Contents

Agilent VISA User's Guide

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Introduction

Introduction

This *Agilent Technologies VISA User's Guide* describes the Agilent Virtual Instrument Software Architecture (VISA) library and how to use it to develop instrument drivers and I/O applications on Windows 95, Windows 98, Windows NT 4.0, and Windows 2000, and on HP-UX version 10.20.

Before you can use VISA, you must install and configure VISA on your computer. See the *Agilent IO Libraries Installation and Configuration Guide for Windows* for installation on Windows systems. See the *Agilent IO Libraries Installation and Configuration for HP-UX* for installation on HP-UX systems.

Unless indicated, Windows NT refers to Windows NT 4.0. Although VISA for Windows supports the Visual Basic programming language, this guide only shows programming techniques using C/C++ language.

NOTE

The **`viBufRead`**, **`viBufWrite`**, **`viGpibControlREN`**, **`viSPrintf`**, **`viVSPrintf`**, **`viSScanf`**, and **`viVSScanf`** functions are VISA Library Specification Revision 2.0.1 features that are available with this version of Agilent VISA.

If You Need Help:

- In the USA and Canada, you can reach Agilent Technologies at these telephone numbers:

  USA: 1-800-452-4844
  Canada: 1-877-894-4414

- Outside the USA and Canada, contact your country's Agilent support organization. A list of contact information for other countries is available on the Agilent web site:

  `http://www.agilent.com/find/assist`

What's in This Guide?

This chapter provides an overview of VISA. In addition, this guide contains the following chapters:

- *Chapter 2 - Building a VISA Application in Windows* describes how to build a VISA application in a Microsoft Windows environment. An example program is provided to help you get started programming with VISA.
- *Chapter 3 - Building a VISA Application in HP-UX* describes how to build a VISA application in the HP-UX environment. An example program is provided to help you get started programming with VISA.
- *Chapter 4 - Programming with VISA* describes the basics of VISA and lists some example programs. The chapter also includes information on creating sessions, using formatted I/O, events and handlers, attributes, locking, and more.
- *Chapter 5 - Programming VXI Devices* describes how to use VISA to communicate over the VXI and GPIB-VXI interfaces to VXI instruments.
- *Chapter 6 - Programming over LAN* provides an overview of the LAN and describes how to use VISA to communicate with devices over LAN.
- *Chapter 7 - VISA Language Reference* provides an alphabetical reference of supported VISA functions.
- *Appendix A - VISA System Information* provides information on VISA software files and system interaction.
- *Appendix B - VISA Attributes* provides a table of all VISA attributes and their associated values.
- *Appendix C - VISA Completion and Error Codes* lists all the completion and error codes for VISA.
- *Appendix D - VISA Type Definitions* lists the VISA data types and their definitions.
- *Appendix E - Editing VISA Configuration* describes how to edit VISA configuration to gain better performance.
- *Glossary* includes a glossary of terms and their definitions.

VISA Overview

VISA is a part of the Agilent IO Libraries. The Agilent IO Libraries consists of two libraries: *Agilent Virtual Instrument Software Architecture (VISA)* and *Agilent Standard Instrument Control Library (SICL).* This guide describes VISA for supported Windows and HP-UX environments.

For information on using SICL in Windows, see the *Agilent Standard Instrument Control Library User's Guide for Windows.* For information on using SICL in HP-UX, see the *Agilent Standard Instrument Control Library User's Guide for HP-UX.*

Using VISA and SICL

Agilent VISA (Virtual Instrument Software Architecture) is an IO library designed according to the VXI*plug&play* System Alliance that allows software developed from different vendors to run on the same system.

Use VISA if you want to use VXI*plug&play* instrument drivers in your applications, or if you want the I/O applications or instrument drivers that you develop to be compliant with VXI*plug&play* standards. If you are using new instruments or are developing new I/O applications or instrument drivers, we recommend you use Agilent VISA.

Agilent Standard Instrument Control Library (SICL) is an I/O library developed by Hewlett-Packard and Agilent that is portable across many I/O interfaces and systems. You can use Agilent SICL if you have been using SICL and want to remain compatible with software currently implemented in SICL.

NOTE

Since VISA and SICL are different libraries, using VISA functions and SICL functions in the same I/O application is not supported.

VISA Support

Agilent VISA is an I/O library that can be used to develop I/O applications and instrument drivers that comply with the VXI*plug&play* standards. Applications and instrument drivers developed with VISA can execute on VXI*plug&play* system frameworks that have the VISA I/O layer. Therefore, software from different vendors can be used together on the same system.

VISA Support on Windows

This 32-bit version of VISA is supported on Windows 95, Windows 98, Windows NT, and Windows 2000. (Support for the 16-bit version of VISA was removed in version H.01.00 of the Agilent IO Libraries.) C, C++, and Visual Basic are supported on all these Windows versions.

For Windows, VISA is supported on the GPIB, VXI, GPIB-VXI, Serial (RS-232), and LAN interfaces. VISA for the VXI interface on Windows NT is shipped with the Agilent Embedded VXI Controller product only. LAN support from within VISA occurs via an address translation such that a GPIB interface can be accessed remotely over a computer network

VISA Support on HP-UX

VISA is supported on the GPIB, VXI, GPIB-VXI, and LAN interfaces on HP-UX version 10.20. LAN support from within VISA occurs via an address translation such that a GPIB interface can be accessed remotely over a computer network

VISA Users

VISA has two specific types of users. The first type is the instrumentation end user who wants to use VXI*plug&play* instrument drivers in his or her applications. The second type of user is the instrument driver or I/O application developer who wants to be compliant with VXI*plug&play* standards.

Software development using VISA is intended for instrument I/O and C/C++ or Visual Basic programmers who are familiar with the Windows 95, Windows 98, Windows 2000, Windows NT, or HP-UX environment. To perform VISA installation and configuration on Windows NT or HP-UX, you must have system administration privileges on the Windows NT system or super-user (`root`) privileges on the HP-UX system.

VISA Documentation

This table shows associated documentation you can use when programming with Agilent VISA in the Windows or HP-UX environment.

Agilent VISA Documentation

Document	Description
Agilent IO Libraries Installation and Configuration Guide for Windows	Shows how to install, configure, and maintain the Agilent IO Libraries on Windows.
Agilent IO Libraries Installation and Configuration Guide for HP-UX	Shows how to install, configure, and maintain the Agilent IO Libraries on HP-UX.
VISA Online Help	Information is provided in the form of Windows Help.
VISA Example Programs	Example programs are provided online to help you develop VISA applications.
VXI*plug&play* System Alliance *VISA Library Specification 4.3*	Specifications for VISA.
IEEE Standard Codes, Formats, Protocols, and Common Commands	ANSI/IEEE Standard 488.2-1992.
VXIbus Consortium specifications (when using VISA over LAN)	*TCP/IP Instrument Protocol Specification* - VXI-11, Rev. 1.0 *TCP/IP-VXIbus Interface Specification* - VXI-11.1, Rev. 1.0 *TCP/IP-IEEE 488.1 Interface Specification* - VXI-11.2, Rev. 1.0 *TCP/IP-IEEE 488.2 Instrument Interface Specification* - VXI-11.3, Rev. 1.0

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Building a VISA Application in Windows

Building a VISA Application in Windows

This chapter gives guidelines to build a VISA application in a Windows environment. The chapter contains the following sections:

- An Example VISA Program
- Compiling and Linking a VISA Program
- Logging Error Messages

An Example VISA Program

This section lists an example program called **idn** that queries a GPIB instrument for its identification string. This example assumes a Win32 Console Application using Microsoft or Borland C/C++ compilers on Windows.

For VISA on Windows 95 or Windows 98, the **idn** example files are in **\Program Files\VISA\WIN95\AGVISA\SAMPLES**. For VISA on Windows NT or Windows 2000, the **idn** example files are in **\Program Files\VISA\WINNT\AGVISA\SAMPLES**.

Example Source Code

The source file **idn.c** follows. An explanation of the various function calls in the example is provided directly after the program listing. If the program runs correctly, the following is an example of the output if connected to a 54601A oscilloscope. If the program does not run, see the **Event Viewer** for a list of run-time errors.

```
HEWLETT-PACKARD,54601A,0,1.7
```

```
/*idn.c
   This example program queries a GPIB device for an
   identification string and prints the results. Note
   that you must change the address. */

#include <visa.h>
#include <stdio.h>

void main () {

   ViSession defaultRM, vi;
   char buf [256] = {0};

   /* Open session to GPIB device at address 22 */
   viOpenDefaultRM(&defaultRM);
   viOpen(defaultRM, "GPIB0::22::INSTR",VI_NULL,VI_NULL, &vi);

   /* Initialize device */
   viPrintf(vi, "*RST\n");

   /* Send an *IDN? string to the device */
```

```
viPrintf(vi, "*IDN?\n");
/* Read results */
viScanf(vi, "%t", buf);

/* Print results */
printf("Instrument identification string: %s\n", buf);

/* Close session */
viClose(vi);
viClose(defaultRM);}
```

Example Program Contents

A summary of the VISA function calls used in the example program follows. For a more detailed explanation of VISA functionality, see *Chapter 4 - Programming with VISA.* See *Chapter 7 - VISA Language Reference* for more detailed information on these VISA function calls.

visa.h. This file is included at the beginning of the file to provide the function prototypes and constants defined by VISA.

ViSession. The **`ViSession`** is a VISA data type. Each object that will establish a communication channel must be defined as **`ViSession`.**

viOpenDefaultRM. You must first open a session with the default resource manager with the **`viOpenDefaultRM`** function. This function will initialize the default resource manager and return a pointer to that resource manager session.

viOpen. This function establishes a communication channel with the device specified. A session identifier that can be used with other VISA functions is returned. This call must be made for each device you will be using.

viPrintf and viScanf. These are the VISA formatted I/O functions that are patterned after those used in the C programming language. The **`viPrintf`** call sends the IEEE 488.2 **`*RST`** command to the instrument and puts it in a known state. The **`viPrintf`** call is used again to query for the device identification (**`*IDN?`**). The **`viScanf`** call is then used to read the results.

viClose. This function must be used to close each session. When you close a device session, all data structures that had been allocated for the session will be deallocated. When you close the default manager session, all sessions opened using that default manager session will be closed.

Compiling and Linking a VISA Program

This section provides a summary of important compiler-specific considerations for several C/C++ compiler products when developing Win32 applications.

Linking to VISA Libraries

Your application must link to one of the VISA import libraries as follows, assuming default installation directories.

- VISA on Windows 95 or Windows 98:

  `C:\Program Files\VISA\WIN95\LIB\MSC\VISA32.LIB`
  (Microsoft compilers)
  `C:\Program Files\VISA\WIN95\LIB\BC\VISA32.LIB`
  (Borland compilers)

- VISA on Windows NT or Windows 2000:

  `C:\Program Files\VISA\WINNT\LIB\MSC\VISA32.LIB`
  (Microsoft compilers)
  `C:\Program Files\VISA\WINNT\LIB\BC\VISA32.LIB`
  (Borland compilers)

Microsoft Visual C++ Version 6.0 Compilers

1. Select **`Project | Update All Dependencies`** from the menu.
2. Select **`Project | Settings`** from the menu.
   - ❑ Click the **`C/C++`** button.
   - ❑ Select **`Code Generation`** from the **`Category`** list box and select **`Multi-Threaded using DLL`** from the **`Use Run-Time Libraries`** list box. (VISA requires these definitions for Win32.)
   - ❑ Click **`OK`** to close the dialog boxes.

3. Select **Project | Settings** from the menu. Click the **Link** button and add **visa32.lib** to the **Object / Library Modules** list box. Optionally, you may add the library directly to your project file. Click **OK** to close the dialog boxes.

4. You may want to add the include file and library file search paths. They are set by:

   - Select **Tools | Options** from the menu.
   - Click the **Directories** button to set the include file path.
   - Select **Include Files** from the **Show Directories For** list box.
   - Click the **Add** button and type one of the following:
     C:\Program Files\VISA\WIN95\INCLUDE *OR*
     C:\Program Files\VISA\WINNT\INCLUDE.

5. Select **Library Files** from the **Show Directories For** list box.

6. Click the **Add** button and type one of the following:
   C:\Program Files\VISA\WIN95\LIB\MSC

   OR

   C:\Program Files\VISA\WINNT\LIB\MSC

Borland C++ Version 4.0 Compilers

You may want to add the include file and library file search paths. They are set under the **Options | Project** menu selection. Double-click **Directories** from the **Topics** list box and add one of the following:

C:\Program Files\VISA\WIN95\INCLUDE
C:\Program Files\VISA\WIN95\LIB\BC

OR

C:\Program Files\VISA\WINNT\INCLUDE
C:\Program Files\VISA\WINNT\LIB\BC

Logging Error Messages

When developing or debugging your VISA application, you may want to view internal VISA messages while your application is running. You can do this by using the **Message Viewer** utility (for Windows 95 or Windows 98), the **Event Viewer** utility (for Windows 2000 or Windows NT), or the **Debug Window** (for Windows 95/98/2000/NT). There are three choices for VISA logging:

- Off (default) for best performance
- Event Viewer/Message Viewer
- Debug Window

Using the Event Viewer

For Windows 2000 or Windows NT, the **Event Viewer** utility provides a way to view internal VISA error messages during application execution. Some of these internal messages do not represent programming errors and are actually error messages from VISA which are being handled internally by VISA. The process to use the **Event Viewer** is:

- Enable VISA logging from the **Agilent IO Libraries Control**, click **VISA Logging | Event Viewer**.
- Run your VISA program.
- View VISA error messages by running the **Event Viewer**. From the **Agilent IO Libraries Control**, click **Run Event Viewer**. VISA error messages will appear in the application log of the **Event Viewer** utility.

Using the Message Viewer

For Windows 95 or Windows 98, the **Message Viewer** utility provides a way to view internal VISA error messages during application execution. Some of these internal messages do not represent programming errors and are actually error messages from VISA which are being handled internally by VISA.

The **Message Viewer** utility must be run BEFORE you run your VISA application. However, the utility will receive messages while minimized. This utility also provides menu selections for saving the logged messages to a file and for clearing the message buffer. The process to use the **Message Viewer** is:

- Enable VISA logging from the **Agilent IO Libraries Control**, click **VISA Logging | Message Viewer**.
- Start the **Message Viewer**. From the **Agilent IO Libraries Control**, click **Run Message Viewer.**
- Run your VISA program.
- View error messages in the **Message Viewer** window.

Using the Debug Window

- When VISA logging is directed to the **Debug Window**, VISA writes logging messages using the Win32 API call OutputDebugString(). The most common use for this feature is when debugging your VISA program using
  an application such as Microsoft Visual Studio. In this case, VISA messages will appear in the Visual Studio output window. The process to use the **Debug Window** is:
- Enable VISA logging from the **Agilent IO Libraries Control**. Click **VISA Logging | Debug Window**.
- Run your VISA program from Microsoft Visual Studio (or equivalent application).
- View error messages in the Visual Studio (or equivalent) output window.

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Building a VISA Application in HP-UX

Building a VISA Application in HP-UX

This chapter gives guidelines to build a VISA application on HP-UX version 10.20 or later. The chapter contains the following sections:

- An Example VISA Program
- Compiling and Linking a VISA Program
- Logging Error Messages
- Using Online Help

An Example VISA Program

This section lists and example program called `idn` that queries a GPIB instrument for its identification string. The **`idn`** example program is located in the following subdirectory:

`opt/vxipnp/hpux/hpvisa/share/examples`

Example Source Code

The source file `idn.c` follows. An explanation of the various function calls in the example is provided directly after the program listing.

```
/*idn.c
   This program queries a GPIB device for an ID string and prints
   the results. Note that you must change the address. */

   #include <visa.h>
   #include <stdio.h>

void main () {

   ViSession defaultRM, vi;
   char buf [256] = {0};

   /* Open session to GPIB device at address 22 */
   viOpenDefaultRM(&defaultRM);
   viOpen(defaultRM, "GPIB0::24::INSTR", VI_NULL,VI_NULL, &vi);

   /* Initialize device */
   viPrintf(vi, "*RST\n");

   /* Send an *IDN? string to the device */
   viPrintf(vi, "*IDN?\n");

/* Read results */
   viScanf(vi, "%t", buf);

   /* Print results */
   printf ("Instrument identification string: %s\n", buf);

   /* Close sessions */
   viClose(vi);
   viClose(defaultRM);
}
```

Example Program Contents

A summary of the VISA function calls used in the example program follows. For a more detailed explanation of VISA functionality, see *Chapter 4 - Programming with VISA.* See *Chapter 7 - VISA Language Reference* for more detailed information on these VISA calls.

visa.h. This file is included at the beginning of the file to provide the function prototypes and constants defined by VISA.

ViSession. The **`ViSession`** is a VISA data type. Each object that will establish a communication channel must be defined as **`ViSession`.**

viOpenDefaultRM. You must first open a session with the default resource manager with the **`viOpenDefaultRM`** function. This function will initialize the default resource manager and return a pointer to that resource manager session.

viOpen. This function establishes a communication channel with the device specified. A session identifier that can be used with other VISA functions is returned. This call must be made for each device you will be using.

viPrintf and viScanf. These are the VISA formatted I/O functions that are patterned after those used in the C programming language. The **`viPrintf`** call sends the IEEE 488.2 **`*RST`** command to the instrument and puts it in a known state. The **`viPrintf`** call is used again to query for the device identification (**`*IDN?`**). The **`viScanf`** call is then used to read the results.

viClose. This function must be used to close each session. When you close a device session, all data structures that had been allocated for the session will be deallocated. When you close the default manager session, all sessions opened using that default manager session will be closed.

Running the Example Program

To run the **idn** example program, type the program name at the command prompt. For example:

```
idn
```

If the program run correctly, the following is an example of the output if connected to a 54601A oscilloscope:

```
Hewlett-Packard,54601A,0,1.7
```

If you have problems running the `idn` example program, first check to make sure the device address specified in your program is correct. If the program still does not run, check the I/O configuration. See the *Agilent I/O Libraries Installation and Configuration Guide for HP-UX* for information on I/O configuration.

Compiling and Linking a VISA Program

You can create your VISA applications in ANSI C or C++. When compiling and linking a C program that uses VISA, use the **-lvisa** command line option to link in the VISA library routines. The following example creates the **idn** executable file:

```
cc -Aa -o idn idn.c -lvisa
```

- The **-Aa** option indicates ANSI C
- The **-o** option creates an executable file called **idn**
- The **-l** option links in the VISA library

Logging Error Messages

To view any VISA internal errors that may occur on HP-UX, edit the **/etc/opt/vxipnp/hpux/hpvisa/hpvisa.ini** file. Change the `ErrorLog=` line in this file to the following:

```
ErrorLog=true
```

The error messages, if any, will be then be printed to **stderr**.

Using Online Help

Online help for VISA on HP-UX is provided with Bristol Technology's HyperHelp Viewer, or in the form of HP-UX manual pages (**man** pages), as explained in the following subsections.

Using the HyperHelp Viewer

The Bristol Technology HyperHelp Viewer allows you to view the VISA functions online. To start the HyperHelp Viewer with the VISA help file, type:

```
hyperhelp/opt/hyperhelp/visahelp.hlp
```

When you start the Viewer, you can also specify any of the following options

-k *keyword*	Opens the Viewer and searches for the specified *keyword*.
-p *partial_keyword*	Opens the Viewer and searches for a specific *partial keyword*.
-s *viewmode*	Opens the Viewer in the specified *viewmode*. If **1** is specified as the *viewmode*, the Viewer is shared by all applications. If **0** is specified, a separate Viewer is opened for each application (default).
-display *display*	Opens the Viewer on the specified *display.*

Using HP-UX Manual Pages

To use manual pages, type the HP-UX **man** command followed by the VISA function name:

man *function*

The following are examples of selecting online help on VISA functions:

```
man viPrintf
man viScanf
man viPeek
```

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Programming with VISA

Programming with VISA

This chapter describes how to program with VISA. The basics of VISA are described, including formatted I/O, events and handlers, attributes, and locking. Example programs are also provided and can be found in the **`SAMPLES`** subdirectory on Windows environments, or in the **`examples`** subdirectory on HP-UX.

See *Appendix A - VISA System Information* for the specific location of the example programs on your operating system. For specific details on VISA functions, see *Chapter 7 - VISA Language Reference*.This chapter contains the following sections:

- Using Device Sessions
- Sending I/O Commands
- Using VISA Attributes
- Using Events and Handlers
- Trapping Errors and Using Locks

Using Device Sessions

This section shows how to use VISA device sessions, including:

- Including the VISA Declarations File
- Opening a Device Session
- Addressing a Device Session
- Closing a Device Session
- Searching for Resources

Including the VISA Declarations File

For C and C++ programs, you must include the **`visa.h`** header file at the beginning of every file that contains VISA function calls:

```
#include "visa.h"
```

This header file contains the VISA function prototypes and the definitions for all VISA constants and error codes. The **`visa.h`** header file also includes the **`visatype.h`** header file.

The **`visatype.h`** header file defines most of the VISA types. The VISA types are used throughout VISA to specify data types used in the functions. For example, the **`viOpenDefaultRM`** function requires a pointer to a parameter of type **`ViSession`**. If you find **`ViSession`** in the **`visatype.h`** header file, you will find that **`ViSession`** is eventually typed as an unsigned long. VISA types are also listed in *Appendix D - VISA Type Definitions*.

Opening a Device Session

A session is a channel of communication. Sessions must first be opened on the default resource manager, and then for each device you will be using. The following is a summary of sessions that can be opened:

- A **resource manager session** is used to initialize the VISA system. It is a parent session that knows about all the opened sessions. A resource manager session must be opened before any other session can be opened.

- A **device session** is used to communicate with a device on an interface. A device session must be opened for each device you will be using. When you use a device session you can communicate without worrying about the type of interface to which it is connected.

This insulation makes applications more robust and portable across interfaces. Typically a device is an instrument, but the device could be a computer, a plotter, or a printer.

NOTE

All devices used must be connected and operational prior to the first VISA function call (**`viOpenDefaultRM`**). The system is configured only on the *first* **`viOpenDefaultRM`** per process.

Therefore, if **`viOpenDefaultRM`** is called without devices connected and then called again when devices are connected, the devices will not be recognized. You must close **ALL** Resource Manager sessions and reopen with all devices connected and operational.

Resource Manager Sessions

There are two parts to opening a communications session with a specific device. First you must open a session to the default resource manager with the **`viOpenDefaultRM`** function. The first call to this function initializes the default resource manager and returns a session to that resource manager session. You only need to open the default manager session once. However, subsequent calls to **`viOpenDefaultRM`** returns a unique session to the same default resource manager resource.

Device Sessions

Next, you open a session with a specific device with the **`viOpen`** function. This function uses the session returned from **`viOpenDefaultRM`** and returns its own session to identify the device session. The following shows the function syntax:

`viOpenDefaultRM(`*sesn***`);`**
`viOpen(`*sesn***`,` *rsrcName*`,` *accessMode*`,` *timeout*`,` *vi*`);`**

The session returned from **`viOpenDefaultRM`** must be used in the *sesn* parameter of the **`viOpen`** function. The **`viOpen`** function then uses that session and the device address specified in the *rsrcName* parameter to open a device session. The *vi* parameter in **`viOpen`** returns a session identifier that can be used with other VISA functions.

Your program may have several sessions open at the same time by creating multiple session identifiers by calling the **`viOpen`** function multiple times. The following table summarizes the parameters in the previous function calls.

Parameter	Description
sesn	This is a session returned from the **viOpenDefaultRM** function that identifies the resource manager session.
rsrcName	This is a unique symbolic name of the device (device address).
accessMode	This parameter is not used for VISA 1.0. Use **VI_NULL**.
timeout	This parameter is not used for VISA 1.0. Use **VI_NULL**.
vi	This is a pointer to the session identifier for this particular device session. This pointer will be used to identify this device session when using other VISA functions.

Example: Opening a Device Session

This example shows one way of opening device sessions with a GPIB multimeter and a GPIB-VXI scanner. The example first opens a session with the default resource manager. The session returned from the resource manager and a device address is then used to open a session with the GPIB device at address 22. That session will now be identified as **dmm** when using other VISA functions.

The session returned from the resource manager is then used again with another device address to open a session with the GPIB-VXI device at primary address 9 and VXI logical address 24. That session will now be identified as **scanner** when using other VISA functions. See "Addressing a Device Session" for information on addressing particular devices.

```
ViSession defaultRM, dmm, scanner;
.
.
viOpenDefaultRM(&defaultRM);
viOpen(defaultRM, "GPIB0::22::INSTR", VI_NULL, VI_NULL,&dmm);
viOpen(defaultRM, "GPIB-VXI0::24::INSTR", VI_NULL, VI_NULL,&scanner);
.
.
viClose(scanner);
viClose(dmm);
viClose(defaultRM);
```

Addressing a Device Session

As shown in the previous section, the *rsrcName* parameter in the **viOpen** function is used to identify a specific device. This parameter consists of the VISA interface name and the device address. The interface name is determined when you run the VISA configuration utility. This name is usually the interface type followed by a number.

The following table illustrates the format of the *rsrcName* for different interface types. **INSTR** is an optional parameter that indicates that you are communicating with a resource that is of type **INSTR**, meaning instrument. For compatibility with future releases of VISA, you must include the **INSTR** parameter in the syntax.

Interface	Syntax
VXI	VXI[*board*]::*VXI logical address*[::INSTR]
GPIB-VXI	GPIB-VXI[*board*]::*VXI logical address*[::INSTR]
GPIB	GPIB[*board*]::*primary address*[::*secondary address*][::INSTR]
ASRL	ASRL[*board*][::INSTR]

The following table describes the parameters used above.

Parameter	Description
board	This optional parameter is used if you have more than one interface of the same type. The default value for *board* is 0.
VXI logical address	This is the logical address of the VXI instrument.
primary address	This is the primary address of the GPIB device.
secondary address	This optional parameter is the secondary address of the GPIB device. If no secondary address is specified, none is assumed.

Some examples of valid symbolic names follow.

Name	Description
VXI0::24::INSTR	Device at VXI logical address 24 that is of VISA type INSTR.
VXI2::128	Device at VXI logical address 128, in the third VXI system (VXI2).
GPIB-VXI0::24	A VXI device at logical address 24. This VXI device is connected via a GPIB-VXI command module.
GPIB0::7::0	A GPIB device at primary address 7 and secondary address 0 on the GPIB interface.
ASRL1::INSTR	A serial device located on port 1 that is of VISA type INSTR.

Example: Opening a Device Session

This example shows one way to open a device session with the GPIB device at primary address 23.

```
ViSession defaultRM, vi;
.
.
viOpenDefaultRM(&defaultRM);
viOpen(defaultRM, "GPIB0::23::INSTR", VI_NULL, VI_NULL,&vi);
.
.
viClose(vi);
viClose(defaultRM);
```

Closing a Device Session

The **viClose** function must be used to close each session. You can close the specific device session, which will free all data structures that had been allocated for the session. If you close the default resource manager session, all sessions opened using that resource manager session will be closed.

Since system resources are also used when searching for resources (**viFindRsrc**), the **viClose** function needs to be called to free up find lists. See "Searching for Resources" for more information on closing find lists.

Searching for Resources

When you open the default resource manager, you are opening a parent session that knows about all the other resources in the system. Since the resource manager session knows about all resources, it has the ability to search for specific resources and open sessions to these resources. You can, for example, search an interface for devices and open a session with one of the devices found.

Use the **viFindRsrc** function to search an interface for device resources. This function finds matches and returns the number of matches found and a handle to the resources found. If there are more matches, use the **viFindNext** function with the handle returned from **viFindRsrc** to get the next match:

```
viFindRsrc(sesn, expr, findList, retcnt, instrDesc);
.
.
viFindNext(findList, instrDesc);
.
.
viClose(findList);
```

Where the parameters are defined as follows.

Parameter	Description
sesn	The resource manager session.
expr	The expression that identifies what to search (see table that follows).
findList	A handle that identifies this search. This handle will then be used as an input to the **viFindNext** function when finding the next match.

retcnt	A pointer to the number of matches found.
instrDesc	A pointer to a string identifying the location of the match. Note that you must allocate storage for this string.

The handler returned from **viFindRsrc** should be closed to free up all the system resources associated with the search. To close the find object, pass the *findList* to the **viClose** function.

Use the *expr* parameter of the **viFindRsrc** function to specify the interface to search. You can search for devices on the specified interface. Use the following table to determine what to use for your *expr* parameter.

NOTE

Because VISA interprets strings as regular expressions, the string **GPIB?*INSTR** applies to *both* GPIB and GPIB-VXI devices.

Interface	*expr* Parameter
GPIB	**GPIB[0-9]*::?*INSTR**
VXI	**VXI?*INSTR**
GPIB-VXI	**GPIB-VXI?*INSTR**
GPIB and GPIB-VXI	**GPIB?*INSTR**
All VXI	**?*VXI[0-9]*::?*INSTR**
ASRL	**ASRL[0-9]*::?*INSTR**
All	**?*INSTR**

Example: Searching VXI Interface for Devices

This example searches the VXI interface for devices. The number of matches found is returned in **nmatches**, and **matches** points to the string that contains the matches found. The first call returns the first match found, the second call returns the second match found, etc. Note that **VI_FIND_BUFLEN** is defined in the **visa.h** declarations file.

```
ViChar buffer [VI_FIND_BUFLEN];
ViRsrc matches=buffer;
ViUInt32 nmatches;
ViFindList list;
.
.
```

```
viFindRsrc(defaultRM, "VXI?*INSTR", &list, &nmatches,
matches);
.
.
.
viFindNext(list, matches);
.
.
viClose(list);
```

Sending I/O Commands

This section gives guidelines to send I/O commands, including:

- Types of I/O
- Using Formatted I/O
- Using Non-Formatted I/O

Types of I/O

Once you have established a communications session with a device, you can start communicating with that device using VISA's I/O routines. VISA provides both formatted and non-formatted I/O routines.

- **Formatted I/O** converts mixed types of data under the control of a format string. The data is buffered, thus optimizing interface traffic.

- **Non-formatted I/O** sends or receives raw data to or from a device. With non-formatted I/O, no format or conversion of the data is performed. Thus, if formatted data is required, it must be done by the user.

You can choose between VISA's formatted and non-formatted I/O routines. However, since the non-formatted I/O performs the low-level I/O, you should not mix formatted I/O and non-formatted I/O in the same session. See the following sections for descriptions and examples using formatted I/O and non-formatted I/O in VISA.

Using Formatted I/O

The VISA formatted I/O mechanism is similar to the C **`stdio`** mechanism. The VISA formatted I/O functions are **`viPrintf`**, **`viQueryf`**, and **`viScanf`**. There are also two non-buffered and non-formatted I/O functions that synchronously transfer data, called **`viRead`** and **`viWrite`** and two that asynchronously transfer data, called **`viReadAsync`** and **`viWriteAsync`**.

These are raw I/O functions and do not intermix with the formatted I/O functions. See "Non-Formatted I/O" in this chapter. See *Chapter 7 - VISA Language Reference* for more information on how data is converted under the control of the format string.

Formatted I/O Functions

As noted, the VISA formatted I/O functions are **`viPrintf`**, **`viQueryf`**, and **`viScanf`**.

- The **`viPrintf`** functions format according to the format string and send data to a device. The **`viPrintf`** function sends separate *arg* parameters, while the **`viVPrintf`** function sends a list of parameters in *params*:

  `viPrintf(`*vi, writeFmt[, arg1][, arg2][, ...]***`);`**
  `viVPrintf(`*vi, writeFmt, params***`);`**

- The **`viScanf`** functions receive and convert data according to the format string. The **`viScanf`** function receives separate *arg* parameters, while the **`viVScanf`** function receives a list of parameters in *params*:

  `viScanf(`*vi, readFmt[, arg1][, arg2][, ...]***`);`**
  `viVScanf(`*vi, readFmt, params***`);`**

- The **`viQueryf`** functions format and send data to a device and then immediately receive and convert the response data. Hence, the **`viQueryf`** function is a combination of the **`viPrintf`** and **`viScanf`** functions. Similarly, the **`viVQueryf`** function is a combination of the **`viVPrintf`** and **`viVScanf`** functions. The **`viQueryf`** function sends and receives separate *arg* parameters, while the **`viVQueryf`** function sends and receives a list of parameters in *params*:

  `viQueryf(`*vi, writeFmt, readFmt[, arg1][, arg2][, ...]***`);`**
  `viVQueryf(`*vi, writeFmt, readFmt, params***`);`**

Formatted I/O Conversion

The formatted I/O functions convert data under the control of the format string. The format string specifies how the argument is converted before it is input or output. The format specifier sequence consists of a **%** (percent) followed by an optional modifier(s), followed by a conversion character.

%[*modifiers*]*conversion character*

Zero or more modifiers may be used to change the meaning of the conversion character. Modifiers are only used when sending or receiving formatted I/O. To send formatted I/O, the asterisk (*****) can be used to indicate that the number is taken from the next argument.

However, when the asterisk is used when receiving formatted I/O, it indicates that the assignment is suppressed and the parameter is discarded. Use the pound sign (**#**) when receiving formatted I/O to indicate that an extra argument is used. The following are supported modifiers. See the **viPrintf** function in *Chapter 7 - VISA Language Reference* for additional enhanced modifiers (**@1, @2, @3, @H, @Q**, or **@B**).

- **Field Width.** Field width is an optional integer that specifies how many characters are in the field. If the **viPrintf** or **viQueryf** (*writeFmt*) formatted data has fewer characters than specified in the field width, it will be padded on the left, or on the right if the **– flag** is present.

  You can use an asterisk (*****) in place of the integer in **viPrintf** or **viQueryf** (*writeFmt*) to indicate that the integer is taken from the next argument. For the **viScanf** or **viQueryf** (*readFmt*) functions, you can use a **#** sign to indicate that the next argument is a reference to the field width.

  The field width modifier is only supported with **viPrintf** and **viQueryf** (*writeFmt*) conversion characters **d, f, s**, and **viScanf** and **viQueryf** (*readFmt*) conversion characters **c**, **s**, and **[]**.

  Example: Using Field Width Modifier

  The following example pads **numb** to six characters and sends it to the session specified by *vi*:

  ```
  int numb = 61;
  viPrintf(vi, "%6d\n", numb);
  ```

  Inserts four spaces, for a total of 6 characters: **61**

- **.Precision.** Precision is an optional integer preceded by a period. This modifier is only used with the **viPrintf** and **viQueryf** (*writeFmt*) functions. The meaning of this argument is dependent on the conversion character used. You can use an asterisk (*****) in place of the integer to indicate the integer is taken from the next argument.

Conversion Character	Description
d	Indicates the minimum number of digits to appear is specified for the **@1, @H, @Q,** and **@B** flags, and the **i, o, u, x,** and **X** conversion characters.
f	Indicates the maximum number of digits after the decimal point is specified.
s	Indicates the maximum number of characters for the string is specified.
g	Indicates the maximum significant digits are specified.

Example: Using the Precision Modifier

This example converts **numb** so that there are only two digits to the right of the decimal point and sends it to the session specified by *vi*:

```
float numb = 26.9345;
viPrintf(vi, "%.2f\n", numb);
```

Sends : **26.93**

- **Argument Length Modifier**. The meaning of the optional argument length modifier **h, l, L, z'** or **Z** is dependent on the conversion character, as listed in the following table. Note that **z** and **Z** are not ANSI C standard modifiers.

Argument Length Modifier	Conversion Character	Description
h	**d, b, B**	Corresponding argument is a short integer or a reference to a short integer for **d**. For **b** or **B**, the argument is the location of a block of data or a reference to a data array. (**B** is only used with **viPrintf** or **viQueryf** (writeFmt).)

Argument Length Modifier	Conversion Character	Description
l	**d, f,** **b, B**	Corresponding argument is a long integer or a reference to a long integer for **d**. For **f**, the argument is a double float or a reference to a double float. For b or B, the argument is the location of a block of data or a reference to a data array. (**B** is only used with **viPrintf** or **viQueryf** (writeFmt).)
L	**f**	Corresponding argument is a long double or a reference to a long double.
z	**b, B**	Corresponding argument is an array of floats or a reference to an array of floats. (**B** is only used with **viPrintf** or **viQueryf** (writeFmt).)
Z	**b, B**	Corresponding argument is an array of double floats or a reference to an array of double floats. (**B** is only used with **viPrintf** or **viQueryf** (writeFmt).)

- **, Array Size**. The comma operator is a format modifier that allows you to read or write a comma-separated list of numbers (only valid with **%d** and **%f** conversion characters). It is a comma followed by an integer. The integer indicates the number of elements in the array. The comma operator has the format of **,***dd* where *dd* is the number of elements to read or write.

  For **viPrintf** or **viQueryf** (*writeFmt*), you can use an asterisk (*****) in place of the integer to indicate that the integer is taken from the next argument. For **viScanf** or **viQueryf** (*readFmt*), you can use a # sign to indicate that the next argument is a reference to the array size.

  Example: Using Array Size Modifier

  This example specifies a comma-separated list to be sent to the session specified by *vi*:

  ```
  int list[5]={101,102,103,104,105};
  viPrintf(vi, "%,5d\n", list);
  ```

  Sends: **101,102,103,104,105**

- **Special Characters**. Special formatting character sequences will send special characters. The following describes the special characters and what will be sent.

  The format string for **`viPrintf`** and **`viQueryf`** (*writeFmt*) puts a special meaning on the newline character (**`\n`**). The newline character in the format string flushes the output buffer to the device. All characters in the output buffer will be written to the device with an END indicator included with the last byte (the newline character).

  This means you can control at what point you want the data written to the device. If no newline character is included in the format string, the characters converted are stored in the output buffer. It will require another call to **`viPrintf`**, **`viQueryf`** (*writeFmt*), or **`viFlush`** to have those characters written to the device.

  This can be very useful in queuing up data to send to a device. It can also raise I/O performance by doing a few large writes instead of several smaller writes. The **`*`** while using the **`viScanf`** functions acts as an assignment suppression character. The input is not assigned to any parameters and is discarded.

Special Character	Description
`\n`	Sends the ASCII line feed character. The END identifier will also be sent.
`\r`	Sends an ASCII carriage return character.
`\t`	Sends an ASCII TAB character.
`\###`	Sends ASCII character specified by octal value.
`\"`	Sends the ASCII double quote character.
`\\`	Sends a backslash character.

Conversion Characters. This table summarizes the conversion characters for sending and receiving formatted I/O.

Conversion Character	Description
viPrintf/viVPrintf and viQueryf/viVqueryf (*writeFmt*)	
d, i	Corresponding argument is an integer.
f	Corresponding argument is a double.
c	Corresponding argument is a character.
s	Corresponding argument is a pointer to a null terminated string.
%	Sends an ASCII percent (**%**) character.
o, u, x, X	Corresponding argument is an unsigned integer.
e, E, g, G	Corresponding argument is a double.
n	Corresponding argument is a pointer to an integer.
b, B	Corresponding argument is the location of a block of data.
viPrintf/viVPrintf and viQueryf/viVqueryf (*readFmt*)	
d,i,n	Corresponding argument must be a pointer to an integer.
e,f,g	Corresponding argument must be a pointer to a float.
c	Corresponding argument is a pointer to a character sequence.
s,t,T	Corresponding argument is a pointer to a string.
o,u,x	Corresponding argument must be a pointer to an unsigned integer.
[	Corresponding argument must be a character pointer.
b	Corresponding argument is a pointer to a data array.

Example: Receiving Data From a Session

This example receives data from the session specified by the *vi* parameter and converts the data to a string.

```
char data[180];
viScanf(vi, "%t", data);
```

Formatted I/O Buffers

The VISA software maintains both a read and write buffer for formatted I/O operations. Occasionally, you may want to control the actions of these buffers. You can modify the size of the buffer using the **viSetBuf** function. See *Chapter 7 - VISA Language Reference* for more information on this function.

The write buffer is maintained by the **viPrintf** or **viQueryf** (*writeFmt*) functions. The buffer queues characters to send to the device so that they are sent in large blocks, thus increasing performance. The write buffer automatically flushes when it sends a newline character from the format string. It may occasionally be flushed at other non-deterministic times, such as when the buffer fills.

When the write buffer flushes, it sends its contents to the device. If you set the **VI_ATTR_WR_BUF_OPER_MODE** attribute to **VI_FLUSH_ON_ACCESS**, the write buffer will also be flushed every time a **viPrintf** or **viQueryf** operation completes. See "Using VISA Attributes" in this chapter for information on setting VISA attributes.

The read buffer is maintained by the **viScanf** and **viQueryf** (*readFmt*) functions. It queues the data received from a device until it is needed by the format string. Flushing the read buffer destroys the data in the buffer and guarantees that the next call to **viScanf** or **viQueryf** reads data directly from the device rather than data that was previously queued.

If you set the **VI_ATTR_RD_BUF_OPER_MODE** attribute to **VI_FLUSH_ON_ACCESS**, the read buffer will be flushed every time a **viScanf** or **viQueryf** operation completes. See "Using VISA Attributes" in this chapter for information on setting VISA attributes.

You can manually flush the read and write buffers using the **viFlush** function. Flushing the read buffer also includes reading all pending response data from a device. If the device is still sending data, the flush process will continue to read data from the device until it receives an **END** indicator from the device.

Example: Sending and Receiving Formatted I/O

This C program example shows sending and receiving formatted I/O. The example opens a session with a GPIB device and sends a comma operator to send a comma-separated list. This example program is intended to show specific VISA functionality and does not include error trapping. Error trapping, however, is good programming practice and is recommended in your VISA applications. See "Trapping Errors" in this chapter.

