
NI-9144

Features

2022-07-20

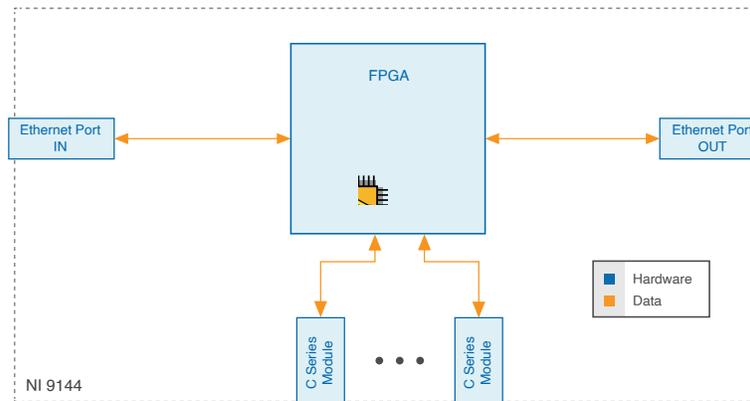


Contents

Overview.....	3
NI 9144 Features.....	3
POWER LED Indicators.....	3
FPGA LED.....	3
RUN LED Indicators.....	3
ERR LED Indicators.....	4
Safe-State Outputs.....	5
Slave Timing Modes.....	5
Mounting the Device.....	5
Dimensions.....	6
Mounting Requirements.....	7
Ambient Temperature.....	8
Mounting the Device Directly on a Flat Surface.....	8
Mounting the Device on a Panel.....	9
Mounting the Device on a DIN Rail.....	11
Mounting the Device on a Rack.....	13
Mounting the Device on a Desktop.....	13
Upgrading from the NI 9144 to the NI 9145.....	15
Resetting the NI 9144 Network Configuration.....	17
Updating Your Firmware.....	17
How to Upgrade Your Firmware.....	18
Using the NI 9144 with an EtherCAT Third-Party Master.....	18
Using AoE/SDO.....	19
Using CoE/SDO.....	19
Vendor Extensions to the Object Dictionary.....	19
NI Services.....	20

Overview

This document describes the features of the NI 9144 and contains information about mounting and operating the device.



NI 9144 Features

The NI 9144 provides the following features.

POWER LED Indicators

The following table lists the POWER LED indicators.

LED Color	LED Pattern	Indication
Green	Solid	The NI 9144 is powered on and the connected power supply is adequate.
—	Off	The NI 9144 is powered off.

Table 1. POWER LED Indicators

FPGA LED

You can use the FPGA LED to help debug your application or easily retrieve application status. Use the LabVIEW FPGA Module and NI-RIO software to define the FPGA LED to meet the needs of your application

RUN LED Indicators

The following table lists the RUN LED indicators.

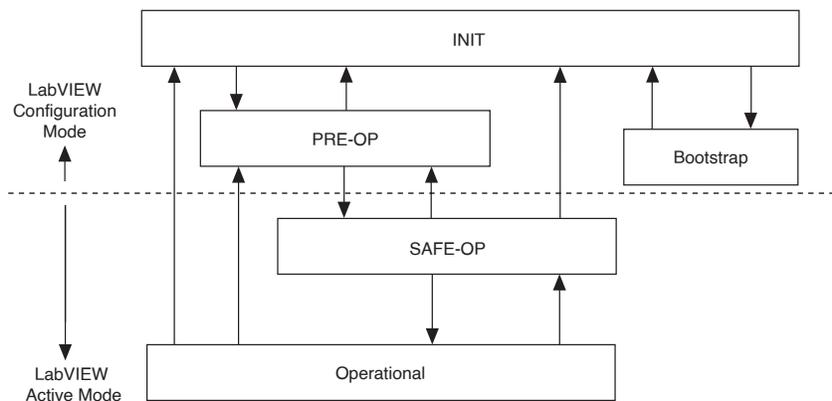
LED Color	LED Pattern	Indication
Green	Off	The NI 9144 is in initialize (INIT) run mode. The NI 9144 is initializing and discovering slaves.
	Continuously blinks	The NI 9144 is in pre-operational (PRE-OP) run mode. The NI 9144 is detecting modules, configuring, and synchronizing.
	Blinks once and pauses	The NI 9144 is in safe-operational (SAFE-OP) run mode. The NI 9144 inputs are functional and outputs drive constant safe values.
	Solid	The NI 9144 is in operational run mode. The NI 9144 inputs and outputs are functional.
	Flickering	The NI 9144 is in bootstrap run mode. The NI 9144 is updating firmware.

