RT Series

DAQ Device User Manual

Worldwide Technical Support and Product Information

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FCC/Canada Radio Frequency Interference Compliance*

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The Federal Communications Commission (FCC) has rules to protect wireless communications from interference. The FCC places digital electronics into two classes. These classes are known as Class A (for use in industrial-commercial locations only) or Class B (for use in residential or commercial locations). Depending on where it is operated, this product could be subject to restrictions in the FCC rules. (In Canada, the Department of Communications (DOC), of Industry Canada, regulates wireless interference in much the same way.)

Digital electronics emit weak signals during normal operation that can affect radio, television, or other wireless products. By examining the product you purchased, you can determine the FCC Class and therefore which of the two FCC/DOC Warnings apply in the following sections. (Some products may not be labelled at all for FCC, if so the reader should then assume these are Class A devices.)

FCC Class A products only display a simple warning statement of one paragraph in length regarding interference and undesired operation. Most of our products are FCC Class A. The FCC rules have restrictions regarding the locations where FCC Class A products can be operated.

FCC Class B products display either a FCC ID code, starting with the letters **EXN**, or the FCC Class B compliance mark that appears as shown here on the right.

The curious reader can consult the FCC web site http://www.fcc.gov for more information.
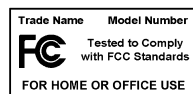
FCC/DOC Warnings

This equipment generates and uses radio frequency energy and, if not installed and used in strict accordance with the instructions in this manual and the CE Mark Declaration of Conformity**, may cause interference to radio and television reception. Classification requirements are the same for the Federal Communications Commission (FCC) and the Canadian Department of Communications (DOC).

Changes or modifications not expressly approved by National Instruments could void the user's authority to operate the equipment under the FCC Rules.

Class A
Federal Communications Commission

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Canadian Department of Communications

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

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Federal Communications Commission

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful

interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Canadian Department of Communications

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

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Readers in the EU/EEC/EEA must refer to the Manufacturer's Declaration of Conformity (DoC) for information** pertaining to the CE Mark compliance scheme. The Manufacturer includes a DoC for most every hardware product except for those bought for OEMs, if also available from an original manufacturer that also markets in the EU, or where compliance is not required as for electrically benign apparatus or cables.

* Certain exemptions may apply in the USA, see FCC Rules §15.103 **Exempted devices**, and §15.105(c). Also available in sections of CFR 47.

** The CE Mark Declaration of Conformity will contain important supplementary information and instructions for the user or installer.

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About This Manual

This manual contains information about the RT Series Data Acquisition (DAQ) devices and working with LabVIEW RT. The RT Series DAQ hardware consists of the following devices:

- PCI-7030/6040E
- PCI-7030/6030E
- PCI-7030/6533
- PXI-7030/6040E
- PXI-7030/6030E
- PXI-7030/6533

The RT Series DAQ family of boards are multifunction I/O boards with an embedded processor. You can use LabVIEW RT and NI-DAQ to create embedded, real-time applications that run on the RT Series DAQ board.
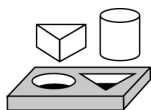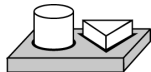
Conventions

The following conventions appear in this manual:

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

This icon denotes the beginning of an activity.

This icon denotes the end of an activity.

This icon denotes a tip, which alerts you to advisory information.

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

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

italic	Italic text denotes variables, emphasis, a cross reference, or an introduction to a key concept. This font also denotes text that is a placeholder for a word or value that you must supply.
`monospace`	Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames and extensions, and code excerpts.

Related Documentation

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

- *LabVIEW RT User Manual*

- *LabVIEW RT Release Notes*

- *LabVIEW RT Help*, available by selecting **Help»LabVIEW RT Help**

- *LabVIEW QuickStart Guide*

- *LabVIEW User Manual*

- *G Programming Reference Manual*

- *LabVIEW Data Acquisition Basics Manual*

- *LabVIEW Online Reference*, available by selecting **Help»Online Reference**

Refer to the hardware user manual for the specific I/O board attached to your RT Series board for more information about the I/O portion of your hardware. For example, if you are using the PXI-7030/6040E, refer to the *PXI E Series User Manual* for information on the 6040E daughterboard.

1

Introduction

This chapter describes the RT Series DAQ boards, lists what you need to get started, explains how to unpack your RT Series DAQ board, and describes the software you need to use.

About the RT Series

The RT Series DAQ boards are multifunction DAQ boards with an embedded processor. The RT Series DAQ board, along with LabVIEW RT and NI-DAQ, provide an easy-to-use system for real-time applications.

Each RT Series DAQ board is made up of two parts—a processor board and a DAQ daughterboard. The processor board contains a microprocessor that runs real-time, embedded LabVIEW RT applications. The RT Series DAQ board provides the same high-performance data acquisition as other National Instruments DAQ boards. For example, the PXI-7030/6040E contains a DAQ board that is equivalent to the PXI-6040E.

This manual does not contain detailed information about the DAQ component of the RT Series DAQ boards. Refer to the appropriate DAQ hardware user manual for more information, including optional equipment and custom cabling for your DAQ device. Table 1-1 lists the appropriate DAQ board user manual for each of the RT Series DAQ boards.

Table 1-1. RT Series DAQ Board and Corresponding DAQ Device Manual

RT Series DAQ Board	DAQ Manual
PXI-7030/6040E	*PXI E Series User Manual*
PXI-7030/6030E	*PXI E Series User Manual*
PXI-7030/6533	*DIO 6533 User Manual*
PCI-7030/6040E	*PCI E Series User Manual*
PCI-7030/6030E	*PCI E Series User Manual*
PCI-7030/6533	*DIO 6533 User Manual*

What You Need to Get Started

To set up and use your RT Series DAQ board, you need the following:

❑   One of the following boards:

  –   PXI-7030/6*XXX*

  –   PCI-7030/6*XXX*

❑   This manual

❑   Hardware user manual for your DAQ daughterboard, shown in Table 1-1

❑   LabVIEW RT

❑   *LabVIEW RT User Manual*

❑   *LabVIEW RT Release Notes*

❑   NI-DAQ and the NI-DAQ documentation installed with the software

❑   Your computer

Unpacking

Your RT Series DAQ board is shipped in an antistatic package to prevent electrostatic damage to the board. Electrostatic discharge can damage several components on the board. To avoid such damage in handling the board, take the following precautions:

•   Ground yourself by using a grounding strap or by holding a grounded object.

