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G6-PM-MET1-INT/G6-PM-MET1-INT-SC

GOES Transmitter for use with Met One E-BAM and E-SAMPLER

Operating Manual

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CHAPTER 1 INTRODUCTION

1.1 ABOUT THE MANUAL

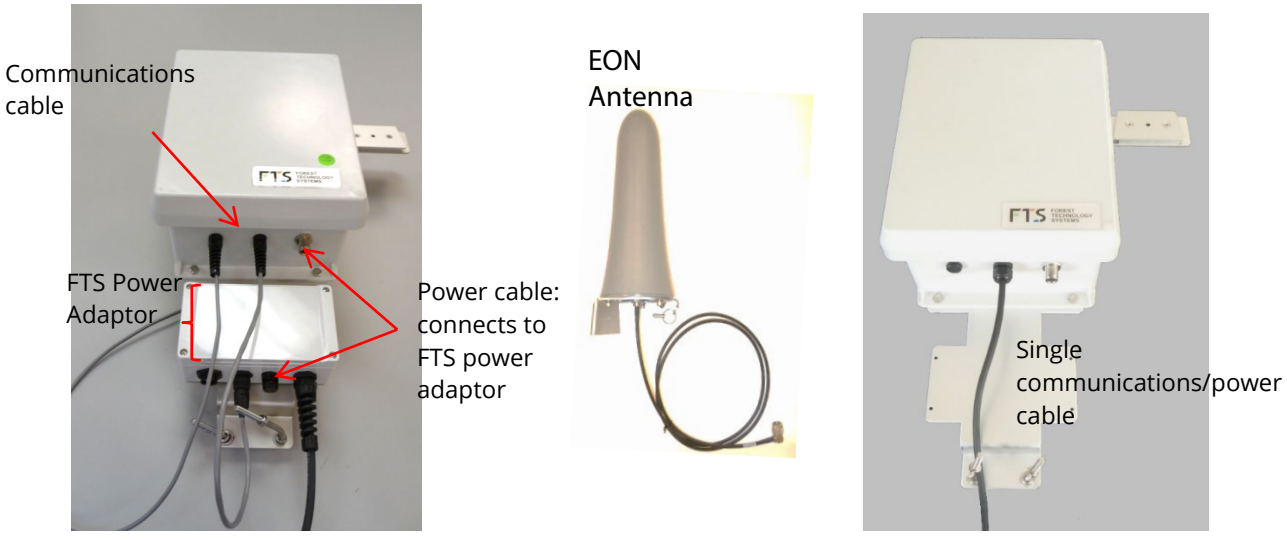
This manual describes the installation and setup of the G6-PM-MET1-INT and G6-PM MET1-INT-SC GOES Transmitters for use with Met One E-BAM and E-SAMPLER particulate monitors. As all functions of the two GOES transmitters are the same, the transmitters will be referred to as the GOES transmitter throughout the document except in those areas where a distinction between models is essential (specifically installation), at which point they will be referred to by the model number.

1.2 GENERAL DESCRIPTION

Forest Technology Systems' GOES transmitter is an add-on GOES transmitter for Met One E-SAMPLER or E-BAM particulate monitors. When deployed, the GOES transmitter assembly will automatically sense which style particulate monitor is connected. The GOES transmitter assembly (Figure 1-1) is housed in a sealed case and attaches onto the same tripod used to hold the Met One particulate monitor. For ease of installation, an omni-directional GOES antenna that eliminates the need to aim the antenna at the satellite is included along with all connectorized cable/cables for power and communication between the GOES transmitter and the particulate monitor. Upon installation, station information and sensor data will automatically be transmitted over the GOES satellite system.

The G6-PM-MET1-INT comes equipped with separate Communication and Power cables and must be used with the FTS power adapter (G6-PM-MET1-INT-PWR). The G6-PM MET1-INT-SC has a combined Communication and Power Cable and does not require the FTS power adapter (See Figure 1-1). They both come with the EON GOES antenna. Installation of the two options is slightly different but all other functions are the same.

The GOES assembly option you need is dictated by the type of E-BAM or E-SAMPLER you have. See Section 1.3 for details.



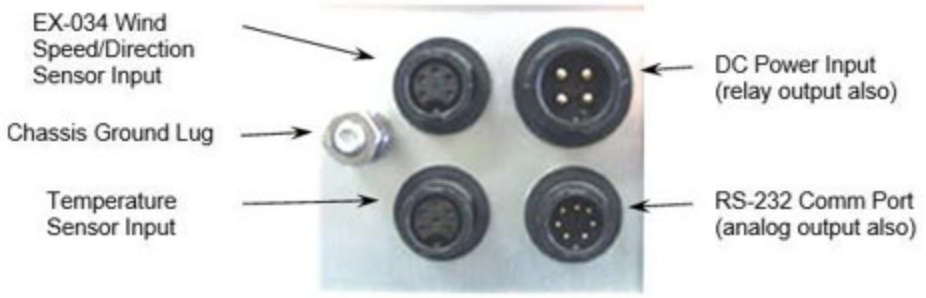
G6-PM-MET1-INT (dual cable) with power adaptor

G6-PM-MET1-INT-SC (single cable)

Figure 1-1: GOES-PM-MET1 options with EON antenna

1.3 DETERMINING THE GOES TRANSMITTER OPTION FOR YOUR E-BAM/ E-SAMPLER

In order to determine if you need a dual or single cable GOES transmitter for your Met One particulate monitor, inspect the Met One instrument connectors.

E-BAM/E-SAMPLER VARIANTS	GOES TRANSMITTER OPTION
 E-BAM and E-SAMPLER	G6-PM-MET1-INT Must be used with: FTS power adapter (G6-PM-MET1-INT-PWR)
 E-BAM  E-SAMPLER	G6-PM-MET1-INT-SC

Note that the E-BAM pictured below cannot support a GOES transmitter.

CHAPTER 2 GOES TRANSMITTER ASSEMBLY

The GOES transmitter assembly has several components. The function of each component is as follows.

