GETTING STARTED GUIDE

NI 5741

16-Channel Signal Generator

📋 **Note** Before you begin, install and configure your chassis and controller.

The NI 5741 is a 16-channel, 1 MS/s analog output adapter module designed to work in conjunction with your NI FlexRIO™ FPGA module.

The NI 5741 features 16-bit analog output channels that can be configured to drive either unipolar or bipolar output.

This document explains how to install and connect signals for the NI 5741R, which is composed of a FlexRIO FPGA module and the NI 5741.

⚠️ **Caution** The protection provided by the NI 5741 can be impaired if it is used in a manner not described in this document.

The following figure shows an example of a properly connected FlexRIO device.

Figure 1. FlexRIO Device

NI FlexRIO   NI FlexRIO
Adapter Module + FPGA Module = NI FlexRIO Device

Contents

NATIONAL INSTRUMENTS™

Electromagnetic Compatibility Guidelines

This product was tested and complies with the regulatory requirements and limits for electromagnetic compatibility (EMC) stated in the product specifications. These requirements and limits are designed to provide reasonable protection against harmful interference when the product is operated in the intended operational electromagnetic environment.

This product is intended for use in industrial locations. However, harmful interference may occur in some installations, when the product is connected to a peripheral device or test object, or if the product is used in residential or commercial areas. To minimize interference with radio and television reception and prevent unacceptable performance degradation, install and use this product in strict accordance with the instructions in the product documentation.

Furthermore, any modifications to the product not expressly approved by National Instruments could void your authority to operate it under your local regulatory rules.

⚠ **Caution** To ensure the specified EMC performance, operate this product only with shielded cables and accessories.
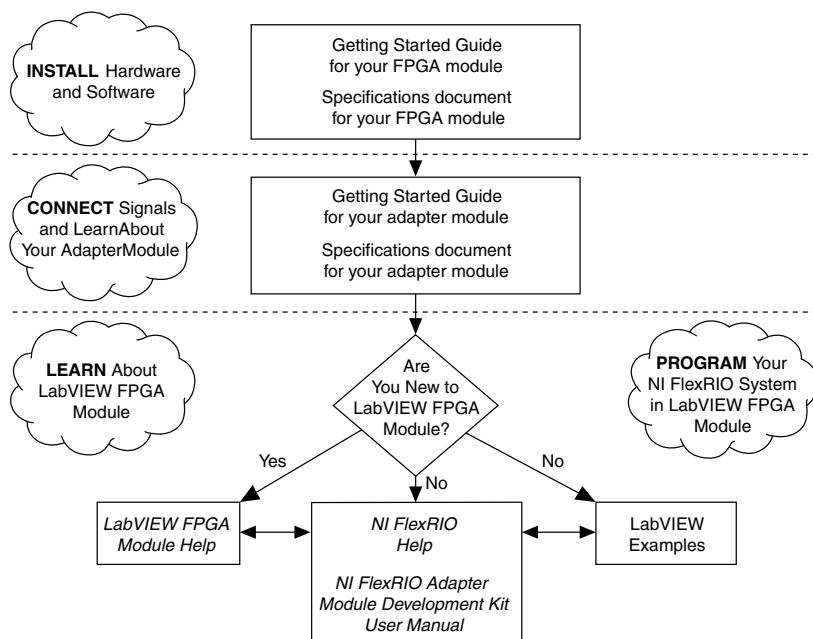
📝 **Note** To ensure the specified EMC performance, the length of all I/O cables must be no longer than 30 m (100 ft).

How to Use Your FlexRIO Documentation

Refer to the following flowchart for information about how to use FlexRIO documentation.

Figure 2. How to Use Your FlexRIO Documentation

FlexRIO Documentation Locations

Table 1. FlexRIO Documentation Locations and Descriptions

Document	Location	Description
Getting started guide for your FPGA module	Available from the Start menu and at *ni.com/manuals*.	Contains installation instructions for your FlexRIO system.
Specifications document for your FPGA module	Available from the Start menu and at *ni.com/manuals*.	Contains specifications for your FPGA module.
Getting started guide for your adapter module	Available from the Start menu and at *ni.com/manuals*.	Contains signal information, examples, and CLIP details for your adapter module.
Specifications document for your adapter module	Available from the Start menu and at *ni.com/manuals*.	Contains specifications for your adapter module.

