PRODUCT MANUAL

Communications Device

TX325

Satellite Transmitter for GOES V2

Revision: 05/2025

RELIABLE MONITORING SINCE 1974

Campbell SCIENTIFIC®

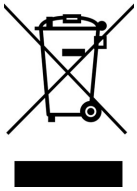
Please read first

About this manual

Please note that this manual was produced by Campbell Scientific Inc. primarily for the North American market. Some spellings, weights and measures may reflect this. In addition, while most of the information in the manual is correct for all countries, certain information is specific to the North American market and so may not be applicable to European users. Differences include the U.S. standard external power supply details where some information (for example the AC transformer input voltage) will not be applicable for British/European use. Please note, however, *that when a power supply adapter is ordered from Campbell Scientific it will be suitable for use in your country*.

Reference to some radio transmitters, digital cell phones and aerials (antennas) may also not be applicable according to your locality. Some brackets, shields and enclosure options, including wiring, are not sold as standard items in the European market; in some cases alternatives are offered.

Recycling information for countries subject to WEEE regulations 2012/19/EU



At the end of this product's life it should not be put in commercial or domestic refuse but sent for recycling. Any batteries contained within the product or used during the products life should be removed from the product and also be sent to an appropriate recycling facility, per The Waste Electrical and Electronic Equipment (WEEE) Regulations 2012/19/EU. Campbell Scientific can advise on the recycling of the equipment and in some cases arrange collection and the correct disposal of it, although charges may apply for some items or territories. For further support, please contact Campbell Scientific, or your local agent.

Table of contents

1. Introduction

The TX325 transmitter sends data via Geostationary Operational Environmental Satellites (GOES) and is the successor to the TX321. In the Western Hemisphere, the TX325 is compatible for use with NOAA GOES DCS with a coverage range including Canada, the United States of America, and Mexico—as well as most countries in Central America and many South American countries.

The TX325 is the telemetry backbone for many data collection platforms (DCP) that use GOES. The satellite transmitter can be integrated with several Campbell Scientific data loggers and is an available communications option for many systems, serving a wide range of applications.

2. Precautions

- READ AND UNDERSTAND the Safety section at the back of this manual.
- Although the TX325 is rugged, it should be handled as a precision scientific instrument.
- A proper antenna connection is required before transmission occurs. Failure to use a properly matched antenna cable and antenna may cause permanent damage to the radio frequency (RF) amplifiers.
- People using pacemakers or hearing aids should consult a physician first before interacting with the satellite terminal within one meter.
- Do not install the satellite terminal during electrical storms, which could result in severe personal injury or death.
- Never use the satellite terminal where blasting work is in progress. Observe all restrictions and follow any regulations or rules. Areas with a potentially explosive environment are often, but not always, clearly marked.
- Do not stand in front of the antenna. This device emits radio frequency energy. To avoid injury, do not place head or other body parts in front of the satellite outdoor unit (ODU) when system is operational. Maintain a distance of 1 m or more from the front of the satellite terminal ODU.

- Do not disassemble your satellite terminal. The unit does not contain consumer-serviceable components. Changes or modifications to the terminal not expressly approved by Campbell Scientific will void the warranty and could void your authority to operate this equipment.
- Properly connect the protective earth ground to help minimize chance of damage.
- Leaving a computer connected to the unit may result in excessive data usage and overage charges.
- To avoid impaired terminal performance, ensure the unit antenna is not damaged or covered with foreign material such as paint or labeling.
- When connecting the interface cables, do not use excessive force.
- Use only a soft, damp cloth to clean the terminal and antenna.

3. Initial inspection

- Upon receipt of the TX325, inspect the packaging and contents for damage. File damage claims with the shipping company.
- Check the ships with list to ensure all components are received.

4. QuickStart

Use our ***Device Configuration Utility*** to enter the required National Environmental Satellite Data and Information Service (NESDIS) information that is unique to each data collection platform (DCP). This QuickStart is for the CR6 (≥OS 10), CR300-series (≥OS 10), CR1000X (≥OS 4), and GRANITE-series (≥OS1) data loggers.

1. Connect the data logger **RS-232** to the TX325 **RS-232** connector and connect the data logger to a power supply.
2. Connect the TX325 power connector to the transmitter power supply.

> **CAUTION:**
> The TX325 should never directly draw power from the data logger. The transmitter draws 2.5 A of power during transmission. The data logger can provide a maximum of

> 0.9 A over its 12 VDC terminals, which is insufficient. To avoid transmission issues, ensure that the TX325 power is directly connected to the charging regulator or the battery.

3. Connect to the data logger using ***Device Configuration Utility***.
    a. Do the following to directly connect your data logger to the ***Device Configuration Utility***:
        i. Use the USB cable to connect the data logger to the computer.
        ii. Click your data logger model for the **Device Type** in the ***Device Configuration Utility***.
        iii. Click **Direct** for the **Connection Type**.
        iv. Select the **Communication port** on the computer to which the data logger is connected.
        v. Click **Connect**.
    b. For data loggers on an IP connection, do the following to remotely connect with the ***Device Configuration Utility***:
        i. Click your data logger model for the **Device Type** in the ***Device Configuration Utility***.
        ii. Click **IP** for the **Connection Type**.
        iii. Type the **Server Address**.
        iv. Type the **PakBus/TCP Password**.
        v. Click **Connect**.
4. Click the **Settings Editor** tab.

5. Click the **GOES Radio** sub tab (Figure 4-1 [p. 4]).

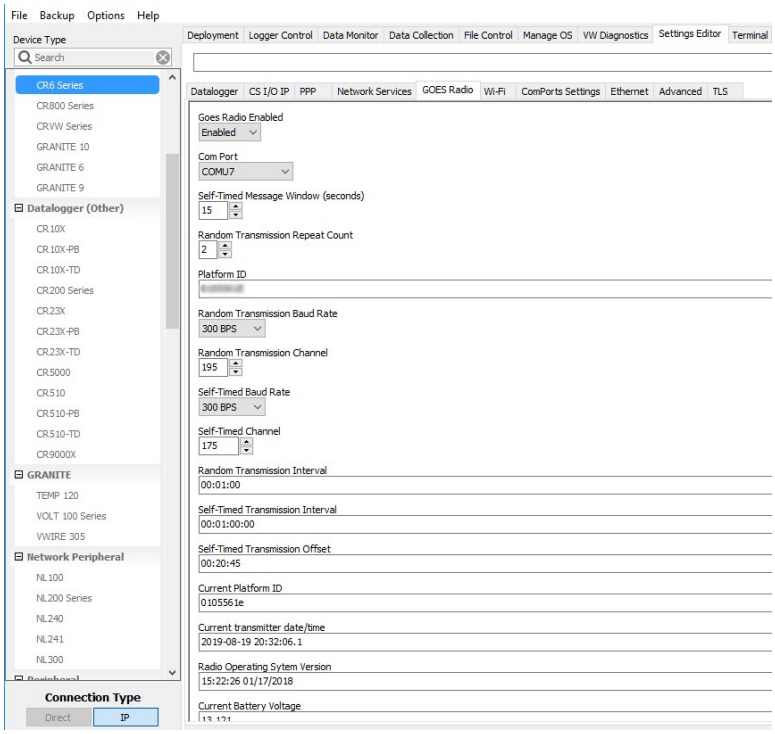
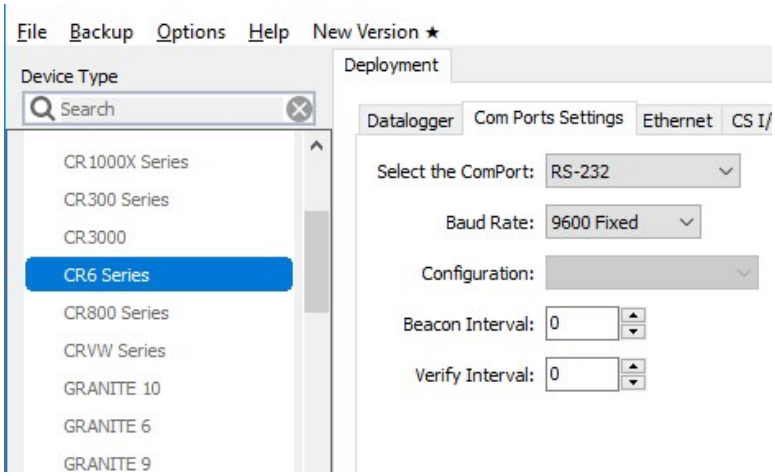


*Figure 4-1. **Device Configuration Utility** GOES Radio screen*

6. Select **Enabled** from the **Goes Radio Enabled** field.
7. Select the **Com Port** to which the GOES radio is connected.
8. Type the **Self-timed Message Windows (in seconds)** as assigned by the GOES DCS Program.
9. Type the **Platform ID** (in HEX) as assigned by the GOES DCS Program.
10. Select the **Random Transmission Baud Rate** as assigned by the GOES DCS Program.
11. Type the **Random Transmission Channel** as assigned by the GOES DCS Program.
12. Select the **Self-Time Baud Rate** as assigned by the GOES DCS Program.
13. Type the **Self-Time Channel** as assigned by the GOES DCS Program.
14. Type the **Random Transmission Interval** as assigned by the GOES DCS Program. Format is hh:mm:ss.
15. Type the **Self-timed Transmission Interval** as assigned by the GOES DCS Program. Format is dd:mm:hh:ss.

16. Type the **Self-timed Transmission Offset** as assigned by the GOES DCS Program. Format is hh:mm:ss.
17. Click the **Deployment** tab.
18. Click the **Com Port Settings** sub tab.
19. Select 9600 for the **Baud Rate**.



20. Click **Apply** to save the changes.

Now the settings are stored in the data logger. CRBasic programming is required to push data over the network. The `GOESTable()` and `GOESField()` CRBasic instructions used in conjunction with `DataTable()` facilitate the transmission of data across the GOES satellite network.

4.1 Data collection platform (DCP) installation

1. Yagi antenna installation procedure:
    a. Mount the Yagi antenna to a pole or mast by using the U-bolts included with the antenna mount.
    b. Attach elements to boom.

> **NOTE:**
> When attaching elements to the boom, make sure to place them such that the number of grooves on the element equals the number of dimples on the boom. For example, the element with four grooves should be placed at the spot on the boom with four dimples, and so forth.

c. Aim the Yagi antenna at the spacecraft; azimuth and elevation angle positions are included on the bracket label.

2. GPS antenna installation procedure:

   a. Connect the GPS cable to the GPS antenna.

   b. Route the cable through the 0.75-inch IPS threaded pipe and insert the pipe into the GPS antenna.

   c. Mount the 0.75-inch IPS threaded pipe to a crossarm by using the Nu-Rail® fitting or right-angle mounting kit.

> **CAUTION:**
> The GPS antenna will not receive a GPS signal through steel roofs or steel walls. Concrete might also be a problem. Heavy foliage, snow, and ice will attenuate the GPS signal.

3. Mount the TX325, the power supply, and the data logger to the backplate of an enclosure.
4. Mount the enclosure and solar panel to the pole or tripod.
5. Connect the COAXNTN cable to the Yagi antenna. Route the COAXNTN cable through the enclosure conduit and connect it to the **RF Out** connector on the TX325 (Figure 4-2 [p. 7]).

Figure 4-2. TX325 connectors

6. Route the GPS antenna cable through the enclosure conduit and connect it to the **GPS** connector on the TX325 (Figure 4-2 [p. 7]).
7. Plug the green connector from the power supply to the green receptacle on the TX325.

> **CAUTION:**
> The TX325 should never directly draw power from the data logger. The transmitter draws 2.5 A of power during transmission. The data logger can provide a maximum of 0.9 A over its 12 VDC terminals, which is insufficient. To avoid transmission issues, ensure that the TX325 power is directly connected to the charging regulator or the battery.

8. Connect the data logger to the TX325 **RS-232** terminal.

9. Route the solar panel cable through the enclosure conduit and connect the red and black wires to the CHG terminals on the CH150, CH200, or CH201.

5. Overview

The TX325 can transmit either self-timed or random GOES messages to the GOES West and GOES East satellites. In a typical configuration, the TX325 is connected to a data logger via an RS-232 serial connection. The data logger makes measurements, then formats those values to create a data packet, which is transferred to the transmitter at time of transmission. The data logger buffers the message until its transmission window (or random transmission time), then transmits the data at either 300 or 1200 bps.

GPS is required for the radio to work in the GOES network. The GOES network is a TDMA network that requires all the radios in the network to have exact timing of their transmissions so they don't step on each other during transmissions. Extremely accurate timing is obtained from the integrated GPS receiver (±100 µs), and the internal clock is capable of maintaining accurate time for a minimum of six days without a GPS fix. If the TX325 finds itself without an accurate time, it suspends data transmissions until an accurate time is obtained. The GPS time is synced every 11 hours. The data logger clock is synced with the GPS time of the TX325 when using a GRANITE-series, CR6, CR1000X-series, and CR300-series data logger.

> **NOTE:**
> If the user does not want the data logger synced to the GPS time, they can adjust the `UTCOffset` setting using the `SetSetting()` CRBasic instruction in the data logger program or using the ***Device Configuration Utility*** software (**Settings Editor** > **Advanced** > **UTC Offset**). See Table 7-4 (p. 19) for more information.

Features:

- NESDIS HDR V2 certified
- Based on Signal Engineering OmniSat3 design
- Compatible with GOES DCS system
- Easy integration with Campbell Scientific data loggers
- Field tested and proven track record of reliability
- Embedded GPS receiver for stabilized internal time keeping and transmit frequency for long service intervals
- Low standby current consumption for battery-powered systems at remote DCP installation sites
- Quick assessment of radio health via monitoring of diagnostic data from the radio

- Compatible CRBasic data loggers: GRANITE series, CR6, CR1000X, and CR300 series are fully compatible. The CR3000, CR800 series, and CR1000 have limited compatibility.

5.1 GOES, NESDIS, and transmit windows

GOES coverage area is latitude 68° North to 68° South and longitude 150° East to 2° West (see Figure 5-1 [p. 9]). GOES satellites have orbits that coincide with the Earth rotation, allowing each satellite to remain above a specific region (geosynchronous). GOES has two satellites: GOES East located at 75° West longitude and GOES West located at 135° West longitude. Both satellites are located over the equator. Within the United States, odd-numbered channels are assigned to GOES East, and even-numbered channels are assigned to GOES West. Channels used outside of the United States are assigned to either spacecraft.

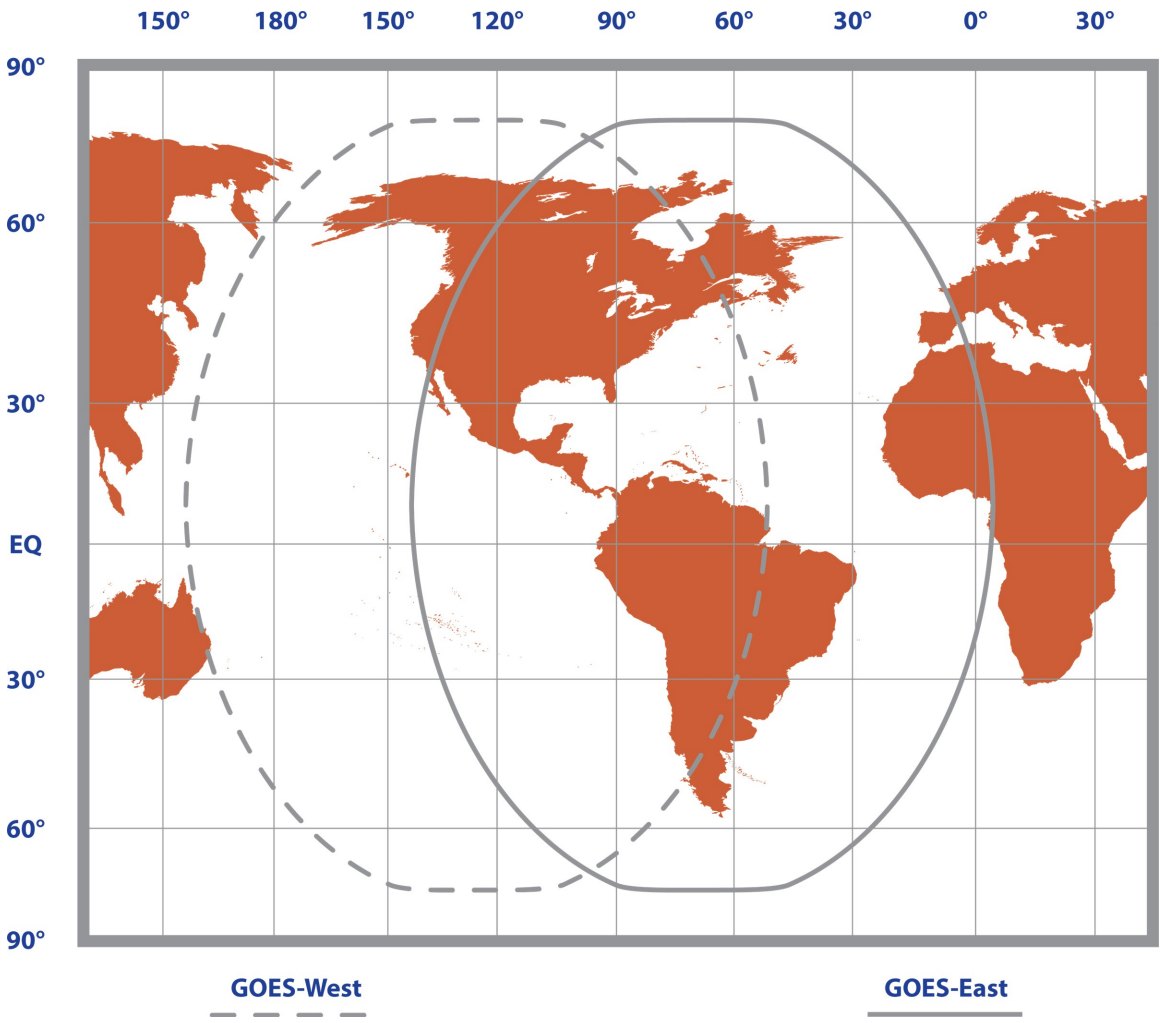


Figure 5-1. Coverage of GOES East and GOES West satellites

The GOES system is administered by the National Environmental Satellite Data Information Service (NESDIS), which assigns addresses, uplink channels, and self-timed/random transmit time windows. Self-timed windows allow data transmission only during a predetermined time frame (typically 10 seconds every hour). Random windows are for applications of a critical nature, such as flood reporting, and allow transmission immediately after a threshold has been exceeded. The transmission is randomly repeated to ensure it is received. A combination of self-timed and random transmission can be executed by the TX325.

Refer to Eligibility and getting onto the GOES system (p. 42) for more information.

6. Specifications

Compliance:	Refer to Compliance documents and certificates (p. 80) and www.campbellsci.com/tx325
Transmissions supported:	Timed (scheduled), random
Data formats:	ASCII (SHEF), pseudo binary
Radio module:	OmniSat-3
Temperature range	
Operating:	–40 to 60 °C
Storage:	–55 to 75 °C
Case dimensions	
Without connectors:	15.88 x 12.7 x 4.57 cm (6.25 x 5 x 1.8 in)
With connectors:	15.88 x 14.99 x 4.57 cm (6.25 x 5.9 x 1.8 in) additional clearance required for cables, wires, and antennas
Weight:	0.77 kg (1.7 lb)
Supply voltage range:	10.5 to 16 VDC
Current drain at 12 VDC	
While transmitting:	< 2.5 A (1.8 typical)
Standby:	< 5 mA (2.8 typical)
During GPS acquisition:	< 50 mA (25 mA typical)
Baud rates:	300 and 1200 bps

Transmit power

Maximum:	31 dBm (300 bps), 37 dBm (1200 bps)
Max EIRP[1]:	41 dBm (300 bps), 47 dBm (1200 bps); based on a 11 dbm gain antenna with 1 dbm line loss
Typical EIRP[1]:	37 to 41 dBm (300 bps), 43 to 47 dBm (1200 bps)
Frequency range:	401.701 to 402.09925 MHz
Initial frequency stability:	±20 Hz disciplined to GPS (GPS fix occurs after power up and once per day thereafter)
Channel bandwidth:	1500 Hz (300 bps), 2250 Hz (1200 bps)

GPS receiver

> NOTE:
> The TX325 can source up to 19 mA at 2.7 V for an external GPS antenna. Campbell Scientific recommends a maximum antenna Low-Noise Amplifier (LNA) of 1.5 dB.

Maximum RF input gain:	3.3 V active
Receiver type:	25 dB

Timekeeping

Initial accuracy:	±100 µs (synchronized to GPS)
Drift:	±40 ms/day (without GPS)
GPS schedule:	1 fix at power up (updated at ~11-hour rate)
Transmission continuation without GPS fix:	6 days

Interface connectors

RS-232:	DB9 F, DCE, 3-wire RS-232
Satellite RF transmit out:	Type N jack
GPS:	SMA jack
Power:	2-pin screw terminal, 0.2 in. pitch

[1]Equivalent, isotropically radiated power (EIRP)

7. Installation

7.1 Field site requirements

Prepare an area for the station, approximately five meters in diameter. Remove any obstructions, brush and tall weeds, while disturbing the ground surface and other natural vegetation as little as possible.

