

# RT Series

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## PXI™/CompactPCI Controller User Manual

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# About This Manual

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This manual contains information about the RT Series PXI/CompactPCI controller and working with LabVIEW Real-Time (RT). You can use LabVIEW RT and NI-DAQ to create embedded, real-time applications that run on an RT Series PXI controller.

## Conventions

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The following conventions apply to this manual:

»

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



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



This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.

**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.

**`monospace bold`**

Bold text in this font denotes the messages and responses that the computer automatically prints to the screen. This font also emphasizes lines of code that are different from the other examples.

## Related Documentation

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

- *LabVIEW Real-Time User Manual*
- *LabVIEW Real-Time Release Notes*
- *LabVIEW Real-Time Help*, select **Help»LabVIEW Real-Time** from the LabVIEW toolbar
- Your RT Series PXI controller hardware user manual and documentation
- *Getting Started with LabVIEW*
- *LabVIEW User Manual*
- *LabVIEW Help*, select **Help»Contents and Index** from the LabVIEW toolbar
- *LabVIEW Application Builder Release Notes*
- Measurement & Automation Explorer, select **Tools»Measurement & Automation Explorer** from the LabVIEW toolbar
- *MAX Help*, select **Help»Help Topics** from the MAX toolbar

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# Introduction

This chapter introduces the RT Series PXI/CompactPCI controller and lists what you need to begin working with LabVIEW Real-Time (RT) and your RT Series PXI controller.

## RT Series PXI Controllers

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Using LabVIEW RT with any RT Series PXI system provides an easy-to-use system for real-time applications. When you run the RT Engine on an RT Series PXI controller, the RT Series PXI system acts as a headless system, running applications on the system without input from the keyboard or mouse. You use a separate host PC or PXI system running Windows to control the RT Series PXI system through an Ethernet connection. When controlled by a host PC or Windows-operated PXI system, the microprocessor on the RT Series PXI controller runs real-time, embedded LabVIEW RT applications. Refer to Chapter 1, *Introduction*, of the *LabVIEW Real-Time User Manual* for more information about the RT Engine.

No physical differences exist between an RT Series PXI controller and a PXI controller with a Windows operating system installed. The difference is the operating system which the PXI controller boots into, either the RT Engine operating system or Windows. Refer to the National Instruments Web site at [ni.com/express](http://ni.com/express) and enter the Info Code: RT0001 for more information about LabVIEW RT support of specific National Instruments PXI controllers.

When you use an RT Series PXI system, you can write applications that use all the Input/Output (I/O) capability of National Instruments PXI data acquisition (DAQ) devices installed in the system, SCXI and other signal conditioning devices, and so on. Some features of the RT Series PXI controller itself are also supported by the RT Engine. For example, you can use the GPIB and serial ports onboard the PXI-8156B controller for instrument control in LabVIEW RT applications. Refer to the National Instruments Web site at [ni.com/express](http://ni.com/express) and enter the Info Code: RT0001 for more information about the features supported by the RT Engine on a specific RT Series PXI controller.



You must use a separate host PC or PXI system running Windows to install and configure the RT Engine on the RT Series PXI controller. You also use the host PC or Windows-based PXI system to develop and launch LabVIEW RT applications on the RT Series PXI controller.

## What You Need to Get Started

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To set up and use LabVIEW RT with your RT Series PXI controller, you need the following:

- ☐ A National Instruments PXI chassis with an RT Series PXI controller
- ☐ A floppy disk if LabVIEW RT is not pre-installed on your RT Series PXI controller
- ☐ *LabVIEW Real-Time User Manual*
- ☐ This manual
- ☐ A host PC or PXI system
- ☐ LabVIEW RT
- ☐ NI-DAQ, which is included with LabVIEW RT and can be installed during the LabVIEW RT installation
- ☐ A CAT-5 crossover cable if the RT Series PXI controller is not configured on a network

## Installation and Configuration

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Refer to the *MAX Help* for more information about how to install and configure the RT Engine on your RT Series PXI controller.

