RV-M21 and RV-M22
   Tech Series Products

Version K8

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A Myriad of IO Options

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Table of Contents

1. About This Manual

This manual covers interface options for Raveon's Tech Series products. Various radio models may be incorporated into the Tech Series products, so refer to the particular radio module Technical Manual for specific information about how to configure and use the radio features.

This manual covers Tech Series I/O features. The manuals for the radios used in Tech Series products are:

RV-M8   VHF/UHF 5W radio modem module

RV-M6   VHF/UHF 2W radio modem module

RV-M50   915MHz ISM Daisy radio, License Free

RV-Z50   3G cellular radio modem

RV-Z55   LTE cellular radio modem

There are two different *Tech Series* Enclosures:

RV-M21   For M8 radio modules, up to 5 watts TX power.
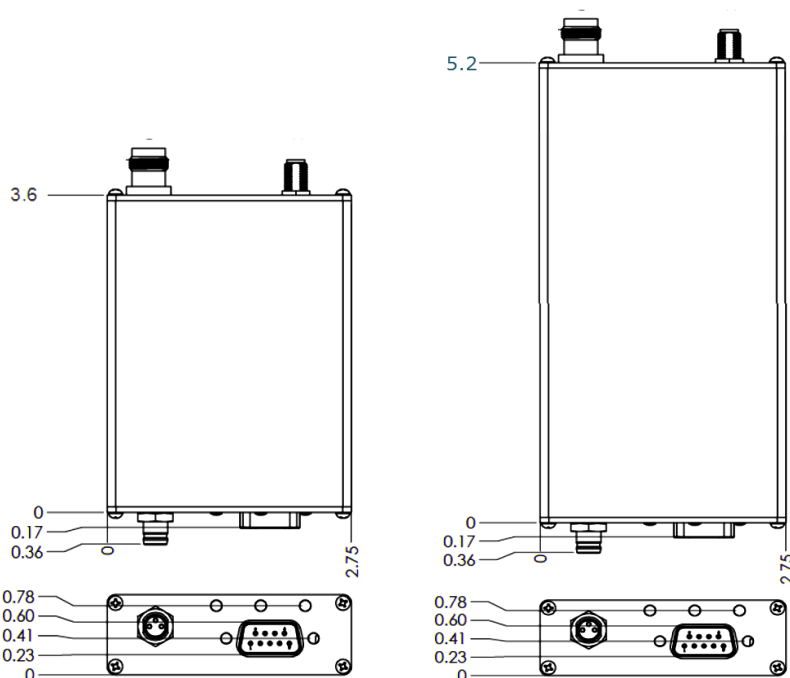
RV-M22   For M6, M50m, Z50 radio models. Low power, miniature enclosure.

2. Tech Series Overview

2.1. M21 and M22

M22 Enclosure   M21 Enclosure

The M21 is larger to utilize the 5 watt M8 radio modems. Both enclosures have GPS options and can utilize the myriad of IO options.
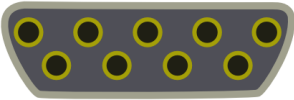
2.2. I/O Options

The front interface of the M21 is fully field-reconfigurable. The following interface boards may be attached or changed at any time:

- RS-232 [S]   5T835   RS232 serial port, DB9. 3 Digital INputs
- USB   [U]   5T837   USB for computer communication.
- RS-485 [T]   5T836-1 RS-485 2-wire interface.
- RS-422 [F]   5T836-2 RS-422 4-wire interface.
- GPIO   [G]   contact sales   General Purpose IO.
- Analog [A]   5T838   Analog radio interface.
- FIO   [D]   5T832-1 Flexible IO. Digital INs and OUTs
- RS-232 [N]   5T842   RS232 serial port, DB9. 5 digital Inputs.

2.3. Tech Series Flexibility

The Tech Series radios from Raveon is the most flexible radio platform in the industry. A myriad of I/O options, and many RF band options, GPS options, wide/narrow channels, Arduino option, and wide DC input voltage range.

I/O Connector Type	Connector Code
	S
	U
	F, G, T
	A, D
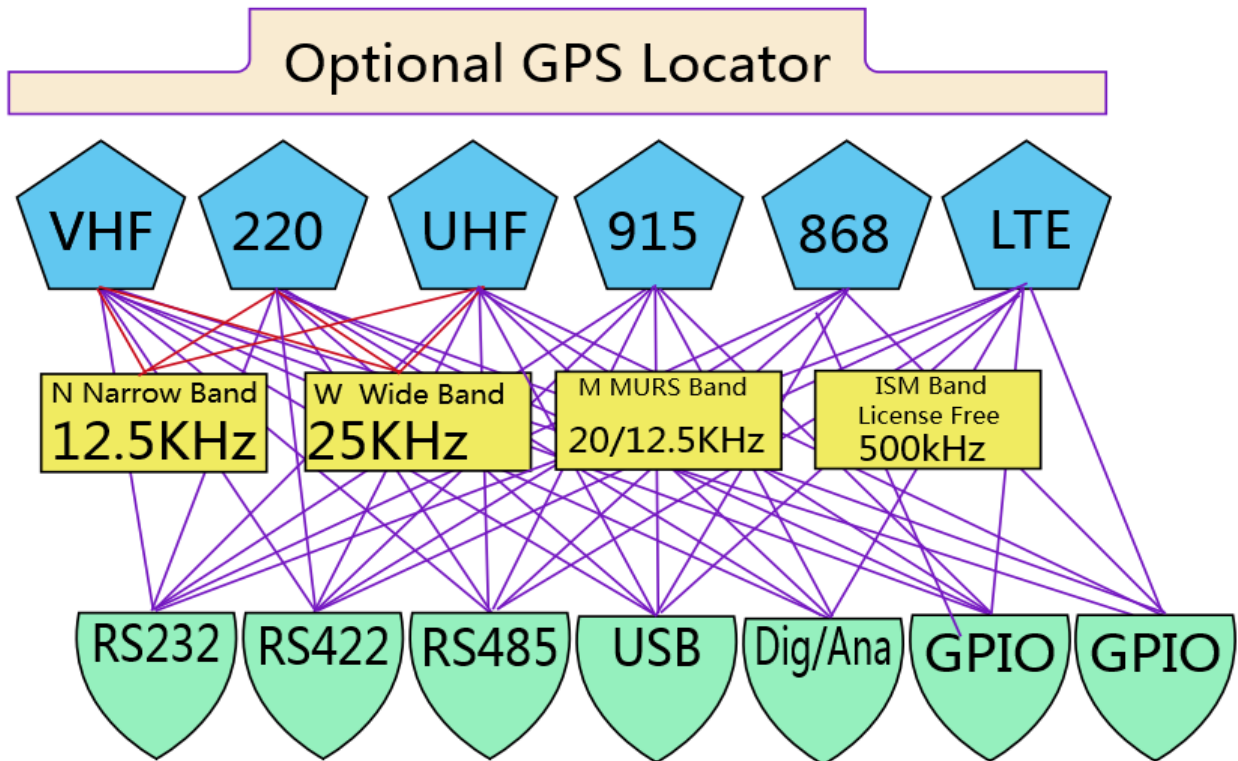
The Tech Series radio modems come pre-configured from Raveon with the bandwidth, frequency band, GPS, and I/O option. The I/O interface may be changed in the field.

2.4. *Features*

The Tech Series radio modems from Raveon have many unique features. Compared to most radio modems, and Raveon's industry-standard M7 radio modem. Tech Series products feature:

1) **Water-proof** DC power connection

2) **Locking DC** connector. A screw-on M8 type connector that will not come off without unscrewing it.

3) **Numerous I/O** options. I/O options such as RS232/485/422 and USB are all available, and field upgradable. The radio within the Tech Series enclosure detects the I/O it is using, and adjusts its operation accordingly.

4) **Low power** consumption. The power supplies, receiver, GPS, and transmitter all have lower power consumption than legacy products.

5) **Secure.** Built in AES encryption options allow users to add additional security to their communication systems.

6) **App Processor Option.** You can order a TechSeries product with a built-in Arduino application processor to run your own application on.

7) **Broad RF Options.** Radio modems used within the TechSeries enclosure are available from Raveon in VHF, 220MHz, UHF, 800MHz, 900MHz, and 3G cellular bands.

8) **Wide DC input.** Most Tech Series modems will work off of any DC input voltage from 10V to 30V DC, twice the range of most radios.

9) **Multiple Protocols.** Tech series radios support many different protocols, such as 4800, 9600, 19200 baud data modems, Bell 202 legacy analog AFSK modulation, POCSAG paging, and audio modulation. 3G cellular and LoRa WAN are also available.

2.5. Power

The TechSeries products from Raveon utilize a 3-pin power connector.
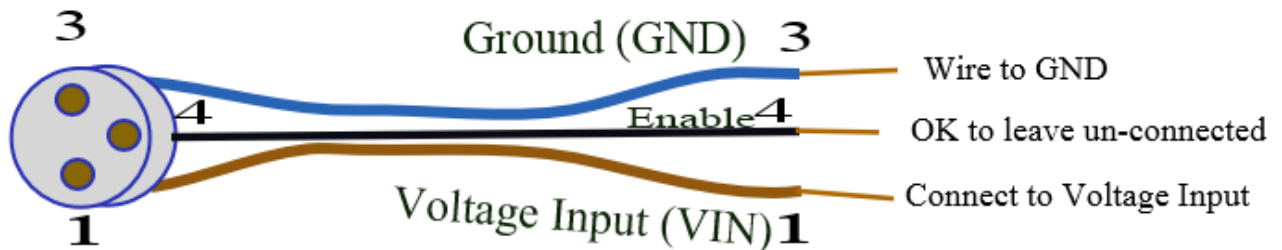
Coincidentally, the industry name for this connector is "**M8**". The three pins are:

1. **VIN.** DC input voltage. Refer to the specific model number data sheet for input voltage range.

