

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 (GRV-R7-MM1001-10 model)
- > 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 including *groov*® Manage, Node-RED, and MQTT
- > 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

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.
- 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.

Part Number

Part	Description
GRV-R7-MM1001-10	<i>groov</i> RIO edge I/O; 8 multifunction channels, 2 form C electromechanical relay output channels

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.

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

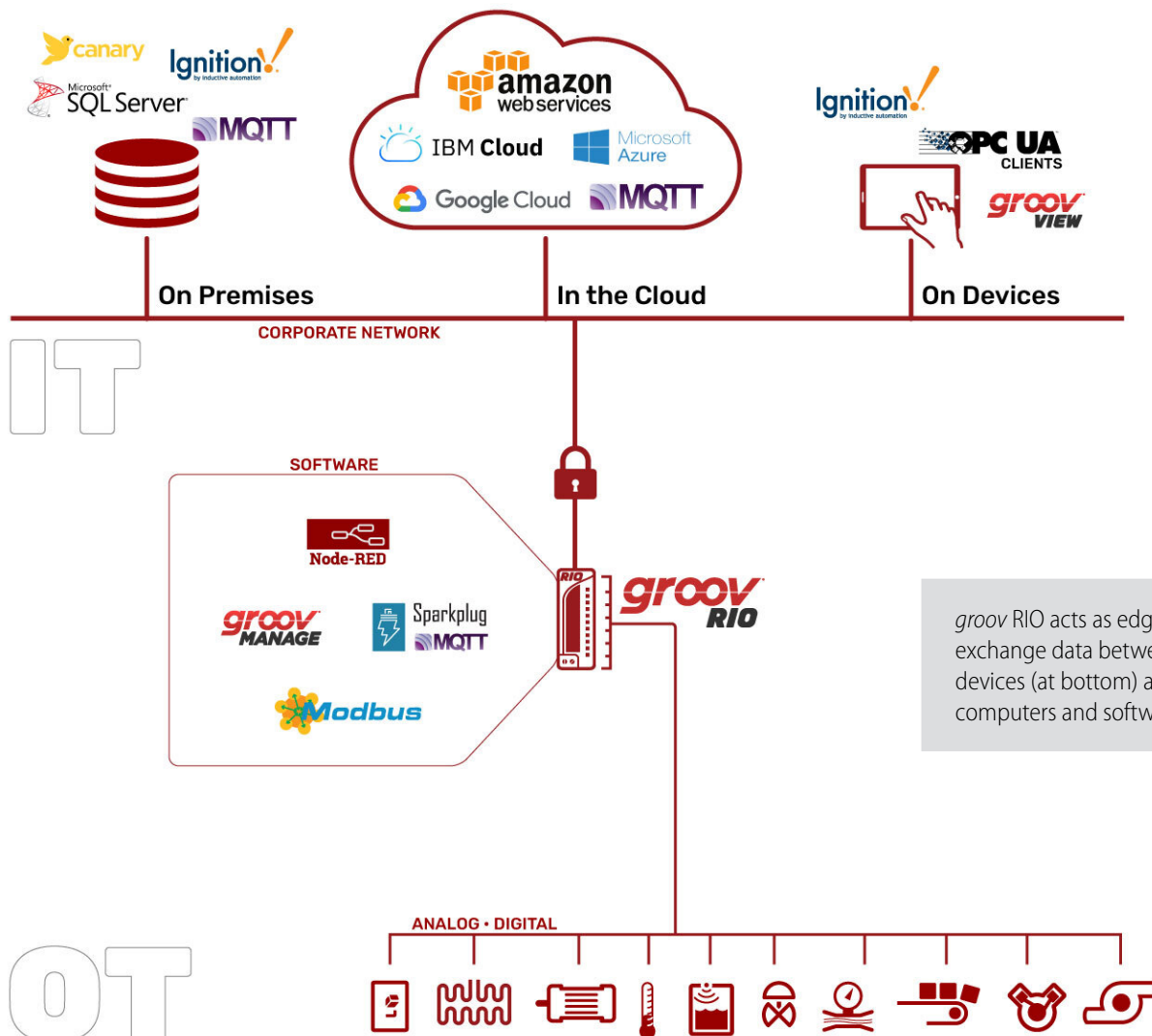
from a PoE-supplying network switch to ETH1—bringing power and networking over a single cable.

