INSTRUCTION MANUAL

SC105 9-Pin to RS-232-DCE Interface

Revision: 8/10

Warranty and Assistance

The **SC105 9-PIN TO RS-232-DCE INTERFACE** 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

For all returns, the customer must fill out a "Declaration of Hazardous Material 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 435-750-9579. Campbell Scientific will not 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.

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FIGURE 1. SC105 9-Pin to RS-232-DCE Interface

1. General Description

The SC105 (Figure 1) is used to interface a CSI datalogger to any modem that is configured with an RS-232 DCE (Data Communications Equipment) serial port. The SC105 is an intelligent interface that buffers data (1k buffer size), allowing many RS-232 data rates, and all CS I/O port modes.

Features include:

- True RS-232 signal levels.
- Power for the SC105 is supplied from the 5 V supply on pin 1 of the datalogger's I/O port. The SC105 will use the 5 V supply to power the RS-232 modem if needed.
- Two way (interactive) communication.
- Supports most RS-232 baud rates.
- Supports all CS I/O port modes.

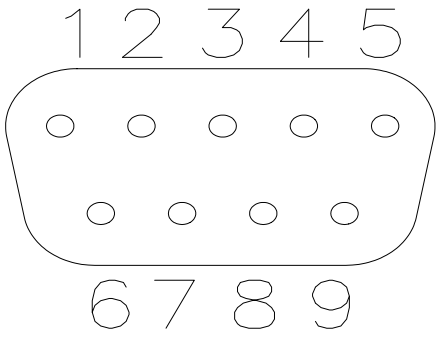
The SC105 is frequently used with a short haul modem to communicate across a dedicated line made of two pairs of twisted wire with a shield. Section 3 describes the details of this application using a short haul modem built by RAD.

The SC105 is also commonly used with satellite transmitters, cellular modems, and spread spectrum radios.

The SC105 also supports one way output or printer communication.

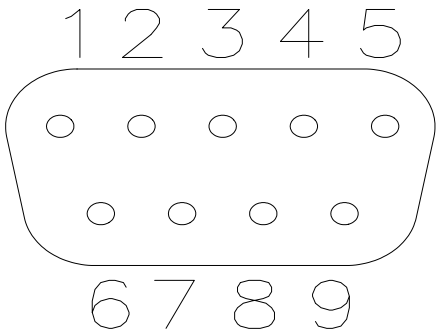
2. Specifications

RS-232 9-Pin Female Connector Pin-out:



Pin No.	I/O	Name	Description
1	In	DCD	Data Carrier Detect (No Connection)
2	In	RXD	Received Data
3	Out	TXD	Transmitted Data
4	Out	DTR	Data Terminal Ready
5		GND	Signal Ground
6	In	DSR	Data Set Ready (No Connection)
7	Out	RTS	Request to Send – Modem Enable
8	In	CTS	Clear to Send
9	In	Ring	Rings Datalogger

CS I/O 9-Pin Male Connector Pin-out:



Pin No.	I/O	Name	Description
1	in	+5V	Regulated 5 Volt supply
2		GND	Ground
3	out	RING	Ring signal to datalogger
4	out	RXD	SC105 transmits on this line
5	in	ME	Modem Enable—must be high for transfer in ME mode
6	in	SDE	Synchronous Device Enable
7	In	CLK/HS	Clock/Handshake (for synchronous communication)
8		+12V	Not Used
9	in	TXD	SC105 receives on this line

RS-232 Baud Rates

The SC105 will support the following baud rates:
1200, 9600, 19200, 38400, 57600, 115200

RS-232 Parity and Data

The SC105 supports the following:
Parity: Even, Odd, None
Data Bits: 7, 8

CS I/O Port Modes:

CSDC, SDC, ME, *Addressed Print Device* for P96 output

Electrical

The SC105 uses power from the +5 V line on the 9-pin interface connected to the datalogger.

