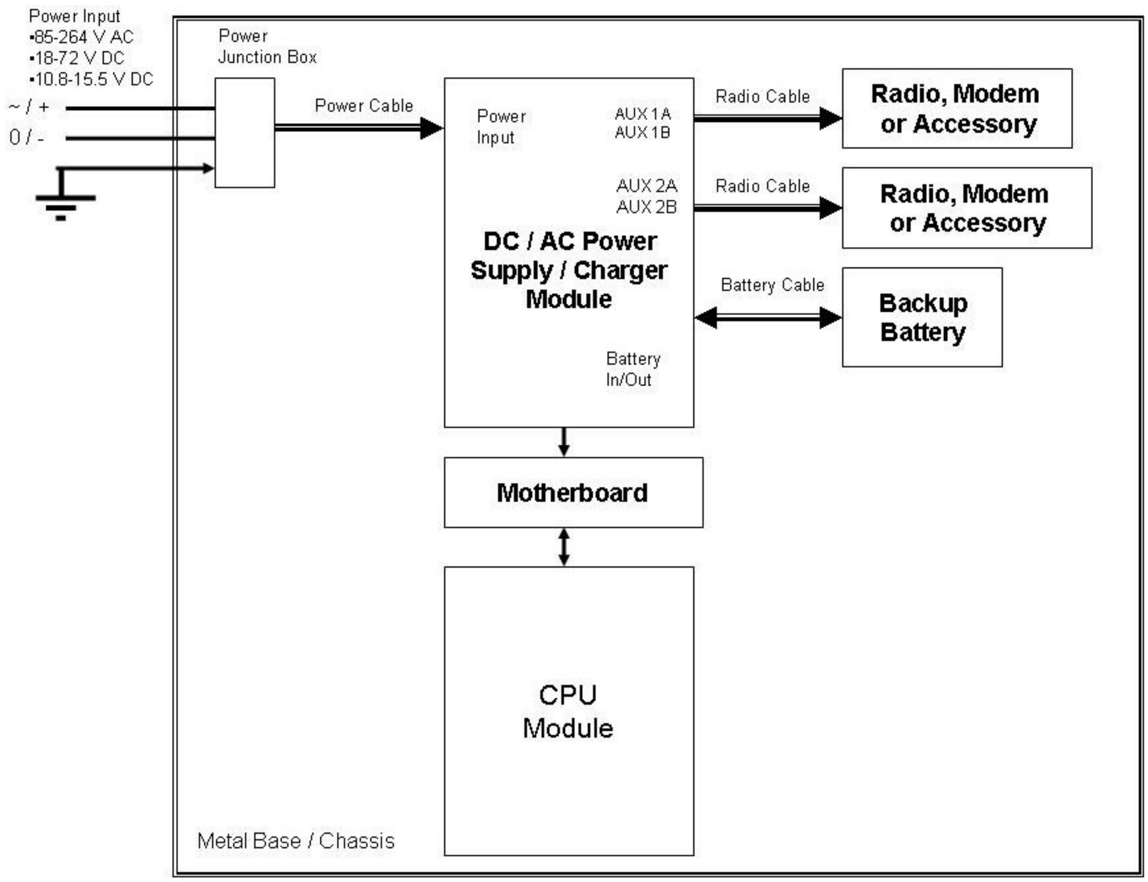


Figure 21-4 Electrical Interconnection (RTUs with no I/O slots)

APPENDIX A: GENERAL SPECIFICATIONS

Specifications

The specifications below are for the RTU as a whole. For the individual technical and performance specifications of each module in the RTU, see the specific module chapter.

Table A-1 ACE3600 Specifications

General	
Frames	No I/O slots - PS and CPU modules only, wall mount, Dimensions (WxHxD): 117 x 244 x 198* mm (4.61" x 8.23" x 7.80"*), Weight: 0.95 Kg (2.1 lb) 3 I/O slots - PS, CPU and 3 I/O modules, wall mount, Dimensions (WxHxD): 234 x 244 x 198* mm (9.21" x 9.61" x 7.80"*), Weight: approx. 1.9 Kg (4.19 lb) 5 I/O slots - PS, CPU and 5 I/O modules, wall mount, Dimensions (WxHxD): 314 x 244 x 198* mm (12.36" x 9.61" x 7.80"*), Weight: approx. 2.4 Kg (5.3 lb) 7 I/O slots - PS, CPU and 7 I/O modules; wall mount, Dimensions (WxHxD): 391 x 244 x 198* mm (15.39" x 9.61" x 7.80"*), Weight: 3.0 Kg (6.6 lb) 8 I/O slots - PS , CPU and 8 I/O modules, wall mount or 19" rack, Dimensions (WxHxD): 435 x 244 x 198* mm (17" x 9.61" x 7.80"*), Weight: approx. 3.3 Kg (7.3 lb) * Depth including Module panel
Metal Chassis	Large - for PS, CPU and up to 7 I/O slot frame, two radios and 6.5 or 10 Ah backup battery, wall mount , Dimensions (WxHxD): 448 x 468 x 200* mm (17.64"x 18.43" x 7.88"*) Small - for PS, CPU and up to 3 I/O slot frame, one radio and 6.5 Ah backup battery, wall mount, Dimensions (WxHxD): 335 x 355 x 198* mm (13.19" x 13.98" x 7.8"*) * Depth including Frame and Module

Housing	Large Nema 4X / IP65 painted metal - up to 7 I/O slot frame, two radios and 6.5 or 10 Ah, backup battery, Dimensions (WxHxD): 500 x 500 x 210 mm (19.7" x19.7" x 8.26") Small Nema 4X / IP65 painted metal - up to 3 I/O slot frame one radio and 6.5 Ah backup battery, Dimensions (WxHxD): 380 x380 x 210 mm (15" x 15" x 8.26")
Power Supply	10.8-16 V DC low-tier 10.8-16 V DC (default) 18-72 V DC 18-72 V DC with 12V smart battery charger 90-264 V AC, 50-60 Hz 90-264 V AC, 50-60 Hz, with 12V smart battery charger
Backup Battery	6.5 Ah - Sealed Lead-Acid 10 Ah - Sealed Lead-Acid
Operating Temperature	-40 ºC to +70 ºC (-40 ºF to 158 ºF) Notes: 1) When using a metal housing option, the maximum operating temperature outside the housing is +60 ºC (140 ºF). 2) ACT module and Motorola radios operating temperature range is: -30 ºC to +60 ºC (-22 ºF to 140 ºF).
Storage Temperature	-55 ºC to +85 ºC (-67 ºF to 185 ºF)
Operating Humidity	5% to 95% RH @ 50 ºC without condensation
Mechanical Vibrations	Per EIA / TIA 603 Base-station, Sinusoidal 0.07mm @ 10 to 30 Hz, 0.0035 mm @ 30-60 Hz
Operating Altitude	-400m to +4000 meter (-1312 ft to + 13120 ft) above sea level Note: When using 18-72V DC or 90-264 VAC Power supply the operating altitude is -400 to +2000m

Regulatory Standards

Safety	UL 60950-1 (UL listed), CSA 22.2-950-1, EN60950-1, IEC 60950-1, AS/NZS 60950
Emission	Emission standards for industrial environments CFR 47 FCC part 15, subpart B (class A); CE EMC: EN50081-2/EN61000-6-4 (CISPER 11 / EN55011 class A)
Immunity	Immunity standards for industrial environments Per EN50082-2 /IEC 61000-6-2

Communications	
Communication Ports	Up to 5 Ports per CPU Serial - up to 4 x RS232 ports Multi-drop – up to 3 x RS485 port Ethernet - up to 2 x 10/100 MB ports and 1 x 10 MB Two-way radio / analog trunked radio - up 2 x modem ports
Motorola Radio Support	Mobile conventional two-way radios – CM 200 , CM 340, GM 3188, EM 200, CDM750 Portable conventional two-way radios – HT750, GP320, GP328, PRO5150 Analog trunked radios – XTL5000, XTL2500, XTS2500 Digital trunked radios – XTL5000, XTL2500, XTS2500, MTM800 (TETRA)
Third Party Radio Support	Two-way radios, Data radios, TETRA radios (PD)
Modem Support	Dial-up modems, Cellular modems (dial mode and PD)
Protocols	MDLC, TCP, UDP, IP, PPP, NTP, DHCP
Third Party Protocol Support	MODBUS RTU: master on RS232/RS485, slave on RS232/RS485/Ethernet DF1 (Allen Bradley): master on RS232 DNP 3.0: master/slave on RS232/RS485/Ethernet IEC 60870-5-101: slave on RS232
User Protocol (user program)	Possible on RS232, RS485 and Ethernet ports

Specifications subject to change without notice.

APPENDIX B: ENVIRONMENTAL PROTECTION

Disposal of Components

All components of the ACE3600 should be properly disposed of, in accordance with local regulatory standards and laws.

All ACE3600 models comply with RoHS European Directive no. 2002/95/EC (Restriction of the use of Hazardous Substances) and WEEE Directive no. 2002/96/EC (Strategy of Waste management), with the exception of parts:

- XTL5000 radio (included in models F7523A/F7513A/F7524A/F7514A/F7585A/F7586A)
- XTL2500 radio (F7533A/F7593A/F7534A/F7594A/F7538A/F7598A)
- XTS2500 radio (F7543A/F7544A/F7548A)
- CDM750 radio (F7563A/F7564A)
- ACT Module (option V155AE and kit FLM)

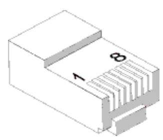
Note: The ACE3600 RTU is categorized as Monitoring and Control Equipment. Currently (December 2007) Monitoring and Control Equipment are exempt from RoHS compliance. This exemption may be cancelled in the future.

APPENDIX C: RS232/RS485 ADAPTOR AND ETHERNET CABLES

General

NOTE

Note: On all of the Motorola RJ45 connector heads (except for Ethernet crossover), the numbering of the pins is different than the standard, as shown in the figure below. Pin 1-8 are left to right rather than right to left, as shown below. Therefore, only original Motorola cables should be used.



This appendix provides the information required for connecting an RTU RS232 port to various units, as detailed below:

- Connection to a computer/terminal (MDLC protocol or User port)
- Connection to a modem (MDLC protocol or User port)
- Connection to the GPS receiver (MDLC protocol)
- Connecting a User port to a printer
- Connecting a User port to an external unit
- Connection to a radio (MDLC protocol)
- RTU-to-RTU connection using MDLC protocol through RS232 ports (RS-Link)
- ACE3600 RTU-to-ACE3600 RTU connection using MDLC protocol through RS485 ports (RS-Link)
- ACE3600 RTU-to-MOSCAD RTU connection using MDLC protocol through RS485 ports (RS-Link)
- ACE3600 RTU-to-PC Ethernet port connection without a hub

Connection to a Computer or Terminal

To connect one of the RTU RS232 ports to a computer/terminal, use the FLN6457B adaptor, which ends with the female 25-pin or 9-pin, D-type connector. The port may be defined either as a MDLC protocol port or as a User port.

The signals that appear on the female 25-pin or 9-pin D-type connector are according to the RS232 standard – see the following table. In this case, the RTU serves as DCE (Data Communication Equipment).

RS232 Function	8-pin Connector (on RTU)	25-pin Female	9-pin Female	Direction
TX-DATA	2 ←	2	3	from DTE
RX-DATA	1 →	3	2	to DTE
RTS	5 ←	4	7	from DTE
CTS	8 →	5	8	to DTE
DSR	7 →	6	6	to DTE
GND	4	7	5	-
DTR	3 ←	20	4	from DTE
DCD (Rec line)	6 →	8	1	to DTE

To extend the cable, you may use any extension cable with male and female D-type connectors (connected pin-to-pin, not crossed).

Note: When a User port is defined as Computer/Terminal with DTR support:

The RTU will not transmit unless it receives DTR=ON from the computer/terminal.

The RTU will not receive unless it receives RTS=ON from the computer/terminal.

Connection to a Modem

To connect one of the RTU RS232 ports to an RS232 modem, use one of the adaptors provided in kit FLN6458B (option V213AE):

- 9-pin adaptor for Async (#0189968V32)
- RS232-E adaptor (#0189968V33) as in Connection to IDEN Radio below.
- RS232-E+ adaptor (#0189968V34) as in Connection to TETRA Radio below.

The asynchronous adaptor (#0189968V32) ends with the male 9-pin D-type connector. The port may be defined either as a MDLC protocol port or as a User port.

The signals that appear on the male 9-pin D-type (or 25-pin) connector are according to the RS232 standard – see the following table. In this case, the RTU serves as DTE (Data Terminal Equipment).

RS232 Function	8-pin Connector(on RTU)	25-pin Male	9-pin Male	Direction
TX-DATA	1 →	2	3	from RTU
RX-DATA	2 ←	3	2	to RTU
RTS	6 →	4	7	from RTU
CTS	3 ←	5	8	to RTU
GND	4	7	5	-

RS232 Function	8-pin Connector(on RTU)	25-pin Male	9-pin Male	Direction
DTR	8 →	20	4	from RTU
DCD (Rec line)	5 ←	8	1	to RTU

To extend the cable, you may use any extension cable with male and female D-type connectors (connected pin-to-pin, not crossed).

Before transmitting, the RTU sends RTS=ON to the modem, and waits for CTS=ON from the modem as a condition for transmitting.

The RTU will receive data from the modem only when DCD=ON.

When using a modem in auto-answer mode (connected to a Computer port) for remote service, the RTU does not support RTS/CTS protocol since the port is designated to operate with a local computer as well as with a modem.

For modems which support RS232-E, use either the RS232-E adaptor (#0189968V33) as in Connection to IDEN Radio below, or the RS232-E+ adaptor (#0189968V34), as in Connection to TETRA Radio below.

Connection to GPS Receiver

When an off-the-shelf GPS timing receiver is purchased (e.g. Synergy SynPaQ/E PPS Sensor with M12+), the data and power cable for that receiver should be purchased as well.

Connect the data wire of the cable to the CPU port using the ACE3600 asynchronous RS232-E adaptor cable. The port should be defined as a GPS receiver port (RS232, Async).

Connect the power wire of the cable to a cable with the following connectors:

RTU side: The connector should fit the auxiliary power connector on the ACE3600 power supply module.

GPS Receiver side: The connector should fit the power connector on the GPS receiver cable.

Connecting a User Port to a Printer

To connect one of the RTU RS232 ports defined as a User port to a printer, you may use one of the two cables described in the previous paragraphs. Since the connection to the printer is not defined by the RS232 standard, every printer manufacturer has defined the connectors for his own convenience. Therefore, select the adaptor according to the functions of the various pins.

If the FLN6458B adaptor (with the male 9-pin D-type connector) is used, refer to the following table.

RS232 Function	9-pin Male	Used as	Direction
TX-DATA	3	Serial Data	to Printer
CTS	8	Printer Ready	from Printer
GND	5	GND	-

If the FLN6457B adaptor (with the female 9-pin, D-type connector) is used, refer to the following table.

RS232 Function	9-pin Female	Used as	Direction
RX-DATA	2	Printer Rx-Data	to Printer
DTR	4	Printer Ready	from Printer
GND	5	GND	-

Connecting a User Port to an External Unit

To connect one of the RTU RS232 ports defined as a User port to an external unit (which supports RS232), you may use one of the two adaptors (FLN6457B or FLN6458B) according to the port definition in the site configuration.

If the FLN6457B adaptor is used, refer to the pin assignment given in Connection to a Computer or Terminal in this chapter.

If the FLN6458B adaptor is used, refer to the pin assignment given in Connection to a Modem in this chapter.

Connection to a Radio

For detailed instructions on connecting a radio to the ACE3600 RTU, see the Radio Types and Installation Kits chapter above.

Connection to IDEN Radio

To connect the RTU (via onboard serial or plug-in port) to an IDEN radio, use an adaptor which ends with the male 9-pin, D-type connector. The port should be defined as RS-232, Async, PPP, iDEN, MDLC over IP.

RS232 Function	8-pin Connector(on RTU)	9-pin Male	Direction
TX-DATA	1 →	3	from RTU
RX-DATA	2 ←	2	to RTU
CTS	3 ←	8	to RTU
GND	4	5	-
CD (Rec line)	5 ←	1	to RTU
RTS	6 →	Not used	
	7 →	4	from RTU
DTR	8 →	7	from RTU

Connection to TETRA Radio

To connect the RTU (via onboard serial or plug-in port) to a TETRA radio, use an RS232-E+ type adaptor which ends with the male 9-pin, D-type connector. The port should be defined as RS232, Async, PPP, Tetra, MDLC over IP.

RS232 Function	8-pin Connector(on RTU)	9-pin Male	Direction
TX-DATA	1 →	3	from RTU
RX-DATA	2 ←	2	to RTU
CTS	3 ←	8	to RTU
GND	4	5	-
CD (Rec line)	5 ←	1	to RTU
RTS	6 →	4	from RTU
	7	Not used	
DTR	8 →	7	from RTU

RTU-to-RTU Connection Using MDLC Protocol through RS232

To establish a link between two RTUs using MDLC protocol, the ports of both RTUs should be defined as RS232 RTU-to-RTU (RS-Link). The ports of the two RTUs should be connected by the FLN6457B and FLN6458B adaptors, when the adaptors are connected.

IMPORTANT

Do not connect between RTUs without the adaptor cables. A direct connection will cause a short circuit between the pins that have the same function.

RTU-to-RTU Synchronous Communication Using Plug-in Port

The pin assignment of the cable to be used for RTU-to-RTU synchronous communication (using a plug-in port) is given below.

RS232 Function	8-pin Connector (on sending RTU)	8-pin Connector (on receiving RTU)	Direction
TX-DATA	1 →	2 ←	from RTU
RX-DATA	2 ←	1 →	to RTU
CTS	3 +6 →*	5 ←	from RTU
Signal GND	4	4	-
CD (Rec line)	5 ←	3 +6 →*	to RTU
RTS	6 +3 →*	5 ←	from RTU

RS232 Function	8-pin Connector (on sending RTU)	8-pin Connector (on receiving RTU)	Direction
TX_CLK	7 →	8 ←	from RTU
RX_CLK	8 ←	7 →	to RTU

*Pins 3 and 6 are shorted.

ACE3600 RTU-to-ACE3600 RTU Connection Using MDLC Protocol through RS485

To establish a link between more than two ACE3600 RTUs using MDLC protocol, the ports of all RTUs should be defined as RS485 RTU multidrop. The ports of the RTUs should be connected using the RS485 connection box V186AD (FLN3641A). Cable FKN8427A should be connected between ACE3600 RS485 port and one of the seven inlets of the connection box.

RS485 Function	8-pin Connector* (on ACE3600)
B (RX/TX-)	1
A (RX/TX+)	8

*Note: All seven connectors are shorted.

ACE3600 RTU-to-MOSCAD RTU Connection Using MDLC Protocol through RS485

To establish a link between an ACE3600 unit and a MOSCAD RTU using MDLC protocol, the ports of both RTUs should be defined as RS485 RTU multidrop. The ports of the two RTUs should be connected using the FKN8527A cable.

IMPORTANT

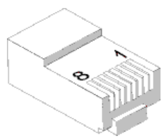
Do not connect between RTUs without the adaptor cables. A direct connection will cause a short circuit between the pins that have the same function.

RS485 Function	8-pin Connector (on ACE3600)	4-pin Connector (on MOSCAD)
B (RX/TX-)	1	2
A (RX/TX+)	8	3

ACE3600 RTU-to-PC Ethernet Port Direct Connection without Hub

NOTE

Note: The RJ45 connector head for this connection is standard. The numbering of the pins is according to the standard, as shown in the figure below. Pin 1-8 are right to left, as shown below. Therefore, any standard Ethernet crossover cable may be used.



To establish a link between an ACE3600 unit and the Ethernet port of a PC, without using a hub, the RTU port should be defined as an IP port (10/100 BT, Static, Ethernet LAN) with an IP address. The ports should be connected using an Ethernet crossover cable.

IP Function	8-pin Connector (Plug 1)	8-pin Connector (Plug 2)
TX-DATA +	1 →	3 ←
TX-DATA -	2 →	6 ←
RX-DATA +	3 ←	1 →
N/A	4	7
N/A	5	8
RX-DATA -	6 ←	2 →
N/A	7	4
N/A	8	5

APPENDIX D: ACE3600 MAXIMUM POWER RATINGS

Power Rating Tables

The tables below list the maximum power consumption (at room temperature) for each of the ACE3600 RTU building blocks (CPU, Power Supply, I/O modules, radios, etc) and the maximum peak power allowed for a fully loaded RTU, based on the housing type.

The measurements below assume the worst case, in terms of input voltage.

Before deploying your RTU, add up the power consumption of all components of your system to verify that it is within the maximum peak power for your housing type.

Table D-1 Maximum Peak Power Allowed for Fully Loaded RTU

Housing Description	Maximum Input Power into Power Supply Module (in watts)
19" Rack (w/out metal enclosure)	120w
Large NEMA metal housing (50x50 cm)	120w
Small NEMA metal housing (40x40 cm)	105w

Table D-2 Power Consumption per RTU Module

Module Name	Self Power Consumption (no active I/O) (in watts)	Maximum Power Consumption per Active I/O (in watts) (when powered by internal 24V PS)
Power Supply (maximum)	12.6	
CPU (3640/3610)	5.2	
Digital Input (16/32)	0.5	0.1
Digital Input IEC Type 2 (16/32)	0.5	0.23
Digital Output Relay ML (8/16)	0.1	0.01
Digital Output Relay EE (8/16)	0.15	0.18
Digital Output/Digital Input FET (all types)	0.22	0.015
Mixed I/O (DO ML +DI IEC Type 2)	0.43	Additional maximum 3.1w from the 24V PS for the entire module.
Mixed I/O (DO EE + DI IEC Type 2)	0.5	Additional maximum 4.9w from 24V PS for the entire module.
Analog Output (@20mA)	0.94	0.6
Analog Input Current/Voltage (8/16)	0.5	
Mixed Analog Current/Voltage (@20mA)	1.2	0.6
24V Floating Plug-In Power Supply (No load)	0.3	
24V Floating Plug-In Power Supply (externally loaded 150mA)	4.8	

Plastic Box Interface	Typical Power (in watts)	Power when all I/Os are on (in watts)
Audio Control and Tone (ACT) Module	0.6	2.2

Radios	Power in RX Mode (in watts)	Power in TX Mode (in watts)
XTL5000 (15W)	8.8	66.9
XTL2500 (15W)	8.8	66.9
XTS2500 (3W)	1.2	9.9
HT750/GP320/PRO5150/GP328 (UHF 4W/ VHF 5W)	0.7	13.1
CM200/CM140/EM200/GM3188 (UHF 20W/ VHF 25W)	3.7	75.1
GM328/338/339/340 (UHF 20W/ VHF 25W)	3.6	73.2
CDM750 (UHF 20W/VHF 25W)	3.9	74.5

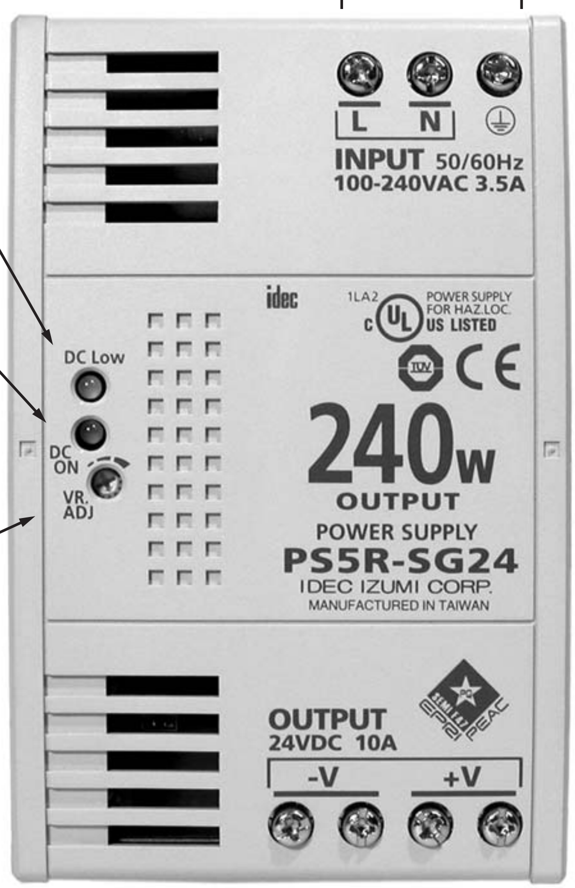
PS5R Slim Line Series — Switching Power Supplies

Designed with Accessibility and Convenience in Mind

DC Low Indicator
(120W & 240W Slim Line Only)
The indicator turns on when the output voltage drops below 20V DC. This assists troubleshooting power supply problems.

DC ON Indicator
The indicator turns on when the unit is powered up. This is a convenient way to know when the power supply is receiving power.

Output Voltage Adjustment
The output voltage can be easily adjusted within +10% of the rated voltage.

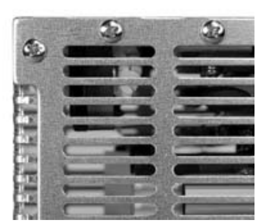


Universal Inputs
The power inputs have a range of 85-264V AC to 100-370V DC, and automatically adjust to the correct input power. This makes IDEC power supplies suitable for use anywhere in the world. Power factor correction has also been included to minimize harmonic distortion, resulting in a longer operating life and increased reliability.

Long Life Expectancy
IDEC power supplies are very reliable, with a life expectancy of 70,000 hrs. (minimum) or longer, depending on usage.

Output Channel
With very low output ripples of less than 1% peak to peak, the 120W and 240W power supplies are some of the best in the industry. The output comes with overload protection that avoids damaging the power supply. The 240W power supply also has the convenience of two output sets of output screws for wiring.

Fingersafe, Spring-up Screw Terminals
Never worry about losing screws or getting an inadvertent shock from a terminal. The terminals are captive spring-up screws, which makes using them as easy as pushing a screw down and tightening it. They are shock and vibration resistant, and work with ring lugs, fork connectors or stripped wire connections. The terminals are rated IP20 which means when tightened, they are recessed to keep finger and objects from touching the input contacts.



Ventilation Grill
Provides cooling for the power supply and prevents small objects from falling into the power supply circuitry.

L

Power Supplies

Features & Part Numbers

Key features of the PS5R Slim Line series include:

- Lightweight and Compact in size
- Wide Power Range: 30W – 240W
- Universal Input:
  30W to 90W:85-264V AC/100-370V DC
  120W and 240W:85-264V AC/100-350V DC
- Power Factor Correction (EN61000-3-2) for 60W to 240W
- Meets SEMI F47 Sag Immunity (120W & 240W)
- NEC Class 2 rated (30W & 60W)
- Approved for Class 1, Div. 2 Hazardous Locations
- Fused input
- Overcurrent protection, auto-reset
- Overvoltage protection, shut down
- Spring-up Screw Terminal type, IP20
- DIN rail or Panel Surface Mount
- Approvals:
  CE Marked
  TÜV
  c-UL, UL 508
  UL 1310 (PS5R-SC, -SD)
  UL 1604
  EN 50178:1997
  LVD: EN60950:2000
  EMC: Directive EN61204-3:2000
  (EMI: Class B, EMS: Industrial)

File # E234997

(SEMI F47 120W & 240W only)

Part Numbers

Part Number	Item	Watts	Rated Voltage	Rated Current
PS5R-SC12		30	12V DC	2.5A
PS5R-SC24			24V DC	1.3A
PS5R-SD24		60	24V DC	2.5A
PS5R-SE24		90	24V DC	3.75A
PS5R-SF24		120	24V DC	5A
PS5R-SG24		240	24V DC	10A

Specifications

Part Numbers	12VDC output		**PS5R-SC12**	–	–	–	–
	24VDC output		**PS5R-SC24**	**PS5R-SD24**	**PS5R-SE24**	**PS5R-SF24**	**PS5R-SG24**
Output Capacity			30W	60W	90W	120W	240W
Input	**Input Voltage** (single-phase, 2-wire)		85 to 264 VAC, 100 to 370 VDC			85 to 264V AC, 100 to 350V DC	
Input	**Input Current (typical)**	100VAC	0.9A	1.7A	2.3A	1.8A	3.5A
Input		200VAC	0.6A	1.0A	1.4A	1.0A	1.7A
Input	**Internal Fuse Rating**		3.15A	3.15A	4A	4A	6.3A
Input	**Inrush Current (cold start)**		50A maximum (at 200V AC)				
Input	**Leakage Current (at no load)**		0.75mA maximum			1mA maximum	
Input	**Typical Efficiency**	12VDC	78%	–	–	–	–
Input		24VDC	80%	83%	82%	84%	
Output	**Output Current Ratings**	12VDC	2.5A	–	–	–	–
Output		24VDC	1.3A	2.5A	3.75A	5A	10A
Output	**Voltage Adjustment**		±10% (V. ADJ control on front)				
Output	**Output Holding Time**		20ms minimum (at rated input and output)				
Output	**Starting Time**		–	–	–	650ms maximum	500ms maximum
Output	**Rise Time**		100ms maximum (at rated input and output)			200ms maximum	
Output	**Line Regulation**		0.4% maximum				
Output	**Load Regulation**		1.5% maximum				0.8% max
Output	**Temperature Regulation**		0.05% degree C maximum				
Output	**Ripple Voltage**		2% peak to peak maximum (including noise)			1% peak to peak maximum (including noise)	
Output	**Overcurrent Protection**		105% or more, auto reset		103 to 110%, auto reset	105 to 130%, auto reset	
Output	**Overvoltage Protection**		120% min. SHUTDOWN				
Parallel Operation			No	No	No	No	No
Dielectric Strength			Between Input and Ground: 2000 VAC, 1 minute*				
Insulation Resistance			Between Input & Output Terminals: 100 MΩ Min				
Operating Temperature			-10 to 60°C (14 to 140°F)				
Storage Temperature			-25 to 75°C (-13 to +167°F)				
Operating Humidity			20 to 90% relative humidity (no condensation, no freezing)				
Vibration Resistance			Frequency 10 to 55Hz, Amplitude 0.375mm				
Shock Resistance			300m/s^2 3 times each in 6 axes				
Approvals			EMC: EN61204-3 (EMI: Class B, EMS: Industrial), LVD: EN60950, EN50178:1997, UL 1604, UL 508, UL1310 (PS5R-SC, -SD), c-UL (CSA 22.2 No. 14)				
			–			SEMI F47	
Harmonic Directive (EN61000-3-2)			N/A		EN61000-3-2 A14 class A		
Weight (approx.)			250g	285g	440g	630g	1000g
Terminal Screw			M3.5 slotted-Phillips head screw (screw terminal type)				
IP protection			IP20 fingersafe				
Dimensions H x W x D (mm)			95 x 36 x 108		115 x 46 x 121	115 x 50 x 129	125 x 80 x 149.5
Dimensions H x W x D (inches)			3.74 x 1.42 x 4.25		4.53 x 1.81 x 4.76	4.53 x 1.97 x 5.08	4.92 x 3.15 x 5.89

1. For dimensional drawings, see page L-7.
*2. *Between input and output: 3000VAC, 1 minute; Between output and ground: 500VAC, 1 minute*

Sunlight Visible LED Alarm Light

INGRAM PRODUCTS, INC.

Part No. SunBurst II: SBN120AC, SBN1224AD

The Ingram SunBurst II is a super bright, daylight visible LED light that can not be ignored. It is designed for use as an alarm beacon. It requires only a 3/4" knockout (1-1/16" diameter hole) to mount. It can be installed on panels up to 1/4" thick. Meets UL Type 3, 3R, 4, 4X, 12, and, 13 requirements.

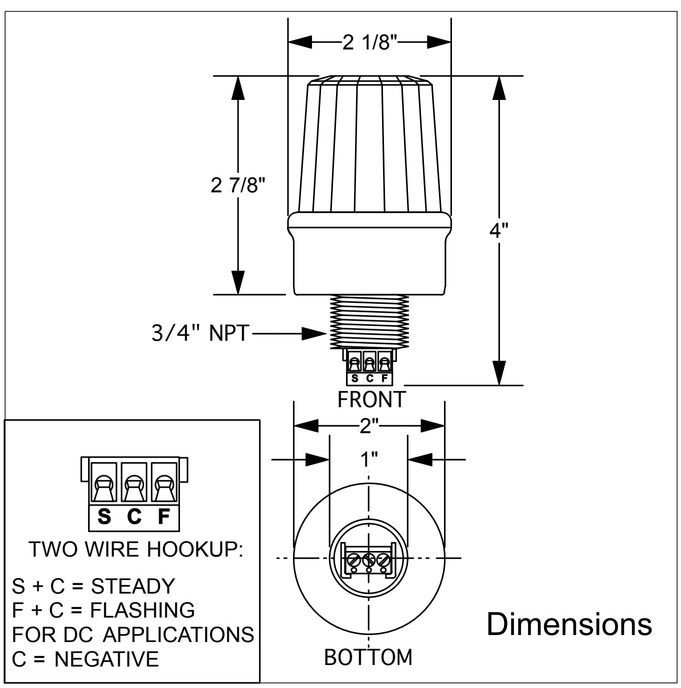
Features

- Super Bright - Daylight Visible
- 2 operation modes: steady on and flash
- Molded from GE Lexan
- Hermetically sealed for corrosion resistance and reliability
- Available with red, amber, green, clear and blue lens
- Easy one hole mounting
- Provides 360° visibility
- Comes with gasket and Lexan mounting nut
- UL Recognized - File E121431

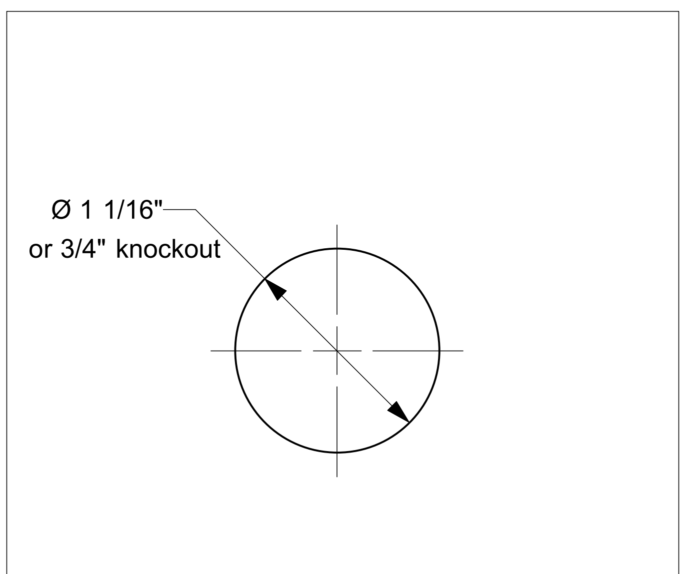
Technical Specifications

• Voltage:	SBN120AC	120VAC
	SBN1224AD	12/24VDC or VAC
• Current :	SBN120AC	48mA (max.)
	SBN1224AD	230mA (max.)@12V
		125mA flashing
		110mA (max.)@24V
		67mA flashing

- Flash rate: 60 flashes per minute
- Mounting Nut Torque: 14 in-lbs.



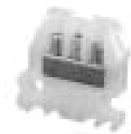
Dimensions



Hole Pattern for Mounting

8725 Youngerman Court, Ste 206, Jacksonville, FL 32244 ■ 888-875-2221 ph (904)778-2444 fax ■ Website:www.ingramproducts.com ■ e-mail: info@ingramproducts.com

NEMA Type Terminal Blocks
Box Lug Termination

CLASS 9080		TYPE GM6	TYPE GR6	TYPE GR6T
		 High Density Block	 Without Test Probe Adapter	 With Test Probe Adapter
Maximum Voltage Rating		600	600	600
Maximum Amperage Ratingv ✯	UL	30	60	60
	CSA	30	60	60
Wire Range		#22 to #10 AWG	#22 to #8 AWG	#22 to #8 AWG
Maximum Wire Combination		1 - #10 1 or 2 - #18 1 - #12 1 to 5 - #20 1 - #14 1 to 8 - #22 1 or 2 - #16	1 - #8 1 to 4 - #16 1 - #10 1 to 5 - #18 1 to 3 - #12 1 to 8 - #20 1 to 4 - #14 1 to 10 - #22	1 - #8 1 to 4 - #16 1 - #10 1 to 5 - #18 1 to 3 - #12 1 to 8 - #20 1 to 4 - #14 1 to 10 - #22
Wire Type		Solid or Stranded Copper Wire	Solid or Stranded Copper Wire	Solid or Stranded Copper Wire
Density - Sections per foot		51	34	34
Approx. Dimensions (D)x(H)x(W)		1.72 x 1.82 x .235 inches 44 x 46 x 6 mm	1.72 x 1.82 x .35 inches 44 x 46 x 9 mm	1.72 x 1.82 x .35 inches 44 x 46 x 9 mm
Block Material		Nylon		
Busbar Material		Tin Plated Brass	N/A	N/A
Screw Material		Steel with Zinc Plating and Chromate Film		
Box Lug Material		Zinc Plated Steel	Copper	
Temperature Rating		-40 to 257° F -40 to 125° C	-40 to 257° F -40 to 125° C	-40 to 257° F -40 to 125° C
Flammability Rating		UL94V2	UL94V2	UL94V2
Recommended Screw Tightening Torque		7-8 lbf-in 0.8-0.9 N-m	18-20 lbf-in 2.1-2.3 N-m	18-20 lbf-in 2.1-2.3 N-m
Listings		UL File E60616 Guide XCFR2	CSA File LR62144 Class 6228 01	
FINGERSAFE® per DIN 57470		YES	YES	YES
Block: Natural (White)		GM6	GR6	GR6T
Black		GMB6	GRB6	
Blue		GML6	GRL6	
Green		GMG6	GRG6	
Grey		GME6	GRE6	
Orange		GMS6	GRS6	
Red		GMR6	GRR6	
Yellow		GMY6	GRY6	
End Barrier		GM6B	GM6B	GM6B
6 Foot Assembly		GM6296BC	GR6204BC	
Mounting Track: ▲				
DIN 3 :	0.5 meter long	MH320	MH320	MH320
	1.0 meter long	MH339	MH339	MH339
	2.0 meter long	MH379	MH379	MH379
Standard:	3 Foot Long	GH136	GH136	GH136
Snap-Off:	3 Foot Long	GH236	GH236	GH236
High Rise:	3 Foot Long	GH336	GH336	GH336
End Clamps:	Screw-in	GH10	GH10	GH10
	Slip-in	GH11	GH11	GH11
	DIN 3 End Clamp	MHA10	MHA10	MHA10
Jumpers: 2 pole		GH700	GH72	GH72
6 pole		GH710	GH73	GH73
Fanning Strip			GH52	GH52
Cover			GH62	GH62
Vinyl Marking Strip		GH220	GH220	GH220
Sheets of Blank Marking Tabs			GH200	GH200
Sheets of Marked Tabs			GH210	GH210
Marking Strip End Plug		GH60	GH60	GH60

▲ For additional mounting track, see page 8.
✯ These maximum current values assume the use of insulated copper conductors with 75° C temperature rating, and are calculated based on NEC Article 310, Table 310-16. In most cases this value is the maximum ampacity of that wire or combination of wires (as listed in the above table) which has the greatest current carrying capacity. The actual allowable current for a particular application is dependent upon the number, size, insulation class and other characteristics of the wires used.

