

USER GUIDE

NI CB-2162

Single-Ended Digital I/O Accessory

The NI CB-2162 is a connector block and prototyping board for National Instruments digital waveform generator/analyzer modules. The NI CB-2162 provides an easy way to:

- Terminate digital I/O (DIO) and control channels
- Connect to other devices for testing and debugging
- Develop and interface to prototype circuits
- Probe DIO and control channels

This guide explains how to set up and use the NI CB-2162 single-ended DIO accessory.

Contents

What You Need to Get Started	2
Related Documentation	3
Parts Locator Diagram	4
Installing Cables	5
Connecting Signals	6
Using 1 × 2 Header Receptacles	9
Using a Ribbon Cable	10
Making a Wire-Wrap Connection	11
Terminating Signals	12
Minimizing the Effects of Stubs	12
Terminating DIO Channel Signals	12
Terminating Control Channel Signals	14
Using the NI CB-2162 Prototyping Area	15
Connecting Power	16
Prototyping Circuits	16
Replacing Components	16
Mounting the NI CB-2162 in an Enclosure	17
Specifications	21
Technical Support Resources	22

What You Need to Get Started

To set up and use the NI CB-2162, you need the following items:

- SHC68-C68-D2 cable assembly
- Compatible NI digital waveform generator/analyzer, installed in a PXI or CompactPCI chassis

You also may need the following optional items:

- Resistors and 10-pin single-inline packaged resistor networks for pull-up/pull-down and series termination.
- The NI CB-2162 ships populated with a 0 Ω resistor. A 50 Ω resistor also is included for optional STROBE series termination.
- 30-gauge wire
- Wire-wrap tool
- 1 \times 2 header receptacle(s)
- DC power supply for the prototyping area
- CA-1000 (NI part number 777664-01), rack-mount side panels (NI part number 777665-01), and an NI CB-2162 CA-1000 mounting kit for mounting the NI CB-2162 in an enclosure
- The documentation included with the digital waveform generator/analyzer module and the NI-HSDIO driver software

Related Documentation

National Instruments digital waveform generator/analyzer modules ship with several documents designed to familiarize you with different aspects of the module. The documentation set includes the following pieces:

- *NI Digital Waveform Generator/Analyzer Getting Started Guide*—This printed document should be the first thing you read. Its purpose is to guide you through setting up the digital waveform generator/analyzer and configuring it to generate or acquire your first samples.
- *NI Digital Waveform Generator/Analyzer Help*—This online document provides more in-depth information about the hardware capabilities of the digital waveform generator/analyzer, theory of operation discussion, and information on programming flow and software reference.
- NI digital waveform generator/analyzer specifications—This printed document provides specifications for the NI hardware.

These documents also are located in the Start menu at **Program Files» National Instruments»NI-HSDIO»Documentation**. Visit ni.com/manuals for the most current documentation.

You also may 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 CB-2162.