The GPS antenna must have a clear view of most of the sky and the transmission antenna must have a clear view of the spacecraft. The TX325 must be installed in a well-desiccated, environmentally sealed enclosure. Its mounting plate has keyholes for securing the TX325 to the backplate of a Campbell Scientific enclosure. Most GOES systems are powered by a battery charged by a solar panel. The solar panel must have a clear view of the southern sky. Pay special attention to winter sun angles.

7.2 LED function

A green **Status** LED and a red **Failsafe** LED indicate the state of the TX325 transmitter by using various blink patterns. Table 7-1 (p. 13) and Table 7-2 (p. 13) provide the blink patterns for the green **Status** and red **Failsafe** LEDs, respectively.

Table 7-1: Green LED Status indicator blink patterns	
Blink pattern	Indicates
At power up, blinks on and off two times.	Normal software is running. RS-232 control interfaces enabled. Power-up initialization complete and ready to receive commands.
At power up, blinks on and off three times.	Bootloader software is running. Ready to load new operating system.
On continuously.	Transmitter failed to start up normally after power up. Turn the transmitter off and on to reboot.

Table 7-2: Red LED Failsafe indicator blink patterns	
Blink pattern	Indicates
Blinks on and off four times per second.	A transmission is in progress.
Blinks on and off two times per second for 30 s.	The post-transmit interval is in progress. The transmitter enters this state after its RF output is turned off either by a **Reset** command or by the normal completion of a data message transmission. The radio needs to wait 30 seconds before making another transmission to keep it from going into **Failsafe** mode.
On continuously.	TX325 is in the **Failsafe** mode. To clear a **Failsafe** mode, push the **Reset** button (Figure 8-1 [p. 33]). A power cycle will NOT clear the **Failsafe** mode.

7.3 Ports and connectors

The RS-232 port is a DB9 male connector configured as DTE. Only three pins are used, transmit on pin two, receive on pin three, and ground on pin five. Transmit is an output and receive is an input to the TX325. The RS-232 port allows the transmitter to be connected to a data logger. Refer to the following table for the cable options and data logger connection.

Table 7-3: Cable options, data logger compatibility, and data logger connections		
Cable description	Compatible data loggers	Data logger connection
RJ45 to DB9 female cable (-R option when ordered with the TX325)	Granite-series, CR6, CR1000X	**RS-232/CPI** RJ45 port
SC110 TX/RX cable (-C option when ordered with the TX325)	Granite-series, CR6, CR1000X	White: Odd **C** or **U** terminal Brown: Even **C** or **U** terminal Yellow: **G** Clear: **G** or ⏚
RS-232 DB9 female to DB9 male serial cable (-S option when ordered with the TX325)	CR800-series, CR300-series, CR3000, CR1000	**RS-232** 9-pin port
Female null modem serial cable > SC105 interface[1] > SC12 CS I/O cable (-IO option)	Granite-series, CR6, CR1000X	**CS I/O** port
[1]For the SC105, use the default **CS I/O ME Baud Rate** and **Baud Rate** settings of 9600.		

The **RF Out** connector is for attaching the transmission antenna. A properly matched antenna cable and antenna must be connected to the TX325 before transmission occurs.

> **WARNING:**
> Failure to use a properly matched antenna cable and antenna may cause permanent damage to the radio frequency (RF) amplifiers.

The nominal impedance is 50 ohms; the frequency range is approximately 400 to 403 MHz. Maximum EIRP for GOESV2 is 41 dBm for 300 bps and 47 dBm for 1200 bps. The antenna gain can be set while configuring the transmitter. If not set, the TX325 will use an antenna gain of 11 dBi and a transmitter-antenna cable loss of 1 dB. Under those conditions, at 300 bps transmission rates, the maximum transmit power from the transmitter is 31 dBm. At 1200 bps, the transmit power is 37 dBm.

Effective Antenna Gain is defined as antenna gain (in dBi) minus the transmitter-antenna cable loss (in dB). If the **Effective Antenna Gain** is set and enabled, the transmitter automatically adjusts the radio power output to limit the EIRP to the maximum allowed value. The adjusted power output may be up to 37 dBm, depending on the **Antenna Gain** and **Baud Rate** settings.

The **GPS** port on the TX325 is an SMA female connector for attaching an active 3.3 V GPS antenna. Operation without a GPS antenna connected will not cause damage, but the transmitter will not transmit without a valid GPS fix. The transmitter uses the GPS receiver for two functions.

The precise GPS time is used to ensure scheduled transmissions occur at the proper time. The one-second GPS synchronization pulse is used to ensure a precise, drift-free carrier frequency.

The TX325 power connector has two pins: ground and 12 V for connection of the power supply. The input power requirement is 10.5 to 16 VDC can use up to 2.5 A. A power supply consisting of a CH150, CH200, or CH201 regulator, BP12 or BP24 battery, and a solar panel typically can support these requirements. The regulator connects to the TX325 power connector.

CAUTION:
The TX325 should never directly draw power from the data logger. The transmitter draws 2.5 A of power during transmission. The data logger can provide a maximum of 0.9 A over its 12 VDC terminals, which is insufficient. To avoid transmission issues, ensure that the TX325 power is directly connected to the charging regulator or the battery.

7.4 Transmission antenna

CAUTION:
Do not stand in front of the antenna. This device emits radio frequency energy. To avoid injury, do not place head or other body parts in front of the satellite outdoor unit (ODU) when system is operational. Maintain a distance of 1 m or more from the front of the satellite terminal ODU.

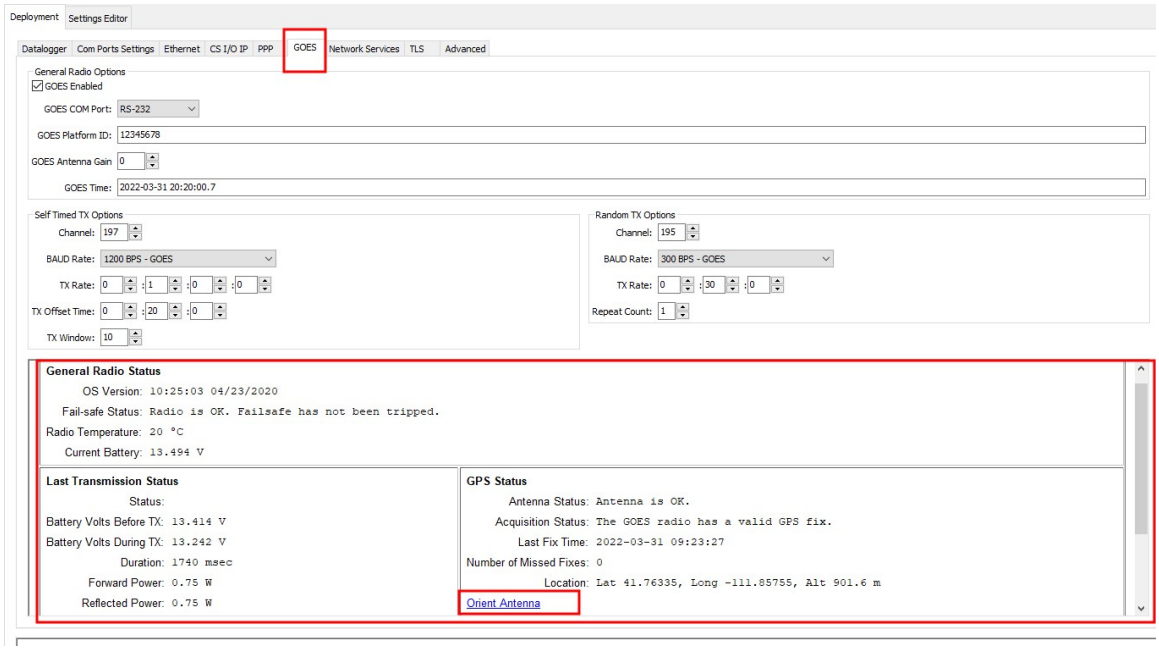
The TX325 transmission antenna is a right-hand circular polarized Yagi with 11 dBi gain. A bracket is included with the antenna for mounting to a mast or pole. The antenna is directional and should be aimed at the spacecraft. Both elevation and azimuth are unique to the location on the planet and must be set. A poorly aimed antenna will cause a drop in signal strength or possibly prevent successful transmission. As a guide, if the antenna is aimed 20 degrees off the spacecraft, the received power will be half of a properly aimed antenna. Beyond 20 degrees, the received power drops off quickly.

NOTE:
When attaching elements to the boom, make sure to place them such that the number of grooves on the element equals the number of dimples on the boom. For example, the element with four grooves should be placed at the spot on the boom with four dimples, and so forth.

The *Device Configuration Utility* software has a tool for helping to point the transmitter antenna.

1. When connected to the CR6, CR1000X, CR350, or CR300 Series data logger, click the **Deployment** > **GOES** tab.

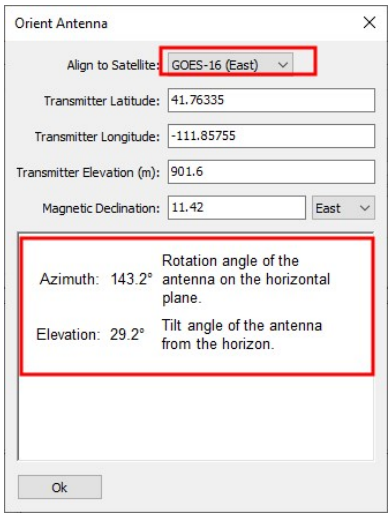
2. Under the **General Radio Status**, scroll down to the **Orient Antenna** link.



3. Click **Orient Antenna**. A small **Orient Antenna** window will open. Select the satellite (**GOES-16 [East]** or **GOES-16 [West]**).

> **NOTE:**
> GOES has two satellites, GOES East and GOES West (Figure 5-1 [p. 9]). Both satellites are located over the equator. Within the United States, odd-numbered channels are assigned to GOES East, and even-numbered channels are assigned to GOES West. Channels used outside of the United States are assigned to either spacecraft. If you are unsure check with DCS Help Desk online at https://dcs1.noaa.gov.

Check that the **Latitude**, **Longtitude**, **Elevation**, and **Magnetic Declination** are correct for your site; this information should be pulled from the GPS receiver. The bottom window will display the correct Azimuth and Elevation for pointing your antenna.



TIP:
To use this tool with the CR3000, CR1000, or CR800-series, select a newer data logger, such as the CR1000X, and use the offline mode (**File> Offline Mode>CR1000X Measurement and Control Datalogger with a TX325/TX326 Radio**). In the **Offline Mode**, click the **Deployment** > **GOES** tab then click **Orient Antenna** to access the **Orient Antenna** window. Values for **Latitude**, **Longitude**, **Elevation** , and **Magnetic Declination** need to be manually entered.

7.5 GPS antenna

The GPS antenna mounts to the end of a crossarm by using a 0.75-inch IPS threaded pipe and a 0.75-inch-by-1-inch Nu-Rail® fitting or right-angle mounting kit. Mount the GPS antenna above obstructions, but with the shortest cable possible. The GPS antenna will not receive GPS signals through steel roofs, steel walls, or possibly concrete. Heavy foliage, snow, and ice will attenuate the GPS signal. An unobstructed view provides better GPS performance resulting in fewer (or no) missed transmissions. Poor GPS antenna placement increases the number of missed transmissions, and possibly stops all GPS transmissions.

7.6 Data logger programming

NOTE:
This section provides programming information for the GRANITE-series (≥OS 1), CR6 (≥OS 10), CR1000X (≥OS 4), and CR300-series (≥OS 10), data loggers. For information on programming the CR3000, CR800-series, and CR1000 data loggers, refer to TX321 program converted to TX325 program (CR1000, CR3000, CR800-series) (p. 69) and the example program at www.campbellsci.com/downloads/tx325-example-program-cr3000-cr1000-cr800 or contact Campbell Scientific.

The CRBasic program can read and enter TX325 settings. Settings can also be entered using the *Device Configuration Utility* (see QuickStart [p. 2]). Table 7-4 (p. 19) provides the TX325 settings that can be read and entered. Table 7-5 (p. 22) provides the read-only settings.

The CRBasic program should include the `GOESTable()` and `GOESField()` instructions used in conjunction with the `DataTable()` instruction to facilitate the transmission of data across the GOES satellite network. The `GOESTable()` instruction has the following syntax:

```
GOESTable (Result, ComPort, Model, BufferControl, Fields_Scan_Order,Newest_
First,Format)
```

The **Result** is a string variable that holds either the data to be output in its specified format or a message indicating there are no data to output to the transmitter. For the **Model**, enter 3 to use the TX325. For the **BufferControl**, a value of 0 writes to the self-timed buffer and a value of 1 writes to the random buffer. Data formats and transmission durations (p. 43) discusses the **Format** options.

The `GOESField()` instruction has the following syntax:

```
GOESField(NumVals, Decimation, Precision, Width, SHEF)
```

The **NumVals** is the number of historical values of the field to output. For **Decimation**, enter 1 to output every value, enter 2 to output every other value, etc. **Width** specifies the number of characters in the field. Use empty quotes ("") for **SHEF**[1] if no SHEF code is specified.

[1]Standard Hydrologic Exchange Format (SHEF) is a text based format developed by the National Weather Service (NWS) for exchange of real time operational data with other agencies.

An example of using the the GOESTable() and GOESField() instructions follows:

```
DataTable (ST_DATA, TRUE, -1)
  DataInterval(0, 15, Min, 4)
  GOESTable (st_table_results, COMRS232, 3, 0, TRUE, TRUE, 3)
  GOESField (4, 1, 3, 6, "")
  Sample (1, battery_voltage, IEEE4)
  GOESField (4, 1, 3, 6, "")
  Sample (1, panel_temperature, IEEE4)
EndTable
```

In the main portion of the program, settings are written using SetSetting() instruction with the following the syntax:

```
SetSetting ( "FieldName", Value )
```

The FieldName must be enclosed in quotes as shown. The following example instruction sets the port used to communicate with the TX325 to the RS-232 port:

```
SetSetting("GOESComPort", COMRS232)
```

The CRBasic program reads the TX325 settings using the following format:

```
Variable = Settings.FieldName
```

For example, goes_comport = Settings.GOESComPort reads the Com port setting and stores it in the GOESComPort variable. The TX325 settings are typically read in a SlowSequence section of the program. Table 7-4 (p. 19) provides the TX325 settings that can be set and read. Table 7-5 (p. 22) provides the read-only settings.

A downloadable example program is available at: www.campbellsci.com/downloads/tx325-example-program-granite-cr6-cr1000x-cr300.

7.6.1 Read and write settings

Table 7-4: Read and write TX325 settings

Field name	Device Configuration Utility setting	Description
GOESComPort	GOES COM Port	Port used to communicate with the GOES transmitter.
GOESEnabled	GOES Enabled	Controls whether the data loggers polls the GOESComPort to see if a TX325 radio is attached to it. With the default setting of 0 (not enabled), the data logger ignores all other GOES settings. A value of 1 enables the setting.

Table 7-4: Read and write TX325 settings		
Field name	Device Configuration Utility setting	Description
GOESGainSetting	GOES Antenna Gain	Specifies the maximum specified gain (in dbi) for the antenna minus the loss in the cable connecting the TX325 to the antenna. The maximum value is 14 dBi for 300 bps transmissions and 20 dBi for 1200 bps transmissions. The default value of 0 assumes the antenna has the same effective gain as the Yagi antenna used for certification. The TX325 sets the output power so that the EIRP is close to, without exceeding, the maximum EIRP. Maximum permitted EIRP for GOES V2 is 41 dBm for 300 bps and 47 dBm for 1200 bps transmissions.
GOESMsgWindow	Self Timed TX Options> TX Window	Length, in seconds, of the assigned self-timed transmission window assigned by NESDIS. Valid entries are 1 to 110 s.
GOESPlatformID	GOES Platform ID	8-digit hexadecimal identification number assigned by NESDIS. Value is a string.
GOESRTBaudRate	Random TX Options> BAUD Rate	Baud rate for the random transmissions. Valid settings are 100, 300, or 1200. The baud rate must match the user's NESDIS-channel assignment.
GOESRTChannel	Random TX Options> Channel	Channel used for the random transmission assigned by NESDIS. Valid channel numbers are 0 through 566. The default value of 0 disables random transmissions.

Table 7-4: Read and write TX325 settings		
Field name	Device Configuration Utility setting	Description
GOESRTInterval	**Random TX Options**> **TX Rate**	Average time between random transmissions. The value is a string entered in the format of Hours:Minutes:Seconds. Typically, the assigned interval is in hours, so the minutes and seconds parameters are left at 0. For example, “01:00:00” setups up an hourly interval. Maximum interval is 24 hours; minimum interval is 1 minute.
GOESSTBaudRate	**Self Timed TX Options**> **BAUD Rate**	Baud rate for self-timed transmissions. Valid settings are 300 or 1200. The baud rate must match the user's NESDIS-channel assignment.
GOESSTChannel	**Self Timed TX Options**> **Channel**	Channel used for the self-timed transmission assigned by NESDIS. Valid channel numbers are 0 through 566. The default value of 0 disables the self-timed transmissions.
GOESSTInterval	**Self Timed TX Options**> **TX Rate**	Time between self-timed transmissions. The value is a string entered in the format of Days:Hours:Minutes:Seconds. Typically, the assigned interval is in hours, so the days, minutes and seconds parameters are left at 0. For example, "00:01:00:00" sets up an hourly interval. Maximum interval is 14 days; minimum interval is 1 minute.
GOESSTOffset	**Self Timed TX Options**> **TX Offset Time**	Time after midnight for the first self-timed transmission as assigned by NESDIS. The value is a string entered in the format of "Hours:Minutes:Seconds". Typically, only hours and minutes are used, and seconds are 0, unless the transmission window is less than 60 seconds. Maximum offset is 23:59:59. A value 0 results in no offset.

Table 7-4: Read and write TX325 settings		
Field name	Device Configuration Utility setting	Description
GOESRepeatCount	Random TX Options> Repeat Count	Number of times within the random transmit interval that the TX325 will transmit the message data. Valid entries are 1 to 3.
UTCOffset		Adjust this setting if you do not want the data logger to use the Coordinated Universal Time (UTC), which is used by the GPS antenna. The data logger automatically syncs to the GPS time. Specify the offset in seconds.

7.6.2 Read-only settings

Table 7-5: Read-only TX325 settings	
FieldName	Description
GOESid	Current ID programmed into the radio. The ID isn't programmed into the radio until right before a radio transmission starts.
GOESdateTime	Current date and time (UTC) of the TX325 radio. Value is a string.
GOESversion	Current radio firmware version. Value is a string.
GOESCurrentbattery	Battery voltage in VDC.
GOESCurrenttemperature	Current radio temperature in degrees Celsius.
GOESbatteryBeforeTx	Battery voltage of the radio just prior to its last transmission.
GOEStemperatureBeforeTx	Radio temperature before the last transmission.
GOESbatteryDuringTx	Radio-battery voltage during the last transmission.
GOESLatitude	Latitude in decimal format of the GOES radio.
GOESLongitude	Longitude in decimal format of the GOES radio.
GOESAltitude	Altitude of the GOES radio in meters.

Table 7-5: Read-only TX325 settings	
FieldName	Description
GOESTimeLastGPSPosition	Date and time (UTC) of the last GPS position fix. Value is a string.
GOESNumberOfMissedGPS	Number of times the radio has failed to get a GPS fix.
GOESTimeLastMissedGPSFix	Last date and time (UTC) that the radio failed to get a GPS fix. Value is a string.
GOESGPSAcquisitionStatus	Acquisition status of the radio GPS. 0 = valid GPS fix 1 = no GPS position fix, no GPS satellites in view 8 = no GPS position fix, no usable GPS satellites in view 9 = no GPS position fix, one usable GPS satellite in view 10 = no GPS position fix, two usable GPS satellites in view 11 = no GPS position fix, three usable GPS satellites in view
GOESGPSAntennaStatus	Status of the GPS antenna. 0 = GPS antenna is working 16 = GPS antenna is not connected 48 = GPS antenna is shorted
GOESFailSafeIndicator	Radio failsafe status. 1 = Failsafe has been tripped 0 = Radio is OK and Failsafe has not been tripped
GOESDurationOfTransmit	Duration of the last transmission of the GOES radio in milliseconds.
GOESForwardTxPower	Forward RF power of the transmitter in watts.
GOESReflectedRfPower	Reflected RF power of the transmitter in watts.
GOESVSWR	Voltage standing wave ratio (SWR) of the radio.
GOESLastTxControlFlags	Control flags used in the last transmission.
GOESLastTxStartTime	Start time (UTC) of the last radio transmission. Value is a string.
GOESLastTxChannel	Channel number used during the last radio transmission.
GOESLastTypeCode	Type of transmission used during the last radio transmission.
GOESLastDatelength	Number of bytes in the last radio transmission.