Mini–CAS 120

PART NO. 14-407129

Features:

- Plug in replacement for existing MiniCAS / FUS unit
- 120 VAC, 24 VAC, or 24 VDC powered
- Durable plastic enclosure with flange for mounting on door of pump control enclosure
- Highly visible red LEDs for indication of Leakage and Temperature alarms
- Green LED for indication power is applied
- Temperature alarm reset mode select switch, for selection of Manual or Auto reset modes
- Temperature alarm reset push-button on front of unit
- Input power transient protected
- Sensor input circuit transient protected
- Sensor input circuit short circuit protected
- Noise Filter on Sensor Input
- Sensor circuit supply voltage regulated to 12 VDC
- Detailed connection diagram on side of unit

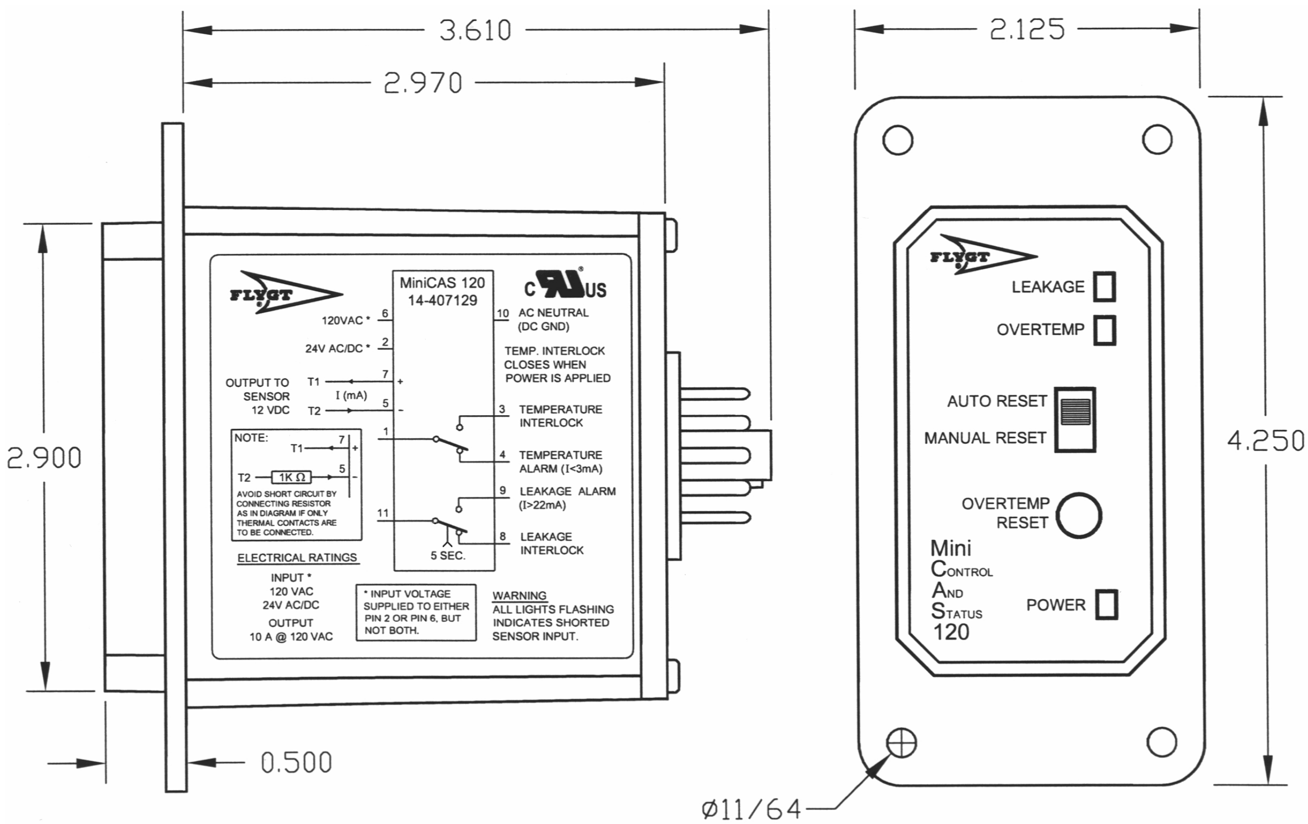
ITT Industries
Engineered for life

ITT FLYGT CORPORATION
35 Nutmeg Drive
Trunbull, Connecticut 06611

Phone (203) 380-4700
FAX (203) 380-4705

Mini–CAS 120

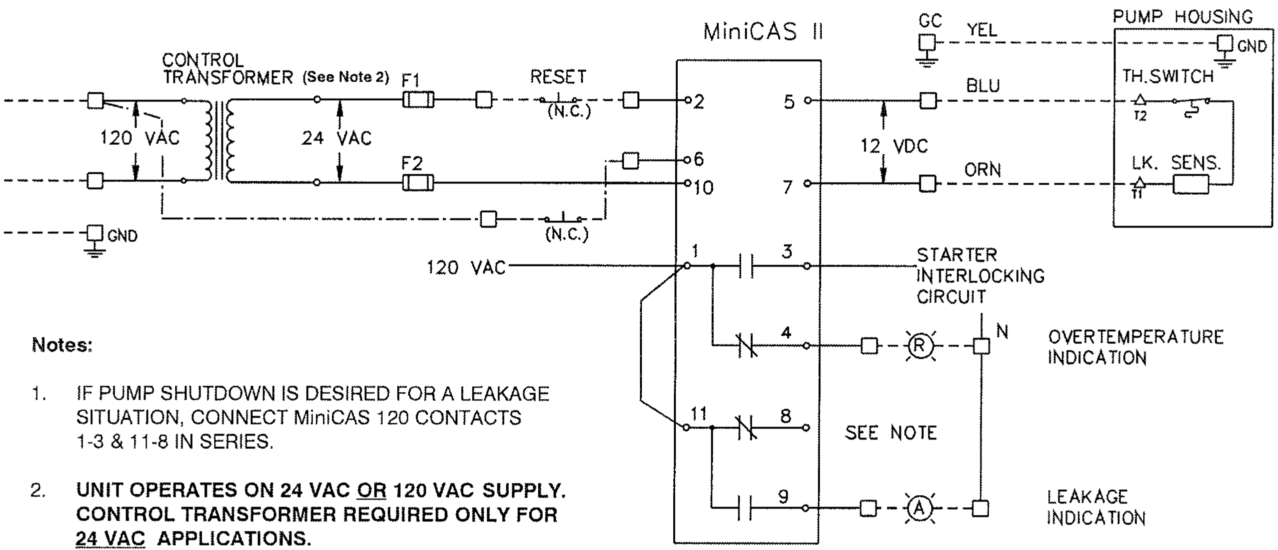
PART NO. 14-407129



Specifications:

- Input Power: 120 VAC ±10%, 7.0 VA max
  24 VAC ±10%, 3.5 VA max
  24 VDC ±10%, 125 mA max
- Input Power Transient Protection: Metal Oxide Varistor
- Sensor Input Transient Protection: Metal Oxide Varistor
- Relay Contact Rating: 10A @ 250 VAC
- Relay Contact Material: Silver Cadmium Oxide (AgCdO)
- Ambient Operating Temperature: –20°C to +65°C (–4°F to +149°F)
- Agency Approvals: UL 508, CAN/CSA (Pending)
- Alarm Indicators: Super Bright Red LED
- Power On Indicator: Green LED
- Enclosure: Blue Lexan (141R) or Noryl (PX9406)
- Faceplate Overlay: Silver Lexan with Black Text
- Side Label: Silver Lexan with Black Text
- Sensor Circuit Supply Voltage: Regulated 12 VDC ±10%,
- Weight 11.75 oz (334 grams)
- Temperature Alarm Trip Point: Sensor Current ≤3 mA ±5%
- Leak Alarm Trip Point: Sensor Current ≥22 mA ±5%

Wiring Diagram (MiniCAS - 120/FUS)



Notes:

1. IF PUMP SHUTDOWN IS DESIRED FOR A LEAKAGE SITUATION, CONNECT MiniCAS 120 CONTACTS 1-3 & 11-8 IN SERIES.

2. **UNIT OPERATES ON 24 VAC OR 120 VAC SUPPLY. CONTROL TRANSFORMER REQUIRED ONLY FOR 24 VAC APPLICATIONS.**

Mode of Operation

In normal conditions, when the MiniCAS - 120 is powered, the yellow LED is 'ON' and the relay contact status is as follows:

- Overtemperature relay contacts: 1-3 closed, 1-4 open;
- Leakage relay contacts: 11-8 closed, 11-9 open.

If an overtemperature condition occurs, the unit will turn the pump off and lock it out.
Relay contact status:

- Overtemperature relay contacts: 1-3 open, 1-4 closed;
- Leakage relay contacts: 11-8 closed, 11-9 open.

The power to the pump can be restored after the stator temperature has decreased to a point of safe operation and the thermal switches are closed. The MiniCAS 120 can be reset either manually or automatically.

Note:
When selecting the "Automatic Reset" mode, the control panel should include a latching type circuit for overtemperature alarm display. This circuit will retain the information that an overtemperature situation has occurred and the operator should check the possible cause for motor overtemperature.

If a leakage is detected, after a 5 sec. delay an alarm will be activated or the pump will be shut down. Relay contact status:

- Overtemperature relay contacts: 1-3 closed, 1-4 open;
- Leakage relay contacts: 11-8 open, 11-9 closed.

Once the leakage condition is removed, power is restored to the pump automatically.

ARC ARMOR® ENCLOSURE

PATENTED
US D646,239 S

The innovative, multiple compartment design of the **ARC ARMOR® Enclosure** reduces the risk of injury resulting from arc flash and electric shock.

The control and power circuitry are isolated in separate compartments, thus preventing unnecessary exposure of arc flash to operators.

WHAT IS ARC FLASH?

With 5-10 arc flash incidents occurring per day, arc flash is a leading cause of death and burn accidents for maintenance staff when servicing electrical control panels in North America today.

Onsite damages caused by an arc flash incident include: OSHA citations or fines, down time, loss of revenue and equipment damage. In worst case scenarios, arc flash may result in long term disability or even death thereby having a significant impact on the liability of the municipality. Arc flash events usually occur in less than 0.2 seconds and can create:

- Intense heat
- Thermo-acoustic shock wave
- Molten metal
- Shrapnel
- Blinding light
- Toxic smoke
- Contact with energized components

The multiple compartment design of the **ARC ARMOR® Enclosure** will limit access to electrical equipment capable of producing arc flash incidents. Electrical control equipment is segregated within an enclosure where only control voltage is present (120VAC max).

High energy circuits, such as Motor Controls are located in the MCC compartment, while low energy circuits, such as controllers and low voltage controls, are located in the Control Compartment. This allows the maintenance staff to safely work on control circuits with minimum Personal Protective Equipment (PPE).

FEATURES

- Patented enclosure design is manufactured by an ISO 9000 certified company
- Reduces exposure to arc flash and arc blast
- Integrated multiple compartment design
- Single wall construction
- Small footprint reduces installation costs
- Single sheet drip cap with rolled edge drip loops on free standing models
- 304L stainless steel construction
- Electro-statically precipitated white polyester powder coating
- High finish white color reduces heat buildup from solar radiation heat
- Positive ventilation to further reduce heat buildup
- 3 point lockable latches

APPLICATIONS & CUSTOMIZATION

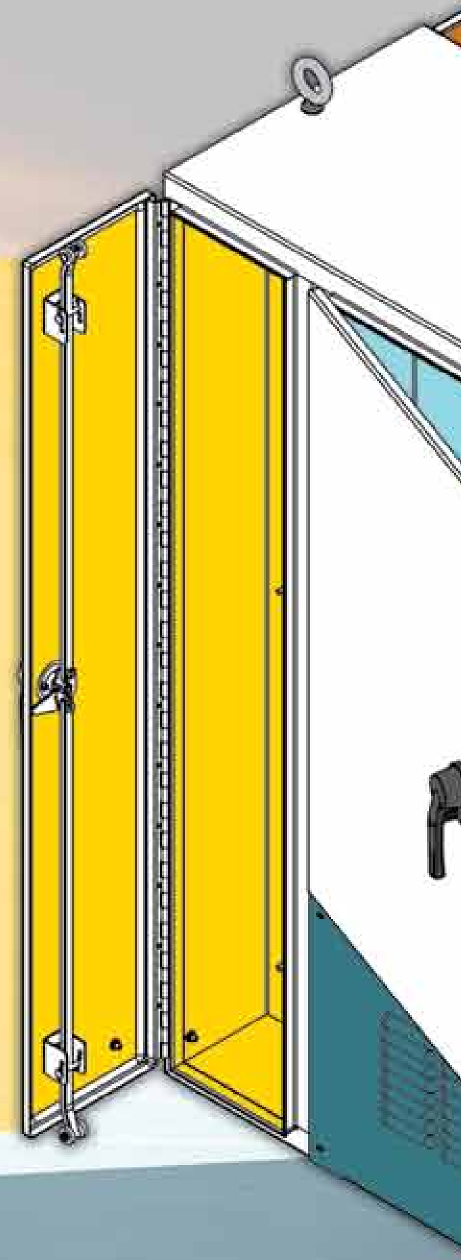
Your Control Solutions Provider can engineer a customized control solution using the Arc Armor® enclosure to meet your individual specifications. Common applications including multiple pump control for:

- Municipal Lift Stations
- Booster Stations
- Storm Water
- Irrigation
- Industrial

For more information on a customized Arc Armor® solution, please contact your Control Solutions Provider.

c UL us LISTED

UNIQUE MULTIPLE COMPARTMENT ENCLOSURE DESIGN

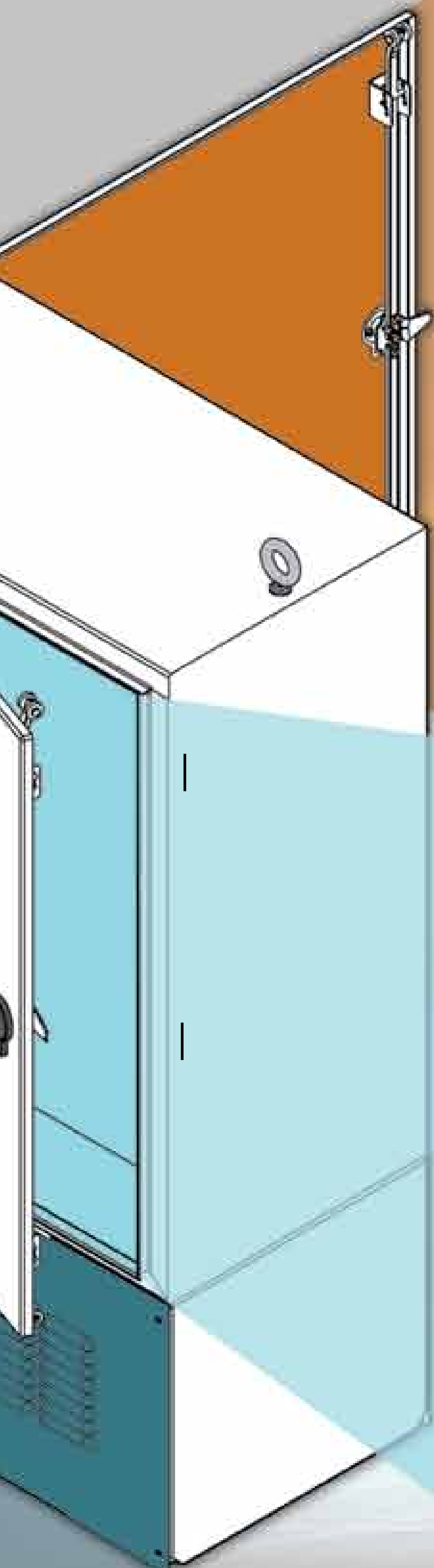


››››› ZONE 1 - Service Compartment

- **Danger Zone:** Contains the most dangerous arc flash potential and risk of electrical shock
- Entry is limited to authorized personnel only and proper personal protection equipment (PPE) must be used
- All service entrance devices and conductors are confined to this compartment to avoid accidental contact or faults
- Isolated from potential corrosive gases
- Locker-style service entrance
- Can be service entrance rated
- NEMA 3R enclosure rating (free standing)
- NEMA 4X enclosure rating (pole mount)

››››› ZONE 4 - Skirt Compartment *(does not apply to AA-363020 Pole Mount Enclosure)*

- **Gas Isolation Zone:** Provides gas isolation from wet well in wastewater lift station applications
- Can be used to house the control transformer
- Vented space for sealing cable penetrations



››››› ZONE 2 - MCC Compartment

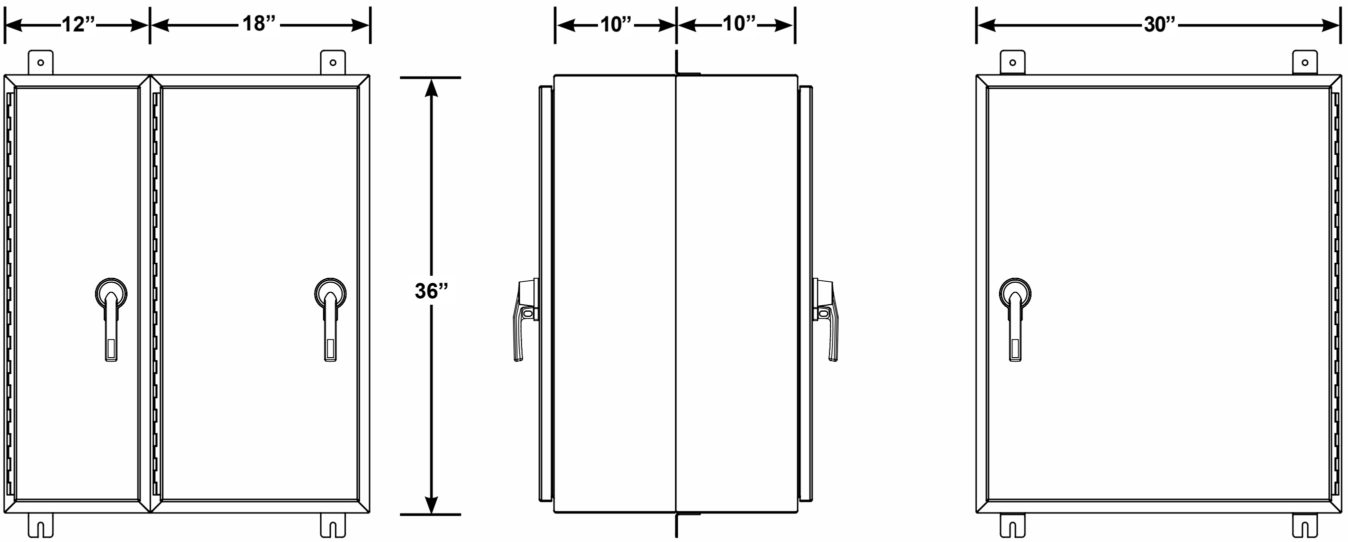
- **Danger Zone:** Entry is limited when energized to service personnel with proper NFPA 70 safety gear or may be “Lockout/Tagout” protected for unrestricted access.
- Can be completely de-energized from line voltage
- Contains motor control devices that are full voltage rated
- Isolated from potential corrosive gases
- Thermal Management: Environmentally-conditioned independent from other zones (i.e. VFD cooling)
- NEMA 3R enclosure rating (free standing)
- NEMA 4X enclosure rating (pole mount)

››››› ZONE 3 - Control Compartment

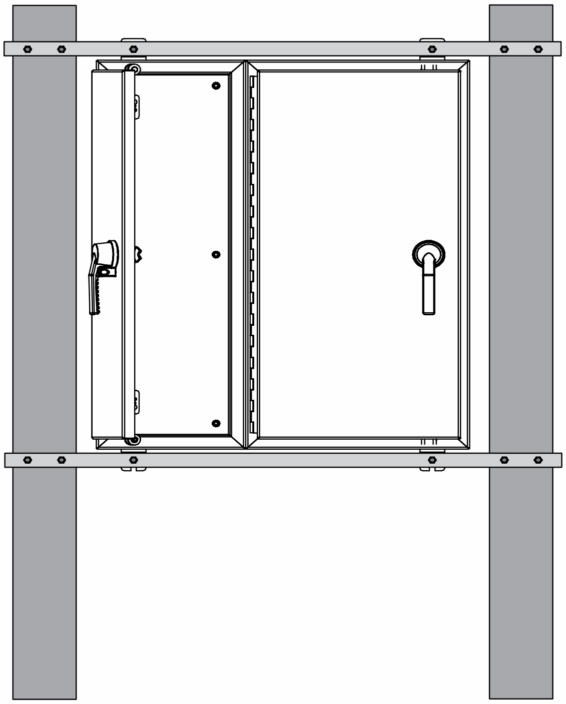
- **Operator Safety Zone** (120VAC or lower only)
- Minimum PPE required
- Houses all sensitive control devices and maintains complete isolation from high energy power components
- System operation and low voltage troubleshooting can be accomplished while being isolated from potential arc flash risks
- Isolated from corrosive gases
- NEMA 4X enclosure rating

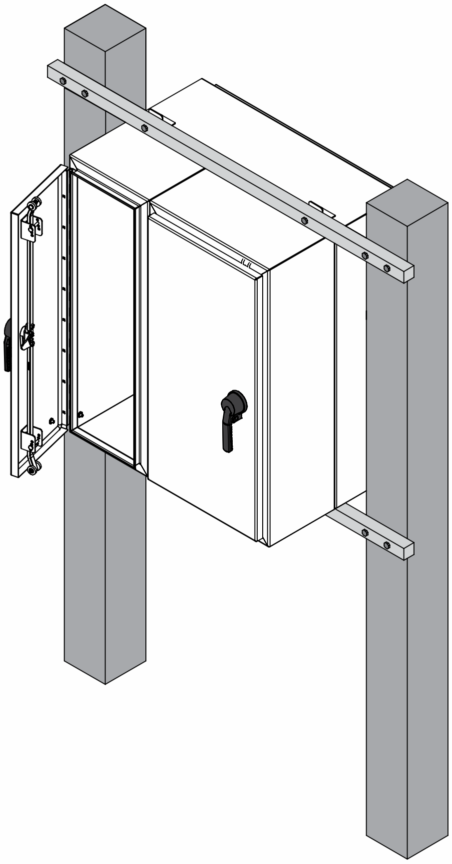
AA-363020 (Pole Mount)

OVERALL DIMENSIONS 36"H x 30"W x 20"D



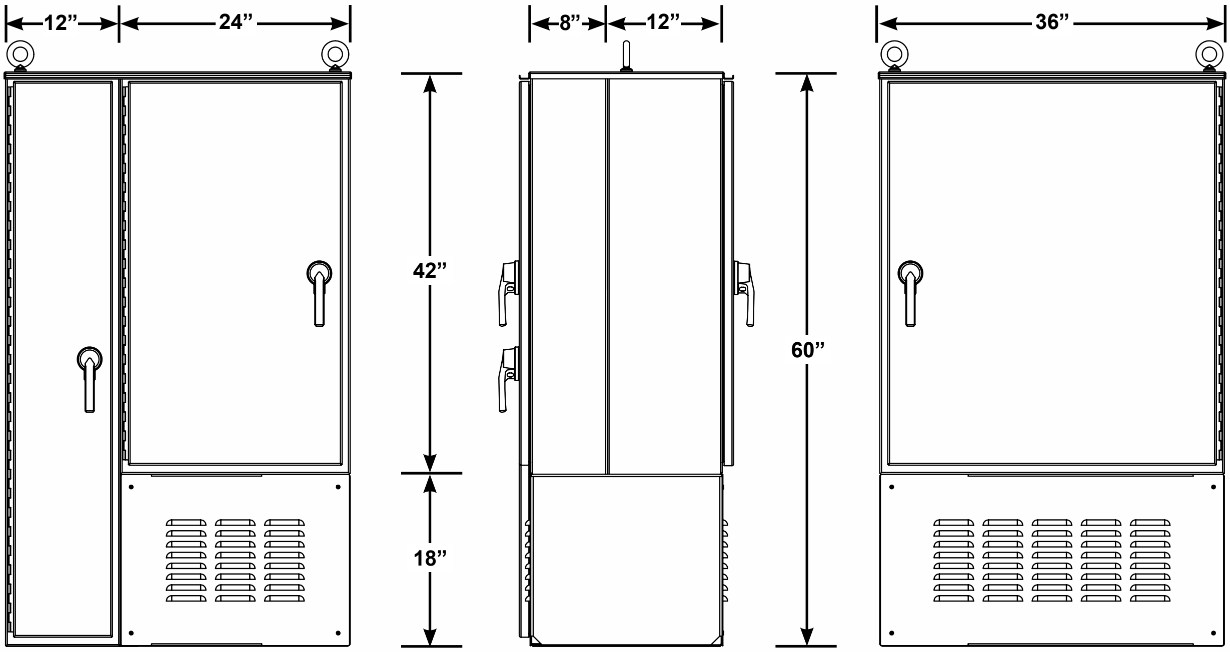
TYPICAL INSTALLATION





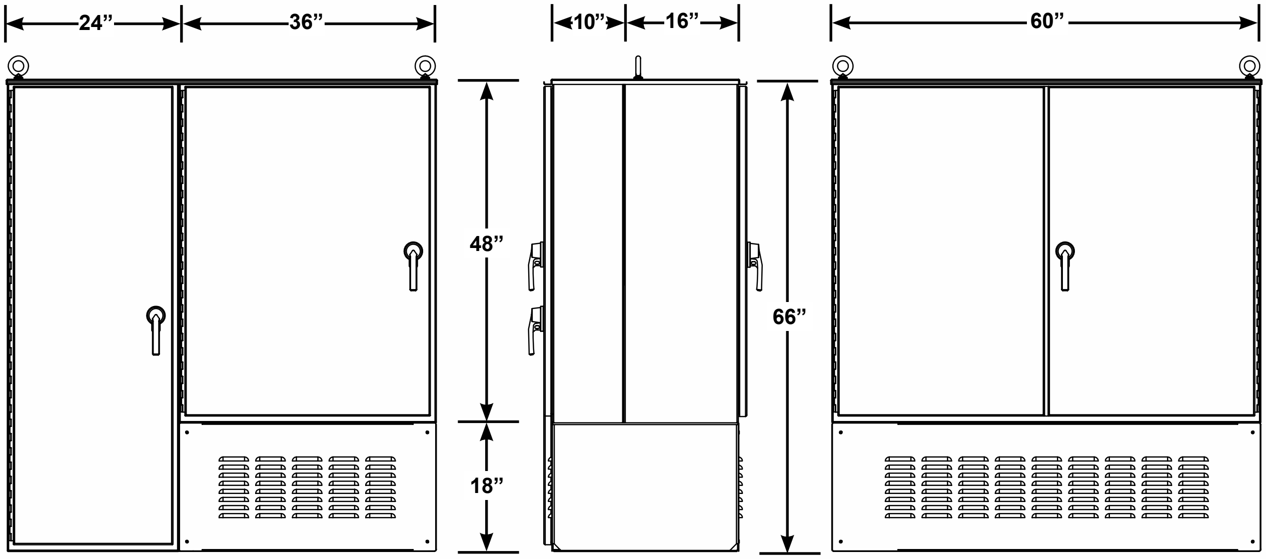
AA-603620 (Free Standing)

OVERALL DIMENSIONS 60"H x 36"W x 20"D



AA-666026 (Free Standing)

OVERALL DIMENSIONS 66"H x 60"W x 26"D



LET US DESIGN A CONTROL SOLUTION USING AN ARC ARMOR® ENCLOSURE FOR YOUR APPLICATION.

ARC ARMOR 06/12

For more information visit www.ArcArmorEnclosure.com.

User Guide OI/FET100–EN Rev. D

WaterMaster FET100 Electromagnetic flowmeter Transmitter

The perfect fit for all water industry applications

Introduction

WaterMaster™ is a range of high performance electromagnetic flowmeters for the measurement of electrically-conductive fluids and systems are normally supplied factory-configured and calibrated.

This User Guide provides installation, connection, security, start-up and basic setup details. For programming and configuration information refer to the Programming Guide – IM/WMP.

For a comprehensive overview of publications available for the WaterMaster transmitter, refer to the inside cover of this publication. Web links, QR code and reference numbers are also included.

Power and productivity for a better world™

The Company

We are an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a part of ABB, a world leader in process automation technology, we offer customers application expertise, service and support worldwide.

We are committed to teamwork, high quality manufacturing, advanced technology and unrivalled service and support.

The quality, accuracy and performance of the Company's products result from over 100 years experience, combined with a continuous program of innovative design and development to incorporate the latest technology.

Quality Control

The UKAS Calibration Laboratory No. 0255 is just one of the ten flow calibration plants operated by the Company and is indicative of our dedication to quality and accuracy.

UKAS CALIBRATION
0255

UKAS Calibration Laboratory No. 0255

For more information…

Further publications for the WaterMaster transmitter are available for free download from www.abb.com/flow (see links and reference numbers below) or by scanning this code:

	search for or click on:
Programming Guide	IM/WMP
User Guide Supplement, PROFIBUS RS485 Physical Layer (FEX100–DP)	IM/WMPBS–EN
User Guide Supplement, PROFIBUS FEX100-DP Parameter Tables	IM/WMPBST–EN
User Guide Supplement, MODBUS RS485 Physical Layer (FEX100–MB)	COI/FEX100/MOD–EN
User Guide Supplement, MODBUS Tables	COI/FEX100/MOD/TBL–EN

1 Safety

Information in this manual is intended only to assist our customers in the efficient operation of our equipment. Use of this manual for any other purpose is specifically prohibited and its contents are not to be reproduced in full or part without prior approval of the Technical Publications Department.

1.1 Electrical Safety

This equipment follows, obeys the requirements of CEI/IEC 61010-1:2001-2 'Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use' and follows, obeys NIST and OSHA.

If the equipment is used in a manner NOT specified by the Company, the protection provided by the equipment may be impaired.

1.2 Symbols

One or more of the following symbols may appear on the equipment labeling:

⚠	**Warning** – Refer to the manual for instructions
⚡	**Caution** – Risk of electric shock
⏚	Protective earth (ground) terminal
⏚	Earth (ground) terminal

⎓	Direct current supply only
～	Alternating current supply only
≂	Both direct and alternating current supply
⧈	The equipment is protected through double insulation

1.3 Health & Safety

Health and Safety

To ensure that our products are safe and without risk to health, the following points must be noted:

- The safety requirements of this equipment, any associated equipment and the local environment must be taken into consideration during installation.
- Install and use this equipment and any associated equipment in accordance with the relevant national and local standards.
- The relevant sections of these instructions must be read carefully before proceeding.
- Warning labels on containers and packages must be observed.
- Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
- Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and / or temperature.
- Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
- When disposing of chemicals ensure that no two chemicals are mixed.
- Product liability – advice and assistance provided without charge is given in good faith but without liability.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

Warning.

- System configuration must be carried out only by users or personnel with approved access rights (user privileges).
- Read all relevant sections of this guide before configuring the system or modifying system parameters.
- Install and use associated equipment in accordance with the relevant national and local standards.

2 Mechanical Installation

2.1 Installation Conditions

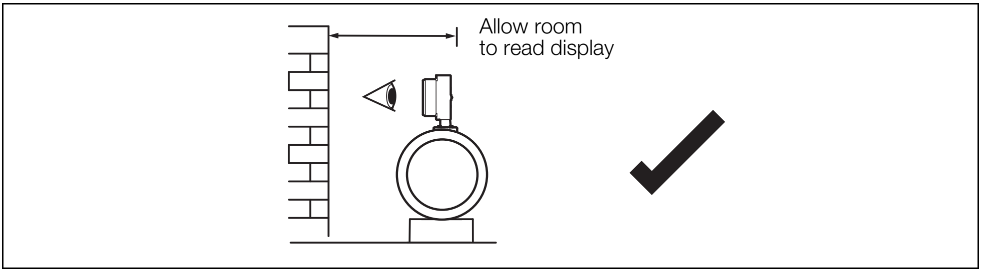


Fig. 2.1 Siting

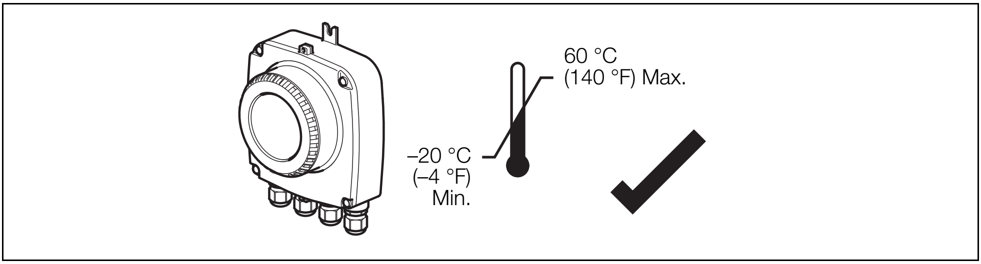


Fig. 2.2 Within Temperature Limits

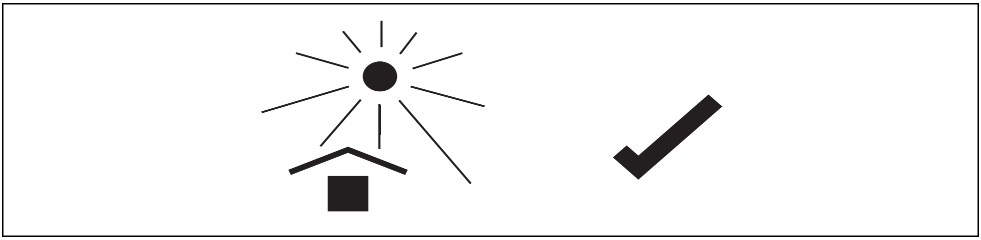


Fig. 2.3 Shade

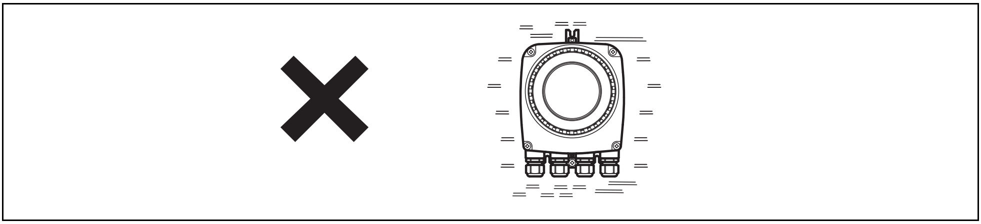


Fig. 2.4 Vibration

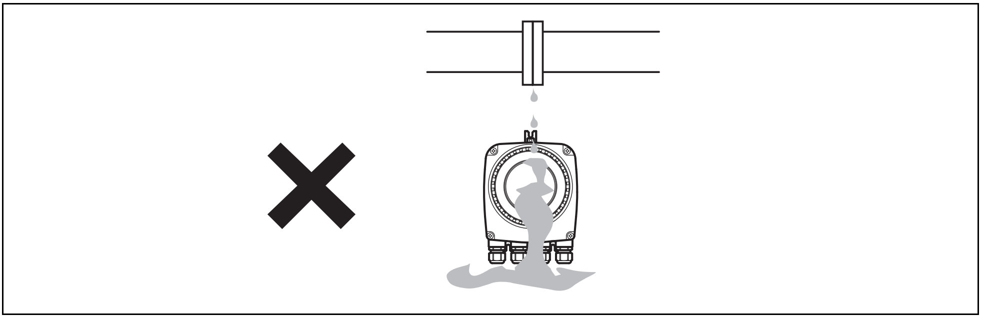


Fig. 2.5 Spillage

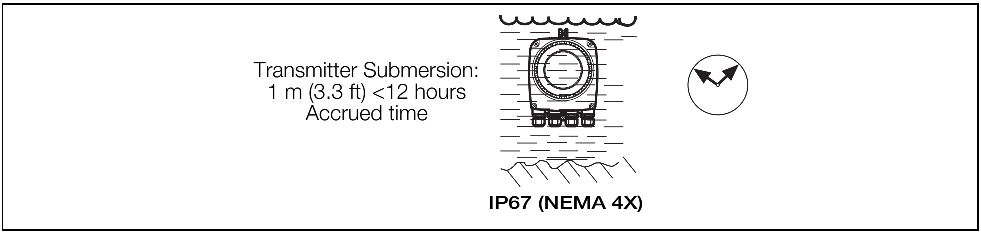


Fig. 2.6 Within Environmental Rating

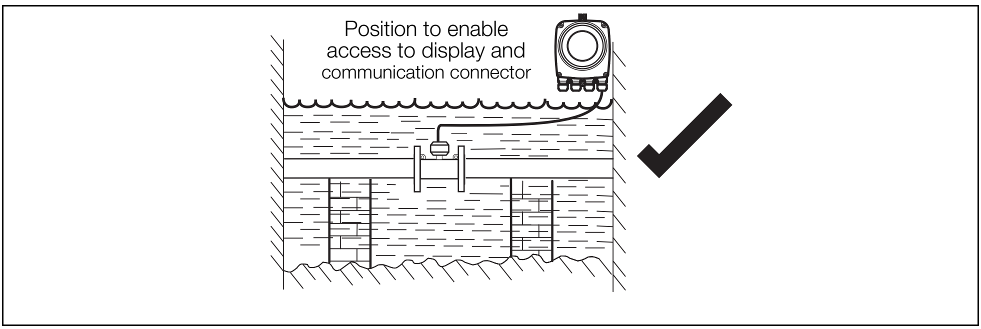


Fig. 2.7 Access to Transmitter

2.2 Dimensions

Dimensions in mm (in).

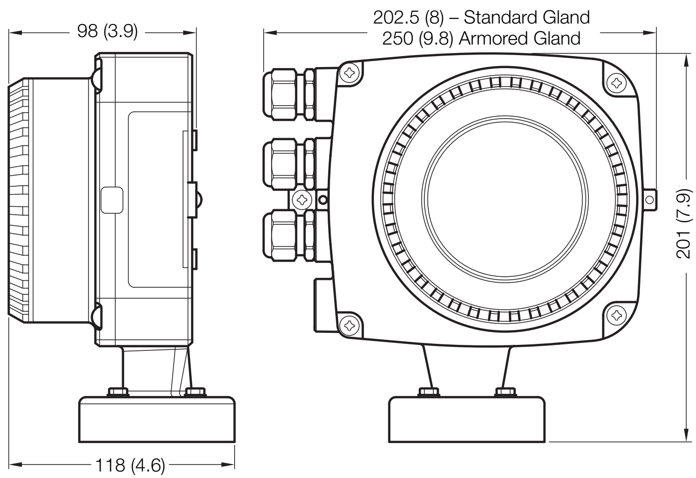


Fig. 2.8 Integral Transmitter Dimensions (Standard Gland Shown)

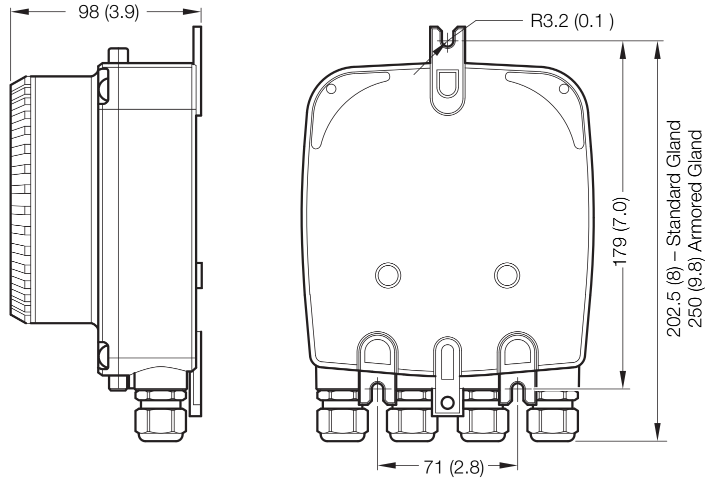


Fig. 2.9 Remote Transmitter Dimensions (Standard Gland Shown)

Note. Fix remote transmitter to a secure surface using 3 x M5 screws (not supplied).

3 Electrical Installation

3.1 Remote Transmitter / Sensor Arrangement

Note. For bonding connections use ≥ 4mm^2 (< 10AWG) cable.

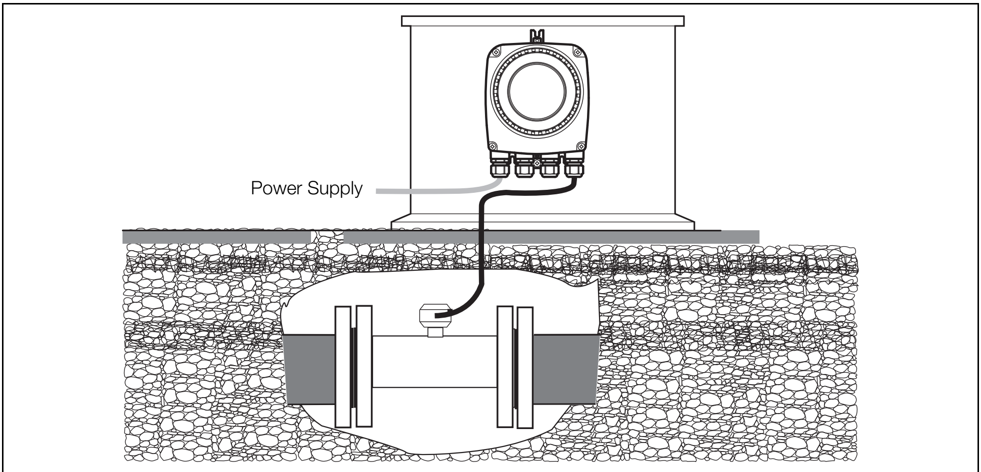


Fig. 3.1 Remote Transmitter in Roadside Cabinet – Flanged Sensor

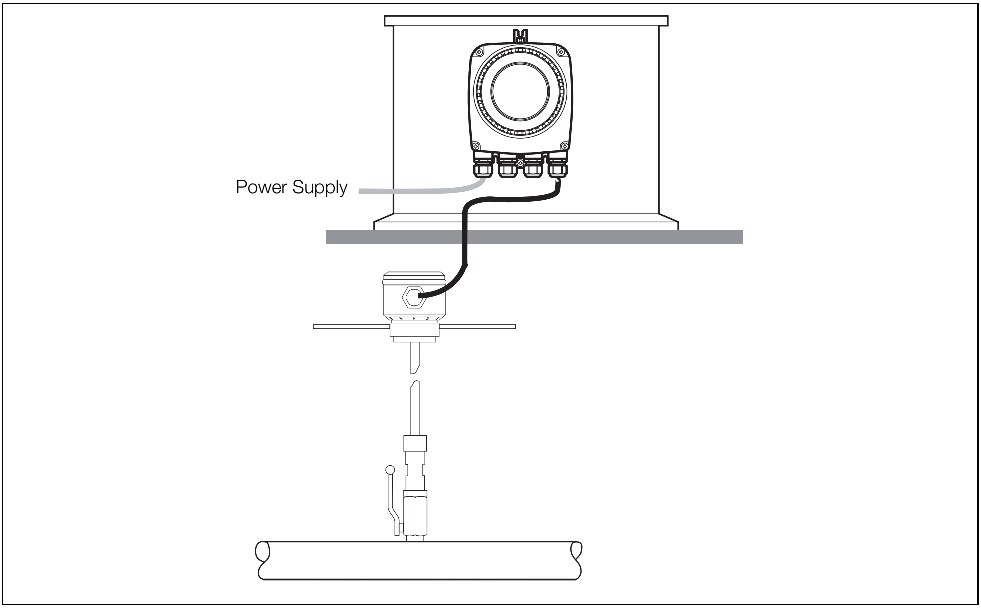


Fig. 3.2 Remote Transmitter in Roadside Cabinet – Probe Sensor

3.2 Transmitter Terminal Connections

> **Warning.** Isolate the transmitter from power supplies before removing the cover.

