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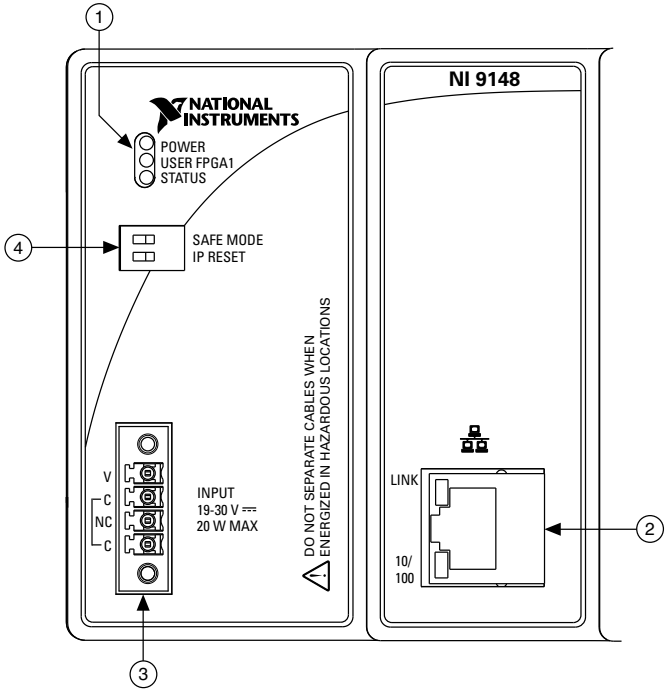
USER MANUAL AND SPECIFICATIONS

NI 9148

Ethernet Expansion Chassis for C Series Modules

This document describes how to connect the NI 9148 to a network and how to use the NI 9148 features. This document also contains specifications for the NI 9148.

Figure 1. NI 9148 Front Panel



1. LEDs
2. RJ-45 Ethernet Port
3. Power Connector
4. DIP Switches

Safety Guidelines

Operate the NI 9148 only as described in this document.

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Caution Do not operate the NI 9148 in a manner not specified in this document. Product misuse can result in a hazard. You can compromise the safety protection built into the product if the product is damaged in any way. If the product is damaged, return it to NI for repair.

Safety Guidelines for Hazardous Locations

The NI 9148 is suitable for use in Class I, Division 2, Groups A, B, C, D, T4 hazardous locations; Class I, Zone 2, AEx nA IIC T4 and Ex nA IIC T4 hazardous locations; and nonhazardous locations only. Follow these guidelines if you are installing the NI 9148 in a potentially explosive environment. Not following these guidelines may result in serious injury or death.

Caution Do not disconnect the power supply wires and connectors from the controller unless power has been switched off.

Caution Do not disconnect I/O-side wires or connectors unless power has been switched off or the area is known to be nonhazardous.

Caution Do not remove modules unless power has been switched off or the area is known to be nonhazardous.

Caution Substitution of components may impair suitability for Class I, Division 2.

Caution For Division 2 and Zone 2 applications, install the system in an enclosure rated to at least IP54 as defined by IEC/EN 60079-15.

Special Conditions for Hazardous Locations Use in Europe and Internationally

The NI 9148 has been evaluated as Ex nA IIC T4 Gc equipment under DEMKO Certificate No. 07 ATEX 0626664X and is IECEx UL 14.0089X certified. Each device is marked Ⓔx II 3G and is suitable for use in Zone 2 hazardous locations, in ambient temperatures of -40 °C ≤ Ta ≤ 70 °C.

Caution You must make sure that transient disturbances do not exceed 140% of the rated voltage.

Caution The system shall only be used in an area of not more than Pollution Degree 2, as defined in IEC 60664-1.

Caution The system shall be mounted in an ATEX/IECEx-certified enclosure with a minimum ingress protection rating of at least IP54 as defined in IEC/EN 60079-15.

Caution The enclosure must have a door or cover accessible only by the use of a tool.

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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.

Special Conditions for Marine Applications

Some products are Lloyd's Register (LR) Type Approved for marine (shipboard) applications. To verify Lloyd's Register certification for a product, visit *ni.com/certification* and search for the LR certificate, or look for the Lloyd's Register mark on the product.

