NI-9145 Getting Started

Contents

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
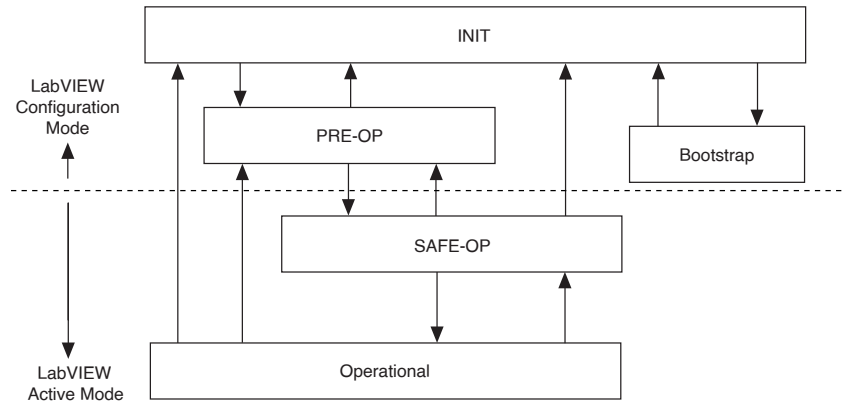
The following table lists the RUN LED indicators.

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 1. 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.

NI-9145 Block Diagram
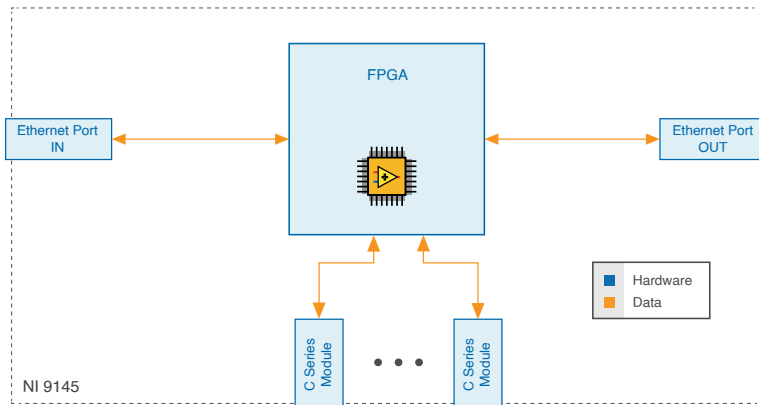
Unpacking the Kit

> **Notice** 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.

> **Notice** Never touch the exposed pins of connectors.

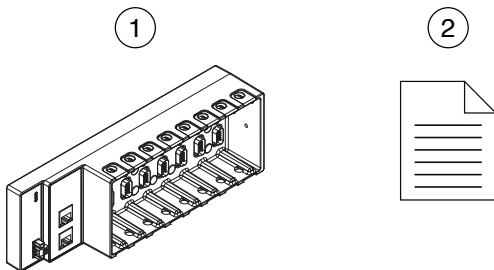> **Note** Do not install a device if it appears damaged in any way.

3. Unpack any other items and documentation from the kit.

Store the device in the antistatic package when the device is not in use.

Verifying the Kit Contents

Verify that the following items are included in the NI 9145 kit.

Figure 2. NI 9145 Kit Contents

1. Chassis with power connector
2. Safety, Environmental, and Regulatory Information

Installing Software on the Host Computer

When using an NI master controller with the NI-9145, you must install the following application software and device drivers on the host computer in this order:

1. LabVIEW 2016 or later
2. LabVIEW 2016 Real-Time Module or later
3. NI CompactRIO Device Drivers August 2016 or later
4. NI-Industrial Communications for EtherCAT 16.1 or later
5. LabVIEW 2016 FPGA Module or later[1]

> 🖉 **Note** For more information about downloading and getting started with EtherCAT hardware drivers, go to ni.com/r/ecatdriver. NI recommends that you install the latest version of NI-Industrial Communications for EtherCAT.

1. Optional installation for FPGA functionalities.

Connecting the NI-9145

The NI-9145 has the following connectors and LEDs.

