NI PXIe-6544/6545/6547/6548 Getting Started

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Contents

NI-HSDIO Device Purpose

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

This document explains how to install, configure, and test the NI 6544/6545/6547/6548. The NI 6544/6545/6547/6548 is a digital waveform generator/analyzer that features 32 bidirectional channels clocked at a maximum of 200 MHz.

To access NI 6544/6545/6547/6548 documentation, go to **Start** » **All Programs** » **National Instruments** » **NI-HSDIO** » **Documentation**.

Note The protection provided by the NI 6544/6545/6547/6548 may be impaired if it is used in a manner not described in this document.

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

Note To ensure the specified EMC performance when connecting a cable to the Digital Data and Control (DDC) connector, install two snap-on, ferrite beads (NI part number 711627-01) included in the shipping kit onto the cable. Place one ferrite bead at each end of the cable, as close to the connector as practical.

Verifying the System Requirements

To use the NI-HSDIO instrument driver, your system must meet certain requirements.

Refer to the product readme, which is available online on the driver software download page or at ni.com/manuals, for more information about minimum system requirements, recommended system, and supported application development environments (ADEs).

Unpacking the Kit

Notice 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.

   Notice 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.

Kit Contents

The kit contains the following items:

- NI-HSDIO instrument driver software media, which installs the following:
  - NI-HSDIO driver
  - NI Script Editor
  - ***NI Digital Waveform Generator/Analyzer Help***
  - ***NI PXIe-6544/6545/6547/6548 Getting Started Guide*** (this document)
- NI Digital Waveform Editor software media
- NI 6544/6545/6547/6548 device
- snap-on ferrite beads (2x) (NI part number 711627-01)
- ***Using Ferrites to Reduce High-Frequency Emissions Note to Users*** document

Preparing the Environment

Ensure that the environment in which you are using the NI 6544/6545/6547/6548 meets the following specifications.

PXI Express Modules

Operating Environment	
Ambient temperature range	0 °C to 40 °C
Relative humidity range	10% to 90%, noncondensing
Maximum altitude	2,000 m (800 mbar) (at 25 °C ambient temperature)
Pollution Degree	2

Indoor use only.

Installing the Software

You must be an Administrator to install NI software on your computer.

1. Install an ADE, such as LabVIEW or LabWindows™/CVI™.
2. Download the driver software installer from ni.com/downloads.
   Package Manager downloads with the driver software to handle the installation. Refer to the Package Manager Manual for more information about installing, removing, and upgrading NI software using Package Manager.
3. Follow the instructions in the installation prompts.

   Note Windows users may see access and security messages during installation. Accept the prompts to complete the installation.

4. When the installer completes, select **Restart** in the dialog box that prompts you to restart, shut down, or restart later.

NI Script Editor

The NI Script Editor helps you develop linking and looping waveform generation operations.

The NI Script Editor is installed when you install NI-HSDIO. For more information, launch the NI Script Editor and select **Help » NI Script Editor Help** from the toolbar.

NI Digital Waveform Editor

The NI Digital Waveform Editor (NI DWE) allows you to create, edit, and import digital test vectors.

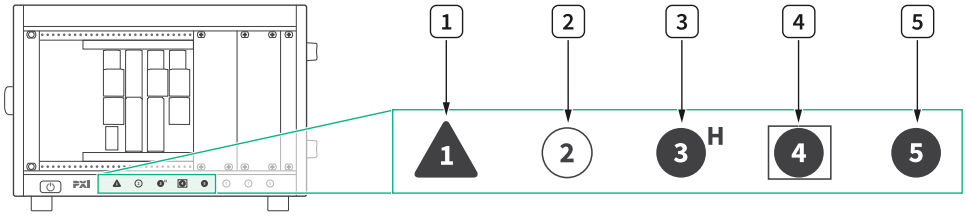
Note To use the NI DWE, install it after you install NI-HSDIO.

Installing the NI 6544/6545/6547/6548

Notice To prevent damage to the NI 6544/6545/6547/6548 caused by ESD or contamination, handle the module using the edges or the metal bracket.

