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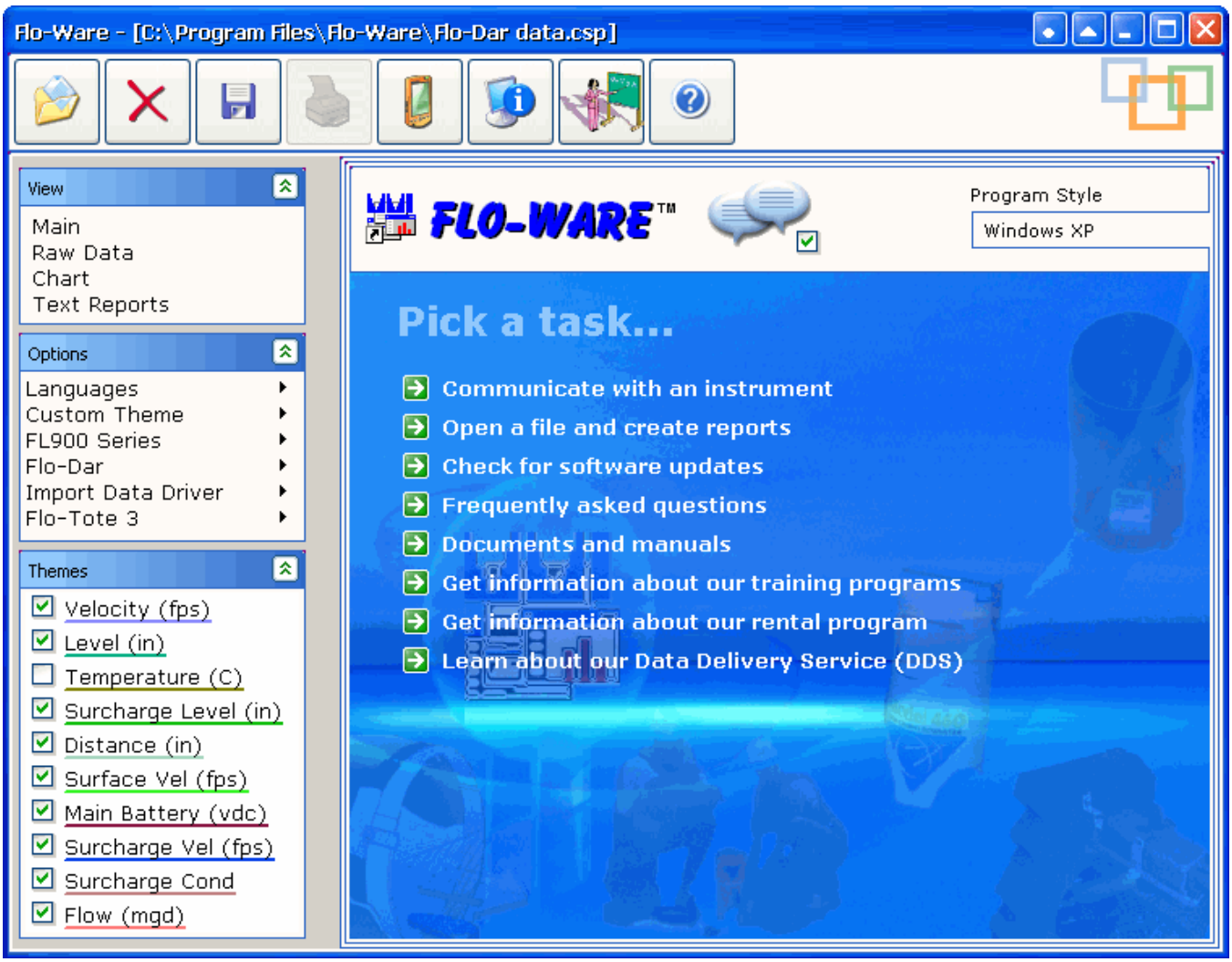
Flo-Ware 4 Software

User Manual

01/2013, Edition 3



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Section 1 General information

1.1 Use of hazard information

⚠ DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTICE

Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

1.2 Product overview

Flo-Ware is a software system for communication with supported instruments. The system uses a modular format, where "plug-in" file drivers are installed for each instrument type that is used.

Additionally, data can be processed from supported instruments at the same time. For example, data can be plotted from the Flo-Tote system and from the Flo-Dar system in the same chart or text report.

Flo-Ware options:

- Data charts
- Data reports
- Data reconstruction and edit functions
- International language support
- Custom formats for data reports

File Driver options:

- International language support
- Communications with devices directly or via modem
- Original file-type reading
- Data calculations
- Other instrument services

Compatible programs:

- Report Designer—the Report Designer is used to change the design of text reports. The reports can be saved as templates for easy reuse.
- Instrument-specific drivers—these "plug-ins" are designed for each instrument type that operates with Flo-Ware. After the driver is installed, Flo-Ware will automatically communicate with and record data from the associated instrument.

Table 1 Instrument-specific drivers

Driver	Instrument
FL900 Series	FL900 Series Logger and attached sensors or modules
Flo-Dar	Marsh McBirney Logger and Flo-Station with a Flo-Dar Sensor

Table 1 Instrument-specific drivers (continued)

Driver	Instrument
Flo-Tote 3	Marsh McBirney Logger and Flo-Station wtih a Flo-Tote 3 Sensor
Flo-Tote	Marsh McBirney Logger and Flo-Station wtih a Flo-Tote Sensor
Sigma	Sigma 910/911 Logger with a Submerged Area/Velocity Sensor

1.3 PC requirements

The computer must have the following minimum requirements:

- Windows® 2000 or XP operating system
- Pentium class processor or equivalent, 90 MHz
- 16 MB RAM
- Video adapter card for 1024 x 768, 96 dpi resolution, 16-bit color

Section 2 Installation

2.1 Install the files

Two installations are necessary:

- Flo-Ware—contains the main application, the Language Editor and the Report Designer.
- File Drivers—must be installed for communication with devices.

1. Find the link for the Flo-Ware 4 installation from the website or from the CD:
   - Go to http://www.hachflow.com/p_soft_floware_down.html.
   - Put the CD in the computer. If the main window does not open automatically, find and open the startcd.exe file on the CD.
2. Follow the on-screen instructions to install the software. When the installation is complete, a Flo-Ware shortcut icon is shown on the desktop.
3. Find and install the Flo-Ware Help File. Follow the on-screen instructions to install the file.
4. Find and install the File Driver for each instrument that is used. Follow the on-screen instructions to install the file.
5. Install any associated files that are shown for the instrument, such as a USB driver. If the USB driver install wizard does not appear, go to C:\Program Files\Flo-Ware \FL9xx\USB Driver.

2.2 Install updates

The application and drivers are updated regularly for continued improvement. Install the updated files for best results.

1. Make sure that the computer is connected to the internet.
2. Open Flo-Ware and click on the HELP button. The Help, About window opens.
3. Find the version of the application and drivers that are in use.
4. Click on the **CHECK FOR UPDATES** button. An internet browser opens and the download center is shown.
5. Compare the version number of the installation files on the download page to the version of the application and drivers that are in use.
6. If a newer file is available, close the application and install the updated files.

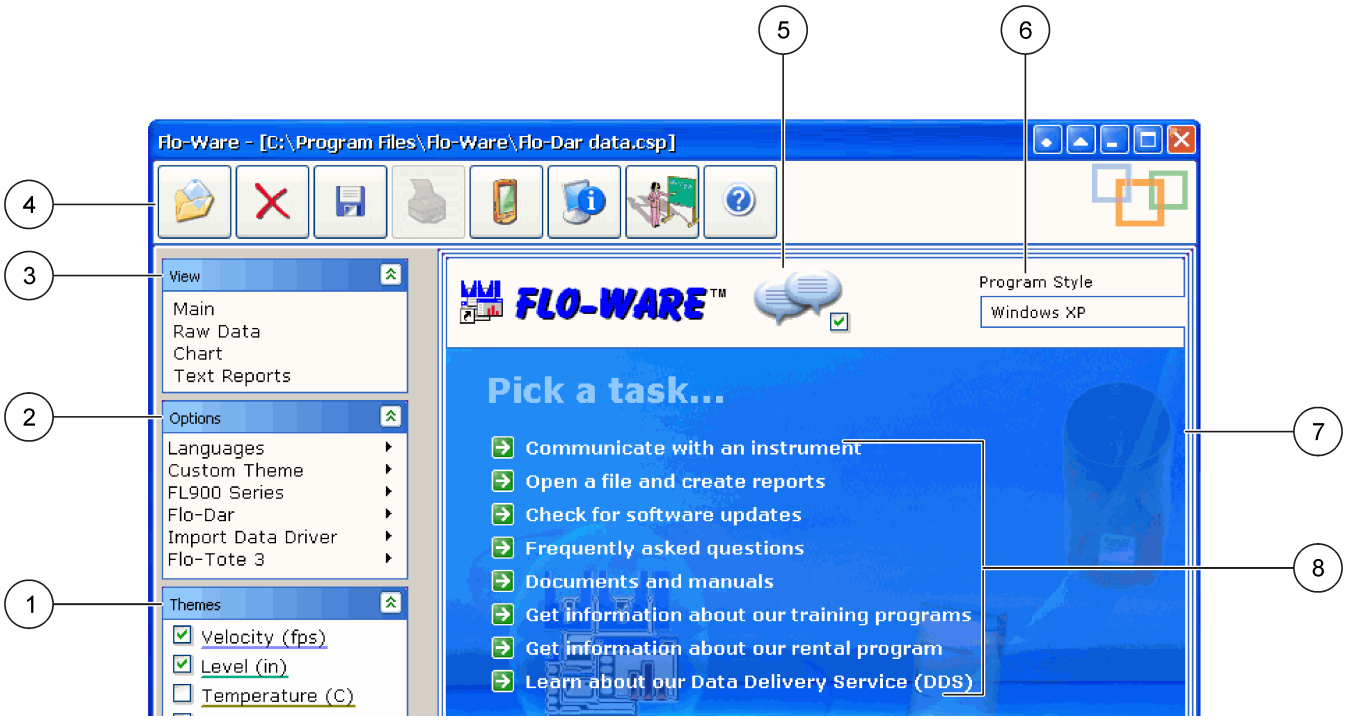
Section 3 Operation

3.1 User interface

Main window

Double-click the **FLO-WARE** icon on the desktop to open the main window (Figure 1).

Figure 1 Main window

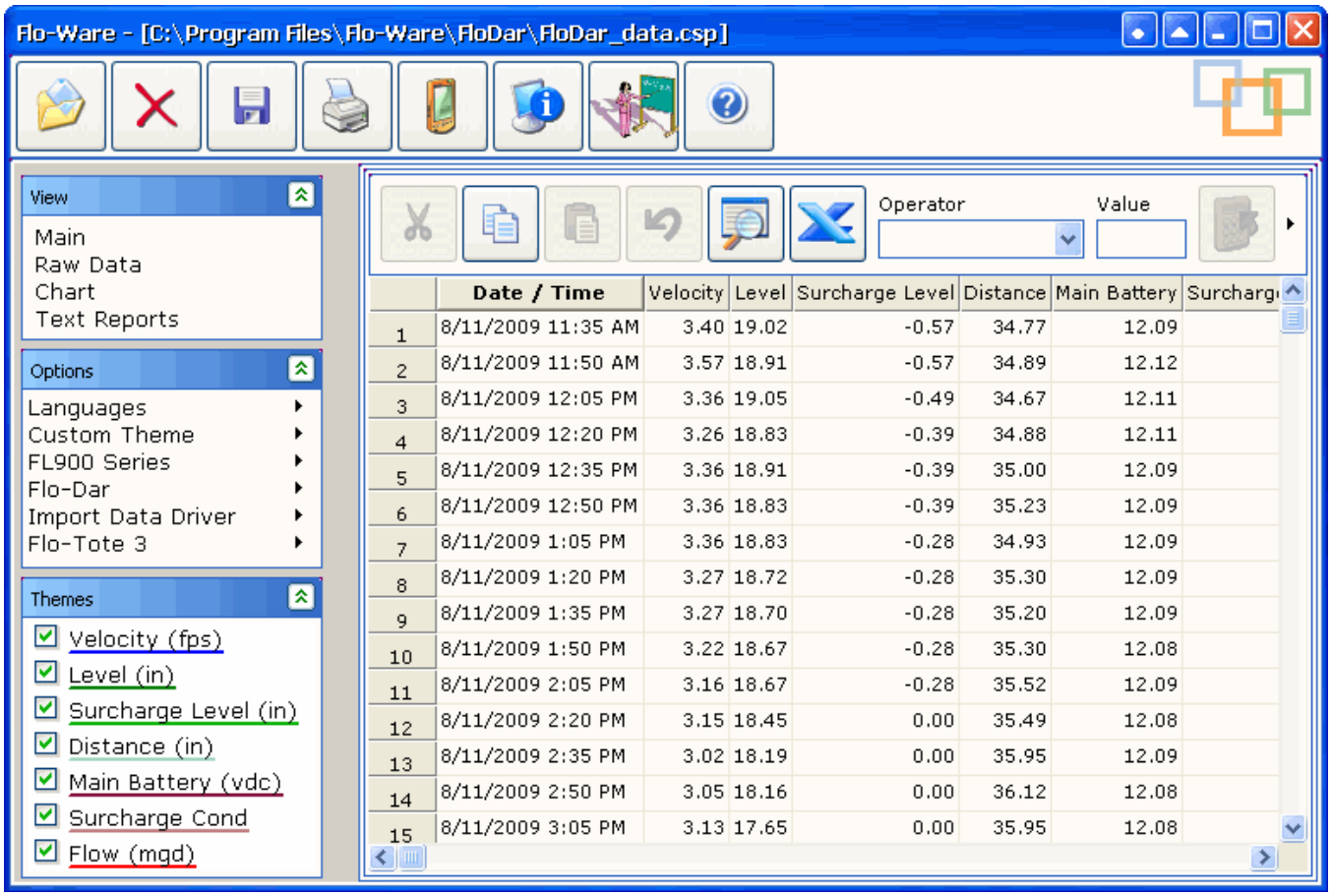


1	Themes panel—measurement channels	**5**	Balloon help—descriptions of icons and links
2	Options panel—language options and device drivers	**6**	Program style—color and style options for Flo-Ware
3	View panel—main view and data views	**7**	Main view—changes with the selected menu
4	Main toolbar—icons shown in all windows	**8**	Main-view tasks—links for basic tasks and information

3.2 Raw data

The Raw Data view shows the data or project file in a spreadsheet. The columns correspond to the themes that are shown in the Themes panel. The maximum number of records is limited only by the computer memory.

Navigation in the Raw Data view is similar to navigation in common spreadsheet software. Use the arrow keys on the computer keyboard to move up, down, left or right. Use hot keys such as **Ctrl** + **End** to move the cursor to the last cell in the spreadsheet. Use **Ctrl** + **Home** to move the cursor to the first cell in the spreadsheet.



3.2.1 Edit data

Data can be adjusted in the raw data view to change incorrect values. For example, if a value for the level measurement indicates 0 volume, the corresponding velocity value should also be 0. If the velocity value is not 0, a velocity value of 0 can be entered.

1. Click to select a data cell in the raw data view.
2. Use a method to change the values:

Option	Description
Manual	Use the computer keyboard to change the value. Any calculated values, such as flow, are automatically recalculated. For example, if the velocity value is doubled, the flow is automatically recalculated.
Find/Replace	Use the **FIND/REPLACE** button to search for data and replace the value.
Calculator	Select one or more data cells and and select add, subtract, multiply or divide from the Operator field on the toolbar. Enter a value and click the **RECALCULATE SPREADSHEET** button. ***Note:*** *To highlight multiple cells, click in a data cell and drag down. Alternatively, click in a data cell, press the shift key and click in another cell.*

3.2.2 Export data

Data can be saved in a .txt or .csv file format for use in common applications such as Microsoft® Excel® spreadsheet software.

1. Open a data or project file in the Raw Data view.
2. Click the **EXPORT** button from the toolbar of the Raw Data view. The Export window opens.

