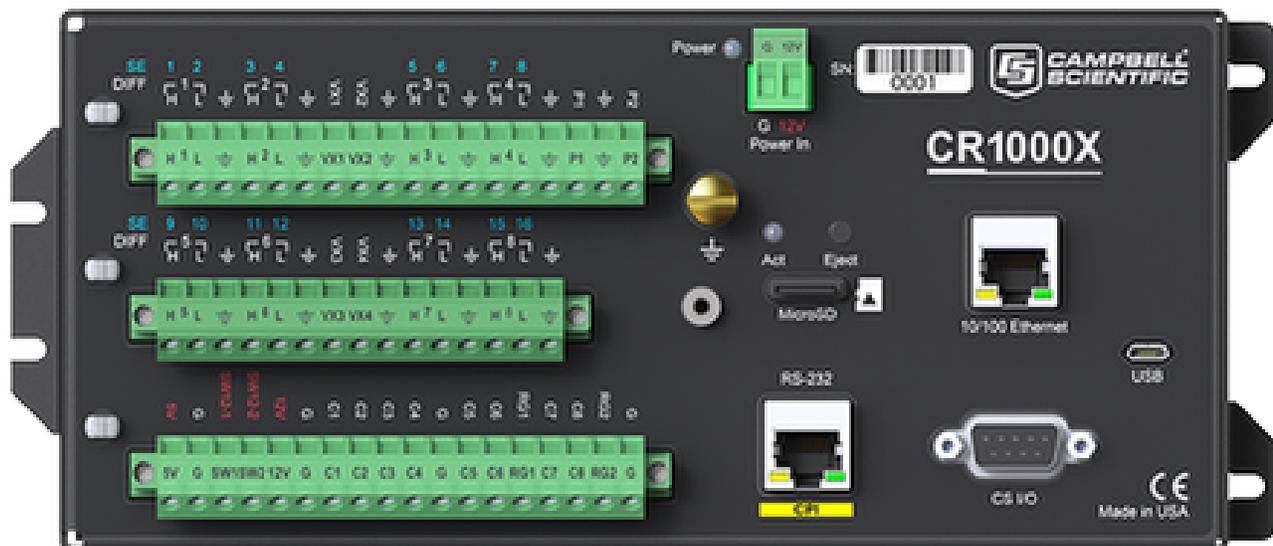


# CR1000X

## 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 throughout this manual.

This exercise will guide 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.com](http://www.campbellsci.com)). If you do not have all of these items, you can provide suitable substitutes.

- Power supply (if not connecting via USB)
- Type-T Thermocouple, 4 to 5 inches long; one is shipped with the data logger
- For a USB connection:
  - Computer with a USB port
  - USB cable
- For an RS-232/CPI connection:
  - Computer with a nine-pin RS-232 port
  - Serial cable or RS-232/CPI RJ45 to DB9 cable
- Data logger support software

Additional Campbell Scientific publications are available online at [www.campbellsci.com](http://www.campbellsci.com). Video tutorials  are available at <https://www.campbellsci.com/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 or RS-232 communications

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Setting up a USB or RS-232 connection is a good way to begin communicating with your data logger. Because these connections do 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.com/videos> .

Initial setup instruction follows. 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 and PC200W users, click **Add Datalogger** .
2. Click **Next**.
3. Select your data logger from the list, type a name for your data logger (for example, a site or project name), and click **Next**.
4. If prompted, 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 or RS-232 cable. The USB connection supplies 5 V power as well as a communications link, which is adequate for setup, but 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.

