COM310 VOICE COMMUNICATIONS MODEM
INSTRUCTION MANUAL

REVISION: 7/03

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COM310 Voice Communications Modem

1. Introduction

The COM310 is a replacement for the COM300 with added support for certain table-based dataloggers. The COM310 voice-synthesizer modem enables voice capable (see Section 4.3) Campbell Scientific dataloggers to announce by telephone the data stored in input locations, the status of control ports, and the status of user flags. Included is the ability to toggle datalogger ports and flags by telephone. You can call a datalogger site and listen to announcements, or you can program the datalogger to 'call back' your telephone when alarm conditions are met.

The COM310 includes LoggerTalk software for the IBM^{TM} PC and compatibles which provides the tools to create voice code for voice capable dataloggers.

Although the primary function of the COM310 is voice communications, the modem is also capable of *data* communications. In data mode the COM310 supports standard LoggerNet and PC208W functions including datalogger originated callback.

This manual provides information regarding COM310 specifications, installation, and operation. Quick Start (Section 3) is a primer, enabling you to quickly learn the basics of creating voice code, installing it and operating a voice announcement system. Tutorials are available in LoggerTalk helps.

✗ Please read Section 6.3 which explains how to properly connect an earth ground to maximize protection against lightning/electro-static discharge.
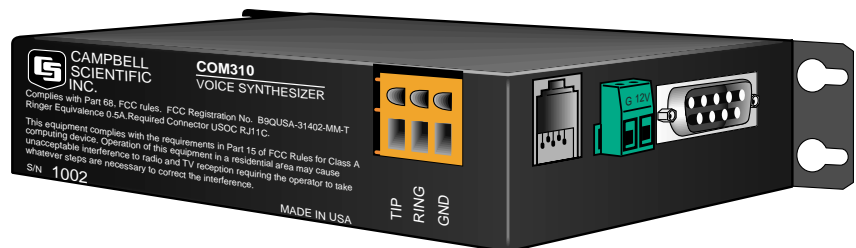

FIGURE 1. COM310 Voice Synthesizer Modem

2. Specifications

- Bell 212A, CCITT V.21, and V.32BIS compatible
- Full duplex at 9600 and 1200 baud to datalogger
- V.42 LAPM and MNP2-4 error detection/correction
- Hayes AT command set
- RJ-11C telephone jack
- FCC and IC (formerly known as DOC) approval
- Pulse or tone dialing
- Power supply voltage requirement: 12 VDC
- Power supply current drain: 100 μA quiescent, 180 mA active
- Internally switches 12 VDC power to minimize current drain
- Connects directly to CS I/O port with many CSI dataloggers (for communications and 12V power)
- 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
- 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

For information regarding the COM310 theory of operation refer to Appendix A of this manual.

3. Quick Start

This section is intended as a primer, helping you to quickly put together a basic COM310 voice communications system in preparation for building your application system. In Quick Start you will need the following hardware and software or the equivalent:

1) COM310
2) LoggerTalk software (included with COM310)
3) SC12 Cable (included with COM310)
4) CR10X, CR23X, CR510 datalogger (or CR10 with UVEPROM)
5) CR10KD (not needed with CR23X)
6) PS512 Power Supply
7) Analog phone line

NOTE Some PBX office phone lines are digital and cannot be used with analog modems such as the COM310.

You will also need:

1) An IBM^{TM} compatible PC with available COM port
2) LoggerNet or PC208W installed
3) SC32B (or A) Interface (not needed with CR23X)

Step 1 – Write "Basic.dld" Test Program

a. Run Edlog (in LoggerNet or PC208W) and input the following program.

```
;{CR10X}
;

*Table 1 Program
  01: 1           Execution Interval (seconds)

1:  Batt Voltage (P10)
  1:   1          Loc [ BATT    ]

2:  Internal Temperature (P17)
  1:   2          Loc [ TEMP    ]

3:  Do (P86)
  1:   10         Set Output Flag High (Flag 0)

4:  Real Time (P77)
  1:   110        Day,Hour/Minute (midnight = 0000)

6:  Sample (P70)
  1:   1          Reps
  2:   2          Loc [ TEMP    ]

7:  Average (P71)
  1:   1          Reps
  2:   1          Loc [ BATT    ]

*Table 2 Program
  02: 0.0000      Execution Interval (seconds)

*Table 3 Subroutines

End Program
```

b. After you have input this program to Edlog, save it with the name "Basic" and Compile to create the BASIC.DLD file.

Step 2 – Create Voice Code and Append It to BASIC.DLD File

a. Install LoggerTalk to your PC
(insert floppy, in Run enter a:\setup <ENTER>)

b. Run LoggerTalk

c. Click on File \ "Open".
Navigate to where BASIC.DLD is located, and Open it.

d. You should now see:
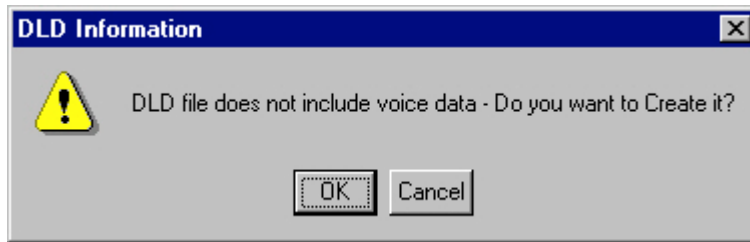
This message appears because BASIC.DLD is still as Edlog created it, with no LoggerTalk code appended to it. Click "OK" to "associate" BASIC.DLD with the voice communications code you are about to create in LoggerTalk. The voice code will be appended to BASIC.DLD later on when you click on "Save Edits." The voice codes will not be visible from Edlog, however, you can open a *.dld file in a text editor such as Notepad® to view them. For a guide to interpreting voice codes that LoggerTalk creates, see Appendix F of this manual. After once saving voice edits to BASIC.DLD, LoggerTalk will no longer display the above screen when opening it.

e. Next you will see:
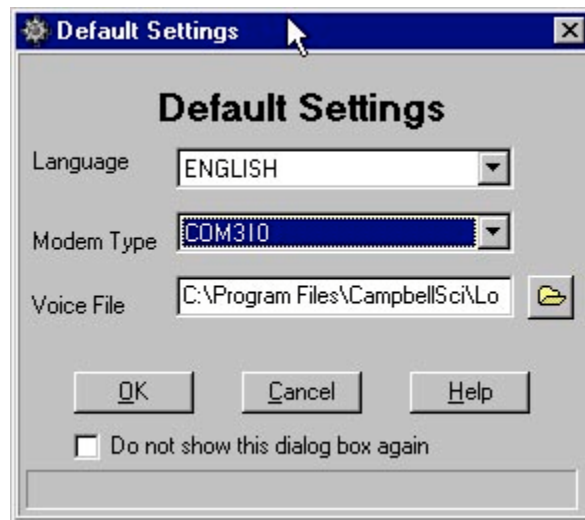
If necessary, find the location of the voice file -VOICE.TXT. This should default to: C:\Program Files\CampbellSci\LoggerTalk\VOICE.TXT

f. Click on "OK". You should now see:
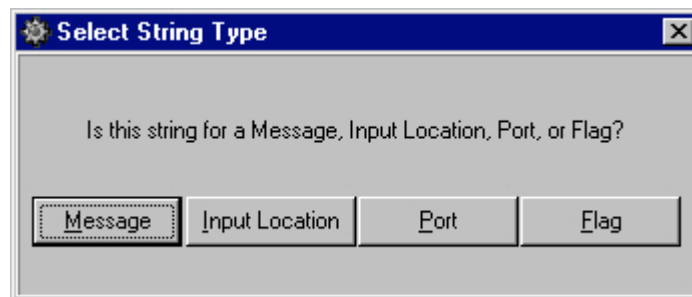
g. Click the "Message" button

h. You should see:

i. Put a check mark in the "☐ Initial Messages" box (this causes the string to be spoken when the station answers).

j. Click on the "Word List" button.
    You will now see the word list available for creating announcements:
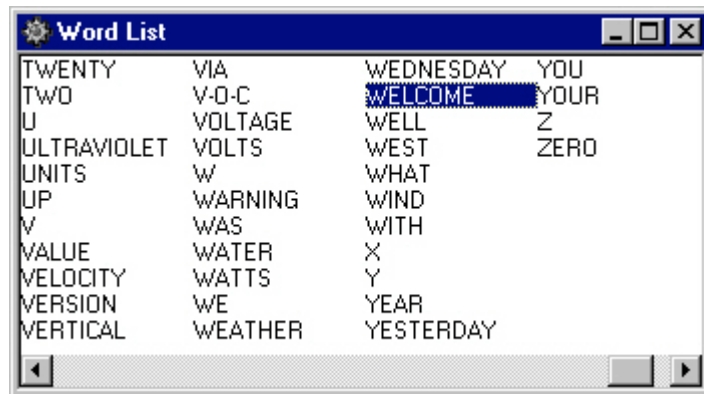
k. Double-click on "WELCOME." It should appear in the Message String field. Double-click on these words: "TWO" "SITE" "FIVE"

    As you learn the word list, you can type words directly into the Message String field. When you Click on "OK" it will advise you of any words not in the list.

