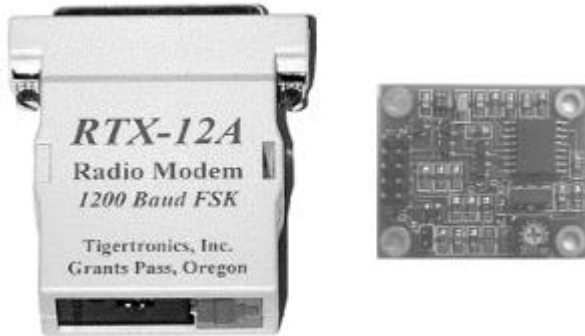




# Model RTX-12 Radio Modem

154 Hillview Drive Grants Pass, Oregon 97527 (541) 474-6700 Fax: (541) 474-6703



## - INTRODUCTION -

The RTX-12A and RTX12OEM are half-duplex 1200 baud radio modems, designed especially for telemetry and remote data transfer applications using inexpensive "voice grade" radios. While the standard RTX modem is Bell 202 compatible, an optional CCITT v.23 model is available. The RTX modems provides an inexpensive solution to interfacing computers and microcontrollers to radio links. The modem utilizes FSK audio tones to provide reliable communications over narrow bandwidth channels. The modem is easily interfaced to radios designed for either telemetry or voice communications (hand-held, mobile or base). The data interface is designed to be compatible with both standard RS-232 levels and CMOS logic levels. The total power consumption is less than 25 milliwatts, making it ideal for battery powered applications. When operated from a standard RS-232 port, no external power source is required. The modem has its own micropower voltage regulator, allowing it to operate from a single polarity unregulated power source as low as +4.8 volts. Thus, it can be powered directly from the +5 volt logic supply in microcontroller applications.

The RTX-12 is available in two different versions: The RTX-12A and the RTX-12OEM. Both versions are functionally and electrically identical. The only difference between them is their physical layout and the connectors used for the radio and data interfaces. The RTX-12A is packaged in a custom injection molded case and is designed to plug directly into a standard 25-pin RS-232 serial port. Connection to the radio is through an RJ-11 connector (cable included). The RTX-12OEM model is intended for embedded applications and is provided without an enclosure. This modem is extremely small (1-1/4" x 1-1/2") and is easily installed inside other equipment. A single 10-pin header provides connections for both the radio and controller. An optional color coded ribbon cable is available for this modem.

Both the RTX-12A and the RTX-12OEM are normally supplied with full transmit and receive capability. However, in high volume applications, either modem can be specially ordered in a Transmit or Receive *Only* version.

## - RADIO INTERFACE -

The radio interface on the RTX-12 consists of four signal lines and is described in detail below. Please refer to the "Specifications" section for the specific connector and pin-out used with each version of the modem.

*Ground* - This is the signal ground for both microphone and receive audio from the radio. It is also connected to power ground in the modem.

*PTT* - This line is used to "key" the transmitter. The modem switches this line to ground with a FET transistor, when it receives a transmit command. The transistor can "sink" currents as high as 50ma. When interfacing older radios that use mechanical switches (relays) in the PTT circuit, precautions must be taken to insure that voltage and current limits are not exceeded (see specifications). Special provisions have been made to key the PTT of some "hand-held" radios. See the "HT Operation" section for details.

*Rx Audio* - This is the receive audio input to the modem. It is high impedance and capacitively coupled inside the modem. The nominal input level is 300mv p-p. A factory option is available to attenuate this input and/or provide a lower impedance if required. Care should be taken not to overdrive this input (see specifications).

*Mic Audio* - This is the transmit audio output from the modem. The output is capacitively coupled and should be connected to the microphone input of the radio. The level of this output can be adjusted by the "LEVEL" control on the RTX-12 from zero to 290mv p-p (Hi Z). The output is factory adjusted to 20mv p-p into a 1000 ohm load. This level should be correct for most modern radios that use "electret" type microphone inputs. A factory option is available to modify the output level.

*CAUTION* - Be sure that the cable you plug into the RJ-11 connector (RTX-12A only) does not have the wires in reverse order! Verify the orientation as follows: When viewing the connector from the rear of the RTX-12A, oriented such that the release lever is UP, the left most wire MUST BE YELLOW.

## - DATA INTERFACE -

The data interface on the RTX-12 consists of the six signal lines described below. Please refer to the Specifications section for the specific connector and pin-out used with each version of the modem.