2. **GND.** Chassis ground and sometimes cable shield. No physical pin.

3. **GND**. Chassis and signal ground.

4. **Enable**. Input to enable/disable the product. Connect to ground to turn off the radio. It has an internal pull-up resistor on it. It must be >2V and <5V for the product to start working, unless another resistor is placed in line per 2.6 below.

2.6. Power Cable

The cable that connects to the M21 and all Tech Series products is typically wired as shown here. This 2 meter cable is Raveon part number 4C850-1.
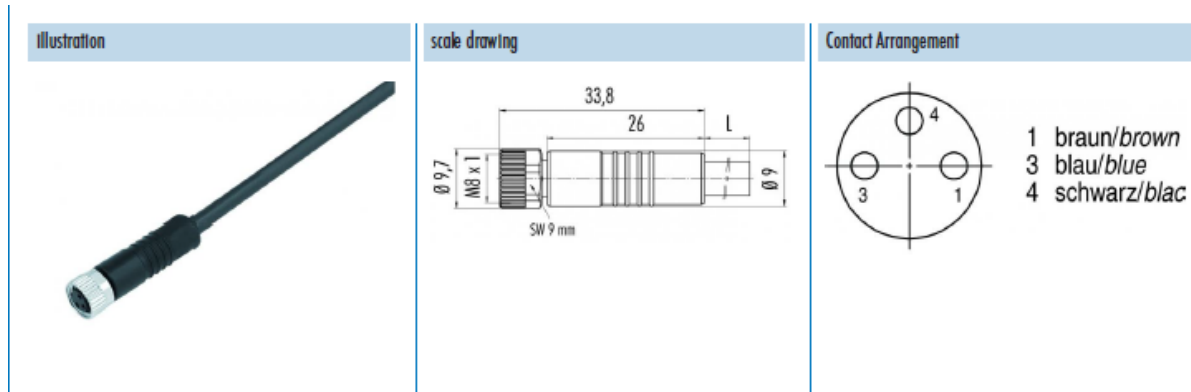
Pin 1 (VIN) is a brown wire. Connect to + DC input voltage.

Pin 3 (Ground) is a blue wire. Connect to Ground or negative input voltage.

Pin 4 (Enable) is a black wire. Ground to disable product, or leave unterminated so the radio comes on when powered. Alternatively, connect Pin 4 to a voltage source > 2V and <5V to enable product. For enable voltages between 5V and 30V, put a 1K ohm resistor in series with the lead.

2.7. LED Indicators

The TechSeries have 3 LEDs on their front panel:

PWR Power LED

The power LED blinks green every two seconds. To conserve energy, the blink is a very short amount of time. If you look carefully at the PWR led, you will see the periodic green flicker of light when the product is powered on.

STAT LED

The status LED indicates the status of the transmitter, receiver, and GPS.

Green: The receiver is receiving data over the air, or the channel is busy.

Red: The transmitter is transmitting data.

Orange: The GPS receiver in the product has not yet locked to the GPS satellites.

LINK LED

The LINK led is used on DART systems where the radio modem connects to a secure network, and the LINK LED indicates the status. If the Dart system is not used, the link LED will remain off.

Connected: The device is authenticated and can communicate on the network.

Red: The device is denied access to the network.

Off: The system does not use the LINK LED, or the user disabled it.

3.   Tech Series I/O Interface Information

Products that are compatible with the Tech Series enclosure usually have an I/O mode command to configure them for auto-detect of Tech Series I/O interfaces. ATIO is the command. ATIO 8 sets the product to search the Tech Series front panel for information about which panel is plugged into it.

3.1. RS-232   [S]   5T835   [N] 5T842 with 5 Inputs

The RS-232 9-pin serial I/O connector is a female 9-pin D-subminiature connector having the following pins configuration. It is pinned out so that it may be plugged directly into a computer or PC's 9-pin COM port.   **RV-M21S** or **RV-M21N**   have RS-232 interfaces.
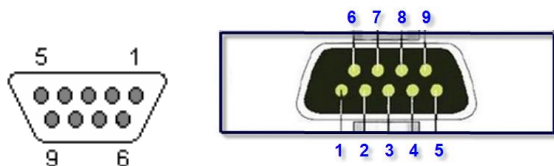
Front-view of DB-9 connector on modem (female)

Pin Name	Dir	Function	Level / Specification	IO Report
1 CD	out	Carrier detect	If enabled, indicates presence of carrier. Logical 0 (+ voltage on RS-232) means carrier is present. Logical 1 (- voltage) means no carrier detected. If disabled, it is asserted (0) whenever the modem is operational, and not in the configuration mode. It will be a 1 when the modem is in the configuration mode.	4 N
2 RxD	out	Receive data	Data out of the modem. It is the data received over the air.	
3 TxD	in	Transmit data	Data into the modem. Also used as digital input IN2 for exception reporting. GND or floating for a 0, >3V for digital 1. If enabled for digital inputs, the serial data entering this pin is ignored (except in the command mode). Use the TRIGBITS command to set which bits are used as inputs.	
4 DTR	in	Data terminal read	Normally ignored by the *RV-M7* modem. May control the power-state of the modem in low-power mode if this feature is enabled. Also used as digital input IN0 for exception reporting. GND or floating for a 0, >3V for digital 1. Use the TRIGBITS command to set which bits are used as inputs.	0
5 GND		Ground connection	Signal and power ground	
6 DSR	out	Data Set Ready	Normally is set to 0 when modem is powered on and running. Modem sets to a 1 when in low-power mode.	3 N
7 RTS	in	Request to send or IN**1**	Used to stop/start the flow of data coming out of the modem TxD pin. 0 = OK to send, 1 = don't send. Leave disconnected if not used. Also used as digital input IN1 for exception reporting. GND or floating for a 0, >3V for digital 1. Use the TRIGBITS command to set which bits are used as inputs.	2
8 CTS	out	Clear to send	Used to stop the flow of data going into the RxD pin from the device connected to the *RV-M7*. 0 = OK to send, 1 = don't send. If the *RV-M7* cannot accept more data, it will negate this signal (level=1).	1
9 Power	In/out	DC power	User may supply the DC power to the modem on this pin.	

Note: RS-232 signals use positive and negative voltages to represent digital 1s and 0s. A positive voltage is a 0, and a negative voltage is a digital 1. This pin-out allows it to be directly plugged into a computer's 9-pin serial port using a conventional 9-pin RS-232 serial cable. To connect it to a modem, or peripheral that has a serial port, you will need a "*null-modem*" cable. IO Report pins get reported on GPS versions, Mimic mode, and other features to report. The N version of the terminal has IO pins 3 & 4 with 5 IO pins. The RS-232 standard S version cannot send data from pins 3 & 4.
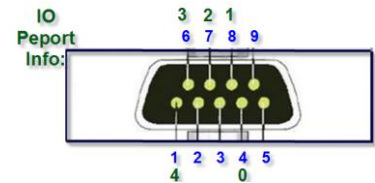
3.2. *Analog DTX 15 [A] 5T838*

For sending or receiving analog signals or voice, this DTX 15 interface and OTA protocol features can be used. When this interface is used ATMT 8 is auto-setup in the modem.

The DB15 connector on the front panel has the following pin functions.

Pin#	Function	Description
1	MIC	Analog Input can be: Microphone Input
2	Audio Out	Analog Output
3	RSSI	Radio Signal Strength Out
4	IOC	General IO – C
5	DTR	Digital DTR out
6	VIN	DC Voltage Input
7	V3	3./3V Output
8	RXD	RX data out, RS232 level
9	TXD	TX data in, RS232 level
10	CTS	CTS, 3V digital level
11	NC	No connect
12	PTT	Transmitter Enable Line. Active low. Input impedance is 10K. TX Mode: Input < 2.9V RX Mode: > 3.0V or open circuit
13	NC	No connect
14	DCD	Data/Carrier Detect output. 0-0.1V no carrier, 2.2K pull-up resistor to VIN when carrier is detected. The 2200ohm pull-up resistor is driven by a MOSFET pulling it to ground when no carrier is present. With a 12V DC input, this output can go to 12V.
15	GND	Ground, chassis and power gnd.
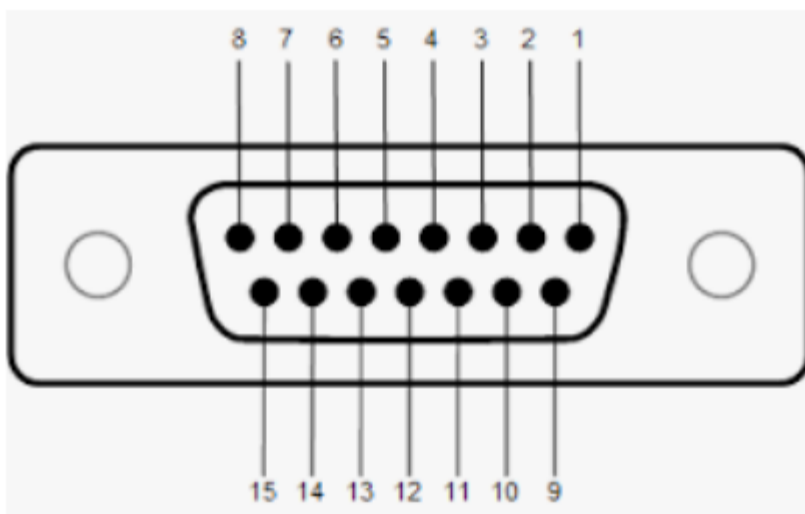
Pin 12 is the Push To Talk (PTT) input. It has a pull-up resistor of about 10K on it. When PTT is low, the transmitter in the M8T will turn on, and output the audio signal on pin 1.

