Brooks Service Tool™ for QUANTIM® Precision Mass Measurement and Control

Brooks Instrument

www.BrooksInstrument.com

EMERSON

Process Management

Essential Instructions
Read this page before proceeding!

Brooks Instrument designs, manufactures and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you must properly install, use and maintain them to ensure they continue to operate within their normal specifications. The following instructions must be adhered to and integrated into your safety program when installing, using and maintaining Brooks Products.

- Read all instructions prior to installing, operating and servicing the product. If this instruction manual is not the correct manual, please see back cover for local sales office contact information. Save this instruction manual for future reference.
- If you do not understand any of the instructions, contact your Brooks Instrument representative for clarification.
- Follow all warnings, cautions and instructions marked on and supplied with the product.
- Inform and educate your personnel in the proper installation, operation and maintenance of the product.
- Install your equipment as specified in the installation instructions of the appropriate instruction manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, use qualified personnel to install, operate, update, program and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Brooks Instrument. Unauthorized parts and procedures can affect the product's performance and place the safe operation of your process at risk. Look-alike substitutions may result in fire, electrical hazards or improper operation.
- Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified persons, to prevent electrical shock and personal injury.

⚠ CAUTION

This instrument contains electronic components that are susceptible to damage by static electricity. Proper handling procedures must be observed during the removal, installation or other handling of internal circuit boards or devices.

Handling Procedure:
1. Power to unit must be removed.
2. Personnel must be grounded, via a wrist strap or other safe, suitable means before any printed circuit card or other internal device is installed, removed or adjusted.
3. Printed circuit cards must be transported in a conductive container. Boards must not be removed from protective enclosure until immediately before installation. Removed boards must immediately be placed in protective container for transport, storage or return to factory.

Comments
This instrument is not unique in its content of ESD (electrostatic discharge) sensitive components. Most modern electronic designs contain components that utilize metal oxide technology (NMOS, SMOS, etc.). Experience has proven that even small amounts of static electricity can damage or destroy these devices. Damaged components, even though they appear to function properly, exhibit early failure.

Dear Customer,

The Brooks Service Tool™ is a Windows® - based application that provides expanded control of Brooks QUANTIM® QMA and QMB Mass Flow Control (MFC) devices for servicing tasks that include setup and configuration, troubleshooting, and tuning.

We recommend that you read this manual in its entirety as this will enable efficient and proper use of the Brooks Service Tool. Should you require any additional information concerning the Brooks Service Tool, please feel free to contact your local Brooks Sales and Service Office, see back cover for contact information, or visit us on the web at www.BrooksInstrument.com. We appreciate this opportunity to service your fluid measurement and control requirements,and trust that we will be able to provide you with further assistance in future.

Yours sincerely,

Brooks Instrument

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Section 1 - Introduction

Brooks Service Tool™ for QUANTIM®

1 Introduction

1.1 Description

The Brooks Service Tool is a Windows-based application that provides expanded control of Brooks QUANTIM QMA and QMB Mass Flow Control (MFC) devices for servicing tasks that include setup and configuration, troubleshooting, and tuning.
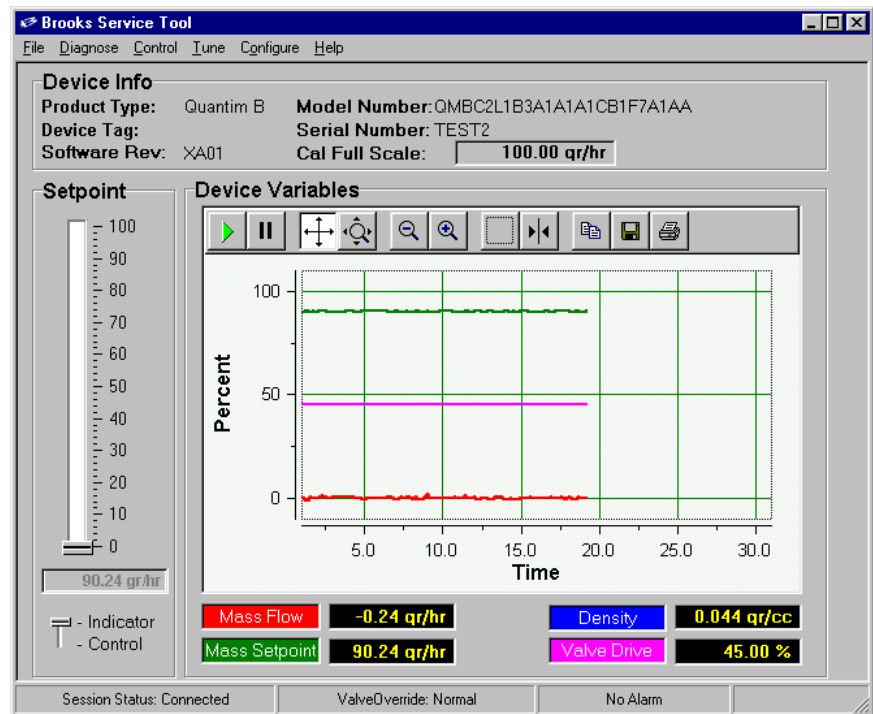
Brooks Service Tool Main Window

Using an RS-232 connection between a personal computer (PC) and the device's service port, you can use the Service Tool to view, control, and modify data such as:

- Flow
- Setpoint
- Analog input/output (I/O) configuration
- I/O ranging
- Valve tuning
- Device I/O calibrations
- Diagnostics

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1.2 How to Use This Manual

It is recommended that you read this manual before installing or using the Service Tool.

The manual is organized into the following sections:

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Section 2 - Theory of Operation

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2 Theory of Operation

A typical mass flow measurement and control system consists of two components:

- **Mass flow meter.** A mass flow meter incorporates a sensor that measures the amount of mass flow and generates an electrical output signal directly proportional to the mass flow rate.

- **Control valve.**

Mating a control valve with a mass flow meter provides a mass flow controller (MFC).

Implementing a mass flow controller requires using the mass flow output signal as one input and a user-supplied setpoint signal as another input into a comparator circuit. These two signals are then compared and a control signal is generated to operate the opening or closing of the valve. The setpoint signal is, in effect, a request that the mass flow controller maintain a fixed mass flow rate.

A setpoint signal can come in many forms. The Brooks QUANTIM QMA and QMB devices are analog—the input/output (I/O) signals between the mass flow device and the user's control side are represented as a voltage (0–5 Vdc) or current (4–20 mA).

The Brooks Service Tool, which communicates with the device through an RS-232 connection between the PC and the device's service port connector, uses a digital signal based on a proprietary protocol. The Service Tool has two operating modes:

- **Indicator**, in which the Service Tool is reporting on the data sent to it from the device, which is being controlled by the normal setpoint source.

- **Control**, in which the Service Tool user specifies the setpoint, overriding the normal setpoint source.

In either arrangement, the device will attempt to manage the opening and closing of the control valve to maintain the amount of mass flow as requested by the setpoint source.

Note that the Brooks Service Tool is meant to be used as a startup and troubleshooting tool. It is not intended to be permanently connected to the device in your application.

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3 Installation

This section describes how to install the Service Tool application onto a personal computer (PC), and how to connect the PC to the device.

3.1. Installing the Service Tool Application

The Service Tool application can be installed on a Windows PC under the following requirements:

• Windows 95, 98, Me, NT 4, 2000, or XP

• PC running at a minimum of 450 MHz, with at least 64 MB of RAM and a CD-ROM drive

To install the Service Tool application, load the Service Tool CD-ROM into the drive. On the CD-ROM disk, find the installation file, **Setup.exe**, and double-click it to launch the installation wizard. Follow the installation instructions in the wizard.

3.2. Connecting the PC to the Device

The following topics list the hardware requirements and describe the procedure for connecting the PC running the Service Tool to the device's service port.

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3.2.1 Hardware Requirements

The following tools and cables are required to connect the PC serial port to the device's service port:

• RS-232 to TTL communications interface adapter.

• Standard RS-232 serial cable (between your PC's serial connector and the communications interface adapter).

NOTE:

If the distance between the PC and the device is short enough, the RS-232 cable is not necessary. Plug the communications interface adapter directly into the PC serial port.

• 3-wire communications cable (between the interface connector and the device's service port connector)
• Straight (flat blade) screwdriver
• 3/16-in. nut driver

Communications interface
adapter

3-wire communications
cable

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3.2.2 Connection Procedure

To connect the PC to the device's service port:

1. Turn off power to the device.

2. Remove the standard cable from the device's 15-pin D-connector.

3. Remove the screw at the center of the top cover and the two 3/16-in. standoffs on the 15-pin D-connector.

4. Remove the cover.

Black service port connector located behind D-connector

15-pin D-connector

D-connector standoffs

Center cover screw

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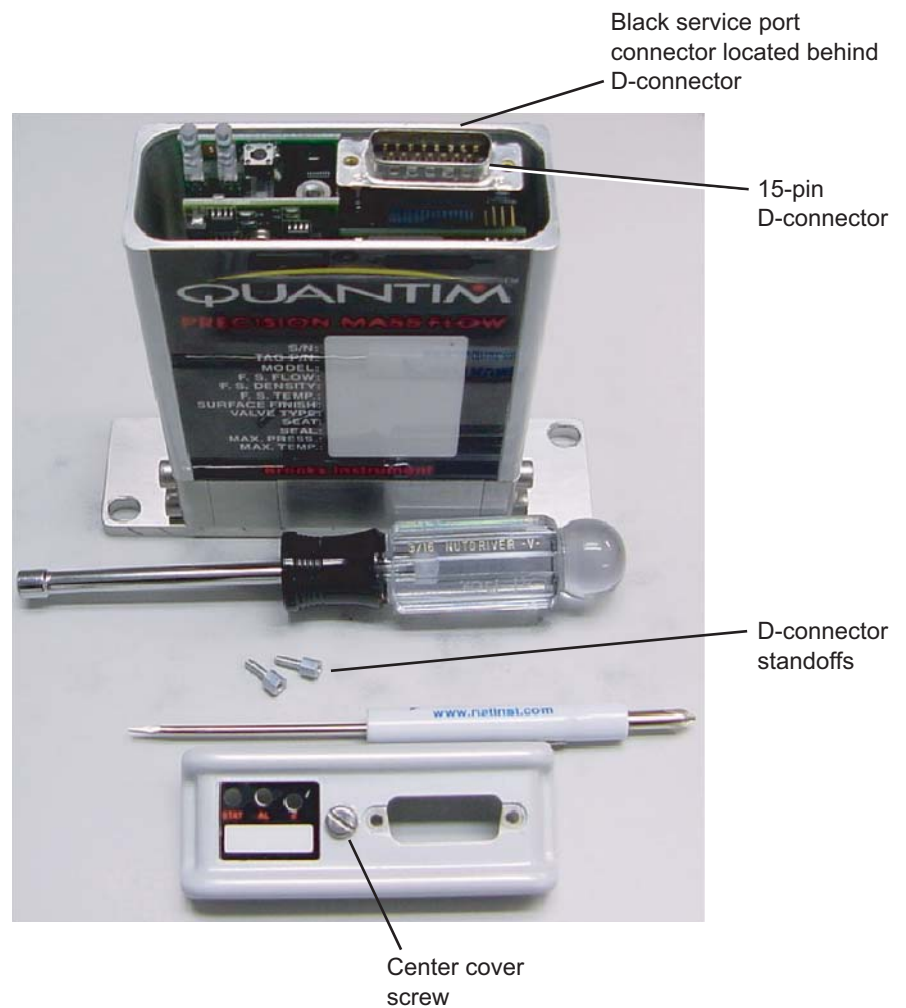
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5. Assemble the RS-232 serial cable, communications interface adapter, and Service Tool 3-wire communications cable.

6. Connect the RS-232 serial cable to a serial port on your computer.

If the distance is short enough, you can connect the communications interface adapter directly to the PC's serial port, as shown below, and do not need the RS-232 serial cable.

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7. Connect the 3-wire communications cable to the device's service port, the black connector located behind the D-connector. Align the communications cable's 5-pin connector with the **black wire** towards the **center** of the device (towards the LEDs).

The QUANTIM QMA model's service port has a 6-pin connector. To attach the communications cable's 5-pin connector to the 6-pin service port, make the connection so that the unused pin is the innermost pin (the pin closest to the center or LEDs), as shown in the following illustration.
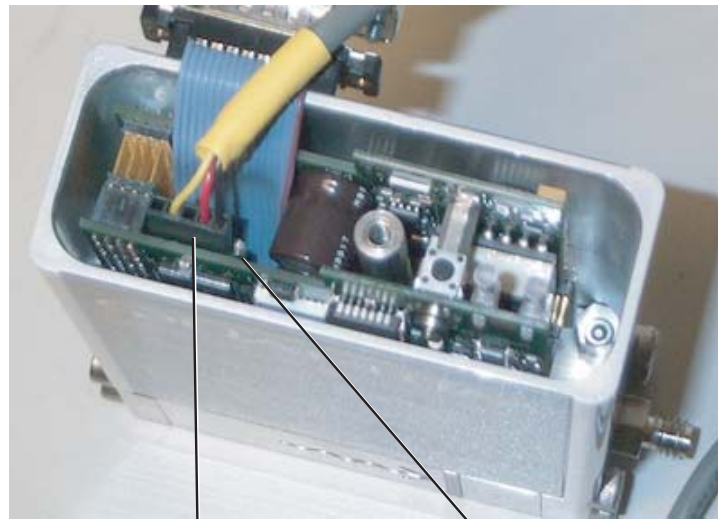
Service port
connector attached
(viewed from rear of device)

Unused 6th pin
on QUANTIM QMA

8. Reconnect the standard cable to the device's D-connector.

This connection is used to apply power and the analog setpoint to the device while using the Service Tool.

9. Turn on power to the device.

10. Verify that the device initializes properly, as indicated by the Status LED being solid green.

You are now ready to use the Service Tool.

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3.2.3 Disconnecting the PC from the Device

When you are done using the Service Tool, you should disconnect the PC from the device and reinstall the device's cover.

To disconnect the PC from the device's service port:

1. Exit from the Service Tool.

2. Turn off power to the device.

3. Disconnect the standard cable and the 3-wire communications cable from the device.

4. Disconnect the RS-232 serial cable (or interface adapter) from your PC.

5. Place the cover onto the device, and reattach it using the screw at the center of the top cover and the two 3/16-in. standoffs on the 15-pin D-connector.

6. Reconnect the standard cable to the device's 15-pin D-connector.

You can now reapply power to the device and begin using it in its process application.

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3.3 Device D-Connector Pin-Outs

The QUANTIM device pin-outs are listed below.
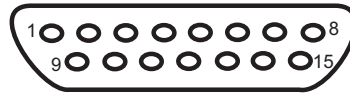
Pin No.	Function
1	Setpoint Return
2	0 to 5 Vdc Flow Signal Output
3	Not used
4	4 to 20 mA Flow Signal Output
5	+13- to +30-Vdc Power Supply
6	Not used
7	4 to 20 mA Setpoint Input
8	0 to 5 Vdc Setpoint Input
9	Power Supply Common
10	Signal Output Return
11	+5 V Reference Output
12	Valve Override Input
13	4 to 20 mA Density or Temperature
14	Not used
15	Not used

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4 Basic Operations

This section describes the Service Tool's basic operations, including:

• Starting the tool and opening a new session

• Setting the options to determine what variables will be displayed in the main window and how they will be displayed

• Putting the tool into Indicator or Control mode, which determines whether the tool can initiate changes in setpoint values

• Controlling different aspects of how the trending graphs are displayed in the main window

• Capturing the current state of the trend graph to the clipboard or a file, and/or by printing it to a hard copy

• Closing the session and exiting the tool

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4.1 Starting the Service Tool and Opening a New Session

To start the Service Tool and open a new session:

1. Select the Brooks Service Tool from your **Start** menu, or double-click its application file. The main window displays, with no session open.
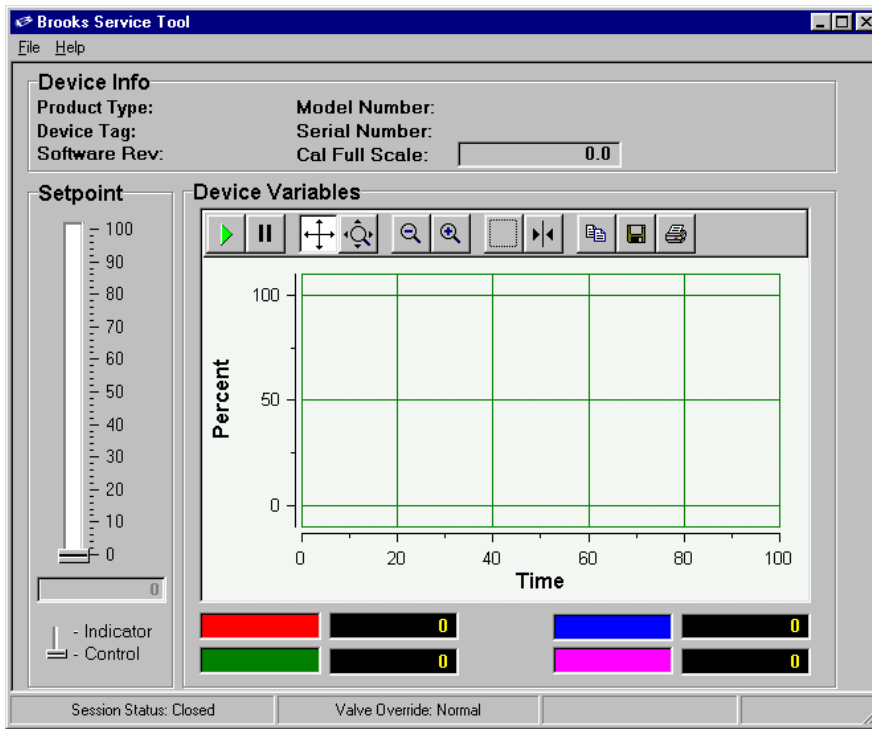
2. To open a new session, open the **File** menu and select **New Session**.

   The Open Session dialog box displays.

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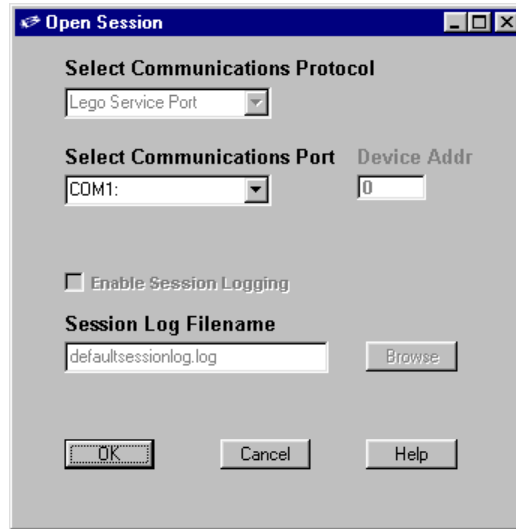
3. From the **Select Communications Port** drop-down list, select the Comm port to which the Service Tool cable is connected, then click **OK**.

The Trend Graph and Status indicators begin showing the data that is being read from the device.

