

groov EPIC PROCESSOR

Features

- > High-resolution LCD display with touch capability for edge configuration and *groov*® View HMI
- > Web-based commissioning, troubleshooting, and HMI
- > Built-in security with encryption, user authentication including LDAP, device firewall, VPN client, and more
- > Pre-loaded software includes *groov* Manage, *groov* View, Node-RED, Ignition Edge®, and CODESYS® Runtime Engine
- > Programmable with flowcharts and scripting, or IEC 61131-3 compliant languages including ladder diagram, or with C/C++, Python, Java, or other languages using secure shell access (SSH)
- > Dual independent Gigabit Ethernet network interfaces
- > Dual USB ports for serial communication, touchscreen monitors, keyboards, or a mouse
- > HDMI port for external monitors or touchscreen
- > UL Hazardous Locations approved and ATEX compliant

DESCRIPTION

The **Edge Programmable Industrial Controller** is an embedded Linux® real-time controller with gateway functions, well suited for any automation or industrial internet of things (IIoT) application.

A compact industrial computer, the *groov* EPIC processor features a resistive-touch, high-resolution LCD display for on-the-spot configuration, troubleshooting, and HMI. The LCD display swings open to provide easy access to the power button, power supply connectors, network interfaces, ports, and status LEDs.

- Dual, independent Gigabit Ethernet network interfaces securely segment trusted networks (like your control network) from untrusted networks (like the internet).
- Dual USB ports connect to serial interfaces, WiFi adapters, and keyboard, mouse, and touchscreen controls.
- An HDMI port connects to an external monitor for displaying configuration and *groov* View HMI on an external large screen, useful for local process visualization and OEM applications.

The processor can operate through a wide range of operating temperatures (-20 to 70 °C), and with its industrial design, it can be used in a large variety of applications and operating environments. The CPU is an industrial, quad-core ARM® processor running open-source Linux with real-time extensions.



groov EPIC processor

With built-in touchscreen display that opens to reveal power button, LEDs, ports, and connectors



Models

Two *groov* EPIC processors are available. Both have the same features and include the same software, with the following differences:

- **GRV-EPIC-PR1** has 2 GB RAM and 6 GB user space. It ships with Inductive Automation's Ignition version 7 pre-installed but can be upgraded to version 8 with a firmware update (license required for either).
- **GRV-EPIC-PR2** has more memory and disk space: 3.75 GB RAM and 22 GB user space on its embedded industrial SSD. It ships pre-installed with Ignition version 8 (license required).

For included software and license information, see [page 2](#).

For more specifications, see [page 5](#).

Part Numbers

Part	Description
GRV-EPIC-PR1	On-the-rack controller for the <i>groov</i> EPIC system, with Ignition 7
GRV-EPIC-PR2	On-the-rack controller for the <i>groov</i> EPIC system, with increased RAM & storage and Ignition 8
GROOV-LIC-EDGE	Activation key for Ignition Edge software, version 7
GROOV-LIC-EDGE8	Activation key for Ignition Edge software, version 8
GROOV-LIC-CRE	Activation key for CODESYS Runtime Engine software
GROOV-LIC-SHELL	Activation key for secure shell access to Linux operating system

Software

Both models include the following software:

- **groov Manage** for browser-based management of your *groov* EPIC system, from the integrated front touchscreen display or any browser-based device
- **PAC Project™** Basic Software Suite (installed and running on your Microsoft® Windows® computer) for developing control programs and a Windows-based HMI
- **CODESYS** Development System and Runtime Engine for creating and running **IEC 61131-3** compliant programs. All IEC 61131-3 languages are supported, including Function Block Diagram (FBD), Structured Text (ST), Sequential Function Charts (SFC), and Ladder Diagram (LD). (Requires the free CODESYS Runtime Engine License, [GROOV-LIC-CRE](#).)
- Access to the Linux operating system through a **secure shell** to run custom applications (requires the free SSH License, [GROOV-LIC-SHELL](#))
- **groov View** for building and viewing custom operator interfaces for local, mobile, and browser-based devices
- **Node-RED** for creating data flows to connect cloud services, databases, and APIs through pre-built nodes
- **Ignition** or **Ignition Edge** from Inductive Automation®, running on *groov* EPIC (no PC required):
 - Ignition Edge connects to Allen-Bradley®, Siemens®, and Modbus®/TCP devices via OPC UA and offers efficient IIoT communications using MQTT with Sparkplug B payload (requires purchase of license [GROOV-LIC-EDGE](#) for Ignition Edge version 7 or [GROOV-LIC-EDGE8](#) for version 8).
 - Full Ignition includes MQTT with Sparkplug B, connects to PLCs, adds external access to the OPC UA server, and offers scripting, database support, and a wide array of Ignition modules. [Contact us](#) for Ignition license information.

Programming

You can run complex control programs on the *groov* EPIC processor developed with any of the following:

- PAC Control, Opto 22's flowchart-based programming language
- CODESYS Development System V3 using any IEC 61131-3 compliant programming language
- Python, C/C++, JavaScript, and other popular software development tools

Configuration

The *groov* Manage app gives you central access to your *groov* EPIC for configuration, troubleshooting, and commissioning. Use *groov* Manage from your computer, smartphone, tablet, or the *groov* EPIC's touchscreen—the interface is consistent and easy to use on all devices.

In addition to configuring I/O channels for signal inputs and features including PID (proportional-integral-derivative) control loops, you can also set up security, networking, software, and other features in *groov* Manage.

HMI

groov View offers easy browser-based, mobile-ready development of a custom HMI with trending, events, and user notification. Communication is secured with user authentication and TLS encryption. And, because the HMI is web server-based, what you build can be viewed on any authorized device with a web browser.

The *groov* EPIC System

GRV-EPIC-PR1 and GRV-EPIC-PR2 are part of the *groov* EPIC system, which provides a complete control and communications system at the network's edge, including:

- **I/O.** Connect to field devices and translate their electrical signals into the ones and zeros that computer systems understand. The *groov* EPIC system offers analog, digital, and serial functions, including thermocouple linearization, local PID loop control, watchdog, totalizing, and much more.
- **Control.** Automate equipment and systems at the network's edge. Create flowchart-based control strategies, IEC 61131-3 compliant programs, or custom-developed applications with popular software development tools.
- **Connectivity and Data Handling.** Acquire, move, and share data from industrial systems, legacy equipment, business and IT systems, and the cloud through a variety of connecting technologies like Node-RED, RESTful APIs, and Ignition SCADA.
- **Visualization.** Securely monitor, control, and use data as you need it—locally, on premises, or from anywhere using *groov* View. Authorized users can view your operator interface on the *groov* EPIC's touchscreen, a mobile device, a computer, or anything with a web browser.

The system includes processor, software, I/O modules, chassis, and power supply.

- The chassis holds the power supply, processor, and selected, modular I/O modules you need for your application. For more information, see the [groov EPIC Chassis Data Sheet \(form 2247\)](#).
- Power supplies are available for AC power, DC conversion, and pass-through connections from a DC power supply you already own. For more information, see the [groov EPIC Power Supplies Data Sheet \(form 2246\)](#).
- The *groov* I/O modules connect a variety of field devices to your *groov* EPIC system. The table on the next page lists the available I/O modules and the form numbers to learn more about them.

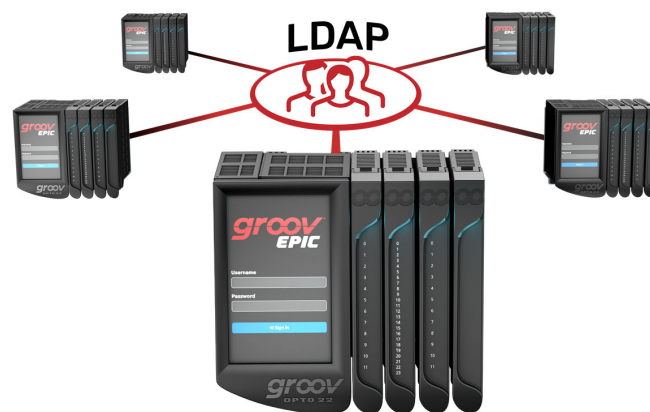
groov I/O MODULES

Module description	Part numbers	Form number
groov 115 VAC Input Modules	GRV-IAC-24, GRV-IACS-24, GRV-IACI-12, GRV-IACIS-12	2226
groov 180–280 VAC Input Modules	GRV-IACHV-24, GRV-IACHVS-24, GRV-IACIHV-12, GRV-IACIHVS-12	2222
groov DC Input Modules	GRV-IDC-24, GRV-IDCS-24, GRV-IDCI-12, GRV-IDCIS-12, GRV-IDCIFQ-12, GRV-IDCSW-12	2236
groov 2–16 VAC VDC Input Modules	GRV-IACDCTL-24, GRV-IACDCTLS-24	2237
groov 12–250 VAC Output Modules	GRV-OAC-12, GRV-OACI-12, GRV-OACS-12, GRV-OACIS-12	2231
groov 5–60 VDC Output Modules	GRV-ODCI-12, GRV-ODCIS-12	2238
groov DC Output Sourcing Module	GRV-ODCSRC-24	2242
groov Mechanical Relay Output Module	GRV-OMRIS-8	2243
groov ICTD Temperature Input Module	GRV-IICTD-12	2300
groov Thermistor/Resistor Input Module	GRV-IRTD-8, GRV-ITR-12	2301
groov Analog Current Input Module	GRV-IMA-24, GRV-IMAI-8	2239
groov Analog Thermocouple/Millivolt Input Module	GRV-ITM-12, GRV-ITMI-8	2240
groov Analog Voltage Input Module	GRV-IV-24, GRV-IVI-12, GRV-IVIRMS-10	2241
groov Analog Voltage and Current Output Module	GRV-OVMALC-8, GRV-OVMAILP-8	2244
groov Serial Module	GRV-CCANI-2, GRV-CSERI-4	2296

SECURITY

Designed for secure data communication, *groov* EPIC processors help you create and maintain a secure system with features like these:

- **Two independent network interfaces**—Use one for your trusted network and the other for an untrusted network, like the internet. Plug in a compatible USB-to-Wifi adapter and add a wireless network. Data cannot pass between networks.
- **Data encryption**—Out of the box, all connections to *groov* EPIC from your computer or mobile device are encrypted using SSL/TLS. So is the data EPIC communicates to on-premises or cloud-based software, systems, and services.
- **Device firewall and security certificates**—You have control over firewall ports on *groov* EPIC and can upload server and client security certificates as needed.
- **VPN client**—Data on *groov* EPIC can be securely accessed from remote locations through a virtual private network, using the built-in Open VPN client.
- **Controlled user access**—From the time you first turn it on, *groov* EPIC requires user authentication. You control all user accounts and groups. And you can scale up your control system more easily by configuring *groov* EPICs to connect to your LDAP-compatible directory service. With **LDAP**, your IT staff can manage all users for all EPICs from a central place. Centralized user management can also help satisfy data integrity requirements in regulated industries.



- **MQTT/Sparkplug B**—Communicate data more securely and efficiently using device-originated, outbound connections between *groov* EPIC and an MQTT broker located either on premises or in the cloud. For more on MQTT, see [Getting Started with MQTT in groov Products](#) (form 2350).
- **OptoSupport Remote Support Service (RSS)**—If problems arise, you can use OptoSupport RSS to create a secure, encrypted connection between your *groov* EPIC and Opto 22's support team, so they can remotely help diagnose and troubleshoot. The remote connection can only be started by you, and only after you and an Opto 22 support team member have determined that the best way to help you is through a remote connection.

REMOTE I/O TOOLS

groov Manage provides a robust complement of features to configure EPIC as remote I/O:

- **Easy I/O configuration**—With just a few clicks, you can:
 - Configure Digital inputs/outputs with features like latches
 - Configure Analog inputs/outputs with features like scaling
 - Enable and disable Watchdogs
 - Configure features like temperature units for the entire chassis.
- **PID configuration**—Configure PIDs, then monitor and change values directly on the touchscreen or through a browser. In the browser, you can view trends and then adjust scaling to view trends over a long period of time or zoom in on specific values or axes.
- **Scratch Pad**—Peer-to-peer communication of values: define your area and then set the values through *groov* Manage.
- **Generic MMP**—Look up and change values in OptoMMP memory map areas.
- **MMP and Modbus Calculators**—Need help calculating the hexadecimal address of the Analog Channel Write area of the OptoMMP map for the fourth channel of the third module? Or, how about converting it to the correct Modbus Unit ID and register? These two calculators can help.

NETWORKING CAPABILITY AND TOOLS

groov EPIC provides dual, independent Gigabit Ethernet network interfaces, helping you connect to up to two different networks. Plug in a compatible USB-to-WiFi adapter and you can expand connectivity to include a wireless network. Set up an OpenVPN server (on-site or in a cloud) and create a Virtual Private Network (VPN) connection to your *groov* EPIC with the on-board OpenVPN client.

You can connect to a single, flat network right-out-of-the-box: insert an Ethernet cable to ETH0 and turn on *groov* EPIC. Have a slightly more complex network or need to fine-tune some network settings? *groov* EPIC provides networking capabilities so that your IT department can:

- Add or override existing DNS server IP addresses, domain names, and Gateway IP addresses assigned by DHCP servers, plus manage their query order.
- Enable port forwarding control the flow of network traffic to, through, and out of the network interfaces.

If you encounter any issues, on-board networking tools can help you diagnose them:

- **Ping**—A commonly used tool to test basic connectivity from each of the *groov* EPIC processor's interfaces.
- **Test TCP Port**—Helps determine if a port on a particular server is open or closed.
- **Traceroute**—A tool to help you see the route a packet takes to reach its destination.
- **Nslookup**—Determine the domain name and IP address of a DNS server at the host.

