

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.

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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
- 1x2 header receptacle(s)
- DC power supply for the prototyping area
- 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 module 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.

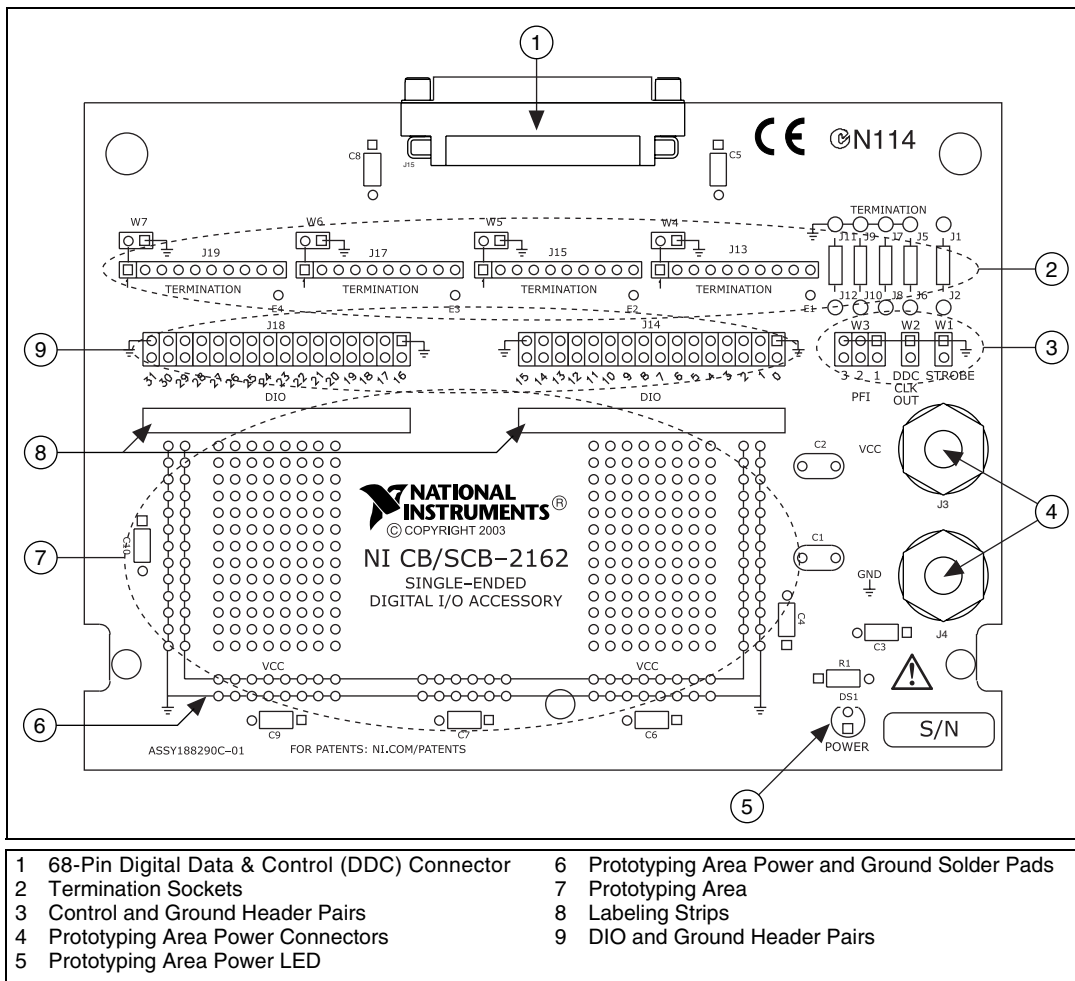


Figure 1. NI CB-2162 Parts Locator Diagram

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.

