



COM9602 Short Burst Data Modem

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Precautions

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.ca or by telephoning (780) 454-2505 (Canada). 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 personnel (e.g. 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.
- Use only qualified personnel for installation, use, and maintenance of tripods and towers, and any attachments to tripods and towers. The use of licensed and qualified contractors is highly recommended.
- Read all applicable instructions carefully and understand procedures thoroughly before beginning work.
- Wear a **hardhat** and **eye protection**, and take **other appropriate safety precautions** while working on or around tripods and towers.
- **Do not climb** tripods or towers at any time, and prohibit climbing by other persons. Take reasonable precautions to secure tripod and tower sites from trespassers.
- Use only manufacturer recommended parts, materials, and tools.

Utility and Electrical

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

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 CLIENT ASSUMES ALL RISK FROM ANY INJURY RESULTING FROM IMPROPER INSTALLATION, USE, OR MAINTENANCE OF TRIPODS, TOWERS, OR ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC.

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COM9602 Short Burst Data Modem

1. Introduction

The COM9602 modem enables the remote transmission of Short Burst Data (SBD) messages via the Iridium network and the Internet. The COM9602 supports machine to machine (M2M) services and does not use a SIM card. Each data message from the remote system is sent as an email to a specified address.

In most applications there will be a need for automated data retrieval, which requires the transfer of email data to a database. Campbell Scientific Data Services offers customized solutions to assist with the collection, hosting, storage, and processing of Short Burst Data with the goals of simplifying the process for the client and providing ongoing support.

Before using the COM9602, please study

- Section 2, *Cautionary Statements*
- Section 3, *Initial Inspection*

2. Cautionary Statements

- READ AND UNDERSTAND the Precautions section at the front of this manual.
- Due to the potential complexity of the COM9602 related programming and the implications of remote installations, it is recommended that any programming and hardware configurations be tested prior to deployment.
- Care should be taken when opening the shipping package to not damage or cut the cable jacket. If damage to the cable is suspected, consult a Campbell Scientific Measurement Consultant.
- Although the COM9602 is rugged, it should be handled as a precision scientific instrument.
- The black outer jacket of the cable is Santoprene® rubber. This compound was chosen for its resistance to temperature extremes, moisture, and UV degradation. However, this jacket will support combustion in the air. It is rated as slow burning when tested according to U.L. 94 H.B. and will pass FMVSS302. Local fire codes may preclude its use inside buildings.

3. Initial Inspection

- The COM9602 Short Burst Data Modem & Interface Kit ships with the L18663 null modem cable, L17855 interface cable, C2626 right angle coax adapter connector, SAF5350A antenna, L30626 antenna mount and C2945 power & control cable.
- Upon receipt of the COM9602, inspect the packaging and contents for damage. File any claims with the shipping company. Contact Campbell Scientific to facilitate repair or replacement.
- Immediately check package contents against shipping documentation. Thoroughly check all packaging material for product that may be trapped inside. Contact Campbell Scientific immediately about any discrepancies. Model numbers are found on each product. On cables, the model number is often found at the connection end of the cable. Check the correct lengths of cables are received.

4. Overview

The Iridium satellite network consists of a constellation of 66 satellites situated in 6 planes in low-earth orbit. Each plane is populated by 11 satellites in polar orbits, giving the Iridium network excellent coverage in high latitudes that equatorial satellites often cannot reach.

Iridium provides 5 different services: dial-up data, Short Burst Data (SBD), Short Messaging Service (SMS), Internet Connection, and Router Based Unrestricted Digital Internetworking Connectivity Solution (RUDICS). For the purposes of this manual we will discuss Short Burst Data (SBD). However, while other services may not be directly relevant to datalogger operations, the end user may find them valuable. Please contact Campbell Scientific (Canada) with questions on these methods.

Their relatively low altitude (780 km) means that they are situated close to transmitting modems and therefore require less transmission energy. Additionally, the Iridium network consists of 66 satellites in eleven planes with an extra 6 satellite reserved as backups. This redundancy potentially gives the Iridium system excellent reliability versus other systems that rely on two or three satellites.

