

groov THERMISTOR/RESISTOR INPUT MODULE

Features

- > Select from fixed input ranges or autorange
- > Module cover with LED indicates module status
- > Touch-sensitive pad triggers display of module information on groov EPIC® processor's display
- > Groups of input channels divided into two isolated zones
- > Operating temperature: -20 to 70 °C
- > Guaranteed for life

DESCRIPTION

groov I/O modules are part of the groov EPIC® (Edge Programmable Industrial Controller) system. Wired directly to field devices (sensors and actuators), groov I/O translates the electrical signals from those devices into the digital language computers understand—so you can monitor and control devices and use their data wherever you need it, in your local computer network or in cloud services.

The **GRV-ITR-12** module has 12 channels of analog to digital conversion that convert resistance to temperature or to Ohms. The 12 channels are divided into two groups: channels 0-5 are isolated from channels 6-11.

The module is ideal for NTC thermistors commonly used in HVAC, refrigeration, and process control applications. It may also be used with PTC thermistors in resistance sensing applications.

The module reads variable resistance type transducers. You can configure each channel for one of the following:

- Select from 12 resistance input ranges from 500 Ohms to 400 K Ohms, or autorange (where the module selects the appropriate resistance input range).

- Select one of the four predefined curves (based on the Steinhart-Hart equation) for popular thermistors listed in "" on page 5.

- Create a custom curve (based on the Steinhart-Hart equation), where you specify the custom coefficients. See "Custom Thermistor Temperature Curves" on page 6.

Range dependent resolution is from 20 milliOhms to 16 Ohms.

The **GRV-IRTD-8** analog input module provides 8 input channels, each individually software configurable. The 8 channels are divided into two groups: channels 0-3 are isolated from channels 4-7. This module is commonly used for 3-wire RTD temperature inputs but is also suited to high-resolution resistance measurements.



GRV-ITR-12 module



GRV-IRTD-8 module

You can individually configure each of the module's 8 channels for a fixed range in ohms or choose from two methods of auto-ranging:

Full Auto-range—The module scrolls up and down the entire set of ranges and dynamically chooses the appropriate range for best resolution. Note that this channel type can result in higher latency when ranging up (see "Specifications: GRV-IRTD-8" on page 3). The data returned is resistance in ohms.

Auto-range Down—The module scrolls down and up within the specified range limit. If the value goes above the specified range, the module issues an out-of-range value (16-bit). These channel types allow auto-ranging within the selected range but limit the data latency when ranging up. The data returned is resistance in ohms.

The GRV-IRTD-8 module does not offer channel-to-channel isolation, so make sure you use isolated RTD probes.

Part Numbers

Part	Description
GRV-IRTD-8	Analog input, temperature (RTD) or resistance, 8 channels
GRV-ITR-12	Analog input, temperature (thermistor) or resistance, 12 channels



Wiring is simplified with a top-mounted connector, which provides spring-clamp terminals for common and field wiring. The connector is held in place by a single, captive retention screw but can be removed with the field wiring intact for wiring in advance or easier module field replacement.

A swinging, two-position cover protects wiring from inadvertent contact, as does the dead-front design. The two positions of the cover offer the option of more space to accommodate larger wire. The module cover provides a touch-sensitive pad; touch the pad and the *groov* EPIC processor displays information about the module, including specifications and a wiring diagram.

The module pivots into place and is held securely in place by a captive retention screw.

groov I/O modules are hot swappable (which means they can be installed or removed without turning off power to the unit) and self-identifying—as soon as you mount the module to the chassis, it communicates to the processor and identifies itself.

Each *groov* I/O module cover provides a large module LED to indicate module health at a glance.

All *groov* power supplies, voltage converters, pass-through power adapters, and processors are UL/cUL listed and compliant with the ATEX, Low Voltage, and EMC CE directives. Each module is factory tested twice before shipment and most modules are guaranteed for life.

FEATURES AND SPECIFICATIONS

Features

Features	GRV-IRTD-8	GRV-ITR-12
Scaling	x	x
Offset and Gain	x	x
Minimum/Maximum Values	x	x
Average Filter Weight	x	x
Simple Moving Average (SMA)	x	x
Analog Totalizing	x	x
Problem indication	x	x



Specifications: GRV-IRTD-8

Specification	GRV-IRTD-8
Input Ranges (Ohms)	8.0 K, 4.0 K, 2.0 K, 1.0 K, 800, 400, 200, 100, 80, 40, 20, 10, and Autoranges
Accuracy (Ohms @ Range)	4.2@8 K, 2.6@4 K, 1.8@2 K, 1.4@1 K, 0.47@800, 0.31@400, 0.23@200, 0.19@100, 0.082@80, 0.066@40, 0.058@20, 0.058@10 Ohms
Excitation RMS Current (Range & Load Watts Dissipated)	>301 μ A (8 K & 363 μ W), (4 K & 182 μ W), (2 K & 91 μ W), (1 K & 46 μ W), >1.84 mA (800 Ohms & 1.355 mW), (400 Ohms & 677 μ W), (200 Ohms & 339 μ W), (100 Ohms & 169 μ W), >3.96 mA (80 Ohms & 627 μ W), (40 Ohms & 313 μ W), (20 Ohms & 156 μ W), (10 Ohms & 78 μ W)
Data Refresh Time	950 ms
Analog Data Filtering	-3 dB @ 23.5 Hz / -18 dB @ 60 Hz
Software Filtering: Simple Moving Average (SMA)	1 to 32 readings
Software Filtering: Weighted Average	1 to 4096
Step Response Time (to 1%)	57 ms
Total Lead Resistance ^a	200 Ohms Max
Problem Indication	out of range
Isolation (field-to-logic)	300 V working, 1500 V transient (1 minute)
Isolation (channel-to-channel)	300 V between channel group 0-3 & group 4-7. None within a group.
Number of Channels	8
Chassis Power Consumption	1.3 W
Minimum GRV-EPIC-PR1 Firmware Version	1.4.2
Minimum PAC Project Version	10.2003
Minimum Library Package for CODESYS Version	1.0.2.0
Wire Size	28–14 AWG
Torque, connector screw	2.5 in-lb (0.28 N-m)
Torque, hold-down screw	3.5 in-lb (0.4 N-m)
Temperature (operating)	-20 °C to +70 °C
Temperature (storage)	-40 °C to +85 °C
Humidity (non-condensing)	5–95% RH
Agency Approvals	UL/cUL(Class 1 Div. 2), CE, ATEX(Category 3, Zone 2), RoHS, DFARS
Warranty	Lifetime

a. The sum of the resistance in both lead wires cannot exceed this value. For example: a 24 AWG wire would need to be longer than 4,000 feet (or 1.2 kilometers), in each lead, to exceed 200 Ohms.



