Bustec VISA Library and Tools User Manual

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1. Introduction

In 1993, a group of leading VXI technology vendors formed the VXIplug&play Systems Alliance, which defined complete system frameworks that gave end-users “plug & play” interoperability at both the hardware and system software level. The system frameworks ensure that a VXIplug&play system can be assembled without concern for the compatibility or interoperability of the selected components. Each VXIplug&play system component conforms to one or more system frameworks. The system designers select the framework that meet their needs and then select VXIplug&play components that conform to the selected framework.

The major component of each framework is the VISA (Virtual Instrument Software Architecture) library, which provides a standardized I/O interface to/from the instruments for both instruments drivers and application programs. While designed mainly to handle VXIbus systems, its open architecture from the start supported other hardware interfaces like serial ports or GPIB. Nowadays it supports a variety of interfaces and allows the design of multivendor, hybrid test systems using common software architecture.

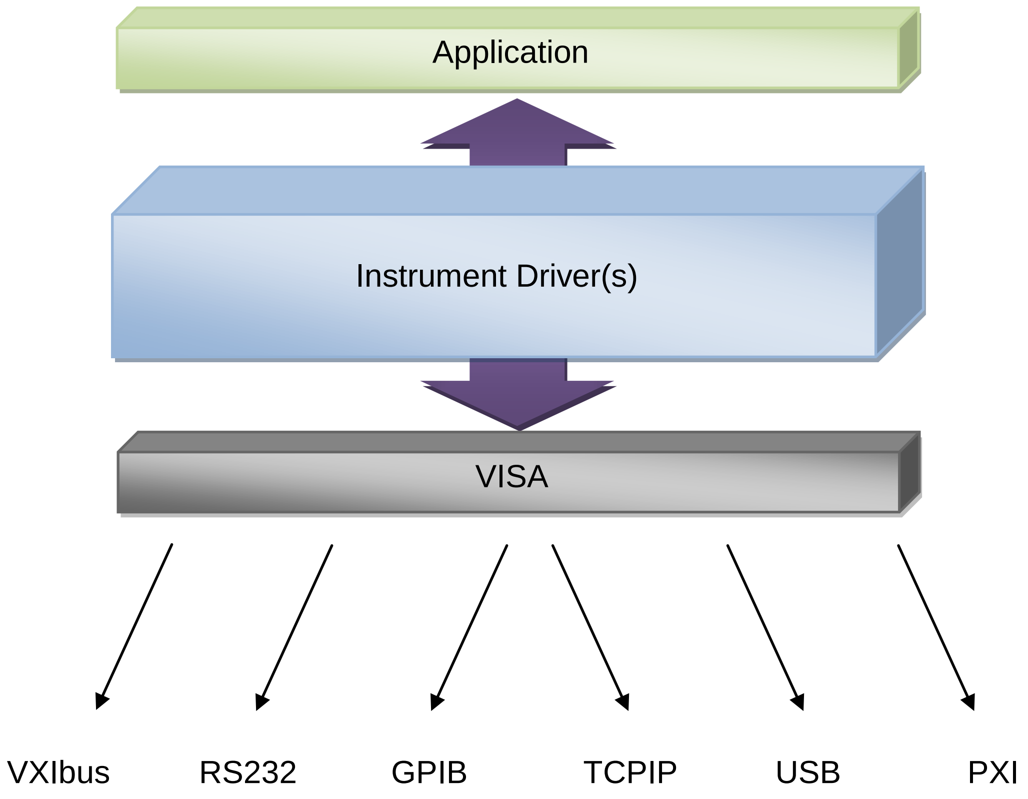


Figure 1 - VXIplug&play System Architecture

This manual describes the implementation, configuration and use of the Bustec implementation of the VISA library and tools.

1.1 Related Documentation

In 1997 the Interchangeable Virtual Instruments (IVI) Foundation was formed, which defined a set of interchangeable instrument driver models built on VXIplug&play-compliant frameworks. The VXIplug&play Systems Alliance merged with the IVI Foundation in 2003, which now maintains all specifications related to the standard.

VPP-1:	Charter Document
VPP-2:	System Frameworks Specification
VPP-3.1:	Instrument Drivers Architecture and Design Specification
VPP-3.2:	Instrument Driver Functional Body Specification
VPP-3.3:	Instrument Driver Interactive Developer Interface Specification
VPP-3.4:	Instrument Driver Programmatic Developer Interface Specification
VPP-4.3:	The VISA Library
VPP-4.3.2:	VISA Implementation Specification for Textual Languages
VPP-4.3.3:	VISA Implementation Specification for the G Language
VPP-4.3.4:	VISA Implementation Specification for COM
VPP-4.3.5:	VISA Shared Components
VPP-6:	Installation and Packaging Specification
VPP-7:	Soft Front Panel Specification
VPP-9:	Instrument Vendor Abbreviations

These standards are available on the IVI Foundation web site (www.ivifoundation.org) for download.

Other documents:

- ANSI/IEEE Standard 488.1-1987, IEEE Standard Digital Interface for Programmable Instrumentation
- ANSI/IEEE Standard 488.2-1992, IEEE Standard Codes, Formats, Protocols, and Common Commands
- ANSI/IEEE Standard 1014-1987, IEEE Standard for a Versatile Backplane Bus: VMEbus
- VXI-1, VXIbus System Specification, Revision 4.0, VXIbus Consortium
- VXI-11, TCP/IP Instrument Protocol, VXIbus Consortium

1.2 Terms and Acronyms

The following are some commonly used terms within this document:

Address	A string (or other language construct) that uniquely locates and identifies a resource. VISA defines an ASCII-based grammar that associates strings with particular physical devices or interfaces and VISA resources.
ADE	Application Development Environment
API	Application Programmers Interface. The direct interface that an end user sees when creating an application. The VISA API consists of the sum of all of the operations, attributes, and events of each of the VISA Resource Classes.
Attribute	A value within a resource that reflects a characteristic of the operational state of a resource.
Device	An entity that receives commands from a controller. A device can be an instrument, a computer (acting in a non-controller role), or a peripheral (such as a plotter or printer). In VISA, the concept of a device is generally the logical association of several VISA resources.
DLL	Dynamic Link Library
Instrument	A device that accepts some form of stimulus to perform a designated task, test, or measurement function. Two common forms of stimuli are message passing and register reads and writes. Other forms include triggering or varying forms of asynchronous control.
Instrument Driver	Library of functions for controlling a specific instrument.
Interface	A generic term that applies to the connection between devices and controllers. It includes the communication media and the device/controller hardware necessary for cross-communication.
Mapping	An operation that returns a reference to a specified section of an address space and makes the specified range of addresses accessible to the requester. This function is independent of memory allocation.
mDNS	Multicast DNS
Operation	An action defined by a resource that can be performed on a resource.
Process	An operating system component that shares a system's resources. A multiprocess system is a computer system that allows multiple programs to execute simultaneously, each in a separate process environment.

Register	An address location that either contains a value that is a function of the state of hardware or can be written into to cause hardware to perform a particular action or to enter a particular state. In other words, an address location that controls and/or monitors hardware.
Resource Class	The definition for how to create a particular resource. In general, this is synonymous with the connotation of the word class in object-oriented architectures. For VISA Instrument Control Resource Classes, this refers to the definition for how to create a resource that controls a particular capability of a device.
Resource or Resource Instance	In general, this term is synonymous with the connotation of the word object in object-oriented architectures. For VISA, resource more specifically refers to a particular implement-tation (or instance in object-oriented terms) of a Resource Class. In VISA, every defined software module is a resource.
Session	The same as Communication Channel. A communication path between a software element and a resource. Every communication channel in VISA is unique.
VISA	Virtual Instrument Software Architecture. This is the general name given to this document and its associated architecture. The architecture consists of two main VISA components: the VISA Resource Manager and the VISA Instrument Control Resources.
VISA COM	VISA for COM. VISA COM is an architecture that provides VISA functionality via a COM API.
WOW64	Windows On Windows 64, a Microsoft technology for allowing the execution of 32-bit native code programs on 64-bit operating systems.

2. The VISA Library

2.1 Shared Components

Starting with release version 4.2 of the VISA library, the VISA Shared Components, a common set of VISA components for developing multivendor software programs, are installed with each vendor-specific VISA implementation.

The components are “shared” because multiple VISA and VISA COM vendor-specific implementations must share a single copy of each component. Because there may only be a single copy of the component per PC, and the behaviour of each component is precisely described, the IVI Foundation supplies a standard implementation of each of them; in fact, the IVI Foundation implementation of each shared component must be used wherever the component is called for.

The VISA Shared Components include the VXIplug&play infrastructure, VISA COM components, and VISA Plug-In Architecture components. The VXIplug&play infrastructure includes the framework directory structure, registry entries, and environment variables. The VISA Plug-In Architecture components include shared files that allow multiple vendor-specific VISA libraries to be installed on a single PC. In the past, the standard did not directly support this, as each vendor-specific VISA library had to install a file named visa32.dll in the system directory.

The VISA COM components include shared VISA COM functionality, including the VISA COM type library, the associated PIA, the Global Resource Manager, and Basic Formatted IO.

2.1.1 VXIplug&play Infrastructure

The VXIplug&play infrastructure includes the directories, registry keys and values, and environment variables for each installed VXIplug&play framework.

The WinNT framework is installed on 32-bit Windows operating systems.

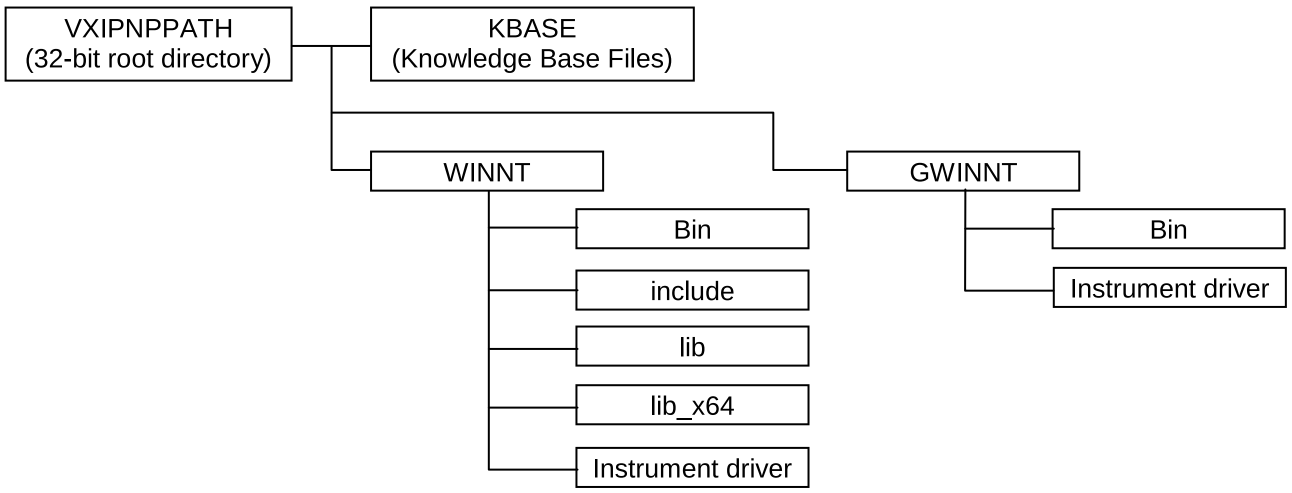


Figure 2 - 32-bit Systems Directory Structure

Both the WinNT and Win64 frameworks are installed on 64-bit Windows operation systems. On 64-bit operations systems, the WinNT framework is installed to the appropriate Windows On Windows 64 (WOW64) directories and registry keys.

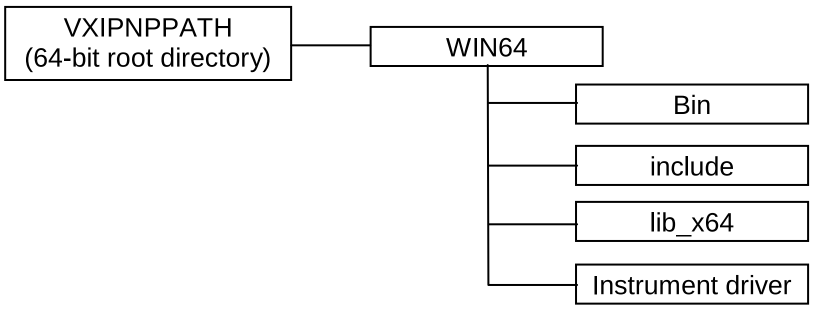


Figure 3 - 64-bit Systems Directory Structure

2.1.1.1 WINNT Framework

On a 32-bit system, the root directory for the WINNT framework defaults to

```
$(ProgramFiles)\IVI Foundation\VISA.
```

On a 64-bit system, the root directory for the WINNT framework defaults to

```
$(ProgramFiles(x86))\IVI Foundation\VISA.
```

In addition to creating the necessary infrastructure, the shared components installer will install the header files `visa.h` and `visatype.h` in the `WINNT\include directory`. To support the building of 64-bit application on 32-bit systems, it installs the link library visa64.lib in the `WINNT\lib_x64\msc` directory. This is the link library for the VISA router (see 2.1.2)

In the Windows system directory `$(SYSTEMROOT)\system32` (32-bit systems) or `$(SYSTEMROOT)\SysWOW64` (64-bit systems) it will install:

`visaConfMgr.dll`	Conflict Manager DLL

On 32-bit systems the conflict manager is used together with the VISA COM router.

2.1.1.2 WIN64 Framework

The root directory for the WIN64 framework defaults to

```
$(ProgramFiles)\IVI Foundation\VISA.
```

The shared components installer will create the infrastructure both the WINNT and the WIN64 framework. In the WIN64 framework directory structure, it will install the files

```
WIN64\include\visa.h
WIN64\include\visatype.h
WIN64\lib_x64\msc\visa32.lib
WIN64\lib_x64\msc\visa64.lib
```

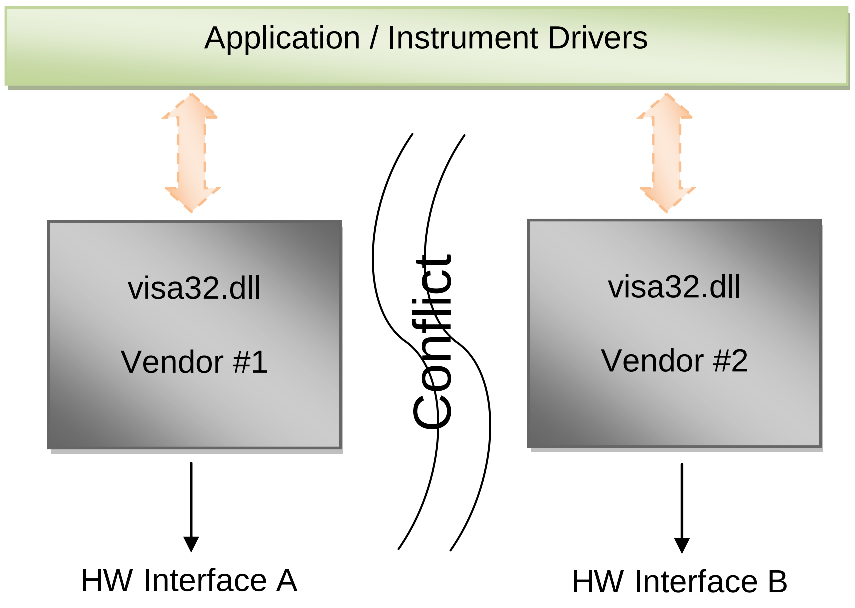
In the Windows system directory `$(SYSTEMROOT)\system32` it will install:

`visa32.dll`	64-bit Forwarding VISA DLL
`visa64.dll`	64-bit VISA Router DLL
`visaConfMgr.dll`	Conflict Manager DLL
`visaUtilities.dll`	Misc. VISA utility functions

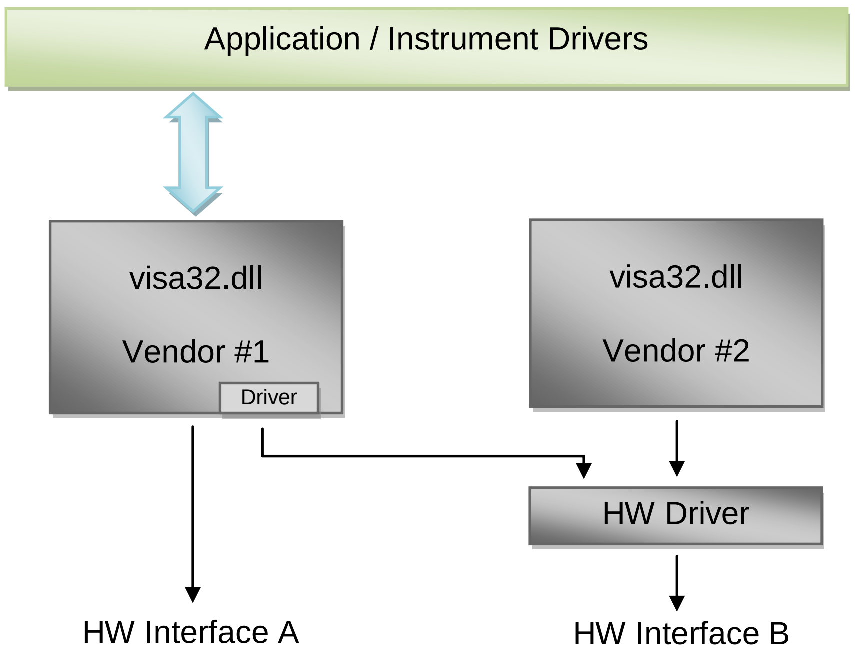
The 64-bit forwarding VISA DLL `visa32.dll` provides compatibility with earlier version of the WIN64 framework. It should no longer be used by application and system designers. All applications must be linked to the VISA Router DLL `visa64.dll` via the link library `visa64.lib`. The VISA Router and Conflict Manager are described in the next chapters.

2.1.2 The VISA Router

Prior to the release version 4.2 of the VISA standard, it was required of each vendor who implemented the VISA library, to install it in the same location and under the same name. For a user to use communication (hardware) interfaces from different vendors on the same machine was impossible.

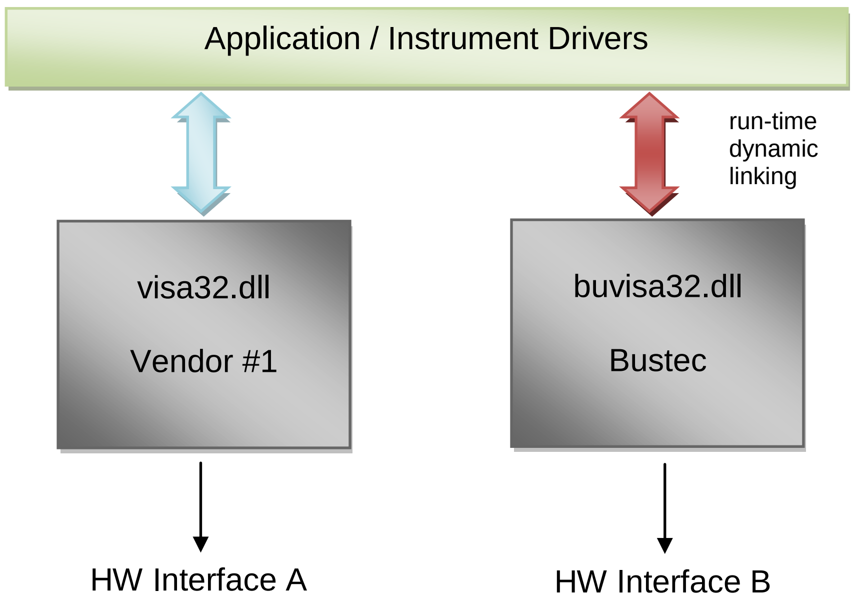


The only solution was the implementation of special driver interfaces, which could communicate with the hardware specific driver of the other manufacturer.