    Click on the "OK" button. You should now see:

5
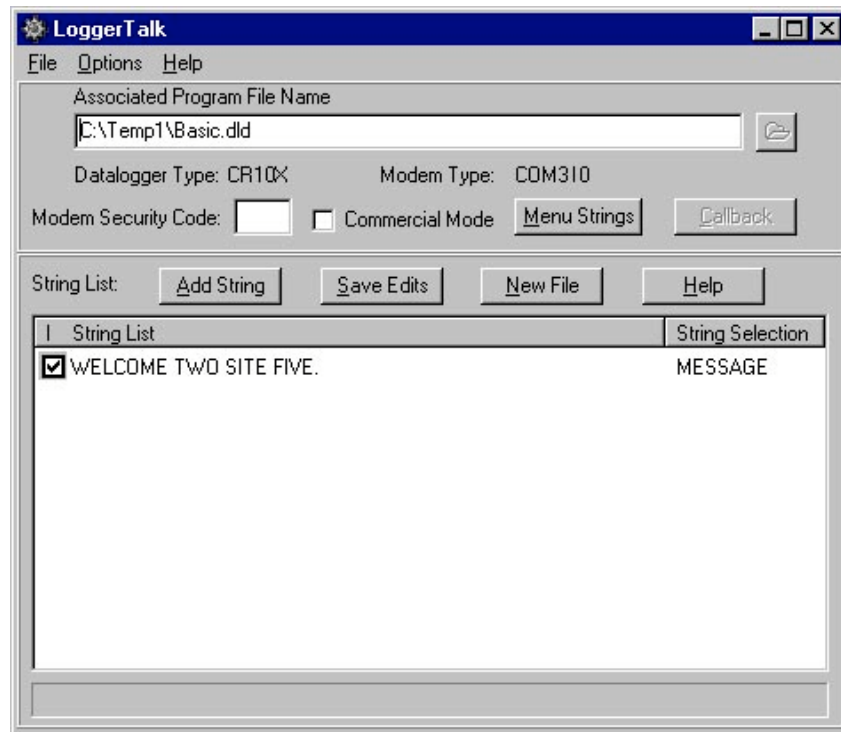
l. Click "Add String" button (or double-click with pointer in the open field) and then click the "Input Location" button. You should see a window like in substep h. but entitled, "Input Location String." You now have the options (1) to select the decimal accuracy and (2) to select whether or not the phrase is announced when the station is first called.

m. To build the phrase Click on "Word List" and double-click in turn the words: "THE" "CURRENT" "BATTERY" "VOLTAGE" and "IS".

n. Click on "Labels." Select "BATT" and exit. You should see "$1" added to the Input String. When this string is voiced the value of Input Location 1 will be voiced.

o. Click on the "OK" button. You will see the LoggerTalk message:
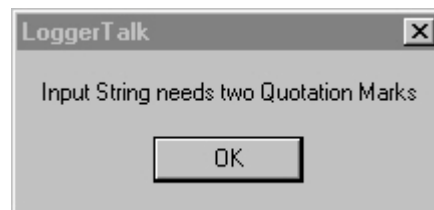
This message appears because we didn't put quotation marks around the part of the phrase we wanted voiced as a menu choice when telephoning the station.

p. Click on "OK" to return to the Input Location String window. Add quotation marks around "BATTERY VOLTAGE." Click the "OK" button to see the Input Location string appear on the LoggerTalk String List.

q. Click on "Add String" and then the "Port" button. You should see a window entitled, "Port Strings." You can choose to make this an "Initial Message" (leave it unchecked). Select Port 2 in the list.

r. Click in the Set (High) String field. Click on the Word List and insert "TEMPERATURE" "IS" "TWO" "HOT" "50MS." Click in Reset (Low) String field. Insert "TEMPERATURE" "IS" "OK" "50MS." Click "OK" to return to main menu. The "50MS" 'word' is a pause you can insert so words don't run together.

s. Click on "Add String" and then the "Flag" button. You should see a window entitled, "Flag Strings." Leave the "Initial Message" box unchecked and choose Flag 7 in the list.

t. Click in the Set (High) String field. Click on Word List and insert "PRESSURE" "IS" "TWO" "HIGH" "50MS." Click in Reset (Low) String field. Insert "PRESSURE" "IS" "OK" "50MS." Click OK.
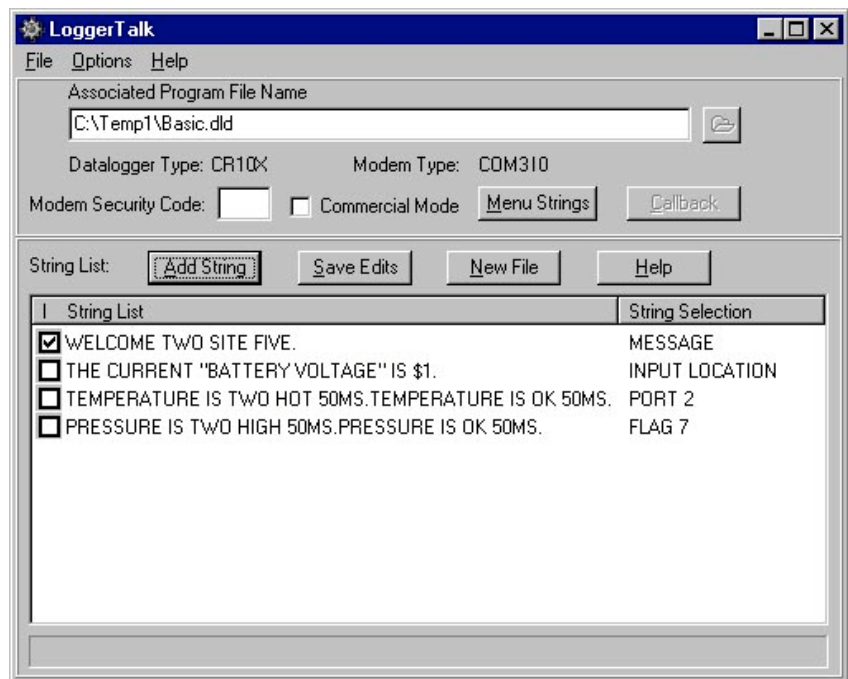
u. To edit any string again, simply double-click that string in the main menu.

v. Finally, press the "Save Edits" button to append the voice code just created to the end of the associated BASIC.DLD file.

w. You can return to LoggerTalk at any time, associate with the desired *.dld file, edit any existing voice code, and press "Save Edits" to send changes to the *.dld file. Be sure to send the modified *.dld file to the datalogger again to implement the changes.

Step 3 – Put It Together

Now that you have created a voice communications edited *.dld file, let's put the hardware together and send the file to the datalogger.

a. Connect the CR10X to the PS512 for power

b. Connect PC running LoggerNet or PC208W to SC32B (or A) interface. Connect interface's 9-pin port using SC12 cable to the CR10X.

c. Connect to datalogger and Send BASIC.DLD to the CR10X following instructions in the LoggerNet or PC208W manual regarding datalogger communications and program sending. Disconnect in LoggerNet or PC208W and remove the SC32B from the CR10X.

d. Using SC12 cable, connect the COM310's 9-pin port to the CR10X's CS I/O port. If datalogger does not provide 12VDC on its CS I/O pin 8, connect alternate 12VDC supply cable to COM310's green connector (see Section 6.2 for more information).

e. Connect analog phone line to COM310

f. Your voice communications station is now complete

Step 4 – Try It Out

a. Using a touch-tone telephone, call station's phone number.

b. The station should first announce the string you checked as an "Initial Message." In this case you should hear:

"WELCOME TWO SITE FIVE"

"For Input Locations press 1"
"For Ports press 2"
"For Flags press 3"
"Press # to hear menu again"
"Press * to disconnect"

c. If you **press 1** you should hear:

"You have selected the Input Locations Menu"
"Press the # key following your selection"
"For Battery Voltage press 1" (text put in quotation marks in LoggerTalk)
"Press # to hear menu again"
"Press * to return to previous menu"

If you press 1 # you should hear, "battery voltage is xx.xx"
(xx.xx = actual value in datalogger Input Location 1)

d.   If you **press 2** you should hear:

"You have selected the Ports Menu"
"To monitor status press 1 through 8"
"Press # to hear the menu again"
"Press * to return to previous menu"
    If you press 2 you should hear:
    "Temperature is ok"
    "To toggle port press # #"
        If you press ## you should hear:
        "Temperature is two hot"

e.   If you press 3 you should hear:

"You have selected the Flags Menu"
"To monitor status press 1 through 8"
"Press # to hear menu again"
"Press * to return to previous menu"
    If you press 7 you should hear:
    "Pressure is ok"
    "To toggle flag press ##"
        If you press ## you should hear:
        "Pressure is two high"

f.   If you press no key for approximately 15 seconds, the station will say "Good Bye" and hang up.