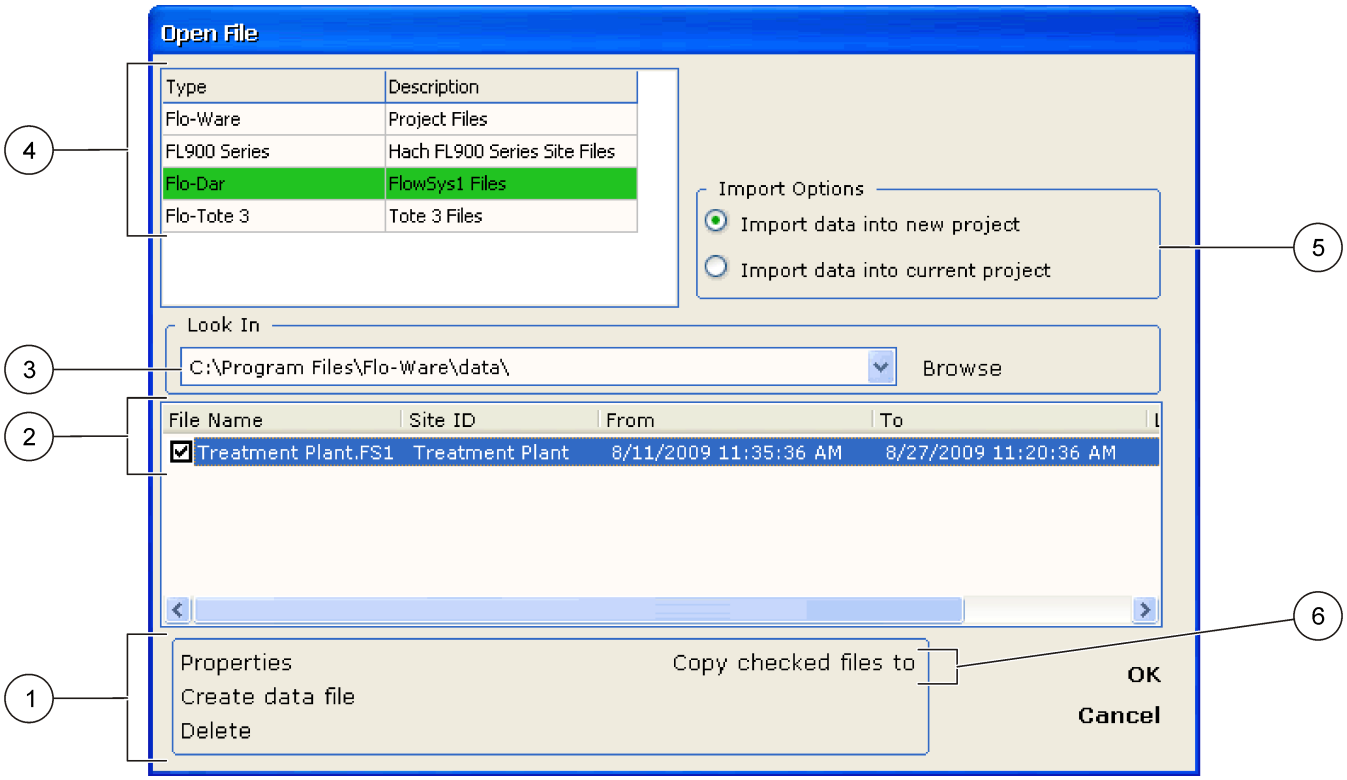
3. To change the date and time range, click on the start time or end time that is shown. The Date/Time window opens. Select a new date and time range and click **OK**.
4. Select a Data Interval. The intervals in the exported data file can be different from the intervals in the raw data file. For example, the raw data file can have 15 minute intervals and the exported data can have hourly or daily intervals.
5. Click **EXPORT**. The Save Export File As window opens.
6. Enter a file name and location.
7. Select either the tabbed text (.txt) or comma separated values (.csv) file format and click **SAVE**.

3.2.3 Open data or project files

A data file is created whenever data is transferred from an instrument to the computer. Open these files to view and analyze the data. When data files are opened in Flo-Ware, a project file is automatically created.
The project file contains the charts, text reports, themes and analysis for the data. Save the project to retain the changes that were made. When the project file is opened at a later date, the project opens up at the point where it was last saved.

1. Click on the **FILE OPEN** button on the main toolbar. The Open File window opens (Figure 2).
2. In the Type section, select a file type:
   - Flo-Ware Project Files—previously-opened files that were saved as a project.
   - Instrument Files—available for an instrument if the file driver for that instrument was installed.
3. In the Look In section, click **BROWSE** to select the folder where the data files are located. Once a path is selected, it will be available from the drop-down list.
4. In the File Name section, click to highlight the data file to open. To highlight more than one file, press and hold the shift key and then click additional files.
5. If a project is currently open, the Import Options section is shown. Select whether to start a new project or import the data into the current project.

Figure 2 Open file window



1	Options for highlighted files	**4**	File type (dependent on installed file drivers)
2	Data or project files	**5**	Options for multiple files
3	Path to file location on PC or network	**6**	Options for checked files

6. Click OK. The Data Interval window opens.
7. Select the time span and data interval.

Option	Description
Start Time	The start time of the data file is shown initially. A different date and time can be selected.
End Time	The end time of the data file is shown initially. A different date and time can be selected.
Data Interval	The data interval that is set for the instrument is shown initially. A different interval can be selected and the data will be averaged. ***Note:*** *Some intervals are not compatible with the intervals set for the instrument. For example, if the instrument is set to record in 3- or 15-minute intervals, the 1- and 5-minute intervals in Flo-Ware are not available.*

8. Click **OK**. The file, if a single file and a new project, opens in the Raw data view.
9. If the file is imported into the current project, or if multiple files are opened, the Theme Data window opens. Select Import (side by side) or Append (string the data together) and click **OK**.

Option	Description
Import Data	A side-by-side presentation is useful when the data from many different sites is plotted in one project. This presentation is useful, for example, when comparing upstream and downstream sites within the same project.
Append Data	Data files from the same site can be appended to create long continuous projects that are several months or several years long. Make sure to append data only from the same site.

The data file will open in the Raw data view. Flo-Ware copies the selected data file(s) and imports it into the project, leaving the original raw data file unchanged and intact for archival purposes.

3.2.3.1 Change file properties

In the Open File window, the properties of a data file can be changed. For example, if the wrong year was assigned to a connected flow meter during installation, the start date for the file can be changed. Each supported instrument has a unique set of file properties.
Note: *The file properties cannot be changed for project files.*

1. Click the **FILE OPEN** button and select the file type and path in the Open File window.
2. Highlight the file name and click **Properties**. The File Properties window opens.
3. For FL900 Series files, select a port/sensor.
4. Click in one of the fields, edit the information and click **OK**.

3.2.3.2 Make a new data file

The user can make a new data file from one or more highlighted data files. This can be useful when several data files exist for one month of data, for example. The first data file may not start exactly on the first day of the month at 0:00 hours, and the last file may not end exactly on the last day of the month at 24:00 hours. These data files can be combined into one data file that is exactly one month long.
Note: *Some instruments that are supported by Flo-Ware allow the user to select the exact span of data. In this case, a data file can be created with the exact span that is needed.*

1. Click the **FILE OPEN** button and select the file type and path in the Open File window.
2. Highlight one or more file names and click **Create data file**. The Select Data Span window opens.

   Note: *To open multiple files, highlight the first file, then hold down the* ***Ctrl*** *or* ***Shift*** *key and highlight additional files.*
3. Select or enter the start date and time, the end date and time and click **OK**. The Save File window opens.
4. Enter a name for the file and click **Save**.

3.2.3.3 Delete files

Data and project files can be deleted if necessary.

1. Click the **FILE OPEN** button and select the file type and path in the Open File window.
2. Highlight the file name to delete and click **Delete**. A confirmation window opens.
3. Click **YES** to delete the file.

3.2.3.4 Copy files to a new location

A data or project file can be copied and pasted to a different location on the computer or network.

1. Click the **FILE OPEN** button and select the file type and path in the Open File window.
2. Click the check box next to one or more file names.
3. Click **Copy Checked files to**. Select the new location on the computer or network and click **OK**. The files are copied and pasted to the new location.

3.3 Themes

Themes are shown as data columns in the Raw Data view. Each theme name is also shown in the Themes panel (refer to Figure 1 on page 7).

The available themes correspond to the channels that were selected for logging during the site setup of the associated instrument. For example, the level and velocity themes are shown when a Flo-Tote 3 sensor is set up with level and velocity logging. A flow theme is also calculated and added.

The check boxes in the themes panel allow the user to show or remove a theme in charts and text reports. Themes are always shown in the raw data view. To change the order of a theme, click and drag the theme up or down in the Themes panel.

3.3.1 Set up themes

Themes can be shown in a chart with different colors and attributes such as line width or style. For example, the velocity theme can have one color and the level theme can have a different color.

1. Right-click a theme name from the Themes panel and select Theme Setup. The Properties window for the theme opens.
2. Change the attributes that are shown on each of the tabs and click **OK**.

Option	Description
General	Changes the basic attributes of a theme such as the name and units. The available attributes change with the type of chart that is selected in the View panel.
Marks	Changes the appearance of the marks or labels on a chart that shows individual data points. The changes affect only the theme that is selected on the General tab.
Line, Bar or Area	Changes the appearance of the theme in a line, bar or area, pie or scatter chart. The available attributes change with the theme that is selected on the General tab.

3.3.2 Edit site information

The user can view and edit information about the site that is associated with the data file. Each supported instrument has a unique set of site information attributes.
Edit the attributes when information was entered incorrectly during setup. For example, if an incorrect pipe diameter were entered, the flow data in the site file will be incorrect. The pipe diameter can be changed in the Site Information window. The flow data is then calculated correctly in the site file.

1. Open the site file.
2. Right-click the theme name from the Themes panel.
3. Select Site Information. The Site Information window opens.
4. Edit the site information and click **OK**.

Note: *Refer to the help system for the associated instrument for more details about Site Information.*

3.3.3 Delete a theme

A theme can be removed from a project at any time.

1. Right-click the theme name to be removed from the Themes panel.
2. Select Delete Theme. A confirmation window opens.
3. Click **YES** to delete the theme.

3.3.4 Make a custom theme

A Custom Theme adds a new column in the raw data view for user data such as infiltration/inflow, temperature, pH or maximum allowable flow.

1. Click **Custom Theme** in the Options view and select **New**. The Data Interval window opens.
2. Enter the start time and end time. If the project is new, select the data interval.
   Note: *If in an existing project, the interval that was set when the first file was added to the project is used for the data interval.*
3. Click **OK**. The Custom Unit Editor window opens.
4. Define the units of measure for the chart and report labels:
   - Standard unit of measurement—enter the units and abbreviation.
   - Unit of measurement for totals—enter the units and abbreviation to use for totals. If the standard unit involves a rate, select the rate of measurement.
5. Click **OK**. The Custom Properties window opens.
6. Enter a name for the custom theme.
7. Make selections on the **General**, **Marks** and **Attributes** tabs to define all of the attributes for the new custom theme. Click **OK**.
8. To add data, select the Raw Data view. Type the data in the new column or paste data from a program such as Microsoft Excel spreadsheet software.
   All charts and text reports will reflect the selections that were made for the custom theme.

3.4 Charts

To view data in a chart, open a data file and click **Chart** in the View panel.

3.4.1 About charts

Charts allow the user to see the data in a graphical format. Charts can show trends, anomalies, maximums, minimums and totals. Data can be shown in 4 different types of charts:

- **Combination**—shows data as a line, a bar or an area. One theme can be shown as a data line, for example, and another theme can be shown as a bar
- **Bar**—shows data as vertical bars. The summary type for the theme must be set to show total values. The total values are calculated based on the data interval. Each theme is shown as a portion of each bar.
- **Pie**—shows data as a area. The summary type for the theme must be set to show total values. The total values are calculated based on the data interval. Each theme is shown as a section of the pie. The pie chart should only be used with the same type of data, for example flow data.
- **Scatter plot**—shows data as (x, y) data pairs for two different themes. The first two checked themes are shown on the chart. The first checked theme is shown on the x-axis and the second checked theme is shown on the y-axis. To show the data for

different themes, select or deselect the check box next to the theme name or change the order of the themes.

Use the buttons on the chart toolbar to navigate in the chart. To move the chart to the right or to the left, click on the **PAN** button, then right-click on the chart and drag the mouse to the left or right. The **ZOOM IN** and **ZOOM OUT** buttons allow the user to increase or decrease the amount of data that is shown in the chart view. The chart length can be increased up to 1 year.

Charts can have multiple pages. The page navigator in the main window shows the total number of pages and the page number that is currently shown. Click the right or left arrows to go forward or back, or enter a number in the edit box and press **ENTER** on the computer keyboard.

3.4.2 Set up charts

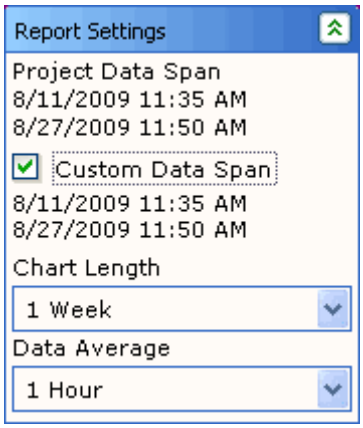
The appearance of charts can be configured for attributes such as background color, titles, legends and 3-dimensional effects. The changes affect all of the themes in a project. After a chart is configured, the settings can be saved to a template for use with other data files.

1. Open a data or project file.
2. Click **Chart** from the View panel.
3. Select a chart type (Combination, Bar, Pie or Scatter).
4. Click the **CHART SETUP** button from the Chart toolbar. The Chart Setup window opens.
5. Change the attributes that are shown on each of the tabs and click **OK**.

Option	Description
General	Changes the data span per chart page and sets 3D effects.
Background	Changes the background color of the chart and adds a background image or frame.
Legend	Changes the location and style of the legend.
Axes	Changes the settings for any axis of the chart. Select one of the axes from the left panel and then change the attributes for that axis.
Titles	Adds up to 9 different titles in a chart. Select one of the options from the left panel and then change the title attributes for that option.
Walls	Change the appearance the 3-dimensional walls that make up a 3D chart. The 3D Charting option must be enabled in the General tab of the Chart Setup window. Select one of the walls from the left panel and then change the attributes for that wall.

3.4.2.1 Change the data range

The data span for the chart is shown in the Report Settings panel. The data span, chart length and data interval can be changed and the updates can then be seen in the chart view. Changes that are made to the span, chart length and data interval will change the number of chart pages.



1. Select the check box next to Custom Data Span in the Report Settings panel. The start and end dates are shown.
2. To change the date and time range, click on the start time or end time. The Date/Time window opens. Select a new date and time range and click **OK**.
3. Select a chart length to be shown on each page of the chart.
4. Select the data interval to be shown. The chart view is updated to show the changes.

3.4.2.2 Make a template for charts

The settings that are made in the Chart Setup window can be saved as a template file for use with other data files.

1. Click on the **CHART TEMPLATE** button on the Chart toolbar. The Template Set Options window opens.
2. Select Save Template Set and click **Next**. The Save Template Set Options window opens.
3. Select one of the options:
   - Save as Default Template—the current chart settings are used automatically each time a chart is viewed. Click **Finish** and **YES**.
   - Save Template Set to File—the current chart settings can be saved and loaded into a project at any time. Click **Next**. Enter a file name and description for the new template. Click **Finish**.

3.4.2.3 Use a chart template

A chart template can be used as the default setup for charts, or it can be imported at any time.

1. Click on the **CHART TEMPLATE** button on the Chart toolbar. The Template Set Options window opens.
2. Select Load Template Set and click **Next**. The Load Template Set Options window opens.
3. Select one of the options:
   - Load Default Template Set—use the default template to make a new chart. Click **Finish**.
   - Load Template Set from File—use a previously saved template for the current project. Click **Next**. Select a template file from the drop-down box. Click **Finish**.

3.4.3 Print a chart

A paper copy of a chart can be made from a local or network printer.

1. From the View panel, select **Chart**.
2. Click the **PRINT** button. The Print window opens.
3. Select the printer, the number of pages to be printed and make any necessary changes to the properties. Click **OK**. The chart is sent to the printer.

3.5 Reports

Reports of raw data can be shown for different time intervals or as a summary of maximum, minimum, average and total values.

3.5.1 Make a report

Use the Text Report toolbar to make a text report.

1. Open a data or project file.
2. From the View panel, select **Text Reports**.
3. Select a report type from the Available Reports drop-down list on the Text Report toolbar. The report is shown in the view window. Use the page navigator on the main toolbar to view additional pages.

   Note: *After a report type is selected, it is available in the Installed Reports list.*
4. To add or remove a theme (column), go to the Themes panel and select or deselect a theme.
5. To change the order of themes, go to the Themes panel and click and drag the theme name up or down.
6. To change the date range:

   a. Go to the Report Settings panel.
   b. Select the check box next to **Custom Data Span**. The start and end dates and times are shown.
   c. Click on the start or the end date and time. The Date/Time window opens.
   d. Select a new date and time and click **OK**. The report will update and show the new date and time.

3.5.2 Print a report

A paper copy of a report can be made from a local or network printer.

1. Open a text report.
2. Click the **PRINT** button. The Print window opens.
3. Select the printer, the number of pages to be printed and make any necessary changes to the properties. Click **OK**. The report is sent to the printer.

3.6 Data reconstruction

The data reconstruction workspace gives the user the flexibility to analyze data and, if necessary, repair or reconstruct the data. The example in this section describes the removal of an error in the velocity theme from a flow meter.

3.6.1 About data reconstruction

When a set of data suddenly shows a large change from a stable pattern, the data should be examined to find the cause for the change. As an example, imagine that the flow and velocity themes suddenly become erratic and go to very low values for approximately 1 day. This change can be due to a true decrease in the flow, or to a condition such as debris that collected on the sensor.

Upon examination, the level theme shows a stable pattern for this day. If the flow actually did decrease, the level data is expected to decrease also. The conclusion can then be made that the velocity data has an error on that day.

This error can be removed with the reconstruct option. The span of inaccurate data can be replaced with a span of data that is known to be accurate. The result will be more accurate data, better flow balances and a higher level of statistical confidence.

The line chart or the scatter plot can be used to remove errors from most data files. The line chart is used to repair sections of data (Use a reconstruction table on page 17). The scatter plot can be used to reconstruct an entire set of data (Use the scatter plot on page 18).

3.6.2 Use a reconstruction table

The example that follows shows the removal of an error in the velocity theme based on the level data. The level data is referred to as the Base Theme. Before reconstruction, find a span of data that is considered to be accurate and that follows a noticeable pattern.

1. Open the data or project file and select View>Chart. Select the Combination Chart from the toolbar.
2. Right-click the Velocity theme in the Themes panel and select **Reconstruct**. The Reconstruct Velocity window opens.
3. Select the **Level** theme from the drop-down box as the basis for the reconstruction and click **OK**. The Data Reconstruct panel is shown.
4. In the Data Reconstruct panel, select Table > New. The Reconstruction Table Properties window opens.

   Note: *To edit a reconstruction table that was previously saved from the same site, select Table > Open.*
5. Update the options as follows:

   - Decimal Precision—set the decimal precision for the 2 themes. The higher the precision for the base theme, the longer it will take to populate the table with data.
   - Base Theme Data Range—select the approximate minimum and maximum values of good data for the base theme (as seen in the line chart).
   - Notes—enter a comment about the site for future use.
6. Click **OK**. A data reconstruction table is added to the Data Reconstruct panel. The left column of the table shows the Base Theme. The right column of the table shows the theme to be reconstructed.
7. In the chart, select a span of data that is known to be accurate. First, left-click the start of the data, then right-click the end of the data span. The selected data for both themes will change color. Make sure that the selected span includes only accurate data.