When PTT is high, the M8T is in the receive mode, and the receive audio will be output on pin 2. Tech Series products utilizing M8 radio modules, the PTT can be set to active high via the **ATPTT** command.

There are a few commands designed specifically for use in configuring the operation of the M8S in audio pass-through mode.

Command	Description	Range	Default
AFMOD	**Analog Mode** – The analog/audio input can be in different modes for efficient emission compliance. 0: Audio, auto-centered, 1: DC analog input, 2: Data Input 1, or 0.	0, 1, 2	0
AFDC	**Audio input DC offset** – The DC bias level on the audio input in millivolt. Adjust this setting so the audio transmissions are on the center of the channel. Set to 0 to have the M8S auto-detect the average. Set some value	-2000 to 2000 mV	0
AFLVL	**Audio input level gain** – internal gain of the audio input signal, in % . Adjust this setting for the audio input deviation level.	0-2000% mV	100
AFLIM	**Audio deviation limit** – Sets the peak audio deviation limit for TX audio in the audio pass-through mode. In % of data deviation 100% limits audio to same as default FM data deviation.	0 - 100% W 0 - 150% N	100
TXTOT	**Transmit Time-Out-Timer** – Sets the maximum number of seconds that the M8S will stay transmitting when the PTT input is asserted.	0 - 500 seconds	10
ATPTT	**Push To Talk Polarity** – Sets the PTT polarity. Default is active low (0) and set to 1 for active high.	0-1	0
ATOP	**Options to Turn On** – Hexadecimal Number input. For various systems, and customers, new options are added and enabled here. Defaults is 0. Bit 1 is the RV_M21N version.	0-FF	0
ATR2	**Audio Frequency Response** – In the audio mode use the ATR2 OTA baud setting to set the audio frequency response. See table below	0-6	3

Receive Frequency Response:
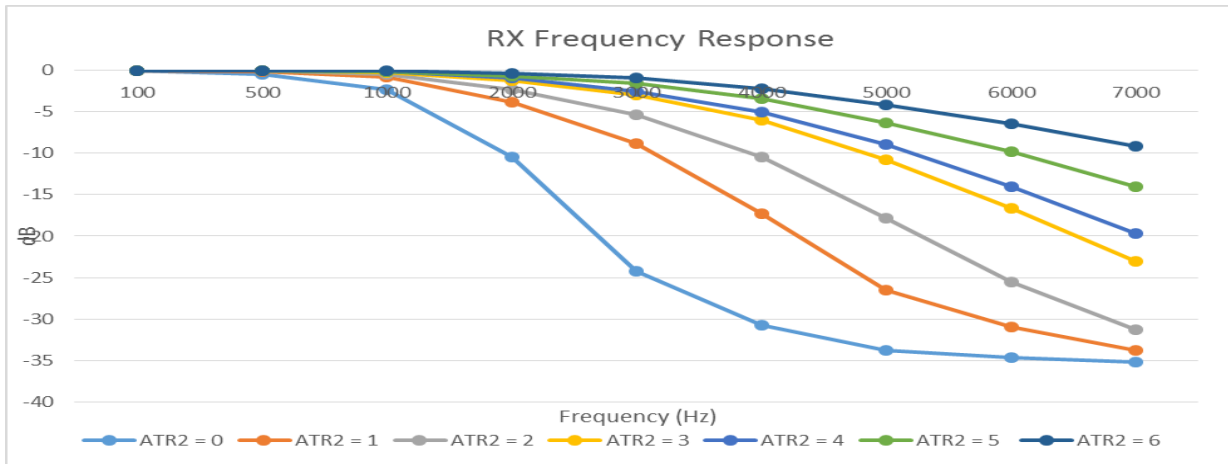
Transmit Sampling Rate Info

ATR2 Data Rate mode.	Sampling Rate	Audio Filter	Dev. adjust
ATR2 = 0	8kHz	0.7Hz	15%
ATR2 = 1	12kHz	0.7kHz	12%
ATR2 = 2	24kHz	1.5kHz	8%
ATR2 = 3	48kHz	2kHz	0
ATR2 = 4	64kHz	0	0
ATR2 = 5	57kHz	6kHz	0
ATR2 = 6	67kHz	0	20%
ATR2 = 7	52kHz	5kHz	0

The Audio Filter in the radios DSP is shown above in the sample rate table.

The PLL in the radio also has modulation filter to meet FCC regulations. If you use modes 4 or 6, make sure the deviation of your data is limited to meet FCC bandwidth requirements. Do not use modes 4 or 6 if you do not have a modulation expert that can verify adjacent channel noise.

ATR2 modes 0,1,2, and 6 do have slightly higher FM deviation levels than 3,4,5, and 7. The *Dev. Adjust* shows approximate deviation adjustments in various ATR2 modes.

TX Analog Deviation

The transmit audio input pin 1 is designed to have audio sent in with a 1.66V DC bias. The analog input range of the M8S is 0-3.3V. 500mV changes will produce +/- 2kHz of FM deviation in narrow band mode. In versions with DC input, the DC center voltage default is 1.66V. The Tech Series Analog input has a capacitor on its input to block DC.

If the audio input has a different DC bias voltage, the M8 can be reconfigured to use the different DC bias offset. The **AFDC** sets the nominal DC bias voltage. Note, the analog input range of the M8S is 0-3.3V. Ideally bias the DC input to 1.66V or AC couple it with a capacitor and add two bias resistors to ground and 3.3V. One hundred counts (or 100mV) will shift the frequency about 700Hz, use caution with this command. To have the M8 determine the DC bias input automatically and use the measured DC level as the DC input.

Set **AFMOD 0** to have the radio automatically find the DC input bias and compensate for it. This is the factory default mode. **AFMOD** usable in M8w with firmware version H9 and above.

Set **AFMOD 1** to have the radio use the defined DC input bias. In **AFMOD 1**, the input in analog data input, and the FM deviation is based on the size of the DC input above or below the DC center.

The **AFLVL** command sets the DC gain of the TX audio input. With it set to 100%, an audio signal with a peak-to-peak value of 500mV will produce 2.2kHz of FM deviation on narrow band channel.

With **AFLVL** set to 200, 250mV p-p input will give 2.2kHz p-p of FM deviation. This tech series audio input has audio amplifier for 16K input impedance. It attenuates input audio about 20% lower as it passes it into the radio modem.

The **AFLIM** command sets a hard FM deviation limit, which will stop the M8 from deviating the FM carrier beyond the preset limit when the input TX audio exceeds a threshold that would cause the M8 to over-deviate.

Raveon suggests the **AFDC**, **AFLVL**, and **AFLIM** always be adjusted and calibrated by trained radio technicians familiar with setting FM deviation gain and FM limiters.

FM Deviation Information on different channel types.

Channel BW	500V change: +/-250V input		Default Max FM Deviation
N 12.5kHz	+/- 2.0kHz		2200Hz
W 25kHz	+/- 5.0kHz		3800Hz
S 6.25kHz	+/- 1.0kHz		1200Hz

The AFLVL command can be used to adjust the deviation so it is correct and perfect for the channel you use.

The **TXTOT** command sets the transmit time-out-timer (TOT). The TOT protects the radio and the system from damage and interference due to accidental over-keying of a transmitter. Set the **TXTOT** value to the maximum number of seconds a TX audio pass-through transmission

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should ever take. If the **TXTOT** times-out, the M8 will automatically un-key, and not re-key again until the PTT line is negated, and then some time re-asserted.

RX Analog Output

Typically, the audio output with a 2kHz FM deviation, will have a peak to peak of 300mV - 400mV and a DC offset around 500-1000mV. If your circuit does not accommodate DC offset be sure to add a coupling capacitor.

3.3. USB [U] 5T837

The USB works as a serial to USB converter. This requires a FTDI USB driver. This should automatically install to your computer when the radio is plugged in, if not, please download the driver from the Raveon website.

3.4. RS-485   [T] 5T836-1

RS-485 is two-wire connection, with the pair of wires transmitting and receiving data.
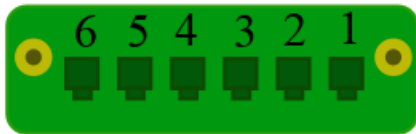
Pin #	Name	Direction	Function	Level / Specification
1				Do not connect this pin to anything.
2	**B**	I/O	B(+)	Non-inverting RS-485 data line
3	**A**	I/O	A(-)	Inverting RS-485 data in line
4				Do not connect this pin to anything.
5				Do not connect this pin to anything.
6	GND	-	Ground	Connect to earth ground.

The RS-485 differential line consists of two pins, A and BB

B TxD+/RxD+ aka non-inverting pin which is positive (compared to A) when the line is idle.

A TxD-/RxD- inverting pin which is negative (compared to B) when the line is idle.

Configuring

The radio will auto-detect the 485 Tech Series board and set all necessary parameters to enable RS485 communication.

The radio will only support RS485 Simplex. In simplex RS-485 mode, the *radio's* serial data receiver is internally disabled whenever it sends a character out the serial port, so that it will not receive its own data.

If you wish to run the RS-485 in full-duplex mode using two radios, the interface must be wired with two separate pairs of wires; A&B on one pair, and Out+ & Out- on the other pair.

The radio's RS-485 I/O circuit uses 3.3V logic to drive the lines, and the RS-485 pins are ESD protected to ±15kV and 7kV human body model. Input current is less than 150uA. Output current when not driving the line is less than 50uA.

