Tigertronics
Grants Pass, Oregon

Model RTX-24 Radio Modem

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- INTRODUCTION -

The RTX-24 is a half-duplex 2400 baud modem, designed especially for interfacing computers and microcontrollers to radio links. The modem employs Minimum Shift Keying (MSK) using 1200/2400 Hz tones. MSK allows the modem to achieve a higher data rate in a narrower bandwidth than would an FSK modem. The modem is easily interfaced to data and telemetry radios, but does require direct connection to the discriminator and modulator circuitry to get adequate bandwidth. The RTX-24 will not operate correctly when connected to speaker and microphone interfaces. The modem can however be used with normal voice radios that have undergone appropriate modification.

The RTX-24's data interface is designed to be compatible with both standard RS-232 levels and CMOS logic levels. The total power consumption is less than 35 milliwatts, making it ideal for battery powered applications. The modem has it's own micropower voltage regulator, allowing it to operate from a single polarity unregulated power source as low as +4.6 volts. Thus, it can be powered directly from a +5 volt logic supply in microcontroller applications. When operating from a standard RS-232 serial port, no external power source is required. The modem is available in three configurations: Transmit Only (TX-24), Receive Only (RX-24) and Transmit/Receive (RTX-24).

- RADIO INTERFACE -

The radio interface is connected via a standard four conductor RJ-11 connector. The signals on the connector are as follows:

Black	-	Ground
Red	-	PTT
Green	-	Rx Audio
Yellow	-	Transmit Audio

Ground (Black) - This is the signal ground for both transmit and receive audio from the radio. It is also connected to power ground in the modem.

PTT (Red) - 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).

Rx Audio (Green) - This is the receive audio input to the modem. It is high impedance and capacitively coupled inside the modem. It should be connected to the radio's discriminator output. 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).

Tx Audio (Yellow) - This is the transmit audio output from the modem. The output is capacitively coupled and should be connected directly to the radio's modulator circuitry. The output level determines transmitter deviation. This level can be adjusted through a small hole on the front panel of the modem. For radios that require a lower transmit audio level, an internal jumper (JP3) can be removed to decrease the maximum level available.

CAUTION - There is a lack of standardization in the way RJ-11 cables are constructed. If you are using a cable that was not supplied by Tigertronics, make sure that the cable has the proper wire orientation (colors in correct order). You can verify the orientation as follows: When the cable is plugged into the front of the RTX-24, the yellow wire MUST BE on the RIGHT SIDE.

- DATA INTERFACE -

The data interface is connected via a DB-25S connector. This connector can be plugged directly into the serial RS-232 port of most computers. Serial ports utilizing DB-9 connectors can be accommodated with standard adapters. The signals on the data connector are as follows:

Pin #2	(RXD)	-	Receive Data
Pin #3	(TXD)	-	Transmit Data
Pin #4	(RTS)	-	Negative In / PTT
Pin #6	(DSR)	-	Carrier Detect
Pin #7	(GND)	-	Ground
Pin #20	(DTR)	-	Positive Supply

Receive Data (Pin #2) - Data from computer/controller to the modem. This input is high impedance and will

accommodate either standard RS-232 levels (+/- 12v) or CMOS logic levels (0/+5v). The data on this pin must be 2400 baud, 8 Data Bits, No Parity and 1 (or 2) Stop Bits.

Transmit Data (Pin #3) - Data output from modem to computer/controller. Output levels are RS-232 compatible or CMOS logic compatible depending on the state of Pin #4 (see below).

Negative In / PTT (Pin #4) - 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 zero volts during receive. This input is also used to control the transmit/receive status of the modem. 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 active and MSK modulation will be sent to the radio.

Carrier Detect (Pin #6) - This output indicates the presence of valid carrier (tones) from the receiver. This output should be monitored by the software to determine when valid data is available. This output is "low" when carrier tones are detected and "high" when carrier is absent.

Ground (Pin #7) - This pin provides both signal and power grounds to the modem.

Positive Supply (Pin #20) - This input provides operating power to the modem. When using supply voltages of less than 6 volts (min 4.6 volts), you must connect the power supply to this pin. In RS-232 applications, this pin should be held in a "high" state (+12v) by the software at all times to power the modem. 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).

- MODEM OPERATION -

Although the RTX-24 sends and receives *asynchronous* data to and from the computer/controller, the modem is actually a *synchronous* device. Special data buffering and re-timing circuitry inside the modem converts the data from asynchronous to synchronous during transmission and from synchronous to asynchronous during receive. The error status of the retiming data buffer is monitored by a Bi-Color LED on the front of the modem. During normal operation, the LED will be green while transmitting and off while receiving. In the event of a retiming buffer overflow, the LED will turn red indicating possible data loss. The error indication can only be reset by temporarily removing power from the modem. This error will only occur if the input baud rate exceeds the output baudrate for an extended period. In power sensitive applications, the error LED can be disabled by removing internal jumper JP-1.

