# ART RADIO MODEM SERIES

ADVANCED
RADIO
TECHNOLOGIES

**RFDataTech**

*The "State of the Art" ART Series was designed as a result of extensive market research. The product will therefore fit into almost any system operating on licensed, or license-exempt data and telemetry channels in the VHF, UHF or 900MHz bands.*

*The unique feature of the ART Series is the advanced microprocessor with integrated "SoftModem" which enables all of the radio's parameters to be controlled by software.*

*A large flash memory and E²PROM enables software upgrades, code changes or bespoke client code to be programmed via the serial port or over the radio link. As a further enhancement, the ART has individual synthesisers for the receiver and transmitter to enable full duplex operation, but in the semi-duplex mode the receiver can be left on to achieve a very fast turnaround time.*

## MODES OF OPERATION AND PROTOCOL HANDLING

### OPERATION

### Simplex and Duplex Operation

The ART can be supplied for simplex, semi-duplex with single or dual antenna operation, or full duplex dual antenna operation. For single antenna full duplex operation an external duplexer will be required.

### Store and Forward or Repeater Operation

The ART can be used in a single or dual configuration for Store & Forward messaging or dual for a Repeater. In Store & Forward operation the message is received, the address checked and is only forwarded if the address matches one in the routing table. In the Repeater mode, any message being received will be passed on with only a few data bits of delay.

### MODES AND PROTOCOL HANDLING

The various operating modes are as follows:

### Dumb Mode

The radio has no knowledge of the data it is transmitting; data is simply transmitted and received under hardware control with the option of RTS control or initiation of transmit after receipt of serial data, with CTS providing an optional flow control.

This configuration is useful when expanding older systems where the radios must be compatible with others of a different manufacture.

### Frame Specific Mode

The radio recognises a complete frame and only transmits and receives data conforming to that format. No addressing of radios or routing of data is performed. Protocols such as MODBUS, DNP3 and IEC can be supported in this way.

### Protocol Specific Mode

The radios recognise a protocol specific frame and the address to which the frame is to be sent. Routing information must be stored in any radio that originates a call. Any radio in the system can operate as a repeater. The radio does not perform any acknowledgement or retries. Any protocol using a fixed address field such as MODBUS or DNP3, etc can be supported.

### Dial Up Mode

Hayes protocol is used to dial up the radio link which may include repeaters or store & forward stations. The route information is not stored but is passed in the dial up command in the form of a telephone number. Once the link is established it is transparent and therefore independent of the protocol being transported. This allows point to point protocols such as SLIP and PPP (and hence TCP/IP) to be conveyed. The dial up mode is less efficient for small data transactions because of the data transactions carried out during the connect and disconnect operation.

### Custom Protocol

Custom protocols can be written and downloaded via a PC or over the air as systems require change, thereby minimising disruption. Should a special protocol or interface be required please contact the sales office.

## CHANNEL SELECTION

The ART Series can be PC programmed with up to 80 channels. Alternatively, complete band allocations like the UK MPT1329 and MPT1411 bands, can be downloaded and stored within the radio. Once programmed, channels can then be selected via rotary switches on the front panel (or via the keypad on the display version), from a PC program, via the serial port or over the radio link.

## PROGRAMMABILITY

All the parameters of the ART Series can be programmed via the serial port using either DOS or Windows 95/98 based software or over the radio link via the ART's secure "over air programming mode". The individual program can be stored on disc for future use or printed.

## INTERNAL/EXTERNAL MODEM OPERATION

Both internal and external modems are supported: the external interface provides both flat and de/pre-emphasised response for compatibility with older systems.

### Internal Soft Modem
Data is presented to the modem via the RS232/TTL port at speeds between 150 and 38400 and then transmitted at the programmed baud rate. Buffering is provided when the data rate is higher than the transmission rate.

The ART features a full duplex internal "soft modem" which offers unparalleled performance and flexibility over a wide range of speeds and formats and enables future formats to be downloaded from a PC or over the air. Within a 12.5KHz channel, the unit can be programmed for 150, 300, 600, 1200 and 2400bps FSK/FFSK with Bell202 and V23 supported, 4800bps GMSK and 9600bps 4 Level FSK.

### External Modem Applications
In external mode the 600 ohm input and output will accommodate a programmable range of +3dBm to –30dBm. The output can be muted in the absence of a carrier.

### Tone Operated Switch (TOX)
When using an external modem via the 600 ohm port, the soft decoder within the ART can be programmed to detect incoming FFSK or PSK signals. Once detected the transmitter will key up and pass the incoming data.