Channel Types

The channels on the GRV-IRTD-8 module can be configured to one of three types of input ranges:

RTD—Converts Ohms to temperature for the chosen RTD type:

- RTD: 1000 Ohm @ 70 °F Ni 3-wire
- RTD: 1000 Ohm @ 0 °C Ni 3-wire
- RTD: 1000 Ohm Pt 3-wire
- RTD: 120 Ohm Ni 3-wire
- RTD: 100 Ohm Ni 3-wire
- RTD: 100 Ohm Pt 3-wire
- RTD: 10 Ohm Cu 3-wire

Autorange—Measures Ohms within the specified limits and automatically chooses the highest resolution possible. Configuration selection is faster with smaller ranges.

Fixed range—Measures Ohms within the specified limits with the same resolution across the entire range. (The resolution is the range divided by 100,000.)

Channel Type	Units	Low Limit	High Limit
RTD: 1000 Ohm @ 70 °F Ni 3-wire	°C	-45	250
RTD: 1000 Ohm @ 0 °C Ni 3-wire	°C	-60	250
RTD: 1000 Ohm Pt 3-wire	°C	-200	850
RTD: 120 Ohm Ni 3-wire	°C	-80	260
RTD: 100 Ohm Ni 3-wire	°C	-60	250
RTD: 100 Ohm Pt 3-wire	°C	-200	850
RTD: 10 Ohm Cu 3-wire	°C	-200	260
0-8k Ohms (autorange)	Ohms	0	8000
0-4k Ohms (autorange)	Ohms	0	4000
0-2k Ohms (autorange)	Ohms	0	2000
0-1k Ohms (autorange)	Ohms	0	1000
0-800 Ohms (autorange)	Ohms	0	800
0-400 Ohms (autorange)	Ohms	0	400
0-200 Ohms (autorange)	Ohms	0	200
0-100 Ohms (autorange)	Ohms	0	100
0-80 Ohms (autorange)	Ohms	0	80
0-40 Ohms (autorange)	Ohms	0	40
0-20 Ohms (autorange)	Ohms	0	20
0-8k Ohms	Ohms	0	8000
0-4k Ohms	Ohms	0	4000
0-2k Ohms	Ohms	0	2000
0-1k Ohms	Ohms	0	1000
0-800 Ohms	Ohms	0	800
0-400 Ohms	Ohms	0	400
0-200 Ohms	Ohms	0	200
0-100 Ohms	Ohms	0	100
0-80 Ohms	Ohms	0	80
0-40 Ohms	Ohms	0	40
0-20 Ohms	Ohms	0	20
0-10 Ohms	Ohms	0	10



Specifications: GRV-ITR-12

Specification	GRV-ITR-12
Input Ranges (Ohms)	400 K, 200 K, 100 K, 50 K, 40 K, 20 K, 10 K, 5 K, 4 K, 2 K, 1 K, 500 Ohms, and Autorange
Accuracy (Ohms @ Range)	400@400 K, 200@200 K, 100@100 K, 50@50 K, 40@40 K, 20@20 K, 10@10 K, 5@5 K, 4@4 K, 2@2 K, 1@1 K, 0.5@500 Ohms
Excitation Current (Range & Load Watts Dissipated)	>7.9 μ A (400 K & 25 μ W), (200 K & 12.4 μ W), (100 K & 6.2 μ W), (50 K & 3.1 μ W), >84.7 μ A (40 K & 287 μ W), (20 K & 144 μ W), (10 K & 72 μ W), (5 K & 36 μ W), >169.2 μ A (4 K & 115 μ W), (2 K & 57 μ W), (1 K & 29 μ W), (500 & 14 μ W)
Data Refresh Rate	950 ms
Analog Data Filtering	-3 dB @ 2.4 Hz / -25 dB @ 60 Hz
Software Data Filtering:	
Simple Moving Average (SMA)	SMA (1 to 32 readings)
Weighted Average	Weighted Average (1 to 4096)
Step Response Time (to 1%)	85 ms
Problem Indication	out of range
Isolation (field-to-logic)	300 V working, 1500 V transient (1 minute)
Isolation (channel-to-channel)	300 V between channel group 0-5 & channel group 6-11. None within a group.
Number of Channels	12
Chassis Power Consumption	1.3 W
Minimum GRV-EPIC-PR1 Firmware Version	1.3.0
Minimum PAC Project Version	10.2000
Minimum Library Package for CODESYS Version	1.0.0.0
Wire Size	28–14 AWG
Torque, connector screw	2.5 in-lb (0.28 N-m)
Torque, hold-down screw	3.5 in-lb (0.4 N-m)
Temperature (operating)	-20 °C to +70 °C
Temperature (storage)	-40 °C to +85 °C
Humidity (non-condensing)	5-95% RH
Agency Approvals	UL/cUL(Class 1 Div. 2), CE, ATEX(Category 3, Zone 2), RoHS, DFARS
Warranty	Lifetime



You can configure the channels on the GRV-ITR-12 module to read resistance input from any of the ranges listed in the specification table, or to read temperature input according to predefined or custom curves.

Predefined Thermistor Temperature Curves

The table below shows temperatures in °C and °F that correlate with resistance values in Ohms for the generic curve types of four popular thermistors using the [Steinhart-Hart equation](#). When you configure a channel, you can select Thermistor and the corresponding curve as the channel type.

Custom Thermistor Temperature Curves

To create a custom curve, you can enter custom coefficients through any of the following:

- **PAC Control**—When you add an analog channel on a GRV-ITR-12 module, select the custom curve channel type and enter three coefficient values for the Steinhart-Hart equation. For more instructions, see [PAC Control User's Guide, form 1700](#).

