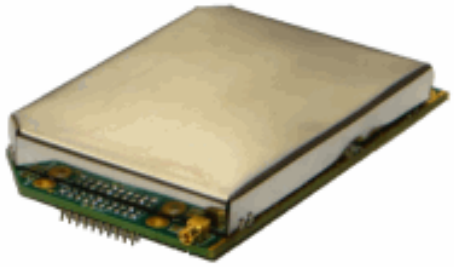
RV-M8G

GPS Transponder / Radio Modem

Technical Manual

Version D1

June 2019



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1. General Information about the RV-M8

1.1. Congratulations!

Congratulations on your purchase of an *M8G* OEM radio modem – the most advanced radio modem of its kind available today.

Please take a few minutes to read this manual carefully. The information presented here will allow you to derive maximum performance from your radio modem. After reading it, keep the manual handy for quick reference, in case questions arise later on.

1.2. NOTICE

There are no user-serviceable points inside this transceiver. All service work must be referred to your Authorized Service Center or Raveon Technologies Service Department.

1.3. Safety / Warning Information

Blasting Caps and Blasting Areas

To avoid possible interference with blasting operations, turn off this radio or remove the DC power when you are near electrical blasting caps, in a blasting area, or in areas posted: "**Turn off two-way radio**." Obey all signs and instructions.

Potentially Explosive Atmospheres

Turn off your radio prior to entering any area with a potentially explosive atmosphere. Do not install this product for use in areas with potentially explosive atmospheres. Do not remove, install, or charge batteries in such areas. Sparks in a potentially explosive atmosphere can cause an explosion or fire resulting in bodily injury or even death.

Note: The areas with potentially explosive atmospheres referred to above include fueling areas such as below decks on boats, fuel or chemical transfer or storage facilities, areas where the air contains chemicals or particles, such as grain, dust or metal powders, and any other area where you would normally be advised to turn off your vehicle engine. Areas with potentially explosive atmospheres are often but not always posted.

1.4. OEM Use

This radio module is for OEM use, and it is the responsibility of the OEM user to notify the end-users of RF and electrical safety issues.

2. Overview

The *M8G* RF Paging/Data radio modem is capable of high-speed narrow-band data communications and GPS position tracking paging decoding. Its powerful microprocessor enables it to perform as both a data radio modem and GPS tracker. It contains a receiver, a transmitter, and modem, creating an easy-to-use transparent data radio link. The *M8G's* user interface is asynchronous digital data into and out of the *M8G.* Modem operation is virtually transparent to the user and the configuration of the modem is via the user serial port.

The M8G can be configured in either a GPS tracking mode or a data modem mode. The command-line interface is similar to Raveon's other data radio products, and configuring the mode is very easy. The M8G also has a digital input pin that may be used to electrically change modem types between data modem and paging modes.

The *M8G* is an easy to use and its re-programmability makes it extremely versatile. Most parameters within the modem may be re-configured to optimize it for specialized operations, extended range, or higher data throughput.

It is also available in a receive-only version called the M8G. The M8R is the same electrical design and has the same features as the M8G except the transmit circuits are not populated.

2.1. Features

For the specifications of a feature, See the data sheet of the version of the product you are using.

General Features

- *Serial input and output. Programmable serial baud rates up to 57600.*
- *Small sized and single-board construction.*
- *Very efficient circuitry. (< 700mW receiving, < 8W transmitting)*
- *Lowest current draw in industry.*
- *Easy to use. Transmit data in = Receive data out.*
- *Receive-only version available*
- *Easily configured using "AT" commands*
- *Extensive diagnostic capabilities*
- *Serial communication may be 7 or 8 bit ASCII, or WMX*
- *Audio pass-through mode*

Data Radio Modem Features

- *High-speed over the air data rates.*
- *Built-in radio transceiver with integrated modem*
- *Wide input voltage with high-efficiency switching voltage regulator.*
- *Capable of store-and-forward repeating operation.*
- *16 bit addressing for up to 65,525 different unique device addresses per channel*
- *Supports group and broadcast transmissions. Network mask allows groups of any size.*

- *Up to 2-5 watts of RF output. Other RF power levels available upon request. See the product's data sheet.*
- *Very fast Transmit-to-Receive turn around time.*
- *Serial input and output. Programmable serial baud rates up to 57600.*
- *Programmable over-the-air data rates for long-range or high-speed*
- *Automatic key of transmitter on data.*
- *RF carrier-detect is not required receiving. No squelch setting required.*

GPS Tracking Features

- *Build in GPS receiver and tracking protocols.*
- *Automatically report location, speed, heading, voltage, temperature, altitude.*
- *Ultra-fast 3mS TX-RX switching and 4-level GFSK modem allows truly "Real Time" tracking and status.*
- *Outputs and accepts NMEA 0183 GLL, TLL, WPT, GSV, and PRAVE messages.*
- *Built-in TDMA channel access allowing truly real-time tracking (200 transmission in 10 seconds)*
- *Very low current draw. As low as 25mA average.*
- *Numerous I/O options and protocols to interface to many different terminals, displays, and software programs.*

2.2. Firmware Updating

The M8G is a software based radio and modem. There are times an existing unit needs to get updated with a new feature, and this can often be done by loading the new firmware into the older radio modem. In firmware program called the "Boot Loader" is permanently installed inside the M8G's microcontroller. During power up, it checks to see if the user wants to update the application program in the microcontroller. The STAT2 pin is used to trigger the Boot Loader. See application note AN186 for details on how to boat load new firmware into the M8G.

3. Operation

The M8G uses a built-in time-division multiple access (TDMA) protocol to allow thousands of transponders to share a single RF channel and still reliable communicate with no interference. Read mora about TDMA here: http://www.raveon.com/data_radio_info/tdma-transmission-overview-361/

Before deploying a new system, the system must be configured for proper TDMA operation by configuring these parameters:

1. The TDMA epoch (TDMATIME command)
2. The TDMA slot time for each radio. (SLOTTIME command)

The individual M8G transponders are configured for their:\

3. Report rate (TXRATE command)
4. Their individual ID (MYID command)

The *M8G* operates in a number of different “GPS Modes”, each mode specific to the application it is being used in. The mode of operation is set with one simple command, the **GPS x** command. The main GPS modes of operation are:

1)Transponder: Periodically transmits position and status over the UHF radio. Its radio receiver is disabled reducing current draw. It cannot receive messages, data, or locating information from other *M8G* transponders. 4800bps serial port.

2)RavTrack PC: Connect the *M8G* to a personal computer running RavTrack PC (or other PC software) to view a map showing location, status, log movement, set alerts, and make reports from the data. 38400bps serial port.

3)Radar Display: Connect *M8G* to a marine plotter or radar display, and icons will appear on the display showing the location of all other *M8G* radios in the system. 38400bps serial port.

4)GPS display: Connect *M8G* to a hand-held or mobile GPS, and icons will appear on the display showing the location of all other *M8G* radios in the system. 4800bps serial port.

12)Mobile Data: Outputs WPL messages for position, and transmits and receives data. Connect the M8G *GX* to a hand-held or mobile GPS, and icons will appear on the display showing the location of all other *M8G* radios in the system. Data sent into the RS-232 port will be transmitted over-the-air in the proper time-slot, and may be received with other M8G’s.

The different modes change the operation of the *M8G* in a number of ways. The **GPS X** command is a “macro” that sets a host of various parameters within the M8G to configure it to operate in the desired way. The serial-port data rate is set, the types of NMEA messages it wills send out or accept is set, as will as how the internal UHF radio is used. The table below summarizes the 4 standard GPS modes, as well as listing other specialized operation modes that the M8G GX supports.

GPS mode 2 is the factory default mode.

GPS Mode #	Common Usage	Serial Port Baud Rate	Output Messages	Description
GPS 0	M8G Radio Modem *Radio Modem. No GPS, tracking, or TDMA features.*	Un-changed	-	The *M8G* will operate like an M8G (no GPS features).
GPS 1	Transponder *Simple tracking, AVL, security.*	4800	(local GSV, GLL, RMC)	The *M8G* will only transmit in this mode. The receiver is off and GPS is turned off between transmissions. This is the lowest-power consuming mode, but it is send-only.
GPS 2	PC / Base Station *Proprietary interface for PC applications that monitor M8G Transponders.*	38400	$PRAVE (local GSV, GLL, RMC)	Connect the *M8G* to a PC computer running RavTrack PC (or a custom application), The PRAVE message is in NMEA format, and provides location and status information for every transponder it receives.
GPS 3	Marine Radar *Displaying the location of M8G transponders on a ship RADAR screen.*	38400	$GPTLL (local GSV, GLL, RMC)	Connect the *M8G* to a marine RADAR display or plotter with a serial port, and waypoints will appear on the GPS screen at the location of all *M8G* transponders within radio range. The display must support the NMEA 0183 TLL message.
GPS 4	GPS Display *Lowrance and Garmin GPS displays. Mobile displays.*	4800	$GPWPL (local GSV, GLL, RMC)	Connect the *M8G* to a mobile or hand-held GPS with a serial port, and waypoints will appear on the GPS screen at the location of all *M8G* transponders within radio range.
GPS 9	TDMA Diagnostics *Displaying TDMA slot diagnostic information*	38400	$PRAVE (local GSV, GLL, RMC)	Factory use only. Used for timing analysis.

When the **GPS x** command is executed, it configures the following parameters, so if your application requires any of these to be non-standard, you must issue the command to modify them AFTER the **GPS x** command is issued.

- *Serial port output message format*
- *Echo characters (ATEx command)*
- *NMEAOUT*
- *NMEARATE*
- *Hardware flow control*
- *Serial port* baud rate
- *Data mute setting*
- *WMX protocol*

4. Specifications

Please refer to the RV-M8 Data Sheet for RF and electrical specifications related to the particular model and frequency band you are using.

5. Electrical Inputs and Outputs

5.1. LEDs

Status LED (TX) This LED blinks red when the transmitter keys and is putting out RF power. It blinks green upon the reception of data or RF carrier. It turns orange when decoding a paging message.

Power LED (PWR) This LED does a short blink, once every two seconds, indicating to the user that the power to the modem is ON and the modem is working. When the modem is in the command mode, this LED will blink on and off, once per second.

5.2. I/O Pinout

The I/O connector is a 20-pin header, with 2mm pin spacing. See the AN224 UWORC Application Manual for more information out this type of IO.