SYSTEM COMPATIBILITY

The *groov* EPIC system is compatible with many other Opto 22 products:

- Your *groov* EPIC processor is fully compatible with *groov* RIO Ethernet-based edge I/O modules. EPIC can use them not only as traditional remote I/O but also for exchanging data with sensors and devices that *groov* RIO is wired to and applications it connects to. See the *groov* RIO Data Sheet (form 2317), for more information on these capable multifunction, multi-signal I/O industrial units.
- A *groov* EPIC processor running a PAC Control strategy can also use existing SNAP PAC I/O units as remote I/O.
- If you already have a SNAP PAC controller running a PAC Control strategy and need additional capabilities in your system, you can add *groov* EPIC for remote I/O and to easily connect with PLCs, enterprise software, and cloud services for IIoT applications.

SPECIFICATIONS

Specification	GRV-EPIC-PR1	GRV-EPIC-PR2
Power requirements	7.1 W typical, 9.1 W max.	
Memory	2 GB RAM 2 MB battery-backed RAM 6 GB user space	3.75 GB RAM 2 MB battery-backed RAM 22 GB user space
Backup battery for real-time clock	BR2032	
Screen size and resolution	5 inches diagonal; 480 x 800 pixels	
Ethernet Communication (wired)	Two independent 10/100/1000 Mbps RJ-45 connectors, each with a separate IP address (separate IP networks)	
USB	USB 2.0 (two ports; can be used to connect serial devices via a USB-to-serial converter with an FTDI chipset)	
HDMI	Connector Type: A. HDMI Specification: Version 1.4a. Max. Resolution: 1920 x 1080 pixels at 60 Hz	
Minimum PAC Project Version	10.000	10.3003
Minimum Opto 22 Library Package For CODESYS Version	1.0.0.0	2.0.1.0
Maximum Number of PAC Control Engine Charts	64	64
Torque, bottom hold-down screw	3.5 in-lb (0.4 N-m)	3.5 in-lb (0.4 N-m)
Torque, top hold-down screw	1.5 in-lb (0.17 N-m)	1.5 in-lb (0.17 N-m)
Operating temperature	-20 °C to +70 °C	-20 °C to +70 °C
Storage temperature	-40 °C to +85 °C	-40 °C to +85 °C
Humidity	5–95% RH	5–95% RH
MTBF (minimum, 25 °C)	900,000 hours	750,000 hours
Agency approvals and certifications	UL/cUL (Class 1 Div. 2 ^a), CE, ATEX (Category 3, Zone 2), RoHS, DFARS	
Warranty	30 months	30 months

a. For use in hazardous locations, equipment must be mounted in an enclosure that meets the requirements of the National Electrical Code, ANSI/NFPA 70, and ANSI/ISA-61010-1 (82.02.01).

Device Compatibility

The following USB devices have been tested to be compatible with *groov* EPIC processors for the function listed.

Serial communication

The following USB-to-serial adapters have been tested and proven to be compatible with *groov* EPIC:

Device Manufacturer	Model
B&B Electronics	USOPTL4 (isolated RS-485)
	USPTL4 (non-isolated RS-485)
	USO9ML2 (isolated RS-232)
Gearmo	GM-482422 (non-isolated RS-485/RS-422)
	GM-FTD1-A12 (non-isolated RS-232)
	SERIAL-B (non-isolated RS-232)

Wireless communication

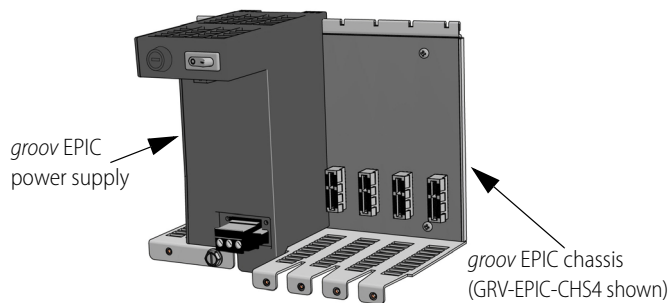
The following WiFi USB adapters have been tested and proven to be compatible with *groov* EPIC:

Device Manufacturer	Model
Netis®	WF2180
	WF2190

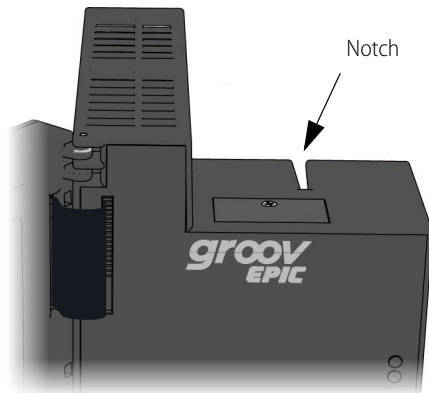
INSTALLING AND REMOVING THE PROCESSOR

Installing the Processor

1. Make sure you installed the power supply according to the directions in the [groov EPIC Power Supplies, Converters, and Adapters Data Sheet](#) (form 2246).



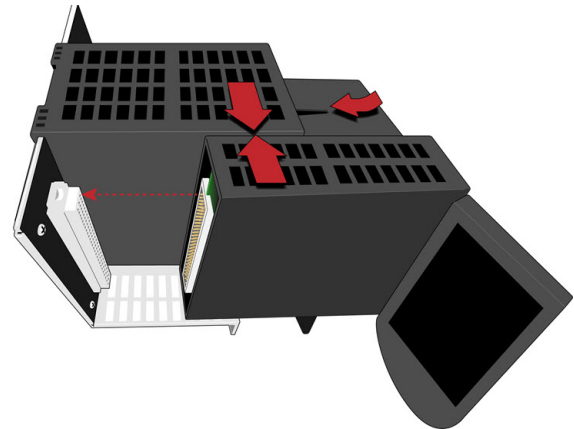
2. Review “[Processor orientation](#)” on [page 8](#) to understand which side of the processor is the top, underside, back, and face.
3. Lift open the LCD display so you can see the notch on the top side of the processor.



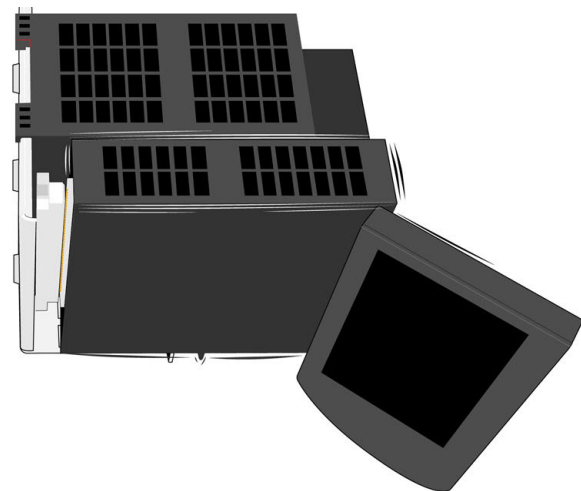
4. Hold the processor by the left side, and make sure that the notch on the processor aligns with the guide tab on the power supply.



5. **Align the connectors.** With the LCD display open, slowly guide the processor straight onto the chassis—holding it flush against the side of the power supply—until you feel the processor start to touch the connector on the chassis.

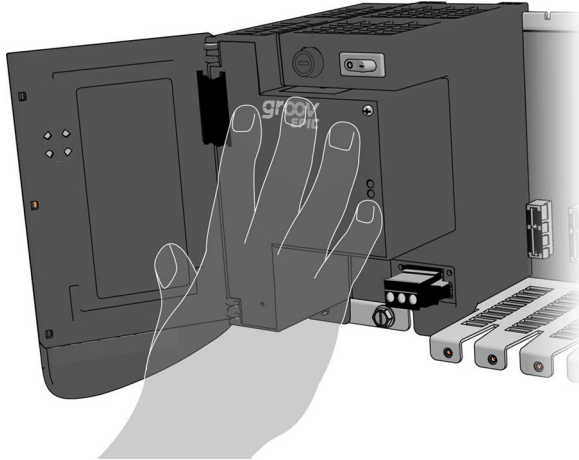


When it touches, lightly jiggle the processor to help the pins on the processor's connector properly align themselves into the holes of the chassis' connector.

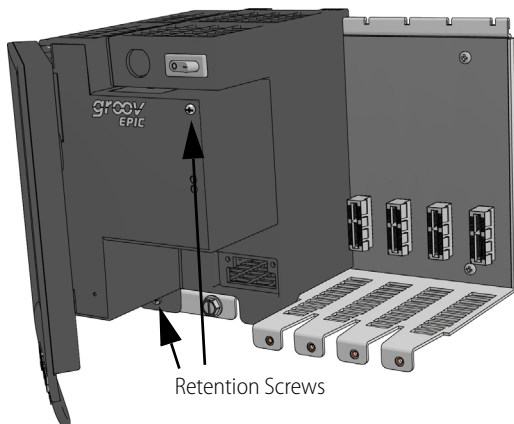


6. **Seat the processor.** Push the processor (not the LCD display) into the connector until it resists further pressure.

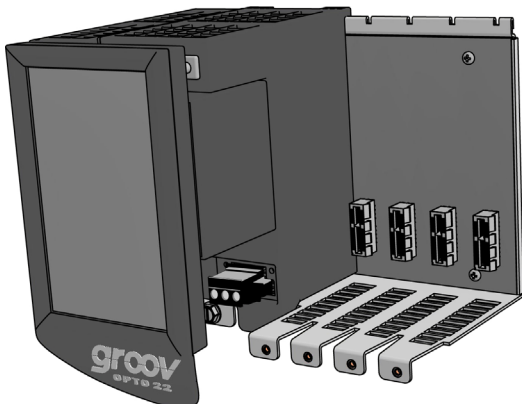
IMPORTANT: Do not push on the LCD display.



7. Tighten the retention screws that attach the processor to the power supply and the chassis to the recommended torque listed in "Specifications" on page 5.



8. Close the LCD display.

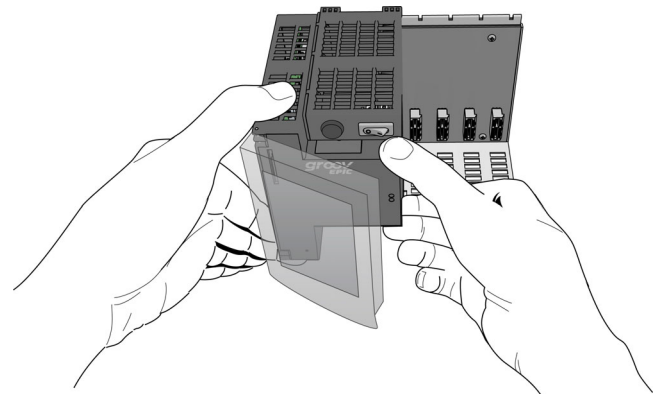


Removing the Processor

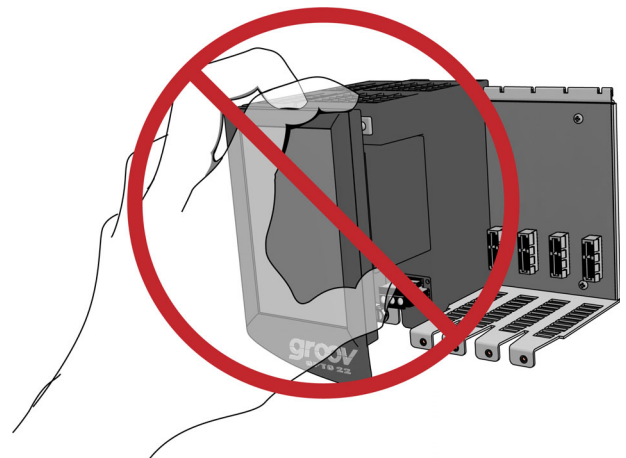
1. Lift the LCD display so that you can access the retention screws and power switch.
2. Turn off the unit.

IMPORTANT: Do not attempt to remove the processor and power supply as a single unit.

3. Remove the retention screws that attach the processor to the power supply and the chassis.
4. Hold the processor with both hands, one hand on the left side and the other hand at the top



IMPORTANT: Do not attempt to remove the processor by grasping the screen.



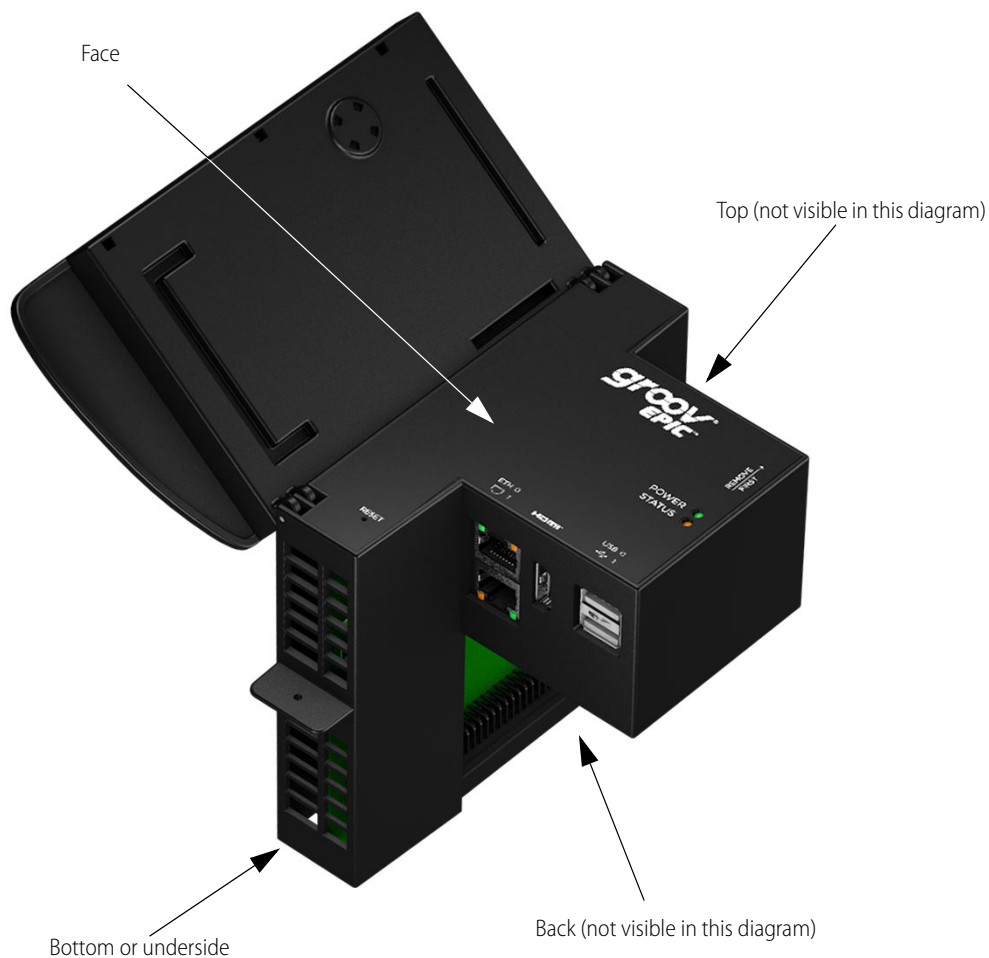
5. Pull the processor straight out. Do not wiggle the processor.

