



## RV-M7 GX with TDMA data

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### Overview

The RV-M7 GX transceiver with built in GPS is an exceptional AVL transceiver, and it is also possible to use it to send mobile data.

The RV-M7 GX uses a TDMA protocol to transmit data over the air. TDMA protocols greatly increase the available channel bandwidth but they require more system planning than conventional carrier-sense methods.

The Technical Brief describes various issues related to transmitting data using the RV-M7 GX to transmit and receive position information *and* data via the serial port.

For data transmission, Raveon Recommends setting the RV-M7 GX into the GPS 2 mode. This sets the serial port data rate to 38400, and the unit will output \$PRAVE messages when it receives data. After issuing the **GPS 2** command, other parameters may be modified to optimize the system. The other useful GPS mode for data is **GPS 6**. It will output \$GPWPL messages, and sets the serial port to 4800 baud. Both GPS modes 2 and 6 will allow the user to send data sent into the RV-M7's serial port over-the-air.

### Low-Latency Configuration

Low-latency data transmission is useful when real-time data must be transmitted from one unit out to many other units. Differential GPS corrections and Mobile Dispatch Messaging are examples of system which require outbound data from one unit to be quickly sent. The latency on the return path is less critical.

#### Over-the-air Rates

For low-latency data, the over-the-air data rate should be as fast as possible. For narrow-band radios, the choice is usually, 4800 baud 2-level or 8000 baud 4-level. For wide-band versions, the choice is 9600 2-level or 14400 4-level.

Table 1

<b>Over-the-air rate</b>	<b>Radio Bandwidth</b>	<b>Number of Modulation Levels</b>	<b>Position /Status Transmission Duration</b>	<b>Recommended TDMA SLOTTIME in mS</b>
4800bps (ATR2=3)	12.5kHz	2	70mS	100 (200 with repeaters)

8000bps (ATR2=4)	12.5kHz	4	50mS	50 (150 with repeaters)
9600bps (ATR2=5)	25kHz	2	45mS	50 (100 with repeaters)
14400bps (ATR2=10)	25kHz	4	30mS	50 (100 with repeaters)

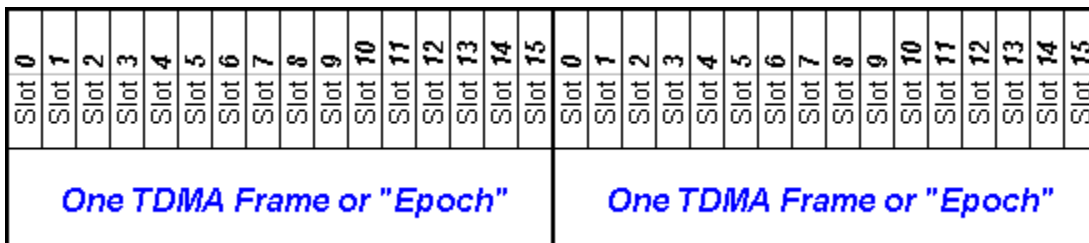
Use the **ATR2** x command to set the over the air rate.

Use the **SLOTTIME** xx to set the TDMA slot time. The SLOTTIME must be wide enough to accommodate a Position/Status transmission from the GPS. Refer to the table above to determine how long a position/status transmission will take.

### The TDMA Frame Length

The TDMATIME is the length of one TDMA frame/epoch. A TDMA frame contains small time slots where each radio is allowed to transmit in. The slots are sequentially numbered.

Figure 1



Radio number 1 transmits in Slot 1. Radio number 2 in slot 2...

TDMA Frames have a pre-set number of slots, and once the TDMA Frame Time has passed, the frame restarts at slot 0 again. Slot 0 is reserved for future base-station control signals. The length of a TDMA Frame is set with the **TDMATIME** xx command.

The TDMA Slot Time is programmable, in 50mS increments. The **SLOTTIME** xx command is used to set the slot width. Typically it is set at 50, 100, 150, or 200mS. The factory default is 200mS.

For example, with a **TDMATIME** of 1 second, and a **SLOTTIME** of 100mS, there are enough slots to support 9 radios reporting every second. The Frame will repeat every second so every second, each of the 9 radios has 100mS of air-time available.

