

# INSTRUCTION MANUAL



## **Spectra 920** **Spread Spectrum Data Radio/Modem**

January 2007



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**CAMPBELL SCIENTIFIC**  
C A N A D A C O R P .

11564 - 149 street - edmonton - alberta - T5M 1W7  
tel 780.454.2505 fax 780.454.2655

[www.campbellsci.ca](http://www.campbellsci.ca)

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# 1. Introduction

The Spectra 920 is a high-performance, spread-spectrum radio modem capable of high-speed communication over long distances. This document is offered as a supplement to the operating manual provided by the manufacturer of the Spectra 920. Outlined herein is the information required to interface the Spectra 920 modem with a Campbell Scientific datalogger.

## 2. Specifications

### 2.1 Spectra 920 Specifications

Detailed electrical and physical specifications for the Spectra 920 can be found in section 2 of the manufacturer's manual. Listed below are the power consumption characteristics of the Spectra 920.

Sym	Characteristic	Min	Typical	Max	Units
V <sub>CC</sub>	Supply Voltage	8	12	30	V
I <sub>HR</sub>	Maximum Supply Current	1500	1200	500	mA
I <sub>CT0</sub>	*Modem Supply Current at 1mW Transmit	164	182	200	mA
I <sub>CT1</sub>	*Modem Supply Current at 10mW Transmit	175	194	213	mA
I <sub>CT2</sub>	*Modem Supply Current at 100mW Transmit	225	247	269	mA
I <sub>CT3</sub>	*Modem Supply Current at 1W Transmit	398	442	486	mA
V <sub>IL</sub>	Input Low Voltage (Pins 3,4,7)	-12		-6	V
V <sub>IH</sub>	Input High Voltage (Pins 3,4,7)	6		12	V

FIGURE 1. Spectra 920 DC Characteristics

### 2.2 Spectra 920 Power Requirements

- It is recommended that the included AC adapter power the Spectra 920 (if possible). This adapter will provide up to 1200mA of current at 12VDC.
- Where AC power is not available, the Spectra 920 should be powered by a regulated 12VDC power supply that can supply the necessary current, such as the PS100 or CH100 available from Campbell Scientific.
- The Spectra 920 can also be powered by the datalogger's 12V or SW12V terminal. Using the SW12V terminal, the modem can be turned on and off during scheduled transmission intervals to minimize power consumption.

## 3. Hardware Requirements

This section is intended to clarify the equipment required to interface a Spectra 920 radio system with a Campbell Scientific datalogger.

### **3.1 Base Station Requirements**

- PC with available COM port, running Campbell Scientific's Loggernet or PC400 software.
- Spectra 920 radio modem with suitable power supply. (Refer to Section 2.2)
- Antenna. (See section 3.4 for antenna information)
- L10873 interface cable to connect the Spectra 920 to the PC.
- C1995 diagnostic cable (optional but recommended).
- C1996 programming cable (optional but recommended).

### **3.2 Repeater Station Requirements**

- Spectra 920 radio modem with suitable power supply (Refer to Section 2.2)
- Antenna. (See section 3.4 for antenna information)
- Environmental Enclosure, such as the ENC 10/12, ENC 12/14, or ENC 16/18 available from Campbell Scientific.

### **3.3 Datalogger Station Requirements**

- Spectra 920 radio modem with suitable power supply (Refer to Section 2.2)
- Antenna. (See section 3.4 for antenna information)
- Datalogger. The following dataloggers are compatible with the Spectra 920: CR510, CR10(X), CR1000, CR23(X), CR7, CR5000, CR200/205.
- SC105 or SC932A interface – to connect the Spectra 920 modem to the CS I/O port of the CR510, CR10(X), or CR7.
- L14392 Null Modem Cable – to connect the Spectra 920 modem to the RS-232 port of the CR1000, CR23X, CR5000 or CR200/205.

