Technical Brief
AN139Rev A0

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

Over-the-air rate	*Radio Bandwidth*	*Number of Modulation Levels*	*Position /Status Transmission Duration*	*Recommended TDMA SLOTTIME in mS*
4800bps (ATR2=3)	12.5kHz	2	70mS	100 (150 with repeaters)

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

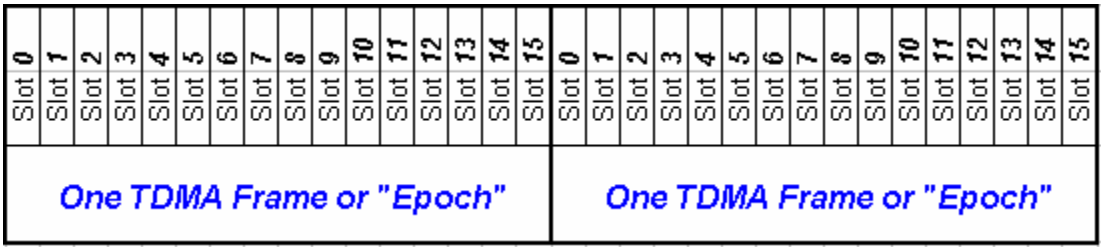
Use the **ATR2** x command to set the over the air rate.

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



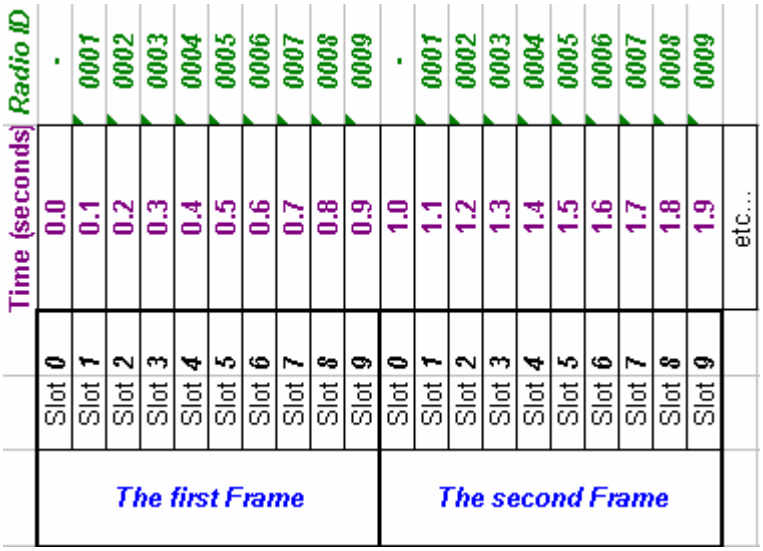
Radio number 1 transmits in Slot 1. Radio number 2 in slot 2…

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

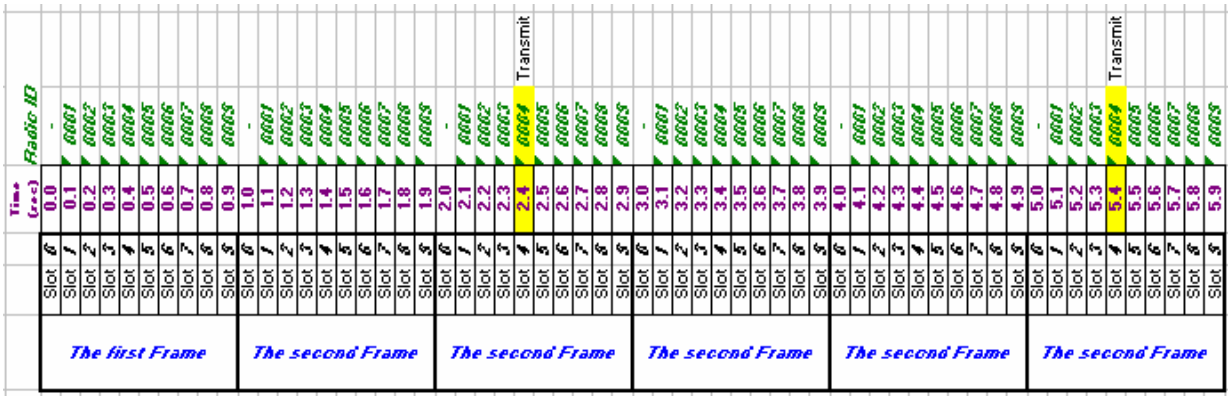


Position/Status Transmissions

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.