CODESYS Development System—When you are configuring channel features and parameters on an analog channel, select the custom curve channel type and enter three coefficient values for the Steinhart-Hart equation. For more instructions, see [groov EPIC User's Guide, form 2267](#).

groov Manage—Navigate through *groov Manage* to the configuration page of the channel, select the custom curve as the channel type and enter three coefficient values for the Steinhart-Hart equation. For more instructions, see [groov EPIC User's Guide, form 2267](#).

Working with 2-Wire Thermistors

Typically, 3-wire thermistors are used. When using 2-wire thermistors, it's important to make sure that the thermistor resistance in the temperature range used in the application is significantly higher than the resistance of the thermistor lead wires.

Also keep in mind that lower value curves (2252 or 3K) work best at cooler temperatures (less than 25 °C or 77 °F) because long lead wire resistance can add significant errors to the measurement.

Temp °C	Temp °F	2252 curve	3K curve	10K type 3 curve	10K type 2 curve
		Resistance (Ohms)			
-40	-40	75,769.0	100,935.0	239,686.0	336,450.0
-35	-31	54,647.0	72,798.0	179,200.0	242,660.0
-30	-22	39,851.0	53,088.0	135,185.0	176,960.0
-25	-13	29,368.0	39,123.0	102,861.0	130,410.0
-20	-4	21,861.0	29,122.0	78,913.0	97,072.0
-15	5	16,429.0	21,885.0	61,020.0	72,951.0
-10	14	12,459.0	16,598.0	47,543.0	55,326.0
-5	23	9,532.0	12,698.0	37,313.0	42,326.0
0	32	7,353.0	9,795.0	29,490.0	32,650.0
5	41	5,718.0	7,617.0	23,457.0	25,391.0
10	50	4,481.0	5,970.0	18,780.0	19,899.0
15	59	3,538.0	4,713.0	15,130.0	15,711.0
20	68	2,813.0	3,748.0	12,263.0	12,492.0
25	77	2,252.0	3,000.0	10,000.0	10,000.0
30	86	1,814.0	2,417.0	8,194.0	8,057.0
35	95	1,471.0	1,959.0	6,752.0	6,531.0
40	104	1,200.0	1,598.0	5,592.0	5,326.0
45	113	983.8	1,311.0	4,655.0	4,368.0
50	122	811.2	1,081.0	3,893.0	3,602.0
55	131	672.5	895.8	3,271.0	2,986.0
60	140	560.3	746.3	2,760.0	2,488.0



Temp °C	Temp °F	2252 curve	3K curve	10K type 3 curve	10K type 2 curve
		Resistance (Ohms)			
65	149	469.0	624.8	2,339.0	2,083.0
70	158	394.5	525.5	1,990.0	1,752.0
75	167	333.1	443.8	1,700.0	1,479.0
80	176	282.7	376.6	1,458.0	1,255.0
85	185	240.9	320.9	1,255.0	1,070.0
90	194	206.2	274.6	1,084.0	915.4
95	203	177.1	236.0	939.3	786.6
100	212	152.8	203.6	816.8	678.6
105	221	132.3	176.3	712.6	587.6
110	230	115.0	153.2	623.6	510.6
115	239	100.3	133.6	547.3	445.2
120	248	87.7	116.9	481.8	389.6
125	257	77.0	102.6	425.3	341.9
130	266	67.8	90.3	376.4	301.0
135	275	59.9	79.7	334.0	265.8
140	284	53.0	70.6	297.2	235.4
145	293	47.1	62.7	265.1	209.0
150	302	41.9	55.8	237.0	186.1

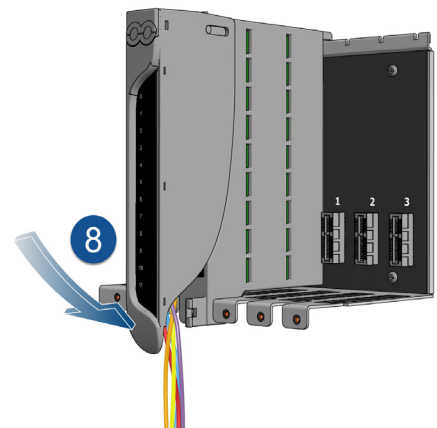
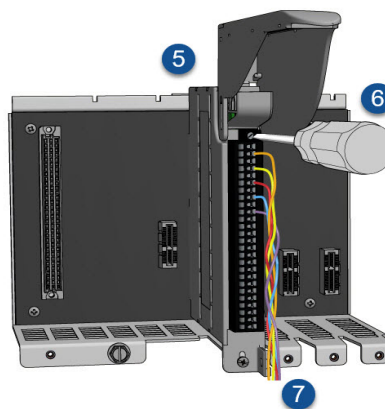
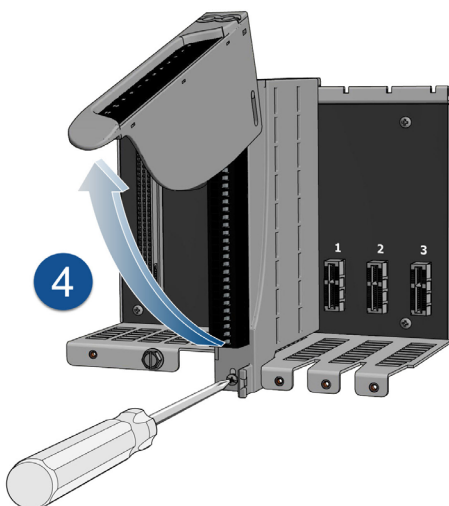
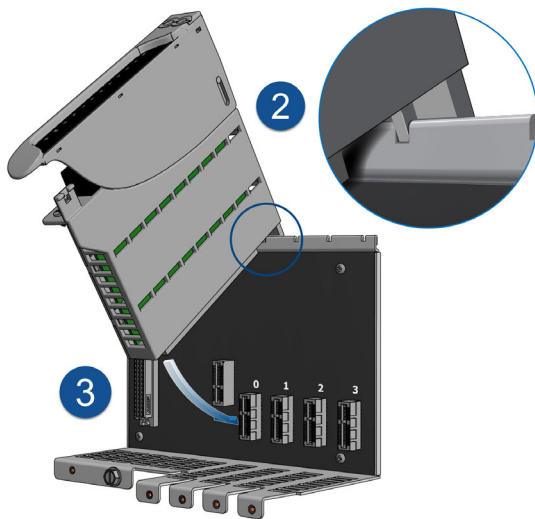
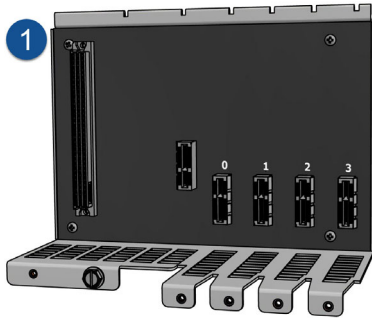
The information in this table is provided by Automation Components, Inc.