4.1 Data Services

Campbell Scientific Data Services offers customized solutions to assist with collection, hosting, storage, and processing of data with the goals of simplifying the process for the client and providing ongoing support.

For Short Burst Data (COM9602), the available services include a detailed analysis of the client's expected data values and volume (collection frequency). The goal of this analysis would be to identify the best (satellite carrier) plan that matches the data the client is expected to send from the device. Once the proper plan has been selected, all the Data Services department needs to begin collection of data is the international mobile equipment identity (IMEI) code from the device. Once the IMEI code has been registered on the satellite carrier's system, the Data Services' standard offerings (see below) can begin shortly thereafter.

Standard Data Services offerings:

- On-going monitoring of device health and communications
- Access to the received messages in near real-time through secure FTP

Additional Services:

- Development of a website to display data that can be accessible from any internet connection (including mobile devices)
- Development of customized website
- Applying simple or advanced quality checks on the received data
- Creating alarm triggers which will automatically email a preset list of recipients when the specific condition occurs in the data
- Email delivery of received messages on a pre-determined schedule (i.e. weekly)

For additional support and information regarding Data Services, please contact:

dataservices@campbellsci.ca

Or visit

<https://www.campbellsci.ca/data-services>.

4.2 Modem and Accessories

The COM9602 modem enables short burst data (SBD) message transmission from a remote Campbell Scientific datalogger via the Iridium network and the Internet.

The COM9602 provides an RS-232 port for communication along with a power and control terminals. The COM9602 can be connected to the datalogger's RS-232, CS I/O, or COM Port. When possible, the

recommended connection of the modem to a datalogger is via a COM Port. All datalogger connections require appropriate cabling and interface accessories (see Table 6-1).

The antenna used for the COM9602 is fixed mast antenna, pn SAF5350A. For best signal reception, the antenna should be mounted so that it has an unobstructed view of the sky and the horizon. Reception quality changes as satellites move overhead; therefore, it is critical that the view be clear. See Section 7 *Troubleshooting*, for information about checking signal quality.

Table 4-1 COM9602 Modem & Interface Kit Equipment List
COM9602 Short Burst Data Modem
L18663 Null Modem Cable (1 ft lead)
L17855 9-pin Male DTE to bare leads
SAF5350A Antenna
Antenna Cable – See Options
L30626 Antenna Mount
C2626 Right Angle SMA Adaptor
C2945 Power & Control Cable
Options
LMR240-16 Antenna Cable for SAF5350A
LMR240-30 Antenna Cable for SAF5350A
LMR240-50 Antenna Cable for SAF5350A
SC932A with L10873 & SC12 (only required if using CSI/O port of datalogger)

5. Specifications

Power Supply	
Operating:	9-18 VDC, 12 VDC nominal <1 mA (quiescent), 45 mA (average idle) 190 mA (average SBD message transfer) 1.5 A (peak transmit)
Operating Temperature:	-40°C to +70°C
Operating Humidity Range:	≤ 75%
Maximum Message Length:	340 bytes (per transmission burst)
Delivery Format:	Email
Control Input Voltage	
Guaranteed ≤ Off:	< 1.25 volts
Guaranteed ≤ On:	> 3.24 volts
Maximum Voltage:	18 VDC
Mechanical	
Length:	201 mm (with mounting ears)
Length:	170mm (without mounting ears)
Width:	38 mm
Weight:	476 g
Compliance:	EMC standard EN61326-1:2013, RoHs standard EN50581:2012.

6. Installation

6.1 Antenna

Note Do not connect power to the modem until installation is complete, as damage to the equipment may occur.

The antenna used for the COM9602 is the SAF5350A mast mount antenna. For best signal reception, the antenna should be mounted so that it has an unobstructed view of the sky and horizon. Reception quality changes as satellites move overhead, so it is critical that the view be clear. See Section 7 for information about checking signal quality.

This installation does not have to precede the modem installation. It should be conducted in the most convenient and logical order.

