



May 26, 2011

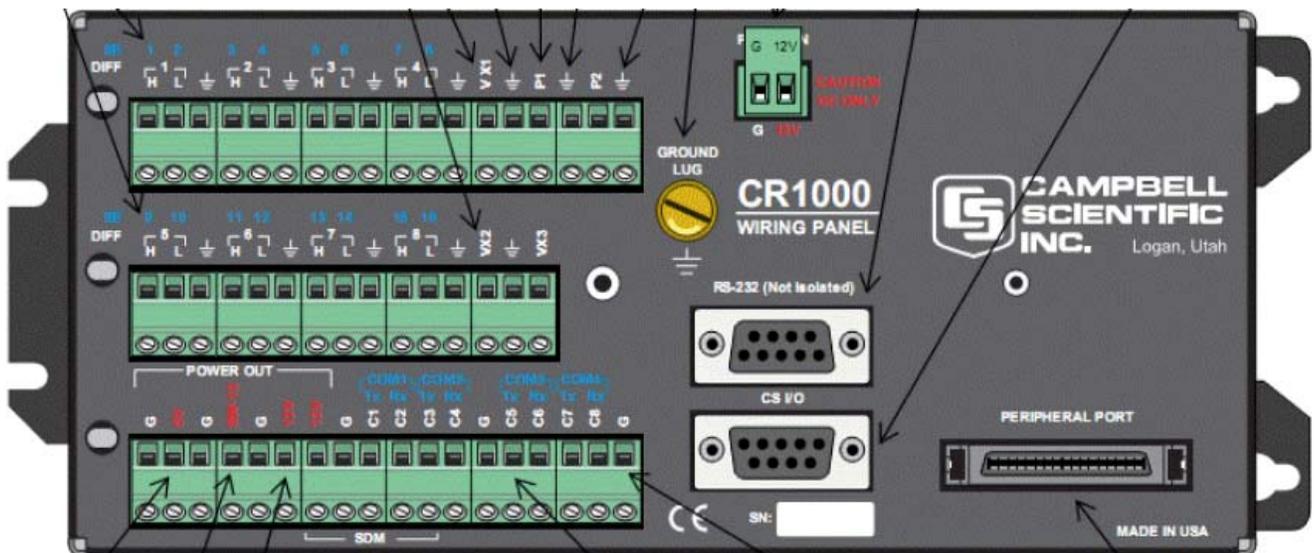
The SolarTrak® Prospector™

Instructions for Wiring and Data Collection

Using the

CR-1000 Datalogger

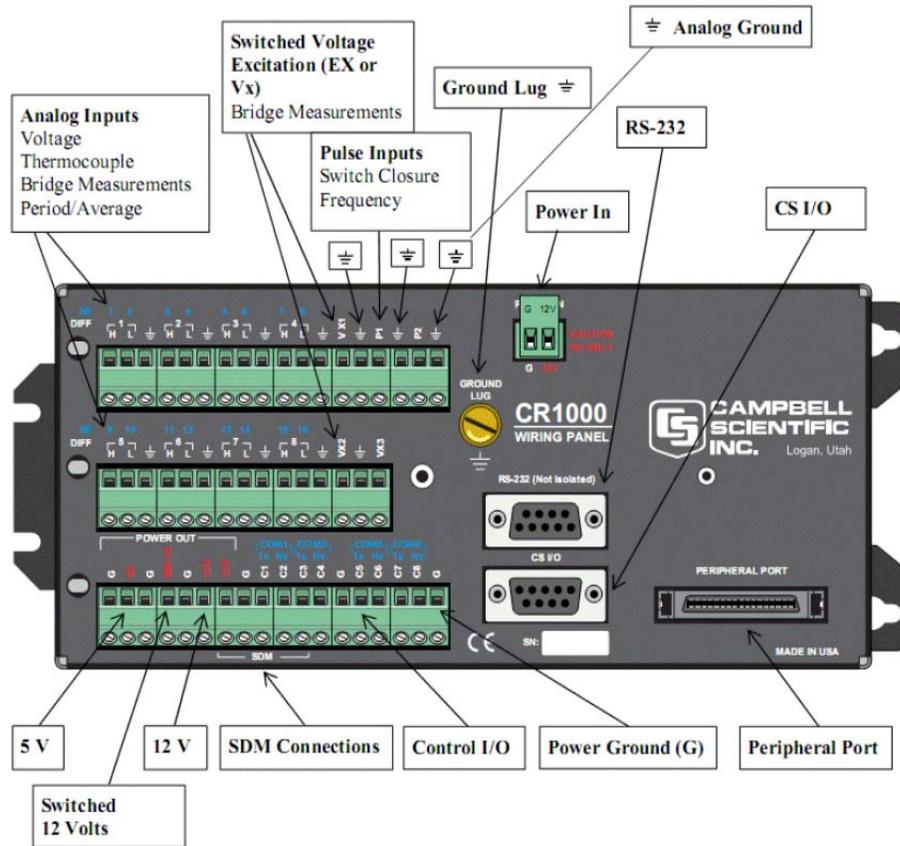
by Campbell Scientific, Inc.



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Complete information on the use and options for the CSI CR-1000 is available in the 'CR1000 Datalogger Manual.pdf' provided on the documentation CD and on the Campbell Scientific website at www.campbellsci.com ...



The CRBasic program provided with your Prospector already reflects both the input wiring assignments and the calibration factors of any instruments delivered with the unit. If additional instruments are added or changed, calibration factors must be entered into the code, re-compiled and uploaded to the datalogger. The following is an example wiring input map for a standard Prospector as found at the beginning the CRBasic code provided on the documentation CD.

'
'
Input Channel Usage:

' **Diff 01 = N/C**

' **S.E. 01 (1H) = NRG #200P Wind Direction**

' **S.E. 02 (1L) = NRG #110S Air Temperature**

' **Diff 02 = N/C**

' **S.E. 03 (2H) = NRG 2047 Relative Humidity**

' **S.E. 04 (2L) = NRG #BP20 Pressure**

' **Diff 03 = N/C**

' **S.E. 05 (3H) = N/C**

' **S.E. 06 (3L) = N/C**

' **Diff 04 = N/C**

' **S.E. 07 (4H) = N/C**

' **S.E. 08 (4L) = SolarTrak System Battery - STBatt**

' **Diff 05 = Hukseflux DR-01 Pyrheliometer #1**

' **Diff 06 = Hukseflux SR-11 Pynometer #1**

' **Diff 07 = Hukseflux SR-11 Pynometer #2**

' **S.E. 13 (7H) = N/C**

' **S.E. 14 (7L) = N/C**

' **Diff 08 = N/C**

' **S.E. 15 (8H) = N/C**

' **S.E. 16 (8L) = N/C**

'
Pulse Input Channel Usage:

' **P1 = NRG #40H Wind Speed w/pull-up**

' **P2 = NovaLYNX Rainfall w/pull-up**
'

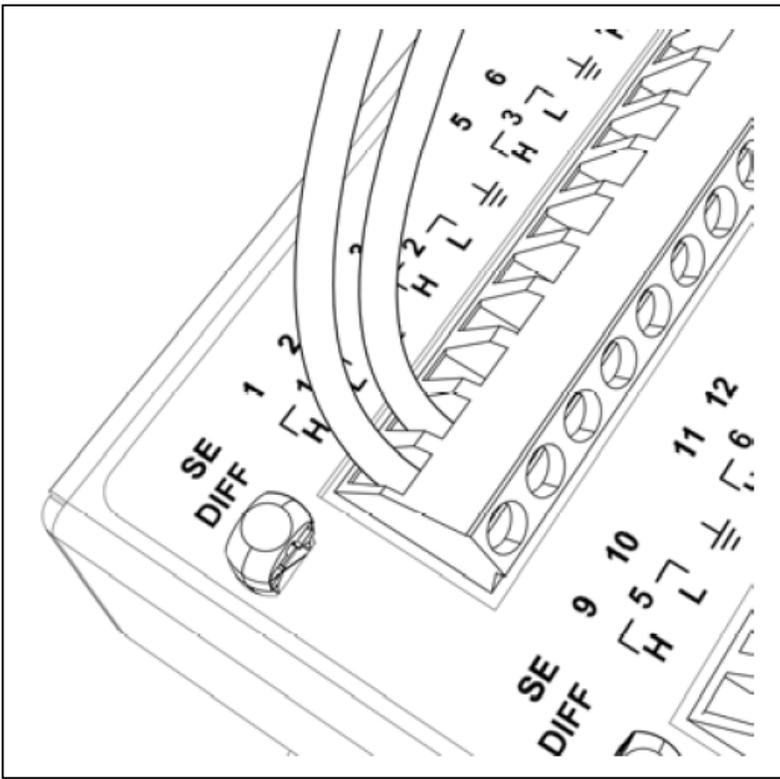
Table 1. Single-ended and Differential Input Channels

<i>Differential Channel</i>	<i>Single-Ended Channel</i>
1H 1L	1 Wind Direction - Green 2 Temperature - White
2H 2L	3 Relative Humidity - White 4 Barometric Pressure - White
3H 3L	5 6
4H 4L	7 8 SolarTrak Battery - Green
5H Pyrheliometer #1 - White 5L Pyrheliometer #1 - Green	9 10
6H Pynometer #1 - White 6L Pynometer #1 - Green	11 12
7H Pynometer #2 - White 7L Pynometer #2 - Green	13 14
8H 8L	15 16

