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LabVIEW™

LabVIEW Datalogging and Supervisory Control Module Developer's Manual

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Conventions

This manual uses the following conventions:

»

The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options** directs you to pull down the **File** menu, select the **Page Setup** item, and select **Options** from the last dialog box.

📝

This icon denotes a note, which alerts you to important information.

⚠

This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.

bold

Bold text denotes items that you must select or click on in the software, such as menu items and dialog box options. Bold text also denotes parameter names.

italic

Italic text denotes variables, emphasis, a cross reference, or an introduction to a key concept. This font also denotes text that is a placeholder for a word or value that you must supply.

`monospace`

Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames and extensions, and code excerpts.

`monospace bold`

Bold text in this font denotes the messages and responses that the computer automatically prints to the screen. This font also emphasizes lines of code that are different from the other examples.

`monospace italic`

Italic text in this font denotes text that is a placeholder for a word or value that you must supply.

Platform

Text in this font denotes a specific platform and indicates that the text following it applies only to that platform.

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1

Introduction

The LabVIEW Datalogging and Supervisory Control (DSC) module adds features and capabilities to LabVIEW to help you create automation applications or applications that must keep track of a large number of data points. The LabVIEW DSC module provides solutions for supervisory control of a wide variety of distributed systems using the flexibility of graphical LabVIEW programming. Before you use the LabVIEW DSC module, you should be familiar with LabVIEW.

Use the LabVIEW DSC module to change setpoints or send control instructions to individual devices while monitoring the entire system. The LabVIEW DSC module provides the following features and capabilities:

- Configuration utilities and wizards
- Real-time database
- Historical data collection and trending
- Alarm and event reporting and logging
- Security
- Connection to PLC and industrial device networks
- OPC server and client
- Connection to a wide selection of device servers

Related Documentation

The following documents contain information that you might find helpful as you read this manual:

- LabVIEW documentation, including the *LabVIEW Help*
- *LabVIEW Datalogging and Supervisory Control Module Help*

Online Help

Select **Help»Datalogging & Supervisory Control** to access the *LabVIEW Datalogging and Supervisory Control Module Help* for more information about the LabVIEW DSC module palettes, tools, VIs, and functions. The

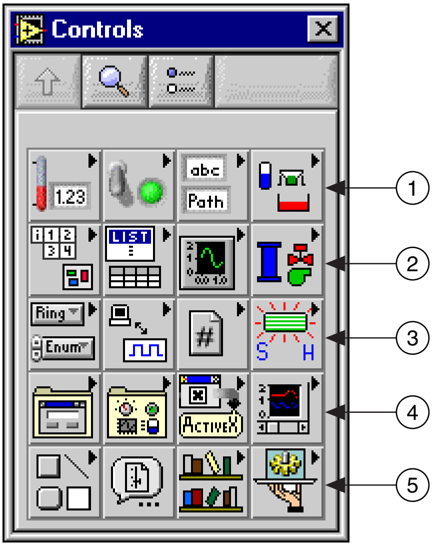
LabVIEW Datalogging and Supervisory Control Module Help also includes step-by-step instructions for using the LabVIEW DSC module features.

Select **Help»Contents and Index** to access the *LabVIEW Help* and help files you create. Refer to the *LabVIEW Help* for more information about creating help files.

Controls Palette

The LabVIEW DSC module installs the following subpalettes on the **Controls** palette, as shown in Figure 1-1:

- **Vessels**—Several tanks, a hopper, and a bin. All objects on this subpalette are numeric.
- **Pipes, Pumps, & Valves**—Various Boolean pipe, pump, and valve objects.
- **Alarms and Events**—A set of displays, formatting tools, and summary tools for handling alarms and events.
- **Trends**—Historical trend XY graph and real-time trend waveform chart.
- **DSC Server Data Types**—Various data type definitions you can use to write VI-based servers for the LabVIEW DSC module. Refer to the *Developing Device Servers* section of Chapter 3, *Servers*, for more information about developing device servers.



1 Vessels
2 Pipes, Pumps, and Valves
3 Alarms and Events
4 Trends
5 DSC Server Data Types

Figure 1-1. Controls Palette with the LabVIEW DSC Module

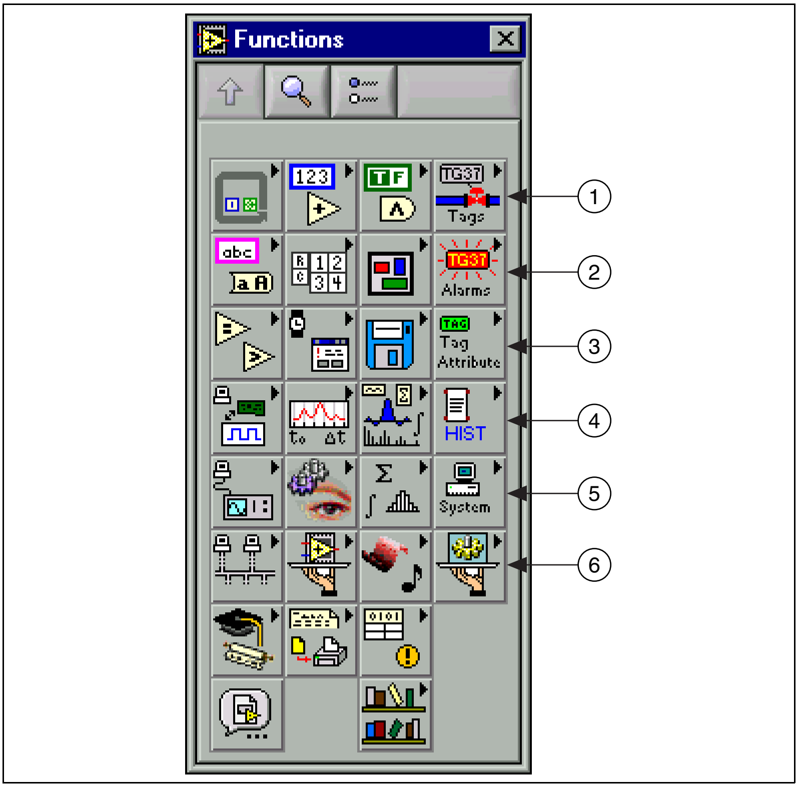
The LabVIEW DSC module also installs the tag control on the **Controls»I/O** palette. Use the tag control to select a tag from those configured in the active configuration (`.scf`) file.

Functions Palette

The LabVIEW DSC module installs the following subpalettes on the **Functions** palette, as shown in Figure 1-2. Refer to the *LabVIEW Datalogging and Supervisory Control Module Help* for more information about the VIs and functions on these subpalettes.

- **Tags**—Use these VIs and functions to read the most recent value of a tag, write a new value to a tag, or obtain data for a real-time trend.
- **Alarms & Events**—Use these VIs to acknowledge alarms, display alarm summary or event history information, or obtain alarm summary status.
- **Tag Attributes**—Use these VIs to read and write tag configuration parameters programmatically.

- **Historical Data**—Use these VIs to read and write historical data about a tag, to resample trend data, compute statistical data for a historical trend, or convert historical trend data to a spreadsheet.
- **System**—Use these VIs to launch or shut down the Tag Engine, to enable or disable event logging, historical datalogging, or printing, or to manipulate the LabVIEW DSC module environment.
- **System»Security**—Use these VIs to access security information about your application.
- **DSC Server Development**—Use these VIs to develop VI-based device servers. Refer to the *Developing Device Servers* section of Chapter 3, *Servers*, for more information about developing device servers.



1	Tags	4	Historical Data
2	Alarms and Events	5	System (Includes Security)
3	Tag Attributes	6	DSC Server Development

Figure 1-2. Functions Palette with the LabVIEW DSC Module

Utilities

Tag Utilities Toolbar

Use the **Tag Utilities** floating toolbar to open other LabVIEW DSC module utilities without selecting them through the menus. Select **Tools»Datalogging & Supervisory Control»Show Toolbar** to display the **Tag Utilities** toolbar.

Tag Configuration Editor

Use the Tag Configuration Editor to create, edit, or delete all of the tags in the LabVIEW DSC module system and to configure Tag Engine parameters. Select **Tools»Datalogging & Supervisory Control»Configure Tags** to open the Tag Configuration Editor.

The Tag Configuration Editor records all tag information and Tag Engine parameters and stores this information in a configuration (`.scf`) file. The Tag Engine reads this file to determine all of the configuration parameters for execution.

Tag Monitor

Use the Tag Monitor to monitor the value, timestamp, alarm state, and connection status for selected tags in the system and to write the value to an output or input/output tag. Select **Tools»Datalogging & Supervisory Control»Monitor Tags** to open the Tag Monitor.

Tag Engine

The Tag Engine runs as a separate process, independent of the HMI application. Both the device servers and the HMI application communicate with the Tag Engine. Select **Tools»Datalogging & Supervisory Control»Launch Engine** to start the Tag Engine.

The Tag Engine performs the following tasks for the LabVIEW DSC module:

- Starts and stops device servers
- Scales and initializes data
- Processes alarms
- Logs alarms and events to the Citadel historical database
- Logs historical data

Servers and the HMI application send data to the Tag Engine. The Tag Engine logs data to the Citadel historical database and maintains the real-time database.

Citadel Historical Database

Citadel is a National Instruments database used by the LabVIEW DSC module, Lookout, and other National Instruments products. It efficiently stores data acquired and processed by applications.

Refer to Chapter 7, *Historical Data Logging and Extraction*, for more information about the Citadel database.

Historical Trend Viewer

Use the Historical Trend Viewer (HTV) to view the data stored in any Citadel database. Select **Tools»Datalogging & Supervisory Control» Historical Trend Viewer** to open the HTV.

Refer to the *Accessing Historical Data Using the Historical Trend Viewer* section of Chapter 7, *Historical Data Logging and Extraction*, for more information about the Historical Trend Viewer.

Real-Time Database

The real-time database (RTDB) is a snapshot of the current state of all tags defined in the active `.scf` file. The RTDB stores the tag values, status, date, time, and alarm information. When you read and write tags and acknowledge alarms, the Tag Engine updates the RTDB.

User Manager

Use the User Manager to set up and edit individual accounts for users and groups of users who use either the LabVIEW DSC module or the applications you create with it. Use the User Manager to create an account for a user, assign a password, control how long the password is valid, set the security level for that user, and determine which security group or groups that user belongs to.

Select **Tools»Datalogging and Supervisory Control»Security»Edit User Accounts** to open the User Manager.

Refer to the *Creating and Editing User and Group Accounts* section of Chapter 8, *Security*, for more information about the User Manager.

Server Browser

In the LabVIEW DSC module, a *device server* is an application that communicates with and manages I/O devices such as PLCs, remote I/O devices, remote Tag Engines, and data acquisition (DAQ) plug-in devices. These servers read selected input items and write to them on demand. Refer to Chapter 3, *Servers*, for more information about device servers.

Use the Server Browser to see the device servers in a computer and in other computers on the network. You can view server information and display the front panel of VI servers (if the server is running), launch server configuration software for compatible servers, change OPC settings, and unregister a server. Select **Tools»Datalogging & Supervisory Control» Advanced»Server Browser** to open the Server Browser.

Image Navigator

Use the Image Navigator to browse through a collection of images you can use to create front panels. Select **Tools»Datalogging & Supervisory Control»Image Navigator** to open the Image Navigator.

The Image Navigator and its image files are installed in `Program Files\National Instruments\SymbolFactory`. To start the Image Navigator while LabVIEW is not running, run `imgnav.exe` in this directory.

Refer to the *Adding and Customizing Graphics* section of Chapter 5, *Displaying and Controlling Data*, for more information about the Image Navigator.

Customizing Your Work Environment

Complete the following steps to customize your work environment and to set startup options. Refer to the LabVIEW documentation for more information about customizing the LabVIEW work environment.

1. Select **Tools»Datalogging & Supervisory Control»Options** to display the **Options** dialog box.
2. Select among the options on the **Environment** and **Startup** tabs.

   To view descriptions of these options, select **Help»Show Context Help** and move the cursor over any option.
3. Click the **OK** button.

Changing Palette Views

The LabVIEW DSC module also installs a Datalogging & Supervisory Control palette view for the **Controls** and **Functions** palettes. If the Datalogging & Supervisory Control palette view is not active, complete the following steps to change to this palette view.

1. Click the **Options** button in the **Controls** or **Functions** palette toolbar.
2. Select **Datalogging & Supervisory Control** in the **Palette Set** field.
3. Click the **OK** button.

2

Developing an Application

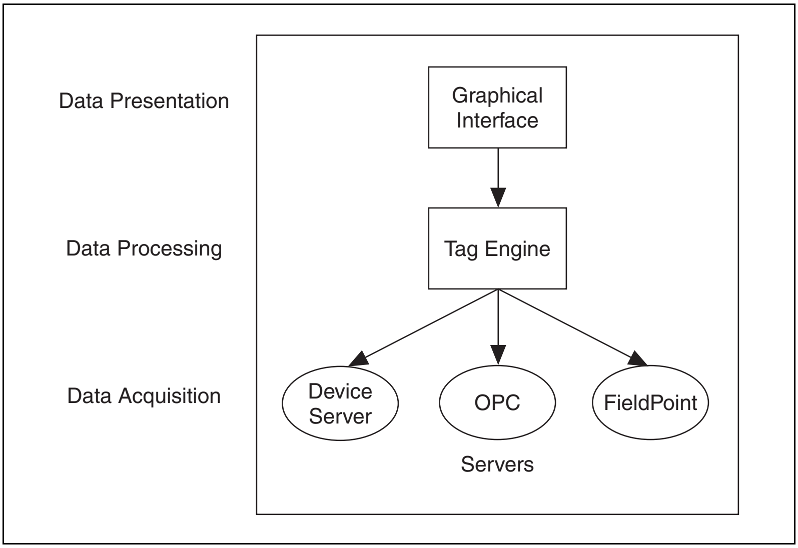
To develop a LabVIEW Datalogging and Supervisory Control (DSC) module application, you must be familiar with LabVIEW. Refer to the LabVIEW documentation for tutorial activities, examples, and general information about LabVIEW.

Example Applications

Before you develop a LabVIEW DSC module application, select **Help»Examples**, click **Other NI Product Examples**, and review the **Datalogging and Supervisory Control** examples.

Parts of a LabVIEW DSC Module Application

A LabVIEW DSC module application contains three parts that work together—the graphical interface or HMI application, the Tag Engine, and various device servers, as shown in the following illustration. The Tag Engine, with any device servers, runs as a separate process independent of the HMI application.



Basics Steps for Developing an Application

1. Plan your application requirements, such as channel count, logging, types of channels, security, and performance. Do not skip this step, because it impacts your decisions at every stage of development including setting up servers, configuring tags, and setting up network clients and servers.
2. Determine which hardware you will use.
3. Physically establish a connection to your hardware. Connect, configure, test, and troubleshoot.
4. Install and configure servers to connect to real-world I/O points. This creates the mechanism to handle communication with the hardware.
5. When possible, before you access servers in LabVIEW, test them according to instructions in the server documentation. Doing so can simplify any necessary troubleshooting.
6. Use the Tag Configuration Editor and Tag Configuration Wizard to create and configure tags and save the configuration (`.scf`) file.
7. Use the Tag Monitor to test the servers and tags.
8. Use the LabVIEW and LabVIEW DSC module VIs and functions to create the user interface or HMI application and any other functionality. Create the HMI application the same way you would create any LabVIEW application.
9. Deploy, test, and document your application.

3 Servers

In the LabVIEW Datalogging and Supervisory Control (DSC) module, a *device server* is an application that communicates with and manages I/O devices such as PLCs, remote I/O devices, remote Tag Engines, and DAQ plug-in devices. These servers read selected input items and write to them on demand.

The LabVIEW DSC module can connect to any OPC-compliant server and to many third-party device servers. You also can connect to National Instruments servers, including National Instruments DAQ and FieldPoint servers.

A server *item* is a channel, I/O point, or variable in a hardware device. You connect to these items with tags. Device servers monitor the values acquired by the hardware and the Tag Engine updates the tags when the server sends new data to the Tag Engine. Servers also update each output when the HMI application writes that tag value, and they handle and report communications and device errors. A good device server covers all device- and hardware-specific details, thereby establishing a device-independent I/O layer for the LabVIEW DSC module. Many device servers include a configuration utility as well as the run-time application that communicates with the Tag Engine.

When a LabVIEW DSC module application runs, it determines from the configuration (`.scf`) file which servers are needed and which items are needed from those servers. The LabVIEW DSC module launches each server it needs and monitors the specific items of interest through the Tag Engine.

The LabVIEW DSC module also can function as an OPC server and as a data source for the Logos networking protocol.

A server is not the same as a device driver or an instrument driver. In general, an instrument driver is a software component that is designed to control a programmable instrument such as a multimeter. A device driver is typically a low-level software component that a computer needs to work with a plug-in interface. Such a driver also can function as a server if it meets certain standards, such as the OPC specification.

Selecting a Server

The LabVIEW DSC module supports several types of servers including the following:

- **OPC servers**—Compliant with the OPC Foundation OPC Data Access specification 2.0 and earlier.
- **DDE servers**—Any server that supports the Dynamic Data Exchange (DDE) server interface. Refer to the *Using DDE Servers with the LabVIEW DSC Module* section for more information about DDE servers.
- **IA device servers**—A type of server developed by National Instruments. IA device servers have two implementations—VI-based and DLL-based.
  - **VI-based servers**—Use VIs to provide data to the Tag Engine.
  - **DLL-based servers**—Also known as IAK device servers or Industrial Automation Servers (IAS).

You also can use servers provided by a third-party hardware manufacturer. You can build a VI-based server when you have a uniquely configured or custom device that you want to use with the LabVIEW DSC module. Refer to the *Developing Device Servers* section for more information about creating developing VI-based device servers.

IAK Servers

Before the release of Windows 2000, National Instruments used IAK and OPC servers. However, with the release of Windows 2000, using the DLL-based IAK servers became problematic for reasons of compatibility.

To be compatible with future Windows versions, National Instruments recommends that you use OPC servers, specifically the OPC servers for NI-DAQ (including SCXI), National Instruments FieldPoint, and National Instruments FOUNDATION Fieldbus. Refer to the *Notes for BridgeVIEW Users* PDF document, installed with the LabVIEW DSC module, for more information about server compatibility and server strategies for the future.

You can purchase separately the National Instruments Servers CD, which includes the Lookout Protocol Drivers OPC server. You can use the Lookout Protocol Drivers OPC server to connect to a wide variety of devices through the OPC interface protocols. These devices include Allan-Bradley, Siemens, Modbus, and more. The Lookout Protocol Drivers OPC server also includes a large number of reliable, time-tested, and field-proven Lookout drivers. You can use these Lookout drivers to replace IAK servers, if necessary. The National Instruments Servers CD also includes a patch allowing IAK servers to run in Windows 2000. This patch is provided for backwards compatibility only, without the guarantee that IAK servers can continue to work in future Windows versions.

Installing and Configuring Servers

After you select the device servers to use with your hardware, install and configure them according to the server documentation.

For many servers, you must use the device server configuration utility to configure how the server monitors items, including how often it polls the devices and other server-specific and device-specific parameters.

Registering and Unregistering Servers

You might need to register your device servers manually for the LabVIEW DSC module to access them.

Registering OPC Servers

If a server complies with the OPC specification, it should register itself according to that specification. If an OPC server does not appear in the **Servers** listbox in the Tag Configuration Wizard, refer to the server documentation for information about registering the server.

Note If you change the server registration while the Tag Configuration Editor is open, the change does not appear in the **Servers** listbox. To update the **Servers** listbox while the Tag Configuration Editor is open, select **Servers»Refresh**.

Registering DDE Servers

You do not need to register DDE servers.

Registering VI-Based Servers

VI-based servers include a VI you use to register the server. Before you can use a VI-based server, you must run this registration VI.

The LabVIEW DSC module installs VI-based servers, which are the servers used in the LabVIEW DSC module examples. These servers include the tanks server, the SIM server, and the cookie server and are in `labview\examples\lvdsc\servers`.

These servers should already be registered. If they do not appear in the **Servers** listbox in the Tag Configuration Wizard, complete the following steps to manually register the server.

1. Open the server registration VI in `labview\examples\lvdsc\servers`. For example, open the Register Tanks Server VI to register the tanks server.
2. Run the VI.
3. Close the VI.
4. Repeat steps 1 through 3 for each server you need to register.

If you are writing VI-based device servers, refer to these server registration VIs for examples of registering your servers.

Unregistering a Device Server

You can unregister an OPC server only by uninstalling the server software.

You can usually unregister VI-based or IAK servers in the Server Browser. Do this only if no tags are configured to use that server and you no longer want to access any items defined by the server. After you unregister a server, you can no longer connect to it from the LabVIEW DSC module and any tag configured to use that server no longer has a valid configuration. After you unregister a device server, you must run the server configuration utility and register it to use it with the LabVIEW DSC module again.

Complete the following steps to unregister a VI-based or IAK device server.

1. Open the Server Browser.
2. Select the server you want to unregister.
3. Click the **Unregister Server** button.
4. Click the **Close** button.

Refer to the server documentation for information about unregistering third-party servers.

Launching Server Configuration Utilities

When you register a VI-based or IAK device server in your system, the LabVIEW DSC module also registers the location of its configuration utility, if possible.

Note On Windows NT, you might need to log in as an administrator to access server configuration utilities.

Complete the following steps to use the Server Browser to open these same configuration utilities, when available.

1. Open the Server Browser.
2. Select the server you want to configure in the **Servers** listbox.
3. Click the **Run Server Configuration** button. If no configuration utility is associated with that server, the **Run Server Configuration** button is dimmed.

You also can open registered server configuration utilities from the Tag Configuration Editor by selecting **Servers»*Server Name* Configuration**, where ***Server Name*** is the name of the server.

Viewing Server Information

Use the Server Browser to view information about the device servers in your system and on the network. You also can use the Server Browser to view certain properties of OPC and VI-based servers.

You also can use the Engine Manager to view information about running servers.

Viewing Information about All Servers

Complete the following steps to use the Server Browser to view information about all servers.

1. Open the Server Browser.
2. Select a server in the **Servers** listbox. The symbol to the left of the server name indicates the following information:
   - A black diamond indicates that the server is loaded and running.
   - A white diamond indicates that the server is loaded but not running.
   - No symbol indicates that the server is not being used in the current tag configuration.
3. Click the **View Server Information** button. A **Server Information** dialog box appears.

   This dialog box varies based on the type of server you selected and displays general information about the server, devices, and server items. If the Server Browser does not find any devices or items, a checkmark appears in the **No devices found** or **No items found** checkbox, respectively.

OPC servers have an optional Server Browse Address Space Interface. If a server supports this interface, the LabVIEW DSC module can query it to find which items are available from the server and display them in this dialog box.

4. Select a parameter in the **Sort By** pull-down menu to sort this table by item name, data type, or direction.

Viewing Information about Running Servers

Complete the following steps to use the Engine Manager to view information about running servers.

1. Open the Engine Manager.
2. Click the **View Servers in Use** button in the toolbar, shown at left. The **Servers In Use** window appears, listing the servers currently running and supplying data to the Tag Engine.
3. Select a server in the **Server** column. If the server is VI-based, click the **Show** or **Hide** button to show or hide the front panel of the server.
4. Click the **Details** button. A **Server Information** dialog box appears.

   This dialog box varies based on the type of server you selected and displays general information about the server, devices, and server items. If the Server Browser does not find any devices or items, a checkmark appears in the **No devices found** or **No items found** checkbox, respectively.

   OPC servers have an optional Server Browse Address Space Interface. If a server supports this interface, the LabVIEW DSC module can query it to find which items are available from the server and display them in this dialog box.
5. Select a parameter in the **Sort By** pull-down menu to sort this table by item name, data type, or direction.

Connecting Server Items to Tags

After you install, register, and configure a device server, use the Tag Configuration Editor to connect tags to server items. Refer to Chapter 4, *Using Tags to Manage I/O in LabVIEW*, for more information about creating and configuring tags to read from and write to server items.

Testing a Server

Complete the following steps to use the Server Browser to make sure your servers are properly installed and configured.

1. Open the Server Browser.
2. Check the **Servers** listbox to see if your server is listed. If it is not, skip to step 4.
3. Double-click the server to display the **Server Information** dialog box. If the items on that server appear in the dialog box, you successfully installed and configured the server. If the server items do not appear, continue to step 4.
4. Use the configuration utility for that server to check the installation and configuration.

After you configure the tags and save them, complete the following steps to make sure the server is providing data properly.

1. Start the Tag Engine.
2. Open the Tag Monitor.
3. Use the Tag monitor to connect to tags.
4. Make sure the data values and timestamps change.
5. If you cannot get live data with the Tag Monitor, use the configuration utility for that server to check the installation and configuration.

Using the LabVIEW DSC Module as an OPC Server

LabVIEW without the DSC module can act as an OPC client through a DataSocket connection. However, with the LabVIEW DSC module, the Tag Engine can operate both as an OPC client and as an OPC server.

Because it is an OPC server, an OPC client can launch the Tag Engine. When an OPC client launches the Tag Engine, the Tag Engine loads the current `.scf` file. The Tag Engine can then load any servers that the tags in that `.scf` file require. However, an OPC client cannot specify which `.scf` file the Tag Engine should use. The Tag Engine can use only the current `.scf` file, so you must make sure the correct `.scf` file is set as the default if you want this type of access.

When you access data from the Tag Engine acting as an OPC server, the client software, such as Lookout or some other OPC client software, sees the Tag Engine as an OPC server named `National`

`Instruments.OPCLabVIEW`, while the tag names you set in the `.scf` file appear as the OPC item names.

If the `.scf` file contains memory tags that hold values calculated by one of your VIs, those values do not update unless you run the LabVIEW application manually. However, neither the Tag Engine nor an OPC client run LabVIEW, so you have to launch the correct VI manually for the memory tag data to update.

Accessing OPC Servers Using the LabVIEW DSC Module as an OPC Client

The LabVIEW DSC module can function as an OPC client and communicate with any server implementing the OPC Foundation OPC server interface, which is a Microsoft COM-based standard. The LabVIEW DSC module finds all OPC servers installed on your computer and reads any available information about the server capabilities and items directly from the server.

Configuring the LabVIEW DSC Module OPC Client

You might need to configure the LabVIEW DSC module OPC client for the following reasons:

- If the server does not support asynchronous communication, you can force the client to use synchronous communication.
- If the server has many OPC items, you can increase the maximum number of items that display while you browse the server.
- If you perform many writes to the server and receive an output queue overflow, you can increase the length of the OPC write queue, which contains requested but not completed asynchronous writes to the OPC server.

Complete the following steps to configure the LabVIEW DSC module OPC client.

1. Open the Server Browser.
2. Click the **OPC Client Settings** button.
3. Complete the following steps to use synchronous communications with an OPC server.
    a. Click the **View All** button to display the **View All OPC Servers** dialog box.

   b. Select the server(s).
   c. Click the **Add** button. You also can type the server name in the textbox next to the **Add** button and click the **Add** button.
4. Change the **Max Browse Length** value to change the maximum number of OPC items that display while you browse an OPC server.
5. Change the **Max OPC Output Queue** to change the length of the OPC write queue.

Accessing Remote OPC Servers through the LabVIEW DSC Module

You can use the LabVIEW DSC module to access OPC servers running on other computers on the network. Use this method to access remote OPC servers so you can access different instances of the same server, such as National Instruments DAQ OPC, running both on your local computer and on the remote computer.

Complete the following steps to use the LabVIEW DSC module to access remote OPC servers.

1. Open the Server Browser.
2. Click the **Network OPC Servers** button to display the **Browse OPC Servers on Network** dialog box.

   You also can open the Tag Configuration Editor and select **Servers»Browse Network OPC Servers** to display the **Browse OPC Servers on Network** dialog box.
3. In the **Network** listbox, navigate to the OPC server you want to access.
4. Select the server and click the **Add Server** button.

