

ProDAQ

User Manual

ProDAQ 3030

PCI Express VXIbus Slot-0 Interface

PUBLICATION NUMBER: 3030-XX-UM-1000

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1. Introduction

PCI Express, the third-generation input/output standard, provides performance for peripheral devices beyond that of the older Peripheral Component Interconnect (PCI) and PCI Extended (PCI-X) busses. The higher performance of PCI Express derives from its faster, serial-bus architecture, which provides dedicated, bi-directional I/O links to devices with 2.5 GHz (GEN1) or 5 GHz (GEN2) clocking, versus the slower 133 MHz parallel bus of PCI-X.

The ProDAQ 3030 PCI Express VXIbus Slot-0 Interface utilizes a four lane (x4) cable connection as defined in the PCI Express® External Cabling Specification to provide a link between the VXIbus and the host computer. In the host computer the ProDAQ 3261 PCI Express Host Interface Card provides the necessary cable connector and switch to connect the external cable to the computer's PCI Express link.

This manual describes the implementation, configuration and use of the ProDAQ 3030 PCI Express VXIbus Slot-0 Interface and the ProDAQ 3261 PCI Express Host Interface Card.

1.1 Requirements

To set up and use the ProDAQ 3261 PCI Express Host Interface Card and the ProDAQ 3030 PCI Express VXIbus Slot-0 Interface, you need the following:

- A PC compatible computer with
 - Windows XP® 32-bit; or Windows 7®, 32-bit or 64-bit
 - a free PCI Express x4, x8 or x16 slot
- The ProDAQ 3261 PCI Express Host Interface Card
- A VXI mainframe
- The ProDAQ 3030 PCI Express VXIbus Slot-0 Interface
- A ProDAQ 8034 PCI Express x4 Cable
- ProDAQ Driver CD

1.1.1 The Host Computer

The ProDAQ 3261 Host Interface Card together with the ProDAQ 3030 Slot-0 Interface allows your host computer to perform as if it is plugged directly into the VXI backplane. You will need one empty PCI Express expansion slot to install the ProDAQ 3261 into it. The ProDAQ 3261 needs in minimum a PCI Express slot with four lanes (x4), it cannot be installed in a one lane slot (x1). If you install it in an eight or sixteen lane slot (x8 / x16), the additional lanes will be ignored. The software currently supports Windows XP (and Windows 7, both in 32-bit or 64-bit versions). It is recommended to have the latest service pack installed.

1.1.2 The ProDAQ 3261 PCI Express Host Interface Card

The ProDAQ 3261 is a standard height, half length PC add-in card. It interfaces a four lane PCI Express expansion slot to the four lane PCI Express External Cabling port via a non-transparent PCI Express switch, enabling devices connected via the cable port to be power-cycled and plug/unplugged without influencing the host computers operations.

1.1.3 The VXI Mainframe

The ProDAQ 3030 PCI Express VXIbus Slot-0 Interface is a single-slot wide, C-size VXI module, which needs to be installed in the left most slot of the mainframe (slot "0"). Installing it into any other slot is not recommended, as the signals it generates might generate conflicts with any slot-0 controller installed in the same mainframe.

The ProDAQ 3030 was designed according to the VXIbus standard VXI-1 Revision 4.0. It features the 160-pin VXIbus connectors introduced in this revision of the standard and supports the new, high-speed synchronization clock as well as the faster transfer modes like 2eVME and 2eSST. If you install it in a VXIbus mainframe with a backplane featuring the 96-pin connectors of the previous VXIbus revisions, some these features will not be supported. All other functionalities will not be affected, i.e. the ProDAQ 3030 will support all functionalities already defined in the previous revisions of the VXIbus standard.

Note

If you install the ProDAQ 3030 in a VXIbus mainframe equipped with a backplane compatible to earlier revisions of the VXIbus standard than Revision 4.0, it will only support signals and transfer modes already defined in these revisions. Signals like for example LSYNC100/LCLK100 or the 2eSST data transfer modes will not be supported.

Note

Being a C-size module, the ProDAQ 3030 does not provide a P3 connector as used in D-size mainframes. If used as a slot-0 controller in a D-size mainframe, it cannot provide the necessary control for instruments using the additional features of the P3 connector (CLK100, Star Trigger, add. Trigger and Local Bus Lines).

1.1.4 The ProDAQ 3030 PCI Express VXIbus Slot-0 Interface

The ProDAQ 3030 PCI Express VXIbus Slot-0 Interface is a C-size, register based VXIbus module providing a direct link between the high-speed PCI Express bus and the VXI backplane. The PCI Express to VXIbus bridge in the ProDAQ 3030 allows for low-latency, memory-mapped single accesses as well as high-speed, block transfers controlled by the internal DMA machines. A build-in PCI Express switch allows connecting further ProDAQ 3030 controller in a daisy-chain configuration.

In addition to the standard front-panel trigger and clock I/O an optional LXI compatible trigger interface allows the routing of the complete VXIbus trigger lines between multiple crates or to share them with other devices equipped with a similar trigger bus.

1.1.5 The ProDAQ 8034 PCI Express x4 Cable

To connect the ProDAQ 3030 PCI Express VXIbus Slot-0 Interface to your host computer, the ProDAQ 8034 PCI Express x4 cable is available in different lengths up to 7 meter. Besides the signals that are required to transmit/receive data on the PCI Express interface, it also transmits signals that are necessary to implement the PCI Express interface in a distributed system environment like for example cable present detect, cable power on and a reference clock as defined in the PCI Express External Cabling standard.

2. Installation

To use the ProDAQ 3030 PCI Express VXIbus Slot-0 Interface to control your VXIbus mainframe(s), you need to install hard- and software into your system. To do so, use the installation sequence as described in this chapter:

- Step 1: Unpacking and Inspection
- Step 2: Installing the ProDAQ 3261 Interface Card
- Step 3: Installing the VISA Library
- Step 4: Installing the ProDAQ 3030 Interface
- Step 5: Connecting the ProDAQ 3030 to the Host Computer

2.1 Unpacking and Inspection

All ProDAQ modules are shipped in an antistatic package to prevent any damage from electrostatic discharge (ESD). Proper ESD handling procedures must always be used when packing, unpacking or installing any ProDAQ module, ProDAQ plug-in module or ProDAQ function card:

- Ground yourself via a grounding strap or similar, e.g. by holding to a grounded object.
- Remove the ProDAQ module from its carton, preserving the factory packaging as much as possible.
- Discharge the package by touching it to a grounded object, e.g. a metal part of your VXIbus chassis, before removing the module from the package.
- Inspect the ProDAQ module for any defect or damage. Immediately notify the carrier if any damage is apparent.
- Only remove the module from its antistatic bag if you intend to install it into a VXI mainframe or similar.

When reshipping the module, use the original packing material whenever possible. The original shipping carton and the instrument's plastic foam will provide the necessary support for safe reshipment. If the original anti-static packing material is unavailable, wrap the ProDAQ module in anti-static plastic sheeting and use plastic spray foam to surround and protect the instrument.

2.2 Installing the ProDAQ 3261 PCI Express Interface Card

To install the ProDAQ 3261 PCI Express Interface Card into your computer, you need first to switch it off, open its enclosure and locate a free PCI Express slot. The PCI Express slot needs to be either a x4, x8 or x16 slot to allow installation of the ProDAQ 3261 card (see Figure 1 – PCI Express Slot Types). The card cannot be installed in a x1 slot often found in older motherboards.

If you use multiple PCI Express slots of the types x4, x8 or x16 on your motherboard, make sure that the total amount of PCI Express lanes used is still supported by your chip-set. In some combinations slots may revert to x1 slots even while providing more connections on the connector. See your motherboard or PC documentation for details.

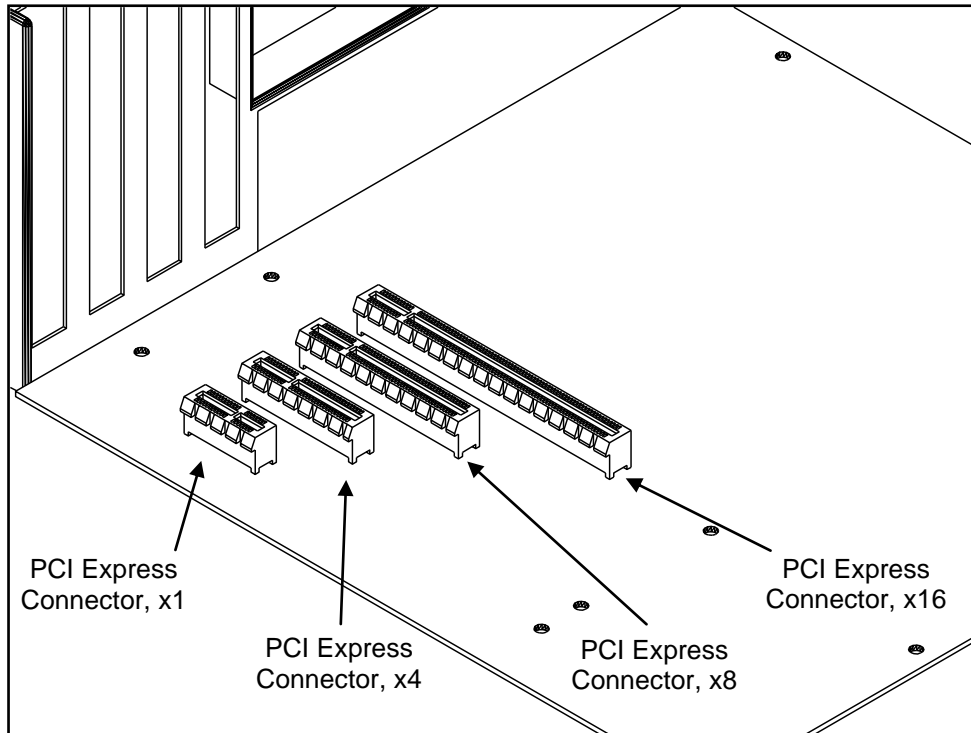


Figure 1 - PCI Express Slot Types

To install the ProDAQ 3261 card into your computer, slide it into the slot chosen and use a screw or the retention feature provided by your computer to fix the card's I/O bracket in place:

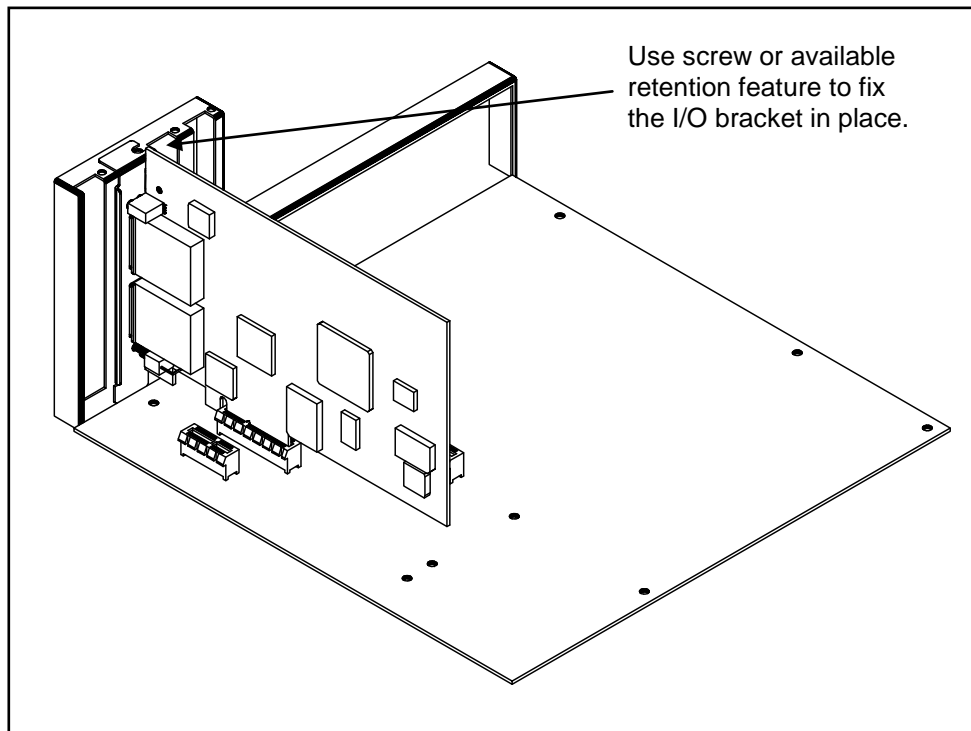


Figure 2 - ProDAQ 3261 Installation

When you restart your computer after installing the ProDAQ 3261 Interface Card, the card will be visible in the device manager as “Other PCI Bridge Device” (see Figure 3)

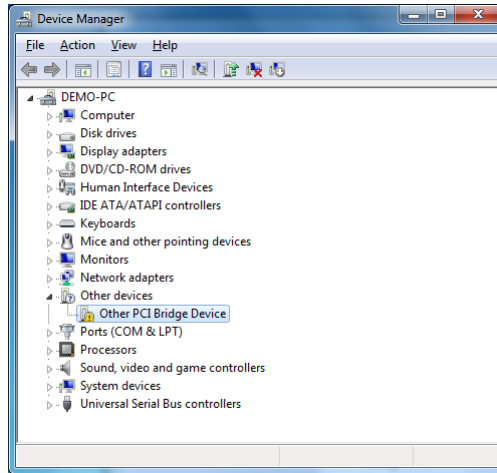


Figure 3 - Device Manager Display after 3261 Installation

If you are encountering problems starting your computer after installing the 3261, you should check whether the PCI Express switch on the card could successfully establish a link to the PCI Express root complex in the computer. The LED indicating the link is located on the rear I/O bracket of the ProDAQ 3261 (see Figure 4, “Host Link”). If it is off, the PCI Express switch located on the 3261 was not able to establish the PCI Express link to the host. If it is blinking, a link with a speed of 2.5 GT/s (GEN1) was established, if it is on constantly, a link with a speed of 5 GT/s (GEN2) was established.

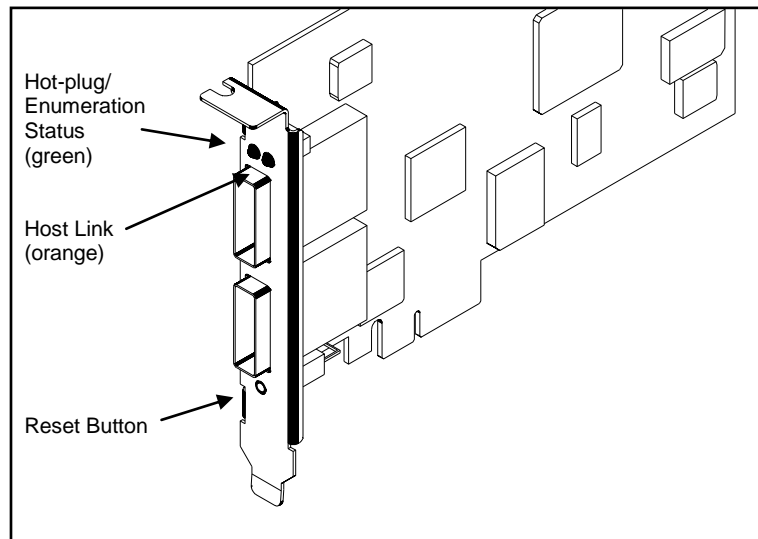


Figure 4 – ProDAQ 3261 Status LEDs

Common problems after installing the ProDAQ 3261 are caused mainly by the way motherboard manufacturers have implemented the Spread Spectrum Clock for the PCI Express and the usage of PCI and PCI express resources in your computer.

In the following table you may find a description of the error you are encountering and some recommendations to solve the problem. If none of the descriptions describe your problem and/or none of the recommendations solve the problem, please contact our support team at “support@bustec.com” for further assistance.

Error Description	Host Link Status	Recommendation
PC does not boot, no access to BIOS	LED is off (no link)	Remove 3261, boot your PC to access the BIOS settings, change setting for the spread spectrum clock (also called “SSC”) in the BIOS (disable it if it was enabled or vice versa)
	LED is on or blinking (link established)	Remove all unnecessary peripheral or onboard devices to reduce resource usage on the PCI / PCI Express busses. Start by removing expansion cards, if the PC does still not boot, remove unnecessary motherboard devices by disabling them in the BIOS.
PC boots normal, but no new “Other PCI bridge device” visible in the device manager	LED is off (no link)	Change setting for the spread spectrum clock (also called “SSC”) in the BIOS (disable it if it was enabled or vice versa)
	LED is on or blinking (link established)	Remove all unnecessary peripheral or onboard devices to reduce resource usage on the PCI / PCI Express busses. Start by removing expansion cards, if the PC does still not boot, remove unnecessary motherboard devices by disabling them in the BIOS.

The reset button allows you to boot the computer with a default setting for the ProDAQ 3261 once you may have changed its configuration (see chapter 3.1). To do so, keep it pressed while rebooting your computer. Release the button once you hear the beep signaling the end of the POST phase of the BIOS boot process or when the operating system load process starts.

WARNING

Do not press the reset button on the ProDAQ 3261 during normal operation. To do so may damage the configurations stored on the card and may render it unusable.

2.3 Installing the VISA Library

The installation package for the Bustec VISA library installs all necessary drivers, libraries and applications onto your system to communicate to VXI instruments installed in VXIbus mainframe(s) connected via the ProDAQ 3030 PCI Express VXIbus Slot-0 Interface to the host PC.

Note

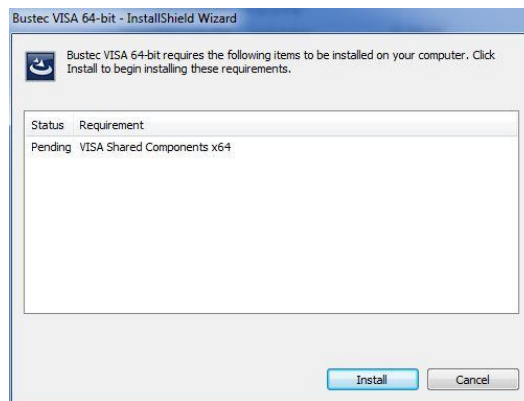
On Microsoft Windows XP®, Microsoft Windows VISTA® or Microsoft Windows 7® systems it is recommended to install the VISA library and hardware drivers from an account having administrator privileges.

To install it on your PC, do the following:

1. Apply power to your PC and boot your operating system. Close all open applications to allow for a safe installation of the new components.
2. Insert the driver CD provided with the module into your PC CD-ROM drive or, in case you downloaded the installation, extract the files from the archive downloaded into a directory on your hard drive.

To start the installation of the Bustec VISA, start the executable “setup.exe” from the CD or the directory you extracted the installation files into.

3. After startup, the VISA installation first checks whether the VISA Shared Components are installed on your machine. If required, it will ask you to install them first:



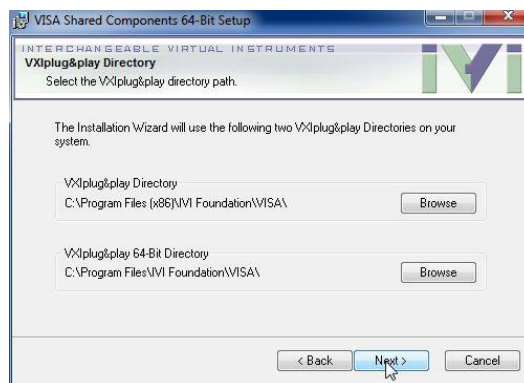
4. After selecting “Install”, the installation of the VISA Shared Components will start:



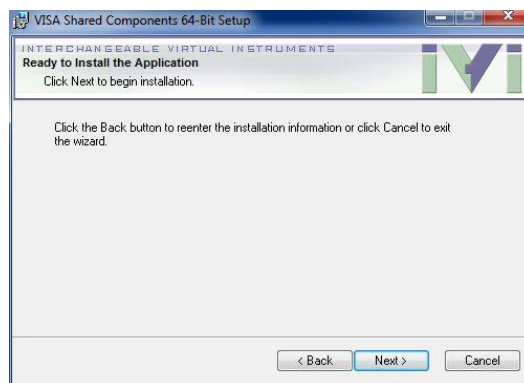
5. Select “Next” to view the license agreement:



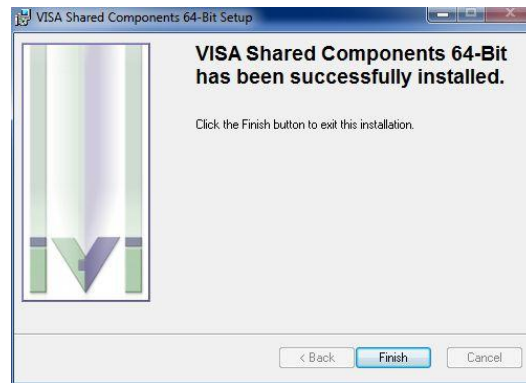
6. After accepting the license agreement and selecting “Next”, the VISA Shared Components installation will ask you for the root directory of the VXIplug&play framework installation. It is highly recommended to use the default values.



After selecting “Next”, the VISA Shared Components installation is ready to start the installation process.

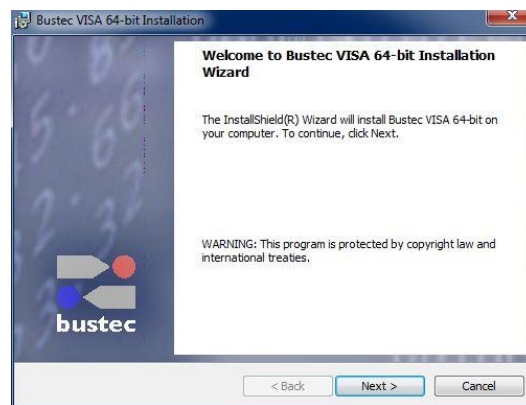


7. The installation will now create the required directory structure in the location(s) you have chosen in step 6, copy the common components to your hard drive and register them.