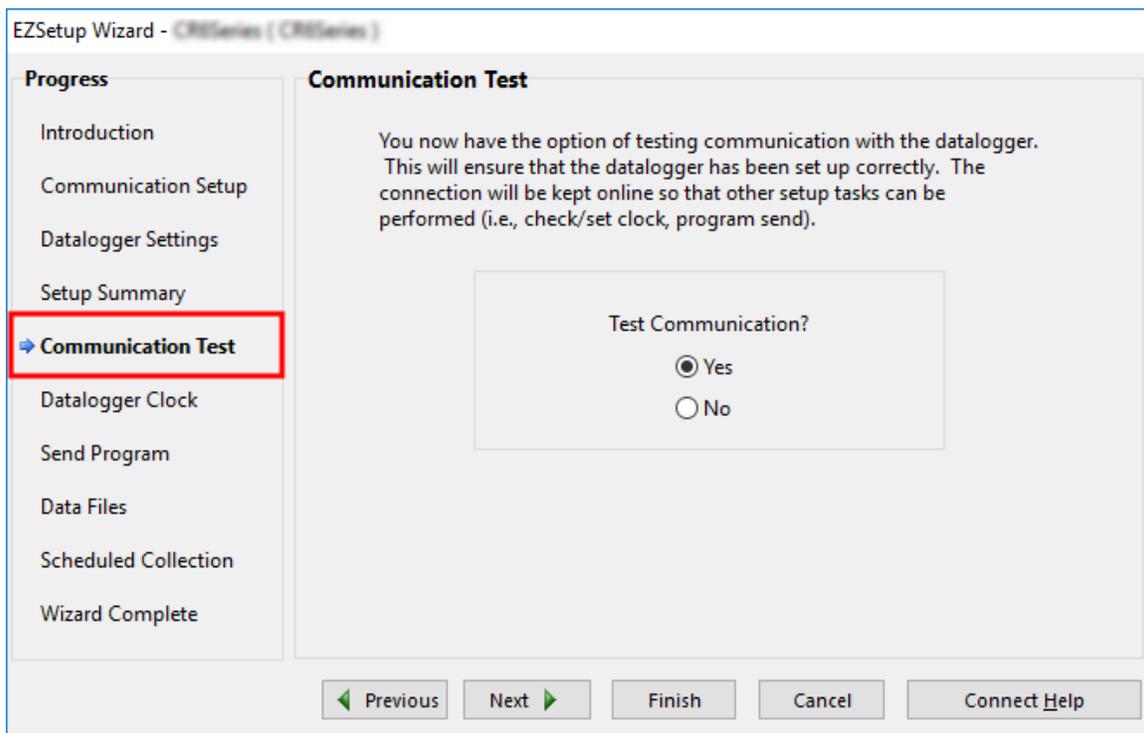
7. From the **COM Port** list, select the COM port used for your data logger.

8. USB and RS-232 connections do not typically require a **COM Port Communication Delay** - this allows time for the 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. RS-232 connections default to 115200 baud.
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 communication failure error.
11. LoggerNet and PC400 users can set a **Max Time On-Line** to limit the amount of time the data logger remains connected. When the data logger is contacted, communication with it is 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

1. Using data logger support software EZ Setup, access the **Communication Test** window. This window is accessed during EZ Setup (see [USB or RS-232 communications](#) (p. 2) for more information). Alternatively, you can double-click a data logger from the station list to open the EZ Setup Wizard and access the **Communication Test** step from the left side of the window.



2. Ensure the data logger is connected to the computer, select **Yes** to test communications, then click **Next** to initiate the test.
3. With a successful connection, the **Datalogger Clock** window displays the time for both the data logger and the computer.
  - The **Adjusted Server Date/Time** displays the current reading of the clock for the computer or server running your data logger support software. If the **Datalogger Date/Time** and **Adjusted Server Date/Time** don't match, you can set the data logger clock to the **Adjusted Server Date/Time** by clicking **Set Datalogger Clock**.

- Use the **Time Zone Offset** to specify a positive or negative offset to apply to the computer time when setting the data logger clock. This offset will allow you to set the clock for a data logger that needs to be set to a different time zone than the time zone of the computer (or to accommodate for changes in daylight saving time).
4. Click **Next**.
  5. 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**.
  6. 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.
  7. Click **Finish**.

