



## ***RV-M21 and RV-M22*** Tech Series Products

*Version C1*

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# 1. About This Manual

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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. It is document 5A836. The radio manuals are:

- RV-M8      VHF/UHF 5W radio modem module
- RV-M6      VHF 2W radio modem module
- RV-D50     915MHz ISM Daisy radio
- RV-Z50     3G cellular radio modem

There are two different *Tech Series* Enclosures:

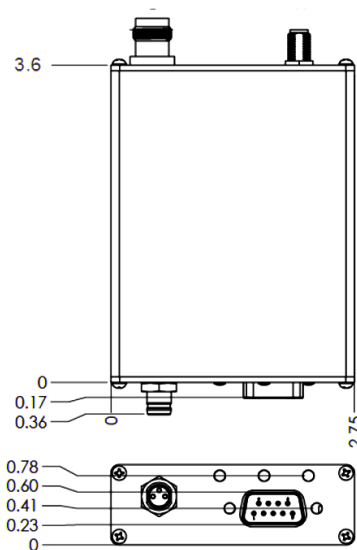
- RV-M21**    For M8 radio modules, up to 5 watts TX power.
- RV-M22**    For M6, M50m, Z50 radio models. Low power, miniature enclosure.

# 2. Tech Series Overview

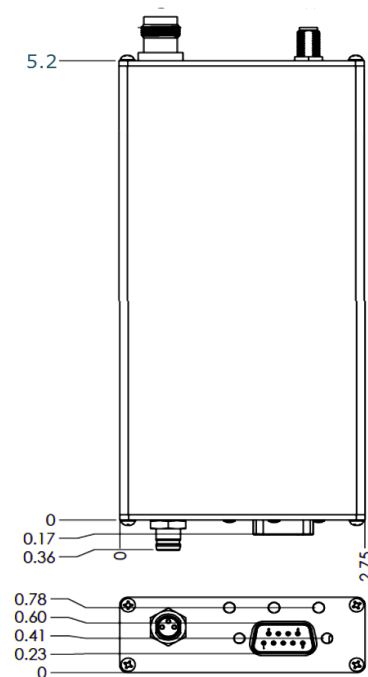
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## 2.1. M21 and M22

**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.

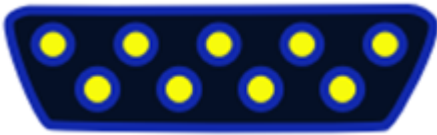


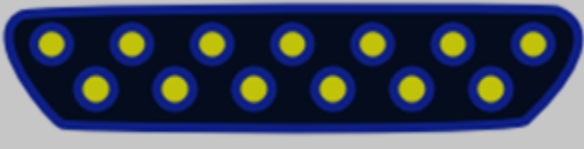
## 2.2. I/O Options

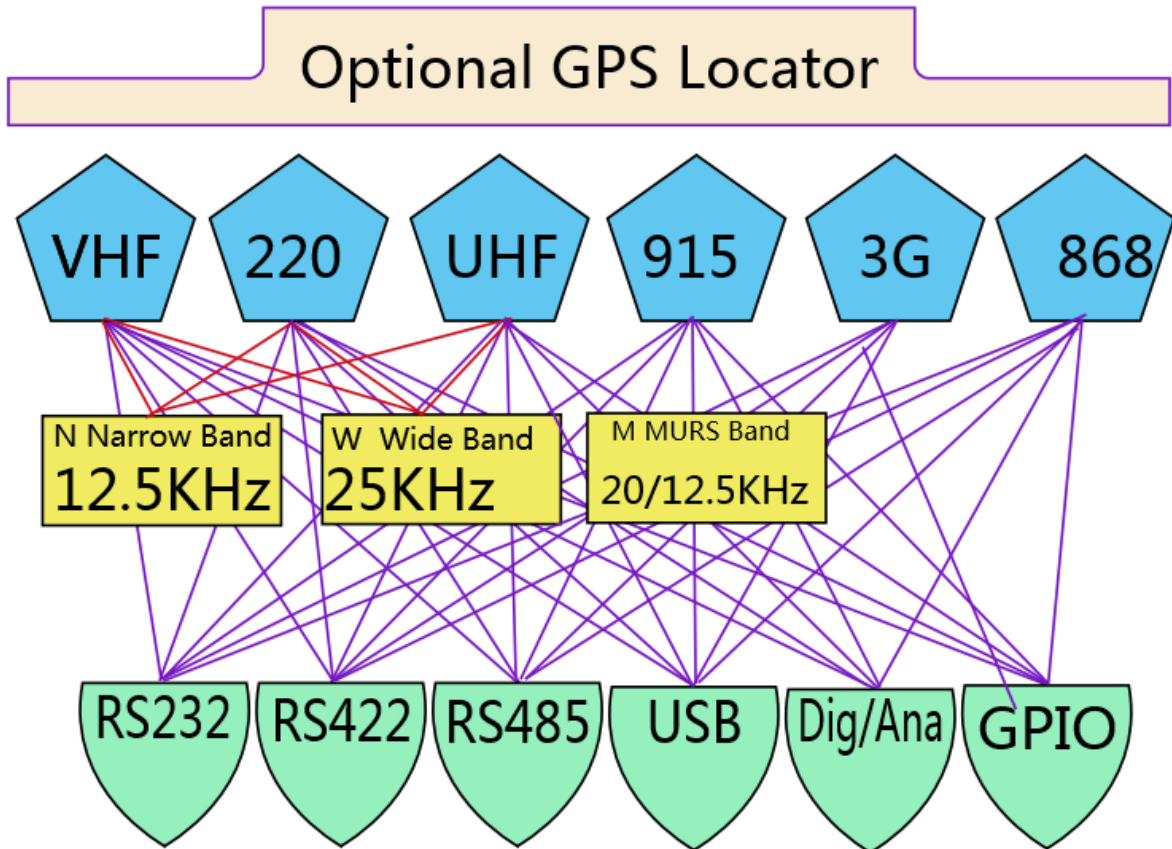
The front interface of the M21 is fully field-reconfigurable. The following interface boards may be attached or changed at any time:

- RS-232 [ S ] 5T835
- USB [ U ] 5T837
- RS-485 [ T ] 5T836-1
- RS-422 [ F ] 5T836-2
- GPIO [ G ] contact sales
- Analog [ A ] 5T838
- FIO [ D ]

## 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
	G, T
	A



The Tech Series RV-M21-xxxx 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, the 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.

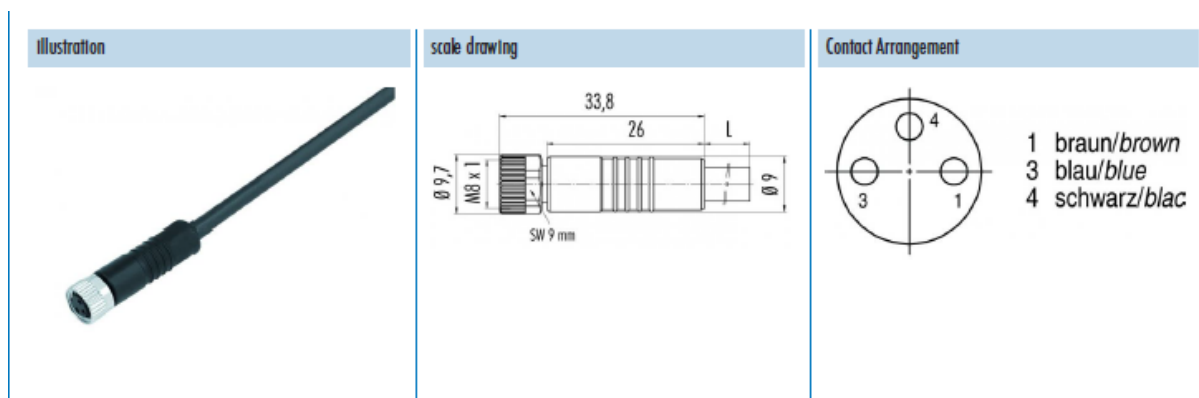
## 2.5. Power

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.
3. **GND.** Chassis and signal ground.
4. **Enable.** Voltage input to enable/disable the product. Normally this is connected to VIN. It must be > 2V for the product to start working.

## 2.6. Power Cable

The cable that connects to the M21 and all Tech Series products is typically wires 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. Connect to Pin 1 or a voltage > 2V to enable product.

## **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.

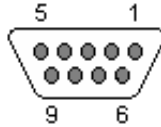
## **3. Tech Series I/O Interface Information**

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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**

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.



**Front-view of DB-9 connector on modem (female)**

<b>Pin</b>	<b>Name</b>	<b>Dir</b>	<b>Function</b>	<b>Level / Specification</b>
1	CD	out	Carrier detect	If enabled, indicates presence of carrier. Logical 0 (+ voltage on RS-232) means carrier is present. 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.
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 <i>RV-M7</i> 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.
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.
7	RTS	in	Request to send or IN1	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.
8	CTS	out	Clear to send	Used to stop the flow of data going into the RxD pin from the device connected to the <i>RV-M7</i> . 0 = OK to send, 1 = don't send. If the <i>RV-M7</i> cannot accept more data, it will negate this signal (level=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.