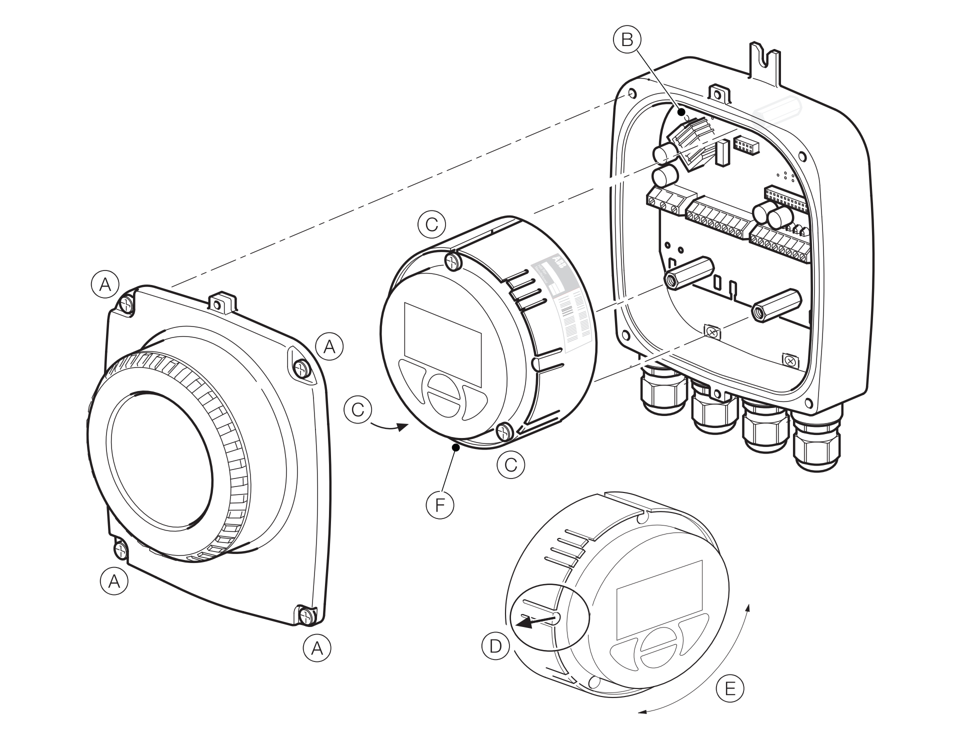


Fig. 3.3 Accessing the Transmitter Terminals

Referring to Fig. 3.3:

1. Slacken (but do not remove) the four transmitter cover screws A.
2. Remove the transmitter cover.
3. Check that the power indicator LED B on the backplane is **not** lit.

> **Warning.** If the power indicator LED B is lit, the transmitter is still powered up. Before continuing, isolate the transmitter power supply.

4. If screws C are not visible, access them by gently pulling the rotation lock D back and rotating the cartridge E until the cartridge screw access holes align with the cartridge screw heads.
5. Slacken the three cartridge screws and lift the cartridge F away from the housing.

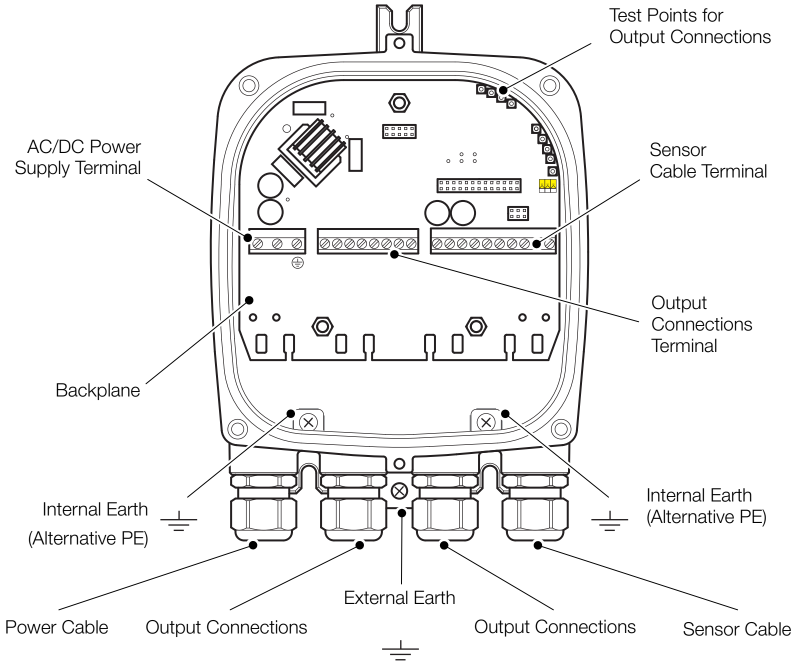


Fig. 3.4 Cable Gland / Conduit Entry (Remote Transmitter Shown)

3.3 Cable Preparation (Remote Systems Only)

To prepare the cable for connection at the transmitter and sensor terminal blocks:

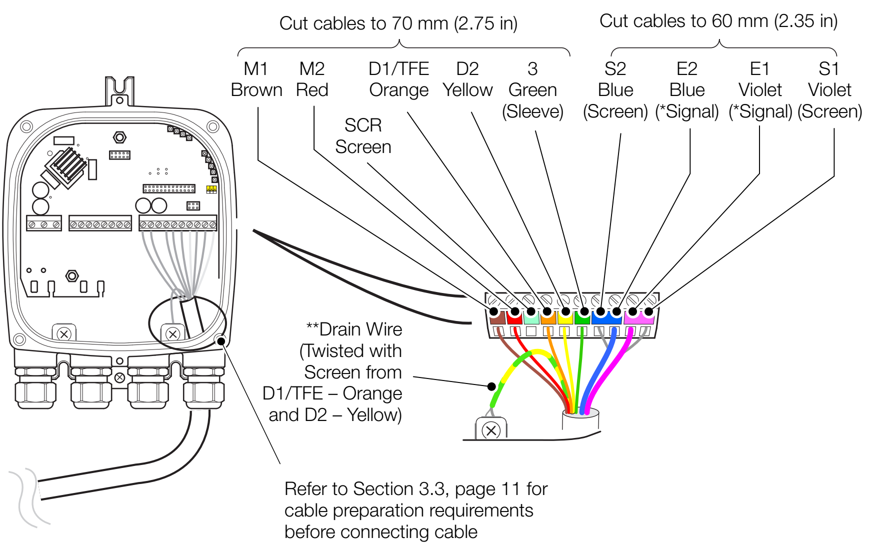
1. Remove the outer cable insulation and Mylar® wrap.
2. Ensure the drain wire is sleeved.
3. Cut the cable connection wires to the lengths shown in Fig 3.5, page 12.

3.4 Transmitter / Sensor Cable Connections

Caution.

- Make connections only as shown.
- Twist the screen wire of D1 / TFE + D2 with the outer screen drain wire and sleeve them.
- For standard (non-cathodically protected) systems, connect the drain wire to the earth screw.
- For cathodically protected systems, connect the drain wire to terminal SCR, ensuring no braid or wires touch the exposed copper areas within the transmitter sensor cable wiring area.
- If an earth screw is not available at the transmitter enclosure, connect the drain wire to terminal SCR.
- Ensure the seal and mating surfaces are clean to maintain environmental rating.
- Conduit connections must provide cable entry sealing.
- Ensure cable glands are tightened after wiring. Do not overtighten the plastic cable glands to avoid destroying their sealing properties. Initially, tighten finger-tight, then a further $^{1}/_{2}$ to $^{3}/_{4}$ turn using a suitable spanner or wrench.
- Fit blanking plugs where required.

3.4.1 Sensor Cable Terminal Connections and Recommended Cable Lengths



*Inner wire
**For cathodically protected systems (or if the transmitter enclosure does not have an earth screw) connect the drain wire to terminal SCR.

Fig. 3.5 Sensor Cable Connections at Transmitter Terminal Block – Standard System

3.5 Output Connections

Caution.

- Inductive loads must be suppressed or clamped to limit voltage swings.
- Operation of outputs is programmable.
- External isolators are not normally required as the pulse and alarm circuit is electrically separated from all other WaterMaster connections.

3.5.1 Frequency Outputs

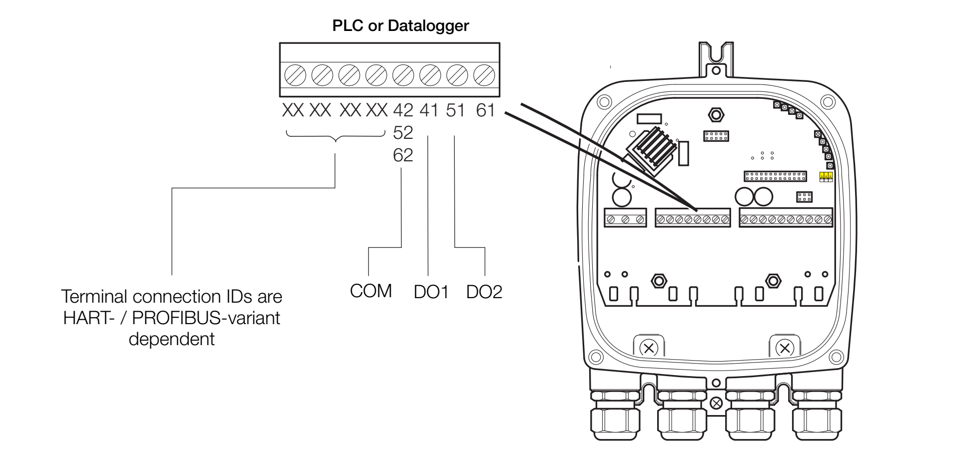


Fig. 3.6 PLC / Datalogger Connections

Note. Digital outputs DO1 and DO2 are polarity sensitive. The common (negative) connection for these outputs is designated 'COM'.

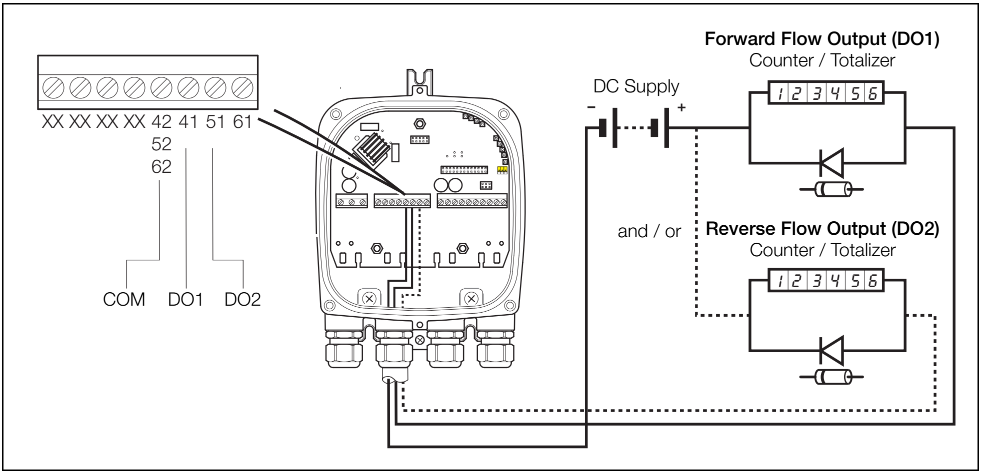


Fig. 3.7 Electromechanical Connections

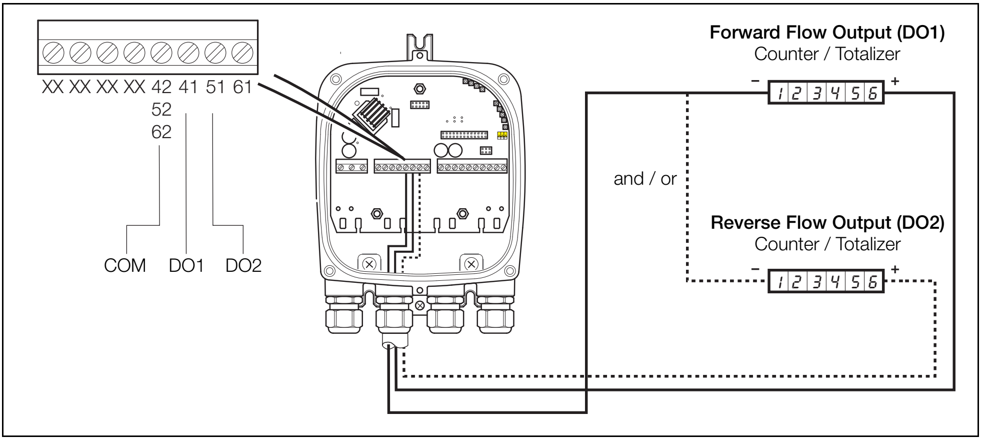


Fig. 3.8 Telemetry / Electronic Counters (etc.) Connections

3.5.2 Alarm Outputs

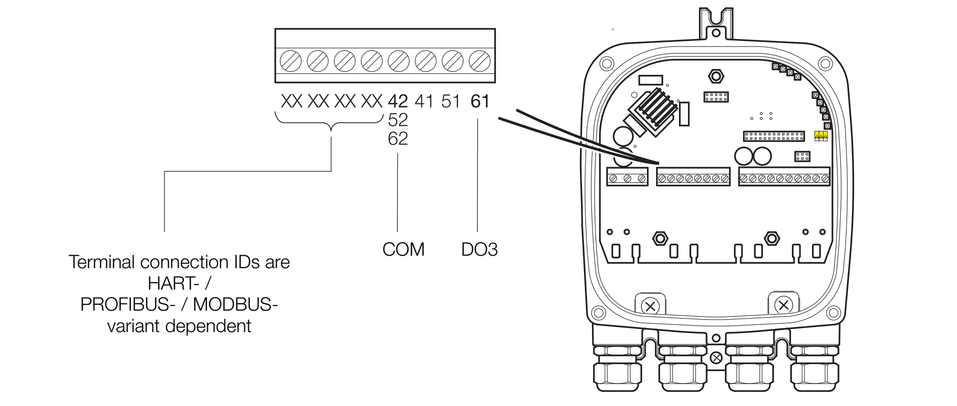


Fig. 3.9 Alarm Output Connections

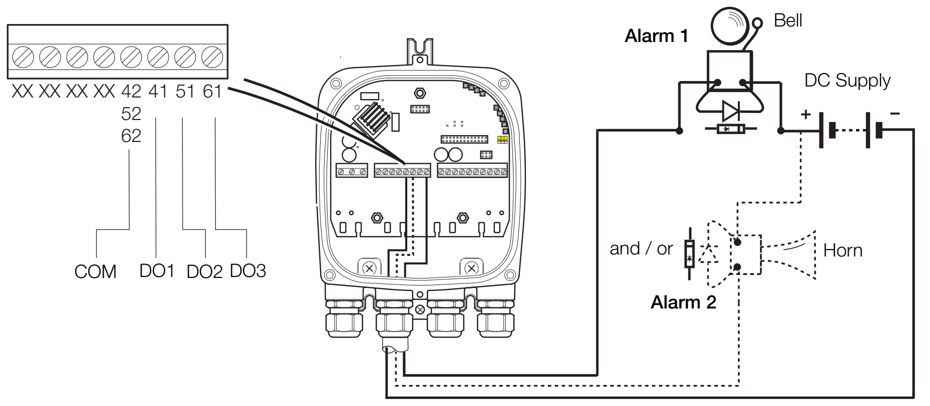


Fig. 3.10 Alarm Output Connections

Note.

- Normal alarm / logic output is from DO3 (terminal 61). DO1 (41) and DO2 (51) can also be configured as alarms if required but are then NOT available as frequency / pulse outputs as shown in Figs 3.7 and 3.8).
- Bell and horn shown for example only. Any suitable alarm device may be used (for example, lamp, siren, buzzer etc.).

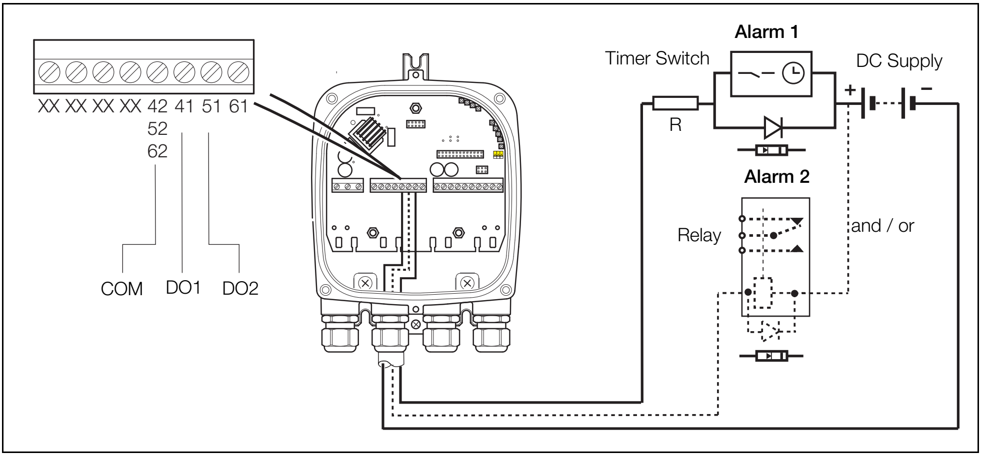


Fig. 3.11 Relay and Timers Output Connections

Note. Relay and timer switch shown for example only. Connect as required.

3.5.3 Contact Input

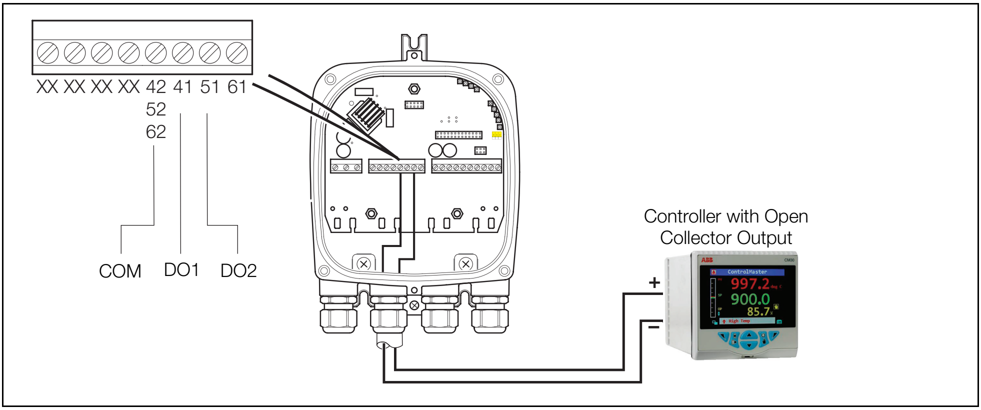


Fig. 3.12 Open Collector (or Grounded Contact) Connections

3.5.4 PLC Interface

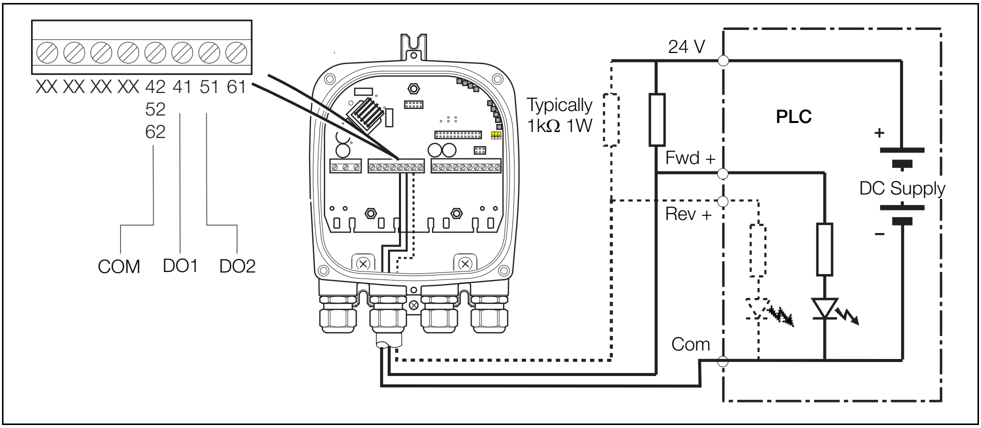


Fig. 3.13 PLC – Common –ve Connections

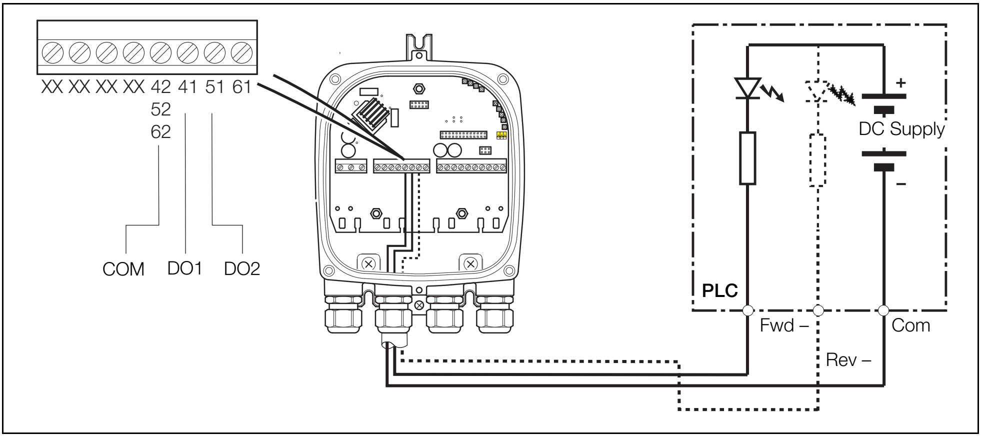


Fig. 3.14 PLC – Common +ve Connections

Note.

- WaterMaster digital outputs are NPN optocoupled transistors used as switches.
- Maximum allowed voltage at collector is 30 V DC
- Maximum allowed current across transistor is 220 mA.

3.5.5 Current Output (4 to 20 mA) – HART (FEX100) Variant

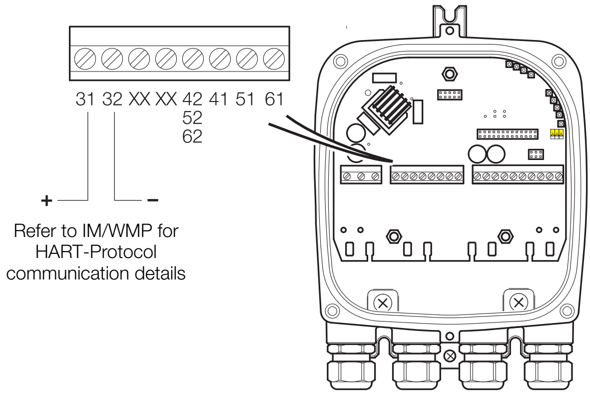


Fig. 3.15 Current Output (4 to 20 mA) – HART (FEX100) Variant

3.5.6 RS485 Communications – PROFIBUS (FEX100-DP) and MODBUS (FEX100-MB) Variants

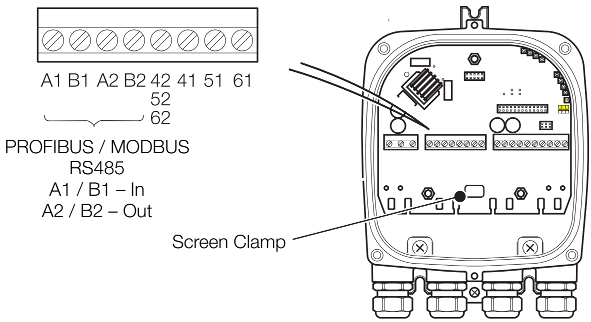
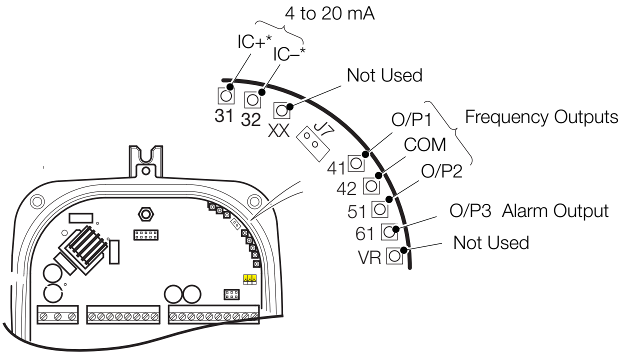


Fig. 3.16 WaterMaster RS485 Backplane Connections to PROFIBUS / MODBUS Networks

3.5.7 Test Point Access

Note. A typical DVM probe can access (fit) the PCB's test holes.



*These 2 test points are connected on the HART FEX100 backplane only
(they are present on the PROFIBUS FEX100-DP / MODBUS FEX100-MB backplane but are not connected)

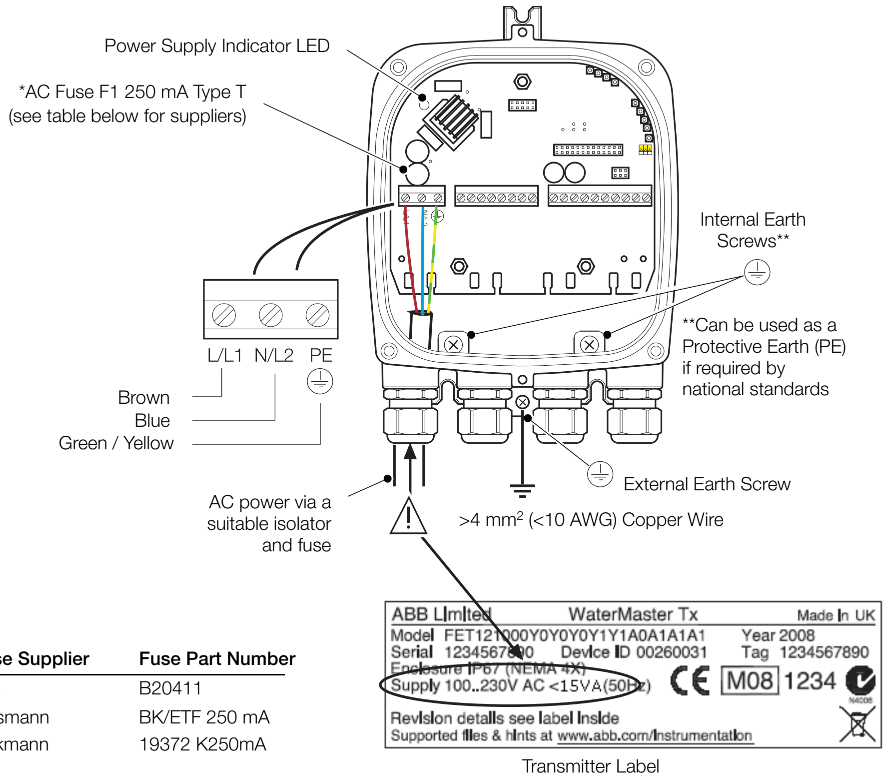
Fig. 3.17 Transmitter PCB Board Test Point Access

3.6 Power Supply Connections

Warning.

- Electrical installation and earthing (grounding) must be in accordance with relevant national and local standards.
- Power must be connected via a suitable isolator and fused in accordance with relevant standards.
- When changing fuses F1 or F2, isolate the power supply and wait 20 seconds before opening the enclosure.
- Replace fuses with the correct part – see Fig 3.18 (AC power) and 3.19, page 21 (DC power).

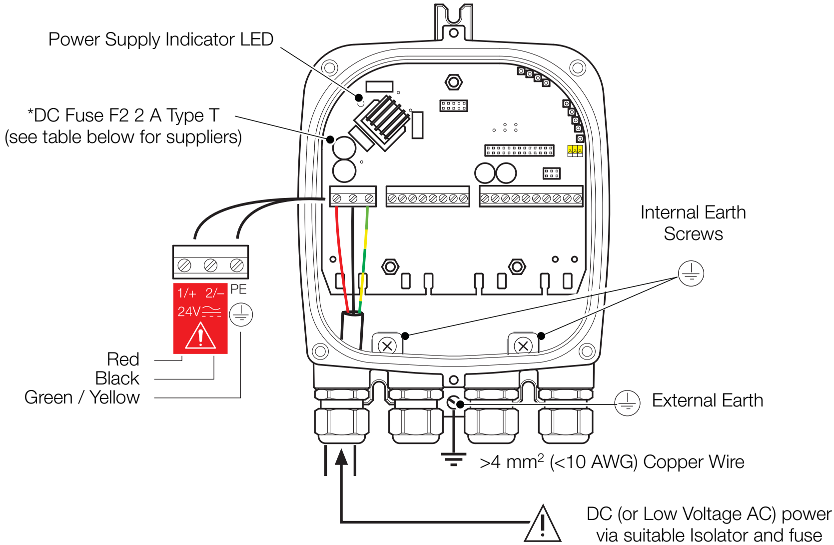
3.6.1 AC Power Supply



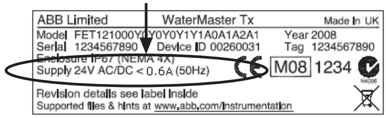
*Fuse Supplier	Fuse Part Number
ABB	B20411
Bussmann	BK/ETF 250 mA
Wickmann	19372 K250mA

Fig. 3.18 AC Power Supply Connections

3.6.2 DC (and Low Voltage AC) Power Supply



*Fuse Supplier	Fuse Part Number
ABB	B20412
Bussmann	BK/ETFZM
Wickmann	19372 K2A



Transmitter Label (DC)

Fig. 3.19 DC (and Low Voltage AC) Power Supply Connections

3.6.3 Configuration DIP Switches

Three configuration DIP switches are mounted on the transmitter backplane board.

These are factory-set as follows:

- Remote transmitter – all OFF
- Integral transmitter – SW3 ON

For MID-compliant flowmeters set the read-only / MID protection switch to 'ON' to ensure the meter is secure from tampering.

For HART software versions prior to 01.02.XX, this switch (set after commissioning) prevents login via the keypad or bus at any security level.

From HART software version 01.03.XX onwards and for all PROFIBUS software versions, on MID meters, all metrological-related parameters are locked and inaccessible at the Service level. Standard and Advanced user level parameters can still be modified via the HMI or bus.

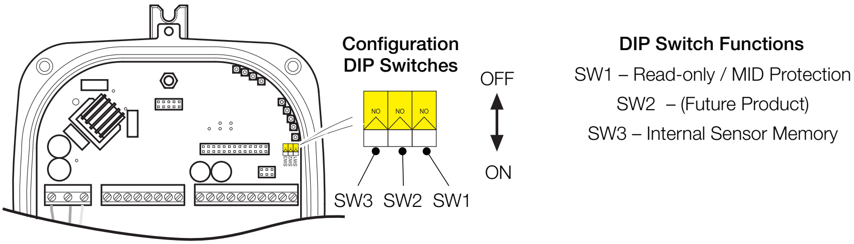


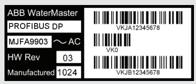
Fig. 3.20 Configuration DIP Switches

3.7 Refitting the Cartridge and Cover

Warning. Ensure the transmitter is isolated from power supplies before refitting the cover.

Caution.

- The communications bus type is HART FEX100 if not specified on the cartridge label. An example of the PROFIBUS FEX100-DP variant cartridge label is shown on the right.
- The cartridge communications type must match the communications type of the transmitter backplane PCB.
- To avoid damaging the cartridge during refitting, do not overtighten the cartridge screws.



PROFIBUS variant cartridge label

Referring to Fig. 3.21:

1. Confirm that the cartridge to be fitted is of the correct power supply and for the correct communications bus type (HART, PROFIBUS OR MODBUS) by checking the label (A) on the side of the cartridge:
   - AC cartridges have one **black** label on the cartridge side.
   - DC (and low voltage AC) cartridges have two **red** DC labels – one on the cartridge side and one on the cartridge rear plate.
2. Align the three cartridge screws (B) with the cartridge housing pillars and tighten the screws carefully until the cartridge is held in position.
3. If necessary, rotate the cartridge to the required orientation before refitting the cover – see Fig. 3.3, page 10 for details.
4. For high integrity / security installations, set DIP switch SW1 to the 'ON' (Read-only) position – see Fig. 3.20, page 22.
5. Align the transmitter cover with the housing and tighten the four cover screws (C) carefully.
6. For high integrity / security installations or where MID is required, fit anti-tamper seals to the security fixtures (D).

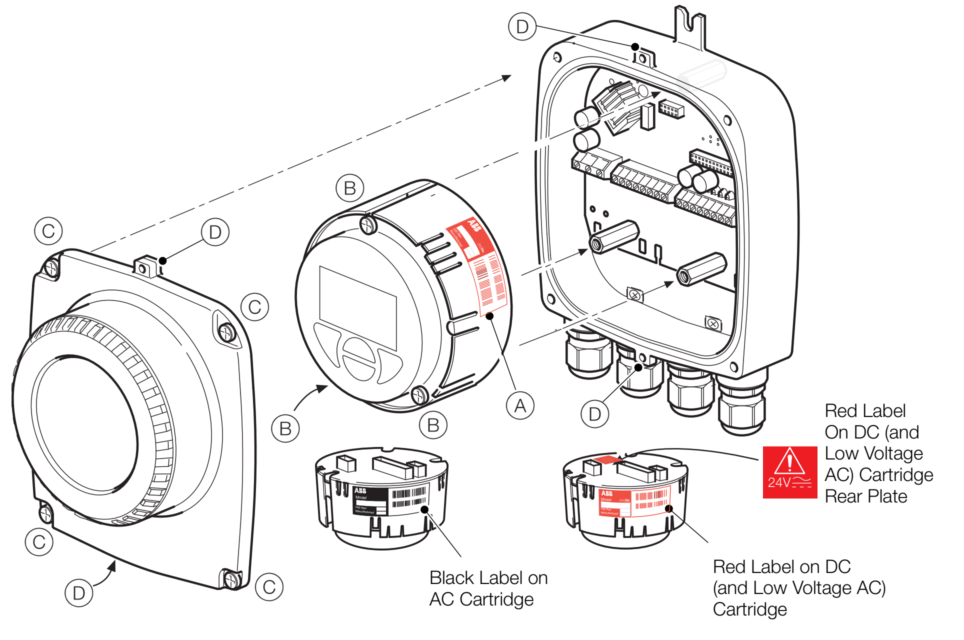


Fig. 3.21 Refitting the Cartridge and Cover

4 Start-up and Operation

Note. This section describes the options available at the 'Easy Setup' menu. Refer to the Programming Manual (IM/WMP) for comprehensive details of all end-user menus and operating levels.

4.1 Navigating the Menus and Parameters

The four keys below the display are used to navigate through the menus and to execute all system commands and selections.

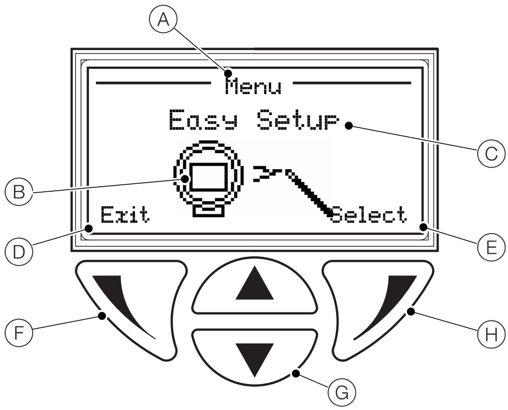


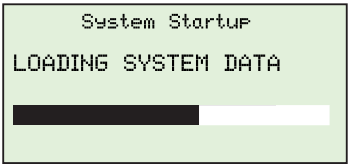
Fig. 4.1 Display and Keys

Item	Description
A	Screen title at the current level / parameter
B	Main level icon
C	Menu level title
D	Prompt executed by pressing the key
E	Prompt executed by pressing the key
F	Left key – used for parameter navigation and to enter editable parameters
G	Up / Down keys – used to scroll through menu options and to increase / decrease values in editable parameters
H	Right key – used to accept / select parameter values / selections and exit sub-levels

4.2 Start-up Screens

At start-up, the type of screen displayed indicates the status of the system.

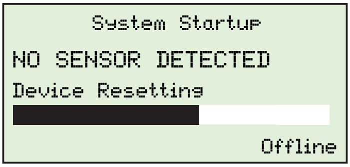
There are four common start-up screen types as follows:



System Start-up

At system start-up, a progress bar is displayed for the duration of the start-up period.

After this period, one of the four following screens is displayed according to the current status of the system.



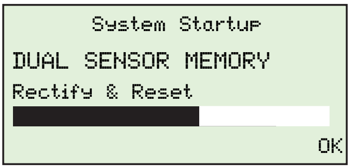
No Sensor Connected

If no sensor is detected during start-up, an auto-recovery routine is run to look for the sensor. If no sensor is detected, this routine continues until it is stopped manually.

If 'Offline' is selected during auto-recovery (by pressing the key) the transmitter ceases to operate as a flowmeter and the following conditions apply at the transmitter:

- Plant and transmitter data can be configured.
- Sensor data cannot be configured.

Note. If this screen is displayed on an integral transmitter, check that DIP switch SW3 is in the 'ON' position (refer to Fig. 3.20, page 22).

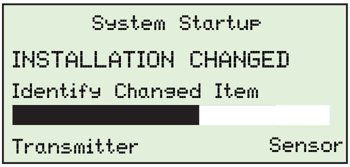


Dual Sensor Memory

Integral and retrofit systems have the sensor memory mounted on the transmitter backplane board.

If two sensor memory types (integral and remote) are detected at start-up, the warning 'DUAL SENSOR MEMORY' is displayed.

To correct this condition, set DIP switch SW3 to the 'OFF' position (refer to Fig. 3.20, page 22).



Installation Changed

If the sensor data stored in the transmitter memory does not match the data of the connected sensor, the warning 'INSTALLATION CHANGED' is displayed.

The changed item(s) (transmitter or sensor) can be identified and data copied as follows:

Transmitter

Selecting this option copies plant and stack data from the sensor memory to the transmitter memory and loads the totalizer from the sensor memory.

It is used to make the following changes:

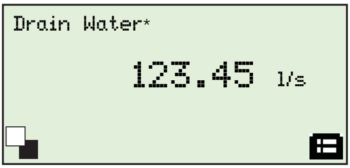
- Remote or integral cartridge change
- Remote Tx change
- New installation

Sensor

Selecting this option copies data from the transmitter memory to the sensor and loads the totalizer from the sensor memory.

It is used to make the following changes:

- Integral backplane change
- Sensor change
- Integral transmitter change



Example legend only

Process Display (Operator Page)

When the 'Process Display' (Operator Page) is displayed, normal operation is assumed.

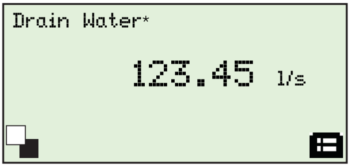
To access menus at a permitted access level, press the key to display the 'Access Level' screen – see Section 4.3, page 27.

4.3 Security Levels and Password Access

At power-up, the 'Start-up Display' and 'Process Display' screens are activated in sequence.

Note.

- Passwords at 'Standard' and 'Advanced' level can be set and changed by end-users.
- Access to the 'Service' level is reserved for factory-only personnel and not available to end-users.
- To navigate from the 'Operator Page(s)' directly back to the menus, accept the default access level selection at the 'Access Level' screen and press the key.

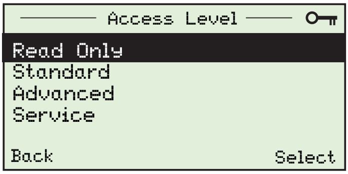


*Example legend only

Operator Pages (Process Display)

When the start-up routine is completed, and if no changes have occurred since last start-up, the 'Process Display' (Operator Page) screen is displayed.

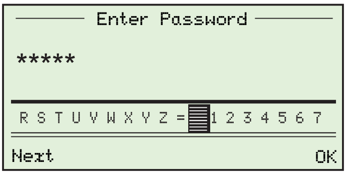
Press the key to display the 'Access Level' screen where the level of user access is selected.



Access Level

Passwords are required for 'Standard' and 'Advanced' level access. Passwords are not required for 'Read Only' access.

Select the permitted level of access and press the key to display the 'Enter Password' screen (the 'Enter Password' screen is bypassed if 'Read Only' is selected).



Enter Password

Enter the password and press the key to display menus available at the permitted access level.

Note. If a time-out occurs (5 minutes of no activity), enter the password again to access the menus.

4.3.1 Default Passwords

The WaterMaster transmitter is supplied with default passwords for access to 'Standard' and 'Advanced' level menus.

The two passwords are:

- 'Standard' access password: 2 or blank
- 'Advanced' access password: 3 or blank

Passwords can contain up to 5 characters and are not case sensitive.

To prevent unauthorized access ABB recommend the default passwords are changed on commissioning.

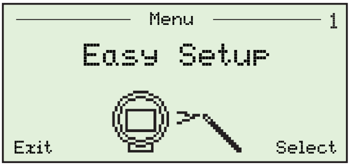
> **Note.** When allocating passwords, record a copy of each password and store in a safe location. It is not possible to interrogate the transmitter to 'recover' passwords once they have been set.

4.3.2 Entering Passwords

To select password characters and enter passwords:

1. Scroll to the 'Access Level' screen and select the required access level. Press the key to display the 'Enter Password' screen.
2. Use the and keys to scroll to and highlight the first password character to be selected.
3. Press the key to select the highlighted character (add it to the password set).
4. Use the and keys to highlight the next password character to be selected.
5. Repeat steps 2 to 4 until all characters have been added to the password.
6. Press the key to accept the password and display menus available at the requested access level.

4.4 Easy Setup



Easy Setup

The 'Easy Setup' level is used to set the system up quickly and contains a series of options for users with 'Standard' and 'Advanced' access permission. Users with 'Read Only' access cannot make selections at this level.

To navigate the 'Easy Setup' parameters:

- Enter 'Easy Setup' by pressing the key at the 'Select' prompt.
- View and edit a parameter by pressing the key at the 'Edit' prompt.
- Scroll parameter options by pressing the and keys (press and retain contact to scroll multiple options consecutively).
- Edit parameters by pressing the key at the 'Next' prompt to enter the text field and press the and keys to increase or decrease the value. Press the key at the 'OK' prompt to accept the new value.
- Accept a highlighted parameter by pressing the key at the 'OK' prompt.
- Exit the current parameter without changing the setting by pressing the key at the 'Cancel' prompt.
- Move to the next parameter by pressing the key at the 'Next' prompt.
- Exit 'Easy Setup' level by pressing the key at the 'Exit' prompt on the 'Easy Setup' main level screen.

Parameter	**Range**	**[Default]** ***Note***
Language	English, Deutsch, Français, Español, Italiano, Polski, Portuguese	[English] Selectable
Q (Flowrate) Unit	m^3/s, m^3/min, m^3/h, m^3/d, ft^3/s, ft^3/min, ft^3/h, ft^3/d, ugal/s, ugal/min, ugal/h, ugal/d, Mugal/d, igal/s, igal/min, igal/h, igal/d, bls/s, bls/min, bls/h, bls/d, hl/h, ml/s, ml/min, l/s, l/min, l/h, Ml/d,	[m^3/h] Selectable
Qmax	Dependent on sensor size	[Factory set]
Volume & Pulse Unit	m^3, l, ml, ft^3, hl, igal, ugal, bls, Ml, Mugal	Selectable*
Pulse Width	0.09 to 2000.00 ms	[0.09 ms] Editable
Pulses / Unit	0.000010 to 10,000,000 pulses / unit	[1.0] Editable (Only shown when Pulse Mode is Pulse / Unit)
Fullscale Frequency	0.250000 to 10,000,000 Hz	[5,000.000] Editable (Only shown when Pulse Mode is Fullscale Frequency)
Damping	0.02 to 60 s	[3.00 s] Editable
Mains Frequency	50 or 60 Hz	[50 Hz] Selectable

* For OIML and MID flowmeters, only m^3 must be used.