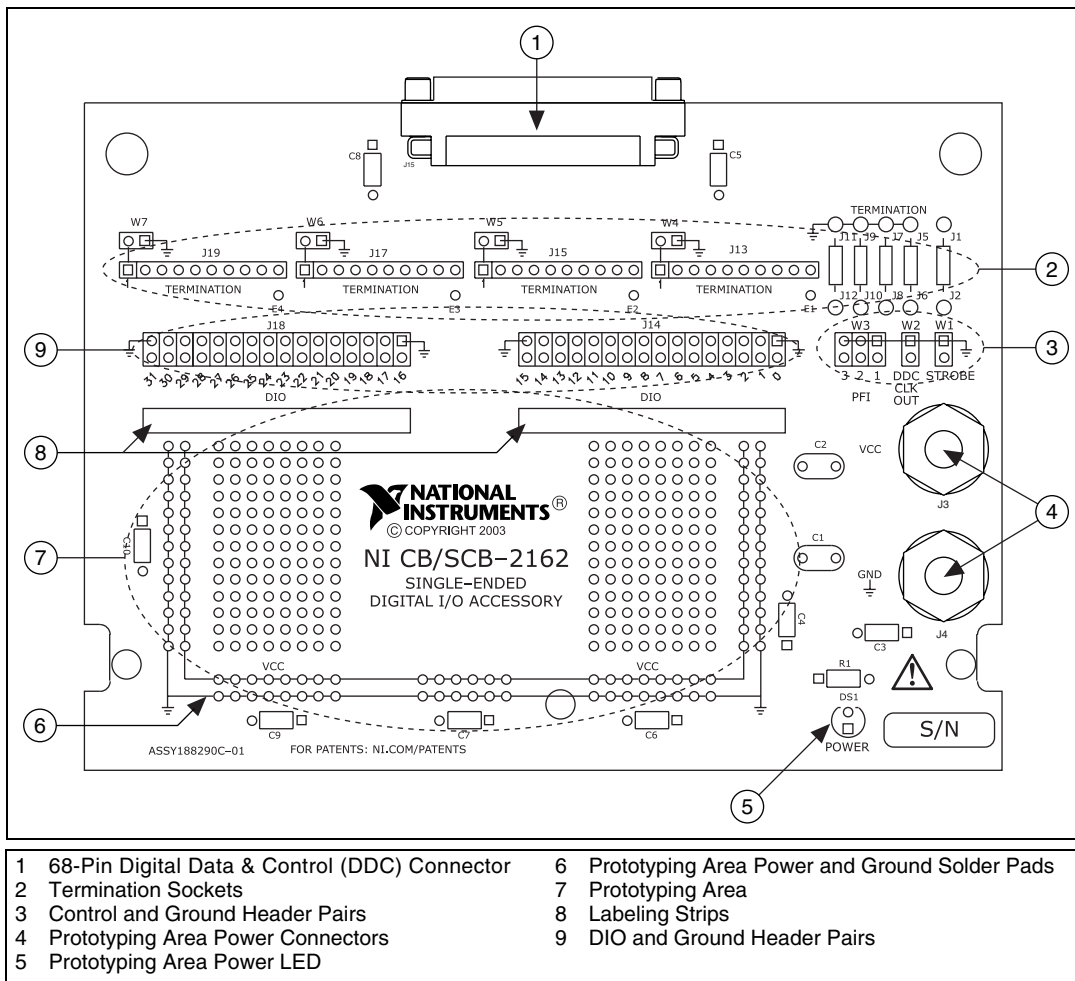


Figure 1. NI CB-2162 Parts Locator Diagram

Installing Cables

The NI SHC68-C68-D2 cable is designed to connect the NI CB-2162 to the digital waveform generator/analyzer. Figure 2 shows how to install this cable.

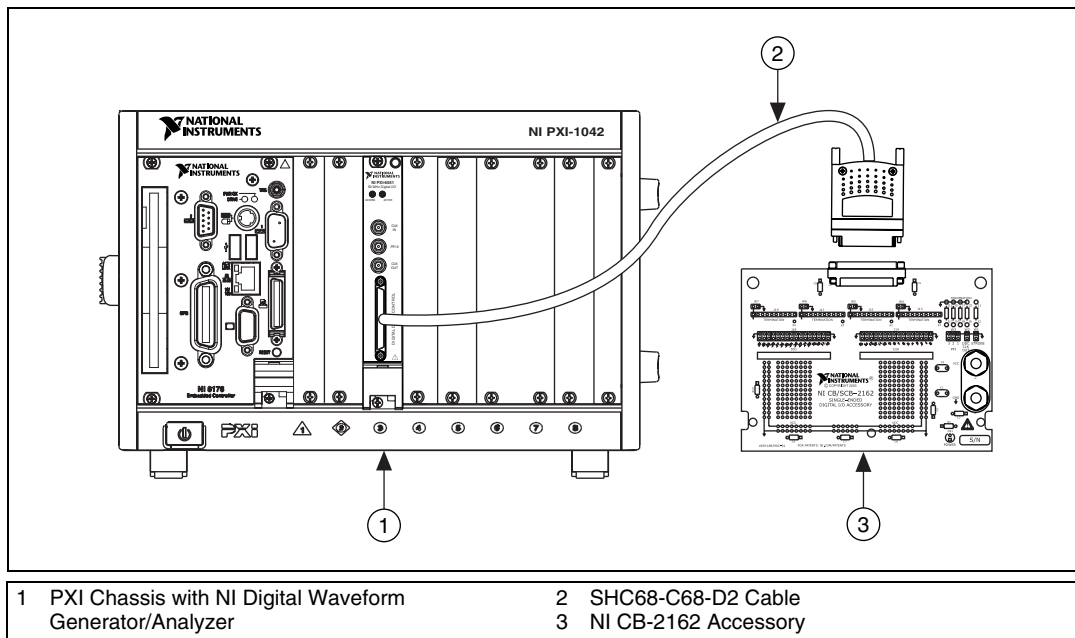


Figure 2. Connecting a 68-Pin Digital Waveform Generator/Analyzer to the CB-2162

Refer to Figure 2 as you complete the following steps to install the NI SHC68-C68-D2 cable:



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

1. Install NI-HSDIO and the digital waveform generator/analyzer by following the installation procedure in the *NI Digital Waveform Generator/Analyzer Getting Started Guide*.



Caution Before attaching any cables or accessories, install the digital waveform generator/analyzer in a PXI/CompactPCI chassis. Refer to the *NI Digital Waveform Generator/Analyzer Getting Started Guide* for instructions on installing the module.

2. Attach either end of an NI SHC68-C68-D2 cable assembly to the DDC connector of the digital waveform generator/analyzer module and secure the cable with the captive screws on the cable connector.
3. Attach the other end of the NI SHC68-C68-D2 cable assembly to the DDC connector of the NI CB-2162 and secure them together with the captive screws on the cable connector.

Connecting Signals

Each DIO, PFI, and clock channel of the digital waveform generator/analyzer connects to a corresponding pin on the NI CB-2162.

Refer to Figure 1 for the location of these pins on the NI CB-2162.



Caution Before powering down the digital waveform generator/analyzer module, remove power from the prototyping area of the NI CB-2162. NI is *not* liable for any damage resulting from improper signal connections.

Figure 3 shows the DDC connector pinout of the NI CB-2162.

DIO 31	1	35	DIO 30
GND	2	36	GND
DIO 29	3	37	DIO 28
GND	4	38	GND
DIO 27	5	39	DIO 26
GND	6	40	GND
DIO 25	7	41	DIO 24
RESERVED	8	42	GND
DIO 23	9	43	DIO 22
GND	10	44	GND
DIO 21	11	45	DIO 20
GND	12	46	GND
DIO 19	13	47	DIO18
GND	14	48	GND
DIO 17	15	49	DIO 16
GND	16	50	GND
DIO 15	17	51	DIO 14
GND	18	52	RESERVED
DIO 13	19	53	DIO 12
GND	20	54	GND
DIO 11	21	55	DIO 10
GND	22	56	GND
DIO 9	23	57	DIO 8
GND	24	58	GND
DIO 7	25	59	DIO 6
PFI 1	26	60	RESERVED
DIO 5	27	61	DIO 4
GND	28	62	GND
DIO 3	29	63	DIO 2
PFI 3	30	64	PFI 2
DIO 1	31	65	DIO 0
GND	32	66	GND
DDC CLK OUT	33	67	STROBE
GND	34	68	GND

Figure 3. NI CB-2162 DDC Connector Pinout



Note Refer to the *NI Digital Waveform Generator/Analyzer Help* for information about the number of available DIO channels on your device. DIO <20..31> may not be applicable to your device.

