

Getting Started with the LabVIEW™ Datalogging and Supervisory Control Module

This document provides an introduction to the LabVIEW Datalogging and Supervisory Control (DSC) Module and contains exercises to help you understand the functionality that the DSC Module provides. To use this document effectively, you should be familiar with LabVIEW and the shared variable and with building an application in LabVIEW.

The following resources contain information you might find useful:

- The *Getting Started with LabVIEW* manual, available in the LabVIEW 8.0\manuals directory, contains introductory information about LabVIEW.
- The *LabVIEW Help*, available by selecting **Help»Search the LabVIEW Help**, contains extensive information about LabVIEW.
- The *Sharing Live Data Using Shared Variables* topic in the *LabVIEW Help* contains information about the shared variable in LabVIEW.
- The NI Example Finder, available by selecting **Help»Find Examples**, contains example VIs and LabVIEW projects.

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What Is the DSC Module?

The DSC Module extends the LabVIEW graphical development environment with additional functionality for the rapid development of distributed measurement, control, and high-channel-count monitoring applications.

The DSC Module also enhances the LabVIEW shared variable. Use the shared variable to access and pass data among several VIs in a LabVIEW project or across a network. A shared variable can represent a value or an I/O point. With the DSC Module, you can log data automatically; add alarming, scaling, and security to the shared variable; and configure the shared variable programmatically.

The DSC Module includes the following components:

- **Functions and VIs Palettes**—The DSC Module installs the following palettes: **Alarms & Events**, **Database Management**, **Database Writing**, **DataSets**, **Engine Control**, **Event Structure Support**, **Historical**, **IO Primitives**, and **Security**. The DSC Module also includes the Historical Trend Express VI and the Real-Time Trend Express VI.
- **DSC Module Controls Palettes**—The DSC Module installs the following controls palettes to help you build user interfaces that resemble a plant or system and to view real-time data from the plant or system: **2D Pipes**, **2D Valves**, **2D Pumps**, **3D Pipes**, **3D Valves**, **3D Pumps**, **Vessels**, and **Alarms Controls**. The DSC Module also includes the Historical Trend control and the Real-Time Trend control.
- **Citadel Database**—The DSC Module logs shared variable data to the Citadel database. The Citadel database stores historical data, alarms, and events. You can access and view Citadel data using the Historical Data Viewer and using the Historical VIs.
- **Historical Data Viewer**—Use the Historical Data Viewer to view data stored in the Citadel database. Select **Tools»DSC Module»View Historical Data** to launch the Measurement & Automation Explorer (MAX). Expand the **Historical Data** category to select a database that appears under **Citadel 5 Universe**. You also can use the Call HDV VI to launch the Historical Data Viewer programmatically.

- **Published Variable Monitor**—Use the Published Variable Monitor to view the current value of a shared variable and its status and alarm state. Select **Tools»DSC Module»Monitor Variables** to launch the Published Variable Monitor.

The DSC Module also provides tools for graphing historical or real-time trends, enhancing the security of front panels, and writing custom I/O servers. You can read or write to OLE for Process Control (OPC) connections, programmable logic controllers (PLC), or custom I/O servers that you write. The DSC Module provides solutions for supervisory control of a wide variety of distributed systems using graphical LabVIEW programming.

Building a DSC Module Application

In the following exercises, you will build a VI with DSC Module functionality.

Opening and Running an Example

The DSC Module includes several examples you can use to learn about DSC Module features and applications. In this exercise you will look at an example you will use later to create a custom I/O server.

Complete the following steps to run the DSC Tank Simulator example.

1. Select **Help»Find Examples** to display the NI Example Finder.
2. Select **Directory Structure** in the **Browse according to** section. Browse to the `lv\dsc\Getting Started\Tank Simulator` folder and open the DSC Tank Simulator VI. This VI simulates a tank filling with water.
3. Run the VI.
4. Move the sliders to increase or decrease the rate at which the water fills the tank. As you move the sliders, notice that you control how fast the water flows into the tank.
5. Stop and close the VI.