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 Channels

The first product in the *groov* RIO family is the GRV-R7-MM1001-10, a 10-channel, multi-signal, multifunction edge I/O unit with thousands of unique field I/O combinations. (How is this possible? Take a look at

groov RIO as Edge I/O



groov RIO acts as edge I/O to exchange data between OT field devices (at bottom) and IT computers and software (at top).

the wiring diagram on [page 17](#) to see all the available functions 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 supported by the selected channel—such as counting, latching, clamping, and more—and then save your configuration.

Send Data Wherever You Like

Once *groov* RIO is configured, continue to use *groov* Manage to directly send data wherever you need it, without requiring a PLC or middleware.

- Configure and enable **MQTT** on RIO to securely send data—as Sparkplug-B or string payloads—to MQTT brokers on premises or in the cloud.
- 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.
- Develop simple user interfaces (UIs) with Node-RED UI nodes and serve them directly from RIO to any mobile or web-based device.

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 create more users and set their passwords and permissions.

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.

groov RIO in an Opto 22 Control Program

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 a custom control program**—You can access *groov* RIO I/O programmatically through OptoMMP or REST APIs.

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 the RIO unit, even if communication to the controller is lost.

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.

More Ways To Exchange Data

groov RIO supports both OT and IT protocols and tools, making it easier to safely move data among field devices and computer networks. 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.

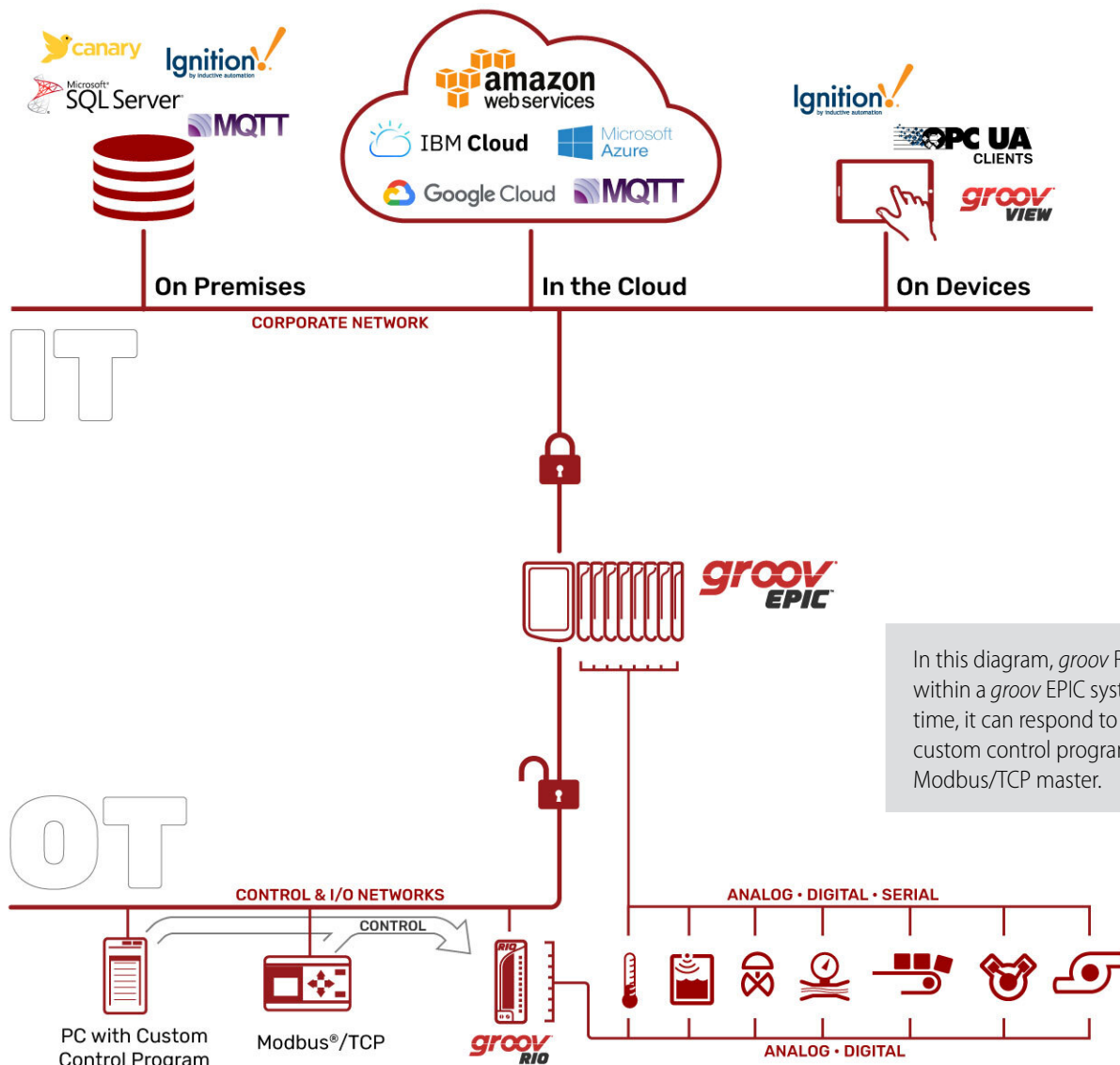
MQTT broker/server—An efficient and robust publish/subscribe protocol, MQTT is an ideal method of exchanging data for industrial internet of things (IIoT) applications. *groov* RIO has support for MQTT built in, requiring only a simple configuration to publish I/O data and subscribe to commands as Sparkplug-B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

