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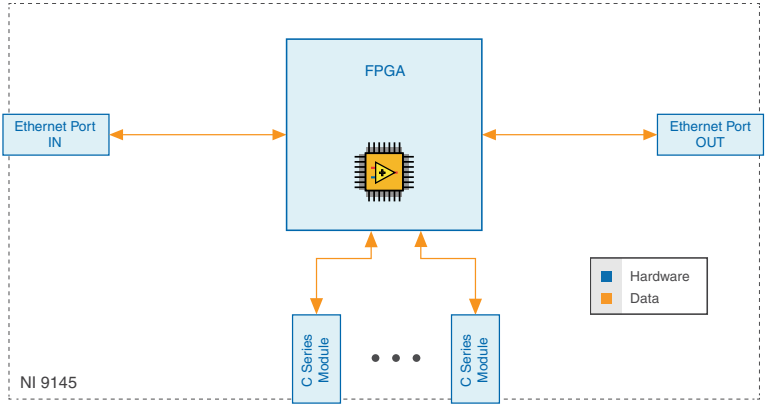
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USER MANUAL

NI 9145

Deterministic Ethernet Expansion Chassis for C Series Modules

This document describes the features of the NI 9145 and contains information about mounting and operating the device.



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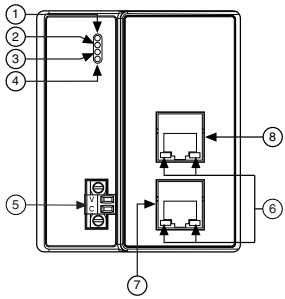
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NI 9145 Features

The NI 9145 provides the following features.

Figure 1. NI 9145 Front Panel



1. POWER LED
2. FPGA LED
3. RUN LED
4. ERR LED
5. Power Connector
6. Ethernet LEDs
7. Out Port
8. In Port

POWER LED Indicators

The following table lists the POWER LED indicators.

Table 1. POWER LED Indicators

LED Color	LED Pattern	Indication
Green	Solid	The NI 9145 is powered on and the connected power supply is adequate.
—	Off	The NI 9145 is powered off.

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.

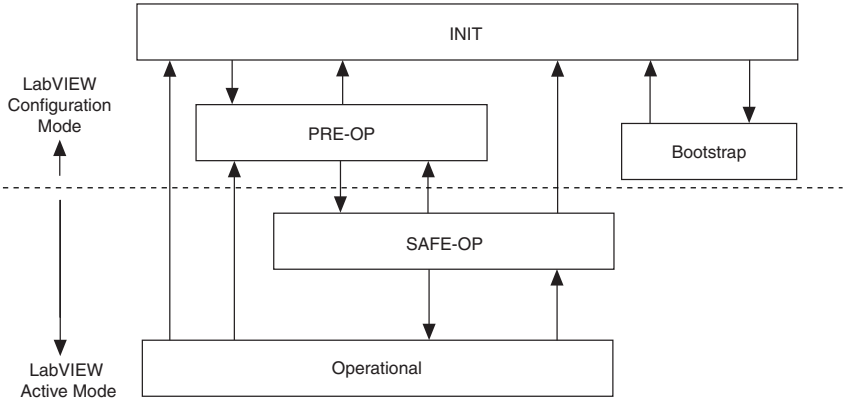
Table 2. RUN LED Indicators

LED Color	LED Pattern	Indication
Green	Off	The NI 9145 is in initialize (INIT) run mode. The NI 9145 is initializing and discovering slaves.
	Continuously blinks	The NI 9145 is in pre-operational (PRE-OP) run mode. The NI 9145 is detecting modules, configuring, and synchronizing.
	Blinks once and pauses	The NI 9145 is in safe-operational (SAFE-OP) run mode. The NI 9145 inputs are functional and outputs drive constant safe values.
	Solid	The NI 9145 is in operational run mode. The NI 9145 inputs and outputs are functional.
	Flickering	The NI 9145 is in bootstrap run mode. The NI 9145 is updating firmware.

Run Mode Transition

The following figure shows the Run Mode transition.

Figure 2. EtherCAT Modes



ERR LED Indicators

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

Table 3. ERR 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 9145 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.

Safe-State Outputs

The NI 9145 has an EtherCAT safe state that the device passes through when moving from LabVIEW Active Mode to LabVIEW Configuration Mode. The NI 9145 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 9145 operates in free-run mode or synchronized mode using the EtherCAT distributed clock (DC).

