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cRIO-9114

NI CMS-9024

NI Condition Monitoring System for NI InsightCM™ Enterprise

This document describes how to maintain the CMS-9024 NI Condition Monitoring System. The CompactRIO-based CMS-9024 is a bundle of hardware and software that includes the following components and features:

- cRIO-9024 controller and cRIO-9114 chassis
- NI C Series modules installed in the chassis
- Pre-installed NI InsightCM Server software
- Network configuration via USB drive



Note Complete the steps in the *NI CMS-9024 and CMS-9068 Quick Start* before using this document.

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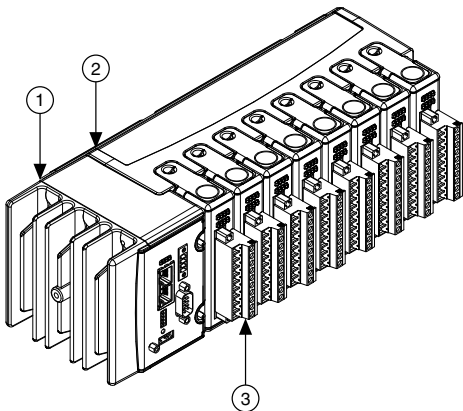
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CompactRIO Reconfigurable Embedded System

The following figure shows the components of the CompactRIO reconfigurable embedded system.

Figure 1. CompactRIO Reconfigurable Embedded System

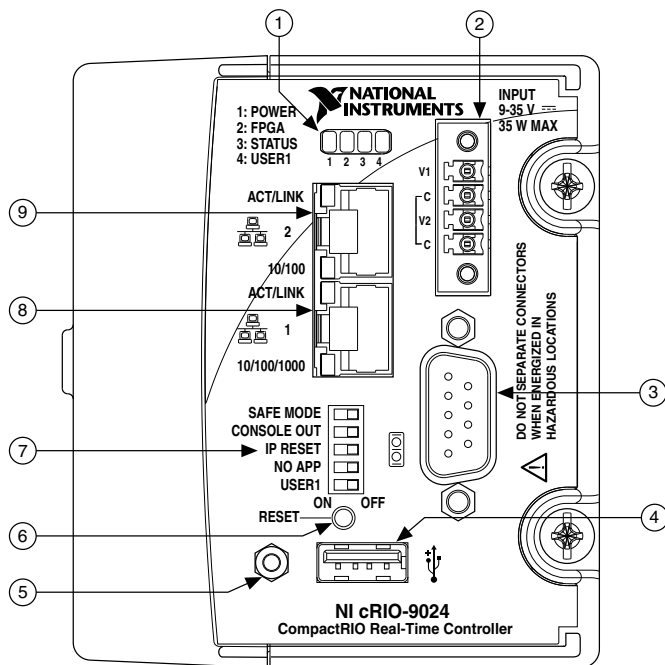


- 1. cRIO-9024 intelligent real-time embedded controller
- 2. cRIO-9114 eight-slot reconfigurable embedded chassis
- 3. C Series I/O module

Controller Front Panel

The following figure shows the I/O ports and other features of the cRIO-9024 controller.

Figure 2. cRIO-9024 Controller Front Panel



- | | |
|---------------------------|--------------------------|
| 1. LEDs | 6. Reset button |
| 2. Power connector | 7. DIP Switches |
| 3. RS-232 Serial port | 8. RJ-45 Ethernet port 1 |
| 4. USB port | 9. RJ-45 Ethernet port 2 |
| 5. USB retention standoff | |



Note NI Condition Monitoring Systems do not use the DIP switches. Leave these switches in the OFF position.

Mounting the Chassis

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

You can also mount the chassis in other orientations, on a nonmetallic surface, on a 35-mm DIN rail, on a desktop, or in a rack, but mounting the chassis in these or other configurations

can reduce the maximum allowable ambient temperature and can affect the typical accuracy of modules in the chassis.



Note For more information about typical accuracy specifications for modules, visit ni.com/info and enter the Info Code `criotypical`.

Refer to the following sections of this document for more information about mounting the chassis in these configurations. Refer to the following table for additional resources you can use when you consider an appropriate mounting configuration for your application.