This example program is installed on your system in the **SAMPLES** subdirectory on Windows environments, or in the **examples** subdirectory on HP-UX. See *Appendix A - VISA System Information* for locations of example programs on your operating system.

```
/*formatio.c
   This example program makes a multimeter measurement
   with a comma-separated list passed with formatted
   I/O and prints the results. Note that you must change
   the device address. */

#include <visa.h>
#include <stdio.h>

void main () {

   ViSession defaultRM, vi;
   double res;
   double list [2] = {1,0.001};

   /* Open session to GPIB device at address 22 */
   viOpenDefaultRM(&efaultRM);
   viOpen(defaultRM, "GPIB0::22::INSTR", VI_NULL,VI_NULL, &vi);

   /* Initialize device */
   viPrintf(vi, "*RST\n");

   /* Set up device and send comma separated list */
   viPrintf(vi, "CALC:DBM:REF 50\n");
   viPrintf(vi, "MEAS:VOLT:AC? %,2f\n", list);
   /* Read results */
   viScanf(vi, "%lf", &res);

   /* Print results */
   printf("Measurement Results: %lf\n", res);
   /* Close session */
   viClose(vi);
   viClose(defaultRM);}
```

Using Non-Formatted I/O

There are two non-buffered, non-formatted I/O functions that synchronously transfer data called **viRead** and **viWrite**. Also, there are two non-formatted I/O functions that asynchronously transfer data called **viReadAsync** and **viWriteAsync**. These are raw I/O functions and do not intermix with the formatted I/O functions.

Non-Formatted I/O Functions

The non-formatted I/O functions follow. For more information, see the **viRead**, **viWrite**, **viReadAsync**, **viWriteAsync**, and **viTerminate** functions in *Chapter 7 - VISA Language Reference.*

- **viRead.** The **viRead** function synchronously reads raw data from the session specified by the *vi* parameter and stores the results in the location where *buf* is pointing. Only one synchronous read operation can occur at any one time.

  viRead(*vi, buf, count, retCount***);**

- **viWrite.** The **viWrite** function synchronously sends the data pointed to by *buf* to the device specified by *vi*. Only one synchronous write operation can occur at any one time.

  viWrite(*vi, buf, count, retCount***);**

- **viReadAsync.** The **viReadAsync** function asynchronously reads raw data from the session specified by the *vi* parameter and stores the results in the location where *buf* is pointing. This operation normally returns before the transfer terminates. Thus, the operation returns *jobId*, which you can use with either **viTerminate** to abort the operation or with an I/O completion event to identify which asynchronous read operation completed.

  viReadAsync(*vi, buf, count, jobId***);**

- **viWriteAsync.** The **viWriteAsync** function asynchronously sends the data pointed to by *buf* to the device specified by *vi*. This operation normally returns before the transfer terminates. Thus, the operation returns *jobId*, which you can use with either **viTerminate** to abort the operation or with anI/O completion event to identify which asynchronous write operation completed.

  viWriteAsync(*vi, buf, count, jobId***);**

Example: Using Non-Formatted I/O Functions

This example program illustrates using non-formatted I/O functions to communicate with a GPIB device. This example program is intended to show specific VISA functionality and does not include error trapping. Error trapping, however, is good programming practice and is recommended in your VISA applications. See "Trapping Errors" in this chapter.

```
/*nonfmtio.c
   This example program measures the AC voltage on a
   multimeter and prints the results. Note that you must
   change the device address. */

#include <visa.h>
#include <stdio.h>

void main () {

   ViSession defaultRM, vi;
   char strres [20];
   unsigned long actual;

   /* Open session to GPIB device at address 22 */
   viOpenDefaultRM(&defaultRM);
   viOpen(defaultRM, "GPIB0::22::INSTR", VI_NULL,VI_NULL,
   &vi);

   /* Initialize device */
   viWrite(vi, (ViBuf)"*RST\n", 5, &actual);

   /* Set up device and take measurement */
   viWrite(vi, (ViBuf)"CALC:DBM:REF 50\n", 16, &actual);
   viWrite(vi, (ViBuf)"MEAS:VOLT:AC? 1, 0.001\n", 23,
   &actual);

   /* Read results */
   viRead(vi, (ViBuf)strres, 20, &actual);

   /* NULL terminate the string */
   strres[actual]=0;

   /* Print results */
   printf("Measurement Results: %s\n", strres);

   /* Close session */
   viClose(vi);
   viClose(defaultRM);
}
```

Using VISA Attributes

This section gives guidelines to use VISA attributes, including:

- What are VISA Attributes?
- VISA Resource Attributes
- VISA Generic Instrument Attributes
- VISA Interface-Specific Instrument Attributes
- VISA Event Attributes

What are VISA Attributes?

Attributes are associated with resources or sessions. You can use attributes to determine the state of a resource or session or to set a resource or session to a specified state.

Use the **`viGetAttribute`** function to read the state of an attribute for a specified session, event context, or find list. There are read only (RO) and read/write (RW) attributes. Use the **`viSetAttribute`** function to modify the state of a read/write attribute for a specified session, event context, or find list.

The pointer passed to **`viGetAttribute`** must point to the exact type required for that attribute: **`ViUInt16`**, **`ViInt32`**, etc. For example, when reading an attribute state that returns a **`ViUInt16`**, you must declare a variable of that type and use it for the returned data. If **`ViString`** is returned, you must allocate an array and pass a pointer to that array for the returned data.

VISA attributes are described in the following subsections. For programming information on attributes, such as attribute types and ranges, see *Appendix B - VISA Attributes*.

Example: Reading a VISA Attribute

This example reads the state of the **`VI_ATTR_TERMCHAR_EN`** attribute and changes it if it is not true.

```
ViBoolean state, newstate;
newstate=VI_TRUE;
.
.
viGetAttribute(vi, VI_ATTR_TERMCHAR_EN, &state);
if (state err !=VI_TRUE) viSetAttribute(vi,
   VI_ATTR_TERMCHAR_EN, newstate);
```

VISA Resource Attributes

The VISA resource attributes are primarily used to return information about the VISA version implemented and its manufacturer. Information can also be obtained about the current resource manager session, as well as the locking state of a resource.

Attribute	Description
VI_ATTR_MAX_QUEUE_LENGTH	Specifies the maximum number of events that can be queued.
VI_ATTR_RM_SESSION	Returns the session of the resource manager that was used to open this session.
VI_ATTR_RSRC_IMPL_VERSION	Returns the resource identification.
VI_ATR_RSRC_LOCK_STATE	Returns the current locking state of the resource.
VI_ATTR_RSRC_MANF_ID	Returns the VXI manufacturer's identification of the manufacturer that created the implementation.
VI_ATTR_RSRC_MANF_NAME	Returns the VXI manufacturer's name of the manufacturer that created the implementation.
VI_ATTR_RSRC_NAME	Returns the identifier of the resource compliant with the address specified.
VI_ATTR_RSRC_SPEC_VERSION	Returns the VISA version.
VI_ATTR_USER_DATA	This is a place for you to store your own data.

VISA Generic Instrument Attributes

The following are generic attributes that can be called on sessions. These attributes determine such things as when a buffer is flushed, timeout values, and the type of interface the device is on.

Attribute	Description
VI_ATTR_INTF_NUM	Returns the board number of the specified interface.
VI_ATTR_INTF_TYPE	Returns the interface type for the specified session.
VI_ATTR_INTF_INST_NAME	Human-readable text describing the interface.
VI_ATTR_IO_PROT	For VXI, specifies if you use normal word serial or fast data channel (FDC) protocol. For GPIB, only normal data transfers are accepted.
VI_ATTR_RD_BUF_OPER_MODE	Determines when the read buffer is flushed.
VI_ATTR_SEND_END_EN	Specifies whether the END is asserted during the transfer of the last byte of the buffer during a **ViWrite** only.
VI_ATTR_SUPPRESS_END_EN	Specifies whether the END is suppressed during a **ViRead** only.
VI_ATTR_TERMCHAR	Specifies if the termination character is to be used. When **VI_ATTR_TERMCHAR_EN** is enabled and the termination character is read, the read operation will terminate.
VI_ATTR_TERMCHAR_EN	Determines if the read operation will terminate when a termination character is received.
VI_ATTR_TMO_VALUE	Specifies a timeout value.
VI_ATTR_TRIG_ID	Specifies the current trigger line.
VI_ATTR_WR_BUF_OPER_MODE	Determines when the write buffer is flushed.

VISA Interface-Specific Instrument Attributes

The interface-specific attributes provide information about an interface or a device on an interface. The attributes are listed by interface type.

GPIB and GPIB-VXI Interfaces	
VI_ATTR_GPIB_PRIMARY_ADDR	Returns the primary address of the GPIB device for the specified session.
VI_ATTR_GPIB_SECONDARY_ADDR	Returns the secondary address of the GPIB device for the specified session.
VI_ATTR_GPIB_READDR_EN	Specified whether to use repeat addressing before each read or write operation.
VI_ATTR_GPIB_UNADDR_EN	Specifies whether to unaddress the device (UNT and UNL) after each read or write operation.

VXI and GPIB-VXI Interfaces	
VI_ATTR_CMDR_LA'	Returns the logical address of the commander of the VXI device in the specified session.
VI_ATTR_DEST_INCREMENT	Specifies how much the destination offset is to be incremented after every transfer in the **viMoveOut***XX* function. If set to 0, the **viMoveOut**XX function will always write to the same element, essentially treating the destination as a FIFO register.
VI_ATTR_FDC_CHNL	Determines which fast data channel (FDC) will be used to transfer the buffer.
VI_ATTR_FDC_GEN_SIGNAL_EN	Setting this attribute to **VI_TRUE** lets the servant send a signal when control of the FDC channel is passed back to the commander. This action frees the commander from having to poll the FDC header while engaging in an FDC transfer.

VXI and GPIB-VXI Interfaces (cont'd)	
VI_ATTR_FDC_MODE	Determines which FDC mode to use (Normal or Stream mode).
VI_ATTR_FDC_USE_PAIR	If set to **VI_TRUE**, a channel pair will be used for transferring data. Otherwise, only one channel will be used.
VI_ATTR_IMMEDIATE_SERV	Specifies whether or not the given device is an immediate servant of the controller running VISA.
VI_ATTR_MAINFRAME_LA	Returns the lowest logical address in the mainframe. **VI_UNKNOWN_LA** is returned if the logical address is not known.
VI_ATTR_MANF_ID	Returns the manufacturer's identification number of the VXI device in the specified session.
VI_ATTR_MEM_BASE	Returns the base address of the device in A24 or A32 VXI memory address space.
VI_ATTR_MEM_SIZE	Returns the size of memory requested by the device in A24 or A32 VXI address space.
VI_ATTR_MEM_SPACE	Returns the VXI address space used by the device (A16, A16/A24, or A16/A32).
VI_ATTR_MODEL_CODE	Returns the model code of the device in the specified session.
VI_ATTR_SLOT	Returns the physical slot location of the VXI device in the specified session.
VI_ATTR_SRC_INCREMENT	Specifies how much the source offset is to be incremented after every transfer in the **viMoveIn**XX function. Default is 1; set it to either 0 or 1. If set to 0, the **viMoveIn**XX function will always read from the same element, essentially treating the source as a FIFO register.

VXI and GPIB-VXI Interfaces (cont'd)	
VI_ATTR_VXI_LA	Returns the logical address of the VXI device in the specified session.
VI_ATTR_WIN_ACCESS	Returns the mode in which the current window can be accessed.
VI_ATTR_WIN_BASE_ADDR	Returns the base address of the interface bus to which this window is mapped.
VI_ATTR_WIN_SIZE	Returns the size of the region mapped to this window.
VI_ATTR_SRC_BYTE ORDER	Specifies the byte order ot be used in high-level access operations, such as **viInxx** and **viMoveInxx**, when reading from the source.
VI_ATTR_DEST_BYTE_ORDER	Specifies the byte order ot be used in high-level access operations, such as **viOutxx** and **viMoveOutxx**, when writing to the destination.
VI_ATTR_WIN_BYTE_ORDER	Specifies the byte order to be used in low-level access operations, such as **viMapAddress**, **viPeekxx**, and **viPokexx**, when accessing the mapped window.
VI_ATTR_SRC_ACCESS_PRIV	Specifies the address modifier used in high-level access operations, such as **viInxx** and **viMoveInxx**, when reading from the source.
VI_ATTR_DEST_ACCESS_PRIV	Specifies the address modifier used in high-level access operations, such as **viOutxx** and **viMoveOutxx**, when writing to the destination.
VI_ATTR_WIN_ACCESS_PRIV	Specifies the address modifier to be used in low-level access operations, such as **viMapAddress**, **viPeekxx**, and **viPokexx**, when accessing the mapped window.

GPIB-VXI Interface	
VI_ATTR_INTF_PARENT_NUM	Returns the board number of the GPIB interface to which the GPIB-VXI is attached.

ASRL Interface	
VI_ATTR_ASRL_AVAIL_NUM	Returns the number of bytes available in the global receive buffer.
VI_ATTR_ASRL_BAUD	Returns the baud rate of the interface.
VI_ATTR_ASRL_DATA_BITS	Returns the number of data bits contained in each frame (from 5 to 8). The data bits for each frame are located in the low-order bits of every byte stored in memory.
VI_ATTR_ASRL_END_IN	Indicates the method used to terminate read operations.
VI_ATTR_ASRL_END_OUT	Indicates the method used to terminate write operations.
VI_ATTR_ASRL_FLOW_CNTRL	Returns the kind of flow control that the transfer mechanism is using.
VI_ATTR_ASRL_PARITY	Returns the parity used with every frame transmitted and received.
VI_ATTR_ASRL_STOP_BITS	Returns the number of stop bits used to indicate the end of a frame.
VI_ATTR_ASRL_CTS_STATE	Shows the current state of the Clear To Send (CTS) input signal.

ASRL Interface (cont'd)	
VI_ATTR_ASRL_RTS_STATE	Manually assert or unassert the Request To Send (RTS) output signal. When the **VI_ATTR_ASRL_FLOW_CNTRL** attribute is set to **VI_ASRL_FLOW_RTS_CTS**, this attribute is ignored when changed, but can be read to determine whether the background flow control is asserting or unasserting the signal.
VI_ATTR_ASRL_DTR_STATE	Manually assert or unassert the Data Terminal Ready (DTR) output signal.
VI_ATTR_ASRL_DSR_STATE	Shows the current state of the Data Set Ready (DSR) input signal.
VI_ATTR_ASRL_DCD_STATE	Shows the current state of the Carrier Detect (DCD) input signal. The DCD signal is often used by modems to indicate the detection of a carrier (remote modem) on the telephone line. The DCD signal is also known as Receive Line Signal Detect (RLSD).
VI_ATTR_RI_STATE	Shows the current state of the Ring Indicator (RI) input signal.

VISA Event Attributes

The following attributes are read-only attributes that can only be read on event contexts returned from event handlers or **viWaitOnEvent**.

Attribute	Description
VI_ATTR_EVENT_TYPE	Returns the type of event enabled.
VI_ATTR_SIGP_STATUS_ID	Returns the 16-bit status (ID) value. (Only for **VI_EVENT_VXI_SIGP** event type.)
VI_ATTR_RECV_TRIG_ID	Returns which trigger line was fired. (Only for **VI_EVENT_TRIG** event type.)
VI_ATTR_STATUS	Returns the return code of the asynchronous I/O operation that has completed. (Only for **VI_EVENT_IO_COMPLETION** event type.)
VI_ATTR_JOB_ID	Returns the job identifier (ID) of the asynchronous operation that has completed. (Only for **VI_EVENT_IO_COMPLETION** event type.)
VI_ATTR_BUFFER	Returns the address of a buffer that was used in an asynchronous operation. (Only for **VI_EVENT_IO_COMPLETION** event type.)
VI_ATTR_RET_COUNT	Returns the actual number of elements that were asynchronously transferred. (Only for **VI_EVENT_IO_COMPLETION** event type.)

Using Events and Handlers

This section gives guidelines to use events and handlers, including:

- Events and Attributes
- Using the Callback Method
- Using the Queuing Method

Events and Attributes

Events are special occurrences that require attention from your application. Event types include Service Requests (SRQs), interrupts, and hardware triggers. Events will not be delivered unless the appropriate events are enabled.

Event Notification

There are two ways you can receive notification that an event has occurred:

- Install an event handler with **`viInstallhandler`**, and enable one or several events with **`viEnableEvent`**. If the event was enabled with a handler, the specified event handler will be called when the specified event occurs. This is called a **callback**.
- Enable one or several events with **`viEnableEvent`** and call the **`viWaitOnEvent`** function. The **`viWaitOnEvent`** function will suspend the program execution until the specified event occurs or the specified timeout period is reached. This is called **queuing**.

These methods are independent of each other and one or both can be used at one time. The callback method is generally used when immediate response is needed, and the queuing method is for non-critical events.

Events That can be Enabled

The following events can be enabled. The **VI_EVENT_VXI_SIGP** and **VI_EVENT_TRIG** events are *not* supported on the GPIB-VXI interface. Event contexts should *not* be closed in event handlers. Do *not* use **viClose** to close contexts in event handlers.

Event Name	Description
VI_EVENT_SERVICE_REQ	Notification that a device is requesting service.
VI_EVENT_VXI_SIGP	Notification that a VXI signal or VXI interrupt has been received from a device.
VI_EVENT_TRIG	Notification that a hardware trigger was received from a device.
VI_EVENT_IO_COMPLETION	Notification that an asynchronous operation has completed.

Getting Event Information

Once the application has received an event, information about that event can be obtained by using the **viGetAttribute** function on that particular event context. The following table lists the events and associated read-only attributes that can be read to get event information on a specific event. Use the VISA **viReadSTB** function to read the status byte of the service request.

Event Name	Attributes	Data Type	Values
VI_EVENT_ SERVICE_REQ	**VI_ATTR_EVENT_TYPE**	**ViEventType**	**VI_EVENT_ SERVICE_REQ**
VI_EVENT_VXI_SIGP	**VI_ATTR_EVENT_TYPE** **VI_ATTR_SIGP_STATUS_ID**	**ViEventType** **ViUInt16**	**VI_EVENT_VXI_SIGP** **0 to FFFF$_h$**
VI_EVENT_TRIG	**VI_ATTR_EVENT_TYPE** **VI_ATTR_RECV_TRIG_ID**	**ViEventType** **ViInt16**	**VI_EVENT_TRIG** **VI_TRIG_TTL0 to VI_TRIG_TTL7** **VI_TRIG_ECL0 to VI_TRIG_ECL1**
VI_EVENT_IO_ COMPLETION	**VI_ATTR_EVENT_TYPE** **VI_ATTR_STATUS** **VI_ATTR_JOB_ID** **VI_ATTR_BUFFER** **VI_ATTR_RET_COUNT**	**ViEventType** **ViStatus** **ViJobId** **ViBuf** **ViUInt32**	**VI_EVENT_IO_ COMPLETION** **N/A** **N/A** **N/A** **0 to FFFFFFFF$_h$**

Example: Reading Event Attributes

Once you have decided which attribute to check, you can read the attribute using the **viGetAttribute** function. The following example shows one way you could check which trigger line fired when the **VI_EVENT_TRIG** event was delivered.

Note that the *context* parameter is either the event *context* passed to your event handler, or the *outcontext* specified when doing a wait on event. See "Using VISA Attributes" in this chapter for more information on reading attribute states.

```
ViInt16 state;
.
.
viGetAttribute(context, VI_ATTR_RECV_TRIG_ID, &state);
```

Using the Callback Method

The callback method of event notification is used when an immediate response to an event is required. To use the callback method for receiving notification that an event has occurred, you must do the following. Then, when the enabled event occurs, the installed event handler is called.

- Install an event handler with the **`viInstallHandler`** function
- Enable one or several events with the **`viEnableEvent`** function

Example: Using the Callback Method

This example shows one way you can use the callback method.

```
void my_handler (ViSession vi, ViEventType eventType,
   ViEvent context, ViAddr usrHandle) {

/* your event handling code here */

}
main(){
ViSession vi;
ViAddr addr=0;
.
.
viInstallHandler(vi, VI_EVENT_SERVICE_REQ, my_handler,
addr);
viEnableEvent(vi, VI_EVENT_SERVICE_REQ, VI_HNDLR,
VI_NULL);
.
   /* your code here */
.
viDisableEvent(vi, VI_EVENT_SERVICE_REQ, VI_HNDLR);
viUninstallHandler(vi, VI_EVENT_SERVICE_REQ, my_handler,
addr);
.
}
```

Installing Handlers

A handler is installed on a specified session. Only one handler can be installed on a specific event in a given session, or you can install a different handler for each event type. However, the same handler can be installed on more than one event type. Use the following function when installing an event handler:

`viInstallHandler(`*vi, eventType, handler, userHandle*`);`**

Where the parameters are defined as follows.

Parameter	Description
vi	The session on which the handler will be installed.
eventType	The event type that will activate the handler.
handler	The name of the handler to be called.
userHandle	A user value that uniquely identifies the handler for the specified event type.

The *userHandle* parameter allows you to assign a value to be used with the *handler* on the specified session. Thus, you can install the same handler for the same event type on several sessions with different *userHandle* values. The same handler is called for the specified event type.

However, the value passed to *userHandle* is different. Therefore the handlers are uniquely identified by the combination of the *handler* and the *userHandle*. This may be useful when you need a different handling method depending on the *userHandle*.

Example: Installing an Event Handler

This example shows how to install an event handler to call **`my_handler`** when a Service Request occurs. Note that **`VI_EVENT_SERVICE_REQ`** must also be an enabled event with the **`viEnableEvent`** function for the service request event to be delivered.

```
viInstallHandler(vi, VI_EVENT_SERVICE_REQ, my_handler,
addr);
```

Use the **`viUninstallHandler`** function to uninstall a specific handler. Or you can use wildcards (**`VI_ANY_HNDLR`** in the *handler* parameter) to uninstall groups of handlers. See **`viUninstallHandler`** in *Chapter 7 - VISA Language Reference* for more details on this function.

Writing the Handler

The *handler* installed needs to be written by the programmer. The event handler typically reads an associated attribute and performs some sort of action. See the event handler in the example program later in this section.

Enabling Events

Before an event can be delivered, it must be enabled using the **viEnableEvent** function. This function causes the application to be notified when the enabled event has occurred, Where the parameters are defined as follows.

viEnableEvent(*vi, eventType, mechanism, context***);**

Using **VI_QUEUE** in the *mechanism* parameter specifies a queuing method for the events to be handled. If you use both **VI_QUEUE** and one of the mechanisms listed above, notification of events will be sent to both locations. See the next subsection for information on the queuing method.

Parameter	Description
vi	The session on which the handler will be installed.
eventType	The type of event to enable.
mechanism	The mechanism by which the event will be enabled. It can be enabled in several different ways: Use **VI_HNDLR** in this parameter to specify that the installed handler will be called when the event occurs. Use **VI_SUSPEND_HNDLR** in this parameter which puts the events in a queue and waits to call the installed handlers until **viEnableEvent** is called with **VI_HNDLR** specified in the *mechanism* parameter. When **viEnableEvent** is called with **VI_HNDLR** specified, the handler for each queued event will be called.
context	Not used in VISA 1.0. Use **VI_NULL**.

Example: Enabling a Hardware Trigger Event

This example illustrates enabling a hardware trigger event.

```
viInstallHandler(vi, VI_EVENT_TRIG, my_handler,&addr);
viEnableEvent(vi, VI_EVENT_TRIG, VI_HNDLR, VI_NULL);
```

The **VI_HNDLR** mechanism specifies that the handler installed for **VI_EVENT_TRIG** will be called when a hardware trigger occurs.

If you specify **VI_ALL_ENABLE_EVENTS** in the *eventType* parameter, all events that have previously been enabled on the specified session will be enabled for the *mechanism* specified in this function call.

Use the **viDisableEvent** function to stop servicing the event specified.

Example: Trigger Callback

This example program installs an event handler and enables the trigger event. When the event occurs, the installed event handler is called. This program is intended to show specific VISA functionality and does not include error trapping. Error trapping, however, is good programming practice and is recommended in your VISA applications. See "Trapping Errors" in this chapter.

This example program is installed on your system in the **SAMPLES** subdirectory on Windows environments, or in the **examples** subdirectory on HP-UX. See *Appendix A - VISA System Information* for locations of example programs on your operating system.

```
/* evnthdlr.c
   This example program illustrates installing an event
   handler to be called when a trigger interrupt occurs.
   Note that you must change the address. */

#include <visa.h>
#include <stdio.h>

/* trigger event handler */
ViStatus _VI_FUNCH myHdlr(ViSession vi, ViEventType
      eventType, ViEvent ctx, ViAddr userHdlr){
   ViInt16 trigId;

/* make sure it is a trigger event */
if(eventType!=VI_EVENT_TRIG){
   /* Stray event, so ignore */
   return VI_SUCCESS;
}
/* print the event information */
printf("Trigger Event Occurred!\n");
```

```
   printf("...Original Device Session = %ld\n", vi);

   /* get the trigger that fired */
   viGetAttribute(ctx, VI_ATTR_RECV_TRIG_ID, &trigId);
   printf("Trigger that fired: ");
   switch(trigId){
      case VI_TRIG_TTL0:
         printf("TTL0");
         break;
      default:
         printf("<other 0x%x>", trigId);
         break;
   }

   printf("\n");

   return VI_SUCCESS;
}

void main(){
   ViSession defaultRM,vi;

   /* open session to VXI device */
   viOpenDefaultRM(&defaultRM);
   viOpen(defaultRM, "VXI0::24::INSTR", VI_NULL, VI_NULL, &vi);

   /* select trigger line TTL0 */
   viSetAttribute(vi, VI_ATTR_TRIG_ID, VI_TRIG_TTL0);
   /* install the handler and enable it */
   viInstallHandler(vi, VI_EVENT_TRIG, myHdlr,
   (ViAddr)10);
   viEnableEvent(vi, VI_EVENT_TRIG, VI_HNDLR, VI_NULL);
   /* fire trigger line, twice */
   viAssertTrigger(vi, VI_TRIG_PROT_SYNC);
   viAssertTrigger(vi, VI_TRIG_PROT_SYNC);

   /* unenable and uninstall the handler */
   viDisableEvent(vi, VI_EVENT_TRIG, VI_HNDLR);

   viUninstallHandler(vi, VI_EVENT_TRIG, myHdlr,
   (ViAddr)10);

   /* close the sessions */
   viClose(vi);
   viClose(defaultRM);
}
```

Example: SRQ Callback

This program installs an event handler and enables an SRQ event. When the event occurs, the installed event handler is called. This example program is intended to show specific VISA functionality and does not include error trapping. Error trapping, however, is good programming practice and is recommended in your VISA applications. See "Trapping Errors" in this chapter.

This program is installed on your system in the **SAMPLES** subdirectory on Windows environments, or in the **examples** subdirectory on HP-UX. See *Appendix A - VISA System Information* for locations of example programs on your operating system.

```
/* srqhdlr.c
   This example program illustrates installing an event
   handler to be called when an SRQ interrupt occurs.
   Note that you must change the address. */

#include <visa.h>
#include <stdio.h>
#if defined (_WIN32)
   #include <windows.h> /* for Sleep() */
   #define YIELD Sleep( 10 )
#elif defined (_BORLANDC_)
   #include <windows.h>  /* for Yield() */
   #define YIELD Yield()
#elif defined (_WINDOWS)
   #include <io.h>      /* for _wyield */
   #define YIELD   _wyield()
#else
   #include <unistd.h>
   #define YIELD sleep (1)
#endif

int srqOccurred;

/* trigger event handler */
ViStatus _VI_FUNCH mySrqHdlr(ViSession vi, ViEventType
      eventType, ViEvent ctx, ViAddr userHdlr){

   ViUInt16 statusByte;

   /* make sure it is an SRQ event */
   if(eventType!=VI_EVENT_SERVICE_REQ){
      /* Stray event, so ignore */
      printf( "\nStray event of type 0x%lx\n", eventType );
      return VI_SUCCESS;
```

```
   }
   /* print the event information */
   printf("\nSRQ Event Occurred!\n");
   printf("...Original Device Session = %ld\n", vi);

   /* get the status byte */
   viReadSTB(vi, &statusByte);
   printf("...Status byte is 0x%x\n", statusByte);

   srqOccurred = 1;
   return VI_SUCCESS;
}

void main(){
   ViSession defaultRM,vi;
   long count;

   /* open session to message based VXI device */
   viOpenDefaultRM(&defaultRM);
   viOpen(defaultRM, "GPIB-VXI0::24::INSTR", VI_NULL, VI_NULL,
   &vi);

   /* Enable command error events */
   viPrintf( vi, "*ESE 32\n" );

   /* Enable event register interrupts */
   viPrintf( vi, "*SRE 32\n" );

   /* install the handler and enable it */
   viInstallHandler(vi, VI_EVENT_SERVICE_REQ, mySrqHdlr,
   (ViAddr)10);
   viEnableEvent(vi, VI_EVENT_SERVICE_REQ, VI_HNDLR,
   VI_NULL);

   srqOccurred = 0;

   /* Send a bogus command to the message based device to
   cause an SRQ. Note: 'IDN' causes the error -- 'IDN?'
   is the correct syntax */
   viPrintf( vi, "IDN\n" );

   /* Wait a while for the SRQ to be generated and for the
   handler to be called. Print something while we wait */
```

```
printf( "Waiting for an SRQ to be generated ." );
for (count = 0 ; (count < 10) && (srqOccurred ==
0);count++) {
   long count2 = 0;
   printf( "." );
   while ( (count2++ < 100) && (srqOccurred ==0) ){
      YIELD;
   }
}
printf( "\n" );

/* disable and uninstall the handler */
viDisableEvent(vi, VI_EVENT_SERVICE_REQ, VI_HNDLR);
viUninstallHandler(vi, VI_EVENT_SERVICE_REQ, mySrqHdlr,
(ViAddr)10);

/* Clean up after ourselves - don't leave device in error state */
viPrintf( vi, "*CLS\n" );

/* close the sessions */
viClose(vi);
viClose(defaultRM);
printf( "End of program\n" );}
```

Using the Queuing Method

The queuing method is generally used when an immediate response from your application is not needed. To use the queuing method for receiving notification that an event has occurred, you must do the following:

- Enable one or several events with the **`viEnableEvent`** function.
- When ready to query, use the **`viWaitOnEvent`** function to check for queued events.

If the specified event has occurred, then the event information is retrieved and the program returns immediately. If the specified event has not occurred, then the program suspends execution until a specified event occurs or until the specified timeout period is reached.

Example: Using the Queuing Method

This example program shows one way you can use the queuing method.

```
main();
ViSession vi;
ViEventType eventType;
ViEvent event;
.
.
viEnableEvent(vi, VI_EVENT_SERVICE_REQ, VI_QUEUE,
VI_NULL);
.
.
viWaitOnEvent(vi, VI_EVENT_SERVICE_REQ,
VI_TMO_INFINITE,
   &eventType, &event);
.
.
viClose(event);
viDisableEvent(vi, VI_EVENT_SERVICE_REQ, VI_QUEUE);
}
```

Enabling Events

Before an event can be delivered, it must be enabled using the **viEnableEvent** function:

viEnableEvent(*vi, eventType, mechanism, context***);**

where the parameters are defined as follows:

Parameter	Description
vi	The session the handler will be installed on.
eventType	The type of event to enable.
mechanism	The mechanism by which the event will be enabled. Specify **VI_QUEUE** to use the queuing method.
context	Not used in VISA 1.0. Use **VI_NULL**.

When you use **VI_QUEUE** in the *mechanism* parameter, you are specifying that the events will be put into a queue. Then, when a **viWaitOnEvent** function is invoked, the program execution will suspend until the enabled event occurs or the timeout period specified is reached. If the event has already occurred, the **viWaitOnEvent** function will return immediately.

Example: Enabling a Hardware Trigger Event

This example illustrates enabling a hardware trigger event.

```
viEnableEvent(vi, VI_EVENT_TRIG, VI_QUEUE, VI_NULL);
```

The **VI_QUEUE** mechanism specifies that when an event occurs, it will go into a queue.

If you specify **VI_ALL_ENABLE_EVENTS** in the *eventType* parameter, all events that have previously been enabled on the specified session will be enabled for the *mechanism* specified in this function call.

Use the **viDisableEvent** function to stop servicing the event specified.

Wait on the Event

When using the **viWaitOnEvent** function, specify the session, the event type to wait for, and the timeout period to wait:

viWaitOnEvent(*vi, inEventType, timeout, outEventType, outContext***);**

The event must have previously been enabled with **VI_QUEUE** specified as the *mechanism* parameter.

Example: Wait on Event for SRQ

This example shows how to install a wait on event for service requests.

```
viEnableEvent(vi, VI_EVENT_SERVICE_REQ, VI_QUEUE,
VI_NULL);
viWaitOnEvent(vi, VI_EVENT_SERVICE_REQ,
VI_TMO_INFINITE,
     &eventType, &event);
.
.
viDisableEvent(vi, VI_EVENT_SERVICE_REQ, VI_QUEUE);
```

Every time a wait on event is invoked, an event context object is created. Specifying **VI_TMO_INFINITE** in the *timeout* parameter indicates that the program execution will suspend indefinitely until the event occurs. To clear the event queue for a specified event type, use the **viDiscardEvents** function.

Example: Trigger Event Queuing

This program enables the trigger event in a queuing mode. When the **viWaitOnEvent** function is called, the program will suspend operation until the trigger line is fired or the timeout period is reached. Since the trigger lines were already fired and the events were put into a queue, the function will return and print the trigger line that fired.

This program is intended to show specific VISA functionality and does not include error trapping. Error trapping, however, is good programming practice and is recommended in your VISA applications. See "Trapping Errors" in this chapter.

This example program is installed on your system in the **SAMPLES** subdirectory on Windows environments, or in the **examples** subdirectory on HP-UX. See *Appendix A - VISA System Information* for locations of example programs on your operating system.

```
/* evntqueu.c
   This example program illustrates enabling an event
   queue using viWaitOnEvent. Note that you must change
   the device address. */

#include <visa.h>
#include <stdio.h>

void main(){
   ViSession defaultRM,vi;
   ViEventType eventType;
   ViEvent eventVi;
   ViStatus err;
```

```
ViInt16 trigId;

/* open session to VXI device */
viOpenDefaultRM(&defaultRM);
viOpen(defaultRM, "VXI0::24::INSTR", VI_NULL, VI_NULL,
&vi);

/* select trigger line TTL0 */
viSetAttribute(vi, VI_ATTR_TRIG_ID, VI_TRIG_TTL0);

/* enable the event */
viEnableEvent(vi, VI_EVENT_TRIG, VI_QUEUE, VI_NULL);

/* fire trigger line, twice */
viAssertTrigger(vi, VI_TRIG_PROT_SYNC);
viAssertTrigger(vi, VI_TRIG_PROT_SYNC);

/* Wait for the event to occur */
err=viWaitOnEvent(vi, VI_EVENT_TRIG, 10000, &eventType,
&eventVi);
if(err==VI_ERROR_TMO){
   printf("Timeout Occurred! Event not received.\n");
   return;
}

/* print the event information */
printf("Trigger Event Occurred!\n");
printf("...Original Device Session = %ld\n", vi);

/* get trigger that fired */
viGetAttribute(eventVi, VI_ATTR_RECV_TRIG_ID,
&trigId);
printf("Trigger that fired: ");
switch(trigId){
   case VI_TRIG_TTL0:
      printf("TTL0");
      break;
   default:
      printf("<other 0x%x>",trigId);
      break;
}
printf("\n");

/* close the context before continuing */
viClose(eventVi);
```

```
   /* get second event */
   err=viWaitOnEvent(vi, VI_EVENT_TRIG, 10000, &eventType,
   &eventVi);
   if(err==VI_ERROR_TMO){
      printf("Timeout Occurred! Event not received.\n");
      return;
   }
   printf("Got second event\n");

   /* close the context before continuing */
   viClose(eventVi);

   /* disable event */
   viDisableEvent(vi, VI_EVENT_TRIG, VI_QUEUE);

   /* close the sessions */
   viClose(vi);
   viClose(defaultRM);
}
```

Trapping Errors and Using Locks

This section gives guidelines to trap errors and to use locks, including:

- Trapping Errors
- Using Locks

Trapping Errors

The example programs in this guide show specific VISA functionality and do not include error trapping. Error trapping, however, is good programming practice and is recommended in all your VISA application programs. To trap VISA errors you must check for **VI_SUCCESS** after each VISA function call.

If you want to ignore WARNINGS, you can test to see if **err** is less than (**<**) **VI_SUCCESS**. Since WARNINGS are greater than **VI_SUCCESS** and ERRORS are less than **VI_SUCCESS**, **err_handler** would only be called when the function returns an ERROR. For example:

```
if(err < VI_SUCCESS) err_handler (vi, err);
```

Example: Check for VI_SUCCESS

This example illustrates checking for **VI_SUCCESS**. If **VI_SUCCESS** is not returned, an error handler (written by the programmer) is called. This must be done with each VISA function call.

```
ViStatus err;
.
.
err=viPrintf(vi, "*RST\n");
if (err < VI_SUCCESS) err_handler(vi, err);
.
.
```

Example: Printing Error Code

The following error handler prints a user-readable string describing the error code passed to the function:

```
void err_handler(ViSession vi, ViStatus err){

   char err_msg[1024]={0};
   viStatusDesc (vi, err, err_msg);
   printf ("ERROR = %s\n", err_msg);
   return;
}
```

Example: Checking Instrument Errors

When programming instruments, it is good practice to check the instrument to ensure there are no instrument errors after each instrument function. This example uses a SCPI command to check a specific instrument for errors.

```
void system_err(){

   ViStatus err;
   char buf[1024]={0};
   int err_no;

   err=viPrintf(vi, "SYSTEM:ERR?\n");
   if (err < VI_SUCCESS) err_handler (vi, err);

   err=viScanf (vi, "%d%t", &err_no, &buf);
   if (err < VI_SUCCESS) err_handler (vi, err);

   while (err_no >0){
      printf ("Error Found: %d,%s\n", err_no, buf);
      err=viScanf (vi, "%d%t", &err_no, &buf);
   }
   err=viFlush(vi, VI_READ_BUF);
   if (err < VI_SUCCESS) err_handler (vi, err);

   err=viFlush(vi, VI_WRITE_BUF);
   if (err < VI_SUCCESS) err_handler (vi, err);
}
```

Using Locks

In VISA, applications can open multiple sessions to a VISA resource simultaneously. Applications can, therefore, access a VISA resource concurrently through different sessions. However, in certain cases, applications accessing a VISA resource may want to restrict other applications from accessing that resource.

Lock Functions

For example, when an application needs to perform successive write operations on a resource, the application may require that, during the sequence of writes, no other operation can be invoked through any other session to that resource. For such circumstances, VISA defines a locking mechanism that restricts access to resources.

The VISA locking mechanism enforces arbitration of accesses to VISA resources on a per-session basis. If a session locks a resource, operations invoked on the resource through other sessions either are serviced or are returned with an error, depending on the operation and the type of lock used.

If a VISA resource is not locked by any of its sessions, all sessions have full privilege to invoke any operation and update any global attributes. Sessions are *not* required to have locks to invoke operations or update global attributes. However, if some other session has already locked the resource, attempts to update global attributes or invoke certain operations will fail.

See descriptions of the individual VISA functions in *Chapter 7 - VISA Language Reference* to determine which would fail when a resource is locked.

viLock/viUnlock Functions

The VISA **`viLock`** function is used to acquire a lock on a resource.

`viLock(`*vi, lockType, timeout, requestedKey, accessKey*`);`**

The **`VI_ATTR_RSRC_LOCK_STATE`** attribute specifies the current locking state of the resource on the given session, which can be either **`VI_NO_LOCK`**, **`VI_EXCLUSIVE_LOCK`**, or **`VI_SHARED_LOCK`**.

The VISA **`viUnlock`** function is then used to release the lock on a resource. If a resource is locked and the current session does not have the lock, the error **`VI_ERROR_RSRC_LOCKED`** is returned.

VISA Lock Types

VISA defines two different types of locks: Exclusive Lock and Shared Lock.

- **Exclusive Lock** - A session can lock a VISA resource using the lock type **`VI_EXCLUSIVE_LOCK`** to get exclusive access privileges to the resource. This exclusive lock type excludes access to the resource from all other sessions.

  If a session has an exclusive lock, other sessions cannot modify global attributes or invoke operations on the resource. However, the other sessions *can* still get atttributes.

- **Shared Lock** - A session can share a lock on a VISA resource with other sessions by using the lock type **`VI_SHARED_LOCK`**. Shared locks in VISA are similar to exclusive locks in terms of access privileges, but can still be shared between multiple sessions.

  If a session has a shared lock, other sessions that share the lock can also modify global attributes and invoke operations on the resource (of course, unless some other session has a previous exclusive lock on that resource). A session that does not share the lock will lack these capabilities.

Locking a resource restricts access from other sessions and, in the case where an exclusive lock is acquired, ensures that operations do not fail because other sessions have acquired a lock on that resource. Thus, locking a resource prevents other, subsequent sessions from acquiring an exclusive lock on that resource. Yet, when multiple sessions have acquired a shared lock, VISA allows one of the sessions to acquire an exclusive lock along with the shared lock it is holding.

Also, VISA supports nested locking. That is, a session can lock the same VISA resource multiple times (for the same lock type) via multiple invocations of the **`viLock`** function. In such a case, unlocking the resource requires an equal number of invocations of the **`viUnlock`** function. Nested locking is also explained in detail later in this section.