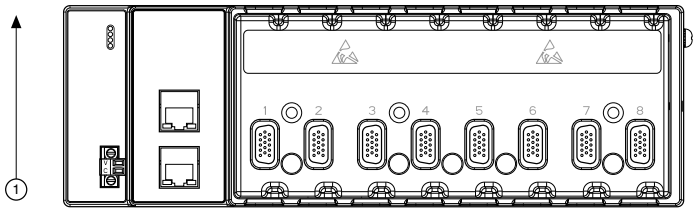
By default, free-run mode runs the conversion cycle at the rate of the slowest module. You can slow the free-run mode conversion cycle down by writing a minimum cycle time in nanoseconds to index 0x3001.1 of the NI 9145.

In synchronized mode, each conversion cycle begins with a signal from the EtherCAT master/scan engine. The NI 9145 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 9145 horizontally on a flat, metallic, vertical surface such as a panel or wall. You can mount the NI 9145 directly to the surface or use the NI Panel Mounting Kit. The following figure shows the NI 9145 mounted horizontally.

Figure 3. NI 9145 Horizontal Mounting



1. Up

You can also mount the NI 9145 in other orientations, on a nonmetallic surface, on a 35-mm DIN rail, on a desktop, or in a rack. Mounting the NI 9145 in these or other configurations can reduce the maximum allowable ambient temperature and can affect the typical accuracy of modules in the NI 9145. 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 `criotypical`.

Caution Make sure that no C Series modules are in the NI 9145 before mounting it.

Tip Before using any of these mounting methods, record the serial number from the back of the NI 9145 so that you can identify the NI 9145 in MAX. You will be unable to read the serial number after you mount the NI 9145.

Dimensions

The following figures show the front and side dimensions of the NI 9145. For detailed dimensional drawings and 3D models, visit *ni.com/dimensions* and search for the module number.

Figure 4. NI 9145 Front Dimensions

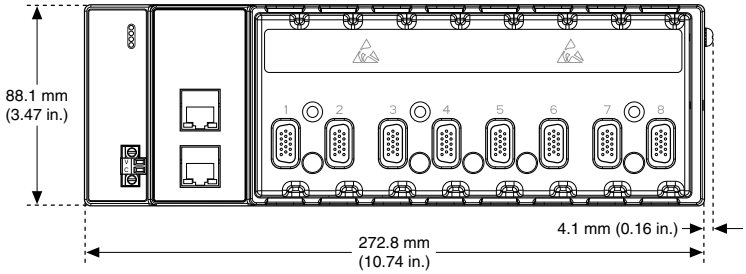
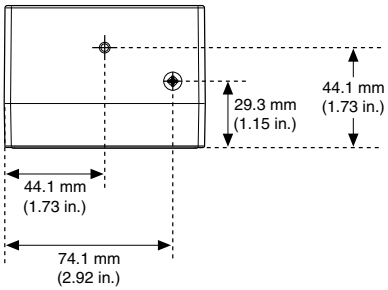


Figure 5. NI 9145 Side Dimensions

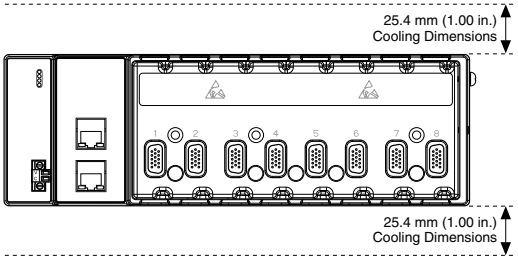


Mounting Requirements

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

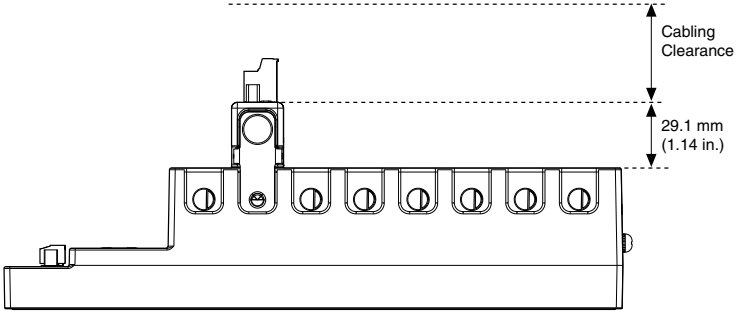
Allow 25.4 mm (1.00 in.) on the top and the bottom of the NI 9145 for air circulation, as shown in the following figure.