Table 7-5: Read-only TX325 settings	
FieldName	Description
GOESLastHDRFlagWord	HDR flag word used in the last radio transmission.
GOESTxResultCode	Status of the last radio transmission. 0 = Last transmission was OK 1 = Transmission aborted, radio battery voltage is too low 2 = Transmission aborted, radio PLL lock failure 3 = Transmission aborted, radio flash is corrupt
GOESCurrentTxState	Current state of the radio. 0 = Idle 1 = Transmission is in progress 2 = Post transmission failsafe wait is in progress

8. Troubleshooting

For assistance with the TX325, contact Campbell Scientific. Refer to the last page of this document for contact information.

8.1 Check TX325 and data logger power

Do the following to verify the data logger is properly powered:

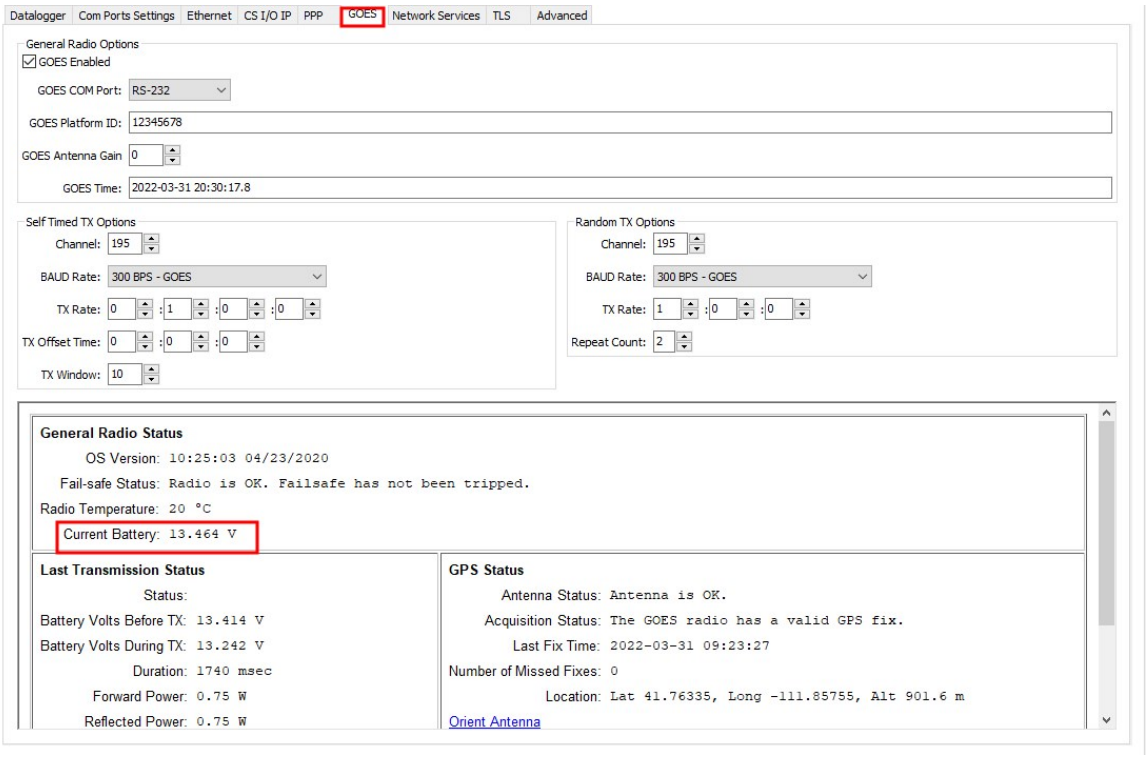
1. Access the ***Device Configuration Utility*** software.
2. Select your data logger for the Device Type and connect the data logger to the computer.
3. Click the data logger **Data Monitor** tab and check the battery voltage in the **Status** table. Voltage is typically a little over 12 VDC. For example, a reading of 13.5 VDC is acceptable. Lower values such as 11 or 10.5 VDC can keep your system from communicating optimally and may prevent communications.

   > CAUTION:
   > The TX325 should never directly draw power from the data logger. The transmitter draws 2.5 A of power during transmission. The data logger can provide a maximum of 0.9 A over its 12 VDC terminals, which is insufficient. To avoid transmission issues, ensure that the TX325 power is directly connected to the charging regulator or the battery.

Do the following to ensure that the TX325 properly powered:

1. Ensure that the power connector attached to the TX325 has the correct polarity. To do this, use a multimeter to verify that positive is connected to the positive terminal and negative is connected to the negative terminal.
2. Connect the data logger to the TX325.
3. Access the ***Device Configuration Utility*** software.
4. Select your data logger for the **Device Type** and connect the data logger to the computer.

5. Click the data logger **Deployment** > **GOES** tab and check the **Current Battery** voltage in the diagnostics at the bottom of the screen and ensure that it is 12 VDC or higher. If the TX325 and data logger are drawing power from the same source, always ensure that the voltage is more than 12 VDC.



8.2 Check RS-232 connection

Verify the RS-232 cable is connected to both the data logger RS-232 port and the TX325. Check the cable for corrosion, frayed wires, and good contact with the ports on the two devices. RS-232 cables occasionally wear out without visible signs of failure. Keep a spare RS-232 cable for troubleshooting RS-232 connections.

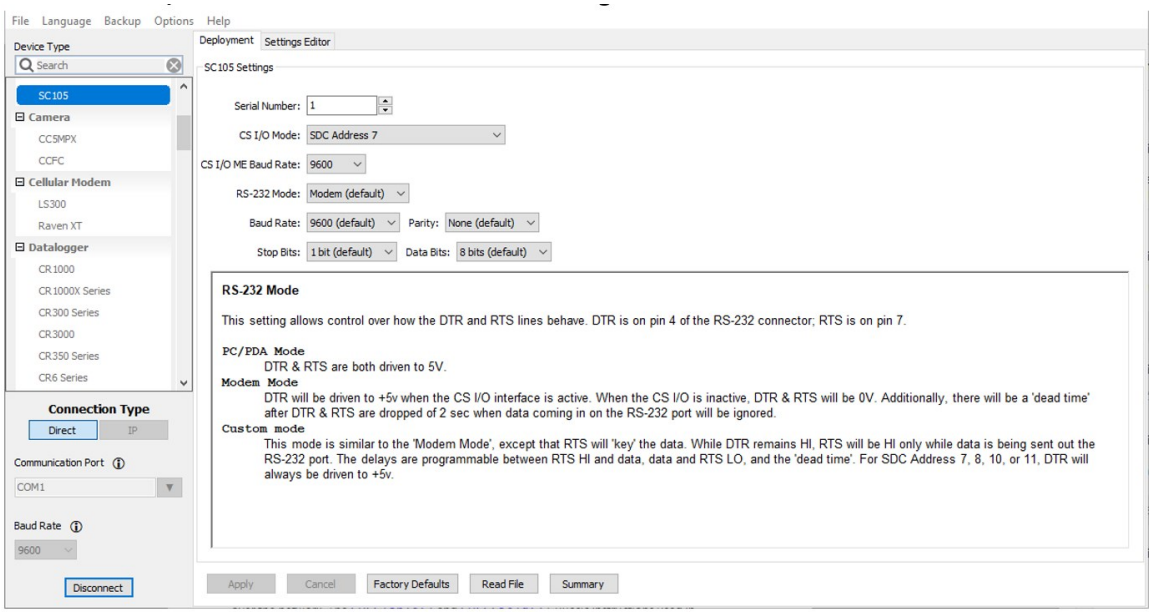
Campbell Scientific offers three RS-232 cables that support different data loggers or wiring configurations. Refer to Table 7-3 (p. 14) for the cable descriptions, compatible data loggers, and the data logger connections.

8.3 Check SC105 baud rate settings

If using an SC105 on the CS I/O port, verify the following:

1. Use the SC12 cable to connect the data logger **CS I/O** port to the SC105 **CS I/O** port and connect the data logger to a power supply.

2. Use the socket null modem serial cable to connect the SC105 to the computer.
3. Open *Device Configuration Utility*.
4. Type SC105 in the **Device Type** box and click **SC105**.
5. Select the **Communication Port** on the computer to which the SC105 is connected.
6. Click **Connect**.
7. Ensure the **CS I/O ME Baud Rate** and **Baud Rate** settings are 9600.



8. Click **Apply** if the baud rate values were changed.

8.4 Check mounting and connections for the antennas

Verify that both the GPS and transmitter antennas are mounted correctly, and securely attached to the correct connector on the TX325. The GPS antenna cable has an SMA connector that fastens to the **GPS** port of the TX325. The transmitter antenna connects to the **RF Out** port on the TX325.

Visually inspect both antenna cables looking for breaks, frayed wires, and corrosion on the connectors and ports.

Valid GPS antennas include the following. Refer to www.campbellsci.com/order/tx325 for more information.

- **27 dBi GPS Antenna with Magnetic Mount and cable**: This antenna is for applications where signal strength is strong and the likelihood of snow is low.

- **28 dBi GPS Antenna, Jam Resistant**:This antenna is better for all weather conditions and for applications where a weak GPS signal may be present. This antenna requires the purchase of an GPS antenna cable.

> **NOTE:**
> If using surge protection with the GPS antenna verify the surge protector is DC coupled so that it can supply power to the antenna. Campbell Scientific offers a suitable kit (www.campbellsci.com/order/tx325).

For the transmitter antenna, Campbell Scientific recommends using the GOES Yagi RHCP Antenna listed on the website (www.campbellsci.com/order/tx325).

Refer to Data collection platform (DCP) installation (p. 5) for instructions about correctly mounting the GPS and transmitter antennas.

8.5 Verify antenna positioning

Verify the GPS antenna has a clear view of most of the sky and the transmission antenna has a clear view of the satellite. The ideal location for the GPS antenna is high enough to be above everything, but with the shortest cable possible. Cement, steel roofing, or steel walls will restrict or prevent GPS communications.

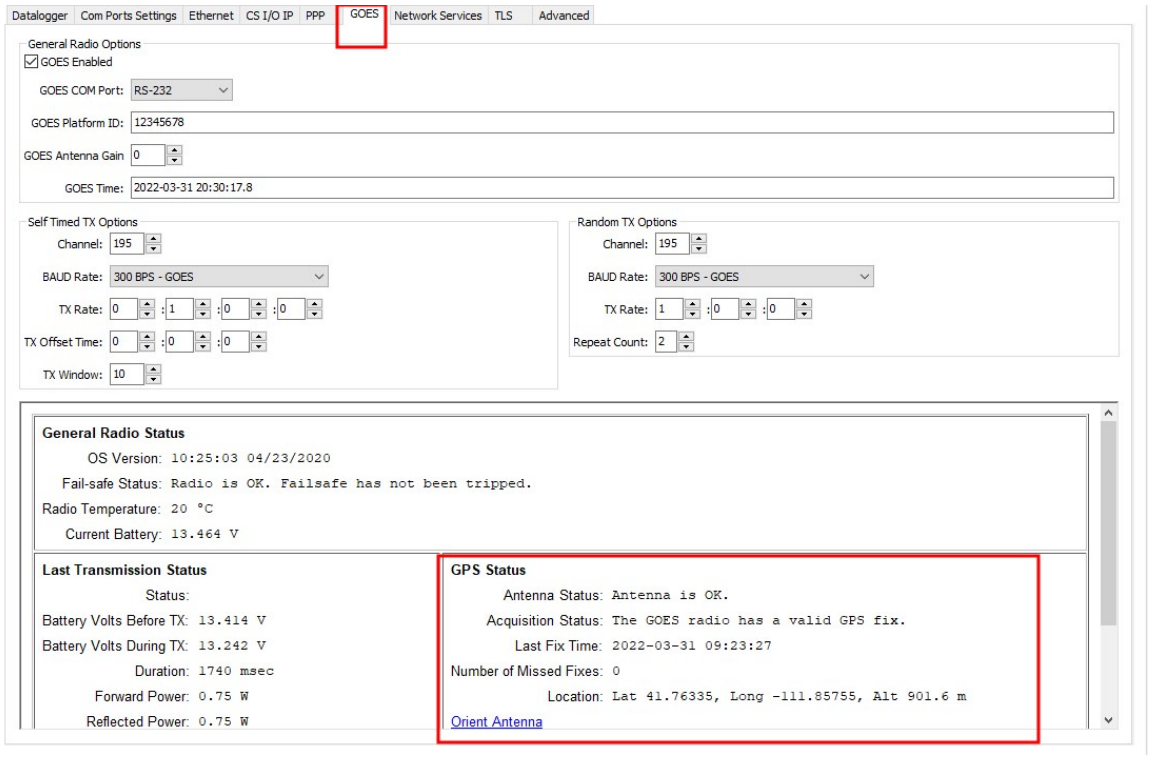
Check that the transmitter antenna is properly aimed. A poorly aimed antenna will cause a drop in signal strength or possibly prevent successful transmission. As a guide, if the antenna is aimed

20 degrees off the spacecraft, the received power will be half of a properly aimed antenna. Beyond 20 degrees, the received power drops off quickly.

The ***Device Configuration Utility*** software has a tool for helping to point the transmitter antenna. Refer to Transmission antenna (p. 15) for more information.

8.6 Verify GPS fix

Ensure that the TX325 has a valid GPS fix. For the newer data loggers, use the data logger **GOES** tab in the ***Device Configuration Utility***, and check the diagnostics at the bottom of the screen.



8.7 Verify data logger operating system (OS) is compatible

The following table lists the data logger operating systems that are compatible with the TX325 transmitter:

Table 8-1: Compatible data logger operations systems	
Data logger	Operations system
CR1000X	6.02 or newer
CR6	12.02 or Newer
CR300-series	10.08 or Newer
CR350	1.05 or Newer
CR1000/CR800/CR3000	32.06 or Newer

To verify the data logger OS version, connect to the data logger using the ***Device Configuration Utility*** and navigate to **Deployment** > **Datalogger** > **OS Version**.

8.8 Check TX325 settings

GOES radio settings are typically set in the data logger program, but can be verified in the ***Device Configuration Utility*** or through **LoggerNet** > **Connect** > **Datalogger** > **Settings Editor**.

> **NOTE:**
> Change the settings in the data logger program because the data logger program will reset the ***Device Configuration Utility*** settings.

In the ***Device Configuration Utility*** software, click the **GOES** tab:

1. Access the ***Device Configuration Utility***.
2. Select your data logger in **Device Type**.
3. Under **Deployment**, click the **GOES** tab.

   > **NOTE:**
   > The **GOES** tab is not available for the CR3000, CR1000, and CR800 Series.

4. Verify the **GOES Enabled** box is checked.
5. Ensure that the eight digit **GOES Platform ID** is correct.
6. The GOES Antenna Gain setting should be the default value of 0 when using the standard Yagi antenna offered by Campbell Scientific. Only change this value if using a user-supplied antenna (refer to Antenna gain for nonstandard antennas (p. 67) for more information).
7. Verify that the **Self-Timed BAUD Rate** is correct.
8. Ensure that the **Self-Timed Channel** is correct.
9. Verify that the **Self-Timed TX Interval** is correct and in the format of dd:hh:mm:ss.

10. Verify that the **Self-Timed TX Offset** is correct and in the format of hh:mm:ss.
11. If applicable, verify that the **Random TX BAUD Rate** is correct.
12. If applicable, verify that the **Random TX Channel** is correct.
13. If applicable, verify that the **Random TX Rate** has been applied and that the format is hh:mm:ss.
14. Click the **COM Port Settings** tab.
15. Ensure that the **ComPort** setting matches the communications port in which the TX325 is connected.
16. Verify that the **BAUD Rate** is 9600.

8.9 Check data logger program

CAUTION:
Data logger programs for an older GOES radio such as the TX312, TX320, or TX321 will not work with a TX325.

Verify the data logger program is structured for the correct data logger model. The CRBasic program for newer data loggers (CR1000X, CR6, CR350, CR300-series) is different and not interchangeable with the CRBasic program for older data loggers (CR3000, CR1000, CR800-series). Example programs for the newer and older data loggers are available at www.campbellsci.com/tx325.

NOTE:
If converting from using an older TX321 radio to a newer TX325, you will have to make significant changes to your program. Refer to TX321 program converted to TX325 program (CR1000, CR3000, CR800-series) (p. 69) for more information.

Find the `ConstTable` near the top of your data logger program. Check the values in this table to ensure that they are entered correctly. These values include but are not limited to the following:

Table 8-2: Constant table parameters

Constant	Description
`Const GOES_COMPORT`	Generally COMRS232 depending on data logger
`Const GOES_ID`	Is a unique value that is also called the DCP ID. Value must be in quotes.

Table 8-2: Constant table parameters	
Constant	Description
`Const UTC_OFFSET`	Number of seconds from the UTC time. –25200 is mountain time.
`Const SELF_TIMED_CHANNEL`	Also called the Primary Channel.
`Const SELF_TIMED_BAUD_RATE`	DCS assigns either 300 or 1200
`Const SELF_TIMED_INTERVAL`	Must be in quotes. Format is DD:HH:MM:SS
`Const SELF_TIMED_OFFSET`	Must be in quotes. Format is DD:HH:MM:SS
`Const SELF_TIMED_WINDOW`	DCS calls this window. Size of TX window
`Const RANDOM_CHANNEL`	Also called the Secondary Channel.
`Const RANDOM_BAUD_RATE`	DCS assigns either 300 or 1200
`Const RANDOM_INTERVAL`	Must be in quotes. Format is DD:HH:MM:SS
`Const RANDOM_OFFSET`	Must be in quotes. Format is DD:HH:MM:SS
`Const RANDOM_WINDOW`	DCS calls this window. Size of TX window
`Const DATA_FORMAT`	Generally either pseudo binary or ASCII data
`Const NUMBER_OF_VALUES_TO_TX`	The number of values you transmit to DCS for each variable. By default this will send 4 values for each variable one for each 15 min interval during the hour.

Comments in the example programs will provide guidance on the valid parameters for these fields. Also, refer to the information provided by the NOAA DCS system. This information is unique for each GOES connection.

8.10 Check for fail-safe mode

The TX325 transmitter will go into the fail-safe mode if one of two events occurs:

1. The transmitter RF output is turned on and left on for more than 110 seconds.
2. The transmitter is given a command to transmit less than 30 seconds after a transmission has taken place.

If a fail-safe condition occurs, the red fail-safe LED is on continuously; the RF output is disabled; and the microprocessor is reset, causing the transmitter to restart. While in the fail-safe mode,

the transmitter can communicate normally with the data logger, but is unable to transmit until the fail-safe mode has been cleared.

There are two ways to check if the TX325 is in fail-safe mode. The first is on site by checking the red fail-safe LED on the TX325 (see LED function [p. 12]). The fail-safe LED is located above the **Reset** button in the side of the transmitter housing (Figure 8-1 [p. 33]). If the red LED is on continuously, the radio is in fail-safe mode.