MOUNTING

Mount *groov* I/O modules onto a *groov* EPIC chassis. See [groov EPIC Chassis Data Sheet](#) (form 2247). You may also want to review the diagrams in the Description of Module Parts section so you learn the names of the various parts of the module.

Installing the module



The numbers on the diagrams correspond to the numbered steps in these instructions.

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

1. Orient the *groov* EPIC chassis so that the module connector numbers are right-side up, with module connector zero on the left, as shown in the diagram.
2. Hold the module at a 45° angle, lining up the alignment tab on the back tip of the module with the slot at the back of the chassis.
3. Pivot the front of the module down to the module connector on the chassis. Push to snap the module into the connector.
4. Swing the module cover up so you can access the module retention screw. Secure the module into position by tightening the module retention screw.

CAUTION: Do not over-tighten. See the torque specs in the Specifications table.

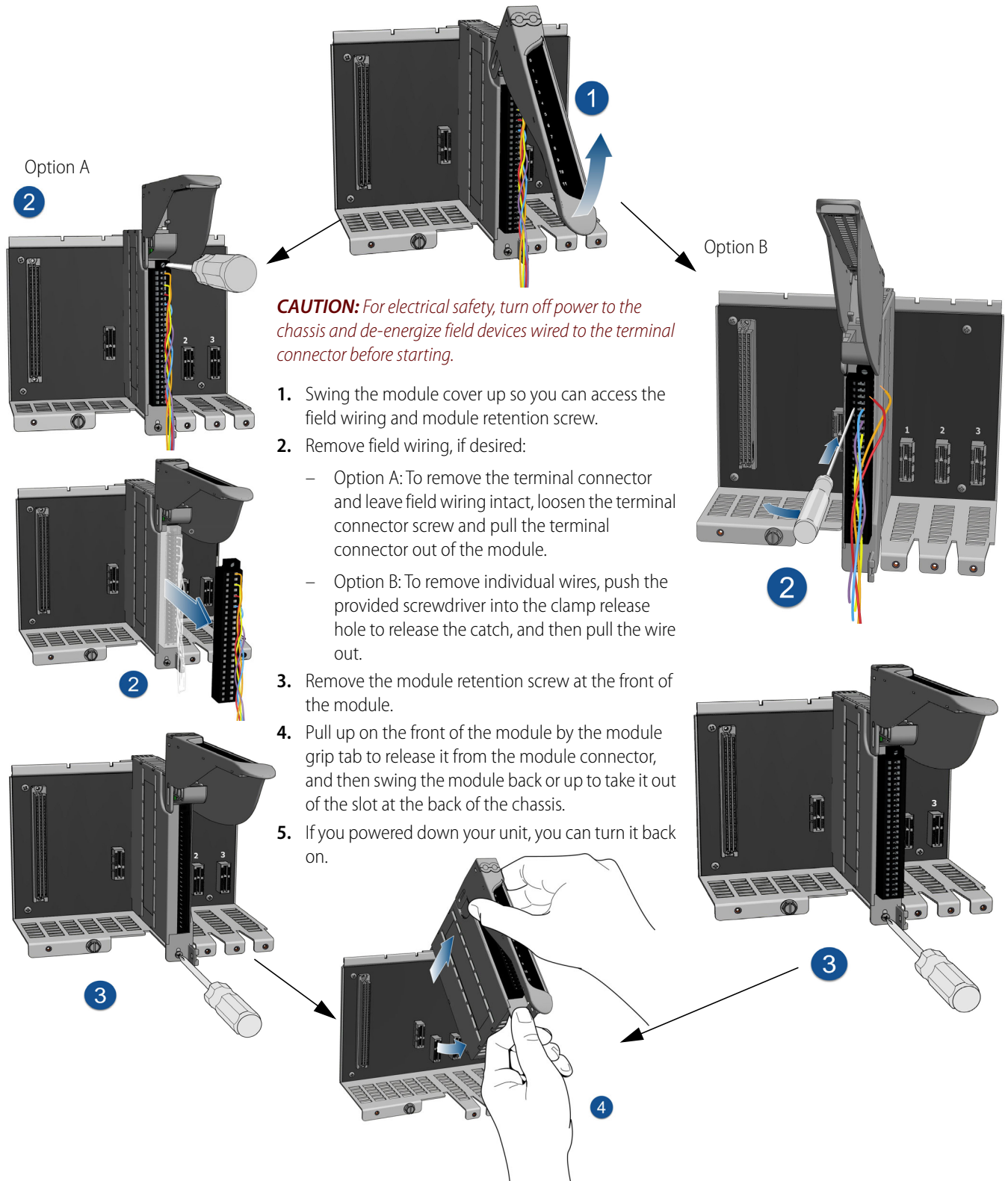
5. If the module does not have a terminal connector, install one.
6. Secure the terminal connector by tightening the terminal connector screw.

CAUTION: Do not over-tighten. See the torque specs in the Specifications table.

7. Follow the wiring instructions in the Pinout and Wiring section to wire your field devices to the channels on the terminal connector.
8. When wiring is complete, swing the module cover back down to cover the wires. If the wires are too thick to close the module cover easily, lift the module cover, then raise the back of the module cover up to the higher position. Swing the module cover back down to cover the wires.

When you are done installing modules and wiring, if you powered down your unit, you can turn it back on.

