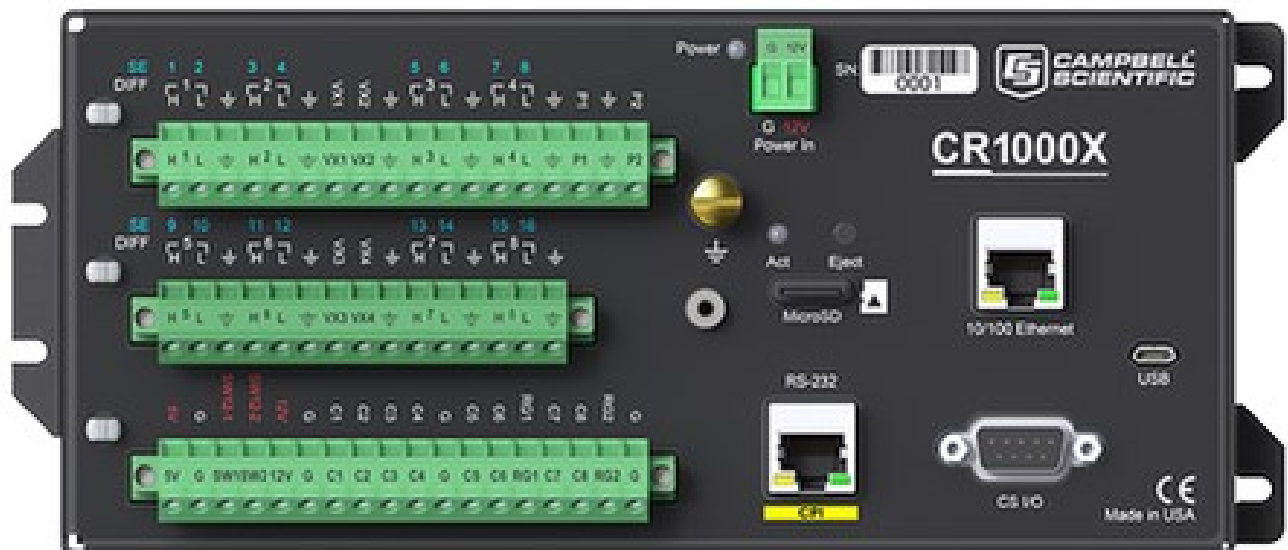


# CR1000X

## Measurement and Control Datalogger



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# 1. Getting started

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**Getting Started** provides a cursory view of data acquisition and walks you through a procedure to set up a simple system. You may not find it necessary to progress beyond this. However, should you want to dig deeper into the complexity of the data logger functions or quickly look for details, extensive information is available in the full CR1000X manual.


This exercise guides you through the following steps:

- Connecting the data logger to a computer
- Attaching a sensor to the data logger
- Creating a program for the data logger to measure the sensor
- Making a simple measurement
- Storing measurement data on the data logger
- Collecting data from the data logger with a computer
- Viewing real-time and historical data with a computer

In addition to your data logger, the following items are used in this exercise (many are shipped with your data logger and all are available on [www.campbellsci.eu](http://www.campbellsci.eu)). 


- Type-T Thermocouple, 4 to 5 inches long; one is shipped with the data logger
- Computer with a USB port
- USB cable
- Data logger support software such as LoggerNet or PC400

Additional Campbell Scientific publications are available online at [www.campbellsci.eu](http://www.campbellsci.eu). 



Video tutorials are available at [www.campbellsci.eu/videos](http://www.campbellsci.eu/videos).  Generally, if a particular feature of the data logger requires a peripheral hardware device, more information is available in the help or manual written for that device.

## 2. USB communications

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Setting up a USB connection is a good way to begin communicating with your data logger. Because this connection does not require configuration (like an IP address), you need only set up the communications between your computer and the data logger. Use the following instructions or watch the Quickstart videos at <https://www.campbellsci.eu/videos>. 