   The server appears in the **Registered Remote OPC Servers** listbox. Select a server and click the **Remove Server(s)** button to remove a server from this listbox.

   If you receive an error while connecting to the server, run the `dcomcnfg.exe` Windows utility on the remote computer to configure OPC security options to allow your computer access to launch and connect to the remote computer.

Accessing Remote OPC Servers with dcomcnfg.exe

If necessary, you can use the `dcomcnfg.exe` Windows utility to configure an OPC server to run on a remote computer rather than your local computer. However, if you use `dcomcnfg.exe` to select a remote server, you can run only one version of that server, either locally or on one remote computer. You cannot use the same server on more than one computer.

Refer to the *Accessing Remote OPC Servers through the LabVIEW DSC Module* section for more information about accessing different instances of the same server.

Complete the following steps to configure an OPC server to run remotely.

1. Make sure `dcomcnfg.exe` is installed on your computer.
2. Run `dcomcnfg.exe`.
3. Click the **Applications** tab.
4. Select the OPC server in the list.
5. Click the **Properties** button to display the **Properties** dialog box.
6. Click the **Location** tab.
7. Remove the checkmark from the **Run application on this machine** checkbox and place a checkmark in the **Run application on the following computer** checkbox.
8. Type the name of the remote computer or click the **Browse** button to navigate to it.
9. Click the **OK** button.
10. Click the **Default Properties** tab and set the following options.
    a. Place a checkmark in the **Enable Distributed COM on this computer** checkbox.
    b. Set the **Default Authentication Level** to **Connect**.
    c. Set the **Default Impersonation Level** to **Identify**.
11. Click the **Default Security** tab.
12. Click the **Edit Default** button. Make sure that the computer on which you want to launch the OPC server is allowed to access your computer. This is necessary for the remote computer to call the LabVIEW DSC module on your computer when supplying OPC values.

Using Other Remote Servers

You can access data from any LabVIEW or Lookout application and FieldPoint FP-1600 module running on computers in your network through the Logos networking protocol.

To access LabVIEW and Lookout applications as servers, you must register the computers on which they are running. Refer to the *Registering Networked Computers* section of Chapter 9, *Networking and Deploying Applications*, for more information about registering computers.

Using DDE Servers with the LabVIEW DSC Module

The LabVIEW DSC module can communicate with any server using DDE as its interface. A DDE server is a simple server in which you type a device and item string to select a specific data point to which to connect.

Third-party DDE servers do not register themselves with the LabVIEW DSC module. Therefore, the LabVIEW DSC module cannot start the DDE server automatically when it runs the HMI application. To use a DDE server, start or run the DDE server before you start the Tag Engine. The LabVIEW DSC module returns system error messages if it cannot connect to the DDE server when it starts the Tag Engine. Thereafter, it attempts to reconnect to the DDE server periodically.

Developing Device Servers

You can use the LabVIEW DSC module to develop a VI-based device server to emulate hardware or connect the LabVIEW DSC module to hardware for which no device server exists. You can use the same LabVIEW development environment to create the server as you use to develop your application.

Use the controls located on the **Controls»DSC Server Data Types** palette and the VIs located on the **Functions»DSC Server Development** palette to write a VI-based device server.

Refer to the server registration VIs in `labview\examples\lvdsc\servers` for examples of registering your VI-based servers.

The LabVIEW DSC module also installs an Interactive Server Tester utility you can use to debug VI-based servers. Select **Tools»Datalogging & Supervisory Control»Advanced»Interactive Server Tester** to open the Interactive Server Tester. This tool is useful only with VI-based servers.

Refer to `viserver.pdf` in `labview\manuals` for information about building a VI-based device server and using the Interactive Server Tester.

4

Using Tags to Manage I/O in LabVIEW

In the LabVIEW Datalogging and Supervisory Control (DSC) module, you use a *tag* to create and maintain a connection to a real-world I/O point. You also can use a *memory tag* for data held by your application that you need to use or track. A *network tag* is a tag remotely connected to any type of tag on another Tag Engine.

The tasks you perform through tags depend on how you configure the tag attributes. Tag attributes include how the data a tag reports are scaled; whether, where, and how a tag is logged to a historical database; and alarm levels and priorities for the tag data.

In addition, you can organize tags into logical groups for convenience and efficiency, configure the tag data type, set initialization values, set separate deadbands for logging or updating data, attach units of measurement to data, attach an alarm message to a tag whose values enter the alarm ranges you set, and set alarm deadbands separate from the logging and update deadbands.

You perform tag management in the Tag Configuration Editor, which you access by selecting **Tools»Datalogging & Supervisory Control»Configure Tags**. Before you create or configure tags, you must install and configure your servers. Refer to Chapter 3, *Servers*, for more information about installing and configuring servers.

Configuration Files

After you create tags and configure their attributes, you save that information in a configuration (`.scf`) file. Any LabVIEW DSC module utility that needs tag information uses the `.scf` file. These utilities include the Tag Engine, Tag Monitor, and HMI Wizard, which generally access the `.scf` file to find a list of active tags and other configuration information.

The `.scf` file does not contain any information about the VIs in the HMI. In fact, it does not need to be specific to any single application. Multiple applications can run concurrently if they use the same `.scf` file.

Changing the Active .scf File

With the exception of the first time you run the LabVIEW DSC module, the active (default) `.scf` file is the last `.scf` file you saved with the Tag Configuration Editor. The Tag Configuration Editor opens the active `.scf` file by default and the Tag Engine accesses the active `.scf` file by default. You can change the active `.scf` file manually or programmatically.

Changing the Active .scf File Manually

Complete the following steps to change the active `.scf` file manually.

1. Select **Tools»Datalogging & Supervisory Control»Options**.
2. Click the **Environment** tab.
3. Change the **Default SCF** value.

   This change could take effect immediately, depending on the options you select in the **Options** dialog box.

Changing the Active .scf File Programmatically

Complete the following steps to change the active `.scf` file programmatically in a VI.

1. Use the Load SCF VI or Engine Launch VI located on the **Functions»System** palette.
2. Connect the `.scf` filename you want to the **Configuration File to Use** input terminal.

Creating Tags

You can create tags in several ways:

- Generate tags automatically in the Tag Configuration Wizard.
- Create tags manually in the Tag Configuration Editor.
- Create tags in the HMI Wizard before you connect front panel objects to a tag value.

Note You must create DDE server connections manually in the Tag Configuration Editor, instead of in the Tag Configuration Wizard.

Generating Tags Automatically

Use the Tag Configuration Wizard to generate tags from the server information if you want the Tag Engine to monitor a large number of I/O points in your system. When you run the server configuration utilities for the servers on your system, you can define devices and items for the I/O points that the servers monitor and control. You can then generate tags from these server items in the Tag Configuration Wizard.

The wizard uses the tag name, data type, I/O group, I/O connection, and scaling attributes for each server item to create the tags. For IAK and VI-based servers, the wizard reads server information from the Common Configuration Database (CCDB). For OPC servers that support the Server Browse Address Space Interface, the wizard reads server information by browsing the server address space. The wizard uses the default tag attributes to configure the remaining attributes. You can change the default tag attributes in the Tag Configuration Wizard by clicking the **Set Tag Defaults** button. Refer to the *Defining Default Values for Tag Configuration Fields* section for more information.

Note You must create DDE server connections manually in the Tag Configuration Editor, instead of in the Tag Configuration Wizard. Refer to the *Creating Tags Manually* section for more information about creating tags in the Tag Configuration Editor.

Complete the following steps to use the Tag Configuration Wizard to generate tags.

1. Open the Tag Configuration Editor.
2. Click the **Configuration Wizard** button in the toolbar, shown at left.
3. Expand each server branch in the **Servers** tree view to display the devices and items for one or more servers. If the **Servers** tree view lists item ranges instead of individual item names, skip to step 6.
4. Select the items for which you want to create tags.

   Select a branch in the **Servers** tree view to generate tags for all the items in that branch. Select a server branch to generate tags for all items on that server.
5. Click the **Add Item(s)** button. The Tag Configuration Wizard moves the selected items to the **Selected Items** listbox.
6. (Optional) Some OPC servers do not list individual item names in their hierarchical tree, but instead provide ranges for item names. This is common when the server contains a large set of items. These item ranges help you create specific item names. The format for the item

ranges depends on the OPC server. If your server uses item ranges, complete the following steps to generate tags from an item range.

a. Select an item range.

b. Click the **Add as Range** button to display the **Add Items in a Range** dialog box.

c. Type the starting item name and set the number of items that you want to create.

   The Tag Configuration Wizard creates the item names, incrementing the trailing numbers in the starting item name. If you did not add a trailing number to the starting item name, the Tag Configuration Wizard appends a zero to the first name and increments trailing numbers in each subsequent name.

7. (Optional) The Tag Configuration Wizard uses the tag configuration defaults to set most of the tag parameter values. To change these defaults, click the **Set Tag Defaults** button.

8. (Optional) The Tag Configuration Wizard automatically creates I/O groups for each server and uses the tag configuration defaults to set the I/O group rate and deadband settings. The Tag Configuration Wizard also sets the I/O group name to the server name. Complete the following steps to change the I/O group settings for each server.

   a. Select a server.

   b. Click the **Properties** button to display the **Properties of Tags Generated for Device/Server** dialog box.

   c. Click the **I/O Group** tab.

   d. Select among the I/O group settings.

9. (Optional) The Tag Configuration Wizard sets the tag name to the item name for each tag created. For non-OPC servers that have devices, the tag name contains both the device and item name if the server has more than one device. Follow these steps if you want to change the tag name format for a server.

   a. Select a server.

   b. Click the **Properties** button to display the **Properties of Tags Generated for Device/Server** dialog box.

   c. Click the **Tag Names** tab.

   d. Set the tag name format.

10. To remove individual items from the **Selected Items** listbox, select the items and click the **Remove Item(s)** button. To remove all of the items, click the **Remove All** button.

11. When all the items for which you want to create tags are in the **Selected Items** listbox, click the **OK** button.

    The Tag Configuration Editor creates tags for each item and appends the tags to the current tag configuration (`.scf`) file.

12. (Optional) If you want the changes to be a separate `.scf` file, select **File»Save As** and save the file with a different name.

Creating Tags Manually

When you generate tags, you can either add them to an existing configuration, or you can create a new configuration file (`.scf`). You can later manually change the configuration of any tag.

1. If you have not already done so, install and configure your server(s) as described in Chapter 3, *Servers*.
2. Open the Tag Configuration Editor.
3. Select **Edit»Create** and select the type of tag you want to create. A **Tag Configuration** dialog box appears.
4. Select among the tag configuration options. The tag name must be unique within a given `.scf` file. Refer to the *Configuring Tag Attributes* section for more information about the tabs and fields in this dialog box.
5. Click the **OK** button to create the new tag or click the **Create Next Tag** button to create the new tag and create another tag of the same type.
6. Select **File»Save** to save the changes.

Creating Tags from the HMI Wizard

You can create a tag when you right-click a front panel control or indicator and run the HMI Wizard. Refer to the *Connecting Controls and Indicators to Tags* section of Chapter 5, *Displaying and Controlling Data*, for more information.

Editing Tags

You can edit tags manually, programmatically, or in a spreadsheet.

Editing Tag Configuration Manually

1. Open the Tag Configuration Editor.
2. Double-click the tag to display the **Tag Configuration** dialog box.

3. Select among the tag configuration options. Refer to the *Configuring Tag Attributes* section for more information about the tabs and fields in this dialog box.
4. Click the **OK** button. A diamond appears next to the tag to indicate it has changed.
5. Select **File»Save** to save the changes.

If you want to update the Tag Engine and any static attributes have been changed, the Tag Engine shuts down and restarts. If you have changed only dynamic attributes in the `.scf` file, the Tag Engine is updated without restarting.

Caution Communication between the Tag Engine and any device server is stopped temporarily when the Tag Engine shuts down and restarts.

Editing Tag Configuration Programmatically

You can edit tag configuration information programmatically, which is helpful when displaying engineering units, scales, and other information about the tag or changing a tag from `Offscan` to `Onscan`. Use the Tag Attributes VIs to edit tag configuration information programmatically. Refer to the *Changing Tag Attributes Programmatically* section of Chapter 5, *Displaying and Controlling Data*, for more information about the Tag Attributes VIs.

Editing Tag Configuration in a Spreadsheet

With the Tag Configuration Editor, you can export tag configuration information to spreadsheet files and import tag configuration information from spreadsheet files. The files are tab-delimited text (`.txt`) files.

If you use spreadsheet files with the Tag Configuration Editor, it is important that you consider the following:

- If you do not select *all* of the fields when exporting data, you lose configuration information when you import it back to the Tag Configuration Editor.
- You can export a subset of information, and then rely on tag default parameters when you import the data back into the Tag Configuration Editor. However, each row in the spreadsheet file must contain the tag name and data type fields, or the import mechanism cannot read it.
- Some configuration parameters, such as those in the **Historical Logging Configuration** and **Event Configuration** dialog boxes, are

inherited from the currently open `.scf` file when you import spreadsheet data.

- When importing, you can append the imported tags to the current `.scf` file.
- If you create a spreadsheet file to import as a tag configuration, use the same format as a file created by exporting an existing tag configuration.

Exporting Tag Configuration to a Spreadsheet

1. Open the Tag Configuration Editor.
2. Select **File»Export** to save the file as a tab-delimited `.txt` file.
3. A dialog box prompts you to select and order the fields you want in the spreadsheet file. If you want to edit the spreadsheet and import the edited data back into the Tag Configuration Editor, click the **All** button to select all available fields. Click the **Default Order** button to restore the order of the fields to the default order.

Importing Tag Configuration from a Spreadsheet

1. Save the spreadsheet as a `.txt` file.
2. In LabVIEW, open the Tag Configuration Editor.
3. (Optional) Select **File»New** to open a new `.scf` file for the imported tag configuration.
4. Select **File»Import** and select the `.txt` file to import the data from the spreadsheet.
5. Select **File»Save** to save the changes.

Defining Default Values for Tag Configuration Fields

You can simplify the tag configuration process by defining default values for several fields. These default values are then used when you create tags automatically, such as with the Tag Configuration Wizard or by importing. For example, you might want to set the default to **Log Data** or **Log Events**, or set the log deadband to a particular value by default.

1. Open the Tag Configuration Editor.
2. Select **Configure»Default Parameters** to display the **Set Default Parameters** dialog box. You also can click the **Set Tag Defaults** button in the Tag Configuration Wizard to display this dialog box.

3. Set the default values for the parameters listed. Refer to the *Configuring Tag Attributes* section for more information about these parameters.
4. Click the **OK** button.

The default values apply when creating a new tag, importing a tag from a server, or importing a tag from a spreadsheet. In the case of a spreadsheet, a value in the spreadsheet overrides the default value for the field.

Setting Tag Deadbands

A deadband is a filter that eliminates noise from data. Any changes in value from a data point are compared to the previous value, and only if the difference between the new value and the previous value exceeds the deadband does the new value replace the old. In LabVIEW applications, deadbands are set as a percentage of the value range of a data point.

The Tag Engine uses update deadband and log deadband values to eliminate unnecessary processing on insignificant data value changes. Deadband allows you to define what constitutes a significant change. The Tag Engine ignores an operation if the change in data is not considered significant. You can increase engine throughput by increasing deadband size (though this might compromise data resolution). If you set the update deadband too high, the RTDB might not be updated. This might result in inadequate historical logging or alarm management. In addition, you can configure a server to apply a deadband to items associated with an I/O group.

Deadbanding Interaction

Three deadband settings are directly under your control when you configure individual tags. The fourth takes advantage of an OPC specification and is consequently subject to how that specification was implemented in a given OPC server.

The three deadband settings that are directly under your control are update deadband, log deadband, and alarm deadband.

The update deadband affects how the Tag Engine updates values in the RTDB. The log and the alarm deadbands both operate on the values contained in the RTDB, that is, values that have passed through the update deadband. If the update deadband is set too wide, under some circumstances, it can interfere with your intended alarm and log settings. A careful analysis of the interaction of your deadbands might be indicated, depending on how critical your requirements are.

The deadband setting that takes advantage of an OPC specification is the OPC server I/O group deadband. This deadband is implemented in the server. This deadband affects values coming from the server before the Tag Engine gets the value, so the effects of a deadband setting here can ripple through the update deadband and the log and alarm deadbands. Also, because items in an I/O group can have different ranges, the percentage you select as a deadband might have different numeric results with different items. Refer to your server documentation before you change OPC server I/O group deadband settings.

Setting Update Deadbands

When you set an update deadband, any new value acquired by the Tag Engine is compared to the existing value held in the RTDB. The new value replaces the existing value in the RTDB only when the difference between the new value and the existing value exceeds the update deadband. You set the update deadband in the tag configuration **Operations** tab.

Example

For a data point with a range of values of 0 to 100, set the update deadband to 1%. The existing value in the RTDB is 12.3. If the Tag Engine reports a new value of 13, the RTDB does not update because the change in value did not exceed the deadband. If the Tag Engine reports a new value of 11, the RTDB updates because the difference is greater than the deadband.

Setting Log Deadbands

When you set a log deadband, the new value in the RTDB is compared to the old value in the RTDB. The new value is logged if it exceeds the log deadband. You set the log deadband in the tag configuration **Operations** tab.

The default setting for the log deadband is 1%.

Example

For a data point with a range of values of 0 to 100, set the logging deadband to 2%. The last value logged was 12.3. When the RTDB updates to 11, the updated value is not logged because it is smaller than the deadband. The value in the RTDB must be greater than 14.3 or less than 10.3 for the data point to be logged.

Setting Alarm Deadbands

When you set an alarm deadband, the new value in the RTDB is compared to the old value in the RTDB. The alarm is triggered when the value falls outside the range of the deadband and is cleared when it reaches the inside range of the deadband. You set the alarm deadband in the tag configuration **Alarm** tab.

Example

For a data point with a range of values of 0 to 100, set a LO condition alarm at a value of 12 with a deadband of 1.5%. Your alarm condition is not triggered to active until the RTDB value drops to 12 or below. The alarm stays active until the RTDB value rises to 13.5 or greater.

Setting I/O Group Deadbands with OPC Servers

When you set a deadband for I/O groups in OPC servers, the OPC server gets the tag value, then filters the tags in the I/O group by deadband before sending the data to the Tag Engine. The Tag Engine can filter data by deadband again before sending the values to the RTDB.

Complete the following steps to set I/O group deadbands.

1. Open the Tag Configuration Editor.
2. Double-click a tag in the I/O group for which you want to set deadbands. The **Tag Configuration** dialog box appears.
3. Click the **Connection** tab.
4. Click the **Edit** button located under the **I/O Group** pull-down menu to display the **IO Group Configuration** dialog box.
5. Change the **Update Rate** and **Deadband** values.
6. Click the **OK** button twice.

The percentage you set applies to the range of each individual OPC item, so the actual raw value of the deadband might change from item to item. This I/O group deadband takes place in the OPC server. Settings made in the OPC server might impact the effect of your deadband setting. Refer to your OPC server documentation for more information about that server.

Deleting Tags

1. Open the Tag Configuration Editor.
2. Select the tag(s) you want to delete.
3. Click the **Delete Tag** button on the toolbar. A trash can icon appears next to the tags.
4. Select **File»Save** to delete the marked tags. The Tag Configuration Editor removes the tag and its configuration information from the `.scf` file. You still can retrieve historical and event information about the tag, but the Tag Configuration Editor removes information such as the tag description, units, range, and alarm settings.

You can use the **Delete Tag** button in the button bar of the Tag Configuration Editor to undelete tags if all selected tags have a trash can symbol.

Configuring Tag Attributes

Tag attributes set how the Tag Engine handles a tag. There are five categories of tag attributes: General, Connection, Operations, Scaling, and Alarms.

When you create a tag using the Tag Wizard, the Tag Wizard assigns the default values for each tag attribute. Refer to the *Defining Default Values for Tag Configuration Fields* section for more information about setting tag default values.

When you create a tag manually by selecting **Edit»Create** in the Tag Configuration Editor, you can set each attribute in the **Tag Configuration** dialog box that appears.

Complete the following steps to edit the attributes of an existing tag.

1. Open the Tag Configuration Editor.
2. Double-click the tag to display the **Tag Configuration** dialog box.
3. Click the following tabs and select among the options.
   - **General**—Attributes such as tag name, group, and description.
   - **Connection**—Attributes that describe where the Tag Engine sends or receives values for the tag and how to access that data.

     These tags have access rights of input, output, or input/output. Memory tags are not connected to a real-world I/O point; set their

Tag Access to **Memory**. Refer to the *Determining When to Use Memory Tags* section for more information about memory tags.

- **Operations**—Attributes that describe additional functionality that the Tag Engine performs on a tag or its values.
- **Scaling**—Attributes that describe which scaling function is applied to a tag value.
- **Alarms**—Attributes that describe abnormal process conditions for a given tag.

4. Click the **OK** button.
5. Select **File»Save** to save the changes.
6. Use the Tag Monitor to test the tag configuration and make sure you are reading and writing data properly with your servers. Refer to the *Monitoring and Writing Tag Values* section for more information about using the Tag Monitor.

Tag Data Type

How you configure a tag varies slightly depending on the data type. Tag data types include analog, discrete, bit array, and string tags.

Analog Tags

An *analog tag* is a continuous value representation of a connection to a real-world I/O point or memory variable. This type of tag can vary continuously over a range of values within a signal range.

Use an analog tag when you want to express a continuous value (for example, 0 to 100).

Discrete Tags

A *discrete tag* (Boolean control or indicator in LabVIEW) is a two-state (ON/OFF) value representation of a connection to a real-world I/O point or memory variable. This type of tag can be either a 1 (TRUE) or a 0 (FALSE).

Use a discrete tag when you want to express a two-state (ON/OFF) value.

Bit Array Tags

A *bit array tag* is a multi-bit value representation of a connection to a real-world I/O point or memory variable. This type of tag can be comprised of up to 32 discrete values.

Use a bit array tag when you have a multi-bit value in which each of the bits represents a flag or single value that is turned on or off. The maximum length of a bit array tag is 32.

LabVIEW stores a bit array as a number (which is what displays in the Tag Monitor), but it is an array of bit values.

String Tags

A *string tag* is an ASCII or binary character representation of a connection to a real-world I/O point or memory variable.

Use a string tag when you have binary information or an ASCII value. For example, you might use a string tag to obtain values from a bar code reader, or if you have data that do not fit into any other data type. You also can use a string tag for PLC control strings and PLC reporting strings.

Static and Dynamic Attributes

Tag attributes are classified as either static or dynamic attributes. *Static attributes* require you to restart the Tag Engine when you change them in the Tag Configuration Editor. A static attribute change is marked with a solid diamond in the Tag Configuration Editor. Examples of static attributes include general attributes and I/O connection attributes, such as server, device, or item.

Dynamic attributes do not require the Tag Engine to restart. The Tag Configuration Editor can change a dynamic tag attribute in a running Tag Engine. A dynamic attribute change is marked with a hollow diamond in the Tag Configuration Editor. Examples of dynamic attributes include enabling logging operations, alarm attributes, and some scaling attributes.

Defining a Tag Group

Use tag groups to define a subset of tags in the system. You also can use tag groups to examine the alarm states for a subset of tags in the system. Refer to Chapter 6, *Alarms and Events*, for more information about alarm groups.

1. Open the Tag Configuration Editor.
2. Double-click a tag to display the **Tag Configuration** dialog box.
3. Click the **General** tab.
4. Select an existing tag group or define a new tag group by selecting **Enter New**.

5. (Optional) To view the tag groups, select **Configure»Tag Groups**. The **Tag Group Display** dialog box appears. Click the **Remove Tag Group** button to delete the tag group.
6. Click the **OK** button.
7. Select **File»Save** to save the changes.

Configuring I/O Groups

I/O groups are used to configure item rate and deadband for items of a server and to select a specific device, if the server uses devices. For servers that support resource configuration, you also can use I/O groups to configure devices and communication resources. For OPC servers, an I/O group conforms to the concept of an OPC group, which is user-defined and controls timing. Each I/O group you create maps to an OPC group in the OPC server with the same attributes. An I/O group is associated with only one server and, if that server uses devices, with only one device. A server can have multiple I/O groups associated with it.

Any tag other than a memory tag must be part of an I/O group. If you are editing a tag an I/O group probably already exists. If you want the tag to go into a new I/O group or your are creating a tag, you will have to create an I/O group before connecting your tag to a server item.

Complete the following steps to edit the I/O group configuration.

1. Open the Tag Configuration Editor.
2. Double-click the tag to display the **Tag Configuration** dialog box.
3. Click the **Connection** tab.
4. Click the following buttons, which are located under the **I/O Group** pull-down menu. If the **I/O Group** pull-down menu is dimmed, set **Tag Access** to something other than **Memory**.
   - To create an I/O group, click the **Create** button. Select a device from the list of available devices that appears.

     A list of items connected to that device appears in the **Tag Configuration** dialog box. For a selected device and item, the Tag Configuration Editor imports any available item engineering range and unit information and also makes sure the directions or access rights for an item are compatible with the access rights you have selected for the tag.

     If a device server does not appear in the server name list, you must run the configuration or registration utility for your server before the LabVIEW DSC module can access the server. Refer to the

Installing and Configuring Servers section of Chapter 3, *Servers*, for more information.

- To edit an I/O group, select a group in the **I/O Group** pull-down menu and click the **Edit** button.
- To delete an I/O group, select a group in the **I/O Group** pull-down menu and click the **Delete** button. The I/O group is deleted from the server configuration. Deleting an I/O group does not delete the device and communication resource from the server configuration.

5. Click the **OK** button.
6. Select **File»Save** to save the changes.

Configuring DDE Devices and Items

1. Open the Tag Configuration Editor.
2. Double-click the tag to display the **Tag Configuration** dialog box.
3. Click the **Connection** tab.
4. Click the **Create** or **Edit** button under the **I/O Group** pull-down menu. The **I/O Group Configuration** dialog box appears.
5. Click the **Add** button under the **Device** pull-down menu.
6. Type the DDE application name and topic in the form *`application`*|*`topic`* in the **Device** textbox. For example, type `excel`|*`worksheetname`* to connect to a cell in Microsoft Excel.

   If you are using network DDE to use a DDE server running on another computer, use the network DDE name for the *`application`* part of the device name. Refer to your DDE server documentation for more information about application and topic names.
7. Click the **OK** button twice.
8. Click the **Add** button under the **Access Path** pull-down menu.
9. Type the name of the item you want to connect to in the **Item** textbox. For example, type `r2c2` to connect to cell B2 in Excel. You cannot browse a DDE server for available items. Refer to your DDE server documentation for more information about item names.
10. Click the **OK** button.
11. Select **File»Save** to save the changes.

Configuring Communication Resources

You can configure communication resources only for IAK servers. Complete the following steps to configure the communication resource.

1. Open the Tag Configuration Editor.
2. Double-click a tag to display the **Tag Configuration** dialog box.
3. Click the **Connection** tab.
4. Click the **Create** or **Edit** button under the **I/O Group** pull-down menu. The **I/O Group Configuration** dialog box appears.
5. Click the following buttons, which are located under the **Communication Resource** pull-down menu.
    - To create a new communication resource, click the **Create** button.
    - To edit a communication resource, select a resource in the **Communication Resource** pull-down menu and click the **Edit** button.
    - To delete a communication resource, select a resource in the **Communication Resource** pull-down menu and click the **Delete** button.
6. Click the **OK** button twice.
7. Select **File»Save** to save the changes.

Configuring Device Names

You can configure device names only for servers that allow users to configure device names, such as DDE servers. DDE servers use the device name to specify the DDE application and topic. Complete the following steps to configure the device name.

1. Open the Tag Configuration Editor.
2. Double-click a tag to display the **Tag Configuration** dialog box.
3. Click the **Connection** tab.
4. Click the **Create** or **Edit** button under the **I/O Group** pull-down menu. The **I/O Group Configuration** dialog box appears.
5. Click the following buttons, which are located under the **Device** pull-down menu.
    - To add a device name, click the **Add** button. In the **Add Device Name** dialog box, enter a new device name for a server and click the **OK** button.