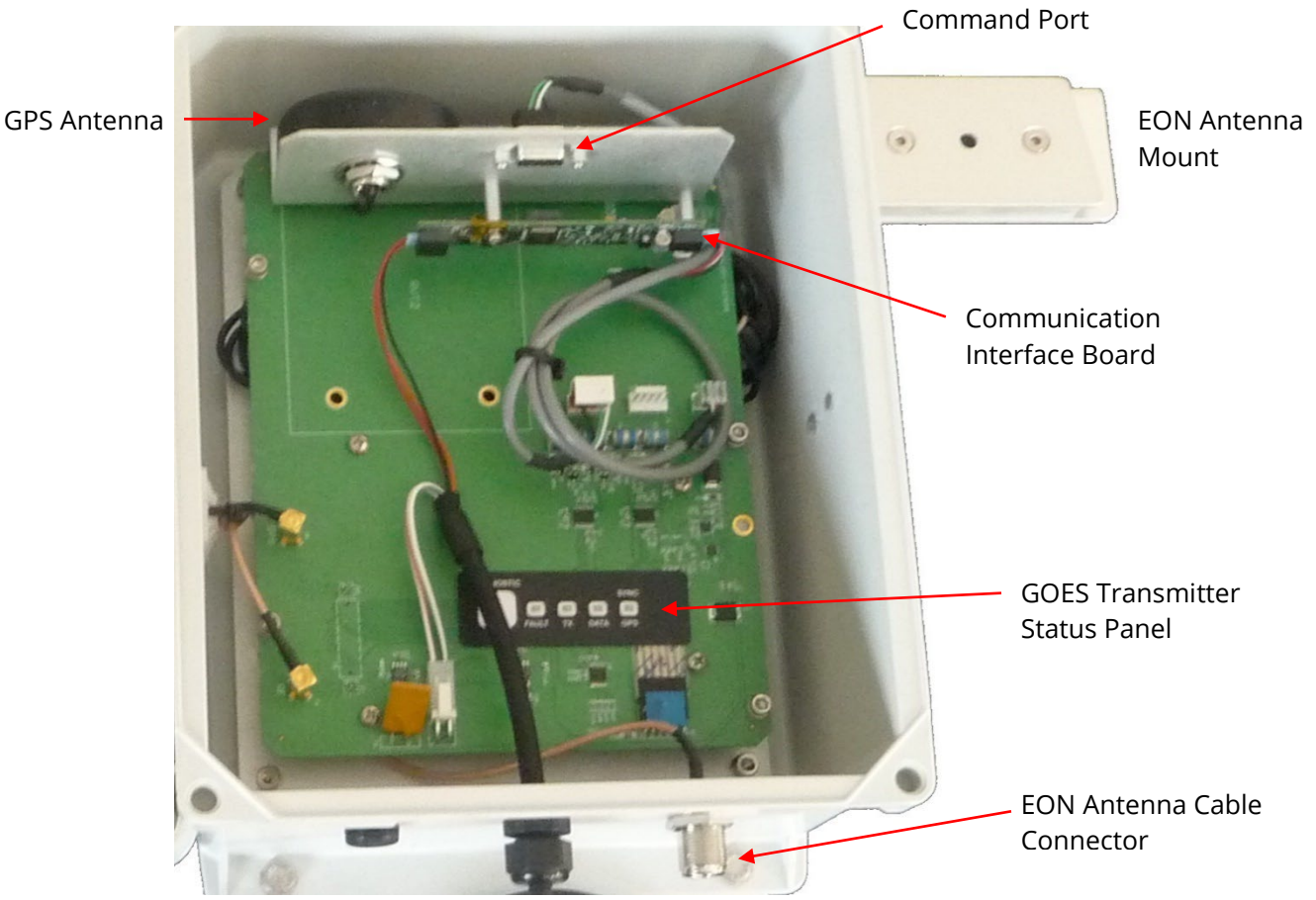


Figure 2-1: Interior assembly components

NOTE: This figure shows the G6-PM-MET1-INT-SC. The interior components for the G6-PM-MET1-INT will be the same with additional wiring for the power cable on the left-hand side.

2.2 GOES TRANSMITTER

The GOES transmitter is the main component in the assembly. The GOES transmitter is responsible for initiating communications to the attached particulate monitor as well as performing the GOES transmissions. The GOES transmitter is manufactured by FTS and is field proven and highly reliable

2.3 GPS ANTENNA

The GPS Antenna signal is used by the GOES transmitter as a timing calibration standard in order to meet the time and frequency tolerance requirements of the GOES system. The GPS antenna is housed inside the enclosure to protect the antenna from the elements.

2.4 EON GOES ANTENNA

The EON GOES Antenna is an omni-directional antenna used to transmit the signal from the transmitter to the GOES satellite. The omni-directional characteristic of the antenna eliminates the need for the user to orient the station in a specific direction or to aim the antenna at the satellite at latitudes less than 53 degrees.

2.5 COMMAND PORT

The Command Port is a 9-pin (DB9) connector. This port uses RS-232 serial protocol and features a command line, text-based interface to configure the transmitter. The Command Port can also be used to check communications with the particulate monitor and to provide operational details on the GOES transmitter. The RS-232 port settings required are:

- 9600 baud
- 8 data bits
- no parity
- 1 stop bit
- no flow control

Typically, Tera Term or another terminal emulation-style program running on a PC is used to communicate with the transmitter. Communication with the GOES transmitter is normally achieved through a USB serial port adaptor connected to the transmitter assembly's Command Port. Through the PC's Control Panel, select Device Manager, and then Ports. The USB serial port adaptor will use the COM port. Note the COM port number. When setting up the Tera Term (or similar program), select Serial and the appropriate Communications Port.

Figure 2-2: Command port serial cable connection

2.6 STATUS PANEL

The Status Panel on the GOES transmitter consists of four indicators and a pushbutton. The indicators provide visual feedback on the operation of the transmitter, and the pushbutton enables the user to query the state of the transmitter failsafe circuit. Also, when power is first applied to the GOES transmitter, the transmitter will go through a sequence of self-tests indicated by cycling four times through the FAULT, TX, DATA, and SYNC GPS indicators.

2.6.4 Synchronize Clock to GPS Indicator (SYNC GPS)

After power is first applied to the GOES transmitter and the self-test cycle is completed, the transmitter will attempt to acquire a GPS fix.

If all connections are correct, the SYNC GPS indicator will illuminate indicating that the transmitter is acquiring a GPS fix and is trying to synchronize its clock to UTC time. The indicator will turn off when time

synchronization is complete. Once the transmitter time is synchronized, it will be able to transmit on the specified time schedule.

If the GPs antenna is not connected the synchronization light will illuminate for two seconds and then turn off for a minute and a half. Check your antenna connections. It will continue this cycle until it detects a GPS antenna.

> IMPORTANT! Ensure you take at least two minutes to observe the Synchronize Clock to GPS indicator once it turns off, to verify that it has synchronized. If the light remains off, synchronization has been achieved. If it blinks and then turns off again, it does not detect an antenna and you must check your connections and equipment.
>
> Note that the first GPS fix after power up will normally be acquired within five minutes; however, UTC time synchronization can take as long as 20 minutes. If the transmitter cannot synchronize to UTC time during the first 20 minutes, the transmitter will switch off the GPS module for one minute and then will restart the synchronization cycle. This process continues until the transmitter successfully synchronizes to UTC time.

After initial time synchronization, the transmitter will attempt a single resynchronization to UTC time every 24 hours to correct its time drift. The transmitter is capable of operating for 28 days without a time resynchronization. After 28 days, if a time resynchronization is not achieved, the transmitter will disable transmissions. However, it will continue to attempt time resynchronization and, if successful, will re-enable transmissions.

The most common reason for time resynchronization failure is because the GPS antenna is being blocked by snow. If transmissions do not recommence with expected snow melt, or snow blockage is an unlikely reason, contact FTS Support.

2.6.5 DATA indicator

The DATA indicator shows that the transmitter has acquired data from the particulate monitor and has stored that data in the transmitter's data buffer. The DATA indicator should be illuminated from approximately 2 minutes past the sensor interval (when the particulate monitor is read) until one minute prior to transmission time (when the transmitter empties and formats the buffer contents in preparation for transmission). The light will remain illuminated if the sensor is read within the time frame prior to transmission. Any data received within 1 minute of data transmission or during a timed transmission, will not be included in the current transmission but will be buffered for the next interval.

2.6.6 TRANSMIT (TX) Indicator

The TX indicator will illuminate at transmission time for the duration of the data transmission (about three seconds in total); however, if there is a failsafe error the FAULT indicator will blink twice to show that failsafe has been tripped and the transmitter has been switched off.

2.6.7 FAULT Indicator

The FAULT indicator is used in conjunction with the DIAGNOSTIC button to examine the state of the transmitter's failsafe circuit. If there is a failsafe error the FAULT indicator will blink twice when the DIAGNOSTIC button is pressed. Typically, a failsafe error could occur if a transmission is attempted when the supply battery voltage falls below 10.5 volts.

