Paroscientific, Inc.   **Technical Note**

TITLE: Integrating Digiquartz® MET4 and MET4A   Doc. No. G8077 Rev. NC 06 Nov. 2007
Broadband Meteorological Systems with a GPS Receiver

Integrating Digiquartz® MET4 and MET4A
Broadband Meteorological Systems
with a GPS Receiver

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"The standard by which other standards are measured"

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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 considerations. The high performance of Digiquartz® Instruments is a result of innovative design, meticulous manufacturing, and extensive calibration and testing.

Paroscientific's MET4 and MET4A Broadband Meteorological Measurement Systems were 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. 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® MET4 and MET4A 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 MET4 and MET4A 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 500 to 1100 hPa. Temperature resolution is 0.01 degree C. The fan-aspirated MET4A has a total temperature accuracy of 0.2 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 MET4A after 100% RH saturation is less than 20 seconds.

These fully integrated systems are housed in environmental enclosures designed for indoor or outdoor mounting. Installation hardware and software are included and optional interface cabling and power adapter kit is available for easy system integration. The MET4 solar radiation shield protects the temperature and humidity sensors from precipitation and solar radiation. The MET4A features a multi-chamber fan-aspirated solar radiation shield for superior immunity to temperature measurement errors caused by solar radiation. The MET4 and MET4A utilize a high performance pressure port (DigiPort) to reduce dynamic pressure errors caused by wind.

Microprocessor-based electronics provide fully temperature compensated and linearized outputs via bi-directional RS-232 and RS-485 interfaces. 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.

The purpose of this document is to provide generic information in addition to the MET4 and MET4A User's Manual to facilitate the integration of a MET station with any compatible GPS receiver. Once the MET stations are set up properly in the field, these instruments are designed to operate reliably for years under rugged environmental conditions. 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 technical guidance to diagnose communication problems between a MET station and a GPS receiver.

Operating Principle of the MET4/4A Meteorological Measurement Systems

MET4/4A Meteorological Measurement Systems include the world's most accurate, stable, and reliable **Digiquartz® Barometers**, packaged with a precision temperature and humidity probe. Integral electronics and packaging make installation and communication with these instruments simple.

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

1. **The MET instrument must be powered up.**

MET stations can be powered via pin 9 of the RS232 connector on the GPS in conjunction with the Paroscientific Cable and Power Adapter Kit for the MET4/4A (P/N 2367-0XX). In this case the DC power supply in the kit is not required. If your GPS receiver is not capable of providing a voltage output of 7 to 16 VDC (35 mA typical) for the MET4 or 11 to 16 VDC (225 mA typical) for the MET4A power must be supplied using the Paroscientific Cable and Power Adapter Kit, including the DC power supply.

2. **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 when the pressure unit is set to "bar". MET4 and MET4A pressure units are set to "bar" at the factory. 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 explained in the User's Manual. To download the most recent version of the DQI software, please visit www.paroscientific.com/software.htm

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

Paroscientific provides (optionally available) GPS to MET interface cables. This cable connects the MET station directly to the GPS Receiver, or to another GPS interface cable provided by the GPS receiver manufacturer. If you are using a custom-made MET cable and are experiencing communication problems, please check the MET4/4A User's Manual for pin assignments.

4. **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 when the P9 command is received. The MET station returns the pressure, temperature and humidity in standard NMEA[1] format.

Please refer to the operating manual of your GPS receiver to configure your receiver to issue a P9 command every time position data is acquired. The P9 command must be in the following format.

*(Two-digit address of the MET Station)00P9 <Cr><Lf>

In this format, (Two-digit address of the MET Station) corresponds to the address of your MET station. By default, it is "01". If you did not change the address of the MET station, *0100P9<Cr><Lf> command should be issued by the GPS receiver to get a response from the MET station. If you changed this address, please use the correct address in the format above. The <Cr> and <Lf> correspond to carriage return (ASCII 13) and line feed (ASCII 11).

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

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[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.

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A typical response to a P9 command is as follows:

$WIXDR,P,<Pres Value>,B,<SN>,C,<Temp value>,C,<SN>,H,<RH value>,P,<SN><Cr><Lf>

            Pressure   Temperature   Humidity

P=Pressure
Pres Value=Pressure Value
B=Bar
C=Temperature
Temp Value=Temperature value
C=Celcius
H=Humidity
RH Value=Humidity Value
P=Percent

<SN> = Transducer Serial Number (Typically – XXXXXX)

This response must be parsed out by your GPS receiver and stored in RINEX format in your GPS receiver.

Quick Set-Up & Troubleshooting

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

1. Download and install our free setup and configuration software Digiquartz® Interactive (DQI) 2.0 version 1.2.0 or later from www.paroscientific.com/software.htm or install it from the Digiquartz® CD Library that was shipped to you with the purchase of your MET station.
2. Connect the MET4 serial cable to the MET4 or MET4A. Connect the serial cable to an RS-232 port of a Windows PC. Note: The Paroscientific Cable and Power Adapter Kit will (P/N 2367-0XX) enable you to quickly and easily connect a Windows PC to the MET4/4A.
3. Since PCs are not equipped to power a MET station, the DC power supply contained in the Cable and Power Adapter Kit must be used. See the User's Manual for further instructions.   The MET stations are equipped with an LED indicator panel that allows you to determine whether input power has been applied to the unit and to monitor RS-232 or RS-485 serial activity. The LED is located on the bottom surface of the unit, opposite the electrical connector. After power is applied, the RED power light on the LED indicator panel should be ON. Check your applied voltage and wiring if the RED power light does not illuminate.
4. Start the DQI program. Select Configuration and Monitoring and click Next. Set the Search Type to RS-232/USB. If the RS-232 COM port number is known, set COM Port to that value; if the COM port number is unknown, set COM Port to All. Set Baud Rate to All. Click Begin Search. DQI will attempt to detect the MET4/MET4A, and if successful, will display its serial number and communications parameters. Click Next to proceed. Select the Numerical Display tab. Click Start to begin acquiring and displaying barometric pressure, temperature, and humidity measurements.
5. If DQI fails to detect the MET4/MET4A, check for correct power and wiring. RS-232 communications can be monitored using the LED indicator panel. When the PC sends data to the MET4/MET4A, the RS232 RX indicator should flicker. When the MET4/4A sends data to the PC, the RS-232 TX indicator should flicker.
6. If the above communication fails you should contact a Paroscientific Sales and Applications Engineer for further troubleshooting advice. support@paroscientific.com

The following table explains the function of the LED indicator panel::

Indicator color	Function
PWR (Red)	ON: Input power on OFF: Input power off
RX (Green)	FLICKERING: Activity on RS-232 (or RS-485) receive line OFF: No activity on RS-232 (or RS-485) receive line
TX (Yellow)	FLICKERING: Activity on RS-232 (or RS-485) transmit line OFF: No activity on RS-232 (or RS-485) transmit line

The RS-232/RS-485 interface is capable of driving signals over long distances with good quality shielded cable. See http://www.paroscientific.com/manuals/G8776.pdf for further details. It is recommended that you bench test your unit with the installation cable, especially if you are driving the signal a long distance.

Technical Support

After performing your bench top test, if you are still having problems, 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.