Follow these steps to get started. These settings can be revisited using the data logger support software **Edit Datalogger Setup** option 

1. Using data logger support software, launch the EZSetup Wizard.
  - *LoggerNet* users, click **Setup** , click the **View** menu to ensure you are in the **EZ (Simplified)** view, then click **Add Datalogger**.
  - *PC400* users, click **Add Datalogger** .
2. Click **Next**.
3. Select your data logger from the list, type a meaningful name for your data logger (for example, a site identifier or project name), and click **Next**.
4. Select the **Direct Connect** connection type and click **Next**.
5. If this is the first time connecting this computer to a CR1000X via USB, click **Install USB Driver**, select your data logger, click **Install**, and follow the prompts to install the USB drivers.
6. Plug the data logger into your computer using a USB cable. The USB connection supplies 5 V power as well as a communications link, which is adequate for setup. A 12V battery will be needed for field deployment. If using RS-232, external power must be provided to the data logger and a CPI/RS-232 RJ45 to DB9 cable is required to connect to the computer.

### NOTE:

The Power LED on the data logger indicates the program and power state. Because the data logger ships with a program set to run on power-up, the Power LED flashes 3 times every 10 seconds when powered over USB. When powered with a 12 V battery, it flashes 1 time every 10 seconds. When no program is running, the LED is always on.

7. From the **COM Port** list, select the COM port used for your data logger.

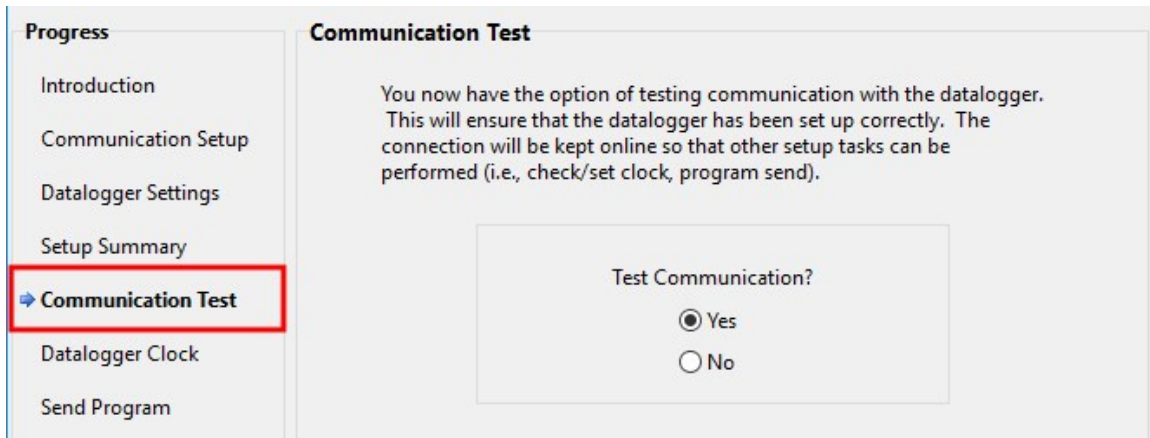
8. USB connections do not typically require a **COM Port Communication Delay** - which allows time for hardware devices to "wake up" and negotiate a communications link. Accept the default value of **00 seconds** and click **Next**.
9. The baud rate and PakBus address **must match** the hardware settings for your data logger. The default PakBus address is **1**. A USB connection does not require a baud rate selection.
10. Set an **Extra Response Time** if you have a difficult or marginal connection and you want the data logger support software to wait a certain amount of time before returning a communications failure error. Accept the default value of **00 seconds** and click **Next**.
11. Set a **Max Time On-Line** to limit the amount of time the data logger remains connected. When the data logger is connected, communications with it are terminated when this time limit is exceeded. A value of **0** in this field indicates that there is no time limit for maintaining a connection to the data logger.
12. Click **Next**.
13. By default, the data logger does not use a security code or a PakBus encryption key. Therefore, the **Security Code** can be set to **0** and the **PakBus Encryption Key** can be left blank. If either setting has been changed, enter the new code or key.
14. Click **Next**.
15. Review the **Setup Summary**. If you need to make changes, click **Previous** to return to a previous window and change the settings.