## POWER SAVE MODE

The ART Series has both internal and external power save modes.

### Internal Power Save Mode
The microprocessor controls the on/off function of the receiver and after a pre-programmed time the MPU will switch on the receiver to look for a carrier. If a carrier is not detected then the transceiver goes back into sleep mode. If during the time the transceiver is awake a carrier is received, the unit will stay awake. After the carrier drops out, the receiver will stay awake until the programmed resume time elapses. Once the resume time has elapsed the transceiver will go back into sleep mode. The save ON/OFF and resume time are all programmable via the PC program.

### External Power Save Mode
In the external mode the ON/OFF function of the modem is controlled by the host via the DTR line.

### Time Scheduling using the RTC
The ART contains an embedded Real Time Clock that can be used to wake the radio modem to process information, report back or be ready for a poll. The RTC can be synchronised during the wake-up communication for accurate time slotting.

## AUTOMATIC FREQUENCY ADJUSTMENT

With the Network Management software, the RX and TX frequencies of outstations and repeaters can be checked and compared with the base station's frequency. If the offset is large, simply pressing a button will automatically lock and re-align all the outstations and repeaters to the frequency of the base station. The new parameters are then stored in EEROM. This minimises the effects of any long term frequency drift (ageing).

## SQUELCH TAIL ELIMINATION

For old or non tolerant protocols, where the presence of a mute (Squelch) tail may cause dribble bits at the end of a message, a simple packetising option can be enabled from within the PC programming software.

## FORWARD ERROR CORRECTION
Forward error correction is a programmable option at 9600bps, but as with all FEC's, the overhead will reduce through put. However, since the "SoftModem" offers many data speeds, data integrity can be improved simply by running at a lower speed.

## "RSSI" RECEIVE SIGNAL STRENGTH INDICATION

The RSSI signal is accurately measured by an internal A-D converter and compared to an individually calibrated RSSI graph held within the processor. The signal strength can then be accurately read in dB micro volts from a PC connected to the serial port or remotely over the air. In the case of the LCD version the level can be directly read from the display. Alternatively the raw 0-5VDC relative to the RSSI is available on one of the connectors.

## RF POWER

The ART's are available in two power ranges: 10mW to 1750mW for ultra low power requirements, and 50mW to 5 Watts. Calibrated RF power levels are PC and over air programmable directly in Watts & Milli-watts with an accuracy of +/-1dB.

## STATUS LEDs

The ART has 11 LEDs to enable the operator to see at a glance the status of the radio, serial port and hardware/software. The System LED provides the operator with a quick visual health check and if the software detects an error, a code is flashed on the LED to indicate the error and the radio will reset. The fault can then be determined simply by counting the number of flashes and looking up the error code in the installation, operation and programming manual. If the error persists the radio will stay in the error mode permanently.

## TX TIME-OUT TIMER

The transmitter within the ART has a time-out timer which allows the maximum continuous transmission time to be set in order to prevent channel blocking due to a fault. The timer operates in all modes and can be programmed in one second steps between 0 and 255 seconds. If programmed and the time is exceeded, transmission will cease until the action that normally causes transmission is removed and then re-applied.

## CONTROLLER FOR A FULLY DUPLICATED OUTSTATION

Two ART's can work in a fully duplicated mode for critical outstation applications with the aid of an ART790 DIN bay-changer module.

## INPUT VOLTAGE AND TEMPERATURE MEASUREMENT

The input Voltage and internal Temperature can be measured and read from a PC connected to the serial port or over the radio link by using the Network Management software.

## EXTERNAL I²C BUS

The ART Series features an I²C bus which is used to communicate with other modules over short or medium distances. The main feature of the bus is its address mode, which will only wake up modules that are being addressed, thereby ensuring low power operation.

## LOCAL/EXTERNAL I.O.

The ART Series has two local inputs and two outputs that can be read and configured respectively from the Network Management Software. For additional analogue or digital I.O. the ART700 Series of I.O. modules can easily be connected to the external I²C bus interface.

## PC SOFTWARE

Dedicated PC software packages for Programming, Installation, Network Management and Service have been written to run under DOS or Windows 95/98. These packages provide unrivalled versatility combined with ease of use for the user.