•   Touch the antistatic package to a metal part of your computer chassis before removing the board from the package.

•   Remove the board from the package and inspect the board for loose components or any other sign of damage. Notify National Instruments if the board appears damaged in any way. Do *not* install a damaged board into your computer.

•   *Never* touch the exposed pins of connectors.

Software Programming Choices

You can use the RT Series DAQ boards with LabVIEW RT and NI-DAQ. NI-DAQ is included with LabVIEW RT and you can install it during the LabVIEW RT installation. For specific information on LabVIEW RT and NI-DAQ version compatibility, refer to your *LabVIEW RT Release Notes*. Refer to Chapter 2, *Installation and Configuration*, for more information about installing your RT Series hardware.

2

Installation and Configuration

This chapter explains how to install and configure your RT Series DAQ hardware.

Hardware Installation

You can install the RT Series DAQ board in any available expansion slot in your computer or PXI chassis. However, to reduce noise, leave as much room as possible between the RT Series DAQ board and other boards and hardware. The following are general installation instructions, so refer to your computer user manual or technical reference manual for specific instructions and warnings about installing hardware.

Note Install LabVIEW RT and NI-DAQ before you install your RT Series DAQ hardware. Refer to Chapter 2, *Installation*, of the *LabVIEW RT User Manual* for more information about installing LabVIEW RT and NI-DAQ.

PCI Installation

Complete the following steps to install your RT Series PCI board:

1. Write down the RT Series DAQ board serial number for future reference.

2. Power off and unplug your computer.

3. Remove the cover to your computer.

4. Remove the expansion slot cover on the back panel of the computer.

5. Insert the RT Series DAQ board into a 5 V PCI slot. Gently rock the board to ease it into place. It may be a tight fit, but do *not* force the board into place.

6. Screw the mounting bracket of the RT Series DAQ board to the back panel rail of the computer.

7. Replace the cover.

8. Plug in and power on your computer.

Your RT Series DAQ device is installed. You are now ready to configure your software.

PXI Installation

Complete the following steps to install your RT Series PXI board:

1. Write down the PXI E Series board serial number for future reference.

2. Power off and unplug your computer.

3. Choose two adjacent unused PXI slots in your system.

4. Remove the filler panels for the slots you have chosen.

5. Insert the RT Series DAQ board into the 5 V PXI slots. Use the injector/ejector handle to fully insert the board into the chassis.

6. Screw the front panel of the RT Series DAQ board to the front panel mounting rail of the system.

7. Plug in and power on your computer.

Your RT Series DAQ device is installed. You are now ready to configure your software.

Board Configuration

Because of the National Instruments standard architecture for data acquisition and the PCI and PXI bus specifications, the RT Series DAQ boards are completely software configurable.

The PCI RT Series DAQ boards are fully compatible with the industry standard *PCI Local Bus Specification* Revision 2.0. The PXI RT Series DAQ boards are fully compatible with the *PXI Specification* Revision 1.0. This compatibility allows the PCI or PXI system to automatically perform all bus-related configurations and requires no user interaction.

DAQ-related configuration includes such settings as analog input polarity and range, analog input mode, and others. You also can configure virtual channels, SCXI, and DAQ accessories. You can modify these settings through Measurement & Automation Explorer and through LabVIEW RT and NI-DAQ.

After you complete the installation, double-click the Measurement & Automation Explorer icon on your desktop. Measurement & Automation Explorer finds the RT Series DAQ board and any other DAQ boards you have in your system and assigns device numbers to them. The RT Series DAQ device appears in Measurement & Automation Explorer as shown in Figure 2-1.
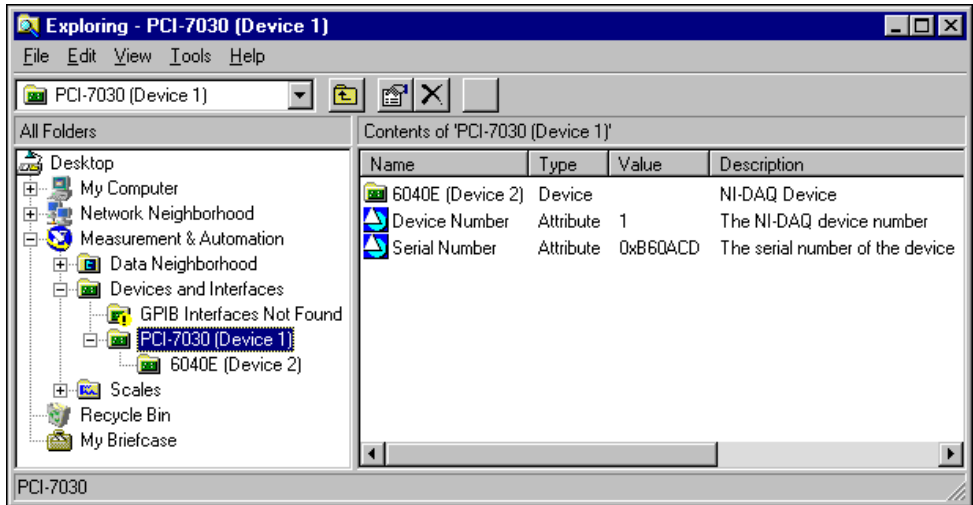
Figure 2-1. Measurement & Automation Explorer

Notice that Measurement & Automation Explorer assigns separate device numbers to the PCI/PXI-7030 device and the DAQ daughterboard, as shown in Figure 2-1. The DAQ daughterboard is shown as a separate device under the 7030. However, the daughterboard has a device number that is different from the 7030.