Pin #	Function	I/O	Function
1	GND	-	Ground
2	Vcc	I	DC Input
3	CD	O	Carrier Detect Out. Low for carrier. Logic high for no carrier. *RF* or *DATA* carrier detect set with ATR1 command. Default: RF.
4	TX On	O	Pin is High when module is transmitting. Low when off, receiving, or sleeping.
5	Data In (TXD)	I	Transmit data input.
6	Data Out (RXD)	O	Receive data output.
7	Enable	I	Low (<.7V) to shut down the module. High (>2.5V) to enable it.
8	Sleep	i	CPU Sleep input
9	CTS	O	Clear to send output. Indicates state of internal input buffer. ATJF command sets the threshold where CTS is negated.
10	RTS	I	RTS input for serial flow control. In audio pass-through mode, functions as PTT. 0=TX, 1=RX.
11	RSSI	0	Receiver signal strength indicator
12	3.3V out	O	3.3V out of the M8 module. 50mA max current draw.
13	IOA AUDIO IN	I/O	General purpose digital I/O. 3V digital logic from CPU on M8. If the Audio option is used, this pin is used to input transmit audio.
14	IOB	I/O	General purpose I/O. 3V digital logic from CPU on M8. By default functions as DSR. 0= ready&running. 1=sleeping. If enable=0, this line will =0.
15	Decode Mode	I	3V digital logic with 10k pull-up. Leave open circuit unless utilizing two protocols. High/open = Primary decoder mode. Low/ground=Alternate receive protocol. This feature enabled by setting the alternate protocol with the ATMA command.
16	STAT1	O	Output to drive external dual-color LED. Connect led between STAT1 and STAT2.
17	RX Audio	O	Receive and transmit audio output for factory test. Do not connect to anything. If the AUDIO option is used, this pin is the receive audio output.
18	STAT2	O	Output to drive external dual-color LED. Do not connect the LED to ground or DC voltage.

19	GND	-	System Ground to M8
20	Vbu	I	Backup battery input to CPU to retain memory. Not required to be connected to anything.

5.3. Heatsinking

The M8G operates at up to 30% transmit duty cycle at ambient temperatures up to 50°C. For duty cycles over 50%, the module requires additional heat sinking.

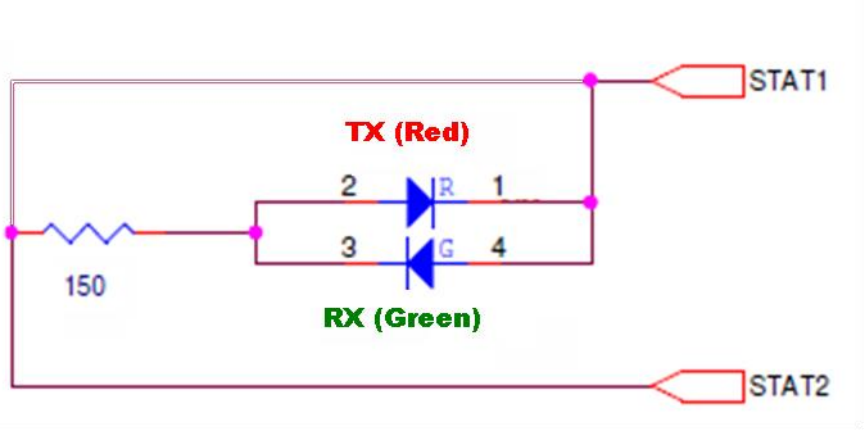
If an external heat sink presses against the “GND PAD” is on the PCB, the RF power transistor will run cooler, and allow higher duty cycles.

5.4. Mounting Holes

6 mounting holes are provided on the module. For best RF performance, the M8G module should be mounted to the system ground, using metal stand-offs.

5.5. STAT LED Outputs

An external dual-color LED may be connected to STAT1 and STAT2 pins to show the status of the modem. Do not connect the LED to power or ground! Connect the LED as show below.



Because the STAT2 signal is also used to put the modem into the “bootloader’ mode, the led must be wired as shown above to ensure a reliable start-up. The Red LED will blink when the modem transmits, and the green LED will blink on receive of data.

6. User Serial Port Commands

6.1. Overview

The serial portion the RF modem is used to send and receive data over the air, as well as to configure the RF modem. In normal operation, the user sends data into the TXD pin of the IO connector, and this data is transmitted over the air. Received data from another RF modem is output to the user via the RXD pin of the IO connector. This is the default operating condition of the RF modem. No special characters, hardware control lines, or timing is required to operate the *M8G* modem.

There is also a "Command Mode" used to program and configure the *M8*. In the Command Mode, the *M8G* modem accepts commands via the serial port TxD pin. The commands can be used to change certain internal parameters of the *M8G* modem as well as to read-out the current configuration and diagnostic statistics.

6.2. Command Mode

The *M8G* modem may be put into a "Command Mode", by entering a sequence of three plus characters (+++). To keep the *M8G* modem from unintentionally entering the Command Mode because of the +++ pattern occurring in a stream of data entering the modem, there must be a pause in the data stream before the +++ as well as a pause after the +++ is sent. If either pause is missing, the modem will not enter the command mode.

Using serial communications software such as *HypterTerminal*, send the 3-character command sequence "+++" while observing times of silence before [BT (Silence Before Sequence) Command] and after [AT (Silence After Sequence) Command] the command characters. The default BT and AT times are 500mS.

The default sequence for entering into AT Command Mode:

1. No characters sent for ½ a second.

2. Input three (3) plus characters ("+++") within ½ of a second.

3. No characters sent for ½ a second.

When the *M8G* modem first enters the Command Mode, it sends the phrase

Raveon M8G (transceiver version)

or

Raveon M8R (receive only version)

out of its serial port, and then an "OK" sequence. The "OK" sequence is a sequence of 4 characters:

An "**O**", "**K**", <**CR**>, and <**LF**> characters
(**<CR>** = ASCII 0D, **<LF>** = ASCII 0A)

6.3. Setting a Parameter

To set a parameter in the *M8G* modem, enter the Command Mode as described above. Then enter the proper AT command, a space, the parameter, and then a carriage return. For Example, to set the address of the *M8G* modem to 1234, enter the following command:

ATDT 1234 <CR>

Once a Parameter is changed, the modem will begin using the new parameter and the new parameter is saved to non-volatile.

6.4. Reading a Parameter

To read the value of a particular setting, issue the command, with no parameter. The modem will return the value followed by an "OK". The modem's OK response is:

The value in ASCII decimal format.

A <CR> <LF> (<CD> = ASCII 0D, <LF> = ASCII 0A).

An "O", "K", <CR>, and <LF> sequence.

For example, if the user enters the command to read the *M8's* modem address and its address was 1234, the user would issue the following command:

ATDT<cr>

and the modem will respond with:

1234 <CR> <LF> **OK** <CR> <LF>

To get on-line help with a command, enter the command and put a question mark in for the parameter. For example, to see what the ATDT command is for, type:

ATDT ?

The modem will respond by listing a brief description of the command. To see a list of all commands, type **HELP**.

Many commands support the "**MIN**" and "**MAX**" parameters to read the minimum and maximum allowable settings. For example, type **ATJF MAX** to find the maximum value the CTS negation threshold may be set to.

6.5. CONFIG Button

If certain parameters within the modem are modified in a manner that causes the modem to cease functioning or if the user cannot enter the command mode via the "+++" method described above, there is a small push button internal to the *M8G* modem to assist in this case. This CONFIG button may be pressed at any time, and forces the modem into a known operational state. The CONFIG button is located inside the modem. Remove the rear cover,

exposing the two circuit boards. The button is in the front edge of the radio module's circuit board.

The default settings that the modem will revert to when the CONFIG button is pressed are:

1. *Serial port 9600 baud, 8 data bits 1 stop, no parity*
2. *ATCT setting set to 60000 (60 second time-out)*
3. *Serial port on the front of the unit in RS232 mode, 9600bps, N/8/1.*

Even though the serial baud rate reverts to 9600 baud when the CONFIG button is pressed and the IO port is RS232, it will revert back to the settings programmed into the *M8G* modem once the Command Mode is exited.

6.6. Exiting the Command Mode

There are three ways to exit the command mode. They are:

1. **ATCN** Issuing the **ATCN**. The M8G radio will exit the command mode, and begin normal operation.

2. **EXIT** Issuing the **EXIT**. The M8G radio will exit the command mode, and begin normal operation.

3. **Time Out**. After a pre-set amount of time (60 seconds is the factory default time), the modem will automatically exit the Command Mode, and continue normal operation. Changes will not automatically be saved. This time-out duration may be set with the **ATCT** command.

7. Command Mode Commands

7.1. General Command

These commands apply to the general configuration of the M8G, 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 5= 38400 1 = 2400 6=57600 2 = 4800 7=115200 3 = 9600 4 = 19200	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 charators.	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=EAS128 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	Range: See product data sheet. For MURS products, frequency	See product data sheet.

	automatically be saved in non-volatile memory (flash) for this current channel number.	cannot be changed.	
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 amo0unt 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	Range: 0, 1, 2	0

	receiver. When set to 4, the RX is turned off, and the transmitter will still send data and GPS position report.		
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.

7.2. Data Modem Mode Related Commands

These commands apply to the operation of the 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
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: -1000 – 1000	120**
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 5 = 9600 2L 1 = 1200 6 = 19200 4L 2 = 2400 7 = 5142 2L 3 = 4800 8 = 9600 4L 4 = 8000 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.

7.3. GPS Transponder Related Commands

The following commands are specific to the operation of the 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 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 f seconds between NMEA messages from the internal local GPS.	1-99	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, 12=$GPRMC, 12=GGA, 13=GLL, 14=GLL&VTG, 16=!AIVDM&$PRAVE		$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)
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	0 - 9999	10

	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.		
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
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	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
TRIGEX	**Report on change.** Sets which input bits cause a report on change. If a particular bit is a 1, then it will trigger a report when it changes. The input bit must also be enabled with the TRIGBITS. This is a HEX number. Bit 0 is IN0, bit 1 is IN1…	0-FF	0

7.4. Factory Default Settings

RV-M8G-xx (Transceiver)

For the UHF M8G, model RV-M8G-UC, the main factory defaults are:

General Settings

Primary Protocol: (ATMT 0)..... Packet Data
Alternate Protocol: (ATMA 3)..... None
WMX (WMX 0) ..... OFF
Security KEY ..... RAVEON

TDMA and GPS Transponder Settings

TDMATIME:..... 10
SLOTTIME 100
TXRATE 10
Slot Number (SLOTNUM)..... 1
Slot Quantity (SLOTQTY)..... 1
GPS Mode..... 4 (Transponder)
Serial port output message:..... $GPWPL

Data Modem Settings:

Over-the-air data modem baud rate: ..... 4800 baud, 2-level
Serial port..... 9600baud, N/8/1
Hardware flow control..... Off
RF Power Output..... 100% (2watts)
Channel number selected..... 1
ID (ATMY) 1234
Address Mask (ATMK) ..... FFFF
Frequencies
Ch 1 ..... 462.2125 MHz

8. Using the M8G as GPS Transponder or Receiver

This section describes the operation of the M8G as a GPS transponder and GPS position report receiver. An M8G can perform either or both functions. It can be a GPS transponder by reporting is location and status. It can receive GPS position reports over the air, and output them via its serial port for display or logging.

