

**Integrating Digiquartz[®] MET3 and MET3A
Broadband Meteorological Systems
with Leica GX1200 Series GPS Receivers**



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“The standard by which other standards are measured”

Integrating Digiquartz[®] MET3 and MET3A Broadband Meteorological Systems with Leica GX1200 Series GPS Receivers

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1. Introduction

Paroscientific is the leader in the high precision pressure measurement field where high resolution, accuracy, reliability, ruggedness, long-term stability, and low cost of ownership are important requirements. The high performance of Digiquartz[®] Instruments is a result of careful design, meticulous manufacturing, and extensive calibration and testing.

Paroscientific's MET3 and MET3A Broadband Meteorological Measurement Systems were uniquely designed for GPS-Meteorology and geophysical applications. For both of these applications, an intermediary goal is to calculate the amount of precipitable water vapor (PWV) in the atmosphere either to make very accurate position measurements or to forecast short-term weather very precisely. For these applications, precision, accuracy, reliability, and long-term stability of the MET stations equate to low total cost-of-ownership for the life of the program. The broadband feature of these instruments also enables scientists to measure other atmospheric and geophysical signals with a network of GPS receivers co-located with Digiquartz[®] MET3 and MET3A Meteorological Measurement Systems.

Since surface pressure and temperature measurements are important parameters for PWV calculations, the data reliability and integrity from the MET stations are of paramount importance.

The MET3 and MET3A precision measurement instruments provide high accuracy data from barometric pressure, temperature, and relative humidity sensors. Pressure resolution is better than 1 microbar with a total accuracy of ± 0.08 hPa over the extended barometric range of 620 to 1100 hPa. Temperature resolution is 0.01 degree C. The fan-aspirated MET3A has a total temperature accuracy of 0.1 degree C over the full temperature range of -50 to $+60$ degrees C. Relative humidity performance is better than 2% at 25 degrees C, and humidity recovery time for the MET3A after 100% water saturation is less than 2 minutes.

These fully integrated systems are housed in environmental enclosures facilitating rapid installation and allowing stand-alone, indoor or outdoor mounting. Installation hardware and software are included, and optional interface cabling is available for easy system integration. The MET3 radiation shield protects the temperature and humidity sensors from precipitation and solar radiation. The MET3A utilizes a high performance, tuned barometric pressure port to reduce dynamic pressure errors caused by wind.

Microprocessor-based electronics provide fully temperature compensated and linearized outputs via a two-way RS-232 interface. The serial interface allows complete remote configuration and control of all operating parameters including resolution, sample rates, choice of engineering units, integration time, and sampling commands. Individual measurement parameters or a "unified" data word with all sensor outputs are easily interfaced with computer systems, GPS receivers, and data loggers.

The purpose of this document is to provide specific integration and diagnostic information to facilitate the integration of a MET station with Leica GX1200 Series GPS receivers. This information is in addition to the MET3 and MET3A Installation, Operation and Maintenance Guides. Once the MET stations are set up properly in the field, these instruments are designed to work under rugged environmental conditions for years with minimal, if any, maintenance. The operating principle of a MET station with a GPS receiver is simple and relies on a few critical parameters. This technical paper elaborates on these critical parameters and provides a step-by-step technical recipe to integrate Leica GX1200 Series GPS receivers with a MET station.

2. What do you need for GPS-MET Integration?

Upon your purchase of a Leica GX1200 GPS receiver and a Broadband Digiquartz® MET3 or MET3A Meteorological package, you receive the following items from each vendor. If any of these items are missing from your package, please contact your local Leica representative or Paroscientific, Inc. for the respective equipment.



GPS Receiver



GPS Antenna



MET and PC Cable



Ethernet Cable (Only Pro Series)



Leica Geo Office & Software Key



Power Adapter

Table 1. Items provided by Leica



MET Station



MET Cable (optional)



Power Adapter, PC Cable and Connector (optional)



Digiquartz® Software CD

Table 2. Items provided by Paroscientific

3. Operating Principle of MET Stations

MET stations include the world's most accurate, stable, and reliable **Broadband Digiquartz® Barometers**, packaged with a precision temperature and humidity probe. Integral electronics and packaging make installation and communication with these instruments an easy task.

In order for a MET station to work with a GPS receiver, regardless of the GPS receiver manufacturer, the following conditions **must** be met.

a. The MET instrument must be powered up.