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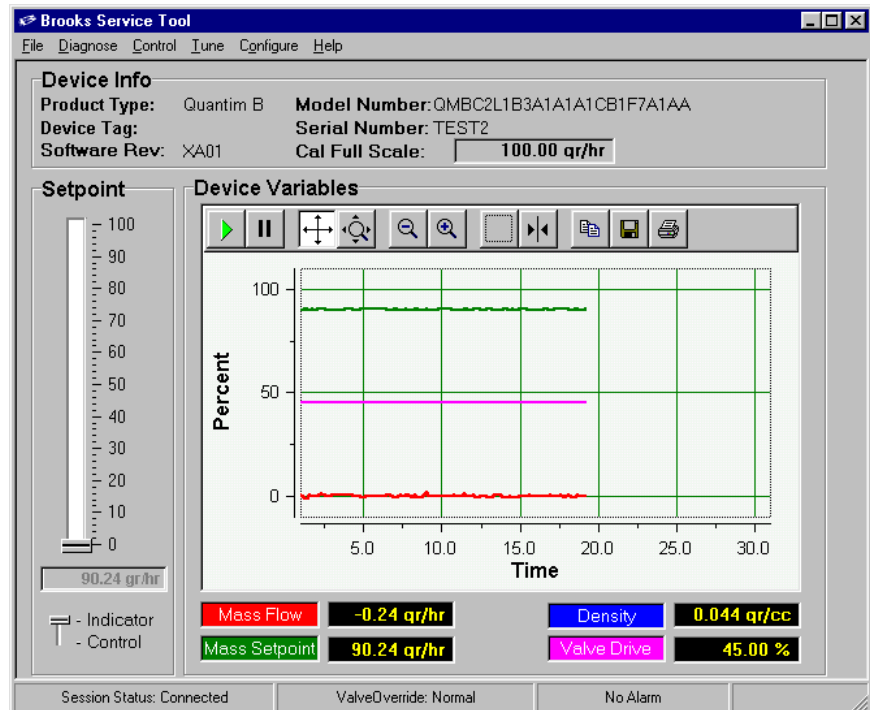
4.2 Main Window Elements

Figure 4-1 indicates the major elements of the main window.
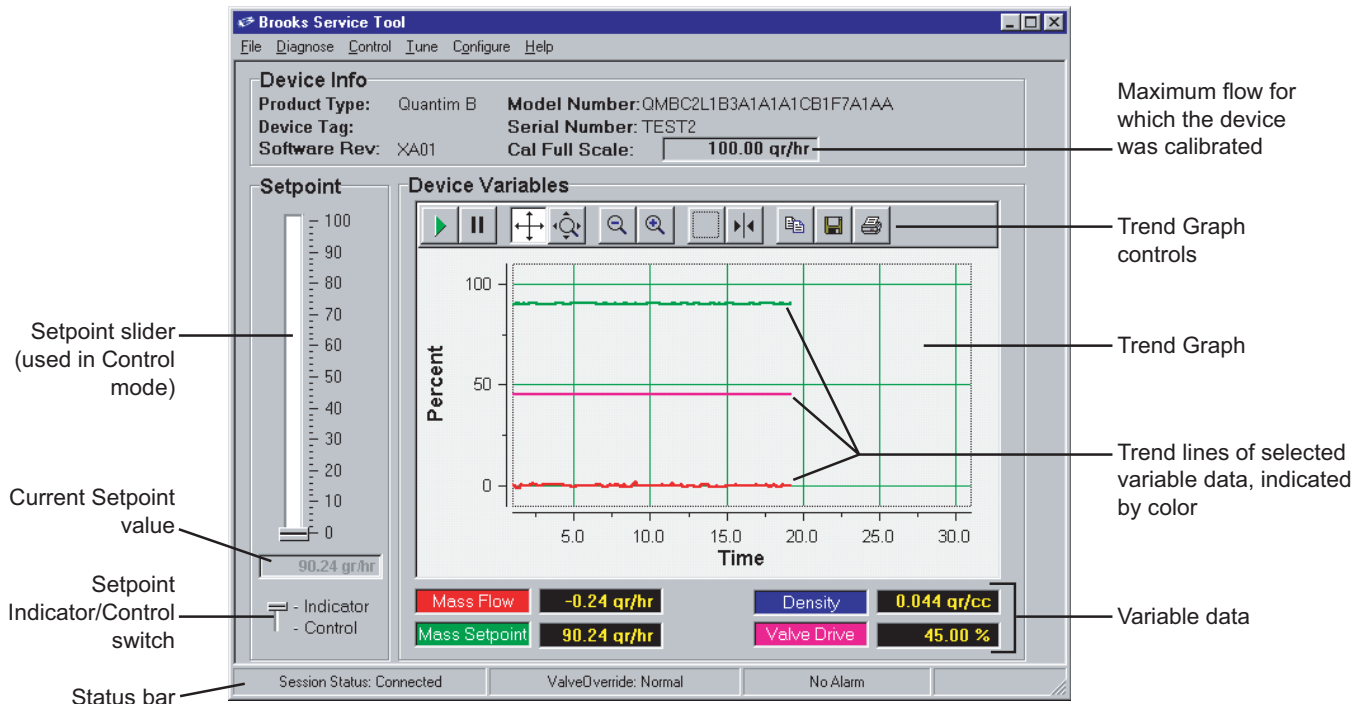
Figure 4-1 Main Window Elements

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4.3 Setting the Main Window Options

To set the main window options, open the **File** menu and select **Options**. The Options window displays. From this window, you can perform the functions described in Table 4-1.
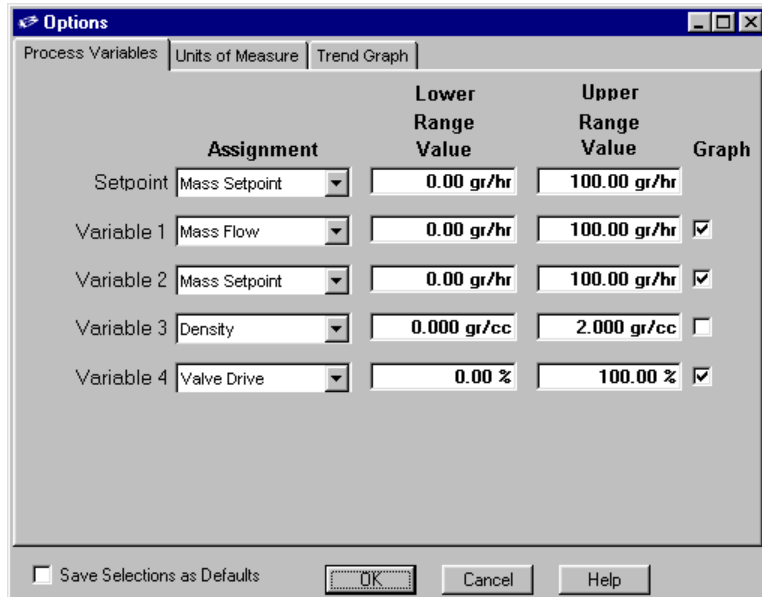
Table 4-1 Options Window Functions

Function	Description
Modify the current settings	You can modify the options settings on any of the three tabs. The options on the three tabs, and which elements on the main window they control, are illustrated in Figures 4-2 through 4-4.
Save current settings as defaults	Changes that you make to the option settings are in effect only for the current session. However, you can save the current settings so that they are used as the default values the next time a session is opened. To do this, select the **Save Selections as Defaults** option at the bottom of the Options window.
Cancel your setting changes	Click the **Cancel** button.
Save your setting changes	Click **OK**.

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NOTE: Range values here affect only the trend graph; they do not change the representation of the variable on an analog output.

Range values determine variable data values at 0% and 100% scale

Graph options determine which variable data is trend graphed

Assignment options determine Setpoint type and what variable data is displayed

Figure 4-2 Process Variables Options

Select unit of measure for each variable data type

Enter precision of measurement data

Select this option to save current settings as default values next time a session is opened

Figure 4-3 Units of Measure Options

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X-Axis Scroll Method determines how trend graph will advance over time:

• **Smooth** (continuously), or

• **Page** (in time window increments; for example, every 30 seconds)
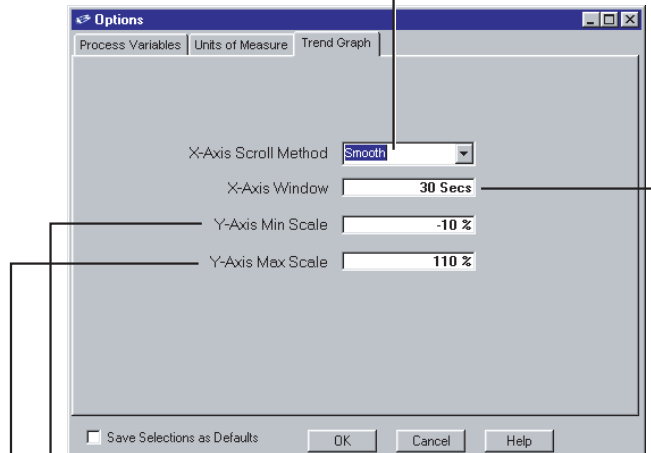
Y-Axis Scale values determine upper and lower percentage values along the Y-axis

X-Axis Window determines the time window displayed along the X-axis
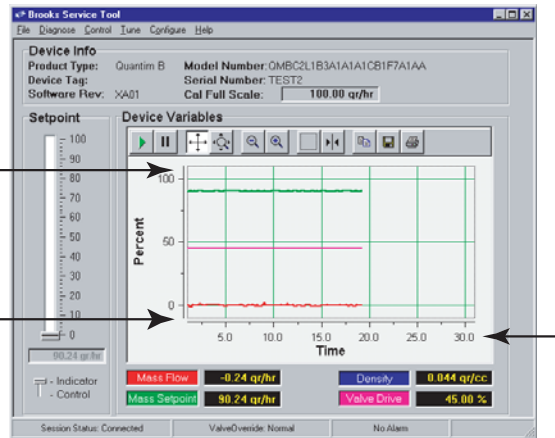
Figure 4-4 Trend Graph Options

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4.4 Putting the Service Tool in Indicator or Control Mode

By default, a session opens with the Service Tool in Indicator mode. In this mode, the setpoint is being controlled by the standard setpoint input source. The setpoint data in the Service Tool's main window "indicates" what the device is currently reporting as its setpoint.

However, you can control the setpoint directly from the Service Tool by moving the Setpoint Switch to **Control**, then using the slider to set the setpoint or entering a value in the field below the slider. Figure 4-5 shows the Setpoint controls and trend graph in Control mode.

Indicates when Setpoint slider was moved to current position

In Control mode, use slider to choose setpoint

or

Enter setpoint value here, then press the Enter key

Setpoint switch in Control mode, setpoint at 51.82 gr/hr
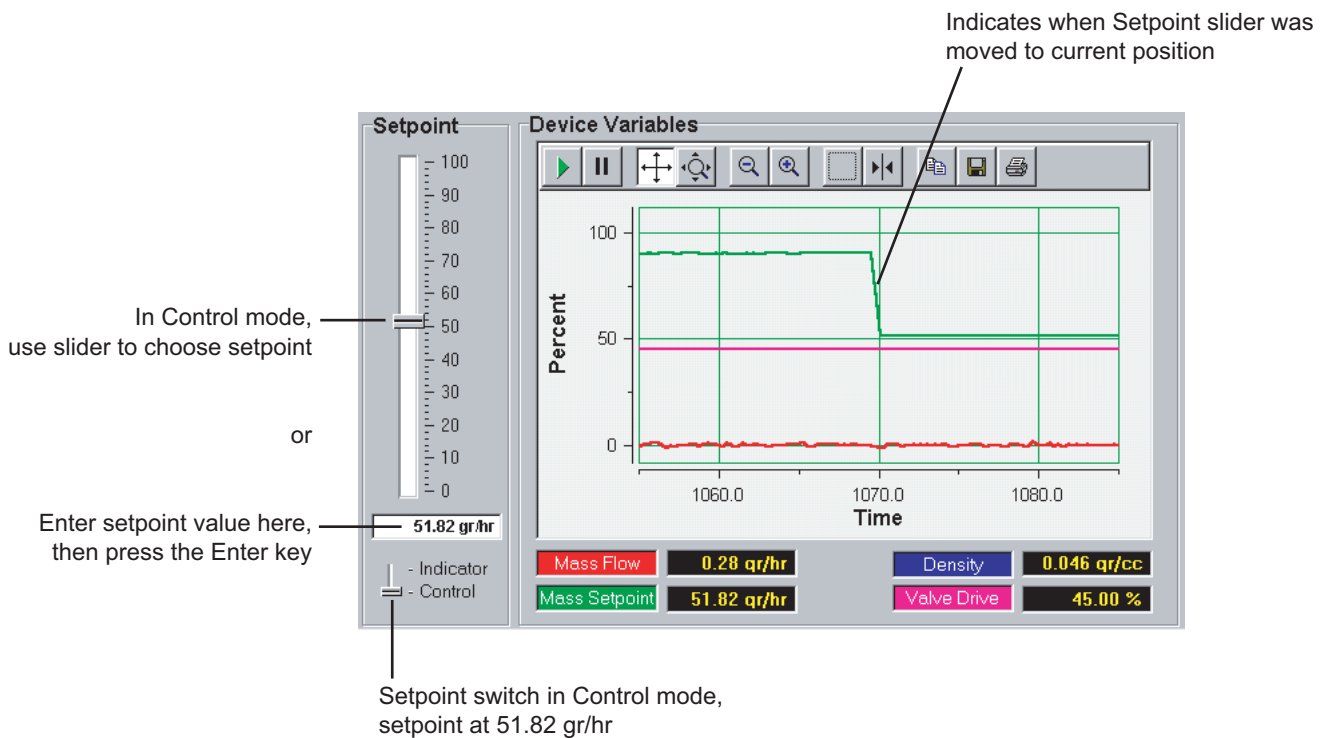
Figure 4-5 Setpoint Switch in Control Mode

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4.5 Trend Graph Functions

The following topics cover the functions that you can perform on the trend graph.

4.5.1 Trend Graph Elements

Figure 4-6 shows the Trend Graph's main elements. Table 4-2 summarizes the Trend Graph's toolbar functions.

The data graphs are coordinated by color to the variable data to which they correspond. Note that the selection of what variable data to graph is determined by settings in the main window's options; refer to "4.3 Setting the Main Window Options" on p. 4-5.
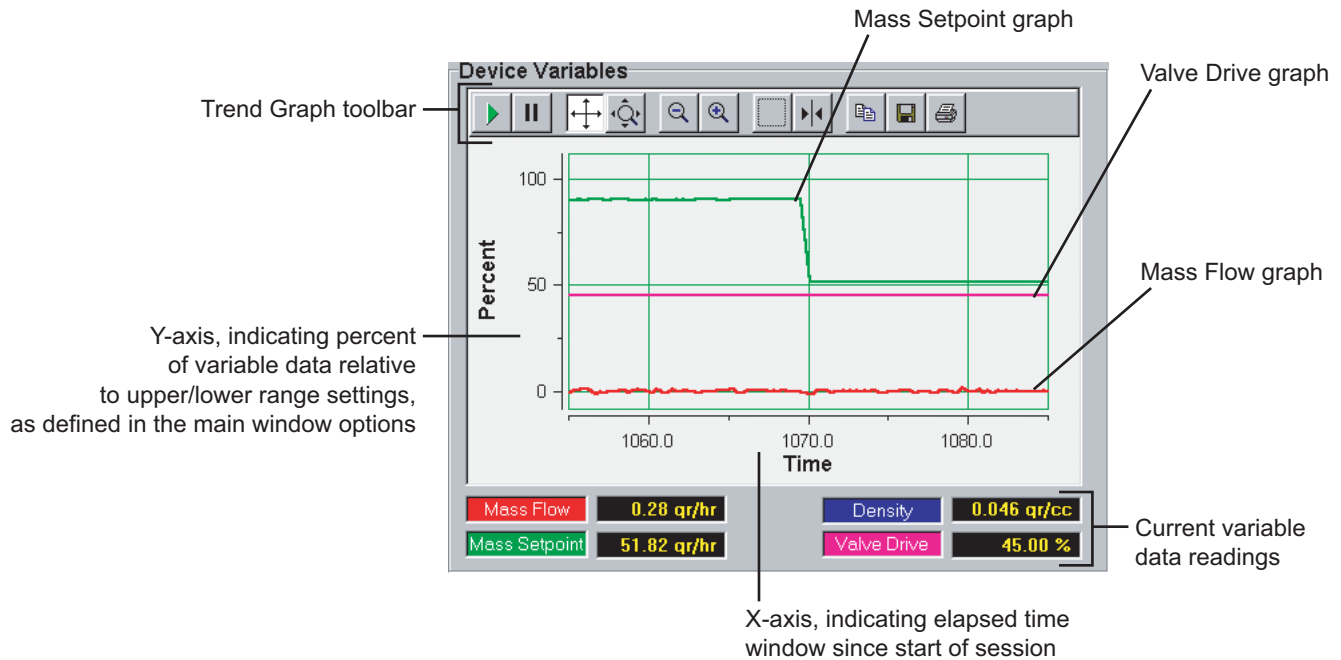
Figure 4-6 Trend Graph Main Elements

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Table 4-2 Summary of Trend Graph Toolbar Functions

Function	Description
▶	Starts variable data trending, if it has been stopped.
❚❚	Stops variable data trending.
✛	Scroll up and down the Y-axis, or back and forth across the X-axis.
⬖Q⬗	Zoom in and out of a selected axis.
⊖ ⊕	Zoom in and out of both axes simultaneously.
▢	Zoom in on a region of the trend graph.
▶│◀	View the X- and Y-axes values at a given point in time the trend graph.
🗐	Copy the trend graph to the clipboard.
💾	Save the trend graph as a file.
🖨	Print the trend graph.

The following topics provide more detail about each of the Trend Graph toolbar functions.

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4.5.2 Stopping and Starting Trending

You can stop the real-time updating of trending data at any time. For example, you may want to analyze the current window of data for troubleshooting. Stopping the updating freezes the data as it is currently displayed.

To stop trending, click the ⏸ button in the Trend Graph toolbar. Data will continue to be collected from the device, but the trend graph is not updated. With trending stopped, you can continue to use the other toolbar functions.

To restart trending, click the ▶ button. When you restart trending, the trend graph will jump to display the most recently collected data. To see data collected while the trend graph was stopped, use the X-axis Scroll Tool, covered in the next topic.

4.5.3 Scrolling a Graph Axis

The Scrolling tool allows you to scroll up and down the Y-axis, or back and forth across the X-axis. This can be helpful in seeing other areas of the trend graph (for example, if you have zoomed in on it, or if you want to see previous portions of the trend graph).

To scroll on an axis, click the ⊹ button in the Trend Graph toolbar and move the pointer over the axis on which you want to scroll. The pointer turns into a pointing hand. Click and drag in the direction you want to scroll.
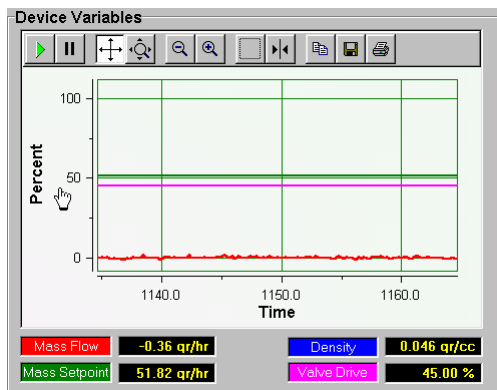
Before Y-axis scrolling

After Y-axis scrolling

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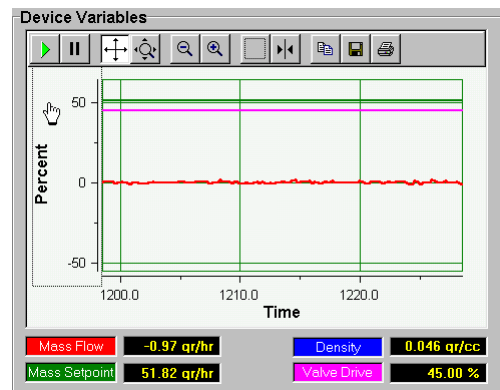
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4.5.4 Zooming on a Single Graph Axis

The Zooming on a Single Axis tool allows you to zoom on the X- or Y-axis.

To zoom on an axis, click the [⊕] button in the Trend Graph toolbar and move the pointer over the axis on which you want to scroll. The pointer turns into a double-headed arrow, pointing in the directions relative to the axis it is over. Click and drag in the direction you want to zoom.
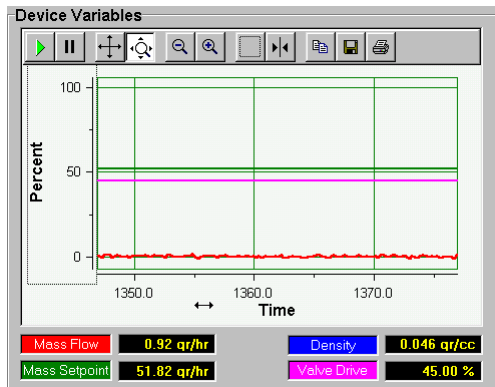
Before X-axis zooming   *After X-axis zooming*

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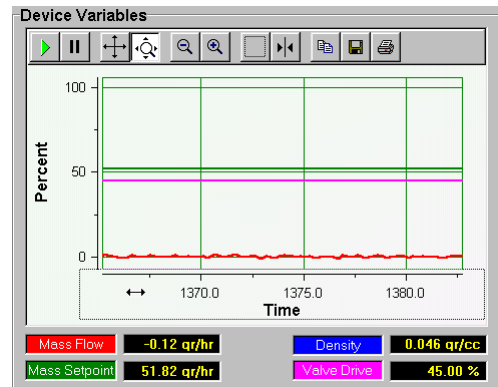
4.5.5 Zooming on Both Graph Axes

The Zooming on Both Axes tool allows you to zoom on the X- and Y-axes at the same time.