Ready to Run, or Need a Little Help? Try the *groov* RIO Explorer

We know the idea of contemplating thousands of unique field I/O combinations is a bit much, 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](#).

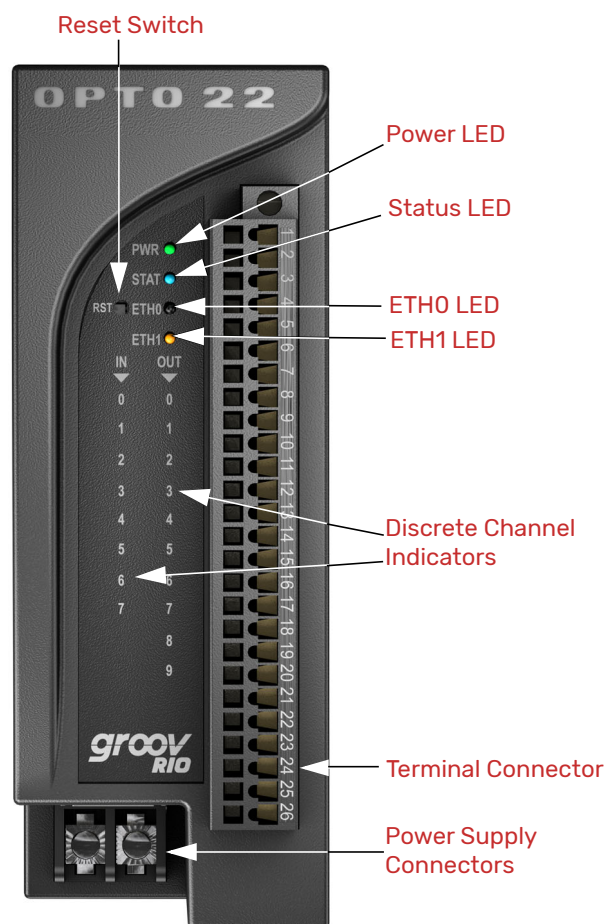
With this web app, you can select which function you want on each channel, and then the app displays the corresponding wiring diagram. You can print out the wiring diagram or save it as an image for reference.

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).



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 terminal connector for GRV-R7-MM1001-10 is gray in color to 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 the GRV-R7-MM1001-10 to accurately read thermocouple inputs.

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.