MET stations are powered via pin 9 of its RS-232 connector. Please check the operating manual of your GPS receiver to review if your receiver is capable of providing power to MET stations. If your GPS receiver is not capable of providing a voltage output of +7 to +16 VDC through pin 9 of its RS-232 connector, please contact Paroscientific Sales and Application engineers to purchase the MET cable and power adapter kits (Part Number 2361-XXX for 110 VAC, 2362-XXX for 220 VAC, XXX corresponds to cable length). You may order this kit during your purchase of the MET station as well.

Note: MET stations shipped after 8/02 have Power & Status LEDs, which indicate the instrument is powered up and/or transmitting/receiving data.

b. The MET station must be set to transmit pressure data in units of “bar” (UN=3).

The MET stations only respond to a GPS receiver P9 command when the pressure unit is set to “bar”. Broadband MET3 and MET3A Meteorological Measurement Systems' pressure units are set to “bar” at the factory before shipment. This corresponds to UN parameter (set to) “3” in the configuration. If your instrument is set to a different pressure unit, you can use the Digiquartz® Interactive (DQI) software (provided with the MET station) to change the pressure unit as illustrated in Figure 1. To download the most recent version of the DQI software, please visit [our web site](#).

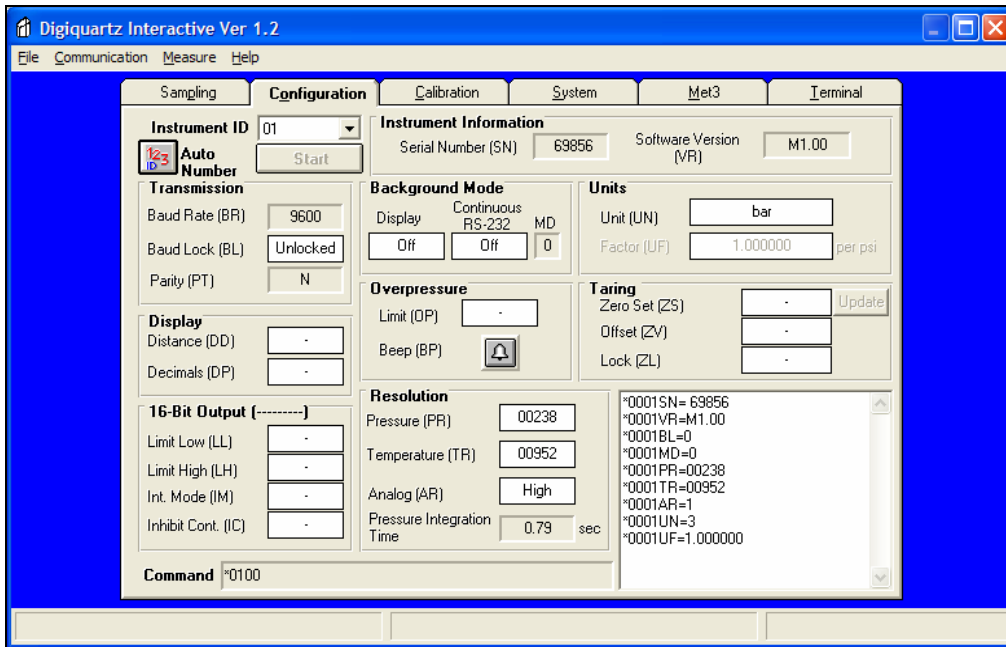


Figure 1. MET Station pressure unit must be set to UN=3 (bar)

c. Correct cable type between the GPS receiver and MET station must be used.

Paroscientific provides GPS-to-MET interface cables. This cable connects the MET station directly to the GPS, or to another GPS interface cable provided by the GPS receiver manufacturer. If you are using a custom made cable or lack the right GPS cable to interface with the MET cable, you may experience communication problems. If you are using a custom-made MET cable, please check the [MET3/3A Installation, Operation, and Maintenance Guide](#) for proper pin connection information.

Important Note: Leica GRX1200 Series GPS receivers come with a LIMO 8-pin cable (Part Number: 733280). Since both this cable and the MET station cable were designed to connect to host devices, you will need a null modem cable between these two cables.

d. The GPS receiver must be configured to send a P9 command to the MET station.

Once the GPS receiver and MET station are connected and powered up, the MET station is ready to respond to a P9 command issued from the GPS receiver. The GPS receiver must be configured to send a P9 command to the MET station. The MET station returns the pressure, temperature and humidity in standard NMEA¹ format.