Some VISA operations may be permitted even when there is an exclusive lock on a resource, or some global attributes may not be read when there is any kind of lock on the resource. These exceptions, when applicable, are mentioned in the descriptions of the individual VISA functions and attributes.

See *Chapter 7 - VISA Language Reference* for descriptions of individual functions to determine which are applicable for locking and which are not restricted by locking.

Lock Sharing

Because the locking mechanism in VISA is session-based, multiple threads sharing a session that has locked a VISA resource have the same privileges for accessing the resource. Some applications, though, may have separate sessions to a resource and may want all the sessions in that application to have the same privilege as the session that locked the resource.

In other cases, there may be a need to share locks among sessions in different applications. Essentially, a session that acquired a lock to a resource may share the lock with other sessions it selects, and exclude access from other sessions.

As previously mentioned, VISA defines the **VI_SHARED_LOCK** lock type to give exclusive access privileges to a session along with the capability to share these exclusive privileges with other sessions at the discretion of the original session.

When locking the resource using the **VI_SHARED_LOCK** lock type, the **viLock** function returns an *accessKey* that can be used to share the lock. The session can then share this lock with any other session by passing around this *accessKey*.

Before other sessions can access the locked resource, they need to acquire the lock by passing the *accessKey* in the *requestedKey* parameter of the **viLock** function. Invoking **viLock** with the same key will register the new session to have the same access privileges as the original session.

The new session that acquired the access privileges through the sharing mechanism can also pass the *accessKey* to other sessions for sharing of the resource, etc. Of course, all the sessions sharing a resource via the shared lock should synchronize their accesses to maintain a consistent state of the resource.

VISA also provides the flexibility for the application(s) to specify a key to use as the *accessKey*, instead of VISA generating the *accessKey*. The application(s) can suggest a key value to use through the *requestedKey* parameter of the **viLock** function. If the resource was not locked, the resource will use this *requestedKey* as the *accessKey*.

If the resource was locked using a shared lock, and the *requestedKey* matches the key with which the resource was locked, the resource will grant shared access to the session. If an application attempts to lock a resource using a shared lock, but passes **VI_NULL** as the *requestedKey* parameter, then VISA will generate an *accessKey* for the session.

A session seeking to share exclusive access to a resource with other sessions needs to acquire a **VI_SHARED_LOCK** for this purpose. If it requests **VI_EXCLUSIVE_LOCK** instead, no valid *accessKey* will be returned. Consequently, the session will not be able to share the lock with any other sessions.

Acquiring an Exclusive Lock While Holding a Shared Lock

When multiple sessions have acquired a shared lock on a resource, VISA allows one of the sessions to acquire an exclusive lock along with the shared lock it is holding via the **viLock** function. The session holding both the exclusive and shared lock will have the same access privileges that it had when it was holding only the shared lock.

However, this precludes the other sessions holding the shared lock from accessing the locked resource. This is useful when multiple sessions holding a shared lock must synchronize operations, or when one of the sessions must execute a critical operation.

When the session holding the exclusive lock unlocks the resource via the **viUnlock** function, all the sessions (including the one that had acquired the exclusive lock) will again have all the access privileges associated with the shared lock.

Note that in the reverse case where a session is holding an exclusive lock only (no shared locks), VISA does *not* allow it to change to **VI_SHARED_LOCK**.

Nested Locks

VISA also supports **nested locking**, in which a session can lock the same VISA resource multiple times (for the same lock type) via multiple invocations of the **viLock** function. Unlocking the resource requires an equal number of invocations of the **viUnlock** operation. In other words, for each invocation of **viLock**, a lock count will be incremented, and for each invocation of **viUnlock**, the lock count will be decremented. A resource will be truly unlocked only when the lock count is 0 (zero).

Each session maintains a separate lock count for each type of lock. Therefore, repeated invocations of the **viLock** function for the same session will increase the appropriate lock count, depending on the type of lock requested. In the case of a shared lock, nesting **viLock** functions will return with the same *accessKey* every time. In the case of an exclusive lock, **viLock** will not return any *accessKey*, regardless of whether it is nested or not.

For nesting shared locks, VISA does not require an *accessKey* be passed in to invoke the **viLock** function. That is, a session does not need to pass in the *accessKey* obtained from the previous invocation of **viLock** to gain a nested lock on the resource. However, if an application *does* pass in an *accessKey* when nesting shared locks, it must be the correct one for that session. See the description of the **viLock** function in *Chapter 7 - VISA Language Reference* for further details on the *accessKey* parameter.

Example: Exclusive Lock

This example shows a session gaining an exclusive lock to perform the **viPrintf** and **viScanf** VISA operations on a GPIB device. It then releases the lock via the **viUnlock** function.

```
/* lockexcl.c
   This example program queries a GPIB device for an
   identification string and prints the results. Note that
   you must change the address. */

#include <visa.h>
#include <stdio.h>

void main () {

   ViSession defaultRM, vi;
   char buf [256] = {0};

   /* Open session to GPIB device at address 22 */
   viOpenDefaultRM (&defaultRM);
   viOpen (defaultRM, "GPIB0::22::INSTR", VI_NULL,VI_NULL,
   &vi);

   /* Initialize device */
   viPrintf (vi, "*RST\n");

   /* Make sure no other process or thread does anything
   to this resource between the viPrintf() and the viScanf()
   calls */

   viLock (vi, VI_EXCLUSIVE_LOCK, 2000, VI_NULL,
   VI_NULL);

   /* Send an *IDN? string to the device */
   viPrintf (vi, "*IDN?\n");

   /* Read results */
   viScanf (vi, "%t", &buf);
```

```
   /* Unlock this session so other processes and threads
   can use it */
   viUnlock (vi);

   /* Print results */
   printf ("Instrument identification string: %s\n",
   buf);

   /* Close session */
   viClose (vi);
   viClose (defaultRM);
}
```

Example: Shared Lock

This example shows a session gaining a shared lock with the *accessKey* called **lockkey**. Other sessions can now use this *accessKey* in the *requestedKey* parameter of the **viLock** function to share access on the locked resource. This example then shows the original session acquiring an exclusive lock while maintaining its shared lock.

When the session holding the exclusive lock unlocks the resource via the **viUnlock** function, all the sessions sharing the lock again have all the access privileges associated with the shared lock.

```
/* lockshr.c
   This example program queries a GPIB device for an
   identification string and prints the results. Note
   that you must change the address. */

#include <visa.h>
#include <stdio.h>

void main () {

   ViSession defaultRM, vi;
   char buf [256] = {0};
   char lockkey [256] = {0};

   /* Open session to GPIB device at address 22 */
   viOpenDefaultRM (&defaultRM);
   viOpen (defaultRM, "GPIB0::22::INSTR", VI_NULL,VI_NULL,&vi);

   /* acquire a shared lock so only this process and processes
   that we know about can access this resource */
   viLock (vi, VI_SHARED_LOCK, 2000, VI_NULL, lockkey);


   /* at this time, we can make 'lockkey' available to
   other processes that we know about. This can be done
   with shared memory or other inter-process communication
   methods. These other processes can then call
   "viLock(vi,VI_SHARED_LOCK, 2000, lockkey, lockkey)"
   and they will also have access to this resource.  */

   /* Initialize device */
   viPrintf (vi, "*RST\n");
```

```
   /* Make sure no other process or thread does anything
   to this resource between the viPrintf() and the
   viScanf()calls Note: this also locks out the processes
   with which we shared our 'shared lock' key.  */
   viLock (vi, VI_EXCLUSIVE_LOCK, 2000, VI_NULL,VI_NULL);
   /* Send an *IDN? string to the device */
   viPrintf (vi, "*IDN?\n");

   /* Read results */
   viScanf (vi, "%t", &buf);

   /* unlock this session so other processes and threads
   can use it */
   viUnlock (vi);

   /* Print results */
   printf ("Instrument identification string: %s\n",
   buf);

   /* release the shared lock too */
   viUnlock (vi);

   /* Close session */
   viClose (vi);
   viClose (defaultRM);
}
```

5

Programming VXI Devices

Programming VXI Devices

VISA supports three interfaces you can use to access VXI: GPIB, VXI, and GPIB-VXI. This chapter provides information to program VXI devices with the VXI or GPIB-VXI interfaces, including:

- Introduction to VXI Devices
- Using High-Level Memory Functions
- Using Low-Level Memory Functions
- Using VXI Backplane Memory I/O Methods
- Using the Manual Memory Access Resource (MEMACC)
- Using VXI Specific Attributes

See *Chapter 4 - Programming with VISA* for general information on VISA programming for the GPIB, VXI, and GPIB-VXI interfaces. For information on the specific VISA functions, see *Chapter 7 - VISA Language Reference*.

Introduction to VXI Devices

VISA supports three interfaces you can use to access VXI: GPIB, VXI, and GPIB-VXI. The GPIB interface can be used to access VXI instruments via a Command Module. In addition, the VXI backplane can be directly accessed with the VXI or GPIB-VXI interfaces. This section summarizes some VXI interfaces and VXI device types.

Interface Descriptions

This chapter shows how to use VISA to program VXI instruments over two different interfaces: VXI and GPIB-VXI. The following table describes these interfaces.

Interface	Description
VXI Interface	Uses an embedded VXI controller or other VXI interface. Accesses VXI instruments directly over the VXI backplane.
GPIB-VXI Interface	Uses the GPIB interface connected to a Command Module to directly access the VXI backplane.

NOTE

You can also use VISA with a GPIB interface to access VXI instruments via a Command Module. In this case, the GPIB interface communicates with a Command Module, which then sends commands to the VXI instruments. There is no direct access to the VXI backplane.

When using the GPIB interface, you will need to use the specific commands listed in the applicable Command Module manual. Also, commands created for a specific vendor's Command Module will probably not work for another vendor's Command Module.

VXI Device Types

This chapter gives guidelines to use the VXI and GPIB-VXI interfaces for direct access to the VXI backplane. When directly accessing the VXI backplane, you must know whether you are programming a message-based or a register-based VXI device (instrument).

Message-Based Devices

A **message-based VXI device** has its own processor that allows it to interpret high-level commands such as SCPI (Standard Commands for Programmable Instruments). When using VISA, you can place the SCPI command within your VISA output function call. Then, the message-based device interprets the SCPI command.

In this case you can use the VISA formatted I/O or non-formatted I/O functions and program the message-based device as you would a GPIB device. However, if the message-based device has shared memory, you can access the device's shared memory by doing register peeks and pokes. VISA provides two different methods you can use to program directly to the registers: high-level memory functions or low-level memory functions.

Register-Based Devices

A **register-based VXI device** typically does not have a processor to interpret high-level commands. Therefore, the device must be programmed with register peeks and pokes directly to the device's registers. VISA provides two different methods you can use to program register-based devices: high-level memory functions or low-level memory functions.

Using High-Level Memory Functions

High-level memory functions allow you to access memory on the interface through simple function calls. There is no need to map memory to a window. Instead, when high-level memory functions are used, memory mapping and direct register access are automatically done.

The tradeoff, however, is speed. High-level memory functions are easier to use. However, since these functions encompass mapping of memory space and direct register access, the associated overhead slows program execution time. If speed is required, use the low-level memory functions discussed in “Using Low-Level Memory Functions”.

Programming the Registers

High-level memory functions include the **`viIn`** and **`viOut`** functions for transferring 8-, 16-, or 32-bit values, as well as the **`viMoveIn`** and **`viMoveOut`** functions for transferring 8-, 16-, or 32-bit blocks of data into or out of local memory. You can therefore program using 8-, 16-, or 32-bit transfers.

High-Level Memory Functions

This table summarizes the high-level memory functions.

Function	Description
`viIn8`(*`vi, space, offset, val8`*);	Reads 8 bits of data from the specified offset.
`viIn16`(*`vi, space, offset, val16`*);	Reads 16 bits of data from the specified offset.
`viIn32`(*`vi, space, offset, val32`*);	Reads 32 bits of data from the specified offset.
`viOut8`(*`vi, space, offset, val8`*);	Writes 8 bits of data to the specified offset.
`viOut16`(*`vi, space, offset, val16`*);	Writes 16 bits of data to the specified offset.
`viOut32`(*`vi, space, offset, val32`*);	Writes 32 bits of data to the specified offset.
`viMoveIn8`(*`vi, space, offset, length, buf8`*);	Moves an 8-bit block of data from the specified offset to local memory.

Function	Description
viMoveIn16(*vi, space, offset, length, buf16*);	Moves a 16-bit block of data from the specified offset to local memory.
viMoveIn32(*vi, space, offset, length, buf32*);	Moves a 32-bit block of data from the specified offset to local memory.
viMoveOut8(*vi, space, offset, length, buf8*);	Moves an 8-bit block of data from local memory to the specified offset.
viMoveOut16(*vi, space, offset, length, buf16*);	Moves a 16-bit block of data from local memory to the specified offset.
viMoveOut32(*vi, space, offset, length, buf32*);	Moves a 32-bit block of data from local memory to the specified offset.

Using `viIn` and `viOut`

When using the **`viIn`** and **`viOut`** high-level memory functions to program to the device registers, all you need to specify is the session identifier, address space, and the offset of the register. Memory mapping is done for you. For example, in this function:

`viIn32(`*vi, space, offset, val32*`**);**

vi is the session identifier and *offset* is used to indicate the offset of the memory to be mapped. *offset* is relative to the location of this device's memory in the given address space.The *space* parameter determines which memory location to map the space. Valid *space* values are:

- **`VI_A16_SPACE`** - Maps in VXI/MXI A16 address space.
- **`VI_A24_SPACE`** - Maps in VXI/MXI A24 address space.
- **`VI_A32_SPACE`** - Maps in VXI/MXI A32 address space.

The *val32* parameter is a pointer to where the data read will be stored. If, instead, you write to the registers via the **`viOut32`** function, the *val32* parameter is a pointer to the data to write to the specified registers. If the device specified by *vi* does not have memory in the specified address space, an error is returned. The following example uses **`viIn16`**.

```
ViSession defaultRM, vi;
ViUInt16 value;
.
viOpenDefaultRM(&&defaultRM);
viOpen(defaultRM, "VXI::24", VI_NULL, VI_NULL, &vi);
viIn16(vi, VI_A16_SPACE, 0x100, &value);
```

Using `viMoveIn` and `viMoveOut`

You can also use the **`viMoveIn`** and **`viMoveOut`** high-level memory functions to move blocks of data to or from local memory. Specifically, the **`viMoveIn`** function moves an 8-, 16-, or 32-bit block of data from the specified offset to local memory, and the **`viMoveOut`** functions moves an 8-, 16-, or 32-bit block of data from local memory to the specified offset. Again, the memory mapping is done for you. For example, in this function:

`viMoveIn32(`*vi, space, offset, length, buf32*`);`**

vi is the session identifier and *offset* is used to indicate the offset of the memory to be mapped. *offset* is relative to the location of this device's memory in the given address space. The *space* parameter determines which memory location to map the space and the *length* parameter specifies the number of elements to transfer (8-, 16-, or 32-bits).

The *buf32* parameter is a pointer to where the data read will be stored. If, instead, you write to the registers via the **`viMoveOut32`** function, the *buf32* parameter is a pointer to the data to write to the specified registers.

High-Level Memory Functions Examples

Two example programs follow that use the high-level memory functions to read the ID and Device Type registers of a device at the VXI logical address 24. The contents of the registers are then printed out.

The first program uses the VXI interface and the second program accesses the backplane with the GPIB-VXI interface. These two programs are identical except for the string passed to **`viOpen`**.

Example: Using the VXI Interface (High-Level)

This program uses high-level memory functions and the VXI interface to read the ID and Device Type registers of a device at VXI0::24.

```
/* vxihl.c
   This example program uses the high-level memory functions
   to read the id and device type registers of the device at
   VXI0::24. Change this address if necessary. The register
   contents are then displayed.*/

#include <visa.h>
#include <stdlib.h>
#include <stdio.h>
```

```
   void main () {

      ViSession defaultRM, dmm;
      unsigned short id_reg, devtype_reg;

   /* Open session to VXI device at address 24 */
   viOpenDefaultRM(&defaultRM);
   viOpen(defaultRM, "VXI0::24::INSTR", VI_NULL,VI_NULL, &dmm);

   /* Read instrument id register contents */
   viIn16(dmm, VI_A16_SPACE, 0x00, &id_reg);

   /* Read device type register contents */
   viIn16(dmm, VI_A16_SPACE, 0x02, &devtype_reg);

   /* Print results */
   printf ("ID Register = 0x%4X\n", id_reg);
   printf ("Device Type Register = 0x%4X\n", devtype_reg);

   /* Close sessions */
   viClose(dmm);
   viClose(defaultRM);
}
```

Example: Using the GPIB-VXI Interface (High-Level)

This program uses high-level memory functions and the GPIB-VXI interface to read the ID and Device Type registers of a device at GPIB-VXI0::24.

```
   /*gpibvxih.c
      This example program uses the high-level memory functions
      to read the id and device type registers of the device at
      GPIB-VXI0::24. Change this address if necessary. The
      register contents are then displayed.*/

   #include <visa.h>
   #include <stdlib.h>
   #include <stdio.h>

   void main () {

      ViSession defaultRM, dmm;
      unsigned short id_reg, devtype_reg;

      /* Open session to VXI device at address 24 */
      viOpenDefaultRM(&defaultRM);
      viOpen(defaultRM, "GPIB-VXI0::24::INSTR",
           VI_NULL,VI_NULL, &dmm);
```

```
    /* Read instrument id register contents */
    viIn16(dmm, VI_A16_SPACE, 0x00, &id_reg);

    /* Read device type register contents */
    viIn16(dmm, VI_A16_SPACE, 0x02, &devtype_reg);

    /* Print results */
    printf ("ID Register = 0x%4X\n", id_reg);
    printf ("Device Type Register = 0x%4X\n", devtype_reg);

    /* Close sessions */
    viClose(dmm);
    viClose(defaultRM);
}
```

Using Low-Level Memory Functions

Low-level memory functions allow direct access to memory on the interface just as do high-level memory functions. However, with low-level memory function calls, you must map a range of addresses and directly access the registers with low-level memory functions, such as **viPeek32** and **viPoke32**.

There is more programming effort required when using low-level memory functions. However, the program execution speed can increase. Additionally, to increase program execution speed, the low-level memory functions do not return error codes.

Programming the Registers

When using the low-level memory functions for direct register access, you must first map a range of addresses using the **viMapAddress** function. Next, you can send a series of peeks and pokes using the **viPeek** and **viPoke** low-level memory functions. Then, you must free the address window using the **viUnmapAddress** function. A process you could use is:

1. Map memory space using **viMapAddress**.
2. Read and write to the register's contents using **viPeek32** and **viPoke32**.
3. Unmap the memory space using **viUnmapAddress**.

Low-Level Memory Functions

You can program the registers using low-level functions for 8-, 16-, or 32-bit transfers. This table summarizes the low-level memory functions.

Function	Description
viMapAddress(*vi, mapSpace, mapBase, mapSize, access, suggested, address*);	Maps the specified memory space.
viPeek8(*vi, addr, val8*);	Reads 8 bits of data from address specified.
viPeek16(*vi, addr, val16*);	Reads 16 bits of data from address specified.

Function	Description
viPeek32(*vi, addr, val32*);	Reads 32 bits of data from address specified.
viPoke8(*vi, addr, val8*);	Writes 8 bits of data to address specified.
viPoke16(*vi, addr, val16*);	Writes 16 bits of data to address specified.
viPoke32(*vi, addr, val32*);	Writes 32 bits of data to address specified.
viUnmapAddress(*vi*);	Unmaps memory space previously mapped.

Mapping Memory Space

When using VISA to access the device's registers, you must map memory space into your process space. For a given session, you can have only one map at a time. To map space into your process, use the VISA **viMapAddress** function:

viMapAddress(*vi, mapSpace, mapBase, mapSize, access, suggested, address***);**

This function maps space for the device specified by the *vi* session. *mapBase*, *mapSize*, and *suggested* are used to indicate the offset of the memory to be mapped, amount of memory to map, and a suggested starting location, respectively. *mapSpace* determines which memory location to map the space. The following are valid *mapSpace* choices:

VI_A16_SPACE - Maps in VXI/MXI A16 address space.
VI_A24_SPACE - Maps in VXI/MXI A24 address space.
VI_A32_SPACE - Maps in VXI/MXI A32 address space.

A pointer to the address space where the memory was mapped is returned in the *address* parameter. If the device specified by *vi* does not have memory in the specified address space, an error is returned.

Some example **viMapAddress** function calls are:

```
/* Maps to A32 address space */
viMapAddress(vi, VI_A32_SPACE, 0x000, 0x100, VI_FALSE, VI_NULL,
     &address);

/* Maps to A24 address space */
viMapAddress(vi, VI_A24_SPACE, 0x00, 0x80, VI_FALSE, VI_NULL,
     &address);
```

Reading and Writing to Device Registers

When you have mapped the memory space, use the VISA low-level memory functions to access the device's registers. First, determine which device register you need to access. Then, you need to know the register's offset. See the applicable instrument User manual for a description of the registers and register locations. You can then use this information and the VISA low-level functions to access the device registers.

Example: Using viPeek16

An example using **viPeek16** follows.

```
ViSession defaultRM, vi;
ViUInt16 value;
ViAddr address;
ViUInt16 value;
.
.
viOpenDefaultRM(&&defaultRM);
viOpen(defaultRM, "VXI::24::INSTR", VI_NULL, VI_NULL, &vi);
viMapAddress(vi, VI_A16_SPACE, 0x00, 0x04, VI_FALSE,
     VI_NULL, &address);
viPeek16(vi, addr, &value)
```

Unmapping Memory Space

Make sure you use the **viUnmapAddress** function to unmap the memory space when it is no longer needed. Unmapping memory space makes the window available for the system to reallocate.

Low-Level Memory Functions Examples

Two example programs follow that use the low-level memory functions to read the ID and Device Type registers of the device at VXI logical address 24. The contents of the registers are then printed out.

The first program uses the VXI interface and the second program uses the GPIB-VXI interface to access the VXI backplane. These two programs are identical except for the string passed to **viOpen**.

Example: Using the VXI Interface (Low-Level)

This program uses low-level memory functions and the VXI interface to read the ID and Device Type registers of a device at VXI0::24.

```
/*vxill.c
   This example program uses the low-level memory functions to
   read the id and device type registers of the device at
   VXI0::24. Change this address if necessary. The register
   contents are then displayed.*/
```

```
#include <visa.h>
#include <stdlib.h>
#include <stdio.h>

void main () {

   ViSession defaultRM, dmm;
   ViAddr address;
   unsigned short id_reg, devtype_reg;

   /* Open session to VXI device at address 24 */
   viOpenDefaultRM(&defaultRM);
   viOpen(defaultRM, "VXI0::24::INSTR", VI_NULL,VI_NULL, &dmm);

   /* Map into memory space */
   viMapAddress(dmm, VI_A16_SPACE, 0x00, 0x10, VI_FALSE,
        VI_NULL, &address);

   /* Read instrument id register contents */
   viPeek16(dmm, address, &id_reg);

   /* Read device type register contents */
   /* ViAddr is defined as a void * so we must cast it to
      something else */
   /* in order to do pointer arithmetic */
   viPeek16(dmm, (ViAddr)((ViUInt16 *)address + 0x01),
        &devtype_reg);

   /* Unmap memory space */
   viUnmapAddress(dmm);

   /* Print results */
   printf ("ID Register = 0x%4X\n", id_reg);
   printf ("Device Type Register = 0x%4X\n", devtype_reg);

   /* Close sessions */
   viClose(dmm);
   viClose(defaultRM);
}
```

Example: Using the GPIB-VXI Interface (Low-Level)

This program uses low-level memory functions and the GPIB-VXI interface to read the ID and Device Type registers of a device at GPIB-VXI0::24.

```
/*gpibvxil.c
   This example program uses the low-level memory functions to
   read the id and device type registers of the device at
   GPIB-VXI0::24. Change this address if necessary. The
   register contents are then displayed.*/

#include <visa.h>
#include <stdlib.h>
#include <stdio.h>
void main () {

   ViSession defaultRM, dmm;
   ViAddr address;
   unsigned short id_reg, devtype_reg;

   /* Open session to VXI device at address 24 */
   viOpenDefaultRM(&defaultRM);
   viOpen(defaultRM, "GPIB-VXI0::24::INSTR", VI_NULL,VI_NULL,
        &dmm);

   /* Map into memory space */
   viMapAddress(dmm, VI_A16_SPACE, 0x00, 0x10, VI_FALSE,
        VI_NULL, &address);

   /* Read instrument id register contents */
   viPeek16(dmm, address, &id_reg);

   /* Read device type register contents */
   /* ViAddr is defined as a void * so we must cast it to
      something else */
   /* in order to do pointer arithmetic */
   viPeek16(dmm, (ViAddr)((ViUInt16 *)address + 0x01),
        &devtype_reg);

   /* Unmap memory space */
   viUnmapAddress(dmm);

   /* Print results */
   printf ("ID Register = 0x%4X\n", id_reg);
   printf ("Device Type Register = 0x%4X\n", devtype_reg);
   /* Close sessions */
   viClose(dmm);
   viClose(defaultRM);}
```

Using VXI Backplane Memory I/O Methods

VISA supports three different memory I/O methods for accessing memory on the VXI backplane, as shown. All three of these access methods can be used to read and write VXI memory in the A16, A24, and A32 address spaces. The best method to use depends on the VISA program characteristics.

- Low-level **`viPeek/viPoke`**
  - **`viMapAddress`**
  - **`viUnmapAddress`**
  - **`viPeek8, viPeek16, viPeek32`**
  - **`viPoke8, viPoke16, viPoke32`**
- High-level **`viIn/viOut`**
  - **`viIn8, viIn16, viIn32`**
  - **`viOut8, viOut16, viOut32`**
- High-level **`viMoveIn/viMoveOut`**
  - **`viMoveIn8, viMoveIn16, viMoveIn32`**
  - **`viMoveOut8, viMoveOut16, viMoveOut32`**

Using Low-Level `viPeek/viPoke`

Low-level **`viPeek/viPoke`** is the most efficient in programs that require repeated access to different addresses in the same memory space.

The advantages of low-level **`viPeek/viPoke`** are:

- Individual **`viPeek/viPoke`** calls are faster than **`viIn/viOut`** or **`viMoveIn/viMoveOut`** calls.
- Memory pointer may be directly dereferenced in some cases for the lowest possible overhead.

The disadvantages of low-level **`viPeek/viPoke`** are:

- **`viMapAddress`** call is required to set up mapping before **`viPeek/viPoke`** can be used.
- **`viPeek/viPoke`** calls do not return status codes.
- Only one active **`viMapAddress`** is allowed per *vi* session.
- There may be a limit to the number of simultaneous active **`viMapAddress`** calls per process or system.

Using High-level `viIn/viOut`

High-level **`viIn/viOut`** calls are best in situations where a few widely scattered memory access are required and speed is not a major consideration.

The advantages high-level **`viIn/viOut`** are:

- Simplest method to implement.
- No limit on number of active maps.
- A16, A24, and A32 memory access can be mixed in a single *vi* session.

The disadvantage of high-level **`viIn/viOut`** calls is that they are slower than **`viPeek/viPoke`**.

Using High-level `viMoveIn/ viMoveOut`

High-level **`viMoveIn/viMoveOut`** calls provide the highest possible performance for transferring blocks of data to or from the VXI backplane. Although these calls have higher initial overhead than the **`viPeek/viPoke`** calls, they are optimized on each platform to provide the fastest possible transfer rate for large blocks of data.

For small blocks, the overhead associated with **`viMoveIn/voMoveOut`** may actually make these calls longer than an equivalent loop of **`viIn/ viOut`** calls. The block size at which **`viMoveIn/viMoveOut`** becomes faster depends on the particular platform and processor speed.

The advantages of high-level **`viMoveIn/viMoveOut`** are:

- Simple to use.
- No limit on number of active maps.
- A16, A24, and A32 memory access can be mixed in a single *vi* session.
- Provides the best performance when transferring large blocks of data.
- Supports both block and FIFO mode.

The disadvantage of **`viMoveIn/viMoveOut`** calls is that they have higher initial overhead than **`viPeek/viPoke`**.

Example: Using VXI Backplane Memory I/O

This program demonstrates using various types of VXI memory I/O.

```
/* memio.c
   This example program demonstrates the use of various memory
   I/O methods in VISA. */

#include <visa.h>
#include <stdlib.h>
#include <stdio.h>

#define VXI_INST "VXI0::24::INSTR"

void main () {
   ViSession defaultRM, vi;
   ViAddr         address;
   ViUInt16       accessMode;
   unsigned short *memPtr16;
   unsigned short id_reg;
   unsigned short devtype_reg;
   unsigned short memArray[2];

   /*Open the default resource manager and a session to our
   instrument*/
   viOpenDefaultRM (&defaultRM);
   viOpen (defaultRM, VXI_INST, VI_NULL,VI_NULL, &vi);

/*    ================================================
      Low level memory I/O = viPeek16 = direct memory
      dereference (when allowed)
      ================================================*/

   /* Map into memory space */
   viMapAddress (vi, VI_A16_SPACE, 0x00, 0x10, VI_FALSE,
   VI_NULL, &address);

   /* ================================================
      Using viPeek
      ================================================/*

   Read instrument id register contents */
   viPeek16 (vi, address, &id_reg);
```

```
/* Read device type register contents
ViAddr is defined as a (void *) so we must cast it
to something else in order to do pointer arithmetic. */

viPeek16 (vi, (ViAddr)((ViUInt16 *)address + 0x01),
&devtype_reg);

/* Print results */
printf ("   viPeek16: ID Register = 0x%4X\n", id_reg);
printf ("   viPeek16: Device Type Register = 0x%4X\n",
devtype_reg);

/* Use direct memory dereferencing if it is supported */
viGetAttribute( vi, VI_ATTR_WIN_ACCESS, &accessMode );
if ( accessMode == VI_DEREF_ADDR ) {

   /* assign the pointer to a variable of the correct type */
   memPtr16 = (unsigned short *)address;

   /* do the actual memory reads */
   id_reg =      *memPtr16;
   devtype_reg = *(memPtr16+1);

   /* Print results */
   printf ("dereference: ID Register = 0x%4X\n", id_reg);
   printf ("dereference: Device Type Register = 0x%4X\n",
   devtype_reg);
}

/* Unmap memory space */
viUnmapAddress (vi);

/*================================================
 High Level memory I/O = viIn16
================================================== */

/* Read instrument id register contents */
viIn16 (vi, VI_A16_SPACE, 0x00, &&id_reg);

/* Read device type register contents */
viIn16 (vi, VI_A16_SPACE, 0x02, &devtype_reg);

/* Print results */
printf ("     viIn16: ID Register = 0x%4X\n", id_reg);
printf ("     viIn16: Device Type Register = 0x%4X\n",
devtype_reg);
```

```
/* ======================================================
   High Level block memory I/O = viMoveIn16

   The viMoveIn/viMoveOut commands do both block read/write
   and FIFO read write. These commands offer the best
   performance for reading and writing large data blocks on
   the VXI backplane. Note that for this example we are only
   moving 2 words at a time. Normally, these functions would be
   used to move much larger blocks of data.

   If the value of VI_ATTR_SRC_INCREMENT is 1 (the default),
   viMoveIn does a block read. If the value of
   VI_ATTR_SRC_INCREMENT is 0, viMoveIn does a FIFO read.

   If the value of VI_ATTR_DEST_INCREMENT is 1 (the default),
   then viMoveOut does a block write. If the value of
   VI_ATTR_DEST_INCREMENT is 0, viMoveOut does a FIFO write.

   ======================================================*/

/* Demonstrate block read.
   Read instrument id register and device type register into
   an array.*/
   viMoveIn16 (vi, VI_A16_SPACE, 0x00, 2, memArray);

   /* Print results */
   printf (" viMoveIn16: ID Register = 0x%4X\n", memArray[0]);
   printf (" viMoveIn16: Device Type Register = 0x%4X\n",
   memArray[1]);

/* Demonstrate FIFO read.
   First set the source increment to 0 so we will repetatively
   read from the same memory location.   */
   viSetAttribute( vi, VI_ATTR_SRC_INCREMENT, 0 );

   /* Do a FIFO read of the Id Register */
   viMoveIn16 (vi, VI_A16_SPACE, 0x00, 2, memArray);

   /* Print results */
   printf (" viMoveIn16: 1 ID Register = 0x%4X\n", memArray[0]);
   printf (" viMoveIn16: 2 ID Register = 0x%4X\n", memArray[1]);

   /* Close sessions */
   viClose (vi);
   viClose (defaultRM); }
```

Using the Memory Access Resource

For VISA 1.1 and later, the Memory Access Resource (MEMACC) type has been added to VXI and GPIB-VXI. VXI::MEMACC and GPIB-VXI::MEMACC allow access to all of the A16, A24, and A32 memory by providing the controller with access to arbitrary registers or memory addresses on memory-mapped buses.

The MEMACC resource, like any other resource, starts with the basic operations and attributes of other VISA resources. For example, modifying the state of an attribute is done via the the operation **`viSetAttribute`** (see *Chapter 7 - VISA Language Reference* for details).

Memory I/O Services

Memory I/O services include high-level memory I/O services and low-level memory I/O services.

High-Level Memory I/O Services

High-level Memory I/O services allow register-level access to the interfaces that support direct memory access, such as the VXIbus, VMEbus, MXIbus, or even VME or VXI memory through a system controlled by a GPIB-VXI controller. A resource exists for each interface to which the controller has access.

You can access memory on the interface bus through operations such as **`viIn16`** and **`viOut16`**. These operations encapsulate the map/unmap and peek/poke operations found in the low-level service. There is no need to explicitly map the memory to a window.

Low-Level Memory I/O Services

Low-level Memory I/O services also allow register-level access to the interfaces that support direct memory access. Before an application can use the low-level service on the interface bus, it must map a range of addresses using the operation **`viMapAddress`**.

Although the resource handles the allocation and operation of the window, the programmer must free the window via **`viUnMapAddress`** when finished. This makes the window available for the system to reallocate.

Example: MEMACC Resource Program

This program demonstrates one way to use the MEMACC resource to open the entire VXI A16 memory and then calculate an offset to address a specific device.

```
/* peek16.c */
#include <stdio.h>
#include <stdlib.h>
#include <visa.h>

#define EXIT    1
#define NO_EXIT 0

/* This function simplifies checking for VISA errors. */
void checkError( ViSession vi, ViStatus status, char *errStr,
int doexit){
   char buf[256];
   if (status >= VI_SUCCESS)
      return;
   buf[0] = 0;
   viStatusDesc( vi, status, buf );
   printf( "ERROR 0x%lx (%s)\n '%s'\n", status, errStr, buf );
   if ( doexit == EXIT )
      exit ( 1 );
}

void main()  {
   ViSession drm;
   ViSession vi;
   ViUInt16   inData16 = 0;
   ViUInt16   peekData16 = 0;
   ViUInt8    *addr;
   ViUInt16   *addr16;
   ViStatus   status;
   ViUInt16   offset;

   status = viOpenDefaultRM ( &drm );
   checkError( 0, status, "viOpenDefaultRM", EXIT );

   /* Open a session to the VXI MEMACC Resource*/
   status = viOpen( drm, "vxi0::memacc", VI_NULL, VI_NULL,
   &vi );
   checkError (0, status, "viOpen", EXIT );
```

```
   /* Calculate the A16 offset of the VXI REgisters for the
   device at VXI logical address 8. */
   offset = 0xc000 + 64 * 8;

   /* Open a map to all of A16 memory space. */
   status = viMapAddress(vi,VI_A16_SPACE,0,0x10000,VI_FALSE,0,
   (ViPAddr)(&addr));
   checkError( vi, status, "viMapAddress", EXIT );

   /* Offset the address pointer retruned from viMapAddress
   for use with viPeek16. */
   addr16 = (ViUInt16 *) (addr + offset);

   /* Peek the contents of the card's ID register (offset 0
   from card's base address. Note that viPeek does not return
   a status code. */
   viPeek16( vi, addr16, &peekData16 );

   /* Now use viIn16 and read the contents of the same
   register */
   status = viIn16(vi, VI_A16_SPACE, (ViBusAddress)offset,
   &inData16 );
   checkError(vi, status, "viIn16", NO_EXIT );

   /* Print the results. */
   printf( "inData16 : 0x%04hx\n", inData16 );
   printf( "peekData16: ox%04hx\n", peekData16 );

   viClose( vi );
   viClose (drm );
}
```

MEMACC Attribute Descriptions

Generic MEMACC Attributes

The following Read Only attributes (**VI_ATTR_TMO_VALUE** is Read/Write) provide general interface information.

Attribute	Description
VI_ATTR_INTF_TYPE	Interface type of the given session.
VI_ATTR_INTF_NUM	Board number for the given interface.

Attribute	Description
VI_ATTR_TMO_VALUE	Minimum timeout value to use, in milliseconds. A timeout value of **VI_TMO_IMMEDIATE** means operation should never wait for the device to respond. A timeout value of **VI_TMO_INFINITE** disables the timeout mechanism.
VI_ATTR_INTF_INST_NAME	Human-readable text describing the given interface.

VXI and GPIB-VXI Specific MEMACC Attributes

The following attributes, most of which are read/write, provide memory window control information.

Attribute	Description
VI_ATTR_VXI_LA	Logical address of the local controller.
VI_ATTR_SRC_INCREMENT	Used in **viMoveIn*xx*** operation to specify how much the source offset is to be incremented after every transfer. The default value is 1 and the **viMoveIn*xx*** operation moves from consecutive elements. If this attribute is set to 0, the **viMoveIn*xx*** operation will always read from the same element, essentially treating the source as a FIFO register.
VI_ATTR_DEST_INCREMENT	Used in **viMoveOut*xx*** operation to specify how much the destination offset is to be incremented after every transfer. The default value is 1 and the **viMoveOut*xx*** operation moves into consecutive elements. If this attribute is set to 0, the **viMoveOut*xx*** operation will always write to the same element, essentially treating the destination as a FIFO register.

Attribute	Description
VI_ATTR_WIN_ACCESS	Specifies modes in which the current window may be addressed: not currently mapped, through the **viPeek*xx*** or **viPoke*xx*** operations only, or through operations and/or by directly de-referencing the address parameter as a pointer.
VI_ATTR_WIN_BASE_ADDR	Base address of the interface bus to which this window is mapped.
VI_ATTR_WIN_SIZE	Size of the region mapped to this window.
VI_ATTR_SRC_BYTE_ORDER	Specifies the byte order used in high-level access operations, such as **viIn*xx*** and **viMoveIn*xx*,** when reading from the source.
VI_ATTR_DEST_BYTE_ORDER	Specifies the byte order used in high level access operations, such as **viOut*xx*** and **viMoveOut*xx***, when writing to the destination.
VI_ATTR_WIN_BYTE_ORDER	Specifies the byte order used in low-level access operations, such as **viMapAddress**, **viPeek*xx***, and **viPoke*xx***, when accessing the mapped window.
VI_ATTR_SRC_ACCESS_PRIV	Specifies the address modifier used in high-level access operations, such as **viIn*xx*** and **viMoveIn*xx***, when reading from the source.
VI_ATTR_DEST_ACCESS_PRIV	Specifies address modifier used in high-level access operations such as **viOut*xx*** and **viMoveOut*xx***, when writing to destination.
VI_ATTR_WIN_ACCESS_PRIV	Specifies address modifier used in low-level access operations, such as **viMapAddress,** **viPeek*xx***, and **viPoke*xx***, when accessing the mapped window.

GPIB-VXI Specific MEMACC Attributes

The following Read Only attributes provide specific address information about GPIB hardware.

Attribute	Description
VI_ATTR_INTF_PARENT_NUM	Board number of the GPIB board to which the GPIB-VXI is attached.
VI_ATTR_GPIB_PRIMARY_ADDR	Primary address of the GPIB-VXI controller used by the session.
VI_ATTR_GPIB_SECONDARY_ADDR	Secondary address of the GPIB-VXI controller used by the session.

MEMACC Resource Event Attribute

The following Read Only events provide notification that an asynchronous operation has completed.

Attribute	Description
VI_ATTR_EVENT_TYPE	Unique logical identifier of the event.
VI_ATTR_STATUS	Return code of the asynchronous I/O operation that has completed.
VI_ATTR_JOB_ID	Job ID of the asynchronous I/O operation that has completed.
VI_ATTR_BUFFER	Address of a buffer used in an asynchronous operation.
VI_ATTR_RET_COUNT	Actual number of elements that were asynchronously transferred.

Using VXI Specific Attributes

VXI specific attributes can be useful to determine the state of your VXI system. Attributes are read only and read/write. Read only attributes specify things such as the logical address of the VXI device and information about where your VXI device is mapped. this section shows how you might use some of the VXI specific attributes. See *Appendix B - VISA Attributes* for programming information on VISA attributes.

Using the Map Address as a Pointer

The **VI_ATTR_WIN_ACCESS** read-only attribute specifies how a window can be accessed. You can access a mapped window with the VISA low-level memory functions or with a C pointer if the address is de-referenced. To determine how to access the window, read the **VI_ATTR_WIN_ACCESS** attribute.

VI_ATTR_WIN_ACCESS Settings

The **VI_ATTR_WIN_ACCESS** read-only attribute can be set to one of the following:

Setting	Description
VI_NMAPPED	Specifies that the window is not mapped.
VI_USE_OPERS	Specifies that the window is mapped and you can only use the low-level memory functions to access the data.
VI_DEREF_ADDR	Specifies that the window is mapped and has a de-referenced address. In this case you can use the low-level memory functions to access the data, or you can use a C pointer. Using a de-referenced C pointer will allow faster access to data.

