Form 2267

groov EPIC USER'S GUIDE

groov EPIC
USER'S GUIDE

for
GRV-EPIC-PR1

Form 2267-200618—June 2020

OPTO 22
The Future of Automation.

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groov EPIC User's Guide

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The information in this manual has been checked carefully and is believed to be accurate; however, Opto 22 assumes no responsibility for possible inaccuracies or omissions. Specifications are subject to change without notice.

Opto 22 warrants all of its products to be free from defects in material or workmanship for 30 months from the manufacturing date code. This warranty is limited to the original cost of the unit only and does not cover installation, labor, or any other contingent costs. Opto 22 I/O modules and solid-state relays with date codes of 1/96 or newer are guaranteed for life. This lifetime warranty excludes reed relay modules, *groov* and SNAP serial communication modules, SNAP PID modules, and modules that contain mechanical contacts or switches. Opto 22 does not warrant any product, components, or parts not manufactured by Opto 22; for these items, the warranty from the original manufacturer applies. Refer to Opto 22 form 1042 for complete warranty information.

Opto 22
Automation Made Simple.

The equipment covered by this report is considered to be a component intended to be professionally configured/installed into another manufacturer's end-product equipment. Also the equipment is intended to be mounted in an #IP54 enclosure according to the manual. No cleaning instruction is provided in manual. Therefore, testing and evaluation for the requirements of these clauses is not considered necessary.

IMPORTANT INSTALLATION INSTRUCTIONS

Power, input, and output wiring must be in accordance with Class I, Division 2 wiring methods, Article 501-4 (b) of the National Electrical Code, NFPA 70 for installation in the U.S., or as specified in Section 18-1J2 of the Canadian Electrical Code for installations in Canada, and in accordance with the authority having jurisdiction. The following warning must be heeded:

WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS 1, DIV. 2.

WARNING - EXPLOSION HAZARD - WHEN IN HAZARDOUS LOCATIONS, TURN OFF POWER BEFORE REPLACING OR WIRING MODULES.

WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

THIS DEVICE SHALL BE POWERED BY CLASS 2 OUTPUTS ONLY.

MVI (Multi Vendor Interface) Modules

WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

AVERTISSEMENT - RISQUE D'EXPLOSION - AVANT DE DÉCONNECTER L'ÉQUIPEMENT, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX.

WARNINGS

North America Warnings

Power, input, and output wiring must be in accordance with Class I, Division 2 wiring methods, Article 501-4 (b) of the National Electrical Code, NFPA 70 for installation in the U.S., or as specified in Section 18-1J2 of the Canadian Electrical Code for installation sin Canada, and in accordance with the authority having jurisdiction. The following warnings must be heeded:

A Warning - Explosion Hazard - Substitution of components may impair suitability for Class 1, Div. 2.
E Warning - Explosion Hazard - When in hazardous locations, turn off power before replacing or wiring modules.
F Warning - Explosion Hazard - Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.
Avertissement - Risque d'explosion - Avant de déconnecter l'équipment, couper le courant ou s'assurer que l'emplacement est désigné non dangereux.
G Suitable for use in Class I, Division 2 Groups A, B, C and D Hazardous Locations or Non-Hazardous Locations.

ATEX Warnings and Conditions of Safe Usage

Power, input, and output (I/O) wiring must be in accordance with the authority having jurisdiction.

A Warning - Explosion Hazard - When in hazardous locations, turn off power before replacing or wiring modules.
E Warning - Explosion Hazard - Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.
F These products are intended to be mounted in an IP54 enclosure. The devices shall provide external means to prevent the rated voltage being exceeded by transient disturbances of more than 40%. This device must be used only with ATEX certified backplanes.
G DO NOT OPEN WHEN ENERGIZED.

MARKINGS

Electrical Ratings

- Power Requirements: 7.1 W typical, 9.1 W max.
- Operating Temperature: -20 °C to +70 °C
- Storage Temperature: -40 °C to +85 °C
- Relative Humidity: 5–95%

For the electrical ratings of power supplies, I/O modules, and chassis, see their respective data sheets.

Label Markings

ATEX

II3 G Ex NA IIC T4 Gc
-20 °C ≤ Ta ≤ 70 °C

cULus

Class 1 Division 2, Groups A, B, C, D
T4
-20 °C ≤ Ta ≤ +70 °C

Agency Approvals and Certifications

Agency	Applicable Standard
RoHS	
CE	EMC-EN61326- 1:2006; EN61000-6- 4:2007
Hazardous Locations	ANSI/I.S.A. 12.12.01-2015, Rev. 2015-11-17; CAN/CSA C22.2 No. 213-16, 2nd Ed., Issued 2016-05-11
ATEX	EN60079-15:2003; EN60079-15:2010
cULus	UL61010-1: 2010, 3rd Ed.; UL61010-201, 1st Ed.
DFARS	

Table of Contents

1: Welcome to *groov* EPIC

The *groov* EPIC® system is the next step in the evolution of automation. The system includes:

- An **E**dge **P**rogrammable **I**ndustrial **C**ontroller with an embedded Linux® operating system and gateway functions. We call it the *groov* EPIC processor because it can do controller functions and so much more:
  - **E**dge–Moving more visualization, control, and data acquisition functions to the place where it all happens: at the edge.
  - **P**rogrammable–Offering more ways to support the creation of control programs that fit your needs: flowchart programming through PAC Control, IEC 61131-3 compliant programming through CODESYS®, or custom programming in popular programming languages with access to the Linux operating system through a secure shell.
  - **I**ndustrial–Designed to work in a wide range of environments, meeting UL and ATEX requirements for hazardous locations.
  - **C**ontroller®–You can rely on real-time control and I/O from an automation manufacturer with 45+ years of experience. Opto 22's worldwide reputation for quality was built on solid state relays and I/O, and all our experience is poured into the design of *groov* EPIC.
- *groov*® I/O modules, most guaranteed-for-life and available in discrete, analog, and serial models. All are configurable by the *groov* EPIC processor and have up to 24 channels per module.
- *groov* EPIC power supplies for AC power, DC conversion, and adapters for pass-through connections from a DC power supply you already own.
- *groov* EPIC chassis that holds the processor, I/O modules, and power supply. Available in 4-, 8-, and 16-module models.

SYSTEM REQUIREMENTS

- To build PAC Control strategies with the PAC Project Basic Software Suite that comes with *groov* EPIC, you will need:
  - A computer with a standard or mainstream processor and (at least) the minimum memory required for your version of Microsoft Windows. (Low-end CPUs are not recommended.) Additional memory may be required for some configurations.
  - One of the following operating systems:
    - Microsoft Windows 10 Professional (32-bit or 64-bit)
    - Windows 8.1 Professional (32-bit or 64-bit)
    - Windows 7 Professional (32-bit or 64-bit)
- To build operator interfaces with *groov* View, you'll need:
  - Any computer with a web browser (does not have to be a Windows PC)
  - One or more of the following:
    - A Modbus/TCP device

  - A database, online service, or software program to get data from or put data into a Data Store using the *groov* API
  - A *groov* EPIC processor or SNAP PAC controller (SNAP PAC S-series, R-series, or SoftPAC, with firmware R9.2a or newer), running a PAC Control strategy
  - An Opto 22 SNAP PAC I/O unit
  - A database, cloud application, API, or serial device accessible via a Node-RED node.
  - OPC UA-compatible automation system or equipment. Ignition Edge supplies an internal server and drivers for *groov* EPIC. Additional drivers or an external OPC UA server may be required for your equipment.
- To build control programs with the CODESYS Development System, you'll need:
  - A computer that meets the minimum requirements established by CODESYS. For more information, visit the CODESYS website (www.codesys.com).
  - The Opto 22 Library Package, which contains the information that CODESYS Development System needs to correctly configure and connect to a *groov* EPIC processor. For instructions on downloading and installing this package, see "Adding the Opto 22 Library Package to CODESYS Development System" on page 64.
  - CODESYS Development System, V3.5 SP13 Patch 1 or newer (32-bit version). For instructions, see "Downloading and Installing CODESYS Development System" on page 64.

    If you are using CODESYS PROFINET Controller SL, you will need CODESYS Development System, V3.5 SP15 Patch 10 or newer. You also want to make sure the CODESYS PROFINET device is at version 3.5.15.10 or newer. To check:

    1. Click Tools > Device Repository.
    2. Expand Fieldbusses > Profinet I/O > Profinet I/O Device.
    3. Find CODESYS Profinet Device and check the version.
  - A *groov* EPIC processor (GRV-EPIC-PR1) with minimum firmware version 1.3.0.

    Note: *If you are using CODESYS PROFINET Controller SL, you need version 1.5.0 or newer.*

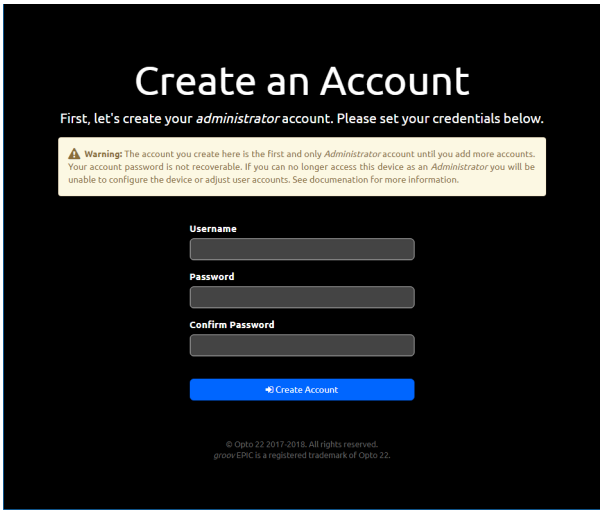
ABOUT THIS GUIDE

This user's guide shows you how to assemble and initialize your *groov* EPIC unit, how to configure the software and I/O modules, how to configure system settings, and much more.

Throughout this guide, you might see two versions of the same page. This is done to show you important differences between viewing a page through the *groov* EPIC processor's touchscreen and viewing the same page through a computer web browser or mobile device.

groov EPIC touchscreen

Computer web browser



What's in This Guide

Chapter 1: Welcome to groov EPIC (this chapter) introduces this user's guide and *groov* EPIC.

Chapter 2: Additional Safety and Operating Instructions describes important safety and operating information.

Chapter 3: Assembling your groov EPIC describes how to assemble the parts of a *groov* EPIC unit (the processor, the power supply, the chassis, and the I/O modules).

Chapter 4: Initializing the groov EPIC Processor describes the configuration steps you might want to do first to get your *groov* EPIC system up and running.

Chapter 5: Navigating Through the groov EPIC Processor describes how to navigate through software on the *groov* EPIC processor touchscreen, some differences between navigating on the touchscreen and navigating through a web browser, and introduces you to some of the important features of some of the screens, like the Modules page.

Chapter 6: Controlling Access to groov EPIC Processor describes the security features available on the *groov* EPIC processor and how you might want to configure these features to control who has access to your unit.

Chapter 7: Connecting groov EPIC to a Network or Multiple Networks describes the options available to connect a *groov* EPIC processor to more complex networking environments.

Chapter 8: Enabling MQTT describes the options available for publishing automation data in a MQTT infrastructure, as well as what to do to set up these options.

Chapter 9: Configuring System Features describes how to modify features (like networking) so they work the way you need them to in your application.

Chapter 10: Configure CODESYS and groov EPIC for IEC61131-3 describes how to enable the CODESYS Runtime Engine so you can build and download applications developed with the CODESYS Development System.

Chapter 11: Working with groov EPIC Devices in CODESYS Projects describes how to add and configure a *groov* EPIC processor to your CODESYS Development System, and how to configure processor parameters and channel features so you can begin programming.

Chapter 12: Downloading and Running PAC Control Programs describes how to download and run PAC Control strategies.

Chapter 13: Downloading and Running Custom Control Programs describes how to access the secure shell feature to develop and download control programs written in other programming languages.

Chapter 14: Developing and Deploying Node-RED flows describes how to get started building and deploying Node-RED flows, including how to add the Opto 22 nodes.

Chapter 15: Monitoring and Configuring Modules and Channels describes the features available on the *groov* EPIC processor to help view the status of your modules and how to configure them.

Chapter 16: Maintaining Your groov EPIC Unit describes the tasks you can do to keep your *groov* EPIC unit running in top shape, like applying maintenance. It also describes how to start an OptoSupport Remote Support Service session.

Chapter 17: Troubleshooting describes what to do when you encounter problems (troubleshooting).

Appendix A: Processor Specifications provides the technical specifications of the *groov* EPIC processor.

Appendix B: Power Supply Specifications provides the technical specifications of the *groov* EPIC power supply, power converter, and power adapter.

Appendix C: Chassis Specifications provides the technical specifications of the *groov* EPIC chassis.

Appendix D: I/O Module Specifications provides the technical specifications of all the *groov* I/O modules.

Appendix E: I/O Module Wiring Diagrams provides the wiring diagrams for all the *groov* I/O modules.

Appendix F: Installing the Correct License describes how to properly install licenses for *groov* EPIC processors that have versions of firmware older than 1.3.0.

Appendix G: Advanced Networking Configurations describes special networking functions that are usually managed by network administrators for specific and rare situations.

2: Additional Safety and Operating Instructions

SAFETY INSTRUCTIONS

Read all the guidelines described in this section before operating or servicing your *groov* EPIC unit:

- CAUTION: There is a possibility of electric shock. Before accessing any terminals connected to modules rated as HAZARDOUS LIVE voltage, disconnect or isolate the *groov* EPIC unit from HAZARDOUS LIVE voltage.
- Use only Opto 22-provided parts or accessories and in a manner instructed in this guide; do not use un-authorized parts or accessories. If un-authorized parts or accessories are used on your *groov* EPIC unit, the protection provided by the *groov* EPIC unit may be impaired.
- Use your *groov* EPIC unit only in a manner in which it complies with all safety and additional instructions described in this guide. If the *groov* EPIC unit is used in a manner not specified by Opto 22, the protection provided by the *groov* EPIC unit may be impaired.
- The normal environmental conditions for a *groov* EPIC unit in regards to temperature and humidity are those conditions that fall within the ranges described in the specifications listed in Appendix A: Processor Specifications, Appendix B: Power Supply Specifications, Appendix C: Chassis Specifications, and Appendix D: I/O Module Specifications.
- The *groov* EPIC unit is to be used indoors or installed in a protective cabinet that provides the conditions described in Appendix A: Processor Specifications, Appendix B: Power Supply Specifications, Appendix C: Chassis Specifications, and Appendix D: I/O Module Specifications.
- The *groov* EPIC unit is rated to withstand transient overvoltages up to the levels of overvoltage category II.
- The *groov* EPIC unit is rated to be installed in environments where non-conductive pollution occurs except where occasionally a temporary conductivity caused by condensation might be expected (Pollution Degree 2).
- The *groov* EPIC unit can operate in altitudes of up to 2000 m.

SAFETY INSTRUCTIONS FOR INSTALLING THE *groov* EPIC UNIT AS PART OF MACHINERY

When you permanently install your *groov* EPIC unit into another machine, you must attach a power disconnect device to your *groov* EPIC unit. The power disconnect device must comply with the following requirements:

- It must be a switch or a circuit breaker that is easy to reach and operate from the outside of the machine.
- It must disconnect all power lines simultaneously.
- It must be clearly labeled as a power disconnecting device for the controller.

EXPLANATION OF LABELS OR SYMBOLS

The following table explains the labels or symbols you might see on the *groov* EPIC power supplies, processor, or modules:

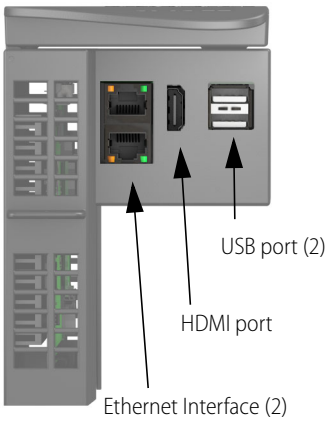
Label or Symbol	Explanation
	CAUTION: Please consult the user's guide for additional safety information and instructions for proper installation, operation, maintenance, and service of this unit.
	CAUTION: Possibility of electric shock.

OPERATING CONTROLS

The following diagrams describe the operating controls available on the *groov* EPIC processor. The bottom view shows the network interfaces and ports. The front view shows the processor's touchscreen. Administrator and operator controls are provided through the touchscreen interface.

- If you log in with a user ID that has administrator level privileges, you can access controls to view and change settings such as network addresses, channel IDs, or to do some tasks, like restarting the device.
- If you log in with a user ID that has operator level privileges, you can access controls that run the machinery, equipment, and processes that are controlled and monitored by the control program running on the *groov* EPIC processor.

(bottom view)



(front view)

SERVICE AND MAINTENANCE

To keep your *groov* EPIC unit up-to-date with the latest software and firmware fixes and features, you'll want to regularly check for and apply maintenance to your unit, as described in "Updating Firmware on a groov EPIC Unit" on page 157.

If you encounter any problems with your *groov* EPIC unit, follow the instructions in "Collecting Information for Product Support" on page 165 to collect information before contacting Opto 22 Product Support.

Service (Product Support)

If you are having problems installing or using *groov* EPIC products and cannot find the help you need in this guide or on our website, contact Opto 22 Product Support.

Phone:	800-TEK-OPTO (800-835-6786 toll-free in the U.S. and Canada) 951-695-3080 Monday through Friday, 7 a.m. to 5 p.m. Pacific Time	*NOTE: Email messages and phone calls to Opto 22 Product Support are grouped together and answered in the order received.*
Fax:	951-695-3017	
Email:	support@opto22.com	
Opto 22 website:	www.opto22.com	

3: Assembling your *groov* EPIC

GATHERING YOUR EQUIPMENT AND INFORMATION

Gathering up all the supplies, information, and equipment you need to help you assemble your *groov* EPIC unit can make assembling your unit easier:

- A work table and good lighting.
- An accessible power source that complies with the requirements described in Appendix B: Power Supply Specifications or in the *groov* EPIC Power Supplies, Converters, and Adapters Data Sheet (form 2246).
- The proper gauge wires to connect the *groov* EPIC power supply to your power source. For guidance on selecting the correct wire gauge, see Appendix B: Power Supply Specifications or the *groov* EPIC Power Supplies, Converters, and Adapters Data Sheet (form 2246).
- The proper gauge wires to connect your field devices to the I/O modules. For guidance on selecting the correct wire gauge, see "Connecting field devices to the groov I/O modules" on page 20 or review the *groov* I/O module data sheets.
- Pen and paper to note important information that you might need during this process or to keep for future reference.
- If you are connecting the processor to a network, an Ethernet cable.
- The *groov* EPIC power supply you selected for your project.
- The *groov* EPIC chassis you selected for your project. Make sure you have the correct size chassis to hold the number of modules you are installing.
- The *groov* I/O modules that you selected for your project.
- The screwdriver that ships with your I/O modules, which helps you connect field device wires to the terminal connector.

In addition, make sure you have a list of all the I/O channels (sometimes referred to as points) that you need set up. This might be in a form of a document that maps which channel of which module will connect to a specific field device/point. If you are working with a terminal strip, review the terminal number assignments, making sure you understand which terminal numbers are assigned to specific modules and channels.

Any additional information you might need will depend on other factors, like any special configurations for your network or whether you need to create additional users that have limited access.

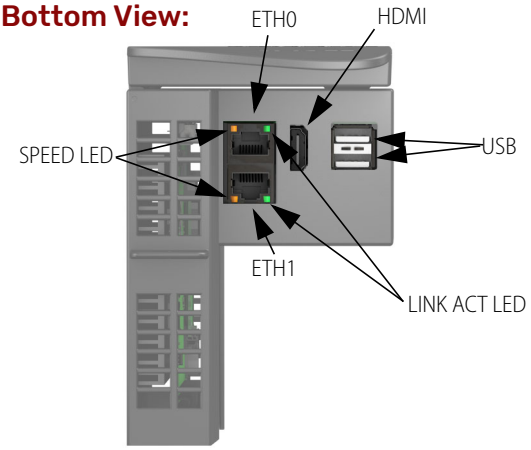
After you assemble your unit, you'll initialize it as described in Chapter 4: Initializing the groov EPIC Processor. After you finish initializing the unit, it will be ready to run.

FAMILIARIZE YOURSELF WITH THE PROCESSOR AND *groov* I/O MODULES

Take a few minutes to review the next couple of pages, which show you the different features of the processor and *groov* I/O modules. The installation instructions in the documentation rely on these terms to explain how to handle a processor and a module.

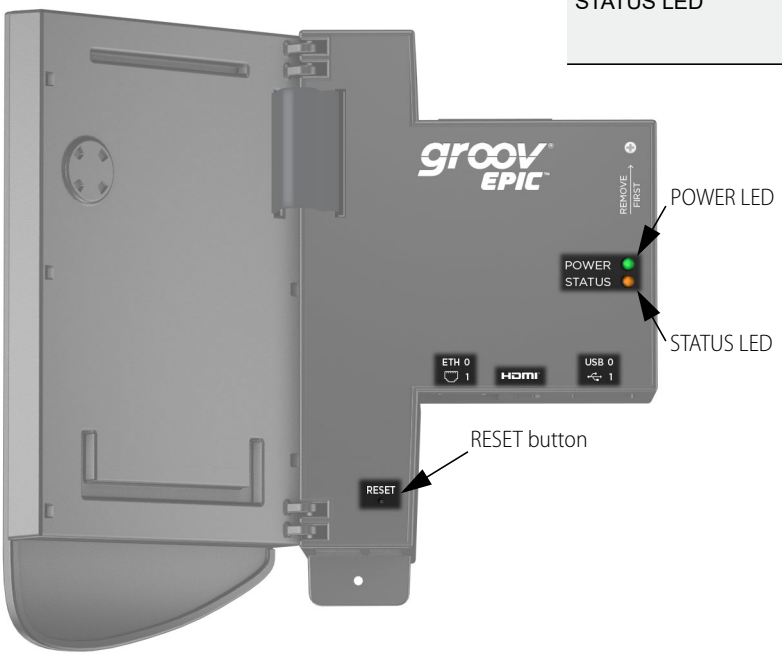
groov EPIC Processor

Bottom View:

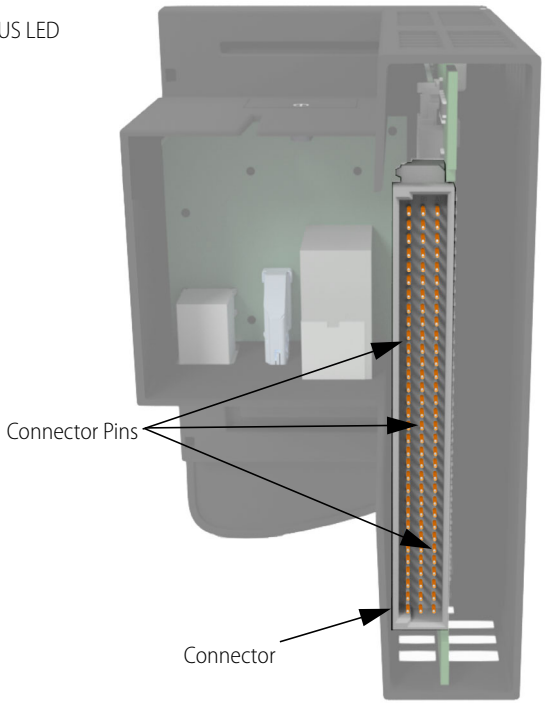


LED	Indicates
SPEED LED	Indicates link speed (Off = 10 Mbps, Green = 100 Mbps, Orange = 1000 Mbps)
LINK ACT LED	Indicates link status or activity (on/solid = link present, blinking = link present and local activity)
POWER LED	Indicates status of power (Green = on; Red = on, resetting)
STATUS LED	Indicates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

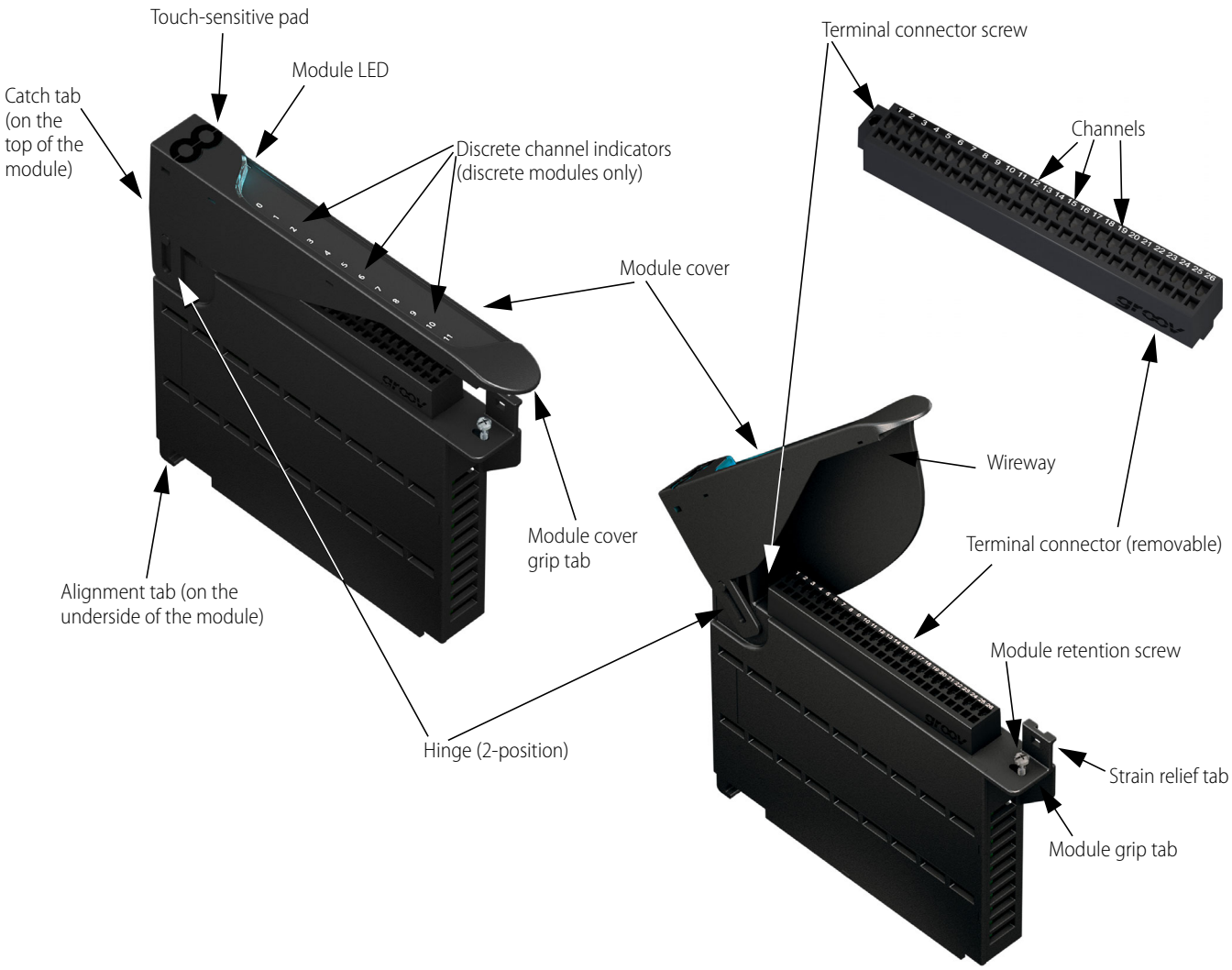
Face View:



Back View:



groov I/O Modules



To learn what colors the module LED displays, see "Checking Module Status Through the Module LED" on page 140.

VERIFYING SERIAL NUMBER ON THE PROCESSOR

When you unpack your *groov* EPIC processor, open the LCD display and verify that you can find the serial number on the label attached to the back of the LCD display.

ACTIVATING THE *groov* EPIC UNIT AND DOWNLOADING THE LICENSE FILE

Each *groov* EPIC processor comes with an activation code, which helps you obtain your license file.

1. Make a note of the serial number of your *groov* EPIC processor, which is on a label attached to the back of the LCD display.
2. On a computer or mobile device connected to the Internet, go to manage.groov.com.

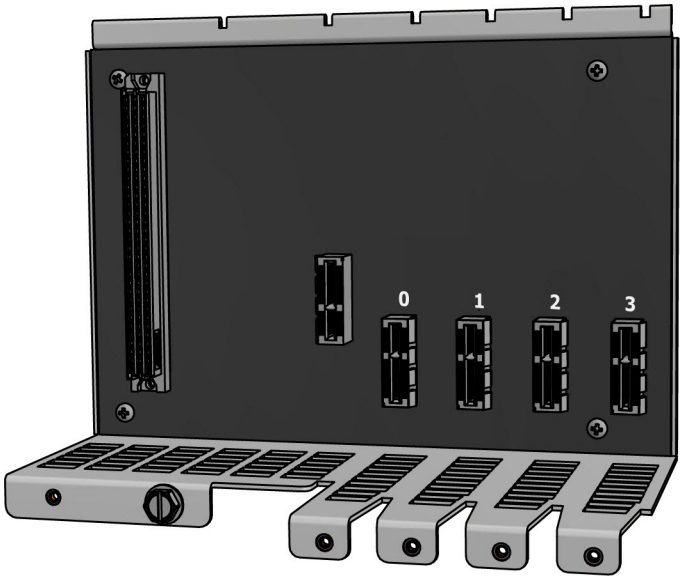
3. Follow the directions for activating your *groov* EPIC processor and obtaining a license file.
4. Save the license file onto your computer or mobile device and remember where you saved it. You'll need that information when you initialize your *groov* EPIC unit, as described in Chapter 4: Initializing the groov EPIC Processor.

ASSEMBLING YOUR UNIT

After you complete the steps in this section, you will have mounted the power supply, the processor, and the I/O modules on to the chassis. In the section that follows, you'll wire the I/O modules to field devices, and the power supply to the power source.

CAUTION: For electrical safety, do not turn on the power supply. Make sure to de-energize field devices wired to the module terminal connectors before proceeding with these steps.

1. Orient the *groov* EPIC chassis so that the module connector numbers are right-side up, with zero on the left, as shown in the diagram below.

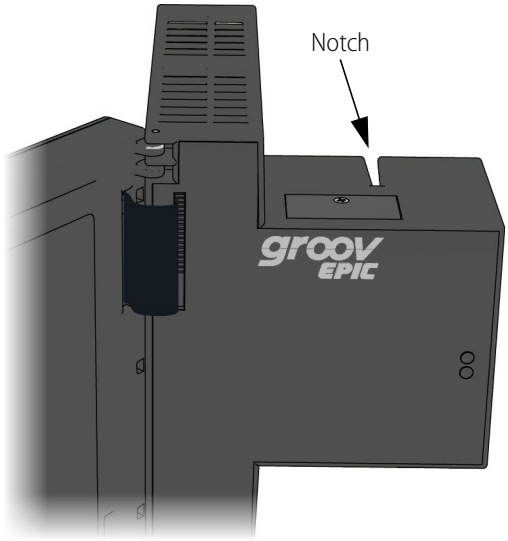


2. Install the power supply:
   a. Hold the power supply at a 45° angle, with the tabs at the back of the supply aligned with the notches on the chassis.

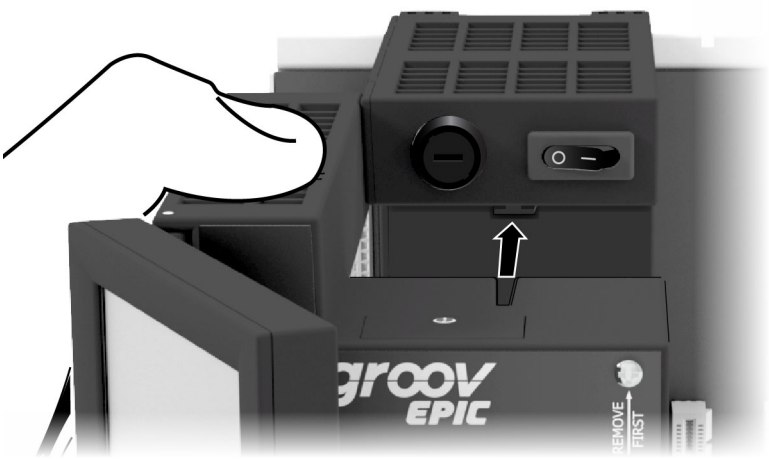
b. Lower the front-end of the supply onto the chassis until you feel the plug snap into the slot.

3. Install the processor:

a. Lift the LCD display so you can see the notch on the processor.

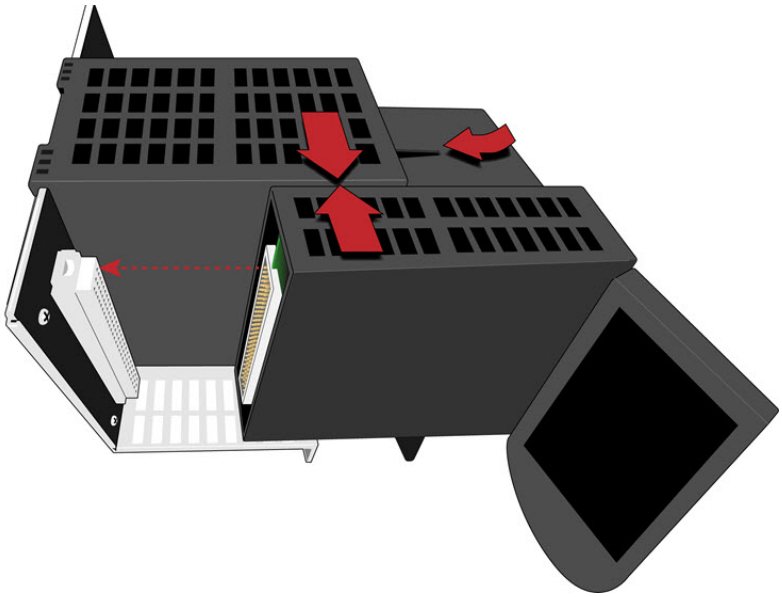


b. Hold the processor by the left side, and make sure that the notch on the processor aligns with the guide tab on the power supply.

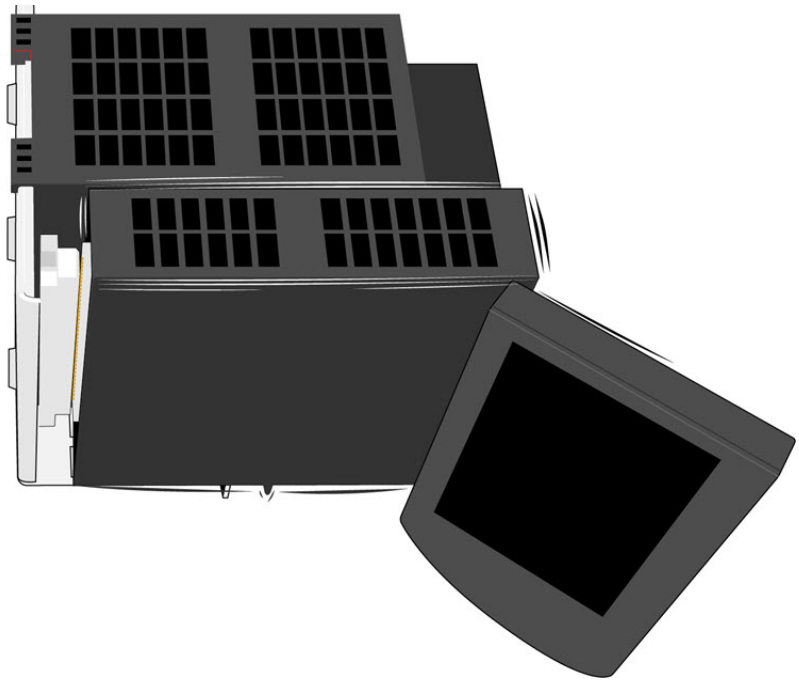


c. Align and then seat the processor:

– **Align the processor.** 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.

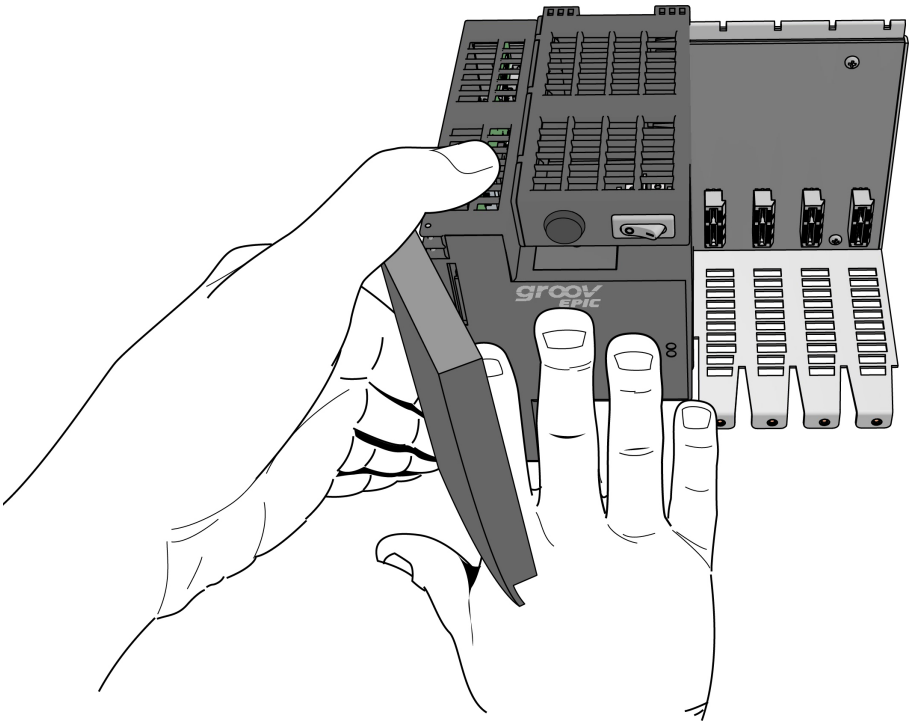


When it touches, lightly jiggle the processor to help the pins on the processor's connector properly align themselves into the holes of the chassis' connector.

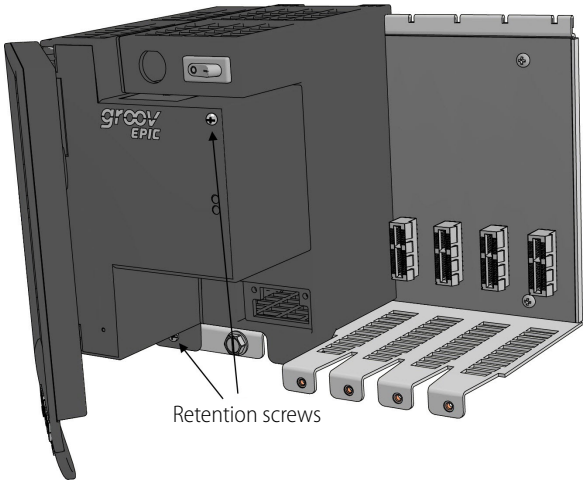


– **Seat the processor.** Push the processor (not the LCD display) into the connector until it resists further pressure.

IMPORTANT: *Do not push on the LCD display.*



d. Tighten the retention screws that attach the processor to the power supply and the chassis to the recommended torque listed in Appendix A: Processor Specifications.

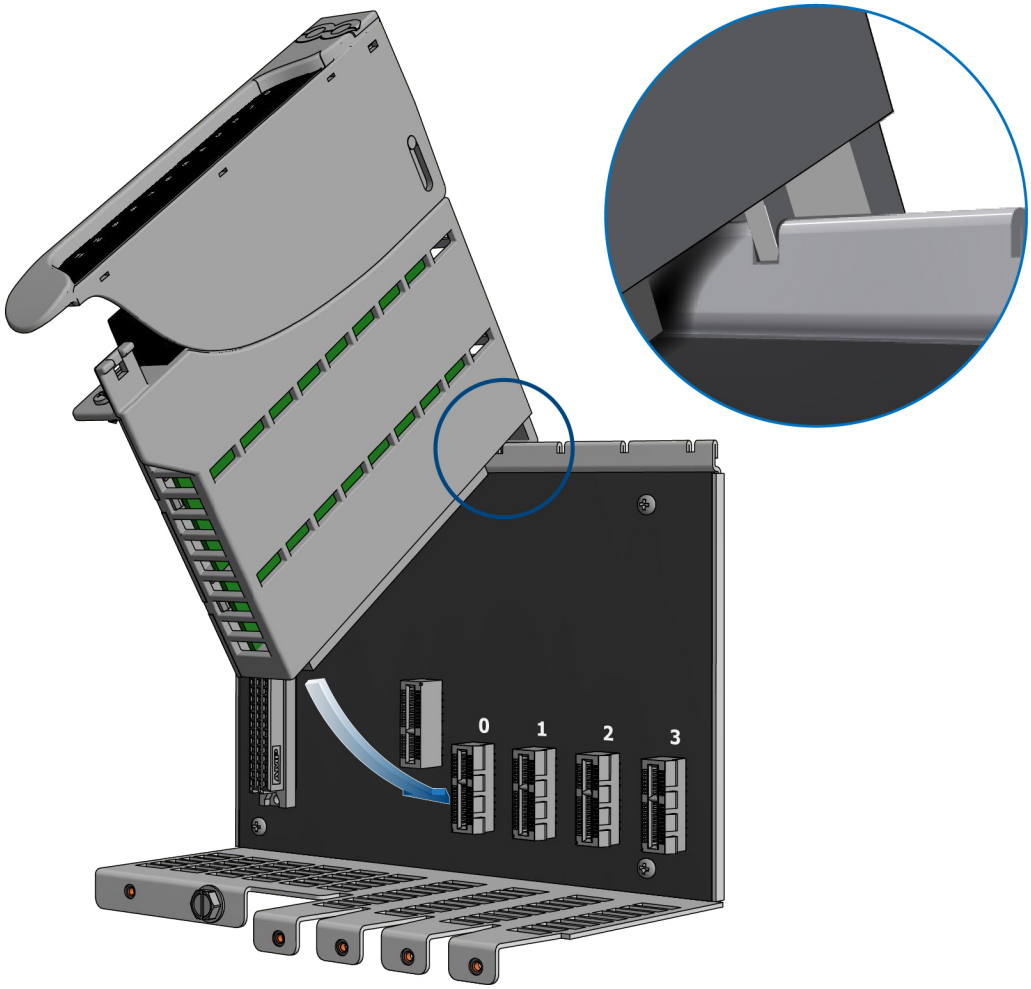


e. Close the LCD display.

4. Install the modules:

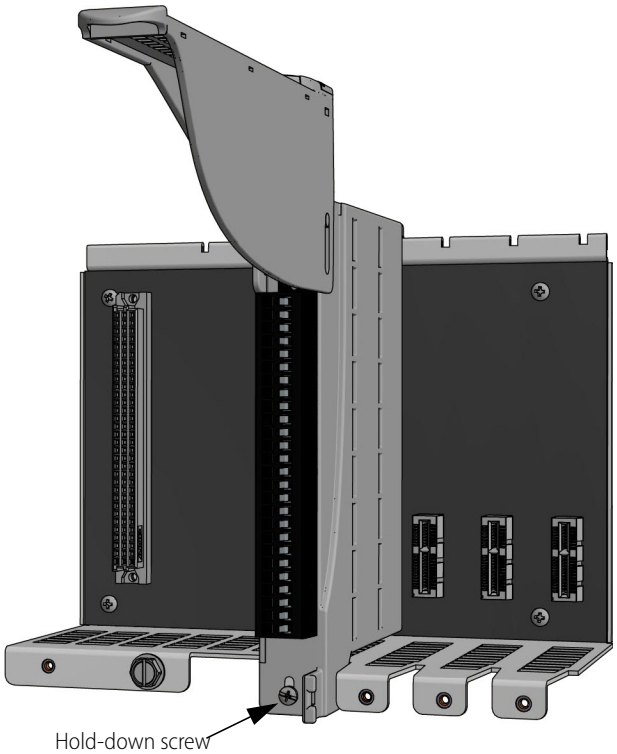
a. Hold the module at a 45° angle, lining up the alignment tab on the back tip of the module with the slot at the back of the chassis.

b. Pivot the front of the module down to the module connector on the chassis. Push to snap the module into the connector.



c. Swing the module cover up so you can access the module hold-down screw. Secure the module into position by tightening the module hold-down screw.

CAUTION: Do not over-tighten. See the torque specs in Appendix D: I/O Module Specifications.



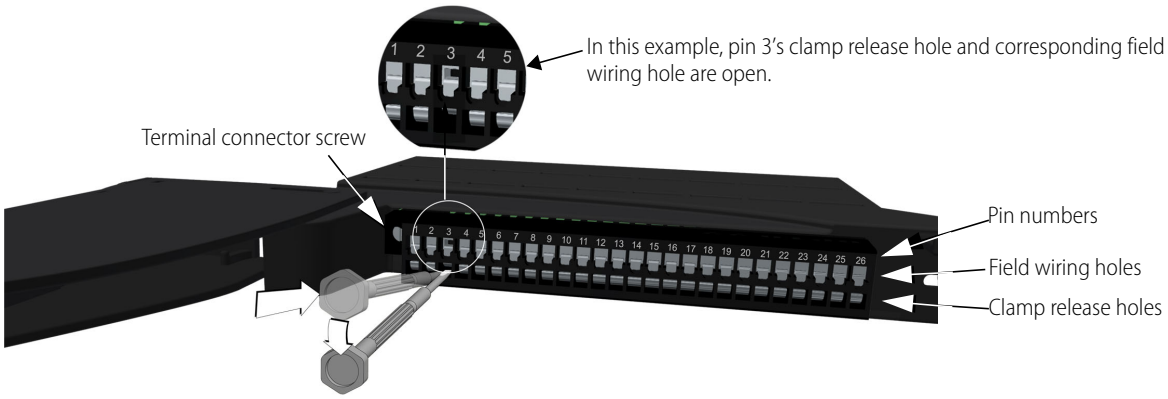
CONNECTING POWER SUPPLY WIRES AND FIELD DEVICE WIRES

After you complete the steps in this section, you will turn on you *groov* EPIC unit and move on to initializing the unit.

Connecting field devices to the *groov* I/O modules

Before you begin wiring, do the following tasks:

- Select the appropriate wire. The terminal connectors are rated for 28–14 AWG wire. If you're using stranded wire, tin the strands for an easier, better connection.
- 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 the following page and in "Familiarize yourself with the Processor and groov I/O modules" on page 11.
- 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 up 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 on the following page. 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:

1. Orient the module or terminal connector to match the wiring diagrams, which are listed on Appendix E: I/O Module Wiring Diagrams. 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.

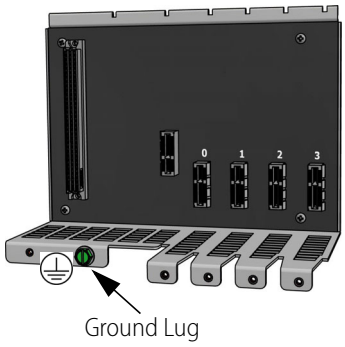
   Note: If you push in too hard, the screwdriver might pop out of the clamp release hole and you'll have to return to step 2.

   - 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.

Connecting ground

Connect a ground strap to the ground lug on the chassis. The ground lug is colored green on the chassis to make it easier to identify.



Connecting power supply wires

Here are a few guidelines to review before connecting your power supply wires:

Always use a separate field supply

Use a separate power supply for the field side of the I/O. Using the chassis supply for field actuation and monitoring defeats the isolation the I/O modules offer and therefore increases the chance of a ground loop within the control system. Additionally, fluctuations on the field side can cause undesirable voltage fluctuations that may interfere with the processor's operation.

Some modules (for example, the GRV-OVMALC-8) provide their own isolated, regulated, field-side power supply.

Power wiring guidelines

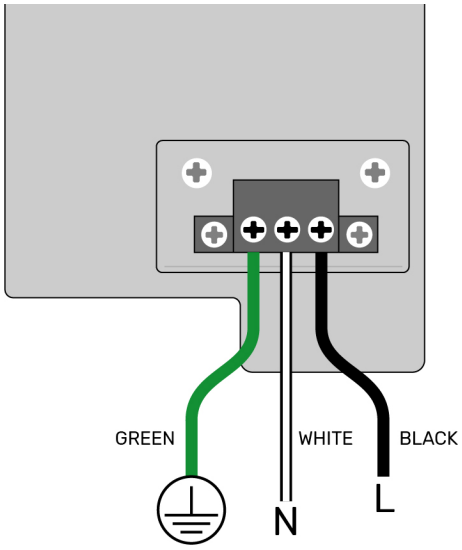
Opto 22 recommends you follow these wiring guidelines:

- Use a mains-isolated 24 to 48 VDC power source or supply to feed the GRV-EPIC-PSDC.
- Use the appropriate gage wire:
  - For GRV-EPIC-PSDC or GRV-EPIC-PSPT with DC input, use 16 to 12 AWG. Keep the wires as short as possible.
  - For GRV-EPIC-PSAC, use 18 to 12 AWG . Keep the wires as short as possible.

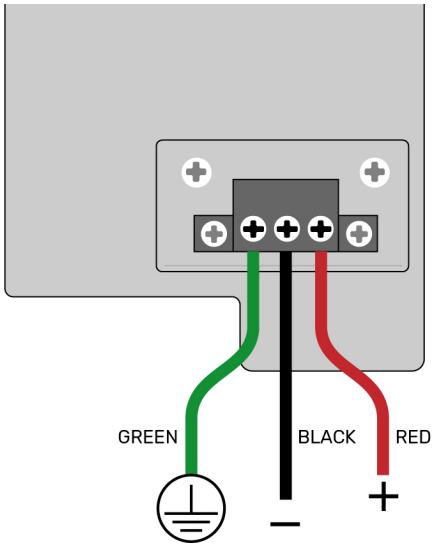
Power wiring diagrams

Before wiring the GRV-EPIC-PSAC, GRV-EPIC-PSDC or GRV-EPIC-PSPT, verify that your wiring cables conform to the requirements described previously.

GRV-EPIC-PSAC



GRV-EPIC-PSDC, GRV-EPIC-PSPT



CONNECTING THE ETHERNET CABLE

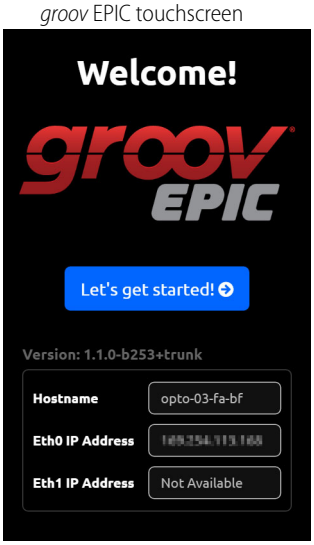
If the LCD display is closed, lift it so you can more easily access the Ethernet network interfaces. Connect your Ethernet cable to the network interface labeled `ETH0`.

TURN ON UNIT AND CONTINUE WITH INITIALIZING THE UNIT

If the LCD display is closed, lift it so you can access the power switch. Flip the power switch and then close the LCD display. The LCD display shows you the progress of the processor's start-up sequence. When you see the "Welcome!" screen, you are ready to initialize your *groov* EPIC unit. For important instructions about initializing your unit, see Chapter 4: Initializing the groov EPIC Processor.

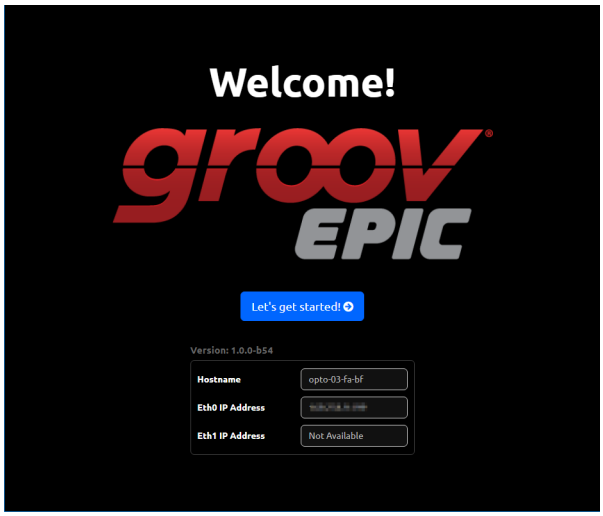
4: Initializing the *groov* EPIC Processor

groov EPIC touchscreen



After you assemble your *groov* EPIC unit and turn it on, the *groov* EPIC processor runs through its start-up sequence and then displays the Welcome! screen, shown to the right. If the Eth0 IP Address box does not show an IP address, see "Ethernet Cable is Plugged In, but No IP Address" on page 171.

If the Eth0 IP Address box shows an IP address, try connecting to that IP address with a web browser by typing `https://<ip address>` in the browser's URL bar. The browser displays the same Welcome! screen, shown below. If the Welcome! screen does not appear in the browser, see "Web Browser Can't Connect to Processor" on page 171.



Before you click or tap on Let's get started! (Let's get started!), make sure you have the following information and supplies:

- Your license file. If you don't have one, you can get one by following the instructions in "Activating the groov EPIC unit and downloading the license file" on page 13.
- A computer or mobile device connected to the Internet.
- A hostname for your processor. You may want to consult with your network administrator for guidance on selecting a hostname.
- A user name and password that follows strong security recommendations. This username and
- password is the first administrator level user for your Learning Center. **Remember it!** *groov* EPIC does not provide a way to recover a lost password or username.

- Pen and paper to note important information that you might need during this process or to keep for future reference.

If this is the first time you navigate through a controller with a touchscreen or you are new to the *groov* EPIC processor, you might want to read through Chapter 5: Navigating Through the groov EPIC Processor to become familiar with how to operate it and how it behaves.

You may also want to make note of the information shown in the lower-half of the Welcome! screen:

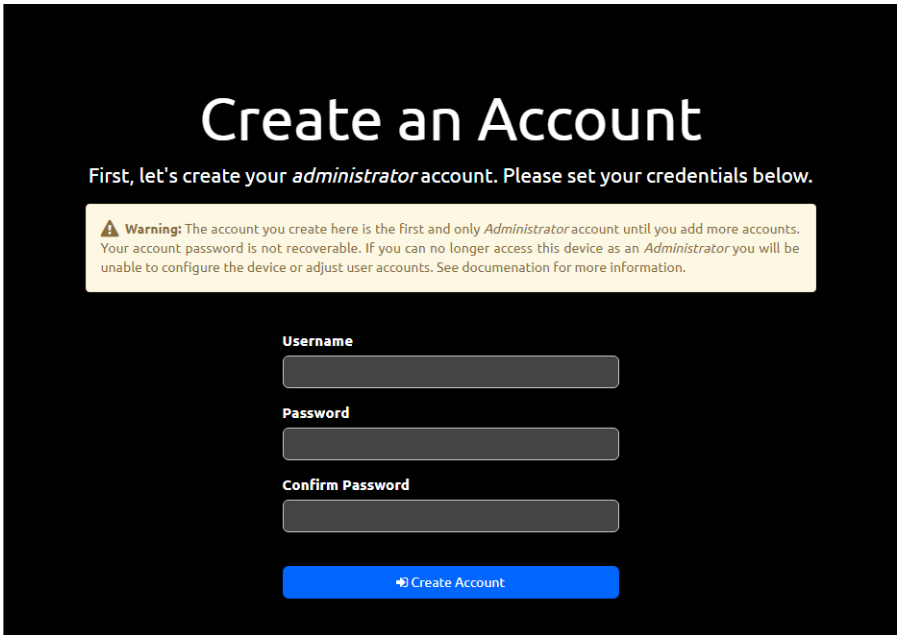
- You want the firmware version number so that you can compare it to the firmware updates available on the Opto 22 web site. If the firmware on the web site is newer than the one installed on the processor, you may want to apply the new firmware after you finish initializing the *groov* EPIC processor.
- If the Eth0 IP Address box displays an IP address and you were able to connect to it through a browser, you can finish the steps in this chapter by navigating through the web browser with a mouse and entering data with the keyboard.

CREATING THE FIRST ADMINISTRATOR ACCOUNT

Click or tap on Let's get started! (Let's get started!). You'll see the Create an Account screen, shown below.

groov EPIC touchscreen

Computer web browser



Read the information in the warning box. This first administrator account is very important because it provides administrator privileges over the *groov* EPIC processor, which gives you access to all the functions you need to configure the processor, maintain it, and create other accounts.

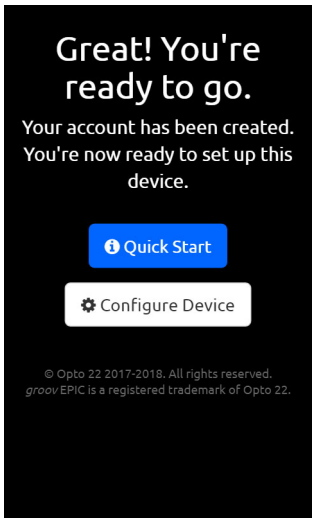
It's also important to remember the password to this account. The *groov* EPIC processor does not provide a way to recover this password nor an alternate way to access this account if you forget the password. Also, Opto 22 cannot recover this password or provide access to the account.

It is a good idea to follow best practices regarding passwords (for example, mixing cases and including numbers) when you create your password. Your password must be a minimum of 1 character and can be a maximum of 128 characters.

After you type in the user ID and password, click or tap on Create Account.

CHOOSING BETWEEN QUICK START AND CONFIGURE DEVICE

After you create an account, the *groov* EPIC processor displays the screen below.



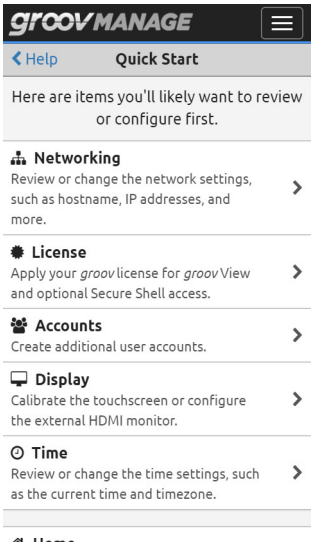
- Quick Start. The quick start provides a list of suggested configuration steps that you should complete first to get your *groov* EPIC system up and running. You may want to choose this option if this is the first time you configure a *groov* EPIC unit.
- Configure Device. If you select this option, the *groov* EPIC processor displays the main *groov* Manage page, where you can make any configuration changes. You may want to choose this option if you have configured a *groov* EPIC processor before or you feel confident you have all the information and understand the technology and software installed on the processor to complete any configuration steps.

If you choose to run Quick Start, the rest of this chapter can help you make additional decisions about the initial configuration steps. If you choose Configure Device, you can skip the rest of this chapter and configure your *groov* EPIC processor, referring to the rest of the user's guide for additional information.

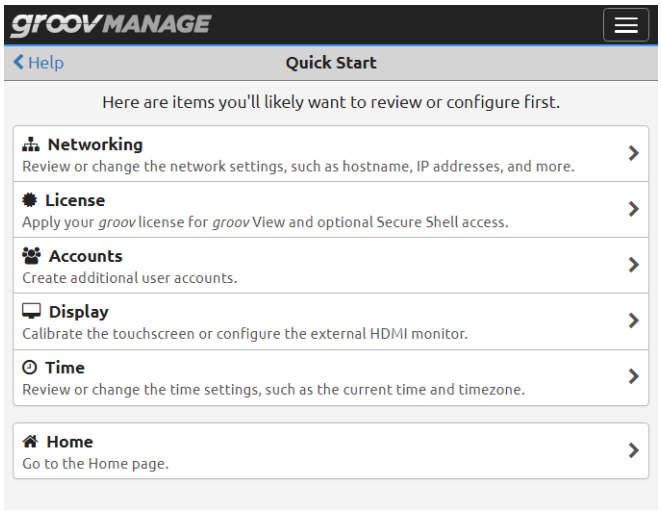
COMPLETING THE QUICK START

When you click or tap Quick Start (Quick Start), the *groov* EPIC processor displays the page below.

groov EPIC touchscreen



Computer web browser



The boxes are organized to suggest an order in which to complete the configuration. However, you do not have to follow this order nor do a configuration task for every box. Here's why you might want to complete each step:

- Networking. You might want to configure or change networking settings because:
  - You noticed that the Eth0 IP address box displayed the message Not Available and you want to set the IP addresses manually or configure settings so that the processor can connect to a DHCP server and obtain an IP address automatically.
  - You want to change the IP address that was assigned to the processor. You might want to connect to a specific DHCP server or set the IP address manually (which would make it a static IP address).
- License. Your *groov* View license comes with the purchase of the *groov* EPIC processor. If you ordered some of the optional licenses (for example, GROOV-LIC-EDGE) and you have that license file handy, you can also upload it. You'll need to do this step on a computer or mobile device; you can't upload licenses through the *groov* EPIC processor's touchscreen.
- Accounts. You might want to create additional accounts as required by the design of your control program and HMI.
- Display. You might want to calibrate the *groov* EPIC processor's touchscreen to ensure smooth operation. If you want to connect an external monitor, you might want to connect it through the HDMI port and configure it at this time.
- Time. You can choose between manually setting the date and time, selecting a time zone from a list, or selecting a time server that will synchronize your processor's date and time with that time server's date and time.

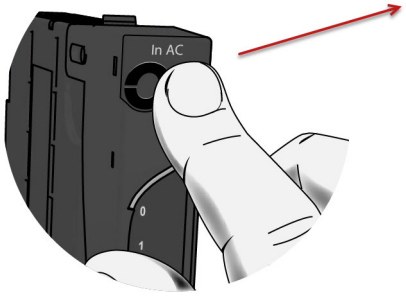
After you complete these initial configuration steps, you should check whether you have the latest firmware installed on your *groov* EPIC processor. If you do, you can continue on to more advanced configuration or begin to download and run a strategy or other control program.

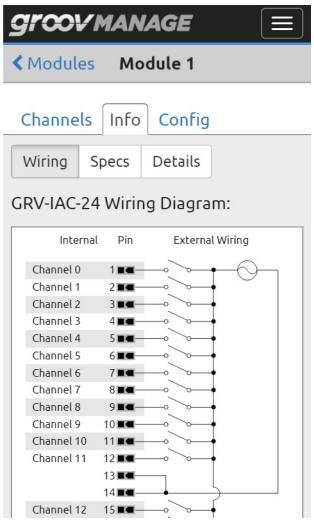
5: Navigating Through the *groov* EPIC Processor

You navigate through the *groov* EPIC processor touchscreen in much the same way you navigate through a smart phone or tablet. You can tap on navigation aids, swipe up or down to see more information, or swipe right to return to a previous page. The touchscreen responds to the touch of a finger or a stylus, although it might require a slightly stronger push or slide than a typical smart phone or tablet. When you connect an external touchscreen monitor to the processor, you navigate in the same manner as if you were touching the processor touchscreen.

The *groov* modules include a touch-sensitive pad. When you place your finger on the touch-sensitive pad of a module for more than two seconds, *groov* Manage displays information about that module on the touchscreen. The following diagram shows what the *groov* EPIC processor displays on the touchscreen after you touch the touch-sensitive pad of a module (GRV-IAC-24) mounted on slot 1, and then tap on the Info tab.

Press the touch-sensitive pad for 2 seconds. The *groov* EPIC processor displays that module's information. Tap on the Info tab to see the wiring diagram.





When you connect to the processor through a web browser on a computer, you navigate through the web browser in much the same way you navigate through any other web application on your computer. You can click on navigation aides like the navigation bar or links, and scroll up and down with a mouse.

CLICK OR TAP YOUR WAY AROUND *groov* MANAGE

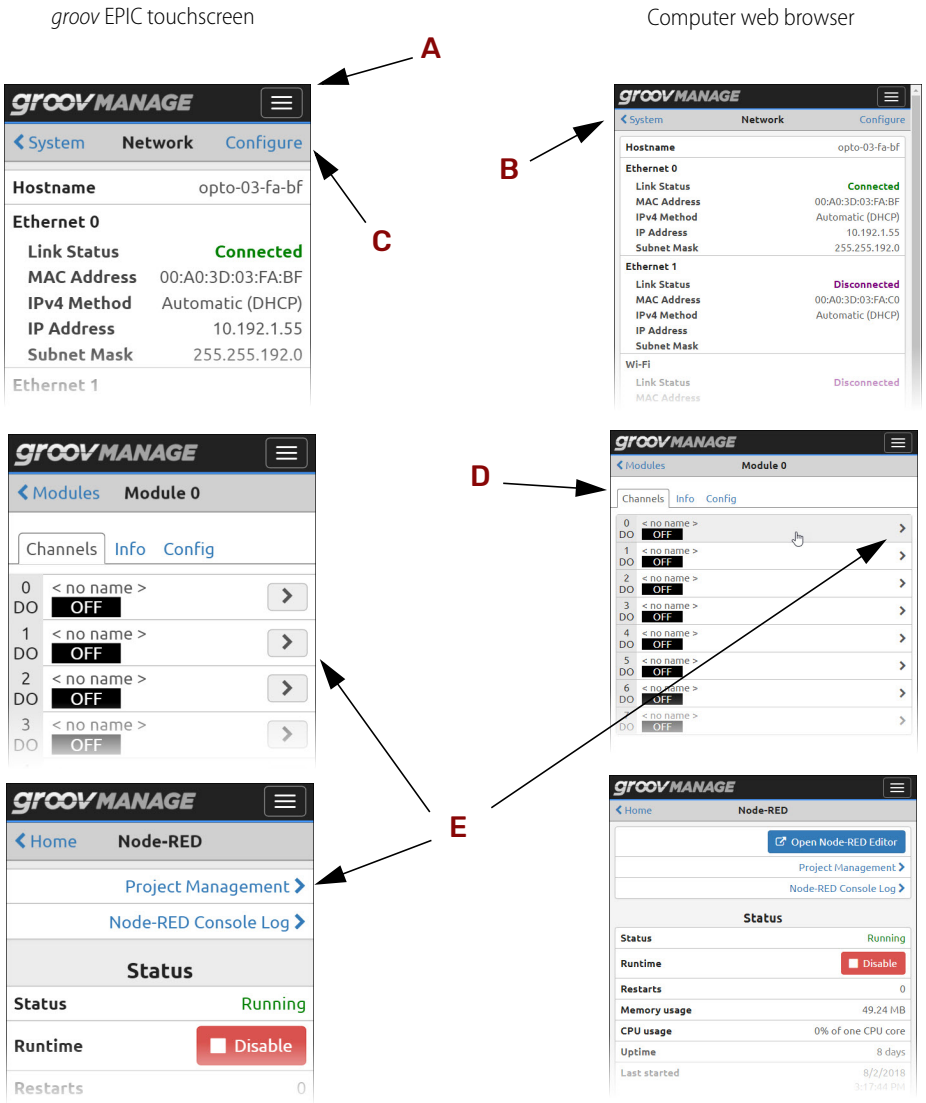
After you configure your *groov* EPIC processor with an IP address, you can connect to the processor through a web browser with that IP address. When you connect through a web browser, the processor displays the login

page. If you enter a user ID with administrator privileges, the processor displays *groov* Manage. You can navigate through *groov* Manage in much the same way you navigate through any web application.

Because you can access the processor through a browser or through the processor's touchscreen, the directions in this guide are written with both methods in mind. So, you may notice that instructions include the phrase "Click or tap": "click" as a reference to clicking with a mouse on a computer screen, "tap" to indicate touching the processor's touchscreen with your finger or a stylus.

LEARNING THE SCREEN NAVIGATION AIDS

The diagram below shows some of the differences and similarities between pages when you look at them through the *groov* EPIC processor or a web browser (either on a computer or a mobile device). The diagram also identifies some of the important navigation aids, which are described on the following page:



A Menu button ( ). Click or tap on this button to access a list of frequently visited pages. This button can help you quickly jump to these pages.

B Cancel or previous page. The upper-left area of the screen provides a way to cancel any changes you might have made to a page, to return to the previous page, or both.

C Save or Configure. If there are settings on the page that you can change, the upper-right area of the page displays the word Configure. Click on Configure to open up the page where you actually make the changes.

If this area shows the word Save, you must click on it to save any changes you made to settings on the page. If, after saving, the processor must restart an application or service, it displays a message to let you know.

If this area is blank, that means you can't make any changes to this page.

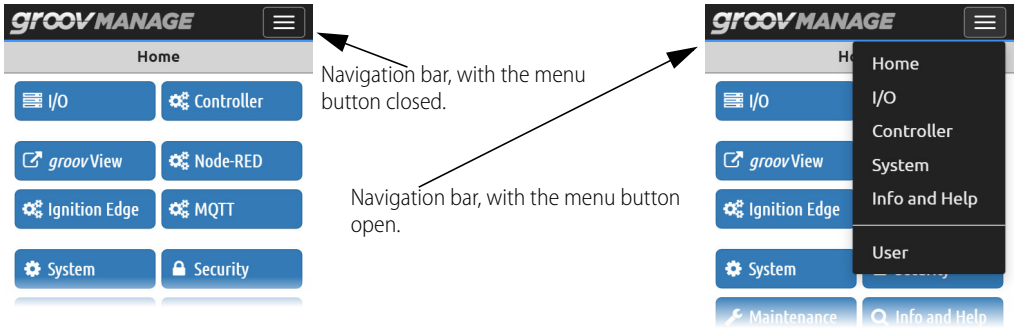
D Tabs. A method of grouping information related to one object into different categories. For example, information related to a module is divided into three categories: Channels, Info (specification information), and Config (module-specific information, like serial number). Each of these categories is in its own tab.

E Links. When you see these arrows, it indicates that clicking or tapping on the arrow will open another page that displays more information and provides more functions related to the item. For example, when you click or tap on Project Management in the Node-RED page, the processor displays another page with information and functions to help you manage a Node-RED project.

There is a small difference you might notice with links, depending on whether you are viewing a *groov* Manage page through the *groov* EPIC processor's touchscreen or a web browser. In a web browser, you can click on any area along the same row where the link is located to navigate through that link. In the *groov* EPIC touchscreen, you must tap on the arrow to navigate through that link.

NAVIGATING THROUGH *groov* MANAGE

At the top of the *groov* Manage page is a navigation bar that always remains visible as you navigate through the screens. This navigation bar contains a menu button ( ) that gives you quick access to the most frequently visited screens of *groov* Manage:



- **Home**, the main page of *groov* Manage.
- **I/O**, the page that displays a visual representation of the chassis, indicating which slots have modules mounted on them, what type of modules are mounted on those slots, and the status of the modules.
- **Controller**, the page that guides you to either the PAC Control Engine page or the CODESYS Runtime Engine page. From either of those two pages, you can access several features, including:
  - Viewing the status of the engine.
  - Viewing the name of the strategy or applications running on the processor.
  - Disabling or enabling the engine.

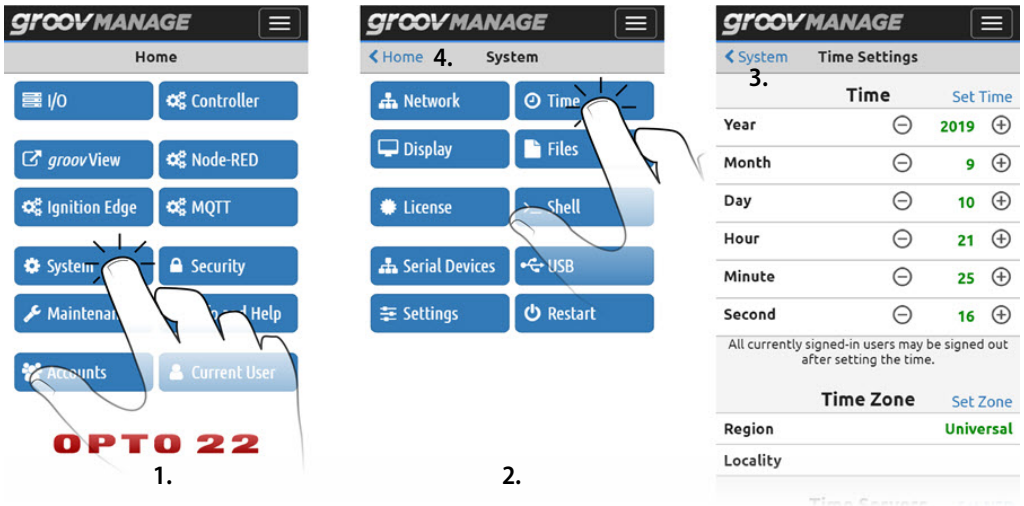
- **System**, the page that displays functions to help you configure system-level settings, like network settings, display settings (for the touchscreen and external monitors), time zone settings, licenses, and the ability to restart the processor.
- **Info and Help**, the page that displays functions to help you learn more information about the processor, like system logs, current system up-time information, firmware versions, as well as a way to access the Quick Start feature.
- **User**, the page that displays the user name of the current user and the fields to change the current user's password.

