

## Integrating the RXTX Telependulum MultiLogger Application Note #10

### Overview

The Application Note will provide all of the necessary hardware and software integration information so that RXTX Telependulum may be connected to a Campbell Scientific Control Module, typically the CR10X. This facilitates easier datalogging and management of the Telependulum network.

The Telependulum is an electronic detection instrument designed to measure and record the movements of auscultation pendulum used in various Civil Engineering works: dams, hydro and nuclear power stations, bridges, buildings and rock foundations. The Telependulum can measure horizontal movements in the two axes and in the case of penduli equipped with an additional Invar levelling wire it can also measure vertical movements.

**Note: Measurement and storage of the Telependulum Z, or vertical, output is not supported at this time. Contact Canary Systems if you require storage of this output.**

Refer to the Telependulum Installation and Configuration Manual for more information on the RXTX Telependulum.

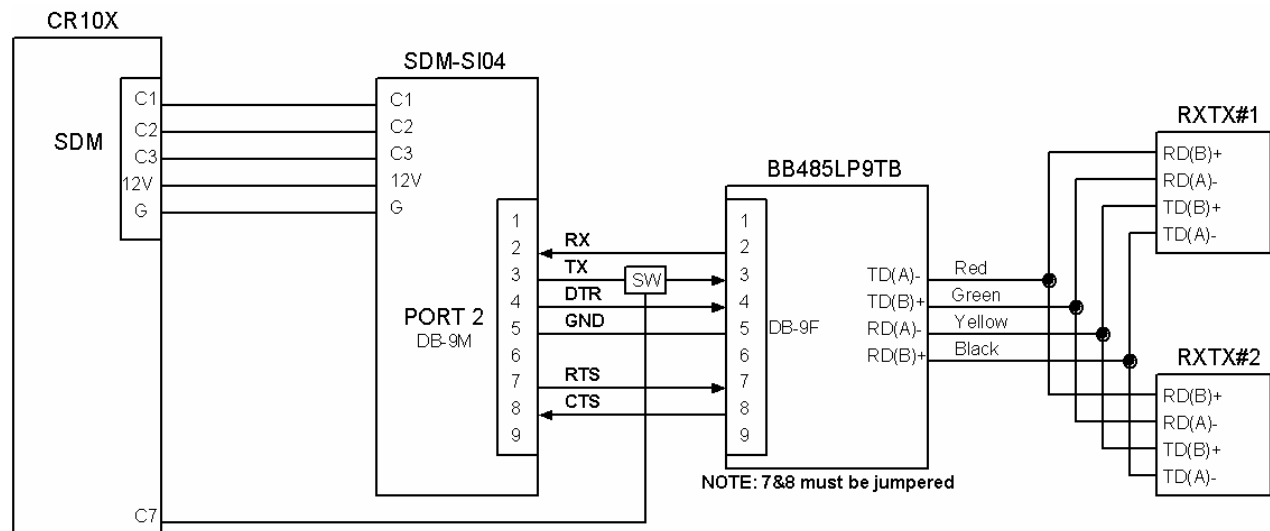
Refer to the MultiLogger User's Guide for more information on the MultiLogger software.

Refer to the Campbell Scientific CR10X Operators Manual for more information on the Control Module.

### Hardware Interface

This Application Note assumes that the RXTX Telependulum is connected to the Campbell Control Module via the slave RS-485 port. Contact RXTX directly to verify installation of the slave RS-485 hardware.

A block diagram of the interface is shown below, this Application Note describes using the B&B Electronics Model 485LP9TB as the RS-485 interface.



Note in the diagram a switch in series with the **TX**, or transmit data line between the SDM-SIO4 and the RS-485 adaptor. This switch is necessary to supply a BREAK signal to the RS-485 network, which resets the network and allows for proper addressing of the RXTX slave units.

Contact Canary Systems to obtain the interface cable which includes the switch circuitry.