Table 1. FlexRIO Documentation Locations and Descriptions (Continued)

Document	Location	Description
LabVIEW FPGA Module Help	Embedded in *LabVIEW Help* and at *ni.com/manuals*.	Contains information about the basic functionality of the LabVIEW FPGA Module.
NI FlexRIO Help	Available from the Start menu and at *ni.com/manuals*.	Contains information about the FPGA module, adapter module, and CLIP configuration information.
NI FlexRIO Adapter Module Development Kit User Manual	Available from the Start menu at **Start»All Programs»National Instruments»NI FlexRIO»NI FlexRIO Adapter Module Development Kit» Documentation**.	Contains information about how to create custom adapter modules for use with FlexRIO FPGA modules.
LabVIEW Examples	Available in NI Example Finder. In LabVIEW, click **Help»Find Examples»Hardware Input and Output»FlexRIO**.	Contains examples of how to run FPGA VIs and Host VIs on your device.
IPNet	Located at *ni.com/ipnet*.	Contains LabVIEW FPGA functions and intellectual property to share.
NI FlexRIO product page	Located at *ni.com/flexrio*.	Contains product information and data sheets for FlexRIO devices.

Verifying the System Requirements

To use the NI 5741, your system must meet certain requirements. For more information about minimum system requirements, recommended system, and supported application development environments (ADEs), refer to the readme, which is available on the software media or online at *ni.com/updates*.

Unpacking the Kit

⚠️ **Caution** To prevent electrostatic discharge (ESD) from damaging the device, ground yourself using a grounding strap or by holding a grounded object, such as your computer chassis.

1. Touch the antistatic package to a metal part of the computer chassis.

2. Remove the device from the package and inspect the device for loose components or any other sign of damage.

⚠ **Caution** Never touch the exposed pins of connectors.

📝 **Note** Do not install a device if it appears damaged in any way.

3. Unpack any other items and documentation from the kit.

Store the device in the antistatic package when the device is not in use.

Preparing the Environment

Ensure that the environment you are using the NI 5741 in meets the following specifications.

Operating temperature..0 °C to 55 °C
(IEC 60068-2-1, IEC 60068-2-2)

Operating humidity...10% to 90% RH, noncondensing
(IEC 60068-2-56)

Pollution Degree...2

Maximum altitude...2,000 m at 25 °C ambient temperature

Indoor use only.

📝 **Note** Refer to the *NI 5741 Specifications* at *ni.com/manuals* for complete specifications.

Installing the Application Software and Driver

Before installing your hardware, you must install the application software and instrument driver. Visit *ni.com/info* and enter rdsoftwareversion as the Info Code to determine which minimum software versions you need for your device. Install the software in the following order:

1. Install LabVIEW.

   Refer to the *LabVIEW Installation Guide* for installation instructions for LabVIEW and system requirements for the LabVIEW software. Refer to the *LabVIEW Upgrade Notes* for additional information about upgrading to the most recent version of LabVIEW for Windows. Documentation for LabVIEW is available at *ni.com/manuals* and by selecting **Start**»**All Programs**»**National Instruments**»**LabVIEW**»**LabVIEW Manuals**.

2. Install the LabVIEW FPGA Module.

   Refer to the *LabVIEW FPGA Module Release and Upgrade Notes* for installation instructions and information about getting started with the LabVIEW FPGA Module.

Documentation for the LabVIEW FPGA Module is available at *ni.com/manuals* and by selecting **Start»All Programs»National Instruments»LabVIEW»LabVIEW Manuals**.

3. (Optional) Install the LabVIEW Real-Time Module.

   Refer to the *LabVIEW Real-Time Module Release and Upgrade Notes* for system requirements, installation instructions, and additional information about using the LabVIEW Real-Time Module.