Remember the device numbers of your RT Series DAQ hardware. You need them to download and run LabVIEW RT VIs to your RT Series DAQ boards. You can change device numbers and other configuration settings for the devices using Measurement & Automation Explorer. Changes to these settings do not take effect on the RT Series DAQ board until you reset the board.

You can test the resources of the 7030 using Measurement & Automation Explorer. However, you cannot test resources or run test panels for the DAQ daughterboard because even though the daughterboard is configured using the host PC, the daughterboard is actually located on the local PCI bus of the of the RT Series daughterboard. Only LabVIEW RT applications targeted to the 7030 can access the DAQ daughterboard. For this reason, the resource configuration on the PCI bus cannot be tested from the host PC. You do not need to test the resource configuration because National Instruments configures it and it does not change. In addition, applications run on the host PC cannot access the DAQ daughterboard directly, even

though the DAQ daughterboard is configured as a separate device. Only LabVIEW RT applications targeted to the RT Series DAQ device can access the DAQ daughterboard.

Tip   If you want to test whether the DAQ daughterboard is working, run any DAQ example that ships with LabVIEW RT.

Save the configuration information by selecting **File»Save**. Then close Measurement & Automation Explorer.

3

Hardware Overview

This chapter describes the PCI and PXI RT Series DAQ hardware. You can find most of the hardware information you need in the DAQ board manual. Table 1-1, *RT Series DAQ Board and Corresponding DAQ Device Manual*, lists the DAQ board manuals for the various RT Series DAQ boards.

As shown in Figure 3-1 and Figure 3-2, a DAQ daughterboard attaches to the processor board, and together they form the RT Series DAQ hardware. The following sections describe the components that make up the RT Series DAQ hardware.

Processor Board

DAQ Daughterboard
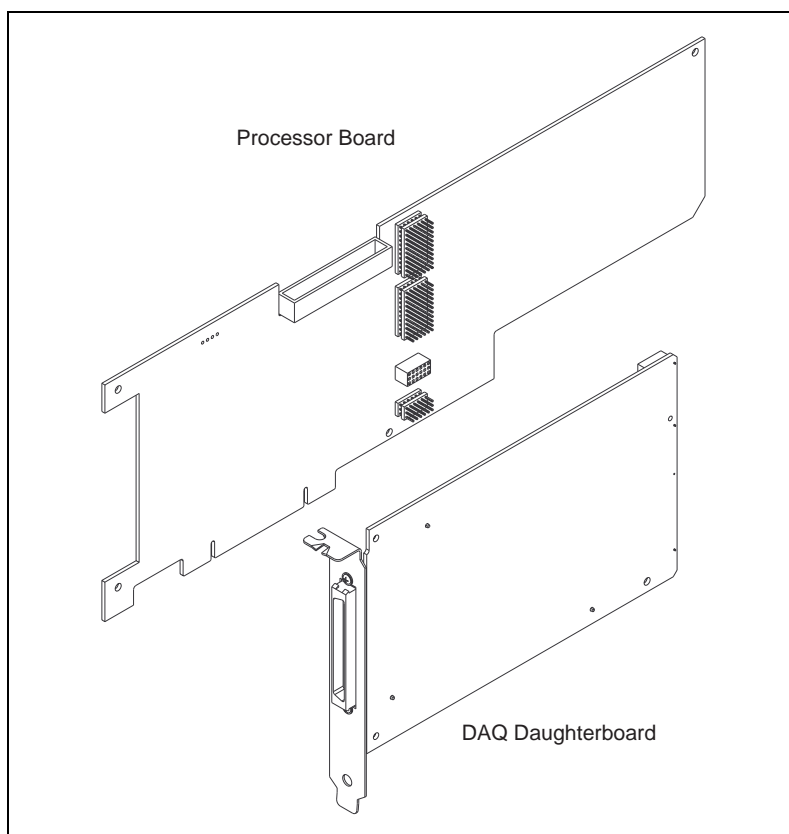
Figure 3-1. PCI RT Series Real-Time Data Acquisition Hardware
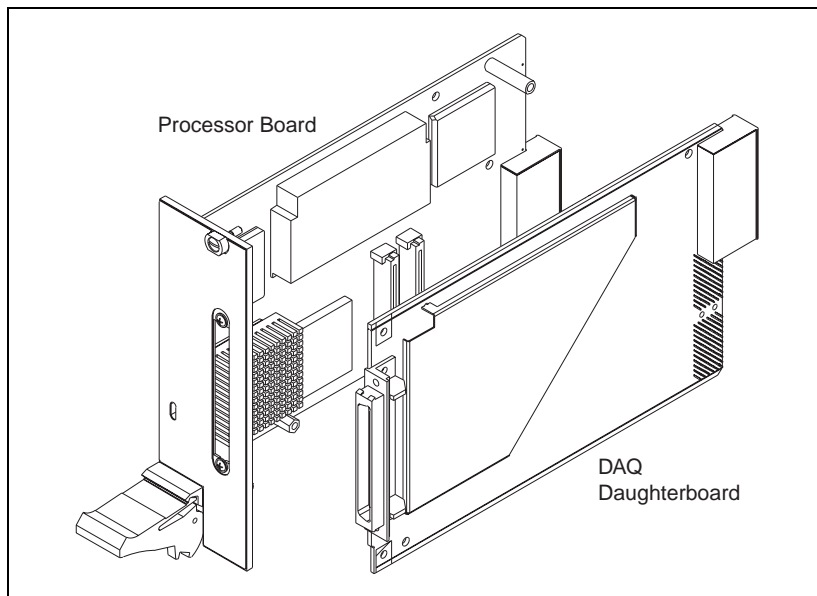
Figure 3-2. PXI RT Series Real-Time Data Acquisition Hardware

Processor Board

The 7030 processor board contains a microprocessor and support circuitry, as shown in Figure 3-3. The support circuitry includes a chipset with PCI controller and ISA bridge, main memory (DRAM), L2 cache (SRAM), and BIOS. The LabVIEW RT software uses this embedded processor system for its execution platform.

