



TX325

Satellite Transmitter for GOES V2



Guarantee

This equipment is guaranteed against defects in materials and workmanship. We will repair or replace products which prove to be defective during the guarantee period as detailed on your invoice, provided they are returned to us prepaid. The guarantee will not apply to:

- Equipment which has been modified or altered in any way without the written permission of Campbell Scientific
- Batteries
- Any product which has been subjected to misuse, neglect, acts of God or damage in transit.

Campbell Scientific will return guaranteed equipment by surface carrier prepaid. Campbell Scientific will not reimburse the claimant for costs incurred in removing and/or reinstalling equipment. This guarantee and the Company's obligation thereunder is in lieu of all other guarantees, expressed or implied, including those of suitability and fitness for a particular purpose. Campbell Scientific is not liable for consequential damage.

Please inform us before returning equipment and obtain a Repair Reference Number whether the repair is under guarantee or not. Please state the faults as clearly as possible, and if the product is out of the guarantee period it should be accompanied by a purchase order. 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 a "Declaration of Hazardous Material and Decontamination" form will be issued for completion.

When returning equipment, the Repair Reference Number must be clearly marked on the outside of the package. Complete the "Declaration of Hazardous Material and Decontamination" form and ensure a completed copy is returned with your goods. Please note your Repair may not be processed if you do not include a copy of this form and Campbell Scientific Ltd reserves the right to return goods at the customers' expense.

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PLEASE READ FIRST

About this manual

Please note that this manual was originally produced by Campbell Scientific Inc. primarily for the North American market. Some spellings, weights and measures may reflect this origin.

Some useful conversion factors:

Area: 1 in ² (square inch) = 645 mm ²	Mass: 1 oz. (ounce) = 28.35 g 1 lb (pound weight) = 0.454 kg
Length: 1 in. (inch) = 25.4 mm 1 ft (foot) = 304.8 mm 1 yard = 0.914 m 1 mile = 1.609 km	Pressure: 1 psi (lb/in ²) = 68.95 mb
	Volume: 1 UK pint = 568.3 ml 1 UK gallon = 4.546 litres 1 US gallon = 3.785 litres

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 it will be suitable for use in your country.*

Reference to some radio transmitters, digital cell phones and aerials 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. Details of the alternatives will be covered in separate manuals.

Part numbers prefixed with a “#” symbol are special order parts for use with non-EU variants or for special installations. Please quote the full part number with the # when ordering.

Recycling information



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.

Campbell Scientific Ltd 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 advice or support, please contact Campbell Scientific Ltd, or your local agent.



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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.eu or by telephoning +44(0) 1509 828 888 (UK). 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

- 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, or 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.

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.

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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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 a number of 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](#) (p. iii) section at the front 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.

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 (\geq OS 10), CR300-series (\geq OS 10), CR1000X (\geq OS 4), and GRANITE-series (\geq 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. Also ensure the TX325 has power.
2. 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 **COM 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**.
3. Click the **Settings Editor** tab.