Table 3. RUN LED Indicators

Run Mode Transition

The following figure shows the Run Mode transition.

Figure 1. EtherCAT Modes



ERR LED Indicators

The following table lists the ERR (error) LED indicators.

LED Color	LED Pattern	Indication
Red	Off	There is no error.
	Continuously blinks	There is an invalid configuration from an unsupported module, bad device profile, object dictionary, or configuration.
	Blinks once and pauses	There is an unsolicited change and the NI 9144 or module is in an emergency condition.
	Blinks twice and pauses	There is an application watchdog timeout. The slave did not receive a scheduled EtherCAT telegram.
	Solid	There is a Process Data Interface (PDI) watchdog timeout. The slave failed to transfer I/O data in scheduled time.
	Flickering	There is a booting error from corrupt firmware or a hardware error.

Table 3. ERR LED Indicators

Safe-State Outputs

The NI 9144 has an EtherCAT safe state that the device passes through when moving from LabVIEW Active Mode to LabVIEW Configuration Mode. The NI 9144 passes through the EtherCAT safe state during normal operation or in case of a serious error.

In the EtherCAT safe state, output modules are set to pre-defined safe values. By default, zero is the safe value in the output module channel configuration. You can change the safe values by writing to the appropriate object dictionary entries for your output module.

Slave Timing Modes

The NI 9144 operates in free-run mode or synchronized mode using the EtherCAT distributed clock (DC).

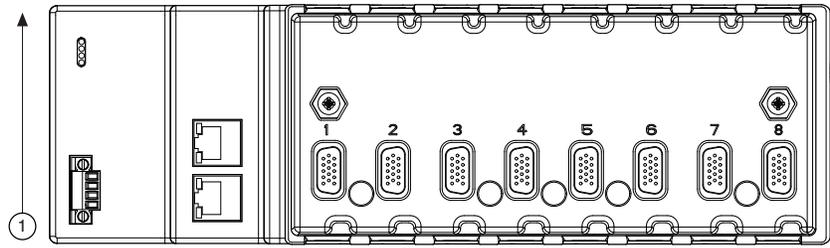
By default, free-run mode runs the conversion cycle at the rate of the slowest module. You can slow the free-run mode conversion cycle down by writing a minimum cycle time in nanoseconds to index 0x3001.1 of the NI 9144.

In synchronized mode, each conversion cycle begins with a signal from the EtherCAT master/scan engine. The NI 9144 procedures an error if the external cycle time is too fast for a module. NI Indcom for EtherCAT only supports synchronized mode.

Mounting the Device

To obtain the maximum allowable ambient temperature of 70 °C, you must mount the NI 9144 horizontally on a flat, metallic, vertical surface such as a panel or wall. You can mount the NI 9144 directly to the surface or use the NI Panel Mounting Kit. The following figure shows the NI 9144 mounted horizontally.

Figure 2. NI 9144 Horizontal Mounting



1. Up

You can also mount the NI 9144 in other orientations, on a nonmetallic surface, on a 35-mm DIN rail, on a desktop, or in a rack. Mounting the NI 9144 in these or other configurations can reduce the maximum allowable ambient temperature and can affect the typical accuracy of modules in the NI 9144. For more information about typical accuracy specifications for C Series modules and temperature deratings caused by different mounting configurations, visit ni.com/info and enter the Info Code criotypicaljp.



Caution Make sure that no C Series modules are in the NI 9144 before mounting it.



Tip Before using any of these mounting methods, record the serial number from the back of the NI 9144 so that you can identify the NI 9144 in the . You will be unable to read the serial number after you mount the NI 9144.

Dimensions

The following figures show the front and side dimensions of the NI 9144. For detailed dimensional drawings and 3D models, visit ni.com/dimensions and search for the module number.