Please refer to section 4 of this document to configure your receiver to issue a P9 command every time position data is acquired. The P9 command must be in the following format.

***0100P9 <cr><lf>**

In this format, the first two digits correspond to the address of the MET Station. This address has to be "01". If this address is set to any other value, the MET station will not communicate with the Leica

¹ The NMEA 0183 (National Marine Electronics Association) Standard for Interfacing Marine Electronics Devices is a voluntary industry standard, first released in March of 1983. The NMEA has become a standard protocol for interfacing navigational devices such as GPS and DGPS receivers. It defines electrical signal requirements, data transmission protocol, timing and specific sentence formats.

receiver. Please use DQI and make sure that the MET station address is set to “01”. By default, MET station address is set to “01” at the factory before it is shipped.

The MET station P9 command only works with a single device. It will not work in an RS-232 loop.

A typical response to a P9 command is as below.

```
$WIXDR,P,<Pres Value>,B,<SN>,C,<Temp value>,C,<SN>,H,<Hum value>,P,<SN><CR><LF>
```

└─── Pressure ───┬─── Temperature ───┬─── Humidity ───┘

Transducer	Field	Units
Pressure	P	B=Bar
Temperature	C	C=Celsius
Humidity	H	P=Percent

<SN> = Transducer Serial Number (Typically - DQ#####)

This response will be parsed out by your GPS receiver and stored in its log file.

Important Note: Leica GRX1200 receiver expects “\$PASHS” in the response string as the header. The default header string “\$WIXDR” is modified during the configuration. When the Leica receiver port is configured, the receiver issues a “*0100EW*0100NH=\$PASHS,” command to the MET station. For any reason, if the header string is not modified to “\$PASHS”, the receiver will not communicate with the MET station.

4. Integration Procedure

After the introductory information above, we are now ready to integrate a Leica GPS receiver with a Paroscientific MET station. Please follow these steps:

1. Unpack the MET station and make sure that all the accessories defined in Table 2 are received.
2. Connect the MET station to a PC with the provided data cable. Connect the power adapter and the breakout module to the MET data cable and attach the data cable to the RS-232 port of a PC. Make sure that the power light is “ON” on the MET station as in Figure 2.



Figure 2. MET Station LEDs (Power –ON)

3. Load the Digiquartz Interactive software.
4. Launch DQI and detect the MET station. Make sure that the ID is set to “01”. Go to the “Configuration” page in DQI and click on the “Start” button to read the configurations from the MET station. On this page, make sure that the UN parameter is set to “3”, which is bar.
5. Visit the MET3 menu under the Measure menu in DQI and make sure that you are displaying data from your MET station.

6. Unpack the GPS receiver. Review the contents of your order. You need the receiver, antenna, antenna cable, PC and MET station cable, software dongle, Leica GeoOffice software and power adapter. These contents are listed in Table 1.
7. Connect the Leica receiver and the antenna with supplied antenna cable to the “ANT” (TNC) port on the front panel. Refer to the GPS receiver manual to position your antenna.

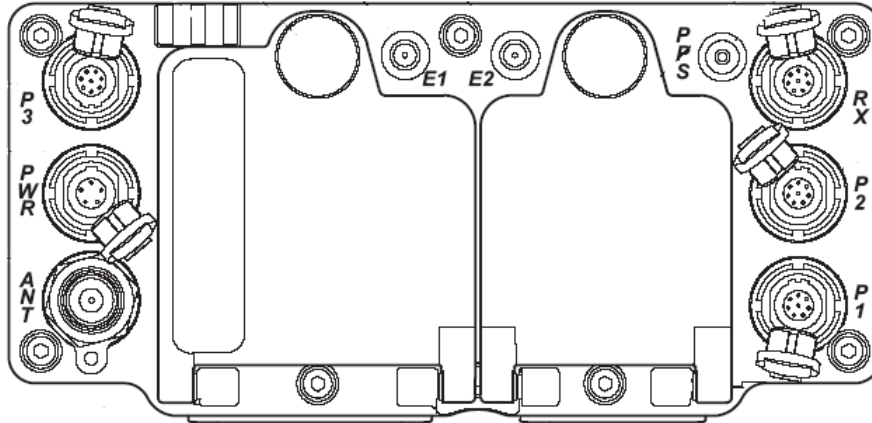


Figure 3. GRX1200 Connection Panel

8. Connect the GPS receiver power cable to the power “PWR” port on the front panel of the receiver.
9. Connect the GPS data interface cable to P1, P2 or P3 ports on the receiver.
10. Disconnect the MET station from the PC and connect the MET data cable to Leica receiver interface cable with a null modem cable.
11. Power up the Leica GPS receiver unit. See the Power LED is green and the MET station power LED is ON. Refer to the GPS manual for details of LED status.
12. After system check up, the menu system in Figure 4 will appear.



