INSTRUCTION MANUAL

ST-20 Argos Satellite Transmitter

Revision: 6/07

Warranty and Assistance

The **ST-20 ARGOS SATELLITE TRANSMITTER** is warranted by CAMPBELL SCIENTIFIC, INC. to be free from defects in materials and workmanship under normal use and service for twelve (12) months from date of shipment unless specified otherwise. Batteries have no warranty. CAMPBELL SCIENTIFIC, INC.'s obligation under this warranty is limited to repairing or replacing (at CAMPBELL SCIENTIFIC, INC.'s option) defective products. The customer shall assume all costs of removing, reinstalling, and shipping defective products to CAMPBELL SCIENTIFIC, INC. CAMPBELL SCIENTIFIC, INC. will return such products by surface carrier prepaid. This warranty shall not apply to any CAMPBELL SCIENTIFIC, INC. products which have been subjected to modification, misuse, neglect, accidents of nature, or shipping damage. This warranty is in lieu of all other warranties, expressed or implied, including warranties of merchantability or fitness for a particular purpose. CAMPBELL SCIENTIFIC, INC. is not liable for special, indirect, incidental, or consequential damages.

Products may not be returned without prior authorization. The following contact information is for US and International customers residing in countries served by Campbell Scientific, Inc. directly. Affiliate companies handle repairs for customers within their territories. Please visit www.campbellsci.com to determine which Campbell Scientific company serves your country. To obtain a Returned Materials Authorization (RMA), contact CAMPBELL SCIENTIFIC, INC., phone (435) 753-2342. After an applications engineer determines the nature of the problem, an RMA number will be issued. Please write this 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

CAMPBELL SCIENTIFIC, INC. does not accept collect calls.

ST-20 Table of Contents

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

Figures

Table

ST-20 Argos Satellite Transmitter

1. Overview

The ST-20 is a certified Argos PTT satellite transmitter for use with Campbell Scientific, Inc. CRBasic dataloggers. Service Argos data transceivers fly aboard two NOAA polar orbiting satellites. With an orbit altitude close to 800 kilometers, the satellites are at a relatively low orbit. The low orbit allows for low transmit power, low battery power requirements and the use of an omni-directional antenna. The orbit period is approximately 1 hour and 45 minutes, which allows hourly data at extreme northern and southern latitudes. Near the equator there are about six satellite passes per day that are not evenly spaced. During the average satellite pass, the satellite is in view for about 10 minutes.

FIGURE 1-1. ST-20 Argos Satellite Transmitter

1.1 Specifications

Power supply:	Nominal 12 volts DC, 10 volts DC minimum, 16 volts DC maximum
Current drain at 12 volts:	1.12 mA quiescent, 375 mA during transmit
Data Buffers:	7 buffers, 32 byte each. Note: 28 bit ID numbers reduce buffers to 31 bytes.
Dimensions:	7.5 L x 2.25 H x 1.25 W inches, 19 L x 6 H x 3 W cm.
Weight:	7.9 oz, 224 gm

1.2 Serial Port

The ST-20 is specifically designed to work with Campbell Scientific, Inc. CRBasic dataloggers. The ST-20 serial port is connected to the CS I/O port of the datalogger. The datalogger provides 12 volt DC power and ground through pins 8 and 2 respectively. Communications utilize the Campbell Scientific, Inc. Synchronous Device for Communications (SDC) protocol, which allows several devices to be connected to the CS I/O port at the same time. Each device is addressed or pin enabled; the ST-20 is address 4.

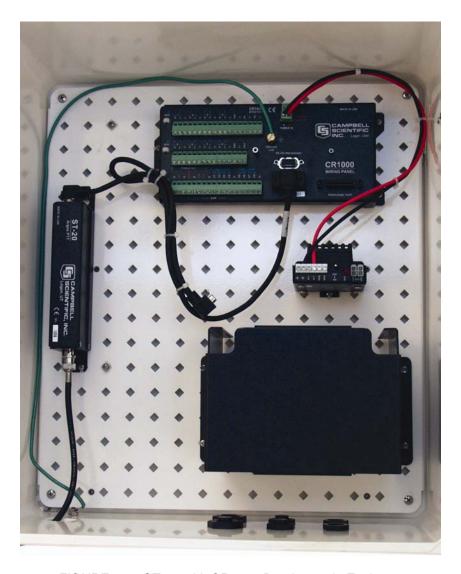| TABLE 1-1. ST-20 Serial Port Configuration	
Pin number	**Function**
1	+5 volts
2	Ground
3	NC
4	TXD (data out)
5	NC
6	SDE (input)
7	CLK/HS (input)
8	+12 volts
9	RXD (data in)