2.6.8 DIAGNOSTIC button

The Diagnostic button allows the user to query the state of the transmitter failsafe circuit and also allows the user to clear the transmitter failsafe circuit if the failsafe has been tripped. To query the state of the failsafe, push and hold the Diagnostic button for about 2 seconds and monitor the state of the Fault indicator. The Fault indicator will flash once if the failsafe is OK (not tripped) or twice to indicate the failsafe has been tripped.
A tripped failsafe indicates that there is a problem with the GOES transmitter. The failsafe is designed to disable a malfunctioning transmitter in order to protect other users of the satellite system from a transmitter that is transmitting outside its assigned transmission window. If the failsafe has tripped it can be cleared by depressing the Diagnostic button for at least 10 seconds. If the failsafe continues to trip, the unit should be returned to FTS for repair or replacement.

2.7 SAMPLER COMMUNICATION INTERFACE BOARD

The Sampler Communication Interface Board is an interface between the transmitter and the particulate monitor. When requested by the transmitter, the interface retrieves and formats data from the attached particulate monitor. The interface board automatically parses data from an E-SAMPLER or an E-BAM and returns a common data string to the transmitter.

CHAPTER 3 INSTALLING THE TRANSMITTER ASSEMBLY

This chapter outlines the steps to install the transmitter and configure the particulate monitor.

The G6-PM-MET1-INT is an add-on GOES transmitter which easily connects to either a Met One E-SAMPLER or E-BAM particulate monitor. The transmitter assembly is self-contained: both the transmitter assembly and the EON antenna are pre-mounted on their mounting brackets. The transmitter assembly also easily attaches to either the E-SAMPLER or the E-BAM model particulate monitor.

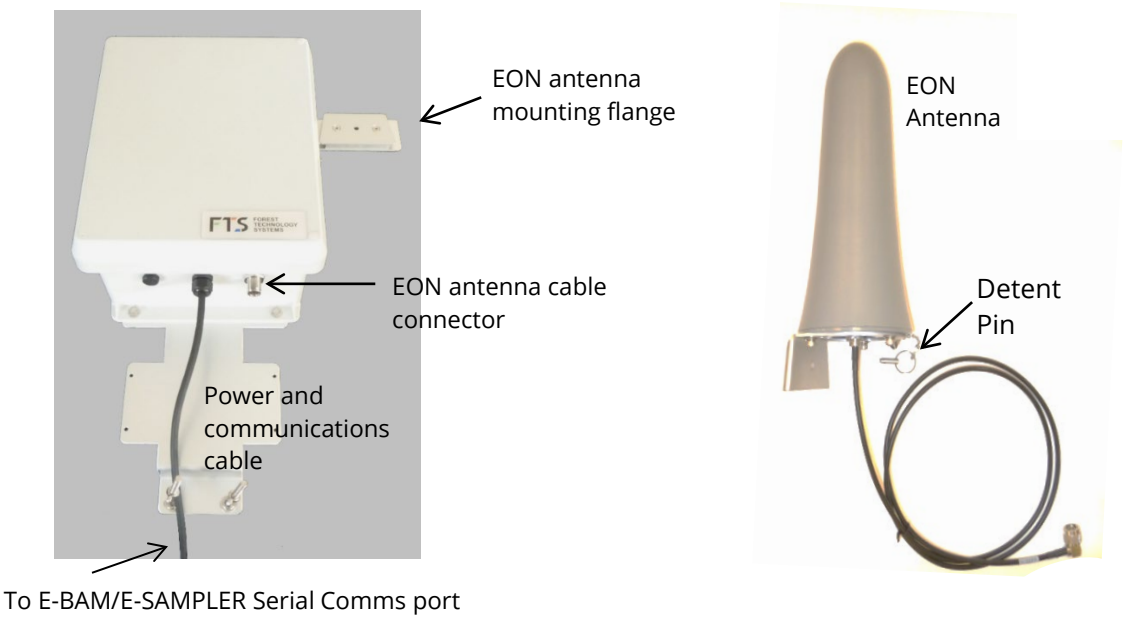


Figure 3-1: Transmitter assembly components (single cable design illustrated)

3.2 STEPS TO SETTING UP THE GOES TRANSMITTER

In order to set up and verify operation of the GOES transmitter assembly, the following steps must be completed. A detailed description of each step can be found in the noted sections.

1) Mount the transmitter assembly – see Section 3.2.1;
2) Connect to the E-BAM/E-SAMPLER:
    a. G6-PM-MET1-INT-SC (single cable) – see Section 3.2.2;
    b. G6-PM-MET1-INT (dual cable) - see Section 3.2.3. ;
3) Configure the particulate monitor for communication with the GOES Transmitter - see Section 3.3;
4) Setup GOES satellite communications and configuration - see Chapter 4;
5) Confirm Transmission Status - see Chapter 5 – Section 5.2;
6) **Optional** - Conduct a test transmission - see Chapter 5 - Section 5.3.

    Note: test transmissions are conducted prior to the unit leaving the factory. For more information on when and how to conduct a test transmission, refer to Appendix C.

3.2.1 Mount the transmitter assembly (single and dual cable options)

The GOES transmitter assembly mounts to the tripod which holds the particulate monitor. First, set-up the particulate monitor as per its instructions with the exception of mounting the cross-arm for external sensors (this is mounted later). Then connect the GOES transmitter assembly and cross-arm (if using) as described in the following steps.

To mount the transmitter assembly:

1) Remove the U-bolt on the bottom of the transmitter assembly
2) If installed on the tripod, remove the cross-arm used to mount the external sensors.
3) Align the cutout in the GOES transmitter's mounting bracket with the cross-arm post and slide assembly down until it comes to a rest on top of the tripod
4) Place the U-bolt around the tripod, through the assembly flange and tighten
5) Reconnect the sensor cross-arm (if originally installed)
6) Slide the EON antenna onto its mounting flange and secure the antenna with the detent pin
7) Connect the EON antenna cable to the antenna cable port on the transmitter assembly

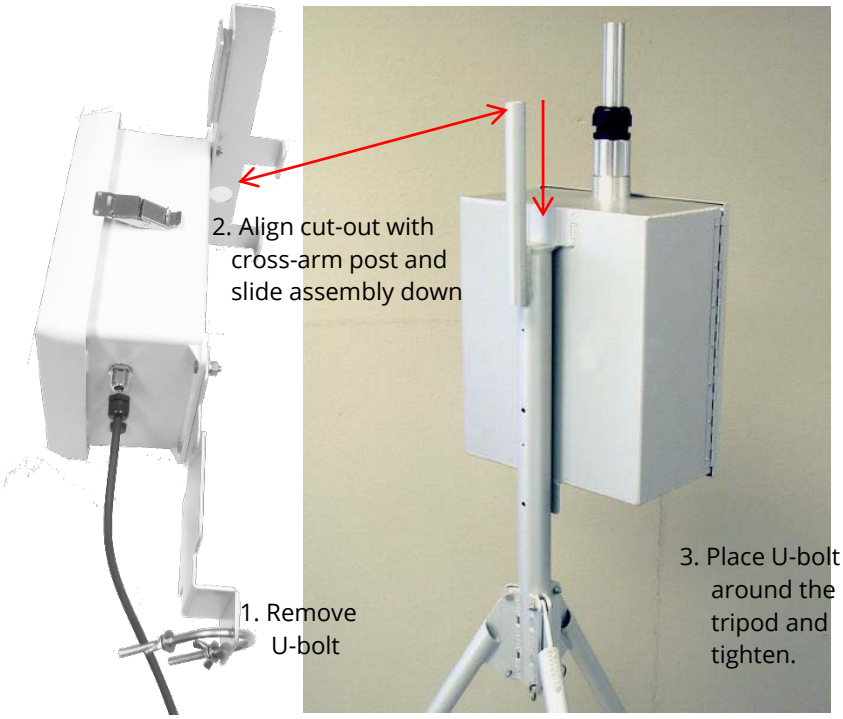


Figure 3-2: GOES Transmitter Assembly Connection

3.2.2 CONNECT G6-PM-MET1-INT-SC (SINGLE CABLE OPTION)

Power for the GOES transmitter assembly is supplied from the particulate monitor. The transmitter assembly automatically starts operating when power is applied.