Example: Using VI_ATTR_WIN_ACCESS

This example shows how you can read the **VI_ATTR_WIN_ACCESS** attribute and use the result to determine how to access memory.

```
ViAddr address;
ViUInt16 access;
ViUInt16 value;
.
.
.
viMapAddress(vi, VI_A16_SPACE, 0x00, 0x04, VI_FALSE,
```

```
   VI_NULL, &address);
viGetAttribute(vi, VI_ATTR_WIN_ACCESS, &access);
.
.
If(access==VI_USE_OPERS) {
   viPeek16(vi, (ViAddr)(((ViUInt16 *)address) +
        4/sizeof(ViUInt16)), &value)
}else if (access==VI_DEREF_ADDR){
   value=*((ViUInt16 *)address+4/sizeof(ViUInt16));
}else if (access==VI_NMAPPED){
   return error;
}
.
.
```

Setting the VXI Trigger Line

The **VI_ATTR_TRIG_ID** attribute is used to set the VXI trigger line. This attribute is listed under generic attributes and defaults to **VI_TRIG_SW** (software trigger). To set one of the VXI trigger lines, set the **VI_ATTR_TRIG_ID** attribute as follows:

```
viSetAttribute(vi, VI_ATTR_TRIG_ID, VI_TRIG_TTL0);
```

The above function sets the VXI trigger line to TTL trigger line 0 (**VI_TRIG_TTL0**). The following are valid VXI trigger lines:

VXI Trigger Line	VI_ATTR_TRIG_ID Value
TTL 0	**VI_TRIG_TTL0**
TTL 1	**VI_TRIG_TTL1**
TTL 2	**VI_TRIG_TTL2**
TTL 3	**VI_TRIG_TTL3**
TTL 4	**VI_TRIG_TTL4**
TTL 5	**VI_TRIG_TTL5**
TTL 6	**VI_TRIG_TTL6**
TTL 7	**VI_TRIG_TTL7**
ECL 0	**VI_TRIG_ECL0**
ECL 1	**VI_TRIG_ECL1**

Once you set a VXI trigger line, you can set up an event handler to be called when the trigger line fires. See *Chapter 4 - Programming with VISA* for more information on setting up an event handler.

Once the **VI_EVENT_TRIG** event is enabled, the **VI_ATTR_TRIG_ID** becomes a read only attribute and cannot be changed. You must set this attribute prior to enabling event triggers.

The **VI_ATTR_TRIG_ID** attribute can also be used by the **viAssertTrigger** function to assert software or hardware triggers. If **VI_ATTR_TRIG_ID** is **VI_TRIG_SW**, the device is sent a Word Serial Trigger command. If the attribute is any other value, a hardware trigger is sent on the line corresponding to the value of that attribute.

6

Programming over LAN

Programming over LAN

This chapter gives guidelines to use VISA over a LAN (Local Area Network). A LAN is a way to extend the control of instrumentation beyond the limits of typical instrument interfaces. The chapter contents are:

- LAN Overview
- Using the LAN

NOTE

To communicate over the LAN, you must first configure the **`VISA LAN Client`** during Agilent IO Libraries configuration. See the *Agilent IO Libraries Installation and Configuration Guide* for installation information.

To start or stop the LAN server, see the *Agilent IO Libraries Installation and Configuration Guide* for details.

LAN Overview

This section provides an overview of the LAN, including:

- LAN Client/Server Model
- LAN Hardware Architecture
- LAN Software Architecture
- LAN Configuration and Performance

LAN Client/Server Model

The LAN software provided with VISA allows instrumentation control over a LAN. Using standard LAN connections, instruments can be controlled from computers that do not have special interfaces for instrument control.

The LAN software provided with VISA uses the client/server model of computing. **Client/server computing** refers to a model where an application (the **client)** does not perform all necessary tasks of the application itself. Instead, the client makes requests of another computing device (the **server**) for certain services. Examples include shared file servers, print servers, or database servers.

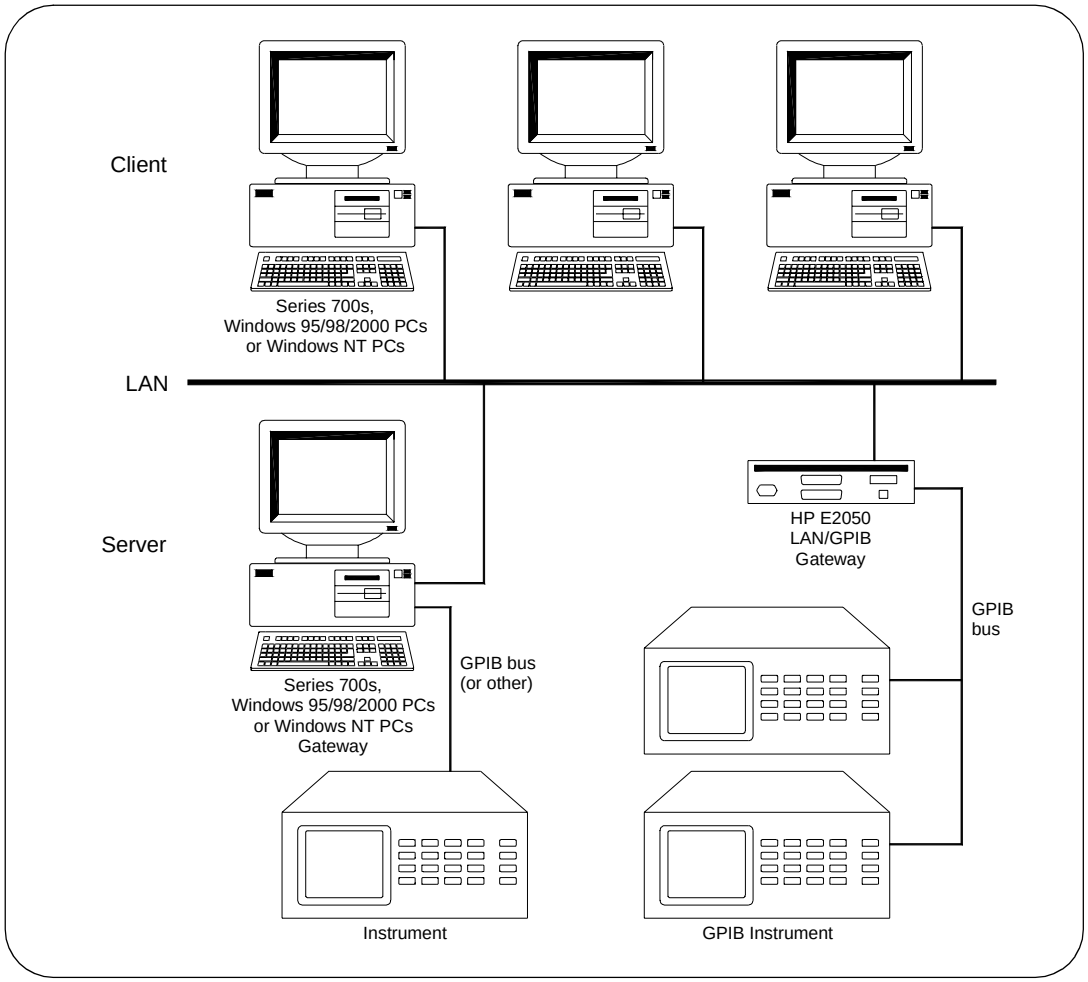
The use of LAN for instrument control also provides other advantages associated with client/server computing, such as resource sharing by multiple applications/people within an organization or distributed control, where the computer running the application controlling the devices need not be in the same room (or even the same building) as the devices.

LAN Hardware Architecture

As shown in the following figure, a LAN client computer system (a Series 700 HP-UX workstation, a Windows 95/98/2000 PC, or a Windows NT PC) makes VISA requests over the network to a LAN server (a Series 700 HP-UX workstation, a Windows 95/98/2000 PC, a Windows NT PC, or an E2050 LAN/GPIB Gateway).

The LAN server is connected to the instrumentation or devices to be controlled. Once the LAN server has completed the requested operation on the instrument or device, the LAN server sends a reply to the LAN client. This reply contains requested data and status information that indicates whether or not the operation was successful.

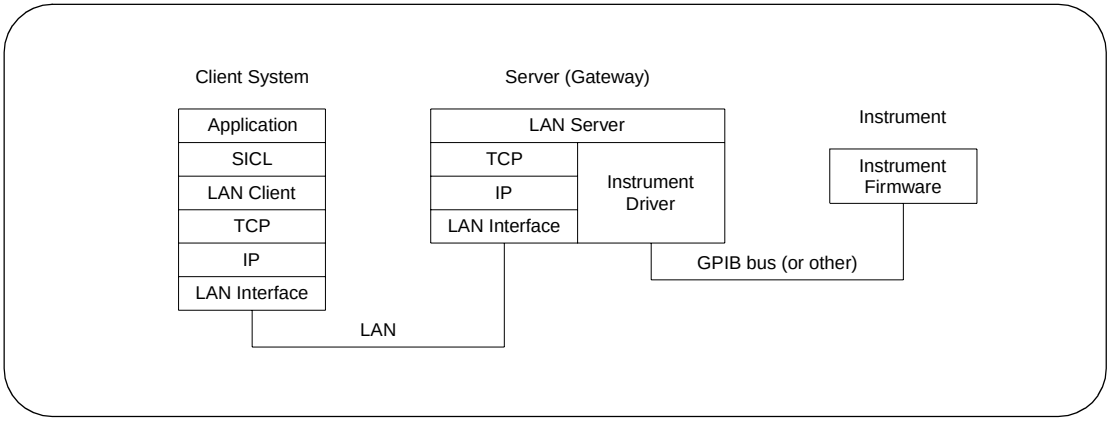
The LAN server acts as a **gateway** between the LAN that the client system supports and the instrument-specific interface that the device supports. Devices or interfaces that are accessed via one of the LAN-to-instrument/ interface gateways are called a LAN-gatewayed device or a LAN-gatewayed interface.



LAN Client/Server (Gateway) Architecture

LAN Software Architecture

As shown in the following figure, the client system contains the LAN client software and the LAN software (TCP/IP) needed to access the server (gateway). The gateway contains the LAN server software, LAN (TCP/IP) software, and the instrument driver software needed to communicate with the client and to control the instruments or devices connected to the gateway.



LAN Networking Protocols

The LAN software provided with VISA is built on top of standard LAN networking protocols. There are two LAN networking protocols provided with the VISA software. You can use one or both of these protocols when configuring your systems (via the Agilent IO Libraries configuration) to use VISA over LAN.

- **SICL LAN Protocol** is a networking protocol developed by Hewlett-Packard and Agilent that is compatible with all VISA LAN products. This LAN networking protocol is the default choice in the Agilent IO Libraries configuration when configuring the LAN client. The SICL LAN protocol on HP-UX 10.20, Windows 95, Windows 98, Windows 2000, and Windows NT supports VISA operations over LAN to GPIB interfaces.

- **TCP/IP Instrument Protocol** is a networking protocol developed by the VXIbus Consortium based on the SICL LAN Protocol that permits interoperability of LAN software from different vendors who meet the VXIbus Consortium standards.

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NOTE

The TCP/IP Instrument Protocol may not be implemented with all LAN products. The TCP/IP Instrument Protocol on Windows 95, Windows 98, Windows 2000, and Windows NT supports VISA operations over the LAN to GPIB interfaces.

When using either of these networking protocols, the LAN software provided with VISA uses the TCP/IP protocol suite to pass messages between the LAN client and the LAN server. The server accepts device I/O requests over the network from the client and then proceeds to execute those I/O requests on a local interface (GPIB, etc.).

You can use both LAN networking protocols (SICL LAN Protocol and TCP/IP Instrument Protocol) with a LAN client. To do this, configure a LAN client and a VISA LAN client interface for each protocol, one specifying the SICL LAN Protocol and one specifying the TCP/IP Instrument Protocol. The LAN client and VISA LAN client are configured during the Agilent IO Libraries configuration. See the *Agilent IO Libraries Installation and Configuration Guide* for information.

When you have configured VISA LAN client interfaces, one specifying SICL LAN Protocol and one specifying TCP/IP Instrument Protocol, you can then use the interface name specified during configuration in your VISA **`viOpen`** call of your program. However, the LAN server does *not* support simultaneous connections from LAN clients using the SICL LAN Protocol and from LAN clients using the TCP/IP Instrument Protocol.

LAN Client and Threads

You can use multi-threaded designs (where VISA calls are made from multiple threads) in VISA applications over LAN. However, only one thread is permitted to access the LAN driver at a time. This sequential handling of individual threads by the LAN driver prevents multiple threads from colliding or overwriting one another.

Requests are handled sequentially even if they are intended for different LAN servers. If you want concurrent threads to be processed simultaneously with VISA over LAN, use multiple processes.

LAN Server

There are three LAN servers that can be used with VISA: the E2050 LAN/GPIB Gateway, an HP Series 700 computer running HP-UX, or a PC running Windows 95, Windows 98, Windows 2000, or Windows NT. To use this capability, the LAN server must have a local GPIB interface configured for I/O. See the *Agilent IO Libraries Installation and Configuration Guide* for configuration information.

NOTE

Timing of operations performed remotely over a network will be different from the timing of operations performed locally. The extent of the timing difference will, in part, depend on the bandwidth of the network and the traffic on the network being used.

LAN Configuration and Performance

As with other client/server applications on a LAN, when deploying an application which uses VISA over LAN, consideration must be given to the performance and configuration of the network to which the client and server will be attached. If the network to be used is not a dedicated LAN or otherwise isolated via a bridge or other network device, current use of the LAN must be considered.

Depending upon the amount of data to be transferred over the LAN via the VISA application, performance problems could be experienced by the VISA application or other network users if sufficient bandwidth is not available. This is not unique to VISA over LAN, but is a general design consideration when deploying any client/server application.

If you have questions concerning the ability of your network to handle VISA traffic, consult with your network administrator or network equipment providers.

Using the LAN

This section gives guidelines to use the LAN, including:

- Communicating with Devices over LAN
- Using Timeouts over LAN
- Using Signal Handling over LAN
- Using Service Requests over LAN

Communicating with Devices over LAN

VISA supports LAN-gatewayed sessions to communicate with configured LAN servers. Since the LAN server configuration is determined by the type of server present, the only action required by the user is to configure VISA for a **`VISA LAN Client`** during Agilent IO Libraries configuration. See the *Agilent IO Libraries Installation and Configuration Guide* for information on configuring a **`VISA LAN Client`**.

NOTE

A LAN session to a remote interface provides the same VISA function support as if the interface was local, except that all VXI specific functions are *not* supported over LAN.

Addressing a Session

In general, the rules to address a LAN session are the same as to address a GPIB session. The only difference for a LAN session is that you use the VISA Interface Name (provided during I/O configuration) that relates to the **`VISA LAN Client`**. This example illustrates addressing a GPIB device configured over the LAN.

GPIB0::7::0	A GPIB device at primary address 7 and secondary address 0 on the GPIB interface. This GPIB interface (GPIB0) is configured as a VISA LAN Client in the Agilent IO Libraries configuration.

This example shows one way to open a device session with a GPIB device at primary address 23. See *Chapter 4 - Programming with VISA* for more information on addressing device sessions.

```
ViSession defaultRM, vi;.
.
viOpenDefaultRM(&defaultRM);
viOpen(defaultRM, "GPIB0::23::INSTR", VI_NULL,
     VI_NULL, &vi);
.  .
viClose(vi);
viClose(defaultRM);
```

Example: LAN Session

This program opens a session with a GPIB device and sends a comma operator to send a comma-separated list. The program is intended to show specific VISA functionality and does not include error trapping. Error trapping, however, is good programming practice and is recommended in your VISA applications. See *Chapter 4 - Programming with VISA* for information on error trapping.

```
/*formatio.c
   This example program makes a multimeter measurement
   with a comma-separated list passed with formatted I/O and
   prints the results. Note that you must change the device
   address. */

#include <visa.h>
#include <stdio.h>

void main () {

   ViSession defaultRM, vi;
   double res;
   double list [2] = {1,0.001};

   /* Open session to GPIB device at address 22 */
   viOpenDefaultRM(&defaultRM);
   viOpen(defaultRM, "GPIB0::22::INSTR", VI_NULL,VI_NULL, &vi);

   /* Initialize device */
   viPrintf(vi, "*RST\n");

   /* Set up device and send comma-separated list */
   viPrintf(vi, "CALC:DBM:REF 50\n");
   viPrintf(vi, "MEAS:VOLT:AC? %,2f\n", list);

   /* Read results */
   viScanf(vi, "%lf", &res);
```

```
   /* Print results */
   printf ("Measurement Results: %lf\n", res);

   /* Close session */
   viClose(vi);
   viClose(defaultRM);
}
```

Using Timeouts over LAN

The client/server architecture of the LAN software requires the use of two timeout values: one for the client and one for the server.

Client/Server Operation

The server's timeout value is specified by setting a VISA timeout via the **VI_ATTR_TMO_VALUE** attribute. The server will also adjust the requested value if infinity is requested. The client's timeout value is determined by the values set when you configure the **LAN Client** during the Agilent IO Libraries configuration. See the *Agilent IO Libraries Installation and Configuration Guide* for configuration information.

When the client sends an I/O request to the server, the timeout value determined by the values set with the **VI_ATTR_TMO_VALUE** attribute is passed with the request. The client may also adjust the value sent to the server if **VI_TMO_INFINITE** was specified. The server will use that timeout in performing the I/O operation, just as if that timeout value had been used on a local I/O operation.

If the server's operation is not complete in the specified time, the server will send a reply to the client which indicates that a timeout occurred, and the VISA call made by the application will return an error.

When the client sends an I/O request to the server, it starts a timer and waits for the reply from the server. If the server does not reply in the time specified, the client stops waiting for the reply from the server and returns an error.

LAN Timeout Values

The **`LAN Client`** configuration specifies two timeout-related configuration values for the LAN software. These values are used by the software to calculate timeout values. See the *Agilent IO Libraries Installation and Configuration Guide* for information on setting these values.

- **Server Timeout**. Timeout value passed to the server when an application sets the VISA timeout to infinity (**`VI_TMO_INFINITE`**). Value specifies the number of seconds the server will wait for the operation to complete before returning an error. If this value is zero (0), the server will wait forever.

- **Client Timeout Delta.** Value added to the VISA timeout value (server's timeout value) to determine the LAN timeout value (client's timeout value). Value specifies the number of seconds.

The timeouts are adjusted using the following algorithm.

- The VISA Timeout, which is sent to the server for the current call, is adjusted if it is currently infinity (**`VI_TMO_INFINITE`**). In that case, it will be set to the Server Timeout value.

- The LAN Timeout is adjusted if the VISA Timeout plus the Client Timeout Delta is greater than the current LAN Timeout. In this case, the LAN Timeout is set to the VISA Timeout plus the Client Timeout Delta.

- The calculated LAN Timeout increases as necessary to meet the needs of the application, but never decreases. This avoids the overhead of readjusting the LAN Timeout every time the application changes the VISA Timeout.

To change the defaults:

1. Run the **`IO Config`** utility (Windows) or the **`visacfg`** utility (HP-UX).
2. Edit the **`LAN Client`** interface.
3. Change the Server Timeout or Client Timeout Delta parameter. (See online help for information on changing these values.)
4. Restart the VISA LAN applications.

Application Terminations and Timeouts

If an application is killed either via **Ctrl**+**C** or the HP-UX **`kill`** command during a VISA operation performed at the LAN server, the server will continue to try the operation until the server's timeout is reached.

By default, the LAN server associated with an application using a timeout of infinity that is killed may not discover that the client is no longer running for up to two minutes. (If you are using a server other than the LAN server supported with the product, check that server's documentation for its default behavior.)

If both the LAN client and LAN server are configured to use a long timeout value, the server may appear "hung." If this situation is encountered, the LAN client (via the Server Timeout value) or the LAN server may be configured to use a shorter timeout value.

If long timeouts must be used, the server may be reset. An HP-UX server may be reset by logging into the server host and killing the running **`siclland`** daemon(s). However, this procedure will affect all clients connected to the server.

A Windows 95, Windows 98, Windows 2000, or Windows NT server may be reset by typing **Ctrl**+**C** in the LAN Server window and then restarting the server from the **`Agilent IO Libraries`** program group. This procedure will also affect all clients connected to the server.

Using Signal Handling over LAN

VISA uses SIGIO signals for SRQs on LAN interfaces on HP-UX. The VISA LAN client installs a signal handler to catch SIGIO signals. To enable sharing of SIGIO signals with other portions of an application, the VISA LAN SIGIO signal handler remembers the address of any previously installed SIGIO handler and calls this handler after processing a SIGIO signal itself.

If your application installs a SIGIO handler, it should also remember the address of a previously installed handler and call it before completing. The signal number used with LAN (SIGIO) *cannot* be changed.

Using Service Requests over LAN

If multiple devices assert SRQs at roughly the same time causing the SRQ line to stay asserted, even after all devices have been polled using **`viReadSTB`**, subsequent service requests from devices may be lost since the SRQ handler(s) will not be invoked again until the line is cleared.

For SRQs to be reliably delivered, an SRQ handler must not exit without first clearing the SRQ line. However, VISA does not provided a way to check the SRQ line. One way to ensure reliable delivery of SRQs is to service all devices from one handler, disabling all devices from sending additional SRQs at the top of the handler. One way to do this follows.

```
disable all devices from requesting service
serial_poll (device1)
if (needs_service) service_device1
serial_poll (device2)
if (needs_service) service_device2
.
.
enable all devices to send service requests
```

Even if different sessions are in different processes, it is important to stay in the SRQ handler until the SRQ line is released. However, the only way to ensure true independence of multiple GPIB processes is to use multiple GPIB interfaces.

Another way this situation can be avoided is to configure a VISA LAN client to use the SICL LAN protocol. Then, if the LAN server is a Windows 95, Windows 98, Windows 2000, Windows NT, or HP-UX 10.x system running the LAN server that is shipped with this product, this method is handled transparently.

Notes:

7

VISA Language Reference

VISA Language Reference

This chapter describes each function in the VISA library for the Windows and HP-UX programming environments. VISA functions are listed in alphabetical order.

VISA Functions Overview

VISA functions can be grouped according to the types of functions performed, as shown in the following table. The **OUT** parameters are identified by the type definition. That is, all **OUT** parameters are defined with a pointer type: **ViPUInt16**, **ViPRsrc**, etc.

The data types for the VISA function parameters (for example, **ViSession**, **ViEventType**, etc.) are defined in the VISA declarations file. They are also explained in *Appendix D - VISA Type Definitions*.

Operation	Function (Type *Parameter1*, Type *Parameter2*, ...);
Resource Management: Open Default Resource Manager Session	**viOpenDefaultRM(ViPSession** *sesn***);**
Lifecycle: Open Session	**viOpen(ViSession** *sesn***, ViRsrc** *rsrcName***,** **ViAccessMode** *accessMode***, ViUInt32** *timeout***,** **ViPSession** *vi***);**
Close Session	**viClose(ViSession/ViEvent/ViFindList** *vi***);**
Characteristic Control: Get Attribute	**viGetAttribute(ViSession/ViEvent/ViFindList** *vi***,** **ViAttr** *attribute***, ViPAttrState** *attrState***);**
Set Attribute	**viSetAttribute(ViSession/ViEvent/ViFindList** *vi***,** **ViAttr** *attribute***, ViAttrState** *attrState***);**
Get Status Code Description	**viStatusDesc(ViSession/ViEvent/ViFindList** *vi***,** **ViStatus** *status***, ViPString** *desc***);**

Operation	Function (Type *Parameter1*, Type *Parameter2*, ...);
Asynchronous Operation Control: Terminate Asynchronous Operation	**viTerminate(ViSession vi, ViUInt16** *degree*, **ViJobId** *jobId*);
Access Control: Lock Resource	**viLock(ViSession** *vi*, **ViAccessMode** *lockType*, **ViUInt32** *timeout*,**ViKeyId** *requestedKey*, **ViPKeyId** *accessKey*);
Unlock Resource	**viUnlock(ViSession** *vi*);
Event Handling: Enable Event	**viEnableEvent(ViSession** *vi*, **ViEventType** *eventType*, **ViUInt16** *mechanism*, **ViEventFilter** *context*);
Disable Event	**viDisableEvent(ViSession** *vi*, **ViEventType** *eventType*, **ViUInt16** *mechanism*);
Discard Events	**viDiscardEvents(ViSession** *vi*, **ViEventType** *eventType*, **ViUInt16** *mechanism*);
Wait on Event	**viWaitOnEvent(ViSession** *vi*, **ViEventType** *inEventType*, **ViUInt32** *timeout*, **ViPEventType** *outEventType*, **ViPEvent** *outContext*);
Install Handler	**viInstallHandler(ViSession** *vi*, **ViEventType** *eventType*, **ViHndlr** *handler*, **ViAddr** *userHandle*);
Uninstall Handler	**viUninstallHandler(ViSession** *vi*, **ViEventType** *eventType*,**ViHndlr** *handler*, **ViAddr** *userHandle*);
Event Handler Prototype	**viEventHandler(ViSession** *vi*, **ViEventType** *eventType*, **ViEvent** *context*, **ViAddr** *userHandle*);
Searching: Find Device	**viFindRsrc(ViSession** *sesn*, **ViString** *expr*, **ViPFindList** *findList*, **ViPUInt32** *retcnt*, **ViPRsrc** *instrDesc*);
Find Next Device	**viFindNext(ViFindList** *findList*, **ViPRsrc** *instrDesc*);

Operation	Function (Type *Parameter1*, Type *Parameter2*, ...);
Basic I/O:	
Read Data from Device	**viRead(ViSession** *vi*, **ViPBuf** *buf*, **ViUInt32** *count*, **ViPUInt32** *retCount*);
Read Data Asynchronously from Device	**viReadAsync(ViSession** *vi*, **ViPBuf** *buf*, **ViUInt32** *count*, **ViPJobId jobId);**
Write Data to Device	**viWrite(ViSession** *vi*, **ViBuf** *buf*, **ViUInt32** *count*, **ViPUInt32** *retCount*);
Write Data Asynchronously to Device	**viWriteAsync(ViSession** *vi*, **ViBuf** *buf*, **ViUInt32** *count*, **ViPJobId** *jobId*);
Assert Software/Hardware Trigger	**viAssertTrigger(ViSession** *vi*, **ViUInt16** *protocol*);
Read Status Byte	**viReadSTB(ViSession** *vi*, **ViPUInt16** *status*);
Clear a Device	**viClear(ViSession** *vi*);

Operation	Function (Type *Parameter1*, Type *Parameter2*, ...);
Formatted I/O:	
Set Size of Buffer	**viSetBuf(ViSession** *vi*, **ViUInt16** *mask*, **ViUInt32** *size*);
Unformatted Read/Write to Formatted I/O Buffers	**viBufRead(***vi, buf, count, retCount*); **viBufWrite(***vi, buf, count, retCount*);
Flush Read and Write Buffers	**viFlush(ViSession** *vi*, **ViUInt16** *mask*);
Convert, Format, and Send Parameters	**viPrintf(ViSession** *vi*, **ViString** *writeFmt*, *arg1*, *arg2*, ...); **viVPrintf(ViSession** *vi*, **ViString** *writeFmt*, **ViVAList** *params*); **viSPrintf(***vi, buf, writeFmt, arg1, arg2, ...*); **viVSPrintf(***vi, buf, writeFmt, params*);
Read, Convert, Format, and Store Data	**viScanf(ViSession** *vi*, **ViString** *readFmt*, *arg1*, *arg2*, ...); **viVScanf(ViSession** *vi*, **ViString** *readFmt*, **ViVAList** *params*); **viSScanf (***vi, buf, readFmt, arg1, arg2, ...*); **viVSScanf** (*vi, buf, readFmt, params*);
Write and Read Formatted Data	**viQueryf(ViSession** *vi*, **ViString** *writeFmt*, **ViString** *readFmt*, *arg1*, *arg2*, ...);
Write and Read Formatted Data	**viVQueryf(ViSession** *vi*, **ViString** *writeFmt*, **ViString** *readFmt*, **ViVAList** *params*);

Operation	Function (Type *Parameter1*, Type *Parameter2*, ...);
Memory I/O:	
Read 8-bit Value from Memory Space	**viIn8(ViSession** *vi*, **ViUInt16** *space*, **ViBusAddress** *offset*, **ViPUInt8** *val8*);
Read 16-bit Value from Memory Space	**viIn16(ViSession** *vi*, **ViUInt16** *space*, **ViBusAddress** *offset*, **ViPUInt16** *val16*);
Read 32-bit Value from Memory Space	**viIn32(ViSession** *vi*, **ViUInt16** *space*, **ViBusAddress** *offset*,**ViPUInt32** *val32*);
Write 8-bit Value to Memory Space	**viOut8(ViSession** *vi*, **ViUInt16** *space*, **ViBusAddress** *offset*,**ViUInt8** *val8*);
Write 16-bit Value to Memory Space	**viOut16(ViSession** *vi*, **ViUInt16** *space*, **ViBusAddress** *offset*, **ViUInt16** *val16*);
Write 32-bit Value to Memory Space	**viOut32(ViSession** *vi*, **ViUInt16** *space*, **ViBusAddress** *offset*, **ViUInt32** *val32*);
Move data from source to destination	**viMove (ViSession** *vi*, **ViUInt16** *srsSpace*, **ViBusAddress** *srcOffset*, **ViUInt16** *srcWidth*, **ViUInt16** *destSpace*, **ViBusAddress** *destOffset*, **ViUInt16** *destWidth*, **ViBusSize** *length***)**
Move data from source to destination asynchronously	**viMoveAsync (ViSession** *vi*, **ViUInt16** *srsSpace*, **ViBusAddress** *srcOffset*, **ViUInt16** *srcWidth*, **ViUInt16** *destSpace*, **ViBusAddress** *destOffset*, **ViUInt16** *destWidth*, **ViBusSize** *length*, **ViJobId** *jobId***)**
Move 8-bit Value from Device Memory to Local Memory	**viMoveIn8(ViSession** *vi*, **ViUInt16** *space*, **ViBusAddress** *offset*,**ViBusSize** *length*, **ViAUInt8** *buf8*);
Move 16-bit Value from Device Memory to Local Memory	**viMoveIn16(ViSession** *vi*, **ViUInt16** *space*, **ViBusAddress** *offset*,**ViBusSize** *length*, **ViAUInt16** *buf16*);
Move 32-bit Value from Device Memory to Local Memory	**viMoveIn32(ViSession** *vi*, **ViUInt16** *space*, **ViBusAddress** *offset*,**ViBusSize** *length*, **ViAUInt32** *buf32*);

Operation	Function (Type *Parameter1*, Type *Parameter2*, ...);
Move 8-bit Value from Local Memory to Device Memory	**viMoveOut8(ViSession** *vi*, **ViUInt16** *space*, **ViBusAddress** *offset*,**ViBusSize** *length*, **ViAUInt8** *buf8*);
Move 16-bit Value from Local Memory to Device Memory	**viMoveOut16(ViSession** *vi*, **ViUInt16** *space*, **ViBusAddress** *offset*,**ViBusSize** *length*, **ViAUInt16** *buf16*);
Move 32-bit Value from Local Memory to Device Memory	**viMoveOut32(ViSession** *vi*, **ViUInt16** *space*, **ViBusAddress** *offset*,**ViBusSize** *length*, **ViAUInt32** *buf32*);
Map Memory Space	**viMapAddress(ViSession** *vi*, **ViUInt16** *mapSpace*, **ViBusAddress** *mapBase*, **ViBusSize** *mapSize*, **ViBoolean** *access*,**ViAddr** *suggested*, **ViPAddr** *address*);
Unmap Memory Space	**viUnmapAddress(ViSession** *vi*);
Read 8-bit Value from Address	**viPeek8(ViSession** *vi*, **ViAddr** *addr*, **ViPUInt8** *val8*);
Read 16-bit Value from Address	**viPeek16(ViSession** *vi*, **ViAddr** *addr*, **ViPUInt16** *val16*);
Read 32-bit Value from Address	**viPeek32(ViSession** *vi*, **ViAddr** *addr*, **ViPUInt32** *val32*);
Write 8-bit Value to Address	**viPoke8(ViSession** *vi*, **ViAddr** *addr*, **ViUInt8** *val8*);
Write 16-bit Value to Address	**viPoke16(ViSession** *vi*, **ViAddr** *addr*, **ViUInt16** *val16*);
Write 32-bit Value to Address	**viPoke32(ViSession** *vi*, **ViAddr** *addr*, **ViUInt32** *val32*);
Shared Memory:	
Allocate Memory	**viMemAlloc(ViSession** *vi*, **ViBusSize** *size*, **ViPBusAddress** *offset*);
Free Memory Previously Allocated	**viMemFree(ViSession** *vi*, **ViBusAddress** *offset*);
GPIB Specific Services	**viGpibControlREN(***vi, mode***);**

viAssertTrigger

Syntax

viAssertTrigger(ViSession *vi*, **ViUInt16** *protocol*);

> **NOTE**
>
> This function is *not* supported with the GPIB-VXI interface.

Description

This function asserts a software or hardware trigger dependent on the interface type. For a GPIB device, the device is addressed to listen, and then the GPIB GET command is sent.

For a VXI device, if **VI_ATTR_TRIG_ID** is **VI_TRIG_SW**, the device is sent the Word Serial Trigger command. For a VXI device, if **VI_ATTR_TRIG_ID** is any other value, a hardware trigger is sent on the line corresponding to the value of that attribute.

For GPIB and VXI software triggers, **VI_TRIG_PROT_DEFAULT** is the only valid protocol. For VXI hardware triggers, **VI_TRIG_PROT_DEFAULT** is equivalent to **VI_TRIG_PROT_SYNC**.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
protocol	IN	**ViUInt16**	Trigger protocol to use during assertion. Valid values are: **VI_TRIG_PROT_DEFAULT**, **VI_TRIG_PROT_ON**, **VI_TRIG_PROT_OFF**, and **VI_TRIG_PROT_SYNC**.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	The specified trigger was successfully asserted to the device.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_INV_PROT	The protocol specified is invalid.
VI_ERROR_TMO	Timeout expired before function completed.
VI_ERROR_RAW_WR_PROT_VIOL	Violation of raw write protocol occurred during transfer.
VI_ERROR_RAW_RD_PROT_VIOL	Violation of raw read protocol occurred during transfer.
VI_ERROR_INP_PROT_VIOL	Device reported an input protocol error occurred during transfer.
VI_ERROR_BERR	Bus error occurred during transfer.
VI_ERROR_LINE_IN_USE	The specified trigger line is currently in use.
VI_ERROR_NCIC	The interface associated with the given *vi* is not currently the controller in charge.
VI_ERROR_NLISTENERS	No Listeners condition is detected (both NRFD and NDAC are deasserted).
VI_ERROR_INV_SETUP	Unable to start operation because setup is invalid (due to attributes being set to an inconsistent state).

viBufRead

Syntax

viBufRead (*vi, buf, count, retCount***);**

Description

Similar to **viRead**, except that the operation uses the formatted I/O read buffer for holding data read from the device. This operation is similar to **viRead** and does not perform any kind of data formatting. It differs from **viRead** in that the data is read from the formatted I/O read buffer (the same buffer as used by **viScanf** and related operations) rather than directly from the device. This operation can intermix with the **viScanf** operation, but use with the **viRead** operation is discouraged.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
buf	OUT	**ViBuf**	Represents the location of a buffer to receive data from the device.
count	IN	**ViUInt32**	Number of bytes to be read.
retCount	OUT	**ViUInt32**	Represents the location of an integer that will be set to the number of bytes actually transferred.

Special Values for *retCount* Parameter

Value	Action Description
VI_NULL	Do not return the number of bytes transferred.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Codes	Description
VI_SUCCESS	The operation completed successfully and the END indicator was received (for interfaces that have END indicators).
VI_SUCCESS_TERM_CHAR	The specified termination character was read.
VI_SUCCESS_MAX_CNT	The number of bytes read is equal to *count*.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_TMO	Timeout expired before function completed.
VI_ERROR_IO	An unknown I/O error occurred during transfer.

See Also

viWrite, viScanf

viBufWrite

Syntax

viBufWrite (*vi, buf, count, retCount***);**

Description

Similar to **viWrite**, except the data is written to the formatted I/O write buffer rather than directly to the device. This operation is similar to **viWrite** and does not perform any kind of data formatting.

It differs from **viWrite** in that the data is written to the formatted I/O write buffer (the same buffer as used by **viPrintf** and related operations) rather than directly to the device. This operation can intermix with the **viPrintf** operation, but mixing it with the **viWrite** operation is discouraged.

If you pass **VI_NULL** as the retCount parameter to the **viBufWrite** operation, the number of bytes transferred will not be returned. This may be useful if it is important to know only whether the operation succeeded or failed.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
buf	IN	**ViBuf**	Represents the location of a data block to be sent to the device.
count	IN	**ViUInt32**	Number of bytes to be written.
retCount	OUT	**ViUInt32**	Represents the location of an integer that will be set to the number of bytes actually transferred.

Special Values for *retCount* Parameter

Value	Action Description
VI_NULL	Do not return the number of bytes transferred.

Return Values

Type **`ViStatus`** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
`VI_SUCCESS`	Operation completed successfully.

Error Codes	Description
`VI_ERROR_INV_SESSION` **`VI_ERROR_INV_OBJECT`**	The given session or object reference is invalid (both are the same value).
`VI_ERROR_NSUP_OPER`	The given *vi* does not support this function.
`VI_ERROR_RSRC_LOCKED`	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
`VI_ERROR_TMO`	Timeout expired before function completed.
`VI_ERROR_INV_SETUP`	Unable to start write operation because setup is invalid (due to attributes being set to an inconsistent state).
`VI_ERROR_IO`	An unknown I/O error occurred during transfer.

See Also

viWrite, `viBufRead`

viClear

Syntax

```
viClear(ViSession vi);
```

Description

This function performs an IEEE 488.1-style clear of the device. VXI uses the Word Serial Clear command and GPIB uses the Selective Device Clear command.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Operation completed successfully.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_TMO	Timeout expired before function completed.
VI_ERROR_RAW_WR_PROT_VIOL	Violation of raw write protocol occurred during transfer.

Error Codes	Description
VI_ERROR_RAW_RD_PROT_VIOL	Violation of raw read protocol occurred during transfer.
VI_ERROR_BERR	Bus error occurred during transfer.
VI_ERROR_NCIC	The interface associated with the given *vi* is not currently the controller in charge.
VI_ERROR_NLISTENERS	No Listeners condition is detected (both NRFD and NDAC are deasserted).
VI_ERROR_INV_SETUP	Unable to start operation because setup is invalid (due to attributes being set to an inconsistent state).

viClose

Syntax

viClose(ViSession/ViEvent/ViFindList *vi***);**

Description

This function closes the specified resource manager session, device session, find list (returned from the **viFindRsrc** function), or event context (returned from the **viWaitOnEvent** function, or passed to an event handler). In this process, all the data structures that had been allocated for the specified *vi* are freed.

NOTE

The **viClose** function should not be called from within an event handler. In VISA 1.1 and greater, **viClose** (**VI_NULL**) returns **VI_WARN_NULL_OBJECT** rather than an error.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession** **ViEvent** **ViFindList**	Unique logical identifier to a session, event, or find list.

Return Values

Type **`ViStatus`** This is the function return status. It returns either a completion code or an error code as follows.

Completion Codes	Description
`VI_SUCCESS`	Session closed successfully.
`VI_WARN_NULL_OBJECT`	The specified object reference is uninitialized.

Error Codes	Description
`VI_ERROR_INV_SESSION` **`VI_ERROR_INV_OBJECT`**	The given session or object reference is invalid (both are the same value).
`VI_ERROR_CLOSING_FAILED`	Unable to deallocate the previously allocated data structures corresponding to this session or object reference.

See Also

viOpen, viFindRsrc, viWaitOnEvent, viEventHandler

viDisableEvent

Syntax

```
viDisableEvent(ViSession vi, ViEventType eventType,
    ViUInt16 mechanism);
```

Description

This function disables servicing of an event identified by the *eventType* parameter for the mechanisms specified in the *mechanism* parameter. Specifying **VI_ALL_ENABLED_EVENTS** for the *eventType* parameter allows a session to stop receiving all events.

The session can stop receiving queued events by specifying **VI_QUEUE**. Applications can stop receiving callback events by specifying either **VI_HNDLR** or **VI_SUSPEND_HNDLR**. Specifying **VI_ALL_MECH** disables both the queuing and callback mechanisms.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
eventType	IN	**ViEventType**	Logical event identifier. (See the following tables.)
mechanism	IN	**ViUInt16**	Specifies event handling mechanisms to be disabled. The queuing mechanism is disabled by specifying **VI_QUEUE.** The callback mechanism is disabled by specifying **VI_HNDLR** or **VI_SUSPEND_HNDLR**. It is possible to disable both mechanisms simultaneously by specifying **VI_ALL_MECH**. (See the following table.)

Special Values for *eventType* Parameter

Value	Action Description
VI_ALL_ENABLED_EVENTS	Disable all events that were previously enabled.

The following events can be disabled:

Event Name	Description
VI_EVENT_SERVICE_REQ	Notification that a device is requesting service.
VI_EVENT_VXI_SIGP	Notification that a VXI signal or VXI interrupt has been received from a device.
VI_EVENT_TRIG	Notification that a hardware trigger was received from a device.
VI_EVENT_IO_COMPLETION	Notification that an asynchronous operation has completed.