Figure 3. NI-9145
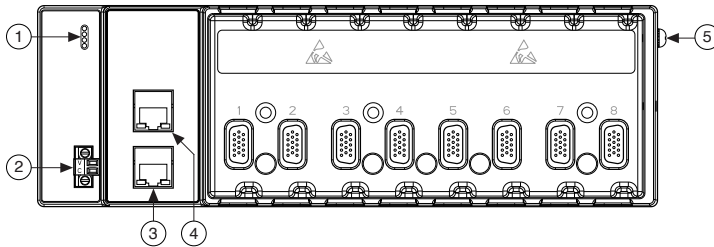
1. LEDs
2. Power Connector
3. OUT Port
4. IN Port
5. Grounding Terminal

Connecting the NI-9145 to Ground

You must connect the NI-9145 grounding terminal to the grounding electrode system of the facility.

What to Use

- Ring lug
- Wire, 1.31 mm^2 (16 AWG) or larger
- Screwdriver, Phillips #2

What to Do

Complete the following steps to ground the NI-9145.

1. Attach the ring lug to the wire.
2. Remove the grounding screw from the grounding terminal on the NI-9145.
3. Attach the ring lug to the grounding terminal.

4. Tighten the grounding screw to 0.5 N · m (4.4 lb · in.) of torque.
5. Attach the other end of the wire to the grounding electrode system of your facility using a method that is appropriate for your application.

> ⓘ **Notice** If you use shielded cabling to connect to a C Series module with a plastic connector, you must attach the cable shield to the chassis grounding terminal using 1.31 mm^2 (16 AWG) or larger wire. Attach a ring lug to the wire and attach the wire to the chassis grounding terminal. Solder the other end of the wire to the cable shield. Use shorter wire for better EMC performance.

For more information about ground connections, visit ni.com/r/emcground.

Connecting the NI 9145 to Power

The NI 9145 requires a 9 V to 30 V external power supply. The NI 9145 filters and regulates the supplied power and provides power for the C Series modules. The NI 9145 has one layer of reverse-voltage protection.

The following table lists the POWER LED indicators.

Table 4. 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.

What to Use

- Screwdriver, 2.54 mm (0.10 in.) flathead
- Power supply, 9 V to 30 V, 20 Wminimum
- Wire, 2.0 mm^2 (14 AWG) or larger

NI recommends the power supply listed in the following table for the NI-9145.

Table 5. NI Power Supplies

Power Supply	Part Number
NI PS-15 Industrial Power Supply (24 V DC, 5 A, 100 V AC to 120 V AC/200 V AC to 240 V AC input)	781093-01

What to Do

Complete the following steps to connect a power supply to the NI 9145.

1. Ensure that your power supply is powered off.
2. Remove the power connector from the NI 9145.

> ⚠ **Caution** Do not tighten or loosen the terminal screws on the power connector while the NI 9145 is powered on.

3. Connect the power supply to the power connector, as shown in the following figure.

Figure 4. NI 9145 Power Connections
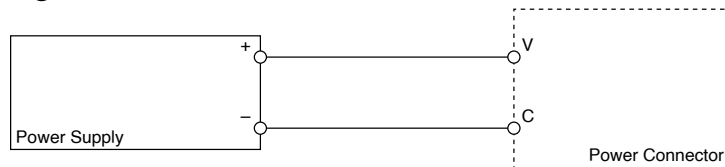
> ✎ **Note** The C terminals are internally connected to each other.

4. Tighten the terminal screws on the power connector to 0.20 N · m to 0.25 N · m (1.8 lb · in. to 2.2 lb · in.) of torque.
5. Install the power connector on the front panel of the NI 9145.
6. Tighten the power connector screw flanges to 0.3 N · m to 0.4 N · m (2.7 lb · in. to 3.5 lb · in.) of torque.
7. Power on the power supply.

Connecting the NI 9145 to an NI Master Controller

Before you connect the NI 9145 to an NI master controller, you must setup and connect the NI master controller to a network. Refer to your master controller documentation for setup information.

NI recommends that you install a private network segment for your deterministic Ethernet expansion devices. Slave devices cause network flooding on a standard network. Non-EtherCAT frames jeopardize the system performance and determinism on an EtherCAT network. Refer to the EtherCAT Technology Group Web site at www.ethercat.org for more information.

What to Use

- NI 9145
- NI Master Controller[2]
- Category 5 Ethernet Cable

> **Note** To prevent data loss and to maintain the integrity of your EtherCAT installation, do not use a CAT-5 Ethernet cable longer than 100 m. NI recommends using a CAT-5 or better shielded twisted-pair Ethernet cable

What to Do

Connect the NI 9145 to the NI master controller as shown in the following figure.