Simplex or Full Duplex

Simplex is the default. In simplex RS-485 mode, the serial data receiver is internally disabled whenever it sends a character out the serial port, so that it will not receive its own data nor will it receive data from any other device when it is sending data out.

If you want to use RS-485 full duplex with tri-state outs, utilize the RS-422 version of the Tech Series panel, and use it in your system. RS-422 4-wire tri-state operates the same as RS-485 *4-Wire Tri-State Simplex.*

Tech Series RS-485 Interface
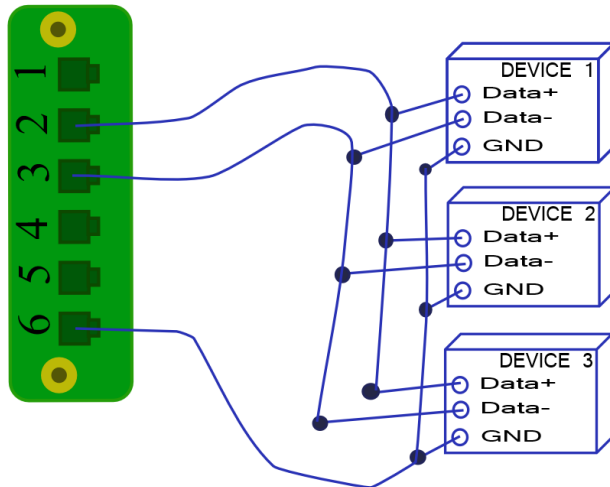
3.5. RS-422   [F] 5T836-2

RS-422 communication uses 4-wire differential signals. The Tech Series 422 board has the following pin configuration.

Pin #	Name	Direction	Function	Level / Specification
1	**MODE**	I	T Mode	1(or Float) to default to tri-state simplex mode. 0(ground) to enable full duplex, dual mode output.
2	**Y+**	Out	Out+	Non-inverting RS-422 data OUT line
3	**Z-**	Out	Out-	Inverting RS-422 data OUT line

4	**B+**	In	In+	Non-Inverting data INPUT pin
5	**A-**	In	In-	Inverting data INPUT pin
6	**GND**	-	Ground	Connect to earth ground.

Configuring for RS-422 Dual-State (Duplex Communications)

The Tech Series enclosure will detect auto-detect the 422 Tech Series board and set all necessary parameters to enable RS422 communication. The Tech Series hardware connector is identical to the RS485 version.

Raveon's RS-422 I/O circuit uses 3.3V logic to drive the lines, and the RS422 pins are ESD protected to ±15kV and 7kV human body model. Output is tri-state (0, 1, and Open circuit). Tri-State is used for full duplex communications.

RS-422 installations typically have a termination resistor across the Input and the Output lines. A value of 150 ohms should work in most applications.

Connect Pin 1 (MODE) to ground to enable the *Full Duplex Dual-State* operation.

RS-422 Duplex Comm *(Duplex to One Device) TX to Many Devices*

Tech Series
RS-422 Interface
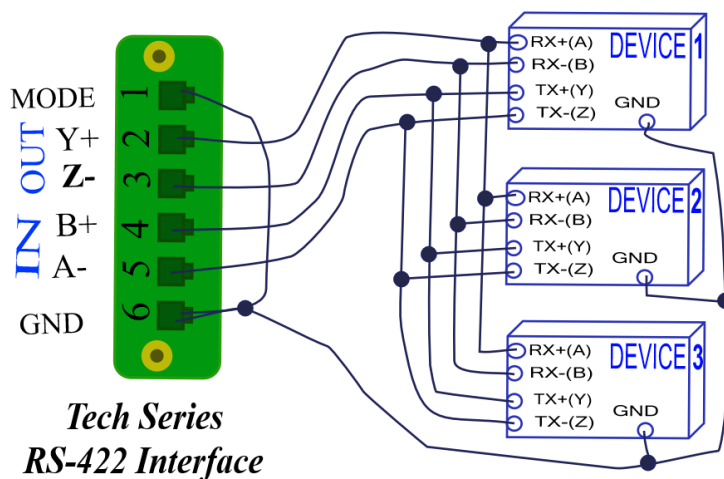
Configuring RS-422 Tri-State (Simplex Communication).

To put the RS422 into a tri-state mode, do not connect pin 1 (MODE) to anything. Leave it disconnected or set to 3.3V.

When the MODE pin is open or at 3.3V, the TX driver is in a tri-state mode, so communications is Half Duplex, meaning the device cannot receive data when it is sending data. 1-2mS after it sends out data, it can start receiving inbound data.

If you want to use RS-485 *Simplex Tri-State* outs, Order the RS422 version of the Tech Series panel, and use it in your system. RS-422 4-Wire Tri-State operates the same as RS-485 4-Wire Tri-State.

RS-422 Simplex (Simplex to/from many Devices)

Tech Series RS-422 Interface
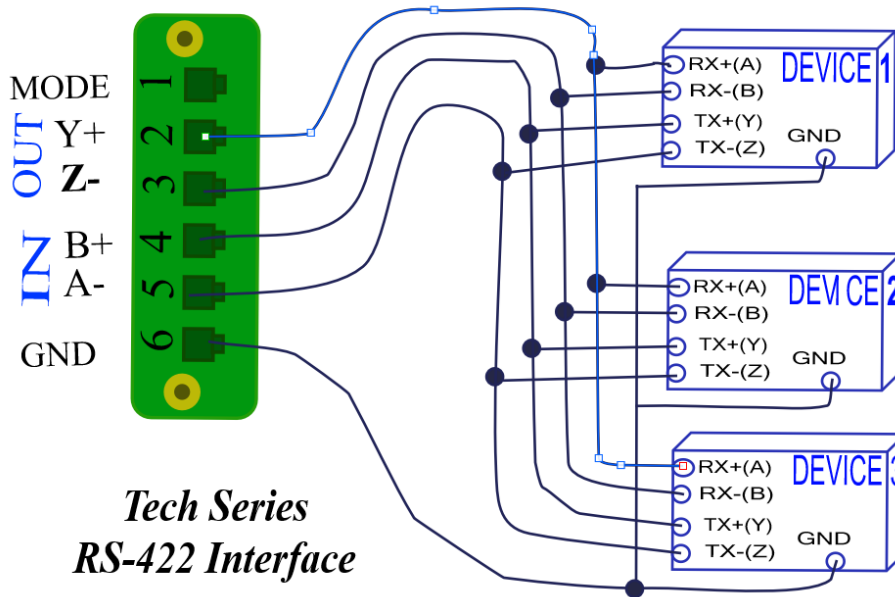
As you can see, the MODE pin is not grounded, which is correct for simplex. If you want, you can wire up the RS-422 Simplex to act like an RS-485 2-wire.

RS-422 Simplex like an RS-485 2-wire

Tech Series RS-422 Interface
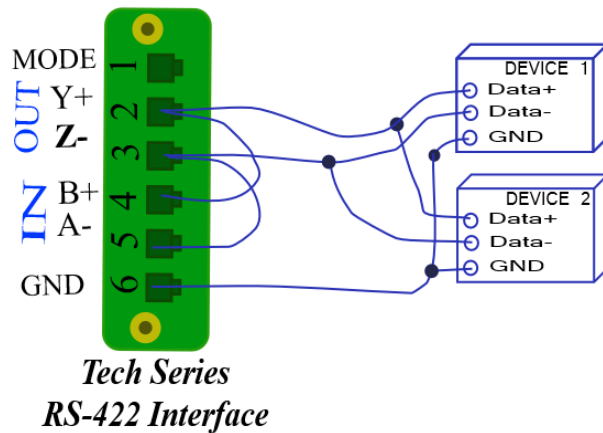
3.6. GPIO   [G]

Uses the same IO connector as the RS-485, and has serial IO and general purpose IO functions that are software configurable. The pin-numbers on this connector are different than the RS-485 pin-out.

Pin #	Name	Direction	Function	Level / Specification
1	**RX**	In	Serial data Input	RS232
2	**TX**	Out	Serial Data Output	RS232
3	**IO0**	I/O	I/O Pin 0	Configurable General Purpose IO (GPIO). Available Modes: A, C, E
4	**IO1**	I/O	I/O Pin 1	Configurable General Purpose IO (GPIO) Available Modes: A, C, D, E
5	**IO2**	I/O	I/O Pin 2	Configurable General Purpose IO (GPIO). Available Modes: A, C, D, E
6	**GND**	-	Ground	Connect to earth ground.

The GPIO pins have a variety of IO mode options. They are configured with the **IOPIN** command. The configuration codes for the various modes are:

A   Digital Input bit.

B   Digital output bit. (Not supported in GPIO mode)

C   Open drain MOSFET output.

D   DC switched power output.

E   Analog; voltage input

F   4-20mA sensor mode.
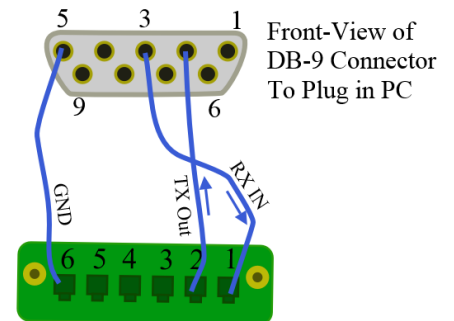
An RS232 serial cable can be connected to pins 1, 2, and 6 to configure the internal radio modem and the MIMIC mode features. Here is a wiring diagram for an RS232 DB9 connector to be wired to the GPIO connector.

To monitor 4-20mA sensors, the E mode can be used to wirelessly monitor a 4-20mA sensor. Inside this device Raveon or you can add a 140 ohm resistor in the front panel PCB to take the current in. You can also add the resistor on this GPIO terminal port to monitor current sensors.