Table 1 describes the DDC signals shown in Figure 3.

Table 1. DDC Connector Pinout Descriptions

DDC Pin	Signal Description
DIO <0..31>	Bidirectional digital data channels 0 through 31.
STROBE	External sample clock source for pattern acquisition.
DDC CLK OUT	Exported sample clock signal.
PFI <1..3>	Programmable functional interface (PFI) channels 1 through 3.
GND	Ground reference for signals.
RESERVED	These channels are reserved for system use. Do not connect signals to these channels.

The NI CB-2162 provides connectivity to up to 32 of the single-ended DIO channels of an NI digital waveform generator/analyzer. The 32 DIO channels are divided into two bundles of 16×2 header pins. Each bundle is grouped by signal and ground pairs. The ground pins provide ground return paths for the DIO channels.

You can make connections to the DIO channels, the PFI channels, DDC CLK OUT, or STROBE on the NI CB-2162 using a 1×2 header receptacle, ribbon cable, a wire-wrap technique, or by soldering directly to the pins. Examples of how to make these connections are provided in the following sections.



Caution Connections that exceed any of the maximum ratings for the NI CB-2162 or the NI digital waveform generator/analyzer module can damage the module and the computer. Maximum input ratings are provided in the *Specifications* section and in the specifications document that shipped with the digital waveform generator/analyzer. NI is *not* liable for any damage resulting from such signal connections.

Using 1 × 2 Header Receptacles

Each signal and ground header pair is labeled on the NI CB-2162 and in Figure 1. These header pairs are arranged so that you can make quick connections using a 1 × 2 header receptacle to a coaxial cable assembly.



Note Header receptacle assemblies are not included with the NI CB-2162, but you can create custom assemblies by purchasing parts from vendors such as 3M.

Connectivity is made by inserting the receptacle onto the appropriate header pair. Refer to the receptacle documentation to assure that proper connections are made to signal and ground.

Figure 4 shows how to make 1 × 2 header receptacle connections.

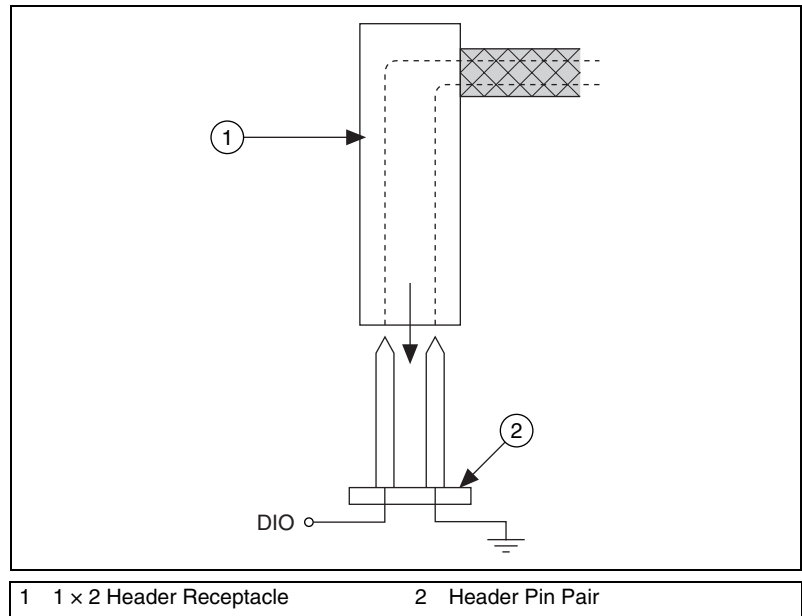


Figure 4. 1 × 2 Header Receptacle

Using a Ribbon Cable

The header pairs on the NI CB-2162 are available for single wire probing. You also can use 32-pin ribbon cables to easily connect a large number of channels to other devices. Cable type and quality can dramatically affect how well the signal integrity is maintained. NI recommends using short twisted-pair ribbon cables.

Refer to the device or cable manufacturer for additional information on proper connectivity to the NI CB-2162 signal and ground connections.

Figure 5 shows how to connect a ribbon cable to the accessory.