FIGURE 1-2. ST-20 with CR1000 Datalogger in Enclosure

1.3 Data Buffers

The ST-20 has 8 internal data buffers. Before a data buffer can be used, a valid Argos ID number, repetition rate and frequency must be assigned to the buffer. The Argos ID numbers must be entered as a decimal and a Hexadecimal number. The ST-20 uses the Hexadecimal format to determine if the ID is a 28 bit ID number. When using 28 bit ID numbers, 31 bytes of data can be stored in the buffer. When using 20 bit ID numbers, 32 bytes of data can be stored in the buffer. The data buffers are numbered 0 through 7, with 7 being reserved for other uses.

Data buffer setup can be done by the factory or under datalogger control. The factory settings are stored in non-volatile memory. Settings that have been changed by the datalogger are erased when the ST-20 resets.

1.4 Multiple Argos ID Numbers

The use of multiple ID numbers can significantly change how the datalogger is programmed. When multiple ID numbers are used, the ArgosTransmit() function works best. When ArgosTransmit() is executed, the contents of the specified data buffer are transmitted once. ArgosTransmit() gives full control of timing of transmissions to the datalogger programmer. Special care must be taken to avoid transmitting too often. The programmed repetition period must match the System Use Agreement between the user and Service Argos.

1.5 One Argos ID Number

The ArgosDataRepeat() function is most useful when only one Argos ID number is used. It does not matter how many data buffers use the same ID. ArgosDataRepeat() allows the selection of which data buffers will be transmitted, and at what repetition period. When ArgosDataRepeat() is used to start data transmission, the ST-20 will wait one repetition period between each transmission. One buffer is transmitted each transmission, regardless of how many buffers have been enabled. The maximum number of transmissions that can be scheduled with ArgosDataRepeat() is 255.

2. Datalogger Programming

There are 5 programming instructions available for use with the ST-20 Argos PTT: ArgosSetup, ArgosData, ArgosDataRepeat, ArgosTransmit, and ArgosError. The use of ArgosSetup is optional. ArgosData and ArgosDataRepeat are used to enable transmission of data. More advanced applications can use ArgosTransmit. If the setup parameters of the PTT need to be changed, use ArgosSetup first. The setups are maintained in memory until the PTT resets. Once the setup parameters are set, use ArgosData followed by ArgosAutoRepeat. Data in a buffer is saved until the PTT resets or is overwritten by another occurrence of ArgosData. If either the ArgosDataRepeat or ArgosTransmit instruction tries to use a data buffer that has not been setup, the instruction will fail.

2.1 Argos Setup

ArgosSetup (Result Code, Buffer Number, Decimal ID, Hexadecimal ID, Frequency)

2.1.1 Result Code

Result Code used to determine if command executed successfully. The Result Code is set true on success, and false on failure.

2.1.2 Buffer Number

Buffer Number is the ST-20 buffer to setup. Valid entries are 0 through 6.

2.1.3 Decimal ID Number

The Decimal ID number, and Hexadecimal ID are assigned to the Buffer Number. Entries must be valid ID numbers or ArgosSetup will return False. The decimal ID is not a different representation of the same number as the Hexadecimal ID. The two ID numbers are different.

2.1.4 Frequency

Frequency to be assigned to the Buffer Number. Frequency is in Hertz. Valid entries: 401630000 to 401656000 in steps of 2000 Hz and 401676000, 401678000, and 401680000 Hz.

2.2 ArgosData

ArgosData (ResultCode, ST20Buffer, DataTable, NumRecords, DataFormat)

2.2.1 General Description

The ArgosData instruction is used to load data to one of the 7 available data buffers. The data buffers are numbered 0 through 7, with number 7 being reserved for the ST-20 internal temperature. When ArgosData is executed, any data already in the associated buffer is erased before new data is loaded. If the Argos ID number associated with the buffer is a 20 bit ID number, up to 32 bytes of data can be loaded. If the associated ID number is a 28 bit ID, then only 31 bytes can be loaded. Extra bytes are discarded. The ArgosData instruction does not enable data transmission. To enable data transmission, the ArgosDataRepeat, or ArgosTransmit instruction must be used.