Connect the transmitter assembly's communication/power cable to the particulate monitor's Serial Comms port located on the underside of the particulate monitor's enclosure (see Figure 3-3).

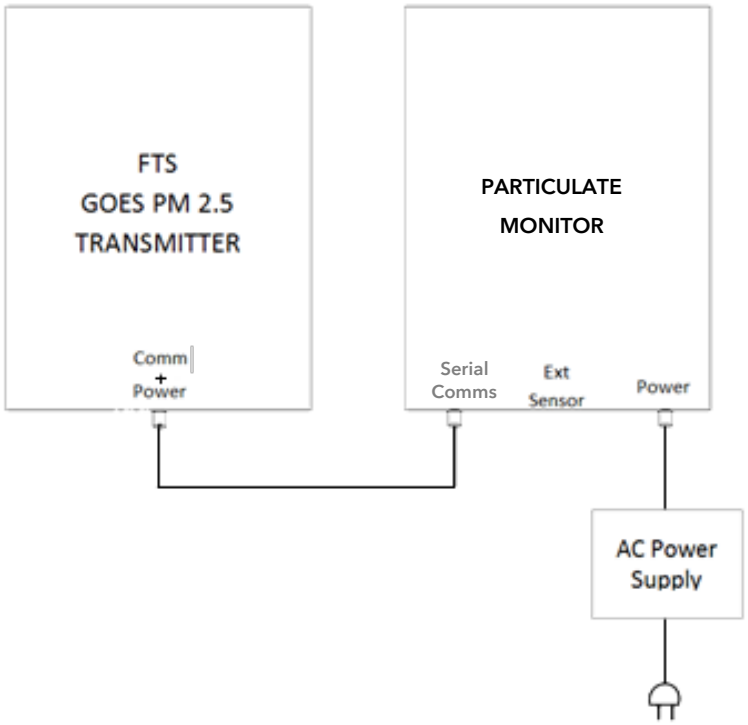


Figure 3-3: Connection from G6-PM-MET1-INT-SC to E-BAM/E-SAMPLER

3.2.3 CONNECT G6-PM-MET1-INT (DUAL CABLE OPTION)

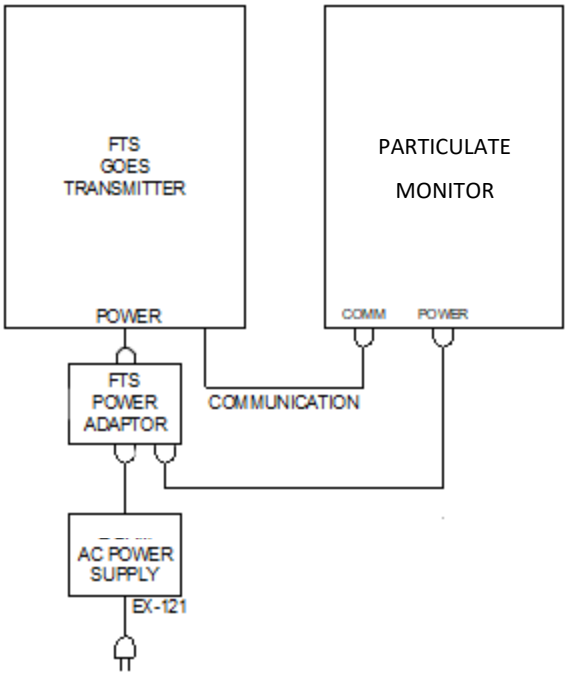
The FTS Power Adaptor is used in-line with the E-BAM/E-SAMPLER's power supply to provide power to the GOES transmitter assembly. Make the connections as shown in Figure 3-5 and described below:

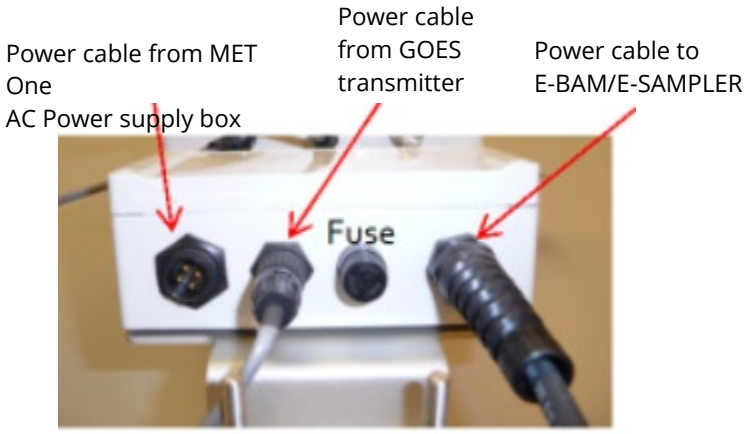
1) Connect the GOES transmitter's communication cable to the Met One's sensor communication port;

2) Connect the GOES transmitter's power cable to the FTS Power adapter as shown in Figure 3-5;

3) Connect the power cable from the FTS Power adapter to the Met1One Power port;

4) Connect the power cable from the Met One sensor AC Power supply box to the FTS Power Adaptor as shown in Figure 3-5





Detail of FTS Power Adaptor connections

Figure 3-4: Connections from G6-PM-MET1-INT to E-BAM/E-SAMPLER (dual cable)

3.3 PARTICULATE MONITOR (PM) CONFIGURATION

In order for consistent data collection and proper system operation with the GOES transmitter, the following settings must be input into the particulate monitor. Refer to the particulate monitor's manual for details.

ITEM	SETTING	PM MODEL	EXPLANATION
Time	UTC	E-SAMPLER E-BAM	Time must be synchronized with the GOES transmitter[1].
Average Period	60 minutes	E-SAMPLER	This is the National Wildfire Coordinating Group (NWCG) standard.
Real Time Average		E-BAM	
Baud Rate	9600	E-SAMPLER	For communication between the transmitter and the PM.
GOES Setting	ON	E-BAM	From menu select: Item: GOES Setting: ON
Engineering Units	Metric	E-SAMPLER	This is the NWCG standard.
Concentration Units	mg/m^3	E-SAMPLER	

Once the particulate monitor is configured proceed to Chapter 4 to configure GOES satellite communications.

[1] If the time on the particulate monitor is not synchronized, the transmitter may be supplied with the previous hour's data

CHAPTER 4 CONFIGURING GOES SATELLITE COMMUNICATIONS

4.2 GENERAL

Normally the GOES transmitter assembly is supplied completely preconfigured and ready for deployment with the exception of the GOES transmit parameters (unless these had been supplied to FTS prior to shipping).

To determine the status of your transmitter, refer to the orange label found inside the transmitter assembly. The Serial number and Date will be filled in at the factory. If the GOES parameters section has been filled in, they were configured by the factory and once the assembly is powered up, no further action is required – your system is ready to start collecting and transmitting data.

If the GOES parameters portion is left blank, you will have to configure the GOES satellite communications with your NOAA assigned parameters following instructions in Sections 4.3 and 4.4.