This VI does not use any DSC Module features. In the exercises that follow, you will create a DSC Module application based on this VI.

Creating a New Project Library

In this exercise you will learn how to create a new LabVIEW project and a project library. The project allows you to manage shared variables, project libraries, and VIs in one window. LabVIEW project libraries are collections of VIs, type definitions, shared variables, palette menu files, and other files, including other project libraries.

Complete the following steps to create a LabVIEW project library.

1. Click the **Empty Project** link in the **Getting Started** window. The **Project Explorer** window appears.
2. Right-click **My Computer** in the **Project Explorer** window and select **New»Library** from the shortcut menu.
3. Select **File»Save All**. The **Name the Project** dialog box appears.
4. Enter `Tank System` in the **File name** text box.
5. Click the **OK** button. The **Name the Library** dialog box appears.
6. Enter `Tank System IO Server` in the **File name** text box.
7. Click the **OK** button.

You now have a project containing a project library. In the following exercise you will use the project library in the project to create a periodic I/O server.

Creating a Periodic I/O Server

A server is an application that communicates with and manages input/output devices such as PLCs, remote input/output devices, remote Shared Variable Engines, and data acquisition (DAQ) plug-in devices. These servers read selected input items and write to them on demand. The DSC Module can connect to any OPC-compliant server and to many third-party device servers. You also can create custom I/O servers. You will build a periodic I/O server in the following exercise. The periodic I/O server will run as a service and publish NI Publish-Subscribe Protocol (NI-PSP) data items to the network.

Complete the following steps to add the periodic I/O server to the project.

1. Right-click the **Tank System IO Server.lvlib** project library in the **Project Explorer** window and select **New»I/O Server** from the shortcut menu. The **Create New I/O Server** dialog box appears.
2. Select **Custom VI – Periodic** from the **I/O Server Type** list and click the **Continue** button. The **Custom VI – Periodic I/O Server Configuration** dialog box appears.
3. Click the **New** button to display the **Select VI** step of the Custom VI - Based Server – Periodic Assistant.

4. Complete the following steps to select the VI from the *Opening and Running an Example* exercise to convert into a periodic I/O server on the **Select VI** page.
 - a. Click the button with the file folder icon. The **Open** dialog box appears.
 - b. Navigate to the LabVIEW 8.0\examples\lvdsc\Getting Started\Tank Simulator folder in the **Open** dialog box.
 - c. Select the DSC Tank Simulator VI and click the **OK** button.
 - d. Click the **Next** button in the Custom VI - Based Server – Periodic Assistant to advance to the **Select Controls and Indicators To Publish** step.
5. Complete the following steps on the **Select Controls and Indicators To Publish** page to select the front panel objects you want to publish as shared variables.
 - a. Remove the checkmark from the **stop** checkbox in the **Controls** list. You will publish the remaining controls and indicators.
 - b. Click the **Next** button to advance to the **Select Method To Stop The Server** page.
6. Complete the following steps on the **Select Method To Stop The Server** page to select the mechanism you want to use to stop the VI.
 - a. Select **Stop the following While Loops**.
 - b. Place a checkmark in the **While Loop** checkbox.



Tip Click the **View on block diagram** button to highlight the While Loop you select on the block diagram. Use this option if you have multiple While Loops on the block diagram to make sure you select the correct While Loop.

- c. Click the **Next** button to advance to the **Configure Server Distribution Component** step.
7. You can select what you want the assistant to build on the **Configure Server Distribution Component** page. For this exercise, leave the default options and click the **Next** button to advance to the **Server Distribution Component** page.
8. The DSC Module displays a summary of the files that the Custom VI - Based Server – Periodic Assistant will create from the **Server Distribution Component** page. Click the **Build** button. The assistant displays the **Build Status** dialog box as it creates a VI template file, a registration VI, and a support DLL and VIs.
9. After the assistant creates the periodic I/O server, the **Custom VI – Periodic I/O Server Configuration** dialog box appears with the name of the periodic I/O server and the data items it contains. Click the

OK button. LabVIEW adds the periodic I/O server to the Tank System IO Server project library.