Table 1. Additional Resources for Mounting Configurations

Consideration	Resource
How can different mounting configurations cause temperature derating?	Visit ni.com/info and enter the Info Code <code>criomounting</code> .
How can different mounting configurations affect the accuracy of C Series modules?	Visit ni.com/info and enter the Info Code <code>rdcriotemp</code> .
What do I need to know about mounting the chassis in environments with high shock and vibration?	Visit ni.com/info and enter the Info Code <code>criomounting</code> .

Precautions to Take before Mounting the Chassis

Before you mount the chassis, ensure that you have taken the following precautions:

- Record the serial number from the back of the chassis so that you can identify the NI Condition Monitoring System in software. You cannot read the serial number after you have mounted the chassis.
- Ensure that the chassis does not contain any I/O modules.

Measuring the Ambient Temperature of the Chassis

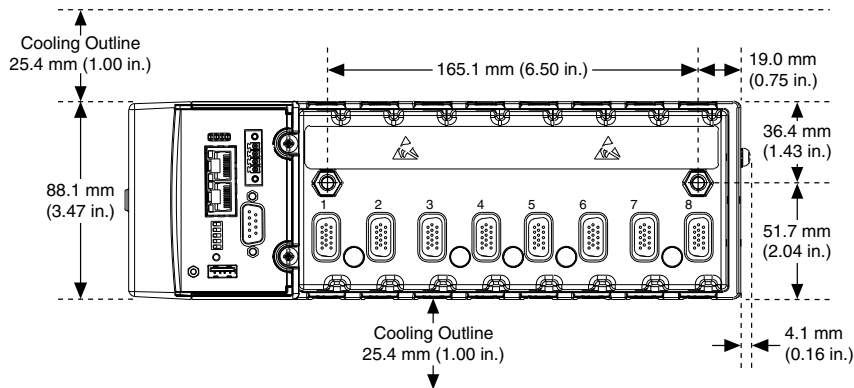
Measure the ambient temperature at each side of the chassis, 63.5 mm (2.5 in.) from the side and 25.4 mm (1 in.) forward from the rear of the chassis.

Accommodating Air Circulation and Cabling Clearance

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

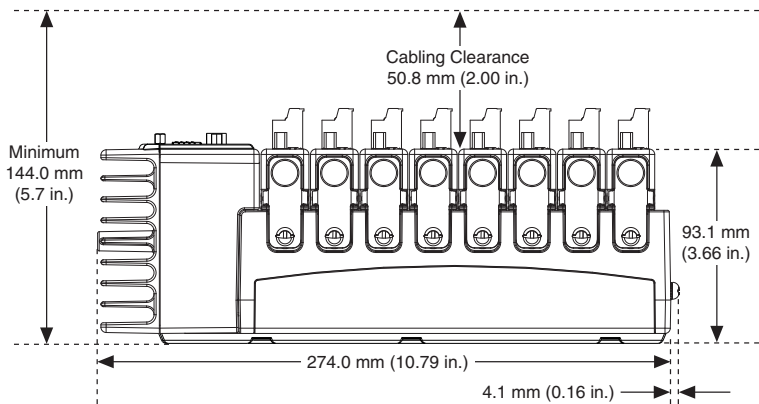
- Allow 25.4 mm (1 in.) on the top and the bottom of the chassis for air circulation, as shown in the following figure.

Figure 3. cRIO-9114 Front View with Dimensions and Air Circulation Requirements



- Allow 50.8 mm (2 in.) in front of modules for cabling clearance for common connectors, such as the 10-terminal, detachable screw terminal connector, as shown in the following figure.

Figure 4. cRIO-9114 Cabling Clearance Requirements



Refer to the following table for additional resources about system dimensions and cabling clearance considerations.