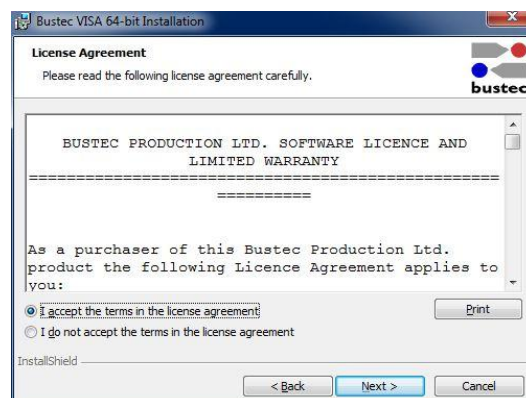


Select “Finish” to exit the VISA Shared Components installation and return to the Bustec VISA installation.

8. After finishing the VISA Shared Components installation the Bustec VISA installation welcome screen will be shown.



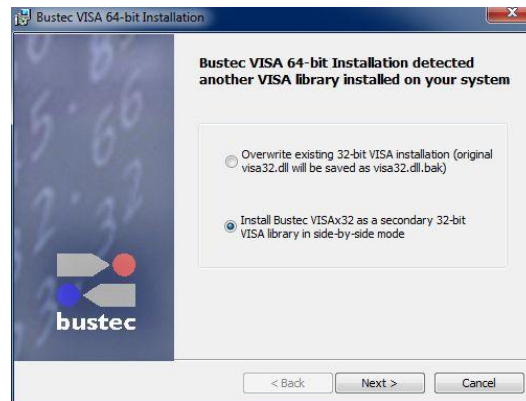
9. Select “Next” to review the license agreement for the Bustec VISA library. You will need to accept the terms of the agreement by selecting “Yes” to be able to install the Visa library.



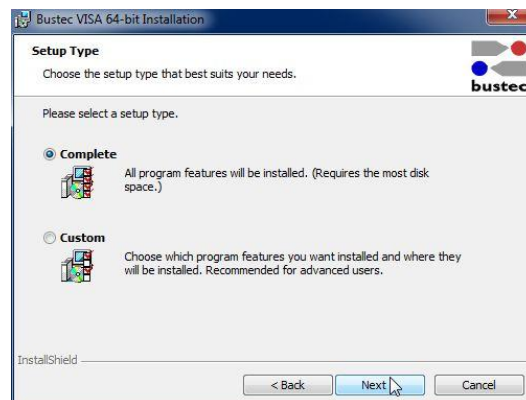
If needed, a copy of the license agreement can be printed by selecting the “Print” button.

10. On 64-bit platforms such as Windows XP 64-bit, Windows VISTA 64-bit and Windows 7 64-bit, both the 32-bit version (visa32.dll) and the 64-bit version (visa64.dll)

of the VISA library are installed. As the common access mechanism via the VISA router (see the Bustec VISA User Manual) is not defined for the 32-bit version of the VISA library, it is still necessary to install one 32-bit version as the primary VISA and all others as secondary VISAs. In case the Bustec VISA 64-bit installation detects that a 32-bit version of the VISA library is already installed on your system, it will allow you to either overwrite the existing VISA (making the Bustec VISA the primary VISA) or to install the Bustec VISA as buvisa32.dll as a secondary VISA.

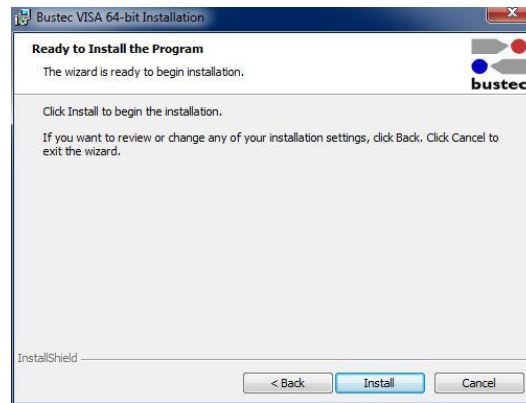


11. In the next step you can choose between a standard or custom installation. The standard installation will make a full install of all components, drivers and libraries coming with the Bustec VISA installation. If you do not want to install certain parts or drivers, choose the custom installation and select/deselect the parts to install in the list shown.



Currently the selection can be made to either include or exclude the 32-bit version of the VISA library and tools, the 64-bit version of the VISA library and the 64-bit kernel driver, which are used for both the 32- and 64-bit version of the VISA. After finishing your selection, select again “Next” to advance to the next step.

12. Now the installation wizard is ready to install the files on your machine.



Select "Install" to start the installation.

13. After the installation is finished, the wizard will show the completion page, where you can select whether the configuration utility shall automatically be launched after you exit the installation. Check or uncheck this box and then select "Finish" to exit the installation.

The ProDAQ 3261 should now be visible in the device manager as a bridge device for the ProDAQ 3030 PCI Express VXIbus Slot-0 Controller:

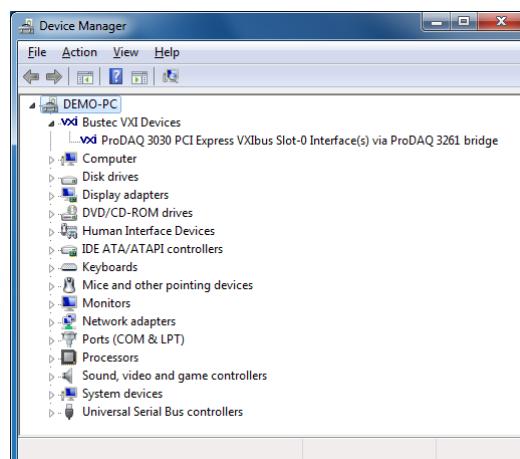


Figure 5 - Device Manager Display after Driver Installation

Note:

As the VISA Library is not designed to handle run-time power management events, you will need to prevent your computer to enter the standby (sleep) or hibernate power states while working with the ProDAQ 3261/ProDAQ 3030. To do so, open your control panel, select "Power Options" and change the settings for the "System standby" and "System hibernates" modes to "Never".

2.4 Installing the ProDAQ 3030 Interface

To prevent damage to the ProDAQ module being installed, remove the power from the mainframe or switch it off before installing.

Insert the module into the mainframe using the guiding rails inside the mainframe as shown in Figure 10. Push the module slowly into the slot until the modules backplane connectors seat firmly in the corresponding backplane connectors. The top and bottom of the front panel of the module should touch the mounting rails in the mainframe.

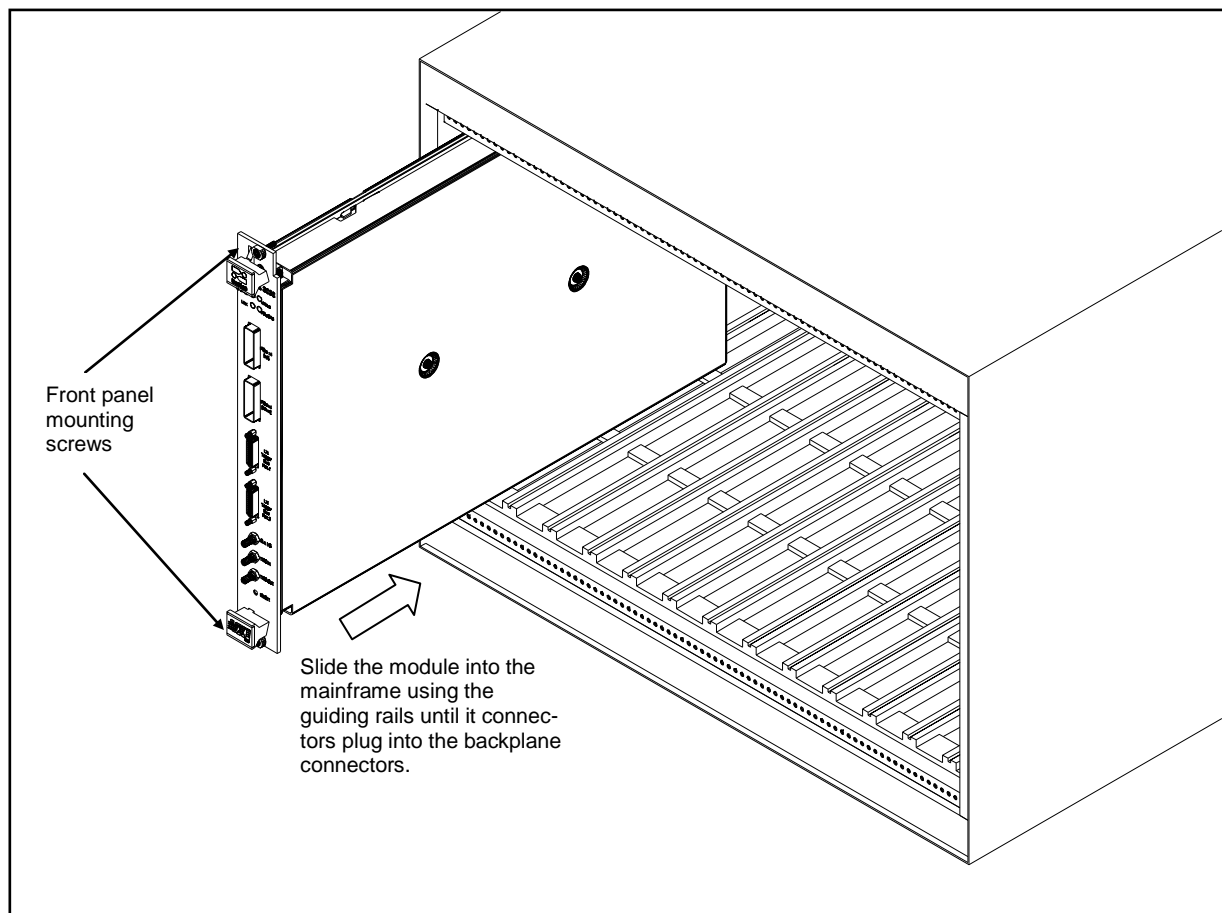


Figure 6 - Installing the ProDAQ 3030 into a C-Size Mainframe

Note:

To ensure proper grounding of the module, tighten the front panel mounting screws after installing the module in the mainframe.

Note:

The ProDAQ 3030 PCI Express VXIbus Slot-0 Interface does not extend the VXI backplane between mainframes in a multi-mainframe system. This means that devices sharing the VXI local bus must be installed in the same mainframe.

