Product Manual

Communications Device

TX321

Transmitter

Revision: 5/19

RELIABLE SINCE 1974 MONITORING

CAMPBELL SCIENTIFIC

Limited Warranty

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Assistance

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To obtain a Returned Materials Authorization (RMA) number, contact CAMPBELL SCIENTIFIC, INC., phone (435) 227-9000. Please write the issued RMA number clearly on the outside of the shipping container. Campbell Scientific's shipping address is:

CAMPBELL SCIENTIFIC, INC.
RMA#_____
815 West 1800 North
Logan, Utah 84321-1784

For all returns, the customer must fill out a "Statement of Product Cleanliness and Decontamination" form and comply with the requirements specified in it. The form is available from our website at *www.campbellsci.com/repair*. A completed form must be either emailed to *repair@campbellsci.com* or faxed to (435) 227-9106. Campbell Scientific is unable to process any returns until we receive this form. If the form is not received within three days of product receipt or is incomplete, the product will be returned to the customer at the customer's expense. Campbell Scientific reserves the right to refuse service on products that were exposed to contaminants that may cause health or safety concerns for our employees.

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 or by telephoning (435) 227-9000 (USA). 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, 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.

Table of Contents

PDF viewers: These page numbers refer to the printed version of this document. Use the PDF reader bookmarks tab for links to specific sections.

1. Introduction 1

2. Precautions 1

3. Initial Inspection 1

3.1 Ships With List 1

4. QuickStart 1

4.1 Step 1 – Configure the TX321 1
4.1.1 Accessing *DevConfig* 2
4.1.2 Settings Editor | Configuration 2
4.1.3 Settings Editor | GPS 5
4.2 Step 2 – Program the Data Logger 5
4.3 Step 3 – Install the Data Collection Platform (DCP) 5

5. Overview 11

5.1 GOES System 12
5.1.1 Orbit 12
5.1.2 NESDIS and Transmit–Windows 12
5.1.3 Data Retrieval 12

6. Specifications 13

7. Installation 16

7.1 Field Site Requirements 16
7.2 TX321 Functions 16
7.2.1 LED Function 16
7.2.2 Communication Ports 18
7.2.2.1 CS I/O Port 18
7.2.2.2 RS-232 Port 18
7.2.2.3 USB Port 19
7.2.3 RF Connectors 19
7.2.3.1 RF Transmission Connector 19
7.2.3.2 GPS Connector 19
7.2.4 Power Connector 19
7.3 Transmission Antenna 20
7.4 GPS Antenna 20
7.4.1 How the GPS Signal is Acquired and Used 20
7.4.2 GPS Antenna Location 20
7.5 CRBasic Programming 21
7.5.1 GOESData() 21
7.5.1.1 Result Code 21
7.5.1.2 Data Table 21
7.5.1.3 Table Option 21

7.5.1.4 Buffer Control 21
7.5.1.5 Data Format 22
7.5.1.6 GOESData() CR1000X Example 23
7.5.2 GOESStatus() 24
7.5.2.1 GOESStatus Read Time 24
7.5.2.2 GOESStatus Read Status 24
7.5.2.3 GOESStatus Read Last Message Status 25
7.5.3 GOESGPS 26
7.5.4 GOESSetup 26
7.5.4.1 Result Code 27
7.5.4.2 Platform ID 27
7.5.4.3 Window 27
7.5.4.4 Timed Channel 27
7.5.4.5 Timed Baud Rate 27
7.5.4.6 Random Channel 27
7.5.4.7 Random Baud Rate 27
7.5.4.8 Timed Interval 27
7.5.4.9 Timed Offset 28
7.5.4.10 Random Interval 28
7.5.4.11 GOESSetup() Example 28

8. Troubleshooting/Diagnostics 28

8.1 Fail-safe Conditions 28
8.2 Fault Button 29
8.3 Result Codes 29
8.4 Using *DevConfig* for Troubleshooting/Testing 30
8.4.1 Settings Editor | GPS 30
8.4.2 Settings Editor | Status 32
8.4.3 Terminal 33

Appendices

A. Information on Eligibility and Getting Onto the GOES System A-1

A.1 Eligibility A-1
A.2 Acquiring Permission A-1

B. GOES DCS Transmit Frequencies B-1

C. GOES Data Formats C-1

C.1 Data Formats C-1
C.2 ASCII C-1
C.2.1 7-Byte Floating Point ASCII C-1
C.2.2 Fixed Decimal ASCII C-2
C.2.3 RAWS7, 7 Data Point ASCII C-2
C.3 Pseudo Binary C-2
C.3.1 FP2, 16-bit Floating Point Number C-3
C.3.2 18-bit Integer C-4
C.3.3 Additional Pseudo Binary Representations C-4

D. Extended ASCII Command Set D-1

D.1 Command Interface D-1
D.1.1 Port Interfaces D-1
D.1.1.1 RS-232 Details D-1
D.1.1.2 Command Protocol D-1
D.1.1.3 Command Access Level D-2
D.2 General Configuration Commands D-2
D.2.1 Clock Read/Set D-2
D.2.2 Replacement Character Read/Set D-3
D.2.3 Save Configuration D-3
D.2.4 Restore Configuration D-3
D.2.5 Restore Default Configuration D-3
D.2.6 Enable Transmissions D-4
D.2.7 Disable Transmissions D-4
D.2.8 Read Configuration D-4
D.2.9 Enable Technician Command Mode D-5
D.2.10 Enable User Command Mode D-5
D.2.11 Set GPS Fix Interval D-5
D.3 GOES Transmission Configuration Commands D-5
D.3.1 Set GOES DCP Platform ID D-6
D.3.2 Set Self-Timed Transmission Channel Number D-6
D.3.3 Set Self-Timed Transmission Bit Rate D-6
D.3.4 Set Self-Timed Transmission Interval D-6
D.3.5 Set Self-Timed Transmission First Transmission Time D-7
D.3.6 Set Self-Timed Transmission Transmit Window Length D-7
D.3.7 Enable or Disable Self-Timed Transmission Message Centering D-7
D.3.8 Enable or Disable Self-Timed Buffer Empty Message D-7
D.3.9 Set Self-Timed Transmission Preamble Length D-8
D.3.10 Set Self-Timed Transmission Interleaver Mode D-8
D.3.11 Set Self-Timed Transmission Data Format D-8
D.3.12 Set Random Transmission Channel Number D-8
D.3.13 Set Random Transmission Bit Rate D-9
D.3.14 Set Random Transmission Interval D-9
D.3.15 Set Random Transmission Randomizing Percentage D-9
D.3.16 Set Random Transmission Repeat Count D-9
D.3.17 Enable or Disable Random Transmission Message Counter D-10
D.4 Data Buffer Loading Commands D-10
D.4.1 Load Self-Timed Transmission Buffer D-10
D.4.2 Read Number of Bytes in the Self-Timed Transmission Buffer D-11
D.4.3 Read the Maximum Self-Timed Message Length D-11
D.4.4 Clear Self-Timed Transmission Buffer D-11
D.4.5 Load Random Transmission Buffer D-11
D.4.6 Read Length of the Message in the Random Transmission Buffer D-12
D.4.7 Read the Maximum Random Message Length D-12
D.4.8 Clear Random Transmission Buffer D-12
D.5 Status and Other Commands D-12
D.5.1 Read Version Information D-13
D.5.2 Read Transmission Status D-13
D.5.3 Read Last Transmission Status D-13
D.5.4 Read GPS Status D-14
D.5.5 Read GPS Position D-15
D.5.6 Read Audit Log D-15
D.5.7 Read Forward Power D-15
D.5.8 Read Reflected Power D-16

D.5.9 Read Power Supply D-16
D.5.10 Read TCXO Temperature D-16
D.5.11 Read Measured Frequency D-16

E. Meteosat E-1

E.1 General Specifications E-1

F. Compliance Documents and Certificates F-1

Figures

4-1. Ports used for computer connection 2
4-2. Settings Editor Configuration in DevConfig 4
4-3. Yagi antenna 6
4-4. Alignment Tab in DevConfig 7
4-5. Exploded view of the GPS antenna mounted to a crossarm via the CM220 8
4-6. GPS antenna mounted to a crossarm via the CM220 8
4-7. Antenna connectors 9
4-8. TX321 connectors 10
4-9. DCP enclosure 11
5-1. Major components of the GOES/DCP system (GPS antenna and solar panel not shown) 13
7-1. TX321 LEDs 16
8-1. TX321 Fault Button 29
8-2. Settings Editor | GPS in DevConfig 31
8-3. Settings Editor | Status in DevConfig 32
8-4. Terminal Tab in DevConfig 33
F-1. TX321 FCC Supplier Declaration of Conformity and FCC Statement F-1
F-2. DCPRS and CGMS certificate F-2
F-3. EUMETSAT certificate F-3

Tables

7-1. GOESStatus Command 0: Read Time 24
7-2. GOESStatus Command 1: Read Status 25
7-3. GOESStatus Command 2: Read Last Message Status 25
8-1. Result Codes Indicating Communication Problems 30
8-2. GOESSetup and GOESData Run-time Result Codes 30
B-1. GOES DCPRS Transmit Frequencies Certification Standard 1.0 ..... B-1
B-2. GOES DCPRS Transmit Frequencies Certification Standard 2.0 ..... B-4
E-1. Meteosat Transmit Frequencies E-2

CRBasic Examples

7-1. GOESData() Instruction 23
7-2. GOESSetup() Instruction 28

TX321 Transmitter

1. Introduction

The TX321 is a high data rate transmitter that supports one-way communications, via satellite, from a Campbell Scientific data logger to a ground receiving station. Satellite telemetry offers a convenient telecommunication alternative for field stations where phone lines or radio systems are impractical.

Before installing the TX321, please study

- Section 2, *Precautions* *(p. 1)*
- Section 3, *Initial Inspection* *(p. 1)*
- Section 4, *QuickStart* *(p. 1)*

Additional information is provided in the following sections.

2. Precautions

- Although the TX321 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 TX321, 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. Ships with list is provided in Section 3.1, *Ships With List* *(p. 1)*.

3.1 Ships With List

- (1) USB Cable
- (1) SC12 Serial Cable
- (1) Power Cable Set of Red and Black Wires, 24 in.
- (4) #6-32 x .375 Pan Phillips Screws
- (4) Grommets

4. QuickStart

4.1 Step 1 – Configure the TX321

Use our *Device Configuration Utility* (*DevConfig*) to enter the required National Environmental Satellite Data and Information Service (NESDIS) information that is unique to each data collection platform (DCP). *DevConfig* must be version 2.11 or newer. The TX321 has non-volatile memory to store the setup information.

4.1.1 Accessing *DevConfig*

The following steps are required for accessing *DevConfig*:

- Connect the TX321 to the computer. A standard 9-pin serial cable or SC12 can be used to connect the TX321 RS-232 port to the computer RS-232 port. Alternatively, the transmitter can be connected to the computer USB port via a USB cable (see FIGURE 4-1).

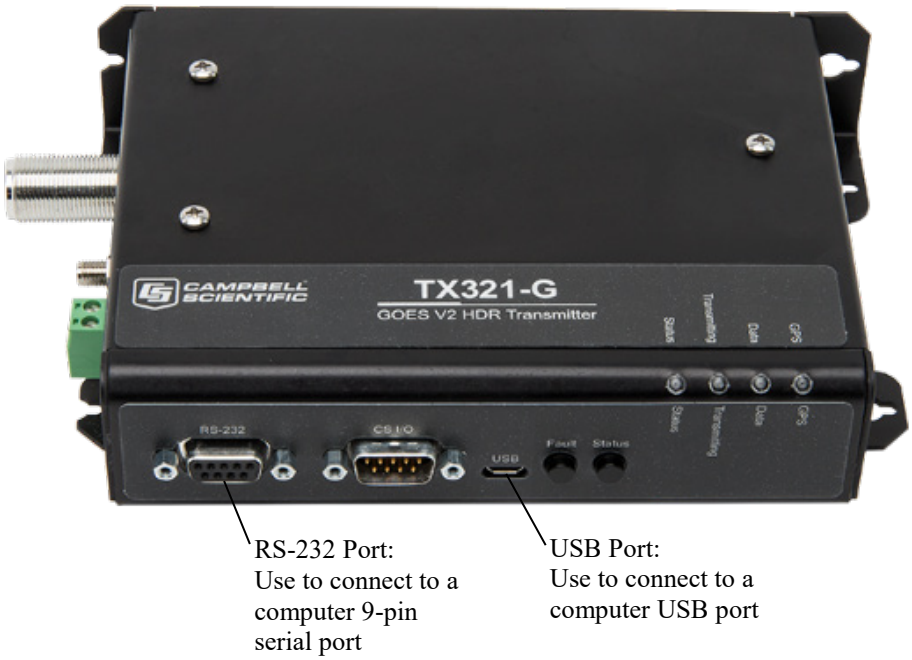

FIGURE 4-1. Ports used for computer connection

- Connect the TX321 to a 12 VDC power source.
- To obtain GPS coordinates for aiming the satellite antenna, the GPS antenna also needs to be connected to the transmitter and have a clear view of the sky.
- Click on **TX321/TX320/TX312** for the device type in *DevConfig*.
- Select the port matching the **COM** or **USB** port on the computer to which the transmitter is connected.
- Click the **Connect** button on the bottom left of the *DevConfig* screen.

4.1.2 Settings Editor | Configuration

FIGURE 4-2 provides an example of parameters entered in the **Configuration** tab.

Platform ID: Type your NESDIS-assigned ID number. This is an 8-digit hex number.

CS2 Self Timed Transmission Channel: Select the NESDIS-assigned self-timed transmission channel. For 1200-baud channels, the formal channel designation is the channel number followed by the letter A, for example: 99A. Setting the channel number to a value of zero disables timed transmissions.

CS2 Self Timed Transmission Bit Rate: Select the NESDIS-assigned channel bit rate (baud rate). This value is either 300 or 1200 for a Certification Standard Version 2 (CS2) device.

Self Timed Transmission Interval: Type the interval between timed transmissions (specified as dd:hh:mm:ss). The default value of 00:01:00:00 transmits the data every hour. The valid range for this setting is 00:00:05:00 to 30:23:59:59.

Self Timed Transmission First Time: Type an offset from the **Self Timed Transmission Interval** that specifies when the first transmission takes place; must be less than the **Self Timed Transmission Interval**. Example: **Self Timed Transmission Interval** = 00:01:00:00 (1 hour) and the **Self Timed Transmission First Time** = 00:15:00 (15 min). The transmission pattern starting at midnight is the following 00:15:00, 01:15:00, 02:15:00...23:15:00.

Self Timed Transmission Window Length (s): Type the NESDIS-assigned length of the self-timed transmission window in units of seconds.

Self Timed Transmission Message Centered: Specify whether the **Self Timed Transmission** occurs at the center (**Yes**) or at the beginning of the **Self Timed Interval** (**No**).

Self Timed Transmission Data Format: Specify whether to transmit self-timed data in **ASCII**, **Binary**, or **Pseudo-Binary** format. This setting does not change the format of the data; it only changes the flag word. The data logger program determines the data format and should match the format chosen for this setting.

NOTE **Binary** has not been implemented in the GOES data collection system (DCS). Do not use.

Self Timed Send Buffer Empty Message: Specify whether the transmitter sends a **BUFFER EMPTY** message if the timed buffer is empty at the time of transmission.

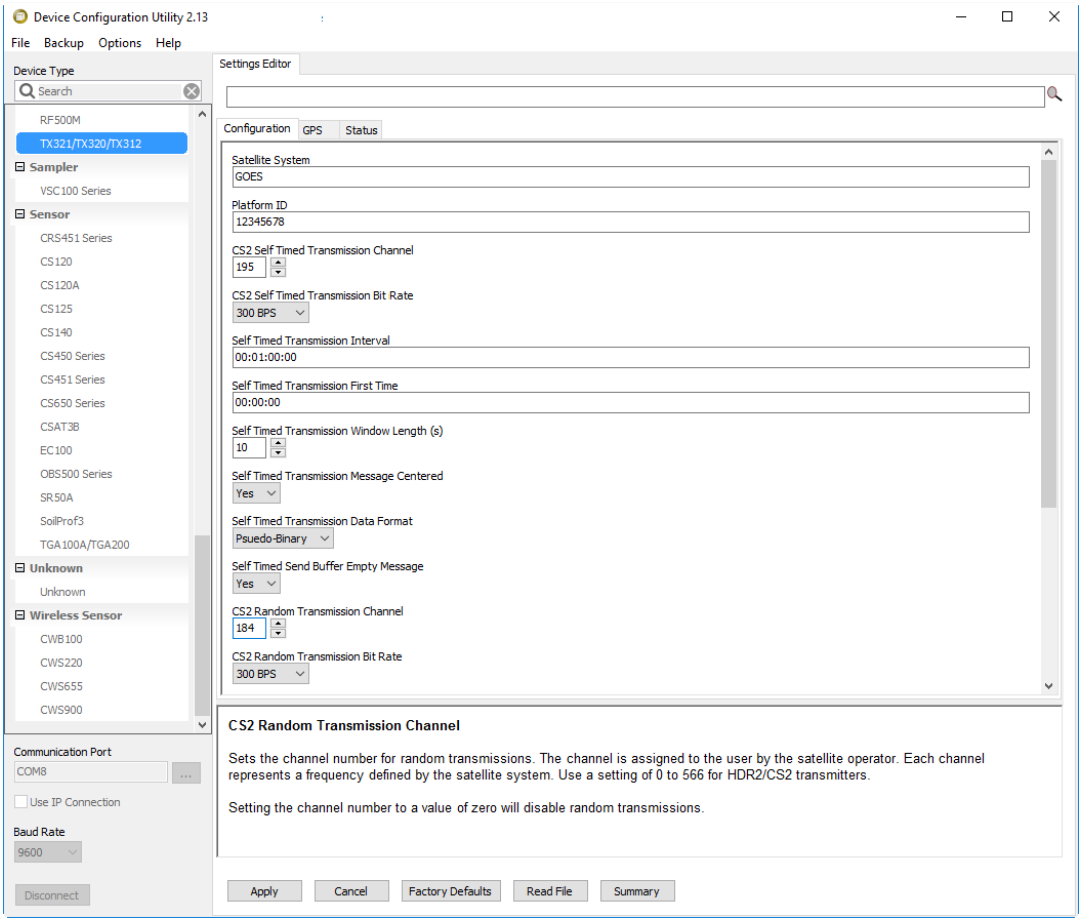

FIGURE 4-2. Settings Editor Configuration in DevConfig

NOTE If NESDIS has not assigned a Random Channel, the following parameters do not apply.