   Note: *If the Pan or Zoom buttons are enabled, the data cannot be selected.*
8. In the Data Reconstruct panel, select Table > Populate with Data. The velocity data will be added to the velocity column. Some of the data cells will be empty.
9. Use one of the options that follow to fill in the empty data cells:

   - Select additional data spans to populate the table with more data.
   - Enter a reasonable value for the velocity using the keyboard.

- Interpolate over blank cells: click and drag to highlight data from above the first empty data cell to below the last empty data cell. Select Edit > Interpolate. The table is updated with the linear interpolated data. The start and end cells are used as reference points.
- Change to the Scatter Plot view and click in the scatter plot where the data should likely be (refer to Use the scatter plot on page 18).

10. Select a span of inaccurate data in the chart. First, left-click the start of the data, then right-click the end of the inaccurate data span. The selected data for both themes will change color. Make sure that the selected span includes the data to be reconstructed.

    Note: *If the Pan or Zoom buttons are enabled, the data cannot be selected.*

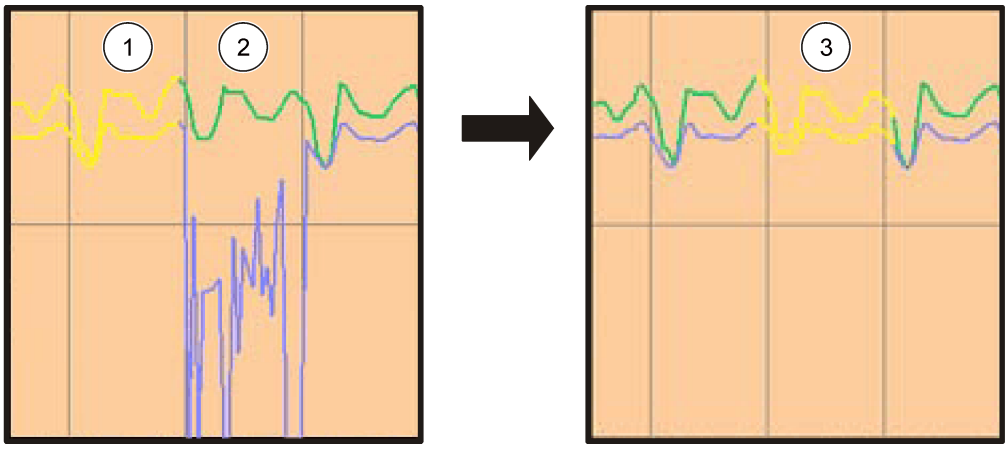
11. In the Data Reconstruct panel, select Table > Reconstruct. The theme is updated to show the correction (Figure 3).
12. Select Table > Save to save the table. Enter a file name and location to store the file.

    Note: *This table can be used for future data reconstruction at the same site.*

13. Close the Data Reconstruct panel to exit the reconstruction session.

    Note: *To reverse the reconstruction, select the Raw Data view and click the undo button.*

Figure 3 Data before and after reconstruction



1 Valid data	**2** Incorrect data	**3** Repaired data

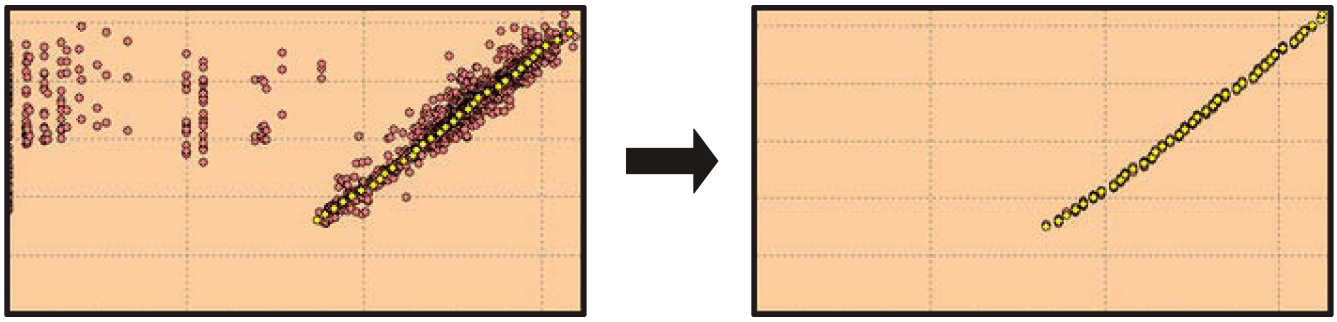
3.6.3 Use the scatter plot

Use the scatter plot when it is necessary to reconstruct the entire set of data. First, select a span of accurate data with the line chart to populate the reconstruction table. Then change to the scatter plot view to reconstruct the data.

1. Complete 1 to 9 to in Use a reconstruction table on page 17.
2. Click on the **SCATTER PLOT** button. The data from the reconstruction table is shown in the scatter plot in a different color from the rest of the data set (Figure 4).
3. If necessary, edit the data in the reconstruction table. The data points on the scatter plot are updated to show the new values.
4. In the Data Reconstruct panel, select Table > Reconstruct. The entire set of data is updated to match the table data (Figure 4).
5. Save the reconstruction file and close the Data Reconstruct panel.

   Note: *To reverse the reconstruction, select the Raw Data view and click the **UNDO** button.*

Figure 4 Data before and after reconstruction



Section 4 Device communication

⚠CAUTION

Refer to the safety information in the user manual for the device before any connections are made to the device.

When the driver for a device is installed, Flo-Ware can communicate directly with the device for various purposes such as data collection and site configuration.

4.1 FL900 series logger

4.1.1 Initial setup

4.1.1.1 Install the Flo-Ware FL900 Driver

Note: *During driver installation this message will appear: "The following device has not passed the Windows Logo testing to verify its compatibility with Windows. Continuing your installation of this software may impair the correct operation of your system either immediately or in the future. Microsoft strongly recommends that you stop this installation now and contact the hardware vendor for software that has passed Windows Logo testing." Hach engineers have fully tested this product and determined that it is compatible with Windows. Press the "Continue anyway" button to finish the installation.*

Pre-requisite: Before the FL900 logger is attached to a computer, make sure that Flo-Ware is installed on the computer.

The FL900 Series Driver must be installed on the PC to communicate with the logger.

1. Find the link for the FL900 Series Driver on the Flo-Ware CD or from the website http://www.hachflow.com/p_soft_floware_down.html
2. Click on the link and run the application. The install wizard starts.
3. Follow the on-screen instructions to install the driver. Use the recommended settings.

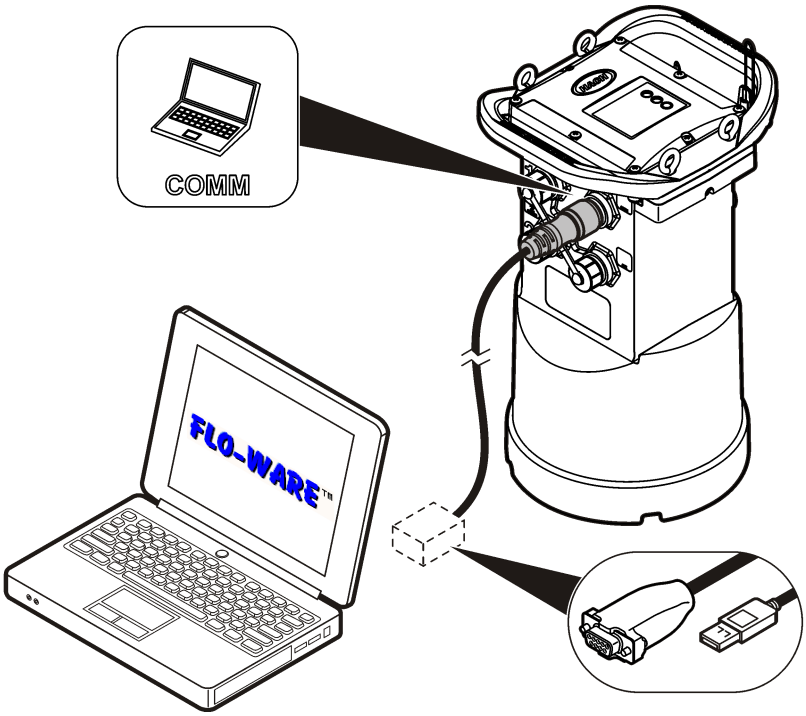
4.1.1.2 Attach the logger to the computer

Pre-requisite: Make sure that the FL900 driver is installed on the computer.

Connect only one logger to the computer.

1. Attach the logger to the computer (Figure 5).
2. When a USB cable is attached for the first time, the Found New Hardware wizard opens. Run the new hardware wizard to install the USB driver for the logger. When finished, the message “Your new hardware is installed and ready to use” is shown. In the event the wizard does not run or the install fails, contact Hach Flow Tech Support to assist with trouble shooting your specific operating system.

Figure 5 Attach the logger to a computer



4.1.1.3 Attach a sensor or external devices to the logger

Pre-requisite: Make sure that the connection status is offline.

⚠WARNING

Sensor Hazardous Locations and RF Exposure Hazards. Some sensors have RF radiation exposure hazards and are used in explosive atmospheres. See sensor manual warnings and instructions before connecting a sensor to the logger.

The number of sensors that can attach to the logger varies with the model of the logger. Some sensors must attach to an external module that is used as an interface between the sensor and the logger. Figure 7 shows the AV9000 Area Velocity Analyzer module on the side of the logger and the connection to a submerged area/velocity sensor.

1. If the sensor cable has connectors on both ends, attach the cable to the sensor first.
2. Attach the sensor (or module) to any SENSOR port on the logger (Figure 6 or Figure 7). Tighten the connector by hand.

   Note: *For rain gauges, attach the sensor to the RAIN connector.*
3. If the sensor uses an external module, attach the module to the logger, then attach the sensor to the module (Figure 7).
4. If the sensor cable has a desiccant hub, align the desiccant hub vertically and make sure that the air port points down (Figure 6).

Figure 6 Attach a sensor to the logger

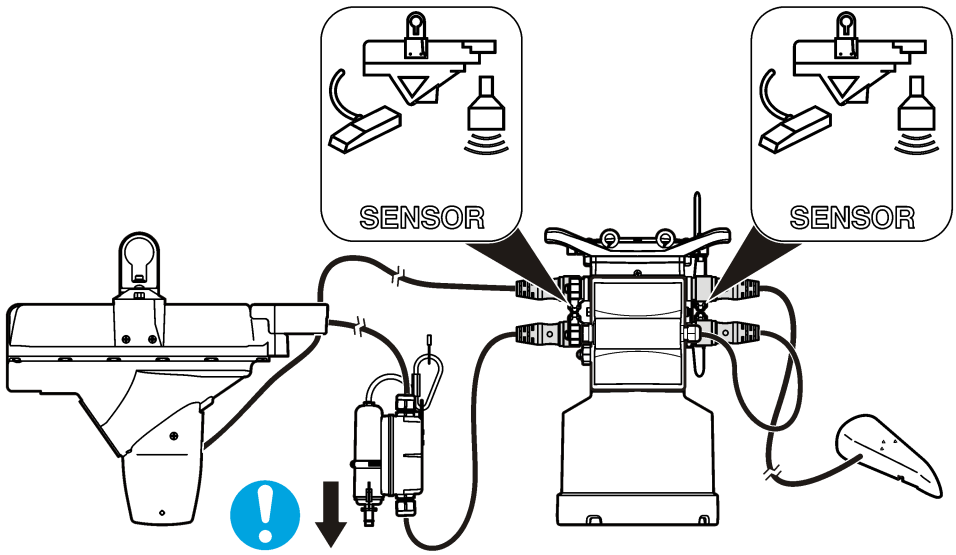
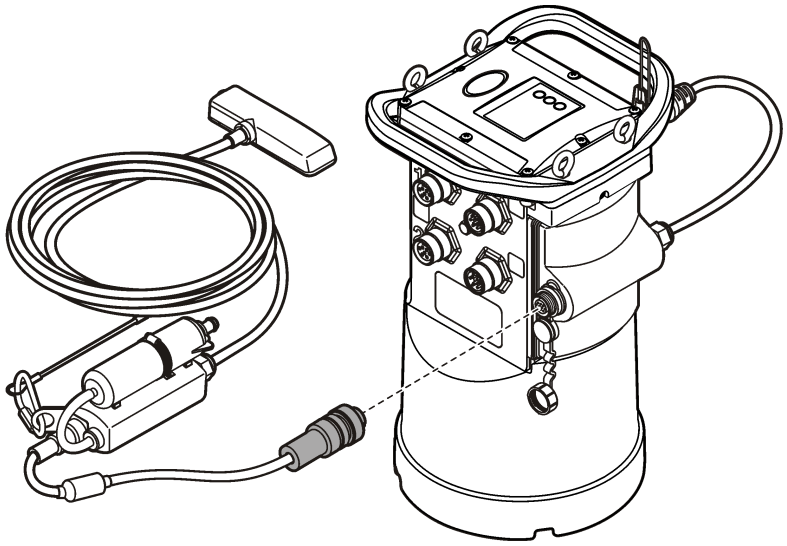


Figure 7 Attach a sensor to an external module

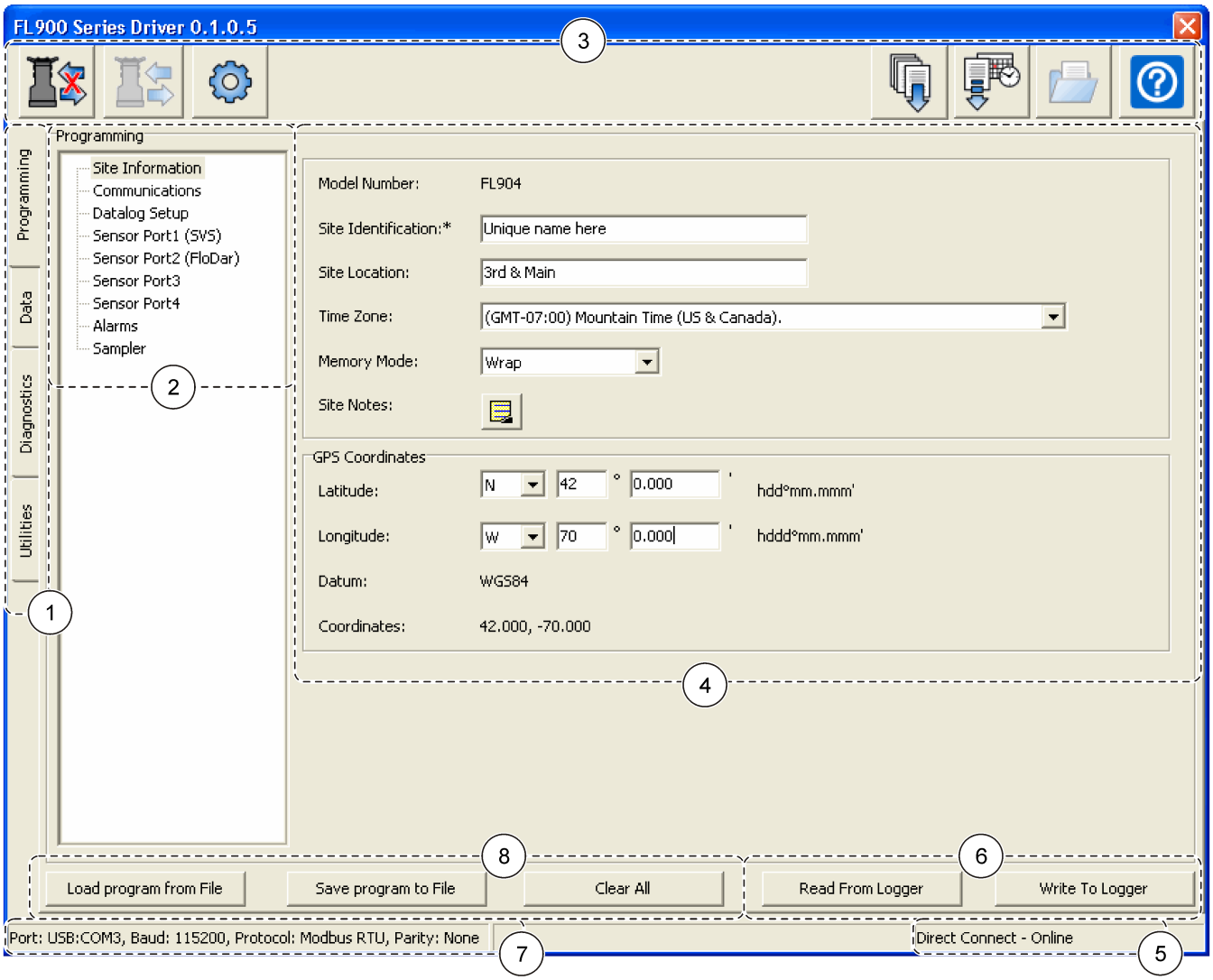


4.1.2 User interface and navigation

4.1.2.1 Driver window description

From the Options panel in Flo-Ware, select FL900 Series>Communications. The FL900 Series Driver window opens (Figure 8). The FL900 Series Driver window has tabs and buttons to complete tasks or access menus. The connection status is shown on the bottom bar (Connection status on page 24).

Figure 8 FL900 Series Driver window



1 Menu tabs	**5** Connection status—online or offline
2 Menu options	**6** Read/Write buttons (online only)
3 Toolbar buttons	**7** Connection details
4 Main section	**8** Load/Save/Clear buttons

4.1.2.2 Connection status

The connection status shows when a communication session is open:

- Online—a communication session with the logger is open. Any attached sensors are shown in the driver window. The user can download and view data from the logger and write a program to the logger.
- Offline—the FL900 driver is not connected to the logger. The user can open a site file or make a logger program for later use.