Navigating Through *groov* Manage on the *groov* EPIC Processor Touchscreen

Some screens contain more information than can fit in the display. Remember to slide your finger or stylus up and down on the screen to view more information.

While navigating through the screens on the *groov* EPIC processor touchscreen, in addition to tapping on buttons or other navigation aids, you can swipe your finger or stylus across the screen from left to right to return to a previous page.

The following example shows how to navigate through a set of screens by either swiping or tapping the buttons on the screen:

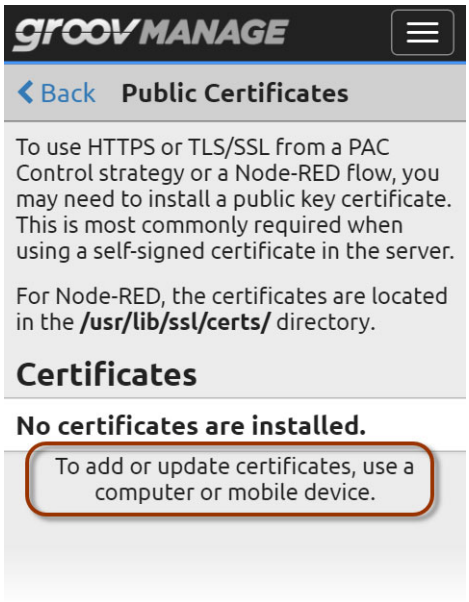


1. Starting from the Home page, tap on System (System) to open the System page.
2. Tap on Time (Time) to open the Time Settings page.
3. To go from the Time Settings page back to the System page, tap on System near the top left corner or swipe your finger on the screen from left to right.
4. To go from the System page to the Home page, tap on Home near the top left corner or swipe your finger from left to right.

As a quick alternative, you can go from the Time Settings page to the Home page by tapping on the menu button ( ), then tapping on Home.

Whenever you change settings, remember to press Save (usually at the top right corner of screen) to save your changes. If you don't want to save your changes, press Cancel (usually at the top left corner of the screen) or swipe from left to right. Some changes might require a restart of the processor or a service; the processor will notify you of these instances.

There are some functions that can only be done through a computer or mobile device. When that happens, the processor's touchscreen displays a message like the following:

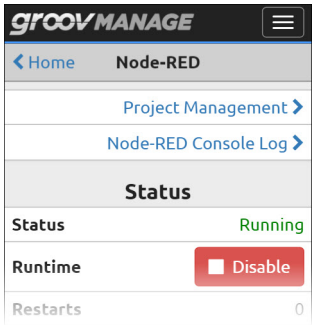


Navigating Through *groov* Manage on a Computer or Mobile Device

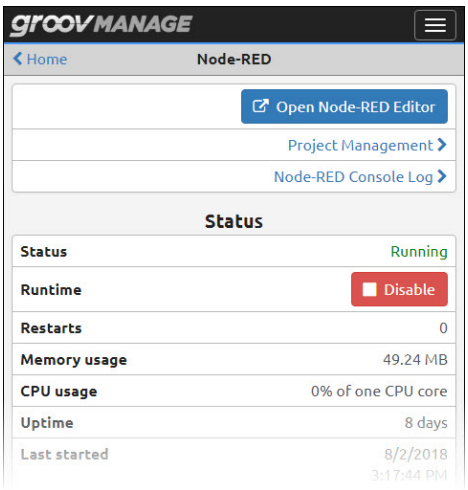
You can navigate through *groov* Manage on a computer or mobile device in much the same way you navigate through any other web application. There are some differences, however:

- **Drag-and-drop**—This is a feature commonly used on a computer to visually and easily move files from one location to another. You can drag-and-drop files into the *groov* EPIC processor on any *groov* Manage page with an upload button.
- **Editors**—You can't build Node-RED flows or *groov* View HMIs through the processor's touchscreen. That's why, on some pages, you'll see buttons or options when you are on a computer that you can't see when you are on the processor's touchscreen. For example, on the Node-RED page, you won't see the Open Node-RED Editor button when you are on the processor's touchscreen:

groov EPIC touchscreen



Computer web browser

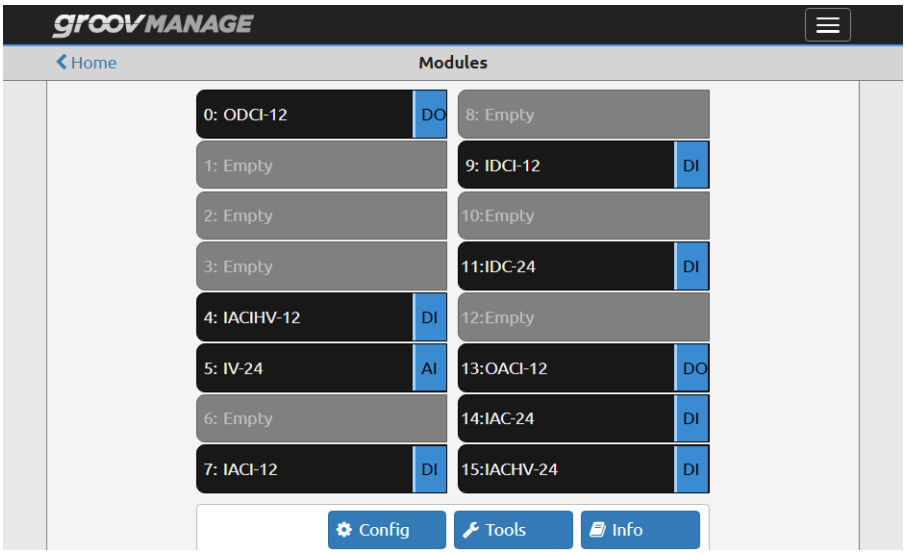


FINDING INFORMATION ABOUT I/O MODULES AND THEIR CHANNELS

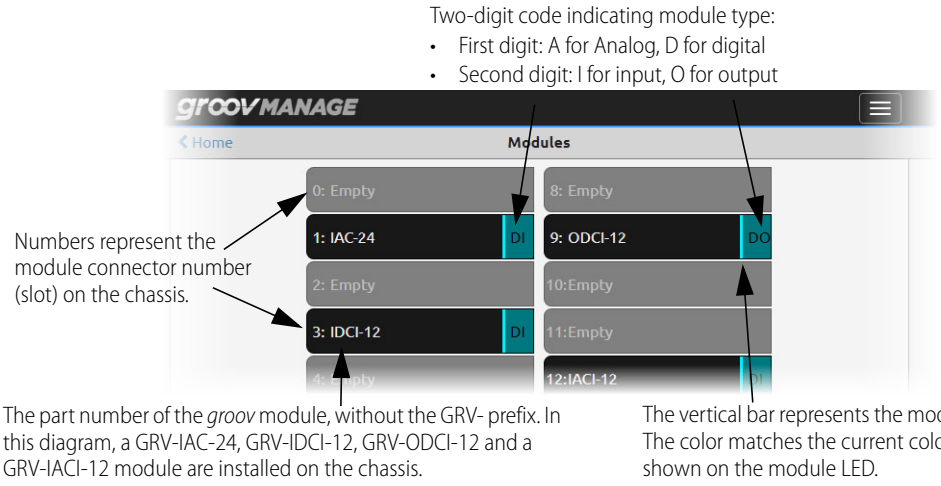
To view information about and making changes to I/O modules and their channels is through the Modules page of *groov* Manage. To reach that page, log into your *groov* EPIC processor with a user ID that has administrator privileges and then do any of the following:

- Click or tap on the menu button ( ), then select I/O.
- In the Home page, click or tap on I/O (I/O).

Either action displays the Modules page. The page displays an image that simulates the chassis and the I/O modules mounted on the chassis, along with colors that match the color shown by the module LED. The following diagram displays a 16-module chassis with 9 modules mounted on the chassis in slots 0, 4, 5, 7, 9, 11, 13, 14, and 15. All modules are operating normally, which is indicated by the blue color on the right of each box that represents a mounted module.

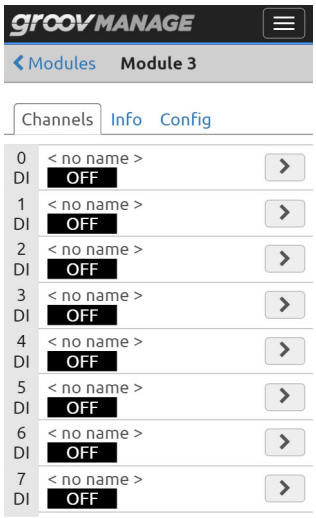


Each box represents a slot on the chassis. If the box is gray and shows the word "Empty", that means no module is installed in that slot on the chassis. If the box is black, that means a module is installed in that slot on the chassis. The following diagram explains the information displayed in the black boxes:

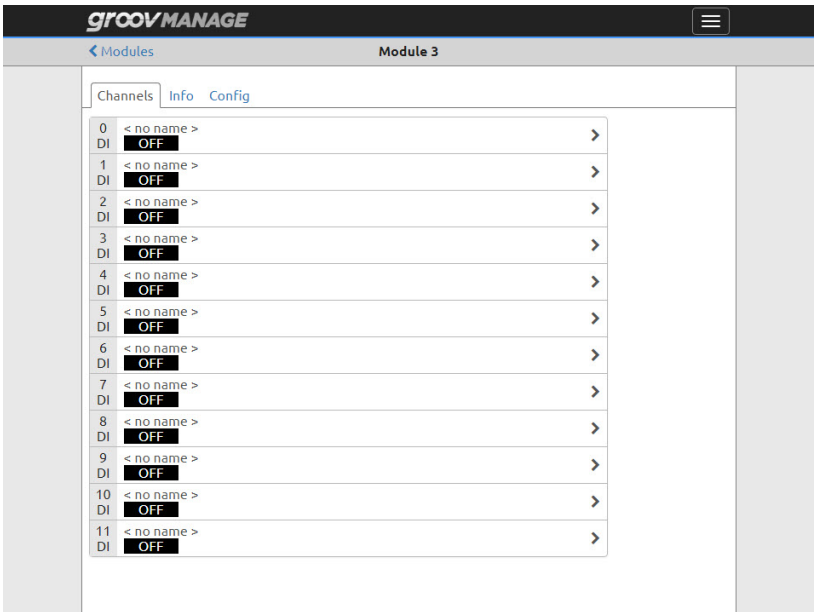


You can click or tap on a black box to show current information about that module. For example, if you click or tap on module 3 (3: IDCI-12 DI), the *groov* Manage displays the following page:

groov EPIC touchscreen



Computer web browser



The three tabs display the following information:

- The Channels tab lists the channels on the module, displays the status of each channel, and provides a link to the configuration page for each channel. In the configuration page, you can change the name of the channel, get more information about a quality error, or change options that are specific to each module.
- The Info tab shows you information about the module, like the wiring diagram, the specification information, and firmware version.
- The Config tab, when you view it through a computer or mobile device, provides a way for you to upload new firmware to the module.

6: Controlling Access to *groov* EPIC Processor

PART OF AN OVERALL SECURITY SYSTEM

When you control access to the *groov* EPIC processor, consider it as part of a total security system that includes other best practices you might want to implement; for example, requiring that authorized users change their passwords every three months or securing the control equipment in a locked cabinet with keys accessible to a limited number of personnel.

The *groov* EPIC Security Design and Best Practices Technical Note (form 2310) describes some of the security features designed into the *groov* EPIC processor. Review this technical note carefully and coordinate with your IT department to determine which security features provided by the *groov* EPIC processor will work best with your application and network.

IMPORTANT: *groov Manage does not provide timeout-based logout. You must implement the important practice of always logging out of any ID that has administrator privileges to prevent unauthorized access to the processor.*

CREATING USER IDS AND CONFIGURING THEIR ACCESS

With *groov* Manage, you can create user IDs and limit access to functionality, features, or even HMIs. Before you create a user ID, consider the following questions:

- How many users do you want to create?
- What functions do you want the users to access?
- How will you secure (encrypt or password-protect) the information about the users?

Choosing Access Levels for Users

The following information can help you determine what access to give a user and what level of access to give a user for a particular service or feature:

- A system-wide administrator can do the following:
  - Create other user accounts
  - Access all applications and services running on this processor
  - Change the passwords of other accounts
  - Sign out any and all users currently logged into this processor
  - Disable the control engine
  - Change system-level settings like network, I/O, display, time and date, etc.
- *groov* Manage

groov Manage is an administrator-level function, so if the user is a system-wide administrator, they have access to *groov* Manage. If the user is not a system-wide administrator, they do not have access to *groov* Manage.

- *groov* View

  There are several levels of access to *groov* View. These levels are available only if the user is not a system-wide administrator.

  – Editor
  – Operator
  – Kiosk
  – None

  A system-wide administrator has administrator access to *groov* View, which means that they can switch to *groov* View and, when connected to the processor through a web browser, switch to build mode to build *groov* View HMIs.

- Node-RED

  Access to Node-RED is either Editor or Off. For system-wide administrators, Editor is the automatic and only access level. For all other users, you can set the access level to either Editor or Off.

- PAC REST API

  Access to the PAC REST APIs can be one of the following:

  – Read-Write
  – Read-Only
  – None

Creating User IDs

After you consider what types of users you want to create and what they will have access to, do the following:

1. Log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. Click or tap Accounts (Accounts).
3. Click or tap Add (in the upper right corner).
4. Type in the required information and select the permissions you want that user to have.
5. Click or tap Save (in the upper right corner).

Repeat these steps for every user account you want to create.

MANAGING THE SSL SECURITY FEATURES OF YOUR *groov* EPIC PROCESSOR

The SSL security features on the *groov* EPIC processor help you establish secure communication between the *groov* EPIC processor and web browsers, servers, brokers, and cloud services.

Learning How SSL Works on *groov* EPIC

If you are not familiar with SSL, you might want to spend some time reading the following OptoBlog, Understanding SSL/TLS and HTTPS.

Each *groov* EPIC processor comes with a unique certificate (called a self-signed, server SSL certificate) to enable communication between its internal web applications (like *groov* Manage, *groov* View, and Node-RED) and web browsers on computers and mobile devices. When you connect to the *groov* EPIC processor through a web browser for the first time, the browser will display a warning message that the site (in this case, the *groov* EPIC processor) is untrusted. To avoid the warning, you can install the self-signed, server SSL certificate into the certificate store of the web browser. Afterwards, the browser will "trust" your processor (the site) and no longer display that warning.

Why Change the SSL Security Features on Your *groov* EPIC Processor?

A self-signed certificate is useful for network situations with few users, limited accessibility, or limited scope. For example, an internal test lab where the *groov* EPIC processor communicates only to one computer or when you are developing your control application so that you can conduct testing in your own closed control network.

However, you might want to change the SSL security features on your *groov* EPIC processor for any of the following situations:

- You want to allow access to the processor by many more users and through many devices (like computers, smartphones, and tablets).
- You want to allow access to the processor by servers, brokers, and cloud services, like MQTT with Sparkplug or Node-RED.
- You want to allow communication to travel through the Internet.

In these situations, you might want to switch to using a CA-signed certificate, where CA means "Certificate Authority". A Certificate Authority is an organization which vouches for your *groov* EPIC processor's identity. CA-signed certificates relieve you of the work of installing the certificate on the countless number of web browsers, servers, brokers, and cloud services that might want to connect to your processor. When the CA-signed certificate is installed on the *groov* EPIC processor and devices that access the processor, the certificate validates the connection between the user and the processor. So long as you stay connected directly to the *groov* EPIC processor on a secure connection (using https), you are protected from a man-in-the-middle attack.

Creating a Self-Signed Certificate

1. On a computer or mobile device, log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. Click Security (Security).
3. Click Server SSL (Server SSL).
4. Click Create Certificate (Create Certificate).
5. In the Create Certificate page, enter the information requested.

   Server Name—Enter the fully qualified domain name or IP address of this *groov* EPIC processor that client browsers will use to access it. The server name may contain letters a–z (case insensitive), digits 0–9, or a hyphen (-). No other characters are allowed. The server name must not start with a hyphen.

   Example:

   If the URL you will use to access the processor in client browsers is https://process1.acme.com, then type in `process1.acme.com`

   Example:

   If the URL that the client browsers will use to access the processor is https://mobilehmi.mydomain.com, then type in `mobilehmi.mydomain.com`

   Email—The email address of the individual in your organization requesting the certificate and who would be responsible for responding to any inquiries about this certificate.

   Department—Information to differentiate between divisions within an organization. For example, "Engineering" or "IT". If applicable, you can enter the DBA (doing business as) name in this field.

   Organization—The legally registered name of your business. The listed organization must be the legal registrant of the domain name in the certificate request. If you are enrolling as a small business or sole proprietor, please enter the certificate requester's name in this field, and the DBA (doing business as) name in the Organizational Unit field.

   City or Locality—Name of the city or locality where your organization is located. Please spell out the name of the city or locality. Do not abbreviate.

State—Name of state, province, region, territory where your organization is located. Please enter the full name. Do not abbreviate.

Country Code—The two-letter International Organization for Standardization (ISO-) format country code for the country in which your organization is legally registered. See http://www.digicert.com/ssl-certificate-country-codes.htm for a list of codes. For example, the code for the United States is US.

Days until expiration—Enter the number of days before the certificate is expired and has to be replaced. Opto 22 recommends 3560 (10 years).

RSA key size—Enter the size of the RSA key. The default size of 2048 is a generally recommended value. Higher values will take longer to create.

6. Click Create. *groov* Manage immediately installs the new private key and certificate, and then restarts *groov* Manage.

The processor now has new copies of the Public Certificate, Private key, and CSR , which you can download when you need to request a CA-signed certificate.

Switching to a CA-signed Certificate

When you switch to a CA-signed certificate, consider the following:

- The cost of a certificate from a certificate authority ranges from free to $300 or more, depending on the features and company you buy them from. Please work with your IT department before you begin this task.
- You will send the CSR to the certificate authority of your choice. The certificate authority verifies the identification information and signs the CSR, which then becomes a CA-signed certificate. That's why it is important that you enter accurate information in step 5 of "Creating a Self-Signed Certificate" on page 39.

If you have not created a self-signed certificate, do that first. See "Creating a Self-Signed Certificate" on page 39.

1. On a computer or mobile device, log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. Click Security.
3. Click Server SSL.
4. Click Download CSR.
5. Navigate to a folder where you want to store the CSR file. Make a note of the file name and path to the folder. Click Save.
6. Go to the certificate authority (most likely a web site) and provide them with the information they request in whatever format they request.

   When filling out a form for a CA-signed certificate, keep in mind that an SSL certificate works with any operating system. If you are asked to select an operating system, select "other" if it an option. It's OK to select a specific operating system, if necessary.
7. Finish the transaction with the certificate authority and receive your new SSL certificate.
8. Upload the new SSL certificate to your *groov* EPIC processor
   a. Return to the View Certificate page. (See steps 1 through 3.)
   b. Click Upload Certificate.
   c. Click Public Certificate.
   d. Navigate to the folder where you stored the new SSL certificate. Click Open. *groov* Manage uploads the file and then displays the Upload Certificate page.
   e. Click Private Key.
   f. Navigate to the folder where you stored the private key file. Click Open. *groov* Manage uploads the file and then displays the Upload Certificate page.

g. Click Upload (in the top right). *groov* Manage displays a message that it must restart. Click on Reload.

After *groov* Manage restarts, you can begin working with services that requires a CA-signed certificate.

Uploading a Public Key Certificate

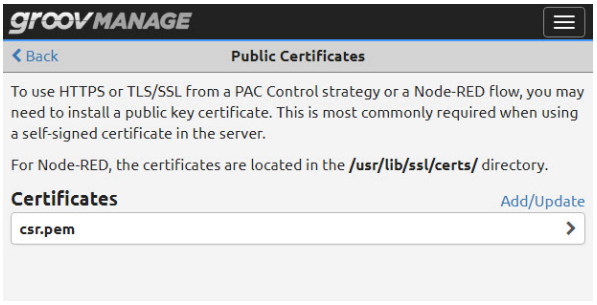
There are several reasons you might need to upload a public key certificate:

- To enable secure client/server communication (with HTTPS or TLS/SSL) between the *groov* EPIC processor (acting as client) and a PAC Control strategy or a Node-RED flow (acting as a server).
- To enable secure communications through Sparkplug.

To upload a public key certificate, you must make sure that it is stored on a computer or mobile device that can connect to the *groov* EPIC processor.

1. On a computer or mobile device, log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. Click Security.
3. Click Client SSL.
4. In the Public Certificates window, click Add/Update.

5. Navigate to the folder where you stored the certificate and select the certificate (.pem) file.
6. Click Open. *groov* Manage uploads the file and you'll see it listed in the Certificates section.



If you need to upload another certificate, repeat steps 4 through 6.

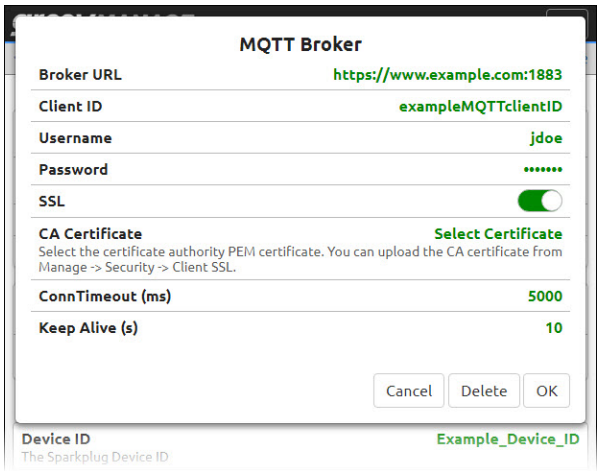
Changing SSL Security Features for Sparkplug

If you are using Sparkplug with MQTT to publish data from the *groov* EPIC processor, you must first create and install a CA-signed Certificate on the processor.

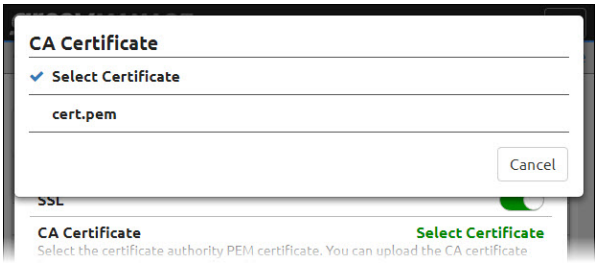
- For instructions on creating the certificate, see "Switching to a CA-signed Certificate" on page 40.
- For instructions on installing the certificate on the processor, see "Uploading a Public Key Certificate" on page 41.

After you installed the certificate(s):

1. Log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. Click or tap Sparkplug.
3. For each MQTT Broker that you have listed on the Sparkplug page and for which you want to enable SSL:
   a. Click or tap the broker name to open its MQTT Broker settings window.
   b. Move the slider to the right so that it shows green ( ). *groov* manage displays a new row below the SSL row.



   c. Click or tap Select Certificate. *groov* Manage displays the CA Certificate window with a list of public key certificates installed on the processor. Select the certificate you want.



   groov Manage refreshes the MQTT Broker settings window to show the name of the certificate you chose.
   d. Click OK.
4. When you are done modifying all the MQTT Brokers that you wanted to change, click or tap Save.

   If there are any errors in any of changes you made, groov Manage highlights the broker with the error in red. Select that broker to view more information about the errors. Make any necessary changes and try saving again.

CONFIGURING THE FIREWALL

You might be accustomed to hearing or reading about firewalls to protect corporate networks, home networks, and even individual computers. The *groov* EPIC processor also contains firewall technology to protect it from unauthorized connections and communication.

Before you configure the firewall on the processor, make sure you understand the following:

- Firewall rules and how they work.
- If you need to create a new rule, you need to know the protocol you want to select (TCP, UDP, or both) and the port number, or range of port numbers, to which this rule will apply.
- The default firewall rules. These rules are in the firewall as part of the default factory settings:

Component/System	Port Numbers	Network Interface
groov EPIC	80, 443	Allow: ETH0, ETH1, WLAN0 Deny:
OptoMMP	2001	Allow: ETH0 Deny: ETH1, WLAN0
ModbusTCP	8502	Allow: ETH0 Deny: ETH1, WLAN0
PAC Controller	22001, 22002	Allow: ETH0 Deny: ETH1, WLAN0
CODESYS Controller TCP	1217, 4840, 11740	Allow: ETH0 Deny: ETH1, WLAN0
CODESYS Controller UDP	1740–1743, 4840, 22006–22007	Allow: ETH0 Deny: ETH1, WLAN0

- The reserved firewall rules. These rules are created when the corresponding license product is applied to your *groov* EPIC processor:

Component/System	Port Numbers	Network Interface
Ignition Edge	8043, 8060	Allow: ETH0 Deny: ETH1, WLAN0
Designer Access to Ignition Edge	8088	Allow: ETH0 Deny: ETH1, WLAN0
Shell	22	Allow: ETH0, ETH1, WLAN0 Deny:

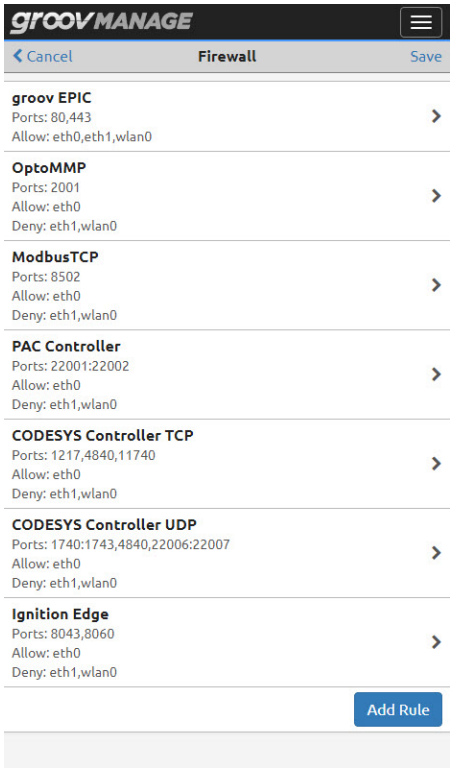
Creating a Firewall Rule

When you make changes to the *groov* EPIC processor's firewall, the changes take effect immediately. So, make sure you schedule this change during a time that minimizes the impact to your system and users. If necessary, notify your users of this change so they can plan accordingly.

To create a new rule for the firewall:

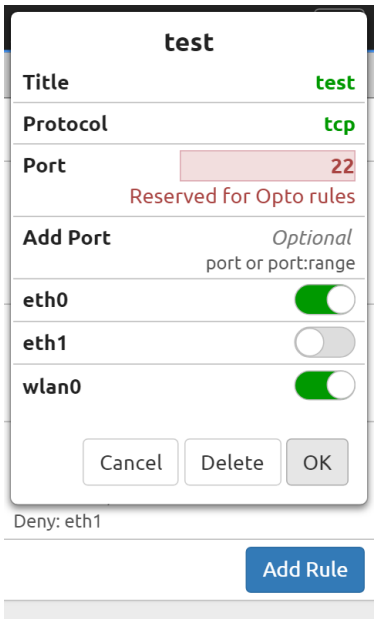
1. Log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. Click or tap Security.

3. Click or tap Firewall. The Firewall page displays the rules currently in effect and may look similar to this:



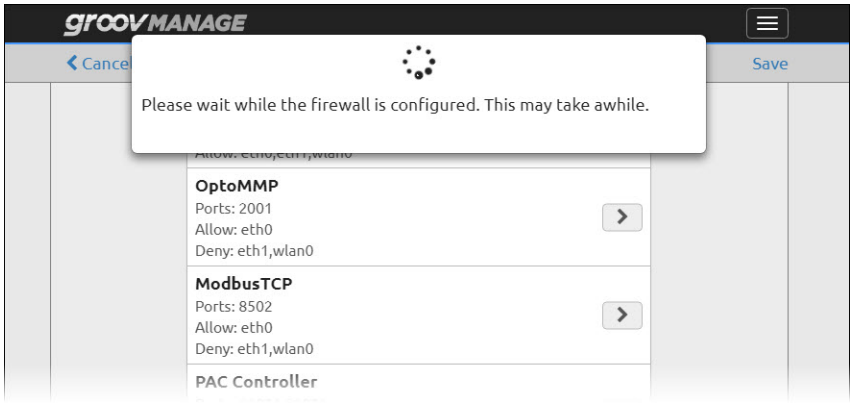
4. Click or tap on Add Rule. Type in information for the new rule:
   - **Title**—This will display as a new section title, which has limited space. A title of less than 30 character fits well in the space.
   - **Protocol**—Select which protocol this rules applies to.
   - **Port**—Type in the port number or port number range. Specify a port range by typing in the first port number in the range, followed by a colon, then the last number in the port range, with no spaces between the numbers and the colon.
   - **eth0**, **eth1**, or **wlan**—Select which port this rule applies to by moving the slider to the right so that it shows green ( ).

5. Click or tap OK. If there are any errors in your selections *groov* Manage highlights the error and displays an error message.



Fix the error or errors and then click OK.

6. Repeat the previous two steps for any additional rules you want to create.
7. Click Save. *groov* Manage displays a message that it is configuring the firewall.



After *groov* Manage finishes saving and implementing the changes, it displays the Security page.

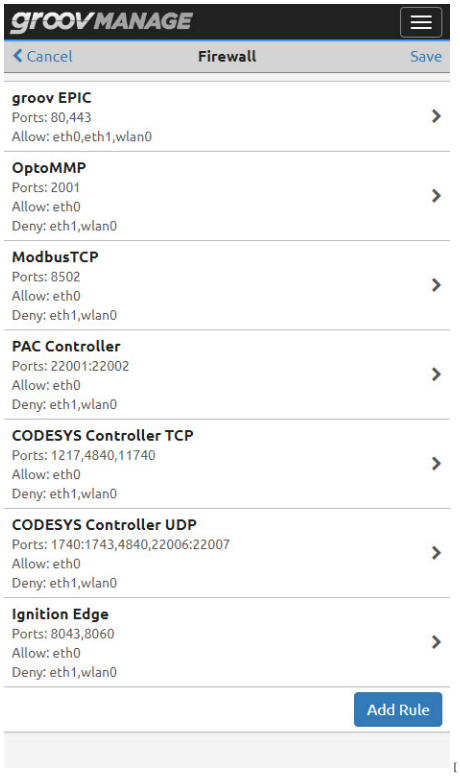
Please note that adding or changing firewall rules (which effectively opens ports in the firewall) does not start the listening services that may or may not be behind those ports. If you encounter problems accessing those services, check that the services are on and listening.

Changing a Firewall Rule

When you make changes to the *groov* EPIC processor's firewall, the changes take effect immediately. So, make sure you schedule this change during a time that minimizes the impact to your system and users. If necessary, notify your users of this change so they can plan accordingly.

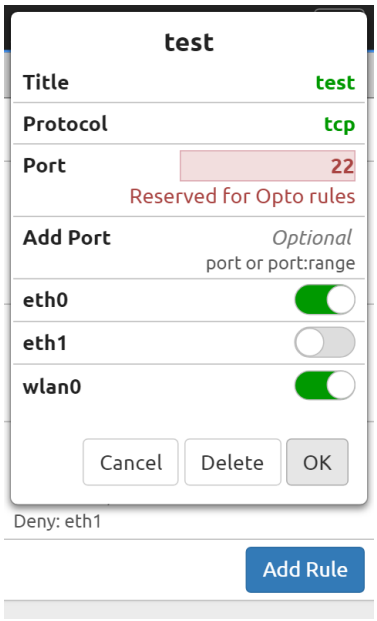
To change a firewall rule:

1. Log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. Click or tap Security > Firewall. The Firewall page displays the rules currently in effect and may look similar to this:



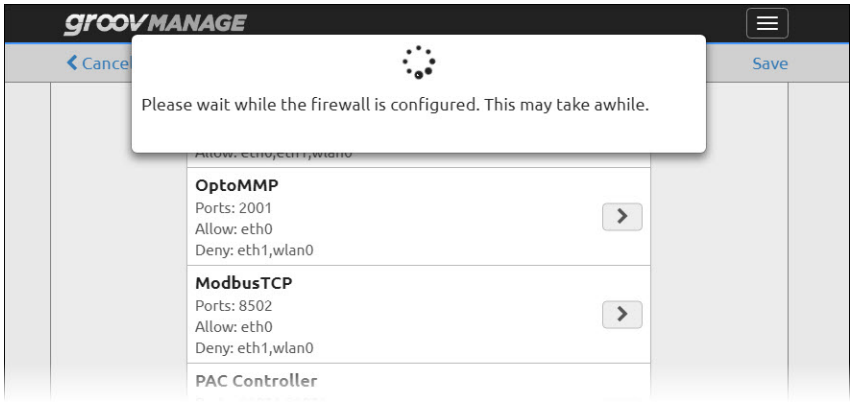
3. Click or tap on the rule you want to change.
4. Make changes.

5. Click or tap OK. If there are any errors in your changes, *groov* Manage highlights the error and displays an error message.



Fix the error or errors and then click OK.

6. Click or tap Save. *groov* Manage displays a message that it is configuring the firewall. If there are any conflicts with existing rules, *groov* Manage will highlight the row with the conflict and then you can change the rule to eliminate the conflict.



After *groov* Manage finishes saving and implementing the changes, it displays the Security page.

Please note that adding or changing firewall rules (which effectively opens ports in the firewall) does not start the listening services that may or may not be behind those ports. If you encounter problems accessing those services, check that the services are on and listening.

7: Connecting *groov* EPIC to a Network or Multiple Networks

The topic of networking can be complex. In this chapter, we cover the following scenarios:

- Connecting the *groov* EPIC processor to a local area network, either wired or wireless.
- Connecting the *groov* EPIC processor to a virtual private network (VPN).

The configuration changes will require a restart of the network connections on the processor. Schedule this task at a time that minimizes the impact on your application and equipment.

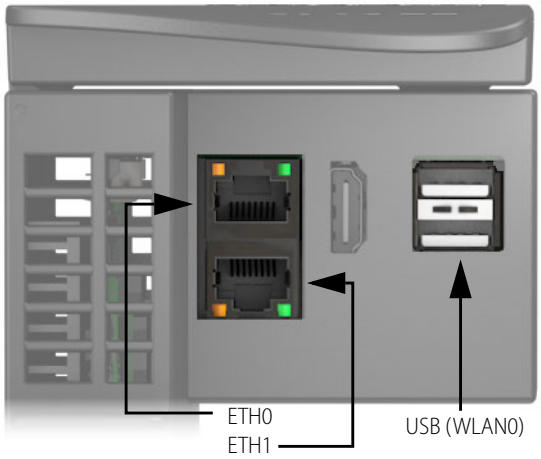
If you have an IT department, work with them as you complete these steps:

1. Review your current networking requirements and practices, as well as the *groov* EPIC processor's networking capabilities and default settings. Decide whether the default network settings are sufficient for your network or if you need to change some of the defaults. For more information, see "Selecting a Network Configuration" on page 50.
2. If you'll be changing the default network settings or connecting to a virtual private network with OpenVPN, gather up and verify the information you need before you begin changing settings. See "Collecting Network Configuration Information" on page 53.
3. Configure the appropriate network interfaces (ETH0, ETH1, and WLAN0) on your *groov* EPIC processor with the information you collected from the previous step. See "Configuring the Network Interfaces" on page 57.
4. If you are connecting to a virtual private network with OpenVPN, configure the OpenVPN Tunnel 0 interface as described in "Connecting to a Virtual Private Network (VPN)" on page 60.
5. Test your network connections and fine-tune your security. See "Testing the Network Connections and Fine-Tuning Security" on page 62.

SELECTING A NETWORK CONFIGURATION

You can connect the *groov* EPIC processor to up to four different networks:

- A virtual private network (VPN), connected through either ETH0, ETH1, or WLAN0.
- Wired communications through either ETH0 or ETH1.
- Wireless communication, through one approved USB WiFi adapter connected to either USB port. For a list of approved adapters, see "Installing an Approved USB WiFi Adapter" on page 97. (You cannot have more than one USB WiFi adapter plugged into the processor.)



ETH0, ETH1, and WLAN0 are physically separated from each other, which means there is no communication or routing between the networks.

The *groov* EPIC processor is set up, by default, for you to plug an Ethernet cable into ETH0, turn on the processor, and it automatically connects to the network. This works best in a networking environment that is simple (for example, a computer and a few devices) and managed by a DHCP server. If your *groov* EPIC processor will be running in this type of networking environment, review "Initializing with ETH0" on page 50 and "Keeping Networks Separate" on page 51, then go to "Configuring the Network Interfaces" on page 57.

For more complex networking environments, you can configure the network interfaces to connect to several networks in a variety of combinations. For example:

- Configure ETH0 to connect to a local control network and configure ETH1 to connect to a local office network.
- Configure ETH0 to connect to a local network, configure OpenVPN Tunnel 0 to connect to a virtual private network, and leave the other two interfaces alone or, for enhanced security, disable them.
- Configure ETH0 to connect to your local control network and configure WLAN0 to connect to the Internet.

To help you determine a combination that is best suited for your application, review all the information in this section before configuring network settings in the *groov* EPIC processor.

Initializing with ETH0

When you *initialize* your processor or if you are setting up local I/O for CODESYS projects, you must connect the processor to a network through ETH0, which means a wired network connection. (For more information about initialization, see Chapter 4: Initializing the groov EPIC Processor.) So, plan on starting with a wired network connection to ETH0. After you finish all the initialization (which can include configuring the network interfaces for other types of network connections), you'll switch to the networking configuration you want, or you can do any of the following:

- Leave ETH0 connected to that network.
- Disconnect ETH0 (remove the Ethernet cable) from that network.
- Disconnect ETH0 from that network and connect it to a different network.
- Disable ETH0 through *groov* Manage.

Keeping Networks Separate

Each network interface must be connected to a separate network. Here are a few simple things you can check to prevent connecting the network interfaces to the same network:

- Do not connect the cables that are connected to ETH0 and ETH1 to the same switch, hub, or router.
- If you do connect the cables to different switches, hubs, or routers, make sure that those switches, hubs, or routers are not connected to the same network. Check with your IT department to ensure these devices are not on the same network.
- Make sure that the wireless access point (SSID) that you select for WiFi is not on the same network as either ETH0 or ETH1.

Reviewing Network Requirements

In a simple network, a DHCP server assigns the following to any new device that joins the network:

- IP address
- Subnet mask
- DNS server: IP address and domain name
- Gateway IP address

With simple applications and networks, having the DHCP server manage these assignments is usually sufficient. The *groov* EPIC processor's default configuration is designed to work with this type of network. If your application and network fall into this category, review "Choosing between Automatic and Manual Connections" (below).

However, for certain applications or in some complex networking environments, you may want the *groov* EPIC processor to override or ignore the information it receives from the DHCP server.

- **Example 1**—Your IT department may want to assign the *groov* EPIC processor a specific IP address and subnet mask.
- **Example 2**—Your IT department may want to assign a specific gateway address, or DNS server IP address and domain name to a network interface (ETH0, ETH1, WLAN, or OpenVPN Tunnel 0).
- **Example 3**—Your IT department may want to route traffic leaving the *groov* EPIC processor through a specific path.

These examples illustrate why it is important to work with your IT department (if you have one) before connecting your *groov* EPIC processor to a complex network. Review the information in the rest of this section with your IT department. As you review the information, you'll be collecting information that you'll need when it's time to configure the network interfaces. Instructions on what information you need to collect are in "Collecting Network Configuration Information" on page 53.

Choosing between Automatic and Manual Connections

For each physical network interface on the *groov* EPIC processor that you are connecting to a network, you can choose one of two connection methods:

- **Automatic**—The DHCP server assigns the IP address and subnet mask. Select this method if:
  - Your network is simple (for example, the only devices on the network are your computer and the *groov* EPIC processor).
  - The default network settings on the *groov* EPIC processor meet the needs of your network environment.
  - The default network settings meet your networking requirements and you plan to add a wireless adapter.
  - The DHCP server can assign the IP address and subnet mask, but you want to be able to override the gateway address or DNS IP address and name server.

  For any of these situations, review "Collecting Information for Automatic Connections" on page 53.

- **Manual**—You or the IT administrator need to enter an IP address, a subnet mask, and, in the cases described below, additional configuration information. Select this method if you or your IT department require advanced network configurations.

Implementing Advanced Networking Requirements

For the unique cases described earlier, review the information below. Most of these options are available on all the network interfaces (ETH0, ETH1, WLAN0, and OpenVPN Tunnel 0).

- If you need to override the DNS server IP address and domain name assigned by the DHCP server, see "Overriding the DNS Server IP Address and Domain Name Assigned by DHCP Server" (below).
- If you need to do either of the following, see "Adding DNS Servers and Specifying the Order in which DNS Servers are Queried" (below):
  - Add more DNS server IP addresses and domain names.
  - Specify the order in which the DNS servers are added to the DNS resolver's configuration.
- If you need to do either of the following, see "Adding Gateway IP Address or Overriding the Gateway IP Address Assigned by the DHCP Server" (below).
  - Add a gateway IP address or override the gateway IP address assigned by the DHCP server.
  - Alter the order in which gateways are invoked. Gateway Order determines which interface's gateway is used for off-subnet destination-based routing. The gateway associated with the active interface with the lowest gateway order will be used as the default gateway. For more information about this topic, see "G: Advanced Networking Configurations" on page 249.

Overriding the DNS Server IP Address and Domain Name Assigned by DHCP Server. If your network policy is for the DHCP server to assign the IP address and subnet mask, but the IT administrator manually assigns the domain name server (DNS), you will need the IP address and domain name of that server when it's time to configure the *groov* EPIC processor. Record this information "Table of Additional Gateways IP Addresses, DNS IP Addresses and Name Servers, and Order" on page 55 (in the Automatic section, as DNS Server 1 Override and DNS Domain 1 Override, under the network interface that requires this configuration) so that it is readily available when you configure the processor.

You can specify additional domain name servers, entering them as the second (DNS Server 2 Override with DNMS Domain 2 Override) and third (DNS Server 3 Override with DNMS Domain 3 Override) entries in the table, also in the Automatic section.

Adding DNS Servers and Specifying the Order in which DNS Servers are Queried. You can assign up to three domain name servers to each network interface on the processor and indicate the order in which to communicate with the servers. You can set the DNS Order of a network provisioning domain to specify the priority that name servers and search domains are added to the DNS resolver's configuration, which has a maximum limit of three name servers and six search domains. When a DNS request is made, the resolver queries name servers in series in the order defined in the configuration. If a response is received with either a successful resolution or with a reply code such as "Name not found", no other name servers are queried. If the DNS request times out, the next name server is tried until all name servers are exhausted. Be aware that name resolution of secondary and tertiary name servers may be slow due to the sequential nature of queries by the DNS resolver.

For each network interface that requires this configuration, make a note of the DNS server IP addresses and domain names in the Automatic section (for network interfaces where you selected Automatic connection) or the Manual section (for network interfaces where you selected Manual connection) of "Table of Additional Gateways IP Addresses, DNS IP Addresses and Name Servers, and Order". The DNS Order is per network interface, with 1 being the highest priority (the network interface queried first).

Adding Gateway IP Address or Overriding the Gateway IP Address Assigned by the DHCP Server. If your network policy requires the assignment of a specific gateway IP address, review the information in "Redirecting Traffic Initiated by an Incoming Connection Request" on page 249 to understand how the *groov* EPIC processor manages gateway assignments and prioritizes their use.

For each network interface that requires this configuration, make a note of the gateway IP address in the Automatic section (for network interfaces where you selected Automatic connection) or the Manual section (for network interfaces where you selected Manual connection) of "Table of Additional Gateways IP Addresses, DNS IP Addresses and Name Servers, and Order". The Gateway Order is per network interface, with 1 being the highest priority (the network interface queried first).

COLLECTING NETWORK CONFIGURATION INFORMATION

If you will be changing the default network setting or connecting to a virtual private network (VPN), you will want to collect some configuration information from your IT administrator. To help you organize this information and make it quicker to do the configuration, print the following tables and fill them out as you collect the information.

- "Tables for IP Address, Subnet Mask, and Additional Wireless Settings" on page 54
- "Table of Additional Gateways IP Addresses, DNS IP Addresses and Name Servers, and Order" on page 55

Save this information in a secure location that you can quickly access and refer to this information when you start following the instructions in "Configuring the Network Interfaces" on page 57.

Collecting Information for Automatic Connections

By default, the *groov* EPIC processor connects to networks automatically. If this method adequately meets the needs of your application, then:

- For wired communications, there is no additional information that you need to collect. Fill in the table ("Tables for IP Address, Subnet Mask, and Additional Wireless Settings") with "Automatic" in the ETH0 and ETH1 columns to remind you that you do not need this information.
- For wireless communications, fill in the IP address and Subnet mask rows of the table with "Automatic"; you don't need to manually specify an IP address and Subnet mask with Automatic. However, you do need to collect the following information:
  - **SSID**—A text string from 1 to 32 characters that uniquely identifies the wireless network. This should be the name of the wireless network access point you want the *groov* EPIC processor to join.
  - **Encryption**—The type of encryption to secure the packets:
    - **None**—Do not encrypt the packets.
    - **WEP**—A wireless security protocol that is not secure and has been deprecated by the Institute of Electrical and Electronics Engineers (IEEE). Do not select WEP for new installations unless it is the only option available. Instead, select WPA or WPA2.
    - **WPA**—Encrypt the packets with TKIP encryption (RC4) and an 8 to 63 digit ASCII or 64 digit hexadecimal key.
    - **WPA2**—Encrypt the packets with CCMP encryption (AES) and an 8 to 63 digit ASCII or 64 digit hexadecimal key.
  - **Key Type**—Select one of the following:
    - **Passphrase (ASCII)**—This is the typical key type for WPA.
    - **PSK (HEX)**—This is the typical key type for WEP.
  - **Key**—The password the *groov* EPIC processor must provide when it tries to join the wireless network.

TABLES FOR IP ADDRESS, SUBNET MASK, AND ADDITIONAL WIRELESS SETTINGS

WIRED		
	ETH0	ETH1
IP address		
Subnet mask		

WIRELESS	
	WLAN0
IP address	
Subnet mask	
SSID	
Encryption type	❑ None ❑ WEP ❑ WPA ❑ WPA2
Key type	❑ Passphrase (ASCII) ❑ PSK (HEX)
Key	Do not write down.

Collecting Information for Manual Connections

If you want to specify network configuration information manually, work with your IT department (if available), and note the following information in the "Tables for IP Address, Subnet Mask, and Additional Wireless Settings" on page 54:

- **IP Address** and **Subnet Mask**—These two pieces of information work together to create a unique network address. It's very important that you create a unique network address by assigning each network interface a different IP address and subnet mask. While the IP address must be *different* than any other device *on the same network*, the subnet mask must be the *same* as all other devices *on the same network*. For example:
  - All the devices on network A are assigned a subnet mask of 255.255.0.0.
  - All the devices on network B are assigned a subnet mask of 255.0.0.0.

  If you connect the processor to network A, make sure to specify 255.255.0.0 as the subnet mask.
- For wireless communications, in addition to the IP address and subnet mask, you need to collect the **SSID**, **Encryption**, **Key Type**, and **Key**, as described "Collecting Information for Automatic Connections" on page 53.

If you are also configuring the network interfaces for the complex scenarios described in "Implementing Advanced Networking Requirements" on page 52, that section described what information to collect and where to store in "Table of Additional Gateways IP Addresses, DNS IP Addresses and Name Servers, and Order" on the next page.

TABLE OF ADDITIONAL GATEWAYS IP ADDRESSES, DNS IP ADDRESSES AND NAME SERVERS, AND ORDER

	Setting	ETH0	ETH1	WLAN0	OpenVPN Tunnel 0
Automatic	Gateway Override				
	DNS Server 1 Override				
	DNS Server 2 Override				
	DNS Server 3 Override				
	DNS Domain 1 Override				
	DNS Domain 2 Override				
	DNS Domain 3 Override				
	Gateway Order				
	DNS Order				
Manual	Gateway Address			N/A	
	DNS Server 1				
	DNS Server 2				
	DNS Server 3				
	DNS Domain 1				N/A
	DNS Domain 2				
	DNS Domain 3				
	Gateway Order				
	DNS Order				

Collecting Network Configuration Information for OpenVPN Connection

There are many resources available online to help you learn about and set up a virtual private network (VPN) with OpenVPN technology. This section assumes you have a functioning OpenVPN server. The *groov* EPIC processor works as an OpenVPN client that connects to the OpenVPN server. (The *groov* EPIC processor cannot be set up as an OpenVPN server.) You'll need the OpenVPN server administrator to provide you with the following:

- A username and password to login to the OpenVPN server.
- If necessary, a username and password for proxy connections.
- Depending on the security and authentication configuration of the OpenVPN server, you may need some or all of these files or information:
  - A public key, also known as a certificate, which is typically available as a file that ends in `.crt`.
  - A private key that is created specifically for the *groov* EPIC processor. It is typically available as a file that ends in `.key`.
  - A Certificate Authority (CA) certificate and key, which helps verify the public and private keys. These are also typically provided in files, with the certificate file that ends in `.crt` and the key file that ends in `.key`.
  - An OpenVPN static key, if required. Not all sites implement OpenVPN static keys. This key is typically stored in a file called `static.key`.
- The following server information:
  - **Protocol**–The communications protocol used by the OpenVPN server.
  - **OpenVPN server hostname** and **port number**–The hostname is usually a fully-qualified domain name (for example, vpnserver.example.com) or it could be an IP address.

- **Encryption Cipher**–The encryption cipher used by the OpenVPN server.
- **LZO Compression**–If the OpenVPN server uses LZO compression, then you will need to enable it on the *groov* EPIC processor.

Some of this information can be provided in a configuration file, which you can then upload into the *groov* EPIC processor. Uploading a configuration file could make configuring the processor easier and you will be less likely to introduce typing errors. When you receive the configuration file, review it to make sure it has the following information (and in the format indicated), as appropriate for your OpenVPN server's security and authentication configuration:

- Certificate Authority (CA)—The CA section should be surrounded by `<ca>` and `</ca>` tags. Inside those tags, the certificate text should be surrounded by `<cert>` and `</cert>` tags.
- Private and Public Key—The key text should be surrounded by `<key>` and `</key>` tags.
- Open VPN static key—The key text should be surrounded by `<tls-auth>` and `</tls-auth>` tags.

If it doesn't contain this information, you can edit the file and add it, making sure it is surrounded by the tags described previously.

If the administrator can't provide a configuration file, print the following table to collect the above information, save it in a secure place, and have it handy when you follow the instructions in "Connecting to a Virtual Private Network (VPN)" on page 60.

TABLE OF OpenVPN SETTINGS

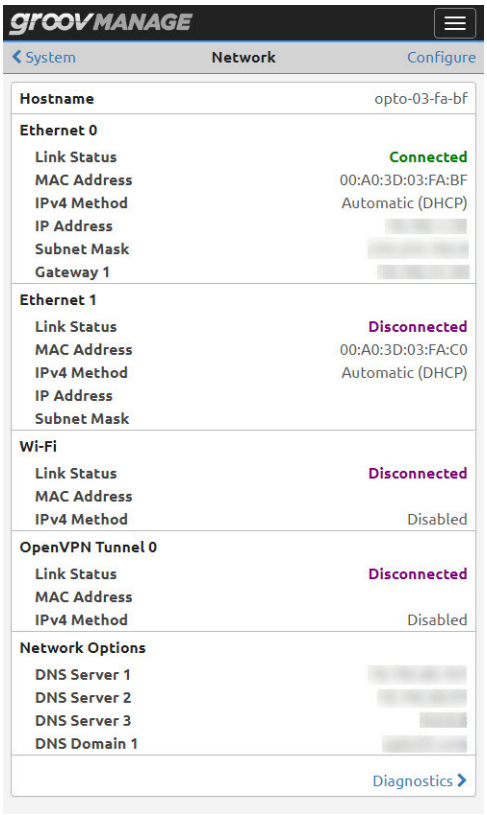
Information	Value
Protocol	❑ udp ❑ tcp-client
OpenVPN Server Host Name	_____
OpenVPN Server Port Number	_____
Remote Public Certificate Path and File Name	_____
User Name	_____
Password	Do not write down.
Proxy User Name	_____
Proxy Password	Do not write down.
Encryption Cipher	❑ none ❑ _____
LZO Compress	❑ yes ❑ no

CONFIGURING THE NETWORK INTERFACES

1. Log into the *groov* EPIC processor with a user ID that has administrator privileges.
2. Click or tap System.
3. Click or tap Network. *groov* Manage displays the Network status page.

   The Network status page shows you the current network configuration, and provides access to the Network configuration page, as well as diagnostic tools.

   In the example to the right, the processor is connected to a network through a cable plugged into ETH0. There is no network connection through ETH1, no WiFi connection through WLAN0, and no connection to a virtual private network. The values listed in the Network Options section were assigned by the local DHCP server.

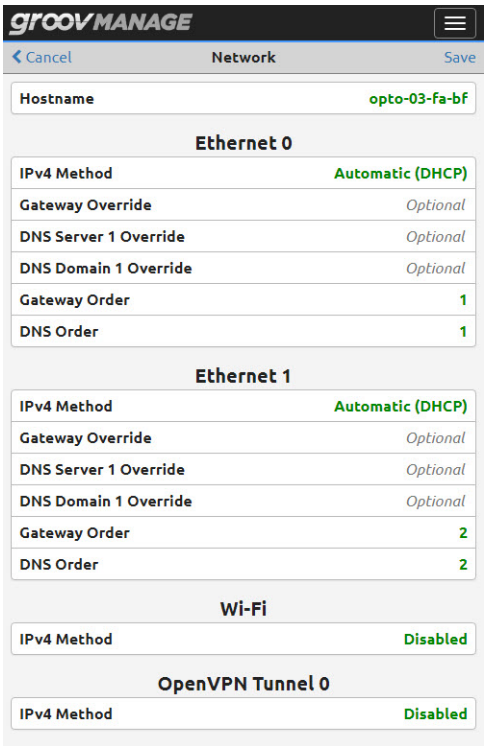


4. Click or tap Configure. *groov* Manage displays the Network configuration page. The example to the right shows the default settings.

   Ethernet 0 and Ethernet 1 show the current settings for ETH0 and ETH1, respectively. Wi-Fi shows the current settings for WLAN0. OpenVPN Tunnel 0 shows the current settings for a virtual private network.

   – To configure either ETH0 or ETH1 for wired communications, see "Configuring ETH0 or ETH1" on page 58.
   – To configure WLAN0 for wireless communications, see "Configuring WLAN0" on page 59.

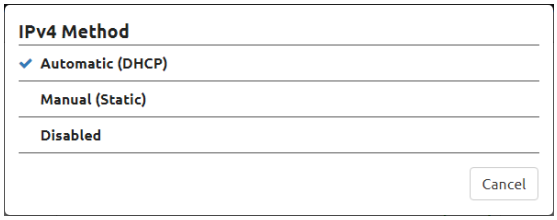
   When you are done with all the configurations, go to "Saving the Configuration" on page 60.



Configuring ETH0 or ETH1

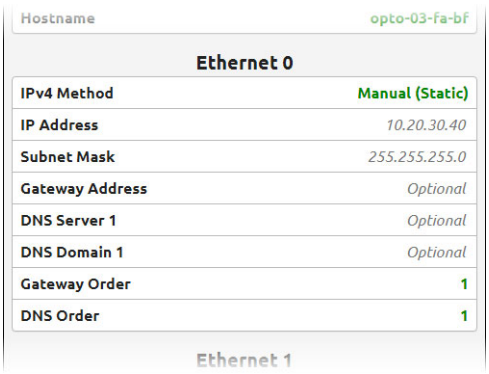
You'll want to have the information you collected when you read through "Collecting Network Configuration Information" on page 53 available as you follow these steps:

1. From the Network configuration page, click or tap the IPv4 Method currently assigned (the text in green) to ETH0 or ETH1. *groov* Manage displays the IPv4 Method window (see right).
2. Click or tap the connection method you want. If you choose Disable, skip to step 5.
3. If you selected Automatic and you don't want to override the DHCP server settings for gateway, DNS address, and DNS name server, skip to step 5. Otherwise, now is when you enter those override values from "Table of Additional Gateways IP Addresses, DNS IP Addresses and Name Servers, and Order" on page 55.



4. If you selected Manual, the Network configuration page changes to display additional fields. You'll want to refer to the values you entered in "Table of Additional Gateways IP Addresses, DNS IP Addresses and Name Servers, and Order" to fill out these fields:
   - IP Address
   - Subnet Mask
   - Gateway Address
   - DNS Server 1 and DNS Domain 1

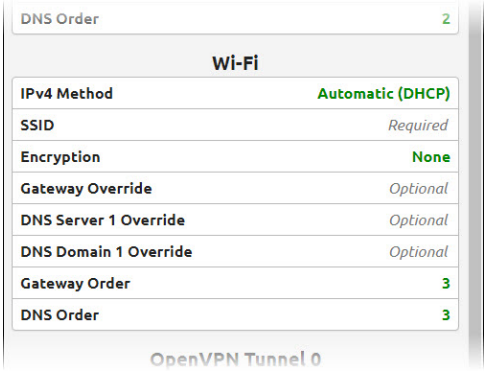
     These two fields must be specified as a set. If you need to enter more than one set, *groov* Manage displays fields to enter a second and third set after you enter the previous set.
   - Gateway Order
   - DNS Order

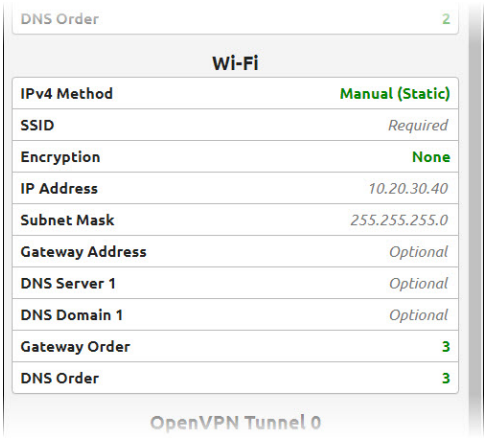


5. Choose from the following:
   - If you need to configure another network interface for wired communication, return to step 1.
   - If you need to configure WLAN0 for wireless communications, go to "Configuring WLAN0" on page 59.
   - If you are done configuring the physical network interfaces, go to "Saving the Configuration" on page 60.

Configuring WLAN0

1. From the Network configuration page, click or tap the IPv4 Method in the Wi-Fi section and select the connection method you want. *groov* Manage updates the Network configuration page as shown below (automatic on the left, manual on the right):



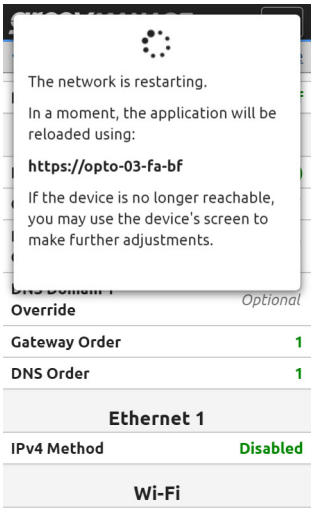


2. Enter the information you collected in "Collecting Network Configuration Information" on page 53.
3. Choose from the following:
   - If you need to configure a network interface for wired communication, see "Configuring ETH0 or ETH1" on page 58.
   - If you are done configuring the network interfaces, go to "Saving the Configuration" on page 60.

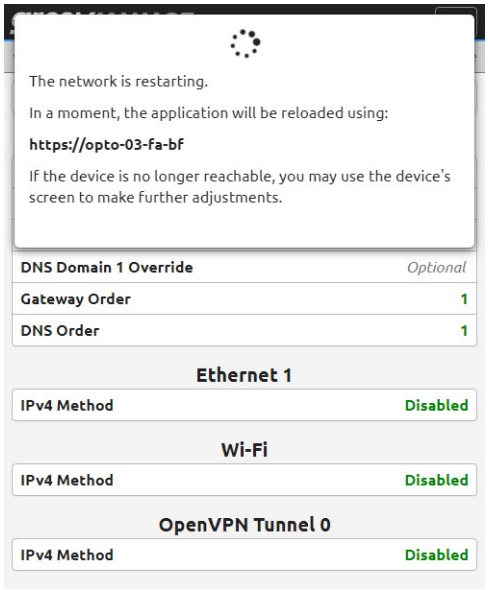
SAVING THE CONFIGURATION

In the Network configuration page, click or tap on Save. *groov* Manage displays a message that it will restart the network connections.

groov EPIC touchscreen



Computer web browser



After the network is restarted, you can test the network connections and fine-tune your security settings. If you need to set up a virtual private network (VPN), see "Connecting to a Virtual Private Network (VPN)" on page 60.

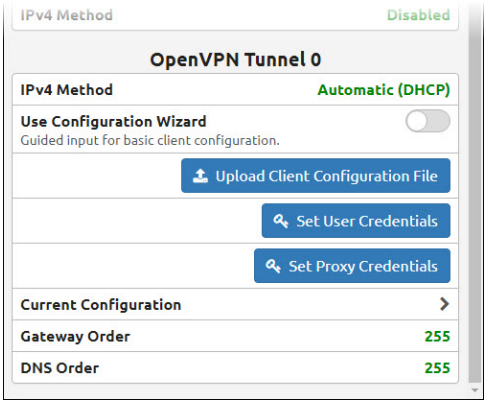
CONNECTING TO A VIRTUAL PRIVATE NETWORK (VPN)

Before you begin:

- Make sure you've configured at least one physical network interface (see "Configuring the Network Interfaces" on page 57) and that it's functioning.
- Check that you have all the information you collected when you reviewed "Collecting Network Configuration Information for OpenVPN Connection" on page 55.
- Verify that the OpenVPN server is reachable.

Let's begin:

1. From a browser, connect to the *groov* EPIC processor and log into *groov* Manage with a user ID and password that has administrator privileges.
2. If you will be entering the configuration manually (without a configuration file as described in "Collecting Network Configuration Information for OpenVPN Connection" on page 55), upload the public key.
   a. From the *groov* Manage Home page, click Security > Client SSL.
   b. Click Add/Update.
   c. Navigate to the folder where you stored the public key (`.crt`) file.
   d. Select the key, then click Open.
3. Click Back > Home to return to the *groov* Manage Home page, then click System > Network.
4. Click Configure.
5. In the OpenVPN Tunnel 0 section, click IPv4 Method and select Automatic (DHCP).



6. Enter the configuration information you collected when you reviewed "Collecting Network Configuration Information for OpenVPN Connection" on page 55.
   - If your VPN information is in a client configuration file, click Upload Configuration File. Navigate to the folder where you stored the configuration file, select it, then click Open. Click Set User Credentials to enter the OpenVPN server user name and password. If necessary, click Set Proxy Credentials to enter the proxy credentials. Go to step 7.
   - If you need to enter the configuration information manually, slide the User Configuration Wizard switch to the right, until it turns green.

   a. Click Protocol to select the protocol used by your OpenVPN server.

   b. Enter the IP address or full domain name of the OpenVPN server in the Remote Host field

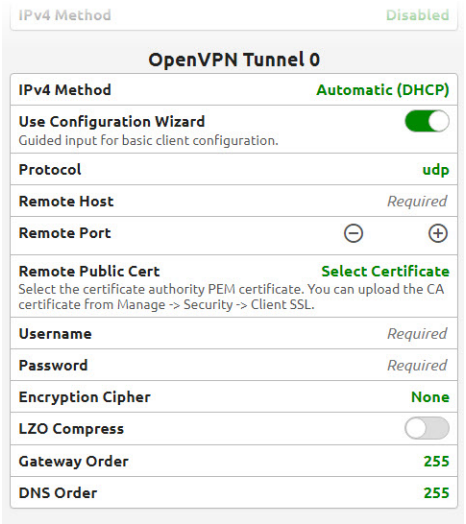
   c. To enter the port number, click in the space between the - and + sign. Type in the port number.

   d. Click Select Certificate and select the certificate you uploaded in step 2 on page 60.

   e. In the Username and Password fields, type in the OpenVPN server username and password. (Not the proxy username and password.)

   f. Click Encryption Cipher and select the cipher used by your OpenVPN server from the list.

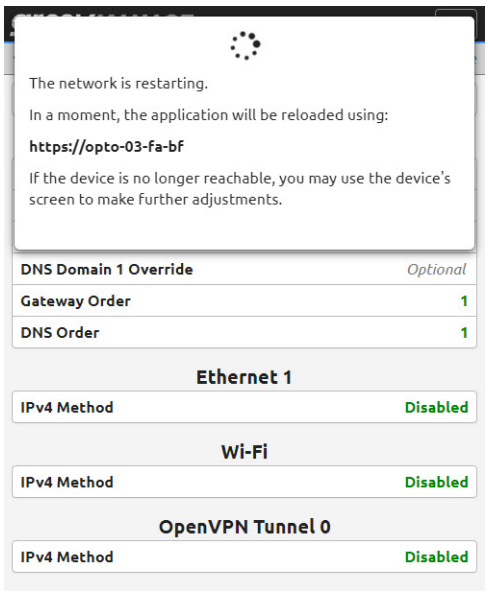
   g. If the OpenVPN server users LZO compression, slide the LZO Compress switch to the right, until it turns green.



   h. If you need to modify the Gateway and DNS order, click on those numbers and change them.

7. Click Save. If *groov* Manage reports any errors, fix those errors and click Save. Otherwise, *groov* Manage displays a message that it will restart the network connections.

Computer web browser



TESTING THE NETWORK CONNECTIONS AND FINE-TUNING SECURITY

To test the network connections, do one of the following:

- If you switched to Automatic, wait a few seconds for the processor to receive an IP address from the DHCP server. The logon page will refresh and display the IP address after it receives it.
- If you switched to Manual, verify that the IP address works by trying to connect to the processor from a web browser. Or, from a Windows computer that's connected to the same network, you can try the ping command in a command prompt window.

If you encounter any issues with ETH0, ETH1, and WLAN0, see Chapter 17: Troubleshooting for topics regarding network connections. If you are troubleshooting issues with an OpenVPN connection, you can review the VPN client logs for messages. To access the logs, from the *groov* Manage home page, click Info and Help > Logs > OpenVPN Client.

For enhanced security, disable any network interfaces you aren't using.

You may also want to update your security options and firewall settings:

- "Managing the SSL Security Features of your groov EPIC Processor" on page 38
- "Configuring the Firewall" on page 42

8: Enabling MQTT

WHAT IS MQTT?

MQTT is a publish/subscribe (pub/sub) protocol that's suited to many IIoT applications because of its architecture.

In a pub/sub architecture, a central source, called a broker, receives, distributes, and, in some cases, stores data. MQTT clients can publish data to the broker or subscribe to get data from a broker (or both). Clients who publish data send it only when the data changes. Clients who subscribe to data automatically receive it from the broker only when it changes. To view a video that explains how an MQTT broker works and why it's a great choice for automation applications, visit our website (www.opto22.com), and search for "What is an MQTT broker?"

Contrast this with a client/server architecture. With this architecture, the client and server must be connected, because the client requests data directly from the server. The client doesn't know when the data changes, so it must request it at regular intervals.

MQTT pub/sub offers three main advantages over client/server for IoT applications:

- Network traffic is reduced overall, because data is published and sent only when it changes, rather than at regular intervals.
- Because the broker is a central source that manages data, servers don't have to strain to serve multiple clients. And even remote devices with irregular connections or low bandwidth can publish or subscribe to data. If a publisher can't connect to the broker, for example, the publisher can optionally buffer its data and send it at a later time.
- For data publishers and subscribers, there's another important advantage: data is published and subscriptions are initiated through an outbound connection. Most firewalls block inbound traffic requests (for example, an external OPC client requesting data from an internal OPC server), but they allow outbound connections over secure TCP ports.

For more information about the protocol, see mqtt.org.

CHOOSING AN MQTT TRANSMISSION OPTION

The *groov* EPIC processor provides several ways to transmit payloads formatted to meet the Sparkplug B specification or formatted as strings. It can transmit those payloads with its own MQTT "transmission engine" or through Ignition's MQTT Transmission module.

Review the following and select the transmission option best suited for your application:

- **MQTT with string payloads**—Select this option if:
  - Your application requires that the payload be formatted as a string.

  - Your application is simple, perhaps monitoring or controlling only a few devices and operating in an area with limited connectivity.
  - Your application requires automation data from *groov* EPICs and SNAP PACs, but not from other PLCs.
  - You are looking for a cost-effective option. This option does not require the purchase of additional licenses.

  With this option, you will need to:

  - Convert data within your application. With payloads formatted as strings, you will need to add logic to your application to convert strings to the correct data type, when necessary.
  - Define the topic namespace.
- **MQTT with Sparkplug payloads published from GRV-EPIC-PR1**—Select this option if:
  - Your application requires that the payload be formatted to comply with the Sparkplug B specification.
  - Your application requires automation data from *groov* EPICs and SNAP PACs, but not from other PLCs.
  - You are looking for a cost-effective option. This option does not require the purchase of additional licenses.

  With this option, you'll be able to queue data into RAM, which will then be transmitted when the service is available. However, because the queued data is stored in RAM, it can be lost when power is cycled or space runs out.

  Keep in mind that you will need to:

  - Define the topic namespace.
  - Provide the MQTT configuration information through *groov* Manage and then enable the service.

  To view a video that explains the benefits of transmitting tag data through MQTT with Sparkplug B payloads, visit our website (www.opto22.com), and search for "Intro to MQTT with Sparkplug".
- **MQTT with Sparkplug B payloads published through Ignition Edge software**—Select this option if your application requires:
  - That the payload be formatted to comply with the Sparkplug B specification.
  - Automation data from *groov* EPICs and SNAP PACs, as well as from Allen-Bradley, Siemens PLCs, and devices that communicate through Modbus/TCP.
  - Ignition or Ignition Edge software from Inductive Automation, with access to features like:
    - State management
    - Storage of up to one week of data
    - Persistence
    - Work with other Ignition Edge modules or full Ignition platform.

  Applications that need this option are typically SCADA or SCADA-like applications and critical applications. The Ignition Edge software is preloaded on the *groov* EPIC processor. You will also need either the GROOV-LIC-EDGE license (to use the Ignition Edge software) or a full Ignition license (to use the Ignition software).

  To view a video that explains the benefits of transmitting tag data through MQTT with Sparkplug B payloads, visit our website (www.opto22.com), and search for "Intro to MQTT with Sparkplug".

For instructions on configuring MQTT with string payloads, see "Configuring and Enabling MQTT with String Payloads" on page 65.

For instructions on configuring MQTT with Sparkplug payloads published from GRV-EPIC-PR1, see "Configuring and Enabling MQTT with Sparkplug B Payloads from GRV-EPIC-PR1" on page 68.

For instructions on configuring MQTT with Sparkplug payloads published through Ignition software, see "Configuring and Enabling MQTT with Sparkplug Payloads Published through Ignition Edge Software" on page 72.

COMBINING MQTT TRANSMISSION OPTIONS ON A *groov* EPIC PROCESSOR

You can run **MQTT with Sparkplug payloads published through Ignition Edge software** with either of the following at the same time:

- MQTT with Sparkplug payloads published from GRV-EPIC-PR1
- MQTT with string payloads

However, you cannot run **MQTT with Sparkplug payloads published from GRV-EPIC-PR1** with **MQTT with string payloads** at the same time.

You cannot run all three options at the same time.

CONFIGURING AND ENABLING MQTT WITH STRING PAYLOADS

To connect your *groov* EPIC processor to an MQTT infrastructure, you will need to:

- Create a new MQTT broker or establish access to an existing one. The broker can be located on your premises or in the cloud. Information is available online to set one up; setting up an MQTT broker is not covered in this guide.
- Configure and start the MQTT service through *groov* Manage.

To help the configuration go more smoothly, it's helpful to first collect some information about the MQTT broker, as well as determine some identifying information for the *groov* EPIC processor, and review some settings that may affect the transmission performance of the processor.

Collecting Information and Reviewing Processor Settings

Collecting information about the MQTT broker

You'll need to collect the following information about the MQTT broker:

- **Broker URL**—The URL of the MQTT server.
- **Client ID**— This is optional. Only enter a client ID if one was supplied. If you do not enter a client ID, the MQTT service will generate one.
- **Username**—The username you need to access the broker.
- **Password**—The password you need to access the broker. This is optional, not all MQTT implementations require a password.
- **SSL**—If your MQTT server requires SSL, make sure you upload the correct SSL certificate (before you begin configuring the MQTT service), as described in "Managing the SSL Security Features of your groov EPIC Processor" on page 38.
- **ConnTimeout (ms)**—The default connection timeout value is 5000 milliseconds. You can adjust this value to account for slower or faster infrastructures. (For example, if your *groov* EPIC processor is in an area with "spotty" or slow connection, you may want to increase this value.) The minimum is 1000; the maximum is 30,000.
- **Keep Alive (s)**—The number of seconds between heartbeats. If there is no heartbeat for longer than the keep alive time, the last will and testament is sent.