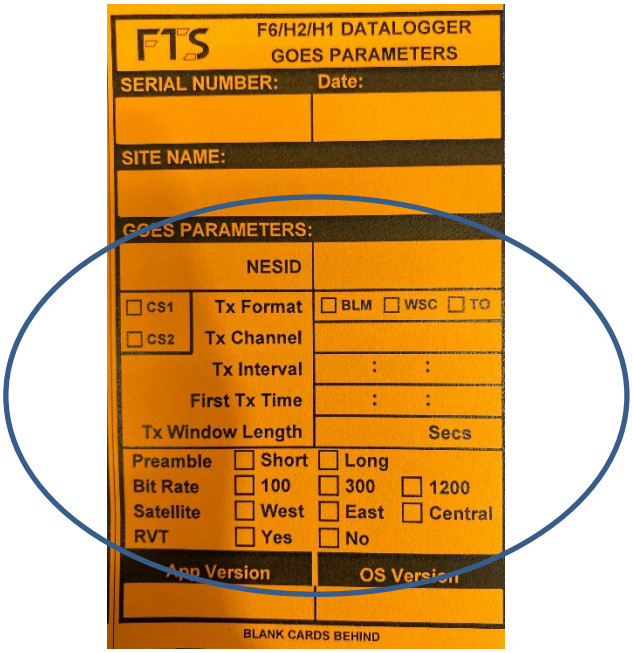


Figure 4-1: GOES Parameters label

Once power is supplied to the GOES transmitter, it will go through a booting up cycle and GPS synchronization (see section 2.5.1). While the GPS synchronization is taking place, the transmitter can be configured to communicate with the GOES satellite system.

4.3 COMMUNICATING WITH THE GOES TRANSMITTER

Communication with the GOES transmitter is enabled by connecting a PC which has a terminal emulation program installed, such as Windows Hyper Terminal or Tera Term, to the transmitter assembly's Command Port. See Figure 2-1.

The GOES transmitter implements an ASCII command line interface protocol. ASCII commands are not case sensitive but commas and some other characters are mandatory so care must be used when inputting the commands to ensure the syntax is correct.

Communication with the transmitter is initiated by the carriage return (CR) command which is generated by striking the Enter (or Return) key. The transmitter responds with a **>** prompt to indicate that it is ready to receive a command. Commands can then be input and terminated by the Enter key (CR).

If no characters are entered for 60 seconds, the transmitter will enter low power mode. Any partially entered commands will be deleted and the communication port will go to sleep. Communication must be re-established by striking the Enter key (CR) until the **>** prompt is returned.

Commands must be terminated with the Enter key (CR). Any character received following an Enter will be ignored. If you have message data with a CR in the line feeds (ie: so data will be printed out in columns rather than a line), then the CR must be preceded with a tilde (~). Backspace (BS) deletes the last character entered. ESC will delete the entire command.

Once all parameters or changes have been input, there are three commands which must be entered prior to exiting

1) >SAVE – this will save the changes to the non-volatile memory
2) >RCFG – read configuration to confirm the input changes are accurate
3)>ETX – enable transmissions to check parameters for validity

If the >ETX command returns BAD PARAMETER instead of OK, an error was made inputting the transmit parameters. Review the configuration and then re-enter the erroneous command with the correct parameter.

4.4 SETTING UP NOAA/EUMETSAT TRANSMIT PARAMETERS

The first step in configuring the GOES is to enter the assigned transmit parameters. Transmit parameters are provided to your agency by the United States National Oceanic and Atmospheric Administration (NOAA) or the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), depending on your area of operations. These parameters allow users to retrieve data from their remote site using the GOES Data Collection System (DCS).

The transmit parameters consist of the following:

NESID[2] : The ADDRESS (an eight-character identifier) for your assignment.
Channel : Your assigned PRIME CHANNEL (TCH)
Bit Rate : Your assigned platform baud rate (TBR)
Interval : Your assigned REPORT RATE (TIN)
First Tx : Your assigned FIRST TRANSMISSION time (FTT)
Window : Your assigned XMT (transmit) WINDOW (TWL)

NOAA/EUMETSAT Assigned Item	Comments/Explanation
NESID	This is the unique ADDRESS (eight character identifier) specific for the GOES Station (for the position, not for the transmitter). Must end in an even number.
NESID Channel	Channel number specified by NESID. Even channels are on the west satellite and odd on the east.
NESID Bit Rate	Baud rate varies between platforms. NOAA will assign you a Baud rate based on the information provided on your NESID request.
Transmission Interval	The transmission interval is how often transmissions are made and is specified in dd:hh:mm:ss format. Valid range is 00:00:05:00 to 30:23:59:59.
First Transmission Time	First time of transmission in hh:mm:ss format and in 24 hour clock. Valid range is 00:00:00 to 23:59:59.
Transmission Window Length	Window sizes can vary. The most common are 10 or 15 second windows.

Table 4-1: Transmit Parameters explanations

The steps required for setting the transmit parameters follow:

1) Connect the PC to the Command Port and then start the terminal emulation program.
2) Start a text file capture so that you have a record of the Command Port session.
3) Ensure the transmitter is powered.
4) Press enter, then wait 2 seconds and then press enter again to wake the transmitter. The transmitter should respond with a > prompt.

NOTE: Examples of the commands are provided. ASCII commands are indicated in bold, example parameters or values are in red. Ensure you input your assigned parameters and do not copy the red examples.

[2] The NOAA uses the term NESID (National Environmental Satellite Identification). The equivalent EUMETSAT term is DCPID (Data Collection Platform Identification) or DCP Address. This document uses NESID.

5) Set the assigned NESID address

>NESID=01234568	: for example, set the NESID to 01234568
OK	: the transmitter responds with the OK message

6) Set the Channel

>TCH=187	: for example, set the channel to 187
OK	: the transmitter responds with the OK message

7) Set the assigned Bit Rate

>TBR=300	: for example, set the bit rate to 300 baud
OK	: the transmitter responds with the OK message

8) Set the assigned Interval

>TIN=00:01:00:00	: for example, set the interval to 1 hour
OK	: the transmitter responds with the OK message

9) Set the assigned First Transmit Time

>FTT=00:17:40	: for example, set the first transmit time to 17 minutes, 40 seconds past midnight
OK	: the transmitter responds with the OK message

10) Set the Window

>TWL=10	: for example, set the window length to 10 seconds
OK	: the transmitter responds with the OK message

11) Issue a Save command to store the parameters in the transmitter's nonvolatile memory.

>SAVE	: save current parameters to non-volatile memory
OK	: the transmitter responds with the OK message

12) Read the transmitter's configuration to confirm the parameters. The following list will be returned. Note that following the transmit parameters, the additional parameters are at factory default settings and are explained in Table 4-2.

>RCFG	: enter the “read the current configuration” command
NESID=01234568	: the transmitter responds with the configuration –
TCH=187	NOTE: the displayed configuration is in accordance with the
TBR=300	example parameters (in red). Yours will return the figures/values
TIN=00:01:00:00	you input in the previous steps
FTT=00:17:40	
TWL=10	
CMSG=Y	
EBM=Y	
TPR=S	
TIL=N	
TDF=A	
RCH=0	
RBR=0	
RIN=0	
RPC=0	
RRC=0	
RDF=A	
RMC=N	
IRC=?	
GIN=00:00:00	
SDIMODE=SDI	
SDF=3	
ESBV=N	
SIN=01:00:00	: Sensor Sample Interval
SOF=00:02:00	: Sensor Sample Offset
SDI 0 empty	SDI Command Table
SDI 1 empty	N/A for use with particulate monitors.
SDI 2 empty	
SDI 3 empty	
SDI 4 empty	
SDI 5 empty	
SDI 6 empty.	
SDI 7 empty	
SDI 8 empty	
SDI 9 empty	

If any of the returned parameters are different than the expected default settings, you must enter the correct configuration. Section 4.4 provides details of the commands.