Figure 5. Connecting to an NI Master Controller
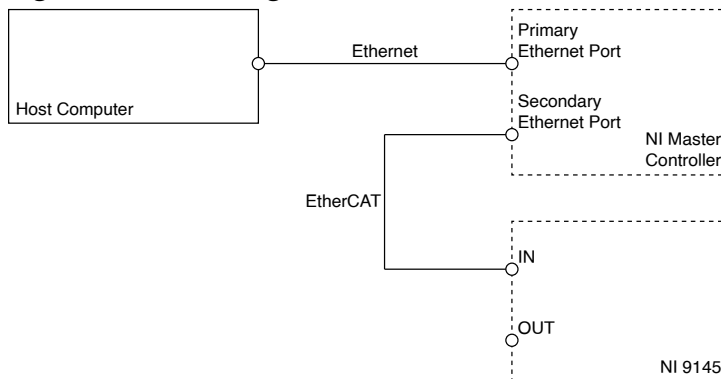
> **Tip** Use the OUT port on the NI 9145 to connect additional slave chassis.

> **Note** NI recommends downloading the latest version of the firmware to the NI 9145 before deploying your system. Each firmware release expands module support and ensures compatibility with the most recent version of

2. For supported NI master controllers, visit ni.com/r/ecatmaster.

the NI EtherCAT driver.

Mounting the NI-9145

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 6. NI-9145 Horizontal Mounting
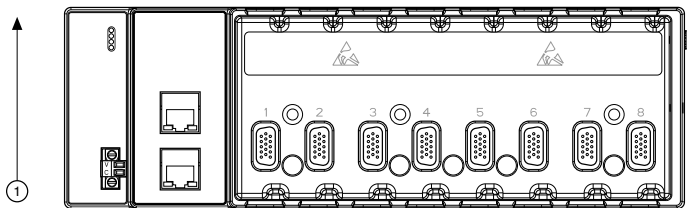
1. Up

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/r/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 model number.
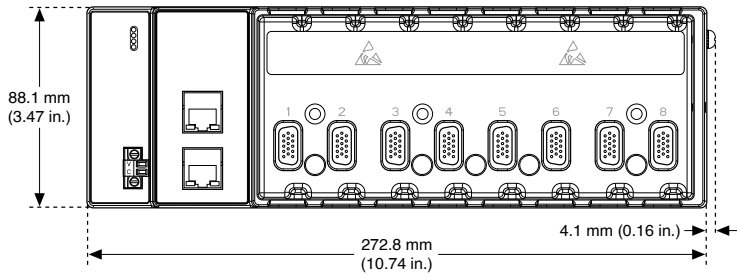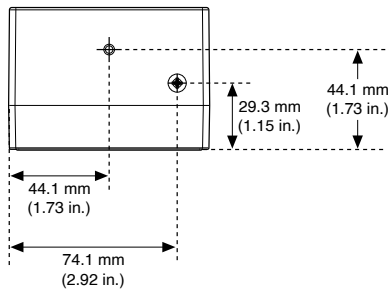
Figure 7. NI-9145 Front Dimensions
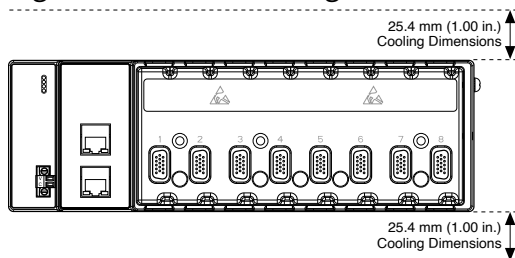