# Software Programming Choices

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LabVIEW RT supports the following software programs:

- NI-DAQ
- National Instruments Virtual Instrument Software Architecture (VISA)
- NI-Motion
- NI-Serial
- NI-488.2

Refer to the National Instruments Web site at [ni.com/express](http://ni.com/express) and enter the Info Code: RT0002 for the most recent information about software programs supported by LabVIEW RT.

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# LabVIEW RT Programming

This chapter contains information about targeting LabVIEW Real-Time (RT) to a platform, network options for restricting access to your RT Series PXI controller, embedding LabVIEW RT applications on your RT Series PXI controller, and launching embedded applications when your RT Series PXI controller starts up.

## Targeting LabVIEW RT to a Platform

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You can target LabVIEW RT to your RT Series PXI controller or the host PC. When you select a target platform other than the host PC, the RT Development System downloads any LabVIEW RT application you subsequently run to the selected target platform. Refer to Chapter 1, *Introduction*, and to Chapter 3, *Software Overview*, of the *LabVIEW Real-Time User Manual* for more information about the RT Development System.

## Targeting LabVIEW RT to Your RT Series PXI Controller

When you target LabVIEW RT to your RT Series PXI controller, you can run LabVIEW RT applications on the controller. However, when targeted to your RT Series PXI controller, LabVIEW RT lacks some features found in LabVIEW for Windows because the controller does not have all the components found in a PC. The following LabVIEW features are not supported in LabVIEW RT when targeted to your RT Series PXI controller:

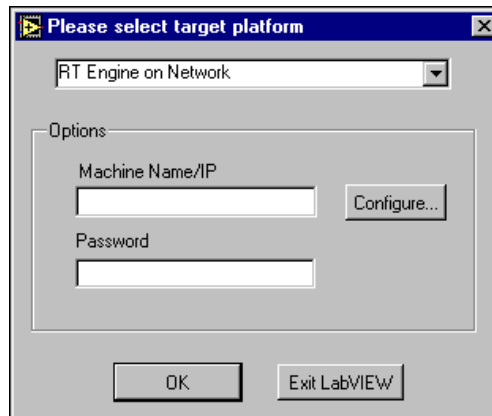
- ActiveX
- Front panel datalogging
- Dialog boxes
- Printing
- Programmatic menus

If you download a LabVIEW RT application that has any of the unsupported functionality listed above to your RT Series PXI controller and run that application on your controller, the application runs.

However, unsupported functions do not work and return standard LabVIEW error codes.

Complete the following steps on the host PC to target LabVIEW RT to your RT Series PXI controller.

1. Start LabVIEW.
2. Select **Operate»Switch Execution Target** to open the **Select Target Platform** dialog box, shown in Figure 2-1.



**Figure 2-1.** Select Target Platform Dialog Box

3. Select **RT Engine on Network** from the pull-down menu to target your RT Series PXI controller.



**Note** When targeting LabVIEW RT to an RT Series PXI system, the RT Series PXI controller does not need to reside on the same subnet as the host PC.

4. Enter the IP address and password you specified for the RT Series PXI system in Measurement & Automation Explorer (MAX). If no password is specified for the RT Series PXI controller, leave the password field blank. Refer to Measurement & Automation Explorer (MAX) for more information about MAX. Refer to [Related Documentation](#) in the *About This Manual* section of this manual for information about how to access MAX.

If the IP address of the host PC appears in the **RT Target: Access** list of the RT Series PXI controller, you do not need to enter the password. Refer to the [RT Target: Access](#) section of this chapter for more information about **RT Target: Access**.

5. Click the **OK** button. Click the **Configure** button to configure RT Series PXI systems using MAX.

## Targeting LabVIEW RT to the Host PC

When you target LabVIEW RT to the host PC, you can use LabVIEW RT like LabVIEW for Windows.

Complete the following steps to target LabVIEW RT to the host PC.

1. Complete steps 1 and 2 of the [Targeting LabVIEW RT to Your RT Series PXI Controller](#) section of this chapter.
2. Select **Host PC (LabVIEW for Windows)** from the pull-down menu.
3. Click the **OK** button.