*Transmit Data* - Data from computer/microcontroller to the modem. This input will accommodate either standard RS-232 levels (+/- 12v) or CMOS logic levels (0/+5v). This input is high impedance (see specifications).

*Receive Data* - Data output from modem to computer/controller. Output levels are RS-232 compatible or CMOS logic depending on the state of the Negative In / PTT line (see below).

*Negative In / PTT* - This input determines the low voltage level available from the Receive Data pin during receive operation of the modem. For RS-232 applications, this input should be set to a low level (-12v) by the software, during receive. In logic level applications (CMOS), it should be held at a low level (0v) during receive. This input is also used to signal a transmit command to the modem (PTT). Raising this input to a high level (+12v/RS-232 or +5v/CMOS) will cause the modem to enter transmit mode. In this condition, the PTT keying transistor will be turned on and the FSK modulation will be active on the microphone input of the radio.

*Carrier Detect* - This output from the modem indicates the presence of valid carrier (tones) from the receiver. This output can be monitored by the software to determine when valid data is available. This output is low when carrier tones are detected and high state when carrier is not present.

*Ground* - This pin provides both signal and power grounds to the modem.

*Positive Supply* - This input provides operating power to the modem. In RS-232 applications, this pin should be held in a high state (+12v) by the software at all times. In logic level applications, connect this pin to any convenient source of positive voltage (see specifications). Direct connection to a +5 volt logic supply is satisfactory. The power supplied to this pin is regulated within the modem, so an unregulated source of power may be used (battery).

## - HT OPERATION -

If you are connecting the RTX-12 to a hand-held radio, you may find that there is no separate PTT input line. Many of these radios key the PTT by grounding the microphone input line through a resistor. If this is the case in your installation, you can activate an internal PTT keying resistor (2.7K) by installing a shunt across the HT jumper on the modem. This jumper is located on the rear of the RTX-12A, and just to the side of the 10-pin header on the RTX-12OEM. If you use the keying resistor option, you

should not attach anything to the PTT line at the radio end of the cable. If the modem's internal keying resistor value is not appropriate for your radio, you should not install the shunt, but rather install the correct value resistor between the PTT and Mic Audio lines at the radio interface. Note that radios specifying a higher value for the keying resistor, will work with the lower value. Radios requiring an external resistor are very rare. *Note:* When using hand-held radios, it is very desirable to install an external antenna. If at all possible, the antenna should be located at least ten feet from the radio and computer. This will prevent the intense RF field generated by the transmitter from interfering with the proper operation of the modem and computer. *Warning:* Excessively high levels of RF can permanently damage your equipment.

## - CALIBRATION -

All critical functions within the modem are controlled by a precision quartz crystal and will never require calibration. Normally, the only adjustment that may be required by the user is the LEVEL adjust on the modem. While this level has been factory adjusted to the correct level for most radios, there may be instances where adjustment is necessary. In such cases, the level should be set to provide a transmitter deviation of 3.5 to 4.0 KHz. Generally, the lower deviation level is better. Note that this is less deviation than would be appropriate for voice communications. The lower deviation provides superior phase distortion characteristics for data transmission, resulting in lower data error rates.

## - SOFTWARE CONSIDERATIONS -

Because the RTX-12 is a general purpose radio modem, the software required for its use will vary according to your specific application. We have supplied a test program (RTXDEMO.EXE) on the installation disk that will allow you to exercise the modem for test purposes. We have also included sample source code for transmit and receive routines (RTXSRC.BAS), written in POWER BASIC. This code is meant only to be a starting point for those who contemplate writing their own software. If you require extensive software support, Tigertronics may be able to provide consulting services or recommend a third party software developer who can meet your needs. Contact our Tech Support Department for further details.

If you are writing your own software for the modem, the following basic guidelines should be considered:

*Transmit* - It is important to remember that it takes some finite time for the transmitter to become operational after keying. It will also take some amount of time for the receiver at the other end of your link to detect the transmitted signal and open its squelch, allowing audio to pass to the modem. In addition, the modem requires time to lock on to the signal before decoding begins. As a result, your software must key the transmitter a moment before data transmission begins, to prevent data loss. This time

delay is called  $\delta$ TXDELAY and will vary with the specific equipment employed. Typical times will be on the order of 300ms.

You must also allow the transmitter to remain keyed momentarily after data transmission stops, so that the receiving software sees a clear separation between the end of valid data and the burst of noise it receives when the transmit carrier drops and the receiver squelch activates. We call this delay  $\delta$ TAIL. It can generally be shorter than TXDELAY and will normally be on the order of 200ms.

