

# **COM210 TELEPHONE MODEM INSTRUCTION MANUAL**

**REVISION: 11/02**

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# Warranty and Assistance

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**CAMPBELL SCIENTIFIC, INC.**

RMA# \_\_\_\_\_

815 West 1800 North

Logan, Utah 84321-1784

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Non-warranty products returned for repair should be accompanied by a purchase order to cover the repair.



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# ***COM210 Telephone Modem***

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# ***COM210 Telephone Modem***

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## **1. Introduction**

### **1.1 General Description**

The COM210 Modem is a 9600 baud phone modem employing the Hayes AT command set. Its primary use is as a remote site phone modem connected to a CSI datalogger. The modem is powered and enabled by the battery-powered datalogger. When not active, the COM210 draws less than 120  $\mu$ A from the datalogger's 12 VDC output. The COM210 is a drop in replacement for the COM200.

The COM210 is connected to a CSI datalogger by using a 9-pin subminiature D connector cable. This is the same 9-pin CS I/O connection common to all Campbell Scientific products. This is **not** an RS-232 connection. Appendix B describes the configuration of this connector.

The COM210 can be used as an originate modem at the datalogger site. To originate a call to the computer, the datalogger is programmed using Instruction 97. Instruction 97 is described in detail in the datalogger manual.

The COM210 features a built-in speaker to allow monitoring of calling and connection operations. See Appendix A.3 for the Hayes AT commands that affect the speaker on/off and volume settings.

### **1.2 Computer Requirements**

A Hayes-compatible modem is used at the computer site with Campbell Scientific computer software to call the datalogger attached to the COM210. The computer's modem must be configured to the proper settings using the modem initialization strings listed in the software programs.

## **2. Specifications**

- Bell 212A, CCITT V.22, and CCITT V.32 compatible
- Full duplex at 9600 (default setting) and 1200 baud to datalogger
- V.42 LAPM and MNP2-4 error correction
- Hayes AT command set
- On-board speaker
- RJ-11C telephone jack
- FCC and IC (formerly known as DOC) approval

- Pulse or tone dialing
- Current drain: 120  $\mu$ A quiescent, 160 mA active
- Direct connection to and powered by CSI dataloggers
- Supply requirements: 12 VDC regulated power supply
- Internally switches 12 VDC external power minimizing current drain
- Logic levels: below 1.5 V inputs a low state and above 3.5 V inputs a high state. A low voltage level on the TX data input (pin 9) and RX data output (pin 4) represents a mark
- Operational temperature: -25°C to +50°C standard (Extended operational temperature range of -55°C to +85°C is available at time of purchase.)
- Size: 5.2" x 1.7" x 3.6" // 13.1 x 4.3 x 9.2 cm
- Weight: 0.75 lbs // 0.34 kg

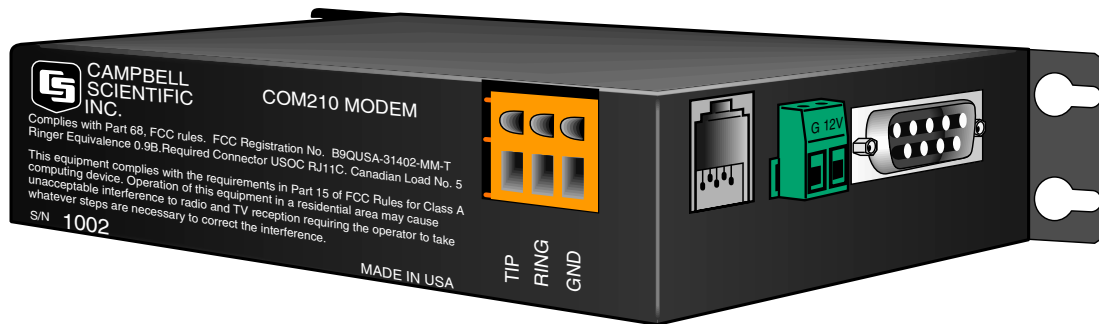


FIGURE 1. COM210

## 3. Installation

The COM210 is designed to be used with standard analog telephone lines. It will not work with a digital telephone line. Connection to telephone-company-provided coin service (central office implemented systems) is prohibited. Connection to party line service is subject to state tariffs.