1. Connect a DC power source to the DC IN connection on the front of the modem.
2. Connect a good quality antenna, cut to the operating frequency, to the RF connector on the front of the modem. Use a good quality antenna, and place it as high-above obstructions as possible.
3. Connect a computer terminal, or PC computer running *HyperTerminal*, to the serial I/O connector. The serial I/O connector is 3.3V digital logic, so you may need a digital-RS232 voltage converter. Raveon's Tech Series enclosures have these built, so you may plug the RV-M8G into the "S" interface of a Tech Series to do the RS232 conversion. USB and RS485 are also available in the Tech Series. The factory default serial ports settings are 4800 bps, 8 data bits, 1 stop, no parity. Note, the serial port may be 38400bps if the M8G is in GPS modes 2 or 3.
4. Put the *M8G* into the command mode. (enter **+++** per Section **Error! Reference source not found.**)
5. Program the modem's operating frequency to your desired operating frequency. This is done with the **ATFX xxx.xxxxx** command. See the Section **Error! Reference source not found.** for information describing the various parameters that may be modified in the modem. In most applications, the default settings from the factory will work fine.
   Note: The MURS version of the M8G (M8G-VM), the unit is pre-set to the 5 MURS channels on channels 1-5. The user cannot change the frequency of the M8G, only the channel number.
6. With the unit in the command mode, change any of the default operating parameters that must be modified as you desire. From the factory, the modems are configured and delivered ready-to-use. Out of the box, they will communicate on the default radio channel using the factory defaults. Raveon highly recommends you test them first with the factory defaults and see how they work before reprogramming them. In general, the parameters you may want to modify will be:

ATFX	Frequency for this channel. Set to your frequency.
GPS x	Set the operating mode of this unit. See Section 8.2 for a list of the various modes.
ATMY	The individual ID of this unit. Default is 0001. Number all of your *M8G* transponders with a different MYID. Raveon recommends sequentially numbering them, starting at number 1.

ATDT The address of the unit this modem will talk to. Default is 0001.

ATMK The network address mask. Default is F000. This means this unit will receive all transmissions from any other unit with an ID beginning with 0 (0001 thru 0999).

KEYPHRASE Enter a security key code. Use any word or phrase 1-16 characters long. It is case-sensitive. DO NOT FORGET WHAT YOU SET IT TO! The **KEYPHRASE** is the only parameter that cannot be read out of the *M8G*. It must be the same as the **KEYPHRASE** programmed into all the other *M8G* transponders in your system. The factory default **KEYPHRASE** is **RAVEON**, call capitols.

SLOTNUM 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 not 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.

7. Connect your serial data device (GPS, Plotter, PC…) to the 9-pin connector on the front of the modem.

The radio is now ready to use. Any serial data going into the modem will be transmitted over the air, and any data received over the air will be sent out the serial port.

Remember, that from the factory, all *M8G* modems are configured to simply work. Plug in power and connect to the serial port at 4800 baud, and the modems will communicate on the default channel. Change the channel frequency to your specific frequency, and they will be ready to work on your channel.

What you will see come out of the serial port with the factory default settings (GPS 4 mode), is a *$GPWPL…* message, every time one M8G in your system transmits.

8.1. Programming Channels and Frequencies

The *M8G* modem has memory for up to 6 channels. In most applications, only one channel is needed. A channel is a pair of frequencies, one for transmit and one for receive. They may be different or they may be the same. You may program any valid frequency into any channel number. To program a channel, perform the following steps.

1. Change to the channel you wish to program, using the **ATHP x** command, where x is the channel number. The factory default is channel 1.
2. Program the frequency for this channel x, using the **ATFX** command. Note that the frequency my be entered in MHz as long as you use a decimal point. For Example, enter **ATFX 450.1** to set the channel frequency to 450.100MHz. Alternately, you may enter the frequency in hertz by entering **ATFX 450100000**. You must enter all of the zeros if you enter the frequency in hertz. To enter different TX and RX frequencies us the **ATFR** and **ATFT** commands.
3. Review the frequency setting with the **ATFT**, **ATFR**, or **ATFX** command. To see a list of all of the channels , enter **ATF**.

4. To change the radio channel, use the **ATHP x** command while the modem is in the command mode.

The M8G-VM MURS version of the M8G has five user selectable channels. The channel is selected with the **ATHP** command. The M8G-VM modem is factory-set to these five channels, and the modem cannot be programmed to operate on any frequency other than these five.

1 151.820 MHz
2 151.880 MHz
3 151.940 MHz
4 154.570 MHz
5 154.600 MHz

8.2. GPS Operation Mode Configuration

The **GPS x** command is provided to make configuring the M8G simple to setup for common configurations. The following table summarizes the various standard configurations. Choose the configuration that is most similar to your usage, and execute the appropriate **GPS x** command.

See **Section 3** for a complete list of the various GPS modes.

To review the overall configuration of the GPS features of the M8G radio, type **GX** when in the command mode. A listing of the GPS features will be displayed. An example listing of a *M8G* in GPS mode 2 is shown below:

```
-GX GPS mode          : 2   RavTrack PC
Serial Protocol       : Raveon $PRAVE
Serial port baud rate: 38400 N 1
Position TX Interval : 60seconds (will TX when still.)
Proximity Alert       : OFF
External Triggers     : OFF
Speed limit trigger   : 0 (OFF)
TX method             : 1 (Time Slot)
mS per TDMA slot      : 200   4 X 50mS ticks
TDMA slot number      : 4
TDMA frame time       : 2
Waypoint Prefix       : V
Security key is enabled.
OK
```

After the **GPS x** command is executed, the operation of the unit may be customized for special applications. The following table summarizes the parameters that may be modified, *AFTER* the **GPS x** command.

M8G GPS Modes of Operation

The **GPX x** command is used to configure the M8G for various common configurations. The following table lists the parameters that are configured and saved when the GPS x command is executed. After the command is executed, individual parameters may be modified to customize the operation of the unit.

Parameter / Command used to modify this parameter	*GPS mode* / **GPS x**	*Output Message Format* / Position message format **OUTPUT x**	*NMEA Position* / Local NMEA data **NMEAOUT x**	*Local GPS NMEA messages* / Local NMEA messages **NMEAMASK**	*Position/status report rate* / **TXRATE xx**	*Data communication via RS-232 also* / **DATAMUTE x**	*Capable of Speed triggered position reports*	*Speed Trigger default* / **TRIGSPEED xx**	*Serial Port Baud Rate* / **ATBD X**	*Can be a repeater* / **Repeat X** Default = 0(off)	*Minimum firmware versoin*
Transponder	**1**	Nothing (X=3)	No (0)	GGA, GLL, RMC	10	TX only (1)	Yes	0 (off)	4800	NO	
RavTrack PC	**2**	$PRAVE (x=1)	Yes (1)	GGA, GLL, RMC	10	TX & RX (0)	Yes	0 (off)	38400	Yes	
Radar	**3**	$GPTLL (x=2)	Yes (1)	GGA, GLL, RMC	10	TX & RX (0)	Yes	0 (off)	38400	Yes	
GPS Display	**4**	$GPWPL (x=3)	No (0)	GGA, GLL, RMC	10	RX only (1)	Yes	0 (off)	4800	Yes	
-LX receive only	**5**	$PRAVE (x=1)	No(0)		10	RX (1)	No	N/A *1	38400	Yes	
GPS display and/or MDT	**6**	$GPWPL (x=3)	No(0)	GGA, GLL, RMC	10	RX & TX (0)	Yes	0	4800	Yes	
Data Modem with GPS info	**11**	nothing (x=3)	Yes(1)	RMC	10	RX & TX (0)	No	N/A	38400	Yes	
Data Modem with GPS info	**13**	$GPGLL & GPVTG	No(0)		10	RX & TX (0)	Yes	0 (off)	4800	Yes	

Notes: *1. –LX units typically do not have a GPS receiver in them. They receive position reports over the air from other units, but do not transmit position or status.

8.3. Position Transmission

When the M8G transmits its position, it also reports other status information such as voltage, input bits, temperature, velocity, and heading. All of these parameters are compressed into a short data packet, and sent over the air in the proper TDMA time slot. Each *M8G* is assigned a time slot, based upon its ID. ID 1 is slot 1, ID 2 is slot 2…

Position/status reporting happens in one of 2 different intervals.
A) At the **TXRATE** setting. This is the transmit frequency interval setting. The user configures **TXRATE** to be shortest acceptable interval between reports. The factory default is 10 seconds.

B) At the **IDLERATE** setting. This is the idle reporting interval, usually the longest acceptable time between position reports.

IDLERATE is used as a slow-reporting rate for parked vehicles, vehicles that have no active trigger inputs, no proximity alerts, and that the user has programmed them to require a minimum movement distance before they will report.

8.4. Set the Transmission Report rate

Using the **TXRATE xx** command to set the report rate, in seconds, for the *M8G* transponder. For example, if you wish the M8G to report every 5 minutes, set the report rate to 300 seconds (**TXRATE 300**).

Important!: Set the minimum distance the unit must move before a transmission occurs with the **TRIGDX xx** command. If TRIGDX is set to zero, then the unit will always report at the interval set with the **TXRATE xx** command.

For example, to transmit every 2 minutes when idle, and every 10 seconds when moving more than 500 meters, use these commands:

IDLERATE 120 (to set the idle moving update interval to 2 minutes.)