10. Right-click the **Custom VI – Periodic1** item in the **Project Explorer** window and select **Rename** from the shortcut menu. Rename the periodic I/O server **Tank1**. The **Project Explorer** window appears as shown in Figure 1.

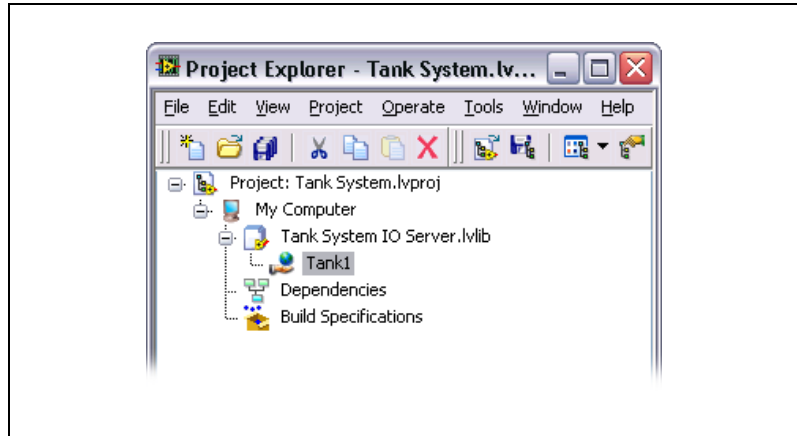


Figure 1. Tank System Project

11. Select **File»Save All** in the **Project Explorer** window to save the project, project library, and periodic I/O server.

Deploying the Periodic I/O Server

Now you must deploy the periodic I/O server so that the data items in the I/O server are available for use in other VIs and across the network. In this exercise you will deploy the periodic I/O server and view the I/O server data in the Published Variable Monitor.



Note The periodic I/O server runs continuously in the background until you undeploy the library in the **Project Explorer** window that contains the I/O server.

Complete the following steps to deploy the Tank1 periodic I/O server and view the data.

1. Right-click the **Tank System IO Server.lvlib** project library under the **My Computer** item and select **Deploy All** from the shortcut menu to deploy the project library.
2. Select **Tools»DSC Module»Monitor Variables**. The **National Instruments Published Variable Monitor** window appears. Notice that the Tank System IO Server appears in the left pane of the window.

3. Expand **Tank System IO Server»Tank1** in the left pane. Notice that the controls and indicators of the I/O server appear under **Tank1**. Because you deployed the project library in step 1, the I/O server is running and each control and indicator is an I/O data item.
4. Click each data item and drag it into the upper right pane. The data items appear in the table.
5. Double-click the **Tank1.Input Flow Rate [GPM]** control in the upper right pane. The **Write Network Item** tab appears.
6. Enter a value of 10 and click the **OK** button. Notice that the values of **Tank1.Tank Level [Gallons]** and **Tank1.Tank Output Flowrate [GPM]** begin increasing.
7. Close the Published Variable Monitor. The periodic I/O server continues to run.

Creating Shared Variables

In this exercise you will add the network-published shared variables that represent the data items in the periodic I/O server to the Tank System Shared Variables project library.

Complete the following steps to add the Tank System Shared Variables project library to the Tank System project.

1. Select **Tools»DSC Module»Multiple Variable Editor**. The **Multiple Variable Editor** window appears.
2. Select **Edit»Create Bindings** in the **Multiple Variable Editor** window. The **Create Bound Variables** dialog box appears.
3. Expand **localhost»Tank System IO Server»Tank1** on the **Network** tab. The shared variables appear under **Tank1**.
4. Select each shared variable with the data type **DBL** and click the **Add** button to add each variable to the **Added Variables** list.
5. Click the **OK** button. The **Create Bound Variables** dialog box closes and the variables appear in the spreadsheet area at the top of the **Multiple Variable Editor** window.
6. Select **File»Save As**. The **Save Library** dialog box appears.
7. Enter `Tank System Shared Variables` in the **File name** text box.
8. Click the **Save** button. LabVIEW binds the shared variables in the Tank System Shared Variables project library to the corresponding items on the network.

