iMet-XQ User Guide and Manual with Application Notes

252004 Version 06

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1 Introduction to the iMet-XQ

This document outlines sensor specifications, how to use the iMet-XQ, and communication and specification properties compatible with the iMet-XQ.

1.1 Overview

an overview of the general operating principles of the iMet-XQ.

Table 1: iMet-XQ System Overview

General	
Power	Rechargeable Battery
Battery Life / Charging Time	Approx. 120 / 70-80 minutes
Data Storage	16 Mb Flash Memory (Up to 18 hrs)
Data Transfer	USB
Sampling Rate	1 Hz
Size/Weight	10 x 3 cm / 15 g
Operating Conditions	
Pressure	1200 to 10 hPa
Temperature	-40 to 50 C
Humidity	0 to 100 % non-condensing

1.2 Sensor Details and Specifications

Table 2 is a list of the sensors used on the iMet-XQ.

Table 2: Sensor Information

Sensor	Type	Manufacturer	Model
Pressure	Digital piezoelectric	Measurement Specialties	MS5607
Temperature	NTC Thermistor	Shibaura	PB5-41E
Humidity	Digital capacitive	Measurement Specialties	HTU21D
GPS	UBlox M8 Engine	UBlox	CAM-M8Q

Table 3 define the specifications for each sensor on the iMet-XQ and Table 4 provide details on the GPS receiver.

Table 3: Sensor Specifications

Sensor	Range / Resolution	Response Time	Accuracy
Pressure	1200 to 10 hPa / 0.02 hPa	< 1 second	± 1.5 hPa
Temperature	-95 to 50 C / 0.01	< 1 second @ 5 m/s	± 0.3 C
Humidity	0 to 100 % / 0.7%	5 seconds @ 25 C (typical)	± 5% @ 20 C

Table 4: GPS Specifications

Range / Resolution	Horizontal Accuracy	Vertical Accuracy	Update Rate
40 km/0.01 m	10 m	20 m	1 second

Note: GPS and sensor performance will vary depending on sensor orientation. Chapter 2 will explain the ideal setup for the sensor. All Accuracies are listed at a 95% confidence interval.

2 Using Your XQ

Refer to Quick start guide 200806 for quick setup instructions.

2.1 Handling instructions

The iMet-XQ comes with a cap (red) mounted over the sensor. This cap should be removed from the XQ before operating to ensure the best quality PTU (pressure, temperature, relative humidity) measurements. Please do not touch the sensors as they are fragile and not easily repaired. Figure 1 shows the XQ and its sensors. The angles above the InterMet sticker represent the ideal orientation for GPS reception in either an upright or flat orientation (Figure 2).

Note that GPS reception can sometimes be marginal due to the small size of the receiver backplane. GPS will work best if the antenna has a clear, unobstructed view of the sky. There will be no GPS reception indoors.

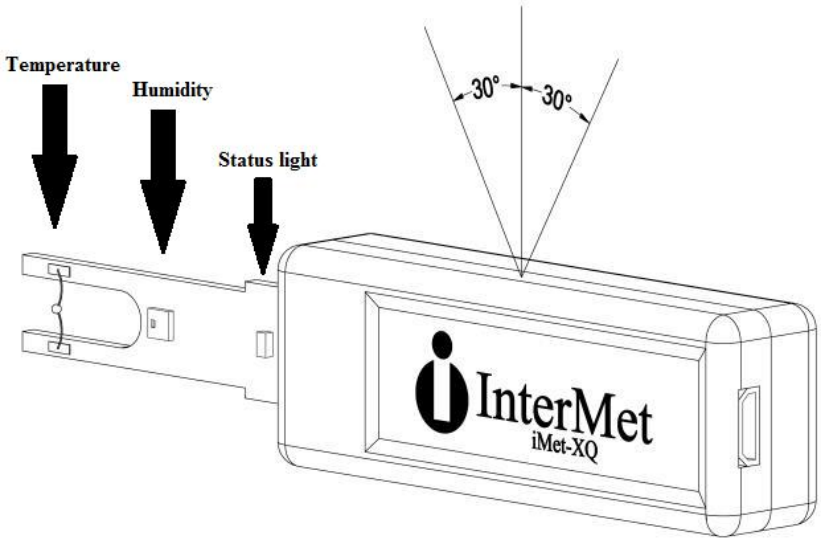

Figure 1: iMet-XQ sensors

Figure 2: iMet-XQ to scale

2.2 Powering Up the XQ and Viewing Data

Before turning on your XQ, make sure that it is fully charged. Plug a micro-USB port into the XQ and charge it from a computer or wall plug. Charge time is approximately 75 minutes for a fully de-charged battery. You will notice two status lights when the XQ is plugged in, a blue and yellow light. Refer to Table 5 for the meaning of the status lights.