2.5 Connecting the ProDAQ 3030 to the Host Computer

To connect the ProDAQ 3030 PCI Express VXIbus Slot-0 Interface to your computer, use a ProDAQ 8034 PCI Express Cable. The cable is equipped with a connector featuring a push/pull lock mechanism. To connect the ProDAQ 3030 to your host computer, plug one end of the 8034 cable into the upper cable connector socket of the ProDAQ 3261 installed in your computer:

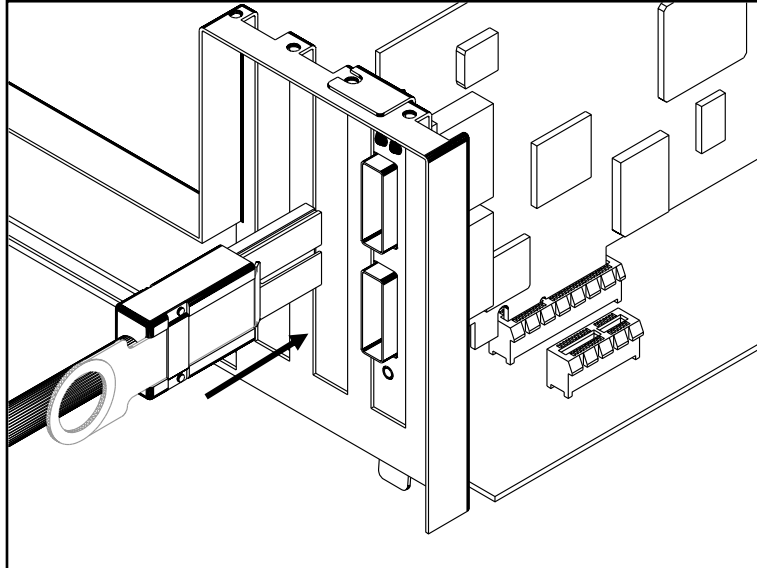


Figure 7 - Connecting the PCI Express Cable to the ProDAQ 3261

Push the connector in firmly until the lock mechanism holds the connector in place. To unplug the connector, use the pull to release the lock mechanism and slide the connector out of the socket:

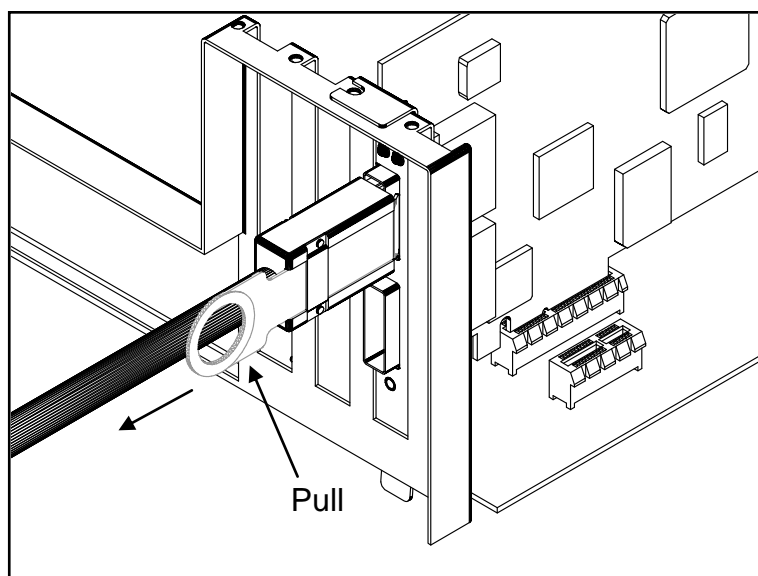


Figure 8 - Unplugging a PCI Express Cable Connector

Connect the other end of the ProDAQ 8034 PCI Express cable to the uplink port of the ProDAQ 3030 installed into your VXI mainframe:

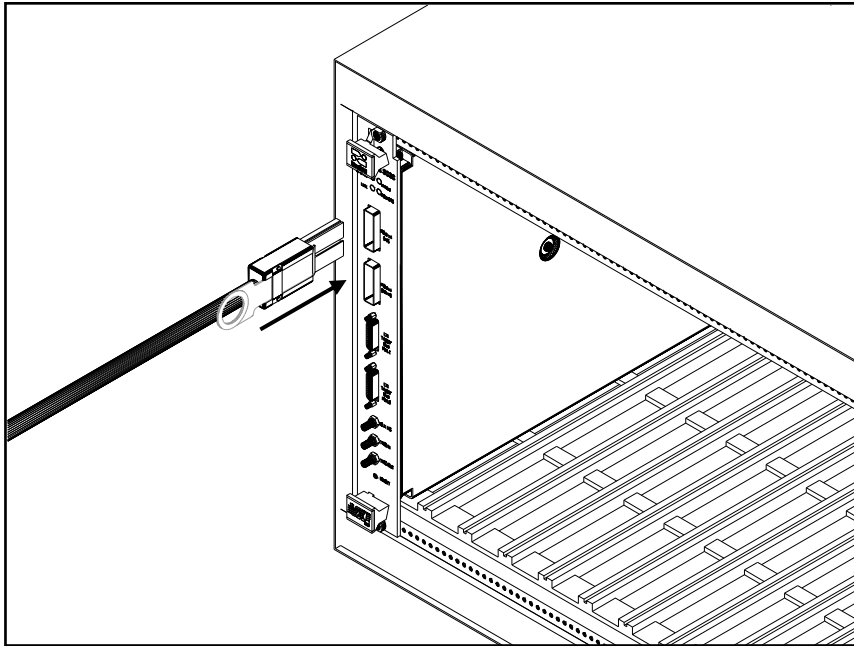


Figure 9 - Connecting the (first) ProDAQ 3030

If you want to connect multiple ProDAQ 3030 to the same host computer, connect additional ProDAQ 3030 by daisy-chaining the downlink port of the already connected 3030 to the uplink port of the next 3030:

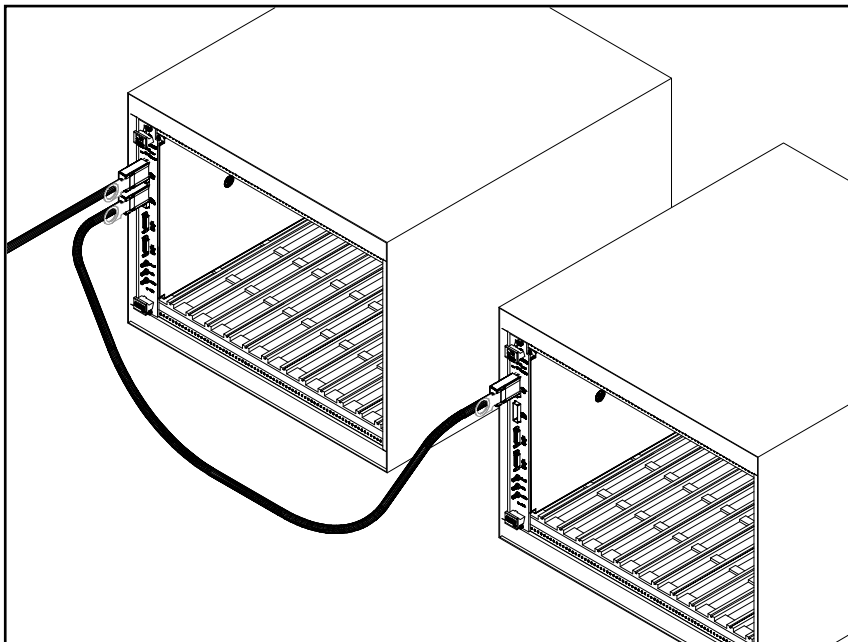


Figure 10 - Daisy-chain Configuration

Note:

In a daisy-chain configuration, each ProDAQ 3030 with devices connected to the downlink port must be powered on to allow the host PC access to these devices.

Note:

Due to the hot-plug capabilities of the 3261/3030 system, the PCI Express cables connecting the host computer to the mainframe(s) can be plugged and unplugged without powering off the VXI mainframe(s). Yet, if in a daisy-chain configuration a cable to a ProDAQ 3030, which has other 3030 connected to its downlink port, is unplugged and plugged in again without power cycling the mainframes, all systems on the downlink side will not be accessible anymore and will need to be power-cycled or reset.

Every time a connection is initiated by plugging in a cable or power-cycling a mainframe, the processor on the ProDAQ 3261 will establish the communication to the connected devices and enumerate them. During this time, the “Hot-plug/Enumeration Status” LED on the rear I/O bracket of the ProDAQ 3261 will blink. It will return to its default “on” state once all devices are enumerated. As a result, a PCI Express “Link” is established between the devices. The status of the link between the devices is indicated by LEDs on the front-panel of the ProDAQ 3030 (see Figure 24 and Figure 25):

Name	Color	Mode	Description
Link	Green	On	Device enumerated.
	Green	Blinking	Device not enumerated
PCIe SPD	Yellow	On	Link established, speed 5.0 GBit (GEN2)
	Yellow	Blinking	Link established, speed 2.5 GBit (GEN1)
	-	Off	no link

2.6 Assigning Interface Names

The VISA library uses interface names and numbers to access available hardware interfaces. In order to enable the VISA library to use a ProDAQ 3030 interface, which is connected to 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 this ProDAQ 3030 interface together with its serial number and will be used for this device whenever it is connected to this host.

To assign an interface name/number and configure the ProDAQ 3030, connect the uplink port to the host PC or to the downlink port of a ProDAQ 3030 which is already connected to a daisy chain configuration with your host computer and turn on the VXI mainframe.

From the Bustec VISA program group created during the installation of the VISA library, select “VISA Configuration Utility” (“Start” → “Programs” → “Bustec VISA” → “VISA Configuration Utility”). This will start the configuration tool for the VISA library.

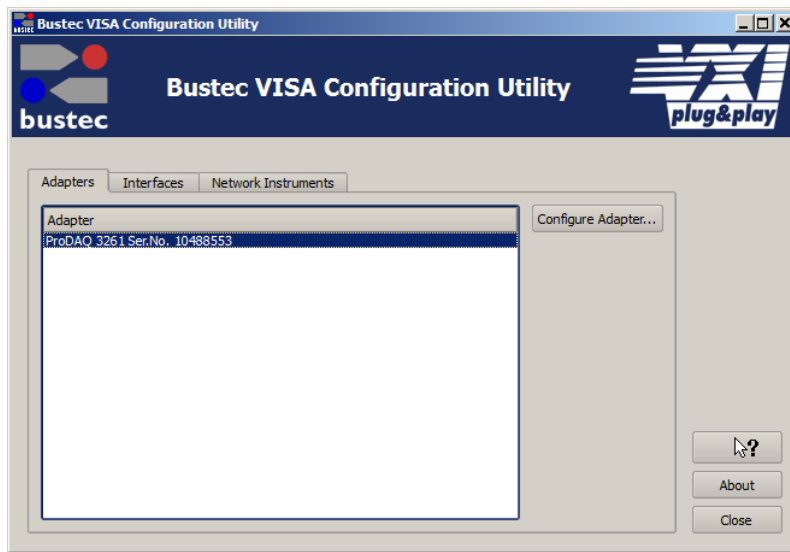


Figure 11 - VISA Library Configuration Utility

After start, it shows the list of adapter cards installed in your computer. Please check whether the ProDAQ 3261 you installed in the previous steps is visible. The ProDAQ 3261 is installed with a default configuration which will allow you to access the VXI instruments in your crate and should be sufficient for most applications. If your application has special requirements, you can change this configuration later by selecting the “Configure Adapter ...” button on the right (see 3.1).

To add a new interface, select the “Interfaces” tab and click “Add Interfaces”. A new dialog “Add New Interface” is shown with a list of unconfigured devices found in the system. ProDAQ 3030 interfaces appear as interfaces of the type “VXI” together with a description containing the serial number of the device.