Configuring Data Logging

When you add logging to a shared variable, the DSC Module logs shared variable data, including the shared variable value, timestamp, whether the value is in an alarm state, and the quality of the value. The DSC Module logs all data to the Citadel database. Complete the following steps to add logging for the Tank Level [Gallons] shared variable.

1. Select the **Tank Level [Gallons]** shared variable in the spreadsheet area of the **Multiple Variable Editor** window.
2. Select **Logging** from the **Category** list.
3. Place a checkmark in the **Enable Logging** checkbox. LabVIEW enables the **Log Events** checkbox and the **Log Data** checkbox automatically. The **Log Data** option enables historical datalogging for the shared variable.
4. Enter 0.1 in the **Value Resolution** text box. This value compresses the value to one decimal point when the DSC Module logs the values of this shared variable to the Citadel database.
5. Leave the **Value Deadband** text box with the default value. This value specifies that the DSC Module log the shared variable value only when the shared variable value differs from the previous shared variable value by 1% of the shared variable engineering scale range, which is 0–100 by default.
6. Click the **Apply** button to apply the changes to the shared variable.

Configuring Alarming

An alarm is an abnormal condition on a shared variable or a user-defined condition. An alarm occurs if a shared variable value goes out of its defined alarm limits or if a shared variable has bad status. In this exercise you will add an alarm for the Tank Level [Gallons] shared variable.

Complete the following steps to add alarming.

1. Select **Alarming** from the **Category** list in the **Multiple Variable Editor** window.
2. Place a checkmark in the **Enable Alarming** checkbox.
3. Click the **Configure** button to display the **Configure Double Alarms** dialog box.
4. Place a checkmark in the **HI** checkbox to enable a HI alarm. Notice that the default value of the HI alarm is 75.
5. Click the **OK** button. The **Configure Double Alarms** dialog box closes and the alarm appears in the **Alarms** table of the **Multiple Variable Editor** window.

6. Click the **Apply** button to apply the changes.
7. Select **File»Save**.
8. Select **File»Close** to close the **Multiple Variable Editor** window.

Adding the Project Library to the Project

In the following exercise you will add the project library of shared variables you created in the previous exercises to the Tank System project. You also will enable data logging and alarm and event logging for the project library.

Complete the following steps to create a project library of shared variables and to enable data logging and alarm and event logging for the project library.

1. Right-click **My Computer** in the **Project Explorer** window and select **Add File** from the shortcut menu. The **Select a File to Insert** dialog box appears.
2. Navigate to the Tank System Shared Variables project library and click the **Add File** button. The Tank System Shared Variables project library appears in the **Project Explorer** window.
3. Right-click the **Tank System Shared Variables.lvlib** project library in the **Project Explorer** window and select **Properties** from the shortcut menu. The **Project Library Properties** dialog box appears.
4. Select **DSC Settings: Database** from the **Category** list.
5. Verify that the options in the **DSC Settings: Database** page appear as shown in Figure 2.