Table 5: LED Indicators

	Off	Blinking (1 time/ second)	Solid	Blinking Fast (4 times/ second)
Blue LED	Off	On - no GPS solution	GPS acquired and logging data	Memory is full. Data not logging.
Yellow LED	Not charging or Fully Charged		Charging	

While the XQ is charging, data may be viewed and stored using the iMet-X control software. Device drivers must be installed for the software to work with your XQ. Download the device drivers from http://www.ftdichip.com/Drivers/VCP.htm and install them on your Windows operating system. iMet-X software can be downloaded at http://www.intermetsystems.com under Customer Resources > Software > iMet-X User Software (user account required). With the XQ is plugged into the computer, open the iMet-X software, and select a COM port for connecting to the XQ (Figure 3). After several seconds, the Communications box at the bottom of the software should display incoming data.

Note that you will need to register for an account so gain access to the Customer Resources tab at www.intermetsystems.com. Registration requires authorization from InterMet so please allow enough time for your account to be approved.

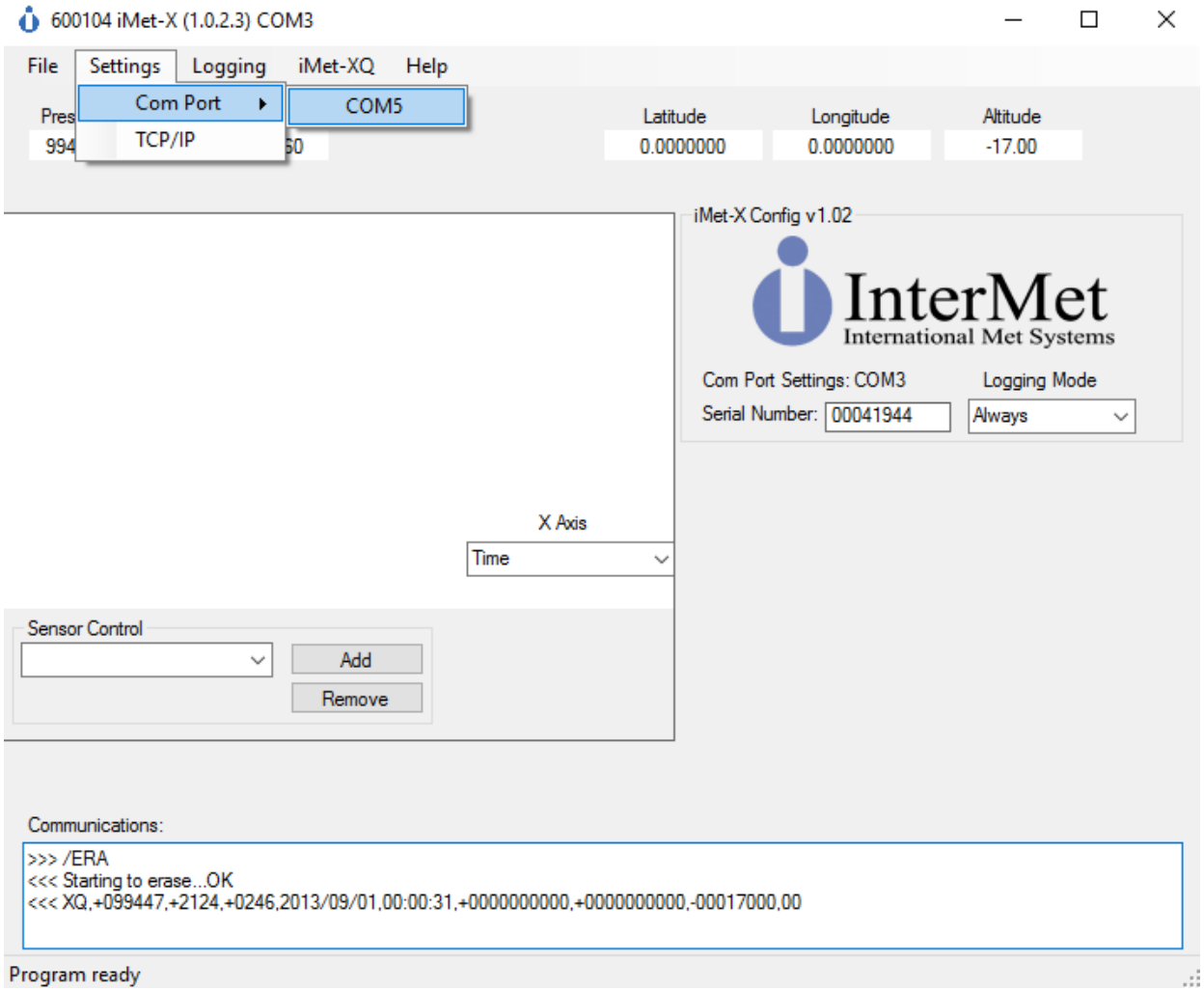

Figure 3: COM Port Selection

The "Sensor Control" box above the "Communications" box may be used to add plots of the real-time data. Add sensors to the plot as desired.

2.3 Retrieving Stored Data and Logging Mode

Logging may be done in several ways after connection to the XQ is established, but you will also want to configure the XQ for remote operations. With the XQ connected to the computer:

1) Select Logging > Start Logging. Specify the filename and its saved location.
2) Select File > Save Data. Specify the filename and its saved location.

When you receive the XQ, limited data may be stored on the device. To download this data, select iMet-XQ > Save Memory Data and specify the save location. Data may be erased by clicking iMet-XQ > Erase Memory Data. Before erasing data, verify that you have saved the data. It cannot be recovered after this point.