The DAQ daughterboard resides on the embedded PCI bus as shown in Figure 3-3. This provides a high-performance system for communication between the software running on the processor and the DAQ daughterboard.

The processor board also holds the shared memory that communicates between the host system and the embedded processor. Refer to the *Host-to-RT Series DAQ Board Communication* section later in this chapter and to Chapter 3, *Software Overview*, of the *LabVIEW RT User Manual*, for more information about using shared memory for your applications.
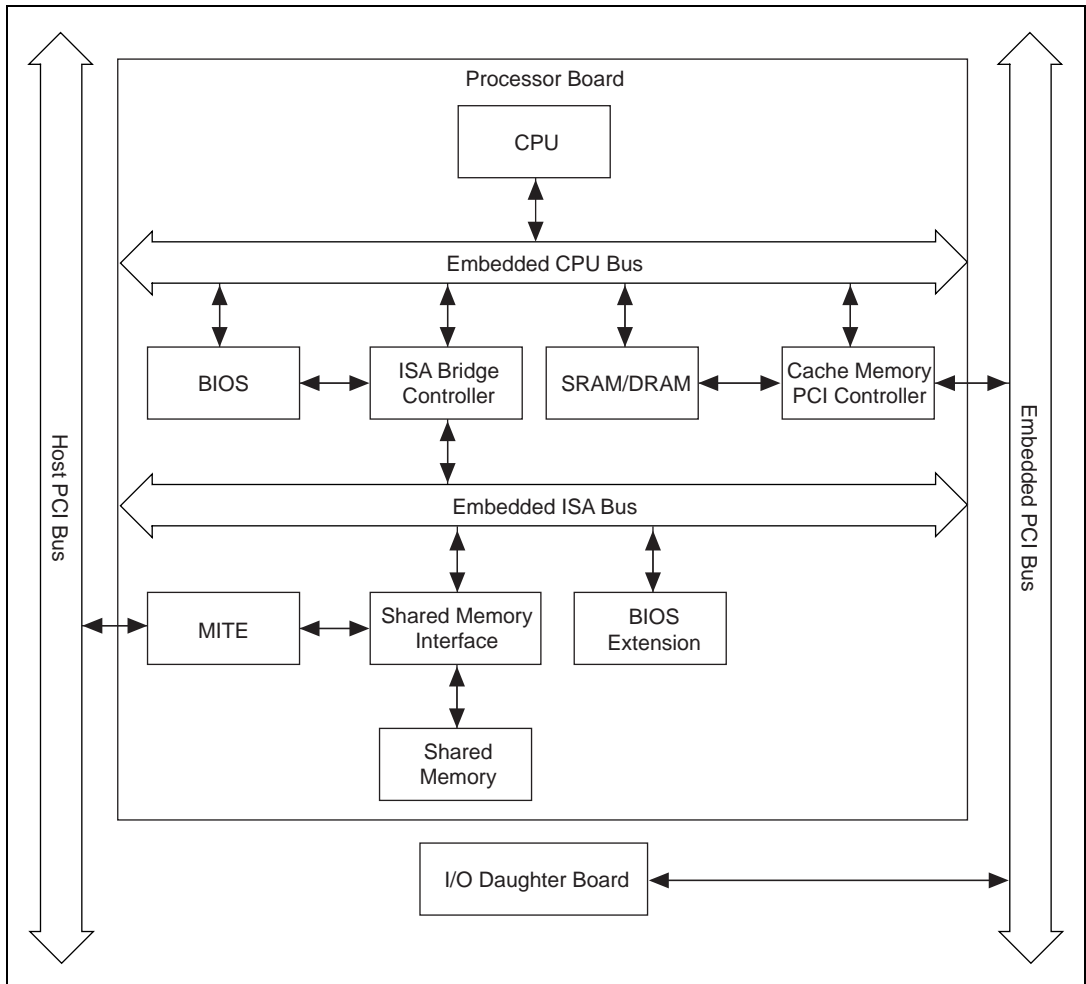
Figure 3-3. RT Series Processor Board Diagram

DAQ Daughterboard

The daughterboard in the RT Series system provides the DAQ functionality. Each daughterboard is a National Instruments PXI DAQ device with some mechanical modifications to allow it to connect to the processor board. This means that you can expect the same high performance and specifications from the daughterboard that you do from the standard version of the device. For example, the PCI/PXI-7030/6040E boards have the same DAQ characteristics as the PXI-6040E. For this reason, you should refer to appropriate daughterboard manual for

specifications, cabling requirements, and accessory information. Table 1-1, *RT Series DAQ Board and Corresponding DAQ Device Manual*, lists the appropriate manual for each available daughterboard. Refer to the DAQ section of the *LabVIEW Online Reference*, available by selecting **Help»Online Reference** in LabVIEW, for more information about hardware and software configuration.

Host-to-RT Series DAQ Board Communication

The computer into which the RT Series DAQ board is installed is called the *host computer*. The RT Series DAQ board communicates to the host computer in which it resides through shared memory on the 7030 processor board. Both the host computer and the embedded processor have access to the shared memory. The memory is allocated for various tasks. For example, the LabVIEW RT Development System, on the host, uses part of the shared memory for downloading software to the board. There is also some memory space allocated to the user for passing data between the host computer and the processor board.

RTSI

The real-time system integration bus (RTSI bus) directly connects DAQ boards for precise synchronization of functions. The RT Series boards provide all RTSI functionality. The RTSI bus allows you to connect RT Series boards to any other DAQ board regardless of whether the other board is an RT Series board or standard DAQ board.