Setup is now complete, and the EZSetup Wizard allows to you click **Finish** or click **Next** to test communications, set the data logger clock, and send a program to the data logger. See [Testing communications with EZSetup](#) (p. 4) for more information.


# 3. Testing communications with EZSetup

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1. Advance to, or select, the **Communication Test** step in EZ Setup. See [USB communications](#) (p. 2) for more information.





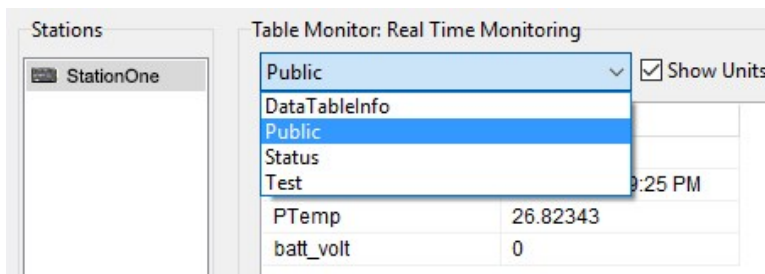
2. Ensure the data logger is physically connected to the computer, select **Yes** to test communications, then click **Next** to initiate the test.
3. With a successful connection, the **Connection Time** with the data logger is displayed in the lower left corner of the wizard. Click **Next**.
4. The **Datalogger Clock** window displays the time for both the data logger and the computer (server).
  - The **Adjusted Server Date/Time** displays the current reading of the clock for the computer running your data logger support software. If the **Datalogger Date/Time** and **Adjusted Server Date/Time** don't match, click **Set Datalogger Clock** to set the data logger clock to the computer clock.
  - Optionally, specify a positive or negative **Time Zone Offset** to apply when setting the data logger clock. This offset allows you to set the clock for a data logger that is in a different time zone than the computer (or to accommodate for changes in daylight saving time).
5. Click **Next**.



6. The data logger ships with a default **GettingStarted** program. If the data logger does not have a program, you can choose to send one by clicking **Select and Send Program**. Click **Next**.
7. **LoggerNet** only - Use the following instructions or watch the [Scheduled/Automatic Data Collection video](#)   
  - The **Datalogger Table Output Files** window displays the data tables available to be collected from the data logger and the output file name. By default, all data tables set up in the data logger program will be included for collection. Make note of the **Output File Name** and location. Click **Next**.
  - Check **Scheduled Collection Enabled** to have **LoggerNet** automatically collect data from the data logger on the **Collection Interval** entered. When the **Base Date** and **Time** are in the past, scheduled collection will begin immediately after finishing the EZSetup wizard. Click **Next** twice.
8. Click **Finish**.

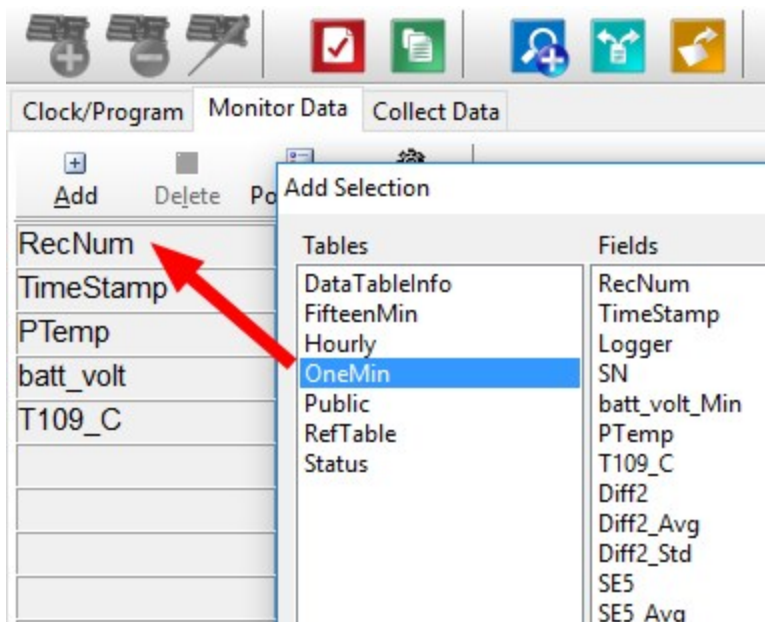
# 4. Making the software connection

Once you have configured your hardware connection (see [USB communications](#) (p. 2)), your data logger and computer can communicate. Use the **Connect** screen to send a program, set the clock, view real-time data, and manually collect data.