Figure 6. NI 9145 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`.

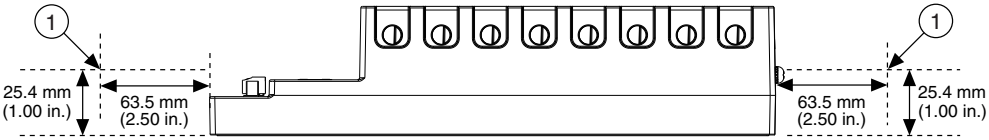
Figure 7. NI 9145 Cabling Clearance



Ambient Temperature

Measure the ambient temperature at each side of the NI 9145, 63.5 mm (2.50 in.) from the side and 25.4 mm (1.00 in.) forward from the rear of the NI 9145, as shown in the following figure.

Figure 8. NI 9145 Ambient Temperature Location



1. Location for measuring the ambient temperature

Mounting the Device Directly on a Flat Surface

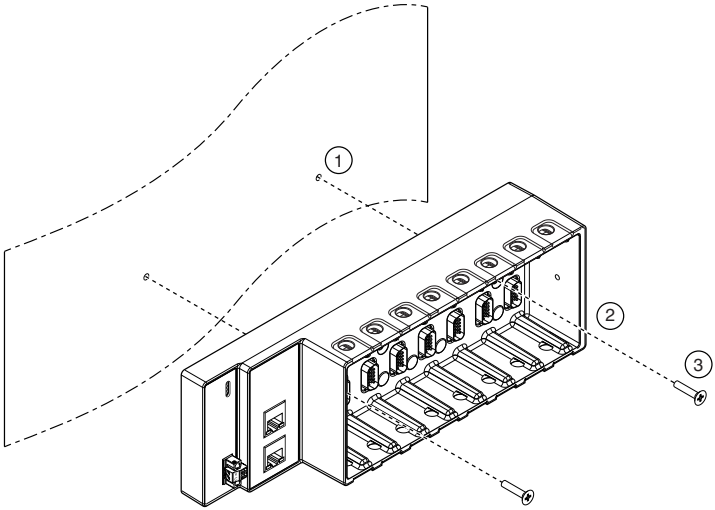
For environments with high shock and vibration, NI recommends mounting the NI 9145 directly on a flat, rigid surface using the mounting holes in the NI 9145.

What to Use

- NI 9145
- Screwdriver, Phillips #2
- M4 or number 8 screw (x2), user-provided, longer than 19.0 mm (0.75 in.) to pass all the way through the NI 9145

What to Do

Complete the following steps to mount the NI 9145 directly on a flat surface.

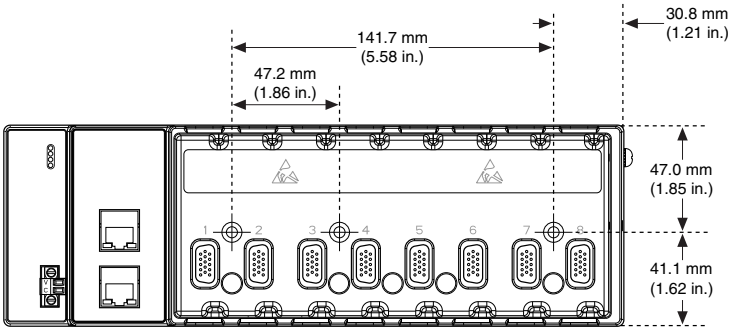


1. Prepare the surface for mounting the NI 9145 using the *Surface Mounting Dimensions*.
2. Align the NI 9145 on the surface.
3. Fasten the NI 9145 to the surface using the M4 or number 8 screws appropriate for the surface. Tighten the screws to a maximum torque of 1.3 N · m (11.5 lb · in.).

Surface Mounting Dimensions

The following figure shows the surface mounting dimensions for the NI 9145.