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:

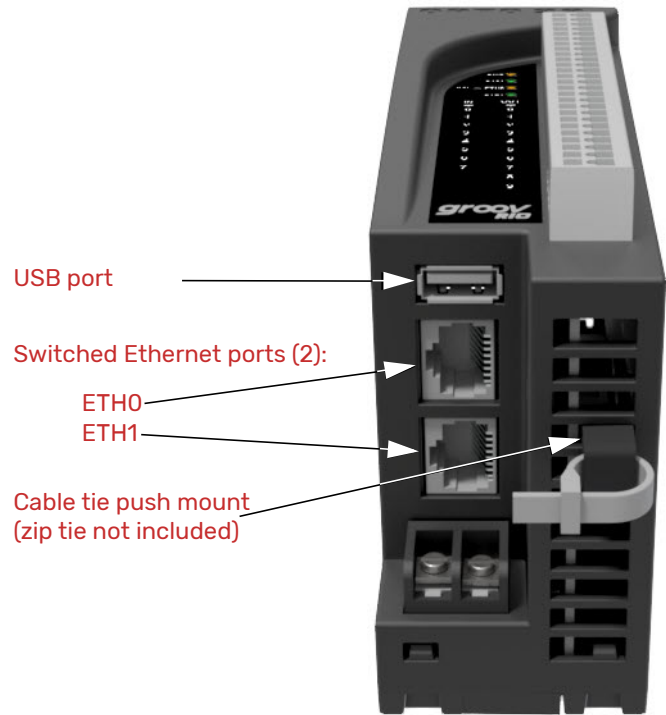
- WiFi adapter to add wireless connectivity.
- USB-to-serial adapter to read and write data to serial devices.
- USB memory stick to expand the storage space; for example, to increase data logging capacity.

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							
	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
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
Over-range Limit	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	
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
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
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 μ A 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
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
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	1 GB RAM, 4.0 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 GRV-R7 Firmware Version	N/A
Minimum GRV-EPIC-PR1 Firmware Version	2.0.0 (3.0.0 for Thermistors)
Minimum PAC Project Version	10.3000 (10.3003 for Thermistors)
Minimum Library Package for CODESYS Version	2.0.0.0 (2.0.1.0 for Thermistors)
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
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

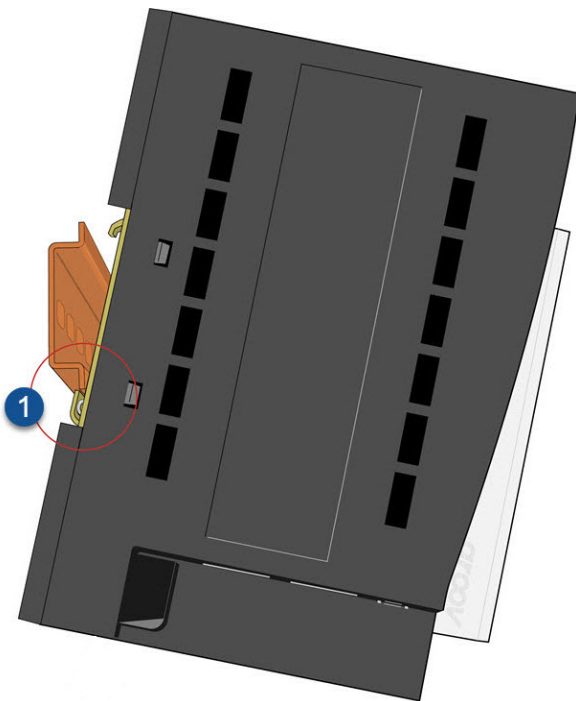
Before mounting your RIO:

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

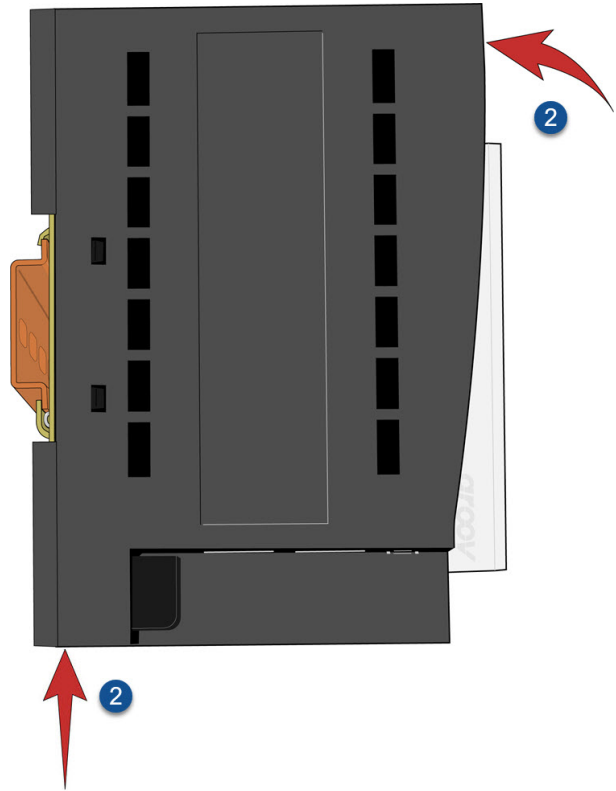
The *groov* RIO is built with DIN rail adapters for use on 35 mm DIN rail. No additional assembly is required.