Figure 3. NI 9144 Front Dimensions

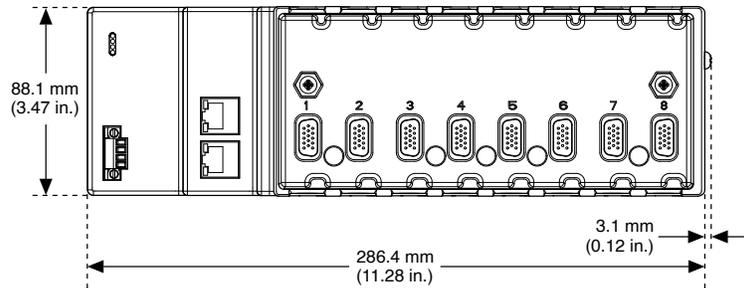
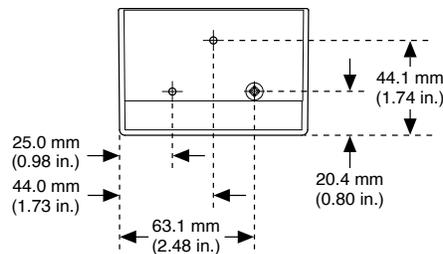


Figure 4. NI 9144 Side Dimensions

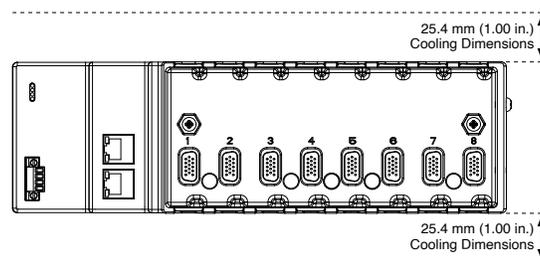


Mounting Requirements

Your installation must meet the following requirements for cooling and cabling clearance.

Allow 25.4 mm (1.00 in.) on the top and the bottom of the NI 9144 for air circulation, as shown in the following figure.

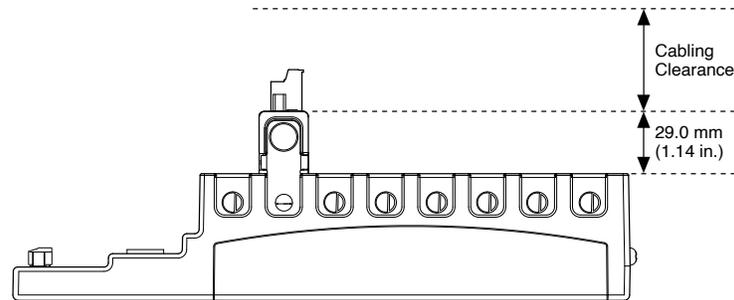
Figure 5. NI 9144 Cooling Dimensions



Allow the appropriate space in front of C Series modules for cabling clearance, as shown in the following figure. The different connector types on C Series modules

require different cabling clearances. For a complete list of cabling clearances for C Series modules, visit ni.com/info and enter the Info Code crioconn.

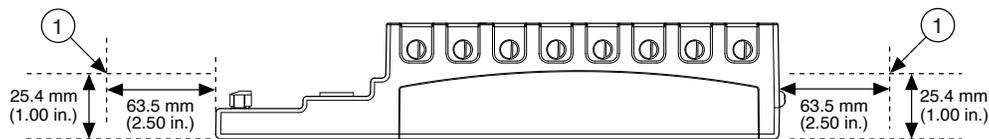
Figure 6. NI 9144 Cabling Clearance



Ambient Temperature

Measure the ambient temperature at each side of the NI 9144, 63.5 mm (2.50 in.) from the side and 25.4 mm (1.00 in.) forward from the rear of the NI 9144, as shown in the following figure.