CS2 Random Transmission Channel: Select the NESDIS-assigned random transmission channel. Setting the channel number to a value of zero disables random transmissions.

CS2 Random Transmission Bit Rate: Select the NESDIS-assigned channel bit rate (baud rate). This value is either 300 or 1200 for a CS2 device.

Random Transmission Interval (m): Specify the randomizing interval in units of minutes. This value is the interval for transmitting random buffer data if data is in the random buffer. The actual interval is random but, on average, occurs at this rate.

Random Transmission Randomizing Percentage: Specify the range of randomization as a percentage of the randomizing interval. Random transmissions occur at a uniformly distributed random time within this range and, on average, occur at the random transmission interval rate. For example, for a random transmission interval of 15 minutes and a randomizing percentage

of 20, the time between any two random transmissions is between 12 to 18 minutes.

Random Transmission Repeat Count: Specify the number of times that a random transmission is repeated. A value greater than zero specifies the number of times the TX321 transmits random buffer data before the random buffer is automatically cleared. A value of zero specifies that random transmissions occur on the interval until the random buffer is cleared by the host.

Random Transmission Data Format: Specify whether random data is transmitted in **ASCII**, **Binary**, or **Pseudo-Binary** format. This setting does not change the format of the data; it only changes the flag word. The data logger program determines the data format and should match the format chosen for this setting.

NOTE **Binary** has not been implemented in the GOES DCS. Do not use.

Random Transmission Message Counter: Specify whether a message counter is included at the beginning of each random message transmission.

IRC: Specify the ASCII character to be substituted for a prohibited character detected in the transmission data when operating in ASCII or Pseudo Binary mode. Only printable characters (excluding space) are permitted.

NOTE The default values for many parameters in **Settings Editor** | **Configuration** can be used for many applications.

Click **Apply** after changing settings.

4.1.3 Settings Editor | GPS

GPS Fix Interval: Type the interval at which the transmitter attempts to get a GPS position fix (specified as hh:mm:ss). This should be left at **00:00:00** unless GPS is used for position. The **GPS Fix Interval** MUST NOT coincide with the **Self Timed Transmission Interval**. A GPS fix event must occur at least two minutes on either side of a self-timed transmission. Click **Apply** after changing the setting.

NOTE The default value of 00:00:00 disables periodic GPS position fixes, although these still occur at power up and every 24 hours because of the daily automatic OCXO calibration.

4.2 Step 2 – Program the Data Logger

The CRBasic program needs to include the **GOESData()** instruction, which tells the data logger to send data to the transmitter. Refer to Section 7.5.1, *GOESData()* *(p. 21)*, for programming details and example.

4.3 Step 3 – Install the Data Collection Platform (DCP)

1. Mount the 25316 Yagi antenna to a pole or mast by using the U-bolts included with the antenna mount (see FIGURE 4-3).

2. Install 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, place the element with four grooves at the spot on the boom with four dimples, and so forth.

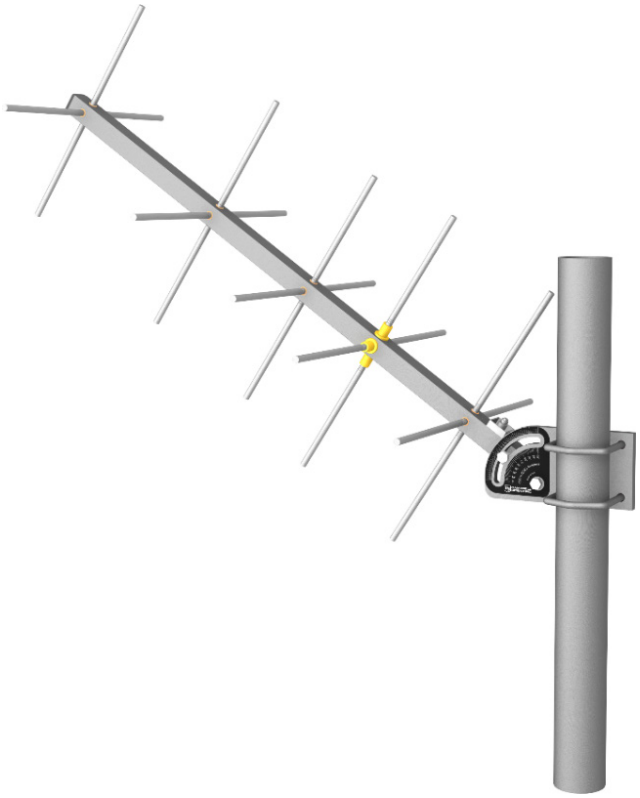

FIGURE 4-3. Yagi antenna

3. Aim the Yagi antenna at the spacecraft; azimuth and elevation angle positions are included on the bracket label. The **Alignment** tab in *DevConfig* can be used to determine the correct coordinates for the azimuth and elevation (see FIGURE 4-4). From the **Align to Satellite** list, select either the **East** or the **West** satellite, type the **Transmitter Latitude**, **Transmitter Longitude**, **Transmitter Altitude**, and the **Magnetic Declination**. The correct angles are then displayed in the lower panel.

NOTE Refer to Section 4.1.1, *Accessing DevConfig (p. 2)*, for information about accessing *DevConfig*. The transmitter internal GPS can be used to acquire azimuth and elevation information. To use the internal GPS device, connect the GPS antenna (see FIGURE 4-7). The information is listed on the GPS tab of *DevConfig*.

NOTE Additional information about the Yagi antenna is provided in Section 7.3, *Transmission Antenna* *(p. 20)*.

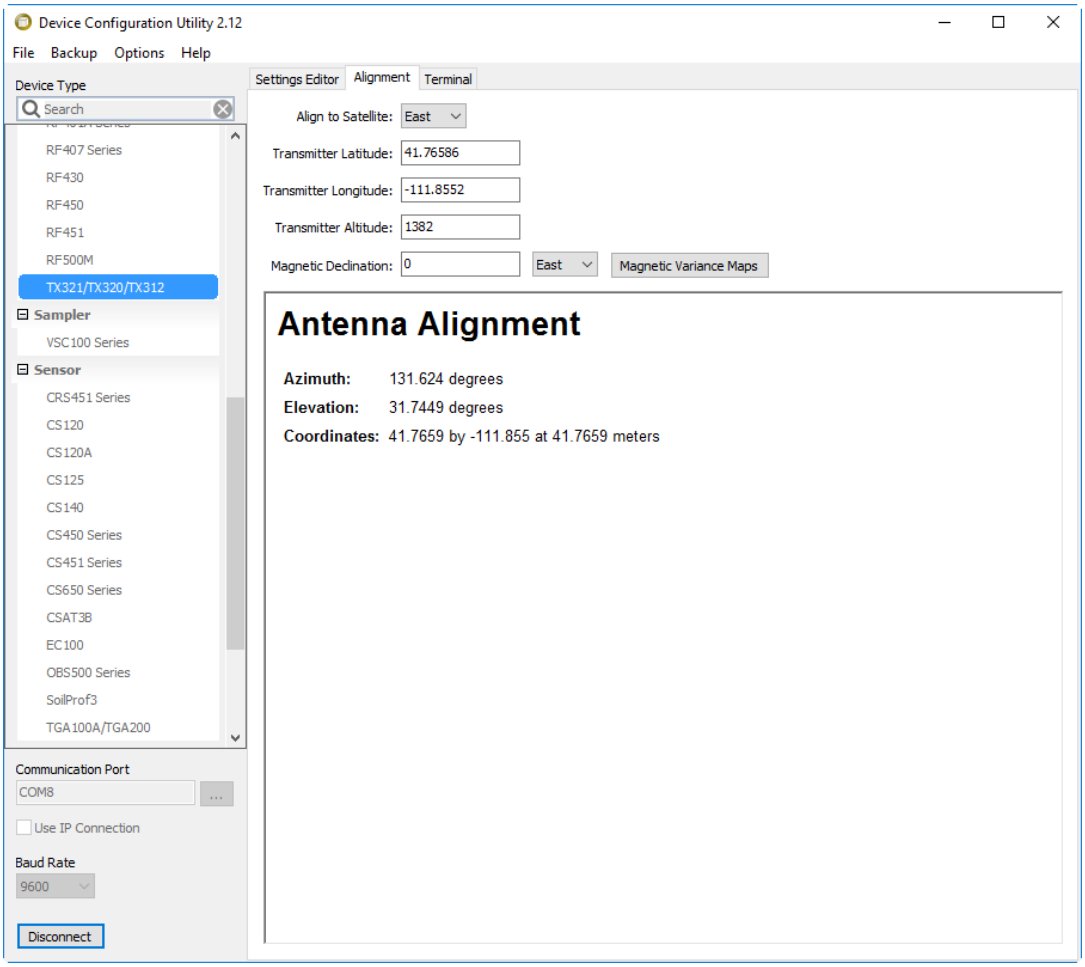

FIGURE 4-4. Alignment Tab in DevConfig

4. Connect the cable first. Be careful not to twist the cable when inserting the 3/4 IPS aluminum pipe into the GPS antenna (see FIGURE 4-5).

5. Mount the 3/4 IPS aluminum pipe to a crossarm via a CM220 mount or Nu-Rail® fitting. FIGURE 4-5 and FIGURE 4-6 show the GPS antenna mounted to a crossarm by using a CM220 mount. The ideal location for the GPS antenna is above everything, with the shortest cable possible. Refer to Section 7.4, *GPS Antenna* *(p. 20)*, for additional information about the GPS antenna.

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.

FIGURE 4-5. Exploded view of the GPS antenna mounted to a crossarm via the CM220

FIGURE 4-6. GPS antenna mounted to a crossarm via the CM220

6. Mount the TX321, the CH150 or CH200 regulator, the BP12 or BP24 battery pack, and the data logger to the backplate of an ENC16/18 enclosure (see FIGURE 4-9).

7. Mount the enclosure and solar panel to the pole or tripod.

8. Connect the COAXNTN cable to the Yagi antenna. Route the COAXNTN cable through the enclosure conduit and connect it to the TX321 connector labeled RF Out (see FIGURE 4-7 and FIGURE 4-8).

9. Connect the TNC connector of the GPS antenna cable to the GPS antenna. Route the GPS antenna cable through the enclosure conduit and connect it to the TX321 connector labeled GPS (see FIGURE 4-7 and FIGURE 4-8).

10. Wire the TX321, the CH150 or CH200 regulator, the BP12 or BP24 battery, and the data logger according to FIGURE 4-8 and FIGURE 4-9.

11. 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.

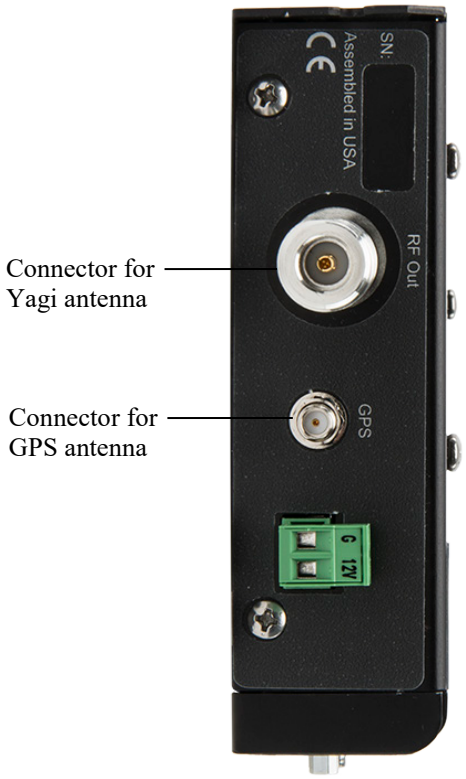

FIGURE 4-7. Antenna connectors

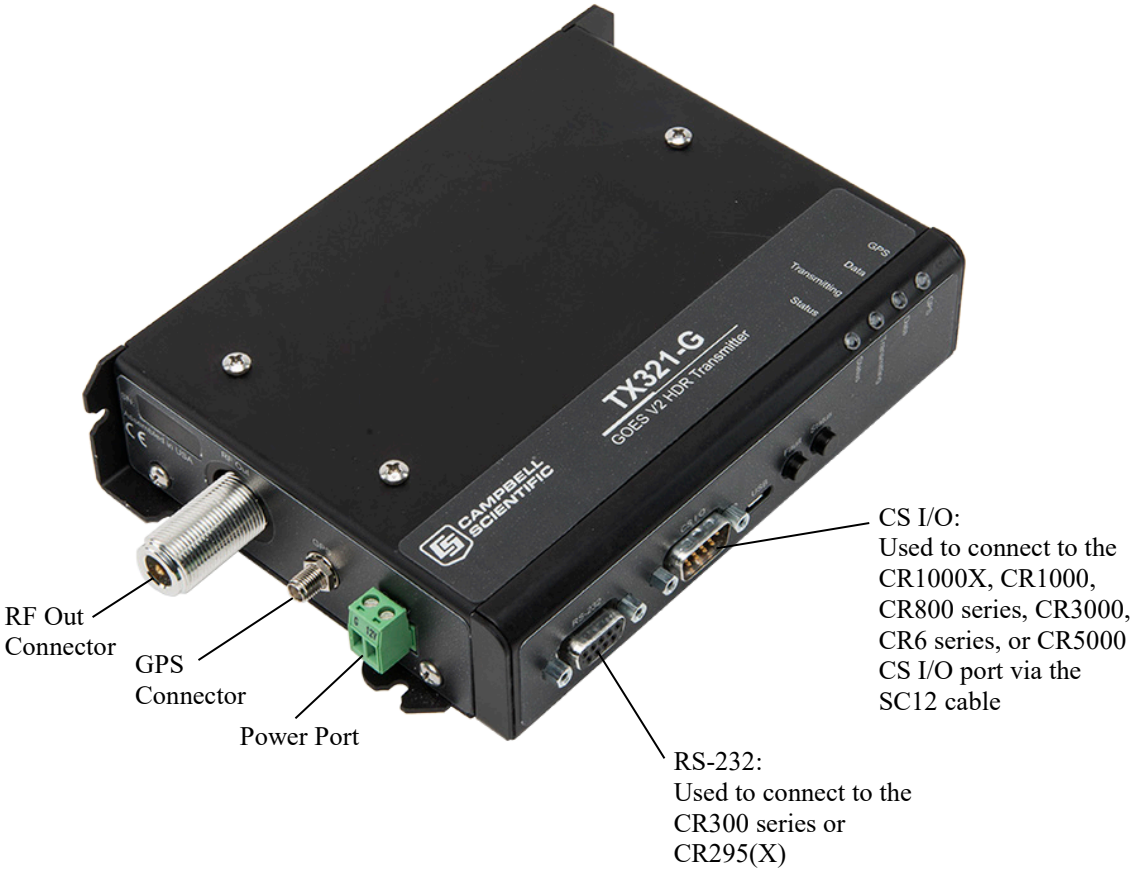

FIGURE 4-8. TX321 connectors

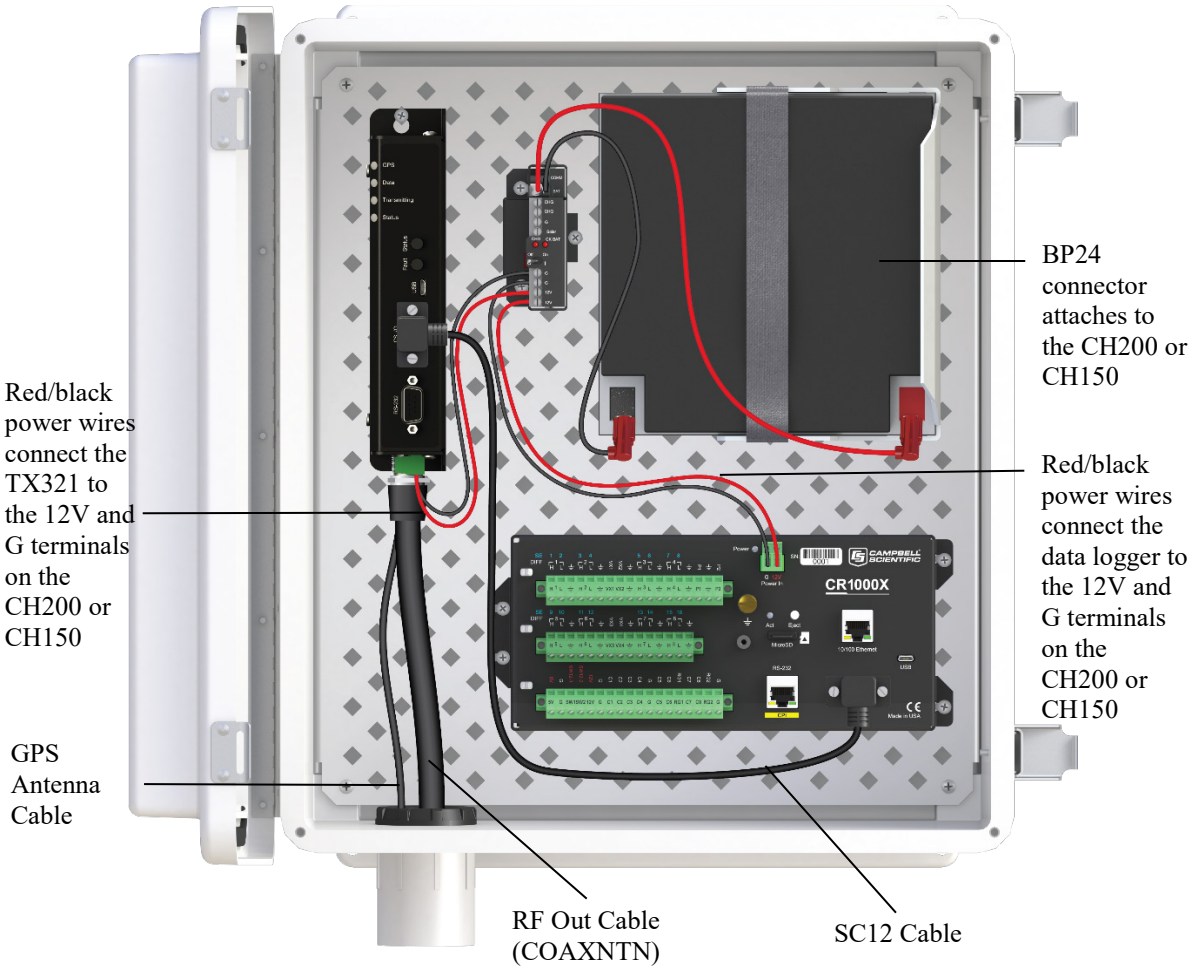

FIGURE 4-9. DCP enclosure

5. Overview

The TX321 uses non-volatile memory to store configuration information, such as platform ID, transmission baud rate, channel number, scheduled transmission time, offset time, and message window length. The TX321 also has a 15.7 kB RAM buffer for scheduled transmissions and a buffer for random transmissions. The clock is maintained with a GPS receiver.