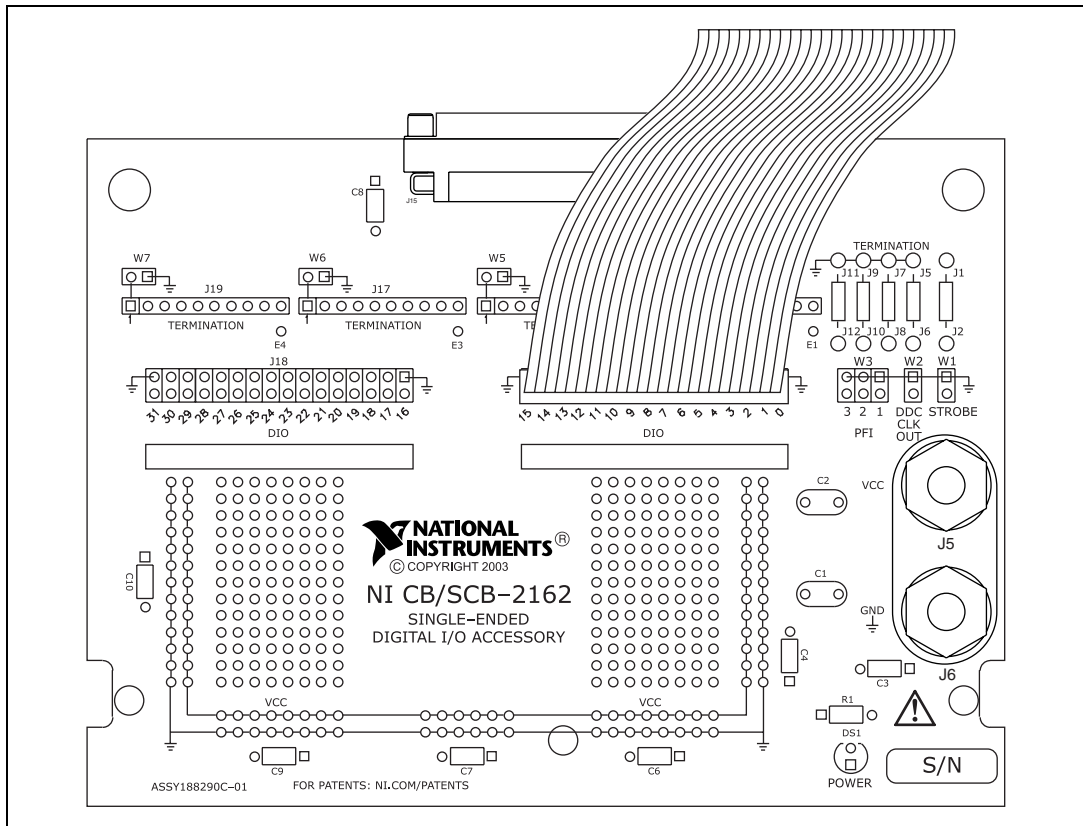


Figure 5. Using a Ribbon Cable with the NI CB-2162

Making a Wire-Wrap Connection

Make connections from the appropriate 1×1 header with a standard wire-wrap tool and 30-gauge or similar wire. Strip the wire and insert it into the receptacle end of the wire-wrap tool. Place the wire-wrap tool over the appropriate header pair pin, and twist the tool around the header post. You then can make connections to the device under test (DUT) as defined by the device manufacturer. Connect the DIO channel and ground header pins for each channel being used.

Figure 6 provides an illustration for making a wire-wrap connection.

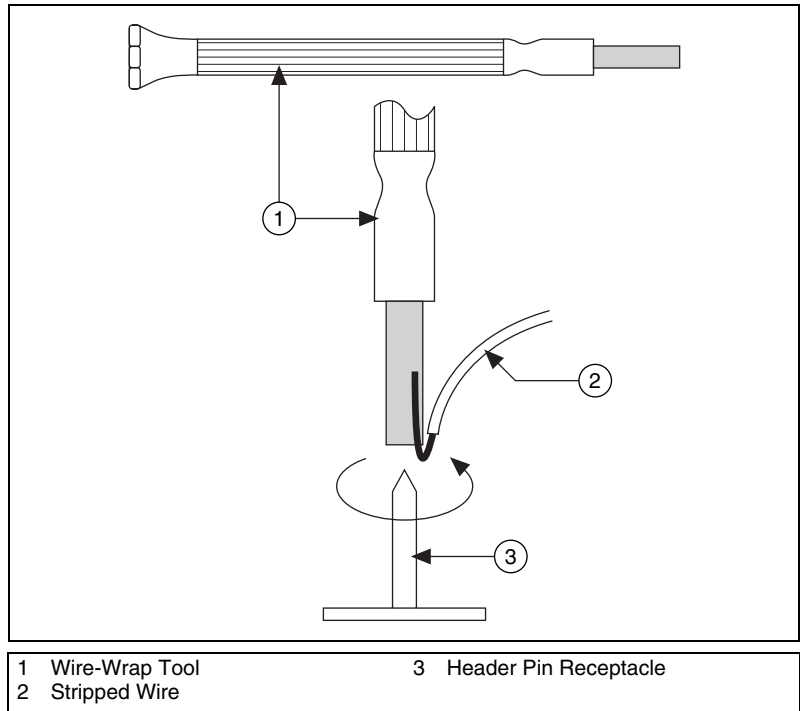


Figure 6. Wire-Wrap Connections

Terminating Signals

Termination of high-speed digital signals is necessary to prevent signal reflections and to force signal channels to a known state when no signal is present. Sockets for terminating resistors are connected to all DIO and control channels on the NI CB-2162. These sockets are labeled in Figure 1.



Note Proper termination needs are application-specific. For some special considerations for choosing resistor values, refer to the [Terminating Control Channel Signals](#) section.

Minimizing the Effects of Stubs

Stubs are unterminated tributaries from the original signal path. Stubs decrease the signal quality of the system by adding reflections to the transmission channels. To minimize the effect of stubs, termination is placed at the end of the signal path.

If your signal transmission line ends on the NI CB-2162, you can use the provided termination socket. If your signal terminates somewhere other than the NI CB-2162, NI recommends terminating the transmission line at the final signal destination.



Note Refer to the *NI Digital Waveform Generator/Analyzer Help* for more information about proper signal termination.

Terminating DIO Channel Signals

Table 2 shows the relationship between DIO channels and the termination sockets.

Table 2. DIO Termination Sockets

DIO Channels	Termination Socket
DIO <0..7>	J13
DIO <8..15>	J15
DIO <16..23>	J17
DIO <24..31>	J19



Note Refer to the *NI Digital Waveform Generator/Analyzer Help* for information about the number of available DIO channels on your device. DIO <20..31> may not be applicable to your device.

You can use different resistor networks and jumper placements to terminate the DIO channels in multiple configurations.

Figure 7 shows the J13 connector as an example of this termination scheme.