1. Ensure the AC power source is connected to the chassis before installing the module.
   The AC power cord grounds the chassis and protects it from electrical damage while you install the module.
2. Power off the chassis.
3. Inspect the slot pins on the chassis backplane for any bends or damage prior to installation. Do not install a module if the backplane is damaged.
4. Remove the black plastic covers from all the captive screws on the module front panel.
5. Identify a supported slot in the chassis. The following figure shows the symbols that indicate the slot types.

Figure 1. Chassis Compatibility Symbols

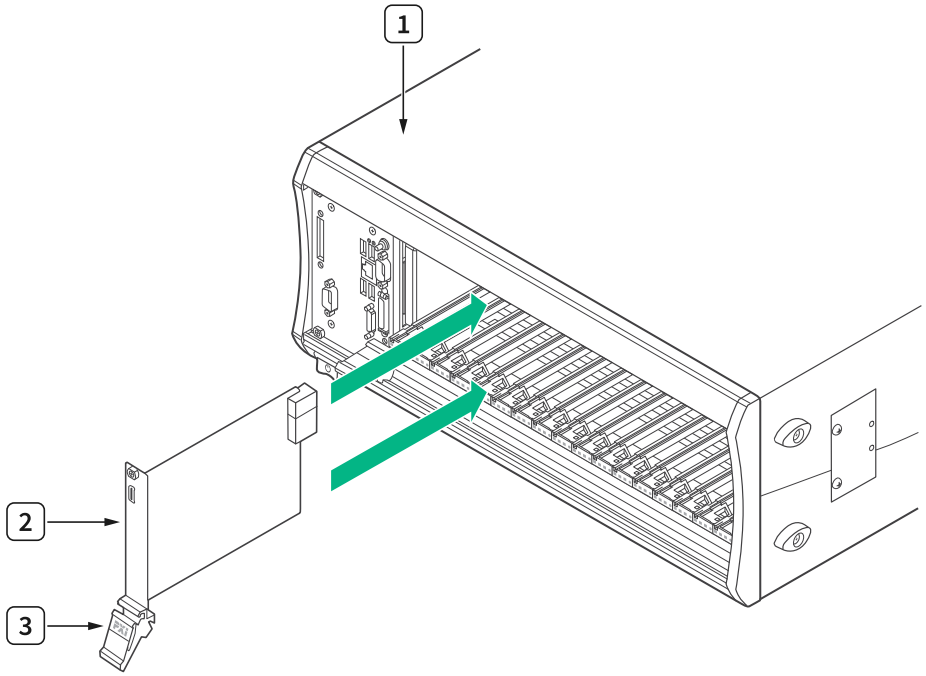


1. PXI Express System Controller Slot
2. PXI Peripheral Slot
3. PXI Express Hybrid Peripheral Slot
4. PXI Express System Timing Slot
5. PXI Express Peripheral Slot

NI 6544/6545/6547/6548 modules can be placed in PXI Express peripheral slots, PXI Express hybrid peripheral slots, or PXI Express system timing slots.

6. Touch any metal part of the chassis to discharge static electricity.
7. Ensure that the ejector handle is in the downward (unlatched) position.
8. Place the module edges into the module guides at the top and bottom of the chassis. Slide the module into the slot until it is fully inserted.

Figure 1. Module Installation



1. Chassis
2. Hardware Module
3. Ejector Handle in Downward (Unlatched) Position

9. Latch the module in place by pulling up on the ejector handle.
10. Secure the module front panel to the chassis using the front-panel mounting screws.

> **Note** Tightening the top and bottom mounting screws increases mechanical stability and also electrically connects the front panel to the chassis, which can improve the signal quality and electromagnetic performance.

11. Cover all empty slots using either filler panels (standard or EMC) or slot blockers with filler panels, depending on your application.

> **Note** For more information about installing slot blockers and filler panels, go to ni.com/r/pxiblocker.