Removing the module



PINOUTS AND WIRING

Before you begin wiring, do the following tasks:

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

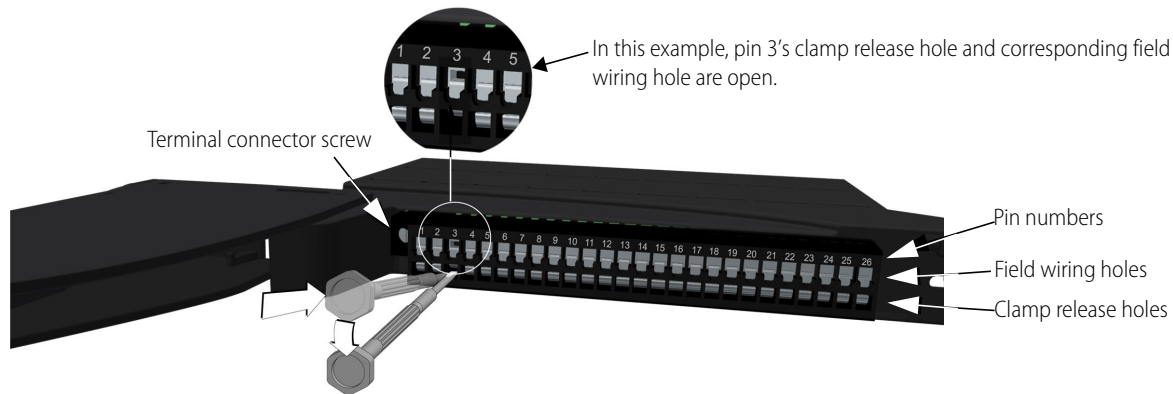
Select the appropriate wire. The terminal connectors are rated for 28–14 AWG wire. If you're using stranded wire, you can make an easier and better connection by tinning the strands or adding ferrules.

Ensure that you have the screwdriver supplied with your module. If you are unfamiliar with the names of some of the parts of the module, review the diagrams on this page and in the Description of Module Parts section.

It may be easier to insert wires if you remove the terminal connector from the module. To remove the terminal connector, loosen the terminal connector screw at one end of the connector, then pull the connector straight out to remove it from the module.

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 screwdriver. 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.



Follow these instructions to connect your field wires to the module:

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

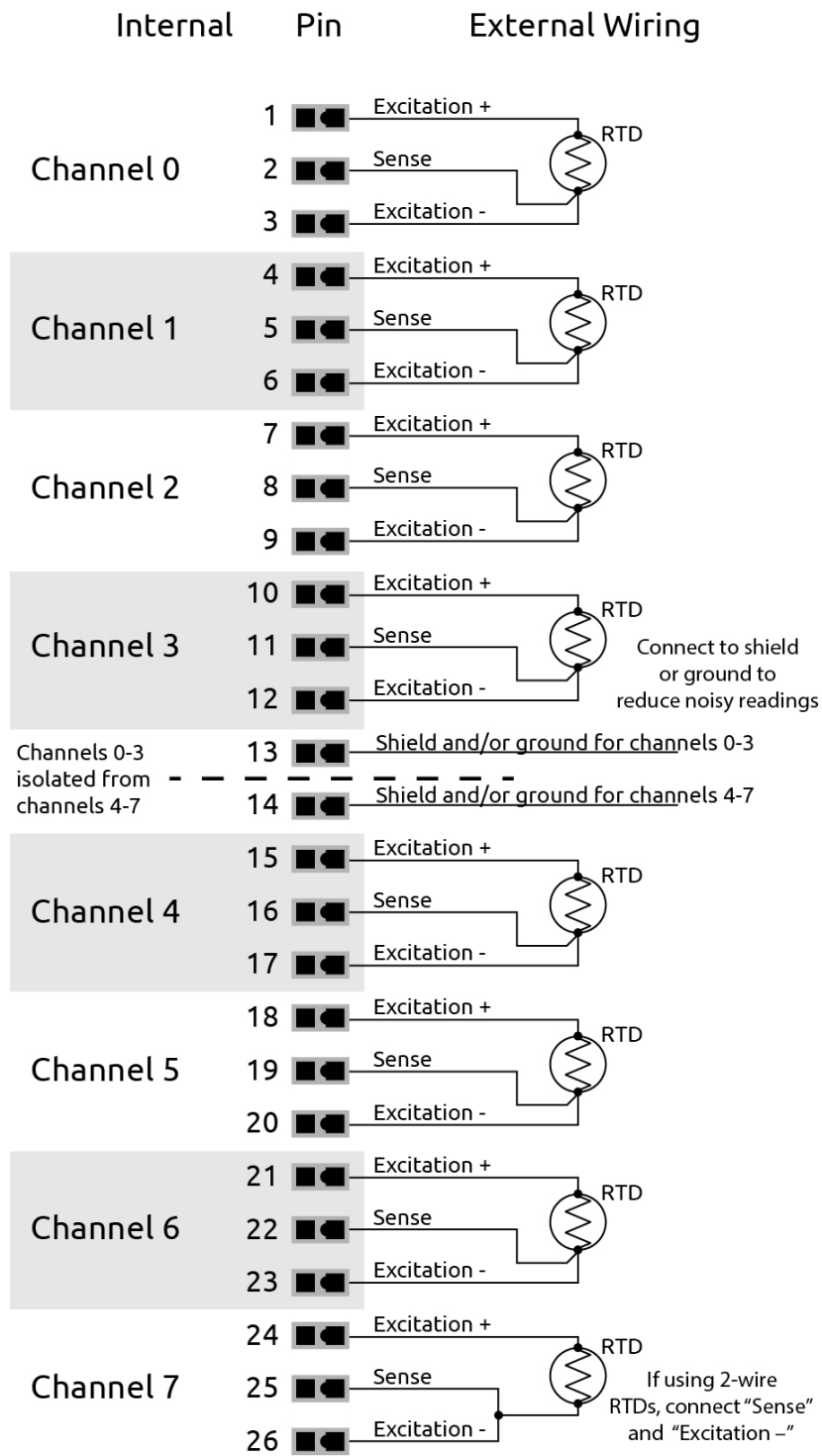
1. Orient the module or terminal connector to match the wiring diagrams on the following page. To make it easier to handle the screwdriver and the field wires, secure the module by doing one of the following:
 - If you are working with the terminal connector while it is attached to the module, make sure the module is screwed securely to the chassis.
 - If you are working only with the terminal connector, secure the terminal connector with a clamp.
2. Hold the screwdriver so that you can place the flat side of the blade against the left side of the clamp release hole.
3. Slide the screwdriver into the clamp release hole, along the left side, until you feel the blade begin to meet some resistance. Gently push the screwdriver in a little more, until you feel the screwdriver stop.