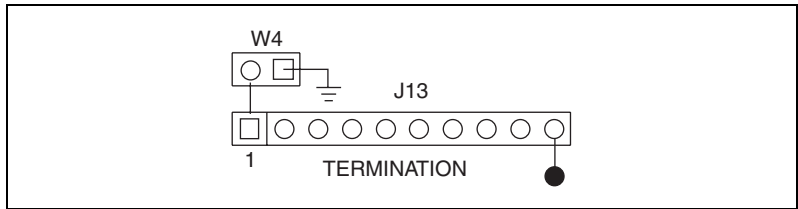


Figure 7. Termination Connectivity

Parallel Termination

Figure 8 shows a typical parallel resistor network.

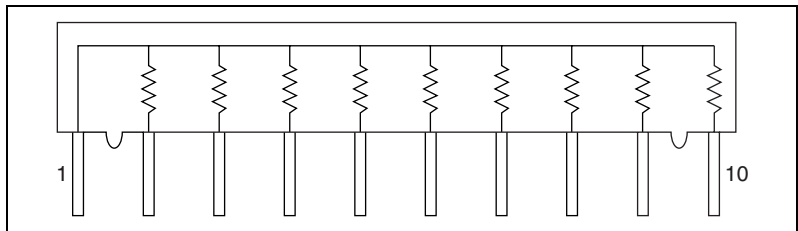


Figure 8. Example of Parallel Resistor Network

You can implement a pull-up or pull-down termination using a parallel configuration. Insert the 10-pin parallel resistor network into the appropriate termination socket with the common pin of the resistor network (pin 1 in Figure 8) connected to pin 1 of the socket, as shown in Figure 7.

With jumpers W<4..7> in place, pin 1 of J13, J15, J17, and J19 are all pulled to ground. The signal can be alternately pulled up or terminated to a nonground voltage if you remove the jumpers and apply power to the jumper pin connected to pin 1 of the socket.

Alternatively, the common pin of the parallel resistor network shown in Figure 7 can be inserted into pin 10 of the socket shown in Figure 8. External power can then be applied to the connection point located below pin 10 of the socket to provide proper termination.

Thevenin (Dual) Termination

In some applications, you might need to provide a Thevenin (dual) termination or a pull-up and pull-down configuration. Figure 9 shows a typical dual-termination resistor network, which can accomplish this task.

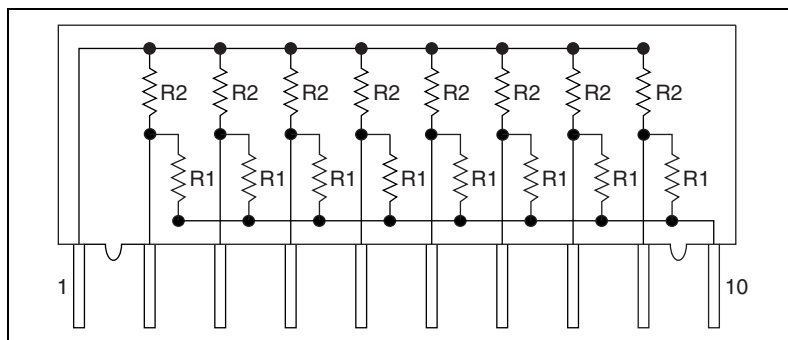


Figure 9. Example of Dual-Termination Resistor Network

To implement this configuration, insert the 10-pin resistor network into the J connector corresponding to the desired DIO channel. Make connections to ground using a jumper to connect W4, W5, W6, and/or W7 with the pull-down configuration mentioned previously. This jumper effectively terminates the signal or pulls the signal to ground by a value provided by R2 of Figure 9.

You can use the pull-up terminating resistance by connecting pin 10 of the resistor network to the solder pads connected to pin 10 of the socket, as shown in Figure 7. Connect external power to this solder point. Refer to the resistor network manufacturer documentation for information on proper pin labeling and resistor values.

Terminating Control Channel Signals

The control channel termination sockets are intended to accept standard through-hole resistors. Refer to Figure 1 for the location of the termination sockets.

Table 3 lists the termination sockets for control channel termination resistors.

Table 3. Control Channel Termination

Control Channel	Termination Sockets	Termination Type
STROBE (W1)	J1, J2	Series
DDC CLK OUT (W2)	J5, J6	Parallel (pull-down)

Table 3. Control Channel Termination (Continued)

Control Channel	Termination Sockets	Termination Type
PFI 1 (W3)	J7, J8	Parallel (pull-down)
PFI 2 (W3)	J9, J10	Parallel (pull-down)
PFI 3 (W3)	J11, J12	Parallel (pull-down)

The series termination socket for the STROBE channel is intended for use when the originating source of the signal being applied to the STROBE terminal of the DDC connector is near the 1 × 2 STROBE control channel pin and has a source impedance of less than 50 Ω. In this case, you might want to add series resistance to raise the total source impedance to 50 Ω to minimize reflections. This socket is populated with a 0 Ω resistor before the NI CB-2162 is shipped.



Note To ensure proper high-speed operation, make sure that the connections from the DIO pins to your device under test are matched in length.

When inserting a resistor into any of the control channel termination sockets, first trim the leads of the resistor to an appropriate length and ensure that the resistor fits securely into the socket.

Using the NI CB-2162 Prototyping Area

The NI CB-2162 prototyping area is designed to aid you in the following tasks:

- Prototyping and testing circuits—Use the NI CB-2162 in conjunction with an NI digital waveform generator/analyzer for prototyping, evaluating, and testing custom circuits and/or components.
- Creating custom interfaces—Use the NI CB-2162 for creating custom interfaces to other cables or devices. You can use the prototyping area to mount and interface the integrated circuits (ICs) or connectors required for your application.
- Prototyping a DUT load board—Use the NI CB-2162 as a simple DUT interface board or as a prototype of a custom DUT load board.