Depending on your specific application, hardware and software, you may be able to shorten these times significantly. For instance, if a constant carrier is sent, you will not need them at all.

*Receive* - To receive without error, your software must be able to identify the TXDELAY and TAIL periods. TXDELAY detection tells your software that data will soon follow. TAIL detection signals the end of valid data and warns that a burst of noise will probably appear when the transmitted carrier drops. In some applications you may find the  $\delta$ carrier detect signal helpful in detecting these events. The carrier detect signal will be  $\delta$ low when the carrier is detected and  $\delta$ high when no carrier tone are present. Your software should detect a  $\delta$ stable carrier signal for some time before processing data.

#### - LIMITED WARRANTY -

Tigertronics warrants the RTX-12 modem to be free of defects in material and workmanship for a period of 90 days from the date of shipment. Tigertronics will repair or replace, at its option, any parts found to be defective during the warranty period. This warranty does not include any unit which has been subject to misuse, neglect, improper installation or operation. This warranty is in lieu of all others, express or implied, and no person or representative is authorized to assume for Tigertronics any other liability in connection with the sale or use of this product. Tigertronics will not be responsible for any expense or loss of revenue or property incurred by the user due to operation or malfunction of this equipment. Tigertronics reserves the right to make circuit or component changes, or to incorporate new features, at any time, without obligation.

#### - RETURN POLICY -

A Return Material Authorization Number (RMA#) must be obtained from the factory before any product will be accepted for return or repair. Items received at the factory without an RMA# clearly marked on the OUTSIDE of the package WILL NOT BE ACCEPTED. Items being returned must be sent prepaid. Returned items should have a tag attached showing the RMA#, customer name, return address, phone number, and action requested. Units being returned for warranty repair must be accompanied by a copy of the original sales invoice showing the date of purchase.

Customers wishing to return a product for refund, for ANY reason, must receive an RMA# within 15 days from the shipping date shown on the original sales invoice. Customers returning products for refund will be charged a Restocking Fee equal to 20% of the purchase price, to cover the cost of re-testing and re-stocking. Products which have been damaged or modified in any way, may not be returned. Contact our Technical Support department for the RMA#.

#### - TECHNICAL SUPPORT -

Technical Support for this product is available by calling our Support Hotline at (541) 862-2639 any Monday, Wednesday, or Friday between 1 PM and 5 PM (PST).

#### - FCC STATEMENT -

TIGERTRONICS, INC.

FCC ID: EVFRTX12

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

*Caution:* Changes or modifications not expressly approved by the party responsible for compliance could void the users authority to operate the equipment. To meet FCC requirements, shielded cables are required to connect this device to a personal computer or other Class B certified device.

**- RTX-12A CONNECTIONS -**

**Data Connector (DB-25S):**

Pin #2 (TXD)	-	Transmit Data Level: RS-232 (+/- 15v max) CMOS (0/+5v typ)
Pin #3 (RXD)	-	Receive Data Level: RS-232 (+/- 3v min) CMOS (0/+4.7v typ)
Pin #4 (RTS)	-	Negative In / PTT Level: RS-232 (+/- 4.7v min) CMOS (0/+4.7v typ)
Pin #6 (DSR)	-	Carrier Detect Level: RS-232 (+/- 3v min) CMOS (0/+4.7v typ)
Pin #7 (GND)	-	Power/Digital Ground
Pin #20 (DTR)	-	Positive Supply Input: +4.8 volts (min) +15 volts (max) Current: 5 millamperes (typ)

**Radio Connector (RJ-11):**

Pin #1 (Yellow)	-	Mic audio  Output Level: 0 - 290 mv p-p (Hi Z) 0 - 80 mv p-p (1K ohm) Factory Set: 20 mv p-p (1K ohm)
Pin #2 (Green)	-	Receive Audio  Input Level: 300 mv p-p (nom) 780 mv p-p (max) Input Z: 50K (typ)
Pin #3 (Red)	-	PTT Output  Output Level: Sink 50ma (max) Output Voltage: 15 volts (max) Output Type: Open Drain (FET)
Pin #4 (Black)	-	Ground
øHTö Jumper	-	Connects 2.7K resistor between the PTT and Mic Audio lines for keying some hand-held radios. See notes in øHTö section.
øLEVELö	-	Adjustment on modem that adjusts transmit audio (deviation) level.