The installation of the antenna and cable should begin by feeding the antenna cable through the nut, then spacer, and finally antenna mount (Figure 6-1). Next, loosen the 4 Phillips screws at the base of the antenna and separate the two pieces. Feed the antenna cable through the bottom half and secure the cable in place, reattach the bottom half of the antenna and secure the 4 Phillips screws. Be sure to use the alignment notches on the two halves before securing the antenna together.



Figure 6-1 Antenna, Mount, and Cable

Thread the antenna onto the $\frac{3}{4}$ inch supplied nut, being sure not to cross the threads (Figure 6-2).



Figure 6-2 Antenna Attached to Mount

For ease of installation, the C2626 right angle SMA adaptor is used between the COM9602 antenna connector and the SAF5350A antenna cable.

6.2 Modem

The modem installation should employ the following steps:

1. Secure the COM9602 interface in the enclosure in appropriate location. Keep in mind all cable runs (i.e. antenna, power/control, and interface).
2. Connect the antenna cable to the “Antenna” connector of the modem. Use the C2626 right angle adaptor between the antenna cable and modem to reduce cable strain.
3. Connect the L17855 cable between the COM9602 data port and the datalogger COM Port. Refer to Table 6-1 for connection details. If you are using datalogger’s CS I/O port refer to the manual for the appropriate interface device or cable.
4. Connect the bare leads of the COM9602 power and control terminal to the to datalogger and power supply. Start your connections with the power control leads. Be sure to power off at the power supply when making these connections.

Once all the items are attached, power can be applied to the modem.

6.3 Datalogger Configuration

Note

In order to ensure the proper operation and transmission of data, the example programming included in Section 6.6 must be integrated into the application datalogger program. Please refer to Section 6.6 for details.

To ensure proper communication with the COM9602, it is necessary to configure the datalogger. This can be done via the Device Configuration Utility. Follow the instructions provided to connect to the datalogger.

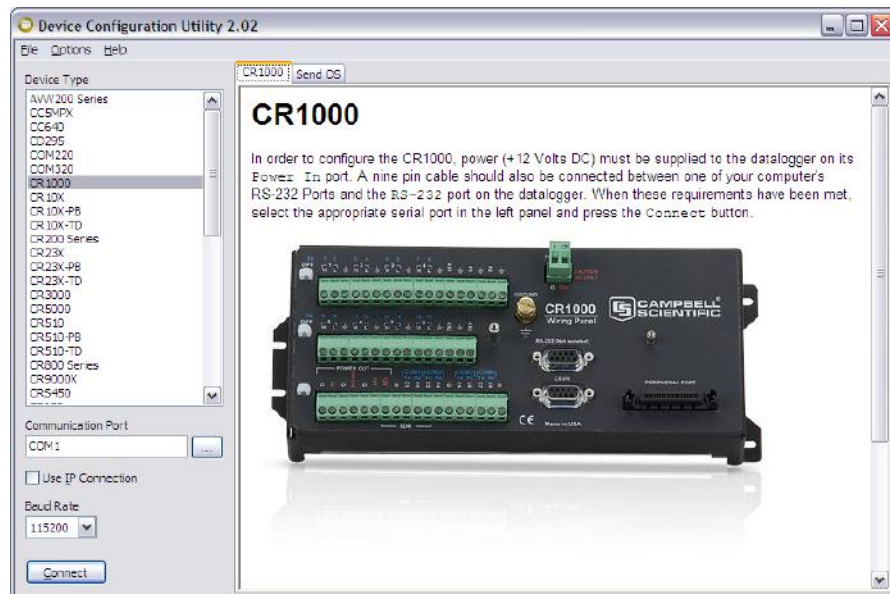


Figure 6-3 Device Configuration Utility

Select the File Control tab once connected to the datalogger. Click the Send button, select and then open both the datalogger program and the appropriate Include file (i.e. COM9602_Sub_str_Enc.CR1) in the CPU drive.