This multiplied the amount of work - each vendor supporting such a scheme would need not only to test the proper function of his own drivers, but also of all drivers from other vendors he supports.

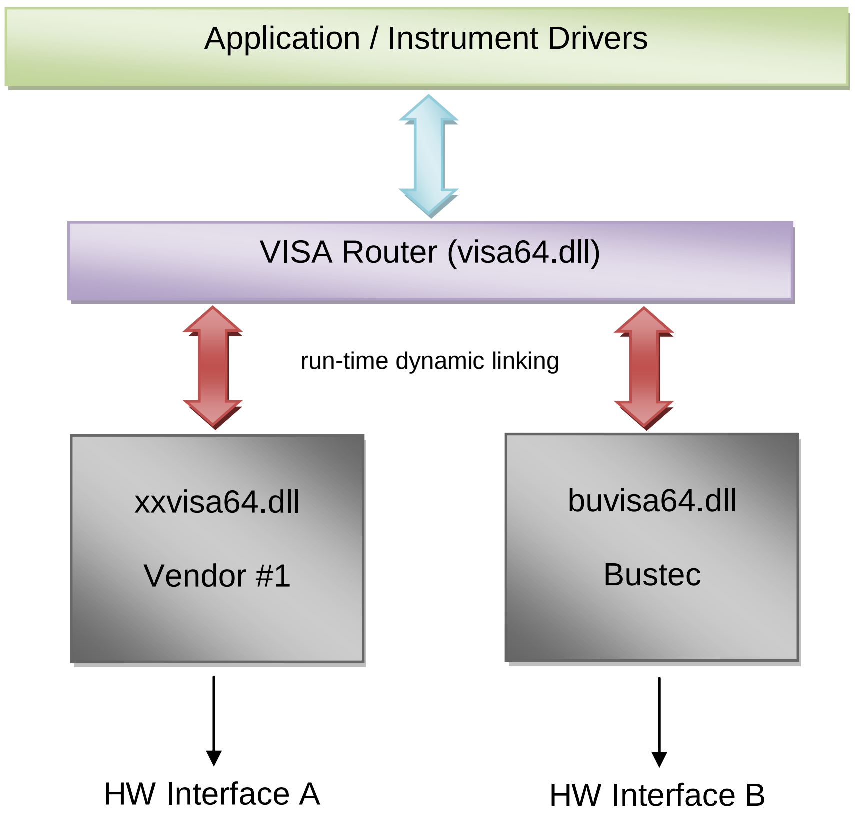
Another possibility is the so called side-by-side installation of multiple VISAs. In this case one VISA would install in the way required by the standard (“Primary” VISA), and all other VISAs would install using a vendor-specific name (“Secondary” VISAs). The Bustec VISA library supports this type of installation for 32-bit systems.



In this case the VISA library using the vendor-specific name must be used using run-time dynamic linking and function name resolving. Precompiled instrument drivers cannot be used with the secondary VISAs, they need to be recompiled using the created interface.

Starting with release version 4.2 on 64-bit systems now all vendor specific VISA libraries will be installed as secondary VISAs. The VISA router implemented by the IVI Foundation and distributed with the VISA Shared Components implements entry points defined by the VISA API, but only so that it can call the corresponding entry points in vendor-specific implementations of VISA. VISA users call the VISA API through the VISA Router. The VISA Router routes calls to the appropriate vendor-specific VISA, and also handles callbacks from the vendor-specific VISA to the calling program. The VISA object handles used by the Visa Router are unique and different from the VISA object handles returned from the underlying vendor-specific VISA libraries. The VISA Router takes care of mapping its object handles to the handles used by each of the underlying VISA libraries.

Once a session is opened in the VISA Router, most of the VISA entry points simply map the VISA session handle passed into the call to the handle of the underlying vendor-specific VISA, call the underlying VISA, and return the results. There are a few entry points, however, where the process is more complicated because the router needs either to call more than one underlying VISA or determine which underlying VISA to call.



In cases where more than one vendor-specific VISA library can connect to an interface, the conflict resolution manager, also part of the VISA shared components, provides information regarding available vendor-specific VISA libraries and user preferences.

Based on this information, the router tries to establish a connection to a resource in the following order and returns with the first one that succeeds:

1. The VISA that the user chose to handle devices on the interface the resource string specifies.
2. The VISA that was last used to successfully open this resource.
3. The “preferred” VISA, if one was specified.
4. Each VISA in the list of installed VISA libraries that has not already been tried

The manual assignment of an interface to a particular VISA implementation, selection of the “preferred” VISA and the enabling/disabling of VISA implementations are done via interfaces to the conflict resolution manager, which are implemented in the vendor specific tools accompanying most VISA implementations. The Bustec VISA Conflict Manager (see 3.6: Conflict Manager) is such an interface to the conflict resolution manager so that the user can choose how available system resources are handled by the underlying VISA implementations.

2.2 Bustec VISA Implementation

Bustec's implementation of VISA complies with the VXIplug&play standard VPP4.3 revision 5.0. For its application programmer's interface and related standards for its installation, tools, extensions and interoperability with other vendor-specific VISA implementations, see section 1.1.

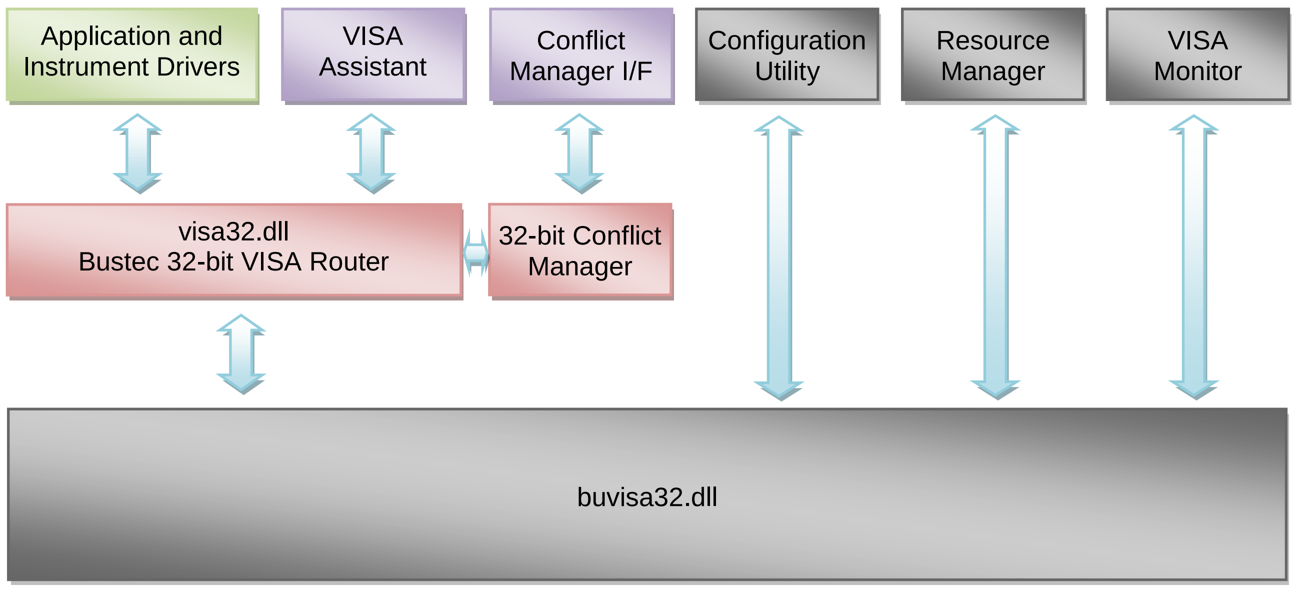
The VISA library provided by Bustec Ltd allows communication to the ProDAQ Slot-0 modules and the VXI instruments installed together with them in the same mainframe. It also allows to access devices through standard interfaces like TCPIP and ASRL.

2.2.1 VISA Implementation for 32-bit Systems

Coming forward the customers' needs, Bustec provides own 32-bit VISA router library. It works exactly as the 64-bit VISA router provided by the IVI Foundation. However, due to compatibility issues, the setup process is slightly different.

Bustec's VISA library is installed always as a secondary VISA (`buvisa32.dll`) and the `visa32.dll` file remains untouched. At the very last step of the installation process Bustec 32-bit Conflict Manager tool is started. It checks and allows proper configuration of all the VISAs installed in the system. If no `visa32.dll` file is found in the system it creates it – a Bustec 32-bit VISA Router. If such a file already exists (third-party primary VISA was previously installed), the Conflict Manager renames that file and again sets up `visa32.dll` file as Bustec 32-bit VISA Router. Since that moment multiple VISAs are residing in the system as secondary libraries, while the Bustec 32-bit VISA Router is the primary VISA that handles connections to them.

If a third-party VISA is installed later and the `visa32.dll` file is overwritten, the Bustec 32-bit Conflict Manager must be run manually to fix the configuration.



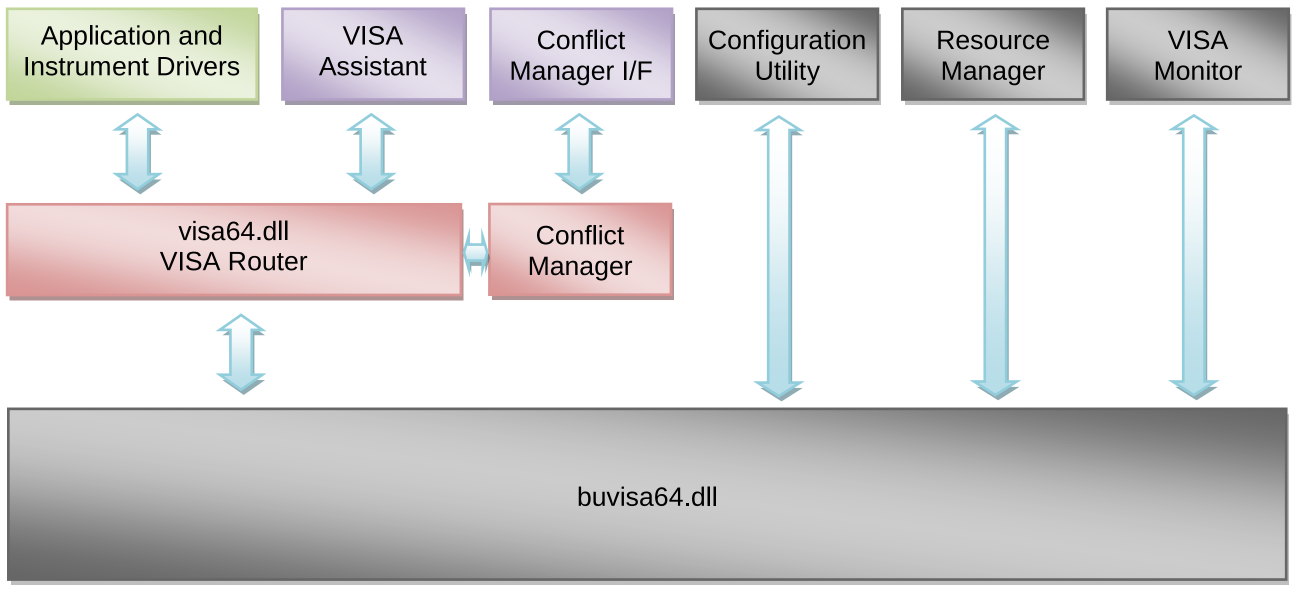
The configuration utility, the resource manager and the VISA monitor are directly linked to the buvisa32.dll, as they can only work with Bustec's VISA implementation. The VISA Assistant links to visa32.dll.

All tools are installed to `$(VXIPNPPATH)\WINNT\buvisa`. The visa32.dll and the buvisa32.dll are installed into the Windows system directory `$(SYSTEMROOT)\system32` (32-bit systems) or `$(SYSTEMROOT)\SysWOW64` (64-bit systems).

Configuration data and other user writeable files are stored in
`$(ALLUSERSPROFILE)\Bustec\buvisa`.

2.2.2 VISA Implementation for 64-bit Systems

On 64-bit systems the Bustec VISA library is always installed as a secondary VISA an accessed through the VISA router. Still the tools accompanying the VISA are directly linked to the Bustec VISA library as they require special functionality not provided by the router.



All tools are installed to `$(VXIPNPPATH64)\WIN64\buvisa`. The buvisa64.dll is installed into the Windows system directory `$(SYSTEMROOT)\system32`.

Configuration data and other user writeable files are stored in
`$(ALLUSERSPROFILE)\Bustec\buvisa`.

2.2.3 VISA Implementation for non-Windows Platforms

TBD

2.2.4 VISA Extensions

The Bustec VISA implementation adds a number of binary compatible extensions to the VISA standard. Definitions for those extensions can be found in the header file `buvisa.h`, which is installed in the standard include directory by the Bustec VISA installer. This file is common for all frameworks.

2.2.4.1 Support for 2eVME and 2eSST protocols

To support the advanced backplane protocols introduced with the VXIbus standard VXI-1 revisions 3 and 4, the Bustec VISA implementation adds four more access privileges to the list of privileges which can be used to specify the way the functions `viMoveInXX[Ex]()`, `viMoveOutXX[Ex]()`, `viMove[Ex]()` and `viMoveAsync[Ex]()` access the VXIbus.

The access mode must be selected using the function `viSetAttribute()` using the attributes `VI_ATTR_SRC_ACCESS_PRIV` and `VI_ATTR_DEST_ACCESS_PRIV` prior to using the functions.

Attribute Value	Selected Transfer Mode
`BUVISA_D64_2eVME`	A32/A64 2eVME D64 transfer
`BUVISA_D64_SST160`	A32/A64 2eSST D64 transfer, 160 MB/s
`BUVISA_D64_SST267`	A32/A64 2eSST D64 transfer, 267 MB/s
`BUVISA_D64_SST320`	A32/A64 2eSST D64 transfer, 320 MB/s

2.3 Installing the Bustec VISA Library

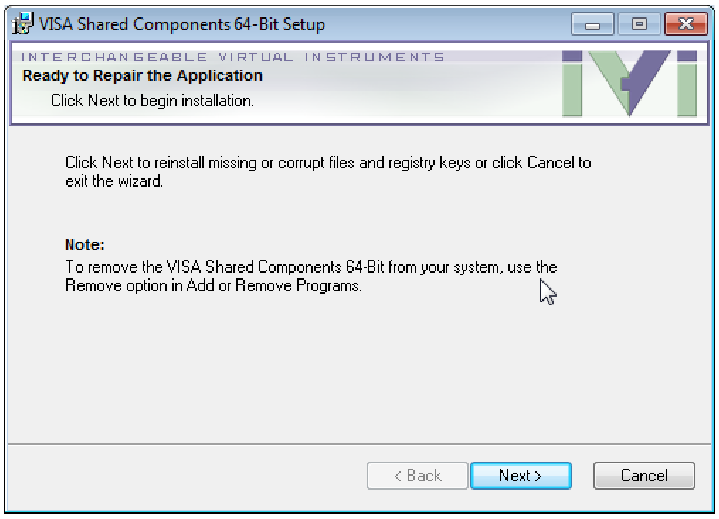
The installation procedure is the following:

1. Close all unnecessary applications running on your system and run the Bustec VISA installer suitable for your system – 32 or 64-bit. The 32-bit version installs only the 32-bit files, while the 64-bit one installs both versions.

Note

The best practice is to run the installer after fresh start of the system. In case if there is already a 32-bit primary VISA installed, it ensures that there are no applications or services running that keep lock on the visa32.dll file.

2. At the beginning, the IVI Shared Components package is installed (either a 32 or 64-bit version).


VISA Shared Components 64-Bit Setup
INTERCHANGEABLE VIRTUAL INSTRUMENTS
< Back
Next >
Cancel

Ready to Repair the Application

Click Next to begin installation.

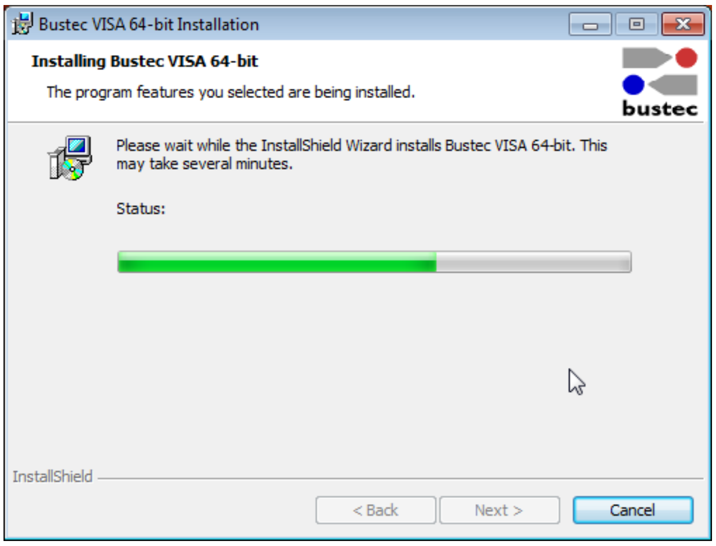
Click Next to reinstall missing or corrupt files and registry keys or click Cancel to exit the wizard.

Note:
To remove the VISA Shared Components 64-Bit from your system, use the Remove option in Add or Remove Programs.

Figure 4 – Installation of the IVI Shared Components

3. When it's done, the main part of the installer is started. First you have to read and accept the license agreement. If you don't agree to the terms you cannot install and use Bustec VISA.

4. After the license agreement is accepted the files are copied to the disk and the necessary configuration is done.



Installing Bustec VISA 64-bit

The program features you selected are being installed.

Please wait while the InstallShield Wizard installs Bustec VISA 64-bit. This may take several minutes.

Status:

Figure 5 – Bustec VISA installation progress

5. When the installation is complete, the Bustec 32-bit Conflict Manager is started. It finalizes the setup of the Bustec 32-bit VISA Router. If the visa32.dll file doesn't exist, it creates such – a Bustec router library. If the file already existed (third-party primary VISA was previously installed), the tool renames it, sets up Bustec router as the new visa32.dll and configures the multi-VISA environment. For more details please refer to section 3.6.

6. It's advised to restart the computer after the installation is complete.

2.4 Installing drivers for Slot-0 modules

The drivers for Bustec's Slot-0 modules (like ProDAQ 3020 or ProDAQ 3030) are not installed along with Bustec VISA. The installers are separate for each module.

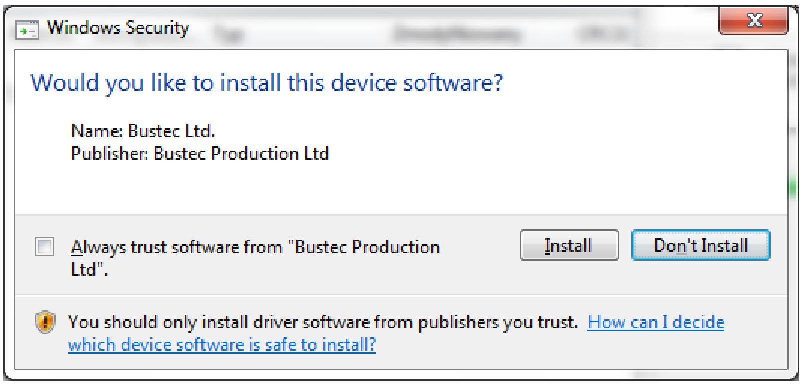
The installation procedure is the following:

1. Close all unnecessary applications running on your system and run the installer suitable for your system, either the 32 or 64-bit.

