

INTRODUCTION

This technical note provides recommendations for the most reliable methods of providing control power to Opto 22 SNAP PACs, SNAP Ultimate I/O™, SNAP Ethernet I/O™, SNAP I/O™, *mistic*™, Optomux®, Pamux®, and direct I/O.

IMPORTANT: *This technical note does NOT apply to groov EPIC® systems, which have their own integrated power supplies.*

GENERAL RECOMMENDATIONS

Providing the most reliable control power to your Opto 22 equipment is essential to the long-term success of your installations. Follow these recommendations to minimize unnecessary startup and maintenance issues.

Use Opto 22 power supplies. For Opto 22 product lines where Opto 22 has power supplies available (for example, SNAP), we recommend using the Opto 22 power supplies. Opto 22 designs its power supplies specifically for use with our control equipment, so this is usually the best option.

When it is not possible to use Opto 22 power supplies, choose appropriate isolated power supplies.

- Isolated switching power supplies are a good choice. The key is the isolation feature. Not all switching power supplies are the same, so check with the manufacturer to ensure that the ones you choose are isolated (that is, the output is isolated from the input) and are not direct-coupled.
- Linear power supplies are excellent for use with Opto 22 equipment because they provide stable, tight voltage regulation. Linear power supplies with a *remote sense* feature provide the best voltage regulation and noise immunity.
- Direct-coupled switching power supplies are NOT recommended. This type of power supply tends to pass noise and transients through to the DC side.
- DC-DC converters are NOT recommended. These converters tend to handle noise poorly and have difficulty maintaining output voltage tolerances through minor power fluctuations on the input side.

Use separate individual power supplies for each I/O rack if at all possible. A separate power supply ensures that voltage to each device can be properly adjusted. If you use one larger power supply for many racks, it can be difficult or even impossible to get the voltage of all the devices to be at the correct level, since only one power supply adjustment can be made.

If you have to use one power supply to power more than one rack, connect only racks with the same current load in order to minimize voltage differences from one rack to the next.

Use separate power supplies for control devices and field devices. Keep the control power for the Opto 22 equipment separate from the power used to supply field devices or other control equipment. Separate power supplies make sure that:

- The electrical isolation between the field devices and the control equipment provided by the Opto 22 I/O modules is maintained.
- Transients caused by cycling loads are prevented from affecting the control power.
- Fewer voltage drops and ground loops occur. Voltage drops and ground loops may occur when power is distributed over a large system.
- The failure of a single power supply causes only a single rack failure, not a total system failure.

Use the heaviest gauge wire practical for the installation. Use 14 AWG between the power supply and the Opto 22 racks. Using heavy gauge wire reduces voltage drops due to wiring.

Keep wire lengths as short as possible to reduce the voltage loss in the wiring and also to reduce the possibility of noise being induced into the control power wiring.

Use a star wiring topology for control power. Do not multi-drop or daisy-chain control power. Using a star topology for control power helps keep the voltage of each device within a close tolerance of other devices.

Use equal length wires from power distribution terminal blocks to each rack. Connect the remote sense input of the power supply to the power supply side of the power distribution terminal blocks.

Important Notes for All Power Supplies

Do not connect the negative DC terminal of any power supply to the computer chassis or to earth ground. In other words, the negative DC terminal of each power supply must remain floating in order to prevent ground loops between power supplies and other devices on the communication link. When using RS-485 or RS-422 communications, the negative terminal of the power supply connected to the rack is connected through the communication cable signal common wire to other racks and devices. If you use multiple power supplies, every rack power supply must be isolated and floating. However, the power supplies are still referenced to each other because they all share the same reference via the signal common wire of the communication cable.

The exception to this rule is when using *mistic* bricks (for example, the G4D16R and the G4A8R). In this case, the requirement is just the opposite. *mistic* bricks use the G4REG voltage regulator and require that the 24 VDC return be tied to earth ground. This requirement is met internally if you use *mistic* power supplies.

With a third terminal for ground, connect to earth or chassis ground. For any Opto 22 product where the power connector has connections for DC voltage supply and ground, for example, +, and -, and a third terminal for ground, it is best to connect the ground terminal to earth or chassis ground in order to reduce the effects of electrical noise. Technically, the ground terminal connection to earth or chassis ground is optional, but it is highly recommended.

The third terminal for ground must NOT be connected to the negative DC terminal and must NOT be connected to the power supply negative terminal. All SNAP racks have this third terminal for ground.