4. System Components

4.1 COM310 Modem

Connecting a COM310 modem to the datalogger allows voice retrieval of data and it allows you to toggle control ports and user flags. The COM310 ships with an SC12 cable (9-pin to 9-pin) to connect between the modem's CS I/O port and datalogger's CS I/O port.

NOTE   The COM310's communication port is designed to function with a Campbell Scientific CS I/O port. This is not a standard RS-232 port. See Appendix E for the CS I/O port description.

4.2 Surge Suppressor

If the phone company does not provide surge protection at the datalogger site, you will need to install some. CSI offers surge protectors in two forms. Item # 6362 is a surge protector with environmental enclosure mounting hardware. Item # 4330 is the surge protector with no mounting hardware (see Figure 3).

4.3 Voice Capable Dataloggers

There are several Campbell Scientific dataloggers that are capable of voice communications. The following sections tell which array-based and table-based dataloggers are capable of which functions.

4.3.1 Array Based

A CR23X, CR10X, CR510, CR500 or CR10 with *array based* OS is capable of voice communications. The CR10 requires a special UVEPROM for voice communications which can be obtained by contacting Campbell Scientific or your Campbell Scientific representative. The CR10X operator's manual provides information on installing the UVEPROM.

4.3.2 Table Based

The CR23X, CR10X, and CR510 Table Data OSs support COM310 voice communications except for data callback (voice callback is supported).

DATALOGGER	Table Data OS
CR510	OS510TD
CR10X	OS10XTD
CR23X	OS23XTD

4.4 Telephone

A touch-tone phone is normally used to call the COM310 modem. A rotary phone will work if the programmed voice announcements do not require you to navigate through the COM310's menu system.

NOTE   The COM310 must connect to an analog phone line. Some office environment PBX phone lines are digital and don't work with an analog modem such as the COM310.

5. Software Setup

5.1 LoggerTalk

To program a voice-capable datalogger for voice communications, special voice codes are appended to the datalogger's *.dld file. LoggerTalk software is shipped with the COM310 to accomplish this. LoggerTalk requires a PC running Windows 95/NT/98/ME/2000/XP and equipped with a 3.5" floppy drive.

5.1.1 Install

To install LoggerTalk, insert the disk into the floppy drive. From the Windows Start Menu, choose Run. In the dialog box type "a:\setup" and press <ENTER>. Then follow directions to finish the install.

NOTE   If an error should occur at the beginning of installation, check the C:\TEMP directory and remove any files. This directory is used during installation. The TEMP directory limits the number of files. If close to the limit, installation of the software is prevented.

5.1.2 Helps and Tutorials

LoggerTalk basics are described in the Quick Start section. More information is available in LoggerTalk's extensive help system. You can access help by pressing the F1 key, by selecting Help from the main window, or by clicking the Help button.

Two tutorials are included in LoggerTalk Help. The first is a basic tutorial on creating voice strings, sending the LoggerTalk edited *.dld program to the datalogger, and navigating through the voice modem menus. The second tutorial is a more advanced tutorial for setting up voice callback. Example program files are included for use in the tutorials. If you've had little experience in creating/editing datalogger programs in Edlog, we suggest that you begin with Quick Start (Section 3) and the basic LoggerTalk tutorial, referring to the help system with any questions you might have.

For a guide to interpreting the voice codes that LoggerTalk appends to a *.dld program, see Appendix F of this manual.

5.1.3 Modem Security Code

A "Modem Security Code" can be assigned which allows a caller to hear only the initial message(s) and prevents access to further data and control unless the modem security code is presented. If a modem security code is not assigned, by default all callers will have access to input locations, and can check status and toggle datalogger ports and flags. The assignment of a modem security code is done in LoggerTalk. The code becomes part of the associated *.dld program when you click "Save Edits." Refer to the LoggerTalk help system for more information.

If you should forget an assigned modem security code, you can run LoggerTalk, open (associate) the datalogger program file and obtain the assigned modem security code from the main menu.

NOTE   LoggerTalk's Modem Security Code is unrelated to the Datalogger's *C mode passwords. For more information on the datalogger's *C mode, please refer to the datalogger operator's manual.

5.1.4 Commercial Mode

If you use LoggerTalk to put your voice communications system in "Commercial Mode" the station will then announce the initial message(s) up to two times. If the correct security code is not presented within about 15 seconds the station will hang up.

A Modem Security Code must be assigned in LoggerTalk in order to program the *.dld file for Commercial Mode. Remember to re-send to the datalogger any *.dld program "Saved and Edited"' in LoggerTalk for the changes to take effect.

5.1.5 Custom Menu Strings

When you call the station, after the initial messages are announced you are prompted to select *Input Locations*, *Ports*, or *Flags*. You can use LoggerTalk to rename these prompts. A dialog box to edit the strings is invoked by clicking the "<u>M</u>enu Strings" button in the main LoggerTalk window. Refer to the software help for more information.

5.1.6 Voice Callback

LoggerTalk can program a voice callback when associated with a *.dld file that includes a P97 with Parameter 1 = "31" for array-based dataloggers or "39" for table-based dataloggers (see Section 5.2.2).

LoggerTalk allows you to input multiple phone numbers to increase the probability that the alarm message will get through. If the first phone is not 'picked up' then the second number is dialed. If the second number is not picked up then the third number is dialed, etc..

There is a LoggerTalk Help tutorial to guide you through setting up datalogger initiated callback.

5.2 Datalogger

5.2.1 Program Voice Code

You can add voice communications code to *.dld files for a CR10, CR10X, CR500, CR510, and CR23X dataloggers. This code enables voice announcement of data when you call the station or during voice callback. The voice ability comes from the voice code LoggerTalk appends to the datalogger's *.dld file in conjunction with the connected COM310.

Although the voice code LoggerTalk adds to a *.dld file is not visible in Edlog, you can open a *.dld file in a text editor such as Notepad® and view voice codes appended to the *.dld file. The text editor is only recommended for viewing the file (not editing it). See Appendix F of this manual for a guide to interpreting the voice codes.

To remove voice code from a *.dld file, open it in LoggerTalk, remove all voice strings, and click on "Save Edits."

5.2.2 Callback

Callback is the ability of the datalogger/COM310 station to initiate a phone call 'back' to a PC (data mode) or to a telephone (voice mode). You can include data and voice calls in the same program (multiple P97s). Be sure to use a different flag for each P97.

5.2.2.1 Data Callback

A station can be programmed to do a data callback to a PC (with modem) running LoggerNet or PC208W in the event specified conditions are met. Data callback causes final storage data to be collected. An array-based datalogger program uses a P97 with, for example, a "42" in Parameter 1 for 9600 baud. A callback ID is required in P97's Parameter 8 matching that assigned in the LoggerNet or PC208W Setup. You must enable Callback in LoggerNet or PC208W.

Currently, data callback is not supported in table-based (TD) OSs.

5.2.2.2 Voice Callback

The COM310 gives you the ability to do *voice* callbacks. Using LoggerTalk you can program a station to call one or more telephone numbers and announce an alarm message when conditions you specify are met. You can input multiple phone numbers to increase the probability that someone will receive the message.

Array-based datalogger programs require a P97 with a "31" in Parameter 1. Table-based dataloggers include a P97 in the program with a "39" in Parameter 1. No callback ID is used in either case.

For more setup information refer to LoggerTalk Help's Callback Tutorial. Also, the datalogger operator's manual includes general information regarding voice callback.