Note: If you push in too hard, the screwdriver might pop out of the clamp release hole and you'll have to return to step 2.

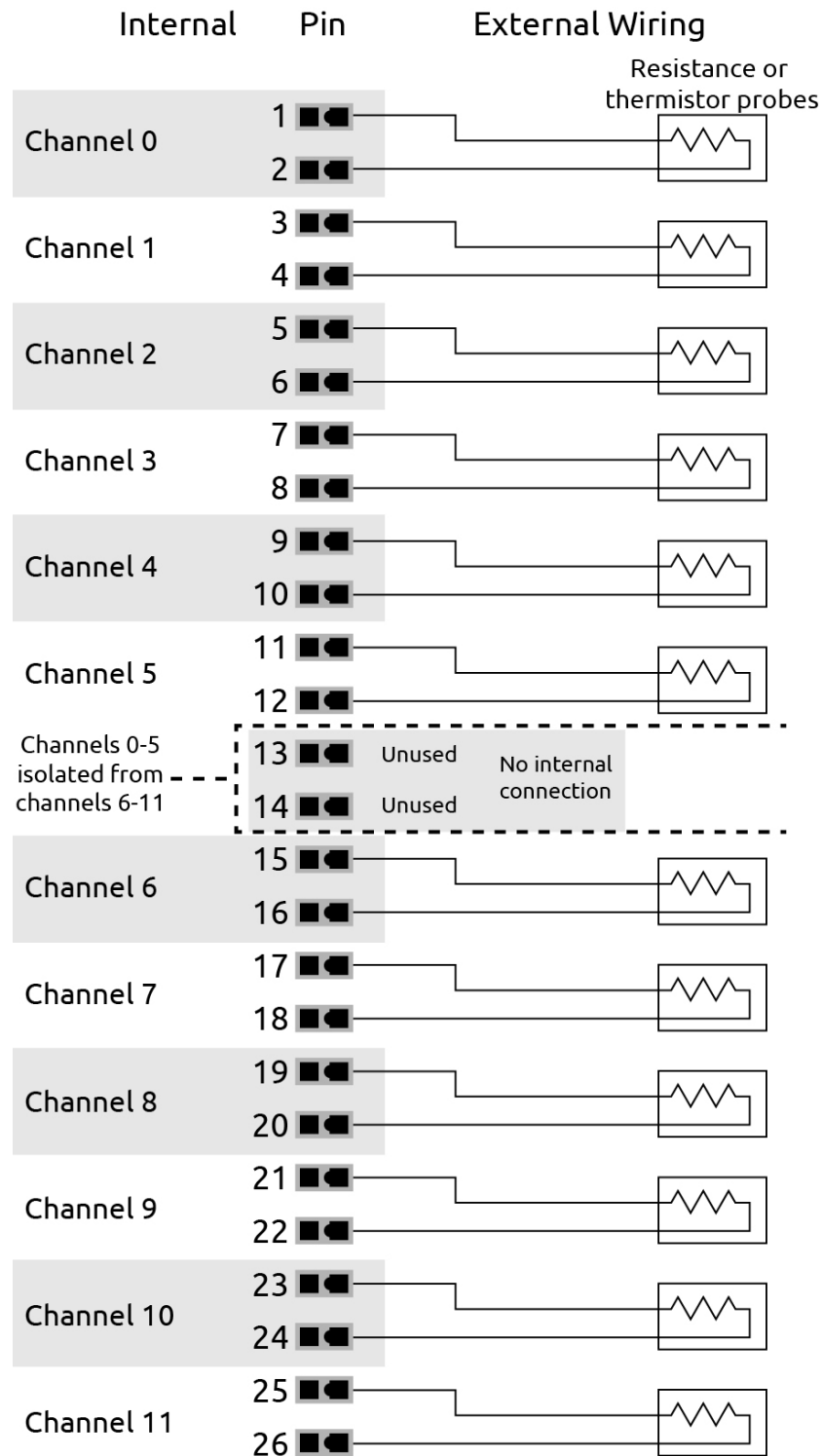
- Look into the field wiring hole. If it is dark, the clamp is open. You can go to the next step.
 - If you can still see the highly reflective surface, gently pull the screwdriver handle to the left until you feel the blade stop. Hold the screwdriver in that position. Look into the field wiring hole. If it is dark, the clamp is open. You can go to the next step.
4. Insert the wire into the field wiring hole until it meets complete resistance. Then pull out the screwdriver.
 5. 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 screwdriver into the clamp release hole as described in steps 2 and 3 above, and then pull the wire out.