Logging mode can either be set to "Always" or "GPS". The "Always" mode ensures that even if a small amount of GPS data is lost, PTU data will still be logged on the XQ. This mode can be changed on the right-hand side of the iMet-X configuration software (Figure 3) under "Logging Mode".

2.4 Ideal Configuration

Ideal configuration deals with two aspects of the iMet-XQ, its orientation and placement.

The iMet-XQ orientation mainly concerns GPS reception, but it could also affect sensor performance. For maximum GPS performance, a clear-sky view is desirable. This is achieved by orienting the iMet-XQ either with the label-side pointing up or so that the writing is facing upwards. Both Figure 1 and Figure 2 will serve as examples.

Optimal sensor placement is not yet fully understood but there are some rough guidelines that can be followed. This will help to minimize effects of the aircraft and obtain high quality PTU measurements.

1) Maximize distances to dark surfaces
2) Avoid close contact with the battery and internal components of the UAV (which can affect GPS too)
3) Attempt to provide maximum airflow to the sensor (this is different for fixed wings and multi-rotors)

The consensus is not established yet, but ideal orientation on a multi-rotor UAV seems to be underneath the maximum prop-wash of a rotor. An example is pictured in Figure 4 where the sensor would ideally be in the red box. This advice is based on findings at the 2017 NCAR/EOL Community Workshop on UAS for Atmospheric Research. Since each aircraft has its own aerodynamic properties, some trial and error will be required to find the best location.

Note:

Figure 4 orientation may not be ideal for GPS performance due to the rotor and UAV arm obstructing the sky view

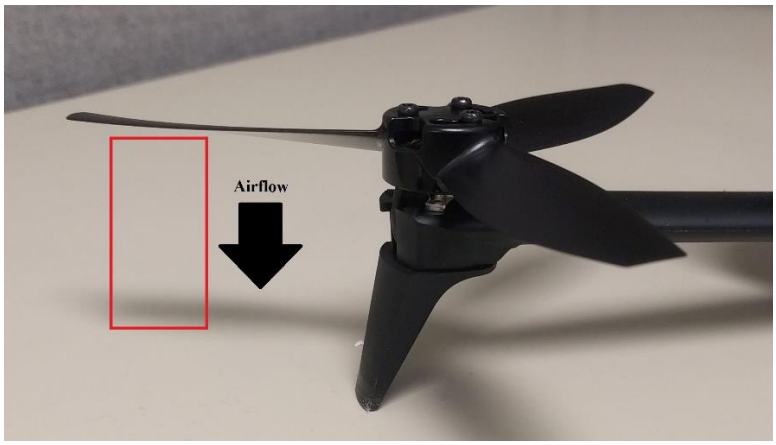

Figure 4: Multi-rotor prop-wash

2.5 Storage and Care

After operations on a UAV (or other use), the iMet-XQ should be protected from harsh environments to maximize the lifetime and performance of the sensors. Replace the red cap to protect the TU sensors and store it inside, away from any precipitation and sunshine.