2.2.2 ResultCode

The Result Code is a numeric variable used to store the result of the ArgosData instruction. If the result code is true (-1), ArgosData executed successfully.

2.2.3 ST20Buffer

The ST20Buffer is the number of the buffer where data should be loaded. Valid buffer numbers are 0 through 6.

2.2.4 DataTable

DataTable is the name of the data table where data records will be read from.

2.2.5 NumRecords

NumRecords is the number of data records that will be copied from the data table to the Argos PTT. Care should be taken to make sure the total amount of data does not exceed what the buffer can hold, 32 bytes for a 20 bit ID number and 31 bytes for a 28 bit ID number. See DataFormat (section 2.2.6) for details on regarding memory usage.

2.2.6 DataFormat

There are two data formats. Enter "FP2" to use the Campbell Scientific two byte, floating decimal point format. To use FP2, the data table (section 2.2.4) must store data as type FP2. Each data value will use two bytes of memory. Enter "nnn.nnn.nnn…" to use the integer format, where nnn is an integer that specifies the total number of bits to be used for each data value. As an example: "5,8,16,8,3" would use 5 bytes or 40 bits for five data values. The first data value would have 5 bits of resolution, then 8 for the next, then 16 for the third and so forth. With the integer format, data must be stored in the data table as type Long.

When using integer format with bits/data point designator, each data point in the data record needs to be accounted for in the DataFormat field, or the datalogger will assume 2 bytes (16 bits) for each unaccounted for data point.

2.3 ArgosDataRepeat

Usage:
Dim BufferNumber(8) as Boolean
ArgosDataRepeat(Result Code, Repetition Rate, Number Repeats, BufferNumber())

2.3.1 Result Code

The Result Code is a numeric variable that is set true (-1) when the ArgosDataRepeat instruction is successful.

2.3.2 Repetition Rate

The Repetition Rate will set the time between each repetition. A negative number will cause the default repetition rate to be used. Using a value between 0 and 255 will set the repetition rate to the new value plus 42 seconds. The ST-20 adds 42 seconds to the repeat rate with the maximum being 297.

2.3.3 Number Repeats

Number Repeats is how many times the transmission will be repeated. Valid 0 to 255.

2.3.4 Buffer Number

BufferNumber() is an eight element array of Boolean. Each element of BufferNumber corresponds to the same buffer number -1 in the ST-20. Set the corresponding element to true to use a buffer, or false to not use the buffer. Data can be in a buffer that is set to false.

The ArgosDataRepeat instruction is most useful when only using 1 ID number because time between each buffer transmission is the rep rate. When using several ID numbers for each platform, the ArgosTransmit instruction allows the datalogger to control the timing of each transmission.

If a buffer is set to transmit, but the buffer has not been setup with valid parameters, ArgosDataRepeat will fail.

2.4 ArgosTransmit

Usage: ArgosTransmit(Result Code, Buffer Number)

2.4.1 Result Code

The Result Code is a numeric variable that is set true (-1) when the ArgosTransmit instruction is successful.

2.4.2 Buffer Number

The Buffer Number designates which ST-20 buffer is transmitted. Valid entries are 0 through 7.

ArgosTransmit is used to initiate a single transmission immediately. One must be careful because the datalogger program is totally responsible for the actual repetition rate when using this instruction. Works well for those with multiple ID numbers needing more data throughput and total control over the timing of transmissions.

When multiple ID numbers are used, the ArgosTransmit() function works best. When ArgosTransmit() is executed, the contents of the specified data buffer are transmitted once. ArgosTransmit() gives full control of timing of transmissions to the datalogger programmer. Special care must be taken to avoid transmitting too often. The programmed repetition period must match the System Use Agreement between the user and Service Argos.

2.5 ArgosError (Error as string)

Public ErrorCodes as string * 20
ArgosError(ErrorCodes)

2.5.1 ErrorCodes

ErrorCodes is a string variable. ArgosError sends the command &h09, and then waits for the returned string plus the ACK or NAK character. The returned string is stored in the string variable ErrorCodes. If NAK (&h15) is returned, then ArgosError() did not receive a proper response from the ST-20.