13) Issue an Enable Transmission command

>ETX	: enable transmissions
OK	: the transmitter responds with the OK message

NOTE: If it returns BAD PARAMETER instead of OK, an error was made inputting the transmit parameters. Review the configuration and then re-enter the erroneous command with the correct parameter.

4.5 DETAILS OF DEFAULT CONFIGURATION PARAMETERS

The default configuration parameters are set at the factory specifically for communication with the particulate monitor and transmission of the data. The default settings should not be changed. The following table provides a brief explanation of the configuration parameters.

Default Setting	Item	Comments
CMSG=Y	Center Message in Window	Option Y (yes) selected. Message will be centered in the transmission window. See Appendix C for details.
EBM=Y	Empty Buffer Message	Option Y (yes) selected. Transmitter will always transmit even if there is no data in the transmit buffer. See Appendix B for details.2.
TPR=S	Transmit Preamble Length	Default Setting. Do not change.
TDF=A	Transmit Data Format	Default setting is A (ASCII).
RCH=0	Random Channel	N/A as the G6-PM-MET1 is not capable of random transmissions (a data logger is needed to perform that function).
RBR=0	Random Baud Rate	
RIN=0	Random Interval	
RPC=0	Random Tx Random Percentage	
RRC=0	Random Tx Repeat Count	
RDF=A	Random Tx Data Format	
RMC=N	Random Tx Message Counter	
IRC=?	ASCII Replacement Character	Prohibited ASCII characters detected in the transmission data will be replaced with a question mark (?) when operating in ASCII or Pseudo-Binary mode.
GIN=00:00:00	GPS Fix Interval	The GPS will fix at power up and every 24 hours. .
SDIMODE=SDI	Transmitter Mode	SDI is the only mode available
SDF=3	SDI Data Format	This format is specific for use with particulate monitors. Do not change.
ESBV=Y	Enable SDI Battery Voltage	Option Y (yes) selected in order to receive a reading of the battery voltage levels in the transmitted data.
SIN=01:00:00	Sensor Sample Interval	Samples taken every hour. In hh:mm:ss format[3].
SOF=00:02:00	Sensor Sample Offset	Samples will be taken 2 minutes after the hour.

CHAPTER 5 VERIFYING COMMUNICATIONS

In order to verify communications, connect a PC to the transmitter assembly's Command Port and then start the terminal emulation program

[3] It is important to understand the difference between SIN and SOF. The SIN is how often samples will be taken, and the SOF is the time at which the samples will be taken within the hourly interval.

5.2 TRANSMISSION CYCLE

Once the equipment is powered and operating, the data transmission cycle is as follows:

1) At the top of the hour, the particulate monitor calculates the concentration average.
2) At two minutes past the top of the hour, the transmitter reads data from the particulate monitor and illuminates the DATA indicator
3) The DATA indicator remains illuminated until one minute prior to data transmission.
4) At transmission time, the transmitter sends the GOES message and illuminates the TX indicator for the duration of the transmission.
5) The cycle repeats.

Note that once a day, the GPS SYNC indicator will illuminate while the transmitter is updating its GPS fix. GPS updates are done on power-up and then every 24 hours afterwards.

5.2.4 Time Synchronization

Time synchronization between the particulate monitor and GOES transmitter is necessary for timely data transmission. The transmitter is always time synchronized to UTC time and will always request the latest data from the particulate monitor at two minutes past the top of the hour. If the particulate monitor's clock was set incorrectly or has drifted so that the particulate monitor's time is more than two minutes ahead of the transmitter time, then the transmitter will end up transmitting the previous hour's particulate data. It is important for the user to ensure the particulate monitor's time is accurately set to UTC time.

5.2.5 First Transmission Requirements

Two events need to take place after the particulate monitor / transmitter assembly is first powered in order for particulate data to be transmitted. First, the particulate monitor must obtain an hourly sample so that there is data to transmit. Second, the transmitter must acquire GPS synchronization so that it is able to transmit.

Depending on when the equipment is powered, the first expected transmission may not occur if GPS synchronization has not been obtained, or if the particulate monitor does not have valid data then the first transmission may occur but the transmission will not contain particulate data

5.3 CONFIRMING TRANSMISSION STATUS

In order to get the status of the transmission and confirm transmission details, enter a ***Get Transmission Status*** command

>RST	:Get transmission status
Transmitter: Enabled	:the transmitter responds with the following information
GPS: On	Note that this is an example and times and values will be
RTC: Valid	different for individual systems
Time To Next Tx: 00:00:46:39	
Timed Message Length: 119 bytes	: if there is no data in the buffer it will be 0 bytes
Next Timed Tx: 2015/03/19 18:00:20	
Random Message Length: 0 bytes	
Random Message Tx Count: 0	
Next Random Tx: N/A	
Failsafe: OK	
Supply voltage: 11.7 V	

This message indicates that all is ready to transmit

5.4 FIELD MESSAGE RETRIEVAL

It is possible to use a computer or smartphone to confirm if the station has transmitted correctly. Visit http://eddn.usgs.gov/fieldtest.html and enter the station's DCP (NESID) address and the number of hours of data you wish to inspect. The retrieved information will include the signal strength of the specific transmissions.

5.5 GOES TRANSMISSION MESSAGE FORMAT

The format of the GOES transmission is the same for E-SAMPLER and E-BAM particulate monitors. Transmissions occur hourly with 16 fields following the GOES header. The fields are:

Field 1.	Latitude	6 decimals	
Field 2.	Longitude	6 decimals	
Field 3.	Particulate Monitor Type 0 = E-BAM $PM_{2.5}$ 1 = E-BAM PM_{10} 9 = E-SAMPLER	Integer	
Field 4.	Particulate Monitor Serial Number	Integer	
Field 5.	Concentration RT in mg/m^3	3 decimals	
Field 6.	Concentration HR in mg $/m^3$	3 decimals	: E-BAM only
Field 7.	Flow rate in liters per minute	1 decimal	
Field 8.	Ambient Temperature in Celsius	1 decimal	

Field 9.	Ambient Humidity in %	Integer	: optional sensor
Field 10.	Barometric Pressure in Pascals	Integer	: E-SAMPLER only
Field 11.	Filter Temperature in Celsius	1 decimal	: E-BAM only
Field 12.	Internal Humidity in %	Integer	
Field 13.	Wind Speed in meters/second	1 decimal	: optional sensor
Field 14.	Wind Direction in degrees	Integer	: optional sensor
Field 15.	Battery voltage in Volts	1 decimal	
Field 16.	Alarm status	Integer	

Note that data fields not supported by the particulate monitor will be filled with -999 and that all fields will be filled with -999 if the particulate monitor fails to respond to the transmitter. The Alarm status value is as reported by the particulate monitor.