4. Install NI FlexRIO.

   Refer to the *NI FlexRIO Readme* on the NI FlexRIO installation media for system requirements and installation instructions for NI FlexRIO Support. Documentation for NI FlexRIO Support is available at *ni.com/manuals* and by selecting **Start»All Programs»National Instruments»NI FlexRIO**.

   Note If you are not using an adapter module, skip step 5.

5. Install NI FlexRIO Adapter Module Support.

   Refer to the *NI FlexRIO Adapter Module Support Readme* on the NI FlexRIO Adapter Module Support installation media for system requirements and installation instructions. Documentation for NI FlexRIO Adapter Module Support is available at *ni.com/manuals* and by selecting **Start»All Programs»National Instruments»NI FlexRIO»NI FlexRIO Adapter Module Documentation**.

Installing the NI FlexRIO Devices

Note You must install the software before installing the hardware.

Installing the NI FlexRIO Adapter Module

Refer to the getting started guide for your FlexRIO FPGA module for FlexRIO FPGA module installation instructions.

1. Gently insert the guide pins and the high-density card edge of the NI FlexRIO adapter module into the corresponding connectors of the NI FlexRIO FPGA module, as shown in the figure below.

Figure 3. Installing the NI FlexRIO Adapter Module
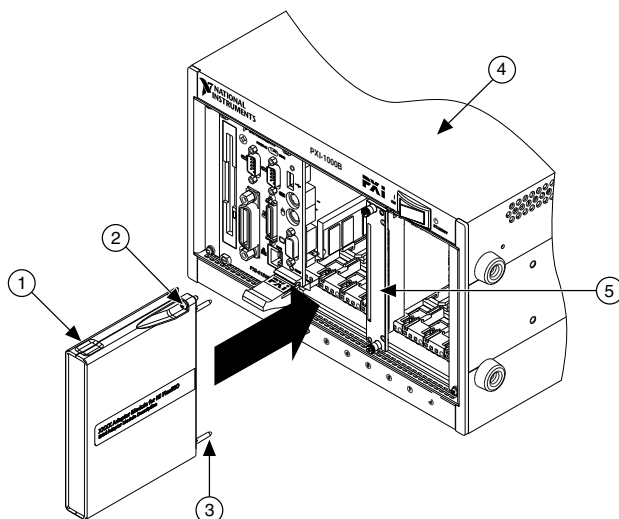
1. NI FlexRIO Adapter Module	4. PXI/PXI Express Chassis
2. Captive Screw	5. NI FlexRIO FPGA Module
3. Guide Pin	

The connection may be tight, but do not force the adapter module into place.

2. Tighten the captive screws on the NI FlexRIO adapter module to secure it to the NI FlexRIO FPGA module. NI recommends using the laser-tipped screwdriver (part number 748677-01) included in the NI 5741 packaging.

3. Launch LabVIEW to begin configuring your NI FlexRIO system.

Connecting Cables

- Use any shielded 50 Ω SMA cable to connect signals to the connectors on the front panel of your NI 5741

- Use the SHH19-H19-AUX cable (NI part number: 152629-01 or 152629-02) to connect to the digital I/O (DIO) and programmable function interface (PFI) signals on the AUX I/O connector. NI recommends using the SCB-19 connector block to access the DIO and PFI signals.

- Use the NI SHC68-C68-D4 VHDCI cable (NI part number: 196275-01) to connect to the AO 0-15 connector.

Removing the Adapter Module

Complete the following steps to remove the adapter module from the FlexRIO FPGA module.

Disabling the Adapter Module in LabVIEW FPGA

To properly remove an adapter module from the FlexRIO FPGA module, you must disable the adapter module within the LabVIEW FPGA user interface. To disable the adapter module within LabVIEW, complete the following steps.

1. In your LabVIEW **Project Explorer** window, right-click the **IO Module** item under the FPGA Target and select **Properties** to display the **IO Module Properties** dialog box.

2. Click the **Status** category to view the adapter module **Status** dialog.

3. Deselect the checkbox for **Enable IO Module Power**. When this option is deselected, firmware tristates the FlexRIO I/O and disables all adapter module power rails.