Putting the IO mode in E or F (4-20mA sensor mode) assumes it is 140 ohm, and it can be re-calibrated to use any other resistor. Raveon production can do this for your system.

Or contact Raveon to have the device pre-configured when it is purchased.

MIMIC Mode Feature

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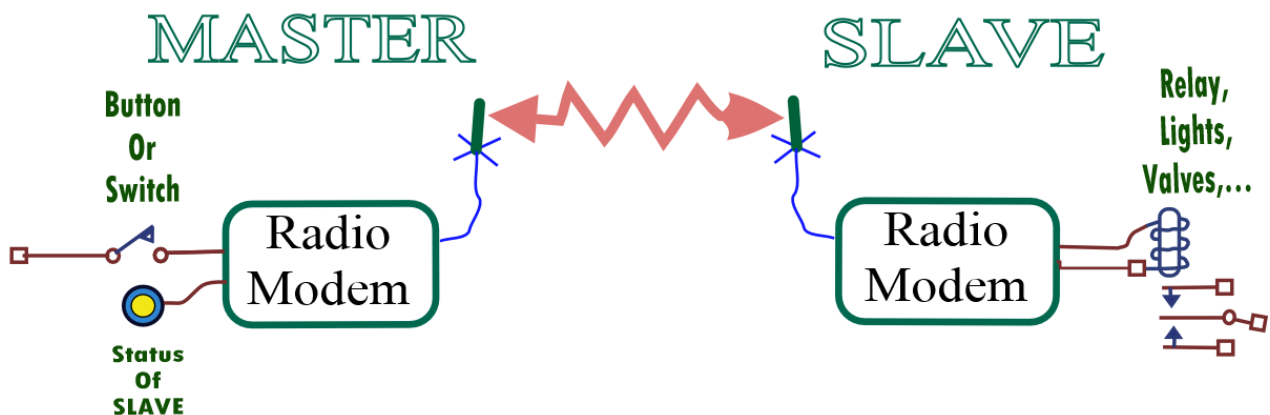
Application note AN162 describes the Tech Series MIMIC mode features. Raveon's Tech Series data radio modems include "*MIMIC*" mode operation for wireless I/O extension. **MIMIC** mode lets a smart *MASTER* radio modem send data status to a *SLAVE* radio modem, and the *SLAVE* outputs the same status bits so the slave's outputs: mimic the master's inputs. The *MASTER*'s output shows the status of the *SLAVE* output. For IO pins used in MIMIC the IO commands like SBIT and CBIT should not be used because MIMIC OTA controls the MIMIC IO pins.

SCADA and Telemetry Use

The GPIO is an ideal interface for wireless SCADA and Telemetry systems. It can operate as a Remote Terminal Unit (RTU) which saves cost in your system. The Tech Series radio modems support MODBUS RTU communication messages, so Telemetry systems can utilize MODBUS messages to read and manage the GPIOs. See application note AN234 for details on how MODBUS is incorporated into these Tech Series modems. AN230 has detailed information about the MODBUS communication protocol.

Configuring

The radio will auto-detect the GPIO board and set all necessary parameters to enable it. By default, the IO pins are set to digital inputs.

Summary of Input and Output functions.

IO pins 3, 4, and 5 can be configured with built-in commands to be either digital inputs, digital outputs, analog inputs, switched DC power output, open-drain outputs.

A - Digital Input Specifications:

    Low-level input voltage: Less than 0.5V

    High-level input voltage: Greater than 2.2V

    Input resistance: 5K-10K pull-down resistance.

B - Digital Output Specifications:

    Low-level Output voltage: Less than 0.5V

    High Level Output Voltage: 3.0 - 3.3V

    Output resistance: 250 ohms

C - Open Drain Output Specifications:

    Low-level Output voltage, on: 0V to 0.5V drawing less than 2.1A.

    Open drain off leakage resistance   500uA, 0-5V, < 1mA 5-20V.

    High Level Output Voltage, off: 0 - 20V

    Output resistance, on:<250 milliohms to ground

D - Switched DC power output: (IO1 and IO2*) IO0 does not have this capability*.

    Output voltage, on: Same as DC input, 90%-100%.

Maximum Output Current   2.0 amps

On state internal resistance   100-250mOhms.

Maximum reverse input voltage when off   DC input + 150mV

Off output off leakage resistance   5-200uA

High Level Output Voltage, off: Same limit as RF board within the M21 enclosure.

Output resistance, on:<25   0 milliohms to ground

E - 96k Input Specifications:

Low-level input voltage: 0V

High-level input voltage: Vin -1.0V. Vin is the voltage powering the Tech Series product.

Input resistance: 220K.

3.7. FIO [D] Flexible IO

The Tech Series FIO Flexible IO version of the RV-M21 and RV-M22 series radio modems is ideal for SCADA and telemetry. Here is a summary of the standard FIO features. If you need other IO features or additional IO, please contact Raveon sales personnel.

The FIO connector on the product is DB15 female.

The IO modes FIO pins can be set to are: **A**: Digital TTL Input, B: Digital TTL Output, **C**: Open Drain MOSFET output. Please see the following table to see which FIO ports can be used for which IO modes.

Pin #	Name	Direction	Function	Level / Specification	GPIO Modes this pin can be configured as:
1	**VIN**		DC Voltage Input		
2	**TxD**	In	Serial Data Input. Data to TX or command inputs.		
3	**OD0**	Out	Open Drain Out		**C**
4	**IO0**	I/O	I/O Pin 0 (digital bit 0)	Digital IO pin. Input or output.	**A, B**

12	**IO1**	I/O	I/O Pin 1	Digital IO pin. Input or output.	**A, B**
5	**IO2**	I/O	I/O Pin 2	Digital IO pin. Input or output.	**A, B**
13	**IO3**	I/O	I/O Pin 3	Digital IO pin. Input or output.	**A, B**
6	**IO4**	I/O	I/O Pin 4	Digital IO pin. Input or output.	**A, B**
14	**IO5**	I/O	I/O Pin 5	Digital IO pin. Input or output.	**A, B**
7	**IO6**	I/O	I/O Pin 6	Digital IO pin. Input or output.	**A, B**
15	**IO7**	I/O	I/O Pin 7	Digital IO pin. Input or output.	**A, B**
9	**RxD**	Out	RX serial data output.	RS232	
10	**VDIG**		Digital Voltage	The internal IO port voltage regulator outputs its voltage on this pin.	*A*, *B*, **C, D, E**
8, 11	**GND**	-	Ground		

An RS232 serial cable can be connected to pins 2&9 and 8 to configure the internal radio modem. Here is a wiring diagram for an RS232 DB9 connector to be wired to the FIO connector.

Built in commands allow users to setup the FIO as they desire. Contact Raveon sales to have the device pre-configured when it is purchased.

The FIO input pins' state is measured and recorded every 50mS, and the status in the input state registers is updated at this interval.
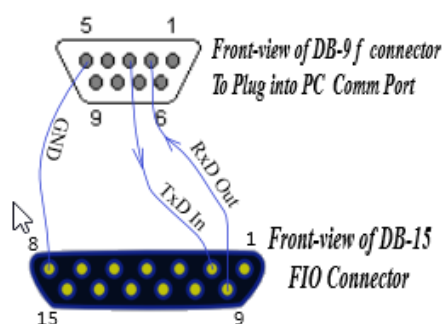
SCADA and Telemetry Use

The FIO is an ideal interface for wireless SCADA and Telemetry systems. It can operate as a Remote Terminal Unit (RTU) which saves cost in your system. The Tech Series radio modems support MODBUS RTU communication messages, so Telemetry systems can utilize MODBUS messages to read and manage the FIOs. See application note AN234 for details on how MODBUS is incorporated into these Tech Series modems. AN230 has detailed information about the MODBUS communication protocol.

Summary of Input and Output functions.

IO pins 4, 5, 6, 7, 12, 13, 14, 15 can be configured with built-in commands to be either digital inputs, digital outputs.

Digital Input Specifications:

Low-level input voltage: Less than 0.5V

High-level input voltage: Greater than 2.2V

Input resistance: Floating, > 2K resistance.

Digital Output Specifications:

Low-level Output voltage: Less than 0.5V

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High Level Output Voltage: 3.0 - 3.3V

Output resistance: 330 ohms.

4.   GPIO and FIO Commands and Configuration

Application Note AN234 has more information about how to use the Tech Series Radios for SCADA Applications. Here is a summary of the information.

For many SCADA systems, the Tech Series GPIO interface is the ideal interface to monitor remote devices or control them. The ones with serial interfaces such as RS-232, USB, and RS485 can be connected to a SCADA controller or HMI to communicate with a remote Tech Series radio modem that has the GPIO interface.

4.1.   SCADA and Telemetry Commands

The following commands are powerful SCADA and telemetry features in Tech Series devices.