# 4. Making the software connection

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Once you have configured your hardware connection (see [USB or RS-232 communications](#) (p. 2)), your data logger and computer can communicate. You'll use the **Connect** screen to send a program, set the clock, view real-time data, and manually collect data.

- LoggerNet users, select **Main** and **Connect**  on the LoggerNet toolbar, select the data logger from the **Stations** list, then **Connect** .
- PC400 and PC200W users, select the data logger from the list and click **Connect** .

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 do control. 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. Variables are 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 the Short Cut software to generate a program for your data logger. Short Cut is included with your data logger support software.

This section will guide 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 and PC200W users, click **Short Cut** .
2. Click **Create New Program**.
3. Select **CR1000X Series** and click **Next**.

## NOTE:

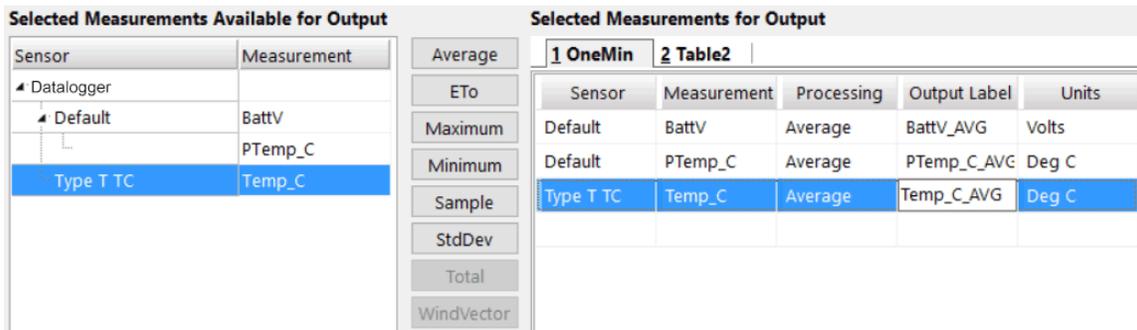
The first time Short Cut is run, a prompt will ask for a noise rejection choice. Select **60 Hz Noise Rejection** for North America and areas using 60 Hz ac voltage. Select **50 Hz Noise Rejection** for most of the Eastern Hemisphere and areas that operate at 50 Hz.

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** display. 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 **OK**.
8. Click **Wiring Diagram** on the left side of the window 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 conductor, not the wire insulation. Use the included flat-blade screwdriver to open/close the terminals.
9. Click **Sensors** on the left side of the window to return to the sensor selection window, then click **Next** at the bottom of the window.
10. Type 1 in the **How often should the data logger measure its sensor(s)?** box.
11. Use the **Output Setup** options to specify how often measurements are to be made and how often outputs are to be stored. Note that 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: to 1 minute.
14. Click **Next**.
15. Select the 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 **Average** button to add it to the **Selected Measurements for Output** list. Repeat this procedure for **PTemp\_C** and **Temp\_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 (see [Making the software connection](#) (p. 6) for more information), 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. 10).

**TIP:**

It is good practice is to always retrieve data from the data logger before sending a program; otherwise, data may be lost. See [Collecting data](#) (p. 13) for detailed instruction.

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.

**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 is to always retrieve data from the data logger before sending a program; otherwise, data may be lost. See [Collecting data](#) (p. 13) 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 (see [Making the software connection](#) (p. 6) for more information).
2. Using your data logger support software, click **Send New...** or **Send Program** (located in the **Current Program** section on the right side of the window).
3. Navigate to the program, select it, and click **Open**. For example: navigate to **C:\Campbellsci\SCWin** and select **MyTemperature.CR1X**.
4. Confirm that you would like to proceed and erase all data tables saved on the data logger. The program will send and compile.
5. Review the **Compile Results** window for errors, messages and warnings.