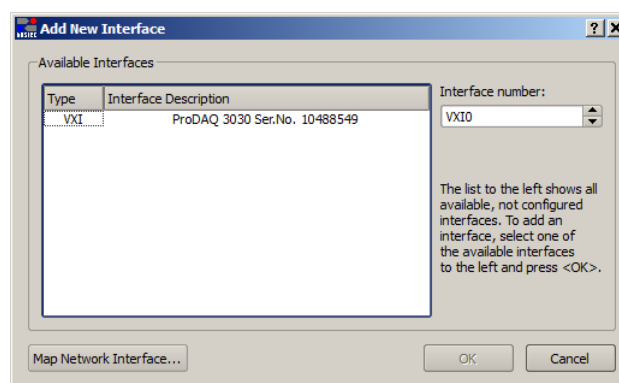


Figure 12 - Add New Interface Dialog

To configure and add a ProDAQ 3030 interface, select the entry for the device in the list, choose an interface number on the right side and select ‘OK’. The list of configured interfaces in the main dialog will now display the newly added interface with its interface name and number:

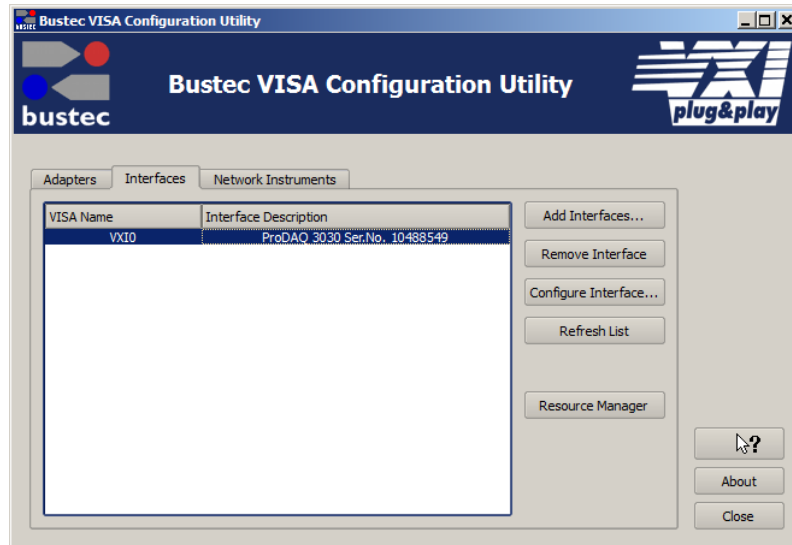


Figure 13 – Displaying known Interfaces

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

2.7 Verifying the Installation

Once you have completed the installation as described above, you can verify the installation by using the tools supplied with the VISA library and by installing VXI *plug&play* drivers and running the instruments soft front panels or by running your application.

2.7.1 Running the VXIbus Resource Manager

Before you can use the VISA library to communicate to the instruments, you must run the resource manager. The resource manager searches for VXI GPIB instruments connected to your PC and configure them. To run the resource manager, select “VXIbus Resource Manager” from the Bustec VISA program group in the start menu (“Start” → “Programs” → “Bustec VISA” → “VXI Resource Manager”) or click on the desktop icon.

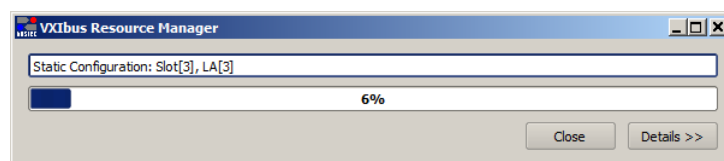


Figure 14 - Running the VXI Resource Manager

After start, the resource manager will wait a defined time to allow all devices to complete their initialization and self-test (if available). Then he 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.

To configure these parameters, start the configuration utility by selecting the "VISA Configuration Utility" entry in the Bustec VISA program group in the start menu ("Start" → "Programs" → "Bustec VISA" → "VISA Configuration Utility"). In the configuration utility, select the "Interfaces tab" and then the "Resource Manager" button on the right hand side (see Figure 13). This will show the configuration dialog for the resource manager, which allows configuring the output file destination and initial delay.

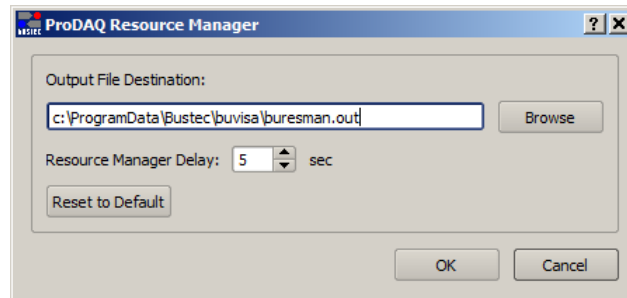


Figure 15 - Resource Manager Configuration

Note

To run the resource manager for a VXI mainframe connected via a ProDAQ 3030 PCI Express VXIbus Slot-0 Interface to your computer, the ProDAQ 3030 must be located in the left most slot (slot "0") of the VXI mainframe and must be configured to use the logical address 0 (00_{hex}).

Note

Although the ProDAQ 3030 PCI Express VXIbus Slot-0 Interface can be hot-plugged, 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/disconnected to/from your computer or power-cycled while being connected to 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.

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3. System Configuration

The ProDAQ 3261 adapter cards and the ProDAQ 3030 slot-0 interfaces are shipped with a default configuration targeted to work with most applications. It is recommended to apply changes to this configuration only if your application requires them, as some configurations might render your system unusable.

3.1 Configuring the ProDAQ 3261 Adapter Card

The ProDAQ 3261 adapter card makes it possible to hot-plug/hot power-cycle ProDAQ 3030 interfaces by providing a fixed PCI Express endpoint to the host system and translating all accesses to the interfaces through this endpoint. Depending on your application and the way it accesses the VXIbus instruments, you may need to optimize the configuration of this endpoint and the translation performed.

3.1.1 Theory of operation

The ProDAQ 3261 interface card allocates a fixed area in the host computers address range and maps it to the address space used on the external PCI Express busses to give the host computer access to the devices – the ProDAQ 3030 interfaces - there. Each of the ProDAQ 3030 then uses its part of the address space on the external PCI Express busses to map parts of the VXIbus address spaces into it – thus giving the host computer access to the VXIbus instruments.

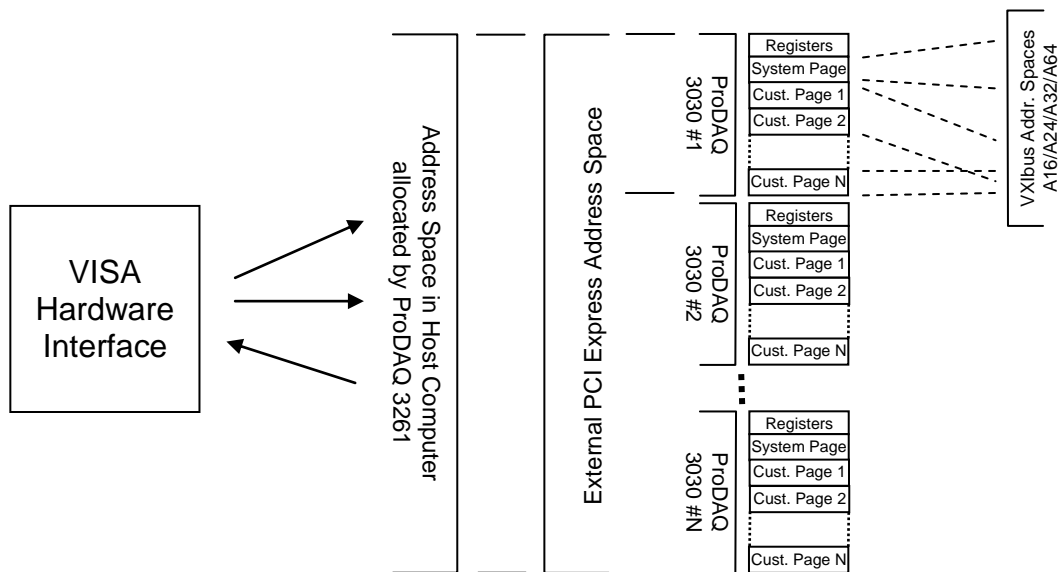


Figure 16 - ProDAQ 3261/ProDAQ 3030 System Overview

To configure the system correctly, it is necessary to understand how the application uses the VISA library to access the VXIbus instruments.

The VISA library offers a number of different ways to access VXIbus instruments. From the point of view of the hardware interface, they fall into three categories:

1. Single register accesses using VISA library functions

This are all accesses to VXIbus instruments using VISA library functions like `viRead()` / `viWrite()` and all functions based on them (e.g. `viWriteAsync()`, `viPrintf()`, `viQueryf()`, etc.), as the word serial protocol is implemented by reading/writing to the communication registers of a message based device; and all `viInXX()` / `viOutXX()` functions.

2. Single register accesses using mapped address areas

This are all accesses performed directly to address spaces of VXIbus instruments mapped into the host computers address space by using the VISA library functions `viMapAddress()` / `viMapAddressEx()`; either by using the VISA library functions/macros `viPeekXX()` / `viPokeXX()` or direct program access (e.g. by using pointers).

3. Block moves using VISA library functions

last not least are all access moving blocks of data using the VISA library functions like `viMoveInXX()`, `viMoveOutXX()`, `viMove()`, etc.

To perform accesses of the types 1 and 3 (single accesses and block moves using VISA library functions), the ProDAQ 3261/ProDAQ 3030 driver inside the VISA library needs access to the ProDAQ 3030 registers and the system page. The system page is a relatively small area which is used to access directly the VXIbus address spaces under driver control, while the registers are used for configuration and for example to set up DMA machines for the block moves etc. These two spaces need to be mapped by the ProDAQ 3261 into the host address space (see Figure 16).

To perform accesses of type 2 (accesses using mapped address spaces) each ProDAQ 3030 has additional address pages, which can be used separately or combined to map portions of the VXIbus address space A16/A24/A32 and A64. The more PCI Express address space per ProDAQ 3030 is allocated, the more custom pages for mapping address space using `viMapAddress()` and/or `viMapAddressEx()` are available.

To allow full VISA functionality, the default configuration PCI Express endpoint of the ProDAQ 3261 adapter by default allocates and maps not only enough address space to allow access to these two spaces for the maximum number of ProDAQ 3030 interfaces to be connected to each of its ports, but also some extra space to allow further mapping via `viMapAddress()` and/or `viMapAddressEx()`.

3.1.2 The Configuration Dialog

To configure a ProDAQ 3261 adapter, you must run the VISA Configuration Utility. From the Bustec VISA program group created during the installation of the VISA library, select “VISA Configuration Utility” (“Start” → “Programs” → “Bustec VISA” → “VISA Configuration Utility”). This will start the configuration tool for the VISA library.