### 3.1 Connecting to Datalogger

Connect the cable from the telephone RJ11C jack to the modem as shown in Figure 3. If the telephone company has not installed surge protection in the telephone line (no RJ11C jack), one must install surge protection (CSI item number 6362 or 4330) and connect the ring and tip terminal blocks as shown in Figure 2.



Current Campbell Scientific dataloggers provide 12 VDC to the COM210 via the SC12 cable (Figure 2). Older dataloggers do not provide 12 VDC on the datalogger's CS I/O 9 pin connector. When used with the older dataloggers listed in Table 1, 12 VDC and ground need to be connected via the green power connector on the side of the COM210 (see Figure 3).

**Table 1. Dataloggers that Require Direct 12 VDC Connection to COM210**

CR10(X) with silver wiring panel  
 CR10(X) with black CR10 wiring panel (P/N 8032)  
 21X(L)—serial number 13,442 or lower  
 CR500—serial number 1764 or lower  
 CR7—700X serial number 2778 or lower  
 BDR301 and BDR320

## 3.2 Connecting to Earth Ground

Connect the green 14 awg grounding wire (provided with the COM210) to the grounding terminal (GND) on the COM210 and to the enclosure's earth ground connection. If the site does not have a grounded enclosure, then connect the ground wire directly to an earth ground connection. The datalogger ground should also be tied to the earth ground.

### CAUTION

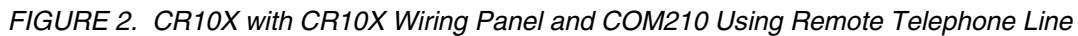
The modem must be grounded for its transient protection to work.

## 3.3 Telephone to MD9 or Telephone to RF Systems

Telephone to MD9 or telephone to radio systems can be utilized for communicating with multiple dataloggers through one telephone line. Nothing additional or special is required for the telephone part of the link. See the MD9 or RF Manuals for complete information on their special requirements.

## 3.4 Telephone Service

The goal of the telephone company is to provide you with the best service it can. In order to do this, it may occasionally be necessary for them to make changes in their equipment, operations, or procedures. If you have any questions about your telephone line, such as how many pieces of equipment you can connect to it, the telephone company will provide this information upon request. If the telephone company requests information concerning the equipment which you have connected to your telephone line, the FCC registration number and the ringer equivalence number (REN) of the COM210 are listed on its label. Additional technical information from the FCC and IC on the COM210 is available in Appendix D and E, respectively.