Current

Standby: 0.16 mA
Communicating: 1 to 4 mA

Additional current (up to 8 mA) from the 5 V supply may be used by the RS-232 device connected to the SC105.

Physical

Height: 0.9 in (2.3 cm)
Width: 1.6 in (4.1 cm)
Length: 3.5 in (8.9 cm)
Weight: 1.6 oz (45.4 g)

Environmental

Temperature: -25° to +50°C
Humidity: up to 95% non-condensing

3. Set-up Menu

The SC105 has a built-in Set-up Menu for configuring communication mode, CS I/O port configuration, RS-232 port configuration, and other parameters. The Set-up Menu is shown in Figure 2. It is accessed by connecting the SC105's RS-232 port to a PC with the included null modem cable. The SC105 also needs to have power. Usually the SC105 is powered by connecting the SC105's CS I/O port to the CS I/O port of a datalogger.

With the null modem connection to the PC, typically Campbell Scientific's Device Configuration (DevConfig) Utility is used, but a terminal program such as HyperTerminal™ or Procomm™ (always 9600 baud, 8-N-1) can also be used. Press the "Program" button on the SC105 for one second to access the Set-up Menu. Changed settings are saved in flash memory by selecting Apply

in DevConfig or menu item "4" if using HyperTerminal or Procomm. If left idle, the Set-up Menu will time out 60 seconds after the last received character and exit without saving any parameter changes with the message "Set-up Timeout." A datalogger can remain connected to the CS I/O port (to provide power to SC105) while setting SC105 parameters on the RS-232 port, although CS I/O communications would be inactive until exiting the Set-up Menu.

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SC105 - SW Version 2.0

Main Menu:                      Current Configuration

(1) CS I/O Port Configuration   [Modem Enable]

(2) RS-232 Port Configuration   [9600]