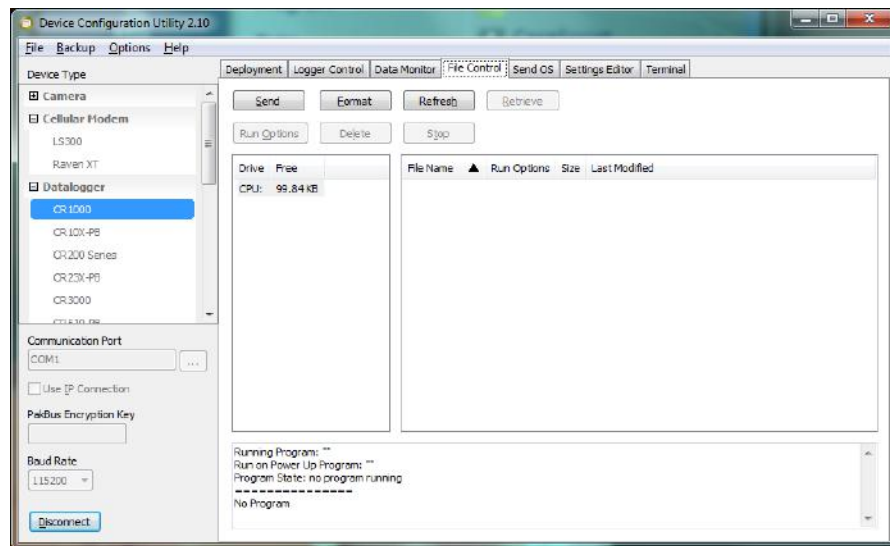


Figure 6-4 File Control Tab

Once both files are located on the CPU, right click the datalogger program, select Run Options and check both the "Run Now" and "Run on Power Up" boxes, click OK.

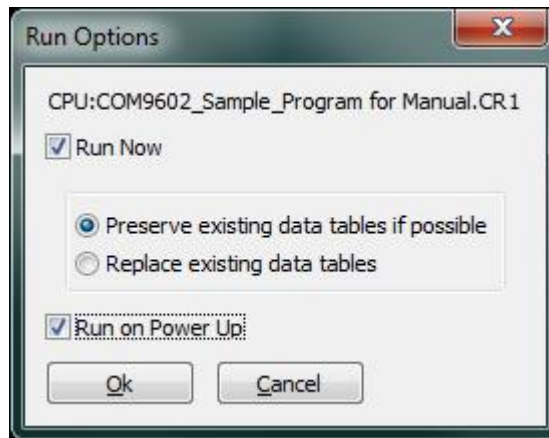


Figure 6-5 Run Options

The datalogger will compile the programming to confirm its operation. Once the compile is complete, click OK in the dialogue box.

Note

You may receive a compile warning related to USR memory size. This warning should be automatically resolved once the programming starts to populate related data tables.

It is possible to view data and the results of an SBD transmission in the DataMonitor tab. Whenever possible, it is recommended to confirm a data transmission before leaving the site. The result of a SBD transmission can be confirmed by Public variable “COM9602_ResultString”. A successful transmission will be noted as:

“Successful Transmission SS=X Retries=Y” where SS=Signal Strength (0-5 range) and Retries=number of transmission attempts (range 1-5)