Figure 2

	Time (seconds)	Radio ID
<i>The first Frame</i>	Slot 0	0.0
	Slot 1	0.1
	Slot 2	0.2
	Slot 3	0.3
	Slot 4	0.4
	Slot 5	0.5
	Slot 6	0.6
	Slot 7	0.7
	Slot 8	0.8
	Slot 9	0.9
<i>The second Frame</i>	Slot 0	1.0
	Slot 1	1.1
	Slot 2	1.2
	Slot 3	1.3
	Slot 4	1.4
	Slot 5	1.5
	Slot 6	1.6
	Slot 7	1.7
	Slot 8	1.8
	Slot 9	1.9
	etc....	

Position/Status Transmissions

At a pre-programmed rate, the RV-M7 will report its position and its status. This rate should normally be at the **TDMATIME** rate or longer. The rate at which a unit transmits its position/status is set with the **TXRATE xx** command.

For example to have the unit number 4 transmit its position every 3 seconds, set the TXRATE to 3 (**TXRATE 3**) in the RV-M7 which has the MYID of 0004. With a **TDMATIME** of 1 second, unit number 4 will transmit at 2.4 seconds and 5.4 seconds, and continue on every 3 seconds.

Figure 3

	Time (Sec)	Radio ID
<i>The first Frame</i>	Slot 0	0.0
	Slot 1	0.1
	Slot 2	0.2
	Slot 3	0.3
	Slot 4	0.4
	Slot 5	0.5
	Slot 6	0.6
	Slot 7	0.7
	Slot 8	0.8
	Slot 9	0.9
<i>The second Frame</i>	Slot 1	1.1
	Slot 2	1.2
	Slot 3	1.3
	Slot 4	1.4
	Slot 5	1.5
	Slot 6	1.6
	Slot 7	1.7
	Slot 8	1.8
	Slot 9	1.9
	<i>The second Frame</i>	Slot 1
Slot 2		2.2
Slot 3		2.3
Slot 4		2.4
Slot 5		2.5
Slot 6		2.6
Slot 7		2.7
Slot 8		2.8
Slot 9		2.9
<i>The second Frame</i>		Slot 0
	Slot 1	3.1
	Slot 2	3.2
	Slot 3	3.3
	Slot 4	3.4
	Slot 5	3.5
	Slot 6	3.6
	Slot 7	3.7
	Slot 8	3.8
	Slot 9	3.9
<i>The second Frame</i>	Slot 0	4.0
	Slot 1	4.1
	Slot 2	4.2
	Slot 3	4.3
	Slot 4	4.4
	Slot 5	4.5
	Slot 6	4.6
	Slot 7	4.7
	Slot 8	4.8
	Slot 9	4.9
<i>The second Frame</i>	Slot 1	5.1
	Slot 2	5.2
	Slot 3	5.3
	Slot 4	5.4
	Slot 5	5.5
	Slot 6	5.6
	Slot 7	5.7
	Slot 8	5.8
	Slot 9	5.9

With a **TXRATE** of 1, it will transmit every second as shown below.

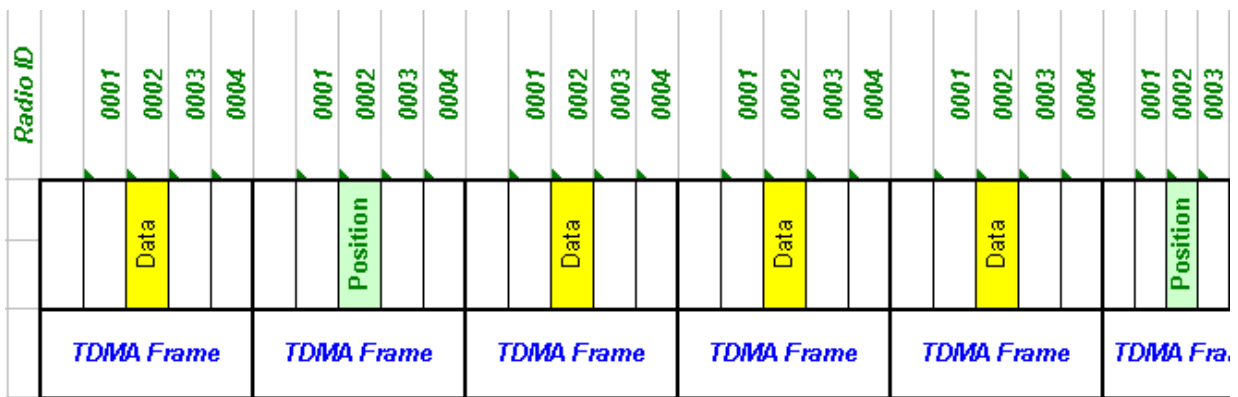




1. Set the **SLOTTIME** wider to give extra time for data. (As shown in the diagram above)
2. Use the **SLOTQTY** command to allocate some specific RV-M7 GX transceivers extra slots. **SLOTQTY** is normally 1, and each unit gets one slot. If it is set to some other number, the unit will assume it has additional slots.
3. Increase the time between position/status transmission with the **TXRATE** command.