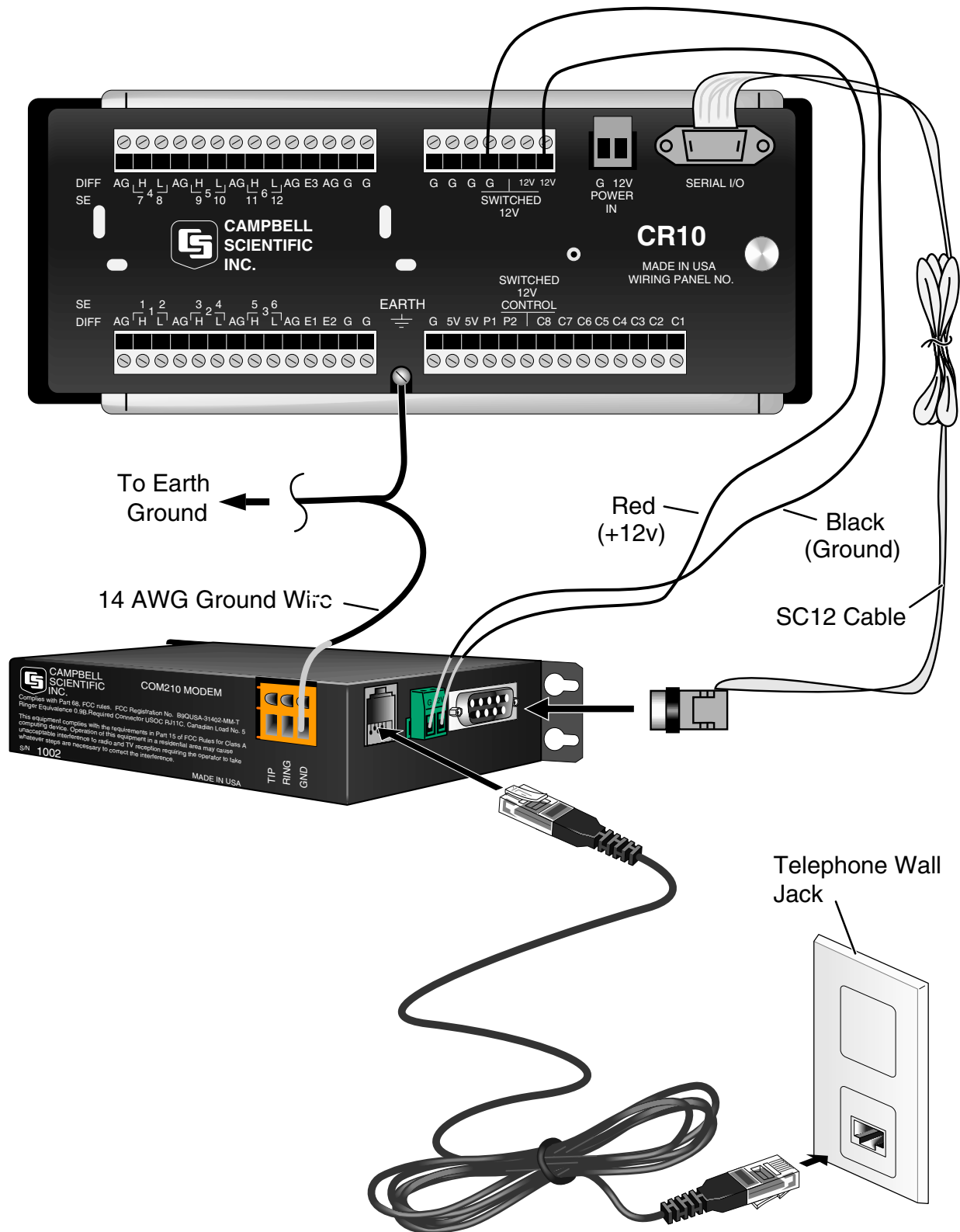


FIGURE 3. CR10X with CR10 Wiring Panel and COM210 Using RJ11C Telephone Jack

## 4. Troubleshooting

When the Campbell Scientific software cannot establish a link to the remote datalogger that is connected to the COM210, check the following:

- 1) Verify the modem initialization settings have been changed for the specific calling modem on the computer. See software manual and/or help screens for more information.
- 2) Verify nothing else is using the same COM port on the computer. Even if a program is minimized in windows, it may have a lock on the COM port. Some notebook computers do not automatically activate the COM ports. Verify the COM port you are using is activated.
- 3) The Campbell Scientific software will display an activity of communication as the link is being established. Assuming the above items are O.K., the software should display in the activity window/screen something such as "ATDT#####". Where the ##### is the telephone number listed in the dialing path of the software for the datalogger you are trying to call.

The local modem attached to the computer will respond back to the computer with result codes showing how the call is progressing. These result codes can be either numeric (0, 1, 2, etc.) or "verbose" ("OK", "CONNECT", "RING", etc.). Prior to PC208W 3.0, our software expected numeric result codes. PC208W 3.0 and newer uses "verbose" result codes to determine call progress. The V command is used to select between numeric or verbose result codes. Depending on the version of PC208W being used, the initialization string for the modem may need to be changed for the appropriate form of result codes. The result code returned may indicate why the call is unsuccessful. Appendix A has a list of possible result codes.

- 4) Can you attach a normal analog telephone to the line and make a call out? If not, contact your local telephone company. If you can make a call out but the connection is poor or faint, contact your local telephone company.
- 5) Verify the COM210 is receiving 12 VDC. If the COM210 is receiving 12 VDC from a separate power supply instead of the datalogger, is the ground of the separate power supply connected to the datalogger's ground?
- 6) Verify the COM210 is the only Modem Enable device connected to the datalogger. Other common Campbell Scientific modem enable devices are the SC32A, some RF modems, and the MD9.
- 7) Verify the datalogger is turned on.

