USING OPTO 22 ANALOG MODULES WITH VARIABLE FREQUENCY DRIVES

INTRODUCTION

Variable frequency drives (VFDs) control output speed and torque on an AC motor, adjusting the motor's output to match requirements.

VFDs are often installed to save energy. VFDs save energy in two ways: by ramping the motor up instead of abruptly starting it (which takes less energy and reduces stress on the motor), and by running the motor only at the level required for current needs. Because VFDs save electrical energy, many utility companies offer rebates if customers add them to their motors.

Typically VFDs are used with three-phase motors. You can choose from a wide variety of VFDs to handle various motor sizes, designs, and applications.

A VFD can be automated so it controls the motor based on specific conditions or processes. For example, you could automate a VFD to control the motor of an air handling unit in response to the value from a thermocouple input or even as part of a PID (proportional integral derivative) loop.

This technical note briefly discusses how to use Opto 22 analog modules for this purpose. In addition, it discusses two methods to minimize electrical noise from the VFD and therefore produce more accurate readings.

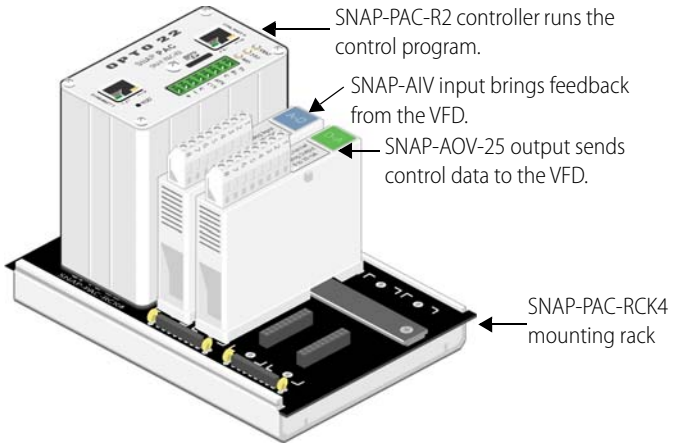
CONTROLLING VFDS

An Opto 22 I/O processor (SNAP PAC rack-mounted controller or brain) and SNAP I/O analog modules are frequently used to control VFDs. Older model analog I/O modules such as G4 or G1 and compatible brain boards and controllers can also be used.

Consult the user's guide for the VFD model you have. The guide should show wiring and options for controlling the drive using an external source. Usually you can control VFDs to change speed based on an analog input value such as 0–10 VDC or 4–20 mA. Then connect an analog output module to the VFD control circuit as shown in the VFD manual. Program the I/O based on the details of your application.

SNAP I/O Example

For example, you could use a SNAP-PAC-R2 rack-mounted controller and a SNAP-PAC-RCK4 mounting rack, with a SNAP-AIV (0-10 VDC) for speed feedback from the VFD and a SNAP-AOV-25 (0-10 VDC) for the drive signal into the VFD. This combination is illustrated on the following page.



Wire the I/O to the VFD as shown in the VFD's manual. Program the controller using free PAC Project control software (HMI is also included if you need it).

Additional points on the I/O modules can be used for the inputs that determine motor requirements, for more VFDs, or for other application needs. Additional I/O modules can be added and a larger rack used if required.

REDUCING ELECTRICAL NOISE

Variable frequency drives (VFDs) are inherently noisy devices. When an analog module is used to interface with a VFD, the electrical noise from the VFD can sometimes cause interference with the analog module. The VFD adds high-frequency distortion to the signal that the Opto 22 analog module expects.

The best solution to this noise problem is to shield and ground each cable of the VFD installation. Alternatively (or in addition), you can add a low-pass filter to the analog signal circuit, as close as possible to the analog module.

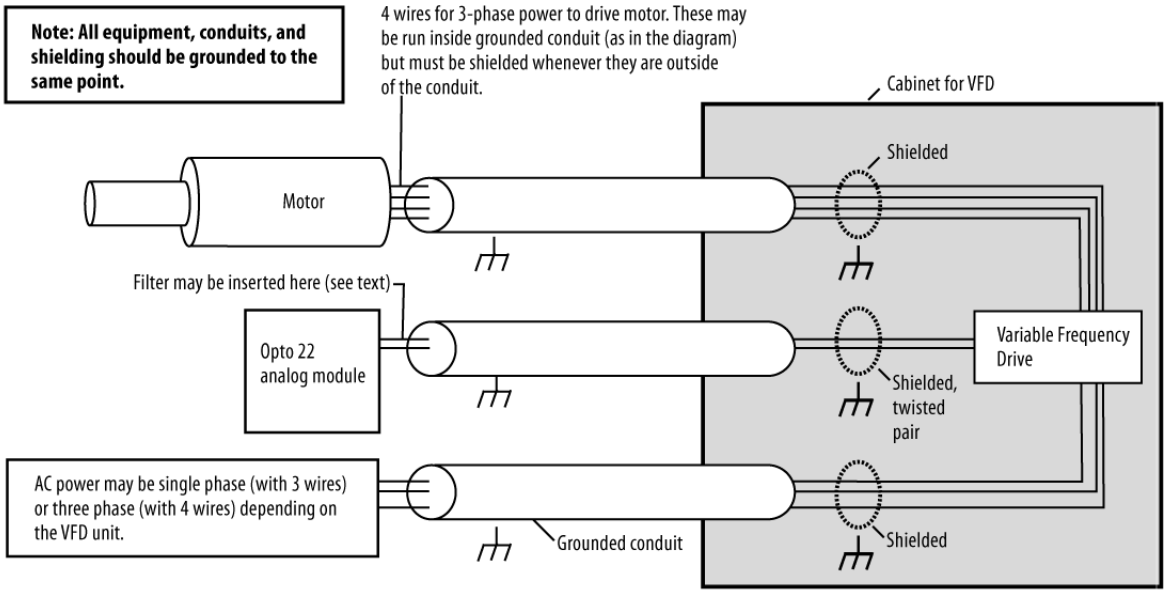
Start by reviewing the installation manual for your VFD for recommendations to minimize electrical noise.