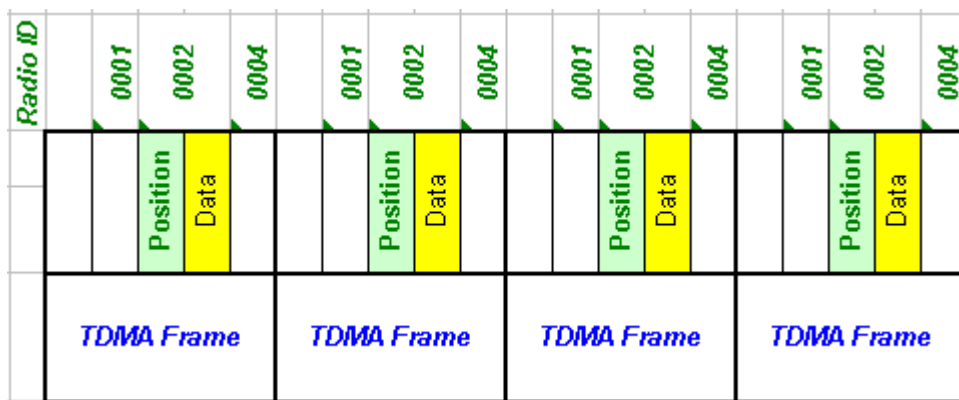
For example, if the **TDMATIME** frame rate is 2 seconds, setting the **TXRATE** to 10 seconds will allow the RV-M7 to use 4 out of every 5 of its time slots for data as shown below. Unit 0002 reports position every 5<sup>th</sup> frame, and uses its other slots for data.

Figure 6



In the example above, the **SLOTQTY** could have been increased by one (**SLOTQTY 2** command), giving unit 0002 extra time, but then there could be no unit 0003, as his slot was allocated to 0002.

Figure 7



### Base Station Aliasing

One interesting method of creating more transmission bandwidth and reduce latency is to use “*aliasing*” of the TDMA Frame. When the number of RV-M7 radio in a system gets large, the TDMA Frame time must also be large, so that all radios have a

slot to transmit in. This creates latency in transmitting data as a station wishing to transmit must wait until its slot time arrives, which may take almost a whole frame. If the TDMA Frame time is set to say 30 seconds, this delay can become noticeable when sending data messages.

When a system needs low-latency, but has a long TDMA Frame, there is a simple way to allocate additional periodic slot to one or more units by setting the TDMA Frame time very short on a select few units. For example, the TDMA Frame time may be set to 30 seconds for most RV-M7s in the system, but the base-station's TDMA Frame time may be set to 1 second.

The effect of this is that each unit in the system, except for the base, will transmit every 30 seconds. The base station, (which originates most messages), will have a time slot every second. This is illustrated in the diagram below.

**Figure 8**

TDMA Frame for the BASE Station in the system		TDMA Frame for the non-base units in the system	
Slot Number	Radio ID	Slot Number	Radio ID
0	-	0	-
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
0	-	5	5
1	1	6	6
2	2	7	7
3	3	8	8
4	4	9	9
0	-	10	10
1	1	11	11
2	2	12	12
3	3	13	13
4	4	14	14
0	-	15	15
1	1	16	16
2	2	17	17
3	3	18	18
4	4	19	19
0	-	20	20
1	1	21	21
2	2	22	22
3	3	23	23
4	4	24	24
0	-	25	25
1	1	26	26
2	2	27	27
3	3	28	28
4	4	29	29
0	-	30	30
1	1	31	31
2	2	32	32
3	3	33	33
4	4	34	34
0	-	35	35
1	1	36	36
2	2	37	37
3	3	38	38
4	4	39	39

The “BASE” station will have a slot (Slot 1) every second where it may send data and position out. Because the BASE’s available slots arrive every second (as shown in yellow), there are certain ID codes that cannot be used by the other radios in the system. The ID codes that cannot be use are shown in RED (6 ,11 ,16 ,21 , ...).