12. Power on the chassis.

NI 6544/6545/6547/6548 Front Panels

The NI 6544/6545/6547/6548 front panel exposes the following connections:

- Three SMA connectors named CLK IN, PFI 0, and CLK OUT
- One 68-pin VHDCI connector named DIGITAL DATA & CONTROL, or DDC

Figure 3. NI 6544/6545/6547/6548 Front Panel with VHDCI Connector Pinout

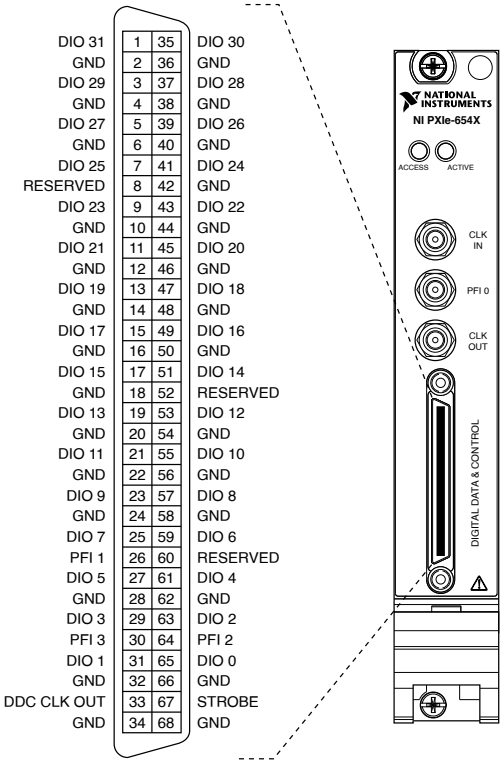


Table 1. NI 6544/6545/6547/6548 DDC Connector Pins

Pins	Signal Name	Signal Type	Signal Description
33	DDC_CLK OUT	Control	Output terminal for the exported Sample Clock.
67	Strobe	Control	Terminal for the external Sample clock source, which can be used for dynamic acquisition.
1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 35, 37, 39, 41, 43, 45, 47, 49, 51, 53, 55, 57, 59, 61, 63, 65	DIO <0..31>	Data	Bidirectional digital I/O data channels 0 through 31.
26, 30, 64	Programmable Function Interface	Control	Input terminals to the device for external triggers, or output

Pins	Signal Name	Signal Type	Signal Description
	(PFI) <1..3>		terminals from the device for events.
2, 4, 6, 10, 12, 14, 16, 18, 20, 22, 24, 28, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 54, 56, 58, 62, 66	GND	Ground	Ground reference for signals.
8, 52, 60	RESERVED	N/A	Terminals reserved for future use. Do not connect to these pins.

Table 2. NI 6544/6545/6547/6548 SMA Connectors

Connector	Signal Name	Signal Type	Description
CLK IN	Reference Clock Input	Control	Terminal for the external Reference clock used for the PLL or for the external Sample clock used for dynamic generation and/or acquisition.
PFI 0	PFI 0	Control	Single-ended input terminals to the device for static I/O, for external triggers, or for output terminals from the device for events. Refer to the device

Connector	Signal Name	Signal Type	Description
			specifications for signal voltage levels.
CLK OUT	Reference Clock Output	Control	Terminal for the exported PLL Reference clock or the exported Sample clock.

Table 3. ACTIVE LED Indicators

Color	Indications
Off	Device not armed and not triggered.
Amber	Device armed and awaiting Start Trigger. If performing a dynamic acquisition operation, the device may be acquiring pretrigger samples.
Green	Device received Start Trigger.
Red	Error condition.

Table 4. ACCESS LED Indicators

Color	Indications
Off	Device not ready.
Amber	Device being accessed by software.
Green	Device ready to be programmed
Red	Running the niHSDIO Self Test VI or calling the niHSDIO_self_test function produced a failure.