Example P97 for array-based datalogger voice callback:

```
18:  Initiate Telecommunications (P97)
 1: 31       VS1-Com300/310 Voice
 2: 5        Disabled when User Flag 5 is High
 3: 45       Seconds Call Time Limit
 4: 30       Seconds Before Fast Attempts
 5: 1        Fast Attempts
 6: 30       Minutes Before Slow Attempts
 7: 2        Failure Loc [ P97_Failures   ]
 8: 0000     Call-Back ID
```

5.2.3 Voice Final Storage Data

Final storage data is normally sent to a datalogger's ring memory. The COM310 can only voice *input location* data. To voice final storage data, therefore, it is necessary to redirect the desired final storage data to input locations. Datalogger Instruction P80 is used to redirect final storage output data to input locations. For more information on the P80 instruction refer to the datalogger operator's manual.

5.3 LoggerNet and PC208W

By default the COM310 is in *voice* mode, enabling you to call a station and hear voice announcements or enabling the station to call you and announce an alarm. The COM310 also has the ability to function in *data* mode. In data mode, the COM310 supports data collection and other standard LoggerNet or PC208W supported functions.

You can set up LoggerNet to call and perform scheduled collections of final storage data or you can program the datalogger (see Section 5.22.1) to call back under conditions you specify so that LoggerNet will collect data.

For scheduled collection (or manual) you must put the COM310 in *data* mode by including commas and a "9" in LoggerNet's (or PC208W's) dial script (or string) after the station phone number. In the case of callback collection, the program's P97 with Callback ID puts the COM310 in data mode.

The commas create a delay so that the "9" is received by the COM310 during the voice announcement. When the COM310 detects the "9" it disables *voice* communications and enables data mode for the remainder of that connection. In LoggerNet the dial script is found in the Setup Screen's Hardware Tab for PhoneRemote. In PC208W the dialing string is located in Setup's station Hardware Tab.

For example, in LoggerNet, if the phone number is "555-4321" then in order to call the COM310 and enable data mode the dial script becomes:

"555-4321,,,,,,9"

In LoggerNet a comma represents a 1 second delay. In PC208W a comma represents a 2 second delay, so you insert only three commas (and a "9"). With either software, you may need to adjust the number of commas so that the "9" occurs during the voice announcement, depending upon the length of time required to establish the connection with the modem.

For information on creating a datalogger program and downloading it to the COM310 station, refer to Quick Start (Section 3) and to the Basic Tutorial in LoggerTalk help.

6. Hardware Installation

6.1 Site Requirements

NOTE   Connection to telephone company provided COIN service (Central Office Implemented systems) is prohibited. Connection to party line service is subject to state tariffs.

The COM310 is compatible with standard (analog) telephone lines. It connects to the telephone line by means of a USOC RJ11C jack (standard modular telephone jack). Connect the cable from the telephone RJ11C jack to the modem as shown in Figure 2.
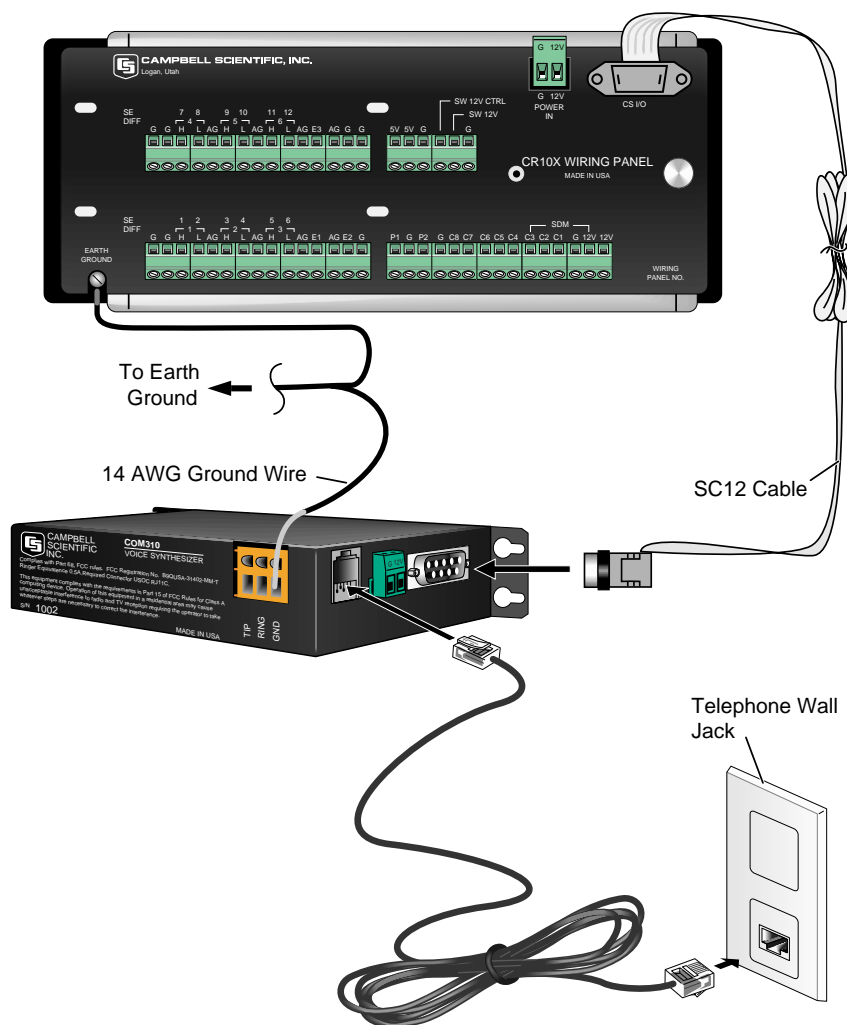
FIGURE 2. COM310 Hardware Connection Using Standard RJ11 Phone Jack
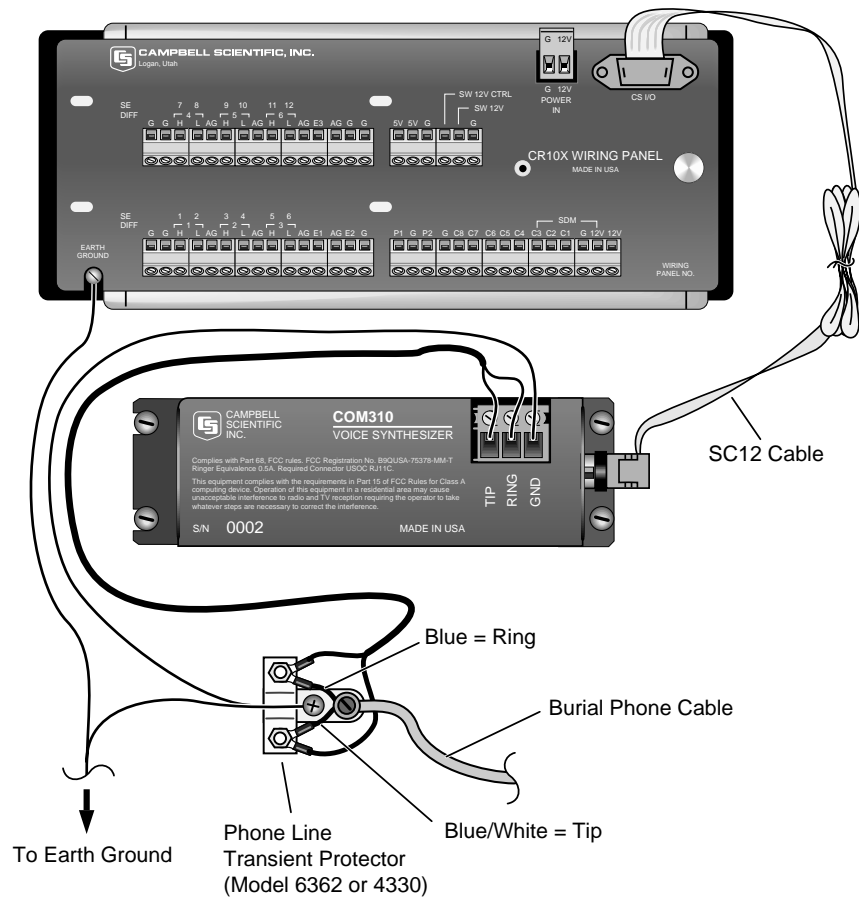
FIGURE 3. COM310 / CR10X Using Surge Protection Device
(where there's no available Standard RJ11 Connection)

6.2 Powering the COM310 Modem

Newer Campbell Scientific dataloggers provide 12 VDC on CS I/O connector pin 8 for powering peripherals such as the COM310. The alternative, if you have a dataloggers/wiring panel lacking 12 VDC on pin 8, is to wire the green connector on the side of the COM310 to the datalogger +12 VDC and power ground terminals (refer to Figure 4). The COM310 comes with a mating green power connector for this purpose. The following Campbell Scientific dataloggers lack 12 VDC power on CS I/O pin 8.