- To edit a device name, select a device in the **Device** pull-down menu and click the **Edit** button. In the **Edit Device Name** dialog box, edit the existing device name for a server and click the **OK** button.
- To delete a device name, select a device in the **Device** pull-down menu and click the **Delete** button. The selected device name is removed from the device list.

6. Click the **OK** button.
7. Select **File»Save** to save the changes.

Configuring Device Resources

You can configure device resources only for servers that allow users to configure device resources. Complete the following steps to configure the device resources.

1. Open the Tag Configuration Editor.
2. Double-click a tag to display the **Tag Configuration** dialog box.
3. Click the **Connection** tab.
4. Click the **Create** or **Edit** button under the **I/O Group** pull-down menu. The **I/O Group Configuration** dialog box appears.
5. Click the following buttons, which are located under the **Device** pull-down menu. The options in the **Device Configuration** dialog box vary depending on the type of server.
    - To create a new device configuration, click the **Create** button. In the **Device Configuration** dialog box, configure the device and click the **OK** button.
    - To edit a device configuration, select a device in the **Device** pull-down menu and click the **Edit** button. In the **Device Configuration** dialog box, edit the existing device configuration and click the **OK** button.
    - To delete a device configuration, select a device in the **Device** pull-down menu and click the **Delete** button. The selected device name is removed from the server configuration.
6. Click the **OK** button.
7. Select **File»Save** to save the changes.

Configuring Item Names

You can configure item names only for servers that allow users to configure item names, such as DDE servers. Complete the following steps to configure item names.

1. Open the Tag Configuration Editor.
2. Double-click a tag to display the **Tag Configuration** dialog box.
3. Click the **Connection** tab.
4. Click the following buttons, which are located under the **Access Path** pull-down menu. If the server does not support item names, these buttons are disabled.
    - To add an item name, click the **Add** button. In the **Add Item Name** dialog box, enter a new item name for a selected server and click the **OK** button.
    - To edit an item name, select an item in the **Item** pull-down menu and click the **Edit** button. In the **Edit Item Name** dialog box, edit the existing item name for a selected server and click the **OK** button. If the server has access paths, you also can edit an access path.

      For OPC servers, you also can click the **Browse** button to view the hierarchical organization of the server items, navigate to an item, select it, click the **OK** button, and click the **Edit** button.
    - To delete an item name, select an item in the **Item** pull-down menu and click the **Delete** button. The selected item name is removed from the item list. If the server has access paths, the selected access path is removed from the access path list.
5. Click the **OK** button.
6. Select **File»Save** to save the changes.

Configuring Item Resources

You can configure item resources only for servers that allow users to configure item resources, such as many OPC servers. Complete the following steps to configure item resources.

1. Open the Tag Configuration Editor.
2. Double-click a tag to display the **Tag Configuration** dialog box.
3. Click the **Connection** tab.

4. Click the following buttons, which are located under the **Access Path** pull-down menu. If the server does not support item configuration, or if the selected item is not valid, these buttons are disabled.
   - To create an item resource, click the **Add** button. In the configuration dialog box, configure a new item for a selected server and click the **OK** button.
   - To edit an item resource, select an item in the **Item** pull-down menu and click the **Edit** button. In the server-dependent dialog box, edit the configuration of the selected item and click the **OK** button
   - To delete an item resource, select an item in the **Item** pull-down menu and click the **Delete** button. The selected item is removed from the server configuration.
   - To browse available items from OPC servers that support browsing, click the **Browse** button. In the **Browse OPC Server** dialog box, browse the list of available items, select an item and associated access path, and click the **OK** button
   - To use the item name as the tag name, click the **Paste Item Name to Tag Name** button. Clicking this button replaces any name in the **Tag Name** field on the **General** tab.
5. Click the **OK** button.
6. Select **File»Save** to save the changes.

Configuring a Tag to Log Data or Events

By default, when a tag is first created, the LabVIEW DSC module enables logging, so when you start logging, you log all tags except those you have configured not to be logged. To start logging, you either manually activate it in the Engine Manager or you set logging to begin automatically when the Tag Engine starts.

To enable logging programmatically, use the System VIs that enable event or historical data logging.

Complete the following steps to configure logging manually.

1. Open the Tag Configuration Editor.
2. Double-click the tag to display the **Tag Configuration** dialog box.
3. Click the **Operations** tab.
4. Place or remove checkmarks from the **Log/Print Events** and **Log Data** checkboxes. Set the logging deadband and the data resolution, if applicable.

5. Click the **OK** button.
6. Select **File»Save** to save the changes.
7. Make sure the Tag Engine is set to log historical data or events.
   - Select **Configure»Historical** to log data and **Configure»Events** to log events. Place a checkmark in the **Start logging on system start-up** checkbox in either dialog box to set automatic logging when the Tag Engine starts. Change the **Maximum time between logs** value to force the LabVIEW DSC module to log a value at a set interval, even if the tag value does not exceed the deadband. When the Tag Engine loads an `.scf` file with these settings configured to start historical logging, the Tag Engine logs data (and events) from the moment it starts, and checkmarks are placed in the logging option checkboxes in the Engine Manager. This setting is part of the `.scf` file and can change when you change active `.scf` files.
   - If you have not configured the `.scf` file to initiate logging when the Tag Engine starts, you can start logging manually through the Engine Manager by placing checkmarks in the appropriate checkboxes.

   In both cases, the LabVIEW DSC module logs data from all tags that have been configured for logging.

Setting Startup Tag Values

Set startup values to initialize a tag to a known value when the Tag Engine starts.

1. Open the Tag Configuration Editor.
2. Double-click a tag to display the **Tag Configuration** dialog box.
3. Click the **Operations** tab.
4. Place a checkmark in the **Set Initial Value** checkbox.
5. Type the initial value in the adjacent textbox.
6. Click the **OK** button.
7. Select **File»Save** to save the changes.

Scaling Tags

Scaling is useful for converting the range of values from measured units into a calculated range. Only analog (numeric), discrete, and bit array tags have scaling attributes. There is no scaling for string tags.

Often an application needs the LabVIEW DSC module to manipulate the raw data used in the device server to put it in a form, called engineering units, suitable for the operators.

Scaling Analog Tags

You can define the raw range and engineering range for a tag to perform simple conversions between the two ranges. The raw range, defined by Raw Full Scale and Raw Zero Scale, refers to the values used by the device server. Engineering range, defined by Engineering Full Scale and Engineering Zero Scale, refers to the values used by the Tag Engine and HMI.

1. Open the Tag Configuration Editor.
2. Double-click an analog tag to display the **Tag Configuration** dialog box.
3. Click the **Scaling** tab.
4. Select **Linear** in the **Scale Type** pull-down menu to enable a linear *(mx + b)* conversion between raw and engineering ranges. Select **Square Root** to enable a square root conversion between the raw and engineering ranges.
5. Click the **OK** button.
6. Select **File»Save** to save the changes.

Square Root and Linear Scaling

Linear scaling is a straight proportional scale of raw values to engineering unit values.

Square root scaling is a proportional way of scaling raw values to engineering units. It is generally used when scaling down by scaling to the square root of the of the raw unit (after compensating for any offsets involved).

Suppose you want to scale a raw value that ranges from 0 to 100 to engineering units ranging from 0 to 10. The tag returns values, as shown in the Table 4-1.

Table 4-1. Square Root and Linear Scaling Example Values

Raw Units	Linear Scale	Square Root Scale
0	0	0
4	.4	2

Table 4-1. Square Root and Linear Scaling Example Values (Continued)

Raw Units	Linear Scale	Square Root Scale
9	.9	3
16	1.6	4
25	2.5	5
36	3.6	6.
49	4.9	7
81	8.1	9
64	6.4	8
10	1	3.16
20	2	4.47
30	3	5.48
40	4	6.32
50	5	7.07
60	6	7.75
70	7	8.37
80	8	8.94
90	9	9.49
100	10	10

Table 4-2 shows a raw value that ranges from 0 to 100 scaled to engineering units ranging from 15 to 30. Offsets deliver somewhat more complicated results.

Table 4-2. Scaling with Offset Example Values

Raw Units	Linear Scale	Square Root Scale
0	15	15
4	15.60	18
16	17.40	21

Table 4-2. Scaling with Offset Example Values (Continued)

Raw Units	Linear Scale	Square Root Scale
36	20.40	24
64	24.60	27
10	16.50	19.74
20	18	21.71
30	19.50	23.22
40	21	24.49
50	22.50	25.61
60	24	26.62
70	25.50	27.55
80	27	28.42
90	28.5	29.23
100	30	30

Example—Linear Scaling

A device server returns a simple voltage from 0 to 5 V. The voltage is related to a position sensor, and the real-world position is measured in centimeters, with 0 volts mapped to 50 cm and 5 V mapped to 100 cm.

Configure the tag for raw range from zero (Raw Zero Scale) to five (Raw Full Scale). Select **Linear**, and set the engineering range from 50 (Eng Zero Scale) to 100 (Eng Full Scale).

Example—Square Root Scaling

A flow meter measures the flow rate of a liquid using a differential pressure reading. The device server provides 4–20 mA readings. The actual flow is measured in gallons per minutes (GPM). 4 mA corresponds to 0 GPM; 20 mA corresponds to 100 GPM.

Configure the tag for raw range from 4 (Raw Zero Scale) to 20 (Raw Full Scale). Select **Square Root Scaling** and set the engineering range from 0 (Eng Zero Scale) to 100 (Eng Full Scale).

Assigning Units to an Analog Tag

Use the **Engineering Unit** field to assign units to a tag. If the desired unit is not in the list, select **Enter New** and enter the desired unit. In the previous example, you select units of GPM.

Scaling Discrete Tags

The only scaling available for discrete (Boolean) tags is invert scaling.

1. Open the Tag Configuration Editor.
2. Double-click a discrete tag to display the **Tag Configuration** dialog box.
3. Click the **Scaling** tab.
4. Place a checkmark in the **Invert Data** checkbox for the Tag Engine to invert the discrete value when it communicates with the device server.
5. Click the **OK** button.
6. Select **File»Save** to save the changes.

Scaling Bit Array Tags

Bit array tags can have invert and/or select mask scaling.

1. Open the Tag Configuration Editor.
2. Double-click a bit array tag to display the **Tag Configuration** dialog box.
3. Click the **Scaling** tab.
4. Place a checkmark in the **Scale Data** checkbox.
5. Set which bits you do not need in the **Scaling Select Mask** textbox. Masked bits in an array are reported as zeros.
6. Set which bits are inverted between the device server and the Tag Engine in the **Scaling Invert Mask** textbox. You can invert only the bits selected in the **Scaling Select Mask** textbox.
7. Click the **OK** button.
8. Select **File»Save** to save the changes.

Table 4-3 shows examples of tags configured for bit array scaling.

Table 4-3. Bit Array Scaling Examples

Tag Name	Length	Raw Value	Scaling Invert Mask	Scaling Select Mask	Scaled Value
Tag 1	8	0x0F	0x00	0xFF	0x0F
Tag 2	8	0x0F	0x33	0xFF	0x3C
Tag 3	8	0x0F	0x33	0x0F	0x0C
Tag 4	8	0x0F	0x00	0x33	0x03
Tag 5	8	0x0F	0x33	0x33	0x30
Tag 6	16	0x0FF0	0x000F	0x00FF	0x00FF

Mask Scaling

Mask scaling applies only to bit arrays.

LabVIEW stores a bit array as a number, translating it back into a 32-bit array when needed. The array holds a collection of 32 values, each value limited to 1 or 0.

The following is an example of what the readout of a bit array might look like:

10110011100011001100111000110010

Mask scaling lets you decide which of these array members to pay attention to. Any bit filtered out by the mask shows up as a zero; bits not filtered out show up as zero or one, reflecting the actual value. A mask configured as follows, where X marks a position to be filtered out and O marks a place to report would read the bit array:

xxxxxxxxxxxxxxxxoooooooooooooooo

as the following:

00000000000000001100111000110010

Note The invert mask does not invert bits that are masked out.

Setting Alarms

Alarms are useful for notifying users of abnormal conditions for a given tag. These attributes include whether to enable alarms, under what circumstances a tag is in alarm, the priority level of an alarm, and how alarms are acknowledged. Each alarm limit has a priority, ranging between 1 and 15. In the LabVIEW DSC module, 15 is the highest priority and 1 is the lowest.

Alarms include two main types:

- Alarms based on status
- Alarms based on tag values

Configuration for alarms based on tag values is specific to data type. Therefore, many alarm attributes apply to only a subset of the tag data types. Refer to Chapter 6, *Alarms and Events*, for more information about accessing alarm information, building alarm summary displays, and retrieving historical events files.

Complete the following steps to set alarms.

1. Open the Tag Configuration Editor.
2. Double-click a tag to display the **Tag Configuration** dialog box.
3. Click the **Alarms** tab.
4. Place a checkmark in the **Enable Alarms** checkbox.

   Alarms are generated depending on the value or state of a tag. The alarms based on value vary with the tag data type. For any tag, if the status is bad, a bad status alarm is generated. By default, **Bad Status Alarm** is enabled and has the highest priority (15).
5. Set the alarm attributes. The available attributes vary depending on the type of tag you are configuring.
6. Click the **OK** button.
7. Select **File»Save** to save the changes.

Setting Alarms for Analog Tags

Analog tags have four alarm levels: HI_HI, HI, LO, and LO_LO. By providing separate alarm levels, you can provide more information about the nature of the alarm condition. Alarms are calculated after scaling is performed. Alarm levels are expressed in engineering units.

Setting Alarm Deadband on Analog Tags

Alarm Deadband defines how much a tag value must change from the alarm limit before it is considered normal. For example, if a tag that represents a temperature value hovers near an alarm limit of 40 degrees Celsius, the tag might go in and out of alarm many times in a relatively short period of time. Table 4-4 shows examples of events with Alarm Deadband set to 0.0%.

Table 4-4. Events with Alarm Deadband = 0.0%

Time	Value	Event	Alarm Type
9:15:05	40.1	Yes	HI
9:15:10	39.9	Yes	Normal
9:15:15	40.1	Yes	HI
9:15:20	38.5	Yes	Normal

This type of situation clogs event files with redundant information and can cause operators some frustration in having to acknowledge alarms constantly when the tag has not changed significantly. You can use the Alarm Deadband to alleviate this problem.

For the tag to go into alarm, it must go above the exact Alarm Value (in the previous example, 40). However, to be considered normal again, it must leave the Alarm Value by an amount greater than the Alarm Deadband. For example, if the range is 0 to 100 degrees Celsius, an Alarm Deadband of 1.0% (one degree Celsius) eliminates unnecessary events. Table 4-5 shows examples of events with Alarm Deadband set to 1.0%.

Table 4-5. Events with Alarm Deadband = 1.0%

Time	Value	Event	Alarm Type
9:15:05	40.1	Yes	HI
9:15:10	39.9	No	HI
9:15:15	40.1	No	HI
9:15:20	38.5	Yes	Normal

Setting Alarms for Discrete Tags

Discrete tags have two alarm states—either the tag is in alarm or it is not. You can determine whether a discrete tag is in alarm when it is ON (high) or OFF (low).

Setting Alarms for Bit Array Tags

You can enable one of two types of alarms for bit array tags. **Alarm on Any** indicates the overall tag is in alarm if any of its bits are in alarm state. **Alarm on All** means the tag is in alarm only if all of the bits are in the alarm state. You can use the Invert Mask to determine the bits that should use alarm on low (OFF) rather than the default alarm on high (ON). You can use the Select Mask (logical AND) to determine the bits that should be considered for the alarm. If you have bits in the Select Mask that are zero (OFF), these bits are not used in calculation of the tag alarm state.

Setting Alarms for String Tags

String tags have no alarm states based on tag value. They only support Bad Status alarms.

Keeping an Alarm Unacknowledged after the Alarm Returns to Normal

On the **Alarms** tab in the **Tag Configuration** dialog box, select the **Alarm Acknowledgement Mode** field and select either **Auto Ack on Normal** or **User Must Ack**:

- **Auto Ack on Normal**—With this option enabled, when a tag returns to normal state, the alarm is automatically acknowledged. A message is logged to the event file if event logging is turned on for the tag. By default, **Auto Ack On Normal** is enabled.
- **User Must Ack**—With this option enabled, an alarm remains unacknowledged until the operator acknowledges the alarm.

Accessing Tags Over a Network

A LabVIEW DSC module *server* is a computer that allows tags configured in the current `.scf` file to be accessed by other computers connected to it. A LabVIEW DSC module *client* is a computer that gets its data through tags from one or more LabVIEW DSC module servers. Tags connected to remote LabVIEW DSC module servers are *network tags*. An `.scf` file for a LabVIEW DSC module client can contain network tags from multiple

LabVIEW DSC module servers, as well as other servers. If you import a set of tags from a LabVIEW application using BridgeVIEW 2.*x* networking, you can only import from one `.scf` file per computer. Also, you must make sure that any LabVIEW application running as a data server is using the correct `.scf` file for your client application to work properly.

A LabVIEW DSC module server also can act as a client and get its data from other LabVIEW DSC module server computers.

Importing Network Tags

You can import tags into a local `.scf` file from an `.scf` file located on another computer. Refer to the *Importing Network Tags* section of Chapter 9, *Networking and Deploying Applications*, for more information about importing network tags.

Accessing Tags Over the Network using BridgeVIEW

If you are using BridgeVIEW in your system, you have to perform some additional steps to make sure tags created in the LabVIEW DSC module can be accessed by BridgeVIEW applications. This is also true for BridgeVIEW applications you might be running using the LabVIEW DSC module.

1. On the server computer, open the Tag Configuration Editor.
2. Open the `.scf` file that contains the tags you want to access over the network.
3. Select **Configure»Network»BridgeVIEW 2.x Networking»Allow Network Access**. Select **Configure»Network»BridgeVIEW 2.x Networking»Clients have write access** if you want network clients to be able to write to the tags in the `.scf` file.
4. Select **File»Save** to save the changes.
5. On the client computer, open the Tag Configuration Editor.
6. Select **Configure»Network»BridgeVIEW 2.x Networking»Import Network Configuration** to display the **Select Tags for Network Import** dialog box. Only tags exposed through BridgeVIEW 2.*x* networking appear.
7. Click the **Add** buttons to add the tags you want to import to the **Selected Tags** listbox.
8. Click the **Convert** button.
9. Select **File»Save** to save the changes.

Determining When to Use Memory Tags

Use memory tags when you want to perform alarm calculations or log historical data and event information on data that are either a software-generated values or combinations of values from different I/O tag readings. You do not need to use a memory tag for program variables unless you want to use the historical and event logging or alarm management capabilities of the Tag Engine.

Scenario 1—Use a Memory Tag

Suppose a simple device server returns several data values, but you are interested in some linear combination of these I/O points. The design of the device and its server software might not allow you to combine these values within the server to make a single tag. But the operators need historical trends and alarm management based on this calculated value. In this situation, you could read individual tag values and calculate the linear combination in the application, then write the calculated value to the memory tag in the Real-Time Database. The Tag Engine would perform historical logging and alarm calculations according to the memory tag configuration.

Scenario 2—Do Not Use a Memory Tag

Suppose an HMI calculates and displays the difference between the current temperature reading and a previous temperature reading. Although the individual readings are logged for historical trends, the difference between them is not. If you do not need to perform any alarm management or historical logging based on the difference, you do not need to use a memory tag.

Creating a Memory Tag

1. Open the Tag Configuration Editor.
2. Select **Edit»Create** and select the type of tag you want to create.
3. Click the **Connection** tab.
4. Set **Tag Access** to **Memory**.
5. Select any other settings you want for the memory tag.
6. Click the **OK** button.
7. Select **File»Save** to save the changes.

Viewing Additional Attributes in the Tag Configuration Editor

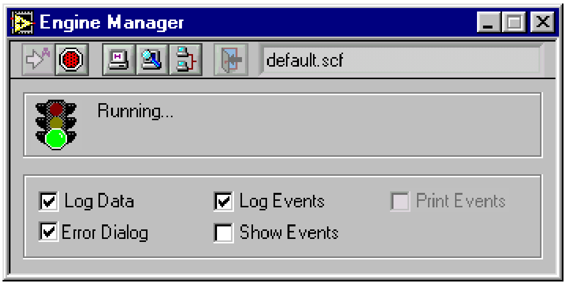
1. Open the Tag Configuration Editor.
2. Select **Edit»Column Setup** to display the **Select Tag Fields to View** dialog box. You can display the same columns of information, describing every tag attribute, as in the spreadsheet import/export options in the Tag Configuration Editor.
3. Select tag fields in the Available Tag Fields listbox and click the **Add** button to move the fields to the **Fields to View** listbox. Click the **All** button to move all fields to the **Fields to View** listbox.
4. Select tag fields in the **Fields to View** listbox and click the **Move Up** or **Move Down** buttons to customize the order of appearance of columns. You also can drag and drop fields to rearrange them.
5. Click the **OK** button.

Viewing Tag Engine Status

Launch the Tag Engine and open the Engine Manager. If the Tag Engine is already launched and running, the Engine Manager might be minimized and appear only as an icon in the system tray of your Windows taskbar. Double-click the Tag Engine icon to open the Engine Manager display.

You can leave the Engine Manager display minimized unless you want to use it to start or stop the Tag Engine, start or stop historical logging, event logging and printing, view system events, or view server information.

The Tag Engine works with tags configured in the `.scf` configuration file and created in the Tag Configuration Editor. The Engine Manager shows the current state of the Tag Engine.



default.scf

Running...

☑ Log Data ☑ Log Events □ Print Events
☑ Error Dialog □ Show Events

Table 4-6 describes the fields in the **Engine Manager** window.

Table 4-6. Engine Manager Field Descriptions

Field	Description
Engine Status (next to the traffic signal)	Displays the current status of the Tag Engine—whether launching, running, or stopped.
Log Data	Turns on or off logging of historical data to file. To turn on logging of historical data to file automatically, select **Configure»Historical** from the Tag Configuration Editor, then select **Start logging on system start-up**. If you do not have a valid historical log path configured, logging of historical data to file is disabled.
Log Events	Turns on or off logging of alarms and events to file. To turn on logging of alarms and events to file automatically, select **Configure»Events** from the Tag Configuration Editor, then select **Start event logging on system start-up** on the **Event Logging** tab. If you do not have a valid event log path configured, logging of alarms and events to file is disabled.
Print Events	Turns on or off printing of alarms and events to a line printer. To turn on printing of alarms and events automatically, select **Configure»Events** from the Tag Configuration Editor, then select **Start printing on system start-up** on the **Printing** tab. If you do not have a printer configured, printing of alarms and events is disabled.
Error Dialog	Enables or disables showing the **Error** dialog box. If this checkbox contains a checkmark, a **System Error Display** dialog box appears for you to acknowledge the event when a system error occurs.

Table 4-6. Engine Manager Field Descriptions (Continued)

Field	Description
Show Events	Shows or hides the System Event Display. The System Event Display shows the following when **Show Events** contains a checkmark: • LabVIEW system events • When the Tag Engine started and stopped • Which servers have been launched • Any system errors that have occurred
Toolbar	
Start the Tag Engine	Starts the Tag Engine.
Stop the Tag Engine	Stops the Tag Engine and shuts down any running servers.
Start Tag Monitor	Opens the Tag Monitor.
View Servers in Use	Displays the servers in use by the Tag Engine.
View Client Connections	Shows all the computers currently accessing data from the LabVIEW application.
Exit the Tag Engine	Closes and exits the Tag Engine process.

Configuring Tag Engine Parameters

The Tag Engine has several default settings for parameters. Complete the following steps to override these defaults.

1. Open the Tag Configuration Editor.
2. Select **Configure»Engine** to display the **Engine Configuration** dialog box.
3. Select among the options. View help for each option by selecting **Help»Show Context Help** and moving the cursor over the option.

Note Although you can configure these parameters, it is highly recommended you maintain the default values. If you use a large number of string tags and the string tags are large or change rapidly, you might need to increase the input queue binary size to be larger than the default 2,000 bytes.

4. Click the **OK** button.
5. Select **File»Save** to save the changes.

The Tag Engine allocates certain amounts of memory for various queues. You can configure some of the parameters used by the Tag Engine and Tags VIs to allocate memory for the Tag Engine buffers.

Monitoring and Writing Tag Values

You can use the Tag Monitor to monitor the value, timestamp, alarm state, and quality for selected tags in the system, as well as write the value to an output or input/output tag.

1. Open the Tag Monitor.
2. Navigate to the tags you want to monitor using the tree in the left pane. Select **View»Default** to restore the full tree.

   You can see tags both directly in your local computer, under the **My Computer** node, and across the network, under the computer name under the **Network** node. You also can see data from other software and devices on other networked computers. To find tags or data on another computer, you must first register the computer. Refer to the *Registering Networked Computers* section of Chapter 9, *Networking and Deploying Applications*, for more information about registering and unregistering computers.
3. To select a tag for monitoring, double-click the tag to move it to the tag display pane on the right. You also can select one or more tags and drag them to the tag display pane or you can select tags, right-click, and select **Add** from the shortcut menu. The **Quality** column shows status information for the tags.
4. To add, remove, write to, or edit the properties of a tag, select the tag and select the corresponding options in the **Items** menu. You also can right-click a tag to access these options.
5. Select **View»Refresh** to refresh the tree view in the left pane and the alarm view in the bottom right pane. The tags in the tag display pane update continuously and do not need to be refreshed.
6. Select **File»Save As** to save different sets of tags to monitor.

5

Displaying and Controlling Data

An HMI is the interface through which an *operator* interacts with the LabVIEW system and with the outside environment that LabVIEW monitors and controls. In LabVIEW, you use VIs as your HMI. The LabVIEW Datalogging and Supervisory Control (DSC) module installs custom controls, indicators, VIs and functions to make HMI creation easier. Refer to Chapter 1, *Introduction*, for more information about these objects.

The example block diagrams shown in this chapter are taken from some of the examples you can find in `labview\examples\lvdsc`.

The LabVIEW DSC module includes a set of VIs with which you can control your HMI, access the Real-Time Database and the Citadel historical database, perform calculations and logic, and change between different displays. The LabVIEW DSC module VI library adds Alarm and Event VIs, Historical Data VIs, System VIs, Tags VIs, and Tag Attributes VIs.

There are several general LabVIEW programming principles with which you should be familiar before you build an HMI. For more advanced HMI programming, you also should know how to use Property Nodes and the VI Server. Refer to the LabVIEW documentation for more information about Property Nodes and the VI Server.

To develop an HMI application, create the front panel interface and then complete the block diagram.

Building Front Panels

Refer to the LabVIEW documentation for more information about building front panels. This section describes the specific front panel features you get with the LabVIEW DSC module.

A front panel is the user interface of a VI. You might want to divide an HMI into several front panels so the operator can navigate through them using buttons on the screen. The Panel Wizard can help you do this by automatically generating code and attaching it to front panel buttons.

Use the HMI Wizard to connect controls and indicators to tags. You invoke the HMI Wizard on the front panel, but it adds elements to the block diagram.

Graphics, both as decorations and as controls and indicators, can make front panels easier to operate and more informative.

Creating Front Panel Controls and Indicators

You build the front panel of a VI with a combination of controls and indicators representing the values of the tags. Controls supply data, and indicators display data. Select controls and indicators on the **Controls** palette and place them on the front panel.