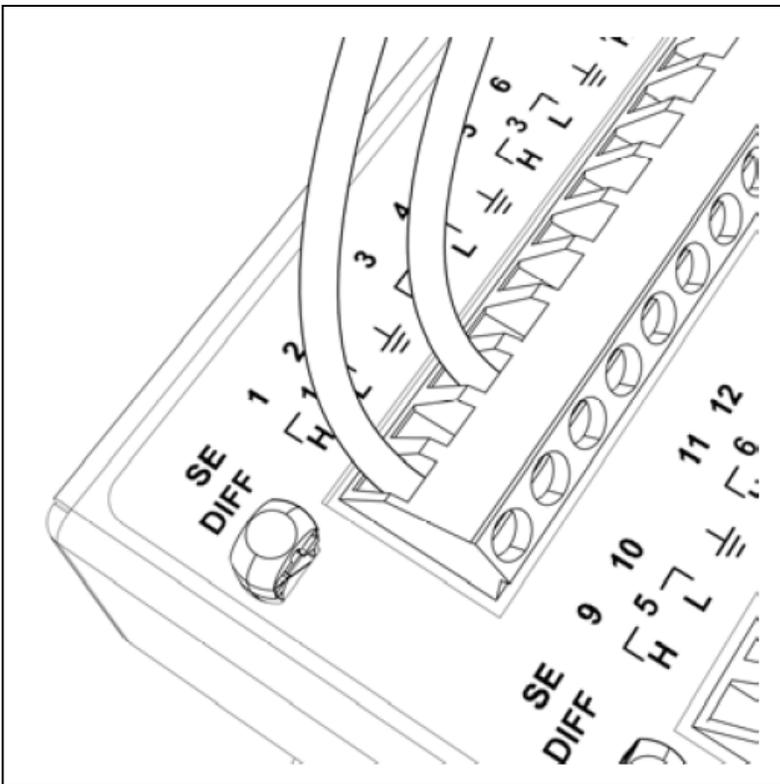
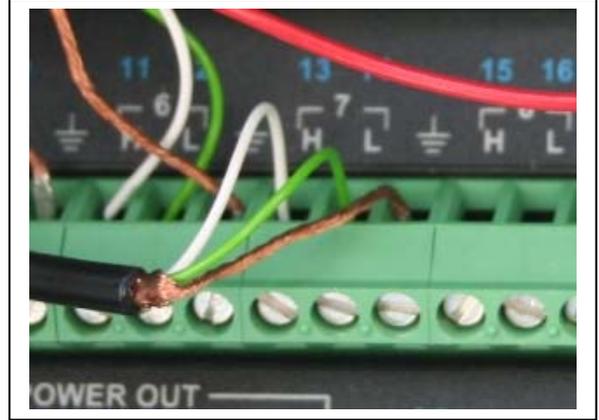
Pulse Channels

P1 – Anemometer #1 – Green – with 10K pull-up resistor

P2 – Rain Bucket – Red – with 10K pull-up resistor



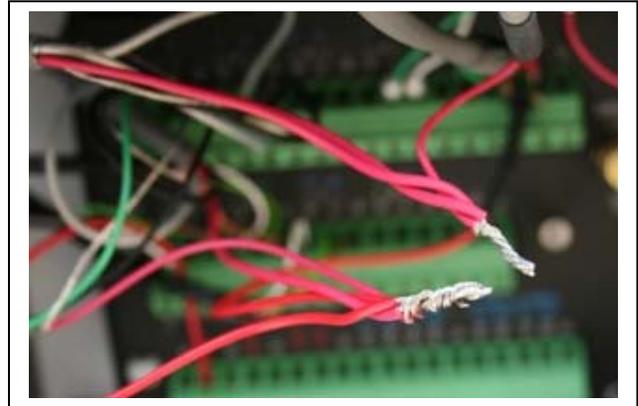
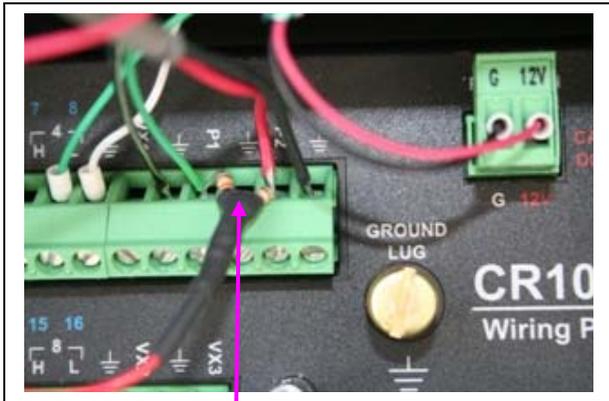
A typical differential input connection – to the left, Diff. #1 – and below in the picture, Diff. #7 – there will usually also be a braided shield wire that is connected to the ground terminal (\perp) next to it.



A typical single-ended input connection – this one to S.E. #1 – there will usually also be a braided shield wire that is connected to the ground terminal (\perp) next to it along with the standard ground reference wire... all ground wires going into a single grounding terminal should be twisted together before inserting into the terminal block to reduce the possibility of 'whiskers'.



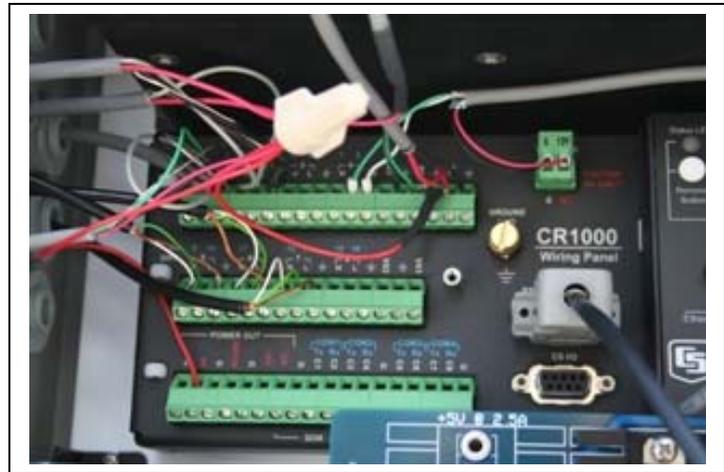
Five of the six weather instruments require 5 VDC power. In each case, except for the rain bucket, the red wire will need to be attached to the +5 V terminal on the datalogger... the unit is shipped with a single red wire already attached to the 5V terminal... this wire and a second wire attached to the two pull-up resistors will be joined with the five power leads of the weather instruments.



Two pull-up Resistors join the Wind Speed input in P1 and the Rain Bucket input in P2... the other end of the pull-up resistor wire joins the other 5V power leads in the wire nut...

It will be easier to install the wire nut if the 5V wires are twisted into two bundles of 3 or four leads each...

Then combine the two bundles and twist on the wire nut.



Instrument	Power Lead	Ground	Shield	Signal	Terminal
Temperature	Red	Black	Bare	White	S.E. #2
Barometric Pressure	Red	Black	Bare	White	S.E. #4
Relative Humidity	Red	Black	Bare	White	S.E. #3
Wind Speed	Red	Black	None	Green	P1
Wind Direction	Red	Black	None	Green	S.E. #1
Rain Bucket	None	Black	None	Red	P2
SolarTrak Battery Level Signal	None	White	None	Green	S.E. #8

Further down in the CRBasic code from the initial port assignment list will be a list of constants that define the calibration factors. Two versions of this table exist, the latest being more straightforward in its programming.

Original Version

```
*****  
Declare Constants  
*****  
Const Pynrometer1 = 77.51938 ' SR-11 S/N 7040 - Sensitivity 12.90 - Multiplier is 1000 / Cal Factor of sensor  
Const Pyrheliometer1 = 99.502488 ' DR-01 S/N 8014 - Sensitivity 10.05 - Multiplier is 1000 / Cal Factor of sensor  
Const Pynrometer2 = 77.51938 ' SR-11 S/N 7040 - Sensitivity 12.90 - Multiplier is 1000 / Cal Factor of sensor  
Const PressSlope = 0.02179 ' Slope is supplied on Calibration Report for NRG BP20 Sensor / 1000  
Const PressOffset = 10.54 ' Offset is supplied on Calibration Report for NRG BP20 Sensor  
Const STBattConv = 0.0061 ' Conversion is for 51K/10K voltage divide.
```

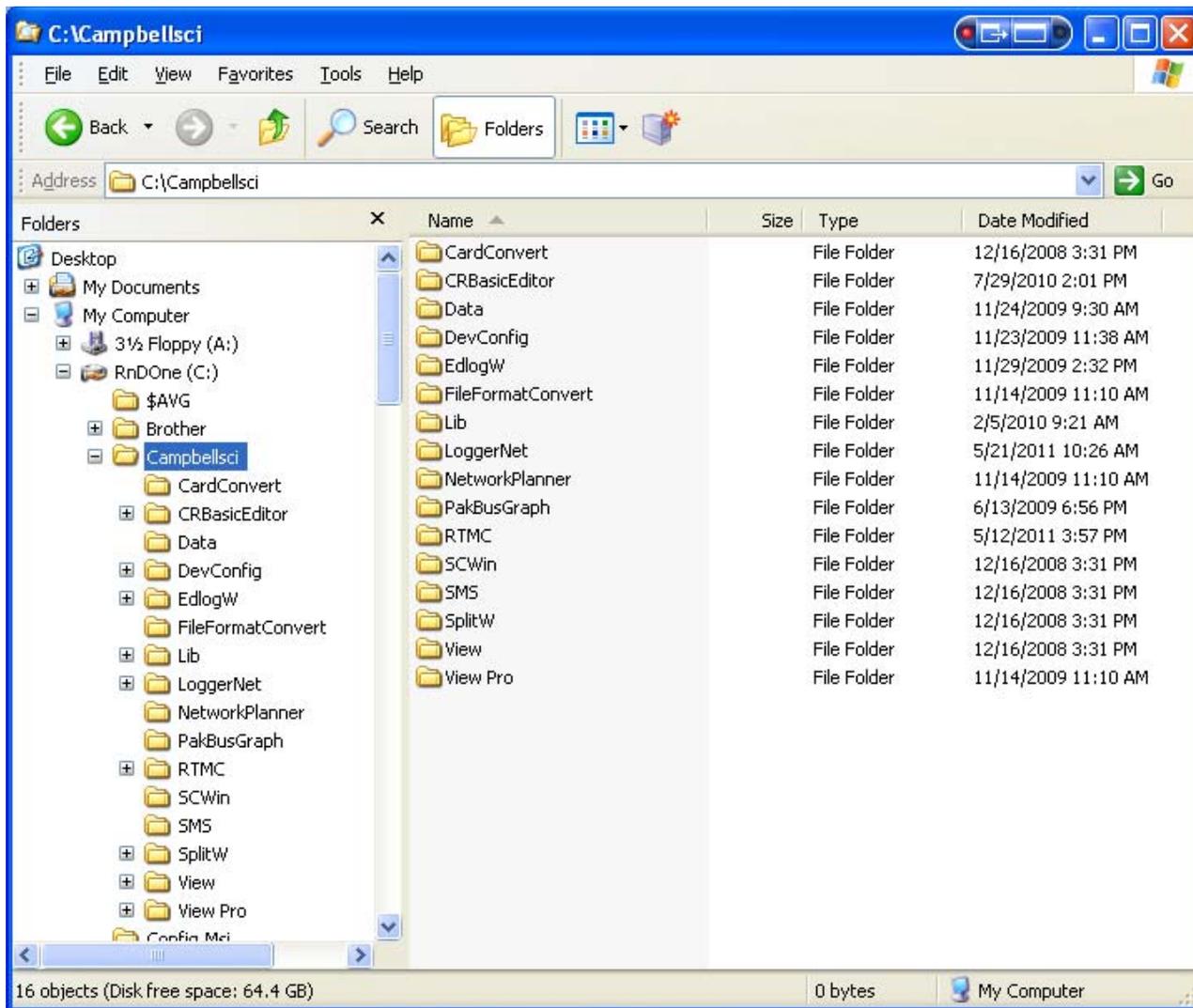
This version requires doing a computation to convert the sensitivity of the radiation sensors to Watts per square meter per millivolt and the pressure slope of the barometric pressure transducer to Kilo-Pascals per millivolt.