IMPORTANT: Handle and carry the processor only by the plastic case. Do not touch any of the exposed circuitry.

6. Close the LCD display.

PROCESSOR ORIENTATION

The following diagram identifies which side of the processor is the bottom or underside, the face, the top and the back. This helps orient you when you are reading the installation and removal instructions.



LCD DISPLAY

The LCD display features resistive-touch capability, which means you can manipulate the display with gloved fingers or a stylus (not included).

The LCD display is your window to both your control system and HMI. With *groov* Manage, you can:

- Configure and troubleshoot all *groov* I/O modules mounted on the chassis, including I/O channel signal inputs and features like PID control loops.
- Configure the EPIC's Ethernet network interfaces and device firewall, and create rules to control access to its ports.

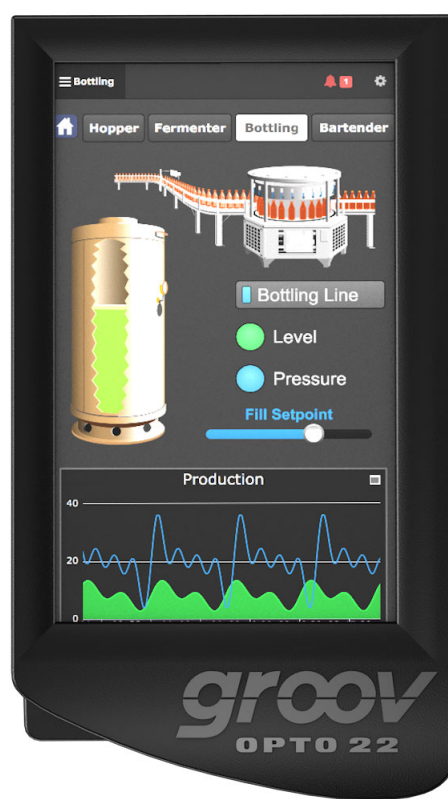
- View the current state of input channels and set the state of output channels.
- Access a library of information about all *groov* I/O modules available through Opto 22, including specifications and wiring diagrams.
- Review logs for troubleshooting.

The LCD display also shows your *groov*View HMI, which you can build and configure within your web browser on your PC. This HMI is also available to authorized users on computers and mobile devices.

groov Manage



groov View HMI



LEDs, NETWORK INTERFACES, AND PORTS

The diagram below describes the LEDs, network interfaces, and ports on the *groov* EPIC processor. All of these interfaces and indicators are easily accessed by lifting the hinged LCD display. When the LCD display is closed, it does not interfere with cables connecting the processor to external devices such as an external monitor. For more information about LEDs, network interfaces, and ports, see [groov EPIC User's Guide](#) (form 2267).

LEDs

LED	Indicates
SPEED LED	Indicates link speed (Off = 10 Mbps, Green = 100 Mbps, Orange = 1000 Mbps)
LINK ACT LED	Indicates link status or activity (on/solid = link present, blinking = link present and local activity)
POWER LED	Indicates status of power (Green = on; Red = on, resetting)
STATUS LED	Indicates whether the unit is running with full functionality. (Green = all normal; blink green and red = starting a restore to defaults)

Ports

The HDMI port offers a connection to an external monitor, such as an HDMI-ready touch-screen monitor, so that you can display *groov* Manage or your *groov* View HMI on a separate screen.

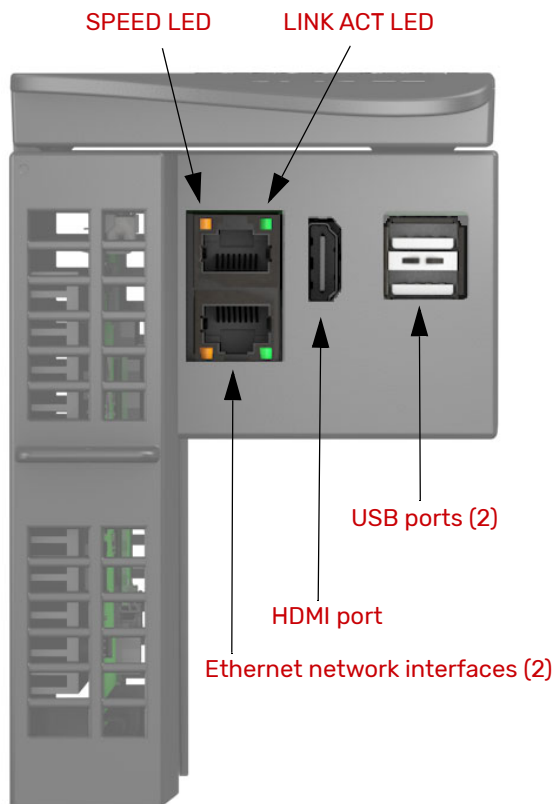
The two USB ports offer several ways to extend the capabilities of the processor. You can connect:

- Serial devices via a USB-to-serial converter
- A mouse, keyboard, or both to make it easier to type in data and navigate through the screens
- WiFi adapters to add wireless connectivity

For device compatibility information, see ["Device Compatibility"](#) on page 5.

Independent Ethernet Network Interfaces

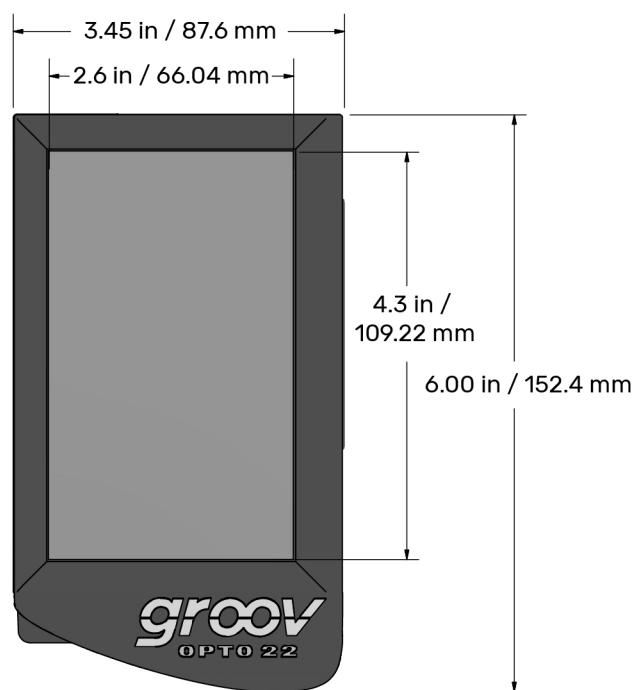
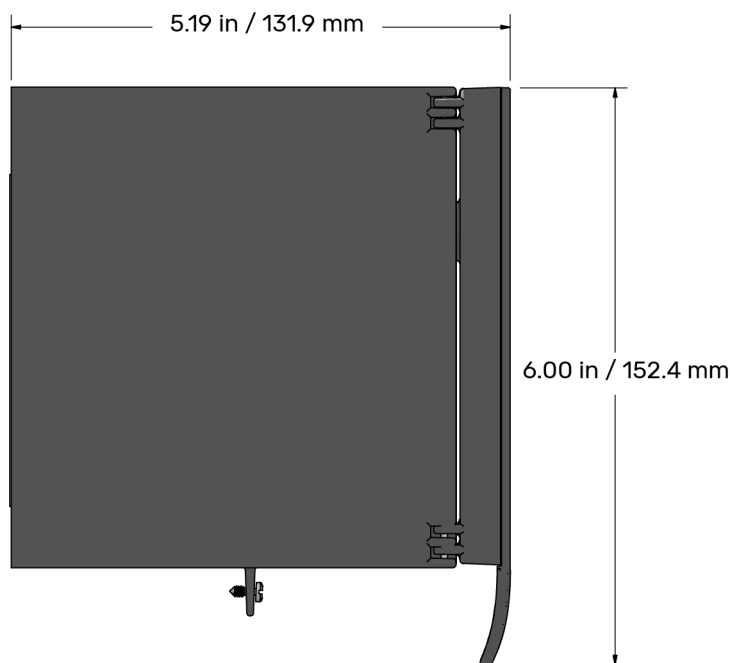
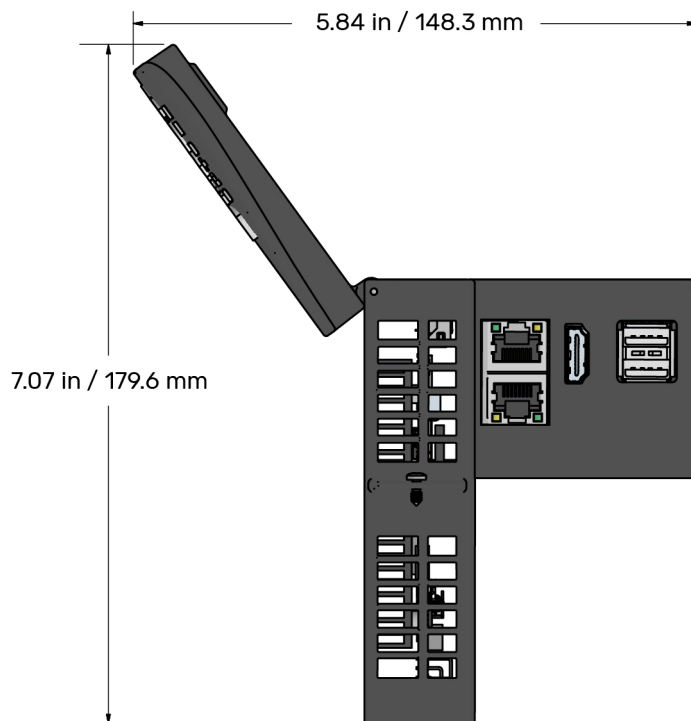
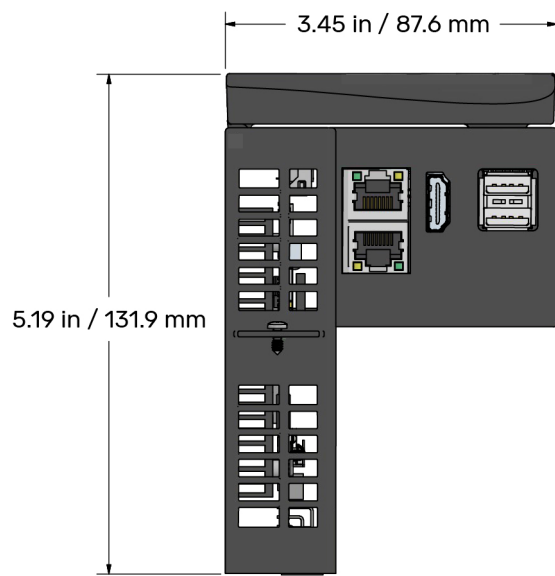
The Ethernet network interfaces are independent, which means they are not connected internally. Each requires its own IP address, and the two interfaces must be on different subnets.



The labels on the face of the processor identify the locations of the interfaces and ports, which are on the underside of the processor, as shown on the image to the left.

DIMENSIONS: GRV-EPIC-PR1 AND GRV-EPIC-PR2

The processor features an LCD display that swings open and closed. The diagram to the right shows the LCD display open to its fullest extent. The diagram below shows the LCD display closed.