## Network Options

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When you target LabVIEW RT to a networked RT Series PXI controller, select **Tools»Options** to access LabVIEW options. The options in the **Options** menu only apply to the RT Development System running on the host PC.

You also can set options for the RT Engine on the RT Series PXI controller when you target LabVIEW RT to the controller. With LabVIEW RT targeted to your RT Series PXI controller, select **Tools»Network Options** to access RT Engine options. RT Engine options apply to LabVIEW RT applications running on the RT Series PXI controller. The **Performance and Disk**, **VI Server**, and **Web Server** option dialog boxes are identical to the normal LabVIEW option dialog boxes. However, the settings are applied to the RT Series PXI controller. Refer to the *LabVIEW Help*, available by selecting **Help»Contents and Index** from the LabVIEW toolbar, for more information about **Performance and Disk**, **VI Server**, and **Web Server** options.

You also can use the following two additional groups of options for LabVIEW RT applications on networked RT Series PXI controllers:

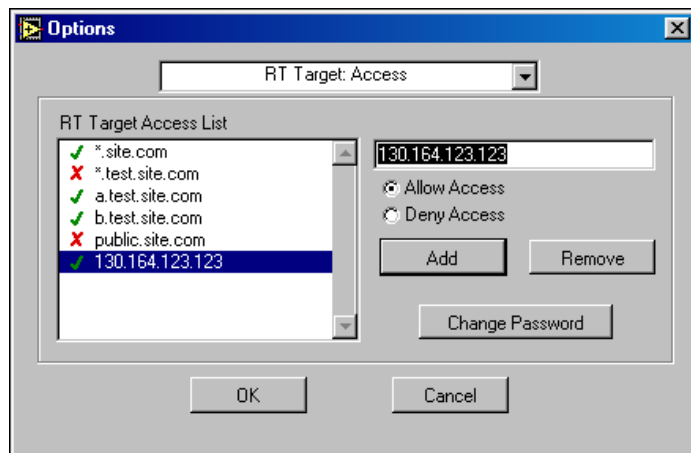
**RT Target: Access** and **RT Target: Miscellaneous**.

## RT Target: Access

Use **RT Target: Access** options to limit which host PCs can target the RT Engine on the RT Series PXI controller.

Complete the following steps to open the **RT Target: Access** dialog box, shown in Figure 2-2.

1. Target LabVIEW RT to your RT Series PXI controller. Refer to the [Targeting LabVIEW RT to Your RT Series PXI Controller](#) section of this chapter for more information about targeting LabVIEW RT to your RT Series PXI controller.
2. Select **Tools»Network Options**.
3. Select **RT Target: Access** from the pull-down menu.



**Figure 2-2.** RT Target: Access Options Dialog Box

If the IP address of your host PC matches an entry that allows access, you can target the RT Series PXI controller without providing a password, even if the RT Series PXI system configuration is locked. If your host IP address does not match any entry or matches an entry that denies access, you must provide the correct password to target the RT Series PXI controller.

When you try to target the RT Engine on an RT Series PXI controller from a host PC through the RT Development System, the RT Engine compares the host PC IP address to the entries in the **RT Target: Access** list to determine if the host PC is permitted access. You define the **RT Target: Access** list entries to indicate whether or not a host PC is permitted or denied access. If an entry in the list matches the host PC address, the RT Engine either allows or denies access based on what you

define for the entry. If a subsequent entry also matches the host PC address, that permission is used in place of the previous permission. For example, in Figure 2-2, `a.test.site.com` and `b.test.site.com` are permitted access even though the list indicates by the `*` wildcard that all addresses ending in `.test.site.com` are denied access. A checkmark next to a list entry denotes that access is permitted, while an `x` denotes that access is denied. If no entry matches the host PC address, access is denied unless you supply a password.

Table 2-1 shows examples of **RT Target: Access** list entries and provides information about the `*` wildcard and permitting matching access entries.

To specify an Internet host address, enter its domain name or IP address. Use the `*` wildcard when specifying Internet host addresses. For example, you can specify all hosts within the domain `site.com` with the entry `*.site.com`. You can specify all hosts in the subnet whose first two numbers are 130.164 with the entry `130.164.*`. The entry `*` matches all addresses.