Connecting Controls and Indicators to Tags

1. Place the control or indicator on the front panel.
2. Right-click a control or indicator and select **HMI Wizard** from the shortcut menu.
3. Select the tag to which you want to connect in the **Tag** pull-down menu. Click the **Create New Tag** button, shown at left, to create a new tag.
4. Select among the following options on the **Data Connection** tab:
    - **Match control label to tag name**—Matches the label on the control or indicator to the tag name.
    - **Match scale to tag configuration**—Adjusts the object scale to match the maximum and minimum of the tag you select.
5. Click the **Alarms** tab.
6. Select among the following options on the **Alarms** tab:
    - **Change colors with alarm state**—Changes the color of the control or indicator when the tag is in an alarm state.
    - **Blink when**—Makes the control or indicator blink when the tag is in an alarm state or when the alarm is unacknowledged.
7. Click the **OK** button to generate any necessary block diagram code for the options you selected.

Refer to the *Auto-Generating Code with the HMI Wizard* section for more information about working with the HMI Wizard and the block diagram elements it generates.

Creating a Tag Control

The tag control lets you select a tag name from the list of all configured tags in the active `.scf` file. You also can enter the name of the tag you want through the keyboard.

The tag control is located on the **Controls»I/O** palette. You also can use a tag control in an array.

If you organized tags into groups, you see a folder icon for each tag group. You can select a tag group as well as an individual tag. You can use tag groups to acknowledge all alarms on all tags in a group. You cannot use a tag group to read or write all tags in the group.

By default, the tag control does not allow you to enter a name that is not contained in the current `.scf` file. But you can configure each tag control, indicator, or constant to permit entry of names not contained in the current `.scf` file by right-clicking the tag object and selecting **Allow Undefined Tags** from the shortcut menu.

You can create, edit or copy a tag by right-clicking the tag control, indicator, or constant, and selecting **Create Tag**, **Edit Tag**, or **Copy Tag** from the shortcut menu. Selecting any of these options invokes the Tag Wizard. Any new or changed tags are automatically saved to the active `.scf` file, and the list of available tags is then updated. Refer to the *Configuring Tag Attributes* section of Chapter 4, *Using Tags to Manage I/O in LabVIEW*, for more information about configuring tags.

Tag controls and indicators saved with default values and tag constants on the block diagram retain the tag name or group selected when you save the VI. The name contained in the tag control, indicator, or constant is dimmed if the name is not contained in the currently selected `.scf` file. This might happen if the tag name was deleted from the `.scf` file or the VI was created using a different `.scf` file than the one currently loaded. If you try to run the VI in this condition, you get a system error for each tag that is undefined in the current `.scf` file.

Adding and Customizing Graphics

The **Controls** palette includes Boolean controls and indicators such as pipes, valves, and pumps, and numeric controls and indicators such as tanks and hoppers. These images change to reflect the state of the tags you connect them to.

The LabVIEW DSC module also includes an extensive library of supervisory control and other images ranging from basic geometric shapes to drawings of special equipment. Use the Image Navigator to access these images.

Select **Tools»Datalogging & Supervisory Control»Image Navigator** to open the Image Navigator. Refer to the *Image Navigator Help* for more information about editing, copying, and importing and exporting graphics, and other Image Navigator options.

Building an Application with Multiple Front Panels Using the Panel Wizard

If size or other considerations make it desirable, consider dividing the HMI into several front panels so the operator can navigate through them using onscreen buttons.

Use the Panel Wizard to generate a front panel navigation system for operators. With the Panel Wizard, you can attach code to buttons that, when clicked by the operator, open VIs. The Panel Wizard only operates on Boolean controls. If you are unfamiliar with LabVIEW, the Panel Wizard can be a quick way to produce applications that can navigate among multiple windows and front panels.

1. Save the VI. Because the code created by the Panel Wizard contains file path information, some features do not generate correct block diagram code until the calling front panel is saved to disk.
2. Place a button on the front panel.
3. Right-click the button and select **Panel Wizard** from the shortcut menu.
4. In the **With this Control** pull-down menu, select whether to open or close a front panel when the Boolean control is activated. The Panel Wizard can create block diagram code to open several types of front panels:
    - Login prompt.
    - Historical Trend Viewer.
    - Tag Monitor.
    - VIs that you have created and saved to disk. When opening VIs that you have created, specify the path to the VI by typing it in the **Path to VI** field or by selecting the **Browse** button. You can configure the Panel Wizard to store the file path as a relative path or as an absolute path. If the VI that you connect to the

control is generally kept in a path that is relative to the top-level VI, select the **Relative path** setting.

5. Click the **Button** tab.
6. Place a checkmark in the **Match button label to action** checkbox to change the button label to match the VI name you are using the button to call. If you are using the wizard to invoke the login dialog, Historical Trend Viewer, or Tag Monitor, the label reflects those choices. Placing a checkmark in the **Match Boolean text to action** checkbox does the same for the Boolean text.
7. Select a **Mechanical Action** option. These options function the same way as the mechanical action options available by right-clicking a Boolean control.
8. Click the **Polling** tab.
9. Select a **Poll this control** option.
   - **Until engine shutdown**—If you run the calling VI while the Tag Engine is not running, the VI polls when started and continues to poll until the Tag Engine starts and then shuts down. However, if the Tag Engine is restarted after having stopped, the VI does not resume polling until you restart the calling VI.
   - **Always**—Always polls the control.

Block Diagram Tools and Functions

Refer to the LabVIEW documentation for more information about building block diagrams. This section describes the block diagram features specific to the LabVIEW DSC module.

Auto-Generating Code with the HMI Wizard

Use the HMI Wizard to generate common sections of block diagram code. To open the HMI Wizard, right-click a front panel object and select **HMI Wizard** from the shortcut menu. The HMI Wizard operations vary, depending on the front panel object. The HMI Wizard makes a DataSocket connection between a front panel control or indicator and a tag, and, when necessary, generates a subdiagram for any configuration that you specify. Refer to the LabVIEW documentation for more information about DataSocket.

Refer to the *Connecting Controls and Indicators to Tags* section for more information about generating block diagram code from a front panel object.

Table 5-1 lists front panel objects and describes how the HMI Wizard operates on each of them.

Table 5-1. HMI Wizard Operations for Various Front Panel Objects

HMI Function	Front Panel Object	Description
Control analog tags	Numeric control	Invoke the HMI Wizard on a numeric control to associate an analog output tag value with that control. You can set the colors and blink options on the **Alarms** tab.
Display analog values	Numeric indicator	Invoke the HMI Wizard on a numeric indicator to associate an analog input tag value with that indicator. You can set the color and blink options on the **Alarms** tab.
Control discrete tags Acknowledge alarms	Boolean control	Invoke the HMI Wizard on a Boolean control to associate a discrete output tag value or an alarm acknowledgement action with that control. To change the control association from tag value to alarm acknowledgement mode, change the **Attach Control to** field from **Tag Value** to **Alarm Acknowledgement**. Select a set of tags that requires acknowledgement when the control is TRUE.
Display discrete values Indicate an alarm state	Boolean indicator	Invoke the HMI Wizard on a Boolean indicator to associate a discrete input tag value or an alarm state with that indicator. To change the control association from tag value to alarm state, change the **Attach Indicator to** field from **Tag Value** to **Tag Alarm State**. Select the tag for which the indicator displays the alarm state.
Control string tags	String control	Invoke the HMI Wizard on a string control to associate a string output tag value with that control. You can set the colors and blink options on the **Alarms** tab, and specify the updates to happen only when the control value changes.

Table 5-1. HMI Wizard Operations for Various Front Panel Objects (Continued)

HMI Function	Front Panel Object	Description
Display string values	String indicator	Invoke the HMI Wizard on a string indicator to associate a string input tag value with that indicator. You can set the color and blink options on the **Alarms** tab. You can display strings in normal form or as hex codes. You also can set the indicator to use a scrollbar if you anticipate any need to display long strings.
Display alarm summary	Alarm summary display listbox or any table indicator	Use the alarm & event display control on the **Controls»Alarms and Events** palette. This ActiveX control connects directly to the Citadel historical database and does not need to be connected or configured with the HMI Wizard. You can set the HMI Wizard to Alarm Summary mode by setting the value of the **Use this indicator for** field to **Alarm Summary**. Select a set of tags whose alarms require monitoring. You also can set colors of acknowledged and unacknowledged alarms and column format of the summary. Preformatted alarm summary indicators are located on the **Controls»Alarms and Events** palette.
Display event history information	Event history display listbox or any table indicator	You also can invoke the HMI Wizard on a multicolumn listbox or table indicator to obtain a history of past events and alarms (Event History). For an event history display, you can set the HMI Wizard to Event History mode by setting the value of the **Use this indicator for** field to **Event History**. Select a set of tags whose history needs to be displayed. You also can set colors of acknowledged and unacknowledged alarms, normal and event entries, and column format of the summary. You can set filters to determine how many and what sort of alarms are displayed. Preformatted event history indicators are located on the **Controls»Alarms and Events** palette.

Table 5-1. HMI Wizard Operations for Various Front Panel Objects (Continued)

HMI Function	Front Panel Object	Description
Display a real-time trend	Real-time trend or waveform chart indicator	Invoke the HMI Wizard on a real-time trend or waveform chart indicator to select a set of tags for which the values need to be displayed in a chart (real-time trend). You also can set engineering units for the display, percentage of scale, and the time (in seconds) between updates.
Display a historical trend	Historical trend or XY graph indicator	Invoke the HMI Wizard on a historical trend or XY graph indicator to select a set of tags for which the values need to be displayed in an XY graph (historical trend).

Changing Auto-Generated Block Diagram Code

The lock in the upper-right corner of a block diagram structure indicates that the subdiagram has been locked.

While the subdiagram is locked, you can right-click the front panel object, select **HMI Wizard** from the shortcut menu, and change your selections in the dialog box.

To edit the block diagram directly, right-click the subdiagram and select **Release Wizard Lock** from the shortcut menu. After you release the lock, any wizard association is broken. You can no longer use the HMI Wizard to make changes.

Tag Data Types

Many LabVIEW DSC module VIs and functions require a tag name as an input. So in addition to standard LabVIEW data types, the LabVIEW DSC module includes the tag data type. All LabVIEW DSC module functions that can operate on tags or tag groups use the tag data type. The tag data type is marked with a valve icon. Constants and wires on the block diagram carrying this tag information are displayed in purple. Tag constants also can be contained in arrays. Many LabVIEW DSC module VIs operate on arrays of tags.

The tag constant used as constant input for a tag and/or the tag attribute VI is located on the **Functions»Tags** palette. The **Functions»Tags** palette also contains functions that convert between a tag data type and a string data type, and a special **Not a Tag** constant. The **Not a Tag** function is a constant that reports Not a Tag. This constant is most often used in case structures when one condition contains a tag name and another does not.

The tag data type uses tag and tag group names from the tag configuration file (`.scf`). When you start LabVIEW, the tag data type list of available tag names and tag group names is automatically updated from the default `.scf` file. The default `.scf` file is the last file you edited in the Tag Configuration Editor. If the list of names is empty, you need to open an `.scf` file in the Tag Configuration Editor.

Tasks Common to Both Tags and Alarms and Events VIs

Use the VIs and functions located on the **Functions»Tags** and **Functions»Alarms & Events** palettes to operate on tags by wiring the tag name or tag group name into the **tag name** or **group/tag name** input of the VI. Some VIs accept arrays of tag names or tag and tag group names.

Reading Tag Engine Status Programmatically

The Tags VIs and Alarms and Events VIs return several flags that indicate the state of the Tag Engine. They return a Boolean **error** flag to indicate whether the operation was successful. If the **error** flag is TRUE, the tag-specific information returned by the VI might not be valid. Some VIs also return a more detailed **value status** variable.

When an application runs one of the Tags VIs or Alarms and Events VIs, that VI checks the status of the Tag Engine. If it is not running, the VI automatically starts the Tag Engine, which loads and executes all required device servers. When the VI returns, the Tag Engine remains running until you shut it down either programmatically or through the Engine Manager. LabVIEW DSC module VIs that do not access the Real-Time Database, such as the Historical Data VIs, can run without the Tag Engine running and do not launch the Tag Engine.

You can monitor the shutdown status of the Tag Engine with the **shutdown** output of any of the Tags VIs or Alarms and Events VIs, or with the Get Engine Status VI. If TRUE, this output indicates that the Tag Engine is in the shutdown state, and the application must finish running so that shutdown can finish. If the Tag Engine goes into the shutdown state while these VIs are waiting on an event, the VI terminates the wait and returns immediately to the calling block diagram. You can use this output to tell the block diagram to complete execution.

Starting or Stopping the Tag Engine Manually

You can start or stop the Tag Engine manually in the Engine Manager, the Tag Configuration Editor, or the **Tag Utilities** toolbar. As the Tag Engine shuts down, first it checks whether any application is running that requires its services. If so, it waits until that application halts before shutting down. After it shuts down, it sends a shutdown message to the device servers.

Setting the Database Read Rate

All VIs that read information from the LabVIEW DSC module Real-Time Database can return information immediately or wait for the database to be updated with new information before returning. The **timeout** input controls this behavior. This input tells the VI how long to wait, in seconds, for the tag information to be updated in the Real-Time Database. Table 5-2 describes the behavior for each **timeout** value.

Table 5-2. Timeout Values and Behavior

VI Timeout Input	Behavior
0	VI immediately reads the database and returns the current tag information.
Less than 0	VI continues to wait until the tag is updated or the Tag Engine shuts down.
Greater than 0	VI waits until the tag is updated in the database, or the timeout period is exceeded, whichever occurs first, then reads the database and returns the current tag information.

If you wire nothing to the **timeout** input of the block diagram, the default value is 0—the VI reads the database and returns immediately. How you use the **timeout** input depends on whether you want to implement event-driven or polled programming techniques in the HMI.

Updating Tag Displays When Values Change

You can use a **changed?** output to update the front panel only if information has changed. All VIs that read information from the LabVIEW DSC module Real-Time Database have a **changed?** output that is TRUE if the returned information is new or updated. If the VI returns and **changed?** is FALSE, the VI might have timed out, or the information in the database did not change since the last read.

Determining When the HMI Needs to Be Initialized

Some of the more advanced Tags VIs and Alarms and Events VIs also return an **initialize headers** or **config changed** output that tells the VI whether the front panel object needs to be initialized with new information. In most cases, this corresponds to the first time the VI is called, and you only need to update that part of the user interface once.

Controlling System Behavior Programmatically

As you develop more sophisticated user interfaces, you might find that you need to exercise control over portions of the LabVIEW environment from your own applications. Use the VIs located on the **Functions»System** palette to control the Tag Engine programmatically.

The System VIs provide you with several options for controlling actions such as launching and shutting down the Tag Engine, and enabling and disabling logging.

Note One of these functions, the Get Engine Status VI, is what the HMI Wizard looks for when deciding whether to insert a Tag Engine monitoring loop into the block diagram. If you use this VI before using the HMI Wizard, you might want to create a Tag Engine monitoring loop yourself.

Starting or Stopping the Tag Engine Programmatically

Use the Engine Launch VI to launch the Tag Engine programmatically with a specified configuration file. Use the Engine Shutdown VI to stop the Tag Engine and the servers currently executing.

Starting or Stopping Historical Logging Programmatically

Use the Enable Historical Data Logging VI to start historical logging. If the input value is TRUE, historical logging is turned on if it is currently off. If the input value is FALSE, historical logging is turned off if it is currently on.

Starting or Stopping Event Logging Programmatically

Use the Enable Event Logging VI to start event logging. If the input value is TRUE, event logging is turned on if it is currently off. If the input value is FALSE, event logging is turned off if it is currently on.

Starting or Stopping Event Printing Programmatically

Use the Enable Printing VI to start event printing. If the input value is TRUE, event printing is turned on if it is currently off. If the input value is FALSE, event printing is turned off if it is currently on.

Changing Tag Attributes Programatically

Use the VIs located on the **Functions»Tag Attributes** palette to read or change configuration information about tags programmatically. Most of these *tag attributes* are parameters you can configure for a tag with the Tag Configuration Editor.

While you can change tag attributes programmatically, not all tag attributes can be changed dynamically. To change a tag attribute dynamically means to change it while the Tag Engine is running. You can change all operations, alarms, and most scaling, and raw or engineering range information dynamically. These are the same attributes you can update with the Tag Configuration Editor without shutting down and restarting the Tag Engine.

Other tag attribute changes might require the Tag Engine to be stopped and restarted to take effect.

Tag attribute changes only affect the current Tag Engine process until they are subsequently changed or the Tag Engine stops. If you stop the Tag Engine and start it again, the changes are lost.

There are certain attributes you cannot change dynamically. These attributes require you to edit the `.scf` file with the Tag Configuration Editor. They include information such as:

- Tag name
- Tag description
- Scaling type
- Engineering unit
- Data type (analog, discrete, bit array, string)
- Tag group name
- Access rights (input only, output only, Input/Output, memory)
- Tag connection information (server, IO Group, and item)

You can programmatically take a tag on or off scan. If a tag is off scan, it is not processed or updated in the Real-Time Database, alarms are not calculated, and data are not logged. You can start these activities by putting that tag back on scan.

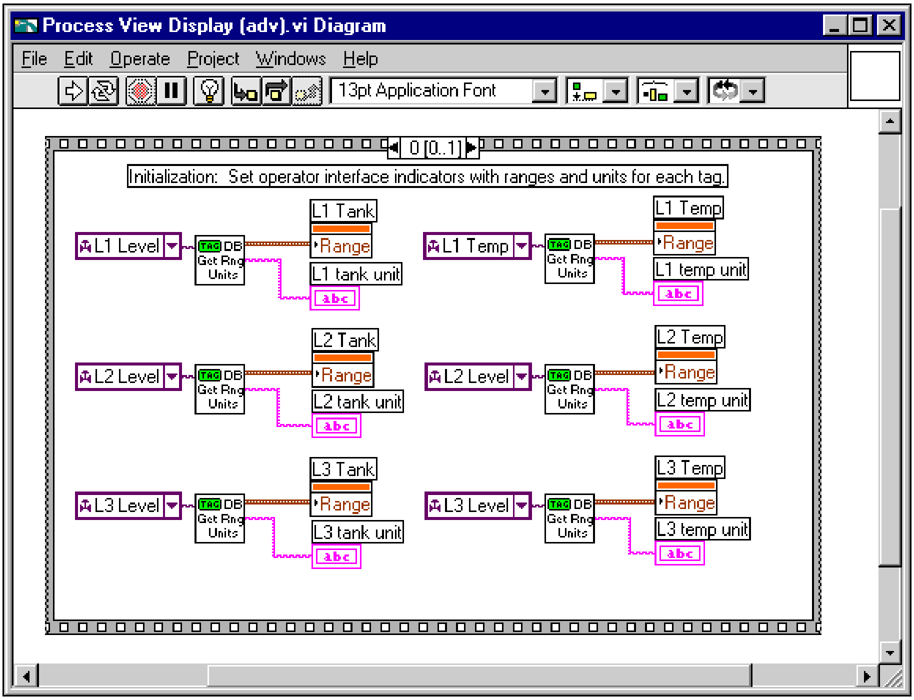
If the Tag Engine is running, you can change tag attributes programmatically with the Set Tag Attribute VI, Set Multiple Tag Attributes VI, or the Tag Configuration Editor. These VIs return an error if the Tag Engine is not running. Use these VIs to change attributes of a tag dynamically, as with logging, alarm, or scaling information, or taking a tag on or off scan.

Note If you programmatically change a tag attribute, the LabVIEW DSC module does not save the change in the `.scf` file, so you cannot access the changed attribute after your application closes.

Refer to the *Configuring Tag Attributes* section of Chapter 4, *Using Tags to Manage I/O in LabVIEW*, for more information about tag attributes.

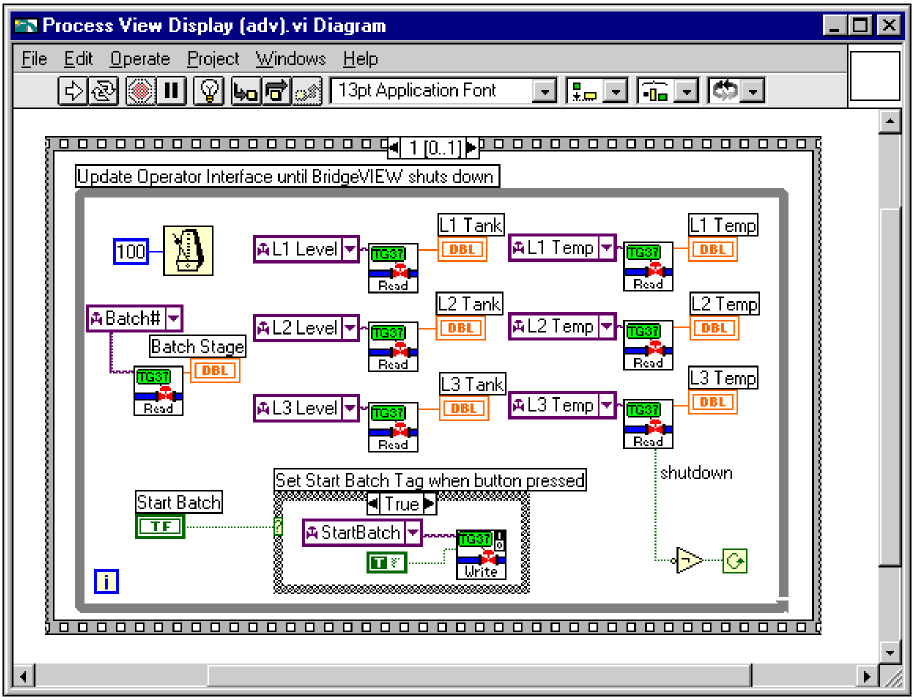
Example of Changing Tag Attributes Programmatically

The following figure shows a simple case where the scale range for all the front panel level and temperature indicators are set to the engineering scale that is configured for the tag. A unit string display for each **L1** and **Temp** indicator is initialized to the engineering unit for the respective tag. The Get Tag Range and Units VI returns the engineering scale range information in a form that can be wired directly to a control or indicator scale range Property Node. The VI also returns the engineering units configured for the tag.



Initialization: Set operator interface indicators with ranges and units for each tag.

The following figure illustrates the subsequent frame of the Sequence structure. The HMI runs in a loop, monitoring the various tags and front panel controls until the Tag Engine shuts down.


Process View Display (adv).vi Diagram
File Edit Operate Project Windows Help
13pt Application Font
1 [0..1]
Update Operator Interface until BridgeVIEW shuts down
100
L1 Level
L2 Level
L3 Level
L1 Tank
L2 Tank
L3 Tank
L1 Temp
L2 Temp
L3 Temp
DBL
TG37
Read
Batch#
Batch Stage
shutdown
Set Start Batch Tag when button pressed
True
Start Batch
TF
StartBatch
Write

Setting Timing Execution of While Loops

Normally, you use one or more While Loops on the block diagram, with a single wait operation inside of each loop. Each While Loop executes once after its wait operation completes. The wait operation can be either a polling or event-driven construction. Either technique is appropriate, depending on whether you want regular updates or only need to update following certain events. The following sections describe the different While Loop constructions.

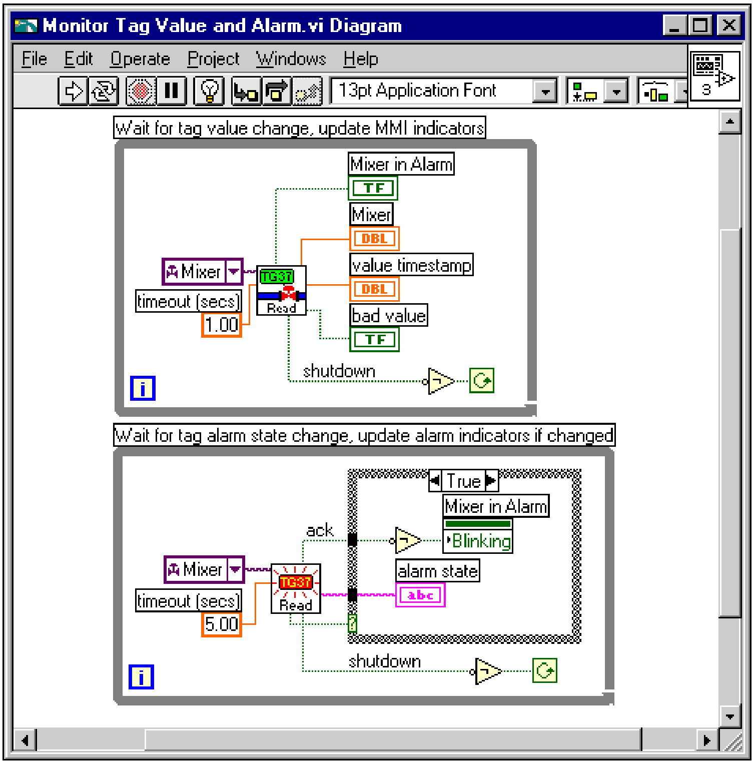
You can wait on multiple events for which timing is not related to each other in parallel on the same block diagram, but you must wait for each event in a separate While Loop.

Implementing Event-Driven Programming

Event-driven programming means the block diagram waits for one or more events to happen and, as each event occurs, the part of the VI waiting on that event is executed. You can develop applications that wait on different events and do operations in parallel by using multiple While Loops in the block diagram.

To implement an event-driven loop, you can use a Tags VIs or Alarms and Events VIs with the **timeout** input wired to a non-zero value.

The following figure shows an example using event-driven programming to monitor tag value and tag alarm state. One loop monitors the value of the **Mixer** tag and another loop monitors alarm information for the **Mixer** tag. These two loops run independently. When the **Mixer** tag value changes, or when `1.00` second has elapsed, the Read Tag VI returns and updates the **Mixer in Alarm**, **Mixer**, **value timestamp**, and **bad value** indicators. When the **alarm state** of the **Mixer** tag changes, or `5.00` seconds have elapsed, the Read Tag Alarm VI returns and updates the **alarm state** indicator, and controls the blinking of the **Mixer in Alarm** indicator. Both loops run in parallel until **shutdown** is TRUE.



The **Mixer in Alarm Blinking** attribute and the **alarm state** indicator are updated only when the **changed?** output of the Read Tag Alarm VI is TRUE. This example demonstrates how you might use the **changed?** output. In this example, it is not important to use the Case structure because the indicators update only when the displayed information changes.

If you use a large number of indicators or Property Nodes or more complex indicators such as tables and graphs, updating the indicator when changed by using a Case structure in the block diagram can improve the display performance of the VI.

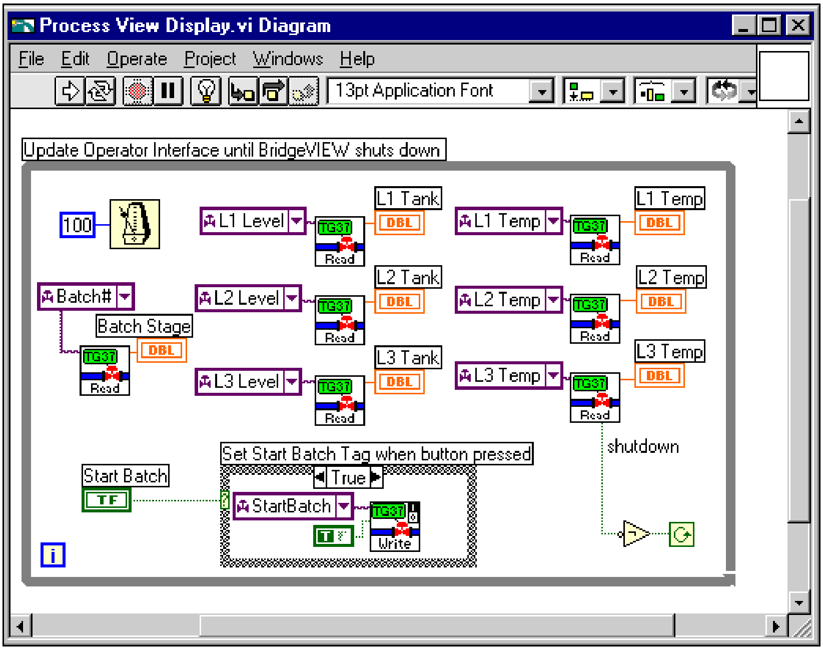
Implementing Polled Programming

In a polled technique, the wait operation you use inside the While Loop is one of the Time and Dialog functions such as the Wait Until Next ms Multiple function. With this method, the block diagram controls loop execution.