The TX321 transmitters currently support the:

- GOES Data Collection Platform Radio Set (DCPRS) Certification Standards at 300 bps and 1200 bps, version 2, effective date: June 2009 (also known as CS2) (see FIGURE F-2)
- 300/1200 bps DCPRS Certification Standard version 1.0b – March 2000
- Meteosat Data Collection Platform (see Appendix E, *Meteosat* *(p. E-1)*, for more details)

The TX321 supports High Data Rate specifications.

The TX321 includes the following communication ports:

- CS I/O port for Campbell Scientific data loggers
- RS-232 port for data loggers and computer communications
- USB port for computer communications

The CS I/O port is a Campbell Scientific synchronous device for communication (SDC) port, address 4.

NOTE The 21X and CR7 data loggers do not support SDC or the TX321.

5.1 GOES System

Appendix A, *Information on Eligibility and Getting Onto the GOES System* *(p. A-1)*, provides information about getting onto the GOES system and eligibility.

5.1.1 Orbit

The TX321 transmitter sends data via Geostationary Operational Environmental Satellites (GOES). GOES satellites have orbits that coincide with the Earth's rotation, allowing each satellite to remain above a specific region. This allows a user to point the GOES antenna at a fixed position in the sky.

There are two satellites, GOES East and GOES West. GOES East is located at 75° West longitude and GOES West is 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 the United States are assigned to either spacecraft.

5.1.2 NESDIS and Transmit–Windows

GOES is managed by the National Environmental Satellite Data Information Service (NESDIS). NESDIS assigns the platform ID, uplink channel number, and self-timed or random transmit windows. Self-timed windows allow data transmission only during a predetermined time frame (typically 10 seconds every hour). The self-timed data is erased from the transmitter buffer after each transmission; random data is not. Random windows are for critical applications (for example, flood reporting) and allow transmission almost 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 TX321.

5.1.3 Data Retrieval

Data retrieval via the TX321 and the GOES system is illustrated in FIGURE 5-1. The DAPS User Interface Manual, provided by NOAA/ NESDIS, describes the process of retrieving the data from the NESDIS ground station. The data is in the form of three-byte ASCII. You can also retrieve data directly from the NESDIS ground station via DOMSAT, LRGS, or LRIT. DOMSAT is

only practical for organizations with many GOES users. Contact NESDIS for more information (*www.noaasis.noaa.gov/DCS*).

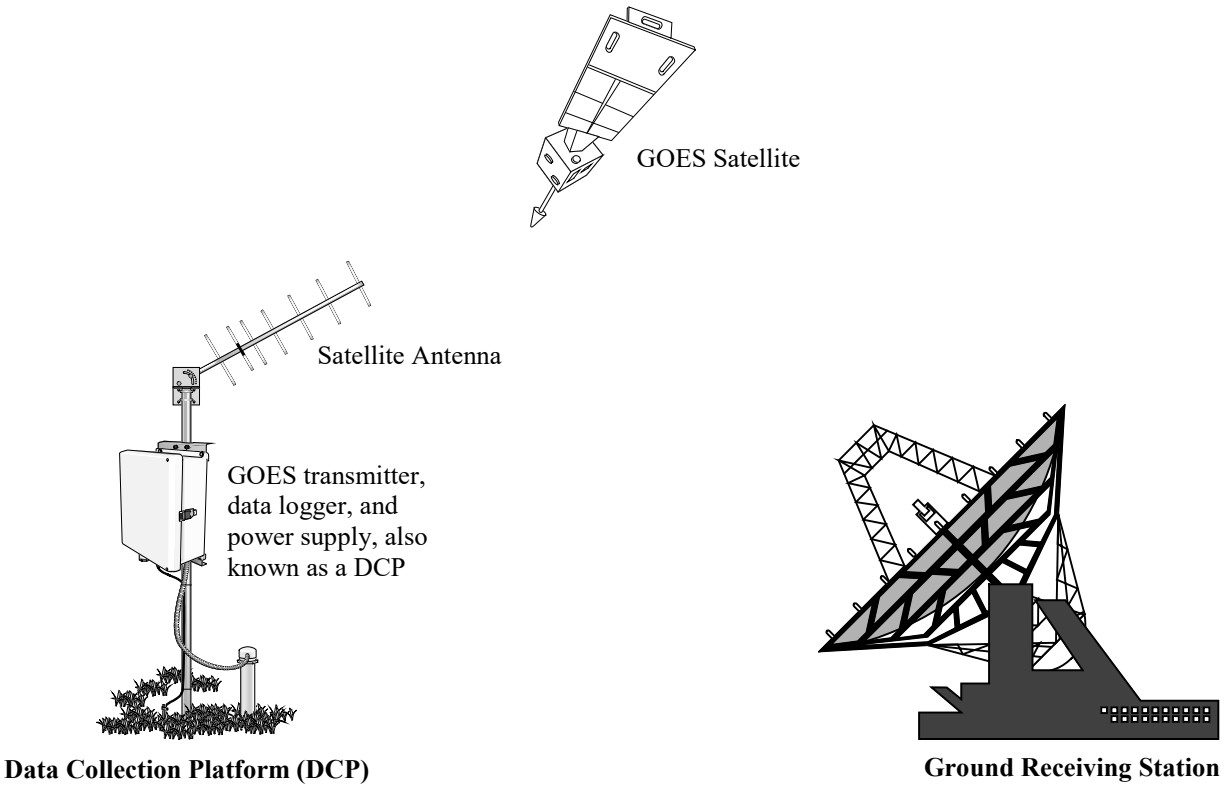

FIGURE 5-1. Major components of the GOES/DCP system (GPS antenna and solar panel not shown)

6. Specifications

Compatible Data Loggers:	CR295(X), CR800 Series, CR1000, CR1000X Series, CR3000, CR6 Series, CR300 Series[1], and CR5000
Supply Power	
Supply Voltage:	10.8 to 16 VDC
Typical Current Draw @ 12 VDC	
Idle:	< 5 mA
During GPS Fix:	< 100 mA (by default, once per day for 15 minutes)
Transmit:	< 2.6 A
Connector:	Removable 2 pin screw terminal, 5 mm pitch

[1] CR300 Series requires a null modem cable.

Satellite General

Supports timed and random transmissions
Supports ASCII and pseudo-binary message transmission
Transmit RF out connector: Type N jack
G6 OEM radio module

Satellite GOES

NOAA/NESDIS GOES High Data Rate Certification Standards version 2

Baud Rates: 300 and 1200 bps

Transmit Power[2]

Settings default for use with 11 dBi Yagi antenna

300 bps Default: 31.5 dBm
1200 bps Default: 37.5 dBm
Maximum: 38 dBm

Frequency Range: 401.701 to 402.0985 MHz

Initial Frequency Stability: ±20 Hz disciplined to GPS; GPS fix occurs after power up and once per day thereafter

Channel Bandwidth

300 bps: 750 Hz
1200 bps: 1.5 KHz

Emission Designators

300 bps: 300HG1D
120 bps: 1K20G1D

Satellite Meteosat

EUMETSAT Meteosat SRD

Baud Rates: 100 bps

Transmit Power[3]

Default configuration for use with 11 dBi Yagi antenna

100 bps Default: 37.5 dBm
Maximum: 41.5 dBm

Frequency Range: 402.0355 to 402.4345 MHz

Initial Frequency Stability: ±20 Hz disciplined to GPS; GPS fix occurs after power up and once per day thereafter

Channel Bandwidth: 3 kHz (100 bps)

GPS Receiver

Type: 3.3 V active
Connector: SMA jack

RS-232 Serial Port Signal Levels

Input: Low < 0.8 V; High > 0.8 V
Output: Typically ±5.4 V

CS I/O Port

Signal Levels: TTL
Command Protocol: Campbell Scientific Synchronous Device Communication, Address 4

---

[2] When transmitting to GOES-13 or later, transmit EIRP is 37 to 41 dBm for 300 bps and 43 to 47 dBm for 1200 bps.

[3] Meteosat SRD transmit EIRP should be 43.25 to 52 dBm.

Timekeeping

Initial Accuracy:	±100 µs synchronized to GPS
Drift:	±10 ms/day without GPS (over operating temperature range)
GPS Schedule:	1 fix at power up, 1 fix per day afterwards
Transmission Continuation without GPS Fix:	28 days

Interface Connectors

USB:	micro B, USB device
RS-232:	DB9 F, DCE, 3 wire RS-232
CS I/O:	DB9 M, SDC 4
Satellite RF Transmit Out:	Type N jack
GPS:	SMA jack
Power:	Removable 2 pin

Temperature Range

Operating:	–40 to 60 °C
Storage:	–55 to 70 °C

Transmitter Size

Case Dimensions:	18.5 x 12.7 x 3.8 cm (7.3 x 5.0 x 1.5 in)
Dimensions Including Connectors:	20.96 x 13.34 x 4.06 cm (8.25 x 5.25 x 1.6 in)
Weight:	0.77 kg (1.7 lb)

Interface Command Protocols

Binary Command Protocol:	Available on CS I/O when connected Available on RS-232 if CS I/O is not connected
ASCII Command Protocol:	Available on all ports

25316 Transmit Antenna

Gain:	11 dBi
Type:	Right hand circular polarization Yagi
Connector:	Type N female
Wind Load:	~100 knots

17992 GPS Antenna

Type:	3.3 V active dome, pipe mount
Gain:	28 dBi
Connector:	TNC jack

31182 GPS Antenna

Type:	3.3 V active patch, magnetic mount
Gain:	27 dBi
Connector:	SMA plug

Compliance

Refer to Appendix F, *Compliance Documents and Certificates* *(p. F-1)*, and *www.campbellsci.com/tx321*

7. Installation

7.1 Field Site Requirements

The TX321 has two siting requirements for proper operation. The GPS antenna must have a clear view of most of the sky. The transmission antenna must have a clear view of the spacecraft. The following are general siting requirements, not specific to the TX321. The TX321 must be mounted in an enclosure to protect it from the environment, including condensation. Most GOES systems are powered by a battery that is 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 TX321 Functions

7.2.1 LED Function

The TX321 has four LEDs used to indicate the state of the TX321 transmitter (FIGURE 7-1).

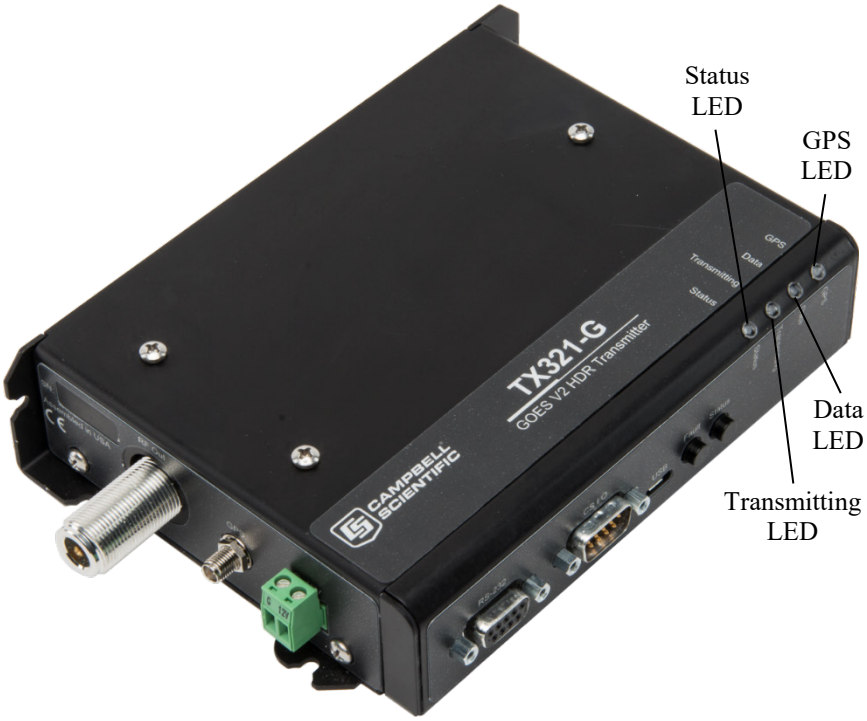

FIGURE 7-1. TX321 LEDs

When power is first applied to the TX321, the four LEDs cycle through quickly, then the **GPS** LED lights for 15 minutes.

If there is data in a buffer waiting for transmission time, the **Data** LED lights.

During transmission, the **Transmitting** LED lights.

The **Status** LED only lights after the **Fault** button has been pressed. Press and hold the **Fault** button for about 2 seconds. The **Status** LED flashes once to indicate the fail-safe has not been tripped. If the LED flashes twice, the fail-safe has tripped. To clear the fail-safe, press and hold the **Fault** button for about 10 seconds

Holding the **Status** button for 1 second before releasing causes the TX321 to run a diagnostics routine. The results of the diagnostics routine are indicated by the LEDs in the following order:

1. All of the LEDs will light green, then red, then yellow to show that all LEDs and states are functional.

2. The LEDs indicate the power supply voltage, as seen by the internal radio module. The LEDs collectively represent a level indicator by counting the number of LEDs that are on.

LED	12+ Volts	11.3 to 12 Volts	10.8 to 11.3 Volts	< 10.8 Volts
GPS	Green	OFF	OFF	OFF
Data	Yellow	Yellow	OFF	OFF
Transmitting	Yellow	Yellow	Yellow	OFF
Status	Red	Red	Red	Red

3. The **GPS** LED turns on to indicate GPS and real-time-clock (RTC) synchronization state, that is "Has the TX321 received a GPS fix yet?"

Color	State
Green	RTC is synched to GPS GPS location coordinates are acquired
Yellow	RTC is not synched to GPS
Red	GPS fix and time synch is not complete

4. The **Data** LED turns on when data is waiting to be transmitted in the timed and/or random transmission buffer(s). If data is present in both the timed and random transmission buffers, the **Data** LED lights up green then yellow.

Color	State
Green	There is data in timed transmission buffer
Yellow	There is data in the random transmission buffer
Red	Neither buffer contains data

5. The **Transmitting** LED turns on to indicate if the transmitter is enabled or disabled due to a configuration issue or fault.

Color	State
Green	Enabled for transmission
Red	Disabled – will not transmit

6. The **Status** LED turns on to indicate the RF transmit standing wave ratio (SWR). This allows for a quick check of how your antenna and coax cable assemblies are performing.

Color	State
Green	SWR of 1 to 2
Yellow	SWR of 2 to 4
Red	SWR greater than four OR there has not been a transmission since power on

Holding the **Status** button for 10+ seconds before releasing causes the TX321 to perform a forced test transmission on the random transmit channel. The TX321 will only perform the forced test transmission, if the random transmit channel has been configured.

1. If GPS is active or the RTC is invalid, the TX321 will flash all LEDs red. If the GPS is not active and the RTC is valid, the TX321 will flash all LEDs green.

2. The **Transmitting** light will blink green intermittently as the test progresses.

3. The **Transmitting** light will display solid green once the transmission has begun.

4. A successful transmission will be indicated by all LEDs rapidly flashing green. An unsuccessful transmission will be indicated by all LEDs rapidly flashing red.

7.2.2 Communication Ports

7.2.2.1 CS I/O Port

The CS I/O port is an SDC port, specifically designed to work with Campbell Scientific SDC-capable data loggers. The CS I/O port is used by Campbell Scientific data loggers to transfer data from the data logger to the TX321 transmitter. The CS I/O SDC port allows other SDC devices and one modem-enabled device to be connected to the same port at the same time. This SDC port will allow the TX321 transmitter, an RF407 radio, and a CR1000KD keyboard display to be connected to the data logger serial port all at the same time. The CS I/O port is a DB9 male; voltage levels are TTL, SDC address 4, pin out is:

1, 3, 5 are not used
2 = Ground
4 = RXD (output)
6 = SDE (input)
7 = CLK (input)
8 = 12V (input)
9 = TXD (input)

7.2.2.2 RS-232 Port

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 TX321.

The RS-232 port allows the transmitter to be connected to a computer 9-pin serial port or to a data logger RS-232 port. Connection to a computer is required to configure the transmitter via *DevConfig*.

7.2.2.3 USB Port

The transmitter also has a micro B USB port for connecting to a computer. Many newer computers only have USB ports. Configuration of the transmitter via *DevConfig* requires that the transmitter is connected to a computer.

7.2.3 RF Connectors

7.2.3.1 RF Transmission Connector

The TX321 uses the type N female connector for RF power out. This connector must have a proper antenna connection before transmission occurs. Failure to use a properly matched antenna cable and antenna may cause permanent damage to the RF amplifiers. The nominal impedance is 50 ohms; the frequency range is approximately 400 to 403 MHz. For GOES at 300 bps transmission rates, the default transmit power is 31.5 dBm. At 1200 bps, the default transmit power is 37.5 dBm. (Campbell Scientific standards use about 6 dBm higher power.) For Meteosat, the default transmit power is 37.5 dBm.

7.2.3.2 GPS Connector

The GPS connector is an input to the TX321. Operation without an antenna connected will not cause damage, but the transmitter will not transmit without a valid GPS fix. The GPS connector is an SMA female. The GPS receiver uses an active 3.3 V antenna.

The TX321 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. See Section 7.4, *GPS Antenna (p. 20)*, for more information regarding GPS and GPS antenna placement.

7.2.4 Power Connector

The TX321 power connector has two pins: ground and 12 V. The input power requirement is 10.8 to 16 VDC at 3 A. Because the TX321 can use up to 3 A, the power should be connected directly to the battery.