6. Click **Details**, 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. 12) for more information.

# 7. Working with data

## 7.1 Default data tables

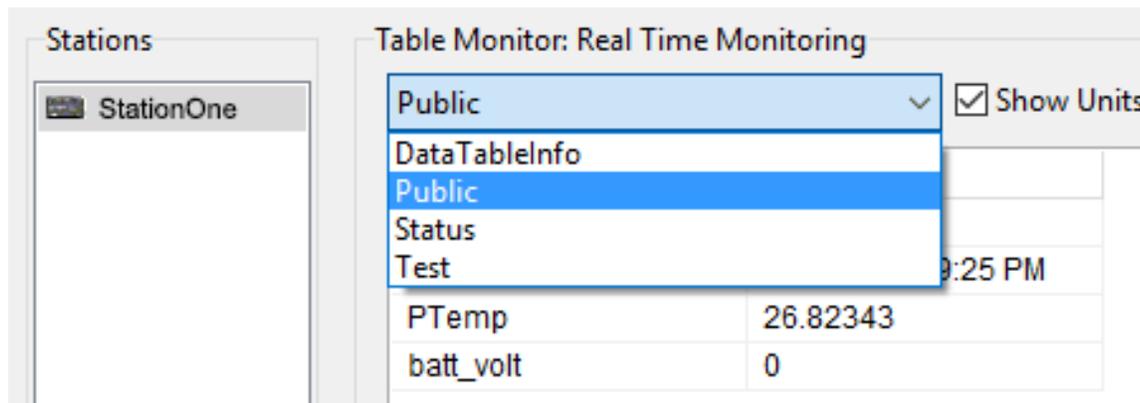
By default, the data logger includes three tables: **Public**, **Status**, and **DataTableInfo**. Each of these tables only contains the most recent measurements and information.

- 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.

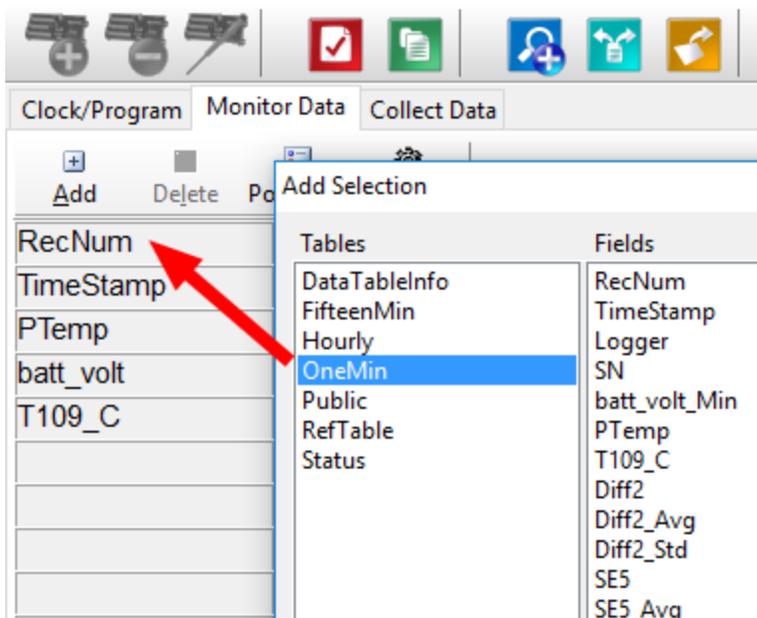
For information on collecting your data, see [Collecting data](#) (p. 13).

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, select the data logger from the **Stations** list, then click **Connect** . Once connected, select a table to view using the **Table Monitor**.



PC400 and PC200W 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. 14)

### 7.2.2 Collecting data using PC200W or PC400

1. Click **Connect**  on the main PC200W or PC400 window.
2. Go to the **Collect Data** tab.

3. 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 and appends this data to the end of the existing table 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 replaces the existing data files on the computer.
4. By default, all output tables set up in the data logger program are selected for collection.
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. 14)

## 7.3 Viewing historic data

Open data files using View Pro. 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, you should 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. 13) for more information).
2. Open View Pro:
  - LoggerNet users click **Data** then **View Pro**  on the LoggerNet toolbar.
  - PC200W and 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**.



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