Command	Command Description	Parameters	Default Setting gs
ATS330	**ATS310 B SSSS** Read or Configure the *Pulse Counter*. **B** is the bit number (0-15) that is being configured or read. **SSSS** is the integer value to set it to. Set **SSSS** to 0 to reset the counter to 0. For example, **ATS300 4 0** will reset bit 4 (5th bit) to 0.	B: 0 - 15 SS: 0 - 65536	0
ATS331	**ATS310 B SSSS** Read or Configure a *Reset Time* used to reset the bit's **Pulse Counter** to 0. B is the bit number (0-15) that is being configured. **SSSS** is the interval number of seconds that the transition counter (pulse counter) will be reset to 0. Set **SSSS** to 0 to disable this feature on the bit, and never automatically reset the counter.	B: 0 - 15 SS: 0 - 65536	0
ATS332	**ATS310 B SSSS** Read or Set an *UP Timer*. UP Timer is the number of milli-seconds an input is UP (digital 1). *UP Timer* ticks up **B** is the bit number (0-15) that is being read or configured. **SSSS** is the new integer timer value.	B: 0 - 15 SS: 0 - 65536	0
ATS333	**ATS310 B SSSS** Read or Configure a *Down Timer*. Down Timer is the number of milli-seconds an input is Down (digital 0). *Down Timer* ticks up **B** is the bit number (0-15) that is being read or configured. **SSSS** is the new timer value if you want to change it.	B: 0 - 15 SS: 0 - 65536	0
CALADC	**CALADC X V.VV** Used for calibrating the ADC input. By default it is 1V per V, but users may recalibrate for other scaling factors. V.VV is the voltage input in mV. X is the input pin numer 0 through… CALADC 1 2.50 calibrates using input 1 to measure the current voltage as 2.5V. All inputs are then re-calibrated.		
ADCMV	**ADCMV xxxx** Get/ set the ADC resolution. The value is mV per 100 ADC steps on the internal ADC converter. 1140 would mean an ADC value of 200 is 2.28V.		
GOUT	**GOUT** Get the output bit register in hexadecimal format. Example: will return 00**C3** if bits 0, 1, 14, 15 are set(1) and all other clear (0).	Returns Hex value, 16 bits max.	
GVOLT	**GVOLT X** Get/read the voltage on an input X.	Returns floating point, 3 decimal places. .	

GIO	**GIO** – Get the status of Output bit, Input bits and Analog values		
GINP	**GINP** Get the input bit register in hexadecimal format. Example: will return 00**C3** if bits 0, 1, 14, 15 are set(1) and all other clear (0).	Returns Hex value, 16 bits max.	
CBIT	**CBIT XX** Clears output bits, **XX** is hexadecimal format. Any bit in x set to 1 will cause the same output bit in the modem's output register to be cleared to 0. No bits get set. X=C3 to set bits 0, 1, 14, 15. To read the output bit register, enter **CLRBIT** with no parameter or better to use **GETOUT** command.	0-FF	
SBIT	**SBIT XX** Sets output bits, **XX** is hexadecimal format of the bits being set. Any bit in x set to 1 will cause the same output bit in the modem's output register to be set. No bits get cleared. X=C3 to set bits 0, 1, 14, 15. To read the output bit register, enter SETBIT with no parameter or better to use **GETOUT** command.	0-FF	0
TBIT	**TBIT XX MMM** Sets output bits for a specific time, **XX** is hexadecimal format of the bits. Any bit in x set to 1 will cause the same output bit in the modem's output register to be set. **MMM** is in mS. 1000=one second, 60000=one minute,…To set bit #3 to 1 for 250mS: **TBIT 4 250** After the time expires, the bits that was st in XX is cleared to 0.	0-FF 2 – 4000000000 *(2mS – 1100hours)*	
CNTTM	**CNTTM B SS** Configure a timer to reset the bit's binary counter. **B** is the bit number (0-15) that is being configured. **SS** is the interval number of seconds that the transition counter will be reset to 0. Set **SS** to 0 to never automatically reset the counter.	B: 0 - 15 SS: 0 - 65536	
IOPIN	**IOPIN XX M** Set the GPIO bits on the Tech Series GPIO front panel to inputs or outputs. **XX** parameter are the hexadecimal representation of the pins being configured. M is the mode for the XX pins. Mode M values: **A**:Digital TTL Input, **B**:Digital TTL Output. **C**:Open Drain MOSFET output, **D**:DC Power switch output. **E**:Analog Input **X**:Unused pin.	XX=Hex 00-FF M=(A,B,C,D)	7 (Digital Inputs)

4.2.   *General Command*

These commands apply to the general configuration of the internal M8, and are applicable in both the data modem mode and paging mode.

Command	Command Description	Parameters	Factory Default
ATAT	**Silence AFTER Sequence** - Sets period of silence after the command sequence characters in mS.	Range:0 – 1000 (mS)	500
ATBD	**Baud Rate** – Sets serial com port baud rate (bps). Type the range index (0-7) or the actual desired baud rate.	Range: 0 – 7 0 = 1200 1 = 2400 2 = 4800 3 = 9600 4 = 19200 5= 38400 6=57600 7=115200	3
AFDC	**Audio input DC offset** – The DC bias level on the audio input in millivolt. Adjust this setting so the audio transmissions are on the center of the channel. Set to 0 to have the M8G auto-detect the average.	Range: 0-3300 mV	1650
AFLVL	**Audio input level gain** – internal gain of the audio input signal, in %. Adjust this setting for the audio input deviation level.	Range: 0-2000% mV	100

AFLIM	**Audio deviation limit** – Sets the peak audio deviation limit for TX audio in the audio pass-through mode. In % of data deviation 100% limits audio to same as data. .	Range: 0-300%	100
ATBT	**Silence BEFORE Sequence** – Sets period of silence before the command sequence character in mS.	Range: 0-1000 mS	500
ATCD	**Carrier Detect Threshold** – Read/set the carrier detect threshold, in dBm. -113 means -113dBm.	-113	-120 to -60
ATCH	**Configure Hardware Flow Control** – Enable (1) or disable (0) flow control. When enabled, the modem will monitor the RTS line, and if it is negated, stop sending data out the serial port. If disabled, the modem will ignore the state of RTS, and always send out characters.	1 = Enable 0 = Disable	0
ATCI	**Handshaking Invert** – Used to invert the RTS handshaking signal. 0=normal, 1 = inverted.	1 = Invert 0 = Normal active low.	0
ATCT	**Command Time Out** – If no valid commands have been received via the serial port within this time period (in milliseconds), modem returns to normal operation mode from Command mode. If the CONFIG button inside the *M8G* is pressed, this parameter will be automatically set to 60000.	Range: 100-60000mS	60000
ATE	**Echo –** Character echo set on (E1) or off (E0). This applies to the Command Mode only.	Range: 0 , 1	1 (echo)
ATEN	**Encryption Mode –** o= off. 1=AES128 for GPS location report. IO data unencrypted. 2=AES128 encryption for GPS data and also serial port data.	Range: 0 - 2	0
ATF	**Display frequencies** – Display all of the frequencies programmed into all of the channel memories.		N/A
ATFT	**Transmit Frequency –** Program the transmit frequency for this channel. Enter in Hz or in MHz. The frequency will automatically be saved in non-volatile memory (flash) for this current channel number.	Range: See product data sheet. For MURS products, frequency cannot be changed.	See product data sheet.
ATFR	**Receive Frequency –** Program the receive frequency for this channel. Enter in Hz or MHz. The frequency will automatically be saved in non-volatile memory (flash) for this current channel number.	Range: See product data sheet. For MURS products, frequency cannot be changed.	See product data sheet.
ATFX	**TX and RX Frequency –** Program the receive and transmit frequency for this channel. Enter in Hz or MHz. Same as issuing an ATFR and an ATFT command. The frequency will automatically be saved in non-volatile memory (flash) for this current channel number.	Range: See product data sheet.	N/A
ATHN	**Channel Number** Select current radio channel number. This command does not store the channel number into EEPROM,	Range: 1 - 6	1
ATHP	**Channel Number** – Select current radio channel number. The channel number is stored in EEPROM memory.	Range: 1 - 6	1
ATIC	**Read Current Draw** Read the current draw in mA. Accuracy is within 20% of actual current draw.	Range: 0-9999	N/A
ATIO	**Read/Set the Input/Output mode.** ATIO 5 for M8G stand-alone OEM module. ATIO 8 when used in the Tech Series enclosure.	0-10	5
ATJF	**Read/set the CTS threshold** – Set the serial buffer threshold where the CTS line is negated. By default the ATJF level is at 80% of the internal buffer size.	1 - 2000	3800
ATL	**Enable/Disable the LEDs** – 1 = LEDs always off. This reduces some power consumption. 0 = LED operate normally.	0 or 1	0

ATMT	**Protocol Select** – The over-the-air communication protocol. 0=Packetized mode, 3=POCSAG paging receiver. 8=Audio pass-through.	Range: 0 or 3	0
ATNS	**Stop Bits –** Selects the number of stop bits.	Range: 1-2	1
ATR1	**Select CD pin output signal** – CD may be RF carrier detect, or modem data detect.	Range : 0 - 4 4 = Data Framing 3= Always negate CD 2 = Always assert CD 1 = Data CD 0 = RF CD	0
ATR3	**Serial Port Time Out** – The time in milliseconds for the serial port to time out. When data is entering the serial port, and this amount of time passes with no more data, the M8G will begin to transmit the data over the air.	Range: 1 - 999	20 20mS is the default.
ATR8	**Frequency Offset.** Used to set the radio on the center of the radio channel.	Range: -500 to +500	0**
ATRQ	**Receiver Signal Level** – Reads the Receiver Signal strength this instant, and returns the level in dBm.	Range: - 40 to –130 (dBm)	-
ATRS	**RSSI** (Receive Signal Strength Indicator) – Returns the signal level of last received packet. The reading is in dBm. Usable for relative comparison of signals, but absolute value is within10dB at -90dBm.	No parameters. Returns a number : -50 to –140 (dBm) varies by model.	none
ATSL	**Serial Number** – Reads and returns a unique serial number for thjs unit.	Read Only 1 - 999999999	unique
ATSM	**LPM Operation Enable** – When Low Power Mode (LPM) is set to 1, the DTR input line controls the M8's low-power operation. When set to 0, the M8G will not go into LPM, regardless of the state of the DTR pin. When set to 2, the modem is forced into a low-power mode, disabling the receiver. When set to 4, the RX is turned off, and the transmitter will still send data and GPS position report.	Range: 0, 1, 2	0
ATST	**Statistics –** Show the unit's operational statistics. See Statistics section of user manual.	0, 1,2, 3, 4, or 5	None
ATTD	**Transmit Test Data** – When issued, the modem will begin transmitting data. The type of data sent is set in the parameter. Entering a <CR> will terminate the transmission.	0 = Go back to normal 1 = Random 3 = 1010… at ¼ baud rate 4 = TX all 0s 5 = TX all 1s 6 = Test Points ON 7 = Transmit CW 8 = Transmit 1010101…	
ATTE	**Read product temperature –** Read the internal temperature of the unit's circuit board in degrees Celsius.	-40 to +99	-
ATVB	**Read DC input Voltage–** Returns the DC input voltage reading, in mV (12500 = 12.5VDC input).	None	none
ATVR	**Firmware Version** – Returns firmware version currently loaded on the module.	Read Only, 3 characters	none
AT&F	**Restore Factory** – Restore the factory default values. This command will not erase the calibration values. After this command executes, the modem will still be in the CONFIG mode.		none
BAND	**Read the Band – Reads the frequency band of the radio. First parameter is the text version (UA, UC, VB, …), second parameter is the lower limit, and the third parameter is the upper limit in MHz. Use to read the band that the radio is tuned to cover.**	None	-
CONFIG	**Display the M8's configuration.**	0, 1, or 2	-