Caution In order to meet the EMC requirements for marine applications, install the product in a shielded enclosure with shielded and/or filtered power and input/output ports. In addition, take precautions when designing, selecting, and installing measurement probes and cables to ensure that the desired EMC performance is attained.

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.

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What You Need to Install the NI 9148

- NI 9148 Ethernet Expansion Chassis
- NI-RIO Software DVD
- C Series I/O modules
- DIN rail mount kit (for DIN rail mounting only)
- Panel mount kit (for panel mounting only)
- Two M4 or number 8 flathead screws (for mounting the chassis without one of the listed mounting kits)
- A number 2 Phillips screwdriver
- Power supply
- Ethernet cable

Note Visit *ni.com/info* and enter the Info Code `rdsoftwareversion` to determine which software you need to use the NI 9148.

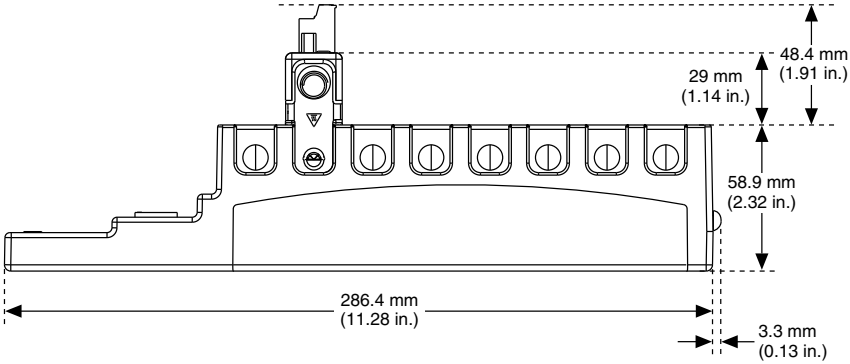
Mounting the Chassis

You can mount the chassis in any orientation on a 35 mm DIN rail or on a panel. Use the DIN rail mounting method if you already have a DIN rail configuration or if you need to be able to quickly remove the chassis. Use the panel mount method for high shock and vibration applications.

Your installation must meet the following requirements for space and cabling clearance:

- Allow 25.4 mm (1 in.) on the top and the bottom of the chassis for air circulation.
- Allow 50.8 mm (2 in.) in front of modules for cabling clearance.

Figure 2. NI 9148 Bottom View with Dimensions



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Figure 3. NI 9148 Front View with Dimensions

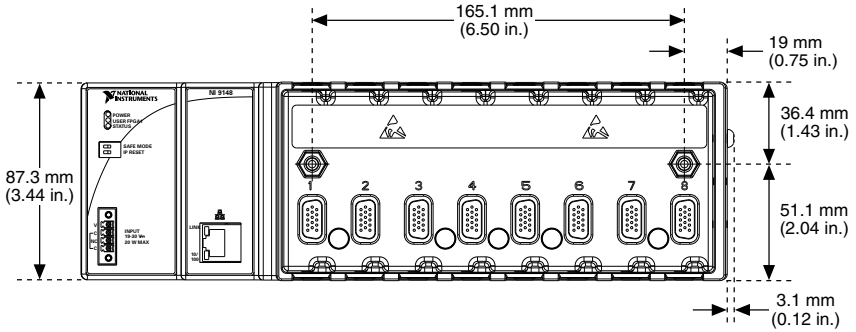
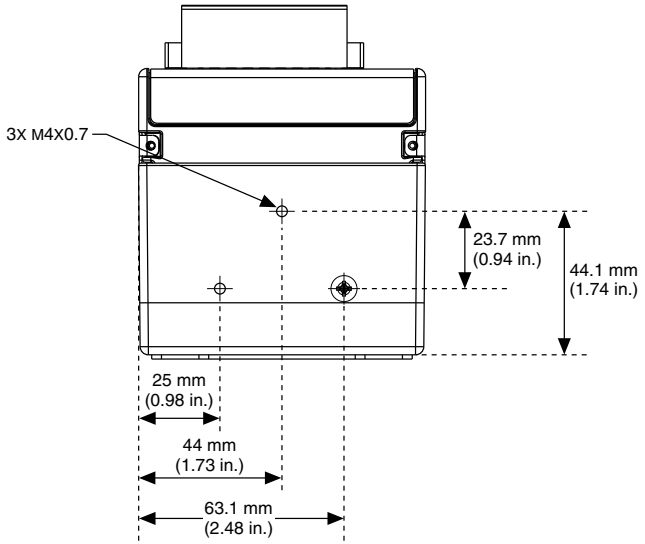


Figure 4. NI 9148 Side View with Dimensions



The following sections give instructions for the mounting methods. Before using any of these mounting methods, record the serial number from the back of the chassis. You will be unable to read the serial number after you have mounted the chassis.