Latest Version

```
*****  
Declare Constants  
*****  
Const Pyro1Sensitivity = 8.53 ' uV / W / M^2 ... DR-01 S/N 8009 Direct Normal Insolation  
Const Rad1Sensitivity = 16.90 ' uV / W / M^2 ... SR-11 S/N 7093 Horizontal Diffuse  
Const Rad2Sensitivity = 15.80 ' uV / W / M^2 ... SR-11 S/N 7087 Total P-O-A  
Const Rad3Sensitivity = 0.0 ' uV / W / M^2 ... SR-11 S/N 70yy  
Const Rad4Sensitivity = 0.0 ' uV / W / M^2 ... SR-11 S/N 70yy  
  
Const PressSlope = 21.79 ' kPa / V Slope is supplied on Calibration Report for NRG BP20 Sensor  
Const PressOffset = 10.64 ' kPa Offset is supplied on Calibration Report for NRG BP20 Sensor  
  
Const STBattConv = 0.0061 ' Conversion is for 51K/10K voltage divide.
```

The newer version of code will directly accept the actual sensitivity in microvolts per watt per meter squared and perform the required computations elsewhere in the code. The Pressure slope is also taken directly from the calibration sheet of the manufacturer in kPa per Volt as well as the offset. It is the offset that changes from sensor to sensor.

To make these code changes, first install the LoggerNet software using the CSI LoggerNet V4.0 installation CD. The installation leaves two icons on your desktop; one labeled 'Device Configuration Utility' and the other, 'LoggerNet'. A folder named 'Campbellsci' will be created off the root drive. Within it are data storage folders for the various data manipulation utilities. There are only three that will come into play within these instructions... 'LoggerNet', 'CRBasicEditor' and 'RTMC'.



Downloaded data will default to the 'LoggerNet' folder although another can be defined when setting up the data file information in 'Setup' (see below). CRBasic files (extension *.CR1) generally reside in CRBasicEditor and the Real-time Monitor screen definitions (*.rtmc2) go to RTMC. When retrieving files such as CRBasic code, a dialog box will ask for a place to store them so this will be the local directory tree you're working with.

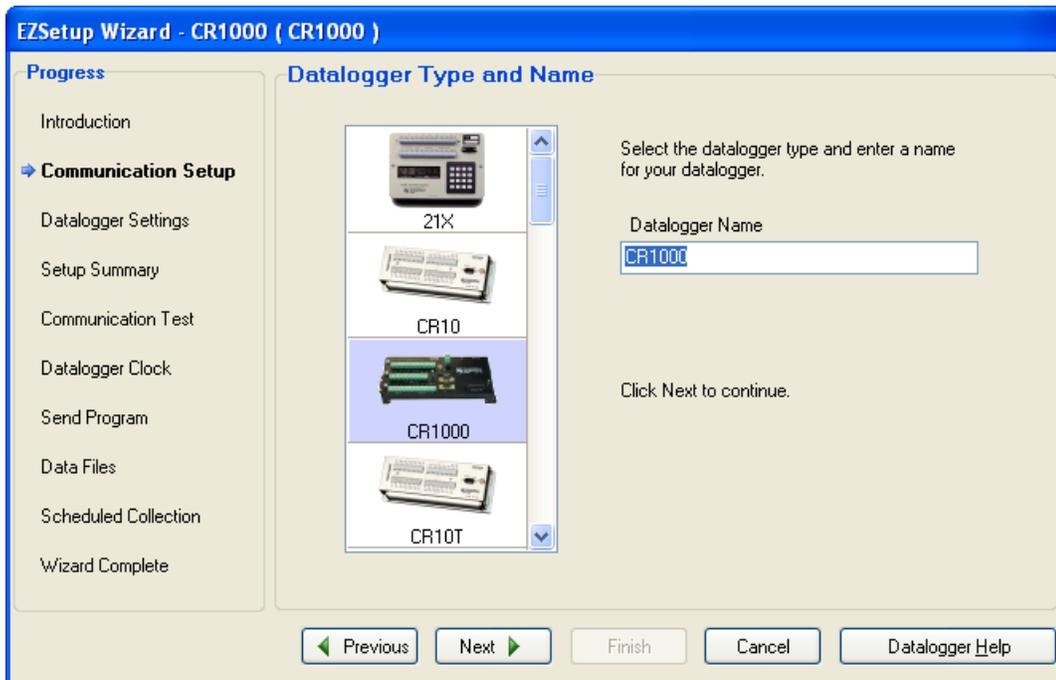
Start up the LoggerNet software using the 'LoggerNet' desktop icon provided to get the following window.



As you move the mouse over the left column categories you will see the right column change to present various operational utilities. i.e.: Move the cursor over 'MAIN' then move straight to the right to access the 'Main' category menu selections'

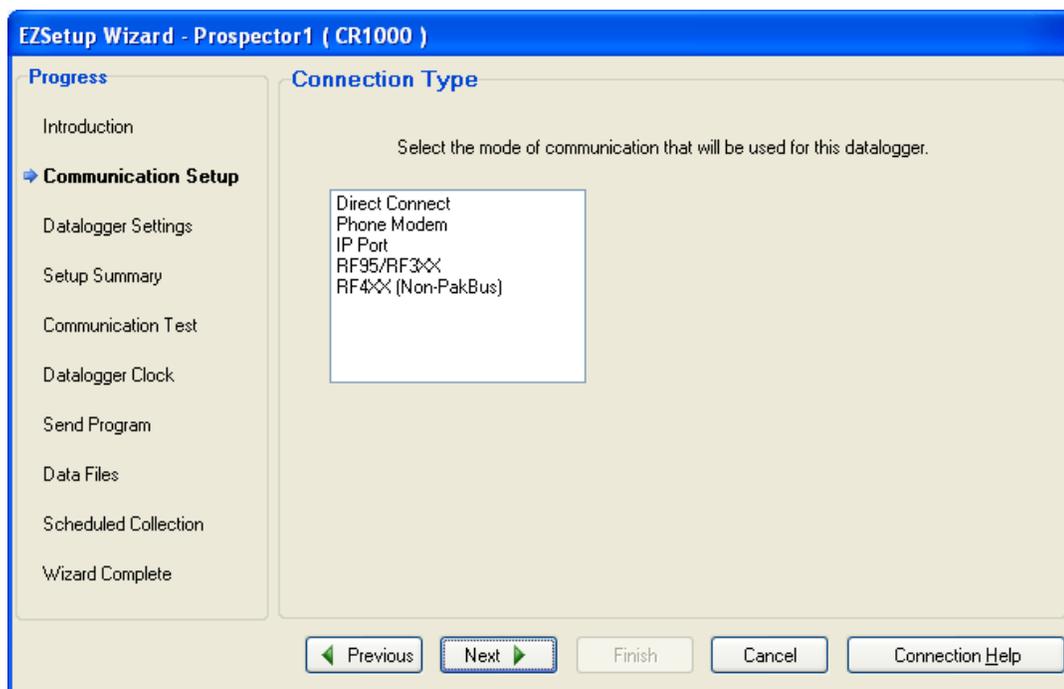
In order to proceed, you will first need to 'Setup' LoggerNet to talk to your CR-1000 datalogger. Click 'Setup' on this window found under the 'Main' menu selections then click 'Add' on the menu bar to get the following dialog box: Then click 'Next'.





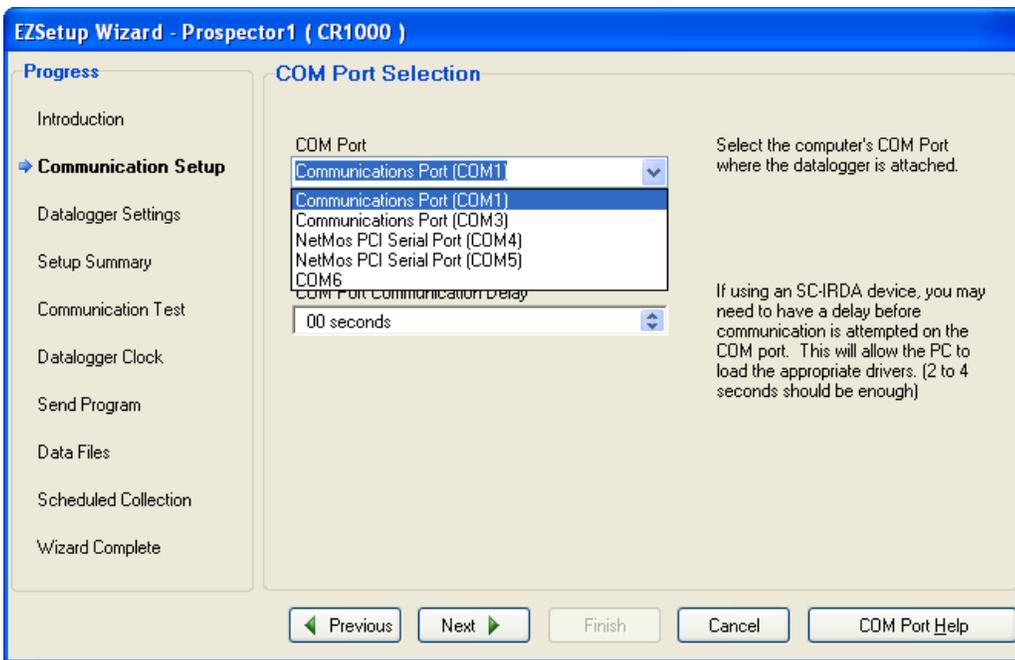
Select the CR1000 from the picture menu selections then change the highlighted 'CR1000' to 'Prospector1' and click 'Next'...