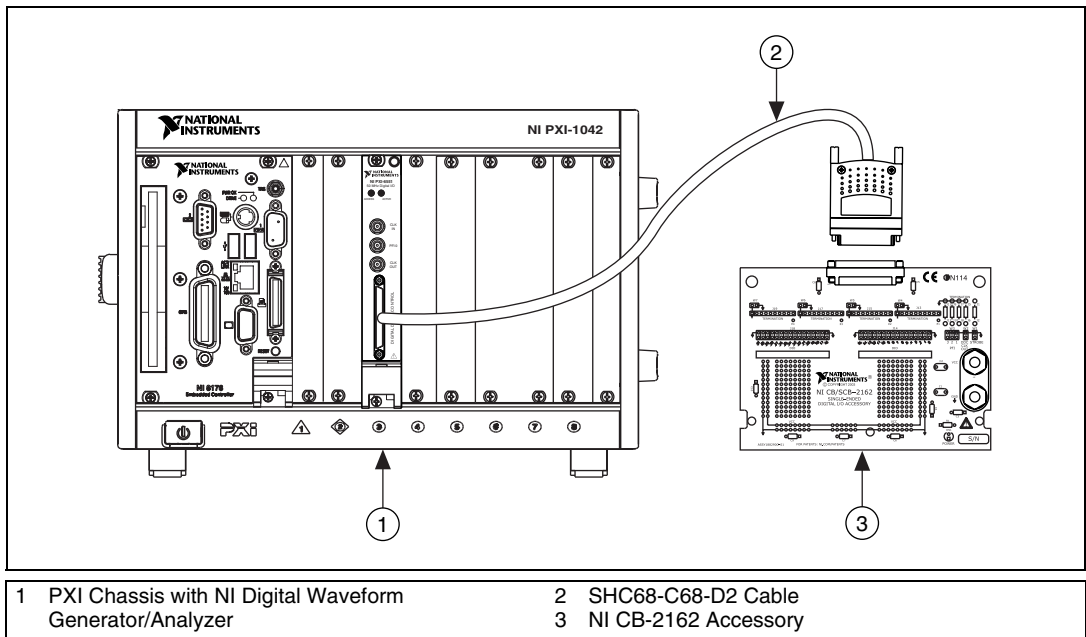


Figure 2. Connecting a 68-Pin Digital Waveform Generator/Analyzer to the CB-2162

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.

DIO31	1	35	DIO30
GND	2	36	GND
DIO29	3	37	DIO28
GND	4	38	GND
DIO27	5	39	DIO26
GND	6	40	GND
DIO25	7	41	DIO24
RESERVED	8	42	GND
DIO23	9	43	DIO22
GND	10	44	GND
DIO21	11	45	DIO20
GND	12	46	GND
DIO19	13	47	DIO18
GND	14	48	GND
DIO17	15	49	DIO16
GND	16	50	GND
DIO15	17	51	DIO14
GND	18	52	RESERVED
DIO13	19	53	DIO12
GND	20	54	GND
DIO11	21	55	DIO10
GND	22	56	GND
DIO9	23	57	DIO8
GND	24	58	GND
DIO7	25	59	DIO6
PFI 1	26	60	RESERVED
DIO5	27	61	DIO4
GND	28	62	GND
DIO3	29	63	DIO2
PFI 3	30	64	PFI 2
DIO1	31	65	DIO0
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 16x2 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 1x2 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 1x2 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 1x2 header receptacle, such as the 3M Monosignal Socket Connector (3M part number TS0870), to a coaxial cable assembly. 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 1x2 header receptacle connections.

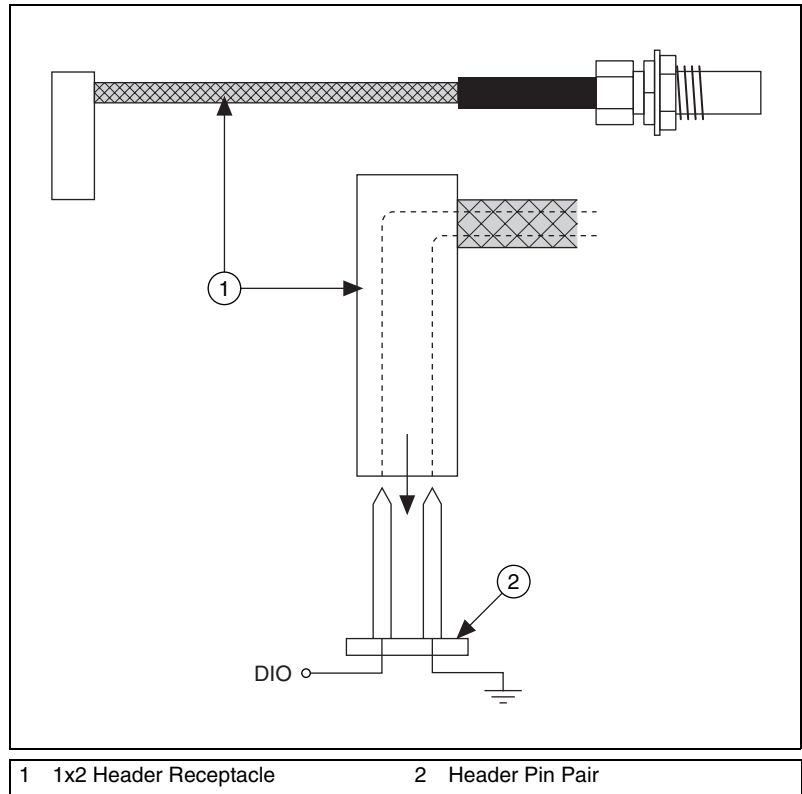


Figure 4. 1x2 Header Receptacle

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.