HARDWARE ARCHITECTURE

groov EPIC Power Supply

Available in three models:

- AC power supply
- DC power converter
- Pass-through power adapter

groov I/O Modules

- Removable cage-clamp field wiring connector with single, captive hold-down screw
- Pivoting, two-position cover
- Touch-sensitive pad
- Hot swappable
- LEDs indicate module health and channel status
- UL Hazardous Locations approved and ATEX compliant

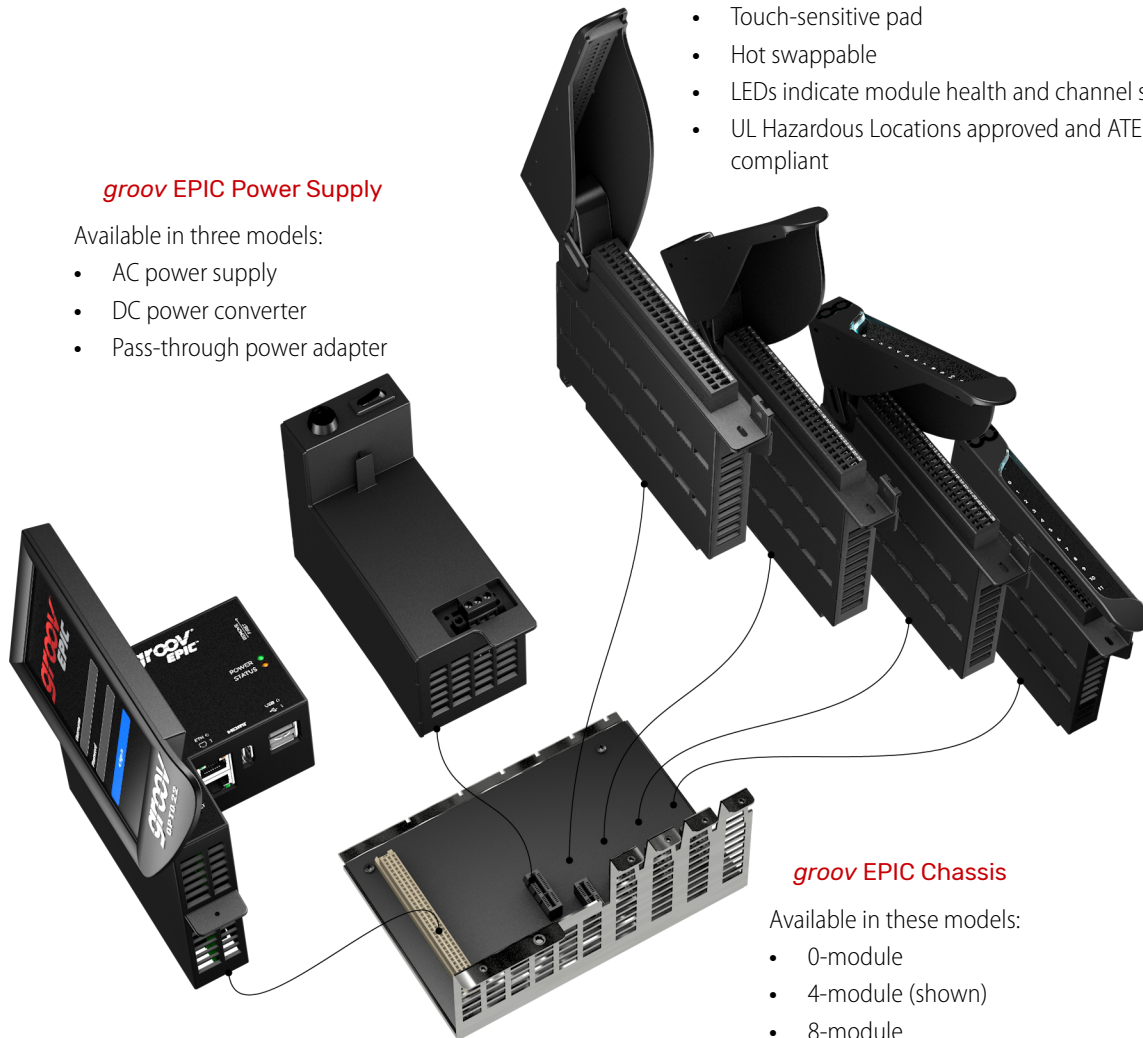
groov EPIC Chassis

Available in these models:

- 0-module
- 4-module (shown)
- 8-module
- 16-module

groov EPIC Processor

- Web-based commissioning, troubleshooting, and groov View HMI
- Compatible with PAC Project Basic (installs on Windows computer)
- Pre-installed software: *groov* Manage, *groov* View, Node-RED, Ignition, and CODESYS Runtime Engine
- LCD touch display
- Dual USB ports for serial communications or touchscreen monitors
- HDMI port for external monitors, touchscreens, and WiFi adapters
- Dual independent Gigabit Ethernet network interfaces
- Supports up to 16 groov I/O modules
- Available in two models: GRV-EPIC-PR1, GRV-EPIC-PR2



PRODUCTS

Opto 22 develops and manufactures reliable, easy-to-use, open standards-based hardware and software products. Industrial automation, process control, building automation, industrial refrigeration, remote monitoring, data acquisition, and industrial internet of things (IIoT) applications worldwide all rely on Opto 22.

groov EPIC® System

Opto 22's *groov Edge Programmable Industrial Controller (EPIC) system* gives you an industrially hardened system with guaranteed-for-life I/O, a flexible Linux®-based processor with gateway functions, and software for your automation and IIoT applications.

groov EPIC I/O

groov I/O connects locally to sensors and equipment with up to 24 channels on each I/O module. Modules have a spring-clamp terminal strip, integrated wireway, swing-away cover, and LEDs indicating module health and discrete channel status.

groov I/O is hot swappable, UL Hazardous Locations approved, and ATEX compliant.

groov EPIC Processor

The heart of the system is the *groov* EPIC processor. It handles a wide range of digital, analog, and serial functions for data collection, remote monitoring, process control, and discrete and hybrid manufacturing.

In addition, the EPIC provides secure data communications among physical assets, control systems, software applications, and online services, both on premises and in the cloud.

Configuring and troubleshooting I/O and networking is easier with the EPIC's integrated high-resolution color touchscreen. Authorized users can manage the system locally on the touchscreen or on a monitor connected via the HDMI or USB ports.

groov EPIC Software

Software included in the *groov* EPIC processor:

- PAC Control engine to run PAC Control and PAC Display
- CODESYS Runtime engine to run IEC61131-3 compliant programs built with CODESYS Development System
- Optional access to the Linux operating system through a secure shell (SSH) to download and run custom applications
- *groov* View for building your own device-independent HMI, viewable on the touchscreen, PCs, and mobile devices
- Node-RED for creating simple logic flows from pre-built nodes
- Ignition Edge® from Inductive Automation®, with OPC-UA drivers to Allen-Bradley®, Siemens®, and other control systems, and MQTT communications with Sparkplug for efficient IIoT data transfer

groov RIO®

groov RIO revolutionizes remote I/O by offering a single, compact, PoE-powered industrial package with web-based configuration, commissioning, and flow logic software built in, plus support for multiple OT and IT protocols.

Standing alone, it meets the needs of small, variable I/O count applications, especially those that require data logging or data communications, commonly found in IIoT applications. *groov* RIO can also be used with a Modbus/TCP master or as remote I/O for a *groov* EPIC system.

Older products

From solid state relays (our first products) to world-famous G4 and SNAP I/O, to SNAP PAC controllers, older Opto 22 products are still supported and still doing the job at thousands of installations worldwide. You can count on us to give you the reliability and service you expect, now and in the future.



QUALITY

Founded in 1974, Opto 22 has established a worldwide reputation for high-quality products. All are made in the U.S.A. at our manufacturing facility in Temecula, California.

Because we test each product twice before it leaves our factory rather than testing a sample of each batch, we can afford to guarantee most solid-state relays and optically isolated I/O modules for life.

FREE PRODUCT SUPPORT

Opto 22's California-based Product Support Group offers free, comprehensive technical support for Opto 22 products from engineers with decades of training and experience. Support is available in English and Spanish by phone or email, Monday–Friday, 7 a.m. to 5 p.m. PST.

Support is always available on our website, including [free online training](#) at OptoU, how-to [videos](#), [user's guides](#), the Opto 22 KnowledgeBase, troubleshooting tips, and [OptoForums](#). In addition, instructor-led, hands-on [Premium Factory Training](#) is available at our Temecula, California headquarters, and you can [register online](#).

PURCHASING OPTO 22 PRODUCTS

Opto 22 products are sold directly and through a worldwide network of distributors, partners, and system integrators. For more information, contact Opto 22 headquarters at **800-321-6786** (toll-free in the U.S. and Canada) or **+1-951-695-3000**, or visit our website at www.opto22.com.

groov RIO®

Features

- > Powered by either 10-32 VDC power supply or Power over Ethernet (PoE) (star topology only)
- > 10 channels of multi-signal, multifunction inputs and outputs
- > Analog I/O, temperature, discrete I/O, and mechanical relays
- > Two switched Gigabit Ethernet network interfaces for wired networks; supports star or daisy-chain topologies
- > Embedded web-based applications: *groov*® Manage, Node-RED, and MQTT; GRV-R7-MM2001-10 includes Ignition Edge®
- > USB port for adding devices like Wi-Fi adapter or USB memory drive (user supplied)
- > Built-in security with encryption and authentication



GRV-R7-MM1001-10, GRV-R7-MM2001-10

DESCRIPTION

Opto 22's *groov* RIO—remote Ethernet I/O for industrial internet of things (IIoT) and automation applications—solves two main problems with most remote I/O today:

- First, specifying all the required components (rack, power supply, bus coupler, module types, and more) is time-consuming, difficult, and requires significant domain expertise.
- Second, communicating data among field devices, control systems, company software, and cloud services is complex and costly, requiring PLCs, programming, and middleware.

groov RIO revolutionizes remote I/O by solving both problems.

- **One part number.** A single part number includes built-in multifunction, multi-signal I/O; an I/O processor; power over Ethernet; and mounting without the need for a rack or chassis—in a compact industrial package.
- **Built-in processing and communication.** Web-based configuration, flow logic software, efficient data communication methods, and multiple operations technology (OT) and information technology (IT) protocols simplify any IIoT or automation application.

groov RIO is Edge I/O

These features make *groov* RIO a new kind of I/O product—*edge* I/O. It does not require a PLC, PAC, or industrial PC, but is designed as an intelligent, distributed I/O device to meet the needs of IIoT projects, especially those that require data acquisition or communications.

With *groov* RIO, you can:

- Place the unit almost anywhere for remote I/O and data communications. *groov* RIO operates through a wide range of operating temperatures (-20 to 70 °C), is UL/cUL listed, and complies with the ATEX, Low Voltage, and EMC CE directives.
- Supply power to *groov* RIO through either:
 - The ETH1 network interface connected to a Power over Ethernet Switch and cable (802.3af PoE Class 0).
 - The power supply terminals connected to a 10–32 V DC power supply.
- Connect the two switched Gigabit Ethernet network interfaces in a daisy-chain configuration or in a standard star configuration. Both interfaces use a single IP address.
- Connect additional devices like a Wi-Fi adapter, a USB memory stick (up to 32 GB), or a USB-to-serial adapter via the *groov* RIO's USB port (additional devices are user supplied).
- Simplify field connections using the 26-pin removable field I/O termination connector with spring clamp wire retention.

Part Number

Part	Description
GRV-R7-MM1001-10	<i>groov</i> RIO edge I/O; 8 multifunction, 2 form C electromechanical relay output channels
GRV-R7-MM2001-10	<i>groov</i> RIO edge I/O; 8 multifunction, 2 form C electromech. output channels; Ignition Edge
GROOV-LIC-EDGE8	Activation key for Ignition Edge software, version 8.1 (only for GRV-R7-MM2001-10)
GROOV-LIC-SHELL	Activation key for secure shell access to Linux operating system

- Easily see the status of power, network, and I/O activity on the unit's LEDs.
- Use embedded software to quickly set up data communications between field devices and on-premises or cloud-based systems and software.

Get Up and Running Faster

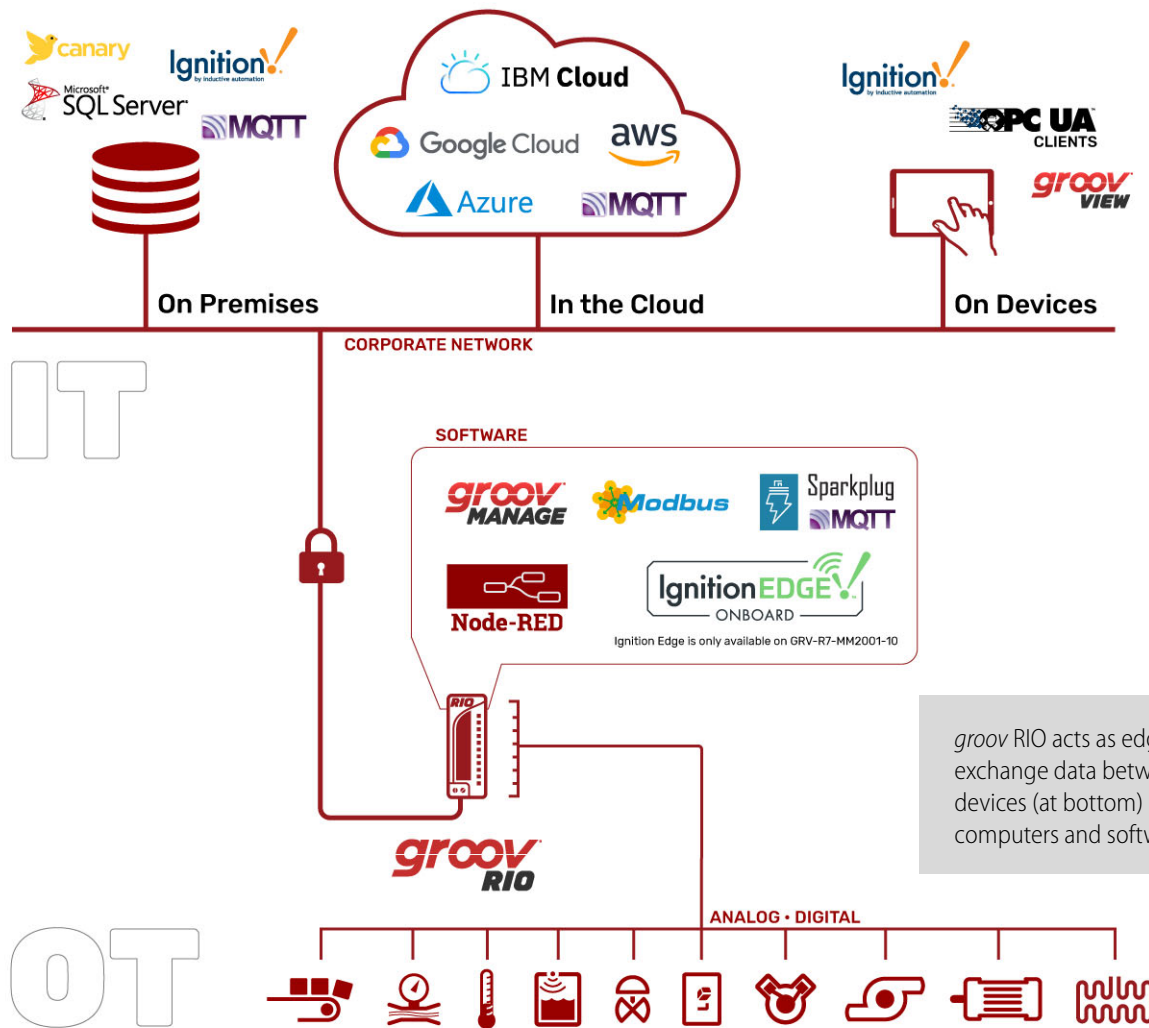
groov RIO's single part number gives you everything you need for edge I/O, plus options. With Power over Ethernet, you can avoid the extra time and expense of routing power or adding a power supply dedicated to *groov* RIO. Just run a Category 5e or 6 Ethernet cable from a PoE-supplying network switch to ETH1—bringing power and networking over a single cable.

groov RIO as Edge I/O

After you power up your *groov* RIO, open a web browser on a computer or mobile device to connect to your RIO's IP address or hostname. *groov* Manage—a web app that gives you command center-like access to your *groov* RIO—opens so you can configure, troubleshoot, and commission built-in I/O, networking, and security.