You do not have to use a separate loop for each Tags or Alarms and Events VI. This can be cumbersome to build for a large number of tag reads. The alternative is to poll the database for several tags at regularly timed intervals. You usually need one While Loop in the block diagram to poll the front panel controls so that you can monitor what the operator is doing. Using polling, you can both monitor front panel controls and read in tag values and alarm states.

The following figure shows an example implementing a complex user interface that polls all input tags and the front panel **Start Batch** button at 100 ms intervals. When you leave the **timeout** input unwired, all Read Tag VIs read the LabVIEW DSC module Real-Time Database immediately by default. In this case, you must explicitly add the loop wait time by using the Wait Until Next ms Multiple VI. If you do not, the loop operates as often as possible and requires most of the CPU time.

This example also illustrates use of the Write Tag VIs. In this case, the Write Tag (discrete) VI is called only when the front panel button is clicked. In other cases, you might want to write the tag value at each iteration. You also can use the Write Tag on Change VI to update the RTDB only when the value of the front panel control changes. This can improve over all application performance.


Process View Display.vi Diagram
File Edit Operate Project Windows Help
13pt Application Font
Update Operator Interface until BridgeVIEW shuts down
100
L1 Level
L1 Tank
L1 Temp
L2 Level
L2 Tank
L2 Temp
L3 Level
L3 Tank
L3 Temp
Batch#
Batch Stage
DBL
TG37
Read
shutdown
Set Start Batch Tag when button pressed
Start Batch
True
StartBatch
Write
TF
i

Initialize and Shut Down Multiple-Loop Applications

When you have a multiple-loop application, you can add initialization code before executing the loops, and some cleanup or shutdown code after all the loops finish executing. You can use the Sequence structure for this purpose. Put the initialization code in the first frame of the Sequence structure, put all the loops in the second frame of the Sequence structure, and put the shutdown code in the final sequence. This guarantees that none of the loops start execution until the initialization code is complete and that all loops complete execution before you execute the shutdown code.

You also can use dataflow programming to enforce sequential operation. In some cases, the block diagram might be easier to read using this technique. It is possible that you might have some data flow between the initialization code and the loops anyway. There is no difference in performance using either technique.

Displaying Trends

A *trend* is a display of tag values over time. The LabVIEW DSC module displays tag values with two types of trends: real-time trends and historical trends. These trend controls and indicators are located on the **Controls»Trends** palette.

Displaying Real-Time Trends

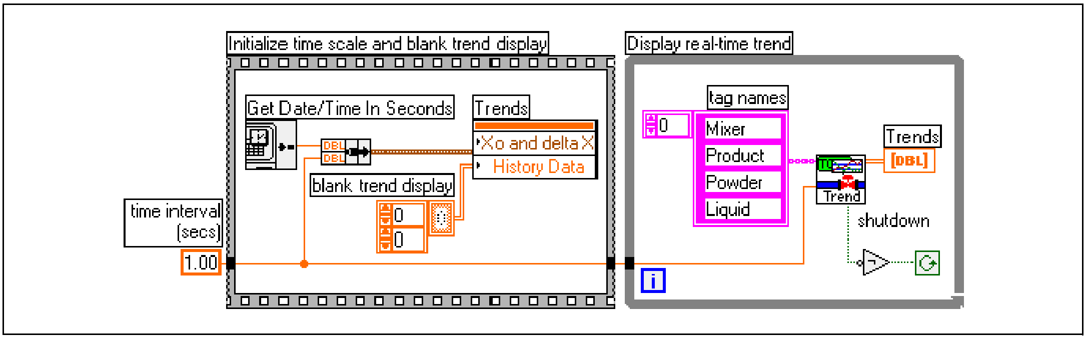
A real-time trend is a display of tag values as they are collected in real time over a relatively short period of time.

1. Select a real-time trend indicator on the **Controls»Trends** palette and place it on the front panel.
2. Build the block diagram in one of the following ways:
   - Generate code automatically by right-clicking the indicator on the front panel and selecting **HMI Wizard** from the shortcut menu. Refer to the *Connecting Controls and Indicators to Tags* section for more information about generating block diagram code from a front panel object.
   - You can assemble the code manually on the block diagram using a While Loop and the Trend Tags VI. Wire the **trend data** output of the Trend Tags VI to the real-time trend indicator terminal.

     Because the Trend Tags VI waits the specified **time interval**, place the VI in its own While Loop to control the loop execution rate. To run other VIs at the same rate that the real-time trend updates, place them in the same While Loop.

     The real-time trend indicator updates with a value for each tag every time the indicator is written to. If a VI using this indicator runs several times, it still has previous data displayed. For this reason, you might want to initialize the real-time trend indicator before the loop begins execution.

     You also can control attributes of the real-time trend indicator such as time scale. The following block diagram shows a single real-time trend display VI that initializes the time scale of the trend indicator to the current time using the Get Date/Time In Seconds function and initializes the interval corresponding to the Trend Tags VI **time interval** input. It also clears the trend display by writing an empty array to the **Trends History Data** attribute.



This example illustrates the use of dataflow programming. By wiring the **time interval** constant through the Sequence structure and into the While Loop, the While Loop does not execute until the Sequence structure has completed execution. You also can enforce this order of execution by placing the While Loop inside the second frame of the Sequence structure.

Displaying Historical Trends

A historical trend is a display of tag values that have been logged to disk, usually over a relatively long period of time. If your application is set up to log values, you can display a historical trend either by launching the HTV utility or by using the Get Historical Tag List and Read Historical Trend VIs located on the **Functions»Historical Data** palette. Refer to Chapter 7, *Historical Data Logging and Extraction*, for more information about extracting and displaying historical data.

Configuring Startup VIs

Startup VIs are VIs that run automatically when LabVIEW starts.

1. Select **Tools»Datalogging & Supervisory Control»Advanced» Startup VIs** to display the **Configure Startup VIs** window.
2. Click the **Add** button.
3. Navigate to the VI you want to run when LabVIEW starts and click the **Open** button.
4. Place or remove checkmarks from the **Show Panel** and **Run** checkboxes.

   If you remove the checkmark from the **Show Panel** checkbox, the VI must open a reference to itself to continue running after it is loaded. Refer to the LabVIEW documentation for information about using the VI Server to open a reference.

5. Select a VI in the **Startup VIs** listbox and click the **Move Up** or **Move Down** buttons to change the order in which the VI loads.
6. Click the **OK** button.

6

Alarms and Events

This chapter describes how to report, log, and respond to *alarms* and *events* with LabVIEW Datalogging and Supervisory Control (DSC) module applications.

An alarm is an abnormal process condition pertaining to a tag. In the LabVIEW DSC module, alarms are generated based on changes in a tag value or status.

An event is something that happens within the LabVIEW DSC module system. Events can be divided into two groups: *tag events* that pertain to individual tags, and *system events* that pertain to the overall LabVIEW DSC module system. An example of a tag event is a change of alarm state for a tag. Examples of system events include a user logging on, the Tag Engine starting up, or historical logging being turned on.

Because alarms are generated by tag values, you set most alarm attributes as a part of configuring tags. Refer to the *Setting Alarms* section of Chapter 4, *Using Tags to Manage I/O in LabVIEW*, for more information. You also enable tag event logging when you configure tags. Refer to the *Configuring a Tag to Log Data or Events* section of Chapter 4, *Using Tags to Manage I/O in LabVIEW*, for more information.

Configure Logging and Printing Options

You can configure logging and printing options for alarms and events through the **Event Configuration** dialog box. This configures the format of alarms and events written to `.evt` files or printed.

1. Open the Tag Configuration Editor.
2. Select **Configure»Events** to display the **Event Configuration** dialog box.
3. Select among the logging and printing options. To view descriptions of these options, select **Help»Show Context Help** and move the cursor over any option.
4. Click the **OK** button.
5. Select **File»Save** to save the changes.

Configuring Shift Times for Logging Events

If an application is used by different workforce shifts, shifts can be valuable in configuring event logging. You can use shift start and stop times to determine how event (`.evt`) files are segmented. End of shift reports can use these files to determine process and line statistics.

Shift times only segment the `.evt` files. Events logged to the Citadel database can be segmented in SQL and ODBC queries.

You set shift times in the Tag Configuration Editor by selecting **Configure»Events** and editing shift change times in the **Shift Display** textbox on the **Event Logging** tab.

Viewing Alarms and Events

You can use several different approaches to display and manage alarms and events generated in LabVIEW DSC module applications. Some approaches operate through traditional VIs; others use capabilities built in to National Instruments networking. The multiplicity of approaches is provided not only for flexibility, but also for compatibility with existing BridgeVIEW applications.

Both alarms and events enter the RTDB and are then stored in the Citadel historical database. For reasons of compatibility with earlier versions of BridgeVIEW, events are also logged to an ASCII file named in the format *`YYYYMMDDHHMM`*`.evt`, which indicates the time of the first event to be logged. *`YYYY`* is the year, *`MM`* is the month, *`DD`* is the day, *`HH`* is the hour, *`MM`* is the minute, and `.evt` is the extension for all event log files.

Note To log remote operator changes of a control as an event, select **Configure»Engine** in the Tag Configuration Editor. On the **Events** tab, place a checkmark in the **Generate Event when Remote User Changes Value** checkbox.

The easiest way to view and acknowledge alarms and events is to use the alarm & event display control located on the **Controls»Alarms and Events** palette. You also can view alarms and events with an alarm summary display or event history display located on the **Controls»Alarms and Events** palette. You also can use the Tag Monitor to view alarms and events. Refer to the *Monitoring and Writing Tag Values* section of Chapter 4, *Using Tags to Manage I/O in LabVIEW* for more information about the Tag Monitor. You also can view the `.log` or `.evt` files with a text viewer.

Viewing Alarms and Events with the Alarm & Event Display Control

The alarm & event display is the easiest way to monitor and acknowledge alarms and events. Use the alarm & event display control located on the **Controls»Alarms and Events** palette or view the display in the bottom right pane of the Tag Monitor. In both cases, the alarm & event display shows alarms and events from every computer and process you configure it to display.

The alarm & event display automatically monitors all alarms generated by a process from which you are monitoring one or more tags. To monitor alarms from a process you are *not* monitoring a tag in, you must first select the source of the alarms.

1. Open the Tag Monitor or place the alarm & event display control on the front panel.
2. Right-click the alarm & event display and select **Select Processes** from the shortcut menu. The **Select Processes** dialog box appears.
3. In the **Available Processes** listbox, navigate to the process for which you want to view alarms, select it, and click the **Add** button. The process appears in the **Selected Processes** listbox.
4. Click the **OK** button.

Acknowledging Alarms in the Alarm & Event Display Control

Right-click an alarm and select an acknowledgement option from the shortcut menu to acknowledge alarms.

Filtering Alarms and Events in the Alarm & Event Display Control

You can set filter criteria so you only see certain alarms and events in a display.

1. Display the **Filter Options** dialog box in one of two ways:
    - Right-click the alarm & event display in the bottom right pane of the Tag Monitor and select **Filter Options** from the shortcut menu.
    - Right-click the alarm & event display on the front panel while the VI is running and select **Filter Options** from the shortcut menu.

2. Select among the filter options.
    a. Place a checkmark in the **Priority** checkbox and type values in **Min** and **Max** to monitor alarms with specific priorities.
    b. Place a checkmark in the **User Name** checkbox and type a user name to restrict alarm monitoring to alarms generated while that user is logged on. You can select only one user name at a time, but you can use asterisk (`*`) or question mark (`?`) wildcards to widen the scope of the alarms reported.
    c. Place a checkmark in the **Ack User Name** checkbox and type a user name to restrict alarm monitoring to alarms acknowledged by that user. You can select only one user name at a time, but you can use wildcards to widen the scope of the alarms reported.
    d. Place a checkmark in the **Ack Comment** checkbox and type a comment to restrict the alarms displayed to those with that acknowledgement comment.
    e. Place a checkmark in the **Object Name** checkbox and type an tag name to restrict alarm monitoring to alarms involving that tag name. You can enter only one tag name at a time, but you can use wildcards to widen the scope of the alarms reported. The tag name must be a completely qualified tag name, as displayed in the tag display pane above the alarm view.
    f. Place a checkmark in the **Description** checkbox and type a description to restrict monitoring to alarms that meet your criteria. You can select only one description category at a time, but you can use wildcards to widen the scope of the alarms reported. The categories HiHi, Hi, Lo, or LoLo are added as a prefix to any descriptions and are ignored by description filtering.
    g. Place a checkmark in the **Area Name** checkbox and type an area name to restrict monitoring to that alarm area. You can enter only one alarm area at a time.
    h. Use the fields in the **Old Alarms** section to display alarms after they have been acknowledged.
    i. Select a **Show** option to display alarms only, events only, or both alarms and events.
    j. Place a checkmark in the **Audible Alarms** checkbox to enable a sound alert when an alarm takes place. The sound depends on your system setting for error sounds.
3. Click the **OK** button. The alarm & event display control displays only the alarms that meet all the filter criteria in the alarm view.

Using an Alarm Summary Display

You can report alarms to an HMI by using the alarm summary display listbox located on the **Controls»Alarms and Events** palette. An *alarm summary* is a collection of all the alarms that currently exist in the system. In addition, if a tag previously in alarm returns to normal but is unacknowledged, a notification is posted in the alarm summary. You can invoke the HMI Wizard to create the block diagram for an alarm summary, or you can build your own block diagram.

If you are building a block diagram, use the Read Alarm Summary VI. If you want to change the default fields (time, date, tag name, alarm limit) that are visible in the alarm summary display listbox, you can use the alarm summary format control located on the **Controls»Alarms and Events** palette and change the checkbox selections. You also can change the default colors of alarms, acknowledged alarms, and unacknowledged tags that have returned to normal using the color codes for alarm summary control located on the **Controls»Alarms and Events** palette.

The alarms displayed in the alarm summary display listbox can be filtered using the HMI Wizard by group or tag names, priority, and acknowledgment status.

Using an Event History Display

You can report recent events to an HMI by using the event history display listbox located on the **Controls»Alarms and Events** palette. An *event history* is a collection of all the alarms and events pertaining to tag values that have occurred in the LabVIEW DSC module since the Tag Engine started. You can invoke the HMI Wizard to create the block diagram code for an event history. You also can build your own block diagram and use the Read Event History VI located on the **Functions»Alarms & Events** palette.

If you want to change the default fields (time, date, tag name, alarm limit) that are visible in the event history display listbox, you can use the event history format control located on the **Controls»Alarms and Events** palette and change the checkbox selections. You also can change the default colors of alarms, events, and normal and acknowledged alarms using the color codes for event history control located on the **Controls»Alarms and Events** palette.

The alarms displayed in the event history display listbox can be filtered using the HMI Wizard by group or tag names, priority, and acknowledgment status.

Acknowledging Alarms in the Alarm Summary and Event History Displays

To acknowledge alarms and events displayed by the alarm summary and event history controls, create an **ACK** button by selecting a button on the **Controls»Boolean** palette and wiring it on the block diagram to the Acknowledge Alarms VI located on the **Functions»Alarms & Events** palette.

When you acknowledge these alarms, the acknowledgment status in the display changes from `UNACK` to `ACK`, and the color of the text changes from red to yellow. These are the default colors, and you can change them on the block diagram or using the HMI Wizard.

There are two modes for handling tags that were previously in alarm but have returned to normal: **Auto Acknowledge** and **User Must Acknowledge**. These modes are configured in the Tag Configuration Editor for each tag. If a tag is configured for **Auto Acknowledge**, the acknowledgment status automatically changes from `UNACK` to `ACK` when the tag returns to normal. If the tag is configured for **User Must Acknowledge**, the status remains at `UNACK` until the operator clicks the **ACK** button to acknowledge the alarm.

You can select the tags for which you want to acknowledge alarms. It is a good idea for this tag list to be identical to the list of tags you display alarms for in the alarm summary or event history display. For example, if you select group `<ALL>` in the Acknowledge Alarm VI, you can acknowledge alarms for all tags that were configured for alarms as they occur. In the tag selection, you also can select a combination of tag names and groups.

Reporting and Viewing Alarm Status in the Alarm Summary and Event History Display

You can report the status of alarms currently in the system using the output of either Read Alarm Summary VI or Read Event History VI, or by using the Get Alarm Summary Status VI. This status includes the number of active alarms and unacknowledged alarms in the system. You can use the alarm summary status control located on the **Controls»Alarms and Events** palette to display this information on the front panel.

Viewing System Errors and Events

System errors are conditions on a system level (as opposed to a per tag basis) that result in problematic functioning of the LabVIEW DSC module. When a system error occurs, LabVIEW prompts you with a dialog box. You can turn this dialog box on or off.

System events are changes in the system that cause a change in behavior that is not problematic. These include events reported by utilities such as the Tag Configuration Editor.

Detailed system error and event messages are logged to a system log file. The messages are written to an ASCII file with a `.log` extension in the `SYSLOG` directory. The LabVIEW DSC module automatically creates this directory, if it does not exist already. The system log file names take the format, `YYYYMMDDHHMM.log` where `YYYY` = year, `MM` = month, `DD` = day, `HH` = hour, and `MM` = minute.

Error Handling

Errors that occur in the LabVIEW DSC module VIs can be handled in one of two ways: by the Tag Engine or by each VI. The Tag Engine handles errors for the Tags VIs and the Alarms and Events VIs. The other VIs include standard LabVIEW **error in** and **error out** parameters for error handling.

Errors Reported by the Tag Engine

The LabVIEW DSC module reports error handling information for Tags VIs, Tag Attributes VIs, and Alarms and Events VIs to the system. If you try to access a tag that does not exist in the Tags VIs or the Alarms and Events VIs, the Tag Engine reports an error. The error shows up in the Engine Manager display. Refer to the *Viewing Tag Engine Status* section of Chapter 4, *Using Tags to Manage I/O in LabVIEW*, for more information about the Engine Manager.

Errors Not Reported by the Tag Engine

If a LabVIEW DSC module VI does not report to the Tag Engine, it uses a standard LabVIEW control and indicator (**error in** and **error out**) to notify you that an error has occurred. Refer to the LabVIEW documentation for more information about error handling.

7

Historical Data Logging and Extraction

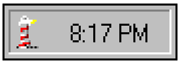
The real-time database (RTDB) is contained in memory; there is no file created to hold the data. When the Tag Engine is stopped, the RTDB retains the last data received, but does not update any values until the Tag Engine begins to run again. Because data logged to the Citadel historical database are taken from the RTDB, no data can be logged to Citadel while the Tag Engine is stopped.

Citadel Historical Database

The LabVIEW Datalogging and Supervisory Control (DSC) module uses the National Instruments Citadel historical database. The LabVIEW DSC module also includes the Citadel ODBC driver that has special commands to perform data transforms, so you can retrieve, manipulate, and analyze historical data automatically from outside the LabVIEW environment. Refer to Appendix A, *Using SQL to Access Historical Data in Citadel*, for more information.

(Windows 2000/NT) Citadel runs on your computer as a service, accessible through the Service Manager.

To start and stop National Instruments services, right-click the lighthouse icon located in the system tray of the Windows taskbar, as shown in the following example.



Data you configure to be logged to Citadel reside in a set of files in the target directory you set for logging. These data can include values from the application as well as alarms and events. You control which data are logged to what location through tag configuration and alarm and event configuration. You can log data to your local computer or to a remote computer on your network, but the directory to which you want to log must be writable from the computer running the Tag Engine.

You access Citadel data through the Historical Trend Viewer, Historical Data VIs, SQL queries, or any other ODBC-compliant application such as Microsoft Query, Microsoft Access, or even Microsoft Excel.

Logging Historical Data

Complete the following steps to log historical data.

1. Open the Tag Configuration Editor.
2. Double-click a tag to display the **Tag Configuration** dialog box.
3. Click the **Operations** tab.
4. Place a checkmark in the **Log Data** checkbox.
5. Click the **OK** button.
6. Select **Configure»Historical** to display the **Historical Logging Configuration** dialog box.
7. Type or navigate to the directory of the historical database. This sets the logging directory for a `.scf` file.
8. Select among the historical logging options. To view descriptions of these options, select **Help»Show Context Help** and move the cursor over any option.
9. Click the **OK** button.
10. Select **File»Save** to save the changes.
11. Open the Engine Manager.
12. Place checkmarks in the **Log** checkboxes to turn on historical logging.

    You also can use the Enable Historical Data Logging VI located on the **Functions»System** palette to turn historical data logging on or off dynamically for all the tags in the system, while the Tag Engine is running.

Archiving Historical Data

When you log historical data for an application, there is a coupling between the configuration (`.scf`) file and the Citadel database. When you decide to archive historical data, copy the `.scf` file along with the historical files to the new location. Although you can retrieve historical data without the `.scf` file, you do not have the tag configuration information, such as engineering range and unit, unless you archive the `.scf` file as well.

Preferably, maintain the relative path between the `.scf` file and the historical files in this new location. For example, if the `.scf` file is in `C:\ARCHIVE`, keep the historical database in `C:\ARCHIVE\DATA`. If you save a new `.scf` file and have not specified a historical data directory, you are prompted to specify the path and the directory is created for you.

Historical data are stored in a number of files created both by the LabVIEW DSC module and by the Citadel database. Consequently, you should always log data to a directory exclusively reserved for those files.

When you create an `.scf` file, the default location for the data generated by the tags configured in that file is in a directory called `data` located in the directory in which you saved the `.scf` file. If you reset the target location for data files and they ended up intermingled with other files, you need to archive files with the following extensions:

- `.evt`
- `.ale`
- `.adx`
- `.dat`
- `.mdx`
- `.bak`
- `.tbd`
- `.tdx`
- `.thd`

These files are not independently accessible.

Extracting and Viewing Historical Data

There are three methods in the LabVIEW DSC module for viewing historical data that has been logged to disk.

- Use the Historical Data VIs.
- Use the Historical Trend Viewer (HTV).
- Use an ODBC-compliant program to query the Citadel database.

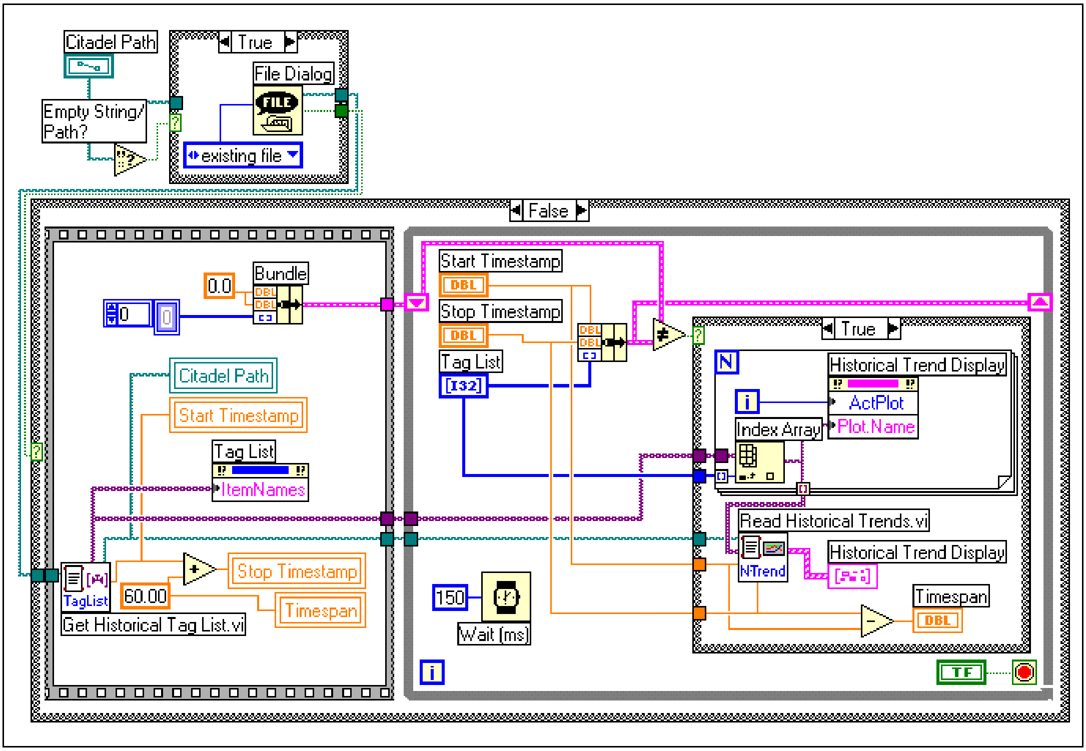
Accessing Historical Data Using Historical Data VIs

There are several VIs you can use in an HMI to manipulate data logged in Citadel files. These VIs access disk files and do not require the Tag Engine to be running. You can use these VIs to browse files, extract the information in a format that can be displayed in a Historical Trend display

(XY graph), or export the data to a spreadsheet file format. There are several examples in `labview\examples\lvdsc` to illustrate this. The main VIs for getting historical data and manipulating them are as follows.

- Call HTV
- Decimate Historical Trend
- Decimate Historical Trends
- Get Historical Tag List
- Get Historical Trend Info
- Historical Trend Statistics
- Historical Trends to Spreadsheet
- Historical Trends to Spreadsheet File
- Read Historical Trend
- Read Historical Trends
- Read Historical String Trend
- Read Historical String Trends

The following illustration shows a VI for viewing historical data files anywhere in the system.



If the Citadel Path is empty, the File Dialog function runs. This brings up a file dialog box that lets the operator select the directory containing the historical data files.

The example then uses the **history tag list** returned by the Get Historical Tag List VI to set up a list of names in the front panel array of tag controls. It uses the **first timestamp** output to initialize the **Start Timestamp** control on the front panel. By default, the example displays the first 60 seconds worth of data on the historical data display. Historical data are displayed using the historical trend XY graph located on the **Controls»Trends** palette.

The Read Historical Trends VI returns historical data from **Start Timestamp** to **Stop Timestamp** for the tags that are selected in the Tag List listbox and returns data in a form that can be wired directly to an XY graph.

The shift register in the While Loop is used to detect user input changes on the operator interface by remembering the previous **Start Timestamp**, **Stop Timestamp**, and the selected **tag list**. If any of these controls are changed, historical data are retrieved for the new settings and the historical trend XY graph is updated.

Using URLs with Historical Data VIs

You can use URLs as well as tag names as the **Tag Name** input to the Historical Data VIs. A URL is the way Logos networking protocol locates data. To use this feature, you must set the tag control to allow undefined tag names. Right-click the tag control to set this option.

The general form for the URLs for LabVIEW DSC module tags is

`\\computername\LabVIEW\tagname`

or more generally, it is

`\\computername\ProcessName\tagname`

where *`computername`* is the name of the computer running the LabVIEW application containing the *`tagname`* on your network and *`tagname`* is the name of the data point you want to connect to.

When you are connecting to a data source in Lookout or in some other National Instruments data source using the Logos networking protocol, you use the URL address element *`ProcessName`*, where *`ProcessName`* is the name of the process containing the data point you want to connect to.