With the potential for a 3000 mA current drain, the voltage drop along the battery power wires must be considered. The battery power wires run from the battery to the power input connectors of the TX321. To calculate the voltage drop along the power wires, we must know the resistance of the wire and the length of the wire. Usually the resistance of the wire is listed as ohms per 1000 feet. For example, a 24 AWG wire used by Campbell Scientific has a resistance of 23 ohms per 1000 feet. The length of the wire is the distance the wire travels from the battery to the transmitter multiplied by two. You must consider the current travels from the battery to the transmitter and back to the battery.

The TX321 will operate with a battery voltage range from 10.8 to 16 V. A fully charged lead acid battery will have a voltage of about 12.5 V. If the battery is fully charged, a 1.7 V drop along the battery wires will stop the transmitter from transmitting. At 3 A, 1.7 V will be dropped with 0.566 ohms of resistance. Using the 24 AWG wire with 23 ohms resistance per 1000 ft,

24 ft of wire (12 ft long battery power wires) will prevent transmission. A reliable system that will transmit without a perfect battery voltage will minimize voltage drop along the battery power wires. To minimize voltage drop, keep the battery power wires short. A five-foot power wire is a long power wire. If you must have a longer wire, use heavy wire. For power wires less than ten feet but more than five feet, use no smaller than 18 AWG.

7.3 Transmission Antenna

The TX321 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.

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 4 grooves should be placed at the spot on the boom with 4 dimples, and so forth.

The accuracy of the antenna aiming is not critical, but should be reasonably good. 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.

7.4 GPS Antenna

7.4.1 How the GPS Signal is Acquired and Used

The GPS receiver will acquire a complete GPS fix at power up and once a day. The TX321 transmitter will continue to operate normally for 28 days without a GPS fix.

The GPS signal is used for two functions: to set real time and to regulate the oscillator. Four satellites are required to perform these functions. To correct the oscillator frequency, the GPS receiver will output an accurate 1-second pulse. The 1-second pulse is used to correct oscillator drift caused by changes in temperature and crystal aging.

The GPS is required for proper operation. After the transmitter is reset or first powered up, it can't schedule a transmission until a GPS fix is established or the internal clock has been manually set. After the first fix, the TX321 will acquire a GPS fix once a day. Each time the GPS system acquires a fix, the entire GPS almanac is downloaded, which requires about 15 minutes.

7.4.2 GPS Antenna Location

The GPS antenna mounts to the end of a crossarm via the 7623 3/4-in. IPS threaded pipe and a 1049 Nu-Rail® fitting or CM220 mounting bracket. The ideal location for the GPS antenna is above everything, with the shortest cable possible. The GPS antenna will not receive the GPS signal through a steel roof or steel walls. Concrete will probably act like steel. Heavy foliage, snow, and ice will attenuate the GPS signal. The more of the sky the antenna has a clear

unobstructed view of, the better the GPS performance. Better GPS performance will show up as less or no missed transmissions. Poor GPS antenna placement will increase the number of missed transmissions, or possibly stop all transmission.

7.5 CRBasic Programming

This section covers CRBasic programming concepts. Not all options are available for the CR5000 and CR295(X) data loggers. There are four program instructions directly related to the TX321 GOES transmitter: **GOESData**, **GOESStatus**, **GOESGPS** and **GOESSetup**.

7.5.1 GOESData()

The **GOESData()** instruction is used to send data from the data logger to the TX321 transmitter. Each time **GOESData()** is executed, data is ordered with the newest data to be transmitted first.

There are five parameters to the **GOESData()** instruction: ***Result Code***, ***Data Table***, ***Table Option***, ***Buffer Control***, and ***Data Format***.

In **GOESData()**, ***Table Option***, ***Buffer Control*****,** and ***Data Format*** can be variables declared as type long. Error checking is done at run time instead of compile time. See Section 8.3, *Result Codes* *(p. 29)*, for run-time error codes and their descriptions.

CRBasic data loggers store time of maximum or minimum as number of seconds since 1990, which does not work for GOES transmission.

7.5.1.1 Result Code

The ***Result Code*** is used to determine if the **GOESData()** instruction executed successfully. When successful, **GOESData()** will return a ***0*** to the ***Result Code*** variable. When **GOESData()** executes successfully, but there is no new data in the specified table, the ***Result Code*** is set to ***100***. See Section 8.3, *Result Codes* *(p. 29)*, for details regarding result codes.

7.5.1.2 Data Table

The ***Data Table*** argument is used to specify which data table the **GOESData()** instruction is to copy data from.

7.5.1.3 Table Option

The ***Table Option*** is used to specify what data is copied from the data table. There are three options. Use ***0*** to specify all new data. Use ***1*** to specify only the most current record. Use any other positive number to specify the number of records to be copied each time **GOESData()** is executed. When copying data, the entire record, except the timestamp and record number, is copied from the data logger to the TX321 transmitter.

7.5.1.4 Buffer Control

Buffer Control is used to determine which buffer data is copied to, and if the buffer is erased before data is copied to the buffer. Use ***0*** to append to the self-timed buffer; use ***1*** to overwrite the self-timed buffer. Use ***2*** to append to the random buffer, and ***3*** to overwrite the random buffer. Use ***9*** to erase the random buffer.

7.5.1.5 Data Format

Data Format is used to determine what format the data is transmitted in. This is the format of the data sent over the satellite. The TX321 does not determine the actual data format used, but can be set to match the data format selected with this instruction. Use ***0*** for CSI floating point Pseudo Binary. Use ***1*** for floating point ASCII. Use ***2*** for 18-bit signed integer Pseudo Binary. Options ***3*** through ***8*** are used for RAWS7 or Fire Weather applications.

In data loggers that support strings as a data type, all data format options except ***3*** (RAWS7) will support strings. Strings are transmitted from the first character until the null terminator. If strings contain illegal characters, the TX321 will replace the character with another character. By default, the replacement character is an asterisk. The replacement character can be changed.

NOTE Both the random and timed buffers of the TX321 can be set to accept ASCII or Pseudo Binary data. If the TX321 is set to Pseudo Binary, all ASCII data is transmitted as the replacement character, which is an asterisk by default. When the TX321 is set to ASCII data, both Pseudo Binary and ASCII data are transmitted normally. Data format options 0 and 2 are Pseudo Binary, all others are ASCII.

NOTE When transmitting random messages in Pseudo Binary format, the message counter must be turned off (RMC=N). The message count is a simple three-digit count of how many times the transmission has been repeated. Digits 0 to 9 are not legal characters in Pseudo Binary mode and are replaced at transmission time with the replacement character specified by the IRC command. The default IRC character is *. If the random message counter is on when the random data format is set to Pseudo Binary, the first three characters sent are 0x20,0x20,0x2a (space,space,*) instead of the intended 0x20,0x20,0x31 (space,space,1).

NOTE The order data appears in each transmission can be controlled. Only whole records are copied from the data logger to the TX321. Each record is copied in the same order it appears in the data logger memory. The order of data records, oldest to newest or newest to oldest, can be controlled. To arrange data records oldest to newest, execute the **GOESData()** instruction when data is written to the data table. To arrange data newest to oldest, execute the **GOESData()** instruction once per timed transmission. Either method works best when the *Table Option* is set to 0.

7.5.1.6 GOESData() CR1000X Example

CRBasic Example 7-1. GOESData() Instruction

```
' GOESData() Example

' Sample program makes a few simple measurements and
' stores the result in the table named Tempdata.
' All new data from TempData is copied to the
' transmitter hourly.

' An hourly record containing stats regarding
' the Last GOES message is stored in another table

'declarations
Public TCTemp
Public PanelT
Public battery1
Public RC_Data
Public LastStatus(14)

Alias LastStatus(1)=RC_Last
Alias LastStatus(2)=Lst_Type
Alias LastStatus(3)=Lst_Bytes
Alias LastStatus(4)=Lst_Forward
Alias LastStatus(5)=Lst_Reflected
Alias LastStatus(6)=Lst_BattVolt
Alias LastStatus(7)=Lst_GPS
Alias LastStatus(8)=Lst_OscDrift
Alias LastStatus(9)=Lat_Deg
Alias LastStatus(10)=Lat_Min
Alias LastStatus(11)=Lat_Secd
Alias LastStatus(12)=Long_Deg
Alias LastStatus(13)=Long_Min
Alias LastStatus(14)=Long_Secd

'program table
DataTable (Tempdata,1,-1)
  DataInterval (0,15,min,10)
  Sample (1,TCTemp,FP2)
  Sample (1,PanelT,FP2)
  Sample (1,battery1,FP2)
EndTable

DataTable(GOESStats,true,300)
DataInterval(0,1,hr,0)
  Sample(14,LastStatus(),fp2)
EndTable

BeginProg
  Scan (10,Sec,3,0)
    Battery (battery1)
    PanelTemp (PanelT,250)
    TCDiff (TCTemp,1,mV200C,2,TypeT,PanelT,True,0,250,1.8,32)
    CallTable TempData
    If TimeIntoInterval (0,1,Hr)
      GOESData (RC_Data,TempData,0,0,1)
    EndIf
    If TimeIntoInterval (0,10,min)
      GOESStatus (LastStatus(),2)
    EndIf
    CallTable GOESStats
  NextScan
EndProg
```

7.5.2 GOESStatus()

The **GOESStatus()** instruction is used to read information from the TX321. Information that can be read and stored in the data logger includes information relating to the next transmission, the last transmission, GPS time and position, and all logged errors. The status information can be used to set the data logger clock and troubleshoot any problems that might arise. The **GOESStatus()** instruction also includes options to initiate a random transmission on command.

The **GOESStatus()** instruction includes seven different functions: *Read Time, Read Status, Read Last Message Status, Transmit Random Message, Read Error Register, Clear Error Register, Return Transmitter to Online Mode*.

NOTE *Transmit Random Message*, *Read Error Register*, *Clear Error Register*, and *Return Transmitter to Online Mode* are for use with previous versions of the GOES transmitter and will not be described here.

GOESStatus() expects two parameters. The first is the array used to store the data returned by **GOESStatus()**; the second is the command to be issued. The first element of each array returned by the **GOESStatus()** command is the result code. The result code is used to test if the **GOESStatus()** instruction executed successfully. When the result code is zero, **GOESStatus()** executed successfully.

7.5.2.1 GOESStatus Read Time

Example:

```
Public gps(4)

GOESStatus(gps(), 0)
```

Command ***0*** (Read Time) will read the TX321 clock. Under normal operating conditions, the time is GMT. There are delays in reading the time from the TX321. The array needs to be four elements or more. As shown in TABLE 7-1, data is returned as: result code, hour, minute, second.

TABLE 7-1. GOESStatus Command 0: Read Time

Index	Contents
1	Command Result Code
2	Hours (GMT)
3	Minutes
4	Seconds

7.5.2.2 GOESStatus Read Status

Example:

```
Public Stats(13)

GOESStatus(Stats(), 1)
```

Command ***1*** (Read Status) is used to read information regarding the current status of the transmitter. As shown in TABLE 7-2, information returned includes the number of bytes in each data buffer, the time until transmission, and a loaded battery voltage.

TABLE 7-2. GOESStatus Command 1: Read Status

Index	Contents
1	Command Result Code
2	Bytes of data in self-timed buffer
3	Time until next self-timed transmission: Days
4	Time until next self-timed transmission: Hours
5	Time until next self-timed transmission: Minutes
6	Time until next self-timed transmission: Seconds
7	Bytes of data in random buffer
8	Time until next random transmission interval start: Hours
9	Time until next random transmission interval start: Minutes
10	Time until next random transmission interval: Seconds
11	Fail-safe, 1 indicates transmitter disabled due to fail-safe.
12	Loaded power supply voltage, 1-amp load (tenths of volts)
13	Average GPS acquisition time (tens of seconds)

7.5.2.3 GOESStatus Read Last Message Status

Example:

```
Public LastStats(14)

GOESStatus(LastStats(), 2)
```

Command ***2*** (Read Last Message Status) is used to read information regarding the last transmission. As shown in TABLE 7-3, information includes the type of transmission, size, forward power, reflected power, and so forth. Also returned is the GPS derived latitude and longitude, which is updated once a day. The GPS update interval can be changed.

TABLE 7-3. GOESStatus Command 2: Read Last Message Status

Index	Contents
1	Command Result Code
2	Message type: Self-timed or Random
3	Size of message in bytes
4	Forward power in tenths of watts
5	Reflected power in tenths of watts
6	Power supply voltage under full load, in tenths of volts
7	GPS acquisition time in tens of seconds
8	Oscillator drift (signed, hundreds of Hz)
9	Latitude degrees
10	Latitude minutes
11	Latitude seconds

TABLE 7-3. GOESStatus Command 2: Read Last Message Status	
Index	**Contents**
12	Longitude degrees
13	Longitude minutes
14	Longitude seconds

7.5.3 GOESGPS

Example:

```
Public GPSdata(6), GPStime(7)

GOESGPS(GPSdata(), GPStime())
```

The instruction **GOESGPS()** returns two arrays of information. The first array is six elements long. The first array includes the result code (see TABLE 8-1), time in seconds since January 1, 2000, latitude in fractional degrees with 100 nanodegree resolution, longitude in fractional degrees with 100 nanodegree resolution, elevation as a signed 32-bit number in centimeters, and magnetic variation in fractional degrees with a one millidegree resolution.

The second array, which must be dimensioned to seven, holds year, month, day, hour (GMT), minute, seconds, microseconds. The second array can be used to set the data logger clock. See the **ClockSet()** instruction in the *CRBasic Editor Help* for details.

7.5.4 GOESSetup

In **GOESSetup()**, all parameters can be variables of type long, except for the *Timed Interval*, *Timed Offset*, and *Random Interval*, which are all of type string.

The **GOESSetup()** and **GOESData()** only return error messages at run time.

Using **GOESSetup()**, the data logger can configure the transmitter under program control. Because the parameters in the **GOESSetup()** instruction can be variables, error checking is done at run time, not compile time. Using **GOESSetup()**, the custom display menu options, and the data logger keypad/display, programs can be written to allow TX321 configuration via simple menus on the keypad/display. See **DisplayMenu()/EndMenu** in the *CRBasic Editor Help* for details. **GOESSetup()** can also be used with constant values allowing fixed GOES configuration parameters to be stored in the data logger, and executed when needed.

After **GOESSetup()** executes, several TX321 settings are set to default values.

1. Messages are not centered in the transmission window.
2. Self-timed message format is set to ASCII, which ONLY changes the flag word. Pseudo Binary formats will still work.
3. Random message format is set to ASCII, which ONLY changes the flag word. Pseudo Binary formats will still work.
4. Empty buffer message is turned off.
5. Randomizing percentage is set to 50%.

6. Data in the random buffer is repeated until cleared by the data logger.
7. Random message counter is turned off.

Instruction details:

GOESSetup(*Result Code, Platform ID, Window, Timed Channel, Timed Baud Rate, Random Channel, Random Baud Rate, Timed Interval, Timed Offset, Random Interval***)**

7.5.4.1 Result Code

Result Code is used to indicate success or failure. Zero indicates success. Positive result codes indicate communication problems; negative result codes indicate an illegal value in one of the parameters. Refer to Section 8.3, *Result Codes* *(p. 29)*, for error code tables and further details.

7.5.4.2 Platform ID

Platform ID is an eight-character hexadecimal number assigned by NESDIS. The *Platform ID* is always divisible by two. Valid characters are 0 to 9 and A to F.

7.5.4.3 Window

Window is the message window length in seconds. Valid range is 5 to 120.

7.5.4.4 Timed Channel

Timed Channel is the assigned self-timed transmission channel. For Campbell Scientific, valid range is 0 to 266 for 300 bps, and 0 to 133 for 1200 bps. Often, 1200 bps channels are referred to using the 300 channel number scheme. See TABLE B-1. Divide by two to get the real 1200 baud channel number. For CS2, valid range is 1 to 566. See TABLE B-2.

7.5.4.5 Timed Baud Rate

Timed Baud Rate is assigned. The assigned value for a CS2-compliant transmitter is either 300 or 1200.

7.5.4.6 Random Channel

Random Channel is the assigned random channel number. See *Timed Channel* description for valid entries.

7.5.4.7 Random Baud Rate

Random Baud Rate is assigned and channel dependent. The assigned value for a CS2-compliant device is either 300 or 1200.

7.5.4.8 Timed Interval

Timed Interval is assigned by NESDIS and is a string variable in the format of "dd_hh_mm_ss", where dd is days and usually 00, hh is hours and usually 01, mm is minutes and usually 00, and ss is seconds and usually 00.

7.5.4.9 Timed Offset

Timed Offset is assigned by NESDIS and is a string variable in the format of "hh_mm_ss", where hh is hours and usually 00, mm is minutes, and ss is seconds.

7.5.4.10 Random Interval

Random Interval is a string variable in the format of "hh_mm_ss" where hh and ss are usually zero and mm is 30 or 45.

7.5.4.11 GOESSetup() Example

CRBasic Example 7-2. GOESSetup() Instruction

```
Public setup_RC, setup as Boolean

Sub Gsetup
  GOESSetup (setup_RC,&H12345678,10,195,300,0,100,"0_01_00_0" ,"0_16_20" ,"1_0_0" )
  If setup_RC = 0 Then setup = false
EndSub

BeginProg
  setup = true
  Scan (10,Sec,0,0)
    If setup Then Call Gsetup
  NextScan
EndProg
```

8. Troubleshooting/Diagnostics

8.1 Fail-safe Conditions

The built-in fail-safe processor helps prevent malfunctioning transmitters from interfering with other transmissions. It disables satellite transmissions if one of these events occur:

- A transmission occurs too close (≤ 30 s) to the previous transmission
- A transmission continues for an excessive amount of time (≥ 105 seconds for GOES, ≥ 90 seconds for EUMETSDAT)
- Supply battery voltage is below 10.5 VDC

The fail-safe operation is independent of the main processor and cannot be disabled.

8.2 Fault Button

FIGURE 8-1. TX321 Fault Button

The **Fault** button indicates whether or not the fail-safe has been tripped. Press and hold the **Fault** button for about 2 seconds. The **Status** LED flashes once to indicate the fail-safe has not been tripped, and flashes twice to indicate the fail-safe has been tripped. To clear the fail-safe, press and hold the **Fault** button for about 10 seconds.