Special Values for *mechanism* Parameter

Value	Action Description
VI_QUEUE	Disable this session from receiving the specified event(s) via the waiting queue.
VI_HNDLR or **VI_SUSPEND_HNDLR**	Disable this session from receiving the specified event(s) via a callback handler or a callback queue.
VI_ALL_MECH	Disable this session from receiving the specified event(s) via any mechanism.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Codes	Description
VI_SUCCESS	Event disabled successfully.
VI_SUCCESS_EVENT_DIS	Specified event is already disabled for at least one of the specified mechanisms.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_INV_EVENT	Specified event type is not supported by the resource.
VI_ERROR_INV_MECH	Invalid mechanism specified.

See Also

See the handler prototype **viEventHandler** for its parameter description, and **viEnableEvent**. Also, see **viInstallHandler** and **viUninstallHandler** descriptions for information about installing and uninstalling event handlers. See event descriptions for context structure definitions.

viDiscardEvents

Syntax

viDiscardEvents(ViSession *vi*, **ViEventType** *eventType*, **ViUInt16** *mechanism*);

Description

This function discards all pending occurrences of the specified event types for the mechanisms specified in a given session. The information about all the event occurrences which have not yet been handled is discarded. This function is useful to remove event occurrences that an application no longer needs.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
eventType	IN	**ViEventType**	Logical event identifier. (See the following tables.)
mechanism	IN	**ViUInt16**	Specifies the mechanisms for which the events are to be discarded. **VI_QUEUE** is specified for the queuing mechanism and **VI_SUSPEND_HNDLR** is specified for the pending events in the callback mechanism. It is possible to specify both mechanisms simultaneously by specifying **VI_ALL_MECH**. (See the following table.)

Special Values for *eventType* **Parameter**

Value	Action Description
VI_ALL_ENABLED_EVENTS	Discard events of every type that is enabled.

The following events can be discarded**:**

Event Name	Description
VI_EVENT_SERVICE_REQ	Notification that a device is requesting service.
VI_EVENT_VXI_SIGP	Notification that a VXI signal or VXI interrupt has been received from a device.
VI_EVENT_TRIG	Notification that a hardware trigger was received from a device.
VI_EVENT_IO_COMPLETION	Notification that an asynchronous operation has completed.

Special Values for *mechanism* **Parameter**

Value	Action Description
VI_QUEUE	Discard the specified event(s) from the waiting queue.
VI_SUSPEND_HNDLR	Discard the specified event(s) from the callback queue.
VI_ALL_MECH	Discard the specified event(s) from all mechanisms.

Return Values

Type **`ViStatus`** This is the function return status. It returns either a completion code or an error code as follows.

Completion Codes	Description
`VI_SUCCESS`	Event queue flushed successfully.
`VI_SUCCESS_QUEUE_EMPTY`	Operation completed successfully, but queue was empty.

Error Codes	Description
`VI_ERROR_INV_SESSION` **`VI_ERROR_INV_OBJECT`**	The given session or object reference is invalid (both are the same value).
`VI_ERROR_INV_EVENT`	Specified event type is not supported by the resource.
`VI_ERROR_INV_MECH`	Invalid mechanism specified.

See Also

viEnableEvent, viWaitOnEvent, viInstallHandler

viEnableEvent

Syntax

```
viEnableEvent(ViSession vi, ViEventType eventType,
  ViUInt16 mechanism, ViEventFilter context);
```

Description

This function enables notification of an event identified by the *eventType* parameter for mechanisms specified in the *mechanism* parameter. The specified session can be enabled to queue events by specifying **VI_QUEUE**.

Applications can enable the session to invoke a callback function to execute the handler by specifying **VI_HNDLR**. The applications are required to install at least one handler to be enabled for this mode.

Specifying **VI_SUSPEND_HNDLR** enables the session to receive callbacks, but the invocation of the handler is deferred to a later time. Successive calls to this function replace the old callback mechanism with the new callback mechanism.

Specifying **VI_ALL_ENABLED_EVENTS** for the *eventType* parameter refers to all events which have previously been enabled on this session, making it easier to switch between the two callback mechanisms for multiple events.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
eventType	IN	**ViEventType**	Logical event identifier. (See the following tables.)

Name	Direction	Type	Description
mechanism	IN	**ViUInt16**	Specifies event handling mechanisms to be enabled. The queuing mechanism is enabled by specifying **VI_QUEUE**, and the callback mechanism is enabled by specifying **VI_HNDLR** or **VI_SUSPEND_HNDLR**. It is possible to enable both mechanisms simultaneously by specifying "bit-wise OR" of **VI_QUEUE** and one of the two mode values for the callback mechanism.
context	IN	**ViEventFilter**	**VI_NULL** (Not used for VISA 1.0.)

Special Values for *eventType* **Parameter**

Value	Action Description
VI_ALL_ENABLED_EVENTS	Switch all events that were previously enabled to the callback mechanism specified in the mechanism parameter.

The following events can be enabled:

Event Name	Description
VI_EVENT_SERVICE_REQ	Notification that a device is requesting service.
VI_EVENT_VXI_SIGP	Notification that a VXI signal or VXI interrupt has been received from a device.
VI_EVENT_TRIG	Notification that a hardware trigger was received from a device.
VI_EVENT_IO_COMPLETION	Notification that an asynchronous operation has completed.

Special Values for *mechanism* Parameter

Value	Action Description
VI_QUEUE	Enable this session to receive the specified event via the waiting queue. Events must be retrieved manually via the **viWaitOnEvent** function.
VI_HNDLR	Enable this session to receive the specified event via a callback handler, which must have already been installed via **viInstallHandler**.
VI_SUSPEND_HNDLR	Enable this session to receive the specified event via a callback queue. Events will not be delivered to the session until **viEnableEvent** is invoked again with the **VI_HNDLR** mechanism.

NOTE

Any combination of VISA-defined values for different parameters of this function is also supported (except for **VI_HNDLR** and **VI_SUSPEND_HNDLR**, which apply to different modes of the same mechanism).

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Codes	Description
VI_SUCCESS	Event enabled successfully.
VI_SUCCESS_EVENT_EN	Specified event is already enabled for at least one of the specified mechanisms.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_INV_EVENT	Specified event type is not supported by the resource.
VI_ERROR_INV_MECH	Invalid mechanism specified.
VI_ERROR_INV_CONTEXT	Specified event context is invalid.
VI_ERROR_HNDLR_NINSTALLED	A handler is not currently installed for the specified event. The session cannot be enabled for the **VI_HNDLR** mode of the callback mechanism.

See Also

See the handler prototype **viEventHandler** for its parameter description and **viDisableEvent**. Also, see the **viInstallHandler** and **viUninstallHandler** descriptions for information about installing and uninstalling event handlers.

viEventHandler

Syntax

```
viEventHandler(ViSession vi, ViEventType eventType,
  ViEvent context, ViAddr userHandle);
```

Description

This is a prototype for a function, which you define. The function you define is called whenever a session receives an event and is enabled for handling events in the **VI_HNDLR** mode. The handler services the event and returns **VI_SUCCESS** on completion.

Because each *eventType* defines its own context in terms of attributes, refer to the appropriate event definition to determine which attributes can be retrieved using the *context* parameter.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
eventType	IN	**ViEventType**	Logical event identifier. (See the following table.)
context	IN	**ViEvent**	A handle specifying the unique occurrence of an event.
userHandle	IN	**ViAddr**	A value specified by an application that can be used for identifying handlers uniquely in a session for an event.

The following table lists the events and the associated read only attributes that can be read to get event information on a specific event:

Event Name	Attributes	Data Type	Values
VI_EVENT_SERVICE_REQ	**VI_ATTR_EVENT_TYPE**	**ViEventType**	**VI_EVENT_SERVICE_REQ**
VI_EVENT_VXI_SIGP	**VI_ATTR_EVENT_TYPE** **VI_ATTR_SIGP_STATUS_ID**	**ViEventType** **ViUInt16**	**VI_EVENT_VXI_SIGP** **0 to FFFF$_h$**

Event Name	Attributes	Data Type	Values
VI_EVENT_TRIG	**VI_ATTR_EVENT_TYPE** **VI_ATTR_RECV_TRIG_ID**	**ViEventType** **ViInt16**	**VI_EVENT_TRIG** **VI_TRIG_TTL0 to VI_TRIG_TTL7** **VI_TRIG_ECL0 to VI_TRIG_ECL1**
VI_EVENT_IO_COMPLETION	**VI_ATTR_EVENT_TYPE** **VI_ATTR_STATUS** **VI_ATTR_JOB_ID** **VI_ATTR_BUFFER** **VI_ATTR_RET_COUNT**	**ViEventType** **ViStatus** **ViJobId** **ViBuf** **ViUInt32**	**VI_EVENT_IO_COMPLETION** **N/A** **N/A** **N/A** **0 to FFFFFFFF$_h$**

Use the VISA **viReadSTB** function to read the status byte of the service request.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Event handled successfully.

See Also

See *Chapter 4 - Programming with VISA* for more information on event handling and exception handling.

viFindNext

Syntax

```
viFindNext(ViFindList findList, ViPRsrc instrDesc);
```

Description

This function returns the next resource found in the list created by **viFindRsrc**. The list is referenced by the handle that was returned by **viFindRsrc**.

Parameters

Name	Direction	Type	Description
findList	IN	**ViFindList**	Describes a find list. This parameter must be created by **viFindRsrc**.
instrDesc	OUT	**ViPRsrc**	Returns a string identifying the location of a device. Strings can then be passed to **viOpen** to establish a session to the given device.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Resource(s) found.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	Given *findList* does not support this function.
VI_ERROR_RSRC_NFOUND	There are no more matches.

See Also **viFindRsrc**

viFindRsrc

Syntax

viFindRsrc(ViSession *sesn*, **ViString** *expr*, **ViPFindList** *findList*, **ViPUInt32** *retcnt*, **ViPRsrc** *instrDesc*);

Description

This function queries a VISA system to locate the resources associated with a specified interface. This function matches the value specified in the *expr* parameter with the resources available for a particular interface.

On successful completion, it returns the first resource found in the list and returns a count to indicate if there were more resources found that match the value specified in the *expr* parameter.

This function also returns a handle to a find list. This handle points to the list of resources, and it must be used as an input to **viFindNext**. When this handle is no longer needed, it should be passed to **viClose**.

Parameters

Name	Direction	Type	Description
sesn	IN	**ViSession**	Resource Manager session (should always be the Default Resource Manager for VISA returned from **viOpenDefaultRM**).
expr	IN	**ViString**	This expression sets the criteria to search an interface or all interfaces for existing devices. (See the following table for description string format.)
findList	OUT	**ViFindList**	Returns a handle identifying this search session. This handle will be used as an input in **viFindNext**.
retcnt	OUT	**ViUInt32**	Number of matches.
instrDesc	OUT	**ViRsrc**	Returns a string identifying the location of a device. Strings can then be passed to **viOpen** to establish a session to the given device.

Description String for *expr* Parameter

Interface	Expression
GPIB	**GPIB[0-9]*::?*INSTR**
VXI	**VXI?*INSTR**
GPIB-VXI	**GPIB-VXI?*INSTR**
GPIB and GPIB-VXI	**GPIB?*INSTR**
All VXI	**?*VXI[0-9]*::?*INSTR**
ASRL	**ASRL[0-9]*::?*INSTR**
All	**?*INSTR**

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Resource(s) found.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given *sesn* does not support this function.
VI_ERROR_INV_EXPR	Invalid expression specified for search.
VI_ERROR_RSRC_NFOUND	Specified expression does not match any devices.

See Also

viFindNext, viClose

viFlush

Syntax

viFlush(ViSession *vi*, **ViUInt16** *mask*);

Description

This function manually flushes the read and write buffers associated with formatted I/O functions.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
mask	IN	**ViUInt16**	Specifies the action to be taken with flushing the buffer. (See the following table.)

Values for *mask* **Parameter**

Flag	Interpretation
VI_READ_BUF	Discard the read buffer contents and, if data was present in the read buffer and no END-indicator was present, read from the device until encountering an END indicator (which causes the loss of data). This action resynchronizes the next **viScanf** call to read a <TERMINATED RESPONSE MESSAGE>. (Refer to the IEEE 488.2 standard.)
VI_READ_BUF_DISCARD	Discard the read buffer contents (does not perform any I/O to the device).
VI_WRITE_BUF	Flush the write buffer by writing all buffered data to the device.
VI_WRITE_BUF_DISCARD	Discard the write buffer contents (does not perform any I/O to the device).
VI_ASRL_IN_BUF	Discard the receive buffer contents (same as **VI_ASRL_IN_BUF_DISCARD**).
VI_ASRL_IN_BUF_DISCARD	Discard the receive buffer contents (does not perform an I/O to the device).

Flag	Interpretation
VI_ASRL_OUT_BUF	Flush the transmit buffer by writing all buffered data to the device.
VI_ASRL_OUT_BUF_DISCARD	Discard the transmit buffer contents (does not perform any I/O to the device).

NOTE

It is possible to combine any of these read flags with a write flag (and vice-versa) by ORing the flags. However, combining two read flags or two write flags in the same call to **viFlush** is illegal.

In this implementation, it is not possible to discard the ASRL in and out buffers separately. **VI_ASRL_IN_BUF_DISCARD** and **VI_ASRL_OUT_BUF_DISCARD** must always be set together. If only one is set, **VI_ERROR_INV_MASK** is returned.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Buffers flushed successfully.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_IO	Could not perform read/write function because of I/O error.
VI_ERROR_TMO	The read/write function was aborted because timeout expired while function was in progress.
VI_ERROR_INV_MASK	The specified *mask* does not specify a valid flush function on read/write resource.

See Also **viSetBuf**

viGetAttribute

Syntax

```
viGetAttribute(ViSession/ViEvent/ViFindList vi,
  ViAttr attribute, ViPAttrState attrState);
```

Description

This function retrieves the state of an attribute for the specified session.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession** **ViEvent** **ViFindList**	Unique logical identifier to a session, event, or find list.
attribute	IN	**ViAttr**	Resource attribute for which the state query is made.
attrState	OUT	See Note below.	The state of the queried attribute for a specified resource. The interpretation of the returned value is defined by the individual resource. Note that you must allocate space for character strings returned.

NOTE

The pointer passed to **viGetAttribute** must point to the exact type required for that attribute, **ViUInt16, ViInt32**, etc.. For example, when reading an attribute state that returns a **ViChar**, you must pass a pointer to a **ViChar** variable. You must allocate space for the returned data.

Return Values

Type **`ViStatus`** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
`VI_SUCCESS`	Resource attribute retrieved successfully.

Error Codes	Description
`VI_ERROR_INV_SESSION` **`VI_ERROR_INV_OBJECT`**	The given session or object reference is invalid (both are the same value).
`VI_ERROR_NSUP_ATTR`	The specified attribute is not defined by the referenced resource.

See Also

viSetAttribute

viGpibControlREN

Syntax

viGpibControlREN(*vi***,** *mode***);**

Description

Controls the state of the GPIB REN interface line and, optionally, the remote/local state of the device. This operation asserts or deasserts the GPIB REN interface line according to the specified mode.

The mode can also specify whether the device associated with this session should be placed in local state (before deasserting REN) or remote state (after asserting REN). This operation is valid only if the GPIB interface associated with the session specified by *vi* is currently the system controller.

An INSTR resource implementation of **viGpibControlREN** for a GPIB System supports all documented modes. An INTFC resource implementation of **viGpibControlREN** for a GPIB System supports the modes **VI_GPIB_REN_DEASSERT**, **VI_GPIB_REN_ASSERT**, and **VI_GPIB_REN_ASSERT_LLO**.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
mode	IN	**ViUInt16**	Specifies the state of the REN line and, optionally, the device remote/local state.

Special Values for *mode* Parameter

mode	Action Description
VI_GPIB_REN_DEASSERT	Deassert REN line.
VI_GPIB_REN_ASSERT	Assert REN line.
VI_GPIB_REN_DEASSERT_GTL	Send the Go To Local command (GTL) to this device and deassert REN line.
VI_GPIB_REN_ASSERT_ADDRESS	Assert REN line and address this device.
VI_GPIB_REN_ASSERT_LLO	Send LLO to any devices that are addressed to listen.

mode	Action Description
VI_GPIB_REN_ASSERT_ADDRESS_LLO	Address this device and send it LLO, putting it in RWLS.
VI_GPIB_REN_ADDRESS_GTL	Send the Go To Local command (GTL) to this device.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Resource attribute retrieved successfully.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given *vi* does not support this operation.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_NCIC	The interface associated with this session is not currently the controller in charge.
VI_ERROR_NLISTENERS	No listeners condition is detected (both NRFD and NDAC are deasserted).
VI_ERROR_NSYS_CNTLR	The interface associated with this session is not the system controller.
VI_ERROR_INV_MODE	The value specified by the *mode* parameter is invalid.

viIn8, viIn16, and viIn32

Syntax

```
viIn8(ViSession vi, ViUInt16 space, ViBusAddress offset,
  ViPUInt8 val8);

viIn16(ViSession vi, ViUInt16 space, ViBusAddress offset,
  ViPUInt16 val16);

viIn32(ViSession vi, ViUInt16 space, ViBusAddress offset,
  ViPUInt32 val32);
```

Description

This function reads in an 8-bit, 16-bit, or 32-bit value from the specified memory space (assigned memory base + *offset*). This function takes the 8-bit, 16-bit, or 32-bit value from the address space pointed to by *space*. The *offset* must be a valid memory address in the *space*. This function does not require **viMapAddress** to be called prior to its invocation.

If the **viSession** parameter (*vi*) refers to an INSTR session, the *offset* parameter specifies a relative offset from the start of the instrument's address *space*. If the **viSession** parameter (*vi*) refers to a MEMACC session, the *offset* parameter is an absolute offset from the start of memory in that VXI address *space*.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
space	IN	**ViUInt16**	Specifies the address space. (See the following table.)
offset	IN	**ViBusAddress**	Offset (in bytes) of the memory to read from.
val8, val16, or val32	OUT	**ViPUInt8, ViPUInt16,** or **ViPUInt32**	Data read from bus (8-bits for **viIn8**, 16-bits for **viIn16**, and 32-bits for **viIn32**).

Values for *space* Parameter

Value	Description
VI_A16_SPACE	Maps in VXI/MXI A16 address space.
VI_A24_SPACE	Maps in VXI/MXI A24 address space.
VI_A32_SPACE	Maps in VXI/MXI A32 address space.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Operation completed successfully.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_BERR	Bus error occurred during transfer.
VI_ERROR_INV_SPACE	Invalid address space specified.
VI_ERROR_INV_OFFSET	Invalid offset specified.
VI_ERROR_NSUP_OFFSET	Specified offset is not accessible from this hardware.
VI_ERROR_NSUP_WIDTH	Specified width is not supported by this hardware.
VI_ERROR_NSUP_ALIGN_OFFSET	The specified offset is not properly aligned for the access width of the operation.

See Also

viOut8, viOut16, viOut32, viPeek8, viPeek16, viPeek32, viMoveIn8, viMoveIn16, viMoveIn32

viInstallHandler

Syntax

```
viInstallHandler(ViSession vi, ViEventType eventType,
  ViHndlr handler, ViAddr userHandle);
```

Description

This function allows applications to install handlers on sessions for event callbacks. The handler specified in the *handler* parameter is installed along with previously installed handlers for the specified event. Applications can specify a value in the *userHandle* parameter that is passed to the handler on its invocation. VISA identifies handlers uniquely using the handler reference and this value.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
eventType	IN	**ViEventType**	Logical event identifier.
handler	IN	**ViHndlr**	Interpreted as a valid reference to a handler to be installed by an application.
userHandle	IN	**ViAddr**	A value specified by an application that can be used for identifying handlers uniquely for an event type.

The following events can be enabled:

Event Name	Description
VI_EVENT_SERVICE_REQ	Notification that a device is requesting service.
VI_EVENT_VXI_SIGP	Notification that a VXI signal or VXI interrupt has been received from a device.
VI_EVENT_TRIG	Notification that a hardware trigger was received from a device.
VI_EVENT_IO_COMPLETION	Notification that an asynchronous operation has completed.

Return Values

Type **`ViStatus`** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
`VI_SUCCESS`	Event handler installed successfully.

Error Codes	Description
`VI_ERROR_INV_SESSION` **`VI_ERROR_INV_OBJECT`**	The given session or object reference is invalid (both are the same value).
`VI_ERROR_INV_EVENT`	Specified event type is not supported by the resource.
`VI_ERROR_INV_HNDLR_REF`	The given handler reference is invalid.
`VI_ERROR_HNDLR_NINSTALLED`	The handler was not installed. This may be returned if an application attempts to install multiple handlers for the same event on the same session.

See Also

viEventHandler

viLock

Syntax

viLock(ViSession *vi*, **ViAccessMode** *lockType*, **ViUInt32** *timeout*, **ViKeyId** *requestedKey*, **ViPKeyId** *accessKey*);

NOTE

The **viLock** function is *not* supported on network devices.

Description

This function is used to obtain a lock on the specified resource. The caller can specify the type of lock requested (exclusive or shared lock) and the length of time the operation will suspend while waiting to acquire the lock before timing out. This function can also be used for sharing and nesting locks.

The *requestedKey* and *accessKey* parameters apply only to shared locks. These parameters are not applicable when using the lock type **VI_EXCLUSIVE_LOCK**. In this case, *requestedKey* and *accessKey* should be set to **VI_NULL**. VISA allows user applications to specify a key to be used for lock sharing through the use of the *requestedKey* parameter.

Alternatively, a user application can pass **VI_NULL** for the *requestedKey* parameter when obtaining a shared lock, in which case VISA will generate a unique access key and return it through the *accessKey* parameter. If a user application does specify a *requestedKey* value, VISA will try to use this value for the *accessKey*.

As long as the resource is not locked, VISA will use the *requestedKey* as the access key and grant the lock. When the operation succeeds, the *requestedKey* will be copied into the user buffer referred to by the *accessKey* parameter.

The session that gained a shared lock can pass the *accessKey* to other sessions for the purpose of sharing the lock. The session wanting to join the group of sessions sharing the lock can use the key as an input value to the *requestedKey* parameter.

VISA will add the session to the list of sessions sharing the lock, as long as the *requestedKey* value matches the *accessKey* value for the particular resource. The session obtaining a shared lock in this manner will then have the same access privileges as the original session that obtained the lock.

It is also possible to obtain nested locks through this function. To acquire nested locks, invoke the **viLock** function with the same lock type as the previous invocation of this function. For each session, **viLock** and **viUnlock** share a lock count, which is initialized to **0**. Each invocation of **viLock** for the same session (and for the same *lockType*) increases the lock count.

A shared lock returns with the same *accessKey* every time. When a session locks the resource a multiple number of times, it is necessary to invoke the **viUnlock** function an equal number of times in order to unlock the resource. That is, the lock count increments for each invocation of **viLock**, and decrements for each invocation of **viUnlock**. A resource is actually unlocked only when the lock count is **0**.

NOTE

On HP-UX, SIGALRM is used in implementing the **viLock** when *timeout* is non-zero. The **viLock** function's use of SIGALRM is exclusive – an application should not also expect to use SIGALRM at the same time.

NOTE

On HP-UX, some semaphores used in locking are permanently allocated and diminish the number of semaphores available for applications. If the operating system runs out of semaphores, the number of semaphores may be increased by doing the following:

1. Run **sam**.
2. Double-click **Kernel Configuration**.
3. Double-click **Configurable Parameters**.
4. Change **semmni** and **semmns** to a higher value, such as **300**.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
lockType	IN	**ViAccessMode**	Specifies the type of lock requested, which can be **VI_EXCLUSIVE_LOCK** or **VI_SHARED_LOCK**.

Name	Direction	Type	Description
timeout	IN	**ViUInt32**	Absolute time period (in milliseconds) that a resource waits to get unlocked by the locking session before returning this operation with an error. **VI_TMO_IMMEDIATE** and **VI_TMO_INFINITE** are also valid values.
requestedKey	IN	**ViKeyId**	This parameter is not used and should be set to **VI_NULL** when **lockType** is **VI_EXCLUSIVE_LOCK** (exclusive lock). When trying to lock the resource as **VI_SHARED_LOCK** (shared lock), a session can either set it to **VI_NULL** so that VISA generates an *accessKey* for the session, or the session can suggest an *accessKey* to use for the shared lock. See "Description" for more details.
accessKey	OUT	**ViPKeyId**	This parameter should be set to **VI_NULL** when *lockType* is **VI_EXCLUSIVE_LOCK** (exclusive lock). When trying to lock the resource as **VI_SHARED_LOCK** (shared lock), the resource returns a unique access key for the lock if the operation succeeds. This *accessKey* can then be passed to other sessions to share the lock.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Codes	Description
VI_SUCCESS	The specified access mode was successfully acquired.
VI_SUCCESS_NESTED_EXCLUSIVE	The specified access mode was successfully acquired, and this session has nested exclusive locks.
VI_SUCCESS_NESTED_SHARED	The specifed access mode was successfully acquired, and this session has nested shared locks.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given *vi* does not identify a valid session or object.
VI_ERROR_RSRC_LOCKED	The specified type of lock cannot be obtained because the resource is already locked with a lock type incompatible with the lock requested.
VI_ERROR_INV_LOCK_TYPE	The specified type of lock is not supported by this resource.
VI_ERROR_INV_ACCESS_KEY	The *requestedKey* value passed is not a valid access key to the specified resource.
VI_ERROR_TMO	The specified type of lock could not be obtained within the specified timeout period.

See Also

viUnlock. For more information on locking, see *Chapter 4 - Programming with VISA*.

viMapAddress

Syntax

```
viMapAddress(ViSession vi, ViUInt16 mapSpace,
  ViBusAddress mapBase, ViBusSize mapSize,
  ViBoolean access, ViAddr suggested, ViPAddr address);
```

Description

This function maps in a specified memory space. The memory space that is mapped is dependent on the type of interface specified by the *vi* parameter and the *mapSpace* parameter (see the following table). The *address* parameter returns the address in your process space where memory is mapped.

If the **viSession** parameter (*vi*) refers to an INSTR session, the *mapBase* parameter specifies a relative offset in the instrument's *mapSpace*. If the **viSession** parameter (*vi*) refers to a MEMACC session, the *mapBase* parameter is an absolute offset from the start of the VXI *mapSpace*.

NOTE

For a given session, you can only have one map at one time. If you need to have multiple maps to a device, you must open one session for each map needed.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
mapSpace	IN	**ViUInt16**	Specifies the address space to map. (See the following table.)
mapBase	IN	**ViBusAddress**	Offset (in bytes) of the memory to be mapped.
mapSize	IN	**ViBusSize**	Amount of memory to map (in bytes).
access	IN	**ViBoolean**	**VI_FALSE**.

Name	Direction	Type	Description
suggested	IN	**ViAddr**	If suggested parameter is not **VI_NULL**, the operating system attempts to map the memory to the address specified in *suggested*. There is no guarantee, however, that the memory will be mapped to that address. This function may map the memory into an address region different from *suggested*.
address	OUT	**ViPAddr**	Address in your process space where the memory was mapped.

Values for *mapSpace* Parameter

Value	Description
VI_A16_SPACE	Maps in VXI/MXI A16 address space.
VI_A24_SPACE	Maps in VXI/MXI A24 address space.
VI_A32_SPACE	Maps in VXI/MXI A32 address space.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Map successful.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given vi does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_INV_SPACE	Invalid *mapSpace* specified.

Error Codes	Description
VI_ERROR_INV_OFFSET	Invalid *offset* specified.
VI_ERROR_NSUP_OFFSET	Specified region is not accessible from this hardware.
VI_ERROR_TMO	**viMapAddress** could not acquire resource or perform mapping before the timer expired.
VI_ERROR_INV_SIZE	Invalid size of window specified.
VI_ERROR_ALLOC	Unable to allocate window of at least the requested size.
VI_ERROR_INV_ACC_MODE	Invalid access mode.
VI_ERROR_WINDOW_MAPPED	The specified session already contains a mapped window.
VI_ERROR_INV_SETUP	Unable to start operation because the setup is invalid (due to attributes being set to an inconsistent state).

See Also **viUnmapAddress**

viMemAlloc

Syntax

viMemAlloc(ViSession *vi*, **ViBusSize** *size*, **ViPBusAddress** *offset*);

Description

This function returns an offset into a device's memory region that has been allocated for use by this session. If the device to which the given *vi* refers is located on the local interface card, the memory can be allocated either on the device itself or on the computer's system memory.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
size	IN	**ViBusSize**	Specifies the size of the allocation.
offset	OUT	**ViPBusAddress**	Returns the offset of the allocated device memory.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	The operation completed successfully.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given *vi* does not support this operation.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_INV_SIZE	Invalid size specified.

Error Codes	Description
VI_ERROR_ALLOC	Unable to allocate shared memory block of the requested size.
VI_ERROR_MEM_NSHARED	The device does not export any memory.

See Also **viMemFree**

viMemFree

Syntax

viMemFree(ViSession *vi*, **ViBusAddress** *offset*);

Description

This function frees the memory previously allocated using **viMemAlloc**.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
offset	IN	**ViBusAddress**	Specifies the memory previously allocated with **viMemAlloc**.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	The operation completed successfully.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given *vi* does not support this operation.
VI_ERROR_INV_OFFSET	Invalid offset specified.
VI_ERROR_WINDOW_NMAPPED	The specified offset is currently in use by **viMapAddress**.

See Also

viMemAlloc

viMove

Syntax

```
viMove (ViSession vi, ViUInt16 srcSpace,
        ViBusAddress srcOffset, ViUInt16 srcWidth,
        ViUInt16 destSpace, ViBusAddress destOffset,
        ViUInt16 destWidth, ViBusSize length)
```

Description

This operation moves data from the specified source to the specified destination. The source and the destination can either be local memory or the offset of the interface with which this INSTR or MEMACC resource is associated. This operation uses the specified data width and address space.

If the **viSession** parameter (*vi*) refers to an INSTR session, the offset parameters specify relative offsets from the start of the instrument's address space. If the **viSession** parameter (*vi*) refers to a MEMACC session, the offset parameters are absolute offsets from the start of memory in the specified VXI address space.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
srcSpace	IN	**ViUInt16**	Specifies the address space of the source.
srcOffset	IN	**ViBusAddress**	Offset of the starting address or register from which to read.
srcWidth	IN	**ViUInt16**	Specifies the data width of the source.
destSpace	IN	**ViUInt16**	Specifies the address space of the destination.
destOffset	IN	**ViBusAddress**	Specifies the address space of the destination
destWidth	IN	**ViUInt16**	Specifies the data width of the destination.

Name	Direction	Type	Description
length	IN	**ViBusSize**	Number of data elements to transfer, where the data width of the elements to transfer is identical to the source data width.

Valid entries for specifying address space:

Value	Description
VI_A16_SPACE	Address A16 memory address space of the VXI/MXI bus.
VI_A24_SPACE	Address A24 memory address space of the VXI/MXI bus.
VI_A32_SPACE	Address A32 memory address space of the VXI/MXI bus.
VI_LOCAL_SPACE	Addresses the process-local memory (using virtual address).

Valid entries for specifying widths**:**

Value	Description
VI_WIDTH_8	Performs an 8-bit (D08) transfer.
VI_WIDTH_16	Performs a 16-bit (D16) transfer.
VI_WIDTH_32	Performs a 32-bit (D32) transfer.

Return Values

Type **ViStatus** This is the operational return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Operation completed successfully.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given *vi* does not support this operation.

Error Codes	Description
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_BERR	Bus Error occurred during transfer.
VI_ERROR_INV_SPACE	Invalid source or destination address specified.
VI_ERROR_INV_OFFSET	Invalid source or destination offset specified.
VI_ERROR_INV_WIDTH	Invalid source or destination width specified.
VI_ERROR_NSUP_OFFSET	Specified source or destination offset is not accessible from this hardware.
VI_ERROR_NSUP_VAR_WIDTH	Cannot support source and destination widths that are different.
VI_ERROR_INV_SETUP	Unable to start operation because setup is invalid (due to attributes being set to an inconsistent state).
VI_ERROR_NSUP_WIDTH	Specified width is not supported.
VI_ERROR_NSUP_ALIGH_OFFSET	The specified offset is not properly aligned for the access width of the operation.
VI_ERROR_INV_LENGTH	Invalid length specified.

See Also

viMoveAsync. Also, see MEMACC Resource Description.

viMoveAsync

Syntax

```
viMoveAsync (ViSession vi, ViUInt16 srcSpace,
             ViBusAddress srcOffset, ViUInt16 srcWidth,
             ViUInt16 destSpace, ViBusAddress destOffset,
             ViUInt16 destWidth, ViBusSize length,
             ViJobId jobId)
```

Description

This operation asynchronously moves data from the specified source to the specified destination. This operation queues up the transfer in the system, then it returns immediately without waiting for the transfer to complete. When the transfer terminates, a **VI_EVENT_IO_COMPLETE** event indicates the status of the transfer.

The operation returns *jobId* which you can use either with **viTerminate**() to abort the operation or with **VI_EVENT_IO_COMPLETION** events to identify which asynchronous move operations completed. The source and destination can be either local memory or the offset of the device/interface with which this INSTR or MEMACC Resource is associated. This operation uses the specified data width and address space.

If the **viSession** parameter (*vi*) refers to an INSTR session, the offset parameters specify relative offsets from the start of the instrument's address space. If the **viSession** parameter (*vi*) refers to a MEMACC session, the offset parameters are absolute offsets from the start of memory in the specified VXI address space.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
srcSpace	IN	**ViUInt16**	Specifies the address space of the source.
srcOffset	IN	**ViBusAddress**	Offset of the starting address or register from which to read.
srcWidth	IN	**ViUInt16**	Specifies the data width of the source.

Name	Direction	Type	Description
destSpace	IN	**ViUInt16**	Specifies the address space of the destination.
destOffset	IN	**ViBusAddress**	Offset of the starting address or register to write to.
destWidth	IN	**ViUInt16**	Specifies the data width of the destination.
length	IN	**ViBusSize**	Number of data elements to transfer, where the data width of the elements to transfer is identical to the source data width.
jobId	OUT	**ViJobId**	Represents the location of an integer that will be set to the job identifier of this asynchronous move operation. Each time an asynchronous move operation is called, it is assigned a unique job identifier.

Valid entries for specifying address space:

Value	Description
VI_A16_SPACE	Address A16 memory address space of the VXI/MXI bus.
VI_A24_SPACE	Address A24 memory address space of the VXI/MXI bus.
VI_A32_SPACE	Address A32 memory address space of the VXI/MXI bus.
VI_LOCAL_SPACE	Addresses the process-local memory (using virtual address).

Valid entries for specifying widths:

Value	Description
VI_WIDTH_8	Performs an 8-bit (D08) transfer.
VI_WIDTH_16	Performs a 16-bit (D16) transfer.
VI_WIDTH_32	Performs a 32-bit (D32) transfer.

Special value for *jobId* parameter:

Value	Description
VI_NULL	Operation does not return a job identifier.

Return Values

Type **ViStatus** This is the operational return status. It returns either a completion code or an error code as follows.

Completion Codes	Description
VI_SUCCESS	Asynchronous operation completed successfully.
VI_SUCCESS_SYNC	Operation Perfomed synchronously.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given *vi* does not support this operation.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_QUEUE	Unable to queue move operation.

See Also

viMove. Also, see the INSTR and MEMACC Resource descriptions.

viMoveIn8, viMoveIn16, and viMoveIn32

Syntax

```
viMoveIn8(ViSession vi, ViUInt16 space,
  ViBusAddress offset, ViBusSize length, ViAUInt8 buf8);

viMoveIn16(ViSession vi, ViUInt16 space,
  ViBusAddress offset, ViBusSize length, ViAUInt16 buf16);

viMoveIn32(ViSession vi, ViUInt16 space,
  ViBusAddress offset, ViBusSize length, ViAUInt32 buf32);
```

Description

This function moves an 8-bit, 16-bit, or 32-bit block of data from the specified memory space (assigned memory base + *offset*) to local memory. This function reads the 8-bit, 16-bit, or 32-bit value from the address space pointed to by *space*. The *offset* must be a valid memory address in the *space*. These functions do not require **viMapAddress** to be called prior to their invocation.

If the **viSession** parameter (*vi*) refers to an INSTR session, the offset parameters specify relative offsets from the start of the instrument's address space. If the **viSession** parameter (*vi*) refers to a MEMACC session, the offset parameters are absolute offsets from the start of memory in the specified VXI address space.

NOTE

The **viMoveIn** functions do a block move of memory from a VXI device if **VI_ATTR_SRC_INCREMENT** is **1**. However, they do a FIFO read of a VXI memory location if **VI_ATTR_SRC_INCREMENT** is **0** (zero).

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
space	IN	**ViUInt16**	Specifies the address space. (See the following table.)
offset	IN	**ViBusAddress**	Offset (in bytes) of the starting address or register to read from.

Name	Direction	Type	Description
length	IN	**ViBusSize**	Number of elements to transfer, where the data width of the elements to transfer is 8-bits for **viMoveIn8**, 16-bits for **viMoveIn16**, or 32-bits for **viMoveIn32**.
buf8, buf16, or *buf32*	OUT	**ViAUInt8, ViAUInt16, or ViAUInt32**	Data read from bus (8-bits for **viMoveIn8**, 16-bits for **viMoveIn16**, and 32-bits for **viMoveIn32**).

Values for *space* Parameter

Value	Description
VI_A16_SPACE	Maps in VXI/MXI A16 address space.
VI_A24_SPACE	Maps in VXI/MXI A24 address space.
VI_A32_SPACE	Maps in VXI/MXI A32 address space.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Operation completed successfully.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_BERR	Bus error occurred during transfer.
VI_ERROR_INV_SPACE	Invalid address space specified.

Error Codes	Description
VI_ERROR_INV_OFFSET	Invalid offset specified.
VI_ERROR_NSUP_OFFSET	Specified offset is not accessible from this hardware.
VI_ERROR_NSUP_WIDTH	Specified width is not supported by this hardware.
VI_ERROR_INV_LENGTH	Invalid length specified.
VI_ERROR_NSUP_ALIGN_OFFSET	The specified offset is not properly aligned for the access width of the operation.
VI_ERROR_INV_SETUP	Unable to start operation because setup is invalid (due to attributes being set to an inconsistent state).

See Also **viMoveOut8, viMoveOut16, viMoveOut32, viIn8, viIn16, viIn32**

viMoveOut8, viMoveOut16, and viMoveOut32

Syntax

```
viMoveOut8(ViSession vi, ViUInt16 space,
  ViBusAddress offset, ViBusSize length, ViAUInt8 buf8);

viMoveOut16(ViSession vi, ViUInt16 space,
  ViBusAddress offset, ViBusSize length, ViAUInt16 buf16);

viMoveOut32(ViSession vi, ViUInt16 space,
  ViBusAddress offset, ViBusSize length, ViAUInt32 buf32);
```

Description

This function moves an 8-bit, 16-bit, or 32-bit block of data from local memory to the specified memory space (assigned memory base + *offset*). This function writes the 8-bit, 16-bit, or 32-bit value to the address space pointed to by *space*. The *offset* must be a valid memory address in the *space*. This function does not require **viMapAddress** to be called prior to its invocation

If the **viSession** parameter (*vi*) refers to an INSTR session, the offset parameters specify relative offsets from the start of the instrument's address space. If the **viSession** parameter (*vi*) refers to a MEMACC session, the offset parameters are absolute offsets from the start of memory in the specified VXI address space.

NOTE

The **viMoveOut** functions do a block move of memory from a VXI device if **VI_ATTR_DEST_INCREMENT** is **1**. However, they do a FIFO read of a VXI memory location if **VI_ATTR_DEST_INCREMENT** is **0** (zero).

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
space	IN	**ViUInt16**	Specifies the address space. (See the following table.)
offset	IN	**ViBusAddress**	Offset (in bytes) of the starting address or register to write to.
length	IN	**ViBusSize**	Number of elements to transfer, where the data width of the elements to transfer is 8-bits for **viMoveOut8**, 16-bits for **viMoveOut16**, or 32-bits for **viMoveOut32**.
buf8, buf16, or buf32	IN	**ViAUInt8, ViAUInt16,** or **ViAUInt32**	Data written to bus (8-bits for **viMoveOut8**, 16-bits for **viMoveOut16**, and 32-bits for **viMoveOut32**).

Values for *space* **Parameter**

Value	Description
VI_A16_SPACE	Maps in VXI/MXI A16 address space.
VI_A24_SPACE	Maps in VXI/MXI A24 address space.
VI_A32_SPACE	Maps in VXI/MXI A32 address space.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Operation completed successfully.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_BERR	Bus error occurred during transfer.
VI_ERROR_INV_SPACE	Invalid address space specified.
VI_ERROR_INV_OFFSET	Invalid offset specified.
VI_ERROR_NSUP_OFFSET	Specified offset is not accessible from this hardware.
VI_ERROR_NSUP_WIDTH	Specified width is not supported by this hardware.
VI_ERROR_INV_LENGTH	Invalid length specified.
VI_ERROR_NSUP_ALIGN_OFFSET	The specified offset is not properly aligned for the access width of the operation.
VI_ERROR_INV_SETUP	Unable to start operation because setup is invalid (due to attributes being set to an inconsistent state).

See Also **viMoveIn8, viMoveIn16, viMoveIn32, viOut8, viOut16, viOut32**

viOpen

Syntax

```
viOpen(ViSession sesn, ViRsrc rsrcName,
   ViAccessMode accessMode, ViUInt32 timeout, ViPSession vi);
```

Description

This function opens a session to the specified device. It returns a session identifier that can be used to call any other functions to that device.