To zoom on both axes simultaneously, click one of the [magnifier buttons] buttons in the Trend Graph toolbar.
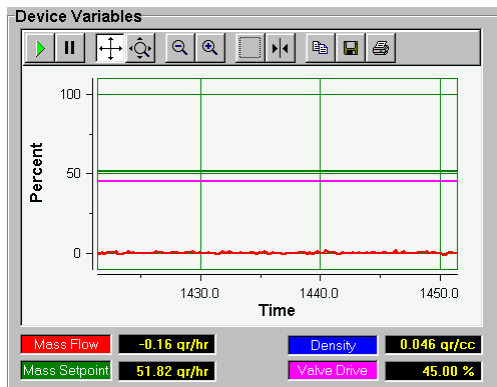
Before zooming in on both axes

After zooming in on both axes

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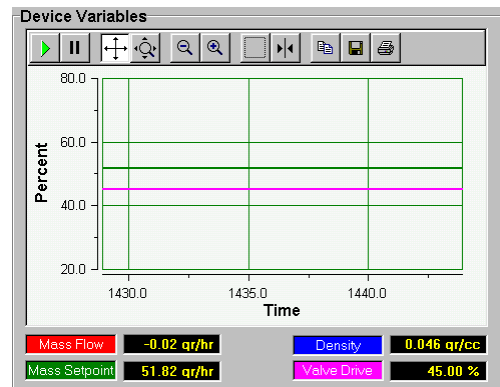
4.5.6 Zooming on a Region of the Graph

The Zooming on a Region tool allows you to zoom on a region on the trending graph, adjusting the X- and Y-axes scales accordingly.

To zoom on a region of the trend graph, click the ⬜ button in the Trend Graph toolbar and move the pointer over the trend graph. The pointer turns into an arrow with a box. Click and drag to draw a box around the region on which you want to zoom, then release the mouse button.
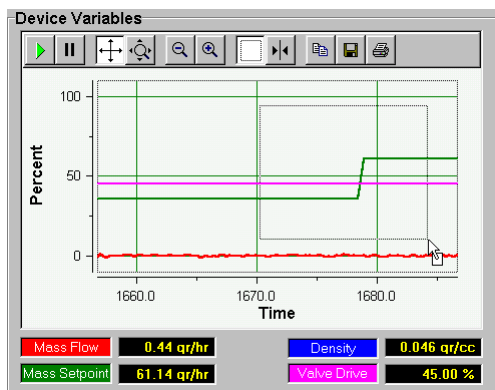
With region to zoom selected in box
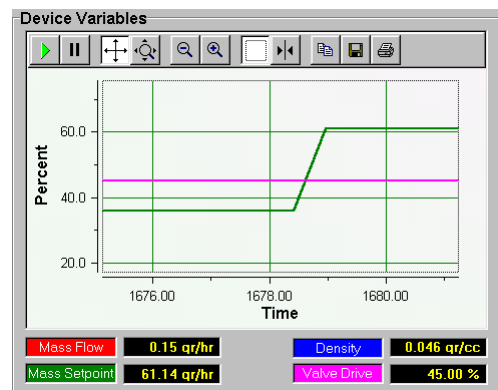
After region was zoomed on

NOTE:

When you release the mouse button, the trend graph freezes on the bounded region. You have to click the ▶ button to resume trending.

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4.5.7 Displaying X and Y Values at a Particular Point

The Values tool allows you to select a point along the Mass Flow trending graph and display the corresponding X- and Y-axis values at that point.

To display the exact X and Y values of the trend graph, click the ▶|◀ button in the Trend Graph toolbar and move the pointer over the trend graph. The pointer turns into pointing finger over a colored vertical line—the *cursor*. The X,Y values for the current cursor position are displayed. As you click and drag the cursor across the trend graph, the X,Y values dynamically update.
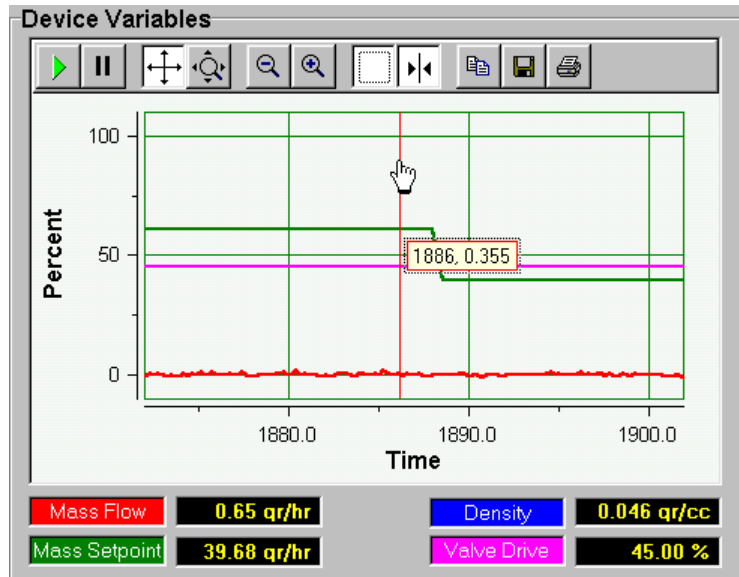
X,Y values at current cursor position

If you right-click on the cursor, a pop-up menu displays, allowing you to select from several options that control the cursor's attributes. These options are described in Table 4-3.

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Table 4-3 Trend Graph Cursor Options

Option	Description
Channel	Allows you choose the channel to which the cursor is attached. The channels correspond to the variables (Mass Flow, Density, and so on).
Style	Allows you to choose the measurement being made: • **Value X-Y.** Cursor is a single line. • **Value X.** Cursor is a single line. • **Value Y.** Cursor is a single line. • **Period.** Cursor is two vertical lines connected with a dotted line, showing the time/frequency between the lines. • **Peak-Peak.** Cursor is two horizontal lines connected by a dotted line showing the percentage difference between the lines (because Y-axis is in percent). • **Frequency.** Cursor is two vertical lines connected with a dotted line, showing the time/frequency between the lines. For Styles whose cursor is two lines, you can drag each line separately to make measurements.
Options>Use Channel Color	If selected (the default), the cursor is the color related to the variable. If not selected, the cursor is yellow.
Options>Hide Hint on Release	If selected, the values associated with the cursor are shown only while the left mouse button is held down.
Flip Alignment	Enabled only with single-line cursor styles. If selected, moves the values displayed to the opposite side of the vertical line.

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4.5.8 Copying the Graph to the Clipboard

You can copy the current state of the trend graph to the clipboard, for pasting into another Windows application.

To copy the current state of the trend graph to the clipboard, click the

button in the Trend Graph toolbar. The trend graph is copied to the clipboard. A sample of the trend graph pasted into a document is shown below.

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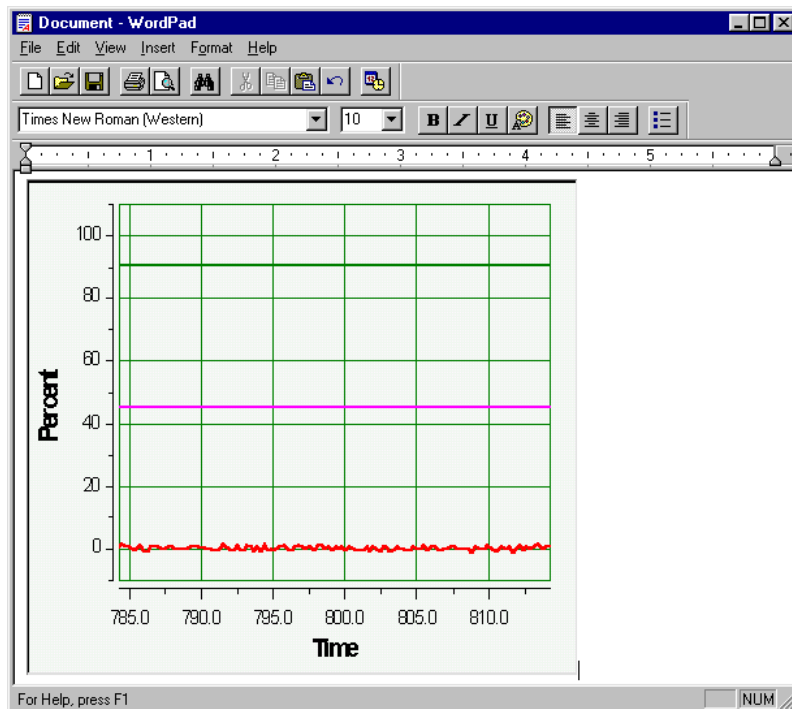
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4.5.9 Saving the Graph to a File

You can save the current state of the trend graph to a graphic file.

To save the current state of the trend graph to a graphic file, click the

[save icon] button in the Trend Graph toolbar. The Save As dialog box displays.
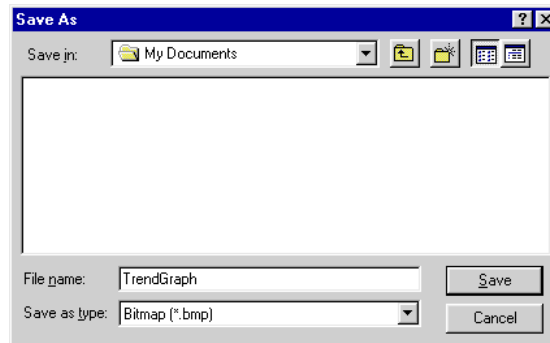
Navigate to the desired directory and enter a name for the file. You can also specify the graphic format—Bitmap (.bmp), Enhanced Metafile (.emf), or JPEG (.jpg)—from the **Save as type** drop-down list. Click the **Save** button to save the file.

4.5.10 Printing the Graph

You can print the current state of the trend graph to a printer.

To print the current state of the trend graph, click the [print icon] button in the Trend Graph toolbar. The standard Windows Print dialog box displays.

4.6 Closing the Session and Exiting the Service Tool

To close the current session and exit the Service Tool, open the **File** menu and choose **Exit**, or click the window's close button (at the upper right corner).

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**Section 5 - Viewing and Setting
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5 Viewing and Setting the Device Configuration

This section describes how to view and set device configuration parameters.

NOTE:

Any changes you make to the device configuration parameters are saved for the current and subsequent sessions. Prior to making changes to device configuration settings, it is recommended that you save the current settings. This will allow you to restore the device configuration to a known, working state. For more information about how to save the current settings, refer to "5.10. Saving the Current Device Configuration" on p. 5-17.

5.1 Setting Input (Setpoint) and Output Upper and Lower Range Values

The Service Tool's I/O Ranging function allows you to change the upper and lower range values for the setpoint and output flow values. For example, if you wanted to change the device's factory-calibrated full-scale flow rate to a lower value, you would use this function. After changing the upper range value, the full value signal (5 V or 20 mA) would correspond to the new value.

> ⚠ **CAUTION**
>
> Upper range values should never exceed the factory full-scale calibration value.

To change the input (setpoint) and output upper or lower range values, open the **Configure** menu and choose **I/O Ranging**. The Input/Output Ranging Wizard window opens.

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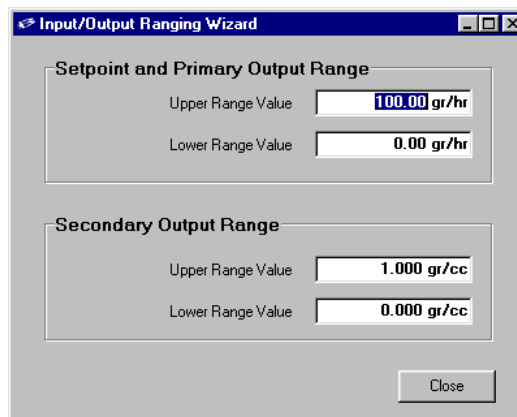
Change any of the range values, then click the **Close** button.

Note that, to use the I/O Ranging function, the setpoint and primary output must be set to the same variable. For example, Mass Setpoint and Mass Flow for output are of the same type; however, Mass Setpoint and Volumetric Flow for output are not.

If you attempt to use the I/O Ranging function and the setpoint and primary output are not set to the same variable, a message window will display indicating that the setpoint and primary output do not match and, therefore, the I/O Ranging function cannot be used for the device.

To correct this condition, go to the Variables and Setpoint tabs in the Configure Parameters window to change the setpoint and primary output to the same variable. For more information, refer to "5.5 Viewing and Setting Primary and Secondary Output Parameters" on p. 5-10 and "5.7 Viewing Setpoint Parameters" on p. 5-13.

5.2 Viewing and Setting Alarms

You can configure the device to report predefined alarm and warning conditions. The alarm and warning parameters are settable using the Service Tool. All alarm and warning conditions are reported to the Service Tool and indicated by green or red flashing codes on the device's Status and Alarm LEDs. You can also configure alarms and warnings to enable pin 3 of the device's D-connector.

To access the alarm/warning configuration parameters, open the **Configure** menu and choose **Configure Parameters**. The Configure Parameters window opens.

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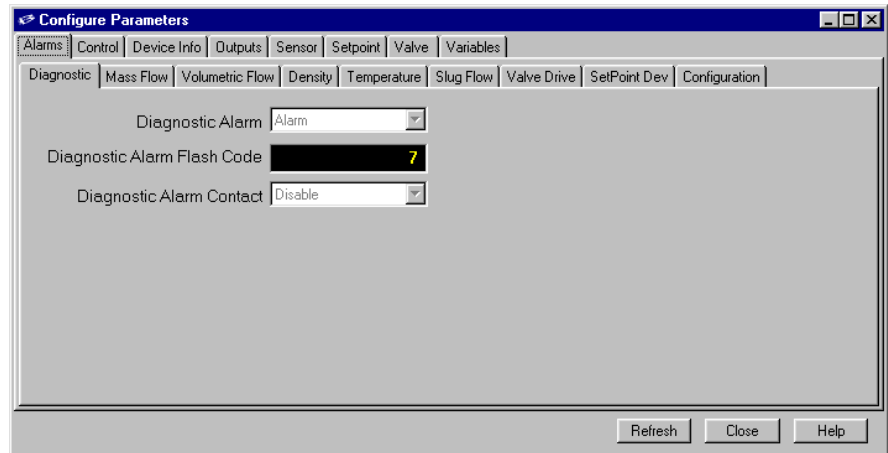
The following topics provide detailed information about the Diagnostic alarm, which is configured by default, and the optional alarm/warning conditions that be configured.

For information on viewing the warning and alarm conditions from the Service Tool, refer to "6.1. Checking the Warning, Alarm, and Diagnostic Status" on p. 6-1.

5.2.1 Diagnostic Alarm

By default, the Service Tool monitors the device's Diagnostic alarm status. This is the alarm signal that drives the Status and Alarm LEDs at the top of the device, and that is available to external devices at pin 3 of the device's D-connector.

The device continuously runs diagnostics. If the diagnostics detect a fatal error, the device goes to a safe state of operation and will not respond to the setpoint. Also, the Status LED turns a solid red and the Alarm LED flashes a red code 7 (7 flashes, followed by brief delay).

NOTE:

The fields in the Configure Parameters window's Alarms:Diagnostics tab are read-only.

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5.2.2 Configuring Optional Warnings and Alarms

In addition to the Diagnostic alarm, you can use the Service Tool to configure the device to report warning and alarm conditions related to the following variables:

• Mass flow
• Volumetric flow
• Density
• Temperature
• Slug flow
• Valve drive
• Setpoint deviation

Each of these variables has a tab in the Alarms tab in the Configuration Parameters window (the Density tab is shown below). The tab includes the field and options described in Table 5-1.

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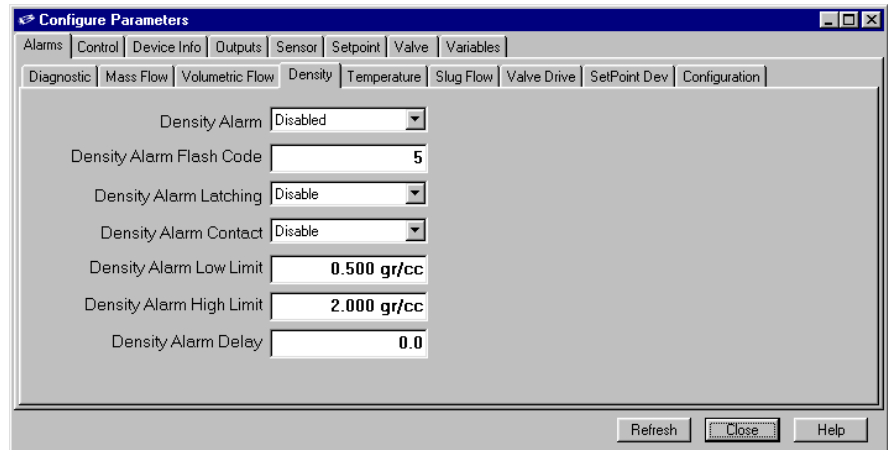
Table 5-1 Alarm/Warning Conditions Fields and Options

Field/Option	Description
Alarm	Condition reported: • **Disabled.** No warning/alarm will be set if low or high limits are exceeded. • **Warning.** A warning condition is set if low or high limits are exceeded. Alarm LED flashes green, but the device will continue normal operation. • **Alarm.** An alarm condition is set if low or high limits are exceeded. Alarm LED flashes red. Device will continue normal operation, unless the alarm was set by the device diagnostics. If a diagnostic alarm is set, the device enters a safe state, ignoring setpoint.
Flash Code	The code flashed by the Alarm LED to indicate a warning/alarm condition for this variable.
Latching	If enabled, the warning/alarm condition will persist, even if the condition goes away.
Alarm Contact	If enabled, a warning/alarm condition for this variable will cause the open-collector output at pin 3 of the device's D-connector to be active.
Alarm Low Limit	Lower limit for this variable. If the **Alarm** option is set to Warning or Alarm, and the variable's data value drops below the low limit value, the variable's warning/alarm condition will be active.
Alarm High Limit	Upper limit for this variable. If the **Alarm** option is set to Warning or Alarm, and the variable's data value exceeds the high limit value, the variable's warning/alarm condition will be active.
Alarm Delay	Number of seconds that the warning/alarm condition must be active before the warning/alarm is indicated on the Alarm LED and Alarm contact (and reported to the Service Tool, if a session is open).

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5.2.3 Modifying Standard Alarm Behavior

You can globally modify the behavior of alarms to automatically disable when one or both of the following conditions exist: setpoint is zero and valve override is active.

• **Setpoint Zero Alarm Disable.** When this option is enabled, the alarms defined in Table 5-2 below will not occur if the setpoint is zero. For example, if the Mass Flow Alarm is enabled and you do not want the alarm to occur while the setpoint is zero (flow is commanded to be zero), causing flow to be less than the lower limit, set the Setpoint Zero Alarm Disable option to On (enabled).

• **Valve Override Alarm Disable.** When this option is enabled, the alarms defined in Table 5-2 will not occur if the valve override is in the open or closed state. For example, if the Mass Flow Alarm is enabled and you do not want the alarm to occur while the valve override is set to open, causing flow to exceed the upper alarm limit, then set the Valve Override Alarm Disable option to On (enabled).