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.

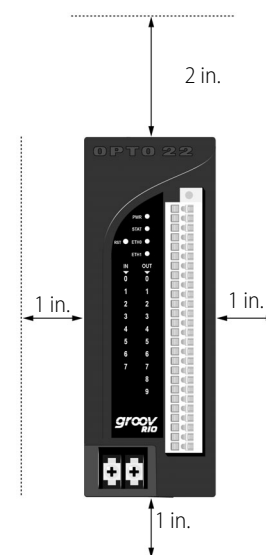


2. Push the bottom part of RIO upward, making sure that you feel the clip catch on to the rail, and simultaneously push the top half of RIO toward the DIN rail until the top of the DIN rail adapter engages the top lip of the DIN rail.



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

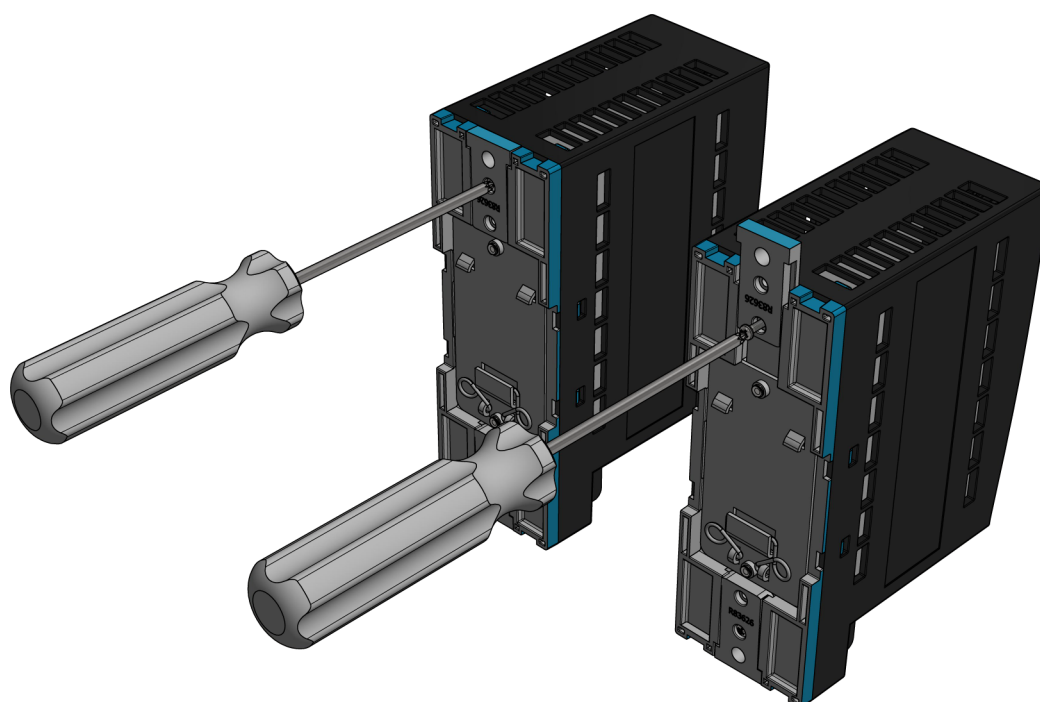
Before mounting your RIO:

- Ensure that the vents around RIO are not obstructed.
 - Review "Mounting on a Panel" to ensure good ventilation and optimal performance.
1. Flip the 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 the RIO.
 4. Reinsert the screw.