Figure 4. GRX1200 Main Menu

13. By using the left/right and up/down arrows, navigate to “**Configuration**” menu option. Press the “**Enter**” key. The same function can be accomplished by pressing the “**5**” key on the terminal.

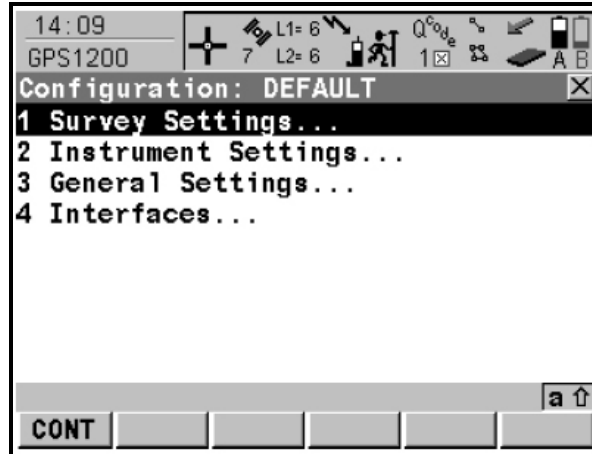


Figure 5. GRX1200 Configuration Menu Options

14. You will be given the menu options in Figure 5. Choose the “**Interfaces...**” option. This option will bring up the following interfaces. Highlight the “**Meteo**” option to interface a MET 3 or MET3A Broadband Meteorological System. Press the “**F3**” (Edit) button to select it.

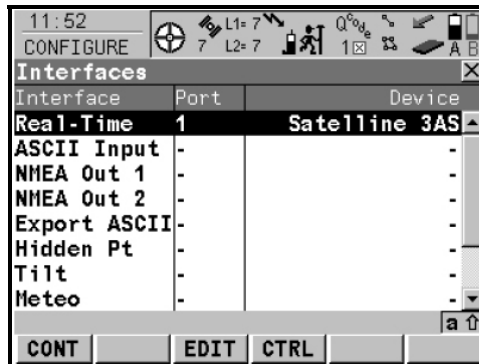


Figure 6. GRX1200 Interface Configuration Menu

15. You will be prompted the “**Use Device**” menu option on the display. Toggle to “**Yes**” option. This will enable the other configuration options on the display. Select Port 1, Port 2 or Port 3 (whichever MET station is connected to.) Press **F5** and select your MET station, either MET3 or MET3A. Once the selection is done, press “**F1**” to continue. At this point, you should see “**Meteo Met3**” or “**Meteo Met3A**” across the device option.
16. Adjust the data rate. This rate controls the time interval at which a P9 command will be sent to the MET station. This rate does not control the logging rate. Logging rate is adjusted at the observation rate of GPS static survey. See GPS manual for setting up observation/recording rate.
17. Set the “**Log to File**” option to “**Yes**”. This will include the MET data along with the static observation data.

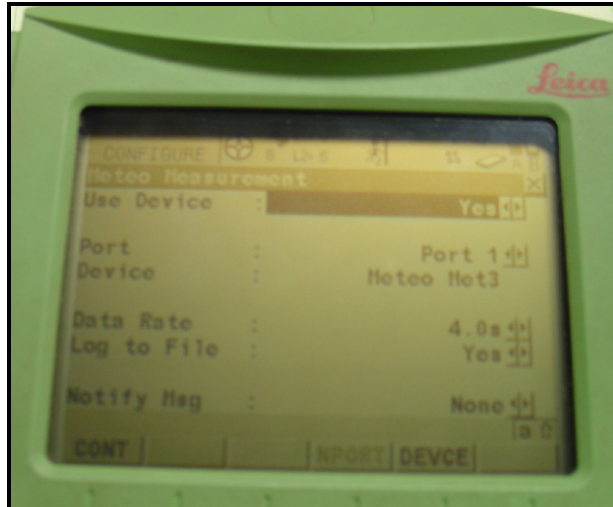


Figure 7. MET Station Configuration Screen

18. Leave “Notify Msg” options as “None”. Press “F1” twice to continue. At this point, watch the MET station TX and RX LEDs. They should be blinking at the interval specified during setup.
19. To make sure that your GPS receiver is receiving data from MET station, press the “USER” button on the terminal. Press the “F3” button to display status. Highlight “Interface” option. Press “Enter” key on the terminal. This will give you a list of interfaces. Select “Meteo” and press the “F3” key (IFACE). This will switch the receiver to a mode in which it displays real-time data from the MET station as in Figure 8.