(3) Restore Factory Defaults

(4) Save and Exit

(5) Exit w/o Saving Settings

(9) Help



Enter Choice:
```

FIGURE 2. Set-up Menu

3.1 Set-up Menu Selections

1) CS I/O Port Configuration

   An SC105 may be activated either by the Modem Enable signal or by a Synchronous Device (SDC) address (7, 8, or 9).

   If PakBus Networking is being used, SDC address 7 or 8 should be selected.

   Addressed Print Device is a mode that allows output from the datalogger when it executes the P96 instruction.

2) RS-232 Port Configuration

   RS-232 baud rate, data bits, and parity are configured here, as well as the RS-232 Auto Power Down (APD) Mode. The APD mode should be left enabled, unless the attached RS-232 device requires power from the RS-232 lines.

   The DTR and RTS Mode setting allows control over how these two lines behave.

   DTR is on pin 4 of the RS-232 connector; RTS is on pin 7.

'PC/PDA mode': DTR and RTS are both driven to 5 V.

'Modem mode': DTR will be driven to +5 V when the CS I/O interface is active for Modem Enable, SDC Address 9, and Addressed Print Device configurations. When the CS I/O is inactive, DTR will be 0 V.

Additionally, there will be a 'dead time' after DTR is dropped of 2 sec when data coming in on the RS-232 will be ignored.

For SDC Address 7 or 8, DTR will always be driven to +5 V.

RTS will 'key' the data; it will be driven (+5 V) 20 msec prior to data being sent out the RS-232, and remain driven for 5 seconds after the last data is sent out the RS-232.

'Custom mode': This mode is identical to the 'Modem mode', except the delays between RTS HI and data, data and RTS LO, and the 'dead time' are all configurable.

4. Installation

Connect the SC105 to the RS-232 device and to the datalogger with the SC12 9-pin cable (included). If the device has a 25-pin connector, a 9-pin female to 25-pin male adapter is required (CSI PN 15751).

Proper transient protection should be installed to protect the computer and datalogger in areas where damage due to lightning is possible. If this is a RAD modem application, see Section 5.2.

5. RAD Modem Application

The SC105 is frequently used with a short-range modem to communicate across a 4-wire, unconditioned dedicated line. Campbell Scientific offers a kit (PN TBD) that includes the SC105, the 9- to 25-pin adapter (PN 15751), and a mounting bracket (PN 6282). The bracket will mount the RAD, SC105, and adapter to the back plate in a Campbell Scientific enclosure. This section describes using a short-range asynchronous modem built by RAD*.

* SRM - 5A RAD Modem
RAD Data Communications, Inc.
900 Corporate Drive
Mahwah, NJ 07430
Tel: (201) 529-1100
Fax: (201) 529-5777
Email: market@radusa.com
http://www.rad.com

For transmission, the RAD modem uses a cable made of two pairs of twisted wires with a shield. Data rates up to 9600 bps are possible. The low voltage transmission levels minimize cross talk between adjacent lines within the same cable. Data are transmitted and received at a balanced impedance, providing excellent immunity to circuit noise. Table 1 gives the data rate possible for several gage cables across several distances.

TABLE 1. Approximate Range, miles and km

Data Rate Bps	19 Gauge (0.9 mm)		24 Gauge (0.5 mm)		26 Gauge (0.4 mm)	
	miles	km	Miles	km	miles	km
9,600	6.2	10.0	2.8	4.5	2.0	3.3
1,200	7.6	12.2	3.4	5.5	2.5	4.0

5.1 RAD Modem - Two Way

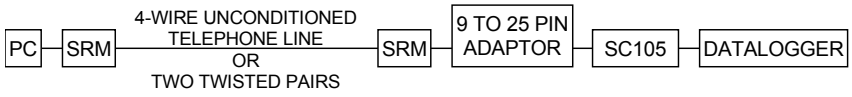

FIGURE 3. Two Way Communication