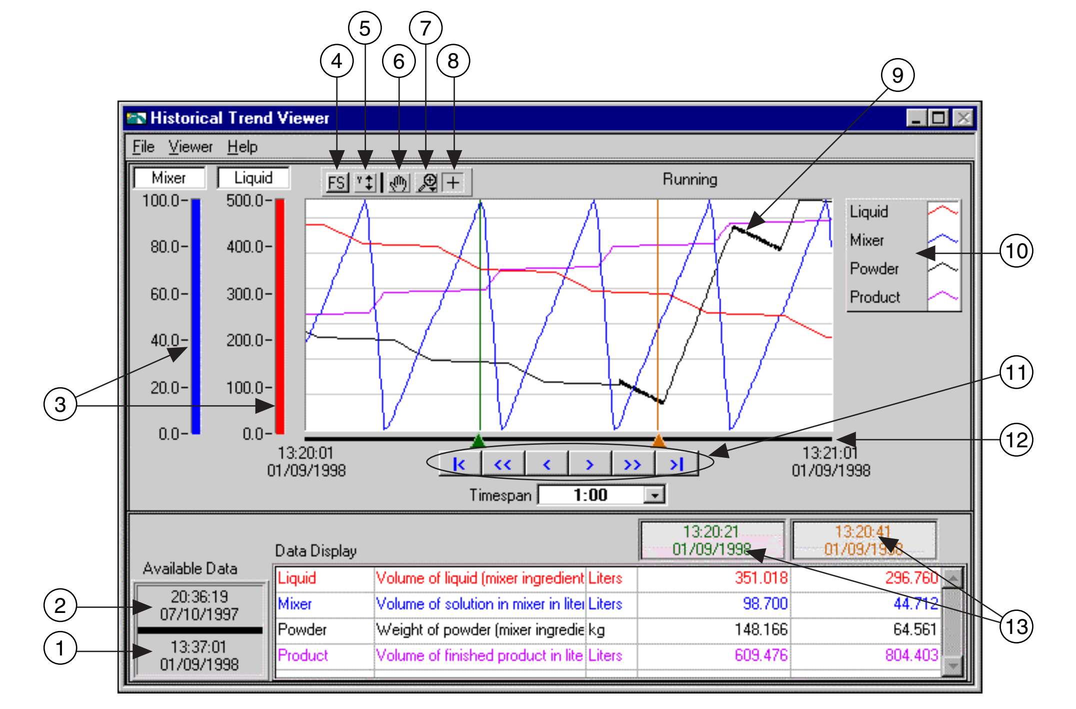
If you use a URL input for **Tag Name** in addition to a data path for **Citadel Path In**, the LabVIEW DSC module checks the directory specified by **Citadel Path In** for the tag part of the URL. If the LabVIEW DSC module does not find that tag, it reports that it cannot access the tag.

If you use a URL input for **Tag Name** while the **Citadel Path In** input is blank, the LabVIEW DSC module uses the URL to locate the tagged data.

Accessing Historical Data Using the Historical Trend Viewer

The Historical Trend Viewer (HTV) is a stand-alone utility that enables you to look at historical data in your system. The HTV limits you to viewing no more than eight tags at a time. If you want to look at more tags in a single historical trend, you should build your own utility using the Historical Data VIs.

To open the HTV, select **Tools»Datalogging & Supervisory Control» Historical Trend Viewer**. The HTV is shown in the following illustration.



Available Data

20:36:19
07/10/1997

13:37:01
01/09/1998

Data Display

			13:20:21 01/09/1998	13:20:41 01/09/1998
Liquid	Volume of liquid (mixer ingredient	Liters	351.018	296.760
Mixer	Volume of solution in mixer in liter	Liters	98.700	44.712
Powder	Weight of powder (mixer ingredie	kg	148.166	64.561
Product	Volume of finished product in lite	Liters	609.476	804.403

1	Stop time	5	Autoscale Y button	8	Cursor Movement tool	11	Panning buttons
2	Start time	6	Scrolling tool	9	Trend display	12	Time axis
3	Y-axis displays	7	Zoom button	10	Plot legend	13	Cursor displays
4	Full Scale button						

Selecting Tags to Display in the HTV

1. Open the HTV. The **Select Tags for HTV** dialog box appears. If the HTV is already open, select **File»Select Tags** to display the dialog box.

2. Select either an `.scf` file or a directory of Citadel files. The default is to select an `.scf` file. The `.scf` file you select must point to a valid directory of Citadel files. If the Tag Engine is running, the `.scf` file being used by the Tag Engine is the default.

Note You can look at data from only one Citadel database at a time.

3. Select the tags you want to display in the **Available Tags** listbox and click the **Add** button to display them in the **Tags to Display** listbox on the right. The HTV displays the tags in the order that they are listed in the **Tags to Display** list.

View configuration information about a tag by selecting it in the **Available Tags** listbox and clicking the **Tag Information** button.

4. Click the **OK** button.

Changing the HTV Time Axis with Panning Buttons

You can change the time axis for a trend within the HTV manually, or by using panning buttons. The panning buttons allow you to move backward and forward through the historical data in the trend. The buttons do not affect the timespan of the trend. For example, if the trend displays data from 9:45 to 9:55 on the same day, the timespan is ten minutes. Table 7-1 describes the panning button functions.

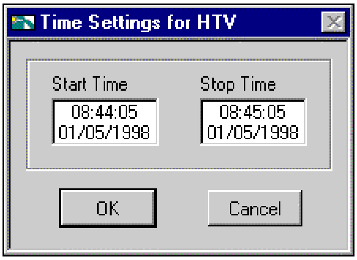
Table 7-1. Panning Button Functions

Button	Name	Description
I<	Retrieve oldest data	Displays the first available page of data.
<<	Back to closest point	Centers the display around the closest point to the left of the timespan. If there is no data in the previous time span, skips to the previous end of data.
<	Back one-half page	Moves the display back by half of the current timespan.
>	Forward one-half page	Moves the display forward by half of the current timespan.
>>	Forward to closest point	Centers the display around the closest point to the right of the timespan. If there is no data in the next time span, it skips to the next start of data.
>I	Most recent data	Displays the most recent available page of data.

Changing the HTV Time Axis Manually

You also can change the time access for a trend within the HTV manually. To do so, select the text at either end of the time axis and change the data. You must enter the date in the correct format. If you make an error, the input is ignored.

You can select and enter the time and date on the time (X) axis of the historical trend on the HTV directly. However, the HTV responds immediately to any changes you make. If you want to make manual edits to both the start and stop time on the time axis, you can select the **Viewer»Time & Date** option. When you select this option, the following dialog box appears and you can enter the start and stop time of the data displayed in the trend.



Start Time 08:44:05 01/05/1998

Stop Time 08:45:05 01/05/1998

Changing the HTV Timespan of Data Displayed

The **Timespan** pull-down menu displays the amount of relative time between the start and end points of the time axis. To change the amount of time between these points, you either can manually reenter data in the start or end point on the time axis, or use the **Timespan** pull-down menu.

By default, **Timespan** contains the values 1:00, 5:00, 10:00, and 30:00. Select **Enter New** in **Timespan** if you want to enter a different amount of data to display.

Viewing an HTV Tag Value at a Specific Point in Time

The Data Display table on the HTV shows the tags displayed in the trend, the tag description, and, for analog tags, the engineering units associated with the tag. The two rightmost columns show the values of the tags at the two cursor locations in the trend. For discrete tags, the values in these columns are either `On` or `Off`. To move the cursors, drag the triangles at the bottom of the trend display.

Changing the HTV Y Axis

The HTV displays two Y axes at any time. Each Y axis displays the color of the tag associated with it. All discrete tags show their ranges as going from `On` to `Off`. Click the Y axis to make it rotate through the tags displayed in the trend.

To change the range in the Y axis for analog and bit array tags, select the text at the top or bottom of the scale and type in the desired value. When you enter the value, that trend scale changes and the trend display updates. Discrete tags are displayed without Y axis scales, and ranges are shown as `On` or `Off`.

Changing the HTV Plot Colors and Style

Click the **Trend Legend**. The shortcut menu contains several options with which you can change the plot colors and styles used in the trend.

Zooming In on an HTV

The **HTV Trend** palette contains a **Zoom** button, shown at left, that allows you to zoom in on points of interest.

Click the Zoom button and select from the following options, clockwise from the top left, to zoom in and out of the trend:

- **Zoom to Rectangle**—Click a point on the display you want to be the corner of the zoom area and drag the tool until the rectangle covers the zoom area.
- **X-zoom**—Zooms in on an area of the graph along the x-axis.
- **Y-zoom**—Zooms in on an area of the graph along the y-axis.
- **Zoom Out about Point**—Click a point you want to zoom out from.
- **Zoom In about Point**—Click a point you want to zoom in on. Press the <Shift> key to change between Zoom In about Point and Zoom Out about Point.
- **Undo Zoom**—After you zoom in or out, use this option to return to the previous view.

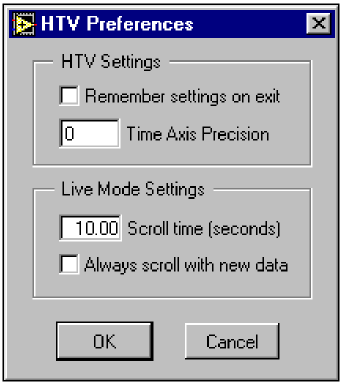
Exporting HTV Data to a Spreadsheet

From the HTV, select **File»Export**. The HTV exports the information currently displayed in the trend to a tab-delimited file. A dialog box prompts you for the name and location of the file to create.

The HTV resamples data in periodic intervals so that all tags have the same number of data points. The frequency defaults to a value according to the frequency of data in the historical files. If you want to override this value, enter the frequency you want in the dialog box.

Setting HTV Tag, Time, and Color Preferences

Set the preference for the HTV to remember settings for display time and color on exit by selecting **Viewer»Preferences**. When you exit the HTV, the state of the viewer is recorded.



HTV Preferences

HTV Settings

□ Remember settings on exit

0 Time Axis Precision

Live Mode Settings

10.00 Scroll time (seconds)

□ Always scroll with new data

Place a checkmark in the **Remember settings on exit** checkbox if you want to update your settings each time you exit the HTV.

Viewing Newly Logged HTV Data Automatically

You can use Live mode to watch incoming data after they have been logged. When historical logging is enabled, the **Live** button appears to the right of the panning buttons. When you click the **Live** button, the trend automatically updates periodically. Select **Viewer»Preferences** in the **HTV Preferences** dialog box to set how often the trend displays the new data. The default is 10 seconds. If **Always scroll with new data** contains a checkmark, the display updates when new data are logged.

While Live mode is turned on, the values for each tag are extrapolated to the last time the trend was updated. These extrapolated values are marked with an asterisk in the Data Display. When a cursor or slider is placed before the extrapolation begins for a tag, the asterisk is not present. Turning off Live mode also turns off extrapolation.

Calling the HTV from an Application

In many HMI applications you might elect not to give the operator access to the standard menu bar. You can use the Call HTV VI located on the **Functions»Historical Data** palette to call the HTV dynamically from an HMI application.

Printing Historical Data

You can print logged, historical data in the following ways:

- Print historical data from the HTV. Open the HTV by selecting **Tools»Datalogging & Supervisory Control»Historical Trend Viewer**. Refer to the online help for information about selecting tags, adjusting the timespan, and printing data.
- Print historical data from a spreadsheet. To export historical data, use the Historical Trends to Spreadsheet VI or Historical Trends to Spreadsheet File VI, or export data from the HTV. Then print the data from the resulting spreadsheet file. Refer to the *Logging Historical Data* and *Extracting and Viewing Historical Data* sections for more information about logging and exporting historical data.
- Use an ODBC-compatible application to query the Citadel historical database and print the results. Refer to Appendix A, *Using SQL to Access Historical Data in Citadel*, for more information about using ODBC applications with the Citadel database.

8 Security

To implement security in an application, set up user and group accounts. Then configure and restrict access to the LabVIEW environment and your specific HMI.

A system with permission-based security is a system in which users are allowed various degrees of access to tools or data depending on the permission attached to their account name in the access property of the tool or data involved.

For example, to control access to a front panel object, right-click the object and select **Security** from the shortcut menu to display the **Access Rights** dialog box. Add to the list all the individual user accounts or groups of users you want to have access to that control. You can then set the access level each user or group is allowed, from full to no access.

Creating and Editing User and Group Accounts

You use the User Manager to create and edit the properties of groups, create or edit the properties of user accounts, assign users to one or more groups, and otherwise manage security accounts for LabVIEW and Lookout applications. Only an administrator or someone whose account is a member of the Administrator group can create, revise, or delete system user accounts.

Note For user accounts to work consistently across your network, you must use the same `lookout.sec` file for all installed copies of Lookout or the LabVIEW Datalogging and Supervisory Control (DSC) module. Refer to the *Duplicating Security Files for Networked Computers* section of Chapter 9, *Networking and Deploying Applications*, for more information.

Creating User Accounts

1. Select **Tools»Datalogging & Supervisory Control»Security»Edit User Accounts** to open the User Manager.
2. Select **User»New User**.
3. Enter the domain name of the new user in the **Username** field.

4. Enter the **Full Name** of the user.
5. Enter job titles or other relevant information in the **Description** field.
6. Enter the user password in the **Password** field.
7. Enter the password a second time in the **Confirm Password** field to make sure there was no typing error in the first entry.
8. Set the **Security Level** for the new user. Security levels range from 0 to 10, with 10 being the highest possible security authorization. Assign level 10 access only to those people responsible for system security.
9. **Minutes idle until logoff** sets how long LabVIEW runs with no operator interaction before logging the current user off automatically. Setting this value to 0 (the default) means there is no timeout in effect.
10. You can set an expiration time for passwords. Users cannot reset their own password; a member of the Administrator group must set the password for them. The default is for passwords never to expire.
11. Place a checkmark in the **Account Disabled** checkbox if you want to disable a user account without removing the user from the system.
12. Click the **Groups** button to add this user to various local security groups. The **Group Memberships** dialog box appears.

    The default groups are Administrators, Guests, Operators, and System Operators. Any groups you have created are also shown.
13. To enter a user in a group, highlight the group in the **Not Member of** field and click the **Add** button. To remove a user from membership in a group, highlight a group in the **Member of** field and click the **Remove** button.

Note When you add an individual user whose individual account has a security level different than that of the group, that user has the higher of the security levels.

14. Click the **OK** button.

Creating Groups

1. Open the User Manager.
2. Select **User»New Local Group**.
3. Assign a name to the group in the **Group Name** field.
4. Enter a description of the group in the **Description** field.
5. Assign the security level for members of this group in the **Security Level** field.

Note When you add an individual user whose individual account has a security level different than that of the group, that user has the higher of the security levels.

6. To add **Members**, click the **Add** button. The **Add Users and Groups** dialog box appears.
7. The **List Names From** listbox selects the domain to list user names from. At this time, you are restricted to your local domain.
8. Highlight the names you want to add in the **Names** field, and click the **Add** button to add those users to your group.

Modifying User and Group Accounts

The dialog boxes for editing users and groups are essentially the same as those for creating users and groups. Complete the following steps to modify user and group accounts.

1. Open the User Manager.
2. Either double-click the user or group you want to edit, or highlight the user or group and select **User»Properties**. The **User Properties** dialog box appears and displays information about user activity.
3. Use the **User Properties** dialog box as you would the new user dialog box. Refer to the *Creating User Accounts* section for more information about the fields in this dialog box.
4. Click the **OK** button.

Special Pre-Defined User and Group Accounts

The National Instruments User Manager comes with several user accounts and groups built-in. The built-in user accounts include Administrator, Everyone, Guest, and (nobody). The built-in groups include Administrators, Guests, Operators, and System Operators. You cannot delete any of these accounts, though you can edit the properties of some of them.

The Administrator account overrides all other security settings and has access to everything in LabVIEW. This override extends to all individual accounts added to the Administrators group.

You cannot delete the Administrator account or change its security level. You can set the password and enter the name and a description of the Administrator. You can add or remove individual user accounts from the Administrator group.

The (nobody) account cannot be edited or deleted, and does not actually appear as an account in the User Manager. This account is what LabVIEW defaults to when no authorized user is logged on. It always has a security level of 0.

You can edit all the properties of the Guest user account and of the Guests, Operators, and System Operators groups.

Logging In and Out

To log in, select **Tools»User Name**. Type your account name and password. If you do not know your account name, or have forgotten your password, contact your LabVIEW administrator.

To log out, select **Tools»Datalogging & Supervisory Control» Security»Logout**.

Accessing User Information

After you log into the LabVIEW DSC module, you can find out what your user privileges are, along with other user information, by selecting **Tools» Datalogging & Supervisory Control»Security»User Info**.

The default tab for the **User Information** dialog box lists the identity of the logged in user along with activity information for this user. Other tabs reveal the permissions set for a given user.

Changing Your Password

You must be logged in to change your password. Select **Tools»Datalogging & Supervisory Control»Security»Change Password**.

Type your old password, then your new password. Type your new password again to verify it.

Restricting Access to the LabVIEW Environment

After you set up your user and group accounts, you can implement security in several ways. You can configure access to most LabVIEW DSC module utilities and the Tag Engine on a per-user or group basis. HMI VIs can enforce security by determining whether the current user can operate, or even see, a particular control or indicator. In general, security set up by selecting **Tools»Datalogging & Supervisory Control»Options** or **Tools»Datalogging & Supervisory Control»Security** applies to everything in the LabVIEW environment, security set up in the Tag Configuration Editor applies only to the `.scf` file, and security implemented on a block diagram applies only to that application.

Setting Permissions for Accessing Tools

Complete the following steps to set permissions for the Tag Configuration Editor, Tag Engine, Historical Trend Viewer, Tag Monitor, Server Browser, startup VIs, or server tester.

1. Log in as an administrator.
2. Select **Tools»Datalogging & Supervisory Control»Options**.
3. Click the **Advanced** tab.
4. Click the **Tools Access** button. The **Tools Access** dialog box appears.
5. Click the tab for the tool for which you want to configure permissions and click the **Edit** button. The standard LabVIEW DSC module **Access Rights** dialog box appears with the name of the tool for which you are configuring permissions above the list of users and groups.
6. This dialog box displays a list of access rights for specific users and groups.
    - To remove a user or group, select it and click the **Remove** button.
    - To change a user or group permission, select it and select from the options in the **Access** listbox.
    - To add a new user or group, click the **Add** button. The **Add Users and Groups** dialog box appears.
7. Highlight the user or group you want to add and click the **Add** button. Set the **Access** rights, and click the **OK** button when you are finished.

Configuring Tag Security

Complete the following steps to configure access to a specific tag.

1. Open the Tag Configuration Editor.
2. Double-click the tag to display the **Tag Configuration** dialog box.
3. On the **General** tab, click the **Security** button to display the **Access Rights** dialog box.
4. Set the access rights
5. Click the **OK** button twice and save your changes.

Complete the following steps to configure access to general `.scf` file tasks.

1. Open the Tag Configuration Editor.
2. Select **Configure»Security**. The **Access Rights Configuration** dialog box appears.
3. Click the **SCF File Access**, **Network Data Access**, and **Tag Editor Access** tabs to configure different aspects of security.

Setting .SCF File Access

Click the **SCF File Access** tab to set security on the `.scf` file itself; specifically setting who can edit a given `.scf` file. This permission is part of each `.scf` file and can vary from file to file.

1. Open the Tag Configuration Editor.
2. Select **Configure»Security**.
3. Click the **SCF File Access** tab, and click the **Edit** button. The **Tag Configuration File Access Rights** dialog box appears.
4. The large field in the center of this dialog box lists the groups and user accounts that have permission to work with the `.scf` file shown at the top of the dialog box.
    - To remove a user or group, select it and click the **Remove** button.
    - To change a user or group permission, select it and select from the options in the **Access** listbox.
    - To add a new user or group, click the **Add** button. The **Add Users and Groups** dialog box appears.
5. Highlight the user or group you want to add and click the **Add** button. Set the **Access Rights**, and click the **OK** button when you are finished.

Setting Network Data Access

Click the **Network Data Access** tab to set who has access to tag data on the network. Security settings here determine who can and cannot connect to tags configured in an `.scf` file. The settings you make here are specific to a given `.scf` file, and can vary from file to file. All tags in a given `.scf` file inherit the settings you make in this tab, except for any tags you edit security settings for individually. The Host Access controls whether a particular computer can access data on your computer, no matter who is logged on that computer. You also can grant or deny access to specific users and groups.

1. Open the Tag Configuration Editor.
2. Select **Configure»Security**.

3. Click the **Network Data Access** tab, and click the **Edit** button. The **Access Rights** dialog box appears.

4. Configure the network security for User or Group access. The large field in the center of this dialog box lists the groups and user accounts that have permission to work with the `.scf` file shown at the top of the dialog box.

   - To remove a user or group, select it and click the **Remove** button.
   - To change a user or group permission, select it and select from the options in the **Access** listbox.
   - To add a new user or group, click the **Add** button. The **Add Users and Groups** dialog box appears.

5. Highlight the user or group you want to add and click the **Add** button. Set the **Access Rights**, and click the **OK** button when you are finished.

6. Configure the network security for Host access—computers on your network can access the data configured by the active `.scf` file. Click the **Configure Host Access** button. The **Configure Network Access** dialog box appears.

7. You can use the asterisk wildcard to enable or disable all computers or all computers in a set. For instance, entering `*.yourdomain.com` would select all the computers with that domain address. This is the same syntax used by the Server TCP/IP Access VI, available by selecting **Tools»Options**, then selecting **VI Server:TCP/IP Access**. Refer to the LabVIEW documentation for more information about the VI Server and wildcards you can use in the **TCP/IP Access List**.

8. If you are uncertain of the computer names you want to allow or deny access to, you can browse the network and select individual computers by clicking the **Browse** button. The **Network Browser** dialog box appears.

9. Click the network node to expand the network view, and select the computer you want to allow or disable access for. Click the **OK** button to add this computer to the access list.

10. If you have enabled BridgeVIEW 2.x networking in the Tag Configuration Editor (by selecting **Configure»Network» BridgeVIEW 2.x Networking»Allow Network Access**), it enables the **Advanced** button on the **Configure Network Access** dialog box. Clicking this button opens the **Network Settings** dialog box that functions in the same way it did in BridgeVIEW 2.*x*.

11. Click the **OK** button.

Setting Tag Configuration Editor Access

Click the **Tag Editor Access** tab to set who has access to the Tag Configuration Editor.

1. Open the Tag Configuration Editor.
2. Select **Configure»Security**.
3. Click the **Tag Editor Access** tab, and click the **Edit** button. The **Access Rights** dialog box appears.
4. The large field in the center of this dialog box lists the groups and user accounts that have permission to work with the `.scf` file shown at the top of the dialog box.
   - To remove a user or group, select it and click the **Remove** button.
   - To change a user or group permission, select it and select from the options in the **Access** listbox.
   - To add a new user or group, click the **Add** button. The **Add Users and Groups** dialog box appears.
5. Highlight the user or group you want to add and click the **Add** button. Set the **Access Rights**, and click the **OK** button when you are finished.

Setting Startup Login Options

You can set several login options, such as whether the last user is logged in automatically when LabVIEW starts or whether a dialog box appears at startup so you must log in manually.

1. Log in as an administrator.
2. Select **Tools»Datalogging & Supervisory Control»Options.**
3. Click the **Advanced** tab.
4. Click the **Security Preferences** button.
5. Click the **Startup** tab.
6. Set the options to make it easier for an operator to log in when using LabVIEW.
7. Click the **OK** button.

Checking User Privileges

Use the DSC Check Operator Privilege VI located on the **Functions»System»Security** palette. This VI checks the privileges of the current user to determine whether the user has a particular privilege.

Disabling Special Keys

Complete the following steps to prevent anyone logged in below a certain security level from using the special key combinations, including <Ctrl-Alt-Delete>, <Ctrl-Esc>, <Alt-Esc>, <Alt-Tab>, <Alt-Enter>, <Ctrl-Alt-Esc>, and the Windows logo key.

1. Log in as an administrator.
2. Select **Tools»Datalogging & Supervisory Control»Options**.
3. Click the **Advanced** tab.
4. Click the **Security Preferences** button.
5. Click the **Advanced** tab.
6. Set the security level at which you want to disable special keys.
7. Click the **OK** button.

Prompting an Operator to Log into an Application

Use the NI SEC Invoke Login DialogVI located on the **Functions»System»Security** palette. This VI launches the **Login** dialog box and returns the user name and access level. You can have the application control login as part of its HMI.

Logging an Operator into or out of an Application Programmatically

Use the NI SEC Programmatic Login VI located on the **Functions» System»Security** palette. To use this VI, you must enter a user name and password. If successful, the user is logged in to the system, and no **Login** dialog box appears.

Use the NI SEC Programmatic Logout VI located on the **Functions» System»Security** palette. This VI logs the current user out of the LabVIEW DSC module.

Identifying the Current Operator

Use the NI SEC Interactive User Info VI located on the **Functions»System»Security** palette to return the name and current operator name and information. Use the NI SEC User Account Info VI to retrieve information about any user account.

9

Networking and Deploying Applications

This chapter describes how to set up applications for use on a network and how to deploy applications on computer systems and networks other than the system on which you developed the applications.

National Instruments uses a special networking technology known as the Logos networking protocol, installed as a service on your computer when you install the LabVIEW Datalogging and Supervisory Control (DSC) module. The Logos networking protocol functions across the network without you performing any special configuration or work; you only need to browse for the data points you want to access from a software client with Logos capability (such as the Tag Configuration Editor or the Tag Configuration Wizard) to see any Logos data on your network.

Note LabVIEW without the DSC module can acquire Logos data through the DataSocket, but cannot act as a Logos server. You can use the LabVIEW DSC module to connect tags and data directly through the Logos networking protocol and to act as a Logos server.

Before you can access this Logos data, you must register the computers and devices running on your network. For logging of historical data to be accurate, you must also synchronize the internal clocks on the networked computers and devices. Refer to the *Registering Networked Computers* and *Setting up Time Synchronization for Networked Computers* sections of this chapter for more information.

The LabVIEW DSC module also adds OPC functionality to LabVIEW, allowing LabVIEW applications to operate as OPC servers and clients. Again, you do not need to perform any special configuration operations to use this OPC capability. Any LabVIEW application is visible to any OPC client software. The Tag Configuration Editor and the Tag Configuration Wizard can browse for any OPC servers on the network and access those tags.

Setting up Networked Applications

To use a LabVIEW DSC module application on a network, you need to register the computers or devices on your network that use the Logos networking protocol, make sure the clocks of all your computers or devices are synchronized, make sure your security files are compatible on your networked computers, and make sure you have all necessary services running.

Registering Networked Computers

To access LabVIEW and Lookout applications or FieldPoint hardware using the Logos networking protocol, you must register the computers the applications are running on or the FieldPoint device. You can register computers through the Tag Configuration Editor, the Tag Monitor, the LabVIEW DSC module options, or the Server Browser.

Complete the following steps to register or unregister a computer.

1. Log in as Administrator or with administrator privileges.
   - Open the Tag Configuration Editor and select **Configure»Network»Registered Computers**.
   - Open the Tag Monitor, right-click the **Network Neighborhood** node, and select **Register Computer** from the shortcut menu.
   - To use the LabVIEW DSC module options, select **Tools»Datalogging & Supervisory Control»Options**, click the **Advanced** tab, and click **Registered Computers**.
   - Open the Server Browser and click the **Register Computer** button.
2. Complete the following steps to add a computer to the list of registered computers.
   a. Click the **Add** button in the **Registered Machines** dialog box. The **Register Computer** dialog box appears.
   b. Enter the computer you want to access in the **Computer Name** field, or browse for the computer in the network tree.
   c. Click the **Register** button, then click the **OK** button when you are finished.

3. Complete the following steps to remove a computer from the list of registered computers.
   a. In the **Registered Machines** dialog box, select the computer you want to remove.
   b. Click the **Remove** button.

You also can unregister a computer in the Tag Monitor by right-clicking it and selecting **Unregister** from the shortcut menu.

Setting up Time Synchronization for Networked Computers

To keep data properly time stamped, make sure the times on your computers are properly synchronized. The National Instruments time synchronization service is installed as a service in Windows 2000/NT that runs every time you run your computer. Time synchronization runs as a background process in Windows 9*x*. Make sure that the order of search for time servers is the same for all the computers on your network you want to synchronize, including the primary time synchronization server.

Determining Time Server Search Order

Suppose you have four computers you need to have synchronized. If one fails, the others look for the next in line to synchronize to as time servers.

Note If you have both Windows 2000/NT and Windows 9*x*/Me computers on the same network, you might have better results if a Windows NT computer is the primary time synchronization server.