Figure 8. NI-9145 Side Dimensions

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 9. 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/r/crioconn.
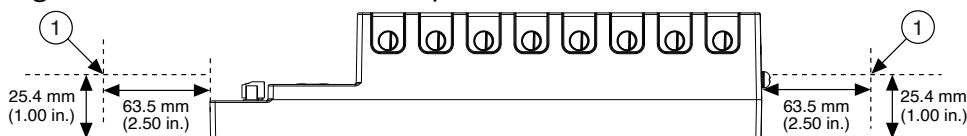
Figure 10. NI-9145 Cabling Clearance
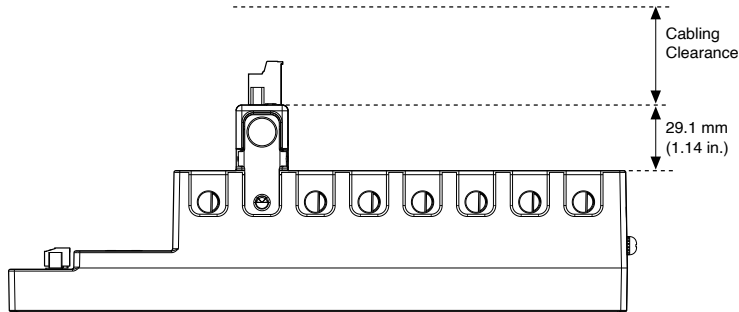
Ambient Temperature

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 11. NI-9145 Ambient Temperature Location

1. Location for measuring the ambient temperature

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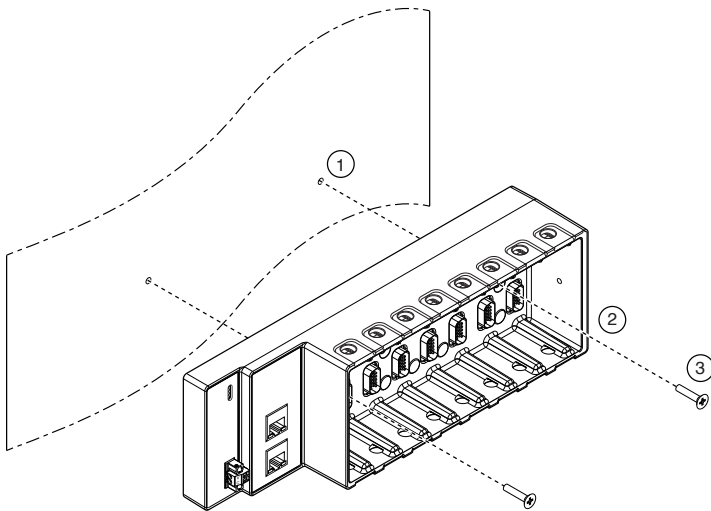
1. Prepare the surface for mounting the NI 9145 using the **Surface Mounting Dimensions**.
2. Align the NI 9145 on the surface.
3. Fasten the NI 9145 to the surface using the M4 or number 8 screws appropriate for the surface. Tighten the screws to a maximum torque of 1.3 N · m(11.5 lb · in.).

Surface Mounting Dimensions

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

Figure 12. NI-9145 Surface Mounting Dimensions
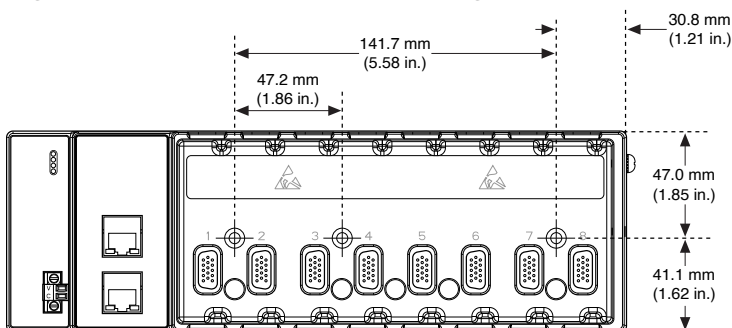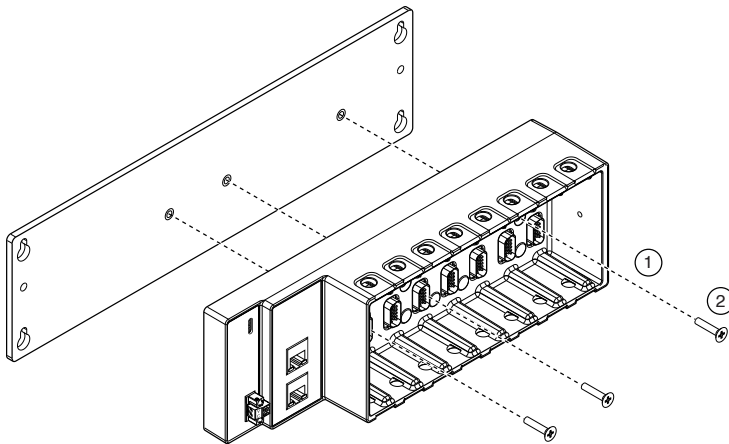