The prototyping area is labeled in Figure 1. Also labeled in this diagram are the erasable labeling strips for your notes as you use the prototyping area.

Connecting Power



Caution NI is *not* liable for any device damage or personal injury resulting from improper connections that exceed the maximum specifications of the NI CB-2162.

To provide power to the prototyping area, connect V_{CC} from a DC power supply to J3 (red terminal) and ground to J4 (black terminal). Refer to the [Specifications](#) section for the acceptable voltage ranges.

The green power LED is lit when a positive voltage is applied to the NI CB-2162. However, if negative voltage is applied, the Power LED does not light. The power connectors and LED for the prototyping area are labeled in Figure 1.

Prototyping Circuits

The prototyping area of the NI CB-2162 consists of 304 through-hole solder pads—208 isolated pads for component mounting and wire connections, 48 pads connected to V_{CC} , and 48 pads connected to ground—and space for gluing surface-mount components.

Refer to the [Specifications](#) section and to the NI digital waveform generator/analyzer modules specifications for information on the voltage limitations on circuits created in the prototyping area.

Replacing Components

The NI CB-2162 does not use replaceable fuses. If you need to replace the LED, choose a replacement that meets the specifications described in the [Specifications](#) section.

Mounting the NI CB-2162 in an Enclosure

You may want to mount the NI CB-2162 in an enclosure to reduce radio interference or for convenience when using the NI CB-2162 in a rack-mount system.

You can purchase a CA-1000 (777664-01) and an NI CB-2162 CA-1000 Mounting Kit (192065-01) for mounting your NI CB-2162 in an enclosure. The mounting kit contains a VHDCI panelette and three screws. The CA-1000 includes the standoffs that will be required to attach the CB-2162 to the bottom of the CA-1000.

If you want to rack-mount the NI CB-2162 after it is installed in the CA-1000, you can purchase rack-mount side panels (777665-01).

To install the NI CB-2162 in the CA-1000, complete the following steps:

1. Remove the jackscrews and washers from the NI CB-2162 DDC connector, as shown in Figure 10.

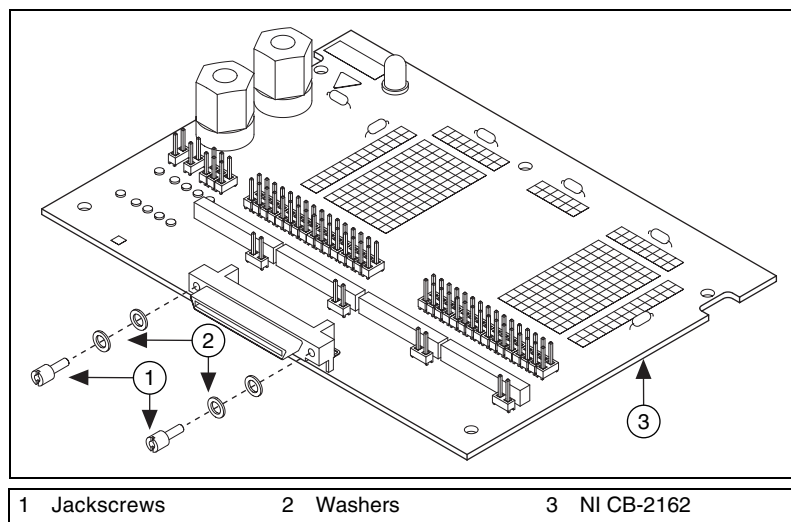


Figure 10. Remove Jackscrews from DDC Connector



Note You will not need the washers to mount the NI CB-2162 in the CA-1000. Save the washers in case you ever need to remove the NI CB-2162 from the CA-1000 and use it outside the enclosure.

2. Remove the eight 4-40 × 1/4 in. flathead Phillips-head screws from the top cover of the CA-1000, as shown in Figure 11.
3. Remove the top cover.

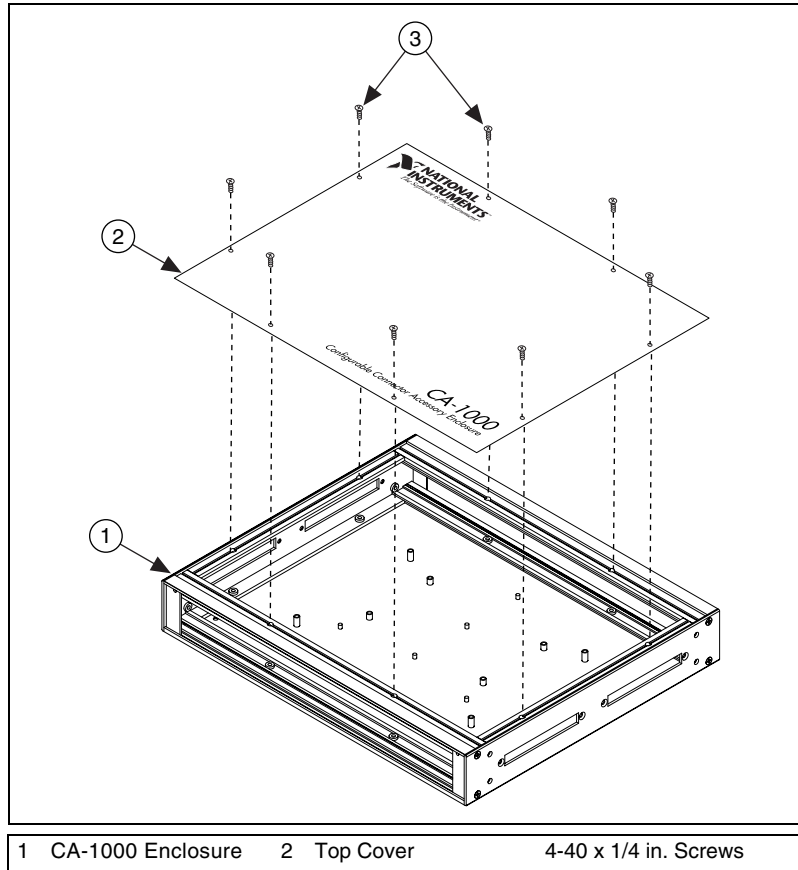


Figure 11. Remove Cover from CA-1000 Enclosure

Refer to Figure 12 as you complete the following steps.