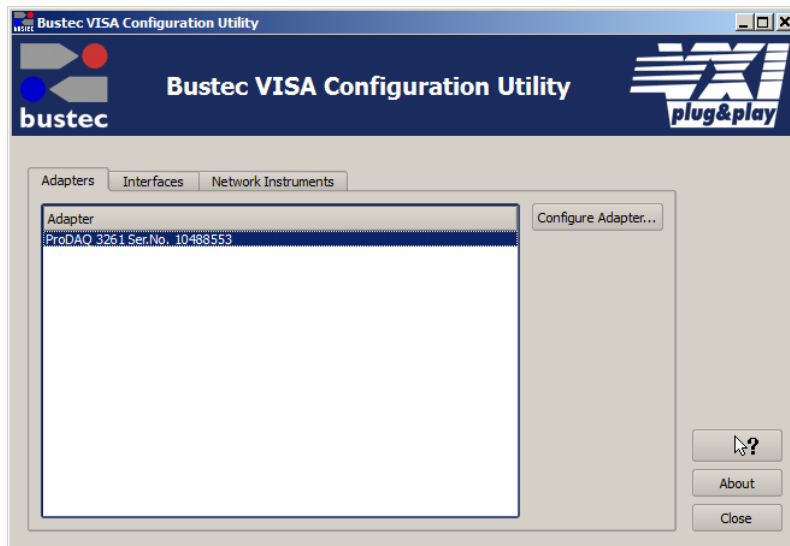


Figure 17 - VISA Library Configuration Utility

After start, it shows the list of adapter cards installed in your computer. Select the adapter in the list you want to configure and then click on the “Configure Adapter ...” button on the right side.

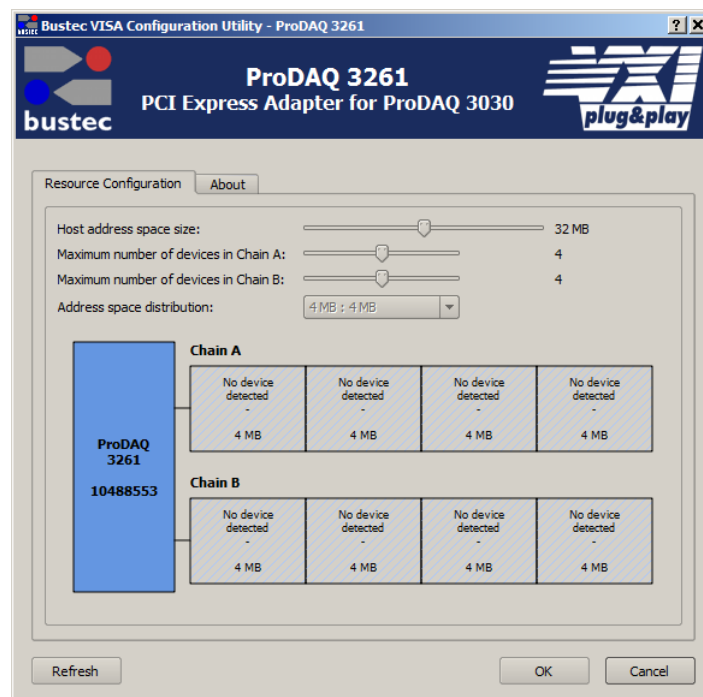


Figure 18 - Adapter Configuration Dialog

The dialog shows the configuration of the address space allocation performed by the ProDAQ 3261 and its distribution between the two possible PCI Express chains and the ProDAQ 3030 interfaces in them. The top slider (“Host address space size”) shows the total amount of memory allocated by the ProDAQ 3261 in the host address space for being mapped onto the external PCI Express address space, while the two sliders below allow configuring the number of ProDAQ 3030 interfaces which are possible to connect to each chain. The actual configuration is shown graphically as list of actual devices detected (showing the interface model and serial number; see Figure 19, Chain “A”, first two devices) or reserved address spaces per chain (displaying “No device detected”). All ProDAQ 3030 in one chain have to have the same amount of memory allocated; it is not possible to allocate in the same chain different address ranges per ProDAQ 3030. But it is possible to allocate different sizes of address ranges for the devices in chain “A” and chain “B”, so the last parameter “Address space distribution” allows you to select which chain shall receive which amount of the address space selected by the top slider in case the selected address space size and number of devices in chain “A” and “B” allow for multiple combinations.

The default configuration (see Figure 18) reserves 32 Mbytes in the host address space and allows connecting up to four ProDAQ 3030 interfaces per chain at the same time. Each ProDAQ 3030 interface then has its own address space of 4 Mbytes allocated inside this space to allow the mentioned general access and some mapping. In fact, the general access uses only 64 Kbytes out of the reserved space per ProDAQ 3030, so that using the default configuration allows mapping up to 4032 Kbytes per VXIbus crate of the instruments address spaces into the application. To increase this size to allow bigger VXIbus address spaces to be mapped into the application, you can now either move the top slider to the right, so that the ProDAQ 3261 adapter allocates more memory which is then distributed to the ProDAQ 3030 interfaces, or move the bottom two sliders to the left to decrease the number of ProDAQ 3030 which can be connected to each port of the ProDAQ 3261. To decrease the size and/or number of devices per chain, move the sliders to the left.

The size of the allocated address spaces for both the host address space and the ProDAQ 3030 address space is selectable between 4 and 256 Mbytes (4, 8, 16, 32, 64, 128 or 256 Mbytes), so that it is possible to select a variety of combinations to adapt for any given situation. As the amount of host address space which can be allocated by the ProDAQ 3261 depends on the actual hardware configuration of the host PC and its BIOS settings, it is recommended to start off by calculating the amount of address space mapping needed for the overall system and choosing the minimal amount of address space allocation in the host which allows this.

Figure 19 and Figure 20 show two examples with modified configurations. In the configuration shown in Figure 19 the ProDAQ 3261 will allocate 64 Mbytes of the host address space to map it to the ProDAQ 3030 interfaces in the external PCI Express address space. Because the number of devices per chain is set to allow a maximum of three ProDAQ 3030 per chain, the 64 Mbytes can be either distributed evenly into 8 Mbytes per ProDAQ 3030; or one chain can be selected to receive a bigger portion of the address space so that the distribution becomes one chain with three ProDAQ 3030 each having 16 Mbytes allocated for and the other chain with three ProDAQ 3030 each having 4 Mbytes allocated for.

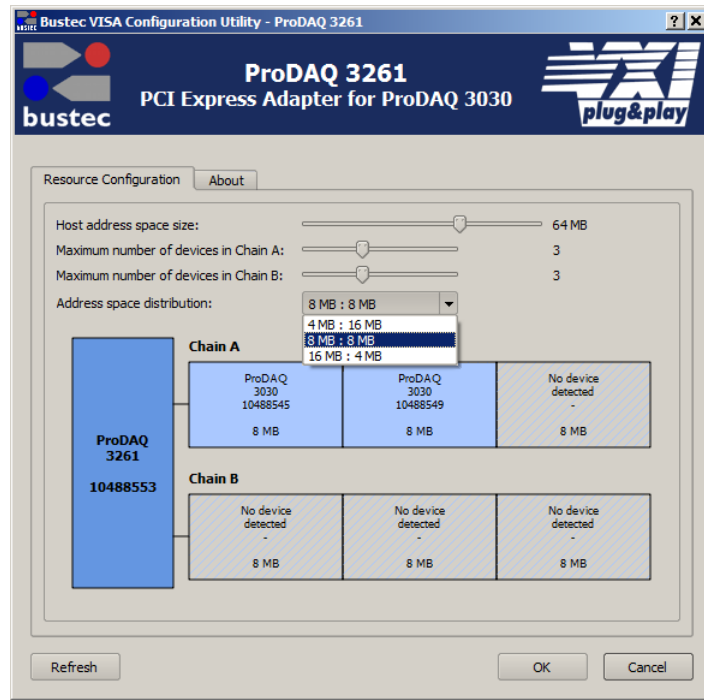


Figure 19 - Adapter Configuration with three Devices and 8 Mbytes Address Space per Device

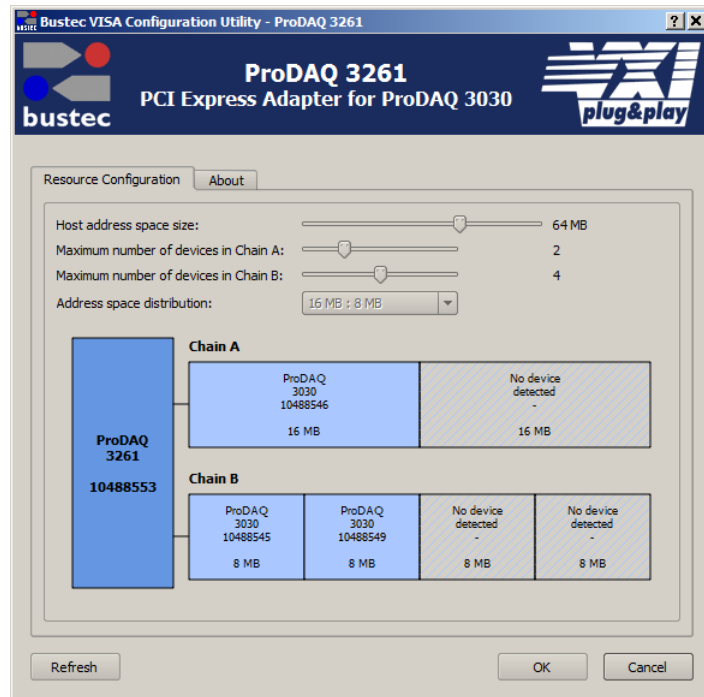


Figure 20 - Adapter Configuration with different Number of Devices and Address Space Size per Chain

3.1.3 Applying the new Configuration

To apply the new configuration, click the “Ok” button on the dialog. If you have made changes to the host address space size, you will need to also close the Configuration Utility and reboot the host computer. After the restart you can use the adapter configuration dialog again to check the existing configuration. If you have only changed the number of ProDAQ 3030 interfaces per chain or the memory distribution between the chains, you only need to re-run the VXIbus Resource Manager after closing the Configuration Utility.

If you have increased the “Host address space size”, the BIOS of the host computer may not longer be able to fit the ProDAQ 3261 together with the other PCI / PCI Express resources in the host computers address space. As a result the computer might not longer boot or, if the computer still boots as normal, the ProDAQ 3261 may not longer be visible. In this case you can use the reset button on the ProDAQ 3261 to boot the host computer with a minimal configuration.

Keep it pressed while rebooting the computer. Release the button once you hear the beep signaling the end of the POST phase of the BIOS boot process, or, when this signal is not available, latest when the operating system starts its load process.

WARNING

Do not press the reset button on the ProDAQ 3261 except during boot time. Using the button during normal operation might damage the configurations stored and render the card unusable.

The minimal configuration the ProDAQ 3261 uses when booted while the reset button is pressed can only be used to enable the computer to boot correctly. To restore your system into a working condition, you must use the configuration utility again to assign the configuration used before or any other known working configuration and reboot again.

WARNING

The minimal configuration used when booting the system while pressing the reset button on the ProDAQ 3261 cannot be used for normal operation. A known good configuration needs to be assigned and the computer rebooted before continuing.

3.2 Configuring the ProDAQ 3030 Interface

The ProDAQ 3030 PCI Express VXIbus Slot-0 Interface has a number of characteristics that can be configured with the configuration utility. The settings are stored together with the device name/number and the serial number on the host system and applied whenever the device is connected to the host system and the resource manager is executed.