4.1.2.3 Toolbar

The toolbar buttons are always shown, but some buttons are enabled only when the connection status is online or offline.

Table 2 FL900 Series Driver toolbar

	Connect—starts a communication session with the logger.		Download since last—downloads only the data that was logged since the previous download.
	Disconnect—stops the communication session with the logger.		Open a file—opens a site file or sensor diagnostics file from the default file path.
	Global settings—opens the settings window where various default settings such as file paths can be changed.		Help—opens the help window.
	Download all data—downloads all data from the logger.		

4.1.2.4 Menu tabs

Use the tabs to access the various menu options:

- Programming—sets all of the user-adjustable parameters in the logger.
- Data—allows the user to view data (tabular and graph) and get sample history from a site file that has been downloaded from the logger.
- Diagnostics—contains the event log, alarm log, current status of the logger and real-time modem and sensor diagnostics.
- Utilities—contains tools such as firmware updates.

4.1.3 Connect to the logger

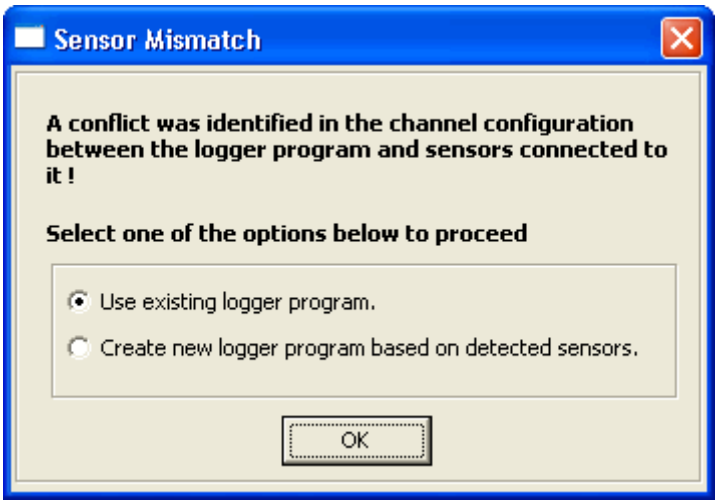
When a communications session is started, the connection status changes from offline to online.

1. In the FL900 Series Driver window, click the **CONNECT** button. The Communications window opens.
2. Select the computer port (COM or USB) from the drop-down list. For COM ports, select the communications protocol for the computer.

   Note: *When a USB cable is attached to the computer, a virtual serial port (e.g. USB:COM3) is assigned.*
3. Click **OK**. The driver reads the logger program and looks for sensors that are specified in the program.
   A Sensor Mismatch message is shown for the following situations:

   - The current logger program does not include an attached sensor
   - The current logger program includes a sensor that is not attached
   - The current logger program includes a sensor that is attached to an incorrect port
4. If the Sensor Mismatch message is shown, select one of the options and click **OK**:

   - Use existing logger program—ignore the attached sensors and import the program from the logger.
   - Create new logger program based on detected sensors—include the attached sensors in a new program. The new program can then be written to the logger.



4.1.4 Make a logger program

The logger must have a program to specify all of the necessary parameters for data collection. The program can be made when the logger is online or offline. When made offline, the program is saved to a file and later written to the logger.

The logger can have only one program. When a new program is written to the logger, the previous program is erased.

1. From the Options panel in Flo-Ware, select FL900 Series>Communications to open the driver window.
2. Start a communication session.
3. Click the **Programming** tab.
4. Complete each menu option:

Option	Description
Site information on page 27	Specifies general settings such as the model number, site ID, time zone, memory mode and GPS coordinates.
Communications settings—remote on page 28	Contains the remote communication settings for the logger.
Communications settings—local on page 27	Contains the local communication settings for the logger.
Datalog setup on page 29	Specifies which measurements will be recorded, what values trigger an alarm and what actions will occur during an alarm condition.
Flo-Dar setup—Cal Wizard on page 30	Sets the sensor units, flow channel geometry and the sensor calibration with the calibration wizard.
Flo-Dar setup—manual on page 31	Sets the sensor units, flow channel geometry and the sensor calibration manually.
Flo-Tote setup—Cal Wizard on page 36	Sets the sensor units, flow channel geometry and the sensor calibration with the calibration wizard.
Flo-Tote setup—manual on page 36	Sets the sensor units, flow channel geometry and the sensor calibration manually.
Ultrasonic setup—Cal Wizard on page 37	Sets the sensor units, flow channel geometry and the sensor calibration with the calibration wizard.
Ultrasonic setup—manual on page 39	Sets the sensor units, flow channel geometry and the sensor calibration with the calibration manually.

Option	Description
AV9000 Analyzer Module setup—Cal Wizard on page 41	Sets the sensor units, flow channel geometry and the sensor calibration with the calibration wizard.
AV9000 Analyzer Module setup—manual on page 42	Sets the sensor units, flow channel geometry and the sensor calibration manually.
IM9001 module setup on page 44	Contains the communication settings for a Sigma Flow Meter.
Set up alarms on page 45	Sets the system alarms and specifies the address or number for email or text message notification.
Set sampler options on page 46	Specifies the time interval that triggers the sampler to collect samples.

4.1.4.1 Site information

The site information menu contains the identification information for the site.

1. Click the **Programming** tab.
2. Complete the information in the Site Information menu:

Option	Description
Model Number	If online, the model number is selected automatically. If offline, select the model number of the logger that will be programmed.
Site Identification	Enter a unique name for the site (mandatory, maximum 16 characters). When telemetry is used for remote monitoring, a site repository is made on the server with this name.
Site Location	The optional location description (maximum 30 characters).
Time Zone	Select the correct time zone for the site. When telemetry is used, the server uses this time zone to synchronize the clock.
Memory Mode	The memory mode specifies how the datalog operates when the memory becomes full. Wrap (default): the oldest data points are deleted as new data is added. Slate: data collection stops.
Site Notes	Click the note icon to enter optional comments. Click the save icon to save the comments. The note file is saved as a .sn file in the default file path location.
GPS Coordinates	Enter the GPS coordinates for the site (optional). Use Datum WGS84 as the reference location and the format that is shown for Latitude and Longitude. When telemetry is used, these coordinates are shown on the map in FSDATA.

4.1.4.2 Communications settings—local

Local settings apply when the logger is connected to a computer with a communications cable. These settings are stored in the logger. When a communication session is started, the settings in the computer must be the same as the settings in the logger. The default local settings are sufficient for most applications. Change the settings only for specific communication requirements such as connection to a third-party device.

1. Click the **Programming** tab.
2. Click on the Communications menu.
3. Change any of the options:

Option	Description
Modbus Address	The address that is used for network communication with the logger (default address: 2).

Option	Description
Baud Rate	The baud rate assigned to the logger.
Parity	Even, odd or none.
Protocol	Modbus RTU (default) or Modbus ASCII.

4.1.4.3 Communications settings—remote

A modem can be used to transmit data to a server or to send email or text messages from the logger. The modem can be for wireless or landline (dialup) communication. When a GPRS wireless modem is used, the user must first install the SIM card from the mobile provider (refer to the documentation for the logger).
For connection to the internet, the user must first configure the server for the instrument and get the Security Verification Code (SVC). Refer to the user manual for the FL900 logger for more information.

1. Click the **Programming** tab.
2. Click on the Communications menu. If online, most of the settings are completed automatically.
3. Change any of the options for the modem:

Option	Description
Enable Modem	Makes the modem active. If the modem is not used, deselect this option to save battery power.
Modem Type	Selects the type of modem (refer to the label on the logger). Options: GPRS, Verizon, Sprint, Dialup.
Modem Frequency	GPRS only—sets the modem frequency to be used. Options: 850, 900E, 1800, 1900, 850/1900 (North America), 900E/1800 (EU), 900E/1900 MHz.
Network Provider	Wireless only—selects the mobile provider. Options: EU Mobistar 1, EU Mobistar 2, US AT&T, US TMobile.
Access Point Name	GPRS only—the access point name is entered automatically when the network provider is selected.
Username	If the network provider supplied a user name and password, enter the information.
Password	If the network provider supplied a user name and password, enter the information.
Programming Code	Verizon or Sprint only—this information is supplied by the network provider.
Mobile Station ID	Verizon or Sprint only—this information is supplied by the network provider.
Mobile Data Number	Verizon or Sprint only—this information is supplied by the network provider.
Primary dial number	Dialup only—this information is supplied by the internet service provider.
Secondary dial number	Dialup only—this information is supplied by the internet service provider.

4. Change any of the options for the server:

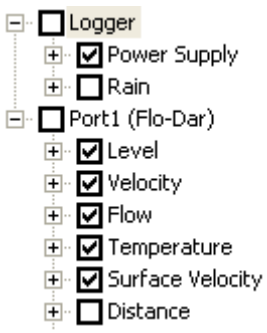
Option	Description
Server IP Address	Internet server address, supplied by the manufacturer.
Port Number	Internet connection information, supplied by the manufacturer.

Option	Description
Primary Call Interval	The frequency that the logger calls the server, not to exceed the logging interval. Options: 5, 6, 10, 12, 15, 30, 60 minutes; 2, 3, 4, 6, 12, 24 hours.
Secondary Call Interval	The frequency that the logger calls the server during an alarm condition. Options: 5, 6, 10, 12, 15, 30, 60 minutes; 2, 3, 4, 6, 12, 24 hours.
SMS to E-mail Gateway	GPRS only—completed automatically when the provider is selected.
SMS Service Center	GPRS only—completed automatically after the provider is selected.
Server Verification Code	The customer-specific ID that connects an instrument to the customer account during telemetry.

4.1.4.4 Datalog setup

Use the datalog setup menu to specify which channels will be recorded in the datalog. A channel can be a reading from an attached sensor, the battery voltage from the logger or a statistical value based on a sensor reading. A channel must be selected before any data can be saved. A maximum of 16 channels can be selected.
Note: *If channels are added to or removed from an existing program, all data in the logger will be erased. Be sure to download the data from the logger to a safe location before the modified program is written to the logger.*

1. Click on the **Programming** tab in the FL900 Series Driver window. If online, the attached sensors and ports are shown.
2. If offline, click on the Datalog Setup menu. Select the sensor(s) from the drop-down list in the Port Assignments section that agree with the sensor and port configurations on the logger.
3. Click on the **Datalog Setup** menu.
4. Select the channels to be logged in the Select Datalog Channels section:
   a. Expand the tree for the Logger channel group. The Power Supply channel is always shown in this group. Logging the power supply value is useful in order to know when the batteries should be replaced. A low value alarm can be set to send an email or SMS when a specified voltage value is reached. If the logger contains a port for a rain gauge, the Rain channel is also shown. To include a Logger channel in the datalog, select the check box next to the channel name.
   b. Expand the tree for each Port[1](Sensor Name) channel group to view the available channels for the sensor.
   c. To include a Sensor channel in the datalog, select the check box next to the channel name. The log channel count increases each time a channel is selected.
      Note: *For loggers with multiple sensor ports, the port number is added to the channel name. For example, Velocity 3 is the velocity channel name for sensor port 3.*



5. To set the logging interval for a channel group:

a. Click on the channel group name, for example **Port1 (Flo-Dar)**. The logging intervals are shown.
b. Select the interval from the drop-down list. The primary logging interval is used for normal operation. The secondary logging interval is used during alarm conditions.

Note: *The logging interval cannot be set for an individual sensor channel.*

6. To change the units for a channel, click on the channel name. The units are shown. Select the units from the drop-down list.

4.1.4.5 Flo-Dar setup—Cal Wizard

The sensor can be configured and calibrated with the calibration wizard. The sensor must be installed in the process and the connection status must be online for calibration.

1. Click on the **Programming** tab in the FL900 Series Driver window. If online, the attached sensors and ports are shown.
2. Click on Sensor Port[1] (sensor name).
3. Select the units in the Unit Preferences section. These units can be different from the logged units that are specified in the Datalog Setup menu.
4. Click on the **CAL WIZARD** button. The Calibration Wizard window opens.
5. Select the options on each screen and click **NEXT**:

Option	Description
Number of samples	The number of times the sensor is sampled for the calibration measurements (1, 2 or 3).
Flow parameters	The shape and dimensions of the flow channel (circular, rectangular, trapezoidal or U-shaped).
Ultrasonic transducer	The level (depth) sensor that is used during non-surcharge conditions (standard or extended range).
Surcharge velocity	The SVS sensor for velocity measurements during surcharge conditions (yes, no. If yes, select the sensor port where the SVS is attached).
Sensor height	The distance from the bottom of the flow channel to the top of the sensor frame (direct—measured by user or indirect—measured by sensor. If indirect, the user must enter the liquid level after the measurement has been sampled from the sensor).
Calibration screen	The calibration measurements are taken.
Actual level	The liquid level (depth) measured by the user in the flow channel.
Actual velocity	The user can measure the velocity with a different instrument and enter the value (optional).

6. When the Calibration Complete screen is shown, click **FINISH**. The Calibration Wizard window closes.

Note: *The Calibration Complete screen shows the values that were entered by the user and the values that were measured by the sensor. If the values are different, the calibration adjustment value or multiplier is shown.*

7. Click **WRITE TO LOGGER** to save the settings. A message window is shown:

Option	Description
Warning: all data will be lost. Continue?	All data that is stored in the logger is erased when a program is written to the logger. To save the data, select No and download the data to a safe location. Select Yes to erase all data and update the logger with the new program.
Set Logger Clock	Synchronize to Computer Clock—the logger uses the date and time settings of the computer. Set Logger Clock—the logger uses the date and time settings that are set by the user. If the unit has a modem, the logger automatically uses the date and time settings of the server.

4.1.4.6 Flo-Dar setup—manual

The Calibration Wizard is the easiest method to set up the sensor. Use the manual setup for odd-shaped flow channels or to adjust some of the calibration parameters. The sensor must be installed in the process and the connection status must be online for calibration. Be sure to complete the level calibration before the velocity calibration.

1. Click on the **Programming** tab in the FL900 Series Driver window. If online, the attached sensors and ports are shown.
2. Click on Sensor Port[1] (sensor name).
3. Select the units in the Unit Preferences section. These units can be different from the logged units that are specified in the Datalog Setup menu.
4. Click on the **Flow Settings** tab and select the shape of the flow channel.
5. Enter the dimensions of the flow channel. Be sure to enter the correct depth for non-circular channels.
6. If the flow channel is odd-shaped, a table is shown. A cross-section of the shape can be divided into parts and the area of the parts can be entered into the table.
7. Click **WRITE TO LOGGER** to save the settings. A message window is shown:

Option	Description
Warning: all data will be lost. Continue?	All data that is stored in the logger is erased when a program is written to the logger. To save the data, select No and download the data to a safe location. Select Yes to erase all data and update the logger with the new program.
Set Logger Clock	Synchronize to Computer Clock—the logger uses the date and time settings of the computer. Set Logger Clock—the logger uses the date and time settings that are set by the user. If the unit has a modem, the logger automatically uses the date and time settings of the server.

8. If an SVS sensor if used, complete the following steps:
   a. Click on the Surcharge Settings tab.
   b. Select the Use SVS Sensor check box.
   c. Select the sensor port on the logger where the SVS is attached.
   d. Change any of the SVS settings if necessary:

Option	Description
Reversed SVS Sensor	Select if the Flo-Dar sensor is installed in the reverse direction.
Conductivity Trigger	The conductivity value that starts the Flo-Dar surcharge mode (secondary trigger).
Distance Turn-On	The distance that starts the SVS operation (primary trigger).

Option	Description
Distance Switchover	The distance that starts the Flo-Dar surcharge mode (primary trigger).
Surcharge Level Trigger	The surcharge level that starts the SVS operation (secondary trigger).
SVS Velocity Multiplier	The multiplier that is used to adjust the SVS measurements.

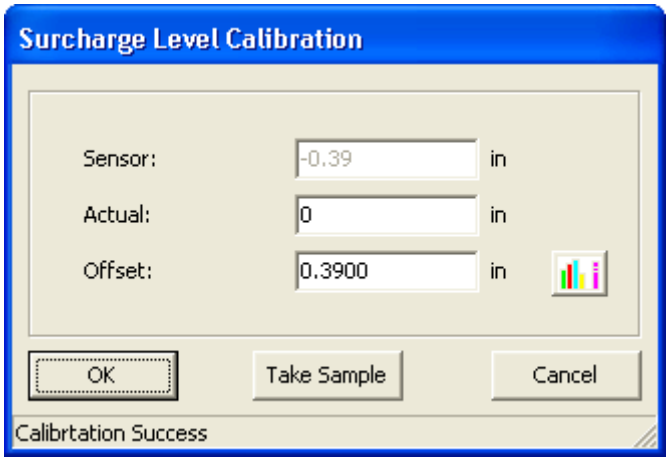
Note: *After the SVS port number is specified in the Flo-Dar setup, the menus are the same for the Sensor Port[1] (Flo-Dar) and the Sensor Port[2] (SVS) screens.*

If an SVS is not used, make sure that the Use SVS Sensor check box is not selected.

4.1.4.6.1 Calibrate the Flo-Dar surcharge level

Calibration of the surcharge level sensor is usually not necessary when the auto calibration function is enabled. The value for the surcharge level should be zero during normal flow conditions. If the value is high or drifts, replace the desiccant cartridge.

1. Click on the **Advanced Settings** tab in the Sensor Port[1] (FloDar) menu and click **CALIBRATE**. The Surcharge Level Calibration window opens.