Caution Make sure that no I/O modules are in the chassis before mounting it.

Mounting the Chassis on a Panel

You can use the NI 9905 panel mount kit to mount the NI 9148 on a flat surface. Complete the following steps to mount the NI 9148 on a panel.

1. Fasten the chassis to the panel mount kit using a number 2 Phillips screwdriver and two M4 × 25 screws. National Instruments provides these screws with the panel mount kit.

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You must use these screws because they are the correct depth and thread for the panel. Tighten the screws to a maximum torque of 1.3 N · m (11.5 lb · in.).

Figure 5. Installing the Panel Mount Accessory on the NI 9148

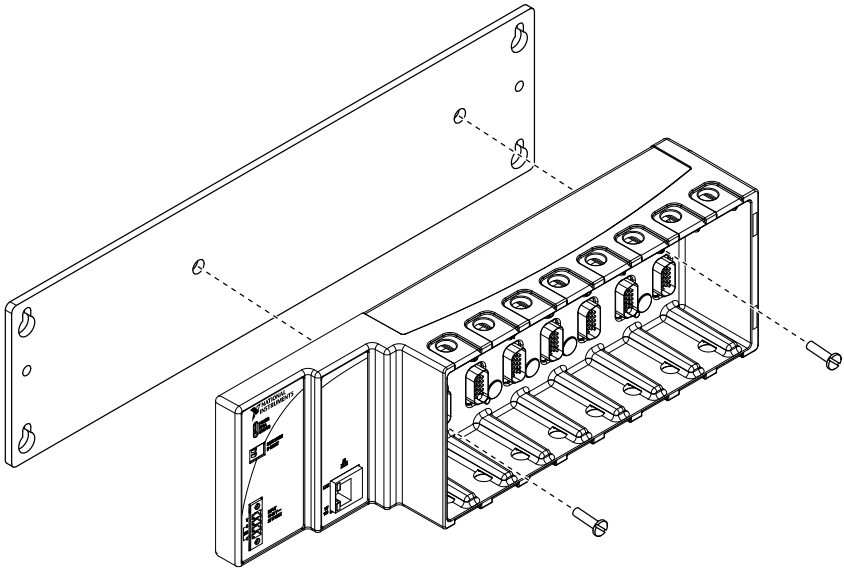
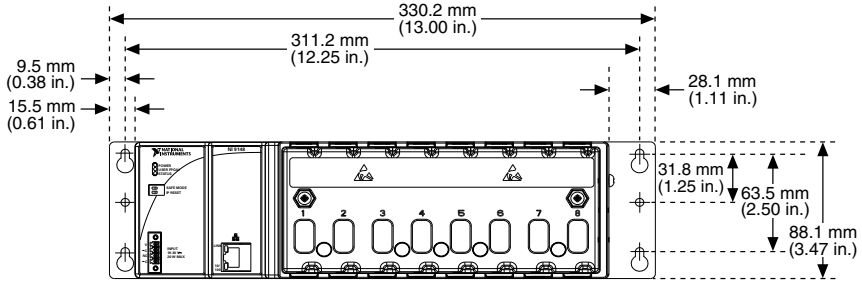


Figure 6. Dimensions of NI 9148 with Panel Mount Accessory Installed



2. Fasten the NI 9905 panel to the wall using the screwdriver and screws that are appropriate for the wall surface. The maximum screw size is M4 or number 8.

Caution Make sure that no I/O modules are in the chassis before removing it from the panel.