5.5.4 Sample GOES Transmission

Note: The example shows a signal strength of 42 dBm as shown by the highlighted portion

001057E210151161941G42+1NN195EXE00111 : GOES Header
48.444214 : latitude
-123.520828 : longitude
+9 : type
+5530 : serial number
+0.001 : concentration, real-time
-999 : concentration, hourly
+2.0 : flow
+24.5 : ambient temperature
+0 : ambient humidity
+100037 : barometric pressure
-999 : filter temperature
+32 : internal humidity
+0.3 : wind speed
+1 : wind direction
+14.1 : battery voltage
+0 : alarm

CHAPTER 6 MAINTENANCE AND TROUBLE SHOOTING GUIDE

6.2 MAINTENANCE

Field maintenance is limited to a periodic check of cables and connectors for deterioration and any obvious external damage to the G6-PM-MET1 assembly and EON antenna. If further maintenance is required, contact FTS Support.

6.3 TROUBLESHOOTING

If you are unable to resolve your issue after using this guide or have any questions, contact FTS support.

Troubleshooting is done using a PC and a terminal emulation program:

1) Connect the PC to the Command Port and then start the terminal emulation program.
2) Start a text file capture so that you have a record of the Command Port session.
3) Ensure the transmitter is powered.
4) Press enter, then wait 2 seconds and then press enter again to wake the transmitter. The transmitter should respond with a > prompt.

6.3.1 Verify Sampler Interface Board Communication

5) Issue the Transparent mode command (ETM) and wait for the * prompt.
   >ETM

   *****

6) At the asterisk prompt, enter the following command **0I!** (that is: the number zero, followed by a capital letter i, followed by an exclamation mark). The sampler interface board should reply with the string "013FTS-----232-PM-v1<serial#>" where <serial#> is the serial number of the transmitter assembly.
   *** 0I!** 013FTS-----232-PM-v1<serial#>

   *****

7) Press the escape key <Esc> to exit from transparent mode and return to the > prompt.
8) Close the text file capture and disconnect from the Command Port.

6.3.2 Verify Particulate Monitor Communication

Following is a series of steps required for verifying communications to the particulate monitor:

1) Connect the PC to the Command Port and then start the terminal emulation program.
2) Start a text file capture so that you have a record of the Command Port session.
3) Ensure the transmitter is powered.
4) Press enter, then wait 2 seconds and then press enter again to wake the transmitter. The transmitter should respond with a > prompt.
5) Issue the SDI Test (STT) and wait 3 seconds.
   >STT

: the transmitter queries the particulate monitor
and displays the results.

```
>
-1111.109985          : latitude as supplied by the transmitter
-1111.109985          : longitude as supplied by the transmitter
+9                    : Particulate Monitor Data
+5530
+0.000
-999
+1.9
+24.2
+0
+100291
-999
+36
+0.3
+1
+12.8
+0
```

Notes

a) Latitude and longitude values will not be correct until a GPS fix is obtained.

b) Communication to the particulate monitor is not correct if -999 is displayed in the particulate monitor data fields. Check the particulate monitor's baud rate setting to ensure it is set to 9600. Also, check the cable connection between the transmitter assembly and the particulate monitor.

6) Close the text file capture and disconnect from the Command Port.

6.3.3 Trouble Shooting Using the Audit Log

If you are not receiving data or the data returned is not as expected, you can use the audit log to help determine the source of the problem. Any time there is a significant event or a fault detected, the G6 will create an event message which can be reviewed via the audit log.

To review the audit log, enter the Read Audit Log command:

```
>RAL

yy/mm/dd hh:mm:ss event message        eg: 14/06/17 20:34:16 Failsafe Tripped
```

Most of the event messages are self-explanatory (ie: "GPS antenna disconnected", "TX aborted: Supply Voltage too low", "Invalid bitrate") and can be solved at the user level. FTS Support should be sought for messages that are not self-evident or which are not covered in the following table.

"Message"	Explanation/Reason	Solution
"Failsafe Tripped"	The G6 transmitter is transmitting longer or more frequently than its maximum allowance	Clear the failsafe by depressing the Diagnostic button for at least 10 seconds. If the failsafe continues to trip, the unit should be returned to FTS for repair or replacement.

		Call FTS for support.
"GPS 28 days stale"	After 28 days, if a time resynchronization is not achieved, the transmitter will disable transmissions. However, it will continue to attempt time resynchronization and, if successful, will re-enable transmissions	1) GPS antenna blocked (usually by snow) 2) GPS antenna damaged 3) Other equipment damage or failure
"Msg Truncated"	More data loaded into the buffer than could be transmitted at the assigned bitrate. Message is cut off when maximum size is reached.	Reduce the amount of data to be transmitted 1) Increase the sensor sample time interval so there is less data per transmission; 2) If option 1 is not feasible, you can contact the United States National Oceanic and Atmospheric Administration (NOAA) and request to increase your bit rate from 300 bps to 1200 bps or increase your Tx window. *If you increase your bit rate, you will have to adjust your power levels
"TX Aborted: Timed Tx buffer Empty"	1) Transmission intervals are more frequent than the sensor reading intervals 2) Sensor not writing to the G6 transmitter	1) Adjust sensor and transmission time intervals so that there will be data written to the buffer prior to transmission 2) Faulty sensor or faulty G6 transmitter. Contact FTS support.
"Tx Aborted: VSWR Too High"	1) If the SWR is greater than 1.5 this indicates a line of sight issue. The signal is being reflected or absorbed by neighbouring features.	1) Determine what may be responsible for the interference and remove it, or move the antenna/assembly to a clear area.

6.3.4 Failed Transmission

If the transmission failed, there are two ways to troubleshoot the issue.

1) Read the audit log. This will return a list of recent events. See Section 8.3 for details of possible audit log messages.

   >RAL
   2015/03/19 17:34:22 TX Aborted: Timed Tx Buffer Empty : example message

2) Get the status of the last failed transmission.

   Example 1:

   >LTXL
   Tx Status: TX Aborted: Timed Tx Buffer Empty : example message
   Tx Type: Self Timed
   Last TX Length: 0 bytes
   Last Tx Start Time: 2015/03/19 17:34:22

Last Tx Stop Time: N/A
Forward Power: N/A
Reflected Power: N/A
SWR: N/A
Power Supply: N/A

Note that some fields will be marked as N/A depending on the context of the failure which is described by 'Tx Status'.

Example 2:

>LTXL
Tx Status: Msg Truncated
Tx Type: Self Timed
Last Tx Length: 2214 bytes
Last Tx Start Time: 2012/06/13 21:36:59
Last Tx Stop Time: 2012/06/13 21:37:58
Forward Power: 32.0 dBm
Reflected Power: 16.3 dBm
SWR: 1.39
Power Supply: 10.9 V

Msg Truncated (message truncated) indicates that there was more data than could have been transmitted within the transmission window.

If you are unable to resolve your issue or have any questions, contact FTS support.

APPENDIX A G6 SPECIFICATIONS

NESDIS Certification Number: 1014-000114 Transmitter Model G6

Operating Voltage Range 10.8 – 16.0 VDC

Current Consumption

- Standby < 3 mA
- Transmit < 2.6 A
- GPS On < 50 mA

Communication Protocol ASCII, Binary (serial port1 only)

Serial Interface (Two Serial Ports) 3V3 volt levels suitable for RS-232 transceivers

Dimensions 4.0” x 5.0” x 0.9”

Weight 0.332kg (0.732 lbs)

Operating Temperature Range -40 to +60 °C

Transmission Data Rates 100, 300 and 1200 BPS

Transmit Frequency Range 401.701 MHz – 402.09850 MHz

Channel Bandwidth

- 100 BPS 3kHz
- 300 BPS 750 Hx
- 1200 BPS 1.5kHz

Nominal Transmit Power

GOES

- 300 BPS 14 W max
- 1200 BPS 14 W max

Meteosat

- 100 BPS 14 W max

Antenna Requirements

- Satellite Transmit Right hand circular polarization
- GPS 3.3V active patch

APPENDIX B MESSAGE CENTERING AND EMPTY BUFFER MESSAGE

B.1 MESSAGE CENTERING

Message Centering causes the GOES to transmit its data centered in the middle of its transmission window instead of transmitting right at the start of its transmission time.