Table 5-2 Alarms Affected by Alarm Disable Options

Alarm	Setpoint Zero Alarm Disable	Valve Override Alarm Disable
Mass Flow	Yes	Yes
Volumetric Flow	Yes	Yes
Density	Yes	No
Temperature	No	No
Slug Flow	Yes	No
Valve Drive	Yes	Yes
Setpoint Deviation	Yes	Yes

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To set the alarm behavior when setpoint is zero or valve override is active, open the **Configure** menu and choose **Configure Parameters**. The Configure Parameters window opens. Click the Alarms:Configuration tab. Choose whether to enable (On) or disable (Off) the option.
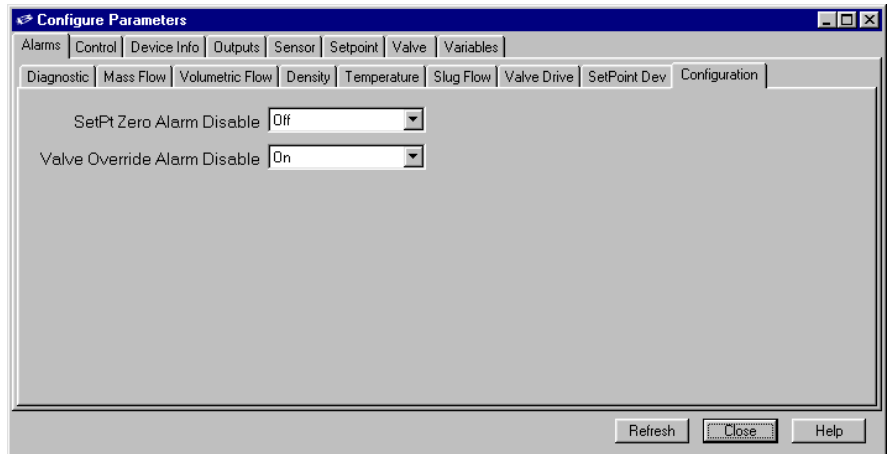
5.3 Viewing and Setting Configuration Parameters

You can view the current settings of the control parameters from the Configuration Parameters window. Some control parameters can be modified, typically indicated by their field having a white background.

To access the control parameters, open the **Configure** menu and choose **Configure Parameters**. The Configure Parameters window opens. Click the Control tab. The next two topics describe the Control:Response and Control:Configuration tabs.

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5.3.1 Viewing the Control Response Parameters

The response parameters on the Control:Response tab are read-only, as shown below. However, you can adjust the proportional and integral gain values; refer to "7.2.2.3 Tuning the Valve Response (Proportional and Integral Gain)" on p. 7-18.

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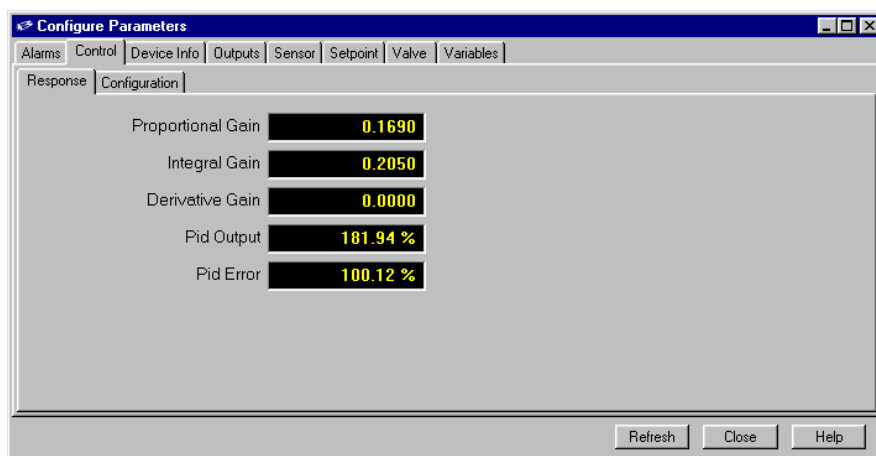
5.3.2 Viewing and Setting the Control Configuration Parameters

The Control:Configuration tab is shown below.
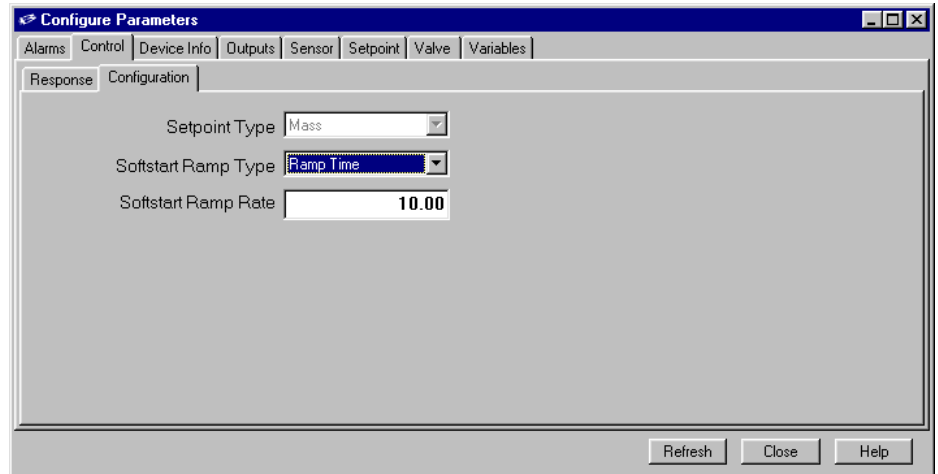
The Setpoint Type parameter on this tab is read-only; it must be set at the factory.

The two Softstart Ramp parameters allow you to configure the ramp behavior during a soft start of the device.

To configure the softstart ramp behavior, select Ramp Rate from the **Softstart Ramp Type** drop-down list, then enter the ramp rate (in percent per second) in the **Softstart Ramp Rate** field.

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5.4 Viewing Device Information

To view device information, open the **Configure** menu and choose **Configure Parameters**. The Configure Parameters window opens. Click the Device Info tab.
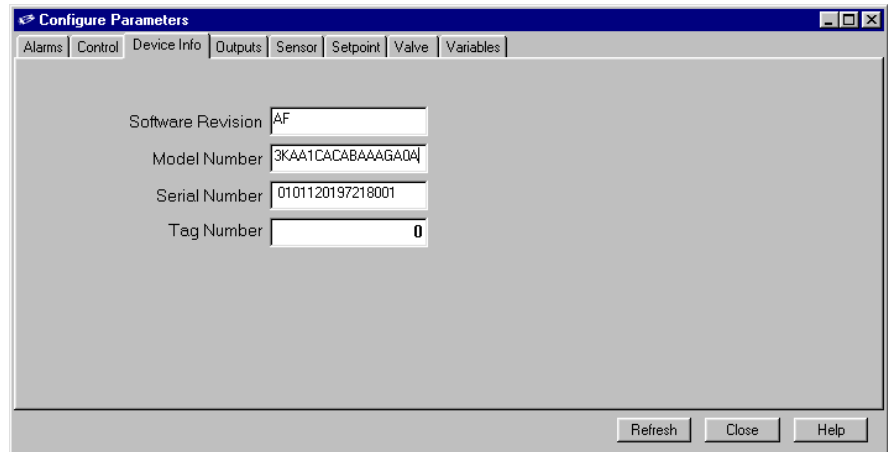
The device information parameters are read-only except for the Tag Number field. For a QUANTIM QMA, you can enter the device's tag number.

5.5 Viewing and Setting Primary and Secondary Output Parameters

You can view the current settings of the primary and secondary output parameters from the Configuration Parameters window. You can also modify the output data assignment, the output configuration (voltage or current), and, for a QUANTIM QMA, what happens to the output in the event of an alarm condition.

To access the primary and secondary output parameters, open the **Configure** menu and choose **Configure Parameters**. The Configure Parameters window opens. Click the Outputs tab. This tab includes Primary and Secondary Output tabs.

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You can modify the following settings:

• **Out Source.** Specifies the output data assignment.

NOTE:

For the primary output, its data assignment must match the setpoint assignment.

• **Analog Output Config.** Specifies the type of analog output—voltage or current.

• **Out Alarm Behavior** (QUANTIM QMA only). Specifies the behavior of the output during an alarm condition.

The Out Alarm Behavior choices are:

• **Downscale.** Output will go to 0 V or 3.8 mA.

• **Hold.** Output will be remain at the value in effect when the alarm condition was detected.

• **Track.** Output will continue to report the value of the measured process variable.

• **Upscale.** Output will go to 5.5 V or 22 mA.

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5.6 Viewing Sensor Parameters

To view the sensor parameters, open the **Configure** menu and choose **Configure Parameters**. The Configure Parameters window opens. Click the Sensor tab. All of the fields in the three Sensor tabs are read-only.

Configure Parameters

Alarms | Control | Device Info | Outputs | Sensor | Setpoint | Valve | Variables

Flow Calibration | Density Cal | Status

FCF Linearization A4 Coeff.	0.00000
FCF Linearization A3 Coeff.	0.00000
FCF Linearization A2 Coeff.	0.00000
FCF Linearization A1 Coeff.	0.18606
FCF Linearization AO Coeff.	0.00000
FCF Temp Correction	5.00
Meter Full Scale	3000.00 gr/hr
Setpoint Full Scale	3000.00 gr/hr

Refresh | Close | Help

Configure Parameters

Alarms | Control | Device Info | Outputs | Sensor | Setpoint | Valve | Variables

Flow Calibration | Density Cal | Status

Density Cal Factor D1	0.00
Density Cal Factor D2	1.00
Density Cal Factor K1	4524.60
Density Cal Factor K2	4776.01
Density Cal Factor Ktp	2.09
Density Cal Factor F3, A2	0.00
Density Cal Factor F3, A1	0.00

Refresh | Close | Help

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5.7 Viewing Setpoint Parameters

To view the setpoint parameters, open the **Configure** menu and choose **Configure Parameters**. The Configure Parameters window opens. Click the Setpoint tab. All of the fields in this tab are read-only.

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5.8 Viewing Valve Parameters

To view the valve parameters, open the **Configure** menu and choose **Configure Parameters**. The Configure Parameters window opens. Click the Valve tab. All of the field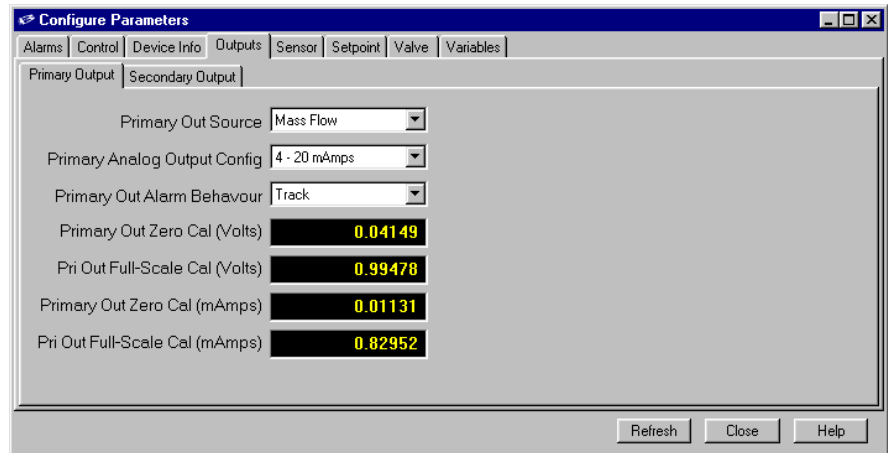s in this tab are read-only. To adjust the valve parameters, refer to "7.2.2 Optimizing the Valve Behavior for Process Conditions" on p. 7-10.

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5.9 Viewing Device Variables

To view the device variable parameters, open the **Configure** menu and choose **Configure Parameters**. The Configure Parameters window opens. Click the Variables tab. All of the fields in the four Variables tabs are read-only.

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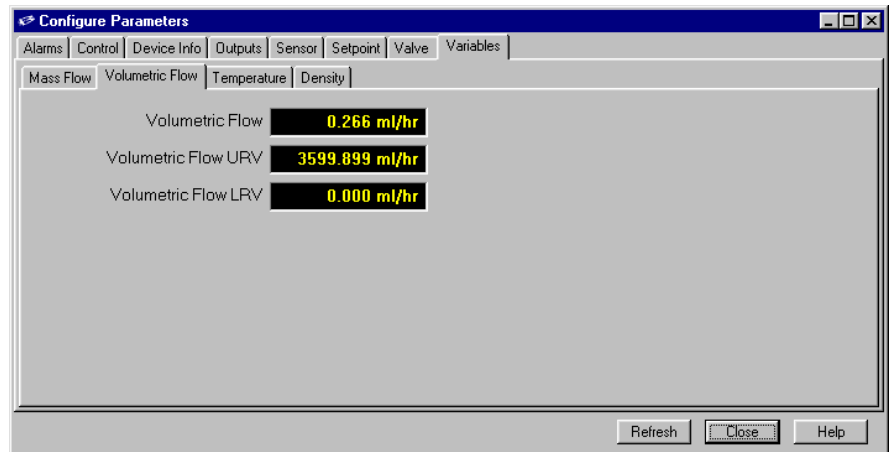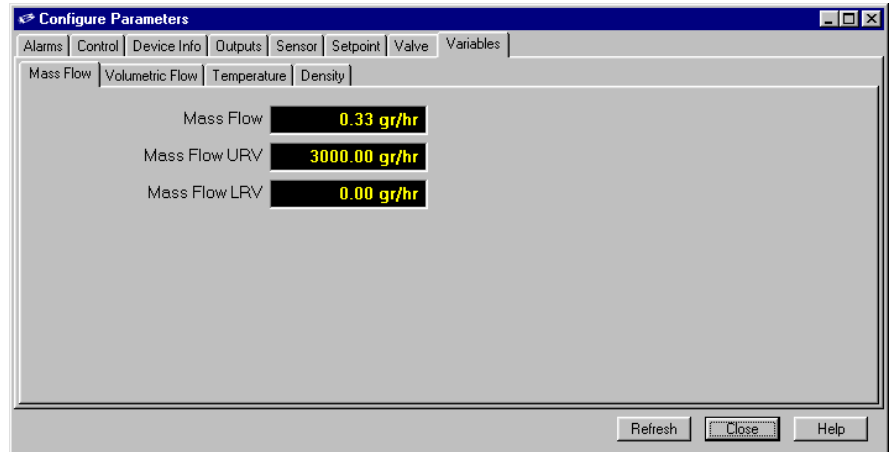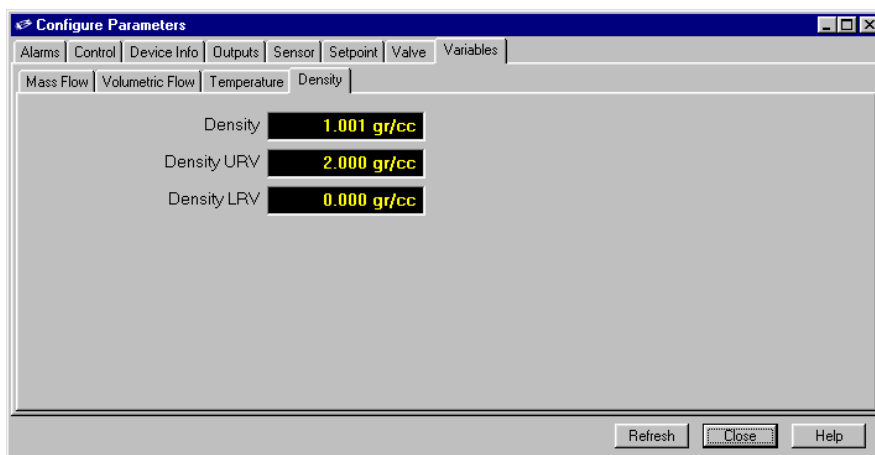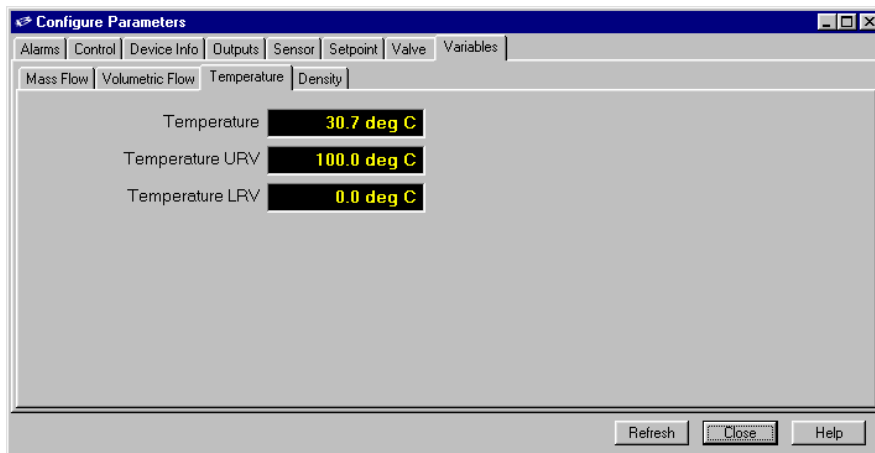
5.10 Saving the Current Device Configuration

When you close the Configure Parameters window, any setting changes you made are saved. Prior to making changes to device configuration settings, it is recommended that you save the current settings. This will allow you to restore the device configuration to a known, working state.

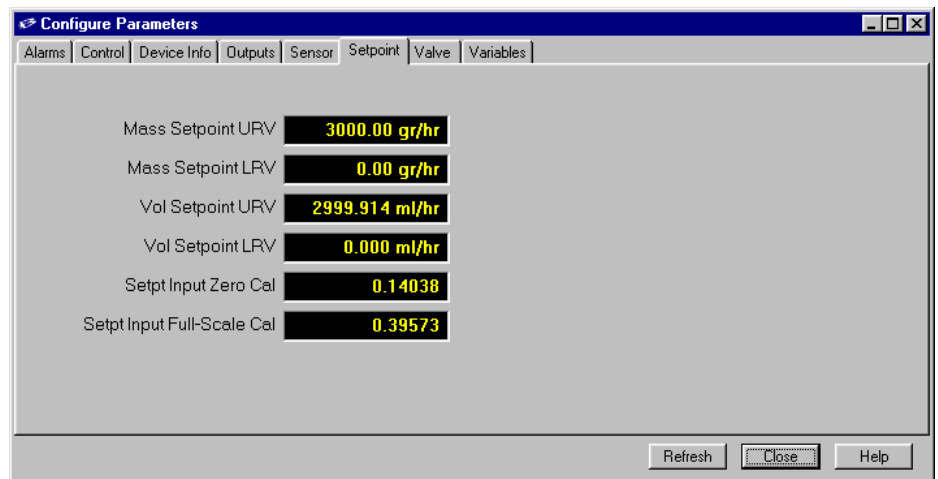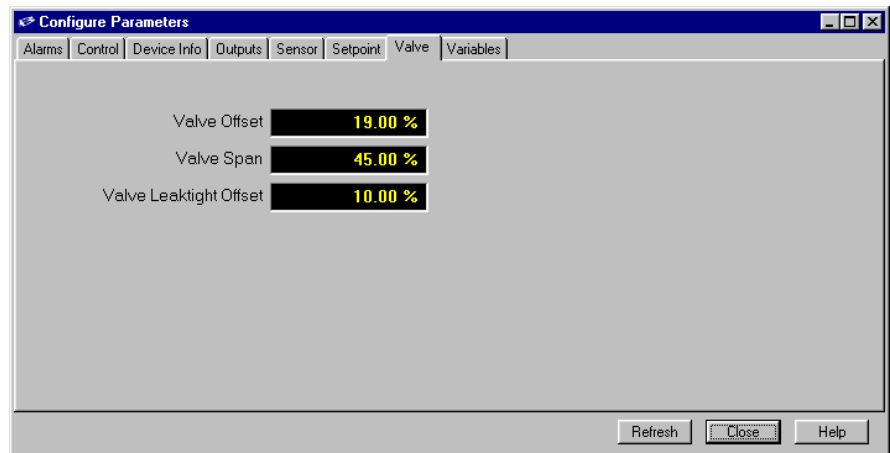**To save the current device configuration settings,** open the **File** menu and choose **Save Device Config**. The Save Device Configuration File window displays.
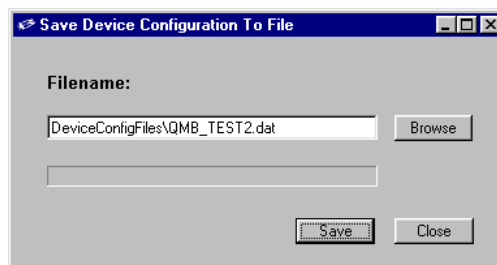
To accept the default file name and directory, click the **Save** button. You can also change the file path and name by editing the file name field entry, or by clicking the **Browse** button to display a Save As dialog box.