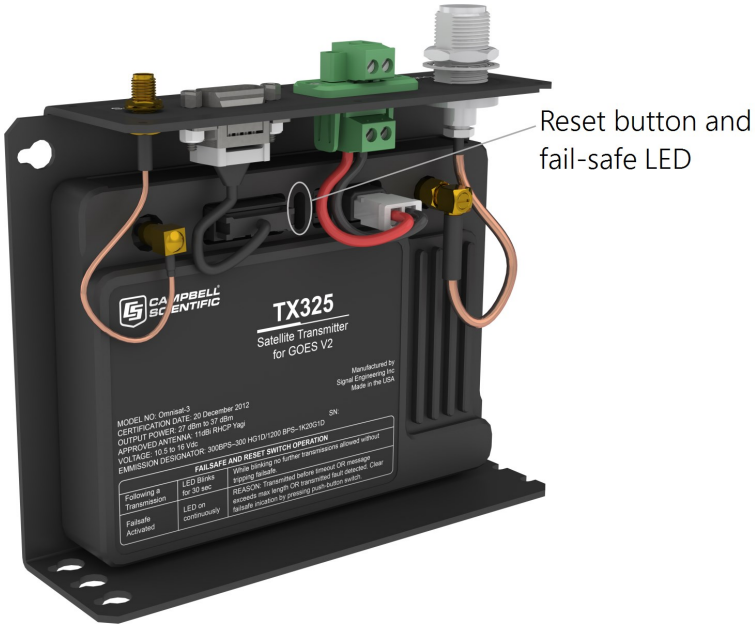
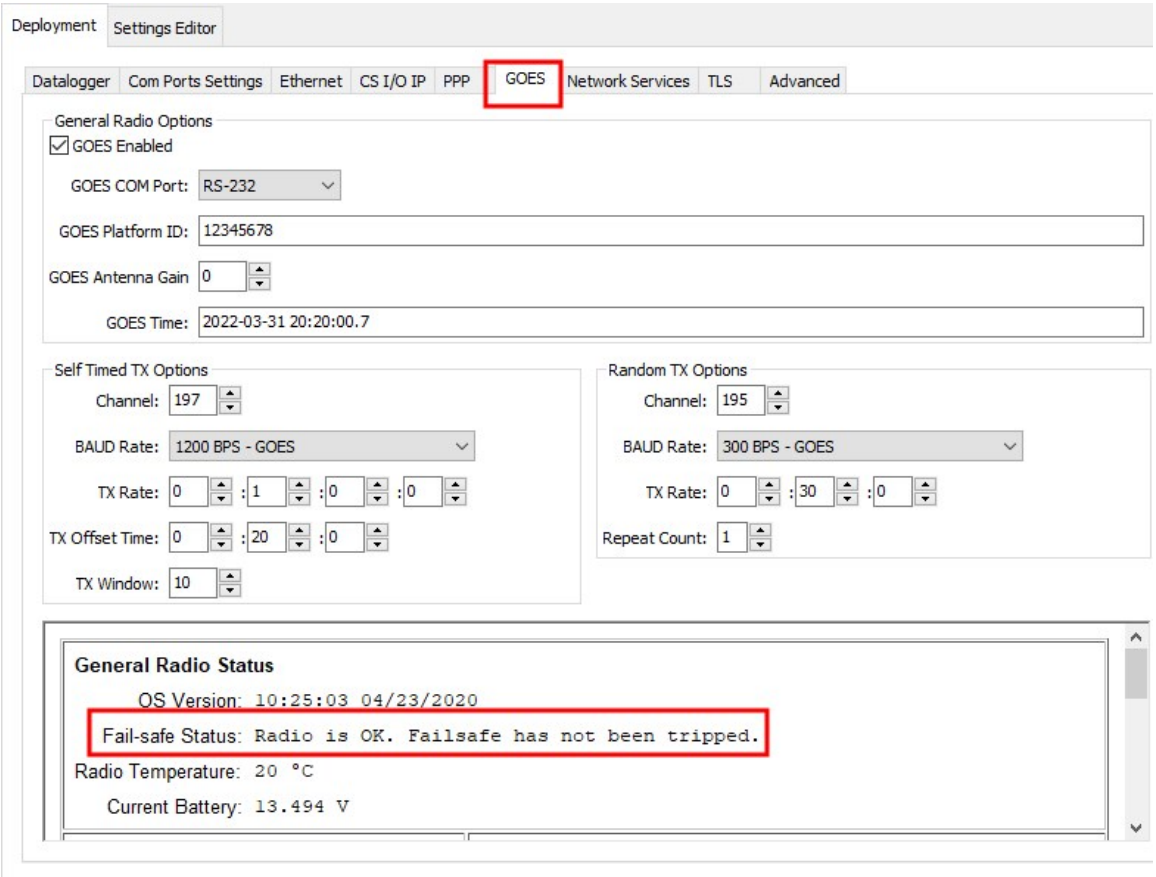


Figure 8-1. Reset button and fail-safe LED location

The fail-safe mode can also be checked using the ***Device Configuration Utility***. To use this method, connect to the data logger and click the **Deployment** > **GOES** tab. The **Fail-safe Status** is displayed in the **General Radio Status** section of the screen.



The only way to reset the fail-safe mode is to push the **Reset** button (Figure 8-1 [p. 33]).

> **CAUTION:**
> A power cycle will not clear the fail-safe mode.

8.11 Watch RS-232 transmission

The following instructions show the process of using the terminal mode in the ***Device Configuration Utility*** to watch the RS-232 traffic to ensure that the data logger and TX325 GOES radio are communicating with each other:

1. Connect the data logger to the computer and access the ***Device Configuration Utility***.
2. Click the **Terminal** tab.
3. Press enter until **CR1000X>** (or a different data logger model) is displayed.
4. Type **W** and press Enter.
5. Type the RS-232 port number and press Enter.

6. When prompted for **ASCII (Y)**, type **N** for no and press Enter.

```
CR1000X>W

1: ComRS232
2: ComME
3: Com310
4: ComSDC7
5: ComSDC8
6: Com320
7: ComSDC10
8: ComSDC11
9: ComC1
10: ComC3
11: ComC5
12: ComC7
13: ComUSB
15: TCP/IP
16: SDM-SIO4
17: Ethernet
22: USB network
23: IP Trace
32..47: SDM-SIO1
Select: 1

 ASCII (Y)? N

 opening 1

 hit ESC to exit, any other key to renew timeout
```

7. After entering the communications watch mode for the GOES interface, either trigger the GOES communication or wait for a transmission to take place.

The data logger time is displayed on the left in the hh:mm:ss.sss format. After the time, either a T or an R is displayed. T indicates that the data logger is transmitting data to the GOES radio and R indicates that the data logger is receiving data from the GOES radio. After the T or R, the transmitted data is displayed.

> **NOTE:**
> If you answered **Y** for step 6, you wouldn't be able to read the raw data in the Terminal mode

The following shows an example RF traffic screen:

```
12:10:00.536 R 00 00 00 00 00 00 0B                        ........
12:10:00.546 R 7C 23 FE FF 60 15 23 FE                     |#..`.#.
12:10:00.556 R FF 80 12 00 43 00 43 23                     ....C.C#
12:10:00.566 R FB 02 23 FE 66 00 00 23                     ..#.f..#
12:10:00.576 R FE DF 00 00 20 00 10 13                     .... ...
12:10:00.586 R 05 0A 00 00 C3 23 FE 00                     .....#..
12:10:00.596 R 4C 20 00 00 D7 04                           L ....
12:10:07.053 T 01 00 1F 1F 04                              .....
12:10:07.063 R 01 02 F0                                    ...
12:10:07.073 R 23 FB F6 04                                 #...
12:10:07.093 T 01 00 14 14 04                              .....
12:10:07.103 R 01 0A 14                                    ...
12:10:07.113 R 00 00 20 00 10 13 0A 07                     .. .....
12:10:07.123 R 23 FE 73 04                                 #.s.
12:10:07.120 T 01 00 10 00 10 04                           ......
12:10:07.130 R 01 06                                       ..
12:10:07.140 R 10 00 23 FE 23 FB D2 F0                     ..#.#...
12:10:07.150 R DD 04                                       ..
12:10:07.170 T 01 00 1E 00 00 20 00 10 13 0A 0A 00 4E 55 4C 4C  ..... ......NULL
12:10:07.170 T 2E 44 41 54 00 00 00 00 00 00 00 00 00 C3 00  .DAT............
12:10:07.170 T 4C 23 FE 00 00 00 00 00 00 00 00 00 00 00 00  L#..............
12:10:07.170 T 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ...............
12:10:07.170 T 00 0D 0A 31 33 2E 36 31 32 2C 31 33 2E 36 31 34  ...13.612,13.614
12:10:07.170 T 2C 31 33 2E 36 33 36 2C 31 33 2E 36 33 34 2C 31  ,13.636,13.634,1
12:10:07.170 T 33 2E 36 31 36 2C 0D 0A 32 34 2E 36 30 33 2C 32  3.616,..24.603,2
12:10:07.170 T 34 2E 35 38 37 2C 32 34 2E 35 37 32 2C 32 34 2E  4.587,24.572,24.
12:10:07.170 T 35 35 39 2C 32 34 2E 35 34 35 2C 0D 0A AB 04     559,24.545,....
12:10:07.330 R 01 02 1E 00 20 04                           .... .
```

A full set of test results from a sniff showing the communications between the TX325 and a data logger is available in Watch test results (p. 65).

8.12 Diagnostic table

This summary of the most relevant diagnostic values contained in the **GOES_DIAGNOSTICS** table can help users troubleshoot communications.

Low power is a common issue. The following diagnostic values can indicate power issues. Refer to Check TX325 and data logger power (p. 25) for more information.

- **goes_battery**: Current GOES battery voltage. For the 12 V data logger system, this always needs to stay at 12 V or more.
- **goes_battery_before_tx**: System voltage before transmission. This value should be 12 V or higher.

- goes_battery_during_tx: System voltage during transmission. A value below 12 V indicates power problems and that the power sources (battery, solar panel) will be unable to provide enough power for transmission.

The following diagnostic values can indicate problems in getting a GPS fix, which is likely a GPS antenna issue. For more information, refer to Check mounting and connections for the antennas (p. 27) and Verify antenna positioning (p. 28).

- goes_time_last_gps_position: The GOES time and GPS position of the last GPS fix. The TX325 can operate for a few days without a current GPS fix, but will eventually fail.
- goes_number_of_missed_gps: The number of attempts that failed to get a GPS fix. A high number indicates a poor GPS signal.

  > NOTE:
  > The TX325 does not require a new GPS fix each day.

- goes_time_last_missed_gps_fix: The last time a GPS fix attempt was missed.
- goes_gps_acquisitions_status: The current status of the GPS fix attempt.

The following are used to troubleshoot issues with the RF Out cable or transmitter antenna. For antenna help, refer to Check mounting and connections for the antennas (p. 27) and Verify antenna positioning (p. 28).

- goes_forward_tx_power: GOES forward TX Power in Watts. The values contained in the Forward RF Power field are approximate measurements, intended to help diagnose antenna and RF cable issues. These values can also be affected by antenna impedance and antenna cable characteristics. The range is 0 to 4 W. A value of 0 indicates a problem. If the values are too low, check the transmitter antenna.
- goes_reflected_rf_power: GOES Reflected RF Power in watts. The values contained in the Reflected RF Power field are approximate measurements, intended for use in detecting and diagnosing antenna and RF cable issues. These values can also be affected by antenna impedance and antenna cable characteristics. A value over 1 indicates a problem. If the values are too high, check the transmitter antenna.

  > NOTE:
  > The CR1000, CR800 series, and CR3000 data loggers do not provide Forward and Reflective Power in the GOES Diagnostics Table.

- goes_vswr: Voltage standing wave ratio (VSWR) is a ratio of the forward and reflected power. The VSWR values indicate the following:
  - VSWR < 2.0 indicates a good connection between transmitter and antenna.
  - VSWR between 2.0 and 3.0 possibly indicates a poor connection. Check the cables.
  - VSWR > 3.0 indicates a poor connection between transmitter and antenna. The cable might be damaged or disconnected.

The following are a couple of other relevant diagnostic values contained in the GOES_DIAGNOSTICS table:

- goes_fail_safe_indicator: Shows whether the fail safe has been triggered. For information about resetting the fail safe, refer to Check for fail-safe mode (p. 32).
- goes_tx_result_code: These codes provide likely reasons that data was not output to the TX325 transmitter. The following result codes are also available using the `GOESTable` CRBasic instruction:
  - "No Output"
  - "Write error"
  - "Timed out waiting for STX character from transmitter after SDC addressing"
  - "Wrong character received after SDC addressing"
  - "Timed out waiting for ACK or OK"
  - "CS I/O port not available; GOES not attached"
  - "Buffer Control Error"
  - "COM9602 not communicating"
  - "Illegal data format"
  - "Transmitter not set up"

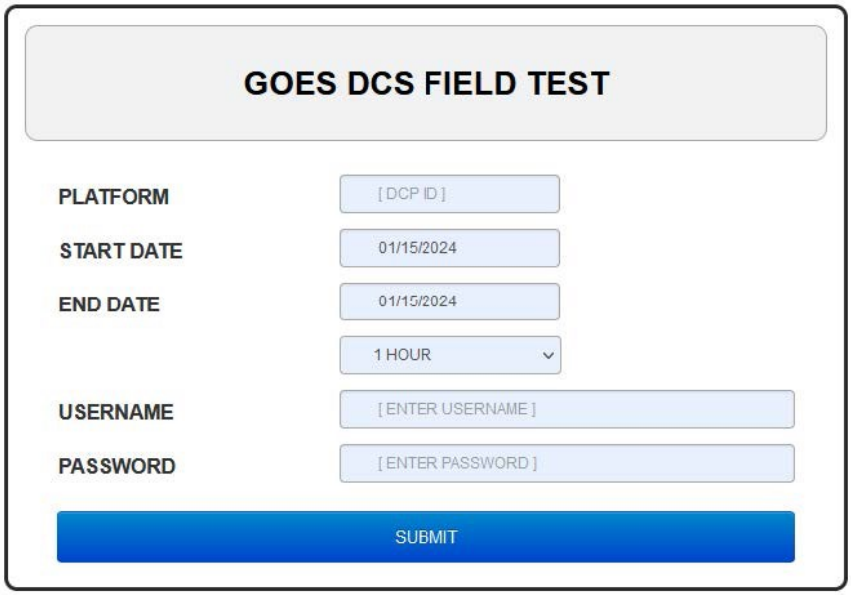
8.13 Troubleshooting over-air transmissions

TX325 users within the GOES system can troubleshoot their over-the-air data transmissions by using one of the following websites:

- https://dcs1.noaa.gov/Account/FieldTest
- https://dcs2.noaa.gov/Account/FieldTest
- https://dcs3.noaa.gov/Account/FieldTest
- https://dcs4.noaa.gov/Account/FieldTest

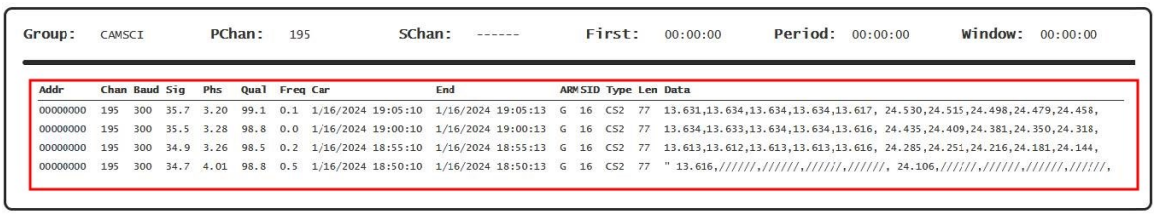
The DCS Field Test with your GOES connection will return information about the platform and any message data found in the date/time range specified by the query. If values are displayed after performing the DCS field test, the GOES transmitter is sending data to the DCS system. If the received values are within the acceptable parameters, the connection is working well.

1. Type your eight-character GOES Platform ID in the **PLATFORM** field.
2. Type the **START DATE**.
3. Type the **END DATE**.
4. Select the number of hours you want the field test system to go back to.
5. Type the **USERNAME** and **PASSWORD**.
6. Click **SUBMIT**.



The top of the output shows the assigned GOES Platform ID (**Group**), channels (**PChan**, **SChan**), transmission times (**First**, **Period**), and window length (**Window**). Make sure your settings in your DCP match this information. Failure to do so will result in loss of data and transmitting over the top of other DCP scheduled slots and also will result in the loss of other user data.

The bottom table shows information that can help determine the health of the DCP transmissions. Example results:.



Field descriptions of DCS results:

- **Addr**: GOES Platform ID
- **Chan**: GOES channel that the transmission used.
- **Baud**: Baud rate of the transmission. Either 300 or 1200.
- **Sig**: Signal strength, which should be in a range of 25 to 56. If the received **Sig** is too low (under 25), transmissions won't meet the reception threshold to communicate and the connection will not be reliable. **Sig** over 56 is a violation of the user certification and user agreement and will increase noise for other users who might be transmitting. Ideally, for 300 baud, the signal strength should be around 42.
- **Phs**: Phase that should be near 0 or a low single digit.
- **Qual**: Signal quality in percent that should be in the 90s.
- **Freq**: Frequency offset of the transmission indicates how far outside of the channel center frequency that the transmission was at. DCS allows plus or minus 150 Hz from the channel center. Messages outside the limit will not be received by the satellite. Significant deviation in **Freq** usually is caused by a faulty transmitter.

An extra character could be in front of the transmitted data message, indicating whether or not the GPS time synced (Table 8-3 [p. 40]). This character is added to the number of bytes (shown as LEN) that were in the data transmission.

Table 8-3: Characters indicating time sync

Character	Data type	Time synced since last transmission
Space	ASCII	No
Double quote (")	ASCII	Yes
Apostrophe (')	Binary	No
Lower case b	Binary	Yes

NOTE:
If values in DCS or the **GOES_Data** table are showing as NAN, INF, -7999, +7999, or a series of forward slashes (/) instead of measurement values, either the system is having trouble making a good sensor measurement or there is a problem with the variable types in your data table. For variable type issues see Data formats and transmission durations (p. 43).

8.14 Verify GOES service and check GOES data

If it has been a while since accessing the GOES service or the station has frequently violated the timing window, the GOES service may not be active. To verify that your GOES service is still active, go to https://dcs2.noaa.gov then contact **DADDS Technical Support/Customer Service** using the online information.

LoggerNet does not interface directly with GOES. Users can get data from the GOES system through NOAA by logging into https://dcs4.noaa.gov/Account/Login or using the ***LRGS Client*** software also called ***OPEN DCS***. The client ***OPEN DCS*** allows the data to be downloaded to a local computer. A *Getting Started Guide* for the client is available on the GOES website (https://dcs3.noaa.gov/LRGS/LRGS-Client-Getting-Started.pdf).

For variable type issues or trouble getting good sensor values, refer to Data formats and transmission durations (p. 43).

Appendix A. Eligibility and getting onto the GOES system

U.S. federal, state, or local government agencies, or users sponsored by one of those agencies, may use GOES. Potential GOES users must apply for and be granted a System Use Agreement (SUA) by NESDIS, which is typically renewable every 5 years. Use the following procedure to acquire permission for getting onto the GOES system:

1. Follow the steps provided at: https://dcs2.noaa.gov to submit an application for GOES DCS SUA. Once submitted, the approving authorities will review the application and notify you within two weeks. If you are approved NESDIS will send you a *Memorandum of Agreement (MOA)*.
2. Sign and submit the MOA. After the MOA is approved, NESDIS will issue a channel assignment and an GOES platform ID.
3. **IMPORTANT:** Contact NESDIS to coordinate a start-up date.

See https://dcs2.noaa.gov for more information.

Appendix B. Data formats and transmission durations

Data transmissions are generally described as having an ASCII or pseudobinary format. The particular nature of how the data is formatted prior to sending the data over-the-air. The data order in those transmissions is determined by the content and organization of the DataTables() and execution of GOESTable() and GOESField(). Scan-order (interleaved) and channel-order data can be sent by using an ASCII or pseudobinary format with one of the native data logger data format options. The flexibility of CRBasic allows virtually any message type to match the decode system requirements.

B.1 ASCII data format

ASCII data formats are used to transmit data in plain readable text. This format is widely used for random or alert transmissions. They can be used for self-timed messages. Several standard formats are selectable within CRBasic. Formats not included can be easily formed using string-formatted data fields, allowing the content to be tailored to your application needs. String-formatted data fields are limited to 13 characters for each field.

B.1.1 7-byte floating-point ASCII (GOESTable() format option 1)

The 7-byte floating-point ASCII data type is a fixed-width format with variable precision.

- Operating range of ±7999, depending on placement of decimal point (see Table B-1 [p. 44]).
- Variable precision of 0.001 to 1, depending on placement of decimal point (see Table B-1 [p. 44]).
- Precision (placement of decimal point) is automatically determined based on the magnitude of the value (Table B-1 [p. 44]).
- Number are rounded to selected precision during conversion. For example, +12.345, will be rounded to +12.35.
- Value is always 7 characters including a trailing comma.
- Value is always signed (+/-).

- Leading zeros and trailing zeros are added to maintain the width (7 characters) of the value transmitted.
- Value always has a trailing comma. This includes the last value sent.
- Valid data outside of operating range are set to –7999 or +7999, unless it is a NAN, +INF, or -INF (see Table B-1 [p. 44]).

Table B-1: 7-byte floating-point ASCII data

Range	Maximum precision	Example ASCII output
±7.999	0.001	+1.200,
±79.99	0.01	+12.00,
±799.9	0.1	+120.0,
±7999	1	+1200.,
NAN[1] = –8190.,		
+INF[2] = +8191.,		
-INF[2] = -8191.,		

[1]Not A Number

[2]Infinity

Example output (with 10 fields):

```
GoesTable() Fields_Scan_Order = FALSE, Newest_First=FALSE, Format = 1
GoesField() Decimation = 1
   <CR><LF>-7994.,-7994.,+8191.,-8191.,-8190.,+8191.,-8191.,-8190.,+13.10,+27.32,


GoesTable() Fields_Scan_Order = FALSE, Newest_First=FALSE, Format = 1
GoesField() Decimation = 4
   <CR><LF>-7997.,-7997.,+8191.,-8191.,-8190.,+8191.,-8191.,-8190.,+13.15,+26.08,
   <CR><LF>-7996.,-7996.,+8191.,-8191.,-8190.,+8191.,-8191.,-8190.,+13.16,+26.04,
   <CR><LF>-7995.,-7995.,+8191.,-8191.,-8190.,+8191.,-8191.,-8190.,+13.17,+26.03,
   <CR><LF>-7994.,-7994.,+8191.,-8191.,-8190.,+8191.,-8191.,-8190.,+13.19,+26.18,
```

```
GoesTable() Fields_Scan_Order = True, Newest_First=FALSE, Format = 1
GoesField() Decimation = 1
   <CR><LF> -7994.,
   <CR><LF> -7994.,
   <CR><LF> +8191.,
   <CR><LF> -8191.,
   <CR><LF> -8190.,
   <CR><LF> +8191.,
   <CR><LF> -8191.,
   <CR><LF> -8190.,
   <CR><LF> +13.13,
   <CR><LF> +27.72,
```

```
GoesTable() Fields_Scan_Order = True, Newest_First=FALSE, Format = 1
GoesField() Decimation = 4
   <CR><LF>-7997.,-7996.,-7995.,-7994.,
   <CR><LF>-7997.,-7996.,-7995.,-7994.,
   <CR><LF>+8191.,+8191.,+8191.,+8191.,
   <CR><LF>-8191.,-8191.,-8191.,-8191.,
   <CR><LF>-8190.,-8190.,-8190.,-8190.
   <CR><LF>,+8191.,+8191.,+8191.,+8191.,
   <CR><LF>-8191.,-8191.,-8191.,-8191.,
   <CR><LF>-8190.,-8190.,-8190.,-8190.,
   <CR><LF>+13.12,+13.12,+13.12,+13.11,
   <CR><LF>+27.59,+27.59,+27.59,+27.60,
```

B.1.2 ASCII table space (GOESTable() format option 2)

This option provides a tabular format. Columns are fixed width, according to the field format, and are space delimited. Lines are <CR><LF> delimited. You can send either the newest or oldest data first. A <CR><LF> is added at the end of the final line sent.