Specifying Default Topics for the *groov* EPIC Processor

You'll need to collect or create the following information to uniquely identify your *groov* EPIC processor in your MQTT infrastructure. If necessary, consult with someone that assigns topics to determine if the processor will be assigned a specific set of topics, and whether you should follow a particular naming convention. All of the following information is required:

- **MQTT Base Topic**—The base topic is prefixed to the MQTT topic used to publish data.
- **MQTT Group Topic**—Identifies the group that your *groov* EPIC processor belongs to.
- **MQTT Subgroup Topic** —Identifies a subdivision within the group.

In addition, you'll need:

- **MQTT Device Topic**—Identifies your *groov* EPIC processor within the subgroup.
- **Use Comma in Floats**—If your application uses a comma to separate values (for example, pi is denoted as 3,14 instead of 3.14), you'll want to indicate that when you enter configuration information in *groov* Manage.

Assigning a Device ID and Reviewing Performance Settings

While the format of the payload is string, the content can be either tag data or OptoMMP memory maps. This flexibility can make the *groov* EPIC processor look like two differences *devices*. In fact, you can configure your *groov* EPIC processor to transmit both, where each device is identified by a unique ID that you create called a *device ID*. In *groov* Manage, the device that transmits tag data is called "Controller" and the device that transmits OptoMMP memory maps is called "OptoMMP". Each device can have its own performance and connectivity settings, which can affect throughput in an MQTT infrastructure. You configure these settings when you create the device and then you can fine-tune the settings as you monitor the device's performance.

For each device you want to create, collect the following information:

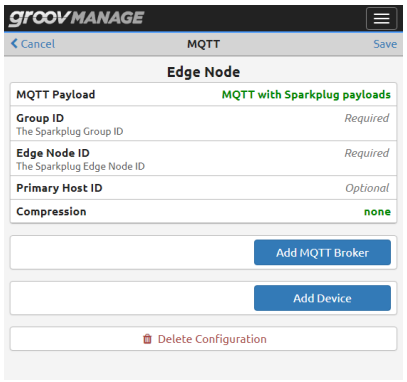
- **Device ID**—This is a unique ID that identifies the type of device data you are transmitting from your *groov* EPIC processor: tag or OptoMMP memory maps. If you want to transmit both tag data and OptoMMP memory maps, you will create two devices and each will require a device ID, so it would be helpful to indicate in the name which is OptoMMP and which is tag data. For example, `MyEPIC_tags` for tag data and `MyEPIC_OptoMMP` for OptoMMP memory maps.
- **Host TCP Port**—(Controller only.) This is the value of the *groov* EPIC processor's host TCP port. The default TCP port number is 22001. If you change this value, the new value must match the processor's host port.
- **CommTimeout(ms)**—The number of milliseconds that MQTT waits for the controller to respond to a request. If you set this value too small, you may see erratic communication timeouts.
- **Scan Time (ms)**—The scan interval in milliseconds. You may need to adjust this if the scans can't finish before the time is up.
- **Additional Host Tasks**—(Controller only, though you may see it on the OptoMMP dialog.) This is optional. If you notice performance degradation in your application due to a high number of tag access requests, you may want to set this parameter to 2, 3, or 4. The default value is 0.
  - Entering 2 moves the reads and writes to their own host tasks. This may be useful when writes are accumulating and you don't need an increase in read speed.
  - Entering 3 or 4 increases the alternate host tasks used for reads. This may be useful to reduce the read latency. This will be important when a substantial number of I/O tags or a very large read list is requested from the controller.

  Note that each additional task takes up a chart time slice. Therefore, if you are running 64 charts simultaneously and you increase this value, MQTT transmissions may fail.

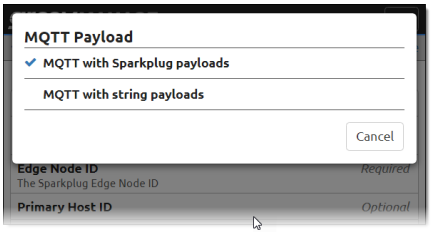
Configuring and Enabling MQTT Service

Make sure you are logged into your *groov* EPIC processor with an ID with administrator privileges before starting:

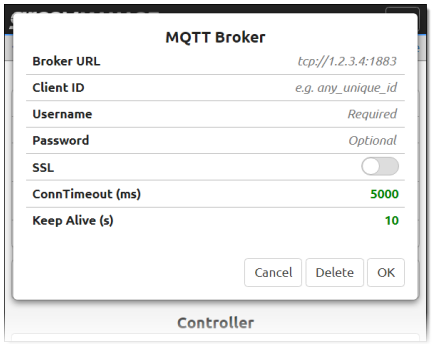
1. From the *groov* Manage Home page, click MQTT, then Configuration.



2. In the Edge Node section:
   a. Click MQTT Payload.

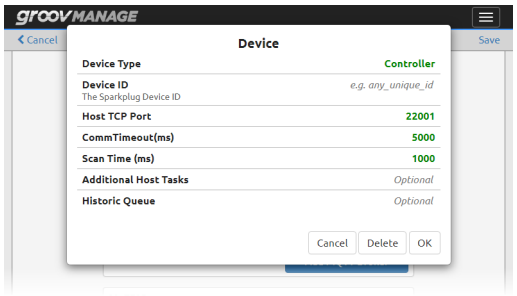


   b. Click MQTT with string payloads.
   c. Enter the information you collected in "Specifying Default Topics for the groov EPIC Processor" on page 66.
3. Click Add MQTT Broker.

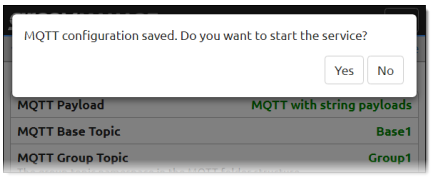


Enter the information you collected in "Collecting information about the MQTT broker" on page 65. Click OK to close the MQTT Broker window and return to the MQTT page.

4. Click Add Device.



   – If you want to create a Controller device, enter the information you collected in "Assigning a Device ID and Reviewing Performance Settings" on page 66.
   – If you want to create an OptoMMP device, click Device Type and select OptoMMP. Enter the information you collected in "Assigning a Device ID and Reviewing Performance Settings" on page 66.
5. Click OK.
6. Click Save. *groov* Manage validates the information that you entered.
   – If there are errors, *groov* Manage prompts you to fix the errors, highlighting (in red) the fields with invalid information. After you fix the errors, you can click Save.
   – If there are no errors, *groov* Manage saves the settings and then prompts you to confirm that you want to start the MQTT service. Click Yes. When it is done, *groov* Manage displays the MQTT page.



CONFIGURING AND ENABLING MQTT WITH SPARKPLUG B PAYLOADS FROM GRV-EPIC-PR1

To connect your *groov* EPIC processor to an MQTT infrastructure, you will need to:

- Create a new MQTT broker or establish access an existing one. The broker can be located on your premises or in the cloud. Information is available online to set one up; setting up an MQTT broker is not covered in this guide.
- Configure and enable the MQTT service through *groov* Manage.

To help the configuration go more smoothly, it's helpful to first collect some information about the MQTT broker, as well as determine some identifying information for the *groov* EPIC processor, and review some settings that may affect the transmission performance of the processor.

Collecting Information and Reviewing Processor Settings

Collecting information about the MQTT broker

You'll need to collect the following information about the MQTT broker:

- **Broker URL**—The URL of the MQTT server.
- **Client ID**— This is optional. Only enter a client ID if one was supplied.

- **Username**—The username you need to access the broker.
- **Password**—The password you need to access the broker. This is optional, not all MQTT implementations require a password.
- **SSL**—If your MQTT server requires SSL, make sure you have uploaded the correct SSL certificate, as described in "Managing the SSL Security Features of your groov EPIC Processor" on page 38.
- **ConnTimeout (ms)**—The default connection timeout value is 5000 milliseconds. You can adjust this value to account for slower or faster infrastructures. (For example, if your *groov* EPIC processor is in an area with "spotty" connection, you may want to increase this value.) The minimum is 1000; the maximum is 30,000.
- **Keep Alive (s)**—The number of seconds between heartbeats. If there is no heartbeat for longer than the keep alive time, the last will and testament is sent.

Specifying Unique Identifiers for the *groov* EPIC Processor

You'll need to collect or create the following information to uniquely identify your *groov* EPIC processor in your MQTT infrastructure. If necessary, consult with someone that assigns these IDs to determine if the processor will be assigned a specific set of IDs, and whether you should follow a particular naming convention.

- **Group ID**—Identifies the group that your *groov* EPIC processor belongs to.
- **Edge Node ID**—Identifies a subdivision within the group.
- **Device ID**—Identifies your *groov* EPIC processor within Edge node.

You will also need:

- **Primary Host ID**—This is optional. It enables notifications as to the "state" (offline or online) of the MQTT server.
- **Compression**—The algorithm used to compress payloads before they are published to the MQTT server, if necessary.

Assigning a Device ID and Reviewing Performance Settings

While the format of the payload is Sparkplug B, the content can be either tag data or OptoMMP memory maps. This flexibility can make the *groov* EPIC processor act like two differences *devices*. In fact, you can configure your *groov* EPIC processor to transmit both, where each device is identified by a unique ID that you create called a *device ID*. In *groov* Manage, the device that transmits tag data is called "Controller" and the device that transmits OptoMMP memory maps is called "OptoMMP". Each device can have its own performance and connectivity settings, which can affect throughput in an MQTT infrastructure. You configure these settings when you create the device and then you can fine-tune the settings as you monitor the device's performance.

For each device you want to create, collect the following information:

- **Device ID**—This is a unique ID that identifies the type of device data you are transmitting from your *groov* EPIC processor: tag or OptoMMP memory maps. If you want to transmit both tag data and OptoMMP memory maps, you will create two devices and each will require a device ID, so it would be helpful to indicate in the name which is OptoMMP and which is tag data. For example, `MyEPIC_tags` for tag data and `MyEPIC_OptoMMP` for OptoMMP memory maps.
- **Host TCP Port**—(Controller only.) This is the value of the *groov* EPIC processor's host TCP port. The default TCP port number is 22001. If you change this value, the new value must match the processor's host port.
- **CommTimeout(ms)**—The number of milliseconds that Sparkplug waits for the controller to respond to a request. If you set this value too small, you may see erratic communication timeouts.
- **Scan Time (ms)**—The scan interval in milliseconds. You may need to adjust this if the scans can't finish before the time is up.

- **Additional Host Tasks**—(Controller only, though you may see it on the OptoMMP dialog.) This is optional. If you notice performance degradation in your application due to a high number of tag access requests, you may want to set this parameter to 2, 3, or 4. The default value is 0.
  - Entering 2 moves the reads and writes to their own host tasks. This may be useful when writes are accumulating and you don't need an increase in read speed.
  - Entering 3 or 4 increases the alternate host tasks used for reads. This may be useful to reduce the read latency. This will be important when a substantial number of I/O tags or a very large read list is requested from the controller.

  Note that each additional task takes up a chart time slice. Therefore, if you are running 64 charts simultaneously and you increase this value, MQTT transmissions may fail.
- **Historic Queue**—The maximum number of publications that may be saved in memory when the connection to the broker fails. The value may range from 0 to 65535. Opto 22 recommends a value of 3600, a value that takes into account the fixed size of memory, which is also utilized by system applications. You may want to change this value after considering the following factors:
  - **Memory is limited. Saving publications can quickly consume memory.** The publications are stored in memory, so when you specify a large value, memory can be consumed quickly.
  - **Scan Time and frequency of change** in values. The following examples show why these two factors can create a large difference in the number of publications created:
    - Scan Time: 1 millisecond vs 1 second scan time. In a 2 second time period, the 1 millisecond scan time could create 2000 publications, whereas the 1 second scan time could create only two publications.
    - A tag that changes value every second versus every hour. In a 2 hour time period, a tag that changes value every second could create up to 7200 publications, whereas a tag that changes value every hour could create only two publications.

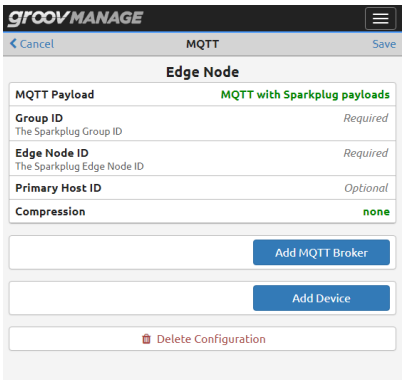
    Review your Scan Time and how frequently the values of your tags may change within a given time period to help you estimate how many publications might be created.
  - **The size of a publication** can vary greatly. Publications created by a PAC Control strategy can contain many tags (in the thousands). Publications created directly by the MQTT service on your EPIC processor or RIO module can contain as few as one tag.
  - **The number of devices creating publications** simultaneously. If you are configuring MQTT on a *groov* EPIC processor, you can create one or two MQTT devices to scan for values, each creating publications. (To learn more about multiple devices, see the first paragraph under "Assigning a Device ID and Reviewing Performance Settings" on page 66.) If you are running two devices, you are creating more publications than if you run one device.
  - If you are configuring MQTT on a RIO module, the previously mentioned factors (size of publications and number of devices) are less likely to quickly consume memory because a RIO module doesn't run PAC Control strategies, can not run more than one MQTT device to scan for values, and there are fewer tags . Therefore, it may be possible to specify a higher value for Historic Queue. However, pay particular attention to how Scan Time and how frequently a tag changes value can affect how many publications are generated, which then affects how much memory is consumed.

  If the number of publications exceeds this value, the oldest entries are discarded to make room for newer entries.

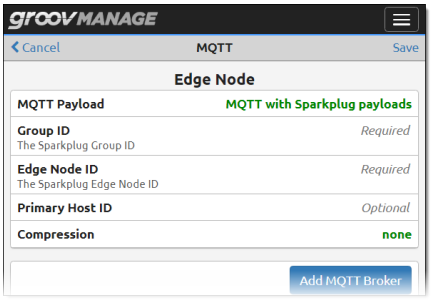
Configuring and Enabling MQTT Service

Make sure you are logged into your *groov* EPIC processor with an ID with administrator privileges before starting:

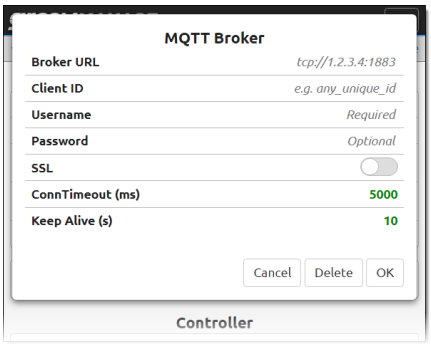
1. From the *groov* Manage Home page, click MQTT, then Configuration.



2. In the Edge Node section, enter the information you collected in "Specifying Unique Identifiers for the groov EPIC Processor" on page 69.

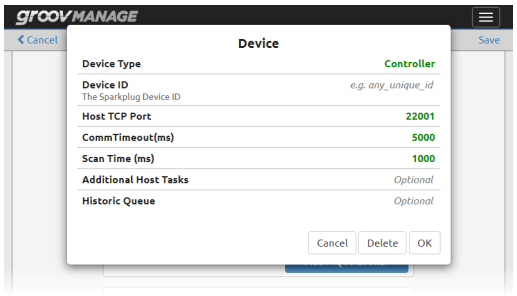


3. Click Add MQTT Broker. In the MQTT Broker page, enter the information you collected in "Collecting information about the MQTT broker" on page 68.

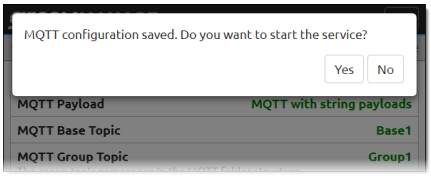


4. Click OK.

5. Click Add Device.



   - If you want to create a Controller device, enter the information you collected in "Assigning a Device ID and Reviewing Performance Settings" on page 69.
   - If you want to create an OptoMMP device, click Device Type and select OptoMMP. Enter the information you collected in "Assigning a Device ID and Reviewing Performance Settings" on page 69.
6. Click OK.
7. Click Save. *groov* Manage validates the information that you entered.
   - If there are errors, *groov* Manage prompts you to fix the errors, highlighting (in red) the fields with invalid information. After you fix the errors, you can click Save.
   - If there are no errors, *groov* Manage saves the settings and then prompts you to confirm that you want to start the MQTT service. Click Yes. When it is done, *groov* Manage displays the MQTT page.



CONFIGURING AND ENABLING MQTT WITH SPARKPLUG PAYLOADS PUBLISHED THROUGH IGNITION EDGE SOFTWARE

Ignition Edge software is preloaded onto your *groov* EPIC processor; you just need to enable it, and then configure it. If you are not familiar with Ignition Edge software, see "What is Ignition Edge?" on page 73.

Before you begin, make sure you have the correct license for the Ignition software you'll be using:

- **Ignition Edge**—purchase the GROOV-LIC-EDGE license from Opto 22.
- **Ignition**—purchase the appropriate license from Inductive Automation.

For an explanation of the two different types of licenses and how to obtain them, see "Licensing Ignition Software" on page 75.

These are the high-level tasks you need to do:

1. In *groov* Manage, select your preferred Ignition software platform and, if desired, enable Ignition Designer. For help deciding which platform to select and step-by-step instructions, see "Configuring and Starting Ignition Software" on page 74.
2. Configure the Ignition Edge System Gateway to:
   - Set the correct authentication and tag exposure settings for the OPC UA server.
   - Set the correct SSL security settings for the Gateway.

For step-by-step instructions and more explanation, see "Configuring the Ignition Edge System Gateway" on page 74.

If you selected Ignition in step 1, refer to the Ignition User Manual for any configuration information regarding security and authentication.

3. License the Ignition software. For step-by-step instructions on licensing Ignition Edge, see "Installing (Activating) the Ignition Edge License" on page 76. For instructions on licensing Ignition, refer to the Ignition User Manual.
4. Change the default password on the Ignition Edge Gateway. For step-by-step instructions, see "Changing the Default Password for Ignition Edge Gateway" on page 77.
5. Install the Opto 22 *groov* EPIC and SNAP PAC Driver. For detailed instructions, see "Installing the OPC UA groov EPIC and SNAP PAC Driver" on page 78.
6. Install the MQTT module. For detailed instructions, see "Installing the Ignition Edge MQTT Module" on page 78.

What is Ignition Edge?

Ignition Edge is an Industrial Internet of Things (IIoT) software application developed by Inductive Automation to help you develop applications for the network's edge. It's included in your *groov* EPIC processor and provides two key connectivity tools for IIoT applications:

- An internal **OPC UA** server and drivers for a number of commonly used PLCs, plus devices that communicate through Modbus/TCP. Additional drivers may be available for purchase from Inductive Automation and their partners.
- An **MQTT** module that enables the transmission of payloads that follow the Sparkplug specification. MQTT is a transport protocol that is highly useful in IIoT applications because of its architecture. To understand what sets it apart from other protocols, see "What is MQTT?" on page 63.

Because Ignition Edge is included in the *groov* EPIC processor, you can use its tags (in your *groov* View operator interface, Node-RED flows, and MQTT with Sparkplug payload communications):

- Without having to purchase a separate OPC UA server
- Without requiring a PC at the network's edge

The *groov* EPIC processor with Ignition Edge is especially useful for the plant floor, geographically dispersed locations, and OEMs, because everything is included in one compact, secure, industrial appliance.

With Ignition Edge in the *groov* EPIC processor:

- Data from many PLCs becomes easier to access for IIoT applications.
- Authorized operators can monitor and control these PLC systems from your *groov* View operator interface.
- All data in Ignition Edge can be published and subscribed to via MQTT with Sparkplug.
- Node-RED flows can use tags from the Ignition Edge tag database.
- It's easy to add other Inductive Automation products:
  - Other Ignition Edge-compatible modules
  - Additional drivers like DNP3, Omron®, and TCP/UDP
  - Ignition Edge Panel or Enterprise Administration Module (EAM)

You can work with the Ignition or Ignition Edge platforms on the *groov* EPIC processor:

- Through the Ignition Edge platform, only the Ignition applications and internal applications (like Node-RED and *groov* View) can access the OPC UA server. (This option requires the GROOV-LIC-EDGE license.)
- Through the Ignition platform, external applications can access the OPC UA server. (This requires the purchase of a full Ignition license; the GROOV-LIC-EDGE license is not compatible with the Ignition platform.)

Configuring and Starting Ignition Software

If your facility or site already uses Ignition software, the *groov* EPIC processor provides a few different options to help you take advantage of additional functionality available in Ignition software.

Enable Ignition Edge and Designer? If you enable only Ignition Edge, you will be able to:

- Access OPC UA-compatible drivers for *groov* EPICs, SNAP PACs, Allen-Bradley PLCs, Siemens PLCs, and other Modbus/TCP devices. After you install the drivers, you can access tags from these devices in your *groov* View projects and Node-RED flows. However, you can't access these drivers externally.
- Publish automation data (formatted to comply with the Sparkplug specification), then transmit it through MQTT (as a Sparkplug payload) to an MQTT broker on premises or in the cloud.

If you also want to work with advanced tag configuration features available in Ignition Designer, as well as additional modules like Panel and Enterprise Administration Module (EAM), then you'll also want to enable Designer in *groov* Manage.

You can change these choices at any time. However, keep in mind that if you disable Ignition Edge, the *groov* EPIC processor also disables Designer.

Choosing Between Ignition or Ignition Edge. Ignition and Ignition Edge are two platforms by Inductive Automation. Either platform can help you with the functions listed in "What is Ignition Edge?" on page 73 One of the major differences between the two platforms is that, with Ignition Edge, the OPC UA server and drivers are available only to internal applications (for example, Node-RED and *groov* View). With full Ignition, the OPC UA server and drivers are available to external applications, as well.

- If you choose **Ignition Edge**, you'll need to purchase and install the Opto 22 Ignition Edge license (GROOV-LIC-EDGE); contact Opto 22 Sales at sales@opto22.com for more information.
- If you choose **Ignition**, you can't use the Opto 22 Ignition Edge license (GROOV-LIC-EDGE). You will need to purchase and install a full Ignition license. Contact sales@opto22.com for details. If you select this option, support from Opto 22 is limited.

After you've made the decision about which platform (Ignition or Ignition Edge) to use and whether to enable Designer:

1. Log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. From the *groov* Manage Home page, click Ignition Edge.
3. In the Config section, click on Ignition Edge to select it. If you want to run Designer, click on it to select it. (You must first click on Ignition Edge before you can select Designer.)

   Note: To enable the Ignition or Ignition Edge platforms, you must select Ignition Edge in the Config section. If you do not select it, you will not be able to access either platform.

4. Scroll down to the Advanced section. To switch the platform, click on the currently selected platform name to open the Platform window, then select the platform you want.
5. Click Save. This will save your selections and enable the selected Ignition software.

Configuring the Ignition Edge System Gateway

The Ignition Edge Gateway is a service that runs on the *groov* EPIC processor, in the background. You access it through a web browser (either through *groov* Manage or by entering a URL in the browser). The Gateway helps you connect to devices and databases, configure its settings (including options like security and authentication), and add Ignition Edge modules that add more capabilities to the Ignition Edge platform.

These instructions help you configure the Ignition **Edge** gateway. If you selected the full Ignition platform, refer to the Ignition User Manual for instructions on configuring the Ignition Gateway.

1. Log into your *groov* EPIC processor with a user ID that has administrator privileges.

2. From the *groov* Manage Home page, click Ignition Edge, then Open Ignition Edge.

   NOTE: In the future, you can open Ignition Edge from this page in groov Manage, or you can go directly to Ignition Edge in your web browser by entering as the URL:
   `https://[your groov EPIC's hostname]:8043`
   Don't forget the "s" in https. Example:
   `https://opto-00-d2-da:8043`

3. Wait while Ignition Edge starts. (It may take a few minutes initially.)

   The Ignition Edge gateway webpage appears, showing that it's running in trial mode.

4. Sign in using the default username `admin` and password `password` and press Enter. (When you license Ignition Edge for full use, you will change your Ignition Edge password.)
5. In the top navigation bar, click Configure.
6. In the left navigation panel, scroll down and choose OPC-UA Server > Settings.
7. Change only the following:
   a. Under Authentication, check the box to Allow Anonymous Access.

      Allowing anonymous access does not create a security issue, because the Ignition Edge OPC server is on the same box as *groov* View.

   b. Under Expose Configured Tags, check the box to Expose Tag Providers (allows the server to get tags automatically for some manufacturers' devices).
8. Scroll to the bottom of the page and click Save Changes.
9. In the left navigation panel, choose System > Gateway Settings.
10. Scroll down and check the box next to Use SSL:

    Because Ignition Edge is in the *groov* EPIC processor and it includes a self-signed certificate, a purchased certificate may not be necessary. For more information on certificates, see "Managing the SSL Security Features of your groov EPIC Processor" on page 38.
11. Scroll to the bottom of the page and click Save Changes.

Licensing Ignition Software

The Ignition software on the *groov* EPIC processor runs for only two hours (trial mode), after which you will have to restart it. You can reset the trial as often as you wish. To run the software without the time restraint, you will need to purchase the correct license for the platform you selected in "Choosing Between Ignition or Ignition Edge" on page 74.

- For an Ignition Edge license, you need to purchase part number GROOV-LIC-EDGE, and then install the license key.

  Important: *For any of these situations, you will want to follow the instructions in "F: Installing the Correct License" on page 247, not the instructions in this section:*

  - You are installing firmware earlier than version 1.3.0.
  - You are restoring to defaults and the default version is earlier than 1.3.0.
- For an Ignition license, you need to purchase the license from Inductive Automation. Contact our Pre-sales team at systemseng@opto22.com for details on licenses.

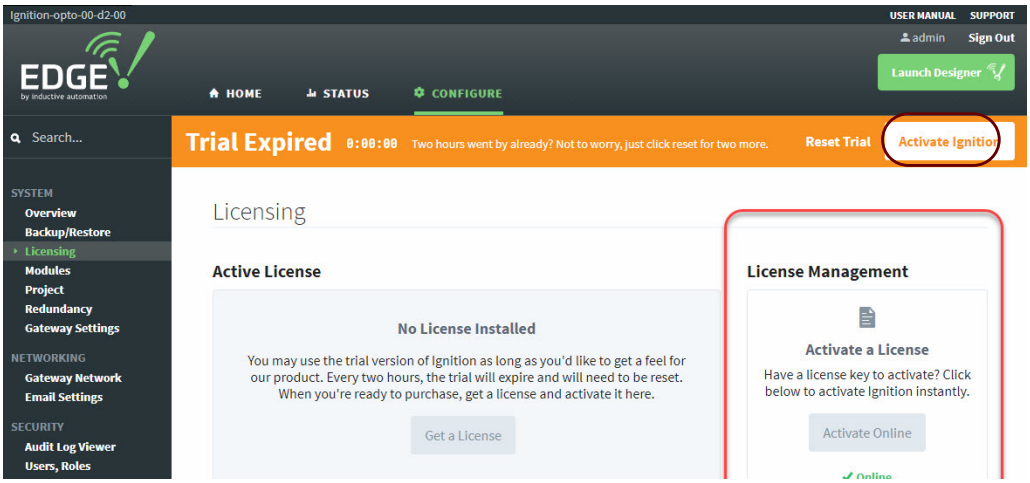
The rest of the instructions in this section help you license Ignition **Edge**. For instructions on licensing Ignition, refer to the Ignition User Manual.

Obtaining License Keys

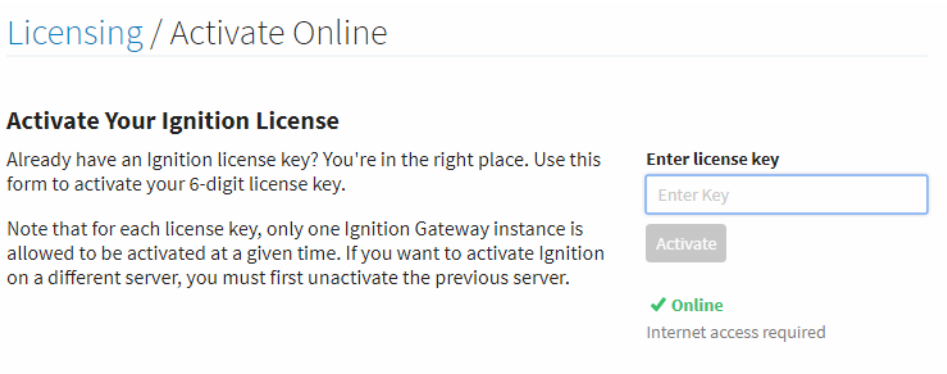
To obtain an Ignition Edge License Key, you must purchase part number GROOV-LIC-EDGE from Opto 22. After you receive the License Key file, save it in a secure place and remember where you stored it.

Installing (Activating) the Ignition Edge License

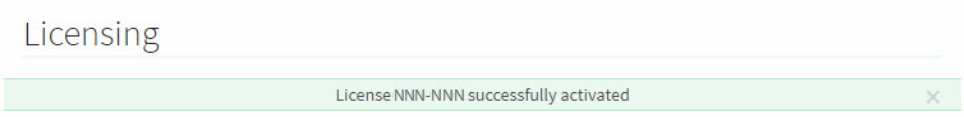
1. If it's not already open in a browser, open the Ignition Edge gateway page:
   - By entering a URL in your browser: `https://[your groov EPIC's hostname]:8043`
   - From *groov* Manage Home page, click Ignition Edge > Open Ignition Edge.
2. Click Activate Ignition (upper right).



3. Under License Management at the right, if your *groov* EPIC processor has Internet access, click Activate Online.



4. To activate online, enter the Ignition Edge license key you received from Opto 22 and click Activate. A confirmation message appears, stating that your license was successfully activated.



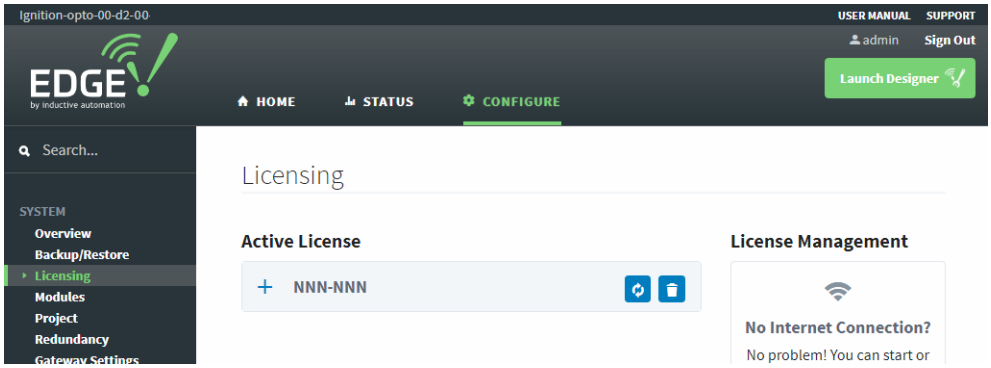
Deactivating the Ignition Edge license

Before you update your *groov* EPIC processor or reset it to factory defaults, be sure to deactivate your Ignition Edge license. After the update or reset is finished, activate the license again. By deactivating and then reactivating, you avoid having to contact Ignition Edge to have the license reinstated.

1. If it's not already open in a browser, open the Ignition Edge gateway page:

- By entering a URL in your browser: `https://[your groov EPIC's hostname]:8043`
- From *groov* Manage Home page, click Ignition Edge > Open Ignition Edge.

2. Click the Configure tab. In the left navigation panel, choose System > Licensing.



***IMPORTANT**: Make sure you have a record of your license number, so you can reactivate it later.*

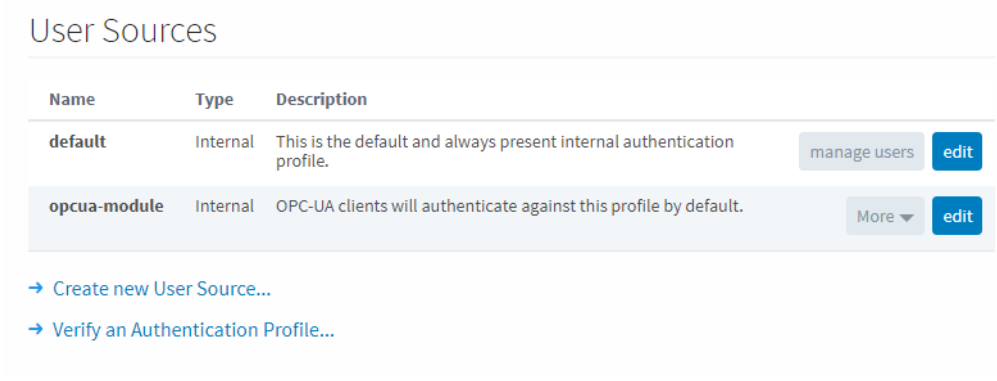
3. To deactivate, click the trash can button next to your license number.
4. To confirm, click Yes, Unactivate.

When you're ready to activate your license again, follow the steps in "Installing (Activating) the Ignition Edge License" on page 76.

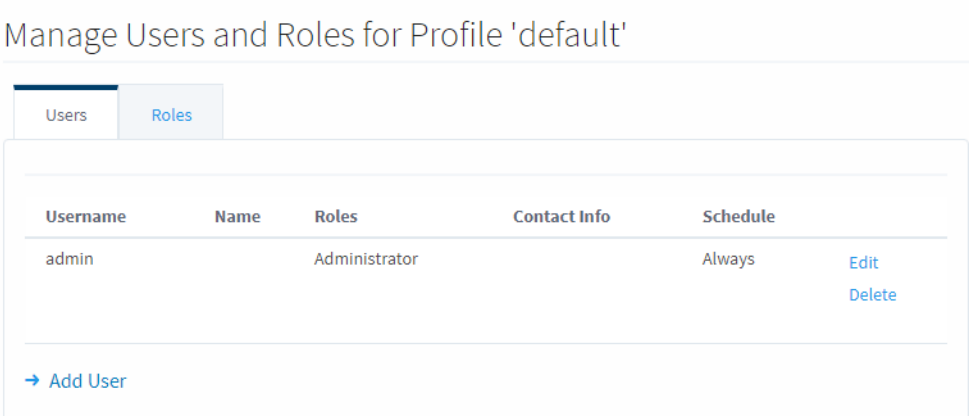
Changing the Default Password for Ignition Edge Gateway

You can change your username and password for Ignition whenever you want to. Be sure you change them after you license Ignition software. These instructions apply to Ignition **Edge**. For instructions on changing the default password for Ignition, refer to the Ignition User Manual.

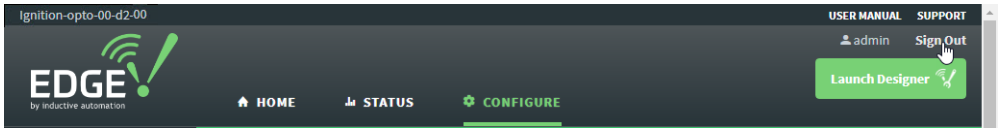
1. If it's not already open in a browser, open the Ignition Edge gateway page:
   - By entering a URL in your browser: `https://[your groov EPIC's hostname]:8043`
   - From *groov* Manage Home page, click Ignition Edge > Open Ignition Edge.
2. In the Ignition Edge gateway webpage, click the Configure tab.
3. In the left navigation panel, choose Security > Users, Roles.



4. For the default user, click the manage users button.



5. Click Edit and complete the following fields:
   - Username: enter new username
   - Check Change Password?
   - Password/Password: enter new password
   - (Optional) First Name/Last Name and Language: enter or change as necessary
6. Scroll to the bottom of the screen and click Save Changes.
7. In the top right corner of the page, locate Sign Out.



8. Click Sign Out. Then sign back in using your new username and password.

Installing the OPC UA *groov* EPIC and SNAP PAC Driver

1. If it's not already open in a browser, open the Ignition Edge gateway page:
   - By entering a URL in your browser: `https://[your groov EPIC's hostname]:8043`
   - From *groov* Manage Home page, click Ignition Edge > Open Ignition Edge.
2. In the top navigation, click Configure.
3. In the left navigation, click Modules (under the System heading). Scroll down until you see the `Opto 22 groov EPIC and SNAP PAC Driver` module.
4. Click Install. Confirm that you want to install the module.
5. Review the Module License Agreement.
6. Check "I accept the terms in the License Agreement". Click Accept License.

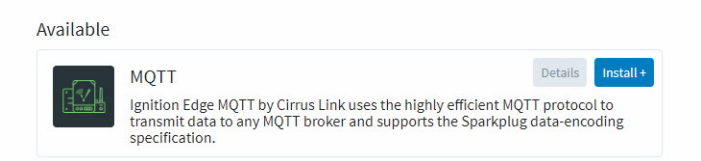
   When the success message appears, you can scroll down and see the `Opto 22 groov EPIC and SNAP PAC Driver` module listed under Cirrus Link Solutions.

To see documentation for the module, click More > documentation.

Installing the Ignition Edge MQTT Module

The MQTT module from Inductive Automation adds to Ignition Edge the capability of creating and managing MQTT with Sparkplug payload transmissions. Remember that if you selected MQTT with string payload, you do not do this task, nor use any of the Ignition software.

1. If it's not already open in a browser, open the Ignition Edge gateway page:
   - By entering a URL in your browser: `https://[your groov EPIC's hostname]:8043`
   - From *groov* Manage Home page, click Ignition Edge > Open Ignition Edge.
2. In the top navigation, click Configure. Scroll down till you see MQTT.



3. Click Install. On the next page, scroll down to find Quarantined modules and click the install button for MQTT Transmission. Then follow directions on the screen to accept the license.
4. Check "I want to add this certificate to my trusted certificates and install the module" and then click the button to install.

   When the success message appears, you can scroll down and see the MQTT Transmission module listed under Cirrus Link Solutions.

To see documentation for the module, click More > documentation.

9: Configuring System Features

A user with administrator privileges is the only user that can change system features. System features provide services like access control, device management, and time management.

SWITCHING BETWEEN PAC CONTROL ENGINE AND CODESYS RUNTIME ENGINE

The PAC Control Engine and the CODESYS Runtime Engine are mutually exclusive; you can run one or the other, but not both. When you switch between these engines, please be aware of the following:

- If you are running any control programs through secure shell, they will continue to run. As you design your control programs, make sure that they do not interfere with each other. For example, make sure they do not try to control the same channel.

If you are switching from PAC Control Engine to CODESYS Runtime Engine, your PAC Control strategy will be erased and Sparkplug will be disabled. Any CODESYS applications you might have previously downloaded will not be restored. You will need to restore them.

When you are ready to switch from the PAC Control Engine to the CODESYS Runtime Engine, follow the instructions in "Enabling the CODESYS Runtime Engine" on page 73.

If you are switching from CODESYS Runtime Engine to PAC Control Engine, your CODESYS applications will be erased. Any PAC Control strategy you might have previously downloaded will not be restored. You will need to restore it.

When you are ready to switch from the CODESYS Runtime Engine to the PAC Control Engine, follow the instructions in "Enabling the PAC Control Engine" on page 122. After you restore your PAC Control strategy, if the strategy was communicating through an MQTT broker, you need to enable Sparkplug before you try running the strategy:

1. Log into the *groov* EPIC processor with a user ID that has administrator authority.

2. From the *groov* Manage home page, click or tap Sparkplug.
3. In the Sparkplug Status box, click or tap Enable.

SETTING AND ADJUSTING DATE, TIME, AND TIME ZONES

Setting and adjusting the date, time, and time zones can help you with more than just setting your *groov* EPIC processor to your local time:

- You can change the date and time of your *groov* EPIC processor to test time-sensitive features of your control program.
- You can synchronize the clock on your *groov* EPIC processor to any number of time servers from around the world.
- You can specify multiple time servers to function as backups of each other, or specify a device (for example, a router) as a time server.

When you turn on your *groov* EPIC processor for the first time and after it establishes network connectivity, it will set the time from a default time server. To see the default time server, from the *groov* Manage Home page, click or tap System > Time. The bottom half of the screen lists the time servers.

Setting the Date and Time Manually

There might be a few reasons why you want to set the date and time manually instead of synchronizing to time servers:

- You want to test time-sensitive features in your control program, so you want to be able to adjust the date and time to test those features.
- You are working in an environment (for example, a disconnected test environment) where changes in time will not affect production or other critical applications.

Note: *Changing the time manually will log out any users that are currently logged onto your groov EPIC processor. Carefully choose when you will change the time to minimize any adverse effect on other users.*

To set the date and time manually:

1. Log into the *groov* EPIC processor with a user ID that has administrator authority.
2. Click or tap System (System), then Time (Time).
3. In the Time Servers section, turn off the Enable NTP setting by moving the slider to the left so that it shows grey ( ).
4. Click Set NTP.
5. In the Time section, select values for Year, Month, Day, Hour, Minute, and Second.
6. Click or tap Set Time.

Now your date and time are set.

IMPORTANT: *If you set the date and time manually, the time will not be updated for Daylight Savings Time (for those areas that observe Daylight Savings Time). So, you must remember to manually update the date and time during those events.*

Setting the Date, Time, and Time Zone by Synchronizing with Time Servers

If you are not familiar with time servers, you can learn more about them through the NTP Pool Project at www.pool.ntp.org. When you are selecting a time server, remember the following:

- It is a good idea to select a couple of time servers to serve as backups in case the *groov* EPIC processor cannot establish a connection to the primary time server or if that time server becomes unavailable. The steps below instruct you to set two additional time servers.

- If you had set your date and time manually, setting the date and time as described in this section will overwrite your manual settings.

Note: Changing the time manually will log out any users that are currently signed into your groov EPIC processor. Carefully choose when you will change the time to minimize any adverse affect on other users.

To select the primary time server and a few backups:

1. Log into the *groov* EPIC processor with a user ID that has administrator privileges.
2. Click or tap System (System), then Time (Time).
3. In the Time Servers section, click or tap Time Server 1. Enter the host name of the time server.
4. Click or tap Time Server 2. Enter the host name of a second time server.
5. Click or tap Time Server 3. Enter the host name of a third time server.
6. Click or tap Set NTP.

Now your date and time are set, as well as the time zone. The date and time will be updated automatically during the switches between Standard Time and Daylight Savings Time, according to the schedule set by the time servers.

Setting the Time and Time Zone by Selecting a Location

If you want to change the time by selecting your location, do the following steps:

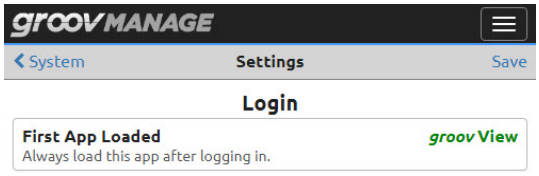
1. Log into the *groov* EPIC processor with a user ID that has administrator privileges.
2. Click or tap System (System), then Time (Time).
3. In the Time Zone section, click or tap Region to select a general geographical area of the world.

   To set the time for cities or regions in the United States of America, select America as the region. America encompasses North, Central, and South America.
4. In the Time Zone section, click or tap Locality to select a specific city that most closely approximates the city within the time zone you want to set.
5. Click or tap Set Zone.

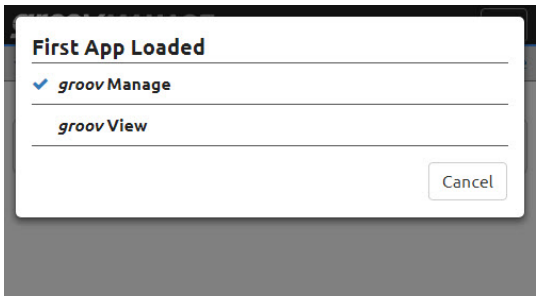
SELECTING WHICH APP TO LOAD AFTER USER LOG IN

By default, the *groov* EPIC processor starts *groov* Manage after a user logs in. You can change this:

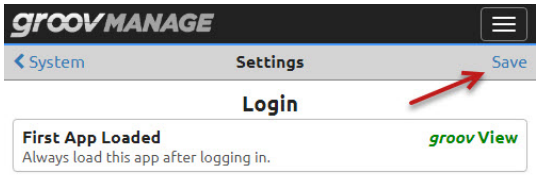
1. From the *groov* Manage home screen, click or tap System > Settings. *groov* Manage displays the Settings page.



2. Click or tap on the name of the app to change it.



3. Click or tap Save.



CONFIGURING THE *groov* EPIC PROCESSOR FOR SHELL ACCESS

Accessing the *groov* EPIC processor through the secure shell is for advanced programming. There is no additional configuration needed, other than uploading the *groov* EPIC SSH Access license. Connect to the shell through whatever SSH client you prefer. If you need to find the IP address and port number to connect your SSH client, see "Verifying SSH Access" on page 123.

IMPORTANT: *Be aware that Opto 22 provides very limited support if you choose to connect to and run through SSH.*

CONNECTING SERIAL DEVICES

There are two ways to connect serial devices:

- Directly to the *groov* EPIC processor by inserting a USB-to-serial adapter into one of the USB ports on the *groov* EPIC processor
- To the *groov* I/O unit by installing a *groov* serial module (GRV-CSERI-4 or GRV-CCANI-2)

Connecting a Serial Device Directly to the *groov* EPIC Processor

To connect serial devices directly to the *groov* EPIC processor, insert a USB-to-serial adapter into the USB port of the processor. The following table lists USB-to-serial adapters supported by the processor.

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)

There are two USB ports on the processor, which means you can connect up to two serial devices directly to the processor. However, you can expand the number of serial devices by installing USB hubs. When you do this, it's important to keep track of the device names and port numbers that the processor assigns to the serial devices attached to each USB port (see "Understanding How the Processor Assigns Numbers and Names to Serial Devices" on page 85). If you move a serial device from one USB port to another, the processor assigns it a new port number, and possibly a new device name. These changes might require changes to your PAC Control strategy, CODESYS application, or custom control program.

Connecting a Serial Device Through a *groov* Serial Module

To connect a serial device through a *groov* serial module, review the specifications in the *groov* Serial Module Data Sheet (form 2296) for information about the transmission mode supported by each module, as well as the wiring diagrams to properly wire your serial field devices to the module.

Device Name, Port Number, CAN Port Number, and CAN Port Name

The *groov* EPIC processor assigns device names, port numbers, CAN port numbers, and CAN port names to channels on *groov* serial modules and USB ports with USB-to-serial adapters attached. You use these names and numbers in your control program to access the serial device. Which one you use depends on the module and your control program:

	PAC Control	CODESYS	Node-RED	Shell (custom control program)
USB-to-serial Adapter	Port number	Port number		Device name
GRV-CCANI-2	CAN port name	CAN port number	CAN port name	
GRV-CCSERI-4	Port number	Port number		Device name

Understanding How the Processor Assigns Numbers and Names to Serial Devices

The *groov* EPIC processor follows two conventions for assigning device names, port numbers, CAN port numbers, and CAN port names:

- If the serial device is connected to the processor directly (through a USB-to-serial adapter), the convention is based on the location of the USB port relative to other USB ports.

  IMPORTANT: If you move the adapter from one USB port to another USB port, the processor will assign a new port number and name to the adapter. Any PAC Control strategy, CODESYS application, or custom control program that references the old port number and name will need to be modified to refer to the new port number and name.

- If the serial device is connected through a *groov* serial module, the convention is based on a calculation that factors in the fixed number of ports on the *groov* serial module and the number of the slot (where you mounted the module) on the chassis.

Device names and port numbers for serial devices connected to USB ports with USB-to-serial adapters. When the serial devices are connected through the USB ports, the device name and port number is based on the USB port location. If you connect a serial device and its corresponding adapter directly to the *groov* EPIC processor, the processor assigns port numbers and names as follows:

A USB-to-serial adapter connected to USB port...	is assigned a device name of...	and a port number of
0	/dev/ttySer0	0
1	/dev/ttySer1	1

If you connect a USB ***hub*** to either of the USB ports, the *groov* EPIC processor includes a suffix to the device name and port number to identify the port number on the USB ***hub***: *.USB_hub_port_number*. For example, if you connect a 4-port USB hub to USB port 0 on the *groov* EPIC processor, then the processor assigns device names and port numbers as follows:

A USB hub connected to *groov* EPIC USB port...	with a USB-to-serial adapter connected to port *x* of the USB hub...	is assigned a device name of...	and a port number of...
0	1	/dev/ttySer0.1	0.1
0	2	/dev/ttySer0.2	0.2
0	3	/dev/ttySer0.3	0.3
0	4	/dev/ttySer0.4	0.4

If you connect an 8-port USB hub to USB port 1 on the *groov* EPIC processor, then the processor assigns port numbers as follows:

A USB hub connected to *groov* EPIC USB port...	with a USB-to-serial adapter connected to port *x* of the USB hub...	is assigned a device name of...	and a port number of...
1	1	/dev/ttySer1.1	1.1
1	2	/dev/ttySer1.2	1.2
1	3	/dev/ttySer1.3	1.3
1	4	/dev/ttySer1.4	1.4
1	5	/dev/ttySer1.5	1.5
1	6	/dev/ttySer1.6	1.6
1	7	/dev/ttySer1.7	1.7
1	8	/dev/ttySer1.8	1.8

Device names, port numbers, CAN port name, and CAN port numbers for serial devices connected through groov I/O serial modules. Unlike connecting through USB ports, where you can expand the number of ports by adding USB hubs, *groov* serial modules have a fixed number of ports:

- GRV-CCANI-2 has 2 ports.
- GRV-CSERI-4 has 4 ports.

The processor assigns device names, port numbers, CAN port names, and CAN port numbers as follows:

- **GRV-CCANI-2**—CAN port names (`can<number>`) or CAN port numbers (`<number>`), where `<number>` is calculated based on a formula that uses the channel number and chassis slot number.
- **GRV-CSERI-4**—Device names are in the format `/dev/ttySerMod<slot number>.<channel number>` and port numbers are in the format `<slot number>.<channel number>`, where:
  - `<slot number>` can be 0, 1, 2, or 3, and corresponds to the slot on the chassis.
  - `<channel number>` corresponds to the channel number, which is listed in the wiring diagram for the serial module. (See "GRV-CSERI-4 Pinout and Wiring Diagram" on page 218.)

  For example, if you connect a serial device to channel 3 of a GRV-CSERI-4 module, which is mounted into slot 1, the device name is: `/dev/ttySerMod1.3`. The port number is `1.3`.

Finding Device Names, Port Numbers, CAN Port Names, or CAN Port Numbers

You can find device names, port numbers, CAN port names, or CAN port number through *groov* Manage or through shell commands.

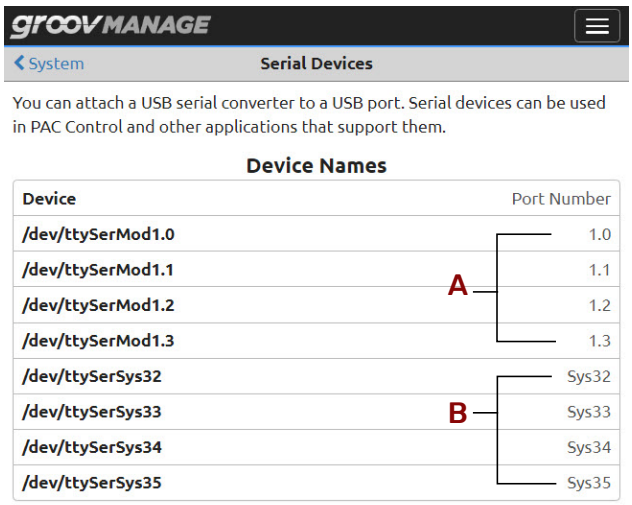
Finding Device Names and Port Numbers Assigned to USB ports or a GRV-CSERI-4 Module

You can view a list of device names and port numbers of the USB-to-serial adapters plugged into USB ports and ports of GRV-CSERI-4 modules currently mounted on the chassis by doing the following:

1. Log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. Click or tap the menu button ( ).
3. Click or tap System > Serial Devices. The Serial Devices page shows the device names and port numbers for any USB-to-serial adapters plugged into USB ports and GRV-CSERI-4 modules currently mounted on the chassis. The diagram below shows two examples.

An example of one USB-to-serial adapter connected to USB port 1.

An example of a GRV-CSERI-4 module mounted on to slot 1 of the chassis.

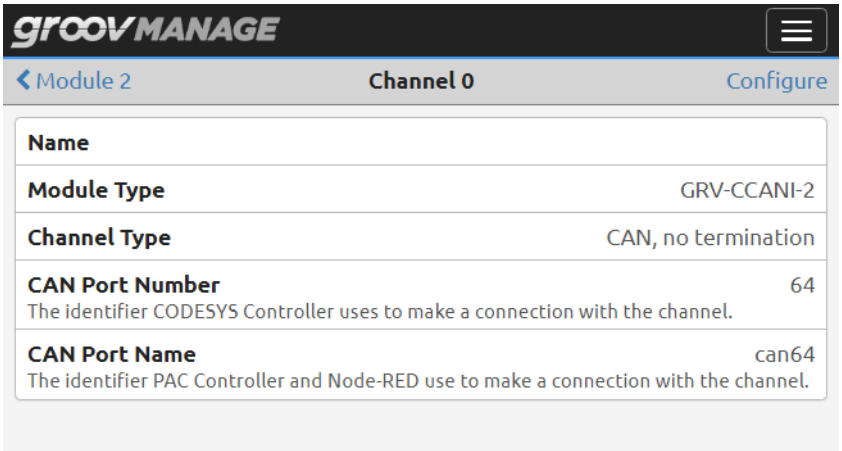


A These are the port numbers you use for PAC Control and Node-RED.
B These are the port numbers you use for CODESYS; do not include the `Sys` that prepends the number.

Finding CAN Port Names and Numbers Assigned to a GRV-CCANI-2 Module

To view a list of the port numbers and port names for any GRV-CCANI-2 module currently mounted on the chassis:

1. Log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. Click I/O.
3. Click on a GRV-CCANI-2 module.
4. In the Channels tab, click on the channel. You'll see the CAN Port Number and CAN Port Name.



Finding Device Names Through Shell Commands

If you are accessing the processor through secure shell (SSH), enter the `ls /dev/ttySer*` command. The following diagrams show two examples.

- An example of one USB-to-serial adapter connected to port 1.

```
opto22shelluser@opto-03-fa-bf:/dev$ ls /dev/ttySer*
/dev/ttySer1
opto22shelluser@opto-03-fa-bf:/dev$
```

- An example of a GRV-CSERI-4 module mounted on to slot 0 of the chassis.

```
a@opto-03-fa-bf:~$ ls /dev/ttySer*
/dev/ttySerMod0.0  /dev/ttySerMod0.1  /dev/ttySerMod0.2  /dev/ttySerMod0.3
a@opto-03-fa-bf:~$
```

Configuring the Communication Ports or Handles to Serial Devices

Configuring the communications ports or handles in your control program depends on your programming environment.

- If you are writing PAC Control strategies, you specify the initial value of the communication handle variable with `ser` to access a serial device attached:
  - to a GRV-CSERI-4 serial module.
  - to a *groov* EPIC processor through a USB port.

  For a description of Format 2 (which describes `ser`), see "Creating a communications handle for serial devices" in PAC Control User's Guide (form 1700).
- If you are developing CODESYS applications, review the instructions in "Configuring Processor Parameters and Channel Features" on page 110 for tips on configuring channels on GRV-CSERI-4 and GRV-CCANI-2 modules.
- If you are writing your own control programs, refer to your programming language's reference for instructions on where to specify the device name.

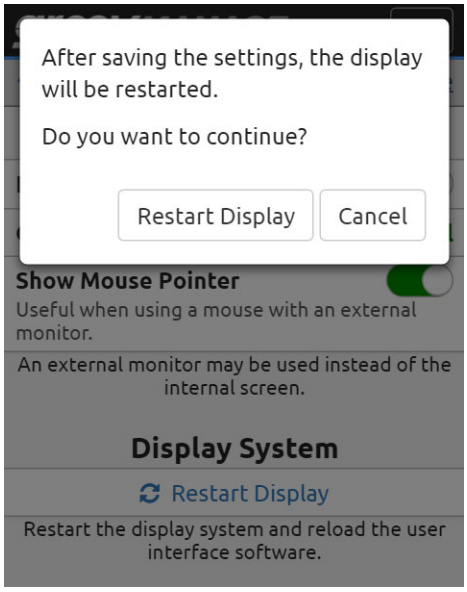
CONNECTING A MOUSE AND A KEYBOARD

You can connect a mouse or a keyboard to the *groov* EPIC processor through the USB ports.

Before you connect a mouse, it's a good idea to enable the Show Mouse Pointer feature. If you try to connect your mouse first, then you won't see the small pointer on the touchscreen. You'll have a hard time navigating through the *groov* Manage screens because you won't see a pointer that helps you aim accurately.

These steps will require that you restart your *groov* EPIC processor's display, which means you will be logged out and then you will have to log back in.

1. Log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. Click or tap the menu button ( ), then select System.
3. Click or tap Display (Display).
4. In the Display page, look for the Show Mouse Pointer field in the External Monitor section. Move the slider to the right so that it shows green ( ).
5. Click or tap Save. *groov* Manage displays the following message:



6. Click or tap Restart Display (Restart Display).

   After your processor restarts the display, you'll be able to see a small pointer on the touchscreen.
7. Plug your mouse into either USB 0 or USB 1 and wait a few seconds for the processor to connect to the mouse. Move the mouse and verify that the small pointer moves around the screen in response to your movements.

Now you can click around the *groov* EPIC processor's touchscreen in much the same way you click around your computer screen.

For a keyboard, you don't have to do anything else other than to plug it into an available USB port. Wherever you can enter data, you can type it in with your keyboard.

CONNECTING AN EXTERNAL MONITOR

The *groov* EPIC processor supports the option of connecting an external monitor, with or without touchscreen capability, to display *groov* Manage and your HMI. When you connect an external monitor, the touchscreen on the *groov* EPIC processor becomes disabled.

- If the monitor is non-touchscreen, you'll also need to connect a mouse to navigate through *groov* Manage and your HMI. If you don't want to enter information through the on-screen keyboard, you can also connect a keyboard to the processor to type in information. Remember that the *groov* EPIC

processor has two USB ports and one HDMI port; check which type of connector is on your monitor, keyboard, and mouse and make sure you have ports available for all three devices.

- If the monitor is a touchscreen, it must be single-touch and comply with one of the following:
  - Use P-CAP (projected capacitive) technology.
  - A resistive touchscreen from the list below.

  Remember that the *groov* EPIC processor has two USB ports and one HDMI port; check which type of connectors are on your monitor and make sure you have ports available for all the connectors.

Opto 22 has tested and approves the following resistive touch monitors for use with GRV-EPIC-PR1:

- The following touchscreen monitors are manufactured by American Industrial Systems (AIS) and are listed by AIS part number
  - **ITM-TMNA0U-12AC-000C—**12.1 inch, HDMI input, 9–36 VDC powered
  - **ITM-TMNA0U-21AC-000C—**21.5 inch, widescreen, HDMI input, 9–36 VDC powered

  Note that for these two monitors, 640 x 480 resolution is not supported and only Landscape mode is supported. For more information about American Industrial Systems (AIS) monitors, visit the AIS website at www.aispro.com.
- **SL-LCD-17A-RTOUCH-2** by SuperLogics. For more information about this monitor, visit the SuperLogics website at www.superlogics.com.
- **HIS-UM15-CTBH** by Hope Industrial Systems. For more information about this monitor, visit the Hope Industrial Systems website at www.hopeindustrial.com.
- **Dell 2314T**, a 23-Inch Touchscreen LED-lit Monitor by Dell.

Connecting an External Monitor

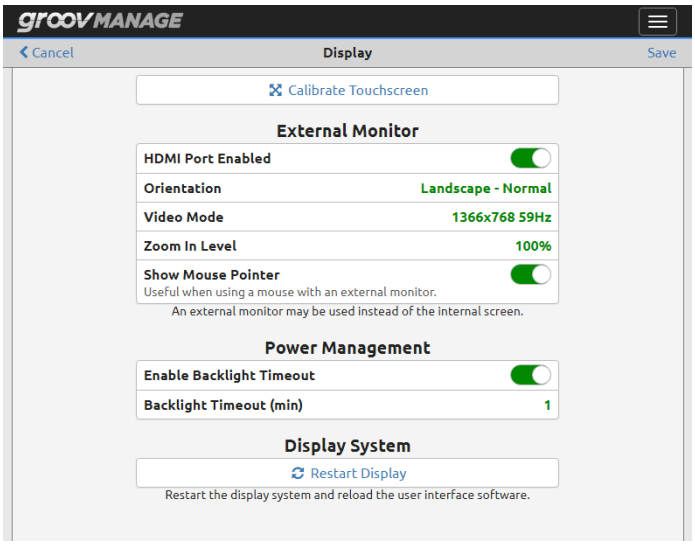
When you connect an external monitor, *groov* Manage will automatically detect the monitor, stop displaying on the *groov* EPIC touchscreen and start displaying on the external monitor. You will want a computer or mobile device with access to the *groov* EPIC nearby so you can change the orientation and resolution of the external monitor; these changes cannot be made through the external monitor.

1. For non-touchscreen monitors, connect the keyboard and mouse. *groov* Manage will automatically detect them. You can verify this by moving the mouse and seeing the mouse pointer on the GRV-EPIC-PR1 touchscreen move.
2. Connect the monitor. *groov* Manage will automatically detect the monitor.

If you want to change the resolution and orientation, see "Changing Resolution and Orientation" on page 90. For touchscreen monitors, if you want to calibrate the touchscreen, see "Calibrating an External Touchscreen Monitor" on page 92.

Changing Resolution and Orientation

1. On a computer or mobile device, log into your *groov* EPIC processor with a user ID that has administrator authority.
2. Click System > Display. The External Monitor section of the Display page lists the options you can adjust on the external monitor.



In *groov* Manage on the computer, make the following changes while checking the results on the external monitor:

– To change what is commonly called the resolution, click on the current value of Video Mode. The list is dependent on what your monitor supports and the default value is typically set at the best resolution.

– To change the orientation of the screen, click on the current value of Orientation and select another value:

Landscape - Normal	The longest part of the screen is oriented horizontally.	
Portrait - Right	The longest part of the screen is oriented vertically and *groov* Manage and your HMI are rotated 90° clockwise.	
Portrait - Left	The longest part of the screen is oriented vertically and *groov* Manage and your HMI are rotated 90° counterclockwise.	

– To scale the text and HMI elements to a larger size, change the Zoom In level. Keep in mind that the larger the size, the more likely that text and HMI elements on *groov* Manage or your HMI may not all fit on the screen. You'll have to swipe up and down, left and right to view text and HMI elements.

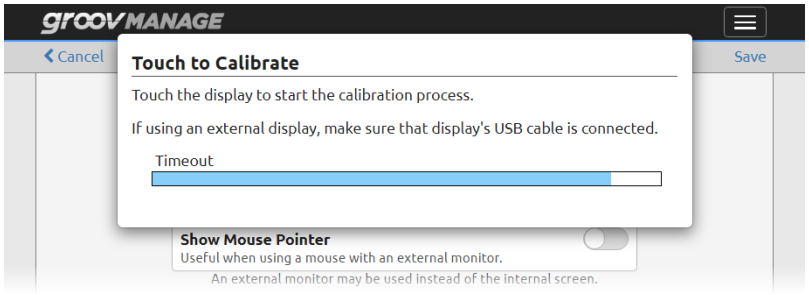
3. Click Save. *groov* Manage will ask you to verify your changes. Click Restart Display.

   The external monitor will restart. This might take 15 to 30 seconds. If your selections don't create the result you want, return to step 2 to make different selections.

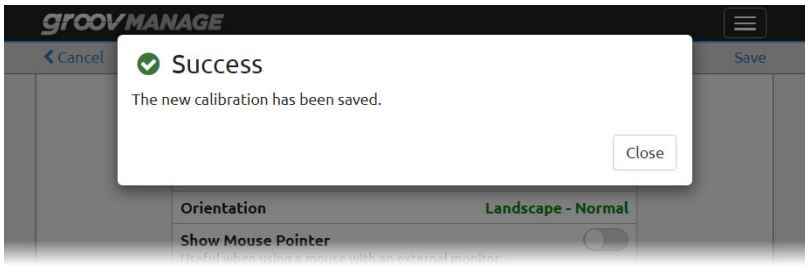
Calibrating an External Touchscreen Monitor

You can start the calibration from either the browser or on the touchscreen monitor directly.

1. On a computer or mobile device, log into your *groov* EPIC processor with a user ID that has administrator authority.
2. Click System > Display.
3. Click or tap Calibrate Touchscreen at the top of the page. *groov* Manage displays the Touch to Calibrate message, which will indicate how much time you have left to complete the calibration process.



4. On the external touchscreen monitor touch the screen. Follow the instructions on the screen.
5. When the calibration is done, *groov* Manage displays the following message:



Calibration settings are saved in *groov* EPIC backups.

Disconnecting an External Monitor

When you disconnect an external monitor, *groov* EPIC processor enables its touchscreen. You can resume using it to navigate through *groov* Manage and your HMI.

CONNECTING A USB STORAGE DEVICE

You can connect a USB storage device to either USB port on the *groov* EPIC processor, then use *groov* Manage on the processor's touchscreen to copy files to and from the processor's internal storage. Adding a USB storage device can increase the amount of storage available for your PAC Control strategy, CODESYS application, Node-RED flow, or custom control program to create, read, and write to files.

Important: *You should store any files critical to your control program in the processor's internal storage. Internal storage utilizes a power-fail safe file system that prevents data, file and file system corruption in the event that power is removed. USB storage devices do not utilize a power-fail safe file system.*

The *groov* EPIC processor supports reading and writing to USB storage devices formatted in either FAT or FAT32 file systems. This means that the largest partition that the *groov* EPIC processor can access is 32 GB. You can either:

- select USB storage devices no larger than 32 GB, or
- on a computer, format a USB storage device that is larger than 32GB with multiple FAT32 partitions.

If you do connect a USB storage device, keep the following points in mind:

- Because there is no mechanism to physically secure (or lock) the USB storage device to the processor, it can be removed by anyone that has access to the processor. It's important to apply important security practices, like keeping the processor secured under lock and key and providing the key to only trusted individuals.
- It's also important to remember not to remove the USB storage device without first evaluating the consequences; for example, would it cause an interruption to your control program or automation process? After evaluating consequences and taking measure to mitigate those consequences, to remove the USB storage device, go through *groov* Manage to unmount it (see "Mounting and Unmounting USB Storage Devices" on page 94) before pulling out the USB storage device.
- To prevent someone from inserting an unauthorized USB storage device that could contain malicious software, automounting is disabled by default. Carefully consider the security risks before disabling automount for an extended period of time. It would be a good practice to disable automount after mounting the USB storage device; you will still be able to access files on the storage device with automount disabled.
- If you do not plan on using USB storage devices, it would be a good security practice to disable the ability to access USB storage devices. You can still use the USB ports for other devices, like USB-to-serial adapters, keyboards, or supported WiFi adapters. For instructions, see "Disabling Access to USB Storage Devices" on page 93.
- Determine whether you want the USB storage device to be listed in the secured or unsecured areas. The following table describes which applications or services can access files stored in secured and unsecured areas.

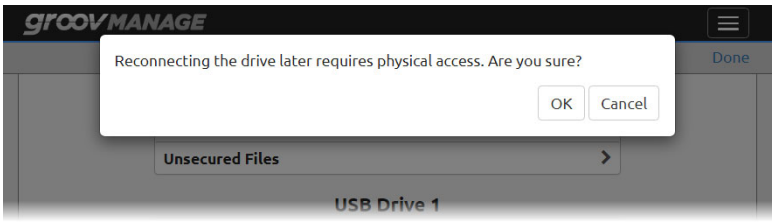
Secured Area	Unsecured Area
• *groov* Manage • custom control programs through shell access • Node-RED flows	• *groov* Manage • custom control programs through shell access • Node-RED flows • CODESYS applications • PAC Control strategies

Disabling Access to USB Storage Devices

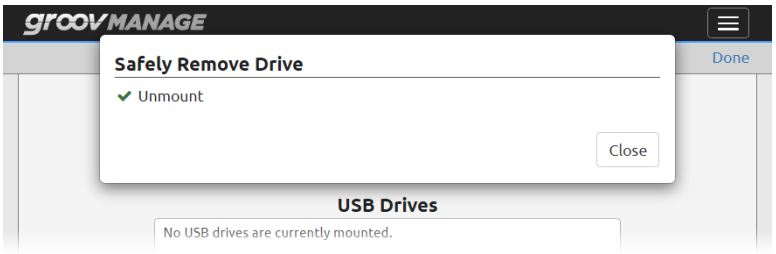
If you disable access to USB Storage Devices, you can still use the USB ports for other devices, like USB-to-serial adapters, keyboards, or supported Wi-Fi adapters.

1. Log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. From the *groov* Manage Home page, click or tap System > USB.
3. If you have any USB storage devices connected to the *groov* EPIC processor, unmount them.
   a. Click or tap USB Files.

b. Click or tap Safely Remove. *groov* Manage displays the following message; click or tap OK to continue:



When *groov* Manage successfully unmounts the storage device, it displays the following message. Click or tap Close to continue.



c. Repeat these steps for each USB storage device connected to the processor. When you are done, click or tap Done to return to the USB page.

4. Move the Enable USB slider to the left or tap it so that it shows gray ( ).
5. Click Save. You have now disabled access to USB storage devices. *groov* Manage displays the System page.

Mounting and Unmounting USB Storage Devices

Follow the instructions below before inserting a USB storage device into a USB port, and unmount USB storage devices (see "Unmounting a USB Storage Device" on page 95) before pulling it out of a USB port.

Note: *If you change the Permissions setting (see step 2 below), you will need to restart the controller for the change to take effect. Make sure to schedule this activity during a time that won't disrupt your applications or systems.*

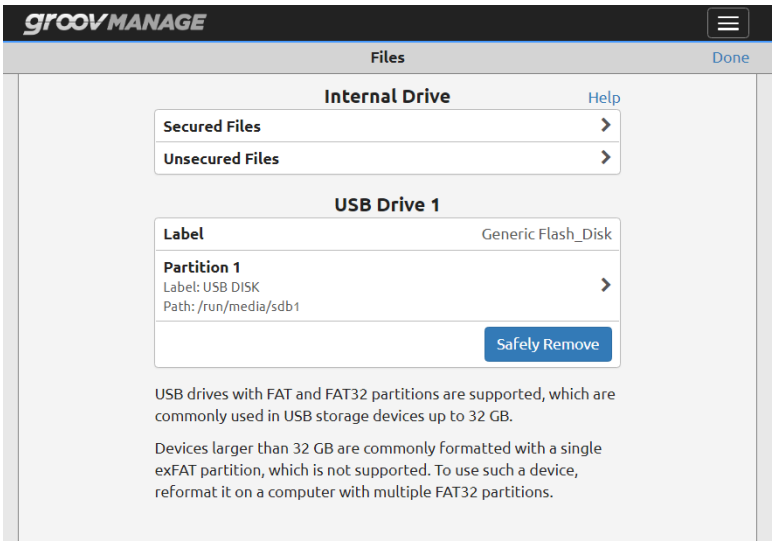
Mounting a USB Storage Device

1. Log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. From the *groov* Manage Home page, click or tap System > USB.
   - If Enable USB shows gray, it's disabled. Click or tap on the slider so that it shows green: .
   - If Automount shows gray, it's disabled. Click or tap on the slider so that it shows green: .
   - Click or tap on Permissions to select whether you want the USB storage device to be listed in the secured or unsecured area. To understand the difference, review the table on page 93.
3. Click Save.
4. If you changed the Permissions, restart the controller:
   a. Click Home > Controller.
   b. Restart the controller:
   - If you are running the PAC Controller, click PAC Controller. Click Disable. After *groov* Manage indicates that the controller is disabled, click Enable. After the controller is enabled, remember to download and run your strategy. For instructions, see PAC Control User's Guide (form 1700).

- If you are running the CODESYS Controller, click CODESYS Controller. Click Disable. After *groov* Manage indicates that the controller is disabled, click Enable. After the controller is enabled, remember to download and run your CODESYS application. For instructions, see "Downloading and Running CODESYS Applications" on page 117.

c. Click Back > Home > System to resume the rest of the instructions.

