Introduction:

This servo interface board has been introduced to facilitate straightforward control of servo drives from the AH-HA! PC based control system. It consists of a micro controller based position tracking system with analogue outputs to control the servo drive speed and to simulate a tachometer where needed. It derives its position from digital encoders.

Encoders:

The board may be set for several types of encoder. For those systems where encoders have not been previously fitted it is recommended to use a type with differential 5 volt line driver outputs. Encoders with single outputs or with open-collector outputs may also be used but are less immune to electrical interference.

NB. differential encoders have six output signals CHA,*CHA, CHB, *CHB, CHZ & *CHZ, while single ended encoders have three output signals, CHA, CHB & CHZ.

Settings:

This section describes the setting links and the digital rotary switch settings. If you are not sure if your encoders have open collector or differential line driver outputs set the system up for open collector. Once the system is working correctly try setting up as differential line driver. If it does not then work correctly go back to the open collector settings.

LK1	makes connection from the 5 volt common to the on board analogue common. Normally fitted.
LK2/3/4	as a group, sets board for the type of encoder output on channel A. for differential line driver encoder outputs: set LK2 to A-C (Left), LK3 to A-C (Left), remove LK4. for differential open collector encoder outputs: set LK2 to C-B (Right), LK3 to C-B (Right), remove LK4. for single ended line driver encoder outputs: set LK2 to A-C (Left), LK3 to C-B (Right), fit LK4. for single ended open collector encoder outputs: set LK2 to C-B (Right), LK3 to C-B (Right), fit LK4.
LK5/6/7	as a group provide the same facilities as LK2/3/4 but for channel B.
Note	The reference to left and right link setting is with the board mounted with text horizontal and the terminals to the right.

LK8	Multiplication of encoder pulses by 1 when fitted Multiplication of encoder pulses by 4 when omitted.
LK9	When fitted enables detection of certain encoder faults but can only be used with differential encoder inputs.
LK10	selects totally linear output (a-b) or a modified slope with higher gain at low levels (b-c).
GAIN	allows the speed command to be adjusted so that the axis runs smoothly without hunting or overshoot on position.
DERIV	allows a certain amount of initial 'kick' when the axis speed is changed.
INTEG	allows a certain amount of correction for small errors at constant speed.
MPYR	allows the step input pulses to be multiplied by an integer of 1 to 16 to match the step size to the encoder pitch. 0 = x 1, 1 = x 2 etc.
TACH	varies the ratio between the encoder frequency and the Tacho output. It should be noted that maximum tacho output is plus/minus 10 volts so that this must be adjusted on commission to restrict this to the above limit.

LED Indicators:

LED1	shows power to board.
LED2	On when board is operating under control. Off when position error exceeds the counter limit.
LED3/4/5	give a binary representation of the position error (lag), LED3 being the least significant digit. During rapid traverse LED3 & LED4 may be expected to be on. When all three are on then the position counter is likely to be exceeded.

Maximum input step frequency 10 Khz (After any multiplier)

