The NI 653x cable adapter interfaces with National Instruments high-speed digital I/O (DIO) devices. The cable adapter provides an easy way to connect the Very High Density Connector Interface (VHDCI) connectors, labeled as Digital Data & Control, on the NI 6535/6536/6537 devices and NI 6535B/6536B/6537B devices to the 68-pin DAQ connectors found on older NI 6533/6534 accessories and fixturing. The cable adapter is also compatible with the NI 654x and NI 655x digital pattern generator/analyzer devices.

For best signal integrity, NI recommends using the NI 6535/6536/6537 and 6535B/6536B/6537B devices with newer accessories such as the NI CB-2162 and NI SMB-2163.

This guide explains how to set up and use the NI 653x cable adapter.
What You Need to Get Started

To set up and use the NI 653x cable adapter, you need the following items:

- NI SHC68-C68-D2 or NI C68-C68-D4 cable assembly (for NI 6535/6536/6537/654x/655x and NI 6535B/6536B/6537B devices)
- Compatible NI high-speed digital I/O device (NI 6535/6536/6537/654x/655x or NI 6535B/6536B/6537B)
- (Optional) 22- to 26-gauge wire
- (Optional) The documentation included with the NI high-speed DIO device and the driver software included with your device
- (Optional) NI 6533 or NI 6534 supported terminal block

Related Documentation

National Instruments high-speed DIO devices ship with several documents designed to familiarize you with different aspects of the device. The titles and location of the documents vary based on the driver that supports the NI device, but you should have the following types of documentation:

- Getting Started Guide—This printed document should be the first thing you read. Its purpose is to guide you through setting up the high-speed DIO device and configuring it to generate or acquire your first samples.
- Help—This online document provides more in-depth information about the hardware capabilities of the high-speed DIO device, theory of operation discussion, and information on programming flow and software reference.
- Specifications—This printed document provides specifications for the NI hardware.

Visit ni.com/manuals for the most current documentation.

You may also have documentation for any application development environment (ADE) you are using.
Parts Locator Diagram

Refer to Figure 1 to locate connectors and components on the NI 653x cable adapter.

![Parts Locator Diagram](image)

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Enclosure Base</td>
</tr>
<tr>
<td>2</td>
<td>Jacksockets (M2.5 Screw, #2-56 Socket)</td>
</tr>
<tr>
<td>3</td>
<td>68-Pin DAQ Connector</td>
</tr>
<tr>
<td>4</td>
<td>Enclosure Top Cover</td>
</tr>
<tr>
<td>5</td>
<td>M2.5 × 6 mm Phillips Flathead Countersunk Screws</td>
</tr>
<tr>
<td>6</td>
<td>Terminal Connectors</td>
</tr>
<tr>
<td>7</td>
<td>VHDCI Connector</td>
</tr>
<tr>
<td>8</td>
<td>#2-56 Custom Screw</td>
</tr>
</tbody>
</table>

**Figure 1.** NI 653x Cable Adapter Parts Locator Diagram
Installing Cables

An SHC68-C68-D2 or C68-C68-D4 cable connects the NI 653x cable adapter to the NI high-speed DIO device. Figure 2 shows how to install the cable.

![Diagram showing cable installation](image)

**Figure 2.** Connecting a SHC68-C68-D2 or C68-C68-D4 Cable to the NI 653x Cable Adapter

**Caution** Before connecting the cable, disconnect power from the NI device and any other connected hardware to prevent damage to the hardware and personal injury. NI is not liable for damage resulting from improper connections.

Refer to Figure 2 as you complete the following steps to install the cable adapter:

1. Insert the cable into the cable adapter.
2. Tighten the cable jackscrews.

**Caution** Before attaching any cables or accessories, install the NI high-speed DIO device. Refer to the Getting Started Guide that shipped with your device for instructions on installing the device.
Removing the NI 653x Cable Adapter from its Enclosure

You will need to remove the NI 653x cable adapter from its enclosure to connect signals. To remove the cable adapter from its enclosure, complete the following steps:

1. Remove the screws from the cable adapter enclosure top cover, as shown in Figure 3.

![Figure 3. Remove Screws from the Enclosure](image)

2. Remove the enclosure top cover.

Note Be sure to remove the screws from the side with the NI logo label, as shown in Figure 3.
Connecting Signals

The NI 653x cable adapter provides connectivity to up to 32 of the single-ended DIO channels of an NI high-speed DIO device. Each DIO, PFI, and clock channel of the NI high-speed DIO device connects to a corresponding pin on the NI 653x cable adapter. The 32 DIO channels are directly connected between the two bulk connectors. PFI <0..5> from the NI 6535/6535B, NI 6536/6536B, and NI 6537/6537B VHDCI connector are connected to a 6-position screw terminal. PFI <0..7> from the NI 6533/6534 68-pin DAQ connector are connected to an 8-position screw terminal.