Parameters

Name	Direction	Type	Description
sesn	IN	**ViSession**	Resource Manager session (should always be the Default Resource Manager for VISA returned from **viOpenDefaultRM**).
rsrcName	IN	**ViRsrc**	Unique symbolic name of a resource. (See the following tables.)
accessMode	IN	**ViAccessMode**	Specifies the modes by which the resource is to be accessed. The value **VI_EXCLUSIVE_LOCK** is used to acquire an exclusive lock immediately upon opening a session. If a lock cannot be acquired, the session is closed and an error is returned. The **VI_LOAD_CONFIG** value is used to configure attributes specified by some external configuration utility. If this value is not used, the session uses the default values provided by this specification. Multiple access modes can be used simultaneously by specifying a "bit-wise OR" of the values. (Must use **VI_NULL** in VISA 1.0.)

Name	Direction	Type	Description
timeout	IN	**ViUInt32**	If the accessMode parameter requires a lock, this parameter specifies the absolute time period (in milliseconds) that the resource waits to get unlocked before this operation returns an error. Otherwise, this parameter is ignored. (**M**ust use **VI_NULL** in VISA 1.0.)
vi	OUT	**ViPSession**	Unique logical identifier reference to a session.

Address String Grammar for *rsrcName* Parameter

Interface	Grammar
VXI	**VXI[board]::***VXI logical address***[::INSTR]**
GPIB-VXI	**GPIB-VXI[***board***]::***VXI logical address***[::INSTR]**
GPIB	**GPIB[***board***]::***primary address***[::***secondary address***][::INSTR]**
ASRL	**ASRL[***board***][::INSTR]**

Examples of Address Strings for *rsrcName* Parameter

Address String	Description
VXI0::1::INSTR	A VXI device at logical address **1** in VXI interface **VXI0**.
GPIB-VXI::24::INSTR	A VXI device at logical address **24** in a GPIB-VXI controlled VXI system.
GPIB::1::0::INSTR	A GPIB device at primary address **1** and secondary address **0** in GPIB interface **0**.
ASRL1::INSTR	A serial device located on port **1**.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Codes	Description
VI_SUCCESS	Session opened successfully.
VI_SUCCESS_DEV_NPRESENT	Session Opened Successfully, but the device at the specified address is not responding.
VI_WARN_CONFIG_NLOADED	The specified configuration either does not exist or could not be loaded using VISA-specified defaults.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given *sesn* does not support this function. For VISA, this function is supported only by the Default Resource Manager session.
VI_ERROR_INV_RSRC_NAME	Invalid resource reference specified. Parsing error.
VI_ERROR_INV_ACC_MODE	Invalid access mode.
VI_ERROR_RSRC_NFOUND	Insufficient location information or resource not present in the system.
VI_ERROR_ALLOC	Insufficient system resources to open a session.
VI_ERROR_RSRC_BUSY	The resource is valid but VISA cannot currently access it.
VI_ERROR_RSRC_LOCKED	Specified type of lock cannot be obtained because the resource is already locked with a lock type incompatible with the lock requested.
VI_ERROR_TMO	A session to the resource could not be obtained within the specified timeout period.

See Also **viClose**

viOpenDefaultRM

Syntax

```
viOpenDefaultRM(ViPSession sesn);
```

Description

This function returns a session to the Default Resource Manager resource. This function must be called before any VISA functions can be invoked. The first call to this function initializes the VISA system, including the Default Resource Manager resource, and also returns a session to that resource. Subsequent calls to this function return unique sessions to the same Default Resource Manager resource.

NOTE

All devices to be used must be connected and operational prior to the first VISA function call (**viOpenDefaultRM**). The system is configured only on the *first* **viOpenDefaultRM** per process.

If **viOpenDefaultRM** is first called without devices connected and then called again when devices are connected, the devices will not be recognized. You must close **ALL** Resource Manager sessions and reopen with all devices connected and operational.

Parameters

Name	Direction	Type	Description
sesn	OUT	**ViSession**	Unique logical identifier to a Default Resource Manager session.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Codes	Description
VI_SUCCESS	Session to the Default Resource Manager resource created successfully.

Error Codes	Description
VI_ERROR_SYSTEM_ERROR	The VISA system failed to initialize.
VI_ERROR_ALLOC	Insufficient system resources to create a session to the Default Resource Manager resource.
VI_ERROR_INV_SETUP	Some implementation-specific configuration file is corrupt or does not exist.

See Also **viOpen, viFindRsrc, viClose**

viOut8, viOut16, and viOut32

Syntax

viOut8(ViSession *vi*, **ViUInt16** *space*, **ViBusAddress** *offset*, **ViUInt8** *val8*);

viOut16(ViSession *vi*, **ViUInt16** *space*, **ViBusAddress** *offset*, **ViUInt16** *val16*);

viOut32(ViSession *vi*, **ViUInt16** *space*, **ViBusAddress** *offset*, **ViUInt32** *val32*);

Description

This function writes an 8-bit, 16-bit, or 32-bit word to the specified memory space (assigned memory base + *offset*). This function takes the 8-bit, 16-bit, or 32-bit value and stores its contents to the address space pointed to by *space*. The *offset* must be a valid memory address in the *space*. This function does not require **viMapAddress** to be called prior to its invocation.

If the **viSession** parameter (*vi*) refers to an INSTR session, the *offset* parameter specifies a relative offset from the start of the instrument's address *space*. If the **viSession** parameter (*vi*) refers to a MEMACC session, the *offset* parameter is an absolute offset from the start of memory in that VXI address *space*.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
space	IN	**ViUInt16**	Specifies the address space. (See the following table.)
offset	IN	**ViBusAddress**	Offset (in bytes) of the address or register to write to.
val8, *val16*, or *val32*	IN	**ViUInt8**, **ViUInt16**, or **ViUInt32**	Data to write to bus (8-bits for **viOut8**, 16-bits for **viOut16**, and 32-bits for **viOut32**).

Values for *space* Parameter

Value	Description
VI_A16_SPACE	Maps in VXI/MXI A16 address space.
VI_A24_SPACE	Maps in VXI/MXI A24 address space.
VI_A32_SPACE	Maps in VXI/MXI A32 address space.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Operation completed successfully.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_BERR	Bus error occurred during transfer.
VI_ERROR_INV_SPACE	Invalid address space specified.
VI_ERROR_INV_OFFSET	Invalid *offset* specified.
VI_ERROR_NSUP_OFFSET	Specified *offset* not accessible from this hardware.
VI_ERROR_NSUP_WIDTH	Specified width is not supported by this hardware.
VI_ERROR_NSUP_ALIGN_OFFSET	The specified offset is not properly aligned for the access width of the operation.
VI_ERROR_INV_SETUP	Unable to start operation because setup is invalid (due to attributes being set to an inconsistent state).

See Also

viIn8, viIn16, viIn32, viPoke8, viPoke16, viPoke32, viMoveOut8, viMoveOut16, viMoveOut32

viPeek8, viPeek16, and viPeek32

Syntax

viPeek8(ViSession *vi*, **ViAddr** *addr*, **ViPUInt8** *val8*);

viPeek16(ViSession *vi*, **ViAddr** *addr*, **ViPUInt16** *val16*);

viPeek32(ViSession *vi*, **ViAddr** *addr*, **ViPUInt32** *val32*);

Description

This function reads an 8-bit, 16-bit, or 32-bit value from the address location specified in *addr*. The address must be a valid memory address in the current process mapped by a previous **viMapAddress** call.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
addr	IN	**ViAddr**	Specifies the source address to read the value.
val8, *val16*, or *val32*	OUT	**ViPUInt8**, **ViPUInt16**, or **ViPUInt32**	Data read from bus (8-bits for **viPeek8**, 16-bits for **viPeek16**, and 32-bits for **viPeek32**).

NOTE

ViAddr is defined as a **void ***. To do pointer arithmetic, you must cast this to an appropriate type (**ViUInt8**, **ViUInt16**, or **ViUInt32**). Then, be sure the offset is correct for the type of pointer you are using. For example, (**ViUInt8 ***)**addr + 4** points to the same location as (**ViUInt16 ***)**addr + 2**.

Return Values

None.

See Also

viPoke8, viPoke16, viPoke32, viMapAddress, viIn8, viIn16, viIn32

viPoke8, viPoke16, and viPoke32

Syntax

```
viPoke8(ViSession vi, ViAddr addr, ViUInt8 val8);

viPoke16(ViSession vi, ViAddr addr, ViUInt16 val16);

viPoke32(ViSession vi, ViAddr addr, ViUInt32 val32);
```

Description

This function takes an 8-bit, 16-bit, or 32-bit value and stores its content to the address pointed to by *addr*. The address must be a valid memory address in the current process mapped by a previous **viMapAddress** call.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
addr	IN	**ViAddr**	Specifies the destination address to store the value.
val8, val16 or *val32*	IN	**ViUInt8, ViUInt16,** or **ViUInt32**	Data written to bus (8-bits for **viPoke8**, 16-bits for **viPoke16**, and 32-bits for **viPoke32**).

NOTE

ViAddr is defined as a **void *** . To do pointer arithmetic, you must cast this to an appropriate type (**ViUInt8, ViUInt16**, or **ViUInt32**). Then, be sure the offset is correct for the type of pointer you are using. For example, (**ViUInt8 ***)**addr + 4** points to the same location as (**ViUInt16 ***)**addr + 2**.

Return Values

None.

See Also

viPeek8, viPeek16, viPeek32, viMapAddress, viOut8, viOut16, viOut32

viPrintf

Syntax

viPrintf(ViSession *vi*, **ViString** *writeFmt*, *arg1*, *arg2*,...**);**

Description

This function converts, formats, and sends the parameters *arg1*, *arg2*, ... to the device as specified by the format string. Before sending the data, the function formats the *arg* characters in the parameter list as specified in the *writeFmt* string. You should not use the **viWrite** and **viPrintf** functions in the same session.

The *writeFmt* string can include regular character sequences, special formatting characters, and special format specifiers. The regular characters (including white spaces) are written to the device unchanged. The special characters consist of \ (backslash) followed by a character. The format specifier sequence consists of % (percent) followed by an optional modifier (*flag*), followed by a conversion character.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
writeFmt	IN	**ViString**	String describing the format for arguments.
arg1, arg2	IN	(varies)	Parameters format string is applied to.

Special Formatting Characters

The special formatting characters and what they send to the device are:

\n	Sends the ASCII LF character. The END identifier will also be automatically sent.
\r	Sends an ASCII CR character.
\t	Sends an ASCII TAB character.
\###	Sends the ASCII character specified by the octal value.
\"	Sends the ASCII double-quote (**"**) character.
****	Sends a backslash (****) character.

Format Specifiers

The format specifiers convert the next parameter in the sequence according to the modifier and conversion character, after which the formatted data is written to the specified device. The format specifier has the following syntax:

%[*modifiers***]***conversion character*

where *conversion character* specifies which data type the argument is represented in. The *modifiers* are optional codes that describe the target data.

In the following tables, a **d** conversion character refers to all conversion codes of type integer (**d, i, o, u, x, X**), unless specified as **%d** only. Similarly, an **f** conversion character refers to all conversion codes of type float (**f, e, E, g, G**), unless specified as **%f** only.

Every conversion command starts with the **%** character and ends with a conversion character. Between the **%** character and the *conversion character*, the *modifiers* in the following tables can appear in the sequence.

ANSI C Standard Modifiers

Modifier	Supported with Conversion Character	Description
An integer specifying *field width.*	**d, f, s** conversion characters	This specifies the minimum field width of the converted argument. If an argument is shorter than the field width, it will be padded on the left (or on the right if the **-** flag is present). An asterisk (*****) may be present in lieu of a field width modifier, in which case an extra *arg* is used. This *arg* must be an integer representing the field width. Special case: For the **@H, @Q,** and **@B** flags, the *field width* includes the **#H, #Q,** and **#B** strings, respectively.
An integer specifying *precision*.	**d, f, s** conversion characters	The precision string consists of a string of decimal digits. A . (decimal point) must prefix the *precision* string. An asterisk (*****) may be present in lieu of a *precision* modifier, in which case an extra *arg* is used. This *arg* must be an integer representing the precision of a numeric field. The *precision* string specifies the following: a. The minimum number of digits to appear for the **@1, @H, @Q,** and **@B** flags and the **i, o, u, x,** and **X** conversion characters. b. The maximum number of digits after the decimal point in case of **f** conversion characters. c. The maximum numbers of characters for the string (**s**) specifier. d. Maximum significant digits for **g** conversion character.
An argument length modifier. **h, l, L, z,** and **Z** are legal values. (**z** and **Z** are not ANSI C standard flags.)	**h** (**d, b, B** conversion characters) **l** (**d, f, b, B** conversion characters) **L** (**f** conversion character) **z, Z** (**b, B** conversion characters)	The argument length modifiers specify one of the following: a. The **h** modifier promotes the argument to a short or unsigned short, depending on the conversion character type. b. The **l** modifier promotes the argument to a long or unsigned long. c. The **L** modifier promotes the argument to a long double parameter. d. The **z** modifier promotes the argument to an array of floats. e. The **Z** modifier promotes the argument to an array of doubles.

Enhanced Modifiers to ANSI C Standards

Modifier	Supported with Conversion Character	Description
A comma (,) followed by an integer *n*, where *n* represents the array size.	**%d** and **%f** only	The corresponding argument is interpreted as a reference to the first element of an array of size *n*. The first *n* elements of this list are printed in the format specified by the conversion character. An asterisk (*****) may be present after the , modifier, in which case an extra *arg* is used. This *arg* must be an integer representing the array size of the given type.
@1	**%d** and **%f** only	Converts to an IEEE 488.2 defined NR1 compatible number, which is an integer without any decimal point (e.g., **123**).
@2	**%d** and **%f** only	Converts to an IEEE 488.2 defined NR2 compatible number. The NR2 number has at least one digit after the decimal point (e.g., **123.45**).
@3	**%d** and **%f** only	Converts to an IEEE 488.2 defined NR3 compatible number. An NR3 number is a floating point number represented in an exponential form (e.g., **1.2345E-67**).
@H	**%d** and **%f** only	Converts to an IEEE 488.2 defined <HEXADECIMAL NUMERIC RESPONSE DATA>. The number is represented in a base of sixteen form. Only capital letters should represent numbers. The number is of the form **#H***XXX***..**, where *XXX***..** is a hexadecimal number (e.g., **#HAF35B**).
@Q	**%d** and **%f** only	Converts to an IEEE 488.2 defined <OCTAL NUMERIC RESPONSE DATA>. The number is represented in a base of eight form. The number is of the form **#Q***YYY***..**, where *YYY***..** is an octal number (e.g., **#Q71234**).
@B	**%d** and **%f** only	Converts to an IEEE 488.2 defined <BINARY NUMERIC RESPONSE DATA>. The number is represented in a base two form. The number is of the form **#B***ZZZ***..**, where *ZZZ***..** is a binary number (e.g., **#B011101001**).

The following are the allowed conversion characters. A format specifier sequence should include one and only one conversion character.

Standard ANSI C Conversion Characters

%	Send the ASCII percent (%) character.
c	Argument type: A character to be sent.
d	Argument type: An integer.

Modifier	Interpretation
Default functionality	Print integer in NR1 format (integer without a decimal point).
@2 or @3	The integer is converted into a floating point number and output in the correct format.
field width	Minimum field width of the output number. Any of the six IEEE 488.2 modifiers can also be specified with *field width*.
Length modifier **l**	*arg* is a long integer.
Length modifier **h**	*arg* is a short integer.
, array size	*arg* points to an array of integers (or long or short integers, depending on the length modifier) of size *array size*. The elements of this array are separated by *array size* – 1 commas and output in the specified format.

f Argument type: A floating point number.

Modifier	Interpretation
Default functionality	Print a floating point number in NR2 format (a number with at least one digit after the decimal point).
@1	Print an integer in NR1 format. The number is truncated.
@3	Print a floating point number in NR3 format (scientific notation). *Precision* can also be specified.
field width	Minimum field width of the output number. Any of the six IEEE 488.2 modifiers can also be specified with *field width*.
Length modifier **l**	*arg* is a double float.
Length modifier **L**	*arg* is a long double.

Modifier	Interpretation
, array size	*arg* points to an array of floats (or doubles or long doubles), depending on the length modifier) of size *array size*. The elements of this array are separated by *array size* – 1 commas and output in the specified format.

s Argument type: A reference to a NULL-terminated string that is sent to the device without change.

Enhanced Format Codes

b Argument type: A location of a block of data.

Flag or Modifier	Interpretation
Default functionality	The data block is sent as an IEEE 488.2 <DEFINITE LENGTH ARBITRARY BLOCK RESPONSE DATA>. A count (long integer) must appear as a flag that specifies the number of elements (by default, bytes) in the block. A *field width* or *precision* modifier is not allowed with this conversion character.
* (asterisk)	An asterisk may be present instead of the count. In such a case, two *args* are used, the first of which is a long integer specifying the count of the number of elements in the data block. The second *arg* is a reference to the data block. The size of an element is determined by the optional length modifier (see below), the default being byte width.
Length modifier **h**	The data block is assumed to be an array of unsigned short integers (16-bits). The count corresponds to the number of words rather than bytes. The data is swapped and padded into standard IEEE 488.2 (big endian) format if native computer representation is different.
Length modifier **l**	The data block is assumed to be an array of unsigned long integers. The count corresponds to the number of longwords (32-bits). Each longword data is swapped and padded into standard IEEE 488.2 (big endian) format if native computer representation is different.

Flag or Modifier	Interpretation
Length modifier **z**	The data block is assumed to be an array of floats. The count corresponds to the number of floating point numbers (32-bits). The numbers are represented in IEEE 754 (big endian) format if native computer representation is different.
Length modifier **Z**	The data block is assumed to be an array of doubles. The count corresponds to the number of double floats (64-bits). The numbers are represented in IEEE 754 (big endian) format if native computer representation is different.

B Argument type: A location of a block of data. The functionality is similar to **b**, except the data block is sent as an IEEE 488.2 <INDEFINITE LENGTH ARBITRARY BLOCK RESPONSE DATA>. This format involves sending an ASCII LF character with the END indicator set after the last byte of the block.

y Argument Type: A location of block binary data.

Flag or Modifier	Interpretation
Default functionality	The data block is sent as raw binary data. A count (long integer) must appear as a flag that specifies the number of elements (by default, bytes) in the block. A *field width* or *precision* modifier is not allowed with this format code.
***** (asterisk)	An asterisk may be present instead of the count. In such a case, two *args* are used, the first of which is a long integer specifying the count of the number of elements in the data block. The second *arg* is a reference to the data block. The size of an element is determined by the optional length modifier (see below), the default being byte width.
Length modifier **h**	The data block is an array of unsigned short integers (16-bits). The count corresponds to the number of words rather than bytes. If the optional **`!ol`** byte order modifier is present, the data is sent in little endian format. Otherwise, the data is sent in standard IEEE 488.2 format. Data will be byte swapped and padded as appropriate if native computer representation is different.

Flag or Modifier	Interpretation
Length Modifier **`l`**	The data block is an array of unsigned long integers (32 bits) . The count corresponds to the number of longwords rather than bytes. If the optional **`!ol`** byte order modifier is present, the data is sent in little endian format; otherwise, the data is sent in standard IEE 488.2 format. Data will be byte swapped and padded as appropriate if native computer representation is different.
Byte order modifier **`!ob`**	Data is sent in standard IEE 488.2 (big endian) format. This is the default behavior if neither **`!ob`** nor **`!ol`** is present.
Byte order modifier **`!ol`**	Data is sent in little endian format.

Return Values

Type **`ViStatus`** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
`VI_SUCCESS`	Parameters were successfully formatted.

Error Codes	Description
`VI_ERROR_INV_SESSION` **`VI_ERROR_INV_OBJECT`**	The given session or object reference is invalid (both are the same value).
`VI_ERROR_RSRC_LOCKED`	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
`VI_ERROR_IO`	Could not perform write function because of I/O error.
`VI_ERROR_TMO`	Timeout expired before write function completed.
`VI_ERROR_INV_FMT`	A format specifier in the *writeFmt* string is invalid.
`VI_ERROR_NSUP_FMT`	A format specifier in the *writeFmt* string is not supported.
`VI_ERROR_ALLOC`	The system could not allocate a formatted I/O buffer because of insufficient resources.

See Also

viVPrintf

viQueryf

Syntax

```
viQueryf(ViSession vi, ViString writeFmt,
  ViString readFmt, arg1, arg2,...);
```

Description

This function performs a formatted write and read through a single operation invocation. This function provides a mechanism of "Send, then receive" typical to a command sequence from a commander device. In this manner, the response generated from the command can be read immediately.

This function is a combination of the **viPrintf** and **viScanf** functions. The first *n* arguments corresponding to the first format string are formatted by using the *writeFmt* string and then sent to the device. The write buffer is flushed immediately after the write portion of the operation completes. After these actions, the response data is read from the device into the remaining parameters (starting from parameter *n* + 1) using the *readFmt* string.

This function returns the same VISA status codes as **viPrintf**, **viScanf**, and **viFlush**.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
writeFmt	IN	**ViString**	**ViString** describing the format of the write arguments.
readFmt	IN	**ViString**	**ViString** describing the format of the read arguments.
arg1, arg2	IN OUT	N/A	Parameters on which write and read format strings are applied.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Successfully completed the Query operation.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_IO	Could not perform read/write operation because of I/O error.
VI_ERROR_TMO	Timeout occurred before read/write operation completed.
VI_ERROR_INV_FMT	A format specifier in the *writeFmt* or *readFmt* string is invalid.
VI_ERROR_NSUP_FMT	The format specifier is not supported for current argument type.
VI_ERROR_ALLOC	The system could not allocate a formatted I/O buffer because of insufficient resources.

See Also

viPrintf, viScanf, viVQueryf

viRead

Syntax

```
viRead(ViSession vi, ViPBuf buf, ViUInt32 count,
  ViPUInt32 retCount);
```

Description

This function synchronously transfers data from a device. The data that is read is stored in the buffer represented by *buf*. This function returns only when the transfer terminates. Only one synchronous read function can occur at any one time.

NOTE

You must set specific attributes to make the read terminate under specific conditions. See *Appendix B - VISA Attributes*.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
buf	OUT	**ViPBuf**	Represents the location of a buffer to receive data from device.
count	IN	**ViUInt32**	Number of bytes to be read.
retCount	OUT	**ViPUInt32**	Represents the location of an integer that will be set to the number of bytes actually transferred.

Special value for *retCount* **Parameter**:

VI_NULL	Do not return the number of bytes transferred.

Return Values

Type **`ViStatus`** This is the function return status. It returns either a completion code or an error code as follows.

Completion Codes	Description
`VI_SUCCESS`	The function completed successfully and the END indicator was received (for interfaces that have END indicators).
`VI_SUCCESS_TERM_CHAR`	The specified termination character was read.
`VI_SUCCESS_MAX_CNT`	The number of bytes read is equal to *count*.

Error Codes	Description
`VI_ERROR_INV_SESSION` **`VI_ERROR_INV_OBJECT`**	The given session or object reference is invalid (both are the same value).
`VI_ERROR_NSUP_OPER`	The given *vi* does not support this function.
`VI_ERROR_RSRC_LOCKED`	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
`VI_ERROR_TMO`	Timeout expired before function completed.
`VI_ERROR_RAW_WR_PROT_VIOL`	Violation of raw write protocol occurred during transfer.
`VI_ERROR_RAW_RD_PROT_VIOL`	Violation of raw read protocol occurred during transfer.
`VI_ERROR_OUTP_PROT_VIOL`	Device reported an output protocol error occurred during transfer.
`VI_ERROR_BERR`	Bus error occurred during transfer.
`VI_ERROR_INV_SETUP`	Unable to start read function because setup is invalid (due to attributes being set to an inconsistent state).
`VI_ERROR_NCIC`	The interface associated with the given *vi* is not currently the controller in charge.
`VI_ERROR_NLISTENERS`	No Listeners condition is detected (both NRFD and NDAC are deasserted).
`VI_ERROR_ASRL_PARITY`	A parity error occurred during transfer.

Error Codes	Description
VI_ERROR_ASRL_FRAMING	A framing error occurred during transfer.
VI_ERROR_ASRL_OVERRUN	An overrun error occurred during transfer. A character was not read from the hardware before the next character arrived.
VI_ERROR_IO	An unknown I/O error occurred during transfer.

See Also

viWrite

viReadAsync

Syntax

```
viReadAsync(ViSession vi, ViPBuf buf, ViUInt32 count,
  ViPJobId jobId);
```

Description

This function asynchronously transfers data from a device. The data that is read is stored in the buffer represented by *buf*. This function normally returns before the transfer terminates. An I/O Completion event is posted when the transfer is actually completed.

This function returns *jobId*, which you can use either with **viTerminate** to abort the operation or with an I/O Completion event to identify which asynchronous read operation completed.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
buf	OUT	**ViPBuf**	Represents the location of a buffer to receive data from the device.
count	IN	**ViUInt32**	Number of bytes to be read.
jobId	OUT	**ViPJobId**	Represents the location of a variable that will be set to the job identifier of this asynchronous read operation.

Special value for *jobId* Parameter:

VI_NULL	Do not return a job identifier.

Return Values

Type **`ViStatus`** This is the function return status. It returns either a completion code or an error code as follows.

Completion Codes	Description
`VI_SUCCESS`	Asynchronous read operation successfully queued.
`VI_SUCCESS_SYNC`	Read operation performed synchronously.

Error Codes	Description
`VI_ERROR_INV_SESSION` **`VI_ERROR_INV_OBJECT`**	The given session or object reference is invalid (both are the same value).
`VI_ERROR_RSRC_LOCKED`	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
`VI_ERROR_QUEUE_ERROR`	Unable to queue read operation.

See Also

viRead, viTerminate, viWrite, viWriteAsync

viReadSTB

Syntax

viReadSTB(ViSession *vi*, **ViPUInt16** *status*);

Description

This function reads a status byte of the service request from a service requester (the message-based device). For example, on the IEEE 488.2 interface, the message is read by polling devices. For other types of interfaces, a message is sent in response to a service request to retrieve status information.

If the status information is only one byte long, the most significant byte is returned with the zero value. If the service requester does not respond in the actual timeout period, **VI_ERROR_TMO** is returned.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to the session.
status	OUT	**ViPUInt16**	Service request status byte.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Operation completed successfully.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.

Error Codes	Description
VI_ERROR_SRQ_NOCCURRED	Service request has not been received for the session.
VI_ERROR_TMO	Timeout expired before function completed.
VI_ERROR_RAW_WR_PROT_VIOL	Violation of raw write protocol occurred during transfer.
VI_ERROR_RAW_RD_PROT_VIOL	Violation of raw read protocol occurred during transfer.
VI_ERROR_BERR	Bus error occurred during transfer.
VI_ERROR_NCIC	The interface associated with the given *vi* is not currently the controller in charge.
VI_ERROR_NLISTENERS	No Listeners condition is detected (both NRFD and NDAC are deasserted).
VI_ERROR_INV_SETUP	Unable to start operation because setup is invalid (due to attributes being set to an inconsistent state).

viScanf

Syntax

viScanf(ViSession *vi*, **ViString** *readFmt, arg1, arg2,...*);

Description

This function receives data from a device, formats it by using the format string, and stores the data in the *arg* parameter list. The format string can have format specifier sequences, white space characters, and ordinary characters.

The white characters (blank, vertical tabs, horizontal tabs, form feeds, new line/linefeed, and carriage return) are ignored except in the case of **%c** and **%[ ]**. All other ordinary characters except **%** should match the next character read from the device.

A format specifier sequence consists of a **%**, followed by optional *modifier* flags, followed by one of the *conversion characters*, in that sequence. It is of the form:

%[*modifiers***]***conversion character*

where the optional *modifier* describes the data format, while *conversion character* indicates the nature of data (data type). One and only one *conversion character* should be performed at the specifier sequence. A format specification directs the conversion to the next input *arg*.

The results of the conversion are placed in the variable that the corresponding argument points to, unless the asterisk (*****) assignment-suppressing character is given. In such a case, no *arg* is used, and the results are ignored.

The **viScanf** function accepts input until an END indicator is read or all the format specifiers in the *readFmt* string are satisfied. It also terminates if the format string character does not match the incoming character. Thus, detecting an END indicator before the *readFmt* string is fully consumed will result in ignoring the rest of the format string.

Also, if some data remains in the buffer after all format specifiers in the *readFmt* string are satisfied, the data will be kept in the buffer and will be used by the next **viScanf** function.

Parameters

Name	Direction	Type	Description
vi	IN	`ViSession`	Unique logical identifier to a session.
readFmt	IN	`ViString`	String describing the format for arguments.
arg1, arg2	OUT	N/A	A list with the variable number of parameters into which the data is read and the format string is applied.

The following two tables describe optional modifiers that can be used in a format specifier sequence.

ANSI C Standard Modifiers

Modifier	Supported with Conversion Character	Description
An integer representing the *field width*	`%s, %c, %[ ]` conversion characters	It specifies the maximum field width that the argument will take. A # may also appear instead of the integer *field width*, in which case the next *arg* is a reference to the *field width*. This *arg* is a reference to an integer for `%c` and `%s`. The *field width* is not allowed for `%d` or `%f`.
A length modifier (`l, h, L, z` or `Z`). `z` and `Z` are not ANSI C standard modifiers.	`h` (`d, b` conversion characters) `l` (`d, f, b` conversion characters) `L` (`f` conversion character) `z, Z` (`b` conversion character)	The argument length modifiers specify one of the following: a. The h modifier promotes the argument to be a reference to a short integer or unsigned short integer, depending on the conversion character. b. The `l` modifier promotes the argument to point to a long integer or unsigned long integer. c. The `L` modifier promotes the argument to point to a long double floating point parameter. d. The `z` modifier promotes the argument to point to an array of floats. e. The `Z` modifier promotes the argument to point to an array of double floats.
`*` (asterisk)	All conversion characters	An asterisk acts as the assignment suppression character. The input is not assigned to any parameters and is discarded.

Enhanced Modifiers to ANSI C Standards

Modifier	Supported with Conversion Character	Description
A comma (**,**) followed by an integer *n*, where *n* represents the array size.	**%d** and **%f** only	The corresponding argument is interpreted as a reference to the first element of an array of size *n*. The first *n* elements of this list are printed in the format specified by the conversion character. A number sign (**#**) may be present after the **,** modifier, in which case an extra *arg* is used. This *arg* must be an integer representing the array size of the given type.

Conversion Characters

ANSI C Conversion Characters

c Argument type: A reference to a character.

Flags or Modifiers	Interpretation
Default functionality	A character is read from the device and stored in the parameter.
field width	*field width* number of characters are read and stored at the reference location (the default field width is **1**). No NULL character is added at the end of the data block

NOTE

White space in the device input stream is not ignored when using **%c**.

d Argument type: A reference to an integer.

Flags or Modifiers	Interpretation
Default functionality	Characters are read from the device until an entire number is read. The number read must be in one of the following IEEE 488.2 formats: • <DECIMAL NUMERIC PROGRAM DATA", also known as NRf. • Flexible numeric representation (NR1, NR2, NR3, ...). • <NON-DECIMAL NUMERIC PROGRAM DATA> (**#H**, **#Q**, and **#B**).
field width	The input number will be stored in a field at least this wide.
Length modifier **l**	*arg* is a reference to a long integer.
Length modifier **h**	*arg* is a reference to a short integer. Rounding is performed according to IEEE 488.2 rules (**0.5** and up).
, array size	*arg* points to an array of integers (or long or short integers, depending on the length modifier) of size *array size*. The elements of this array should be separated by commas. Elements will be read until either *array size* number of elements are consumed or they are no longer separated by commas.

f Argument type: A reference to a floating point number.

Flags or Modifiers	Interpretation
Default functionality	Characters are read from the device until an entire number is read. The number read must be in either IEEE 488.2 formats: <DECIMAL NUMERIC PROGRAM DATA> (NRf), or <NON-DECIMAL NUMERIC PROGRAM DATA> (**#H**, **#Q**, and **#B**).
field width	The input number will be stored in a field at least this wide.
Length modifier **l**	*arg* is a reference to a double floating point number.
Length modifier **L**	*arg* is a reference to a long double number.

Flags or Modifiers	Interpretation
, array size	*arg* points to an array of floats (or doubles or long doubles, depending on the length modifier) of size *array size*. The elements of this array should be separated by commas. Elements will be read until either *array size* number of elements are consumed or they are no longer separated by commas.

s Argument type: A reference to a string.

Flags or Modifiers	Interpretation
Default functionality	All leading white space characters are ignored. Characters are read from the device into the string until a white space character is read.
field width	This flag gives the maximum string size. If the *field width* contains a # sign, two arguments are used. The first argument read gives the maximum string size. The second should be a reference to a string. In the case of *field width* characters already read before encountering a white space, additional characters are read and discarded until a white space character is found. In the case of # *field width*, the actual number of characters read are stored back in the integer pointed to by the first argument.

Enhanced Conversion Characters

b Argument type: A reference to a data array.

Flags or Modifiers	Interpretation
Default functionality	The data must be in IEEE 488.2 <ARBITRARY BLOCK PROGRAM DATA> format. The format specifier sequence should have a flag describing the *array size*, which will give a maximum count of the number of bytes (or words or longwords, depending on length modifiers) to be read from the device. If the *array size* contains a # sign, two arguments are used. The first argument read is a pointer to a long integer specifying the maximum number of elements that the array can hold. The second one should be a reference to an array. Also in this case, the actual number of elements read is stored back in the first argument. In absence of length modifiers, the data is assumed to be of byte-size elements. In some cases, data might be read until an END indicator is read.
Length modifier **h**	The array is assumed to be an array of 16-bit words, and count refers to the number of words. The data read from the interface is assumed to be in IEEE 488.2 (big endian) byte ordering. It will be byte swapped and padded as appropriate to the native computer format.
Length modifier **l**	The array is assumed to be a block of 32-bit longwords rather than bytes, and count refers to the number of longwords. The data read from the interface is assumed to be in IEEE 488.2 (big endian) byte ordering. It will be byte swapped and padded as appropriate to the native computer format.
Length modifier **z**	The data block is assumed to be a reference to an array of floats, and count refers to the number of floating point numbers. The data block received from the device is an array of 32-bit IEEE 754 format floating point numbers.
Length modifier **Z**	The data block is assumed to be a reference to an array of doubles, and the count refers to the number of floating point numbers. The data block received from the device is an array of 64-bit IEEE 754 format floating point numbers.

t Argument type: A reference to a string.

Flags or Modifiers	Interpretation
Default functionality	Characters are read from the device until the first END indicator is received. The character on which the END indicator was received is included in the buffer.
field width	This flag gives the maximum string size. If an END indicator is not received before *field width* number of characters, additional characters are read and discarded until an END indicator arrives. #*field width* has the same meaning as in **%s**.

T Argument type: A reference to a string.

Flags or Modifiers	Interpretation
Default functionality	Characters are read from the device until the first linefeed character (**\n**) is received. The linefeed character is included in the buffer.
field width	This flag gives the maximum string size. If a linefeed character is not received before *field width* number of characters, additional characters are read and discarded until a linefeed character arrives. #*field width* has the same meaning as in **%s**.

y Argument Type: A location of block binary data.

Flag or Modifier	Interpretation
Default functionality	The data block is read as raw binary data. The format specifier sequence should have a flag describing the *array size*, which will give a maximum count of the number of bytes (or words or longwords, depending on length modifiers) to be read from the device. If the *array size* contains a # sign, two arguments are used. The first argument read is a pointer to a long integer specifying the maximum number of elements that the array can hold. The second argument should be a reference to an array. Also, in this case, the actual number of elements read is stored back in the first argument. In the absence of length modifiers, the data is assumed to be of byte-size elements. In some cases, data might be read until an END indicator is read.
Length modifier **h**	The data block is assumed to be a reference to an array of unsigned short integers (16-bits). The count corresponds to the number of words rather than bytes. If the optional **!ol** byte order modifier is present, the data being read is assumed to be in little endian format; otherwise, the data being read is assumed to be in standard IEE 488.2 format. Data will be byte swapped and padded as appropriate to native computer format.
Length Modifier **l**	The data block is assumed to be a reference to an array of unsigned long integers (32 bits) . The count corresponds to the number of longwords rather than bytes. If the optional **!ol** byte order modifier is present, the data being read is assumed to be in little endian format; otherwise, the data being read is assumed to be in standard IEE 488.2 format. Data will be byte swapped and padded as appropriate if native computer representation is different.
Byte order modifier **!ob**	Data being read is assumed to be in standard IEE 488.2 (big endian) format. This is the default behavior if neither **!ob** nor **!ol** is present.
Byte order modifier **!ol**	Data being read is assumed to be in little endian format.

Return Values

Type **`ViStatus`** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
`VI_SUCCESS`	Data was successfully read and formatted into *arg* parameter(s).

Error Codes	Description
`VI_ERROR_INV_SESSION` **`VI_ERROR_INV_OBJECT`**	The given session or object reference is invalid (both are the same value).
`VI_ERROR_RSRC_LOCKED`	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
`VI_ERROR_IO`	Could not perform read function because of I/O error.
`VI_ERROR_TMO`	Timeout expired before read function completed.
`VI_ERROR_INV_FMT`	A format specifier in the *readFmt* string is invalid.
`VI_ERROR_NSUP_FMT`	A format specifier in the *readFmt* string is not supported.
`VI_ERROR_ALLOC`	The system could not allocate a formatted I/O buffer because of insufficient resources.

See Also

viVScanf

viSetAttribute

Syntax

```
viSetAttribute(ViSession/ViEvent/ViFindList vi,
  ViAttr attribute, ViAttrState attrState);
```

Description

This function sets the state of an attribute for the specified session.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession** **ViEvent** **ViFindList**	Unique logical identifier to a session, event, or find list.
attribute	IN	**ViAttr**	Resource attribute for which the state is modified.
attrState	IN	**ViAttrState**	The state of the attribute to be set for the specified resource. The interpretation of the individual attribute value is defined by the resource.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Codes	Description
VI_SUCCESS	Attribute value set successfully.
VI_WARN_NSUP_ATTR_STATE	Although the specified attribute state is valid, it is not supported by this resource implementation. (The application will still work, but this may have a performance impact.)

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_NSUP_ATTR	The specified attribute is not defined by the referenced resource.
VI_ERROR_NSUP_ATTR_STATE	The specified state of the attribute is not valid, or is not supported as defined by the resource. (The application probably will not work if this error is returned.)
VI_ERROR_ATTR_READONLY	The specified attribute is read-only.

See Also

viGetAttribute. See *Appendix B - VISA Attributes* for a list of attributes and attribute values. *Chapter 4 - Programming with VISA* provides detailed descriptions of the VISA attributes.

viSetBuf

Syntax

viSetBuf(ViSession *vi*, **ViUInt16** *mask*, **ViUInt32** *size*);

Description

This function sets the size of the read and/or write buffer for formatted I/O and/or serial communication. The *mask* parameter specifies whether the buffer is a read or write buffer. The *mask* parameter can specify multiple buffers by "bit-ORing" any of the following values together.

Flag	Interpretation
VI_READ_BUF	Formatted I/O read buffer.
VI_WRITE_BUF	Formatted I/O write buffer.
VI_ASRL_IN_BUF	Serial communication receive buffer.
VI_ASRL_OUT_BUF	Serial communication transmit buffer.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
mask	IN	**ViUInt16**	Specifies the type of buffer. (See previous table.)
size	IN	**ViUInt32**	The size to be set for the specified buffer(s).

Return Values

Type **`ViStatus`** This is the function return status. It returns either a completion code or an error code as follows.

Completion Codes	Description
`VI_SUCCESS`	Buffer size set successfully.
`VI_WARN_NSUP_BUF`	The specified buffer is not supported.

Error Codes	Description
`VI_ERROR_INV_SESSION` **`VI_ERROR_INV_OBJECT`**	The given session or object reference is invalid (both are the same value).
`VI_ERROR_RSRC_LOCKED`	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
`VI_ERROR_ALLOC`	The system could not allocate the buffer(s) of the specified *size* because of insufficient system resources.
`VI_ERROR_INV_MASK`	The system cannot set the buffer for the given *mask*.

viSPrintf

Syntax

viSPrintf(*vi***,** *buf***,** *writeFmt, arg1, arg2, ...);*

Description

Same as **viPrintf,** except the data is written to a user-specified buffer rather than the device. This operation is similar to **viPrintf**, except that the output is not written to the device, but is written to the user-specified buffer. This output buffer will be NULL terminated.

If the **viSPrintf** operations outputs an END indicator before all the arguments are satisfied, the rest of the *writeFmt* string will be ignored and the buffer string will still be terminated by a NULL.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
buf	OUT	**ViBuf**	Buffer where data are to be written.
writeFmt	IN	**ViString**	The format string to apply to parameters in **ViVAList**.
arg1, arg2	IN	N/A	A list containing the variable number of parameters on which the format string is applied. The formatted data are written to the specified device.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Parameters were successfully formatted.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_INV_FMT	A format specifier in the *writeFmt* string is invalid.
VI_ERROR_NSUP_FMT	A format specifier in the *writeFmt* string is not supported.
VI_ERROR_ALLOC	The system could not allocate a formatted I/O buffer because of insufficient system resources.

See Also **viPrintf**

viSScanf

Syntax

viSScanf(*vi***,** *buf***,** *readFmt, arg1, arg2, ...);*

Description

Same as **viScanf**, except data are read from a user-specified buffer instead of a device.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
buf	IN	**ViBuf**	Buffer from which data are read and formatted.
readFmt	IN	**ViString**	The format string to apply to parameters in **ViVAList**.
arg1, arg2	OUT	N/A	A list with the variable number of parameters into which the data are read and the format string is applied.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Data was successfully read and formatted into *arg* parameter(s).