**Table 2-1.** Example RT Target: Access List Entries

Access String	Matches
<code>*</code>	All hosts
<code>test.site.com</code>	The host whose domain name is <code>test.site.com</code>
<code>*.site.com</code>	All hosts whose domain names end with <code>.site.com</code>
<code>130.164.123.123</code>	The host with the IP address <code>130.164.123.123</code>
<code>130.164.123.*</code>	All hosts whose IP addresses start with <code>130.164.123</code>

In Figure 2-2, all hosts in the `site.com` domain can target the RT Engine, with the exception of all hosts in the `test.site.com` domain. Additionally, the hosts `a.test.site.com`, `b.test.site.com`, and `130.164.123.123` also can target the RT Engine. The host `public.site.com` does not have access, even though it is in the `site.com` domain.

The default **RT Target: Access** settings permit any host machine to target the RT Engine on the RT Series PXI controller without a password.



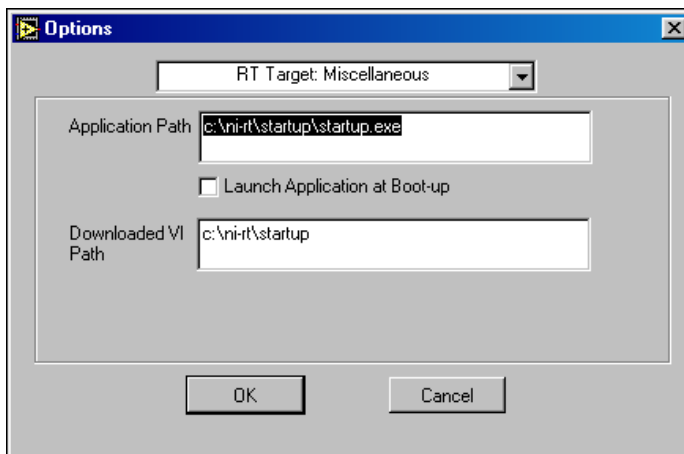
**Note** If the RT Series PXI controller does not have access to a Domain Name Server (DNS), do not use domain name entries in the **RT Target: Access** list. Requests to resolve the domain name or an IP address fail and slow down the RT Series PXI system. Place frequently matched entries toward the bottom of the **RT Target: Access** list to improve system performance.

## RT Target: Miscellaneous

Use **RT Target: Miscellaneous** options to launch LabVIEW RT applications at RT Series PXI system start-up and to specify the **Downloaded VI Path**.

Complete the following steps to open the **RT Target: Miscellaneous** dialog box, shown in Figure 2-3.

1. Target LabVIEW RT to your RT Series PXI controller. Refer to the [Targeting LabVIEW RT to Your RT Series PXI Controller](#) section of this chapter for more information about targeting LabVIEW RT to your RT Series PXI controller.
2. Select **Tools»Network Options**.
3. Select **RT Target: Miscellaneous** from the pull-down menu.



**Figure 2-3.** RT Target: Miscellaneous Options Dialog Box

Use the **Application Path** and **Launch Application at Boot-up** settings to automatically launch a built LabVIEW RT application when you start up the RT Series PXI system. The RT Engine launches the built application specified by **Application Path** when you start up the RT Series PXI system. The specified path also determines the path and application name that appear when you target LabVIEW RT to the PXI controller and create



an embedded LabVIEW RT application. Refer to the *Embedding Applications on the RT Series PXI Controller* and the [Launching Embedded Applications at Start-Up](#) sections of this chapter for more information about embedding and launching LabVIEW RT applications on your RT Series PXI controller.

Select **Launch Application at Boot-up** to launch the application specified in **Application Path** when you start up the RT Series PXI system. You must first create the application using the Application Builder before you select this option. Refer to the *LabVIEW Application Builder Release Notes* and to the *LabVIEW Help* for more information about the Application Builder. Refer to the *Embedding Applications on the RT Series PXI Controller* section of this chapter for more information about creating LabVIEW RT applications.