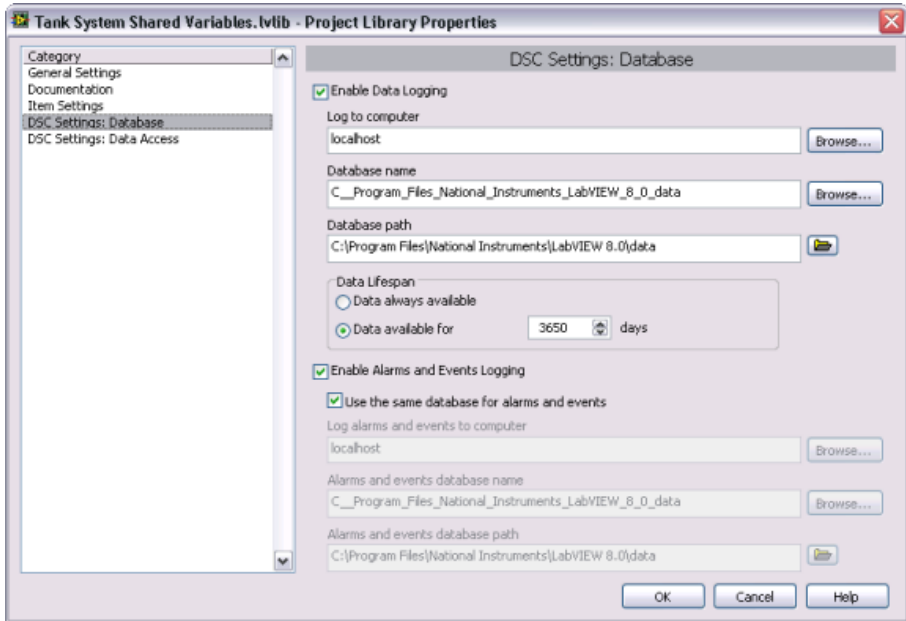


Figure 2. DSC Settings: Database Page of the Project Library Properties Dialog Box

The **Enable Data Logging** option turns on data logging for the project library. **localhost** specifies the local computer. Use **localhost** instead of the name of the computer to reduce the changes you must make if you move this project to another computer. The **Enable Alarms and Events Logging** option turns on event logging for the project library. The **Use the same database for alarms and events** option ensures that the DSC Module logs alarms and events for this project library to the same database that it logs data.



Tip You can change the **Database name** that appears in the **Project Library Properties** dialog box to a more useful or descriptive name.

6. Click the **OK** button to close the **Project Library Properties** dialog box.
7. Right-click the **Tank System Shared Variables.lvlib** project library in the **Project Explorer** window and select **Deploy All** from the shortcut menu to deploy the shared variables.
8. Select **File>Save All** in the **Project Explorer** window to save the project, project library, and periodic I/O server.

Creating the VI

In this exercise you will create a VI to display data on a front panel. You do not need to add any code to the block diagram.

Complete the following steps to create a front panel to display the data items in the periodic I/O server.

1. Right-click **My Computer** in the **Project Explorer** window and select **New»VI** from the shortcut menu. A new VI front panel and block diagram appear.
2. Select the **Tank Level [Gallons]** shared variable from the **Tank System Shared Variables.lvlib** project library in the **Project Explorer** window and drag the shared variable onto the front panel. The shared variable appears as a numeric control. Notice the triangle that appears next to the control. The triangle indicates that this control has been configured for data binding.
3. Right-click the **Tank Level [Gallons]** control and select **Change to Indicator** from the shortcut menu.
4. Right-click the **Tank Level [Gallons]** indicator and select **Replace»DSC Module»Vessels»Open Tank** from the shortcut menu.
5. Use the Positioning tool to resize the **Tank Level [Gallons]** tank.
6. Right-click the **Tank Level [Gallons]** indicator and select **Properties** from the shortcut menu. The **Properties** dialog box appears.
7. Select the **Data Binding** tab in the **Properties** dialog box.



Tip If the **Data Binding** tab is not visible, scroll through the tabs until you reach the **Data Binding** tab.

8. Place a checkmark in the **Blink while Alarm On** checkbox to configure the control to blink when the water level reaches 75, the default alarm you set in the *Configuring Alarming* section of this document.
9. Click the **OK** button.
10. Select the **Input Flowrate [GPM]** shared variable from the **Tank System Shared Variables.lvlib** project library in the **Project Explorer** window and drag the shared variable onto the front panel.
11. Right-click the **Input Flowrate [GPM]** control and select **Replace»Num Ctrls»Pointer Slide**.
12. Select the **Tank Valve [%]** shared variable from the **Tank System Shared Variables.lvlib** project library in the **Project Explorer** window and drag the shared variable onto the front panel.

13. Right-click the **Tank Valve [%]** control and select **Replace» Num Ctrls»Pointer Slide**.
14. Select **File»Save As**. The **Name the VI** dialog box appears.
15. Enter Tank System HMI in the **File name** text box.
16. Click the **OK** button.
17. Click the **Run Continuously** button to run the VI. The VI should function in the same way as the example you ran in the *Opening and Running an Example* exercise. Figure 3 illustrates the front panel of the Tank System VI.