5 Specification

Functional Specification

Power supply

Mains	85 to 265 V AC @ <7 VA
Low voltage	24 V AC +10 %/–30 % @ <7 VA
DC	24 V ±30 % @ <0.4 A

Supply voltage fluctuations within the specified range have no effect on accuracy

Digital outputs (3 off)

Rating 30 V @ 220 mA, open collector, galvanically isolated

Maximum output frequency 5250 Hz

1 off dedicated to Alarm / Logic, programmable function

2 off configurable to either Pulse / Frequency or Alarm/Logic function

Current output – HART FEX100 variant

4 to 20 mA or 4 to 12/20 mA, galvanically isolated

Maximum loop resistance 750 Ω

HART protocol Version 5.7 (HART registered)

Signal levels compliant with NAMUR NE 43 (3.8 to 20.5 mA)

Low alarm 3.6 mA, High alarm 21.8 mA

Additional accuracy

±0.1 % of reading

Temperature coefficient: typically <±20 ppm/°C

RS485 communications – PROFIBUS FEX100-DP variant

Registered name: FEX100-DP

RS485 (9.6kbps to 1.5Mbps), galvanically isolated

DPV0, DPV1

PA Profile 3.01

Standard idents: 9700, 9740, 9741

FEX100-DP specific ident: 3431

3 Concurrent MS2 master connections

RS485 communications – MODBUS FEX100-MB variant

MODBUS RTU protocol

RS485 (9.6kbps to 115.2kbps), galvanically isolated

Electrical connections

20 mm glands, 1/2 in NPT, 20 mm armored glands

Temperature limitations

Ambient temperature	–20 to 60 °C (–4 to 140 °F)
Temperature coefficient	Typically <±10 ppm/°C @ Vel ≥0.5 mls

Environmental protection

Humidity: 0 to 100 %

Rating: IP67 (NEMA 4X) to 1m (3.3 ft) depth

Tamper-proof security

Write access prevented by internal switch combined with external security seals for MID applications

Languages

English, French, German, Italian, Spanish, Polish

Infrared service port

USB adapter (accessory), USB 1.1. and 2.0 compatible

Driver software for Windows 2000, XP, 7 (32-bit) and Vista

Housing material

Powder-coated aluminium with glass window

Hazardous approvals (HART variant only)

FM & FMc Class 1 Div 2

(FM listing NI / 1 / 2 / ABCD / T4, S / II, III / 2 / FG /T4, Ta=60C; Type 4X, IP67 – for transmitter and integral mounting Ta=70C, Type 6P, IP68 – for remote sensor type, IP67 on DN10 to 32)

(FMc listing NI / 1 / 2 / ABCD / T4, DIP / II, III / 2 / FG /T4, Ta=60C; Type 4X, IP67 – for transmitter and integral mounting Ta=70C, Type 6P, IP68 – for remote sensor type, IP67 on DN10 to 32)

FET, FEV, FEW and FEF DN700 to 2200 (27/28* to 84) only

*Size is dependent on flange specification

Declaration of Conformance

Copies of CE and PED certification will be available on request.

WaterMaster has OIML R49 Certificate of Conformity to accuracy class 1 and 2 (FEV DN40 to 200). Copies of accuracy certification are available on request.

WaterMaster (FEV DN40 to 200) has been type examined under directive MID 2004/22/EC, Annex MI-001. Copies of this certificate are available on request.

DS/WM–EN Rev. K

Products and customer support

Automation Systems
For the following industries:
- Chemical & Pharmaceutical
- Food & Beverage
- Manufacturing
- Metals and Minerals
- Oil, Gas & Petrochemical
- Pulp and Paper

Drives and Motors
- AC and 6 Drives, AC and DC Machines, AC Motors to 1kV
- Drive Systems
- Force Measurement
- Servo Drives

Controllers & Recorders
- Single and Multi-loop Controllers
- Circular Chart and Strip Chart Recorders
- Paperless Recorders
- Process Indicators

Flexible Automation
- Industrial Robots and Robot Systems

Flow Measurement
- Electromagnetic Flowmeters
- Mass Flowmeters
- Turbine Flowmeters
- Wedge Flow Elements

Marine Systems & Turbochargers
- Electrical Systems
- Marine Equipment
- Offshore Retrofit and Refurbishment

Process Analytics
- Process Gas Analysis
- Systems Integration

Transmitters
- Pressure
- Temperature
- Level
- Interface Modules

Valves, Actuators and Positioners
- Control Valves
- Actuators
- Positioners

Water, Gas & Industrial Analytics Instrumentation
- pH, Conductivity and Dissolved Oxygen Transmitters and Sensors
- Ammonia, Nitrate, Phosphate, Silica, Sodium, Chloride, Fluoride, Dissolved Oxygen and Hydrazine Analyzers
- Zirconia Oxygen Analyzers, Katharometers, Hydrogen Purity and Purge-gas Monitors, Thermal Conductivity

Customer support
We provide a comprehensive after sales service via a Worldwide Service Organization. Contact one of the following offices for details on your nearest Service and Repair Centre.

UK
ABB Limited
Tel: +44 (0)1453 826661
Fax: +44 (0)1453 829671

USA
ABB Inc.
Tel: +1 215 674 6000
Fax: +1 215 674 7183

Client Warranty
Prior to installation, the equipment referred to in this manual must be stored in a clean, dry environment, in accordance with the Company's published specification.
Periodic checks must be made on the equipment's condition. In the event of a failure under warranty, the following documentation must be provided as substantiation:
- A listing evidencing process operation and alarm logs at time of failure.
- Copies of all storage, installation, operating and maintenance records relating to the alleged faulty unit.

Contact us

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UK
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Process Automation
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USA
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Fax: +1 215 674 7183

www.abb.com

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3KXF208111R4201

OI/FET100–EN Rev. D 10.2012

4.04 INSTRUCTIONS FOR CONDUIT ENTRY

A. Conduit <u>Top</u> of Enclosure Entry:

1. Use only U.L. listed rain tight or liquid tight conduit hubs.
2. Install hubs and conduit according to the hub manufacturer's instructions.
3. Punch or drill the correct hole for the size of hub to be used.
4. Capture <u>all</u> drilling fines to prevent interior component damage.

B. Conduit <u>Bottom</u> of Enclosure Entry:

1. Punch or drill correct hole for the size of the conduit to be used.
2. Use only U.L. listed rain tight or liquid tight conduit hubs or sealing locknuts on the outside entry point.
3. Install conduit, hubs or sealing locknuts as per the manufacturer's instructions.
4. Secure conduits on the inside with locknuts.
5. Use plastic bushing or grounding bushing where applicable.

CONDUIT SIZE	HOLE SIZE
1/2"	7/8"
3/4"	1-1/8"
1"	1-3/8"
1-1/4"	1-3/4"
1-1/2"	2"
2"	2-3/8"
2-1/2"	3"
3"	3-5/8"
3-1/2"	4-1/4"
4"	4-5/8"

C. Conduit hole sealing:

1. Seal all unused holes with hole seals that are recognized for use with the enclosure NEMA rating.
2. Install seals according to the seal manufacturer's instructions.

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Power Generation

Submittal

Bay Meadows

The Power of One™

Cummins Northwest, LLC

Washington, Oregon, Alaska & Montana

Powerful Solutions. Dependable Support. Every Time

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Our energy working for you.™

Power Generation

Quotation

Cummins Northwest, LLC
4711 N Basin Ave
Portland OR 97217 United States
June 27, 2013

Project Name: Romtec-Bay Meadows

Quotation: 2220000000122133

Thank you for your inquiry. We are pleased to quote as follows:

USD

Item	Description	Qty
	Diesel Genset: 60Hz-100kW	
US-Stat	U.S. EPA, Stationary Emergency Application	1
100DSGAA	Genset-Diesel,60Hz,100kW	1
A331-2	Duty Rating-Standby Power	1
L090-2	Listing-UL 2200	1
L169-2	Emission Cert, EPA, Tier 3,NSPS CI Stationary Emergency	1
F173-2	Enclosure-Steel, Sound Attenuated ,Level 2,w/Exhaust System	1
R002-2	Voltage-277/480,3 Phase,Wye,4 Wire	1
B267-2	Alternator-60Hz,12 Ld, Broad Range, Full 1Ph Outp,125C	1
H700-2	GENSET CONTROL-POWERCOMMAND 1.1	1
B184-2	Exciter/Regulator-Pmg, 3 Phase Sensor	1
A366-2	Engine Governor-Electronic, Isochronous Only	1
H609-2	Control Mounting-Left Facing	1
K796-2	Stop Switch-Emergency	1
KU93-2	CB or EB or TB-Left Only	1
KT75-2	CircuitBreaker-200A,Left,3P,600/525V,TM,80%,UL/IEC	1
L163-2	Listing, ULC-S601-07	1
C259-2	Fuel Tank-Dual Wall Subset, 24 Hour Capacity	1
C127-2	Separator-Fuel/Water	1
H574-2	Warning-Fuel in Rupture Basin	1
H645-2	Warning-Low Fuel Level	1
A422-2	Engine Starter - 12 VDC Motor	1
A333-2	Battery Charging Alternator-Normal Output	1
E125-2	Engine Cooling-High Ambient Air Temperature	1
H389-2	Shutdown-Low Coolant Level	1
E089-2	Extension-Engine Coolant Drain	1
H669-2	Engine Coolant-50% Antifreeze, 50% Water Mixture	1

H036-2	Coolant Heater-120 Volt Ac, Single Phase	1
D036-2	Engine Air Cleaner-Heavy Duty	1
L188-2	ST 3YR 900HR Parts, Labor, and Travel	1
F065-2	Rack-Battery	1
SPEC-K	Product Revision - K	1
0541-1464	Over Fill Prevention Valve (OFPV) Kit	1
0541-1466	5 Gallon Round Spill Box Kit	1
0541-1467	Normal Vent Extension Kit	1
	Transfer Switch-Electronic Control: 225A	
OTEC225	Transfer Switch-Electronic Control,225Amp	1
A028-7	Poles-3	1
A046-7	Listing-UL 1008/CSA Certification	1
A044-7	Frequency-60 Hertz	1
A042-7	System-3 Phase,3 Wire Or 4 Wire	1
R026-7	Voltage-480 Vac	1
B002-7	Cabinet-Type 3R	1
KB59-7	Battery Charger-15 Ampere, 12 Volt, 50/60 Hertz	1
M033-7	Genset Starting Battery-12VDC	1
G006-7	Transfer Switch Warranty - 5 Yr Basic	1
SPEC-A	Product Revision - A	1
SUT10	Start Up and Testing	1
GRP4D	Starting Battery	1
OFRT	Freight-FOB Factory Fresno, CA, Off-Loading By Others	1

NOTES:

1. THIS QUOTATION IS SUBJECT TO CUMMINS NORTHWEST, LLC STANDARD TERMS & CONDITIONS - SEE ATTACHMENT

2. THIS UNIT MEETS NATIONAL EPA AND CARB REQUIREMENTS. CONTRACTOR TO VERIFY IF ANY LOCAL EMISSIONS REQUIEMENTS ARE NECESSARY.

3. REGARDING SELECTIVE COORDINATION FOR NEC ARTICLE 700 AND 701 LOADS. CUMMINS GENERATORS ARE EQUIPPED WITH THE MANUFACTURERS RECOMMENDED THERMAL MAGNETIC CIRCUIT BREAKER. INFORMATION REGARDING THIS DEVICE CAN BE SUPPLIED UPON REQUEST. THIS QUOTATION IS NOT VALID IF ANY CHANGES TO THIS CIRCUIT BREAKER(S) IS REQUIRED TO COORDINATE WITH OTHER DEVICES IN THE ELECTRICAL DISTRIBUTION SYSTEM. IF CHANGES ARE REQUIRED, THE CUSTOMER MUST PROVIDE A COPY OF THE COORDINATION STUDY LISTING THE MANUFACTURERS PART NUMBER OF THE DISCONNECT DEVICE TO BE SUPPLIED WITH THE GENERATOR AND A REVISED QUOTATION WILL BE ISSUED.

Submitted by

Matt Chapman , Oregon Power Generation Sales
matt.chapman@Cummins.com
Direct: 503-972-6615

Cummins Northwest, LLC

Attachment to Quotation
-Exclusions-

Exhaust System:	All off-engine piping, hangers, flanges, gaskets, bolts, insulation, and other materials associated with exhaust system installation unless specifically listed in the preceding quotation.
Fuel System:	All off-engine fuel piping for supply, return, venting, valves, coolers, filters, pumps, fittings, fuel storage tank & senders, all fuel for testing and initial fill of fuel.
Cooling System:	Intake louvers, exhaust louvers, air dampers, sheet metal ducting, flex adapters, sound attenuators/baffles. All off engine piping, flexible connections, secondary loop coolant, labor to install coolant for remote cooling systems unless specifically listed in the preceding quotation.
Electrical:	All off-engine wiring, field terminations of wiring, and lugs other than those detailed in our submittal.
Mounting:	Generator mounting bolts and anchors. Vibration isolators (if included) for the generator will be shipped loose for installation at the jobsite by others.
Testing:	All electrical testing, including but not limited to NETA, infrared scanning, harmonic content or other independent agency testing of switchgear, switchboards, protective relays or any other electrical component unless specifically listed in the preceding quotation. All environmental testing, including but not limited to EPA, local air quality district or other unless specifically listed in the preceding quotation. Calculations and Engineering Services - all electrical coordination studies, arc flash studies, seismic engineering calculations and seismic anchorage calculations unless specifically included in the preceding quotation. Programming - all protective relay settings, breaker settings, PLC programming or other user configurable device programming unless specifically included in the preceding quotation
Documentation:	Unless stated otherwise, electronic submittals and O&M manuals will be provided. Printed copies are available upon request, additional charges may apply.
Taxes and Permits:	Any applicable sales tax, permits, licenses.
Bonds	Any bid bond, payment or performance bond, or other type of bond unless specifically listed in the proposal. Cost for any required bond will be reimbursed to CNW by the buyer.

All items listed are excluded and will only be supplied by Cummins Northwest, LLC if agreed upon, in writing, by a sales representative for Cummins Northwest, LLC.

Current factory lead-time is 8-10 weeks after drawing approvals.

-Terms and Conditions-

- This offer and quotation incorporates and is contingent upon acceptance of the terms and conditions in the standard Sales Order of Cummins Northwest, LLC. Purchase Orders or other documents with terms and conditions that are inconsistent with the CNW standard Sales Order will not be accepted unless agreed to in writing by an officer of Cummins Northwest, LLC.
- **Prices are valid for 30 days**
- If included in the quotation, all on-site startup, testing and training assumes weekdays, during standard CNW business hours. **Additional charges may be added for work requested to be done on overtime, weekends, and holidays.**
- **F.O.B. factory, freight allowed to first destination, off-loading is not included**
- Factory direct shipments require credit approval prior to shipment
- Terms are C.O.D., or 30 days ***upon approval of credit***
- Equipment held for longer than 30 days may be charged a monthly storage fee
- Cancellation charges are 25% ***minimum*** after release of order

Cummins Northwest

Cummins Northwest, LLC
4711 N. Basin Ave. (97217)
PO Box 2710
Portland, OR 97208-2710
Phone (503) 289-0900
Fax (503) 240-5553

Project Name: ____________________

Project Number: ____________________

GENERATOR START-UP CHECK LIST

If the equipment is not ready for start-up and testing, the installer will be responsible for all costs associated with the initial site visit. **Start-up services will not be performed by Cummins Northwest, unless this form is returned a minimum of ten (10) business days before scheduled start-up.**

Please review your installation and respond to the check list below:	YES	NO
*1. Utility power available and connected to ATS / MTS (Don't connect door plug to harness)	______	______
2. Owner / Tenant has been notified of the start-up date.	______	______
3. Can emergency loads be transferred to generator at start-up?	______	______
*4. Generator mainline circuit breaker connected to ATS / MTS	______	______
*5. All DC and data interconnect wires run and terminated per submittal specifications.	______	______
6. Fuel supply connected to engine with approved flexible lines.	______	______
7. Fuel available on-site and ready for testing.	______	______
8. Gas plumbing and sizing completed in accordance with submittal specifications.	______	______
9. Natural Gas and / or Propane plumbing requires a minimum 7"-13" of water column.	______	______
10. Propane tank set up for liquid ________ or vapor ________ withdrawal.	______	______
11. Exhaust system installation complete including all piping and insulation.	N/A	______
*12. Fuel day tank power connected. (Do Not Energize Circuit)	N/A	______
13. Remote radiator, piping, expansion tanks installed flushed, filled with coolant.	N/A	______
*14. Engine coolant heater connected to utility (Do Not Energize Circuit)	______	______
15. Generator and isolators mounted to pad properly.	______	______
16. Radiator discharge air exhaust duct installed.	N/A	______
17. Intake and exhaust louvers installed and operational.	N/A	______
18. Generator battery / batteries on site. (Do Not Energize Circuit)	______	______
*19. Battery charger power connected (Do Not Energize Circuit)	______	______
20. Other: ____________________		

* Items **1**, **4**, **5**, **12**, **14 & 19** - **Referenced wiring must be terminated without exception**. CNW is not allowed by ***RCW 19.28***, ***WAC 296-46A*** & **WAC 296-401B** to initially terminate this wiring. Once terminated, CNW can change or correct the wiring.

Interconnect Wiring:
All interconnect wiring must be installed per Cummins Power Generation interconnect wiring drawing recommendations.

Fuel Plumbing:
Recommended fuel line material for diesel systems is schedule 40 black iron pipe.

Exhaust Piping:
Recommended exhaust pipe material is schedule 40 black iron pipe.

The undersigned confirms equipment is ready for startup:

__________ / __________ / __________
Printed Name / Signature / Date

Company: ____________________

Phone #: ____________________

Fax #: ____________________

Return to CNW Project Manager: ____________________

Phone: ____________________

Fax: ____________________

Email Address: ____________________

Form #100804-05 rev 12/09

Commercial Standby Extended Warranty Statements

Performance you rely on.™

Commercial Standby Extended Warranty Statements

Our energy working for you.™

Power Generation

Limited Standby 3 Year or 900 Hour Parts + Labor + Travel Extended Warranty – L188

Commercial Generating Set

When purchased, this limited extended warranty applies to all Cummins Power Generation® branded commercial generating sets and associated accessories (hereinafter referred to as "Product").

This warranty covers any failures of the Product, under normal use and service, which result from a defect in material or factory workmanship.

Warranty Period:

The warranty start date is the date of initial start up, first rental, demonstration or 18 months after factory ship date, whichever is sooner. The coverage duration is 3 years from warranty start date or 900 hours, whichever occurs first.

Emergency Standby Power (ESP) is defined as the maximum power available during a variable electrical power sequence, under the stated operating conditions, for which a generating set is capable of delivering in the event of a utility power outage. The permissible average power output over 24 hours of operation shall not exceed 70% of the ESP.

Cummins Power Generation® Responsibilities:

In the event of a failure of the Product during the extended warranty period due to defects in material or workmanship, Cummins Power Generation® will only be responsible for the following costs:

- All parts and labor required to repair the Product.
- Reasonable travel expenses to and from the Product site location.
- Maintenance items that are contaminated or damaged by a warrantable failure.

Owner Responsibilities:

The owner will be responsible for the following:

- Notifying Cummins Power Generation® distributor or dealer within 30 days of the discovery of failure.
- Installing, operating, commissioning and maintaining the Product in accordance with Cummins Power Generation®'s published policies and guidelines.
- Providing evidence for date of commissioning.
- Providing sufficient access to and reasonable ability to remove the Product from the installation in the event of a warrantable failure.

In addition, the owner will be responsible for:

- Incremental costs and expenses associated with Product removal and reinstallation resulting from non-standard installations.
- Costs associated with rental of generating sets used to replace the Product being repaired.
- Costs associated with labor overtime and premium shipping requested by the owner.
- All downtime expenses, fines, all applicable taxes, and other losses resulting from a warrantable failure.

Limitations:

This limited extended warranty does not cover Product failures resulting from:

- Inappropriate use relative to designated power rating.
- Inappropriate use relative to application guidelines.
- Failures due to normal wear, corrosion, varnished fuel system parts, lack of reasonable and necessary maintenance, unauthorized modifications and/or repair, and use of add-on or modified parts.
- Improper and/or unauthorized installation.
- Owner's or operator's negligence, accidents or misuse.
- Noncompliance with any Cummins Power Generation® published guideline or policy.
- Use of improper or contaminated fuels, coolants or lubricants.
- Improper storage before and after commissioning.

Limitations Continued:

- Owner's delay in making Product available after notification of potential Product problem.
- Replacement parts and accessories not authorized by Cummins Power Generation®.
- Use of Battle Short Mode
- Owner or operator abuse or neglect such as: operation without adequate coolant or lubricants; overfueling; overspeeding; lack of maintenance to lubricating, cooling or air intake systems; late servicing and maintenance; improper storage, starting, warm-up, run-in or shutdown practices, or for progressive damage resulting from a defective shutdown or warning device.
- Damage to parts, fixtures, housings, attachments and accessory items that are not part of the generating set.

This limited extended warranty does not cover costs resulting from:

- Difficulty in gaining access to the Product.
- Damage to customer property.
- Repair of cosmetic damage to enclosures.

Items not covered by this limited extended warranty:

- Batteries
- Enclosures
- Coolant heaters
- Exhaust systems and aftertreatment components
- Maintenance items

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CUMMINS POWER GENERATION® RIGHT TO FAILED COMPONENTS:

Failed components claimed under warranty remain the property of Cummins Power Generation®. Cummins Power Generation® has the right to reclaim any failed component that has been replaced under warranty.

THE WARRANTIES SET FORTH HEREIN ARE THE SOLE WARRANTIES MADE BY CUMMINS POWER GENERATION ® IN REGARD TO THE PRODUCT. CUMMINS POWER GENERATION® MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

IN NO EVENT IS CUMMINS POWER GENERATION® LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

This limited extended warranty shall be enforced to the maximum extent permitted by applicable law. This limited extended warranty gives the owner specific rights that may vary from state to state or from jurisdiction to jurisdiction.

Product Model Number:______________________

Product Serial Number:______________________

Date in Service:____________________________

Power Electronics Extended Warranty Statements

Our energy working for you.™

Power Generation

Power Electronics Extended Warranty Statements

Feature Codes
G004
G006
G007
G008
G013

Our energy working for you.™

Cummins Power Generation

Limited 5 Year Basic Extended Warranty – G006

Transfer Switch and Paralleling Systems

When purchased, this limited extended warranty applies to all Cummins Power Generation® branded Transfer Switches, Paralleling Systems and associated accessories (hereinafter referred to as "Product").

This limited extended warranty covers any failures of the Product, under normal use and service, which result from a defect in material or factory workmanship.

Warranty Period:

The limited extended warranty start date is the date of commissioning†, demonstration or 18 months after factory ship date, whichever is sooner. The coverage duration is 5 years from warranty start date.

† Date of commissioning not to exceed date of Generator Set initial start-up.

Cummins Power Generation® Responsibilities:

In the event of a failure of the Product during the limited extended warranty period due to defects in material or workmanship, Cummins Power Generation® will only be responsible for the following costs:

- All parts required to repair the Product

Owner Responsibilities:

The owner will be responsible for the following:

- Notifying Cummins Power Generation® distributor or dealer within 30 days of the discovery of failure.
- Installing, operating, commissioning and maintaining the Product in accordance with Cummins Power Generation®'s published policies and guidelines.
- Providing evidence for date of commissioning.
- Providing sufficient access to and reasonable ability to remove the Product from the installation in the event of a warrantable failure.

In addition, the owner will be responsible for:

- Incremental costs and expenses associated with Product removal and reinstallation resulting from non-standard installations.
- Costs associated with rental of power generating equipment used to replace the Product being repaired.
- Costs associated with labor overtime and premium shipping requested by the owner.
- Labor and travel after the base warranty period expires.
- All downtime expenses, fines, all applicable taxes, and other losses resulting from a warrantable failure.

Limitations:

This limited extended warranty does not cover Product failures resulting from:

- Inappropriate use relative to designated power rating.
- Inappropriate use relative to application guidelines.
- Non-conformance to applicable industry standards for installation
- Normal wear and tear.
- Improper and/or unauthorized installation.
- Owner's or operator's negligence, accidents or misuse.
- Lack of maintenance or unauthorized repair.
- Noncompliance with any Cummins Power Generation® published guideline or policy.
- Improper storage before and after commissioning.

- Owner's delay in making Product available after notification of potential Product problem.
- Use of steel enclosures within 60 miles of the coast of salt water when aluminum or an alternate non-corrosive material enclosure option is available.
- Replacement parts and accessories not authorized by Cummins Power Generation®.
- Owner or operator abuse or neglect such as: late servicing and maintenance and improper storage.
- Damage to parts, fixtures, housings, attachments and accessory items that are not part of the transfer switch or paralleling system.

This limited extended warranty does not cover costs resulting from:

- Difficulty in gaining access to the Product.
- Repair of cosmetic damage to enclosures.

CUMMINS POWER GENERATION® RIGHT TO FAILED COMPONENTS:
Failed components claimed under warranty remain the property of Cummins Power Generation®. Cummins Power Generation® has the right to reclaim any failed component that has been replaced under warranty.

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THE WARRANTIES SET FORTH HEREIN ARE THE SOLE WARRANTIES MADE BY CUMMINS POWER GENERATION ® IN REGARD TO THE PRODUCT. CUMMINS POWER GENERATION® MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OR OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

IN NO EVENT IS CUMMINS POWER GENERATION® LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.

This limited extended warranty shall be enforced to the maximum extent permitted by applicable law. This limited warranty gives the owner specific rights that may vary from state to state or from jurisdiction to jurisdiction.

Product Model Number:________________________

Product Serial Number:________________________

Date in Service:_______________________________

Cummins

Specification sheet

Diesel Generator set QSB7 series engine

100-200 kW 60 Hz

Description

Cummins Power Generation commercial generator sets are fully integrated power generation systems providing optimum performance, reliability and versatility for stationary standby and prime power applications.

Features

Cummins® heavy-duty engine - Rugged 4-cycle, industrial diesel delivers reliable power, low emissions and fast response to load changes.

Alternator - Several alternator sizes offer selectable motor starting capability with low reactance 2/3 pitch windings, low waveform distortion with non-linear loads and fault clearing short-circuit capability.

Control system - The PowerCommand® 1.1 electronic control is standard equipment and provides total genset system integration including automatic remote starting/stopping, precise frequency and voltage regulation, alarm and status message display, output metering, auto-shutdown at fault detection and NFPA 110 Level 1 compliance. The optional PowerCommand 2.2 control is UL 508 Listed and provides AmpSentry™ protection.

Cooling system - Standard integral set-mounted radiator system, designed and tested for rated ambient temperatures, simplifies facility design requirements for rejected heat.

Enclosures - Optional weather protective and sound attenuated enclosures are available.

NFPA - The genset accepts full rated load in a single step in accordance with NFPA 110 for Level 1 systems.

Warranty and service - Backed by a comprehensive warranty and worldwide distributor network.

	Standby rating		Prime rating		Continuous rating		Data sheets	
Model	60 Hz kW (kVA)	50 Hz kW (kVA)	60 Hz kW (kVA)	50 Hz kW (kVA)	60 Hz kW (kVA)	50 Hz kW (kVA)	60 Hz	50 Hz
DSGAA	100 (125)		90 (113)				D-3349	
DSGAB	125 (156)		113 (141)				D-3350	
DSGAC	150 (188)		135 (169)				D-3351	
DSGAD	175 (219)		160 (200)				D-3516	
DSGAE	200 (250)		180 (225)				D-3517	

Generator set specifications

Governor regulation class	ISO 8528 Part 1 Class G3
Voltage regulation, no load to full load	± 1%
Random voltage variation	± 0.5%
Frequency regulation	Isochronous
Random frequency variation	± 0.25%
Radio frequency emissions compliance	Meets requirements of most industrial and commercial applications

Engine specifications

Bore	107 mm (4.21 in)
Stroke	124.0 mm (4.88 in)
Displacement	6.69 L (408 in^3)
Configuration	Cast iron, in-line, 6 cylinder
Battery capacity	1100 amps minimum at ambient temperature of -18 °C to 0 °C (0 °F to 32 °F)
Battery charging alternator	100 amps
Starting voltage	12 volt, negative ground
Fuel system	Direct injection: number 2 diesel fuel, fuel filter, automatic electric fuel shutoff
Fuel filter	Single element, 10 micron filtration, spin-on fuel filter with water separator
Air cleaner type	Dry replaceable element
Lube oil filter type(s)	Spin-on, full flow
Standard cooling system	High ambient radiator

Alternator specifications

Design	Brushless, 4 pole, drip proof, revolving field
Stator	2/3 pitch
Rotor	Single bearing, flexible discs
Insulation system	Class H
Standard temperature rise	150 °C standby at 40 °C ambient
Exciter type	Torque match (shunt) standard, PMG optional
Phase rotation	A (U), B (V), C (W)
Alternator cooling	Direct drive centrifugal blower fan
AC waveform total harmonic distortion	< 5% no load to full linear load, < 3% for any single harmonic
Telephone influence factor (TIF)	< 50 per NEMA MG1-22.43
Telephone harmonic factor (THF)	< 3

Available voltages

60 Hz Three phase line-neutral/line-line				60 Hz Single phase line-neutral/line-line		
• 110/190	• 115/230 Delta	• 127/220	• 240/416	• 110/220	• 115/230	• 120/240
• 110/220	• 120/208	• 139/240	• 255/440			
• 115/200	• 120/240 Delta	• 220/380	• 277/480			
		• 230/400	• 347/600			
				(not available with DSGAD or DSGAE)		

Note: Consult factory for other voltages.

Generator set options and accessories

Engine
- ☐ 120 V 150 W lube oil heater
- ☐ 120/240 V 1500 W coolant heater

Fuel System
- ☐ 24 hour sub-base tank (dual wall)

Alternator
- ☐ 105 °C rise
- ☐ 125 °C rise
- ☐ 120 V 100 W anti-condensation heater
- ☐ PMG excitation
- ☐ Single phase

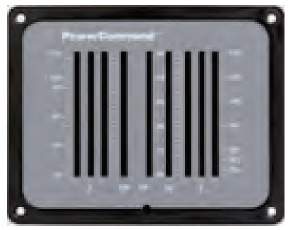
Exhaust system
- ☐ Heavy duty exhaust elbow
- ☐ Slip on exhaust connection

Generator set
- ☐ Battery
- ☐ Battery charger
- ☐ Enclosure: aluminum, steel, weather protective or sound attenuated
- ☐ Main line circuit breaker

- ☐ Remote annunciator panel
- ☐ Spring isolators
- ☐ 2 year prime power warranty
- ☐ 2 year standby power warranty
- ☐ 5 year basic power warranty

Note: Some options may not be available on all models - consult factory for availability.

Control system PowerCommand 1.1



PowerCommand control is an integrated generator set control system providing voltage regulation, engine protection, operator interface and isochronous governing (optional). Major features include:

- Battery monitoring and testing features and smart starting control system.
- Standard PCCNet interface to devices such as remote annunciator for NFPA 110 applications.
- Control boards potted for environmental protection.
- Control suitable for operation in ambient temperatures from -40 °C to +70 °C (-40 °F to +158 °F) and altitudes to 5000 meters (13,000 feet).
- Prototype tested; UL, CSA, and CE compliant.
- InPower™ PC-based service tool available for detailed diagnostics.

Operator/display panel

- Manual off switch
- Alpha-numeric display with pushbutton access for viewing engine and alternator data and providing setup, controls and adjustments (English or international symbols)
- LED lamps indicating genset running, not in auto, common warning, common shutdown, manual run mode and remote start
- Suitable for operation in ambient temperatures from -20 °C to +70 °C
- Bargraph display (optional)

AC protection

- Over current warning and shutdown
- Over and under voltage shutdown
- Over and under frequency shutdown
- Over excitation (loss of sensing) fault
- Field overload

Engine protection

- Overspeed shutdown
- Low oil pressure warning and shutdown
- High coolant temperature warning and shutdown
- Low coolant level warning or shutdown
- Low coolant temperature warning
- High, low and weak battery voltage warning
- Fail to start (overcrank) shutdown
- Fail to crank shutdown
- Redundant start disconnect
- Cranking lockout
- Sensor failure indication
- Low fuel level warning or shutdown
- Fuel-in-rupture-basin warning or shutdown

Alternator data

- Line-to-line and line-to-neutral AC volts
- 3-phase AC current
- Frequency
- Total kVA

Engine data

- DC voltage
- Lube oil pressure
- Coolant temperature
- Engine speed

Other data

- Genset model data
- Start attempts, starts, running hours
- Fault history
- RS485 Modbus® interface
- Data logging and fault simulation (requires InPower service tool)

Digital governing (optional)

- Integrated digital electronic isochronous governor
- Temperature dynamic governing

Digital voltage regulation

- Integrated digital electronic voltage regulator
- 2-phase line-to-line sensing
- Configurable torque matching

Control functions

- Time delay start and cooldown
- Cycle cranking
- PCCNet interface
- (2) Configurable inputs
- (2) Configurable outputs
- Remote emergency stop
- Glow plug control (some models)

Options

- ☐ Auxiliary output relays (2)
- ☐ 120/240 V, 100 W anti-condensation heater
- ☐ Remote annunciator with (3) configurable inputs and (4) configurable outputs
- ☐ PMG alternator excitation
- ☐ PowerCommand iWatch web server for remote monitoring and alarm notification (loose)
- ☐ Auxiliary, configurable signal inputs (8) and configurable relay outputs (8)
- ☐ Digital governing
- ☐ AC output analog meters (bargraph)
  - Color-coded graphical display of:
    - 3-phase AC voltage
    - 3-phase current
    - Frequency
    - kVa
- ☐ Remote operator panel
- ☐ PowerCommand 2.2 control with AmpSentry protection

For further detail see document S-1531.

Ratings definitions

Emergency standby power (ESP):

Applicable for supplying power to varying electrical load for the duration of power interruption of a reliable utility source. Emergency Standby Power (ESP) is in accordance with ISO 8528. Fuel Stop power in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.

Limited-time running power (LTP):

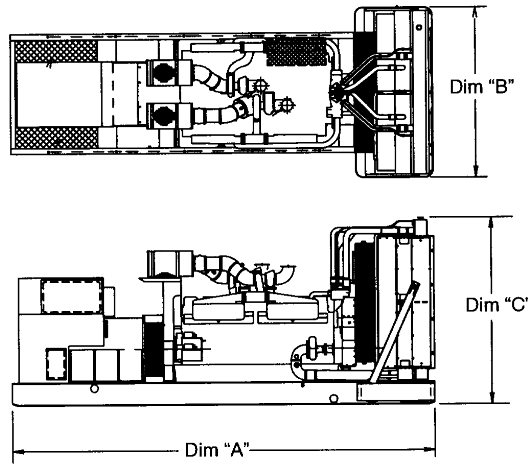
Applicable for supplying power to a constant electrical load for limited hours. Limited Time Running Power (LTP) is in accordance with ISO 8528.

Prime power (PRP):

Applicable for supplying power to varying electrical load for unlimited hours. Prime Power (PRP) is in accordance with ISO 8528. Ten percent overload capability is available in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.

Base load (continuous) power (COP):

Applicable for supplying power continuously to a constant electrical load for unlimited hours. Continuous Power (COP) in accordance with ISO 8528, ISO 3046, AS 2789, DIN 6271 and BS 5514.



This outline drawing is for reference only. See respective model data sheet for specific model outline drawing number.

Do not use for installation design

Model	Dim "A" mm (in.)	Dim "B" mm (in.)	Dim "C" mm (in.)	Set Weight* dry kg (lbs)	Set Weight* wet kg (lbs)
DSGAA	2656 (104.6)	1100 (43.3)	1549 (61)		1180 (2602)
DSGAB	2656 (104.6)	1100 (43.3)	1549 (61)		1225 (2700)
DSGAC	2656 (104.6)	1100 (43.3)	1549 (61)		1263 (2784)
DSGAD	2656 (104.6)	1100 (43.3)	1549 (61)		1361 (3000)
DSGAE	2656 (104.6)	1100 (43.3)	1549 (61)		1361 (3000)

* Note: Weights represent a set with standard features. See outline drawings for weights of other configurations.

Codes and standards

Codes or standards compliance may not be available with all model configurations – consult factory for availability.

ISO 9001	This generator set is designed in facilities certified to ISO 9001 and manufactured in facilities certified to ISO 9001 or ISO 9002.	UL	The generator set is available Listed to UL 2200, Stationary Engine Generator Assemblies for all 60 Hz low voltage models.
PTS	The Prototype Test Support (PTS) program verifies the performance integrity of the generator set design. Cummins Power Generation products bearing the PTS symbol meet the prototype test requirements of NFPA 110 for Level 1 systems.	**U.S. EPA**	Engine certified to Stationary Emergency U.S. EPA New Source Performance Standards, 40 CFR 60 subpart IIII Tier 3 exhaust emission levels. U.S. applications must be applied per this EPA regulation.
CSA	All low voltage models are CSA certified to product class 4215-01.	**International Building Code**	The generator set package is available certified for seismic application in accordance with the following International Building Code: IBC2000, IBC2003 IBC2006, IBC2009 and IBC2012.

Warning: Back feed to a utility system can cause electrocution and/or property damage. Do not connect to any building's electrical system except through an approved device or after building main switch is open.

North America
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Minneapolis, MN 55432
USA
Phone 763 574 5000
Fax 763 574 5298

Our energy working for you.™

Cummins Power Generation

S-1544m (3/13)

Model: DSGAA
Frequency: 60
Fuel type: Diesel
KW rating: 100 standby
90 prime
Emissions level: EPA NSPS Stationary Emergency Tier 3

Generator set data sheet

Cummins Power Generation

Our energy working for you.™

Exhaust emission data sheet:	**EDS-1083**
Exhaust emission compliance sheet:	**EPA-1117**
Sound performance data sheet:	**MSP-1055**
Cooling performance data sheet:	**MCP-170**
Prototype test summary data sheet:	**PTS-285**
Standard set-mounted radiator cooling outline:	**A035C611**
Optional set-mounted radiator cooling outline:	
Optional heat exchanger cooling outline:	
Optional remote radiator cooling outline:	

Fuel consumption

	Standby				Prime				Continuous
	kW (kVA)				kW (kVA)				kW (kVA)
Ratings	100 (125)				90 (113)				
Load	**1/4**	**1/2**	**3/4**	**Full**	**1/4**	**1/2**	**3/4**	**Full**	**Full**
US gph	3.47	5.00	7.17	8.87	3.37	4.59	6.43	8.26	
L/hr	13.1	18.9	27.0	33.6	12.7	17.4	24.3	31.3	

Engine

	Standby rating	Prime rating	Continuous rating
Engine manufacturer	Cummins		
Engine model	QSB7-G5 NR3		
Configuration	Cast iron, in-line, 6 cylinder		
Aspiration	Turbocharged and air-to-air aftercooled		
Gross engine power output, kWm (bhp)	242 (324)	208 (279)	
BMEP at set rated load, kPa (psi)	1204 (175)	1090 (158)	
Bore, mm (in)	107 (4.21)		
Stroke, mm (in)	124 (4.88)		
Rated speed, rpm	1800		
Piston speed, m/s (ft/min)	7.4 (1464)		
Compression ratio	17.2:1		
Lube oil capacity, L (qt)	17.5 (18.5)		
Overspeed limit, rpm	2100		
Regenerative power, kW	19		

Fuel flow

Maximum fuel flow, L/hr (US gph)	106 (28)	
Maximum fuel flow with C174, L/hr (US gph)		
Maximum fuel inlet restriction with clean filter, mm Hg (in Hg)	127 (5)	
Maximum return restriction, mm Hg (in Hg)	152 (6)	

Air	Standby rating	Prime rating	Continuous rating
Combustion air, m^3/min (scfm)	13.7 (486)	12.9 (456)	
Maximum air cleaner restriction with clean filter, kPa (in H_2O)	3.7 (15)		
Alternator cooling air, m^3/min (cfm)	37.0 (1308)		

Exhaust			
Exhaust flow at set rated load, m^3/min (cfm)	31.3 (1105)	28.9 (1021.5)	
Exhaust temperature, ° C (° F)	430 (807)	420 (788)	
Maximum back pressure, kPa (in H_2O)	10 (40)		

Standard set-mounted radiator cooling			
Ambient design, ° C (° F)	55 (131)		
Fan load, kW_m (HP)	9.7 (13.0)		
Coolant capacity (with radiator), L (US Gal)	23 (6.1)		
Cooling system air flow, m^3/min (scfm)	351 (12400)		
Total heat rejection, MJ/min (Btu/min)	6.77 (6408)	6.14 (5813)	
Maximum cooling air flow static restriction, kPa (in H_2O)	0.12 (0.5)		

Optional set-mounted radiator cooling			
Ambient design, °C (°F)			
Fan load, kW_m (HP)			
Coolant capacity (with radiator), L (US Gal.)			
Cooling system air flow, m^3/min (scfm)			
Total heat rejection, MJ/min (Btu/min)			
Maximum cooling air flow static restriction, kPa (in. H_2O)			

Optional heat exchanger cooling			
Set coolant capacity, L (US Gal.)			
Heat rejected, jacket water circuit, MJ/min (Btu/min)			
Heat rejected, aftercooler circuit, MJ/min (Btu/min)			
Heat rejected, fuel circuit, MJ/min (Btu/min)			
Total heat radiated to room, MJ/min (Btu/min)			
Maximum raw water pressure, jacket water circuit, kPa (psi)			
Maximum raw water pressure, aftercooler circuit, kPa (psi)			
Maximum raw water pressure, fuel circuit, kPa (psi)			
Maximum raw water flow, jacket water circuit, L/min (US Gal/min)			
Maximum raw water flow, aftercooler circuit, L/min (US Gal/min)			
Maximum raw water flow, fuel circuit, L/min (US Gal/min)			
Minimum raw water flow at 27 °C (80 °F) iInlet temp, jacket water circuit, L/min (US Gal/min)			
Minimum raw water flow at 27 °C (80 °F) inlet temp, aftercooler circuit, L/min (US Gal/min)			
Minimum raw water flow at 27 °C (80 °F) inlet temp, fuel circuit, L/min (US Gal/min)			
Raw water delta P at min flow, jacket water circuit, kPa (psi)			
Raw water delta P at min flow, aftercooler circuit, kPa (psi)			
Raw water delta P at min flow, fuel circuit, kPa (psi)			
Maximum jacket water outlet temp, °C (°F)			
Maximum aftercooler inlet temp, °C (°F)			
Maximum aftercooler inlet temp at 25 °C (77 °F) ambient, °C (°F)			

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Optional remote radiator cooling[1]

Optional remote radiator cooling[1]	Standby rating	Prime rating	Continuous rating
Set coolant capacity, L (US gal)			
Max flow rate at max friction head, jacket water circuit, L/min (US gal/min)			
Max flow rate at max friction head, aftercooler circuit, L/min (US gal/min)			
Heat rejected, jacket water circuit, MJ/min (Btu/min)			
Heat rejected, aftercooler circuit, MJ/min (Btu/min)			
Heat rejected, fuel circuit, MJ/min (Btu/min)			
Total heat radiated to room, MJ/min (Btu/min)			
Maximum friction head, jacket water circuit, kPa (psi)			
Maximum friction head, aftercooler circuit, kPa (psi)			
Maximum static head, jacket water circuit, m (ft)			
Maximum static head, aftercooler circuit, m (ft)			
Maximum jacket water outlet temp, °C (°F)			
Maximum aftercooler inlet temp at 25 °C (77 °F) ambient, °C (°F)			
Maximum aftercooler inlet temp, °C (°F)			
Maximum fuel flow, L/hr (US gph)			
Maximum fuel return line restriction, kPa (in Hg)			

Weights[2]

Weights[2]	
Unit dry weight kgs (lbs.)	
Unit wet weight kgs (lbs.)	1180 (2602)

Notes:

[1] For non-standard remote installations contact your local Cummins Power Generation representative.