Select 'Direct Connect' if you choose to use a serial cable or IP Port for an Ethernet hookup.

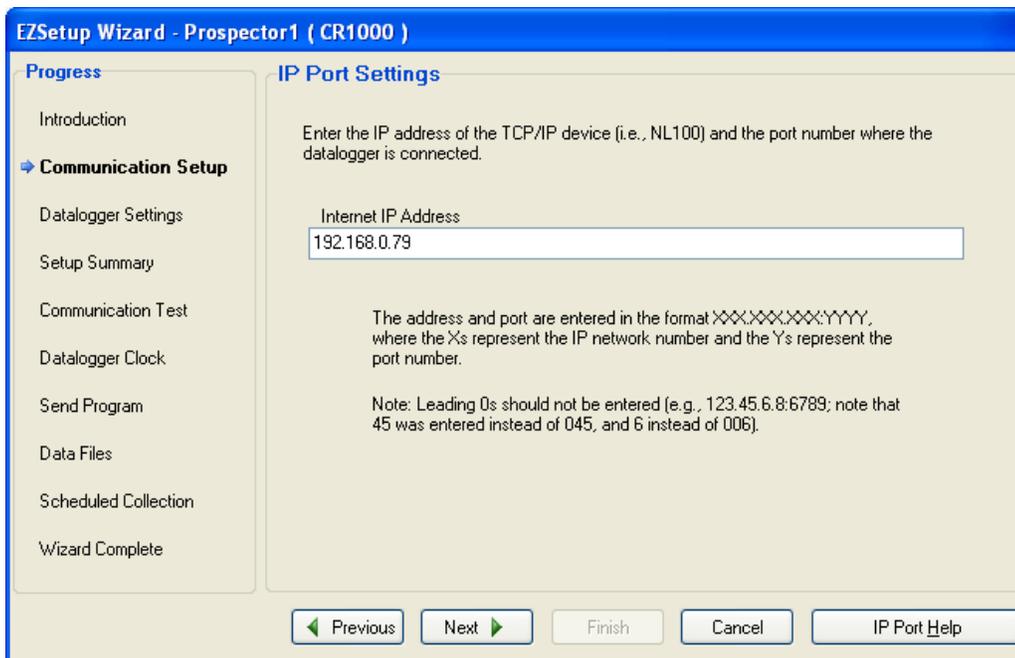


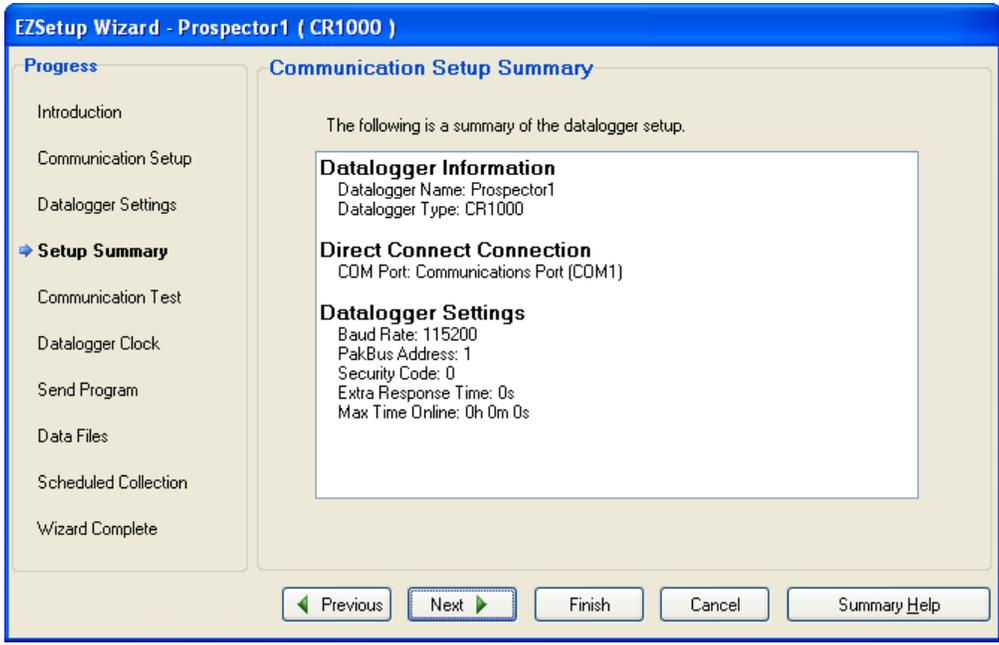
...then click 'Next'...

Choose the appropriate serial communications port and click 'Next'

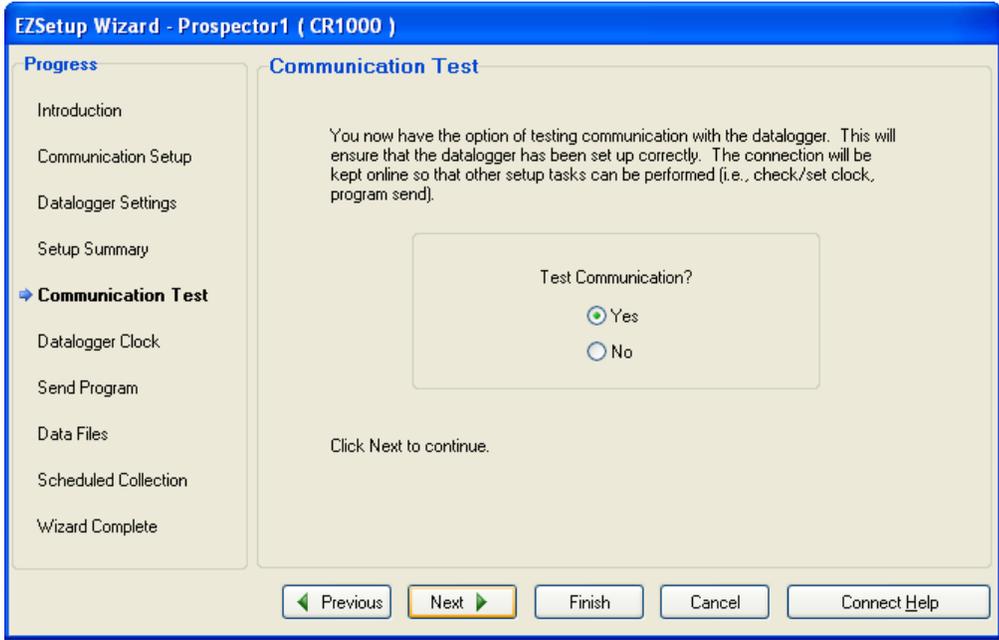


Or, if you chose to use Ethernet, enter the IP: **192.168.0.79** to which your Prospector has been preconfigured... if you need to change this, do so here then you will need to run the Device Configuration Utility later before you can make contact with your CR-1000.



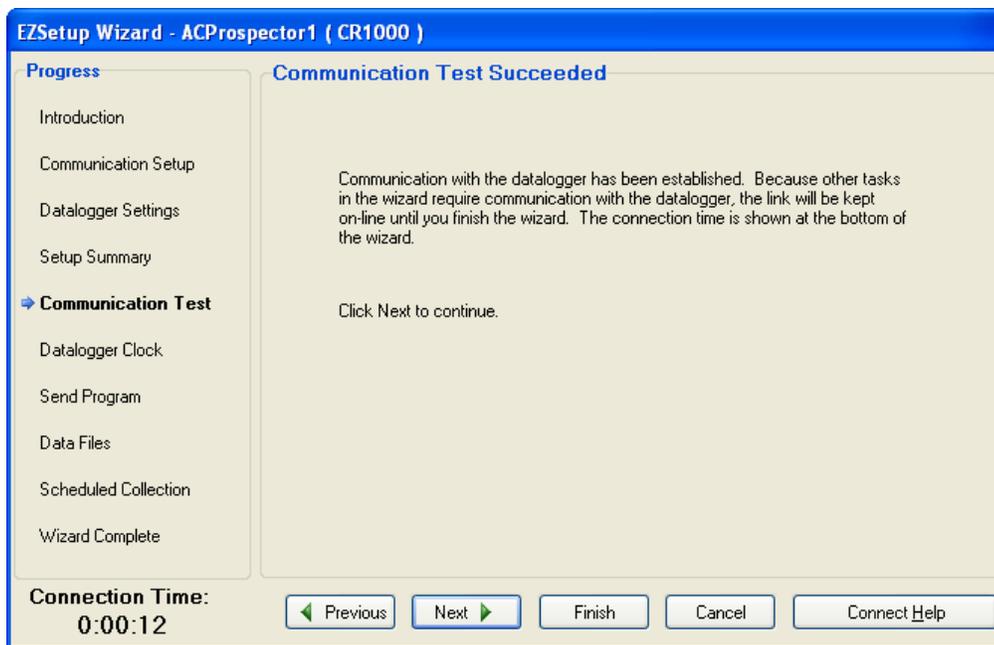


This page will confirm either the direct connection comm port or the selected IP address for Ethernet...



If you have already connected an appropriate cable between your computer and the datalogger and have configured the datalogger for the appropriate communication mode, this will test the connection...

If the communication test works correctly, the timer at the bottom left of the dialog box will start running...