*LoggerNet* users, select the **Main** category and **Connect**  on the *LoggerNet* toolbar, then select the data logger from the **Stations** list, then click **Connect** . Once connected, select a table to view in the **Table Monitor**.



*PC400* users, click **Connect** , then **Monitor Data**. When this tab is first opened for a data logger, values from the Public table are displayed. To view data from other tables, click **Add** , select a table or field from the list, then drag it into a cell on the **Monitor Data** tab.



For more information see [Working with data](#) (p. 14).



**NOTE:**

When powered only by USB the battery voltage is reported as **0.00**. This is to remind you that you need a 12V battery for field deployment.

See [Collecting data](#) (p. 15) for more information on copying stored data from the data logger to the computer.

To disconnect, click **Disconnect** .

For more information see the [Connect Window Tutorial](#) .

# 5. Creating a *Short Cut* data logger program

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You must provide a program for the data logger in order for it to make measurements, store data, or control external devices. There are several ways to write a program. The simplest is to use the program generator called **Short Cut**. For more complex programming the *CRBasic Editor* is used. The program file may use the extension **.CR1X**, **.CRB** or **.DLD**.

Data logger programs are executed on a precise schedule termed the scan interval, based on the data logger internal clock.

Measurements are first stored in temporary memory called variables in the Public table. Data stored in variables is usually overwritten each scan. Periodically, generally on a time interval, the data logger stores data in tables. The data tables are later copied to a computer using your data logger support software.

Use **Short Cut** software to generate a program for your data logger. **Short Cut** is included with your data logger support software.

This section guides you through programming a CR1000X data logger to measure the voltage of the data logger power supply, the internal temperature of the data logger, and a thermocouple. With minor changes, these steps can apply to other measurements. Use the following instructions or watch the [Quickstart part 3 video](#) .

1. Using data logger support software, launch **Short Cut**.
  - **LoggerNet** users, click **Program** then **Short Cut** .
  - **PC400** users, click **Short Cut** .
2. Click **Create New Program**.
3. Select **CR1000X Series** and click **Next**.

## NOTE:

The first time **Short Cut** is run, a prompt asks for a noise rejection choice. Select **60 Hz Noise Rejection** for North America and areas using 60 Hz ac voltage. Select **50 Hz Noise Rejection** for most of the Eastern Hemisphere and areas that operate at 50 Hz.

A second prompt lists sensor support options. **Campbell Scientific, Inc. (US)** is usually the best fit outside of Europe.

To change the noise rejection or sensor support option for future programs, use the **Program** menu.

4. A list of **Available Sensors and Devices** and **Selected Measurements Available for Output** are displayed. Battery voltage **BattV** and internal temperature **PTemp\_C** are selected by default. During operation, battery and temperature should be recorded at least daily to assist in monitoring system status.
5. Use the Search feature or expand folders to locate your sensor or device. Double-click on a sensor or measurement in the **Available Sensors and Devices** list to configure the device (if needed) and add it to the **Selected** list. For the example program, expand the **Sensors/Temperature** folder and double-click **Type T Thermocouple**.
6. If the sensor or device requires configuration, a window displays with configuration options. Click **Help** at the bottom of the window to learn more about any field or option. For the example program, accept the default options:
  - **1 Type T TC sensor**
  - **Temp\_C** as the **Temperature** label, and set the units to **Deg C**
  - **PTemp\_C** as the **Reference Temperature Measurement**.
7. Click the **Wiring Diagram** tab to see how to wire the sensor to the data logger. With the power disconnected from the data logger, insert the wires as directed in the diagram. Ensure you clamp the terminal on the wire, not the colored insulation. Use the included flat-blade screwdriver to open and close the terminals.
8. Click **OK**.
9. Click **Next**.
10. Use the **Output Setup** options to specify how often to make measurements and how often outputs are to be stored. Type **1** in the **How often should the data logger measure its sensor(s)?** box. Leave the units as **Seconds**.
11. Multiple output intervals can be specified, one for each output table (**Table1** and **Table2** tabs). For the example program, only one table is needed. Click the **Table2** tab and click **Delete Table**.
12. In the **Table Name** box, type a name for the table. For example: **OneMin**.
13. Select a **Data Output Storage Interval**. For example: **1 minute**.