3. ST-20 Installation

3.1 BNC Antenna Connector and Antenna

The RF output is 50 ohm impedance at a nominal 1 watt output at about 401.6 MHz. Frequency is dependent on setup. The antenna cable should be kept reasonably short, and connections kept dry. The default antenna is an omni

directional and unity gain. The antenna should be mounted vertically. An antenna with gain will perform significantly worse then an antenna with unity gain.

3.2 Environmental Enclosure

The ST-20 is designed to work in a dry, non-condensing environment. A proper enclosure should be used to keep water, dust and other environmental contaminates away from the ST-20. Always use desiccant inside the enclosure to keep trapped moisture from condensing on the electronics.

4. Satellite Orbit Patterns

At least two NOAA Polar Orbiting Environmental Satellites (POES) carry the Argos transceivers and are operational at any given time. The orbits carry the satellites over the North and South poles of the Earth in a sun synchronous pattern. Orbit period is close to 102 minutes. The satellite foot print is about 5000 km in diameter. At latitudes greater than 75 degrees, each satellite provides coverage each pass. Each satellite passes over the poles 14 times a day providing 28 satellite passes per day. Coverage decreases with latitude. At the equator the PTT will "see" a satellite six or seven times a day. The duration of the POES satellite visibility depends on the angle from the PTT to the satellite. If the satellite passes directly overhead, the satellite will be visible for about 15 minutes. If the satellite passes close to the horizon, as viewed from the PTT, the satellite will only be visible for a short time. On average, each satellite pass is visible for about ten minutes. If using a 200 second repetition rate, a satellite pass could result in three received messages from the PTT.

Satellite coverage must be considered when planning data collection and transmission. Given the variability of satellite coverage, hourly data cannot be expected unless the PTT is located above 75 degrees latitude. The number of successful data transmissions per satellite pass will increase with a decrease in the repetition rate.

More detailed information regarding Service Argos and satellite coverage is available from Service Argos. On the Web, see http://www.argosinc.com/. The Service Argos North American office can be contacted by email at useroffice@argosinc.com or phone (301) 925-4411.

http://www.cls.fr/html/argos/welcome_en.html

5. Antenna Placement

The position of polar orbiting satellites relative to the PTT will change during the satellite pass and with each satellite pass. The antenna must broadcast evenly to all areas of the sky. The antenna is omnidirectional. Mount the antenna vertically. Choose a location with a clear view of the sky in all directions. Any obstruction between the PTT antenna and the sky can block data transmission between the satellite and the PTT.

Campbell Scientific Companies

Campbell Scientific, Inc. (CSI)
815 West 1800 North
Logan, Utah 84321
UNITED STATES
www.campbellsci.com
info@campbellsci.com

Campbell Scientific Africa Pty. Ltd. (CSAf)
PO Box 2450
Somerset West 7129
SOUTH AFRICA
www.csafrica.co.za
cleroux@csafrica.co.za

Campbell Scientific Australia Pty. Ltd. (CSA)
PO Box 444
Thuringowa Central
QLD 4812 AUSTRALIA
www.campbellsci.com.au
info@campbellsci.com.au

Campbell Scientific do Brazil Ltda. (CSB)
Rua Luisa Crapsi Orsi, 15 Butantã
CEP: 005543-000 São Paulo SP BRAZIL
www.campbellsci.com.br
suporte@campbellsci.com.br

Campbell Scientific Canada Corp. (CSC)
11564 - 149th Street NW
Edmonton, Alberta T5M 1W7
CANADA
www.campbellsci.ca
dataloggers@campbellsci.ca

Campbell Scientific Ltd. (CSL)
Campbell Park
80 Hathern Road
Shepshed, Loughborough LE12 9GX
UNITED KINGDOM
www.campbellsci.co.uk
sales@campbellsci.co.uk

Campbell Scientific Ltd. (France)
Miniparc du Verger - Bat. H
1, rue de Terre Neuve - Les Ulis
91967 COURTABOEUF CEDEX
FRANCE
www.campbellsci.fr
info@campbellsci.fr

Campbell Scientific Spain, S. L.
Psg. Font 14, local 8
08013 Barcelona
SPAIN
www.campbellsci.es
info@campbellsci.es

Please visit www.campbellsci.com to obtain contact information for your local US or International representative.