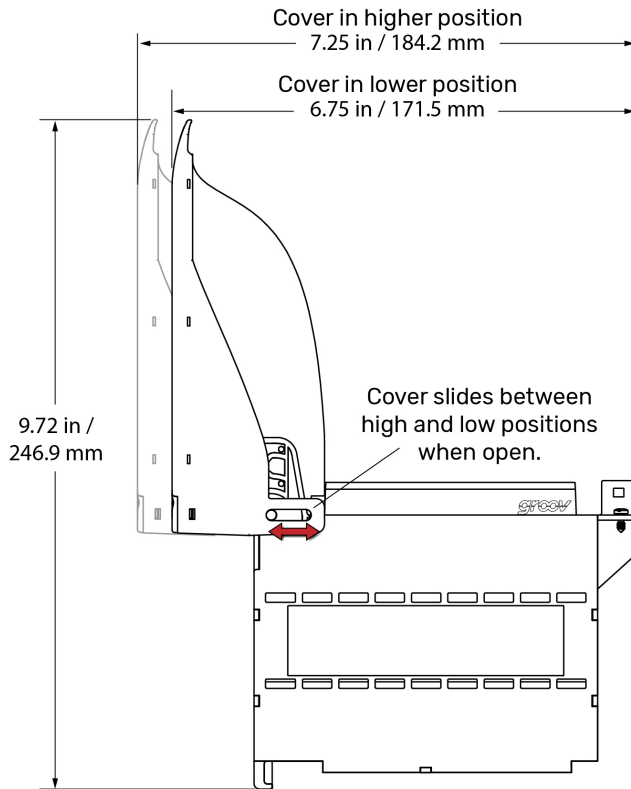
WIRING: GRV-IRTD-8



WIRING: GRV-ITR-12



DIMENSIONS: GRV-IRTD-8, GRV-ITR-12



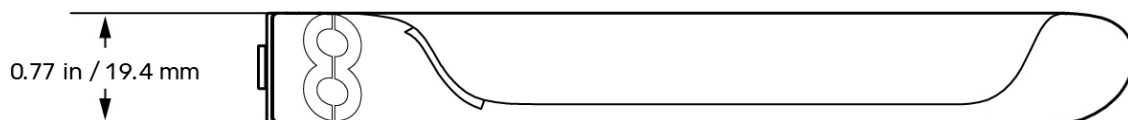
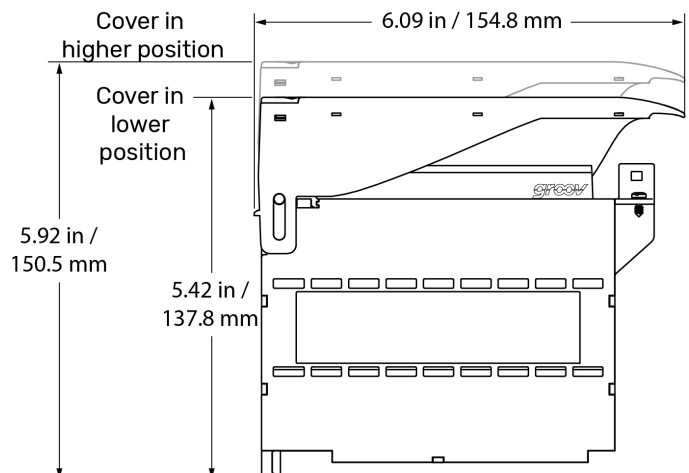
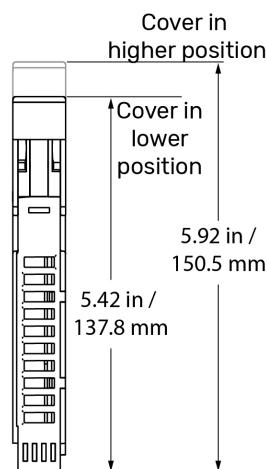
The module cover pivots and can be adjusted to two different heights (positions). The higher position provides more space to accommodate thicker wires.

To switch between higher and lower position, open the cover to at least a 45° angle. Grasp the hinged end of the module cover and do one of the following:

- Pull up on the back hinge to slide it to the higher position.

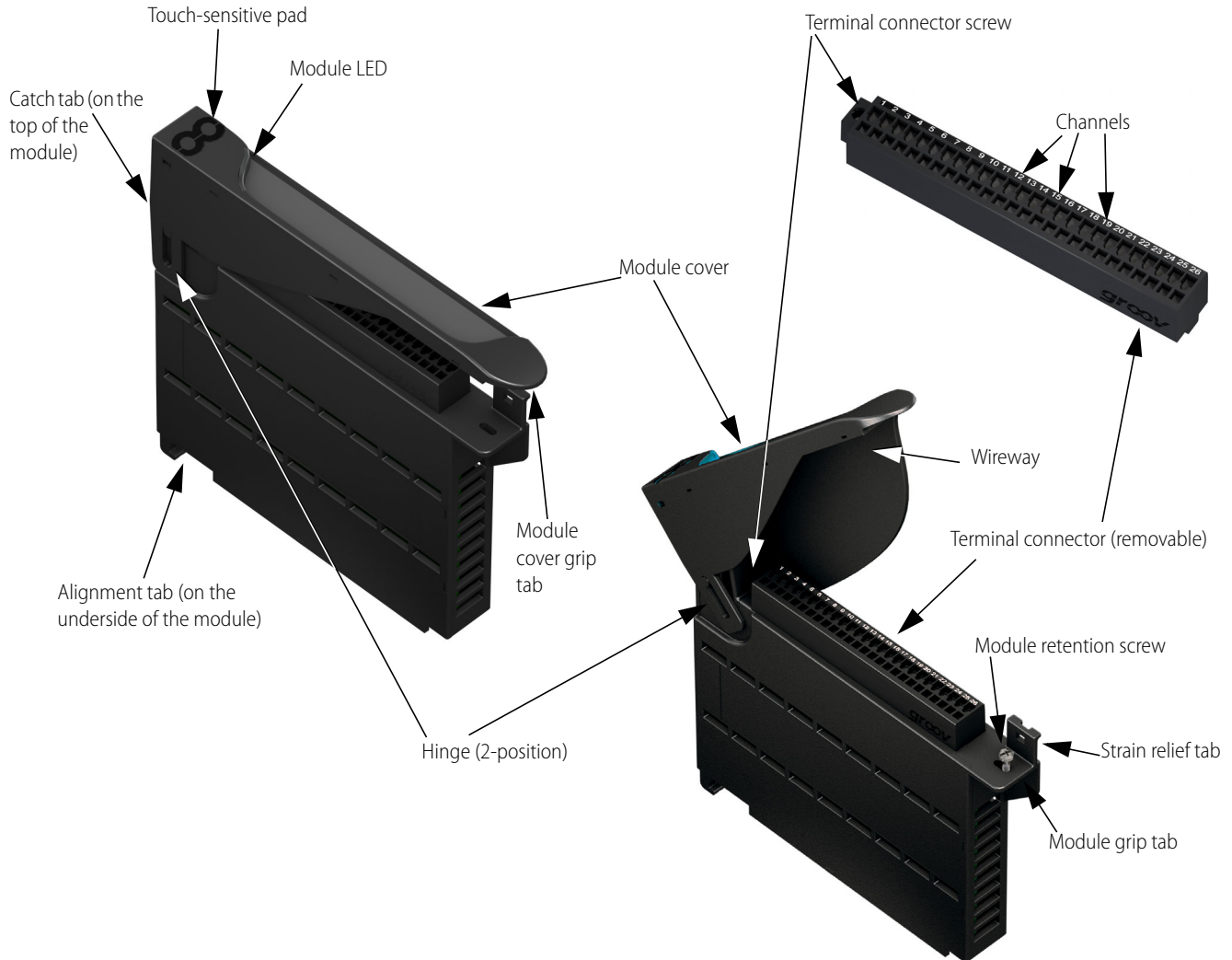
- Push down on the back hinge to slide it to the lower position.