Figure 7. NI 9144 Ambient Temperature Location



1. Location for measuring the ambient temperature

Mounting the Device Directly on a Flat Surface

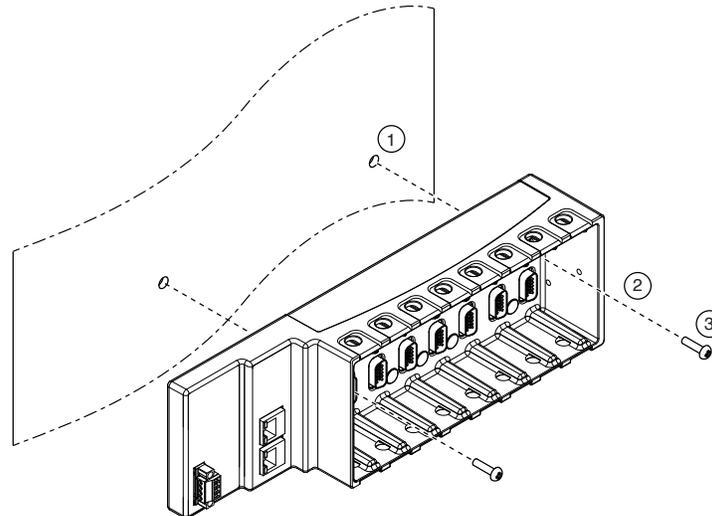
For environments with high shock and vibration, NI recommends mounting the NI 9144 directly on a flat, rigid surface using the mounting holes in the NI 9144.

What to Use

- NI 9144
- Screwdriver, Phillips #2
- M4 or number 8 screw (x2), user-provided, longer than 13.2 mm (0.52 in.) to pass all the way through the NI 9144

What to Do

Complete the following steps to mount the NI 9144 directly on a flat surface.

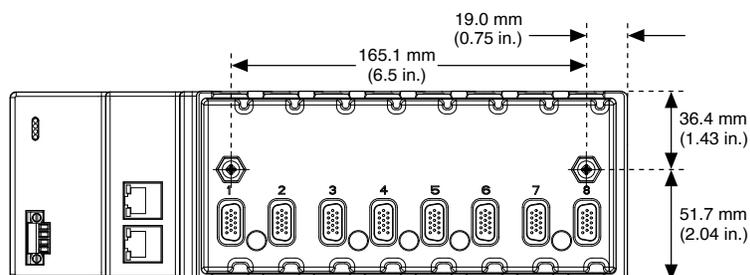


1. Prepare the surface for mounting the NI 9144 using the [Surface Mounting Dimensions](#).
2. Align the NI 9144 on the surface.
3. Fasten the NI 9144 to the surface using the M4 or number 8 screws appropriate for the surface. Tighten the screws to a maximum torque of $1.3 \text{ N} \cdot \text{m}$ ($11.5 \text{ lb} \cdot \text{in.}$).

Surface Mounting Dimensions

The following figure shows the surface mounting dimensions for the NI 9144.

Figure 8. NI 9144 Surface Mounting Dimensions



Mounting the Device on a Panel

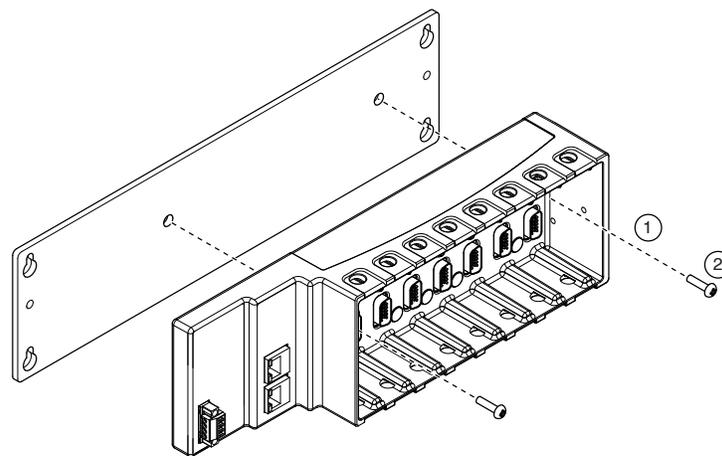
You can use the NI panel mounting kit to mount the NI 9144 on a panel.

What to Use

- NI 9144
- Screwdriver, Phillips #2
- NI panel mounting kit, 779558-01
 - Panel mounting plate
 - M4 × 17 panhead screw (x2)

What to Do

Complete the following steps to mount the NI 9144 on a panel.



1. Align the NI 9144 and the panel mounting plate.
2. Fasten the panel mounting plate to the NI 9144 using the screwdriver and M4 × 17 panhead screws. NI provides these screws with the panel mounting kit. Tighten the screws to a maximum torque of 1.3 N · m (11.5 lb · in.).