ADDITIONAL PRODUCT-SPECIFIC RECOMMENDATIONS

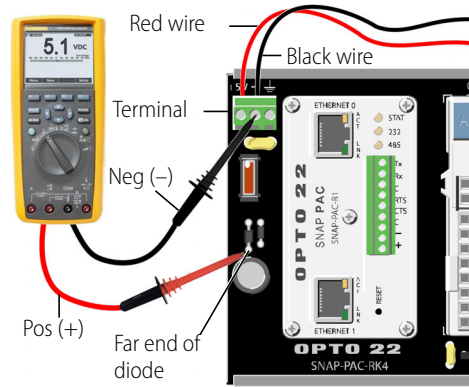
When not using Opto 22 power supplies, it is important to adjust the voltage properly at the Opto 22 device or mounting rack. Here are specific recommendations:

- For all SNAP, *mistic*, Optomux, Pamux, and direct I/O products that require 5 VDC, we have broadened our specifications to allow adjusting the voltage up to 5.20 VDC. We recommend adjusting the power supply to the upper end of the range (5.10 to 5.20 VDC) for best results. This recommendation is based on years of experience and will eliminate many startup, maintenance, and intermittent issues.
- For SNAP racks, measure and adjust the voltage downstream of the fuse on the rack. This location takes into account the voltage drop across the fuse on the rack, and ensures that the I/O processor (brain or on-the-rack controller) and modules receive the correct voltage.
- For Optomux and Pamux systems, measure and adjust the voltage across one of the yellow capacitors on the Optomux or Pamux brain.
- Do NOT exceed 5.20 VDC on any rack or brain!

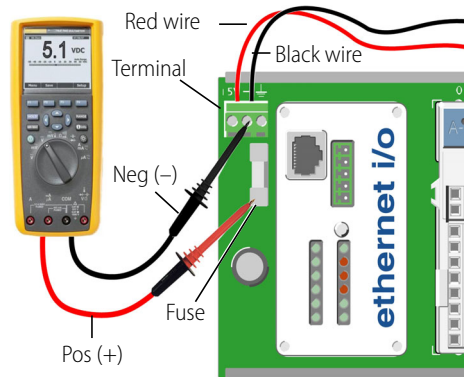
TESTING THE VOLTAGE AT THE RACK

Verifying the voltage level at an I/O rack is very important for equipment safety and point value accuracy. The best way to read the rack voltage is to use a voltmeter or multi-meter and place the negative probe lead at the negative power terminal, then place the positive probe lead to the far end of the diode as shown below. Or, on older legacy SNAP racks you can place the positive probe lead to the

fuse. The reading should be around 5.1 Volts. The brain and all the modules should be installed on the rack while performing these tests.