### **3.4 Antenna Options**

Depending on the topology of the installation site and the configuration of the radio system, an antenna must be chosen for the Spectra 920. Contact a Campbell Scientific Applications Technician for help in determining the best antenna for your application, or refer to Section 6 of the manufacturer's manual. The following antennas are available from Campbell Scientific:

- C1993 - 11dB Yagi Directional Antenna with mounting bracket.

- C1994 – 6dB Omni Antenna with mounting bracket.

**IMPORTANT** FCC Regulations allow up to 36 dBi effective radiated power (ERP). Therefore, the sum of the transmitted power (in dBm), the cabling loss, and the antenna gain cannot exceed 36 dBi or it is in violation of FCC rules.

$$1 \text{ mW} = 0 \text{ dBm}$$

$$10 \text{ mW} = 10 \text{ dBm}$$

$$100 \text{ mW} = 20 \text{ dBm}$$

$$1000 \text{ mW} = 30 \text{ dBm}$$

Calculation value as follows:

$$\text{Power setting} = 36 - \text{Antenna Gain} - \text{Cable Loss}$$

For example, when transmitting 1 Watt (30 dBm), the antenna gain cannot exceed  $36 - 30 = 6$  dBi. If an antenna with a gain higher than 6 dBi were to be used, the power setting must be adjusted appropriately.

Microhard Systems Inc. limits the Spectra 920's transmitted power to 100 mW for all units purchased with antennas with gain above 6 dBi.

Please refer to the following Output Power Level table for further information:

Power Setting S108 (dBm)	Approx. Output Power (mW)
0	1
20	100
21	125
22	160
23	200
24	250
25	320
26	400
27	500
28	630
29	800
30	1000

The Output Power Level determines at what power the Spectra 920 transmits. The Spectra 920's sensitive receiver can operate with very low power levels, so it is recommended that the lowest power necessary is used. Using excessive power contributes to unnecessary "RF pollution".

## 4. Modes of Operation

The Spectra-920 modem has two modes of operation; data mode and command mode. Data mode is the normal operating mode of the Spectra 920

and allows the unit to communicate with other Spectra 920 modems. Command mode is used for configuring and programming the modem. The following section outlines how to set the Spectra 920 to either mode. This information will be required when programming the modem, as described in the next section.

## **4.1 Entering Command Mode**

The default mode for the Spectra 920 is data mode. There are three ways to bring the Spectra 920 into command mode.

### **4.1.1. Boot to Command Mode**

Typing 'mhz' during power up time can put Spectra 920 into command mode.

1. Connect a straight through serial cable (L10873) between the DB9 connector and the serial port on your PC.
2. Run any terminal application program such as Hyperterminal.
3. Set the serial port to 9600 baud 8-N-1.
4. Apply power to the unit.
5. While all three RSSI LED's are blinking, type 'mhz' (you have about 5 seconds to do this). The modem should respond with 'OK'.
6. Type 'AT&V' <ENTER>.

### **4.1.2 Escape from Data Mode**

Typing escape sequence '+++ from data mode can also bring the Spectra 920 into command mode if the unit is operating in RS-232 serial mode.

1. Keep the unit running
2. Connect the straight through serial cable (L10873) between the DB9 connector and the serial port on your PC.
3. Run any terminal application program such as Hyperterminal.
4. Set the serial port to the proper baud rate. The port should match the baud rate of the unit.
5. Type '+++', the modem should show "NO CARRIER" "OK".
6. Type 'AT&V' <ENTER>.

### **4.1.3 Force to Command Mode**

The Spectra 920 can also be forced into command mode for two reasons:

- The baud rate setting in the unit is not known

- The unit has been set to RS-485 mode

1. Power off the unit.
2. Connect a straight through serial cable (L10873) between the DB9 connector and the serial port on your PC.
3. Run any terminal application program such as Hyperterminal.
4. Set the serial port to 9600 baud 8-N-1.
5. Press and hold the “CFG” button.
6. Keep holding the “CFG” button while powering on the unit.
7. Release the “CFG” button.
8. Type anything until the unit shows “Ready”.
9. Type ‘AT&V’ <ENTER>.