5.11 Restoring a Saved Device Configuration

You can restore any previously saved device configuration.

To restore a saved current device configuration, open the **File** menu and choose **Restore Device Config**. The Restore Device Configuration File window displays.
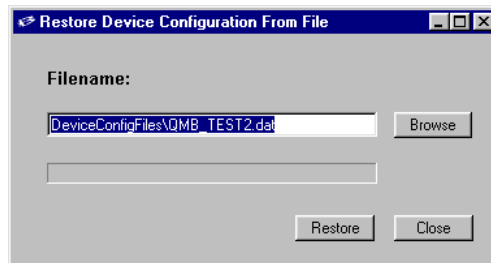
You can enter the file path and name in the file name field or, to select the desired file, click the **Browse** button to display an Open dialog box. Once you have specified the file path and name, click the **Restore** button to restore the configuration from that file.

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Section 6 - Diagnostics

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6 Diagnostics

This section describes how to:

• View the current state of the device's warning/alarm conditions and diagnostic results

• Test that the device is correctly reading its input (setpoint), and correctly setting its primary and secondary outputs

• Capture device logging to a file

6.1. Checking the Warning, Alarm, and Diagnostic Status

The Service Tool monitors the warning or alarm status for all of the data variables to which an alarm can be assigned. The Service Tool also reports on the status of the device diagnostics, which run continuously.

To view the current state of warning/alarm conditions and diagnostic results, open the **Diagnose** menu and choose **Alarm Status**. The Alarms and Diagnostics window opens.

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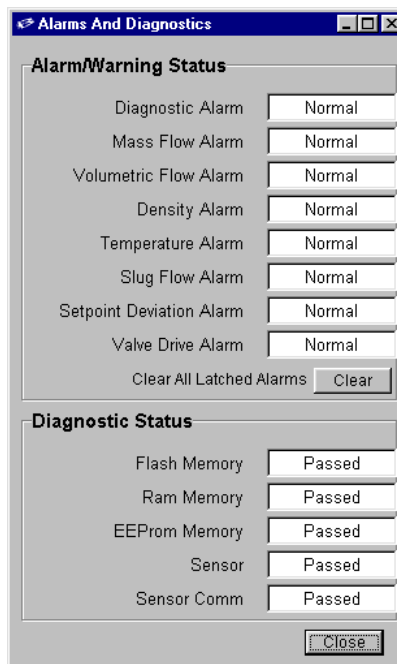
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6.1.1 Clearing Latched Warning and Alarm Conditions

As described in "5.2.2 Configuring Optional Warnings and Alarms" on p. 5-4, a Latching option can be set for a variable's warning/alarm configuration. If latching is enabled for the variable and a warning/alarm condition occurs, the warning/alarm condition will persist even if the condition goes away. However, if you know that it is safe to operate the device, you may want to clear the latched warning/alarm condition.

To clear all latched warning and alarm conditions, click the **Clear** button in the Alarms and Diagnostics window.

6.2. Testing the Primary and Secondary Outputs

You can use the diagnostic Testing Outputs function to verify that the device is correctly setting its primary and secondary outputs.

Prior to using the Service Tool to test the output, you must connect a digital multimeter (DMM) to the output signal to measure the true output reading. Figures 6-1 through 6-3 show how to set up the DMM for the available output type configurations. Note that the secondary output type can be only current.

Note that all of the D-connector pin-outs are listed in "3.3 Device D-Connector Pin-Outs" on p. 3-7.
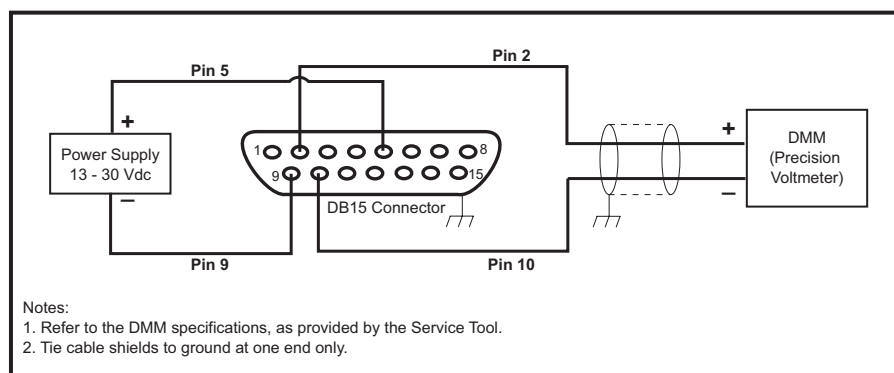
Figure 6-1 Setup for Testing Primary Output Voltage

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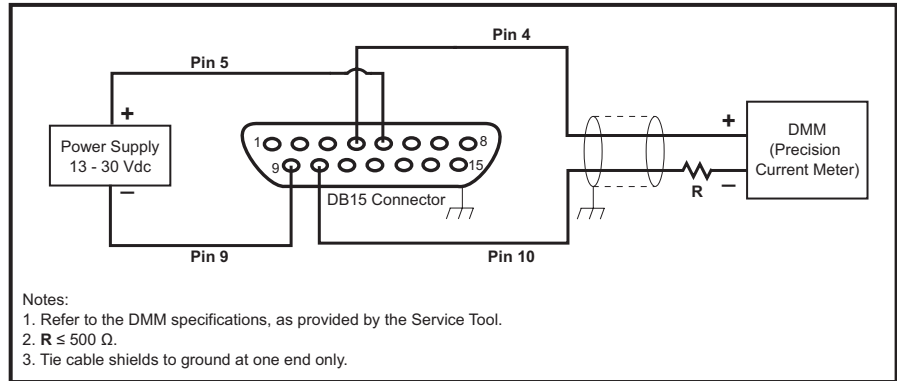
Figure 6-2 Setup for Testing Primary Output Current
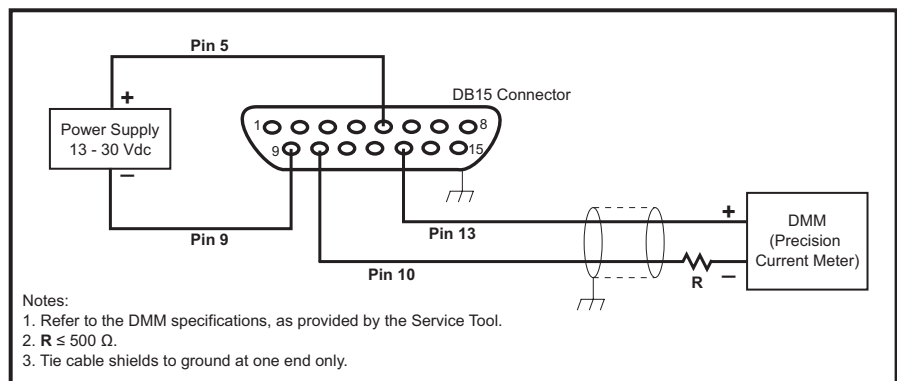
Figure 6-3 Setup for Testing Secondary Output Current

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To test an output:

1.   Open the **Diagnose** menu and choose **Test Outputs>Primary Outputs** or **Test Outputs>Secondary Outputs**.

The Test Output window opens. The following screen sample shows the Test Output window for the primary output, using current.
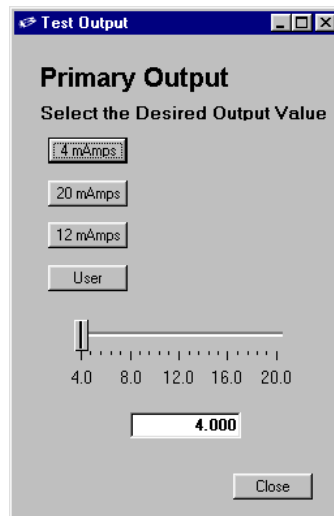
2.   Change the device's output value by:

 •   Clicking one of the preset value buttons, or

 •   Clicking the **User** button, which enables the slider, and choosing a value with the slider.

Regardless of which method you choose, the selected value is shown in the field at the bottom of the window. This is the value at which the Service Tool is telling the device to set its output.

3.   Verify whether the DMM shows the same value as set using the Service Tool.

4.   Try a few additional values to check that the output is correct.

If the DMM reading does not match the value being set in the Test Output window, the device's output may need to be calibrated. Refer to "7.2.6 Calibrating the Primary and Secondary Outputs" on p. 7-28.

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6.3. Testing the Input (Setpoint)

You can use the diagnostic Testing Inputs function to verify that the device is correctly reading its input (setpoint) value.

Prior to using the Service Tool to test the setpoint, you must connect a DMM to the device's setpoint signal to measure the true reading. Figures 6-4 and 6-5 show how to set up the DMM for the available input types.

Note that all of the D-connector pin-outs are listed in "3.3 Device D-Connector Pin-Outs" on p. 3-7.

Notes:
1. Refer to the DMM specifications, as provided by the Service Tool.
2. Tie cable shields to ground at one end only.
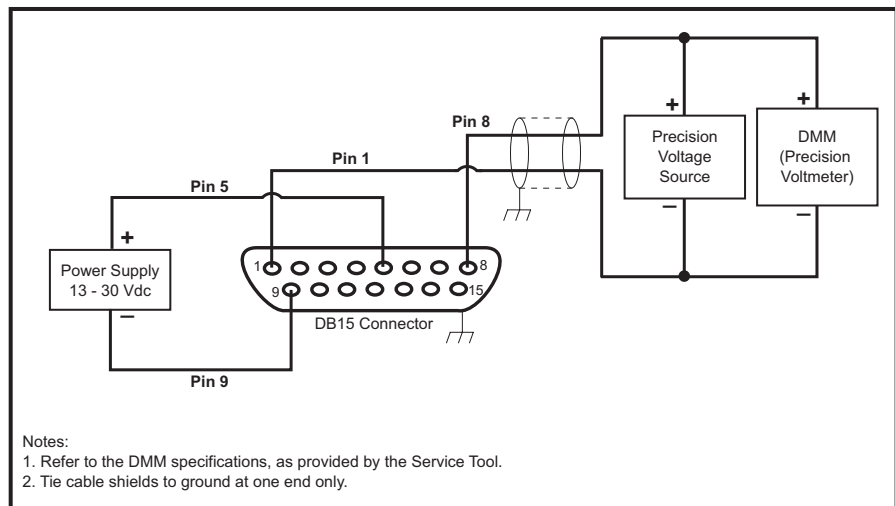
Figure 6-4 Setup for Testing Voltage Setpoint

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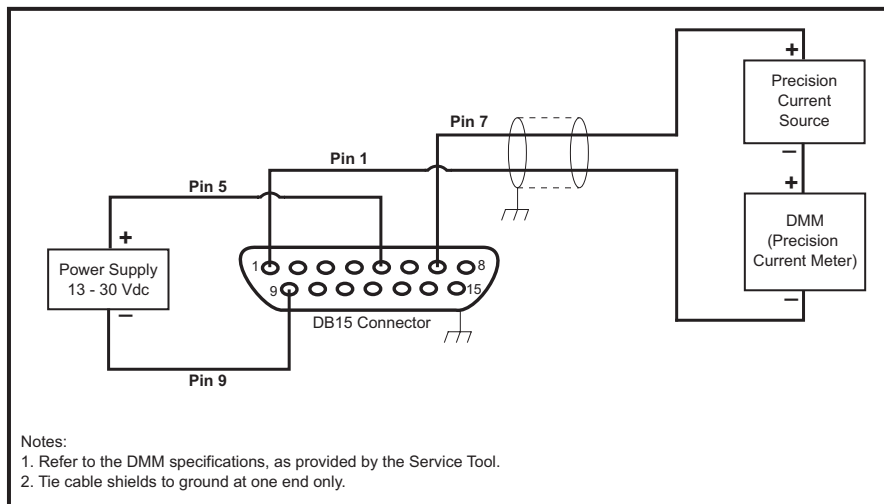
Figure 6-5 Setup for Testing Current Setpoint

To test the device's setpoint reading:

1.   Open the **Diagnose** menu and choose **Test Inputs>Setpoint**.

The Test Inputs window opens.
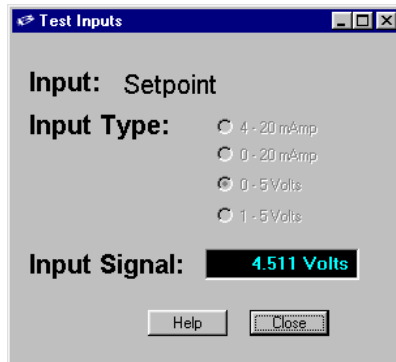
2.   *For the QUANTIM QMA*, select the appropriate input type.

For the QUANTIM QMB, the Service Tool reads the input type and automatically selects it. This selection is read-only.

The device's reading of the setpoint is displayed in the **Input Signal** field.

3.   Verify whether the DMM shows the same value as that shown for the device value in the **Input Signal** field.

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NOTE:

Input signals below the level defined by the Setpoint Low Signal Cutoff parameter will be shown as 0 V or 4 mA.

4. Try a few additional setpoint values by changing the setpoint from the input source, and verify that the value in the **Input Signal** field reflects those changes.

If the DMM reading does not match the value in the Input Signal field, the device's setpoint may need to be calibrated. Refer to "7.2.5 Calibrating the Device Input (Setpoint)" on p. 7-24.

6.4 Capturing Device Log Data to a File

You can capture the device's log data to a file. The log includes entries for all process variables currently displayed in the trend graph, captured at a rate specified by the user.

Note that you can use the main window's Options function to determine which variables are being graphed and, hence, logged. Also, the units and precision of the data placed into the log are controlled by the Units of Measure tab in the Options window. For more information about the Options function, refer to "4.3 Setting the Main Window Options" on p. 4-5.

To save the log data to a file, open the **Diagnose** menu and choose **Data Log**. The Data Log Configuration window displays. From this window, you can perform the functions described in Table 6-1.

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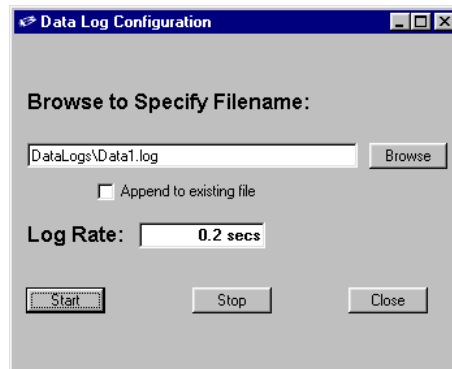
Table 6-1 Data Log Configuration Window Functions

Function	Description
Specify the file name and path	You can change the file name from the default entry by editing the entry in the file name field, or by clicking the **Browse** button to open a Save As dialog box.
Append log entries to the file	Select this option if you want the Service Tool to add new log entries to an existing file, specified in the file name field.
Specify the log rate	Enter the rate, in seconds, at which you want the log file to be updated with an entry.
Start logging	Click the **Start** button to start saving log entries to the specified file.
Stop logging	Click the **Stop** button to stop saving log entries to the specified file.

A sample listing of a log file is shown below.

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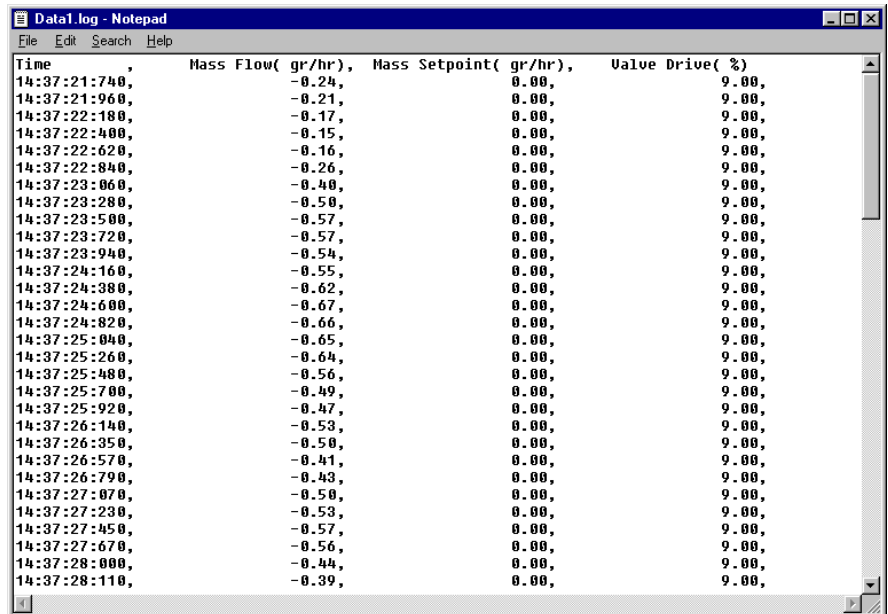
6.4.1 Importing a Data Log File into Excel

The data log file is stored in a comma-delimited (*.csv) compatible format, so it can be easily imported into Excel.

To import a data log file into Excel:

1. In Excel, open the **Find** menu and choose **Open**.
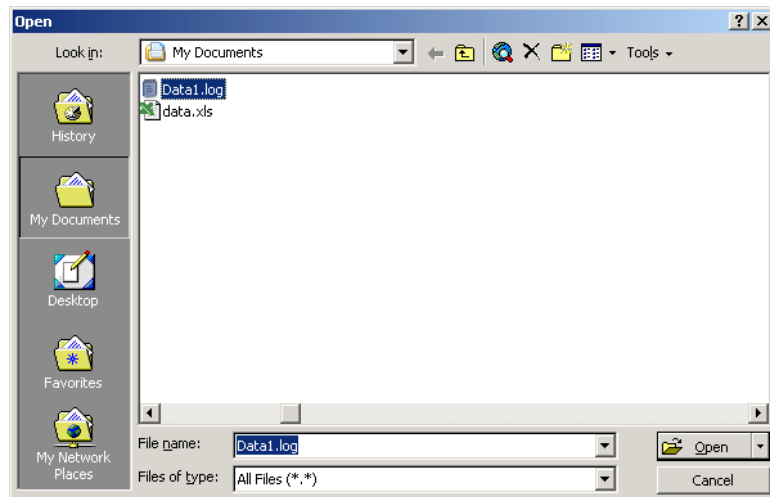
2. Navigate to and open the data log file.

   The Text Input wizard opens.

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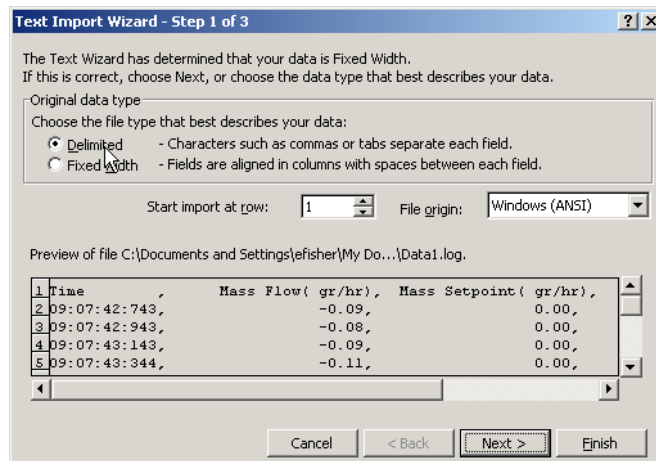
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3. In the **Original data type** panel, select the **Delimited** option, then click the **Next** button.