To comply with FCC rules and regulations, all repairs on the COM210 modem **must** be performed by Campbell Scientific, Inc. or an authorized agent of Campbell Scientific, Inc. For assistance in installation, troubleshooting, or for repair, contact Campbell Scientific:

Campbell Scientific, Inc.  
815 West 1800 North  
Logan, Utah 84321-1784  
Telephone: (435) 753-2342  
Fax: (435) 750-9540  
Web site: [www.campbellsci.com](http://www.campbellsci.com)

## 5. Modem Settings in Non-Volatile Memory

The COM210 comes from the factory with the appropriate settings for most applications. It is programmed to answer the call as soon as it detects the call.

One may modify the COM210's settings in non-volatile memory using Hayes AT commands. Appendix A describes the procedures and commands required to make the changes described in this section.

Some of the settings one may change are:

**Disable auto-answer:** This option is used only when the modem is not to answer a call. For example, the COM210 is connected to a telephone line that is to be used part time for voice communication. In this situation it is best to have the datalogger call the computer.

**Speaker On/Off and Volume:** Default settings have the speaker on during call establishment only and set to a low volume. To conserve on current drain during the connection time or so one doesn't hear the speaker, one may turn the speaker completely off. When one wants to hear the speaker better than the default low volume setting, one may change it to a higher volume level.

**Answer on X<sup>th</sup> ring:** This option is used when the modem is sharing a line and you only want it to answer after a specified number of rings. For example, the COM210 is sharing a line with people at an office. It can be programmed to only answer after the third ring. If the PC calls when the office is closed and no one answers the phone after three rings, the datalogger will pick it up.

**Change telephone system types:** Change from the Bell 212A (U.S. and Canada) system to a CCITT V.32 (foreign, 9600 baud) or CCITT V.22 (foreign, 1200 baud) system. This does not mean that the COM210 is tested and approved for all foreign countries.

CCITT is an international consultative committee that sets international communications usage standards. V.32 and V.22 are standards that the COM210 meets.



# ***Appendix A. Modifying the Non-Volatile Memory***

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To modify the COM210's settings, one must communicate directly to the COM210. This may be accomplished by using one of the two methods below.

## **CAUTION**

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Changing any of the modem's settings may result in communication problems. After changing the settings, try the modem locally before installing it at a remote location. To speed problem resolution when contacting Campbell Scientific for support, please inform us of any modem setting changes that have been made.

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## **A.1 Hardware Connection to COM210**

Connect the COM210 to a computer using an SC532A interface (Figure A-1). The computer software (PC208W) used to communicate with the COM210 must set the RS232 RTS line low.

For example, to change the COM210 to answer on the 3<sup>rd</sup> ring, the following commands would be sent to the COM210 through the PC208W terminal emulator (RTS not active on modem hardware configuration):

```
ATS0=3  
AT&W0
```

## **A.2 Remote Communication to the COM210**

To remotely communicate with the COM210, program the datalogger to initiate a call to it using a program similar to the Example Program 1.\* After this program runs once, the modem is now programmed and the actual program one wants to run may now be downloaded to the datalogger.

\*Please note that this program requires that the option code for an RF modem be used instead of the normal phone modem option.