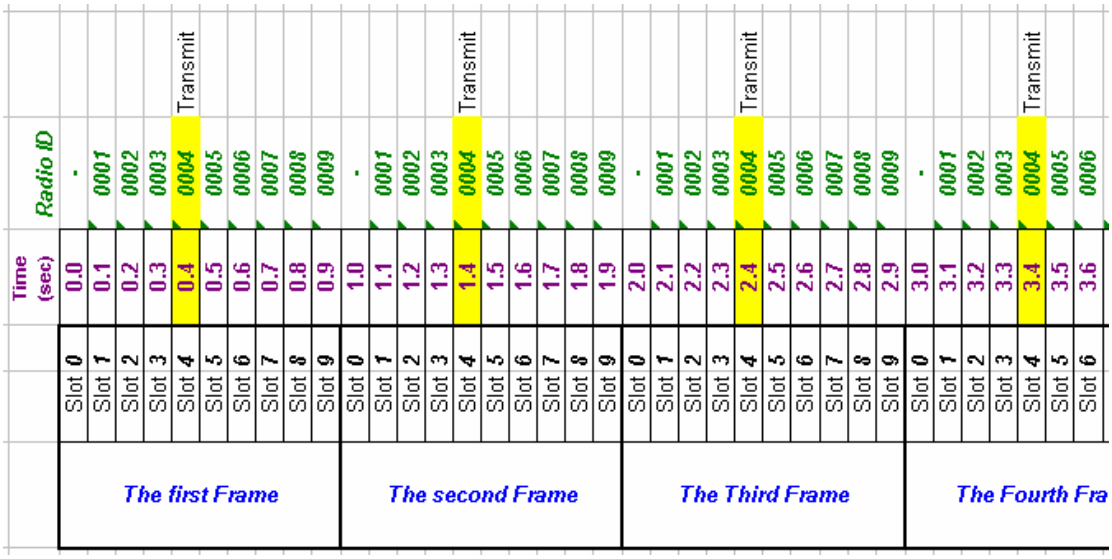
For example to have the unit number 4 transmit its position every 3 seconds, set the TXRATE to 3 (**TXRATE 3**) in the RV-M7 which has the MYID of 0004. With a **TDMATIME** of 1 second, unit number 4 will transmit at 2.4 seconds and 5.4 seconds, and continue on every 3 seconds.

Figure 3



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

Figure 4



Standard RV-M7 GX Output Messages

There are two messages that routinely come out the serial port of the RV-M7 GX. They are:

1. **Position/status** information received from other units. These messages are usually sent out the serial port in the $PRAVE, $GPWPL, $GPTLL,… NMEA format. Everytime an RV-M7 GX receives a position from another RV-M7, it outputs the received information via its serial port.
2. **Local GPS information** may also be sent out the serial port. Internal to the RV-M7 is a GPS receiver, and in certain GPS modes, the local GPS's position and settings will be sent out the serial port of the RV-M7. The standard NMEA messages are sent out ($GPRMC and $GPGLL messages).

In data applications it may not be desirable to have one or both of these types of messages sent out the serial port.

To disable the Position/Status messages from coming out the serial port, use the **OUTPUT 0** command to set the output message format to nothing. This must be done after the **GPS x** command that told the unit what GPS operation mode to be in.

To disable the local GPS NMEA messages from coming out the serial port, use the **NMEAOUT 0** command to disable local GPS NMEA messages. **NMEAOUT 1** enables them. This must be done after the **GPS x** command that told the unit what GPS operation mode to be in.