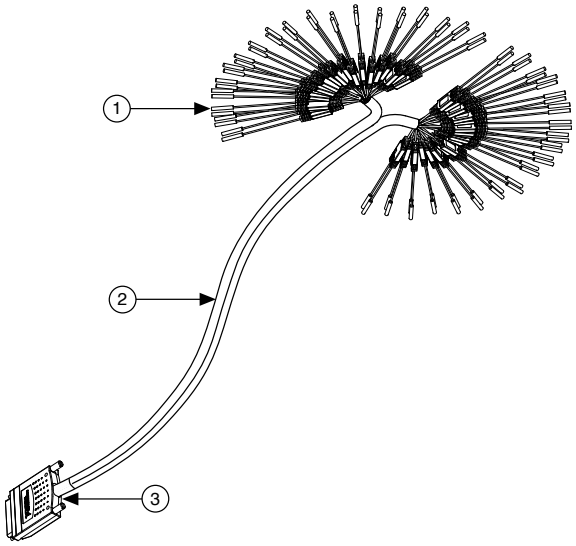
Cables for DDC connector

Note To ensure the specified EMC performance when connecting a cable to the Digital Data and Control (DDC) connector, install the two snap-on, ferrite beads (NI part number 711627-01)included in the shipping kit onto the cable. Place one ferrite bead at each end of the cable, as close to the connector as practical.

Use one of the following cables for connections to the Digital Data and Control (DDC) connector on the NI 6544/6545/6547/6548.

- NI 6544/6545/6547/6548 shielded single-ended cable with individual microcoaxial 50 Ω lines for each signal
- NI 6544/6545/6547/6548 unshielded single-ended digital cable
- NI 6544/6545/6547/6548 shielded low-leakage cable. Use this cable if current leakage is a concern.
- NI 6544/6545/6547/6548 shielded flying lead cable

Figure 4. Single-Ended Flying Lead Cable Parts Locator Diagram



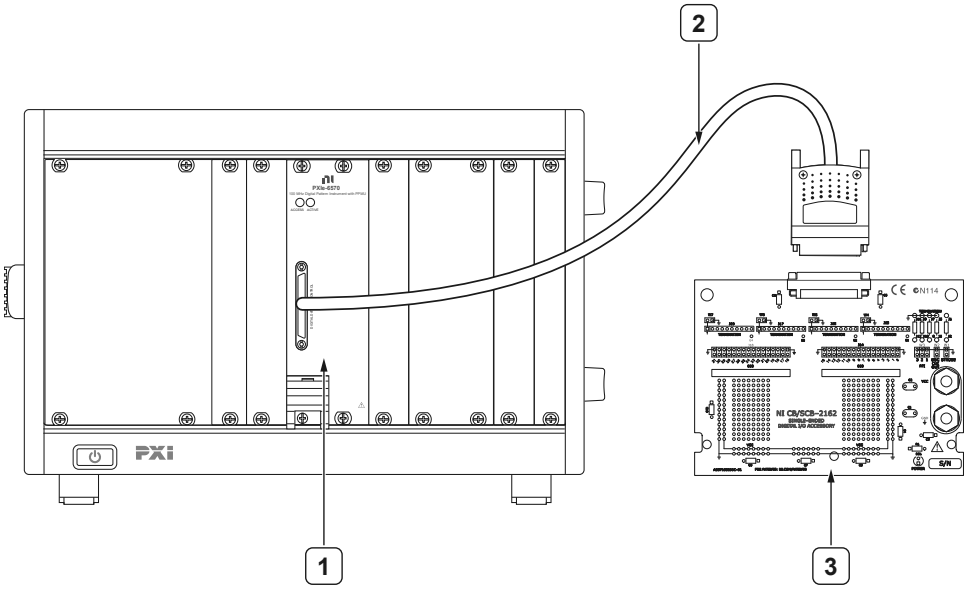
1. Lead Pairs
2. Removable Sleeving
3. 68-Pin VHDCI Connector

Note Always terminate cables properly to avoid improper measurements caused by signal reflections, overshoot, and undershoot. Refer to the ***NI Digital Waveform Generator/Analyzer Help*** for more information about signal termination.

Connecting Accessories

- Connect the NI CB-2162 single-ended digital I/O accessory to access the DDC connector on the device, to terminate the DIO channels on the device, or to develop a platform for prototyping circuits and testing DUTs. Refer to the following figure to the connect the NI CB-2162 to the NI 6544/6545/6547/6548.