**- RTX-12OEM CONNECTIONS -**

**Data Connector (10-pin header):**

Pin #1 (GND)	-	Power/Digital Ground (Brown)
Pin #2 (DTR)	-	Positive Supply Input: +4.8 volts (min) +15 volts (max) Current: 5 millamperes (typ)
Pin #3 (RXD)	-	Receive Data (Orange) Level: RS-232 (+/- 3v min) CMOS (0/+4.5v typ)
Pin #4 (DSR)	-	Carrier Detect (Yellow) Level: RS-232 (+/- 3v min) CMOS (0/+4.5v typ)
Pin #5 (TXD)	-	Transmit Data (Green) Level: RS-232 (+/- 15v max) CMOS (0/+5v typ)
Pin #6 (RTS)	-	Negative In / PTT (Blue) Level: RS-232 (+/- 4.5v min) CMOS (0/+4.5v typ)

**Radio Connector (10-pin header):**

Pin #7	-	Receive Audio (Violet)  Input Level: 300 mv p-p (nom) 780 mv p-p (max) Input Z: 50K (typ)
Pin #8	-	PTT Output (Gray)  Output Level: Sink 50ma (max) Output Voltage: 15 volts (max) Output Type: Open Drain (FET)
Pin #9	-	Mic audio (White)  Output Level: 0 - 290 mv p-p (Hi Z) 0 - 80 mv p-p (1K ohm) Factory Set: 20 mv p-p (1K ohm)
Pin #10	-	Ground (Black)
øHTö Jumper	-	Connects 2.7K resistor between the PTT and Mic Audio lines for keying some hand-held radios. See notes in øHTö section.
øLEVELö	-	Adjustment on modem that adjusts transmit audio (deviation) level.

**- GENERAL SPECIFICATIONS -**

Levels (Radio): Mic Audio - 290mv max (Hi-Z)  
Receive Audio - 300mv (nom)  
PTT - 15v @ 50ma (max)

Levels (Data): RS232 (+/- 3v min)  
CMOS (2.5v min / 5v max)

Power Supply: +4.8v (min), +12v (max) 2.5ma

Operating Mode: Simplex or half duplex

Compatibility: Bell 202 (Opt. CCITT v.23)

Dimensions: Standard: 2.1ö x 2.4ö x .72ö  
OEM: 1.25ö x 1.50ö x .45ö

Connectors: Standard: DB-25S / RJ-11  
OEM: 10 pin header (.1ö cent)

Operating Temp: -30C to +60C

**- OPTIONS -**

CCITT v.23: Factory installed option to provide CCITT v.23 compatible input/output tones (1300/2100 Hz).

Input Level: \*\* Factory installed option for low input impedance (ie: 600 ohms) and increased input level capability (Rx Audio).

Output Level: \*\* Factory installed option to increase or decrease output modulation level.

Rx Only: \*\* Version without transmit components.

Tx Only: \*\* Version without receive components.

\*\* These options available on quantity purchases only.

Note: Contact the factory regarding special configurations, such as Transmit or Receive Only versions. We welcome the opportunity to quote any other special modifications that you may require.

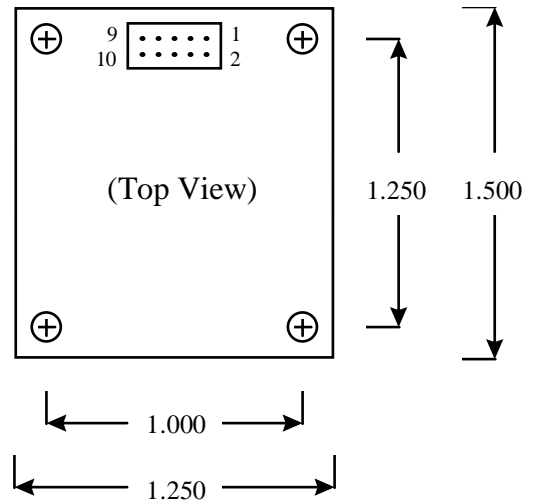
**- MODEL NUMBERS -**

Standard: Model RTX-12A, RTX-12OEM

w/CCITT v.23: Add öV23ö to part number  
(RTX-12AV23)  
(RTX-12OEMV23)

Cable for OEM: OEMCAB1  
(öö Colored Ribbon w/IDC)

**- RTX-12OEM CIRCUIT BOARD DIMENSIONS -**



Mtg. Holes: 4ea 0.120ö (#4 screw)