### **SDM-SIO4 Programming**

The SDM-SIO4 is a 4-channel serial interface for the Campbell Control Modules. It can be programmed to send the necessary ASCII command strings and then apply "format strings" to process the received characters. With the SDM-SIO4 the Control Module can transmit the strings to configure the Teledulum RS-485 network, address the specific units, send the measurement command and then process the received characters, which include the X and Y measurements. The SDM-SIO4 must be programmed prior to deployment with the Teledulum network. The programming is retained in a battery backed memory so it can be done in the office prior to deployment in the field.

To program the SDM-SIO4 you will need to connect 12V power to the screw terminals on the SDM-SIO4, you will need a DB-9 null-modem cable and a PC running Hyperterminal, or other suitable terminal emulation software.

Connect the serial port on a PC to the SDM-SIO4 port labeled PORT1. Start a communication program such as Hyperterminal, configure it for the proper serial port, 9600 baud, 8 data bits, 1 stop bit. After making all cable connections and configuring the communication program, press the small momentary push-button switch located on the SDM-SIO4 next to the Status LED (The Status LED should light momentarily while pressing the button, if it does not then check your power connections to the SDM-SIO4). If all the connections are correct and the communications program is operating and configured properly you will see the **SDMSIO4->** prompt returned by the unit. You are now in command mode.

Three types of commands are used to configure the output format strings (used to send commands to the RXTX network) and the input string (to format and process the output of the RXTX network), these are the **strst** (for string string I guess), **fmtst** (for format string) and **fltst** (for filter string) commands respectively.

The format for these commands is as follows: **command nnn parameter** where "command" is "strst", "fmtst" or "fltst", "nnn" is the filter string number (between 0 and 255) and "parameter" is the value for the string, in quotes. An example is **strst 1 "TP+1^M"**, this command sets filter string #1 to be an output string with the characters "TP+1" followed by a carriage return. This string is used to address the first RXTX in the network. The complete list of output strings and filters that need to be programmed into the SDM-SIO4 follow.

To verify a string entered use the **strrd** command, format is **strrd nnn**, where nnn is the string to display.

To exit the command mode of the SDM-SIO4 use the **exit** command.

See the SDM-SIO4 Operators Manual for a complete list of commands and other details concerning the operation of the unit.

**Note: This Application Note assumes that the default SDM address of 0 will be used. If there are other SDM devices attached to the Control Module it is highly recommended to use address 0 for the SDM-SIO4. Otherwise the Teledulum instruction files must be modified to specify the alternate SDM-SIO4 address.**

Command	Description
strst 1 "TP_01^M"	Select RXTX Pendulum #1
strst 2 "TP_02^M"	Select RXTX Pendulum #2
strst 3 "TP_03^M"	Select RXTX Pendulum #3
strst 4 "TP_04^M"	Select RXTX Pendulum #4
strst 5 "TP_05^M"	Select RXTX Pendulum #5
strst 6 "TP_06^M"	Select RXTX Pendulum #6
strst 7 "TP_07^M"	Select RXTX Pendulum #7
strst 8 "TP_08^M"	Select RXTX Pendulum #8
strst 9 "TP_09^M"	Select RXTX Pendulum #9
strst 10 "TP_10^M"	Select RXTX Pendulum #10
strst 11 "TP_11^M"	Select RXTX Pendulum #11
strst 12 "TP_12^M"	Select RXTX Pendulum #12
strst 13 "TP_13^M"	Select RXTX Pendulum #13
strst 14 "TP_14^M"	Select RXTX Pendulum #14
strst 15 "TP_15^M"	Select RXTX Pendulum #15
strst 16 "TP_16^M"	Select RXTX Pendulum #16
strst 17 "P^M"	Measurement command.
strst 220 "5^M^M"	Select 1200 baud (not used)
strst 221 "10^M^M"	Select 2400 baud (not used)
strst 222 "12^M^M"	Select 9600 baud
strst 223 "16^M^M"	Select 19200 baud (not used)
strst 224 "&&&&^M"	Attention command
fltst 225 "t[DZ]n22FCF"	Filter string to process X, Y results, returns 2 values.
fltst 226 "t[DZ]n2FCFCFCFCFCFCFCFCF"	Filter string to process X, Y, Z results in addition to date/time stamp, returns 9 values. (not used)