PFI channels must be manually connected through screw terminals for flexibility and to ensure correct signal routing. You can make connections between the PFI channels using 22- to 26-gauge wire.

The NI 6533/6534 devices have specific applications for PFI channels and thus require custom wiring to be compatible. An example of how to make these connections is provided in the *NI 6535/6536/6537 or NI 6535B/6536B/6537B Custom Wiring Example* section.
Figure 4 shows the screw terminal locations on the NI 653x cable adapter.

![Diagram of NI 653x Signal Connections]

**Figure 4.** NI 653x Signal Connections

**Note**  Refer to the help file for your device for information about the number of available DIO channels on your device. DIO <20..31> or PFI_0 may not be applicable to your device.
Figures 5 and 6 show pinouts for the VHDCI connector and 68-pin DAQ connector, respectively.

![VHDCI Connector Pinout](image)

**Figure 5.** VHDCI Connector Pinout (NI SHC68-C68-D2 or NI C68-C68-D4 Cable)
Figure 6. 68-pin DAQ Connector (NI 6533/6534 Fixture or Accessory)
Table 1 describes the VHDCI signals shown in Figure 5. Table 2 describes the DAQ connector signals shown in Figure 6.

### Table 1. VHDCI Connector Pinout Descriptions (NI 6535/6536/6537/654x/655x and NI 6535B/6536B/6537B)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal Description</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIO &lt;0..31&gt;</td>
<td>Bidirectional digital data channels 0 through 31.</td>
<td>P0 &lt;0..7&gt;, P1 &lt;0..7&gt;, P2 &lt;0..7&gt;, or P3 &lt;0..7&gt; on a 68-pin DAQ connector</td>
</tr>
<tr>
<td>PFI &lt;0..5&gt;</td>
<td>Programmable functional interface (PFI) channels 0 through 5.</td>
<td>6-position screw terminal (J4)</td>
</tr>
<tr>
<td>GND</td>
<td>Ground reference for signals.</td>
<td>—</td>
</tr>
<tr>
<td>RESERVED</td>
<td>These channels are reserved for system use. Do not connect signals to these channels.</td>
<td>—</td>
</tr>
</tbody>
</table>

Note: Refer to your device documentation for supported channels.

### Table 2. DAQmx Connector Pinout Descriptions (NI 6533/6534)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal Description</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0 &lt;0..7&gt;</td>
<td>Bidirectional digital data port 0 channels 0 through 7.</td>
<td>VHDCI DIO &lt;0..7&gt;</td>
</tr>
<tr>
<td>P1 &lt;0..7&gt;</td>
<td>Bidirectional digital data port 1 channels 0 through 7.</td>
<td>VHDCI DIO &lt;8..15&gt;</td>
</tr>
<tr>
<td>P2 &lt;0..7&gt;</td>
<td>Bidirectional digital data port 2 channels 0 through 7.</td>
<td>VHDCI DIO &lt;16..23&gt;</td>
</tr>
<tr>
<td>P3 &lt;0..7&gt;</td>
<td>Bidirectional digital data port 3 channels 0 through 7.</td>
<td>VHDCI DIO &lt;24..31&gt;</td>
</tr>
<tr>
<td>PFI &lt;0..7&gt;</td>
<td>Programmable functional interface (PFI) channels 0 through 7.</td>
<td>8-position screw terminal (J3)</td>
</tr>
<tr>
<td>+ 5 V</td>
<td>DC power</td>
<td>Unpopulated W1</td>
</tr>
<tr>
<td>C PULL, D PULL</td>
<td>Power on state control</td>
<td>NC</td>
</tr>
</tbody>
</table>

Note: The NI 6535/6536/6537/654x/655x and the NI 6535B/3536B/6537B do not provide +5 V. If your fixtures require this, access to the +5 V signal on the DAQ connector is provided through the unpopulated W1 through-hole solder pad.
**Caution** Connections that exceed any of the maximum ratings for the NI 653x cable adapter or the NI high-speed DIO device can damage the device and the computer. Maximum input ratings are provided in the *Specifications* section and in the specifications document that shipped with the NI high-speed DIO device. NI is not liable for any damage resulting from such signal connections.