[2] Weights represent a set with standard features. See outline drawing for weights of other configurations.

Derating factors

Derating factors	
Standby	Engine power available up to 3048 m (10,000 ft) at ambient temperature up to 50° C (122° F). Consult your Cummins Power Generation distributor for temperature and ambient requirements outside these parameters.
Prime	Engine power available up to 3048 m (10,000 ft) at ambient temperature up to 40° C (104° F) and 2226 m (7300 ft) at 50° C (122° F). Consult your Cummins Power Generation distributor for temperature and ambient requirements outside these parameters.
Continuous	

Ratings definitions

Emergency standby power (ESP):	Limited-time running power (LTP):	Prime power (PRP):	Base load (continuous) power (COP):
Applicable for supplying power to varying electrical load for the duration of power interruption of a reliable utility source. Emergency Standby Power (ESP) is in accordance with ISO 8528. Fuel Stop power in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.	Applicable for supplying power to a constant electrical load for limited hours. Limited Time Running Power (LTP) is in accordance with ISO 8528.	Applicable for supplying power to varying electrical load for unlimited hours. Prime Power (PRP) is in accordance with ISO 8528. Ten percent overload capability is available in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.	Applicable for supplying power continuously to a constant electrical load for unlimited hours. Continuous Power (COP) is in accordance with ISO 8528, ISO 3046, AS 2789, DIN 6271 and BS 5514.

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Power Generation

Alternator data

Three Phase Table[1]		105° C	105° C	105° C	105° C	125° C	125° C	125° C	125° C	125° C	150° C	150° C	150° C
Feature Code		B418	B415	B268	B304	B417	B414	B267	B246	B303	B416	B413	B419
Alternator Data Sheet Number		208	208	210	207	207	207	209	206	207	206	207	206
Voltage Ranges		110/190 Thru 120/208 220/380 Thru 240/416	120/208 Thru 139/240 240/416 Thru 277/480	120/208 Thru 139/240 240/416 Thru 277/480	347/600	110/190 Thru 120/208 220/380 Thru 240/416	120/208 Thru 139/240 240/416 Thru 277/480	120/208 Thru 139/240 240/416 Thru 277/480	139/240 277/480	347/600	110/190 Thru 120/208 220/380 Thru 240/416	120/208 Thru 139/240 240/416 Thru 277/480	347/600
Surge kW		155	155	157	154	152	152	156	151	154	151	152	153
Motor Starting kVA (at 90% sustained voltage)	Shunt	422	422	563	360	360	360	516	313	360	313	360	313
	PMG	497	497	663	423	423	423	607	368	423	368	423	368

Full Load Current - Amps at Standby Rating	120/208	127/220	139/240	220/380	240/416	254/440	277/480	347/600
	347	328	301	190	174	164	151	120

Single Phase Table		105° C	105° C	105° C	125° C	125° C	125° C	150° C					
Feature Code		B418	B415	B268	B417	B414	B267	B413					
Alternator Data Sheet Number		208	208	210	207	207	209	207					
Voltage Ranges		120/240[2]	120/240[2]	120/240[3]	120/240[2]	120/240[2]	120/240[3]	120/240[2]					
Surge kW		149	152	153	149	149	152	149					
Motor Starting kVA (at 90% sustained voltage)	Shunt	250	250	330	215	215	305	215					
	PMG	290	290	385	250	250	360	250					

Full Load Current - Amps at Standby Rating	120/240[2]	120/240[3]
	278	417

[1] Single phase power can be taken from a three phase generator set at up to 2/3 set rated 3-phase kW at 1.0 power factor. Also see Note 3 below.
[2] The broad range alternators can supply single phase output up to 2/3 set rated 3-phase kW at 1.0 power factor.
[3] The extended stack (full single phase output) and 4 lead alternators can supply single phase output up to full set rated 3-phase kW at 1.0 power factor.

Formulas for calculating full load currents:

Three phase output

$$\frac{\text{kW} \times 1000}{\text{Voltage} \times 1.73 \times 0.8}$$

Single phase output

$$\frac{\text{kW} \times \text{Single Phase Factor} \times 1000}{\text{Voltage}}$$

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PowerCommand® 1.1 control system

> Specification sheet

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Control system description

The PowerCommand® control system is a microprocessor-based generator set monitoring, metering and control system designed to meet the demands of today's engine driven generator sets. The integration of all control functions into a single control system provides enhanced reliability and performance compared to conventional generator set control systems. These control systems have been designed and tested to meet the harsh environment in which gensets are typically applied.

Features

- 128 x 64 pixels graphic LED backlight LCD.
- Digital voltage regulation. Single phase full wave SCR type regulator compatible with either shunt or PMG systems.
- Digital engine speed governing (where applicable).
- Generator set monitoring and protection.
- Advanced overcurrent protection.
- Modbus® interface for interconnecting to customer equipment.
- 12 and 24 VDC battery operation.
- Warranty and service. Backed by a comprehensive warranty and worldwide distributor service network.
- Certification. Suitable for use on generator sets that are designed, manufactured, tested and certified to relevant UL, NFPA, ISO, IEC Mil Std., CE and CSA standards.

PowerCommand digital generator set control PCC 1302

Description

The PowerCommand generator set control is suitable for use on a wide range of generator sets in non-paralleling applications. The PowerCommand control is compatible with shunt or PMG excitation style. It is suitable for use with reconnectable or non-reconnectable generators, and it can be configured for any frequency, voltage and power connection from 120-600 VAC line-to-line.

Power for this control system is derived from the generator set starting batteries. The control functions over a voltage range from 8 VDC to 30 VDC.

Features

- 12 and 24 VDC battery operation.
- Digital voltage regulation - Single phase full wave SCR type regulator compatible with either shunt or PMG systems. Sensing is single phase.
- Digital engine speed governing (where applicable) - Provides isochronous frequency regulation.
- Full authority engine communications (where applicable) - Provides communication and control with the Engine Control Module (ECM).
- Common harnessing - with higher feature Cummins Power Generation controls allows for easy field upgrades.
- Generator set monitoring - Monitors status of all critical engine and alternator functions.
- Digital genset metering (AC and DC).
- Genset battery monitoring system - to sense and warn against a weak battery condition.
- Engine starting - Includes relay drivers for starter, fuel shut off (FSO), glow plug/spark ignition power and switch B+ applications.
- Generator set protection - Protects engine and alternator.
- Advanced serviceability - using InPower™, a PC-based software service tool.
- Environmental protection - The control system is designed for reliable operation in harsh environments. The main control board is a fully encapsulated module that is protected from the elements.
- Modbus interface - for interconnecting to customer equipment.
- Configurable inputs and outputs - Four discrete inputs and two dry contact relay outputs.
- Warranty and service - Backed by a comprehensive warranty and worldwide distributor service network.
- Certifications - Suitable for use on generator sets that are designed, manufactured, tested and certified to relevant UL, NFPA, ISO, IEC, Mil Std., CE and CSA standards.

Base control functions

HMI capability

Operator adjustments - The HMI includes provisions for many set up and adjustment functions.

Generator set hardware data - Access to the control and software part number, generator set rating in KVA and generator set model number is provided from the HMI or InPower.

Data logs - Includes engine run time, controller on time, number of start attempts.

Fault history - Provides a record of the most recent fault conditions with control hours time stamp. Up to 10 events are stored in the control non-volatile memory.

Alternator data

- Voltage (single or three phase line-to-line and line-to-neutral)
- Current (single or three phase)
- KVA (three phase and total)
- Frequency

Engine data

- Starting battery voltage
- Engine speed
- Engine temperature
- Engine oil pressure
- Partial Full Authority Engine (FAE) data (where applicable)

Service adjustments - The HMI includes provisions for adjustment and calibration of generator set control functions. Adjustments are protected by a password. Functions include:

- Engine speed governor adjustments
- Voltage regulation adjustments
- Cycle cranking
- Configurable fault set up
- Configurable output set up
- Meter calibration
- Units of measurement

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Engine control

SAE-J1939 CAN interface to full authority ECMs (where applicable) - Provides data swapping between genset and engine controller for control, metering and diagnostics.

12 VDC/24 VDC battery operations - PowerCommand will operate either on 12 VDC or 24 VDC batteries.

Isochronous governing (where applicable) - Capable of controlling engine speed within +/-0.25% for any steady state load from no load to full load. Frequency drift will not exceed +/-0.5% for a 33 °C (60 °F) change in ambient temperature over an 8 hour period.

Temperature dependent governing dynamics (with electronic governing) - Modifies the engine governing control parameters as a function of engine temperature. This allows the engine to be more responsive when warm and more stable when operating at lower temperature levels.

Remote start mode - Accepts a ground signal from remote devices to automatically start the generator set and immediately accelerate to rated speed and voltage. The remote start signal will also wake up the control from sleep mode. The control can incorporate a time delay start and stop.

Remote and local emergency stop - The control accepts a ground signal from a local (genset mounted) or remote (facility mounted) emergency stop switch to cause the generator set to immediately shut down. The generator set is prevented from running or cranking with the switch engaged. If in sleep mode, activation of either emergency stop switch will wake up the control.

Sleep mode - The control includes a configurable low current draw state to minimize starting battery current draw when the genset is not operating. The control can also be configured to go into a low current state while in auto for prime applications or applications without a battery charger.

Engine starting - The control system supports automatic engine starting. Primary and backup start disconnects are achieved by one of three methods: magnetic pickup, battery charging alternator feedback or main alternator output frequency. The control also supports configurable glow plug control when applicable.

Cycle cranking - Configurable for the number of starting cycles (1 to 7) and duration of crank and rest periods. Control includes starter protection algorithms to prevent the operator from specifying a starting sequence that might be damaging.

Time delay start and stop (cooldown) - Configurable for time delay of 0-300 seconds prior to starting after receiving a remote start signal and for time delay of 0-600 seconds prior to shut down after signal to stop in normal operation modes. Default for both time delay periods is 0 seconds.

Alternator control

The control includes an integrated line-to-line sensing voltage regulation system that is compatible with shunt or PMG excitation systems. The voltage regulation system is full wave rectified and has an SCR output for good motor starting capability. Major system features include:

Digital output voltage regulation - Capable of regulating output voltage to within +/-1.0% for any loads between no load and full load. Voltage drift will not exceed +/-1.5% for a 40 °C (104 °F) change in temperature in an eight hour period. On engine starting or sudden load acceptance, voltage is controlled to a maximum of 5% overshoot over nominal level.

The automatic voltage regulator feature can be disabled to allow the use of an external voltage regulator.

Torque-matched V/Hz overload control - The voltage roll-off set point and rate of decay (i.e. the slope of the V/Hz curve) is adjustable in the control.

Protective functions

On operation of a protective function the control will indicate a fault by illuminating the appropriate status LED on the HMI, as well as display the fault code and fault description on the LCD. The nature of the fault and time of occurrence are logged in the control. The service manual and InPower service tool provide service keys and procedures based on the service codes provided. Protective functions include:

Battle short mode

When enabled and the *battle short* switch is active, the control will allow some shutdown faults to be bypassed. If a bypassed shutdown fault occurs, the fault code and description will still be annunciated, but the genset will not shutdown. This will be followed by a *fail to shutdown fault*. Emergency stop shutdowns and others that are critical for proper operation are not bypassed. Please refer to the Control Application Guide or Manual for list of these faults.

Configurable alarm and status inputs

The control accepts up to four alarm or status inputs (configurable contact closed to ground or open) to indicate a configurable (customer-specified) condition. The control is programmable for warning, shutdown or status indication and for labeling the input.

Emergency stop

Annunciated whenever either emergency stop signal is received from external switch.

Hydro mechanical fuel system engine protection

Overspeed shutdown - Default setting is 115% of nominal.

Low lube oil pressure warning/shutdown - Level is preset (configurable with InPower) to match the capabilities of the engine used. Control includes time delays to prevent nuisance shutdown signals.

High lube oil temperature warning/shutdown - Level is preset (configurable with InPower) to match the capabilities of the engine used. Control includes time delays to prevent nuisance shutdown signals.

High engine temperature warning/shutdown - Level is preset (configurable with InPower) to match the capabilities of the engine used. Control includes time delays to prevent nuisance shutdown signals.

Low coolant temperature warning – Indicates that engine temperature may not be high enough for a 10 second start or proper load acceptance.

Sensor failure indication - Logic is provided on the base control to detect analog sensor or interconnecting wiring failures.

Full authority electronic engine protection

Engine fault detection is handled inside the engine ECM. Fault information is communicated via the SAE-J1939 data link for annunciation in the HMI.

General engine protection

Low and high battery voltage warning - Indicates status of battery charging system (failure) by continuously monitoring battery voltage.

Weak battery warning - The control system will test the battery each time the generator set is signaled to start and indicate a warning if the battery indicates impending failure.

Fail to start (overcrank) shutdown - The control system will indicate a fault if the generator set fails to start by the completion of the engine crack sequence.

Fail to crank shutdown - Control has signaled starter to crank engine but engine does not rotate.

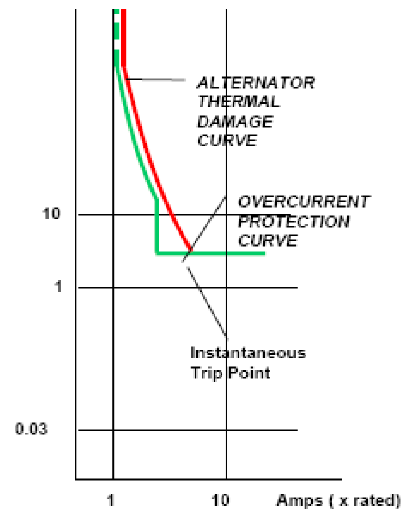
Cranking lockout - The control will not allow the starter to attempt to engage or to crank the engine when the engine is rotating.

Alternator protection

High AC voltage shutdown (59) - Output voltage on any phase exceeds preset values. Time to trip is inversely proportional to amount above threshold. Values adjustable from 105-130% of nominal voltage, with time delay adjustable from 0.1-10 seconds. Default value is 110% for 10 seconds.

Low AC voltage shutdown (27) - Voltage on any phase has dropped below a preset value. Adjustable over a range of 50-95% of reference voltage, time delay 2-20 seconds. Default value is 85% for 10 seconds.

Overcurrent warning/shutdown - Implementation of the thermal damage curve with instantaneous trip level calculated based on current transformer ratio and application power rating.



Under frequency shutdown (81 u) - Generator set output frequency cannot be maintained. Settings are adjustable from 2-10 Hz below nominal governor set point, for a 5-20 second time delay. Default: 6 Hz, 10 seconds.

Over frequency shutdown/warning (81o) - Generator set is operating at a potentially damaging frequency level. Settings are adjustable from 2-10 Hz above nominal governor set point for a 1-20 second time delay. Default: 6 Hz, 10 seconds, enabled.

Loss of sensing voltage shutdown - Shutdown of generator set will occur on loss of voltage sensing inputs to the control.

Field overload shutdown - Uses field voltage to shutdown generator set when a field overload condition occurs.

Field control interface

Input signals to the base control include:

- Remote start
- Local and emergency stop
- Configurable inputs: Control includes (4) input signals from customer discrete devices that are configurable for warning, shutdown or status indication, as well as message displayed

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Output signals from the PowerCommand control include:

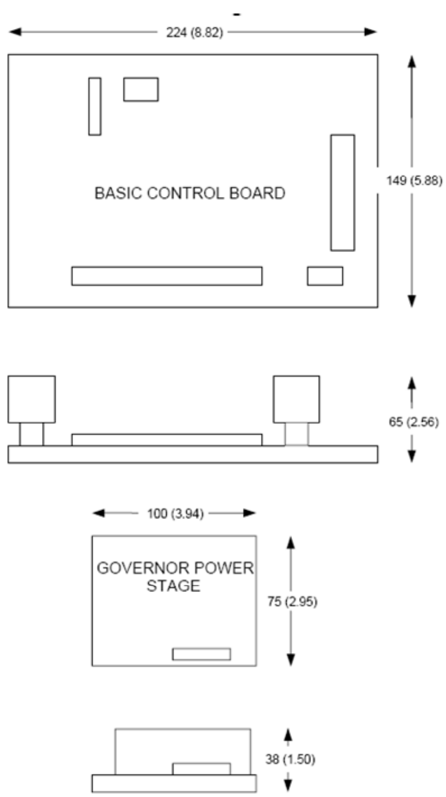
- Configurable relay outputs: Control includes (2) relay output contacts rated at 2 A. These outputs can be configured to activate on any control warning or shutdown fault as well as ready to load, not in auto, common alarm, common warning and common shutdown.
- Ready to load (generator set running) signal: Operates when the generator set has reached 90% of rated speed and voltage and latches until generator set is switched to off or idle mode.

Communications connections include:

- PC tool interface: This RS-485 communication port allows the control to communicate with a personal computer running InPower or PowerCommand for Windows® software.
- Modbus RS-485 port: Allows the control to communicate with external devices such as PLCs using Modbus protocol.

  Note - An RS-232 or USB to RS-485 converter is required for communication between PC and control.
- Networking: This RS-485 communication port allows connection from the control to the other Cummins Power Generation products.

Mechanical drawings



PowerCommand human machine interface HMI211

Description

This control system includes an intuitive operator interface panel that allows for complete genset control as well as system metering, fault annunciation, configuration and diagnostics. The interface includes five generator set status LED lamps with both internationally accepted symbols and English text to comply with customer needs. The interface also includes an LED backlit LCD display with tactile feel soft-switches for easy operation and screen navigation. It is configurable for units of measurement and has adjustable screen contrast and brightness.

The *run/off/auto* switch function is integrated into the interface panel.

All data on the control can be viewed by scrolling through screens with the navigation keys. The control displays the current active fault and a time-ordered history of the five previous faults.

Features

- LED indicating lamps:
  - remote start
  - not in auto
  - shutdown
  - warning
  - auto
  - run
- 128 x 64 pixels graphic LED backlight LCD.
- Four tactile feel membrane switches for LCD defined operation. The functions of these switches are defined dynamically on the LCD.
- Two tactile feel membrane switches dedicated for *off* and *back*.
- Allows for complete genset control setup.
- Certifications: Suitable for use on generator sets that are designed, manufactured, tested and certified to relevant UL, NFPA, ISO, IEC, Mil Std., CE and CSA standards.

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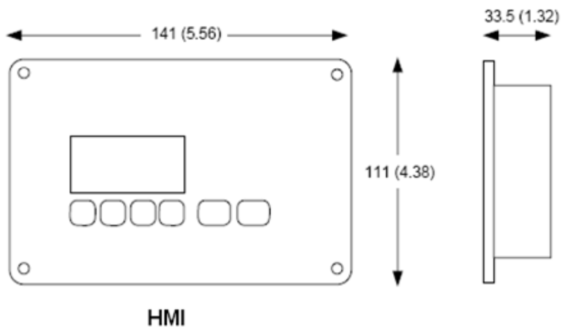
Communications connections

- PC tool interface - This RS-485 communication port allows the HMI to communicate with a personal computer running InPower.
- This RS-485 communication port allows the HMI to communicate with the main control board.

Mechanical drawing



Dimensions: mm (inches)

Software

InPower (beyond 6.0 version) is a PC-based software service tool that is designed to directly communicate to PowerCommand generator sets and transfer switches, to facilitate service and monitoring of these products.

Environment

The control is designed for proper operation without recalibration in ambient temperatures from -40 °C (104 °F) to +70° C (158 °F), and for storage from -55 °C (131 °F) to +80 °C (176 °F). Control will operate with humidity up to 95%, non-condensing.

The HMI is designed for proper operation in ambient temperatures from -20 °C (-4 °F) to +70 °C (158 °F), and for storage from -30 °C (-22 °F) to +80 °C (176 °F).

PC CNet COMPATIBLE

The control board is fully encapsulated to provide superior resistance to dust and moisture. Display panel has a single membrane surface, which is impervious to effects of dust, moisture, oil and exhaust fumes. This panel uses a sealed membrane to provide long reliable service life in harsh environments.

The control system is specifically designed and tested for resistance to RFI/EMI and to resist effects of vibration to provide a long reliable life when mounted on a generator set. The control includes transient voltage surge suppression to provide compliance to referenced standards.

Certifications

PowerCommand meets or exceeds the requirements of the following codes and standards:

- NFPA 110 for level 1 and 2 systems.
- ISO 8528-4: 1993 compliance, controls and switchgear.
- CE marking: The control system is suitable for use on generator sets to be CE-marked.
- EN 50081-1,2 residential/light industrial emissions or industrial emissions.
- EN 50082-1,2 residential/light industrial or industrial susceptibility.
- ISO 7637-2, level 2; DC supply surge voltage test.
- Mil Std 202C, Method 101 and ASTM B117: Salt fog test.
- PowerCommand control systems and generator sets are designed and manufactured in ISO 9001 certified facilities.
- UL 508 recognized or Listed and suitable for use on UL 2200 Listed generator sets.
- CSA C282-M1999 compliance.
- CSA 22.2 No. 14 M91 industrial controls.

Warranty

All components and subsystems are covered by an express limited one year warranty. Other optional and extended factory warranties and local distributor maintenance agreements are available.

See your distributor for more information

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SEISMIC CERTIFICATION
OF
NON-STRUCTURAL
COMPONENTS AND SYSTEMS

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CERTIFICATE OF COMPLIANCE

Cummins Power Generation has qualified the engine generator systems in the mounting configurations and subassemblies listed in Table-1as Certified[1] for seismic performance under the seismic parameters listed in Table-2.

Table-1 Certified Products

Gen Models/ Gen Components	Dimensions				Mounting Configurations				Engine	Alternator	Controller	Radiator
	Max Length (in)	Max Width (in)	Max Height (in)	Max Weigth (lbs)	Fuel Tank Options	External Isolators	Internal Isolators	Enclosure Options	Manufacturer	Manufacturer	Manufacturer	Manufacturer
DSGAA,B,C,D,E	105	41	60	3,209	None	None	Yes	None	Cummins	Cummins	Cummins	Denso Marston
DSGAA,B,C,D,E	138	41	81	4,903	UL142/UL2085	None	Yes	None	Cummins	Cummins	Cummins	Denso Marston
DSGAA,B,C,D,E	158	44	100	5,100	UL142/UL2085	None	Yes	Yes	Cummins	Cummins	Cummins	Denso Marston
DSGAA,B,C,D,E	158	44	78	8,942	None	None	Yes	Yes	Cummins	Cummins	Cummins	Denso Marston

The basis of qualification is by shake table testing and component product line extrapolation/interpolation for active and energized components in accordance with the following International Building Code and Standards:

International Building Code Releases: IBC 2000, IBC 2003, IBC 2006, IBC 2009, IBC 2012
ASCE Standards: ASCE 7-05, ASCE 7-10 and ICC Standard: ICC-AC-156

Models description and options listed in table 1 are included in this certification. A complete list of design documents for certified models and components are detailed in certification report number PAN-CUM-TIG-001-1 as issued by PANACHE ENGINEERING INC. Any change in the components, subassemblies, their materials or configurations without review by PANACHE ENGINEERING INC will invalidate this certificate. Review of the certified components, subassemblies, their materials or configurations is required to issue renewal of this certificate when expired at the expiration date noted below.

This certification includes the engine generator systems, their subassemblies and configurations as limited by the Table-1. The certified systems must be installed and attached to the building structure per the manufacturer supplied seismic installation instructions[2]. This certification is exclusive only to Cummins engine generator systems as listed. Any other component not listed in Table-1 or not manufactured by Cummins is beyond the scope of this certification.

The above referenced equipments are approved for seismic application when properly installed[3] and used per the manufacturer directions.

Table-2 Maximum Seismic Performance Data

Gen Models	Sds (G)	z/h
DSGAA,B,C,D,E	2.48	0
	2.00	1

SEISMIC CERTIFICATION
OF
NON-STRUCTURAL
COMPONENTS AND SYSTEMS

Power Generation

CERTIFICATE OF COMPLIANCE

Notes and Comments:

1. This certification includes the engine generator systems and subassemblies for the model numbers and configurations as limited by the Table-1 and manufacturer equipment drawings listed in the certification report. The seismic certifications are valid for seismic conditions where seismic parameters cannot exceed the maximum listed values in Table-2.

2. This certificate is valid when the certified engine generator units and their sub-components are properly attached to the primary building structure. The structural engineer or design engineer of record is responsible for detailing and/or reviewing the anchorage and/or attachment of the equipment to the supporting structure to meet project seismic and anchorage specifications and applicable building codes. The installer and manufacturers of the anchorage system are responsible for assuring that the mounting requirements and inspections are met per the applicable building codes. Any supporting structures and/ or housekeeping pads must also be seismically designed and approved by the Structure Engineer of Record to withstand the design seismic loads imposed by the equipment per the current IBC.

3. The above referenced equipment is approved for seismic application when properly installed and used as intended. Installation seismic parameters should not exceed the maximum seismic parameters listed in table-2

4. The basis of this certification is Shake table test for the similar equipment and component product line extrapolation and interpolations requirements by the ICC-AC 156 section 4.5. Panache Engineering Inc seismic shake table tested Cummins engine generator systems in accordance with ICC-ES AC-156.

Certification Issues By: **The Panache Engineering Inc.**
Document Control Number: **PAN-CUM-FG10-001**

Issue Date: 05/01/2013
Expiration Date: 05/01/2014

REGISTERED PROFESSIONAL ENGINEER
ALI AHMED HAIDER
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Ahmed Haider, Ph.D., P.E.
Engineering Manager
Panache Engineering Inc

Steven Englund
Codes and Standards
Cummins Power Generation

Exhaust Emission Data Sheet 100DSGAA

60 Hz Diesel Generator Set EPA Emission: Tier 3

Engine Information:

Model:	Cummins Inc. QSB7-G5 NR3	Bore:	4.21 in. (107 mm)
Type:	4 Cycle, In-line, 6 Cylinder Diesel	Stroke:	4.88 in. (124 mm)
Aspiration:	Turbocharged and CAC	Displacement:	408 cu. In .(6.7 liters)
Compression Ratio:	17.2:1		
Emission Control Device:	Turbocharged and CAC		

PERFORMANCE DATA	1/4 Standby	1/2 Standby	3/4 Standby	Full Standby	Full Prime
BHP @ 1800 RPM (60 Hz)	51	87	124	162	147
Fuel Consumption (gal/Hr)	3.4	4.9	7.0	8.7	8.1
Exhaust Gas Flow (CFM)	457	662	888	1106	1022
Exhaust Gas Temperature (°F)	544	689	752	807	788
EXHAUST EMISSION DATA					
HC (Total Unburned Hydrocarbons)	0.71	0.29	0.20	0.12	0.15
NOx (Oxides of Nitrogen as NO2)	2.28	1.85	1.89	1.94	1.92
CO (carbon Monoxide)	2.93	1.80	1.32	0.83	1.03
PM (Particular Matter)	0.16	0.16	0.13	0.10	0.11
SO2 (g/Hp-hr)	0.18	0.17	0.17	0.16	0.17
Smoke (Bosch)	0.41	0.73	0.69	0.65	0.67

All values are Grams per HP-Hour

TEST CONDITIONS

Data is representative of steady-state engine speed (± 25 RPM) at designated genset loads. Pressures, temperatures, and emission rates were stabilized.

Fuel Specification:	ASTM D975 No. 2-D diesel fuel with 0.03-0.05% sulfur content (by weight), and 40-48 cetane number.
Fuel Temperature:	99 ± 9 °F (at fuel pump inlet)
Intake Air Temperature:	77 ± 9 °F
Barometric Pressure:	29.6 ± 1 in. Hg
Humidity:	NOx measurement corrected to 75 grains H2O/lb dry air
Reference Standard:	ISO 8178

The NOx, HC, CO and PM emission data tabulated here are representative of test data taken from a single engine under the test conditions shown above. Data for the other components are estimated. These data are subjected to instrumentation and engine-to-engine variability. Field emission test data are not guaranteed to these levels. Actual field test results may vary due to test site conditions, installation, fuel specification, test procedures and instrumentation. Engine operation with excessive air intake or exhaust restriction beyond published maximum limits or with improper maintenance, may results in elevated emission levels.

2013 EPA Tier 3 Exhaust Emission Compliance Statement 100DSGAA Stationary Emergency
60 Hz Diesel Generator Set

Compliance Information:

The engine used in this generator set complies with Tier 3 emissions limit of U.S. EPA New Source Performance Standards for stationary emergency engines under the provisions of 40 CFR 60 Subpart IIII when tested per ISO8178 D2.

Engine Manufacturer:	Cummins Inc
EPA Certificate Number:	DCEXL0409AAD-008
Effective Date:	05/01/2012
Date Issued:	05/01/2012
EPA Engine Family (Cummins Emissions Family):	DCEXL0409AAD (D313)

Engine Information:

Model:	QSB6.7 / QSB7 / QSB7-G5 NR3	Bore:	4.21 in. (107 mm)
Engine Nameplate HP:	324	Stroke:	4.88 in. (124 mm)
Type:	4 Cycle, In-line, 6 Cylinder Diesel	Displacement:	408 cu. in. (6.7 liters)
Aspiration:	Turbocharged and CAC	Compression Ratio:	17.2:1
Emission Control Device:		Exhaust Stack Diameter:	4 in.

Diesel Fuel Emission Limits

D2 Cycle Exhaust Emissions	Grams per BHP-hr			Grams per kWm-hr		
	NOx + NMHC	CO	PM	NOx + NMHC	CO	PM
Test Results - Diesel Fuel (300-4000 ppm Sulfur)	3.0	0.7	0.08	4.0	1.0	0.11
EPA Emissions Limit	3.0	2.6	0.15	4.0	3.5	0.20
Test Results - CARB Diesel Fuel (<15 ppm Sulfur)	2.7	0.7	0.07	3.7	1.0	0.10
CARB Emissions Limit	3.0	2.6	0.15	4.0	3.5	0.20

The CARB emission values are based on CARB approved calculations for converting EPA (500 ppm) fuel to CARB (15 ppm) fuel.
Test Methods: EPA/CARB Nonroad emissions recorded per 40CFR89 (ref. ISO8178-1) and weighted at load points prescribed in Subpart E, Appendix A for Constant Speed Engines (ref. ISO8178-4, D2)

Diesel Fuel Specifications: Cetane Number: 40-48. Reference: ASTM D975 No. 2-D.
Reference Conditions: Air Inlet Temperature: 25°C (77°F), Fuel Inlet Temperature: 40°C (104°F). Barometric Pressure: 100 kPa (29.53 in Hg), Humidity: 10.7 g/kg (75 grains H2O/lb) of dry air; required for NOx correction, Restrictions: Intake Restriction set to a maximum allowable limit for clean filter; Exhaust Back Pressure set to a maximum allowable limit.

Tests conducted using alternate test methods, instrumentation, fuel or reference conditions can yield different results.
Engine operation with excessive air intake or exhaust restriction beyond published maximum limits, or with improper maintenance, may result in elevated emission levels.

Sound Data

100DSGAA 60Hz

Sound Pressure Level @ 7 meters, dB(A)

See Notes 1-8 listed below

Configuration		Measurement Location Number								Average
		1	2	3	4	5	6	7	8	
Standard-Unhoused (Note 3)	Infinite Exhaust	80.7	84.6	84.6	88.9	87.4	88.5	85.4	85.7	86.3
F182 - Enclosure-Steel, Weather Protective,with ExhSys	Mounted Muffler	82.0	87.6	87.9	89.2	86.4	88.4	86.2	85.6	87.1
F216- Enclosure-Aluminum,Weather Protective,w/Exh System	Mounted Muffler	82.0	87.6	87.9	89.2	86.4	88.4	86.2	85.6	87.1
F173 - Enclosure-Steel,Sound Att,Level 2,w/Exhaust System	Mounted Muffler	71.0	73.6	70.9	71.8	71.4	72.7	70.4	72.2	71.9
F217- Enclosure-Aluminum,Sound Att,Level 2,w/ExhSystem	Mounted Muffler	74.1	75.2	72.4	72.8	70.0	75.4	71.4	73.5	73.2
F232- Enclosure-Steel,Sound Att,Level 3,w/Exhaust System	Mounted Muffler	67.7	68.3	67.8	70.4	68.2	70.3	67.9	69.7	68.9
F233- Enclosure-Aluminum, Sound Att,Level 3,w/ExhSystem	Mounted Muffler	70.9	69.9	69.3	71.4	66.7	73.0	68.9	71.0	70.2

Sound Power Level, dB(A)

See Notes 2-6, 9, 10 listed below

Configuration		Octave Band Center Frequency (Hz)								Overall Sound Power Level
		63	125	250	500	1000	2000	4000	8000	
Standard-Unhoused (Note 3)	Infinite Exhaust	76.8	96.1	107.8	105.7	109.6	108.2	103.3	99.6	114.6
F182 - Enclosure-Steel, Weather Protective,with ExhSys	Mounted Muffler	88.4	99.6	106.7	106.5	111.0	109.0	105.0	102.6	116.0
F216- Enclosure-Aluminum,Weather Protective,w/Exh System	Mounted Muffler	88.4	99.6	106.7	106.5	111.0	109.0	105.0	102.6	116.0
F173 - Enclosure-Steel,Sound Att,Level 2,w/Exhaust System	Mounted Muffler	80.6	91.7	95.2	93.9	95.3	94.9	92.8	89.1	102.2
F217- Enclosure-Aluminum,Sound Att,Level 2,w/ExhSystem	Mounted Muffler	77.2	93.5	97.9	94.4	97.0	96.6	94.4	93.1	104.0
F232- Enclosure-Steel,Sound Att,Level 3,w/Exhaust System	Mounted Muffler	79.0	90.5	92.6	91.0	92.3	91.0	89.6	85.4	99.3
F233- Enclosure-Aluminum, Sound Att,Level 3,w/ExhSystem	Mounted Muffler	75.6	92.3	95.3	91.5	94.0	92.7	91.2	89.4	101.1

Exhaust Sound Pressure Level @ 1 meter, dB(A)

Open Exhaust (No Muffler Rated Load)	Octave Band Center Frequency (Hz)								Sound Pressure Level
	63	125	250	500	1000	2000	4000	8000	
	89.2	98.9	107.0	108.8	113.0	117.5	117.4	116.0	123.0

Note:

1. Position 1 faces the engine front. The positions proceed around the generator set in a counter-clockwise direction in 45° increments. All positions are at 7m (23 ft) from the surface of the generator set and 1.2m (48”) from floor level.
2. Sound levels are subject to instrumentation, measurement, installation and manufacturing variability.
3. Sound data with remote-cooled generator sets are based on rated loads without cooling fan noise.
4. Sound levels for aluminum enclosures are approximately 2 dB(A)s higher than listed sound levels for steel enclosures.
5. Sound data for generator set with infinite exhaust do not include exhaust noise.
6. Data is based on full rated load with standard radiator-cooling fan package
7. Sound Pressure Levels are measured per ANSI S1.13 and ANSI S12.18, as applicable.
8. Reference sound pressure is 20 μPa.
9. Sound Power Levels per ISO 3744 and ISO 8528-10, as applicable.
10. Reference power = 1 pw (10^{-12} W)
11. Exhaust Sound Pressure Levels are per ISO 6798, as applicable.

PROTOTYPE TEST SUPPORT (PTS)
60 HZ TEST SUMMARY

GENERATOR SET MODELS		REPRESENTATIVE PROTOTYPE	
100 DSGAA	125 DSGAB	Model:	200 DSGAE
150 DSGAC	175 DSGAD	Alternator:	UCDI274J
200 DSGAE		Engine:	QSB7-G5 NR3

The following summarizes prototype testing conducted on the designated representative prototype of the specified models. This testing is conducted to verify the complete generator set electrical and mechanical design integrity. Prototype testing is conducted only on generator sets not sold as new equipment.

Maximum Surge Power: **213 kW**

The generator set was evaluated to determine the stated maximum surge power.

Torsional Analysis and Testing:

The generator set was tested to verify that the design is not subjected to harmful torsional stresses. A spectrum analysis of the transducer output was conducted over the speed range of 1350 to 1950 RPM.

Cooling System: 50 °C Ambient
0.50 in. H2O restriction

The cooling system was tested to determine ambient temperature and static restriction capabilities. The test was performed at full rated load in elevated ambient temperature under stated static restriction conditions.

Durability:

The generator set was subjected to a minimum 250 hour endurance test operating at variable load up to the standby rating based upon MIL-STD-705 to verify structural soundness and durability of the design.

Electrical and Mechanical Strength:

The generator set was tested to several single phase and three phase faults to verify that the generator can safely withstand the forces associated with short circuit conditions. The generator set was capable of producing full rated output at the conclusion of the testing.

Steady State Performance:

The generator set was tested to verify steady state operating performance was within the specified maximum limits.