### **Telependulum Programming**

The Telependulums in the network must have their ID's configured to match the list shown above, where RXTX #1 is programmed with ID TP\_01, #2 is ID TP\_02, etc. The Telependulum's are usually programmed using the DB-25 Console Port, a standard serial cable connection to a PC and the software Hyperterminal. Hyperterminal should be configured for 9600 baud, 8 data bits, 1 stop bit and no parity. Press <ENTER> on the PC after powering up the Telependulum and making the cable connections. You should see the console menu returned by the Telependulum. Use the **PW** command to enter the password, the default is **RXTX**. Use the **CF** command to enter the configuration menu, then select **CH** to change the Logical RS-485 ID. See the Telependulum Installation and Configuration Manual for more information.

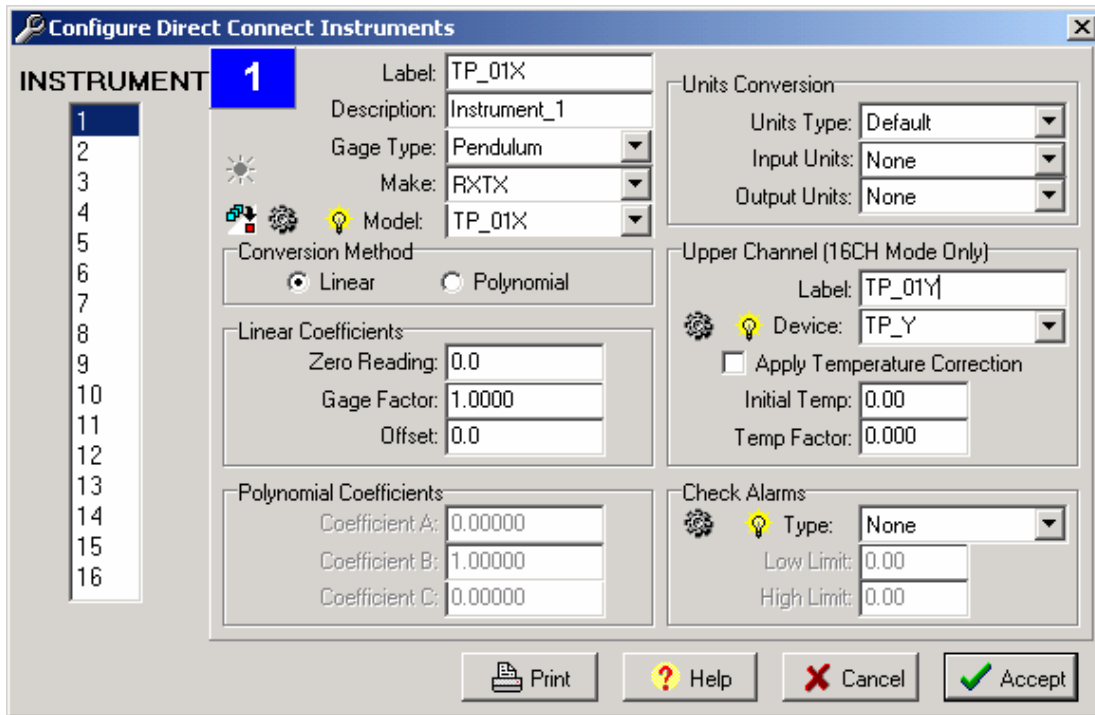
**Note: There are also 2 sets of DIP switches in the Telependulum which configure various hardware and software options. This Application Note assumes the default switch settings.**

