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\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, Engine Control, Historical, Security, and Shared Variables. 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 Controls, 3D Controls, Alarm Controls, Trend Controls, and Vessels. 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.
• **Shared Variable Monitor**—Use the Shared 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 Shared 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 lvdsc\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 Configure Custom VI – Periodic I/O Server dialog box appears.
3. Click the New button to display the Select VI step of the Custom VI-based Server – Periodic Wizard.
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\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 Wizard 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 wizard 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 Wizard will create from the *Server Distribution Component* page. Click the *Build* button. The wizard 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 wizard creates the periodic I/O server, the *Configure Custom VI – Periodic I/O Server* 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.

![Project Explorer - Tank System.lv...](image)

**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 Shared 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. Click the **Done** button to close the **Deploy** dialog box when the deployment is complete.

4. 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.

5. Click each data item and drag it into the upper right pane. The data items appear in the table.


7. 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.


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. Right-click My Computer in the Project Explorer window and select New»Library from the shortcut menu.

2. Right-click the new project library you created and select Create Bound Variables from the shortcut menu to display the Create Bound Variables dialog box.

3. Select Network Items from the Browse Source drop-down box.


5. Select each shared variable with the data type DBL and click the Add button to add each variable to the Added variables list.

6. Click the OK button. The Create Bound Variables dialog box closes and the shared variables appear in the Multiple Variable Editor window.

7. Click the Done button to close the Multiple Variable Editor window.

8. Select File»Save All. The Name the Library dialog box appears.
9. Enter **Tank System Shared Variables** in the **File name** text box.

10. Click the **OK** 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. Right-click the **Tank System Shared Variables.lvlib** project library and select **Edit Variables** from the shortcut menu to open the **Multiple Variable Editor** window.

2. Double-click the **Logging:Enable** cell for the Tank Level [Gallons] shared variable and select **On** from the drop-down list that appears. Additional logging options appear as columns in the table.

3. Double-click the **Logging:Alarms and Events** cell for the Tank Level [Gallons] shared variable and select **On** from the drop-down list that appears. This option enables alarm and event logging for the shared variable.

4. Double-click the **Logging:Data** cell for the Tank Level [Gallons] shared variable and select **On** from the drop-down list that appears. This option enables historical data logging for the shared variable.

5. Double-click and enter **0.1** in the **Logging:Data** cell for the Tank Level [Gallons] shared variable. This value compresses the value to one decimal point when the DSC Module logs the values of this shared variable to the Citadel database.

6. Leave the **Logging:Deadband** cell with the default value of **0.01**. 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.

### 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. In the Multiple Variable Editor window, double-click the Alarming:Enable cell for the Tank Level [Gallons] shared variable and select On from the drop-down list that appears. Additional alarming options appear as columns in the table.

2. Double-click the Alarming:HI:Enable cell for the Tank Level [Gallons] shared variable and select On from the drop-down list that appears. Additional options for the HI alarm you enabled appear as columns in the table. Notice that the default value of the HI alarm is 75, as shown in the Alarming:HI:Limit cell.

3. Click the Done button to apply the changes to the shared variable and to close the Multiple Variable Editor window.

Enabling Logging for the Project Library

Complete the following steps to enable data logging and alarm and event logging for the Tank System Shared Variables project library.

1. 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.

2. Select DSC Settings: Database from the Category list.

3. Verify that the options in the DSC Settings: Database page appear similar to 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.

4. Click the OK button to close the Project Library Properties dialog box.
5. 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.
6. Click the Done button to close the Deploy dialog box when the deployment is complete.
7. 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.

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.
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.
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.
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 Shared Variable Monitor**

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

1. Select **Tools»DSC Module»Monitor Variables** to display the Shared 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.