4. Click the **GOES Radio** sub tab (FIGURE 4-1 (p. 3)).

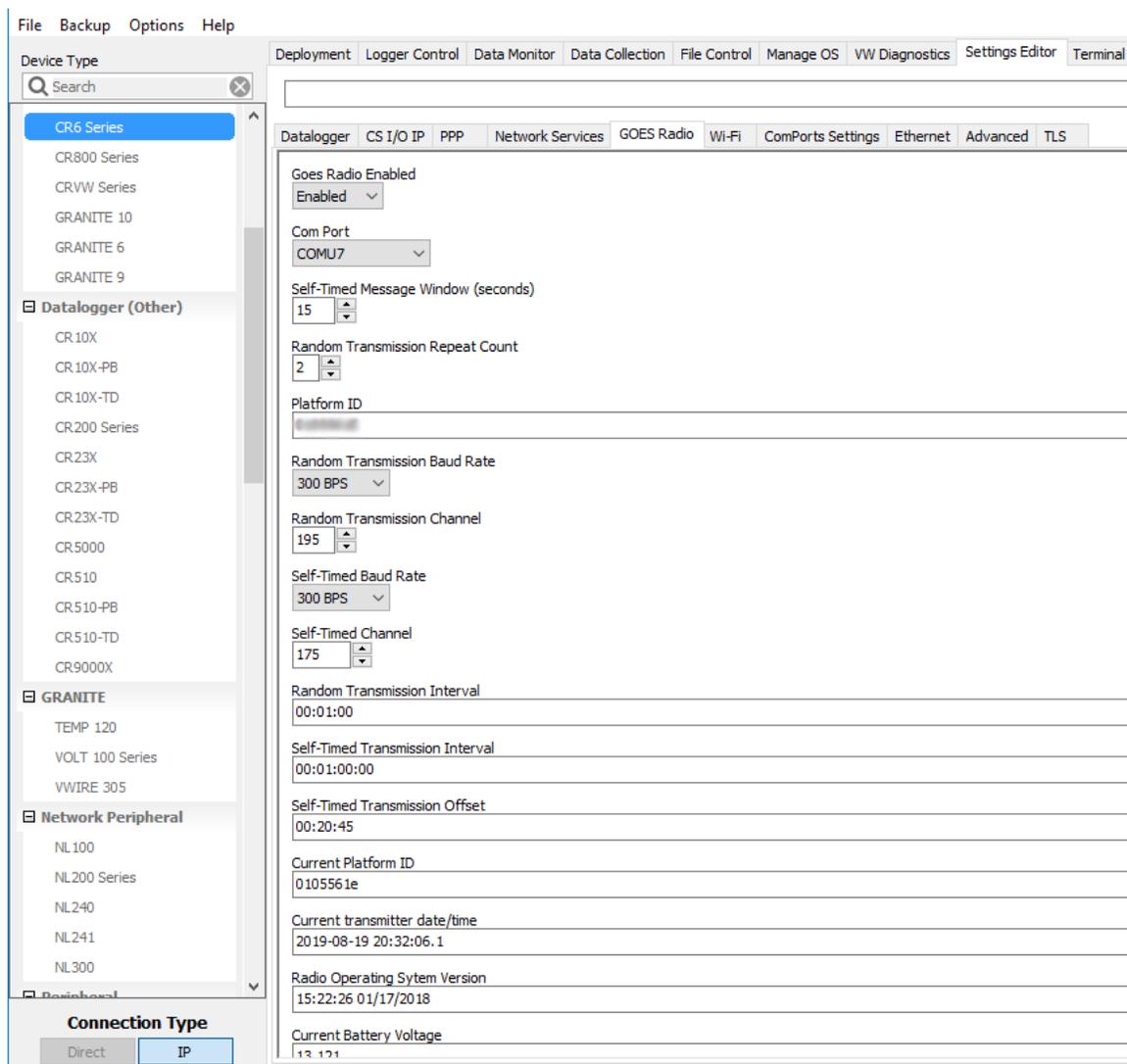
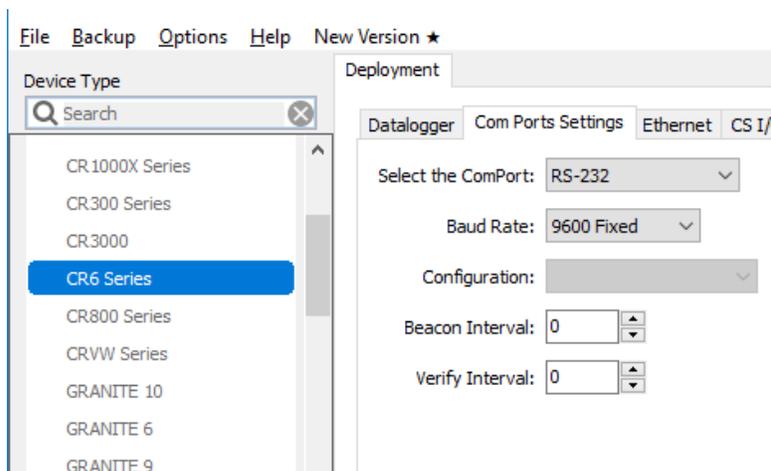


FIGURE 4-1. Device Configuration Utility GOES Radio screen

5. Select **Enabled** from the **Goes Radio Enabled** field.
6. Select the **Com Port** to which the GOES radio is connected.
7. Type the **Self-timed Message Windows (in seconds)** as assigned by GOES DCS Program.
8. Type the **Platform ID** (in HEX) as assigned by the GOES DCS Program.
9. Select the **Random Transmission Baud Rate** as assigned by the GOES DCS Program.
10. Type the **Random Transmission Channel** as assigned by the GOES DCS Program.
11. Select the **Self-Time Baud Rate** as assigned by the GOES DCS Program.