2. Read and accept the license agreement. If you don't agree to the terms you cannot install and use the package.

3. It's now possible to define the target directory for the user-mode program and library files. By default the VXIPNPPATH is used.

4. The installation process is started. The kernel driver installation requires an additional acceptation due to the system's security.


Windows Security

Would you like to install this device software?

Name: Bustec Ltd.
Publisher: Bustec Production Ltd

You should only install driver software from publishers you trust. How can I decide which device software is safe to install?

Figure 6 – Accepting kernel driver installation

5. It's advised to restart the computer after the installation is complete.

Note

If you are not willing to restart the whole system, at least the Bustec Agent must be restarted. Otherwise it won't be able to detect hot-plug events.

3. Tools and Utilities

3.1 Bustec Agent

Bustec Agent is a light application that resides in the system tray. It does not link to the VISA library. Agent gives easy and fast access to Bustec VISA tools, but also detects hot-plug and other notification events from ProDAQ 3030 and ProDAQ 3020. Additionally, it automatically detects network devices using mDNS facilities. To make use of the latter, Bonjour library must be installed in the system (available at: www.apple.com).

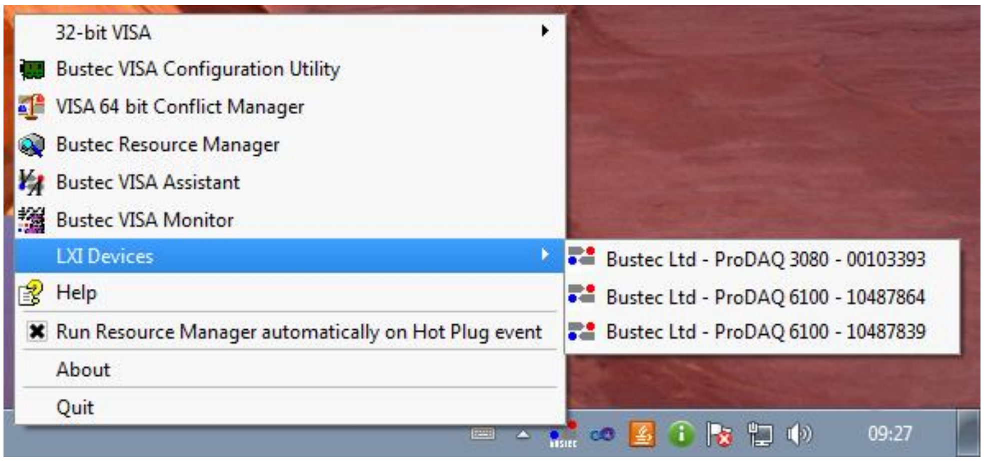

32-bit VISA
Bustec VISA Configuration Utility
VISA 64 bit Conflict Manager
Bustec Resource Manager
Bustec VISA Assistant
Bustec VISA Monitor
LXI Devices
Help
Run Resource Manager automatically on Hot Plug event
About
Quit
Bustec Ltd - ProDAQ 3080 - 00103393
Bustec Ltd - ProDAQ 6100 - 10487864
Bustec Ltd - ProDAQ 6100 - 10487839
09:27

Figure 7 – Bustec Agent

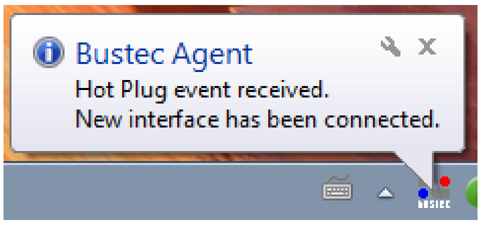

Bustec Agent
Hot Plug event received.
New interface has been connected.

Figure 8 – Hot plug from ProDAQ 3030 detected

3.2 Configuration Utility

3.2.1 Handling Interfaces

The VISA library uses interface names and numbers to access available hardware interfaces. An interface to a particular hardware is for example a ProDAQ VXIbus interface connected to a host PC or an internal bus interface of a ProDAQ embedded controller. In order to enable the VISA library to use an interface, which is connected to or used with a host PC for the first time, a valid interface name and number must be assigned to this device. The assigned interface name and number will be stored internally in the configuration for interface together with its serial number and will be used for this device whenever it is connected to or used with this host.

Note

If you want to assign and configure a ProDAQ VXIbus Slot-0 Interface like the ProDAQ 3020 or the ProDAQ 3030 to be used with your computer, it must be connected to your computer and powered on for the configuration utility to be able to detect it.

From the Bustec VISA program group created during the installation of the VISA library, select “Bustec VISA Configuration Utility” (“Start” ➔ “Programs” ➔ “Bustec VISA”). This will start the configuration tool for the VISA library and for the attached hardware interfaces. Alternatively you can use a link in Bustec Agent.

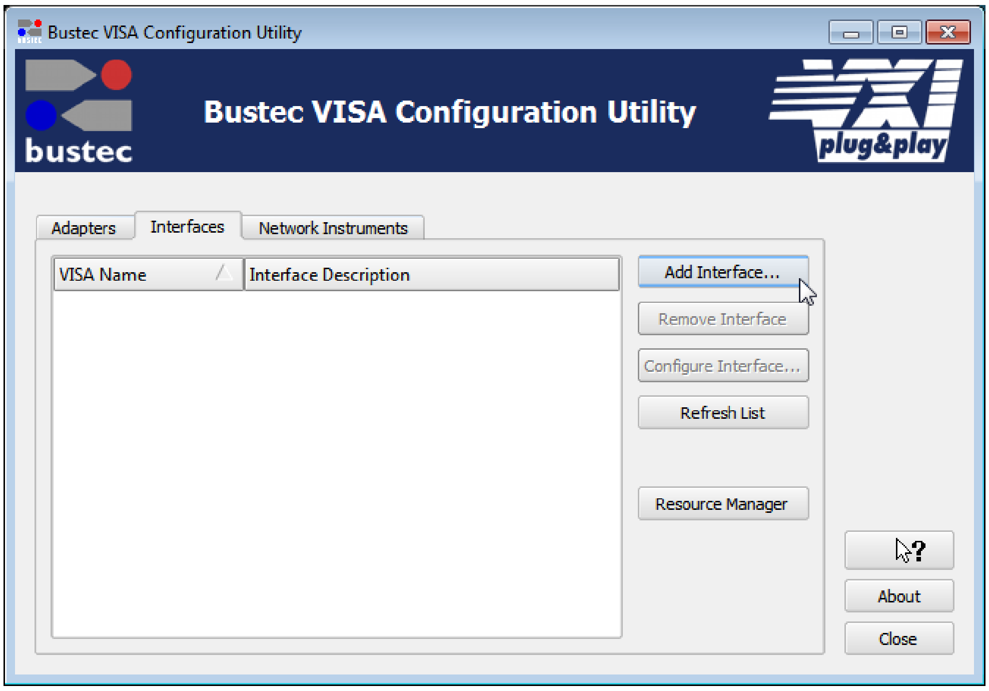


Figure 9 - VISA Library Configuration Utility

To add a new interface, select “Add Interfaces”. A new dialog “Add New Interface” is shown with a list of all devices found in the system. The already configured are disabled. Each interface is listed with its type and with a description containing the serial number of the device.

Note

The optional on-board GPIB interface of a ProDAQ 3020 USB2.0 VXIbus Slot-0 Interface will appear in the list of devices as a separate interface of the type GPIB.

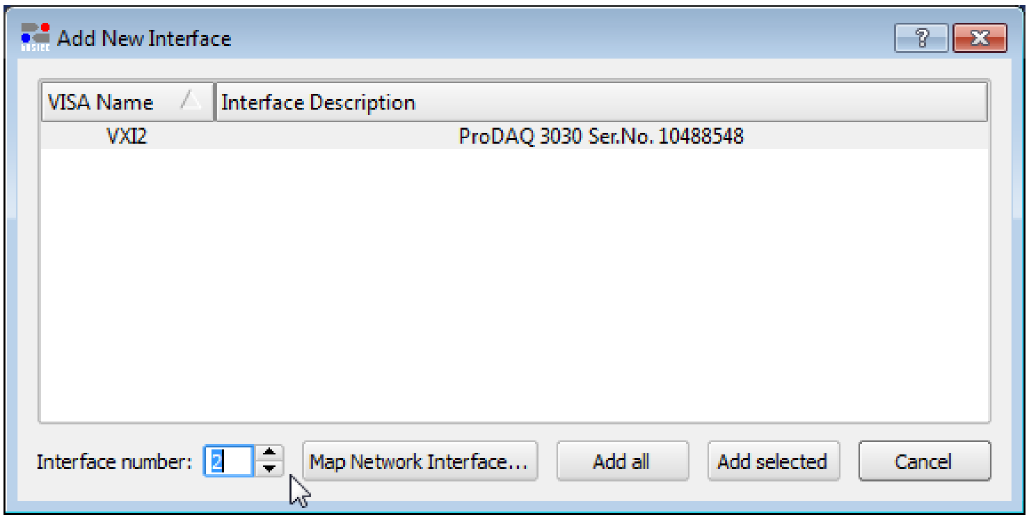


Figure 10 - Adding a new Interface

The interface numbers are assigned automatically from the pool of not yet used values. If you want to change them, just select an interface and modify the value using the spin box control in the bottom. Finally click “Add all” or “Add selected”. The list in the main dialog will be updated with the newly added interfaces.

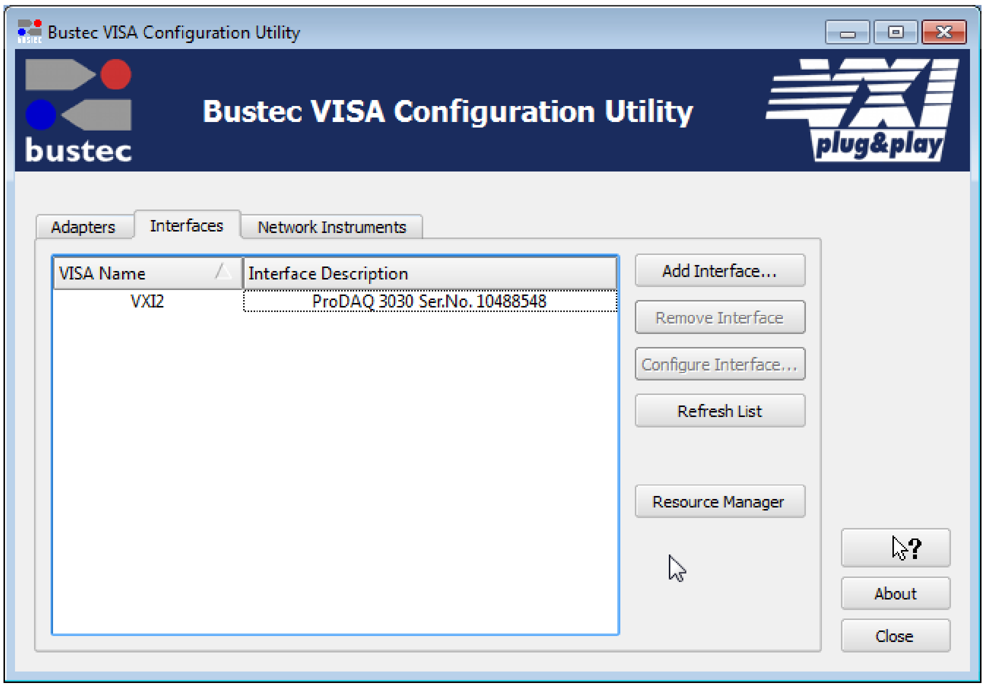


Figure 11 - List of configured interfaces

To remove the configuration for a device from the system, select the device in the list of configured interfaces and select “Remove Interface”. To configure device-dependent parameters of an interface, select “Configure Interface”, or double click on the list entry. If you want to access a hot-plug device which was not connected when the configuration utility was started, but was already configured on this system, the “Refresh List” button can be used to update the list of configured interfaces.

Note

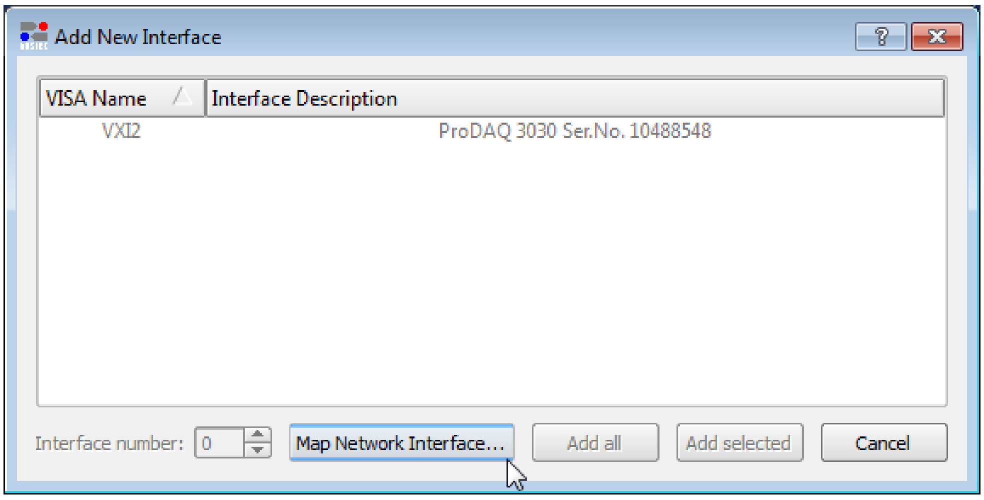
For a detailed explanation of device-dependent parameters, please refer to the user manual of the ProDAQ interface or embedded controller.

Note

The configuration utility may not apply changes in the configuration to the interfaces directly for some interfaces. In this case the new configuration will be stored on your system and will be applied to the interface when the interface is first used (i.e. by the resource manager or an application using the VISA library). Some interfaces or some configuration settings may require the interface to be re-started or the computer housing the interface to be re-booted before becoming active. For detailed information for a particular interface, refer to the user manual of the interface.

3.2.1.1 Mapping network interfaces

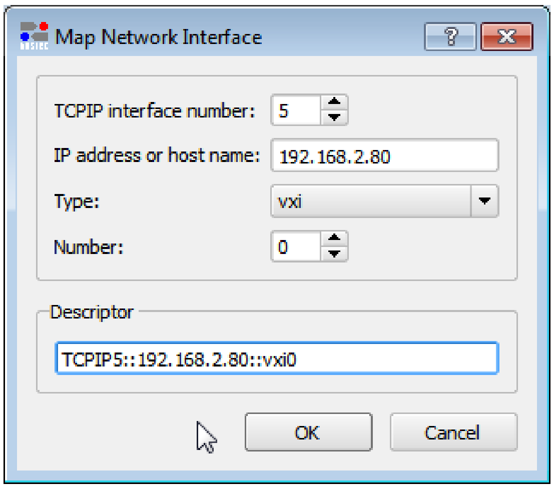
To gain access to all VXIbus instruments via a network Slot-0 Interface, like ProDAQ 3080, it is recommended to map it as a standard VXIbus interface onto the host system. In order to do it select “Map Network Interface” button in the “Add New Interface” dialog.



VISA Name	Interface Description
VXI2	ProDAQ 3030 Ser.No. 10488548

Figure 12 - Add New Interface Dialog – opening the mapping dialog.

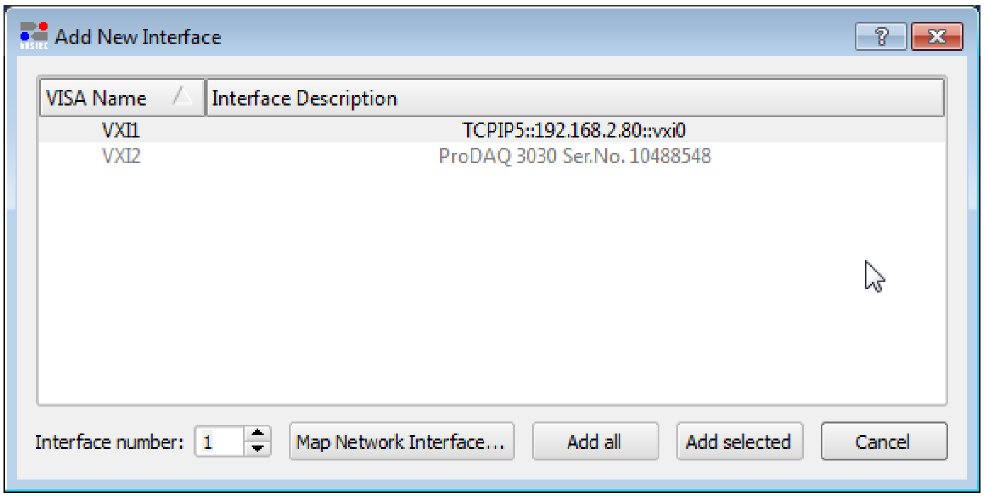
In the "Map Network Interface" dialog you can specify the network address of the remote interface and the local interface on the remote server to use. The TCPIP interface number is a virtual value. It allows differentiation of TCPIP interfaces in case of conflict management when there are multiple VISAs installed in the system.



TCPIP interface number: 5
IP address or host name: 192.168.2.80
Type: vxi
Number: 0
Descriptor: TCPIP5::192.168.2.80::vxi0

Figure 13 - Add Network Interface dialog

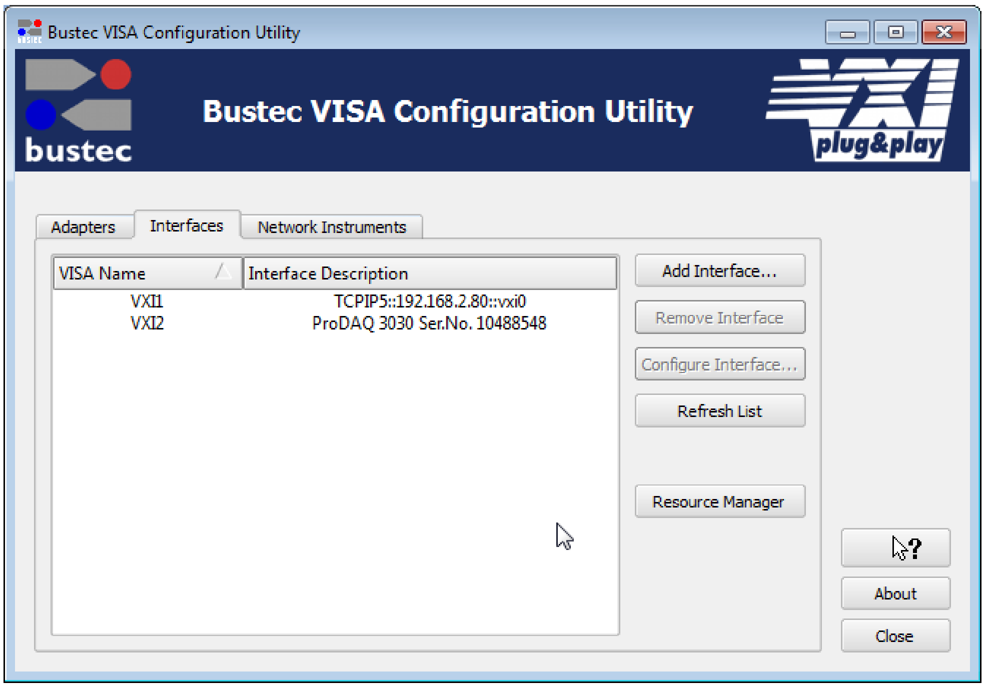
Once the mapped interface is added it can be configured with interface number exactly as any other interface as described earlier.