By changing the **Application Path**, you can create multiple LabVIEW RT applications on the RT Series PXI controller. However, only the application you specify in the **Application Path** launches at start-up, if you select **Launch Application at Boot-up**.

Use **Downloaded VI Path** to specify the default path for the RT Engine VIs downloaded by the RT Development System. VIs are stored on the host PC hard drive and are opened in the host RT Development System. Therefore, the RT Engine does not know the actual path of the downloaded VIs. The RT Engine uses the path specified in **Downloaded VI Path** for operations that require the VI path. For example, the file constant **Current VI's Path** normally returns the path of the VI in which the constant is used. This constant may be used in a VI that reads or writes data to a file on the disk. When you run this VI in the RT Engine on the PXI controller, **Current VI's Path** returns the path specified in the **Downloaded VI Path** option, appended with the name of the VI.

## Embedding Applications on the RT Series PXI Controller

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LabVIEW RT applications built on the host PC with the Application Builder can be embedded on your RT Series PXI controller. This section explains how to embed LabVIEW RT applications on your RT Series PXI controller by using the Application Builder while LabVIEW RT is targeted to the controller.

Refer to Chapter 3, *Software Overview*, of the *LabVIEW Real-Time User Manual* for more information about building LabVIEW RT applications on the host PC. Refer to the *LabVIEW Application Builder Release Notes* and

to the *LabVIEW Help* for more information about using the Application Builder on the host PC.

## Command Line Arguments

Use command line arguments for applications built on the host PC to disable the **Select Target Platform** dialog box and explicitly specify a target for the application. You can use these command line arguments in a shortcut from your Windows Startup folder to automatically launch RT Engine applications and/or host PC applications when you start-up your host PC.

For example, create a shortcut with the following shortcut target:

```
c:\mybuiltapp.exe -target 127.127.44.108 -quithost
```

To disable the **Select Target Platform** dialog box, specify a target, such as the IP address of the RT Series PXI controller, in the command line argument of your built application using `-target`. For example,

```
c:\mybuiltapp_rtengine.exe -target 127.127.44.108
```

or

```
c:\mybuiltapp_host.exe -target host
```

To disconnect the host PC from the RT Engine after all applications are downloaded, use `-quithost`. For example,

```
c:\mybuiltapp_rtengine.exe -target 127.127.44.108  
-quithost
```

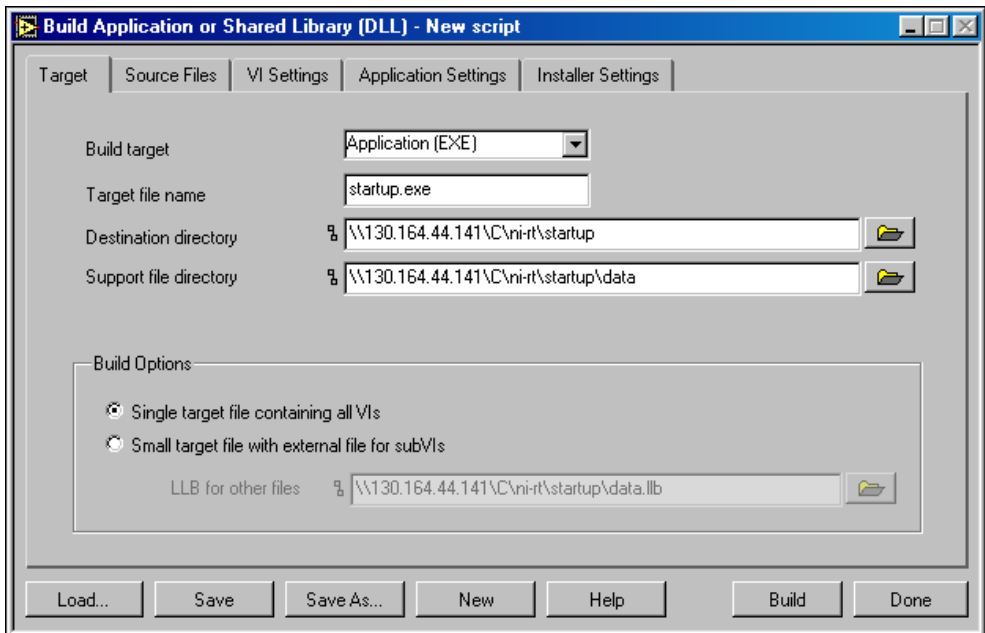
## Using Application Builder

When you target LabVIEW RT to your RT Series PXI controller, use the Application Builder to embed LabVIEW RT applications on your RT Series PXI controller.