12. Type the **Self-Time Channel** as assigned by the GOES DCS Program.
13. Type the **Random Transmission Interval** as assigned by the GOES DCS Program. Format is hh:mm:ss.
14. Type the **Self-timed Transmission Interval** as assigned by the GOES DCS Program. Format is dd:mm:hh:ss.
15. Type the **Self-timed Transmission Offset** as assigned by the GOES DCS Program. Format is hh:mm:ss.
16. Click the **Deployment** tab.
17. Click the **Com Port Settings** sub tab.
18. Select 9600 for the **Baud Rate**.



19. 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 CM220 mounting bracket.



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.
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 or CH200.

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 ($\pm 100 \mu\text{s}$), 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 synched every 11 hours. The data logger clock is synched with the GPS time of the TX325 when using a CR6, CR300-series, CR1000X-series, and GRANITE-series data logger.

5.1 GOES, NESDIS, and transmit windows

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.

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. 20) for more information.

6. Specifications

Features:

- ESDIS 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

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

Compliance:	Refer to Compliance documents and certificates (p. 27), and www.campbellsci.eu/tx325
Transmissions supported:	Timed (Scheduled), Random
Data formats:	ASCII (SHEF), pseudo binary
Radio module:	OmniSat-3
Temperature range	
Operating:	−40 to 55 °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)
Maximum EIRP:	41 dBm (300 bps), 47 dBm (1200 bps); based on a 11 dbm gain antenna with 1 dbm line loss
Typical EIRP:	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 type:	3.3 V active
Timekeeping	
Initial accuracy:	$\pm 100 \mu\text{s}$ (synchronized to GPS)
Drift:	$\pm 40 \text{ ms/day}$ (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

7. Installation

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7.1 Field site requirements

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. 11) and [Table 7-2](#) (p. 11) provide the blink patterns for the green **Status** and red **Failsafe** LEDs, respectively.

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.

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. 19)). A power cycle will NOT clear the Failsafe mode.

7.3 Ports and connectors

The RS-232 port is a DB9 female connector configured as DCE. 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 RS-232 port.

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. At 300 bps transmission rates, the maximum transmit power is 31 dBm. At 1200 bps, the transmit power is 37 dBm.

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 or CH200 regulator, BP12 or BP24 battery, and a solar panel typically can support these requirements. For this power supply, the regulator connects to the TX325 power connector.

7.4 Transmission antenna

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.

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 CM220 mounting bracket. 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 CR6 (\geq OS 10), CR300-series (\geq OS 10), CR1000X (\geq OS 4), and GRANITE-series (\geq OS 1) data loggers. For information on programming the CR800-series, CR1000, and CR3000 data loggers, refer to the example program at www.campbellsci.eu/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. 1)). [Table 7-3](#) (p. 15) provides the TX325 settings that can be read and entered. [Table 7-4](#) (p. 16) 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. [GOES data formats and transmission durations](#) (p. 21) 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` if no SHEF code is specified.

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 by using the `SetSetting()` instruction which has 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 7-3](#) (p. 15) provides the TX325 settings that can be set and read. [Table 7-4](#) (p. 16) provides the read-only settings.

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

7.6.1 Read and write settings

Table 7-3: Read and write TX325 settings	
Field Name	Description
GOESComPort	Port used to communicate with the GOES transmitter.
GOESEnabled	Controls whether the data logger 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.
GOESMsgWindow	Length, in seconds, of the assigned self-timed transmission window assigned by NESDIS. Valid entries are 1 to 110 s.
GOESPlatformID	8-digit hexadecimal identification number assigned by NESDIS. Value is a string.
GOESRTBaudRate	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	Channel used for the random transmission assigned by NESDIS. Valid channel numbers are 0 through 566. The default value of 0 disables random transmissions.
GOESRTInterval	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	Baud rate for self-timed transmissions. Valid settings are 300 or 1200. The baud rate must match the user's NESDIS-channel assignment.
GOESSTChannel	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	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.

Table 7-3: Read and write TX325 settings	
Field Name	Description
GOESSTOffset	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.
GOESRepeatCount	Number of times within the random transmit interval that the TX325 will transmit the message data. Valid entries are 1 to 3.

7.6.2 Read-only settings

Table 7-4: 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 metres.
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.