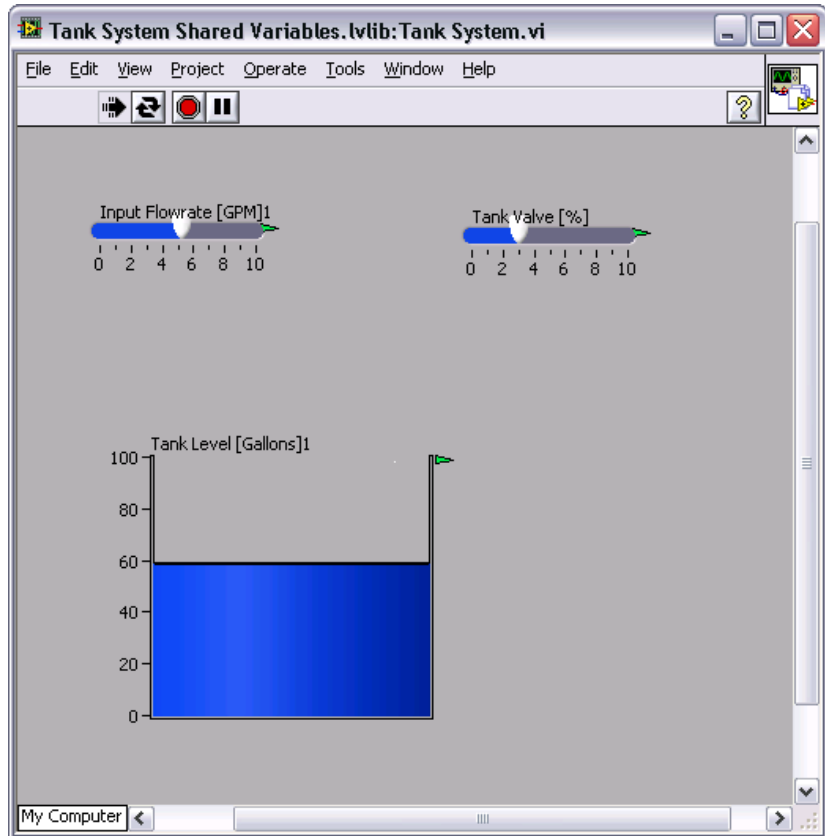


Figure 3. Tank System VI Front Panel

18. Click the **Abort** button to stop the VI.

Additional Exercises

The following exercises introduce some of the additional functionality available with the DSC Module.

Configuring Front Panel Security

Use the DSC Module to add security to front panel controls. The DSC Module provides the **Front Panel Security** dialog box, which you can use to configure security for more than one control at the same time. You also can configure security settings for individual controls. Before you can configure security settings, you must create users and groups. Refer to the *LabVIEW Help* for more information about creating users and groups in the Domain Manager.

In the following exercises, you will add security to controls on an individual basis.

Creating a New Security Domain

Complete the following steps to create a new domain on the local computer.

1. Select **Tools»Security»Domain Account Manager**. The **Domain Manager** window appears.
2. Select **File»New»Local Domain**. The **Domain Properties** dialog box appears.
3. Enter `MyDomain` in the **Domain** text box on the **General** tab.
4. Click the **Access Control** tab.
5. Click the **Add** button in the **Grant List** section.
6. Enter `localhost` in the list.
7. Click the **OK** button. The **Change Password** dialog box appears.
8. Enter a secure password of six or more characters in the **New password** text box.
9. Enter the same secure password of six or more characters in the **Re-type new password** text box.
10. Click the **OK** button to create the new local domain. **MyDomain** appears in the **Domain Manager** window under **My Computer**.

Adding a New User

Complete the following steps to add a user to **MyDomain**.