## **4.2 Programming the Modem**

Once in command mode, a menu will appear showing various parameters for the modem. The Spectra 920 parameters are programmed through a set of AT commands. All command line entries must begin with ‘AT’. The next section (Section 5) outlines the commands that must be entered to program the Spectra 920 modems for use with a Campbell Scientific datalogger.

## **4.3 Returning to Data Mode**

Once the modem has been programmed, the unit should be put back into data mode. Without recycling the power, you can place the modem into Data Mode from command mode either by:

- Issuing the answer command (‘ATA’ <ENTER>).
- Issuing the online command (‘ATO’ <ENTER>).

The modem will now attempt to communicate with other Spectra 920 modems. While in Data Mode, the modem will communicate through the serial port at the baud rate saved in register S102.

# **5. Radio Configuration**

Before the Spectra 920 radios can be used with a Campbell Scientific datalogger, the radio’s operating parameters must be set. This section is intended to allow the user to quickly set-up the Spectra 920 for use with a Campbell Scientific datalogger.



The manufacturer's manual includes a detailed section (Section 4) that describes all of the Spectra 920's parameters. If using the Spectra 920 with another system, please consult the manufacturer's manual.

## **5.1 Radio Programming for Base Station (Master)**

To configure a Spectra 920 modem as a base station, follow the steps below:

1. Attach an antenna to the modem.
2. Connect a straight through serial cable (L10873) between the DB9 connector and the serial port on the PC.
3. Run any terminal application program such as Hyperterminal and set the terminal application's serial port settings to 9600 baud 8-N-1.
4. Apply power to Spectra 920 through plug-in connector, using the included AC adapter.
5. Put the modem into command mode. See Section 4 for details on entering command mode.
6. Configure the unit to Factory Setting 6 by typing 'AT&F6' <enter>. This puts the unit into Master Point-to-Point mode.
7. Change the following parameters:
  - a. Type 'ATS102=7' <ENTER> Sets the baud rate to 9600. If using the CR1000, CR23(X), or CR5000, set the baud rate to 38400 by replacing the 7 with a 3.
  - b. Type 'ATS141=1' <ENTER> ONLY if using a repeater in the network.
  - c. Type 'ATS150=1' <ENTER> to activate quick-sync mode.
8. Type 'AT&W' <ENTER> to store these settings to memory. The modem has now been configured as a base station (Master) with an address of 1.
9. Put the modem into Data Mode by typing 'ATA' (or 'ATO') <ENTER>.

## **5.2 Radio Programming for Repeater Station**

To configure the Spectra 920 modem as a repeater station, follow the steps below:

1. Repeat steps 1-5 as outlined in section 5.1 above.
2. Configure the unit to Factory Setting 7 by typing 'AT&F7' <ENTER>. This puts the unit into Slave Point-to-Point mode.
3. Change the following parameters:

- a. Type 'ATS101=1' <ENTER> to set the modem as a repeater.
  - b. Type 'ATS102=1' <ENTER> to set the baud rate to 115200. This will maximize the data throughput of the repeater regardless of the baud rate of the datalogger.
  - c. Type 'ATS105=2' <ENTER> to set the address of the repeater as 2.
  - d. Type 'ATS118=1' <ENTER> so that the repeater "points" to the previous radio in the network. In this case, the repeater will point back to modem 1 (the Master).
  - e. Type 'ATS143=3' <ENTER> to set the proper sleep mode (sniff mode 1).
  - f. Type 'ATS144=7' <ENTER> to set the sleep time.
  - g. Type 'ATS145=40' <ENTER> to set the awake timeout (in seconds).
  - h. Type 'ATS237=40' <ENTER> to set the sniff duration (in milliseconds).
  - i. Type 'ATS248=40' <ENTER> to set the sync timeout.
4. Type 'AT&W' <ENTER> to store these settings to memory. The modem has now been configured as a repeater with an address of 2.
  5. Put the modem into Data Mode by typing 'ATA' (or 'ATO') <ENTER>.