VISA Name	Interface Description
VXI1	TCPIP5::192.168.2.80::vxi0
VXI2	ProDAQ 3030 Ser.No. 10488548

Interface number: 1

Figure 14 - Updated Available Interfaces List

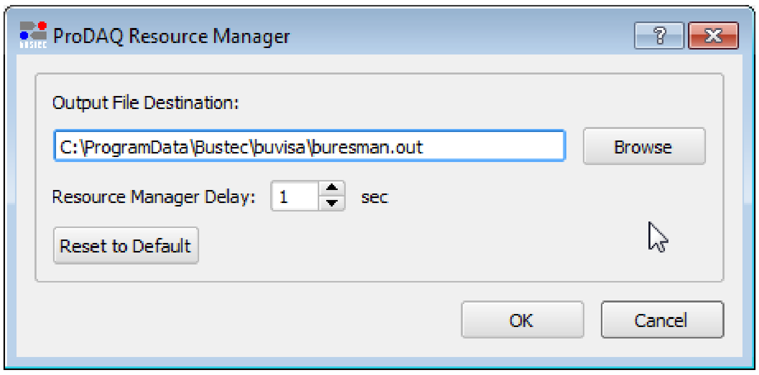


VISA Name	Interface Description
VXI1	TCPIP5::192.168.2.80::vxi0
VXI2	ProDAQ 3030 Ser.No. 10488548

Figure 15 – Updated list of configured interfaces

3.2.2 VXIbus Resource Manager Configuration

The configuration for the VXIbus Resource Manager can also be changed with the configuration utility. In the configuration utility main panel select the “Resource Manager” button on the right hand side. This will show the configuration dialog for the resource manager.



Output File Destination: C:\ProgramData\Bustec\buvisa\buresman.out

Resource Manager Delay: 1 sec

Figure 16 - VXIbus Resource Manager Configuration

Two parameters for VXIbus Resource Manager can be configured using the configuration utility: The initial delay (default value is 5 seconds) and the path to ASCII output file (default value is "$(ALLUSERSPROFILE)\Bustec\buvisa\buresman.out").

Caution

The initial resource manager delay as defined by the VXIbus standard must be in minimum five (5) seconds. Configuring the resource manager to use a shorter delay might not allow all devices to finish their initialization and self-test, preventing the resource manager from identifying and configuring them.

3.2.3 Network Instruments

3.2.3.1 Adding known Network Instruments

In addition to configuring hardware interfaces, the configuration utility allows you to search, identify and configure network instruments. To view already known network instruments or add new, select the “Network Instruments” tab in the configuration utilities main dialog.

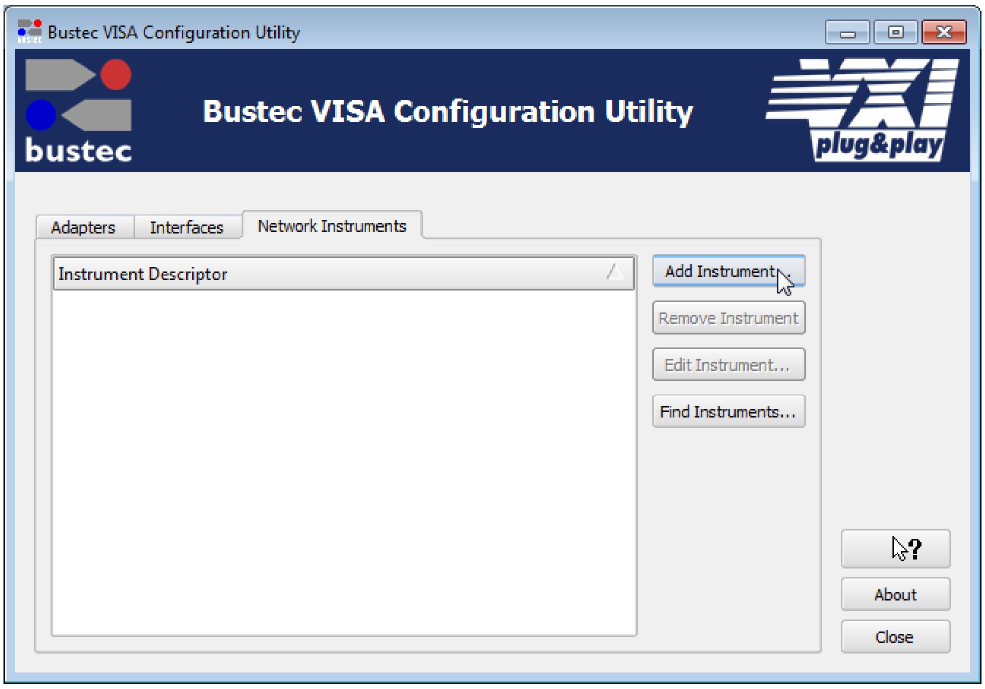
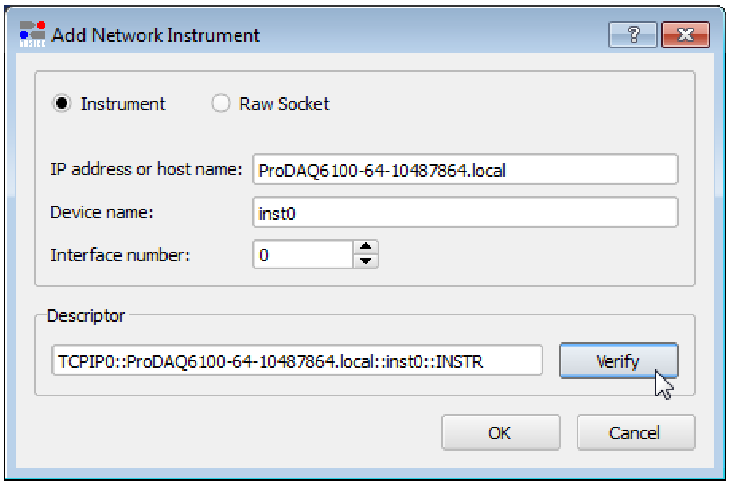


Figure 17 – Configuring Network Instruments

If you know the network address or the host name of your network interface, you can add it to the list of known instruments by selecting the “Add Instrument ...” button on the right.


Add Network Instrument

(● Instrument) ○ Raw Socket

IP address or host name: ProDAQ6100-64-10487864.local

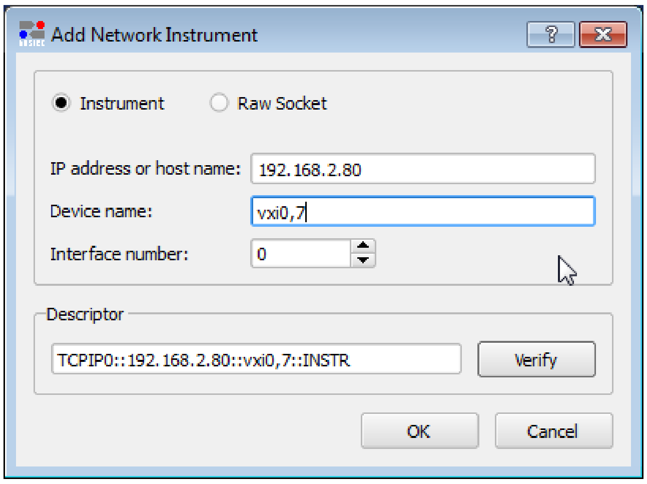
Device name: inst0

Interface number: 0

Descriptor

TCPIP0::ProDAQ6100-64-10487864.local::inst0::INSTR

Figure 18 - Add Network Instrument – using host name


Add Network Instrument

(● Instrument) ○ Raw Socket

IP address or host name: 192.168.2.80

Device name: vxi0,7

Interface number: 0

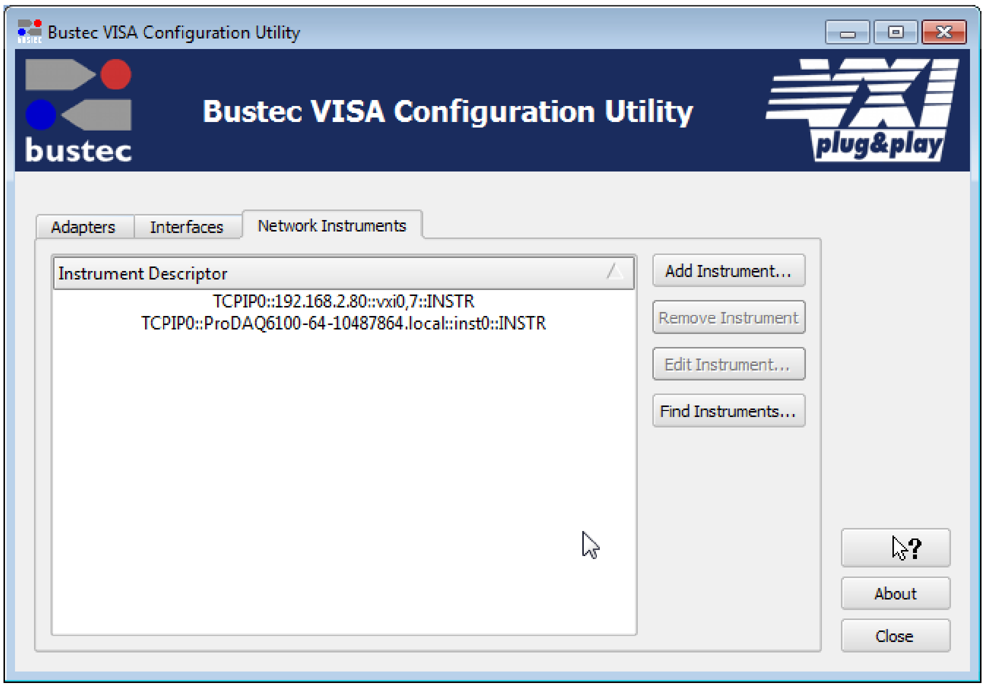
Descriptor

TCPIP0::192.168.2.80::vxi0,7::INSTR

Figure 19 - Add Network Instrument – custom device name

The resulting resource descriptor is shown in the field “Descriptor” below. When you select the “Verify” button to the right of the field, the configuration utility will attempt to open a connection and send a “*IDN?” query to the instrument to verify that the instrument is reachable and switched on.

All known network instruments will be displayed in the “Instrument Descriptor” list in the main dialog. To change the settings for a particular instrument, select the instrument in the list and then select the “Edit Instrument ...” button to the right. To remove an instrument from the list, select the instrument in the list and then select the “Remove Instrument” button.

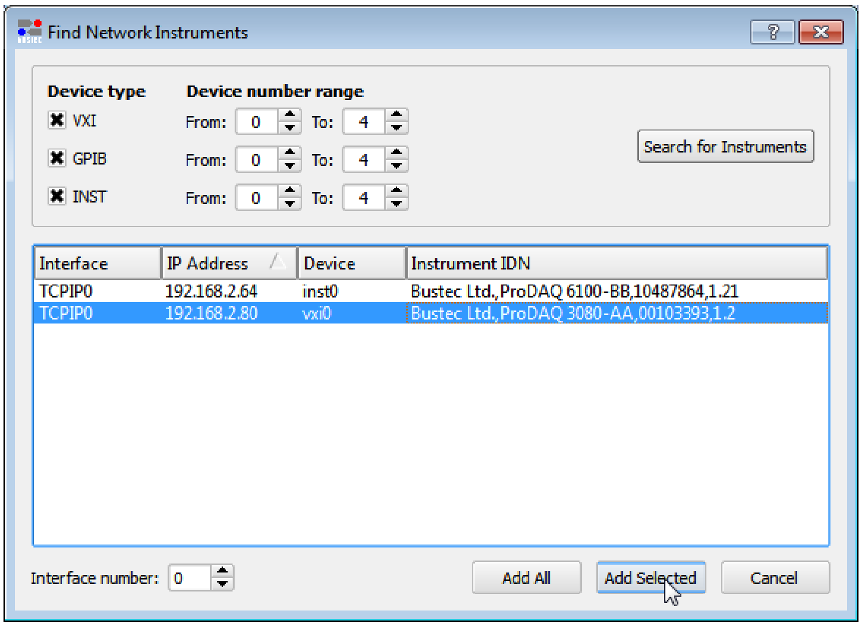


Instrument Descriptor
TCPIP0::192.168.2.80::vxi0,7::INSTR
TCPIP0::ProDAQ6100-64-10487864.local::inst0::INSTR

Figure 20 - List of known Network Instruments

3.2.3.2 Searching for Network Instruments

To search for network instruments located in your subnet, select the “Find Instruments ...” button to the right of the list of instrument descriptors. This opens the “Find Network Instruments” dialog, where you can set search parameters and perform the search.



Device type	Device number range	
☒ VXI	From: 0	To: 4
☒ GPIB	From: 0	To: 4
☒ INST	From: 0	To: 4

Interface	IP Address	Device	Instrument IDN
TCPIP0	192.168.2.64	inst0	Bustec Ltd.,ProDAQ 6100-BB,10487864,1.21
TCPIP0	192.168.2.80	vxi0	Bustec Ltd.,ProDAQ 3080-AA,00103393,1.2

Interface number: 0

Figure 21 - Searching for Network Instruments

To be found, the network instruments must comply to the VXI-11 standard and provide internal “VXIn” (VXI-11.1), “GPIBn” (VXI-11.2) or “INSTn” (VXI-11.3) interfaces and they must be able to respond to the “*IDN?” query. By checking/unchecking the boxes in front of the entries in the interface list the search can be limited to a particular type or set of types of interfaces. By setting the interface number ranges the search is limited to the selected range of interface numbers.

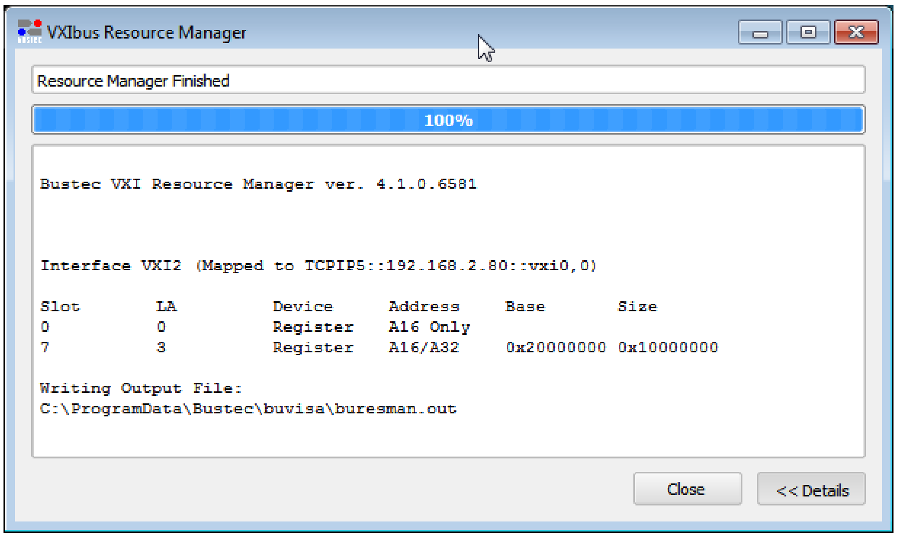
After selecting the “Search for Instruments” button, the utility uses network broadcasts to search for the instruments. Each instrument is then sent an “*IDN?” query and the results are shown in the “Find Network Instruments” dialog.

After a successful search, select the “Add All” button below the list to add all network instruments found to the list of known instruments or select instruments from the list and the “Add Selected” button to add only the instruments selected. The “Cancel” button allows you to close the dialog without adding any instrument

3.3 VXIbus Resource Manager

3.3.1 GUI Application

Before you can use the VISA library to communicate to the instruments, you must run the resource manager. The resource manager finds VXI and GPIB instruments connected to your PC and configures them. To run the resource manager, select “Bustec VXIbus Resource Manager” from the Bustec VISA program group in the start menu (“Start” ➔ “Programs” ➔ “Bustec VISA”) or use the link in Bustec Agent.



```
Bustec VXI Resource Manager ver. 4.1.0.6581


Interface VXI2 (Mapped to TCPIP5::192.168.2.80::vxi0,0)

Slot      LA        Device    Address   Base      Size
0         0         Register  A16 Only
7         3         Register  A16/A32   0x20000000 0x10000000

Writing Output File:
C:\ProgramData\Bustec\buvisa\buresman.out
```

Figure 22 - Running the VXI Resource Manager

The Resource Manager configures all the Bustec Slot-0 modules found in the system – even those not configured with Bustec VISA Configuration Utility. In such a case default configuration and auto-selected interface number is set up.

When started, the Resource Manager waits for a while (as configured with Bustec VISA Configuration Utility) to allow all devices to complete their initialization and finish self-tests (if available). Then it performs the following functions:

1. Identify all VXIbus devices in the system.
2. Manage the system self-test and diagnostic sequence.
3. Configure the system's A24 and A32 address maps.
4. Configure the system's Commander/Servant hierarchies.
5. Allocate the VXIbus IRQ lines.
6. Initiate normal system operation.

Once finished, the information about the VXIbus devices found is made available for the VISA library and a readable version of this information is saved to a file. Both the initial delay and the location of the resource manager output file are configurable using the configuration utility (see 3.2.2).

Note

To run the resource manager for a VXI mainframe connected via a ProDAQ Slot-0 Interface to your computer, the interface module must be located in the left most slot (slot "0") of the VXI mainframe and must be configured to use the logical address 0 (00hex).

Note

To run the resource manager on a ProDAQ Embedded Slot-0 Controller for the VXI mainframe it is located in, the controller module must be located in the left most slot (slot "0") of the VXI mainframe and must be configured to use the logical address 0 (00hex).

Note

Although the ProDAQ 3020 USB 2.0 VXIbus Slot-0 Interface and the ProDAQ 3030 PCIExpress VXIbus Slot-0 Interface are hot-plug able, the resource manager cannot dynamically add or remove devices from its device list. Therefore the resource manager must be run every time a VXI mainframe is connected or disconnected to/from your computer. There is also no protocol available to notify applications of the configuration change. Running applications must be restarted after re-running the resource manager

Caution

The initial resource manager delay as defined by the VXIbus standard must be in minimum five (5) seconds. Configuring the resource manager to use a shorter delay might not allow all devices to finish their initialization and self-test, preventing the resource manager from identifying and configuring them.

Note

The VISA library is a shared library that initializes itself when it is first loaded by an application. Applications started while the VISA library is already loaded just share this configuration. Only when all applications using the VISA library are stopped, it will be unloaded by the system. Therefore all applications using the VISA library must be closed before running the resource manager or using the VISA configuration utility. Take special care while using integrated development environments, they will keep the VISA library loaded even when the application developed in them was stopped.