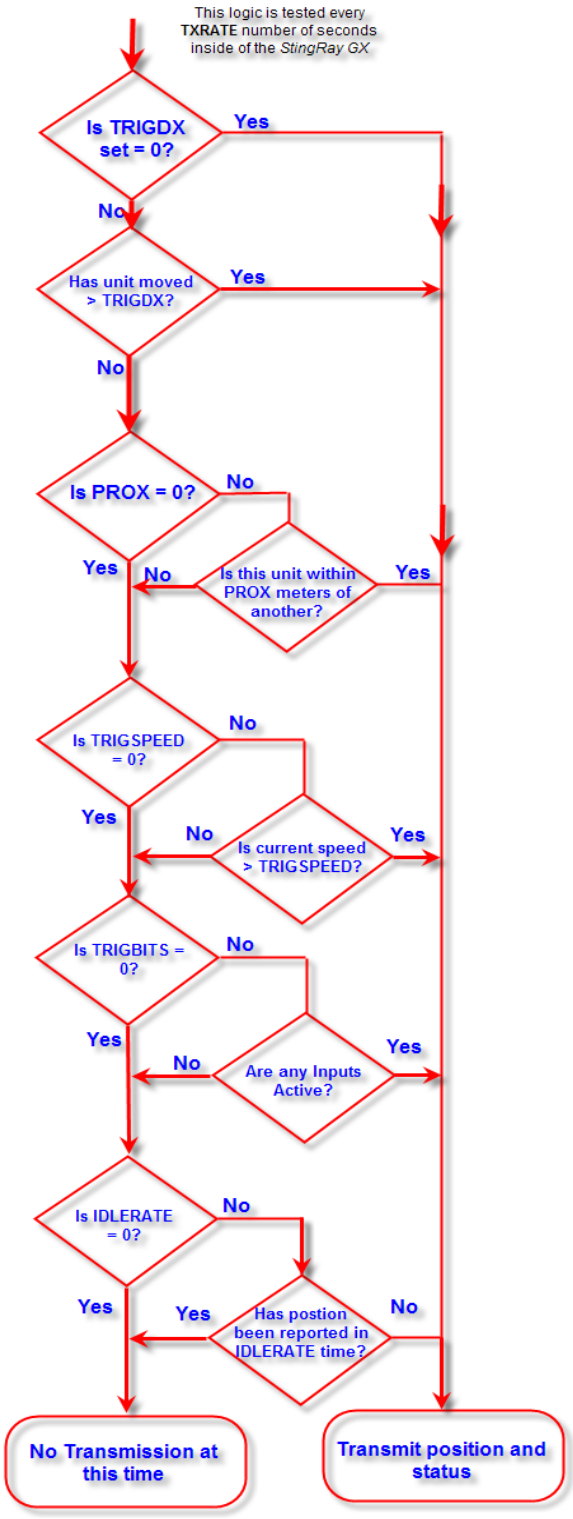
TRIGDX 500 (tells it to report at the IDLERATE if it does not move this far)

TXRATE 10 (configures it to report every 10 seconds whenever it is moves more than TRIGDX meters)

The following diagram illustrates the logic behind the various programmable parameters that can be used to configure the *M8G* to trigger position transmission. The logic inside of the *M8G* shown is tested at a user-programmable rate, called the **TXRATE**. The **TXRATE** is the time interval between *M8G* position/status radio transmissions.

Set to **TXRATE** and **IDLERATE** both to 0 to totally disable position reporting.

GPS Position Transmission Trigger Diagram



8.5. Digital Inputs (Trigger Bits)

The stock *GX* Transponder has 3 digital inputs. The status of these input bits is transmitted every time the M8 reports its position.

When configuring an M8 GPS transponder, you may configure any or all of the digital inputs to be "*Trigger Bits*". The status of all bits is transmitted every time, but when a bit is designated as a *Trigger Bit*, it will also cause the M8 to wake-up if it is sleeping, and triggers it to send a transmission as soon as it can. They are called Trigger Bits because the bits can be used to trigger the M8 to transmit at the faster TXRATE instead of the slower IDLERATE.

The M8 has low-power modes and an idle transmission rate (IDLERATE). The M8 may be configured to use bits designated as *Trigger Bits* to come out of low-power mode or transmit at a faster rate. But, regardless of the rate or Trigger Bit designation, the status of the digital input bits will be transmitted along with each position report. If a bit is designated as a Trigger Bit, its state will be latched when it triggers, and the latched state is transmitted. Older version of firmware do not latch the state, and thus the My reports the state of the bit at the moment the position is transmitted. C2 and higher report the latched state of the trigger bit.

Bits that are designated *Trigger Bits* are digital inputs that trigger the *RV-M8* to trigger a report of the M8's position and status. Normally these inputs are used for RS-232 signals, but they may be used for general-purpose digital inputs. The *RV-M8* may be configured to trigger a position/status report based upon the digital input bits state.

Important: If the digital input function is not needed, the **TRIGBITS** setting must be set to **0**. This is the factory-default setting, and unexpected transmission may happen if the digital inputs are enabled and not used.

If you are not using digital inputs, **TRIGBITS** must be set to 0. (**TRIGBITS 0** command)

If the *RV-M8 GX* was configured to transmit less-often when it is not moving (**IDLERATE** command), activation of the digital inputs will override this causing the unit to report at the interval programmed with the **TXRATE** command.

The digital inputs may be configured to trigger active high, active low, or active on a change in state. The following table lists the available digital inputs on the standard RV-M8 GX:

RS-232 Pin	Function
4 - DTR	Input 0
7 - RTS	Input 1
3 - TXD	Input 2
5 - Ground	GND

There are 3 commands that must be configured to use the digital inputs:

TRIGBITS x This command enables or disables individual bits for use as input triggers. If a bit is designated a Trigger Bit, then its state is latched until it is transmitted.

TRIGPOL x Sets the polarity of the input trigger bit. 0=active high, 1=inverted, active low. Setting TRIGPOL 0 will mean all trigger bits are active high, and their state will be latched as a high (1) if the bit ever goes high.

TRIGEX x Sets which bits are used to report on exception. Exception reporting is when a position/status report is generated when an input changes either low-to-high or high-to-low. A Trigger Bit that is set to trigger by exception with the TRIGEX command will report 0 if it does not change, or 1 if it changed since the last time the M8 reported position.

The xx parameter is the hex binary representation of the bits. Refer to the following table to see the value for **x**.

IN 2 ***(TXD)***	***IN 1*** ***(RTS)***	***IN 0*** ***(DTR)***	***Hexadecimal Representation***
0	0	0	0
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

For example, to enable bits 0 and 2 (DTR and TxD pins) to be used as digital input, issue the following commend:

TRIGBITS 5

If the bits are to be normally active high, then the polarity must be set to 0 (**TRIGPOL 0** command). To set bit 0 so that it is inverted (active low), use the following command:

TRIGPOL 1

This will cause the unit to transmit when bit 0 (DTR pin) is low.

To enable exception reporting, that is transmit when a pin changes from low-to-high or high-to-low, use the **TRIGEX** command. When **TRIGEX is 0**, all inputs are active either high or low. When a bit is set to 1 in **TRIGEX**, then that bit will cause the unit to transmit position/status anytime it changes state. The M8 will report the bit as a 1 if it changes state, or 0 if it did not change state.

For example, to configure the unit to transmit position when bit 0 changes state, issue these commands:

TRIGBITS 1 (enables bit 0)

TRIGEX 1 (configures bit 0 for exception reporting)

To configure all bits to be used to report when they change, issue these commands:

TRIGBITS 7 (enables bit 0, 1 and 2)

TRIGEX 7 (configures bit 0, 1, and 2 for exception reporting)

To configure bit 0 to be used to report when it changes, bit 1 to cause a report when it goes low, and disable bit 2, use these commands.

TRIGBITS 3 (enables bit 0 and 1, disable 2)

TRIGEX 1 (configures bit 0 for exception reporting)

TRIGPOL 2 (configures bit 1 for active-low reporting)

When a digital input triggers a transmission, the transmission will not occur immediately. It will occur when the M8 GX is supposed to report in at the rate programmed into its **TXRATE** parameter. For example, if the **TXRATE** is set to 2 seconds, the unit will transmit every 2 seconds when an input is triggered. If an input is not triggered, the unit will not transmit its position/status (as long as no other event such as speeding or proximity triggered a transmission).

When no inputs are triggering a transmission and no other events are causing the unit to want to transmit, the RV-M8 GX will report in at is **IDLERATE** period. For example if **TXRATE** is **2** and **IDLERATE** is **300**, then the unit will report in every 2 seconds when an input trigger occurs, but will only report in every 5 minutes when input triggers are not happening.

Important: If **TRIGDX** is **0**, the *RV-M8 GX* will always report at the TXRATE setting. The digital inputs will be ignored, although their status is always sent over the air. **TRIGDX** is the minimum distance the RV-M8 GX must move to trigger a transmission. When 0, it always must report. Set **TRIGDX** to some number of meters to ensure the digital inputs are checked.

8.6. TDMA Data Transmission

To transmit data, send one or more bytes of data into the serial port of the modem. When a full packet of data has been collected into the internal buffer of the modem, or when there is a pause in the data, the modem will automatically key its transmitter, and send the data over the air.

GPS mode 1 and GPS mode 4 do not support data transmission. GPS mode 1 does receive serial-port data not because it is a transmit-only mode. It will transmit, but it will not receive data over the air. GPS mode 4 will receive data and it will transmit position and status, but it will not transmit serial data entered into the serial port. Serial port transmit data is disbled because GPS mode 4 is normally used to connect the a hand-held or mobile GPS display to the M8G. The M8G will send $GPWPL messages to the GPS to display the location of

other Transponders. The GPS will normally output various NMEA messages from its serial port. These NMEA messages from the external GPS must not be transmitted, or the radio channel will become much too busy. The *M8G* "mutes" its data input when configured in GPS mode 4.

The *M8G* will send position/status as well as transmit and receive serial data when it is in GPS mode 2.

Serial Port Baud Rate

While the modem is transmitting, the user may continue to send more data into the *M8G.* Because the buffers in the M8G are full-duplex, the serial port data rate and the over-the-air data rates are independent. The serial port baud-rates may be set slow to accommodate legacy equipment, or set at high-speed to minimize latency. The over-the-air data rate us usually 4800 baud for narrow-band channels, and 9600 baud for wide-band, although faster or slower rates may be used.

8.7. Data Reception

Serial Port Data

When the *M8G* receives RS-232 data over the radio, it checks it for errors, and if it is error-free, it will send it out the serial port. Again, the serial port may be set to any baud rate the user wishes, and the radio receiver and transmitter will continue to operate independently of the baud rate.

When the modem receives a radio signal, it will assert the CD hardware signal on the RS-232 serial port if it was configured to do so.

GPS Position and Status

When the *M8G* receives a position report and status from another *M8G*, it will send this information out its RS-232 port, formatted as configured with the **OUTPUT x** command. See Section **Error! Reference source not found.** for detailed information on the type and format of message output from the *M8G* when a position/status report is received from some other unit. Note, the **GPS x** command is a macro that sets many parameters, one of which is the **OUTPUT**. When the GPS x command is executed, it will set the OUTPUT setting to the appropriate message format for the particular GPS mode. After the **GPS x** command is executed, you may then issue the **OUTPUT x** command to modify the output protocol.