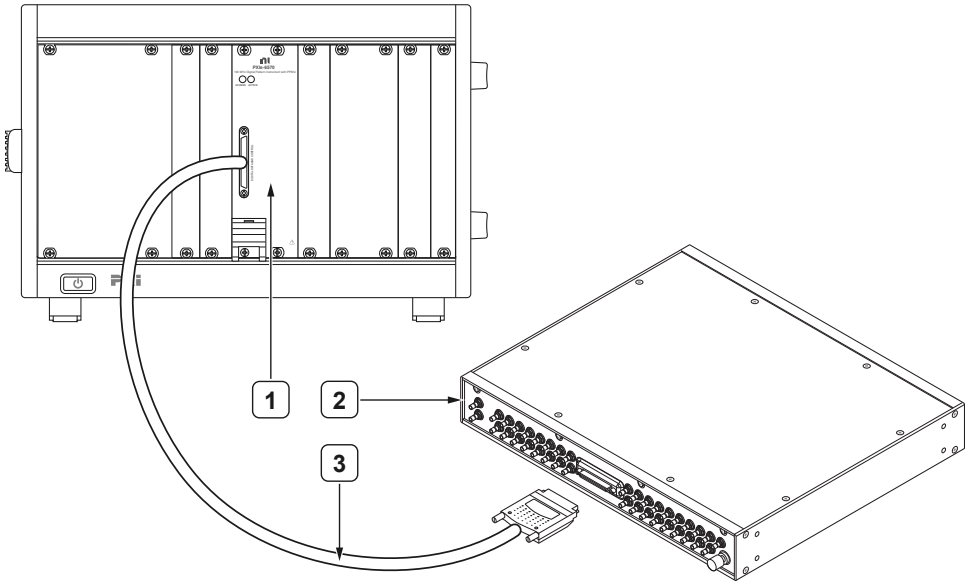
  Figure 5. Connecting the NI CB-2162 and an NI-HSDIO device



  1. Chassis with NI-HSDIO device
  2. NI SHC68-C68-D4 Cable
  3. NI CB-2162 Accessory

- Connect the NI SMB-2163 accessory to the NI 6544/6545/6547/6548 in order to interface to other devices for testing and debugging. Refer to the following figure to the connect the NI SMB-2163 to the NI 6544/6545/6547/6548.

Figure 6. Connecting the NI SMB-2163 and an NI-HSDIO device



1. Chassis with NI-HSDIO device
2. NI SMB-2163 Accessory
3. NI SHC68-C68-D4 Cable

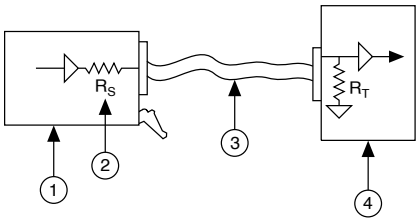
Connecting a Custom Accessory

Many common NI digital waveform generator/analyzer applications require you to create a custom accessory to access the signals of your device under test (DUT). To connect a custom accessory to the VHDCI DDC connector on the NI 6544/6545/6547/6548, purchase a mating connector for the VHDCI cable from NI. For more information, refer to the ***Interfacing to the NI Digital Waveform Generator/Analyzer using the VHDCI Connector*** application note, available by entering the info code `rdinwa` at ni.com/info.

Dynamic Generation Wiring Considerations

You may need additional parallel termination resistance at the destination for optimal signal quality during dynamic generation, depending on the loading of the device under test (DUT). Refer to the ***NI Digital Waveform Generator/Analyzer Help*** for information about signal termination. The following figure shows how the NI 6544/6545/6547/6548 generates data through a matched impedance system.

Figure 7. Dynamic Generation Functional Diagram

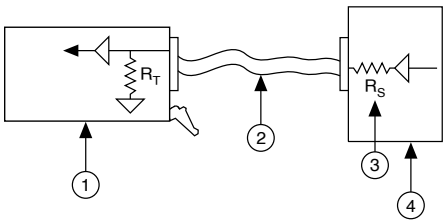


1. NI-HSDIO device
2. 50 Ω source impedance (Rs)
3. 50 Ω cable
4. Device under test (DUT)

Dynamic Acquisition Wiring Considerations

During dynamic acquisition, the device under test (DUT) generating the signals must have a matched source impedance as close to 50 Ω as possible in order to minimize signal reflections and maintain optimal signal quality. The following figure shows how the NI 6544/6545/6547/6548 acquires data through a matched impedance system. Refer to the specifications document for your device for supported input impedances (R_T).