Table 7-4: Read-only TX325 settings

FieldName	Description
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. A value of 0 indicates the GPS antenna is working and a value of 48 indicates the GPS antenna is shorted or is not connected.
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.
GOESLastDataLength	Number of bytes in the last radio transmission.
GOESLastHDRFlagWord	HDR flag word used in the last radio transmission.

FieldName	Description
GOESTxResultCode	Status of the last radio transmission. 0 = Last transmission was OK 1 = Transmission aborted, battery voltage to the radio 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

Issue: TX325 is not transmitting

First, check the power supply and make sure that the TX325 power supply voltage is at least 10.5 VDC (see [Specifications](#) (p. 8)). Next, check the red **Failsafe** LED. If the LED is on continuously, the TX325 is in its fail safe mode, which is cleared by pressing the **Reset** button. The **Reset** button is located near the LEDs and is accessed through a hole in the side of the transmitter housing ([FIGURE 8-1](#) (p. 19)).

CAUTION:

A power cycle will not clear the fail safe mode.

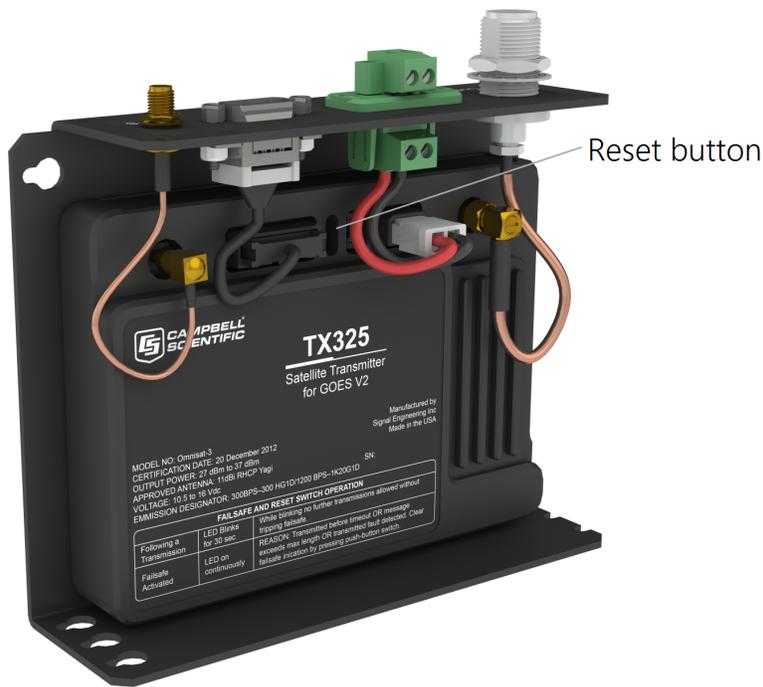


FIGURE 8-1. Reset button location

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 **Failsafe** LED is on continuously; its RF output is disabled; and its microprocessor is reset (causing the transmitter to reboot). While in the fail safe mode, the transmitter can communicate normally with the data logger, but is unable to transmit again until the fail safe mode has been cleared.

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 ID address code.
3. **IMPORTANT:** Contact NESDIS to coordinate a start-up date.

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

Appendix B. GOES data formats and transmission durations

Data transmissions are generally described as having an ASCII or Pseudo Binary format. The particular nature of how the data is formatted and ordered is determined by the content and organization of the data tables and execution of the [GOESData\(\)](#) instruction. Scan-order (interleaved) and channel-order data can be sent by using an ASCII or Pseudo Binary format with one of the data logger native data format options. The flexibility of CRBasic allows virtually any message type to match the decode system requirements.

B.1 ASCII

The ASCII data format is used to transmit data in plain readable text. This format is widely used for self-timed transmissions. 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.

B.1.1 7-byte floating-point ASCII

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

- Operating range of ± 7999
- Variable precision of 0.001 to 1
- Precision (placement of decimal point) is automatically determined based on the magnitude of the value ([Table B-1](#) (p. 22)).
- Number will be rounded to selected precision during conversion, for example, +12.345 will be rounded to +12.35.
- Value is always 7 characters.
- Value is always signed (+/-).
- Value always has trailing comma.
- Valid data outside of operating range will be pegged at -7999 or $+7999$.

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		

B.1.2 Fixed-decimal ASCII

Several fixed-decimal ASCII formats are available in CRBasic that will create fixed-width, space-delimited output.