TABLE 1. Dataloggers/Wiring Panels Lacking 12 VDC on CS I/O Port Pin 8
CR10(X) w/ silver wiring panel
CR10(X) w/ black CR10 wiring panel (P/N 8032)
CR500—serial number 1764 or lower

6.3 Grounding the COM310 System

Connect the green 14 AWG grounding wire (provided with the COM310) to the GND terminal on the COM310 and to the station enclosure's earth ground connection. It is important that you connect the COM310 and datalogger directly to a high quality earth ground. Read the datalogger manual section on GROUNDING for details on creating such an earth ground.

WARNING **A quality EARTH GROUND connection to the COM310 and datalogger maximizes protection against electro-static discharge! Follow carefully the EARTH GROUND scheme in Figure 4. The COM310 employs spark gaps on the phone lines, however, they will be ineffective without quality earth grounding.**
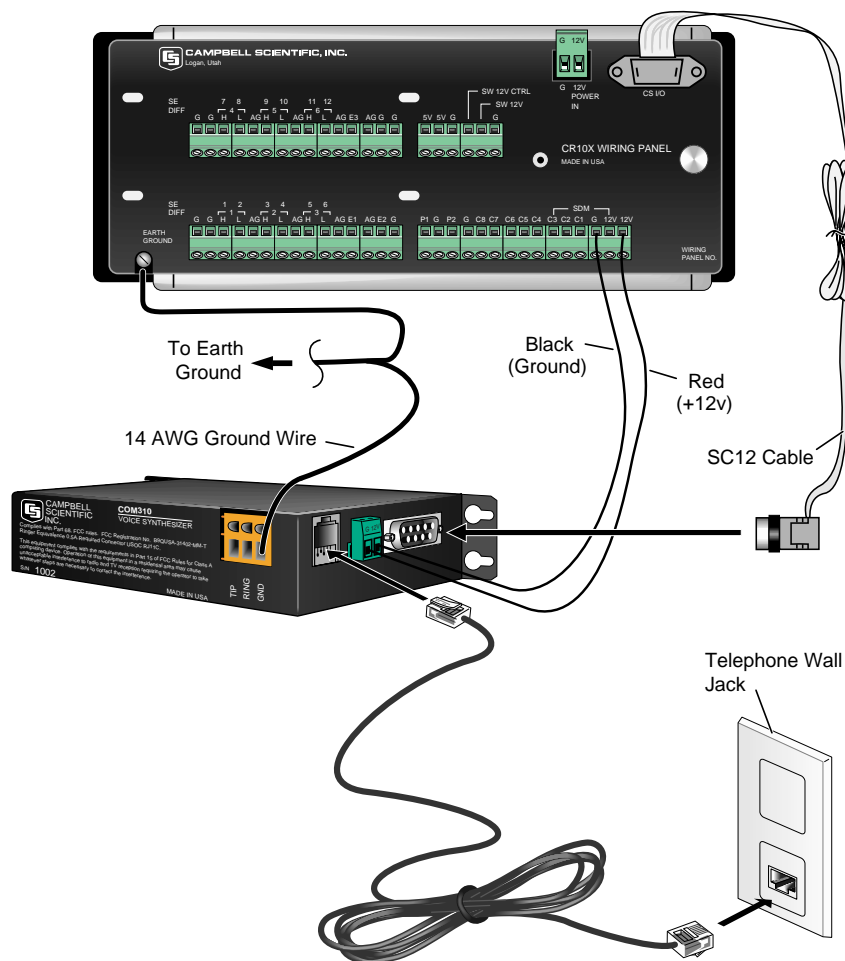
FIGURE 4. COM310 Grounding and Alternate 12VDC Power

6.4 Telephone Service

Telephone companies occasionally 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 should be able to furnish this information upon request. If the telephone company requests information from you concerning the equipment that you have connected to your telephone line, the COM310 label shows its FCC registration number and ringer equivalence number (REN). COM310 information pertaining to the FCC and Industry Canada is available in Appendices B and C.

If any of your telephone equipment is malfunctioning, you should remove it immediately from the telephone line as it may damage the telephone network.

If the telephone company notices a problem from their end, they may temporarily discontinue service. They should notify you in advance of disconnection and give you opportunity to correct the problem. If not feasible, they should notify you as soon as possible.

6.5 Telephone Transfers

The COM310 has the ability to do certain transfers by telephone:

1. Set/Get AT parameters in COM310's Connexant chip set (Appendix D)
2. Retrieve word list from COM310
3. Install OS to COM310
4. Install new words file or add to existing words in COM310

There is some risk in performing such transfers by telephone, especially in regards to *remote* sites. If you have need of doing such a transfer, contact Campbell Scientific for details.

7. Troubleshooting COM310 Voice Systems

Following are some possible reasons for your COM310 system not working or not working properly.

7.1 No Communications

Voice Mode — No voice announcements when you call the station

1) The COM310 not getting 12V power due to an older datalogger/wiring panel that does not provide 12V on CS I/O pin 8.

2) The COM310 is connected to a digital rather than an analog phone line.

3) The COM310 configuration was changed from its default factory settings (see Appendix D).

Data Mode — Can't connect to the station with LoggerNet or PC208W software

1) No commas and/or "9" added to the dial string in LoggerNet/PC208W to temporarily put the COM310 into *data* mode (see Section 5.2 for details).

2) The "9" is being dialed before the CR310 'picks up' and voices the announcement (not enough commas).

3) No phone number in the LoggerNet/PC208W dial string.

4) COM310 not getting 12V power due to an older datalogger/wiring panel that does not provide 12V on CS I/O pin 8.

5) COM310 is connected to a digital rather than an analog phone line.

6) LoggerNet / PC208W configured for the wrong PC modem.

7) LoggerNet / PC208W configured for a baud rate higher than the datalogger can handle.

8) COM310 configuration was changed from its default factory settings (see Appendix D).

7.2 Communications Problems

Voice Mode

1) Can't get beyond the initial voice announcement

   a) Security mode is enabled.

   b) Commercial mode is enabled.

   c) Datalogger is running a *.dld program which hasn't been 'edited and saved' in LoggerTalk. You can open (associate) the *.dld file in LoggerTalk and see if there is voice code.

2) Pressing handset button sometimes fails to produce the correct response

   a) Telephone buttons not being pressed long enough.

   b) Phone line introducing noise or signal attenuation.

   c) Handset introducing noise or producing too low signal levels.

3) Volume levels vary some from word to word

   This is normal due to the PCM voice encoding compression scheme.

Appendix A. Theory of Operation

The COM310 modem is used to transmit data over bandwidth-limited channels such as telephone lines by modulating audio tones, using Phase Shift Keying (PSK) at 9600 or 1200 baud and Frequency Shift Keying (FSK) at 300 baud.

The COM310 has four connectors:

1. RJ11 – telephone line
2. Orange Tip, Ring, GND – alternate telephone line and EARTH GROUND
3. CS I/O – datalogger serial comms and 12 VDC power if more recent wiring panel (see Section 6.2)
4. Green Power – 12 VDC (alternate in case wiring panel doesn't furnish 12 VDC power)

The telephone company places a 40 to 150 V_{RMS} 20 Hz signal on the telephone line to signify a ring, which is typically on for 2 seconds and off for 4 seconds. The COM310's ring detection circuit is continuously powered but draws less than 2 μA. The COM310 passes a detected ring signal on to the datalogger through an opto-coupler. The datalogger responds by addressing the COM310 synchronously (pins 6 and 7) which switches on 5 VDC power to the COM310. The COM310 then negotiates a connection with the calling modem and remains 'off-hook' until it loses the carrier or until the datalogger sends it a shutdown command. The datalogger sends the COM310 a shutdown command upon receipt of an E (end call) command or after 40 seconds without receiving any command. The shutdown command switches off internal 5 VDC power to the COM310, dropping power to the off-hook relay and 'hanging up.'

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

Appendix B. FCC Warning to Users of Class A Computing Devices

WARNING

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.

The REN is used to determine the quantity of devices which may be connected to the telephone line. Excessive REN's on the telephone line may result in the devices not ringing in response to an incoming call. In most, but not all areas, the sum of the REN's should not exceed five (5.0). To be certain of the number of devices that may be connected to the line, as determined by the total REN's, contact the telephone company to determine the maximum REN for the calling area.