4. Screw the standoffs onto the threaded screws in the locations shown in Figure 12.
5. Position the NI CB-2162 on the standoffs of the CA-1000.
6. Secure the NI CB-2162 in the bottom of the CA 1000 using two of the screws provided in the NI CB-2162 CA-1000 Mounting Kit.
7. Place the lower edge of the VHDCI panellette in the groove at the bottom of the enclosure opening.
8. Tilt the VHDCI panelette top back into the enclosure.
9. Secure the VHDCI panelette with one of the panhead screws included with the CA-1000 kit.

10. Reattach the DDC connector jackscrews through the opening in the I/O panelette.

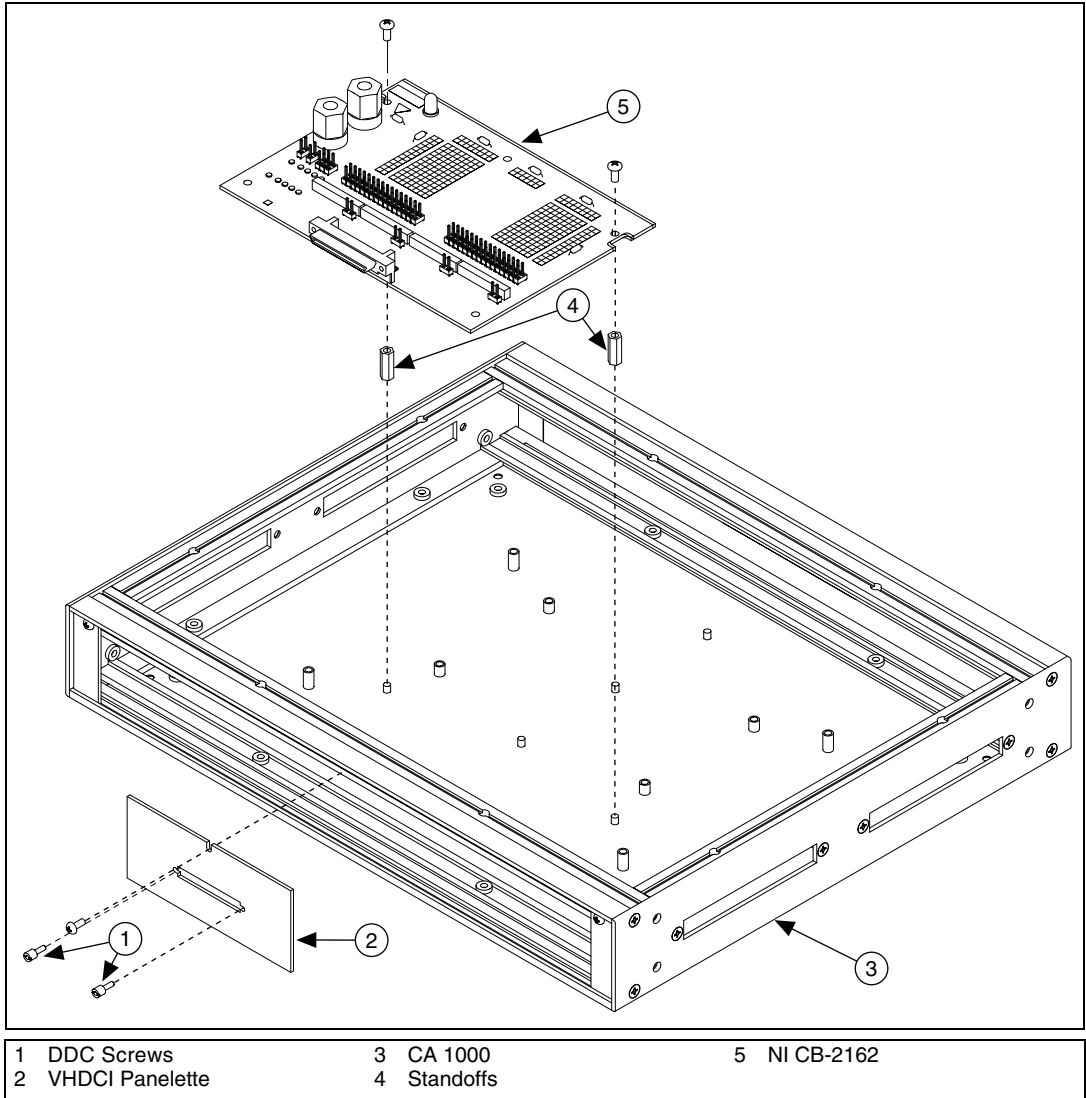


Figure 12. Secure the NI CB-2162 and Attach the I/O Panelette

11. Replace the top cover of the CA-1000 by replacing the screws you removed in step 2. Refer to Figure 11 for an illustration.
12. Install I/O panelettes in the unused panelette openings, as shown in Figure 13. The panelettes in the following figure are blank, but you can purchase many other types of I/O panelettes from NI. For more

information on the other I/O panelettes, go to ni.com and search for I/O Connector Panelettes.