Mounting the NI 9145 on a Panel

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 13. NI-9145 Panel Mounting Dimensions
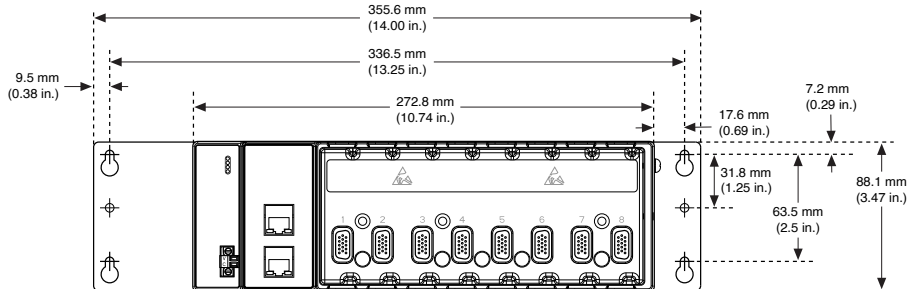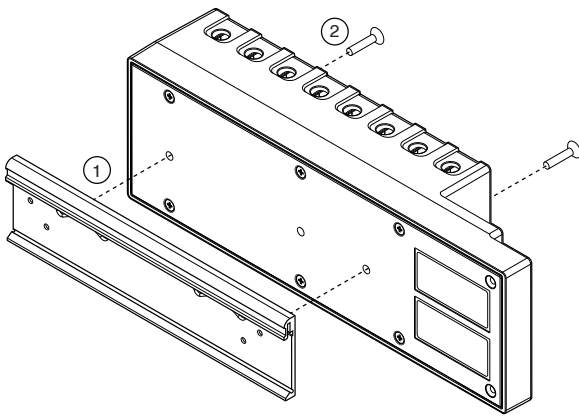

Mounting the NI 9145 on a DIN Rail

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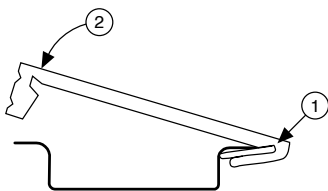
1. Insert one edge of the DIN rail into the deeper opening of the DIN rail clip.
2. Press down firmly to compress the spring until the clip locks in place on the DIN rail.

> ⊘ **Notice** Ensure that no C Series modules are in the NI-9145 before removing it from the DIN rail.

Mounting the Controller 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.
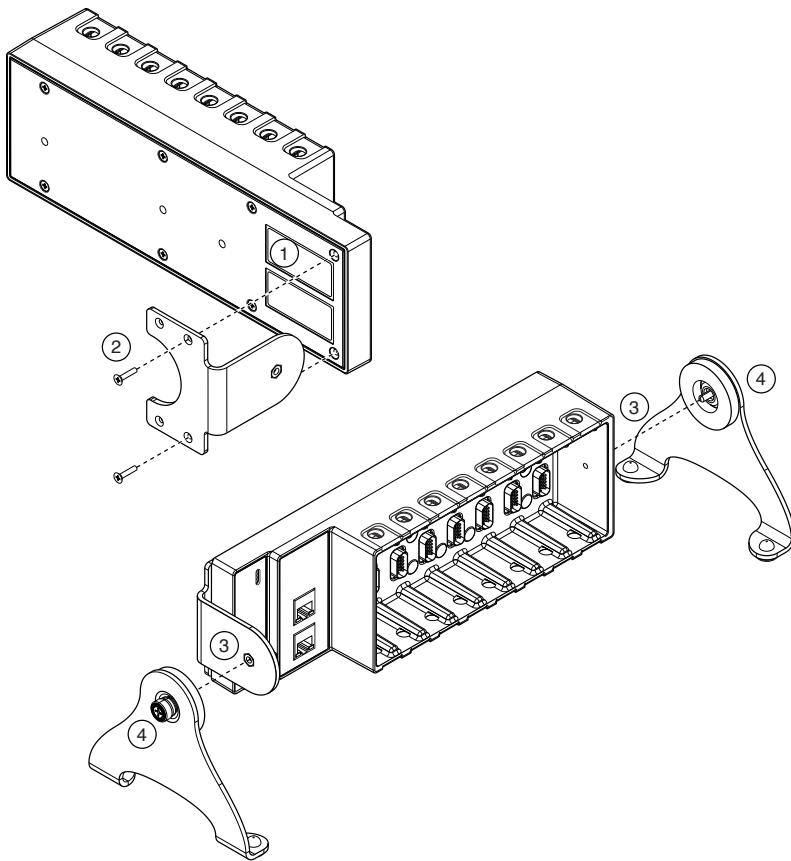
Mounting the Device on a Desktop

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.