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

Attach the 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.

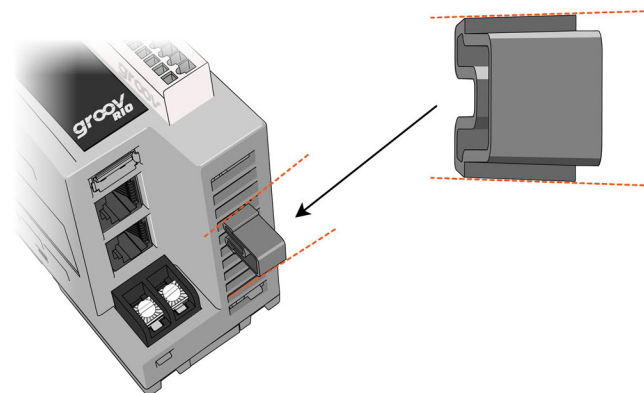


INSERTING A CABLE TIE PUSH MOUNT

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

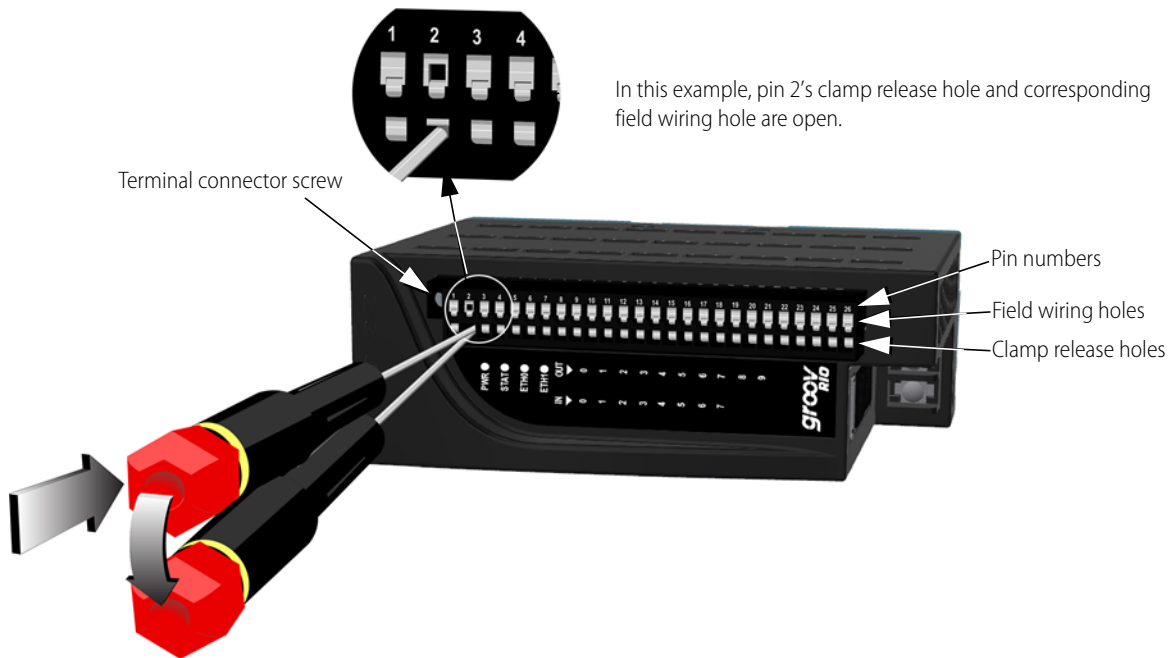
Before you begin wiring, do the following tasks:

- 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.