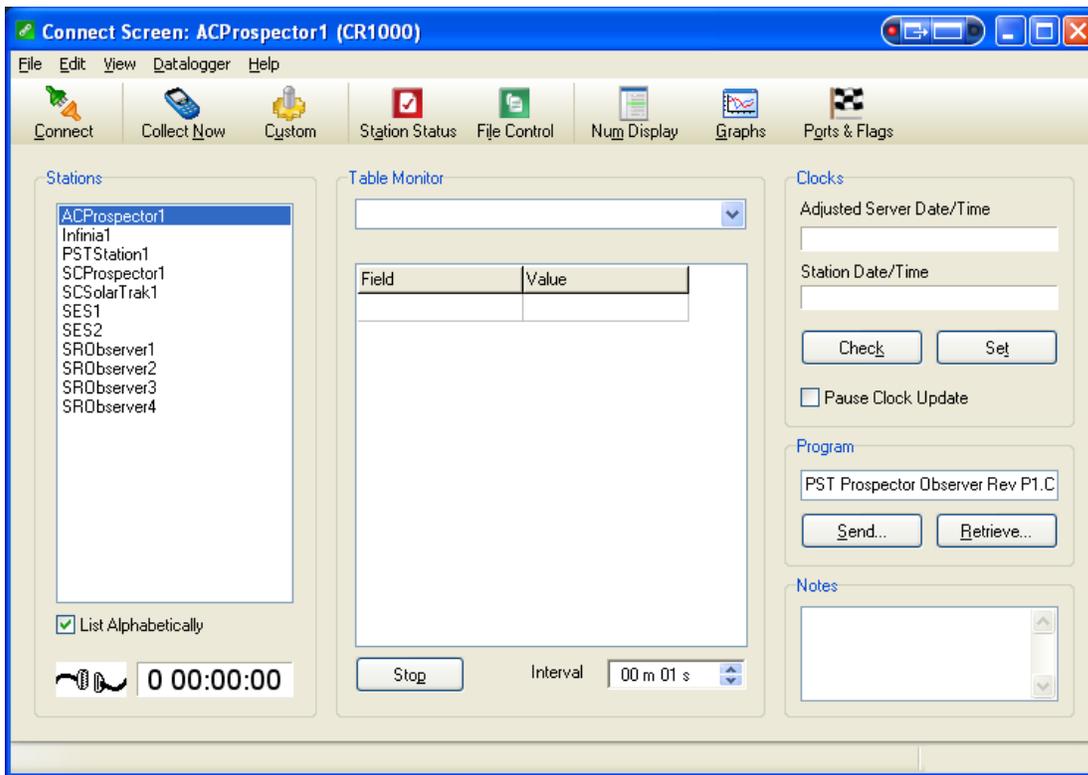


For now, click 'Finish'... the next step, if necessary, is to modify the datalogger program and install it on the datalogger using CRBasic...

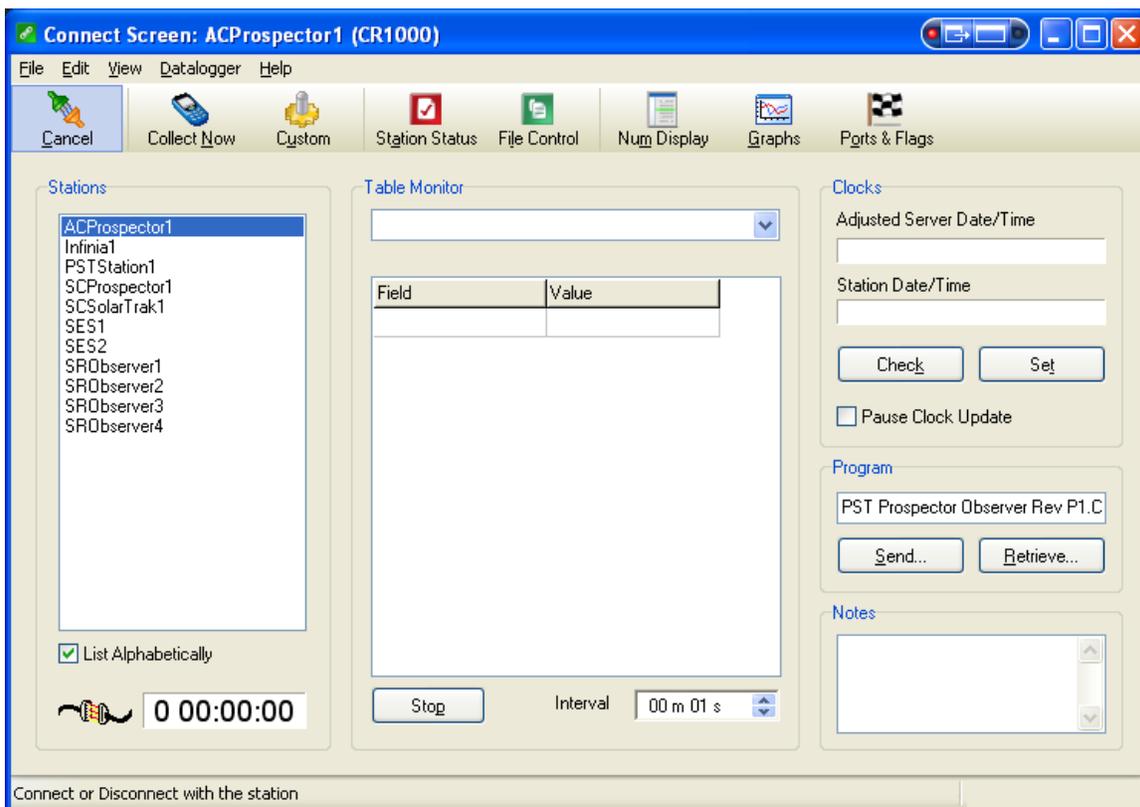
Rather than assume any given copy on your computer is current, it is prudent to simply load the current version off of the datalogger itself. That, among other useful things, can be accomplished by utilizing the 'Connect' screen to log on to the datalogger directly (as opposed to scheduled data downloads) and 'Retrieve' the currently running program.

Again, through the 'Main' menu selection group, pick 'Connect' this time...

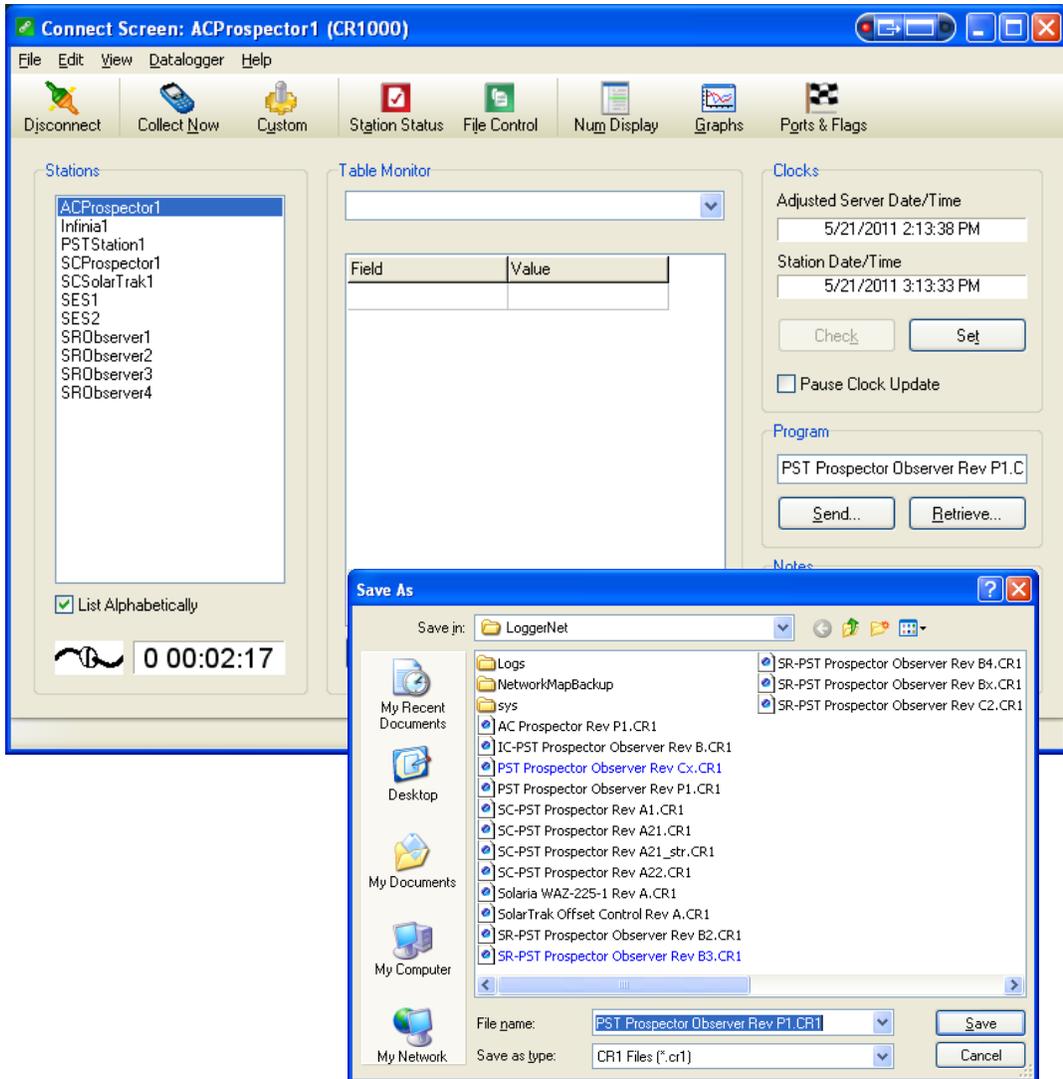




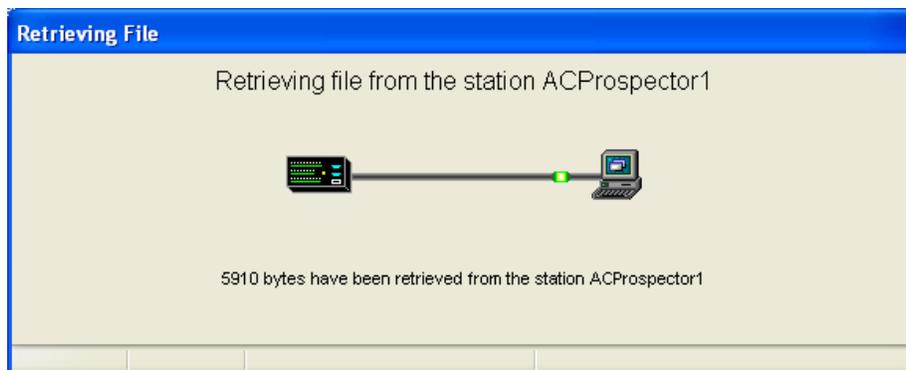
Choose the desired unit from the list under stations then click 'Connect' at the upper left of the screen... the little connectors at the lower left will appear to 'spark' ...