To configure the ProDAQ 3030, select the device you want to configure in the list and select “Configure Interface”. The three tab panels of the configuration dialog allow configuring the different parts of the interface:

VXIbus	Configures various parameters used by the ProDAQ 3030 when accessing the VXIbus.
LXI Triggers	Configures the routing of the TTL backplane trigger lines to/from the front panel LXI trigger bus.
Front Panel I/O	Configures the routing of VXIbus clock and trigger lines to/from the front panel connectors.

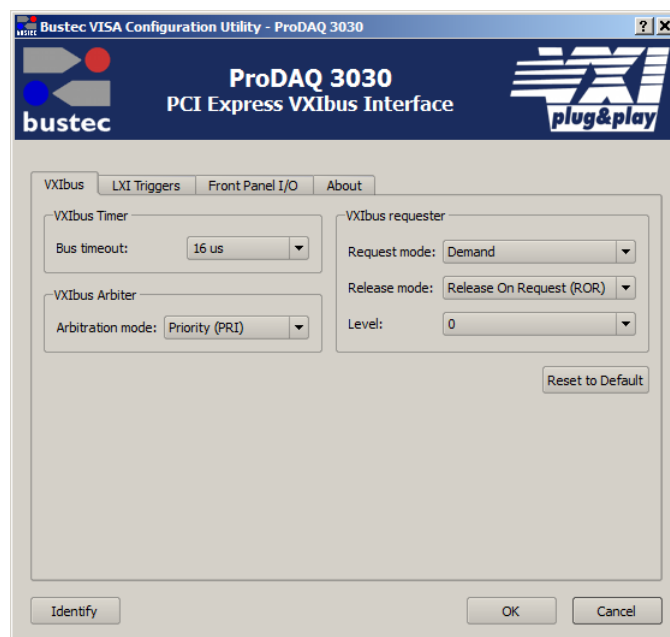


Figure 21 - The ProDAQ 3030 Configuration Dialog

To store the altered configuration, select “OK”. “Cancel” closes the dialog without altering the stored configuration.

3.2.1 Configuring the VXIbus Access

To configure the VXIbus access of the ProDAQ 3030 interface selected, select the tab “VXIbus” in the configuration dialog window (see Figure 18). The configurable parameters are:

Bus Timeout	The time the on-board times needs to expire once a VXI-bus access by the 3030 is started. If it expires, a VXIbus slave did not respond correctly and a bus error is generated. Possible values are: 16 μ sec, 32 μ sec, 64 μ sec, 128 μ sec, 256 μ sec, 512 μ sec, 1025 μ sec and 2048 μ sec.
Arbitration Mode	Selects the bus arbiter mode. Possible values are: "PRI" (Priority), "SGL" (Single) and "RRS" (Round Robin).
Request Mode	Sets the request mode of the ProDAQ 3030. Possible values are "Demand" or "Fair".
Release Mode	Selects the release mode for the ProDAQ 3030. Possible values are "ROR" (Release on Request) or "RWD" (Release when Done).

3.2.2 Configuring the LXI Trigger Bus (-AB version only)

To configure the front panel LXI-compatible LVDS Trigger bus, select the "LXI Triggers" tab in the ProDAQ 3030 configuration dialog.

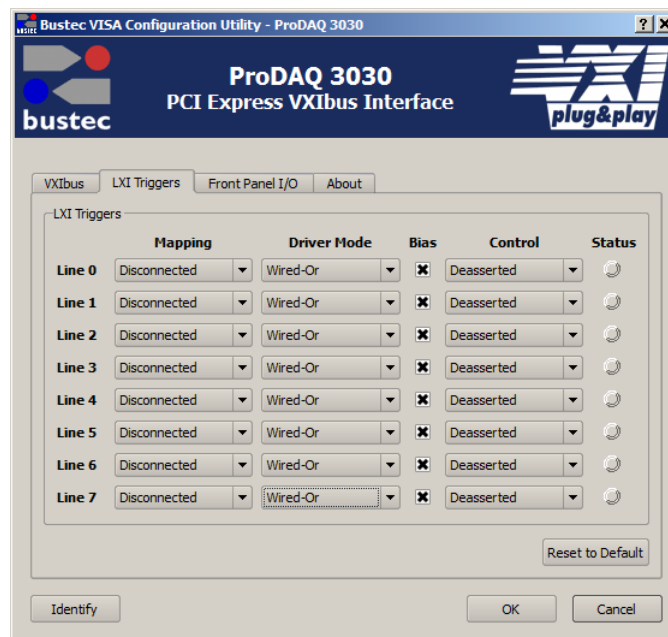


Figure 22 - LXI Trigger Configuration

The parameters for each trigger line are:

Mapping	Selects the direction in which the VXIbus TTL trigger lines are mapped to the front panel LXI trigger lines. Possible values are: "Disconnected", "LXI -> TTL" and "TTL -> LXI".
---------	--

Driver Mode	Selects the operation mode of the LXI trigger bus drivers. The driver mode can be either “Disabled”, “Driven” or “Wired-Or”.
Bias	When in wired-or mode, the driver can be set to provide the bias for all connected drivers. Check the checkbox to enable bias generation, uncheck the box to disable bias generation.

In addition to configuring, the dialog allows to control the LXI trigger lines and to monitor their status. Via the “Control” selection the lines can be individually asserted or de-asserted. The Status LEDs show the actual status of the corresponding line. The status is updated every 0.5 s.

3.2.3 Configuring the Front Panel I/O

The ProDAQ 3030 PCI Express VXIbus Slot-0 Interface supports the synchronization of multi-mainframe systems via shared system clocks (CLK10) and trigger lines. To configure the front panel input and output signals, select the “Front Panel I/O” tab on the right hand side of the configuration utility window (see Figure 23).

If the ProDAQ 3030 is located in the left most slot (slot “0”) of a VXIbus mainframe, it can be configured to either receive a CLK10 signal via the “CLK I/O” connector or to generate a CLK10 signal internally and share it with other mainframes via the “CLK I/O” connector on the front panel. The “CLK10 Source” control allows you to configure this:

Output	The ProDAQ 3030 uses the internal clock generator to generate the CLK10 clock signal for the VXIbus and additionally makes the clock signal available via the front panel “CLK I/O” connector.
Input	The internal clock generator is disabled and the ProDAQ 3030 uses the clock signal from the “CLK I/O” connector to generate the VXIbus CLK10 clock signal.

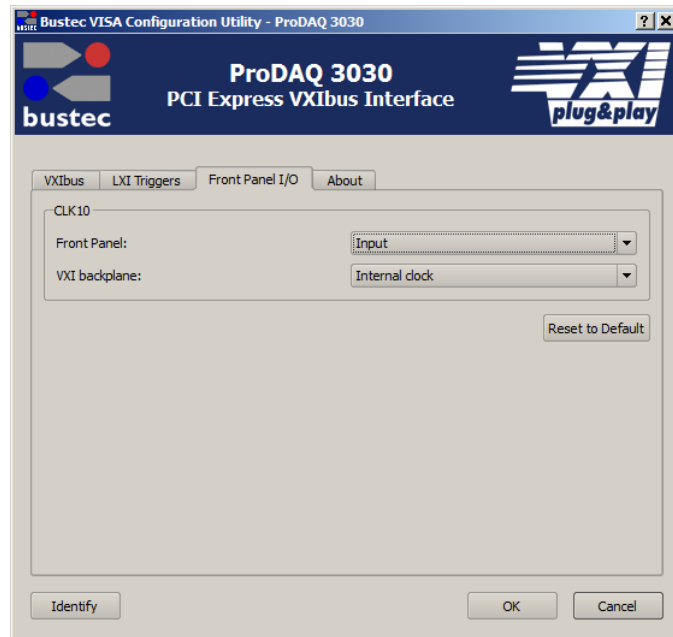


Figure 23 - Configuring the Front Panel I/O

4. VXIbus Register Map

The ProDAQ 3030 features a VXIbus standard register set of 64 bytes in the VXIbus A16 address space.

4.1 Address Map

All addresses are given in hexadecimal notation. Offset value is an offset in relation to the base address in A16 address space defined by Logical Address.

Offset	Name	Access	Description
0x00	ID	RO	ID Register
0x02	DevType	RO	Device Type Register
0x04	Status	RO	Status Register
	Control	WO	Control Register
0x08	MODID	RW	MODID Register

4.2 Register Description

ID (addr=0x00)

Bit	Access & Default	Description
15:14	RO 0x3	Device Class This field defines the module as a Register Based VXIbus device
13:12	RO 0x3	Address Space This field determines the addressing mode of the device's operational registers. A16 Only – 0x3
11:0	RO 0xE70	Manufacturer ID The Manufacturer ID is 0xE70 and has been assigned by the VXIbus Consortium. This number uniquely identifies the manufacturer of the device as Bustec Production Ltd.

DevType (addr=0x02)

Bit	Access & Default	Description
15:12	RO 0xB	Required Memory The board does not require any memory in A24, A32 or A64 address space.
11:0	RO 0xD6	Model Code This field contains the model code of the device. Due to the fact that the 3030 (0xBD6) operates in slot-0 mode only, bits 9-11 are set to zero to comply to rule C.4.18 of the VXIbus standard.

In slot 0 location the read returns 0xB0D6 indicating 0xBD6 model code.

In non slot-0 location the read returns 0xBBD6 indicating 0xBD6 model code.

Status (addr=0x04)

Bit	Access & Default	Description
15	RO 0x0	A32 Active This bit is hard coded to 0.
14	RO h	MODID* A one (1) indicates that the device is not selected via the P2 MODID line. A zero (0) indicates that the device is selected by a high state on the MODID line.
13	RO h	Slot 0 A one (1) indicates that the module is in the leftmost slot of a VXIbus system.
12	-	Reserved
11:4	-	Reserved
3	RO h	Ready A zero (0) indicates that the module has not completed its initialisation process and is executing its self-test.
2	RO h	Passed After the self-test completion (signalled by a one (1) in the Ready bit), the Passed bit indicates the status of the self-test. A one (1) indicates that the self-test has successfully completed. A zero (0) means that the device has failed its self-test.
1:0	-	Reserved

Control (addr=0x04)

Bit	Access & Default	Description
15	-	Reserved
14:2	-	Reserved
1	WO -	Sysfail Inhibit A one (1) written to this bit disables the device from driving the SYSFAIL* line.
0	WO -	Reset A one written to this field forces the device into a reset state. This, for example disables the MODID driver.

MODID (addr=0x08)

Bit	Access & Default	Description
15:14	-	Reserved
13	RW 0	Output Enable Writing a one to this bit enables the Slot 0 MODID driver. Writing a zero disables the MODID driver. This bit is cleared (zero) by device resets. When read, this bit indicates the state of the MODID lines: a one means the drivers are enabled, a zero indicates that the drivers are disabled.
12:0	RW x	MODID[12:0] – MODID lines Writing a one to any of these bits drives the corresponding MODID line high. Writing a zero drives the corresponding line low. Writing to these bits has only effect, if the Output Enable bit is set. When read, each of these bits indicates the actual level of the corresponding MODID line.