14. Click **Next**.
15. Select a measurement from the **Selected Measurements Available for Output** list, then click an output processing option to add the measurement to the **Selected Measurements for Output** list. For the example program, select **BattV** and click the **Minimum** button to add it to the **Selected Measurements for Output** list. Do not store the exact time that the minimum occurred. Repeat this procedure for an **Average PTemp\_C** and **Temp\_C**.

The screenshot shows two main panels. The left panel, titled "Selected Measurements Available for Output", contains a tree view of sensors and their measurements. Under the "CR350" sensor, the "Default" measurement is expanded, showing "BattV", "PTemp\_C", and "Temp\_C". The "Temp\_C" measurement is highlighted in blue. The right panel, titled "Selected Measurements for Output", shows a list of processing options (Average, ETo, Maximum, Minimum, Sample, StdDev, Total, WindVector) and a table of selected measurements. The "Minimum" button is selected. The table below shows the selected measurements:


Sensor	Measurement	Processing	Output Label	Units
Default	BattV	Minimum	BattV_MIN	Volts
Default	PTemp_C	Average	PTemp_C_AV	Deg C
Type T TC	Temp_C	Average	Temp_C_AVG	Deg C

16. Click **Finish** and give the program a meaningful name such as a site identifier. Click **Save**.
17. If **LoggerNet** or other data logger support software is running on your computer, and the data logger is connected to the computer, you can choose to send the program. Generally it is best to collect data first; so, we recommend sending the program using the instructions in [Sending a program to the data logger](#) (p. 12). Click **No**, do not send the program to the data logger.

**TIP:**

It is good practice to always retrieve data from the data logger before sending a program; otherwise, data may be lost. See [Collecting data](#) (p. 15) for detailed instruction.

18. Make note of the newly generated program location and filename. By default, programs created with **Short Cut** are stored in `C:\Campbellsci\SCwin\`.
19. Close **Short Cut**.

If your data acquisition requirements are simple, you can probably create and maintain a data logger program exclusively with **Short Cut**. If your data acquisition needs are more complex, the files that **Short Cut** creates are a great source for programming code to start a new program or add to an existing custom program using CRBasic. See the **CRBasic Editor** help for detailed information on program structure, syntax, and each instruction available to the data logger <https://help.campbellsci.eu/crbasic/cr1000x/>. 

**NOTE:**

Once a *Short Cut* generated program has been edited with *CRBasic Editor*, it can no longer be modified with *Short Cut*.

# 6. Sending a program to the data logger


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## TIP:

It is good practice to always retrieve data from the data logger before sending a program; otherwise, data may be lost. See [Collecting data](#) (p. 15) for detailed instruction.

Some methods of sending a program give the option to retain data when possible. Regardless of the program upload tool used, data will be erased when a new program is sent if any change occurs to one or more data table structures in the following list:

- Data table name(s)
- Data output interval or offset
- Number of fields per record
- Number of bytes per field
- Field type, size, name, or position
- Number of records in table

Use the following instructions or watch the [Quickstart part 4 video](#) .

1. Connect the data logger to your computer.
  - **LoggerNet** users, select **Main** and **Connect**  on the **LoggerNet** toolbar, select the data logger from the **Stations** list, then **Connect** .
  - **PC400** users, select the data logger from the list and click **Connect** .
2. **LoggerNet** users, click **Send New...** (located in the **Current Program** section on the right side of the window).  
**PC400** users, click **Send Program...** (located in the **Datalogger Program** section on the right side of the window).
3. Confirm that you would like to proceed and erase all data tables saved on the data logger. Click **Yes**.
4. Navigate to the program, select it, and click **Open**. For example: navigate to **C:\Campbellsci\SCWin** and select **MyTemperature.CR1X**. Click **Open**.
5. The program is sent and compiled.
6. Review the **Compile Results** window for errors, messages and warnings. Click **OK**.