4. Click **OK**.

Uninstalling the Module

⚠️ **Caution** If the module has been in use, it may exceed safe handling temperatures and cause burns. Allow the module to cool before removing it from the chassis.

1. Disconnect any cables from the module front panel connectors.

⚠️ **Caution** Disconnect any external clock or digital connections to the device front panel. Applying external signals while the device is powered off may cause damage.

2. Power off the chassis.

3. Ground yourself with a grounding strap or touch a grounded metal surface.

4. Unlatch the module by pushing down on the ejector handle.

5. Hold the module by the ejector handle and remove it from the slot.

Store the module in the original antistatic packaging when not in use to avoid damage.

Installing Accessories

The NI SMB-2152 is a breakout box accessory for debugging your NI 5741. The NI part number for the NI SMB-2152 is 189408F-08L.
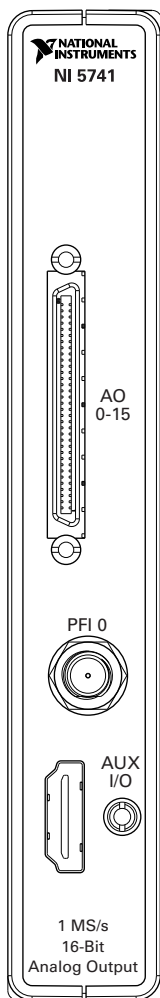
Related Information

For information about installing the NI SMB-2152, refer to the NI SMB-2152 Installation Guide at ni.com/manuals.

Appendix A: NI 5741 Features

Front Panel and Connector Pinouts

The following figure shows the front panel connector and signal descriptions for the NI 5741.

Figure 4. NI 5741 Front Panel Connectors

⚠️ **Caution** To avoid permanent damage to the NI 5741, disconnect all signals connected to the NI 5741 before powering down the module, and connect signals

only after the adapter module has been powered on by the NI FlexRIO FPGA module.

⚠️ **Caution**   Connections that exceed any of the maximum ratings of any connector on the NI 5741 can damage the device and the chassis. NI is not liable for any damage resulting from such connections.

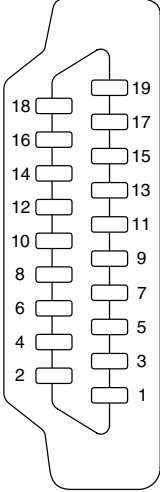**Figure 5.** NI 5741 Analog Output Connector Pinout

Left Signal	Pin	Pin	Right Signal
No Connect	1	35	No Connect
GND	2	36	GND
No Connect	3	37	No Connect
GND	4	38	GND
No Connect	5	39	No Connect
GND	6	40	GND
No Connect	7	41	No Connect
RESERVED	8	42	GND
No Connect	9	43	No Connect
GND	10	44	GND
No Connect	11	45	No Connect
GND	12	46	GND
No Connect	13	47	No Connect
GND	14	48	GND
No Connect	15	49	No Connect
GND	16	50	GND
AO 15	17	51	AO 14
GND	18	52	RESERVED
AO 13	19	53	AO 12
GND	20	54	GND
AO 11	21	55	AO 10
GND	22	56	GND
AO 9	23	57	AO 8
GND	24	58	GND
AO 7	25	59	AO 6
No Connect	26	60	RESERVED
AO 5	27	61	AO 4
GND	28	62	GND
AO 3	29	63	AO 2
No Connect	30	64	No Connect
AO 1	31	65	AO 0
GND	32	66	GND
No Connect	33	67	No Connect
GND	34	68	GND

Related Information

For information about the NI 5741 front panel connector specifications, refer to the NI 5741 Specifications at ni.com/manuals.