3.3.2 Console Application

The resource manager of the Bustec VISA library is also available as console application to support its automated usage in batch files, other applications and the startup folder. To run the resource manager console application, use:

```
resman_con [-v|-s]
```

If the command line switch "-v" is used, the resource manager console application will print out an overview of its progress and findings on the standard output, similar to the output in the "Details" field of the GUI application.

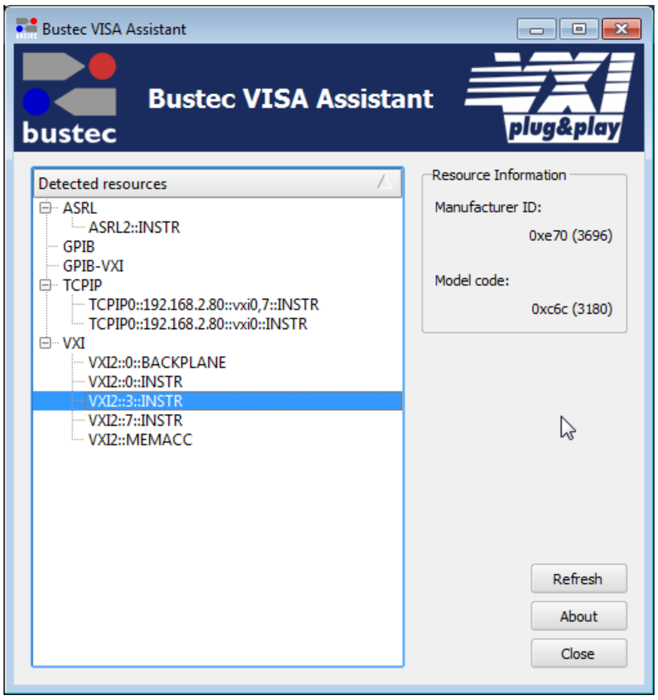
The command line switch "-s" can be used to suppress all output to the standard output.

Once finished, the information about the VXIbus and GPIB devices found is made available for the VISA library and a readable version of this information is saved to a file. Both the initial delay and the location of the resource manager output file are configurable using the Bustec VISA Configuration Utility.

3.4 VISA Assistant

The VISA Assistant is an interactive tool, which allows executing VISA commands without programming. To run the VISA Assistant, select “Bustec VISA Assistant” from the Bustec VISA program group in the start menu (“Start” ➔ “Programs” ➔ “Bustec VISA”). Alternatively you can also use a link in Bustec Agent.

The main window of the Visa Assistant shows a list of all VISA resources in the system.



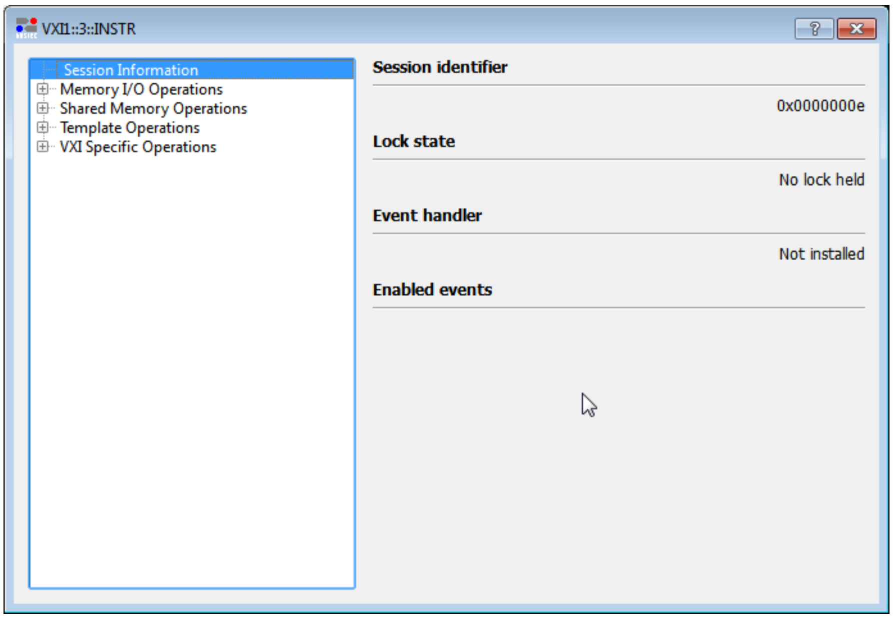
ASRL
ASRL2::INSTR
GPIB
GPIB-VXI
TCPIP
TCPIP0::192.168.2.80::vxi0,7::INSTR
TCPIP0::192.168.2.80::vxi0::INSTR
VXI
VXI2::0::BACKPLANE
VXI2::0::INSTR
VXI2::3::INSTR
VXI2::7::INSTR
VXI2::MEMACC

Manufacturer ID: 0xe70 (3696)

Model code: 0xc6c (3180)

Figure 23 - The VISA Assistant

On selecting one by double-clicking on its entry, the VISA Assistant opens a VISA session for that device in a separate window.



Session identifier: 0x0000000e

Lock state: No lock held

Event handler: Not installed

Enabled events

Figure 24 - VISA Assistant Session Window

In the tree-view control on the left hand side you have access to information about the session and the VISA functions possible for the resource.

The functions available are divided into five groups:

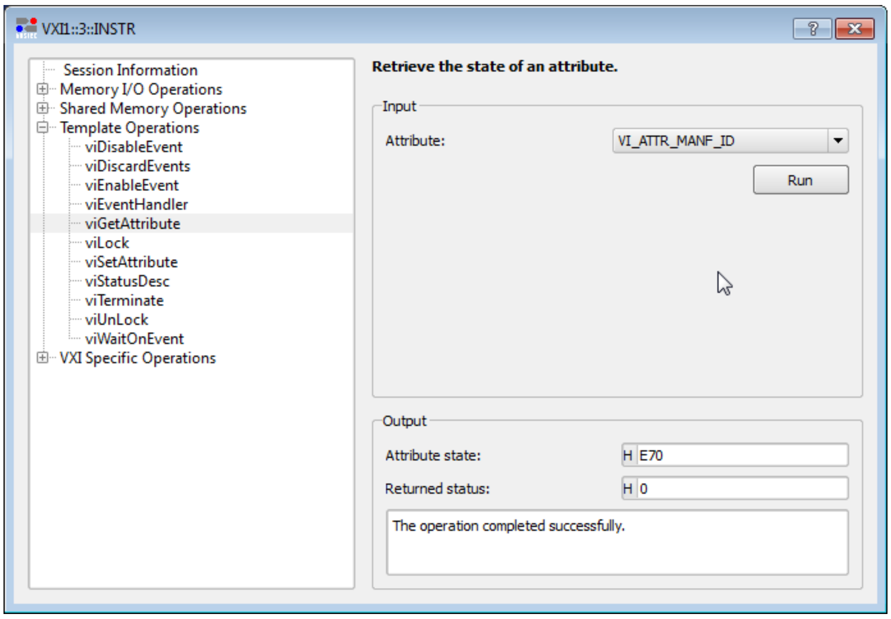
- Template Operations
- Basic I/O Operations
- Memory I/O Operations
- Shared Memory Operations
- VXI Specific Operations

Not all operations are available for all types of devices, so depending on the device type, the tree-view control might not list all the possibilities discussed here.

3.4.1 Template Operations

The VISA standard implements a template of standard services for a resource. The functions in this group provide access to those services. The services available include attribute operations, asynchronous operation control, resource access control and event operations.

As an example, the function viGetAttribute allows to retrieve the values for attributes defined for a resource. Selecting the function in the tree-view control on the left hand side (click on "Template Operations", then on "viGetAttribute") allows you to control the parameters for the function in a dialog on the right hand side of the session window


VXI1::3::INSTR

Session Information
Memory I/O Operations
Shared Memory Operations
Template Operations
viDisableEvent
viDiscardEvents
viEnableEvent
viEventHandler
viGetAttribute
viLock
viSetAttribute
viStatusDesc
viTerminate
viUnLock
viWaitOnEvent
VXI Specific Operations

Retrieve the state of an attribute.

Input

Attribute: VI_ATTR_MANF_ID

Output

Attribute state: H E70

Returned status: H 0

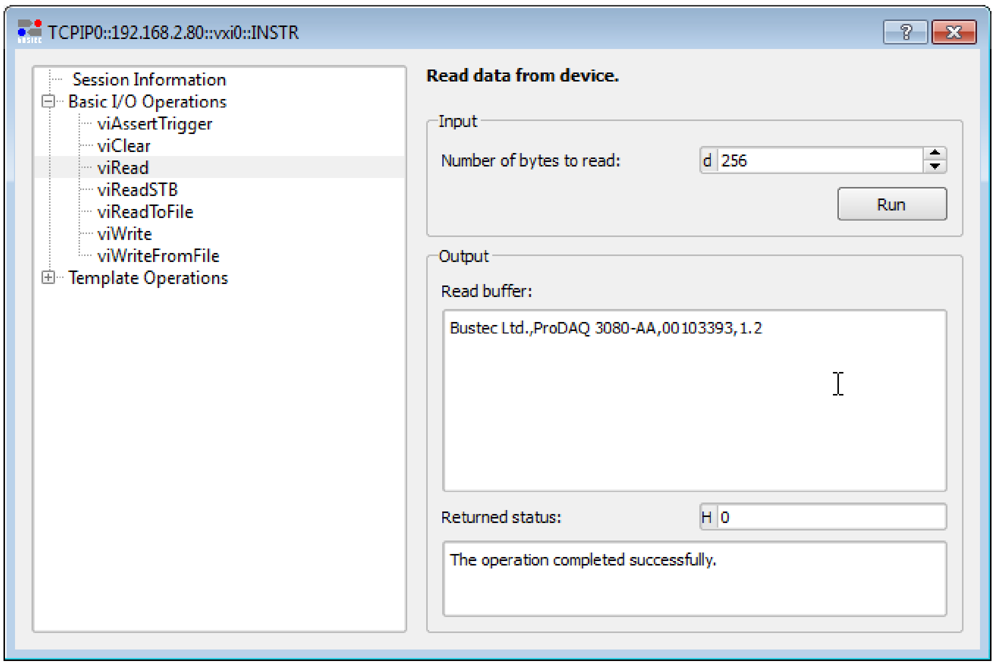
The operation completed successfully.

Figure 25 - Using a template operation

Select one of the attributes to retrieve in the “Attribute” control in the “Input” section and press “Run”. The “Output” section will show the current value of the attribute in the control “Attribute state”, if the operation was successful, and the returned status of the function.

3.4.2 Basic I/O Operations

The basic I/O operations will allow the user to send commands to a device and read back its answer, to trigger the device or read its status.



Read data from device.

Number of bytes to read: d 256

Read buffer:

```
Bustec Ltd.,ProDAQ 3080-AA,00103393,1.2
```

Returned status: H 0

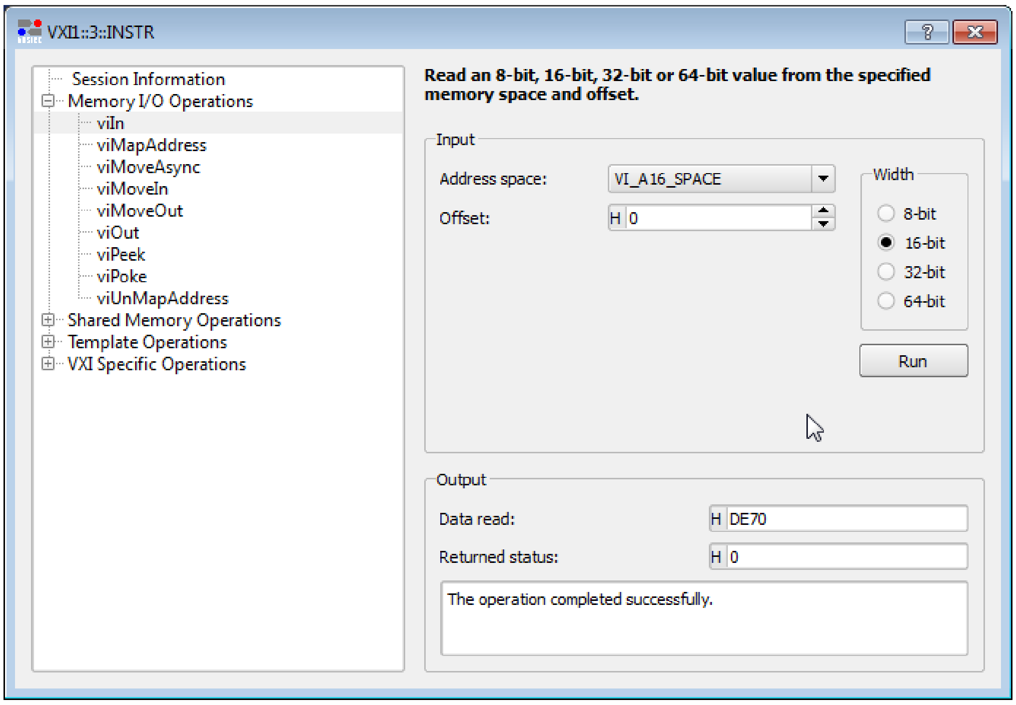
The operation completed successfully.

Figure 26 - Using basic I/O operation

As an example, you can use the viRead function to read data or a message from the device. To do so, just specify the maximum number of bytes to read from the device and press “Run”. As before, the VISA Assistant will show the message read as well as the returned status of the operation.

3.4.3 Memory I/O Operations

The memory I/O operations consist of High- and Low-Level Access services. The High-Level Access Services allow register-level access to devices that support direct memory access. They encapsulate most of the code required to perform the access, such as window mapping, address translation and error checking. The Low-Level Access Services are similar in purpose, but are implemented without the software overhead of the High-Level Services.



Read an 8-bit, 16-bit, 32-bit or 64-bit value from the specified memory space and offset.

Address space: VI_A16_SPACE

Offset: H 0

Width: 8-bit [✓ 16-bit] 32-bit 64-bit

Data read: H DE70

Returned status: H 0

The operation completed successfully.

Figure 27 - Memory I/O Operations

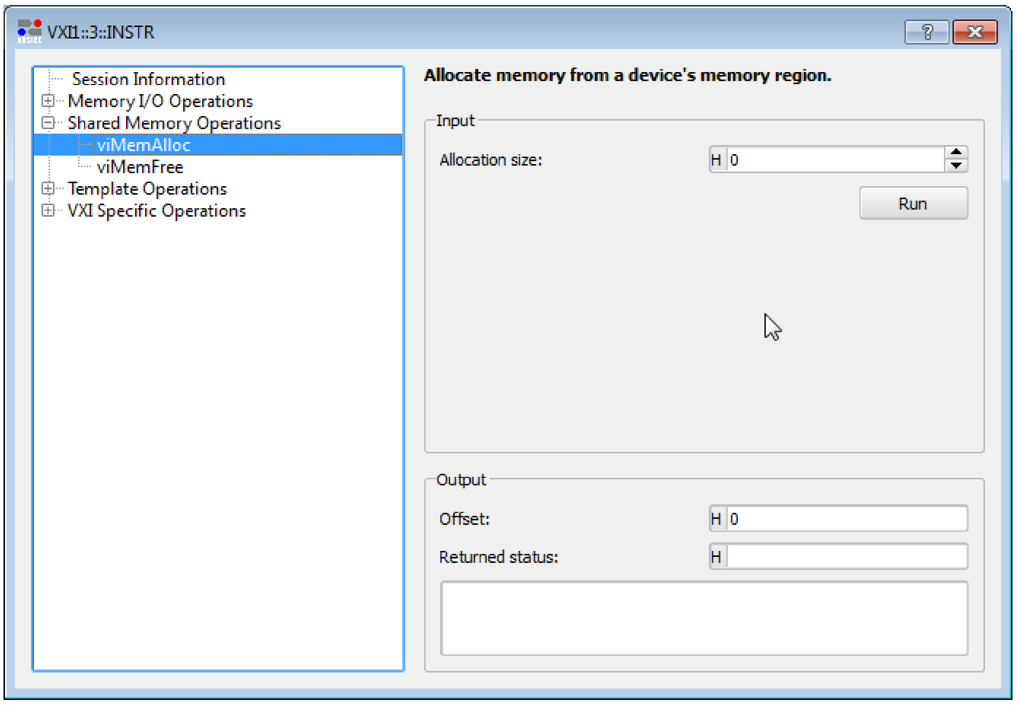
Figure 27 shows an example of the high-level access services. In the “Input” section the user can select an address space, an offset and a transfer width. By pressing “Run”, the functions viIn8, viIn16, viIn32 or viIn64 (depending on the access width) are executed and the result is shown in the “Output” section of the dialog along with the returned status.

The high-level functions viMoveIn, viMoveOut and viMoveAsync will move blocks of data. As with the functions viIn and viOut, the “Input” section will allow you to enter an address space, an offset and a transfer width. Additionally a length parameter will define the number of elements to transfer.

The low-level access services viMapAddress, viUnmapAddress, viPeek and viPoke need to be used together. First a memory mapping must be established by using the function viMapAddress, then viPeek and viPoke can be used to access the mapped register space, and viUnmapAddress must be used to undo the memory mapping.

3.4.4 Shared Memory Operations

Shared memory operations allow allocating memory space on the device to be used exclusively by the session allocating it. Figure 28 shows an example of the shared memory operations.



Allocate memory from a device's memory region.

Allocation size: H 0

Offset: H 0

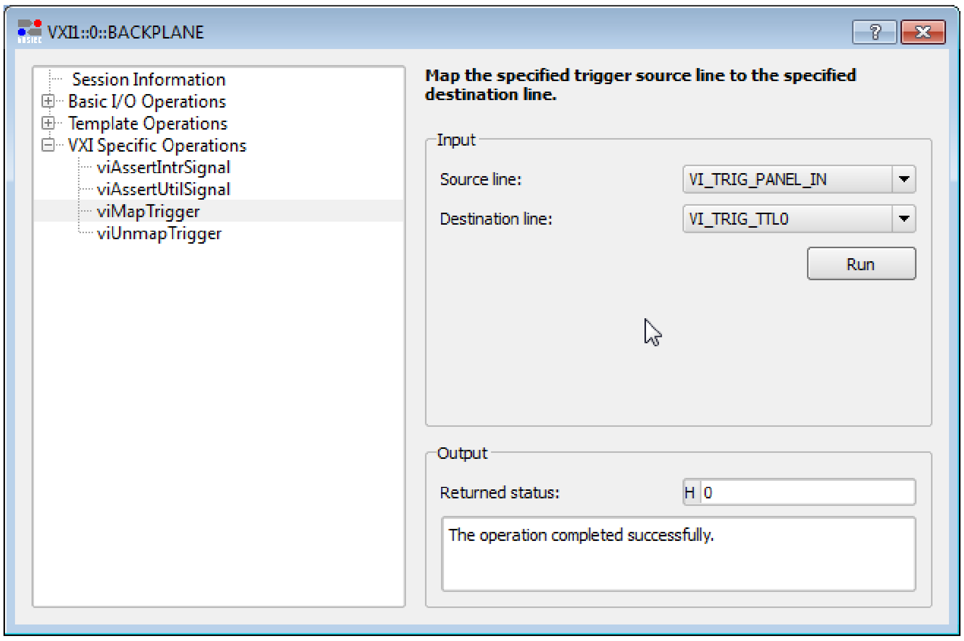
Returned status: H

Figure 28 - Shared Memory Operations

3.4.5 VXI Specific Operations

VXI Specific Operations are those operations, which were implemented to deal with special circumstances you can find only on controller and instruments using the VXIbus to communicate. The example shows an operation, which can be found only for backplane resources of VXIbus mainframes (see Figure 29).