Figure 9. NI 9145 Surface Mounting Dimensions



Mounting the Device on a Panel

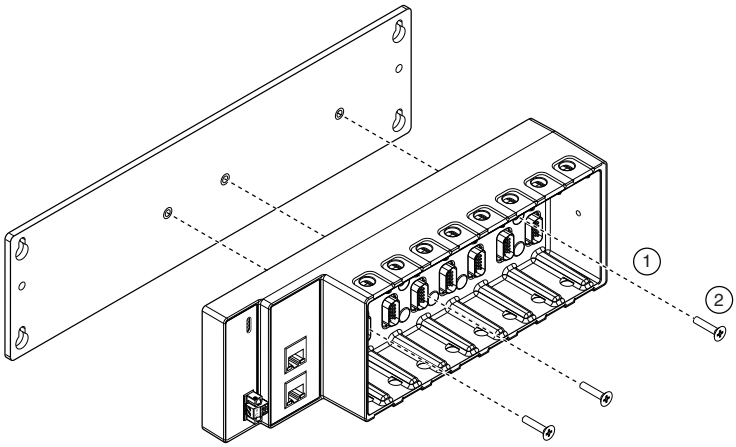
You can use the NI panel mounting kit to mount the NI 9145 on a panel.

What to Use

- NI 9145
- Screwdriver, Phillips #2
- NI panel mounting kit, 782863-01
  - Panel mounting plate
  - M4 × 23 flathead screw (x3)

What to Do

Complete the following steps to mount the NI 9145 on a panel.



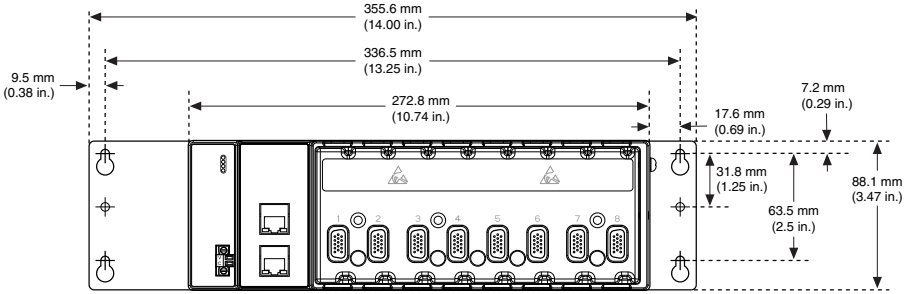
1. Align the NI 9145 and the panel mounting plate.
2. Fasten the panel mounting plate to the NI 9145 using the screwdriver and M4 × 23 flathead screws. NI provides these screws with the panel mounting kit. Tighten the screws to a maximum torque of 1.3 N · m (11.5 lb · in.).

   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 9145.

Figure 10. NI 9145 Panel Mounting Dimensions



Mounting the Device on a DIN Rail

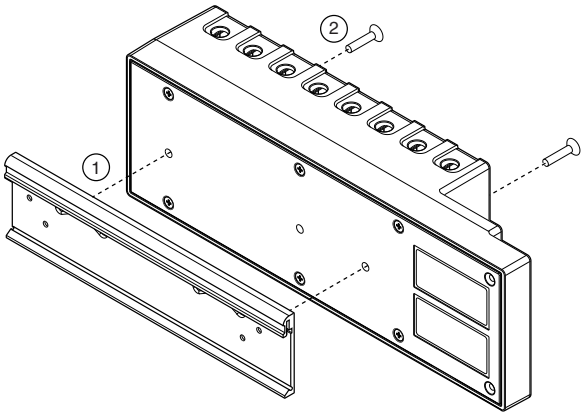
You can use the NI DIN rail mounting kit to mount the NI 9145 on a standard 35-mm DIN rail.

What to Use

- NI 9145
- Screwdriver, Phillips #2
- NI DIN rail mounting kit, 779018-01
  - DIN rail clip
  - M4 × 25 flathead screw (x2)

What to Do

Complete the following steps to mount the NI 9145 on a DIN rail.



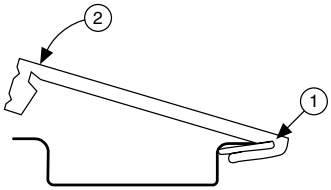
1. Align the NI 9145 and the DIN rail clip.