NOAA's recommendation is to use message centering. Message centering takes into account the full length of the message and then places it in the middle of the window. This helps avoid message collisions due to a neighboring or rogue message going over its 10 second window. If the data to be transmitted fills the entire transmit window some of it may be lost as some of the transmit window time is allotted for the time it takes the message to leave the site, reach the satellite, and be decoded by the ground station.

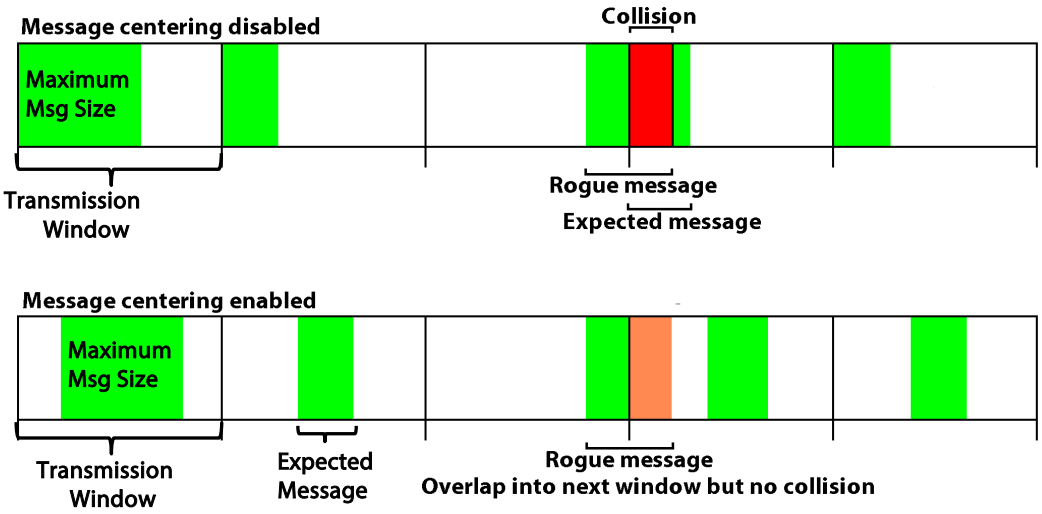


Figure B-0-1: Message Centering

B.2 EMPTY BUFFER MESSAGE (EBM)

When EBM=Y, transmissions will be made even if there is no data in the buffer to send. This can happen for a variety of reasons including equipment failure or having a GOES transmission interval (TIN) which is more frequent than the sampling intervals. A transmission with no data in the buffer will consist of the GOES DCS header followed by a No Data Available for transmission message.

EG: 44A0C67414097210915G30+0HN116WXW00018 21:00:00 No Data Available for Transmission

EBM=Y is good tool for trouble shooting as it is an indicator that if no data is received, it is not a transmitter problem.

APPENDIX C GOES TEST TRANSMISSION

In order to ensure the transmitter is fully functional, a test transmission should be conducted prior to leaving the site. This transmission can be conducted on the manufacturer's test channel: 195 for east satellites or 196 for west satellites. A secondary option would be to use your random channel if your NESID assignment includes one. When conducting a test transmission be aware that there is the possibility that the transmission could be blocked by another transmission on the same channel.

Following is a series of steps required for verifying communications of the GOES transmitter with a satellite system.

> NOTE: All these steps MUST be followed. Failure to complete steps 13-18 will leave the transmitter in a state unable to make transmissions.

1) Connect the PC to the Command Port and then start the terminal program.
2) Start a text file capture so that you have a record of the session.
3) Ensure the transmitter is powered.
4) Press enter, then wait 2 seconds and then press enter again to wake the transmitter. The transmitter should respond with a > prompt.
5) Switch the transmitter to technician mode (case sensitive). Note the WARNING box about operating in technician mode.

   >techmode alpha
   OK

> **WARNING!** When operating in the TECHNICIAN mode, care must be used as changes made can permanently change or damage the transmitter. The transparent mode should only be used as directed in this manual. For any further operations, contact FTS support for guidance.
>
> As long as **>SAVE** or **>SAVECAL** is not entered after changes are made in the TECHNICIAN mode, then the previously saved configuration can be recalled using the **>RSTR** command or by power cycling the G6.

6) Disable regular transmissions:

   >DTX : disable transmissions
   OK

7) Disable GPS synchronization:

   >DAS
   OK

8) Turn on the oven-controlled oscillator (ocxo):

>OCXOON
OK

9) Wait 90 seconds for the oven controlled oscillator to stabilize.

10) Issue the test transmission (the TX indicator will illuminate for approximately 7 seconds).

> **IMPORTANT!** For test transmissions that are operating with the GOES Satellite system it is important that only the type 4 parameter be used (ie: the **FTX 4**,XXX,XXX command).
>
> This command will send a transmission that self terminates thereby limiting the exposure of other users to erroneous traffic on their time slots if the channel were not correct.

>FTX 4[a],Channel[b], bit rate[c] :see the following notes for details.

a) **FTX** - **Must** use FTX 4

b) **Channel** - Use your assigned test channel. If you do not have an assigned test channel, use195
if your assignment is on the GOES East satellite, or 196 if your assignment is on the GOES West satellite.

c) **Bit Rate** - Input your assigned bit rate

Example: **>FTX 4,195,300**

11) Check the transmission using the EDDN field message retrieval webpage,[4] if you have a username and password. If you do not have a username and password, contact FTS support. The transmitted test message will be:

012345681513414356G42-1NN195EXE00392 : GOES header
Operator Initiated Test Transmission: : Test Message will repeat
Operator Initiated Test Transmission:
Operator Initiated Test Transmission:
Operator Initiated Test Transmission:
Operator Initiated Test Transmission:
Operator Initiated Test Transmission:
Operator Initiated Test Transmission:
Operator Initiated Test Transmission:
Operator Initiated Test Transmission:
Operator Initiated Test Transmission:
Operator Initiated Test Transmission:

[4] http://eddn.usgs.gov/fieldtest.html.

12) Get the last transmission status.

>LTXS
Tx Status: OK
Tx Type: Test Message
Last Tx Length: 0 bytes : A test transmission always shows 0 bytes
Last Tx Start Time: 2000/01/01 00:06:16
Last Tx Stop Time: 2000/01/01 00:06:27 : Tx time is 11 seconds
Forward Power: 40.4 dBm
Reflected Power: 9.0 dBm
SWR: 1.05
Power Supply: 11.9 V

The following steps are **CRITICAL.** If you fail to return the transmitter back to this state, no transmissions will be made, necessitating another site visit.

13) Turn the oven controlled oscillator (ocxo) off.

>OCXOOFF
OK

14) Enable automatic GPS synchronization.

>EAS
OK

15) Enable transmissions.

>ETX
OK

16) Return to User mode

>USERMODE
OK

17) Confirm sensor communications:

Issue the SDI-12 Command Table test

>STT

The measurement results will be displayed on the computer screen. Confirm all desired sensors and fields are correct.

18) Close the text file capture and disconnect from the Command Port.

DOCUMENT REVISION HISTORY

REV #	DATE	COMMENTS
1	13 Jun 2022	Original release. Replaces 700-GOES-PM25 and 700-GOES(G6)-PM25-Man.