1. Select **MyDomain** in the **Domain Manager** window.
2. Select **File»New»User**. The **User Properties** dialog box appears.
3. Enter **User1** in the **User name** text box on the **General** tab.
4. Click the **Change Password** button. The **Change Password** dialog box appears.
5. Enter a secure password of six or more characters in the **New password** text box.
6. Enter the same secure password of six or more characters in the **Re-type new password** text box.
7. Click the **OK** button to close the **Change Password** dialog box.
8. Click the **OK** button in the **User Properties** dialog box to add **User1** to **MyDomain**. **User1** appears in the **Domain Manager** window.

Adding Security to a Control

Complete the following steps to add security to the **Input Flowrate [GPM]** control.

1. Open the Tank System VI front panel.
2. Right-click the **Input Flowrate [GPM]** control and select **Properties** from the shortcut menu.
3. Click the **Security** tab in the **Slide Properties** dialog box.



Tip If the **Security** tab is not visible, scroll through the tabs until you reach the **Security** tab.

4. Click the **Add** button to add access to a user you created in the Domain Manager. The **Add New Host/User** dialog box appears.
5. Select **User 1** from the **Users and Groups** list and click the **OK** button.
6. Select **Full Access** from the **Access** drop-down list for **User1**.
7. Click the **Add** button.
8. Select **Guest** from the **Users and Groups** list and click the **OK** button.
9. Select **Disabled & Grayed Out** from the **Access** drop-down list for **Guest**.
10. Click the **OK** button. The **Add New Host/User** dialog box closes and adds security information to the **Input Flowrate [GPM]** control.

11. Run the VI continuously and select **Tools»Security»Login** to log in as User 1. The **Input Flowrate [GPM]** control should be enabled and you should be able to move the slider.
12. Log in as Guest. The **Input Flowrate [GPM]** control should be disabled and grayed out.
13. Stop the VI.



Tip You can add security to multiple controls at one time in the **Front Panel Security** dialog box, available by selecting **Tools»Security»Front Panel Security**.

Viewing Real-Time Data

You can use the DSC Module to view live data. The Real-Time Trend Express VI displays live data from a shared variable on an XY graph. In the following exercise you will add the ability to view live data to the Tank System VI.

Complete the following steps to add a Real-Time Trend Express VI to a block diagram and view live data.

1. Place the Real-Time Trend Express VI, available on the **DSC Module** palette, on the Tank System VI block diagram. The **Configure Real-Time Trend** dialog box appears.
2. Click the down arrow next to the **Shared Variable** list and select **Browse**. The **Browse Shared Variables** dialog box appears.
3. Click the button with the folder icon. The **Open** dialog box appears.
4. Navigate to the **Tank System Shared Variables** project library and click the **OK** button.
5. Select **Tank Volume [Gallons]** in the **Library** list.
6. Click the **OK** button to close the **Browse Shared Variables** dialog box.
7. Click the **Add** button in the **Configure Real-Time Trend** dialog box.
8. Click the **OK** button to close the **Configure Real-Time Trend** dialog box.
9. Place a waveform chart on the front panel.
10. Wire the **trend data** output of the Real-Time Trend Express VI to the waveform chart on the block diagram.
11. Place a While Loop around the waveform chart and Express Real-Time Trend control.
12. Run the VI. The waveform chart shows the water level. Notice that the waveform chart displays the changes when you adjust the **Input Flowrate [GPM]** control.

Viewing Alarms Using the Published Variable Monitor

Complete the following steps to view alarms in the Published Variable Monitor.

1. Select **Tools»DSC Module»Monitor Variables** to display the Published Variable Monitor.
2. Expand the **Tank System Shared Variables** project library in the left pane to display the shared variables.
3. Double-click each shared variable to view shared variable information in the right pane. Notice that the alarm for the **Tank Volume [Gallons]** shared variable that you created in the *Creating Shared Variables* section of this document appears in the lower right pane.

Where to Go from Here

Refer to the following documentation for more information about LabVIEW or the DSC Module:

- *LabVIEW Datalogging and Supervisory Control Module Release and Upgrade Notes*
- *LabVIEW Help*

Select **Help»Find Examples** to display the NI Example Finder and browse LabVIEW and DSC Module examples.

Refer to ni.com for additional developer resources, training, technical support, and so on.

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