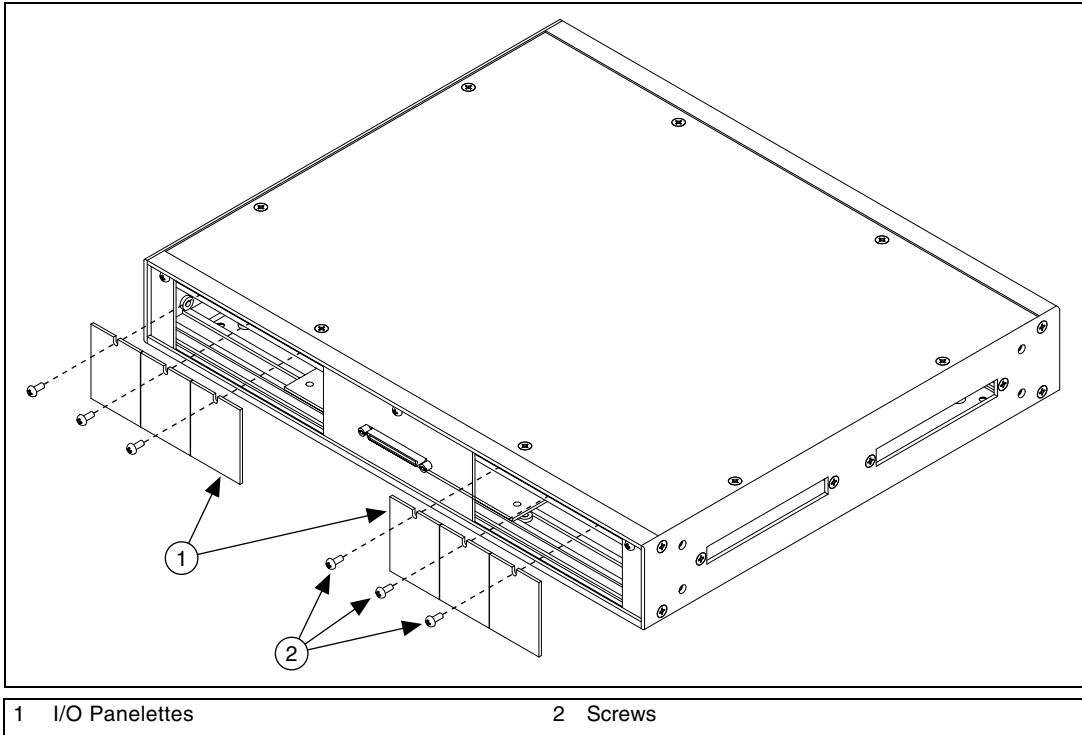


Figure 13. Install Blank I/O Panelettes

The NI CB-2162 is now installed in the CA-1000 enclosure.

Specifications

Digital I/O

DIO channels..... 32, single-ended
Control I/O channels 5, single-ended

Resistors

Number..... 2

LED

Type 5 mm diffused LED, green,
10 mA forward current

Prototyping Area

Dimensions..... 4 × 9 cm (1.57 × 3.54 in.)
Solder pads..... 208 unconnected, 48 ground,
48 V_{CC}

Traces

Type Matched length to 100 mils
AC impedance..... 50 Ω

Power

External DC power supply
Maximum..... 12 V
Minimum -5 V

Physical

Dimensions..... 10 × 14 cm (3.94 × 5.51 in.)
I/O connectors 68-pin DDC connector,
two banana-style connectors,
74 header pins,
4 termination sockets
(8 DIO per socket)

CE Compliance

Refer to the regulatory statement for this product for additional compliance information. To obtain this information for this product, visit ni.com/certification, search by model number or product line, and click the appropriate link in the Certification column.



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.

Technical Support Resources

NI Web Support

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.

Worldwide Support

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. You can access our branch office Web sites from the Worldwide Offices section of ni.com. Branch office Web sites provide up-to-date contact information, support phone numbers, email 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. For telephone support in the United States, dial 512 795 8248. For telephone support outside the United States, contact your local branch office:

Australia 1800 300 800, Austria 43 0 662 45 79 90 0,
Belgium 32 0 2 757 00 20, Brazil 55 11 3262 3599,
Canada (Calgary) 403 274 9391, Canada (Ottawa) 613 233 5949,
Canada (Québec) 450 510 3055, Canada (Toronto) 905 785 0085,
Canada (Vancouver) 604 685 7530, China 86 21 6555 7838,
Czech Republic 420 224 235 774, Denmark 45 45 76 26 00,
Finland 385 0 9 725 725 11, France 33 0 1 48 14 24 24,
Germany 49 0 89 741 31 30, India 91 80 51190000,

Israel 972 0 3 6393737, Italy 39 02 413091, Japan 81 3 5472 2970,
Korea 82 02 3451 3400, Malaysia 603 9131 0918,
Mexico 01 800 010 0793, Netherlands 31 0 348 433 466,
New Zealand 0800 553 322, Norway 47 0 66 90 76 60,
Poland 48 22 3390150, Portugal 351 210 311 210,
Russia 7 095 783 68 51, Singapore 65 6226 5886,
Slovenia 386 3 425 4200, South Africa 27 0 11 805 8197,
Spain 34 91 640 0085, Sweden 46 0 8 587 895 00,
Switzerland 41 56 200 51 51, Taiwan 886 2 2528 7227,
Thailand 662 992 7519, United Kingdom 44 0 1635 523545

National Instruments™, NI™, and ni.com™ are trademarks of National Instruments Corporation. Product and company names mentioned herein are trademarks or trade names of their respective companies. For patents covering National Instruments products, refer to the appropriate location: **Help» Patents** in your software, the `patents.txt` file on your CD, or ni.com/patents.

© 2003–2004 National Instruments Corp. All rights reserved..



370369B-01

Sep04