This equipment cannot be used on the telephone company-provided coin service. Connection to Party Line Service is subject to State Tariffs.

If this equipment cannot be used on the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. If advance notice isn't practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.

Appendix C. IC Information

NOTE	Industry Canada (IC) was formerly known as DOC.

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

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."

Appendix D. Set Rings, AT Parameters

D.1 Set Number of COM310 Rings before Answer

To program the number of rings before the COM310 answers, use the datalogger's *D3 setting. Changing the COM310's ATS0 setting (as with the COM210) will not change the number of rings before answer.

*D3 setup for the CR10X, CR23X, or CR510:-

(1) Key in *D3A
(2) Key in 1, 2, or 3 according to desired number of rings
(3) Press A
(4) Key in *0 to compile

D.2 Telephone Connection to COM310

CAUTION Changing the COM310's AT settings may result in communication problems or loss of communications requiring retrieval of COM310 from remote site and return to factory for non-warranty work. We recommend that you test a setting change locally before changing it remotely.

Also, there is the slight risk of phone line noise causing erroneous setting changes to occur.

The following describes how to view and change AT parameters of the COM310's Connexant chipset via telephone. See above CAUTION.

The following assumes that your PC has an internal or external modem connected.

(1) Step 1

Run HyperTerminal® or similar terminal program

(2) Step 2

(a) Click on File \ New Connection

(b) In the Connection Description window type a name such as "COM310_94." Click on "OK."

(c) Select a configured modem in "Connect Using"
Enter COM310's phone number followed by ",,,,,9,4".
Example: 750-1234,,,,,9,4   Click on "OK."

(d) Click on Modify\Configure\General Tab and select Maximum Speed of 9600.

(e) Press "OK"

(3) Step 3

(a) Dial the phone number

(b) Wait until "Connected" appears at lower-left on screen. You will hear some tones as a modem connection is established.

(c) After connection HyperTerminal should display:
ATA

(d) Wait until you see the ">" prompt

(e) Type a couple of <CR>s until you see "+++"

(f) HyperTerminal should then display:
OK
ATO
CONNECT 9600

>

(g) At the ">" prompt you can type AT commands to the Connexant chipset in your COM310. See CAUTION.

There is a summary of AT commands in the COM210 Instruction Manual, Appendix A available on CSI's web site.

(h) To see version number of the COM310 OS, type, "HOS".
You should see "H8 OS mm.dd.yy" on the terminal screen.

(i) To quit, type "ATH" <ENTER> and wait until "Disconnected" appears at lower-left on screen. This may take a half minute or so.

(j) Save your HyperTerminal connection setup by clicking on "File" and then "Save." Thereafter you can start on Step 3.

Appendix E. CS I/O 9 Pin Serial Port

Pin Description

The COM310 modem connects to the datalogger using an SC12 cable connected to the datalogger's CS I/O port. The COM310's connector configuration is shown in Figure E-1. Table E-1 shows the I/O pin configuration, and gives a brief description of the function of each pin.
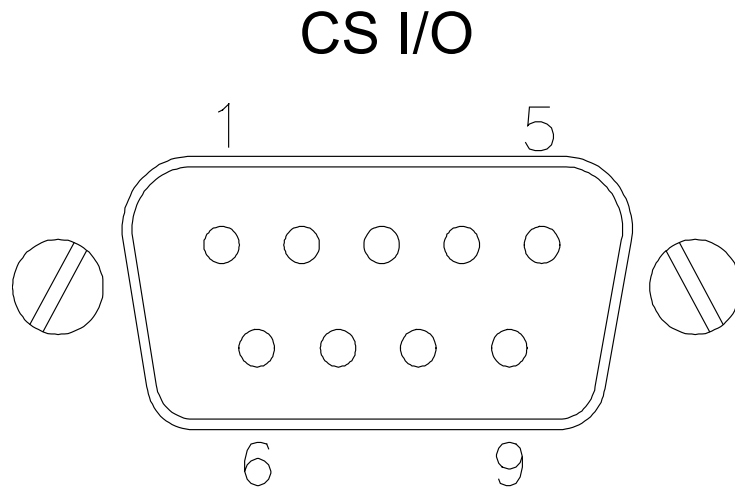
FIGURE E-1. COM310's Male 9 Pin Connector

TABLE E-1. Pin Description			
ABR = Abbreviation for the function name.			
PIN = Pin number.			
O = Signal Out of the datalogger to a peripheral.			
I = Signal Into the datalogger from a peripheral.			
PIN	**ABR**	**I/O**	**Description**
1	5V	I	5 VDC supply (not used for COM310).
2	SG		Signal Ground: Provides a power return for pin 1 (5V), and is used as a reference for voltage levels.
3	RING	O	Ring: Raised by the modem to put the datalogger in the telecommunications mode.
4	RXD	O	Receive Data: Serial data transmitted by the modem are transmitted on pin 4.
5	ME	I	Modem Enable: A logic high internally switches power to the modem. A logic low internally powers down the modem.
6	SDE	I	Synchronous Device Enable: A logic high disables communication with the modem, without removing power or changing the modem's mode.
8	TE	I	+12 VDC power supply.
9	TXD	I	Transmit Data: Serial data are transmitted from the datalogger to the modem on pin 9; logic low marking (0V) logic high spacing (5V) standard asynchronous ASCII, 8 data bits, no parity, 1 start bit, 1 stop bit, 300, 1200, 9600, 76,800 baud (user selectable).

Appendix F. Reading Voice Code in a *.DLD File

When a file is edited and saved in LoggerTalk, the information for voice communications is appended to the *.DLD file. This information can be verified for accuracy.

An example of some typical voice code is shown below. The numbers between the "smiley faces" (☺) and the "&" symbols are the numbers associated with the words used from the word list. The ☺ symbol is equivalent to control code A (^A). Refer to Appendix G to view the word list used with the COM310.

Several lines of code that begin with a tilde (~) may precede the voice code. These strings are setup information. The voice code follows this information. The first line of the voice code is the wording used for input locations. The second line is the wording used for ports. The third line is the wording used for flags. The lines following are used for message descriptions. Each message will terminate with a period.

Notice that line four below starts with ">\4". The > indicates the string is an initial message. The 4 following the slash indicates the number of digits following the decimal point that the COM310 will announce for that input location.

The numbers inside the quotation marks are the words associated with the input location.

The number following the "$" symbol is the input memory location number used in the datalogger.

F.1 Typical Voice Code

Following is code for a typical call:

;|#"☺56&☺57&"#

#"☺53&"#

#"☺52&"#

>\4☺88&☺89&☺109&☺74&☺71&☺71&☺71&"☺109&☺135&☺86&"☺85&$3☺87&☺122&.\

\4"☺109&☺98&☺191&"☺85&$1☺192&.\

|

♣♣

The above code translates to:

Input Locations

Ports

Flags

(four decimal places) Campbell Scientific Datalogger Program (pause) (pause) (pause) "Datalogger Internal Temperature" is (input location 3) Degrees Fahrenheit.

(four decimal places) Datalogger Battery Voltage is (input location 1) Volts.

F.2 Callback Code

If the datalogger has been programmed to initiate voice calls, you will see the phone number associated with the call command at the very end of the listing. The flag number used to initiate the call and the phone number will be between "at" symbols (@).

This example initiates a voice call:

;|#"☺56&☺57&"#

#"☺53&"#

#"☺52&"#

><2\4"☺98&☺191&"☺85&\$1☺192&.\

@2555-1234@

|

♣♣

Line four, above, starts out as "><2/4". The ">" means this message is selected as an initial message. The "<2" indicates that this message will be spoken if flag 2 is the flag that initiates callback. The "2" preceding the phone number "@2555-1234@" means the phone number (555-1234) will be called when flag 2 goes high in the program.

The code translates as:

Input Locations

Ports

Flags

(flag 2) (4 decimal places) "Battery Voltage" Is (input location 1) Volts.

(callback flag 2) (telephone number 555-1234)

F.3 Modem Security Enabled

NOTE

LoggerTalk's Modem Security Code is unrelated to the Datalogger's *C mode passwords. Refer to the datalogger operator's manual for more information on the datalogger's *C mode.

This last example uses the modem security code "1234" to allow access to the second level menu. Notice the characters following the "?" at the beginning of the character stream. The security code will always be the very first thing in the imbedded character portion of the *.DLD file.