8.3 Result Codes

Result Code parameters are included in CRBasic **GOESData()** and **GOESSetup()**. The result codes indicate whether the instruction executed successfully. When successful, a ***0*** will be stored in the variable or input location. A positive result code indicates a communications problem (see TABLE 8-1).

To better understand the communication result codes, it is necessary to understand the sequence of communications with the transmitter. Here are the steps:

1) The data logger **CS I/O** port is checked to see if the serial port is available. If not, ***Result Code*** is ***6***.

2) The transmitter is addressed and should return the STX character within 200 ms. If there is no response from the transmitter, ***Result Code 2*** is returned. If something other than the STX character is received, ***Result Code*** is ***3***.

3) The command to select a data buffer is sent (random or self-timed). The transmitter should respond with the ACK (06) character. If something besides the ACK is received, ***Result Code*** is ***4***. If nothing is received within 500 ms, ***Result Code*** is ***5***.

4) If the first three steps are successful, the data logger sends the command to append or overwrite the data buffer, followed by the data. If the transmitter does not respond with the ACK character within 500 ms after the data has been transferred, the ***Result Code*** is *7*. ***Result Code 7*** indicates the data was not received by the transmitter. The data logger cannot resend the data.

The **GOESData()** and **GOESSetup()** instructions may also have a negative result code (see TABLE 8-2). A negative result code is a run-time error and indicates that there is an illegal value in one of the parameters.

TABLE 8-1. Result Codes Indicating Communication Problems	
0	Command executed successfully
2	Time out waiting for STX character after SDC addressing
3	Wrong character (not STX) received after SDC addressing
4	Something other than ACK returned when select data buffer command executed
5	Timed out waiting for an ACK when data buffer command was sent
6	CS I/O port not available, port busy
7	ACK not returned following data append or insert command

The **GOESData()** and **GOESSetup()** instructions may also have a negative result code (see TABLE 8-2). A negative result code indicates that there is an illegal value in one of the parameters.

TABLE 8-2. GOESSetup and GOESData Run-time Result Codes	
Code	**Error Condition**
-11	Illegal Buffer Control
-12	Illegal Message Window
-13	Illegal Channel Number
-14	Illegal Baud Rate
-15	R Count Error
-16	Illegal Data Format
-17	Illegal Data Format FP2_ASCII
-18	Self-timed Interval Error
-19	Self-timed Offset Error
-20	Random Interval Error
-21	Platform ID Error

8.4 Using *DevConfig* for Troubleshooting/Testing

8.4.1 Settings Editor | GPS

This tab displays information about the GPS communications (see FIGURE 8-2). The GPS is required for proper operation. After the transmitter is reset or first powered up, it can't schedule a transmission until a GPS fix has been established or the internal clock has been manually set.

If a GPS fix was missed, ensure that the GPS fix interval does not coincide with the self-timed transmission interval. A GPS fix event must occur at least two minutes on either side of a self-timed transmission. Click **Apply** after changing the setting.

Also check the GPS antenna placement. Poor GPS antenna placement will increase the number of missed transmissions, or possibly stop all transmission (see Section 7.4, *GPS Antenna* *(p. 20)*, for more information).

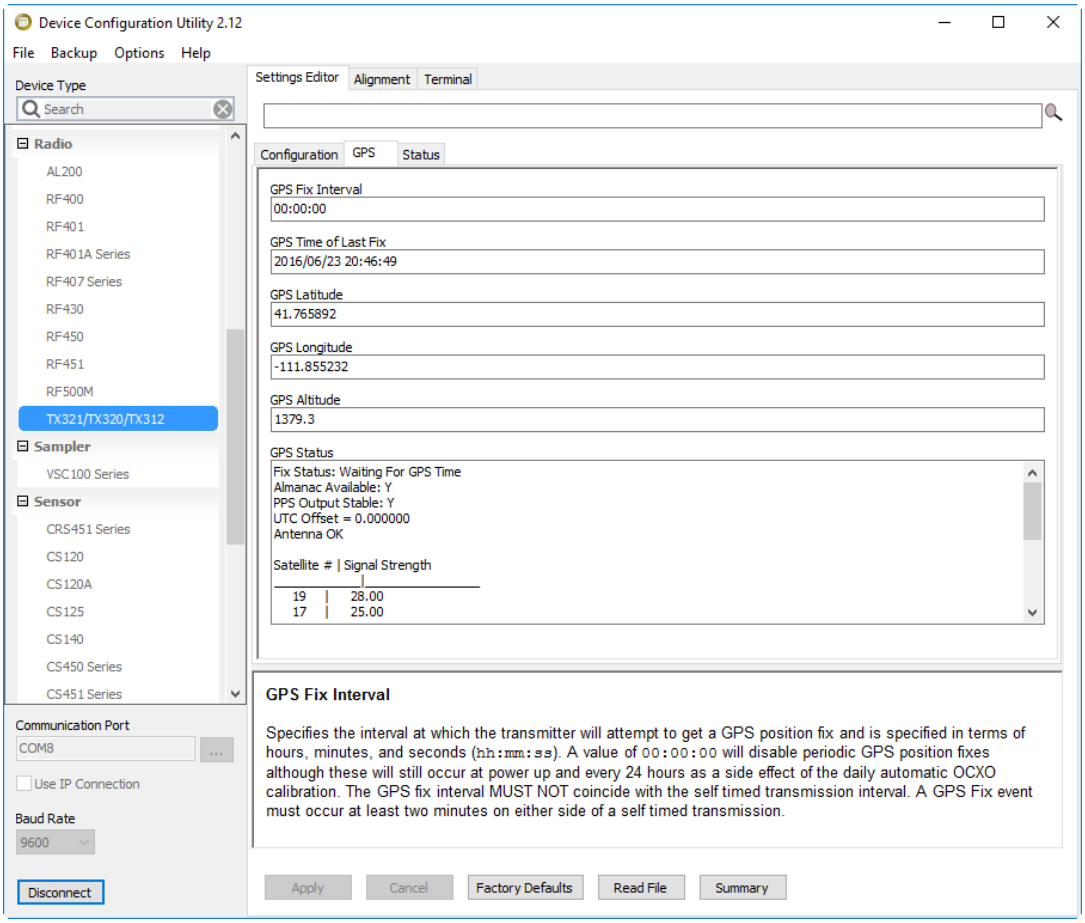

FIGURE 8-2. Settings Editor | GPS in DevConfig

8.4.2 Settings Editor | Status

The **Status** tab provides a lot of useful information about the transmitter that can help in troubleshooting (see FIGURE 8-3). Specifically, ensure that the **Fail Safe Status** is **OK**. Also the supply voltage amount needs to be greater than 10.8 V. Replace the battery if the supply voltage is too low.

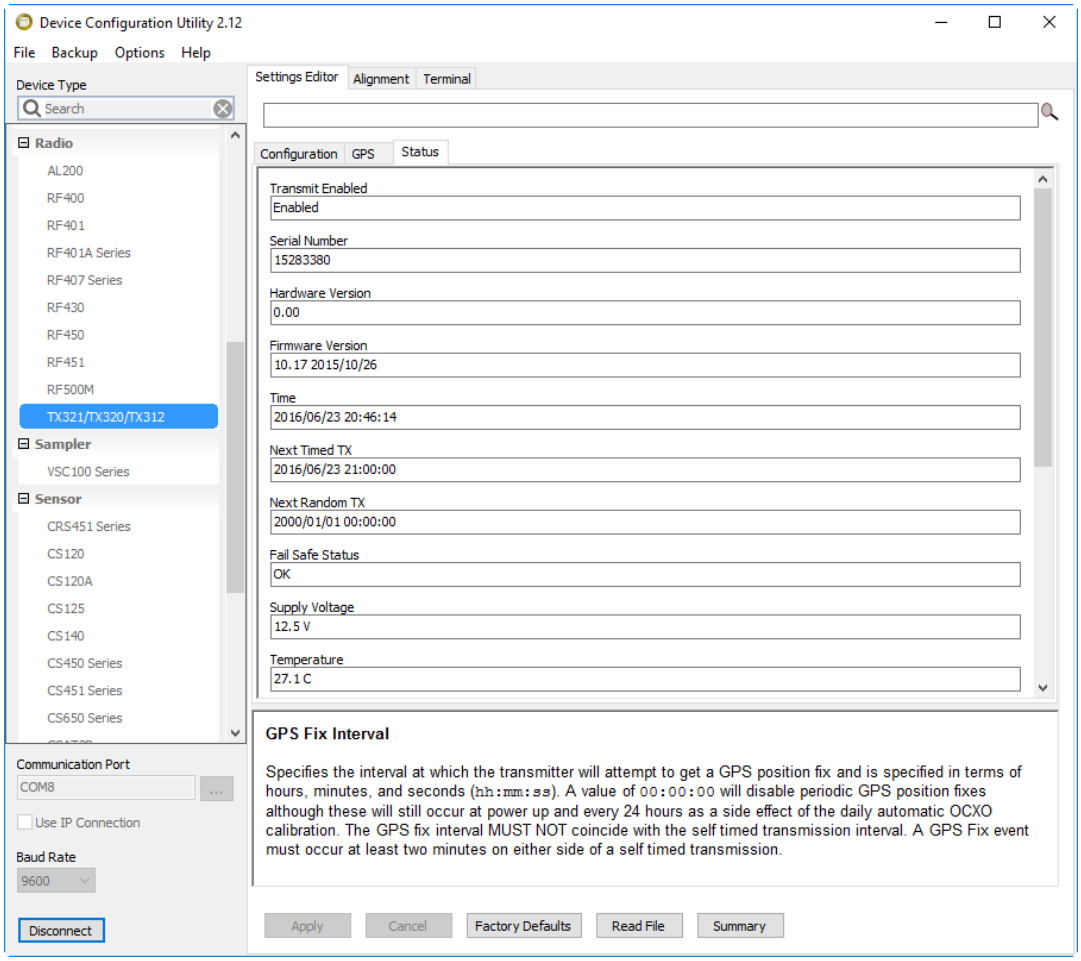

FIGURE 8-3. Settings Editor | Status in DevConfig

8.4.3 Terminal

The **Terminal** tab (see FIGURE 8-4) supports manually-entered commands (see Appendix D, *Extended ASCII Command Set* (p. D-1), for individual commands). It also includes buttons on the right side of the screen that provide the following functions.

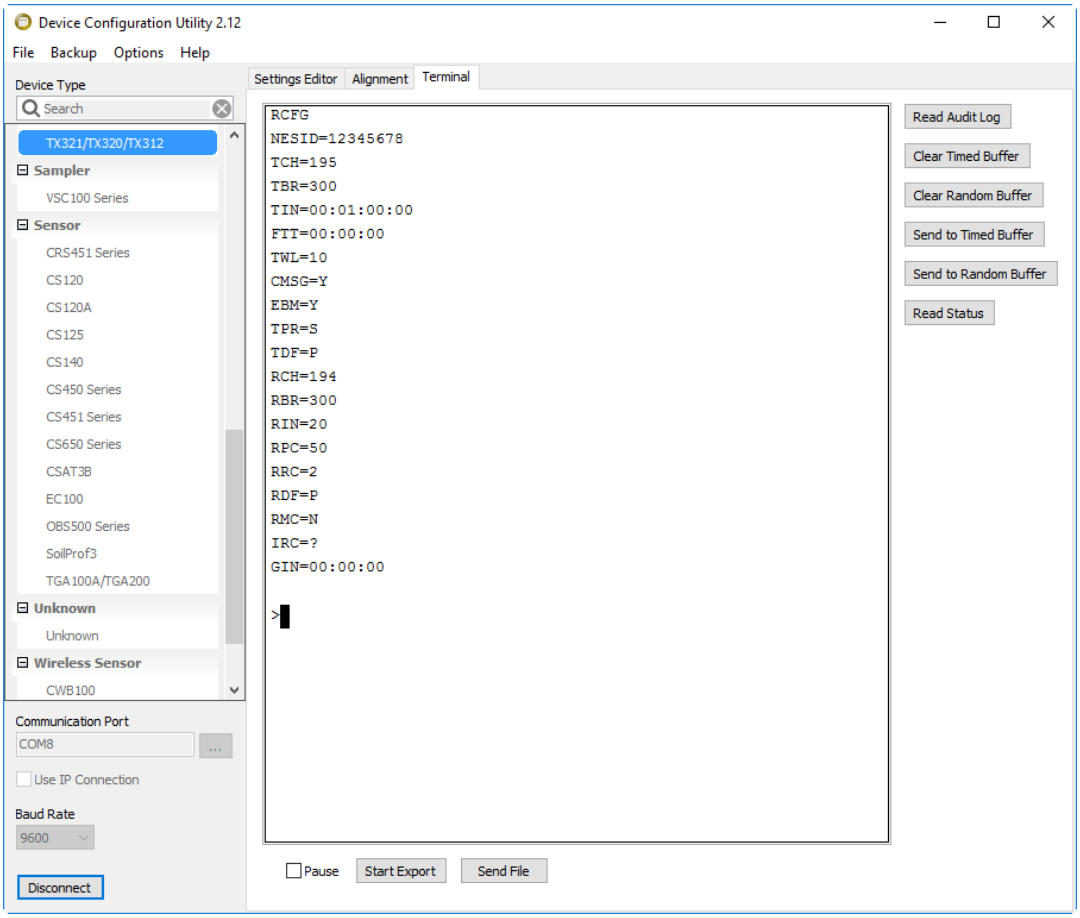

FIGURE 8-4. Terminal Tab in DevConfig

Read Audit Log: Displays a history of the transmitter operation. The latest entry in the audit log is shown at the top of the screen. The audit log will record any error condition that has occurred in the past, plus other events.

Clear Timed Buffer: Erases all data from the self-timed buffer.

Clear Random Buffer: Erases all data from the random buffer.

Send to Timed Buffer: Send data to the self-timed buffer. Data will be scheduled for transmission on the next available time slot.

Send to Random Buffer: Send data to the random buffer. Data will be scheduled for transmission soon.

Read Status: Provides critical information regarding the most recent transmission.

Appendix A. Information on Eligibility and Getting Onto the GOES System

A.1 Eligibility

U.S. federal, state, or local government agencies, or users sponsored by one of those agencies, may use GOES. Potential GOES users must receive formal permission from NESDIS.

A.2 Acquiring Permission

1. The user contacts NESDIS and submits a formal request to transmit data via GOES. Non-U.S. or private users must also submit a written statement indicating that their sponsor requires all or part of the transmitted data. NESDIS will supply the user with a question form to complete and submit for approval.

   noaasis.noaa.gov/DCS

2. Following approval, NESDIS sends a Memorandum of Agreement (MOA). The MOA must be signed and returned to NESDIS.

3. After the MOA is approved, NESDIS will issue a channel assignment and an ID address code.

4. NESDIS MUST BE contacted to coordinate a "start-up" date.

See *noaasis.noaa.gov/DCS* for more information.

Appendix B. GOES DCS Transmit Frequencies

TABLE B-1. GOES DCPRS Transmit Frequencies Certification Standard 1.0

300 & 100 bps Channels		1200 bps	Channels		300 & 100 bps Channels		1200 bps	Channels
Channel Number	Frequency MHz	Channel Number+ A	Frequency MHz		Channel Number	Frequency MHz	Channel Number+ A	Frequency MHz
1	401.701000	1	401.701750		46	401.768500		
2	401.702500				47	401.770000	24	401.770750
3	401.704000	2	401.704750		48	401.771500		
4	401.705500				49	401.773000	25	401.773750
5	401.707000	3	401.707750		50	401.774500		
6	401.708500				51	401.776000	26	401.776750
7	401.710000	4	401.710750		52	401.777500		
8	401.711500				53	401.779000	27	401.779750
9	401.713000	5	401.713750		54	401.780500		
10	401.714500				55	401.782000	28	401.782750
11	401.716000	6	401.716750		56	401.783500		
12	401.717500				57	401.785000	29	401.785750
13	401.719000	7	401.719750		58	401.786500		
14	401.720500				59	401.788000	30	401.788750
15	401.722000	8	401.722750		60	401.789500		
16	401.723500				61	401.791000	31	401.791750
17	401.725000	9	401.725750		62	401.792500		
18	401.726500				63	401.794000	32	401.794750
19	401.728000	10	401.728750		64	401.795500		
20	401.729500				65	401.797000	33	401.797750
21	401.731000	11	401.731750		66	401.798500		
22	401.732500				67	401.800000	34	401.800750
23	401.734000	12	401.734750		68	401.801500		
24	401.735500				69	401.803000	35	401.803750
25	401.737000	13	401.737750		70	401.804500		
26	401.738500				71	401.806000	36	401.806750
27	401.740000	14	401.740750		72	401.807500		
28	401.741500				73	401.809000	37	401.809750
29	401.743000	15	401.743750		74	401.810500		
30	401.744500				75	401.812000	38	401.812750
31	401.746000	16	401.746750		76	401.813500		
32	401.747500				77	401.815000	39	401.815750
33	401.749000	17	401.749750		78	401.816500		
34	401.750500				79	401.818000	40	401.818750
35	401.752000	18	401.752750		80	401.819500		
36	401.753500				81	401.821000	41	401.821750
37	401.755000	19	401.755750		82	401.822500		
38	401.756500				83	401.824000	42	401.824750
39	401.758000	20	401.758750		84	401.825500		
40	401.759500				85	401.827000	43	401.827750
41	401.761000	21	401.761750		86	401.828500		
42	401.762500				87	401.830000	44	401.830750
43	401.764000	22	401.764750		88	401.831500		
44	401.765500				89	401.833000	45	401.833750
45	401.767000	23	401.767750		90	401.834500		

TABLE B-1. GOES DCPRS Transmit Frequencies Certification Standard 1.0 (continued)