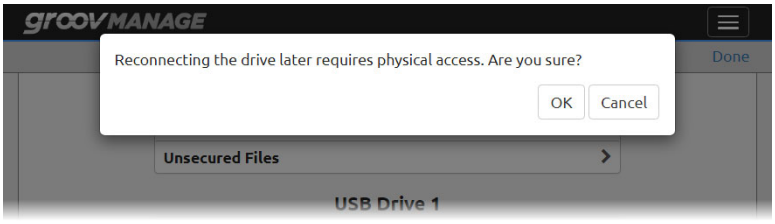
5. Insert the USB storage device into a USB port.
6. To verify that *groov* Manage can access the USB storage device, in *groov* Manage, click or tap USB, then USB Files. *groov* Manage displays the Files page. You can see the storage device when it's listed in a section called USB Drive, typically followed by a number:



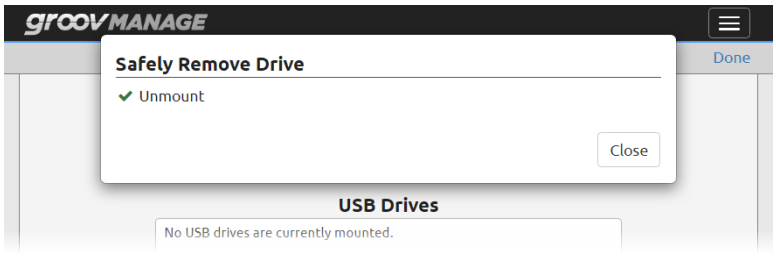
At this point, you can copy or move files from the USB storage device to the processor's internal storage. You could also download a file from the USB storage device to your local machine. (See "Copying, Moving, or Downloading a File on a USB Storage Device" on page 96.)

Unmounting a USB Storage Device

1. From a computer or mobile device, log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. From the *groov* Manage Home page, click or tap System > USB, then USB Files.
3. Click or tap Safely Remove. *groov* Manage displays the following message; the message reminds you that if you want to reconnect the storage device in the future, you will have to physically reinsert it. Click or tap OK to continue:



When *groov* Manage successfully unmounts the storage device, it displays the following message. Click or tap Close to continue.



4. Click or tap Done in the Files page. Now you can pull out the storage device.

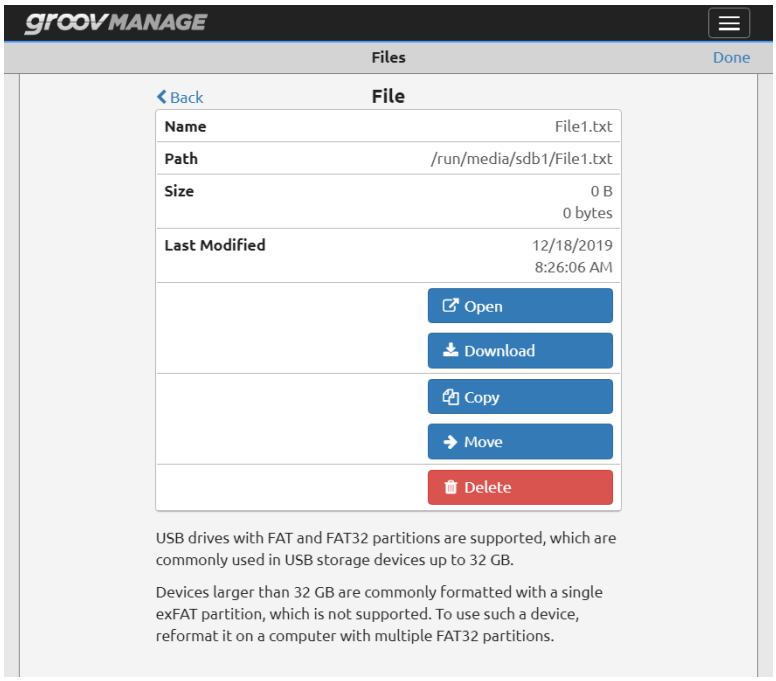
Copying, Moving, or Downloading a File on a USB Storage Device

Before you begin, make sure you have properly mounted the USB storage device as described in "Mounting a USB Storage Device" on page 94. You need to log into *groov* Manage from a computer or mobile device to copy, move, or download files.

- Copy and move means to transfer a file from the USB storage device to the *groov* EPIC processor's internal storage.
- Download means to transfer a file from the USB storage device to you computer or mobile device.

These instructions describe how to copy, move, or download one file at a time.

1. From a computer or mobile device, log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. From the *groov* Manage Home page, click or tap System > USB, then USB Files.
3. Click on Partition 1, or, if you have multiple partitions or USB drives mounted, scroll to the correct partition or drive and click the partition name.
4. In the Directory Listing section, navigate to the file you want to copy, move, or download. *groov* Manage displays a list of all the actions you can take on the file:



   – To copy a file to internal storage, click Copy.

- To move a file to internal storage, click Move.
- To download a file to the computer or mobile device, click Download.

5. If you need to copy, move, or download another file, click Back (top left) to select another file. If you are done copying, moving, or downloading files, click Done (top right corner). *groov* Manage returns you to the USB page.

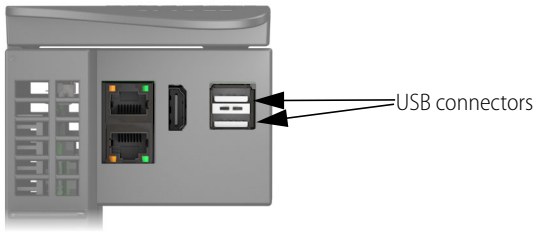
INSTALLING AN APPROVED USB WIFI ADAPTER

If you want to use the *groov* EPIC processor on a wireless network, you must purchase and install one of the following USB WiFi adapters that Opto 22 has tested and approved for use with GRV-EPIC-PR1. Unapproved WiFi adapters should not be used.

- Netis® WF2180
- Netis® WF2190

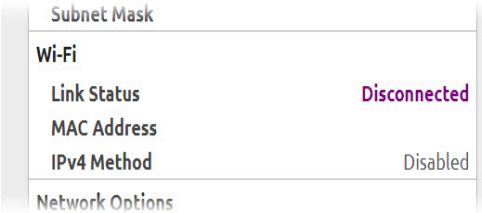
You can install the WiFi adapter with the processor on or off. The following instructions assume that the processor is on:

1. Log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. Insert the WiFi adapter into the USB connector on the bottom of the processor.

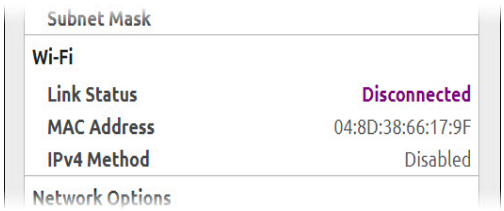


3. To verify that the processor is communicating with the WiFi adapter, go to the Network page (Home > System > Network). Note that the Wi-Fi section of the Network page now has a MAC Address.

No WiFi adapter installed; no MAC address



WiFi adapter installed; MAC address available



Continue on to Chapter 7: Connecting groov EPIC to a Network or Multiple Networks.

CALIBRATING THE PROCESSOR'S TOUCHSCREEN

1. Log into your *groov* EPIC processor through the touchscreen with a user ID that has administrator privileges.
2. Tap System (System).
3. Tap Display (Display).
4. Tap Calibrate Screen Settings.

5. Follow the instructions on the screen to run through the calibration exercise. You might have to repeat the exercise several times.
6. After you successfully complete the exercise, the processor returns to the Display page. Tap Save.
7. The processor asks if you want to restart the display. Tap OK.
8. The processor will restart and you will have to log back in.

UPLOADING FILES TO THE *groov* EPIC PROCESSOR

The *groov* EPIC processor identifies files that you upload as "user files". Before you upload files, you must decide whether they need to be uploaded as secured files:

- Secured. Secured files are files that services can access only with authentication (for example, a user name and password, or an API key) over a secure protocol (HTTPS).
- Unsecured. Unsecured files are accessed primarily by PAC Control strategies, though services that access secured files can also access unsecured files.

Note that when you backup your system, only the first 10 MB of files that you uploaded are included in the backup file. Make sure to track this quantity so that if you exceed this limit, you can manually backup the remaining files through other methods.

1. On a computer or mobile device, log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. Click the menu button () and select System.
3. Click Files ().
4. Click Secured () to upload files that required secure access ***or*** click Unsecured () to upload files that do not require secure access.
5. Click Add/Update.
6. Navigate to the folder that contains the files you want to upload and select those files.
7. Click Open.
8. After *groov* Manage finishes uploading the files, it refreshes the Secured Files or Unsecured Files page to list the files it uploaded.
9. If you need to upload more files, repeat steps 2 through 8.

10: Configure CODESYS and *groov* EPIC for IEC61131-3

Developing and running IEC61131-3 applications on a *groov* EPIC processor becomes possible when you add the Opto 22 Library package to the CODESYS Development System and enable the CODESYS Runtime Engine on the *groov* EPIC processor.

To correctly configure CODESYS Development System and the *groov* EPIC processor, you'll need the following:

- A MyOpto account. For instructions on creating one, visit the Login page at www.opto22.com.
- An activated *groov* EPIC processor. To verify that you have activated your *groov* EPIC processor, review the instructions in "Activating the groov EPIC unit and downloading the license file" on page 13.
- A computer that meets the requirements described in "System Requirements" on page 1, and that can access the *groov* EPIC processor and the internet.

After you complete the following configuration tasks, you can go on to develop and run a CODESYS application on your *groov* EPIC processor:

1. "Obtaining Your CODESYS Activation Key Certificate and Ticket ID" on page 100.

   You'll need the CODESYS Activation Key Certificate and the Ticket ID to fully enable the CODESYS Control Engine.
2. "Downloading and Installing CODESYS Development System" on page 100.

   If you already have CODESYS Development System installed on your computer, make sure it's the correct version listed in "System Requirements" on page 1.
3. "Adding the Opto 22 Library Package to CODESYS Development System" on page 100.

   The Opto 22 Library Package contains all the information that CODESYS Development System needs to correctly identify and communicate with a *groov* EPIC processor and the *groov* I/O modules.
4. "Reviewing Network Configurations" on page 101.

   The *groov* EPIC processor has default networking configurations to communicate with CODESYS Development System. However, if you have a unique networking situation, you might have to make some changes to the *groov* EPIC processor. This section helps you identify the changes you may need to make.
5. "Enable the CODESYS Control Engine on the groov EPIC Processor" on page 101.

   The CODESYS Runtime Engine is preinstalled on the *groov* EPIC processor. However, by default, it is not enabled; if you do enable it, it runs for only two hours (trial mode). To remove trial mode, follow the instructions in this section to license the CODESYS Runtime Engine (which requires the CODESYS Ticket ID you obtained in step 1).
6. "Connecting Processor to Gateway and Entering the CODESYS Ticket ID" on page 101

   In the CODESYS Development System, the gateway manages communication with many devices, including the *groov* EPIC processor. After you add the processor to the gateway, you'll be able to enter the CODESYS ticket ID you obtained in step 1 above, which will install the license on to the processor.

Note: *Throughout this section, instructions may use CODESYS terminology that differs from standard Opto 22 terminology. For example:*

- *In the CODESYS Development System interface, the term "device" refers to many different objects: a controller, an Ethernet adapter, a field device, or an I/O module. In this guide, "device" typically refers to a field device (a valve, a pump, a quadrature encoder, etc.). When you read sections of the guide that do not discuss CODESYS, you can interpret references to "device" to mean the latter definition.*
- *In CODESYS terminology, a groov EPIC processor, a groov RIO, and channels on a groov RIO are referred to as devices; throughout other sections of this guide, a groov EPIC processor is referred to as a processor, a groov RIO is referred to as a RIO module, and a channel is referred to as a channel.*
- *An application, in CODESYS terminology, is roughly equivalent to a PAC control strategy in Opto 22 terminology.*

OBTAINING YOUR CODESYS ACTIVATION KEY CERTIFICATE AND TICKET ID

You need to obtain an Activation Key Certificate from Opto 22 to help you get your CODESYS ticket ID. You'll use the ticket ID when you do the steps in "Connecting Processor to Gateway and Entering the CODESYS Ticket ID" on page 101 to license the CODESYS Runtime Engine on your *groov* EPIC processor.

1. Contact Opto 22 Sales to order (at no additional cost) part number GROOV-EPIC-CRE. Opto 22 will send you an Activation Key Certificate. After you finish all the steps in this section, make sure to save the certificate in a safe place.
2. Open a web browser. Log into manage.groov.com with your email address and your MyOpto password.
3. Click the Activate button.
4. Enter your activation key and click Activate.
5. In the list of products, select the GRV-EPIC-PR1 for which you want to obtain a CODEYS Ticket ID. If you select the incorrect product, you'll have to contact Opto 22 Pre-Sales Support for assistance.
6. When the website displays the CODESYS ticket ID, copy and save it in a safe place.

DOWNLOADING AND INSTALLING CODESYS DEVELOPMENT SYSTEM

If you have CODESYS Development System, V3.5 SP13 Patch 1 or newer (32-bit version) installed on your computer, you can skip this section. Otherwise, follow these steps:

1. If you are new to the CODESYS Store, register (create an account) on the website (store.codesys.com).
2. Find and download CODESYS Development System (32-bit version) from the CODESYS Store.
3. Double-click on the package to install it, choosing typical installation options.

ADDING THE OPTO 22 LIBRARY PACKAGE TO CODESYS DEVELOPMENT SYSTEM

1. Go to the Opto 22 website, www.opto22.com.
2. Enter "Opto 22 Library Package" in the search box to find the page "Opto 22 Library Package for CODESYS Development System" and click the link.
3. Click Download and save the package to the same computer where you installed CODESYS Development System.
4. Open CODESYS Development System and install the package. For instructions on how to do this, see Installing/Uninstalling a Package in the CODESYS Online Help.

REVIEWING NETWORK CONFIGURATIONS

The *groov* EPIC processor assigns the ETH0 network interface as the default network interface for communication between CODESYS Development System and the CODESYS Runtime Engine. Communication runs through the firewall through specific ports, which are listed in tables on page 43.

If these default settings work for your networking environment, you can move on to the next task. However, for the following situations, you'll need to change the network settings on the *groov* EPIC processor:

- The default settings don't work for your networking environment
- You are using CODESYS PROFINET Controller SL. (You'll need to assign a static IP address to the network interface and add a new firewall rule.)

If you need to change the network interface, do both of the following steps. If you only need to change the firewall rules, skip to step 2.

1. If your networking environment is moderately complex (for example, you have an IT network and an OT network), you'll want to review "Selecting a Network Configuration" on page 50.

   If the only change you need to make is to assign a static IP address to ETH0 so that you can use CODESYS PROFINET Controller SL, collect information as instructed in "Collecting Information for Manual Connections" on page 54. Then change the settings for ETH0, following the instructions in "Configuring ETH0 or ETH1" on page 58.
2. To change the firewall rules, see "Changing a Firewall Rule" on page 46.

   If the only change you need to make is to add a new firewall rule so that you can use CODESYS PROFINET Controller SL, follow the instructions in "Creating a Firewall Rule" on page 43.
   - For **Title**, you may want to enter something like "CODESYS PROFINET Controller UDP".
   - For **Protocol**, select UDP.
   - For **Port**, enter 49152:65535, then press Enter, then enter 34964 in the second port field that appears.
   - Select **eth0**, unless you changed the assigned network interface in the previous step. If you did, then select that network interface.

ENABLE THE CODESYS CONTROL ENGINE ON THE *groov* EPIC PROCESSOR

Complete these instructions within two hours to prevent delays in completing the steps in the section that follows:

Note: *If the PAC Control Engine is running when you enable the CODESYS Runtime Engine, the processor disables the PAC Control engine and deletes any PAC Control strategy on the processor. For more details about anything else that changes on the groov EPIC processor when you switch control engines, see "Switching Between PAC Control Engine and CODESYS Runtime Engine" on page 81.*

1. Log into your *groov* EPIC processor with a user ID that has administrative privileges.
2. Click or tap Controller.
3. Click or tap CODESYS Controller.
4. Click or tap Enable. When the processor is done, the status will change to Running.

CONNECTING PROCESSOR TO GATEWAY AND ENTERING THE CODESYS TICKET ID

The CODESYS Gateway manages communication between your computer and your controllers, processors, and other devices. You can have multiple gateways, each running on different computers, and you can configure access to those gateways from other computers with CODESYS Development System. These

instructions assume you have one gateway on your computer and that the gateway connects directly to the *groov* EPIC processor.

1. If CODESYS Development System isn't open, go ahead and open it.
2. Click Tools > License Manager.
3. In the Select target dialog, select Device and click Next.

   IMPORTANT: *Do NOT select Workstation.*

4. In the Select container dialog, select Softcontainer and click Next.
5. Click Scan network. CODESYS Development System will look for controllers on your network. Select your *groov* EPIC processor and click OK.

   If your *groov* EPIC processor does not show up:

   – If you weren't able to use the default network configurations (as described in "Reviewing Network Configurations" on page 101), you'll need to click on Add Device and specify the new IP address or port number.

   – Check through the list in "CODESYS: Can't Connect to groov EPIC Processor" on page 172 for some options to help you troubleshoot the issue. Keep in mind the two-hour time limit on the CODESYS Runtime Engine. After checking all these options, you may have to either repeat the scan of the network or close CODESYS Development System and return to step 1.
6. In the License Manager window, click Install licenses.
7. In the Install Licenses window, select Activate license and click Next.
8. Enter the ticket ID that you saved from Opto 22 into the Ticket ID field. Click Next.

CODESYS Development System automatically creates a license backup file (*.WibuCmRau), as described in Restoring licenses in the CODESYS Online Help. It would be a good idea to create a backup of your *groov* EPIC processor soon after completing these steps (see "Backing up Your groov EPIC Processor Settings" on page 151), in case you need to restore your CODESYS Development System and all the licenses.

Keep in mind that you cannot transfer your license from one *groov* EPIC processor to another by simply installing the ticket ID on the new processor. You must follow the instructions in "Transferring the CODESYS License to Another GRV-EPIC-PR1" on page 103.

MANAGING CODESYS RUNTIME ENGINE AND CODESYS APPLICATIONS

Enabling the CODESYS Runtime Engine

Before you download and run a CODESYS application, make sure you enable the CODESYS Runtime Engine on the *groov* EPIC processor.

Note: *If the PAC Control Engine is running when you enable the CODESYS Runtime Engine, the processor disables the PAC Control engine and deletes any PAC Control strategy on the processor. For more details about anything else that changes on the groov EPIC processor when you switch control engines, see "Switching Between PAC Control Engine and CODESYS Runtime Engine" on page 81.*

1. Log into your *groov* EPIC processor with a user ID that has administrative privileges.
2. Click or tap Controller.
3. Click or tap CODESYS Controller.
4. Click or tap Enable. When the processor is done, the status will change to Running.

You can now go to the CODESYS Development System to download and run your CODESYS application on the *groov* EPIC processor.

Disabling the CODESYS Runtime Engine

When you disable the CODESYS Runtime Engine, the processor stops any running CODESYS applications. However, this does not erase the CODESYS applications. (Enabling the PAC Control Engine does erase CODESYS applications. For more information, see "Switching Between PAC Control Engine and CODESYS Runtime Engine" on page 81.)

1. Log into your *groov* EPIC processor with a user ID that has administrative privileges.
2. Click or tap Controller.
3. Click or tap CODESYS Controller.
4. Click or tap Disable. When the processor is done, the status will change to Disabled.

After you disable the CODESYS Runtime Engine, the CODESYS Development System is disconnected from the *groov* EPIC processor. You will likely see a message like the following from the CODESYS Development System:

Transferring the CODESYS License to Another GRV-EPIC-PR1

Transferring a CODESYS license requires contacting CODESYS product support for specific details. Be aware that this may not be an immediate process, so allow for a day or two to complete the process. The general steps include:

1. Email CODESYS product support, indicating that you want to transfer your license from one (we'll call it the "old") GRV-EPIC-PR1 to another (a "new "GRV-EPIC-PR1).
2. When CODESYS provides you with a "return" ticket ID, install it on the old GRV-EPIC-PR1 through License Manager:
   a. Open CODESYS Development System, then select Tools > License Manager.
   b. In the Select target dialog, select Device and click Next.

      IMPORTANT: *Do NOT select Workstation.*

   c. In the Select container dialog, select Softcontainer and click Next.
   d. In the License Manager window, click Install licenses.
   e. In the Install Licenses window, select Activate license and click Next.
   f. Enter the "return" ticket ID that you received from CODESYS into the Ticket ID field. Click Next.
3. Email CODESYS product support to indicate that you completed the previous step.
4. When CODESYS provides you with a new ticket ID, install it on the new GRV-EPIC-PR1 in the same way you installed your first ticket ID. For instructions, see "Connecting Processor to Gateway and Entering the CODESYS Ticket ID" on page 101.

11: Working with *groov* EPIC Devices in CODESYS Projects

This chapter describes how to add *groov* EPIC processors and *groov* I/O modules to a CODESYS project so that you can design and build CODESYS applications that run on a *groov* EPIC processor and communicate with local I/O. Here's a high-level list of the tasks involved:

1. "Adding a groov EPIC Device to a CODESYS Project" on page 106
2. "Updating groov EPIC and groov I/O Module Information" on page 107
3. "Creating Network Interfaces for the groov EPIC Device" on page 107
4. "Setting Up Local I/O – Adding groov EPIC to the Device Tree" on page 109
5. "Setting Up Local I/O – Plugging in groov I/O Modules" on page 109
6. "Configuring Processor Parameters and Channel Features" on page 110
7. "Creating a Symbol Configuration" on page 116

   This step is only necessary if you have *groov* EPIC firmware 1.3.0. If you have version 1.3.1 or higher, you don't need to do this step.

This chapter does not explain how to design and build applications with the CODESYS Development System. (For this type of information, see the CODESYS Online Help at help.codesys.com.)

When you are ready to download the application to the *groov* EPIC processor to run it and debug it, follow the instructions in "Downloading and Running CODESYS Applications" on page 117.

The instructions in this chapter assume you have successfully completed all the tasks in Chapter 11: Working with groov EPIC Devices in CODESYS Projects.

Note: *Throughout this section, instructions may use CODESYS terminology that differs from standard Opto 22 terminology. For example:*

- *In the CODESYS Development System interface, the term "device" refers to many different objects: a controller, an Ethernet adapter, a field device, or an I/O module. In this guide, "device" typically refers to a field device (a valve, a pump, a quadrature encoder, etc.). When you read sections of the guide that do not discuss CODESYS, you can interpret references to "device" to mean the latter definition.*
- *In CODESYS terminology, a groov EPIC processor, a groov RIO, and channels on a groov RIO are referred to as devices; throughout other sections of this guide, a groov EPIC processor is referred to as a processor, a groov RIO is referred to as a RIO module, and a channel is referred to as a channel.*
- *An application, in CODESYS terminology, is roughly equivalent to a PAC control strategy in Opto 22 terminology.*

ADDING A *groov* EPIC DEVICE TO A CODESYS PROJECT

If this is a new CODESYS project, see "Creating a New CODESYS Project and Adding a groov EPIC Device" on page 106. If you're adding the EPIC to an existing CODESYS project, see "Editing an Existing Project to Add a groov EPIC Device" on page 106. You can add more than one *groov* EPIC device to your project if your application requires it.

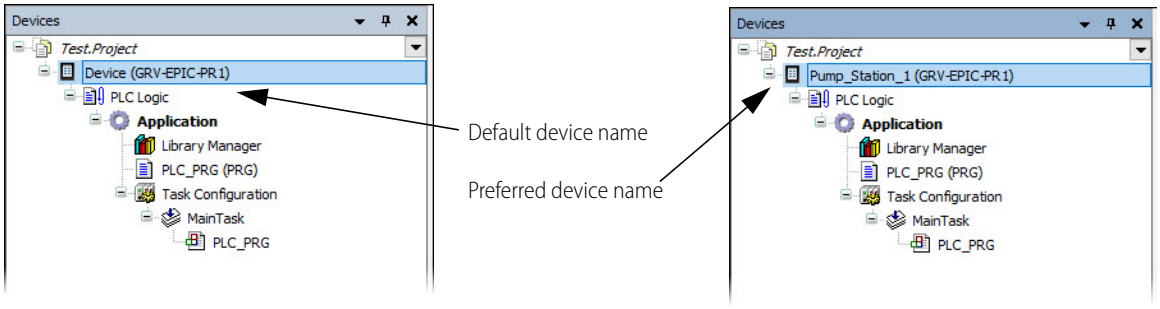
Creating a New CODESYS Project and Adding a *groov* EPIC Device

1. Open CODESYS Development System.
2. Click File > New Project. In the Templates box, make sure Standard project is selected.
3. In the Name field, type in a name for your project, then click OK.
4. In the Standard Project window, select GRV-EPIC-PR1 as the device. In the PLC_PRG field, select your preferred IEC61131-3 programming language, then click OK.

NOTE: *If you see an error message about missing Opto 22 library files, in the Library Manager tab, click the Download Missing Libraries button and follow the on-screen instructions.*

After CODESYS Development System creates the project, you may want to change the standard name that CODESYS gives your device (which is "Device") to something more helpful (for example, "Pump_Station_1").

1. In the Devices view, right click Device (GRV-EPIC-PR1) and select Properties.
2. In the Properties - Device window, change the name "Device" to your preferred name. Click OK.
3. When CODESYS asks if you want all references to the name "Device" changed to your preferred name throughout the entire project (this is called Automatic Refactoring), click Yes. In the Refactoring window, click OK. CODESYS updates the Devices view to show your preferred name for the device.



If you want to add more *groov* EPIC devices to this project, go to step 3 in the next section.

Editing an Existing Project to Add a *groov* EPIC Device

1. Open CODESYS Development System.
2. Click File > Open Project. Navigate to the folder where you stored the project file, select the project file, and then click Open.
3. In the Devices view, right-click the project name and select Add Device.
4. In the Add Device window, type a name for your *groov* EPIC processor in the Name field.
5. Expand the PLCs branch and select GRV-EPIC-PR1.
6. Click Add Device.

   CODESYS Development System adds the GRV-EPIC-PR1 to the Devices view and leaves the Add Device window open, in case you want to add more devices. If you don't need to add any more devices, click Close.

UPDATING *groov* EPIC AND *groov* I/O MODULE INFORMATION

You should periodically check the Opto 22 website for updates to Opto 22 Library Package for CODESYS Development System. The package describes the features and capabilities (of the *groov* EPIC processor, the *groov* I/O modules, and *groov* RIO modules) that are available to the CODESYS Development System. As new modules are introduced, the package gets updated to include the description of the features and capabilities of these new modules, which makes them available to CODESYS Development System.

It's also a good idea to review the readme (there's a link to it from that web page) for information about:

- Enhancements, features, or bug fixes that you might want access to, or
- Pre- or co-requisites, like a new version of firmware for a *groov* I/O module, which might be required by one of these enhancements, features, or bug fixes.

When you have all the information you need:

1. Follow the instructions in "Adding the Opto 22 Library Package to CODESYS Development System" on page 100 to download and install the package.
2. Open the project and, in the Device tree, expand the GRV-EPIC-PR1 device to see all the modules.
3. Right-click GRV-EPIC-PR1 and select Update Device.
4. If the Update Device window does not automatically select GRV-EPIC-PR1, navigate through the window to find it and select it.
5. Click Update Device.
6. Right-click the first module on the GRV-EPIC-PR1 and click Update Device.
7. In the Update Device window, select the same module and choose the highest version number. Then click Update Device.
8. Repeat step 6 and step 7 for each module on the EPIC (required to update the device description in CODESYS).
9. Save your project.

If you noted any changes you might have to make when you reviewed the readme, remember to make those changes. Then rebuild your project, test the changes, and verify that your application works as expected.

If you are in the middle of a new project, go on to the next section. If you are creating a new project, double-check the version number to verify that you are using the recently installed version of the Opto 22 Library Package.

CREATING NETWORK INTERFACES FOR THE *groov* EPIC DEVICE

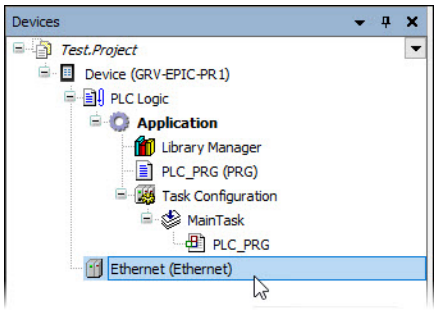
Depending on the design of your application, your network communication requirements may be simple (communicate with the local I/O) or complex (communicate to other services or other devices). You'll need to create a network interface for your local I/O, and a separate network interface for each device you want to communicate with. To create a network interface in CODESYS Development System, you add an Ethernet device to your CODESYS project.

Before you begin adding Ethernet devices to your CODESYS project, review the requirements of the Ethernet network interfaces on the *groov* EPIC processor ("Selecting a Network Configuration" on page 50). If one of the Ethernet network interfaces is connecting to a device with a static IP address, you'll also need to know its subnet mask and default gateway address. Work with your IT department, if available, to determine the correct information. It's also helpful to have a descriptive name for the network interface, to help you identify it as you are programming your application.

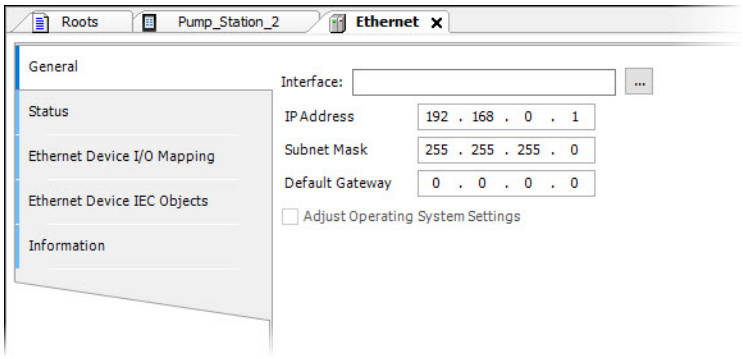
Let's start:

1. In the project's Devices view, right-click your *groov* EPIC processor and select Add Device.
2. Under the Fieldbusses folder, expand Ethernet Adapter and select Ethernet.

3. Click Add Device. CODESYS Development System adds an Ethernet branch to your *groov* EPIC processor's branch. Click Close.



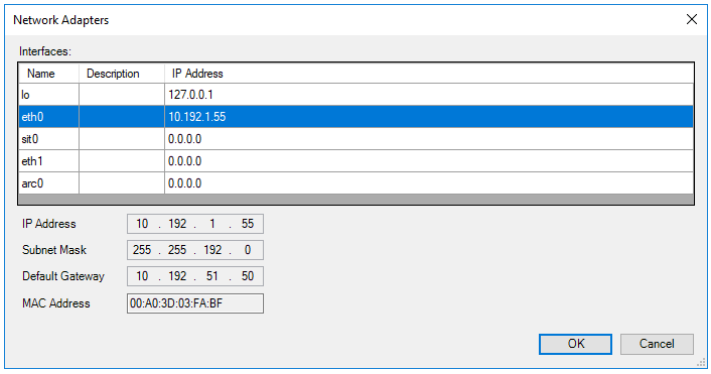
4. In the Devices view, double-click Ethernet (Ethernet). Or if you added a preferred name, double-click the preferred name, for example, control_network (Ethernet).
5. In the Ethernet View, make sure the General tab is selected.



6. On the Interface field, click the more button (...) to see a list of network interface options.

   NOTE: If you receive a "No device detected" message, check "CODESYS: Can't Connect to groov EPIC Processor" on page 172 for possible causes.

7. In the Network Adapters window, select the network interface for this Ethernet device. For the first connection, you typically select eth0.



8. Click OK.
9. If necessary (for example, if you are connecting to a static IP address), enter the IP address, subnet mask, and default gateway addresses.

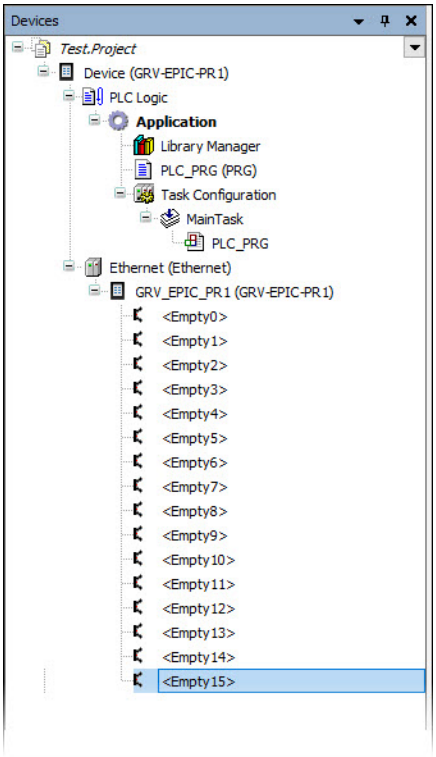
10. Click File > Save.

Repeat these steps for each network interface you need to define.

SETTING UP LOCAL I/O – ADDING *groov* EPIC TO THE DEVICE TREE

1. In the Devices view, right-click Ethernet (Ethernet) or the preferred name for the interface, and select Add Device.
2. In the Add Device dialog box, expand Miscellaneous and select GRV-EPIC-PR1.
3. Click Add Device.

   CODESYS Development System establishes communication to your *groov* EPIC processor and then adds the processor to the Device tree, along with a default 16-slot chassis model. Your actual chassis model may be smaller; keep that in mind as you continue.
4. Click Close.



SETTING UP LOCAL I/O – PLUGGING IN *groov* I/O MODULES

In CODESYS Development System, adding a module is called "plugging in a device." CODESYS Development System can identify the modules mounted on the chassis and automatically add the module information (see "Plugging in I/O modules automatically" on page 109) or you can manually add the modules (see "Plugging in I/O modules manually" on page 110).

Plugging in I/O modules automatically

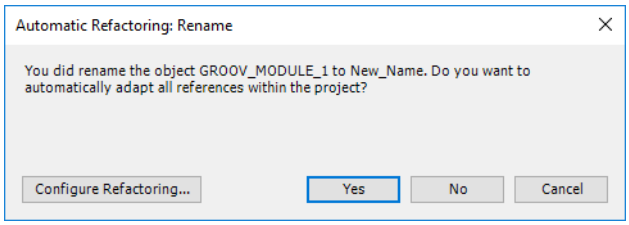
1. Connect to the I/O unit by clicking Online > Login. If you are prompted to create an application on the device, click Yes.
2. In the Devices view, right-click the GRV-EPIC-PR1 and select Scan For Devices.

   The Scan Devices window opens and displays the modules installed on the chassis.
3. Click Copy All Devices to Project.

   CODESYS Development System updates the Devices view to show the modules under the I/O unit, GRV-EPIC-PR1.
4. Click Online > Logout.
5. If you want to change the name of each module from the standard GROOV_MODULE (or its variants):
   a. In the Devices view, right click the module you want to rename and select Properties.

b. In the Properties window, change the name "GROOV_MODULE" (or its variant) to your preferred name. Click OK.

When CODESYS displays the following message, it's asking you if you want all references to the name "GROOV_MODULE" changed to your preferred name throughout the entire project (this is called Automatic Refactoring).



c. Click Yes. In the Refactoring window, click OK.

CODESYS updates the Devices view to show your preferred name for the module.

Plugging in I/O modules manually

If you don't have access to your *groov* I/O modules yet, you can still continue with your CODESYS application development. You can plug in your I/O modules manually and continue on with configuration, mapping, and even some programming.

1. In the Devices view, right-click a module slot that shows "Empty." Select Plug Device.
2. In the Plug Device window, select the *groov* I/O module you want to add. To give that module a name, type the name in the Name field. Click Plug Device, then click Close.
3. Repeat the previous two steps for each module you want to add.

CONFIGURING PROCESSOR PARAMETERS AND CHANNEL FEATURES

After adding the *groov* EPIC processor and *groov* I/O modules to your project, you can configure the processor parameters and set channel features to meet the specific requirements of your application.

Configuring Processor Parameters

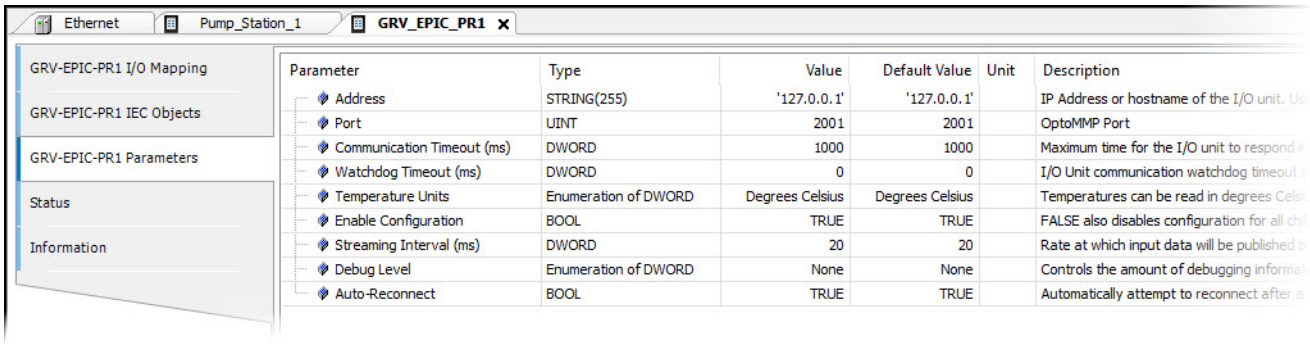
Processor parameters help you control several performance factors and processor settings, like:

- Timeouts and data streaming rates
- IP addresses, port numbers, and temperature units (Celsius or Fahrenheit)

To find and set these parameters:

1. Start CODESYS Development System and open a project that contains your GRV-EPIC-PR1 device.
2. In the Devices view, expand Ethernet.
3. Double-click your GRV-EPIC-PR1 device.

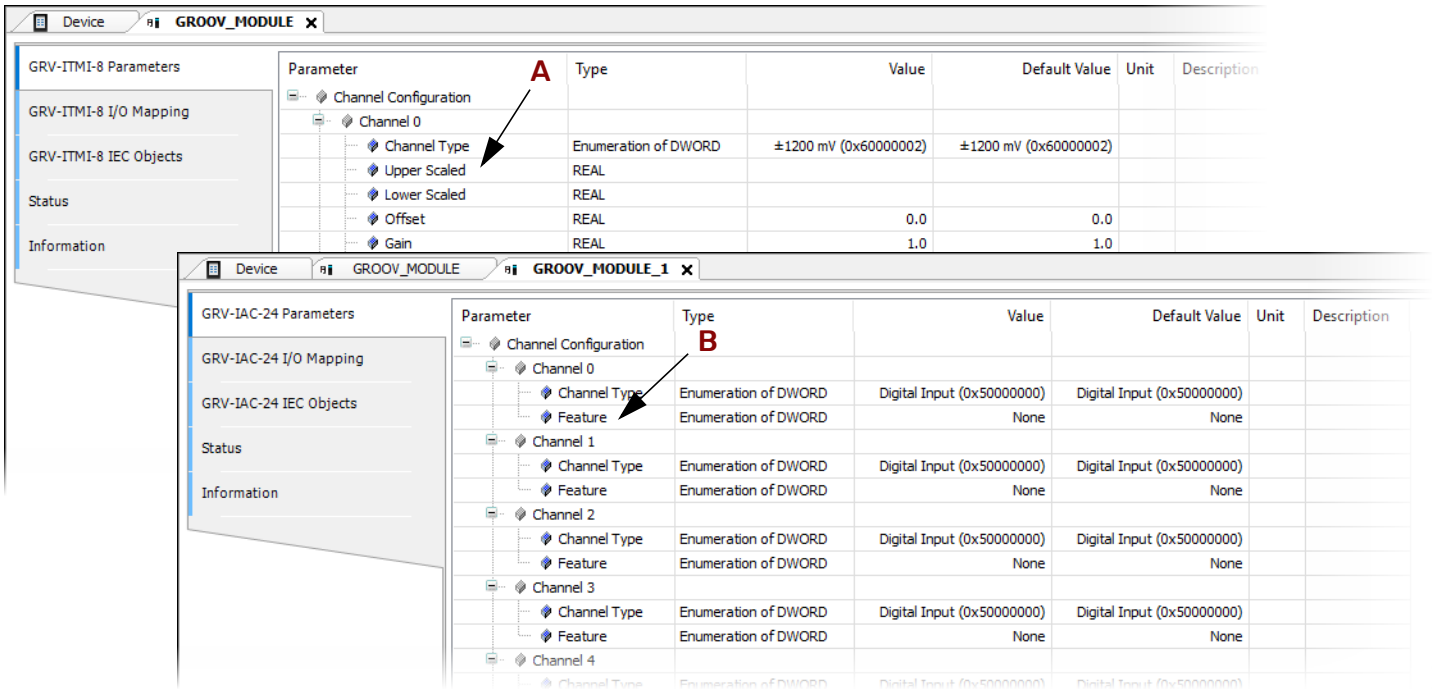
4. In the GRV-EPIC-PR1 editor, click the GRV-EPIC-PR1 Parameters tab.



5. Review all the parameters, paying particular attention to the following:
   - **Address—**Make sure the IP address or hostname of the GRV-EPIC-PR1 is correct in the Value column and surrounded by single quotes (').
   - **Streaming Interval (ms)—**This is the rate at which the I/O unit will stream input data to the CODESYS Runtime Engine. This parameter might require some fine-tuning.
   - **Auto-Reconnect—**This parameter helps with communication error handling.
6. Save your project.

Setting Channel Features

Many *groov* I/O modules offer configurable features; for example, on some analog input modules, you can select from a set of available input ranges. In CODESYS Development System, you indicate which features you want to select or set by configuring a channel parameter. Channel parameters are listed in the Parameters tab of the module view. The following image shows how CODESYS displays the Parameters tab for two different modules:



A GRV-ITMI-8, an analog input module. Each channel on this module has several configurable features, each on its own row. The image shows the first five (of six) configurable features for channel 0.

B GRV-IAC-24, a digital input module. Each channel on this module has one configurable feature, shown in the Feature row. The image shows the first 4 (of 24) channels available on the module.

The following table lists the channel features you can set for the listed modules.

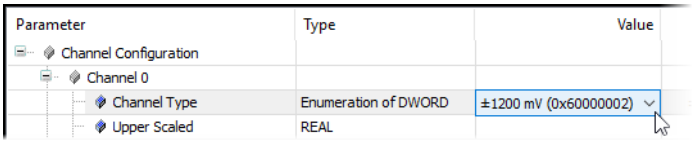
Categories		Module Part Number		Configurable Channel Parameters
Input Modules	Digital	• GRV-IACDCTTL-24 • GRV-IAC-24 • GRV-IACHV-24 • GRV-IACI-12	• GRV-IACIHV-12 • GRV-IDC-24 • GRV-IDCI-12 • GRV-IDCIFQ-12	• Counting
		• GRV-IACDCTTLS-24 • GRV-IACHVS-24 • GRV-IACIHVS-12 • GRV-IACIS-12	• GRV-IACS-24 • GRV-IDCIS-12 • GRV-IDCS-24	• No configurable channel parameters
	Analog	Modules with selectable temperature/input ranges: • GRV-IICTD-12 • GRV-ITMI-8 • GRV-ITR-12		• Input Range or Type (except GRV-IICTD-12) • Upper/Lower Scale • Offset • Gain • Filter Weight
		Modules with selectable input ranges: • GRV-IMA-24 • GRV-IMAI-8 • GRV-IV-24		• Input Range • Upper/Lower Scale • Offset • Gain • Filter Weight
	Commu-nication	• GRV-CCANI-2 • GRV-CSERI-4		• Transmission mode
Output Modules	Digital	• GRV-OAC-12 • GRV-OACI-12 • GRV-OACIS-12 • GRV-OACS-12 • GRV-ODCI-12	• GRV-ODCIS-12 • GRV-ODCSRC-24 • GRV-ODCSRCHCS-12 • GRV-OMRIS-8	• Watchdog
	Analog	• GRV-OVMALC-8 • GRV-OVMAILP-8		• Output Range • Upper/Lower Scale • Watchdog • Upper/Lower Clamp

For a list of all modules and their features, see Appendix D: I/O Module Specifications. If a feature listed in that appendix is not listed in this table, the feature is not configurable through CODESYS Development System.

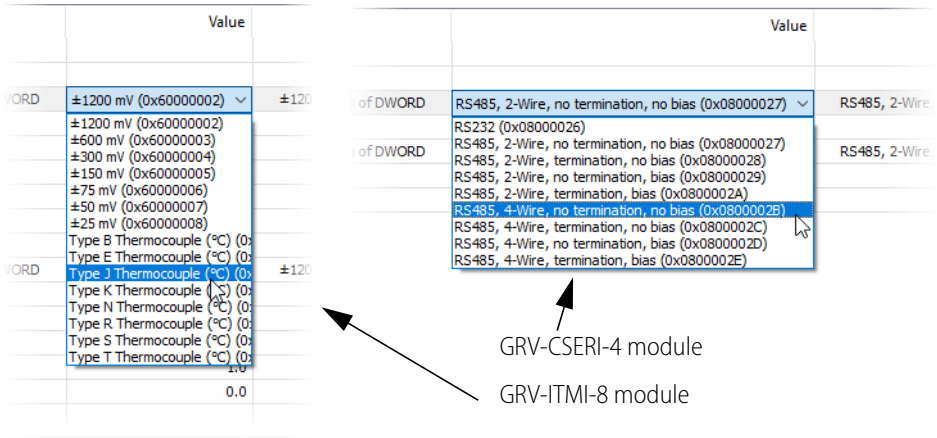
Configuring Channel Parameters

1. If you haven't started CODESYS Development System, start it and open your project.
2. Open or select the Devices view, expand the Ethernet branch, then expand the branch of your *groov* EPIC processor.
3. Double-click the module that contains the channel you want to configure. CODESYS Development System opens a module view for that module. Check that the Parameters tab is selected.

4. Find the channel you want to configure, then expand it to view the features you can set or select:
   - **For channels with selectable input ranges/types:** On the Channel Type row, double-click the Value cell to display the drop-down arrow.



   Click the arrow to display the list of available values. Each module will have a different list of values for Channel Type. Below are a couple of examples. Select the input range/type that you want.

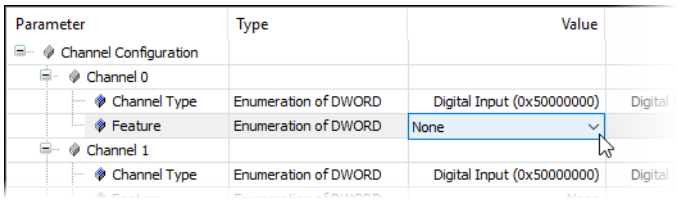


   - **For channels with scaling:** If you want to set scaling values, first determine the upper and lower ends of the scale. For example, if your input range is ± 600 mV and it is connected to a tank that can hold 1000 liters, you can set the lower end of the scale (-600 mV) to represent 0 liters and the upper end of the scale (+600 mV) to represent 1000 liters.
     - On the Upper Scaled row, double-click the Value cell and enter 1000.
     - On the Lower Scaled row, double-click the Values cell and enter 0.

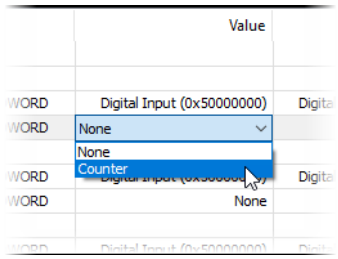
     To set default scaling, leave the Value cells blank or enter 0.
   - **For channels with clamping:** If you want to limit the output sent to the device attached to the channel, first determine the upper and lower end of that range. For example, suppose you want the output range to be 5–15 mA. On a GRV-OVMALC-8 module, you can set the Channel Type to 4–20 mA. Then, to limit the range to 5–15 mA:
     - On the Upper Clamp row, double-click the Value cell and enter 15.
     - On the Lower Clamp row, double-click the Value cell and enter 5.

     To set no clamping, set both Values cells to 0.

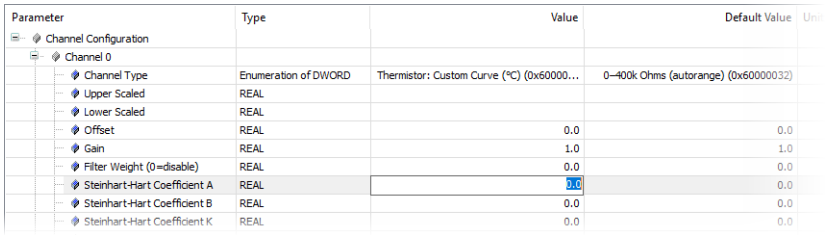
– **For channels with counting:** If you want to use the counting feature, you must select it. On the Feature row, double-click the Value cell to display the drop-down arrow.



Click the arrow to display a list, then select Counter.



– **For channels with user-supplied values:** You can provide values for some parameters; for example, you can specify Steinhart-Hart coefficients when you select "Thermistor: Custom Curve (°C) (0x60000043)" as the Channel Type. To enter a value, double-click the Value cell for the corresponding parameter and type your desired value, then press Enter. The following figure shows what the Value cell for Steinhart-Hart Coefficient A looks like after you double-click it:



5. Repeat step 4 for each channel you want to configure.
6. To configure channels on another module, return to step 3.

Remember to save your project periodically.

Reading or Clearing Latches and States

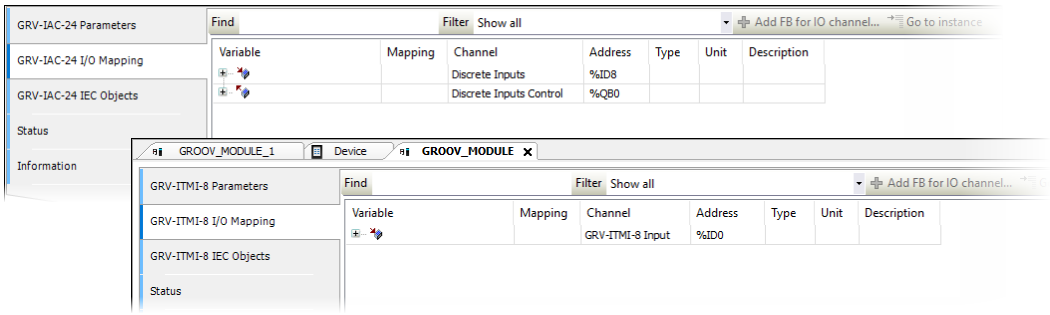
To read or clear a latch or a state, you map a variable to the latch or state, then (in your application logic) program the variable to read or clear the latch or state.

The following table lists the modules that offer latch or state.

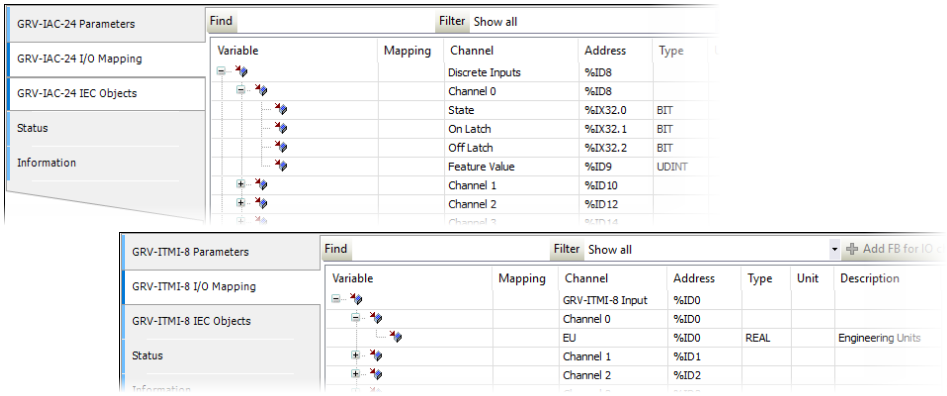
		Module Part Number		Available Feature
Input Modules	Digital	• GRV-IACDCTTL-24 • GRV-IAC-24 • GRV-IACHV-24 • GRV-IACI-12 • GRV-IACIHV-12	• GRV-IDC-24 • GRV-IDCI-12 • GRV-IDCIFQ-12	• On Latch • Off Latch • State
		• GRV-IACDCTTLS-24 • GRV-IACHVS-24 • GRV-IACIHVS-12 • GRV-IACIS-12 • GRV-IACS-24	• GRV-IDCIS-12 • GRV-IDCS-24	• State
	Analog	• GRV-IICTD-12 • GRV-IMA-24 • GRV-IMAI-8	• GRV-IV-24 • GRV-ITMI-8 • GRV-ITR-12	Not applicable
Output Modules	Digital	• GRV-OAC-12 • GRV-OACI-12 • GRV-OACIS-12 • GRV-OACS-12	• GRV-ODCI-12 • GRV-ODCIS-12 • GRV-ODCSRC-24 • GRV-OMRIS-8	• State
	Analog	• GRV-OVMALC-8 • GRV-OVMAILP-8		Not applicable

CODESYS Development System displays a list of latches or states, organized by channel, in the Mapping tab of the module view. The following image shows the Mapping tab for two modules:

- GRV-IAC-24, a digital input module
- GRV-ITMI-8, an analog input module



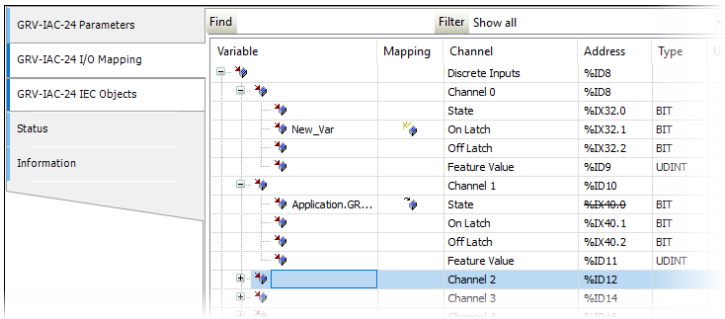
The following image shows the same two modules with channel 0 of both modules expanded.



Mapping a Latch or State to a Variable

1. If you haven't started CODESYS Development System, start it and open your project.
2. Open or select the Devices view, expand the Ethernet branch, then expand the branch of your *groov* EPIC processor.
3. Double-click the module that contains the latch or state that you want to clear or read. CODESYS Development System opens a module view for that module. Click the Mapping tab.
4. Expand the variable list to view the list of channels. Select a channel and expand it to view the list of features.
5. Determine if you want to map a variable to a channel or a specific state or latch:
   - **To a channel:** If you map a variable to a channel, you can access all the features on that channel by appending to the variable a dot (.) and the name of the feature. For example, if you map a variable to channel 0 and call the variable `MyInput` when you want to access the On Latch feature, you write the reference as `MyInput.OnLatch`.
   - **To a specific state or latch:** The variable will access only the feature that it's mapped to; it won't be able to access any of the other features on the same channel or any other channel.
6. Map the variable by creating a new variable or mapping to an existing variable.
   - To create a new variable, click the Variable cell, type in the new variable name, then press Enter.
   - To map an existing variable, click the more button (...) to open the Input Assistant. Navigate or search through the Input Assistant to find the variable, select it, then click OK.

   The following image shows a new variable (New_Var) mapped to On Latch of channel 0, and an existing variable (Application.GR) mapped to State of channel 1:



   In the above example, the name of the existing variable is too long to fit on the space available, so the interface shows ellipses (...) to indicate that the name is longer than what's shown.

7. Repeat steps 3 through 5 for each channel and module you want to map to a variable.

Remember to save your project periodically.

CREATING A SYMBOL CONFIGURATION

This section is necessary only if you are running 1.3.0 on the processor. If you installed 1.3.1 or later, you don't have to do this.

Create a symbol configuration object following instructions in Creating a symbol configuration in the CODESYS Online Help.

REFERENCING FILES STORED IN THE *groov* EPIC PROCESSOR

You can upload files to the *groov* EPIC processor through *groov* Manage. If you want your CODESYS application to access these files, you must upload them to the unsecured area. (For details, see "Uploading Files to the groov EPIC Processor" on page 98.)

When you reference these files (either programmatically or through the CODESYS Development System user interface), you must prefix the file name with either of the following paths:

- `/home/codesys/unsecured/`
- `/home/dev/unsecured/`

If you don't specify a path (in other words, you write only a file name), CODESYS will look for the file in whatever folder CODESYS has defined for that particular program or user interface function. These folders aren't accessible to *groov* Manage.

DOWNLOADING AND RUNNING CODESYS APPLICATIONS

The online help for CODESYS Development System offers detailed instructions on downloading and running CODESYS Applications, under the section "Transferring Applications to the PLC". For the simplest instructions, see "Downloading the Application Code, Logging in, and Starting the PLC". However, you should review all the information under the first section to learn about options, features, or requirements that might help your application run more efficiently.

IMPORTANT: *If you don't license your GRV-EPIC-PR1, you can download and run programs; however, the CODESYS Runtime Engine runs for only two hours. After the two hours expire, the CODESYS Runtime Engine stops running. You'll have to disable it (see "Disabling the CODESYS Runtime Engine" on page 103) and then re-enable it (see "Enabling the CODESYS Runtime Engine" on page 102).*

In addition, the *groov* EPIC processor offers features (through *groov* Manage) that can help you manage your CODESYS application.

Starting or Stopping CODESYS Applications on the *groov* EPIC Processor

In *groov* Manage, you can start or stop a CODESYS application that you downloaded to the *groov* EPIC processor.

1. Log into your *groov* EPIC processor with a user ID that has administrator authority.
2. Click or tap Controller.
3. Click or tap CODESYS Controller.
   - To stop a running application, click or tap Stop Application. Confirm that you want to stop the application by clicking or tapping OK. After the application is stopped, the Status is changed to Stopped.
   - To start a stopped application, click or tap Run Application. Confirm that you want to start running the application by clicking or tapping OK. After the application starts running, the Status is changed to Running.

Monitoring Latches, States, and Counters: CODESYS or *groov* Manage?

While you are running or debugging your CODESYS application, you can monitor the following in *groov* Manage:

- On Latch
- Off Latch
- Counter

However, due to differences in how *groov* Manage and CODESYS Runtime Engine monitor and report information, the values you see in the CODESYS debugger won't match what you see in *groov* Manage. For CODESYS applications, it's more accurate to monitor this data from CODESYS, not from *groov* Manage.

12: Downloading and Running PAC Control Programs

The *groov* EPIC processor can run flowchart programs built with PAC Control. These programs run on the PAC Control Engine.

The PAC Control Engine and CODESYS Runtime Engine are mutually exclusive; that means that you can run one or the other, but not both.

DOWNLOADING AND RUNNING PAC CONTROL STRATEGIES

IMPORTANT: *If you switched the controller from the PAC Control Engine to the CODESYS Runtime Engine, you must switch back to the PAC Control Engine before running PAC Control programs. For instructions, see "Enabling the PAC Control Engine" on page 122.*

When you create your control program with PAC Control, you add a control engine that specifies your *groov* EPIC processor, just as you do when you add a SNAP PAC controller. You develop, download, run, and debug your PAC Control strategies as you do with a SNAP PAC controller. For specific instructions on adding your *groov* EPIC processor as a control engine, see PAC Control User's Guide (form 1700).

Identifying the Strategy that is Running on the *groov* EPIC Processor

1. Log into the *groov* EPIC processor with a user ID that has administrator privileges.
2. Click or tap the menu button ( ) and select Control Engine.

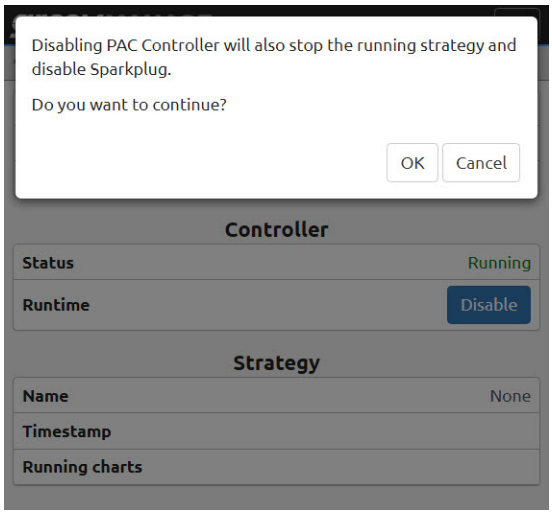
The bottom half of the screen displays the name of the strategy currently running.

Enabling or Disabling Background Downloading

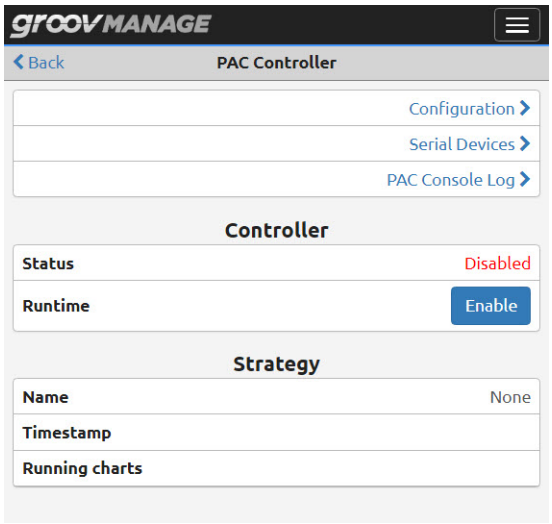
Background downloading enables you to download a strategy onto a *groov* EPIC processor without stopping the strategy that is currently running on the processor. However, for this feature take effect, you must stop the Control Engine and then restart it. This will also disable Sparkplug. Schedule a time to do this task so that it has minimal impact on your application and equipment.

1. Log into the *groov* EPIC processor with a user ID that has administrator privileges.
2. Click or tap the menu button ( ) and select Controller.
3. Click or tap PAC Controller, then Configuration.
4. In the PAC Controller configuration page:
   - To enable background downloading, move the slider to the right so that it shows green ( ).
   - To disable background downloading, move the slider to the left so that it shows grey ( ).
5. Click or tap Save.

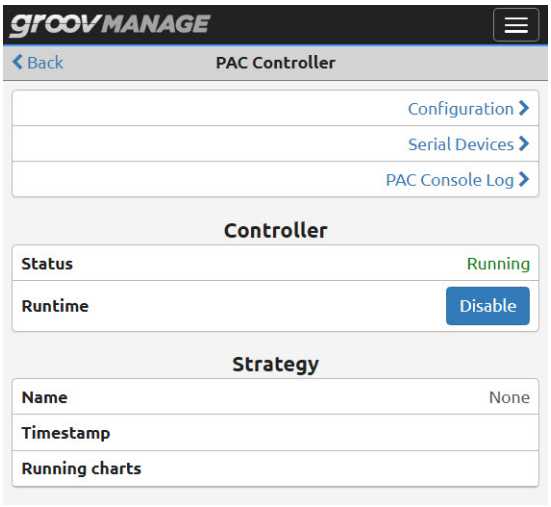
6. In the PAC Controller page, click or tap Disable. Read the warning message, then click OK.



7. Wait a few seconds the processor to stop the Control Engine. When it is done, *groov* Manage changes the Control Engine page to show that the Control Engine was disabled.



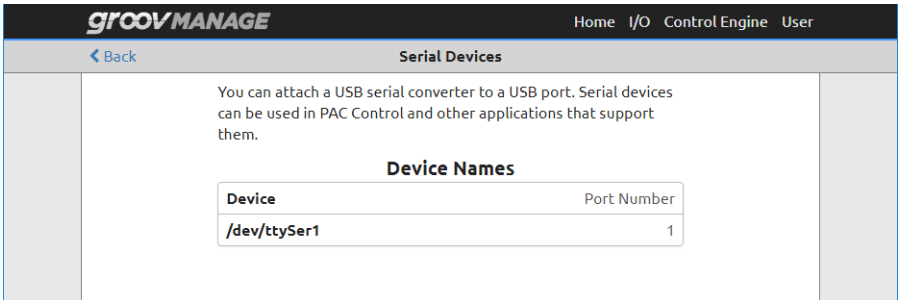
8. Click Enable. Acknowledge the message by clicking OK. Wait a few seconds for the processor to restart the Control Engine. You might see the screen momentarily display Stopped, then change to Running.



The next time you download a strategy, the currently running strategy will continue running while you download another strategy.

Identifying Serial Devices Accessible to the Control Engine

1. Log into the *groov* EPIC processor with a user ID that has administrator privileges.
2. Click or tap the menu button ( ) and select Control Engine.
3. Click or tap Serial Devices (Serial Devices). The Serial Devices page shows the devices attached to the *groov* EPIC processor. In the following example, the Serial Devices page shows that there is one serial device connected to USB port 1.

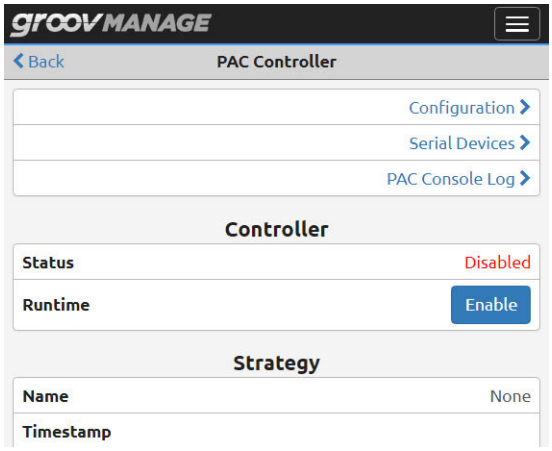


Disabling the PAC Control Engine

When you disable a control engine, the strategy that is currently running stops and Sparkplug (if enabled) is disabled. Make sure you consider all the consequences of disabling a control engine before you continue with this procedure.

1. Log into the *groov* EPIC processor with a user ID that has administrator privileges.
2. Click or tap the menu button ( ) and select Control Engine.
3. Click or tap Disable. The processor display a warning message to verify that you understand the consequences of disabling a control engine and want to proceed.

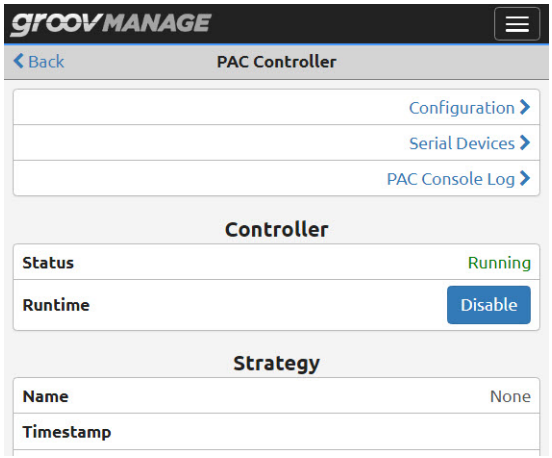
4. Click OK to proceed with disabling the control engine. After a few seconds, the Status section of the Control Engine page indicates that the control engine is disabled and the Runtime button has been changed to a green Enable button.



Enabling the PAC Control Engine

Note: *If the CODESYS Runtime Engine is running when you enable the PAC Control Engine, the processor disables the CODESYS Runtime Engine and deletes any CODESYS applications on the processor. For more details about anything else that changes on the groov EPIC processor when you switch control engines, see* *"Switching Between PAC Control Engine and CODESYS Runtime Engine" on page 81*.

1. Log into the *groov* EPIC processor with a user ID that has administrator privileges.
2. Click or tap the menu button ( ) and select Control Engine.
3. Click or tap Enable. Wait a few seconds for the processor to restart the Control Engine. You might see the screen momentarily display Stopped, then change to Running.

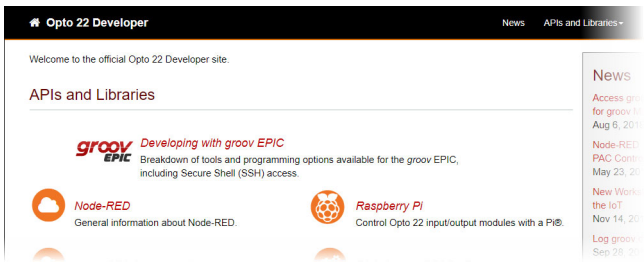


13: Downloading and Running Custom Control Programs

The *groov* EPIC processor can run control programs developed any programming language that can run on Linux OS. These programs can run independently of the PAC Control Engine or CODESYS Runtime Engine.

If you develop custom programs, Opto 22 offers a variety of tools to help you access *groov* EPIC services and *groov* I/O modules. You can find information about these tools, as well as instructions to help you get started using them, at our developer web site, developer.opto22.com.

This user's guide does not describe how to create custom control programs. The guide describes some of the features available on the *groov* EPIC processor to help you run your custom programs. A comprehensive guide to developing custom programs for the *groov* EPIC processor is available on developer.opto22.com, called Developing with *groov* EPIC.



Review the specifications of the *groov* EPIC processor (see Appendix A: Processor Specifications) to make sure your custom program can run on the Linux operating system and available hardware.

You can download and run your program through secure shell (SSH) access. The *groov* EPIC processor offers services to help you verify that you have access to the secure shell (SSH), and, if necessary, start and stop the SSH server.

IMPORTANT: *Be aware that if you are running through SSH access, the product support offered by Opto 22 is limited.*

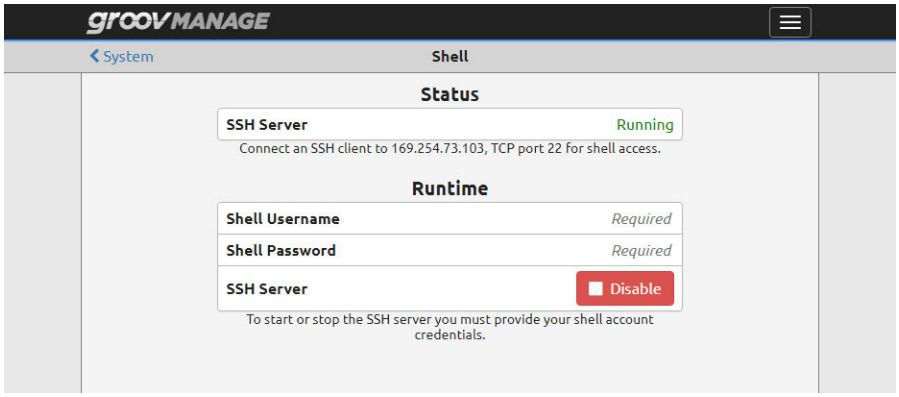
Verifying SSH Access

1. Log into the *groov* EPIC processor with a user ID that has administrator privileges.
2. Click or tap the menu button ( ) and select System.
3. Click or tap Shell (>_ Shell).
4. In the Shell page, if you have access to the secure shell, the Status section displays the SSH Server as running. Underneath that, it displays the IP address and port number to specify on an SSH client to access the SSH server.

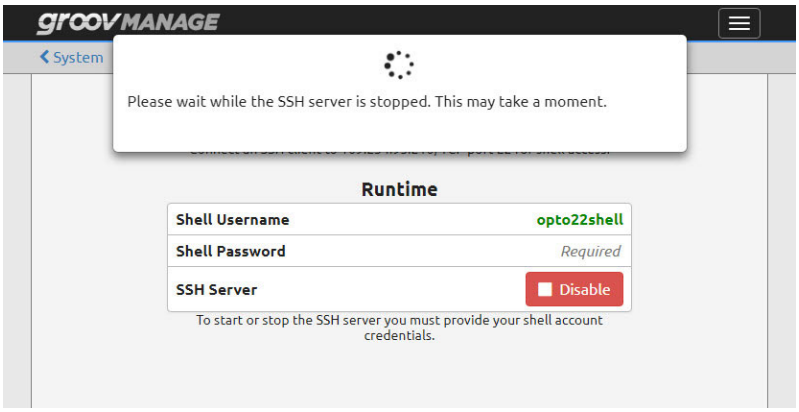
Stopping the SSH Server

To stop the SSH server, you must have the shell user ID and password.

1. Log into the *groov* EPIC processor with a user ID that has administrator privileges.
2. Click or tap the menu button ( ) and select System.
3. Click or tap Shell (>_ Shell).
4. In the Runtime section of the Shell page, enter the SSH user ID in the Shell Username field, the SSH user password in the Shell Password field, and then click or tap the red Disable button.