;|?1234#"☺56&☺57&"#

#"☺53&"#

#"☺52&"#

>\4☺88&☺89&☺109&☺74&☺71&☺71&☺71&"☺109&☺135&☺86&"☺85&$3☺87&☺122&.\

\4"☺109&☺98&☺191&"☺85&$1☺192&.\

This code translates to:

(security code 1234) Input Locations

Ports

Flags

(4 decimal places) Campbell Scientific Datalogger Program (pause) (pause) (pause) "Datalogger Internal Temperature" Is (input location 3) Degrees Fahrenheit.

(4 decimal places) "Datalogger Battery Voltage" Is (input location 1) Volts.

Appendix G. COM310 Word List

G.1 COM310 Word List - Numerical Order

0.	ZERO	47. PREVIOUS	94. AT
1.	ONE	48. STATUS	95. AVERAGE
2.	TWO	49. HIGH	96. BAROMETRIC
3.	THREE	50. LOW	97. BARS
4.	FOUR	51. TOGGLE	98. BATTERY
5.	FIVE	52. FLAGS	99. CALIBRATE
6.	SIX	53. PORTS	100. CELSIUS
7.	SEVEN	54. THRU	101. CENTI
8.	EIGHT	55. PORT	102. CHILL
9.	NINE	56. INPUT	103. CLOSED
10.	TEN	57. LOCATIONS	104. CONDUCTIVITY
11.	ELEVEN	58. FLAG	105. CUBIC
12.	TWELVE	59. AND	106. CURRENT
13.	THIRTEEN	60. OF	107. DAM
14.	FOURTEEN	61. SECURITY	108. DATA
15.	FIFTEEN	62. CODE	109. DATALOGGER
16.	SIXTEEN	63. YOUR	110. DAY
17.	SEVENTEEN	64. POINT	111. DEPTH
18.	EIGHTEEN	65. PLEASE	112. DEVIATION
19.	NINETEEN	66. BY	113. DIRECTION
20.	TWENTY	67. MINUS	114. D-O
21.	THIRTY	68. ENTER	115. DOWN
22.	FORTY	69. SELECTION	116. DRAW
23.	FIFTY	70. GOODBYE	117. EQUAL
24.	SIXTY	71. 50MS	118. E-T-O
25.	SEVENTY	72. MESSAGE	119. EVENT
26.	EIGHTY	73. CALLBACK	120. EXTERNAL
27.	NINETY	74. PROGRAM	121. EXCEEDS
28.	HUNDRED	75. SIGNATURE	122. FAHRENHEIT
29.	THOUSAND	76. EPROM	123. FALL
30.	MILLION	77. KILOBYTES	124. FEET
31.	PRESS	78. MEMORY	125. FLOW
32.	POUND	79. NUMBER	126. FROM
33.	DEW	80. E08'S	127. GALLONS
34.	HEAR	81. TABLE	128. GRAM
35.	MENU	82. OVERRUNS	129. HELLO
36.	AGAIN	83. VERSION	130. SET
37.	STAR	84. REVISION	131. HOUR
38.	DISCONNECT	85. IS	132. HUMIDITY
39.	YOU	86. TEMPERATURE	133. IN
40.	THE	87. DEGREES	134. INCHES
41.	HAVE	88. CAMPBELL	135. INTERNAL
42.	SELECTED	89. SCIENTIFIC	136. KILO
43.	MONITOR	90. ACRE	137. LAST
44.	KEY	91. AIR	138. LEVEL
45.	FOLLOWING	92. ALARM	139. LITER
46.	RETURN	93. ARE	140. RESET

141. MAXIMUM	195. WATTS	249. DURING
142. MERCURY	196. WEATHER	250. E
143. METER	197. WELL	251. EAST
144. METERS	198. WIND	252. EASTERN
145. MICRO	199. A	253. EFFLUENT
146. MILES	200. A-M	254. ELECTRON
147. MILLI	201. ABOVE	255. ELEVATION
148. MINIMUM	202. ACCUMULATE	256. EMPTIED
149. MINUTE	203. ACKNOWLEDGE	257. ENGINE
150. MOISTURE	204. ADDITION	258. ERROR
151. MONTH	205. ADDITIONAL	259. F
152. MULTIPLIER	206. AGO	260. FAILED
153. NEW	207. ALL	261. FAILURE
154. N-T-U	208. AMMONIUM	262. FALLING
155. OFF	209. APPROACH	263. FIRST
156. OFFSET	210. AREA	264. FLUORIDE
157. ON	211. AVAILABLE	265. FREEZER
158. OPEN	212. B	266. FREQUENCY
159. OVERFLOW	213. BACK-UP	267. FRIDAY
160. PARTS	214. BAY	268. FUEL
161. PER	215. BE	269. G
162. PERCENT	216. BEAVER	270. GAS
163. P-H	217. BEDS	271. GATE
164. PRECIPITATION	218. BEHIND	272. GAUGE
165. PRESSURE	219. BELOW	273. GENERATOR
166. PROGRESS	220. BIG	274. GOING
167. P-S-I	221. BILLION	275. GOOD
168. RADIATION	222. BLAST	276. GRADIENT
169. RAIN	223. BOILER	277. GRASS
170. RATE	224. BUILDING	278. GROUND
171. REFERENCE	225. C	279. H
172. RELATIVE	226. C-O	280. H-2-S
173. R-P-M	227. CALCIUM	281. HAD
174. SAMPLE	228. CALL	282. HARDNESS
175. SECOND	229. CALLS	283. HAS
176. SECONDS	230. CAN	284. HASH
177. SIEMENS	231. CEMENT	285. HEAD
178. SITE	232. CENTRAL	286. HEAT
179. SNOW	233. CHECK	287. HERTZ
180. SOIL	234. CHILLER	288. HOLD
181. SOLAR	235. CHLORIDE	289. HOT
182. SPEED	236. CHLORINE	290. HOURS
183. SQUARED	237. CONTACT	291. HYDROLOGIC
184. STAGE	238. CORRECTED	292. I
185. STANDARD	239. CROSSING	293. INDEX
186. STATION	240. CYCLES	294. ING
187. STORM	241. D	295. INTAKE
188. TIME	242. DAYS	296. INTRUDER
189. TURBIDITY	243. DELTA	297. IRRADIANT
190. VELOCITY	244. DING	298. IRRIGATION
191. VOLTAGE	245. DISTRICT	299. IT
192. VOLTS	246. DIVERSION	300. J
193. WARNING	247. DOCK	301. K
194. WATER	248. DOOR	302. KNOTS

303. L	347. POND	391. SUNBURN
304. LAKE	348. POTASSIUM	392. SUNDAY
305. LAYER	349. POWDER	393. SURFACE
306. LINE	350. POWER	394. SURFACTANCE
307. LOAD	351. PREHEAT	395. SYSTEM
308. LOCATED	352. PROBE	396. T
309. LOCATION	353. PRODUCT	397. TAIL
310. LOGAN	354. PUMP	398. TESTING
311. M	355. Q	399. THANK
312. M-R-P	356. QUALITY	400. THAT
313. MANAGEMENT	357. QUIT	401. THIS
314. MENDON	358. R	402. THRESHOLD
315. MID	359. RACE	403. THURSDAY
316. MID-MOUNTAIN	360. RADIAL	404. TING
317. MIDNIGHT	361. RANGE	405. TO
318. MINUTES	362. REACHED	406. TODAY
319. MODEM	363. READING	407. TODAYS
320. MONDAY	364. RECEIVED	408. TOTAL
321. MOUNT	365. RESERVOIR	409. TRIGGERED
322. MOUNTAIN	366. RESIDUAL	410. TUESDAY
323. N	367. RISING	411. U
324. NEEDS	368. RIVER	412. ULTRAVIOLET
325. NETWORK	369. ROAD	413. UNITS
326. NEXT	370. ROOM	414. UP
327. NITRATE	371. RUN	415. V
328. NITROGEN	372. RUNOFF	416. V-O-C
329. NO	373. S	417. VALUE
330. NOON	374. S-O-2	418. VERTICAL
331. NORTH	375. SATURDAY	419. VIA
332. NOT	376. SEDIMENT	420. W
333. O	377. SENSOR	421. WAS
334. OK	378. SENSORS	422. WE
335. OR	379. SHAFT	423. WEDNESDAY
336. OUT	380. SINCE	424. WELCOME
337. OZONE	381. SKIING	425. WEST
338. P	382. SMOG	426. WHAT
339. P-M	383. SODIUM	427. WITH
340. PACIFIC	384. SONAR	428. X
341. PARAMETER	385. SOUTH	429. Y
342. PAST	386. SPILL	430. YEAR
343. PEAK	387. STATES	431. YESTERDAY
344. PENDING	388. STREAMBED	432. Z
345. PHONE	389. SUMMIT	
346. PLANT	390. SUMP	