300 & 100 bps Channels		1200 bps Channels			300 & 100 bps Channels		1200 bps Channels	
Channel Number	Frequency MHz	Channel Number+ A	Frequency MHz		Channel Number	Frequency MHz	Channel Number+ A	Frequency MHz
91	401.836000	46	401.836750		141	401.911000	71	401.911750
92	401.837500				142	401.912500		
93	401.839000	47	401.839750		143	401.914000	72	401.914750
94	401.840500				144	401.915500		
95	401.842000	48	401.842750		145	401.917000	73	401.917750
96	401.843500				146	401.918500		
97	401.845000	49	401.845750		147	401.920000	74	401.920750
98	401.846500				148	401.921500		
99	401.848000	50	401.848750		149	401.923000	75	401.923750
100	401.849500				150	401.924500		
101	401.851000	51	401.851750		151	401.926000	76	401.926750
102	401.852500				152	401.927500		
103	401.854000	52	401.854750		153	401.929000	77	401.929750
104	401.855500				154	401.930500		
105	401.857000	53	401.857750		155	401.932000	78	401.932750
106	401.858500				156	401.933500		
107	401.860000	54	401.860750		157	401.935000	79	401.935750
108	401.861500				158	401.936500		
109	401.863000	55	401.863750		159	401.938000	80	401.938750
110	401.864500				160	401.939500		
111	401.866000	56	401.866750		161	401.941000	81	401.941750
112	401.867500				162	401.942500		
113	401.869000	57	401.869750		163	401.944000	82	401.944750
114	401.870500				164	401.945500		
115	401.872000	58	401.872750		165	401.947000	83	401.947750
116	401.873500				166	401.948500		
117	401.875000	59	401.875750		167	401.950000	84	401.950750
118	401.876500				168	401.951500		
119	401.878000	60	401.878750		169	401.953000	85	401.953750
120	401.879500				170	401.954500		
121	401.881000	61	401.881750		171	401.956000	86	401.956750
122	401.882500				172	401.957500		
123	401.884000	62	401.884750		173	401.959000	87	401.959750
124	401.885500				174	401.960500		
125	401.887000	63	401.887750		175	401.962000	88	401.962750
126	401.888500				176	401.963500		
127	401.890000	64	401.890750		177	401.965000	89	401.965750
128	401.891500				178	401.966500		
129	401.893000	65	401.893750		179	401.968000	90	401.968750
130	401.894500				180	401.969500		
131	401.896000	66	401.896750		181	401.971000	91	401.971750
132	401.897500				182	401.972500		
133	401.899000	67	401.899750		183	401.974000	92	401.974750
134	401.900500				184	401.975500		
135	401.902000	68	401.902750		185	401.977000	93	401.977750
136	401.903500				186	401.978500		
137	401.905000	69	401.905750		187	401.980000	94	401.980750
138	401.906500				188	401.981500		
139	401.908000	70	401.908750		189	401.983000	95	401.983750
140	401.909500				190	401.984500		

TABLE B-1. GOES DCPRS Transmit Frequencies Certification Standard 1.0 (continued)

300 & 100 bps Channels		1200 bps Channels			300 & 100 bps Channels		1200 bps Channels	
Channel Number	Frequency MHz	Channel Number+ A	Frequency MHz		Channel Number	Frequency MHz	Channel Number+ A	Frequency MHz
191	401.986000	96	401.986750		241	402.061000	121	402.061750
192	401.987500				242	402.062500		
193	401.989000	97	401.989750		243	402.064000	122	402.064750
194	401.990500				244	402.065500		
195	401.992000	98	401.992750		245	402.067000	123	402.067750
196	401.993500				246	402.068500		
197	401.995000	99	401.995750		247	402.070000	124	402.070750
198	401.996500				248	402.071500		
199	401.998000	100	401.998750		249	402.073000	125	402.073750
200	401.999500				250	402.074500		
201	402.001000	101	402.001750		251	402.076000	126	402.076750
202	402.002500				252	402.077500		
203	402.004000	102	402.004750		253	402.079000	127	402.079750
204	402.005500				254	402.080500		
205	402.007000	103	402.007750		255	402.082000	128	402.082750
206	402.008500				256	402.083500		
207	402.010000	104	402.010750		257	402.085000	129	402.085750
208	402.011500				258	402.086500		
209	402.013000	105	402.013750		259	402.088000	130	402.088750
210	402.014500				260	402.089500		
211	402.016000	106	402.016750		261	402.091000	131	402.091750
212	402.017500				262	402.092500		
213	402.019000	107	402.019750		263	402.094000	132	402.094750
214	402.020500				264	402.095500		
215	402.022000	108	402.022750		265	402.097000	133	402.097750
216	402.023500				266	402.098500		
217	402.025000	109	402.025750					
218	402.026500							
219	402.028000	110	402.028750					
220	402.029500							
221	402.031000	111	402.031750					
222	402.032500							
223	402.034000	112	402.034750					
224	402.035500							
225	402.037000	113	402.037750					
226	402.038500							
227	402.040000	114	402.040750					
228	402.041500							
229	402.043000	115	402.043750					
230	402.044500							
231	402.046000	116	402.046750					
232	402.047500							
233	402.049000	117	402.049750					
234	402.050500							
235	402.052000	118	402.052750					
236	402.053500							
237	402.055000	119	402.055750					
238	402.056500							
239	402.058000	120	402.058750					
240	402.059500							

TABLE B-2. GOES DCPRS Transmit Frequencies Certification Standard 2.0

Channel Number	Center Frequency	Channel Number	Center Frequency	Channel Number	Center Frequency
1	401.701000	323	401.734750	46	401.768500
301	**401.701750**	**24**	**401.735500**	**346**	**401.769250**
2	401.702500	324	401.736250	47	401.770000
302	401.703250	25	401.737000	347	401.770750
3	**401.704000**	**325**	**401.737750**	**48**	**401.771500**
303	401.704750	26	401.738500	348	401.772250
4	401.705500	326	401.739250	49	401.773000
304	**401.706250**	**27**	**401.740000**	**349**	**401.773750**
5	401.707000	327	401.740750	50	401.774500
305	401.707750	28	401.741500	350	401.775250
6	**401.708500**	**328**	**401.742250**	**51**	**401.776000**
306	401.709250	29	401.743000	351	401.776750
7	401.710000	329	401.743750	52	401.777500
307	**401.710750**	**30**	**401.744500**	**352**	**401.778250**
8	401.711500	330	401.745250	53	401.779000
308	401.712250	31	401.746000	353	401.779750
9	**401.713000**	**331**	**401.746750**	**54**	**401.780500**
309	401.713750	32	401.747500	354	401.781250
10	401.714500	332	401.748250	55	401.782000
310	**401.715250**	**33**	**401.749000**	**355**	**401.782750**
11	401.716000	333	401.749750	56	401.783500
311	401.716750	34	401.750500	356	401.784250
12	**401.717500**	**334**	**401.751250**	**57**	**401.785000**
312	401.718250	35	401.752000	357	401.785750
13	401.719000	335	401.752750	58	401.786500
313	**401.719750**	**36**	**401.753500**	**358**	**401.787250**
14	401.720500	336	401.754250	59	401.788000
314	401.721250	37	401.755000	359	401.788750
15	**401.722000**	**337**	**401.755750**	**60**	**401.789500**
315	401.722750	38	401.756500	360	401.790250
16	401.723500	338	401.757250	61	401.791000
316	**401.724250**	**39**	**401.758000**	**361**	**401.791750**
17	401.725000	339	401.758750	62	401.792500
317	401.725750	40	401.759500	362	401.793250
18	**401.726500**	**340**	**401.760250**	**63**	**401.794000**
318	401.727250	41	401.761000	363	401.794750
19	401.728000	341	401.761750	64	401.795500
319	**401.728750**	**42**	**401.762500**	**364**	**401.796250**
20	401.729500	342	401.763250	65	401.797000
320	401.730250	43	401.764000	365	401.797750
21	**401.731000**	**343**	**401.764750**	**66**	**401.798500**
321	401.731750	44	401.765500	366	401.799250
22	401.732500	344	401.766250	67	401.800000
322	**401.733250**	**45**	**401.767000**	**367**	**401.800750**
23	401.734000	345	401.767750	68	401.801500

NOTE: Bold type face identifies potential 1200 bps channel assignments.

TABLE B-2. GOES DCPRS Transmit Frequencies Certification Standard 2.0 (continued)

Channel Number	Center Frequency	Channel Number	Center Frequency	Channel Number	Center Frequency
368	401.802250	91	401.836000	413	401.869750
69	**401.803000**	**391**	**401.836750**	**114**	**401.870500**
369	401.803750	92	401.837500	414	401.871250
70	401.804500	392	401.838250	115	401.872000
370	**401.805250**	**93**	**401.839000**	**415**	**401.872750**
71	401.806000	393	401.839750	116	401.873500
371	401.806750	94	401.840500	416	401.874250
72	**401.807500**	**394**	**401.841250**	**117**	**401.875000**
372	401.808250	95	401.842000	417	401.875750
73	401.809000	395	401.842750	118	401.876500
373	**401.809750**	**96**	**401.843500**	**418**	**401.877250**
74	401.810500	396	401.844250	119	401.878000
374	401.811250	97	401.845000	419	401.878750
75	**401.812000**	**397**	**401.845750**	**120**	**401.879500**
375	401.812750	98	401.846500	420	401.880250
76	401.813500	398	401.847250	121	401.881000
376	**401.814250**	**99**	**401.848000**	**421**	**401.881750**
77	401.815000	399	401.848750	122	401.882500
377	401.815750	100	401.849500	422	401.883250
78	**401.816500**	**400**	**401.850250**	**123**	**401.884000**
378	401.817250	101	401.851000	423	401.884750
79	401.818000	401	401.851750	124	401.885500
379	**401.818750**	**102**	**401.852500**	**424**	**401.886250**
80	401.819500	402	401.853250	125	401.887000
380	401.820250	103	401.854000	425	401.887750
81	**401.821000**	**403**	**401.854750**	**126**	**401.888500**
381	401.821750	104	401.855500	426	401.889250
82	401.822500	404	401.856250	127	401.890000
382	**401.823250**	**105**	**401.857000**	**427**	**401.890750**
83	401.824000	405	401.857750	128	401.891500
383	401.824750	106	401.858500	428	401.892250
84	**401.825500**	**406**	**401.859250**	**129**	**401.893000**
384	401.826250	107	401.860000	429	401.893750
85	401.827000	407	401.860750	130	401.894500
385	**401.827750**	**108**	**401.861500**	**430**	**401.895250**
86	401.828500	408	401.862250	131	401.896000
386	401.829250	109	401.863000	431	401.896750
87	**401.830000**	**409**	**401.863750**	**132**	**401.897500**
387	401.830750	110	401.864500	432	401.898250
88	401.831500	410	401.865250	133	401.899000
388	**401.832250**	**111**	**401.866000**	**433**	**401.899750**
89	401.833000	411	401.866750	134	401.900500
389	401.833750	112	401.867500	434	401.901250
90	**401.834500**	**412**	**401.868250**	**135**	**401.902000**
390	401.835250	113	401.869000	435	401.902750

NOTE: Bold type face identifies potential 1200 bps channel assignments.

TABLE B-2. GOES DCPRS Transmit Frequencies Certification Standard 2.0 (continued)

Channel Number	Center Frequency	Channel Number	Center Frequency	Channel Number	Center Frequency
136	401.903500	458	401.937250	181	401.971000
436	**401.904250**	**159**	**401.938000**	**481**	**401.971750**
137	401.905000	459	401.938750	182	401.972500
437	401.905750	160	401.939500	482	401.973250
138	**401.906500**	**460**	**401.940250**	**183**	**401.974000**
438	401.907250	161	401.941000	483	401.974750
139	401.908000	461	401.941750	184	401.975500
439	**401.908750**	**162**	**401.942500**	**484**	**401.976250**
140	401.909500	462	401.943250	185	401.977000
440	401.910250	163	401.944000	485	401.977750
141	**401.911000**	**463**	**401.944750**	**186**	**401.978500**
441	401.911750	164	401.945500	486	401.979250
142	401.912500	464	401.946250	187	401.980000
442	**401.913250**	**165**	**401.947000**	**487**	**401.980750**
143	401.914000	465	401.947750	188	401.981500
443	401.914750	166	401.948500	488	401.982250
144	**401.915500**	**466**	**401.949250**	**189**	**401.983000**
444	401.916250	167	401.950000	489	401.983750
145	401.917000	467	401.950750	190	401.984500
445	**401.917750**	**168**	**401.951500**	**490**	**401.985250**
146	401.918500	468	401.952250	191	401.986000
446	401.919250	169	401.953000	491	401.986750
147	**401.920000**	**469**	**401.953750**	**192**	**401.987500**
447	401.920750	170	401.954500	492	401.988250
148	401.921500	470	401.955250	193	401.989000
448	**401.922250**	**171**	**401.956000**	**493**	**401.989750**
149	401.923000	471	401.956750	194	401.990500
449	401.923750	172	401.957500	494	401.991250
150	**401.924500**	**472**	**401.958250**	**195**	**401.992000**
450	401.925250	173	401.959000	595	401.992750
151	401.926000	473	401.959750	196	401.993500
451	**401.926750**	**174**	**401.960500**	**496**	**401.994250**
152	401.927500	474	401.961250	197	401.995000
452	401.928250	175	401.962000	497	401.995750
153	**401.929000**	**475**	**401.962750**	**198**	**401.996500**
453	401.929750	176	401.963500	498	401.997250
154	401.930500	476	401.964250	199	401.998000
454	**401.931250**	**177**	**401.965000**	**499**	**401.998750**
155	401.932000	477	401.965750	200	401.999500
455	401.932750	178	401.966500	500	402.000250
156	**401.933500**	**478**	**401.967250**	**201**	**402.001000**
456	401.934250	179	401.968000	501	402.001750
157	401.935000	479	401.968750	202	402.002500
457	**401.935750**	**180**	**401.969500**	**502**	**402.003250**
158	401.936500	480	401.970250	203	402.004000

NOTE: Bold type face identifies potential 1200 bps channel assignments.

TABLE B-2. GOES DCPRS Transmit Frequencies Certification Standard 2.0 (continued)

Channel Number	Center Frequency	Channel Number	Center Frequency	Channel Number	Center Frequency
503	402.004750	226	402.038500	548	402.072250
204	**402.005500**	**526**	**402.039250**	**249**	**402.073000**
504	402.006250	227	402.040000	549	402.073750
205	402.007000	527	402.040750	250	402.074500
505	**402.007750**	**228**	**402.041500**	**550**	**402.075250**
206	402.008500	528	402.042250	251	402.076000
506	402.009250	229	402.043000	551	402.076750
207	**402.010000**	**529**	**402.043750**	**252**	**402.077500**
507	402.010750	230	402.044500	552	402.078250
208	402.011500	530	402.045250	253	402.079000
508	**402.012250**	**231**	**402.046000**	**553**	**402.079750**
209	402.013000	531	402.046750	254	402.080500
509	402.013750	232	402.047500	554	402.081250
210	**402.014500**	**532**	**402.048250**	**255**	**402.082000**
510	402.015250	233	402.049000	555	402.082750
211	402.016000	533	402.049750	256	402.083500
511	**402.016750**	**234**	**402.050500**	**556**	**402.084250**
212	402.017500	534	402.051250	257	402.085000
512	402.018250	235	402.052000	557	402.085750
213	**402.019000**	**535**	**402.052750**	**258**	**402.086500**
513	402.019750	236	402.053500	558	402.087250
214	402.020500	536	402.054250	259	402.088000
514	**402.021250**	**237**	**402.055000**	**559**	**402.088750**
215	402.022000	537	402.055750	260	402.089500
515	402.022750	238	402.056500	560	402.090250
216	**402.023500**	**538**	**402.057250**	**261**	**402.091000**
516	402.024250	239	402.058000	561	402.091750
217	402.025000	539	402.058750	262	402.092500
517	**402.025750**	**240**	**402.059500**	**562**	**402.093250**
218	402.026500	540	402.060250	263	402.094000
518	402.027250	241	402.061000	563	402.094750
219	**402.028000**	**541**	**402.061750**	**264**	**402.095500**
519	402.028750	242	402.062500	564	402.096250
220	402.029500	542	402.063250	265	402.097000
520	**402.030250**	**243**	**402.064000**	**565**	**402.097750**
221	402.031000	543	402.064750	266	402.098500
521	402.031750	244	402.065500	566	402.099250
222	**402.032500**	**544**	**402.066250**		
522	402.033250	245	402.067000		
223	402.034000	545	402.067750		
523	**402.034750**	**246**	**402.068500**		
224	402.035500	546	402.069250		
524	402.036250	247	402.070000		
225	**402.037000**	**547**	**402.070750**		
525	402.037750	248	402.071500		

NOTE: Bold type face identifies potential 1200 bps channel assignments.

Appendix C. GOES Data Formats

C.1 Data Formats

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.

C.2 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.

C.2.1 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 to +7999
- Variable precision of 0.001 to 1
- Precision (placement of decimal point) is automatically determined based on the magnitude of the value. See the following chart for reference.
- 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.

Range	Max Precision	Example ASCII Output
–7.999 to +7.999	0.001	+1.200,
–79.99 to +79.99	0.01	+12.00,
–799.9 to +799.9	0.1	+120.0,
–7999 to +7999	1	+1200.,
NAN[1] = –8190.,		
+INF = +8191.,		
–INF = –8191.,		
[1]Not A Number		

C.2.2 Fixed Decimal ASCII

There are several fixed decimal ASCII formats to choose from in CRBasic that will create fixed-width, space-delimited output.

- Value has a fixed width, see the following table.
- 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 pegged at the minimum or maximum of the range.
- Value always has a trailing space character.

Format	Width	Precision	Range	Example ASCII Output Containing 2 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

C.2.3 RAWS7, 7 Data Point ASCII

The RAWS7 format is a fixed ASCII output format used to report the NFDRS station minimum sensor complement as specified by the Interagency Wildland Fire Weather Station Standards and Guidelines. This output uses several of the Fixed Decimal ASCII output formats as described in the previous section.

Parameter	Format	Width	Precision	Range
Cumulative Rainfall, inch	xx.xx	5	0.01 inch	0 to 99.99
10-Min Avg Wind Speed, mph	xxx	3	1 mph	0 to 999
10-Min Avg Wind Direction, deg	xxx	3	1 deg	0 to 360
Air Temperature, degC or degF	xxx	3	1 deg	–58 to 140
Fuel Temperature, degC or degF	xxx	3	1 deg	10 to 140
10-Min Avg Relative Humidity, %	xxx	3	1%	0 to 100
Battery Voltage, VDC	xx.x	4	0.1 VDC	0 to 15

C.3 Pseudo Binary

The Pseudo Binary data format is a modified-ASCII format that utilizes 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 up 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 if necessary 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. For example:

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

A Pseudo Binary data message is not easily human readable and therefore relies on a data processing element within the flow of data reception to decode and transform.