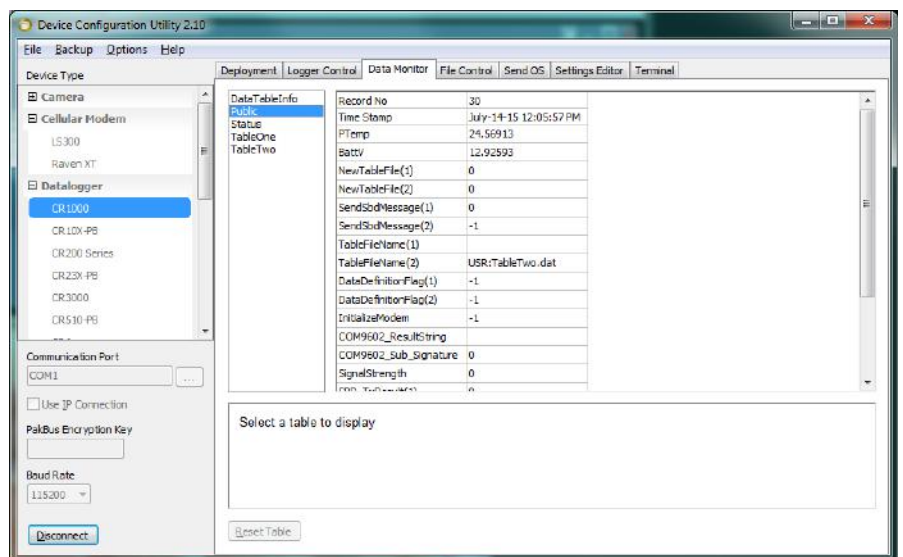


Figure 6-6 Data Monitor Tab

Once these and any other tasks are complete, you can disconnect from the datalogger and close the DevConfig software.

6.4 Datalogger Wiring

Note Be sure that the SAF5350A antenna is connected to either of the modems before applying power, as damage to the equipment may occur.

The recommended connection of the remote modem to dataloggers, when possible is via an available COM port. It is possible for a COM9602 to communicate with a datalogger via either the RS-232 or CSI/O port; however, you will lose the ability to communicate directly on these ports. All datalogger connections will require appropriate cabling and interface accessories (See Table 6-1)

Table 6-1 Campbell Scientific Datalogger Connections			
Description	Hardware/Colour	COM9602	Connection
Antenna SMA Connection		Antenna	Antenna cable via C2626 adapter
Power Control	C2945 White	CTRL	C or U channel
Modem Power	C2945 Red	Power	12V (from datalogger or direct to station power supply)
Modem Power	C2945 Black	Power	G (from datalogger or direct to station power supply)
Communication Option#1 – C or U channel pair	L17855 (DB9M to pigtail cable)	RS-232 DCE	Brown to C1/C3... or U1/3s... White to C2/C4...or U2/U4... Yellow to G
Communication Option#2 – RS-232	L18663 (male-male null modem cable)	RS-232 DCE	9-pin RS-232 port
Communication Option#3 – CS I/O	SC932A (RS-232 DCE interface)	RS-232 DCE	“Datalogger” side CS I/O port via black SC12 cable “DCE Device” side to COM9602 via grey L10873 cable

6.5 Power Control

The datalogger will be used to control power to the COM9602 by using the 5Vdc trigger from a control port or U channel (ex. C1: white wire). It is possible to power the modem from the datalogger; however, it is recommended that a separate power source be used for the modem to avoid loss of data in case of power failure. The COM9602 must draw power directly from a 12 VDC power supply (power + Red, power - Black).

6.6 Programming

The program example and related Include file (i.e. COM9602 CR1000_Sub_str_Enc.CR1) are required to send data from a Campbell Scientific datalogger via the COM9602 Short Burst Data modem.

Programming elements that require configuration:

- Configure the "SBDComPort" Constant. This will tell the datalogger which communication port to use. The default setting is COM1. It is possible to use the RS-232 or CS I/O port; however, once one of these ports is configured, it will affect the ability to directly communicate with the datalogger.
- Configure the "NumberDataTables" Constant to the number of required data tables for the application. Typically for Short Burst Data, hourly and daily data is preferred. This suggests 2 data tables are sufficient.
- Configure the "DataInterval" instruction for each data table.
- Configure the "TableFile" instruction for each data table. Be sure to select Binary (TOB1/Header/TimeStamp) data as part of the configuration of the "TableFile" instruction.
It is recommended to use Binary outputs whenever possible to reduce the data table size for a transmission and the related cost. This feature is configured in the "TableFile" instruction for each data table.
- Configure a "CallTable" instruction for each data table that will be transmitted via SBD.
- Configure the Control port used for the COM9602 power control. The default setting is C3. This configuration must be set in 5 separate instructions: "PortsConfig" and "WriteIO" (4).