- NANs, +INFs, -INFs, and missing values show as forward slashes (/) in the output.
- Each line contains all the values listed in GOESTable() that have been set with GOESField() and are sent in the order they are listed in the data table if Scan_Order is set to False.
- Each line has all data from a single sensor if Scan_Order is set to True.
- SHEF Codes can be added as headers or at the beginning of lines using GOESField() option SHEF.
- Value has a fixed width (Table B-2 [p. 46]).
- Value has a fixed precision (Table B-2 [p. 46]).
- Value only has a leading sign when negative (–).

- Data outside of operating range will be set to the minimum or maximum of the range.
- Value always has a trailing space character.

Table B-2: ASCII format, width, precision, and range

Format	Width	Precision	Range	Example ASCII output containing two values
xxx	3	1	–99 to 999	012 -34
xxxxx	5	1	–9999 to 99999	00012 -0034
xxx.x	5	0.1	–99.9 to 999.9	001.2 -03.4
xx.xx	5	0.01	–9.99 to 99.99	00.12 -0.34
x.xxx	5	0.001	–.999 to 9.999	0.012 -.034

Example outputs (with 10 fields):

```
GoesTable() Fields_Scan_Order = FALSE, Newest_First=FALSE, Format = 2
GoesField() Decimation = 1, Precision = 3, Width = 4
   <CR><LF>-7.982 -7.982 //// //// //// //// //// //// 13.1 25.8<CR><LF>


GoesTable() Fields_Scan_Order = FALSE, Newest_First=FALSE, Format = 2
GoesField() Decimation = 4, Precision = 3, Width = 5
   <CR><LF>-9.81 -9.81 ///// ///// ///// ///// ///// ///// 13.15 26.08
   <CR><LF>-9.80 -9.80 ///// ///// ///// ///// ///// ///// 13.13 26.08
   <CR><LF>-9.79 -9.79 ///// ///// ///// ///// ///// ///// 13.14 26.08
   <CR><LF>-9.78 -9.78 ///// ///// ///// ///// ///// ///// 13.14 26.08<CR><LF>


GoesTable() Fields_Scan_Order = TRUE, Newest_First=FALSE, Format = 2
GoesField() Decimation = 1, Precision = 3, Width = 5
   <CR><LF>-9.68
   <CR><LF>-9.68
   <CR><LF>/////
   <CR><LF>/////
   <CR><LF>/////
   <CR><LF>/////
   <CR><LF>/////
   <CR><LF>/////
   <CR><LF>13.12
   <CR><LF>26.43<CR><LF>
```

```
GoesTable() Fields_Scan_Order = TRUE, Newest_First=FALSE, Format = 2
GoesField() Decimation = 4, Precision = 3, Width = 5
   <CR><LF>-9.45 -9.44 -9.43 -9.42
   <CR><LF>-9.45 -9.44 -9.43 -9.42
   <CR><LF>///// ///// ///// /////
   <CR><LF>///// ///// ///// /////
   <CR><LF>///// ///// ///// /////
   <CR><LF>///// ///// ///// /////
   <CR><LF>///// ///// ///// /////
   <CR><LF>///// ///// ///// /////
   <CR><LF>13.13 13.14 13.13 13.13
   <CR><LF>26.24 26.24 26.24 26.24<CR><LF>


GoesTable() Fields_Scan_Order = FALSE, Newest_First=FALSE, Format = 2
GoesField() Decimation = 1, Precision = 3, Width = 5, SHEF set to HG, TA, VB
   <CR><LF>HG TA VB
   <CR><LF>-7.94 13.13 26.72<CR><LF>


GoesTable() Fields_Scan_Order = FALSE, Newest_First=FALSE, Format = 2
GoesField() Decimation = 4, Precision = 3, Width = 5, SHEF set to HG, TA, VB
   <CR><LF>HG TA VB
   <CR><LF>-8.32 13.14 26.74
   <CR><LF>-8.31 13.14 26.74
   <CR><LF>-8.30 13.14 26.74
   <CR><LF>-8.29 13.14 26.74<CR><LF>


GoesTable() Fields_Scan_Order = TRUE, Newest_First=FALSE, Format = 2
GoesField() Decimation = 1, Precision = 3, Width = 5, SHEF set to HG, TA, VB
   <CR><LF>HG -6.79
   <CR><LF>TA 13.12
   <CR><LF>VB 26.68<CR><LF>


GoesTable() Fields_Scan_Order = TRUE, Newest_First=FALSE, Format = 2
GoesField() Decimation = 4, Precision = 3, Width = 5, SHEF set to HG, TA, VB
   <CR><LF>HG -8.26 -8.25 -8.24 -8.23
   <CR><LF>TA 13.14 13.14 13.13 13.14
   <CR><LF>VB 26.76 26.76 26.76 26.76<CR><LF>


GoesTable() Fields_Scan_Order = TRUE, Newest_First=FALSE, Format = 2
GoesField() Decimation = 4, Precision = 3, Width = 5, SHEF set to HG, TA, VB
```

> NOTE:
> To get a single battery voltage (or other additional data), set `GoesField()` Decimation = 1 for just the `battery_voltage` (or other) value in the `GOESTable()`.

```
<CR><LF>HG -9.70 -9.69 -9.68 -9.67
<CR><LF>TA 13.11 13.13 13.10 13.13
<CR><LF>VB 26.82 26.82 26.82 26.82
<CR><LF>BATTERY 13.13
<CR><LF>DATE 200336
<CR><LF>TIME 101500<CR><LF>
```

B.1.3 ASCII table space, comma separated (GOESTable() format option 3)

This option provides a tabular format. Columns are fixed width, according to the field format, and are comma (,) delimited. Lines are <CR><LF> delimited. You can send either the newest or oldest data first. A <CR><LF> is added at the end of the final line sent.

- NANs, +INFs, -INFs, and missing values show as forward slashes (/) in the output.
- Each line contains all the values listed in GOESTable() that have been set with GOESField() and are sent in the order they are listed in the data table if Scan_Order is set to False.
- Each line has all data from a single sensor if Scan_Order is set to True.
- SHEF Codes can be added as headers or at the beginning of lines using GOESField() option SHEF.
- Value has a fixed width (Table B-2 [p. 46]).
- Value has a fixed precision (Table B-2 [p. 46]).
- Value only has a leading sign when negative (–).
- Data outside of operating range will be set to the minimum or maximum of the range.
- Value always has a trailing comma (,).

Example outputs (with 10 fields):

```
GoesTable() Fields_Scan_Order = FALSE, Newest_First=FALSE, Format = 3
GoesField() Decimation = 1, Precision = 3, Width = 4
   <CR><LF>-7.982,-7.982,////,////,////,////,////,////,13.1,25.8<CR><LF>


GoesTable() Fields_Scan_Order = FALSE, Newest_First=FALSE, Format = 3
GoesField() Decimation = 4, Precision = 3, Width = 5
   <CR><LF>-9.81,-9.81,/////,/////,/////,/////,/////,/////,13.15,26.08
   <CR><LF>-9.80,-9.80,/////,/////,/////,/////,/////,/////,13.13,26.08
   <CR><LF>-9.79,-9.79,/////,/////,/////,/////,/////,/////,13.14,26.08
   <CR><LF>-9.78,-9.78,/////,/////,/////,/////,/////,/////,13.14,26.08<CR><LF>
```

```
GoesTable() Fields_Scan_Order = TRUE, Newest_First=FALSE, Format = 3
GoesField() Decimation = 1, Precision = 3, Width = 5
   <CR><LF>-9.68
   <CR><LF>-9.68
   <CR><LF>/////
   <CR><LF>/////
   <CR><LF>/////
   <CR><LF>/////
   <CR><LF>/////
   <CR><LF>/////
   <CR><LF>13.12
   <CR><LF>26.43<CR><LF>


GoesTable() Fields_Scan_Order = TRUE, Newest_First=FALSE, Format = 3
GoesField() Decimation = 4, Precision = 3, Width = 5
   <CR><LF>-9.45,-9.44,-9.43,-9.42
   <CR><LF>-9.45,-9.44,-9.43,-9.42
   <CR><LF>/////,/////,/////,/////
   <CR><LF>/////,/////,/////,/////
   <CR><LF>/////,/////,/////,/////
   <CR><LF>/////,/////,/////,/////
   <CR><LF>/////,/////,/////,/////
   <CR><LF>/////,/////,/////,/////
   <CR><LF>13.13,13.14,13.13,13.13
   <CR><LF>26.24,26.24,26.24,26.24<CR><LF>


GoesTable() Fields_Scan_Order = FALSE, Newest_First=FALSE, Format = 3
GoesField() Decimation = 1, Precision = 3, Width = 5, SHEF set to HG, TA, VB
   <CR><LF>HG,TA,VB
   <CR><LF>-7.94,13.13,26.72<CR><LF>


GoesTable() Fields_Scan_Order = FALSE, Newest_First=FALSE, Format = 3
GoesField() Decimation = 4, Precision = 3, Width = 5, SHEF set to HG, TA, VB
   <CR><LF>HG,TA,VB
   <CR><LF>-8.32,13.14,26.74
   <CR><LF>-8.31,13.14,26.74
   <CR><LF>-8.30,13.14,26.74
   <CR><LF>-8.29,13.14,26.74<CR><LF>


GoesTable() Fields_Scan_Order = TRUE, Newest_First=FALSE, Format = 3
GoesField() Decimation = 1, Precision = 3, Width = 5, SHEF set to HG, TA, VB
   <CR><LF>HG,-6.79
   <CR><LF>TA,13.12
   <CR><LF>VB,26.68<CR><LF>
```

```
GoesTable() Fields_Scan_Order = TRUE, Newest_First=FALSE, Format = 3
GoesField() Decimation = 4, Precision = 3, Width = 5, SHEF set to HG, TA, VB
   <CR><LF>HG,-8.26,-8.25,-8.24,-8.23
   <CR><LF>TA,13.14,13.14,13.13,13.14
   <CR><LF>VB,26.76,26.76,26.76,26.76<CR><LF>
```

```
GoesTable() Fields_Scan_Order = TRUE, Newest_First=FALSE, Format = 3
GoesField() Decimation = 4, Precision = 3, Width = 5, SHEF set to HG, TA, VB
```

> NOTE:
> To get a single battery voltage (or other additional data), set `GoesField()` Decimation = 1 for just the `battery_voltage` (or other) value in the `GOESTable()`.

```
   <CR><LF>HG,-9.70,-9.69,-9.68,-9.67
   <CR><LF>TA,13.11,13.13,13.10,13.13
   <CR><LF>VB,26.82,26.82,26.82,26.82
   <CR><LF>BATTERY,13.13
   <CR><LF>DATE,200336
   <CR><LF>TIME,101500<CR><LF>
```

B.1.4 Line SHEF (`GOESTable()` format option 6)

ASCII output using standardized SHEF codes in a format that is human readable.

- NANs, +INFs, -INFs, and missing values show as forward slashes (/) in the output.
- LABEL is the SHEF code (two character) parameter. Refer to https://dcs1.noaa.gov/documents/SHEF%20Codes.pdf for details on SHEF codes.
- OFFSET is how long ago the sensor reading was made and stored in the `GOESTable()` data table and is reported in number of minutes.
- INTERVAL is how often the measurement is made. This corresponds to `DataInterval()` of the GOES data table or the scan interval if `DataInterval()` is not used.
- DATA is the data that is stored in the GOES table.
- APPENDED OPTIONS refers to data that can be appended to the transmission.
- SHEF Codes can be added as headers or at the beginning of lines using `GOESField()` option SHEF.
- Value has a fixed width (Table B-2 [p. 46]).
- Value has a fixed precision (Table B-2 [p. 46]).
- Value only has a leading sign when negative (–).
- Data outside of operating range will be set to the minimum or maximum of the range.

Format of data transmitted:

```
: <LABEL1> <OFFSET> #<INTERVAL> <DATA1> <DATA1> ... <DATA1)>
: <LABEL2> <OFFSET> #<INTERVAL> <DATA2> <DATA2> ... <DATA2> ...
: <LABEL(N)> <OFFSET> #<INTERVAL> <DATA(N)> <DATA(N)> ... <DATA(N)>
```

Example output with explanation:

```
GoesTable() Fields_Scan_Order = TRUE, Newest_First=FALSE, Format = 6
GoesField() Decimation = 4, Precision = 3, Width = 5, SHEF set to VB and TA
(see Table B-3 [p. 51])
  <CR><LF><SPC>:VB<SPC>8<SPC>#15<SPC>13.15<SPC>13.13<SPC>13.18<SPC>13.19
  <CR><LF><SPC>:TA<SPC>8<SPC>#15<SPC>26.76<SPC>26.76<SPC>26.85<SPC>26.98<CR><LF>
```

Table B-3: Example SHEF output with descriptions

Output	Description
:VB	SHEF Code VB (Voltage – Battery)
8	Reading is 8 minutes old (happened 8 minutes prior to transmission)
#15	15-minutes measurement interval
13.15	Most recent sensor or measurement reading
13.13	Sensor or measurement reading taken 15 minutes prior to transmission
13.18	Sensor or measurement reading taken 30 minutes prior to transmission
13.19	Sensor or measurement reading taken 45 minutes prior to transmission
:TA	SHEF Code TA (Temperature, air, dry bulb)
8	Reading is 8 minutes old (happened 8 minutes prior to transmission)
#15	15-minutes measurement interval
26.76	Most recent sensor or measurement reading
26.76	Sensor or measurement reading taken 15 minutes prior to transmission
26.85	Sensor or measurement reading taken 30 minutes prior to transmission
26.98	Sensor or measurement reading taken 45 minutes prior to transmission

B.2 Pseudobinary data formats

The pseudobinary data format is a modified-ASCII format that uses the lower 6 bits of each 8-bit data character to represent part of a binary message. To encode a number, its binary form is broken into groups of 6 bits. Each group is placed into the lower 6 bits of a respective byte. The

number 64 is added to each byte to set the seventh bit. Binary numbers are transmitted MSB (most significant bit) first.

Pseudobinary formats are preferred for GOES and Meteosat/EUMETSAT self-timed transmissions because users can include more data in the GOES message. This allows more data to be transmitted in a specific window of transmission time.

> NOTE:
> These messages are not human readable and need to be decoded by computer software or by using custom decoding tables.

Because only 6 bits are used in each byte, the range that a byte or series of bytes can represent is diminished (Table B-4 [p. 52]).

Table B-4: Pseudobinary ranges

Pseudobinary type	Range
1-byte encoded unsigned integer	0 to +63
1-byte encoded signed integer	–32 to +31
2-byte encoded unsigned integer	0 to +4094
2-byte encoded signed integer	–2048 to +2047
3-byte encoded unsigned integer	0 to +262143
3-byte encoded signed integer	–131072 to +131071
4-byte encoded unsigned integer	0 to +16777215
4-byte encoded signed integer	–8388608 to +8388607

B.2.1 Campbell Scientific FP2 data

The FP2 data format uses 16 bits to represent a variable-precision floating point number. FP2 has a total range of -7999 to 7999 and variable precision of 0.001 to 1. It also has the ability to signal +/– INF and NAN, most commonly used to indicate a computational or measurement error. Table B-5 (p. 53) shows the numeric ranges and precision; Table B-6 (p. 53) describes the bits, and Table B-7 (p. 53) provides bit usage in calculating a finished value.

Table B-5: FP2 range and maximum precision		
Range	Maximum precision	b15 and b14 bit pattern
–7.999 to 7.999	0.001	11
–79.99 to 79.99	0.01	10
–799.9 to 799.9	0.1	01
–7,999 to 7,999	1	00

Table B-6: Bit description		
Name	Bit	Description
Sign (S)	16 (MSB)	Specifies the sign of the value. 0 = positive, 1 = negative.
Exponent (E)	15 and 14	Specifies the magnitude of the negative decimal exponent.
Mantissa (M)	13 to 0 (LSB)	Specifies the magnitude of the 13-bit mantissa, 0 to 8191

Table B-7: Calculation of finished value			
Sign (S)	Exponent (E)	Mantissa (M)	FP2 value equals
0	00	8191	+ INF
1	00	8191	– INF
1	00	8190	NAN
0 or 1	00 or 01 or 10	0 to 7999	(–1 ^ S) × (10 ^ –E) × M

When transmitted in a pseudobinary format, the 16 bits are encoded as follows. Bits 16 through 13 are the least significant four bits of the first byte, bits 12 through 7 are the least significant six bits of the second byte, and the last six bits are the least significant bits of the last byte. The following tables are examples of encoding values.

Table B-8: Encoding of 1234

Character 1 = @								Character 2 = S								Character 3 = R							
				Sign	Exponent		Mantissa			Mantissa								Mantissa						
p	1	0	0	b16	b15	b14	b13	p	1	b12	b11	b10	b9	b8	b7	p	1	b6	b5	b4	b3	b2	b1
0	1	0	0	0	0	0	0	0	1	0	1	0	0	1	1	0	1	0	1	0	0	1	0

Table B-9: Encoding of 1.234

Character 1 = F								Character 2 = S								Character 3 = R							
				Sign	Exponent		Mantissa			Mantissa								Mantissa						
p	1	0	0	b16	b15	b14	b13	p	1	b12	b11	b10	b9	b8	b7	p	1	b6	b5	b4	b3	b2	b1
0	1	0	0	0	1	1	0	0	1	0	1	0	0	1	1	0	1	0	1	0	0	1	0

Table B-10: Encoding of 12.34

Character 1 = D								Character 2 = S								Character 3 = R							
				Sign	Exponent		Mantissa			Mantissa								Mantissa						
p	1	0	0	b16	b15	b14	b13	p	1	b12	b11	b10	b9	b8	b7	p	1	b6	b5	b4	b3	b2	b1
0	1	0	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0	1	0	0	1	0

Table B-11: Encoding of 123.4

Character 1 = B								Character 2 = S								Character 3 = R							
				Sign	Exponent		Mantissa			Mantissa								Mantissa						
p	1	0	0	b16	b15	b14	b13	p	1	b12	b11	b10	b9	b8	b7	p	1	b6	b5	b4	b3	b2	b1
0	1	0	0	0	0	1	0	0	1	0	1	0	0	1	1	0	1	0	1	0	0	1	0

Table B-12: Encoding of 0.123

Character 1 = F								Character 2 = A								Character 3 = {							
				Sign	Exponent		Mantissa			Mantissa								Mantissa							
p	1	0	0	b16	b15	b14	b13	p	1	b12	b11	b10	b9	b8	b7	p	1	b6	b5	b4	b3	b2	b1
0	1	0	0	0	1	1	0	0	1	0	0	0	0	0	1	0	1	1	1	1	0	1	1

Table B-13: Encoding of -1234

Character 1 = H								Character 2 = S								Character 3 = R							
				Sign	Exponent		Mantissa			Mantissa								Mantissa							
p	1	0	0	b16	b15	b14	b13	p	1	b12	b11	b10	b9	b8	b7	p	1	b6	b5	b4	b3	b2	b1
0	1	0	0	1	0	0	0	0	1	0	1	0	0	1	1	0	1	0	1	0	0	1	0

Table B-14: Encoding of -1.234

Character 1 = N								Character 2 = S								Character 3 = R							
				Sign	Exponent		Mantissa			Mantissa								Mantissa							
p	1	0	0	b16	b15	b14	b13	p	1	b12	b11	b10	b9	b8	b7	p	1	b6	b5	b4	b3	b2	b1
0	1	0	0	1	1	1	0	0	1	0	1	0	0	1	1	0	1	0	1	0	0	1	0

Table B-15: Encoding of -12.34

Character 1 = L								Character 2 = S								Character 3 = R							
				Sign	Exponent		Mantissa			Mantissa								Mantissa							
p	1	0	0	b16	b15	b14	b13	p	1	b12	b11	b10	b9	b8	b7	p	1	b6	b5	b4	b3	b2	b1
0	1	0	0	1	1	0	0	0	1	0	1	0	0	1	1	0	1	0	1	0	0	1	0

Table B-16: Encoding of -123.4

Character 1 = J								Character 2 = S								Character 3 = R							
				Sign	Exponent		Mantissa			Mantissa								Mantissa							
p	1	0	0	b16	b15	b14	b13	p	1	b12	b11	b10	b9	b8	b7	p	1	b6	b5	b4	b3	b2	b1
0	1	0	0	1	0	1	0	0	1	0	1	0	0	1	1	0	1	0	1	0	0	1	0

Table B-17: Encoding of -0.123

Character 1 = N								Character 2 = A								Character 3 = {							
				Sign	Exponent		Mantissa			Mantissa								Mantissa							
p	1	0	0	b16	b15	b14	b13	p	1	b12	b11	b10	b9	b8	b7	p	1	b6	b5	b4	b3	b2	b1
0	1	0	0	1	1	1	0	0	1	0	0	0	0	0	1	0	1	1	1	1	0	1	1

Table B-18: Encoding of INF

Character 1 = A								Character 2 = ?								Character 3 = ?							
				Sign	Exponent		Mantissa			Mantissa								Mantissa							
p	1	0	0	b16	b15	b14	b13	p	1	b12	b11	b10	b9	b8	b7	p	1	b6	b5	b4	b3	b2	b1
0	1	0	0	0	0	0	1	0	0	1	1	1	1	1	1	0	0	1	1	1	1	1	1

Table B-19: Encoding of -INF

Character 1 = I								Character 2 = ?								Character 3 = ?							
				Sign	Exponent		Mantissa			Mantissa								Mantissa							
p	1	0	0	b16	b15	b14	b13	p	1	b12	b11	b10	b9	b8	b7	p	1	b6	b5	b4	b3	b2	b1
0	1	0	0	1	0	0	1	0	0	1	1	1	1	1	1	0	0	1	1	1	1	1	1

Table B-20: Encoding of NAN

Character 1 = I								Character 2 = ?								Character 3 = ~							
				Sign	Exponent		Mantissa			Mantissa										Mantissa					
p	1	0	0	b16	b15	b14	b13	p	1	b12	b11	b10	b9	b8	b7	p	1	b6	b5	b4	b3	b2	b1
0	1	0	0	1	0	0	1	0	0	1	1	1	1	1	1	0	0	1	1	1	1	1	0

B.2.2 Pseudobinary

Pseudobinary or 18-bit integer data format is used to transmit a signed or unsigned integer. The 18 bits are encoded across 3 bytes. When signed, the value is encoded using a two-complement representation. As an integer cannot directly represent a fractional number, measurements are often scaled before storing to the GOES data table. For example, a water-level surface elevation of 123.45 ft can be multiplied by 100 to get an integer of 12345. This integer is stored for transmission with the encoding shown in Table B-21 (p. 57).