2. Fasten the DIN rail kit to the NI 9145 using the screwdriver and M4 × 25 flathead 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 9145 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 9145 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 9145 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

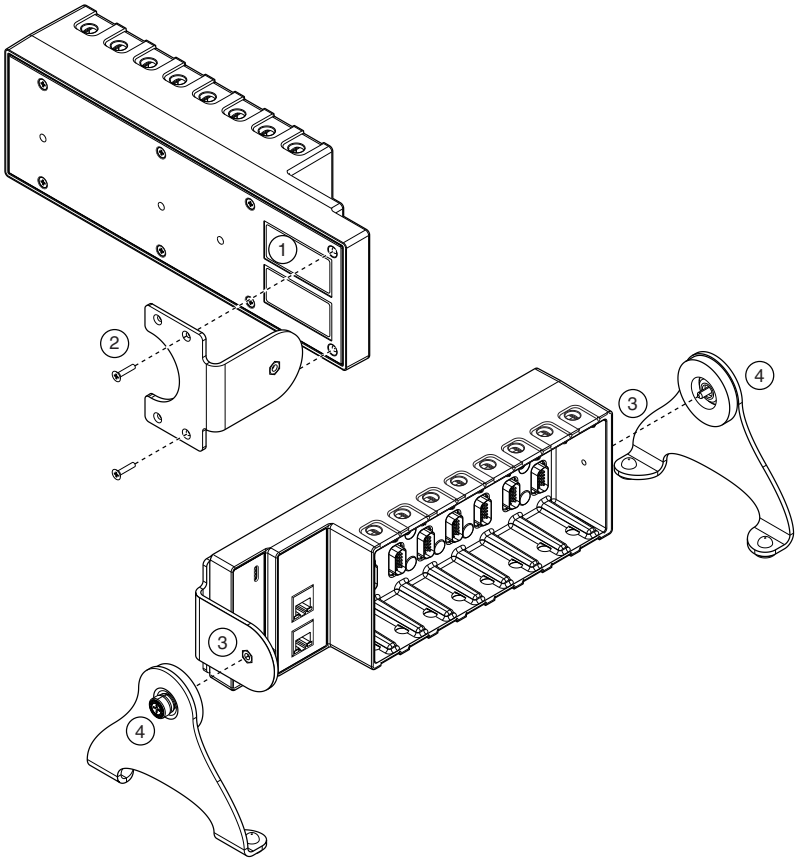
You can use the NI desktop mounting kit to mount the NI 9145 on a desktop.

What to Use

- NI 9145
- Screwdriver, Phillips #1
- Screwdriver, Phillips #2
- NI desktop mounting kit, 779473-01
  - Desktop mounting brackets (x2)
  - Adapter bracket
  - M3 × 20 flathead screw (x2)

What to Do

Complete the following steps to mount the NI 9145 on a desktop.



1. Use the Phillips #1 screwdriver to remove the two screws from the back of the NI 9145.
2. Use the screwdriver and the M3 × 20 flathead screws to attach the adapter bracket to the NI 9145. 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 9145.

3. Align the brackets with the mounting holes on the ends of the NI 9145.
4. 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 9145.

Figure 11. NI 9145 Desktop Mounting Front Dimensions

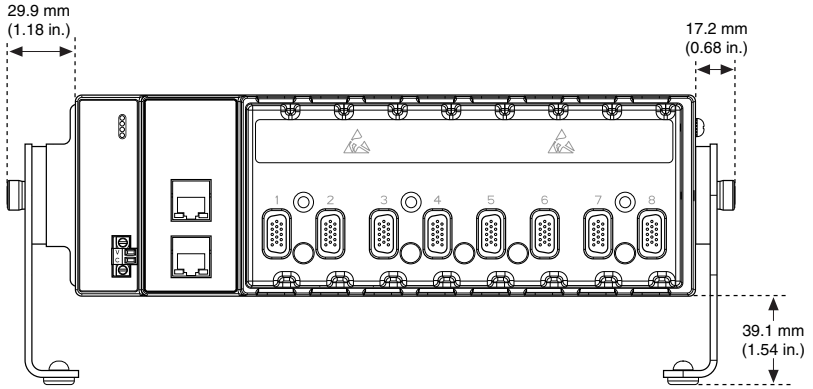
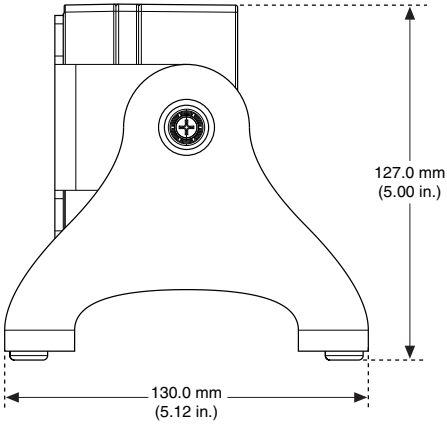