Voltage Regulation:	±0.5%
Random Voltage Variation:	±0.5%
Frequency Regulation:	Isochronous
Random Frequency Variation:	±0.25%

Transient Performance:

The generator set was tested with the alternator listed to verify single step loading capability as required by NFPA 110. Voltage and frequency response on load addition or rejection were evaluated. The following results were recorded:

Full Load Acceptance:		
Voltage Dip:	26.1	%
Recovery Time:	2.9	Second
Frequency Dip:	19.5	%
Recovery Time:	3.9	Second
Full Load Rejection:		
Voltage Rise:	22.5	%
Recovery Time:	1.5	Second
Frequency Rise:	9.1	%
Recovery Time:	1.9	Second

Harmonic Analysis:
(per MIL-STD-705B, Method 601.4)

	Line to Line		Line to Neutral	
Harmonic	No Load	Full Load	No Load	Full Load
3	0.0	0.2	0.0	0.2
5	1.0	0.8	1.0	0.8
7	0.6	1.9	0.6	1.8
9	0.1	0.0	0.1	0.0
11	0.3	0.6	0.3	0.6
13	0.2	0.5	0.2	0.5
15	0.0	0.0	0.0	0.0

Cummins Power Generation

ALTERNATOR DATA SHEET

Frame Size: UC3F

CHARACTERISTICS

WEIGHTS:	Wound Stator Assembly	337 lb	153 kg
	Rotor Assembly	419 lb	190 kg
	Complete Alternator	1175 lb	533 kg

EXCITATION CURRENT: Full Load 2 Amps — No Load 0.5 Amps

INSULATION SYSTEM: Class H Throughout — **MAXIMUM SPEED:** 2250 rpm

1 Ø RATINGS (1.0 power factor)		60 Hz			50 Hz
(Based on specified temperature rise at 40°C ambient temperature)		Double Delta	4 Lead		Double Delta
		120/240	120/240		110-120 / 220-240
125°C Rise Ratings	kW/kVA	109 / 109	125 / 125		96 /96
105°C Rise Ratings	kW/kVA	98 / 98	113 / 113		87 /87

3 Ø RATINGS (0.8 power factor)		Upper Broad Range		LBR*	347/600	Broad Range		
(Based on specified temperature rise at 40°C ambient temperature)		120/208 240/416	139/240 277/480	190-208 380-416	347/600	110/190 220/380	120/208 240/415	127/220 254/440
150°C Rise Ratings	kW	150	170	148	170	136	136	128
	kVA	188	213	185	213	170	170	160
125°C Rise Ratings	kW	145	165	144	165	128	128	120
	kVA	181	206	180	206	160	160	150
105°C Rise Ratings	kW	130	150	128	150	116	116	108
	kVA	163	188	160	188	145	145	135
80°C Rise Ratings	kW	112	128	110	128	101	101	94
	kVA	140	160	138	160	126	126	118

3 Ø REACTANCES (per unit, ±10%) (Based on full load at 105°C Rise Rating)							
Synchronous	2.21	1.92	1.68	1.97	2.04	1.71	1.42
Transient	0.18	0.15	0.14	0.16	0.17	0.15	0.12
Subtransient	0.13	0.11	0.09	0.10	0.12	0.10	0.09
Negative Sequence	0.14	0.12	0.10	0.11	0.13	0.11	0.09
Zero Sequence	0.08	0.07	0.07	0.07	0.08	0.07	0.06

3 Ø MOTOR STARTING					
Maximum kVA	(Shunt)	516	516	516	367
(90% Sustained Voltage)	(PMG)	607	607	607	458

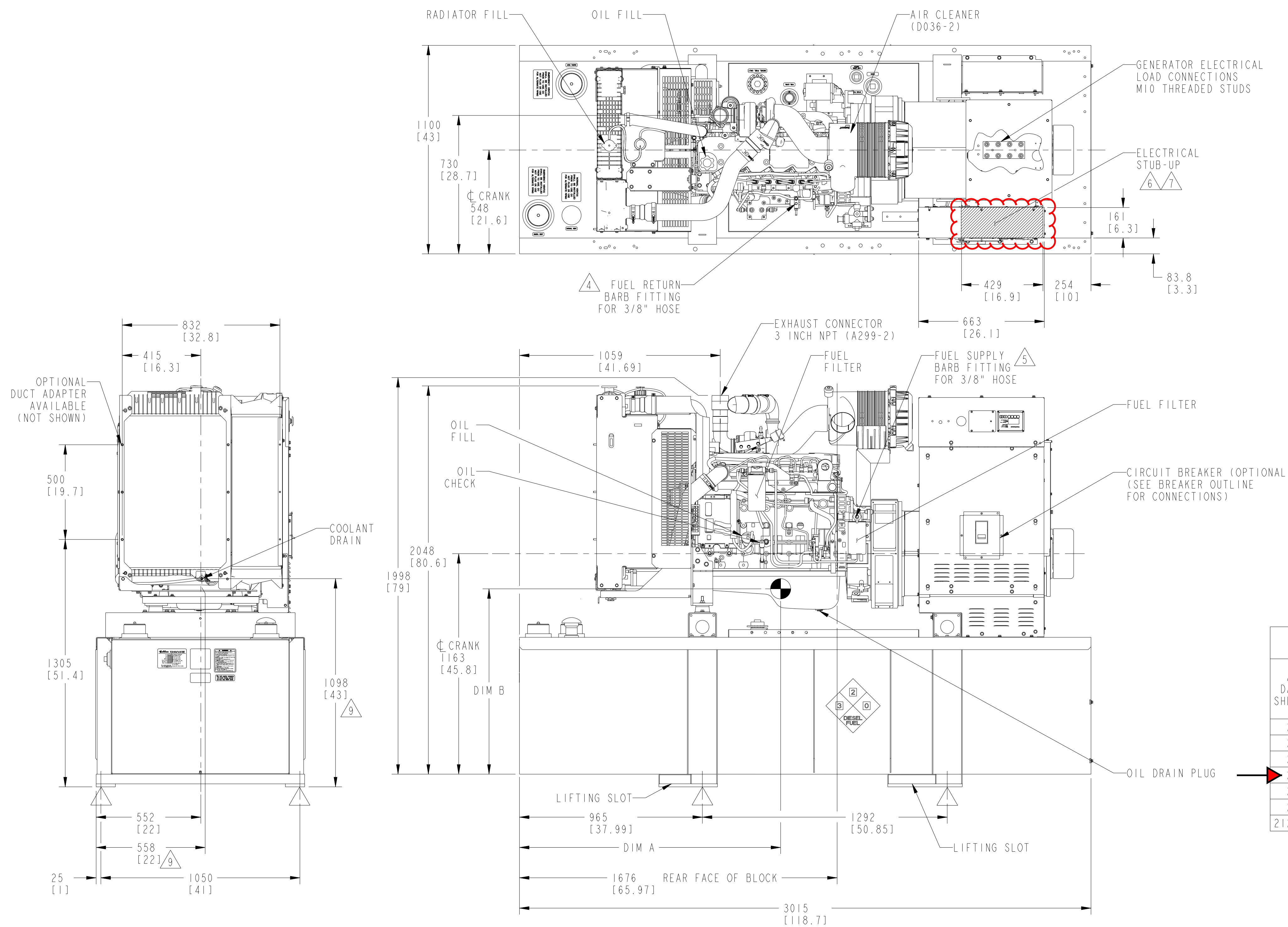
TIME CONSTANTS (Sec)				
Transient	0.035	0.035	0.035	0.035
Subtransient	0.011	0.011	0.011	0.011
Open circuit	0.900	0.900	0.900	0.900
DC	0.009	0.009	0.009	0.009

WINDINGS (@ 20°C)					
Stator Resistance	(Line to Line, Ohms)	0.0480	0.0400	0.0700	0.0480
Rotor Resistance	(Ohms)	0.0480	0.0400	0.0700	0.0480
Number of Leads		12	12	6	12

* Lower broad range 110/190 thru 120/208, 220/380 thru 240/416.

Pro/ENGINEER

REL NO	LTR	NO	REVISION	DWN	CKD	APVD	DATE
ECO-117066	B	1	DRAWING HAS BEEN PICTORIALLY UPDATED	NK	CS	C.STENBERG	31OCT11
		2	SECURITY CLASSIFICATION IN MATRIX WAS PROPRIETARY	NK	CS	C.STENBERG	31OCT11
		3	SEE SHEET 4	NK	CS	C.STENBERG	31OCT11
		4	SEE SHEET 4	NK	CS	C.STENBERG	31OCT11
		5	SEE SHEET 5	NK	CS	C.STENBERG	31OCT11
		6	SEE SHEET 5	NK	CS	C.STENBERG	31OCT11



NOTES:

1. DIMENSIONS SHOWN IN [ ] ARE INCHES.
2. Ø25.4 [1.0] HOLES MARKED BY △ ARE FOR SUBBASE FUEL TANK ATTACHMENT OR SECURING TO MOUNTING SURFACE, OR SUPPLEMENTAL VIBRATION ISOLATORS.
3. GENSET SUPPLIED WITH FLEXIBLE FUEL LINES THAT CAN BE CONNECTED TO ENGINE INTERFACE POINTS.
4. FUEL RETURN LINE: 1067 [42] LONG WITH 1/4-18 NPTF DRYSEAL MALE.
5. FUEL SUPPLY LINE: 815 [32] LONG WITH 1/4-18 NPTF DRYSEAL MALE.
6. REFER TO CIRCUIT BREAKER OUTLINE DRAWING FOR ELECTRICAL STUB-UP AREA FOR SPECIFIC BREAKERS.
7. REFER TO SUBBASE FUEL TANK OUTLINE DRAWING FOR ELECTRICAL STUB-UP AREA AVAILABLE WITH FUEL TANKS.
8. TABULATED WEIGHT AND CG IS FOR GENSET WITH NO OPTIONS.
9. THE DIMENSIONS INDICATED, LOCATE THE COOLANT DRAIN.
10. LOW FUEL LEVEL SWITCH PROVIDES AN ELECTRICAL CONTACT CLOSURE WHEN APPROXIMATELY 21 GALLONS OF USABLE FUEL REMAIN IN THE TANK.
11. FUEL IN RUPTURE BASIN SWITCH PROVIDES AN ELECTRICAL CONTACT CLOSURE WHEN APPROXIMATELY 1.4 GALLONS OF FLUID ARE PRESENT IN THE RUPTURE BASIN.

TABULATION

ALT DATA SHEET #	DIM "A"	DIM "B"	GEN SET WET WEIGHT & FUEL TANK DRY WEIGHT kg (lb)
206	1394 [54.88]	969 [38.13]	1715 (3779)
207	1414 [55.67]	974 [38.33]	1761 (3882)
208	1433 [56.42]	978 [38.52]	1806 (3980)
209	1453 [57.20]	982 [38.67]	1844 (4064)
210	1476 [58.11]	987 [38.87]	1896 (4178)
211	1498 [58.98]	992 [39.04]	1942 (4280)
212/213	1526 [60.08]	1000 [39.35]	2037 (4489)

C259 DUAL WALL SUBSET FUEL TANK (24 HOUR)

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

DIM: X ± 1; .X ± 0.8; .XX ± 0.38

HOLE: 0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13

ANG TOL: ± 1.0° SCALE: 3/32

SIM TO A029W251

DO NOT SCALE PRINT

- CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP

DWN P.THEVAR
CKD S.MOHARE
APVD C.STENBERG
DATE 09JUN11

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994

FIRST USED ON DSGAA,AB,AC

SITE CODE PGF

CUMMINS POWER GENERATION

OUTLINE,GENSET

DWG SIZE D | A040K622 | SHEET 1 OF 6 | DWG REV B

Pro/ENGINEER

REL NO	LTR	NO	REVISION	DWN	CHD	APVD	DATE
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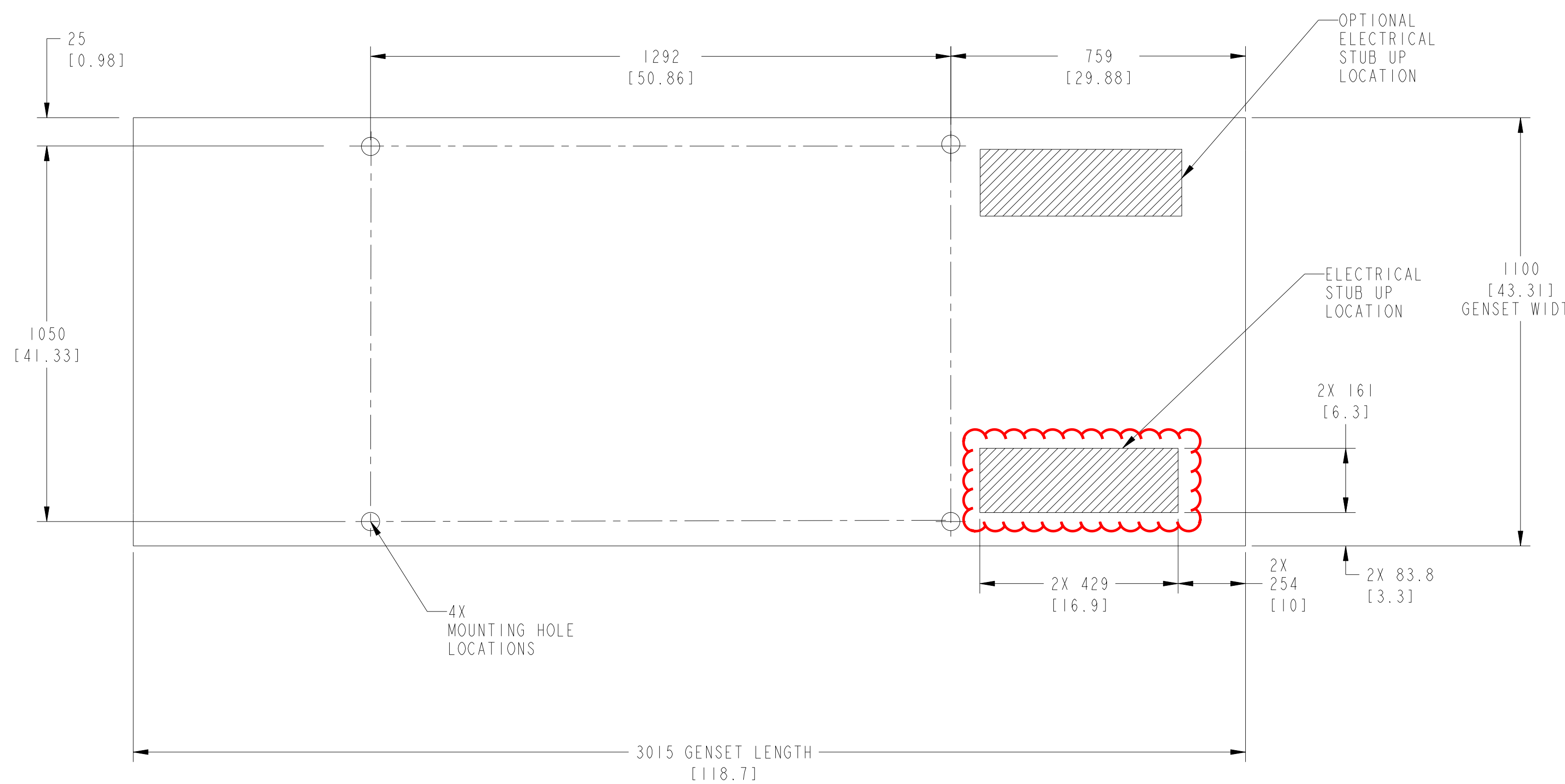

MOUNTING PAD LAYOUT
C259 DUAL WALL SUBSET
FUEL TANK (24 HOUR)

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

DIM: X ± 1; .X ± 0.8; .XX ± 0.38

HOLE: 0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13

ANG TOL: ± 1.0° SCALE: 1/8

SIM TO A029W251

DO NOT SCALE PRINT

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DWN P.THEVAR
CKD S.MOHARE
APVD C.STENBERG
DATE 09JUN11

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994

FIRST USED ON DSGAA,AB,AC

SITE CODE PGF

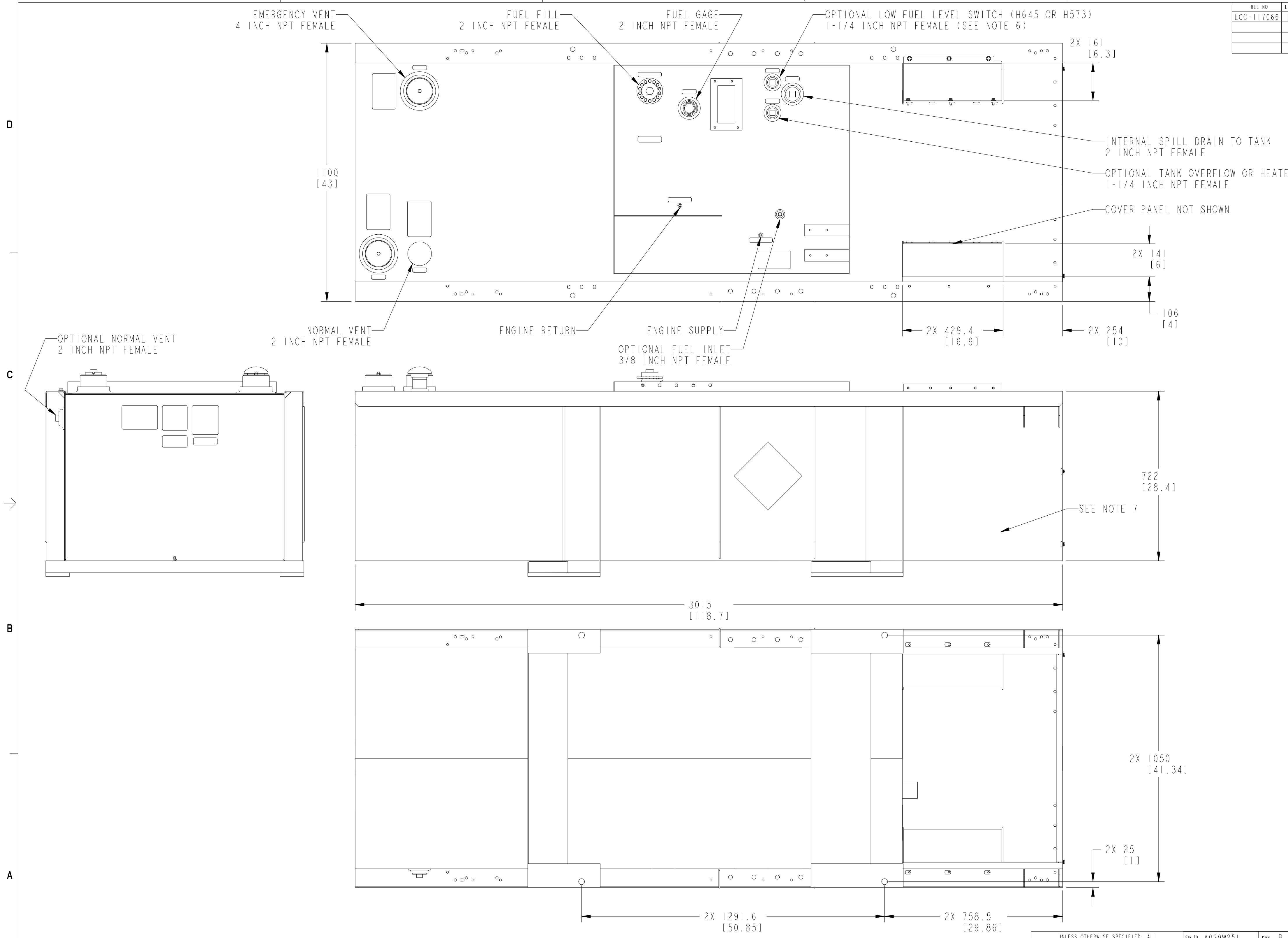
CUMMINS POWER GENERATION

OUTLINE,GENSET

DWG SIZE D | A040K622 | SHEET 2 OF 6 | DWG REV B

Pro/ENGINEER

REL NO	LTR	NO	REVISION	DWN	CKD	APVD	DATE
ECO-117066	B	-	---	NK	CS	C.STENBERG	31OCT11

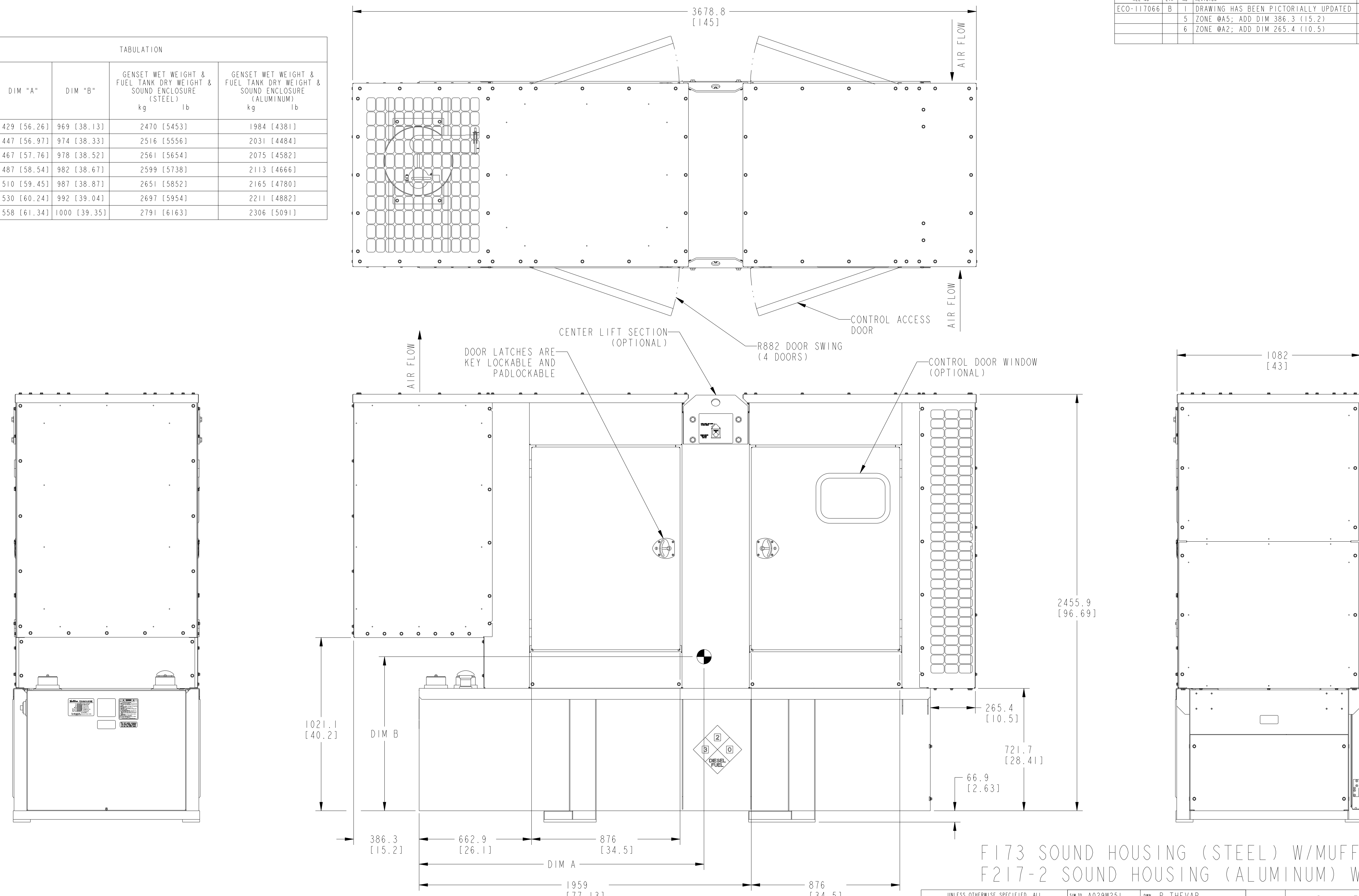


UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS	SIM TO A029W251	DWN P.THEVAR	CUMMINS POWER GENERATION
DIM X ±1, .X ± 0.8, .XX± 0.38 / HOLE 0.00- 4.99 +0.15/-0.08, 5.00- 9.99 +0.20/-0.10, 10.00-17.49 +0.25/-0.13, 17.50-24.99 +0.30/-0.13	DO NOT SCALE PRINT	CKD S.MOHARE	OUTLINE,GENSET
		APVD C.STENBERG	SITE CODE PGF
		DATE 09JUN11	
ANG TOL: ± 1.0° SCALE: 1/8	- CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP	FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994 / FIRST USED ON DSGAA,AB,AC	DWG SIZE D A040K622 SHEET 3 OF 6 DWG REV B

Pro/ENGINEER

TABULATION				
ALT DATA SHEET#	DIM "A"	DIM "B"	GENSET WET WEIGHT & FUEL TANK DRY WEIGHT & SOUND ENCLOSURE (STEEL) kg lb	GENSET WET WEIGHT & FUEL TANK DRY WEIGHT & SOUND ENCLOSURE (ALUMINUM) kg lb
206	1429 [56.26]	969 [38.13]	2470 [5453]	1984 [4381]
207	1447 [56.97]	974 [38.33]	2516 [5556]	2031 [4484]
208	1467 [57.76]	978 [38.52]	2561 [5654]	2075 [4582]
209	1487 [58.54]	982 [38.67]	2599 [5738]	2113 [4666]
210	1510 [59.45]	987 [38.87]	2651 [5852]	2165 [4780]
211	1530 [60.24]	992 [39.04]	2697 [5954]	2211 [4882]
212/213	1558 [61.34]	1000 [39.35]	2791 [6163]	2306 [5091]

REL NO	LTR	NO	REVISION	DWN	CKD	APVD	DATE
ECO-117066	B	1	DRAWING HAS BEEN PICTORIALLY UPDATED	NK	CS	C.STENBERG	31OCT11
		5	ZONE @A5; ADD DIM 386.3 (15.2)	NK	CS	C.STENBERG	31OCT11
		6	ZONE @A2; ADD DIM 265.4 (10.5)	NK	CS	C.STENBERG	31OCT11



F173 SOUND HOUSING (STEEL) W/MUFFLER
F217-2 SOUND HOUSING (ALUMINUM) W/MUFFLER

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

DIM: X ± 1; .X ± 0.8; .XX± 0.38

HOLE: 0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13

ANG TOL: ± 1.0° SCALE: 1/8

SIM TO A029W251

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DWN P.THEVAR
CKD S.MOHARE
APVD C.STENBERG
DATE 09JUN11

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994

FIRST USED ON DSGAA,AB,AC

SITE CODE PGF

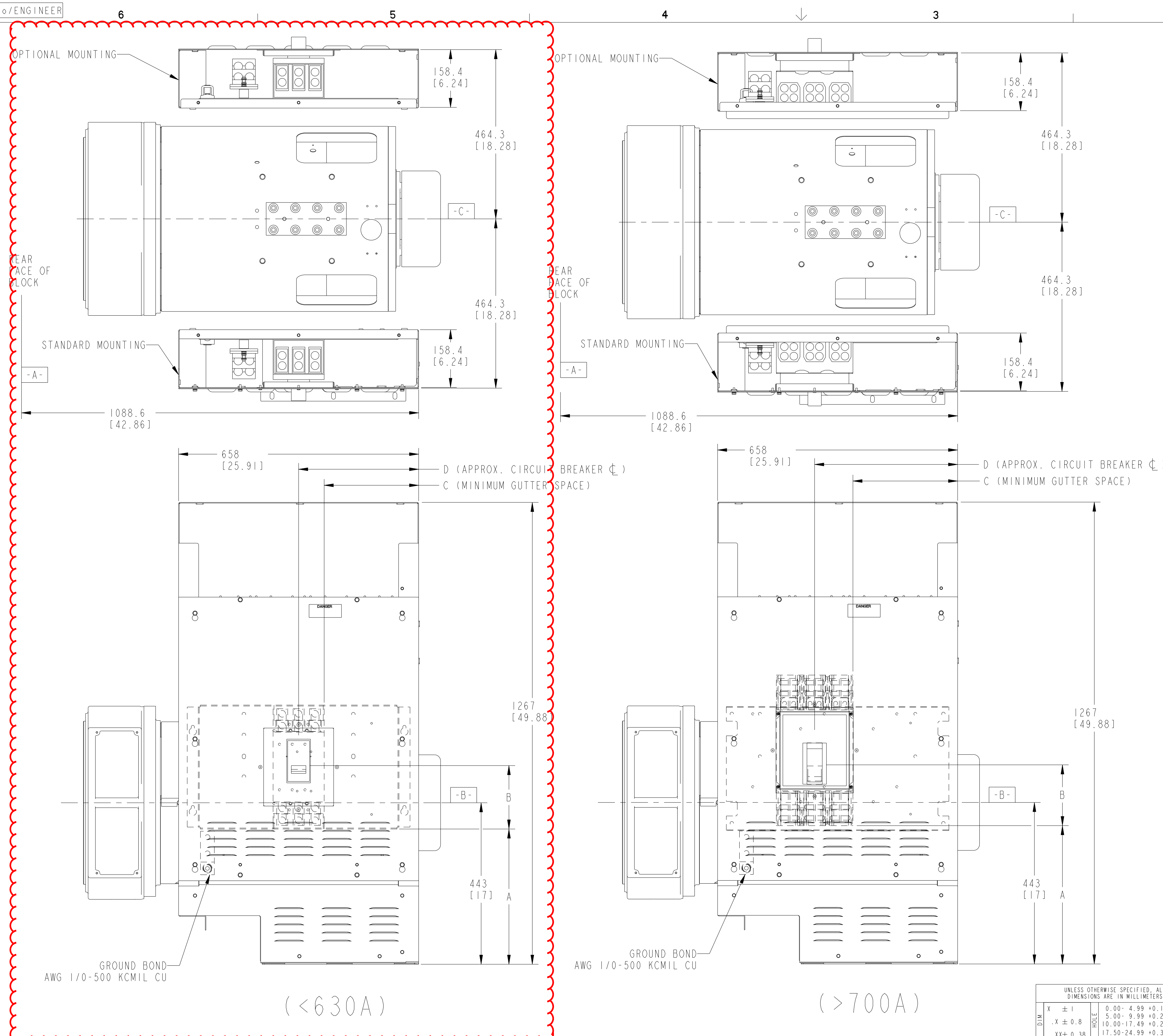
CUMMINS POWER GENERATION

OUTLINE,GENSET

DWG SIZE D A040K622 SHEET 5 OF 6 DWG REV B

Pro/ENGINEER

REL NO	LTR	NO	REVISION	DWN	CHD	APVD	DATE
ECO-117272	A	1	PRODUCTION RELEASE	PT	SM	C.STENBERG	13JUN11



NOTES:

1. DIMENSIONS SHOWN IN [ ] ARE IN INCHES.
2. "NS" SHUNT TRIP HAS NO INTERNAL CONTACTS. IT MUST BE USED IN CONJUNCTION WITH AUXILIARY CONTACTS TO ACCEPT CONTINUOUS APPLIED VOLTAGE. IT CAN OPERATE AT 75% OF NOMINAL VOLTAGE.
3. THE SHUNT TRIP CAN OPERATE AT 70% TO 100% OF NORMAL VOLTAGE AND WILL ACCEPT MOMENTARY OR CONTINUOUS APPLIED VOLTAGE.
4. 800 AMP BREAKER: A LUG ACCEPTING (2) 3/0-600 kcmil CONDUCTORS IS AVAILABLE THRU ACCESSORIES. PGA PART NUMBER 0332-4278.
5. 1200 AMP BREAKER: A LUG ACCEPTING (3) 3/0-600 kcmil CONDUCTORS IS AVAILABLE THRU ACCESSORIES. PGA PART NUMBER 0332-4279.

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

DIM		HOLE	
	X ± 1		0.00- 4.99 +0.15/-0.08
	.X ± 0.8		5.00- 9.99 +0.20/-0.10
	.XX± 0.38		10.00-17.49 +0.25/-0.13
			17.50-24.99 +0.30/-0.13

ANG TOL: ± 1.0° SCALE: 3/16

SIM TO 0500_4668

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DWN P.THEVAR
CKD S.MOHARE
APVD C.STENBERG
DATE 13JUN11

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994

FIRST USED ON DSGAA,AB,AC,AD

SITE CODE PGF

CUMMINS POWER GENERATION

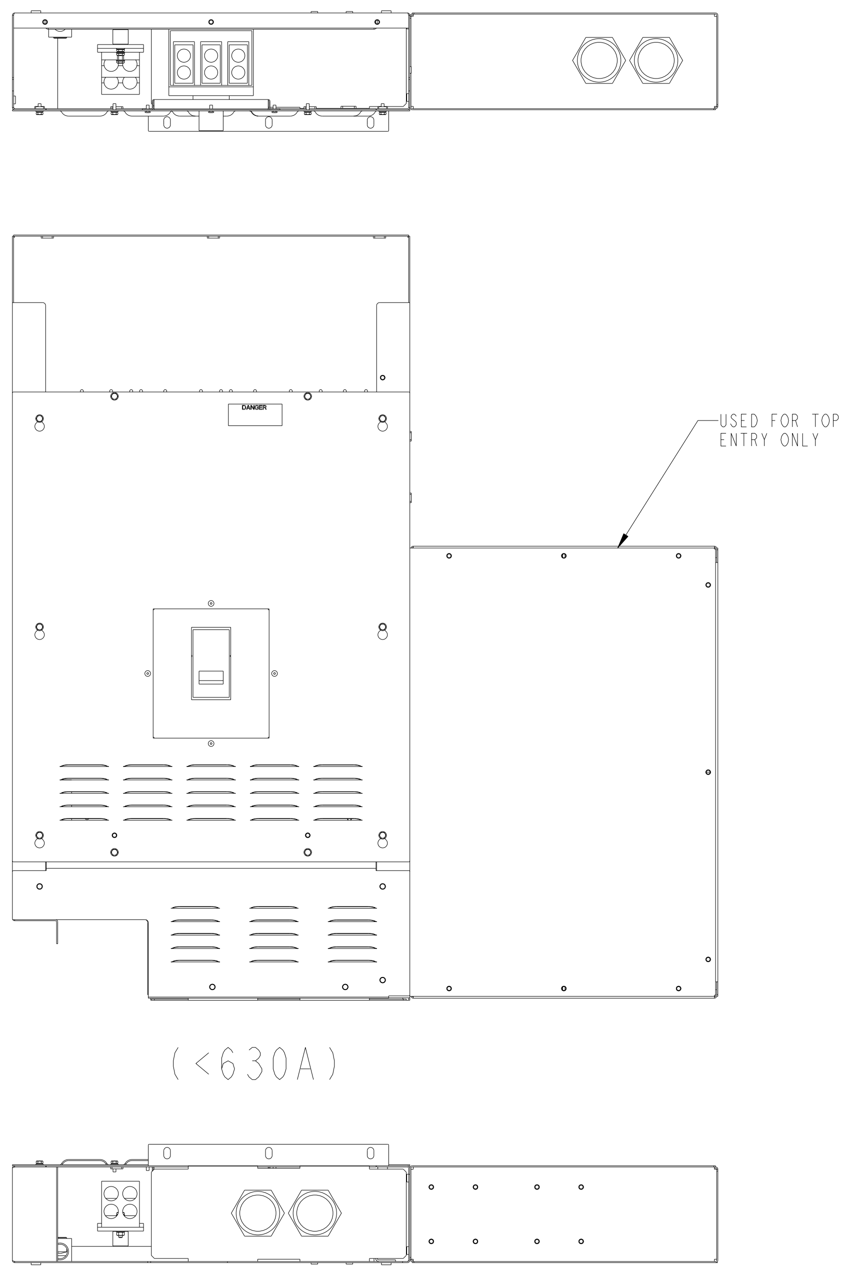
OUTLINE,CIRCUIT BREAKER

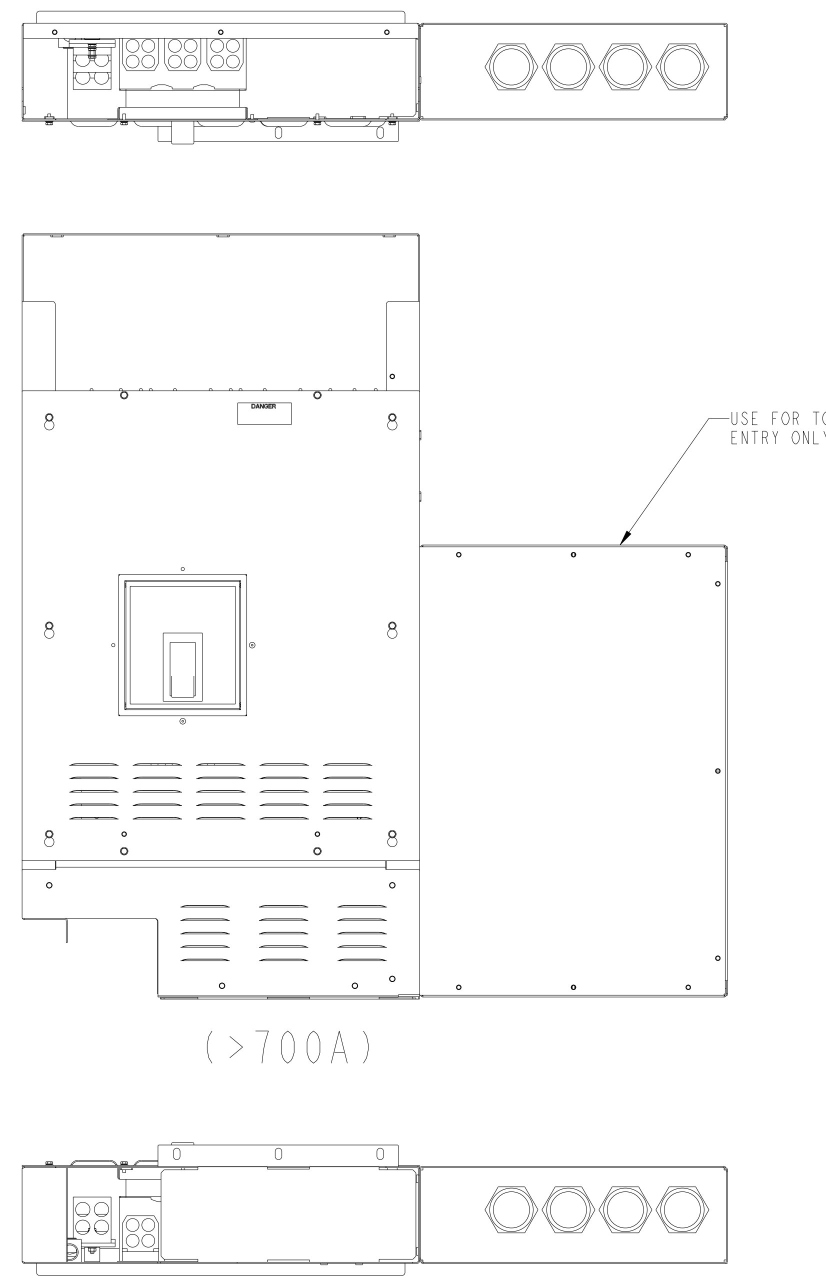
DWG SIZE D A040K670 SHEET 1 OF 3 DWG REV A

Drawing Name: A040K671 Revision: A
Part Name: A040K670 Revision: A
Sheet 1 of 4

Pro/ENGINEER

REL NO	LTR	NO	REVISION	DWN	CKD	APVD	DATE
ECO-117272	A	1	PRODUCTION_RELEASE	PT	SM	C.STENBERG	13JUN11





BREAKER TRIP SETTING	WIRE (COPPER)		CONDUIT	
	QTY	SIZE	QTY	SIZE
600 A	2	350 KCMIL	2	2.5"
400 A	2	3/0	2	2.0"
250 A	1	250 KCMIL	1	2.5"
100 A	1	2	1	1.25"

TYPICAL CONDUIT AND WIRE SIZE BASED ON NEC TABLE 310.16 AT 40C

BREAKER TRIP SETTING	WIRE (COPPER)		CONDUIT	
	QTY	SIZE	QTY	SIZE
1200 A	4	350 KCMIL	4	2.5"
1000 A	3	400 KCMIL	3	3.0"
800 A	3	300 KCMIL	3	2.5"

TYPICAL CONDUIT AND WIRE SIZE BASED ON NEC TABLE 310.16 AT 40C

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

DIM: X ± 1; .X ± 0.8; .XX± 0.38

HOLE: 0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13

ANG TOL: ± 1.0° SCALE: 3/16

SIM TO 0500_4668

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FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994

FIRST USED ON DSGAA,AB,AC,AD

SITE CODE PGF

CUMMINS POWER GENERATION

OUTLINE,CIRCUIT BREAKER

DWG SIZE D | A040K670 | SHEET 2 OF 3 | DWG REV A

Pro/ENGINEER

UL/IEC LUGS								ACCESSORY SPECIFICATIONS			
LUG	FRAME	MAX AMPS	WIRE RANGE COPPER	DIM A	DIM B	DIM C	DIM D	ACCESSORY DESCRIPTION	CONTACT RATING	INRUSH CURRENT	CONNECTION TYPE
	NSJ 600/690V	400A 3 OR 4 POLE	#2-600 KCMIL	381 [15]	176 [6.9]	257 [10.1]	327 [12.9]	12 VDC SHUNT TRIP	-	10A 2	COMPRESSION TERMINALS #20-16 AWG OR SMALLER TORQUE: 10 LB-IN
		600A 3-POLE 630A 4-POLE	2/0-350 KCMIL					1 EA. FORM C 1 AUX CONTACT + 1 TRIP ALARM	6A AT 690 VAC 2.5A AT 48 VDC, 0.3A AT 250 VDC	-	
	QDL 240V	250A 2-POLE	#4-300 KCMIL	466 [18.3]	72 [2.8]	295 [11.6]	314 [12.4]	NONE AVAILABLE			
	QDL 240V	250A 3-POLE	#4-300 KCMIL	466 [18.3]	72 [2.8]	255 [10]	312 [12.3]	NONE AVAILABLE			
	Q4 240V	400A	#1-600 KCMIL	401 [15.8]	123 [4.8]	251 [9.9]	327 [12.9]	NONE AVAILABLE			
4	P	800A 3-POLE	3/0-500 KCMIL	398 [15.7]	127 [5]	285 [11.2]	392 [15.4]	12 VDC SHUNT TRIP	-	200VA 3	COMPRESSION TERMINALS FOR 1 OR 2 #1-18-16 AWG. TORQUE: 10 LB-IN
								1 EA. FORM C 4 AUX CONTACTS + 1 TRIP ALARM	6A AT 240 VAC, 6A AT 480 VAC, 3A AT 600 VAC, 2.5A AT 48 VDC, 0.8A AT 125 VDC, 0.3A AT 250 VDC	-	
5	P	1200A 3-POLE	3/0-500 KCMIL	389 [15.3]	170 [6.7]	285 [11.2]	392 [15.4]	12 VDC SHUNT TRIP	-	200VA 3	COMPRESSION TERMINALS FOR 1 OR 2 #1-18-16 AWG. TORQUE: 10 LB-IN
								1 EA. FORM C 4 AUX CONTACTS + 1 TRIP ALARM	6A AT 240 VAC, 6A AT 480 VAC, 3A AT 600 VAC, 2.5A AT 48 VDC, 0.8A AT 125 VDC, 0.3A AT 250 VDC	-	
	H	15-150	(1) #14-3/0 AWG	464 [18.3]	93.8 [3.69]	275 [10.8]	327 [12.9]	12 VDC SHUNT TRIP	COIL BURDEN < 5W	10A	COMPRESSION TERMINALS #14-#10 AWG, 50 LB-IN #8-3/0, 120 LB-IN
	J	175	(1) 1/0-4/0 AWG	454 [17.9]	108 [4.25]	275 [10.8]	327 [12.9]	1 EA FORM C 1 AUX CONTACT + 1 TRIP ALARM	MIN LOAD = 10 ma WITH 24V DC: 48 2.5A; 125 0.8A; 250 0.3A AC: 240 6.0A; 480 6.0A; 600 3.0A	-	
		200-250	(1) 3/0-350 KCMIL								COMPRESSION TERMINALS 3/0-350 KCMIL 225 LB-IN

REL NO	LTR	NO	REVISION	DWN	CKD	APVD	DATE
ECO-117272	A	1	PRODUCTION_RELEASE	PT	SM	C.STENBERG	13JUN11

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

DIM: X ± 1; .X ± 0.8; .XX ± 0.38

HOLE: 0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13

ANG TOL: ± 1.0° SCALE: 3/16

SIM TO 0500_4668

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DWN P.THEVAR
CKD S.MOHARE
APVD C.STENBERG
DATE 13JUN11

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994

FIRST USED ON DSGAA,AB,AC,AD

SITE CODE PGF

CUMMINS POWER GENERATION

OUTLINE,CIRCUIT BREAKER

DWG SIZE D A040K670 SHEET 3 OF 3 DWG REV A

Transfer switch OTEC open transition

> **Specification sheet**
40 - 1200 Amp

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Description

OTEC transfer switches are designed for operation and switching of electrical loads between primary power and standby generator sets. They are suitable for use in emergency, legally required, and optional standby applications. The switches monitor both power sources, signal generator set startup, automatically transfer power, and return the load to the primary power source once a stable utility is available.

The fully integrated controller is designed for practical functionality, with LED indicators and digital pushbuttons for ease of operator use.

All switches are UL 1008 Listed with UL Type Rated cabinets and UL Listed CU-AL terminals.

All switches are certified to CSA 282 Emergency Electrical Power Supply for Buildings, up to 600 VAC.

Equipment shall be suitable for use in systems compliant to 700, 701 and 702.