Configure a Mix of I/O Channels

The GRV-R7-MM1001-10 and GRV-R7-MM2001-10 are 10-channel, multi-signal, multifunction edge I/O modules supporting thousands of unique field I/O combinations. (How is this possible? Take a look at the wiring diagram on [page 17](#) to see all the available features and input/output configurations or visit info.opto22.com/thousands.)



Through *groov* Manage, you can select a channel, configure its I/O signal, select any feature—such as counting, latching, clamping, and more—supported by the selected channel and then save your configuration.

Exchange/Send Data Wherever You Like

groov RIO supports both OT and IT protocols and tools, making it easier to safely move data among field devices and computer networks, in some cases without requiring a PLC or middleware. Choose the method that works best for you:

Modbus TCP/IP master—*groov* RIO is a Modbus TCP slave out of the box. Use your favorite Modbus TCP master device or software to poll RIO's I/O channels. A Modbus TCP calculator is built into RIO's *groov* Manage application, helping you quickly find the Modbus Unit ID and register for a memory map area.

C++ or .NET and free SDKs—With your favorite development tool and our free SDKs, you can programmatically access I/O values on a *groov* RIO by accessing the OptoMMP memory map locations of each channel. An OptoMMP calculator is built into RIO's *groov* Manage, making it simple to identify the MMP addresses of I/O channels and their features.

HTTP/S, JSON, and REST APIs—The developer community has embraced REST APIs as a method of accessing I/O with HTTP/S and JSON. Opto 22 provides REST APIs for *groov* Manage, which you use to access the I/O values on a RIO unit. A Swagger API document is built into RIO to quickly access REST API calls and evaluate responses.

MQTT broker/server—An efficient and robust publish/subscribe protocol, MQTT is an ideal method of exchanging data for industrial internet of things (IIoT) applications. *groov* RIO has support for MQTT built in, requiring only a simple configuration to publish I/O data and subscribe to commands as Sparkplug-B or string payloads.

Node-RED—Create a data flow with the built-in Node-RED editor and runtime to send data to cloud services, databases, other I/O channels, and APIs through pre-built nodes. Even develop simple user interfaces (UIs) with Node-RED UI nodes and serve them directly from RIO to any mobile or web-based device.

groov RIO in a Control Program or SCADA

In addition to its use as autonomous edge I/O, *groov* RIO can also be used to expand the scope of existing control programs or industrial applications. You can add *groov* RIO units to monitor, control, and collect data from field devices:

- **In a PAC Control™ strategy**—With PAC Project™ Basic or Professional Software Suite, add a *groov* RIO as an I/O unit, configure your I/O points, then download your strategy to a:

- *groov* EPIC® processor running firmware version 2.0.0 or higher.
- SNAP PAC controller or SoftPAC running PAC Controller firmware 10.3 or higher (also requires PAC Project 10.3 or higher).

- **In a CODESYS® application**—Download and install the Opto 22 Library Package for CODESYS Development System, version 2.0.0.0 or later. Update your application and you'll be ready to add a *groov* RIO and configure I/O points.
- **In an Ignition SCADA**—Ignition Edge in GRV-R7-MM2001-10 connects to Allen-Bradley®, Siemens®, and Modbus®/TCP devices via OPC UA and offers efficient IIoT communications using MQTT with Sparkplug B payload (requires purchase of license [GROOV-LIC-EDGE8](#)).
- **In a custom control program**—You can access *groov* RIO I/O programmatically through OptoMMP or REST APIs.

Independent PID Loop Control

A *groov* RIO can independently solve PID loops when any analog output is configured as the Control Output (CO) of the loop. Up to four independent loops are supported, with configurable loop times.

Security

groov RIO provides several features to help keep your data secure.

User account management—*groov* RIO has no default username or password. You must set up the first Admin user account and remember its username and password, as these user credentials are secure and cannot be recovered. You can also locally create more users and set their passwords and permissions.

Centralized user management—*groov* RIO can help you scale your control system by supporting user management through LDAP. Configure your *groov* RIOs to connect to your LDAP-compatible directory service, then your IT staff can manage users/groups from one spot. This can also help satisfy data integrity requirements in regulated industries.

VPN client—You can securely connect to *groov* RIO using a VPN. Support is provided for OpenVPN servers.

Configurable firewall—Configure the device (or host) firewall in *groov* RIO for greater security. You can control which ports, protocols, and interfaces are open for incoming connections to the services listening on each port number. For example, you should disable the ports of unused protocols.

Leverage Existing *groov* and SNAP PAC Knowledge

If you already have *groov* EPIC, a *groov* Box™, or SNAP PAC control systems, you can expand your I/O footprint with the addition of *groov* RIOs. *groov* RIO works as remote I/O with *groov* EPIC and SNAP PACs, and it uses many of the same principles and technologies found in your existing *groov* or SNAP PAC control system:

- *groov* Manage for I/O configuration and other tools to help manage your *groov* RIO
- MQTT to transmit Sparkplug or string payloads
- Node-RED for simple data flows
- OpenVPN client to connect to an OpenVPN server running a virtual private network
- PAC Control for programming and I/O configuration

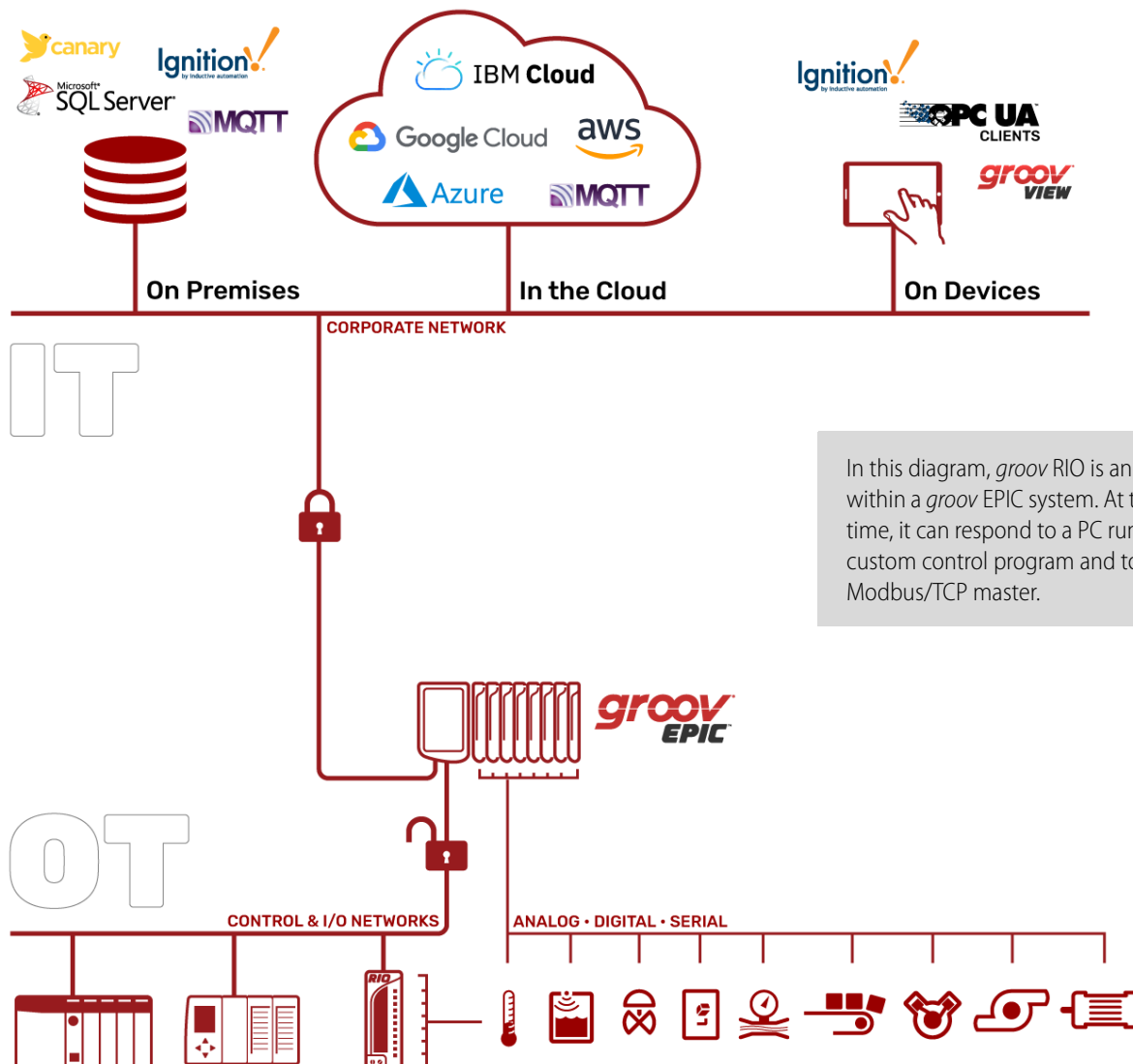
- Distributed control—I/O features like counting, latching, totalization, and minimum & maximum values continue to run independently on RIO, even if communication to the controller is lost.

Need help? Try the *groov* RIO Explorer

It can sound overwhelming sifting through thousands of unique field I/O combinations, so we created an online app to help you select the right combination and correctly wire your field devices to your *groov* RIO: [The *groov* RIO Explorer](#).

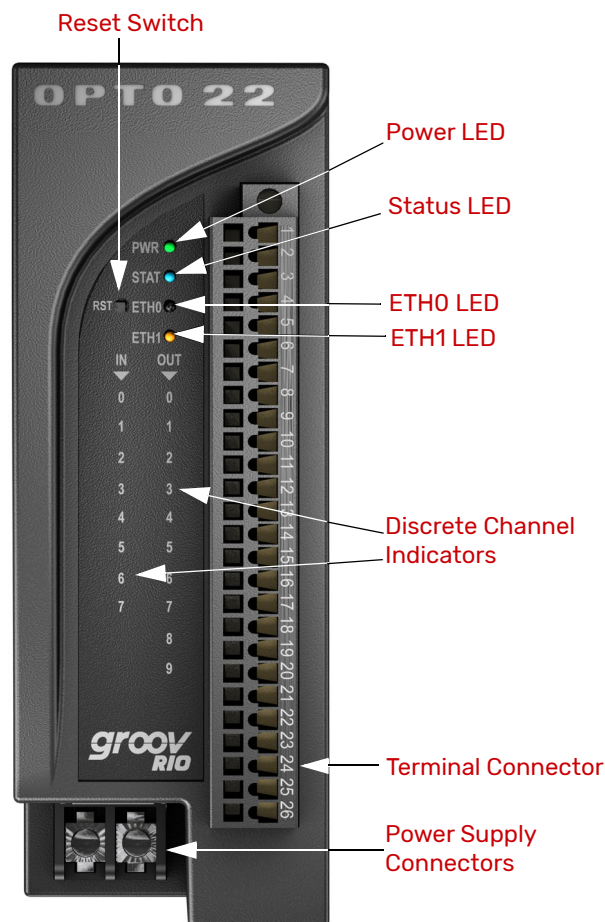
With this web app, you can select which function you want on each channel, and then the app displays the corresponding wiring diagram. You can print out the wiring diagram or save it as an image for reference.

groov RIO in an Opto 22 Control System, also Responding to a Modbus/TCP Master and Custom Program



LEDs, NETWORK INTERFACES, PORTS, AND CONNECTORS

The LEDs, network interfaces, USB port, and connectors (terminal and power supply) on the *groov* RIO offer features to help you review the status and health of your *groov* RIO, as well as connect it to a power supply, a network, and field devices. For more information about these features and how to utilize them, see [groov RIO User's Guide](#) (form 2324).



Reset Switch

This switch reboots your *groov* RIO or can reset it to factory defaults, erasing all the changes you made to your module and setting the firmware to the version installed when it was shipped.

Discrete Channel Indicators

There are two columns of indicators on the face of RIO:

- For discrete input channels, the column on the left indicates state.
- For discrete output channels, the column on the right indicates state.

When a channel is configured for discrete input or output, its corresponding indicator lights up when the channel is on.

LEDs

LED	Indicates
POWER	The status of power. <ul style="list-style-type: none"> • Solid green—RIO is powered on. • Solid red—RIO is restarting.
STATUS	Whether RIO is running or resetting. <ul style="list-style-type: none"> • Solid green—RIO is running normally. • Blinking green—RIO is starting (power on) or restarting (initiated by Reset Switch). • Blinking between green and red—RIO is resetting to factory defaults.
ETH0, ETH1	Network connection speed and whether there is any transmission activity: <ul style="list-style-type: none"> • Solid green: 1 Gbps; transmission activity = No • Blinking green: 1 Gbps; transmission activity = Yes • Solid orange: 10 or 100 Mbps; transmission activity = No • Blinking orange: 10 or 100 Mbps; transmission activity = Yes

Terminal Connector

The terminal connector provides a spring-clamp wiring system to securely connect the wires from your field devices to RIO. To learn how to use a spring-clamp wiring system, see ["Mounting On DIN Rail" on page 14](#).

The gray-colored terminal connector for GRV-R7-MM1001-10 & GRV-R7-MM2001-10 helps differentiate it from *groov* I/O module terminal connectors, which have the same footprint as RIO. The difference in color helps you remember that this terminal connector is designed for RIO modules to accurately read thermocouple inputs.