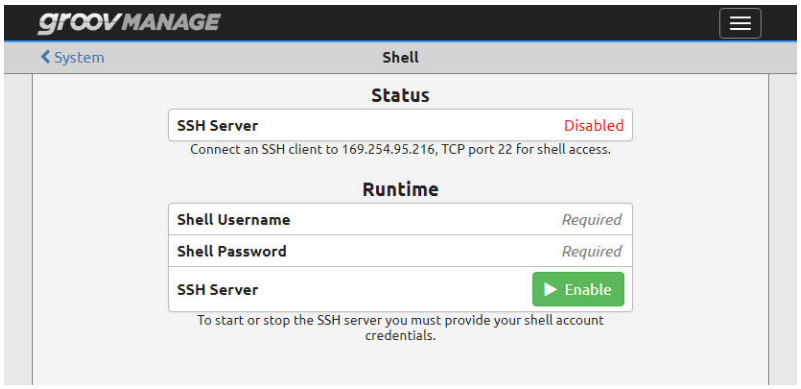


   – If the credentials are valid, the processor displays the following message immediately proceeds to stop the SSH server.



   – If the credentials are invalid, the processor highlights the Shell Username and Shell Password field in red and indicates that they are invalid. Repeat step 4 to try again.

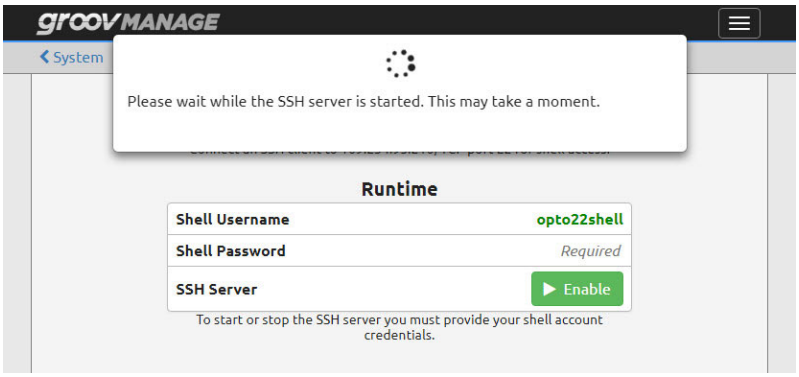
After the SSH server is disabled, *groov* Manage refreshes the Shell page and changes the SSH server button to Enable (▶ Enable).



Starting the SSH Server

To start the SSH server, you must have the shell user ID and password.

1. Log into the *groov* EPIC processor with a user ID that has administrator privileges.
2. Click or tap the menu button ( ) and select System.
3. Click or tap Shell (Shell).
4. In the Runtime section of the Shell page, enter the SSH user ID in the Shell Username field, the SSH user password in the Shell Password field, and then click or tap the green Enable button. The processor displays the following message and immediately proceeds to stop the SSH server.



After the SSH server is started, *groov* Manage refreshes the Shell page and changes the SSH server button to Disable (Disable).

14: Developing and Deploying Node-RED flows

Node-RED is an open-source, multi-platform software program, where you wire together devices, databases, cloud applications, and APIs (application programming interfaces) to create simple logic flows to accomplish specific goals. It is pre-installed on your *groov* EPIC processor

Because Node-RED is integrated with the *groov* EPIC processor, you do not have to download and install it on a computer or embedded device. You can just log into your *groov* EPIC processor and start using Node-RED. This tight integration also means that some system-level functions, like backup, apply to your Node-RED projects.

WHAT IS Node-RED AND HOW DOES IT WORK IN *groov* EPIC?

Node-RED is a visual tool originally designed at IBM® Emerging Technologies to connect hardware devices, APIs, and online services. Many people develop Internet of Things (IoT) applications with Node-RED.

In Node-RED you connect prebuilt *nodes* (provided by device manufacturers or software developers) together to make a *flow*. The flow provides the logic to accomplish your goal. You can also add *function* nodes containing JavaScript to enhance the flow with functionality that may not be available in existing nodes.

Node-RED nodes are available for *groov* View Data Store tags and for Opto22 *groov* EPIC processor and SNAP PAC controllers, which are reliable, industrial-grade controllers used in thousands of applications worldwide. The Node-RED nodes provide access to data in *groov* View Data Stores and values in PAC Control strategies running in *groov* EPIC processors or SNAP PAC controllers. For more information on nodes, see developer.opto22.com.

Node-RED in the *groov* EPIC processor

Node-RED Editor. You can include one or many flows in your Node-RED project, which you build in the standard, browser-based Node-RED Editor. You can access the editor directly through a URL or navigate to it through *groov* Manage.

Because Node-RED is a general-purpose programming environment, you have the freedom to create flows with nodes from a wide variety of sources:

- PAC Control nodes, to read or write values from a PAC Control strategy running on a *groov* EPIC processor or SNAP PAC controllers.
- *groov* View Data Store nodes.
- A wide variety of other nodes that are easy to install.

Debugging. With few programming restraints, it's easy to write bugs into your flow. The Node-RED Editor can help you debug flows. If Node-RED crashes, it automatically restarts. You can also start and stop Node-RED yourself from within *groov* Manage.

Files. Your Node-RED project consists of two files: the main file with all your flows, and a separate file containing all the sensitive credential information used by some nodes, such as usernames and passwords for an email node. The *groov* EPIC processor provides ways to backup and restore Node-RED projects, either separately or as part of the complete system backup and restore.

CREATING YOUR FIRST Node-RED FLOW

If you have never created a Node-RED flow, this section takes you through the creation of a simple Node-RED flow, then builds on that first flow to include real-world communication to a PAC Control strategy running on a *groov* EPIC processor or a SNAP PAC controller.

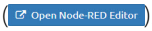
Requirements

- A *groov* EPIC processor
- A computer that can communicate with the *groov* EPIC processor
- For the real-world communication section, you need one of the following:
  - A *groov* EPIC processor running a PAC Control strategy
  - Opto 22 SNAP PAC R-series or S-series controller with firmware R9.5 or higher, running a PAC Control strategy R9.5 or higher, with its built-in RESTful API configured (see Quick Start steps on developer.opto22.com).

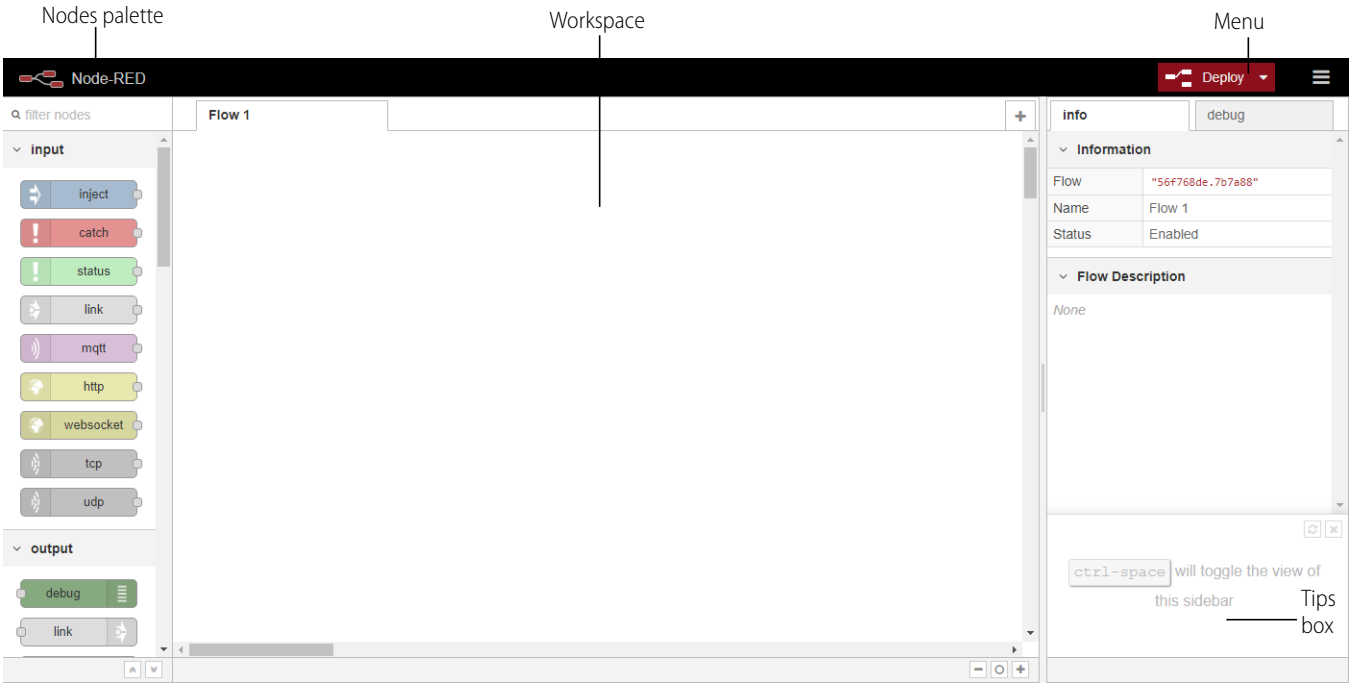
Opening the Node-RED Editor

You can open the Node-RED editor with either of the following methods:

- Open a web browser and enter either of the following in the URL bar:
  - `https://[your groov EPIC processor's hostname]/node-red`
  - `https://[your groov EPIC processor's IP address]/node-red`

  Don't forget the "s" in http**s**. Examples:
  - `https://opto-00-d2-da/node-red`
  - `https://192.0.2.20/node-red`
- If you are in *groov* Manage, click the menu button (), then select Home. From the Home page, click on Node-RED (), then Open Node-RED Editor ().

If you are new to the Node-RED Editor, take a moment to review the following diagram to familiarize yourself with the different parts of the editor.

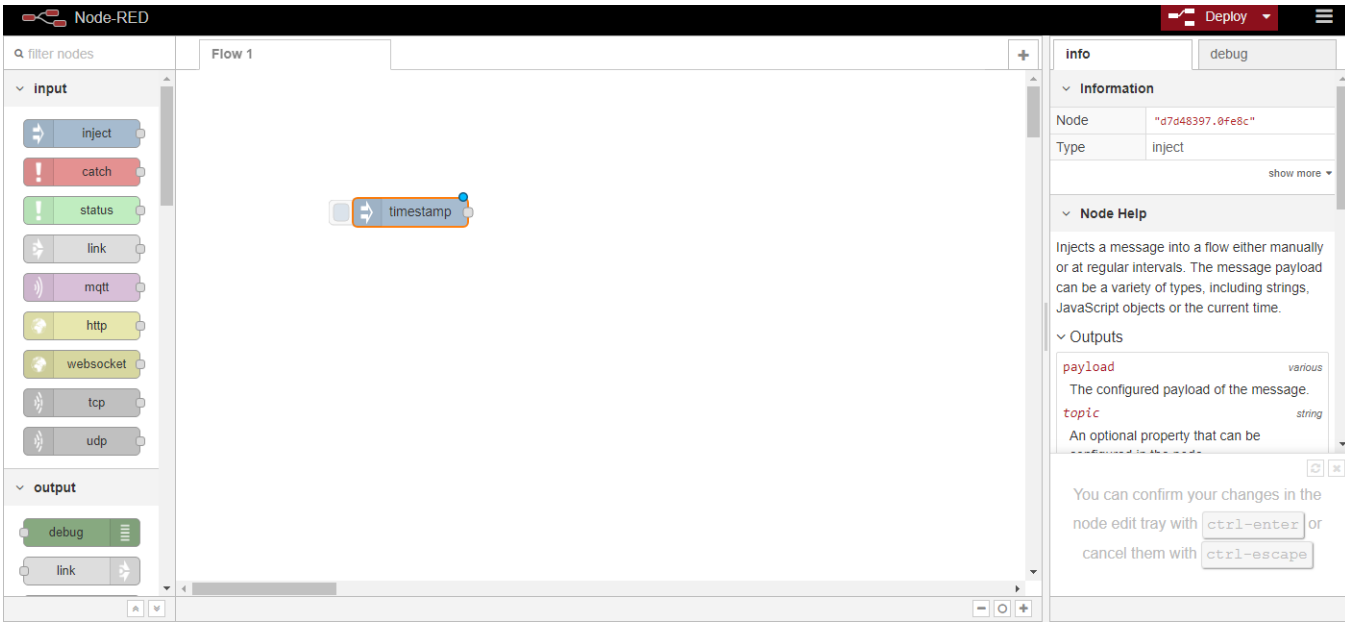


Creating a flow

1. In the Nodes palette on the left, locate the *inject* node. Click and hold on it, then drag it to the workspace.

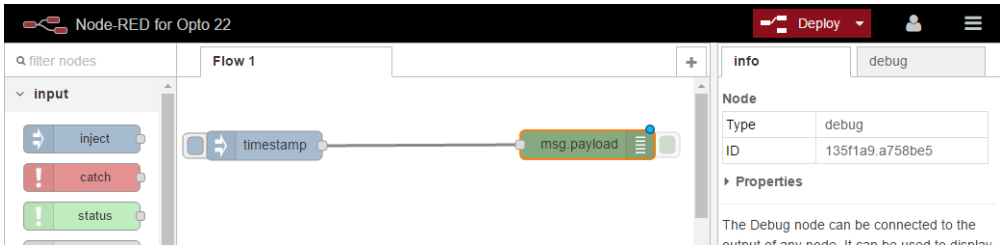
   The inject node lets you inject messages into a flow, either by clicking the button on the node or by setting a time interval between injects.

2. In the **info** tab on the right side-bar, click the inject node to see information about its properties and a description of what it does:



You might want to close the Tips box to remove it so that you can see more information in the **info** tab.

3. Scroll down in the Nodes palette and locate the *debug* node. Drag it to the workspace.
4. Wire the inject and debug nodes together by dragging from the output port of inject to the input port of debug.

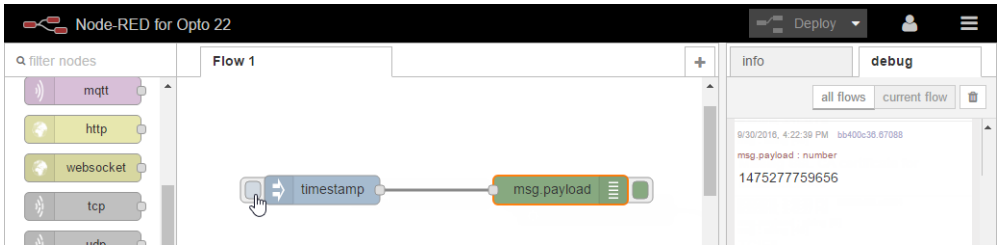


Deploying the flow and testing it

The nodes exist only in the editor and must be deployed to the server.

1. Click the Deploy button in the upper right. 

2. In the sidebar, select the **debug** tab. Click the button on the inject node. Numbers appear in the sidebar:

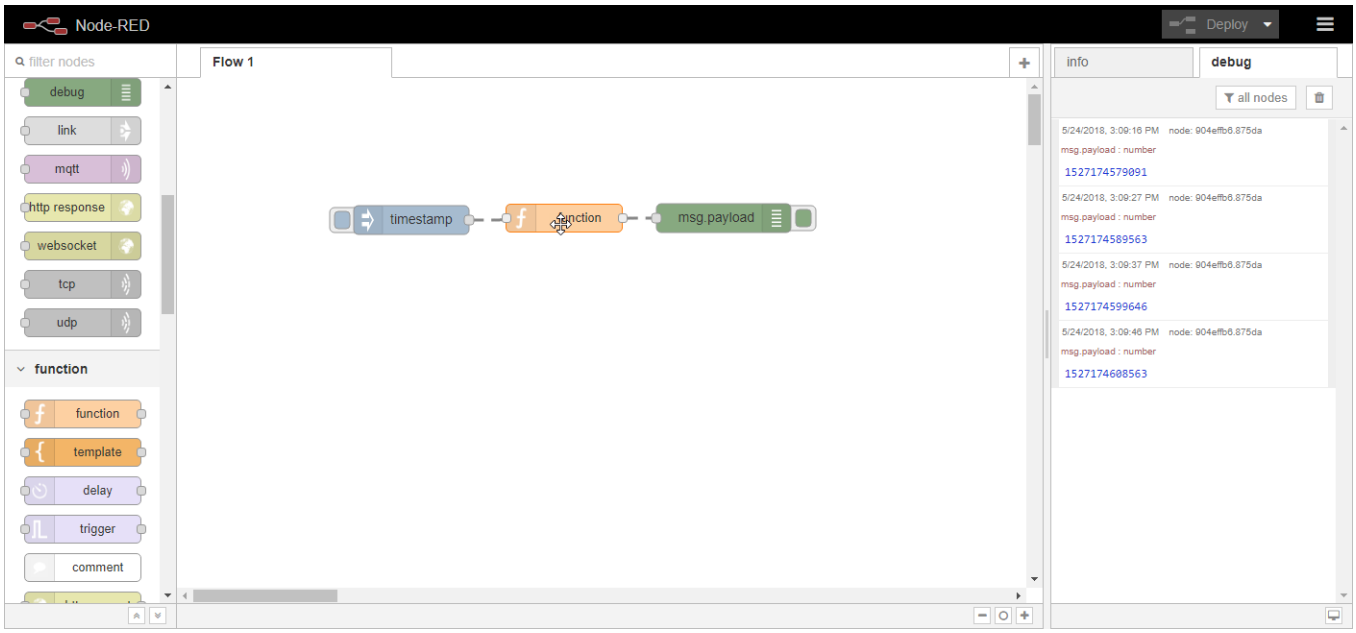


This number is a timestamp representing the number of milliseconds since January 1, 1970. This is the default payload of the Inject node.

Adding a Function node

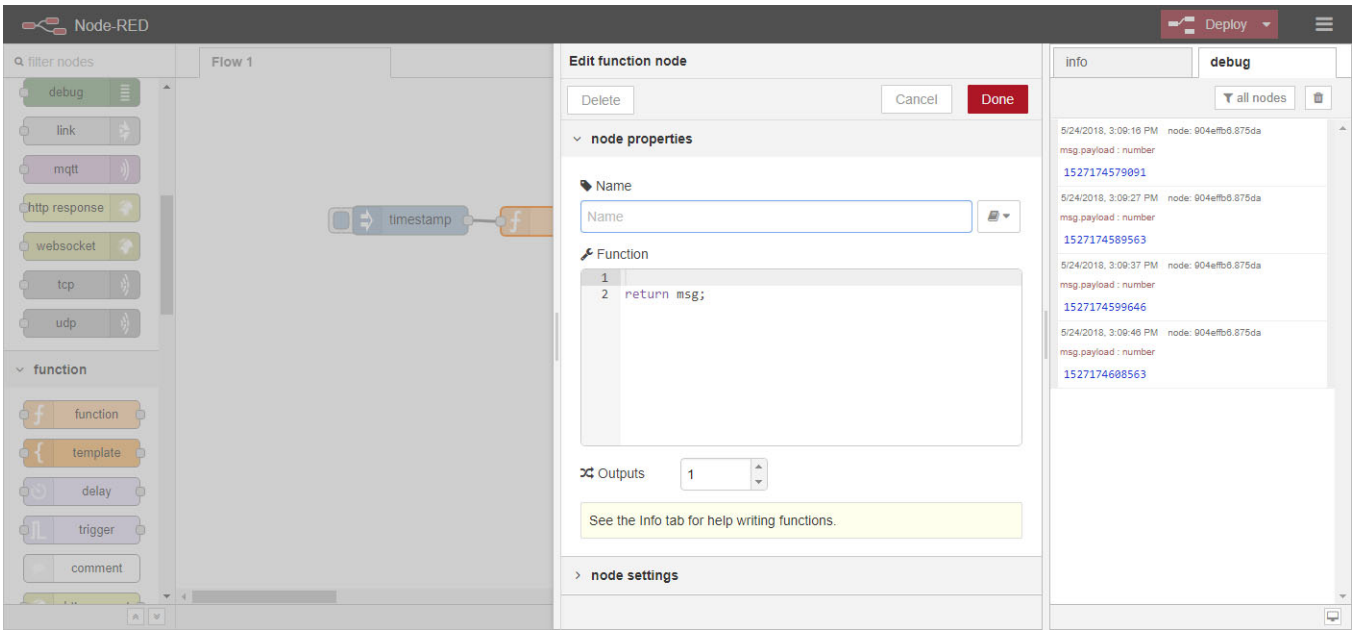
Let's make the timestamp more readable by using a Function node. Function nodes let you pass each message though a JavaScript function. If you don't know JavaScript, you may be able to find code you need using an Internet search.

1. Click and hold on the function node, then drag it to the workspace, placing it between the inject and debug nodes. If the wire between the inject node and debug node becomes a dashed line, let go of the mouse button. The Node-RED editor automatically wires the Function node to the inject node and the debug (msg.payload) node.



If you didn't see a dashed line, you need to delete the existing wires by selecting them and pressing Delete on the keyboard. Add two new wires: one to link the output of the inject node to the input of the function node, the second wire to link the output of the function node to the input of the debug (msg.payload) node.

2. Double-click the Function node to edit it. The Node-RED editor displays the Edit function node panel.



3. In the Name field, type `Human Date`.
4. Copy the following code into the Function field, at line 1:

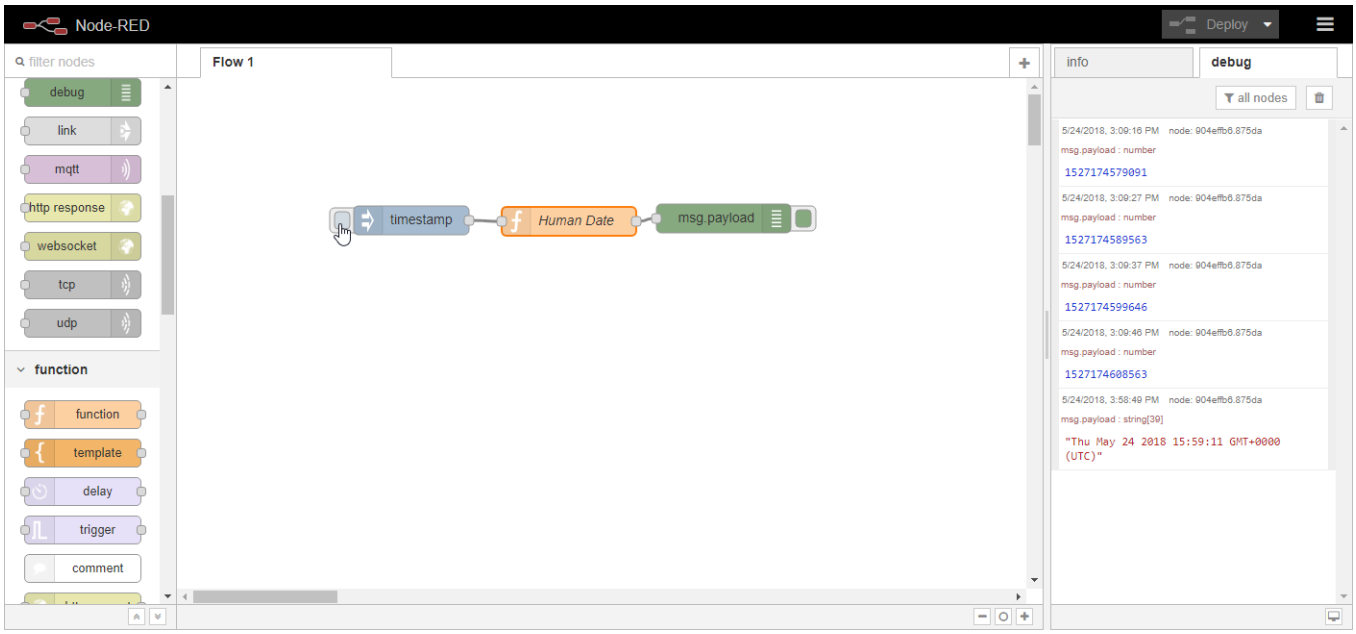
```
// Create a Date object from the payload
var date = new Date(msg.payload);
// Change the payload to be a formatted Date string
msg.payload = date.toString();
```

5. Leave this code in place at the end:

```
return msg;
```

6. Click Done to close the edit dialog box and then click the Deploy button.

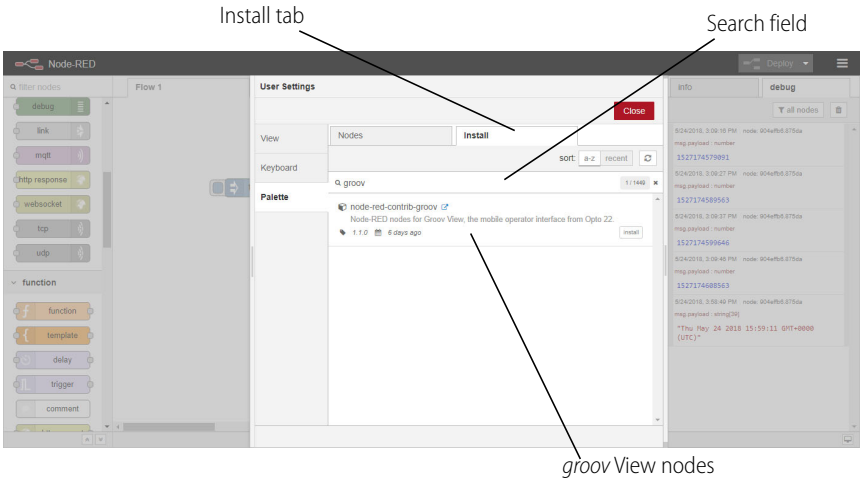
7. Now when you click the Inject button, the message in the sidebar shows a more readable time stamp:



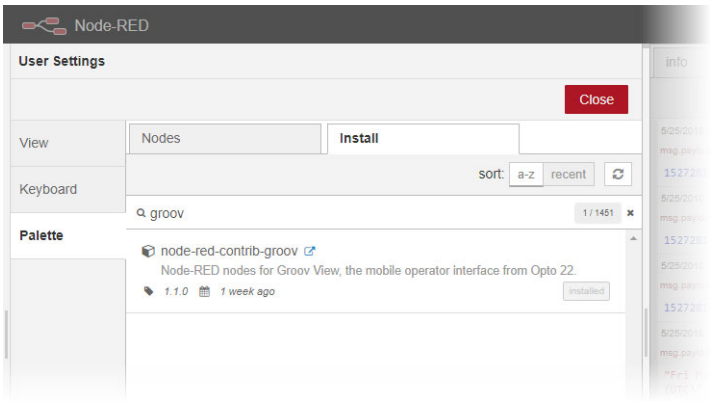
Installing *groov* View nodes

Your *groov* EPIC processor must have access to the Internet to install *groov* View nodes.

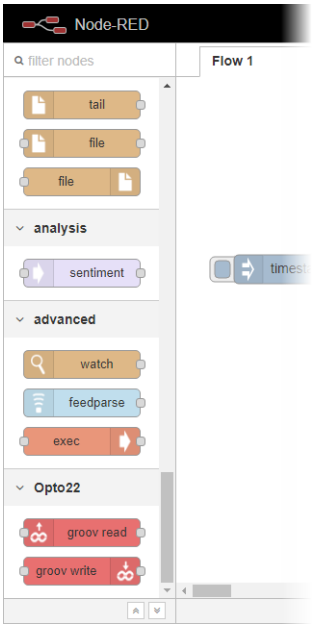
1. Click the menu button ( ), then select Manage palette.
2. Click the Install tab.
3. In the search field, enter `groov`.



4. Find `node-red-contrib-groov` in the list and click the Install button next to it.
5. The Node-RED Editor displays a message about checking dependencies and reviewing node documentation. Click Install. When installation is finished, the small Install button changes color to gray and changes text to Installed. Click Close.



The new *groov* nodes appear at the bottom of the nodes palette. These *groov* View nodes can read and write data from a *groov* View Data Store. For an introduction to Data Stores and how to create them in *groov* View, see "Adding a Data Store" in the *groov View User's Guide* (form 2027). After you create the Data Store in *groov* View, you can access the Data Store in your Node-RED flow by accessing the *groov* View project that contains the Data Store.



Adding an Opto 22 PAC Control node

For this section, you'll add nodes to establish real-world communication with *groov* View Data Stores and tags in PAC Control strategies. You need either of the following:

- An Opto 22 *groov* EPIC processor running a PAC Control strategy, or
- a SNAP PAC S-series or R-series industrial controller with firmware R9.5 or higher, running a PAC Control R9.5 or higher strategy.

For either of these options, you need to complete the configuration instructions on developer.opto22.com. At the website, click on Node-RED for PAC Control, then expand Getting Started. For the *groov* EPIC processor, click on groov EPIC Controller Configuration; for the SNAP PAC controller, click SNAP PAC Controller configuration.

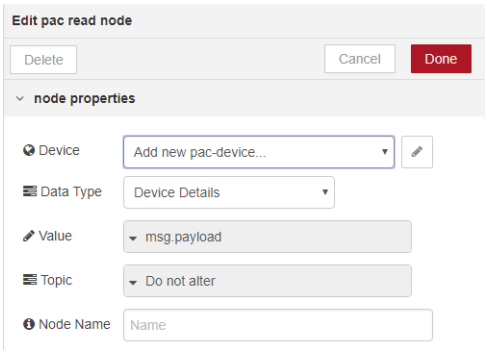
You'll also need the following information, which you can collect as you complete the processor or controller configuration:

- API Key Name and Value
- SSL Certificate

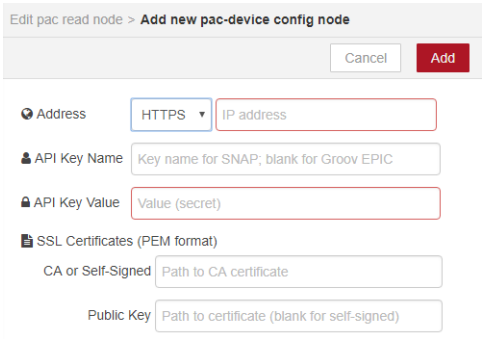
After you set everything up and gathered this information, you can start:

1. Install Node-RED for PAC Control nodes just as you installed the *groov* View nodes. (Menu > Manage palette > Install tab. Search for `node-red-contrib-pac`.)
2. Make sure you have an inject and a debug node in the workspace.
3. Near the bottom of the Nodes palette, click and hold on the pac read node and drag it to the workspace, in between inject and debug (msg.payload).

   The pac read node lets you read I/O and variable data in the PAC Control strategy.
4. Wire the pac node to the inject node and debug node, in the same way you wired the Function node.
5. Click the node and click the **info** tab to see helpful information about the node.
6. Double-click the pac read node to edit it.

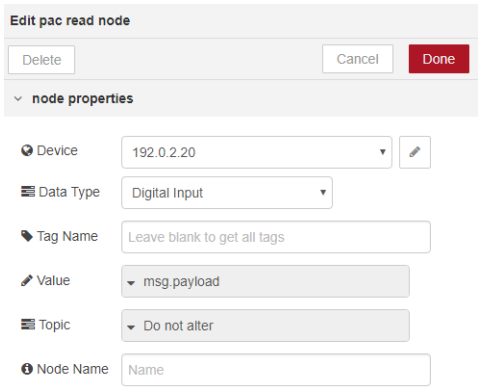


7. Click the pencil at the right of the Controller field.

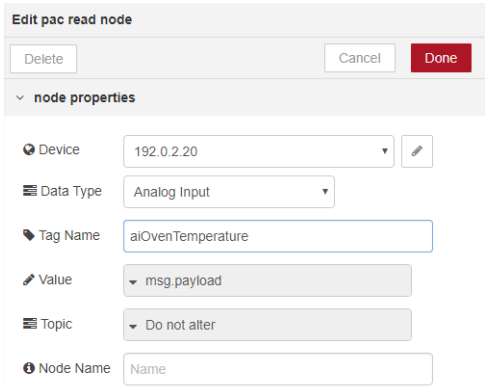


8. Complete the fields:
   a. For PAC Address, choose a protocol (HTTPS is strongly recommended because it is secure) and enter the IP address of the *groov* EPIC processor or the SNAP PAC controller.
   b. If you are configuring a SNAP PAC Controller, enter the API Key ID and Value. If you are configuring a a groov EPIC processor, leave this field blank.
   c. If you are using HTTPS as recommended, as directed in the **info** tab. The information you enter in this section is dependent on where Node-RED is running, so read the help carefully to make sure you enter the correct information.
   d. Click Add.

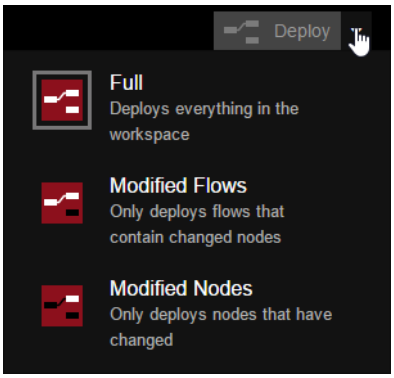
The Node-RED editor returns you to the Edit pac read node panel, where your node is now configured to access the I/O and variable data in the PAC Control strategy running on the *groov* EPIC processor or the SNAP PAC controller:



9. Choose the Data Type from the dropdown list.
   The data type determines what other fields appear. In this example we chose Analog Input, so a field appears for Tag Name.



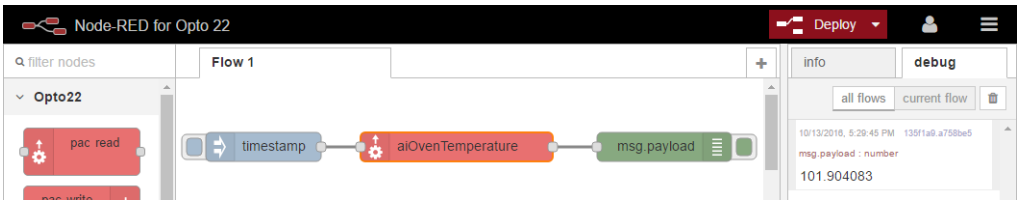
   a. **Tag Name**—Enter the exact I/O point or variable name from the PAC Control strategy running on this controller. If you leave this field blank, you'll receive values for all tags of this type (in this example, all analog inputs).
   b. **Start Index** and **Length**—For a table, enter the starting index and length of the data you want to use.
   c. **Node Name**—(Optional) By default, the tag name is used for this node. If you want to give it a different name, enter it here.
   d. Click Done.
10. Click the down arrow next to Deploy to see your choices.



You can deploy everything, or if you don't want to disturb running flows, you can choose to deploy only the changed flows or changed nodes.

The gray box around the icon shows what will happen when you click the Deploy button. In this example, everything is deployed (Full).

11. Click Deploy. Now click the inject button and see what message appears in the debug tab. You should see the data from your PAC Control strategy. Here's how our example looks:



15: Monitoring and Configuring Modules and Channels

With *groov* Manage, you can do many tasks that help you monitor and configure modules and their channels. For example, you can:

- Check the health (status) of a module at a glance with the module LED or in more detail through the Modules page in *groov* Manage
- View the following information about each module:
  - channel names and status
  - wiring diagrams
  - specification information
  - module-specific information like serial number, module ID, and firmware versions
- Monitor the status of channels on each module and identify some problems through quality indicators (available on some modules)
- Assign names to channels, enable or disable quality indicators, and select features (on some modules) that a channel measures

CHECKING THE HEALTH (STATUS) OF A MODULE

groov EPIC offers two ways to quickly monitor the status of a module:

- Through the module LED on the cover of a module
- Through the Modules page of *groov* Manage

Checking Module Status Through the Module LED

The module LED on the cover of a module changes color and blink pattern to indicate the status of a module:

Off Blue Violet Yellow Red

This color and blink pattern:	Indicates:
No color	Module is off.
Blue, solid	Module is operating normally.
Blue, blinking	The *groov* EPIC processor is currently displaying information about this module on the touchscreen.
Violet, solid	Module is installing a firmware update.
Yellow, solid	Module is indicating that there is a quality error[a] on one or more channels.
Yellow, blinking	Module is indicating that there is a quality error[a] on one or more channels and that the *groov* EPIC processor is currently displaying information about this module on the touchscreen.
Red, solid	Module is on but not communicating with the *groov* EPIC processor.
Red, blinking	Module is trying to establish communication with the *groov* EPIC processor.

[a]To learn more about quality errors, see "Understanding How Quality Errors are Reported" on page 147.

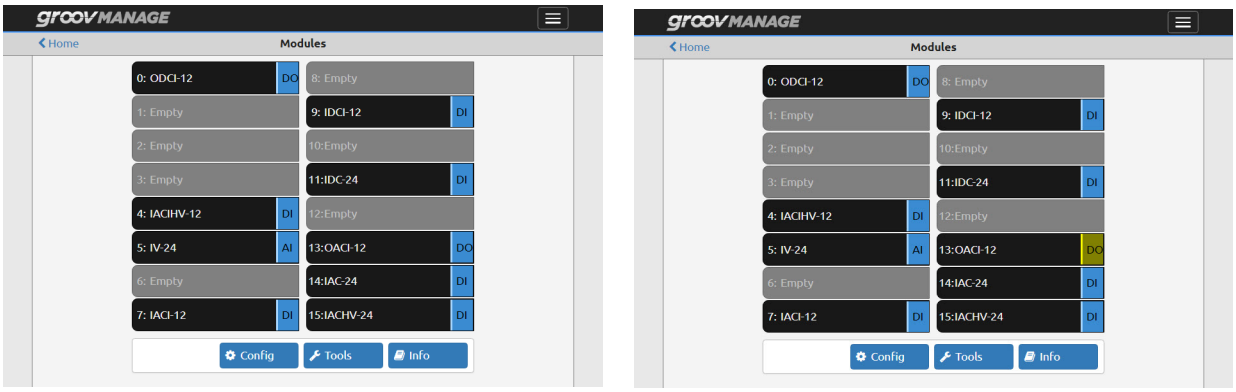
Checking Module Status Through *groov* Manage on a Browser

Checking module status through *groov* Manage is very helpful when you cannot be physically near the modules or easily view the module.

Note: *If you are running a CODESYS application on your groov EPIC processor, check the module status through CODESYS Development System, not through groov Manage.*

To view the status of modules mounted on the chassis:

1. On a computer or mobile device, log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. In the Home page, click I/O (I/O). *groov* Manage displays the Modules page. The following diagram shows examples of two different 16-module chassis:



In the diagram, the chassis on the left has 9 modules mounted on it, all operating normally. The chassis on the right has 9 modules mounted on it, with the module in slot 13 (a GRV-OACI-12 module) showing yellow, indicating that there is a quality error. To find out more about the quality error, see "Understanding How Quality Errors are Reported" on page 147.

CONFIGURING *groov* I/O MODULES AND CHANNELS

There are several ways to configure *groov* I/O modules and channels. You can do it through programming:

- If your *groov* EPIC processor is running a PAC Control strategy, you configure the I/O in PAC Control. For instructions, see PAC Control User's Guide (form 1700).
- If your *groov* EPIC processor is running as part of your CODESYS application, you configure the I/O in CODESYS Development System. For instructions, see "Configuring Processor Parameters and Channel Features" on page 110.
- If your *groov* EPIC processor is running a custom control program, there are several ways to configure your I/O. You can do it through OptoMMP memory maps, through SDKs, or even through Node-RED flows. For instructions, see our special website dedicated to helping custom control programmers, developer.opto22.com.

Another method, which is independent of any control programming, is through *groov* Manage. This method is helpful if you want to manage and transmit I/O strictly through MQTT (with either Sparkplug B or string payloads) or Node-RED flows. This means that the EPIC processor isn't running any control programs that might configure I/O.

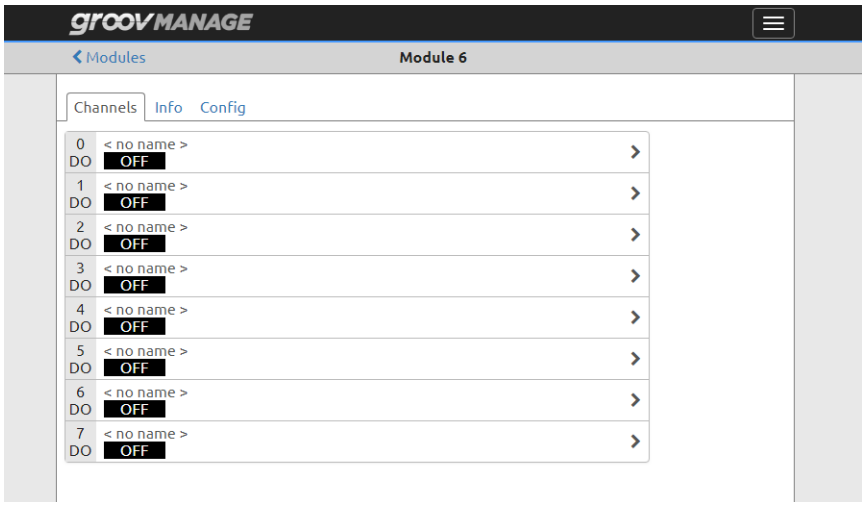
If you choose to configure I/O modules and channels through this method, remember the following:

- If you run a control program that configures *groov* EPIC I/O modules and channels, your control program's configuration will over-write any changes you made through *groov* Manage. The opposite is true, as well: if your control program configures I/O, then you change the any of that I/O configuration through *groov* Manage, the changes made through *groov* Manage could cause errors in your control program.
- It's also important to remember that the changes you make to your channels through *groov* Manage are lost whenever the processor is restarted. If you want to save the configurations made through *groov* Manage, backup your information as described in "Backing up Your groov EPIC Processor Settings" on page 151.

To configure an I/O channel on a module:

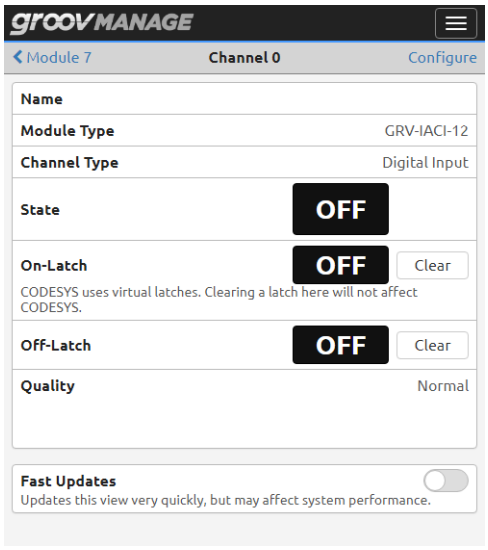
1. Log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. Click or tap the menu button ( ), then select I/O.
3. In the Modules page, click or tap the box that represents the module that contains the channels you want to configure.

groov Manage displays a module page similar to the one below. The number of channels on the page depends on the module type. If the module has 24 channels, then the page shows 24 channels.

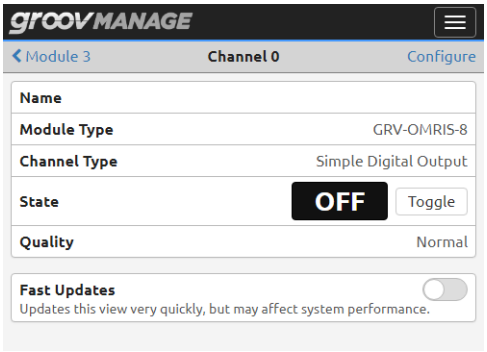


4. Click or tap on the channel you want to configure. *groov* Manage displays a channel page. The information on the page depends on the module type. Here are a few examples:

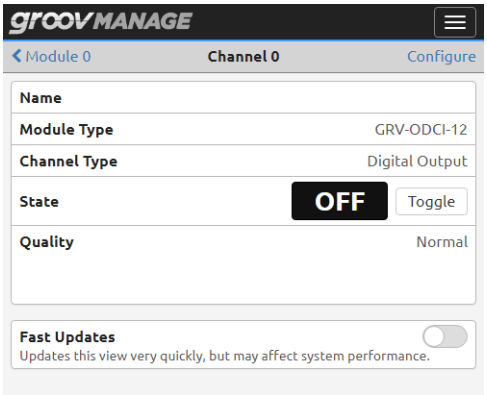
GRV-IACI-12 module—An AC digital input module with 12 channels.



GRV-OMRIS-8 module—A mechanical relay output module with 8 channels.

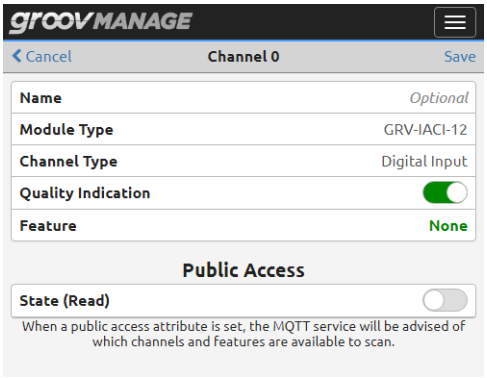


GRV-ODCI-12 module—A DC digital output module with 12 channels.

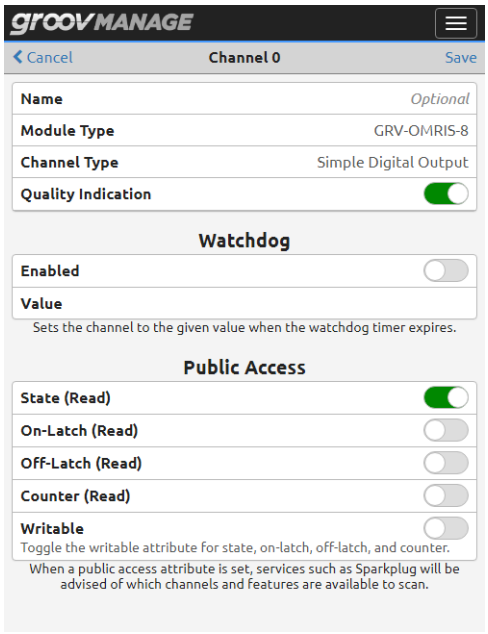


5. Click on Configure. Again, the information displayed on the page depends on the type of module. Here are the configuration pages for the same modules shown in the previous step:

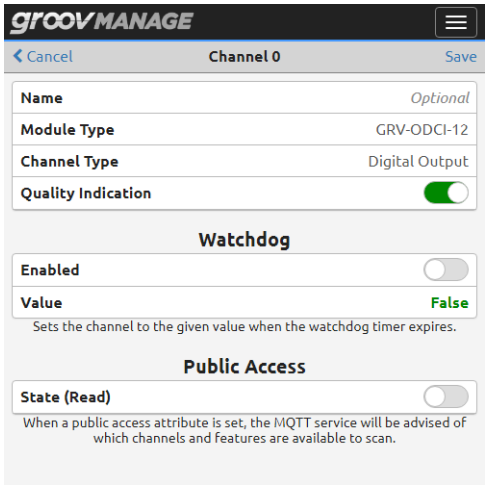
   GRV-IACI-12 module—An AC digital input module with 12 channels.



GRV-OMRIS-8 module—A mechanical relay output module with 8 channels.



GRV-ODCI-12 module—A DC digital output module with 12 channels.

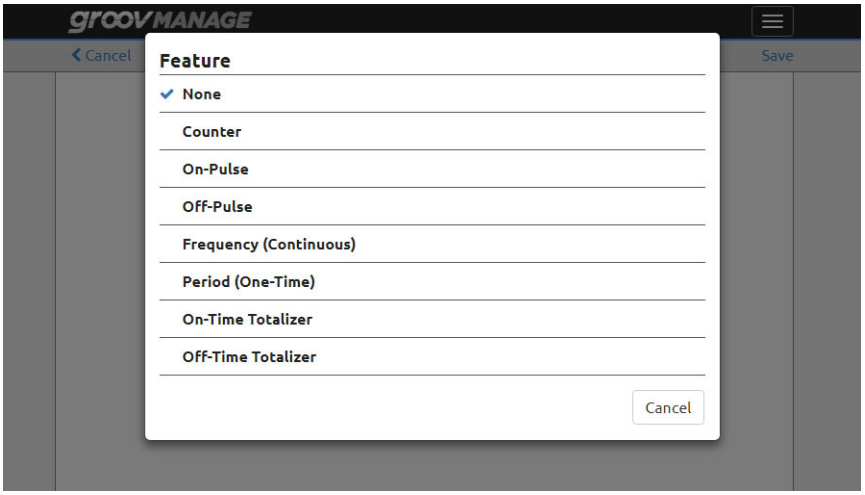


6. Select the changes you want to make. Some of the most frequently occurring fields are:
   - **Name**—You can view this name on the channels page and *groov* Manage saves it when you backup your I/O configuration.
   - **Module Type** and **Channel Type** are for your information. You can't edit these fields
   - **Quality Indication**—(Available on some modules.) This switch enables or disables whether the module LED changes color to indicate that there is a quality error on one or more channels. To determine whether you should enable or disable this feature, see "Understanding How Quality Errors are Reported" on page 147.
   - **Watchdog**—(Available on some modules.) Select whether you want a Watchdog on a channel. With a Watchdog, the *groov* EPIC processor monitors activity on the channel. If no activity is received for the time specified in the Watchdog Timeout field, the channel assumes a Watchdog state; the

output immediately goes to the value you enter or selected. (To find the Watchdog Timeout field, from the *groov* Manage Home page, click I/O > Config.)

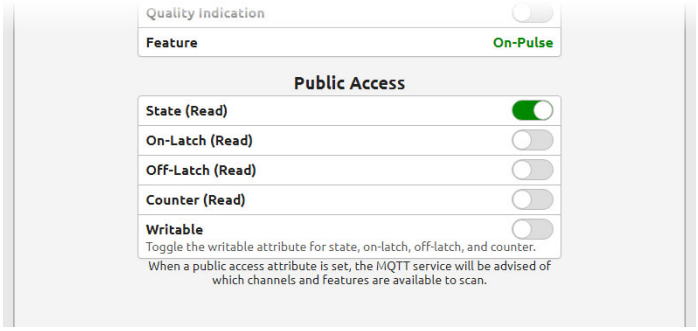
The default is disabled (the slider shows grey). If you move the slider to the right to show green, you enable Watchdog on that channel. Then you can enter or select a value in the Value field. The value you enter or select is what the output is set to after the timer expires.

– **Feature**—This is for modules with full feature sets. Simple modules (modules with part numbers that end in "S") don't have features. When you click on None (or a feature name, if shown), *groov* Manage displays a list of features that this particular module supports. Select a feature you want. The following example shows the feature list for the GRV-IDC-24 module:

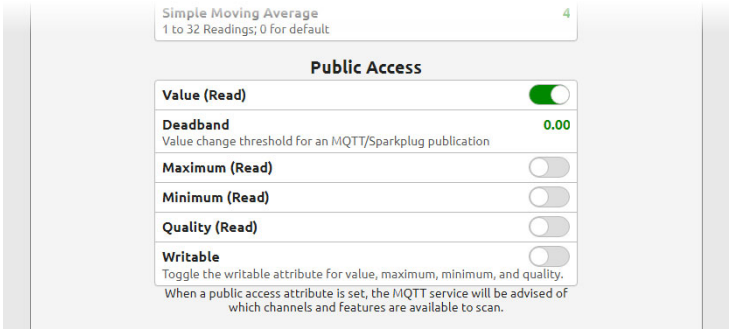


If you select Off-Pulse from this list, after you save your changes, the channel page will show Off-Pulse.

– **Public Access**—A switch that can make the tags from this channel available to services like Sparkplug and Node-RED. When you enable this for discrete channels, you see the following options:

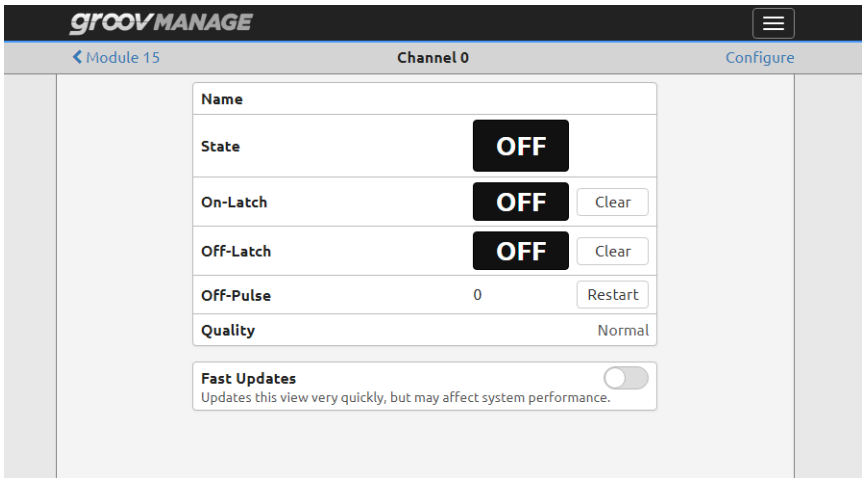


When you enable this for analog channels, you see the following options:



7. Click Save. *groov* Manage refreshes the channel page with any changes we made.

In the previous example, we selected the Off-Pulse feature. The follow diagram shows how *groov* Manage added Off-Pulse to the channel page.



UNDERSTANDING HOW QUALITY ERRORS ARE REPORTED

Channels on a *groov* I/O module can report quality errors, which are common errors like input values that are out of range. The following table lists the *groov* I/O modules that offer this feature and what type of quality errors the channels can report:

Part Number	Quality Error
GRV-IMA-24	Out of range
GRV-IMAI-8	Out of range
GRV-IICTD-12	Out of range
GRV-ITMI-8	Out of range; Open thermocouple
GRV-ITR-12	Out of range
GRV-IV-24	Out of range
GRV-OAC-12	Open circuit
GRV-OACI-12	Open circuit
GRV-OVMALC-8	Current outputs: open circuit; Voltage outputs: over-current
GRV-OVMAILP-8	Current outputs: open circuit; Voltage outputs: none

There are a few ways that the *groov* EPIC system shows you that there is a quality error:

- The module LED changes color to yellow.

  To work correctly, all "connected" channels do not have to enable Quality Indication; however, all "disconnected" channels must have Quality Indication disabled. A channel is "connected" if it is wired to a field device. A good practice while you are configuring a module is to disable this feature for all channels not connected to field devices.

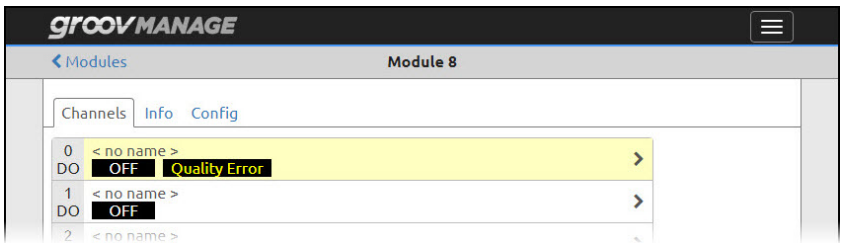
  If one connected channel reports a quality error, the module LED turns yellow. You will then need to do more investigating (for example, by following the instructions in "Viewing Information About a Quality Error" on page 148) to determine which channel is reporting a quality error.

  Regardless of whether you enable the Quality Indication feature at the channel level, the Module page will ***always*** report any quality error.

- In the Modules page of *groov* Manage, the box that represents the module turns yellow:

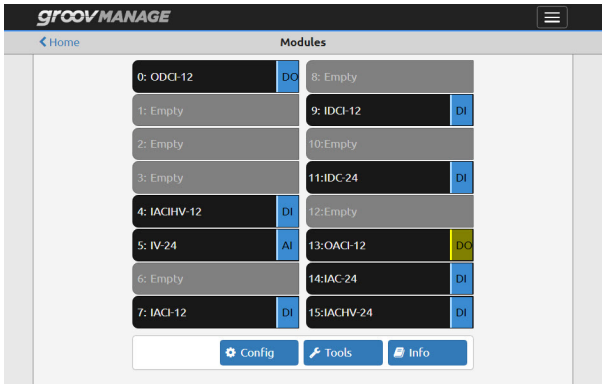
  The color changes to yellow on the Modules page color according to the same rules described for module LED in the previous bullet.

- In the Module page of a specific module, the channel reporting a quality error is highlighted in yellow and displays a message:



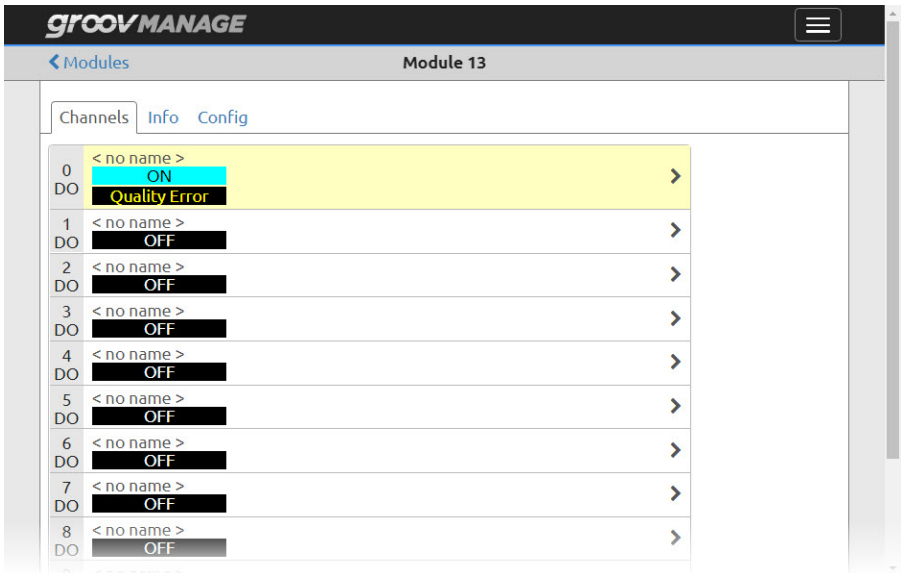
Viewing Information About a Quality Error

1. Log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. Click or tap the menu button ( ), then select I/O. *groov* Manage shows the Modules page.
   In the following diagram, the module in slot 13 is reporting that there is a quality error (as indicated by the yellow color):



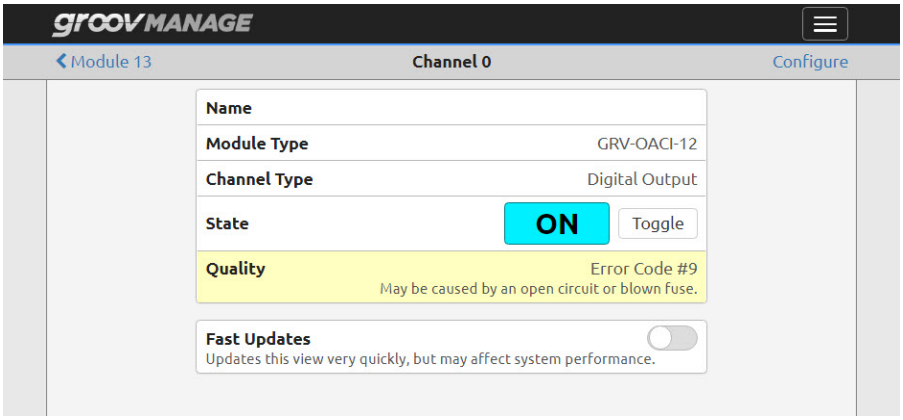
3. In the Modules page, click or tap the box that represents the module that is reporting a quality error.
   In the example from the previous step, click or tap the box labeled `13:OACI-12`.

4. *groov* Manage displays the list of channels for that module and highlights the channel that is reporting the quality error with a yellow background.



Click or tap that channel.

5. *groov* Manage displays the specific information about that channel:



The Quality field shows you a message with an error code number and a possible reason for the error. This information can help you troubleshoot problems with a field device wired to that specific channel.

16: Maintaining Your *groov* EPIC Unit

There are some maintenance activities you'll want to do regularly to keep your *groov* EPIC unit up-to-date, running smoothly, and to make it easier to restore in the event of a reset:

- Back up your information regularly
- Apply firmware updates to the processor and I/O modules

If you encounter problems while operating your *groov* EPIC unit, there are few things you can do:

- You can troubleshoot some problems and, if you can't resolve your problems, there are some steps you can take to help Product Support solve your problems.
- If you had to restore your processor to factory defaults, you can restore the information that you backed up.

BACKING UP YOUR *groov* EPIC PROCESSOR SETTINGS

There are several different recommendations regarding when and how often you should back up your *groov* EPIC unit:

- Back up your unit before you apply a software or firmware update.
- Back up your unit before installing an update of your control program.
- Back up your unit periodically; for example, once a year. Or, if you update it frequently, once a month.

Whichever recommendation you follow, the *groov* Manage Backup feature can save valuable configuration information, which you can then restore at a future date.

However, keep in mind the following:

- The backup feature does not save:
  - Your PAC Control strategy or *groov* View HMI.
  - Your Ignition Edge projects.
  - Your CODESYS applications.
- The backup feature saves only the first 10 MB of user files, which are files that either you uploaded manually to the processor or were placed there by control programs.
- While the backup feature does save your Node-RED projects (flows and credentials), it does not save any nodes you installed; for example, Opto 22 nodes or nodes to access cloud services.
- You can run the backup feature only on a computer or mobile device. You can't run the backup feature from the *groov* EPIC processor touchscreen.

IMPORTANT: *The backup file is not a secured or encrypted file. You must apply your own security or encryption to the file to protect any sensitive information. Also, be aware that if you send a backup file to Opto 22 without any security or encryption, our personnel will have access to all the information in that file.*

After you select a back up folder or media, do the following steps:

1. On a computer or mobile device that is connected to the media or folder where you want to save your back up file, log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. Click Maintenance.
3. Click Backup.
4. On the Backup page, select the information you want to backup by moving the corresponding slider to the right so that it shows green ( ). By default, everything except Server SSL Certificates and network configurations are backed up. If you do not want certain information backed up, move the slider to the left so that it shows grey ( ).
   - **I/O Configuration**—Saves the changes you made to the channels on the modules you had mounted on the chassis at the time you ran the backup. It also saves which type of module was mounted in each slot.
   - **PAC Control Settings**—Saves the settings listed in the PAC Controller configuration page:
     - Background Downloading. For more information, see "Enabling or Disabling Background Downloading" on page 119.
     - REST API String Encoding. For more information, see Using the PAC Control REST API with *groov* EPIC on developer.opto22.com.
   - **Accounts**—The user IDs and passwords, plus the scope of each user ID's access. (The scope of access is described in "Creating User IDs and Configuring Their Access" on page 37.) If there is a secure shell account, it is not included in the backup.
   - **Networking**—Saves all of the following:
     - Hostname
     - The settings for the ETH0, ETH1, and WLAN0 physical network interfaces.
     - The settings for the OpenVPN Tunnel 0 network interface.
     - The settings for the Network Options (DNS server IP address(es) and domain name(s), gateway IP address, the DNS order, and the gateway order).

     This also includes sensitive information like the WiFi SSID and pre-shared key, and the OpenVPN server login credentials. If you select this setting, it's important that you apply your own security or encryption to the backup file to protect this information.
   - **Firewall**—The firewall settings you selected, as well as any rules you created.
   - **Time and User Interface**—The time zone and time servers configurations.
   - **License**—The most recent license file you uploaded.
   - **Node-RED**—Part of a Node-RED project can include a credentials file, which can contain sensitive information like user names, passwords, and security keys. It's important that you apply your own security or encryption to the backup file to protect this information. Remember that any nodes you installed (like Opto 22 nodes or nodes to access cloud services) are not included in the backup.
   - **Sparkplug**—The information you entered or selected when you configured your *groov* EPIC processor to work with Sparkplug.
   - **Client SSL Certificates**—The most recent SSL certificates you may have uploaded.
   - **User Files**—Only the first 10 MB of files you uploaded manually or were placed there by control programs. After you create the backup file, you can review it to see which user files were stored in the backup file.
   - **Server SSL Certificates**—The server SSL certificates include sensitive information, like the web server's private key. If you select this setting, it's important that you apply your own security or encryption to the backup file to protect this information.
5. Click Download Backup.
6. Navigate to the folder or media where you want to store the backup file. *groov* Manage constructs the file name to include the date and time that you run the backup as part of the file name. If you want to give it a different name, change the name in the File name field. Click Save.

NOTE: *Some browsers might automatically download the file to a specific folder. Check your browser's downloads settings to determine where the browser stored the backup file.*

7. Opto 22 recommends that you apply some form of security on the backup file.
8. If you want to back up any of the following, refer to the indicated instructions:
   - *groov* **View HMI**—For instructions on creating backups of your *groov* View HMIs, see the *groov* View User's Guide (form 2027).
   - **PAC Control strategy**—For instructions on creating backups with the archive feature in PAC Control, see PAC Control User's Guide (form 1700).
   - **Ignition Edge projects**—For instructions on creating backups of your Ignition Edge projects, see "Backing up Your Ignition Edge Projects" on page 153.
   - **CODESYS applications**—For instructions on creating backups of your CODESYS applications, see the CODESYS Online Help.

Backing up Your Ignition Edge Projects

It's important to back up your Ignition Edge projects before you apply maintenance or reset your *groov* EPIC processor to factory defaults. It's a good idea to back up your Ignition Edge projects at the same time you back up your *groov* EPIC processor and save the backup file to the same location.

1. On a computer or mobile device that is connected to the media or folder where you want to save your back up file, open a browser and enter the URL of your *groov* EPIC processor's Ignition Edge gateway page: `https://[your groov EPIC's hostname]:8043`
2. Click the Configure tab.
3. In the left navigation, choose System > Backup/Restore.
4. Click Download Backup.
5. Navigate to the folder or media where you want to store the backup file. Ignition Edge constructs the file name to include the date and time that you run the backup as part of the file name. If you want to give it a different name, change the name in the File name field.
6. Click Save.

   NOTE: *Some browsers might automatically download the file to a specific folder. Check your browser's downloads settings to determine where the browser stored the backup file.*

RESTORING A BACKUP OR SPECIFIC SETTINGS FROM A BACKUP FILE

There are a few reasons why you might want to restore all or part of a backup:

- If you had to restore your processor to factory settings, a backup can help you quickly restore a previously-saved configuration.
- You might want to restore a prior configuration or a specific part of a prior configuration; for example, only the firewall settings.
- After you apply an update, restoring a backup can help you quickly restore a previously-saved configuration.

When you want to restore a backup file, remember the following:

- You can run the restore feature only on a computer or mobile device. You can't run the restore feature from the *groov* EPIC processor touchscreen.
- You can restore a subset of the settings stored in a backup file; for example, only the firewall and accounts.

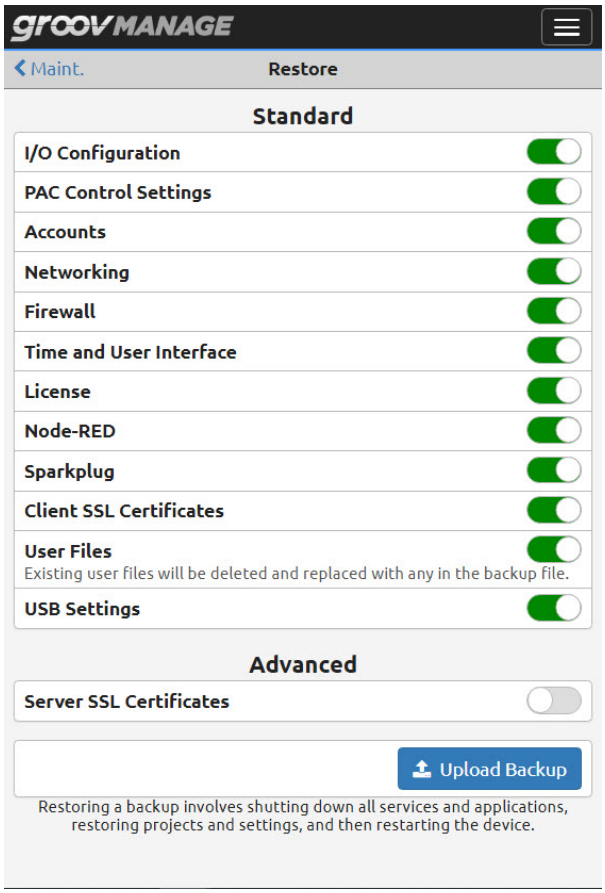
- When you run the restore feature, the *groov* EPIC processor shuts down all services and applications, restores the projects and settings, and then restarts the processor. So, make sure to schedule the restore during a time that minimizes its impact on your applications and equipment.
- The user IDs and passwords that are restored will not include any user IDs that you created after you created the backup file. So, make sure you know the user ID and password of any administrator account saved in the backup file so you can use that ID and password when you log into the *groov* EPIC processor.

To restore a backup file or specific part of a backup file:

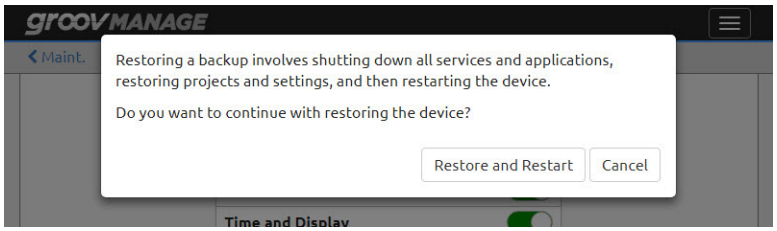
1. Locate the media or folder that contains the backup file and remove any security you may have applied to the file.
2. On a computer or mobile device that contains the folder or is connected to the media that contains the backup file, log into your *groov* EPIC processor with a user ID that has administrator privileges.
3. Click Maintenance.
4. Click Restore.
5. In the Restore page, select or deselect the settings you want to restore. If you want to restore a particular set of settings, leave the slider green ( ). If you do not want to restore a particular set of settings, move the slider to the left so that it shows gray ( ).

   NOTE: If you select a setting that doesn't contain any information in the backup, nothing will be restored for that setting. This can happen:

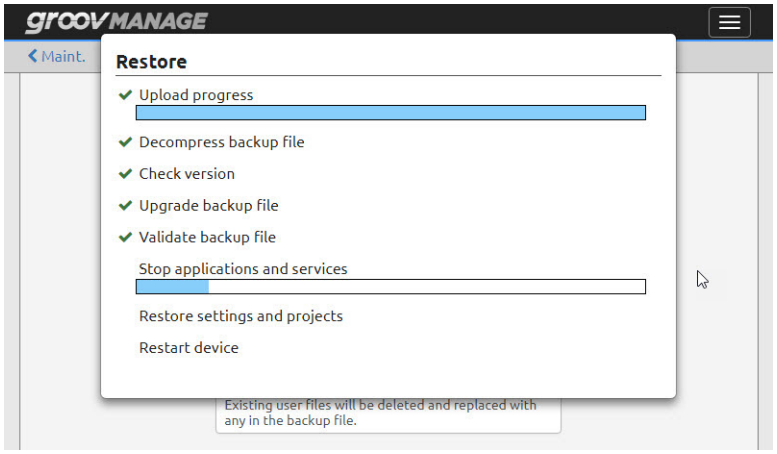
   - *When you created the backup, you deselected the setting.*
   - *You select a setting (below) that was not available in previous versions of the groov EPIC firmware.*



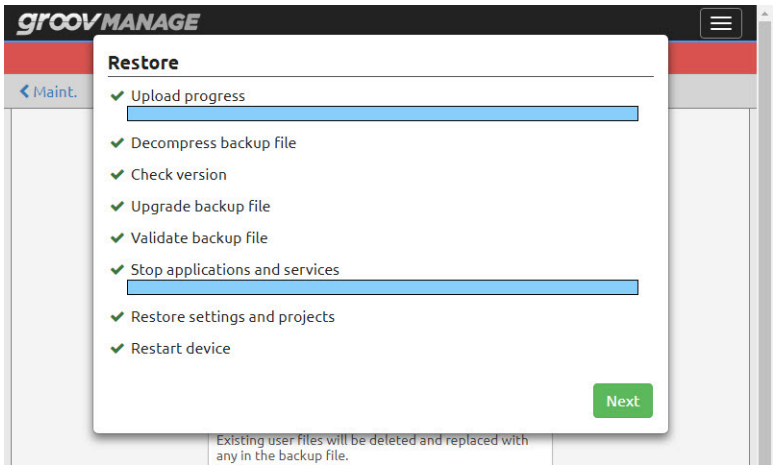
6. Click Upload Backup.
7. Navigate to the folder or media device that contains your backup file.
8. Click Open. *groov* Manage displays the following message, reminding you of what the *groov* EPIC processor will do during the restore:



9. Click Restore and Restart. *groov* Manage displays a message that shows you the progress of the restore:

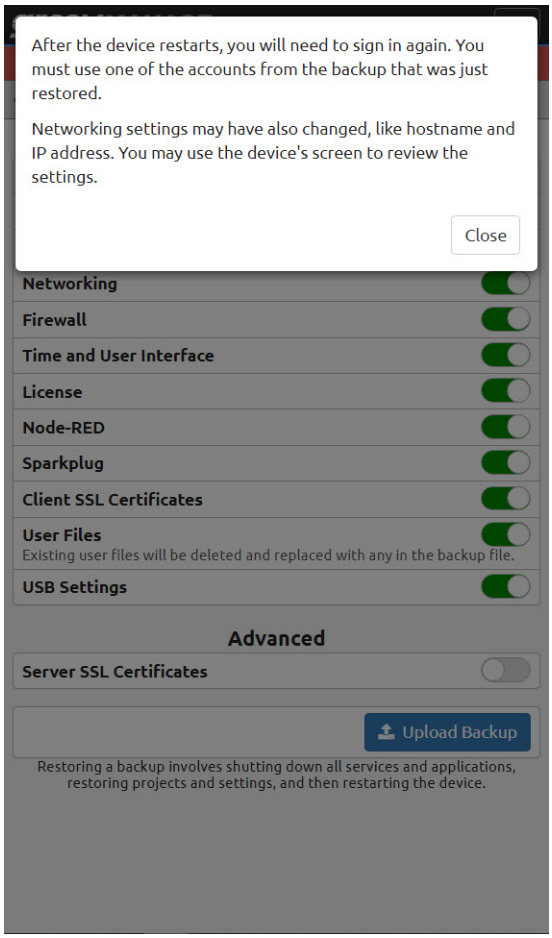


10. When the restore is done, *groov* Manage shows you this message:



Click on Next.