The RTSI connections are made across the PXI trigger bus for the PXI RT boards. For PCI RT Series boards, the connection is made with a connector on the top edge of the board and a RTSI cable available from National Instruments. Refer to your daughterboard user manual for information on how to use the RTSI signals. Table 1-1, *RT Series DAQ Board and Corresponding DAQ Device Manual*, lists the appropriate manual for each available daughterboard.

LEDs

There are two LEDs on the RT Series processor board. You can use these LEDs to indicate the state of your running application. On the PXI-7030, the LEDs are visible on the front panel. On the PCI-7030, the LEDs are located along the top edge of the board, and you must remove the cover from the case of your computer to view them.

The red LED turns on during a portion of the reset of the RT Series DAQ board. Also, the red LED turns on and remains lighted if the RT Engine detects an internal error. You can control both the red LED and a second green LED from LabVIEW RT applications to provide status information.

You can use the RT Board LEDs VI, located in the **Functions»RT»RT Series DAQ»RT Board Utilities** palette, in your application to control each LED independently. You can turn each LED on, off, or toggle its state. Refer to the *LabVIEW RT Online Reference* for more information on the RT Board LEDs VI.

4

LabVIEW RT Programming

This chapter provides an overview of using LabVIEW RT and your RT Series DAQ hardware.

Targeting LabVIEW RT and Downloading VIs

In the LabVIEW RT Development System, select **Operate»Switch Execution Target** to access the **Select Target Platform** dialog box, shown in Figure 4-1.
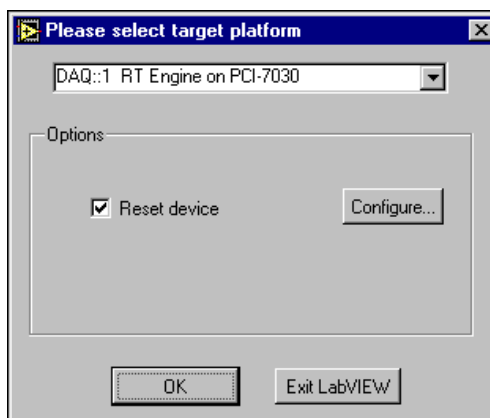
Figure 4-1. Select Target Platform Dialog Box

Use the pull-down menu to select where you want to run VIs. When you select a target platform, the RT Development System downloads any VI you subsequently run to that target platform. Selecting **Host PC (LabVIEW for Windows)** makes LabVIEW RT behave like LabVIEW for Windows on the host PC.

Any RT Series DAQ board that you configured with Measurement & Automation Explorer appears in the pull-down menu. The menu selection for each device displays the device number, for example, **DAQ::1**, where 1 is the device number. Click the **Reset device** checkbox in the **Select Target Platform** dialog box to reset the RT Series DAQ device. Any VIs you previously downloaded to the RT Series DAQ device are aborted and

unloaded from memory. Click **Configure** in the **Select Target Platform** dialog box to launch Measurement & Automation Explorer and configure your RT Series DAQ devices.

Resetting the RT Series DAQ Board

Resetting the RT Series DAQ board is necessary only after you first turn on the system or if communication with the RT Engine cannot be established or has been lost. Also, reset the board when you change the DAQ configuration information for the RT Series DAQ board.

Creating Stand-Alone Executables

Use the Application Builder, included in the LabVIEW RT Professional Development System, to create stand-alone LabVIEW RT applications. Refer to the *LabVIEW RT User Manual* and the *LabVIEW Application Builder Release Notes* for more information about the Application Builder.

✎ **Note**   If you have the LabVIEW RT Full Development System, you can purchase the Application Builder upgrade.

Embedded Applications

Because the RT Series DAQ hardware has no media storage device (for example, a hard drive), you cannot permanently embed applications on the hardware. You must launch applications on the host and target them to the RT Series DAQ device.

Command-Line Arguments

You can use command-line arguments to disable the **Select Target Platform** dialog box and explicitly specify a target for the application. You can use the parameters in a batch file, or shortcut, from your Windows StartUp folder to automatically launch RT Engine VIs when your host PC is booted. For example, create a Windows shortcut with the shortcut target:

```
c:\mybuiltapp.exe -target DAQ::1 -quithost
```

This command line automatically downloads and runs `mybuiltapp` on device 1 and closes the RT Development System on the host PC.

To disable the Select Target Platform dialog box, specify the target platform in the command line argument of your built executable using `-target`. For example:

`c:\mybuiltapp_rtengine.exe -target DAQ::3` (for device 3)

or to run the application on the host PC:

`c:\mybuiltapp_host.exe -target host`

You also can reset the specified board using `-reset`. For example:

`c:\mybuiltapp_rtengine.exe -target DAQ::3 -reset`

To disconnect the host PC from the RT Engine after all VIs are downloaded and leave the RT Engine VIs running, use `-quithost`. For example:

`c:\mybuiltapp_rtengine.exe -target DAQ::3 -quithost`

Programming LabVIEW RT

Because you run LabVIEW RT on hardware platforms that do not have all the components of a computer, LabVIEW RT lacks some LabVIEW features when targeted to the RT Engine. For example, there is no disk drive on the RT Series DAQ device, therefore, LabVIEW RT does not support file I/O when targeted to the RT Series DAQ device. LabVIEW RT does not support the following LabVIEW functions on RT Series DAQ hardware:

- ActiveX
- Datalogging
- Dialog boxes
- Ethernet
- File I/O
- Instrument I/O: VISA, 488, RS-232/Serial
- Printing
- Profiler
- Programmatic Menu Bar

Note If you attempt to download to and run on your target platform a VI that has any of the unsupported functionality listed above, the VI still executes. Unsupported functions do not work and return standard LabVIEW error codes.

Real-Time Programming

This section provides an overview of real-time programming using your RT Series DAQ hardware.