# TECHNICAL SPECIFICATIONS

## General

| | | |
|---|---|---|
| Frequency Range: | ART170TR | 138 – 175MHz |
| | ART400TR | 406 – 512MHz |
| | ART200TR | 175 - 250MHz |
| | | (Special Order) |
| | ART900TR | 820 – 950MHz |
| | 50MHz – 950MHz available on special order | |

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|---|---|
| Power Requirements: | 12VDC (10V – 15.5VDC) |
| Receiver | Duplex 100mA |
| | Simplex 70mA |
| Power saved | 100uA |
| Transmitter | 5Watts 2Amps |
| | 500mW 675mA |
| | 50mW 300mA |

Number of Channels: 80 user programmable frequencies

Min. Programmable
Channel Step: 6.25 or 5KHz

Channel Spacing: 12.5KHz, 20KHz or 25KHz

Operating Temp.
Stability: 2ppm –30 to +60ºC

Construction: Milled aluminium enclosure

Size: 160mm W x 125mm L x 45mm H

Mounting: DIN or can be screwed to a flat surface

Weight: 750gms

| Connectors: | RS232: | 9 Way "D" Type |
|---|---|---|
| | 12VDC | 2Way Klippon Type |
| | I.O. | 8Way Klippon |
| | Line | 4Way Klippon |
| | I 2 C | 10Way RJ45 |
| | RF | BNC |

Led Indicators: TX, BUSY, SYSTEM, RXD, TXD, RTS, CTS, DCD,DTR,DSR,RI

| Approvals: | The products have been designed to meet the following approvals: *(for full information please contact the sales office)* |
|---|---|
| | UK | MPT1411 |
| | European | ETS EN300-220 |
| | | ETS EN300-113 |
| | | ETS EN300-086 |
| | CE: | ETS EN301-489 |
| | Australian: | AS4268.2-1995 |
| | USA: | FCC Part 90/15 |
| | Canadian: | DOC |

## Transmitter

| RF Output Power: | 1Watt unit: | 10mW to 750mW |
|---|---|---|
| | 5watt unit: | 50mW to 5 Watts |
| | Type is signified by ART400TR–1 or –5 | |

| Bandwidth: | Without re-alignment: | VHF | 10MHz |
|---|---|---|---|
| | | UHF | 12MHz |
| | | 900MHz | 30MHz |

Digital Mod: 2 Level FFSK/FSK, 4 level FSK, and GMSK via the internal modem

| | |
|---|---|
| Analogue Mod: | Programmable over the range +3dBm to –30dBm into 600ohm, with a programmable pre-emphasised or flat response. |
| Max. Deviation: | ± 7.5KHz max |
| Adj. Channel Power: | >65dB at 12.5KHz |
| Hum and Noise: | >-37dB |
| Spurious Emissions: | <250nW and 4nW in specified bands |
| Transient response: | As per ETS 300-113 |
| TX Rise Time: | <5mS |

## Receiver

| | |
|---|---|
| Sensitivity: | -120dBm for 12dB SINAD De-emphasised response -116dBm for 12dB SINAD Flat response |

| Bandwidth: | Without re-alignment | VHF | 5MHz |
|---|---|---|---|
| | | UHF | 12MHz |
| | | 900MHz | 20MHz |

| | |
|---|---|
| Spurious Response: | >77dB |
| Blocking: | >90dB relative to 1uV |
| Intermodulation: | >70dB |
| Adjacent Channel: | >65dB at 12.5KHz |
| IF Frequencies: | 45MHz and 455KHz |
| Spurious Emissions: | <ETS300-220/113 |
| Audio Output: | programmable over the range +3dBm to –30dBm into 600 ohm, with a programmable de-emphasised or flat response |
| Mute Response Time: | <2mSec |

## Internal Modem

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|---|---|
| Serial Interface: | Asynchronous or Synchronous with custom software Baud rate programmable between 150bps and 38400bps |
| | Interface selectable for RS232 or 5V TTL, inverted/non-inverted Programmable; Odd, Even or No Parity, 1/2 stop bits, 7/8 data bits. |
| Radio Baud Rate: | 150 – 9600bps within 12.5KHz |
| Signalling Formats: | Programmable within a 12.5KHz channel: FFSK, V23, Bell202 up to 1200baud, 2400 baud uses coherent 1200/2400Hz (1200/1800Hz by special order) GMSK at 4800 baud 4 Level FSK at 9600 baud |
| NRZI: | On or Off |
| Bit Error Rate: | 2400 baud, less than 1 in 10-3 at –120dBm 4800 baud, less than 1 in 10-3 at –117dBm 9600 baud, less than 1 in 10-3 at –115dBm |
| F.E.C. | Programmable on/off at 9600 bps |

*In the interest of improvement the above specifications are subject to change without notice.*