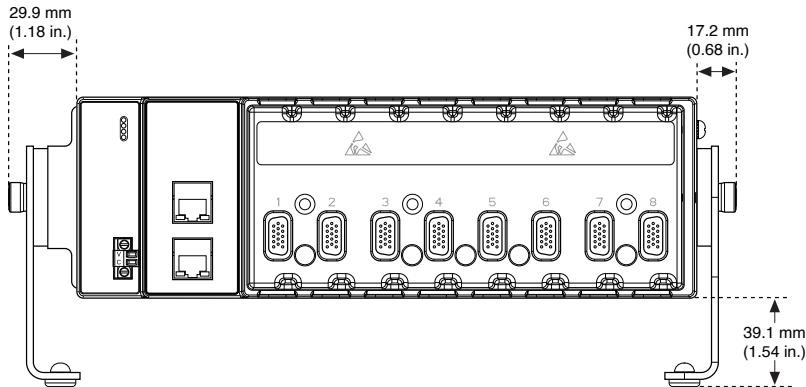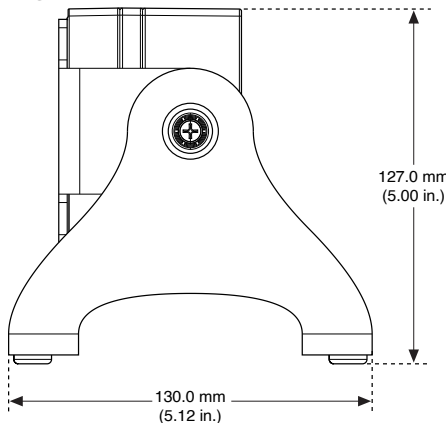Figure 14. NI-9145 Desktop Mounting Front Dimensions

Figure 15. 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.

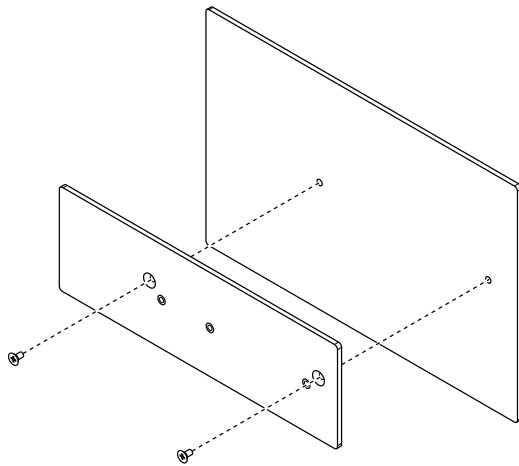## Mounting the NI 9145 Using the Adapter Kit

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 16. 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.
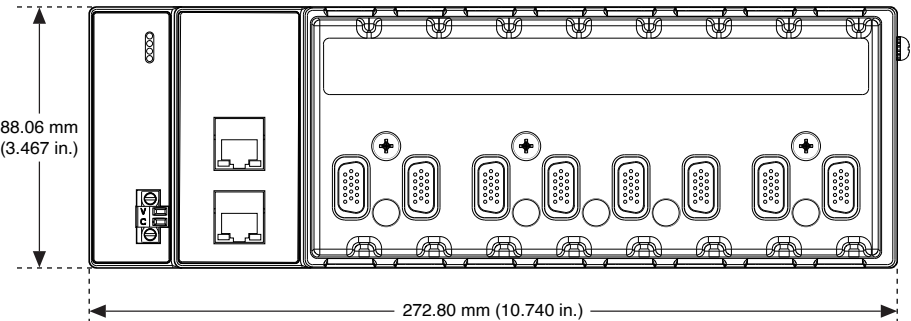
   Note You must use the screws included in the kit because they are the correct depth and thread for the chassis and the adapter mounting plate. Tighten the screws to a maximum torque of 1.3 N · m (11.5 lb · in.).