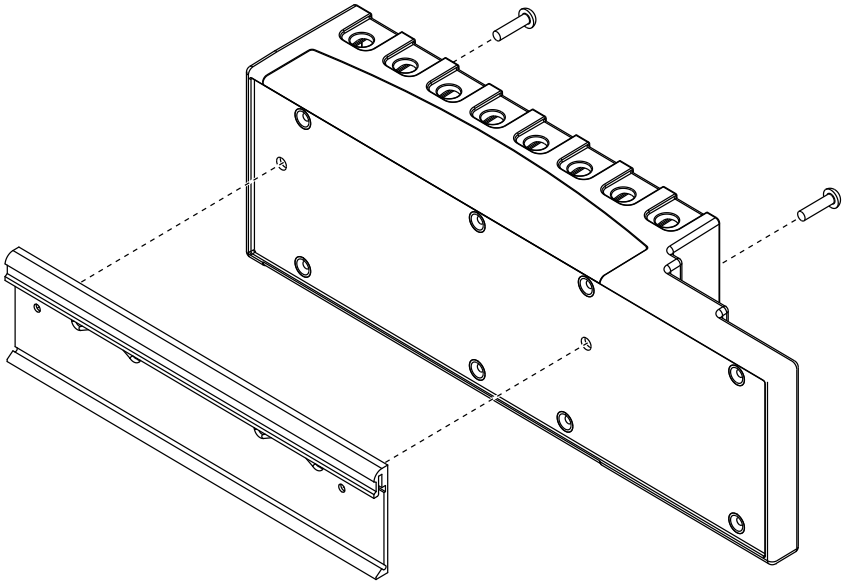
Mounting the Chassis on a DIN Rail

You can order the NI 9915 DIN rail mount kit to mount the NI 9148 on a DIN rail. You need one clip for mounting the chassis on a standard 35 mm DIN rail. Complete the following steps to mount the chassis on a DIN rail.

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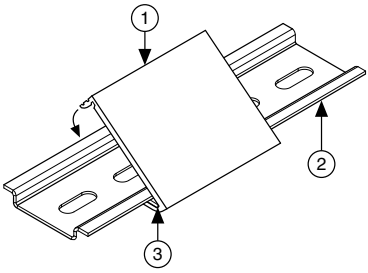
1. Fasten the DIN rail clip to the chassis using a number 2 Phillips screwdriver and two M4 × 16 screws. NI provides these screws with the DIN rail mount kit.

Figure 7. Installing the DIN Rail Clip on the NI 9148



2. Insert one edge of the DIN rail into the deeper opening of the DIN rail clip.

Figure 8. One Edge of the DIN Rail Inserted in a Clip



1. DIN Rail Clip
2. DIN Rail
3. DIN Rail Spring

3. Press down firmly on the chassis to compress the spring until the clip locks in place on the DIN rail.

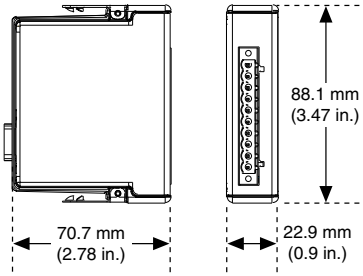
Caution Make sure that no I/O modules are in the chassis before removing it from the DIN rail.

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Installing C Series I/O Modules in the Chassis

The following figure shows the mechanical dimensions of C Series I/O modules.

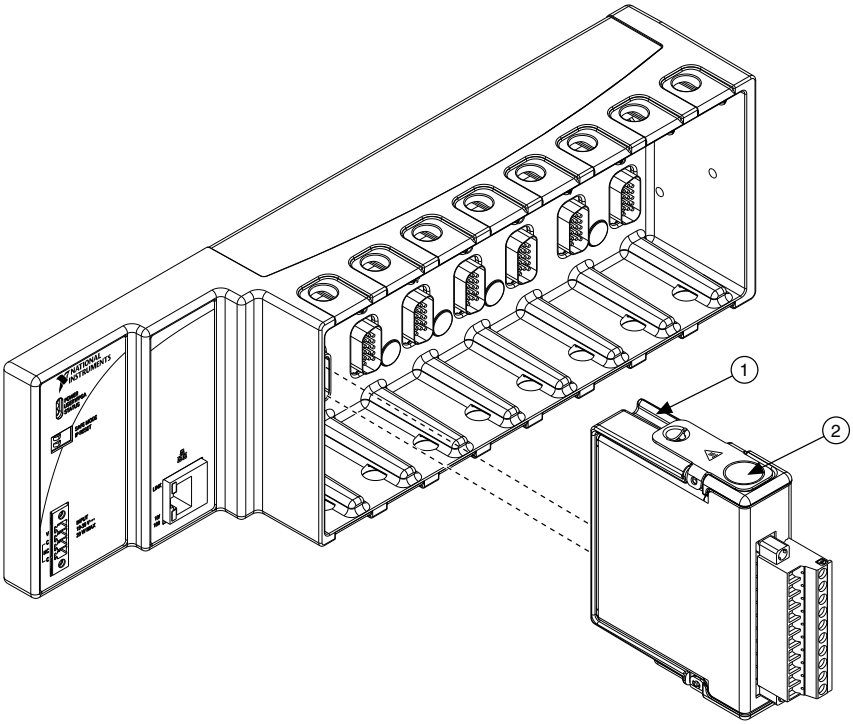
Figure 9. C Series I/O Module, Front and Side View with Dimensions