### **MultiLogger Configuration**

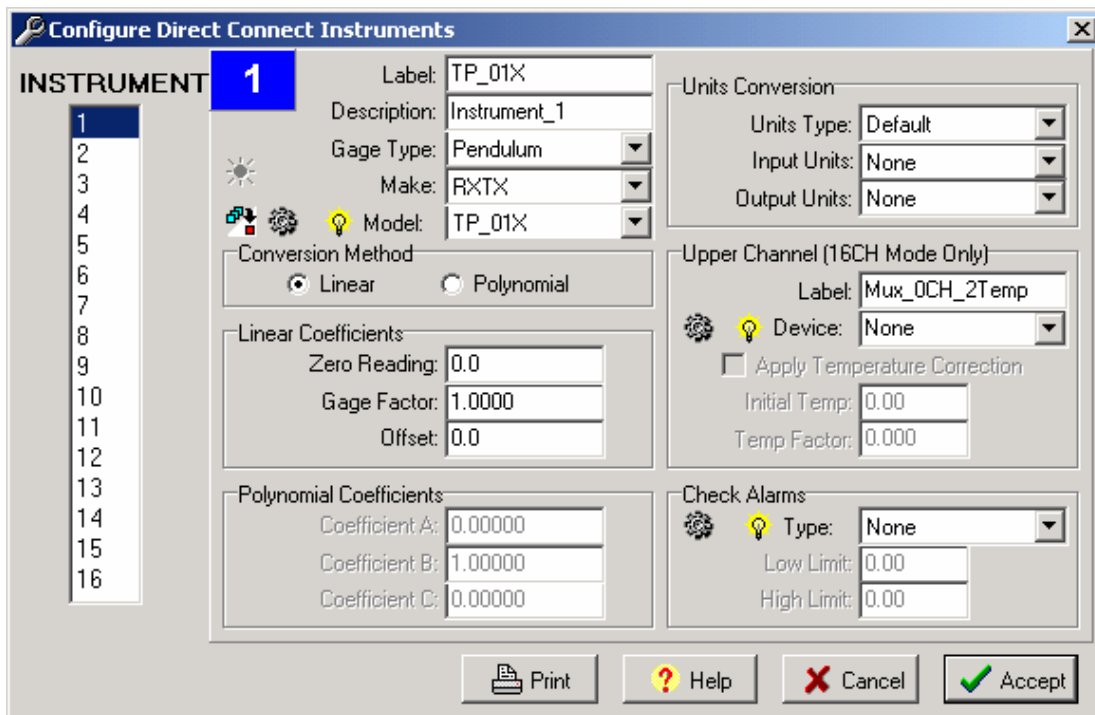
Your system can be programmed to read and store the Telependulum X and Y outputs using MultiLogger.