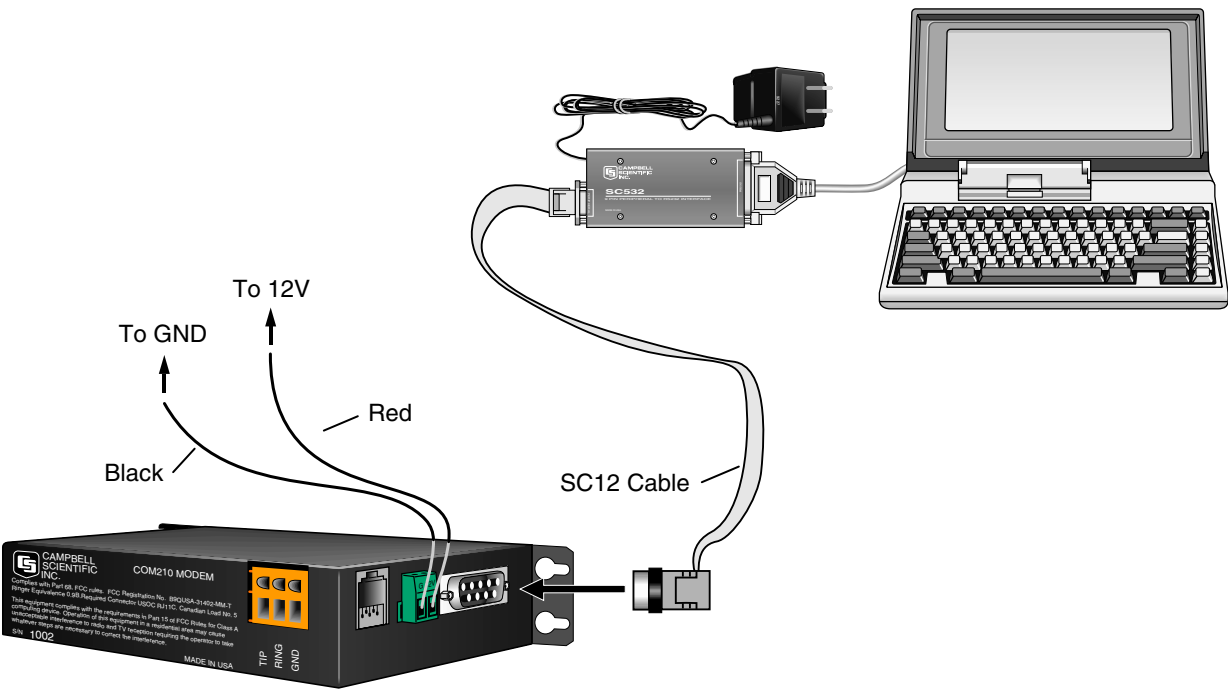


FIGURE A-1. COM210 to Computer Connection

Example Program 1

*Table 1 Program		
01: 1	Execution Interval (seconds)	
1: Initiate Telecommunications (P97)		
1: 02	RF Modem/9600 Baud	
2: 1	Disabled when User Flag 1 is High	
3: 20	Seconds Call Time Limit	
4: 0	Seconds Before Fast Retry	
5: 0	Fast Retries	
6: 0	Minutes before Slow Retry	
7: 1	Failures Loc [ Failure ]	
8: 0	Data Logger ID	
2: Extended Parameters (P63)		
1: 65	Option ;A	
2: 84	Option ;T	
3: 83	Option ;S	
4: 48	Option ;0	
5: 61	Option ;=	
6: 50	Option ;2 results in 3 rings (rings = n + 1)	
7: 38	Option ;&	
8: 87	Option ;W	



**3: Extended Parameters (P63)**

1:	48	Option ;0
2:	68	Option ;D
3:	84	Option ;T
4:	13	Option
5:	00	Option
6:	00	Option
7:	00	Option
8:	00	Option

After sending above program, disconnect from datalogger and wait 30 seconds, allowing program to finish, before connecting again.

## A.3 Hayes AT Command Summary

This manual does not attempt to be a primer on the Hayes AT command set. The commands are, therefore, only summarized below. For most applications, these commands will not need to be used. Except as noted, all commands should begin with an “AT” and end with a carriage return (hit the [Enter] key). There are no “O” as in Oscar commands, only “0” as in Zero commands. All commands must be issued as CAPITAL letters.

### COMMANDS TO CHANGE DEFAULT MODES:

B1 (default)	CCITT V.32 (9600 baud), Bell 212A (1200 baud), and Bell 103 (300 baud)
B0	CCITT V.32 (9600 baud), CCITT V.22 (1200 baud), and CCITT V.21 (300 baud)
L0	Lowest speaker volume
L1 (default)	Low speaker volume
L2	Medium speaker volume
L3	High speaker volume
M0	Speaker always off
M1 (default)	Speaker on during call establishment
M2	Speak on during entire call session
S0=0	Disable Auto Answer
S0=1 (default)	Answer on second ring
S0=2	Answer on third ring
S0=n	Answer on (n + 1) ring. (maximum n is 2)
&F	Restore factory defaults
&W0	Store current profile as Profile to load on power up
&V	Display the current profile to the screen

**RESULT CODES:**

<b>0</b>	OK
1	Connect
2	Ring
3	No Carrier
4	Error
<b>5</b>	Connect 1200 Baud
6	No Dial Tone
7	Busy
8	No Answer
<b>12</b>	Connect 9600 Baud
13	Connect 9600/14400 Baud
17	Connect 9600 Baud

**CAUTION**

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If more than three rings are specified (first P63 parameter 6 > 50), the datalogger may time out before the modem answers; communication will never be established! It is possible in some conditions to allow more than three rings. Consult a Campbell Scientific applications engineer about optimizing modem negotiations before trying this and be sure to try the set up locally before installing at a remote location.