- CALIBRATION -

All critical functions within the modem are controlled by a precision quartz crystal and should never require calibration. The only adjustment that may be required by the user is the setting of modulation level (deviation). This is done via a small screwdriver slot on the front panel of the modem. This level has been factory adjusted to the correct level for most radios, but there may be instances where additional adjustment is necessary. Refer to your transmitter documentation for the correct deviation specification.

- SOFTWARE CONSIDERATIONS -

Because the RTX-24 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 (RTX24.EXE) on the installation disk that will allow you to exercise the modem for evaluation and test purposes. We have also included sample source code for transmit and receive routines (RTX24.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 a transmitter to become operational after keying. It also takes an additional amount of time for the receiver to detect the transmitted signal. As a result, your software must key the transmitter briefly before data transmission begins, to allow the entire link to stabilize. This time delay is called "TXDELAY" and will vary with the specific equipment employed. Typical times will be on the order of 250ms. Because the modem is synchronous, it is also necessary to send a SYNC sequence of alternating "ones" and "zeros" (10101010) at the beginning of each transmission, to allow the modem to synchronize. In practice, it is suggested that this SYNC pattern be transmitted during the entire TXDELAY period.

The transmitter must also remain keyed briefly after all data has been transmitted so that so that the decoding software sees a clear separation between the end of valid data and the burst of noise that it receives when the transmit carrier drops. We call this delay "TAIL". It can generally be shorter than TXDELAY and will normally be on the order of 50ms. Depending on your specific application and hardware, you may be able to shorten these times considerably. In applications where a constant carrier is sent (full duplex or beacon), you will not need these delays at all.

Receive - To receive without error, your software must be able to identify the TXDELAY, SYNC, and TAIL periods. TXDELAY and SYNC detection tells your software that data is about to begin. TAIL detection signals the end of

valid data and warns to ignore the burst of noise that generally appears when the transmit carrier drops. In many applications you will find the "carrier detect" signal helpful in detecting these events. The carrier detect signal will be "low" when the carrier is present and "high" when no carrier is present. Your software should detect a "stable" carrier signal for some time before processing data.

- LIMITED WARRANTY -

Tigertronics warrants the RTX-24 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. This line is open every **Monday, Wednesday**, and **Friday**, from **1:00 PM** to **5:00 PM PACIFIC Time.**

- RTX-24 SPECIFICATIONS -

DATA CONNECTOR:

Connector Type: DB-25S

Pin #2 (RXD) - Receive Data

Level: RS-232 (+/- 10v typ)
CMOS (0/+4.5v typ)

Pin #3 (TXD) - Transmit Data

Level: RS-232 (+4.5v/-8v typ)
CMOS (0/+4.5v typ)

Pin #4 (RTS) - Negative In / PTT

Level: RS-232 (+/- 10v typ)
CMOS (0/+4.5v typ)

Pin #6 (DSR) - Carrier Detect

Level: RS-232 (+4.5v/-8v typ)
CMOS (0/+4.5v typ)

Pin #7 (Gnd) - Power/Digital Ground

Pin #20 (DTR) - Positive Supply from Computer or Microcontroller

Input: +4.6 volts (min)
+15 volts (max)
Current: 5 millamperes (typ)

RADIO CONNECTOR:

Connector Type: RJ-11 (4 pos)

Pin #1 (Yellow) - Transmit 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)

** See options

Pin #2 (Green) - Receive Audio

Input Level: 300 mv p-p (nom)
780 mv p-p (max)
Input Z: 50K (typ)

** See options

Pin #3 (Red) - PTT Output

Output Level: Sink 50ma (max)
Output Voltage: 15 volts (max)
Output Type: Open Drain (FET)

Pin #4 (Black) - Ground

Tx Level - Adjustment on front of modem that adjusts transmit audio level (deviation)

EXTERNAL POWER CONNECTOR:

Connector: 2.1 mm Coaxial - Center Positive

Voltage: +6.0 volts (min)
+15 volts (max)

Current: 10 ma

OPTIONS:

Input Level: ** Factory installed option available to reduce input impedance and increase input level requirement (Pin #2).

Output Level: ** Factory installed option available to increase or decrease output level (Pin #1).

These options available on quantity purchases only.

MODEL NUMBERS:

Transmit/Receive: Model RTX-24

Transmit Only: Model TX-24

Receive Only: Model RX-24

Note: TX-24 and RX-24 versions are only available by special order (min qty 100).