5. Specifications

5.1 Interface Characteristics

Interface Type	PCI Express (PCI Express External Cabling Specification)	
Number of Lanes	4	
Number of Ports	2 (1 x uplink, 1 x downlink)	
Hot-plug Support	Yes	
Connector Type	External PCI Express x4, 38 Circuits, 0.8mm Pitch	
Available Cable Assemblies	8034-Ax 8035-XX	PCI Express x4 External Cable PCI Express x4 Active Optical Cable

5.2 VXIbus Characteristics

5.2.1 General

Device Type	Register-Based
Size	C
Slots	1
Connectors	P1/P2
Slot-0 Functionality	Yes
Resource Manager Functionality	Yes

5.2.2 VXIbus Master

Address Space	A16, A24 and A32
Data Transfer Capabilities	D08, D16, D32, D16BLT, D32BLT, D64MBLT, 2eVME, 2eSST
BLT/MBLT Address Increment	Software Selectable
Bus Timer	16, 32, 64, 128, 256, 512 and 1024 μ s

5.2.3 VXIbus Slave

Address Space	A16
Size	64 Bytes
Base Address	0xC000 + Logical Address * 0x40
Data Transfer Capabilities	D08, D16 and D32

5.2.4 VXIbus Requester

Request Level	BR0 to BR3
Request Mode	“Fair” or “On Demand”
Release Mode	ROR, RWD

5.2.5 VXIbus Arbiter

Arbitration Mode	SGL, PRI, RRS
Arbitration Time-out	10 μ s

5.2.6 VXIbus Interrupts

Interrupt Handler	IRQ1 to IRQ7
Interrupter	IRQ1 to IRQ7
Interrupter Release Mode	ROAK

5.3 Front Panel I/O

5.3.1 CLK10 I/O

Input Level	TTL
Input Protection	-5V to +10V
Connector Type	SMB

Note

When using an external clock to supply the CLK10 signal, you must use a VXIbus standard compliant clock signal (10 MHz, equal or better than ± 100 ppm, 50% \pm 5% duty cycle).

5.3.2 Trigger In

Input Level	TTL
Active Edge	Software selectable
Trigger Detection	- Routable to VXIbus trigger lines TTL0 to TTL7, ECL0/1 - Interrupt on trigger detection
Input Protection	-5V to +10V
Connector Type	SMB

5.3.3 Trigger Out

Output Level	TTL
Active Level	Software selectable
Trigger Generation	- From VXIbus trigger lines TTL0 to TTL7, ECL0/1 - By software command
Connector Type	SMB

5.3.4 LXI Trigger Bus

Input Level	M-LVDS, LXI Class A Trigger Bus compatible	
Lines	8	
Routing	To/from VXIbus TTL Trigger Lines	
Input Trigger Pulse Width	minimum 20 ns	
Connector Type	25-pin Commercial Micro-D	
Mating Connectors	Molex	83424-9014
	ITT Cannon	MDSM-25SC-Z11
Available Cable Assemblies	8036-Ax	LXI Trigger Bus Cable
	8037-AA	LXI Trigger Bus Terminator, 100Ω diff.

5.3.5 Power Supply Loading

Current Consumption	<u>Voltage (V)</u>	<u>Current (mA)</u>
	+5V	2500 mA
	-5.2V	150
	Remark: Other voltages not utilized. Fiber optic cable conf. may require up to 1200 mA additionally on +5V.	
Total Power Consumption	13.3 W	

5.4 Miscellaneous

Operating Temperature	0° to 50° C
Storage Temperature	-40° to +70° C
Humidity	0-90%, non-condensing
Cooling	1 l/s @ 0.25mm H ₂ O
Weight	950 g

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6. Front Panel Controls

6.1 Status LEDs

Name	Color	Mode	Description
SYSFAIL	Red	On	Sysfail line is activated
VXIbus	Green	On	Device accesses the VXIbus
Link	Green	On	Device enumerated.
	Green	Blinking	Device not enumerated
PCIe SPD	Yellow	On	Link established, speed 5.0 GBit (GEN2)
	Yellow	Blinking	Link established, speed 2.5 GBit (GEN1)
	-	Off	no link

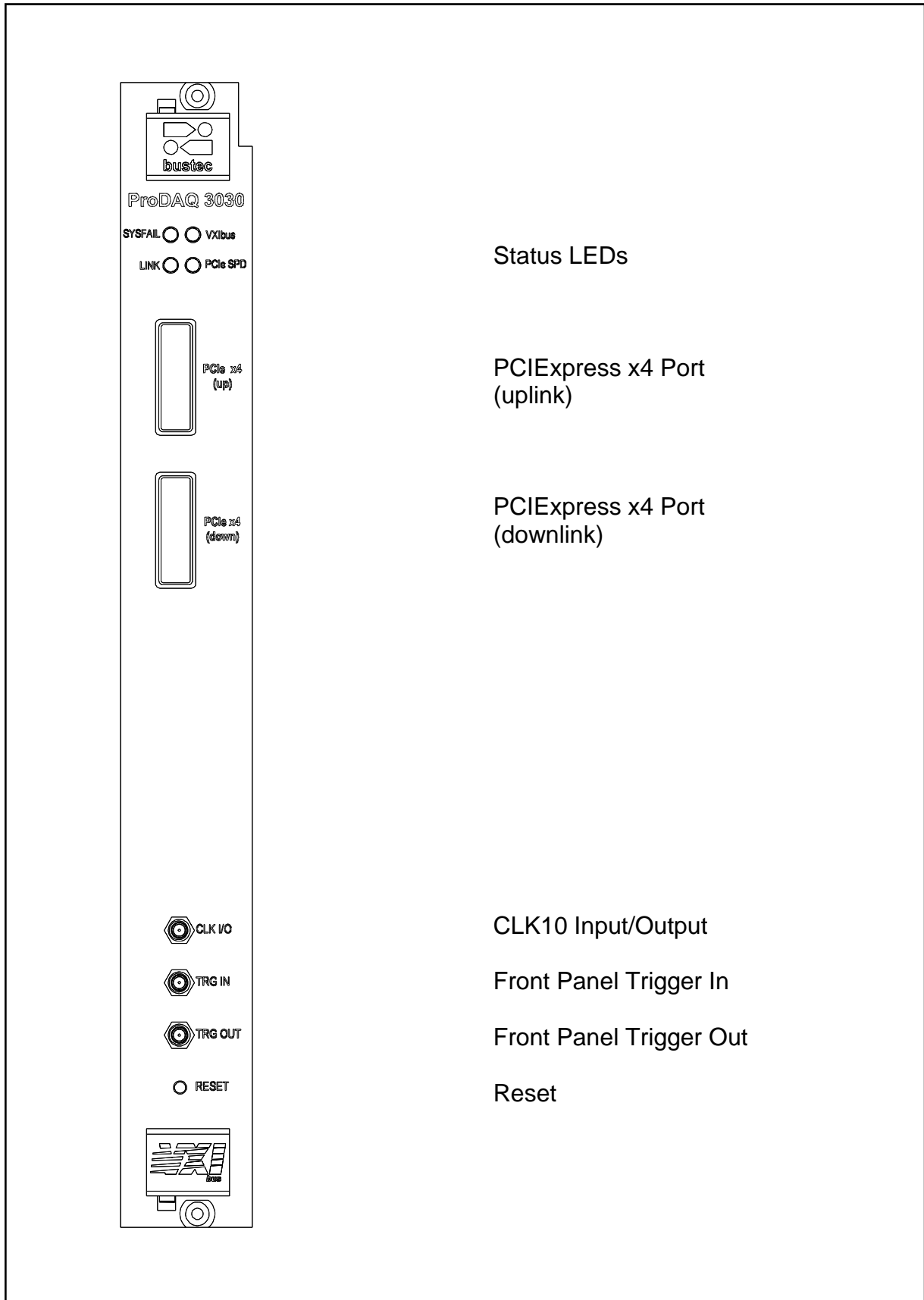
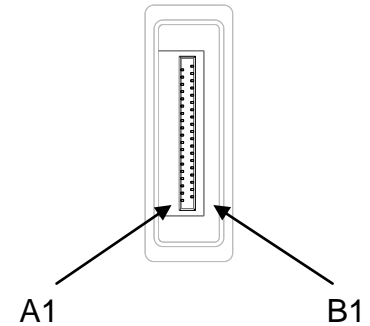


Figure 24 - ProDAQ 3030-AA Front Panel Connectors and Switches

6.2 PCI Express Uplink/Downlink

The two connectors for the PCI Express Uplink/Downlink comply with the “PCI Express® External Cabling Specification Revision 1.0” dated January 4, 2007.

Pin#	Signal	Description Notes
A1	GND	Ground
A2	PETp0	Differential PCI Express TX Lane 0
A3	PETn0	Differential PCI Express TX Lane 0
A4	GND	Ground
A5	PETp1	Differential PCI Express TX Lane 1
A6	PETn1	Differential PCI Express TX Lane 1
A7	GND	Ground
A8	PETp2	Differential PCI Express TX Lane 2
A9	PETn2	Differential PCI Express TX Lane 2
A10	GND	Ground
A11	PETp3	Differential PCI Express TX Lane 3
A12	PETn3	Differential PCI Express TX Lane 3
A13	GND	Ground
A14	CREFCLKp	Differential 100 MHz Ref. Clock
A15	CREFCLKn	Differential 100 MHz Ref. Clock
A16	GND	Ground for Reference Clock
A17	SB_RTN	Signal Return for Sideband Signals
A18	CPRSNT#	Cable Detection
A19	CPWRON	Upstream Power Detection
B1	GND	Ground
B2	PERp0	Differential PCI Express RX Lane 0
B3	PERn0	Differential PCI Express RX Lane 0
B4	GND	Ground
B5	PERp1	Differential PCI Express RX Lane 1
B6	PERn1	Differential PCI Express RX Lane 1
B7	GND	Ground
B8	PERp2	Differential PCI Express RX Lane 2
B9	PERn2	Differential PCI Express RX Lane 2
B10	GND	Ground
B11	PERp3	Differential PCI Express RX Lane 3
B12	PERn3	Differential PCI Express RX Lane 3
B13	GND	Ground
B14	PWR	+3.3 V Power (Optional)
B15	PWR	+3.3 V Power (Optional)
B16	PWR_RTN	Return for +3.3 V Power (Optional)
B17	PWR_RTN	Return for +3.3 V Power (Optional)
B18	CWAKE#	Power Management Signal for Wakeup Events (Optional)
B19	CPERST#	Cable PERST#



6.3 LXI compatible LVDS Trigger Bus

The two connectors for the LXI standard compatible LVDS Trigger Bus comply with the “LXI Standard Revision 1.3 October 30, 2008 Edition”.

Pin #	Signal
1	+3.3V
2	+3.3V_RETURN
3	LXI1p
4	LXI1n
5	GND
6	LXI3p
7	LXI3n
8	GND
9	LXI5p
10	LXI5n
11	Reserved
12	LXI7p
13	LXI7n
14	LXI0p
15	LXI0n
16	Reserved
17	LXI2p
18	LXI2n
19	GND
20	LXI4p
21	LXI4n
22	GND
23	LXI6p
24	LXI6n
25	Reserved
ConnectorShell	CHASSIS

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