Power Supply Connector

To supply power with an external power supply, Opto 22 recommends you follow these wiring guidelines:

- Use a 10 to 32 V DC power source or supply.
- Use wire size 22 to 14 AWG. Keep the wires as short as possible.

Power Wiring Diagram

Before wiring the *groov* RIO to an external power supply, verify that your wiring cables conform to the requirements described above.



Network Ports

The Ethernet ports are part of an internal Ethernet switch, which means you can network *groov* RIOs in a daisy-chain configuration or in a standard star configuration using either Ethernet port. Both ports use the same IP address.

The network ports support speeds of up to 1 Gbps. Check the rating of your Ethernet cable to ensure that it can handle the speeds provided by your network.

The **ETH1** port, when connected to Power Sourcing Equipment (PSE)—for example, a PoE switch—through a PoE-rated Ethernet cable, can power the *groov* RIO module. Powering through PoE is an alternative to powering through a separate external power supply. Opto 22 recommends you select a PSE that supports IEEE 802.3af and has sufficient power available for all the powered devices (PDs) connected to it.

USB Port

The USB port acts as a USB host device that can help you extend the capabilities of the *groov* RIO. You can connect a:

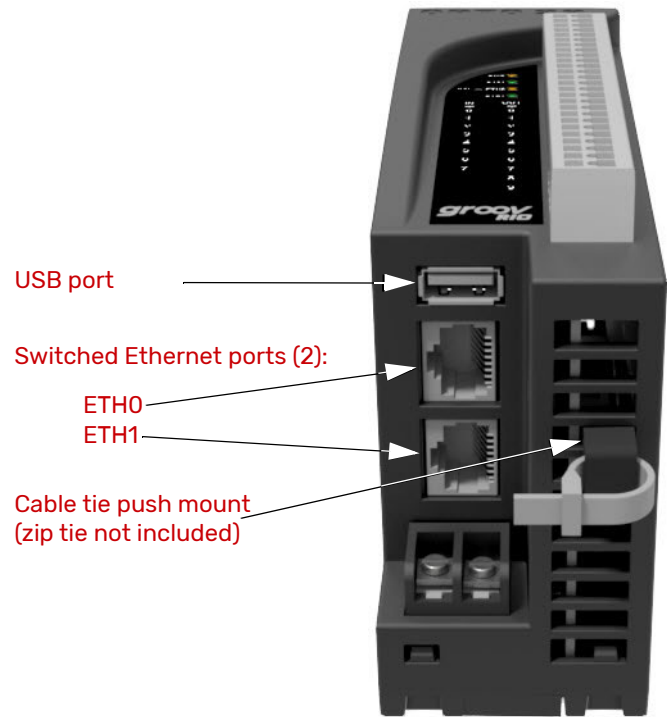
- WiFi adapter to add wireless connectivity.
- USB-to-serial adapter to read and write data to serial devices.
- USB memory stick to expand the storage space; for example, to increase data logging capacity.

The wireless interface WLAN0 (which becomes available when you plug in a WiFi adapter) does not provide access to other RIOs in a daisy-chain configuration because this interface has a separate IP address on a separate subnet.

Wireless Connectivity

The following WiFi USB adapters have been tested and proven to be compatible with *groov* RIO:

Device Manufacturer	Model
Netis	WF2190
Linksys	AE6000
TP-Link	Archer T1U
Sabrent	AC600



Cable Tie Push Mounts (Optional Use)

Cable tie push mounts can help you manage wires. Each *groov* RIO comes with two user-installable cable tie push mounts, which snap into a vent, providing a sturdy loop through which you can thread a zip tie (not included), then bundle the wires together with the zip tie.



FEATURES AND SPECIFICATIONS

Features

The following table lists the features available for each signal type. Note that some signal types are available only on specific channels, as listed in the "Channels" row.

GRV-R7-MM1001-10 GRV-R7-MM2001-10		Signal Type					
	DI: • Discrete • Switch Input, Powered	DI: • Discrete • Switch Input, Powered	DO: • DC Sinking	DO: • Form C Mech. Relay	AI: • Voltage • ICTD • Thermistor • Resistor	AI: • Current • Thermocouple • Millivolt	AO: • Voltage • Current
Channels	0-1	2-7	0-7	8-9	0-7	0-3	4-7
Features							
On/off State	x	x	x	x			
On/off Latching	x						
Counting	x						
On/off Totalization	x						
Frequency Measurement	x						
Period Measurement	x						
Pulse Measurement	x						
Scaling					x	x	x
Offset and Gain					x	x	
Minimum/Maximum Values					x	x	
Average Filter Weight					x	x	
Simple Moving Average							
Analog Totalizing					x	x	
Output Pulsing / TPO			x				
Ramping							x
Clamping							x
Watchdog Timeout Value			x	x			x
Quality Indication					x	x	x

Specifications

The specifications are divided into two categories: common and by-signal type. The common category (located at the bottom of the following table, [page 5](#)) lists the specifications that apply to all channels, regardless of the signal type you select. The by-signal type category applies when the channel is configured for that particular signal type.

Specification		GRV-R7-MM1001-10 GRV-R7-MM2001-10
Voltage Input		
Available Channels		0–7
Input Range		0–10 V DC
Over-range Limit		0–11 V DC
Resolution		0.5 mV
Accuracy		±0.05% of range (±5 mV)
Gain Temperature Coefficient		30 ppm/°C
Offset Temperature Coefficient		15 ppm/°C
Input Impedance		> 425 kOhms
Data Refresh Time		550 ms
50 / 60 Hz rejection		> 90 dB
Current Input		
Available Channels		0–3
Input Range		0–20 mA, 4–20 mA
Over-range Limit		0.0–20.8 mA, 2.0–20.8 mA
Recommended Fuse		32–40 mA, Fast Acting (for example, Eaton S500-32-R)
Resolution		1.0 µA
Accuracy		±0.05% (±10 µA)
Gain Temperature Coefficient		30 ppm/°C
Offset Temperature Coefficient		15 ppm/°C
Input Voltage Drop (±10%)		0.9 V @ 4 mA, 2.0 V @ 20 mA, 25 °C
Equivalent Input Impedance (±10%)		225 Ohms @ 4 mA, 100 Ohms @ 20 mA, 25 °C
Data Refresh Time		550 ms
50 / 60 Hz rejection		> 90 dB
ICTD Input		
Available Channels		0–7
Input Range with ICTD Probe		-40 to +100 °C
Resolution		0.04 °C
Accuracy with ICTD Probe		±1.0 °C (1.8 °F)
Gain Temperature Coefficient		30 ppm/°C
Offset Temperature Coefficient		60 ppm/°C
Data Refresh Time		550 ms
50 / 60 Hz rejection		> 90 dB

Specification		GRV-R7-MM1001-10 GRV-R7-MM2001-10	
Thermocouple Input			
Available Channels	0–3 (see Note)		
Nominal Input Range	-75 to +75 mV		
Full Scale Range	-78 to +78 mV		
Input Resolution	3 microvolts		
Input Impedance	> 1 megohm		
Data Refresh Time	550 ms		
50 / 60 Hz rejection	> 90 dB		
Thermocouple ITS90 Types	± Accuracy / Resolution		
B: 90 °C to 1,820 °C	7 °C / 0.4 °C		
E: -80 °C to 1,000 °C	2 °C / 0.1 °C		
J: -100 °C to 1,200 °C	2 °C / 0.1 °C		
K: -80 °C to 1,372 °C	2 °C / 0.1 °C		
N: -100 °C to 1,300 °C	3 °C / 0.1 °C		
R: 100 °C to 1,768 °C	7 °C / 0.3 °C		
S: 100 °C to 1,768 °C	7 °C / 0.3 °C		
T: -60 °C to 400 °C	3 °C / 0.1 °C		
Note: To achieve the best thermocouple accuracy when also using current outputs or discrete outputs, always configure thermocouples on the lowest channel numbers and outputs on the highest channel numbers.			
Millivolt Input			
Available Channels	0–3		
Input Ranges	±150 mV, ±75 mV, ±25 mV		
Over-range Limits	±165.0 mV, ±78.0 mV, ±27.5 mV		
Resolution	10 µV, 3 µV, 2 µV		
Accuracy	±0.1% of Full Scale (±150 µV) ±0.1% of Full Scale (±75 µV) ±0.2% of Full Scale (±50 µV)		
Input Impedance	> 1 MOhms		
Data Refresh Time	450 ms		
50 / 60 Hz rejection	> 90 dB		

Specification		GRV-R7-MM1001-10 GRV-R7-MM2001-10
Thermistor Input (Requires firmware version 3.0.0 or later)		
Available Channels	0–7 (see Note)	
Input Range (Ohm)	0-400 k	
Accuracy (Ohm @ Range)	greater of 3 Ohm or 0.5% ^{@0-25k,} 400 ^{@25k–50k,} 900 ^{@50k–75k,} 1.5k ^{@75k–100k,} 5k ^{@100k–200k,} 20k ^{@200k–400k}	
Gain Temperature Coefficient	500 ppm/°C	
Resolution (Ohm @ Range)	0.5 ^{@0–1k,} 1 ^{@1k–5k,} 2 ^{@5k–10k,} 5 ^{@10k–25k,} 50 ^{@25k–100k,} 200 ^{@100k–200k,} 700 ^{@200k–400k}	
Power Dissipation @ Resistance (μW @ Ohm)	375 ^{@1k,} 950 ^{@5k,} 1075 ^{@10k,} 875 ^{@25k,} 600 ^{@50k,} 450 ^{@75k,} 350 ^{@100k,} 200 ^{@200k,} 100 ^{@400k}	
Predefined Thermistor Curves	Accuracy (°C) @ Range (°C)	
2252	0.2 °C @ -40 °C to 70 °C	
	2.5 °C @ 70 °C to 150 °C	
3K	0.2 °C @ -40 °C to 70 °C	
	2.5 °C @ 70 °C to 150 °C	
10K type 2	0.75 °C @ -40 °C to -20 °C	
	0.2 °C @ -20 °C to 120 °C	
	0.6 °C @ 120 °C to 150 °C	
10k type 3	0.5 °C @ -40 °C to -20 °C	
	0.3 °C @ -20 °C to 120 °C	
	0.6 °C @ 120 °C to 150 °C	
Custom	depends on curve	
Data Refresh Time	550 ms	
Note: To achieve the best thermistor accuracy when also using current outputs, always configure thermistors on the lowest channel numbers and current outputs on the highest channel numbers.		
0–400 kOhm Input (Requires firmware version 3.0.0 or later)		
Available Channels	0–7 (see Note)	
Input Range (Ohm)	0–400k	
Accuracy (Ohm @ Range)	greater of 3 Ohm or 0.5% ^{@0-25k,} 400 ^{@25k–50k,} 900 ^{@50k–75k,} 1.5k ^{@75k–100k,} 5k ^{@100k–200K,} 20k ^{@200k–400k}	
Gain Temperature Coefficient	500 ppm/°C	
Resolution (Ohm @ Range)	0.5 ^{@0–1k,} 1 ^{@1k–5k,} 2 ^{@5k–10k,} 5 ^{@10k–25k,} 50 ^{@25k–100k,} 200 ^{@100k–200k,} 700 ^{@200k–400k}	
Power Dissipation @ Resistance (μW@Ohm)	375 ^{@1k,} 950 ^{@5k,} 1075 ^{@10k,} 875 ^{@25k,} 600 ^{@50k,} 450 ^{@75k,} 350 ^{@100k,} 200 ^{@200k,} 100 ^{@400k}	
Data Refresh Time	550 ms	
Note: To achieve the best resistance accuracy when also using current outputs, always configure the 0-400 kOhm channel type on the lowest channel numbers and current outputs on the highest channel numbers.		
Discrete DC Input		
Available Channels	0–7	
Input Voltage Range	5–30 V DC	
Minimum ON Voltage	5.0 V	
Maximum OFF Voltage	1.5 V	
Input Impedance	> 425 KOhms	
Max. Input Frequency (50% square wave)	10000 Hz	

Specification		GRV-R7-MM1001-10		GRV-R7-MM2001-10	
Switch Input, Powered					
Available Channels	0–7				
Open Circuit Voltage (Switch Open)	10.5 V (minimum)				
Channel Current Limit	1.1 mA max.				
Channel Operating Current	0.63 mA typical				
Minimum Off Resistance	3300 Ohms				
Maximum On Resistance	1200 Ohms				
Minimum ON Voltage	5 V				
Maximum OFF Voltage	1.5 V				
Maximum Continuous Survivable Input Voltage	32 V				
Input Impedance	> 425 KOhms				
Max. Freq. (50% square wave)	10000 Hz				
Discrete Counter Input					
Available Channels	0–1				
Input Voltage Range	5–30 V DC				
ON Threshold	5 V				
OFF Threshold	1.5 V				
Input Impedance	> 425 KOhms				
Max. Frequency (50% square wave): State, Latches, Counter	10000 Hz				
Max. Frequency (50% square wave): On/Off pulse width, Period, Frequency	2000 Hz				
Max. Frequency (50% square wave): On/Off totalization	750 Hz				
Pulse Width Measurement Resolution	100 microseconds				
Pulse Width Measurement Error (50% square wave)	0.1%	0	to	20	Hz
	1%	21	to	200	Hz
	5%	201	to	2000	Hz
Period/Frequency Error (50% square wave)	0.05%	0	to	20	Hz
	0.1%	21	to	200	Hz
	1%	201	to	2000	Hz
Discrete DC Sinking Output					
Available Channels	0–7 (4-7 if using any thermocouple inputs)				
Line Voltage Range	5–30 V DC				
Maximum Continuous Current	1.0 A				
Peak Current (< 10 ms)	4.0 A				
Recommended Fuse / Circuit Breaker	1 A at 30 V DC				
Output Voltage Drop	175 mV at 1 A				
Off-State Leakage (per channel)	< 80 µA at 24 V, -20 to +70 °C				
Peak Blocking Voltage	32 V				
TPO Period (min, max, resolution)	0.004, 4294967, 0.001				
Turn On / Off Time	20 ms nominal				

Specification		GRV-R7-MM1001-10 GRV-R7-MM2001-10
Form C Relay Output		
Available Channels	8, 9	
Line Voltage Range	0–250 V AC or 5–30 V DC	
Clamp Voltage	440 V nominal	
Current Rating	5 A per channel	
Surge Current	6 A peak for 1 second	
Recommended Fuse / Circuit Breaker	5 A at 250 V AC / > 30 V DC per channel	
Initial Contact Resistance	< 100 milliohms	
Turn On Time	8 ms	
Turn Off Time	4 ms	
Operating Life (to specification)	Min. 30,000 cycles at max. ratings	
Mechanical Life	Min. 10,000,000 cycles	
Voltage Output		
Available Channels	4–7	
Range	0–10 V	
Resolution	2.5 mV	
Accuracy	±0.3% of range (±30 mV)	
Gain Temperature Coefficient	50 ppm/°C	
Offset Temperature Coefficient	20 ppm/°C	
Output Slew Rate	> 15 V/ms	
Minimum Load Resistance	7.5 kOhms	
Output Impedance	< 10 Ohms	
Short-circuit Current	20 mA	
Data Refresh Time	Nominal 20 ms. Proportional to I/O scan time.	
Current Output		
Available Channels	4–7	
Output Range	0–20 mA	
Resolution	5 µA	
Accuracy	±0.325% of range (±65 µA)	
Gain Temperature Coefficient	60 ppm/°C	
Output Slew Rate	> 10 mA/ms	
Maximum Loop Resistance	700 Ohms	
Data Refresh Time	Nominal 20 ms. Proportional to I/O scan time.	