Data Transmission

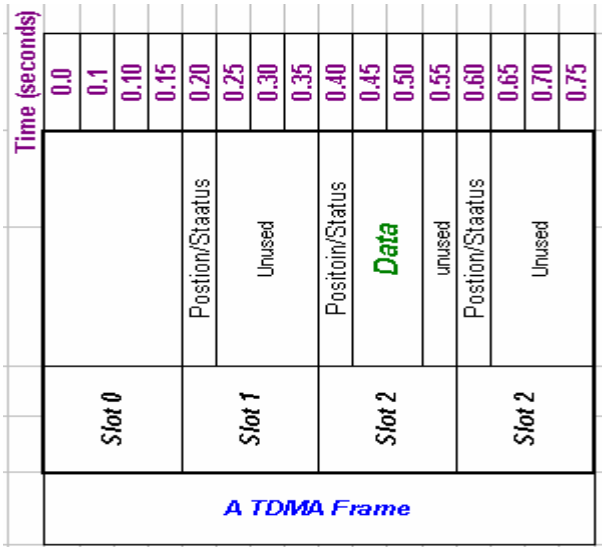
With the release of RV-M7 firmware B8, the RV-M7 GX radio transceiver includes TDMA data transmission as well as GPS position reporting.

When serial data enters the RS-232 serial port of the radio modem, it will transmit the data over the radio to other RV-M7 modems.

When sending data with the RV-M7 GX with the built-in GPS and TDMA protocol, data is buffered in the modem, and only transmitted in the radio's assigned time slot. When the units time-slot arrives, the radio sends the data over the air. If there was more data to send than will fit in the slot, then the data that will fit is sent, and any additional data is stored and sent during the next Frame.

Position/status reports always take precedence, so when it come time to transmit in a unit's assigned time slot, the position transmission will be sent first, immediately at the beginning of the unit's assigned slot. If there still is room for data in the slot, the data will be sent also. In the example below, units 1, 2 and 3 report their position, and unit 2 also sends some data after the position report is sent.

Figure 5



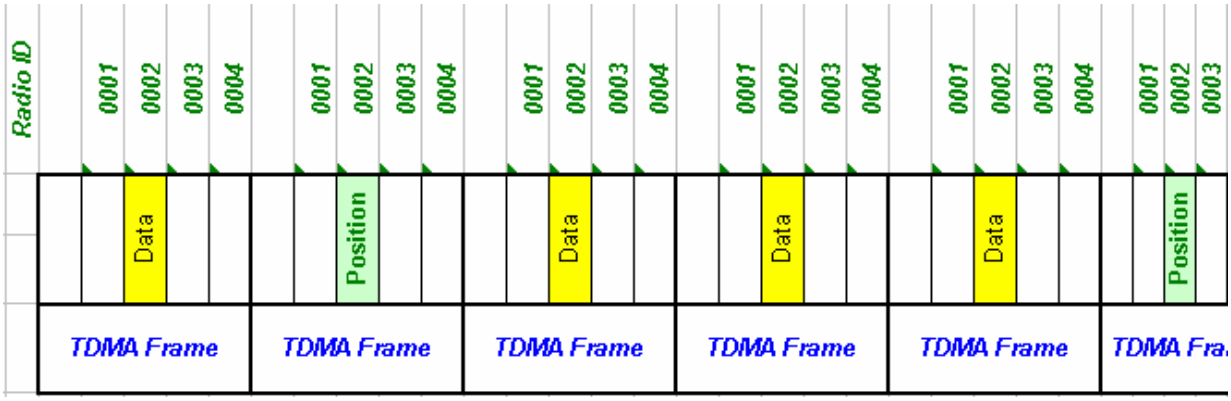
To send data, there must be enough time in the TDMA slot after a position report to send a data message in. If the user sends the SLOTTIME very narrow, say 50mS, then there is only enough time in the slot for the position report, and no data would ever be sent.

There are three ways to ensure that there is time to send data and position report. Any or all of them may be used to add data bandwidth to an GPS system.

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.