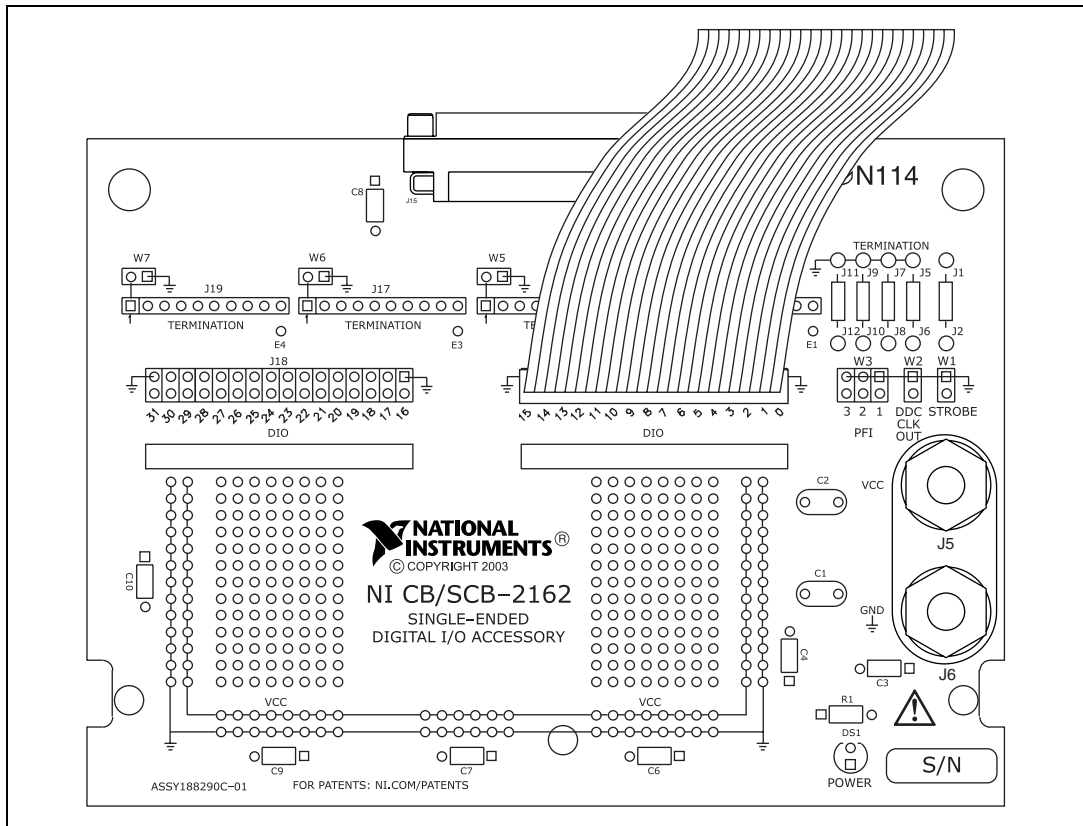


Figure 5. Using a Ribbon Cable with the NI CB-2162

Making a Wire-Wrap Connection

Make connections from the appropriate 1x1 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.

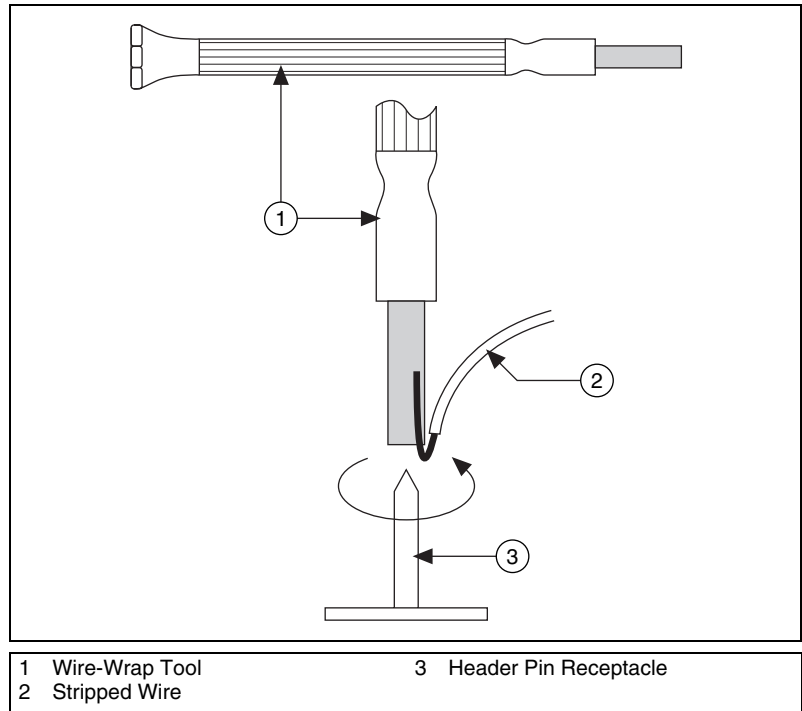


Figure 6. Wire-Wrap Connections

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

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.