2. Click **TAKE SAMPLE**. The sensor measures the surcharge level. When complete, the value is shown in the Sensor field.
3. If the measured depth is not zero (or the measured value), enter zero (or the measured value) in the Actual field. The offset is calculated and shown. The offset is used to adjust the measured value to the correct value.
4. Click **OK**.
5. Change any of the surcharge level settings if necessary:

Option	Description
Level Calibration	Shows the current value for the level calibration.
Stability Variance	Changes the required stability for auto calibration.
Trigger Count	Changes the required number of stable readings for auto calibration.

Option	Description
Auto Range Min	Negative value limit for auto calibration.
Auto Range Max	Positive value limit for auto calibration.

6. Click **WRITE TO LOGGER** to save the settings. A message window is shown:

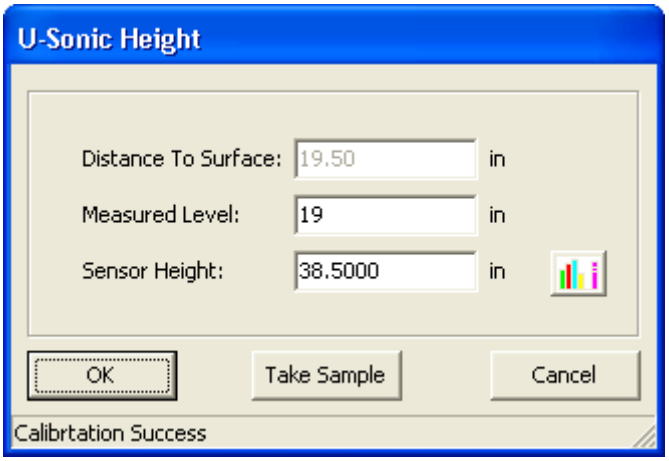
Option	Description
Warning: all data will be lost. Continue?	All data that is stored in the logger is erased when a program is written to the logger. To save the data, select No and download the data to a safe location. Select Yes to erase all data and update the logger with the new program.
Set Logger Clock	Synchronize to Computer Clock—the logger uses the date and time settings of the computer. Set Logger Clock—the logger uses the date and time settings that are set by the user. If the unit has a modem, the logger automatically uses the date and time settings of the server.

The level calibration is complete.
Note: *The data in the Quality Parameters section should not be changed unless recommended by technical support.*

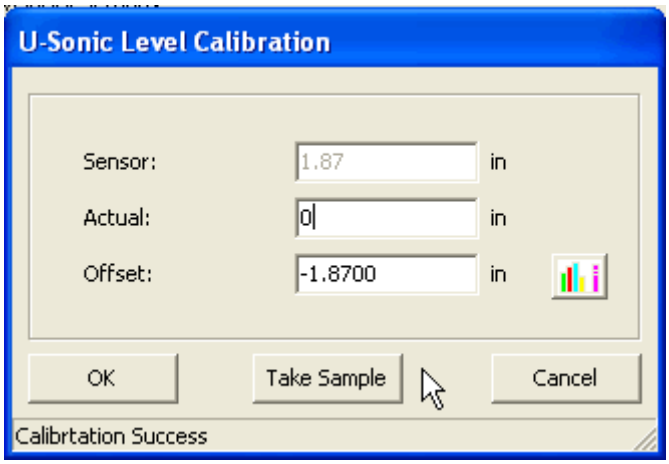
4.1.4.6.2 Calibrate the Flo-Dar ultrasonic level sensor

Calibrations must be done at the location where the sensor is installed. The sensor does not need to be calibrated again unless it is moved.

1. Click on the **General Settings** tab.
2. In the Flo-Dar U-Sonic Level Settings section, select the Transducer Type (standard or extended range).
3. If the sensor height is known, enter the value in the sensor height field. The sensor height is the distance from the bottom of the flow channel to the top of the sensor frame. If the sensor height is not known, do the following:
   a. Click **ENTER**. The U-Sonic Height window opens.
   b. Click **TAKE SAMPLE**. The sensor measures the distance to the liquid surface.
   c. In the Measured Level field, enter the depth of the liquid in the channel. The sensor height is then calculated and shown in the Sensor Height field.



4. Click **OK**. The U-Sonic Height window closes.
5. If there is sediment in the flow channel, enter the amount in the Sediment field.
6. Click the **CALIBRATE** button. The U-Sonic Level Calibration window opens.



7. Click **TAKE SAMPLE**. The sensor measures the distance to the liquid surface and uses the sensor height information to calculate the liquid level. After approximately 45 seconds, the level measurement is shown.
8. If the measured depth is different, enter the measured value in the Actual field. The offset is calculated and shown. The offset is used to adjust the measured value to the correct value.
9. Click **OK**.
10. Click **WRITE TO LOGGER** to save the settings. A message window is shown:

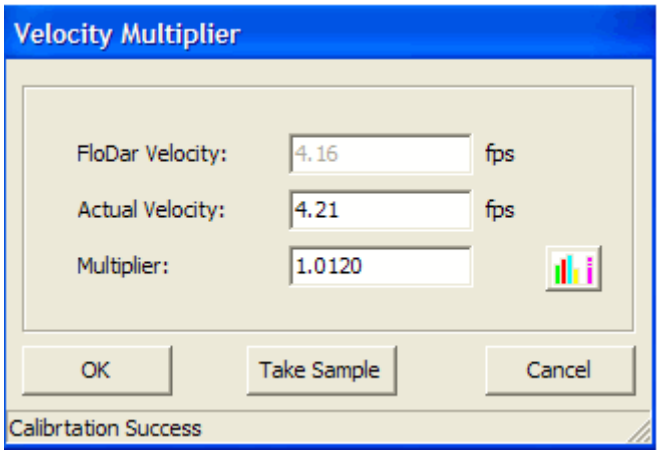
Option	Description
Warning: all data will be lost. Continue?	All data that is stored in the logger is erased when a program is written to the logger. To save the data, select No and download the data to a safe location. Select Yes to erase all data and update the logger with the new program.
Set Logger Clock	Synchronize to Computer Clock—the logger uses the date and time settings of the computer. Set Logger Clock—the logger uses the date and time settings that are set by the user. If the unit has a modem, the logger automatically uses the date and time settings of the server.

The level calibration is complete.

4.1.4.6.3 Calibrate the Flo-Dar velocity

Calibrations must be done at the location where the sensor is installed. The sensor does not need to be calibrated again unless it is moved. Be sure to complete the level calibration before the velocity calibration is started.

1. Click on the **General Settings** tab.
2. In the FloDar Velocity Settings section, select a Velocity Method:
   - Mean Vel—use for circular flow channels.
   - Vel Multiplier—use for non-circular flow channels.
3. If the velocity and flow are known, enter a site multiplier.
   a. Click the **GENERATE** button. The Velocity Multiplier window opens.



b. Click **TAKE SAMPLE**. After approximately 45 seconds, the measured velocity is shown.

c. In the Actual Velocity field, enter the known velocity. The multiplier value is calculated and the value is shown in the Multiplier field.

d. Click **OK**.

e. Repeat steps a–d to make sure the velocity is stable.

4. If the average velocity is not known, a velocity profile should be completed.

a. Click on the Diagnostics tab and then the Current Status menu.

b. Record several real-time velocity readings from the Channel Info section.

c. Calculate the average of the real-time velocity readings.

d. Complete a velocity profile. The Open Channel Profiling Handbook is a good reference on velocity profiling.

e. After the velocity profile is completed, repeat steps a–c.

f. Compare the average velocity from the real-time readings to the velocity profile.

g. Calculate the multiplier to convert the Flo-Dar velocity to the profiled velocity.

h. Click on the **Programming** tab and go to the Flo-Dar sensor port menu.

i. Enter the multiplier in the Site Multiplier field in the **General Settings** tab.

5. Change any of the velocity settings if necessary:

Option	Description
Site Multiplier	Adjusts the Flo-Dar velocity to the profiled or known value.
Min FFT Limit	Narrows the processing window of the velocity measurement.
Max FFT Limit	Narrows the processing window of the velocity measurement.
Min Velocity Cutout	Forces the velocity to a substitute value when the measurement is outside of a user-specified range.
Max Velocity Cutout	Forces the velocity to a substitute value when the measurement is outside of a user-specified range.

6. Click **WRITE TO LOGGER** to save the settings. A message window is shown:

Option	Description
Warning: all data will be lost. Continue?	All data that is stored in the logger is erased when a program is written to the logger. To save the data, select No and download the data to a safe location. Select Yes to erase all data and update the logger with the new program.
Set Logger Clock	Synchronize to Computer Clock—the logger uses the date and time settings of the computer. Set Logger Clock—the logger uses the date and time settings that are set by the user. If the unit has a modem, the logger automatically uses the date and time settings of the server.

The velocity calibration is complete.

4.1.4.7 Flo-Tote setup—Cal Wizard

The sensor can be configured and calibrated with the calibration wizard. The sensor must be installed in the process and the connection status must be online for calibration. If the flow channel is odd-shaped, refer to Flo-Tote setup—manual on page 36.

1. Click on the **Programming** tab in the FL900 Series Driver window. If online, the attached sensors and ports are shown.
2. Click on Sensor Port[1] (FloTote).
3. Select the units in the Unit Preferences section. These units can be different from the logged units that are specified in the Datalog Setup menu.
4. Click on the **CAL WIZARD** button. The Calibration Wizard window opens.
5. Select the options on each screen and click **NEXT**:

Option	Description
Number of samples	The number of times the sensor is sampled for the calibration measurements (1, 2 or 3).
Flow parameters	The shape and dimensions of the flow channel (circular, rectangular, trapezoidal or U-shaped).
Sensor offset	The difference between the measured level and the actual level.
Sediment value	The amount of sediment in the flow channel.
Actual level	The liquid level (depth) in the flow channel. If the sensor height was measured indirectly, the liquid level must be measured manually.
Actual velocity	The user can measure the velocity with a different instrument and enter the value (optional).

6. When the Calibration Complete screen is shown, click **FINISH**. The Calibration Wizard window closes.

   Note: *The Calibration Complete screen shows the values that were entered by the user and the values that were measured by the sensor. If the values are different, the calibration adjustment value or multiplier is shown.*
7. Click **WRITE TO LOGGER** to save the settings. A message window is shown:

Option	Description
Warning: all data will be lost. Continue?	All data that is stored in the logger is erased when a program is written to the logger. To save the data, select No and download the data to a safe location. Select Yes to erase all data and update the logger with the new program.
Set Logger Clock	Synchronize to Computer Clock—the logger uses the date and time settings of the computer. Set Logger Clock—the logger uses the date and time settings that are set by the user. If the unit has a modem, the logger automatically uses the date time settings of the server.

4.1.4.8 Flo-Tote setup—manual

The Calibration Wizard is the easiest method to set up the sensor. Use the manual setup for odd-shaped flow channels or to adjust some of the calibration parameters. The sensor must be installed in the process and the connection status must be online for calibration.

1. Click on the **Programming** tab in the FL900 Series Driver window. If online, the attached sensors and ports are shown.
2. Click on Sensor Port[1] (FloTote).
3. Select the units in the Unit Preferences section. These units can be different from the logged units that are specified in the Datalog Setup menu.
4. Click on the **Flow Settings** tab and select the shape of the flow channel.

5. Enter the dimensions of the flow channel. Be sure to enter the correct depth for non-circular channels.
6. If the flow channel is odd-shaped, a table is shown. A cross-section of the shape can be divided into parts and the area of the parts can be entered into the table.
7. Click **WRITE TO LOGGER** to save the settings. A message window is shown:

Option	Description
Warning: all data will be lost. Continue?	All data that is stored in the logger is erased when a program is written to the logger. To save the data, select No and download the data to a safe location. Select Yes to erase all data and update the logger with the new program.
Set Logger Clock	Synchronize to Computer Clock—the logger uses the date and time settings of the computer. Set Logger Clock—the logger uses the date and time settings that are set by the user. If the unit has a modem, the logger automatically uses the date time settings of the server.

8. Click on the **General Settings** tab.
9. In the velocity settings section, click the **CALCULATE** button. The Site Coefficient window opens.
10. Click **TAKE SAMPLE**. The velocity measurement starts. When complete, the measured velocity is shown.
11. Measure the velocity with a different instrument and enter the value in the Actual Velocity field. The multiplier value adjusts the sensor reading to be the same as the actual velocity value.
12. Click **OK**.
13. In the level settings section, click the **CALIBRATE** button. The Level Calibration window opens.
14. Click **TAKE SAMPLE**. The level measurement starts. When complete, the measured level is shown.
15. Measure the liquid level manually and enter the value in the Actual Level field. The offset value adjusts the sensor reading to be the same as the actual value.
16. Click **WRITE TO LOGGER** to save the settings. A message window is shown:

Option	Description
Warning: all data will be lost. Continue?	All data that is stored in the logger is erased when a program is written to the logger. To save the data, select No and download the data to a safe location. Select Yes to erase all data and update the logger with the new program.
Set Logger Clock	Synchronize to Computer Clock—the logger uses the date and time settings of the computer. Set Logger Clock—the logger uses the date and time settings that are set by the user. If the unit has a modem, the logger automatically uses the date time settings of the server.

4.1.4.9 Ultrasonic setup—Cal Wizard

Make sure to calibrate the sensor in the operating environment at the typical ambient operating temperature. The temperature of the environment is included in calibration and measurement calculations. The sensor has a 60 minute thermal constant over a 20 °C (36 °F) change in temperature. Give the sensor time to adjust to a large temperature change before calibration.

To calculate flow with level-area or head-flow tables, calibrate the sensor manually.

Note: *Only the level is calibrated unless an area velocity measurement is supplied by a velocity sensor on a separate sensor port of the FL900 series flow logger and that sensor port is selected in the Velocity Input field on the Flow tab.*

1. Click the **Programming** tab in the FL900 Series Driver window. If online, the attached sensors and ports show.
2. Select Sensor Port (US900X). The US900X Configuration screen shows.
3. In the Level Unit field, select the measurement units for the level.

   Note: *The level unit can be different from the logged units that are selected in the Datalog Setup tab.*
4. In the Flow Unit field, select the measurement units for the flow rate.
5. Select the options.

Option	Description
Sensor Type	Select the sensor type—Downlooking or In-Pipe.
Sediment	Enter the level of sediment in the bottom of the channel.
Level Offset (optional)	Enter the difference between the measured level and the actual level. Use to correct an offset error without having to do a calibration.

6. Click **CAL WIZARD**. The Calibration Wizard window opens.
7. Select the options on each screen and click **NEXT**.

Option	Description
Sensor Type	Select the sensor type—Downlooking or In-Pipe.
Flow Method	Select the flow calculation method—area velocity, primary device or None. Select an area velocity option to calculate the flow rate based on the area velocity supplied by a velocity sensor that is connected to the flow logger. Select the type of primary device (e.g., flume or weir) to calculate the flow rate based on the type of primary device. ***Note:*** *The ultrasonic sensor can be used as a level measurement device only. Select None to not calculate the flow rate.*
Dimensions	Enter the physical parameters of the selected flow calculation method.
Velocity Input	If the flow calculation method selected in the Flow Method field is an area velocity option, select the source of the area velocity input. For example, if an ultrasonic sensor is connected to Port 1 and a submerged area velocity sensor is connected to Port 2, select Port 2 in the Velocity Input field. ***Note:*** *If a primary device or None is selected in the Flow Method field, the Velocity Input field is disabled.*
Current Level	Enter the flow level in the channel by direct measurement.
Number of Measurements	Select the number of measurements to do during calibration—1, 2 or 3. For more than 1 measurement, Flo-Ware shows the average.

   If the calibration was successful, a summary of values shows:

   - Distance (downlooking)—the distance from the face of the sensor to the water surface
   - Distance (in-pipe)—the distance from the sensor tube to the water surface
   - Temperature—the temperature of the operating environment measured by the sensor
   - Zero Level Distance—the distance from the face of the sensor or sensor tube to the bottom of the channel
   - Echo Loss—the percentage of the ultrasonic signal that was lost during send and receive
8. Click **NEXT**. "Calibration Complete" shows.

Note: *If the calibration was not successful, an error message shows and the sensor takes another measurement.*

9. Click **FINISH**.
10. Click **WRITE TO LOGGER** to save the settings. A window opens.
11. Optional: Select the options.

Option	Description
Set Logger Clock	Set the flow logger clock to the date and time setting of the computer connected to the flow logger. If the flow logger has a modem, the flow logger clock is set to the date and time of the server.
Erase Data	Erase all the data that is kept on the flow logger.

12. Click **OK**.
13. Click the **Flow** tab that is above the Level Settings section. The values entered during calibration show in the fields.

4.1.4.10 Ultrasonic setup—manual

The Calibration Wizard is the easiest method to set up the sensor. Use the manual setup for sites with level-area or head-flow tables. The sensor must be installed in the process and the connection status must be online for calibration.

1. Click the **Programming** tab in the FL900 Series Driver window. If online, the attached sensors and ports show.
2. Select Sensor Port (US900X). The US900X Configuration screen shows.
3. In the Level Unit field, select the measurement units for the flow level.

   Note: *The level unit can be different from the logged units that are selected in the Datalog Setup menu.*
4. In the Flow Unit field, select the measurement units for the flow rate.
5. Select the options.

Option	Description
Sensor Type	Select the sensor type—Downlooking or In-Pipe.
Sediment	Enter the level of sediment in the bottom of the channel.
Level Offset (optional)	Enter the difference between the measured level and the actual level. Use to correct an offset error without having to do a calibration.

6. Click **CALIBRATE**. The selected sensor type shows.
7. Click **TAKE SAMPLE**. The Distance field shows the distance measurement from the sensor.
   - Distance (downlooking)—the distance from the face of the sensor to the water surface
   - Distance (in-pipe)—the distance from the sensor tube to the water surface
8. In the Actual Level field, enter the actual measured level of the water. The Zero Level Distance field shows the zero level.

   The zero level is the distance from the face of the sensor or sensor tube to the bottom of the channel.
9. Click **OK**, then **OK**.
10. Click **WRITE TO LOGGER** to save the settings. A window opens.