Figure 8. Dynamic Acquisition Functional Diagram



1. NI-HSDIO device
2. 50 Ω cable
3. 50 Ω source impedance (Rs)
4. Device under test (DUT)

Configuring the NI 6544/6545/6547/6548 in MAX

Use Measurement & Automation Explorer (MAX) to configure your NI hardware. MAX informs other programs about which NI hardware products are in the system and how

they are configured. MAX is automatically installed with NI-HSDIO.

1. Launch MAX.
2. In the configuration tree, expand **Devices and Interfaces** to see the list of installed NI hardware.

> **Note** If you are using the NI 6544/6545/6547/6548 with the LabVIEW Real-Time Module, expand **Remote Systems**. Find your target IP address or name, expand it, and then expand **Devices and Interfaces**.

3. Expand your **Chassis** tree item.
   MAX lists all modules installed in the chassis. Your default names may vary.

> **Note** If you do not see your module listed, press <F5> to refresh the list of installed modules. If the module is still not listed, power off the system, ensure the module is correctly installed, and restart.

4. Record the identifier MAX assigns to the hardware. Use this identifier when programming the NI 6544/6545/6547/6548.
5. Self-test the hardware by selecting the item in the configuration tree and clicking **Self-Test** in the MAX toolbar.
   The MAX self-test performs a basic verification of hardware resources.

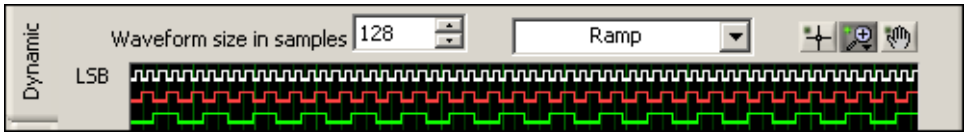
Using the Test Panel to Generate Digital Data

To verify your device configuration, use the device test panel in MAX to generate simple digital data using the NI 6544/6545/6547/6548.

1. Remove any signal connections to the device.
2. Right-click the device under the appropriate **Chassis**, and select **Test Panels**.
3. Select the **Dynamic** tab on the side of the pane.
4. Click **Select All** to select all of your channels. The digital waveform now appears in the graph.
5. Enter the frequency in the **Clock Frequency** control, located on the left side of the test panel.
6. Enter values for the generation and acquisition voltages in the controls below the **Clock Frequency** control. You can enter `High` and `Low` values to create your own

custom levels for the device.

7. Choose a fill pattern. The following figure shows the pattern control and the first few signals in the window.



Note When generating a Marching Ones or Marching Zeroes waveform, make the waveform size a multiple of the number of selected channels.

8. Click **Play** to generate the waveform shown in the graph on the selected channels. The default generation option is **Continuous**, but you can toggle this setting using the control below the graph.
   Because the data channels on the NI 6544/6545/6547/6548 are bidirectional, while the data is being continuously generated on all of the channels, as in the previous step, you can acquire the data being generated.

Note Refer to the specifications document for information about the setup and hold times and propagation delays associated with generation operations of the device. At some frequencies, generating data on the same channels when no cable is attached to the DIGITAL DATA & CONTROL (DDC) connector violates these timing parameters and results in incorrectly sampled data. For information, refer to the ***NI Digital Waveform Generator/Analyzer Help***.

Using the Test Panel to Acquire Digital Data

To verify your device configuration, use the device test panel in MAX to acquire simple digital data using the NI 6544/6545/6547/6548.

1. Click the **Acquisition** tab.
2. Click **Play**.
   The device acquires the digital data that you generated in the previous steps, and the data is displayed on the graph.

3. Click **Close** when you are finished.

Programming the NI-HSDIO

You can generate or acquire data using the NI-HSDIO instrument driver to program the NI 6544/6545/6547/6548 in the supported ADE of your choice.