1. Make sure that no I/O-side power is connected to the I/O module. If the system is in a nonhazardous location, the chassis power can be on when you install I/O modules.
2. Align the I/O module with an I/O module slot in the chassis as shown in the following figure. The module slots are labeled 1 to 8, left to right.

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Figure 10. Installing an I/O Module in the Chassis



1. Insertion Groove
2. Latch

3. Squeeze the latches and insert the I/O module into the module slot.
4. Press firmly on the connector side of the I/O module until the latches lock the I/O module into place.
5. Repeat these steps to install additional I/O modules.

Removing I/O Modules from the Chassis

Complete the following steps to remove a C Series I/O module from the chassis.

1. Make sure that no I/O-side power is connected to the I/O module.
2. Squeeze the latches on both sides of the module and pull the module out of the chassis.

Connecting the Chassis to a Network

Connect the chassis to an Ethernet network using Ethernet port 1 on the front panel. Use a standard Category 5 (CAT-5) or better shielded, twisted-pair Ethernet cable to connect the chassis to an Ethernet hub or a computer.

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Caution To prevent data loss and to maintain the integrity of your Ethernet installation, do not use a cable longer than 100 m.

If you need to build your own cable, refer to the *Cabling* section for more information about Ethernet cable wiring connections.

Note You will configure the IP settings as described in the *Configuring IP Settings* section, after connecting power and powering the chassis on.

The host computer communicates with the chassis over a standard Ethernet connection. If the host computer is on a network, you must configure the chassis on the same subnet as the host computer. If neither the host computer nor the chassis is connected to a network, you can connect the two directly using a crossover cable.

If you want to use the chassis on a subnet other than the one the host computer is on, first connect the chassis on the same subnet as the host computer. Use DHCP to assign an IP address or reassign a static IP address for the subnet where you want it to be and physically move it to the other subnet.

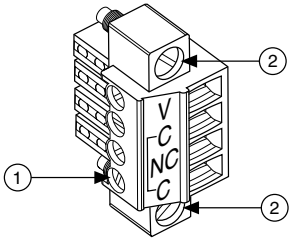
Wiring Power to the Chassis

The NI 9148 requires an external power supply that meets the specifications in the *Power Requirements* section.

The NI 9148 filters and regulates the supplied power and provides power for all of the I/O modules. The NI 9148 has one layer of reverse-voltage protection. Complete the following steps to connect a power supply to the chassis.

1. Ensure that the power supply is turned off.
2. Connect the positive lead of the power supply to the V terminal of the COMBICON power connector shipped with the NI 9148, and tighten the terminal screw. The following figure shows the terminal screws, which secure the wires in the screw terminals, and the connector screws, which secure the power connector on the controller.

Figure 11. COMBICON Power Connector



1. Terminal Screw
2. Connector Screws

3. Connect the negative lead of the power supply to the C terminal of the power connector and tighten the terminal screw.

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4. Install the power connector on the front panel of the NI 9148 and tighten the connector screws.
5. Turn on the power supply.

Powering On the NI 9148

When you apply power to the NI 9148, the chassis runs a power-on self test (POST). During the POST, the Power and Status LEDs turn on. The Status LED turns off, indicating that the POST is complete. If the LEDs do not behave in this way when the system powers on, refer to the *Understanding LED Indications* section.

Chassis Startup Options

The following table lists the startup options available for the NI 9148. These options determine how the chassis behaves when it starts up in various conditions. Use the RIO Device Setup utility to select startup options. Access the RIO Device Setup utility by selecting **Start»All Programs»National Instruments»NI-RIO»RIO Device Setup**.