...and when successful will connect together... additionally, the original 'Connect' button will change to 'Disconnect', the datalogger clock (Station) and adjusted (for offset in 'Setup') PC time (Server) displays will start in the upper right corner and the currently running program name will appear in the box on the lower right where it says 'Program'... to get a copy, click 'Retrieve' and the 'Save As' dialog box will appear... select a directory (see directory tree above), assign a name and click 'Save'...



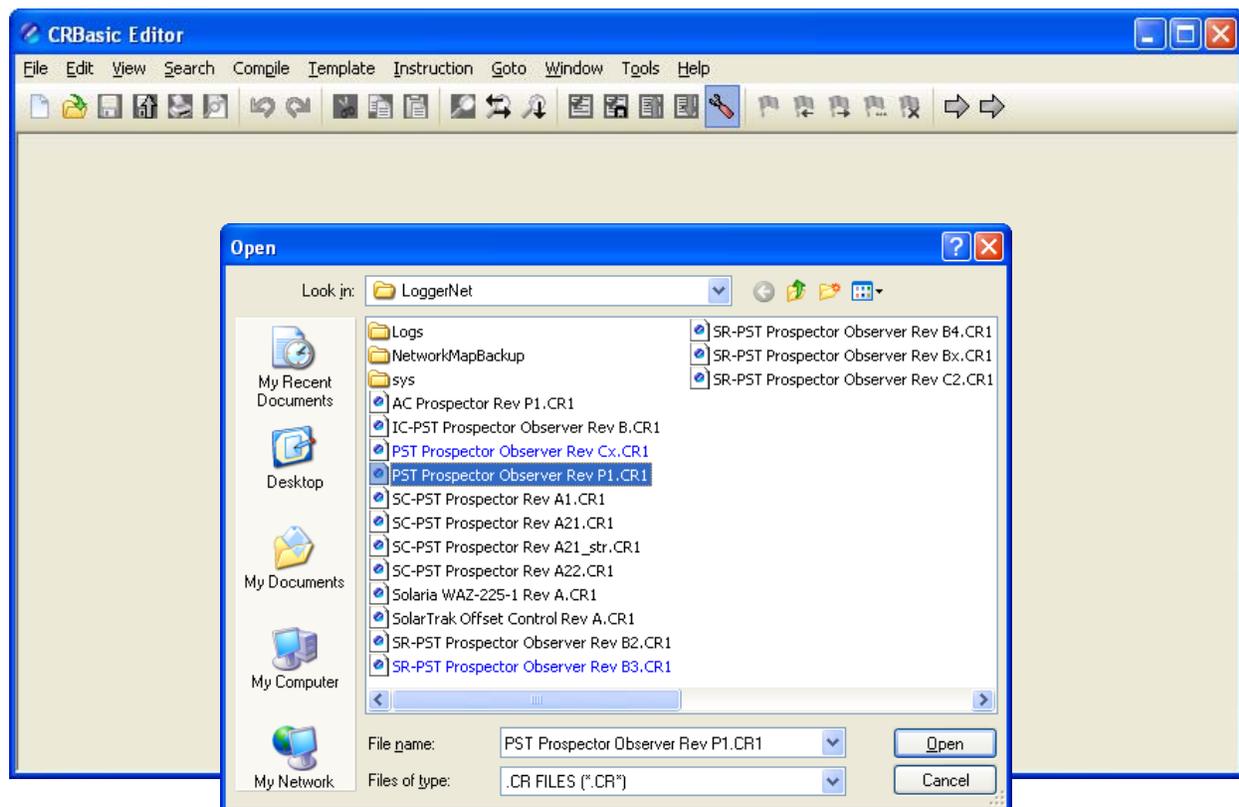
This retrieval and save defaulted to the LoggerNet directory and is as good as any other...



Now that a current copy of the datalogger program has been retrieved it can be modified and reloaded. As before, on the LoggerNet menu, draw the cursor over the word 'Program' then move it straight across to 'CRBasic Editor' and select.



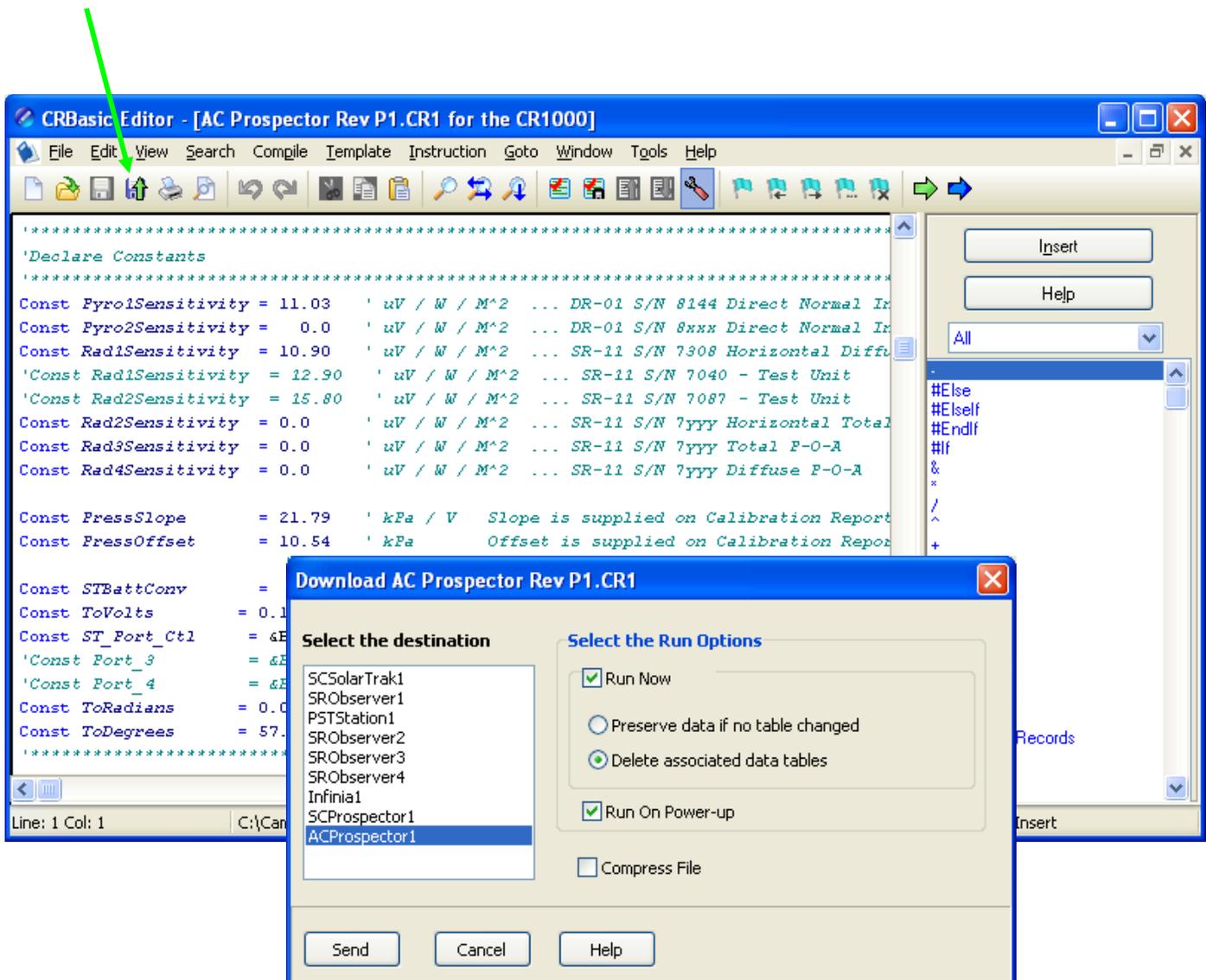
Click the 'Open File' icon, find and select the file you just downloaded, then click 'Open'



In the general vicinity of line 200 you will find a series of statements under the heading of 'Declare Constants'... these values define the sensitivities, conversion factors and offsets that produce data values with standard units rather than voltage levels as recorded on each input channel. Each device has its own range of output voltages and are defined here.

A new instrument to replace another will have a different sensitivity or offset that needs to be put in place of what is already there. Using standard MS editing functions modify the statements to reflect the new values.

Once that is complete, execute the 'Compile, Save and Send' icon [floppy disk with green arrow] on the task bar...