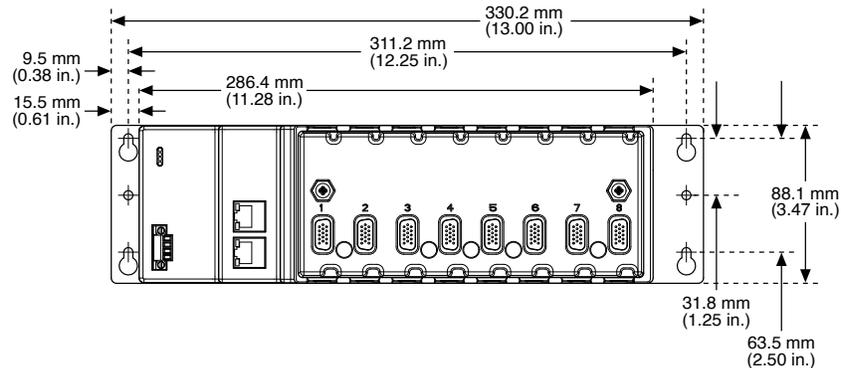
Note You must use the screws provided with the NI panel mounting kit because they are the correct depth and thread for the panel mounting plate.

3. Fasten the panel mounting plate to the surface using the screwdriver and screws that are appropriate for the surface. The maximum screw size is M5 or number 10.

Panel Mounting Dimensions

The following figure shows the panel mounting dimensions for the NI 9144.

Figure 9. NI 9144 Panel Mounting Dimensions



Mounting the Device on a DIN Rail

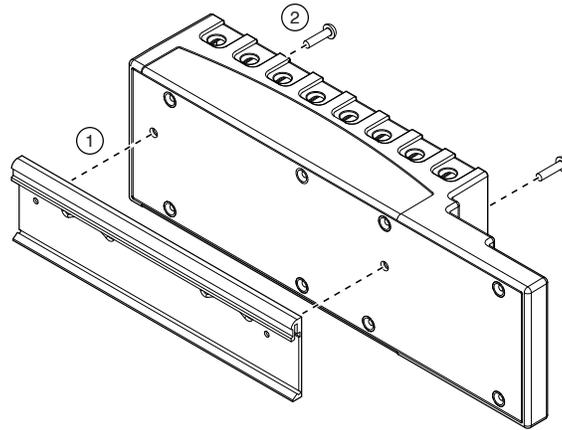
You can use the NI DIN rail mounting kit to mount the NI 9144 on a standard 35-mm DIN rail.

What to Use

- NI 9144
- Screwdriver, Phillips #2
- NI DIN rail mounting kit, 779018-01
 - DIN rail clip
 - M4 × 17 panhead screw (x2)

What to Do

Complete the following steps to mount the NI 9144 on a DIN rail.



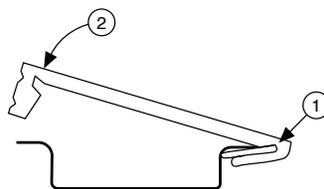
1. Align the NI 9144 and the DIN rail clip.
2. Fasten the DIN rail kit to the NI 9144 using the screwdriver and M4 × 17 panhead screws. NI provides these screws with the DIN rail mounting kit. Tighten the screws to a maximum torque of 1.3 N · m (11.5 lb · in.).



Note You must use the screws provided with the NI DIN rail mounting kit because they are the correct depth and thread for the DIN rail clip.

Clipping the Device on a DIN Rail

Complete the following steps to clip the NI 9144 on a DIN rail.



1. Insert one edge of the DIN rail into the deeper opening of the DIN rail clip.
2. Press down firmly to compress the spring until the clip locks in place on the DIN rail.



Caution Ensure that no C Series modules are in the NI 9144 before removing it from the DIN rail.

Mounting the Device on a Rack

You can use the following rack mount kits to mount the NI 9144 and other DIN rail-mountable equipment on a standard 482.6 mm (19 in.) rack.

- NI Sliding Rack-Mounting Kit, 779102-01
- NI Rack-Mounting Kit, 781989-01



Note You must use the NI DIN rail mounting kit, 779018-01, in addition to a rack-mounting kit.