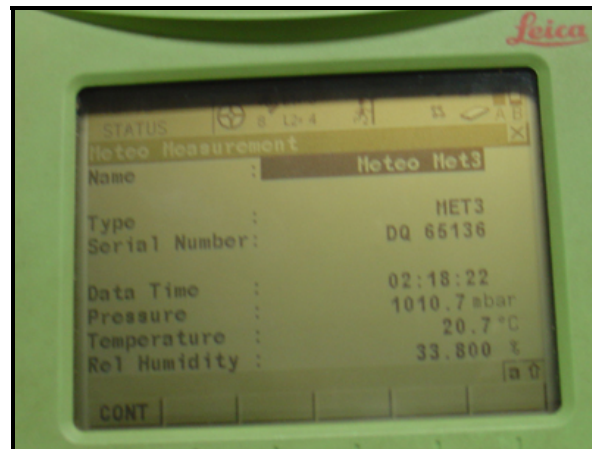


Figure 8. GRX1200 Real-Time Data Display Screen

20. Press “F1” until the main menu is displayed. Now a static survey can be started. As soon as the static survey is started, the meteorological data will be included with the survey data. Refer to the GPS receiver manual to learn about different steps to start a survey.
21. After collecting the survey data, you can download and convert it to RINEX format with Leica GeoOffice Software. This will generate a stand-alone RINEX MET file (along with observation and navigation files) as in Figure 9.
22. The last three columns in the RINEX file are pressure, temperature and humidity values from the MET station.

```
new_0390.05m - Notepad
File Edit Format View Help
2 METEOROLOGICAL DATA G RINEX VERSION / TYPE
LEICA GEO OFFICE 1.1 9-2-5 04:51 PGM / RUN BY / DATE
new MARKER NAME
new MARKER NUMBER
3 PR TD HR DQ 96233 # / TYPES OF OBSERV
DQ 96233 PR SENSOR MOD/TYPE/ACC
DQ 96233 TD SENSOR MOD/TYPE/ACC
-2290146.0831 -3644843.4765 4690817.5914 84.9367 HR SENSOR MOD/TYPE/ACC
PR SENSOR POS XYZ/H
END OF HEADER
5 2 8 22 59 11 1010.2 21.5 29.6
5 2 8 22 59 21 1010.2 21.4 29.5
5 2 8 22 59 31 1010.2 21.4 29.5
5 2 8 22 59 41 1010.2 21.5 29.6
5 2 8 22 59 51 1010.2 21.5 29.5
5 2 8 23 0 1 1010.2 21.5 29.5
5 2 8 23 0 11 1010.2 21.5 29.5
5 2 8 23 0 31 1010.2 21.5 29.5
5 2 8 23 0 41 1010.2 21.5 29.5
5 2 8 23 0 51 1010.2 21.5 29.5
5 2 8 23 1 1 1010.2 21.5 29.5
5 2 8 23 1 11 1010.2 21.5 29.5
5 2 8 23 1 21 1010.2 21.5 29.5
5 2 8 23 1 31 1010.2 21.5 29.5
```

Figure 9. RINEX file containing meteorological data

5. Troubleshooting

Before integrating your GPS and MET station, or in the event of communication loss between a GPS receiver and a MET station, the MET station should be tested separate from the GPS receiver. To perform this test, please follow these steps.