The position/status messages that the *M8G* is able to send out of its serial port are:

None	***No position message output.*** **Output 0** disable the device from outputting any message when a position report is received.
$PRAVE	***Raveon Position & Satus.*** **Output 1** This message is sent out of the *M8G* when it is operating in the **GPS 2** mode. This message is used by third-party and PC applications for tracking location and status information.

$GPWPL	***NMEA WayPoint List.*** **Output 3** This message is commonly used to share waypoint locations among GPS units. The *M8G* can output this message when it receives a position report from other *M8G* transponders. A GPS connected to it, should put a waypoint on its screen, and in its database, at the location specified by the M8G.

8.8. Device Addressing

Security Key

The security KEY programmed into every *M8G* transponder ensures that only *M8G* transponders with the exact same security code can receive position and status information. The security key is case sensitive, so "**Raveon**" and "**RAVEON**" are two different keys.

The security code may be from 2 to 16 characters long. The longer the code, the more secure it is and the less likely anyone could guess what it is. It is up to the user to select and set this code. If the *M8G* is not used in a system where security and privacy are a concern, then it is OK to leave the factory-set code.

If it is important that the *M8G* transmissions and system be secure, Raveon suggest you program the KEY to be a random sequence of letters and numbers at least 8 digits long.

When you program your own security code into your *M8G* transponders, write it down in a secure place. This parameter cannot be read out of the *M8G*. If you forget what it is set to, you will have to reset all the security codes in all of your *M8G* Transponders.

Use the KEYPHRASE command to set the key phrase. For example, to set the key phrase to Jkl53hhp type:

KEYPHRASE Jkl53hhp <enter>

ID Addressing Basics

ID addressing is used to differentiate one M8G Transponder from another. Each must have a unique number programmed into them, so that when a position report is received, the *M8G* that sent the message can be identified. This is called the MYID of the unit that sent the message.

Each *M8G* has a MYID programmed into it, and is represented as a 4 digit decimal number. *M8G* IDs may be any number between 0001 and 9999. The Unit Address is programmed with the **MYID xxxx** command, and the ID of the destination modem it sends its messages to (the Destination Address) is configured with the **ATDT xxxx** command.

The factory default **MYID** in all *M8G* modem is 0001, and 0001 is also the default for the Destination ID also. The ID of your particular *M8G* may have been configured by your dealer or distributor. If so, it is labeled on the rear of the unit. If it is not labeled with an ID, the factory default ID is in it.

The default Address Mask is F000, which means the *M8G* will receive a transmission from any other M8G as long as the fist digit matches, in this case, is a 0.

Make sure you set the **MYID** of each *M8G* in your system to a different number.

For example, to set the ID of your *M8G* to 17, enter:

MYID 17 <enter>

To set your M8G to send its position and status data to M8G number 1, enter:

ATDT 1 <enter>

To set your address mask to receive all messages from units with IDs 1-999, and exclude 1000-9999, enter

ATMK F000 <enter>

Setting A System-Wide Address

If individual addressing is not needed in your system, there are two ways to ensure it is not used. One way is to set all modems in the system with the same Unit Address and Destination Address. From the factory, these are both set to 1234, and thus, all modems can communicate with all other modems, using the address 1234. The advantage of using this system-wide address, is that if there are other M8G modems on the channel, but in some other system, they probably will not have the same Unit Address, and thus will not interfere with your system. To reduce the possibility of data cross-talk, the system implementer may wish to use a different system-wide address for the Unit Address instead of 1234. There are over 65,000 addresses available.

The **ATLA** command can be used to set an additional address that the M8G will listen for.

An alternate way to disable addressing altogether, is set the Address Mask to 0000 (**ATMK** 0000 command). This tells the M8G to ignore the address, and receive every transmission.

Hexadecimal Numbers

For those not familiar with hexadecimal numbers, a hexadecimal digit represents a 4-bit binary pattern. There are 16 possible values (0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,and F). These 16 values represent 4 bits of information, thus 4 hexadecimal digits can represent 16 bits of information. The hexadecimal numbers represent 4 bit data in the following way:

Hexadecimal Table

Hex #	*Binary*		*Hex #*	*Binary*		*Hex #*	*Binary*		*Hex #*	*Binary*
0	0000		**5**	0100		**8**	1000		**C**	1100
1	0001		**6**	0101		**9**	1001		**D**	1101
2	0010		**7**	0110		**A**	1010		**E**	1110
3	0011		**8**	0111		**B**	1011		**F**	1111

When communicating over the air, *M8G* modems transmit their Unit Address and the Destination Address along with the data. Receiving modems check the received Destination Address, and see if it matches their Unit Address. If it does match, the receiving modem outputs the data it received via its serial port. If it does not match, the receiving modem discards the data, and does not send it out the serial port.

Broadcast Transmissions

The double FF is used to identify a broadcast packet. A transmission with a two digit FF in the first two positions of the destination ID, or in the last two positions of the destination ID, will be interpreted as a broadcast, and any modem with an ID that matches the two non-FF digits will receive the data. For example, sending data with a destination ID of 12FF will be received by any modem with a unit ID 1200 through 12FF. Sending data with a destination ID of FF34 will be received by any modem with a unit ID of 0034 through FF34.

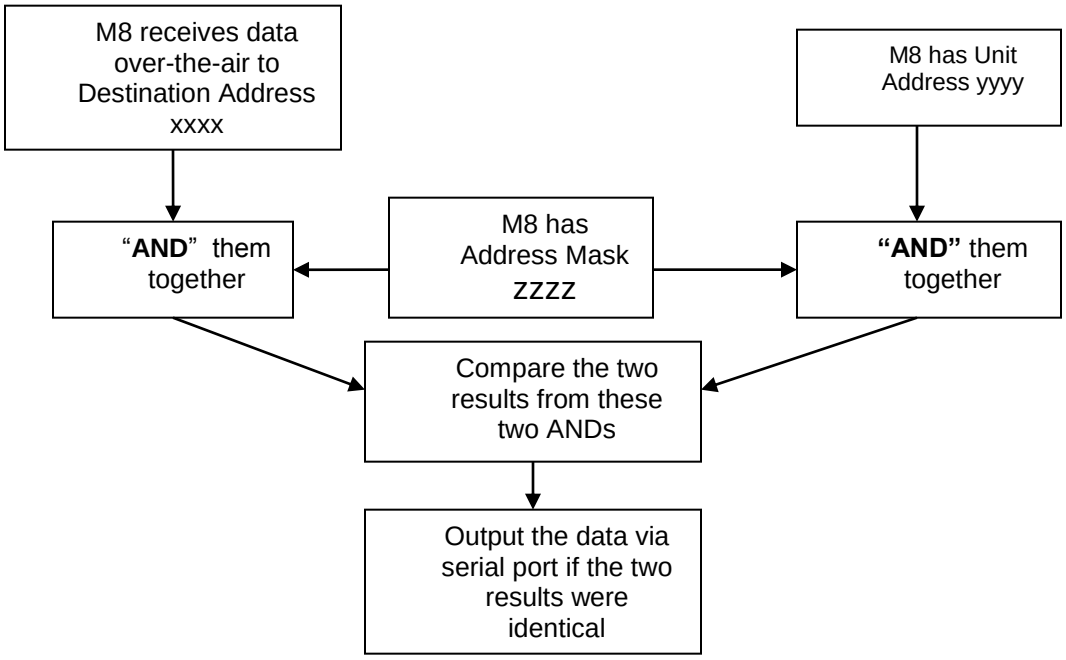
The Address Mask

The reason to use hexadecimal digits to represent the unit address, is that along with the Unit Address programmed into the *M8*, there is an "Address Mask" programmed into it. The default mask is FFFF. The address mask is used to determine if a particular data transmission should be received by the modem.

Only in systems where some modems should only talk to certain other modems, might you want to change the address mask. Whenever data is received over the air, the Destination Address of the transmission is logically "ANDed" with the Address Mask in the receiving modem. This is the *Effective Destination Address*. The receiving *M8G* also ANDs its own Unit Address with its Address Mask. The result is the *Effective Unit Address*. The *Effective Unit Address* is compared to the *Effective Destination Address*, and if the two are identical, the data will be received.

Note: Logically 1 AND 1 = 1, 0 AND 0 = 0, 1 AND 0 = 0, 0 AND 1 = 0

` *Figure 1 (Address Filtering)*



One effect of this is that an address mask of 0000 will cause the *M8G* modem to receive all data from all units that transmit data messages. The Destination Address will effectively be ignored if the mask is set to 0000.

Addressing Examples:

Example 1 (default configuration)

Sending Destination Address = 1234

Receiving Unit Address = 1234

Receiving Unit's Address Mask = FFFF

Result: Unit will receive the data, because the addresses identically match. When the addresses are identical, the value of the mask is not important.

Notes: This is the default configuration. All units have address 1234, and all modems will talk to all other modems with address 1234.

Example 2 (a configuration that won't work)

Sending to Destination Address = **1236**

Receiving Unit Address = **1234**

Receiving Unit's Address Mask = **FFFF**

Result: No data will be received, because the address do not match, and the address mask of FFFF requires that all digits in the address match. .

Example 3 (able to receive a data from a group, 1230 – 123F)

Sending to Destination Address = **1236**

Receiving *M8G* Unit Address = **1234**

Receiving *M8G* Address Mask = **FFF0**

Result: Data will be received. 1236 ANDed with FFF0 is 1230. 1234 ANDed with FFF0 is 1230. The results of the ANDing match, and thus the data will be received.

Example 4 (able to receive from a group, xx34 where xx is any two digits)

Sending Destination Address = **2234**

Receiving *M8*'s Unit Address = **1234**

Receiving *M8*'s Address Mask = **00FF**

Result: Data will be received. 2234 AND 00FF equals 0034. 1234 AND 00FF equals 0034, therefore they match. The results of the ANDing match, and thus the data will be received.

Time Slots

The *M8G* uses a transmission scheme popular in mobile-telephones called TDMA (Time Division Multiple Access). Each *M8G* is allocated a time-slot to use for sending and receiving radio messages.

Refer to Section **Error! Reference source not found.** for detailed explanation of the TDMA scheme. The important point to understand is that for optimum efficiency in a *M8G* system, begin sequentially numbering the MYID of the *M8G* transponders at ID 0001. The second M8G should be ID 0002, and so on.