AUX I/O Connector

Table 2. NI 5741 AUX I/O Connector Pin Assignments

| AUX I/O Connector	Pin	Signal	Signal Description
	1	DIO Port 0 (0)	Bidirectional single-ended (SE) digital I/O (DIO) data channel.
	2	GND	Ground reference for signals.
	3	DIO Port 0 (1)	Bidirectional SE DIO data channel.
	4	DIO Port 0 (2)	Bidirectional SE DIO data channel.
	5	GND	Ground reference for signals.
	6	DIO Port 0 (3)	Bidirectional SE DIO data channel.
	7	DIO Port 1 (0)	Bidirectional SE DIO data channel.
	8	GND	Ground reference for signals.
	9	DIO Port 1 (1)	Bidirectional SE DIO data channel.
	10	DIO Port 1 (2)	Bidirectional SE DIO data channel.
	11	GND	Ground reference for signals.
	12	DIO Port 1 (3)	Bidirectional SE DIO data channel.
	13	PFI 0	Bidirectional SE DIO data channel.
	14	NC	No connect.
	15	PFI 1	Bidirectional SE DIO data channel.
	16	PFI 2	Bidirectional SE DIO data channel.
	17	GND	Ground reference for signals.
	18	+5 V	+5 V power (10 mA maximum).
	19	PFI 3	Bidirectional SE DIO data channel.

⚠ **Caution** The AUX I/O connector accepts a standard, third-party HDMI cable, but the AUX I/O port is not an HDMI interface. Do not connect the AUX I/O port on the NI 5741 to the HDMI port of another device. NI is not liable for any damage resulting from such signal connections.

Block Diagrams

The following figure shows the NI 5741 block diagram and signal flow.

Figure 6. NI 5741 Block Diagram
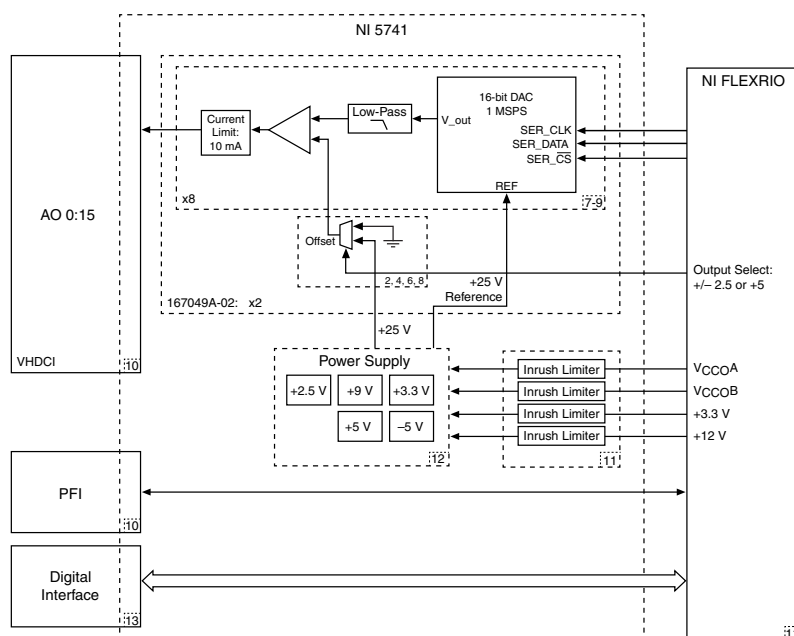
Appendix B: Interfacing with the NI 5741

Component-Level Intellectual Property (CLIP)

The LabVIEW FPGA Module includes component-level intellectual property (CLIP) for HDL IP integration. NI FlexRIO devices support two types of CLIP: user-defined and socketed.

- *User-defined CLIP* allows you to insert HDL IP into an FPGA target, enabling VHDL code to communicate directly with an FPGA VI.
- *Socketed CLIP* provides the same IP integration of the user-defined CLIP, but it also allows the CLIP to communicate directly with circuitry external to the FPGA. Adapter module socketed CLIP allows your IP to communicate directly with both the FPGA VI and the external adapter module connector interface.

The FlexRIO adapter module ships with socketed CLIP items that add module I/O to the LabVIEW project.

CLIP and LabVIEW FPGA

The interface between the NI 5741 CLIP and LabVIEW FPGA in the following figures.

If you are using an NI FlexRIO FPGA module with a Virtex-5 FPGA, refer to the following figure, which shows the relationship between the CLIP and an FPGA VI configured for use with a Virtex-5 FPGA target.