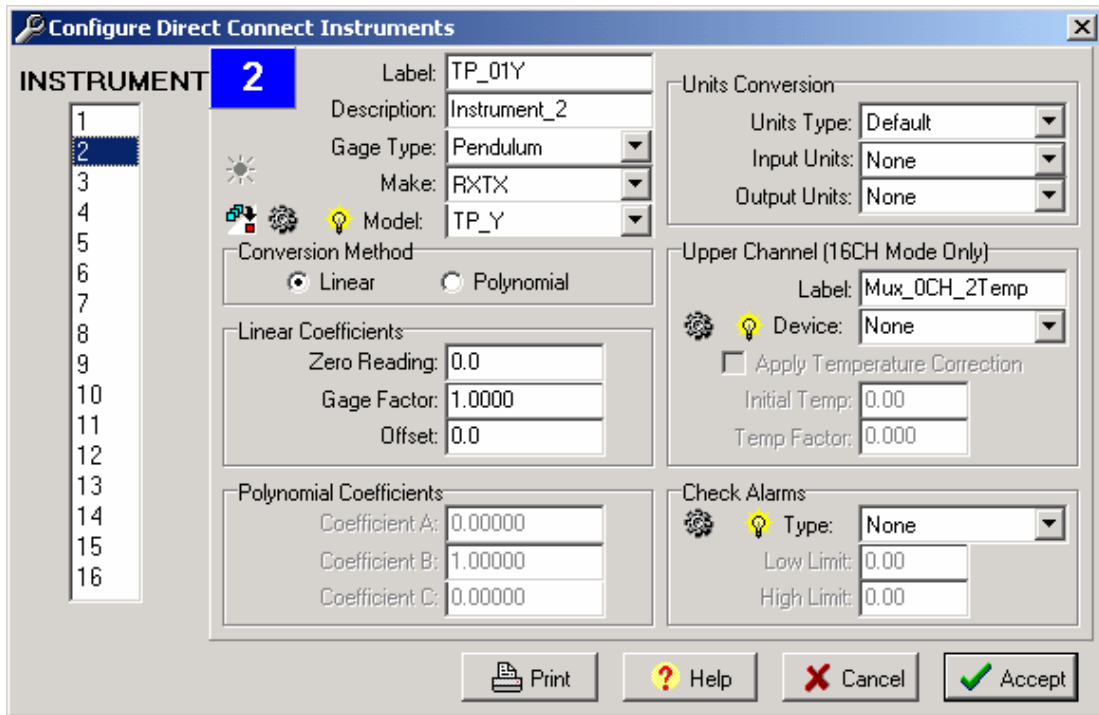
You may configure the reading of the Telependulums using the **Configure Direct Connect Instruments** menu item. Beginning with MultiLogger version 2.1.0 you may read and store the X and Y outputs from up to 16 Telependulums, prior to version 2.1.0 the maximum was 8. If scaling factors must be entered for each output then the maximum is 8 Telependulums. Contact Canary Systems if you must read more than 16 (or 8 with scaling factors) Telependulums. **Note: The RXTX gage types were updated beginning with version 2.1.0, these updates must be obtained for the system to function properly.** Contact Canary Systems to obtain these updates.

Select the menu item **Configure | Direct Connect Instruments** to display the channel configuration form. To configure the X and Y measurements on a single instrument channel use the selections shown.



If scaling factors must be applied then each channel will have either the X or Y output configured, as shown in the following screenshots.





### **RXTX Instruction File**

The X output instruction file can be loaded into the editor by clicking the gear button located to the left of the selected **Model** option (there are actually 16 different versions of this file, the only difference is which addressing command is sent to the Teledendulum network). The instruction file to read the X output from the first Teledendulum is listed below.

```

;-----
;Instruction file to interrogate the RXTX network and extract the X and Y results
;
;Canary Systems, Inc.
;Created April 17, 2001
;Revised March 27,2002
;-----

;Configure Ports - C7 for 1 second pulse
P20 Set Port(s) ;
1:[9699 ] C8,C7,C6,C5 Options ;
2:[9999 ] C4,C3,C2,C1 Options ;

;Make sure we configure the SDM-SIO4 so that the BRK will be transmitted!
;RTS must be set for the RS-485 adaptor to be enabled.
P113 SDM-SIO4 ;
1:[1 ] Reps ;
2:[0 ] Address ;
3:[2 ] P113 SDMSIO4 Mode (Send/Receive Port 2) ;
4:[2049 ] Command ;
5:[3146 ] 1st Parameters ;
6:[0 ] 2nd Parameters ;
7:[0 ] Values per Rep ;
8:[0 ] Loc ;
9:[1 ] Mult ;
10:[0 ] Offset ;