CHNUM	**Read number of channels.** This command will return the number of channels this product has.		6
KEYPHRASE	**Privacy Security Key Code.** Set the privacy key for this device. It must be the same key as used on all other Raveon products in your system. It secures radio transmissions from unauthorized reception. **ATEN** parameter to the type of encryption to use.	2-16 ASCII characters.	"RAVEON"
MODEL	**Read Model number. Read the model number of the unit.**	None	M8G or M8R
QSIZE	**Read the number of queued WMX frames in the WMX queue.**	None	-
QCLR	**Remove all WMX frames from the WMX frame queue.**	None	-
SHOW	**Show/display an overview of the radio's configuration.**	None	-
WMX	**Read/set the WMX serial port protocol. 0=off, 1= enabled.**	0, 1	0
WMXVR	**Read the WMX version**	None	
WMXINFO	**Read WMX information.** Returns: **Aa, bb, ccc, dd** where AA = Number of WMX message buffers in the product's WMX queue. bb = Number of WMX messaged queued up in the product's WMX frame queue. ccd = Total size of WMX message buffers in bytes. dd = WMX version implemented in the product.		

** indicates values that are calibrated in the factory and are unit-specific. If the "Radio Type" is changed, these will need to be re-calibrated.

4.3. *Data Modem Mode Related Commands*

These commands apply to the operation of the internal M8G when it is in the data modem communication mode.

Command	Command Description	Parameters	Factory Default
ATBC	**Busy Channel Lock Out** – Enable/disable the BCL. If enabled, the modem will not transmit on a radio channel that is busy (has RF on if). 0-OFF, 1=ON.	Range: 0-1	0
ATDT	**Destination Address to call**– Sets address of the modem to send data to. Note, this parameter is entered in HEX format. Each digit may be a 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,or an F.	Range: 0-FFFF	1234
ATHS	**Show History** – Show a table of listing the most recent receptions, and the IDs that the data was sent from	No parameter	
ATHX	**Enable/Disable single-hop repeating –** 0=any number of repeats, 1 – unit will not repeat a packet that was already repeated.	*0 or 1*	*0 (multi-hop OK)*
ATLA	**Listen Address** – Configures the listen address for this unit. The unit will receive data if this listen address matches the destination address in a data transmission. FFFF to disable it.	Range: 0000 - FFFF	1234
ATMK	**Address Mask** – Configures local and global address space. Each digit may be a 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,or F. In most applications, this is kept at FFFF.	Range: 0000 - FFFF	FFFF
ATMY	**Unit Address** – Configures the individual; address for this unit. Each digit may be a 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,or F. Note: FF is interpreted as a group. See addressing section.	Range: 0000 - FFFF	1234

Command	Description	Range	Default
ATPE	**Packet Error Display –** Shows statistics to compute packet-error rate. Displays Packets Per Minute (PPM) and a running total.	None (display PER) 1 = reset counters 2 = Stop PER display	None
ATPO	**RF Power Output**. Set or show the RF power output setting. Value is in percent, from 0% to 100%. Use and RF wattmeter to confirm the power setting, and adjust the % accordingly to obtain the desired RF power level.	0-100	100
ATR0	**Symbol Peak Deviation** – Set the peak FM deviation of the transmit symbols. Note: This can be a negative number to invert the modulation.	Range -500 – 500	100
ATR2	**Over-The-Air bit rate** - This is the data rate the radio uses to send data over the air. **All RF modems in the network must use the same over-the-air baud rate**. Refer to section **Error! Reference source not found.** for information on how to set the OTA baud rate.	Range: 0 = 800 1 = 1200 2 = 2400 3 = 4800 4 = 8000 4L 5 = 9600 2L 6 = 19200 4L 7 = 5142 2L 8 = 9600 4L 9 = 2000 2L	3 narrow
ATR5	**Preamble length** – The number of bytes to send over-the-air in the pre-amble. If communicating with an M7 you may want to use 7 bytes.	Range: 3 - 255	5 (Varies based on data rate and radio type)
ATRB	**Number of retries**. If this modem does not get an ACK back when it sends data, this is the number of times it will re-transmit the packet and wait for an ACK. 0=disabled feature.	Range: 0-99	0 (ACKs are not used)
ATRF	**RF Carrier Required** – When enabled, there must be RF energy on the channel for the modem to output data. Streaming data mode only. 1-RF required. 0=ignore RF energy when receiving.	Range: 0, 1	0 (no RF required)
ATRV	**Disable Remote Access** – When enabled (set to a 0), the modem will respond to over-the-air RPR requests, Pings, and over-the-air commands. Default is OFF (1).	0 = Remote Access on 1 = Remote Access off	1
ATTT	**Max Packet Size –** Set the maximum number of bytes in an over-the-air packet.	1 - 512	80
ATXn	**Show or Configure the Repeat Table** – Set the addresses that this unit will store-and-forward data to/from. n = 1, 2, 3, or 4 designating the entry in the table to show or edit..	*Four parameters* aaaa bbbb cccc dddd where aaaa=Source Address bbbb = S.A. Mask cccc = Destination Address dddd = D.A. Mask	
ATXR	**Enable/Disable Store and Forward Repeating –** 0=disabled, 1 – enabled.	*0 or 1*	*0 (Off)*
ATXT	**Read/set repeater delay –** Read or set the repeater delay. This is the time between receiving a data packet, and the time the repeater will re-send it.		
PING	**Ping another modem.** Format is **PING xxxx**, where **xxxx** is the ID of the modem to ping. If remote access is enabled on **xxxx**, it will respond.	*XXXX*	-
REPEAT	**Turn Repeater feature on/off. REPEAT x** If **x**=1, a quick way to enable repeating all packets. If **x**=0, disables the repeat feature.	*0 (off) or 1 (on)*	*0*
RPR	**Remote Procedure Request.** Used to request execution of a command on a remote mode (over the air). See *M8G System Protocol* manual for information on using this feature.		
STAT	**View device statistics.** Enter STAT with no parameter to see general statistics. STAT 1 for GPS tracking related statistics.		

** indicates values that are calibrated in the factory and are unit-specific.

4.4. GPS Transponder Related Commands

The following commands are specific to the operation of the internal M8G in the GPS tracking mode.

Command	Command Description	Parameters	Factory Default
DATAMUTE	**Set/Read Serial Port TX Data Mute.** 0=Unit will transmit serial data over the air. 1=Unit will not send any serial port input data over the air, only position transmissions. Works in TDMA mode only	0 or 1	0
FREEWHEEL	**Freewheel time.** Read/set the number of seconds that the unit will continue to transmit in TDMA time slots when it does not have GPS lock.	1-7200	120
GPS	**Display/Set GPS operation mode GPS X** **X** is GPS mode: 0 = Disable internal GPS and turn off all GPS features 1 = GPS on, normal GPS transponder operation. TX only 2 = Transponders/Base. TX and RX. $PRAVE output **Y**= 0 for off, 1 for on.	1 – 9	2
GXF	**Display/Set Feature GXF X Y** Display, set, or disable various GPS features. **X** is numeric feature code: 3 = GPS Echo. All data from the internal GPS rx is echoed out the user serial port. 4 – Proximity Alert. **Y**= 0 for off, 1 for on.	*1-3*	
GPS&F	**Reset all GPS (-GX version) parameters.** Set the GX version's Operating mode to GPS mode 4, and sets all GPS parameters to factory defaults. It does not erase frequency or other radio-related parameters.	-	-
IDLERATE	**IDLE TX Interval.** Set the number of seconds between position transmissions when the unit is idle (no trigger events occurring such as speed, I/O…)	0-9999 seconds	10
LOCRATE	**Set/Read NMEA interval the internal GPS chip uses to read the M8G's GPS location.** Enter in Seconds, with 500mS resolution if a decimal point is entered. Enter 1 for one second enter 0.5 for 500mS read interval.	0.5- 32000	1
NMEAOUT	**Enable/Disable NMEA messages.** Configures the M8 GX to output standard NMEA messages (GGA, GLL, RMC) out its serial port. **NMEAOUT 0** disables the messages. **NMEAOUT 1** enables them.	0, 1	1
NMEAMASK	**Set/Read NMEA message bit mask.** The NMEAMASK register contains configuration bits to enable various NMEA standard messages from the internal GPS receiver that will be sent out the serial port. The parameter is the decimal integer value of the mask.	0-9999	258 (RMC, GLL, GGA)
NMEARATE	**Set/Read NMEA message rate.** Set/read the number of seconds used to output NMEA messages from the internal local GPS. 10mS resolution, and OK to enter with a decimal point **NMEARATE 3.4** will output NMEA messages every 3.4 seconds.	0.10 – 60.00	5
OUTPUT	**Set Output format.** Set/read the serial port output format to output GPS position/status messages. This parameter is set by the GPS x command. It may be manually reconfigured AFTER the GPS x command is issued. 0=none, 1=$PRAVE, 2= $GPTLL, 3=$GPWPL, 5=PIN, 6=$QVPOS, 9=Debug, 11=$GPGGA, 13=GLL, 14=GLL&VTG, 16=!AIVDM&$PRAVE		1 $PRAVE Set by GPS mode command.