### **3.2. Analog [A] 5T838**

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

<b>Pin#</b>	<b>Function</b>	<b>Description</b>
1	MIC	Analog 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	DCD	Data/Carrier Detect output
14	NC	No connect
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.

On 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.

<b>AFDC</b>	<b>Audio input DC offset</b> – 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.	Range: -2000 - 2000 mV	0
<b>AFLVL</b>	<b>Audio input level gain</b> – internal gain of the audio input signal, in % . Adjust this setting for the audio input deviation level.	Range: 0-2000% mV	100
<b>AFLIM</b>	<b>Audio deviation limit</b> – 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
<b>TXTOT</b>	<b>Transmit Time-Out-Timer</b> – Sets the maximum number of seconds that the M8S will stay transmitting when the PTT input is asserted.	Range: 0-500 seconds	10
<b>ATPTT</b>	<b>Push To Talk Polarity</b> – Sets the PTT polarity. Default is active low (0) and set to 1 for active high.	Range: 0-1	0

The transmit audio input pin 1 is designed to have audio sent in with a 1.66 V DC bias. 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 resistor to ground and 3.3V. One hundred counts (or 100mV) will shift the frequency about .7kHz, 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 **AFDC** to 0 to have the M8 automatically find the DC input bias and compensate for it.

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 +/- 2kHz of FM deviation. With **AFLVL** set to 200, 250mV p-p input will give 2kHz p-p of FM deviation.

The **AFLIM** command sets a hard FM deviation limit, which will stop the M8 from deviating the FM carrier beyond the preset limit with the input TX audio exceeds a threshold that would have cause the M8 or 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.

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 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.

Typically, the audio output with a 2kHz FM deviation, will have a peak to peak of 400mV and a DC offset around 500-1000mV. If you 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 a two-wire connection, with the pair of wires transmitting and receiving data.



<b>Pin #</b>	<b>Name</b>	<b>Direction</b>	<b>Function</b>	<b>Level / Specification</b>
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1	RTS IN	I	Do not connect	Do not connect this pin to anything.
2	<b>A (+)</b>	I/O	A	Non-inverting RS-485 data out line
3	<b>B (-)</b>	I/O	B	Inverting RS-485 data in line
4	<b>Out +</b>	out	Y	Do not connect this pin to anything.
5	<b>Out -</b>	out	Z	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 B.

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

**B** TxD-/RxD- aka inverting pin which is negative (compared to A) 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.

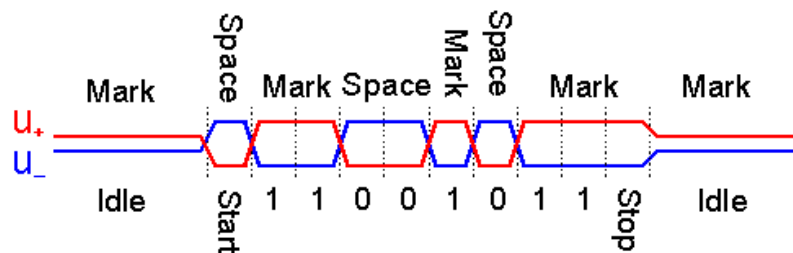
If you wish to run the RS-485 in full-duplex mode using two radios, the interface must be wired with two separate pairs of wires; A&B on one pair, and Out+ & Out- on the other pair.

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  $\pm 15\text{kV}$  and 7kV human body model. Input current is less than 150uA. Output current when not driving the line is less than 50uA.

### Bias and Termination Resistors

RS-485 installations typically have a termination resistor across the A and B lines. For low-speed operation (<57600 baud), this resistor is probably not necessary. If you wish to use a terminating resistor, a value of 150 ohms should work in most applications.

These A/B pin names are all in use on various types of equipment. The RS-485 signaling specification states that signal A is the inverting or '-' pin and signal B is the non-inverting or '+' pin. The same naming is specified in the standards.



When an RS-485 network is in an idle state, all nodes are in listen (receive) mode. Under this condition there are no active drivers on the network. All drivers are tri-stated. Without anything driving the network, the state of the A and B line is unknown. If the voltage level at the receiver's A and B inputs is less than  $\pm 200\text{mV}$  the logic level at the output of the receivers will be the value of the last bit received. In order to maintain the proper idle voltage state, bias resistors must be applied to force the data lines to the idle condition.

