



NATIONAL INSTRUMENTS™
LabVIEW™

VI-Based Server Development Toolkit Reference Manual

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The following conventions are used in this manual:

»

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.

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.

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VI-Based Server Development Tools

The LabVIEW Datalogging and Supervisory Control module includes several VI-based examples with which you can become familiar with developing servers. The server development tools also contain the example VIs referenced in Chapter 3, *Function Reference*.

You can use the Server Browser utility to interactively view the devices, items, and capabilities registered by a server. With this utility, you can launch a server configuration utility (if available) or, from the Tag Engine, display the front panel of a server while it is running. Select **Tools»Datalogging and Supervisory Control»Advanced» Server Browser**.

Because you cannot debug a server while it is running in the Tag Engine, use the Interactive Server Tester instead. This tool emulates the Tag Engine/Server Interface in LabVIEW. With this tool, you also can test launching, error reporting, and reading and writing server data in a full G development system environment. Select **Tools»Datalogging and Supervisory Control»Advanced»Interactive Server Tester**. For more information about its operation, use the Help window (<Ctrl-H>) when you run this utility.

Why Develop VI-Based Servers?

VI-based servers allow you to use your G programming skills to complete simple, yet specific tasks. VI-based servers also provide a means of using existing G-based applications as servers and simulating hardware or actual systems.

The Tag Engine can interface with any server that uses the Tag Engine Server interface. While the server does not need to be implemented in G, it must use G to interface with the Tag Engine using the Tag Engine [Server Interface VIs](#).



Note Three cases exist in which you do not use G to interface with the Tag Engine. If a server is written as a DLL to the National Instruments Industrial Automation Device Server Specification (IA Device Server), the Tag Engine can interface to it through the IAIO Server Proxy. Also, if a server is implemented as a Windows DDE server or an OPC server, the Tag Engine can interface to it directly.

How Do VI-Based Servers Work?

VI-based servers supply data points from several input items to the Tag Engine as these points are read. The Tag Engine also can send values for output items.

The Tag Engine accepts numeric (double precision) values and *string data* from servers. Double values can be analog, discrete (Boolean), or bit array (bit vectors up to 32 bits in length), depending on your tag configuration for a specific device item. String data is a packed array of unsigned 8-bit integers. All scalars must be converted to double precision floating-point values to pass to the Tag Engine. The server converts correctly signed or unsigned values to double floating-point representations.

Ideally, the server timestamps values as they are acquired from items, recording the time at which the value was acquired or sampled. The **timestamp** is in seconds since January, 1904, (Universal time) and is a double precision floating-point number rather than an unsigned 32-bit integer. Therefore, resolution is less than 1 second. If the server cannot timestamp the values as they are acquired, the server can instruct the Tag Engine to timestamp the value when it is received.

Overview of the Server Development Process

The server development process involves several steps, discussed in the following sections. Samples for this toolkit are installed in the folder `labview\examples\lvdsc\servers\`.

Create the Server

Build a server using the Server Interface VIs. See the *Server Operation* section of Chapter 2, *VI-Based Server Interface to the Tag Engine* for information regarding the architecture of a server and which VIs to use. This toolkit includes a server named `dmy_srvr.vi` in the `Sample` folder. In addition to this sample server, several of the VI-based servers shipped with the LabVIEW Datalogging and Supervisory Control module, such as the SIM Server, are in source code form.

Register the Server

In order for the LabVIEW Datalogging and Supervisory Control module to launch a VI-based server and allow a user to configure tags that use the server, you must register the server. See the [Server Registration](#) section of Chapter 2, [VI-Based Server Interface to the Tag Engine](#), for information on the VIs to use to register a server. This toolkit includes a server registration example named `Register Dummy Server.vi` in the `Sample` folder.

Debug the Server

This toolkit provides a utility called the Interactive Server Tester utility with which you load and run a server in LabVIEW, allowing you to debug the server while it is running. See the [Debugging and Testing Your Server](#) section of Chapter 2, [VI-Based Server Interface to the Tag Engine](#), for more information.

View the Server Running in the Tag Engine (Optional)

When the server is running in the Tag Engine, you cannot debug it or view its diagram, but you can view the server front panel while it is running.



Press the **Server Browser** button on the Engine Manager front panel to launch the Server Browser utility. Select your server in the server list—it shows with a diamond symbol next to the server name if the server is loaded, and the diamond is black if the server is running. Select your server and press the **Show Server User Interface** button to open the server and show the front panel while it is running. By adding indicators to the server front panel, you can monitor server operation while it is running in the engine.

Create a Server Configuration Utility (Optional)

Depending on the complexity of the server, you might choose to provide a server configuration utility rather than just a server registration VI. Relevant server configuration information can be stored in a file and retrieved by the server at run time. This configuration utility then also registers the server information. This toolkit includes a server configuration example called `srvr_cfg.llb` available in the `Sample` directory.

VI-Based Server Interface to the Tag Engine

This chapter describes VI-based server configuration and registration, server operation, and error handling and performance issues you might encounter. This chapter concludes with a VI-based server design example.

Server Configuration

Generally, a server has a configuration utility associated with it that allows you to complete the following tasks:

- Set up communication parameters
- Specify error handling
- Configure hardware
- Configure poll rates
- Define a set of valid device and item names

The user executes this utility before using the Tag Configuration Editor to configure any tags using the server and before the Tag Engine executes the server.

During configuration, the server must register information about itself and the devices and items it manages. Although servers are not required to have configuration utilities, they must be registered before the LabVIEW Datalogging and Supervisory Control module can use them.

See the `Srvr_cfg.llb` example in the `examples\lvdsc\servers\sample` directory for an example server configuration utility.

Server Registration

The LabVIEW Datalogging and Supervisory Control module uses the Common Configuration Database (CCDB) file to locate present servers and retrieve details about those servers, such as paths, registered devices, and registered items.

This database maintains tables of servers, devices, and items. Register information about your server as part of your server configuration utility. If you lack a configuration utility for your server, you must provide a VI that performs the registration.

The server uses a set of subVIs to configuration data in the configuration database. These subVIs are contained in the DSC Server Registration palette shown in the following figure.

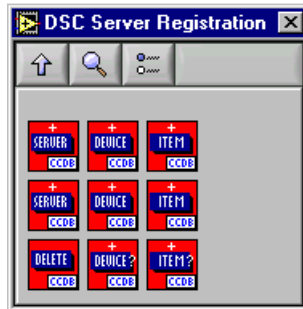


Figure 2-1. DSC Server Registration Palette

To register your server, use the [SVRG Add Server Row VI](#), which creates an entry for your server in the Servers table of the CCDB. When you register your server using the SVRG Add Server Row VI, it appears in the list of servers accessible from the Tag Configuration Editor server list with the name supplied in **Server Name**. To use your server from the LabVIEW Datalogging and Supervisory Control module, you must register the following information:

- **Server Name**—**Server Name** is the same name as that used by the server in the block diagram when using the Server Interface (SRVR) VIs.
- **Server Launch Path** to VI.

Additional information a server can register includes the following:

- Predefined device names
- Predefined item names
- For each item name, item information:
 - **item data type** (see Table 3-1, *Item Data Types*)
 - allowed item directions (**access rights**): input, output, I/O (required)
 - **item range max and min** (optional)
 - **item unit** (optional)
 - **item max length** (optional)

You might want to register one or more devices recognized by your server or configured as part of your server configuration. Use the [SVRG Add Device Row VI](#) to register a device for your server. This VI creates an entry for your device in the Devices table of the CCDB. You are not required to register a device if your server can interpret device strings to identify the device; however, doing so makes it easier for the user to select a device.

When you register one or more devices for a server, the device name appears in the device list when you select that server in the Tag Configuration Editor. Even if you do not have a specific device or all items of interest are associated with a single device, you must register the device if you plan to register any items. In this case, use a default device name such as ALL.

You also might want to register one or more items recognized by your server for a specific device or configured as part of your server device configuration. Use the [SVRG Add Item Row VI](#) to register an item for your server device. You must register a device before you can register an item for that device. This VI creates an entry for your item in the Items table of the CCDB. You are not required to register an item if your server can interpret item strings to identify the device item; however, doing so makes it easier for the user to select an item. When you register one or more items for a server device, the item name appears in the **Item** list when that server and device are selected in the Tag Configuration Editor.

Registering engineering unit information is optional and should be done only if the actual engineering range and unit information for the item can be predetermined. If you do not register engineering unit information, the user can enter the information when creating tags in the Tag Configuration Editor.

Use the [SVRG Delete Row VI](#) to delete a specific row from the Server, Device, or Item tables. If you delete a server from the Server table, all devices for that server in the Device table and all items for that server in the Items table are deleted automatically. You do not need to delete devices and items individually if you want to delete them all. Similarly, if a device is deleted from the Devices table, all items for that device in the Items table are deleted automatically.

The following VIs query information once it is registered in the CCDB:

- SVRG Get Server Row.vi
- SVRG Get Device Row.vi
- SVRG Get Item Row.vi

You can use these VIs if you save information in the CCDB that is useful for your server at launch time. You also can use them to see whether your information is registered successfully.

Register Server Example

The Register Dummy Server VI, shown in Figure 2-2, illustrates how to register information for your server. The user can configure server behavior, devices, or server communications channels with the configuration utility. Registering server, device, and item information is part of server configuration. If you develop a VI-based configuration utility, include the server registration as part of it. You might not develop a server configuration utility in other cases, such as a simple device or fixed server configuration or if you are writing a server to simulate tags. In these cases, you must develop a VI similar to the Register Dummy Server VI in Figure 2-2 and register the items for which your server generates or accepts data. The `examples\lvdsc\servers\Sample` folder includes this VI and a more complete server configuration utility VI example. Most of the simulation server examples for the LabVIEW Datalogging and Supervisory Control module have a register server VI similar to the one shown in Figure 2-2.