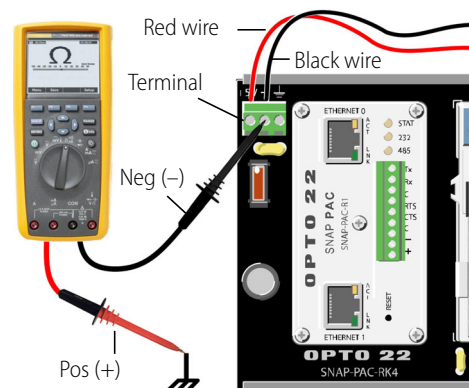


OR



TESTING RACK ISOLATION

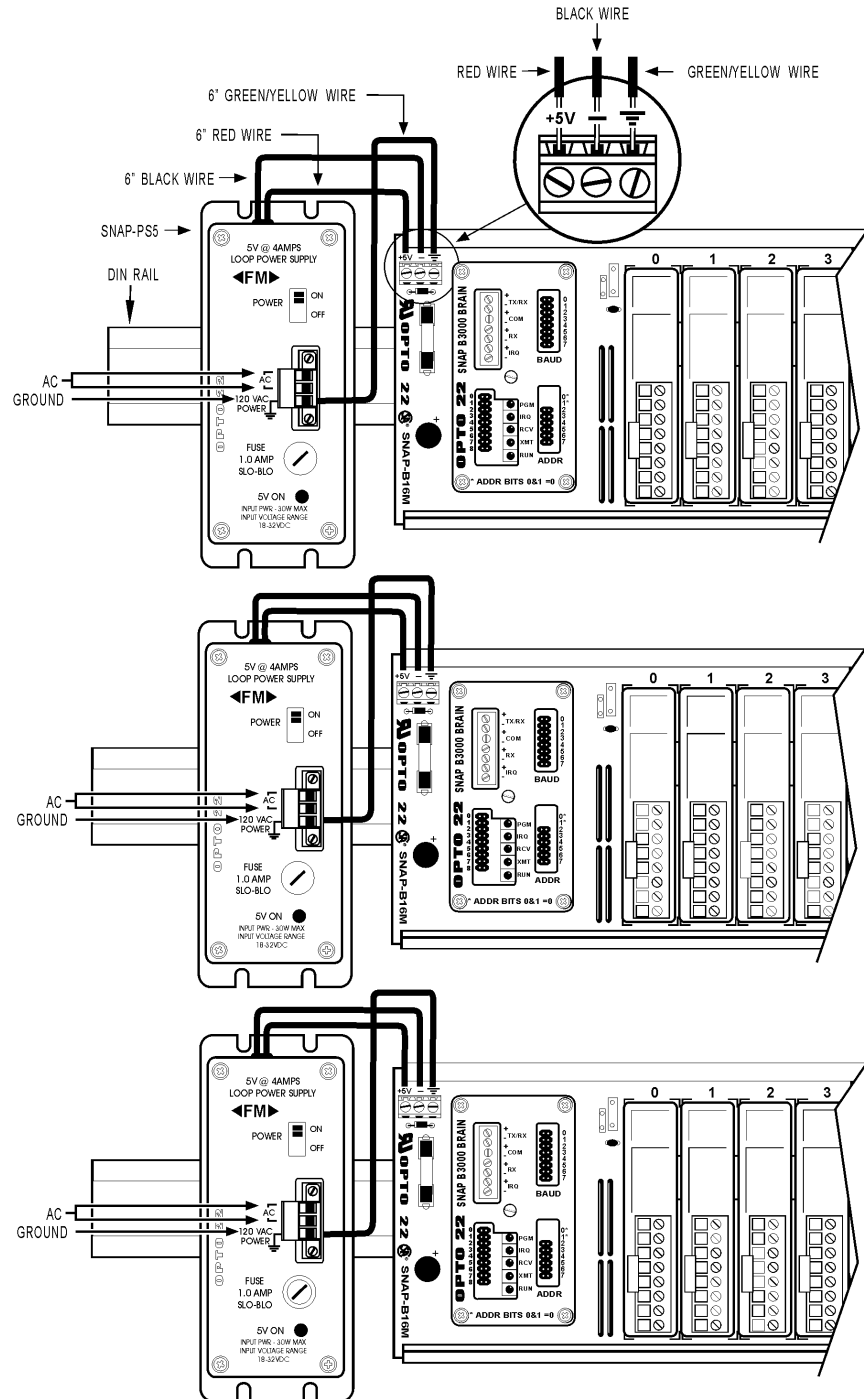
Measure ground isolation from the negative terminal on the power connector to chassis or system ground. Ideally, your meter should read "open circuit." An acceptable resistance measurement would be greater than 1 megaohm.