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.

Error Codes	Description
VI_ERROR_INV_FMT	A format specifier in the *readFmt* string is invalid.
VI_ERROR_NSUP_FMT	A format specifier in the *readFmt* string is not supported.
VI_ERROR_ALLOC	The system could not allocate a formatted I/O buffer because of insufficient system resources.

viStatusDesc

Syntax

```
viStatusDesc(ViSession/ViEvent/ViFindList vi,
  ViStatus status, ViPString desc);
```

Description

This function returns a user-readable string which describes the status code passed to the function.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession** **ViEvent** **ViFindList**	Unique logical identifier to a session, event, or find list.
status	IN	**ViStatus**	Status code to interpret.
desc	OUT	**ViPString**	The user-readable string interpretation of the status code passed to the function. Must be at least 256 characters to receive output.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Codes	Description
VI_SUCCESS	Description successfully returned.
VI_WARN_UNKNOWN_STATUS	The status code passed to the function could not be interpreted.

viTerminate

Syntax

viTerminate(ViSession *vi*, **ViUInt16** *degree*, **ViJobId** *jobId*);

Description

This function requests a VISA session to terminate normal execution of an asynchronous operation.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to an object.
degree	IN	**ViUInt16**	**VI_NULL**
jobId	IN	**ViJobId**	Specifies an operation identifier.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Request serviced successfully.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_INV_DEGREE	Invalid degree specified.
VI_ERROR_INV_JOB_ID	Invalid job identifier specified.

See Also

viReadAsync, viWriteAsync

viUninstallHandler

Syntax

```
viUninstallHandler(ViSession vi, ViEventType eventType,
  ViHndlr handler, ViAddr userHandle);
```

Description

This function allows applications to uninstall handlers for events on sessions. Applications should also specify the value in the *userHandle* parameter that was passed to **viInstallHandler** while installing the handler. VISA identifies handlers uniquely using the *handler* reference and this value. All the handlers, for which the *handler* reference and the value matches, are uninstalled.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
eventType	IN	**ViEventType**	Logical event identifier.
handler	IN	**ViHndlr**	Interpreted as a valid reference to a handler to be uninstalled by an application. (See the following table.)
userHandle	IN	**ViAddr**	A value specified by an application that can be used for identifying handlers uniquely in a session for an event.

The following events are valid:

Event Name	Description
VI_EVENT_SERVICE_REQ	Notification that a device is requesting service.
VI_EVENT_VXI_SIGP	Notification that a VXI signal or VXI interrupt has been received from a device.
VI_EVENT_TRIG	Notification that a hardware trigger was received from a device.
VI_EVENT_IO_COMPLETION	Notification that an asynchronous operation has completed

Special Values for *handler* Parameter

Value	Action Description
VI_ANY_HNDLR	Uninstall all the handlers with the matching value in the *UserHandle* parameter.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Event handler successfully uninstalled.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_INV_EVENT	Specified event type is not supported by the resource.
VI_ERROR_INV_HNDLR_REF	Either the specified handler reference or the user context value (or both) does not match any installed handler.
VI_ERROR_HNDLR_NINSTALLED	A handler is not currently installed for the specified event.

See Also

See the handler prototype **viEventHandler** for its parameter description. See the **viEnableEvent** description for information about enabling different event handling mechanisms. See individual event descriptions for context definitions.

viUnlock

Syntax

```
viUnlock(ViSession vi);
```

Description

This function is used to relinquish a lock previously obtained using the **viLock** function.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Codes	Description
VI_SUCCESS	The lock was successfully relinquished.
VI_SUCCESS_NESTED_EXCLUSIVE	The call succeeded, but this session still has nested exclusive locks.
VI_SUCCESS_NESTED_SHARED	The call succeeded, but this session still has nested shared locks.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given *vi* does not identify a valid session or object.
VI_ERROR_SESN_NLOCKED	The current session did not have any lock on the resource.

See Also

viLock. For more information on locking, see *Chapter 4 - Programming with VISA*.

viUnmapAddress

Syntax

```
viUnmapAddress(ViSession vi);
```

Description

This function unmaps memory space previously mapped by the **viMapAddress** function.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Operation completed successfully.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_WINDOW_NMAPPED	The specified session is not currently mapped.

See Also

viMapAddress

viVPrintf

Syntax

viVPrintf(ViSession *vi*, **ViString** *writeFmt*, **ViVAList** *params*);

Description

This function converts, formats, and sends *params* to the device as specified by the format string. This function is similar to **viPrintf**, except that the **ViVAList** parameters list provides the parameters rather than separate *arg* parameters.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
writeFmt	IN	**ViString**	The format string to apply to parameters in **ViVAList**. See **viPrintf** for description.
params	IN	**ViVAList**	A list containing the variable number of parameters on which the format string is applied. The formatted data is written to the specified device.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Parameters were successfully formatted.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).

Error Codes	Description
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_IO	Could not perform write function because of I/O error.
VI_ERROR_TMO	Timeout expired before write function completed.
VI_ERROR_INV_FMT	A format specifier in the *writeFmt* string is invalid.
VI_ERROR_NSUP_FMT	A format specifier in the *writeFmt* string is not supported.
VI_ERROR_ALLOC	The system could not allocate a formatted I/O buffer because of insufficient resources.

See Also **viPrintf**

viVQueryf

Syntax

```
viVQueryf(ViSession vi, ViString writeFmt,
  ViString readFmt,ViVAList params);
```

Description

This function performs a formatted write and read through a single operation invocation. This function is similar to **viQueryf**, except that the **ViVAList** parameters list provides the parameters rather than the separate *arg* parameter list in **viQueryf**.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
writeFmt	IN	**ViString**	The format string is applied to write parameters in **ViVAList**.
readFmt	IN	**ViString**	The format string is applied to read parameters in **ViVAList**.
params	IN OUT	**ViVAList**	A list containing the variable number of write and read parameters. The write parameters are formatted and written to the specified device. The read parameters store the data read from the device after the format string is applied to the data.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Successfully completed the Query operation.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_IO	Could not perform read/write operation because of I/O error.
VI_ERROR_TMO	Timeout occurred before read/write operation completed.
VI_ERROR_INV_FMT	A format specifier in the *writeFmt* or *readFmt* string is invalid.
VI_ERROR_NSUP_FMT	The format specifier is not supported for current argument type.
VI_ERROR_ALLOC	The system could not allocate a formatted I/O buffer because of insufficient resources.

See Also **viVPrintf, viVScanf, viQueryf**

viVScanf

Syntax

viVScanf(ViSession *vi*, **ViString** *readFmt*, **ViVAList** *params*);

Description

This function reads, converts, and formats data using the format specifier, and then stores the formatted data in *params*. This function is similar to **viScanf**, except that the **ViVAList** parameters list provides the parameters rather than separate *arg* parameters.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
readFmt	IN	**ViString**	The format string to apply to parameters in **ViVAList**. See **viScanf** for description.
params	OUT	**ViVAList**	A list with the variable number of parameters into which the data is read and the format string is applied.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Data was successfully read and formatted into *arg* parameter(s).

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.

Error Codes	Description
VI_ERROR_IO	Could not perform read function because of I/O error.
VI_ERROR_TMO	Timeout expired before read function completed.
VI_ERROR_INV_FMT	A format specifier in the *readFmt* string is invalid.
VI_ERROR_NSUP_FMT	A format specifier in the *readFmt* string is not supported.
VI_ERROR_ALLOC	The system could not allocate a formatted I/O buffer because of insufficient resources.

See Also **viScanf**

viVSPrintf

Syntax

viVSPrintf(*vi, buf, writeFmt, params***);**

Description

Same as **viVPrintf**, except data are written to a user-specified buffer rather than a device. This operation is similar to **viVPrintf**, except the output is not written to the device but is written to the user-specified buffer. This output buffer will be NULL terminated.

If the **viVSPrintf** operation outputs an END indicator before all the arguments are satisfied, the rest of the *writeFmt* string will be ignored and the buffer string will still be terminated by a NULL.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
buf	OUT	**ViBuf**	Buffer where data are to be written.
writeFmt	IN	**ViString**	The format string to apply to parameters in **ViVAList**.
params	IN	**ViVAList**	A list containing the variable number of parameters on which the format string is applied. The formatted data are written to the specified device.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Parameters were successfully formatted.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_INV_FMT	A format specifier in the *writeFmt* string is invalid.
VI_ERROR_NSUP_FMT	A format specifier in the *writeFmt* string is not supported.
VI_ERROR_ALLOC	The system could not allocate a formatted I/O buffer because of insufficient resources.

See Also **viSPrintf, viVPrintf**

viVSScanf

Syntax

viVSScanf(*vi, buf, readFmt, params***);**

Description

This operation is similar to **viVScanf**, except data are read from a user-specified buffer rather than a device.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
buf	IN	**ViBuf**	Buffer from which data are read and formatted.
readFmt	IN	**ViString**	The format string to apply to parameters in **ViVAList**.
params	OUT	**ViVAList**	A list with the variable number of parameters into which data are read and the format string is applied.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Data were successfully read and formatted into arg parameter(s).

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.

Error Codes	Description
VI_ERROR_INV_FMT	A format specifier in the *readFmt* string is invalid.
VI_ERROR_NSUP_FMT	A format specifier in the *readFmt* string is not supported.
VI_ERROR_ALLOC	The system could not allocate a formatted I/O buffer because of insufficient resources.

See Also **viSScanf, viVScanf**

viWaitOnEvent

Syntax

```
viWaitOnEvent(ViSession vi, ViEventType inEventType,
  ViUInt32 timeout, ViPEventType outEventType,
  ViPEvent outContext);
```

Description

This function waits for an occurrence of the specified event for a given session. In particular, this function suspends execution of an application thread and waits for an event *inEventType* for at least the time period specified by *timeout*. See the individual event descriptions for context definitions.

If the specified *inEventType* is **VI_ALL_ENABLED_EVENTS**, the function waits for any event that is enabled for the given session. If the specified *timeout* value is **VI_TMO_INFINITE**, the function is suspended indefinitely.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
inEventType	IN	**ViEventType**	Logical identifier of the event(s) to wait for.
timeout	IN	**ViUInt32**	Absolute time period in time units that the resource shall wait for a specified event to occur before returning the time elapsed error. The time unit is in milliseconds.
outEventType	OUT	**ViPEventType**	Logical identifier of the event actually received.
outContext	OUT	**ViPEvent**	A handle specifying the unique occurrence of an event.

NOTE

Since system resources are used when waiting for events (**`viWaitOnEvent`**), the **`viClose`** function must be called to free up event contexts (*outContext*).

The following table lists the events and the associated read only attributes that can be read using **`viGetAttribute`** to get event information on a specific event:

Event Name	Attributes	Data Type	Values
`VI_EVENT_SERVICE_REQ`	**`VI_ATTR_EVENT_TYPE`**	**`ViEventType`**	**`VI_EVENT_SERVICE_REQ`**
`VI_EVENT_VXI_SIGP`	**`VI_ATTR_EVENT_TYPE`** **`VI_ATTR_SIGP_STATUS_ID`**	**`ViEventType`** **`ViUInt16`**	**`VI_EVENT_VXI_SIGP`** **0 to $FFFF_h$**
`VI_EVENT_TRIG`	**`VI_ATTR_EVENT_TYPE`** **`VI_ATTR_RECV_TRIG_ID`**	**`ViEventType`** **`ViInt16`**	**`VI_EVENT_TRIG`** **`VI_TRIG_TTL0 to VI_TRIG_TTL7`** **`VI_TRIG_ECL0 to VI_TRIG_ECL1`**
`VI_EVENT_IO_COMPLETION`	**`VI_ATTR_EVENT_TYPE`** **`VI_ATTR_STATUS`** **`VI_ATTR_JOB_ID`** **`VI_ATTR_BUFFER`** **`VI_ATTR_RET_COUNT`**	**`ViEventType`** **`ViStatus`** **`ViJobId`** **`ViBuf`** **`ViUInt32`**	**`VI_EVENT_IO_COMPLETION`** **N/A** **N/A** **N/A** **0 to $FFFFFFFF_h$**

Use the VISA **`viReadSTB`** function to read the status byte of the service request.

Special value for *outEventType* **Parameter**

`VI_NULL`	Do not return the type of event.

Special value for *outContext* **Parameter:**

`VI_NULL`	Do not return an event context.

Return Values

Type **`ViStatus`** This is the function return status. It returns either a completion code or an error code as follows.

Completion Codes	Description
`VI_SUCCESS`	Wait terminated successfully on receipt of an event occurrence. The queue is empty.
`VI_SUCCESS_QUEUE_NEMPTY`	Wait terminated successfully on receipt of an event notification. There is still at least one more event occurrence of the specified *inEventType* type available for this session.

Error Codes	Description
`VI_ERROR_INV_SESSION` **`VI_ERROR_INV_OBJECT`**	The given session or object reference is invalid (both are the same value).
`VI_ERROR_INV_EVENT`	Specified event type is not supported by the resource.
`VI_ERROR_TMO`	Specified event did not occur within the specified time period.

See Also

See *Chapter 4 - Programming with VISA* for more information on event handling.

viWrite

Syntax

```
viWrite(ViSession vi, ViBuf buf, ViUInt32 count,
  ViPUInt32 retCount);
```

Description

This function synchronously transfers data to a device. The data to be written is in the buffer represented by *buf*. This function returns only when the transfer terminates. Only one synchronous write function can occur at any one time.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
buf	IN	**ViBuf**	Represents the location of a data block to be sent to device.
count	IN	**ViUInt32**	Specifies number of bytes to be written.
retCount	OUT	**ViPUInt32**	Represents the location of an integer that will be set to the number of bytes actually transferred.

Special value for *retCount* Parameter:

VI_NULL	Do not return the number of bytes transferred.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Code	Description
VI_SUCCESS	Transfer completed.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_TMO	Timeout expired before function completed.
VI_ERROR_RAW_WR_PROT_VIOL	Violation of raw write protocol occurred during transfer.
VI_ERROR_RAW_RD_PROT_VIOL	Violation of raw read protocol occurred during transfer.
VI_ERROR_INP_PROT_VIOL	Device reported an input protocol error occurred during transfer.
VI_ERROR_BERR	Bus error occurred during transfer.
VI_ERROR_INV_SETUP	Unable to start write function because setup is invalid (due to attributes being set to an inconsistent state).
VI_ERROR_NCIC	The interface associated with the given *vi* is not currently the controller in charge.
VI_ERROR_NLISTENERS	No Listeners condition is detected (both NRFD and NDAC are deasserted).
VI_ERROR_IO	An unknown I/O error occurred during transfer.

See Also **viRead**

viWriteAsync

Syntax

```
viWriteAsync(ViSession vi, ViBuf buf, ViUInt32 count,
  ViPJobId jobId);
```

Description

This function asynchronously transfers data to a device. The data to be written is in the buffer represented by *buf*. This function normally returns before the transfer terminates. An I/O Completion event is posted when the transfer is actually completed.

This function returns *jobId*, which you can use either with **viTerminate** to abort the operation, or with an I/O Completion event to identify which asynchronous write operation completed.

Parameters

Name	Direction	Type	Description
vi	IN	**ViSession**	Unique logical identifier to a session.
buf	IN	**ViBuf**	Represents the location of a data block to be sent to the device.
count	IN	**ViUInt32**	Specifies number of bytes to be written.
jobId	OUT	**ViPJobId**	Represents the location of a variable that will be set to the job identifier of this asynchronous write operation.

Special value for *jobId* Parameter:

VI_NULL	Do not return a job identifier.

Return Values

Type **ViStatus** This is the function return status. It returns either a completion code or an error code as follows.

Completion Codes	Description
VI_SUCCESS	Asynchronous write operation successfully queued.
VI_SUCCESS_SYNC	Write operation performed synchronously.

Error Codes	Description
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_QUEUE_ERROR	Unable to queue write operation.

See Also

viRead, viTerminate, viWrite, viReadAsync

A

VISA System Information

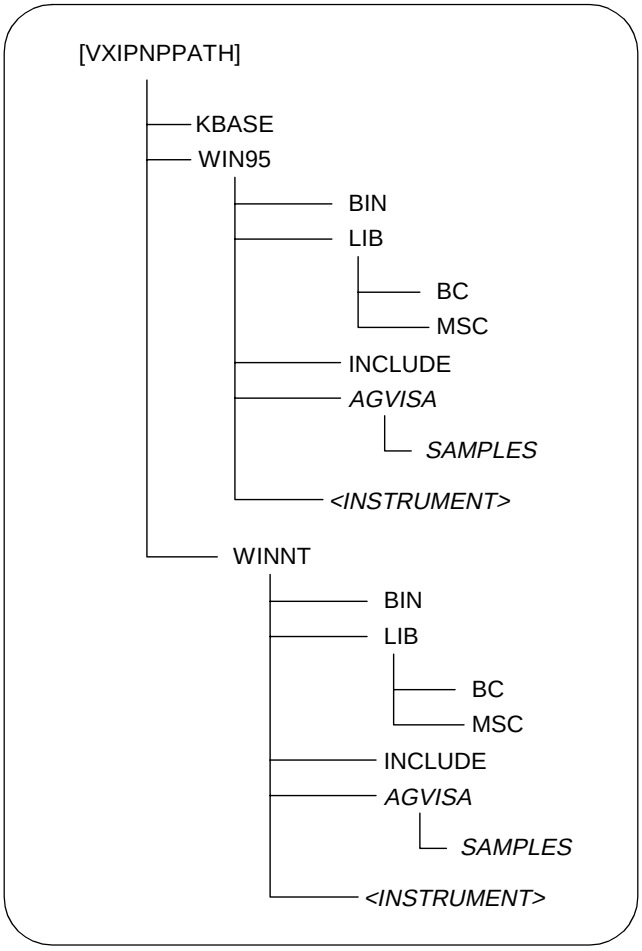
VISA System Information

This appendix provides information about the VISA software files. This information can be used as reference or for removing VISA software from your system, if necessary. The appendix contents are:

- Windows Directory Structure
- HP-UX Directory Structure
- About the Directories

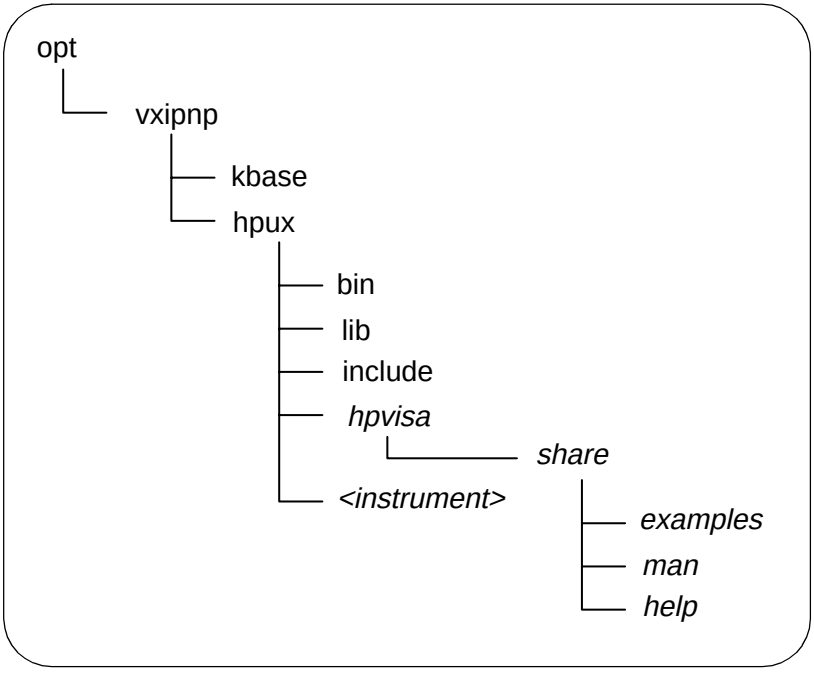
Windows Directory Structure

The VXI*plug&play* alliance defines directory structures to be used with the Windows system framework. As shown in the following figure, VISA files are automatically installed into the **WIN95** subdirectory on Windows 95 or Windows 98 or into the **WINNT** subdirectory on Windows 2000 or Windows NT. The [**VXIPNPPATH**] defaults to **\Program Files\VISA**, but can be changed during software installation. The **VISA32.DLL** file is stored in the **\WINDOWS\SYSTEM** subdirectory (Windows 95 or Windows 98) or in the **\WINDOWS\SYSTEM32** subdirectory (Windows 2000 or Windows NT).



HP-UX Directory Structure

The VXI*plug&play* alliance defines a directory structure to be used with the UNIX system framework. VISA is automatically installed into the following directory structure on HP-UX 10.20. The [**`opt`**] is an optional path that you can change during the software installation.



About the Directories

Element	Description
The VISA Subdirectory	Associated readme files, help files and Agilent-specific DLLs can be found in the **`VISA`** subdirectory.
Include Files	The **`VISA.H`**, **`VISATYPE.H`**, and **`VPPTYPE.H`** include files can be found in the **`INCLUDE`** subdirectory.
Libraries	A VISA library is provided for Microsoft and Borland compilers on Windows and the C compiler for HP-UX. You must use the library for your system.
Sample Programs	Sample programs are provided for the Windows or HP-UX operating system, depending on which system installed. VISA sample programs can be found in the **`VISA\SAMPLES`** subdirectory on Windows or in the **`visa/share/examples`** subdirectory on HP-UX 10.20.
VXI*plug&play* Instrument Drivers	All instrument drivers that comply with the VXI*plug&play* specification can be found in the <*instrument*> subdirectory, where <*instrument*> is the base directory of the instrument driver.

Notes:

B

VISA Attributes

VISA Attributes

This appendix describes VISA attributes, including the following sections. For descriptions of all the attributes and how to use them, see *Chapter 4 - Programming with VISA.*

- VISA Resource Attributes
- VISA Generic Instrument Attributes
- VISA Interface-Specific Instrument Attributes
- ASRL Specific INSTR Resource Interface Attributes
- MEMACC Resource Attributes
- VISA Event Attributes

NOTE

Attributes are local or global. A local attribute only affects the session specified. A global attribute affects the specified device from any session. Attributes can also be read only (RO) and read/write (RW).

Use the **`viGetAttribute`** function to read the state of an attribute for a specified session, event context, or find list. Use the **`viSetAttribute`** function to modify the state of a read/write attribute for a specified session, event context, or find list.

VISA Resource Attributes

Attribute Name	RO or RW	Local or Global	Data Type	Range
VI_ATTR_MAX_QUEUE_LENGTH	RW[1]	Local	**ViUInt32**	1 to 32,767 (50 = default)
VI_ATTR_RM_SESSION	RO	Local	**ViSession**	N/A
VI_ATTR_RSRC_IMPL_ VERSION	RO	Global	**ViVersion**	0h to FFFFFFFFh
VI_ATTR_RSRC_LOCK_STATE	RO	Global	**ViAccessMode**	**VI_NO_LOCK** (default) **VI_EXCLUSIVE_LOCK' VI_SHARED_LOCK**
VI_ATTR_RSRC_MANF_ID	RO	Global	**ViUInt16**	0_h to $3FFF_h$
VI_ATTR_RSRC_MANF_NAME	RO	Global	**ViString**	N/A
VI_ATTR_RSRC_NAME	RO	Global	**ViRsrc**	N/A
VI_ATTR_RSRC_SPEC_ VERSION	RO	Global	**ViVersion**	00100000_h (VISA 1.0 default) 00100100_h (VISA 1.1 default)
VI_ATTR_USER_DATA	RW	Local	**ViAddr**	N/A

1. For VISA 1.0, this attribute becomes RO (read only) once **viEnableEvent** has been called for the first time.

VISA Generic Instrument Attributes

Attribute Name	RO or RW	Local or Global	Data Type	Range
VI_ATTR_INTF_NUM	RO	Global	**ViUInt16**	**0 to FFFF$_h$** (0 default)
VI_ATTR_INTF_TYPE	RO	Global	**ViUInt16**	**VI_INTF_VXI** **VI_INTF_GPIB** **VI_INTF_GPIB_VXI** **VI_INTF_ASRL**
VI_ATTR_INTF_INST_NAME	RO	Global	**ViString**	N/A
VI_ATTR_IO_PROT	RW	Local	**ViUInt16**	**VI_NORMAL** (default) **VI_FDC** **VI_HS488** **VI_ASRL488**
VI_ATTR_RD_BUF_OPER_MODE	RW	Local	**ViUInt16**	**VI_FLUSH_ON_ACCESS** **VI_FLUSH_DISABLE** (default)
VI_ATTR_SEND_END_EN	RW	Local	**ViBoolean**	**VI_TRUE** (default) **VI_FALSE**
VI_ATTR_SUPPRESS_END_EN	RW	Local	**ViBoolean,**	**VI_TRUE** **VI_FALSE** (default**)**
VI_ATTR_TERMCHAR,	RW	Local	**ViUInt8,**	**0 to FF$_h$ (0A$_h$ default)**
VI_ATTR_TERMCHAR_EN,	RW	Local	**ViBoolean,**	**VI_TRUE** **VI_FALSE** (default)
VI_ATTR_TMO_VALUE	RW	Local	**ViUInt32**	**VI_TMO_IMMEDIATE** 1 to FFFFFFFE$_h$ **VI_TMO_INFINITE** (2000 milliseconds = default)

Attribute Name	RO or RW	Local or Global	Data Type	Range
VI_ATTR_TRIG_ID	RW[1]	Local	**ViInt16**	**VI_TRIG_SW** (default) **VI_TRIG_TTL0** to **VI_TRIG_TTL7** **VI_TRIG_ECL0** to **VI_TRIG_ECL1**
VI_ATTR_WR_BUF_OPER_MOD	RW	Local	**ViUInt16**	**VI_FLUSH_ON_ACCESS** **VI_FLUSH_WHEN_FULL** (default)

1. The attribute **VI_ATTR_TRIG_ID** is RW (readable and writable) when the corresponding session is *not* enabled to receive trigger events. When the session is enabled to receive trigger events, this attribute is RO (read only).

VISA Interface-Specific Instrument Attributes

GPIB and GPIB-VXI Interfaces

Attribute Name	RO or RW	Local or Global	Data Type	Range
VI_ATTR_GPIB_PRIMARY_ADDR	RO	Global	**ViUInt16**	**0 to 30**
VI_ATTR_GPIB_SECONDARY_ADDR	RO	Global	**ViUInt16**	**0 to 30** **VI_NO_SEC_ADDR**
VI_ATTR_GPIB_REN_STATE	RO	Global	**ViUInt16**	**VI_STATE_UNKNOWN** **VI_STATE_ASSERTED** **VI_STATE_UNASSERTED**
VI_ATTR_GPIB_READDR_EN	RW	Local	**Viboolean**	**VI_TRUE** (default) **VI_FALSE**
VI_ATTR_GPIB_UNADDR_EN	RW	Local	**Viboolean**	**VI_TRUE** **VI_FALSE** (default)

VXI and GPIB-VXI Interfaces

Attribute Name	RO or RW	Local or Global	Data Type	Range
VI_ATTR_CMDR_LA	RO	Global	**ViInt16**	0 to 255 **VI_UNKNOWN_LA**
VI_ATTR_DEST_INCREMENT	RW	Local	**ViInt32**	0 to 1 (1 = default)
VI_ATTR_FDC_CHNL	RW	Local	**ViUInt16**	0 to 7
VI_ATTR_FDC_GEN_SIGNAL_EN	RW	Local	**ViBoolean**	**VI_TRUE** **VI_FALSE** (default)
VI_ATTR_FDC_MODE	RW	Local	**ViUInt16**	**VI_FDC_NORMAL** (default) **VI_FDC_STREAM**
VI_ATTR_FDC_USE_PAIR	RW	Local	**ViBoolean**	**VI_TRUE** **VI_FALSE** (default)

Attribute Name	RO or RW	Local or Global	Data Type	Range
VI_ATTR_IMMEDIATE_SERV	RO	Global	**ViBoolean**	**VI_TRUE** **VI_FALSE**
VI_ATTR_MAINFRAME_LA	RO	Global	**ViInt16**	0 to 255 **VI_UNKNOWN_LA**
VI_ATTR_MANF_ID	RO	Global	**ViUInt16**	0 to FFF_h
VI_ATTR_MEM_BASE	RO	Global	**ViBusAddress**	N/A
VI_ATTR_MEM_SIZE	RO	Global	**ViBusSize**	N/A
VI_ATTR_MEM_SPACE	RO	Global	**ViUInt16**	**VI_A16_SPACE** (default) **VI_A24_SPACE** **VI_A32_SPACE**
VI_ATTR_MODEL_CODE	RO	Global	**ViUInt16**	0 to $FFFF_h$
VI_ATTR_SLOT	RO	Global	**ViInt16**	0 to 12 **VI_UNKNOWN_SLOT**
VI_ATTR_SRC_INCREMENT	RW	Local	**ViInt32**	0 to 1 (1 default)
VI_ATTR_VXI_LA	RO	Global	**ViInt16**	0 to 255 (VISA 1.0) 0 to 511 (VISA 1.1)
VI_ATTR_WIN_ACCESS	RO	Local	**ViUInt16**	**VI_NMAPPED** **VI_USE_OPERS** **VI_DEREF_ADDR**
VI_ATTR_WIN_BASE_ADDR	RO	Local	**ViBusAddress**	N/A
VI_ATTR_WIN_SIZE	RO	Local	**ViBusSize**	N/A
VI_ATTR_SRC_BYTE_ORDER	RW	Local	**ViUInt16**	**VI_BIG_ENDIAN** **VI_LITTLE_ENDIAN**
VI_ATTR_DEST_BYTE_ORDER	RW	Local	**ViUInt16**	**VI_BIG_ENDIAN** **VI_LITTLE_ENDIAN**
VI_ATTR_WIN_BYTE_ORDER	RW[1]	Local	**ViUInt16**	**VI_BIG_ENDIAN** **VI_LITTLE_ENDIA**N

Attribute Name	RO or RW	Local or Global	Data Type	Range
VI_ATTR_SRC_ACCESS_PRIV	RW	Local	**ViUInt16**	**VI_DATA_NPRIV** **VI-DATA_PRIV** **VI_PROG_NPRIV** **VI_PROG_PRIV** **VI_BLCK_NPRIV** **VI_BLCK_PRIV** **VI_D64_NPRIV** **VI_D64_PRIV**
VI_ATTR_DEST_ACCESS_PRIV	RW	Local	**ViUInt16**	**VI_DATA_NPRIV** **VI-DATA_PRIV** **VI_PROG_NPRIV** **VI_PROG_PRIV** **VI_BLCK_NPRIV** **VI_BLCK_PRIV** **VI_D64_NPRIV** **VI_D64_PRIV**
VI_ATTR_WIN_ACCESS_PRIV	RW[1]	Local	**ViUInt16**	**VI_DATA_NPRIV** **VI-DATA_PRIV** **VI_PROG_NPRIV** **VI_PROG_PRIV** **VI_BLCK_NPRIV** **VI_BLCK_PRIV**

1. For VISA 1.1, the attributes **VI_ATTR_WIN_BYTE_ORDER** and **VI_ATTR_WIN_ACCESS_PRIV** are RW (readable and writeable) when the corresponding session is not mapped (**VI_ATTR_WIN_ACCESS = = VI_NMAPPED**). When the session is mapped, these attributes are RO (Read Only).

GPIB-VXI Interface

Attribute Name	RO or RW	Local or Global	Data Type	Range
VI_ATTR_INTF_PARENT_NUM	RO	Global	**ViUInt16**	0 to $FFFF_h$

ASRL Specific INSTR Resource Interface Attributes

Attribute Name	RO or RW	Local or Global	Data Type	Range
VI_ATTR_ASRL_AVAIL_NUM	RO	Global	**ViUInt32**	0 to FFFFFFFF$_h$
VI_ATTR_ASRL_BAUD	RW	Global	**ViUInt32**	0 to FFFFFFFF$_h$ (9600 default)
VI_ATTR_ASRL_DATA_BITS	RW	Global	**ViUInt16**	5 to 8 (8 default)
VI_ATTR_ASRL_END_IN	RW	Local	**ViUInt16**	**VI_ASRL_END_NONE** **VI_ASRL_END_LAST_BIT** **VI_ASRL_END_TERMCHAR** (default)
VI_ATTR_ASRL_END_OUT	RW	Local	**ViUInt16**	**VI_ASRL_END_NONE** (default) **VI_ASRL_END_LAST_BIT** **VI_ASRL_END_BREAK**
VI_ATTR_ASRL_FLOW_CNTRL	RW	Global	**ViUInt16**	**VI_ASRL_FLOW_NONE** (default) **VI_ASRL_FLOW_XON_XOFF** **VI_ASRL_FLOW_RTS_CTS**
VI_ATTR_ASRL_PARITY	RW	Global	**ViUInt16**	**VI_ASRL_PAR_NONE** (default) **VI_ASRL_PAR_ODD** **VI_ASRL_PAR_EVEN** **VI_ASRL_PAR_MARK** **VI_ASRL_PAR_SPACE**
VI_ATTR_ASRL_STOP_BITS	RW	Global	**ViUInt16**	**VI_ASRL_STOP_ONE** (default) **VI_ASRL_STOP_TWO**
VI_ATTR_ASRL_CTS_STATE	RO	Global	**ViUInt16**	**VI_STATE_ASSERTED** **VI_STATE_UNASSERTED** **VI_STATE_UNKNOWN**
VI_ATTR_ASRL_DCD_STATE	RO	Global	**ViUInt16**	**VI_STATE_ASSERTED** **VI_STATE_UNASSERTED** **VI_STATE_UNKNOWN**
VI_ATTR_ASRL_DSR_STATE	RO	Global	**ViUInt16**	**VI_STATE_ASSERTED** **VI_STATE_UNASSERTED** **VI_STATE_UNKNOWN**

Attribute Name	RO or RW	Local or Global	Data Type	Range
VI_ATTR_ASRL_DTR_STATE	RW	Global	**ViUInt16**	**VI_STATE_ASSERTED** **VI_STATE_UNASSERTED** **VI_STATE_UNKNOWN**
VI_ATTR_ASRL_RI_STATE	RO	Global	**ViUInt16**	**VI_STATE_ASSERTED** **VI_STATE_UNASSERTED** **VI_STATE_UNKNOWN**
VI_ATTR_ASRL_RTS_STATE	RW	Global	**ViUInt16**	**VI_STATE_ASSERTED** **VI_STATE_UNASSERTED** **VI_STATE_UNKNOWN**

MEMACC Resource Attributes

Generic MEMACC Attributes

Attribute Name	RO or RW	Local or Global	Data Type	Range
VI_ATTR_INTF_NUM	RO	Global	**ViUInt16**	0 to $FFFF_h$
VI_ATTR_INTF_TYPE	RO	Global	**ViUInt16**	**VI_INTF_VXI** **VI_INTF_GPIB_VXI**
VI_ATTR_INTF_INST_NAME	RO	Global	**ViString**	**N/A**
VI_ATTR_TMO_VALUE	RW	Local	**ViUInt32**	**VI_TMO_IMMEDIATE** 1 to $FFFFFFFE_h$ **VI_TMO_INFINITE**

VXI and GPIB-VXI Specific MEMACC Resource Attributes

Attribute Name	RO or RW	Local or Global	Data Type	Range
VI_ATTR_VXI_LA	RO	Global	**ViUInt16**	0 to 255
VI_ATTR_SRC_INCREMENT	RW	Local	**ViUInt132**	0 to 1
VI_ATTR_DEST_INCREMENT	RW	Local	**ViUInt132**	0 to 1
VI_ATTR_WIN_ACCESS	RO	Local	**ViUInt16**	**VI_NMAPPED** **VI_USE_OPERS** **VI_DEREF_ADDR**
VI_ATTR_WIN_BASE_ADD	RO	Local	**ViBusAddress**	N/A
VI_ATTR_WIN_SIZE	RO	Local	**ViBusSize**	N/A
VI_ATTR_SRC_BYTE_ORDER	RW	Local	**ViUInt16**	**VI_BIG_ENDIAN** **VI_LITTLE_ENDIAN**
VI_ATTR_DEST_BYTE_ORDER	RW	Local	**ViUInt16**	**VI_BIG_ENDIAN** **VI_LITTLE_ENDIAN**

Attribute Name	RO or RW	Local or Global	Data Type	Range
VI_ATTR_WIN_BYTE_ORDER	RW[1]	Local	**ViUInt16**	**VI_BIG_ENDIAN** **VI_LITTLE_ENDIAN**
VI_ATTR_SRC_ACCESS_PRIV	RW	Local	**ViUInt16**	**VI_DATA_NPRIV** **VI-DATA_PRIV** **VI_PROG_NPRIV** **VI_PROG_PRIV** **VI_BLCK_NPRIV** **VI_BLCK_PRIV** **VI_D64_NPRIV** **VI_D64_PRIV**
VI_ATTR_DEST_ACCESS_PRIV	RW	Local	**ViUInt16**	**VI_DATA_NPRIV** **VI-DATA_PRIV** **VI_PROG_NPRIV** **VI_PROG_PRIV** **VI_BLCK_NPRIV** **VI_BLCK_PRIV** **VI_D64_NPRIV** **VI_D64_PRIV**
VI_ATTR_WIN_ACCESS_PRIV	RW[1]	Local	**ViUInt16**	**VI_DATA_NPRIV** **VI-DATA_PRIV** **VI_PROG_NPRIV** **VI_PROG_PRIV** **VI_BLCK_NPRIV** **VI_BLCK_PRIV**

1. For VISA 1.1 and later, the **VI_ATTR_WIN_BYTE_ORDER** and **VI_ATTR_WIN_ACCESS_PRIV** attributes are RW (readable and writeable) when the corresponding session is not mapped (**VI_ATTR_WIN_ACCESS = = VI_NMAPPED**). When the session is mapped, these attributes are RO (Read Only).

GPIB-VXI Specific MEMACC Resource Attributes

Attribute Name	RO or RW	Local or Global	Data Type	Range
VI_ATTR_INTF_PARENT_NUM	RO	Global	**ViUInt16**	0 TO $FFFF_h$
VI_ATTR_GPIB_PRIMARY_ADDR	RO	Global	**ViUInt16**	0 TO 31
VI_ATTR_GPIB_SECONDARY_ADDR	RO	Global	**ViUInt16**	0 TO 31 **VI_NO_SEC_ADDR**

VISA Event Attributes

Attribute Name	RO or RW	Local or Global	Data Type	Range
VI_ATTR_BUFFER	RO	Local	**ViBuf**	N/A
VI_ATTR_EVENT_TYPE	RO	Local	**ViEventType**	**VI_EVENT_SERVICE_REQ** **VI_EVENT_VXI_SIGP** **VI_EVENT_TRIG** **VI_EVENT_IO_COMPLETION**
VI_ATTR_JOB_ID	RO	Local	**ViJobId**	N/A
VI_ATTR_RECV_TRIG_ID	RO	Local	**ViInt16**	**VI_TRIG_TTL0 to VI_TRIG_TTL7** **VI_TRIG_ECL0 to VI_TRIG_ECL1**
VI_ATTR_RET_COUNT	RO	Local	**ViUInt32**	0 to $FFFFFFFF_h$
VI_ATTR_SIGP_STATUS_ID	RO	Local	**ViUInt16**	0 to $FFFF_h$
VI_ATTR_STATUS	RO	Local	**ViStatus**	N/A

NOTE

The **VI_EVENT_VXI_SIGP** and **VI_EVENT_TRIG** events are not supported with the GPIB-VXI interface.

VISA Completion and Error Codes

VISA Completion and Error Codes

This appendix lists VISA completion and error codes, presented in two ways:

- In alphabetical order.
- According to the VISA function that returns the codes. You can use this list to determine what type of codes to expect from each VISA function.

Alphabetized Completion and Error Codes

This table lists VISA completion and error codes in alphabetical order.

Completion Code	Description
VI_SUCCESS	Operation completed successfully.
VI_SUCCESS_DEV_NPRESENT	Session opened successfully, but the device at the specified address is not responding.
VI_SUCCESS_EVENT_DIS	The specified event is already disabled.
VI_SUCCESS_EVENT_EN	The specified event is already enabled for at least one of the specified mechanisms.
VI_SUCCESS_MAX_CNT	The number of bytes specified were read.
VI_SUCCESS_NESTED_EXCLUSIVE	The specified access mode was successfully acquired and this session has nested exclusive locks.
VI_SUCCESS_NESTED_SHARED	The specified access mode was successfully acquired and this session has nested shared locks.
VI_SUCCESS_QUEUE_EMPTY	The event queue was empty while trying to discard queued events.
VI_SUCCESS_QUEUE_NEMPTY	The event queue is not empty.
VI_SUCCESS_SYNC	The read or write operation performed synchronously.
VI_SUCCESS_TERM_CHAR	The specified termination character was read.
VI_WARN_CONFIG_NLOADED	The specified configuration either does not exist or could not be loaded using VISA-specified defaults.
VI_WARN_NSUP_ATTR_STATE	The attribute state is not supported by this resource.
VI_WARN_NSUP_BUF	The specified buffer is not supported.
VI_WARN_UNKNOWN_STATUS	The status code passed to the function was unable to be interpreted.