In Figure 2-2, the VI that registers the server first deletes the existing server registration information from the CCDB by calling the [SVRG Delete Row VI](#) with the following information:

- **Server Name** (Dummy Server)
- **Delete What** input set to 2 (server)

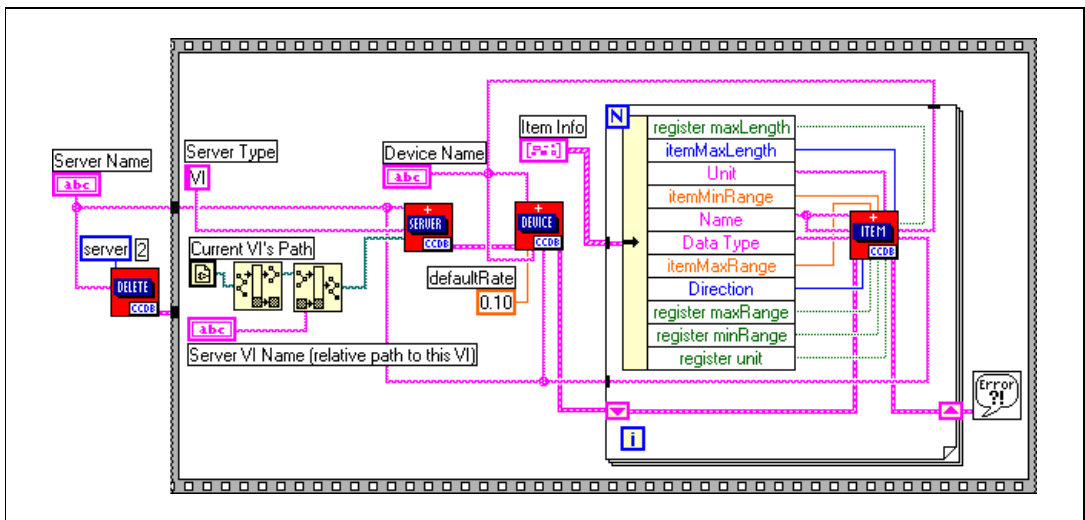
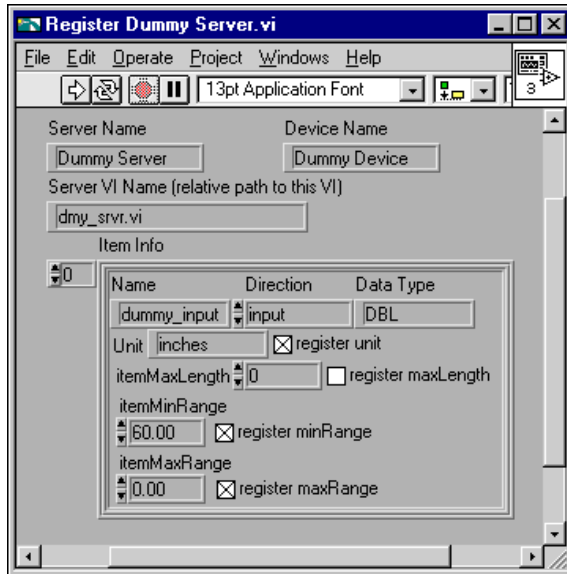


Figure 2-2. Register Dummy Server VI

This action deletes any entry associated with the server name from each of the Server, Device, and Item tables of the CCDB.

Next, the VI supplies new information to the Server, Device, and Item tables by calling the SVRG Add Server Row VI, SVRG Add Device Row VI, and SVRG Add Item Row VI, respectively. See Chapter 3, [Function Reference](#), of this manual for detailed descriptions of these VIs.

In Figure 2-2, the front panel controls of the Register Dummy Server VI store the following as default values:

- **Server Name** (Dummy Server)
- **Server VI Name** (dmy_srvr.vi)
- **Device Name** (Dummy Device)
- **Item Info** (item names and parameters)

Although this example server only registers one device, it registers several items for that device.

The example VI in Figure 2-2 calls the [SVRG Add Server Row VI](#) with the following information:

- The server name (Dummy Server)
- The name of the VI file (dmy_srvr.vi) that implements the server
- The path to dmy_srvr.vi
- The server type set to VI

The path to the configuration utility is left unwired to indicate that no configuration utility exists. Set **server type** to VI to notify the LabVIEW Datalogging and Supervisory Control module that the server is a VI-based server. The LabVIEW Datalogging and Supervisory Control module launches the VI corresponding to that server when the server is selected by a given tag configuration. The Register Dummy Server VI computes the path to dmy_srvr.vi by obtaining the current VI path (current VI is Register Dummy Server VI), removing the VI name, and appending dmy_srvr.vi.

The VI can compute the path because both the Register Dummy Server VI and dmy_srvr.vi are in the same file folder. This example VI leaves all other inputs at their default values.

The example VI in Figure 2-2 calls the [SVRG Add Device Row VI](#) once with the following information:

- The unique **device name** (Dummy Device)
- The **device address** (Dummy Device)
- The **device default rate**, set at 0.1 seconds
- The **server name** associated with the device

You must register at least one device for a server if you plan to register any items, because all items are associated with a specific device. If the server does not handle any devices, choose a default device name such as ALL. Leave all other inputs at their default values.

The Register Dummy Server VI also calls the [SVRG Add Item Row VI](#) for each item registered for the Dummy Server. These items are saved in an array of clusters on the front panel. For each item, this example VI registers the following information:

- A unique **item name**
- An **item data type**
- A direction (input, output, or I/O)

This example VI also registers optional item information, including the following parameters:

- **item max range**
- **item min range**
- **item unit**
- **item max length**

This example VI leaves all other inputs at their default values.

Server Operation

The server uses a set of subVIs to communicate with the Tag Engine during server execution. These are contained in the DSC Server Interface palette shown in the following figure.

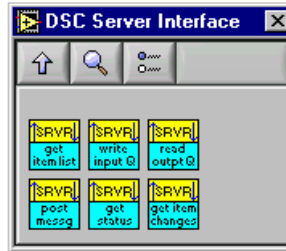


Figure 2-3. DSC Server Interface Palette

The servers are launched when the Tag Engine starts. Servers must execute until the engine's **shutdown** status becomes TRUE. The shutdown status is returned by several of the server interface VIs.

During operation, the server uses the following VIs to communicate with the Tag Engine and to read the status from the Tag Engine. See Chapter 3, *Function Reference*, of this manual for detailed descriptions of these VIs.

- [SRVR Get Item List VI](#)—Returns lists of groups and items, item characteristics, and refnums the Tag Engine uses.
- [SRVR Write Input Queue VI](#)—Writes input and I/O item data to the Tag Engine. This VI also reports errors on specific input or output items. You can set this VI to return status information specifying whether the server is to shut down or if item changes are pending.
- [SRVR Read Output Queue VI](#)—Receives new output values for output and I/O items from the Tag Engine. This VI also returns status information specifying whether the server is to shut down or if item changes are pending.
- [SRVR Post Message VI](#)—Writes error and non-error messages from the server to the Tag Engine where the messages can be logged and displayed to the end-user.
- [SRVR Get Item Changes VI](#)—Returns a list of group and item changes.

Server Initialization

When the Tag Engine launches a server, the server first must call the [SRVR Get Item List VI](#), passing in the server name it registered under. This VI returns the list of items the Tag Engine uses from the server and details on how to use the listed items. This VI also returns a list of groups that specify timing information for the items. Information specified for each item includes the following parameters:

- **device name**
- **item name**
- **datatype**
- **item direction**
- **item datatype**
- **scan rate**
- **notify on change** flag
- **refnum** (a signed 32-bit integer)
- **group name**
- **access path**

Information specified for each group includes the following parameters:

- **group name**
- **scan rate**
- **deadband**
- **device name**



Note The server must use the refnums when it passes item information to the Tag Engine or receives information from it.

You can have multiple tags assigned to an item. The server updates all refnums associated with that item. Although it is best to support this capability, if you cannot, send the **can't support multiple connections to item** status for duplicate items in the item list. Refer to the [Error Handling and the Status Parameter](#) section of this chapter for more information.

Next, the server sorts through the item list. If any device or item names are incorrect, not configured for the requested item direction, or not available for some reason, the server writes the status information using the [SRVR Write Input Queue VI](#). The server can use the group list to determine the timing configuration for each item. The **scan rate** and **device name** information is already duplicated in the item list. One additional parameter,

% deadband, is available only from the group list. A server can ignore the group list if it does not implement **% deadband**.

Finally, the server polls all valid input or I/O items for their current readings and writes those to the input queue. If there are problems with any items, the appropriate status is written to the input queue.

Server Input and Output

The server must run continuously, usually executing two parallel loops: an input polling loop and an output polling loop. Both loops must run until the server is signaled to shut down. The server should configure timing for input polling to match the **scan rate** requested in the item list or as close to the specified **scan rate** as possible.

The server polls its inputs according to its polling configuration and writes all new or changed input data to the input queue, along with **timestamp** and **status** information. The [SRVR Write Input Queue VI](#) returns the number actually written to the input queue, which notifies the server of any queue overflow situations. Ideally, the queues allocated by the Tag Engine are large enough to prevent overflow. By default, the server can instruct the LabVIEW Datalogging and Supervisory Control module to block the server and handle the rewrite. The server directly handles retries by clearing the **block if queue full** input; however, the server also must check and rewrite data as necessary, or the data is lost.

In addition to polling the item inputs, the server occasionally reads the output queue to obtain item output values.

Wire the **server name** to the [SRVR Read Output Queue VI](#), along with a maximum number of values to read (**max # to read** = 0 reads all available values for the server) and a maximum **timeout** period to wait before reading the queue. The VI returns as soon as one of the following events occurs:

- Information is available in the queue
- The server **shutdown** or **changes pending** status is TRUE
- A timeout occurs

To indicate any error status for those items to the Tag Engine, the server must write the server input queue using the **refnums** corresponding to output items to the input queue. If the item is used as an output, only the value is ignored; however, the status is read, saved, and then reported. The server must write to the input queue with the status of an output item when that status changes. If a problem occurs when outputting to the item,

the server must write to the input queue with the appropriate status. If the status previously was bad but has become good, the server also must write to the input queue with a good status value. Refer to the [Error Handling and the Status Parameter](#) section of this chapter for more information.

Server Shutdown

When the engine stops, it sends **shutdown** notification to the servers. Shutdown can be detected from the [SRVR Write Input Queue VI](#), [SRVR Read Output Queue VI](#), and [SRVR Get Status VI](#). The event-driven SRVR Read Output Queue VI is a good place to wait for shutdown notification because it returns immediately if the engine goes into **shutdown** mode. You can use this mechanism even if the server has no output items. You also can explicitly poll the server status occasionally using the SRVR Get Status VI.

A server is given about 30 seconds to shut down by default. If the server has not stopped execution by that time, the user is asked for permission to abort (close) the server.