11. *groov* Manage shows you a message that gives you a few tips about what you might need to do next. Read the message and then click Close.

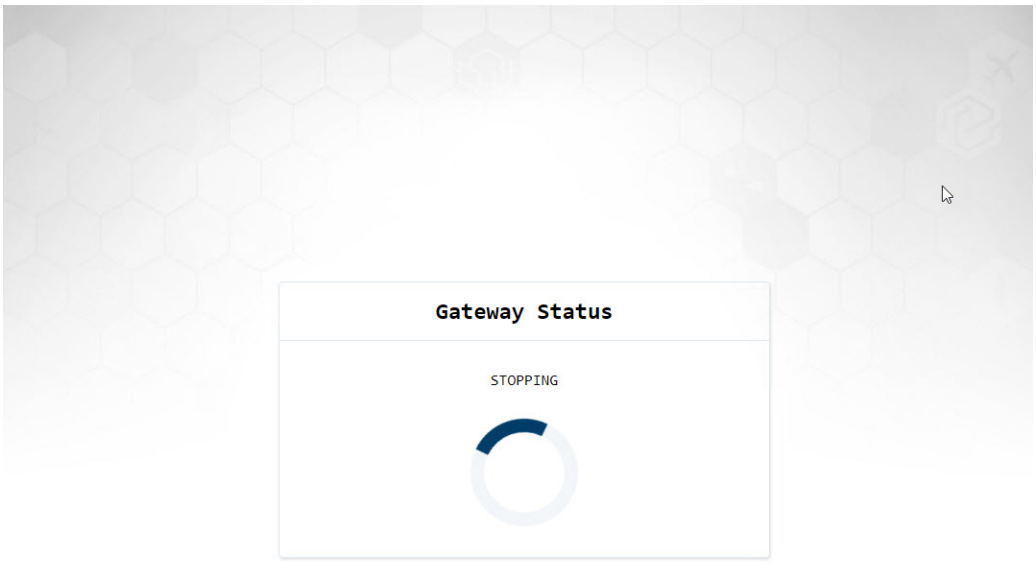


12. The *groov* EPIC processor restarts. Wait for the *groov* EPIC login screen and log back in with any user ID that has administrator authority and was stored in the backup file.
13. Review the configuration settings for things like I/O, date and time, network, and controller, to assess whether you need to make additional changes that were not stored in the backup file. For example, after the restart, the PAC Controller is the control engine running by default. If you want to switch to the CODESYS Controller, you'll have to do this manually. (See "Enable the CODESYS Control Engine on the groov EPIC Processor" on page 101.)
14. Review the following list for additional instructions on other items you may want to restore:
    - Because the backup files contain only the first 10 MB of user files, if there were any additional files that weren't included in those 10 MB, you'll want to upload them, either manually or identify how your control programs saved files on to the processor.
    - For instructions on restoring your Ignition Edge projects, see "Restoring your Ignition Edge Projects" on page 157.
    - For instructions on restoring your *groov* View HMI, see *groov* View User's Guide (form 2027).
    - For instructions on restoring your PAC Control strategy, see PAC Control User's Guide (form 1700).
    - For instructions on restoring your CODESYS applications, see "Downloading and Running CODESYS Applications" on page 117.

Restoring your Ignition Edge Projects

When you restore Ignition Edge projects, Ignition Edge restarts the Ignition Edge the Ignition Gateway. So, make sure to schedule the restore during a time that minimizes its impact on your applications.

1. On a computer or mobile device that contains the folder or is connected to the media that contains the backup file, open a browser and enter the URL of your *groov* EPIC processor's Ignition Edge gateway page: `https://[your groov EPIC's hostname]:8043`
2. Click the Configure tab.
3. In the left navigation panel, choose System > Backup/Restore.
4. Click the Restore tab.
5. Click Choose File and navigate to the folder or media that contains the backup file. Click the file name, then click Open.
6. Click Restore. The Ignition Edge Gateway page refreshes and displays the status of the restart of the gateway.



After the restart finishes, Ignition Edge displays the gateway page.

UPDATING FIRMWARE ON A *groov* EPIC UNIT

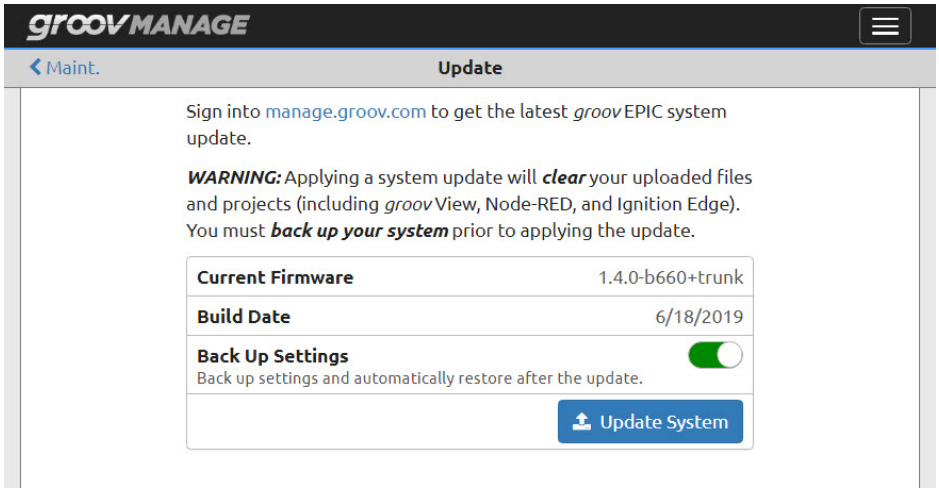
Updating firmware on a *groov* EPIC unit keeps it up-to-date with the latest features and fixes. You can update firmware on the processor or on the *groov* I/O modules. Updating firmware on a processor can take 10 minutes or more to complete and your *groov* EPIC processor will be restarted, so schedule the update during a time when it minimizes impact to your control program and equipment. Updating I/O module firmware update will take a lot less time and will take that specific module offline during that time. Both updates need to be done through a web browser on a computer or mobile device that can connect to the processor.

Important: *If you are doing either of the following, see Appendix F: Installing the Correct License.*

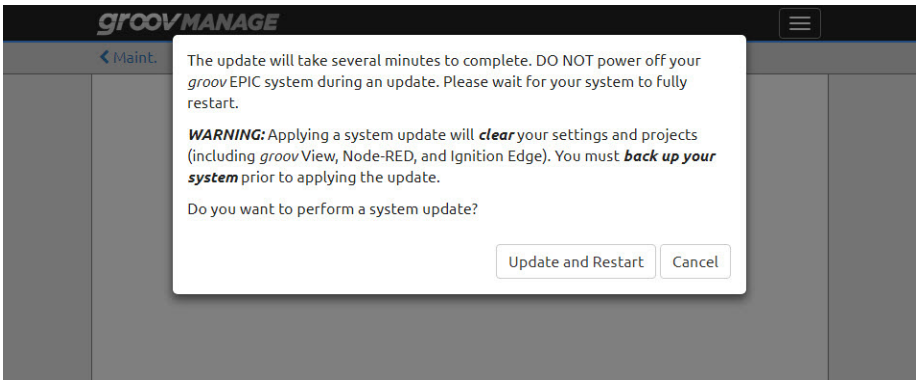
- *Upgrading the firmware on a groov EPIC processor from a version earlier than 1.3.0 to version 1.3.0 or later*
- *You are re-initializing a groov EPIC processor with firmware earlier than version 1.3.0*

Applying a Firmware Update to the *groov* EPIC Processor

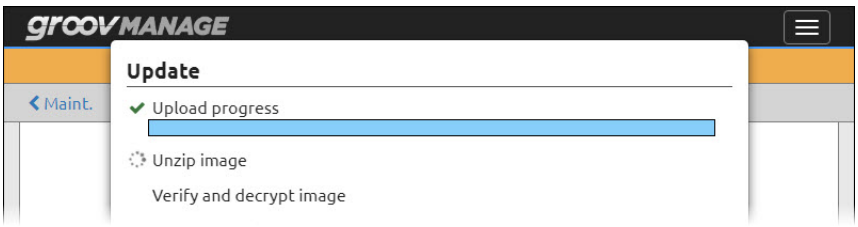
1. If you do not have an account on manage.groov.com, create one.
2. Log on to manage.groov.com.
3. Follow the instructions on the website to download the latest software update. Make sure to download the file to either:
   - a computer or mobile device that can connect to your *groov* EPIC processor, or
   - to media that you can then install to a computer or mobile device that can connect to your *groov* EPIC processor.
4. On a computer or mobile device, log into your *groov* EPIC processor with a user ID that has administrator privileges.
5. If you haven't done so recently, create a backup file (see "Backing up Your groov EPIC Processor Settings" on page 151). Keep this file handy and secure.
6. If you are using Ignition Edge, deactivate the license. For instructions, see "Deactivating the Ignition Edge license" on page 76.
7. If you are using CODESYS, make sure you have the license file (*.WibuCmRaU) so that you can restore it.
8. Click the menu button ( ), then select Home.
9. Click Maintenance and then Update.
10. On the Update page, decide:
    - If you want to save your current settings and then have the *groov* EPIC processor restore them after the restart, leave the slider in the default position (the slider shows green). If you created a backup file in step 5, the information in that backup file is the same information that will be restored if you leave this setting on. This will also save you some steps later on.
    - If you *do not* want the settings saved and restored after the restart, move the slider to the left so that it shows gray ( ). You'll want to select this if you want to restore your processor with settings from a different backup file; perhaps one that has a different set of configurations.



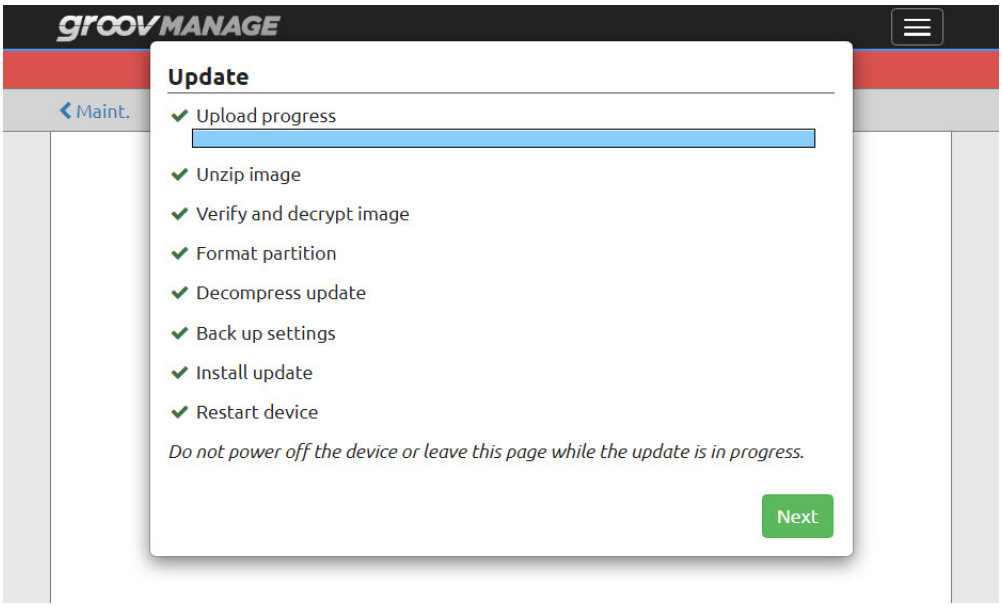
11. Click Update System.
12. Navigate to the software update file you downloaded in step 3.
13. Click Open. *groov* Manage displays a message to remind you that the update clears all your settings and projects, and gives you one more opportunity to cancel and perform that important backup. If you are ready to proceed with the update, click on Update and Restart:



14. *groov* Manage displays an Update message, which shows you the progress of the update. The update can take several minutes to complete. During that time, the banner (in the background) will change color to yellow.

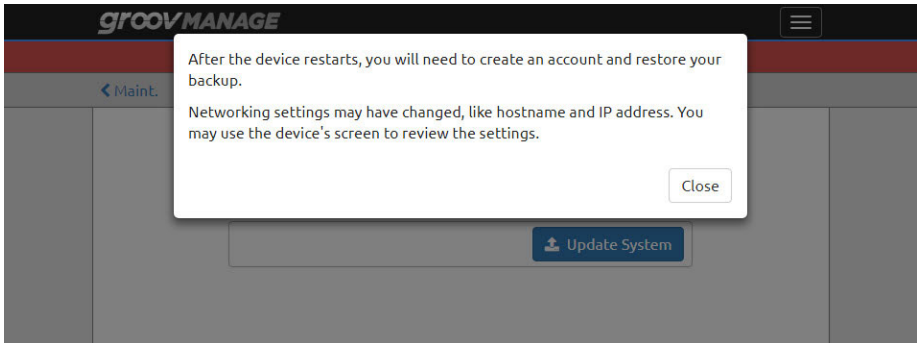


15. When the update is done, the banner turns red, which indicates the processor is now offline. *groov* Manage shows you this screen:



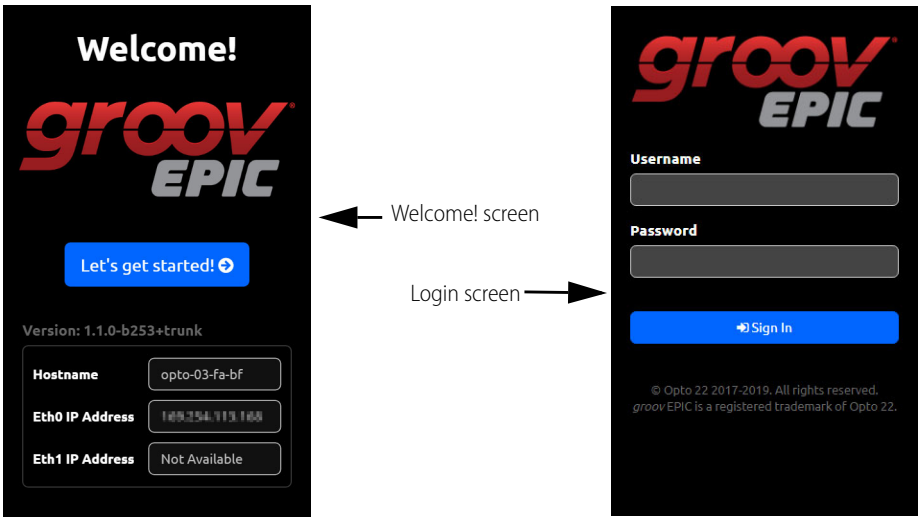
Click Next.

16. *groov* Manage displays a message with instructions on what to do after the device restarts.



Read the instructions and then click Close. The *groov* EPIC processor touchscreen displays the progress of the restart.

17. When the restart is done, you will see one of the following:
    - The Welcome! screen. (You'll see this screen if you **de**selected the Backup Settings option in step 10 on page 158.)
    a. Make a note of the IP address shown in either the Eth0 IP Address box or the Eth1 IP Address box. You'll need it in the next few steps.
    b. Tap Let's get started! and create an administrator user ID and password. (It does not have to match any that might be stored in your backup file; however, you still do have to remember to store it in a safe location for later recall.)
    c. Click on Configure Device.
    - The login screen. You'll see this screen if you selected the Backup Settings option in step 10 on page 158. Log into your *groov* EPIC processor with the user ID that has administrator priveleges.



18. If you are developing and running Node-RED flows, re-install any nodes required by your flows. For example, to re-install the Opto 22 nodes:
    a. Click the menu button ( ) > Manage palette > Install tab.
    b. Search for `node-red-contrib-pac`.
    c. Click the small Install button.

    Repeat the previous steps for any other nodes required by your flows.

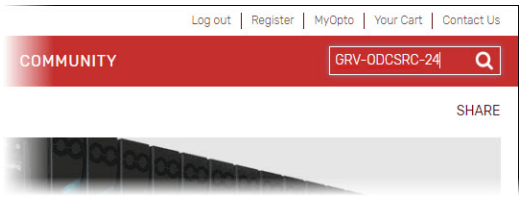
If you do not re-install these nodes and you try to run your flows, you'll receive messages that your flows cannot run due to missing nodes.

19. If you are running a *groov* View HMI, restore your *groov* View HMI as described in the *groov* View User's Guide (form 2027).
20. If you are running with Ignition Edge, activate the license. For instructions, see "Licensing Ignition Software" on page 75.
21. If you are running CODESYS applications:
    - Switch to the CODESYS Runtime Engine. For instructions, see "Enabling the CODESYS Runtime Engine" on page 73.
    - When you restore the *groov* EPIC processor's backup file, make sure you select License as one of the options on the Restore page to restore the CODESYS license file.
22. Restore your backup file as described in "Restoring a Backup or Specific Settings from a Backup File" on page 153, beginning with step 3.

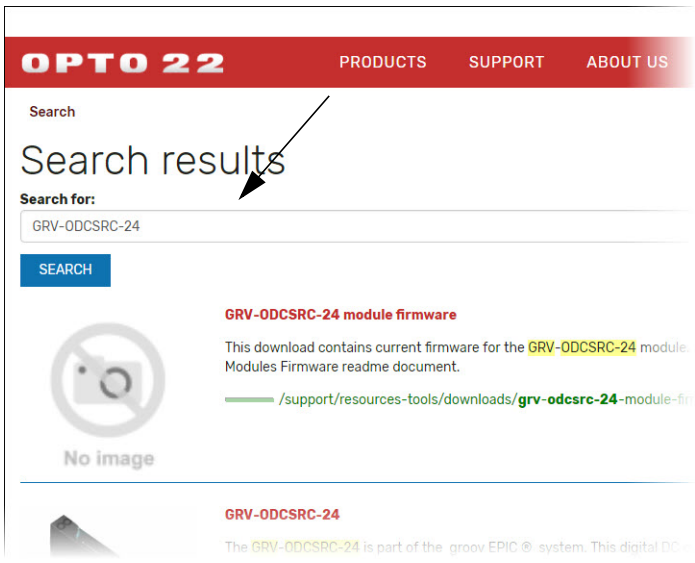
Installing an I/O Module Firmware Update

These instructions work for either installing the most current module firmware or a previous version of module firmware. Make sure you do these instructions on a computer or mobile device that has access to the *groov* EPIC unit with the module you want to update.

1. Go to the Opto 22 web site (www.opto22.com) and look up the module firmware by entering the module part number in the Search box. For example, to find the module firmware for the GRV-ODCSRC-24 module, type in GRV-ODCSRC-24 in the Search box, then press Enter.



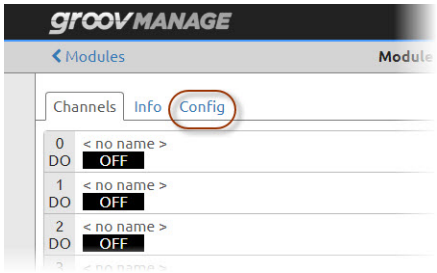
2. In the Search results, click on the result with the module part number and "Module Firmware" in the title.



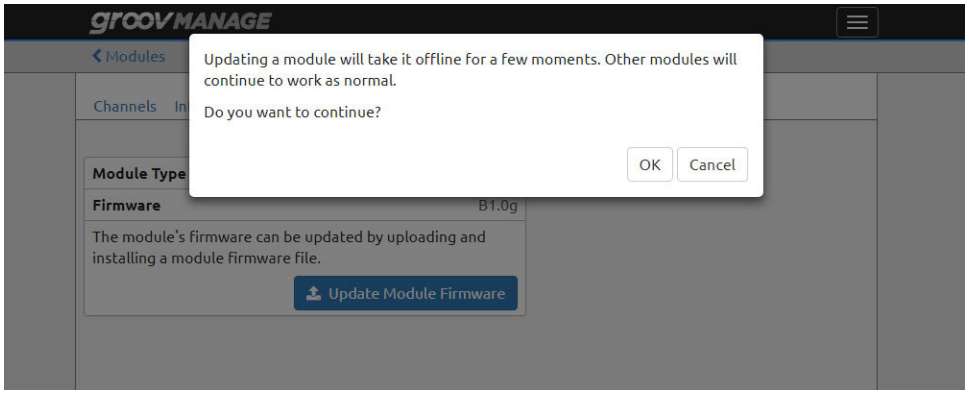
3. Do one of the following:
   - **If you want the most current version of the module firmware–**click Download and save the file your computer or mobile device.
   - **If you want a previous version of the module firmware–**find the version you want from the list provided, click on its link, and save the file your computer or mobile device.

   Note: *If the file has a file type of .zip, decompress the file with a decompression utility on your mobile device or computer before going to the next step.*

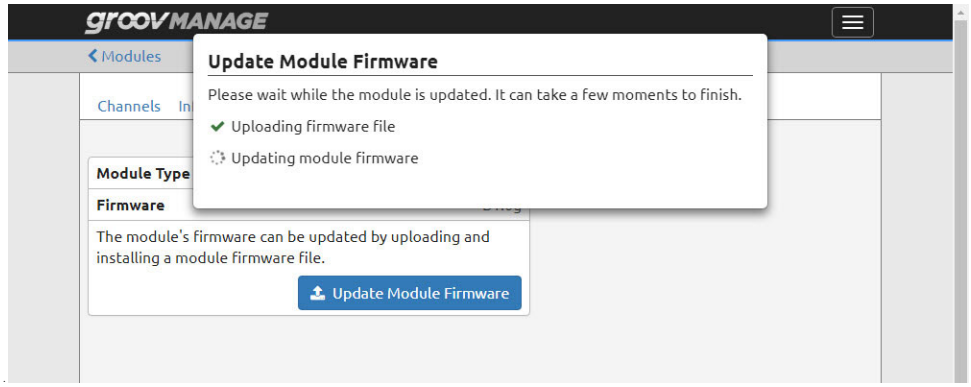
4. On that same computer or mobile device, log into your *groov* EPIC processor with a user ID that has administrator privileges.
5. Run a backup of your unit (see "Backing up Your groov EPIC Processor Settings" on page 151).
6. Click the menu button ( ), then select I/O.
7. In the Modules page, select the module you want to update.
8. In the Module page for that module, click the Config link.



9. In the Config tab, click Update Module Firmware (Update Module Firmware).
10. Navigate to the folder or media device where you saved the firmware update.
11. Click Open.
12. *groov* Manage displays a message to remind you that the module will be offline during the update.

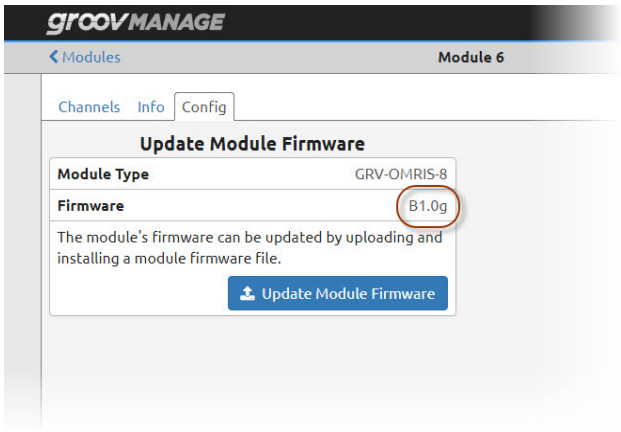


If you are ready to proceed, click OK. *groov* Manage displays a message showing you the progress of the update:

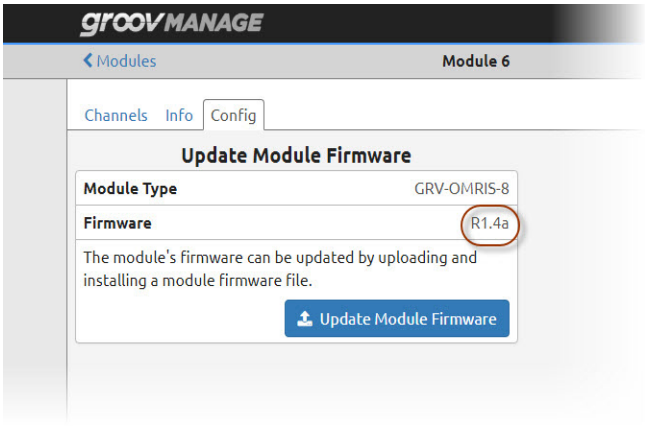


13. When the update is complete, *groov* Manage shows you the module page and you can see that the Firmware field has an updated release number, like in the following example:

Before the firmware update



After the firmware update



REPLACING THE BATTERY

The battery maintains:

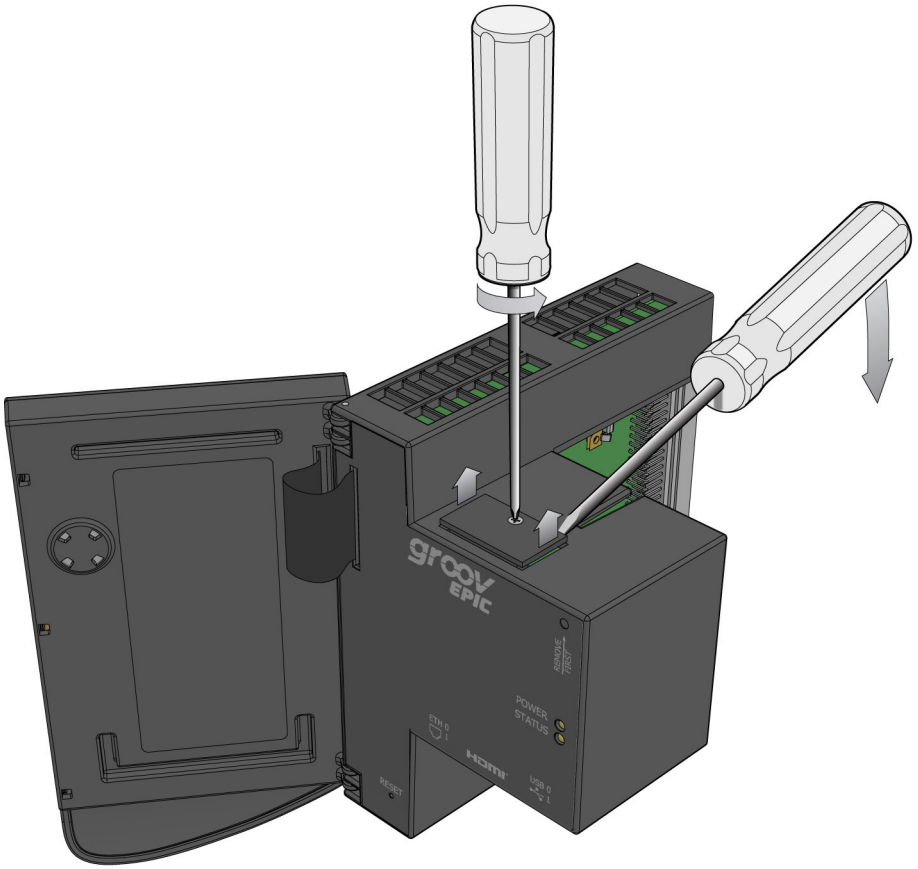
- the date and time
- the RAM that holds persistent data (for example, persistent variables) from the control engine

Battery life is dependent on the ambient temperature; the lower the temperature, the longer the battery life.

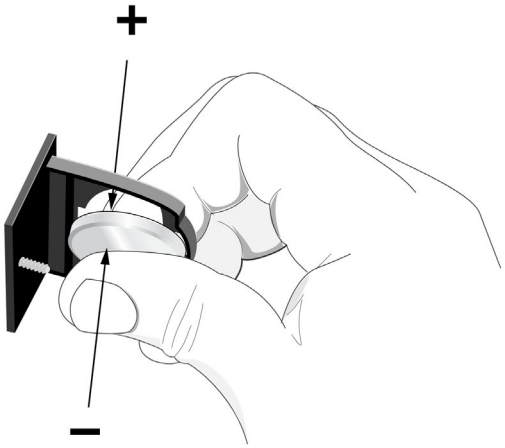
You'll need a BR2032 button cell lithium battery with a nominal voltage of 2.8 volts.

NOTE: *Do not use a CR3032 button cell lithium battery because it cannot withstand the same temperature ranges that the processor can withstand.*

1. On the top of the *groov* EPIC processor, unscrew the captive screw until the battery holder extends out enough to slip a flathead screwdriver in the opening. With the flathead screwdriver, pull out the battery holder until you can grasp it with your fingers to completely pull it out.



2. With your fingers, pop out the old battery.



3. Put in the new battery, push in the holder, and secure the captive screw.

HOW TO RESET TO FACTORY DEFAULTS

You might have to reset to factory defaults if instructed to do so by product support. A reset to factory defaults erases all the changes you made to the *groov* EPIC system, which is why it is important that you perform the following, if possible:

- Back up your system. For instructions, see "Backing up Your groov EPIC Processor Settings" on page 151.
- Deactivate your Ignition Edge license. For instructions, see "Deactivating the Ignition Edge license" on page 76.
- Make sure you have a copy of the CODESYS license file (*.WibuCmRaU).

Use a paper clip to depress the RESET button for approximately 8 seconds. Release the button when the STATUS LED blinks alternately between red and green.

COLLECTING INFORMATION FOR PRODUCT SUPPORT

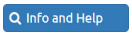
The *groov* EPIC processor displays information in various screens and collects information in several logs that can help Product Support diagnose and solve problems. Product Support will direct you with the specific information to collect. You might want to create a new folder on your computer or mobile device with the name of the Opto 22 ticket number, if you have one, and store all this information into that folder.

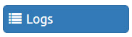
There are a few ways to collect information from the screens:

- If you are working directly with the *groov* EPIC processor touchscreen, you can take pictures of screens, type the information on the screen into a text file, or write down on a piece of paper the information on the screen.

- If you are connected to the processor through a computer or mobile device, you can use the screen capture feature on the computer or mobile device to save (capture) the screens.

If Product Support directs you to send log files, do the following steps:

1. On a computer or mobile device, log into the *groov* EPIC processor with a user ID that has administrator privileges.
2. Click Info and Help (

).
3. Click Logs (

).
4. Click on the specific log or logs as directed by Product Support.
5. Click Download (

).
6. Navigate to a folder on your computer or mobile device where you want to save the log. You might also want to make note of the name of the log file or modify it to something else.
7. Click Save.
8. Repeat steps 4 through 7 for all the logs that Product Support directs you to download.

Send this information to Opto 22 as directed by Product Support.

CONDUCTING AN OPTOSUPPORT REMOTE SUPPORT SERVICE (RSS) SESSION

An OptoSupport Remote Support Service (RSS) session can help expedite the resolution of your support ticket by allowing the OptoSupport team member to remotely connect to your *groov* EPIC processor to continue with diagnostics and troubleshooting.

After evaluating the progress of your ticket, your Opto 22 Support team member might determine that your situation would benefit from an RSS session and discuss with you the benefits and goals of the session. If you agree with this step, our team member will schedule a time to start a Remote Support Service (RSS) session.

Before beginning the session, it's important that you prepare your *groov* EPIC processor by checking the following:

- Verify that your *groov* EPIC processor has an internet connection.
- Verify that, if your internet connection travels through a firewall or router, that the firewall or router does not prevent outbound connections through ports 555.

An RSS session will typically run like this:

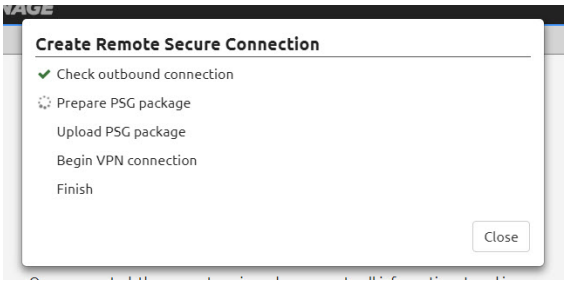
1. At a time agreed upon by you and your OptoSupport team member, you'll initiate a phone call.
2. When instructed, click Create RSC to initiate the session. For detailed instructions and an explanation of what happens during this step, see "Initiating an RSS Session" on page 167.
3. After the session is successfully created, you and your OptoSupport team member will review details of your situation and discuss additional steps. These steps might be:
   - Continue active discussion of the problem over the phone while the OptoSupport team member diagnosis and troubleshoots your *groov* EPIC processor.
   - Agree to a plan of action where you can end the phone call while the OptoSupport team member continues to diagnose and troubleshoot your processor.

   If the session is lengthy, part of the plan might include pausing the session and continuing it at a later time. For additional instructions on pausing and resuming a session, see "Pausing and Resuming an RSS Session" on page 168.
4. When it's time to end the RSS session, click Delete RSC. For important information on what happens when you end an RSS session, see "Ending the RSS Session" on page 168

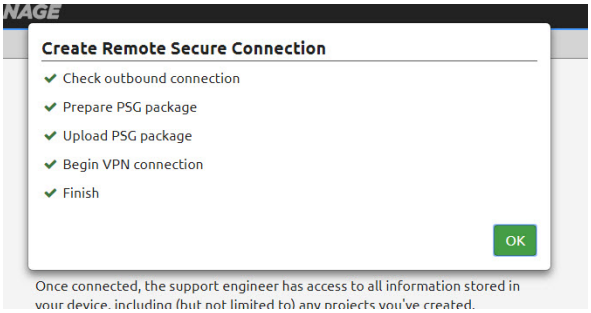
Initiating an RSS Session

1. The Opto 22 Support team member will ask you to navigate to the OptoSupport RSS page, if you haven't already done so. (From the *groov* Manage home page, click or tap Info and Help > OptoSupport RSS.)
2. The Opto 22 Support team member will ask for the serial number listed on the OptoSupport RSS page. This information is necessary for the connection to be successful.
3. When instructed by the Opto 22 Support team member, click ▶ Create RSC .

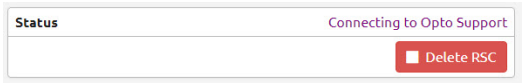
   The first thing you will see is the OptoSupport Remote Support Service Permission and Release Agreement. To proceed with the session, accept the agreement.
4. After you click Accept, *groov* Manage displays a message to indicate the progress of establishing the connection before it starts a connection:



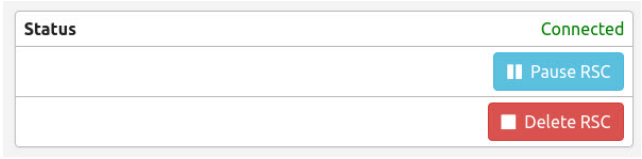
5. When it finishes these steps, click OK to close the message box:



6. While your *groov* EPIC processor is trying to establish a connection, you will see this message on the OptoSupport RSS page:



7. After the connection is established, you will see this message on the OptoSupport RSS page:



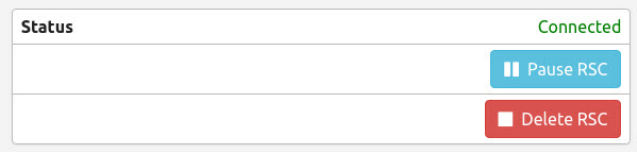
Do not turn off your *groov* EPIC processor after you start the session. If this happens, you will need to start this process over.

Pausing and Resuming an RSS Session

During the course of diagnosis and troubleshooting, you and your OptoSupport team member might agree to pause the session, then resume it at a later time. Pausing the session prevents communication between OptoSupport team member and your *groov* EPIC processor while preserving the information needed to quickly resume the connection.

- To pause a session, click Pause in the OptoSupport RSS page (Info and Help > OptoSupport RSS). *groov* Manage displays a message confirming the pause. Click OK to close the message. The OptoSupport RSS page updates the status to indicate the RSS session is paused:

- To resume a session, click Continue RSC in the OptoSupport RSS page (Info and Help > OptoSupport RSS). After the connection is re-established, the OptoSupport RSS page displays the status as Connected.



Ending the RSS Session

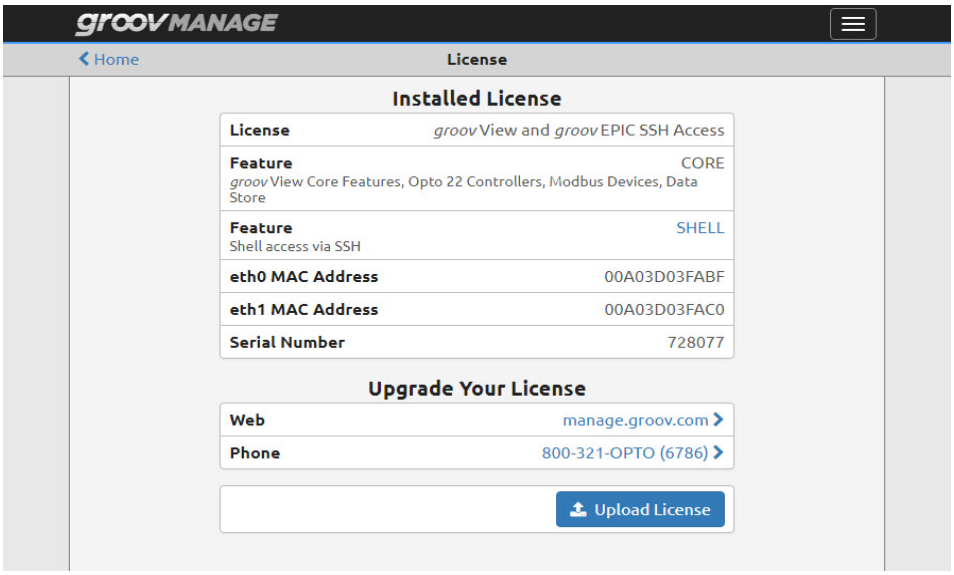
When it's time to end the RSS session, click Delete RSC in the OptoSupport RSS page (Info and Help > OptoSupport RSS). All of the information that your *groov* EPIC processor created to establish the connection will be erased. If you need to start another RSS session, you'll need to start from the first step in "Initiating an RSS Session" on page 167.

17: Troubleshooting

CANNOT CONNECT TO THE SSH SERVER

Verify that you purchased and installed the *groov* EPIC SSH Access license to enable the SSH server.

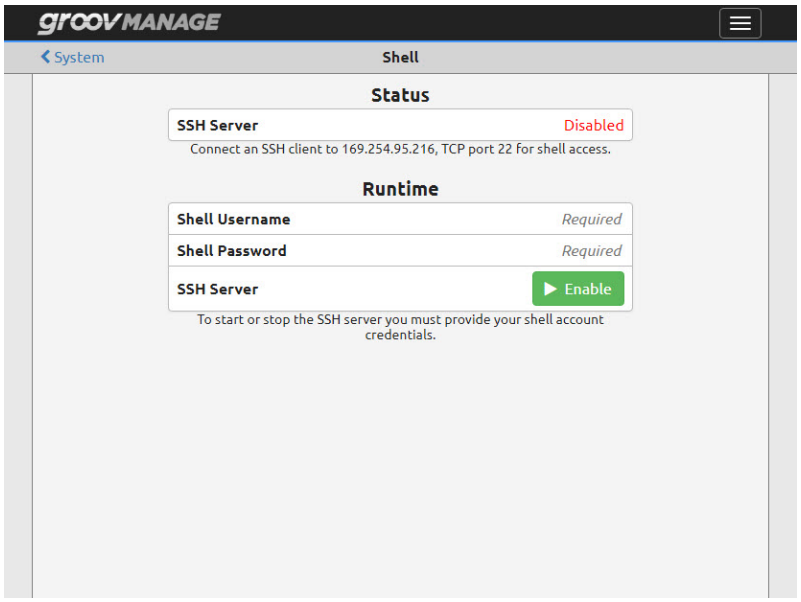
1. Log into your *groov* EPIC processor with a user ID that has administrator privileges.
2. Click or tap System (System).
3. Click or tap License (License). If you have the *groov* EPIC SSH Access license, the processor displays a page similar to the following:



The License field indicates that you have installed and purchased the correct license. If you don't see this text, see "Licensing Ignition Software" on page 75.

Verify that the SSH server is running.

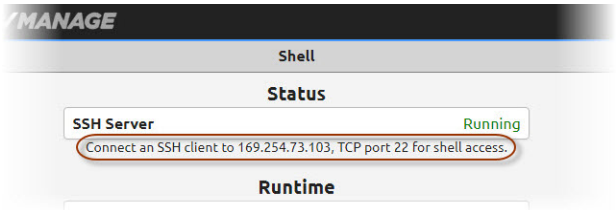
4. Log into your *groov* EPIC processor with a user ID that has administrator privileges.
5. Click or tap System (System).
6. Click or tap Shell (>_ Shell). If the SSH server is disabled, the processor displays the following page:



To enable the SSH server, see "Starting the SSH Server" on page 125.

Check that you entered the correct IP address and port number in your SSH client. To find the correct IP address and port number:

7. Log into your *groov* EPIC processor with a user ID that has administrator privileges.
8. Tap System (System).
9. Tap Shell (Shell). Look underneath the SSH Server field for the IP address and port number for shell access:



ONE OF THE MODULES IS BLINKING RED

This usually indicates that the module is trying to establish communication with the *groov* EPIC processor. For more information, see "Checking Module Status Through the Module LED" on page 140.

ONE OF THE MODULES IS BLINKING VIOLET

When you update the firmware for a module, its module LED turns violet and blinks. This is normal operation.

SSH SERVER USER ID AND PASSWORD ARE REJECTED

Remember that the SSH user ID and password is different from the *groov* Manage user ID and password.

CHANGES AREN'T SAVED OR THEY SUDDENLY CHANGE

Remember to press Save on the upper right corner of the screen after you are done making changes on that page.

GROOV EPIC PROCESSOR TOUCHSCREEN KEEPS JUMPING TO MODULE INFORMATION PAGE

If you notice that your screen keeps jumping to the module information for modules mounted on slots 0, 1, or 2 of the chassis, it might be because you are resting a part of your hand on the touch-sensitive pad of those modules while you are working with the processor's touchscreen. You might have to adjust the angle of your hand when you work on the processor to avoid touching or brushing up against that area of those modules.

TOUCHSCREEN DOESN'T RESPOND ACCURATELY TO FINGER TAPS

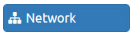
- You might want to switch to using a stylus.
- To improve the accuracy, you can run the screen calibration feature as described in "Calibrating the Processor's Touchscreen" on page 97.

ETHERNET CABLE IS PLUGGED IN, BUT NO IP ADDRESS

- Make sure the LNK ACT LED is lit (see "groov EPIC Processor" on page 12).
- If you are running on a local network hub, manually set the IP address as described in Chapter 7: Connecting groov EPIC to a Network or Multiple Networks.

WEB BROWSER CAN'T CONNECT TO PROCESSOR

If the browser displays a message that indicates the site (the processor) can't be reached, check any of the following:

- Check that the IP address is correct in the address or URL bar. On the processor touchscreen, check the IP address and verify that it matches what you typed in the address or URL bar. To check the IP address on the processor, tap the menu button (), then select System, then tap on Network (

).
  - If your computer or mobile device is connected to the same network as Eth0, compare the IP address in the Eth0 field with what you typed in the address or URL bar.
  - If your computer or mobile device is connected to the same network as Eth1, compare the IP address in the Eth1 field with what you typed in the address or URL bar.
- Verify that your computer or mobile device is connected to the same network as your *groov* EPIC processor. If they are, you might want to use *groov* Find to locate your EPIC on the network.

THE SPEED LED ON THE PROCESSOR CHANGED COLOR

The SPEED LED on the processor changes color to indicate the current speed of the link. This is part of normal operation.

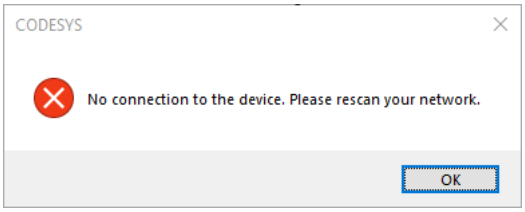
- If the LED is off, the link speed is 10 Mbps (megabits per second).
- If the LED is green, the link speed is 100 Mbps.
- If the LED is orange, the link speed is 1000 Mbps.

TIME ZONE CHANGE NOT SHOWN IN IGNITION EDGE

You set your time zone in *groov* Manage (see page 82). If you are running Ignition Edge and change the time zone, Ignition Edge does not automatically update it. To update it, restart the Ignition Edge Gateway.

CODESYS: CAN'T CONNECT TO *groov* EPIC PROCESSOR

You may see this message from CODESYS Development System when you are trying to connect (Online > Login) to the *groov* EPIC processor or it may appear as you are debugging your application:

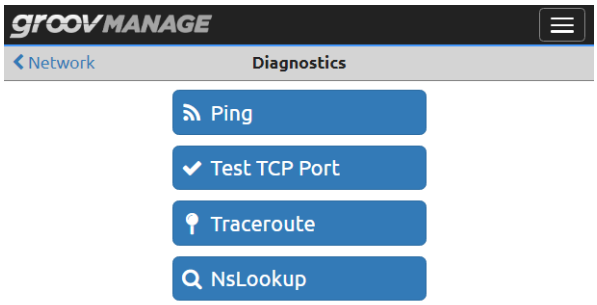


This could be caused by several different reasons:

- **Physical disconnection–**check for the following:
  - Is the *groov* EPIC processor turned off?
  - Is the Ethernet cable disconnected?
  - Did the Ethernet cable get moved to a different Ethernet network interface on the processor? If so, you'll want to review your firewall settings. For instructions, see "Configuring the Firewall" on page 42.
  - If you are connecting to the *groov* EPIC processor through Wifi, was the Wifi adapter removed?
- **Network instability–**check for the following:
  - If you are connecting to the *groov* EPIC processor through Wifi, is the Wifi adapter experiencing connectivity problems?
  - Is the network experiencing instability issues?
- ***groov* EPIC processor configuration issues–**check for the following:
  - If you did not license the CODESYS Runtime Engine, you've been running in two-hour trial mode and the two hours might be up. You can do one of two things:
    - Enable the CODESY Runtime Engine for another two hours (see "Enabling the CODESYS Runtime Engine" on page 73).
    - Obtain and apply the GRV-LIC-CRE license, which removes the two hour time limit (see "Licensing the CODESYS Runtime Engine" on page 67).
  - Was the CODESYS Runtime Engine on the *groov* EPIC processor disabled? To enable it, "Enabling the CODESYS Runtime Engine" on page 73.
  - Was the Ethernet cable plugged into ETH1 and you did not modify the processor's firewall to open a port for CODESYS on ETH1? To open the port, see "Configuring the Firewall" on page 42.
  - If you are connecting to the *groov* EPIC processor through Wifi, did you modify the processor's firewall to open a port for CODESYS on wlan0? To open the port, see "Configuring the Firewall" on page 42.

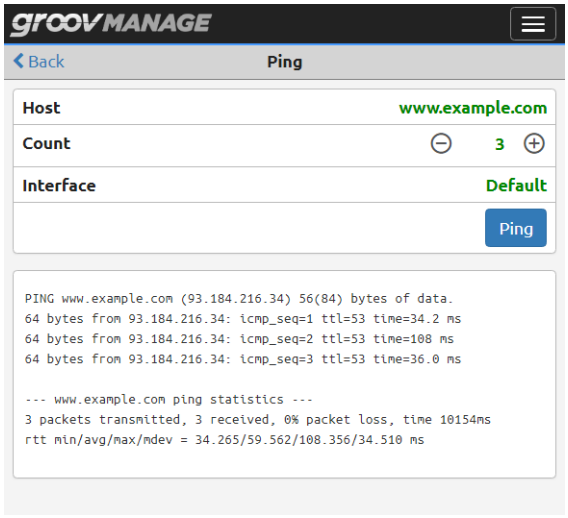
TROUBLESHOOTING NETWORK ISSUES

Troubleshooting networking issues can be a complex job, though it can be made simpler with the right tools. The *groov* EPIC processor provides a few tools to help you diagnose networking issues. You can access all of these tool by clicking or tapping (from the *groov* Manage Home page) System > Network > Diagnostics.



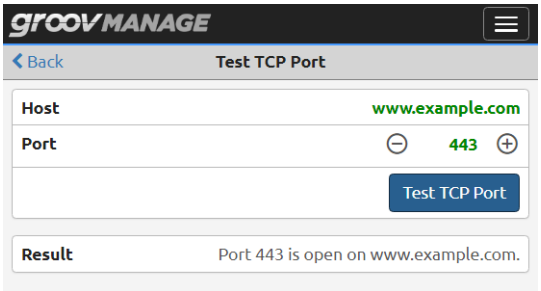
Ping

A well-known and frequently used tool to determine basic connectivity, click or tap on Ping to access the Ping screen, where you can run this tool to test basic connectivity from each of the *groov* EPIC processor's interfaces.



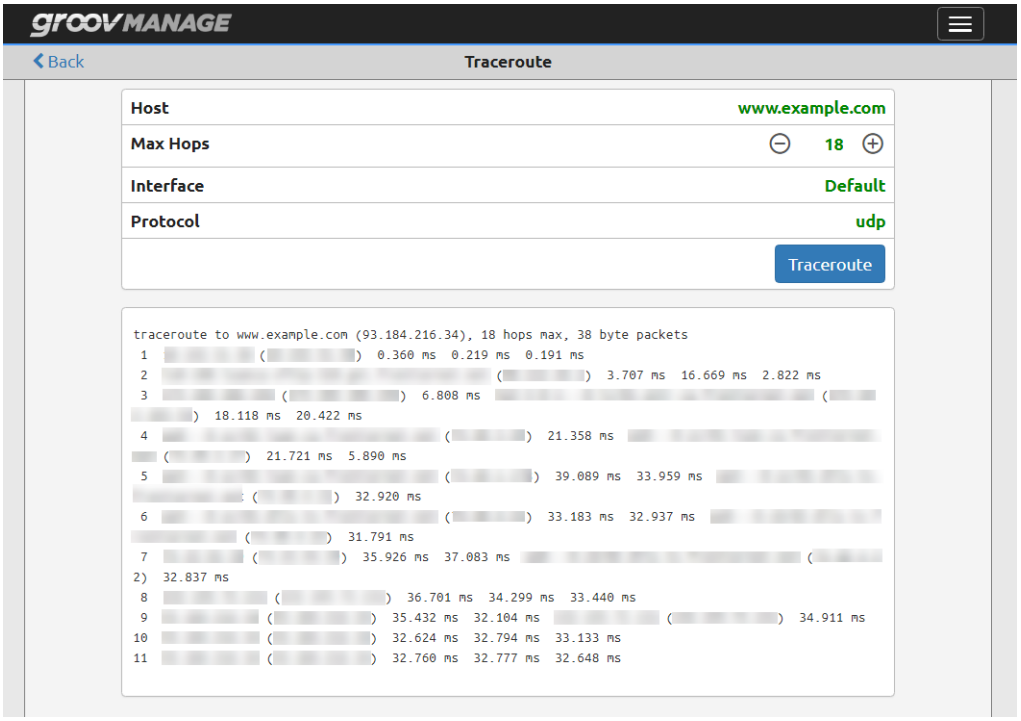
Test TCP Port

The test TCP port tool can help determine if a port on a particular server is open or closed. Specify the IP address or host name of the server in the Host field.



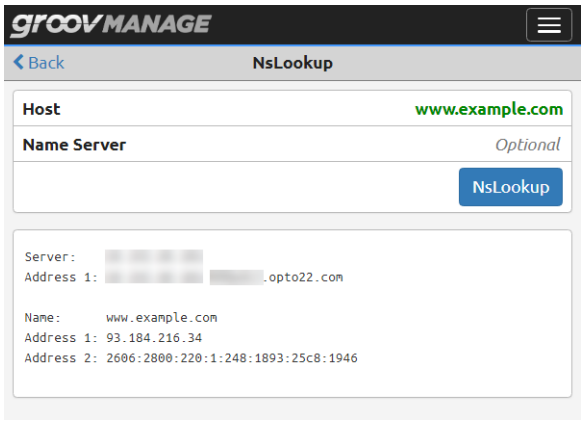
Traceroute

The Traceroute tool can help you see the route a packet takes to reach its destination. The following example shows the route a packet took to reach the destination, www.example.com.



NsLookup

The NsLookup tool can help you determine the domain name and IP address of a DNS server at the host.


groovMANAGE
Back
NsLookup
Host
www.example.com
Name Server
Optional
NsLookup
Server:
Address 1:
.opto22.com
Name: www.example.com
Address 1: 93.184.216.34
Address 2: 2606:2800:220:1:248:1893:25c8:1946

A: Processor Specifications

GRV-EPIC-PR1

The **E**dge **P**rogrammable **I**ndustrial **C**ontroller is an embedded Linux®, real-time controller with gateway functions.

The modern design of the *groov* EPIC processor offers a condensed and sturdy unit that features a resistive-touch, high-resolution LCD display. The LCD display lifts to provide easy access to the power button, power supply connectors, network interfaces, ports, and status LEDs.

- Dual, independent Gigabit Ethernet network interfaces enable the processor to maintain separate connections to your back office network and your controls network.
- Dual USB ports extend the capabilities of the processor so it can handle serial communications or communicate with touchscreen monitors.
- HDMI port displays configuration and *groov* View HMI on an external large screen, which is also useful for OEM applications where the EPIC system is built into a machine.

Software tools include:

- *groov* Manage for browser-based management of your *groov* EPIC system
- *groov* View for building and viewing custom operator interfaces for local, mobile, and browser-based devices
- PAC Project™ Basic Software Suite (installed and running on your Windows computer) for developing control programs and a traditional HMI
- Secure shell access to the Linux operating system to run custom applications (requires purchase of separate license)
- Node-RED for creating simple logic flows using pre-built nodes
- Ignition Edge® from Inductive Automation® for connecting to other devices, such as Allen-Bradley®, via OPC UA, and for efficient IIoT communications using MQTT with Sparkplug payload

The specifications are on the next page.

Specification	GRV-EPIC-PR1
Power requirements	7.1 W typical, 9.1 W max.
Memory	2 GB RAM 2 MB battery-backed RAM 6 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 subnets)
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
Maximum Number of PAC Control Engine Charts	64
Torque, bottom hold-down screw	3.5 in-lb (0.4 N-m)
Torque, top hold-down screw	1.5 in-lb (0.17 N-m)
Operating temperature	-20 °C to +70 °C
Storage temperature	-40 °C to +85 °C
Humidity	5–95% RH
Agency approvals and certifications	UL/cUL (Class 1 Div. 2), CE, ATEX (Category 3, Zone 2), RoHS, DFARS
Warranty	30 months

B: Power Supply Specifications

GRV-EPIC-PSAC, GRV-EPIC-PSDC, GRV-EPIC-PSPT

The **GRV-EPIC-PSAC** power supply and the **GRV-EPIC-PSDC** voltage converter are designed to provide power for a *groov* EPIC chassis with a GRV-EPIC-PR1 processor, and *groov*® I/O modules mounted on the chassis.

The **GRV-EPIC-PSPT** pass-through power adapter is designed to allow you to connect a user-supplied, external 12 V power supply to the I/O unit.

Specification	GRV-EPIC-PSAC	GRV-EPIC-PSDC	GRV-EPIC-PSPT
Max Output Power	60 W (-20 °C ≤ T_a ≤ 50 °C) 50 W (50 °C < T_a ≤ 70 °C)	50 W (-20 °C ≤ T_a ≤ 70 °C)	108 W from external 12 VDC supply, (-20 °C ≤ T_a ≤ 70 °C)
Input Voltage Range	110 to 240 VAC nominal, 100 to 264 VAC max.	24 to 48 VDC nominal, 22 to 50 VDC max.	10 to 15 VDC
Typical Input Current (max load)	0.6 A at 115 VAC	3.5 A at 22 VDC	9 A at 12 VDC
Inrush Current	30 A at 115 VAC	2.5 I^2t (A^2s)	2.5 I^2t (A^2s)
Input Frequency Range	50 Hz to 60 Hz	n/a	n/a
Power Factor	>0.98 at 115 VAC, full load	n/a	n/a
Wire size	28–12 AWG	28–12 AWG	28–12 AWG
Torque (connector screw)	4.4 in-lb	4.4 in-lb	4.4 in-lb
Fuse	2 A 250 V Slow Opto 22 PN: GRV-EPIC-PSAC-FUSE	4 A 250 V Slow Opto 22 PN: GRV-EPIC-PSDC-FUSE	10 A 125 V Fast Opto 22 PN: GRV-EPIC-PSPT-FUSE
Operating Ambient Temperature	-20 °C to 70 °C	-20 °C to 70 °C	-20 °C to 70 °C
Altitude Temperature Derating	5 °C per 1000 m over 2000 m	5 °C per 1000 m over 2000 m	n/a
MTTF (minimum, 25 °C)	650 khrs	4.5 Mhrs	4.5 Mhrs
Agency Approvals	UL/cUL(Class 1 Div. 2), CE, ATEX(Category 3, Zone 2), RoHS, DFARS		
Warranty	30 months	30 months	30 months

C: Chassis Specifications

GRV-EPIC-CHS0, GRV-EPIC-CHS4, GRV-EPIC-CHS8, GRV-EPIC-CHS16

groov EPIC I/O mounting chassis are designed to hold an intelligent *groov* EPIC processor, power supply, and several I/O modules. The GRV-EPIC-CHS0 is designed to hold only the processor and the power supply, making it ideal where no I/O is needed and cabinet space is at a premium.

Since *groov* analog, discrete, and serial I/O modules all have the same footprint, customers using a *groov* chassis can mix all these modules on the same chassis. Field devices are wired directly to the top-mounted connectors on the modules. The module and chassis design allows modules to rock into a specific mounting point on the chassis.

groov EPIC chassis are available in four configurations, accommodating up to 0, 4, 8, or 16 modules.

Specification	GRV-EPIC-CHS16	GRV-EPIC-CHS8	GRV-EPIC-CHS4	GRV-EPIC-CHS0
Number of module slots	16	8	4	0
Maximum Power Rating	60 W with GRV-EPIC-PSAC 50 W with GRV EPIC PSDC 108 W with GRV-EPIC-PSPT			
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; CB Scheme			
Warranty	30 months			

D: I/O Module Specifications

GRV-CCANI-2

The GRV-CCANI-2 serial module provides 2 independent, isolated serial channels (ports) allowing the GRV-EPIC-PR1 to communicate through a Controller Area Network (CAN).

Specifications

Specifications	GRV-CCANI-2
Serial Standards	CAN 2.0
Bit Rates	10 Kbps, 20 Kbps, 50 Kbps, 100 Kbps, 125 Kbps, 250 Kbps, 500 Kbps, 750 Kbps, 1 Mbps
Maximum Bus Length (1 Mbps)	40 m
Maximum Bus Length (50 Kbps)	1000 m
Bus Termination	120 Ohms, selectable
Isolation (field-to-logic)	300 V working, 1500 V transient (1 minute)
Isolation (channel-to-channel)	300 V working
Number of Channels	2 individually configurable channels
Indicators	Transmit and Receive LEDs for each channel
Chassis Power Consumption	1.5 W
Chassis Compatibility	Slots 0–3 only. The maximum number of modules per chassis is 4.
Minimum GRV-EPIC-PR1 Firmware Version	1.5.0
Minimum PAC Project Version	Upcoming release
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
Relative Humidity (non-condensing)	5–95%
Agency Approvals	UL/cUL(Class 1 Div. 2); CE, ATEX(Category 3, Zone 2), RoHS; DFARS; CB Scheme
Warranty	30 months

GRV-CSERI-4

The GRV-CSERI-4 serial module provides 4 independent, isolated serial channels (ports) allowing the GRV-EPIC-PR1 to communicate with RS-232 or RS-485 serial devices. You can set up the module to communicate with RS-485 serial devices in half-duplex (2-wire transmission) or full-duplex (4-wire transmission) mode. Each channel is selectable between RS-232 mode and RS-485 mode, with configurable termination and bias in RS-485 mode. Channel 0 can also be configured to handle modem commands. Baud rates of up to 1 Mbps are supported. Please note that GRV-CSERI-4 modules may only be installed in chassis slots 0-3, for a maximum of 4 modules (16 channels) per chassis.

Features

Feature	Channel 0	Channel 1	Channel 2	Channel 3
RS-232 Tx / Rx	x	x	x	x
RS-232 RTS / CTS	x	x	x	x
RS-232 DCD, DTR, DSR, RI	x			
RS-485 half-duplex mode (TxRx+/-)	x	x	x	x
RS-485 full-duplex Mode (Tx+/-, Rx+/-)	x	x	x	x
RS-485 termination (120 Ohms)	x	x	x	x
RS-485 Bias (750 Ohms to +V and COM)	x	x	x	x

Specifications

Specification	GRV-CSERI-4
Serial Standards	RS-232 (DTE), RS-485 half- and full-duplex
Baud Rates	300 bps - 1 Mbps
Maximum Cable Length (RS-232)	10 m
Maximum Cable Length (RS-485)	1200 m at 38.4 Kbps, 500 m at 115.2 Kbps, 50 m at 1 Mbps
Bus Loading (RS-485)	1/8 Unit Load
Bus Termination	5 KOhms (RS-232 mode), 120 Ohms (RS-485 mode, selectable)
Bus Bias	750 Ohms, (RS-485 mode only, selectable)
Isolation (field-to-logic)	300 V working, 1500 V transient (1 minute)
Isolation (channel-to-channel)	300 V working
Number of Channels	4 individually configurable channels
Indicators	Transmit and Receive LEDs for each channels
Chassis Power Consumption	1.5 W
Chassis Compatibility	Slots 0–3 only. The maximum number of modules per chassis is 4.
Minimum GRV-EPIC-PR1 Firmware Version	1.2.0
Minimum PAC Project Version	10.1000
Minimum Library Package for CODESYS Version	1.0.0.1
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
Relative Humidity (non-condensing)	5–95%
Agency Approvals	UL/cUL (Class 1 Div. 2); CE, ATEX (Category 3, Zone 2), RoHS; DFARS; CB Scheme
Warranty	30 months

GRV-IAC-24, GRV-IACI-12, GRV-IACS-24, GRV-IACIS-12

groov AC input modules are used to sense status from devices such as pumps, fans, and motors that use a 85–140 VAC signal:

- The **GRV-IAC-24** modules can sense status from up to 24 devices.
- The **GRV-IACI-12** modules each have channel-to-channel isolation. They can sense status from up to 12 devices.
- The **GRV-IACS-24** and **GRV-IACIS-12** modules provide input state only, offering a lower cost option for projects with simple requirements.

Features

Feature	GRV-IAC-24	GRV-IACS-24	GRV-IACI-12	GRV-IACIS-12
Number of channels	24	24	12	12
Channel-to-channel isolation			x	x
On/off state	x	x	x	x
On/off latching	x		x	
Counting	x		x	
On/off totalization	x		x	
Frequency measurement	x		x	
Period measurement	x		x	
Pulse measurement	x		x	

Specifications

Specification	GRV-IAC-24	GRV-IACS-24	GRV-IACI-12	GRV-IACIS-12
Nominal Input Voltage Range (RMS)	85–140 VAC	85–140 VAC	85–140 VAC	85–140 VAC
Turn-on Voltage	85 VAC	85 VAC	85 VAC	85 VAC
Turn-off Voltage	35 VAC	35 VAC	35 VAC	35 VAC
Input Impedance (± 5%)	133 kOhms	133 kOhms	68 kOhms	68 kOhms
Operating Frequency	40 Hz to 400 Hz	40 Hz to 400 Hz	40 Hz to 400 Hz	40 Hz to 400 Hz
Isolation (field-to-logic)	300 V working, 1500 V transient (1 minute)			
Isolation (channel-to-channel)	NONE	NONE	300 V working	300 V working
Number of Channels	24	24	12	12
Chassis Power Consumption	1.0 W	1.0 W	1.0 W	1.0 W
Minimum GRV-EPIC-PR1 Firmware Version	1.0.0	1.0.0	1.0.0	1.0.0
Minimum PAC Project Version	10.0000	10.0000	10.0000	10.0000
Wire Size	28–14 AWG	28–14 AWG	28–14 AWG	28–14 AWG
Torque, connector screw	2.5 in-lb (0.28 N-m)	2.5 in-lb (0.28 N-m)	2.5 in-lb (0.28 N-m)	2.5 in-lb (0.28 N-m)
Torque, hold-down screw	3.5 in-lb (0.4 N-m)	3.5 in-lb (0.4 N-m)	3.5 in-lb (0.4 N-m)	3.5 in-lb (0.4 N-m)
Temperature (operating)	-20 °C to +70 °C	-20 °C to +70 °C	-20 °C to +70 °C	-20 °C to +70 °C
Temperature (storage)	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C
Relative Humidity (non-condensing)	5–95%	5–95%	5–95%	5–95%
Agency Approvals	UL/cUL(Class 1 Div. 2); CE, ATEX(Category 3, Zone 2); RoHS; DFARS; CB Scheme			
Warranty	Lifetime	Lifetime	Lifetime	Lifetime

GRV-IACDCTTL-24, GRV-IACDCTTLS-24

groov input modules are used to sense the on or off status for AC or DC devices between 2.5–16 V. They can sense status from up to 24 devices. The channels are not isolated. Note that all channels share a common reference terminal.

- The **GRV-IACDCTTL-24** offers a full set of features.
- The **GRV-IACDCTTLS-24** module provides input state only, offering a lower cost option for projects that require only point states.

Features

Feature	GRV-IACDCTTL-24	GRV-IACDCTTLS-24
Number of channels	24	24
On/off state	x	x
On/off latching	x	
Counting	x	
On/off totalization	x	
Frequency measurement	x	
Period measurement	x	
Pulse measurement	x	

Specifications

Specification	GRV-IACDCTTL-24	GRV-IACDCTTLS-24
Input Voltage[a]	2–16 VAC / VDC	2–16 VAC / VDC
Turn-on Voltage	2.0 VAC (Peak) / VDC	2.0 VAC (peak) / VDC
Turn-off Voltage	0.8 VAC (Peak) / VDC	0.8 VAC (Peak) / VDC
Input Impedance (± 5%)	2 kOhms	2 kOhms
Max. Freq. (50% square wave 5 V_{p-p})	2000 Hz	N/A
IEC Input Type	N/A	N/A
Isolation (field-to-logic)	300 V working, 1500 V transient (1 minute)	300 V working, 1500 V transient (1 minute)
Isolation (channel-to-channel)	None	None
Number of Channels	24	24
Chassis Power Consumption	1.0 W	1.0 W
Minimum GRV-EPIC-PR1 Firmware Version	1.0.0	1.0.0
Minimum PAC Project Version	10.0000	10.0000
Wire Size	28–14 AWG	28–14 AWG
Torque, connector screw	2.5 in-lb (0.28 N-m)	2.5 in-lb (0.28 N-m)
Torque, hold-down screw	3.5 in-lb (0.4 N-m)	3.5 in-lb (0.4 N-m)
Temperature (operating)	-20 °C to +70 °C	-20 °C to +70 °C
Temperature (storage)	-40 °C to +85 °C	-40 °C to +85 °C
Relative Humidity (non-condensing)	5–95%	5–95%
Agency Approvals	UL/cUL(Class 1 Div. 2); CE, ATEX(Category 3, Zone 2), RoHS; DFARS; CB Scheme	
Warranty	Lifetime	Lifetime

[a]The GRV-IACDCTTL-24 is primarily intended for use as a polarity-insensitive low voltage DC input module. It can be used with AC input voltages by reading the On Latch or Off Latch when discrete input latching is enabled. This also applies when using the various features other than state and latches.

GRV-IACHV-24, GRV-IACIHV-12, GRV-IACHVS-24, GRV-IACIHVS-12

These *groov* AC input modules sense status from devices such as pumps, fans, and motors that use a 120–280 VAC signal. You can sense status from up to 24 devices using a 24-channel module, or up to 12 devices using a 12-channel module.

- The **GRV-IACHV-24** module provides 24 channels per module. Field devices are isolated from the logic side of the module, but channels are not isolated from each other: they share a common connection inside the module.
- The **GRV-IACIHV-12** module provides 12 channels per module, with channel-to-channel isolation.
- The **GRV-IACHVS-24** and the **GRV-IACIHVS-12** modules provide input state only, offering a lower cost option for projects that require only on/off status.

Features

Feature	GRV-IACHV-24	GRV-IACHVS-24	GRV-IACIHV-12	GRV-IACIHVS-12
Number of channels	24	24	12	12
Channel-to-channel isolation			x	x
On/off state	x	x	x	x
On/off latching	x		x	
On/off totalization	x		x	
Frequency measurement	x		x	
Period measurement	x		x	
Pulse measurement	x		x	

Specifications

Specification	GRV-IACHV-24	GRV-IACHVS-24	GRV-IACIHV-12	GRV-IACIHVS-12
Nominal Input Voltage Range (RMS)	180–280 VAC	180–280 VAC	180–280 VAC	180–280 VAC
Turn-on Voltage	180 VAC	180 VAC	180 VAC	180 VAC
Turn-off Voltage	35 VAC	35 VAC	35 VAC	35 VAC
Input Impedance (± 5%)	532 kOhms	532 kOhms	271 kOhms	271 kOhms
Operating Frequency	40 Hz to 400 Hz	40 Hz to 400 Hz	40 Hz to 400 Hz	40 Hz to 400 Hz
Isolation (field-to-logic)	300 VAC, 1500 V Transient			
Isolation (channel-to-channel)	N/A	N/A	300 VAC working	300 VAC working
Number of Channels	24	24	12	12
Chassis Power Consumption	1.0 W	1.0 W	1.0 W	1.0 W
Minimum GRV-EPIC-PR1 Firmware Version	1.0.0	1.0.0	1.0.0	1.0.0
Minimum PAC Project Version	10.0000	10.0000	10.0000	10.0000
Wire Size	28–14 AWG	28–14 AWG	28–14 AWG	28–14 AWG
Torque, connector screw	2.5 in-lb (0.28 N-m)	2.5 in-lb (0.28 N-m)	2.5 in-lb (0.28 N-m)	2.5 in-lb (0.28 N-m)
Torque, hold-down screw	3.5 in-lb (0.4 N-m)	3.5 in-lb (0.4 N-m)	3.5 in-lb (0.4 N-m)	3.5 in-lb (0.4 N-m)
Temperature (operating)	-20 °C to +70 °C	-20 °C to +70 °C	-20 °C to +70 °C	-20 °C to +70 °C
Temperature (storage)	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C
Relative Humidity (non-condensing)	5–95%	5–95%	5–95%	5–95%
Agency Approvals	UL/cUL (Class 1 Div. 2); CE, ATEX(Category 3, Zone 2), RoHS; DFARS; CB Scheme			
Warranty	Lifetime	Lifetime	Lifetime	Lifetime

GRV-IDC-24, GRV-IDCI-12, GRV-IDCS-24, GRV-IDCSW-12, GRV-IDCIS-12, GRV-IDCIFQ-12

groov DC input modules can sense the on or off status for 10–30 VDC field devices (proximity switches, push buttons, and auxiliary contacts) or 2.5–30 VDC input devices that produce high-frequency signals:

- The **GRV-IDC-24** is a leakage-tolerant DC input module.
- The **GRV-IDCI-12** is a DC input module that includes channel-to-channel isolation. The 12 channels in these modules do not share any field signal connections inside the module.
- The **GRV-IDCSW-12** module provides 12 channels of contact status input. It supplies power to an external dry contact switch and senses switch closure or opening. The channels can also be configured as DC inputs with a nominal range of 5–30 V.
- The **GRV-IDCS-24** and the **GRV-IDCIS-12** modules provide DC input state only, offering a lower cost option for projects with simple requirements.
- The **GRV-IDCIFQ-12** module provides 12 high-speed digital input channels capable of measuring frequencies up to 25 kHz, channel-to-channel isolation, and can be configured to provide up to 4 axes of quadrature input with an index signal for each axes.