The functions viMapTrigger and viUnmapTrigger enable you to route a trigger signal from a front panel input to one of the VXIbus trigger lines (only for VXIbus controller supporting this feature). In the “Input” section you can select a source trigger line, which should be mapped to a destination trigger line. As in the other examples, pressing “Run” will execute the function and display the result in the “Output” section.



Map the specified trigger source line to the specified destination line.

Source line: VI_TRIG_PANEL_IN

Destination line: VI_TRIG_TTL0

Returned status: H 0

The operation completed successfully.

Figure 29 - VXI Specific Operations

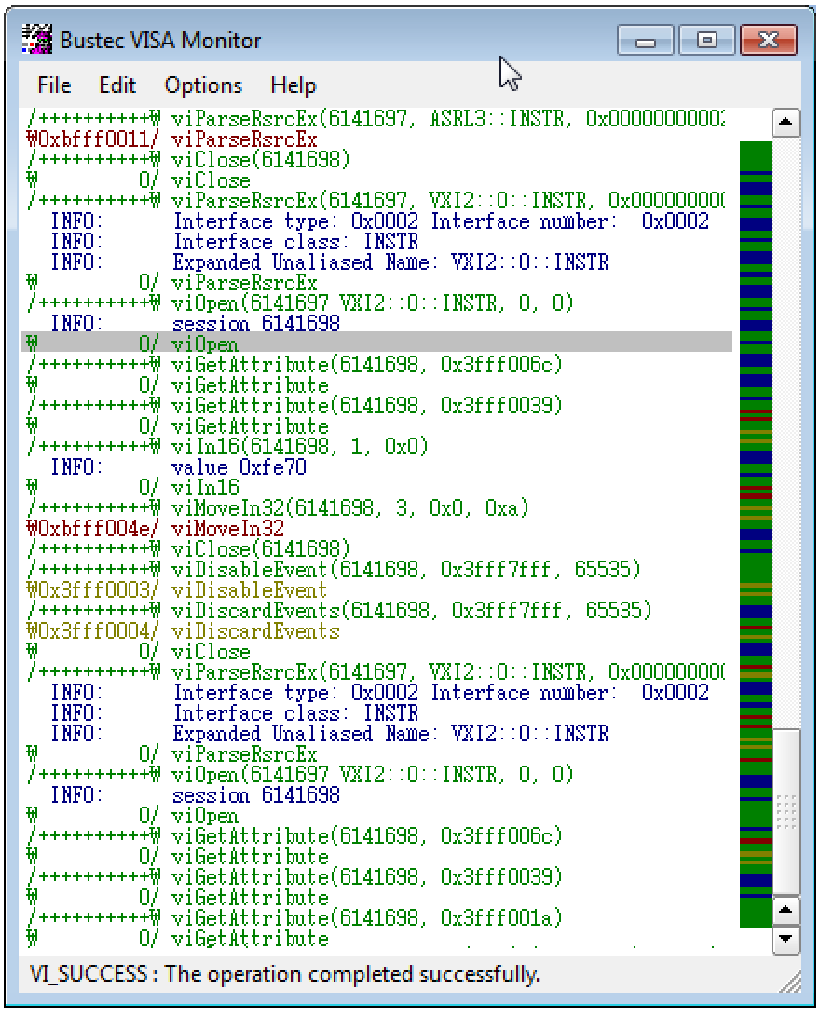
3.5 VISA Monitor

The VISA monitor allows the tracing of function calls inside the Bustec VISA library. It receives the generated trace messages and stores them into a log buffer. The key features of the Bustec VISA Monitor are:

- Works with standard Bustec VISA library, no need to recompile or re-link an application to get the trace output
- Traces the VISA calls from the remote target system over network allows to get information from non-graphical platforms, like VxWorks
- Possibility to store the trace output directly to a log file
- Views previously created log files (off-line viewing)
- Supports four different debug message types
- Per-function and per-type message filtering to avoid the message flooding and loss of system performance
- User can add comments to the trace log both interactively from VISA Monitor and from his program

3.5.1 Main Window

To run the Bustec VISA Monitor, select "Bustec VISA Monitor" from the Bustec VISA program group in the start menu ("Start" ➔ "Programs" ➔ "Bustec VISA"). You can also find a link in Bustec Agent.



```
/++++++++++₩ viParseRsrcEx(6141697, ASRL3::INSTR, 0x0000000000
₩0xbfff0011/ viParseRsrcEx
/++++++++++₩ viClose(6141698)
₩          0/ viClose
/++++++++++₩ viParseRsrcEx(6141697, VXI2::0::INSTR, 0x000000000
  INFO:       Interface type: 0x0002 Interface number:  0x0002
  INFO:       Interface class: INSTR
  INFO:       Expanded Unaliased Name: VXI2::0::INSTR
₩          0/ viParseRsrcEx
/++++++++++₩ viOpen(6141697 VXI2::0::INSTR, 0, 0)
  INFO:       session 6141698
₩          0/ viOpen
/++++++++++₩ viGetAttribute(6141698, 0x3fff006c)
₩          0/ viGetAttribute
/++++++++++₩ viGetAttribute(6141698, 0x3fff0039)
₩          0/ viGetAttribute
/++++++++++₩ viIn16(6141698, 1, 0x0)
  INFO:       value 0xfe70
₩          0/ viIn16
/++++++++++₩ viMoveIn32(6141698, 3, 0x0, 0xa)
₩0xbfff004e/ viMoveIn32
/++++++++++₩ viClose(6141698)
/++++++++++₩ viDisableEvent(6141698, 0x3fff7fff, 65535)
₩0x3fff0003/ viDisableEvent
/++++++++++₩ viDiscardEvents(6141698, 0x3fff7fff, 65535)
₩0x3fff0004/ viDiscardEvents
₩          0/ viClose
/++++++++++₩ viParseRsrcEx(6141697, VXI2::0::INSTR, 0x000000000
  INFO:       Interface type: 0x0002 Interface number:  0x0002
  INFO:       Interface class: INSTR
  INFO:       Expanded Unaliased Name: VXI2::0::INSTR
₩          0/ viParseRsrcEx
/++++++++++₩ viOpen(6141697 VXI2::0::INSTR, 0, 0)
  INFO:       session 6141698
₩          0/ viOpen
/++++++++++₩ viGetAttribute(6141698, 0x3fff006c)
₩          0/ viGetAttribute
/++++++++++₩ viGetAttribute(6141698, 0x3fff0039)
₩          0/ viGetAttribute
/++++++++++₩ viGetAttribute(6141698, 0x3fff001a)
₩          0/ viGetAttribute
```

VI_SUCCESS : The operation completed successfully.

Figure 30 – Bustec VISA Monitor

The main window shows a list of messages from the log buffer. Most recent messages are always added to the bottom of the list. A message can have one of the following types:

Message	Description
`/++++++++++\ viClose(3943168)`	Trace message showing entry to the function with call parameters values
`\          0/ viOpen`	Trace message showing VISA function returning VI_SUCCESS
`\0xbfff001d/ viGetAttribute`	Trace message showing VISA function returning VISA error
`\0x3fff0003/ viDisableEvent`	Trace message showing VISA function returning VISA warning
`  ERROR:      Invalid VISA object`	Error message explaining the details of the error

`WARNING:   User buffer not aligned`	Warning message explaining the details of the warning
`INFO:    Device respond: "+0 No Error"`	Info message showing some useful intermediate results
`COMMENT:   User's comment`	User comment message (see Note 1)
`KERN:      No buffer specified`	Message received from the kernel-level driver

Note

The user comment can be added to the log in two ways: interactively using the "Edit" menu, or programmatically from the user application using *buDebug(const char *message)* function.

Any message or group of continuous messages shown in the main display can be selected. If the selected message contains some error/warning code, the appropriate error/warning code explanation will be shown in the status bar.
The contents of the main display can be edited using the "Edit" menu. The "Edit" menu can be invoked from the menu bar, or as a context menu from the main display.
The map on the right hand side of the list shows a color-coded overview of the contents of the log message buffer. The scroll bar is linked to the colored map and shows current position and size of the displayed part of the log buffer.

3.5.2 Display Settings

The dialog to control the display settings can be opened from the menu by choosing "Options->Display...".

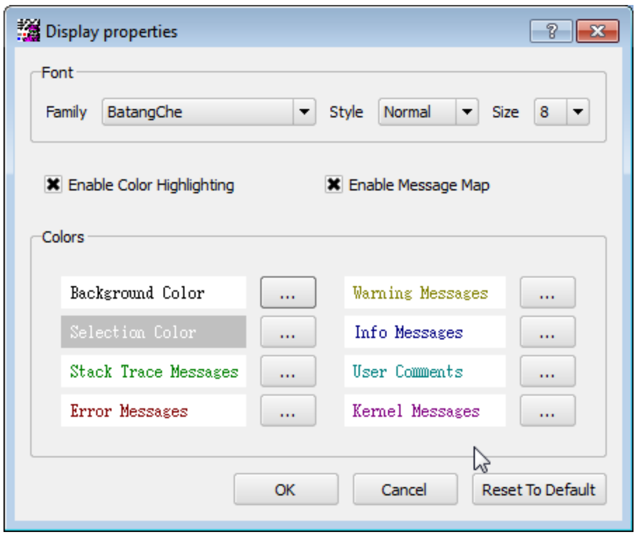
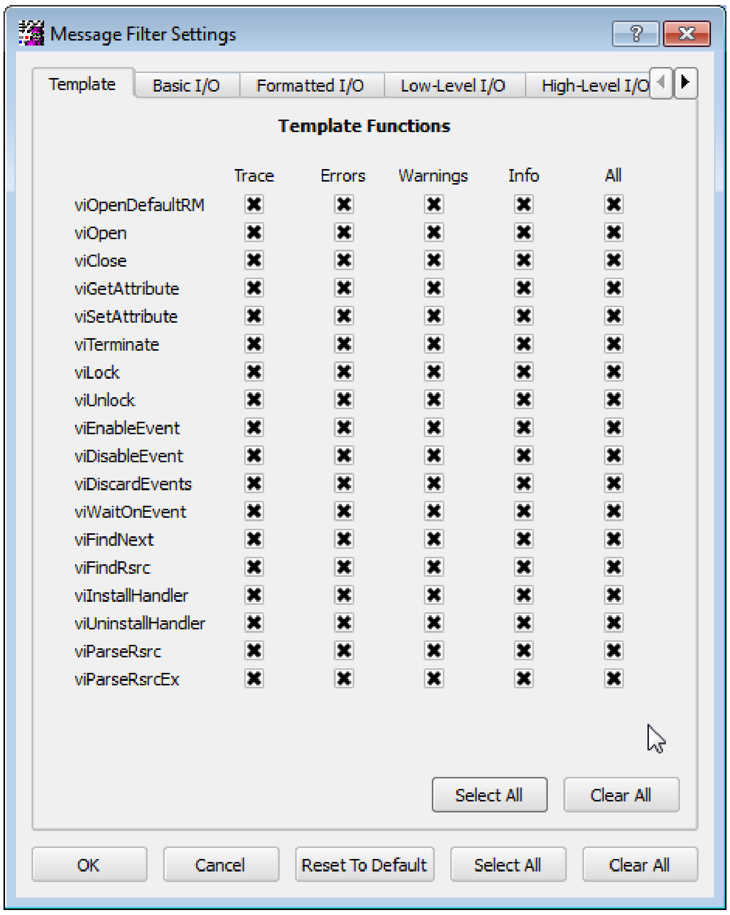


Figure 31 - VISA Monitor Display Settings

The controls in this dialog allow adjusting display settings like font and colors to meet the user requirements. It allows switching off color decoding of messages and the colored map. This can be useful to increase the performance of the monitor.

3.5.3 Message Filtering

The dialog to control the message filter settings can be opened from the menu by choosing "Options->Message Filter...".



Template Functions

	Trace	Errors	Warnings	Info	All
viOpenDefaultRM	☒	☒	☒	☒	☒
viOpen	☒	☒	☒	☒	☒
viClose	☒	☒	☒	☒	☒
viGetAttribute	☒	☒	☒	☒	☒
viSetAttribute	☒	☒	☒	☒	☒
viTerminate	☒	☒	☒	☒	☒
viLock	☒	☒	☒	☒	☒
viUnlock	☒	☒	☒	☒	☒
viEnableEvent	☒	☒	☒	☒	☒
viDisableEvent	☒	☒	☒	☒	☒
viDiscardEvents	☒	☒	☒	☒	☒
viWaitOnEvent	☒	☒	☒	☒	☒
viFindNext	☒	☒	☒	☒	☒
viFindRsrc	☒	☒	☒	☒	☒
viInstallHandler	☒	☒	☒	☒	☒
viUninstallHandler	☒	☒	☒	☒	☒
viParseRsrc	☒	☒	☒	☒	☒
viParseRsrcEx	☒	☒	☒	☒	☒

Figure 32 - Message Filtering Dialog

Sometimes it is important to log only certain type of messages (for instance, only ERROR messages) or messages from specific functions to avoid a flood of messages and, as a result, a loss of system performance. Via the filter settings every particular type of message for every particular VISA function can be enabled or disabled. To make handling easier, the functions are divided in several groups:

- Template Functions
- Basic I/O Functions
- Formatted I/O Functions
- Low-Level Memory Access Functions
- Hi-Level Memory Access Functions
- Block Transfer Functions

- Shared Memory Functions
- Internal Bustec VISA Functions

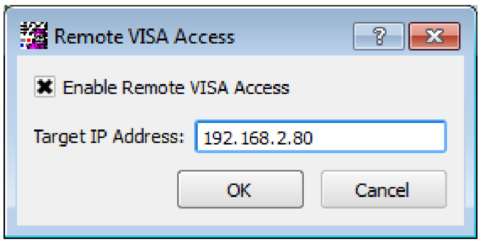
Every function group is placed in a separate tab. The "Select All" and "Clear All" buttons in the tab will switch on/off all message types for all functions in the group. The "All" checkbox switches on/off all message types for a particular function.
The display and filter settings can be saved and restored from the "File" menu (File -> Save/Load Settings...).

Note

By default all messages from internal Bustec VISA functions are switched off as they contain very specific information. However, if the Bustec support was requested, the support team may ask to send log file after run debugging program with this options switched on.

3.5.4 Remote VISA Mode

By default, the Bustec VISA Monitor will connect to the local VISA library, i.e. the VISA library installed on the same computer. To receive trace messages from a remote VISA (a Bustec VISA library running on a machine connected via network), select "Options->Remote VISA..." from the menu and enter the IP address of the remote machine.


Remote VISA Access

[✓] Enable Remote VISA Access

Target IP Address: 192.168.2.80

Figure 33 - Remote VISA Access Dialog

Enable the remote access to the target VISA and press "OK" button. The VISA monitor will try to establish a network connection to the agent running on the remote system. Once the connection is established, a pop-up message will report the successful connection. When the connection is broken, another pop-up message will appear. All the time, while the VISA Monitor is working in remote mode, the target IP address will be shown in the status bar of the main window.

Note

Currently remote VISA access is not implemented for Windows platforms

3.5.5 Redirect Output

The trace messages received by the monitor will be stored in an internal buffer for displaying, which holds the last 512 messages received. To store messages over a longer period of time, the messages can be written directly to a log file. In this mode the main display doesn't show the messages. To do so, choose "File->Start Logging to File..." from the menu, select a target file and press the “Start” button.

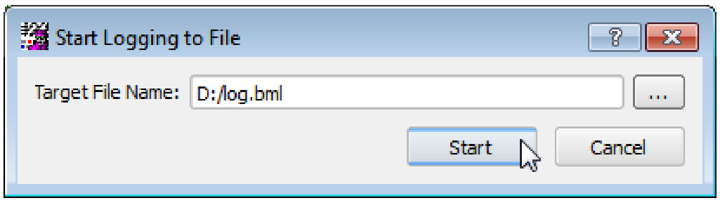


Figure 34 - Redirecting Output

All the time while the VISA Monitor is working in redirected output mode, the output file name will be shown in the status bar of the main window. The contents of the log file can be analyzed later using the Bustec VISA Monitor in Off-line Mode.

3.5.6 Offline Mode

The Bustec VISA Monitor allows reviewing the contents of log files created previously in the Redirected Output Mode.

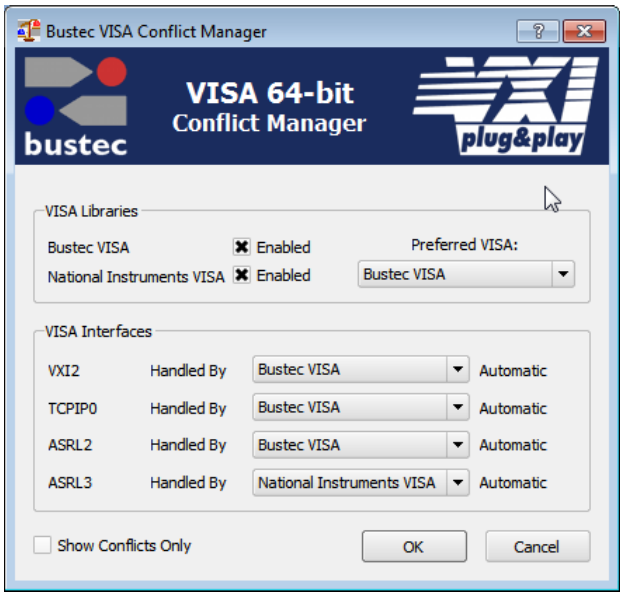
To do it, open the log file by selecting "File->Open Log File..." from the menu. The contents of the log file will be shown in the main display. In this mode the VISA Monitor does not accept any messages from VISA library, it works in off-line mode. To switch back to on-line mode, select "File->Close Log File" from the menu.

Note

VISA Monitor log files are normal ASCII files, so they can be handled with any text processor.

3.6 Conflict Manager

To start the Bustec VISA Conflict Manager interface application, select “VISA 64-bit Conflict Manager” from the Bustec VISA program group created during the installation of the VISA library (“Start” ➔ “Programs” ➔ “Bustec VISA”). You can also use a link in Bustec Agent.



VISA Libraries

Bustec VISA	✖ Enabled	Preferred VISA:
National Instruments VISA	✖ Enabled	Bustec VISA

VISA Interfaces

VXI2	Handled By	Bustec VISA	Automatic
TCPIP0	Handled By	Bustec VISA	Automatic
ASRL2	Handled By	Bustec VISA	Automatic
ASRL3	Handled By	National Instruments VISA	Automatic

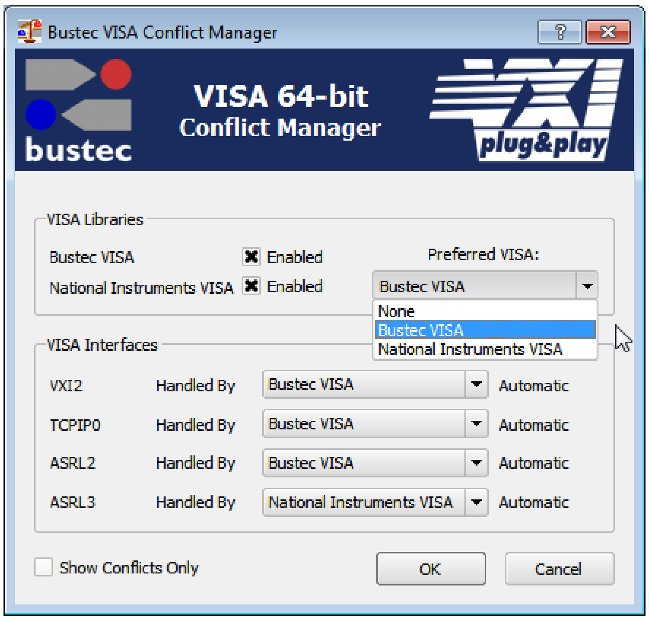
☐ Show Conflicts Only

Figure 35 - Bustec VISA Conflict Manager Interface

In the top section (“VISA Libraries”), the conflict manager displays a list of VISA implementations present in the system. By checking/unchecking the checkboxes to the right of each VISA the particular VISA implementations can be enabled/disabled.