The *M8G* transponders have internal clocks with 20 ticks-per-second. They can measure time and initiate transmissions 20 times every second (every 50mS). The TDMA time slot is configured to be some number of these ticks. The factory default allocation is 4-ticks for one time-slot. So each TDMA time slot is 200mS long, and thus in 10 seconds, up to 50 *M8G* transponders may report position. These parameters are programmable, and may be re-configured based upon the type of system they are used in.

8.9. Local NMEA data from the internal GPS

The M8G GPS transponders and the Atlas PL personal locators may be configured to output NMEA 0183 GPS messages from its internal GPS receiver. For GPS tracking, these GPS transponders can receive GPS position reports from other radios, and they may also be configured to output their own GPS location via their serial port.

Following is a list of the NMEA messages that are available (as of revision C2 of the Firmware).

NMEA Message	***Bit Number*** ***(zero based)***	***Bit Mask*** ***(hex format / decimal)***
GGA	0	0×001 / 1
GLL	1	0×002 / 2
RMC	9	0×100 / 256
!AIVDM	10	0x200 / 512

Once you set the “GPS Mode” of the radio using the GPS X command, you can change the NMEAMASK parameter to modify with of the NMEA sentences will come out the serial port.

For example, to have only the RMC sentence come out the serial port, use the following command”

NMEAMASK 256

To have the GGA and GLL come out the serial port use this command:

NMEAMASK 3

The NMEAMASK parameter is the sum of all of the decimal values of the individual bits corresponding to the NMEA messages.

9. Using the M8G – Packet Data Mode

To use the M8G GPS transponder in the *Packet Mode* of operation, refer the the RV-M8_Technical manual. The standard M8G with the GPS tracking features can be configured to operate in the packet modem mode, and disable the GPS position reports by entering the **GPS 0** command.

In Packet Mode, all transmissions are sent in bursts or packets, and contain address, error detection, and error correction information. Date enters the M8G modem’s serial I/O port, and is stored in a buffer within the modem until it is ready to be transmitted. Packetized operation has these advantages over non-packet modems:

9.1. Setup

8. Connect a DC power source to the M8G.
9. Connect a good quality antenna, cut to the operating frequency, to the BNC connector on the front of the modem. Use a good antenna, and place is at high-above obstructions as possible.
10. Connect a computer terminal, or PC computer running HyperTerminal, to the 9-pin I/O connector. The factory default serial ports settings are 9600 bps, 8 data bits, 1 stop, no parity.
11. Program the modem’s operating frequency to your desired operating frequency. This is done with the **ATFX xxx.xxxxx** command.
12. Using the AT commands, change any of the default operating parameters that must be modified. From the factory, the modems are configured and shipped ready-to-use. Out of the box, they will communicate on the default radio channel using the factory defaults. In general, the parameters you may want to modify will be:

ATFX	Frequency for this channel. Set to your frequency.
ATBD	Serial port baud rate
ATMY	The ID of this unit. Default is 1234.
ATMK	The network address mask. Default is FFFF.
ATDT	The address of the unit this modem will talk to. Default is 1234.

13. Connect your serial data device to the TXD and RXD pins of the I/O connector. To connect the M8G to an RS232 serial port, you will need an external digital to serial level converter.

The M8G is now ready to use. Any serial data going into the modem will be transmitted over the air, and any data received over the air will be sent out the serial port.

Remember, that from the factory, all *M8G* modems are configured to simply work. Plug in power and connect to the serial port at 9600 baud, and the modems will communicate on the default channel. Change the channel frequency to your specific frequency, and they will be ready to work on your channel.

10. Store-and-Forward Repeating

The *M8G* modem has a built-in wireless repeater. Each M8G is capable of not only sending and receiving data from/to its serial port, but also re-transmitting data packets it receives over-the-air data.

Automatic Repeater Configuration

The easiest way to enable store-and-forward repeating is the use the **REPEAT 1** command. **REPEAT 1** will turn on the store-and-forward feature, and configure it to repeat all packets the radio can hear on the air. **REPEAT 0** disables store-and-forward repeating.

It is highly recommended that you use this method to configure your M8G as a repeater.

Important: The Unit ID of the repeater must be unique in the system. No other radio modem in the system can have the ID of the repeater.

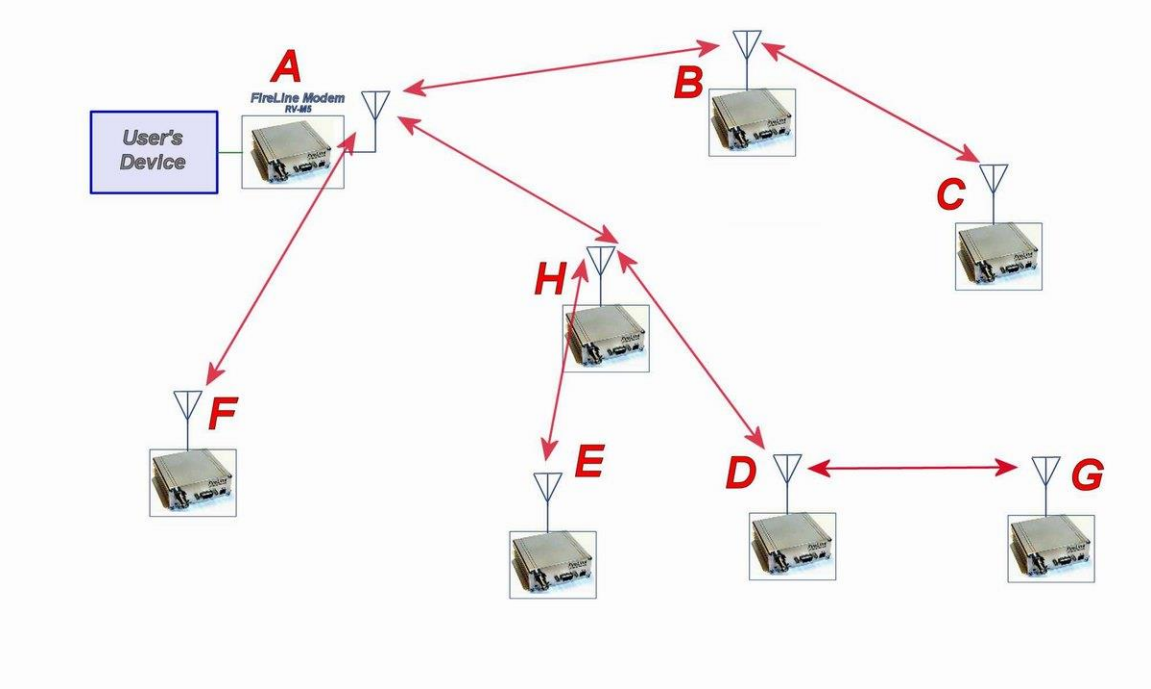
Manual Configuration of the Repeat Feature

There is a sophisticated packet repeating algorithm in the M8, and it may be manually configured for more complex repeating scenarios. In most cases this is not needed. Simply use the **REPEAT 1** command. But, if you do not wish the repeater to repeat all packets, you may manually configure the Repeater Table within the M8. The Repeater Table is a table of IDs that the M8G should repeat. It contains a range of IDs and a mask. There may be up to 4 entries in the Repeater Table, each with a different range of IDs that should be repeated.

Important: The Unit ID of the repeater must be unique in the system. No other radio modem in the system can have the ID of the repeater.

Data is transmitted over-the-air in bursts called packets, and each packet has the Unit ID of the M8G that sent the data and the Destination ID of the unit that the data is intended for.

Figure 2 Overview of Repeater Operation



In the example shown in Figure 3 above, *M8G* **A** is will communicate with all other modems in the system. It can directly communicate with **B, H**, and **F**. Because of propagation limits, it cannot communicate reliable to **E, D, C,** and **G**.

To solve this problem, some of the M8G modems are configured as repeaters. The still are able to send and receive data, but they also will repeat data out to the modems that are out of range of *M8G* **A**.

H is configured to repeat all messages to/from **E, D**, and **G**. **B** is configured to repeat all messages to/from **C**, and **D** is configured to repeat all messages to/from **G**.

The following table illustrates one possible way the M8G could be programmed to accomplish this type of system.

M8	*Unit ID (ATMY)*	*Destination (ATDT)*	*Network Mask (ATMK)*	*Repeat Source*	*Repeat Source Mask*	*Repeat Destination*	*Repeat Destination Mask*
	Addresses programmed into unit			Repeater table programmed into unit			
A	1000	1000	FF00	-	-	-	-
B	1010	1000	FF00	1020	FFFF	1000	FFFF
				1000	FFFF	1000	FFFF
C	1020	1000	FF00	-	-	-	-
D	1030	1000	FF00	1031	FFFF	1000	FFFF
				1000	FFFF	1000	FFFF
E	1032	1000	FF00	-	-	-	-
F	1021	1000	FF00	-	-	-	-
G	1031	1000	FF00	-	-	-	-
H	1022	1000	FF00	1030	FFFF	1000	FFFF
				1000	FFF0	1000	FFFF

Store-and-forward repeating is manually enabled with the ATXR command. **ATXR 1** enables repeating. **ATXR 0** disables it. Unlike the **REPEAT** x command which configures the repeater table to repeat all packets, the **ATXR 1** enables the feature but does not configure the Repeater Table.

The *Repeat Source*, *Repeat Source Mask*, and the *Repeat Destination* are programmed into a Repeater Table in the M8. The ATX command is used to program the Repeater Table. The Repeater Table may have up to 4 entries.

For example, M8G **B** in the above example will have two entries in its Repeater Table. The command to set the two entries is:

ATX1 1020 FFFF 1000 FFFF
ARX2 1000 FFFF 1000 FFFF

The first command above sets the Repeat Source to 1020 and the Repeat Destination to 1000, both with a Mask of FFFF. The FFFF mask means all digits of the source and destination are used to determine if the transmission should be repeated. All packets from units with MYID 1020 (**C**) sent to 1000 will be repeated by this unit. It will not repeat messages from **D, E, F, G,** or **H** because their Unit IDs are not in the *Repeat Source* repeater table.

The second command above sets the Repeat Source to 1000 and the Repeat Destination to 1000, both with a Mask of FFFF. The FFFF mask means all digits of the source and destination are used to determine if the transmission should be repeated. All packets from units with MYID 1000 (**A**)sent 1000 will be repeated by this unit. In other words, all transmissions from **A** will be repeated by **B**.

To view the Repeater Table, use the **ATX** command, with no parameter. To view a single entry in the table, use the **ATXn**, where n=1, 2, 3, or 4.