PREFIX	**ID Prefix.** Set an ID prefix. The prefix is 1-8 characters that will be put in front of the ID when reporting an ID as a waypoint name. A dash means no prefix. Default is a capitol letter V.	1-8 ASCII characters Set it to "0" for no prefix.	V
PROX	**Proximity Alert.** Set a minimum proximity distance (meters). When any *RV-M8 GX* with properly configured ID codes and KEYPHRASE comes within this many meters of this unit, a proximity warning is triggered. The report interval will be at the TXRATE setting, and report the proximity warning at least 8 times or until the distance between the two *RV-M8 GXs* increases beyond the PROX distance.	0-9999 0=feature disabled	Disabled (0)
GNSS	**GNSS X.** X sets the satellite mode the GPS receiver should use. 0=GPS; 2=Galileo; 6=Glonass. Most use 0 (GPS). Some version of the radio can or cannot use Glonass or Galileo. See the data sheet.	0 - 6	0
SLOTQTY	**Quantity of TDMA Slots.** Normally this parameter is set to 1. Each unit gets one slot. To facilitate data transmission, it is possible to set this to a number other than 1. For example, if set to 3, and the ID of the unit is 0008, the unit will be allowed to transmit in slots 8, 9, and 10.	1-9999	1
SLOTNUM	**Change the TDMA slot number.** Use this command with caution! This will change the TDMA slot assignment, leaving the ID (MYID) unchanged. Typically, the ID and the slot number are the same. Once this command is used, the TDMA slot number for this transceiver to will no change if the ID of the device is changed. Set SLOTNUM to -1 to force the Slot Number to be automatically set to the MYID of the radio. This is the factory default setting.	-1, 1-9999 (Decimal number, not hex)	N.A. By default the Slot Number is auto-set to the MYID
SLOTTIME	**TDMA Slot duration.** Configure the width of a TDMA slot. 50mS increments.	50 - 1000	200
TDMATIME	**Set/read TDMA Frame time.** The length of one TDMA time frame, in seconds.	0-3599	10
TRIGDX	**Distance trigger.** Set a distance (in meters) threshold beyond-which the unit will transmit its position and status. If set to 0, the unit always reports at the TXRATE. If set to an distance greater than zero, then the unit reports at the TXRATE intervals if it has moved this distance since the last report. If it has not moved, it will still report its position, but at the rate set by IDLERATE.	0-999	0
TRIGSPEED	**Speeding Report.** Set a speed (in kilometers/hour) threshold above-which the unit will begin reporting its position and status. Set to 0 to disable this feature.	0-999	0
TXRATE	**GPS Report Rate.** Set number of seconds between GPS reports. This is also the rate at which the internal GPS will measure position, speed, etc. Even if the unit is not moving, the GPS periodically measures position and speed to determine if it has triggered a speed or position transmission. Set to TXRATE and IDLERATE both to 0 to totally disable position reporting.	0 - 9999	10

TDMADATA	**Set/read TDMA Data Priority.** Configure the unit to give transmit priority to serial port data over GPS position data. 0=GPS position priority, 1=Serial Data priority. If set to 1, GPS position transmissions are suppressed when there is serial port data to send. If set to 0, GPS is always sent, and extra space in TDMA slot will be filled with any available serial-port data.	0, 1	0 (GPS Position is priority over data)
TRIGBITS	**I/O Change Reporting.** Sets/reads which bits are used as "transmission triggers". This is a HEX number. Bit 0 is IN0, bit 1 is IN1…. IN2 is the serial data input, so if the unit is used to send data, do not set TRIGBITS to a number greater than 3. Note: all input bit status is always sent each transmission, regardless of this setting.	0-7 N version 0-1F	0
TRIGPOL	**Polarity of the input bits.** 0 = normal active high operation(causes unit to transmit when it goes high), 1 = Inverted, active low. This is a HEX number. Bit 0 is IN0, bit 1 is IN1…. Any bit set to one in this parameter will set the particular bit to be "active low". Setting this to 0 will set all input bits to be active high. This does not affect the actual state of the bit transmitted over-the-air. It only effects the polarity that causes a bit to trigger an event or a transmission.	0-FF	0 Active high

The Tech Series SCADA features support custom "safe zones" and alert you automatically if the sensor detects conditions outside of that range. Some safe zone settings can report: On, OFF, XX number of transitions, pulses per second, pulses per minute.

Application Note AN234 has details on how the Tech Series modems can be used as Remote Terminal Units (RTUs) and Slave devices. There are many SCADA and Telemetry features to look into:

1. How to configure the IO pins

2. How to use TTL digital IO, switched DC out, open collector, analog input, voltage inputs, internal sensors…

3. How to read and set parameters.

4. How to configure the device for Pulse Counting.

5. How to setup alert thresholds for automatic reports.

5. *RV-M22 and RV-M21 series products Warranty*

Limited One Year Warranty

If within 12 months from date of purchase, this RV-M21 Tech Series Product fails conforms to Raveon Technologies Corporation's (the Company) published specifications for the model purchased due to a defect in material or workmanship, Raveon Technologies Corporation will repair or replace it, at Raveon's sole discretion. This warranty is extended to the original purchasing end user only and is not transferable. Any claim for breach of warranty must be brought to the Company's attention within such twelve (12) month period and the Product must

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be returned for action on any such claim within twelve (12) months from the date of purchase Within a reasonable period of time after a claim, the Company will correct any failure of the Product to conform to specifications or any defect in materials or workmanship, or replace the Product, or at its option provide a full refund of the purchase price. A repaired or replaced Product is warranted for 90 days from the date of return shipment to the buyer, or for the balance of the original warranty period, whichever is longer. These remedies are the buyer's exclusive remedies for breach of warranty.

This warranty does not apply to: (a) product damage caused by accident, dropping or abuse in handling, acts of God or any negligent use; (b) units which have been subject to unauthorized repair, opened, taken apart or otherwise modified; (c) units not used in accordance with instructions; (d) damages exceeding the cost of the product; (e) batteries; (f) the finish on any portion of the product, such as surface and/or weathering, as this is considered normal wear and tear; (g) transit damage, initial installation costs, removal costs, or reinstallation costs; (h) damage due to lighting, floods, fire, or earthquakes (i) any product, components or parts not manufactured by the Company (j) defects caused by failure to provide a suitable installation environment for the Radio; (k) damage during shipment; (l) that the Product will be free from any claim for infringement of any patent, trademark, copyright or other proprietary right, including trade secrets.

RAVEON TECHNOLOGIES INCORPORATED WILL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING DIRECTLY OR INDIRECTLY OUT OF THE OWNERSHIP, USE OR OPERATION OF THE RADIO REGARDLESS OF WHETHER SUCH DAMAGES ARE PREDICATED OR BASED UPON BREACH OF WARRANTY, BREACH OF CONTRACT, NEGLIGENCE, STRICT TORT, OR ANY OTHER LEGAL THEORY. SUCH DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, LOSS OF PROFITS, LOSS OF SAVINGS OR REVENUE, LOSS OF USE OF THE RADIO OR ANY ASSOCIATED EQUIPMENT, COST OF CAPITAL, COST OF ANY SUBSTITUTE EQUIPMENT, FACILITIES OR SERVICES, THE CLAIMS OF THIRD PARTIES, INCLUDING CUSTOMERS AND INJURY TO PROPERTY. SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU. THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESS OR IMPLIED WARRANTIES. ALL IMPLIED WARRANTIES, INCLUDING THE WARRANTY OF MERCHANTABILITY AND THE WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY MODIFIED TO EXIST ONLY AS CONTAINED IN THIS LIMITED WARRANTY, AND SHALL BE OF THE SAME DURATION AS THE WARRANTY PERIOD STATED ABOVE. SOME STATES DO NOT ALLOW LIMITATIONS ON THE DURATION OF AN IMPLIED WARRANTY, SO THE ABOVE LIMITATION MAY NOT APPLY TO YOU.

This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

No employee of the Company, or any other party is authorized to make any warranty in addition to those made in this document. This warranty limits the Company's risk and allocates the risks of product failure between the Company and the buyer. This allocation is recognized by both parties and is reflected in the price of the goods. The buyer acknowledges that it has read this warranty, understands it, and is bound by its terms. This limited warranty is governed by the laws of the State of California, without reference to its conflict of law provisions or the U.N. Convention on Contracts for the International Sale of Goods.

Warranty service is available by mailing postage prepaid to:

Raveon Technologies Corporation

2320 Cousteau Court

Vista, CA 92081 - USA

To obtain warranty service, include a copy of the original sales receipt or invoice showing the date, location, and price of purchase. Include a written description of the problem with the product, a phone number and name of person who may be contacted regarding the problem, and the address to where the product should be returned.

Products repaired under warranty will typically have their program memories erased and reset to factory default settings.