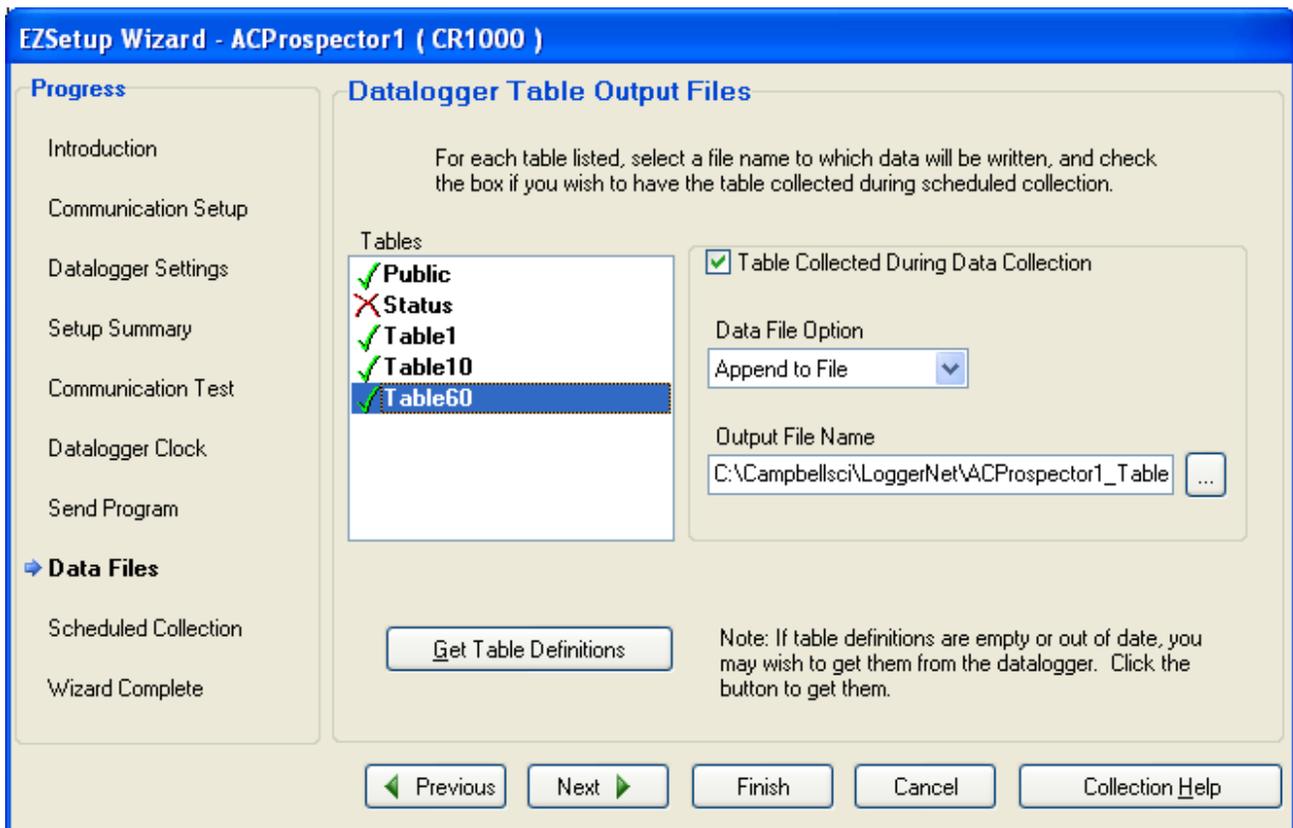


Select the appropriate datalogger station. Also decide if you want to erase previous data stored internally but leave the 'Run Now' and 'Run on Power-up' checked... then click 'Send'. Once the datalogger has stored the file and re-compiled it internally you will get a task-completion notification box.

Setup for Scheduled Data Collection

This setup procedure accommodates long-term data collection and storage as well as routine real-time monitoring.

Re-enter 'Setup' under the 'Main' category of selections, select the target datalogger station and click the 'Edit' icon up on the task bar... then, on the left sidebar menu select 'Data Files'.



The 'Public' table is actually a type of 'internal common block storage' for the sampled data, computations, status variables and other working variable applications through which tasks are accomplished or controlled in the datalogger program. The green checkmarks correlate with the check box to the right labeled 'Table Collected During Data Collection'.

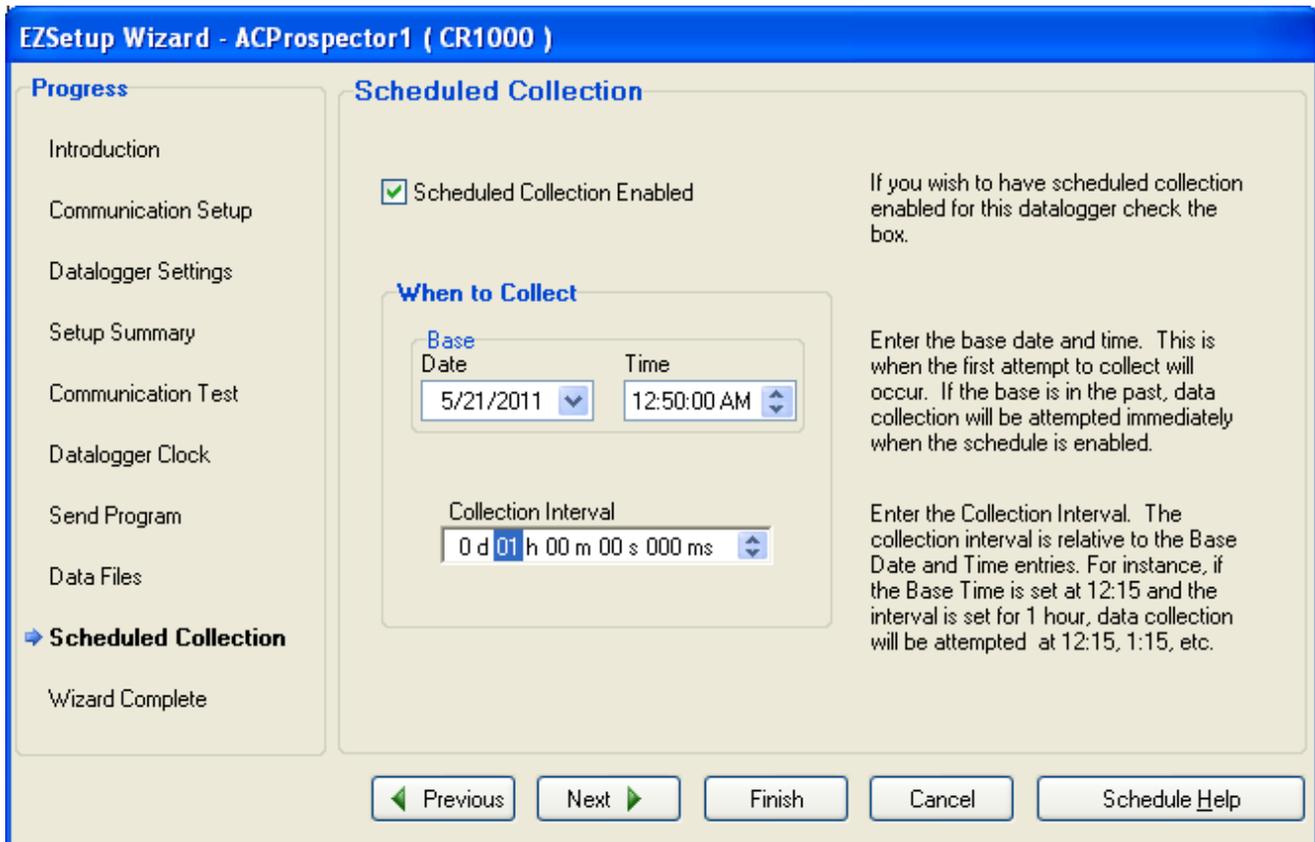
If using the real-time monitoring functionality (RTMC, see below), the 'Public Table' is useful for status alarms, instantaneous data values and progress meters, among other things. The other three tables, 'Table1, 10 and 60', are 1-minute, 10-minute and 60-minute averages recorded by the datalogger using the sampled data recorded in the 'Public' table. Each table can be accessed individually or simultaneously for comparison in tables, charts, graphs and other data display mechanisms. All data is stored in 'CSV' (comma-separated-values) text format that can be easily imported to such applications as MS Excel, Access or other data manipulation software packages.

It is generally not useful to save the 'Public' data in a file and in the 'Data File Option' pull-down selection you should select 'No Output File'. For the other three, selecting 'Append to file' will provide permanent retention of all data in a single, growing file. Selecting 'Overwrite File' will assume that the historical data is either not needed or has been saved in a discrete file through another process such as 'Task Master', another LoggerNet utility (not addressed in these instructions as yet).

It is suggested to download at least the three average tables which are stored internally by the datalogger but are in storage areas (ring buffers) that will, after a period of time, overwrite the oldest data. Each table name will default to a filename and folder including the station name and table name such as:

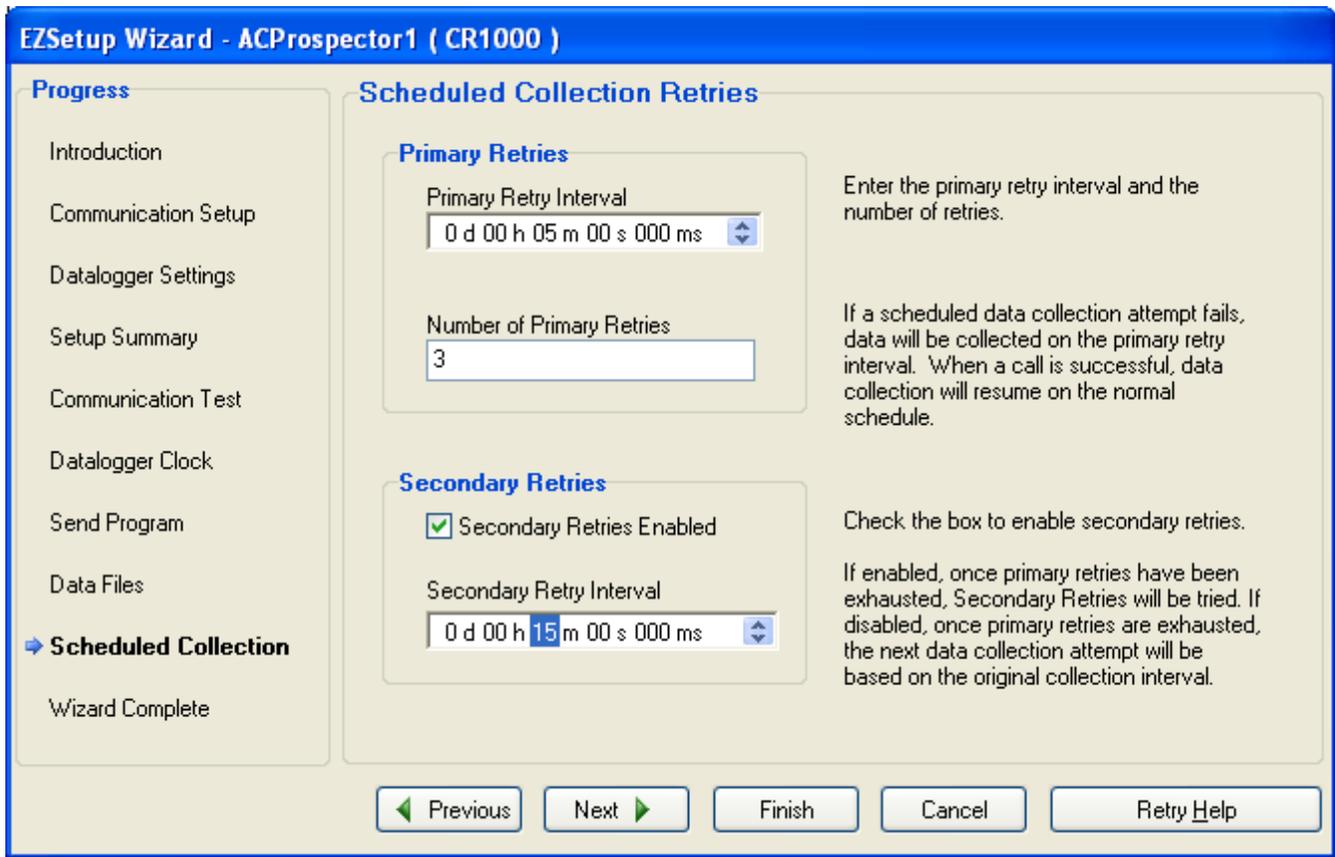
C:\Campbellsci\LoggerNet\ACProspector1_Table1.dat

With these definitions in place, now select 'Scheduled Collection' from the left sidebar.