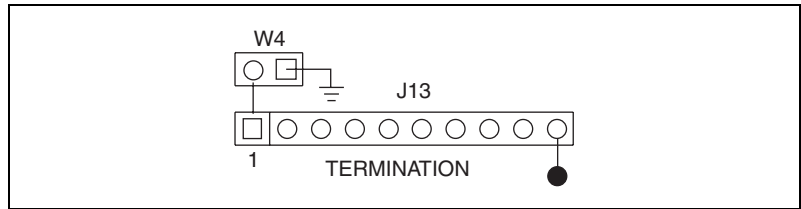


Figure 7. Termination Connectivity

Parallel Termination

Figure 8 shows a typical parallel resistor network.

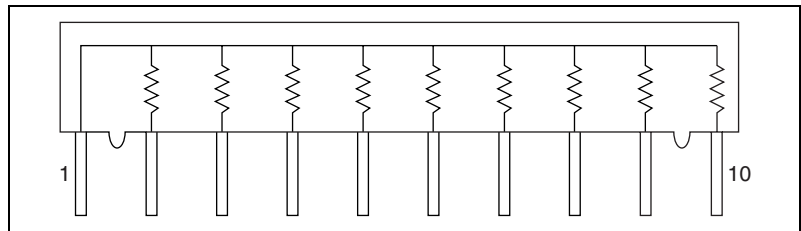


Figure 8. Example of Parallel Resistor Network

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.

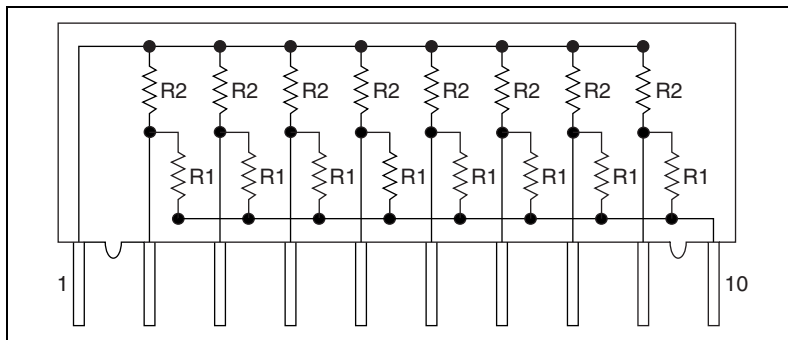


Figure 9. Example of Dual-Termination Resistor Network

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 1x2 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.

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)

General Specifications

Installation Category.....I

Pollution DegreeII

Safety

The NI CB-2162 meets the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 3111-1, UL 61010B-1
- CAN/CSA C22.2 No. 1010.1



Note For UL and other safety certifications, refer to the product label or to ni.com.

Electromagnetic Compatibility

Emissions.....EN 55011 Class A at 10 m
FCC Part 15A above 1 GHz

ImmunityEN 61326:1997 + A2:2001,
Table 1

EMC/EMI.....CE, C-Tick, and FCC Part 15
(Class A) Compliant



Note For EMC compliance, install the NI CB-2162 in a shielded container (not included with the NI CB-2162), and operate the digital waveform generator/analyzer with shielded cabling.

CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

Low-Voltage Directive (safety).....73/23/EEC

Electromagnetic Compatibility
Directive (EMC).....89/336/EEC



Note Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain the DoC for this product, click **Declarations of Conformity Information** at ni.com/hardref.nsf/.

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.

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Canada (Ottawa) 613 233 5949, Canada (Québec) 514 694 8521,
Canada (Toronto) 905 785 0085, Canada (Vancouver) 514 685 7530,
China 86 21 6555 7838, Czech Republic 420 2 2423 5774,
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,
Greece 30 2 10 42 96 427, 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 001 800 010 0793, Netherlands 31 0 348 433 466,
New Zealand 0800 553 322, Norway 47 0 66 90 76 60,
Poland 48 0 22 3390 150, 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,
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Thailand 662 992 7519, United Kingdom 44 0 1635 523545

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