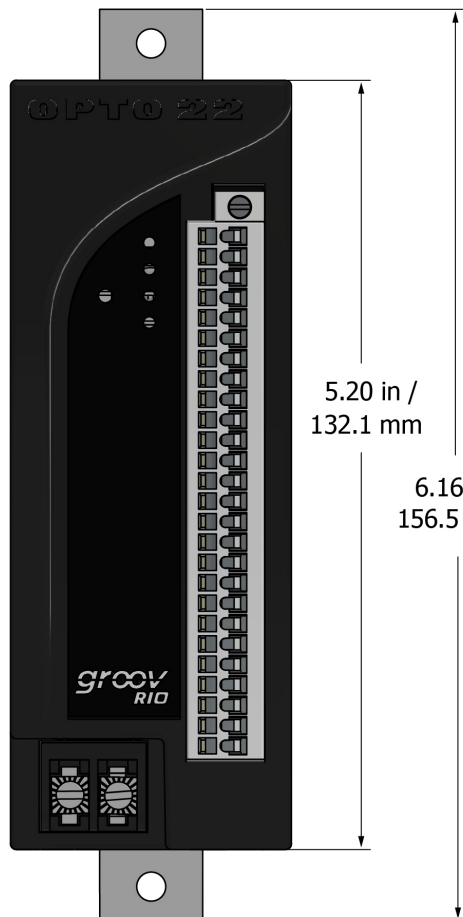
WIRING DIAGRAM

Channel	Internal Pin Wiring	INPUT				OUTPUT			
		Discrete	Discrete Switch Input, Powered	Voltage	Current	2	Discrete	Discrete 1	Analog
								DC Sinking	Current / Voltage
Ch 0	1								
Ch 1	2								
Ch 2	3								
Ch 3	4								
Ch 4	5								
Ch 5	6								
Ch 6	7								
Ch 7	8								
Ch 8	9								
Ch 9	10								
	11								
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	19								
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	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

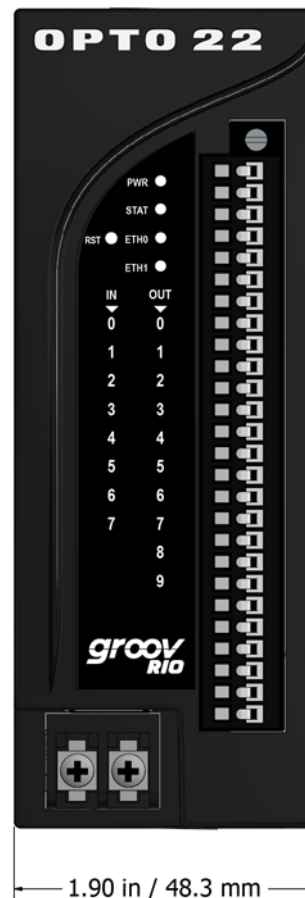
The image on the left shows the height (from the top to the bottom) in two settings:

- 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.

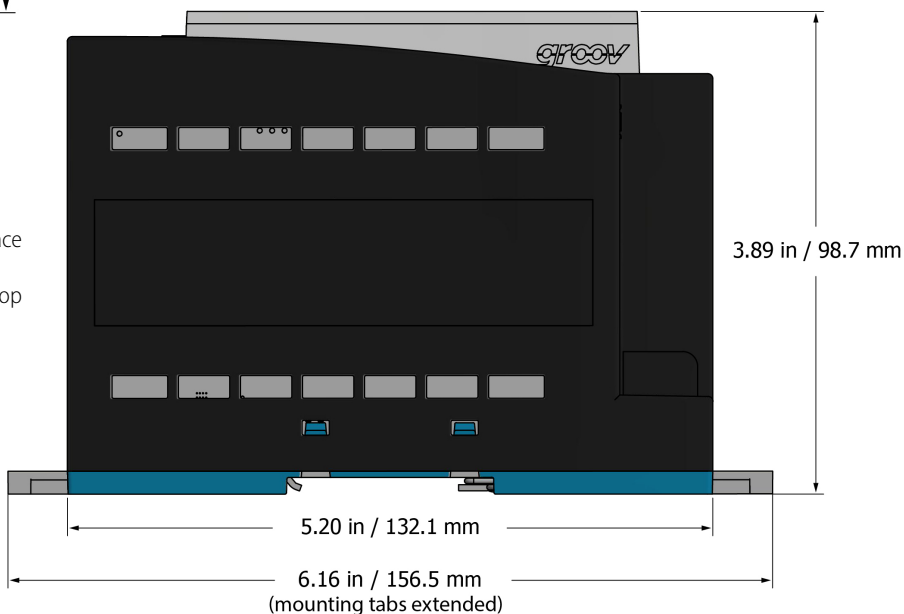
The image on the right shows the width (from one side to the other).



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.