Table 1. NI 9148 Reset Options

Startup Options	Behavior
Do Not Autoload VI	Does not load the FPGA bit stream from flash memory.
Autoload VI on device powerup	Loads the FPGA bit stream from flash memory to the FPGA when the chassis powers on.
Autoload VI on device reboot	Loads the FPGA bit stream from flash to the FPGA when you reboot the chassis either with or without cycling power.

Configuring IP Settings

When you power on the NI 9148 for the first time, it boots into safe mode because there is no software installed on it. This section describes how to configure the IP settings and install software on the chassis.

1. Launch MAX on the host computer and expand **Remote Systems** in the MAX configuration tree. MAX lists the NI 9148 as the model name of the chassis followed by the serial number, for example, **NI9148-XXXXXXXX**.

   The chassis automatically attempts to connect to the network using DHCP. If DHCP is not available, the chassis connects to the network with a link-local IP address with the form `169.254.x.x`. You must connect the chassis directly to the host computer to configure it in this state.
2. Select the chassis under **Remote Systems** to see the **Network Settings** tab in the middle pane of MAX.
3. Enter a name for the chassis in the **Name** field.

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4. Select settings for the chassis in the **IP Settings** section, then click **Apply**.

   Note For information about configuring network settings, refer to the Configuring Network Settings book of the *MAX Remote Systems Help*. In MAX, click **Help»Help Topics»Remote Systems**. On the **Contents** tab, browse to **LabVIEW Real-Time Target Configuration»Configuring Network Settings**.
5. When you click **Apply**, you are prompted to reboot the chassis for the changes to take effect. Click **Yes**. You can also reboot the chassis by right-clicking the name under **Remote Systems** and selecting **Reboot**.
6. After rebooting, the chassis appears under **Remote Systems** with the assigned name. Expand the chassis and select **Software**.
7. Click **Add/Remove Software** in the toolbar to launch the LabVIEW Real-Time Software Wizard.
8. Install the Recommended Software Set that appears in the LabVIEW Real-Time Software Wizard.

For more information about configuring the chassis in MAX, refer to the *MAX Help*. For information about installing and using LabVIEW FPGA, refer to the *LabVIEW FPGA Module Release and Upgrade Notes*.

Configuring DIP Switches

Both DIP switches are in the OFF position when the chassis is shipped from National Instruments.

Figure 12. DIP Switches



SAFE MODE Switch

Safe mode is for troubleshooting, updating configuration, and installing software. Keep the SAFE MODE switch in the OFF position during normal operation. If the switch is in the ON position at startup, the NI 9148 launches only the essential services required for updating configuration and installing software.

Push the SAFE MODE switch to the ON position if the software on the chassis is corrupted. Even if the switch is not in the ON position, if there is no software installed on the chassis, the chassis automatically boots into safe mode. The SAFE MODE switch must be in the ON position to reformat the drive on the chassis. Refer to the *Measurement & Automation Explorer Help* for more about installing software and reformatting the drive.

IP RESET Switch

Push the IP RESET switch to the ON position and reboot the chassis to reset the IP address and other TCP/IP settings of the chassis to the factory defaults. Refer to the *Troubleshooting*

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Network Communication section for more information about resetting the IP address. You also can push this switch to the ON position to unlock a chassis that was previously locked in MAX.

Understanding LED Indications

The following figure shows the NI 9148 chassis LEDs.

Figure 13. NI 9148 LEDs



POWER LED Indicators

The following table lists the POWER LED indicators.

Table 2. POWER LED Indicators

LED Color	LED Pattern	Indication
Green	Solid	The NI 9148 is powered on and the connected power supply is adequate.
—	Off	The NI 9148 is powered off.

User LED

You can define the USER FPGA1 LED to meet the needs of your application. The following table lists the USER FPGA1 LED indicators.

Table 3. User LEDs

LED	LED Color	Description
USER FPGA1	Green/Yellow	Use the LabVIEW FPGA Module and NI-RIO Device Drivers software to define the USER FPGA1 LED. Use the USER FPGA1 LED to help debug your application or retrieve application status. Refer to the *LabVIEW Help* for information about programming this LED.

STATUS LED

The STATUS LED is off during normal operation. The NI 9148 indicates specific error conditions by flashing the STATUS LED a certain number of times every few seconds, as shown in the following table.