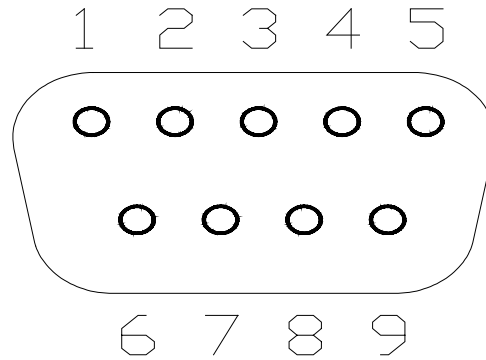
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# ***Appendix B. CS I/O Connection***

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## **B.1 CS I/O 9-Pin Connection**

The pin out of the connector is shown in Figure B-1. The direction of the signal relative to the modem is shown in parenthesis. Unless specified otherwise, all levels are 0 V for logic low, 5 V for logic high.



**FIGURE B-1. CS I/O Pin Out**

1. (input) +5 VDC supply. Not used by COM210.
2. (input) Ground
3. (output) Ring - a logic high signifies a ring signal has been detected
4. (output) RX Data - serial data from COM210
5. (input) Modem Enable - a logic high internally switches power to the modem. A logic low internally shuts off power to the modem.
6. (input) Serial Device Enable - a logic high disables communication with the modem without removing power or changing the modem's mode.
7. (input) SDC clock. Not used by COM210.
8. (input) +12 VDC supply
9. (input) TX Data - serial data to COM210



# ***Appendix C. Theory of Operation***

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## **C.1 Theory of Operation**

The COM210 modem is used to transmit data over bandwidth-limited channels such as telephone lines by modulating audio tones. The COM210 uses various modulation schemes including FSK (Frequency Shift Keying), TCM (Trellis Coded Modulation), QAM (Quadrature Amplitude Modulation), and DPSK (Differential Phase Shift Keying).

The telephone company gives a 40 to 150 VRMS, 20 Hz signal on the telephone lines to signify a ring, which is typically on for two seconds and off for four seconds. The COM210 is supplied with 12 V from the datalogger's CS I/O connector or from the COM210's external power connector. The 12 V is then regulated to +5 V to give power to the ring detect circuitry. The ring detection circuitry is continuously powered but draws less than 2  $\mu$ A. The ring signal is passed on to the datalogger through an opto-coupler. The datalogger responds to a "ring" by raising the Modem Enable line, which internally switches the regulated +5 V supply to the rest of the modem's circuitry.

The modem then answers and remains off-hook until it loses the carrier or the datalogger lowers the Modem Enable line. The datalogger lowers the Modem Enable line by remote command or after 40 seconds in the absence of a command. When the Modem Enable line goes low, the COM210 internally removes the +5 V from the modem circuitry, dropping power to the off-hook relay and thus placing the telephone line on-hook. The COM210's ring circuitry is still powered at this time.

To reject noise common to both telephone lines and to satisfy registration requirements, the modem circuitry is electrically isolated from the telephone lines by using an opto-isolator and a coupling transformer.



## ***Appendix D. FCC Warning to Users of Class A Computing Devices***

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### **WARNING**

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This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a COMMERCIAL ENVIRONMENT. Operation of this equipment in a residential area may cause interference to radio and television reception. The operator must take whatever measures are necessary to correct the interference.

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# ***Appendix E. IC Information***

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## **NOTE**

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Industry Canada (IC) was formerly known as DOC.

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## **CP-01, Issue 8, Part I**

### **Section 14.1**

“NOTICE: The Industry Canada label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements as prescribed in the appropriate Terminal Equipment Technical Requirements document(s). The Department does not guarantee the equipment will operate to the user’s satisfaction.

“Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

“Repairs to certified equipment should be coordinated by a representative designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

“Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

## **CAUTION**

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Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.”

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## **CP-01, Issue 8, Part I**

### **Section 14.2**

“NOTICE: The Ringer Equivalence Number (REN) assigned to each terminal device provides an indication of the maximum number of terminals allowed to be connected to a telephone interface. The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the Ringer Equivalence Numbers of all the devices does not exceed 5.”