G.2 COM310 Word List - Alphabetical Order

71. 50MS	203. ACKNOWLEDGE	206. AGO
199. A	90. ACRE	91. AIR
200. A-M	204. ADDITION	92. ALARM
201. ABOVE	205. ADDITIONAL	207. ALL
202. ACCUMULATE	36. AGAIN	208. AMMONIUM

59. AND	108. DATA	264. FLUORIDE
209. APPROACH	109. DATALOGGER	45. FOLLOWING
93. ARE	110. DAY	22. FORTY
210. AREA	242. DAYS	4. FOUR
94. AT	87. DEGREES	14. FOURTEEN
211. AVAILABLE	243. DELTA	265. FREEZER
95. AVERAGE	111. DEPTH	266. FREQUENCY
212. B	112. DEVIATION	267. FRIDAY
213. BACK-UP	33. DEW	126. FROM
96. BAROMETRIC	244. DING	268. FUEL
97. BARS	113. DIRECTION	269. G
98. BATTERY	38. DISCONNECT	127. GALLONS
214. BAY	245. DISTRICT	270. GAS
215. BE	246. DIVERSION	271. GATE
216. BEAVER	247. DOCK	272. GAUGE
217. BEDS	248. DOOR	273. GENERATOR
218. BEHIND	115. DOWN	274. GOING
219. BELOW	116. DRAW	275. GOOD
220. BIG	249. DURING	70. GOODBYE
221. BILLION	250. E	276. GRADIENT
222. BLAST	118. E-T-O	128. GRAM
223. BOILER	80. E08'S	277. GRASS
224. BUILDING	251. EAST	278. GROUND
66. BY	252. EASTERN	279. H
225. C	253. EFFLUENT	280. H-2-S
226. C-O	8. EIGHT	281. HAD
227. CALCIUM	18. EIGHTEEN	282. HARDNESS
99. CALIBRATE	26. EIGHTY	283. HAS
228. CALL	254. ELECTRON	284. HASH
73. CALLBACK	255. ELEVATION	41. HAVE
229. CALLS	11. ELEVEN	285. HEAD
88. CAMPBELL	256. EMPTIED	34. HEAR
230. CAN	257. ENGINE	286. HEAT
100. CELSIUS	68. ENTER	129. HELLO
231. CEMENT	76. EPROM	287. HERTZ
101. CENTI	117. EQUAL	49. HIGH
232. CENTRAL	258. ERROR	288. HOLD
233. CHECK	119. EVENT	289. HOT
102. CHILL	121. EXCEEDS	131. HOUR
234. CHILLER	120. EXTERNAL	290. HOURS
235. CHLORIDE	259. F	132. HUMIDITY
236. CHLORINE	122. FAHRENHEIT	28. HUNDRED
103. CLOSED	260. FAILED	291. HYDROLOGIC
62. CODE	261. FAILURE	292. I
104. CONDUCTIVITY	123. FALL	133. IN
237. CONTACT	262. FALLING	134. INCHES
238. CORRECTED	124. FEET	293. INDEX
239. CROSSING	15. FIFTEEN	294. ING
105. CUBIC	23. FIFTY	56. INPUT
106. CURRENT	263. FIRST	295. INTAKE
240. CYCLES	5. FIVE	135. INTERNAL
241. D	58. FLAG	296. INTRUDER
114. D-O	52. FLAGS	297. IRRADIANT
107. DAM	125. FLOW	298. IRRIGATION

85. IS	324. NEEDS	165. PRESSURE
299. IT	325. NETWORK	47. PREVIOUS
300. J	153. NEW	352. PROBE
301. K	326. NEXT	353. PRODUCT
44. KEY	9. NINE	74. PROGRAM
136. KILO	19. NINETEEN	166. PROGRESS
77. KILOBYTES	27. NINETY	354. PUMP
302. KNOTS	327. NITRATE	355. Q
303. L	328. NITROGEN	356. QUALITY
304. LAKE	329. NO	357. QUIT
137. LAST	330. NOON	358. R
305. LAYER	331. NORTH	173. R-P-M
138. LEVEL	332. NOT	359. RACE
306. LINE	79. NUMBER	360. RADIAL
139. LITER	333. O	168. RADIATION
307. LOAD	60. OF	169. RAIN
308. LOCATED	155. OFF	361. RANGE
309. LOCATION	156. OFFSET	170. RATE
57. LOCATIONS	334. OK	362. REACHED
310. LOGAN	157. ON	363. READING
50. LOW	1. ONE	364. RECEIVED
311. M	158. OPEN	171. REFERENCE
312. M-R-P	335. OR	172. RELATIVE
313. MANAGEMENT	336. OUT	365. RESERVOIR
141. MAXIMUM	159. OVERFLOW	140. RESET
78. MEMORY	82. OVERRUNS	366. RESIDUAL
314. MENDON	337. OZONE	46. RETURN
35. MENU	338. P	84. REVISION
142. MERCURY	163. P-H	367. RISING
72. MESSAGE	339. P-M	368. RIVER
143. METER	167. P-S-I	369. ROAD
144. METERS	340. PACIFIC	370. ROOM
145. MICRO	341. PARAMETER	371. RUN
315. MID	160. PARTS	372. RUNOFF
316. MID-MOUNTAIN	342. PAST	373. S
317. MIDNIGHT	343. PEAK	374. S-O-2
146. MILES	344. PENDING	174. SAMPLE
147. MILLI	161. PER	375. SATURDAY
30. MILLION	162. PERCENT	89. SCIENTIFIC
148. MINIMUM	345. PHONE	175. SECOND
67. MINUS	346. PLANT	176. SECONDS
149. MINUTE	65. PLEASE	61. SECURITY
318. MINUTES	64. POINT	376. SEDIMENT
319. MODEM	347. POND	42. SELECTED
150. MOISTURE	55. PORT	69. SELECTION
320. MONDAY	53. PORTS	377. SENSOR
43. MONITOR	348. POTASSIUM	378. SENSORS
151. MONTH	32. POUND	130. SET
321. MOUNT	349. POWDER	7. SEVEN
322. MOUNTAIN	350. POWER	17. SEVENTEEN
152. MULTIPLIER	164. PRECIPITATION	25. SEVENTY
323. N	351. PREHEAT	379. SHAFT
154. N-T-U	31. PRESS	177. SIEMENS

75.	SIGNATURE	51.	TOGGLE
380.	SINCE	408.	TOTAL
178.	SITE	409.	TRIGGERED
6.	SIX	410.	TUESDAY
16.	SIXTEEN	189.	TURBIDITY
24.	SIXTY	12.	TWELVE
381.	SKIING	20.	TWENTY
382.	SMOG	2.	TWO
179.	SNOW	411.	U
383.	SODIUM	412.	ULTRAVIOLET
180.	SOIL	413.	UNITS
181.	SOLAR	414.	UP
384.	SONAR	415.	V
385.	SOUTH	416.	V-O-C
182.	SPEED	417.	VALUE
386.	SPILL	190.	VELOCITY
183.	SQUARED	83.	VERSION
184.	STAGE	418.	VERTICAL
185.	STANDARD	419.	VIA
37.	STAR	191.	VOLTAGE
387.	STATES	192.	VOLTS
186.	STATION	420.	W
48.	STATUS	193.	WARNING
187.	STORM	421.	WAS
388.	STREAMBED	194.	WATER
389.	SUMMIT	195.	WATTS
390.	SUMP	422.	WE
391.	SUNBURN	196.	WEATHER
392.	SUNDAY	423.	WEDNESDAY
393.	SURFACE	424.	WELCOME
394.	SURFACTANCE	197.	WELL
395.	SYSTEM	425.	WEST
396.	T	426.	WHAT
81.	TABLE	198.	WIND
397.	TAIL	427.	WITH
86.	TEMPERATURE	428.	X
10.	TEN	429.	Y
398.	TESTING	430.	YEAR
399.	THANK	431.	YESTERDAY
400.	THAT	39.	YOU
40.	THE	63.	YOUR
13.	THIRTEEN	432.	Z
21.	THIRTY	0.	ZERO
401.	THIS		
29.	THOUSAND		
3.	THREE		
402.	THRESHOLD		
54.	THRU		
403.	THURSDAY		
188.	TIME		
404.	TING		
405.	TO		
406.	TODAY		
407.	TODAYS		