Server Changes

To obtain information about item changes for the server, the server either acquires a completely new item list and group list by calling the [SRVR Get Item List VI](#) or retrieves lists of exceptions by calling the [SRVR Get Item Changes VI](#). The SRVR Get Item Changes VI specifically lists the items and groups that are obsolete, new, or have changed. Items with no associated changes are not included in the outputs. Calling the SRVR Get Item List VI or SRVR Get Item Changes VI resets the **changes pending** status.

The server now sorts through the changed item and group lists. If any device or item names are incorrect, not configured for the requested item direction, or not used for some reason, the server must write the status information using the SRVR Write Input Queue VI.

Sample Server Design

The following figure shows the design of a simple server.

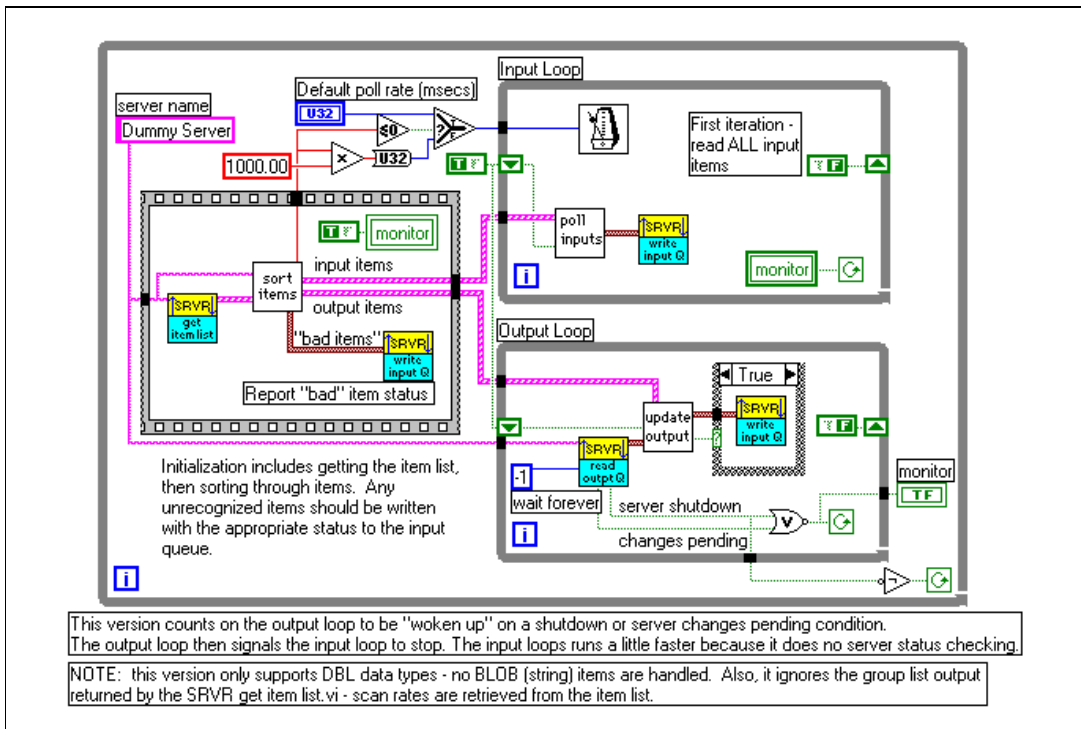


Figure 2-4. Sample VI-Based Server



Note This sample server works only with scalar data types, not strings.

Figure 2-4 demonstrates how the SRVR VIs are often used. The VIs that poll inputs, update outputs, and sort items are server-specific subVIs. The remaining VIs are part of the LabVIEW Datalogging and Supervisory Control module server interface libraries.

The server in Figure 2-4 is launched for the first time by the Tag Engine when a tag configuration using the server is run. First, the server calls the [SRVR Get Item List VI](#), passing in the **server name** under which it is registered (see the [Server Registration](#) section of this chapter for more information). The server then receives a list of items from the Tag Engine to poll, including the following elements:

- Item strings
- Device strings
- Polling rates
- Need for input, output, or both to be performed for the item
- Data type for the item
- Unique reference number the LabVIEW Datalogging and Supervisory Control module uses to identify the item

This server only uses the item information and ignores the group output [SRVR Get Item List VI](#).

Because the LabVIEW Datalogging and Supervisory Control module uses the unique reference number in all subsequent operations, you must configure the server to set up internal lookup tables for converting reference numbers and the server representation for each item. Sort out the items that require inputs and those that require outputs, and initialize the server to perform those functions for the requested items.

While initially sorting through the **item list**, the server checks for errors in the item list, including the following errors:

- Unrecognized device
- Unrecognized item
- Unsupported direction
- Wrong data type for item
- Server cannot support multiple refnums for the item

For any of these conditions, the server writes the appropriate status information to the server input queue for any item or device that is invalid or unusable for any reason, and the LabVIEW Datalogging and Supervisory Control module marks the bad status for those items in the Real-Time Database.

If the error is considered severe, such as not being able to communicate with a device, the server might post an error message to the Tag Engine. These messages are displayed to the user.

The server then sets up the following two (or more) loops:

- **Input Loop**—Regularly polls the requested input and I/O items from one or more devices and writes the corresponding value, status, and time stamp information to the server input queue.
- **Output Loop**—Waits on any output values for the server to be placed in the server output queue from the LabVIEW Datalogging and Supervisory Control module. If any values are read from the output queue, the server writes these values to the output and I/O items.

Both the [SRVR Read Output Queue VI](#) and [SRVR Write Input Queue VI](#) return **shutdown** and **changes pending** information for the server. For the SRVR write input queue VI, pass in the **server name** and set the **return status** input to TRUE for the status information to return. If you use the output loop to monitor this condition, the input loop does not need to check for the condition. In this case, the output loop must notify the input loop to terminate when it detects shutdown. If the **shutdown** status is TRUE, the server then completes execution as soon as possible. If the **changes pending** output is TRUE, the server reads **new item list** or **changed item list** information and adjusts the active items accordingly.

Error Handling and the Status Parameter

Status is an indication of the quality of the value passed to the server—good, uncertain, or bad. The **status** parameter is stored in the Real-Time Database along with the **value** and **timestamp** for each tag. When **status** is less than zero, indicating bad status, the Tag Engine assumes that the value for that item is not valid.

If a value is good or uncertain, LabVIEW updates the **value**, **timestamp**, and **status** fields in the database with the new information, after scaling the value as necessary. The LabVIEW Datalogging and Supervisory Control module also computes alarms and performs historical logging on the value, as was configured for the associated tag.

If a value is bad, LabVIEW updates the **timestamp** and **status** fields in the database but retains the last **value** with a good or uncertain status. LabVIEW does not compute alarm levels. Users can activate bad status alarm notification on any tag as part of the tag configuration.

status is a 32-bit signed integer. The top 16 bits (MSW) must be set to one of the status numbers listed in Table 2-1. The bottom 16 bits (LSW) are used by the server, sometimes to pass server-specific status information; otherwise, leave these bits set at 0. The server determines the appropriate

status meaning and passes the corresponding MSW **status** value. The server-specific information is passed to the LSW. The more specific the **status** returned, the better; however, the server must indicate if the **value** is good, uncertain, or bad.

Table 2-1. Status Reports

Quality	MSW Status Value	Status Meaning	Who Reports?
Good	0	No error—Value and timestamp is valid.	Server
Warning— Value Uncertain	50	Initial/Default Value.	Tag Engine
	60	Value out of range. The value is either out of raw-range or out of the engineering unit range during scaling.	Tag Engine
	61	Value exceeded high range. The value exceeded the high raw-range or engineering unit range during scaling.	Tag Engine
	62	Value exceeded low range. The value exceeded the low raw-range or engineering unit range during scaling.	Tag Engine
	100	Uncertain Value.	Server
	105	Last known value (stale data)—Dev comm error. There is a communication error or failure to communicate with the device. This is the last known valid reading for the item. The server must pass a valid value to use this warning status.	Server
	150	Item reading not accurate.	Server
	160	Item value out of range.	Server
	161	Item value exceeded high range.	Server
162	Item value exceeded low range.	Server	
Error— Value Bad	-1	User Level Error.	Tag Engine
	-2	Uninitialized Tag.	Tag Engine
	-3	Server Execution Error. The Tag Engine is unable to find or launch the server.	Tag Engine or Server

Table 2-1. Status Reports (Continued)

Quality	MSW Status Value	Status Meaning	Who Reports?
	-100	Bad Value.	Server
	-101	Unrecognized Device. The server does not recognize the device name string for this item and cannot acquire or output values.	Server
	-102	Device offline/out-of-service.	Server
	-103	Device/Item Hardware Error (Hardware Bad). Device and item names are valid, but the server is unable to read or write items because of hardware failure or a configuration error.	Server
	-105	Device Communication Error—failure of communications with device. The device might be temporarily offline; however, the server is unable to update a value for the item because of lost communication.	Server
	-111	Unrecognized Item. The server does not recognize the item name string for this item and cannot acquire or output values.	Server
	-112	Unsupported read/write mode. Device and item names are valid, but the server is unable to support the requested read or write mode for the item.	Server
	-113	Unsupported datatype. Device and item names are valid, but the server is unable to support the datatype for the item.	Server
	-114	Unable to support multiple connections to item.	Server

The server must timestamp values even when reporting a bad status.

The server uses the [SRVR Post Message VI](#) to post human-readable events and errors to the Tag Engine system message handler. Use this VI to report catastrophic and general errors, such as losing communication with a device, and the subsequent recovery from such errors. These messages are displayed to the user and logged to a system log file, so be concise and avoid sending excessive messages. As long as things are operating correctly, no messages are necessary. Report these errors once during

start-up/initialization and on a per device basis. The server still must pass the appropriate **status** for all requested items on the input queue. If an error message is reported and the server later recovers from the error, the server should send a non-error message notifying the user of the recovery.



Note Remember to be economical when sending messages. If you send messages frequently, the system log file for the user fills up and the Tag Engine constantly prompts the user.

Server-User Interface

The front panel of the server VI remains hidden from the user during VI execution, but can be displayed using the Server Browser utility from the Tag Engine. The server can display general server status or other information on its front panel. The user sees this information only if the front panel is open. Use **VI Setup** to hide the server toolbar and prevent the user from closing or aborting the server while it is running.