Figure 17. Attaching the NI 9145 to the Adapter Mounting Plate
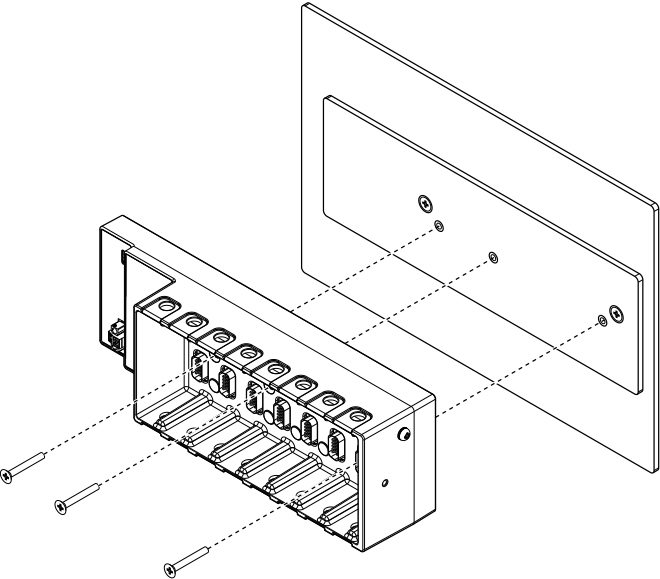
NI 9144 to NI 9145 Adapter Mounting Plate Dimensions

88.06 mm
(3.467 in.)

272.80 mm (10.740 in.)

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 `C:\Program Files (x86)\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.
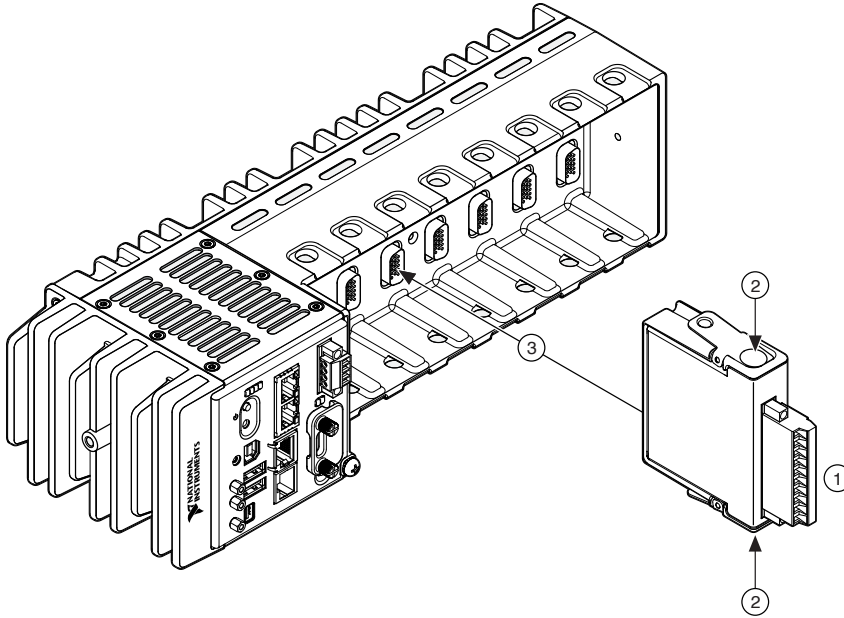
Resetting the NI-9145 Network Configuration

To reset the NI-9145 network configuration, disconnect and reconnect the network cables on the NI-9145 chassis.

Installing C Series Modules

Complete the following steps to install a C Series module.

Figure 18. Installing C Series Modules

1. Verify that power is not connected to the I/O connector(s) on the C Series module. If the system is in a nonhazardous location, the NI-9145 can be powered on when you install modules.
2. Press the latches on the C Series module.
3. Align the C Series module with a slot and seat it in the slot until the latches lock in place.

Removing C Series Modules

Verify that power is not connected to the I/O connector(s) on the C Series module before you remove a module from the NI 9145. If the system is in a nonhazardous location, the NI 9145 can be powered on when you remove modules.

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.

Third-Party Master Controller

Refer to the **_EtherCAT® Expansion Chassis Vendor Configurations Guide_** for more information about integrating the NI-9145 with a third party master controller.