You cannot switch between the higher and lower positions while the cover is closed.



DESCRIPTION OF MODULE PARTS

The following diagram identifies the parts of the modules. The installation instructions in the documentation rely on these terms to describe how to handle the module.



Some parts offer unique features:

Module LED: Provides a visual indication of the health of the module. For example, if it is blue, the module is operating normally. If it is blinking blue, the module's information is being displayed on the *groov* EPIC processor's screen. For a complete list of the various colors that this LED might display, see the [groov EPIC User's Guide](#) (form 2267).

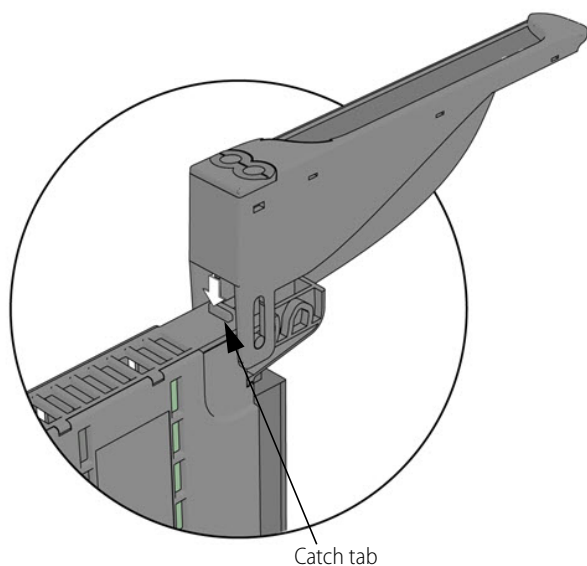
Terminal connector: Specially designed for *groov* I/O modules, it provides a spring-clamp wiring system to securely connect the wires from your field devices to the module. To learn how to use a spring-clamp wiring system, see the Pinouts and Wiring section.

Hinge and Wireway: These two features work together to provide more space for wires. The hinge can be adjusted between a lower position and a higher position. The wireway is the space underneath the module cover. To increase this space, you can raise the hinge to the higher position.

Touch-sensitive pad: Offers a convenient way to display the module's information on the *groov* EPIC processor. Press on the pad for approximately two seconds and the processor displays that module's information on the screen, as well as changing the module LED to a blinking blue light.

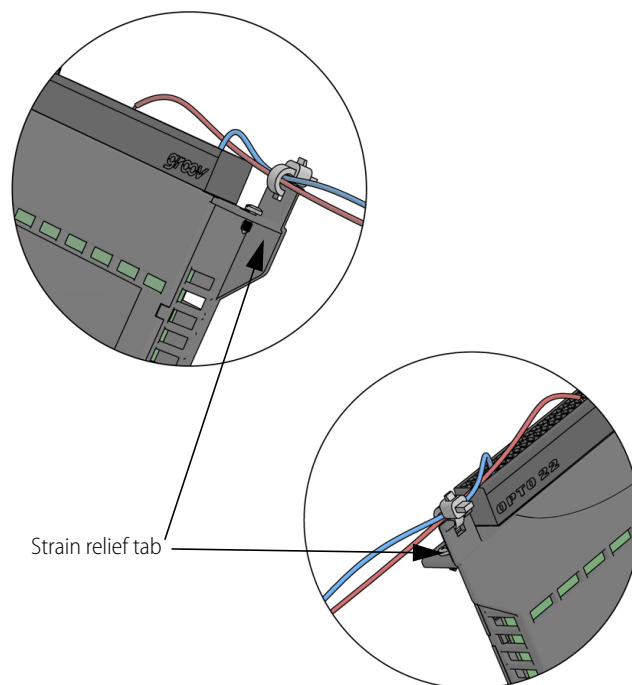


Catch tab: Located at the top of the module, the catch tab provides a place for the cover to “catch” or stop. This prevents the cover from closing so that you can work on attaching or detaching wires to the terminal connector.



Strain relief tab: This tab offers a way to collect wires into a bundle and secure them to the module. Attaching the wires to the strain relief tab can help hold the wires in a semi-fixed position, preventing them from interfering while you work on a nearby module. It also prevents strain on the part of the wire attached to the terminal connector.

Collect the wires into a bundle, pull a zip tie through the hole in the tab, wrap the zip tie around the bundle and tab, then clip the excess zip tie.



PRODUCTS

Opto 22 develops and manufactures reliable, easy-to-use, open standards-based hardware and software products.

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groov EPIC® System

Opto 22's *groov* Edge Programmable Industrial Controller (EPIC) system is the culmination of over 40 years of experience in designing products for the automation industry.

groov EPIC gives you an industrially hardened system with guaranteed-for-life I/O, a flexible Linux®-based processor with gateway functions, and software that meets the needs of your automation and IIoT applications.

groov EPIC I/O

I/O provides the local connection to sensors and equipment. *groov* I/O offers up to 24 channels on each I/O module, with a spring-clamp terminal strip, integrated wireway, swing-away cover, and LEDs indicating module health and digital channel status.

groov I/O is hot swappable, UL Hazardous Locations approved, and ATEX compliant. Opto 22 I/O is so reliable, we guarantee it for life.

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, online services, and more, 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 controller:

- PAC Control engine to run PAC Control strategies and PAC Display projects
- 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/Sparkplug communications for efficient IIoT data transfer

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.