Debugging and Testing Your Server

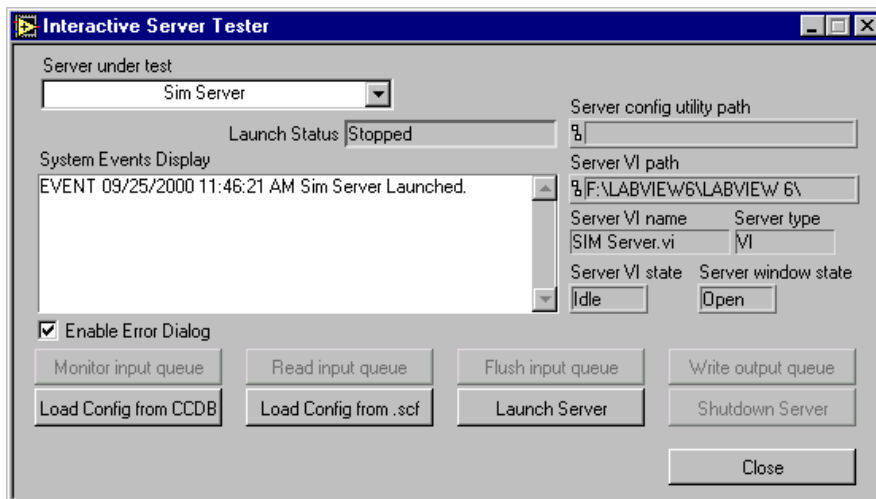
Testing Server Registration

You can use the Server Browser utility to view most of the information registered by your server. To launch the Server Browser utility, select **Tools»Datalogging and Supervisory Controls»Advanced»Server Browser**. Select your server in the Servers list and press the **View Server Information** button to view the device and item information that has been registered by the server. If your server name does not appear in the list then the server is not registered in the currently selected CCDB.

Testing Server Operation

The LabVIEW Datalogging and Supervisory Control module provides a utility, the Interactive Server Tester that allows you to simulate the Tag Engine and run your server in LabVIEW where you can use the G environment debugging tools. You cannot properly test and debug your server without using this tool as the DSC Server Interface VIs do not execute correctly without either the Tag Engine or the Interactive Server tester running.

To launch the Interactive Server Tester, choose **Tools»Datalogging and Supervisory Control»Advanced»Interactive Server Tester**.



Choose the server you want to test in the **Server under test** list box.

The Interactive Server Tester shows the path to the server and other server information. You can then load the server item configuration for testing the server either from the CCDB or from a tag configuration (`.scf`) file. Press the **Load Config from CCDB** button to load all the server items that are currently registered in the CCDB. Press the **Load Config from .scf** button to select an `.scf` file that uses the server. When you select an `.scf` file, only the server items used by that file are loaded.

Once the configuration is loaded, press the **Launch Server** button to launch and load the server. Press the **Monitor input queue** button to bring up a window that displays all items sent by the server to the LabVIEW Datalogging and Supervisory Control module. Normally, you should press this button as soon as you launch the server if your server sends a lot of values to the LabVIEW Datalogging and Supervisory Control module, otherwise the input queue may overflow. Press the **Write output queue** button to bring up a window from which you can simulate writing item values to your server. The **Read input queue** button brings up a display that reads and displays all values currently in the input queue each time you press the **Read** button. If the Monitor Input Queue display is shown, it automatically reads all input values, so the Read Input Queue window may return little information. Press the **Flush input queue** button to clear out any values in the input queue.

Once the server is open and running (the Interactive Server tester will load and show the VI server top level VI if it is not already open), you can use breakpoints and other debugging tools to monitor the server operation. When you are finished, press the **Shutdown Server** button to signal the server to stop execution. If your VI-based server operates correctly using the Interactive Server Tester, it should operate correctly when loaded and run by the Tag Engine.

Try using the SIM Server to familiarize yourself with the Interactive Server Utility.

Viewing the Server While Running in the Engine Process

When the server is running in the engine process, you cannot debug the server or view its diagram, but you can view the server front panel while it is running. Press the **Server Browser** button on the Engine Manager front panel to launch the Server Browser utility. Select your server in the server list—it appears with a diamond symbol next to the server name if the server is loaded, and the diamond is black if the server is running. Select your server and press the **Show Server User Interface** button to open the server and show the front panel while it is running. By adding indicators to the server front panel, you can monitor server operation while it is running in the engine. It is a good idea to minimize the amount of information displayed by the server while it is running so as not to use too much CPU bandwidth. You could use a user interface button on your server front panel that only displays server information when pressed.

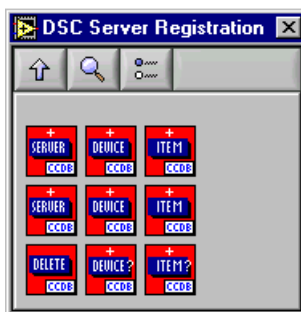
Load and run a tag configuration file that uses the SIM server and then open the SIM server in the Engine Process to see how this works.

Function Reference

This chapter describes the VIs that register VI-based servers and interface the VI-based servers to the Tag Engine during server execution.

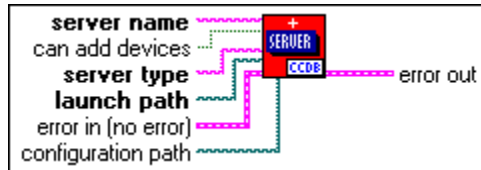
Server Registration VIs

The server uses a set of subVIs to communicate with the Tag Engine. These subVIs are contained in the **DSC Server Registration** palette.



SVRG Add Server Row VI

Registers your server for use with the LabVIEW Datalogging and Supervisory Control module and creates an entry for your server in the Servers table of the CCDB.



server name is the unique name of the server as it should appear in the Server list in the Tag Configuration Editor and other utilities. This is the same name you use in your server VI when calling the SRVR VIs to retrieve information. You must wire a non-empty string for the **server name** and, when possible, use an understandable name. Spaces are permitted in the name, and the maximum length of the string cannot exceed 255 characters.



can add devices (optional) is set to `FALSE`, by default. Set this bit to `TRUE` if your server is capable of interpreting device strings and can accept a new device name at server launch time. When set to `TRUE`, users can create new device names in the Device list for the server. If your server can access only preregistered or predefined devices, you must set this input to `FALSE` or leave it unwired.



server type is the type of the server. You must identify your VI-based servers as such by setting the **server type** string to VI. The LabVIEW Datalogging and Supervisory Control module then interprets your execution path as a VI path.



launch path is the path to the VI implementing the server, including the VI name. The LabVIEW Datalogging and Supervisory Control module locates the path and VI name from the **server name** to dynamically load your server VI.



Note The VI name is independent of the **server name**.



error in (no error) describes the error status before this VI executes.



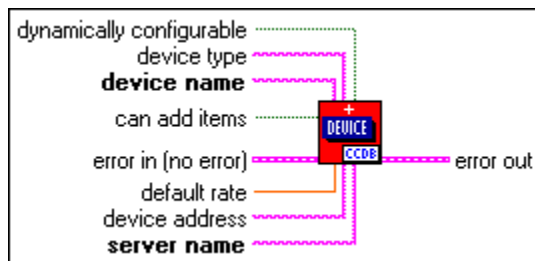
configuration path (optional) is the path to the configuration utility. If there is no configuration utility, leave this input unwired.



error out describes the error status after this VI executes.

SVRG Add Device Row VI

Registers a device for your server with the LabVIEW Datalogging and Supervisory Control module and creates an entry for your device in the Devices table of the CCDB. When you register one or more devices for a server, the **device name** appears in the Devices list when your server is selected in the Tag Configuration Editor. Even if you do not have a specific device or all items of interest are associated with a single device, you must register the device if you plan to register any items. In this case, use a default **device name**, such as ALL. You can use **device name** as a way to logically group the items in your server.



dynamically configurable (optional) is set to TRUE if device values such as **default rate** can be dynamically reconfigured while running the server. By default, this input is FALSE.



device type (optional) is a string documenting the type of device. This input is for documentation purposes only and might be useful for your server. This field is not used by the LabVIEW Datalogging and Supervisory Control module.



device name is the name of the device as it should appear in the Devices list in the Tag Configuration Editor and other utilities. Each device registered for your server must have a unique name. Spaces are permitted in the name, and the maximum length of the string cannot exceed 255 characters.



can add items (optional) is set to FALSE, by default. Set this bit to TRUE if your server is capable of interpreting device strings and can accept a new **device name** at server launch time. When set to TRUE, users can enter new device names in the Devices list for the server. If your server can access only preregistered or predefined devices, you must set this input to FALSE or leave it unwired.



error in (no error) describes the error status before this VI executes.



default rate (optional) is the default sampling period, in seconds, for polling the item.



device address (optional) is an input that you can use to record device address information stored for this device by your server. The LabVIEW Datalogging and Supervisory Control module does not interpret this information.



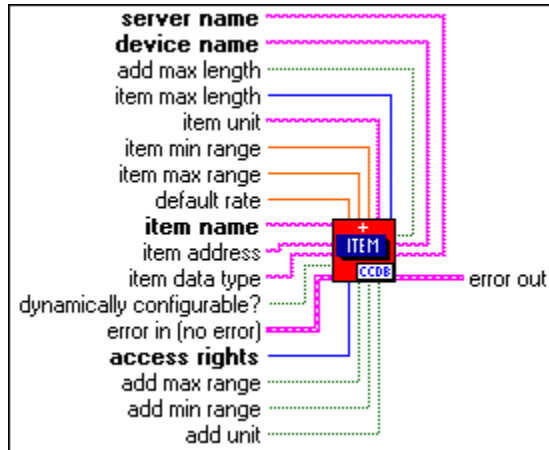
server name is the name of the server associated with this device. Use the same **server name** you used to register the server. You must wire a non-empty string for **server name**.



error out describes the error status after this VI executes.

SVRG Add Item Row VI

Registers an item for your server device with the LabVIEW Datalogging and Supervisory Control module. You must register a device before you can register an item for that device. This VI creates an entry for your item in the Items table of the CCDB.



abc

server name is the name of the server for which this item is registered.

abc

device name is the name of the device for which this item is registered.

TF

add max length is FALSE, by default, and no maximum length value is registered for the item. If you registered a maximum length value, set this input to TRUE.