When using Campbell Scientific's datalogger support software to communicate through the SC105/RAD modem, "Set-up" the link as a direct connect between the datalogger and the desired COM port. Start two way communication using the "Connect" button on the tool bar and the "Connect" button in the "Connect" window.

5.2 RAD Modem Wiring and Grounding

Figure 4 shows a typical set-up of the RAD modems. Installation is as follows:

1. Set the DCE/DTE switch on the back of the RAD modem connected to the SC105 to DCE. For a RAD modem connected to a PC, set the DCE/DTE switch to DCE. For a RAD modem connected to a serial printer, set the DCE/DTE switch to DTE.

2. Select a cable with two or more twisted pairs. A recommended direct burial rodent resistant cable is listed below. They also sell several gopher resistant cables for even greater protection.

Company	Part Number	AWG.
Anixter	F-02P22BPN	22

   Tel: 847-677-2600
   http://www.anixter.com

3. Wiring connections are made as shown in Figure 4. Note wires labeled A and B are one twisted pair of the cable. Wires labeled C and D are the other twisted pair.

4. Transients induced on the communication line may damage any electronics connected at either end of the line. To decrease the chances for damage, spark gaps should be installed as shown in Figure 4. The transient protection shown may be purchased from Campbell Scientific, Inc. (p.n. 5563 shown in Figure 4, p.n. 6536 includes a plastic case, p.n. 6361 includes hardware for mounting to ground lug of CSI enclosures models ENC 10/12, ENC 12/14, or ENC 16/18). Spark gap wiring is straight through such that pin to pin continuity exists between the two modems. If the modems are installed entirely within a building, the transient spark gap protection is probably not needed.

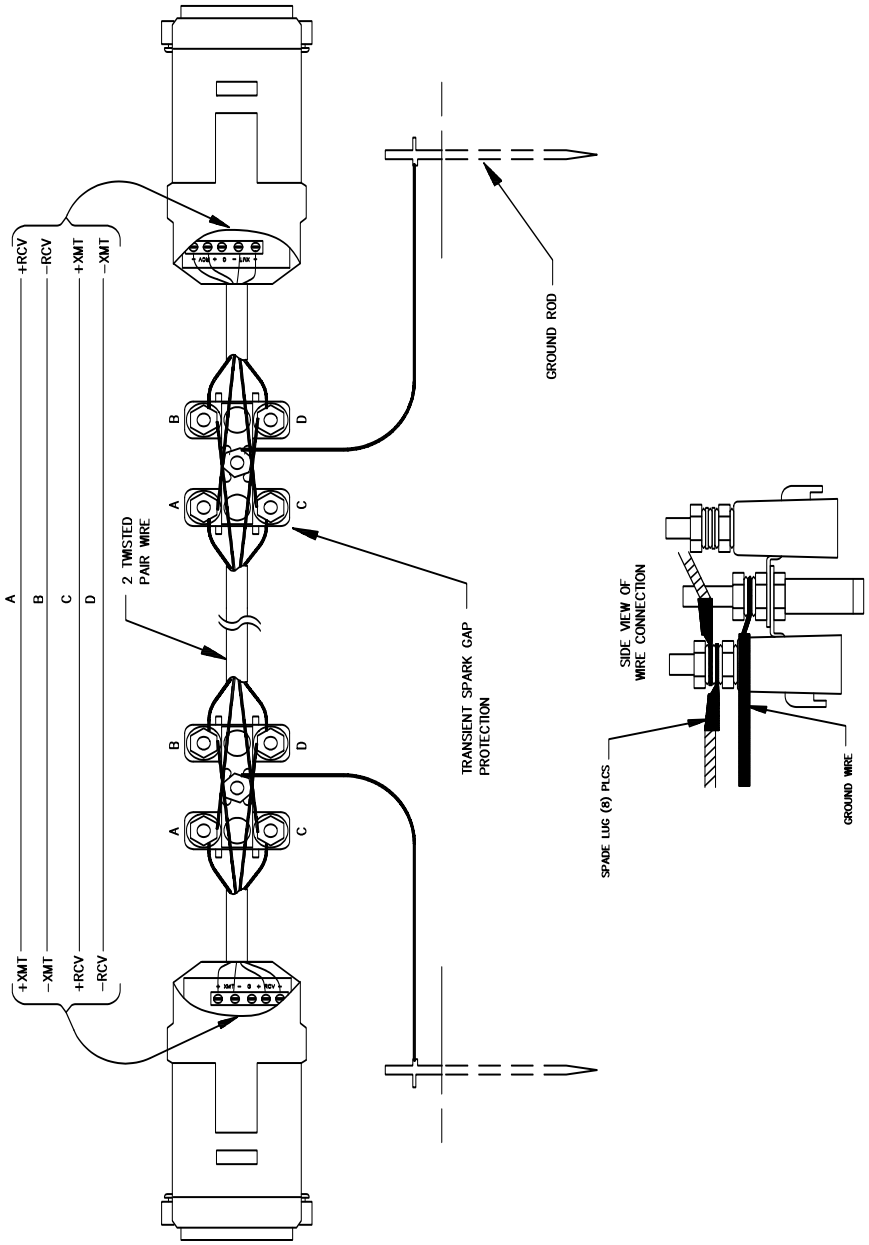

FIGURE 4. Installation of Spark Gap Protection

Occasionally a customer needs to transmit data across longer or smaller gage wires or at higher speeds than can be done with the RAD modem powered by the SC105. RAD does sell a 9-volt power supply that will boost the signals enough to meet some of these more demanding applications. Please contact RAD for more information.

5.3 Testing RAD Modem Communication

The modem communication link is divided into the following three sections: 1) RAD modem computer end, 2) cable from computer modem to datalogger modem, 3) RAD modem datalogger end. When unable to establish communication with the datalogger, test each of the three sections.

Before proceeding through the testing procedures, a terminal emulator software program such as HyperTerminal™ or Campbell Scientific's datalogger support software (Test Terminal Emulator) must be used to communicate through the COM port of the computer. Once the emulator program is set up, testing can proceed as follows:

1. Disconnect the four conductor cables from the SRM-6A RAD modem at the computer end. Jumper the XMT + to RCV + and jumper the XMT - to RCV -. This creates a transmit loop which allows any key pressed at the computer keyboard to be seen on the screen. If the key pressed is not seen, check the following: COM port configuration, 25-pin cable from the computer to the modem and the RAD modem.

2. Reconnect the four conductor cables to the modem at the computer end and disconnect the cable from the modem at the datalogger end. Twist together the XMT + wire and RCV + wire, twist together the XMT - wire and the RCV - wire. Repeat the process of step 1 by pressing a key on the computer keyboard. If the key pressed is not returned, then the cable from the modem at the computer to the datalogger modem is defective and will need to be repaired or replaced.