Figure 7. CLIP and FPGA VI Relationship (Virtex-5)
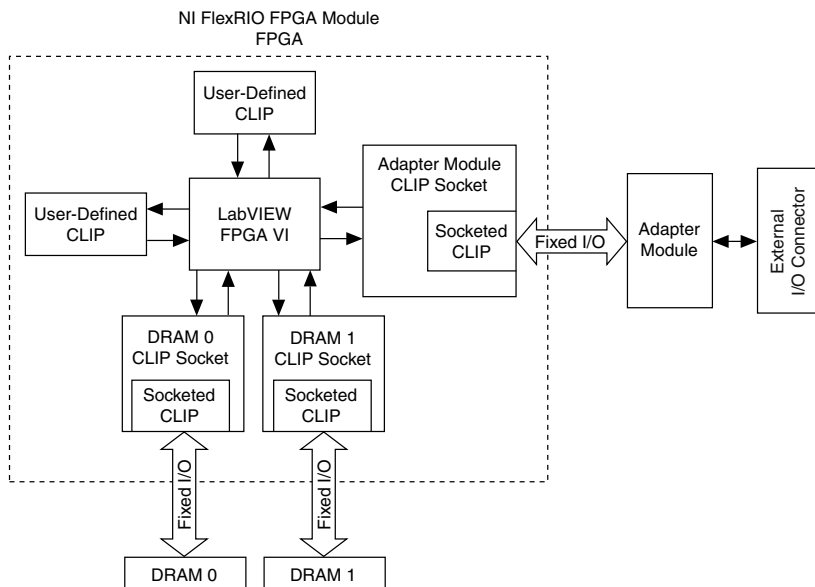
If you are using an NI FlexRIO FPGA module with a Kintex-7 FPGA, refer to the following figure, which shows the relationship between the CLIP and an FPGA VI configured for use with a Kintex-7 FPGA target.
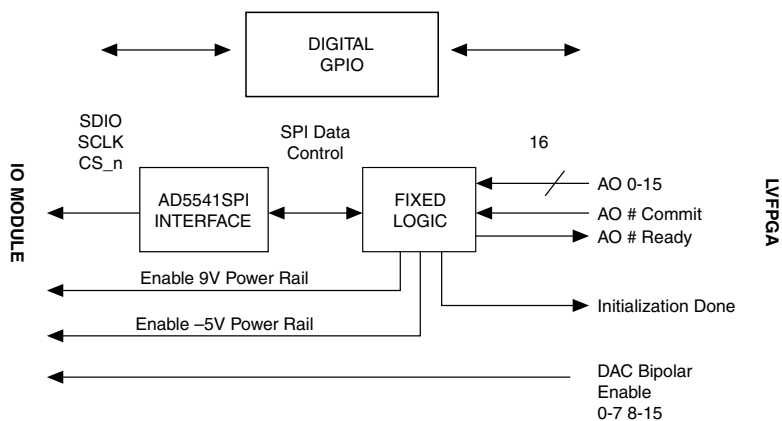
Figure 8. CLIP and FPGA VI Relationship (Kintex-7)
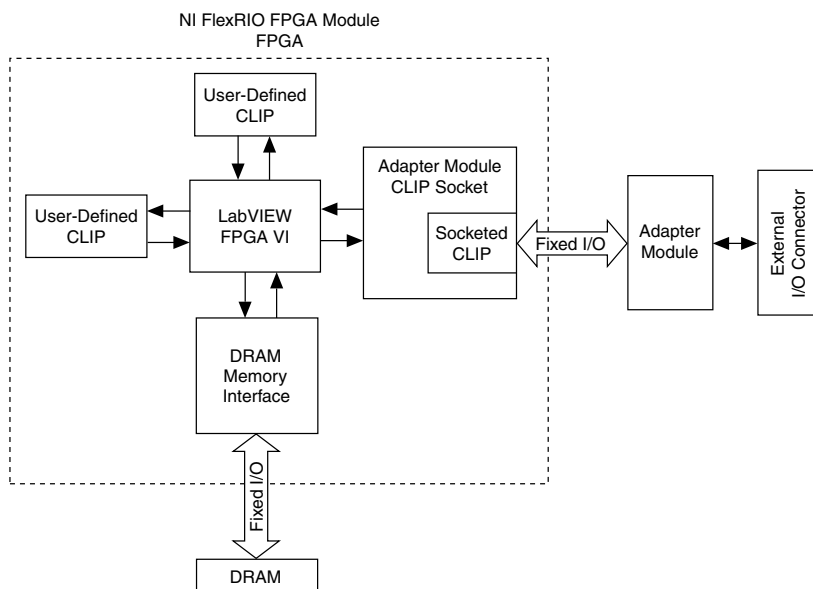
NI 5741 CLIP