Shield Wiring

Next, shield all of the wiring going into and out of the VFD's terminal strip, and ground the shields to the same earth point. Shielding the wiring up to the VFD cabinet enclosure is not enough; the shielding must be continued inside the VFD enclosure all the way up to the VFD terminal strip to minimize the noise effects.

Also, use *separate* grounded conduits or shielded cables for the power feeding the VFD, the power from the VFD to the motor, and the analog signal wires between the analog module and the VFD. Ensure that all equipment is tied in close proximity to the same earth ground.

The figure below illustrates these instructions for minimizing high-frequency interference from the VFD.



TIP: Do not run the power and control wires in parallel. If they are run in parallel (especially when close to each other), the harmonic noise from one wire is coupled to the other wire. Keep the power and control wires as far apart as possible. When they must cross, cross the power and control wires at 90-degree angles to prevent noise from being coupled to the control wires.

Add a Low-pass Filter

If shielding all of the cables to ground doesn't lower the VFD's noise effects enough, add a low-pass filter between the VFD and the Opto 22 analog module.

Radio frequency interference (RFI) power line filters can be used for this purpose and are readily available. One possibility is TE/Corcom part number 1VR1, which can be purchased through Newark Electronics (Newark part number 52K3854).

Connect the two line terminals on the filter to the output of the Opto 22 module, and connect the two load terminals to the analog input of the VFD. The ground terminal on the filter must also be grounded with all other equipment.

As shown in the figure above, insert this filter as close as possible to the Opto 22 analog module in order to minimize noise passed to the module.

For Help

For help using Opto 22 analog modules with VFDs, you can ask questions on the OptoForums

(http://www.opto22.com/community/forum.php) or contact Opto 22 Product Support.

Product Support is free.

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

Email: support@opto22.com

Opto 22 website: www.opto22.com

More about Opto 22

OPTO 22

PRODUCTS

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

groov RIO®

groov RIO edge I/O offers a single, compact, PoE-powered industrial package with web-based configuration and IIoT software built in, support for multiple OT and IT protocols, and security features like a device firewall, data encryption, and user account control.

Standing alone, *groov* RIO connects to sensors, equipment, and legacy systems, collecting and securely publishing data from field to cloud. Choose a universal I/O model with thousands of possible field I/O configurations, with or without Ignition from Inductive Automation®, or a RIO EMU energy monitoring unit that reports 64 energy data values from 3-phase loads up to 600 VAC, Delta or Wye.

You can also use *groov* RIO with a Modbus/TCP master or as remote I/O for a *groov* EPIC system.

groov EPIC® System

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

groov EPIC Processor

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

In addition, the EPIC provides secure data communications among physical assets, control systems, software applications, and online services, both on premises and in the cloud. No industrial PC needed.

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

groov EPIC I/O

groov I/O connects locally to sensors and equipment. Modules have a spring-clamp terminal strip, integrated wireway, swing-away cover, and LEDs indicating module health and discrete channel status. *groov* I/O is hot swappable, UL Hazardous Locations approved, and ATEX compliant.

groov EPIC Software

The *groov* EPIC processor comes ready to run the software you need:

- Programming: Choose flowchart-based PAC Control, CODESYS Development System for IEC61131-3 compliant programs, or secure shell access (SSH) to the Linux OS for custom applications
- Node-RED for creating simple IIoT logic flows from pre-built nodes
- Efficient MQTT data communications with string or Sparkplug data formats
- Multiple OPC UA server options
- HMI: *groov* View to build your own HMI viewable on touchscreen, PCs, and mobile devices; PAC Display for a Windows HMI; Node-RED dashboard UI
- Ignition or Ignition Edge® from Inductive Automation (requires license purchase) with OPC-UA drivers to Allen-Bradley®, Siemens®, and other control systems, and MQTT communications

Older products

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

QUALITY

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

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

FREE PRODUCT SUPPORT

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

Support is always available on our website, including free online training at OptoU, how-to videos, user's guides, the Opto 22 KnowledgeBase, and OptoForums.

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.

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