### 3.5. RS-422 [ F ] 5T836-2

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

<b>Pin #</b>	<b>Name</b>	<b>Direction</b>	<b>Function</b>	<b>Level / Specification</b>
1	RTS IN	I	Do not connect	Do not connect this pin to anything.
2	<b>A (+)</b>	I/O	A	Non-inverting RS-485 data out line
3	<b>B (-)</b>	I/O	B	Inverting RS-485 data in line
4	<b>Out +</b>	out	Y	Non-Inverting data out pin
5	<b>Out -</b>	out	Z	Inverting data out pin
6	GND	-	Ground	Connect to earth ground.

#### Configuring for RS-422

The radio will auto-detect the 422 Tech Series board and set all necessary parameters to enable RS422 communication. The Tech Series hardware 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  $\pm 15\text{kV}$  and 7kV human body model

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

To use 422 in half duplex mode connect A(+) to Out (+) and B(-) to Out(-).

### 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. .



<b>Pin #</b>	<b>Name</b>	<b>Direction</b>	<b>Function</b>	<b>Level / Specification</b>
1	<b>RX</b>	In	Serial data Input	RS232

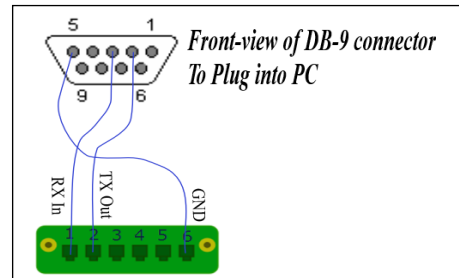
2	<b>TX</b>	Out	Serial Data Output	RS232
3	<b>IO1</b>	I/O	I/O Pin 1	Configurable General Purpose IO (GPIO). Available Modes: A, C
4	<b>IO2</b>	I/O	I/O Pin 3	Configurable General Purpose IO (GPIO). Available Modes: A, B, C, D
5	<b>IO3</b>	I/O	I/O Pin 3	Configurable General Purpose IO (GPIO). Available Modes: A, C, D
6	<b>GND</b>	-	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.
- C Open drain MOSFET output.
- D DC switched power output.
- E Analog Input

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.

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



### 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.

#### **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.

#### **Digital Output Specifications:**

Low-level Output voltage:	Less than 0.5V
High Level Output Voltage:	3.0 - 3.3V
Output resistance:	250 ohms

#### **Open Drain Output Specifications:**

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

**Switched DC power output: (IO2 and IO3) IO1 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: <250 milliohms to ground

### 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.

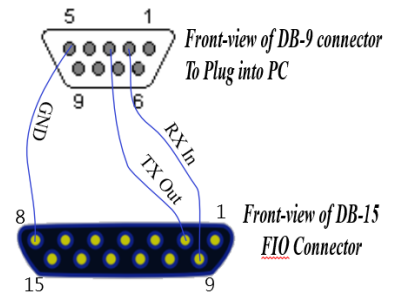


The IO modes FIO pins can be set to are: **A**: Digital TTL Input, **B**: Digital TTL Output, **C**: Open Drain MOSFET output. Please see the following table to see which FIO ports can be used for which IO modes.

Pin #	Name	Direction	Function	Level / Specification	GPIO Modes this pin can be configured as:
1	VIN		DC Voltage Input		
2	TX	Out	Serial Data Output		
3	OD0	Out	Open Drain Out		<b>C</b>
4	IO0	I/O	I/O Pin 0 (digital bit 0)	Digital IO pin. Input or output.	<b>A, B</b>
12	IO1	I/O	I/O Pin 1	Digital IO pin. Input or output.	<b>A, B</b>
5	IO2	I/O	I/O Pin 2	Digital IO pin. Input or output.	<b>A, B</b>
13	IO3	I/O	I/O Pin 3	Digital IO pin. Input or output.	<b>A, B</b>
6	IO4	I/O	I/O Pin 4	Digital IO pin. Input or output.	<b>A, B</b>
14	IO5	I/O	I/O Pin 5	Digital IO pin. Input or output.	<b>A, B</b>
7	IO6	I/O	I/O Pin 6	Digital IO pin. Input or output.	<b>A, B</b>
15	IO7	I/O	I/O Pin 7	Digital IO pin. Input or output.	<b>A, B</b>
9	RX	In	Serial data Input	RS232	
10	VDIG		Digital Voltage	The internal IO port voltage regulator outputs its voltage on this pin.	<b>A, B, C, D, E</b>
8, 11	GND	-	Ground		

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 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.



## 4. *RV-M22 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 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.

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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.