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Table 4. STATUS LED Indicators

Number of Flashes	Indication
1	The chassis is unconfigured. Use MAX to configure the chassis. Refer to the *Measurement & Automation Explorer Help* for information about configuring the chassis.
2	The chassis has detected an error in its software. This usually occurs when an attempt to upgrade the software is interrupted. Reinstall software on the chassis. Refer to the *Measurement & Automation Explorer Help* for information about installing software on the chassis.
3	The chassis is in safe mode because the SAFE MODE DIP switch is in the ON position. Refer to the *Configuring DIP Switches* section for information about the SAFE MODE DIP switch.
4	The software has crashed twice without rebooting or cycling power between crashes. This usually occurs when software on the chassis is corrupted. Reinstall software on the chassis. If the problem persists, contact National Instruments.
Continuous flashing or solid	The device may be configured for DHCP but unable to get an IP address because of a problem with the DHCP server. Check the network connection and try again. If the problem persists, contact National Instruments.

Troubleshooting Network Communication

If the NI 9148 cannot communicate with the network, you can perform the following troubleshooting steps.

1. Move the IP RESET switch to the ON position.
2. Disconnect and reconnect chassis power.
3. Move the IP RESET switch to the OFF position.
4. Configure the IP and other network settings in MAX.

Restoring the BIOS Network Settings

If you are unable to fix network communication with the network settings restored, you can restore the BIOS network settings of the chassis. Refer to the *Configuring IP Settings* section for information about the BIOS network settings for different chassis revisions. Complete the following steps to restore the BIOS network settings of the chassis.

1. Move the IP RESET and SAFE MODE switches to the ON position.
2. Disconnect and reconnect chassis power.

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3. Move the IP RESET and SAFE MODE switches to the OFF position.
4. Configure the IP and other network settings in MAX.

Caution If the chassis is restored to the BIOS network settings, the LabVIEW run-time engine does not load. You must reconfigure the network settings and restart the chassis for the LabVIEW run-time engine to load.

NI 9148 Specifications

This document lists the specifications for the NI 9148 Ethernet Expansion Chassis. The following specifications are typical for the -40 °C to 70 °C operating temperature range unless otherwise noted.

Caution Do not operate the NI 9148 in a manner not specified in this document. Product misuse can result in a hazard. You can compromise the safety protection built into the product if the product is damaged in any way. If the product is damaged, return it to NI for repair.

Network

Network interface	10BaseT and 100BaseTX Ethernet
Compatibility	IEEE 802.3
Communication rates	10 Mbps, 100 Mbps, auto-negotiated
Maximum cabling distance	100 m/segment

Reconfigurable FPGA

Type	Xilinx Spartan-3 2M
Number of logic cells	46,080
Available embedded RAM	720 kbits

Power Requirements

Voltage input range	19 V to 30 V
Maximum power input	20 W maximum
Maximum power consumption	20 W maximum

Physical Characteristics

If you need to clean the NI 9148, wipe it with a dry towel.

Tip For two-dimensional drawings and three-dimensional models of the NI 9148, visit *ni.com/dimensions* and search by module number.

Weight (unloaded)	929 g (32.7 oz)

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Screw-terminal wiring	
Gauge	0.2 mm^2 to 2.1 mm^2 (24 AWG to 14 AWG) copper conductor wire
Wire strip length	6 mm (0.24 in.) of insulation stripped from the end
Temperature rating	85 °C
Torque for screw terminals	0.20 N · m to 0.25 N · m (1.8 lb · in. to 2.2 lb · in.)
Wires per screw terminal	One wire per screw terminal
Connector securement	
Securement type	Screw flanges provided
Torque for screw flanges	0.3 N · m to 0.4 N · m (2.7 lb · in. to 3.5 lb · in.)

Safety Voltages

Connect only voltages that are within the following limits:

V terminal to C terminal	35 V maximum, Measurement Category I

Measurement Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as *MAINS* voltage. MAINS is a hazardous live electrical supply system that powers equipment. This category is for measurements of voltages from specially protected secondary circuits. Such voltage measurements include signal levels, special equipment, limited-energy parts of equipment, circuits powered by regulated low-voltage sources, and electronics.

Caution Do not connect the NI 9148 to signals or use for measurements within Measurement Categories II, III, or IV.