### **5.3 Radio Programming for Datalogger Site Station (Slave)**

To configure the Spectra 920 modem as a remote station, follow the steps below:

1. Repeat steps 1-5 as outlined in section 5.1 above.
2. Configure the unit to Factory Setting 7 by typing 'AT&F7' <ENTER>. This puts the unit into Slave Point-to-Point mode.
3. Change the following parameters:
  - a. Type 'ATS101=2' <ENTER> to set the modem as a slave.
  - b. Type 'ATS102=7' <ENTER> Sets the baud rate to 9600. If using the CR1000, CR23(X), or CR5000, set the baud rate to 38400 by replacing the 7 with a 3.
  - c. Type 'ATS105=3' <ENTER> to set the address of the repeater as 3.

- d. Type 'ATS118=2' <ENTER> so that the repeater "points" to the previous radio in the network. In this case, the repeater will point back to modem 2 (the Repeater).
  - e. Type 'ATS143=3' <ENTER> to set the proper sleep mode (sniff mode 1).
  - f. Type 'ATS144=7' <ENTER> to set the sleep time.
  - g. Type 'ATS145=40' <ENTER> to set the awake timeout (in seconds).
  - h. Type 'ATS237=40' <ENTER> to set the sniff duration (in milliseconds).
  - i. Type 'ATS248=40' <ENTER> to set the sync timeout.
4. Type 'AT&W' <ENTER> to store these settings to memory. The modem has now been configured as a remote (Slave) with an address of 3.
  5. Put the modem into Data Mode by typing 'ATA' (or 'ATO') <ENTER>.

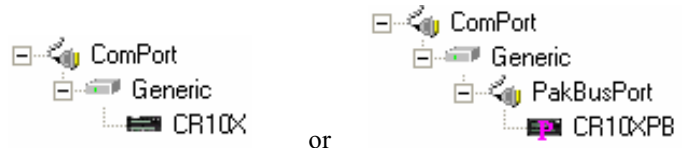
## 6. Software Setup

This section outlines how to build a basic Spectra 920 point-to-point network using Loggernet software.

### 6.1 Loggernet Setup

To setup a Spectra 920 network in Loggernet, follow the steps below:

1. Start Loggernet and open the Setup screen.
2. Select Add Root and add a ComPort.
3. Add a Generic modem to the ComPort.
4. Add a datalogger to the Generic modem.
  - a. If using an array-based datalogger, select it from the list.
  - b. If using a PAKBUS datalogger, add a PAKBUS port and then select the datalogger.



5. On the ComPort page:
  - a. Ensure that the Communications Enabled box is checked.

- b. If using the call back feature, check that box.
  - c. Select the ComPort that is connected to your modem from the drop-down menu.
  - d. Extra Response Time can remain as 0 seconds.
6. On the Generic page:
- a. Ensure that the Communications Enabled box is checked.
  - b. For the CR510, CR10(X), or CR200 dataloggers, set the maximum baud rate to 9600. For the CR23(X), CR1000, and CR5000 dataloggers, set the maximum baud rate to 38400 (when using the RS-232 port).
  - c. Extra Response Time can remain as 0 seconds.
  - d. Under the Modem tab, enter the following dial strings:
    - i. Dial Script: **T"++" D2000 T"ATDT3^M" R"CONNECT"20000**
    - ii. End Script: **D1200 T"++" D1200**
    - iii. Leave the Half Duplex and Raise DTR boxes unchecked.
    - iv. Select "3. The RTS line will be lowered" from the RTS CTS use drop-down box.

**NOTE:** Using the dial string above, Loggernet will attempt to connect to a Spectra 920 radio with an address of 3.

*If there are multiple Spectra 920 Slaves in your network, create a connection for each one, and change the 3 in the dial string to the appropriate address for each station (slave).*

7. On the datalogger page:
- a. Ensure that the Communications Enabled box is checked.
  - b. Ensure that the maximum baud rate matches the baud rate of the Generic modem (if applicable).
  - c. If using a PAKBUS datalogger, ensure that the PAKBUS address is set correctly.
8. Ensure that the settings are saved by clicking the "Apply" button.