3.6.1 Selecting the Preferred VISA

The setting for the “Preferred VISA" decides which VISA will handle interfaces accessible via multiple VISA implementations, except for interfaces manually assigned to a particular VISA (see below).



VISA Libraries

Bustec VISA ☒ Enabled
National Instruments VISA ☒ Enabled
Preferred VISA: Bustec VISA
None
Bustec VISA
National Instruments VISA

VISA Interfaces

VXI2	Handled By	Bustec VISA	Automatic
TCPIP0	Handled By	Bustec VISA	Automatic
ASRL2	Handled By	Bustec VISA	Automatic
ASRL3	Handled By	National Instruments VISA	Automatic

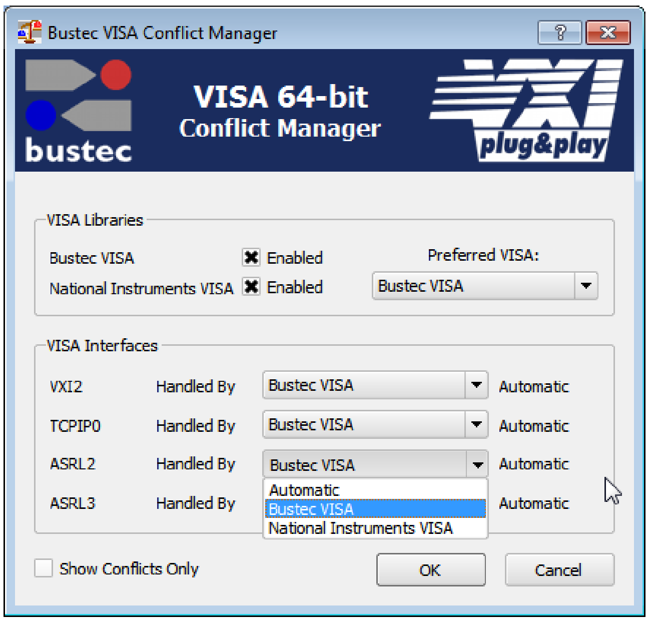
☐ Show Conflicts Only

Figure 36 - Selecting a preferred VISA

3.6.2 Assigning Interfaces

The second section (“VISA Interfaces”) shows a list of interfaces accessible through the installed VISA implementations. Depending on the setting of the checkbox “Show Conflicts Only”, the list consists either of all interfaces present (box unchecked) or only the interfaces which can be accessed via more than one VISA implementation.

For each interface the user can choose either “Automatic”, which means that the interface will be handled by the “Preferred VISA” selected in the top section, or the name of the VISA implementation which should handle the interface regardless of this setting.



VISA Libraries

Bustec VISA ☒ Enabled
National Instruments VISA ☒ Enabled
Preferred VISA: Bustec VISA

VISA Interfaces

VXI2	Handled By	Bustec VISA	Automatic
TCPIP0	Handled By	Bustec VISA	Automatic
ASRL2	Handled By	Bustec VISA	Automatic
ASRL3	Handled By		Automatic

Automatic
Bustec VISA
National Instruments VISA

☐ Show Conflicts Only

Figure 37 - Selecting a VISA Library

Note

If "Automatic" is chosen, the selection is immediately updated to show the resulting choice (i.e. the name of the VISA selected as "Preferred VISA"). Whether this setting is the result of a manual or automatic assignment is displayed to the right of the selection.

For more information about the VISA router, the conflict manager and the conflict resolution, see chapter 2.1.2: The VISA Router and VPP-4.3.5: VISA Shared Components.

3.6.3 32-bit VISA

IVI Foundation provides only 64-bit VISA router library, so conflict resolving is done only for the 64-bit applications linked with VISA. Bustec provides similar implementation of the router library for 32-bit VISAs. Therefore conflict management can also be done for 32-bit applications.

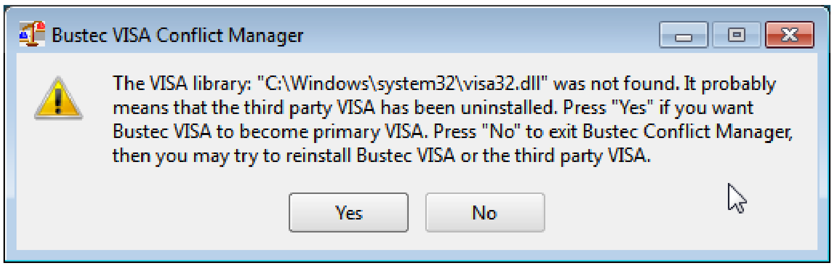
The 32-bit Conflict Manager, as compared to its 64-bit counterpart, has an additional, semi-auto configuration capability. The configuration check is done on each start of the application. In case of inconsistency, the user is notified and can decide what to do. Mainly, there are two situations possible:

- The visa32.dll file does not exist – there is no other VISA in the system, or a third-party primary VISA was removed causing the previously properly installed Bustec 32-bit VISA Router (visa32.dll) to be deleted.

- The visa32.dll is a third-party primary VISA library – it might have been installed before Bustec VISA, or later, overwriting Bustec 32-bit VISA Router.

You should run the Bustec 32-bit VISA Conflict Manager each time installing, reinstalling, or uninstalling other VISAs. Bustec VISA installer starts the program automatically as the last step of the process.

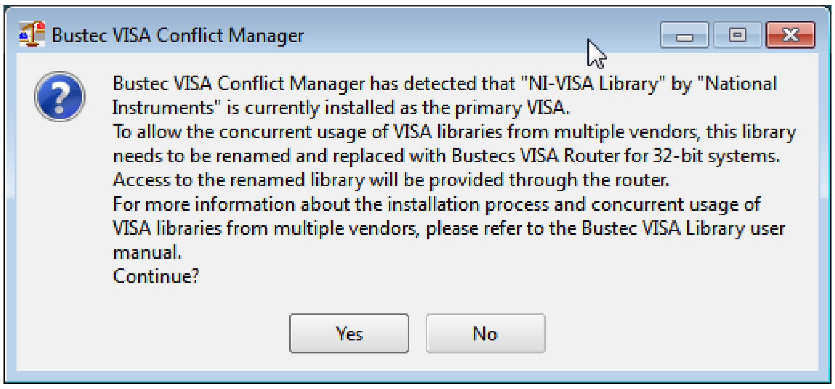
The first situation (no visa32.dll file) is handled by the Conflict Manager by just creating the visa32.dll file – Bustec 32-bit VISA Router library.


Bustec VISA Conflict Manager

The VISA library: "C:\Windows\system32\visa32.dll" was not found. It probably means that the third party VISA has been uninstalled. Press "Yes" if you want Bustec VISA to become primary VISA. Press "No" to exit Bustec Conflict Manager, then you may try to reinstall Bustec VISA or the third party VISA.

Figure 38 – Bustec 32-bit VISA Conflict Manager – no visa32.dll found

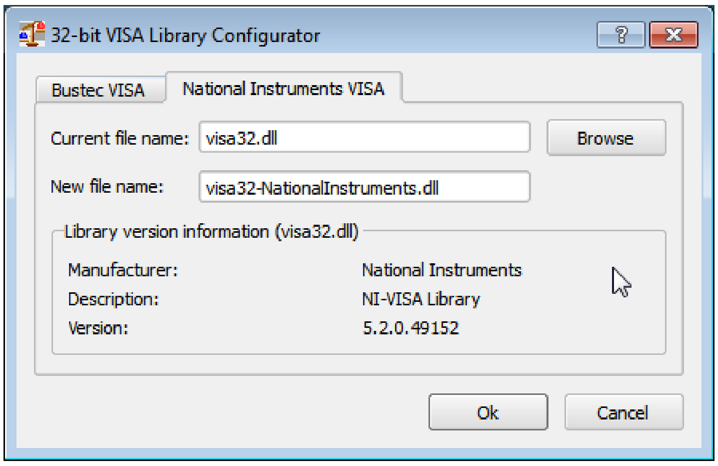
Second problem is resolved by renaming the visa32.dll (third party primary VISA) and setting up new visa32.dll – the Bustec 32-bit VISA Router.



Bustec VISA Conflict Manager

Bustec VISA Conflict Manager has detected that "NI-VISA Library" by "National Instruments" is currently installed as the primary VISA.
To allow the concurrent usage of VISA libraries from multiple vendors, this library needs to be renamed and replaced with Bustecs VISA Router for 32-bit systems.
Access to the renamed library will be provided through the router.
For more information about the installation process and concurrent usage of VISA libraries from multiple vendors, please refer to the Bustec VISA Library user manual.
Continue?

Figure 39 – Bustec 32-bit VISA Conflict Manager, third party primary VISA detected



32-bit VISA Library Configurator

Tabs: Bustec VISA | National Instruments VISA

Current file name: visa32.dll

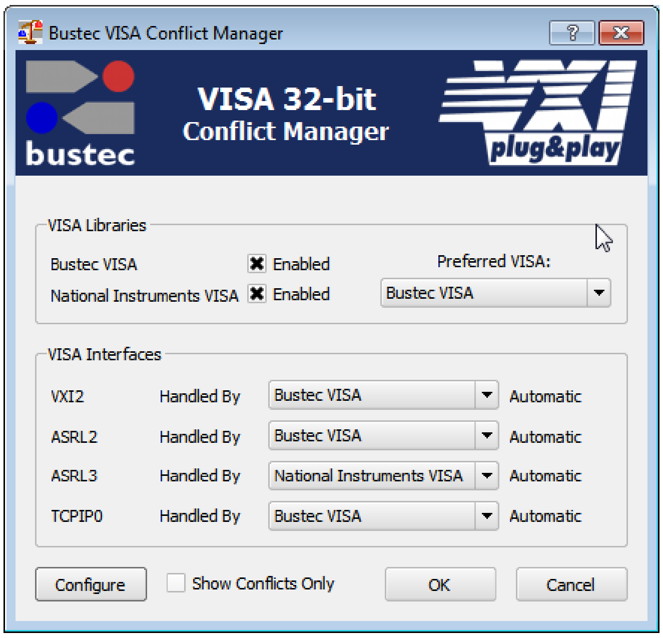
New file name: visa32-NationalInstruments.dll

Library version information (visa32.dll)

Manufacturer:	National Instruments
Description:	NI-VISA Library
Version:	5.2.0.49152

Figure 40 – Bustec 32-bit VISA Conflict Manager – renaming VISA library

When the problem is resolved, the 32-bit Conflict Manager starts to work exactly as the 64-bit version.



Bustec VISA Conflict Manager

VISA 32-bit Conflict Manager

VISA Libraries

Bustec VISA	☒ Enabled	Preferred VISA:
National Instruments VISA	☒ Enabled	Bustec VISA

VISA Interfaces

VXI2	Handled By	Bustec VISA	Automatic
ASRL2	Handled By	Bustec VISA	Automatic
ASRL3	Handled By	National Instruments VISA	Automatic
TCPIP0	Handled By	Bustec VISA	Automatic

☐ Show Conflicts Only

Figure 41 – Bustec 32-bit VISA Conflict Manager

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4. Programming Examples

4.1 Connecting to a Device

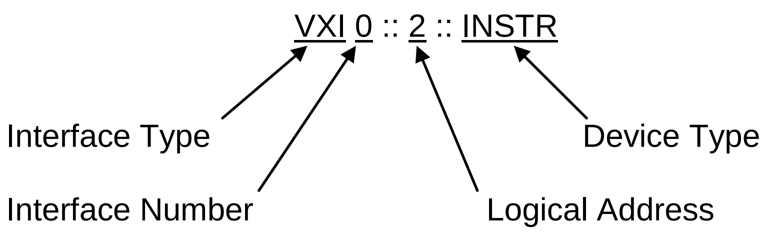
An application using the VISA library to communicate with the instrument needs to open a session for the resource it wants to use. A resource might be a physical resource as for example a VXI instrument or virtual resources like the backplane or the resource manager. The session will handle all accesses, attributes and services for the particular resource. The following example shows all necessary steps to connect to a device using VISA functions:

```
#include <visa.h>

main (int argc, char **argv)
{
    ViStatus status;
    ViSession rm_session;
    ViSession instr_session;
    ViChar descr[256];

    /* open a session to the resource manager */
    if ((status = viOpenDefaultRM (&rm_session)) != VI_SUCCESS)
①   {
        viStatusDesc (rm_session, status, descr);

        if (status > VI_SUCCESS)
            printf ("VISA WARNING: viOpenDefaultRM returned status %08x (%s)\n",
                status, descr);
        else
        {
            printf ("VISA ERROR: viOpenDefaultRM returned status %08x (%s)\n",
                status, descr);
            return status;
        }
    }

    /* open a session to the instrument */
②   if ((status = viOpen (rm_session, "VXI0::2::INSTR",
                                   VI_NULL, VI_NULL, &instr_session)) != VI_SUCCESS)
    {
        viStatusDesc (instr_session, status, descr);

        if (status > VI_SUCCESS)
            printf ("VISA WARNING: viOpen returned status %08x (%s)\n",
                status, descr);
        else
        {
            printf ("VISA ERROR: viOpen returned status %08x (%s)\n",
                status, descr)
            return status;
        }
    }

    /* accessing the instrument */

    /* close the sessions to the instrument and the resource manager */
③   viClose (instr_session);
    viClose (rm_session);
}
```

Figure 42 - Opening a VISA Session

The first step in a program, which uses the VISA library, is always to open a session to the default resource manager (①). It provides connectivity to all VISA resources registered with it and gives applications control and access to individual resources.

The next step is to open a session to the instrument or multiple sessions to multiple instruments (②). The resource name used is a combination of interface type and number, logical address of the VXI device, and a device type:



The interface type for the ProDAQ 3030 PCI Express VXIbus Interface is always “VXI”. The interface number is the number, which was assigned to the particular ProDAQ 3030 by using the VISA configuration utility (see 2.6). The logical address of a VXI device is defined either statically by setting its logical address switch, or dynamically during runtime by the resource manager. If the resource manager assigned the address dynamically, the actual assignment can be found in the output file of the resource manager (see 2.8.1). The device type for VXI instruments is always “INSTR”.

Note

When running the above example, please make sure that the logical address used in it matches the logical address setting of the instrument you want to connect to.

Note

Before you can use the above example to connect to your device, you must run the VXI Resource Manager (see 2.8.1 – Running the VXIbus Resource Manager).

4.2 Programming Register-based Devices

Register-based devices are devices implementing a set of registers in A16 and often in A24 or A32. Programming register-based devices is done by reading and writing these registers to change their contents, either by bit, in groups of bits or in whole.

4.2.1 Accessing Registers

To access single registers, the VISA library offers two groups of functions. The first group, viIn8, viIn16, viIn32, viIn64, viOut8, viOut16, viOut32 and viOut64, provides a standardized, single word access to a device register in A16, A24 or A32 space. Figure 43 shows an example of a function reading a value from a device register (①), modifying the value read and writing it back (②). The driver for the ProDAQ 3030 will automatically take care about byte ordering, i.e. it will swap the words to be read or written between the little-endian host byte ordering your PC is using to the big-endian byte ordering used on the VXIbus.

```
ViStatus function rmw_register (ViSession instr_session, ViBusAddress offset, ViUInt16 mod)
{
    ViStatus status;
    ViChar descr[256];
    ViUInt16 value;

    if ((status = viIn16 (instr_session, VI_A16_SPACE, offset, &value) != VI_SUCCESS)
①   {
        viStatusDesc (instr_session, status, descr);

        if (status > VI_SUCCESS)
            printf (“VISA WARNING: viIn16 returned status %08x (%s)\n”, status, descr);
        else
        {
            printf (“VISA ERROR: viIn16 returned status %08x (%s)\n”, status, descr);
            return status;
        }
    }

    value = value | mod;

    if ((status = viOut16 (instr_session, VI_A16_SPACE, offset, value) != VI_SUCCESS)
②   {
        viStatusDesc (instr_session, status, descr);

        if (status > VI_SUCCESS)
            printf (“VISA WARNING: viOut16 returned status %08x (%s)\n”, status, descr);
        else
        {
            printf (“VISA ERROR: viOut16 returned status %08x (%s)\n”, status, descr);
            return status;
        }
    }

    return VI_SUCCESS;
}
```

Figure 43 - Memory-based I/O

The second group of functions is intended to map a register range into the memory of the host and accessing it directly. Because this ability is architecture and system dependent, the VISA standard foresees an attribute, which allows determining whether the range could be physically mapped or the system architecture does not allow it. Depending on the value of the attribute VI_ATTR_WIN_ACCESS, the range mapped can be directly accessed (e.g. by using a C-style pointer), or the functions viPeek8, viPeek16, viPeek32, viPeek64, viPoke8, viPoke16, viPoke32 and viPoke64 must be used to access registers in the mapped range. Figure 44 shows the same function as in Figure 43, this time implemented with memory mapping functions.

```
ViStatus function rmw_register (ViSession instr_session, ViBusAddress offset, ViUInt16 mod)
{
    ViStatus status;
    ViChar descr[256];
    ViAddr address;
    ViUInt16 win_access;
    ViUInt16 value;

①   if ((status = viMapAddress (instr_session, VI_A32_SPACE, offset,
                  sizeof (ViUInt16), VI_FALSE,  (ViAddr) 0, &address)) != VI_SUCCESS)
    {
        viStatusDesc (instr_session, status, descr);

        if (status > VI_SUCCESS)
            printf (“VISA WARNING: viMapAddress returned status %08x (%s)\n”,
                  status, descr);
        else
        {
            printf (“VISA ERROR: viMapAddress returned status %08x (%s)\n”,
                  status, descr);
            return status;
        }
    }

②   if ((status = viGetAttribute (instr_session,
                          VI_ATTR_WIN_ACCESS, &win_access)) != VI_SUCCESS)
    {
        viStatusDesc (instr_session, status, descr);

        if (status > VI_SUCCESS)
            printf (“VISA WARNING: viGetAttribute returned status %08x (%s)\n”,
                  status, descr);
        else
        {
            printf (“VISA ERROR: viGetAttribute returned status %08x (%s)\n”,
                  status, descr);
            return status;
        }
    }

    if (win_access == VI_DEREF_ADDR)
    {
        /* allowed to use pointer or similar */
        value = *((volatile ViUInt16 *) address);
③       value = value | mod;
        *((volatile ViUInt16 *) address) = value;
    }
    else if (win_access == VI_USE_OPERS)
    {
        /* use functions to access memory */
        viPeek16 (instr_session, address, &value);
④       value = value | mod;
        viPoke16 (instr_session, address, value);
    }

⑤   if ((status = viUnmapAddress (instr_session) != VI_SUCCESS)
    {
        viStatusDesc (instr_session, status, descr);

        if (status > VI_SUCCESS)
            printf (“VISA WARNING: viUnmapAddress returned status %08x (%s)\n”,
                  status, descr);
        else
        {
            printf (“VISA ERROR: viUnmapAddress returned status %08x (%s)\n”,
                  status, descr);
            return status;
        }
    }

    return VI_SUCCESS;
}
```

Figure 44 - Register I/O using memory mapping

In the above example, the function viMapAddress is used to map a register range starting with *offset* and extending over the size of the register into the memory of the host (①). If this is successful, the attribute "VI_ATTR_WIN_ACCESS" is checked to see whether the controller was able to map the address range physically into the memory space of the controller, or whether the mapping was done only logically (②). If the mapping was done physically, the application is allowed to use the address the register range is mapped to, as if it is accessing its own memory. So for example C-style pointers may be used to change the register value (③). If the mapping was done only logically, the application need to use the functions viPeek and viPoke provided by the VISA library to access the mapped register range (④). The VISA library will use the stored values for the mapped offset and range to calculate the physical address and execute a single access in the same way as internally done for the high-level functions. The function viUnmapAddress must be used to undo the mapping of the register range (⑤). Only one mapping per session is allowed by the VISA standard. Please not that the functions viPeek and viPoke will work in both cases (VI_ATTR_WIN_ACCESS equal to VI_DEREF_ADDR or equal to VI_USE_OPERS), but will introduce a slightly higher overhead then using direct access if possible.