Programming Notes:

- Do not use a data table interval faster than 5 minutes. For example, if you have 2 data tables, the minimum data interval should be 10 minutes.
- Be sure to maintain the slow sequence related to checking of new data files.
The COM9602_Sub_str_Enc.CR1 include file is available from the Campbell Scientific Canada ResourceDVD or for download from the web: <http://www.campbellsci.ca/downloads>
- The program is configured to transmit data table definition information once a new program starts.
- Please reference literature related to integrated equipment for programming details.
- When building and testing an application program, be sure not to transmit data via the COM9602 until finalized, as this will be counted against your account.


```

'CR1000 Series Datalogger

'This is a sample program that sends data from the COM9602 Satellite communication
module
'A flag exists that transmits data table definition information once after a new
program
'starts.

'Data for reference/Test
Public PTemp, BattV,

Units PTemp = Degree C
Units BattV = V

'serial port for communications
Const SBDCOMPort = COM1

'Define how many data tables are to be sent using SBD communications
Const NumberDataTables=2

'Require a variable for when a new DataTable file for transmission is created
Public NewTableFile(NumberDataTables) As Boolean
Public SendSbdMessage(NumberDataTables) As Boolean

'Require strings for the unique file names associated with the data table files
Public TableFileName(NumberDataTables) As String * 40

'used to send complete data definition information
'Normally sent once after the program starts
Public DataDefinitionFlag(NumberDataTables) As Boolean

'A flag that will perform an initialization on the Modem to disable handshaking
Public InitializeModem As Boolean

Public SBD_TestTransmissionFlag As Boolean

'This public text from the COM9602 subroutine can be viewed or stored for
diagnostics.
Public COM9602_ResultString As String *50

Dim DataTableCount As Long
Dim cntr2 As Long

'Hourly Data Table
'This is Table "1"
DataTable (TableOne,1,-1)
  DataInterval (0,60,Min,0)
  TableFile ("USR:TableOne",1,0,1,0,0,NewTableFile(1),TableFileName(1))
  Minimum (1,BattV,FP2,0,False)
  Sample (1,PTemp,FP2)
EndTable

'Daily Data Table
'This is Table "2"
DataTable (TableTwo,1,-1)
  DataInterval (0,1440,Min,0)
  TableFile ("USR:TableTwo",1,0,1,0,0,NewTableFile(2),TableFileName(2))
  Minimum (1,BattV,FP2,0,False)
  Sample (1,PTemp,FP2)
EndTable

Include "CPU:Com9602 CR1000_Sub_str_Enc.CR1"

BeginProg
'A USR Drive is required for the COM9602 subroutine to store some temporary files.
SetStatus ("USRDriveSize",32768)

'Setup communication port for the COM9602

```

```

SerialOpen (SBDComPort,19200,3,0,400)

DataDefinitionFlag(1) = True
DataDefinitionFlag(2) = True

'Perform modem initialization
InitializeModem = True

'Configure the power control port for the COM9602 as an output
'Set C3 as output
PortsConfig (&B100,&B100)

Scan (5,Sec,0,0)
    PanelTemp (PTemp,250)
    Battery (BattV)

    For DataTableCount=1 To NumberDataTables Step 1
        If NewTableFile(DataTableCount)=True Then
            SendSbdMessage(DataTableCount)=True
            NewTableFile(DataTableCount)=False
        EndIf
    Next DataTableCount

    'Must call the data tables
    CallTable TableOne
    CallTable TableTwo

NextScan

SlowSequence

Scan(60,sec,0,0)

If SBD_TestTransmissionFlag = True Then

    'Set Flag false so that only one test transmission is sent
    SBD_TestTransmissionFlag = False

    'Turn on power
    WriteIO (&B100,&B100)
    'wait for warmup
    Delay(1,2,sec)

    'Call the test subroutine
    Call SBD_TestTransmission(SBDComPort,COM9602_ResultString)

    Delay(1,1,sec)
    WriteIO (&B100,&B000)
    'Must delay 1 second for modem to power off fully
    Delay(1,2,sec)
EndIf

'The following Checks if there is a new data file created from all required
outputs
'If a new data output exists, call a subrouting to prepare the data and tansmit
it.
For cntr2=1 To NumberDataTables Step 1
    If SendSbdMessage(cntr2) Then
        'Power on the Modem according to the channel using C3
        WriteIO (&B100,&B100)
        'wait for warmup
        Delay(1,2,sec)

        Call SendSBD(SBDComPort,TableFileName(cntr2), cntr2, InitializeModem,
DataDefinitionFlag(cntr2), COM9602_ResultString)
        'Power off the Modem
        'Using C3