Features

Feature	GRV-IDC-24	GRV-IDCS-24	GRV-IDCSW-12	GRV-IDCI-12	GRV-IDCIS-12	GRV-IDCIFQ-12
Number of channels	24	24	12	12	12	12
Channel-to-channel isolation				x	x	x
On/off state	x	x	x	x	x	x
On/off latching	x		x	x		x
Counting	x		x	x		x
On/off totalization	x		x	x		x
Frequency measurement	x		x	x		x
Period measurement	x		x	x		x
Pulse measurement	x		x	x		x
Quadrature						x

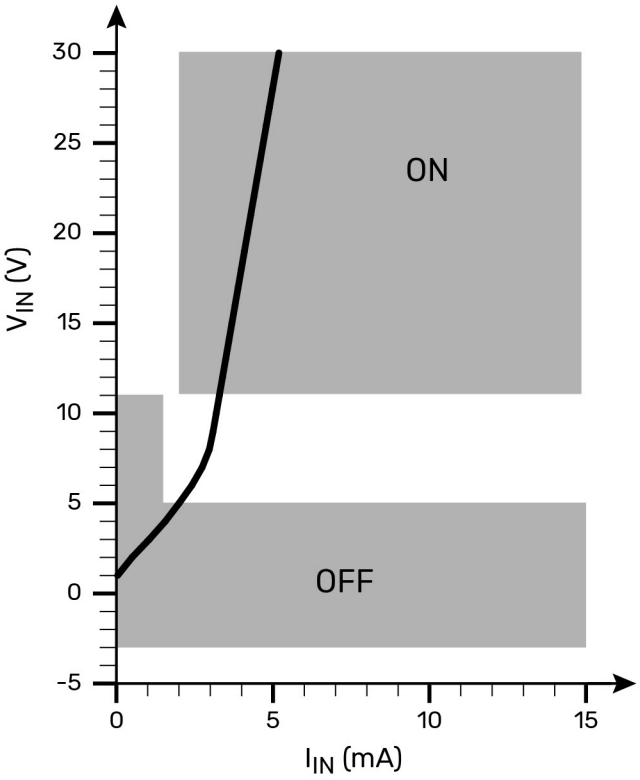
Specifications for GRV-IDC-24, GRV-IDCI-12, GRV-IDCS-24, GRV-IDCIS-12, GRV-IDCIFQ-12

The specifications for GRV-IDCSW-12 are in the next section.

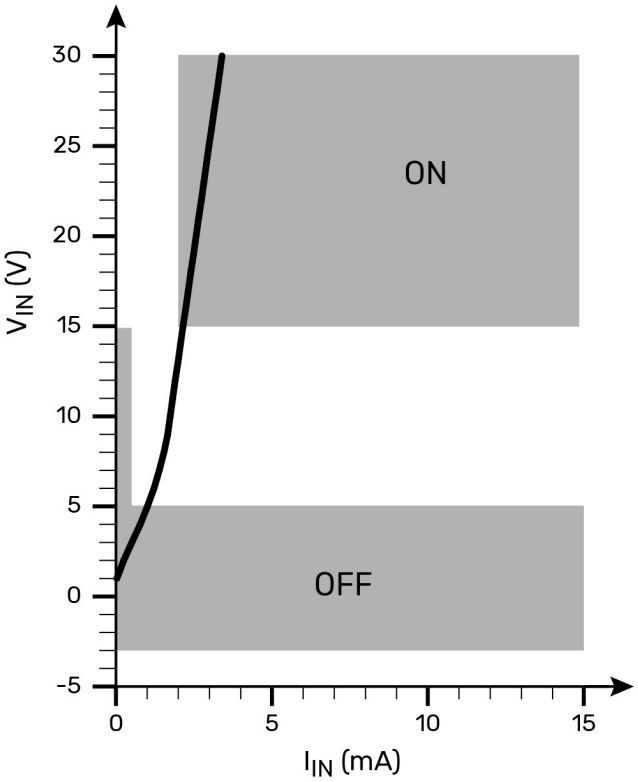
Specification	GRV-IDC-24	GRV-IDCS-24	GRV-IDCI-12	GRV-IDCIS-12	GRV-IDCIFQ-12
Input Voltage (VDC)	15–30 VDC	15–30 VDC	10–30 VDC	10–30 VDC	2.5–30 VDC
IEC Input Type	Type I	Type I	Type III	Type III	N/A
Turn ON Characteristic	15 V, > 2 mA	15 V, > 2 mA	10 V, > 2 mA	10 V, > 2 mA	2.5 V
Turn OFF Characteristic	5 V, < 0.5 mA	5 V, < 0.5 mA	5 V, < 1.5 mA	5 V, < 1.5 mA	1.8 V
Input Impedance (± 5%)	See note 1.	See note 1.	See note 1.	See note 1.	1.1 K at 5 V, 2.2 K at 12 V, 3.5 K at 24 V
Max. Freq. (50% square wave)	1000 Hz (24 V_{p-p})	1000 Hz (24 V_{p-p})	1000 Hz (24 V_{p-p})	1000 Hz (24 V_{p-p})	Counting: 200 kHz Quadrature: 50 kHz
Isolation (field-to-logic)	300 V working, 1500 V transient (1 minute)				
Isolation (channel-to-channel)	None	None	300 V working	300 V working	300 V working
Number of Channels	24	24	12	12	12
Chassis Power Consumption	1.2 W	1.2 W	1.2 W	1.2 W	1.0 W
Minimum GRV-EPIC-PR1 Firmware Version	1.0.0	1.0.0	1.0.0	1.0.0	1.3.0
Minimum PAC Project Version	10.0000	10.0000	10.0000	10.0000	10.2000
Minimum Library Package for CODESYS Version	1.0.0.0	1.0.0.0	1.0.0.0	1.0.0.0	1.0.0.0
Wire Size	28–14 AWG	28–14 AWG	28–14 AWG	28–14 AWG	28–14 AWG
Torque, connector screw	2.5 in-lb (0.28 N-m)	2.5 in-lb (0.28 N-m)	2.5 in-lb (0.28 N-m)	2.5 in-lb (0.28 N-m)	2.5 in-lb (0.28 N-m)
Torque, hold-down screw	3.5 in-lb (0.4 N-m)	3.5 in-lb (0.4 N-m)	3.5 in-lb (0.4 N-m)	3.5 in-lb (0.4 N-m)	3.5 in-lb (0.4 N-m)
Temperature (operating)	-20 °C to +70 °C	-20 °C to +70 °C	-20 °C to +70 °C	-20 °C to +70 °C	-20 °C to +70 °C
Temperature (storage)	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C
Relative Humidity (non-condensing)	5–95%	5–95%	5–95%	5–95%	5–95%
Agency Approvals	UL/cUL(Class 1 Div. 2); CE, ATEX(Category 3, Zone 2), RoHS; DFARS; CB Scheme				
Warranty	Lifetime	Lifetime	Lifetime	Lifetime	Lifetime

Note 1: IEC inputs have non-linear impedance. See the tables for typical V-I curves.

IEC 61131-2 Type 3 DC Input
GRV-IDCI-12



IEC 61131-2 Type 1 DC Input
GRV-IDC-24



Specifications for GRV-IDCSW-12

Specification	GRV-IDCSW-12
Open Circuit Voltage (Switch Open)	> 20 V
Channel Current Limit	2.0 mA ±25%
Channel Operating Current	0.7 mA typical
Minimum Off Resistance	50 KOhms
Maximum On Resistance	10 KOhms
Turn ON Characteristic	> 5 V
Turn OFF Characteristic	< 1.5 V
Maximum Continuous Survivable Input Voltage	32 V
Input Impedance	3.9 KOhms
Max. Freq. (50% square wave)	80 Hz
Debounce Time	> 500 microseconds
Isolation (field-to-logic)	300 V working, 1500 V transient (1 minute)
Isolation (channel-to-channel)	None
Number of Channels	12
Chassis Power Consumption	2.4 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
Relative Humidity (non-condensing)	5–95%
Agency Approvals	UL/cUL(Class 1 Div. 2); CE, ATEX(Category 3, Zone 2), RoHS; DFARS; CB Scheme
Warranty	Lifetime

GRV-IICTD-12

The **GRV-IICTD-12** module collects temperature input data from any industry-standard Integrated Circuit Temperature Device (ICTD). The module has 12 channels of input.

Features

Features	GRV-IICTD-12
Scaling	x
Offset and Gain	x
Minimum/Maximum Values	x
Average Filter Weight	x
Simple Moving Average	x
Analog Totalizing	x
Problem Indication	x

Specifications

Specification	GRV-IICTD-12
Input Range	-270.0 °C to 150 °C (-454.0 °F to 302 °F)
Input Range with ICTD Probe	-40.0 °C to 100 °C (-40.0 °F to 212 °F)
Input Range µA	3 to 425 µA
Over-range limits	-270.0 °C to 150 °C (-454.0 °F to 302 °F)
Resolution	0.005 °C (0.0072 °F)
Accuracy with ICTD PROBE	±0.8 °C (±1.4 °F)
Input Filter	-3 dB at 460 Hz
Software Data Filtering: SMA (simple moving average) Weighted filter (Original)	 1 to 32 Readings, moving average 1 to 4096 Filter Weight
Step Input Response Time	225 ms x SMA value (7.2 s @ 32 SMA, Default SMA = 4)
Data Freshness	225 ms
Analog Data Filtering	-3 dB @ 2.4 Hz / -25 dB @ 60 Hz
Common Mode Rejection	> -120 dB
Problem Indications	out of range
Isolation (field-to-logic)	300 V working, 1500 V transient (1 minute)
Isolation (channel-to-channel)	None
Number of Channels	12
Chassis Power Consumption	1.0 W
Minimum GRV-EPIC-PR1 Firmware Version	1.3.0
Minimum PAC Project Version	10.2000
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
Relative Humidity (non-condensing)	5–95%
Agency Approvals	UL/cUL(Class 1 Div. 2); CE, ATEX(Category 3, Zone 2), RoHS; DFARS; CB Scheme
Warranty	Lifetime

GRV-IMA-24, GRV-IMAI-8

- The **GRV-IMA-24** module provides 24 channels of analog current input with an input range of ±20 mA, 0–20 mA, and 4–20 mA.
- The **GRV-IMAI-8** module provides channel-to-channel isolation on its 8 channels of analog current input with an input range of 0 to 20 mA and 4 to 20 mA.

Features

Features	GRV-IMA-24	GRV-IMAI-8
Scaling	x	x
Offset and Gain	x	x
Minimum/Maximum Values	x	x
Average Filter Weight	x	x
Simple Moving Average	x	x
Analog Totalizing	x	x
Problem indication	x	x

Specifications

Specification	GRV-IMA-24	GRV-IMAI-8
Input Range (per channel)	-20 to +20 mA, 0 to 20 mA, 4 to 20 mA	0 to 20 mA, 4 to 20 mA
Over-range limits	-22 mA to +22 mA, 0.0 to 22.0mA 1.8 mA to 22.0 mA	0 mA to +22 mA, 1.8 mA to 22.0 mA
Resolution	0.02 µA (20-bits)	0.02 µA (20-bits)
Accuracy	± 0.1% (± 20 µA)	± 0.1% (± 20 µA)
Input Voltage Drop nominal (Impedance ± 20%)	5.5 V nominal @ 20 mA (275 Ohms)	5.5 V nominal @ 20 mA (275 Ohms)
Input Filter (hardware)	-3 dB at 140 Hz	-3 dB at 140 Hz
Step Input Response Time	225 ms x SMA value (7.2 s @ 32 SMA, Default SMA = 4)	11 ms x SMA value (.355 s @ 32 SMA, Default SMA = 4)
Data Refresh Time	225 ms	11 ms
Analog Data Filtering	-3 dB @ 2.4 Hz / -25 dB @ 60 Hz	-5 dB @ 60 Hz
Software Filtering: Simple Moving Average	1 to 32 readings	1 to 32 readings
Software Filtering: Weighted Average	1 to 4096	1 to 4096
Common Mode Rejection	> -120 dB	> -120 dB
Max. Survivable Input	± 32 V	± 32 V
Problem Indications	out of range	out of range
Isolation (field-to-logic)	300 V working, 1500 V transient (1 minute)	300 V working, 1500 V transient (1 minute)
Isolation (channel-to-channel)	300 V between group A (ch 0-11) & group B (ch 12-23)	300 V working, 1500 V transient (1 minute)
Number of Channels	24	8
Chassis Power Consumption	1.0 W	1.8 W externally powered loops, 4.5 W chassis powered loops
Minimum GRV-EPIC-PR1 Firmware Version	1.0.0	1.3.0
Minimum PAC Project Version	10.0000	10.2000
Wire Size	28–14 AWG	28–14 AWG
Torque, connector screw	2.5 in-lb (0.28 N-m)	2.5 in-lb (0.28 N-m)
Torque, hold-down screw	3.5 in-lb (0.4 N-m)	3.5 in-lb (0.4 N-m)
Temperature (operating)	-20 °C to +70 °C	-20 °C to +70 °C
Temperature (storage)	-40 °C to +85 °C	-40 °C to +85 °C
Relative Humidity (non-condensing)	5–95%	5–95%
Agency Approvals	UL/cUL(Class 1 Div. 2); CE, ATEX(Category 3, Zone 2), RoHS; DFARS; CB Scheme	
Warranty	Lifetime	Lifetime

GRV-ITM-12, GRV-ITMI-8

The **GRV-ITM-12** and **GRV-ITMI-8** analog modules provides channels to read input from millivolt or thermocouple field devices. Each channel is individually configurable for ±1200 mV, ±600 mV, ±300 mV, ±150 mV, ±75 mV, ±50 mV, ±25 mV or Type B, E, J, K, N, R, S, or T thermocouples.

Features

Features	GRV-ITM-12	GRV-ITMI-8
Scaling	x	x
Offset and Gain	x	x
Minimum/Maximum Values	x	x
Average Filter Weight	x	x
Simple Moving Average	x	x
Analog Totalizing	x	x
Problem indication	x	x

Specifications

Specification	GRV-ITM-12 and GRV-ITMI-8
Millivolt Input Ranges	±1200.0 mV, ±600.0 mV, ±300.0 mV, ±150.0 mV, ±75.0 mV, ±50.0 mV, ±25.0 mV
Over range limits (± 10%)	±1320.0 mV, ±660.0 mV, ±330.0 mV, ±165.0 mV, ±82.5 mV, ±55.0 mV, ±27.5 mV
Resolution	mV Range / 1,048,576 (20 bits)
Accuracy 0.1% of Range	±1200 µV, ±600 µV, ±300 µV, ±150 µV, ±75 µV, ±50 µV, ±50 µV
Thermocouple ITS90 Types	Accuracy (default) / Accuracy (calibrated) / Resolution
B: 90 °C to 1,820 °C	5.0 °C / 3.0 °C / 0.05 °C
E: -270 °C to 1,000 °C	2.0 °C / 0.5 °C / 0.05 °C
J: -210 °C to 1,200 °C	2.0 °C / 0.5 °C / 0.05 °C
K: -270 °C to 1,372 °C	2.0 °C / 0.5 °C / 0.05 °C
N: -270 °C to 1,300 °C	3.0 °C / 2.0 °C / 0.05 °C
R: -50 °C to 1,768 °C	5.0 °C / 3.0 °C / 0.05 °C
S: -50 °C to 1,768 °C	5.0 °C / 3.0 °C / 0.05 °C
T: -270 °C to 400 °C	3.0 °C / 2.0 °C / 0.05 °C

Specification	GRV-ITM-12	GRV-ITMI-8
Cold Junction Compensation	Automatic	Automatic
Data Refresh Time	1.1 s	mV Ranges = 21 ms T/C Ranges = 46 ms
Analog Data Filtering	-3 dB @ 14 Hz -25 dB @ 60 Hz	-3 dB @ 14 Hz -25 dB @ 60 Hz
Software Filtering: Simple Moving Average	1 to 32 readings	1 to 32 readings
Software Filtering: Weighted Average	1 to 4096	1 to 4096
Step Response Time (to 1%)	1.1 s	85 ms
Common Mode Rejection	> -120 dB	> -120 dB
Input Resistance	100 megohm	100 megohm
Problem Indication	out of range, open thermocouple	out of range, open thermocouple
Isolation (field-to-logic)	300 V working, 1500 V transient (1 minute)	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.	300 V working, 1500 V transient (1 minute)
Number of Channels	12	8
Chassis Power Consumption	1.3 W	1.4 W
Minimum GRV-EPIC-PR1 Firmware Version	1.4.2	1.0.0
Minimum PAC Project Version	10.2003	10.0000
Minimum Library Package for CODESYS Version	1.0.2.0	1.0.0.0
Wire Size	28–14 AWG	28–14 AWG
Torque, connector screw	2.5 in-lb (0.28 N-m)	2.5 in-lb (0.28 N-m)
Torque, hold-down screw	3.5 in-lb (0.4 N-m)	3.5 in-lb (0.4 N-m)
Temperature (operating)	-20 °C to +70 °C	-20 °C to +70 °C
Temperature (storage)	-40 °C to +85 °C	-40 °C to +85 °C
Humidity (non-condensing)	5–95% RH	5–95% RH
Agency Approvals	UL/cUL (Class 1 Div. 2); CE, ATEX (Category 3, Zone 2), RoHS; DFARS; CB Scheme	
Warranty Period	Lifetime	Lifetime

GRV-ITR-12, GRV-IRTD-8

The **GRV-ITR-12** and **GRV-IRTD-8** modules can read temperature or resistance:

- The GRV-IRTD-8 module has 8 configurable channels 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.
- The GRV-ITR-12 module has 12 configurable channels 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.

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 for GRV-ITR-12

Specifications for GRV-IRTD-8 are on the following page.

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 µA (400 K & 25 µW), (200 K & 12.4 µW), (100 K & 6.2 µW), (50 K & 3.1 µW), >84.7 µA (40 K & 287 µW), (20 K & 144 µW), (10 K & 72 µW), (5 K & 36 µW), >169.2 µA (4 K & 115 µW), (2 K & 57 µW), (1 K & 29 µW), (500 & 14 µW)
Data Refresh Rate	950 ms
Analog Data Filtering	-3 dB @ 2.4 Hz / -25 dB @ 60 Hz
Software Data Filtering: • Simple Moving Average (SMA) • Weighted Average	 • SMA (1 to 32 readings) • 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

Specifications for 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 µA (8 K & 363 µW), (4 K & 182 µW), (2 K & 91 µW), (1 K & 46 µW), >1.84 mA (800 Ohms & 1.355 mW), (400 Ohms & 677 µW), (200 Ohms & 339 µW), (100 Ohms & 169 µW), >3.96 mA (80 Ohms & 627 µW), (40 Ohms & 313 µW), (20 Ohms & 156 µW), (10 Ohms & 78 µW)
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.

GRV-IV-24, GRV-IVI-12, GRV-IVIRMS-10

The **GRV-IV-24** and **GRV-IVI-12** modules can be configured for any one of the following input ranges on each of their input channels.

±160.0 VDC	±40.0 VDC	±10.0 VDC	±2.5 VDC
±80.0 VDC	±20.0 VDC	±5.0 VDC	±1.25 VDC

A couple of differences to note:

- The **GRV-IV-24** module offers 24 channels; the **GRV-IVI-12** offers 12 channels
- The **GRV-IV-24** module does not offer channel-to-channel isolation; the **GRV-IVI-12** module does offer channel-to-channel isolation.

The **GRV-IVIRMS-10** module provides 10 isolated channels of analog input reading 0-300 V of true RMS AC or DC.

For more details about other differences, see the features and specification tables.

Features

Features	GRV-IV-24	GRV-IVI-12	GRV-IVIRMS-10
Scaling	x	x	x
Offset and Gain	x	x	x
Minimum/Maximum Values	x	x	x
Average Filter Weight	x	x	x
Simple Moving Average	x	x	x
Analog Totalizing	x	x	x
Problem Indication	x	x	x

Specifications

Specification	GRV-IV-24	GRV-IVI-12	GRV-IVIRMS-10
Input Ranges	±160.0 VDC ±80.0 VDC ±40.0 VDC ±20.0 VDC ±10.0 VDC ±5.0 VDC ±2.5 VDC ±1.25 VDC	±160.0 VDC ±80.0 VDC ±40.0 VDC ±20.0 VDC ±10.0 VDC ±5.0 VDC ±2.5 VDC ±1.25 VDC	300.0 V_{rms} AC/DC 150.0 V_{rms} AC/DC 60.0 V_{rms} AC/DC 30.0 V_{rms} AC/DC 20.0 V_{rms} AC/DC 10.0 V_{rms} AC/DC 5.0 V_{rms} AC/DC 1.0 V_{rms} AC/DC 0.5 V_{rms} AC/DC
Over-range limits	±176.0 VDC ±88.0 VDC ±44.0 VDC ±22.0 VDC ±11.0 VDC ±5.5 VDC ±2.75 VDC ±1.375 VDC	±176.0 VDC ±88.0 VDC ±44.0 VDC ±22.0 VDC ±11.0 VDC ±5.5 VDC ±2.75 VDC ±1.375 VDC	333.0 V_{rms} AC/DC 165.0 V_{rms} AC/DC 66.0 V_{rms} AC/DC 33.0 V_{rms} AC/DC 22.0 V_{rms} AC/DC 11.0 V_{rms} AC/DC 5.5 V_{rms} AC/DC 1.1 V_{rms} AC/DC 0.55 V_{rms} AC/DC
Resolution	Range / 1,048,576 (20-bits)	Range / 1,048,576 (20-bits)	Range / 1,048,576 (20-bits)
Accuracy 0.1% of Range	±160 mV ±80 mV ±40 mV ±20 mV ±10 mV ±5 mV ±2.5 mV ±1.25 mV	±160 mV ±80 mV ±40 mV ±20 mV ±10 mV ±5 mV ±2.5 mV ±1.25 mV	N/A
Accuracy @ 50-60 Hz	N/A	N/A	±200 mV and ±0.2% of reading
Accuracy @ 60-400 Hz	N/A	N/A	±200 mV and ±0.3% of reading
Input Impedance Nominal	9.7 megohms	9.7 megohms	9.5 megohms
Input Filter	-3 dB at 46 HZ	-3 dB at 46 HZ	N/A
DC Reversal	N/A	N/A	1% of Range
Software Data Filtering: • Simple Moving Average (SMA) • Weighted Average	 • 1 to 32 readings • 1 to 4096	 • 1 to 32 readings • 1 to 4096	 • 1 to 32 readings • 1 to 4096
Step Input Response Time	225 ms x SMA value (i.e. when SMA = 32, time is 7.2 s) Default SMA: 4	16.5 ms x SMA value (i.e. when SMA = 32, time is 0.53 s) Default SMA: 4	• 0 to 100%: 250 ms x SMA value (i.e. when SMA = 4, time is 1 s) • 100 to 0%: 1,100 ms x SMA value (i.e. when SMA = 4, time is 4.4 s)
Data Refresh Time	225 ms	15.5 ms	50 ms
Analog Data Filtering	-3 dB @ 2.4 Hz -25 dB @ 60 Hz	-3 dB @ 46 Hz -5 dB @ 60 Hz	N/A
Common Mode Rejection	> -120 dB	> -120 dB	> -120 dB
Max. Survivable Input	300 V	300 V	330 V
Max. Operating Common Mode Voltage	250 V	250 V	300 V
Problem Indications	out of range	out of range	out of range
Isolation (field-to-logic)	300 V working, 1500 V transient (1 minute)	300 V working, 1500 V transient (1 minute)	300 V working, 1500 V transient (1 minute)
Isolation (channel-to-channel)	300 V between channel group 0-11 & group 12-23	300 V working, 1500 V transient (1 minute)	300V working, 1500 V transient
Number of Channels	24	12	10
Chassis Power Consumption	1.0 W	2.2 W	1.5 W
Minimum GRV-EPIC-PR1 Firmware Version	1.0.0	1.4.2	1.5.0
Minimum PAC Project Version	10.0000	10.2003	10.2005
Minimum Library Package for CODESYS Version	1.0.0.0	1.0.2.0	1.0.3.0
Wire Size	28–14 AWG	28–14 AWG	28–14 AWG

Specification	GRV-IV-24	GRV-IVI-12	GRV-IVIRMS-10
Torque, connector screw	2.5 in-lb (0.28 N-m)	2.5 in-lb (0.28 N-m)	2.5 in-lb (0.28 N-m)
Torque, hold-down screw	3.5 in-lb (0.4 N-m)	3.5 in-lb (0.4 N-m)	3.5 in-lb (0.4 N-m)
Temperature (operating)	-20 °C to +70 °C	-20 °C to +70 °C	-20 °C to +70 °C
Temperature (storage)	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C
Relative Humidity (non-condensing)	5–95%	5–95%	5–95%
Agency Approvals	UL/cUL(Class 1 Div. 2); CE, ATEX(Category 3, Zone 2), RoHS; DFARS; CB Scheme		
Warranty	Lifetime	Lifetime	Lifetime

GRV-OAC-12, GRV-OACI-12, GRV-OACS-12, GRV-OACIS-12

groov 12–250 VAC output modules are used to switch up to 12 separate AC loads. They provide 300 volts of transient protection for sensitive control electronics from industrial field signals. Output modules that are fused use a standard fuse for easy replacement. AC outputs are zero voltage turn on and zero current turn off to minimize transients during switching.

Choose the module you need based on your requirements:

Module	Channel-to-Channel Isolation	On/Off Only
GRV-OAC-12		
GRV-OACI-12	x	
GRV-OACS-12		x
GRV-OACIS-12	x	x

- The **GRV-OACI-12** and **GRV-OACIS-12** modules offer channel-to-channel isolation (sometimes called galvanic isolation). The 12 channels in these modules do not share any field signal connection inside the module.
- The **GRV-OACS-12** and **GRV-OACIS-12** modules switch output on or off only, offering a lower cost option for projects with simple requirements.

Specifications

Specification	GRV-OACI-12	GRV-OACIS-12	GRV-OAC-12	GRV-OACS-12
Line Voltage	12–250 VAC	12–250 VAC	12–250 VAC	12–250 VAC
Current Rating (per channel)	0.5 A	0.5 A	0.5 A	0.5 A
Recommended Max. Fuse (fast) or Circuit Breaker	2 A 250 VAC / channel, 6 A 250 VAC common	2 A 250 VAC / channel, 6 A 250 VAC common	2 A 250 VAC / channel, 6 A 250 VAC common	2 A 250 VAC / channel, 6 A 250 VAC common
Minimum Load Current	20 mA	20 mA	20 mA	20 mA
Output Voltage Drop	1 V	1 V	1 V	1 V
Off-state Leakage at Nominal Voltage - 60 Hz	1.25 mA @240 VAC 0.7 mA @120 VAC	1.25 mA @240 VAC 0.7 mA @120 VAC	1.25 mA @240 VAC 0.7 mA @120 VAC	1.25 mA @240 VAC 0.7 mA @120 VAC
Peak Blocking Voltage	500 V	500 V	500 V	500 V
Leakage (mA @ 240 V, 60 Hz)	1.0	1.0	1.0	1.0
Operating Frequency	40 to 60 Hz, 400 Hz	40 to 60 Hz, 400 Hz	40 to 60 Hz, 400 Hz	40 to 60 Hz, 400 Hz
Turn-on Time	≤ 1/2 cycle (zero cross-ing)	≤ 1/2 cycle (zero cross-ing)	≤ 1/2 cycle (zero cross-ing)	≤ 1/2 cycle (zero cross-ing)
Turn-off Time	≤ 1/2 cycle (zero cross-ing)	≤ 1/2 cycle (zero cross-ing)	≤ 1/2 cycle (zero cross-ing)	≤ 1/2 cycle (zero cross-ing)
Problem Indication	open circuit	none	open circuit	none
Isolation (field-to-logic)	300 V working, 1500 V transient (1 minute)	300 V working, 1500 V transient (1 minute)	300 V working, 1500 V transient (1 minute)	300 V working, 1500 V transient (1 minute)
Isolation (channel-to-channel)	300 V working	300 V working	NONE	NONE
Number of Channels	12	12	12	12
Chassis Power Consumption	1.3 W	1.3 W	1.3 W	1.3 W
Wire Size	28–14 AWG	28–14 AWG	28–14 AWG	28–14 AWG
Torque, connector screw	2.5 in-lb (0.28 N-m)	2.5 in-lb (0.28 N-m)	2.5 in-lb (0.28 N-m)	2.5 in-lb (0.28 N-m)
Torque, hold-down screw	3.5 in-lb (0.4 N-m)	3.5 in-lb (0.4 N-m)	3.5 in-lb (0.4 N-m)	3.5 in-lb (0.4 N-m)
Temperature (operating)	-20 °C to +70 °C	-20 °C to +70 °C	-20 °C to +70 °C	-20 °C to +70 °C
Temperature (storage)	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C	-40 °C to +85 °C
Relative Humidity (non-condensing)	5–95%	5–95%	5–95%	5–95%
Agency Approvals	UL/cUL(Class 1 Div. 2); CE, ATEX(Category 3, Zone 2), RoHS; DFARS; CB Scheme			
Warranty	Lifetime	Lifetime	Lifetime	Lifetime

GRV-ODCI-12, GRV-ODCIS-12

groov DC output modules provide 12 isolated channels of 5–60 VDC output, each switching a separate DC load. The module features channel-specific LEDs for troubleshooting.

- The **GRV-ODCI-12** includes a full set of features.
- The **GRV-ODCIS-12** switches output on or off only, offering a lower cost option for projects with simple requirements.

Features

Feature	GRV-ODCI-12	GRV-ODCIS-12
Number of channels	12	12
Channel-to-channel isolation	x	x
On/off state	x	x
On/off totalization	x	
Output pulsing	x	
Watchdog Timeout Value	x	x

Specifications

Specification	GRV-ODCI-12	GRV-ODCIS-12
Line Voltage Range (nominal)	5–48 VDC	5–48 VDC
Line Voltage Range (max)	5–60 VDC	5–60 VDC
Current Rating	400 mA per channel or 4.8 A per module (70°C)	400 mA per channel or 4.8 A per module (70°C)
Surge Current	5 A peak for 1 second	5 A peak for 1 second
Recommended Max. Fuse (fast) or Circuit Breaker	3 A 60 VDC / channel, 6 A 60 VDC / module	3 A 60 VDC / channel, 6 A 60 VDC / module
Minimum Load	20 mA	20 mA
Output Voltage Drop	1.2 V max.	1.2 V max.
Off-State Leakage	1 mA at 60 V	1 mA at 60 V
Peak Blocking Voltage	60 V	60 V
TPO Period (min, max, resolution)	0.005 seconds, 429496.72 seconds, 0.001 seconds	N/A
Turn on/ Turn off Time	2.5 ms	
Isolation (field-to-logic)	300 V working, 1500 V transient (1 minute)	300 V working, 1500 V transient (1 minute)
Isolation (channel-to-channel)	300 V working, 1500 V transient (1 minute)	300 V working, 1500 V transient (1 minute)
Number of Channels	12	12
Chassis Power Consumption	1.2 W	1.2 W
Minimum GRV-EPIC-PR1 Firmware Version	1.0.0	1.0.0
Minimum PAC Project Version	10.0000	10.0000
Minimum Library Package for CODESYS Version	1.0.0.0	1.0.0.0
Wire Size	28–14 AWG	28–14 AWG
Torque, connector screw	2.5 in-lb (0.28 N-m)	2.5 in-lb (0.28 N-m)
Torque, hold-down screw	3.5 in-lb (0.4 N-m)	3.5 in-lb (0.4 N-m)
Temperature (operating)	-20 °C to +70 °C	-20 °C to +70 °C
Temperature (storage)	-40 °C to +85 °C	-40 °C to +85 °C
Relative Humidity (non-condensing)	5–95%	5–95%
Agency Approvals	UL/cUL(Class 1 Div. 2); CE, ATEX(Category 3, Zone 2), RoHS; DFARS; CB Scheme	
Warranty	Lifetime	Lifetime

GRV-ODCSRC-24

The **GRV-ODCSRC-24** DC output module (source current to loads) provides 24 DC output channels in one *groov* module. The module can switch 5–60 VDC loads.

Specification	GRV-ODCSRC-24
Line Voltage Range (nominal)	12–24 VDC
Line Voltage Range (max)	5–60 VDC
Current Rating (per channel)	0.4 A
Surge Current	1.5 A for 1.0 Second
Recommended Max. Fuse (fast) / Circuit Breaker	2 A, 60 VDC / channel or 20 A, 60 VDC common
Minimum Load	5.0 mA
Output Voltage Drop	0.3 V max. at 0.4 A
Off-State Leakage (per channel)	<10 µA (@ 60 V, 70 °C)
Peak Blocking Voltage	60 VDC
Isolation (field-to-logic)	300 V working, 1500 V transient
Isolation (channel-to-channel)	None
Number of Channels	24
Chassis Power Consumption	1.2 W
Minimum GRV-EPIC-PR1 Firmware Version	1.0.0
Minimum PAC Project Version	10.0000
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
Relative Humidity (non-condensing)	5–95%
Agency Approvals	UL/cUL(Class 1 Div. 2); CE, ATEX(Category 3, Zone 2), RoHS; DFARS; CB Scheme
Warranty	Lifetime

GRV-OMRIS-8

groov mechanical relay output modules offer 8 channels for switching loads of up to 5 amps at 250 VAC or 30 VDC.

These are form C relays, so each of the 8 mechanical relays can be wired as normally open or normally closed. Fusing is not provided; you must provide fusing when wiring the module.

groov mechanical power relay output modules provide channel-to-channel isolation. These modules can mechanically switch either AC or DC loads, potentially reducing the number of modules needed.

Additionally, *groov* mechanical power relay output modules offer little or no leakage current when the contacts are open. These modules are suitable for piloting electronic coil contactors.

Note: These modules may not be suitable for low-level switching.

Note: Transient protection is recommended for inductive loads. For DC loads, install a reverse-biased diode, such as an 1N4005 (or equivalent) across the load.

Specification	GRV-OMRIS-8
Line Voltage Range (nominal)	0–250 VAC or 5–30 VDC
Current Rating	5 A per channel
Surge Current	6 A peak for 1 second
Recommended Fuse / Circuit Breaker	5 A at 250 VAC / > 30 VDC per channel
Leakage Current	< 2 µA @ 250 VAC
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
Transient Clamp Holding Voltage	440 V
Transient Clamping Voltage (max.)	720 V
Isolation (coil-to-contact)	4000 VAC_{rms} 1 min., 10 mA detect / channel
Isolation (channel-to-channel)	300 VAC operating, 1500 V_{rms} max.
Number of Channels	8
Chassis Power Consumption	1.4 W
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
Shock (misoperation)	5 G
Shock (survival)	100 G
Relative Humidity (non-condensing)	5–95%
Agency Approvals	UL/cUL (Class 1 Div. 2); CE, ATEX (Category 3, Zone 2), RoHS; DFARS; CB Scheme
Warranty	30 months

GRV-OVMAILP-8, GRV-OVMALC-8

The **GRV-OVMAILP-8** is an analog output module with 8 channels, individually configurable for any one of five voltage or current output ranges. The module provides channel-to-channel isolation. Each range has 4096 counts (12 bits) of resolution. The GRV-OVMAILP-8 can power current loops from an internal isolated loop supply powered from the chassis or, on a channel-by-channel basis, from an externally connected loop supply of 22-32 VDC.

The **GRV-OVMALC-8** is an analog output module with 8 channels, individually configurable for any one of seven voltage or current output ranges. Each range has 4096 counts (12 bits) of resolution.

For mA outputs, the GRV-OVMALC-8 contains an isolated loop supply. Because all current is sourced from within the module, outputs are self-sourcing and cannot be used with an external loop supply, loops that are loop-powered, or have a self-sourcing device in the loop.

Each channel is individually current or voltage limited and not affected by opens or shorts on adjacent channels. Connect both field wires to the specific terminals for each channel, so that a change in output on one channel will not affect another channel.

All negative output terminals on the module are tied together internally. To prevent ground loops, drive only loads with isolated inputs or loads that share a common ground.

Features

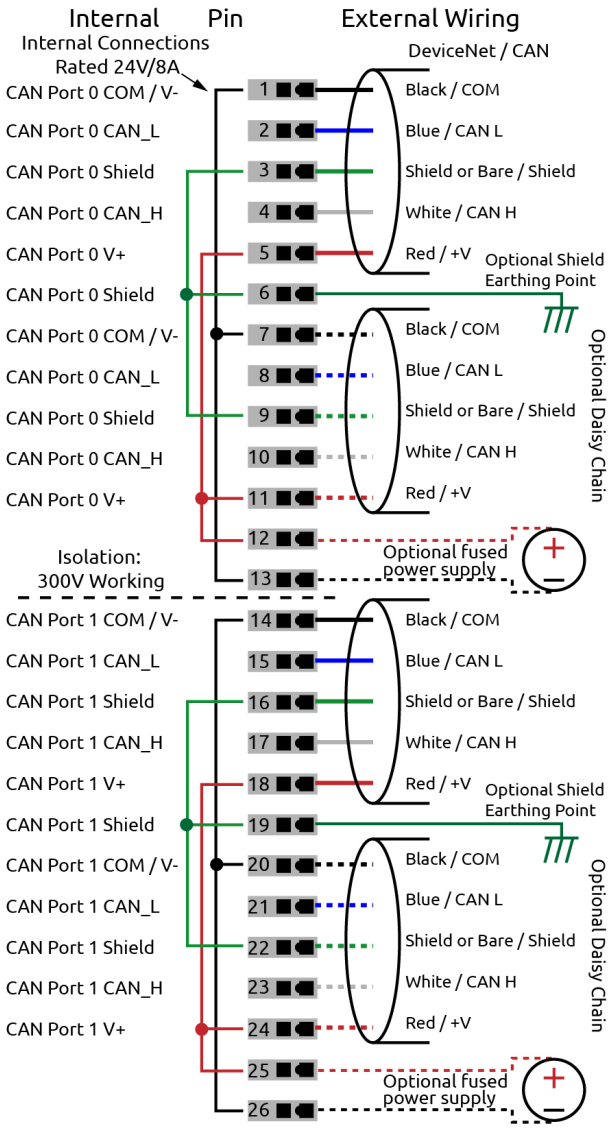
Features	GRV-OVMALC-8	GRV-OVMAILP-8
Channel-to-Channel Isolation		x
Watchdog Timeout Value	x	x
Scaling	x	x
Ramping	x	x
Clamping	x	x
Problem Indication	x	x

Specifications

Specification	GRV-OVMALC-8		GRV-OVMAILP-8	
Output Ranges (Resolution)	**Voltage** 0 to 5 VDC (1.22 mV) 0 to 10 VDC (2.44 mV) -5 to +5 VDC (2.44 mV) -10 to +10 VDC (4.88 mV)	**Current** 4 to 20 mA (4 µA) 0 to 20 mA (5 µA) 0 to 22 mA (6 µA)	**Voltage** 0 to 5 VDC (1.22 mV) 0 to 10 VDC (2.44 mV)	**Current** 4 to 20 mA (4 µA) 0 to 20 mA (5 µA) 0 to 24 mA (6 µA)
Resolution	Range / 4096 (12-bits)		Range / 4096 (12-bits)	
Accuracy	± 0.1% of span		± 0.1% of span	
Max Current for Voltage Output	10 mA		10 mA	
Output impedance	280 Ohms		280 Ohms	
External current loop power	N/A, internal loop power only		20-32 VDC, (under 20 VDC switches to internal loop power)	
Maximum loop resistance	750 Ohms		500 Ohms @ 20 mA, 400 Ohms @ 24 mA	
Minimum loop resistance	50 Ohms		50 Ohms	
Data Refresh Time	10 ms		10 ms	
Problem Indication	Current outputs: Open circuit Voltage outputs: Over-current		Current outputs: Open circuit Voltage outputs: Over-current	
Isolation (field-to-logic)	300 V working, 1500 V transient (1 minute)		300 V working, 1500 V transient (1 minute)	
Isolation (channel-to-channel)	None		300 V working, 1500V transient (1 minute)	
Number of Channels	8		8	
Chassis Power Consumption	1.8 W all voltage outputs 6.2 W all current outputs		1.8 W all voltage outputs 6 W all current outputs-chassis powered loops	
Minimum GRV-EPIC-PR1 Firmware Version	1.0.0		1.3.0	
Minimum PAC Project Version	10.0000		10.2000	
Wire Size	28–14 AWG		28–14 AWG	
Torque, connector screw	2.5 in-lb (0.28 N-m)		2.5 in-lb (0.28 N-m)	
Torque, hold-down screw	3.5 in-lb (0.4 N-m)		3.5 in-lb (0.4 N-m)	
Temperature (operating)	-20 °C to +70 °C		-20 °C to +70 °C	
Temperature (storage)	-40 °C to +85 °C		-40 °C to +85 °C	
Relative Humidity (non-condensing)	5–95%		5–95%	
Agency Approvals	UL/cUL(Class 1 Div. 2); CE, ATEX(Category 3, Zone 2), RoHS; DFARS; CB Scheme			
Warranty	Lifetime		Lifetime	

E: I/O Module Wiring Diagrams

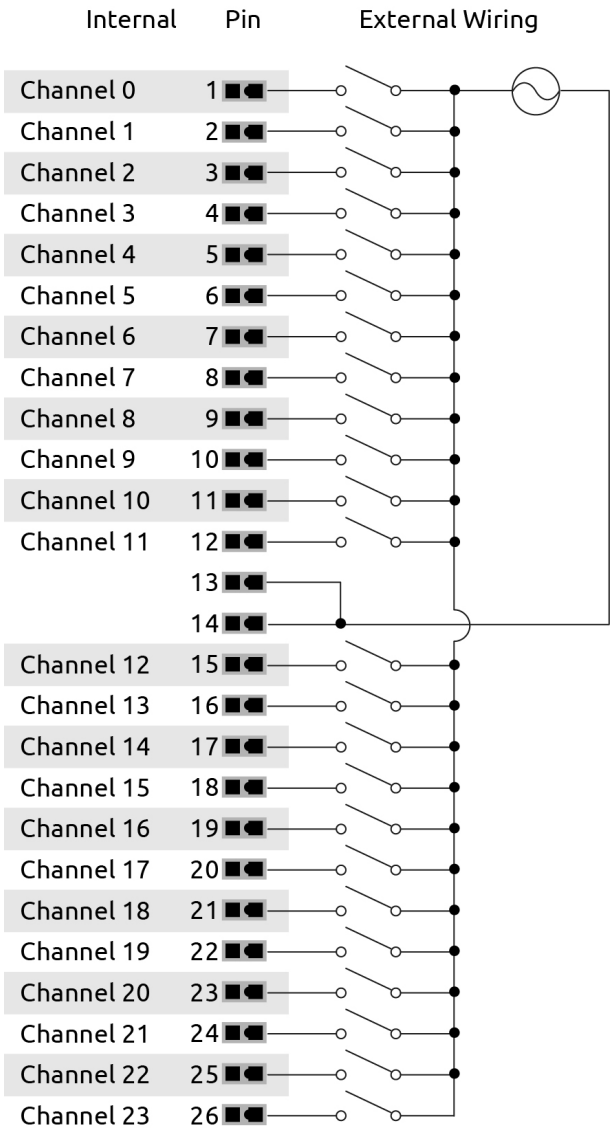
GRV-CCANI-2 PINOUT AND WIRING DIAGRAM



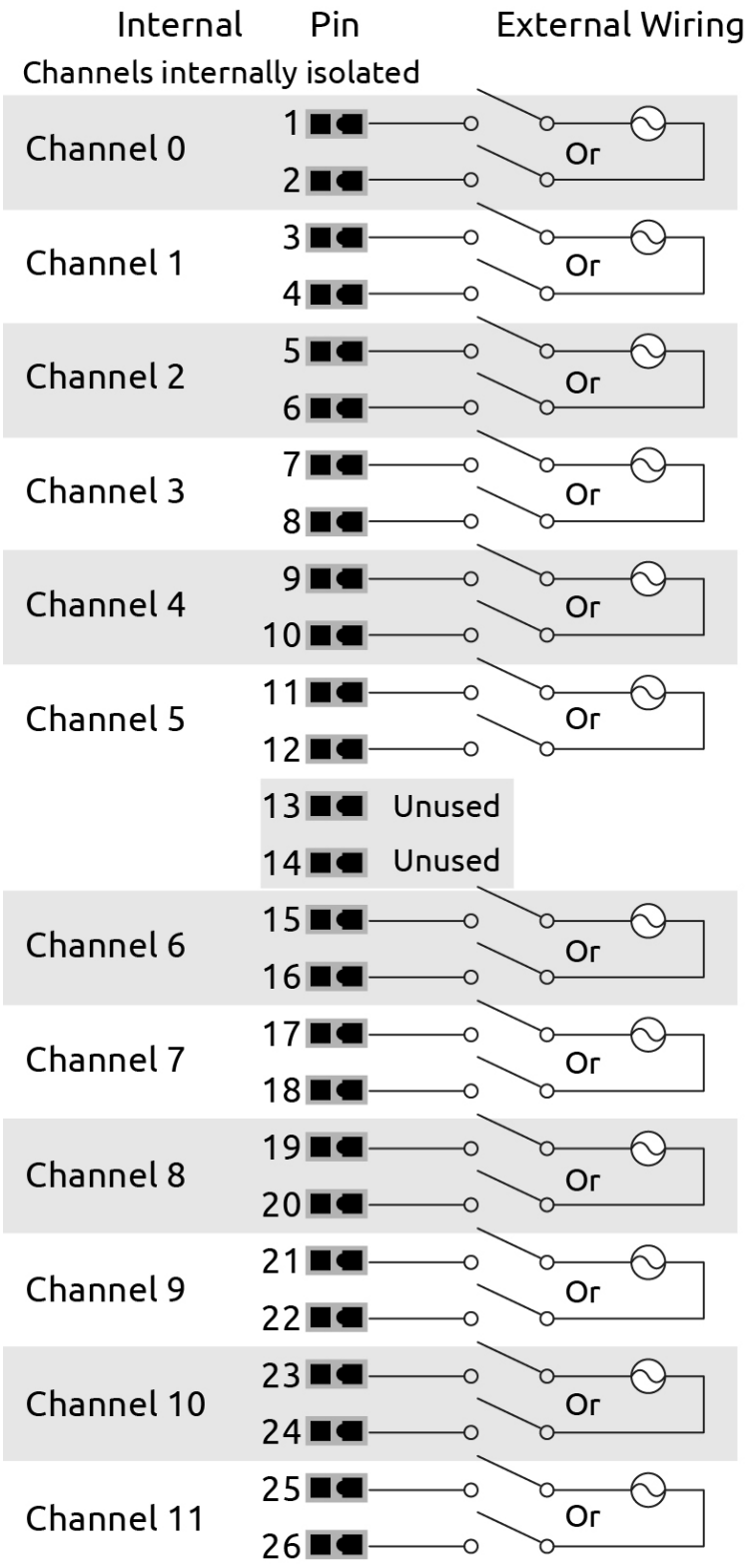
GRV-CSERI-4 PINOUT AND WIRING DIAGRAM

Internal	Pin	External Wiring		
		RS 485 full duplex	RS 485 half duplex	RS 232
Channel 0	1	Tx+	Tx+/Rx+	TxD
	2	Tx-	Tx-/Rx-	RTS
	3	COM	COM	COM
	4	Rx+	Unused	RxD
	5	Rx–	Unused	CTS
	6	Unused	Unused	DTR
	7	Unused	Unused	DSR
	8	Unused	Unused	DCD
	9	Unused	Unused	RI
	10	COM	COM	COM
	11	Unused	Unused	Unused
Channel 1	12	Tx+	Tx+/Rx+	TxD
	13	Tx-	Tx-/Rx-	RTS
	14	COM	COM	COM
	15	Rx+	Unused	RxD
	16	Rx–	Unused	CTS
Channel 2	17	Tx+	Tx+/Rx+	TxD
	18	Tx-	Tx-/Rx-	RTS
	19	COM	COM	COM
	20	Rx+	Unused	RxD
	21	Rx–	Unused	CTS
Channel 3	22	Tx+	Tx+/Rx+	TxD
	23	Tx-	Tx-/Rx-	RTS
	24	COM	COM	COM
	25	Rx+	Unused	RxD
	26	Rx–	Unused	CTS

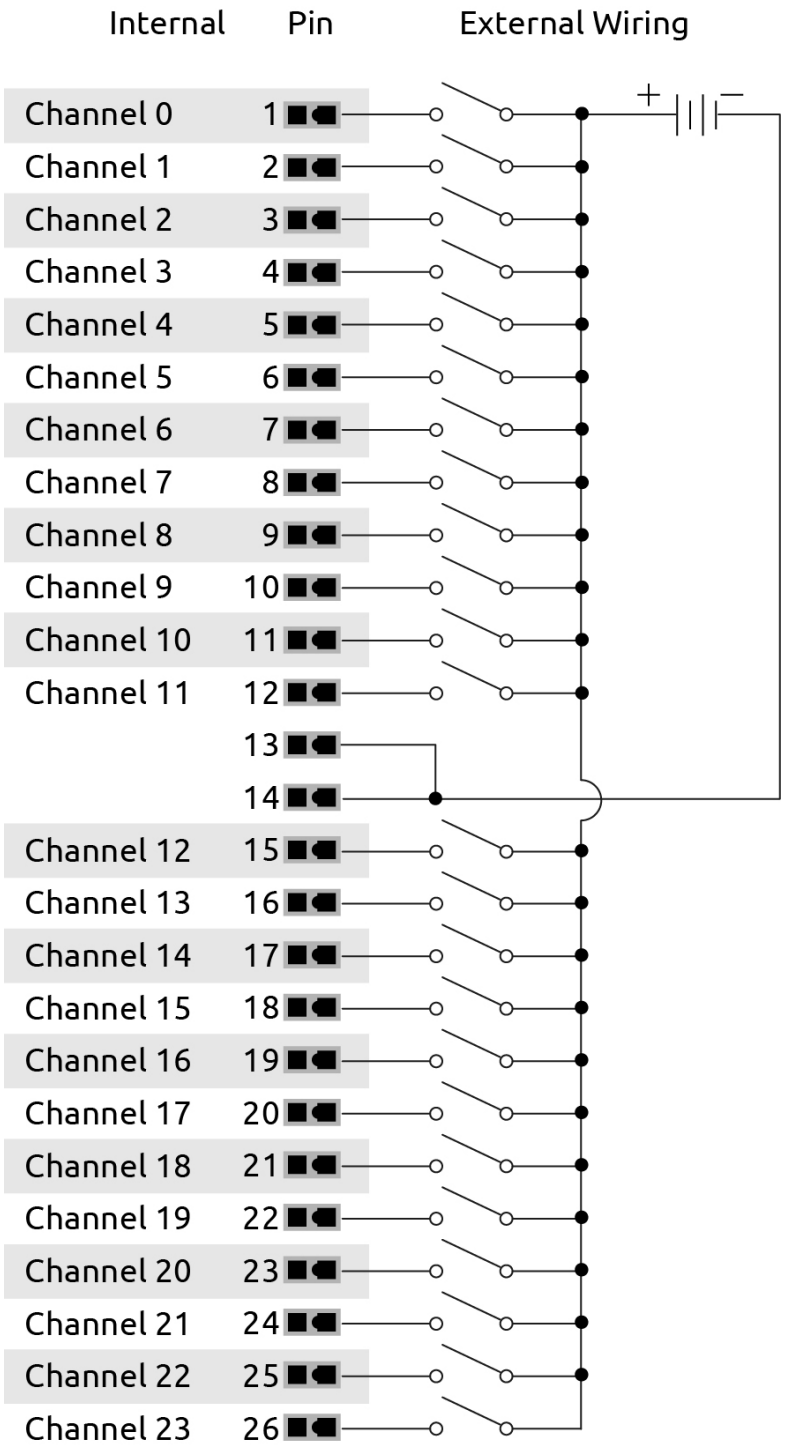
GRV-IAC-24, GRV-IACS-24 PINOUT AND WIRING DIAGRAM