4.2.2 Moving Blocks of Data

To move blocks of data between an instruments memory and the host memory, the VISA library implements the functions viMoveIn and viMoveOut for different transfer sizes. In addition a number of attributes can be used to define the type of transfer performed on the VXIbus.

```
#include <visa.h>

/* buffer used to store data from the instrument */
ViUInt16 data[1024];

main (int argc, char **argv)
{
    ViStatus status;
    ViSession rm_session;
    ViSession instr_session;
    ViChar descr[256];
    ViUInt16 value;

    /* open a session to the resource manager and instrument
     * as shown in Figure 42 - Opening a VISA Session (not shown here) */
     . . . .

    /* now move a block of 16-bit data from the instrument to the buffer */
    if ((status = viMoveIn16 (instr_session,
                              VI_A32_SPACE, MEM_START, 1024, data) != VI_SUCCESS)
    {
        viStatusDesc (instr_session, status, descr);

        if (status > VI_SUCCESS)
            printf ("VISA WARNING: viMoveIn16 returned status %08x (%s)\n", status, descr);
        else
        {
            printf ("VISA ERROR: viMoveIn16 returned status %08x (%s)\n", status, descr);
            return status;
        }
    }

    /* close the sessions as shown in Figure 42 - Opening a VISA Session */
    . . . . .
}
```

Figure 45 - Moving a Block of Data

For each move, one or several packets of data are moved over the VXIbus to the ProDAQ 3030 and via the PCI Express link between the ProDAQ 3030 and the host computer.

The type of transfer used on the VXIbus depends on the value of several attributes:

VI_ATTR_SRC_PRIV	for data moved from a VXIbus instrument to the host
VI_ATTR_DEST_PRIV	for data moved from the host to a VXIbus instrument

Only if the value of those attributes are set correctly prior to moving the data via viMoveIn or viMoveOut, a block transfer on the VXIbus will take place. The following table shows the type of transfers performed by the viMoveIn, viMoveOut and viMove functions for the different values of the attributes:

Settings		**Resulting Transfer**			
Attribute	Address Space	Privilege	Data/Program	Block Transfer	AM(hex)
VI_DATA_PRIV	VI_A16_SPACE	Supervisory	-	-	2D
	VI_A24_SPACE	Supervisory	Data	-	3D
	VI_A32_SPACE	Supervisory	Data	-	0D
VI_DATA_NPRIV	VI_A16_SPACE	Non-priv.	-	-	29
	VI_A24_SPACE	Non-priv.	Data	-	39
	VI_A32_SPACE	Non-priv.	Data	-	09
VI_PROG_PRIV	VI_A16_SPACE	Supervisory	-	-	2D
	VI_A24_SPACE	Supervisory	Program	-	3E
	VI_A32_SPACE	Supervisory	Program	-	0E
VI_PROG_NPRIV	VI_A16_SPACE	Non-priv.	-	-	29
	VI_A24_SPACE	Non-priv.	Program	-	3A
	VI_A32_SPACE	Non-priv.	Program	-	0A
VI_BLCK_PRIV	VI_A16_SPACE	Supervisory	-	-	2D
	VI_A24_SPACE	Supervisory	-	BLT	3F
	VI_A32_SPACE	Supervisory	-	BLT	0F
VI_BLCK_NPRIV	VI_A16_SPACE	Non-priv.	-	-	29
	VI_A24_SPACE	Non-priv.	-	BLT	3B
	VI_A32_SPACE	Non-priv.	-	BLT	0B
VI_D64_PRIV	VI_A16_SPACE	Supervisory	-	-	2D
	VI_A24_SPACE	Supervisory	-	MBLT	3C
	VI_A32_SPACE	Supervisory	-	MBLT	0C
VI_D64_NPRIV	VI_A16_SPACE	Non-priv.	-	-	29
	VI_A24_SPACE	Non-priv.	-	MBLT	38
	VI_A32_SPACE	Non-priv.	-	MBLT	08
VI_D64_2eVME	VI_A32_SPACE	-	-	2eVME	20/01
VI_D64_SST160	VI_A32_SPACE	-	-	2eSST	20/11
VI_D64_SST267	VI_A32_SPACE	-	-	2eSST	20/11
VI_D64_SST320	VI_A32_SPACE	-	-	2eSST	20/11

Figure 46 - VXIbus transfer types

Block transfers are performed on the VXIbus only if the correct attribute (VI_ATTR_SRC_PRIV or VI_ATTR_DEST_PRIV, depending on the direction) is set to one of the types VI_BLCK_PRIV, VI_BLCK_NPRIV, VI_D64_PRIV or VI_D64_NPRIV. The data width of the performed transfer depends on the viMoveXX function used, except for the case that the attribute is set to any of the VI_D64_* values, in which case a D64 transfer is performed.

```
#include <visa.h>

ViUInt16 data[1024];       /* buffer used to store data */

main (int argc, char **argv)
{
    ViStatus status;
    ViSession rm_session;
    ViSession instr_session;
    ViChar descr[256];
    ViUInt16 value;

    /* open a session to the resource manager and instrument
     * as shown in Figure 42 - Opening a VISA Session (not shown here) */

    /**************************************************************************/
    /*  Perform a 16-bit wide block transfer from a VXIbus instrument to the host   */
    /**************************************************************************/

    /* set the correct attribute - VI_ATTR_SRC_PRIV for moving data IN */
    if ((status = viSetAttribute (instr_session,
                                  VI_ATTR_SRC_PRIV, VI_BLK_PRIV)) != VI_SUCCESS)
    {
        /* handle errors or warnings (not shown here) */
    }

    /* now move a block of 16-bit data from the instrument to the buffer */
    if ((status = viMoveIn16 (instr_session,
                              VI_A32_SPACE, MEM_START, 1024, data) != VI_SUCCESS)
    {
        /* handle errors or warnings (not shown here) */
    }

    /**************************************************************************/
    /*  Perform a 32-bit wide block transfer from the host to a VXIbus instrument   */
    /**************************************************************************/

    /* set the correct attribute - VI_ATTR_DEST_PRIV for moving data OUT */
    if ((status = viSetAttribute (instr_session,
                                  VI_ATTR_DEST_PRIV, VI_BLK_PRIV)) != VI_SUCCESS)
    {
        /* handle errors or warnings (not shown here) */
    }

    /* now move a block of 32-bit data from the instrument to the buffer */
    if ((status = viMoveOut32 (instr_session,
                              VI_A32_SPACE, MEM_START, 1024, data) != VI_SUCCESS)
    {
        /* handle errors or warnings (not shown here) */
    }

    /**************************************************************************/
    /*  Perform a 64-bit wide block transfer from the host to a VXIbus instrument   */
    /**************************************************************************/

    /* set the correct attribute - VI_ATTR_DEST_PRIV for moving data OUT */
    if ((status = viSetAttribute (instr_session,
                                  VI_ATTR_DEST_PRIV, VI_D64_PRIV)) != VI_SUCCESS)
    {
        /* handle errors or warnings (not shown here) */
    }

    /* now move a block of 64-bit data from the instrument to the buffer */
    if ((status = viMoveOut32 (instr_session,
                              VI_A32_SPACE, MEM_START, 1024, data) != VI_SUCCESS)
    {
        /* handle errors or warnings (not shown here) */
    }

    /* close the sessions as shown in Figure 42 - Opening a VISA Session */
}
```

Figure 47 - Performing VXIbus Block Transfers

4.3 Programming Message-based Devices

Message-based VXIbus devices implement the word serial protocol to communicate with the application. Programming is done by sending ASCII messages to the device and reading its answer.

4.3.1 Writing and Reading Messages

The basic functions to write and read messages to/from devices are the two functions viRead and viWrite. They implement the word serial protocol for message based devices, but they do so on a very basic level. The user needs to build his message and use viWrite to send it to the device. Then he uses viRead to receive the message sent back. The message received might consist of strings, numbers and formatting characters and he will need to interpret this message. To avoid some of these steps, a couple of higher level functions were implemented in the VISA.
The following example shows how to use the functions viPrintf and viScanf to read the identification of a device:

```
#include <visa.h>

main (int argc, char **argv)
{
    ViStatus status;
    ViSession rm_session;
    ViSession instr_session;
    ViChar descr[256];

    /* open a session to the resource manager */
    if ((status = viOpenDefaultRM (&rm_session)) != VI_SUCCESS)
    {
        /* error handling as shown in the previous examples !*/
    }

    /* open a session to the instrument */
    if ((status = viOpen (rm_session, “VXI0::2::INSTR”,
                                   VI_NULL, VI_NULL, &instr_session)) != VI_SUCCESS)
    {
        /* error handling as shown in the previous examples !*/
    }

    /* reset the device */
①   if ((status = viPrintf (vi, “*RST\n”)) != VI_SUCCESS)
    {
        /* error handling as shown in the previous examples !*/
    }

    /* ask the device for its identification */
②   if ((status = viPrintf (vi, “*IDN?\n”)) != VI_SUCCESS)
    {
        /* error handling as shown in the previous examples !*/
    }

    /* read the identification sent back */
③   if ((status = viScanf (vi, “%256t”, descr)) != VI_SUCCESS)
    {
        /* error handling as shown in the previous examples !*/
    }
    printf (“Device Identification: %s\n”, descr);

    /* close the sessions to the instrument and the resource manager */
    viClose (instr_session);
    viClose (rm_session);
}
```

Figure 48 - Reading the Device Identification

The functions ViPrintf and viScanf use a C-style formatting string to format and scan messages send to and read from the device, freeing the user from the separate steps necessary to do so, if using the lower level function viWrite and viRead. Furthermore the functions implement an extended set of formatting styles specially shaped towards instrument communication.
In the above example the function viPrintf is used to send two messages to the device, first a command to reset the device (①), then a request to send back its identification string (②). viPrinf uses the format string together with the other arguments passed to it to build a message string in a local buffer and then it calls viWrite to send this message to the device.
The example program reads the identification using the function viScanf (③). ViScanf allocates a local buffer, calls the function viRead to receive the message from the device and then it parses the message using the formatting supplied by the format string. In the example the format code "%t" together with a size modifier is used, telling viScanf to expect a string to be returned in the message, and to copy a maximum of 256 characters into the buffer supplied.
The VISA standard supports a wide range of formatted I/O services like the viPrintf/viScanf functions shown in the example. Please refer to the VISA standard document "VXI*plug&play* Systems Alliance VPP-4.3: The VISA library" for a complete list.

4.4 Optimizing Programs

To optimize you programs using the ProDAQ 3030 PCI Express VXIbus Slot-0 Interface, please keep the following in mind:

- Use the functions viMove, viMoveIn or viMoveOut instead of single read and write commands for devices and register ranges, wherever this is possible.
- Use the attributes VI_ATTR_SRC_PRIV and VI_ATTR_DEST_PRIV to specify block transfer privileges for devices where this is possible.
- Use 32-bit or 64-bit moves, whenever possible.
- Align your buffers to 32-bit boundaries. Locking this buffer in memory and allocating a contiguous buffer will help to optimize the performance.
- For maximum single word transfer performance, use viMapAdress and direct memory access via C-style pointer or similar.

4.5 Using VXIbus and Front Panel Trigger Lines

One feature, that differs the VXIbus from other busses, is its ability to use trigger signals to communicate with instruments in real-time, to share clock signals, etc. The VISA library implements functions to control those trigger lines from your application.

4.5.1 Using VXIbus Trigger Lines

The VISA standard implements the function viAssertTrigger together with the attribute VI_ATTR_TRIG_ID to assert and de-assert trigger lines on the VXIbus or sending the word serial trigger command to message-based devices.

```
#include <visa.h>

main (int argc, char **argv)
{
     ViStatus status;
     ViSession rm_session;
     ViSession instr_session;
     ViChar descr[256];

     /* open a session to the resource manager */
     if ((status = viOpenDefaultRM (&rm_session)) != VI_SUCCESS)
     {
          /* error handling as shown in the previous examples !*/
     }

     /* open a session to the instrument */
     if ((status = viOpen (rm_session, "VXI0::2::INSTR",
                                        VI_NULL, VI_NULL, &instr_session)) != VI_SUCCESS)
     {
          /* error handling as shown in the previous examples !*/
     }

     /* defining the trigger line to use */
     if ((status = viSetAttribute (instr_session,
①                                  VI_ATTR_TRIG_ID, VI_TRIG_TTL0)) != VI_SUCCESS)
     {
          /* error handling as shown in the previous examples !*/
     }

     /* send a trigger pulse to the device */
②    if ((status = viAssertTrigger (instr_session, VI_TRIG_PROT_SYNC)) != VI_SUCCESS)
     {
          /* error handling as shown in the previous examples !*/
     }

     /* close the sessions to the instrument and the resource manager */
     viClose (instr_session);
     viClose (rm_session);
}
```

Figure 49 - Sending a Trigger Pulse

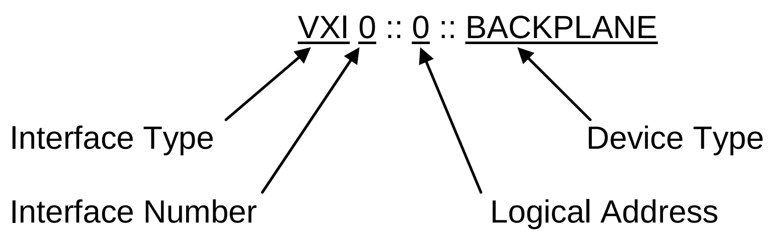
Figure 49 shows an example for sending a trigger pulse to a device. The function viSetAttribute is used (①) to set the attribute VI_ATTR_TRIG_ID to select the trigger line. In general the trigger ID can be set to VI_TRIG_TTL0 to VI_TRIG_TTL7, VI_TRIG_ECL0/VI_TRIG_ECL1 or VI_TRIG_SW. For the setting VI_TRIG_SW, the device is sent the word serial trigger command, the other settings correspond to the VXIbus trigger lines TTL0-TTL7 and ECL0/ECL1.

To send the trigger, the function viAssertTrigger is used in the example (②) with the “protocol” argument set to VI_PROT_DEFAULT. The interpretation of this argument depends on the value, the attribute VI_ATTR_TRIG_ID is set to. For software triggers, the only valid protocol is VI_PROT_DEFAULT. For hardware triggers, the protocols VI_PROT_DEFAULT or VI_PROT_SYNC will generate a trigger pulse on the specified line, while VI_PROT_ON and VI_PROT_OFF let you explicitly assert and de-assert the trigger line.

4.5.2 Using Front-Panel Trigger Lines

The ProDAQ 3030 supports a front-panel trigger input and output, which can be mapped to the VXIbus trigger lines. For this purpose, as for querying and manipulating other VXIbus backplane specific lines, the VISA standard implements a special resource. It encapsulates the VXI-defined operations and properties of the backplane in a VXIbus system. It lets a controller to query and manipulate specific lines on a specific mainframe in a given VXI system. Services are provided to map, unmap, assert, and receive hardware triggers, and also to assert various utility and interrupt signals.

The resource descriptor used for the backplane resource is again a combination of interface type and number, logical address of the VXI device, and the device type BACKPLANE:



As before, the interface type when using the ProDAQ 3030 Interface is always “VXI”. The interface number depends on the assignment you made using the configuration utility (see 2.6). The logical address will be zero (0), as you will need to configure the ProDAQ 3030 for logical address zero to allow it to function as a VXIbus slot-0 controller.

Though the ProDAQ 3030 does not support the mapping of one VXIbus trigger line to another, the standard VISA functions viMapTrigger and viUnmapTrigger can be used to map the front panel trigger input to one or many of the VXIbus trigger lines as well as to map one or many VXIbus trigger lines to the front panel trigger output.
Figure 50 shows an example how to map the trigger lines to/from the front panel input and output. First a session for the backplane resource is opened (①). Then the function viMapTrigger is used to map the front panel input to the VXIbus trigger line TTL1 (②), and also to the VXIbus trigger lines ECL0 (③). This means that whenever an active trigger is detected on the front panel input of the ProDAQ 3030, both lines will be asserted. In general, when the viMapTrigger function is called multiple times with the same source trigger line and different destination trigger lines, an assertion of the source line will cause all of those destination lines to be asserted. To map one or multiple of the VXIbus trigger lines to the front panel output, the value VI_TRIG_PANEL_OUT must be used for the destination parameter (④). As with the front panel input, multiple lines can be mapped to

the front panel output. When calling viMapTrigger multiple times with the same destination line and different source lines, the destination line will be asserted when any of the source lines is asserted.

```
#include <visa.h>

main (int argc, char **argv)
{
    ViStatus status;
    ViSession rm_session;
    ViSession instr_session;
    ViChar descr[256];

    /* open a session to the resource manager */
    if ((status = viOpenDefaultRM (&rm_session)) != VI_SUCCESS)
    {
        /* error handling as shown in the previous examples !*/
    }

    /* open a session to the instrument */
    if ((status = viOpen (rm_session, “VXI0::0::BACKPLANE”,
①                                   VI_NULL, VI_NULL, &instr_session)) != VI_SUCCESS)
    {
        /* error handling as shown in the previous examples !*/
    }

    /* mapping the front panel input to trigger line TTL1 */
    if ((status = viMapTrigger (instr_session,
②                             VI_TRIG_PANEL_IN, VI_TRIG_TTL1, VI_NULL)) != VI_SUCCESS)
    {
        /* error handling as shown in the previous examples !*/
    }

    /* mapping the front panel input also to trigger line ECL0 */
    if ((status = viMapTrigger (instr_session,
③                             VI_TRIG_PANEL_IN, VI_TRIG_ECL0, VI_NULL)) != VI_SUCCESS)
    {
        /* error handling as shown in the previous examples !*/
    }

    /* mapping trigger line TTL6 to the front panel output */
    if ((status = viMapTrigger (instr_session,
④                             VI_TRIG_TTL6, VI_TRIG_PANEL_OUT, VI_NULL)) != VI_SUCCESS)
    {
        /* error handling as shown in the previous examples !*/
    }

    /* close the sessions to the instrument and the resource manager */
    viClose (instr_session);
    viClose (rm_session);
}
```

Figure 50 - Mapping Trigger Lines

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