Running a VI at Time-Critical Priority without the RT Development System

Instead of using TCP/IP or VI Server to communicate data to a host PC application, you can maximize real-time VI performance on RT Series DAQ devices by peeking and poking data to shared memory. Peeking, or reading directly from shared memory, and poking, or writing directly to shared memory, are common programming techniques and do not require the VI to yield any processor time. You can create deterministic control loops that run in excess of 1 kHz when you peek and poke data to shared memory. Refer to Chapter 3, *Software Overview*, of the *LabVIEW RT User Manual* for more information about TCP/IP and VI Server.

✎ **Note**   Windows NT does not support peeking and poking to shared memory on the PC. However, because the shared memory is located on the RT Series DAQ device, Windows NT does support peeking and poking to this shared memory.

Use of Shared Memory

Using peek and poke VIs to write directly to shared memory offers the best performance. Because you can access shared memory both from a host LabVIEW application and from an embedded LabVIEW RT VI, you can write a control loop program that does not have to slow down or yield to communicate with the host system. Many such examples are in the `examples\RT\RTControl.llb` library.

Configuration Issues

The LabVIEW RT Development System downloads the RT Engine to the RT Series DAQ hardware and sends configuration information when you reset the hardware. If you make any change to the board configuration information from Measurement & Automation Explorer, you must reset the RT Series DAQ hardware for the changes to take effect.

LabVIEW RT also supports virtual channels, SCXI, and DAQ accessories on the RT Series DAQ hardware, but their descriptions download to the board when the board is reset. If you add a new channel or change the parameters of a channel using Measurement & Automation Explorer, you must reset the RT Series DAQ hardware for these changes to take effect.

However, unlike virtual channels, you can set board parameters or accessory configuration information programmatically inside a VI without running Measurement & Automation Explorer. Therefore, you can programmatically change these parameters in your VI, without resetting the hardware.

Refer to your NI-DAQ documentation and the DAQ section of the *LabVIEW Online Reference*, available by selecting **Help»Online Reference**, for more information about configuration.
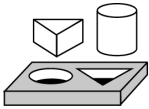
Activity 4-1. Communicating with an Embedded VI

Your objective is to communicate with an embedded VI using shared memory.

1. Open LabVIEW RT and select **Operate»Switch Execution Target** to access the **Select Target Platform** dialog box.

2. Select the appropriate RT Series DAQ board from the **Select Target Platform** dialog box. Click **OK**.

3. Run the Peek Poke I32 - RT Engine VI, found in the `Examples\RT\RTComm.llb` library.

4. Select **Operate»Switch Execution Target** to close the RT Development System but not the embedded VI.

5. Select **Host PC (LabVIEW for Windows)** from the **Select Target Platform** dialog box. Run the Peek Poke I32 - Host PC VI, found in the `Examples\RT\RTComm.llb` library.

   Refer to **Windows»Show VI Info** of these VIs for more information.

Tip   Although peek and poke VIs are the low level, fastest form of communication, using several of these VIs in a control loop can slow down your application. If you need a loop with communication to run at maximum rates, use the RT Incremental Single Write VI and RT Incremental Single Read VI, found on the **RT»RT Series DAQ»RT Board Utilities** palette.

The size of the shared memory is limited to 1 kB. If you need to transfer several megabytes of data, you must separate the data into smaller portions and then transfer them. In doing so, you must make sure that you do not overwrite data in the shared memory before you read it. TCP/IP VIs manage flow control and are more convenient for bulk transfers.

6. Open and run the TCP - RT Engine VI on the RT Series DAQ device. You can find the VI in the `Examples\RT\RTComm.llb` library.

7. Select **Operate»Switch Execution Target** to close the RT Development System but not the embedded VI.

8. Open and run the TCP - Host PC VI on the host PC. You can find the VI in the `Examples\RT\RTComm.llb` library.

9. Exit LabVIEW RT by selecting **File»Exit**. Do not save changes.

   This closes LabVIEW RT and stops and closes the TCP - RT Engine VI on the RT Series DAQ device.
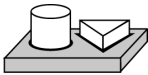
End of Activity 4-1.

RT Series DAQ Functions

This section contains information about the RT Series DAQ VIs. Refer to the *LabVIEW RT Online Help*, available by selecting **Help»LabVIEW RT Help**, for more information about the LabVIEW RT VIs.

In addition to the RT Series DAQ VIs, LabVIEW RT includes the PID Control Toolset, which includes functions for PID and Fuzzy Logic control. The Fuzzy Controller VI requires information for a specific designed fuzzy controller loaded from its corresponding data file (`*.fc`). Because LabVIEW RT does not support file I/O, you must save this information as the default values of the front panel controls of the Fuzzy Controller VI before attempting to use it on the RT Series DAQ device. Refer to the *PID Control for G Reference Manual* for more information about the PID Control and Fuzzy Logic VIs.