Table 5. NI 6544/6545/6547/6548 Programming Options

Application Programming Interface (API)	Location	Description
NI-HSDIO Instrument Driver	LabVIEW—Available on the LabVIEW Functions palette at **Measurement I/O » NI-HSDIO**.	NI-HSDIO configures and operates the device hardware and performs basic waveform generation and acquisition using LabVIEW VIs or LabWindows/CVI functions.
	C or LabWindows/CVI—Available at **Program Files » IVI Foundation » IVI » Drivers » niHSDIO**.	
	Microsoft Visual C/C++—Use examples located in the `<NIDocDir>\NI-HSDIO\examples` directory, where `<NIDocDir>` is one of the following directories: • Windows 8/7/Vista—`Users\Public\Documents\National Instruments` • Windows XP—`Documents and Settings\All Users\Shared Documents\National Instruments`	You can modify an NI-HSDIO C example to create an application with Microsoft Visual C/C++. Copy an NI-HSDIO example to copy required project settings for include paths and library files. Alternatively, refer to the ***Creating an Application with Microsoft Visual C and C++*** topic of the ***NI Digital Waveform Generator/Analyzer Help*** to manually add all required include and library files to your project.

NI-HSDIO Examples

To locate programming examples, refer to the following table.

Table 6. NI-HSDIO Example Locations

Application Development Environment (ADE)	Location
LabVIEW or LabWindows/CVI	Within LabVIEW or LabWindows/CVI, select **Help » Find Examples**, and navigate to **Hardware Input and Output » Modular Instruments**.
ANSI C	Available at `<NIDocDir>\NI-HSDIO\examples\` directory, where `<NIDocDir>` is one of the following directories: • Windows 8/7/Vista—`Users\Public\Public Documents\National Instruments` • Windows XP—`Documents and Settings\All Users\Shared Documents\National Instruments`

Troubleshooting

If an issue persists after you complete a troubleshooting procedure, search our KnowledgeBase for additional information our technical support engineers create as they answer common user questions and resolve unexpected issues.

What Should I Do if the NI 6544/6545/6547/6548 Does Not Appear in MAX?

1. In the MAX configuration tree, expand **Devices and Interfaces**.
2. Expand the **Chassis** tree to see the list of installed hardware, and press <F5> to refresh the list.
3. If the module is still not listed, power off the system, ensure that all hardware is correctly installed, and restart the system.
4. Navigate to the Device Manager by right-clicking the Start button, and selecting **Device Manager**.
5. Verify the NI 6544/6545/6547/6548 appears in the Device Manager.
   a. Under an NI entry, confirm that a NI 6544/6545/6547/6548 entry appears.

> **Note** If you are using a PC with a device for PXI remote control system, under **System Devices**, also confirm that no error conditions appear for the **PCI-to-PCI Bridge**.

b. If error conditions appear, reinstall the NI-HSDIO driver.

What Should I Do if the NI 6544/6545/6547/6548 Fails the Self-Test?

1. Restart the system.
2. Launch MAX, and perform the self-test again.
3. Power off the chassis.
4. Reinstall the failed module in a different slot.
5. Power on the chassis.
6. Perform the self-test again.

Why Is the ACCESS LED Off When the Chassis Is On?

The LEDs may not light until the module has been configured in MAX. Before proceeding, verify that the NI 6544/6545/6547/6548 appears in MAX.

If the ACCESS LED fails to light after you power on the chassis, a problem may exist with the chassis power rails, a hardware module, or the LED.

> **Notice** Apply external signals only while the NI 6544/6545/6547/6548 is powered on. Applying external signals while the module is powered off may cause damage.

1. Disconnect any signals from the module front panels.
2. Power off the chassis.
3. Remove the module from the chassis and inspect it for damage. Do not reinstall a damaged module.
4. Install the module in a different chassis slot from which you removed it.
5. Power on the chassis.

> **Note** If you are using a PC with a device for PXI remote control system,

> power on the chassis before powering on the computer.

6. Verify that the module appears in MAX.
7. Reset the module in MAX and perform a self-test.

NI Services

Visit ni.com/support to find support resources including documentation, downloads, and troubleshooting and application development self-help such as tutorials and examples.

Visit ni.com/services to learn about NI service offerings such as calibration options, repair, and replacement.

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

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