Figure 12. NI 9145 Desktop Mounting Side Dimensions



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

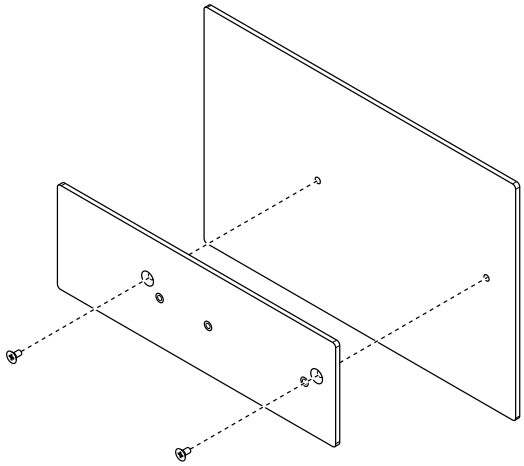
- NI 9145
- #2 Phillips screwdriver

- 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.

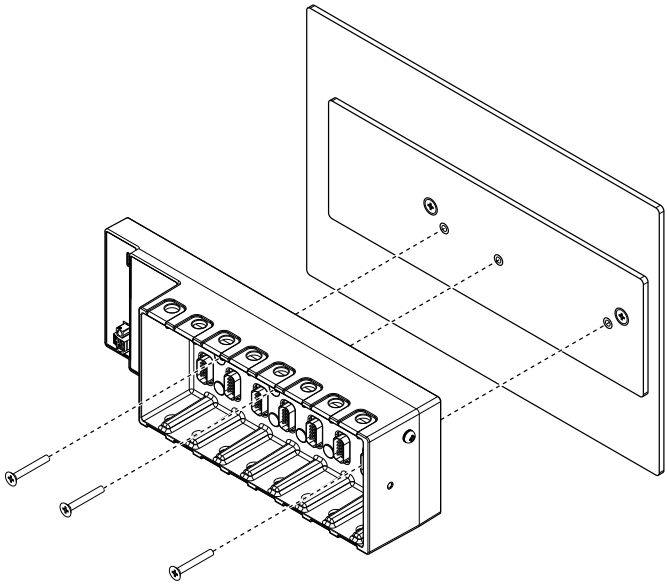
Figure 13. Attaching the Adapter Mounting Plate to the NI 9144 Panel Mounting Plate



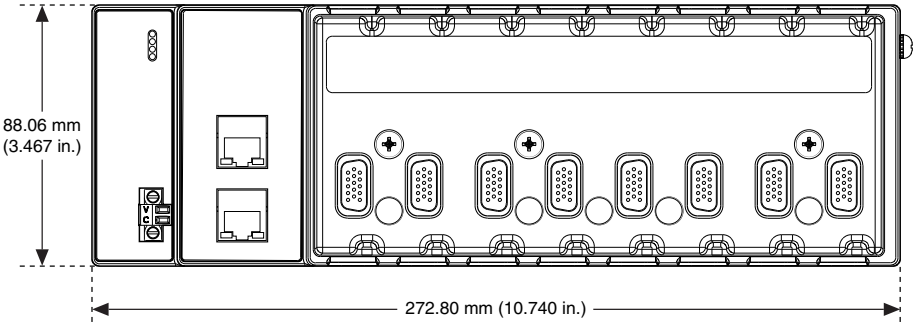
4. Align the NI 9145 chassis to the adapter mounting plate and fasten it using the M4 x 23 mm screws.

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 14. Attaching the NI 9145 to the Adapter Mounting Plate



NI 9144 to NI 9145 Adapter Mounting Plate Dimensions



Resetting the NI 9145 Network Configuration

To reset the NI 9145 network configuration, disconnect and reconnect the network cables on the NI 9145 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 9145 during the update. Refer to your specific master software documentation for the procedure of sending FoE downloads.

The NI 9145 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 9145 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 9145 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.

Vendor Extensions to the Object Dictionary

Most object dictionary entries are defined by the EtherCAT and CANOpen specifications for modular slave devices. The NI 9145 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 9145. 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.

Worldwide Support and Services

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378015B-03 September 11, 2018

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