RT Series DAQ VIs

You can find VIs specific to RT Series DAQ on the **Functions»RT»RT Series DAQ** palette, as shown in Figure 4-2.
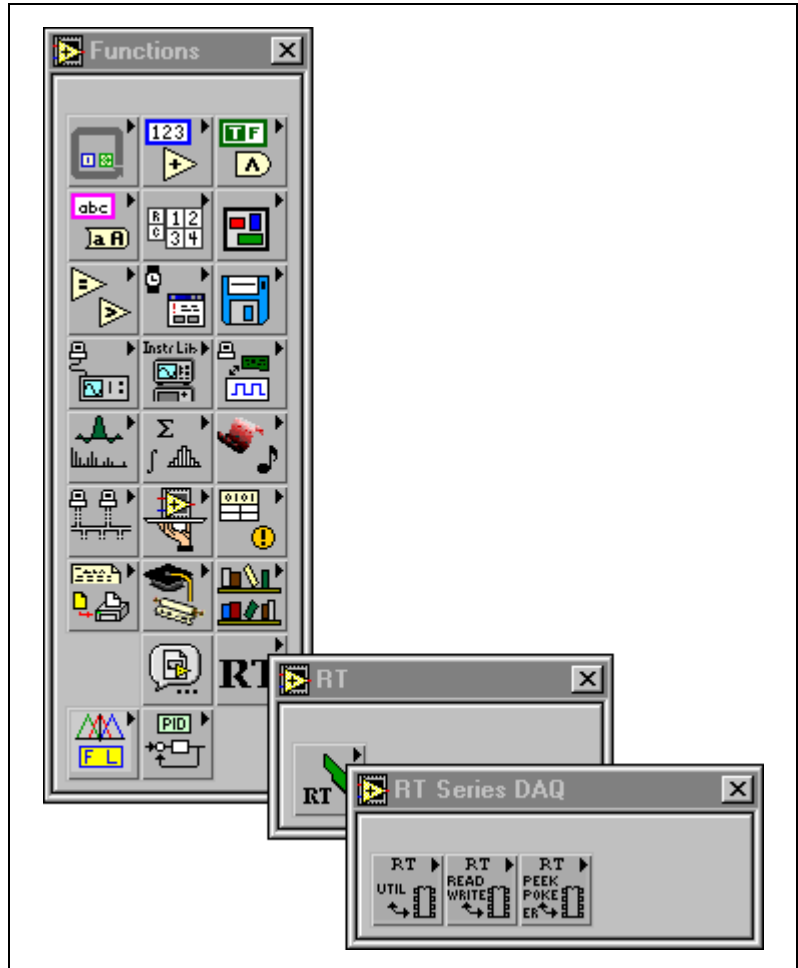
Figure 4-2. RT Series DAQ Functions Palette

RT Board Utilities VIs

Use the RT Board Utilities VIs to check the shared memory size, toggle the board LEDs, and facilitate high-level communication between the RT Series DAQ device and the host PC.

RT Shared Memory Read Write VIs

Use the RT Read Write VIs to read and write data from the shared memory of your PXI or PCI-7030 RT Series DAQ device. The read and write shared memory VIs differ from the peek and poke shared memory VIs in that the read and write shared memory VIs use a read/write flag to determine if data has changed.

RT Peek Poke with Error Cluster VIs

Use the RT Peek Poke VIs to peek and poke data to and from the shared memory on the RT Series DAQ board. The RT Peek Poke VIs differ from the RT Low-Level Peek Poke VIs in that they include the standard error cluster and provide the **next byte offset** indicator.

RT Low-Level Peek Poke VIs

Use the RT Low-Level Peek Poke VIs to peek and poke data to and from the shared memory on the RT Series DAQ board. The RT Low-Level Peek Poke VIs differ from the RT Peek Poke with Error Cluster VIs in that they do not include the standard error cluster nor provide the **next byte offset** indicator.

A

Specifications

This appendix lists the specifications of the embedded processor system.

Processor

Processor .... AMD 486 DX5
32-bit architecture

Processor clock speed .... 133 MHz

CPU bus speed .... 33 MHz

Memory .... 8 MB DRAM user-programmable
60 ns, EDO, 5 V,
72-Pin SODIMM

On-chip cache .... 16 KB write-back

L2 cache .... 256 KB write-back

Floating-point unit .... Yes

Host-Embedded Communication

Shared Memory

Type .... SRAM

Size .... 1 KB user available

Bus Interface

Type .... PCI Slave

Power Requirement

PCI-7030 only (without
daughterboard)......................................1.9 A at +5 VDC (±5%)

PXI-7030 only (without
daughterboard)......................................2.0 A at +5 VDC (±5%)

Note To calculate the total power requirement, add the processor board requirement from this section to the I/O board requirement given in the I/O board manual.

Physical

Dimensions (Not Including Connectors)

PCI-7030..312.9 by 160.5 cm
(12.3 by 4.2 in.)
One PCI slot

PXI-7030 ....16 by 10 cm (6.3 by 3.9 in.)
Two PXI slots

Environment

Operating temperature ....0 to 55 °C

Storage temperature ....–20 to 70 °C

Relative humidity ....10% to 90% noncondensing

RTSI

Refer to the *RTSI* section of Chapter 3, *Hardware Overview*.

I/O Daughterboard Specifications

Refer to the appropriate I/O board manual, listed in Table 1-1, *RT Series DAQ Board and Corresponding DAQ Device Manual*, for more information about I/O daughterboard specifications.

B

Technical Support Resources

This appendix describes the comprehensive resources available to you in the Technical Support section of the National Instruments Web site and provides technical support telephone numbers for you to use if you have trouble connecting to our Web site or if you do not have internet access.

NI Web Support

To provide you with immediate answers and solutions 24 hours a day, 365 days a year, National Instruments maintains extensive online technical support resources. They are available to you at no cost, are updated daily, and can be found in the Technical Support section of our Web site at `www.ni.com/support`

Online Problem-Solving and Diagnostic Resources

- **KnowledgeBase**—A searchable database containing thousands of frequently asked questions (FAQs) and their corresponding answers or solutions, including special sections devoted to our newest products. The database is updated daily in response to new customer experiences and feedback.

- **Troubleshooting Wizards**—Step-by-step guides lead you through common problems and answer questions about our entire product line. Wizards include screen shots that illustrate the steps being described and provide detailed information ranging from simple getting started instructions to advanced topics.

- **Product Manuals**—A comprehensive, searchable library of the latest editions of National Instruments hardware and software product manuals.

- **Hardware Reference Database**—A searchable database containing brief hardware descriptions, mechanical drawings, and helpful images of jumper settings and connector pinouts.

- **Application Notes**—A library with more than 100 short papers addressing specific topics such as creating and calling DLLs, developing your own instrument driver software, and porting applications between platforms and operating systems.

Software-Related Resources

- **Instrument Driver Network**—A library with hundreds of instrument drivers for control of standalone instruments via GPIB, VXI, or serial interfaces. You also can submit a request for a particular instrument driver if it does not already appear in the library.

- **Example Programs Database**—A database with numerous, non-shipping example programs for National Instruments programming environments. You can use them to complement the example programs that are already included with National Instruments products.

- **Software Library**—A library with updates and patches to application software, links to the latest versions of driver software for National Instruments hardware products, and utility routines.