Specification	GRV-R7-MM1001-10 GRV-R7-MM2001-10
Common Specifications	
Ethernet	Two switched Gigabit ports; daisy-chainable; ETH1 with 802.3af PoE powered device (PD)
USB	One Port, USB 2.0 HS
Memory	GRV-R7-MM1001-10: 1 GB RAM, 4.0 GB user space GRV-R7-MM2001-10: 2 GB RAM, 7.0 GB user space
Power Supply	802.3af PoE Class 0 or 10–32 V DC
Power Consumption	10 W
Max. Survivable Input (channels 0 - 7)	32 V DC
Isolation (between channels 0 - 7)	None
Isolation (between channel 8 or 9 and all others)	3000 V AC _{rms} 1 min.
Isolation (field to Ethernet / power input)	1500 V AC _{rms} 1 min.
Minimum <i>groov</i> RIO Firmware Version	GRV-R7-MM1001-10: N/A GRV-R7-MM2001-10: 3.0.0
Minimum <i>groov</i> EPIC Firmware Version	GRV-R7-MM1001-10: 2.0.0 (3.0.0 for Thermistors) GRV-R7-MM2001-10: 3.0.0
Minimum PAC Project Version	GRV-R7-MM1001-10: 10.3000 (10.3003 for Thermistors) GRV-R7-MM2001-10: 10.3003
Minimum Library Package for CODESYS Version	GRV-R7-MM1001-10: 2.0.0.0 (2.0.1.0 for Thermistors) GRV-R7-MM2001-10: 2.0.1.0
Field Connector Wire Size	28–14 AWG
Torque, field connector screw	2.5 in-lb (0.28 N-m)
Power Connector Wire Size	22–14 AWG
Torque, DC power connector screws	7.0 in-lb (0.79 N-m)
Torque, panel mount tab screw	2.0 in-lb (0.23 N-m)
Temperature (operating)	-20 °C to +70 °C
Temperature (storage)	-40 °C to +85 °C
Relative Humidity (non-condensing)	5–95%
MTBF (minimum, 25 °C)	1.2 Mhrs
Agency Approvals	UL/cUL(Class 1 Div. 2); CE, ATEX(Category 3, Zone 2), RoHS; DFARS; CB Scheme
Warranty	30 months

Wire Assignments

The following wire assignments apply to the thermocouple signal type:

Type	-	+	Range
B	Red	Gray	+90 °C to +1,820 °C
E	Red	Purple	-80 °C to +1,000 °C
J	Red	White	-100 °C to +1,200 °C

Type	-	+	Range
K	Red	Yellow	-80 °C to +1,372 °C
N	Red	Orange	-100 °C to +1,300 °C
R,S	Red	Black	100 °C to +1,768 °C
T	Red	Blue	-60 °C to +400 °C

MOUNTING ON DIN RAIL

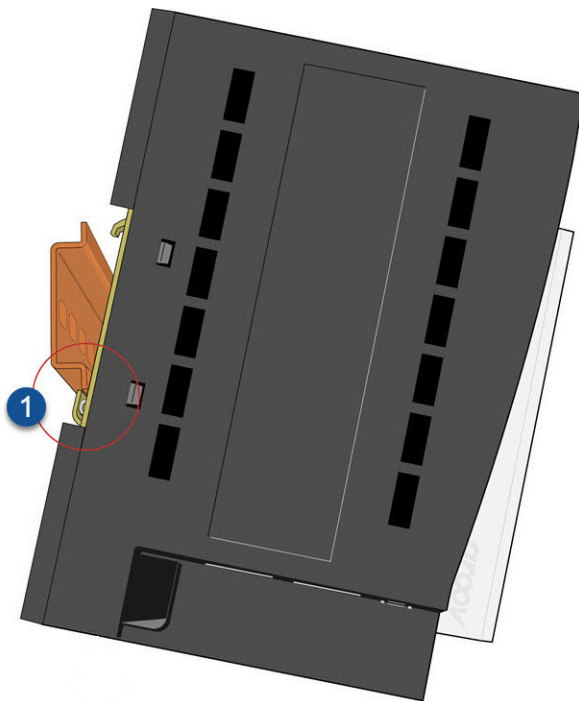
Before mounting your RIO:

- Ensure that the vents around RIO are not obstructed.
- Review "Mounting on a Panel" on page 15 to ensure good ventilation and optimal performance.

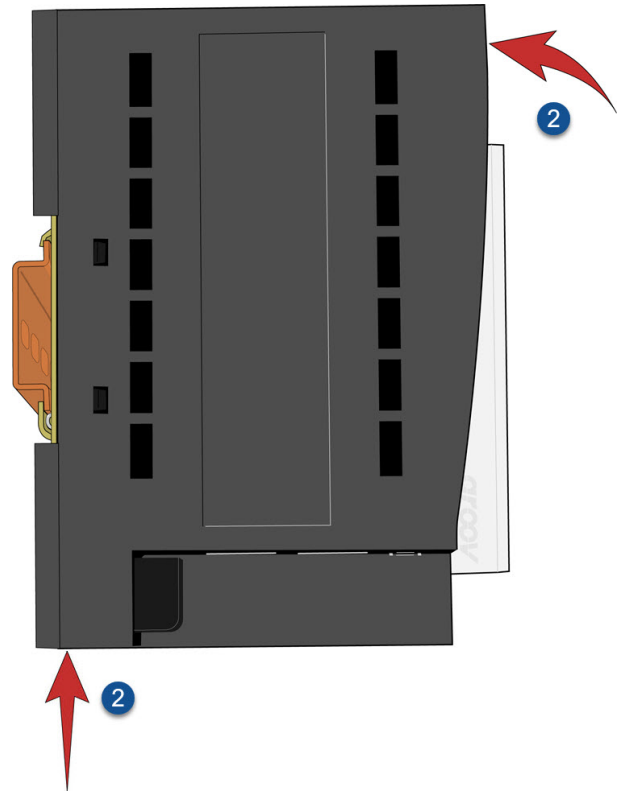
The *groov* RIO is built with DIN rail adapters for use on 35 mm DIN rail. No additional assembly is required.

To mount RIO to a DIN rail, follow these steps:

1. Hold RIO so that the Opto 22 logo is at the top and at an angle such that the top of the DIN rail adapter is away from the DIN rail and the bottom of the DIN rail adapter can slide behind the bottom lip of the DIN rail.

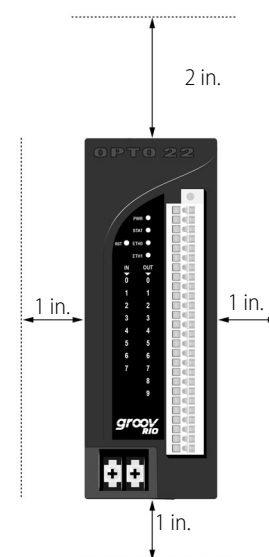


2. Push the bottom part of RIO upward, making sure that you feel the clip catch on to the rail, and simultaneously push the top half of RIO toward the DIN rail until the top of the DIN rail adapter engages the top lip of the DIN rail.



Before you release RIO, verify that the top and bottom of the DIN rail adapters have engaged the DIN rail.

ORIENTATION AND CLEARANCES



Make sure that there is a minimum of 2 inches clearance on the top, and 1 inch clearance on the bottom, each side, and in front of RIO, after it is mounted. Mount RIO as shown in the diagram: with the Opto 22 logo at the top. Compliance with these guidelines helps ensure that *groov* RIO performs as described in the specifications.

MOUNTING ON A PANEL

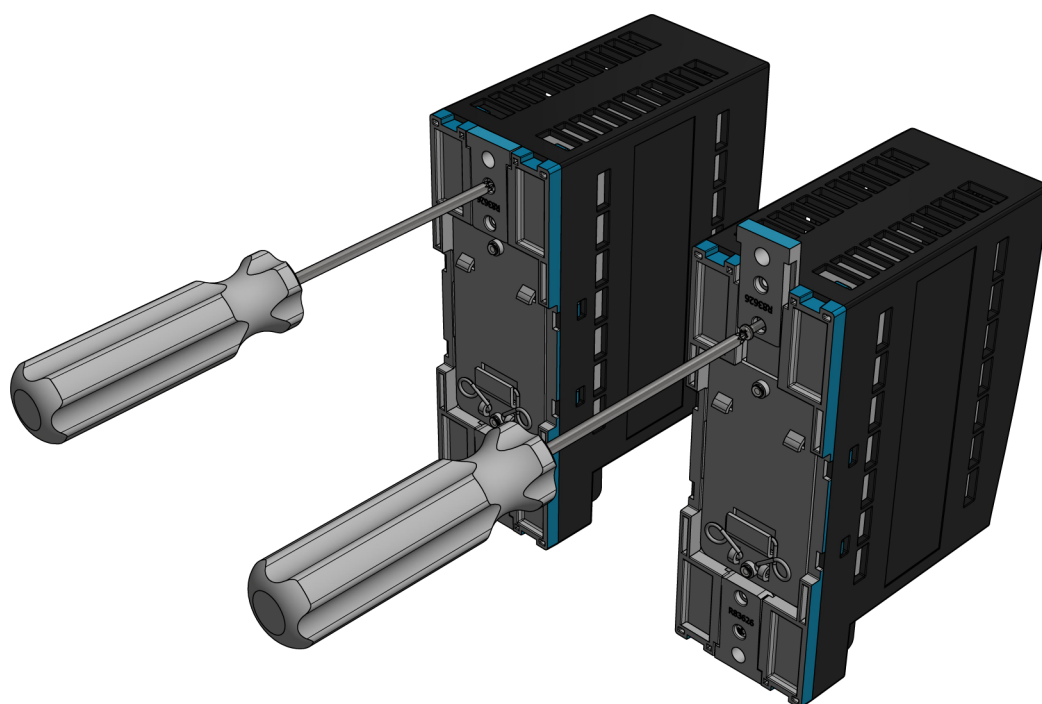
Before mounting your RIO:

- Ensure that the vents around RIO are not obstructed.
 - Review "Mounting on a Panel" to ensure good ventilation and optimal performance.
1. Flip your *groov* RIO so you can see the backside.
 2. With a small Phillips screw driver, remove the screw on the tabs.
 3. Slide tabs out so the middle hole on the tab aligns with the screw hole on *groov* RIO.
 4. Reinsert the screw.

Now, you can use RIO as a template to mark holes on the panel and verify placement before attaching it.

Attach *groov* RIO with screws (not provided):

1. Drill the first screw into the tab up to the torque indicated in the "Common Characteristics" section of the specifications (see "[Specifications](#)" on page 8).
2. Drill the second screw into the second tab up to the torque indicated.
3. Return to the first screw and re-tighten the screw up to the torque indicated.

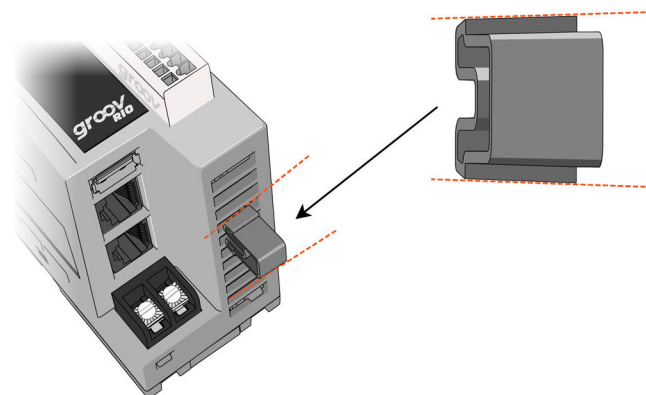


INSERTING A CABLE TIE PUSH MOUNT

Each *groov* RIO comes with two user-installable cable tie push mounts. You only need to insert one mount.

1. Identify the thin side of the mount, then position it over a vent so that the thin side faces the ports and is away from the PCB, which is visible through the vents (see image on [page 6](#)).
2. With one hand, hold the *groov* RIO down on a sturdy surface. With the other hand, push the mount in, beginning with the thin side. Push until you hear a loud click. Verify that the mount is securely inserted by gently pulling on it; it should not come out.

Thread a zip tie (not included) through the mount. Collect the wires into a bundle, wrap the zip tie around the bundle, then clip the excess zip tie.