Step 2 of the wizard displays.
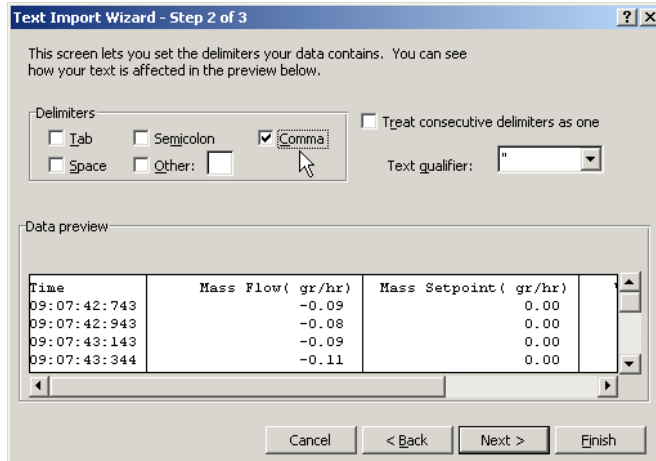
4. In the **Delimiters** panel, select the **Comma** option, then click the **Next** button.

In the Step 2 screen, the data log content is previewed based on your delimiter choice.

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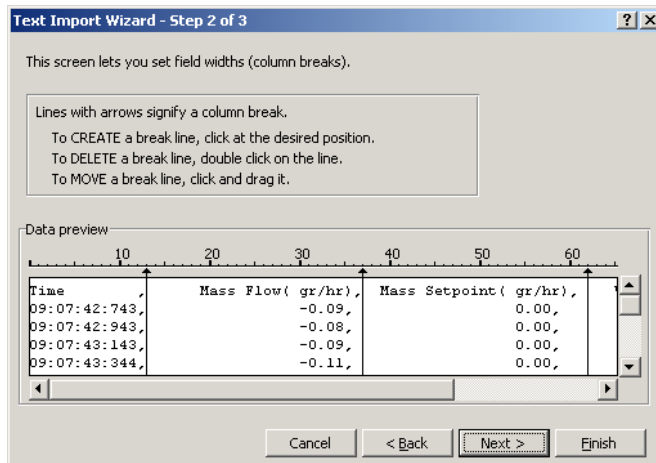
5.   Verify that the data log contents have been logically separated into columns, then click the **Next** button.

Step 3 of the wizard displays.
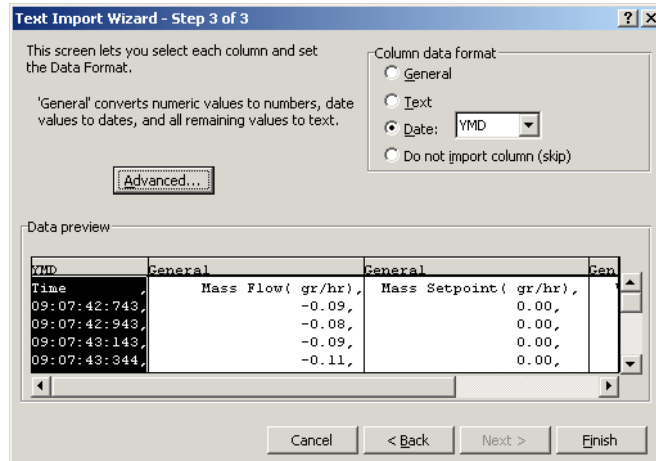
6.   Click the **Finish** button.

The data log file content is opened as an Excel spreadsheet.

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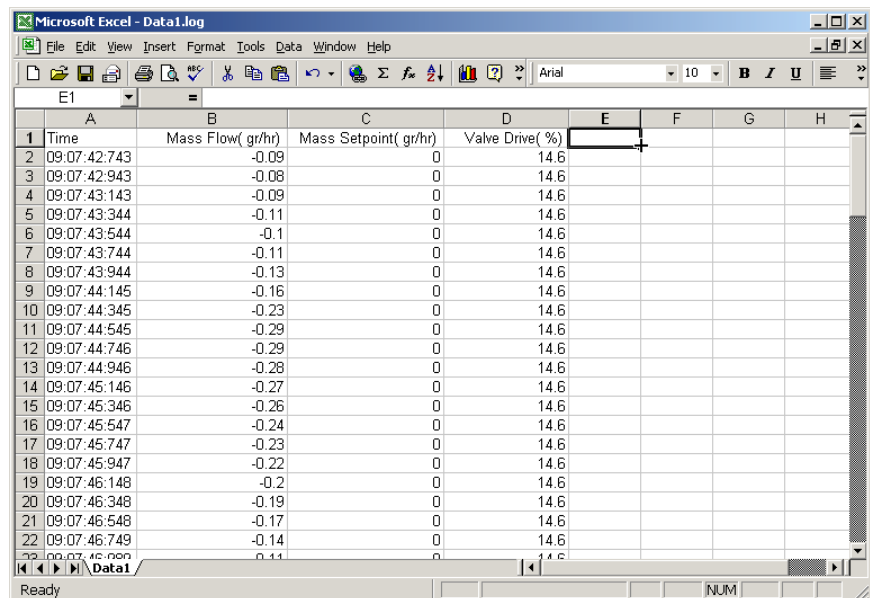
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You can now use Excel to analyze the data (for example, using the chart function as shown below), and save the data in a variety of formats, including the native Excel (*.xls) format.

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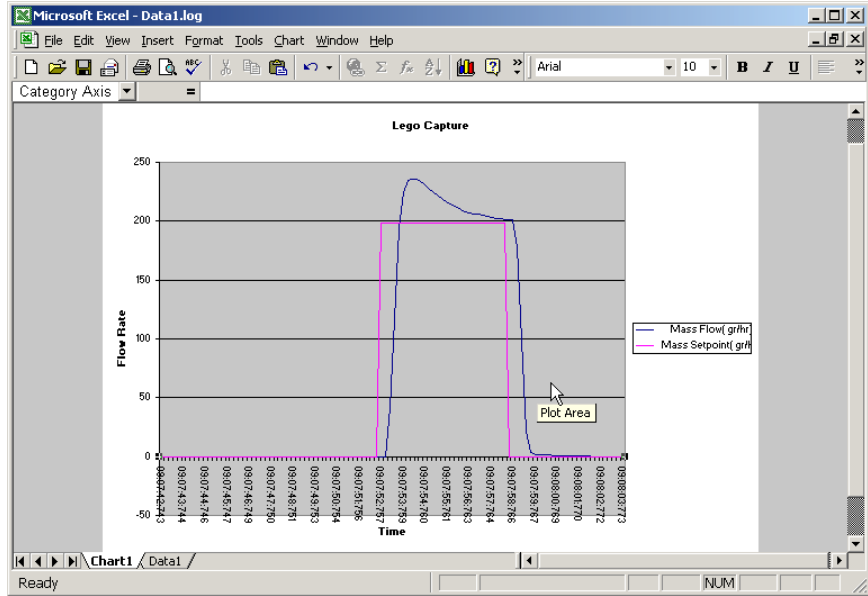
7 Troubleshooting, Tuning, and Calibration

This section provides troubleshooting strategies for responding to device alarms and problem conditions. It also includes procedures for using the Service Tool to make adjustments to the device operation to ensure optimum performance and to correct certain conditions.

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7.1 Troubleshooting Strategies

Tables 7-1 through 7-3 list probable causes and suggest corrective actions for responding to the device's Status and Alarm LEDs, startup problems, and problems that occur during operation of the device.

Table 7-1 LED Indications

LED Condition	Causes	Corrective Action
Status LED solid red, Alarm LED flashes red (flash code 7)	Device diagnostics has detected a critical fault. Device is in its safe state.	1. Use the Service Tool's Alarms and Diagnostics function to view which diagnostic test detected the critical fault. Refer to "6.1. Checking the Warning, Alarm, and Diagnostic Status" on p. 6-1. 2. Check for external vibrations that could be interfering with the sensor frequency. 3. Check for excessive bubbles in the process line. 4. When condition is corrected, recycle power to the device to clear the alarm.
Status LED solid green, Alarm LED flashes red	Alarm condition for a customer-configured fault. For example, flow or density is out of the specified range. Flash code indicates the data parameter that is out of range. Customer-configured alarm conditions do not cause device to enter safe state.	1. Read the Alarm flash code, which indicates the parameter that is out of range. OR Use the Service Tool's Service Tool's Alarms and Diagnostics function to see what parameter is out of range. Refer to "6.1. Checking the Warning, Alarm, and Diagnostic Status" on p. 6-1. 2. Determine what caused the parameter to be out of range, and correct the condition. 3. If alarm is latched (that is, does not clear when condition is corrected), use the **Clear Latches** button in the Service Tool's Alarms and Diagnostics window to clear the alarm.
Status LED solid green, Alarm LED flashes green	Warning condition for a customer-configured fault. For example, flow or density is out of the specified range. Flash code indicates the data parameter that is out of range. Customer-configured warning conditions do not cause device to enter safe state.	1. Read the Alarm flash code, which indicates the parameter that is out of range. or Use the Service Tool's Service Tool's Alarms and Diagnostics function to see what parameter is out of range. Refer to "6.1. Checking the Warning, Alarm, and Diagnostic Status" on p. 6-1. 2. Determine what caused the parameter to be out of range, and correct the condition. 3. If warning is latched (that is, does not clear when condition is corrected), use the **Clear Latches** button in the Service Tool's Alarms and Diagnostics window to clear the warning.

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Table 7-2 Common Start-Up Problems

Condition	Possible Causes	Corrective Action
Clogged valve orifice	Particulates in flow stream, causing agglomeration of fluid or chemical deposits at the orifice. Particulates can exist if the process chemical was not properly purged before storage, or if the process fluid is not adequately filtered.	• Use an inlet filter. • Consider using a larger orifice (although valve stability could suffer). • Institute regular preventive maintenance back flushing. • Flush the device before shutting it down.
Oscillating mass flow output	1. High-pressure push gas is causing bubbles to dissolve in the fluid. Bubbles then form at the valve due to pressure drop, upsetting valve operation.	Use helium as a push gas, with 25- to 50-ft of Teflon tube. Helium is a light gas and can permeate the Teflon tube to release bubbles.
	2. The piston action of the fluid pump is causing pressure oscillations, upsetting valve operation.	Use pressure regulators on the device's inlet and outlet to stabilize pressure variations.

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Table 7-3 Common Operating Problems

Condition	Possible Causes	Corrective Action
Valve will not open, no full scale flow	1. Pressure differential (Delta P) is too low, causing reduced full-scale flow.	Make sure that the device is being operated within its specified conditions, specifically, that the pressures are correct.
	2. The orifice is dirty or clogged, causing flow restriction.	1. Use Valve Override to open the valve; this can clear some clogs (refer to "7.2.3 Using Valve Override to Control the Valve Opening" on p. 7-20). You should achieve 110% flow at the correct operating conditions. 2. With the valve open, try reverse flow with a pressure up to 100 psi. 3. Use a cleaning agent or N2 to clean the orifice.
	3. Analog setpoint source is incorrectly calibrated.	Use the Service Tool's manual setpoint control to verify the valve operation (refer to "4.4 Putting the Service Tool in Indicator or Control Mode" on p. 4-8). If the valve works properly, then the analog setpoint source could be incorrectly calibrated. Check the analog source signal; refer to "6.3. Testing the Input (Setpoint)" on p. 6-5.
	4. Incompatible fluids are causing valve seat to swell.	Make sure that the device is being operated within its specified conditions, specifically, the compatibility of your process fluid against the valve seat material used in your device.
Valve will not close or achieve complete shutoff	1. Device is being used inappropriately as a shutoff valve.	The mass flow device is a control valve, and is not designed as a shutoff valve. Some minor leak-by may be acceptable (see your device's specification). Use a shutoff valve for positive shutoff.
	2. Device is not mounted properly.	Make sure the device is mounted in the attitude defined in its specification.
	3. Delta P is incorrect.	Make sure that the device is being operated within its specified conditions, specifically, that the pressures are correct.
	4. Flow might be allowable leak-by.	Use Valve Override to close the valve (refer to "7.2.3 Using Valve Override to Control the Valve Opening" on p. 7-20). There should be less than 1% leak-by (check the device's specifications for exact leak-by tolerance).
	5. Analog setpoint source is incorrectly calibrated.	• Use the Service Tool's manual setpoint control to verify the valve operation (refer to "4.4 Putting the Service Tool in Indicator or Control Mode" on p. 4-8). If the valve works properly, then the analog setpoint source could be incorrectly calibrated. • Check the analog source signal; refer to "6.3. Testing the Input (Setpoint)" on p. 6-5. • The Setpoint Low Signal Cutoff parameter may not be set correctly for the application.

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Table 7-3 Common Operating Problems (cont.)

Condition	Possible Causes	Corrective Action
Valve will not close or achieve complete shutoff *(Cont.)*	6. Flow is being indicated when there is no actual flow.	Close the device's downstream shutoff to make sure there is no flow. Open the device's valve to equalize the pressure. If there is still a flow signal, re-zero the meter; refer to "7.2.1 Zeroing the Device's Sensor" on p. 7-7.
	7. Valve offset and span might need to be tuned.	Use the Service Tool's manual setpoint control to observe flow against the valve drive position (refer to "4.4 Putting the Service Tool in Indicator or Control Mode" on p. 4-8): • At the valve offset, there should be no flow. • At the valve offset + span, there should be 100% (fullscale) flow. If either of these conditions do not occur, try tuning the valve offset and span. Refer to "7.2.2.1 Tuning the Valve Offset and Span" on p. 7-10.
	8. There is contamination buildup at the edge of the orifice.	1. Use Valve Override to open the valve; this can clear some clogs (refer to "7.2.3 Using Valve Override to Control the Valve Opening" on p. 7-10). 2. With the valve open, try reverse flow with a pressure up to 100 psi. 3. Use a cleaning agent or N2 to clean the orifice.
Unstable control or oscillating flow	1. Incorrect Delta P.	Make sure that the device is being operated within its specified conditions, specifically, that the pressures are correct.
	2. The process fluid has bubbles.	Correct the condition that is causing the bubbles.
	3. Unstable pressures are affecting valve response.	Check to see if the pressures are unstable. Install upstream and downstream regulators if necessary.
	4. If a pump is being used to supply fluid, the pump is interfering with the device's control valve.	Use Valve Override to open the valve (refer to "7.2.3 Using Valve Override to Control the Valve Opening" on p. 7-20): • If the flow still oscillates, the pump could be causing the oscillation. Try installing a damping system to remove the effects of the pump. • If the flow oscillation stops, try tuning the valve offset and span, and the valve response. Refer to "7.2.3 Using Valve Override to Control the Valve Opening" on p. 7-10 and "7.2.2.3 Tuning the Valve Response (Proportional and Integral Gain)" on p. 7-18.

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Table 7-3 Common Operating Problems (cont.)

Condition	Possible Causes	Corrective Action
Flow does not match setpoint	1. Incorrect Delta P.	Make sure that the device is being operated within its specified conditions, specifically, that the pressures are correct.
	2. Input/output signals are not at expected levels.	1. Make sure the correct signal type is chosen: 0–5 V vs. 4–20 A. 2. Check the input/output signals against the device's Calibration Report. 3. Replace the outside analog control with a Brooks 0152i Power Supply and Control Module (and Brooks cable). Check to see if setpoint and flow match with the 0152i as the setpoint source. 4. Use the Service Tool's manual setpoint control and verify whether flow tracks the Service Tool's digital setpoint (refer to "4.4 Putting the Service Tool in Indicator or Control Mode" on p. 4-8). 5. Verify that the device is accurately reading its input signal and setting its output signals using the Service Tool's Diagnostics function. Refer to "6.2. Testing the Primary and Secondary Outputs" on p. 6-2 and "6.3. Testing the Input (Setpoint)" on p. 6-5.
	3. After new installation, wiring to device is not correct.	If device worked before the new installation but not after, verify that the wiring to the device was installed properly.

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7.2 Device Tuning and Calibration Procedures

The Service Tool includes several functions, described in the following topics, that allow you to tune and calibrate the device:
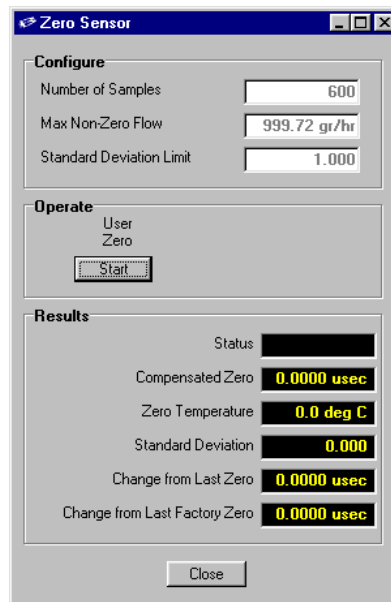
• Zeroing the sensor, to properly set the device to the no-flow state.

• Adjusting the valve offset, span, and response, to optimize the valve behavior during process conditions.

• Overriding the setpoint control of the valve, to fully open or close the valve when investigating the source of flow problems.

• Calibrating the device's input and output signals, to ensure that the device is accurately reading setpoint and sending its output signal.

7.2.1 Zeroing the Device's Sensor

The Service Tool's Zero Sensor function allows you to zero the device's sensor when there is a no-flow condition. The device also includes a Zero pushbutton that performs this same function.

7.2.1.1 Accessing the Service Tool's Zero Sensor Function

To open the Zero Sensor function in the Service Tool, open the **Tune** menu and choose **Zero Sensor**. The Zero Sensor window displays.

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Zero flow configuration values are shown in the read-only fields in the Configure panel.

Clicking the **Start** button begins the zero sensor process. The process takes about half a minute. When the zeroing completes successfully, the **Status** field will display "Passed."

7.2.1.2 Procedure for Zeroing the Sensor

To zero the device's sensor:

1. Allow the device to be powered on for 45 minutes so that it achieves its operating temperature.

2. Use the process gas or fluid.

3. Set the Valve Override to open to start flow through the device.

    For information on using the Valve Override, refer to "7.2.3 Using Valve Override to Control the Valve Opening" on p. 7-20.

4. If the process fluid is liquid, allow it to flow long enough to purge any air or gas bubbles from the lines and device.

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NOTE:
It may be necessary to cycle the Valve Override from open to closed to clear entrapped air bubbles. If the Valve Override control is not available, then cycle the setpoint between 0 and 100%. Refer to "7.2.4 Cycling the Setpoint" on p. 7-22.

5.   Close the downstream shutoff valve.

6.   Wait one or two minutes for the flow signal to drop to zero.

7.   Set the Valve Override to closed, make sure the setpoint is zero, and wait again for the signal stabilization.

 The device should be full of process gas or fluid with no pressure differential and no vibration.

8.   Using the Service Tool's Zero Sensor function or the device's Zero pushbutton, zero the device:

 If using the Zero Sensor function, click the **Start** button in the Zero Sensor window. The **Status** field will display "Passed" when the zeroing operation completes.

 If using the pushbutton, press the pushbutton until the device's Status LED flashes red, then release the pushbutton. A successful zeroing operation is indicated by the Status LED being a steady green.

The device will accept the zero command only when flow is equal to or less than 1% and there is no vibration. Otherwise, the operation will fail, and the Status LED will be a steady red. If using the Zero Sensor function, a failed indication will be displayed in the **Status** field of the Zero Sensor window. You will have to recycle power to the device to clear the alarm condition.

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7.2.2 Optimizing the Valve Behavior for Process Conditions

The Service Tool includes two functions, described in the following topics, that allow you to tune the valve to optimize its performance:

• Tuning the valve's offset (flow just starting, 1–2%) and span (at flow + span, flow just at fullscale, 100%).

• Adjusting the valve's response to make sure it is operating within its specification.

7.2.2.1 Tuning the Valve Offset and Span

Device performance can be affected by contaminants or pressure changes. Tuning the valve offset and span can help to optimize the valve response.

At process conditions with process flow:

• The valve **offset** value corresponds to the valve position (measured as a percentage from fully closed to fully open) at which flow just begins. The factory default is typically around 20%. See your device's settings for the actual offset value.

• The valve **span** value is used to determine the valve position—offset + span—at which flow is just at fullscale.

• The valve **leaktight** offset value corresponds to the valve position that guarantees no flow or leak-through at a setpoint of 0%.

NOTE:

The leaktight offset value is set at the factory for 10%. This is applied at zero setpoint to add extra preload to achieve better shutoff. Do not change this value.