Complete the following steps to embed LabVIEW RT applications on your RT Series PXI controller using the Application Builder.

1. Target LabVIEW RT to your RT Series PXI controller. Refer to the [Targeting LabVIEW RT to Your RT Series PXI Controller](#) section of this chapter for more information about targeting LabVIEW RT to your RT Series PXI controller.
2. Select **Tools»Build Application or Shared Library (DLL)** to open the **Build Application or Shared Library (DLL)** dialog box, shown in Figure 2-4.

3. Select **Application (EXE)** from the **Build target** pull-down menu.
4. Click the **Source Files** tab.
5. Click the **Add Top-Level VI** button.
6. Navigate to the location of the VI to be added.
7. Select the VI to be added.
8. Click the **OK** button.
9. Click the **Build** button.



**Figure 2-4.** Build Application or Shared Library (DLL) Dialog Box

## Target Tab

On the **Target** tab, the Application Builder determines the Target file name, Destination directory, and Support file directory from the **Application Path** setting in **Network Options**. You cannot change the Application name, Destination directory, and Support file directory settings in the Application Builder when you target LabVIEW RT to the RT Series PXI controller. Refer to the [Network Options](#) section of this chapter for more information about accessing and using **Network Options**.

If you select **Small target with external file for subVIs** in the **Build Options** section, you cannot change the **LLB for other files** path because this path is determined from the **Application Path** setting in **Network Options**. Refer to the *LabVIEW Help* for more information about the **Small target with external file for subVIs** option. Refer to the [Network Options](#) section of this chapter for more information about accessing and using **Network Options**.

## Source Files and VI Settings Tabs

Use the **Source Files** and **VI Settings** tabs the same way you do to build a LabVIEW RT application when LabVIEW RT is targeted to the host PC. Refer to the *LabVIEW Help* for more information about the **Source Files** and **VI Settings** tabs.



**Caution** Do not add the file `serpdrv` to your application in the **Source Files** tab. The serial port driver is installed on the RT Series PXI controller with the RT Engine. Manually adding `serpdrv` to your application adds the Windows driver, which is not compatible with the RT Engine on the PXI controller.

## Application Settings and Installer Settings Tabs

The **Application Settings** and **Installer Settings** tabs are disabled when you target LabVIEW RT to the RT Series PXI controller because these settings do not apply to applications embedded on the controller.

# Launching Embedded Applications at Start-Up

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The RT Engine can launch your embedded application each time you start up your RT Series PXI controller. Complete the following steps to launch your embedded application each time your RT Series PXI controller starts up.

1. Target LabVIEW RT to your RT Series PXI controller. Refer to the [Targeting LabVIEW RT to Your RT Series PXI Controller](#) section of this chapter for more information about targeting LabVIEW RT to your RT Series PXI controller.
2. Select **Tools»Network Options**.
3. Select **RT Target: Miscellaneous** from the pull-down menu.
4. Select **Launch Application at Boot-up**.

# File Transfer Capability

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When running on an RT Series PXI controller, the RT Engine has a File Transfer Protocol (FTP) server. The FTP server gives you the ability to use any standard FTP utility for transferring files to and from the hard drive of the RT Series PXI controller. You must provide the correct password when opening a connection to the RT Series PXI controller if the configuration is locked in Measurement & Automation Explorer (MAX).

For programmatic file transfer control in LabVIEW or LabVIEW RT, use the Internet Developers Toolkit, included in the LabVIEW Enterprise Connectivity Toolset. Refer to the National Instruments Web site at [ni.com](http://ni.com) for more information about purchasing and using the LabVIEW Enterprise Connectivity Toolset.