All switches comply with NFPA 70, 99 and 110.

All switches comply with NEMA ICS 10.

All switches comply with IEEE 446 Recommended Practice for Emergency and Standby Power Systems.

This transfer switch is designed and manufactured in facilities certified to ISO9001.

Features

Microprocessor control - Easy-to-use, standard control. LEDs display transfer switch status; pushbuttons allow operator to activate control test, exercise timing and transfer mode.

Programmed transition – Open transition timing can be adjusted to completely disconnect the load from both sources for a programmed time period, as recommended by NEMA MG-1 for transfer of inductive loads.

Advanced transfer switch mechanism - Unique bi-directional linear actuator provides virtually friction-free, constant force, straight-line transfer switch action during automatic operation.

Manual operation - Manual operating handles, shielded termination, and over-center contact mechanisms allow effective manual operation under de-energized conditions.

Positive interlocking - Mechanical and electrical interlocking prevent source-to-source connection through the power or control wiring.

Main contacts - Heavy-duty silver alloy contacts with multi-leaf arc chutes are rated for 100% load interruption. They require no routine contact maintenance and provide 100% continuous current ratings.

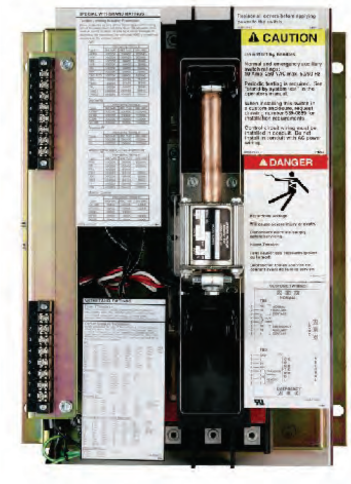
Easy service/access - Single-plug harness connection and compatible terminal markings simplify servicing. Access space is ample. Door-mounted controls are field-programmable; no tool is required.

Complete product line - Cummins Power Generation offers a wide range of equipment, accessories and services to suit virtually any backup power application.

Warranty and service - Products are backed by a comprehensive warranty and a worldwide network of distributors with factory-trained service technicians.

S-1464o (5/12)

Transfer switch mechanism



- Transfer switch mechanism is electrically operated and mechanically held in the Source 1 and Source 2 positions. The transfer switch incorporates electrical and mechanical interlocks to prevent inadvertent interconnection of the sources.
- Independent break-before-make action is used for both 3-pole and 4-pole/switched neutral switches. This design allows use of sync check operation when required, or control of the operating speed of the transfer switch for proper transfer of motor and rectifier-based loads (programmed transition feature).
- True 4-pole switching allows for proper ground (earth) fault sensing and consistent, reliable operation for the life of the transfer switch. The neutral poles of the transfer switch have the same ratings as the phase poles and are operated by a common crossbar mechanism, eliminating the possibility of incorrect neutral operation at any point in the operating cycle, or due to failure of a neutral operator.
- Electrical interlocks prevent simultaneous closing signals to normal and emergency contacts and interconnection of normal and emergency sources through the control wiring.
- High pressure silver alloy contacts resist burning and pitting. Separate arcing surfaces further protect the main contacts. Contact wear is reduced by multiple leaf arc chutes that cool and quench the arcs. Barriers separate the phases to prevent interphase flashover. A transparent protective cover allows visual inspection while inhibiting inadvertent contact with energized components.
- Switch mechanism, including contact assemblies, is third-party certified to verify suitability for applications requiring high endurance switching capability for the life of the transfer switch. Withstand and closing ratings are validated using the same set of contacts, further demonstrating the robust nature of the design.

Specifications

Voltage rating	Transfer switches rated from 40 A through 1200 A are rated up to 600 VAC, 50 or 60 Hz.
Arc interruption	Multiple leaf arc chutes cool and quench the arcs. Barriers prevent interphase flashover.
Neutral bar	A full current-rated neutral bar with lugs is standard on enclosed 3-pole transfer switches.
Auxiliary contacts	Two contacts (one for each source) are provided for customer use. Wired to terminal block for easy access. Rated at 10A continuous and 250 VAC maximum.
Operating temperature	-22 °F (-30 °C) to 140 °F (60 °C)
Storage temperature	-40 °F (-40 °C) to 140 °F (60 °C)
Humidity	Up to 95% relative, non-condensing
Altitude	Up to 10,000 ft (3,000 m) without derating
Total transfer time (source-to-source)	Will not exceed 6 cycles at 60 Hz with normal voltage applied to the actuator and without delayed transition enabled.
Manual operation handles	Transfer switches are equipped with permanently attached operating handles and quick-break, quick-make contact mechanisms suitable for manual operation under de-energized conditions.

Open transition/programmed – Controls the time required for the device to switch from source to source, so that the load-generated voltages decay to a safe level before connecting to an energized source. Recommended by NEMA MG-1 to prevent nuisance tripping breakers and load damage. Adjustable 0-60 seconds, default 0 seconds.

Open transition/in-phase – Initiates open transition transfer when in-phase monitor senses both sources are in phase. Operates in a break-before-make sequence. Includes ability to enable programmed transition as a backup. If sources are not in phase within 120 seconds, the system will transfer using programmed transition.

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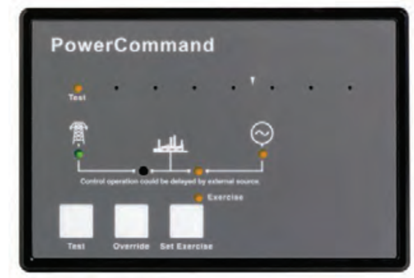
S-1464o (5/12)

Microprocessor control



- Simple, easy-to-use control provides transfer switch information and operator controls
- LED lamps for source availability and source connected indication, exercise mode, and test mode. LED status lamps also provided for control set-up and configuration.
- Pushbutton controls for initiating test, overriding time delays and setting exercise time.
- Field-configurable for in-phase open or programmed open transition.
- Integral exerciser clock
- Control is prototype-tested to withstand voltage surges per EN 60947-6-1.
- Gold-flashed generator start contacts

Control functions

Voltage sensing: All phases on the normal source and single phase on generator source. Normal Source Pickup: adjustable 90-95%, Dropout: adjustable 70-90% of nominal voltage; Generator Source Pickup: 90%, dropout: 75% of nominal voltage.

Frequency sensing: Generator Source Pickup: 90% of nominal frequency; Dropout: 75% of nominal frequency.

Exerciser clock: Switch is furnished with an integral engine exerciser configurable for operation on a 7, 14, 21, or 28-day cycle with a fixed exercise period duration of 20 minutes. A 12-hr exerciser time offset allows for the convenient setting of exercise time without the need to activate the timer at the exact time that you need to schedule the generator exercise for. Software selectable capability allows for the exercising of the generator with or without load.

Time-delay functions

Engine start: Prevents nuisance genset starts due to momentary power system variation or loss. Adjustable: 0-10 seconds; default: 3 seconds.

Transfer normal to emergency: Allows genset to stabilize before application of load. Prevents power interruption if normal source variation or loss is momentary. Allows staggered transfer of loads in multiple transfer switch systems. Adjustable 0-300 seconds, default 5 seconds.

Retransfer emergency to normal: Allows the utility to stabilize before retransfer of load. Prevents needless power interruption if return of normal source is momentary. Allows staggered transfer of loads in multiple transfer switch systems. Adjustable 0-30 minutes, default 10 minutes.

Genset stop: Maintains availability of the genset for immediate reconnection in the event that the normal source fails shortly after transfer. Allows gradual genset cool down by running unloaded. Adjustable 0-30 minutes, default 10 minutes.

Delayed (programmed) transition: Controls the speed of operation of the transfer switch power contacts to allow load generated voltages from inductive devices to decay prior to connecting a live source. Adjustable 0-10 seconds, default 0 seconds.

Elevator signal: Provides a relay output contact for the elevator signal relay (load disconnect). The signal can also be configured to provide a post transfer delay of the same duration. Adjustable: 0-300 seconds (requires optional elevator signal relay for use).

Options

Elevator signal relay: Provides a relay output contact for the signal relay function

Programmable exerciser clock: Provides a fully-programmable 7-day clock to provide greater flexibility in scheduling exercise periods than standard integral exerciser. Time-of-day setting feature operates generator during periods of high utility rates.

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Power Generation

UL withstand and closing ratings

The transfer switches listed below must be protected by circuit breakers or fuses. Referenced drawings include detailed listings of specific breakers or fuse types that must be used with the respective transfer switches. Consult with your distributor/dealer to obtain the necessary drawings. Withstand and Closing Ratings (WCR) are stated in symmetrical RMS amperes.

	MCCB protection			Special circuit breaker protection		
Transfer switch ampere	**WCR at volts max with specific manufacturers MCCBs**	**Max MCCB rating**	**Drawing reference**	**With specific current limiting breakers (CLB)**	**Max CLB rating**	**Drawing reference**
40, 70, 125 3-pole	14,000 at 600	225 A	098-6885	200,000 @ 600	225 A	098-6918
40, 70, 125 4-pole	30,000 at 600	225 A	098-6885	200,000 @ 600	225 A	098-6918
150, 225, 260	30,000 at 600	400 A	098-6886	200,000 @ 600	400 A	098-6919
300, 400, 600	65,000 at 600	1200 A	098-6887	200,000 @ 600	1200 A	098-6920
800, 1000	65,000 at 480 50,000 at 600	1400 A	098-6888	200,000 @ 600	1400 A	098-6921
1200	85,000 at 480 65,000 at 600	1600 A	A030U183	200,000 @ 600	1600 A	A030U185

Fuse protection

Transfer switch ampere	WCR at volts max. with current limiting fuses	Max fuse, size and type	Drawing reference
40, 70, 125 3- and 4-pole	200,000 at 600	200 A Class, J, RK1, RK5, T	098-6885
150, 225, 260	200,000 at 600	1200 A Class L or T, or 600 A class J, RK1, RK5	098-6886
300, 400, 600	200,000 at 600	1200 A Class L or T, or 600 A Class, J, RK1, RK5	098-6887
800, 1000	200,000 at 600	2000 A Class L or 1200 A class T or 600 A class J, RK1, RK5	098-6888
1200	200,000 at 600	2000 A Class L or 1200 A class T or 600 A class J, RK1, RK5	A030U183

3-cycle ratings

Transfer switch ampere	WCR at volts max 3-cycle rating	Max MCCB rating	Drawing reference
1200	42,000 at 600 50,000 at 480	1600 A	A030U183

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S-1464o (5/12)

Power Generation

Enclosures

The transfer switch and control are wall-mounted in a key-locking enclosure. Wire bend space complies with 2008 NEC.

Dimensions - transfer switch in UL type 1 enclosure

	Height		Width		Depth Door closed		Depth Door open		Weight		Outline drawing
Amp rating	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**lb**	**kg**	
40, 70, 125 3-pole	27.0	686	20.5	521	12.0	305	31.5	800	82	37	0310-0544
40, 70, 125 4-pole	35.5	902	26.0	660	16.0	406	41.0	1042	165	75	0500-4896
150, 225	35.5	902	26.0	660	16.0	406	41.0	1042	165	75	0310-0414
260	43.5	1105	28.5	724	16.0	406	43.0	1093	170	77	0310-0540
300, 400, 600	54.0	1372	25.5	648	18.0	457	42.0	1067	225	102	0310-1307
800, 1000	68.0	1727	30.0	762	19.5	495	48.5	1232	360	163	0310-0417
1200	90.0	2286	39.0	991	27.0	698	63.0	1600	730	331	A030L411

Dimensions - transfer switch in UL type 3R, 4, 4X, or 12 enclosure

	Height		Width		Depth Door closed		Depth Door open		Weight		Cabinet type	Outline drawing
Amp rating	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**	**mm**	**lb**	**kg**		
40, 70, 125 3-pole	34.0	864	26.5	673	12.5	318	36.5	927	125	57	3R, 12	0310-0453
											4	0310-0445
	46.0	1168	32.0	813	16.0	406	46.0	1168	255	102	4X	0500-4184
40, 70, 125 4-pole	42.5	1080	30.5	775	16.0	406	44.0	1118	215	97	3R, 12	0500-4896
											4	0500-4896
	46.0	1168	32.0	813	16.0	406	46.0	1168	255	102	4X	0500-4184
150, 225	42.5	1080	30.5	775	16.0	406	44.0	1118	215	97	3R, 12	0310-0454
											4	0310-0446
	46.0	1168	32.0	813	16.0	406	46.0	1168	255	102	4X	0500-4184
260	46.0	1168	32.0	813	16.0	406	46.0	1168	255	102	3R, 12	0310-0455
											4	0310-0447
											4X	0500-4184
300, 400, 600	59.0	1499	27.5	699	16.5	419	41.5	1054	275	125	3R, 12	0310-1315
											4	0310-1316
	73.5	1867	32.5	826	19.5	495	49.5	1257	410	186	4X	0500-4185
800, 1000	73.5	1867	32.5	826	19.5	495	49.5	1257	410	186	3R, 12	0310-0457
											4	0310-0449
											4X	0500-4185
1200	90.0	2286	39.0	991	27.0	698	63.0	1600	730	331	3R, 12	A030L411
											4, 4X	A041N370

Transfer switch lug capacities

All lugs accept copper or aluminum wire unless indicated otherwise.

Transfer switch ampere	Cables per phase	Size
40, 70, 125 3-pole	1	#12 AWG-2/0
40 4-pole	1	#12 AWG-2/0
70, 125 4-pole	1	#6 AWG - 300 MCM
150, 225	1	#6 AWG - 300 MCM
260	1	#6 AWG - 400 MCM
300, 400	1	3/0 - 600 MCM
300, 400	2	3/0 - 250 MCM
600	2	250 - 500 MCM
800	4	250 - 500 MCM
1000,1200	4	#2 AWG-750 MCM

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S-1464o (5/12)

Power Generation

Submittal detail

Amperage ratings
- ☐ 40
- ☐ 70
- ☐ 125
- ☐ 150
- ☐ 225
- ☐ 260
- ☐ 300
- ☐ 400
- ☐ 600
- ☐ 800
- ☐ 1000
- ☐ 1200

Voltage ratings
- ☐ R020 120
- ☐ R038 190
- ☐ R021 208
- ☐ R022 220
- ☐ R023 240
- ☐ R024 380
- ☐ R025 416
- ☐ R035 440
- ☐ R026 480
- ☐ R027 600

Pole configuration
- ☐ A028 Poles - 3 (solid neutral)
- ☐ A029 Poles - 4 (switched neutral)

Frequency
- ☐ A044 60 Hertz
- ☐ A045 50 Hertz

Application
- ☐ A035 Utility to genset

System options
- ☐ A041 Single phase, 2-wire or 3-wire
- ☐ A042 Three phase, 3-wire or 4-wire

Enclosure
- ☐ B002 Type 3R: intended for outdoor use, provides some protection from dirt, rain and snow (similar to IEC Type IP34)
- ☐ B003 Type 4: indoor or outdoor use, provides some protection from wind-blown dust and water spary (similar to IEC Type IP65)
- ☐ B010 Type 12: indoor use, some protection from dust (similar to IEC Type IP61)
- ☐ B025 Type 4X: stainless steel, indoor or outdoor use, provides some protection from corrosion (similar to IEC Type IP65)

Standards
- ☐ A046 UL 1008/CSA certification
- ☐ A080 Seismic certification

Control voltage
- ☐ M033 12V, Genset starting voltage
- ☐ M034 24V, Genset starting voltage

Control options
- ☐ J030 External exercise clock
- ☐ M032 Elevator signal relay

Battery chargers
- ☐ K001 2 amps, 12/24 volts
- ☐ KB59 15 amps, 12 volts
- ☐ KB60 12 amps, 24 volts

Auxiliary relays

Relays are UL Listed and factory installed. All relays provide (2) normally closed isolated contacts rated 10 A @ 600 VAC. Relay terminals accept (1) 18 gauge to (2) 12 gauge wires per terminal.

- ☐ L101 24 VDC coil - installed, not wired (for customer use).
- ☐ L102 24 VDC coil - emergency position - relay energized when switch is in source 2 (emergency) position.
- ☐ L103 24 VDC coil - normal position - relay energized when switch is in source 1 (normal) position
- ☐ L201 12 VDC coil installed, not wired (for customer use)
- ☐ L202 12 VDC coil - emergency position - relay energized when switch is in source 2 (emergency) position
- ☐ L203 12 VDC coil - normal position - relay energized when switch is in source 1 (normal) position

Miscellaneous options
- ☐ C027 Cover - guard
- ☐ M003 Terminal block - 30 points (not wired)

Optional lug kits
- ☐ N032 Lug adapters, compression, ½ stab
- ☐ N045 Cable lugs, mechanical, 600 MCM, 4 per pole
- ☐ N066 Cable lugs, mechanical, 750 MCM, 4 per pole

Warranty
- ☐ G009 1 year comprehensive
- ☐ G004 2 year comprehensive
- ☐ G006 5 year basic
- ☐ G007 5 year comprehensive
- ☐ G008 10 year major components

Shipping
- ☐ A051 Packing - export box (800-1000 A)

Accessories
- ☐ AC-170 Accessories specifications sheet

Cummins Power Generation

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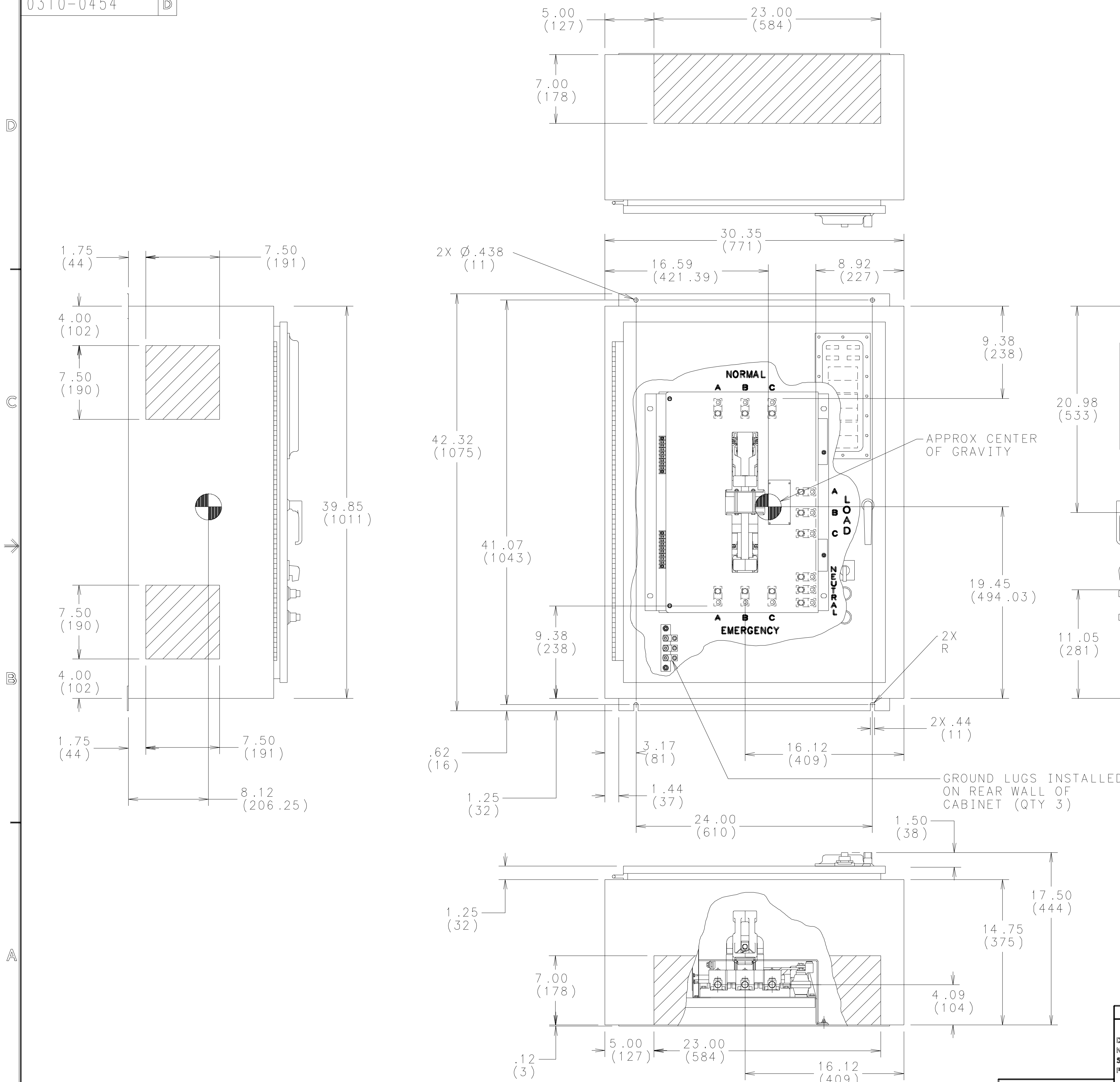
S-1464o (5/12)

Power Generation

0310-0454 D

ER NO.	LTR	NO.	REVISION	ZONE	DR	CHKR	APPROVED	DATE
100026	G	1	REDRAWN ADDED 4 POLE	-	EE	RAE	J.MILLER	5-15-95
		2	REVISED NOTE 4 & 8 PER ER	2-B	EE	RAE	J.MILLER	5-15-95
		3	REVISED VIEW OF SILKSCREEN	-	EE	RAE	J.MILLER	5-15-95



NOTES:

1. U.L. CABINET:
   TYPE 3R, OUTDOOR RAINPROOF
   TYPE 12, INDOOR DUSTTIGHT, DRIPTIGHT
   (EQUIVALENT TO NEMA 3R AND 12)
2. APPROX WEIGHT: 190 lbs
   MASS: 86 kg
3. DIMENSIONS IN () ARE MILLIMETERS.
4. LUG CAPACITY:
   (QTY 1 WIRE) 6-300 (16-150) MCM CU-AL.
   GND LUG CAPACITY:
   (1 WIRE) WIRE RANGE #14-1/0 (2.5-50) CU-AL.
5. USE SEPARATE CONDUITS FOR CONTROL WIRING & POWER WIRING. DO NOT COMBINE.
6. SHADED AREA INDICATES WIRING & CABLE ENTRANCE AREA. DO NOT INSTALL OUTSIDE OF SHADED AREA.
7. WIRE BENDING SPACE CONFORMS TO NEC TABLE 373-6 (B). LUGS ARE REMOVABLE.
8. REFER TO NATIONAL ELECTRIC CODE, ARTICLE 110-16 WHICH STATES THE REQUIREMENT FOR THE MINIMUM CLEAR SPACE IN FRONT OF THIS UNIT.

3 POLE

REVISIO DWG

QTY	ITEM	PART NO.	DWG SIZE	DESCRIPTION OR MATERIAL	REF DES

DO NOT SCALE PRINT

TOLERANCE UNLESS OTHERWISE SPECIFIED

	mm		Inch	
DIM	X ±		.X ± --	
	.X ±		.XX ± --	
	.XX ±		.XXX ± --	
HOLE	0.09- 4.99	+0.15/-0.08	.004-.200	+.006/-.003
	5.00- 9.99	+0.20/-0.10	.201-.421	+.008/-.004
	10.00-17.49	+0.25/-0.13	.422-.703	+.010/-.005
	17.50-24.99	+0.30/-0.13	.704-.999	+.012/-.005

ANG TOL ± --

DRAWN TO SCALE OF 3/16

SIM TO 310-0446 D

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THIRD ANGLE PROJECTION

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	NAME	DATE
DR	E. ENGLE	5-15-95
CHKR ☒ MFG ☐	R. EVENSON	5-15-95
APPROVED	J. MILLER	5-15-95

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ANSI Y14.5M-1982

MODEL FIRST USED ON 150-225A

Cummins Onan

MINNEAPOLIS, MINNESOTA 55432

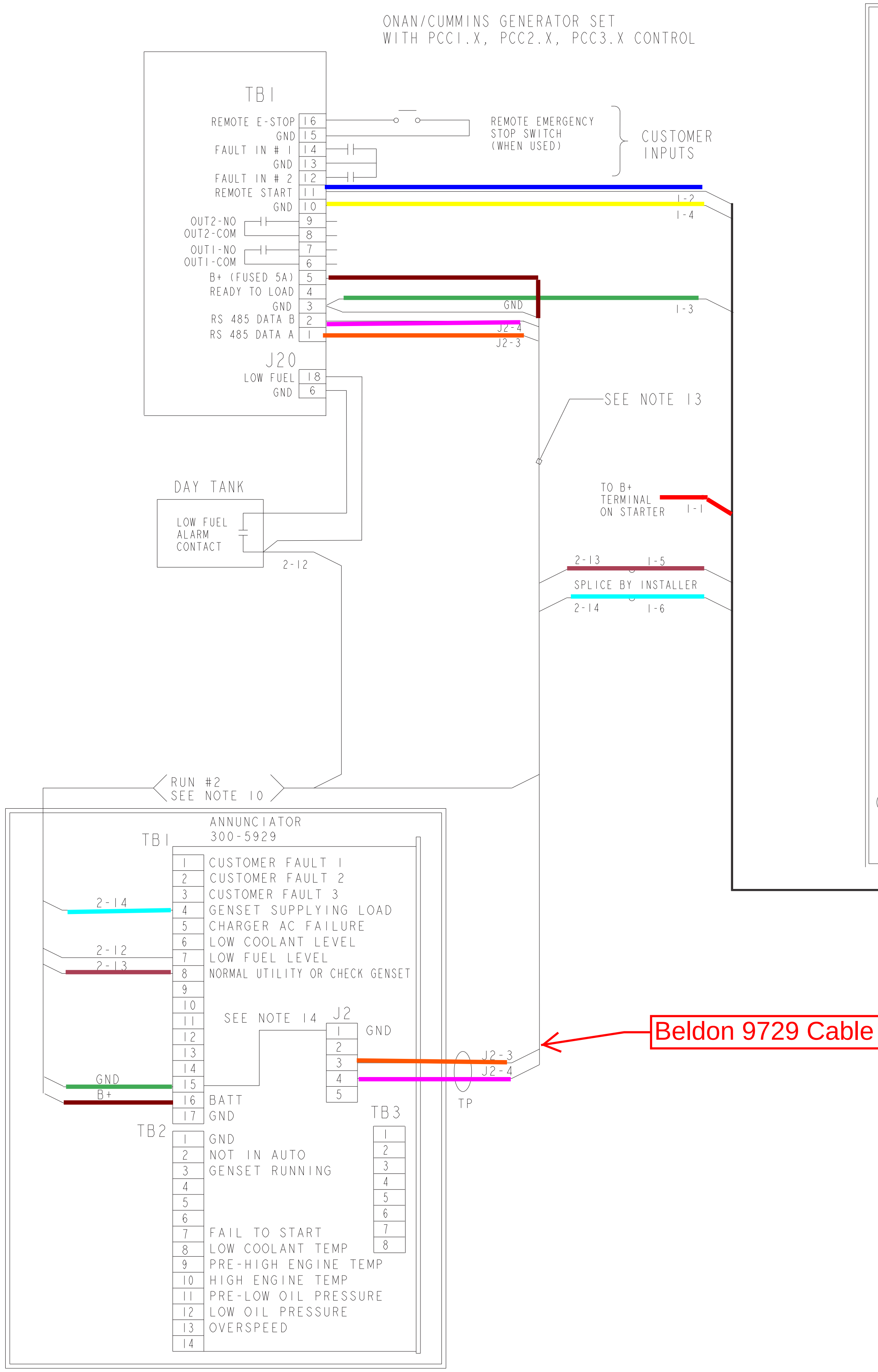
TITLE OUTLINE-CONTROL BOX

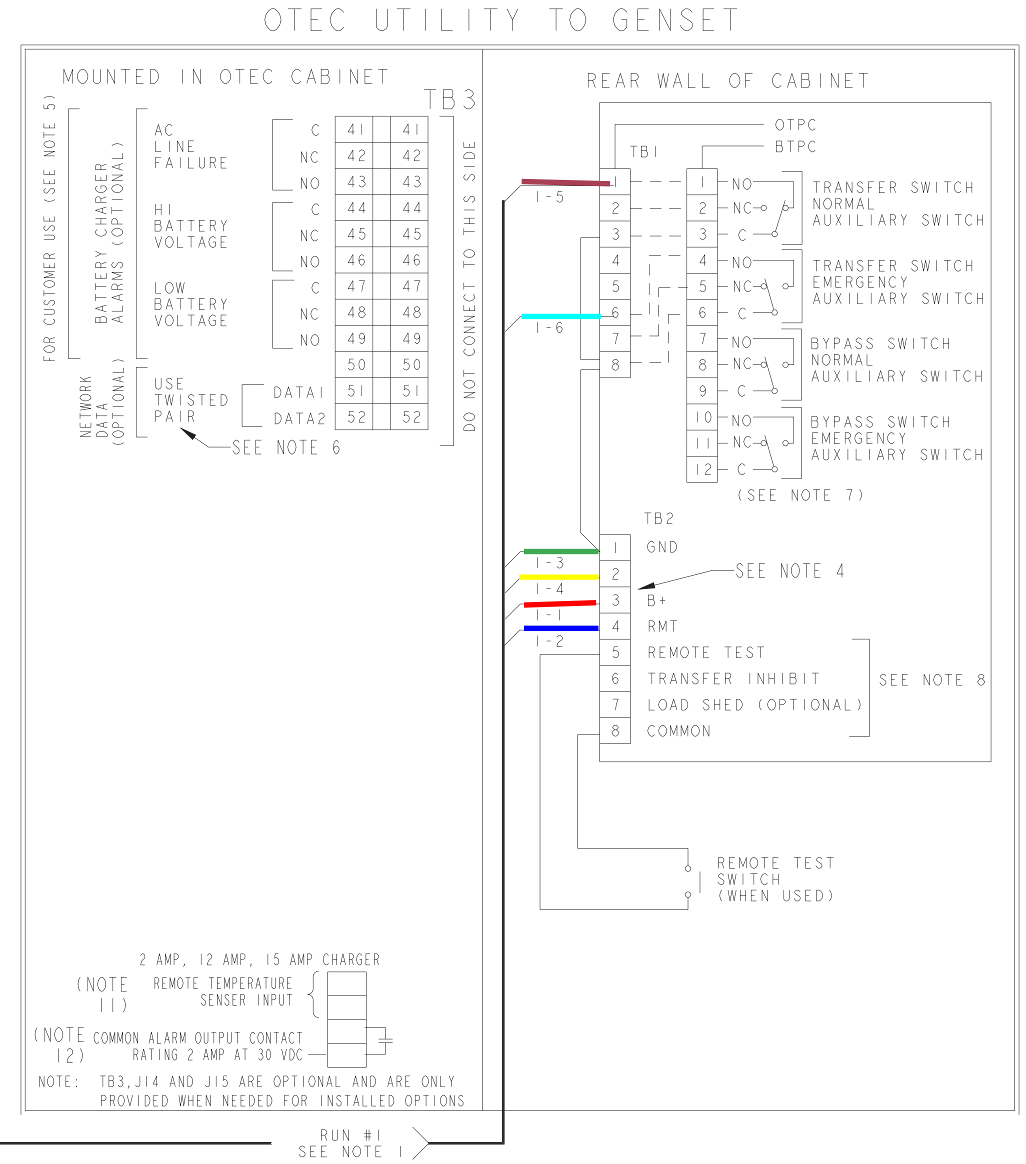
DWG NO. 0310-0454 SHEET 1 OF 2 DWG SIZE D

0630_2810	D	Pro/ENGINEER	METRIC DWG

REL NO	LTR	NO	REVISION	ZONE	DR	CHKR	APPROVED	DATE
ECO-103227	F	2	ADDED THIS SHEET	-	JFM	RS	SCROGGINS	14JAN09

OTEC UTILITY TO GENSET





NOTES:

1. WIRE SIZES MUST BE AS FOLLOWS:
   RUN #1-GENSET TO TRANSFER SWITCH-LEAD SIZE MUST BE INCREASED IF A BATTERY CHARGER IS INSTALLED IN THE SWITCH.
   WITH NO BATT CHARGER-LEADS 1-1, -2, -3, -4, -5 USE COL A.
   WITH 2 AMP CHARGER, MAXIMUM VOLTAGE DROP OF 1.5 VOLTS, LEADS 1-1, &1-3 USE COL B.
   WITH 12/15 AMP CHARGER MAXIMUM VOLTAGE DROP OF 1.5 VOLTS, LEADS 1-1 & 1-3 USE COL. C.
   WITH 2 AMP CHARGER, MAXIMUM VOLTAGE DROP OF 0.75 VOLTS, LEADS 1-1, &1-3 USE COL D.
   WITH 12/15 AMP CHARGER, MAXIMUM VOLTAGE DROP OF 0.75 VOLTS, LEADS 1-1, & 1-3 USE COL E. TO MEET THE NFPA110 REQUIREMENT TO RETURN A FULLY DISCHARGED BATTERY TO 100% OF IT'S AMPERE-HOUR RATING WITHIN 24 HOURS USE COL. E.
2. RUN #2-GENSET TO ANNUNCIATOR-ALL LEADS, USE COL. A
3. FOR MULTIPLE TRANSFER SWITCHES, DUPLICATE RUN #1 FOR EACH SWITCH. DAISY CHAIN CONNECTION IS ACCEPTABLE PROVIDED WIRE SIZE & DISTANCE TO THE LAST SWITCH MEET THE SPECS IN NOTE 1.
4. DO NOT INSTALL JUMPER BETWEEN TB2-2 & TB2-3 AND TB2-1 & TB2-2.
5. CONTACTS RATED: 4 AMPS AT 30 VDC OR 120V MAX.
6. USE STRANDED TWISTED PAIR WIRES WHEN CONNECTING DATA1 AND DATA2 TO THE NETWORK.
7. TRANSFER SWITCH SHOWN CLOSED TO NORMAL BYPASS SWITCH SHOWN IN NEUTRAL POSITION.
8. CONNECT AN OPEN DRY CONTACT BETWEEN THE APPLICABLE TERMINAL AND COMMON (TB2-8). FOR REMOTE TEST, TRANSFER INHIBIT AND LOAD SHED. CLOSE TO ACTIVATE.
9. CONTACTS RATED: 2 AMPS AT 30 VDC OR 0.60 AMPS AT 120 VAC.
10. REFER TO 0900-0301 FOR INSTALLATION OF 0300-5929.
11. USE THE INVENTER REMOTE TEMPERATURE PROBE (0193-0530).
12. THE FOLLOWING FAILS WILL CAUSE A BATTERY CHARGER ALARM OUTPUT: LOW BATTERY VOLTAGE, HIGH BATTERY VOLTAGE, LOW AC INPUT VOLTAGE, HIGH AC INPUT VOLTAGE OVERCURRENT, HIGH CHARGER TEMPERATURE, BATTERY FAILURE, HIGH BATTERY TEMPERATURE (NOT AVAILABLE ON 2 AMP CHARGER).
13. NETWORK CONNECTIONS: USE BELDEN 9729 24 GAUGE TWISTED, STRANDED, SHIELDED CABLE. SHIELD SHOULD BE GROUNDED AT ONE END. TOTAL NETWORK LENGTH NOT TO EEXCEED 4000 FEET. UP TO 20 NODES CAN BE CONNECTED TO THE NETWORK. (NOTE ANY COMMUNICATIONS WIRE CONNECTED TO THE GENSET SHOULD BE STRANDED CABLE.).
14. J2-1 CAN BE INTERCONNECTED TO PROVIDE A COMMON LOGIC REFERANCE WHEN APPLICABLE. J2-1 CAN BE USED TO INTERCONNECT TWO CONTROLS WHERE ONE OF THE CONTROLS USES A FLOATING DC POWER SUPPLY NOT CONNECTED TO EARTH GROUND AND THE OTHER IS CONNECTED TO EARTH GROUND. OTHERWISE, USING J2-1 CAN INDUCE A GROUND LOOP.

WIRE SIZE (AWG)	DISTANCE IN FEET, ONE WAY (MULTIPLY BY 0.3 FOR METERS)				
	A	B	C	D	E
16	1000	90	-	50	-
14	1600	150	20	80	5
12	2400	225	30	125	10
10	4000	350	50	200	15
8	-	600	80	300	25
6	-	1000	125	500	40

DO NOT SCALE PRINT

NAME	DATE
DR G_COLLEEN	02-13-04
CHKR J MILLER	02-13-04
APPROVED J MILLER	02-13-04

MODEL FIRST USED ON: OTEC

CUMMINS POWER GENERATION
1400 73RD AVE NE
MINNEAPOLIS, MINNESOTA 55432

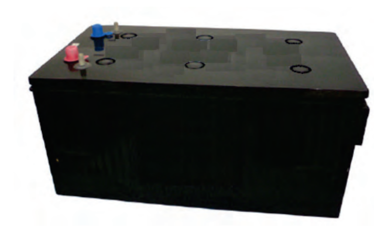
SITE CODE: PGA

TITLE: WD-INTERCONNECTION

DWG NO: 0630_2810

SHEET 10 OF 10 DWG SIZE D

Batteries and accessories



> Specification sheet

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Power Generation

Battery Specifications

Part number	Battery	Cold cranking amps	Voltage	Reserve capacity	Length	Width	Height	Group size	Ship weight lbs	Qts electrolyte
0416-0439	Dry	1400	12	430	20.75	11.00	9.63	8D	110	16.0
0416-0579	Dry	525	12	90	10.25	6.63	8.75	24C-675	20	6.0
0416-0579-01	Wet	525	12	90	10.25	6.63	8.75	24C-675	36	6.0
0416-0796	Wet	725	12	150	13.00	6.88	9.63	31-4	62	4.2
0416-0823	Dry	725	12	150	13.00	6.88	9.63	31-4	42	4.2
0416-0848	Dry	1080	12	270	20.75	8.63	9.63	4D	85	13.0
0416-0980	Wet	1000	12	200	13.00	6.88	9.63	31-5	65	4.2
0416-1040	Dry	800	12	160	13.00	6.88	9.44	31	65	4.2
0416-1051	Wet	530	12	80	8.13	6.63	7.50	26-775	31	3.7
0416-1105	Wet	1400	12	430	20.75	11.00	9.63	8D	125	16.0
0416-1138	Sealed	NA	12	NA	5.88	3.88	3.75	NP12-12	9	4.0
0416-1264	Dry	730	12	420	20.67	10.83	9.45	8D	110	16.0
0416-1291	Sealed	800	12	110	10.00	6.88	7.81	34	38	4.0
0416-1330	Wet	810	12	146	10.25	6.63	8.88	24XL	43	5.9
0416-1332	Dry	420	12	60	9.13	5.25	8.88	22NF	19	4.0

Application

Listed below, by set model, is the specific battery designed to fit the skid mounted battery rack. (Larger batteries, if required, may not fit the standard skid mounted rack.)