Table B-21: Example encoding of water level surface elevation value of 12345

Character 1 = C								Character 2 = @								Character 3 = y							
p	1	b18	b17	b16	b15	b14	b13	p	1	b12	b11	b10	b9	b8	b7	p	1	b6	b5	b4	b3	b2	b1
0	1	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	1	1	1	1	0	0	1

B.2.3 Additional pseudobinary representations

Other pseudobinary representations, such as 6, 12, and 24 bit integers, can be formed and transmitted using CRBasic.

B.3 Transmission durations

Table B-22 (p. 58) provides the transmission durations, calculated from the number of bytes in a message. Table B-23 (p. 58) provides the maximum data bytes for an assigned time slot duration. Users need to convert the data points they want to send to number of bytes.

Table B-22: Calculating transmission duration for GOES 300/1200 bps messages	
Transmit type	Transmission duration (seconds) (where N = number of data bytes in a message)
Self-timed, 300 bps	(137 + (N × 4))/150
Random, 300 bps	(137 + (N × 4))/150
Self-timed, 1200 bps	(223 + (N × 4))/600
Random, 1200 bps	(223 + (N × 4))/600

Table B-23: GOES self-timed-message maximum data bytes and assigned time-slot duration		
Assigned time-slot duration (seconds)	GOES 300 bps maximum data per message (bytes)	GOES 1200 bps maximum data per message (bytes)
5	153	694
10	340	1444
15	528	2194
20	715	2944
25	903	3694
30	1090	4444
35	1278	5194
40	1465	5944
45	1653	6694
50	1840	7444
55	2028	8194
60	2215	8944

Appendix C. GOES Version 2 DCS channel frequencies

The following tables provide the frequencies for each channel.

Table C-1: GOES V 2.0 DCS frequencies for channels 1 through 46 and 301 through 346[1]

Channel number	Frequency (MHz)	Channel number	Frequency (MHz)	Channel number	Frequency (MHz)	Channel number	Frequency (MHz)
1	401.701000	312	401.718250	**24**	**401.735500**	335	401.752750
301	**401.701750**	13	401.719000	324	401.736250	**36**	**401.753500**
2	401.702500	**313**	**401.719750**	25	401.737000	336	401.754250
302	401.703250	14	401.720500	**325**	**401.737750**	37	401.755000
3	**401.704000**	314	401.721250	26	401.738500	**337**	**401.755750**
303	401.704750	**15**	**401.722000**	326	401.739250	38	401.756500
4	401.705500	315	401.722750	**27**	**401.740000**	338	401.757250
304	**401.706250**	16	401.723500	327	401.740750	**39**	**401.758000**
5	401.707000	**316**	**401.724250**	28	401.741500	339	401.758750
305	401.707750	17	401.725000	**328**	**401.742250**	40	401.759500
6	**401.708500**	317	401.725750	29	401.743000	**340**	**401.760250**
306	401.709250	**18**	**401.726500**	329	401.743750	41	401.761000
7	401.710000	318	401.727250	**30**	**401.744500**	341	401.761750
307	**401.710750**	19	401.728000	330	401.745250	**42**	**401.762500**
8	401.711500	**319**	**401.728750**	31	401.746000	342	401.763250
308	401.712250	20	401.729500	**331**	**401.746750**	43	401.764000
9	**401.713000**	320	401.730250	32	401.747500	**343**	**401.764750**
309	401.713750	**21**	**401.731000**	332	401.748250	44	401.765500
10	401.714500	321	401.731750	**33**	**401.749000**	344	401.766250
310	**401.715250**	22	401.732500	333	401.749750	**45**	**401.767000**
11	401.716000	**322**	**401.733250**	34	401.750500	345	401.767750
311	401.716750	23	401.734000	**334**	**401.751250**	46	401.768500
12	**401.717500**	323	401.734750	35	401.752000	**346**	**401.769250**

[1] Bold text indicates possible 1200 bps channel assignments.

Table C-2: GOES V 2.0 DCS frequencies for channels 47 through 108 and 347 through 408[1]							
Channel number	Frequency (MHz)	Channel number	Frequency (MHz)	Channel number	Frequency (MHz)	Channel number	Frequency (MHz)
47	401.770000	362	401.793250	**78**	**401.816500**	393	401.839750
347	401.770750	**63**	**401.794000**	378	401.817250	94	401.840500
48	**401.771500**	363	401.794750	79	401.818000	**394**	**401.841250**
348	401.772250	64	401.795500	**379**	**401.818750**	95	401.842000
49	401.773000	**364**	**401.796250**	80	401.819500	395	401.842750
349	**401.773750**	65	401.797000	380	401.820250	**96**	**401.843500**
50	401.774500	365	401.797750	**81**	**401.821000**	396	401.844250
350	401.775250	**66**	**401.798500**	381	401.821750	97	401.845000
51	**401.776000**	366	401.799250	82	401.822500	**397**	**401.845750**
351	401.776750	67	401.800000	**382**	**401.823250**	98	401.846500
52	401.777500	**367**	**401.800750**	83	401.824000	398	401.847250
352	**401.778250**	68	401.801500	383	401.824750	**99**	**401.848000**
53	401.779000	368	401.802250	**84**	**401.825500**	399	401.848750
353	401.779750	**69**	**401.803000**	384	401.826250	100	401.849500
54	**401.780500**	369	401.803750	85	401.827000	**400**	**401.850250**
354	401.781250	70	401.804500	**385**	**401.827750**	101	401.851000
55	401.782000	**370**	**401.805250**	86	401.828500	401	401.851750
355	**401.782750**	71	401.806000	386	401.829250	**102**	**401.852500**
56	401.783500	371	401.806750	**87**	**401.830000**	402	401.853250
356	401.784250	**72**	**401.807500**	387	401.830750	103	401.854000
57	**401.785000**	372	401.808250	88	401.831500	**403**	**401.854750**
357	401.785750	73	401.809000	**388**	**401.832250**	104	401.855500
58	401.786500	**373**	**401.809750**	89	401.833000	404	401.856250
358	**401.787250**	74	401.810500	389	401.833750	**105**	**401.857000**
59	401.788000	374	401.811250	**90**	**401.834500**	405	401.857750
359	401.788750	**75**	**401.812000**	390	401.835250	106	401.858500
60	**401.789500**	375	401.812750	91	401.836000	**406**	**401.859250**
360	401.790250	76	401.813500	**391**	**401.836750**	107	401.860000
61	401.791000	**376**	**401.814250**	92	401.837500	407	401.860750
361	**401.791750**	77	401.815000	392	401.838250	**108**	**401.861500**
62	401.792500	377	401.815750	**93**	**401.839000**	408	401.862250

[1] Bold text indicates possible 1200 bps channel assignments.

Table C-3: GOES V 2.0 DCS frequencies for channels 109 through 170 and 409 through 470[1]							
Channel number	Frequency (MHz)	Channel number	Frequency (MHz)	Channel number	Frequency (MHz)	Channel number	Frequency (MHz)
109	401.863000	**424**	**401.886250**	140	401.909500	455	401.932750
409	**401.863750**	125	401.887000	440	401.910250	**156**	**401.933500**
110	401.864500	425	401.887750	**141**	**401.911000**	456	401.934250
410	401.865250	**126**	**401.888500**	441	401.911750	157	401.935000
111	**401.866000**	426	401.889250	142	401.912500	**457**	**401.935750**
411	401.866750	127	401.890000	**442**	**401.913250**	158	401.936500
112	401.867500	**427**	**401.890750**	143	401.914000	458	401.937250
412	**401.868250**	128	401.891500	443	401.914750	**159**	**401.938000**
113	401.869000	428	401.892250	**144**	**401.915500**	459	401.938750
413	401.869750	**129**	**401.893000**	444	401.916250	160	401.939500
114	**401.870500**	429	401.893750	145	401.917000	**460**	**401.940250**
414	401.871250	130	401.894500	**445**	**401.917750**	161	401.941000
115	401.872000	**430**	**401.895250**	146	401.918500	461	401.941750
415	**401.872750**	131	401.896000	446	401.919250	**162**	**401.942500**
116	401.873500	431	401.896750	**147**	**401.920000**	462	401.943250
416	401.874250	**132**	**401.897500**	447	401.920750	163	401.944000
117	**401.875000**	432	401.898250	148	401.921500	**463**	**401.944750**
417	401.875750	133	401.899000	**448**	**401.922250**	164	401.945500
118	401.876500	**433**	**401.899750**	149	401.923000	464	401.946250
418	**401.877250**	134	401.900500	449	401.923750	**165**	**401.947000**
119	401.878000	434	401.901250	**150**	**401.924500**	465	401.947750
419	401.878750	**135**	**401.902000**	450	401.925250	166	401.948500
120	**401.879500**	435	401.902750	151	401.926000	**466**	**401.949250**
420	401.880250	136	401.903500	**451**	**401.926750**	167	401.950000
121	401.881000	**436**	**401.904250**	152	401.927500	467	401.950750
421	**401.881750**	137	401.905000	452	401.928250	**168**	**401.951500**
122	401.882500	437	401.905750	**153**	**401.929000**	468	401.952250
422	401.883250	**138**	**401.906500**	453	401.929750	169	401.953000
123	**401.884000**	438	401.907250	154	401.930500	**469**	**401.953750**

Table C-3: GOES V 2.0 DCS frequencies for channels 109 through 170 and 409 through 470[1]							
Channel number	Frequency (MHz)	Channel number	Frequency (MHz)	Channel number	Frequency (MHz)	Channel number	Frequency (MHz)
423	401.884750	139	401.908000	**454**	**401.931250**	170	401.954500
124	401.885500	**439**	**401.908750**	155	401.932000	470	401.955250
[1] Bold text indicates possible 1200 bps channel assignments.							

Table C-4: GOES V 2.0 DCS frequencies for channels 171 through 230 and 471 through 530[1]							
Channel number	Frequency (MHz)	Channel number	Frequency (MHz)	Channel number	Frequency (MHz)	Channel number	Frequency (MHz)
171	**401.956000**	**186**	**401.978500**	**201**	**402.001000**	**216**	**402.023500**
471	401.956750	486	401.979250	501	402.001750	516	402.024250
172	401.957500	187	401.980000	202	402.002500	217	402.025000
472	**401.958250**	**487**	**401.980750**	**502**	**402.003250**	**517**	**402.025750**
173	401.959000	188	401.981500	203	402.004000	218	402.026500
473	401.959750	488	401.982250	503	402.004750	518	402.027250
174	**401.960500**	**189**	**401.983000**	**204**	**402.005500**	**219**	**402.028000**
474	401.961250	489	401.983750	504	402.006250	519	402.028750
175	401.962000	190	401.984500	205	402.007000	220	402.029500
475	**401.962750**	**490**	**401.985250**	**505**	**402.007750**	**520**	**402.030250**
176	401.963500	191	401.986000	206	402.008500	221	402.031000
476	401.964250	491	401.986750	506	402.009250	521	402.031750
177	**401.965000**	**192**	**401.987500**	**207**	**402.010000**	**222**	**402.032500**
477	401.965750	492	401.988250	507	402.010750	522	402.033250
178	401.966500	193	401.989000	208	402.011500	223	402.034000
478	**401.967250**	**493**	**401.989750**	**508**	**402.012250**	**523**	**402.034750**
179	401.968000	194	401.990500	209	402.013000	224	402.035500
479	401.968750	494	401.991250	509	402.013750	524	402.036250
180	**401.969500**	**195**	**401.992000**	**210**	**402.014500**	**225**	**402.037000**
480	401.970250	495	401.992750	510	402.015250	525	402.037750
181	401.971000	196	401.993500	211	402.016000	226	402.038500
481	**401.971750**	**496**	**401.994250**	**511**	**402.016750**	**526**	**402.039250**
182	401.972500	197	401.995000	212	402.017500	227	402.040000
482	401.973250	497	401.995750	512	402.018250	527	402.040750
183	**401.974000**	**198**	**401.996500**	**213**	**402.019000**	**228**	**402.041500**
483	401.974750	498	401.997250	513	402.019750	528	402.042250
184	401.975500	199	401.998000	214	402.020500	229	402.043000
484	**401.976250**	**499**	**401.998750**	**514**	**402.021250**	**529**	**402.043750**
185	401.977000	200	401.999500	215	402.022000	230	402.044500
485	401.977750	500	402.000250	515	402.022750	530	402.045250

[1] Bold text indicates possible 1200 bps channel assignments.

Table C-5: GOES V 2.0 DCS frequencies for channels 231 through 266 and 531 through 566[1]							
Channel number	Frequency (MHz)	Channel number	Frequency (MHz)	Channel number	Frequency (MHz)	Channel number	Frequency (MHz)
231	**402.046000**	**240**	**402.059500**	**249**	**402.073000**	**258**	**402.086500**
531	402.046750	540	402.060250	549	402.073750	558	402.087250
232	402.047500	241	402.061000	250	402.074500	259	402.088000
532	**402.048250**	**541**	**402.061750**	**550**	**402.075250**	**559**	**402.088750**
233	402.049000	242	402.062500	251	402.076000	260	402.089500
533	402.049750	542	402.063250	551	402.076750	560	402.090250
234	**402.050500**	**243**	**402.064000**	**252**	**402.077500**	**261**	**402.091000**
534	402.051250	543	402.064750	552	402.078250	561	402.091750
235	402.052000	244	402.065500	253	402.079000	262	402.092500
535	**402.052750**	**544**	**402.066250**	**553**	**402.079750**	**562**	**402.093250**
236	402.053500	245	402.067000	254	402.080500	263	402.094000
536	402.054250	545	402.067750	554	402.081250	563	402.094750
237	**402.055000**	**246**	**402.068500**	**255**	**402.082000**	**264**	**402.095500**
537	402.055750	546	402.069250	555	402.082750	564	402.096250
238	402.056500	247	402.070000	256	402.083500	265	402.097000
538	**402.057250**	**547**	**402.070750**	**556**	**402.084250**	**565**	**402.097750**
239	402.058000	248	402.071500	257	402.085000	266	402.098500
539	402.058750	548	402.072250	557	402.085750	566	402.099250

[1] Bold text indicates possible 1200 bps channel assignments.

Appendix D. Watch test results

The following is a full set of test results from a watch test showing the communications between the TX325 and a data logger:

```
12:15:00.050 T 01 00 14 14 04                                     .....
12:15:00.066 R 01 0A 14 00 00 20 00 10                          ..... ..
12:15:00.076 R 13 0F 00 23 FE 71 04                               .....
12:15:00.096 T 01 00 1F 1F 04                                    ...#.q.
12:15:00.106 R 01 02 F0                                             ...
12:15:00.116 R 23 FB F6 04                                        #...
12:15:00.136 T 01 00 10 00 10 04                                 ......
12:15:00.146 R 01 06                                                ..
12:15:00.186 T 01 00 1D 1D 04                                    .....
12:15:00.196 R 01 7A 1D                                           .z.
12:15:00.206 R 00 20 20 20 20 20 20 20                             .
12:15:00.216 R 20 31 2E 36 20 20 20 20                           1.6
12:15:00.226 R 20 31 35 3A 32 32 3A 32                         15:22:2
12:15:00.236 R 36 20 20 20 20 20 20 20                               6
12:15:00.246 R 20 30 31 2F 31 37 2F 32                         01/17/2
12:15:00.256 R 30 31 38 20 20 20 20 20                             018
12:15:00.266 R 20 4F 6D 6E 69 53 61 74                         OmniSat
12:15:00.276 R 2D 33 00 20 20 20 20 20                             -3.
12:15:00.286 R 20 20 20 20 20 20 20 20
12:15:00.296 R 20 20 20 20 20 20 20 20
12:15:00.306 R 20 20 20 20 20 20 20 20
12:15:00.316 R 20 20 20 20 20 20 20 20
12:15:00.326 R 20 20 20 20 20 20 20 20
12:15:00.336 R 20 20 20 20 20 20 20 20
12:15:00.346 R 20 20 20 20 20 20 20 20
12:15:00.356 R 20 FF 04                                             ..
12:15:00.376 T 01 00 10 00 10 04                                 ......
12:15:00.386 R 01 06                                                ..
12:15:00.396 R 10 00 23 FE 23 FB D2 F0                         ..#.#...
12:15:00.406 R DD 04                                                ..
12:15:00.426 T 01 00 74 00 00 00 00 5E D2 04                  ..t....^..
12:15:00.466 R 01 60 74 00                                        .`t.
12:15:00.476 R 35 2F 14 35 11 14 34 98                          5/.5..4.
12:15:00.486 R 34 31 34 35 2E 39 34 31                          4145.941
12:15:00.496 R 37 30 4E 31 31 31 35 31                          70N11151
12:15:00.506 R 2E 32 38 32 38 30 57 31                          .28280W1
12:15:00.516 R 34 32 31 2E 33 20 00 10                          421.3 ..
12:15:00.526 R 12 29 1D 00 00 00 00 00                          .).....
12:15:00.536 R 00 00 00 00 00 00 00 0B                          ........
12:15:00.546 R 7C 23 FE FF 60 15 23 FE                          |#..`.#.
12:15:00.556 R FF 80 12 00 43 00 43 23                          ....C.C#
```

```
12:15:00.566 R FB 02 23 FE 00 00 00 23                                  ..#....#
12:15:00.576 R FE DF 00 00 20 00 10 13                                  .... ...
12:15:00.586 R 0A 0A 00 00 C3 23 FE 00                                  .....#..
12:15:00.596 R 4C 20 00 00 76 04                                          L ..v.
12:15:07.053 T 01 00 1F 1F 04                                             .....
12:15:07.063 R 01 02 F0                                                     ...
12:15:07.073 R 23 FB F6 04                                                #...
12:15:07.093 T 01 00 14 14 04                                             .....
12:15:07.103 R 01 0A 14                                                     ...
12:15:07.113 R 00 00 20 00 10 13 0F 07                                  .. .....
12:15:07.123 R 02 79 04                                                   .y.
12:15:07.220 T 01 00 10 00 10 04                                        ......
12:15:07.240 R 10 00 23 FE 23 FB D2 F0                                  ..#.#...
12:15:07.250 R DD 04                                                      ..
12:15:07.270 T 01 00 1E 00 00 20 00 10 13 0F 0A 00 4E 55 4C 4C ..... ......NULL
12:15:07.270 T 2E 44 41 54 00 00 00 00 00 00 00 00 00 00 C3 00 .DAT............
12:15:07.270 T 4C 23 FE 00 00 00 00 00 00 00 00 00 00 00 00 00 L#..............
12:15:07.270 T 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ................
12:15:07.270 T 00 0D 0A 31 33 2E 36 31 33 2C 31 33 2E 36 31 34 ...13.613,13.614
12:15:07.270 T 2C 31 33 2E 36 31 33 2C 31 33 2E 36 31 33 2C 31 ,13.613,13.613,1
12:15:07.270 T 33 2E 36 31 37 2C 0D 0A 32 34 2E 37 31 37 2C 32 3.617,..24.717,2
12:15:07.270 T 34 2E 36 39 31 2C 32 34 2E 36 36 36 2C 32 34 2E  4.691,24.666,24
12:15:07.270 T 36 34 33 2C 32 34 2E 36 32 32 2C 0D 0A A6 04     643,24.622,....
12:15:07.430 R 01 02 1E 00 20 04                                          .... .
```