All valve offset values are calibrated at the factory at the conditions specified on the device's order.
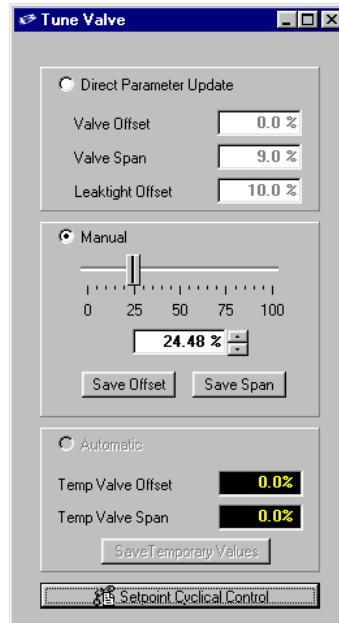
NOTE:

It is highly recommended that you use the Service Tool's Save Device Config function to save the device's current configuration before making any changes. This will allow you to restore a working configuration if the valve tuning results in incorrect settings or faulty operation. For more information, refer to "5.10 Saving the Current Device Configuration" on p. 5-17.

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You should first check to see whether the offset and span values require adjustment.

To check the offset and span values:

1. Open the **Tune** menu and choose **Valve**.

    The Tune Valve window opens.

2. Note the offset and span values in the Direct Parameter Update panel, and check whether they are the correct settings for your application.

3. Set inlet and outlet pressure conditions to match those specified on the device's order or on its Calibration Report.

4. In the Tune Valve window, select the **Manual** option to enable the valve control slider and increment/decrement field.

5. Starting at a value of zero, use the slider or increment button to slowly increase the valve value until flow begins. At the 1–2% flow rate, the valve value should be very close to the offset value shown in the Direct Parameter Update panel's **Valve Offset** field.

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6.   Continue to increment up until 100% flow is reached. The valve value should be equal to offset + span [for example, 20% (offset) + 15% (span) = 35% valve drive value].

 Allow time for flow to stabilize. It may drop slightly.

You should adjust the offset and span values if one of the following are true:

• The process conditions are now different from that specified on the device's order.

• The valve value that produces a flow rate of 1–2% does not match the current offset value in the Direct Parameter Update panel's **Valve Offset** field.

• The valve value that produces a flow rate of 100% does not match the current offset + span values in the Direct Parameter Update panel's **Valve Offset** and **Valve Span** fields.

To adjust the offset and span values:

1.   Set inlet and outlet pressure conditions to your process or application specs.

2.   In the Tune Valve window, select the **Manual** option to enable the valve control slider and increment/decrement field.

3.   Starting at a value of zero, use the slider or increment button to slowly increase the valve value until flow begins. Make sure you have stopped at 1-2% flow.

NOTE:
Do not overshoot and then decrease the valve value to locate the offset position. Because of valve hysteresis, you must start at zero and find the offset value only by increasing up from zero.

4.   Press the **Save Offset** button to save the new offset value.

 You can also manually enter a new offset value by selecting the **Direct Parameter Update** option, entering the value in the **Valve Offset** field, and pressing the Enter key.

5.   Once the offset value is determined and set, continue to slowly increment the valve value. As flow rate approaches 100%, go slowly until 100% is achieved.

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6. Allow flow rate to stabilize. When the flow rate has stabilized, press the **Save Span** button to save the new span value.

You can also manually enter a new span value by selecting the **Direct Parameter Update** option, entering the value in the **Valve Span** field, and pressing the Enter key.

7. Manually adjust the valve to determine whether or not the newly saved offset and span values produce the desired flow rates, that is, 1–2% with the valve drive at offset, and 100% with the valve drive at offset + span.

7.2.2.2 Cleaning the Orifice for a QUANTIM QMA

The QUANTIM QMA has a removable orifice. If the device has become clogged, or you suspect that contamination is interfering with the valve's function and performance, you can remove the orifice for cleaning.

Prior to performing the cleaning procedure, observe the following restrictions and guidelines:

• The QUANTIM QMA is a metal sealed device. Never loosen or remove the QUANTIM QMB assembly bolts. This will compromise the seal integrity.

• Opening the QUANTIM body will void the warranty.

• The QUANTIM valve is a control valve and is not designed as a shutoff valve. Installation of a shutoff valve on the outlet of the device is recommended to achieve positive shutoff.

• Due to small orifice sizes, filters are highly recommended on the inlet to prevent contamination from entering the device.

• Sometimes a swelled valve seat will result in no flow response to a setpoint. Incompatible fluids can cause a seat to swell enough to affect valve control. Check the compatibility of your process fluid against the valve seat material used in your device.

• Before removing the orifice, try cleaning or removing possible clogs by using reverse flow with an inert gas such as nitrogen and the valve fully open using the Valve Override control (refer to "7.2.3 Using Valve Override to Control the Valve Opening" on p. 7-20). Do not use reverse flow pressures higher than 100 psi.

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• It is highly recommended that you use the Service Tool's Save Device Config function to save the device's current configuration before making any changes. This will allow you to restore a working configuration if the valve tuning results in incorrect settings or faulty operation. For more information, refer to "5.10 Saving the Current Device Configuration" on p. 5-17.

7.2.2.2.1 Removing and Cleaning the QUANTIM QMA's Orifice

To remove and clean the QUANTIM QMA's orifice:

1. Locate and remove the external fitting on the outlet side of the device.

NOTE:
Do not remove the body end block.

Remove this fitting
to access orifice

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2.   Insert a 2-mm Allen key into the outlet port until it seats into the orifice.
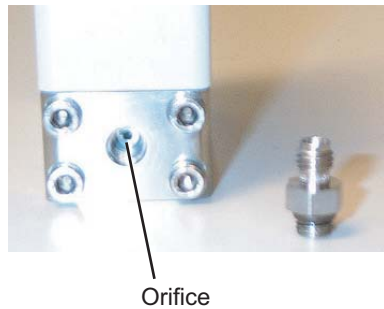
Orifice

3.   Unscrew the orifice until it is removed from the device body.

4.   Clean the orifice with a compatible fluid and clear it with pressurized air or N2.

7.2.2.2.2 Reinstalling the Orifice and Checking the Valve Offset and Span Values

The removal and reinstallation of an orifice in the QUANTIM QMA is very delicate and requires some patience to return the device to factory specifications.

1.   Turn off the inlet shutoff for no flow.

2.   In the Service Tool, open the **Tune** menu and choose **Valve**.

The Tune Valve window opens.

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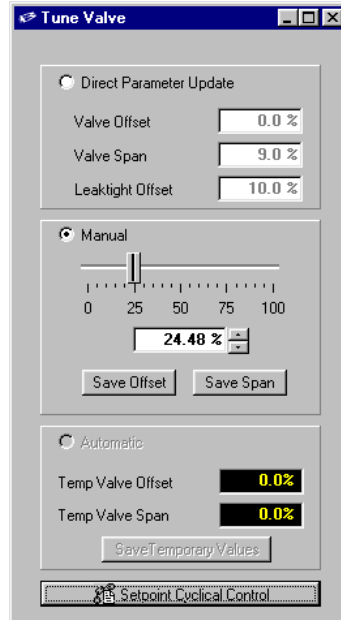
3. Note the offset and span values in the Direct Parameter Update panel.

4. Select the **Manual** option to enable the valve control slider and increment/decrement field.

5. Use the slider or increment button to set the valve drive value to the offset value.

6. Insert the orifice into the device outlet.

7. Turn the orifice using a 2-mm copper beryllium Allen key (nonmagnetic) from the factory until it bottoms out.

NOTE:

You can use a 2-mm steel Allen key, but you will have to remove it after each adjustment to see accurate valve position values, as a steel key will affect the magnetism within the valve.

8. Turn on the inlet process fluid.

9. Adjust for the specified Delta P as stated on the device's Calibration Report.

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10.   Turn the orifice counterclockwise until flow starts, then turn the orifice clockwise until flow goes back to zero.

This is a very fine adjustment. After each adjustment, remove the Allen key and allow some time for the signal to stabilize at a given flow rate. The point is to adjust the orifice slowly until the flow just gets to zero

11.   Repeat the orifice adjustment until you just achieve shutoff at the offset value.

12.   Increment the valve drive value until you get 100% fullscale flow.

The valve value at 100% fullscale flow should be offset + span [for example, 20% (offset) + 15% (span) = 35% valve drive value].

If the valve value at 100% flow is 10% greater than the original offset + span value (that is, based on the offset and span values in the Direct Parameter Update panel), then the orifice is probably in too tight. Readjust the orifice.

13.   When you have completed the orifice adjustments, change the valve drive value to achieve 100% flow, then back to 0 flow, to verify that there is fullscale flow at close to the offset + span value and shutoff at the offset value.

NOTE:

The leaktight offset value is set at the factory for 10%. This is applied at zero setpoint to add extra preload to achieve better shutoff. Do not change this value.

14.   Finally, control the device with a setpoint. Monitor the setpoint, flow, and valve drive value.

Assuming that the current process conditions match the factory calibration process conditions for the device, you should get fullscale flow at around the factory-set offset + span value. DO NOT change the span value. The valve will open to where it needs to achieve fullscale flow.

For example, for the following factory-set values:

Offset value = 20%
Span value = 8%

At a valve value of 20% you should get shutoff, and at a valve value of 28% you should get 100% flow.

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The actual valve value to achieve fullscale flow may be a couple of percentage points higher than the factory-set span value. This is acceptable. However, if the actual span value is more than 10% higher than the factory-set value, then you may want to adjust the orifice counterclockwise slightly. Do not change the span value to correct for a misadjusted orifice.

At the setpoint setting of 0%, the valve value will be offset minus the leaktight offset (for example, 20% – 10% = 10%).

7.2.2.3 Tuning the Valve Response (Proportional and Integral Gain)

The proportional and integral gain settings control the rate at which the valve responds to changes in setpoint. You can adjust these values to tune the valve's response.

When tuning the valve response, you will use the Cycle Setpoint function to cycle the valve opening between two selected setpoint values. You will then use the trend graph to check that the valve's response time is within specification, making adjustments accordingly.

To tune the valve response:

1. Make sure the trending graph can display the range of setpoints between which you want to cycle. For more information about setting the maximum and minimum setpoints displayed on the trend graph, refer to "4.3 Setting the Main Window Options" on p. 4-5.

2. Open the **Tune** menu and choose **Response**.

The Tune Response Form window opens.

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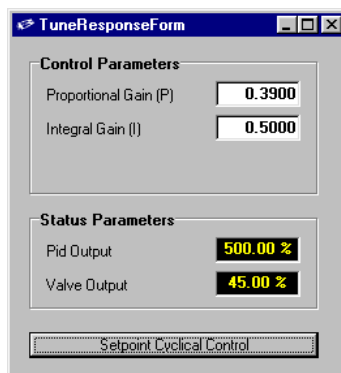
3. Click the **Setpoint Cyclical Control** button (or open the **Control** menu and choose **Cycle Setpoint**).

The Cycle Setpoint window opens.
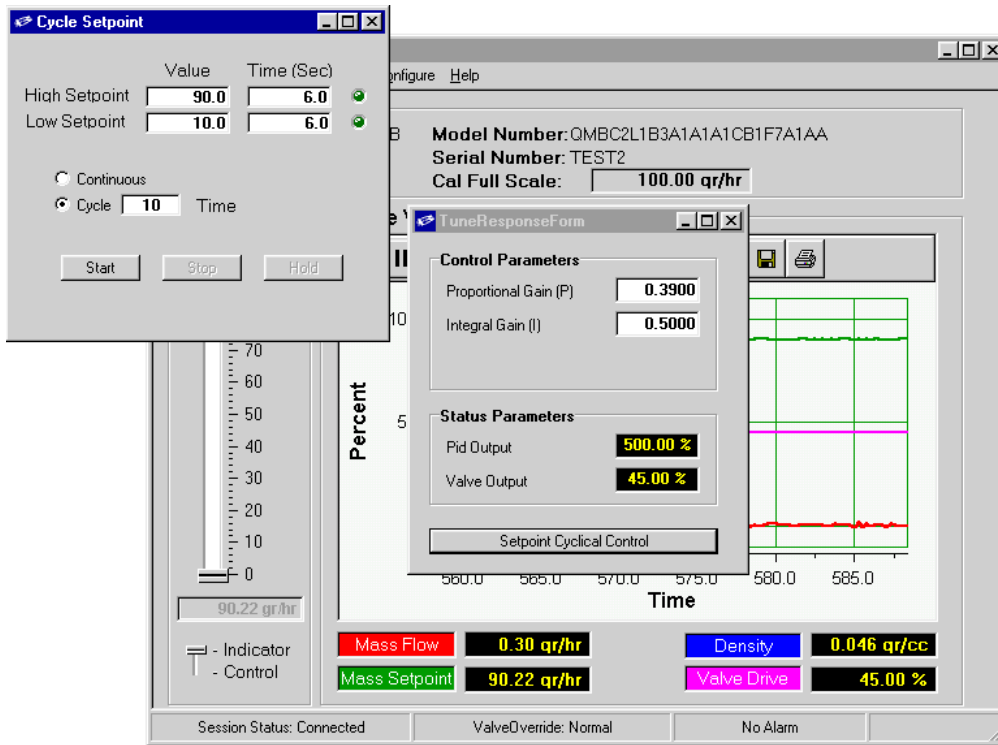
4. Use the fields in the Cycle Setpoint window to establish the cycling condition you want to use:

- Enter the upper setpoint value (in flow units) and cycle time (at least 6 seconds) in the **High Setpoint** fields.

- Enter the lower setpoint value (in flow units) and cycle time (at least 6 seconds) in the **Low Setpoint** fields.

- Select the **Continuous** option to have the cycling continue until you manually stop it, or enter the number of cycles in the **Cycle** field.

5. When you have completed entering the cycling conditions, click the **Start** button to start the cycling process.

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6.   Observe the mass flow and valve drive graph to see how well the valve is responding to the changes in the setpoint.

   In general, flow response should be as fast as possible with minimum overshoot (less than 5%).

7.   If the valve response needs tuning, go to the Tune Response Form window and change the Proportional Gain and Integral Gain values until the valve response is satisfactory.

When adjusting the Proportional and Integral Gain values in the Tune Response Form window, observe the following guidelines:

• Increasing the proportional gain value and/or decreasing the integral gain value speeds up the response time. Conversely, decreasing the proportional gain value and/or increasing the integral gain value slows the response time.

• The Proportional Gain value is nominally 0.6. The Integral Gain value is nominally 0.2. To achieve the desired flow response, first adjust the Proportional Gain value in 0.1 increments, and then adjust the Integral Gain value in 0.05 increments.

7.2.3 Using Valve Override to Control the Valve Opening

You can use the Valve Override (VOR) control to override the setpoint and control the opening of the valve. Valve Override is available by:

• Applying an input signal to pin 12 of the device's 15-pin D-connector

   or

• Using the Service Tool's Valve Override

The following two topics explain both of these methods.

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7.2.3.1 Using Pin 12 to Control the Valve Override

Pin 12 of the device's 15-pin D-connector is a valve override input:

• Grounding pin 12 causes the device to go into VOR Closed.

• Applying a voltage greater than 5 V causes the device to go into VOR Open.

• Applying a voltage from 1 to 3 V causes the device to go into VOR Normal (device tracks setpoint). Note also that simply applying no connection (or "floating") pin 12 of the D-connector will produce the same result.

Note that an input signal to pin 12 takes precedence of the Service Tool's Valve Override function. If the device is in VOR Open or VOR Closed due to the signal at pin 12, then in the Service Tool:

• The status message "Analog Override Active" will appear at the top of the Valve Override Control window

• The Valve Override Control buttons will not change

• The Valve Override in the Status Bar is the actual state of the device

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7.2.3.2 Using the Service Tool's Valve Override Function

To use the Service Tool's Valve Override control, open the **Control** menu and choose **Valve Override**. The Valve Override Control window opens.

```
Valve Override Control                    _ □ ✕

 ┌─Valve Override Control──────────────┐
 │  ● Normal (Tracking)                │
 │  ○ Closed                           │
 │  ○ Open                             │
 │  ○ Manual Control                   │
 └─────────────────────────────────────┘

 ┌─Manual Valve Control────────────────┐
 │  │                                   │
 │ ╟┼┼┼┼┼┼┼┼┼┼┼┼┼┼┼┼┼┼┼┼              │
 │  0    25   50   75   100            │
 │         ┌────────┐ ▲               │
 │         │ 0.00 % │ ▼               │
 │         └────────┘                  │
 └─────────────────────────────────────┘

 ┌─Actual Valve Output─────────────────┐
 │        45.00 %                      │
 └─────────────────────────────────────┘
```
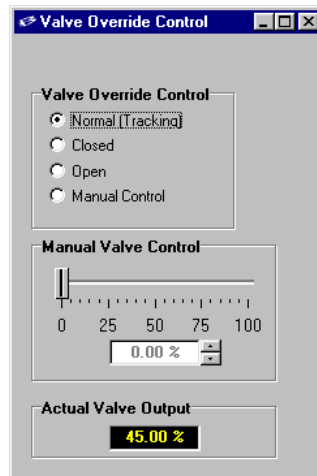
Set the valve position by:

• Clicking one of the preset value buttons—**Normal** (tracks setpoint), **Closed**, or **Open**.

  or

• Clicking the **Manual** button and choosing a value using the slider or the increment/decrement buttons, or by entering the value in the field next to the increment/decrement buttons and pressing the Enter key.

  Regardless of which method you choose, the selected value is shown in the field below the slider, and reflected in the valve drive graph.

7.2.4 Cycling the Setpoint

The Cycle Setpoint function allows you to cycle the setpoint between low and high values that you define. You may need to do this to purge air or gas bubbles from the lines and device. You also use the Cycle Setpoint function when tuning the valve response, as described in "7.2.2.3 Tuning the Valve Response (Proportional and Integral Gain)" on p. 7-18.

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To cycle the setpoint:

1. Open the **Control** menu and choose **Cycle Setpoint**.

    The Cycle Setpoint window opens. (Note that, when tuning the valve, you can access the Cycle Setpoint window by clicking the **Setpoint Cyclical Control** button in the Tune Response Form window.)
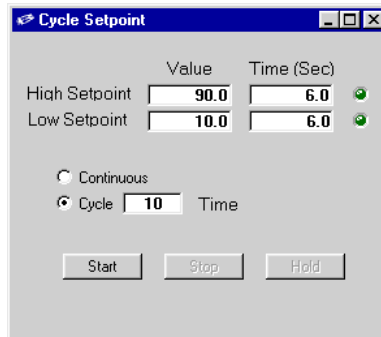
2. Use the fields in the Cycle Setpoint window to establish the cycling condition you want to use:

    •   Enter the upper setpoint value (in flow units) and cycle time (at least 6 seconds) in the **High Setpoint** fields.

    •   Enter the lower setpoint value (in flow units) and cycle time (at least 6 seconds) in the **Low Setpoint** fields.

    •   Select the **Continuous** option to have the cycling continue until you manually stop it, or enter the number of cycles in the **Cycle** field.

3. When you have completed entering the cycling conditions, click the **Start** button to start the cycling process.

    The trend graph should show the flow cycling between the values you specified.

With the setpoint cycling, you can:

• Suspend the cycling by clicking the **Hold** button.

• Stop the cycling by clicking the **Stop** button.

• Restart the cycling by clicking the **Start** button.

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7.2.5 Calibrating the Device Input (Setpoint)

You calibrate the device's input to ensure that the device is accurately reading the setpoint from the analog control.

Prior to using the Service Tool to calibrate the device input, you must connect a digital multimeter (DMM) to the device's setpoint signal, which you will use to verify the actual signal level. Figures 7-1 and 7-2 show how to set up the DMM for the available input types.