Table 2. Additional Resources for System Dimensions and Cabling Clearance

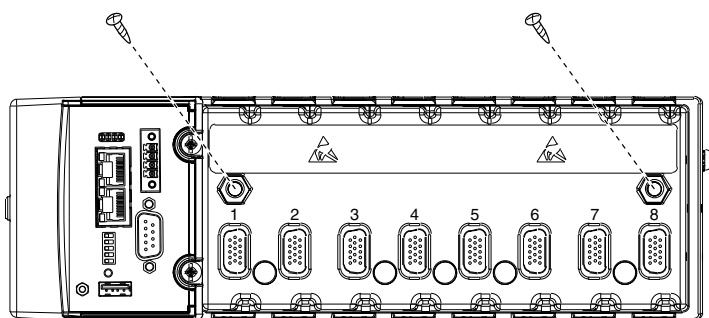
Consideration	Resource
Where can I find more information about dimensions of the system, included detailed dimensional drawings?	Visit ni.com/dimensions .
Where can I find more information about the minimum cabling clearance for C Series modules with other connector types?	Visit ni.com/info and enter the Info Code <code>rdcrioconn</code> .

Mounting the Chassis Directly on a Flat Surface Using the Mounting Holes

Complete the following steps to mount the chassis directly on a flat, rigid surface using the mounting holes in the chassis. National Instruments recommends that you mount the chassis in this manner for environments with high shock and vibration.

1. Use the dimensions provided in this document to prepare the surface for mounting the chassis.
2. Align the chassis on the surface.
3. Fasten the chassis to the surface using two M4 or number 10 panhead screws appropriate for the surface, as shown in the following figure. Screws must be longer than 19 mm (0.75 in.) to pass all the way through the chassis. National Instruments does not provide these screws with the chassis.

Figure 5. Mounting the cRIO-9114 Directly on a Flat Surface



Caution Ensure that the chassis does not contain any I/O modules before you remove it.

Mounting the Chassis the NI Panel Mounting Kit

Complete the following steps to use the NI panel mounting kit (part number 779558-01) to mount the chassis on a flat surface.

1. Fasten the panel mounting plate to the chassis using a number 2 Phillips screwdriver and $M4 \times 22$ screws. National Instruments provides these screws with the panel mounting kit. You must use these screws because they are the correct depth and thread for the panel mounting plate. Tighten the screws to a maximum torque of $1.3 \text{ N} \cdot \text{m}$ ($11.5 \text{ lb} \cdot \text{in.}$).
2. 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.



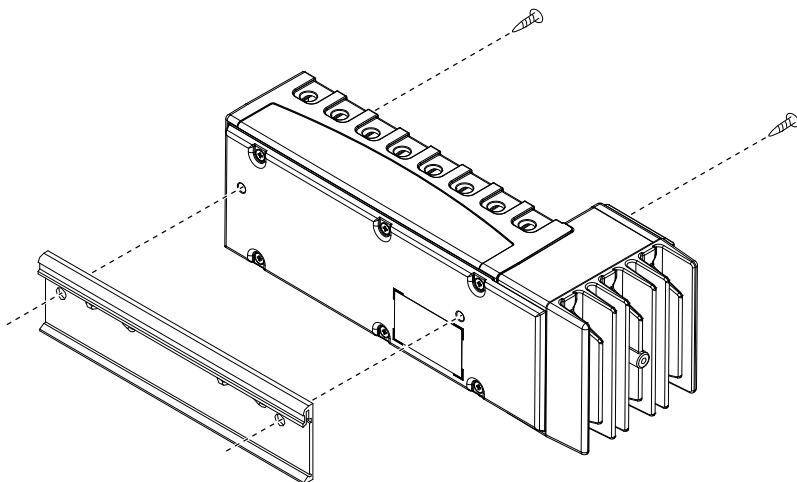
Caution Ensure that the chassis does not contain any I/O modules before you remove it.

Mounting the Chassis on a DIN Rail

Complete the following steps to use the NI 9915 DIN rail mounting kit (part number 779018-01) to mount the chassis on a standard 35-mm DIN rail.