The scheduled collection interval and 'first download' base time are selected here. Clicking next will allow the specification of retry intervals if the first attempt is not successful. There are two stages of 'retries' designated 'Primary' and 'Secondary' each of which can have a different interval.

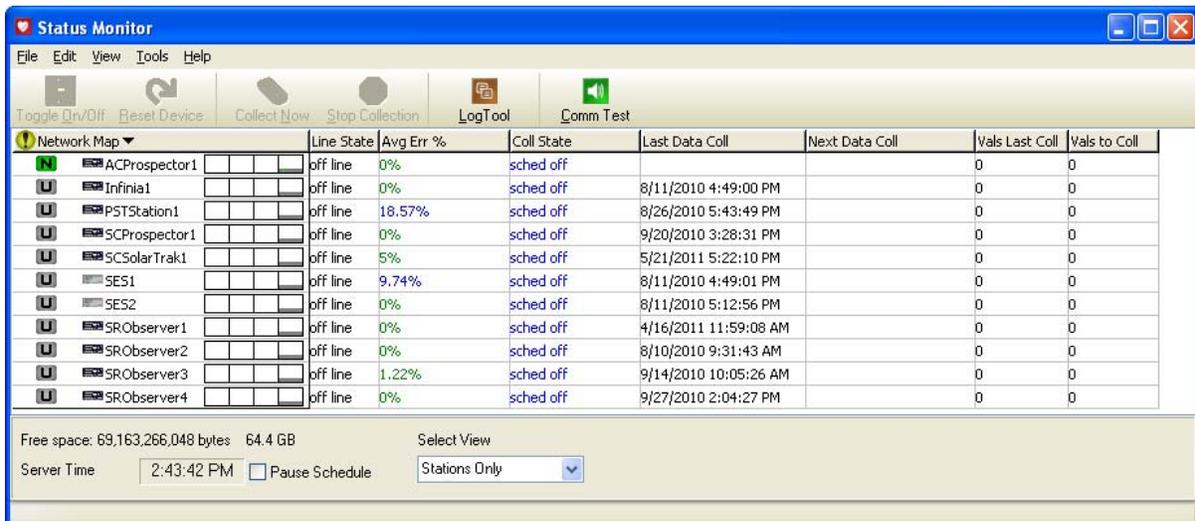
An example would be a ‘Scheduled Collection Interval’ of one hour (01h) with a ‘Primary Retry Interval’ of five minutes (05m) and a ‘Secondary Retry Interval’ of fifteen minutes.



This is the last step in setup so click ‘Finish’.

‘**Status Monitor**’, found under the ‘**Main**’ LoggerNet category will show the status of active data collection and results. It will indicate success or failure and when the next download attempt will occur. There are four different quick-check icons possible at the left of the window under ‘**Network Map**’... each a box with a letter in it:

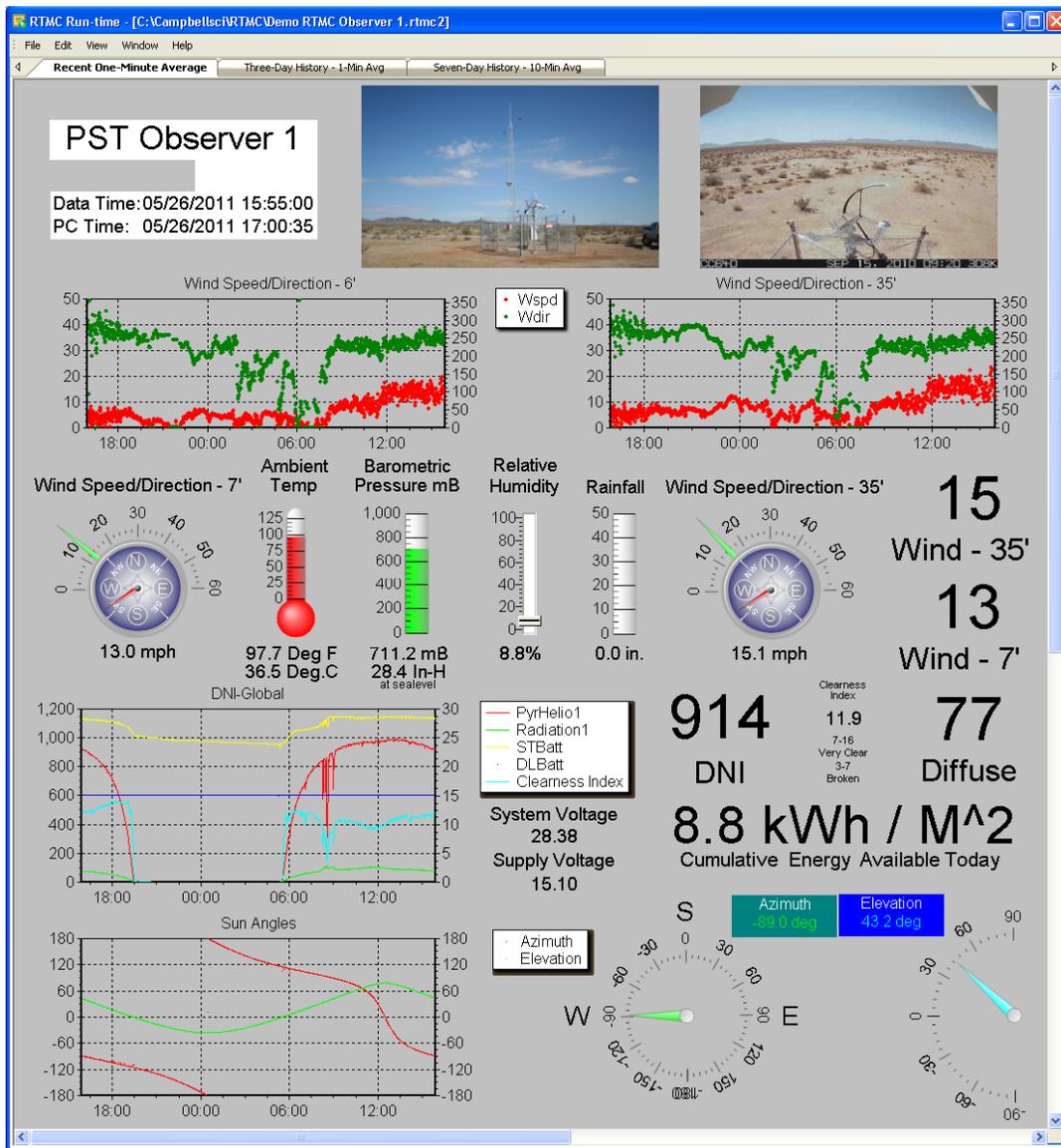
- N** – Normal Operation, No Problems [Green Box]
- M** – Medium Communication Status, intermittent difficulties encountered while downloading [Blue]
- C** – Communication Failure (also accompanied by an exclamation point) [Yellow]
- U** – Undefined status, Awaiting scheduled or Manual download [Gray]



RTMC – Real Time Monitoring and Control Software

It is usually desirable to have a quick access display of data available. The RTMC utility (under the ‘Data’ LoggerNet category) is an easy-to-create, easy-to-use application for accomplishing this task.

This is an RTMC data monitor screen for a standard Prospector with DNI (Direct Normal Insolation) and DHI (Diffuse Horizontal Insolation), six meteorological sensors for wind S/D, rainfall, barometric pressure, temperature and relative humidity as well as indicators for system battery voltage and the datalogger supply voltage. It also notes the date of the most recent data collected and offers a PC system local time display.



This screen layout is designed for at-a-glance assessment of current and recent solar and weather conditions. Its pictorial GUI presentation of data (meters, dials, slides, etc.) is augmented by digital fields with the actual number and units represented.

This is a wide-open option for the customer to arrange things to suit the current needs. A screen has been provided with the Prospector CD that can access and display the data from the Prospector instruments through the datalogger. That screen file can be loaded into the ‘RTMC Development’ utility, modified and re-saved to achieve whatever custom presentation that may be desired. After modifications are complete the RTMC Run-Time utility is used.

At the bottom of this RTMC Monitor Screen (above) are indicators showing the Azimuth and Elevation sun angles that correspond with the sensor data recorded. This information is provided through a communication channel with the SolarTrak controller operating the tracker and providing power for the datalogger and instruments. This channel is two-way and allows the datalogger to monitor the time and date of the SolarTrak, set it if necessary and change a selection of values that are useful for custom tracking control like precision displacements off-axis to test receiver responses. These displacements can be 'set by hand', made to increment on a timed schedule over a range of values and can also be programmed using text-format 'scripts' stored on the CompactFlash backup storage card included with all datalogger systems.

This RTMC Control Screen utilizes access to the 'Public' table to read values, store values and display status variables. Operation of the off-axis control can be done mostly from this screen with the addition of storing the script files on the CF card using the 'Connect' screen 'File Control' function.