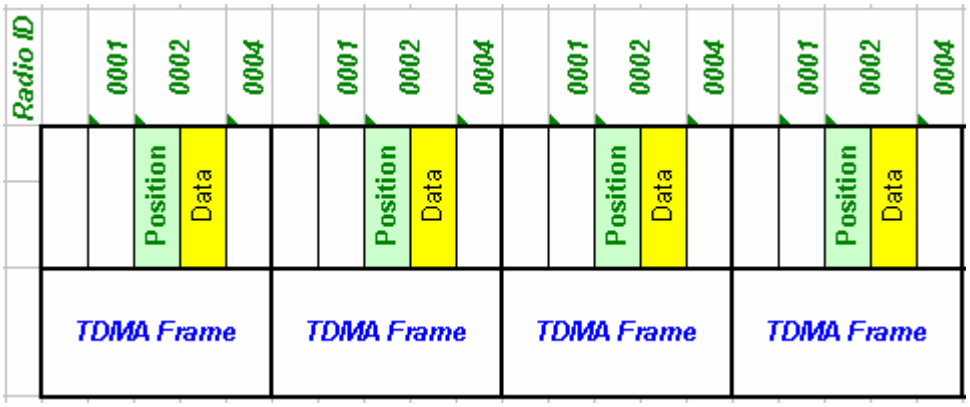
For example, if the **TDMATIME** frame rate is 2 seconds, setting the TXRATE to 10 seconds will allow the RV-M7 to use 4 out of every 5 of its time slots for data as shown below. Unit 0002 reports position every 5th frame, and uses its other slots for data.

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 cold be no unit 0003, as his slot was allocated to 0002.

Figure 7



Base Station Aliasing

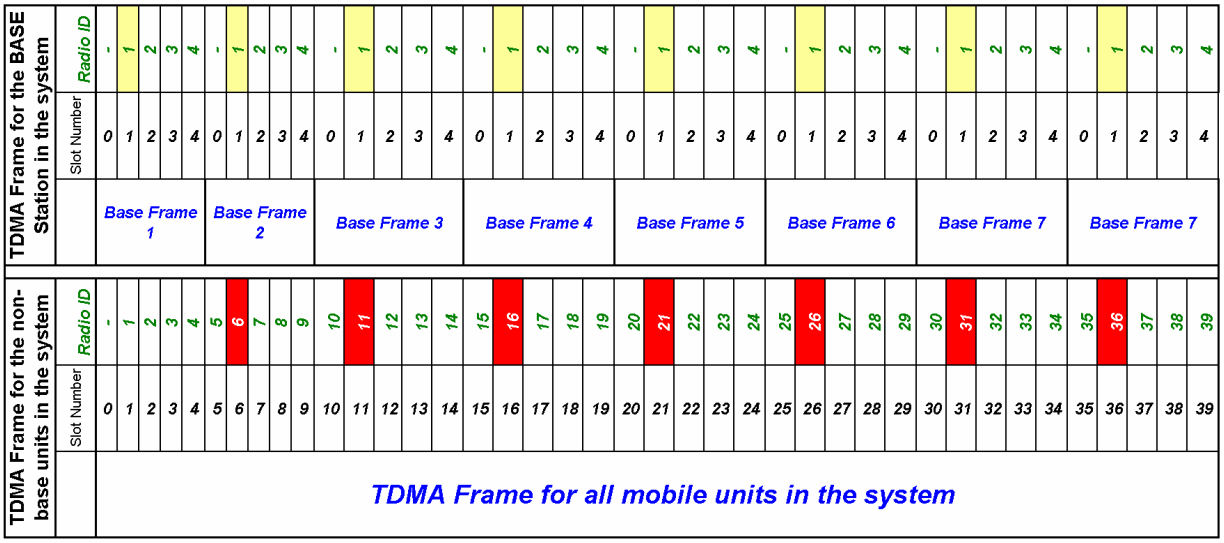
One interesting method of creating more transmission bandwidth and reduce latency is to use "*aliasing*" of the TDMA Frame. When the number of RV-M7 radio in a system gets large, the TDMA Frame time must also be large, so that all radios have a slot to transmit in. This creates latency in transmitting data as a stating 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



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 , …).