C.3.1 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 tables present the numeric ranges and their associated precision. Also shown is a description of each bit and their usage in calculating a finished value.

Range	Max 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

S	E	M	FP2 Value Is =
0	0	8191	+ infinity
1	0	8191	– infinity
1	0	8190	NAN
0 or 1	0 to 3	0 to 7999	(–1 ^ S) • (10 ^ –E) • 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 as shown in the following table. For example, the value of 12.34 would be encoded as follows.

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

C.3.2 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's 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 would first be multiplied by 100 and the resulting integer of 12345 would be stored for transmission with the following encoding.

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

C.3.3 Additional Pseudo Binary Representations

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

Appendix D. Extended ASCII Command Set

Appendix D describes the ASCII command interface for the TX321 transmitter. These commands can be entered using the terminal window of DevConfig, or suitable terminal emulation software.

D.1 Command Interface

D.1.1 Port Interfaces

All data entry and diagnostic functions are accessed using either the RS-232 or USB interface.

D.1.1.1 RS-232 Details

The default settings for the RS-232 port are 9600 baud, 8 data bits, no parity, and 1 stop bit.

Three RS-232 connections (TXD, RXD, and GND) are used, no handshaking is needed and should be set to none in the terminal emulator.

D.1.1.2 Command Protocol

A [CR] (0x0d) must be entered to get the transmitter attention and is used to terminate a command line. The transmitter responds with a '>' (0x3e) to indicate that it is ready to receive a command. If no characters are entered for 60 seconds, any partially entered commands are deleted and the transmitter attention is lost. To get the transmitter attention, a character must be entered followed by a [CR] until the '>' prompt is returned.

Commands can optionally be terminated with [CR][LF]; in other words, a [LF] character received following a [CR] will be ignored.

Each character entered is echoed to the host to allow for simple error checking and to support the terminal nature of the implementation. A backspace character (BS, 0x08) deletes the last character entered. The ESC character (0x1b) deletes the entire command.

The command protocol is not case sensitive. Many commands are used to set or retrieve various configuration parameters. When setting parameters, the command is followed by an equals sign ('=') and a comma separated list of parameters. When retrieving parameters, the command is entered without the '=' or followed by a question mark ('?').

Some commands are used to direct the transmitter to execute a specific function (for example, clear a buffer); in such cases, neither a '=' or a '?' is required. If the command has parameters associated with it, they will appear as a comma separated list following the command itself.

Unless otherwise noted, the transmitter will respond to all commands with one of the following:

"OK[CR][LF]>" if command was accepted
"Bad parameter[CR][LF]>" if a command parameter was invalid
"Unknown Format[CR][LF]>" if there are too many or too few parameters
"Access Denied![CR][LF]>" if the command requires a higher access level
"Unknown Command[CR][LF]>" if the command is unknown
"Execution Error[CR][LF]>" if the command fails during execution
"Transmitter Must Be Disabled[CR][LF]>" if the transmitter must be disabled prior to using this command.
"Transmitter Must Be Enabled[CR][LF]>" if command must first be enabled
"Configuration Not Recognized[CR][LF]>" if configuration is invalid

If the command was a request for a configuration parameter, the transmitter will respond with:

<cmd>=<data>[CR][LF]> when returning data parameters.

D.1.1.3 Command Access Level

All commands are subject to an access right to restrict access to calibration and test commands. Two access levels are defined: USER and TECHNICIAN. An error will be returned if a TECHNICIAN level command is entered while at the USER command access level. USER level commands are always available including when at the TECHNICIAN command access level. The TECHNICIAN level commands are not described here.

The command access level is changed by using the password protected **TECHMODE** command. After power up the access level is always USER. The access level of each command is noted in each command description.

Some commands are only available when transmissions are disabled. This is also noted along with each command description.

D.2 General Configuration Commands

D.2.1 Clock Read/Set

Syntax:
TIME=yyyy/mm/dd hh:mm:ss

Access level: USER
TX321 state: Enabled/Disabled

This command sets the date and time in the transmitter. The date and time will be overwritten when a GPS time synchronization occurs. Self-timed transmissions will not occur until the time has been set either using this command or from the GPS. Random transmissions will occur with or without time being set.

The real time clock starts at 01/01/2000 00:00:00 at power up.

D.2.2 Replacement Character Read/Set

Syntax:
IRC=c

Access level: USER
TX321 state: Enabled/Disabled

This command defines the ASCII character that will be substituted for any prohibited ASCII character detected in the transmission data when operating in ASCII or Pseudo Binary mode. The default character is '*'. Only printable ASCII characters, excluding space, are permitted. In Pseudo Binary mode, numeric characters are considered illegal.

D.2.3 Save Configuration

Syntax:
SAVE

Access level: USER
TX321 state: Enabled/Disabled

This command directs the transmitter to commit the entered configuration parameters to non-volatile memory. Until this command is entered, the previously saved configuration can be recalled using the RSTR command.

D.2.4 Restore Configuration

Syntax:
RSTR

Access level: USER
TX321 state: Enabled/Disabled

This command directs the transmitter to restore the configuration parameters from non-volatile memory. Changes made to the configuration are not automatically saved to non-volatile memory as they are entered. This allows changes to be made and verified before committing them to permanent storage, but provides the ability to recall the last saved settings, if necessary.

D.2.5 Restore Default Configuration

Syntax:
DEFAULT

Access level: USER
TX321 state: Enabled/Disabled

This command directs the transmitter to set the configuration parameters to their factory default (mostly invalid) values; this essentially clears the operation of the transmitter. This command does not automatically save the cleared parameters to non-volatile memory; the SAVE command must be issued to complete the sequence.

This command does not set the calibration data or serial number to factory defaults.

D.2.6 Enable Transmissions

Syntax:
ETX

Access level: USER
TX321 state: Disabled

This command enables transmissions. The configuration parameters will be checked for validity. If valid, they are saved to non-volatile memory and the transmitter is enabled. The enabled/disabled state of the transmitter is also stored in non-volatile memory so that it will resume operation after a power cycle if it was previously enabled.

Note that the factory default configuration is **not** valid. The factory default parameters must be explicitly overwritten with valid values before transmissions can be enabled.

D.2.7 Disable Transmissions

Syntax:
DTX

Access level: USER
TX321 state: Enabled

This command disables transmissions. Normal scheduling of transmissions is suspended.

Note that the transmitter is automatically disabled if configuration parameters are modified and must be re-enabled with the ETX command to resume transmitting.

D.2.8 Read Configuration

Syntax:
RCFG

Access level: USER
TX321 state: Enabled/Disabled

This command lists all of the configuration parameters. Each parameter is in the same format as if its individual command had been executed.

For Example:
RCFG
NESID=326d31d4
TCH=92
.
.
.

The output from the RCFG command can be captured by the host (in a text file) and used to duplicate the configuration in another unit.

D.2.9 Enable Technician Command Mode

Syntax:
TECHMODE password

Access level: USER
TX321 state: Enabled/Disabled

This command changes the command access level to TECHNICIAN. The access level will not change unless the password is correct.

D.2.10 Enable User Command Mode

Syntax:
USERMODE

Access level: USER
TX321 state: Enabled/Disabled

This command changes the command access level back to USER. No password is required. A power cycle of the transmitter will also return the command access level to USER.

D.2.11 Set GPS Fix Interval

Syntax:
GIN=hh:mm:ss

Access level: USER
TX321 state: Disabled
Default value: 00:00:00

This command sets the GPS position fix interval to the hours, minutes, seconds specified in hh:mm:ss. It can also be used without the '=' sign to report the current value. Valid range of hh:mm:ss is 00:05:00 to 24:00:00. A value of 00:00:00 will disable periodic GPS position fixes although they will still occur at power up and every 24 hours as a side effect of the daily automatic OCXO calibration. The current value of the GPS fix interval is also reported by the RCFG command. The parameter is non-volatile when saved using the SAVE or ETX commands.

D.3 GOES Transmission Configuration Commands

The following commands are used to set the configuration parameters for GOES transmissions. Unless otherwise specified, these parameters have invalid default values and must be set explicitly before transmissions can be enabled using the **ETX** command. These parameters are stored in non-volatile memory by issuing the **SAVE** command or will be automatically saved when the transmitter is enabled.

The transmitter is disabled automatically if any of these parameters are modified. Parameters can be read by entering the command without the '=' while transmissions are enabled or disabled. All parameters can be read at the same time using the **RCFG** command.

D.3.1 Set GOES DCP Platform ID

Syntax:
NESID=xxxxxxxx

Access level: USER
TX321 state: Disabled

Sets the transmitter GOES DCP Platform ID to the hex value xxxxxxxx. Valid range is even hex numbers from 2 to 0xfffffffe.

D.3.2 Set Self-Timed Transmission Channel Number

Syntax:
TCH=ccc

Access level: USER
TX321 state: Disabled

This command sets the channel number (**ccc**) for timed transmissions. **ccc** is the channel number and has a valid range of 0 – 266 for bit rates of 100 and 300 bps and a range of 0 – 133 for a bit rate of 1200 bps.

For 100 bps operation on channels 201 – 266, the transmitter will be configured for international operation. Specifically, the 31-bit international End of Transmission (EOT) will be used (0x63CADD04) in place of the ASCII EOT, and the preamble will be forced to Long.

Setting the channel number to 0 will disable timed transmissions.

D.3.3 Set Self-Timed Transmission Bit Rate

Syntax:
TBR=bbbb

Access level: USER
TX321 state: Disabled

This command sets the timed transmission bit rate where **bbbb** is the bit rate parameter and has valid values of 100, 300 and 1200 bps.

D.3.4 Set Self-Timed Transmission Interval

Syntax:
TIN=dd:hh:mm:ss

Access level: USER
TX321 state: Disabled

Set interval between timed transmissions to days, hours, minutes, seconds specified in dd:hh:mm:ss. Valid range is 00:00:05:00 to 30:23:59:59.

D.3.5 Set Self-Timed Transmission First Transmission Time

Syntax:
FTT=hh:mm:ss

Access level: USER
TX321 state: Disabled

Set the time for the first timed transmission of the day. Valid range is 00:00:00 to 23:59:59. The First Transmission Time is also referred to as the Offset, and is between 00:00:00 and the Self-Timed Transmission Interval.

D.3.6 Set Self-Timed Transmission Transmit Window Length

Syntax:
TWL=xxx

Access level: USER
TX321 state: Disabled

Set the length of the timed transmit window. Length is specified in seconds. Valid range is 5 to 240 seconds.

D.3.7 Enable or Disable Self-Timed Transmission Message Centering

Syntax:
CMSG=Y/N

Access level: USER
TX321 state: Disabled

Center the timed transmission in the assigned window if Y otherwise transmit at beginning of assigned window.

D.3.8 Enable or Disable Self-Timed Buffer Empty Message

Syntax:
EBM=Y/N

Access level: USER
TX321 state: Disabled

If EBM is Y, send “BUFFER EMPTY” message if the buffer is empty at time of transmission. If EBM is N, do not transmit if the buffer is empty.

D.3.9 Set Self-Timed Transmission Preamble Length

Syntax:
TPR=S/L

Access level: USER
TX321 state: Disabled

Set the preamble type for timed transmissions. Valid values are S or L (Short or Long). This setting only applies for 100 bps timed transmissions on channels 1 – 200. All 300 and 1200 bps transmissions us short preamble. All 100 bps transmissions on channels above 200 use long preamble.

D.3.10 Set Self-Timed Transmission Interleaver Mode

Syntax:
TIL=S/L/N

Access level: USER
TX321 state: Disabled

Set the timed transmission interleaver type. Valid values are S, L, or N (Short, Long or None). This setting only applies for HDR (high data rate) timed transmissions, for example 300 or 1200 bps. Setting does not apply to CS2 devices.

D.3.11 Set Self-Timed Transmission Data Format

Syntax:
TDF=A/P/B

Access level: USER
TX321 state: Disabled

This command sets the timed transmission format to ASCII, Pseudo Binary or Binary. Valid values are A, P or B. This parameter is used to determine the flag word in 300 and 1200 bps transmissions.

Note: It is the responsibility of the host to ensure the data provided for transmission is in the proper format. ASCII data cannot be transmitted when Pseudo Binary format is selected. Pseudo Binary can be transmitted with ASCII format has been selected.

D.3.12 Set Random Transmission Channel Number

Syntax:
RCH=ccc

Access level: USER
TX321 state: Disabled

This command sets the channel number for random transmissions. **ccc** is the channel number and has a valid range of 0 – 266 for bit rates of 100 and 300 bps and a range of 0 – 133 for a bit rate of 1200 bps.

For 100 bps operation on channels 201 – 266, the transmitter will be configured for international operation. Specifically, the 31-bit international EOT will be used (0x63CADD04) in place of the ASCII EOT.

Setting the channel number to 0 will disable random transmissions.

D.3.13 Set Random Transmission Bit Rate

Syntax:
RBR=bbbb

Access level: USER
TX321 state: Disabled

This command sets the random transmission bit rate, where **bbbb** is the bit rate parameter and has valid values of 100, 300 and 1200.

D.3.14 Set Random Transmission Interval

Syntax:
RIN=mm

Access level: USER
TX321 state: Disabled

Set the random transmission randomizing interval to mm minutes. The randomizing interval is the interval in which a random transmission will occur if there is data in the random transmission buffer. The actual transmission time will be random, but on average will occur at this rate. Valid range is 5 to 99 minutes.

D.3.15 Set Random Transmission Randomizing Percentage

Syntax:
RPC=mm

Access level: USER
TX321 state: Disabled

This value determines the range of randomization as a percentage of the randomizing interval. Random transmissions will occur at a uniformly distributed random time within this range and on average occur at the randomizing interval rate. Valid range is 10 to 50%.

For example, for a randomizing interval = 15 (minutes) and a randomizing percentage = 20 (%), then the time between any two random transmissions will be 12 to 18 minutes (15 ± 3 minutes).

D.3.16 Set Random Transmission Repeat Count

Syntax:
RRC=xx

Access level: USER
TX321 state: Disabled

The random transmission repeat count is the number of times a random transmission will be repeated. The random transmissions will occur once every random transmission interval as specified by the randomizing interval. The valid range of this parameter is 0 – 99. For example, a value of 3 will direct the transmitter to send the data in the random buffer 3 times before clearing it. A value of 0 indicates that random transmissions will occur every random transmission interval until the random buffer is cleared by the host.

D.3.17 Enable or Disable Random Transmission Message Counter

Syntax:
RMC=Y/N

Access level: USER
TX321 state: Disabled

If RMC is Y, a random message counter will be included at the beginning of the message, ahead of the user data. If it is N, the random message count will not be included.

D.4 Data Buffer Loading Commands

The following commands are used to manage and store data in the GOES transmission buffers.

D.4.1 Load Self-Timed Transmission Buffer

Syntax:
TDT=xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Access level: USER
TX321 state: Enabled

This command overwrites the GOES timed buffer with the data provided. The TX321 transmitter will insert the 31 bit GOES ID, any header information (for example, HDR Flag byte), and append the EOT so these should not be included in the TDT data. If the timed data format is ASCII or Pseudo Binary, the transmitter will also insert the correct parity bit for each message character and replace illegal characters with the character specified by the **IRC=c** command before transmission.

Characters that have meaning for the command interface (CR, LF, BS, ESC,'~') must be preceded by a '~' character if they appear in the message data.

The maximum length of the formatted data can be up to 126000 bits, or 15750 bytes.

If there is more data loaded into the buffer than can be transmitted in the assigned transmit window, the message will be truncated.

One minute prior to transmission data is removed from the transmit buffer and encoded for transmission (The **DATA** LED will go out). If this command is received within 1 minute of the transmission time or during a timed

transmission, the data will not be included in the current transmission but will be buffered for the next interval.

D.4.2 Read Number of Bytes in the Self-Timed Transmission Buffer

Syntax:
TML

Access level: USER
TX321 state: Enabled/Disabled

Returns the number of bytes stored in the timed transmission buffer.

D.4.3 Read the Maximum Self-Timed Message Length

Syntax:
MTML

Access level: USER
TX321 state: Enabled

Returns the maximum number of bytes that can be transmitted with the current timed transmission bit rate, window length, and preamble type.

D.4.4 Clear Self-Timed Transmission Buffer

Syntax:
CTB

Access level: USER
TX321 state: Enabled/Disabled

Clears the timed transmission buffer.

D.4.5 Load Random Transmission Buffer

Syntax:
RDT=xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Access level: USER
TX321 state: Enabled

This command overwrites the GOES random buffer with the data provided. The G5 transmitter will insert the 31 bit GOES ID, any header information (for example, HDR Flag byte), and append the EOT so these should not be included in the RDT data. If the random data format is Pseudo Binary the transmitter will also insert the correct parity bit for each message character and replace illegal characters with the character specified by the IRC=c command before transmission.

Characters that have meaning for the command interface (CR, LF, BS, ESC,'~') must be preceded by a '~' character if they appear in the message data.

Loading data into the random transmission buffer, triggers the random reporting sequence. Once triggered, the random reporting mechanism will send the data loaded in the buffer for the number of transmissions as specified by the random repeat count. The buffer will be cleared automatically when the number of transmissions specified have occurred.

If the command is received within 1 minute or during a random transmission, the data will not be included in the current transmission but will be buffered for the next one.

If there is more data loaded into the buffer than can be transmitted at the assigned bit rate the message will be truncated.

D.4.6 Read Length of the Message in the Random Transmission Buffer

Syntax:
RML

Access level: USER
TX321 state: Enabled/Disabled

Returns the number of bytes stored in the random transmission buffer.

D.4.7 Read the Maximum Random Message Length

Syntax:
MRML

Access level: USER
TX321 state: Enabled

Returns the maximum number of bytes that can be transmitted at the current random transmission bit rate.

D.4.8 Clear Random Transmission Buffer

Syntax:
CRB

Access level: USER
TX321 state: Enabled/Disabled

Clear the random transmission buffer.

D.5 Status and Other Commands

The following commands are used by the host to determine the status of the transmitter for display and diagnostics purposes. These commands can be entered with transmissions enabled or disabled.

D.5.1 Read Version Information

Syntax:
VER

Access level: USER
TX321 state: Enabled/Disabled

This command returns the transmitter serial number, hardware version number, operating system version, and GPS module version numbers.