11. Optional: Select the options.

Option	Description
Set Logger Clock	Set the flow logger clock to the date and time setting of the computer connected to the flow logger. If the flow logger has a modem, the flow logger clock is set to the date and time of the server.
Erase Data	Erase all the data that is kept on the flow logger.

12. Click **OK**.
13. Click the **Flow** tab that is above the Level Settings section.
14. Select the options.

Option	Description
Primary Device	Select the flow calculation method—area velocity, primary device or None. Select an area velocity option to calculate the flow rate based on the area velocity supplied by a velocity sensor that is connected to the flow logger. Select the type of primary device (e.g., flume or weir) to calculate the flow rate based on the type of primary device. ***Note:*** *The ultrasonic sensor can be used as a level measurement device only. Select None to not calculate the flow rate.*
Dimensions	Enter the physical parameters of the selected flow calculation method.
Velocity Input	If the flow calculation method selected in the Flow Method field is an area velocity option, select the source of the area velocity input. For example, if an ultrasonic sensor is connected to Port 1 and a submerged area velocity sensor is connected to Port 2, select Port 2 in the Velocity Input field. ***Note:*** *If a primary device or None is selected in the Flow Method field, the Velocity Input field is disabled.*

15. Click **WRITE TO LOGGER** to save the settings.

4.1.4.11 Ultrasonic sensor—application settings

The application settings on the Application Settings tab supply more filtering options to manage difficult sites. For most flow conditions, the factory default settings on the Application Settings tab are correct. Contact technical support before changes are made to the application settings.

1. Click the **Programming** tab in the FL900 Series Driver window. If online, the attached sensors and ports show.
2. Select Sensor Port (US900X). The US900X Configuration screen shows.
3. Click the Application Settings tab. Select the options.

Option	Description
Filter Size	Select the number of readings the flow logger takes and averages for one data point—1–50 (default = 16).
Reject High	Select the number of the highest values that are discarded—0–49. For example, if the filter size is 16 and the reject high and reject low values are 4, the sensor collects 16 measurements and discards the highest 4 and the lowest 4 measurements. The other 8 values are used to calculate the average data point of level.
Reject Low	Select the number of the lowest values that are discarded—0–49.
Number of Holds	Select the number of times the last recorded data point is saved to the log if a failed reading occurs due to echo loss (default = 5). For example, if the number of holds is 5, the last data point replaces the next 5 consecutive failed readings or until a successful reading occurs.

Option	Description
Median Filter	Select the number of data points that will be used in the flow logger median filter (default = None). The flow logger takes median of 3, 5, 7, 9 or 11 data points to decrease noise or outliers. Only the median values are logged. Raw data values are not logged.
Sample Rate	Select the number of samples taken per second—1–10 (default = 4).
Minimum Distance	Select the minimum distance for the sensor. For the in-pipe sensor, the default is 0. For a downlooking sensor, the default is 5.25 in. Distances less than the minimum distance of the sensor are ignored.
Maximum Distance	Select the maximum distance for the sensor. For the in-pipe sensor, the default is 150.75 in. For a downlooking sensor, the default is 156.00 in. Distances more than the maximum distance of the sensor are ignored.

4. Click **WRITE TO LOGGER** to save the settings.

   Note: *To change the configuration settings to the factory defaults, click* ***RESTORE DEFAULTS****.*

4.1.4.12 AV9000 Analyzer Module setup—Cal Wizard

The sensor can be configured and calibrated with the calibration wizard. The sensor must be attached to the logger and online for calibration.

Note: *Only the level is calibrated with the Cal Wizard. The velocity value that is shown does not represent a velocity calibration. A calibration for velocity is not necessary, but can be completed manually (* AV9000 Analyzer Module setup—manual *on page 42).*

1. Click on the **Programming** tab in the FL900 Series Driver window. If online, the attached sensors and ports are shown.
2. Click on Sensor Port[1] (AV9000).
3. Select the units in the Unit Preferences section. These units can be different from the logged units that are specified in the Datalog Setup menu.
4. Click on the **CAL WIZARD** button. The Calibration Wizard window opens.
5. Select the shape and dimensions of the flow channel (circular, rectangular, trapezoidal or U-shaped) and click **NEXT**.

   Note: *If the flow channel is odd-shaped, refer to* AV9000 Analyzer Module setup—manual *on page 42.*
6. Select the type of calibration and click **NEXT**:

Option	Description
Zero calibration in air	The sensor is not installed in the flow channel.
Level adjust in flow	The sensor is installed in the flow channel.

   Note: *It is recommended to do a zero calibration in air to get a reference each time a new sensor is deployed or a sensor is moved to a new site. If a calibration is done in the flow, also do a calibration in air.*
7. If the sensor is installed in the flow channel, select the options on each screen and click **NEXT**:

Option	Description
Number of samples	The number of times the sensor is sampled for the calibration measurements (Enter a value between 1 and 6. Only one value is entered regardless of the number of samples.)
Actual level	The liquid level (depth) in the flow channel. If the sensor height was measured indirectly, the liquid level must be measured manually.

8. When the Calibration Complete screen is shown, click **FINISH**. The Calibration Wizard window closes.

Note: *The Calibration Complete screen shows the values that were entered by the user and the values that were measured by the sensor. If the values are different, the calibration adjustment value or multiplier is shown.*

9. Click **WRITE TO LOGGER** to save the settings. A message window is shown:

Option	Description
Warning: all data will be lost. Continue?	All data that is stored in the logger is erased when a program is written to the logger. To save the data, select No and download the data to a safe location. Select Yes to erase all data and update the logger with the new program.
Set Logger Clock	Synchronize to Computer Clock—the logger uses the date and time settings of the computer. Set Logger Clock—the logger uses the date and time settings that are set by the user. If the unit has a modem, the logger automatically uses the date time settings of the server.

4.1.4.13 AV9000 Analyzer Module setup—manual

The Calibration Wizard is the easiest method to set up the sensor. Use the manual setup for velocity calibration, odd-shaped flow channels or to adjust some of the calibration parameters. The sensor must be online for calibration.

1. Click on the **Programming** tab in the FL900 Series Driver window. If online, the attached sensors and ports are shown.
2. Click on Sensor Port[1] (AV9000).
3. Select the units in the Unit Preferences section. These units can be different from the logged units that are specified in the Datalog Setup menu. If the sensor is mounted downstream in a reversed position, check "reversed sensor" to record flow with a positive value. If applicable, enter values for sensor offset, level or allowance for sediment in the channel.
4. Calibrate the level in the level settings section.
   a. Click the **CALIBRATE** button. The Level Calibration window opens.
   b. Click **TAKE SAMPLE**. The level measurement starts. When complete, the measured level is shown.
   c. Measure the liquid level manually and enter the value in the Actual Level field. The offset value adjusts the sensor reading to be the same as the actual value.
5. Click on the **Flow Settings** tab and select the shape of the flow channel.
6. Enter the dimensions of the flow channel. Be sure to enter the correct depth for non-circular channels.
7. If the flow channel is odd-shaped, a table is shown. A cross-section of the shape can be divided into parts and the area of the parts can be entered into the table.
8. Click on the Application Settings tab.
9. Change the application settings if necessary.

Option	Description
Repeat count	The number of distinct target sets which are measured to determine velocity. Six is the factory default. The user may enter other values. For values greater than 8, a logging interval greater than one minute is necessary. Large repeat counts will shorten the battery life. If multiple sensors are attached, one-minute logging intervals are not recommended.

Option	Description
Delay time	The time paused between the repeats to assure distinct target sets are captured. The factory default is 2500 ms (2.5 sec). The user may enter other values. The optimal delay time value depends on the level and velocity.
Target sets (Target set averaging)	Deals with velocity measurement noise caused by the non-uniform distribution of moving targets in typical waste water flow streams. This target noise can be reduced by averaging several readings based on distinct target sets. There are several options for averaging: • Robust filtering–sorts velocity readings from highest to lowest and averages the middle values • Reject drops–excludes outliers at low absolute velocity • Reject spikes–excludes outliers at high absolute velocity • Lo Freq Rej–Low Frequency Rejection may be useful to eliminate noise in highly turbulent sites where swirling occurs at the nose of the sensor

10. Click on the **Advanced Settings** tab.
11. Change the application setting, if necessary.
12. If the velocity and flow are known, a site multiplier can be generated to calibrate the velocity.
    a. Click the **CALCULATE** button. The Velocity Multiplier window opens.
    b. Click **TAKE SAMPLE**. The velocity measurement starts. When complete, the measured velocity is shown.
    c. Measure the velocity with a different instrument and enter the value in the Actual Velocity field. The multiplier value adjusts the sensor reading to be the same as the actual velocity value.
    d. Click **OK**.
13. Change any of the settings for velocity if necessary:

Option	Description
Site Multiplier	The value that adjusts the sensor velocity reading to be the same as the velocity reading from a different instrument. If not sure, use the default value of 1.0.
Low Level Cutout	Forces the velocity to a substitute value when the level measurement is below a user-specified value. The factory default is enabled at 0.8 inches.
Substitute Velocity	The value of the substitute velocity (typically 0).
Filter Size	Select the type of filter and the filter size (factory default is none). Takes the average and/or median of 3, 5, 7, 9 or 11 data points to reduce noise or outliers. Only the average and/or median values are logged—raw data values are not logged. A significant delay can occur before sudden changes in flow are logged, therefore this option is not recommended for stormwater applications.
Salinity	Select wastewater, salt water or enter a user defined value. Factory default is wastewater.

Option	Description
Analyzer Settings	Doppler Min/Max. Useful to remove noise from turbulent sites. This sets velocity limits based on the FFT defined in Hz. It is recommended to contact Tech Support for FFT evaluation and recommendation.
Diagnostic Mode	Use this mode to capture details useful when troubleshooting with Tech Support. To run diagnostics, go to Diagnostics tab, Sensors, select time series (1 hour, 1 day or 1 week) and Run Diagnostics. Diagnostics will be recorded for the specified time frame. • Normal–Factory default setting. • Asym Spectra–Assymetrical Spectra. Allows comparison of remaining spectra after mirror image is removed. • Extend Spectra–Allows a detailed view of the noise floor of "best scale." • Extend All–Similar to Extend Spectra, but of all scales. • Time Series–Time series sub-measurement data only up to 32 readings. • Combination–Time series (up to 20 points) plus "Normal". Allows viewing of sub-measurements based on repeat count.

14. Click **WRITE TO LOGGER** if connected to logger to save the settings, or click **SAVE PROGRAM TO FILE** to create a template. A message window is shown:

Option	Description
Warning: all data will be lost. Continue?	All data that is stored in the logger is erased when a program is written to the logger. To save the data, select No and download the data to a safe location. Select Yes to erase all data and update the logger with the new program.
Set Logger Clock	Synchronize to Computer Clock—the logger uses the date and time settings of the computer. Set Logger Clock—the logger uses the date and time settings that are set by the user. If the unit has a modem, the logger automatically uses the date and time settings of the server.

15. Change any of the settings for level if necessary.
16. For help with difficult sites and additional diagnostic tools, contact Hach Flow Tech support to assist with diagnostics on the TECH SUPPORT SETTINGS tab.

4.1.4.14 IM9001 module setup

The IM9001 interface module allows the logger to collect data from an attached Sigma Flow Meter and transmit the data via a wireless or local connection. The data can be used to trigger alarms or pace a sampler. The module can also be used as a network interface for Modbus communication (Modbus communication on page 51).

Use the Datalog Setup menu to set the log intervals and to select the channels that are logged (Datalog setup on page 29). The logging intervals that are programmed into the 950 Flow Meter must be greater than or equal to the logging intervals of the logger to be sure that all data is logged.

Note: *The Sigma Flow Meter program cannot be configured through the IM9001 module. The Flow Meter must be programmed with either Flow Center software or the keypad on the Flow Meter before connection to the IM9001 module. Refer to the Sigma User Manual for programming details. The logger program and Sigma Flow Meter programs run independently of each other.*

The IM9001 module must be configured to communicate with a Sigma Flow Meter.

1. Click on the **Programming** tab in the FL900 Series Driver window. If online, the attached sensors and ports are shown.
2. If offline, click on the Datalog Setup menu. Select the sensor(s) from the drop-down list in the Port Assignments section that agree with the sensor and port configurations on the logger.
3. Click on Sensor Port[1] (IM9001).

4. Change any of the options:

Option	Description
Modbus Address	This setting must match the Modbus address that is programmed into the Sigma Flow Meter.
Baud Rate	This setting must match the Baud rate that is programmed into the Sigma Flow Meter.

5. Click **WRITE TO LOGGER** to save the settings. A message window is shown:

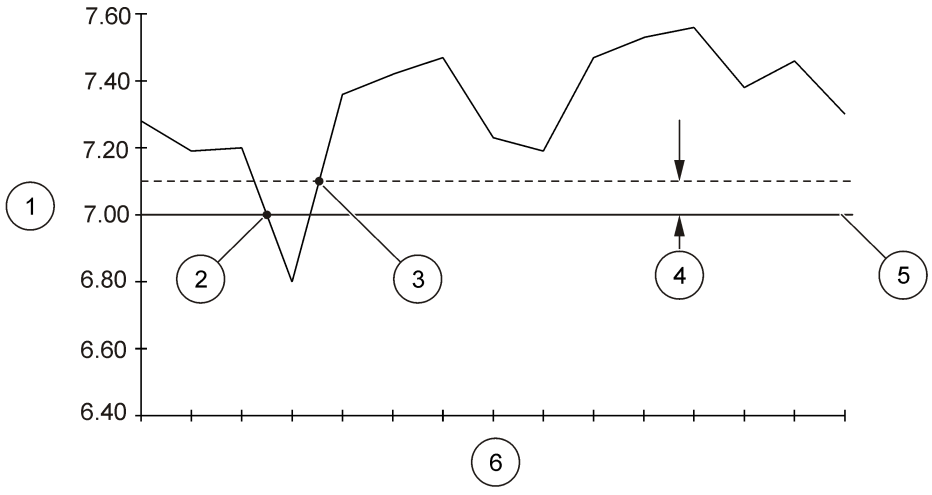
Option	Description
Warning: all data will be lost. Continue?	All data that is stored in the logger is erased when a program is written to the logger. To save the data, select No and download the data to a safe location. Select Yes to erase all data and update the logger with the new program.
Set Logger Clock	Synchronize to Computer Clock—the logger uses the date and time settings of the computer. Set Logger Clock—the logger uses the date and time settings that are set by the user. If the unit has a modem, the logger automatically uses the date time settings of the server.

4.1.4.15 Set up alarms

Use the Alarms menu to set up channel alarms, system alarms and notifications. Channels must first be selected in the Datalog Setup menu before channel alarms can be set. A maximum of 16 channel alarms can be set.

1. Click the **Programming** tab.
2. Click on the Alarms menu.
3. To set a channel alarm, click on the **Channel Alarms** tab:
   a. Click on the **ADD ALARM** button.The Add Channel Alarm window opens.
   b. Select the channel from the drop-down list.
   c. Select the type of alarm (low/low, low, high, high/high) and click **OK**. The channel alarm is shown in the main section.
   d. Enter the trigger value and deadband. An alarm starts when the channel value is equal to the trigger value. An alarm stops when the channel value goes above (low alarm) or below (high alarm) the deadband value.

Figure 9 Low alarm example



1 Channel value	**3** Low alarm stops	**5** Trigger value
2 Low alarm starts	**4** Deadband	**6** Time

e. Select the actions that will start during an alarm condition:

Option	Description
Send SMS from logger	Send an SMS (text) message from the logger—useful when the server cannot be contacted.
Send Email from logger	Send an email message from the logger—useful when the server cannot be contacted.
Trigger sampler	When a sampler is attached, start a sampling program.
Switch to secondary log interval	Switch to secondary log interval—the secondary log interval is used.
Switch to secondary call interval	Switch to secondary call interval—the secondary call interval is used.
Send SMS from server	Send an SMS (text) message from the server—saves battery power on the logger.
Send Email from server	Send an email message from the server—saves battery power on the logger.

4. To set a system alarm, click on the **System Alarms** tab:

a. Select the system alarm type:

Option	Description
Low Main Power	The batteries in the logger or external power supply is less than 8 V.
Low RTC Battery	The battery for the internal clock in the logger is weak.
Low Slate Memory	The datalog is 80% full.
Slate Memory Full	The datalog is full and data collection has stopped.
Sensor Timeout	The sensor has not responded to a call by the server.
Sensor ID Error	The program cannot detect what type of sensor is connected.

b. Select the system alarm actions:

Option	Description
Send SMS from logger	Send a text message from the logger via the network provider.
Send Email from logger	Send an email from the logger via the network provider.
Send SMS from server	Send a text message from the FSDATA server.
Send Email from server	Send an email from the FSDATA server.

5. To set enter recipient information for alarm notifications, click on the **Recipients** tab:

a. Enter the email address for each email recipient (maximum of 5).
b. Enter the number for each SMS (text message) recipient (maximum of 5).

4.1.4.16 Set sampler options

If a sampler is used, the sampler must be attached to the auxiliary port on the logger. Use the Sampler menu to specify when samples are taken.

1. Click the **Programming** tab.
2. Click on the Sampler menu.
3. In the Pacing Source field, select the sensor port that will measure flow for the sampler.
4. Enter the volume interval that generates a flow pulse to the sampler. For example, a sampler can take a sample every 100 gallons of flow.

Note: *The sampler can also take a sample during alarm conditions if the Trigger sampler action is set for a channel alarm.*

4.1.5 View data

4.1.5.1 Download data

When data is downloaded from the logger, the data includes the channel data, the event log, the alarm log and the sample history. The data is automatically saved as a .fl9 file in the default file path.