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# Troubleshooting

This appendix describes various troubleshooting techniques for LabVIEW Real-Time (RT) and your RT Series PXI controller.

## Measurement & Automation Explorer Cannot Find RT Series PXI Controller

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Try the following techniques if your RT Series PXI controller does not appear in Measurement & Automation Explorer:

- When configuring the RT Series PXI controller, ensure that the controller is located on the same subnet of your network as the host PC. If you are unsure of your network configuration, consult your network administrator for assistance.
- If you do not have a keyboard connected to the RT Series PXI controller, check the BIOS settings of the controller. The **Halt On** setting must be set to **All, But Keyboard** for the PXI controller to boot without a keyboard connected. You can find the **Halt On** setting in the **Standard CMOS Setup** options. Refer to your PXI controller user manual for more information about BIOS settings.

## PXI Controller Boots into Windows When an RT Engine Boot Floppy Disk Is Used

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Check the BIOS setting for the **Boot Sequence** of your RT Series PXI controller. The boot sequence for your RT Series PXI controller defined in the BIOS settings must be set to **A, C, . . .** to boot from a floppy disk. If the **Boot Sequence** setting is set to boot from the C: drive before the A: drive, the controller only boots into Windows. You can find the **Boot Sequence** setting in the **BIOS Features Setup** settings. Refer to your PXI controller user manual for more information about BIOS settings.

## Runaway Start-Up Application

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If a runaway start-up application causes the RT Series system to become unresponsive, you must use a PXI Launch Settings Reset Disk to boot the RT Series PXI controller into the RT Engine without launching the start-up application. The PXI Launch Settings Reset Disk resets the system so that the RT Engine does not start any user applications at boot up. No other settings are affected. Refer to *MAX Help* for more information about creating a PXI Launch Settings Reset Disk.

# Technical Support Resources

## Web Support

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National Instruments Web support is your first stop for help in solving installation, configuration, and application problems and questions. Online problem-solving and diagnostic resources include frequently asked questions, knowledge bases, product-specific troubleshooting wizards, manuals, drivers, software updates, and more. Web support is available through the Technical Support section of [ni.com](http://ni.com)

## NI Developer Zone

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The NI Developer Zone at [ni.com/zone](http://ni.com/zone) is the essential resource for building measurement and automation systems. At the NI Developer Zone, you can easily access the latest example programs, system configurators, tutorials, technical news, as well as a community of developers ready to share their own techniques.

## Customer Education

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National Instruments provides a number of alternatives to satisfy your training needs, from self-paced tutorials, videos, and interactive CDs to instructor-led hands-on courses at locations around the world. Visit the Customer Education section of [ni.com](http://ni.com) for online course schedules, syllabi, training centers, and class registration.

## System Integration

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If you have time constraints, limited in-house technical resources, or other dilemmas, you may prefer to employ consulting or system integration services. You can rely on the expertise available through our worldwide network of Alliance Program members. To find out more about our Alliance system integration solutions, visit the System Integration section of [ni.com](http://ni.com)



## Worldwide Support

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National Instruments has offices located around the world to help address your support needs. You can access our branch office Web sites from the Worldwide Offices section of [ni.com](http://ni.com). Branch office Web sites provide up-to-date contact information, support phone numbers, e-mail addresses, and current events.

If you have searched the technical support resources on our Web site and still cannot find the answers you need, contact your local office or National Instruments corporate. Phone numbers for our worldwide offices are listed at the front of this manual.

# Glossary

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## B

boot up                      computer start up

## D

DNS                          Domain Name Server

## E

Ethernet                    a high-speed local area network (LAN) which conforms to the IEEE 802.3 standard

## P

port                        (1) a communications connection on a computer or a remote controller  
(2) a digital port, consisting of four or eight lines of digital input and/or output

## R

RT Series PXI controller   a National Instruments PXI controller running the RT Engine

RT Series PXI system     a National Instruments PXI chassis with an RT Series PXI controller installed

## S

signal conditioning        the manipulation of signals to prepare them for digitizing

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