Note that all D-connector pin-outs are listed in "3.3 Device D-Connector Pin-Outs" on p. 3-7.
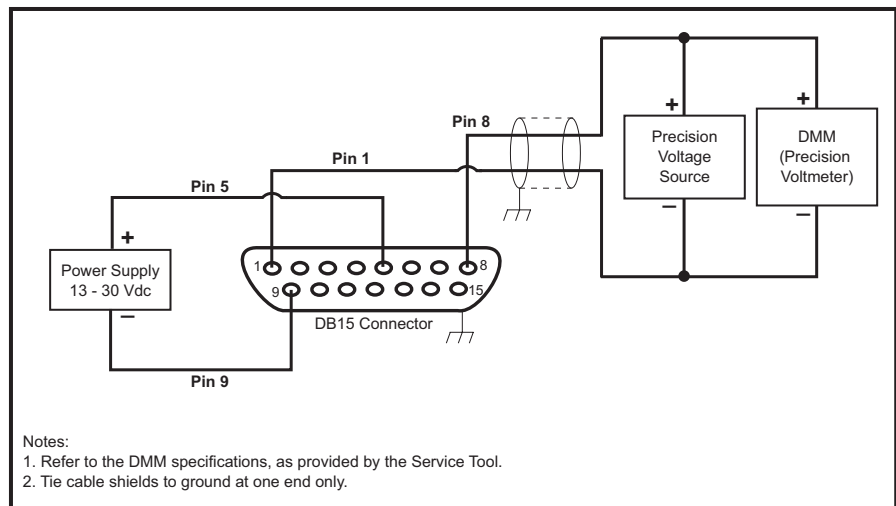
Figure 7-1 Setup for Calibrating to a Voltage Setpoint

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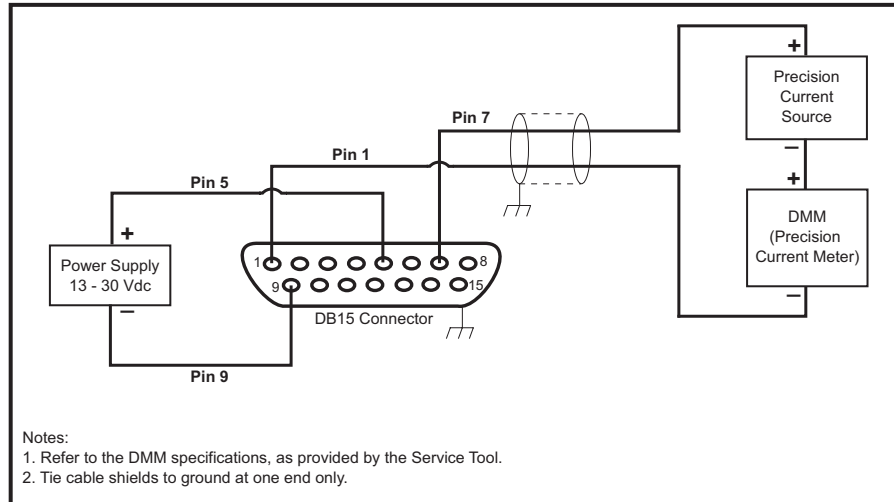
Figure 7-2 Setup for Calibrating to a Current Setpoint

To calibrate the device's input:

1. Open the **Tune** menu and choose **Calibrate Inputs**.

   The Calibrate Input Wizard opens.
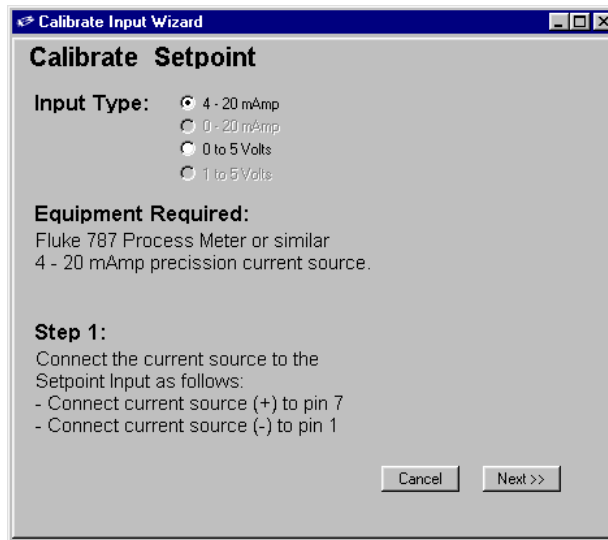
2. *For a QUANTIM QMA*, select the appropriate input type.

   For a QUANTIM QMB, the Service Tool reads the input type and automatically selects it. This selection is read-only.

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3.   Make sure that the DMM is set up as instructed in Step 1 of the wizard (and shown in Figure 7-1 or 7-2), then click the **Next** button to advance to Step 2 of the wizard.
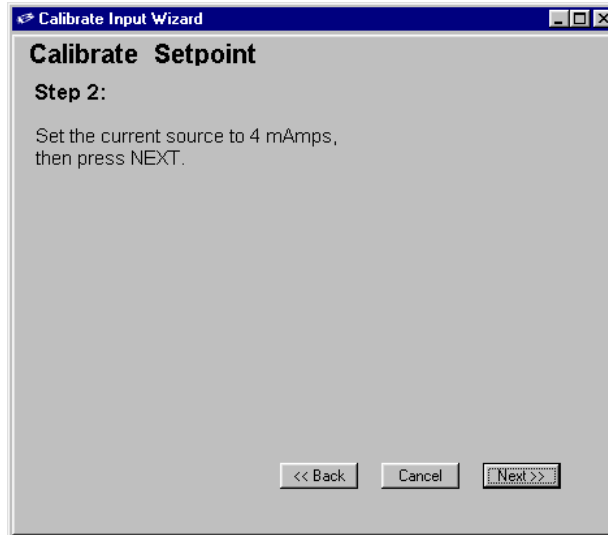
4.   Set the analog source to the value shown in Step 2 of the wizard (0 V or 4 mA). Check the DMM reading to verify that the setpoint from the analog source is accurate.

5.   Click the **Next** button to advance to Step 3 of the wizard.

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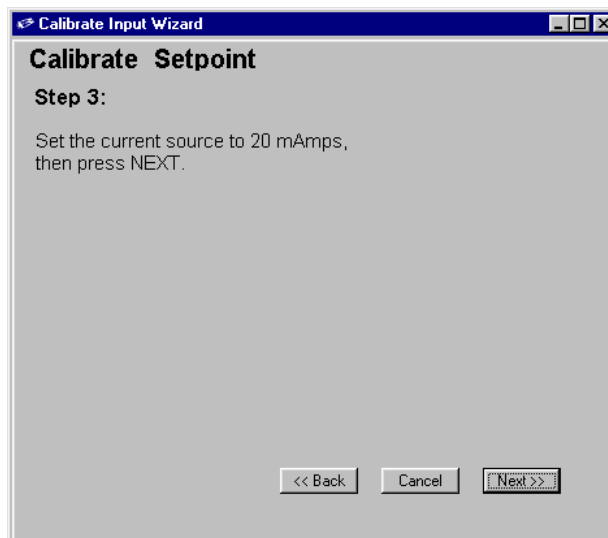
6.   Set the analog source to the value shown in Step 3 of the wizard (5 V or 20 mA). Check the DMM reading to verify that the setpoint from the analog source is accurate.

7.   Click the **Next** button to advance to Step 4 of the wizard.
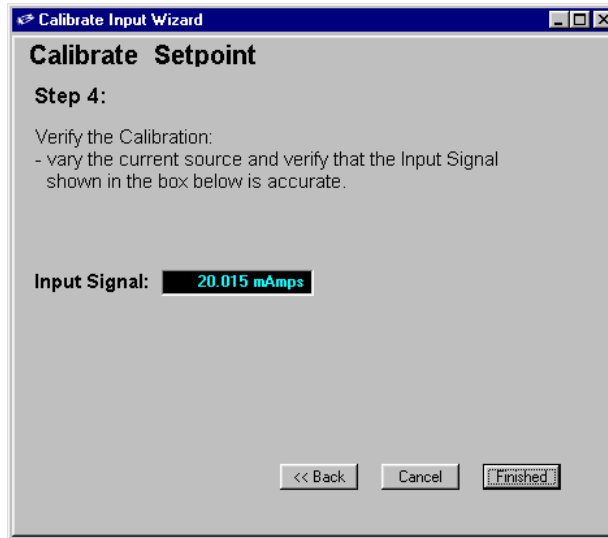
8.   As instructed in Step 4 of the wizard, vary the setpoint and verify that the value in the **Input Signal** field, which is the value as read by the device, is the same as the value on the DMM.

   •   If the value in the **Input Signal** field **is the same** as that on the DMM for several setpoints, the calibration is complete. Click the **Finished** button to save the calibration data.

   •   If the value in the **Input Signal** field **is not the same** as that on the DMM, you can click the **Back** button to go back and repeat the steps in the wizard.

At any point in the wizard, you can click the **Cancel** button to cancel the calibration. You will be prompted to confirm the cancellation. If the calibration is cancelled, the most recently saved calibration data is restored.

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7.2.6 Calibrating the Primary and Secondary Outputs

You calibrate the device's outputs to ensure that the device is accurately setting the primary and secondary output signals and, thus, maintaining the correct flow relative to the setpoint.

Prior to using the Service Tool to calibrate the device outputs, you must connect a DMM to the device's output signal, which you will use to verify the actual signal level. Figures 7-3 through 7-5 show how to set up the DMM for the available output types.

Note that all D-connector pin-outs are listed in "3.3 Device D-Connector Pin-Outs" on p. 3-7.
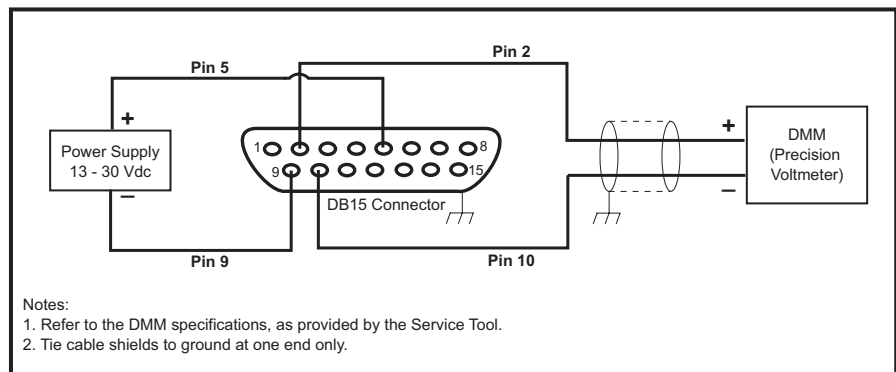
Figure 7-3 Setup for Calibrating to a Primary Output Voltage
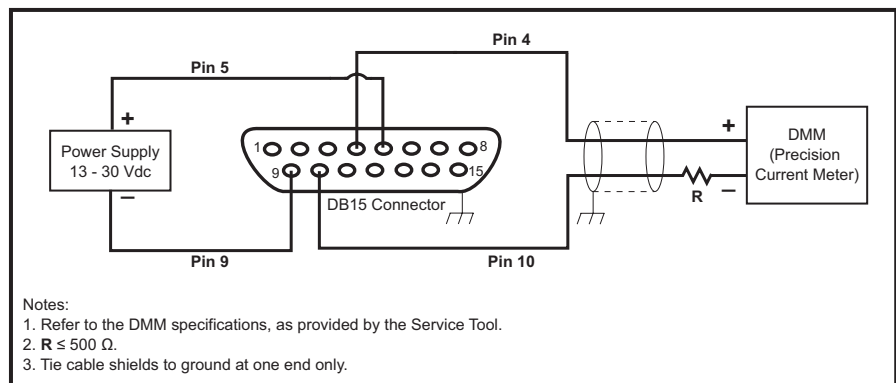
Figure 7-4 Setup for Calibrating to a Primary Output Current

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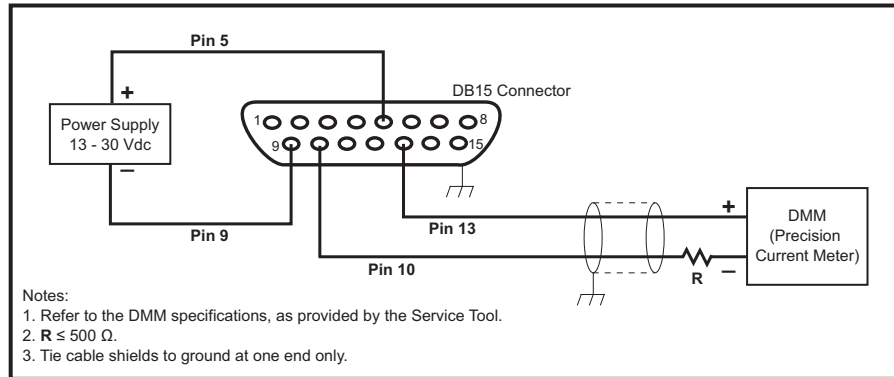
Figure 7-5 Setup for Calibrating to a Secondary Output Current

To calibrate one of the device's outputs:

1. Open the **Tune** menu and choose **Calibrate Outputs>Primary Output** or **Calibrate Outputs>Secondary Output**.

The Calibrate Output Wizard opens.
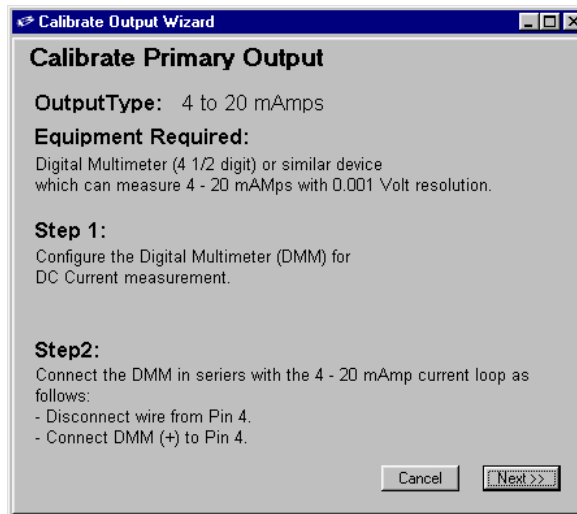
The Service Tool recognizes the output type and automatically selects it.

2. Make sure that the DMM is set up as instructed in Step 1 of the wizard (and shown in Figure 7-3, 7-4, or 7-5), then click the **Next** button to advance to Step 3 of the wizard.

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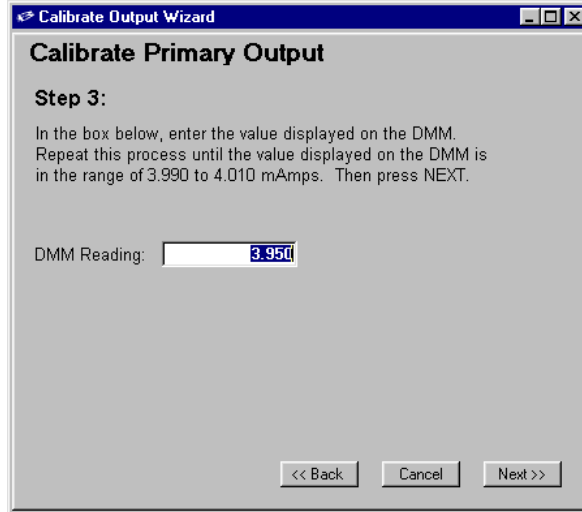
The Service Tool forces the device to output the minimum signal level.

3.   As instructed in Step 3 of the wizard, enter the value displayed on the DMM in the **DMM Reading** field, then press the Enter key. Continue entering the DMM value until it is within 0.2% of the target value (that is, 0.00–0.01 V or 3.96–4.04 mA).

4.   When the DMM value is within 0.2% of the target value, click the **Next** button to advance to Step 4 of the wizard.
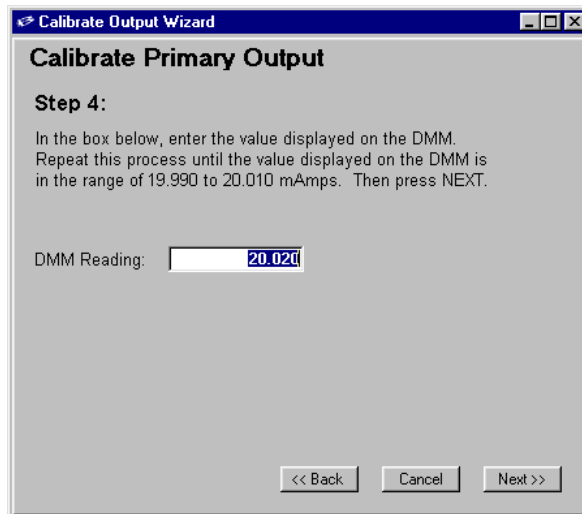
The Service Tool forces the device to output the maximum signal level.

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5.   As instructed in Step 4 of the wizard, enter the value displayed on the DMM in the **DMM Reading** field, then press the Enter key. Continue entering the DMM value until it is within 0.2% of the target value (that is, 4.99–5.01 V or 19.96–20.04 mA).

6.   When the DMM value is within 0.2% of the target value, click the **Next** button to advance to Step 5 of the wizard.
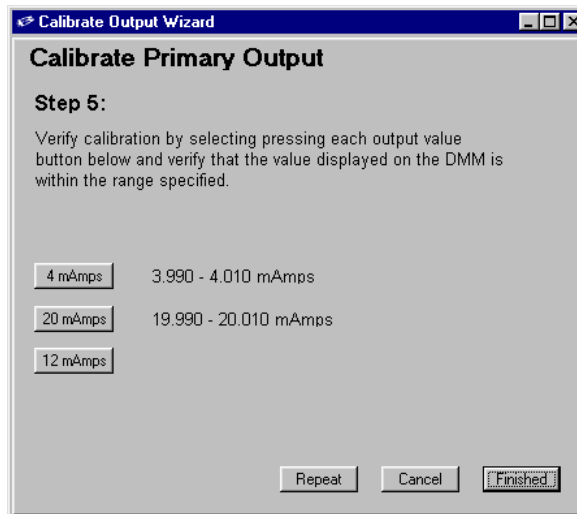
7.   As instructed in Step 5 of the wizard, click each of the output value buttons, checking to make sure that the DMM readings are within 0.2% of the selected output values.

- •   If the DMM readings **are within 0.2%** for all three test values, the calibration is complete. Click the **Finished** button to save the calibration data.

- •   If any of the DMM readings **is not within 0.2%** of the corresponding test button's value when clicked, you can click the **Back** button to go back and repeat the steps in the wizard.

At any point in the wizard, you can click the **Cancel** button to cancel the calibration. You will be prompted to confirm the cancellation. If the calibration is cancelled, the most recently saved calibration data is restored.

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LIMITED WARRANTY

Seller warrants that the Goods manufactured by Seller will be free from defects in materials or workmanship under normal use and service and that the Software will execute the programming instructions provided by Seller until the expiration of the earlier of twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Seller. Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer.

All replacements or repairs necessitated by inadequate preventive maintenance, or by normal wear and usage, or by fault of Buyer, or by unsuitable power sources or by attack or deterioration under unsuitable environmental conditions, or by abuse, accident, alteration, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense.

Goods repaired and parts replaced during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Seller and can be amended only in a writing signed by an authorized representative of Seller.

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Brooks Instrument provides sales and service facilities around the world, ensuring quick delivery from local stock, timely repairs and local based sales and service facilities.

Our dedicated flow experts provide consultation and support, assuring successful applications of the Brooks flow measurement and control products.

Calibration facilities are available in local sales and service offices. The primary standard calibration equipment to calibrate our flow products is certified by our local Weights and Measures Authorities and traceable to the relevant international standards.

START-UP SERVICE AND CALIBRATION

Brooks Instrument can provide start-up service prior to operation when required.

For some process applications, where ISO-9001 Quality Certification is important, it is mandatory to verify and/or (re)calibrate the products periodically. In many cases this service can be provided while replicating actual process conditions, and the results will be traceable to the relevant international quality standards.

CUSTOMER SEMINARS AND TRAINING

Brooks Instrument can provide customer seminars and dedicated training to engineers, end users and maintenance persons. Please contact your nearest sales representative for more details.

HELP DESK

In case you need technical assistance:

Americas	☎	1-888-554-FLOW
Europe	☎	+(31) 318 549265
Asia	☎	+011-81-3-5633-7105

Due to Brooks Instrument's commitment to continuous improvement of our products, all specifications are subject to change without notice.

TRADEMARKS

Brooks .... Brooks Instrument Div., Emerson Electric Co.
Emerson .... Emerson Electric Co.
QUANTIM .... Brooks Instrument Div., Emerson Electric Co.
Windows .... Microsoft Corporation

ISO 9001
QUALITY SYSTEM
Certificate of Conformity
The Quality System at Brooks Instrument conforms to the quality standards set forth in ISO 9001.