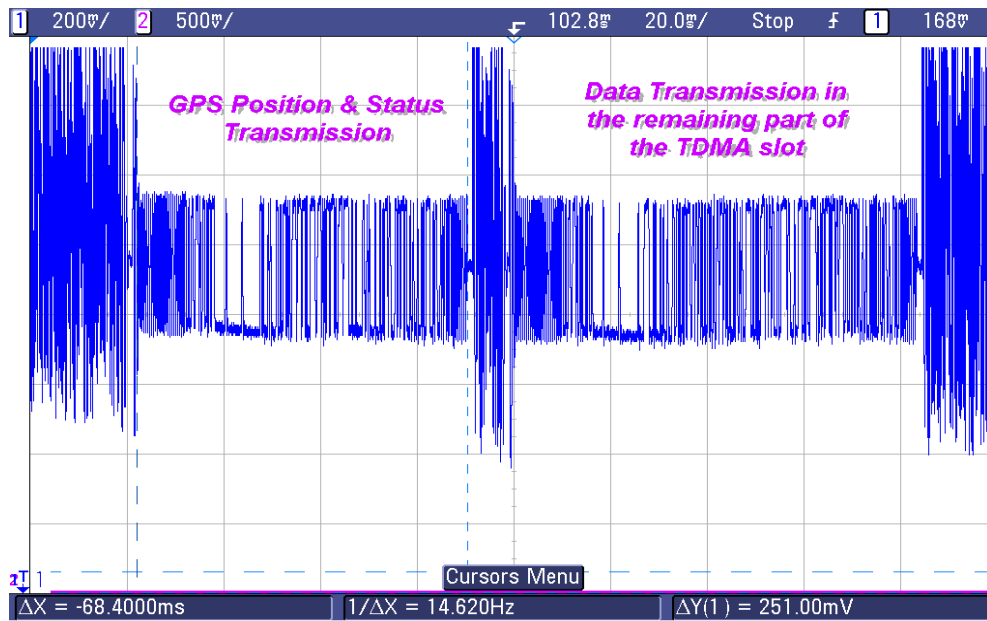
This aliasing technique will increase the TDMA Frame time of the system by 20%, but it can reduce the latency of outbound messages from the base by 09% ore more.

## Example Transmissions

### Example 1

4800 baud position transmission followed by a data transmission of 20 bytes. The SLOTTIME was set to 100mS and the SLOTQTY set to 2, so that this unit had 200mS per Frame allocated to it. It used about 170mS of its slot.

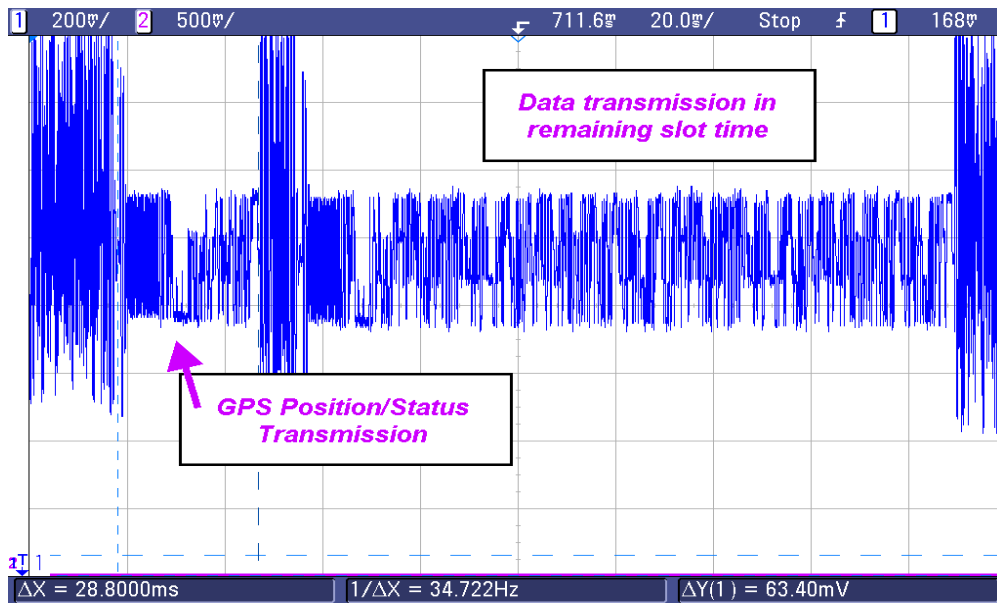
Figure 9



**Example 2**

14400 baud (4-level) position transmission followed by a data transmission of 200 bytes. The SLOTTIME was set to 50mS and the SLOTQTY set to 4, so that this unit had 200mS per Frame allocated to it. It used about 180mS of its slot.