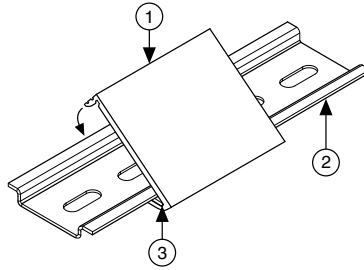
1. Fasten the DIN rail clip to the chassis using a number 2 Phillips screwdriver and $M4 \times 22$ screws, as shown in the following figure. National Instruments provides these screws with the DIN rail mounting kit. Tighten the screws to a maximum torque of $1.3 \text{ N} \cdot \text{m}$ ($11.5 \text{ lb} \cdot \text{in.}$).

Figure 6. Installing the DIN Rail CLIP on the cRIO-9114



2. Insert one edge of the DIN rail into the deeper opening of the DIN rail clip, as shown in the following figure.

Figure 7. 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 Ensure that the chassis does not contain any I/O modules before you remove it.

Mounting the Chassis on a Desktop

You can use the NI 9901 desktop mounting kit to mount the chassis on a desktop. Install the adapter bracket using two M3 × 20 screws. National Instruments provides the adapter bracket and screws with the desktop mounting kit. Refer to the NI 9901 documentation for more information about mounting the chassis on a desktop.

Installing C Series I/O Modules in the Chassis

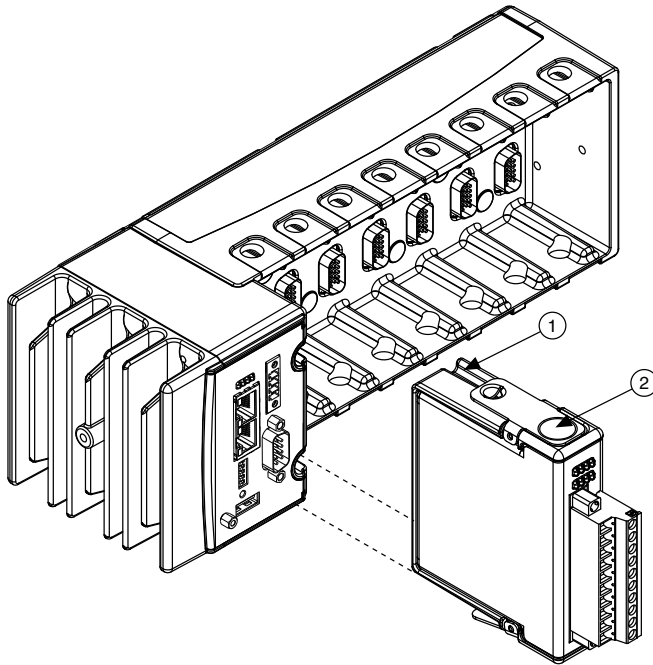


Note Before you install a C Series I/O module in the chassis, ensure that no I/O-side power is connected to the module. If the system is in a nonhazardous location, the chassis power can be on when you install modules.

Complete the following steps to install a C Series I/O module in the chassis.

1. Align the module with a slot in the chassis, as shown in the following figure. The module slots are labeled 1 to 8, left to right.

Figure 8. Installing a C Series I/O Module in the Chassis



1. Insertion groove
2. Latch

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

I/O Module Arrangements

NI InsightCM Server supports only dynamic C Series I/O modules, such as the NI 9232, installed on the CMS-9024. You must fill module slots in ascending order starting with slot 1. You cannot skip any slots but you do not have to use every slot.



Note You must connect tachometers to the module in slot 1. Do not connect any other sensors to the module in slot 1.

Removing I/O Modules from the Chassis



Note Before you remove a C Series I/O module from the chassis, ensure that no I/O-side power is connected to the module. If the system is in a nonhazardous location, the chassis power can be on when you install modules.

To remove a C Series I/O module from the chassis, squeeze the latches on both sides of the module and pull the module from the chassis.

Connecting to a Network

Use a standard Category 5 (CAT-5) or better shielded, twisted-pair Ethernet cable to connect the RJ-45 Ethernet port on the cRIO-9024 to an Ethernet hub.



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

The first time you power up the cRIO-9024, it attempts to initiate a DHCP network connection. If the cRIO-9024 cannot initiate a DHCP connection, it connects to the network with a link-local IP address with the form `169.254.x.x`. After the chassis powers up, you must configure the network settings in Systems Manager.