Worldwide Support

National Instruments has offices located around the globe. Many branch offices maintain a Web site to provide information on local services. You can access these Web sites from `www.ni.com/worldwide`

If you have trouble connecting to our Web site, please contact your local National Instruments office or the source from which you purchased your National Instruments product(s) to obtain support.

For telephone support in the United States, dial 512 795 8248. For telephone support outside the United States, contact your local branch office:

Australia 03 9879 5166, Austria 0662 45 79 90 0, Belgium 02 757 00 20, Brazil 011 284 5011, Canada (Calgary) 403 274 9391, Canada (Ontario) 905 785 0085, Canada (Québec) 514 694 8521, China 0755 3904939, Denmark 45 76 26 00, Finland 09 725 725 11, France 01 48 14 24 24, Germany 089 741 31 30, Greece 30 1 42 96 427, Hong Kong 2645 3186, India 91805275406, Israel 03 6120092, Italy 02 413091, Japan 03 5472 2970, Korea 02 596 7456, Mexico (D.F.) 5 280 7625, Mexico (Monterrey) 8 357 7695, Netherlands 0348 433466, New Zealand 09 914 0488, Norway 32 27 73 00, Poland 0 22 528 94 06, Portugal 351 1 726 9011, Singapore 2265886, Spain 91 640 0085, Sweden 08 587 895 00, Switzerland 056 200 51 51, Taiwan 02 2528 7227, United Kingdom 01635 523545

Glossary

Prefix	Meanings	Value
m-	milli-	10^{-3}
k-	kilo-	10^3
M-	mega-	10^6
G-	giga-	10^9

Numbers/Symbols

%	percent
+	positive of, or plus
–	negative of, or minus
°	degree

A

A	amperes
address	character code that identifies a specific location (or series of locations) in memory

B

b	bit—one binary digit, either 0 or 1
B	byte—eight related bits of data, an eight-bit binary number. Also used to denote the amount of memory required to store one byte of data.
BIOS	basic input/output system—BIOS functions are the fundamental level of any PC or compatible computer. BIOS functions embody the basic operations needed for successful use of the computer's hardware resources.

bus	the group of conductors that interconnect individual circuitry in a computer. Typically, a bus is the expansion vehicle to which I/O or other devices are connected. Examples of PC buses are the ISA and PCI bus.

C

C	Celsius
cache	high-speed processor memory that buffers commonly used instructions or data to increase processing throughput
channel	pin or wire lead to which you apply or from which you read the analog or digital signal. Analog signals can be single-ended or differential. For digital signals, you group channels to form ports. Ports usually consist of either four or eight digital channels.
clock	hardware component that controls timing for reading from or writing to groups
CPU	central processing unit

D

DAQ	data acquisition—(1) collecting and measuring electrical signals from sensors, transducers, and test probes or fixtures and inputting them to a computer for processing; (2) collecting and measuring the same kinds of electrical signals with A/D and/or DIO boards plugged into a computer, and possibly generating control signals with D/A and/or DIO boards in the same computer
device	a plug-in data acquisition board, card, or pad that can contain multiple channels and conversion devices. Plug-in boards, PCMCIA cards, and devices such as the DAQPad-1200, which connects to your computer parallel port, are all examples of DAQ devices. SCXI modules are distinct from devices, with the exception of the SCXI-1200, which is a hybrid.
DIO	digital input/output
DRAM	dynamic RAM

H

hardware	the physical components of a computer system, such as the circuit boards, plug-in boards, chassis, enclosures, peripherals, and cables
Hz	hertz—the number of scans read or updates written per second

I

I/O	input/output—the transfer of data to/from a computer system involving communications channels, operator interface devices, and/or data acquisition and control interfaces
ISA	industry standard architecture

K

K	kilo—the prefix for 1,024, or 2^{10}, used with B in quantifying data or computer memory

L

LabVIEW	laboratory virtual instrument engineering workbench
LED	light-emitting diode
library	a file containing compiled object modules, each comprised of one of more functions, that can be linked to other object modules that make use of these functions. NIDAQMSC.LIB is a library that contains NI-DAQ functions. The NI-DAQ function set is broken down into object modules so that only the object modules that are relevant to your application are linked in, while those object modules that are not relevant are not linked.

M

M	Mega, the standard metric prefix for 1 million or 10^{6}, when used with units of measure such as volts and hertz
MB	megabytes of memory

N

NI-DAQ   National Instruments driver software for DAQ hardware

O

operating system   base-level software that controls a computer, runs programs, interacts with users, and communicates with installed hardware or peripheral devices

P

PCI   Peripheral Component Interconnect—a high-performance expansion bus architecture originally developed by Intel to replace ISA and EISA. It is achieving widespread acceptance as a standard for PCs and work-stations; it offers a theoretical maximum transfer rate of 132 Mbytes/s.

PID control   a three-term control mechanism combining proportional, integral, and derivative control actions. Also see proportional control, integral control, and derivative control.

R

RAM   random-access memory

real time   a property of an event or system in which data is processed as it is acquired instead of being accumulated and processed at a later time

resource locking   a technique whereby a device is signaled not to use its local memory while the memory is in use from the bus

S

shared memory   memory that can be sequentially accessed by more than one controller or processor but not simultaneously accessed. Also known as dual-mode memory.

soft reboot   restarting a computer without cycling the power, usually through the operating system

T

TCP	Transmission Control Protocol
trigger	any event that causes or starts some form of data capture

V

V	volts
VI	virtual instrument—(1) a combination of hardware and/or software elements, typically used with a PC, that has the functionality of a classic stand-alone instrument; (2) a LabVIEW software module (VI), which consists of a front panel user interface and a block diagram program
VISA	virtual instrument software architecture—a new driver software architecture developed by National Instruments to unify instrumentation software GPIB, DAQ, and VXI. It has been accepted as a standard for VXI by the VXIplug&play Systems Alliance.

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