Error Code	Description
VI_ERROR_ALLOC	Insufficient system resources to open a session or to allocate the buffer(s) or memory block of the specified size.
VI_ERROR_ASRL_PARITY	A parity error occurred during transfer.
VI_ERROR_ASRL_FRAMING	A framing error occurred during transfer.
VI_ERROR_ASRL_OVERRUN	An overrun error occurred during transfer. A character was not read from the hardware before the next character arrived.
VI_ERROR_ATTR_READONLY	The attribute specified is read-only.
VI_ERROR_BERR	A bus error occurred during transfer.
VI_ERROR_CLOSING_FAILED	Unable to deallocate the previously allocated data structures for this session.
VI_ERROR_HNDLR_NINSTALLED	A handler is not currently installed for the specified event. The session cannot be enabled for the **VI_HNDLR** mode of the callback mechanism.
VI_ERROR_INP_PROT_VIOL	Input protocol error occurred during transfer.
VI_ERROR_INV_ACCESS_KEY	The *requestedKey* value passed in is not a valid access key to the specified resource.
VI_ERROR_INV_ACC_MODE	The access mode specified is invalid.
VI_ERROR_INV_CONTEXT	The event context specified is invalid.
VI_ERROR_INV_DEGREE	The specified degree is invalid.
VI_ERROR_INV_EVENT	The event type specified is invalid for the specified resource.
VI_ERROR_INV_EXPR	The expression specified is invalid.
VI_ERROR_INV_FMT	The format specifier is invalid for the current argument.
VI_ERROR_INV_HNDLR_REF	The specified handler reference and/or the user context value does not match the installed handler.
VI_ERROR_INV_JOB_ID	The specified job identifier is invalid.
VI_ERROR_INV_LENGTH	The length specified is invalid.
VI_ERROR_INV_LOCK_TYPE	The specified type of lock is not supported by this resource.
VI_ERROR_INV_MASK	The system cannot set the buffer for the given mask, or the specified mask does not specify a valid flush operation on the read/write resource.

Error Code	Description
VI_ERROR_INV_MECH	The mechanism specified for the event is invalid.
VI_ERROR_INV_MODE	The value specified by the *mode* parameter is invalid.
VI_ERROR_INV_OBJECT	The object reference is invalid.
VI_ERROR_INV_OFFSET	The offset specified is invalid.
VI_ERROR_INV_PARAMETER	The value of some parameter is invalid.
VI_ERROR_INV_PROT	The protocol specified is invalid.
VI_ERROR_INV_RSRC_NAME	The resources specified are invalid.
VI_ERROR_INV_SESSION	The session specified is invalid.
VI_ERROR_INV_SETUP	The setup specified is invalid, possibly due to attributes being set to an inconsistent state, or some implementation-specific configuration file is corrupt or does not exist.
VI_ERROR_INV_SIZE	The specified size is invalid.
VI_ERROR_INV_SPACE	The address space specified is invalid.
VI_ERROR_IO	Could not perform read/write function because of an I/O error, or an unknown I/O error occurred during transfer.
VI_ERROR_LINE_IN_USE	The specified trigger line is in use.
VI_ERROR_MEM_NSHARED	The device does not export any memory.
VI_ERROR_NCIC	The session is referring to something other than the controller in charge.
VI_ERROR_NIMPL_OPER	The given operation is not implemented.
VI_ERROR_NLISTENERS	No listeners are detected. (Both NRFD and NDAC are deasserted.)
VI_ERROR_NSUP_ATTR	The attribute specified is not supported by the specified resource.
VI_ERROR_NSUP_ATTR_STATE	The state specified for the attribute is not supported.
VI_ERROR_NSUP_FMT	The format specifier is not supported for the current argument type.
VI_ERROR_NSUP_OFFSET	The offset specified is not accessible.
VI_ERROR_NSUP_OPER	The operation specified is not supported in the given session.
VI_ERROR_NSUP_WIDTH	The specified width is not supported by this hardware.

Error Code	Description
VI_ERROR_NSYS_CNTLR	The interface associated with this session is not the system controller.
VI_ERROR_QUEUE_ERROR	Unable to queue read or write operation.
VI_ERROR_OUTP_PROT_VIOL	Output protocol error occurred during transfer.
VI_ERROR_RAW_RD_PROT_VIOL	A violation of raw read protocol occurred during a transfer.
VI_ERROR_RAW_WR_PROT_VIOL	A violation of raw write protocol occurred during a transfer.
VI_ERROR_RSRC_BUSY	The resource is valid, but VISA cannot currently access it.
VI_ERROR_RSRC_LOCKED	The specified operation could not be performed because the resource identifed by *vi* has been locked for this kind of access.
VI_ERROR_RSRC_NFOUND	The expression specified does not match any device, or resource was not found.
VI_ERROR_SRQ_NOCCURED	A service request has not been received for the session.
VI_ERROR_SYSTEM_ERROR	Unknown system error.
VI_ERROR_TMO	The operation failed to complete within the specified timeout period.
VI_ERROR_USER_BUF	A specified user buffer is not valid or cannot be accessed for the required size.
VI_ERROR_WINDOW_MAPPED	The specified session already contains a mapped window.
VI_ERROR_WINDOW_NMAPPED	The specified session is not currently mapped.

Completion and Error Codes for VISA Functions

VISA functions are listed in alphabetical order with associated completion and error codes for each function.

viAssertTrigger(*vi*,*protocol*)

Codes	Description
VI_SUCCESS	The specified trigger was successfully asserted to the device.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_INV_PROT	The protocol specified is invalid.
VI_ERROR_TMO	Timeout expired before function completed.
VI_ERROR_RAW_WR_PROT_VIOL	Violation of raw write protocol occurred during transfer.
VI_ERROR_RAW_RD_PROT_VIOL	Violation of raw read protocol occurred during transfer.
VI_ERROR_INP_PROT_VIOL	Device reported an input protocol error during transfer.
VI_ERROR_BERR	Bus error occurred during transfer.
VI_ERROR_LINE_IN_USE	The specified trigger line is currently in use.
VI_ERROR_NCIC	*vi* does not refer to an interface that is currently the controller in charge.
VI_ERROR_NLISTENERS	No listeners condition is detected (both NRFD and NDAC are deasserted).
VI_ERROR_INV_SETUP	Unable to start operation because setup is invalid (due to attributes being set to an inconsistent state).

viBufRead (*vi, buf, count, retCount***);**

Codes	Description
VI_SUCCESS	The operation completed successfully and the END indicator was received (for interfaces that have END indicators).
VI_SUCCESS_TERM_CHAR	The specified termination character was read.
VI_SUCCESS_MAX_CNT	The number of bytes read is equal to *count*.
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_TMO	Timeout expired before function completed.
VI_ERROR_IO	An unknown I/O error occurred during transfer.

viBufWrite (*vi, buf, count, retCount*);

Codes	Description
VI_SUCCESS	Operation completed successfully.
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_TMO	Timeout expired before function completed.
VI_ERROR_INV_SETUP	Unable to start write operation because setup is invalid (due to attributes being set to an inconsistent state).
VI_ERROR_IO	An unknown I/O error occurred during transfer.

viClear(*vi*)

Codes	Description
VI_SUCCESS	Operation completed successfully.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_TMO	Timeout expired before function completed.
VI_ERROR_RAW_WR_PROT_VIOL	Violation of raw write protocol occurred during transfer.
VI_ERROR_RAW_RD_PROT_VIOL	Violation of raw read protocol occurred during transfer.
VI_ERROR_BERR	Bus error occurred during transfer.
VI_ERROR_NCIC	*vi* does not refer to an interface that is currently the controller in charge.
VI_ERROR_NLISTENERS	No listeners condition is detected (both NRFD and NDAC are deasserted).
VI_ERROR_INV_SETUP	Unable to start operation because setup is invalid (due to attributes being set to an inconsistent state).

viClose(*vi*)

Codes	Description
VI_SUCCESS	Session closed successfully.
VI_WARN_NULL_OBJECT	The specified object reference is uninitialized.
VI_ERROR_INV_SESSION	The given *vi* does not identify a valid session.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_CLOSING_FAILED	Unable to deallocate the previously allocated data structures corresponding to this session or object reference.

viDisableEvent(*vi,eventType,mechanism*)

Codes	Description
VI_SUCCESS	Event disabled successfully.
VI_SUCCESS_EVENT_DIS	Specified event is already disabled for at least one of the specified mechanisms.
VI_ERROR_INV_SESSION	The given *vi* does not identify a valid session.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_INV_EVENT	Specified event type is not supported by the resource.
VI_ERROR_INV_MECH	Invalid mechanism specified.

viDiscardEvents(*vi,eventType,mechanism*)

Codes	Description
VI_SUCCESS	Event queue flushed successfully.
VI_SUCCESS_QUEUE_EMPTY	Operation completed successfully, but queue empty.
VI_ERROR_INV_SESSION	The given *vi* does not identify a valid session.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_INV_EVENT	Specified event type is not supported by the resource.
VI_ERROR_INV_MECH	Invalid mechanism specified.

viEnableEvent(*vi,eventType,mechanism,context*)

Codes	Description
VI_SUCCESS	Event enabled successfully.
VI_SUCCESS_EVENT_EN	The specified event is already enabled for at least one of the specified mechanisms.
VI_ERROR_INV_SESSION	The given *vi* does not identify a valid session.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_INV_EVENT	The specified event type is not supported by the resource.
VI_ERROR_INV_MECH	Invalid mechanism specified.
VI_ERROR_INV_CONTEXT	Invalid event context specified.

Codes	Description
VI_ERROR_HNDLR_NINSTALLED	A handler is not currently installed for the specified event. The session cannot be enabled for the **VI_HNDLR** mode of the callback mechanism.

viFindNext(*findList,instrDesc*)

Codes	Description
VI_SUCCESS	Resource(s) found.
VI_ERROR_INV_SESSION	The given *findList* is not a valid session.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_NSUP_OPER	The given *findList* does not support this function.
VI_ERROR_RSRC_NFOUND	There are no more matches.

viFindRsrc(*sesn,expr,findList,retcnt,instrDesc*)

Codes	Description
VI_SUCCESS	Resource(s) found.
VI_ERROR_INV_SESSION	The given *sesn* is not a valid session.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_NSUP_OPER	The given *sesn* does not support this function.
VI_ERROR_INV_EXPR	Invalid expression specified for search.
VI_ERROR_RSRC_NFOUND	Specified expression does not match any devices.

viFlush(*vi,mask*)

Codes	Description
VI_SUCCESS	Buffers flushed successfully.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_IO	Could not perform read/write operation because of I/O error.

Codes	Description
VI_ERROR_TMO	The read/write operation was aborted because timeout expired while operation was in progress.
VI_ERROR_INV_MASK	The specified *mask* does not specify a valid flush operation on read/write resource.

viGetAttribute(*vi,attribute,attrState*)

Codes	Description
VI_SUCCESS	Resource attribute retrieved successfully.
VI_ERROR_INV_SESSION	The given *vi* does not identify a valid session.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_NSUP_ATTR	The specified attribute is not defined by the referenced resource.

viGpibControlREN(*vi*, *mode*);

Codes	Description
VI_SUCCESS	Operation completed successfully.
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_NSUP_OPER	The given *vi* does not support this operation.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_NCIC	The interface associated with this session is not currently the controller in charge.
VI_ERROR_NLISTENERS	No listeners condition is detected (both NRFD and NDAC are deasserted).
VI_ERROR_NSYS_CNTLR	The interface associated with this session is not the system controller.
VI_ERROR_INV_MODE	The value specified by the *mode* parameter is invalid.

viIn8(*vi,space,offset,val8*)
viIn16(*vi,space,offset,val16*)
viIn32(*vi,space,offset,val32*)

Codes	Description
VI_SUCCESS	Operation completed successfully.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_BERR	Bus error occurred during transfer.
VI_ERROR_INV_SPACE	Invalid address space specified.
VI_ERROR_INV_OFFSET	Invalid offset specified.
VI_ERROR_NSUP_OFFSET	Specified offset is not accessible from this hardware.
VI_ERROR_NSUP_WIDTH	Specified width is not supported by this hardware.
VI_ERROR_NSUP_ALIGN_OFFSET	The specified offset is not properly aligned for the access width of the operation.

viInstallHandler(*vi,eventType,handler,userHandle*)

Codes	Description
VI_SUCCESS	Event handler installed successfully.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_INV_EVENT	Specified event type is not defined by the resource.
VI_ERROR_INV_HNDLR_REF	The given handler reference is invalid.
VI_ERROR_HNDLR_NINSTALLED	The handler was not installed. This may be returned if an application attempts to install multiple handlers for the same event on the same session.

viLock(*vi,lockType,timeout,requestedKey,accessKey*)

Codes	Description
VI_SUCCESS	The specified access mode was successfully acquired.
VI_SUCCESS_NESTED_EXCLUSIVE	The specified access mode was successfully acquired and this session has nested exclusive locks.
VI_SUCCESS_NESTED_SHARED	The specifed access mode was successfully acquired and this session has nested shared locks.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_RSRC_LOCKED	The specified type of lock cannot be obtained because the resource is already locked with a lock type incompatible with the lock requested.
VI_ERROR_INV_LOCK_TYPE	The specified type of lock is not supported by this resource.
VI_ERROR_INV_ACCESS_KEY	The *requestedKey* value passed is not a valid access key to the specified resource.
VI_ERROR_TMO	The specified type of lock could not be obtained within the specified timeout period.

viMapAddress(*vi,mapSpace,mapBase,mapSize,access,suggested,address*)

Codes	Description
VI_SUCCESS	Map successful.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_INV_SPACE	Invalid address space specified.
VI_ERROR_INV_OFFSET	Invalid offset specified.
VI_ERROR_NSUP_OFFSET	Specified region is not accessible from this hardware.
VI_ERROR_TMO	Could not acquire resource or perform mapping before the timer expired.

Codes	Description
VI_ERROR_INV_SIZE	Invalid size of window specified.
VI_ERROR_ALLOC	Unable to allocate window of at least the requested size.
VI_ERROR_INV_ACC_MODE	Invalid access mode.
VI_ERROR_WINDOW_MAPPED	The specified session already contains a mapped window.
VI_ERROR_INV_SETUP	Unable to start operation because setup is invalid (due to attributes being set to an inconsistent state).

viMemAlloc(*vi,size,offset*)

Codes	Description
VI_SUCCESS	The operation completed successfully.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_NSUP_OPER	The given *vi* does not support this operation.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_INV_SIZE	Invalid size specified.
VI_ERROR_ALLOC	Unable to allocate shared memory block of the requested size.
VI_ERROR_MEM_NSHARED	The device does not export any memory.

viMemFree(*vi,offset*)

Codes	Description
VI_SUCCESS	The operation completed successfully.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_NSUP_OPER	The given *vi* does not support this operation.
VI_ERROR_INV_OFFSET	Invalid offset specified.
VI_ERROR_WINDOW_MAPPED	The specified offset is currently in use by viMapAddress.

viMove*(vi, srcSpace, srcOffset, srcWidth, destSpace, destOffset, destWidth, Length)*

Codes	Description
VI_SUCCESS	Operation completed successfully.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_NSUP_ORDER	The given *vi* does not support this operation.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_BERR	Bus error occurred during transfer.
VI_ERROR_INV_SPACE	Invalid source or destination address space specified.
VI_ERROR_INV_OFFSET	Invalid source or destination offset specified.
VI_ERROR_INV_WIDTH	Invalid source or destination width specified.
VI_ERROR_NSUP_OFFSET	Invalid source or destination offset is not accessible from this hardware.
VI_ERROR_NSUP_VAR_WIDTH	Cannot support source and destination widths that are different.
VI_ERROR_INV_SETUP	Unable to start operation because setup is invalid (due to attributes being set to an inconsistent state).
VI_ERROR_NSUP_WIDTH	Specified width is not supported by this hardware.
VI_ERROR_NSUP_ALIGN_OFFSET	The specified offset is not properly aligned for the access width of the operation.
VI_ERROR_INV_LENGTH	Invalid length specified.

viMoveAsync*(vi, srcSpace, srcOffset, srcWidth, destSpace, destOffset, destWidth, Length, jobId)*

Codes	Description
VI_SUCCESS	Operation completed successfully.
VI_SUCCESS_SYNC	Operation performed synchronously.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.

Codes	Description
VI_ERROR_NSUP_ORDER	The given *vi* does not support this operation.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI-ERROR_QUEUE	Unable to queue move operation.

viMoveIn8(*vi,space,offset,length,buf8*)
viMoveIn16(*vi,space,offset,length,buf16*)
viMoveIn32(*vi,space,offset,length,buf32*)

Codes	Description
VI_SUCCESS	Operation completed successfully.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_BERR	Bus error occurred during transfer.
VI_ERROR_INV_SPACE	Invalid address space specified.
VI_ERROR_INV_OFFSET	Invalid offset specified.
VI_ERROR_NSUP_OFFSET	Specified offset is not accessible from this hardware.
VI_ERROR_NSUP_WIDTH	Specified width is not supported by this hardware.
VI_ERROR_INV_LENGTH	Invalid length specified.
VI_ERROR_NSUP_ALIGN_ OFFSET	the specified offset is not properly aligned for the access width of the operation.
VI_ERROR_INV_SETUP	Unable to start operation because setup is invalid (due to attributes being set to an inconsistent state).

viMoveOut8(*vi,space,offset,length,buf8*)
viMoveOut16(*vi,space,offset,length,buf16*)
viMoveOut32(*vi,space,offset,length,buf32*)

Codes	Description
VI_SUCCESS	Operation completed successfully.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_BERR	Bus error occurred during transfer.
VI_ERROR_INV_SPACE	Invalid address space specified.
VI_ERROR_INV_OFFSET	Invalid offset specified.
VI_ERROR_NSUP_OFFSET	Specified offset is not accessible from this hardware.
VI_ERROR_NSUP_WIDTH	Specified width is not supported by this hardware.
VI_ERROR_INV_LENGTH	Invalid length specified.
VI_ERROR_NSUP_ALIGN_OFFSET	the specified offset is not properly aligned for the access width of the operation.
VI_ERROR_INV_SETUP	Unable to start operation because setup is invalid (due to attributes being set to an inconsistent state).

viOpen(*sesn,rsrcName,accessMode,timeout,vi*)

Codes	Description
VI_SUCCESS	Session opened successfully.
VI_SUCCESS_DEV_NPRESENT	session opened successfully, but the device at the specified address is not responding.
VI_WARN_CONFIG_NLOADED	The specified configuration either does not exist or could not be loaded using VISA-specified defaults.
VI_ERROR_INV_SESSION	The given *sesn* does not identify a valid session.
VI_ERROR_INV_OBJECT	The given object reference is invalid.

Codes	Description
VI_ERROR_NSUP_OPER	The given *sesn* does not support this function. For VISA, this operation is supported only by the Default Resource Manager session.
VI_ERROR_INV_RSRC_NAME	Invalid resource reference specified. Parsing error.
VI_ERROR_INV_ACC_MODE	Invalid access mode.
VI_ERROR_RSRC_NFOUND	Insufficient location information or resource not present in the system.
VI_ERROR_ALLOC	Insufficient system resources to open a session.
VI_ERROR_RSRC_BUSY	The resource is valid, but VISA cannot currently access it.
VI_ERROR_RSRC_LOCKED	Specified type of lock cannot be obtained because the resource is already locked with a lock type incompatible with the lock requested.
VI_ERROR_TMO	A session to the resource could not be obtained within the specified timeout period.

viOpenDefaultRM(*sesn*)

Codes	Description
VI_SUCCESS	Session to the Default Resource Manager resource created successfully.
VI_ERROR_SYSTEM_ERROR	The VISA system failed to initialize.
VI_ERROR_ALLOC	Insufficient system resources to create a session to the Default Resource Manager resource.
VI_ERROR_INV_SETUP	Some implementation-specific configuration file is corrupt or does not exist.

viOut8(*vi,space,offset,val8*)
viOut16(*vi,space,offset,val16*)
viOut32(*vi,space,offset,val32*)

Codes	Description
VI_SUCCESS	Operation completed successfully.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.

Codes	Description
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_BERR	Bus error occurred during transfer.
VI_ERROR_INV_SPACE	Invalid address space specified.
VI_ERROR_INV_OFFSET	Invalid offset specified.
VI_ERROR_NSUP_OFFSET	Specified offset is not accessible from this hardware.
VI_ERROR_NSUP_WIDTH	Specified width is not supported by this hardware.
VI_ERROR_NSUP_ALIGN_ OFFSET	The specified offset is not properly aligned for the access width of the operation.
VI_ERROR_INV_SETUP	Unable to start operation because setup is invalid (due to attributes being set to an inconsistent state).

viPeek8(*vi,addr,val8*)
viPeek16(*vi,addr,val16*)
viPeek32(*vi,addr,val32*)
These functions do not return any completion or error codes.

viPoke8(*vi,addr,val8*)
viPoke16(*vi,addr,val16*)
viPoke32(*vi,addr,val32*)
These functions do not return any completion or error codes.

viPrintf(*vi,writeFmt,arg1,arg2*)

Codes	Description
VI_SUCCESS	Parameters were successfully formatted.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_IO	Could not perform write operation because of I/O error.
VI_ERROR_TMO	Timeout expired before write operation completed.
VI_ERROR_INV_FMT	A format specifier in the *writeFmt* string is invalid.

Codes	Description
VI_ERROR_NSUP_FMT	A format specifier in the *writeFmt* string is not supported.
VI_ERROR_ALLOC	The system could not allocate a formatted I/O buffer because of insufficient resources.

viQueryf(*vi,writeFmt,readFmt,arg1,arg2*)

Codes	Description
VI_SUCCESS	Successfully completed the Query operation.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_IO	Could not perform read/write operation because of I/O error.
VI_ERROR_TMO	Timeout occurred before read/write operation completed.
VI_ERROR_INV_FMT	A format specifier in the *writeFmt* or *readFmt* string is invalid.
VI_ERROR_NSUP_FMT	The format specifier is not supported for current argument type.
VI_ERROR_ALLOC	The system could not allocate a formatted I/O buffer because of insufficient resources.

viRead(*vi,buf,count,retCount*)

Codes	Description
VI_SUCCESS	The operation completed successfully and the END indicator was received (for interfaces that have END indicators).
VI_SUCCESS_TERM_CHAR	The specified termination character was read.
VI_SUCCESS_MAX_CNT	The number of bytes read is equal to *count*.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_TMO	Timeout expired before function completed.

Codes	Description
VI_ERROR_RAW_WR_PROT_VIOL	Violation of raw write protocol occurred during transfer.
VI_ERROR_RAW_RD_PROT_VIOL	Violation of raw read protocol occurred during transfer.
VI_ERROR_OUTP_PROT_VIOL	Device reported an output protocol error occurred during transfer.
VI_ERROR_BERR	Bus error occurred during transfer.
VI_ERROR_INV_SETUP	Unable to start read operation because setup is invalid (due to attributes being set to an inconsistent state).
VI_ERROR_NCIC	*vi* does not refer to an interface that is currently the controller in charge.
VI_ERROR_NLISTENERS	No listeners condition is detected (both NRFD and NDAC are deasserted).
VI_ERROR_ASRL_PARITY	A parity error occurred during transfer.
VI_ERROR_ASRL_FRAMING	A framing error occurred during transfer.
VI_ERROR_ASRL_OVERRUN	An overrun error occurred during transfer. A character was not read from the hardware before the next character arrived.
VI_ERROR_IO	An unknown I/O error occurred during transfer.

viReadAsync(*vi,buf,count,jobId*)

Codes	Description
VI_SUCCESS	Asynchronous read operation successfully queued.
VI_SUCCESS_SYNC	Read operation performed synchronously.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_QUEUE_ERROR	Unable to queue read operation.

viReadSTB(*vi,status*)

Codes	Description
VI_SUCCESS	Operation completed successfully.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_SRQ_NOCCURRED	Service request has not been received for the session.
VI_ERROR_TMO	Timeout expired before function completed.
VI_ERROR_RAW_WR_PROT_VIOL	Violation of raw write protocol occurred during transfer.
VI_ERROR_RAW_RD_PROT_VIOL	Violation of raw read protocol occurred during transfer.
VI_ERROR_BERR	Bus error occurred during transfer.
VI_ERROR_NCIC	*vi* does not refer to an interface that is currently the controller in charge.
VI_ERROR_NLISTENERS	No listeners condition is detected (both NRFD and NDAC are deasserted).
VI_ERROR_INV_SETUP	Unable to start operation because setup is invalid (due to attributes being set to an inconsistent state).

viScanf(*vi,readFmt,arg1,arg2*)

Codes	Description
VI_SUCCESS	Data was successfully read and formatted into *arg* parameter(s).
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_IO	Could not perform read operation because of I/O error.
VI_ERROR_TMO	Timeout expired before read operation completed.
VI_ERROR_INV_FMT	A format specifier in the *readFmt* string is invalid.
VI_ERROR_NSUP_FMT	A format specifier in the *readFmt* string is not supported.

Codes	Description
VI_ERROR_ALLOC	The system could not allocate a formatted I/O buffer because of insufficient resources.

viSetAttribute(*vi,attribute,attrState*)

Codes	Description
VI_SUCCESS	All attribute values set successfully.
VI_WARN_NSUP_ATTR_STATE	Although the specified state of the attribute is valid, it is not supported by this resource implementation
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_RSRC_LOCKED	The specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_NSUP_ATTR	The specified attribute is not defined by the referenced resource.
VI_ERROR_NSUP_ATTR_STATE	The specified state of the attribute is not valid, or is not supported as defined by the resource.
VI_ERROR_ATTR_READONLY	The specified attribute is read-only.

viSetBuf(*vi,mask,size*)

Codes	Description
VI_SUCCESS	Buffer size set successfully.
VI_WARN_NSUP_BUF	The specified buffer is not supported.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_ALLOC	The system could not allocate the buffer(s) of the specified size because of insufficient system resources.
VI_ERROR_INV_MASK	The system cannot set the buffer for the given *mask*.

viSPrintf(*vi*, *buf*, *writeFmt, arg1, arg2, ...);*

Codes	Description
VI_SUCCESS	Parameters were successfully formatted.
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_INV_FMT	A format specifier in the *writeFmt* string is invalid.
VI_ERROR_NSUP_FMT	A format specifier in the *writeFmt* string is not supported.
VI_ERROR_ALLOC	The system could not allocate a formatted I/O buffer because of insufficient system resources.

viSScanf(*vi*, *buf*, *readFmt, arg1, arg2, ...);*

Codes	Description
VI_SUCCESS	Data were successfully read and formatted into *arg* parameter(s).
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_INV_FMT	A format specifier in the *readFmt* string is invalid.
VI_ERROR_NSUP_FMT	A format specifier in the *readFmt* string is not supported.
VI_ERROR_ALLOC	The system could not allocate a formatted I/O buffer because of insufficient system resources.

viStatusDesc(*vi,status,desc*)

Codes	Description
VI_SUCCESS	Description successfully returned.
VI_WARN_UNKNOWN_STATUS	The status code passed to the function could not be interpreted.

viTerminate(*vi,degree,jobId*)

Codes	Description
VI_SUCCESS	Request serviced successfully.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_INV_DEGREE	Invalid degree specified.
VI_ERROR_INV_JOB_ID	Invalid job identifier specified.

viUninstallHandler(*vi,eventType,handler,userHandle*)

Codes	Description
VI_SUCCESS	Event handler successfully uninstalled.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_INV_EVENT	Specified event type is not supported by the resource.
VI_ERROR_INV_HNDLR_REF	Either the specified handler reference or the user context value (or both) does not match any installed handler.
VI_ERROR_HNDLR_NINSTALLED	A handler is not currently installed for the specified event.

viUnlock(*vi*)

Codes	Description
VI_SUCCESS	The lock was successfully relinquished.
VI_SUCCESS_NESTED_EXCLUSIVE	The call succeeded, but this session still has nested exclusive locks.
VI_SUCCESS_NESTED_SHARED	The call succeeded, but this session still has nested shared locks.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_SESN_NLOCKED	The current session did not have any lock on the resource.

viUnmapAddress(*vi*)

Codes	Description
VI_SUCCESS	Operation completed successfully.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_WINDOW_NMAPPED	The specified session is not currently mapped.

viVPrintf(*vi,writeFmt,params*)

Codes	Description
VI_SUCCESS	Parameters were successfully formatted.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_IO	Could not perform write operation because of I/O error.
VI_ERROR_TMO	Timeout expired before write operation completed.
VI_ERROR_INV_FMT	A format specifier in the *writeFmt* string is invalid.
VI_ERROR_NSUP_FMT	A format specifier in the *writeFmt* string is not supported.
VI_ERROR_ALLOC	The system could not allocate a formatted I/O buffer because of insufficient resources.

viVQueryf(*vi,writeFmt,readFmt,params*)

Codes	Description
VI_SUCCESS	Successfully completed the Query operation.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given session or object reference is invalid (both are the same value).
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.

Codes	Description
VI_ERROR_IO	Could not perform read/write operation because of I/O error.
VI_ERROR_TMO	Timeout occurred before read/write operation completed.
VI_ERROR_INV_FMT	A format specifier in the *writeFmt* or *readFmt* string is invalid.
VI_ERROR_NSUP_FMT	The format specifier is not supported for current argument type.
VI_ERROR_ALLOC	The system could not allocate a formatted I/O buffer because of insufficient resources.

viVScanf(*vi,readFmt,params*)

Codes	Description
VI_SUCCESS	Data was successfully read and formatted into *arg* parameter(s).
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_IO	Could not perform read operation because of I/O error.
VI_ERROR_TMO	Timeout expired before read operation completed.
VI_ERROR_INV_FMT	A format specifier in the *readFmt* string is invalid.
VI_ERROR_NSUP_FMT	A format specifier in the *readFmt* string is not supported.
VI_ERROR_ALLOC	The system could not allocate a formatted I/O buffer because of insufficient resources.

viVSPrintf(*vi, buf, writeFmt, params*);

Codes	Description
VI_SUCCESS	Parameters were successfully formatted.
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_INV_FMT	A format specifier in the *writeFmt* string is invalid.
VI_ERROR_NSUP_FMT	A format specifier in the *writeFmt* string is not supported.

Codes	Description
VI_ERROR_ALLOC	The system could not allocate a formatted I/O buffer because of insufficient resources.

viVSScanf(*vi, buf, readFmt, params*);

Codes	Description
VI_SUCCESS	Data were successfully read and formatted into *arg* parameter(s).
VI_ERROR_INV_SESSION **VI_ERROR_INV_OBJECT**	The given session or object reference is invalid (both are the same value).
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_INV_FMT	A format specifier in the *readFmt* string is invalid.
VI_ERROR_NSUP_FMT	A format specifier in the *readFmt* string is not supported.
VI_ERROR_ALLOC	The system could not allocate a formatted I/O buffer because of insufficient resources.

viWaitOnEvent(*vi,ineventType,timeout,outEventType,outcontext*)

Codes	Description
VI_SUCCESS	Wait terminated successfully on receipt of an event occurrence. The queue is empty.
VI_SUCCESS_QUEUE_NEMPTY	Wait terminated successfully on receipt of an event notification. There is still at least one more event occurrence available for this session.
VI_ERROR_INV_SESSION	The given *vi* does not identify a valid session.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_INV_EVENT	Specified event type is not supported by the resource.
VI_ERROR_TMO	Specified event did not occur within the specified time period.

viWrite(*vi,buf,count,retCount*)

Codes	Description
VI_SUCCESS	Transfer completed.
VI_ERROR_INV_SESSION	The given *vi* does not identify a valid session.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_NSUP_OPER	The given *vi* does not support this function.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_TMO	Timeout expired before operation completed.
VI_ERROR_RAW_WR_PROT_VIOL	Violation of raw write protocol occurred during transfer.
VI_ERROR_RAW_RD_PROT_VIOL	Violation of raw read protocol occurred during transfer.
VI_ERROR_INP_PROT_VIOL	Device reported an input protocol error occurred during transfer.
VI_ERROR_BERR	Bus error occurred during transfer.
VI_ERROR_INV_SETUP	Unable to start read operation because setup is invalid (due to attributes being set to an inconsistent state).
VI_ERROR_NCIC	*vi* does not refer to an interface that is currently the controller in charge.
VI_ERROR_NLISTENERS	No listeners condition is detected (both NRFD and NDAC are deasserted).
VI_ERROR_IO	An unknown I/O error occurred during transfer.

viWriteAsync(*vi,buf,count,jobId*)

Codes	Description
VI_SUCCESS	Asynchronous write operation successfully queued.
VI_SUCCESS_SYNC	Write operation performed synchronously.
VI_ERROR_INV_SESSION	The given session is invalid.
VI_ERROR_INV_OBJECT	The given object reference is invalid.
VI_ERROR_RSRC_LOCKED	Specified operation could not be performed because the resource identified by *vi* has been locked for this kind of access.
VI_ERROR_QUEUE_ERROR	Unable to queue write operation.

D

VISA Type Definitions

VISA Type Definitions

VISA Data Type	Type Definition	Description
ViUInt32	**unsigned long**	A 32-bit unsigned integer.
ViPUInt32	**ViUInt32 ***	The location of a 32-bit unsigned integer.
ViAUInt32	**ViUInt32 ***	The location of a 32-bit unsigned integer.
ViInt32	**signed long**	A 32-bit signed integer.
ViPInt32	**ViInt32 ***	The location of a 32-bit signed integer.
ViAInt32	**ViInt32 ***	The location of 32-bit signed integer.
ViUInt16	**unsigned short**	A 16-bit unsigned integer.
ViPUInt16	**ViUInt16 ***	The location of a 16-bit unsigned integer.
ViAUInt16	**ViUInt16 ***	The location of a 16-bit unsigned integer.
ViInt16	**signed short**	A 16-bit signed integer.
ViPInt16	**ViInt16 ***	The location of a 16-bit signed integer.
ViAInt16	**ViInt16 ***	The location of 16-bit signed integer.
ViUInt8	**unsigned char**	An 8-bit unsigned integer.
ViPUInt8	**ViUInt8 ***	The location of an 8-bit unsigned integer.
ViAUInt8	**ViUInt8 ***	The location of an 8-bit unsigned integer.
ViInt8	**signed char**	An 8-bit signed integer.
ViPInt8	**ViInt8 ***	The location of an 8-bit signed integer.
ViAInt8	**ViInt8 ***	The location of an 8-bit signed integer.
ViAddr	**void ***	A type that references another data type.
ViPAddr	**ViAddr ***	The location of a **ViAddr** .
ViChar	**char**	An 8-bit integer representing an ASCII character.
ViPChar	**ViChar ***	The location of a **ViChar**.
ViByte	**unsigned char**	An 8-bit unsigned integer representing an extended ASCII character.
ViPByte	**ViByte ***	The location of a **ViByte**.
ViBoolean	**ViUInt16**	A type that is either **VI_TRUE** or **VI_FALSE**.

VISA Data Type	Type Definition	Description
ViPBoolean	**ViBoolean ***	The location of a **ViBoolean**.
ViBuf	**ViPByte**	The location of a block of data.
ViPBuf	**ViPByte**	The location of a block of data.
ViString	**ViPChar**	The location of a NULL-terminated ASCII string.
ViPString	**ViPChar**	The location of a NULL-terminated ASCII string.
ViStatus	**ViInt32**	Values that correspond to VISA-defined completion and error codes.
ViPStatus	**ViStatus ***	The location of the completion and error codes.
ViRsrc	**ViString**	A **ViString** type.
ViPRsrc	**ViString**	A **ViString** type.
ViAccessMode	**ViUInt32**	Specifies the different mechanisms that control access to a resource.
ViBusAddress	**ViUInt32**	Represents the system dependent physical address.
ViBusSize	**ViUInt32**	Represents the system dependent physical address size.
ViAttr	**ViUInt32**	Identifies an attribute.
ViVersion	**ViUInt32**	Specifies the current version of the resource.
ViPVersion	**ViVersion ***	The location of **ViVersion**.
ViAttrState	**ViUInt32**	Specifies the type of attribute.
ViPAttrState	**void ***	The location of **ViAttrState**.
ViVAList	**va_list**	The location of a list of variable number of parameters of differing types.
ViEventType	**ViUInt32**	Specifies the type of event.
ViPEventType	**ViEventType ***	The location of a **ViEventType**.
ViEventFilter	**ViUInt32**	Specifies filtering masks or other information unique to an event.
ViObject	**ViUInt32**	Contains attributes and can be closed when no longer needed.
ViPObject	**ViObject ***	The location of a **ViObject**.
ViSession	**ViObject**	Specifies the information necessary to manage a communication channel with a resource.

VISA Data Type	Type Definition	Description
ViPSession	**ViSession ***	The location of a **ViSession**.
ViFindList	**ViObject**	Contains a reference to all resources found during a search operation.
ViPFindList	**ViFindList ***	The location of a **ViFindList**.
ViEvent	**ViObject**	Contains information necessary to process an event.
ViPEvent	**ViEvent ***	The location of a **ViEvent**.
ViHndlr	**ViStatus (*) (ViSession# ViEventType# ViEvent# ViAddr)**	A value representing an entry point to an operation for use as a callback.
ViReal32	**float**	A 32-bit# single-precision value.
ViPReal32	**ViReal32 ***	The location of a 32-bit# single-precision value.
ViReal64	**double**	A 64-bit# double-precision value.
ViPReal64	**ViReal64 ***	The location of a 64-bit# double-precision value.
ViJobId	**ViUInt32**	The location of a variable that will be set to the job identifier.
ViKeyId	**ViPString**	The location of a string.

E

Editing the VISA Configuration

Editing the VISA Configuration

When the Agilent IO Libraries are configured, certain values are used as defaults in the VISA configuration. In some cases, the default values may affect your system's performance. If you are having system performance problems, you may need to edit the configuration and change some default values.

This appendix describes how to edit the configuration for VISA on Windows 95, Windows 98, Windows 2000, and Windows NT, and on HP-UX.

Editing on Windows 95/98/2000/NT

When you first configured the Agilent IO Libraries, the default configuration specified that all VISA devices would be identified at runtime. However, this configuration is not ideal for all users.

If you are experiencing performance problems, particularly during **`viOpenDefaultRM`**, you may want to change the VISA configuration to identify devices during configuration. This may be especially helpful if you are using a VISA LAN client. To edit the default VISA configuration on Windows 95/98/2000 or Windows NT:

1. If you have not already done so, start Windows 95/98/2000 or Windows NT.

2. Run the `IO Config` utility, located in the `Agilent IO Libraries` program group.

3. Select the interface to be configured from the `Configured Interfaces` box and click the **Edit** button. The **Interface Edit** window is now displayed.

4. Click the **Edit VISA Config** button at the bottom of the window. The dialog box which allows you to add devices is now displayed. You can now manually identify devices by clicking the **Add Device** button and entering the device address.

NOTE

To turn off the default of identifying devices at runtime, unselect the **`Identify devices at run-time`** box at the top of the dialog box

5. At this time, you may also click the **Auto Add Devices** button at the bottom of the screen to automatically check for devices. If you select this button, the utility will prompt you to make sure all devices are connected and turned on. Once this process is complete, you may edit this list with the **Add Device** and **Remove Device** buttons.

6. Once you have completed adding or removing devices, select the **OK** button to exit the window. Then exit the **`IO Config`** utility to save the changes you have made.

Editing on HP-UX

When you first configured the Agilent IO Libraries, the default configuration specified that all VISA devices would be identified at runtime. However, this is not ideal for all users. If you are experiencing performance problems, particularly during **`viOpenDefaultRM`**, you may want to change the VISA configuration to identify devices during configuration.

To edit the default VISA configuration on HP-UX, use the following command to run the **`visacfg`** utility:

```
/opt/vxipnp/hpux/hpvisa/visacfg
```

Follow the instructions provided in the utility. When prompted, select the **Add Device** button and add all devices that will be used.

Glossary

Glossary

address
A string uniquely identifying a particular device on an interface.

attributes
Values that determine the state of a resource. The operational state of some attributes can be changed.

bus error
An action that occurs when access to a given address fails either because no register exists at the given address, or the register at the address refuses to respond.

controller
A device, such as a computer, used to communicate with a remote device, such as an instrument. In the communications between the controller and the device, the controller is in charge of and controls the flow of communication (that is, the controller does the addressing and/or other bus management).

device
A unit that receives commands from a controller. Typically a device is an instrument but could also be a computer acting in a non-controller role, or another peripheral such as a printer or plotter.

device driver
A segment of software code that communicates with a device. It may either communicate directly with a device by reading to and writing from registers, or it may communicate through an interface driver.

device session
A session that communicates as a controller specifically with a single device, such as an instrument.

handler
A software routine used to respond to an asynchronous event such as an SRQ or an interrupt.

instrument
A device that accepts commands and performs a test or measurement function.

interface
A connection and communication media between devices and controllers, including mechanical, electrical, and protocol connections.

interrupt
An asynchronous event requiring attention out of the normal flow of control of a program.

mapping
An operation that returns a pointer to a specified section of an address space and makes the specified range of addresses accessible to the requester.

process
An operating system object containing one or more threads of execution that share a data space. A multi-process system is a computer system that allows multiple programs to execute simultaneously, each in a separate process environment. A single-process system is a computer system that allows only a single program to execute at a given point in time.

register
An address location that controls or monitors hardware.

resource
An instrument while using VISA.

session
An instance of a communications path between a software element and a resource.

SRQ
Service Request. An asynchronous request (an interrupt) from a remote device indicating that the device requires servicing.

status byte
A byte of information returned from a remote device showing the current state and status of the device.

thread

An operating system object that consists of a flow of control within a process. A single process may have multiple threads with each having access to the same data space within the process. However, each thread has its own stack and all threads may execute concurrently with each other (either on multiple processors, or by time-sharing a single processor). Note that multi-threaded applications are only supported with 32-bit VISA.

VISA

Virtual Instrument Software Architecture. VISA is a common I/O library where software from different vendors can run together on the same platform.

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