Figure 10



## Data Related Configuration Parameters

Command	Command Description	Parameters	Factory Default
<b>ATRV</b>	<b>Disable Remote Access</b> – 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
<b>DATAMUTE</b>	<b>Set/Read Serial Port TX Data Mute.</b> 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.	0, 1	0
<b>FREEWHEEL</b>	<b>Freewheel time.</b> Read/set the number of seconds that the unit will continue to transmit when it loses GPS lock. If the GPS signal is lost, then the unit will stop transmitting position or TDMA data after the free-wheel period. 0=infinite free-wheeling.	1-7200	120
<b>GPS</b>	<b>GPS Operation Mode.</b> Set the GX version's Operating mode. Modes 2 and 6 may be used to send data as well as position reports.	1 – 9	1
<b>SLOTQTY</b>	<b>Quantity of TDMA Slots.</b> 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
<b>SLOTTIME</b>	<b>TDMA Slot duration.</b> Configure the width of a TDMA slot. 50mS increments.	50 - 1000	200
<b>TDMA DATA</b>	<b>Set/read TDMA Data Priority.</b> 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)
<b>TDMA TIME</b>	<b>Set/read TDMA Frame time.</b> The length of one TDMA time frame, in seconds.	0-3599	10
<b>TXRATE</b>	<b>GPS Report Rate.</b> Set number of seconds between GPS reports. This is also the rate at which the internal GPS will measure position, speed, etc. Even if the unit is not moving, the GPS periodically measures position and speed to determine if it has triggered a speed or position transmission.	1 - 9999	10

## Data Operation with a Repeater

Any M7 GX transponder may be configured to also be a repeater. See the technical manual for details on configuring the repeater table. But, for a quick start, use the **REPEAT 1** command to turn any M7 GX into a repeater.

When configured to be a repeater, the M7 will immediately re-broadcast any over-the-air data, position, or status report it receives. This can greatly extend the communication range of a system.

In most systems, there should only be one repeater. Multiple-repeaters often interfere with each other and the system must be carefully planned for this to work.

## Repeater Issues

There are a number of issues with using a repeater in a system. The main ones to consider are:

1. Repeaters immediately re-transmit whatever they receive. There must be no other radio or repeater on the air during the re-transmission. Thus, the TDMA slot width must be wide enough to fit the original transmission in, plus the repeated version of the original transmission.
2. If two repeaters repeat the same message at the same time, then it is likely neither one of the repeaters will be heard. It is important on radio systems that only one radio be on the air at any one time.
3. If you are sending data along with GPS position/status reports, the data is sent out after the position report. If there is a repeater in the system, the data will be interfered with by the repeater, because the repeater will be on the air repeating the GPS position when the data is also being sent.

Items 1 & 2 require careful system planning to solve. Item 3 may be solved with the **TDMADATA** command. If **TDMADATA** is set to **0**, then the M7 will send position reports followed by any data. If **TDMADATA** is set to **1**, then the M7 will suppress a GPS position/status report if there is data to be sent, thus there will only be one transmission per TDMA time slot. **TDMADATA** is only available in the Personal Locator or M7 GX transponders with firmware version B16 or higher.

## Summary

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To configure the RV-M7 GX radio for data and position there are 7 very important parameters to consider:

1. The MYID of the transmitting RV-M7. Programmed with the **MYID xxxx** command.
2. The TDMA Frame time, programmed with the **TDMATIME xx** command.
3. The TDMA Slot Time, programmed with the **SLOTTIME xx** command.
4. The number of TDMA slots the RV-M7 uses, programmed with the **SLOTQTY x** command.
5. The time interval between position/status transmissions, programmed with the **TXRATE xx** command.
6. The data input bit, bit must not be used for a digital input bit. The command **TRIGBITS** enables/disable various input bits.
7. If you wish to execute Remote Procedure Requests (RPRs), then they must be enabled on the receiving modem with the **ATRV** command. **ATRV 1** disables them. **ATRV 0** enables them.
8. If you will have a repeater in the system, set **TDMADATA** to **1** to give data priority over position reports.

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