1. Open a communication session with the logger (Connect to the logger on page 25).
2. Click on one of the download options:

Option	Description
	Download all of the data from the logger.
	Download only the data that was logged since the last download.

3. Wait for the data to download. When complete, a confirmation message is shown. Click **OK**. The data is shown in the FL900 window (Tabular view on page 47).

4.1.5.2 Open a site file

Data files that were downloaded previously can be opened when the connection status is offline.

1. Make sure the connection status is offline. If online, click on the **DISCONNECT** button.
2. Click on the **OPEN A SITE FILE** button. The Open file window opens.
3. Find the file and click **OPEN**. The data is shown in the FL900 window (Tabular view on page 47).

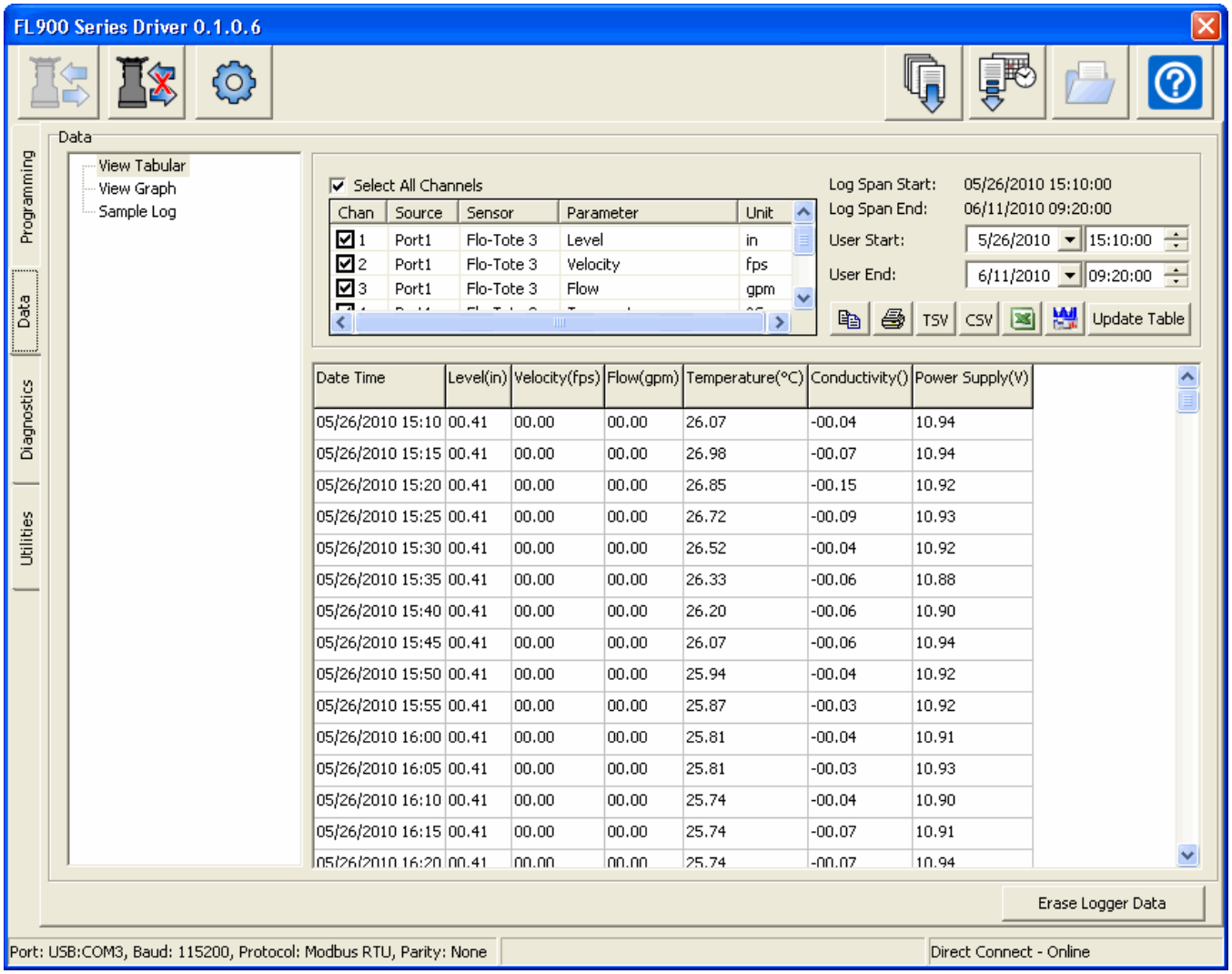
4.1.5.3 Tabular view

The tabular view shows the data in a spreadsheet format (Figure 10). The following options are available:

Option	Description
Open in Flo-Ware	Click on the Flo-Ware icon to open the file in the main Flo-Ware application
Sort data	Click on a column header to sort the data by that column
Show or remove channels	Click on the check box next to a channel and click the **UPDATE TABLE** button to show or remove channels.
Change the date range	Change the date and time range and click the **UPDATE TABLE** button.
Copy to the clipboard	Click on the copy icon to copy the data to the clipboard. The data can then be pasted in a spreadsheet or other application.
Print	Click on the printer icon to send the data to a printer.
Export as tab-separated	Click on the TSV icon to export the data as a tab-separated file.

Option	Description
Export as comma-separated	Click on the CSV icon to export the data as a comma-separated file.
Open in Excel	Click on the Excel icon to open the data in Microsoft® Excel® spreadsheet software.

Figure 10 FL900 tabular data view



4.1.5.4 Graph view

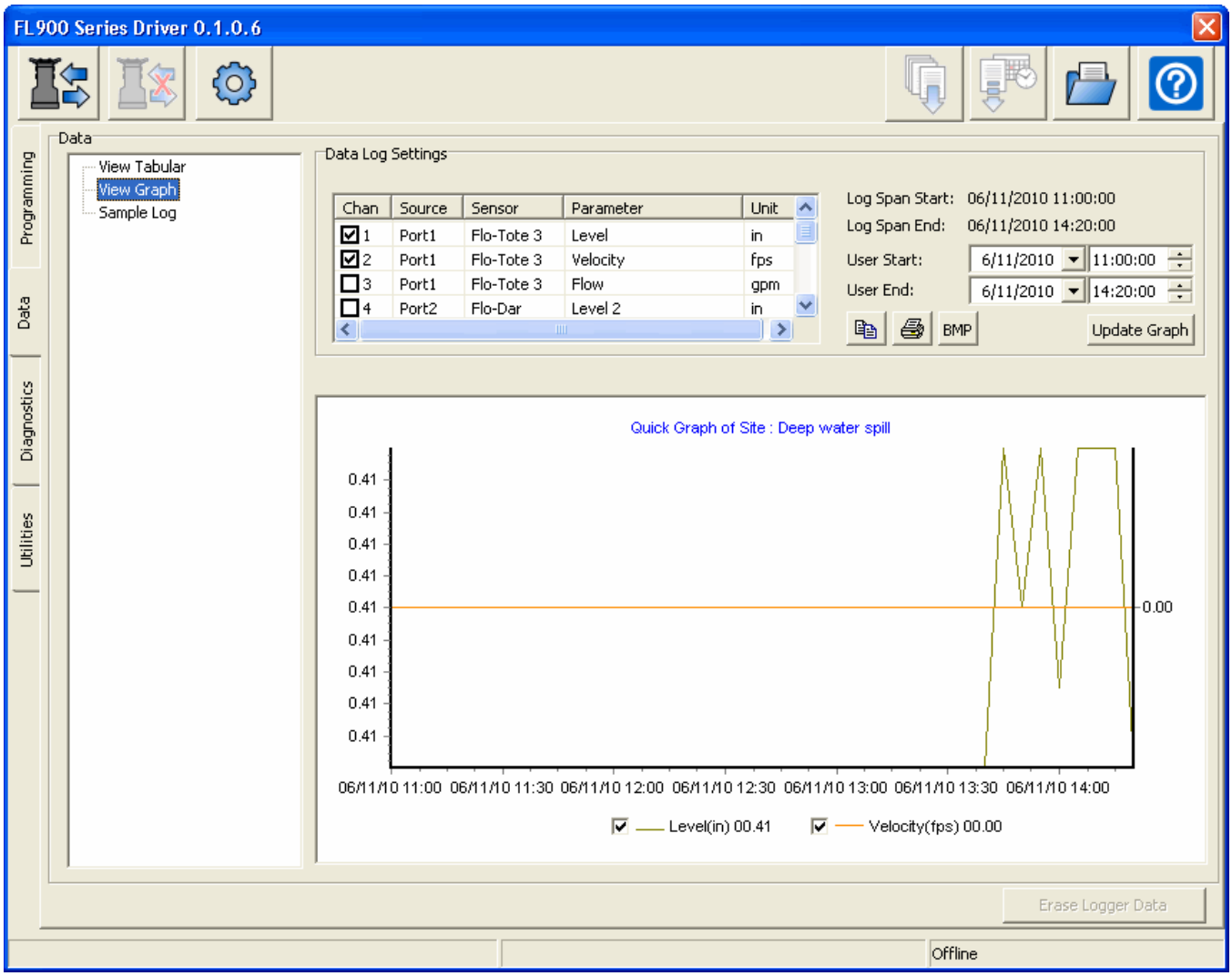
The graph view shows the data in a line graph (Figure 11). A maximum of 2 channels can be shown. The rain gauge and sampler are shown as bars in addition to the 2 selected channels. The bars for the sampler are shown in a green color when a sample was collected and in a red color if the sampler failed to collect a sample.

The following options are available:

Option	Description
Show or remove channels	Click on the check box next to a channel and click the **UPDATE TABLE** button to show or remove channels.
Change the date range	Change the date and time range and click the **UPDATE TABLE** button.

Option	Description
Copy to the clipboard	Click on the copy icon to copy the data to the clipboard. The data can then be pasted in a spreadsheet or other application.
Print	Click on the printer icon to send the data to a printer.
Export as image	Click on the BMP icon to save the graph in a .bmp image format.
Zoom in	Click on the graph and drag to the right to zoom in.
Zoom out	Click on the graph and drag to the left to zoom out.
Pan left, right, up or down	Right-click on the graph and drag to the left, right, up or down to move the graph position.

Figure 11 FL900 graph view



4.1.5.5 Sample log

When a sampler is attached to the logger, the following sample data is collected and shown in the tabular format:

- Date and time of the sample
- Sample status (success or failed)
- Sample number
- Sample bottle number

Refer to the Tabular view on page 47 for a description of the available user options.

4.1.6 Troubleshooting

4.1.6.1 View diagnostic information

The user can view diagnostic information to help solve a problem or to confirm normal operation.

1. Click on the Diagnostics tab.
2. Select one of the menu options:

Option	Description
Event Log	The date and time, event number, event text and event data is shown for all events in the tabular format. Refer to the Tabular view on page 47 for a description of the available user options.
Current Status	When online, real-time general information such as the power supply voltage is shown. The measured channel values are shown and are updated at the same interval that is set in the logger program. If a sampler is connected, the volume before the next sample is taken is shown.
Sensors	When online, the user can download a sensor diagnostic file (.sdf) for use by technical support. The file is saved in the location that is specified in the settings. Technical support may ask the user to take a sample or to run diagnostics for a specified time (1 hour, 1 day or 1 week) to get additional diagnostic information.
Modem	When online, information about the modem and the signal strength is shown. The registration status should show home. The **CALL SERVER** button can be used to connect to the server and to show connection information. When the call is complete, click the **SAVE** button to save the information.
Alarm Log	The data for all alarms is shown in the tabular format. Refer to the Tabular view on page 47 for a description of the available user options.

4.1.6.2 Manual USB driver installation

If there was a problem with the USB driver installation, install the USB driver manually.

1. With the logger attached to the PC, open the Windows Device Manager.
2. Find the FL-9XX port under the Ports node and open the port properties.
3. Install the driver from C:\Program Files\Flo-Ware\FL9xx\Backup (file name: FL-9XX_USB.inf).

4.1.6.3 Restore factory settings

If necessary, the user program in the logger can be replaced with the factory settings.

1. Make sure that the logger is attached to the computer and that the connection status is online.
2. Click on the **Utilities** tab.

3. Select the Restore Factory Settings option.
4. Click **WRITE TO LOGGER** to save the settings. A message window is shown:

Option	Description
Warning: all data will be lost. Continue?	All data that is stored in the logger is erased when a program is written to the logger. To save the data, select No and download the data to a safe location. Select Yes to erase all data and update the logger with the new program.
Set Logger Clock	Synchronize to Computer Clock—the logger uses the date and time settings of the computer. Set Logger Clock—the logger uses the date and time settings that are set by the user. If the unit has a modem, the logger automatically uses the date time settings of the server.

4.1.7 Update the firmware

The firmware is updated regularly for continued improvement. Install the updates for best results.

1. Click on the Utilities tab and select the Firmware Update menu.
2. Select the file to install.
3. Click **START**.
4. Select the udpate option and click **OK**. The update starts. Wait for the status to show complete.

4.1.A Modbus communication

4.1.A.1 Overview

The Modbus protocol can be used for communication with the FL900 Series Loggers. An external network device such as a PLC can attach to the logger and read data as it is logged. Historical data cannot be read.

The Modbus information that follows assumes that the network device is attached to the RS232 interface on the logger.

4.1.A.2 Communications setup

An RS232 communication cable must be used to attach the logger to an external network device such as a PLC. Refer to the user manual for the FL900 Series Flow Logger for detailed information.
The communication settings can be changed with Flo-Ware. Refer to Communications settings—local on page 27. Table 3 shows the default settings and options for each setting.

The logger supports various frame sizes based on the Modbus protocol and parity setting. The parity setting can be modified using Flo-Ware, thereby setting the frame size of the communication hardware. The following frame sizes are supported by the logger:

Modbus RTU

- 8 bits, even parity, 1 stop bit
- 8 bits, odd parity, 1 stop bit
- 8 bits, no parity, 2 stop bit

Modbus ASCII

- 7 bits, even parity, 1 stop bit

- 7 bits, odd parity, 1 stop bit

Table 3 Communication settings

Setting	Default	Options
Protocol	Modbus RTU	Modbus RTU or Modbus ASCII
Address	2	1–247; also responds to broadcast address 0
Baud rate	115200	9600, 19200, 38400, 57600, 115200
Frame size	8 bits, no parity, 2 stop bits	Modbus RTU: 8 bits, even parity, 1 stop bit; 8 bits, odd parity, 1 stop bit; 8 bits, no parity, 2 stop bits
		Modbus ASCII: 7 bits, even parity, 1 stop bit; 7 bits, odd parity, 1 stop bit

4.1.A.3 Communication with the logger

The logger hardware makes use of transmit, receive, and signal ground signals on the RS232 interface. The logger responds to Modbus queries that match the assigned address as well as broadcast address 0. When address 0 is used, the master does not know the logger address, which facilitates peer-to-peer communications on a bus with one master and no other slaves. FloWare can be used to change the Modbus address setting in the FL900.

4.1.A.3.1 Communication timeouts

Minimum and maximum response times are used for reliable exchanges with the Modbus master and to prevent collisions on the RS232 bus. The minimum response time is the wait time before a reply is sent to a Modbus query (default: 30 ms). The maximum response time is the total time that is allowed for a reply to be sent to a Modbus query (default: 1 second).

If a reply cannot be sent within the maximum response time, a timeout occurs. The logger stops processing and prepares for the next Modbus query. The timeout value cannot be modified.

4.1.A.3.2 Sleep modes

Sleep modes are used to extend the battery life of the logger. After 5 seconds of idle time on the RS232 bus, the RS232 interface on the logger closes. To keep the RS232 interface open, a valid Modbus command must be sent to the logger in intervals of < 5 seconds.

If the RS232 interface is closed, a sacrificial Modbus command must be sent to the logger to open the interface. This command serves only to open the interface. No response is made to the sacrificial Modbus command.

If the logger has not shut down at least once in a 3-hour period, a soft reset automatically occurs.

4.1.A.4 Modbus registers

The logger program that is set up by the user shows which measurements are associated with each datalog channel (refer to Datalog setup on page 29). Each datalog channel in the logger is mapped to a Modbus measurement register. If a new program is written to the logger, the user-selected measurements are automatically mapped to the 16 available datalog channels.

Each Modbus measurement register is associated with two Modbus description registers. The description registers, A and B, add additional details about the measurement value.

Each Modbus measurement register reads data as it is currently logged. For example, if an attached sensor has a primary logging interval of 5 minutes, the corresponding Modbus register shows the updated data every 5 minutes.