7. *LoggerNet* users, click **Details**, select the **Table Fill Times** tab.

*PC400* users, click **Station Status** , select the **Table Fill Times** tab.

Ensure that the times shown are expected for your application. Click **OK**.

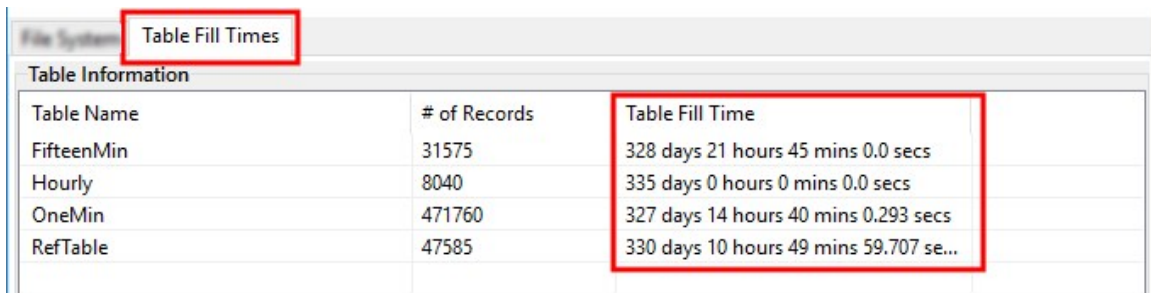


Table Name	# of Records	Table Fill Time
FifteenMin	31575	328 days 21 hours 45 mins 0.0 secs
Hourly	8040	335 days 0 hours 0 mins 0.0 secs
OneMin	471760	327 days 14 hours 40 mins 0.293 secs
RefTable	47585	330 days 10 hours 49 mins 59.707 se...

After sending a program, it is a good idea to monitor the Public table to make sure sensors are taking good measurements. See [Working with data](#) (p. 14) for more information.

# 7. Working with data

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## 7.1 Default data tables

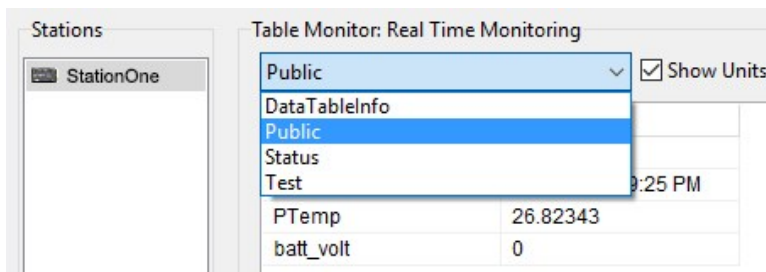
By default, the data logger includes three tables: **Public**, **Status**, and **DataTableInfo**. Each of these tables only contains the most recent measurements and information.



- The **Public** table is configured by the data logger program, and updated at the scan interval set within the data logger program. It shows measurement and calculation results as they are made.
- The **Status** table includes information about the health of the data logger and is updated only when viewed.
- The **DataTableInfo** table reports statistics related to data tables. It also only updates when viewed.
- User-defined data tables update at the schedule set within the program.

For information on collecting your data, see [Collecting data](#) (p. 15).