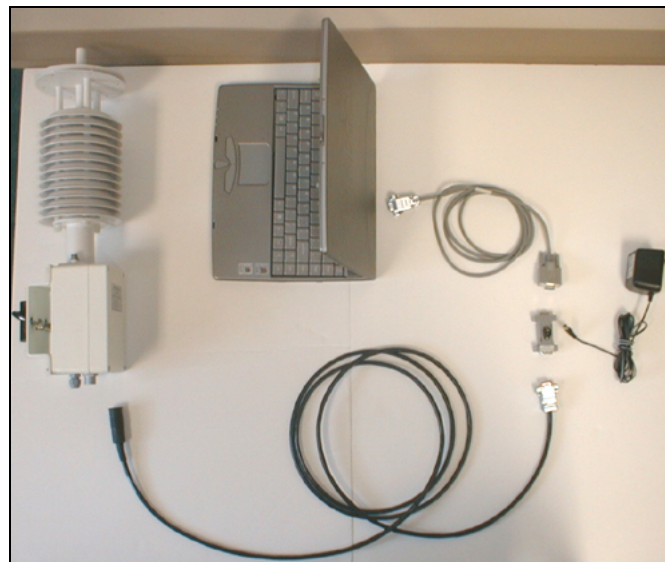


Figure 10. MET to PC Connection

1. Connect the MET station to a laptop computer via the MET station interface cable and the power breakout as in Figure 10. Since PCs are not equipped to power up a MET station, a power breakout must be used. The power breakout must be connected to the PC's serial port and plugged into the MET station RS-232 cable. If your MET station has LEDs, you should see the red power light ON. The power for the MET unit is +7 to 16 VDC.
2. Download our FREE setup and configuration software DigiQuartz® Interactive (DQI) from www.paroscientific.com/software.htm or load it from the DigiQuartz® CD Library that was shipped to you with the purchase of your MET station.
3. Start the DQI program. Select the Communication Port to which the MET station is connected and press "Start". The communication baud rate of the unit has been pre-set to 9600 baud, 8 data bits, and 1 stop bit. DQI will try to communicate with an Intelligent Instrument on the selected Communication Port by using a succession of baud rates. The screen will display a baud rate and instrument identification numbers upon successful communication.

4. If your instrument is powered up (see the LED) and DQI cannot detect your MET station, there is either a problem with the interface cable or the MET station. Please make sure to use the original MET station cable and power breakout (Part Number 1727-00X, X=1 for 110 VAC, X=2 for 220VAC) supplied by Paroscientific. If the problem continues, and you are sure you are not having a cabling problem, please contact us at (425) 883-8700 or at support@paroscientific.com.
5. If DQI detects your instrument, click on the “**OK**” button. You should now see the DQI “Configuration” screen. On this screen, click on the “**Start**” button to read the configuration parameters of MET station. Check the “Pressure Unit (UN)” parameter. Make sure that it is set to bar (factory default). If it is not in bar, click on the pressure unit field and select “**bar**”, then click on the “**OK**” button. Make sure that the pressure unit field is changed to “bar”.
6. On the top menu bar, click on “**Measure**” and select MET3 from the drop-down list. The MET measurement panel will appear on the screen. Each measurement parameter has its own window. Verify that the pressure, temperature, and humidity fields have a reasonable data value. If any field displays “-----” characters, there may be a program or instrument problem. Try increasing the time-out value on this screen to see if it will solve the problem. If it does not, contact our support department. The program Help file also has troubleshooting suggestions.
7. In early 2002, a status indicator panel (LEDs) was added to the MET stations. These status indicators allow you to determine whether input power is applied to the unit and to monitor RS-232 serial activity. The status indicator panel is located on the bottom surface of the unit, adjacent to the electrical connector.

The following table explains the function of the status indicators:

Indicator color	Function
Red	ON: Input power on OFF: Input power off
Green	FLICKERING: Activity on RS-232 receive line OFF: No activity on RS-232 receive line
Yellow	FLICKERING: Activity on RS-232 transmit line OFF: No activity on RS-232 transmit line

Table 3. MET LED Status

8. The RS-232 interface is capable of driving signals over distances of up to 30 meters with good quality shielded cable. It is recommended that you bench test your unit with the installation cable, especially if you are driving the signal a long distance.
9. If your MET station seems to be operating properly and you can not make the GPS receiver communicate with the MET station, this means there is either a problem with the connection between the GPS receiver and MET station or a configuration problem with the GPS receiver.
10. Please make sure that when the GPS receiver cable is connected to the RS-232 cable of the MET station with a **null modem cable**, the Power LED on the MET station must be “ON”.
11. If you still can’t log data, make sure that the GPS receiver is sending a P9 command and the MET station NEMA header is modified to “\$PASHS”. This can be done by connecting the GPS receiver to a terminal program such as Hyperterminal.
12. If you still can’t log data from the GPS receiver and MET station has passed the stand-alone communication test explained in steps 1-6 of this section, please contact your local GPS technical support agent.
13. If you are still having problems with the MET station, please contact Paroscientific’s Application Support Engineers either at (425) 883-8700 or send a description of your problem including the serial number of your instrument via e-mail to support@paroscientific.com.