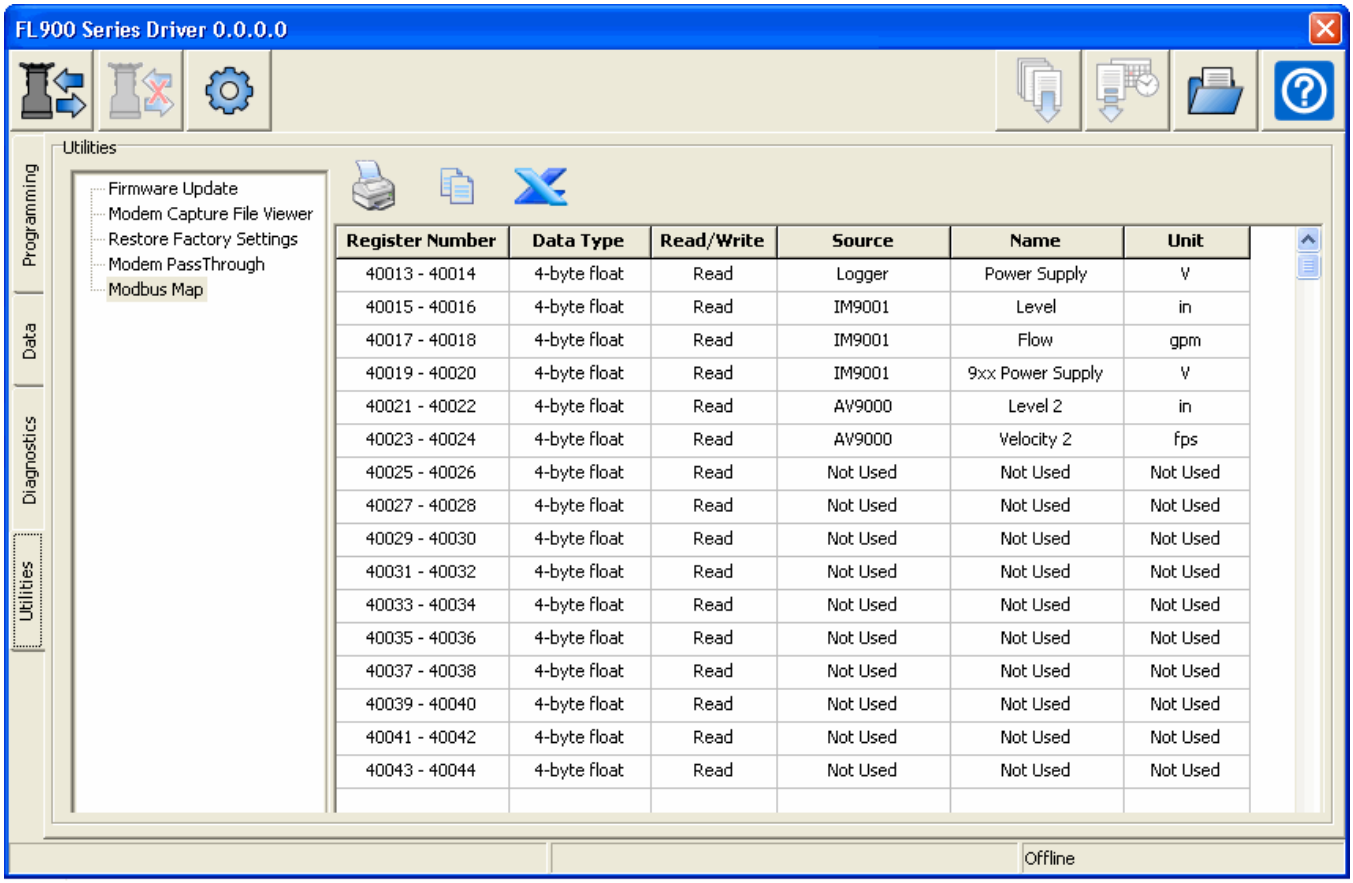
4.1.A.4.1 Register configuration

FloWare is used to generate the Modbus register map from the datalog channel configuration in the logger program. The register map is generated online when connected to a logger or offline using a previously downloaded site file. The map can be

printed, exported to a spreadsheet or copied to the clipboard. If the datalog channel configuration changes, the modbus map changes, and a new Modbus map should be generated.

To generate the map, open the FL900 Series driver in FloWare, select the Utilities tab and then select Modbus Map. The Modbus map is shown for the datalog channel configuration that is current. An example of a Modbus map is shown in Figure 12.

Figure 12 Example Modbus map for logger program



Register Number	Data Type	Read/Write	Source	Name	Unit
40013 - 40014	4-byte float	Read	Logger	Power Supply	V
40015 - 40016	4-byte float	Read	IM9001	Level	in
40017 - 40018	4-byte float	Read	IM9001	Flow	gpm
40019 - 40020	4-byte float	Read	IM9001	9xx Power Supply	V
40021 - 40022	4-byte float	Read	AV9000	Level 2	in
40023 - 40024	4-byte float	Read	AV9000	Velocity 2	fps
40025 - 40026	4-byte float	Read	Not Used	Not Used	Not Used
40027 - 40028	4-byte float	Read	Not Used	Not Used	Not Used
40029 - 40030	4-byte float	Read	Not Used	Not Used	Not Used
40031 - 40032	4-byte float	Read	Not Used	Not Used	Not Used
40033 - 40034	4-byte float	Read	Not Used	Not Used	Not Used
40035 - 40036	4-byte float	Read	Not Used	Not Used	Not Used
40037 - 40038	4-byte float	Read	Not Used	Not Used	Not Used
40039 - 40040	4-byte float	Read	Not Used	Not Used	Not Used
40041 - 40042	4-byte float	Read	Not Used	Not Used	Not Used
40043 - 40044	4-byte float	Read	Not Used	Not Used	Not Used

4.1.A.4.2 Register order

The data order in the logger registers is big-endian with the most significant byte first, followed by the least significant byte second. The register order for multi-register numeric values (floats and integers) is little endian. If a different ordering scheme is needed, the data must be processed externally.

4.1.A.4.3 Measurement registers

The logger implements 16 Modbus measurement registers, where each register maps directly to 1 of 16 data log channels. One or more measurement registers can be read with Modbus Function Code 03 Read Holding Registers. Refer to Table 4.

The definition of each data log channel is made when a user changes the data log configuration and programs the logger. To know what each measurement register represents, the user has two options. The first option is for applications where the logger is connected to an external device that is manually configured by the user. The second option is for applications where the logger is connected to an external device that is

capable of automatic configuration with the use of additional measurement description registers that are supplied by the logger.

Table 4 Modbus measurement registers

Register Number	Data Type	Read/Write	Name	Data Map
40013-40014	4 byte float	Read	Measurement Register 1	Data Log Channel 1
40015-40016	4 byte float	Read	Measurement Register 2	Data Log Channel 2
40017-40018	4 byte float	Read	Measurement Register 3	Data Log Channel 3
40019-40020	4 byte float	Read	Measurement Register 4	Data Log Channel 4
40021-40022	4 byte float	Read	Measurement Register 5	Data Log Channel 5
40023-40024	4 byte float	Read	Measurement Register 6	Data Log Channel 6
40025-40026	4 byte float	Read	Measurement Register 7	Data Log Channel 7
40027-40028	4 byte float	Read	Measurement Register 8	Data Log Channel 8
40029-40030	4 byte float	Read	Measurement Register 9	Data Log Channel 9
40031-40032	4 byte float	Read	Measurement Register 10	Data Log Channel 10
40033-40034	4 byte float	Read	Measurement Register 11	Data Log Channel 11
40035-40036	4 byte float	Read	Measurement Register 12	Data Log Channel 12
40037-40038	4 byte float	Read	Measurement Register 13	Data Log Channel 13
40039-40040	4 byte float	Read	Measurement Register 14	Data Log Channel 14
40041-40042	4 byte float	Read	Measurement Register 15	Data Log Channel 15
40043-40044	4 byte float	Read	Measurement Register 16	Data Log Channel 16

4.1.A.4.4 Description registers

Two description registers, A and B, are associated with each individual Modbus measurement register (Table 5). The Modbus description registers allow third parties to develop external devices that have plug and play capabilities with the FL900 logger and minimize manual setup by the end user. Each description register can be queried by an external device to get more details about the measurement value.

Table 5 Modbus description registers

Register number	Data type	Read/Write	Name
40213-40214	4-byte Unsigned	Read	Measurement 1 Description Register. 'A'
40215-40216	4-byte Unsigned	Read	Measurement 1 Description Register. 'B'
40217-40218	4-byte Unsigned	Read	Measurement 2 Description Register. 'A'
40219-40220	4-byte Unsigned	Read	Measurement 2 Description Register. 'B'
40221-40222	4-byte Unsigned	Read	Measurement 3 Description Register. 'A'
40223-40224	4-byte Unsigned	Read	Measurement 3 Description Register. 'B'
40225-40226	4-byte Unsigned	Read	Measurement 4 Description Register. 'A'
40227-40228	4-byte Unsigned	Read	Measurement 4 Description Register. 'B'
40229-40230	4-byte Unsigned	Read	Measurement 5 Description Register. 'A'
40231-40232	4-byte Unsigned	Read	Measurement 5 Description Register. 'B'
40233-40234	4-byte Unsigned	Read	Measurement 6 Description Register. 'A'
40235-40236	4-byte Unsigned	Read	Measurement 6 Description Register. 'B'
40237-40238	4-byte Unsigned	Read	Measurement 7 Description Register. 'A'

Table 5 Modbus description registers (continued)

Register number	Data type	Read/Write	Name
40239-40240	4-byte Unsigned	Read	Measurement 7 Description Register. 'B'
40241-40242	4-byte Unsigned	Read	Measurement 8 Description Register. 'A'
40243-40244	4-byte Unsigned	Read	Measurement 8 Description Register. 'B'
40245-40246	4-byte Unsigned	Read	Measurement 9 Description Register. 'A'
40247-40248	4-byte Unsigned	Read	Measurement 9 Description Register. 'B'
40249-40250	4-byte Unsigned	Read	Measurement 10 Description Register. 'A'
40251-40252	4-byte Unsigned	Read	Measurement 10 Description Register. 'B'
40253-40254	4-byte Unsigned	Read	Measurement 11 Description Register. 'A'
40255-40256	4-byte Unsigned	Read	Measurement 11 Description Register. 'B'
40257-40258	4-byte Unsigned	Read	Measurement 12 Description Register. 'A'
40259-40260	4-byte Unsigned	Read	Measurement 12 Description Register. 'B'
40261-40262	4-byte Unsigned	Read	Measurement 13 Description Register. 'A'
40263-40264	4-byte Unsigned	Read	Measurement 13 Description Register. 'B'
40265-40266	4-byte Unsigned	Read	Measurement 14 Description Register. 'A'
40267-40268	4-byte Unsigned	Read	Measurement 14 Description Register. 'B'
40269-40270	4-byte Unsigned	Read	Measurement 15 Description Register. 'A'
40271-40272	4-byte Unsigned	Read	Measurement 15 Description Register. 'B'
40273-40274	4-byte Unsigned	Read	Measurement 16 Description Register. 'A'
40275-40276	4-byte Unsigned	Read	Measurement 16 Description Register. 'B'

4.1.A.4.4.1 Description register formats

Two formats, A and B, are used by the description registers to give measurement details. Refer to Figure 13 and Figure 14.

Figure 13 Description register format A

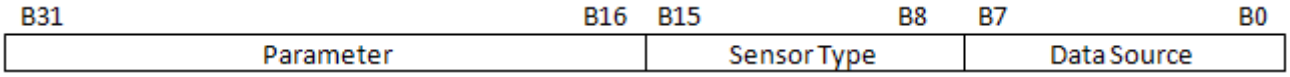
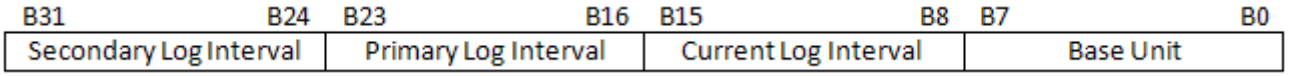


Figure 14 Description register format B



4.1.A.4.4.2 Parameter field

The parameter field shows what the measurement represents (Table 6).

Table 6 Parameter field descriptions

Returned value	Parameter
0	FL900 series power supply
1	Modem signal strength
2	Modem signal quality
3	Flow
4	Level

Table 6 Parameter field descriptions (continued)

Returned value	Parameter
5	Velocity
6	Temperature
7	Surface velocity
8	Distance
9	Minimum distance
10	Maximum distance
11	Distance reading Count
12	Surcharge level
13	PMR
14	NOS
15	Conductivity
16	Surcharge velocity
17	Gain
18	Measurement Flag
19	Rain
20	Raw level
21	pH/ORP
22	Channel 1
23	Channel 2
24	Channel 3
25	Channel 4
26	Channel 5
27	Channel 6
28	Channel 7
29	Best scale
30	Bins

4.1.A.4.4.3 Sensor type field

The sensor type field shows the type of sensor that made the measurement (Table 7).

Table 7 Sensor type field description

Returned value	Sensor type
1	Not detected
3	Logger
4	FloDar
5	FloTote
6	SVS
7	AV9000

Table 7 Sensor type field description (continued)

Returned value	Sensor type
8	IM9001
9	US900X

4.1.A.4.4.4 Data source field

The data source field shows whether the measurement came directly from the logger or from one of the sensor ports on the logger (Table 8).

Table 8 Data source field description

Returned value	Data source
0	Logger
1	Sensor Port 1
2	Sensor Port 2
3	Sensor Port 3
4	Sensor Port 4

4.1.A.4.4.5 Log interval fields

The primary, secondary and current logging interval fields can be queried to show which logging interval is in use. An external device can use this information to optimize the polling interval. The log interval values are returned in minutes.

Dynamic logging occurs with the primary and secondary logging intervals. The primary logging interval is used during normal operation. If an alarm condition occurs, the log rate automatically changes to use the secondary logging interval. When operation returns to normal, the log rate automatically changes to use the primary logging interval again. For more information refer to Set up alarms on page 45.

4.1.A.4.4.6 Base unit field

The base unit field shows the base unit of measure for the measurement regardless of the selected user preference. Table 9 includes units that may not be applicable at this time.

Table 9 Base unit field description

Returned value	Unit of measure
0	mg/L (milligrams per liter)
1	g/L (grams per liter)
2	ppm (parts per million)
3	mE (milliextinction)
4	E (extinction)
5	1/m (per meter)
6	FNU (formazin nephelometric unit)
7	NTU (nephelometric turbidity unit)
8	TE/F (German formazin nephelometric unit)
9	EBC (European brewery congress)
10	% (percent)
11	nm (nanometer)
12	mm (millimeter)

Table 9 Base unit field description (continued)

Returned value	Unit of measure
13	m (meter)
14	msec (milliseconds)
15	sec (seconds)
16	min (minutes)
17	hrs (hours)
18	mA (milliamps)
19	mV (millivolts)
20	mNTU (milliNTU)
21	mFTU (milliFTU)
22	mTE/F (milliTE/F)
23	m % (millipercent)
24	Counts
25	C (degrees Celsius)
26	F (degrees Fahrenheit)
27	pH
28	mV/pH (millivolts per pH unit)
29	uA (microamperes)
30	L/h (liters per hour)
31	ppt (parts per thousand)
32	S/cm (Siemens per centimeter)
33	Ohm/cm (ohms per centimeter)
34	S/m (Siemens per meter)
35	Ohm/m (ohms per meter)
36	kOhm (kiloohm)
37	MOhm (megaohm)
38	ppb (parts per billion)
39	ug/L (micrograms per liter)
40	sat (saturation)
41	mFNU (milliFNU)
42	FTU (formazin turbidity unit)
43	ft (feet)
44	deg (degrees angle or phase)
45	mmHg (millimeters of mercury)
46	inHg (inches of mercury)
47	torr
48	pH/C (pH per degree C)
49	day (day)

Table 9 Base unit field description (continued)

Returned value	Unit of measure
50	uS/cm (microSiemens per centimeter)
51	mS/cm (milliSiemens per centimeter)
52	Ohm
53	%/C (percent per degree C)
54	ppm/uS (ppm per uS)
55	mMol/L (millimole per liter)
56	kOhm/cm (kiloohm per centimeter)
57	MOhm/cm (mega ohm per centimeter)
58	mS/m (milliSiemens per meter)
59	uS/m (microSiemens per meter)
60	degree
61	BAR (bar)
62	kPa
63	Pa
64	psi (pressure per square inch)
65	psia
66	psig
67	gpm (gallons per minute)
68	gps (gallons per second)
69	gph (gallons per hour)
70	mgd (million gallons per day)
71	Lps (liters per second)
72	Lpm (liters per minute)
73	Lph (liters per hour)
74	m^3/sec (cubic meters per second)
75	ft^3/sec (cubic feet per second)
76	m/s (meters per second)
77	fps (feet per second)
78	cm (centimeters)
79	ft (feet)
80	in. (inches)
81	m (meters)
82	volts
83	AU (Absorbtion unit)
84	nA (nanoampere)
85	nA/ppm (nanoampere per ppm)
86	uA/ppm (microampere per ppm)

Table 9 Base unit field description (continued)

Returned value	Unit of measure
87	nA/mg (nanoampere per mg)
88	uA/mg (microampere per mg)
89	Sal (salinity)
90	gal (gallons)
91	ltr (liters)
92	%[1cm] (% transmission in 1-cm path)
93	m^3/h (cubic meters per hour)
94	gpd (gallons per day)
95	mL (milliliters)
96	af (acre feet)
97	cf (cubic feet)
98	m^3 (cubic meters)
99	cm^2 (square centimeters)
100	ft^2 (square feet)
101	in^2 (square inches)
102	m^2 (square meters)
103	afd (acre feet per day)
104	cfm (cubic feet per minute)
105	cfh (cubic feet per hour)
106	cfd (cubic feet per day)
107	cmm (cubic meters per minute)
108	cmd (cubic meters per day)
109	g/kg (grams per kilogram)
110	mils (1/1000 inch)
111	%H_2S
112	%LEL
113	VDC
114	no unit
115	Hz (Hertz)
116	kHz (kiloHertz)
117	mL/L (milliliters per liter)
118	mL/g (milliliters per gram)
119	MHz (megaHertz)
120	ft^3/min (cubic feet per minute)
121	ft^3/h (cubic feet per hour)
122	m^3/min (cubic meters per minute)
123	m^3/day (cubic meters per day)

Table 9 Base unit field description (continued)

Returned value	Unit of measure
124	L/day (liters per day)
125	af/h (acre-feet per hour)
126	mL/day (milliliters per day)
127	mg/L-N (milligrams per liter as Nitrogen)
128	K (degrees Kelvin)
129	%660nm (transmission percent at 660 nm)
130	v660nm (transmission voltage at 660 nm)
132	mS (milliSiemens)
133	uS (microSiemens)
134	$\%O_2$ (percent oxygen)
135	$uE/S/m^2$
136	Kg/L
137	ft^3/day
138	ft^3
139	mg (million gallons)
140	cfs (cubic feet per second)
141	cms (cubic meters per second)
142	cmh (cubic meters per hour)
143	Unknown

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