Mounting the Device on a Desktop

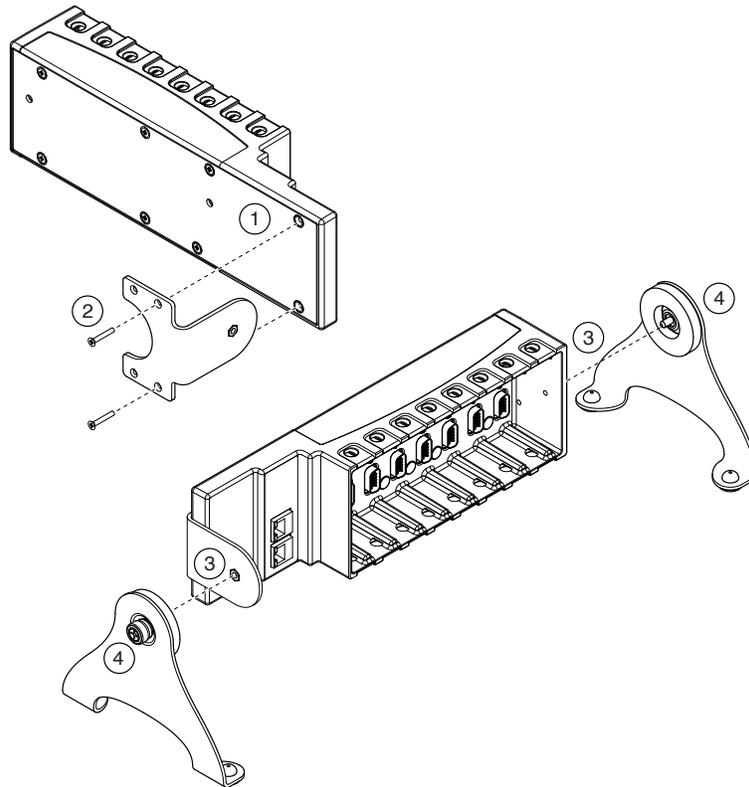
You can use the NI desktop mounting kit to mount the NI 9144 on a desktop.

What to Use

- NI 9144
- Screwdriver, Phillips #1
- Screwdriver, Phillips #2
- NI desktop mounting kit, 779473-01
 - Desktop mounting brackets (x2)
 - Adapter bracket
 - M3 × 14 flathead screw (x2)

What to Do

Complete the following steps to mount the NI 9144 on a desktop.



1. Use the Phillips #1 screwdriver to remove the two screws from the back of the NI 9144.
2. Use the screwdriver and the M3 × 14 flathead screws to attach the adapter bracket to the NI 9144. NI provides these screws with the desktop mounting kit.



Note You must use the screws provided with the NI desktop mounting kit because they are the correct depth and thread for the NI 9144.

3. Align the brackets with the mounting holes on the ends of the NI 9144.

- Use the Phillips #2 screwdriver to tighten the captive screws on the end of the brackets.

Desktop Mounting Dimensions

The following figures show the desktop mounting dimensions for the NI 9144.

Figure 10. NI 9144 Desktop Mounting Front Dimensions

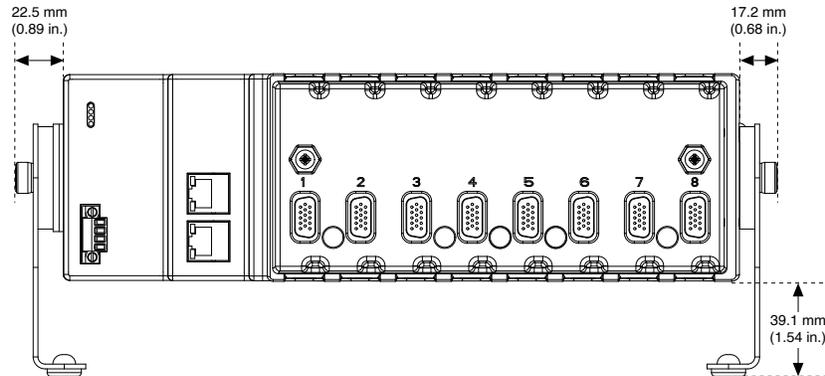
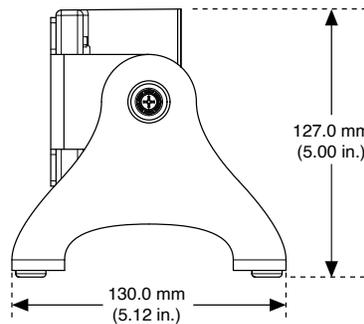


Figure 11. NI 9144 Desktop Mounting Side Dimensions



Upgrading from the NI 9144 to the NI 9145

You can use the NI 9144 to NI 9145 adapter panel mounting kit (NI part number 785984-01) to mount the NI 9145 to an existing NI 9144 panel mounting plate. Contact NI for information about ordering a NI 9144 to NI 9145 adapter panel mounting kit.