Maximum Encoder input frequency 1Mhz

Maximum Count 2,000,000,000

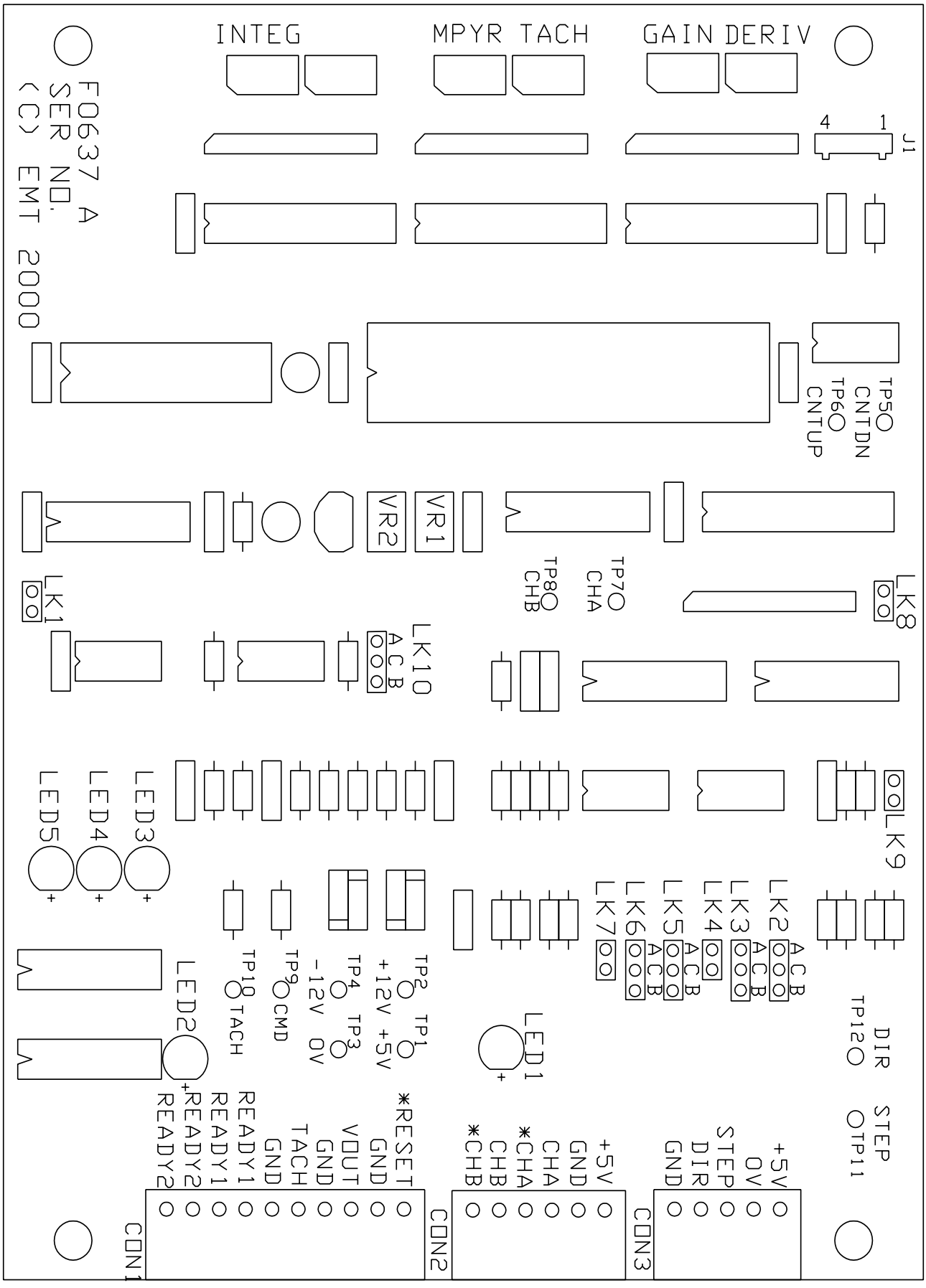
INTEG
MPYR TACH
GAIN DERIV
F0637 A
SER NO.
(C) EMT 2000
J1
4
1
TP5
CNTDN
TP6
CNTUP
VR2
VR1
TP8
CHB
TP7
CHA
LK8
LK1
LK10
A C B
LK9
LED3
LED4
LED5
LK2
LK3
LK4
LK5
LK6
LK7
TP10
TACH
TP9
CMD
TP4
-12V
TP3
0V
TP2
+12V
TP1
+5V
LED2
LED1
DIR
TP12
STEP
TP11
*RESET
GND
VOUT
GND
TACH
GND
READY1
READY2
+READY2
READY1
READY2
CON1
*CHB
CHB
*CHA
CHA
GND
+5V
CON2
GND
STEP
DIR
0V
+5V
CON3

Figure 1

Connections:

Assuming that the encoders used are rated at 5v DC, for F0637A boards provide a regulated (+/-5%) 5volt dc power of 200 milliamps plus encoder load per axis.
Encoder 5v output is available at CON2-6 (+5v) and CON2-5 (0v).
For encoders with single ended outputs connect channel A to CON2-4 & channel B to CON2-2.
For differential encoders connect channel A to CON2-4 with its complement to CON2-3. Channel B to CON2-2 with its complement to CON2-1.
The STEP & DIR inputs should be connected to the signals for the relevant axis and should be open-collector or 5v logic level signals. EMT PCB F0598 provides these outputs on T3-3 to 6 and T4-3 to 6.
The signal return path for the step and direction must be provided by connecting CON3-4 (0v) to the Drive Logic Common on the EMT PCB F0598 T4-1.
A connection should also be made from CON3-5 (+5v) to the Step Diode Common on the EMT PCB F0598 T4-2. This completes the circuit to the diode suppression in the driver IC.