Table 3 shows the relationship between PFI channels and the termination sockets.

**Table 3. PFI Screw Terminals**

<table>
<thead>
<tr>
<th>Connector</th>
<th>Channel</th>
<th>Socket</th>
</tr>
</thead>
<tbody>
<tr>
<td>VHDCI (NI 6535/6536/6537/654x/655x and NI 6535B/6536B/6537B)</td>
<td>PFI &lt;0..5&gt;</td>
<td>J4</td>
</tr>
<tr>
<td>68-Pin DAQ Connector (NI 6533/6534)</td>
<td>PFI &lt;0..7&gt;</td>
<td>J3</td>
</tr>
</tbody>
</table>

**Note** Refer to the help file for your device for information about the number of available DIO channels on your device. DIO <20..31> or PFI_0 may not be applicable to your device.
**NI 6535/6536/6537 or NI 6535B/6536B/6537B Custom Wiring Example**

You can use different wiring schemes to connect the PFI channels in multiple configurations. This section describes a burst handshaking example using an NI 653x cable adapter to provide compatibility between an NI 6533/6534 and an NI 6535/6536/6537 or NI 6535B/6536B/6537B where the fixture is configured to work with the NI 6533/6534. Without changing the fixture setup, the adapter and software can be changed to maintain functionality.

The NI 653x cable adapter can be configured using 22- to 26-gauge wire as shown in Figure 7.

![Figure 7. Example Connectivity](image)
This custom wiring results in the signal assignments shown in the following table.

<table>
<thead>
<tr>
<th>VHDCI</th>
<th>68-Pin DAQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>NI 6535/6536/6537 or NI 6535B/6536B/6537B</td>
<td>NI 6533/6534</td>
</tr>
<tr>
<td>PFI_0</td>
<td>PFI_2 (REQ/Pause)</td>
</tr>
<tr>
<td>PFI_1</td>
<td>PFI_6 (ACK/Ready for Transfer)</td>
</tr>
<tr>
<td>PFI_4</td>
<td>PFI_4 (CLK OUT)</td>
</tr>
</tbody>
</table>

A burst handshaking example using the NI 6533/6534 can be coded in LabVIEW as shown in Figure 8.

![Figure 8. NI 6533/6534 Burst Handshaking Application](image)
Figure 9 shows the changes made to this LabVIEW VI to accommodate the NI 653x cable adapter connections and provide compatibility with the previous application using an NI 6535/6536/6537 or an NI 6535B/6536B/6537B instead of an NI 6533/6534.

Figure 9. NI 653x Burst Handshaking Application with NI 653x Cable Adapter and NI 6535/6536/6537 or NI 6535B/6536B/6537B (Changes Circled)
Specifications

Digital I/O

- VHDCI DIO channels: 32, single-ended
- VHDCI control channels: 6, single-ended
- DAQ DIO channels: 32, single-ended
- DAQ control channels: 8, single-ended

Traces

- Type: Matched length to 100 mils
- AC impedance: 50 Ω

Power

- Maximum voltage rating: 5.5 V

Physical

- Dimensions: 62.7 x 69.3 x 16.7 mm (2.47 x 2.73 x 0.66 in.)
- I/O connectors: 68-pin VHDCI connector, 6 position screw terminal, 8 position screw terminal, 68-pin DAQ connector
- Recommended wire gage: 22-26 AWG
- Recommended torque for screw terminals: 0.3 N·m (2.7 lb·in)
- Recommended torque for cover screws: 0.23 N·m (2.0 lb·in)
- Weight: 60 g (2.1 oz)

Caution: When connected to other test objects, this product may cause radio interference. In a residential environment, the user may be required to take adequate measures to reduce the radio interference.
Where to Go for Support

The National Instruments Web site 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.

A Declaration of Conformity (DoC) is our claim of compliance with the Council of the European Communities using the manufacturer’s declaration of conformity. This system affords the user protection for electromagnetic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting ni.com/certification. If your product supports calibration, you can obtain the calibration certificate for your product at ni.com/calibration.

National Instruments corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. National Instruments also has offices located around the world to help address your support needs. For telephone support in the United States, create your service request at ni.com/support and follow the calling instructions or dial 512 795 8248. For telephone support outside the United States, visit the Worldwide Offices section of ni.com/niglobal to access the branch office Web sites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.