The NI 5741 CLIP provides access to sixteen 16-bit analog output channels, eight bidirectional DIO channels, four bidirectional PFI channels, and one bidirectional trigger line.

The following figure shows the relationship between the NI 5741 and LabVIEW FPGA.

Figure 9. NI 5741 CLIP Operation

Clocking

The NI 5741 clock source controls the sample rate and other timing functions on the device. The following table contains information about the possible NI 5741 clock sources.

Table 3. NI 5741 CLIP Clock Sources

Clock	Frequency
DAC Clock[1]	1 MHz to 50 MHz
Clock 40 MHz	40 MHz

Where to Go Next

Refer to the following figure for information about other product tasks and associated resources for those tasks.

Figure 10. Where to Go Next

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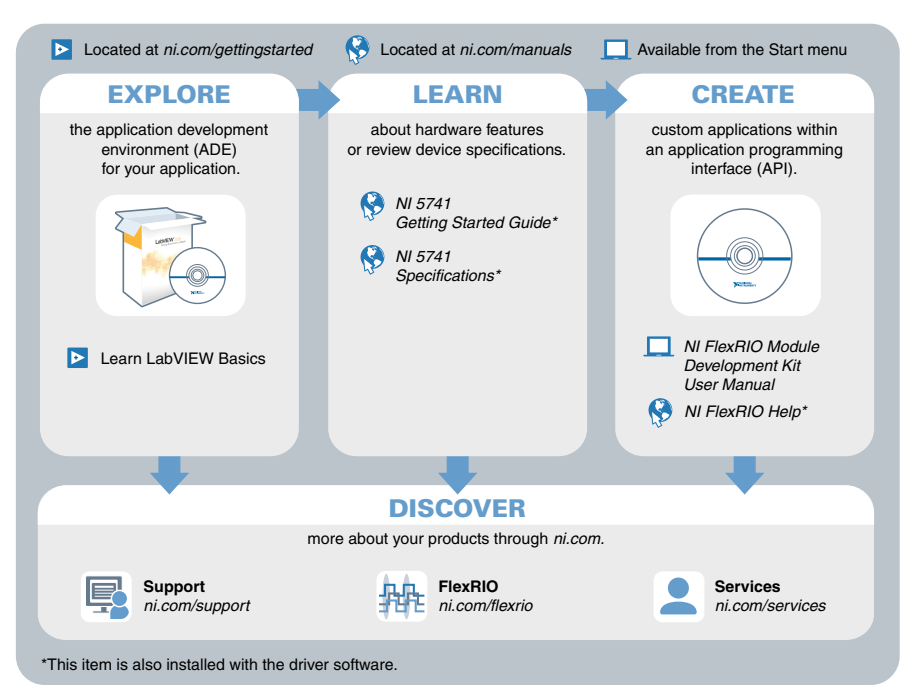
[1] The DAC Clock commits the data to the NI 5741.

Worldwide Support and Services

The National Instruments website is your complete resource for technical support. At *ni.com/support*, you have access to everything from troubleshooting and application development self-help resources to email and phone assistance from NI Application Engineers.

Visit *ni.com/services* for NI Factory Installation Services, repairs, extended warranty, and other services.

Visit *ni.com/register* to register your National Instruments product. Product registration facilitates technical support and ensures that you receive important information updates from NI.

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