The *RESET input should be connected to a normally open push button switch (usually a contact of machine on/reset) with the other terminal connected to 0v (CON3-4).
Command output (CON1-7 & 8) should be connected to the speed input of the servo drive, being careful to observe polarity, with screened cable whose screen is earthed at the drive rack.
Tacho output (CON1-5 & 6) where needed should be connected to the tach input of the servo drive, being careful to observe polarity), with screened cable whose screen is earthed at the drive rack.
The Ready contacts of all axes should be connected in series and put in series with the Estop latching circuit so that if any axis goes not ready the Estop relay should be unlatched.
The READY contacts are potential free normally open, closing when ready, rated at 100v dc, 0.5amp max.

Commissioning:

NOTE: during commissioning there is a strong possibility that the axis being commissioned may run away out of control so be sure to check dead stops are functioning and that the axis has as much travel as possible in both directions.

During commissioning it is advisable to restrict the process to one axis at a time.

Ensure links are set as required from the descriptions above and set the following as a starting point on the rotary switches:-

GAIN	set to 5.
DERIV	set to 0.
INTEG	set to 0.
MPYR	set to 0 (multiplication of 1).
TACH	set to 0 if not used otherwise set to 5.

If the servo has its own tacho, or being an AC drive does not need one, then if possible set up the speed loop with a battery box and aim for rapid traverse to be with a command of between 6 & 9 volts.

For a system using the on board tacho then it may be necessary to re calibrate the drive for a tacho signal of +/- 9 volts at maximum speed. This should be done according to the drive manufacturers documentation with regard to the maximum allowable motor speed and the expected rapid traverse of the axis at the gear ratio involved.

For a system using only the command output from the board the next step is to power up the complete axis and watch for any sign of runaway. If the axis stays put, then attempt to jog it slowly but be ready for runaway. If the axis does run away then it is likely that the encoder is providing positive feedback instead of negative feedback so power off and reverse the encoder signals as follows. For single ended encoders swap the connections to CHA & CHB (CON2-4 & 2). For differential encoders swap the connections to CHB & *CHB (CON2-1 & 2).

If the axis stays in position, check LED2 is on (board enabled) and carefully check that servo is live, but be prepared for sudden movement.

Once the axis is under some control then attempt to jog the axis back and forth to check the response. At this stage the displacement of the axis should be checked over a distance of at least 100 mm for linear axes or 90 degrees for rotary. Any discrepancy should be corrected by adjusting steps per inch on the PC and/or the MPYR control.

Having established correct movement and direction, set up a program to move the axis back and forth over 100mm/90degrees at a feedrate of 50% of rapid with a 1 second dwell at the end of each move. Run the program and if the onboard tacho is being used set the tacho output to between 2.5 and 4.5 volts by adjusting TACH, also set the command voltage during movement to between 2.5 and 4.5 volts by adjusting the GAIN switch.

Also check that there is no instability in the axis at any stage during the execution, if so small adjustments of the GAIN switch may cure it, or the drive may have a stability or time constant control.

If an oscilloscope is available then observation of the tacho signal may show whether or not an amount of DERIV may assist in achieving a rapid acceleration without undue overshoot or undershoot.

The effects of the INTEG control may also be observed - it is likely that too much will cause instability - but a small amount may assist in ‘pulling’ the axis into final position at the end of its move.

The boards are supplied with VR1 & VR2 ready set but if a check is needed then adjust immediately after power on and before the drives are enabled as follows:-

VR1 - connect voltmeter across VOUT & GND and adjust for a reading less than + or - 10 millivolts.

VR2 - connect voltmeter across TACH & GND and adjust for a reading less than + or - 10 millivolts.

Record Sheet:

Machine:

Axis:	X	Y	Z	A/W
Step/inch				
Max. step rate				
Acceleration				
Rapid trav. m/min.				
Encoder PPR.				
DERIV				
GAIN				
TACH				
MPYR				
INTEG				
LK8	On l Off	On l Off	On l Off	On l Off
LK9	On l Off	On l Off	On l Off	On l Off
LK2	Left I Right	Left I Right	Left I Right	Left I Right
LK3	Left I Right	Left I Right	Left I Right	Left I Right
LK4	On l Off	On l Off	On l Off	On l Off
LK5	Left I Right	Left I Right	Left I Right	Left I Right
LK6	Left I Right	Left I Right	Left I Right	Left I Right
LK7	On l Off	On l Off	On l Off	On l Off
LK10	On l Off	On l Off	On l Off	On l Off
LK1	On l Off	On l Off	On l Off	On l Off
VOUT @ rapid				
TACH @ rapid				

NB Odd link order is to match location on PCB top to bottom