- Value has a fixed width (Table B-2 (p. 22)).
- Value will be padded with leading zeros if needed to meet fixed-width requirement.
- Value has a fixed precision, see the following table.
- 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: Fixed-decimal ASCII				
Format	Width	Precision	Range	Example ASCII output containing two values
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

B.1.3 RAWS7, 7 data-point ASCII

The RAWS7 format is a fixed ASCII output format specified in the Interagency Wildland Fire Weather Station Standards and Guidelines in the NFDRS Station Minimum Sensor Complement section (www.nwcg.gov/publications/426-3). Table B-3 (p. 23) shows the parameters, format, width precision, and range. This output uses several of the fixed-decimal ASCII output formats described in [Fixed-decimal ASCII](#) (p. 22).

Parameter (units)	Format	Width	Precision	Range
Cumulative rainfall (in)	xx.xx	5	0.01 in	0 to 99.99
10-minute average wind speed (mph)	xxx	3	1 mph	0 to 999
10-minute average wind direction (°)	xxx	3	1°	0 to 360
Air temperature (°C or °F)	xxx	3	1°	-58 to 140
Fuel temperature (°C or °F)	xxx	3	1°	10 to 140
10-minute average relative humidity (%)	xxx	3	1%	0 to 100
Battery voltage (VDC)	xx.x	4	0.1 VDC	0 to 15

B.2 Pseudo binary

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. The eighth bit serves as an odd parity bit and is set by the transmitter. Binary numbers are transmitted MSB (most significant bit) first.

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. 23)).

Pseudo binary 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

Pseudo binary type	Range
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

Pseudo binary data messages are not easily readable and therefore rely on data processing within the flow of data reception to decode and transform messages.

B.2.1 FP2, 16-bit floating point number

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 +/- infinity and NAN, most commonly used to indicate a computational or measurement error. The following shows the numeric ranges and precision (Table B-5 (p. 24)), bit descriptions (Table B-6 (p. 24)), and bit usage in calculating a finished value (Table B-7 (p. 25)).

Range	Maximum precision
-7.999 to 7.999	0.001
-79.99 to 79.99	0.01
-799.9 to 799.9	0.1
-7,999 to 7,999	1

Name	Bit	Description
Sign (S)	15 (MSB)	Specifies the sign of the value. 0 = positive, 1 = negative.
Exponent (E)	14 and 13	Specifies the magnitude of the negative decimal exponent.
Mantissa (M)	12 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	0	8191	+ infinity
1	0	8191	- infinity
1	0	8190	NAN
0 or 1	0 to 3	0 to 7999	$(-1^S) \times (10^{-E}) \times M$

When transmitted in a pseudo binary format, the 16 bits are encoded within 3 bytes. They are spread across the lower 6 bits of each character. For example, [Table B-8](#) (p. 25) shows how the value of 12.34 is encoded.

Table B-8: Encoding of 12.34																							
Char1 = D								Char2 = S							Char3 = R								
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

B.2.2 18-bit integer

The 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-9](#) (p. 25).

Table B-9: Example encoding of water level surface elevation value of 12345																							
Char1 = C								Char2 = @							Char3 = 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 pseudo binary representations

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

B.3 Transmission durations

Table B-10 (p. 26) provides the transmission duration calculated from the number of bytes in a message. Table B-11 (p. 26) provides the maximum data bytes for the assigned time slot duration.

Transmit type	Transmission duration (seconds) (where N = number of data bytes in a message)
Self-timed, 300 bps	$(137 + (N \times 4))/150$
Random, 300 bps	$(137 + (N \times 4))/150$
Self-timed, 1200 bps	$(223 + (N \times 4))/600$
Random, 1200 bps	$(223 + (N \times 4))/600$

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. Compliance documents and certificates

Compliance documents include the ISO certificate (FIGURE C-1 (p. 27)) and the GOES V2 certificate (FIGURE C-2 (p. 28)). The TX325 EU Declaration of Conformity is available at: www.campbellsci.eu/tx325.



FIGURE C-1. ISO certificate

**National Environmental Satellite, Data, and
Information
Service**

Certificate Number
12142012

Certifies that Signal Engineering, Inc.

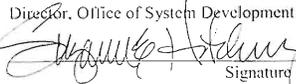
Model OmniSat-3

**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

12/20/12
Date

NOAA Form 83-1
(6-HO)

GOES RADIO SET CERTIFICATION

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

FIGURE C-2. GOES V2 certificate



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