132

item max length is the maximum length associated with this item. It is interpreted as the maximum number of bytes in the item for string types (**item data type** = BLOB or STR) or the maximum number of bits for bit array types (**item data type** = BITA). If you register the maximum length for the item, you also must set the **add max length** input to TRUE; otherwise, the information is not stored in the item row. For all other data types, if **item max length** is greater than 1, the LabVIEW Datalogging and Supervisory Control module interprets it as an array of values and allows the user to configure the item as a string tag.

With the following three inputs—**item unit**, **item min range**, and **item max range**—you can register engineering unit information for the item. If you register engineering unit information, the LabVIEW Datalogging and Supervisory Control module automatically imports the information into the tag configuration when the item is selected, which can be

a convenient way of passing configuration information from the server to the LabVIEW Datalogging and Supervisory Control module if the server holds the information. Users still can modify the information. Registering engineering unit information is optional, and you should only register this information if you can predetermine the actual engineering range and unit information for the item.



item unit (optional) is the engineering unit string for this item. If you register the engineering unit for the item, you also must set the **add unit** input to `TRUE`; otherwise, the information is not stored in the item row.



item min range (optional) is the minimum value in engineering units for this item. If you register the engineering minimum range for the item, you also must set the **add min range** input to `TRUE`; otherwise, the information is not stored in the item row.



item max range (optional) is the maximum value in engineering units for this item. If you register the engineering maximum range for the item, you also must set the **add max range** input to `TRUE`; otherwise, the information is not stored in the item row.



default rate (optional) is the default sampling period, in seconds, for polling the item.



item name is the name of the item as it appears in the Items list in the Tag Configuration Editor and other utilities. Each item registered for a device must have a unique name. Spaces are permitted in the name, and the maximum length of the string cannot exceed 255 characters.



item address (optional) is an input that you can use to record **item address** information stored for this device by your server. The LabVIEW Datalogging and Supervisory Control module does not interpret this information.



item data type is a string input indicating the item data type, such as Double, Boolean, or Integer. This parameter is used to predict the type of tag associated with an item when the Tag Configuration Editor auto-generates a tag configuration file, as shown in Table 3-1, *Item Data Types*. Users can select any scalar (not STR or BLOB) type for any of the tag types—*analog*, *discrete*, or *bit array*—which are internally represented as double floating-point values.



Note The ultimate datatypes used are BLOB (item data type = BLOB or STR) or DBL for all items. LabVIEW uses this field to prevent the user from selecting an item with item data type = BLOB or STR when configuring an analog, discrete, or bit array tag. LabVIEW also uses this field to prevent the user from selecting an item with item data type \neq BLOB or STR when configuring a string tag. The LabVIEW Datalogging and Supervisory Control module treats items with item max length greater than 1, excluding BITA, as string tags.

Table 3-1. Item Data Types

Item Data Type String	Actual Data Type	Default Tag Type
DBL	LabVIEW double (8-byte) IEEE float	Analog
BLOB	LabVIEW string or packed U8 array	String
STR	LabVIEW string or packed U8 array	String
BOOL	LabVIEW Boolean	Discrete
I8	LabVIEW 8-bit signed integer	Analog
I16	LabVIEW 16-bit signed integer	Analog
I32	LabVIEW 32-bit signed integer	Analog
U8	LabVIEW 8-bit unsigned integer	Analog
U16	LabVIEW 16-bit unsigned integer	Analog
U32	LabVIEW 32-bit unsigned integer	Analog
SGL	LabVIEW single (4-byte) float	Analog
BITA	Bit Array up to 32-bit integer	Bit array



dynamically configurable? (optional) is set to `TRUE` if item values such as **default rate** can be dynamically configured when you launch the server. By default, this input is `FALSE`.



error in (no error) describes the error status before this VI executes.



access rights are the access directions supported by the item. If the item is bi-directional, select I/O. Otherwise, select the input or output direction appropriate for an item. The LabVIEW Datalogging and Supervisory Control module uses this field to ensure that a tag is configured to access the item in the directions supported by that item. For example, if an item is registered as an input only item, the user can configure the item only as input when the item is linked to a tag.



add max range is FALSE, by default, and no maximum range engineering value is registered for the item. If you registered an **item max range**, set this input to TRUE.



add min range is FALSE, by default, and no minimum range engineering value is registered for the item. If you registered an **item min range**, set this input to TRUE.



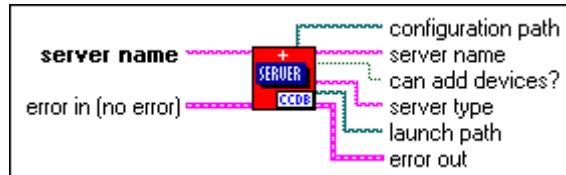
add unit is FALSE, by default, and engineering unit is registered for the item. If you registered an **item unit**, set this input to TRUE.



error out describes the error status after this VI executes.

SVRG Get Server Row VI

Returns the information registered for the **server name** from the Server table. Store this information using the [SVRG Add Server Row VI](#).



server name is the registered name of the server.



error in (no error) describes the error status before this VI executes.



configuration path is the path to the configuration utility for the server. An empty path indicates no configuration utility.



server name returns the registered name of the server.



can add devices? specifies whether devices can be created for the server.



server type returns the type of the server. If it is a VI-based server, the **server type** is VI.



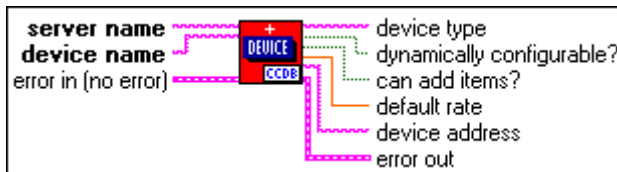
launch path returns the path of the VI implementing the server, including the VI name.



error out describes the error status after this VI executes.

SVRG Get Device Row VI

Returns the information registered for the **device name** corresponding to **server name**. Store this information using the [SVRG Add Device Row VI](#).



abc

server name is the registered name of the server.

abc

device name is the name of a registered device for the server.

error in (no error)

error in (no error) describes the error status before this VI executes.

abc

device type returns a string documenting the type of device. The contents of this string are server specific.

TF

dynamically configurable? returns information on whether device values can be dynamically configured when you launch the server.

TF

can add items? returns information on whether items can be created for the device.

DBL

default rate returns the default sampling period, in seconds, for polling the item.

abc

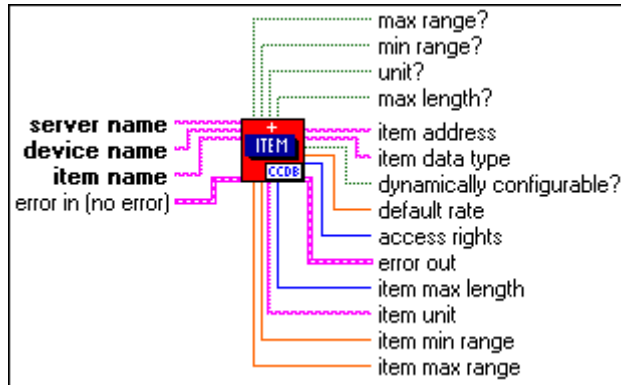
device address returns **device address** information stored for this device by your server. The contents of this string are server specific.

error out

error out describes the error status after this VI executes.

SVRG Get Item Row VI

Returns information registered for **item name** corresponding to the **server name** and **device name**. Store this information using the [SVRG Add Item Row VI](#).



abc

server name is the registered name of the server.

abc

device name is the name of a registered device for the server.

abc

item name is the name of a registered item for the device.

CCDB

error in (no error) describes the error status before this VI executes.

TF

max range? is TRUE if a maximum range was registered for this item.

TF

min range? is TRUE if a minimum range was registered for this item.

TF

unit? is TRUE if a unit was registered for this item.

TF

max length? is TRUE if a maximum length was registered for this item.

abc

item address returns item address information stored for this item. The contents of this string are server specific.

abc

item data type returns the data type stored for this item. Refer to Table 3-1, [Item Data Types](#), for more information on the stored data types.



dynamically configurable? specifies whether this item can be dynamically configured when you launch the server.



default rate returns the default sampling period, in seconds, for polling the item.



access rights are the access directions supported by the item. I/O indicates the item is bi-directional. Input indicates the item is input only. Output indicates the item is output only.



error out describes the error status after this VI executes.



item max length is the maximum length associated with this item. If the **item data type** = BITA, this number is interpreted to be the number of bits associated with the item. If the **item data type** = STR or BLOB, the number is interpreted to be the maximum length the string can be, in bytes. This output is valid only if **max length?** is TRUE.



item unit is the engineering unit string for this item. This output is valid only if **unit?** is TRUE.



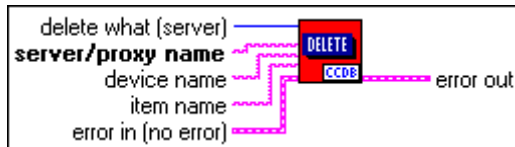
item min range is the minimum value in engineering units for this item. This output is valid only if **min range?** is TRUE.



item max range is the maximum value in engineering units for this item. This output is valid only if **max range?** is TRUE.

SVRG Delete Row VI

Deletes a specific row from the Server, Device, or Item tables. If you delete a server from the Server table, all devices for the server in the Device table and all items for the server in the Items table are deleted automatically. You do not have to delete devices and items individually if you want to delete them all. Similarly, if a device is deleted from the Devices table, all items for that device in the Items table are deleted automatically.



delete what (server) determines the table from which data is deleted.

2: Delete row from the Server table. This deletes all information associated with the server from the Device and Item tables.

1: Delete row from the Device table. This deletes all information associated with the device from the Device table.

0: Delete row from the Item table. This deletes all information associated with the item from the Item table.



server/proxy name is the name of the server for which the table row is being deleted. Always enter a server name.



device name is the name of the device for which the table row is being deleted.



item name is the name of the item for which the table row is being deleted.



error in (no error) describes the error status before this VI executes.



error out describes the error status after this VI executes.

SVRG Get Server Devices VI

Returns a list of devices registered for the server name.



abc

server name is the unique name of the server as it should appear in the Server list in the Tag Configuration Editor and other utilities.

error in (no error)

error in (no error) describes the error status before this VI executes.

error out

error out describes the error status after this VI executes.

TF

no devices found is true if there are not devices registered for this server.

abc

device names lists all the devices registered for the server.