```

```

P22      Excitation with Delay ;
1:[3      ]      Ex Channel      ;
2:[0      ]      Delay W/Ex (units = 0.01 sec) ;
3:[1      ]      Delay After Ex (units = 0.01 sec) ;
4:[0      ]      mV Excitation ;

;Send CTRL-BRK
P86      Do      ;
1:[77     ]      Command Code Option (Pulse Port 7) ;

;Flush our receive buffers
P113     SDM-SIO4 ;
1:[1      ]      Reps      ;
2:[0      ]      Address ;
3:[2      ]      P113 SDMSIO4 Mode (Send/Receive Port 2) ;
4:[3      ]      Command ;
5:[0      ]      1st Parameters ;
6:[0      ]      2nd Parameters ;
7:[0      ]      Values per Rep ;
8:[0      ]      Loc      ;
9:[1      ]      Mult     ;
10:[0     ]      Offset   ;

P22      Excitation with Delay ;
1:[3      ]      Ex Channel      ;
2:[0      ]      Delay W/Ex (units = 0.01 sec) ;
3:[1      ]      Delay After Ex (units = 0.01 sec) ;
4:[0      ]      mV Excitation ;

;Now set up normal communication - 8 data bits, 1 stop, 9600 baud
P113     SDM-SIO4 ;
1:[1      ]      Reps      ;
2:[0      ]      Address ;
3:[2      ]      P113 SDMSIO4 Mode (Send/Receive Port 2) ;
4:[2049   ]      Command ;
5:[1146   ]      1st Parameters ;
6:[0      ]      2nd Parameters ;
7:[0      ]      Values per Rep ;
8:[0      ]      Loc      ;
9:[1      ]      Mult     ;
10:[0     ]      Offset   ;

P22      Excitation with Delay ;
1:[3      ]      Ex Channel      ;
2:[0      ]      Delay W/Ex (units = 0.01 sec) ;
3:[10     ]      Delay After Ex (units = 0.01 sec) ;
4:[0      ]      mV Excitation ;

;Send the communication speed to the RXTX network
P113     SDM-SIO4 ;
1:[1      ]      Reps      ;
2:[0      ]      Address ;
3:[2      ]      P113 SDMSIO4 Mode (Send/Receive Port 2) ;
4:[2304   ]      Command ;
5:[8222   ]      1st Parameters ;
6:[0      ]      2nd Parameters ;
7:[0      ]      Values per Rep ;
8:[0      ]      Loc      ;
9:[1      ]      Mult     ;
10:[0     ]      Offset   ;

P22      Excitation with Delay ;
1:[3      ]      Ex Channel      ;
2:[0      ]      Delay W/Ex (units = 0.01 sec) ;
3:[300    ]      Delay After Ex (units = 0.01 sec) ;
4:[0      ]      mV Excitation ;