Appendix E. Antenna gain for nonstandard antennas

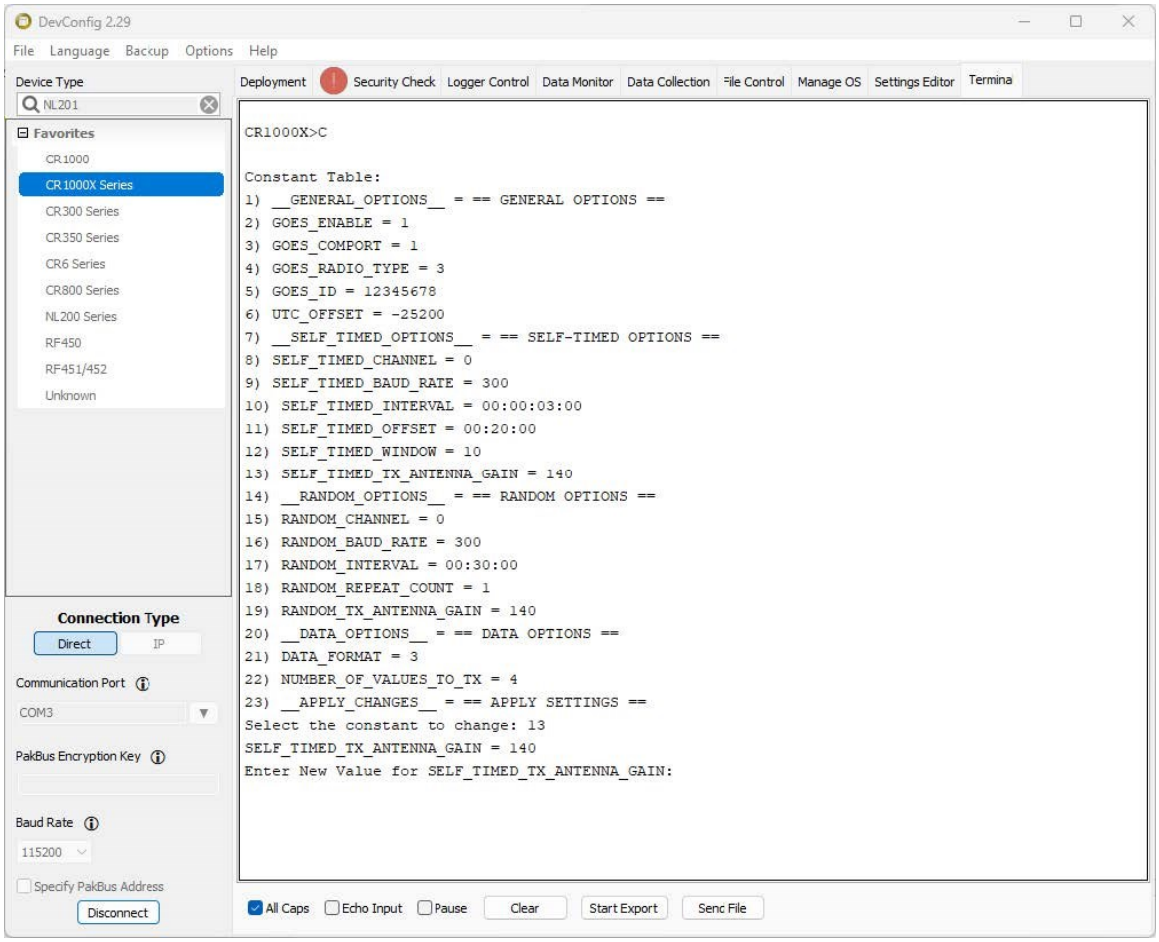
GOES Antenna Gain is for specifying a different value if using an antenna other than the standard Yagi 11 dBi antenna. For standard GOES setups that use the 11 dB directional antenna specified for the system, the default value of 100 will be adequate for your setup.

If your GOES data logger program is based on the example programs, this value should be adjusted in code.

An alternative to adjusting the value in code is to do it in the constants table. Be aware that while this approach is easy, it may not always work well for tracking the current setting held in the data logger and its program. Adjusting the constants can be done from the **Terminal mode** of the data logger using the following procedure:

1. Connect to the data logger using *Device Configuration Utility*.
2. Click the **Terminal** tab.
3. Click in the window and press **Enter** until you see the **CR1000X>** prompt.
4. Type capital **C** and press **Enter**.
5. Specify the number on the left corresponding to the **Constant Value** you want to change and press Enter.

6. Type the value for the constant you would like to change and press **Enter**.



Appendix F. TX321 program converted to TX325 program (CR1000, CR3000, CR800-series)

CAUTION:
Use the latest operating system for your data logger, 32.06 or later. Do not run a program that changes the Platform ID repetitively. Doing so can lead to failure of the EEPROM from excessive write cycles. If your program must use different Platform IDs at different times, the newer data loggers (CR6, CR300 series, CR350 series, CR1000X) support this.

This appendix discusses modifying a program for a CR3000, CR1000, or CR800-series data logger to use a TX325 instead of a TX321. It also discusses the TX325 features and commands that are not supported in the older data loggers and the interfaces required to connect the TX325 to an older data logger.

Some TX325 features and commands are not supported in the older data logger operating system (OS) because of memory size limitations of older data loggers.

The TX321 had a CS I/O interface, so the commands (GOESData) output data to the CS I/O port. The TX325 only has an RS-232 port, so the new commands that were added use the RS-232 interface on the data logger. This means that it will not be possible to connect to the RS-232 with *LoggerNet*, and another interface will need to be used for that. Campbell Scientific recommends using an SC32B, and connect the computer RS-232 (or USB to RS-232 adapter) to the SC32B and to the data logger CS I/O. Additionally, if the data logger has an Ethernet interface, the data logger may use an IP link to connect to the computer. An RS-232 interface is require If the data logger OS need to be updated.

The TX325 uses different CRBasic commands from the TX321. Often, the commands are similar, but not all functions are available. It is highly recommended to download the example program available at www.campbellsci.com/downloads/tx325-example-program-cr3000-cr1000-cr800. This appendix provides the changes that need to be made to a data logger program that allows it to use a TX325 instead of the TX321. It is important to copy/paste or work from the online example, only using this appendix as a guide.

When using a TX321, the configuration parameters for the GOES radio may have been set either using the *Device Configuration Utility* software, or by using the `GOESSetup()` CRBasic

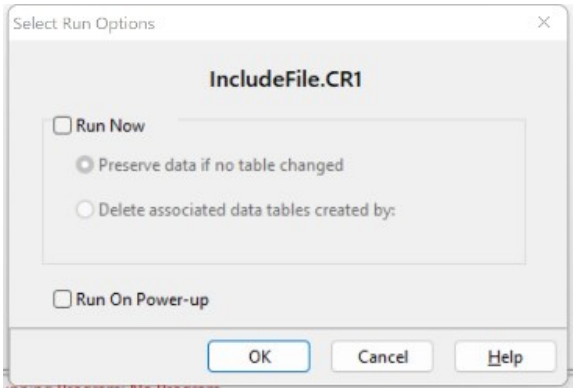
instruction. A ***Device Configuration*** page is not available for the TX325 when it is connected to an older data logger. With an older data logger, the configuration parameters for the GOES radio must be set programmatically using the `EnviroSatRandomSetup` and `EnviroSatSTSetup` commands. The following are the three methods available for adding it to a program:

1. The `EnviroSatRandomSetup` and `EnviroSatSTSetup` commands can be coded with the arguments directly in the program, which is convenient when the user has only one station.
2. The configuration settings can be listed in a `ConstTable`, which allows them to be configured by changing the site specific settings from a template file that is used at multiple sites. Once the Boolean `ApplyAndRestart` is set to true, those changed constants will be applied and the program recompiled. If an archived copy of the program is kept that is running (and we recommend that you do), you will need to download it using **File Control** or do a **Backup Datalogger** (using the ***Device Configuration Utility*** software) and save it so that you know which site it applies to.
3. A file can declare and define the configuration variables and can include the measurement algorithms. The advantage to this is that as the measurements evolve, the same template file can more likely be used at multiple sites, since it does not include site specific parameters. If the program attempts to be compiled without finding the file, the compile will fail, since the variables used in the `EnviroSatRandomSetup` and `EnviroSatSTSetup` commands won't be found.

The following is an example of an include file named **IncludeFile.CR1**. It can have any suffix such as .CR8 or .text. It will simply require changing the filter in the file selector for the file to **Send in File Control**.

```
'GOES configuration settings for MySite
Const dcp_platform_id As Long = &h01234567
Const rt_baud_rate = 300
Const rt_channel = 195
Const rt_count = 2 'we can only send two messages max in a 2 minute RT interval.
'We can send more if our RT interval is larger.

Const rt_interval As String = "00_02_00"
Const st_baud_rate = 300
Const st_channel = 195
Const st_interval As String = "00_01_00_00"
Const st_message_window_size As Long = 10
Const st_offset As String = "00_45_50"
```

Use **File Control** to send it to the CPU drive. Uncheck **Run Now** and **Run On Power-up**, as it will not compile.



In the main file, add the following line before the **BeginProg** command:

```
Include "CPU:IncludeFile.CR1"
```

Send the main file. It should pull in **IncludeFile.CR1** and compile without error.

The TX325 status is sent as an array of 37 values. Allocate and set aliases as follows or similarly:

```
Public tx_325_status(37) As Long
  Alias tx_325_status(1) = status_result
  '0 = success, -1 = timout, -2 = no SOH character returned, -3 = bad checksum
  '-10 = no CTS asserted
Public tx_325_status_results As String * 30
  Alias tx_325_status(2) = time_status
  '&h00 = completed OK, &h0A = time-of-day clock not loaded yet.
Public tx_325_time_status As String * 50
  Alias tx_325_status(3) = reported_year 'current year.
  Alias tx_325_status(4) = julian_day 'current day into the year

Public reported_month As Long
Public reported_day As Long
  Alias tx_325_status(5) = reported_hour
  Alias tx_325_status(6) = reported_minute
  Alias tx_325_status(7) = reported_second
  Alias tx_325_status(8) = reported_tenths_of_a_second
  Alias tx_325_status(9) = reported_radio_id_decimal
  Alias tx_325_status(10) = radio_firmware_build_time
  Alias tx_325_status(11) = radio_firmware_build_date
  Alias tx_325_status(12) = radio_battery_voltage
  Alias tx_325_status(13) = radio_temperature
  Alias tx_325_status(14) = radio_battery_voltage_before_last_tx
  Alias tx_325_status(15) = radio_temperature_before_last_tx
  Alias tx_325_status(16) = radio_battery_during_last_tx
  Alias tx_325_status(17) = latitude_deg
  Alias tx_325_status(18) = latitude_min
  Alias tx_325_status(19) = latitude_direction
  Alias tx_325_status(20) = longitude_deg
  Alias tx_325_status(21) = longitude_min
  Alias tx_325_status(22) = longitude_direction
  Alias tx_325_status(23) = altitude 'reported in meters
```

```
Alias tx_325_status(24) = year_of_last_gps_fix
Alias tx_325_status(25) = julian_day_of_last_gps_fix
Alias tx_325_status(26) = hour_of_last_gps_fix
Alias tx_325_status(27) = minute_of_last_gps_fix
Alias tx_325_status(28) = second_of_last_gps_fix
Alias tx_325_status(29) = number_of_missed_gps_fixes
Alias tx_325_status(30) = year_of_last_missed_gps_fix_attempt
Alias tx_325_status(31) = julian_day_of_last_missed_gps_fix_att
Alias tx_325_status(32) = hour_of_last_missed_gps_fix_attempt
Alias tx_325_status(33) = minute_of_last_missed_gps_fix_attempt
Alias tx_325_status(34) = second_of_last_missed_gps_fix_attempt
Alias tx_325_status(35) = radio_gps_health
Alias tx_325_status(36) = radio_failsafe_status
Alias tx_325_status(37) = duration_of_last_radio_transmission
```

Commands used with the TX321 were named similar to `GOESStatus(GOES_RCode1(1), 2)` The similar, but not equivalent, command that has been added to operating systems for the older data loggers is: `EnviroSatStatus(tx_325_status)`.

> **NOTE:**
> Return values and their meanings may differ or be in different units or formats.

Code similar to the following may be appropriate for retrieving status and interpreting it:

```
Sub GetTX325_StatusAndProcess 'This section of CRBasic code polls the TX325 radio and
'converts some diagnostic data into human readable values.

EnviroSatStatus(tx_325_status)
  If (status_result = 0) Then
    tx_325_status_results = "Success."
    ElseIf (status_result = -1) Then
      tx_325_status_results = "Timed Out."
    ElseIf (status_result = -2) Then
      tx_325_status_results = "No SOH character returned."
    ElseIf (status_result = -3) Then
      tx_325_status_results = "Bad Checksum."
    ElseIf (status_result = -10) Then
      tx_325_status_results = "No CTS Asserted."
  EndIf

  If (time_status = &h00) Then
    tx_325_time_status = "Completed OK."
  ElseIf (time_status = &h0A) Then
     tx_325_time_status = "Time-of-day clock not loaded yet."
  EndIf

'everything done from here is to help make things human readable
  If (status_result = 0) Then
    Sprintf (reported_radio_id_hex, "%08s", Hex (reported_radio_id_decimal))
    'ensures we always have 8 characters shown
     reported_latitude_direction_letter = CHR (latitude_direction)
```

```
    reported_longitude_direction_letter = CHR (longitude_direction)
  Else
    reported_radio_id_hex = Hex ( 0 )
EndIf

If (status_result = 0) Then
  ConvertDayOfYear (julian_day, reported_year, reported_month, reported_day)
    current_tx325_time = reported_month & "/" & reported_day & "/" & _
    reported_year & " " & reported_hour & ":" & reported_minute & _
    ":" & reported_second & ":" & reported_tenths_of_a_second
  Else
    current_tx325_time = "1/0/1992 0:0:0:0"
EndIf

If (StrComp (current_tx325_time, "1/0/1992 0:0:0:0") = 0) Then
  current_tx325_time = "No 3D GPS fix yet or radio is offline!"
EndIf

If (status_result = 0) Then
  year_of_last_gps_fix = year_of_last_gps_fix + 1992

  ConvertDayOfYear (julian_day_of_last_gps_fix, year_of_last_gps_fix, _
  month_of_last_gps _fix,_ day_of_last_gps_fix)

  last_gps_fix_time = month_of_last_gps_fix & "/" & day_of_last_gps_fix & _
  "/" & year_of_last_gps_fix & " " & hour_of_last_gps_fix & ":" & _
  minute_of_last_gps_fix & ":" & second_of_last_gps_fix
Else
  last_gps_fix_time = "1/0/1992 0:0:0"
EndIf

If (StrComp (last_gps_fix_time, "1/0/1992 0:0:0") = 0) Then
  last_gps_fix_time = "No 3D GPS fix yet or radio is offline!"
EndIf

If (status_result = 0) Then
  year_of_last_missed_gps_fix_attempt = year_of_last_missed_gps_fix_attempt + 1992

  ConvertDayOfYear (julian_day_of_last_missed_gps_fix_att,year_of_last_missed_gps_fix_attempt, _
  month_of_last_missed_gps_attempt, day_of_last_missed_gps_attempt)

  last_missed_gps_fix_attempt = month_of_last_missed_gps_attempt & "/" & _
  day_of_last_missed_gps_attempt & "/" & year_of_last_missed_gps_fix_attempt _
  & " " & hour_of_last_missed_gps_fix_attempt & ":" & _
  minute_of_last_missed_gps_fix_attempt & ":" & _
  second_of_last_missed_gps_fix_attempt
Else
  last_missed_gps_fix_attempt = "1/0/1992 0:0:0"
EndIf

If ((StrComp (last_missed_gps_fix_attempt, "1/0/1992 0:0:0") = 0) _
```

```
  AND (status_result = 0)) Then
    last_missed_gps_fix_attempt = "No misses so far!"
  Else
    last_missed_gps_fix_attempt = "Logger did not receive report from GOES radio."
  EndIf
If ((Hex (radio_gps_health) = &h00) AND (status_result = 0)) Then
gps_health = "Have valid GPS position fix."
  ElseIf (status_result <> 0) Then
  gps_health = "No fix, radio is offline!"

  ElseIf (Hex (radio_gps_health) = &h01) Then
  gps_health = "No fix, no GPS Satellites in view."

  ElseIf (Hex (radio_gps_health) = &h08) Then
  gps_health = "No fix, 0 usable GPS satellites in view."

  ElseIf (Hex (radio_gps_health) = &h09) Then
  gps_health = "No fix, 1 usable GPS satellites in view."

  ElseIf (Hex (radio_gps_health) = &h0A) Then
  gps_health = "No fix, 2 usable GPS satellites in view."

  ElseIf (Hex (radio_gps_health) = &h0B) Then
  gps_health = "No fix, 3 usable GPS satellites in view."
EndIf

If ((radio_failsafe_status = 0) AND (status_result = 0)) Then
failsafe_status = "TX325 is idle."
  ElseIf ((radio_failsafe_status = 1) AND (status_result = 0)) Then
  failsafe_status = "Transmit in progress."
  ElseIf ((radio_failsafe_status = 2) AND (status_result = 0)) Then
  failsafe_status = "Post-transmitfailsafe wait in progress."
  ElseIf (status_result <> 0) Then
  failsafe_status = "Logger did not receive report from GOES radio."
EndIf

'rt_tx_data_result_code = -99
If (st_tx_data_result_code = -99) Then
  self_timed_transmission_status = "Logger has not tried to send self-timed data."
  ElseIf (st_tx_data_result_code = 0) Then
  self_timed_transmission_status = "Successful EnviroSatData execution for self-timed."
  ElseIf (st_tx_data_result_code = -11) Then
  self_timed_transmission_status = "Buffer control error."
  ElseIf (st_tx_data_result_code = -16) Then
  self_timed_transmission_status = "Illegal data format sent to the TX325."
  ElseIf (st_tx_data_result_code = -17) Then
  self_timed_transmission_status = "Data format 0 or 1, but table not FP2 or ASCII."
  ElseIf (st_tx_data_result_code = -22) Then
  self_timed_transmission_status = "TX325 not setup correctly by logger."
EndIf
```

```
If (rt_tx_data_result_code = -99) Then
random_transmission_status = "Logger has not tried to send Random data."
  ElseIf (rt_tx_data_result_code = 0) Then
  random_transmission_status = "Successful EnviroSatData execution for Random."
  ElseIf (rt_tx_data_result_code = -11) Then
  random_transmission_status = "There was a buffer control error."
  ElseIf (rt_tx_data_result_code = -16) Then
  random_transmission_status = "Illegal data format was sent to the TX325."
  ElseIf (rt_tx_data_result_code = -17) Then
  random_transmission_status = "Data format 0 or 1, but table not FP2 or ASCII."
  ElseIf (rt_tx_data_result_code = -22) Then
  random_transmission_status = "TX325 was not setup correctly by the data logger."
EndIf

'convert millivolts to volts
current_radio_battery_voltage = radio_battery_voltage * .001
current_radio_battery_during_last_tx = radio_battery_during_last_tx * .001
current_battery_voltage_before_last_tx = radio_battery_voltage_before_last_tx * .001

If (status_result <> 0) Then Erase (tx_325_status())

EndSub
```

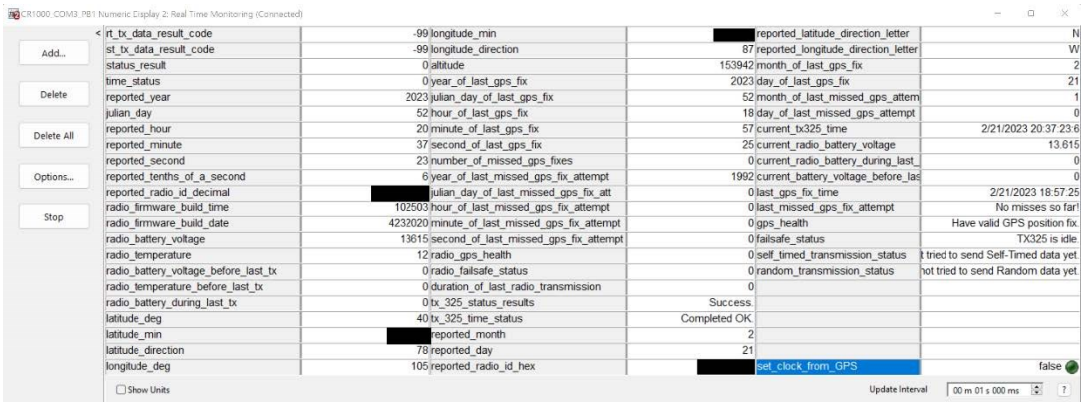
> NOTE:
> Because of priority and available memory, some status reports that were available on the TX321 may not be available from the commands implemented for the TX325 in the OS update for the older data loggers. These include (but may not be limited to): ForwardPower, ReflectPower, GPS_Acq_Time, and Osc_Drift.