D.5.2 Read Transmission Status

Syntax:
RST

Access level: USER
TX321 state: Enabled/Disabled

This command returns the transmitter state, GPS state, time to next transmission, number of bytes in timed transmit buffer, number of bytes in random transmit buffer, number of times random data has been transmitted, fail-safe status, and supply voltage.

The transmitter responds with:

```
Transmitter: Enabled/Disabled[CR][LF]
GPS: On/Off[CR][LF]
RTC: Valid/Invalid[CR][LF]
Time To Next Tx: dd:hh:mm:ss[CR][LF]
Timed Message Length: nnnn[CR][LF]
Next Timed Tx: N/A or mm/dd/yyyy hh:mm:ss
Random Message Length: nnnn[CR][LF]
Random Message Tx Count: nnn[CR][LF]
Next Random Tx: N/A or mm/dd/yyyy hh:mm:ss
Fail-Safe: OK/Tripped[CR][LF]
Supply Voltage: xx.x V
```

D.5.3 Read Last Transmission Status

Syntax:
LTXS

Access level: USER
TX321 state: Enabled/Disabled

This command returns the status of the last transmission. The last transmission could have been a regularly scheduled timed transmission, a random transmission, or a test transmission triggered by a test command.

If a transmission has occurred since the unit was last powered up, the transmitter responds to the command with:

Tx Status: Failsafe Tripped/OK
Tx Type: Timed/Random/Test
Last Tx Length: 30 bytes
Last Tx Start Time: 2004/12/16 23:29:48
Last Tx Stop Time: 2004/12/16 23:29:49
Forward Power: -23.1 dBm
Power Supply: 12.0 V

If a transmission has not occurred since power up, the transmitter will respond with:

No Tx Has Occurred

D.5.4 Read GPS Status

Syntax:
GPS

Access level: USER
TX321 state: Enabled/Disabled

This command returns the current GPS status including satellite numbers and signal strengths in the following format if the GPS is on:

Fix Status: Full Accuracy
Almanac Available: N
PPS Output Stable: N
UTC Offset = 0.000000

Satellite #	Signal Strength
30	10.80
23	no lock
10	4.00
25	1.80
5	6.60
21	no lock
17	6.40
2	6.80

If the GPS is off, the command returns:

GPS is off

D.5.5 Read GPS Position

Syntax:
POS

Access level: USER
TX321 state: Enabled/Disabled

This command returns position obtained during the last GPS fix in the following format:

```
Time of fix: dd/mm/yyyy hh:mm:ss[CR][LF]
Lat: sxx.xxxxx[CR][LF]
Long: sxxx.xxxxx[CR][LF]
Alt: xxxxx[CR][LF]>
```

Where latitude is in degrees, + for N and – for S, longitude is in degrees, + for E and – for W, and altitude is in meters.

If a GPS fix has not yet occurred, the transmitter will respond with: **No GPS Fix[CR][LF]>**

D.5.6 Read Audit Log

Syntax:
RAL

Access level: USER
TX321 state: Enabled/Disabled

The RAL command is used to retrieve the audit log information in the following format:

yy/mm/dd hh:mm:ss event message 1[CR][LF]
yy/mm/dd hh:mm:ss event message 2 [CR][LF]
.
.
.
yy/mm/dd hh:mm:ss event message N[CR][LF]>

Where: **yy/mm/dd hh:mm:ss** are the date and time that the message was created.
event message x is a short text string describing the event detected.

D.5.7 Read Forward Power

Syntax:
RFWD

Access level: USER
TX321 state: Enabled/Disabled

Returns the current forward power in dBm. This value is updated at the bit rate when transmitting and every 30 seconds when not transmitting.

D.5.8 Read Reflected Power

Syntax:
RRFL

Access level: USER
TX321 state: Enabled/Disabled

Returns the reflected power in dBm. This value is updated at the bit rate when transmitting and every 30 seconds when not transmitting.

D.5.9 Read Power Supply

Syntax:
RPS

Access level: USER
TX321 state: Enabled/Disabled

Returns the power supply voltage in volts. This value is updated at the bit rate when transmitting and every 30 seconds when not transmitting.

D.5.10 Read TCXO Temperature

Syntax:
RTEMP

Access level: USER
TX321 state: Enabled/Disabled

Returns the TCXO temperature (PCB temperature) in degrees C. This value is updated at the bit rate when transmitting and every 30 seconds when not transmitting.

D.5.11 Read Measured Frequency

Syntax:
RMF

Access level: TECHNICIAN
TX321 state: Enabled/Disabled

This command returns the last measured OCXO and TCXO frequencies in the following format:

F-OCXO: 10000005.9000
F-TCXO: 43199.9166

Units are Hz.

Appendix E. Meteosat

Appendix E provides general information about the Meteosat capabilities of the TX321.

E.1 General Specifications

The TX321 family is capable of using Meteosat data collection which uses Standard Rate DCP Platforms (SRDCP) to transmit. It transmits at 100 baud and can transmit 649 bytes of platform data in 1 minute. This includes 5 seconds of unmodulated carrier, a preamble, a sync code, and an address. SRDCP has a timing accuracy of ±15 seconds or better. Use the following table to help determine which channel number corresponds to each assigned transmit frequency.

TABLE E-1. Meteosat Transmit Frequencies								
Ch	**No.**	**Frequency**	**Bandwidth**		**Ch**	**No.**	**Frequency**	**Bandwidth**
	1	402035500	1500			51	402110500	1500
	2	402037000	1500			52	402112000	1500
	3	402038500	1500			53	402113500	1500
	4	402040000	1500			54	402115000	1500
	5	402041500	1500			55	402116500	1500
	6	402043000	1500			56	402118000	1500
	7	402044500	1500			57	402119500	1500
	8	402046000	1500			58	402121000	1500
	9	402047500	1500			59	402122500	1500
	10	402049000	1500			60	402124000	1500
	11	402050500	1500			61	402125500	1500
	12	402052000	1500			62	402127000	1500
	13	402053500	1500			63	402128500	1500
	14	402055000	1500			64	402130000	1500
	15	402056500	1500			65	402131500	1500
	16	402058000	1500			66	402133000	1500
	17	402059500	1500			67	402134500	1500
	18	402061000	1500			68	402136000	1500
	19	402062500	1500			69	402137500	1500
	20	402064000	1500			70	402139000	1500
	21	402065500	1500			71	402140500	1500
	22	402067000	1500			72	402142000	1500
	23	402068500	1500			73	402143500	1500
	24	402070000	1500			74	402145000	1500
	25	402071500	1500			75	402146500	1500
	26	402073000	1500			76	402148000	1500
	27	402074500	1500			77	402149500	1500
	28	402076000	1500			78	402151000	1500
	29	402077500	1500			79	402152500	1500
	30	402079000	1500			80	402154000	1500
	31	402080500	1500			81	402155500	1500
	32	402082000	1500			82	402157000	1500
	33	402083500	1500			83	402158500	1500
	34	402085000	1500			84	402160000	1500
	35	402086500	1500			85	402161500	1500
	36	402088000	1500			86	402163000	1500
	37	402089500	1500			87	402164500	1500
	38	402091000	1500			88	402166000	1500
	39	402092500	1500			89	402167500	1500
	40	402094000	1500			90	402169000	1500
	41	402095500	1500			91	402170500	1500

TABLE E-1. Meteosat Transmit Frequencies (continued)								
Ch	**No.**	**Frequency**	**Bandwidth**		**Ch**	**No.**	**Frequency**	**Bandwidth**
	42	402097000	1500			92	402172000	1500
	43	402098500	1500			93	402173500	1500
	44	402100000	1500			94	402175000	1500
	45	402101500	1500			95	402176500	1500
	46	402103000	1500			96	402178000	1500
	47	402104500	1500			97	402179500	1500
	48	402106000	1500			98	402181000	1500
	49	402107500	1500			99	402182500	1500
	50	402109000	1500			100	402184000	1500
	101	402185500	1500			151	402260500	1500
	102	402187000	1500			152	402262000	1500
	103	402188500	1500			153	402263500	1500
	104	402190000	1500			154	402265000	1500
	105	402191500	1500			155	402266500	1500
	106	402193000	1500			156	402268000	1500
	107	402194500	1500			157	402269500	1500
	108	402196000	1500			158	402271000	1500
	109	402197500	1500			159	402272500	1500
	110	402199000	1500			160	402274000	1500
	111	402200500	1500			161	402275500	1500
	112	402202000	1500			162	402277000	1500
	113	402203500	1500			163	402278500	1500
	114	402205000	1500			164	402280000	1500
	115	402206500	1500			165	402281500	1500
	116	402208000	1500			166	402283000	1500
	117	402209500	1500			167	402284500	1500
	118	402211000	1500			168	402286000	1500
	119	402212500	1500			169	402287500	1500
	120	402214000	1500			170	402289000	1500
	121	402215500	1500			171	402290500	1500
	122	402217000	1500			172	402292000	1500
	123	402218500	1500			173	402293500	1500
	124	402220000	1500			174	402295000	1500
	125	402221500	1500			175	402296500	1500
	126	402223000	1500			176	402298000	1500
	127	402224500	1500			177	402299500	1500
	128	402226000	1500			178	402301000	1500
	129	402227500	1500			179	402302500	1500
	130	402229000	1500			180	402304000	1500
	131	402230500	1500			181	402305500	1500
	132	402232000	1500			182	402307000	1500

TABLE E-1. Meteosat Transmit Frequencies (continued)								
Ch	**No.**	**Frequency**	**Bandwidth**		**Ch**	**No.**	**Frequency**	**Bandwidth**
	132	402232000	1500			182	402307000	1500
	133	402233500	1500			183	402308500	1500
	134	402235000	1500			184	402310000	1500
	135	402236500	1500			185	402311500	1500
	136	402238000	1500			186	402313000	1500
	137	402239500	1500			187	402314500	1500
	138	402241000	1500			188	402316000	1500
	139	402242500	1500			189	402317500	1500
	140	402244000	1500			190	402319000	1500
	141	402245500	1500			191	402320500	1500
	142	402247000	1500			192	402322000	1500
	143	402248500	1500			193	402323500	1500
	144	402250000	1500			194	402325000	1500
	145	402251500	1500			195	402326500	1500
	146	402253000	1500			196	402328000	1500
	147	402254500	1500			197	402329500	1500
	148	402256000	1500			198	402331000	1500
	149	402257500	1500			199	402332500	1500
	150	402259000	1500			200	402334000	1500
	201	402335500	1500			251	402410500	1500
	202	402337000	1500			252	402412000	1500
	203	402338500	1500			253	402413500	1500
	204	402340000	1500			254	402415000	1500
	205	402341500	1500			255	402416500	1500
	206	402343000	1500			256	402418000	1500
	207	402344500	1500			257	402419500	1500
	208	402346000	1500			258	402421000	1500
	209	402347500	1500			259	402422500	1500
	210	402349000	1500			260	402424000	1500
	211	402350500	1500			261	402425500	1500
	212	402352000	1500			262	402427000	1500
	213	402353500	1500			263	402428500	1500
	214	402355000	1500			264	402430000	1500
	215	402356500	1500			265	402431500	1500
	216	402358000	1500			266	402433000	1500
	217	402359500	1500			267	402434500	1500
	218	402361000	1500			268	402002500	1500
	219	402362500	1500			269	402004000	1500
	220	402364000	1500			270	402005500	1500
	221	402365500	1500			271	402007000	1500
	222	402367000	1500			272	402008500	1500
	223	402368500	1500			273	402010000	1500

TABLE E-1. Meteosat Transmit Frequencies (continued)								
Ch	**No.**	**Frequency**	**Bandwidth**		**Ch**	**No.**	**Frequency**	**Bandwidth**
	224	402370000	1500			274	402011500	1500
	225	402371500	1500			275	402013000	1500
	226	402373000	1500			276	402014500	1500
	227	402374500	1500			277	402016000	1500
	228	402376000	1500			278	402017500	1500
	229	402377500	1500			279	402019000	1500
	230	402379000	1500			280	402020500	1500
	231	402380500	1500			281	402022000	1500
	232	402382000	1500			282	402023500	1500
	233	402383500	1500			283	402025000	1500
	234	402385000	1500			284	402026500	1500
	235	402386500	1500			285	402028000	1500
	236	402388000	1500			286	402029500	1500
	237	402389500	1500			287	402031000	1500
	238	402391000	1500			288	402032500	1500
	239	402392500	1500			289	402034000	1500
	240	402394000	1500					
	241	402395500	1500					
	242	402397000	1500					
	243	402398500	1500					
	244	402400000	1500					
	245	402401500	1500					
	246	402403000	1500					
	247	402404500	1500					
	248	402406000	1500					
	249	402407500	1500					
	250	402409000	1500					

Appendix F. Compliance Documents and Certificates

Compliance documents include the TX321 FCC Supplier Declaration of Conformity and FCC Statement (FIGURE F-1), the DCPRS and CGMS certificate (FIGURE F-2), and the EUMETSAT certificate (FIGURE F-3). The TX321-M EU Declaration of Conformity and TX321-G Brazilian Certificate of Approval are available at: *www.campbellsci.com/tx321*.

CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

Supplier's Declaration of Conformity
(47 CFR § 2.1077 Compliance Information)

Product: TX321

Manufacturer:
Campbell Scientific, Inc. | 815 W 1800 N | Logan, UT 84321-1784 | 435.227.9000 | 435.227.9001 F www.campbellsci.com

This declaration of conformity is issued under the sole responsibility of the manufacturer for the following product(s):

Model	Description
TX321	GOES HDR V2 / Meteosat Satellite Transmitter

FCC User Manual Compliance Statement(s)
47 CFR part 15, Subpart B- §15.105(a) [Will also suffice for the §15.19 (a) statement]
NOTE:This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

47 CFR part 15, Subpart B- §15.21
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Signed for and on behalf of:
Place: Campbell Scientific Inc.
Date: April 30th, 2019

Karsten Sorensen
Quality Assurance Manager
Campbell Scientific Inc.

FIGURE F-1. TX321 FCC Supplier Declaration of Conformity and FCC Statement

National Environmental Satellite, Data and Information Service

Certificate Number
1014-000114

Certifies that **Forest Technology Service, LTD**
Model **Model G6**

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 NOAA NESDIS GOES Data Collection Platform Radio Set (DCPRS)Certification Standards at 300bps and 1200bps, Version 2.0, June 2009 and CGMS International Standard, Version 1, 2009.

Director, Office of Systems Development
Signature

7/17/14
Date

NOAA Form 83-1
(6-80)

GOES/RADIO SET CERTIFICATION

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

FIGURE F-2. DCPRS and CGMS certificate

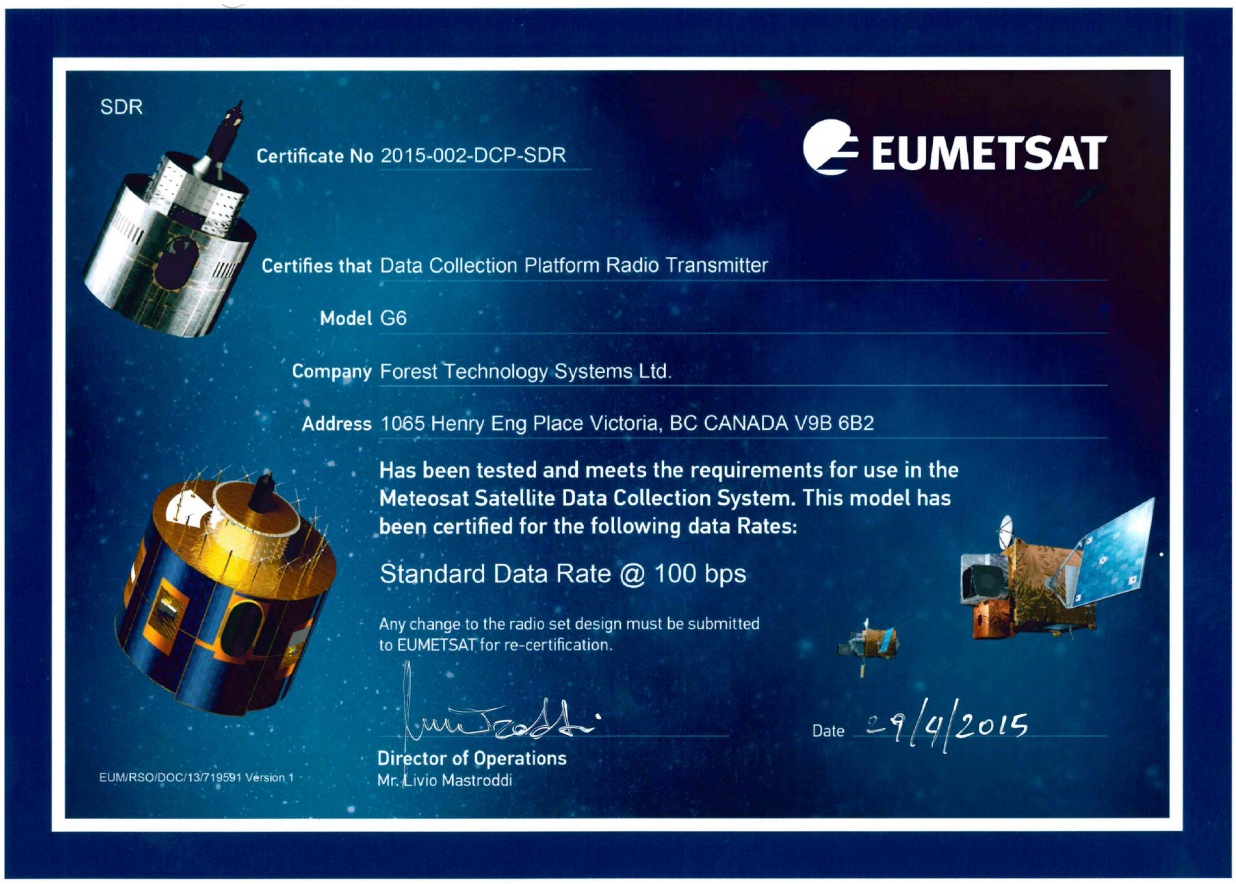

FIGURE F-3. EUMETSAT certificate

CAMPBELL SCIENTIFIC®
WHEN MEASUREMENTS MATTER

Global Sales & Support Network

A worldwide network of companies to help meet your needs

Australia

Location: Garbutt, QLD Australia
Phone: 61.7.4401.7700
Email: info@campbellsci.com.au
Website: www.campbellsci.com.au

Brazil

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