Grounding the Chassis

Complete the following steps to connect the chassis grounding terminal to the grounding electrode system of your facility.

1. Attach a ring lug to a 2.0 mm² (14 AWG) or larger wire.
2. Remove the grounding screw from the grounding terminal on the right side of the chassis.
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 appropriate for the application.



Note If you use shielded cabling to connect to a C Series I/O module with a plastic connector, attach the cable shield to the chassis grounding terminal using 1.3 mm² (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.

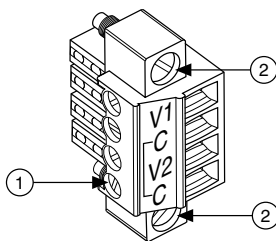
For more information about ground connections, visit ni.com/info and enter the Info Code `emcground`.

Wiring Power to the Controller

The cRIO-9024 requires an external power supply that meets device specifications. The cRIO-9024 filters and regulates the supplied power and provides power for all I/O modules installed in the chassis. The cRIO-9024 has one layer of reverse-voltage protection.

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 front panel.

Figure 9. COMBICON Power Connector

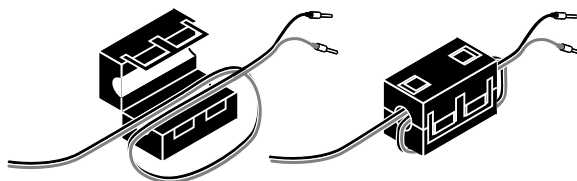


1. Terminal screws
2. Connector screws

Complete the following steps to connect a power supply to the chassis.

1. Install the ferrite provided with the controller across the negative and positive leads of the power supply, approximately 50–75 mm (2–3 in.) from the ends of the leads near the controller, as shown in the following figure.

Figure 10. Installing a Ferrite on the Power Supply Wires



2. Connect the positive lead of the power supply to the V1 or V2 terminal of the COMBICON power connector installed on the front panel of the cRIO-9024 and tighten the terminal screw.
3. Connect the negative lead of the power supply to one of the C terminals of the power connector and tighten the terminal screw.
4. Optionally, connect the positive lead of another power supply to the other V terminal and the negative lead to one of the C terminals.
5. Tighten the connector screws.

Precautions to Take When Wiring Power to the Controller



Note If you connect power to both the V1 and V2 terminals, ensure that the voltage difference between the two power inputs, measured at the controller power connector, is at least 500 mV.



Note The controller draws power from either the V1 or V2 terminals depending on which terminal has a higher voltage. The controller does not draw power from both

terminals. The controller switches between the V1 and V2 terminals without affecting operation.



Caution The C terminals are internally connected to each other. If you use two power supplies, ensure that they share a common ground.



Caution The C terminals are internally connected to the controller to prevent a faulty ground connection from causing the chassis ground to float. If you reverse the input voltage, the positive input voltage is connected directly to the chassis. The controller provides built-in reversed-voltage protection, but reversed voltage can damage connected peripherals if the chassis ground is not reliably connected to earth ground.



Caution Do not tighten or loosen the terminal screws on the power connector while the power connector is plugged in to the controller or while the power supply is on.

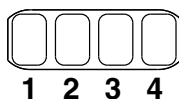
Powering On the Controller

When you apply power to the CompactRIO system, the controller runs a power-on self test (POST). The Power and Status LEDs turn on briefly. When the Status LED turns off, the POST is complete. If the LEDs do not behave in this way when the system powers on, refer to the information in this document about understanding LED indications.

Understanding LED Indications on the Controller

The following figure shows the LEDs on the cRIO-9024.

Figure 11. LEDs on the cRIO-9024



1. POWER

2. FPGA

3. STATUS

4. USER1

POWER LED

The POWER LED is lit while the cRIO-9024 is powered on. This LED indicates that the power supply connected to the controller is adequate.

FPGA LED

NI Condition Monitoring Systems do not use the FPGA LED.


STATUS LED

The STATUS LED is off during normal operation. After the device powers on, the cRIO-9024 indicates specific error conditions by flashing the STATUS LED a certain number of times every few seconds. If you observe this behavior after the device powers on, contact National Instruments support.