Model	Begin spec	Current spec	Battery P/N	Quantity
DFAA	F	H	0416-0439	2
DFAB	G	N	0416-0439	2
DFAC	F	N	0416-0439	2
DFBF	M	Z	0416-0439	2
DFCB	M	Z	0416-0439	2
DFCC	M	Z	0416-0439	2
DFCE	B	J	0416-0439	2
DFEB	M	T	0416-0439	2
DFEC	E	L	0416-0439	2
DFED	B	H	0416-0439	2
DFEG	A	K	0416-0439	2
DFEH	A	K	0416-0439	2
DFEJ	A	K	0416-0439	2
DFEK	A	K	0416-0439	2
DFGA	F	H	0416-0439	4
DFGB	F	L	0416-0439	4
DFGE	A	D	0416-0439	4
DFHA	A	J	0416-0439	2
DFHB	A	J	0416-0439	2
DFHC	A	H	0416-0439	2
DFHD	A	H	0416-0439	2
DFJA	E	M	0416-0439	4
DFJB	E	M	0416-0439	4
DFJC	N	R	0416-0439	4
DFJD	F	H	0416-0439	4
DFLB	M	T	0416-0439	4
DFLC	N	W	0416-0439	4
DFLD	E	N	0416-0439	4
DFLE	A	F	0416-0439	4
DFMB	E	T	0416-0439	4
DGBB	E	M	0416-0848	1
DGBB	E	M	0416-0980	1
DGBC	D	L	0416-0848	1
DGBC	D	L	0416-0980	1
DGCA	M	V	0416-0848	1
DGCA	M	V	0416-0980	1
DGCB	M	V	0416-0848	1
DGCB	M	V	0416-0980	1
DGCG	A	C	0416-0848	1
DGCG	A	C	0416-0980	1
DGDA	A	C	0416-0848	1
DGDA	A	C	0416-0980	1
DGDB	L	S	0416-0848	1
DGDB	L	S	0416-0980	1
DGDK	L	S	0416-0848	1
DGEA	L	S	0416-0980	1
DGFA	A	S	0416-0848	1
DGFB	K	S	0416-0848	1
DGFC	K	S	0416-0848	1
DGFS	K	S	0416-0848	1

Model	Begin spec	Current spec	Battery P/N	Quantity
DGGD	A	E	0416-0980	1
DGHCA	A	A	0416-0980	1
DGHCB	A	A	0416-0980	1
DGHCC	A	A	0416-0980	1
DGHDA	A	A	0416-0980	1
DGHDB	A	A	0416-0980	1
DGHD	A	E	0416-0980	1
DGHE	A	E	0416-0980	1
DKAC	A	C	0416-0579	1
DKAE	A	D	0416-0796	1
DKAF	A	E	0416-0796	1
DNAA	A	B	0416-1040	1
DNAB	A	B	0416-1040	1
DNAF	A	E	0416-1040	1
DQAA	A	F	0416-0439	4
DQAB	A	F	0416-0439	4
DQAD	A	E	0416-0439	2
DQAE	A	E	0416-0439	2
DQAF	A	E	0416-0439	2
DQBA	B	G	0416-0439	2
DQBB	B	G	0416-0439	2
DQCA	A	C	0416-0439	2
DQCB	A	C	0416-0439	2
DQCC	A	C	0416-0439	2
DQDAA	B	F	0416-0848	2
DQDAB	B	F	0416-0848	2
DQDAC	B	E	0416-0848	2
DQFAA	A	E	0416-0439	2
DQFAB	A	E	0416-0439	2
DQFAC	A	E	0416-0439	2
DQFAD	A	E	0416-0439	2
DQGAA	A	C	0416-0439	4
DQGAB	A	C	0416-0439	4
DQGAC	A	B	0416-0439	4
DQGAE	A	A	0416-0439	4
DQGAF	A	A	0416-0439	4
DQHAA	A	E	0416-0439	2
DQHAB	A	E	0416-0439	2
DQKAA	A	D	0416-0439	4
DQKAB	A	D	0416-0439	4
DQKAD	A	A	0416-0439	4
DQKAE	A	A	0416-0439	4
DQKAF	A	A	0416-0439	4
DQKB	A	G	0416-0439	4
DQKC	A	G	0416-0439	4
DQKD	A	A	0416-0439	4
DQKH	A	E	0416-0439	4
DQLA	A	A	0416-0439	6
DQLB	A	A	0416-0439	6
DQLC	A	B	0416-0439	6

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Model	Begin spec	Current spec	Battery P/N	Quantity
DQLD	A	B	0416-0439	6
DQLE	A	C	0416-0439	6
DQLF	A	A	0416-0439	6
DSFAA	A	F	0416-0848	1
DSFAB	A	F	0416-0848	1
DSFAC	A	F	0416-0848	1
DSFAD	A	F	0416-0848	1
DSFAE	A	F	0416-0848	1
DSGAA	A	J	0416-0848	1
DSGAB	A	J	0416-0848	1
DSGAC	A	J	0416-0848	1
DSGAD	A	B	0416-0848	1
DSGAE	A	B	0416-0848	1
DSHAA	B	C	0416-1330	2
DSHAB	B	D	0416-1330	2
DSHAC	B	D	0416-1330	2
DSHAD	A	B	0416-1330	2
DSHAE	B	C	0416-1330	2
DSHAF	A	B	0416-1330	2
DSKAA	A	B	0416-0796	1
DSKAB	A	B	0416-0796	1
DSKBA	A	B	0416-0796	1
DSKCA	A	B	0416-0796	1

Model	Begin spec	Current spec	Battery P/N	Quantity
GGDB	A	K	0416-1332	1
GGFB	A	B	0416-0796	1
GGFC	A	B	0416-0796	1
GGFD	A	K	0416-0796	1
GGFE	A	K	0416-0796	1
GGHB	A	B	0416-0796	1
GGHC	A	B	0416-0796	1
GGHD	A	B	0416-0796	1
GGHE	A	M	0416-0796	1
GGHF	A	M	0416-0796	1
GGHG	A	M	0416-0796	1
GGHH	A	M	0416-0796	1
GGHJ	A	A	0416-0796	1
GGKA	A	C	0416-0848	1
GGKB	A	D	0416-0848	2
GGKC	A	D	0416-0848	2
GGKD	A	D	0416-0848	1
GGLA	A	J	0416-0796	1
GGLB	A	J	0416-0796	1
GGMA	A	C	0416-1332	1
GGMB	A	C	0416-1332	1
GGMC	A	C	0416-1332	1
GGPA	A	B	0416-0796	1
GGPB	A	B	0416-0796	1
GGPC	A	B	0416-0796	1
GNAA	A	D	0416-1040	1
GNAB	A	D	0416-1040	1
GNAC	A	D	0416-1040	1
GQKA	A	B	0416-1264	2
GQMA	A	C	0416-1264	2
GQMB	A	C	0416-1264	2
GQNA	A	C	0416-1264	2
GQNB	A	C	0416-1264	2
GQNC	A	B	0416-1264	2
GQPB	A	C	0416-1264	2
GQPC	A	A	0416-1264	2

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Battery Accessories

Battery racks (Not recommended for mounting on skids.)

Part number	Description
0416-0527	20.5" x 11" (includes hold down brackets)
0416-0475	14.5" x 9.25" (loose rack, not intended for anchoring)
0541-0798	13.725" x 9.725" (includes hold down brackets)

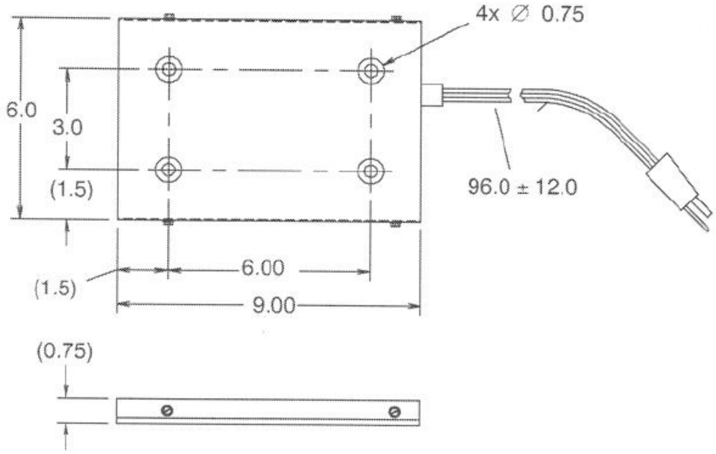
Battery heater Increases battery starting capability in lower than optimum ambient temperatures.

Heater Kit	Temperature Range	Voltage AC	Watts	Inst Sheet	Critical Component
0333-0469	Preset to maintain 80° F	120	200	NA	0333-0469-01
0333-0770	65 ° F on; 80 ° F off	120	50	G744	NA – as purchased
0541-0555	40 ° F / 70 ° F Setting	120	120	C587	0333-0636

Battery box

Part number	Description
0416-1263	Battery box has approximate inside dimensions of 21.125" long X 11.75" wide X 10.5" high. Box is constructed of black plastic with 4 mounting feet and a cover held on by 2 thumb screws. The box also has 2 slots on each side to accommodate battery cables. (see drawing on page 3). Note: Box material will become soft and pliable around 240 °F.

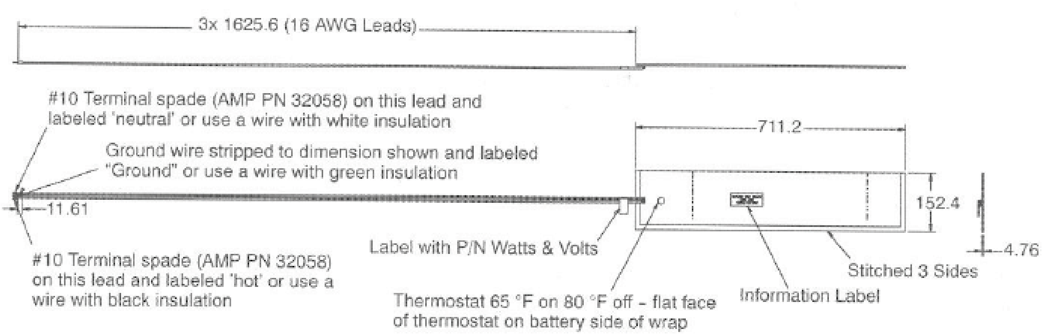
Image 1: 0333-0469



Specifications

200 Watts / 120 Volts
Preset to maintain 80° F

Image 2: 0333-0770



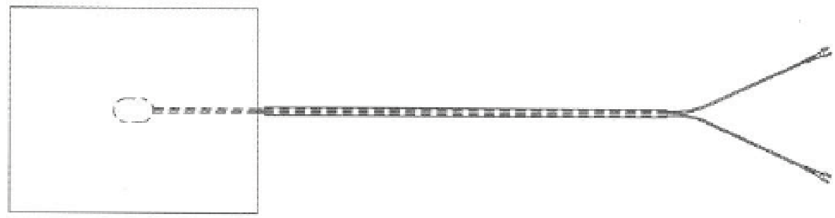
Specifications

50 Watts / 120 Volts
288 Total OHMS; 274 Min OHMS; 317 Max OHMS

Notes

1. All seams folded over onto Battery side are stitched.
2. This area is unheated.
3. Two wire ties attach to the battery

Image 3: 0541-0555



Specifications

120 Watts / 120 Volts
Thermostatically Controlled
40° F / 70° F Setting
24", 22 gauge Teflon leads
6.5" x 7.9" silicone rubber

Components

Item #	Part #	Quantity	Description
1	0333-0636	1	Battery Heater
2	0898-1195-01	2.5	Insulation Sleeving
3	0332-2630	2	Spade Terminal (AMP 52929-3)
4	0418-0079	1	Box
5	000C-0587	1	Instruction Sheet
6	0098-7591-14	1	Label

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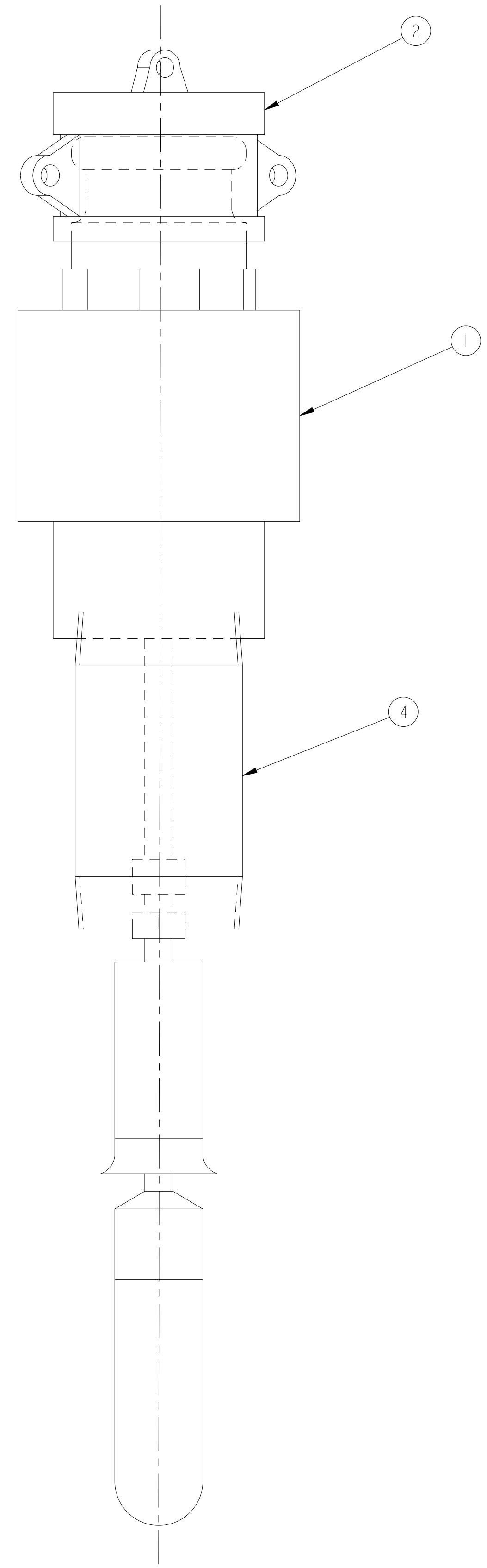
10 Toh Guan Road #07-01
TT International Tradepark
Singapore 608838
Phone 65 6417 2388
Fax 65 6417 2399

Warning: Back feed to a utility system can cause electrocution and/or property damage. Do not connect generator sets to any building electrical system except through an approved device or after building main switch is open.

Warning: For professional use only. Must be installed by a qualified service technician. Improper installation presents hazards of electrical shock and improper operation, resulting in severe personal injury and/or property damage.

REL NO	LTR	NO	REVISION	ZONE	DWN	CKD	APVD	DATE
ECO-101939	B	1	ADD PICTORIAL REPRESENTATION ON THE DRAWING	-	PY	VO	HAWKINS	13NOV08
		2	ADD TABULATION HEADING / CHG ITEM 5 QTY 2 WAS 1	-	PY	VO	HAWKINS	13NOV08



NOTES:

1. THIS PART IS MANUFACTURER SOURCE CONTROLLED.
2. APPLICABLE FOR USE ON FUEL TANKS: 0159-1720-01
   0159-1720-02

SUPPLIER TABULATION FOR REFERENCE ONLY

ITEM NO.	QTY	UAI PART NO.	DESRIPTION	UAI VENDOR PART NO. (REF)
1	1	OFPV 002F	VALVE, OVER FILL PREVENTION 2"	MORRISON 9095S-0500 AV
2	1	QD 800DC	CAP, FUEL INLET 2" AL	MORRISON 800DC
3	1	LA 00028	LABEL, (REV C)	
4	1	NP 20045PT	NIPPLE, 2" NPT X 4.5" LG PAINTED	
5	2	-	LABEL, SHIPPING	
6	1	-	BOX, SHIPPING	
7	1	BOX 212R	BOX, SHIPPING	
8	1	CPG-G737	INSTRUCTION SHEET	

ITEM	PART NO	DESCRIPTION OR MATERIAL

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

DIM: X ±1; .X ±0.8; .XX± 0.38

HOLE: 0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13

ANG TOL: ± 1.0° SCALE: 1/1

SIM TO .

DO NOT SCALE PRINT

- CONFIDENTIAL -
PROPERTY OF CUMMINS POWER GENERATION GROUP

DWN L_ARNOLD
CKD D_GILLETT
APVD D_GILLETT
DATE 02-13-07

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994

FIRST USED ON DSGAA,AB,AC

SITE CODE PGF

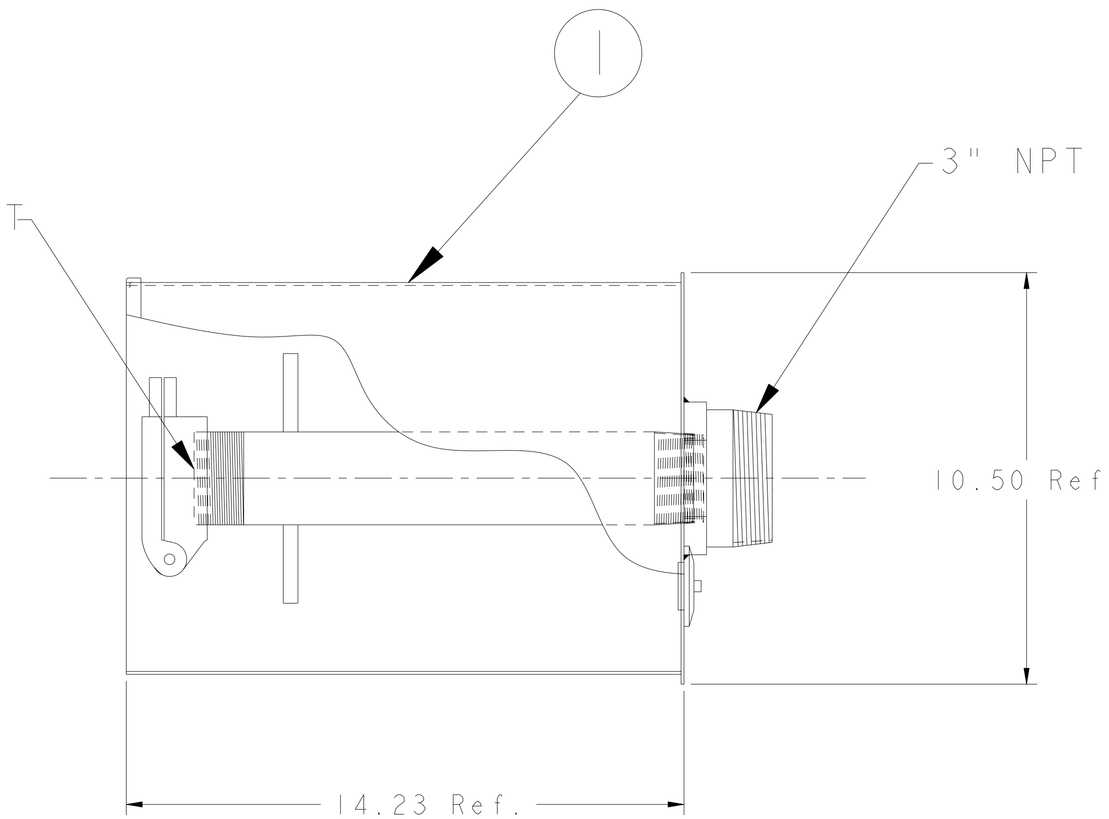
CUMMINS POWER GENERATION
1400 73RD AVENUE NE, MINNEAPOLIS, MN 55432

FUEL SYSTEM KIT
OFPV

DWG SIZE D | 0541_1464 | SHEET 1 OF 1 | DWG REV B

Pro/ENGINEER

REL NO	LTR	NO	REVISION	ZONE	DWN	CKD	APVD	DATE
ECO-101939	B	1	ADD PICTORIAL REPRESENTATION ON THE DRAWING	-	PY	VO	HAWKINS	13NOV08
		2	ADD TABULATION HEADING	-	PY	VO	HAWKINS	13NOV08



NOTES:

1. THIS PART IS MANUFACTURER SOURCE CONTROLLED.
2. APPLICABLE FOR USE ON FUEL TANKS: 0159-1720-01
   0159-1720-02

SUPPLIER TABULATION FOR REFERENCE ONLY

ITEM NO.	QTY	UAI PART NO.	DESRIPTION
1	1	SB 5GALINT-00	5 GALLON (ROUND) SPILL BOX
2	2	-	LABEL, SHIPPING
3	1	S-4166 16X16X16	BOX, SHIPPING
4	1	CPG-G738	INSTRUCTION SHEET

ITEM	PART NO	DESCRIPTION OR MATERIAL

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

DIM		HOLE	
	X ± 1		0.00- 4.99 +0.15/-0.08
	.X ± 0.8		5.00- 9.99 +0.20/-0.10
	.XX± 0.38		10.00-17.49 +0.25/-0.13
			17.50-24.99 +0.30/-0.13

ANG TOL: ± 1.0° SCALE: 1/1

SIM TO .

DO NOT SCALE PRINT

- CONFIDENTIAL -
PROPERTY OF CUMMINS POWER GENERATION GROUP

DWN L_ARNOLD
CKD D_GILLETT
APVD D_GILLETT
DATE 02-13-07

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994

FIRST USED ON DSGAA,AB,AC

SITE CODE PGF

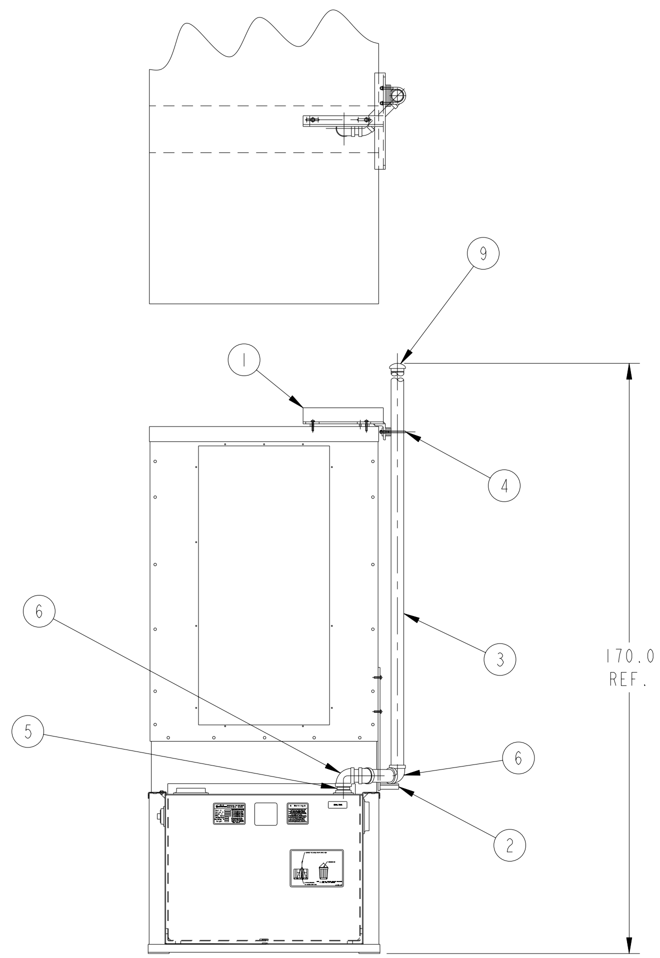
CUMMINS POWER GENERATION
1400 73RD AVENUE NE, MINNEAPOLIS, MN 55432

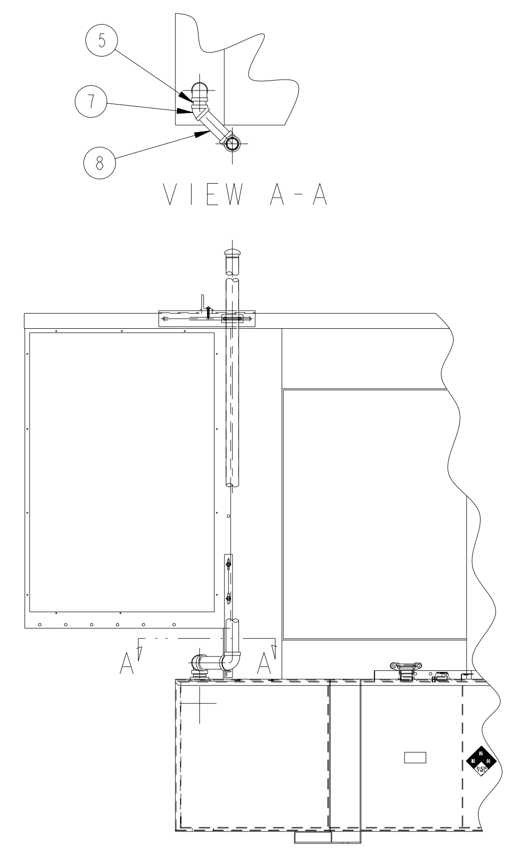
FUEL SYSTEM KIT
SPILL BOX 5 GAL

DWG SIZE D | 0541_1466 | SHEET 1 OF 1 | DWG REV B

Pro/ENGINEER

REL NO	LTR	NO	REVISION	ZONE	DWN	CKD	APVD	DATE
ECO-101939	B	1	ADD PICTORIAL REPRESENTATION ON THE DRAWING	-	PY	VO	HAWKINS	13NOV08
		2	UPDATE THE TABULATION-SEE ECO	-	PY	VO	HAWKINS	13NOV08





NOTES:

1. THIS PART IS MANUFACTURER SOURCE CONTROLLED.
2. APPLICABLE FOR USE ON FUEL TANKS: 0159-1720-01
   0159-1720-02

SUPPLIER TABULATION FOR REFERENCE ONLY

ITEM NO.	QTY	UAI PART NO.	DESRIPTION
1	1	BU 4020	BRACKET, STABILIZER - UPPER
2	1	BL 200	BRACKET, SUPPORT - PRIMARY
3	1	MVA 20132PT	NIPPLE, 2" NPT X 132" LG PAINTED
4	1	CU 200PT	U-BOLT 2" PIPE PAIINTED
5	2	NP 2 CLOSE	NIPPLE 2" NPT X CLOSE (2" LG)
6	2	EL 290PT	ELBOW 2" NPT 90 DEG PAINTED
7	1	EL 2046PT	ELBOW 2" NPT 45 DEG PAINTED
8	1	NP 2006PT	NIPPLE, 2" NPT X 4" LG PAINTED
9	1	MV 0200 PT	VENT, MUSHROOM 2" NPT PAINTED
10	1	LA 00011	LABEL, VENT
11	1	BOX 201614	BOX, 20 X 16 X 14"
12	1	PL0005	PALLET, SHIPPING
13	2	LA-8433	LABEL, SHIPPING
14	2	CT-01	TAG, CABLE TIE 7" LG
15	2	S-2028	TAG, 3.125 X 6.25 WEATHER RESISTANT
16	1	CPG-G739	INSTRUCTION SHEET

ITEM	PART NO	DESCRIPTION OR MATERIAL

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

DIM: X ± 1; .X ± 0.8; .XX ± 0.38

HOLE: 0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13

ANG TOL: ± 1.0° SCALE: 1/1

SIM TO .

DO NOT SCALE PRINT

- CONFIDENTIAL -
PROPERTY OF CUMMINS POWER GENERATION GROUP

DWN L_ARNOLD
CKD D_GILLETT
APVD D_GILLETT
DATE 02-13-07

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994

FIRST USED ON DSGAA,AB,AC

SITE CODE PGF

CUMMINS POWER GENERATION
1400 73RD AVENUE NE, MINNEAPOLIS, MN 55432

INSTALLATION KIT
VENT-EXT

DWG SIZE D | 0541_1467 | SHEET 1 OF 1 | DWG REV B

Pro/ENGINEER

Cummins Power Generation

Recommended Generator Report - 100DGDB

Project - Bay Meadows

Comments - San Mateo, CA

Site Address: Corner of Bermuda Dr. and Saratoga Dr.

Project Requirements

Frequency, Hz	60.0	**Generators Running in Parallel**	1
Duty	Standby	**Site Altitude, ft(m)**	361(152)
Voltage	277/480, Series Wye	**Site Temperature, °C**	25
Phase	3	**Max. Altr Temp Rise, °C**	125
Fuel	Diesel	**Project Voltage Distortion Limit, %**	10
Emissions	No Preference		

Calculated Individual Generator Set Load Running and Peak Requirements

Running kW	84.9	**Max. Step kW**	64.1 In Step 2	**Cumulative Step kW**	95.4
Running kVA	95.3	**Max. Step kVA**	136.0 In Step 2	**Cumulative Step kVA**	166.5
Running PF	0.89	**Peak kW**	None	**Cumulative Peak kW**	None
Running NLL kVA	0.0	**Peak kVA**	None	**Cumulative Peak kVA**	None
				Pct Rated Capacity	85.0

Generator Set Configuration

Alternator	UC3D	**Engine**	6BTA5.9-G4 Nonroad 2
BCode	B413	**Fuel**	Diesel
Excitation	PMG	**Displacement, cu in. (Litre)**	359(6)
Voltage Range	UBR 208-240/416-480	**Cylinders**	6
Number of Leads	12	**Altitude Knee, ft(m)**	8460(2579)
Reconnectable	Yes	**Altitude Slope, % per 1000ft(304.8m)**	4
Full Single Phase Output	No	**Temperature Knee, °F(°C)**	104(40)
Increased Motor Starting	No	**Temperature Slope, % per 10°F(5.56°C)**	1
Extended Stack	No	**Emissions**	No Certification

Set Performance		Load Requirements	
Running At	85.0% Rated Capacity		
Max. Step Voltage Dip, %	17	**Max. Allowed Step Voltage Dip**	20 In Step 2
Max. Step Frequency Dip, %	3	**Max. Allowed Step Frequency Dip**	7 In Step 2
Peak Voltage Dip, %		**Peak Voltage Dip Limit %**	20.0
Peak Frequency Dip, %		**Peak Frequency Dip Limit %**	7
Site Rated Standby kW/kVA	100 / 125	**Running kW**	84.9
		Running kVA	95.3
Site Rated Max. SkW	108	**Effective Step kW**	78.0
Max. SkVA	423	**Effective Step kVA**	166.5
Temp Rise at Full Load, °C	150	**Percent Non-Linear Load**	90.0
Voltage Distortion		**Voltage Distortion Limit**	10

*Note: Higher temperature rise at full rated load.

Note: All generator set power derates are based on open generator sets.

Loads and Steps Detail Report

Project - Bay Meadows

Comments - San Mateo, CA

Site Address: Corner of Bermuda Dr. and Saratoga Dr.

Project Requirements

Frequency, Hz	: 60.0	**Generators Running in Parallel**	: 1
Duty	: Standby	**Site Altitude, ft(m)**	: 361(152)
Voltage	: 277/480, Series Wye	**Site Temperature, °C**	: 25
Phase	: 3	**Max. Altr Temp Rise, °C**	: 125
Fuel	: Diesel	**Project Voltage Distortion Limit, %**	: 10
Emissions	: No Preference		

Calculated Individual Generator Set Load Running and Peak Requirements

Running kW	: 84.9	**Max. Step kW**	: 64.1 In Step 2	**Cumulative Step kW**	: 95.4
Running kVA	: 95.3	**Max. Step kVA**	: 136.0 In Step 2	**Cumulative Step kVA**	: 166.5
Running PF	: 0.89	**Peak kW**	: None	**Cumulative Peak kW**	: None
Running NLL kVA	: None	**Peak kVA**	: None	**Cumulative Peak kVA**	: None

Step1

Calculated Individual Generator Set Step Load Requirements

Running kW	: 27.0	**Starting kW**	: 38.0	**Cumulative Step kW**	: 38.0
Running kVA	: 31.0	**Starting kVA**	: 88.0	**Cumulative Step kVA**	: 88.0
Running Amps	: 37.0	**Starting Non-linear kVA**	: 86.0		
Running Non-linear kVA	: 0.0				
Voltage Distortion Limit for step	: 10				

Motor Load 1 Three Phase Quantity : 1 In this Step

Category : Motor

Running kW	: 25.43	**Starting kW**	: 36.0	**Peak kW**	: None
Running kVA	: 28.57	**Starting kVA**	: 85.71	**Peak kVA**	: None
Running PF	: 0.89	**Starting PF**	: 0.42	**Cyclic**	: No
Running Amps	: 34.41	**Max. % Voltage Dip**	: 20.0	**Max. % Frequency Dip**	: 7.0
Running NLL kVA	: 0.0				
Starting NLL kVA	: 85.71			**Voltage**	: 480

Shaft Hp	: 30.0	**Method**	: Solid State
Shaft kW	: 22.38	**Current Limit**	: 300.0
Efficiency (%)	: 0.88	**LRkVA Factor**	: 5.9
Design	: Standard NEMA Design B,C or D	**LRkVA Code**	: G
Rectifier Type	: 6 pulse	**THDI %**	: 26
		THDV %	: 10

Light Load 1		Three Phase	Quantity	: 1 In this Step
Category	: Light - Incandescent			

Running kW	: 2.0	**Starting kW**	: 2.0	**Peak kW**	: None
Running kVA	: 2.0	**Starting kVA**	: 2.0	**Peak kVA**	: None
Running PF	: 1.0	**Starting PF**	: 1.0	**Cyclic**	: No
Running Amps	: 2.41	**Max. % Voltage Dip**	: 20.0	**Max. % Frequency Dip**	: 7.0
				Voltage	: 480

Step2

Calculated Individual Generator Set Step Load Requirements

Running kW	: 32.0	**Starting kW**	: 64.0	**Cumulative Step kW**	: 92.0
Running kVA	: 36.0	**Starting kVA**	: 136.0	**Cumulative Step kVA**	: 167.0
Running Amps	: 44.0	**Starting Non-linear kVA**	: 86.0		
Running Non-linear kVA	: 0.0				
Voltage Distortion Limit for step	: 10				

Motor Load 2		Three Phase	Quantity	: 1 In this Step
Category	: Motor			

Running kW	: 25.43	**Starting kW**	: 36.0	**Peak kW**	: None
Running kVA	: 28.57	**Starting kVA**	: 85.71	**Peak kVA**	: None
Running PF	: 0.89	**Starting PF**	: 0.42	**Cyclic**	: No
Running Amps	: 34.41	**Max. % Voltage Dip**	: 20.0	**Max. % Frequency Dip**	: 7.0
Running NLL kVA	: 0.0				
Starting NLL kVA	: 85.71			**Voltage**	: 480

Shaft Hp	: 30.0	**Method**	: Solid State
Shaft kW	: 22.38	**Current Limit**	: 300.0
Efficiency (%)	: 0.88	**LRkVA Factor**	: 5.9
Design	: Standard NEMA Design B,C or D	**LRkVA Code**	: G
Rectifier Type	: 6 pulse	**THDI %**	: 26
		THDV %	: 10

Motor Load 4 - Blower		Three Phase	Quantity	: 1 In this Step
Category	: Motor			

Running kW	: 6.58	**Starting kW**	: 28.14	**Peak kW**	: None
Running kVA	: 7.56	**Starting kVA**	: 50.25	**Peak kVA**	: None
Running PF	: 0.87	**Starting PF**	: 0.56	**Cyclic**	: No
Running Amps	: 9.1	**Max. % Voltage Dip**	: 20.0	**Max. % Frequency Dip**	: 7.0
				Voltage	: 480

Shaft Hp	: 7.5	**Method**	: Across the line
Shaft kW	: 5.6	**Low Inertia**	: No
Efficiency (%)	: 0.85	**LRkVA Factor**	: 6.7
Design	: Standard NEMA Design B,C or D	**LRkVA Code**	: H

Step3

Calculated Individual Generator Set Step Load Requirements

Running kW	: 25.0	**Starting kW**	: 36.0	**Cumulative Step kW**	: 95.0
Running kVA	: 29.0	**Starting kVA**	: 86.0	**Cumulative Step kVA**	: 152.0
Running Amps	: 34.0	**Starting Non-linear kVA**	: 86.0		
Running Non-linear kVA	: 0.0				
Voltage Distortion Limit for step	: 10				

Motor Load 3 Three Phase Quantity : 1 In this Step

Category : Motor

Running kW	: 25.43	**Starting kW**	: 36.0	**Peak kW**	: None
Running kVA	: 28.57	**Starting kVA**	: 85.71	**Peak kVA**	: None
Running PF	: 0.89	**Starting PF**	: 0.42	**Cyclic**	: No
Running Amps	: 34.41	**Max. % Voltage Dip**	: 20.0	**Max. % Frequency Dip**	: 7.0
Running NLL kVA	: 0.0				
Starting NLL kVA	: 85.71			**Voltage**	: 480

Shaft Hp	: 30.0	**Method**	: Solid State
Shaft kW	: 22.38	**Current Limit**	: 300.0
Efficiency (%)	: 0.88	**LRkVA Factor**	: 5.9
Design	: Standard NEMA Design B,C or D	**LRkVA Code**	: G
Rectifier Type	: 6 pulse	**THDI %**	: 26
		THDV %	: 10

Steps and Dips Details Report

Project - Bay Meadows

Project Requirements

Frequency, Hz	: 60.0	**Generators Running in Parallel**	: 1
Duty	: Standby	**Site Altitude, ft(m)**	: 361(152)
Voltage	: 277/480, Series Wye	**Site Temperature, °C**	: 25
Phase	: 3	**Max. Altr Temp Rise, °C**	: 125
Fuel	: Diesel	**Project Voltage Distortion Limit, %**	: 10
Emissions	: No Preference		

Calculated Individual Generator Set Load Running and Peak Requirements

Running kW	: 84.9	**Max. Step kW**	: 64.1 In Step 2	**Cumulative Step kW**	: 95.4
Running kVA	: 95.3	**Max. Step kVA**	: 136.0 In Step 2	**Cumulative Step kVA**	: 166.5
Running PF	: 0.89	**Peak kW**	: None	**Cumulative Peak kW**	: None
Running NLL kVA	: 0.0	**Peak kVA**	: None	**Cumulative Peak kVA**	: None

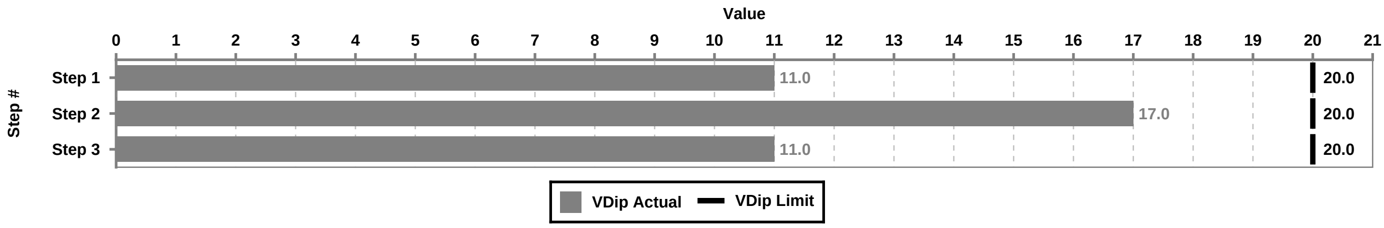
Generator Set Configuration

Model	: 100DGDB	**Alternator**	: UC3D
Engine Model	: 6BTA5.9-G4 Nonroad 2	**Excitation**	: PMG
Fuel	: Diesel		

Step Level Dips Summary

Step #	Voltage Dip Limit (%)	Expected Step Voltage Dip (%)	Voltage Recovery Time (s)	Frequency Dip Limit (%)	Expected Frequency Dip (%)	Frequency recovery Time (s)
1	20	11	0.1	7	2	0.1
2	20	17	0.1	7	3	0.1
3	20	11	0.1	7	2	0.1

Note: Please refer to the model Spec. sheet for bandwidths used to report recovery times. For products manufactured in the United Kingdom it may be assumed that recovery times are based on ISO8528-5 G2 class bandwidths.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2
3
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14
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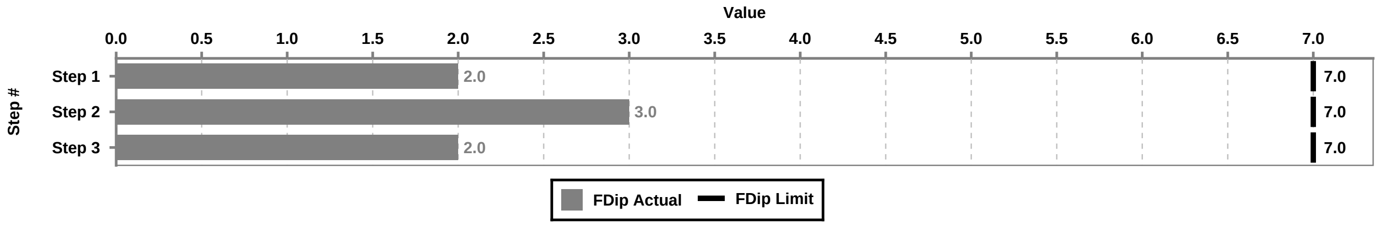
16
17
18
19
20
21
Step #
Step 1
Step 2
Step 3
11.0
17.0
11.0
20.0
20.0
20.0
VDip Actual
VDip Limit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2.5
3.0
3.5
4.0
4.5
5.0
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6.0
6.5
7.0
Step #
Step 1
Step 2
Step 3
2.0
3.0
2.0
7.0
7.0
7.0
FDip Actual
FDip Limit

Power Generation

Sound Data

100DSGAA 60Hz

Sound Pressure Level @ 7 meters, dB(A)

See Notes 1-8 listed below

Configuration		Measurement Location Number								Average
		1	2	3	4	5	6	7	8	
Standard-Unhoused (Note 3)	Infinite Exhaust	80.7	84.6	84.6	88.9	87.4	88.5	85.4	85.7	86.3
F182 - Enclosure-Steel, Weather Protective,with ExhSys	Mounted Muffler	82.0	87.6	87.9	89.2	86.4	88.4	86.2	85.6	87.1
F216- Enclosure-Aluminum,Weather Protective,w/Exh System	Mounted Muffler	82.0	87.6	87.9	89.2	86.4	88.4	86.2	85.6	87.1
F173 - Enclosure-Steel,Sound Att,Level 2,w/Exhaust System	Mounted Muffler	71.0	73.6	70.9	71.8	71.4	72.7	70.4	72.2	71.9
F217- Enclosure-Aluminum,Sound Att,Level 2,w/ExhSystem	Mounted Muffler	74.1	75.2	72.4	72.8	70.0	75.4	71.4	73.5	73.2
F232- Enclosure-Steel,Sound Att,Level 3,w/Exhaust System	Mounted Muffler	67.7	68.3	67.8	70.4	68.2	70.3	67.9	69.7	68.9
F233- Enclosure-Aluminum, Sound Att,Level 3,w/ExhSystem	Mounted Muffler	70.9	69.9	69.3	71.4	66.7	73.0	68.9	71.0	70.2

Sound Power Level, dB(A)

See Notes 2-6, 9, 10 listed below

Configuration		Octave Band Center Frequency (Hz)								Overall Sound Power Level
		63	125	250	500	1000	2000	4000	8000	
Standard-Unhoused (Note 3)	Infinite Exhaust	76.8	96.1	107.8	105.7	109.6	108.2	103.3	99.6	114.6
F182 - Enclosure-Steel, Weather Protective,with ExhSys	Mounted Muffler	88.4	99.6	106.7	106.5	111.0	109.0	105.0	102.6	116.0
F216- Enclosure-Aluminum,Weather Protective,w/Exh System	Mounted Muffler	88.4	99.6	106.7	106.5	111.0	109.0	105.0	102.6	116.0
F173 - Enclosure-Steel,Sound Att,Level 2,w/Exhaust System	Mounted Muffler	80.6	91.7	95.2	93.9	95.3	94.9	92.8	89.1	102.2
F217- Enclosure-Aluminum,Sound Att,Level 2,w/ExhSystem	Mounted Muffler	77.2	93.5	97.9	94.4	97.0	96.6	94.4	93.1	104.0
F232- Enclosure-Steel,Sound Att,Level 3,w/Exhaust System	Mounted Muffler	79.0	90.5	92.6	91.0	92.3	91.0	89.6	85.4	99.3
F233- Enclosure-Aluminum, Sound Att,Level 3,w/ExhSystem	Mounted Muffler	75.6	92.3	95.3	91.5	94.0	92.7	91.2	89.4	101.1

Exhaust Sound Pressure Level @ 1 meter, dB(A)

Open Exhaust (No Muffler Rated Load)	Octave Band Center Frequency (Hz)								Sound Pressure Level
	63	125	250	500	1000	2000	4000	8000	
	89.2	98.9	107.0	108.8	113.0	117.5	117.4	116.0	123.0

Note:

1. Position 1 faces the engine front. The positions proceed around the generator set in a counter-clockwise direction in 45° increments. All positions are at 7m (23 ft) from the surface of the generator set and 1.2m (48") from floor level.
2. Sound levels are subject to instrumentation, measurement, installation and manufacturing variability.
3. Sound data with remote-cooled generator sets are based on rated loads without cooling fan noise.
4. Sound levels for aluminum enclosures are approximately 2 dB(A)s higher than listed sound levels for steel enclosures.
5. Sound data for generator set with infinite exhaust do not include exhaust noise.
6. Data is based on full rated load with standard radiator-cooling fan package
7. Sound Pressure Levels are measured per ANSI S1.13 and ANSI S12.18, as applicable.
8. Reference sound pressure is 20 μPa.
9. Sound Power Levels per ISO 3744 and ISO 8528-10, as applicable.
10. Reference power = 1 pw (10^{-12} W)
11. Exhaust Sound Pressure Levels are per ISO 6798, as applicable.