SVRG Get Server Items VI

Returns a list of items registered for the server name and device name.



abc

server name is the unique name of the server as it should appear in the Server list in the Tag Configuration Editor and other utilities.

error in (no error)

error in (no error) describes the error status before this VI executes.

abc

device name is the name of the device as it should appear in the Devices list in the Tag Configuration Editor and other utilities.

error out

error out describes the error status after this VI executes.

TF

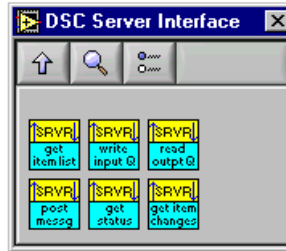
no items found is true if there are no devices registered for this server.

abc

item names lists all the items registered for the server and device.

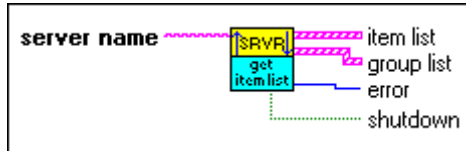
Server Interface VIs

The server also uses a set of subVIs to communicate with the Tag Engine during server execution. These VIs are contained in the **DSC Server Interface** palette.



SRVR Get Item List VI

Returns lists of items, item characteristics, and item refnums that the Tag Engine requests from a specific server.



abc

server name is the registered name of the server.

[]

item list is the specification for items that the server monitors and controls.
item list is an array of the `SRVR item list.ct1` Strict Type Definition.

item spec	
device name	<input type="text"/>
item name	<input type="text"/>
BVE datatype	<input type="text" value="DBL"/>
item dir	<input type="text" value="Input"/>
item datatype	<input type="text" value="-1"/>
scan rate	<input type="text" value="-1.00"/>
notify on change	<input type="text" value="on change"/>
BVE refnum	<input type="text" value="0"/>
group name	<input type="text"/>
access path	<input type="text"/>

abc

device name is a string containing the name of the device. The contents of this string are server specific. For example, you can use the string to pass **device address** information to the server. The user enters or selects this string from a list of preregistered devices during tag configuration. The server must document valid **device name** formats for the user or register a complete list of devices.



item name is a string containing the name of the item. The contents of this string are server specific. For example, you might use the string to pass **item address** information and formatting/conversion information to the server. The user enters or selects this string from a list of preregistered items during tag configuration. The server must document valid **item name** formats for the user or register a complete list of items available for each device present.



BVE datatype is a Double or Binary Large Object (DBL or BLOB) data type that the Tag Engine requests for the item. Items passed to the Tag Engine must be coerced to this datatype.

0: DBL—Indicates you must return a scalar value coerced to a double data type.

1: BLOB—Indicates you must return data as a string or packed U8 array. There is no internal format for this datatype.

LabVIEW treats it only as a byte stream.



item dir can be input, output, or I/O. If **item dir** is input, the server must regularly poll the item. If **item dir** is output, the Tag Engine only can control the item; that is, the item cannot be monitored. If **item dir** is I/O, the server must regularly poll the item, and the Tag Engine can control the item.

0: input

1: output

2: I/O



item datatype is a data type that the user expects to read from the item. This is normally the default data type for that particular device and item.

-1: use default **item datatype**

0: use DBL **item datatype**

1: use BLOB **item datatype**



scan rate is the rate in seconds at which the server polls the item. Use the closest rate available from your server. A rate of -1 indicates the use of the default or preconfigured server **scan rate** for this item.



Note LabVIEW always passes -1: use default **item datatype**.



notify on change, if `TRUE`, passes each new item value read from the device to the Tag Engine only if it has changed (after server start-up, the server must always return the initial item value). If `FALSE`, **notify on change** returns every item value read from the device, even if it has changed. If your server implements **% deadband**, use the **% deadband** parameter in the group corresponding to this item.



BVE refnum is a Tag Engine reference number that the server must use when writing an item to the input queue or reading an output item value from the output queue.



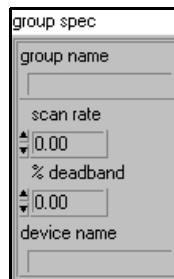
group name is the name of the group to which the user has assigned this item. Obtain group parameters from the **group list** output.



access path is the string for the access path corresponding to the item. Access path is currently reserved for OPC servers only.



group list is the specification for groups of items that the server monitors and controls. The user organizes all items into one or more groups during tag configuration. Each group specifies timing and device information for the item—in other words, all items in a group have the same timing information and association with the same device. Most group information is available from the **item list** output as well; therefore, this information is redundant and can be ignored if the server does not specifically implement deadbanding by percent on items. Because the group list presents common information by group, this additional output is provided to a server as a convenience. **group list** is an array of the `SRVR group info.ct1` Strict Type Definition.



The screenshot shows a dialog box titled "group spec". It contains the following fields:

- group name: []
- scan rate: [0.00]
- % deadband: [0.00]
- device name: []



group name is a string containing a user defined name for a group of items. Each item in the **item list** has a corresponding **group name**.



scan rate is the rate in seconds at which the server polls all items in the group. Use the closest rate available from your server. If your server cannot programmatically configure rates, choose the default rate for your server. A rate of -1 indicates the use of the default or preconfigured server **scan rate** for all items in this group. Notice that this **scan rate** parameter is duplicated in the item list array.



% deadband is the deadband in terms of percent of range that the server applies to all items in the group before sending the item values to the Tag Engine. A value of 0 indicates that no deadbanding should be applied. Use the closest deadband percent available from your server. If your server does not implement deadbands, you can ignore this parameter; however, implement the following cases:

- When **% deadband** is 0 , return all acquired item values.
- When **% deadband** is > 0 , return item values only if they change.

This parameter is related to the **notify on change** parameter in the item list array—**notify on change** is **TRUE** if **% deadband** is greater than 0 . If your server does not implement deadband by percent of range, you can use the **notify on change** parameter in the **item list** array instead.



device name is a string containing the name of the device used by all items in the group. This parameter is duplicated in the **item list** array.



error returns any errors that occurred: 0 indicates no error; -7202 specifies an unrecognized server name.



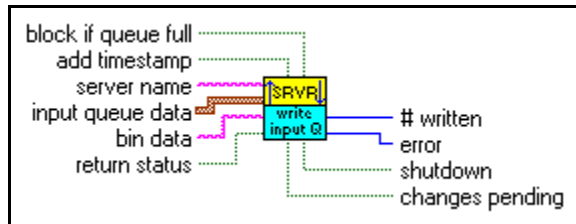
shutdown is the notification to end server execution.



Note The same devices and items can occur for multiple **refnums**. Servers must handle multiple connections to an item or write the **unable to support multiple connections to item** status to the input queue for duplicate items.

SRVR Write Input Queue VI

Writes input item and I/O item data to the Tag Engine. This VI also reports item status on specific input, output, or I/O items. You can set this VI to return engine status.



block if queue full, by default, is **TRUE**. If **TRUE**, the SRVR write input queue VI blocks if the input queue is full. This VI continues trying the writes until successful. If **FALSE**, the server must handle the full input queue. To handle the full input queue, compare the number actually written with the number of queue entries the server attempted to write. If they are not the same, retry with the unwritten entries, or the data is lost.



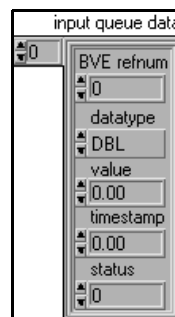
add timestamp to input values. Set this input if you have not time stamped the values yourself. By default, this input is **FALSE** (left unwired), and LabVIEW expects the values to have the correct **timestamp** already.



server name (optional) is the registered name of the server. If the **return status** input is **TRUE**, only pass in **server name**. The **server name** parameter is used to locate and return server status. Otherwise, **input queue data** is passed to the Tag Engine without returning server **shutdown** or **changes pending** status.



input queue data is an array of input item values to pass to the Tag Engine. **input queue data** is an array of the SRVR input queue data.ctl Strict Type Definition.





BVE refnum is the reference number for an item returned by the SRVR get item list VI.



datatype is the Double or Binary Large Object (DBL or BLOB) data type being passed into the Tag Engine. **datatype** must correspond to the data type specified in the **item list**. BLOB signifies that binary data corresponding to this entry is passed into the **bin data** input.



Note If **status** is bad for the item, the **datatype** parameter is ignored. Therefore, you do not need to set the **datatype** parameter when reporting errors.



value is the item value when the item value is passed in as a double-precision floating-point number. Scalar values might be interpreted as analog, discrete (Boolean), or bit array (bit vectors up to 32 bits in length), depending on the user tag configuration for a specific device item. All scalar values must be converted to double-floating points to pass to the Tag Engine. The server must convert signed or unsigned values to double floating-point numbers correctly. When the item value is passed in as a BLOB, you must put the length in bytes (chars) of the **bin data** string corresponding to this item in the **value** field.



timestamp is a double floating-point number set in seconds since January 1, 1904 (Universal time). Use the **Get Date/Time in Seconds** function to read this time into a VI. The server can maintain and calculate its own **timestamp** as long as it corresponds to the same seconds since 1904 used by the LabVIEW Datalogging and Supervisory Control module.



status indicates the quality of the **value** passed to the server—good, uncertain, or bad. See the [Error Handling and the Status Parameter](#) section of Chapter 2, *VI-Based Server Interface to the Tag Engine*, for more information on **status**.



bin data is binary or string data passed to the Tag Engine. If any of the input types are set to BLOB, they are passed in the **bin data** input. All BLOBs are treated as strings in LabVIEW and concatenated together to create a single string to pass to the Tag Engine. For each **input queue data** element writing binary data, the data type in the respective **input queue data** entry is set to BLOB, and the **value** is set to the length of the string section.



return status, if set, enables the SRVR write input queue VI to use the **server name** input to locate and return the server **shutdown** and **changes pending** status.



Note You must pass in the **server name** to get a valid indication of **shutdown** or **changes pending** status. If you are not reading these outputs, you do not need to wire the **server name** input.

I32

written indicates the number of **input queue data** entries successfully passed to the Tag Engine. If this parameter is less than the length of the **input queue data** array, an input queue full condition occurred, and the server writes the remaining data at a later time.

I32

error returns any errors that occurred: 0 indicates no error; -7201 indicates write queue full (unable to complete write); -7202 specifies an unrecognized server name.