Mounting the NI 9145 Using the Adapter Kit

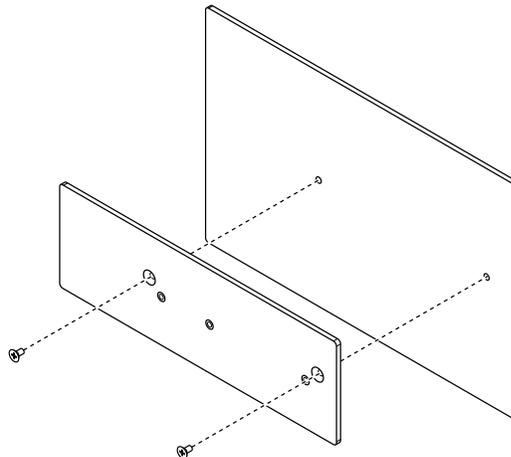
What to Use

- NI 9145
- #2 Phillips screwdriver
- Two (2x) M4 or number 8 flathead screw, 10 mm (0.39 in.) minimum length, user-provided
- NI 9144 to NI 9145 adapter mounting plate kit, 785984-01
 - Adapter mounting plate
 - Three (3x) M4 x 23 mm screws

What to Do

1. Remove the NI 9144 from the NI 9144 panel mounting plate.
2. Align the adapter mounting plate with the holes in the NI 9144 panel mounting plate.
3. Fasten the adapter mounting plate to the NI 9144 panel mounting plate using the M4 or number 8 flathead screws.

Figure 12. Attaching the Adapter Mounting Plate to the NI 9144 Panel Mounting Plate

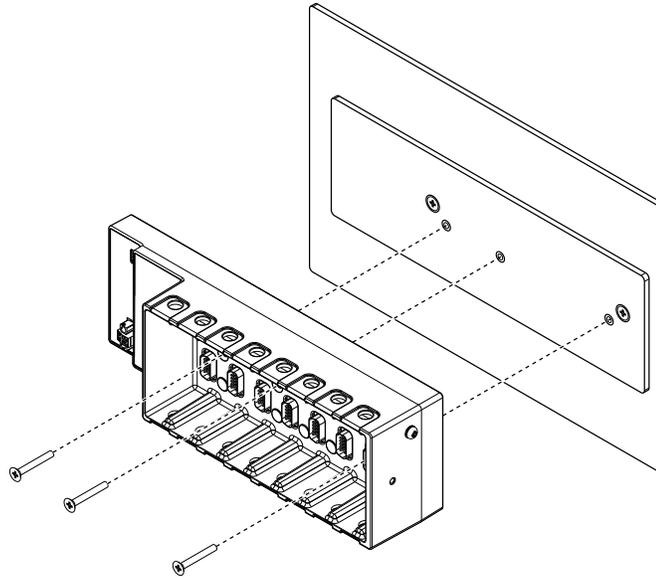


4. Align the NI 9145 chassis to the adapter mounting plate and fasten it using the M4 x 23 mm screws.

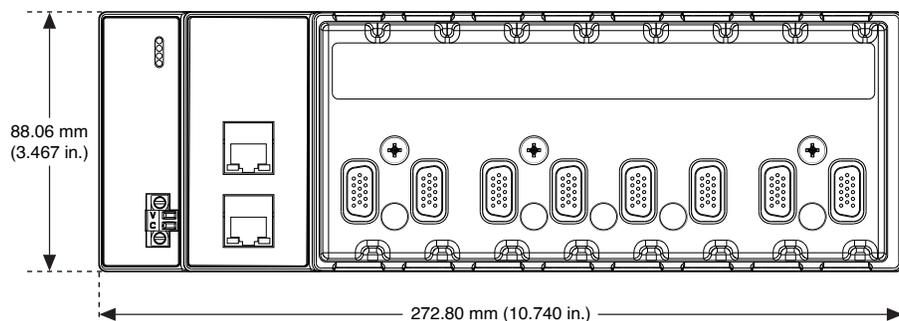


Note You must use the screws included in the kit because they are the correct depth and thread for the chassis and the adapter mounting plate. Tighten the screws to a maximum torque of 1.3 N · m (11.5 lb · in.).