Note Measurement Categories CAT I and CAT O are equivalent. These test and measurement circuits are not intended for direct connection to the MAINS building installations of Measurement Categories CAT II, CAT III, or CAT IV.

Safety and Hazardous Locations Standards

This product is designed to meet the requirements of the following electrical equipment safety standards for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1
- EN 60079-0:2012, EN 60079-15:2010
- IEC 60079-0: Ed 6, IEC 60079-15; Ed 4

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- UL 60079-0; Ed 5, UL 60079-15; Ed 3
- CSA 60079-0:2011, CSA 60079-15:2012

Note For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for sensitive electrical equipment for measurement, control, and laboratory use:

- EN 61326-2-1 (IEC 61326-2-1): Class A emissions; Industrial immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

Note In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia and New Zealand (per CISPR 11) Class A equipment is intended for use only in heavy-industrial locations.

Note Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.

Note For EMC declarations and certifications, and additional information, refer to the *Online Product Certification* section.

CE Compliance CE

This product meets the essential requirements of applicable European Directives, as follows:

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)
- 94/9/EC; Potentially Explosive Atmospheres (ATEX)

Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for this product, visit *ni.com/certification*, search by model number or product line, and click the appropriate link in the Certification column.

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Hazardous Locations

U.S. (UL)	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, AEx nA IIC T4
Canada (C-UL)	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, Ex nA IIC T4
Europe (ATEX) and International (IECEx)	Ex nA IIC T4 Gc

Environmental

Temperature (IEC 60068-2-1 and IEC 60068-2-2)	
Operating	-40 °C to 70 °C
Storage	-40 °C to 85 °C

Caution Failure to follow the mounting instructions in the user manual can cause temperature derating. Visit *ni.com/info* and enter Info Code `criomounting` for more information about mounting configurations and temperature derating.

Ingress protection	IP40
Operating humidity (IEC 60068-2-56)	10% RH to 90% RH, noncondensing
Storage humidity (IEC 60068-2-56)	5% RH to 95% RH, noncondensing
Pollution Degree (IEC 60664)	2
Maximum altitude	2,000 m

Indoor use only.[1]

Shock and Vibration

To meet these specifications, you must panel mount the chassis and affix ferrules to the ends of the terminal wires.

Operating shock (IEC 60068-2-27)	30 g, 11 ms half sine; 50 g, 3 ms half sine; 18 shocks at 6 orientations
Operating vibration	
Random (IEC 60068-2-64)	5 g_{rms}, 10 Hz to 500 Hz
Sinusoidal (IEC 60068-2-6)	5 g, 10 Hz to 500 Hz

Cabling

The following table shows the standard Ethernet cable wiring connections for both normal and crossover cables.

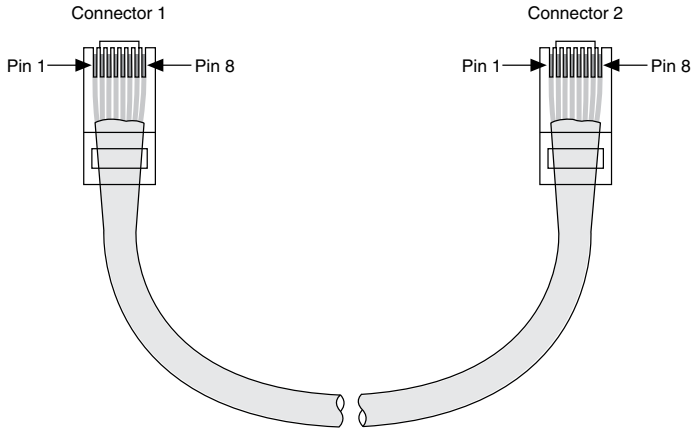
[1] Use NI 9917 and NI 9918 industrial enclosures to protect the device in harsh, dirty, or wet environments.

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Table 5. Ethernet Cable Wiring Connections

Pin	Connector 1	Connector 2 (Normal)	Connector 2 (Crossover)
1	white/orange	white/orange	white/green
2	orange	orange	green
3	white/green	white/green	white/orange
4	blue	blue	blue
5	white/blue	white/blue	white/blue
6	green	green	orange
7	white/brown	white/brown	white/brown
8	brown	brown	brown

Figure 14. Ethernet Connector Pinout



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