To delete an entry in the table so it has no effect on the operation, set the fields to 0. For example, to disable entry 1, use the **ATX1 0 0 0 0** command.

There can be an issue with regard to store-and-forward repeating and busy channels, particularly on polled systems. Raveon's M8G wireless modem has a number of provisions in it to make store-and-forward repeating work smoothly.

For example, in the diagram above, assume A is the master station, and C is a remote station being polled. When the store-and-forward repeater B sees a packet it should repeat, immediately upon reception of the packet, it keys its transmitter and repeats the packet. The scenario that can cause problems is if the end receiving station C actually heard the original transmission from A. In a polled scenario, the end station C will typically then respond to the poll, and want to transmit. Station C's transmission can happen at the same time as the repeater B is trying to repeat the original transmission.

This contention can be reduced/eliminated in the following ways:

1. Turn busy-channel lock-out on (**ATBC 1**) on all modems. This stops them from transmitting on a busy channel (stops them from transmitting when the repeater is transmitting).
2. Set the serial port baud-rate on the end-stations to be fairly slow (**ATBD x**). Thus, when they receive a poll request, there is a delay as they send data in/out of their serial ports, and during this delay, the repeater can do its thing.
3. Increase the serial port time-out value from 20mS to say 250mS (**ATR3 250**). Then, when the polled station responds, there is a 250mS delay before the end station's data gets sent out over the air. This gives a little gap for the repeater to use for repeating messages.
4. Any combination of 1-3.

M8G radio modems will not repeat or receive duplicate versions of the same data packet. If two repeaters are used in the same system, each will repeat a transmission only one time, even if they are within communication range of each other. A repeater will not repeat a transmission if it was the originator of the transmission. If another M8G in the system has the same ID as the repeater, the repeater will not repeat data from that particular unit. The repeater's ID must be unique in the system.

If a M8G is configured as a repeater, and is also used to send and receive data, it will not repeat any transmission that it originated. M8G checks the ID of the station that originated the transmission to determine if the message should be repeated. If the transmission was originated by a station with the same Unit ID as the Unit ID in the receiving station, the data will not be repeated. This is why it is important to have a different ID for each M8G modem in a network that uses repeaters.

11. Debug Related Commands

Bench Testing

(Must be in command mode to test. Enter +++ at the keyboard to put unit into config/test mode.)

ATTD x	Various transmit test routines. 0 = Go back to normal mode. Stops the test. 1 = Random data transmit. 2 = Hop up/down one channel 3 = Force PLL to fast lock mode 4 = Transmit all 0s 5 = Transmit all 1s 6 = Enable the test points on the PCB. 7 = Transmit CW on center of channel 8 = Transmit preamble (101010 pattern)
ML x	Debug Message Level. By default and at power on, this level is set to 0 (no debug messages). 0 = no debug or diagnostic messages 1 = POCSAG, GPS, and data reception related message will come out serial port 2 = Verbose messages, Mostly used for factory and engineering purposes.
SHOW	Display an overview of the configuration.
Ping xxxx	Ping another modem over the air. Transmits a request to xxxx to see if xxxx can hear the sending station. If it does, it answers with a response transmission, containing its ID and the signal strength of the reception. .
STAT	Display statistics of how the modem is working. Enter STAT 1 to see GPS tracking related statistics.

12. Diagnostic Provisions

12.1. Overview of Diagnostics

Internal to the *M8* radio modem, is a powerful smart 32-bit microprocessor. Along with handing all aspects of radio modulation and demodulation, the microprocessor also maintains an extensive array of diagnostic information.

This section details the diagnostic information available, and describes how to us the information to optimize or troubleshoot an *M8* radio network.

12.2. Reading the Diagnostic Information

M8G diagnostic information is read using AT commands, while the unit is in the Command Mode. Refer to the section "User Serial Port Commands" to learn how to put the *M8G* modem into the Command Mode.

To see a general overview of how the modem has been operating, us the **ATST** command (status request command), without any parameter. The radio modem will respond with a list of certain operation statistics that it maintains. All statistics start counting at 0. The **ATST 1** command can be used to reset all statistics back to 0, except the run-time timers.

Other operation and configuration statistics are available using the ATST command, with a parameter to specify the desired statistic. The following table describes the various statistics available.

12.3. Status and Statistics Command

AT Command	Command Description	Response
ST	**General Communication Statistics** – This command will cause the *M8G* to output a table of various operational statistics.	Statistics overview screen
ST1	**GPS Tracking statistics** – Returns various statistics specific to the M8G version. These are subject to change in various firmware revisions.	Low-level statistics screen
ST2	**Low-level internal statistics** – Returns various low-level statistics. These are subject to change in various firmware revisions.	Low-level statistics screen
ST3	**Compile date and time** – Returns the data and the time that the firmware was compiled.	Date and time
ST4	**Run Time** – Returns the amount of time that the modem has been powered up and running.	Run time display screen
ST9	**Reset all statistics counters**	OK

13. Tune-up and Alignment

The *M8G* modem has been factory calibrated, in should not require any re-calibration when installed, or when changing frequency or channel. Unless the user is trained in radio test and calibration, the values stored in the R registers should not be modified. Radio calibration and alignment is performed using the **ATRx** commands.

Improper adjustment of the radio calibration (R0-R9 and RA registers), can result in failure of the radio modem.

Calibration and alignment values are stored internal to the modem in the "R" registers. (R0-R9 and RA). For example, to read R5, issue the **ATR8** command without any parameter. To change the setting, issue the **ATR8 nn** command, where nn is the new value you would like to store.

Once you read a register using an ATRx command, you may modify its value by entering a "U" for up or a "D" for down. U or D will change the value by one. Use this trick carefully, because it modifies the last R register that was read, and it is easy to unintentionally modify the wrong register.

13.1. Periodic Calibration

The only setting that may require adjustment is the center frequency. After years of operation, all crystals will age and change frequency slightly. The ATR8 command is used to adjust the center frequency. Like all narrow-band radios, semi-annual checks and adjustment of frequency is recommended.

13.2. Calibration Commands

The following AT commands are used to calibrate the M8. Do not ever change these unless you have been factory trained to do so.

AT Command	**Command Description**	**Parameters**	**Factory Default**
R0	**Symbol Peak Deviation** – Set the peak FM deviation of the transmit symbols. Note: This can be a negative number to invert the modulation.	Range: -1000 – 1000	120**
R1	**Select CD pin output signal** – CD pin may be RF carrier detect, or modem data detect, off, on, or RX data framing, or on-line status. Line status mode asserts CD when on-line in normal modem operation and it negates CD when in the command mode.	Range : 0 - 5 5 = RX data framing. Assert when outputting data 4 = Line stat. 3 = Always negate CD 2 = Always assert CD 1 = Data CD 0 = RF CD	0 (RF Carrier)
R2	**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**.	Range: 0 = 800 5 = 9600 2L 1 = 1200 6 = 19200 4L 2 = 2400 7 = 5142 2L 3 = 4800 8 = 9600 4L 4 = 8000 4L 9 = 2000 2L	3

R3	**Serial Port time out** – Number of mS of no activity on the serial port before transmitting the data in its buffer.	Range: 1 - 5000	20 (mS)
R5	**Preamble length** – The number of bytes to send over-the-air in the pre-amble.	Range: 3 - 255	4** (Varies based on data rate and radio type. 7 typical)
R8	**Frequency Offset.** Used to set the radio on the center of the radio channel.	Range: -500 to +500	0**
R9	**Modulation Balance.**	Range: 0-100	20**
RA	**Select RF CD output threshold** – This value is the RSSI threshold where the carrier detect is asserted. Note: To force CD always on, set this to 0, and R1 to RF Carrier Detect.	Range : 0 thru -127	-110

13.3. Center Frequency

1. Key the transmitter with CW output using this command:
   ATTD 7
2. The modem will now put out CW on the center of the channel.
3. Read the frequency offset with the **ATR8** command.
4. Adjust the frequency to the center of the channel with the **ATR8** command. You can use the "U" key and the "D" key to change the settings up and down one value in real time.

13.4. TX Deviation

1. Switch to channel 1.
2. Key the transmitter into a 50 ohm load using the **ATTD 3** command. The unit will now transmit, and send a digital 0 continuously. This should be +2.0kHz in frequency for narrow-band radios (12.5kHz spaced channels) and +4.0kHz for wide-band (25kHz channels).
3. Adjust the deviation register setting so that the frequency deviation is correct. The deviation is set with a digital adjustment. Use the ATR0 command to read or set the deviation level.

13.5. TX Modulation Balance

(*Note: This step is not performed on radios with Radio Type 5*)

1. Set-up a service monitor to monitor the FM deviation of the transmitted signal on an oscilloscope. The frequency response of the demodulated FM signal must be greater than 10Hz to 5kHz without any de-emphasis.

2. Transmit random data on the center of the band, using the **ATTD 1** command. This command will cause the *M8G* to automatically key up, and send random data for one minute.
3. Verify the DC center of the demodulated data is stable. The random data should be randomly timed 1s and 0s, and have little to no AC component on them. See pictures below for details.
4. If necessary, change the **ATR9** setting so that the long data bit have the same amplitude and DC value as the shorter ones.
5. On the low end of the band, adjust **ATRL** so that the modulation is proper.
6. On the high end of the bamd, adjust **ATRH** so that the modulation is proper.

13.6. Carrier Detect

The Carrier Detect (CD) signal from the modem is output on pin 3. It may be asserted by the detection of RF, using an internal signal called RSSI (Receive Signal Strength Indication). The RSSI signal is an analog signal representing the strength of the RF carrier. It is compared with a pre-set value, and if it is above this value, Carrier Detect is asserted. The pre-set value may be change with the **ATRA** command.

Note: “Asserted” means low. “Negated” means high. The CD pin will sit at about 3.3V when CD is not asserted. A digital 1 (3.3V) on the CD pin is the standard convention used to indicate no carrier detect. This allows the digital signals like the CD pin to be connected to standard RS232 line driver circuits and operated with the correct polarity.

Mode 0 - RF CD

On this line the modem indicates to the DTE that it has received a carrier from a remote device. It will assert this signal any time there is a carrier detected. The modem may be configured to assert this when an RF carrier is detected (any on-channel RF, voice or data), assert it only when another RF modem signal is detected, or always assert it. The operation of this line is configured with the ATR1 command. The default is 1 (asserts when *M8G* data is detected on the radio receiver).

Mode 1 - Data CD

In this mode, the CD pin is asserted whenever the modem detect a valid data modem signal on the air. If RF is present, but it is voice or some non-data single, then the CD pin is negated.

Mode 2 - CD ON

In this mode, the CD pin is always asserted.