For computers A, B, C and D, where A is the primary time synchronization computer, B is the time synchronization computer if A fails, and so on, you would use the following time server search order in each computer. Table 9-1 shows an example time synchronization order.

Table 9-1. Time Synchronization Order

Computer A	Computer B	Computer C	Computer D
None listed	A	A	A
		B	B
			C

As the primary time server, Computer A would have no other servers listed. If Computer A is running, it should synchronize to itself. Computer B should synchronize to Computer A if A is running. If A is not running, B should synchronize to itself. Computer C should synchronize to Computer A if it is running, Computer B if A is not running, and to itself if neither A nor B is running. This pattern should be used for all the computers you want in one synchronized set.

Configuring Time Synchronization

1. Select **Tools»Datalogging & Supervisory Control»Options**.
2. Click the **Advanced** tab.
3. Click the **Time Synchronization** button. The **Time Server Search Order** dialog box appears.

   Any computer that is running the time synchronization service can serve as a time server or a time client. The primary time server is the first computer listed in the **Time Server Search Order** field. If no computer is set as a primary time server, your computer synchronizes to itself.
4. To add a computer to the **Time Server Search Order** field, click the **Add** button. If you know the name of the computer you want to add, you can type it into the **Computer name** field. If you do not know the exact name of the computer, you can browse for it in the network tree contained in the **Select a Computer** field.

   To remove a computer from the **Time Server Search Order** field, highlight the computer name and click the **Remove** button.
5. To change the order in which your computers search for a time synchronization server, select the computer name and click the **Up** or **Down** buttons.
   - If you have some computers running Windows 9*x* and other computers running Windows 2000/NT in your network, you should list Windows 2000/NT computers first in the server search list. Time synchronization works better between Windows 9*x* and Windows 2000/NT systems when the Windows 2000/NT computer is the server.
   - You do not need to include a computer running LabVIEW in its own list of time synchronization services.
6. Use **Sleep Time (seconds)** to set how long each computer waits between each synchronization. You should set the primary time synchronization server sleep time to 60 seconds.

If the primary server is off-line for some reason, a computer scheduled to synchronize automatically seeks out the second computer on the synchronization server list. At the time of the next synchronization, the computer first looks for the primary server before seeking a secondary synchronization server.

7. Click the **OK** button.
8. Repeat steps 1 through 7 for all computers on your network that you want to synchronize to make sure that the order of search for time servers is the same for all the computers, including the primary time synchronization server.

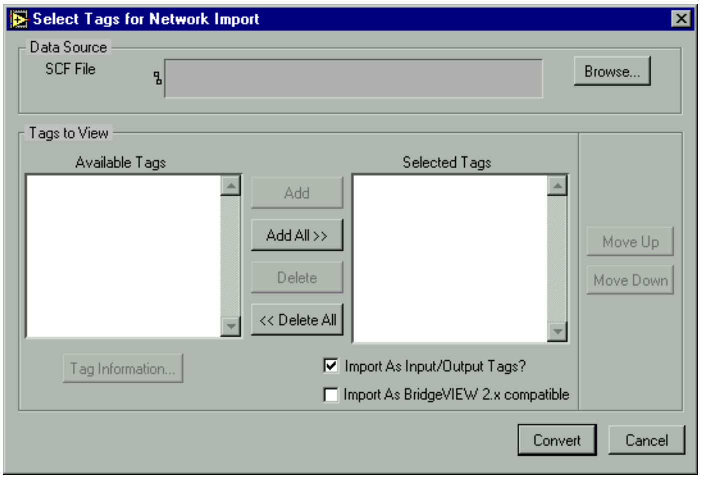
Duplicating Security Files for Networked Computers

For user accounts to work consistently across your network, you must use the same `lookout.sec` file for all your installed copies of Lookout or the LabVIEW DSC module. After you create the `lookout.sec` file, make a copy of it from the `windows\system` directory of Windows 9*x* systems, and the `windows\system32` directory for Windows 2000/NT systems. Place a copy of the file in the `windows\system` or `windows\system32` directory of each of the other computers with which you want to be able to use these user accounts.

Importing Network Tags

You can import tags into a local `.scf` file from an `.scf` file located on another computer.

1. Open the Tag Configuration Editor.
2. Select **File»Import Network Tags** to display the **Select Tags for Network Import** dialog box.



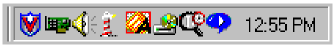
☑ Import As Input/Output Tags?
□ Import As BridgeVIEW 2.x compatible

3. Click the **Browse** button next to the **SCF File** field and navigate to an `.scf` file on any computer on the network.
4. Click the **Add** buttons to add the tags you want to import to the **Selected Tags** listbox.
5. (Optional) To import tags from a remote computer using BridgeVIEW 2.*x* networking, place a checkmark in the **Import As BridgeVIEW 2.x compatible** checkbox. National Instruments recommends converting to the Logos networking protocol when possible, but this option is provided for compatibility with BridgeVIEW 2.*x* networking. Do not place a checkmark in the **Import As BridgeVIEW 2.x compatible** checkbox to convert to the Logos networking protocol.
6. Click the **Convert** button to import tags from that file into the local `.scf` file.

Monitoring Windows Services

The Logos networking protocol requires three background services that run in Windows outside of any National Instruments applications. These services are known as Citadel Server, Classified Ads, and Time Synchronization. In the Windows 2000/NT task manager, these services appear as `Classifieds`, `TimeService`, and `CitadelService`. Under Windows 2000/NT, these services run automatically. If you need to interact with these services, use the Services utility, found in **Start»Settings»Control Panel»Services**.

In Windows 9*x*, the LabVIEW DSC module installs a services manager, denoted by a lighthouse icon located in the system tray of the Windows taskbar, as shown in the following example.



When you right-click this icon, a shortcut menu appears from which you can start or stop any of the Windows services.

Using the Run-Time System

You can deploy LabVIEW DSC module applications using the LabVIEW DSC Run-Time System, which has support for the special LabVIEW DSC module capabilities built in. You must purchase the LabVIEW DSC Run-Time System separately. You cannot run LabVIEW DSC module applications on the LabVIEW Run-Time System.

When you deploy applications, make sure all the proper hardware and hardware drivers are installed and working in the server and client computers.

Preserving Network Names in Deployed Applications

LabVIEW DSC module applications use computer network names to log data and access data sources. When you install applications on a computer system different from your development system, either make sure that all the names and paths on your deployment system are identical to the names and paths on your development system, or make the necessary alterations in your applications to match the network names and data paths of your deployed system.

Viewing Client Connections

Complete the following steps to see what computers are currently accessing data from a LabVIEW DSC module application.

1. Launch the Tag Engine.
1. Click the **View Client Connections** button in the Engine Manager. The **Engine Host Connections** dialog box appears.
2. Select the computer you want to check and click the **Details** button.

3. In the **Connections** dialog box that appears, you can view the data being accessed by the remote computer, along with information characterizing the tags being accessed.
4. The client connections dialog boxes do not update automatically. If you want to see changes in information, you need to close the **Connections** dialog box, click the **Refresh** button in the **Engine Host Connections** dialog box, and click the **Details** button again. You also need to click the **Refresh** button to see changes in the list of computers accessing data from your local computer.

A

Using SQL to Access Historical Data in Citadel

This chapter describes Structured Query Language (SQL), Open Database Connectivity (ODBC), and accessing Citadel data using both SQL and ODBC.

Introduction

The Citadel historical database includes an ODBC driver, which enables other applications to directly retrieve data from Citadel using SQL queries.

What is ODBC?

ODBC is a standard developed by Microsoft. It defines the mechanisms for accessing data residing in database management systems (DBMSs). Nearly all Windows applications that can retrieve data from a database support ODBC.

What is SQL?

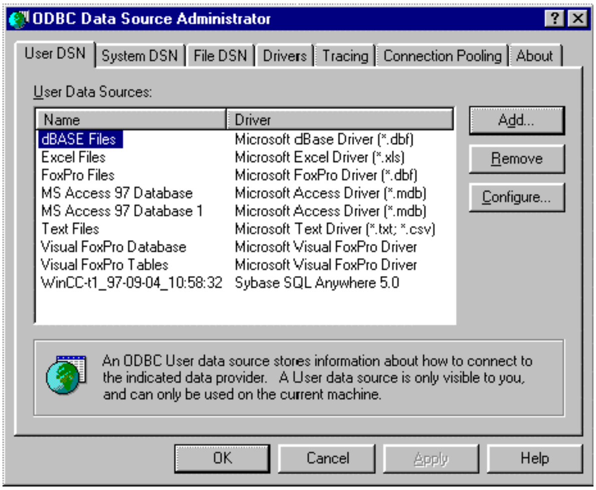
SQL is an industry-standard language used for retrieving, updating, and managing data. In LabVIEW with the Enterprise Connectivity toolkit and in Lookout, you can use SQL to build queries to extract data from Citadel. The Citadel ODBC driver also includes many built-in data transforms to simplify statistical analysis of retrieved data.

Creating a Citadel ODBC Data Source

Complete the following steps to create a Citadel ODBC data source for use with the LabVIEW Datalogging and Supervisory Control (DSC) module.

1. Click the Windows **Start** button and select **Settings»Control Panel**.
2. Run the ODBC applet. It might be called **ODBC** or **ODBC Data Sources** or something similar, depending on your operating system version number.

Note Shut down all ODBC applications, such as databases, spreadsheets, word processors, and Microsoft Query, before you run the ODBC applet.

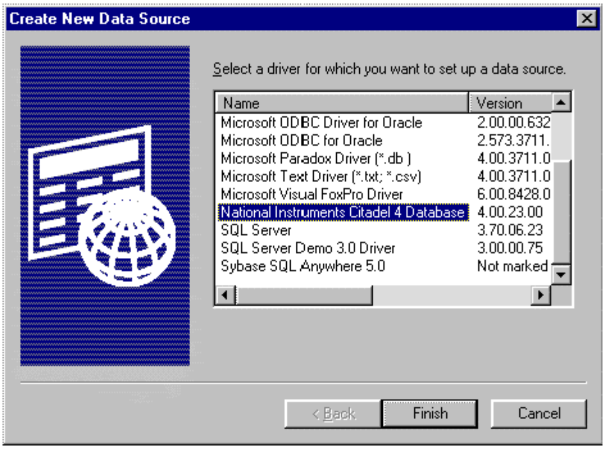


User Data Sources:

Name	Driver
dBASE Files	Microsoft dBase Driver (*.dbf)
Excel Files	Microsoft Excel Driver (*.xls)
FoxPro Files	Microsoft FoxPro Driver (*.dbf)
MS Access 97 Database	Microsoft Access Driver (*.mdb)
MS Access 97 Database 1	Microsoft Access Driver (*.mdb)
Text Files	Microsoft Text Driver (*.txt; *.csv)
Visual FoxPro Database	Microsoft Visual FoxPro Driver
Visual FoxPro Tables	Microsoft Visual FoxPro Driver
WinCC-t1_97-09-04_10:58:32	Sybase SQL Anywhere 5.0

An ODBC User data source stores information about how to connect to the indicated data provider. A User data source is only visible to you, and can only be used on the current machine.

3. Click the **User DSN** tab or the **System DSN** tab, depending on which type of data source you want to create. User DSNs are only visible to the user who created them on the current machine. System DSNs are available to all users on the current machine.
4. Click the **Add** button. The following dialog box appears.



Select a driver for which you want to set up a data source.

Name	Version
Microsoft ODBC Driver for Oracle	2.00.00.632
Microsoft ODBC for Oracle	2.573.3711.
Microsoft Paradox Driver (*.db)	4.00.3711.0
Microsoft Text Driver (*.txt; *.csv)	4.00.3711.0
Microsoft Visual FoxPro Driver	6.00.8428.0
National Instruments Citadel 4 Database	4.00.23.00
SQL Server	3.70.06.23
SQL Server Demo 3.0 Driver	3.00.00.75
Sybase SQL Anywhere 5.0	Not marked

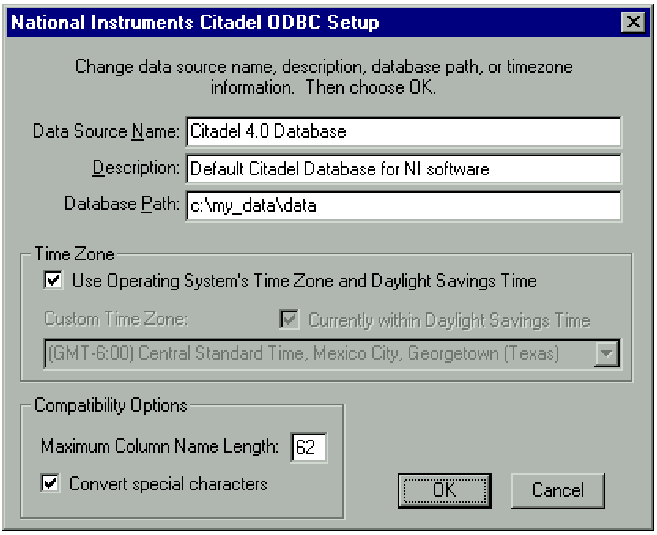
5. Select **National Instruments Citadel 4 Database**, then click **Finish**.

6. In the **National Instruments Citadel ODBC Setup** dialog box, fill in the **Data Source Name**, **Description**, and **Database Path** fields.

   a. The **Data Source Name** is the name that ODBC applications use to select the data source.

   b. **Description** is a free-form text string you can enter to describe the data source.

   c. **Database Path** should match the location of the Citadel database you intend to access. Use a fully qualified path to a remote computer if you are accessing the Citadel database on a remote computer, such as `\\tripper\c:\data`.



Change data source name, description, database path, or timezone information. Then choose OK.

Data Source Name: Citadel 4.0 Database

Description: Default Citadel Database for NI software

Database Path: c:\my_data\data

Time Zone

☑ Use Operating System's Time Zone and Daylight Savings Time

Custom Time Zone: ☑ Currently within Daylight Savings Time

(GMT-6:00) Central Standard Time, Mexico City, Georgetown (Texas)

Compatibility Options

Maximum Column Name Length: 62

☑ Convert special characters

The **Data Source Name** must be different from any other ODBC data source name. The **Description** is arbitrary. The **Database Path** gives the location of the folder where the data for this source are stored. If your `.scf` files use different data locations, you probably want to configure one ODBC data source for each.

7. Click the **OK** button in the **Setup** dialog box, then click the **OK** button in the **ODBC Data Source Administrator** dialog box.

Note Some applications are not completely ODBC compliant. If you plan to use Microsoft Query, Microsoft Access, or Visual Basic, make sure **Maximum Column Name Length** does not exceed 62 characters. These applications cannot handle longer names. Applications that are completely ODBC compliant can handle names up to 126 characters long. All traces whose names exceed the **Maximum Column Name Length** are excluded from queries.

Because tags might include network path information in their names, you might exceed the 62 and 126 character limitations of ODBC. Consideration given to naming and organizing objects can minimize the risk of encountering this difficulty.

If you plan to use Microsoft Access or Visual Basic, select **Convert special characters** to force your tag names into an accepted format by replacing characters within the names with the characters in Table A-1.

Table A-1. Special Access SQL Characters

Special Character	Converted Character
period (.)	at sign (@)

The special characters changed in ODBC 4. If you are converting SQL queries from an earlier version earlier of the ODBC driver, you might have to rewrite any SQL queries you set up in your earlier processes.

Accessing Citadel Data

Traces Table

The ODBC driver presents Citadel data to other applications as a traces table. The table contains a field or column for each tag logged to the Citadel database and three fields you can use to specify query criteria and to time stamp retrieved data: **Interval**, **LocalTime**, and **UTCTime**.

Interval specifies the query value sample rate. **Interval** can range from 10 ms to several years. **Interval** defaults to 1 (one day). **WEEK** is a standard seven days, but **MONTH** and **YEAR** account for different month lengths and leap years.

Because Citadel is event-driven, it only logs a value when the value changes. Using **Interval**, you can query Citadel for values evenly spaced over a period of time.

LocalTime and **UTCTime** are time-stamps that indicate when values are logged. Citadel stores the time in **UTCTime** format and derives **LocalTime** from the stored time.

The following `where clause` query uses **Interval** and **LocalTime** to select data over a specified time at one-minute intervals.

```
SELECT * FROM Traces
WHERE LocalTime>"12/1 10:00"
   AND LocalTime<"12/2 13:00"
   AND Interval="1:00"
```

Points Table

The Points table is used to retrieve the actual values logged for a tag and the times they were logged. Because logging to Citadel takes place asynchronously, there is no correlation between the timestamps for one tag and another. For this reason, when querying the Points table, you can query only one tag at a time.

The *where* clause using **LocalTime** and **UTCTime** is supported for the Points table; however, **Interval** is not relevant to the Points table. The data transforms are also not relevant to the Points table and are not supported.

An example of a query using the Points table could be

```
SELECT LocalTime, Pot1 FROM Points
WHERE LocalTime > "12/1 10:00" AND
LocalTime < "12/2 10:00"
```

Data Transforms

Queries can include special commands that perform data transforms to manipulate and analyze historical data. Table A-2 lists data transform commands.

Table A-2. Data Transform Commands

Command	Transformation
Min{Datapoint}	Returns the minimum for *`Datapoint`* across the interval.
Max{Datapoint}	Returns the maximum for *`Datapoint`* across the interval.
Avg{Datapoint}	Returns the average for *`Datapoint`* across the interval.
Stdev{Datapoint}	Returns the standard deviation for *`Datapoint`* across the interval.
Starts{Datapoint}	Returns the number of starts (that is, the number of transitions from OFF to ON) for *`Datapoint`* across the interval. For numeric points, 0.0 is interpreted as OFF, and all other numbers are treated as ON.

Table A-2. Data Transform Commands (Continued)

Command	Transformation
Stops{Datapoint}	Returns the number of stops (that is, the number of transitions from ON to OFF) for `Datapoint` across the interval.
ETM{Datapoint}	Returns the amount of time `Datapoint` was in the ON state across the interval.
Qual{Datapoint}	There might be gaps in the historical data traces in Citadel because of machine shutdown, Tag Engine shutdown, or a similar occurrences. Qual returns the ratio of time for which valid data exist for `Datapoint` across the interval to the length of the interval itself. If valid data exist for only one-half of the interval, Qual returns 0.5.

Using these data transforms, you can directly calculate and retrieve complex information from the database such as averages and standard deviations, so you do not need to extract raw data and then manipulate them in another application.

For example, you need to know how many times a compressor motor started in December. You also need to know its total runtime for the month. Use the following query to get answers:

```
SELECT"Starts{PLC.MotorRun}",
       "ETM{PLC.MotorRun}"
FROM Traces
WHERE LocalTime>="12/1/95"
  AND LocalTime<"1/1/96"
  AND Interval="31"
```

SQL Examples

The following examples are typical query statements; however, queries might be much more involved, depending on your system requirements.

```
SELECT *
FROM Traces
```

Retrieves the current value of every tag logged to Citadel.

```
SELECT *
FROM Traces
WHERE Interval="0:01"
```

Retrieves the value of every tag logged today in one-second increments. Notice that the interval value is enclosed in quotation marks.

```
SELECT LocalTime, "Pot1"
FROM Traces
WHERE LocalTime>"8:50"
AND Interval="0:01"
```

Retrieves and time stamps the value of Pot1 in one-second increments from 8:50 this morning to now. Names are enclosed by quotes.

```
SELECT LocalTime, "AB1.I:3", "Max{AB1.I:3}"
FROM Traces
WHERE LocalTime>"10/1/95"
AND LocalTime<"11/1/95"
AND Interval="1:00"
```

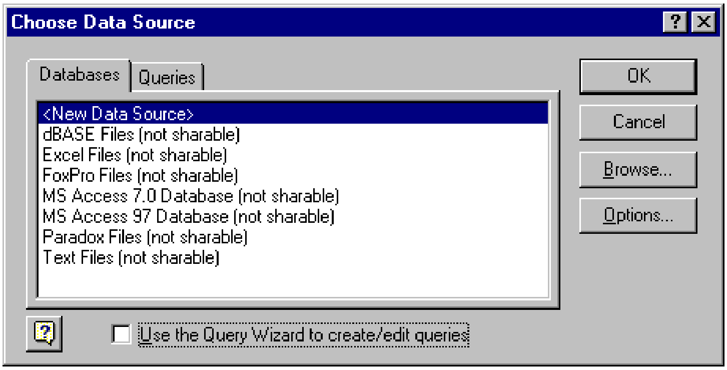
Retrieves and time stamps an Allen-Bradley PLC input in one-minute intervals for the month of October. This query also indicates the highest occurring input value of each minute.

```
SELECT LocalTime, "OVEN1_SP", "PLC.OVEN1_PV",
"Max{PLC.OVEN1_PV}", "Min{PLC.OVEN1_PV}",
"Avg{PLC.OVEN1_PV}"
FROM Traces
WHERE LocalTime>="14:00"
   AND LocalTime <"15:00"
   AND Interval="1:00:00"
```

Retrieves an oven temperature at 3:00 p.m. and shows the highest, lowest, and average temperatures between 2 p.m. and 3 p.m.

Accessing Citadel Data with Microsoft Query

1. Launch Microsoft Query.
2. Select **File»New.** If the Citadel data source is not visible, you must create it. If it is visible, skip to step 3.
   a. Select the `<New Data Source>` entry in the **Databases** tab. Make sure the **Use the Query Wizard to create/edit queries** option is *not* selected.



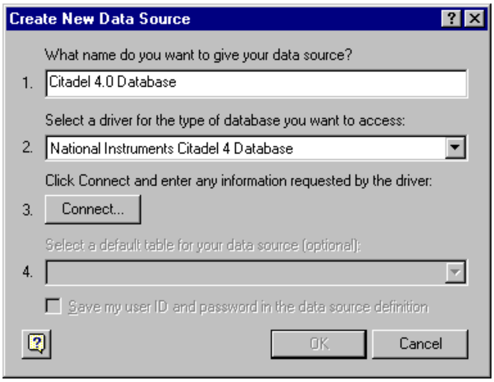
Choose Data Source

Databases | Queries

<New Data Source>
dBASE Files (not sharable)
Excel Files (not sharable)
FoxPro Files (not sharable)
MS Access 7.0 Database (not sharable)
MS Access 97 Database (not sharable)
Paradox Files (not sharable)
Text Files (not sharable)

□ Use the Query Wizard to create/edit queries

b. The **Create New Data Source** dialog box appears. Fill in the fields as shown in the following illustration.



Create New Data Source

What name do you want to give your data source?
1. Citadel 4.0 Database

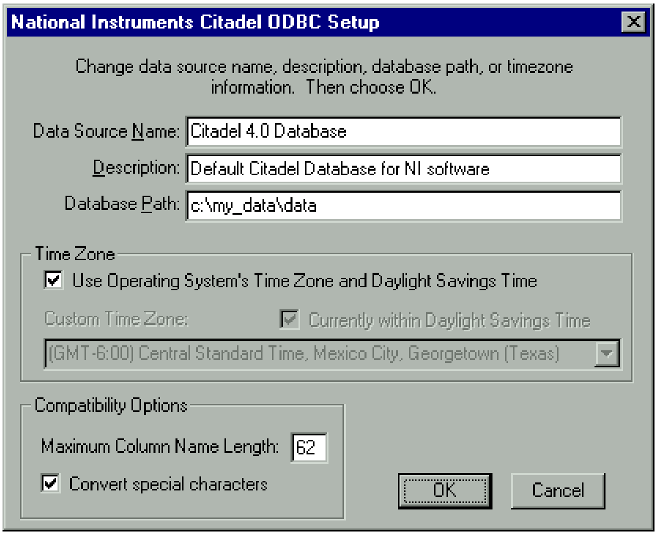
Select a driver for the type of database you want to access:
2. National Instruments Citadel 4 Database

Click Connect and enter any information requested by the driver:
3. Connect...

Select a default table for your data source (optional):
4.

□ Save my user ID and password in the data source definition

c. Click the **Connect** button. The **National Instruments Citadel ODBC Setup** dialog box appears. Fill in the fields as shown in the following illustration. Enter the location of the database in the **Database Path** field.



Change data source name, description, database path, or timezone information. Then choose OK.

Data Source Name: Citadel 4.0 Database

Description: Default Citadel Database for NI software

Database Path: c:\my_data\data

Time Zone

☑ Use Operating System's Time Zone and Daylight Savings Time

Custom Time Zone: ☑ Currently within Daylight Savings Time

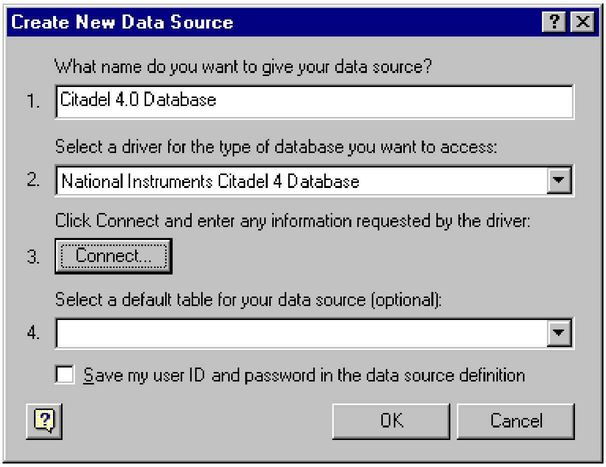
(GMT-6:00) Central Standard Time, Mexico City, Georgetown (Texas)

Compatibility Options

Maximum Column Name Length: 62

☑ Convert special characters

d. Click the **OK** button. The **Create New Data Source** dialog box reappears, and should look like the following illustration.



What name do you want to give your data source?

1. Citadel 4.0 Database

Select a driver for the type of database you want to access:

2. National Instruments Citadel 4 Database

Click Connect and enter any information requested by the driver:

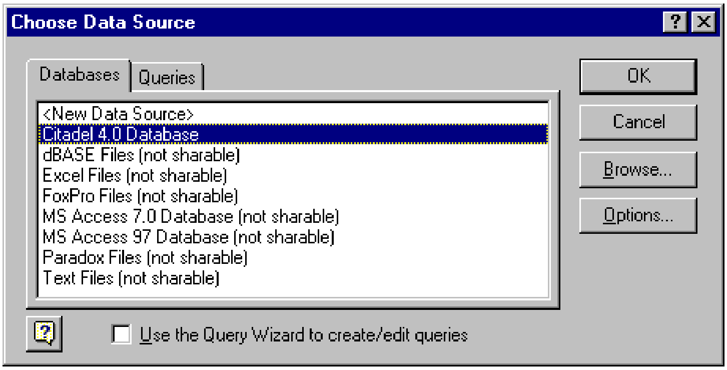
3. Connect...

Select a default table for your data source (optional):

4.

□ Save my user ID and password in the data source definition

e. Do *not* select a default table or save your ID and password. Click the **OK** button. The **Choose Data Source** dialog box appears, this time with the Citadel database as one of the data source choices. Select Citadel as the data source and click the **OK** button.



<New Data Source>
Citadel 4.0 Database
dBASE Files (not sharable)
Excel Files (not sharable)
FoxPro Files (not sharable)
MS Access 7.0 Database (not sharable)
MS Access 97 Database (not sharable)
Paradox Files (not sharable)
Text Files (not sharable)

☐ Use the Query Wizard to create/edit queries

3. Select the `Citadel` data source. Make sure the **Use the Query Wizard to create/edit queries** option is *not* selected.

Note If Microsoft Query is unable to connect to Citadel, make sure you have logged data to Citadel and entered the correct database path in the **ODBC Setup** dialog box.

Note If Citadel is not listed in the **Data Source** dialog box, make sure you have created Citadel as a data source. Refer to the *Creating a Citadel ODBC Data Source* section for more information.

4. In the **Add Tables** dialog box, double-click **Traces** or **Points**, depending on whether you want to view raw data (**Points**) or resampled data (**Traces**). In the following figure, **Traces** are used.