3. If steps 1 and 2 pass, the modem at the datalogger is suspect. Disconnect the modem from the SC105 and bring the modem to the computer site. Attach the modem to the computer, and repeat step 1 by jumpering the terminals of the modem and pressing a key on the computer keyboard.

If the above tests pass and communication to the datalogger still has not been established, perform tests 4, 5, and 6.

4. A 12 V lead acid battery supply should not be discharged below 11.76 V. If this occurs, the batteries will go into a deep discharge state and will need to be replaced. The CR10 will function properly on a battery voltage of 10 to 15 volts. Check the 12 V supply with a voltmeter.

5. On the wiring panel of most Campbell Scientific dataloggers there is a terminal marked 5 V. Check the 5 V supply with a voltmeter. This 5 V supply should be within a tenth of a volt. If not, it would indicate a problem.

6. To verify that the datalogger and its serial I/O port are working, try to access input memory locations using a laptop PC with the SC105 (using a null modem cable connection). Configure the SC105 CS I/O Port to Modem Enable for this test.

7. If test 6 fails, use a CR10KD Keyboard Display to access input locations.

If the datalogger passes tests 4, 5, and 7, but fails test 6, then the SC105 is suspect and will need to be repaired or replaced.

6. CDMA Modem Application

In most modem applications the SC105 can be used with the factory defaults. This sets the SC105 up as modem enable 9600 baud, 8 data bits, Parity None and 1 stop bit. It also sets the DTR dead time to 2 seconds. This dead time is used to prevent characters produce by the modem from waking the datalogger up right after communications has been terminated. The dead time can be adjusted by changing the RS-232 DTR and RTS mode to Custom.

The CS I/O port configuration has several other modes that can be used depending on the operating system used in the datalogger. These other modes offer advantages for some applications. When using the PakBus OS, SDC7 or SDC8 can be used. This allows communications from multiple sources at the same time (for example, CDMA modem, RF400, and CR10KD).

Valid modes by Operating System:

	Modem Enable	SDC 7, SDC 8	SDC 9
Standard OS (Array)	X		X
Table Data OS	X		
PakBus OS	X	X	

7. Freewave Radio Application

Typically, the Freewave Radios will be used in a PakBus network, with PakBus OS dataloggers.

With a PakBus datalogger, the CS I/O port configuration on the SC105 should be set to SDC 7 or SDC 8. The RS-232 baud rate should be set to match the baud rate on the Freewave radios (38.4 k or 115 k are good choices).

If the low power modes of the Freewave radios are to be used, the SC105 DTR and RTS mode setting will need to be configured to compensate for the turn-on latency of the Freewave radio. The radio uses the RTS signal to go in and out of its low power mode. The radio requires a delay from the time that it is brought out of the low power mode and the time it receives data over the RS-232 port.

To do this, the default DTR and RTS mode will have to be changed to Custom with RTS High = 100, and RTS Low = 20. This gives 100 msec between RTS HI and data on the RS-232 port, and 2 seconds between data on the RS-232 port and RTS going LO.

For a detailed Application Note on using Freewave Radios, see PakBus Networking with Freewave Radios. This application note gives complete details on the set-up of the datalogger, the SC105, the Freewave radio, and LoggerNet PC software for this application.

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