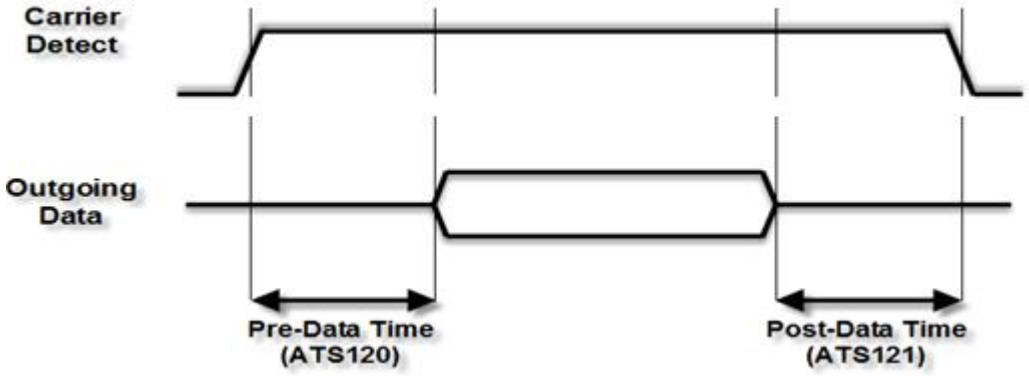
Mode 3 - CD OFF

In this mode, the CD pin is always negated.

Mode 4 - Output Data Framing

To enable the *Output Data Framing* feature, set **ATR1** to **4**, set **ATS120** to the number of mS for the Pre-Data Time, and **ATS121** to the number of mS for the Post-Data Time.

Ouput Data Framing is used when it is necessary for the serial terminal to wake from sleep or enter an appropriate mode to receive data. In this mode, the Carrier Detect handshaking line is nominally low and only goes high to signal that data is being output. The Pre-Data and Post-Data time can be set from 0-254ms, as indicated in the diagram below. The CD signal will normally stay low (near 0 volts), and when the Output Data Framing takes place, it will go high (about 3V).



If *Output Data Framing* is enabled, any other Carrier Detect and flow control output configuration is ignored.

14. Troubleshooting

Symptom: Unit will not receive

Solution #1. Verify that the modem is on the correct RF channel. If it is, the RX LED should blink every time another modem tries to transmit to it. If the RX LED does not blink when it should be receiving, it is on the wrong RF frequency.

Soultion #2. If the addresses match, and RX LED blinks but still no reception of data, verify that the RTS signal is asserted. The *M8G* will not output data if the RTS signal on the DB-9 I/O connector is not asserted. If the user's hardware cannot assert the RTS hardware line, disable hardware flow control in the *M8G* modem, using the **ATCH 0** command.

Solution #3. If the status RX LED blinks green when a different unit transmits, verify that the Unit Address of the sending modem matches the unit address of the receiving modem. If this is OK, verify that the over-the-air baud rate of all modems is the same (ATR2 command).

Solution #4. Verify Low Power Mode. The M8G has an optional Low Power Mode (LPM). If LPM is enabled, the M8G will power down whenever the DTR line of the serial port is turned off. The Power LED will blink once every 10 seconds in the LPM mode. The **ATSM** command is used to set or read the Low Power Mode. **ATSM 1** enables it, and **ATSM 0** disables it. If LPM is used (**ATSM 1**), then the M8G will turn off when the DTR line is off, or the program connected to the serial port is closed, or the RS-232 connector is un plugged.

Symptom: Unit will not transmit

Solution #1. Verify that CTS is wired. Some devices that could be connected to the *M8G* will require the CTS signal to be asserted. The *M8G* does assert this signal, but if the wire is not connected, you device may not be outputting data to the *M8*. If the TX LED blinks, the *M8G* is transmitting data. Every time data enters the modem, the TX LED should blink

Solution #2. Verify that serial port timeout is OK. The ATG0 command sets the number of microseconds that the *M8G* will look for in the serial input data stream. If a pause greater than this value happens, the modem will transmit. If the ATG0 paramter is set very large, say 2000000, this means 2 seconds, and the modem may simply be waiting a long time

Solution #3. Verify that the radio channel is clear or BCL is off. The **ATBC 1** command enables Busy Channel Lockout. If BCL is on, the modem will not transmit on a busy channel. The **ATBC 0** command turns it off, and thus the modem will transmit when it needs to, regardless if the channel is busy. The RX led on the front of the modem is illuminated whenever the radio channel is busy (RF present).

Solution #4. Verify Low Power Mode. The M8G has an optional Low Power Mode (LPM). If LPM is enabled, the M8G will power down whenever the DTR line of the serial port is turned off. The Power LED will blink once every 10 seconds in the LPM mode. The **ATSM** command is used to set or read the Low Power Mode. **ATSM 1** enables it, and **ATSM 0** disables it. If LPM is used (**ATSM 1**), then the M8G will turn off when the DTR line is off, or the program connected to the serial port is closed, or the RS-232 connector is un plugged.

Symptom: Receive light blinks, but no data is received

Solution #1. Verify Input/Output Configuration. The *M8G* has numerous I/O options. RS232 is standard, but Ethernet, RS485 or RS422 may be configured also. Use the ATIO command to view how the I/O is configured. ATIO 0 is the default (RS232 mode).

Solution #2. Verify the serial port baud rate. This is difficult if it is set wrong, because you cannot enter the command mode to check it. Try all possible baud rates, and see if one of them works with the modem. Alternately, remove the rear cover of the modem, and press the CONFIG

button. This will force the modem into the Command Mode, as well as set the serial port to 9600 baud, 8 data bits, one stop, and no parity. If the baud-rate was OK, verify the AT, BT and CT times, that they are long enough for you to enter the +++ string.

Symptom: Long delay before transmitting

Solution #1. Verify that serial port timeout is OK. The ATR3 command sets the number of milliseconds that the *M8G* will look for in the serial input data stream. If a pause greater than this value happens, the modem will transmit. If the ATG0 parameter is set very large, say 2000, this means 2 seconds, and the modem may simply be waiting a long time. Typical settings for this parameter are 20 (20mS).

Symptom: Cannot enter Command Mode

Solution #1. Verify the serial port baud rate. This is difficult if it is set wrong, because you cannot enter the command mode to check it. Try all possible baud rates, and see if one of them works with the modem. Alternately, remove the rear cover of the modem, and press the CONFIG button. This will force the modem into the Command Mode, as well as set the serial port to 9600 baud, 8 data bits, one stop, and no parity. If the baud-rate was OK, verify the AT, BT and CT times, that they are long enough for you to enter the +++ string.

Solution #2. Handshaking. You may have hardware handshaking enabled on your terminal program, but the hardware or cable may not support it. Disable hardware handshaking on your terminal program to verify this is the issue.

Symptom: Modem appears dead.

Solution #1. Verify the power is on. When the modem has good DC power, the PWR LED will blink once per second. If it is not blinking, either the modem does not have power, the modem is broken, or the LEDs have been disabled via the **ATL0** command.

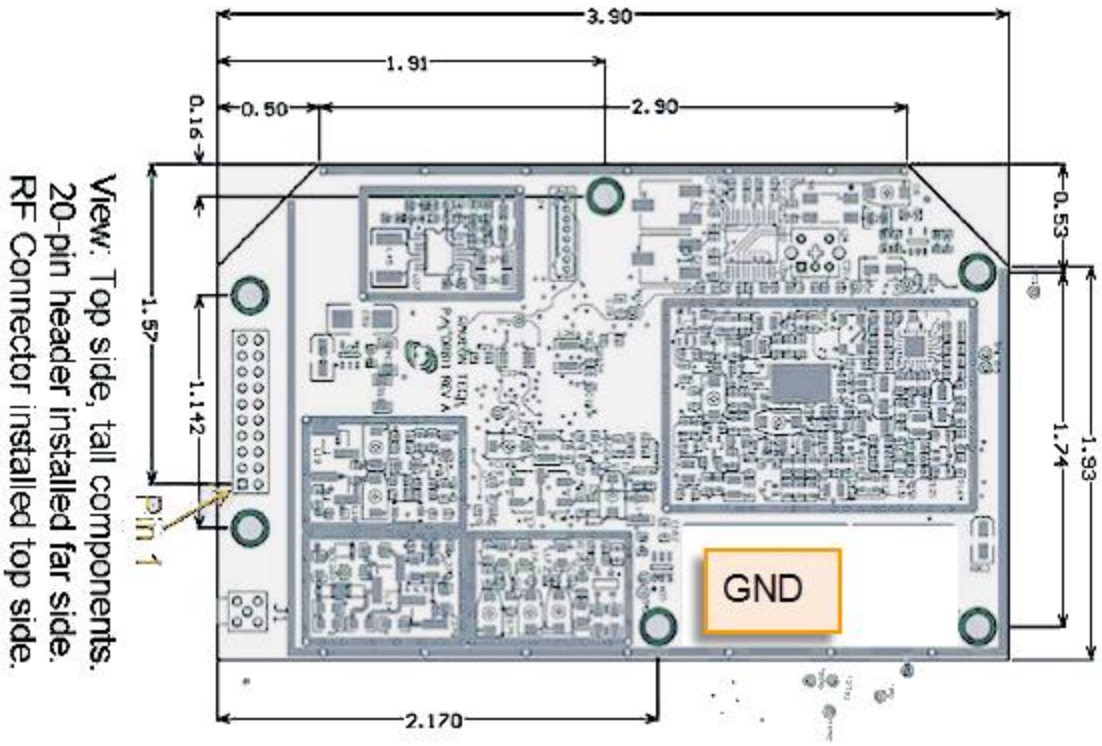
Solution #2. Verify Low Power Mode. The M8G has an optional Low Power Mode (LPM). If LPM is enabled, the M8G will power down whenever the DTR line of the serial port is turned off. The Power LED will blink once every 10 seconds in the LPM mode. The **ATSM** command is used to set or read the Low Power Mode. **ATSM 1** enables it, and **ATSM 0** disables it. If LPM is used (**ATSM 1**), then the M8G will turn off when the DTR line is off, or the program connected to the serial port is closed, or the RS-232 connector is un plugged.

Symptom: Repeater will not repeat.

Solution #1. Verify the repeater's Unit ID is unique. An RV-M8G configured to be a repeater will not repeat messages it originated. If other units in the system have the same ID as the repeater, the repeater will not repeat them because it thinks the it originated the transmission. Set the MTID of the repeater to a unique ID number.

15. Mechanical

A drawing is shown below.



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If within 12 months from date of purchase, this 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.

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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.