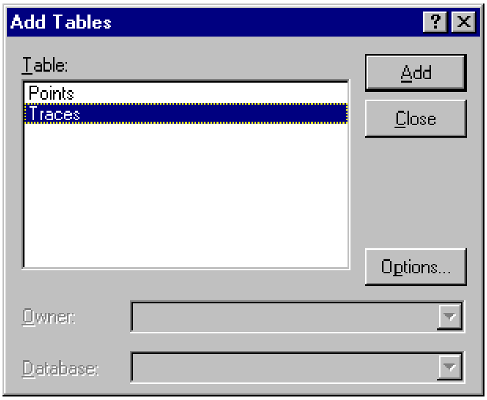


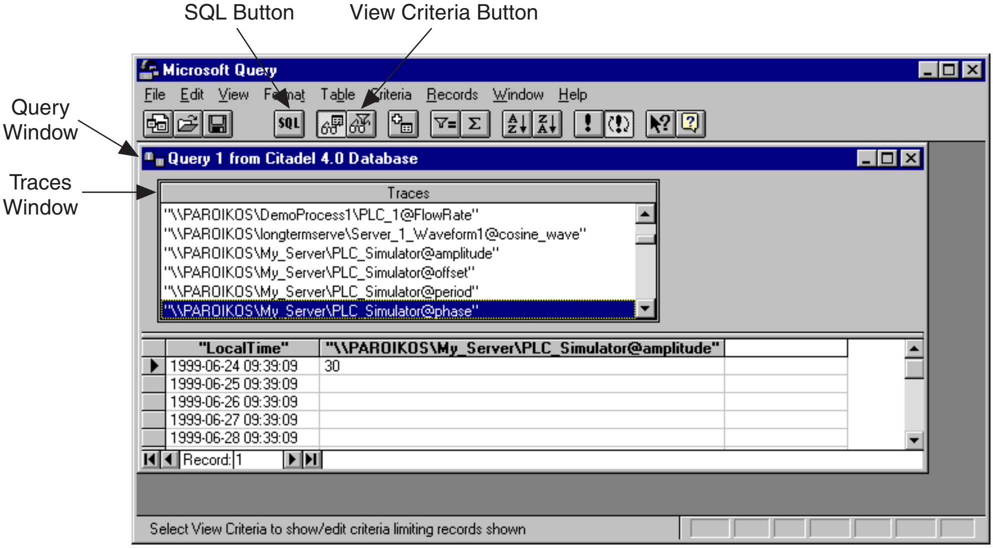
Table:
Points
Traces

Owner:

Database:

5. Close the dialog box.

   Microsoft Query presents the full Query Window with the `Traces` and `Points` tables. The names in these tables are a comprehensive list of all name values that have been logged to Citadel.


SQL Button
View Criteria Button
Query Window
Traces Window
Microsoft Query
File Edit View Format Table Criteria Records Window Help
SQL
Query 1 from Citadel 4.0 Database

Traces
"\\PAROIKOS\DemoProcess1\PLC_1@FlowRate"
"\\PAROIKOS\longtermserve\Server_1_Waveform1@cosine_wave"
"\\PAROIKOS\My_Server\PLC_Simulator@amplitude"
"\\PAROIKOS\My_Server\PLC_Simulator@offset"
"\\PAROIKOS\My_Server\PLC_Simulator@period"
"\\PAROIKOS\My_Server\PLC_Simulator@phase"

"LocalTime"	"\\PAROIKOS\My_Server\PLC_Simulator@amplitude"	
1999-06-24 09:39:09	30	
1999-06-25 09:39:09		
1999-06-26 09:39:09		
1999-06-27 09:39:09		
1999-06-28 09:39:09		

Record: 1

Select View Criteria to show/edit criteria limiting records shown

Figure A-1. The Query Window with Traces Table

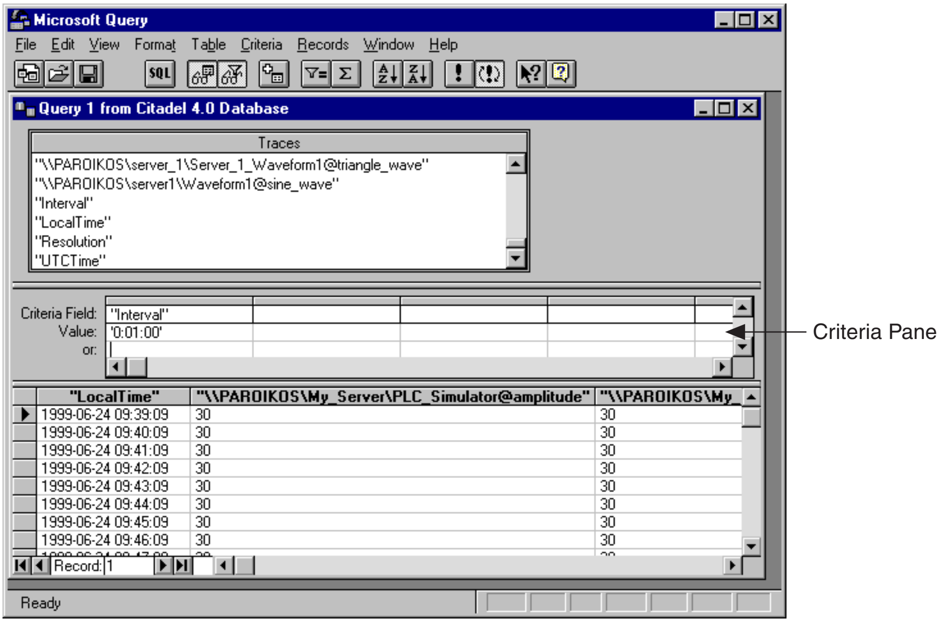
6. To view a trace, double-click or drag the field you want to view to a blank column in the data pane. In Figure A-1, `LocalTime` and `"\\PAROIKOS\My_Server\PLC_Simulator@amplitude"` have been dragged down.

7. To view a data transform value, enter the function directly into a blank column. For example, to view the minimum value of `PLC_Simulator.amplitude`, you would enter `"min{\\PAROIKOS\My_Server\PLC_Simulator@amplitude}"`. You must include the quotation marks and braces.

   The data set in Figure A-1 was retrieved using no specific criteria, so the ODBC driver used the default. Although there are several ways to specify criteria, this example uses the criteria pane.

8. Click the **View Criteria** button. The pane appears in the **Query** window.

9. Add a field to the criteria pane by double-clicking the field, or by dragging it to the blank column in the criteria pane. In the following example, an Interval criteria of one minute was chosen.


Microsoft Query
File Edit View Format Table Criteria Records Window Help
SQL
Query 1 from Citadel 4.0 Database
Record: 1
Ready
Criteria Pane

Traces
"\\PAROIKOS\server_1\Server_1_Waveform1@triangle_wave"
"\\PAROIKOS\server1\Waveform1@sine_wave"
"Interval"
"LocalTime"
"Resolution"
"UTCTime"

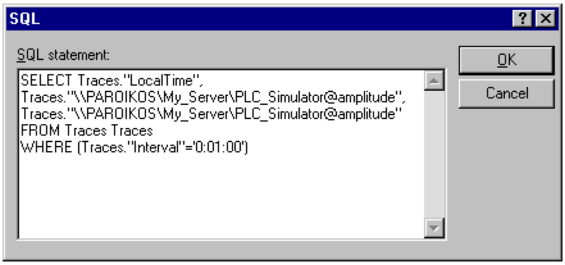
Criteria Field: "Interval"
Value: '0:01:00'
or:

"LocalTime"	"\\PAROIKOS\My_Server\PLC_Simulator@amplitude"	"\\PAROIKOS\My_
1999-06-24 09:39:09	30	30
1999-06-24 09:40:09	30	30
1999-06-24 09:41:09	30	30
1999-06-24 09:42:09	30	30
1999-06-24 09:43:09	30	30
1999-06-24 09:44:09	30	30
1999-06-24 09:45:09	30	30
1999-06-24 09:46:09	30	30

When you enter qualifying criteria values, use the syntax demonstrated in *SQL Examples* earlier in this chapter. Refer to Figure A-2 for more information.

As soon as you specify criteria, Microsoft Query retrieves the specified data. You can save the query at any stage of development, and as you build the query, the application builds an SQL statement.

10. Click the **SQL** button to view or edit the query statement.



SQL statement:

```
SELECT Traces."LocalTime",
Traces."\\PAROIKOS\My_Server\PLC_Simulator@amplitude",
Traces."\\PAROIKOS\My_Server\PLC_Simulator@amplitude"
FROM Traces Traces
WHERE (Traces."Interval"='0:01:00')
```

Figure A-2. SQL Dialog Box

Accessing Citadel Data with Microsoft Excel

1. Launch Excel.
2. Select **Data»Get External Data»Create New Query**. This Excel command directly launches Microsoft Query.
3. Use an existing query or create a new one. Refer to the *Accessing Citadel Data with Microsoft Query* section for more information about querying.
4. When you finish building the query, return the result set with the **File»Return Data to Microsoft Excel** command. Excel prompts you with the **Get External Data** dialog box, enabling you to change or confirm the destination cells of the result set. If you want to query Citadel later to update the result set, place a checkmark in the **Keep Query Definition** checkbox.
5. Click the **OK** button to write the data to an Excel worksheet.
6. To update the result set, select any cell within the worksheet result set, select **Data»Get External Data**, and click the **Refresh** button.

Accessing Citadel Data with Microsoft Access

Note The SQL/92 standard states that a delimited identifier is any string of no more than 128 characters enclosed in quotation marks. It further states that characters within a delimited identifier are exempt from SQL syntax checking. Unfortunately, Microsoft Access performs its own syntax checking for ODBC queries using a non-standard SQL syntax—even within delimited identifiers. For this reason, National Instruments provides a Convert Special Characters selection in the Citadel **ODBC Setup** dialog box. When selected, the ODBC driver converts the special characters to accepted Access characters. Refer to Table A-1 for a complete list of special characters.

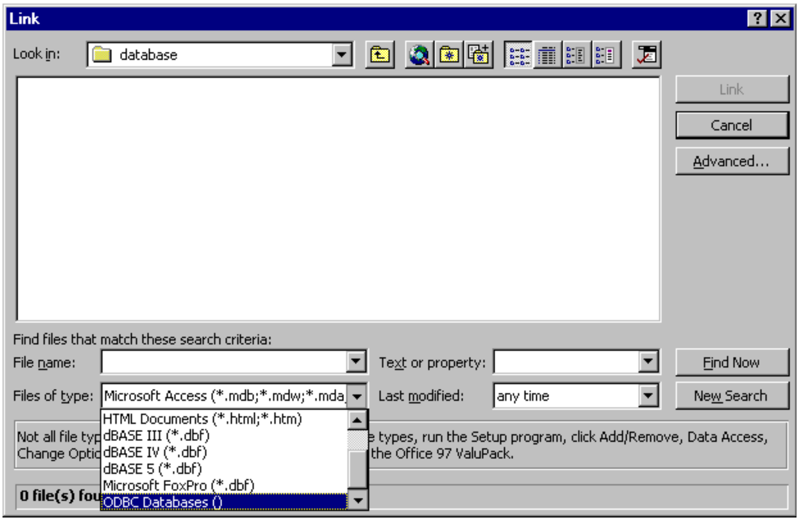
When you query Citadel using Microsoft Access, you must use the Microsoft Access non-standard SQL syntax in the select statement. Remember to consider the following elements:

- Convert special characters for Access compatibility. Refer to Table A-1.
- Place double quotes around Logos trace names to identify them as delimited identifiers.
- Enclose identifiers in square brackets (`[]`).
- Place pound signs (`#`) around time stamps.

For example, to retrieve `LocalTime`, `Pot1`, and `Tiway1.V101`, where `LocalTime` is greater than 11/20/95 18:00:00, and where `Interval` is one second, enter the following query:

```
SELECT LocalTime, ["Pot1"], ["Tiway1@V101"]
FROM Traces
WHERE LocalTime > #11/20/95 6:00:00 PM#
AND Interval = '0:01'
```

1. To query Citadel from within Microsoft Access, open a database and select **File»Get External Data»Link Table**. The **Link** dialog box appears, as shown in the following illustration.



Link

Look in: database

Find files that match these search criteria:

File name:

Text or property:

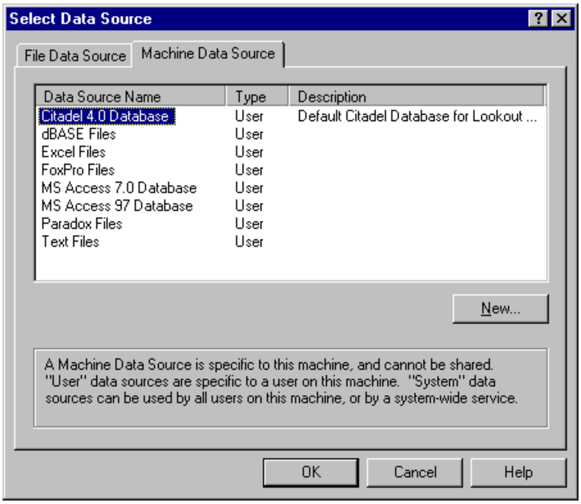
Files of type: Microsoft Access (*.mdb;*.mdw;*.mda

Last modified: any time

Not all file typ... Change Optic... e types, run the Setup program, click Add/Remove, Data Access, ... the Office 97 ValuPack.

0 file(s) fou...

2. Set the **Files of type** field to **ODBC databases()**. The **Select Data Source** dialog box appears.

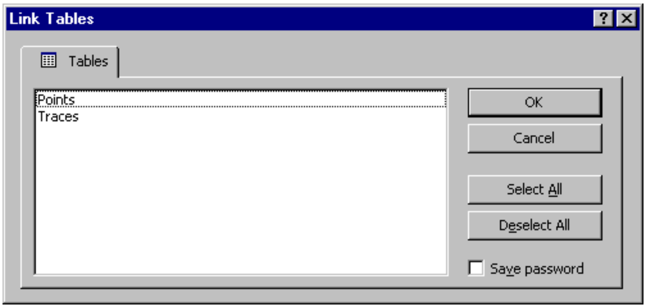


Data Source Name	Type	Description
Citadel 4.0 Database	User	Default Citadel Database for Lookout ...
dBASE Files	User	
Excel Files	User	
FoxPro Files	User	
MS Access 7.0 Database	User	
MS Access 97 Database	User	
Paradox Files	User	
Text Files	User	

A Machine Data Source is specific to this machine, and cannot be shared. "User" data sources are specific to a user on this machine. "System" data sources can be used by all users on this machine, or by a system-wide service.

Figure A-3. The Select Data Source Dialog Box

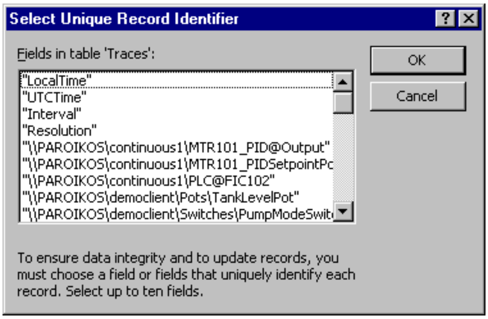
3. Click the **Machine Data Source** tab.
4. Highlight **Citadel 4.0 Database**, as shown in previous dialog box. (This example assumes you have created a Citadel data source as described in the *Creating a Citadel ODBC Data Source* section. If you have not created a Citadel data source, you might not be able to complete this example exercise.)
5. Click the **OK** button. The **Link Tables** dialog box appears.



Points
Traces

6. Select **Traces**. The new table links to your database.

7. The **Select Unique Record Identifier** dialog box appears. Click the **Cancel** button, because Lookout does not support unique record identifiers.



Fields in table 'Traces':

"LocalTime"
"UTCTime"
"Interval"
"Resolution"
"\\PAROIKOS\continuous1\MTR101_PID@Output"
"\\PAROIKOS\continuous1\MTR101_PIDSetpointPc
"\\PAROIKOS\continuous1\PLC@FIC102"
"\\PAROIKOS\democlient\Pots\TankLevelPot"
"\\PAROIKOS\democlient\Switches\PumpModeSwit

To ensure data integrity and to update records, you must choose a field or fields that uniquely identify each record. Select up to ten fields.

8. At this point, you can build queries in Access to extract data directly from the Citadel database. Refer to the Microsoft Access documentation for more information about this process.

Accessing Citadel Data with Visual Basic

Note Visual Basic software relies on Microsoft Access DLLs for performing ODBC queries. Because it uses the Access non-standard SQL syntax, be sure that **Convert Special Characters** is selected in the Citadel **ODBC Setup** dialog box. Refer to the note in the *Accessing Citadel Data with Microsoft Access* section.

You use the Citadel ODBC Driver in Visual Basic the same way you would use any other ODBC driver. To retrieve and view data, you have to create a data control and at least one text control.

1. Place a data control on an open form.
2. Set its **Connect** property to `DSN=Citadel` and double-click its **Record Source** property to identify `Traces` as its source table.
3. If you want to select all of the data for all traces in the Citadel database, leave the **Record Source** property set to `Traces`. If you want to narrow the query, enter an SQL select statement in the **Record Source** property.

   For example, to retrieve `LocalTime`, `Pot1`, and `AB1.I:3` where `LocalTime` is greater than 11/20/95 18:00:00 and less than 18:30:00, and where `Interval` is one minute, enter the following query:

   ```
   SELECT LocalTime, ["Pot1"], ["AB1@I:3"]
   FROM Traces
   ```

```
WHERE LocalTime > #11/20/95 6:00:00 PM#
AND LocalTime < #11/20/95 6:30:00 PM#
AND Interval = '1:0'
```

Note Remember to use the Microsoft Access SQL syntax in the select statement, convert special characters for Access compatibility (refer to Table A-1), place double quotes around Lookout trace names to identify them as delimited identifiers, enclose identifiers in square brackets (`[]`), and place pound signs (#) around time stamps.

4. Place a text control on the form.
5. Set its **Data Source** property to the name of the data control—for example, `Data1`.
6. Click the **Data Field** property to highlight it and then use the property sheet drop-down combo box to select the desired field name. All logged tags should be listed including `LocalTime`, `Interval`, and `Pot1`.
7. Repeat steps 4 through 6 for each tag you want to display on the form.

If you are using Visual Basic 4 or later, you might get a Visual Basic warning telling you `Object variable or with block variable not set`.

Complete the following steps if this problem arises.

1. Make sure that the Citadel ODBC is properly installed. Select **Control Panel»32-bit ODBC** and click the **Users DSN** tab. You should see the Citadel data source listed. If you do not, you must create it. Refer to the *Creating a Citadel ODBC Data Source* section for more information.
2. Make sure you placed a Data Control on your open form.
3. Set the `Connect` property of the Data Control to `ODBC;DSN=Citadel` (or any other name you defined in the **Users DSN** tab in step 1). You should now be able to see **`Traces`** in the **Record Source** property.

B

Technical Support Resources

Web Support

National Instruments Web support is your first stop for help in solving installation, configuration, and application problems and questions. Online problem-solving and diagnostic resources include frequently asked questions, knowledge bases, product-specific troubleshooting wizards, manuals, drivers, software updates, and more. Web support is available through the Technical Support section of `ni.com`

NI Developer Zone

The NI Developer Zone at `ni.com/zone` is the essential resource for building measurement and automation systems. At the NI Developer Zone, you can easily access the latest example programs, system configurators, tutorials, technical news, as well as a community of developers ready to share their own techniques.

Customer Education

National Instruments provides a number of alternatives to satisfy your training needs, from self-paced tutorials, videos, and interactive CDs to instructor-led hands-on courses at locations around the world. Visit the Customer Education section of `ni.com` for online course schedules, syllabi, training centers, and class registration.

System Integration

If you have time constraints, limited in-house technical resources, or other dilemmas, you may prefer to employ consulting or system integration services. You can rely on the expertise available through our worldwide network of Alliance Program members. To find out more about our Alliance system integration solutions, visit the System Integration section of `ni.com`

Worldwide Support

National Instruments has offices located around the world to help address your support needs. You can access our branch office Web sites from the Worldwide Offices section of `ni.com`. Branch office Web sites provide up-to-date contact information, support phone numbers, e-mail addresses, and current events.

If you have searched the technical support resources on our Web site and still cannot find the answers you need, contact your local office or National Instruments corporate. Phone numbers for our worldwide offices are listed at the front of this manual.

Glossary

Prefix	Meanings	Value
m-	milli-	10^{-3}
c-	centi-	10^{-2}

A

A	amperes.
access level	Numeric value between 0 and 10 that can be used to control access to an HMI.
ACK (Acknowledge)	The sequence action that indicates recognition of a new alarm.
alarm	An abnormal process condition. In the LabVIEW DSC module, an alarm occurs if a tag value goes out of its defined alarm limits or if a tag has bad status.
Alarm Summary	A display of tags currently in alarm, or a display of tags previously in an unacknowledged alarm state that have returned to a normal state.
analog tag	A continuous value representation of a connection to a real-world I/O point or memory variable. This type of tag can vary continuously over a range of values within a signal range.
application	The application created using the LabVIEW Datalogging and Supervisory Control Module Development System and run in the LabVIEW Datalogging and Supervisory Control Module Runtime System environment.
Application Programming Interface	A specification of a set of software functions and their input and return parameters.
ASCII	American Standard Code for Information Interchange.

B

bit array tag

A multibit value representation of a connection to a real-world I/O point or memory variable. In the LabVIEW DSC module, this type of tag can be comprised of up to 32 discrete values.

C

Citadel

A database for storing historical tag values.

D

deadband

In process instrumentation, the range through which an input signal can vary, upon reversal of direction, without initiating an observable change in output signal. Deadband is usually expressed in percent of range. *See also* log deadband *and* update deadband.

device server

An application that communicates with and manages a peripheral hardware device such as a Programmable Logic Control (PLC), remote I/O device or plug-in device. Device servers pass tag values to the Tag Engine in real time.

discrete tag

A two-state (on/off) value representation of a connection to a real-world I/O point. In the LabVIEW DSC module, this type of tag can be either a one (TRUE) or a zero (FALSE).

dynamic attributes

Tag attributes that do not require the Tag Engine to be restarted when they are edited or reconfigured. Examples of dynamic attributes include enabling logging operations, alarm attributes, and some scaling attributes. *See also* static attributes.

E

Engine

See Tag Engine.

engineering units (EU)

Terms of data measurement, as degrees Celsius, pounds, grams and so on.

event

Something that happens to a tag. Events include tags going into or out of alarm state and the user setting a tag value.

event-driven programming

A method of programming whereby the program waits on an event occurring before running one or more functions.

G

group

See tag group *or* I/O group.

H

historical trend

A plot of data (values versus time) showing values that were logged to disk.

Historical Trend Viewer (HTV)

A utility that accesses historical data from the Citadel historical database.

HMI Wizard

A utility in the LabVIEW Datalogging and Supervisory Control module that automates the process of generating HMI block diagram code.

Human Machine Interface (HMI)

A graphical user interface for the user to interact with the LabVIEW Datalogging and Supervisory Control module system.

I

input tag

A tag that accepts Real-Time Database values from a device server.

input/output (I/O) tag

A tag that accepts Real-Time Database values from a device server and sends values to the server.

I/O group

A set of related server items, all of which share the same server update rate and deadband.

item

A channel or variable in a real-world device that is monitored or controlled by a device server.

L

LabVIEW Datalogging and Supervisory Control Module Runtime System

An execution environment for applications created using the LabVIEW Datalogging and Supervisory Control Module Development System.

log deadband

The range through which a tag value must change before it is logged to Citadel.

log resolution	The smallest change in a tag value stored in the historical database.

M

m	meters.
Man Machine Interface (MMI)	*See* Human Machine Interface (HMI).
memory tag	A tag not connected to a real-world I/O point. Memory tags are used for user-defined calculations. *See also* tag *and* network tag.

N

network tag	A tag remotely connected to any type of tag on another Tag Engine. *See also* tag *and* memory tag.

O

OPC	OLE for Process Control. A COM-based standard defined by the OPC Foundation that specifies how to interact with device servers. COM is a Microsoft 32-bit Windows technology.
operator	The person who initiates and monitors the operation of a process.
output tag	A tag that sends values to a device server when it is updated in the Real-Time Database.

P

Panel Wizard	A utility in the LabVIEW Datalogging and Supervisory Control module that automates the process of creating front panel controls.
PID	*See* Proportional Integral Derivative (PID) Control.
PLC	*See* programmable logic controller (PLC).
polling	A method of periodically observing each I/O point or user interface control to determine if it is ready to receive data or request computer action.

programmable logic controller (PLC)

A device with multiple inputs and outputs that contains a program you can alter. LabVIEW DSC module device servers establish communication with PLCs.

Proportional Integral Derivative (PID) Control

A combination of proportional, integral, and derivative control actions. Refers to a control method in which the controller output is proportional to the error, its time history, and the rate at which it is changing. The error is the difference between the observed and desired values of a variable that is under control action.

pseudocode

Simplified language-independent representation of programming code.

R

Real-Time Database (RTDB)

An in-memory snapshot of all tags in the system.

real-time trend

A plot of data (values versus time) that is updated as each new point is acquired in the Real-Time Database.

reentrant execution

Mode in which calls to multiple instances of a subVI can run in parallel with distinct and separate data storage.

RTDB

See Real-Time Database (RTDB).

S

s

seconds.

sampling period

The time interval between observations in a periodic sampling control system.

SCADA

Supervisory Control and Data Acquisition.

sensor

A device that produces a voltage or current output representative of some physical property being measured, such as speed, temperature, or flow.

static attributes

Tag attributes that require the Tag Engine to be restarted if they are edited or reconfigured. Examples of static attributes include general attributes and I/O connection attributes, such as server, device, or item. *See also* dynamic attributes.

string tag

An ASCII or binary character representation of a connection to a real-world I/O point.

supervisory control

Control in which the control loops operate independently subject to intermittent corrective action.

system developer

The creator of the application to be run in the LabVIEW Datalogging and Supervisory Control Module Runtime System.

system errors

Errors that happen in the LabVIEW Datalogging and Supervisory Control module system, like a server going down. System errors are displayed in a dialog box, on the Engine User Interface, and also are logged in a syslog file.

system events

Events that occur in the LabVIEW DSC module, like an operator logging on or a utility starting up. System events are logged in a syslog file.

T

tag

A connection to a real-world I/O point or a memory variable. Tags can be one of four data types: analog, binary, discrete, or string.

tag attributes

Parameters pertaining to a tag, like its alarm, limits, or engineering units. Tag attributes are configured in the Tag Configuration Editor but can be changed dynamically using the Tag Attributes VIs.

Tag Configuration Editor

A utility to configure various parameters of a tag, such as connection information, scaling, or logging.

Tag Engine

Maintains the Real-Time Database of all tag values and alarm states. The Tag Engine runs as a separate process, independent of the HMI application.

tag group

A set of tags primarily used for reporting and acknowledging alarms. A tag can be associated with only one tag group. All tags belong to the group `<ALL>` by default.

Tag Monitor

A utility to view the current value of a tag, along with its status and alarm state.

tag status

A value that describes the validity of a tag value. A negative status represents an error, a positive status represents a warning, and a status of zero represents a good tag value.

timestamp — The exact time and date at which a tag value was sampled. Tag values are stored with their timestamps in the RTDB.

trend — A view of data over time. Trends can display real-time or historical data.

U

update deadband — The range through which a tag value must change before it is updated in the Real-Time Database.

user — *See* operator.

V

V — Volts.

W

Wizard — *See* HMI Wizard *and* Panel Wizard.

Wizard lock — A glyph that appears on a tag loop to indicate the LabVIEW Datalogging and Supervisory Control module has protected the association between a front panel object and the automatically generated block diagram. If a Wizard lock exists on a tag loop, you cannot modify that block diagram. After you release the Wizard lock, the association is broken and the Wizard no longer protects that tag loop.

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