```

```

        'wait for shutdown
        Delay(1,1,sec)
        WriteIO (&B100,&B000)
        'Must delay 1 second for modem to power off fully
        Delay(1,2,sec)
        SendSbdMessage(cntr2) = False
    EndIf
Next cntr2
NextScan
EndProg

```

No ongoing maintenance is required.

7. Troubleshooting

Problem: Communication is not working or data is not being transmitted.

Solution 1: Confirm that the COM9602 wiring and cabling is configured as required for your application. If you are using a communication interface between the datalogger and the COM9602, be sure that it is installed as per the related literature. Also, be sure that the datalogger configuration and programming are correct, as per the manual.

Solution 2: Confirm that the baud rate of the COM9602 is set to 19200 by prompting a response using DevConfig terminal emulator. Configure the emulator to 19200 baud. Once the connection is open, enter command:

AT+I4

The modem should response with:

IRIDIUM 9600 Family

If you receive this response, the baud rate has been confirmed as 19200. Please contact Campbell Scientific for further troubleshooting steps.

If you did not receive the expected response, it suggests that the COM9602 baud rate has changed. Through an iterative process, you need to try and determine the baud rate of the modem with the terminal emulator. Change the baud rate configuration of the emulatory and retry the AT14 command until your receive the “IRIDIUM 9600 Family” response. Once the baud rate is confirmed, you need to change it to 19200 baud with the command:

AT+IPR6

Confirm that the baud rate has been corrected with the AT14 command. Be sure to change the baud rate of the emulator back to 19200 baud prior to trying this confirmation.

Problem: Intermittent successful connections from the remote station. The signal strength is weak.

Solution: The antenna may not have a complete 180° view of the sky. Some objects and debris such as snow and trees can interfere with

communications. Make sure that there are no obstructions to the antenna when installing. You may need to reposition or elevate your antenna to obtain the best reception.

The Signal Quality AT command can be used to confirm signal strength during the installation/repositioning of the antenna. This requires the use of a laptop connected to the COM9602 and a terminal emulator. Once the terminal emulator is connected, the following command can be entered to check signal strength:

AT+CSQ

The modem should return a value between 0 and 5 within 10 seconds. Attempt to get the largest value during your installation/repositioning.

The main goal is to install the antenna so it is in a position to capture as much of the sky as possible. This may require increasing the height (in a forest or above other obstructions) of antenna installation. Since Iridium satellites are not geostationary, they pass over your site at different longitudes. During one pass your antenna may have a perfect view of the satellites, whereas during another pass, it may not be as good (if there are obstructions). This could result in some loss of data. The datalogger will automatically retry the transmission up to five times if necessary.

Appendix A. CSC EU Declaration of Conformity

EU Declaration of Conformity

Manufacturer: Campbell Scientific (Canada) Corp.

Address: 14532 - 131 Avenue NW,
Edmonton, Alberta,
T5L 4X4, Canada

This declaration of conformity is issued under the sole responsibility of the manufacturer.

Object of declaration:

COM9602 – Iridium 9602 Short Burst Data Modem

The object of the declaration described above is in conformity with Directives:

RoHS Directive 2011/65/EU
EMC Directive 2004/108/EC

Standards used to which conformity is declared:

EN 50581:2012 Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

EN 61326:1:2013 Electrical equipment for measurement, control and laboratory use – EMC requirements

Signed for and on behalf of:



Brian Day, President / CEO
Edmonton, August 28th 2015