TF

shutdown is the notification to end server execution. **shutdown** is only a valid output if **server name** is passed into the VI. If **TRUE**, the Tag Engine is attempting to stop execution, and you must terminate your server execution as soon as possible.

TF

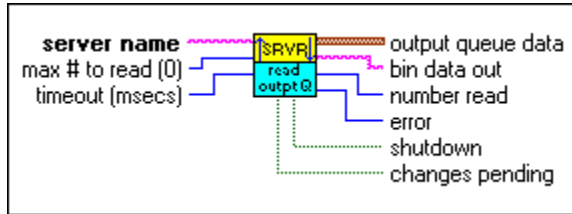
changes pending is only a valid output if **server name** is passed into the VI. If **TRUE**, changes have been made to your server **item list**. Use the [SRVR Get Item List VI](#) to receive an updated list, or call the [SRVR Get Item Changes VI](#) to receive a list of changes to your **item list**. When the server calls either of these VIs to get the most current **item list** information, this flag is cleared.



Note The LabVIEW Datalogging and Supervisory Control module does not currently use the **changes pending** parameter.

SRVR Read Output Queue VI

Receives new output values for output or I/O items from the Tag Engine. This VI also returns status information specifying whether the server is to shutdown or if item changes are pending.



server name

server name is the registered name of the server.

max # to read (0)

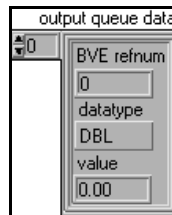
max # to read (0) is the maximum number of values to read from the output queue. If you set **max # to read** to 0, this input reads all available values for the server.

timeout (msecs)

timeout (msecs) is the maximum timeout, in milliseconds, to wait before reading the queue. The VI returns when data is available in the queue for the server or **timeout**, depending on which occurs first. If the server status changes because of **shutdown** notification or **item list** changes for the server, this VI returns immediately. If **timeout (msec) = 0**, the VI returns immediately. If **timeout (msec) = -1**, the VI waits until data is available in the queue for the server or the server status changes to return. Use a fairly long timeout, at least 1 second, to prevent unnecessary looping or use -1 to return only if an event occurs.

output queue data

output queue data is an array of output item values the server writes out to the items. **output queue data** is an array of the SRVR output queue data. `data.ct1` Strict Type Definition.



I32

BVE refnum is the reference number for an item returned by the [SRVR Get Item List VI](#).

U16

datatype is the Double or Binary Large Object (DBL or BLOB) data type returned by the Tag Engine. **datatype** corresponds to the data type specified in the **item list**. BLOB signifies that binary data corresponding to this entry is returned in the **bin data out** output.

DBL

value is normally a double floating-point number that the Tag Engine wants written to the output item. If the **datatype** is a BLOB, binary data is returned in the **bin data out** output, and **value** signifies the length of the binary string in the **bin data out** output corresponding to this entry.

abc

bin data out is binary or string data returned by the Tag Engine. If any of the output types are BLOB, they are passed to the **bin data out** output. All BLOBs are treated as strings in the LabVIEW Datalogging and Supervisory Control module and concatenated into a single string returned by this VI. The **datatype** in the respective **output queue data** entry is then set to BLOB, and **value** is set to the length of the string for that entry.

I32

number read indicates the number of **output queue data** entries that have been read from the Tag Engine.

I32

error returns any errors that occurred: 0 indicates no error; -7202 specifies an unrecognized server name.

TF

shutdown is the notification to end server execution.

TF

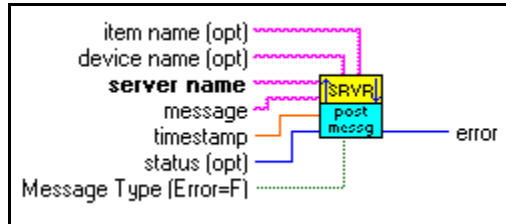
changes pending indicates that changes have been made to your server **item list**. Use the [SRVR Get Item List VI](#) to receive an updated list or call the [SRVR Get Item Changes VI](#) to receive a list of changes to your **item list**. When the server calls either of these VIs to get the latest **item list** information, this flag is cleared.



Note The LabVIEW Datalogging and Supervisory Control module does not currently use the **changes pending** parameter.

SRVR Post Message VI

Writes error messages from the server to the Tag Engine where the messages can be logged and displayed to the user. See [Error Handling and the Status Parameter](#), in Chapter 2, [VI-Based Server Interface to the Tag Engine](#), for more information about when to use this VI.



abc

item name (opt) is the name of the item that caused the error.

abc

device name (opt) is the name of the device that caused the error.

abc

server name is the registered name of the server reporting the error.

abc

message is an ASCII string error message.

DBL

timestamp is the timestamp indicating when the error occurred or when it was reported.

132

status (opt) is the status associated with the error.

TF

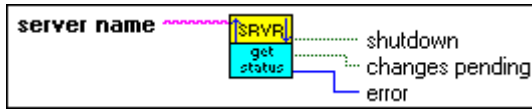
Message Type (Error=F) is the type of message. If `FALSE`, the message is an error message. If `TRUE`, the message is not an error but a server event of interest. By default, **Message Type** is set to `FALSE` to indicate an error message.

132

error returns any errors that occurred: 0 indicates no error; `-7202` specifies an unrecognized server name.

SRVR Get Status VI

Polls the Tag Engine for the current server status.



abc

server name is the registered name of the server.

TF

shutdown is the notification to end server execution.

TF

changes pending indicates that changes have been made to your server **item list**. Use the [SRVR Get Item List VI](#) to receive an updated list or call the [SRVR Get Item Changes VI](#) to receive a list of changes to your **item list**. When the server calls either of these VIs to get the latest **item list** information, this flag is cleared.

I32

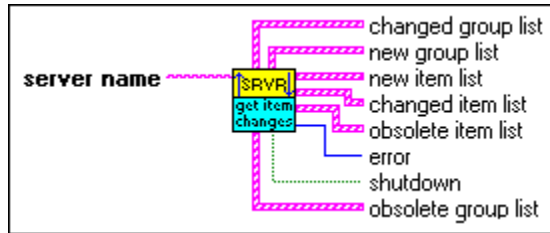
error returns any errors that occurred: 0 indicates no error; -7202 specifies an unrecognized server name.



Note The LabVIEW Datalogging and Supervisory Control module currently does not use the **changes pending** parameter.

SRVR Get Item Changes VI

Returns a list of item changes.



abc

server name is the registered name of the server.

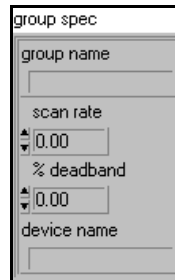
[]

changed group list is a list of groups that have been changed in one or more attributes since the last item update. For parameter definitions, see the following group spec figure.

[]

new group list is a list of groups that have been added for the server to monitor since the last item update. For parameter definitions, see the following group spec figure.

The **new group list**, **changed group list**, and **obsolete group list** are all arrays of the SRVR group info.ct1 Strict Type Definition.



abc

group name is a string containing a user defined name for a group of items. Each item in the **item list** has a corresponding **group name**.



scan rate is the rate in seconds at which the server polls all items in the group. Use the closest rate available from your server. If your server cannot programmatically configure rates, choose the default rate for your server. A rate of -1 indicates the use of the default or preconfigured server **scan rate** for all items in this group. Notice that this **scan rate** parameter is duplicated in the item list array.



% deadband is the deadband in terms of percent of range that the server applies to all items in the group before sending the item values to the Tag Engine. A value of 0 indicates that no deadbanding should be applied. Use the closest deadband percent available from your server. If your server does not implement deadbands, you can ignore this parameter; however, implement the following cases:

- When **% deadband** is 0 , return all acquired item values.
- When **% deadband** is > 0 , return item values only if they change.

This parameter is related to the **notify on change** parameter in the item list array—**notify on change** is **TRUE** if **% deadband** is greater than 0 . If your server does not implement deadband by percent of range, you can use the **notify on change** parameter in the **item list** array instead.



device name is a string containing the name of the device used by all items in the group. This parameter is duplicated in the **item list** array.



new item list is a list of items that have been added for the server to monitor since the last item update. For parameter definitions, see the following *item spec* figure.



changed item list is a list of items that have been changed in one or more attributes since the last item update. For parameter definitions, see the following *item spec* figure.



obsolete item list is a list of items that the Tag Engine no longer wants to monitor. Only the **device name**, **item name**, and **BVE refnum** elements of this list are valid. The server should no longer pass any item values to the server corresponding to these **BVE refnums**. For parameter definitions, see the following *item spec* figure.

The **new item list**, **changed item list**, and **obsolete item list** are all arrays of the SRVR `item list.ct1` Strict Type Definition.

abc

device name is a string containing the name of the device. The contents of this string are server specific. For example, you can use the string to pass **device address** information to the server. The user enters or selects this string from a list of preregistered devices during tag configuration. The server must document valid **device name** formats for the user or register a complete list of devices.

abc

item name is a string containing the name of the item. The contents of this string are server specific. For example, you might use the string to pass **item address** information and formatting/conversion information to the server. The user enters or selects this string from a list of preregistered items during tag configuration. The server must document valid **item name** formats for the user or register a complete list of items available for each device present.

U16

BVE datatype is a Double or Binary Large Object (DBL or BLOB) data type that the Tag Engine requests for the item. Items passed to the Tag Engine must be coerced to this datatype.

0: DBL—Indicates you must return a scalar value coerced to a double data type.

1: BLOB—Indicates you must return data as a string or packed U8 array.

U16

item dir can be input, output, or I/O. If **item dir** is input, the server must regularly poll the item. If **item dir** is output, the Tag Engine only can control the item; that is, the item cannot be monitored. If **item dir** is I/O, the server must regularly poll the item, and the Tag Engine can control the item.

0: input

1: output

2: I/O

I16

item datatype is a data type that the user expects to read from the item. This is normally the default data type for that particular device and item.

–1: use default **item datatype**

0: use DBL **item datatype**

1: use BLOB **item datatype**



Note LabVIEW always passes –1: use default **item datatype**.

DBL

scan rate is the rate in seconds at which the server polls the item. Use the closest rate available from your server. A rate of –1 indicates the use of the default or preconfigured server **scan rate** for this item.