When using the older data logger operating systems the status is only available as a response from the EnviroSatStatus command. Campbell Scientific recommends calling EnviroSatStatus when current information is needed. The following program exerts does this adding a trigger when the command is used to set the data logger clock:

```
' Run following commands everyday at 12 hours and 13 minutes.
If (Time_733m_24h OR set_clock_from_GPS) Then set_clock_from_GPS = False

  ' Obtain GPS time.
  Call GetTX325_StatusAndProcess

  ' Ensure the GOES GPS command executed successfully
  If (tx_325_status_results = "Success." _
  AND tx_325_time_status = "Completed OK.")
  Then
    GOES_Time(1) = reported_year
    GOES_Time(2) = reported_month
    GOES_Time(3) = reported_day
```

```
    GOES_Time(4) = reported_hour
    GOES_Time(5) = reported_minute
    GOES_Time(6) = reported_second
    GOES_Time(7) = reported_tenths_of_a_second * 100000 'tenths to microsec
  EndIf

' Ensure the returned time is valid.
If (GOES_Time(4) >= 0 AND GOES_Time(4) < 24 AND GOES_Time(5) >= 0 _
AND GOES_Time(5) < 60 AND GOES_Time(6) >= 0 AND GOES_Time(6) < 60)
Then
  ' Set the data logger clock to match the GPS time.
   ClockSet(GOES_Time(1))
```

Setting the data logger clock to match the GPS time can also be accomplished by adding the status values to the **Numeric Display** in ***LoggerNet*** and toggling **set_clock_from_GPS** to **True**.



Save this **Numeric Display** configuration by clicking **Numeric Display** > **Options...**> **Setup**> **Save config**. By saving the configuration, users can easily access it at a field site to determine if the TX325 is operating as expected.

> **NOTE:**
> Setting the data logger clock is required to determine the Month and Day of the Month. The status array includes the Day of the Year, which must be converted. The conversion will depend on if it is a Leap Year.

The previous code calls the following subroutine:

```
'This subroutine converts day of year (DOY) to months and years
Sub ConvertDayOfYear (_day_of_year As Long, _year As Long, _month As Long, _day As
Long)
  Dim leap_year As Boolean
  If (_year MOD 4 = 0) Then 'If the year is divisible by 4
  leap_year = TRUE
  If (_year MOD 100 = 0) AND (_year MOD 400 <> 0) Then
  'centuries are not leap years unless they are also divisible by 400
  'see https://docs.microsoft.com/en-us/office/troubleshoot/excel/determine-a-leap-year
  leap_year = FALSE
```

```
  EndIf
Else
  leap_year = FALSE
EndIf

If leap_year = FALSE Then
  'Is the month January
  If _day_of_year <= 31 Then
    _month = 1 : _day = _day_of_year
  'Is the month February
  ElseIf _day_of_year > 31 AND _day_of_year <= 59 Then
    _month = 2 : _day = _day_of_year - 31
  'Is the month March
  ElseIf _day_of_year > 59 AND _day_of_year <= 90 Then
    _month = 3 : _day = _day_of_year - 59
  'Is the month April
  ElseIf _day_of_year > 90 AND _day_of_year <= 120 Then
    _month = 4 : _day = _day_of_year - 90
  'Is the month May
  ElseIf _day_of_year > 120 AND _day_of_year <= 151 Then
    _month = 5 : _day = _day_of_year - 120
  'Is the month June
  ElseIf _day_of_year > 151 AND _day_of_year <= 181 Then
    _month = 6 : _day = _day_of_year - 151
  'Is the month July
  ElseIf _day_of_year > 181 AND _day_of_year <= 212 Then
    _month = 7 : _day = _day_of_year -181
  'Is the month August
  ElseIf _day_of_year > 212 AND _day_of_year <=243 Then
    _month = 8 : _day = _day_of_year - 212
  'Is the month September
  ElseIf _day_of_year > 243 AND _day_of_year <= 273 Then
    _month = 9 : _day = _day_of_year - 243
  'Is the month October
  ElseIf _day_of_year > 273 AND _day_of_year <= 304 Then
    _month = 10 : _day = _day_of_year - 273
  'Is the month November
  ElseIf _day_of_year > 304 AND _day_of_year <= 334 Then
    month = 11 : _day = _day_of_year - 304
  'Is the month December
  ElseIf _day_of_year > 334 Then
    _month = 12 : _day = _day_of_year - 334
EndIf

ElseIf leap_year = TRUE Then 'Are we in the month of January
  'Is the month January
  If _day_of_year <= 31 Then
    _month = 1 : _day = _day_of_year
  'Is the month February
  ElseIf _day_of_year > 31 AND _day_of_year <= 60 Then
    _month = 2 : _day = _day_of_year - 31
```

```
  'Is the month March
  ElseIf _day_of_year > 60 AND _day_of_year <= 91 Then
    _month = 3 : _day = _day_of_year - 60
  'Is the month April
  ElseIf _day_of_year > 91 AND _day_of_year <= 121 Then
    _month = 4 : _day = _day_of_year - 91
  'Is the month May
  ElseIf _day_of_year > 121 AND _day_of_year <= 152 Then
    _month = 5 : _day = _day_of_year - 121
  'Is the month June
  ElseIf _day_of_year > 152 AND _day_of_year <= 182 Then
    _month = 6 : _day = _day_of_year - 152
  'Is the month July
  ElseIf _day_of_year > 182 AND _day_of_year <= 213 Then
    _month = 7 : _day = _day_of_year -182
  'Is the month August
  ElseIf _day_of_year > 213 AND _day_of_year <=244 Then
    _month = 8 : _day = _day_of_year - 213
  'Is the month September
  ElseIf _day_of_year > 244 AND _day_of_year <= 274 Then
    _month = 9 : _day = _day_of_year - 244
  'Is the month October
  ElseIf _day_of_year > 274 AND _day_of_year <= 305 Then
    _month = 10 : _day = _day_of_year - 274
  'Is the month November
  ElseIf _day_of_year > 305 AND _day_of_year <= 335 Then
    month = 11 : _day = _day_of_year - 305
  'Is the month December
  ElseIf _day_of_year > 335 Then
    _month = 12 : _day = _day_of_year - 335
  EndIf
EndIf
EndSub
```

Transmitting data

To edit the old program to transmit data, replace the GOESData() CRBasic instruction with the EnviroSatData() instruction. Refer to the *CRBasic Editor* help to determine the changes that need to be made to the parameters.

The GOESData(), GOESGPS(), GOESSetup(), and GOESStatus() CRBasic instructions are not compatible with the TX325. Replace these instructions with the EnviroSat() instructions for the required functionality.

Connection to the data logger RS-232 with *LoggerNet*

Once a program has been run that sends data to the TX325 through the RS-232 port, the RS-232 port will remain configured at 9600 baud, even after a power cycle. To use the RS-232 interface for ***LoggerNet*** at its normal baud rate, do the following:

1. Connect the SC32B to the data logger CS I/O port.
2. Connect to the data logger with the ***Device Configuration Utility*** software.
3. Select the **File Control** tab, select the running program, then click **Stop**. Backup the data logger if desired.
4. Select **Deployment**> **Com Ports Settings** > **ComPort RS-232**.
5. Set the **Baud Rate** to **115200 Auto**, then click **Apply**.

   > **CAUTION:**
   > Do not run the program again until the RS-232 port is no longer needed.

6. Connect to the data logger RS-232 port from the computer running ***LoggerNet***.

   > **CAUTION:**
   > Do not use the SC32B.

7. Load an OS or other desired task.

After loading and running the program using the RS-232 port to transfer data to a TX325, it will again be set to 9600 baud and will not be able to reliably communicate with ***LoggerNet*** until the program has stopped from running. When sending a large file like the OS, it will transfer much faster at 115200 rather than 9600 baud.

Appendix G. Compliance documents and certificates

Compliance documents include the ISO certificate (Figure G-1 [p. 80]) and the GOES V2 certificate (Figure G-2 [p. 81]). The TX325 EU Declaration of Conformity is available at: www.campbellsci.com/tx325.

NSF ISR

Certificate of Registration

This certifies that the Quality Management System of

Signal Engineering, Inc.

6370 Lusk Blvd., Suite F206
San Diego,, California, 92121, United States

has been assessed by NSF-ISR and found to be in conformance to the following standard(s):

ISO 9001:2015

Scope of Registration:
Engineering Design and Light Manufacturing of Electronic/Radio Communications Systems.

ANAB ACCREDITED MANAGEMENT SYSTEMS CERTIFICATION BODY

IAF MEMBER OF MULTILATERAL RECOGNITION ARRANGEMENT

Certificate Number:	C0195647-IS3
Certificate Issue Date:	24-APR-2018
Registration Date:	14-MAY-2017
Expiration Date *:	12-MAY-2020

Carl Blazik,
Director, Technical
Operations & Business Units,
NSF-ISR, Ltd.

NSF International Strategic Registrations
789 North Dixboro Road, Ann Arbor, Michigan 48105 | (888) NSF-9000 | www.nsf-isr.org

Authorized Registration and /or Accreditation Marks. This certificate is property of NSF-ISR and must be returned upon request.
*Company is audited for conformance at regular intervals. To verify registrations call (888) NSF-9000 or visit our web site at www.nsf-isr.org

Figure G-1. ISO certificate

National Environmental Satellite, Data, and Information Service

Certificate Number
12142012

Certifies that Signal Engineering, Inc.

Model OmniSat-3

Has been type tested and meets the requirements for use in the Geo-stationary Operational Environmental Satellite Data Collection System.

Condition

If design changes or modifications are made that affect its technical performance as specified in the certification standards for this type of equipment, recertification of this model shall be required before placing in operation.

In accordance with Version 2.0 GOES DCPR Certification Standards 300bps and 1200bps data rates.

Director, Office of System Development

Signature

Date 12/20/12

NOAA Form 83-1
(6-HO)

GOES RADIO SET CERTIFICATION

U.S. Department of Commerce
National Oceanic and Atmospheric Administration

Figure G-2. GOES V2 certificate

República Federativa do Brasil
Agência Nacional de Telecomunicações

ANATEL

Certificado de Homologação

(Intransferível)

Nº **07995-21-10644**

Validade: **Indeterminada**

Emissão: **30/06/2021**

Requerente:
CNPJ: 00.369.633/0001-71
CAMPBELL SCIENTIFIC DO BRASIL LTDA

Fabricante:
CAMPBELL SCIENTIFIC INC.
815 W 1800 N
Nº
843211784
ESTADOS UNIDOS DA AMÉRICA

Este documento homologa, nos termos da regulamentação de telecomunicações vigente, o Certificado de Conformidade nº 7363, emitido pelo **FUNDACAO CENTRO DE PESQUISA E DESENVOLVIMENTO DE TELECOMUNICACOES- CPQD.**. Esta homologação é expedida em nome do solicitante aqui identificado e é válida somente para o produto a seguir discriminado, cuja utilização deve observar as condições estabelecidas na regulamentação de telecomunicações.

Tipo - Categoria:
Transceptor para Estação Terrena (não SMM) - III

Modelo - Nome Comercial (s):
TX325 - (Transmissor Satelital GOES CS2/V2)

Características técnicas básicas:

Faixa de Frequências Tx (MHz)	Potência Máxima de Saída (W)
401,701 a 402,09925	10,0

Ensaio de SAR não aplicável.

Observações

O produto deve estar ajustado na(s) potência(s) e frequência(s) autorizada(s) pelo órgão técnico competente da Agência Nacional de Telecomunicações – Anatel, quando da sua utilização.

Constitui obrigação do fabricante do produto no Brasil providenciar a identificação do produto homologado, nos termos da regulamentação de telecomunicações, em todas as unidades comercializadas, antes de sua efetiva distribuição ao mercado, assim como observar e manter as características técnicas que fundamentaram a certificação original.

As informações constantes deste certificado de homologação podem ser confirmadas no SCH - Sistema de Gestão de Certificação e Homologação, disponível no portal da Anatel. (www.anatel.gov.br).

Davison Gonzaga da Silva
Gerente de Certificação e Numeração

Figure G-3. ANATEL certificate of homologation

Limited warranty

Covered equipment is warranted/guaranteed against defects in materials and workmanship under normal use and service for the period listed on your sales invoice or the product order information web page. The covered period begins on the date of shipment unless otherwise specified. For a repair to be covered under warranty, the following criteria must be met:

1. There must be a defect in materials or workmanship that affects form, fit, or function of the device.

2. The defect cannot be the result of misuse.

3. The defect must have occurred within a specified period of time; and

4. The determination must be made by a qualified technician at a Campbell Scientific Service Center/ repair facility.

The following is not covered:

1. Equipment which has been modified or altered in any way without the written permission of Campbell Scientific.

2. Batteries; and

3. Any equipment which has been subjected to misuse, neglect, acts of God or damage in transit.

Campbell Scientific regional offices handle repairs for customers within their territories. Please see the back page of the manual for a list of regional offices or visit www.campbellsci.com/contact to determine which Campbell Scientific office serves your country. For directions on how to return equipment, see Assistance.

Other manufacturer's products, that are resold by Campbell Scientific, are warranted only to the limits extended by the original manufacturer.

CAMPBELL SCIENTIFIC EXPRESSLY DISCLAIMS AND EXCLUDES ANY IMPLIED WARRANTIES OF

MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Campbell Scientific hereby disclaims, to the fullest extent allowed by applicable law, any and all warranties and conditions with respect to the products, whether express, implied, or statutory, other than those expressly provided herein.

Campbell Scientific will, as a default, return warranted equipment by surface carrier prepaid. However, the method of return shipment is at Campbell Scientific's sole discretion. Campbell Scientific will not reimburse the claimant for costs incurred in removing and/or reinstalling equipment. This warranty and the Company's obligation thereunder is in lieu of all other

warranties, expressed or implied, including those of suitability and fitness for a particular purpose. Campbell Scientific is not liable for consequential damage.

In the event of any conflict or inconsistency between the provisions of this Warranty and the provisions of Campbell Scientific's Terms, the provisions of Campbell Scientific's Terms shall prevail. Furthermore, Campbell Scientific's Terms are hereby incorporated by reference into this Warranty. To view Terms and conditions that apply to Campbell Scientific, Logan, UT, USA, see Terms and Conditions. To view terms and conditions that apply to Campbell Scientific offices outside of the United States, contact the regional office that serves your country.

Assistance

Products may not be returned without prior authorization. Please inform us before returning equipment and obtain a **return material authorization (RMA) number** whether the repair is under warranty/guarantee or not. See Limited warranty for information on covered equipment.

Campbell Scientific regional offices handle repairs for customers within their territories. Please see the back page of the manual for a list of regional offices or visit www.campbellsci.com/contact to determine which Campbell Scientific office serves your country.

When returning equipment, a RMA number must be clearly marked on the outside of the package. Please state the faults as clearly as possible. Quotations for repairs can be given on request.

It is the policy of Campbell Scientific to protect the health of its employees and provide a safe working environment. In support of this policy, when equipment is returned to Campbell Scientific, Logan, UT, USA, it is mandatory that a "Declaration of Hazardous Material and Decontamination" form be received before the return can be processed. If the form is not received within 5 working days of product receipt or is incomplete, the product will be returned to the customer at the customer's expense. For details on decontamination standards specific to your country, please reach out to your regional Campbell Scientific office.

> NOTE:
> All goods that cross trade boundaries may be subject to some form of fee (customs clearance, duties or import tax). Also, some regional offices require a purchase order upfront if a product is out of the warranty period. Please contact your regional Campbell Scientific office for details.

Safety

DANGER — MANY HAZARDS ARE ASSOCIATED WITH INSTALLING, USING, MAINTAINING, AND WORKING ON OR AROUND TRIPODS, TOWERS, AND ANY ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC. FAILURE TO PROPERLY AND COMPLETELY ASSEMBLE, INSTALL, OPERATE, USE, AND MAINTAIN TRIPODS, TOWERS, AND ATTACHMENTS, AND FAILURE TO HEED WARNINGS, INCREASES THE RISK OF DEATH, ACCIDENT, SERIOUS INJURY, PROPERTY DAMAGE, AND PRODUCT FAILURE. TAKE ALL REASONABLE PRECAUTIONS TO AVOID THESE HAZARDS. CHECK WITH YOUR ORGANIZATION'S SAFETY COORDINATOR (OR POLICY) FOR PROCEDURES AND REQUIRED PROTECTIVE EQUIPMENT PRIOR TO PERFORMING ANY WORK.

Use tripods, towers, and attachments to tripods and towers only for purposes for which they are designed. Do not exceed design limits. Be familiar and comply with all instructions provided in product manuals. Manuals are available at www.campbellsci.com You are responsible for conformance with governing codes and regulations, including safety regulations, and the integrity and location of structures or land to which towers, tripods, and any attachments are attached. Installation sites should be evaluated and approved by a qualified engineer. If questions or concerns arise regarding installation, use, or maintenance of tripods, towers, attachments, or electrical connections, consult with a licensed and qualified engineer or electrician.

General

- Protect from over-voltage.
- Protect electrical equipment from water.
- Protect from electrostatic discharge (ESD).
- Protect from lightning.
- Prior to performing site or installation work, obtain required approvals and permits. Comply with all governing structure-height regulations, such as those of the FAA in the USA.
- Use only qualified personnel for installation, use, and maintenance of tripods and towers, and any attachments to tripods and towers. The use of licensed and qualified contractors is highly recommended.
- Read all applicable instructions carefully and understand procedures thoroughly before beginning work.
- Wear a hardhat and eye protection, and take other appropriate safety precautions while working on or around tripods and towers.
- Do not climb tripods or towers at any time, and prohibit climbing by other persons. Take reasonable precautions to secure tripod and tower sites from trespassers.
- Use only manufacturer recommended parts, materials, and tools.

Utility and Electrical

- You can be killed or sustain serious bodily injury if the tripod, tower, or attachments you are installing, constructing, using, or maintaining, or a tool, stake, or anchor, come in contact with overhead or underground utility lines.
- Maintain a distance of at least one-and-one-half times structure height, 6 meters (20 feet), or the distance required by applicable law, whichever is greater, between overhead utility lines and the structure (tripod, tower, attachments, or tools).
- Prior to performing site or installation work, inform all utility companies and have all underground utilities marked.
- Comply with all electrical codes. Electrical equipment and related grounding devices should be installed by a licensed and qualified electrician.
- Only use power sources approved for use in the country of installation to power Campbell Scientific devices.

Elevated Work and Weather

- Exercise extreme caution when performing elevated work.
- Use appropriate equipment and safety practices.
- During installation and maintenance, keep tower and tripod sites clear of un-trained or non-essential personnel. Take precautions to prevent elevated tools and objects from dropping.
- Do not perform any work in inclement weather, including wind, rain, snow, lightning, etc.

Internal Battery

- Be aware of fire, explosion, and severe-burn hazards.
- Misuse or improper installation of the internal lithium battery can cause severe injury.

- Do not recharge, disassemble, heat above 100 °C (212 °F), solder directly to the cell, incinerate, or expose contents to water. Dispose of spent batteries properly.

Use and disposal of batteries

- Where batteries need to be transported to the installation site, ensure they are packed to prevent the battery terminals shorting which could cause a fire or explosion. Especially in the case of lithium batteries, ensure they are packed and transported in a way that complies with local shipping regulations and the safety requirements of the carriers involved.
- When installing the batteries follow the installation instructions very carefully. This is to avoid risk of damage to the equipment caused by installing the wrong type of battery or reverse connections.
- When disposing of used batteries, it is still important to avoid the risk of shorting. Do not dispose of the batteries in a fire as there is risk of explosion and leakage of harmful chemicals into the environment. Batteries should be disposed of at registered recycling facilities.

Avoiding unnecessary exposure to radio transmitter radiation

- Where the equipment includes a radio transmitter, precautions should be taken to avoid unnecessary exposure to radiation from the antenna. The degree of caution required varies with the power of the transmitter, but as a rule it is best to avoid getting closer to the antenna than 20 cm (8 inches) when the antenna is active. In particular keep your head away from the antenna. For higher power radios (in excess of 1 W ERP) turn the radio off when servicing the system, unless the antenna is installed away from the station, e.g. it is mounted above the system on an arm or pole.

Maintenance

- Periodically (at least yearly) check for wear and damage, including corrosion, stress cracks, frayed cables, loose cable clamps, cable tightness, etc. and take necessary corrective actions.
- Periodically (at least yearly) check electrical ground connections.

WHILE EVERY ATTEMPT IS MADE TO EMBODY THE HIGHEST DEGREE OF SAFETY IN ALL CAMPBELL SCIENTIFIC PRODUCTS, THE CUSTOMER ASSUMES ALL RISK FROM ANY INJURY RESULTING FROM IMPROPER INSTALLATION, USE, OR MAINTENANCE OF TRIPODS, TOWERS, OR ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC.

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A worldwide network to help meet your needs

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Email:	info@campbellsci.in
Website:	www.campbellsci.in

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Website:	www.campbellsci.es

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Email:	info@campbellsci.asia
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Email:	sales@campbellsci.co.uk
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