USER1 LED

The USER1 LED can display the indications described in the following table:

Table 3. USER1 LED Indications

Indication	Description
Flashing rapidly	Indicates an error condition. Open Systems Manager to the Dashboard page to see the device status.
Flashing steadily	Indicates normal operation.
Solid	<div>Indicates that USB operations are in progress, such as reading or writing the connection information file. You can safely remove the USB drive when this LED resumes blinking steadily.</div> <div> Note This device polls USB drives every 15 seconds, so you might need to wait up to 15 seconds after a USB operation begins for the LED to light.</div>

Troubleshooting Network Communication

If the CMS-9024 does not connect to NI InsightCM Server with a status of Online, try the following troubleshooting tips:

- Check the Ethernet cable connections on the CMS-9024, host computer, and router.
- If you have network firewalls or other security software enabled, try temporarily turning them off. You might also need to add an exception for NI InsightCM Server by completing the following steps:
 1. Navigate to the standard Microsoft Windows Control Panel utility for managing firewall settings.
 2. Click **Allow a program or feature through Windows Firewall**.
 3. Click **Allow another program**.
 4. Select **NI InsightCM** and click **Add**.
 5. Click **OK** and close the firewall settings.
- Ensure that the ports listed in the following table are open to communication on the host computer. If you are using an intelligent switch on the network, ensure that the switch is not disabling these ports.

Table 4. Host Computer Ports That Must Remain Open

Port	Type
5353	UDP (inbound and outbound rules)
6342	TCP (inbound and outbound rules)
44515	UDP (inbound and outbound rules)
44516	TCP (outbound rule)
44525	UDP (inbound and outbound rules)
80/443	TCP (outbound rule)

- If you have multiple network cards on the host computer, ensure that you use the Windows Control Panel to disable all other network adapters, such as wireless adapters. Turning off the wireless antenna is insufficient.

Resetting the Network Configuration of the Controller

Complete the following steps to reset the IP address and connection type of the controller.

1. Insert a USB drive into the USB port on the controller front panel.

The USER1 LED lights solid, which indicates that the controller is writing a text file to the USB drive. The text file contains network and connection properties.



Tip You can use the blank USB drive included in the NI InsightCM Server kit.

2. Remove the USB drive from the controller when the USER1 LED returns to blinking steadily, which indicates that the operation is complete.
3. Insert the USB drive into a USB port on a computer.
4. Browse the file structure of the drive for the *InsightCM* folder and open the text file whose filename matches the device hostname, which is the format of *NI-CRIO-ModelNumber-SerialNumber*.

5. In the `[Ethernet Adapter 0]` section of the file, complete the following steps.

- a) Configure the following properties to set a static IP address:

```
IP Address Request Mode = "Static"
```

```
IP Address = "x.x.x.x"
```

where *x.x.x.x* is the desired IP address.

- b) Enter `True` for the following item:

```
ChangeSettings = False
```




6. Save and close the file.
7. Insert the USB drive back into the USB port on the controller front panel.

The controller reads and applies the new properties.

Where to Go Next

The following figure describes additional documentation and resources as you develop an application with the CMS-9024.

Figure 12. Where to Go Next

1	NI InsightCM™ Server Configuration and Monitoring Help		Help system with instructions for configuring NI InsightCM Server and monitoring NI Condition Monitoring Systems. To launch this help, open Systems Manager in a web browser and click the Help link in the top-right corner of the page.
2	CompactRIO Controller and Chassis Datasheets		Device specifications, including power requirements, physical characteristics, safety and environmental information, and other important information. Visit ni.com/info and enter one of the following Info Codes for your device: <code>crio9024datasheet</code> , <code>crio911xdatasheet</code> , <code>crio9068datasheet</code>
3	C Series Module Documentation		Operating instructions and device specifications for C Series modules that you can install in a CompactRIO chassis. These documents describe how to connect sensors, actuators, and other devices to C Series modules. Visit ni.com/info and enter the Info Code <code>insightcmdocs</code> to access documentation for C Series modules that are compatible with NI InsightCM.

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