EXAMPLE DIAGRAMS

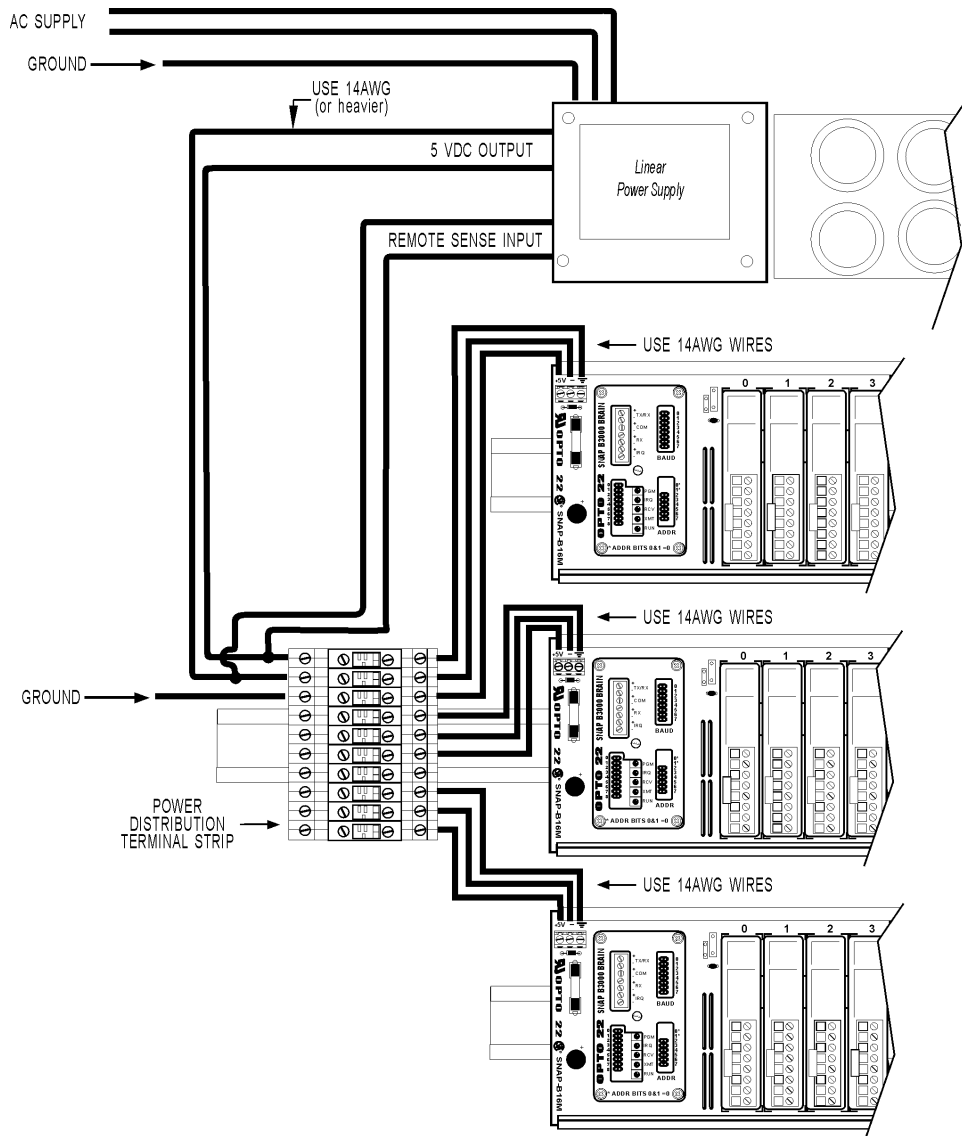
Preferred Method: One Power Supply Per Rack

The following diagram shows multiple SNAP racks with SNAP brains using one Opto 22 power supply per rack (recommended).



Alternate Method: Linear Power Supply for Multiple Racks

The following diagram shows SNAP racks with SNAP brains using one Power-One Linear power supply with remote sense for multiple racks.



- Use 14 AWG wire between the power supply and the Opto 22 racks.
- Connect only racks with the same current load to one power supply to minimize voltage differences from one rack to the next.
- Use equal length wires from the power distribution terminal blocks to each rack.
- Connect chassis ground to the ground connector on each rack.
- Connect the remote sense input of the power supply to the power supply side of the power distribution terminal blocks.
- Adjust the power supply voltage so that the voltage measured at each rack is between 5.10 and 5.20 VDC. Do NOT exceed 5.20 VDC on any rack! Measure voltage at the "downstream" side of the fuse on the rack.

PRODUCTS

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

Industrial automation, process control, building automation, industrial refrigeration, remote monitoring, data acquisition, and industrial internet of things (IIoT) applications worldwide all rely on Opto 22.

groov EPIC® System

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

groov EPIC gives you an industrially hardened system with guaranteed-for-life I/O, a flexible Linux®-based controller with gateway functions, and software for your IIoT application or any application.

groov EPIC I/O

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

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

groov EPIC Controller

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

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

Configuring and troubleshooting I/O and networking is easier with the EPIC's integrated high-resolution touchscreen. Authorized users can see your *groov* View HMI locally on the touchscreen or on a monitor connected via the HDMI or USB ports.

groov EPIC Software

Software includes:

- Flowchart-based PAC Control for control programming, or build your own custom application with optional secure shell access
- *groov* View for building and viewing your own device-independent HMI
- Node-RED for creating simple logic flows from pre-built nodes

- Ignition Edge® from Inductive Automation®, with OPC-UA drivers to Allen-Bradley®, Siemens®, and other control systems, and MQTT/Sparkplug communications for efficient IIoT data transfer

groov Edge Appliance

Visualization, data handling, and connectivity in a compact, industrial box: that's the *groov* Edge Appliance. Included are:

- *groov* View for building and viewing operator interfaces on PCs and mobile
- Node-RED for building simple logic flows
- Ignition Edge from Inductive Automation, for OPC-UA drivers and MQTT/Sparkplug IIoT communications



Older products

From solid state relays (our first products) to world-famous G4 and SNAP I/O, to SNAP PAC controllers, Opto 22 products last a long time. You can count on us to give you the reliability and service you expect.



QUALITY

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

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

FREE PRODUCT SUPPORT

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

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

PURCHASING OPTO 22 PRODUCTS

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