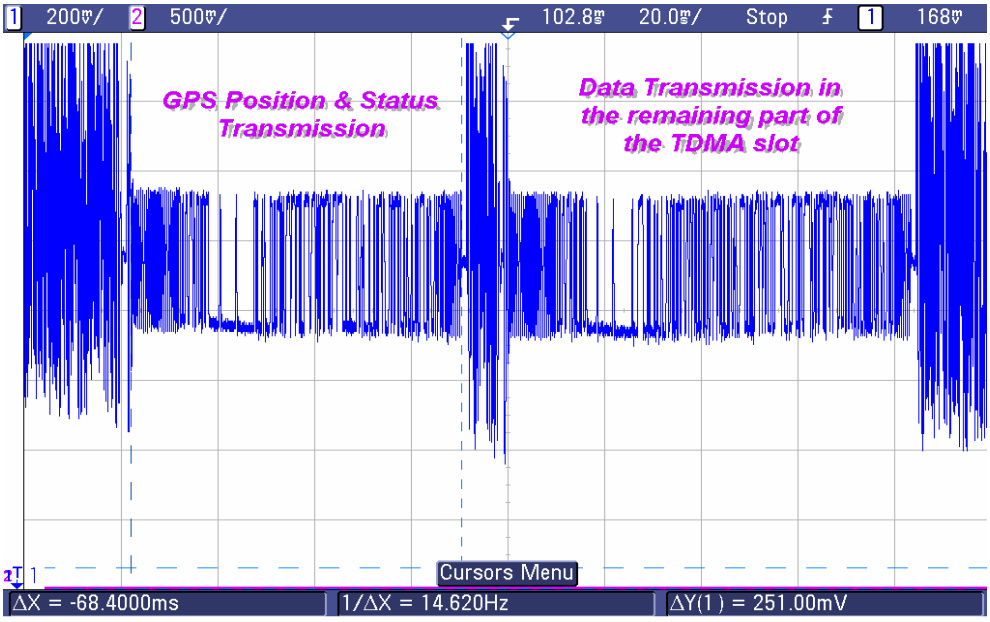
This aliasing technique will increase the TDMA Frame time of the system by 20%, but it can reduce the latency of outbound messages from the base by 09% ore more.

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.

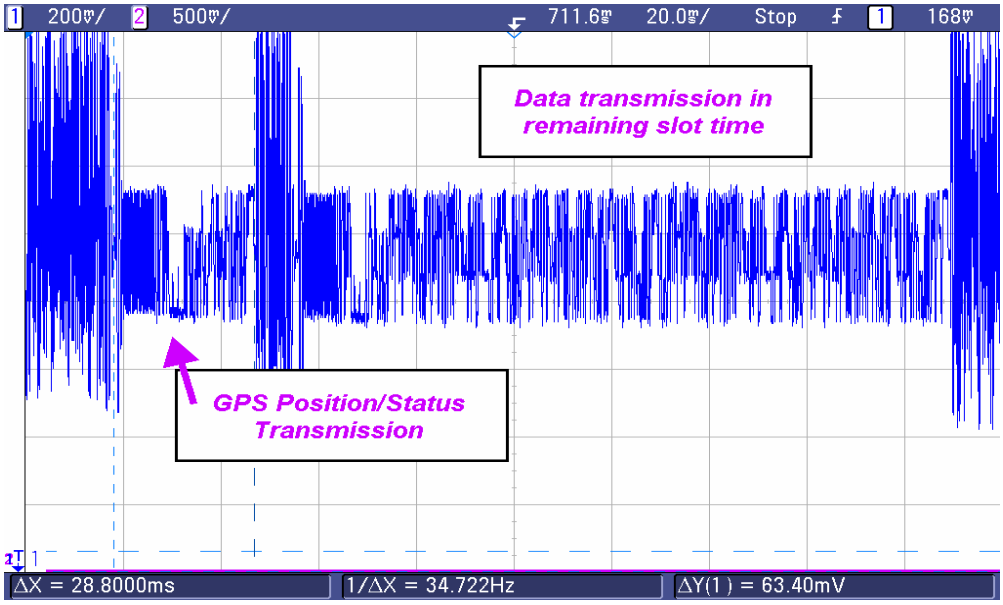
Figure 9



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



Summary

To configure the RV-M7 GX radio for data and position there are 5 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.

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