TF

notify on change, if **TRUE**, passes each new item value read from the device to the Tag Engine only if it has changed (after server start-up, the server must always return the initial item value). If **FALSE**, **notify on change** returns every item value read from the device, even if it has changed. If your server implements **% deadband**, use the **% deadband** parameter in the group corresponding to this item.

132

BVE refnum is a Tag Engine reference number that the server must use when writing an item to the input queue or reading an output item value from the output queue.

abc

group name is the name of the group to which the user has assigned this item. Obtain group parameters from the **group list** output.

abc

access path is the string for the access path corresponding to the item. Access path is currently reserved for OPC servers only.

132

error returns any errors that occurred: 0 indicates no error; -7202 specifies an unrecognized server name.

TF

shutdown is the notification to end server execution.

[]

obsolete group list is a list of groups that the Tag Engine no longer wants to monitor. For parameter definitions, see the preceding *group spec* figure and definition.



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 zone.ni.com 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
p-	pico-	10^{-12}
n-	nano-	10^{-9}
μ -	micro-	10^{-6}
m-	milli-	10^{-3}
k-	kilo-	10^3
M-	mega-	10^6
G-	giga-	10^9
t-	tera-	10^{12}

Numbers/Symbols

°	degrees
%	percent
Hz	Hertz
sec	seconds

A

A/D	Analog-to-digital.
abort	The procedure that terminates a program when a mistake, malfunction, or error occurs.
address	Character code that identifies a specific location (or series of locations) in memory or on a communications network or device.

alarm	An abnormal process condition. In the LabVIEW Datalogging and Supervisory Control module, an alarm occurs if a tag value goes out of its defined alarm limits or if a tag has bad status.
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.
array	An ordered, indexed set of data elements of the same type.
ASCII	American Standard Code for Information Interchange.

B

bit	Binary digit. The smallest possible unit of data: a two-state, yes/no, 0/1 alternative. The building block of binary coding and numbering systems. Several bits make up a <i>byte</i> .
bit array tag	A multibit value representation of a connection to a real-world I/O point or memory variable. In the LabVIEW Datalogging and Supervisory Control module, this type of tag can be comprised of up to 32 discrete values.
bit vector	A string of related bits in which each bit has a specific meaning.
block diagram	Pictorial description or representation of a program or algorithm. In the LabVIEW Datalogging and Supervisory Control module, the block diagram, which consists of executable icons called nodes and wires that carry data between the nodes, is the source code for the virtual instrument. The block diagram resides in the Diagram window of the VI.
Boolean controls and indicators	Front panel objects used to manipulate and display or input and output Boolean (TRUE or FALSE) data. Several styles are available, such as switches, buttons, and LEDs.
broken VI	VI that cannot be compiled or run; signified by a broken arrow in the Run button.
buffer	Temporary storage for acquired or generated data.
byte	A grouping of adjacent binary digits (bits) operated on by the computer as a single unit.

C

Case structure	Conditional branching control structure, which executes one and only one of its subdiagrams based on its input. It is the combination of the If-Then-Else and Case statements in control flow languages.
CCDB	Common Configuration Database. Manages the registered server information by maintaining tables of servers, devices, and items.
channel	Pin or wire lead to which you apply or from which you read the analog or digital signal.
cluster	A set of ordered, unindexed data elements of any data type including numeric, Boolean, string, array, or cluster. The elements must be all controls or all indicators.
Code Interface Node (CIN)	Special block diagram node through which you can link conventional, text-based code to a VI.
command	A directive to a device.
connector	Part of the VI or function node that contains its input and output terminals, through which data passes to and from the node.
control	Front panel object for entering data to a VI interactively or to a subVI programmatically.
CPU	Central processing unit.

D

data acquisition	Process of acquiring data, typically from A/D or digital input plug-in boards.
datatype descriptor	Code that identifies datatypes, used in data storage and representation.
DDE	Dynamic Data Exchange. A client-controlled Windows protocol for communication between applications.
device	An instrument or controller that is addressable as a single entity and controls or monitors real-world I/O points. A device is often connected to the host computer through some type of communication network, or it can be a plug-in device.

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 item values to the Tag Engine in real time.
diagram window	A VI window that contains the VI block diagram code.
dialog box	An interactive screen with prompts in which the user specifies additional information needed to complete a command.
discrete tag	A two-state (on/off) value representation of a connection to a real-world I/O point. In the LabVIEW Datalogging and Supervisory Control module, this type of tag can be either a one (TRUE) or a zero (FALSE).
DLL	Dynamic link library.

E

Engine	<i>See</i> Tag Engine.
engineering units (EU)	Terms of data measurement, as degrees Celsius, pounds, grams, and so on.
error message	An indication of a software or hardware malfunction or an unacceptable data entry attempt.
event	Something that happens to a tag in the LabVIEW Datalogging and Supervisory Control module system. 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 executing one or more functions.
executable	A stand-alone piece of code that runs or executes.

F

FIFO	First-In-First-Out. A method of data storage in which the first element stored is the first one retrieved.
For Loop	Iterative loop structure that executes its subdiagram a set number of times. Equivalent to conventional code: <code>For i = 0 to n-1, do</code>

front panel The interactive user interface of a VI. Modeled from the front panel of physical instruments, it is composed of switches, slides, meters, graphs, charts, gauges, LEDs, and other controls and indicators.

function Built-in execution element comparable to an operator, function, or statement in a conventional language.

G

G Graphical programming language used to develop LabVIEW applications.

group Collection of items associated with the same server and device that share timing configuration.

H

Human Machine Interface (HMI) A graphical user interface for the user to interact with the LabVIEW system. Also known as MMI.

Hz Hertz. The number of scans read or updates written per second.

I

I/O Input/output. The transfer of data to or from a computer system involving communications channels, operator interface devices, and/or data acquisition and control interfaces.

icon Graphical representation of a node on a block diagram.

IEEE Institute of Electrical and Electronic Engineers.

indicator Front panel object that displays output.

Input/Output (I/O) tag A tag that accepts Real-Time Database values from a device server and sends values to the server.

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

iteration terminal The terminal of a For Loop or While Loop that contains the current number of completed iterations.

L

LabVIEW	Laboratory Virtual Instrument Engineering Workbench. A graphical program development application used commonly for test and measurement and industrial automation.
LED	Light-emitting diode.
LSW	Least Significant Word.

M

Man Machine Interface (MMI)	<i>See</i> Human Machine Interface (HMI).
MB	Megabytes of memory.
MSW	Most Significant Word.
multitasking	The ability of a computer to perform two or more functions simultaneously without interference from one another. In operating system terms, it is the ability of the operating system to execute multiple applications/processes by time-sharing the available CPU resources.

N

nodes	Execution elements of a block diagram consisting of functions, structures, and subVIs.
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O

object	Generic term for any item on the front panel or block diagram, including controls, nodes, wires, and imported pictures.
OLE	Object Linking and Embedding.
OLE Automation	A feature that allows the LabVIEW Datalogging and Supervisory Control module to access objects by automation servers in the system.

OPC OLE for Process Control, and industry standard interface to share data between applications.

operator The person who initiates and monitors the operation of a process.

P

palette A display of pictures that represent possible options.

Panel window VI window that contains the front panel, the execution palette, and the icon/connector pane.

path Description of the location of a file or directory, including the volume containing the file or directory, the directories between the top level and the file or directory, and the file or directory name.

polling A method of sequentially observing each I/O point or user interface control to determine if it is ready to receive data or request computer action.

Programmable Logic Control (PLC) A device with multiple inputs and outputs that contains a program you can alter. Device Servers establish communication with PLCs.

Q

query Like a *command*, causes a device to take some action but requires a response containing data or other information. A command does not require a response.

queue A group of items waiting to be acted on by the computer. The arrangement of the items determines their processing priority. Queues usually are accessed in a FIFO fashion.

R

RAM Random access memory.

range The region between the limits within which a quantity is measured, received, or transmitted expressed by stating the lower and upper range values.

read To get information from any input device or file storage media.

Real-Time Database (RTDB)	An in-memory snapshot of all tags in the system.
refnum	An identifier used to refer to specific data or structures, such as files, tags or server items.
register	A high-speed device used in a CPU for temporary storage of small amounts of data or intermediate results during processing.

S

sampling period	The time interval between observations in a periodic sampling control system.
scalar	Number capable of being represented by a point on a scale. A single value as opposed to an array. Scalar Booleans, strings, and clusters are explicitly singular instances of their respective data types.
scan rate	The number of times (or scans) per second that a device acquires data from channels. For example, at a scan rate of 10Hz, a device samples each channel in a group 10 times per second.
Sequence structure	Program control structure that executes its subdiagrams in numeric order. Commonly used to force nodes that are not data dependent to execute in a desired order.
server	The application that receives messages and requests from the client application.
signed integer	n bit pattern, interpreted such that the range is from $-2(n - 1)$ to $+2(n - 1) - 1$.
string	A connected sequence of characters or bits treated as a single data item.
string data	A packed array of unsigned 8-bit integers.
string tag	A string representation of a connection to a real-world I/O point.
structure	Program control element, such as a Sequence, Case, For Loop, or While Loop.
subdiagram	Block diagram within the border of a structure.
subVI	A VI used in the block diagram of another VI.

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 logged in a syslog file.

system events Events that occur in the LabVIEW Datalogging and Supervisory Control module system, 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 datatypes: 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 Browser A utility to view the configuration parameters of a tag, as configured in the Tag Configuration Editor.

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

Tag Engine The heart of the LabVIEW Datalogging and Supervisory Control module system. It maintains the Real-Time Database of all tag values and alarm states. The Tag Engine runs as a separate process, independent of your HMI application.

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

tag status A variable that determines 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.

timeout The time (in milliseconds) that a VI waits for an operation to complete. Generally, a timeout of -1 causes a VI to wait indefinitely.

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

toolbar Bar containing command buttons that you can use to run and debug VIs.

U

- unsigned integer n bit pattern interpreted such that the range is from 0 to $2^n - 1$.
- user *See* operator.
- utility A program that helps the user run, enhance, create, or analyze other programs and systems.

V

- VI Library Special file that contains a collection of related VIs for a specific use.
- virtual instrument (VI) A program in the graphical programming language G; so-called because it models the appearance and function of a physical instrument.

W

- While Loop Post-iterative test loop structure that repeats a section of code until a condition is met. Comparable to a Do loop or a Repeat-Until loop in conventional programming languages.
- wire Data path between nodes.