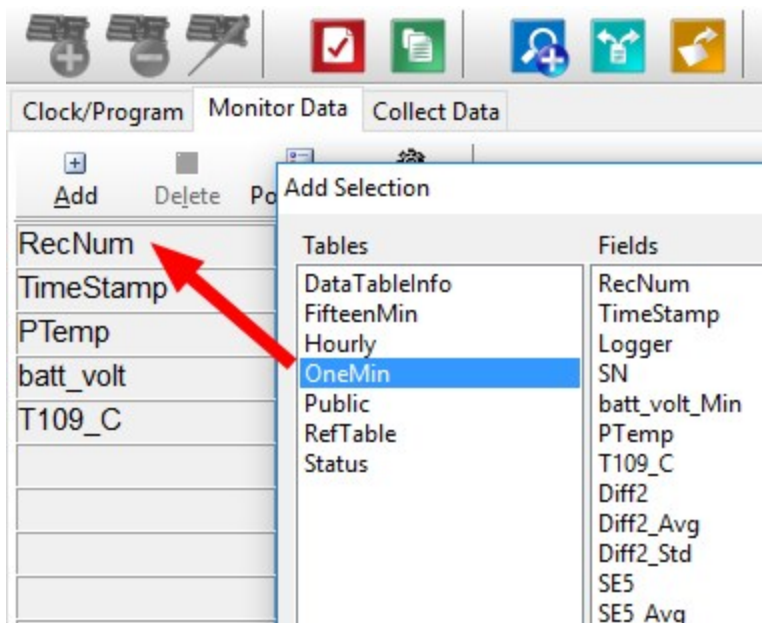
Use these instructions or follow the [Connect Window tutorial](#)  to monitor real-time data.

**LoggerNet** users, select the **Main** category and **Connect**  on the **LoggerNet** toolbar, then select the data logger from the **Stations** list, then click **Connect** . Once connected, select a table to view in the **Table Monitor**.




**PC400** users, click **Connect** , then **Monitor Data**. When this tab is first opened for a data logger, values from the Public table are displayed. To view data from other tables, click **Add** , select a table or field from the list, then drag it into a cell on the **Monitor Data** tab.









## 7.2 Collecting data

The data logger writes to data tables based on intervals and conditions set in the CRBasic program. After the program has been running for enough time to generate data records, data may be collected by using data logger support software. During data collection, data is copied to the computer and still remains on the data logger. Collections may be done manually, or automatically through scheduled collections set in *LoggerNet Setup*. Use these instructions or follow the [Collect Data Tutorial](#) .

### 7.2.1 Collecting data using *LoggerNet*



1. From the *LoggerNet* toolbar, click **Main** and **Connect** , select the data logger from the **Stations** list, then **Connect** .
2. Click **Collect Now** .
3. After the data is collected, the **Data Collection Results** window displays the tables collected and where they are stored on the computer.
4. Select a data file, then **View File** to view the data. See [Viewing historic data](#) (p. 16)

### 7.2.2 Collecting data using *PC400*




1. Click **Connect**  on the main *PC400* window.
2. Go to the **Collect Data** tab.

3. By default, all output tables set up in the data logger program are selected for collection. Typically, the default tables (DataTableInfo, Public, and Status) are not collected.
4. Select an option for **What to Collect**. Either option creates a new file if one does not already exist.
  - **New data from data logger (Append to data files)**: Collects only the data in the selected tables stored since the last data collection from this instance of *PC400* and appends this data to the end of the existing files on the computer. This is the default, and most often used option.
  - **All data from data logger (Overwrite data files)**: Collects all of the data in the selected tables and overwrites (or replaces) the existing data files on the computer.
5. Click **Start Data Collection**.
6. After the data is collected, the **Data Collection Results** window displays the tables collected and where they are stored on the computer.
7. Select a data file, then **View File** to view the data. See [Viewing historic data](#) (p. 16)

## 7.3 Viewing historic data

View Pro  contains tools for reviewing data in tabular form as well as several graphical layouts for visualization. Use these instructions or follow the [View Data Tutorial](#) .

Once the data logger has had enough time to store multiple records collect and review the data.

1. To view the most recent data, connect the data logger to your computer and collect your data (see [Collecting data](#) (p. 15) for more information).
2. Open View Pro:
  - *LoggerNet* users click **Data** then **View Pro**  on the *LoggerNet* toolbar.
  - *PC400* users click **View Data Files via View Pro** .
3. Click **Open** , navigate to the directory where you saved your tables (the default directory is `C:\Campbellsci\[your data logger software application]`). For example: navigate to the `C:\Campbellsci\LoggerNet` folder and select **OneMin.dat**.
4. Click **Open**.



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