PINOUT AND WIRING

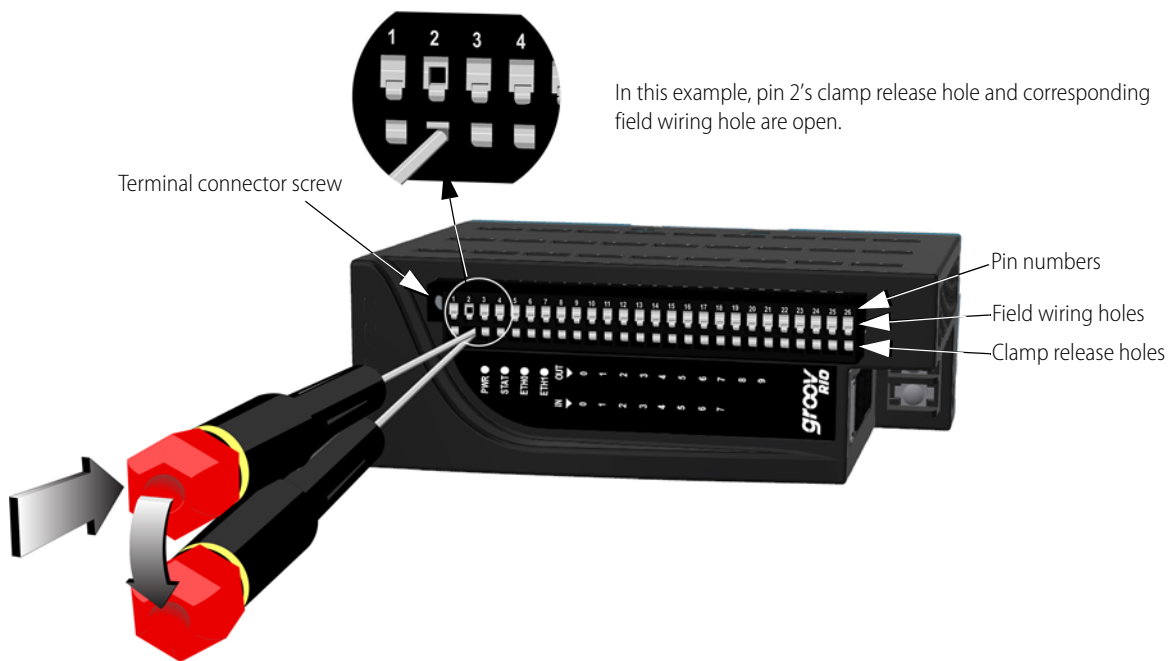
Before you begin wiring, do the following tasks:

- Select the appropriate wire. The terminal connectors are rated for 22–14 AWG wire. If you're using stranded wire, you can make an easier and better connection by tinning the strands or adding ferrules.
- Ensure that you have the spring clamp tool supplied with your *groov* RIO.
- It may be easier to insert wires if you remove the terminal connector from RIO. To remove the terminal connector, loosen

the terminal connector screw at one end of the connector, then pull the connector straight out.

- If you have never used a spring-clamp wiring system, take a moment to familiarize yourself with the diagram below. The clamp release hole is where you will insert the spring clamp tool. The field wiring hole is where you will insert your field wires.

If you look into the field wiring hole, you will see a highly reflective surface. If you can see that surface, that means that the clamp is closed.



Connecting Field Wires

CAUTION: For electrical safety, turn off power to RIO and de-energize field devices wired to the terminal connector before starting.

1. Orient RIO or the terminal connector to match the wiring diagram on the following page. To make it easier to handle the spring clamp tool and the field wires, secure RIO by doing one of the following:
 - If you are working with the terminal connector while it is attached to RIO, make sure RIO is attached securely to the panel or DIN rail.
 - If you are working only with the terminal connector, secure the terminal connector with a clamp.
2. Slide the spring clamp tool into the clamp release hole, along the left side, until you feel the end begin to meet some resistance. Gently push the tool in a little more, until you feel it stop.

- Look into the field wiring hole. If it is dark, the clamp is open. You can go to the next step.
- If you can still see the highly reflective surface, gently pull the tool's handle to the left until you feel it stop. Hold the tool in that position. Look into the field wiring hole. If it is dark, the clamp is open. You can go to the next step.

3. Insert the wire into the field wiring hole until it meets complete resistance. Then pull out the spring clamp tool.
4. Test that the wire is secure by gently pulling on it. If the wire pulls out, repeat steps 2 through 4.

To remove a wire, push the spring clamp tool into the clamp release hole as described in step 2 above, and then pull the wire out.

WIRING DIAGRAM

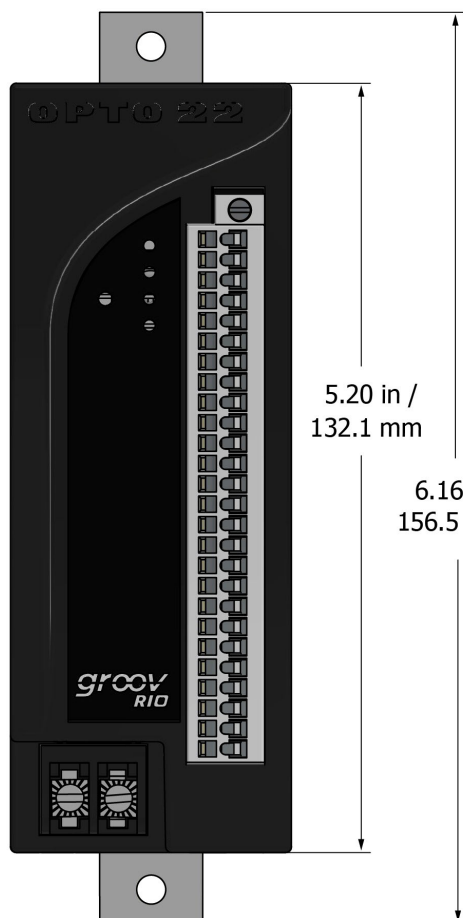
			INPUT							OUTPUT				
			Discrete		Analog					Discrete 1,3		Analog	Mechanical Relay	
			Discrete	Switch Input, Powered	Voltage	Current 2	ICTD	Thermistor/ Resistor	Thermocouple/ Millivolt 3	DC Sinking		Current / Voltage	Form C-NO 1	Form C-NC 1
Channel	Internal Wiring	Pin												
Ch 0		1												
		2												
		3												
Ch 1		4												
		5												
		6												
Ch 2		7												
		8												
		9												
Ch 3		10												
		11												
		12												
Ch 4		13												
		14												
Ch 5		15												
		16												
Ch 6		17												
		18												
Ch 7		19												
		20												
Ch 8		21												
		22												
		23												
Ch 9		24												
		25												
		26												

Notes:

1. You must supply external fusing.
2. Opto 22 recommends adding external fusing. Review the specification table for specific ratings. Compatible with an externally powered or self powered transmitter. Wiring for externally powered transmitter is shown on channels 0 and 1. Wiring for a self powered transmitter is shown on channels 2 and 3.
3. Thermocouple inputs and discrete sinking outputs cannot be mixed on channels 0-3.



DIMENSIONS: *groov RIO*



Face Views

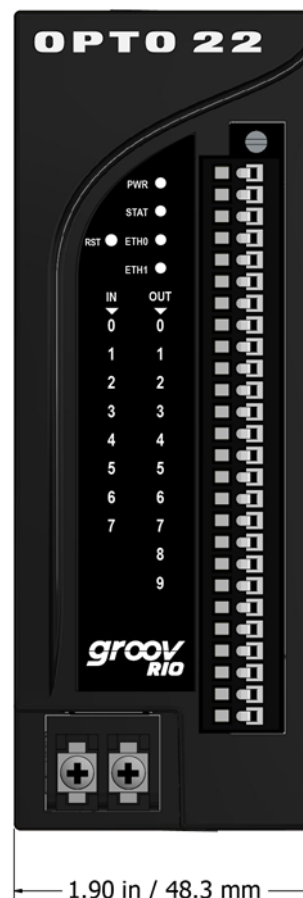
The image on the left shows the height (from the top to the bottom) in two settings:

- With the panel mounting tabs extended (the larger dimension).
- With the panel mounting tabs tucked in (the smaller dimension).

The side view (below) also shows these height dimensions.

Note: If you attach a cable tie mount, the bundle of wires you attach to the mount may exceed the height of the module with the panel mounting tabs extended.

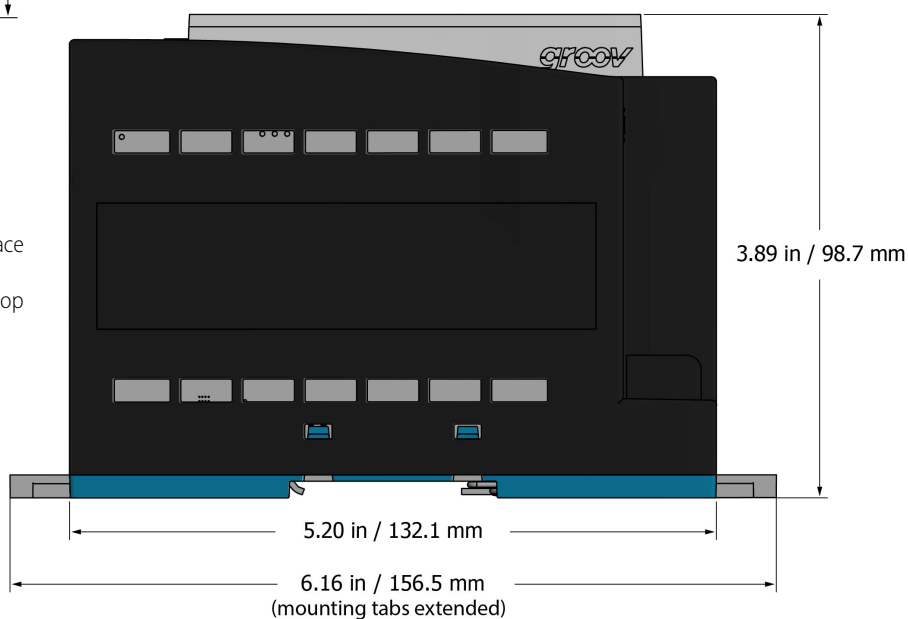
The image on the right shows the width (from one side to the other).



Side View

The image to the right shows two dimensions:

- The depth, which measures from the face to the back of the groov RIO.
- The height, which measures from the top to the bottom. The height varies, depending on whether you have the mounting tabs extended.



PRODUCTS

Opto 22 develops and manufactures reliable, easy-to-use, open standards-based hardware and software products. Industrial automation, process control, building automation, industrial refrigeration, remote monitoring, data acquisition, and industrial internet of things (IIoT) applications worldwide all rely on Opto 22.

groov EPIC® System

Opto 22's *groov Edge Programmable Industrial Controller (EPIC) system* gives you an industrially hardened system with guaranteed-for-life I/O, a flexible Linux®-based processor with gateway functions, and software for your automation and IIoT applications.

groov EPIC I/O

groov I/O connects locally to sensors and equipment with up to 24 channels on each I/O module. Modules have a spring-clamp terminal strip, integrated wireway, swing-away cover, and LEDs indicating module health and discrete channel status.

groov I/O is hot swappable, UL Hazardous Locations approved, and ATEX compliant.

groov EPIC Processor

The heart of the system is the *groov* EPIC processor. It handles a wide range of digital, analog, and serial functions for data collection, remote monitoring, process control, and discrete and hybrid manufacturing.

In addition, the EPIC provides secure data communications among physical assets, control systems, software applications, and online services, both on premises and in the cloud.

Configuring and troubleshooting I/O and networking is easier with the EPIC's integrated high-resolution color touchscreen. Authorized users can manage the system locally on the touchscreen or on a monitor connected via the HDMI or USB ports.

groov EPIC Software

Software included in the *groov* EPIC processor:

- PAC Control engine to run PAC Control and PAC Display
- CODESYS Runtime engine to run IEC61131-3 compliant programs built with CODESYS Development System
- Optional access to the Linux operating system through a secure shell (SSH) to download and run custom applications
- *groov* View for building your own device-independent HMI, viewable on the touchscreen, PCs, and mobile devices
- Node-RED for creating simple logic flows from pre-built nodes
- Ignition Edge® from Inductive Automation®, with OPC-UA drivers to Allen-Bradley®, Siemens®, and other control systems, and MQTT communications with Sparkplug for efficient IIoT data transfer

groov RIO®

groov RIO revolutionizes remote I/O by offering a single, compact, PoE-powered industrial package with web-based configuration, commissioning, and flow logic software built in, plus support for multiple OT and IT protocols.

Standing alone, it meets the needs of small, variable I/O count applications, especially those that require data logging or data communications, commonly found in IIoT applications. *groov* RIO can also be used with a Modbus/TCP master or as remote I/O for a *groov* EPIC system.

Older products

From solid state relays (our first products) to world-famous G4 and SNAP I/O, to SNAP PAC controllers, older Opto 22 products are still supported and still doing the job at thousands of installations worldwide. You can count on us to give you the reliability and service you expect, now and in the future.



QUALITY

Founded in 1974, Opto 22 has established a worldwide reputation for high-quality products. All are made in the U.S.A. at our manufacturing facility in Temecula, California.

Because we test each product twice before it leaves our factory rather than testing a sample of each batch, we can afford to guarantee most solid-state relays and optically isolated I/O modules for life.

FREE PRODUCT SUPPORT

Opto 22's California-based Product Support Group offers free, comprehensive technical support for Opto 22 products from engineers with decades of training and experience. Support is available in English and Spanish by phone or email, Monday–Friday, 7 a.m. to 5 p.m. PST.

Support is always available on our website, including [free online training](#) at OptoU, how-to [videos](#), [user's guides](#), the Opto 22 KnowledgeBase, troubleshooting tips, and [OptoForums](#). In addition, instructor-led, hands-on [Premium Factory Training](#) is available at our Temecula, California headquarters, and you can [register online](#).

PURCHASING OPTO 22 PRODUCTS

Opto 22 products are sold directly and through a worldwide network of distributors, partners, and system integrators. For more information, contact Opto 22 headquarters at **800-321-6786** (toll-free in the U.S. and Canada) or **+1-951-695-3000**, or visit our website at www.opto22.com.