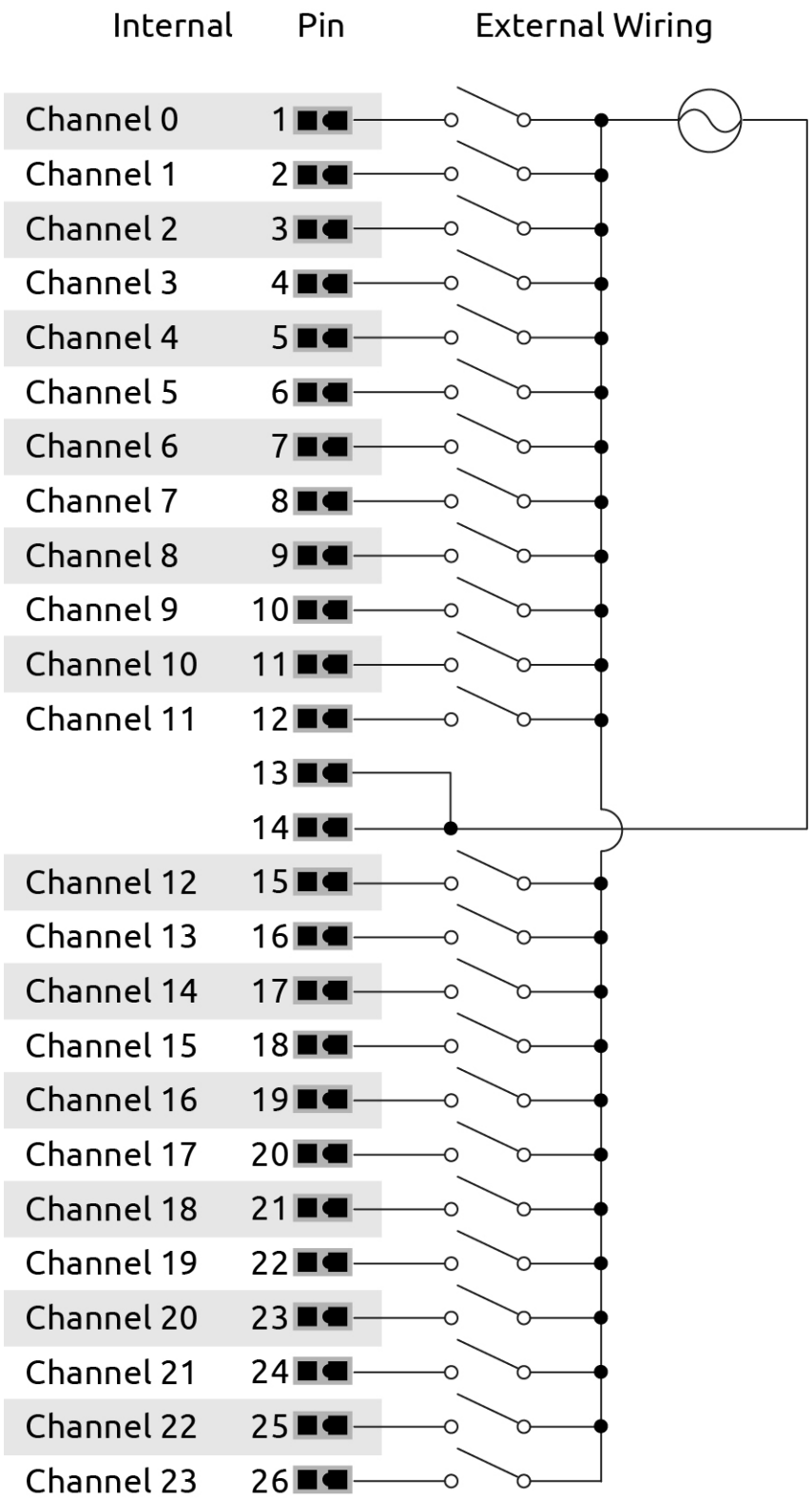
GRV-IACI-12, GRV-IACIS-12 PINOUT AND WIRING DIAGRAM



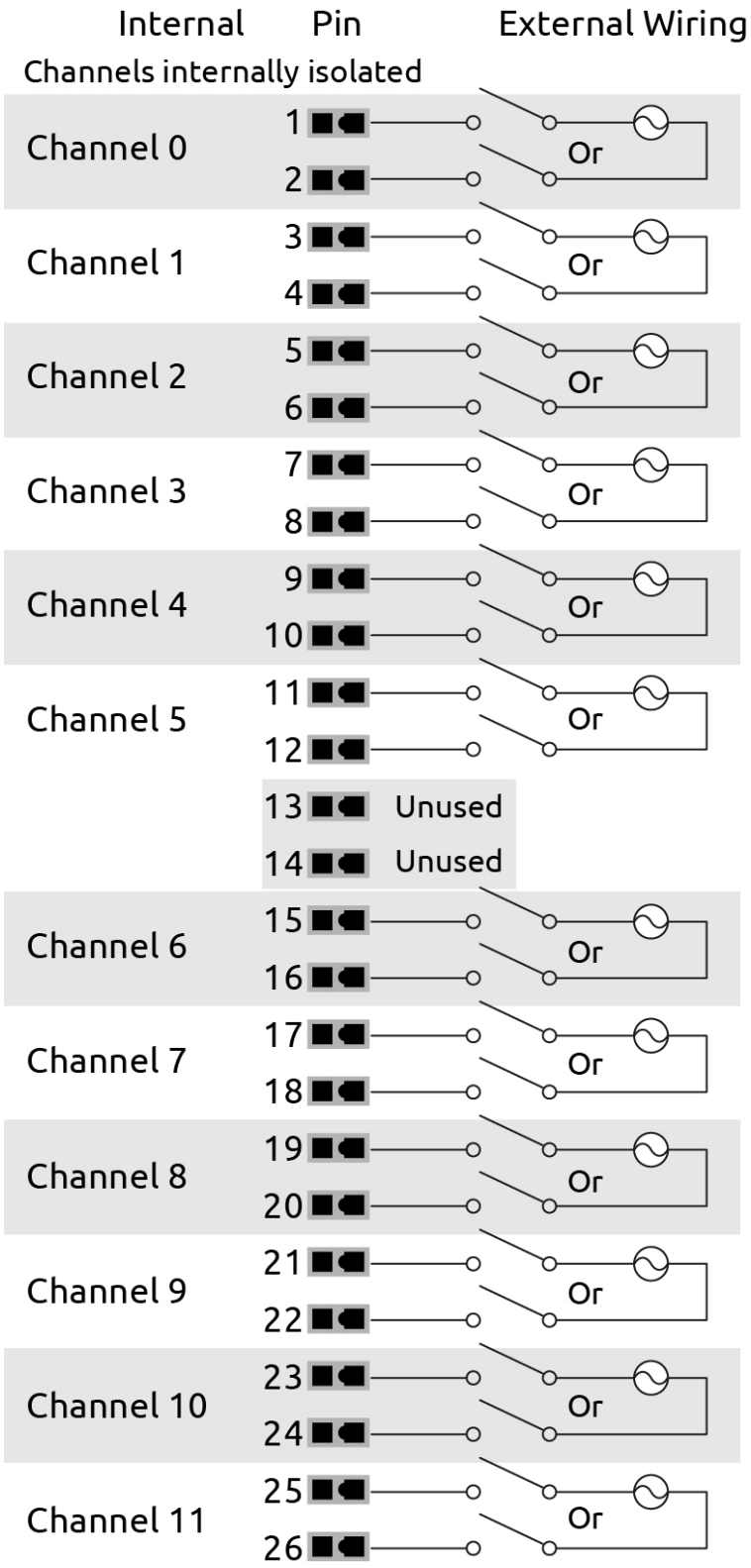
GRV-IACDCTTL-24, GRV-IACDCTTLS-24 PINOUT AND WIRING DIAGRAM



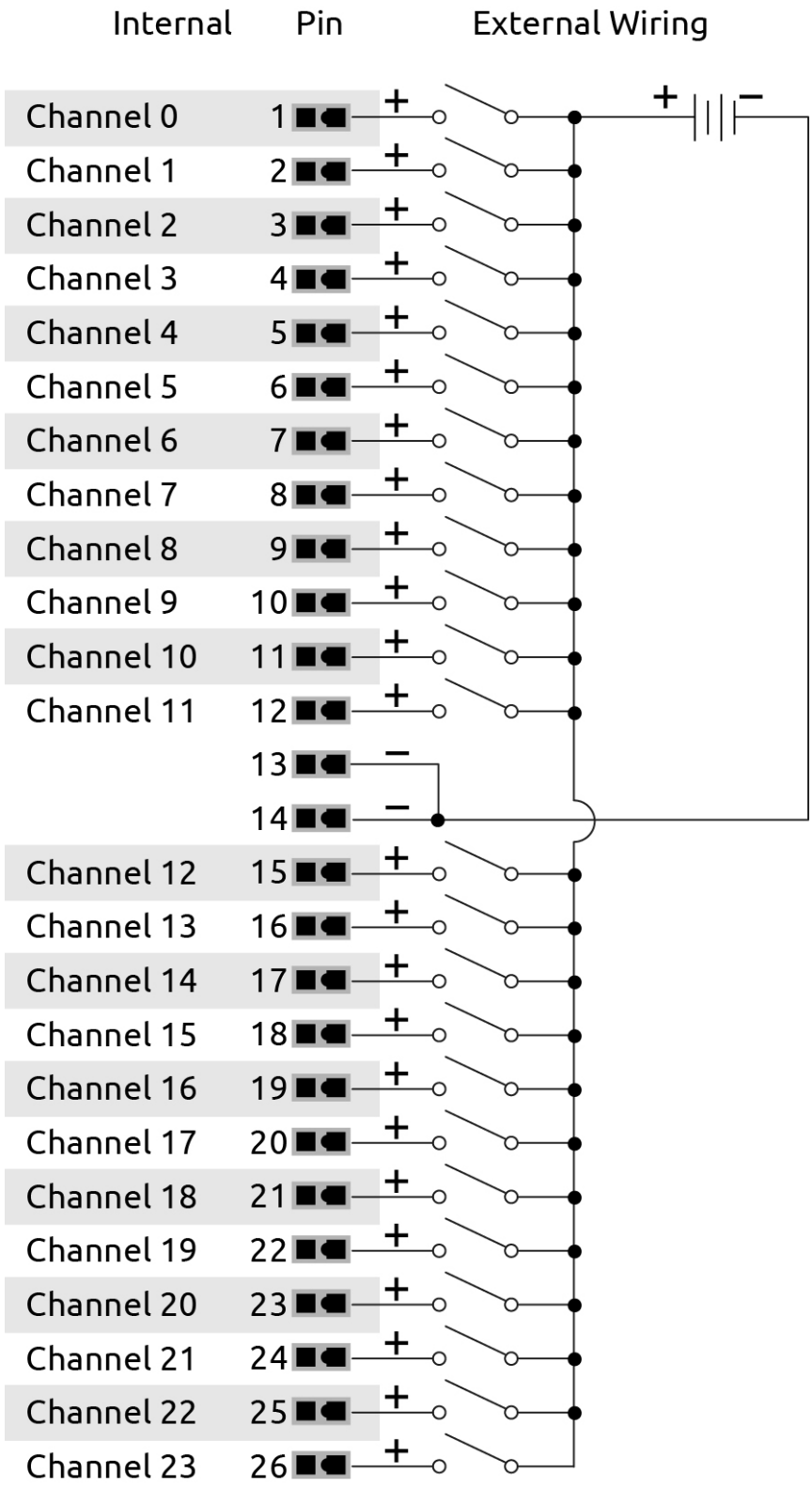
GRV-IACHV-24, GRV-IACHVS-24 PINOUT AND WIRING DIAGRAM



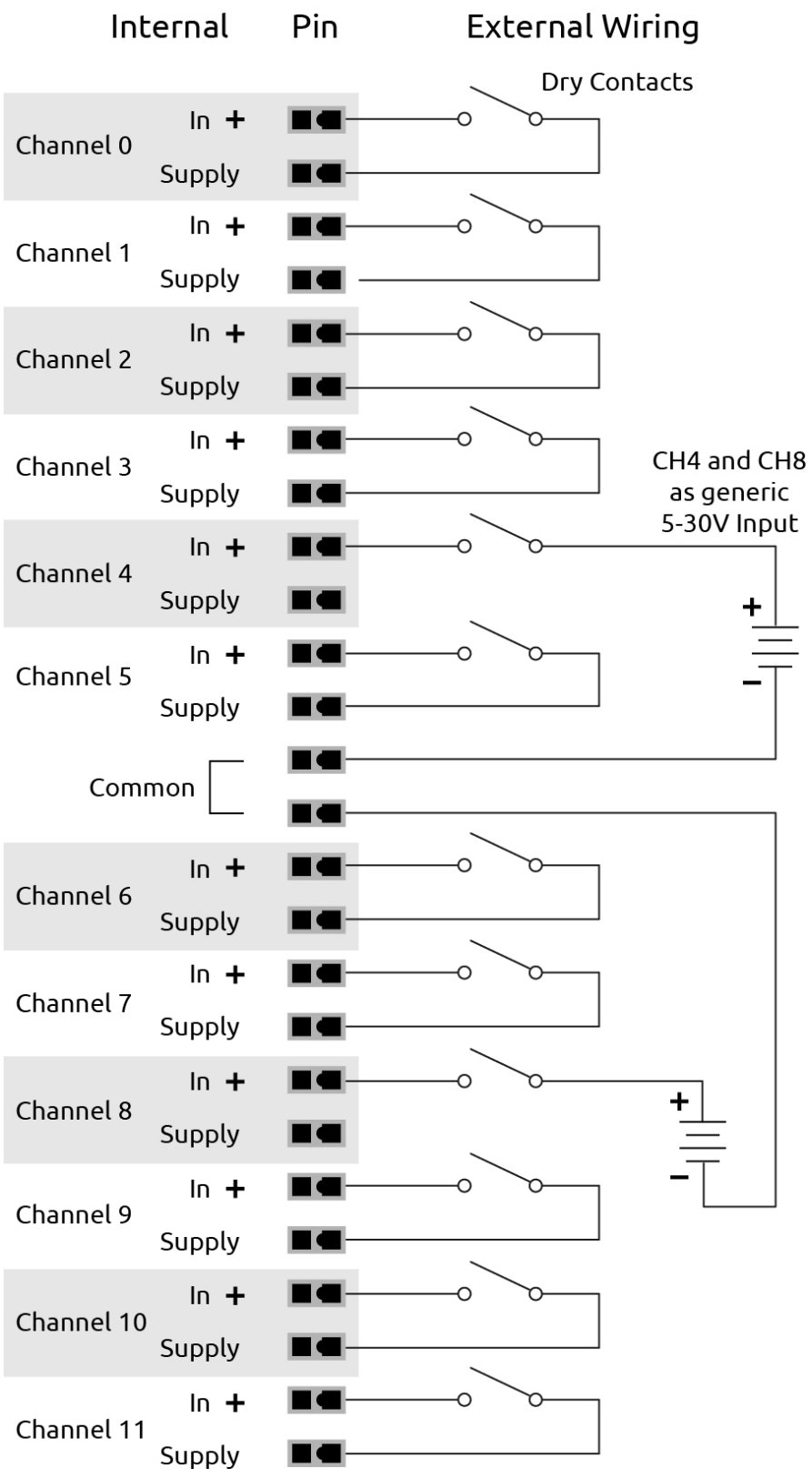
GRV-IACIHV-12, GRV-IACIHVS-12 PINOUT AND WIRING DIAGRAM



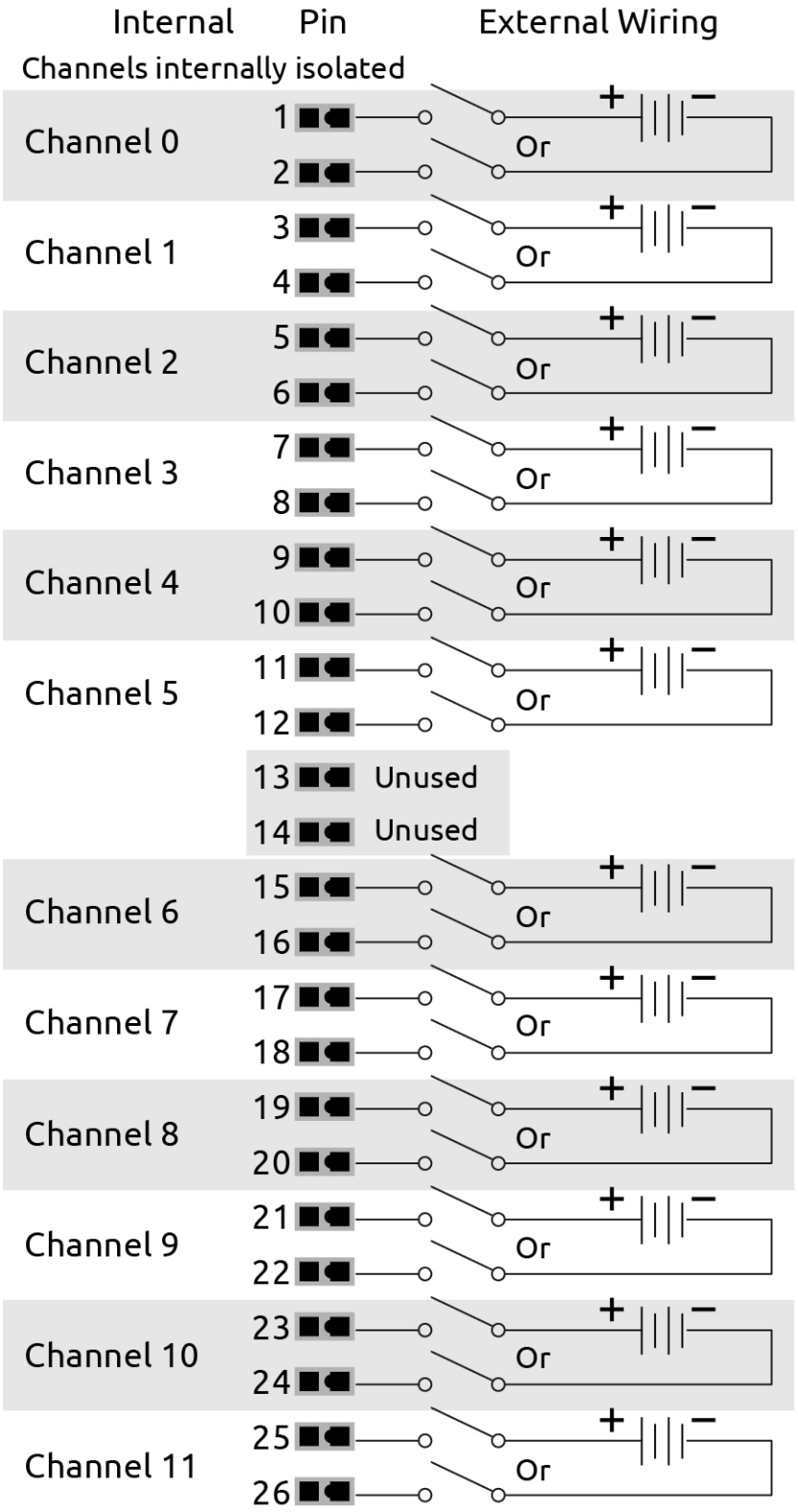
GRV-IDC-24, GRV-IDCS-24 PINOUT AND WIRING DIAGRAM



GRV-IDCSW-12 PINOUT AND WIRING DIAGRAM

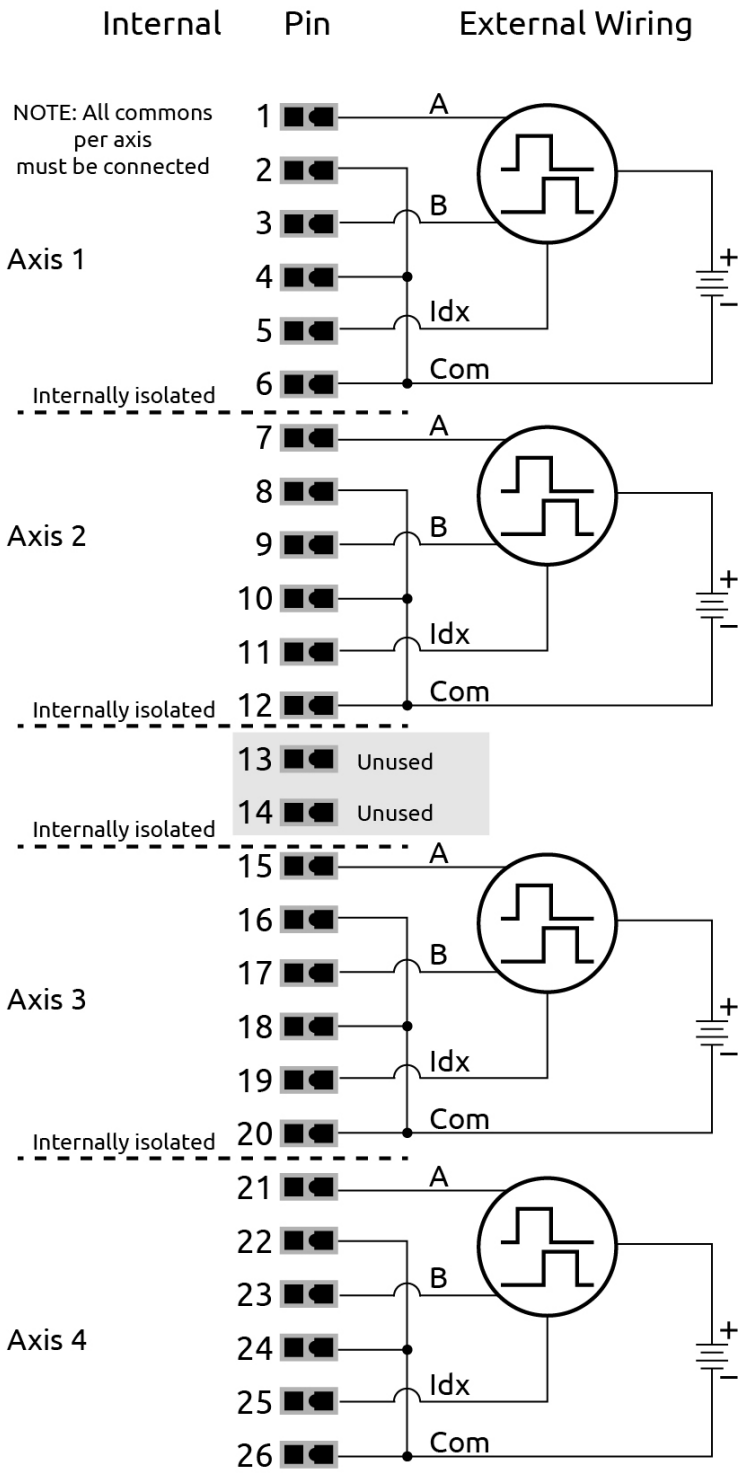


GRV-IDCI-12, GRV-IDCIS-12 PINOUT AND WIRING DIAGRAM

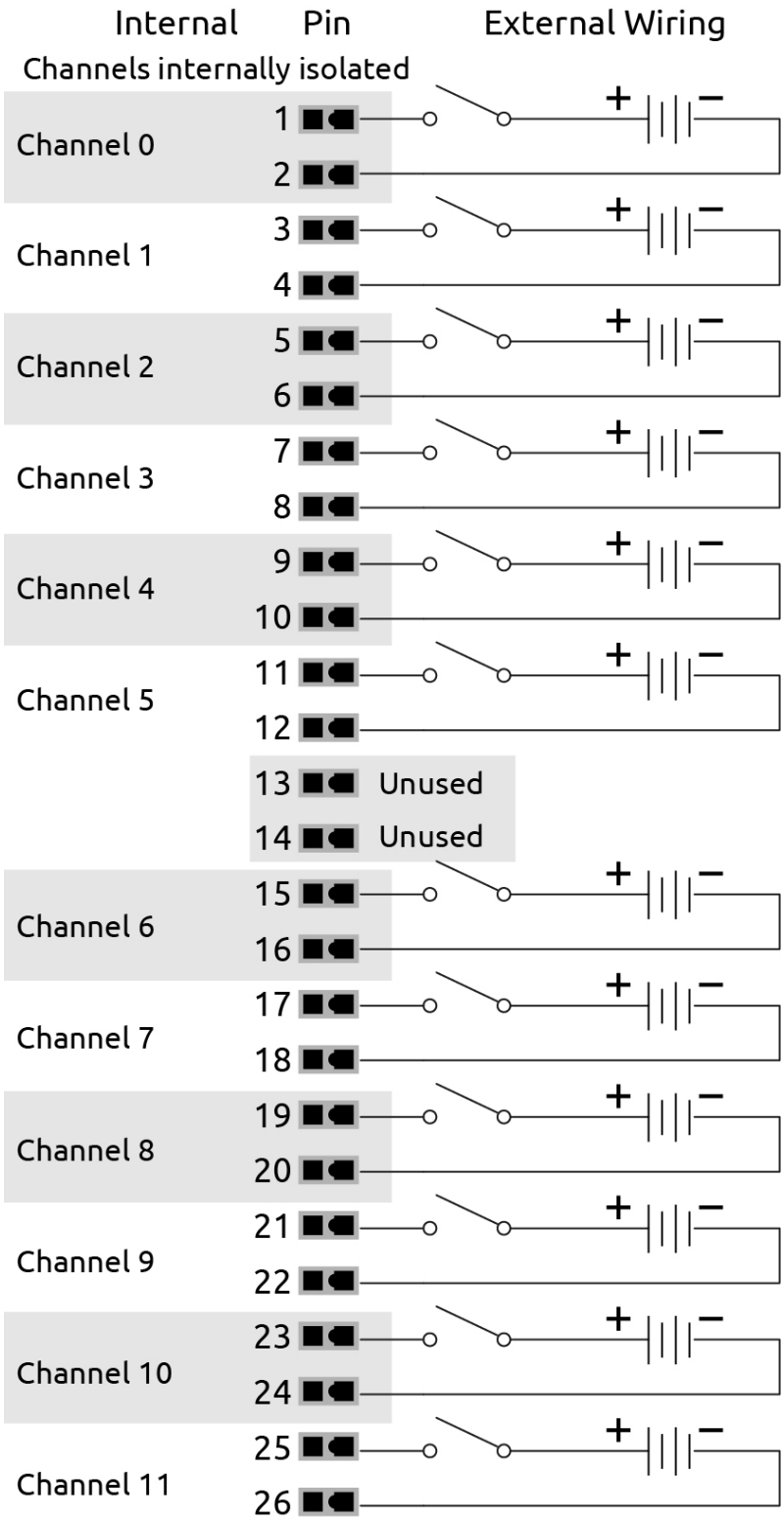


GRV-IDCIFQ-12 PINOUT AND WIRING DIAGRAM

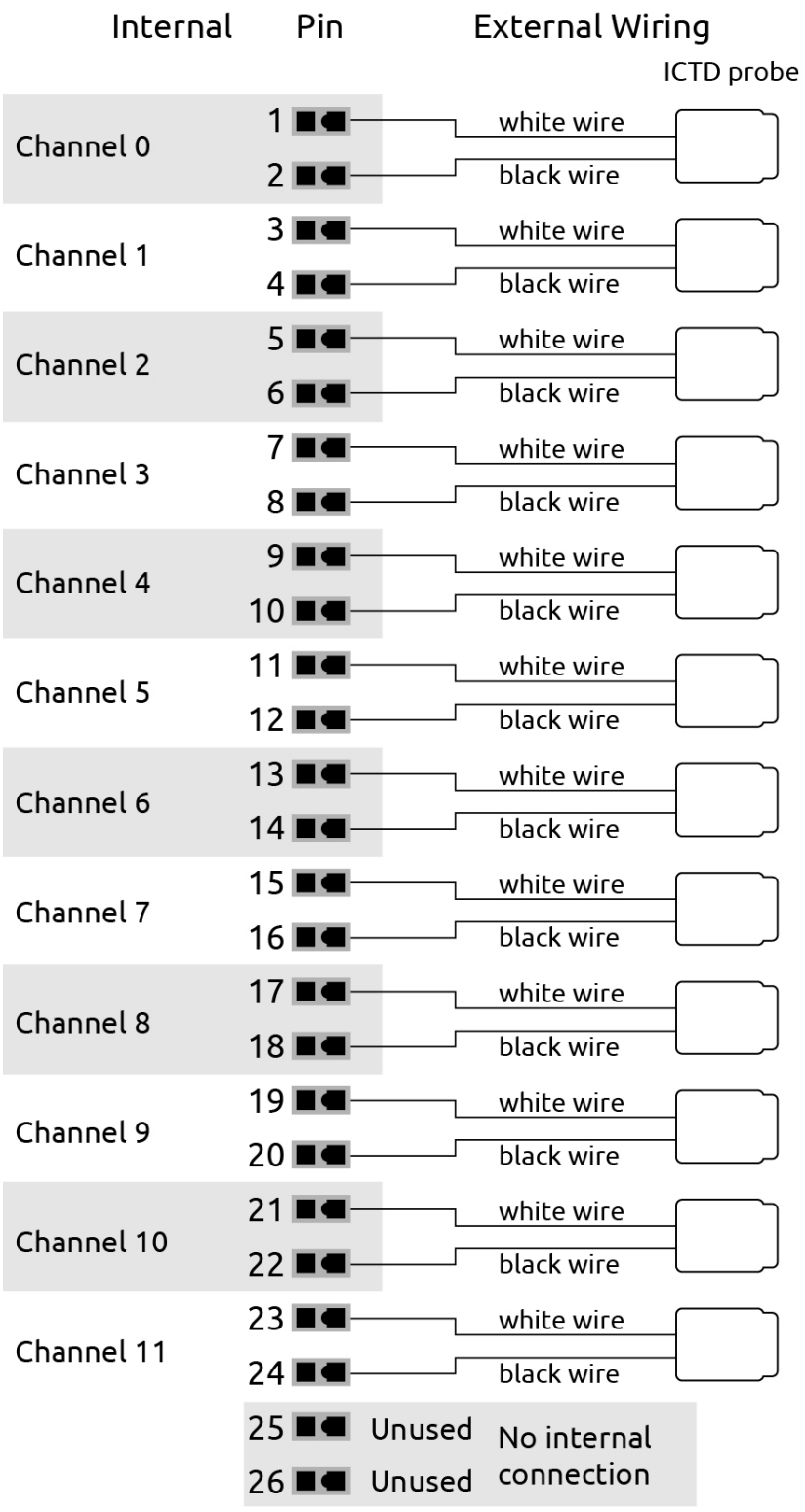
Wiring to Quadrature Encoders



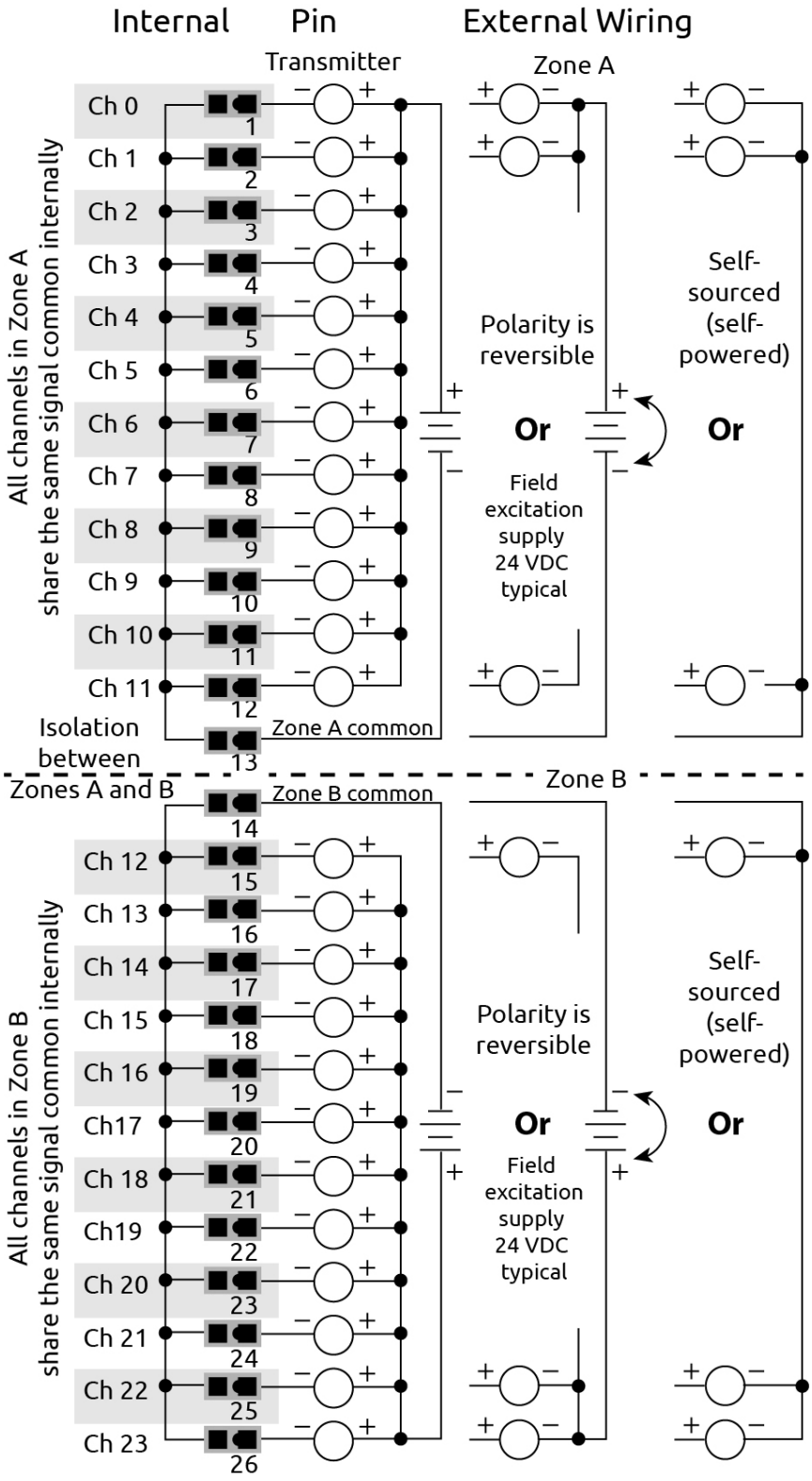
Wiring to Typical (Signal) Sources



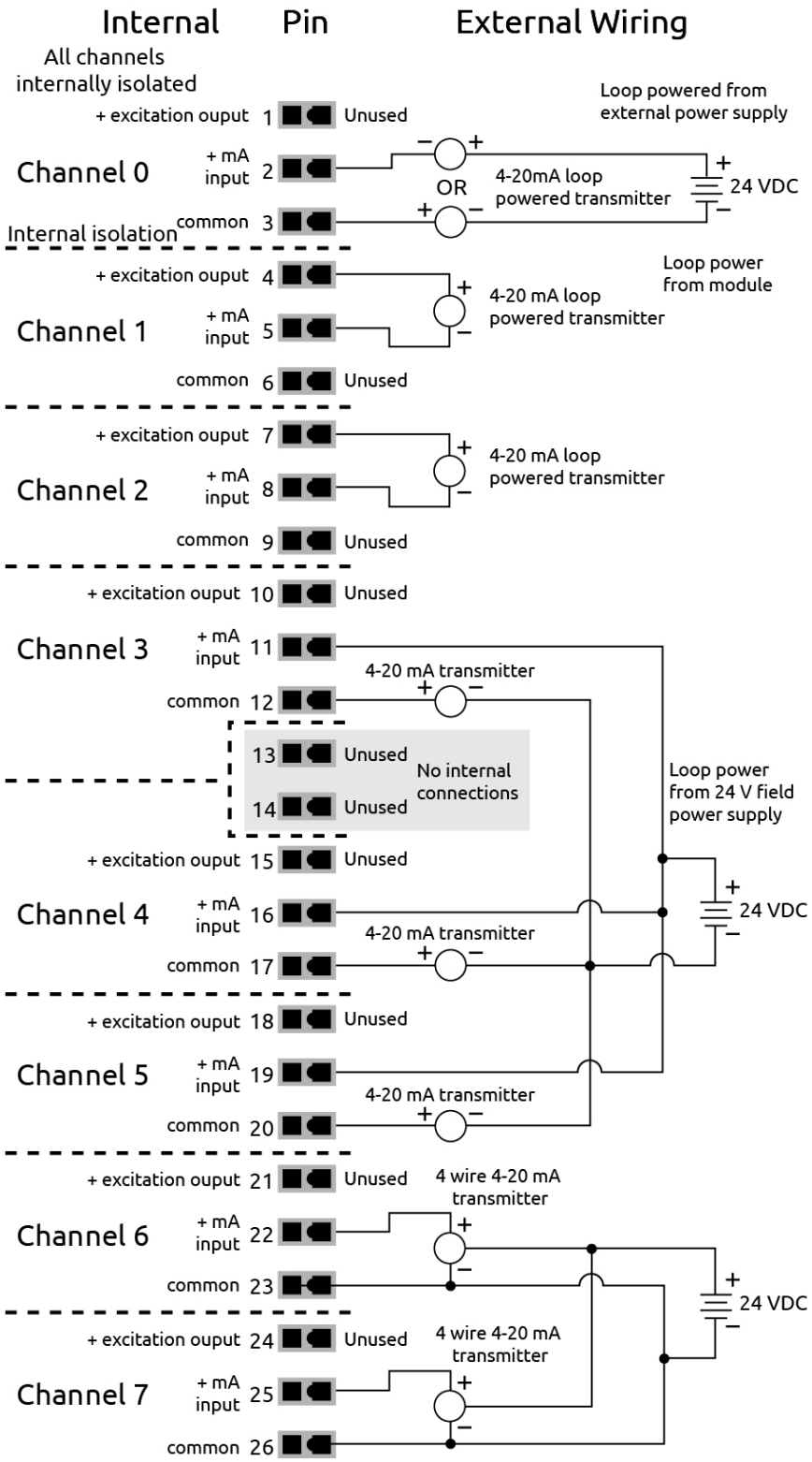
GRV-IICTD-12 PINOUT AND WIRING DIAGRAM



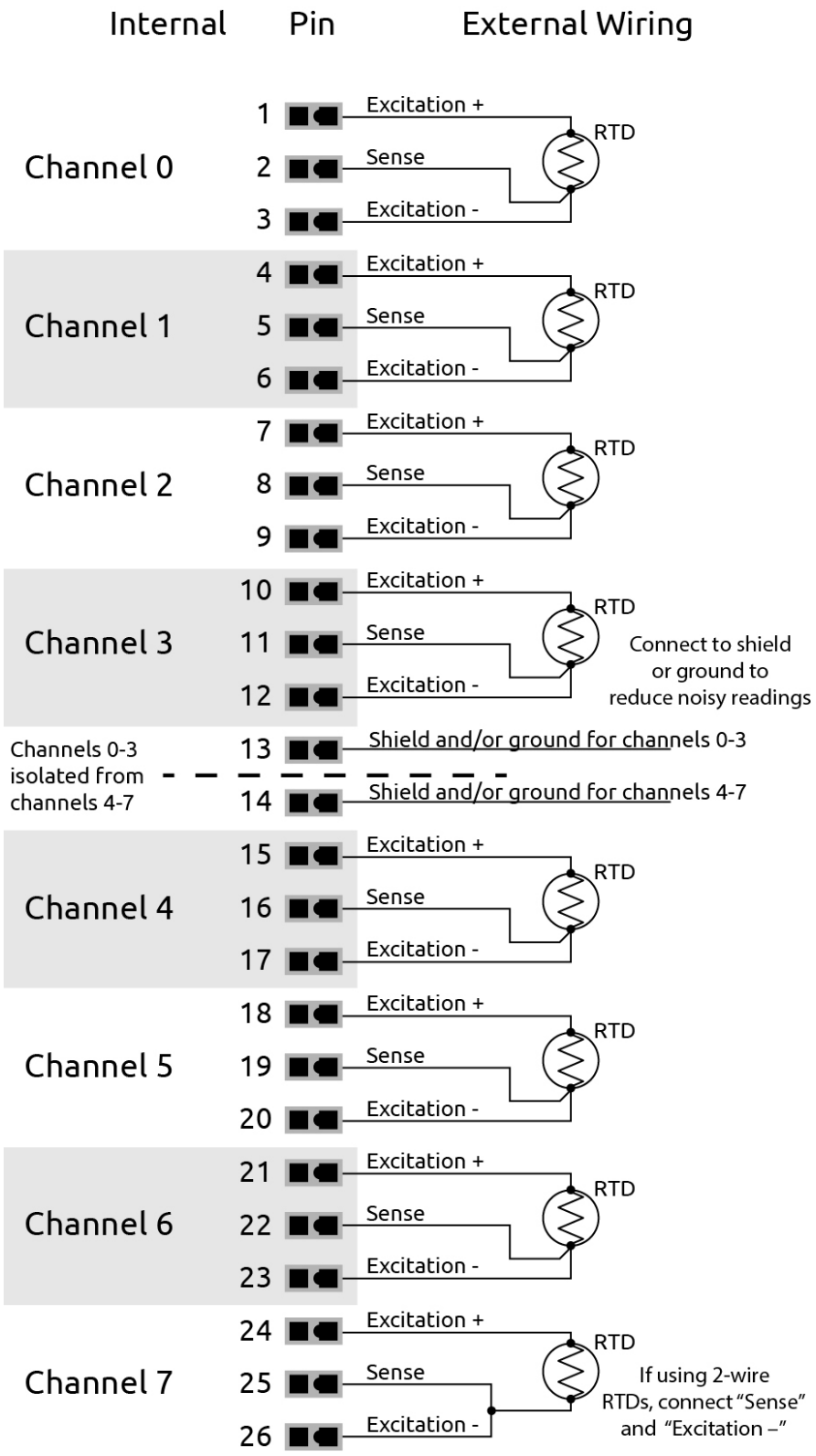
GRV-IMA-24 PINOUT AND WIRING DIAGRAM



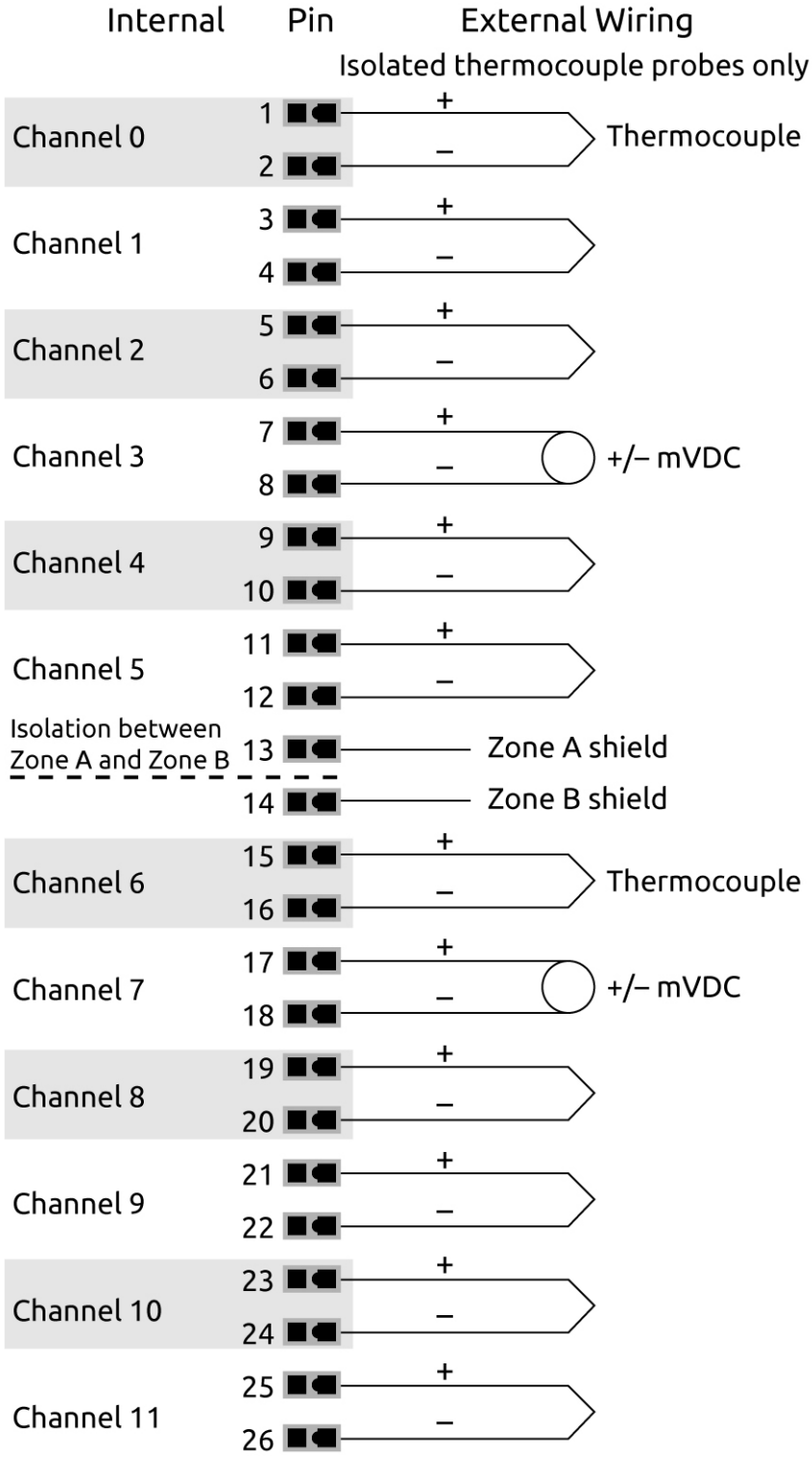
GRV-IMAI-8 PINOUT AND WIRING DIAGRAM



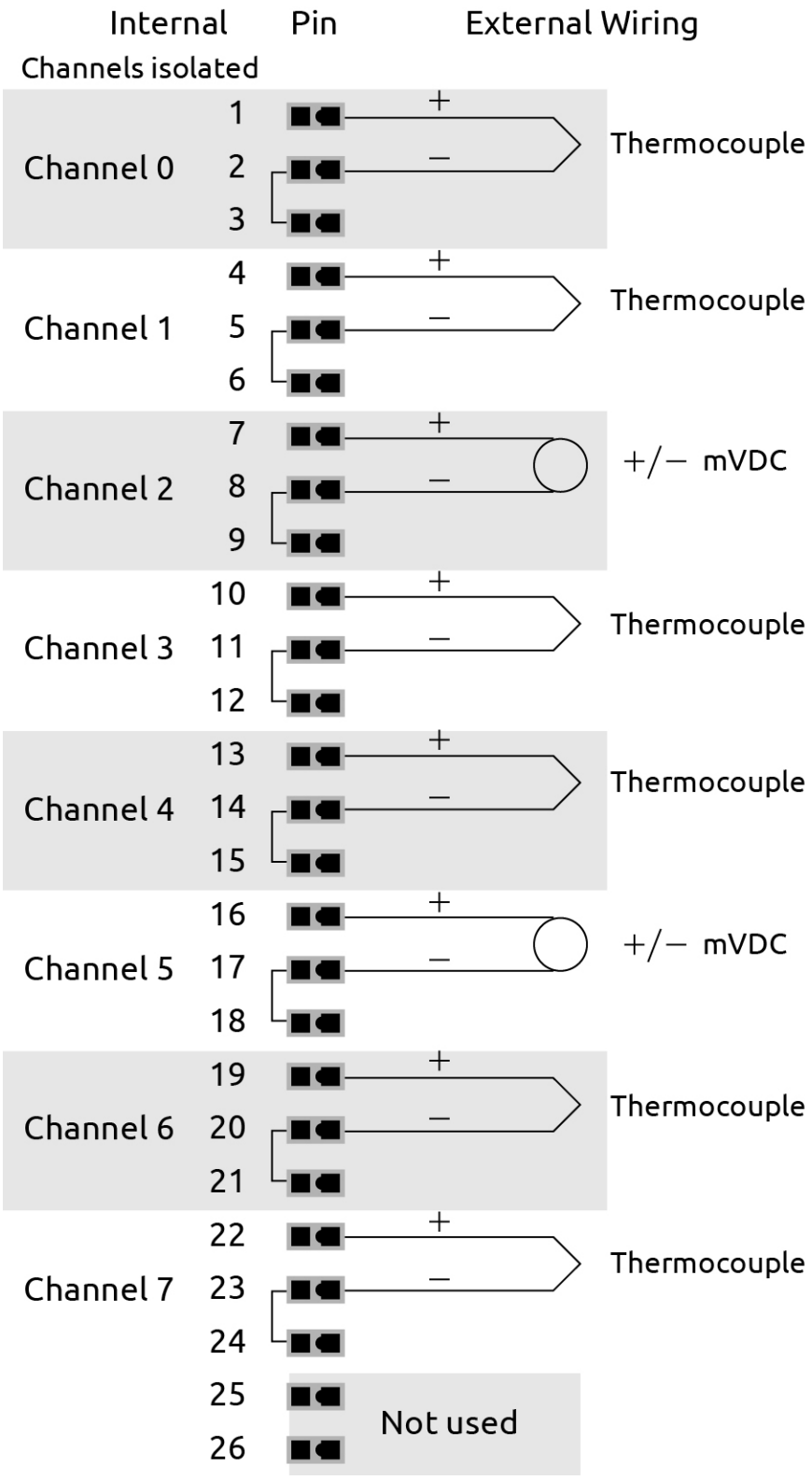
GRV-IRTD-8 PINOUT AND WIRING DIAGRAM



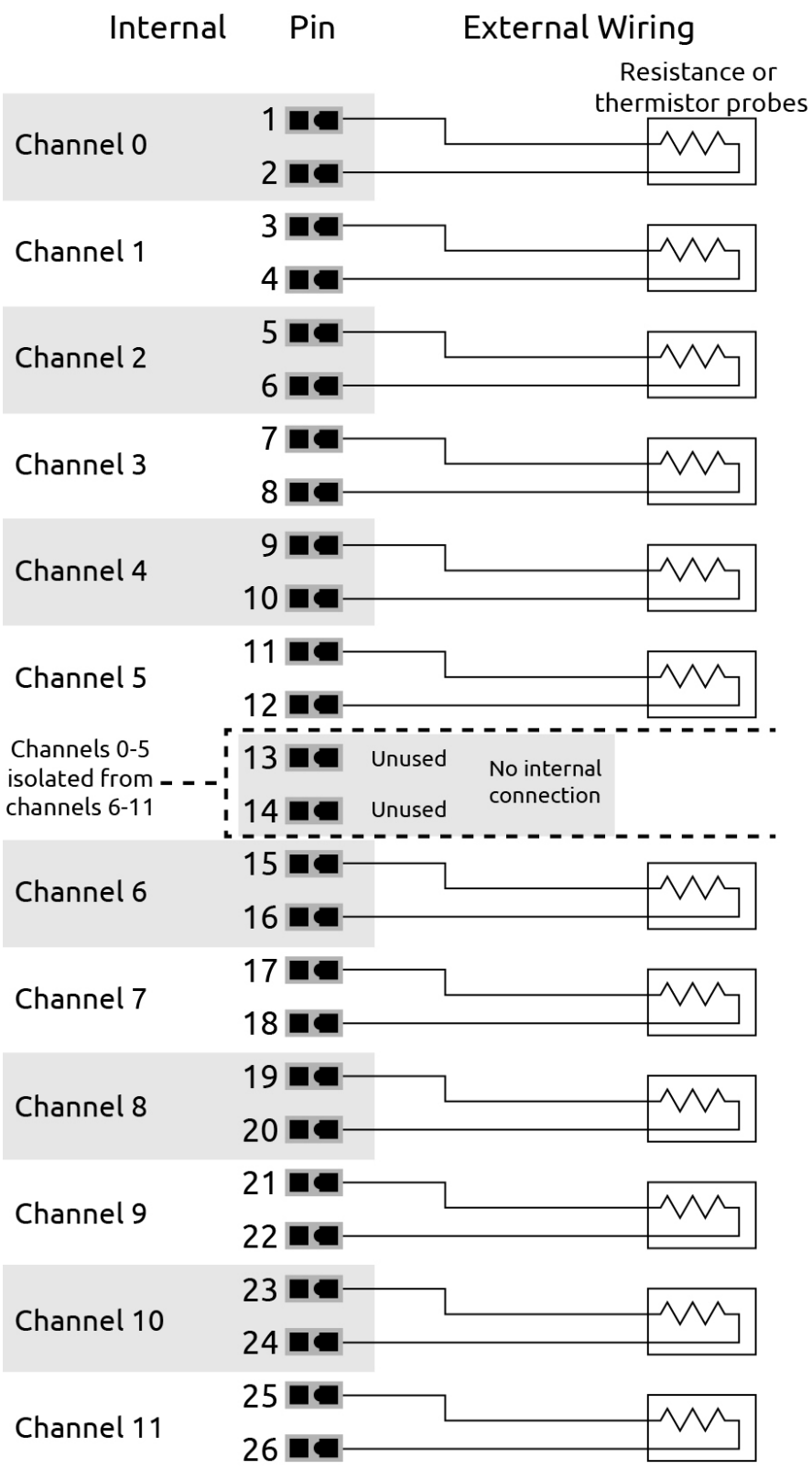
GRV-ITM-12 PINOUT AND WIRING DIAGRAM



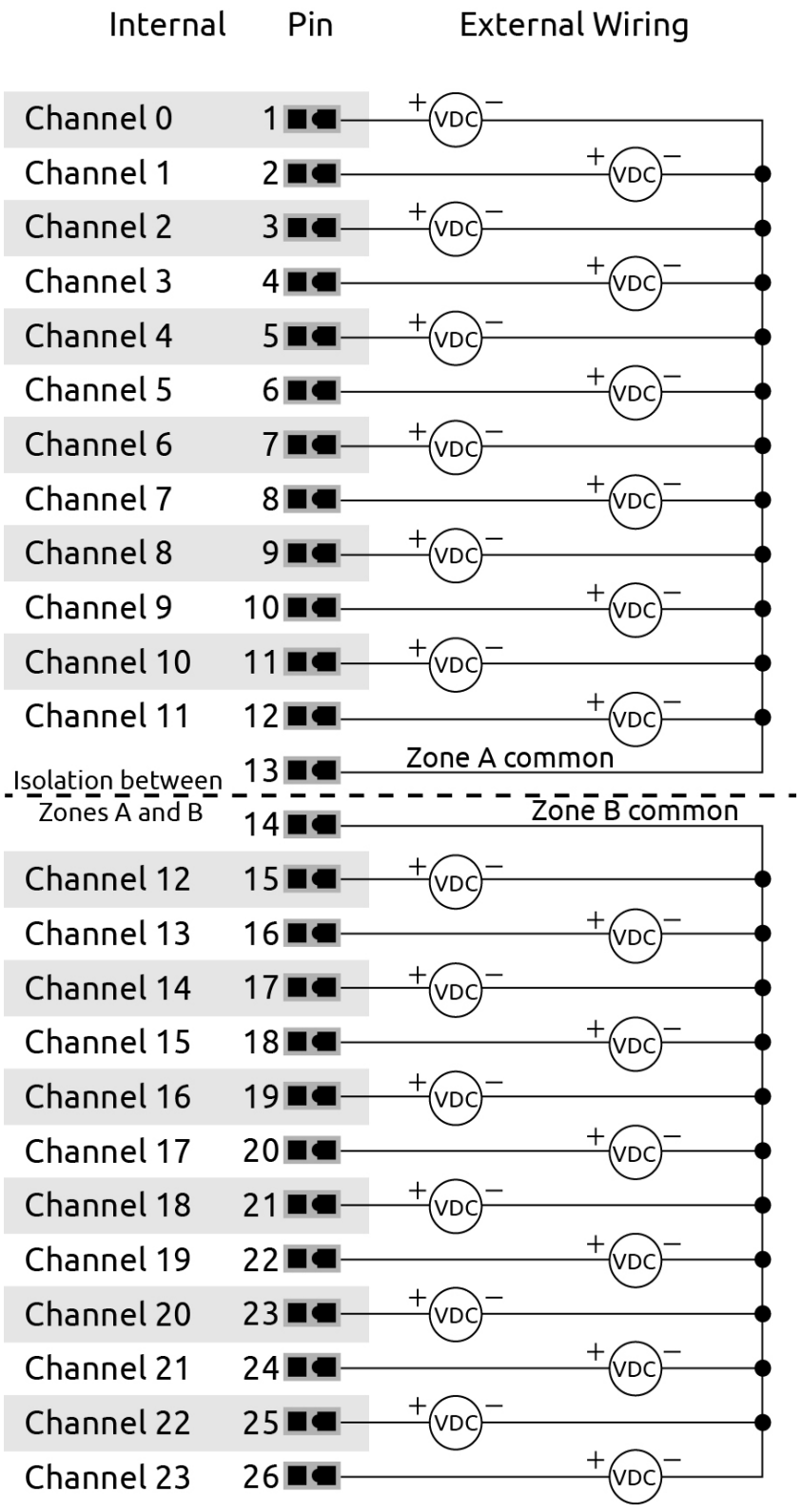
GRV-ITMI-8 PINOUT AND WIRING DIAGRAM



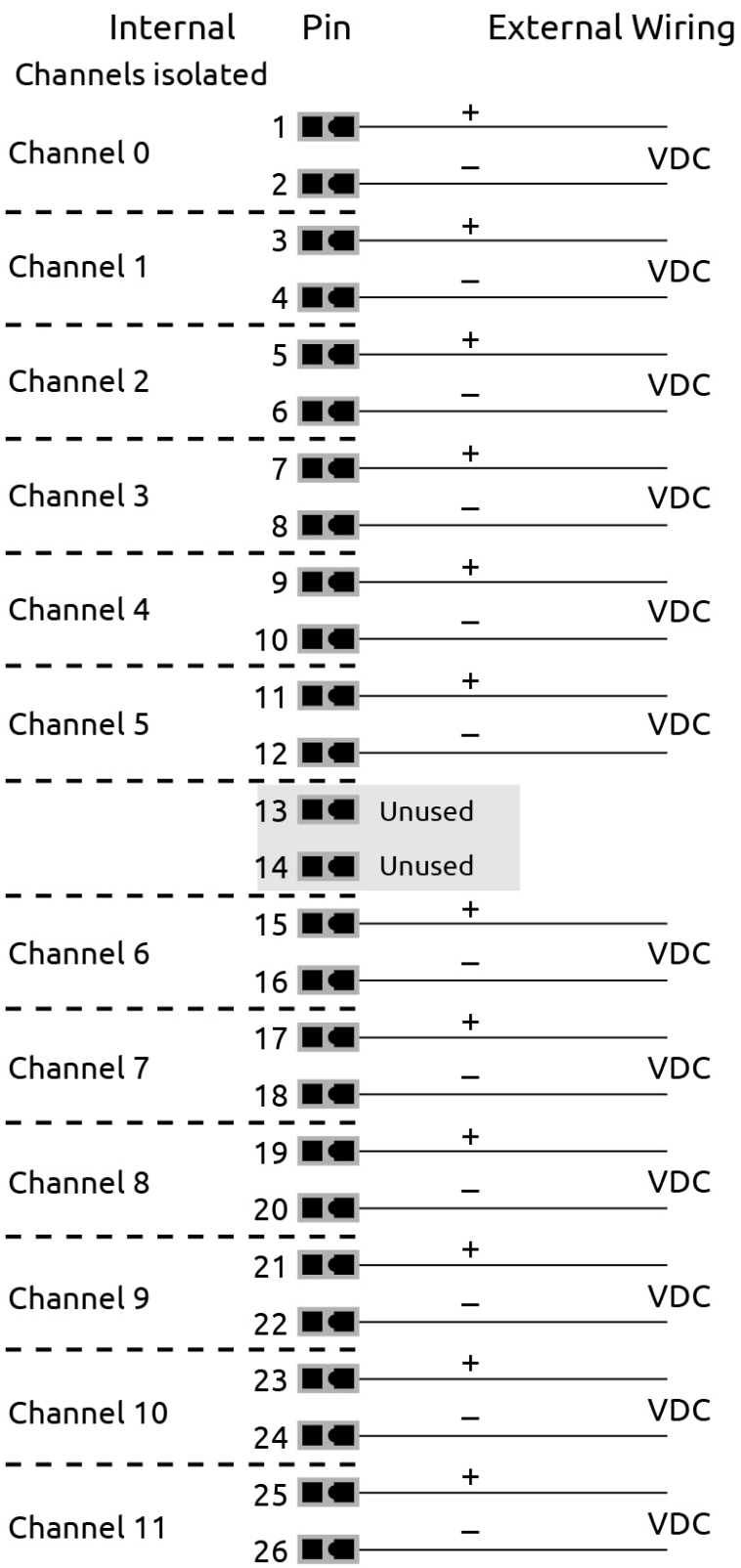
GRV-ITR-12 PINOUT AND WIRING DIAGRAM



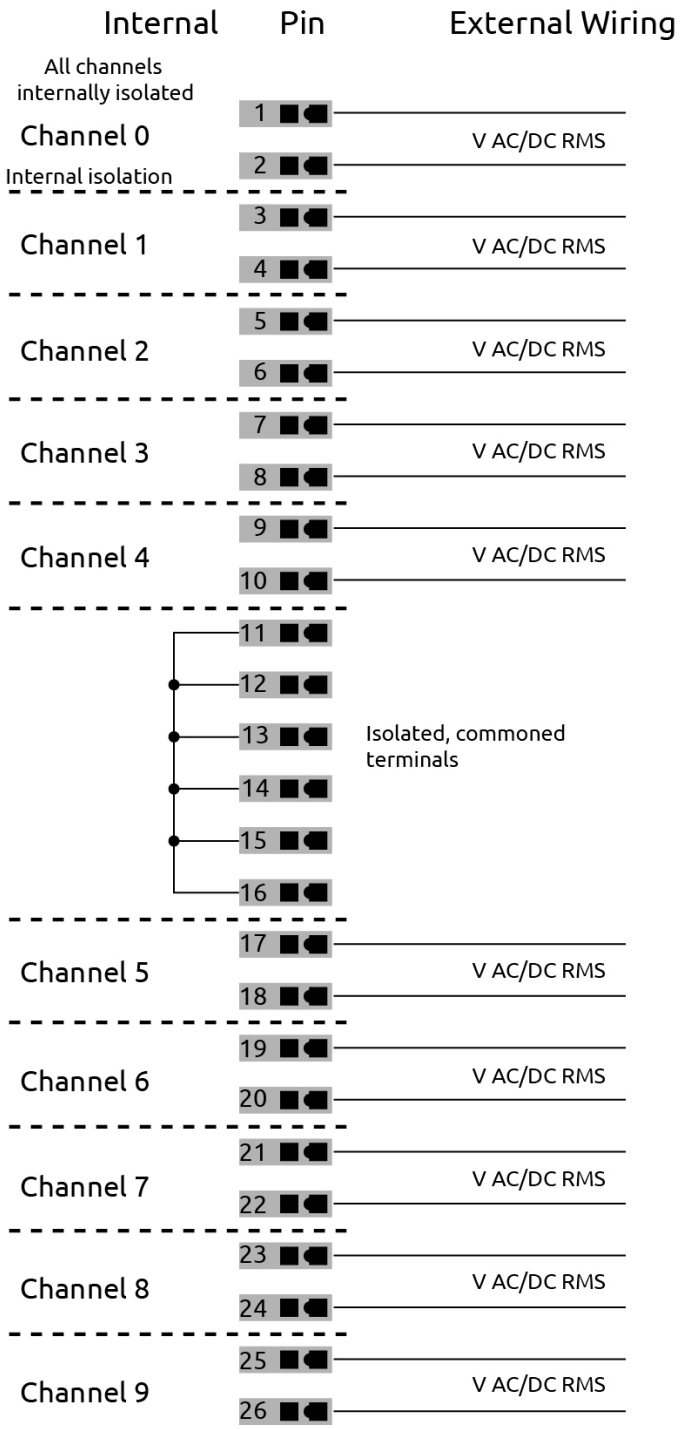
GRV-IV-24 PINOUT AND WIRING DIAGRAM



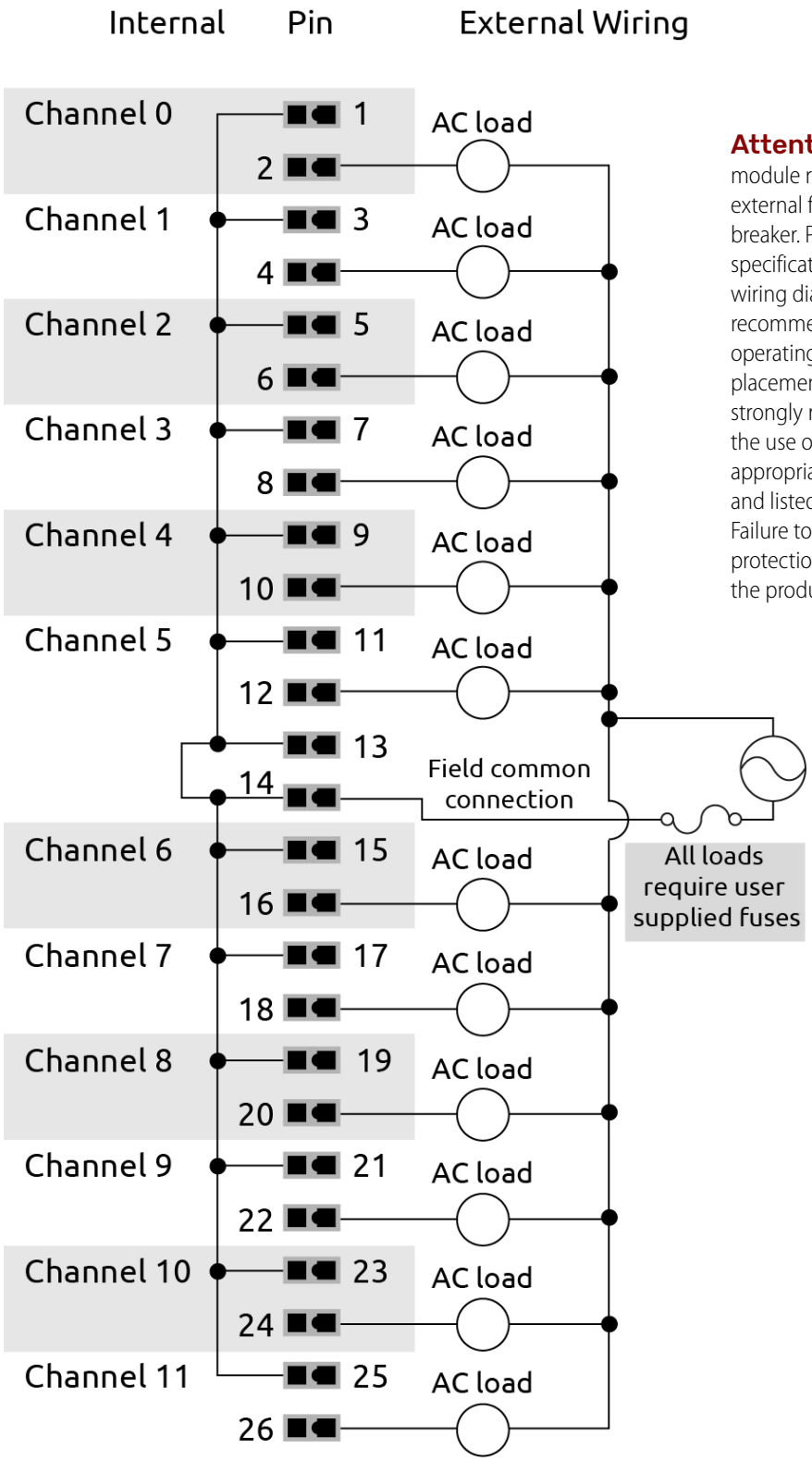
GRV-IVI-12 PINOUT AND WIRING DIAGRAM



GRV-IVIRMS-10 PINOUT AND WIRING DIAGRAM

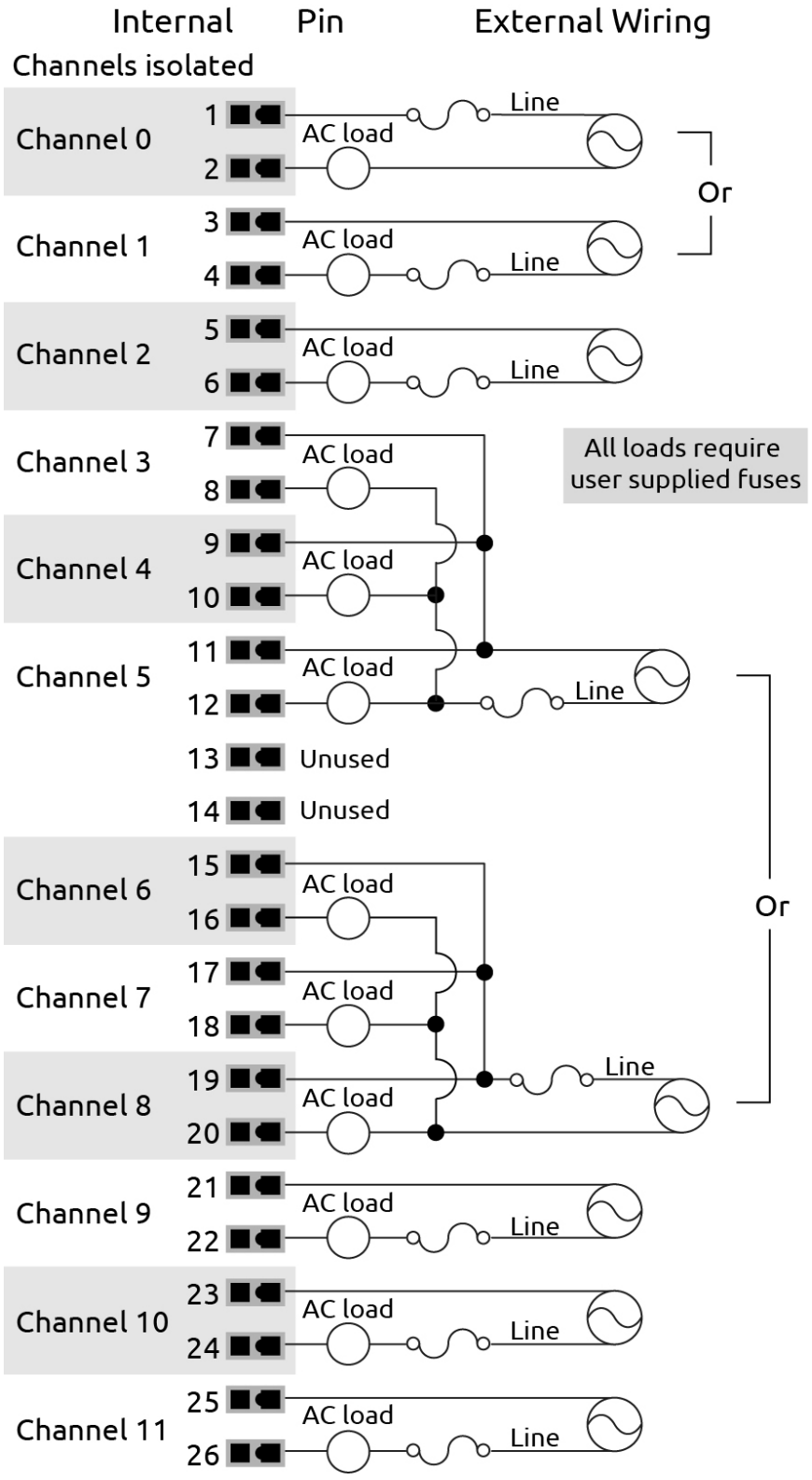


GRV-OAC-12, GRV-OACS-12 PINOUT AND WIRING DIAGRAM



Attention: This module requires an external fuse or circuit breaker. Please see the specification table and wiring diagram for recommended operating currents and placement. Opto 22 strongly recommends the use of an appropriately rated and listed device. Failure to provide protection will void the product warranty.

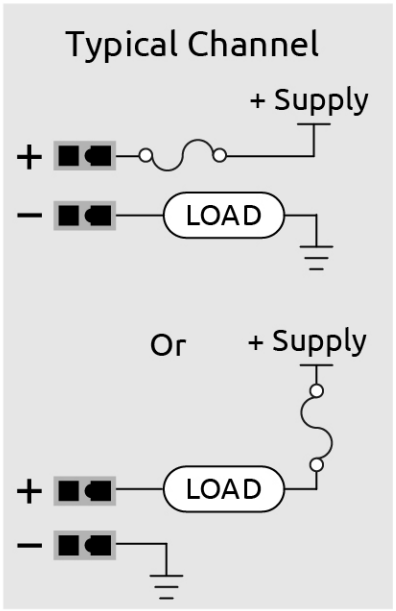
GRV-OACI-12, GRV-OACIS-12 PINOUT AND WIRING DIAGRAM



GRV-ODCI-12, GRV-ODCIS-12 PINOUT AND WIRING DIAGRAM

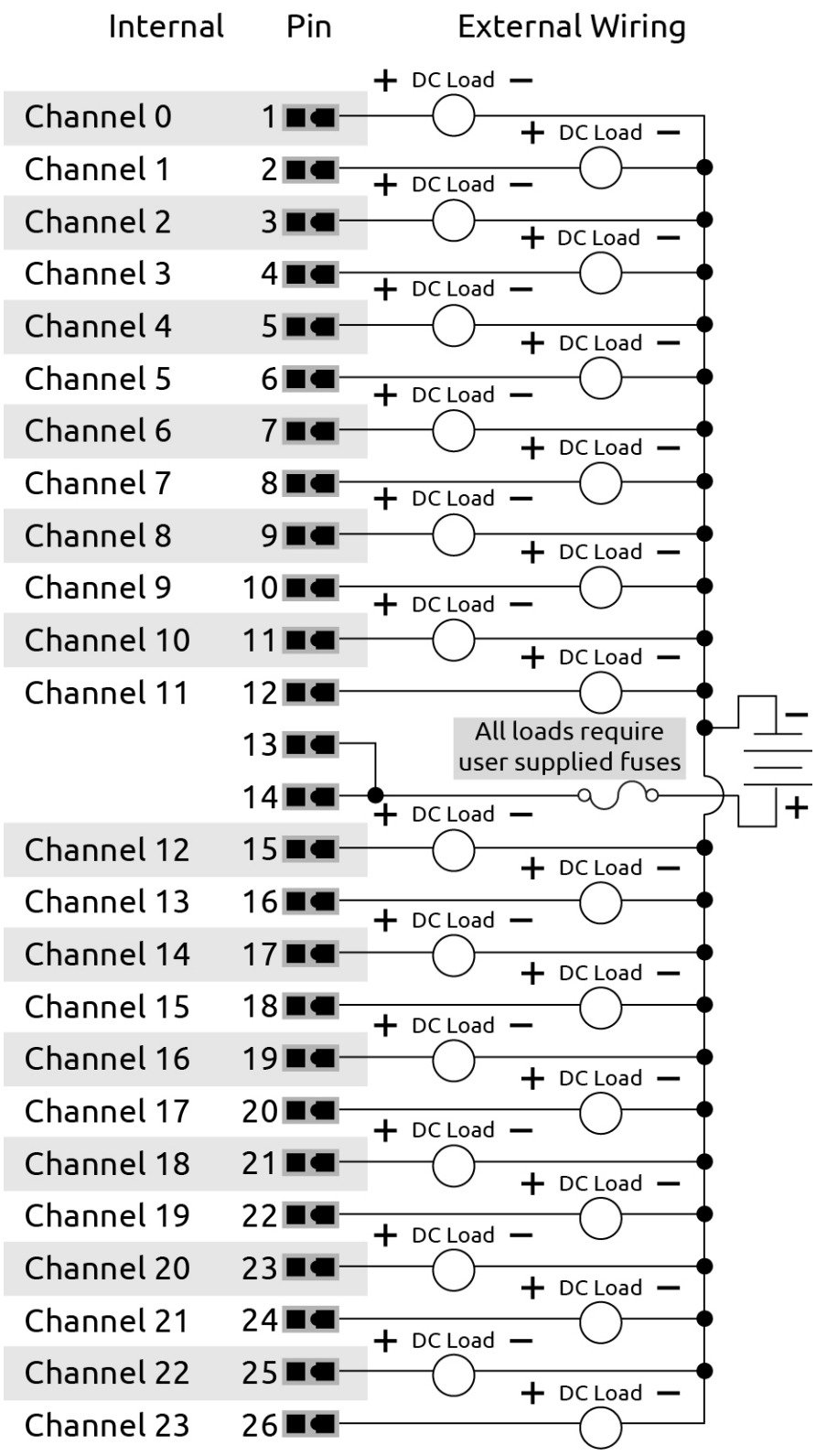
Internal	Pin	
Channels internally isolated		
Channel 0	1	+
	2	–
Channel 1	3	+
	4	–
Channel 2	5	+
	6	–
Channel 3	7	+
	8	–
Channel 4	9	+
	10	–
Channel 5	11	+
	12	–
	13	Unused
	14	Unused
Channel 6	15	+
	16	–
Channel 7	17	+
	18	–
Channel 8	19	+
	20	–
Channel 9	21	+
	22	–
Channel 10	23	+
	24	–
Channel 11	25	+
	26	–

External Wiring



All loads require user supplied fuses

GRV-ODCSRC-24 PINOUT AND WIRING DIAGRAM

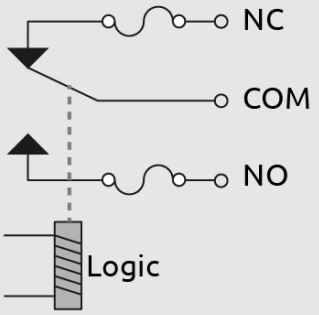


GRV-OMRIS-8 PINOUT AND WIRING DIAGRAM

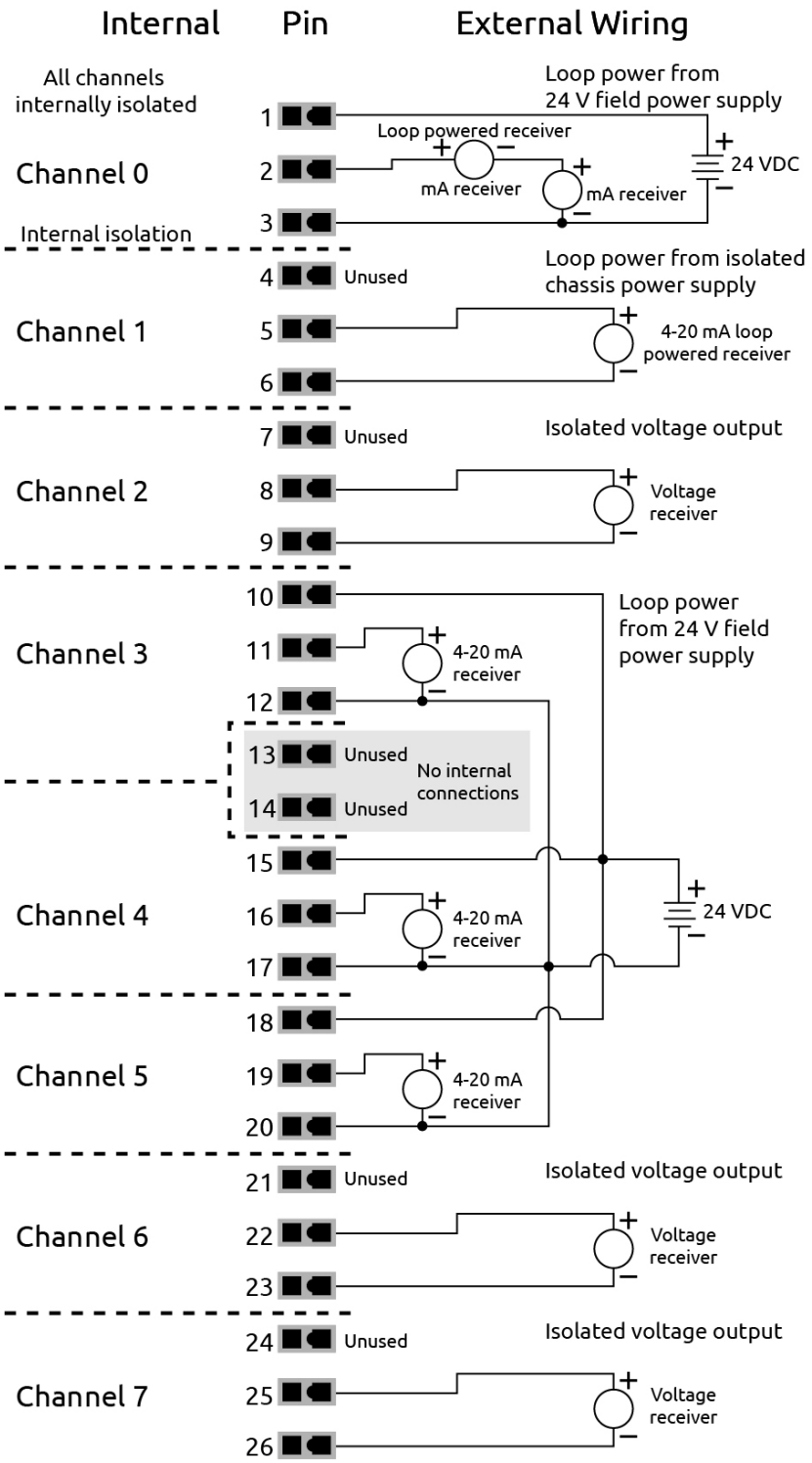
Internal	Pin	External Wiring
Channels internally isolated		
Channel 0	1	NC
	2	COM
	3	NO
Channel 1	4	NC
	5	COM
	6	NO
Channel 2	7	NC
	8	COM
	9	NO
Channel 3	10	NC
	11	COM
	12	NO
	13	Unused
	14	Unused
Channel 4	15	NC
	16	COM
	17	NO
Channel 5	18	NC
	19	COM
	20	NO
Channel 6	21	NC
	22	COM
	23	NO
Channel 7	24	NC
	25	COM
	26	NO

All loads require user supplied fuses

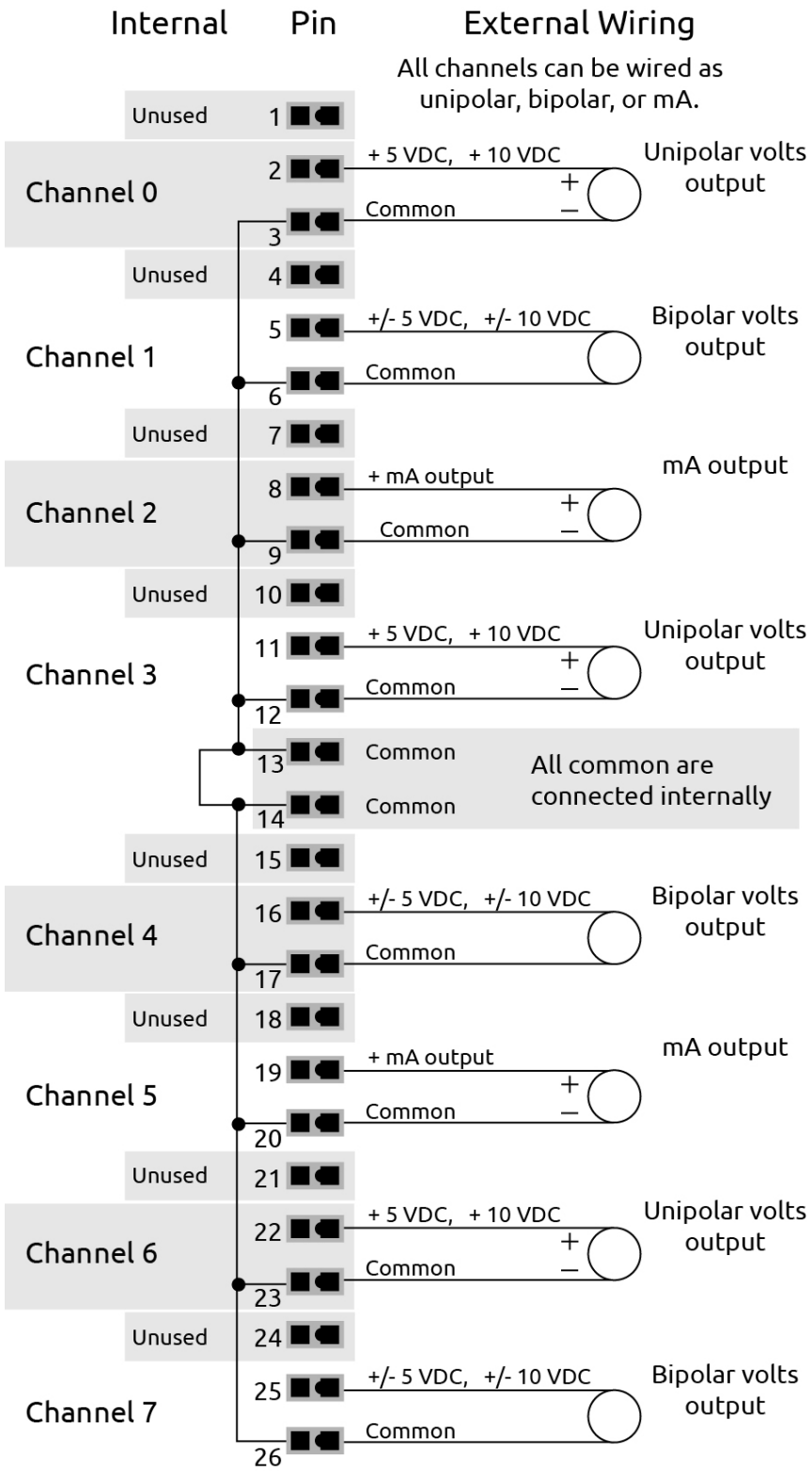
Typical Channel



GRV-OVMAILP-8 PINOUT AND WIRING DIAGRAM



GRV-OVMALC-8 PINOUT AND WIRING DIAGRAM



F: Installing the Correct License

The information in this section can help you:

- If you have a *groov* EPIC processor with firmware version earlier than 1.3.0 ***and*** you need to re-initialize the processor to earlier firmware.
- If you are upgrading the *groov* EPIC processor's firmware from a version earlier than 1.3.0 to version 1.3.0 or later ***and*** you want to add Ignition Edge or CODESYS. You need to understand how licensing changed with the release of 1.3.0 so that you can purchase the correct new license.

INSTALLING LICENSES ON PROCESSORS WITH FIRMWARE EARLIER THAN 1.3.0

Prior to firmware version 1.3.0, to access some of the following software, you needed to purchase or install specific licenses:

- ***groov* View.** This software required the installation of the *groov* Plus license, which you received when you purchased a *groov* EPIC processor (part number GRV-EPIC-PR1).
- ***groov* EPIC SSH Access.** The Secure Shell (SSH) Access required the purchase and installation of the *groov* Enterprise license (part number GROOV-LIC-ENT).
- **OPC UA.** The OPC UA servers required the purchase and installation of the *groov* Enterprise license (part number GROOV-LIC-ENT).
- **Ignition Edge.** The Ignition Edge software required the purchase and installation of the *groov* Enterprise license (part number GROOV-LIC-ENT).

If you are working with a *groov* EPIC processor with older module firmware and you need to reload or re-obtain a copy of the license it came with, see "Activating the groov EPIC unit and downloading the license file" on page 13. Make sure you save the license file in a secure place and remember where you stored it.

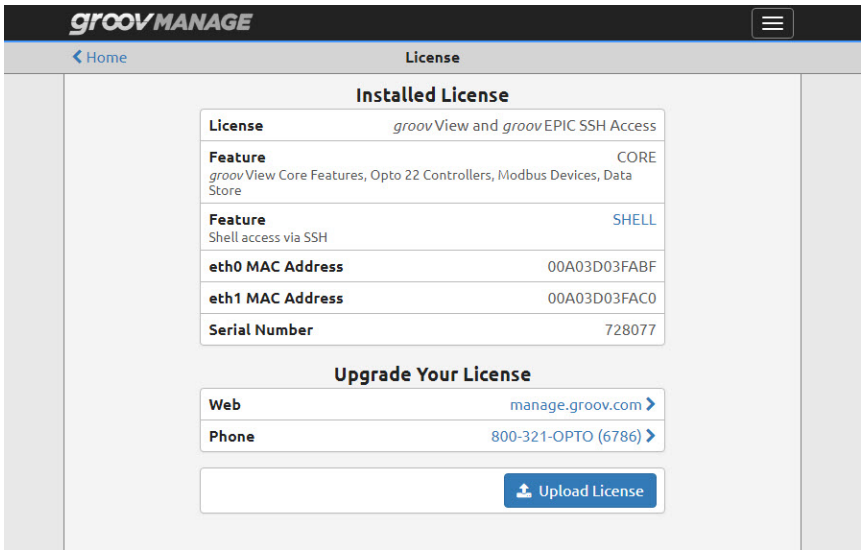
If you already have a *groov* Enterprise license (GROOV-LIC-ENT), make sure you have the Ignition Edge License Key for your *groov* EPIC processor. Follow the instructions in "Licensing Ignition Software" on page 75.

Installing the *groov* Plus or *groov* Enterprise License

When you initialized your *groov* EPIC unit, you may have uploaded your *groov* Plus or *groov* Enterprise license. If you didn't upload your license file, do the following steps:

1. On your computer or mobile device, make sure you know where you stored the license file.
2. On that same computer or mobile device, log into your *groov* EPIC processor with a user ID that has administrator authority.
3. Click System (System).
4. Click License (License).
5. In the License page, click Upload License (Upload License).

6. Navigate to the folder on your computer or mobile device that contains the license file.
7. Select the license file and then click Open. *groov* Manage displays a message as it uploads the license file. After it is done, it refreshes the License page to show the license it installed. The following diagram shows an example of a *groov* Enterprise license:



ADDING IGNITION EDGE OR CODESYS WHEN YOU UPGRADE TO 1.3.0 OR LATER

If you are upgrading to firmware version 1.3.0 and you want to add Ignition Edge or CODESYS, you need to do the following steps:

1. Purchase Ignition Edge (part number GROOV-LIC-EDGE) or order CODESYS (GROOV-LIC-CRE).

   Important: *If you already purchased GROOV-LIC-ENT, you* ***do not*** *need to purchase GROOV-LIC-EDGE.*

2. After you receive your Ignition Edge License Key or CODESY Ticket Number, do the following:
   - "Installing (Activating) the Ignition Edge License" on page 76
   - "Licensing the CODESYS Runtime Engine" on page 67

G: Advanced Networking Configurations

The configuration described in this appendix is for IT or network administrators that need to configure devices to comply with more complex networking policies. Administrators should review this configuration in conjunction with the requirements described in "Reviewing Network Requirements" on page 51.

The IT or network administrator should understand the following networking functions before implementing this configuration:

- Gateways and how they direct network traffic.
- DHCP servers and the functions they perform on a network. In particular, how the DHCP server interacts with gateways and how they read information in packets to direct them to the appropriate destination.
- The difference between an incoming connection request and an outgoing connection request.

REDIRECTING TRAFFIC INITIATED BY AN INCOMING CONNECTION REQUEST

Each network interface on the *groov* EPIC processor can be assigned a gateway address. Normally, a DHCP server manages the assignment of gateway IP addresses to the network interfaces. Prior to version 1.4.0 of the *groov* EPIC firmware, the *groov* EPIC processor would select the gateway of the active network interface and make it the *effective* gateway, the gateway that directs traffic. However, in rare instances called off-subnet destination-based routing, the effective gateway would prevent the passing of or not properly forward legitimate traffic to another network interface on the *groov* EPIC processor. The device that originated the connection request would receive a "timeout" message and report that the network interface on the *groov* EPIC processor was unreachable, even though that was incorrect.

Beginning with version 1.4.0 of the *groov* EPIC firmware, a network administrator can assign a gateway IP address to each network interface on a *groov* EPIC processor. In addition, the network administrator can assign a priority (or order) between all the network interfaces that are assigned a gateway. Therefore, if there are multiple active network interfaces, the processor knows that the active network interface with the lowest gateway order should be the effective gateway. If that gateway cannot direct the traffic, then the processor switches to the active network interface with the next lowest gateway order.

This feature affects traffic initiated by an incoming connection request, with the one exception described in "Outbound Traffic Not Initiated by an Incoming Connection Request".

Before you configure the *groov* EPIC processor, determine the number of gateways, the IP addresses for the gateways, to which network interface to assign them, and what order to use them. Collect this information in "Table of Additional Gateways IP Addresses, DNS IP Addresses and Name Servers, and Order" on page 55 so that it is readily available when you configure the processor.

Outbound Traffic Not Initiated by an Incoming Connection Request

If the *groov* EPIC processor initiates a communication request (called an outgoing connection request), traffic travels through the gateway with the lowest order number (the effective gateway). However, if the outbound traffic specifies a source address or the IP address of the network interface (which is not a common situation), then the second or third gateway in the list order may be used. One example of this uncommon situation is issuing a ping command to contact a host that would require directing the packets through a gateway other than the effective gateway. The ping command would fail unless you specify the `-I` option, which is the interface option that allows you to specify a different source address.