```

```

;Send the addressing command
;This command is the only difference between ins files
P113   SDM-SIO4           ;
1:[1   ]                 ]     Reps   ;
2:[0   ]                 ]     Address ;
3:[2   ]                 ]     P113 SDMSIO4 Mode (Send/Receive Port 2) ;
4:[2304]                 ]     Command ;
5:[8001]                 ]     1st Parameters ;Only difference between ins files!
6:[0   ]                 ]     2nd Parameters ;
7:[0   ]                 ]     Values per Rep ;
8:[0   ]                 ]     Loc     ;
9:[1   ]                 ]     Mult   ;
10:[0  ]                 ]     Offset  ;

P22    Excitation with Delay ;
1:[3   ]                 ]     Ex Channel ;
2:[0   ]                 ]     Delay W/Ex (units = 0.01 sec) ;
3:[300 ]                 ]     Delay After Ex (units = 0.01 sec) ;
4:[0   ]                 ]     mV Excitation ;

;Send the attention command
P113   SDM-SIO4           ;
1:[1   ]                 ]     Reps   ;
2:[0   ]                 ]     Address ;
3:[2   ]                 ]     P113 SDMSIO4 Mode (Send/Receive Port 2) ;
4:[2304]                 ]     Command ;
5:[8224]                 ]     1st Parameters ;
6:[0   ]                 ]     2nd Parameters ;
7:[0   ]                 ]     Values per Rep ;
8:[0   ]                 ]     Loc     ;
9:[1   ]                 ]     Mult   ;
10:[0  ]                 ]     Offset  ;

P22    Excitation with Delay ;
1:[3   ]                 ]     Ex Channel ;
2:[0   ]                 ]     Delay W/Ex (units = 0.01 sec) ;
3:[300 ]                 ]     Delay After Ex (units = 0.01 sec) ;
4:[0   ]                 ]     mV Excitation ;

;Now send the P command and process result
P113   SDM-SIO4           ;
1:[1   ]                 ]     Reps   ;
2:[0   ]                 ]     Address ;
3:[2   ]                 ]     P113 SDMSIO4 Mode (Send/Receive Port 2) ;
4:[2304]                 ]     Command ;
5:[8017]                 ]     1st Parameters ;
6:[9225]                 ]     2nd Parameters ;
7:[0   ]                 ]     Values per Rep ;
8:[0   ]                 ]     Loc     ;
9:[1   ]                 ]     Mult   ;
10:[0  ]                 ]     Offset  ;

P22    Excitation with Delay ;
1:[3   ]                 ]     Ex Channel ;
2:[0   ]                 ]     Delay W/Ex (units = 0.01 sec) ;
3:[500 ]                 ]     Delay After Ex (units = 0.01 sec) ;
4:[0   ]                 ]     mV Excitation ;

;Now get the results
P113   SDM-SIO4           ;
1:[1   ]                 ]     Reps   ;
2:[0   ]                 ]     Address ;
3:[2   ]                 ]     P113 SDMSIO4 Mode (Send/Receive Port 2) ;
4:[4   ]                 ]     Command ;
5:[0   ]                 ]     1st Parameters ;
6:[0   ]                 ]     2nd Parameters ;
7:[2   ]                 ]     Values per Rep ;
8:[ScratchLoc1]         ]     Loc     ;
9:[1   ]                 ]     Mult   ;
10:[0  ]                 ]     Offset  ;

```

```

;Make sure we configure the SDM-SIO4 so that the BRK will be transmitted!
;RTS must be set for the RS-485 adaptor to be enabled.
P113   SDM-SIO4           ;
1:[1   ]                 ]   Reps   ;
2:[0   ]                 ]   Address ;
3:[2   ]                 ]   P113 SDMSIO4 Mode (Send/Receive Port 2)   ;
4:[2049]                 ]   Command ;
5:[3146]                 ]   1st Parameters ;
6:[0   ]                 ]   2nd Parameters ;
7:[0   ]                 ]   Values per Rep ;
8:[0   ]                 ]   Loc    ;
9:[1   ]                 ]   Mult   ;
10:[0  ]                 ]   Offset ;

P22    Excitation with Delay ;
1:[3   ]                 ]   Ex Channel   ;
2:[0   ]                 ]   Delay W/Ex (units = 0.01 sec) ;
3:[1   ]                 ]   Delay After Ex (units = 0.01 sec)   ;
4:[0   ]                 ]   mV Excitation ;

;Reset the network
P86    Do                ;
1:[77  ]                 ]   Command Code Option (Pulse Port 7)   ;

;Copy our X to ReadingLoc
P31    Z=X               ;
1:[ScratchLoc1]         ]   X Loc   ;
2:[ReadingLoc  ]         ]   Z Loc   ;

```

The Y output instruction file is very simple, it simply copies the result obtained using the previously executed X output instruction file.

```

;-----
;Instruction file to copy the Y result from a previous read to our ReadingLoc;
;Canary Systems, Inc.
;April 17, 2001
;Alex Neuwirt
;-----
;Copy our Y to ReadingLoc
P31    Z=X               ;
1:[ScratchLoc2]         ]   X Loc   ;
2:[ReadingLoc  ]         ]   Z Loc   ;

```

## **Documentation**

The following documents provide more information on the individuals of the system. Contact Canary Systems to obtain these documents.

- Teledendum Installation and Configuration Manual
- MultiLogger User's Guide
- CR10X Operators Manual
- SDM-SIO4 Operators Manual
- Model 485LP9TB Application Note