Figure 13. Attaching the NI 9145 to the Adapter Mounting Plate



NI 9144 to NI 9145 Adapter Mounting Plate Dimensions



Resetting the NI 9144 Network Configuration

To reset the NI 9144 network configuration, disconnect and reconnect the network cables on the NI 9144 chassis.

Updating Your Firmware

Firmware updates are performed by way of the File over EtherCAT (FoE) download protocol. All NI factory firmware update files have a .foe extension and have internal identification information that guides the NI 9144 during the update. Refer to your specific master software documentation for the procedure of sending FoE downloads.

The NI 9144 firmware update does not use the filename or password information. You may also use this utility to download custom FPGA projects with a .lvbitx extension.

How to Upgrade Your Firmware

To upgrade your firmware to a new version or reset your device to the factory state, complete the following steps:

1. Discover your real-time target and NI 9144 chassis.
2. Right-click the RT target and select **Deploy All**.
3. After a successful deployment, change the controller to Configuration Mode. Right-click the RT target and select **Utilities»Scan Engine Mode»Switch to Configuration**.
4. Right-click the NI 9144 that requires a firmware change and select **Online Device State**.
5. Change the online state by clicking the **Init** button and then clicking the **Bootstrap** button. The LED beside the **Bootstrap** button lights up.
6. Click the **Download Firmware** button. Navigate to Program Files\National Instruments\NI-IndCom for EtherCAT and select the file with a .foe extension or a custom FPGA project with a .lvbitx extension.
Do not disconnect the device or interrupt firmware while it is downloading.

Using the NI 9144 with an EtherCAT Third-Party Master

When using a third-party master, you can access all of the functionality of the C Series modules using vendor extensions to the object dictionary. Each module

installed in the NI 9144 has its own object dictionary that you can use to configure the module.

If your master software supports ADS over EtherCAT (AoE) services, you can address the module directly. If your master software does not support AoE services, you can still configure your module using NI vendor extensions and CAN over EtherCAT (CoE).

Using AoE/SDO

AoE protocol allows you to specify the destination port or address of the SDO request. An address of 0 indicates the NI 9144. Addresses 1 through 8 route the SDO request to the object dictionary of the module in the addressed slot. If no module is installed in the addressed slot, the request fails. SDOInfo and SDO requests work with module object dictionaries over AoE similar to the NI 9144 main object dictionary.



Tip Depending on the master software interface, you may be required to add 1,000 to the slot number to create a valid AoE address.

Using CoE/SDO

CoE protocol does not have a destination port or address. When using CoE protocol, the NI 9144 provides an object dictionary entry that allows addressing support. Prior to sending an SDOInfo or SDO request, the application writes an address of 1 through 8 to the object dictionary index 0x5FFF, subindex 0. Once the address is written, SDO transactions are sent to the object dictionary of the module in the addressed slot. If no module is installed in the addressed slot, the request fails.

After the module-specific SDOInfo and SDO requests are complete, the application writes 0 to the module object dictionary index 0x5FFF, subindex 0 to return control to the NI 9144 main object dictionary.

Vendor Extensions to the Object Dictionary

Most object dictionary entries are defined by the EtherCAT and CANOpen specifications for modular slave devices. The NI 9144 and the C Series modules have vendor extensions to those specifications.



Note Visit ni.com/manuals to access the NI 951x C Series modules object dictionary.



Note Most object dictionary entries are set to usable defaults during the transition from INIT to PRE-OP of the NI 9144. NI recommends writing down the object dictionary default values, in case you need to revert to them, before you begin to overwrite them with new values prior to the transition to SAFE-OP.

Refer to the **EtherCAT® Expansion Chassis Vendor Configurations Guide** on ni.com/manuals for the list of vendor extensions.

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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