3 Communication Commands

3.1 General

All communications are conducted via a serial port as desired below with each command ended with a carriage return and line feed.

3.2 Serial Configuration

Baud: 57600

Parity: None

Data Bits: 8 bits

Stop Bits: 1 bit

Hardware Flow Control: None

3.3 Command Details

The commands available to send to the iMet-XQ are shown in Table 6.

Table 6: Commands

Command	Detail	Response
/ERA<CR><LF>	Erase data contained in the internal memory	Ok<CR><LF>
/STA<CR><LF>	Start data streaming from the serial port	Ok<CR><LF>
/STP<CR><LF>	Stop data streaming from the serial port	Ok<CR><LF>
/RDA<CR><LF>	Read all data from the internal memory and stream it out the serial port in ASCII format. See data format in data format section.	Data Stream see data format
/RDB<CR><LF>	Read all data from the internal memory and stream it out in binary format.	Data Stream see data format
/MEM? <CR><LF>	Request the percent of memory being used.	MEM=*(uint)* <CR><LF> Ranging from 0-100.
/FMO=<CR><LF>	Set Flash mode 0 = Save disabled 1 = Save only with valid GPS (default) 2 = Save all data	FMO=(uint)<CR><LF>
/RST<CR><LF>	Reset iMet-XQ.	(System Resets no response)
/SRN? <CR><LF>	Request serial number from iMet-XQ.	SRN=(*NUMBER*) <CR><LF>

/SRN=*(NUMBER)* <CR><LF>	Set iMet-XQ serial number.	SRN=(*NUMBER*) <CR><LF>
/SAV<CR><LF>	Save configuration.	Ok<CR><LF>
/DRR? <CR><LF>	Request iMet-XQ data rate.	DRR=*(uint)* <CR><LF>
/DRR=*(uint)* <CR><LF>	Set sensor delay data rate. 1000 = 1 sec	Ok<CR><LF>
/ST0=*(float)* <CR><LF>	Sets Steinhart coefficient 0. Formatted as a float in scientific notation with leading zeros. (/ST0=+0.0000E-00)	Ok<CR><LF>
/ST1=*(float)* <CR><LF>	Sets Steinhart coefficient 1. Formatted as a float in scientific notation with leading zeros. (/ST1=+1.5430E-04)	Ok<CR><LF>
/ST2=*(float)* <CR><LF>	Sets Steinhart coefficient 2. Formatted as a float in scientific notation with leading zeros. (/ST2=-1.26000E-03)	Ok<CR><LF>
/ST3=*(float)* <CR><LF>	Sets Steinhart coefficient 3. Formatted as a float in scientific notation with leading zeros. (/ST3=4.8500E+01)	Ok<CR><LF>
/CTB=(int) <CR><LF>	Sets the offset for the air temperature sensor * 100	Ok<CR><LF>
/CTB? <CR><LF>	Gets the offset for the air temperature sensor / 100	(int)/100<CR><LF>
/CHB=(int) <CR><LF>	Set the offset for the humidity sensor * 100	Ok<CR><LF>
/CHB? <CR><LF>	Gets the offset for the humidity sensor / 100	(int)/100<CR><LF>
/CNT? <CR><LF>	Returns the packet count in the internal memory	CNT=*(ulong)* <CR><LF>

3.4 Error Messages

If a command is entered in incorrectly then the system will respond with one of the following messages from Table 7.

Table 7: Error Messages

Message	Details
ERR01<CR><LF>	Invalid Command
ERR02<CR><LF>	Wrong Command Type
ERR03<CR><LF>	Invalid Parameter
ERR04<CR><LF>	Flash Error

4 Data Output

The iMet-XQ outputs data via the serial port once a second in the following format:

XQ, Pressure, Temperature, Humidity, Date, Time, Latitude x 1000000, Longitude x 1000000, Altitude x 1000, Sat Count

4.1 Output Example

XQ,+098177,+2494,+0430,2015/06/08,18:06:55,+428939479,-855702219,+00242872,13