SIEMENS

APPLICATION GUIDE

AG080819

Variable Frequency Drives and Instrumentation

Using Variable Frequency Drives and Instrumentation Without Interference

Objective: How to prevent EMC interference between VFDs and instrumentation

Equipment: VFD drive and Process Instrumentation

Overview:

This application guide describes the function of Variable Frequency Drive (VFD) and provides tips on how to prevent interference issues when VFDs are used with process instrumentation

What is a Variable Frequency Drive?

A Variable Frequency Drive or VFD controls the rotation of an alternating current motor by varying the frequency of the electrical power supplied to the motor.

These flexible systems provide accurate speed control and minimize energy usage by matching motor output to a required load. For example, rather than using a fixed speed motor for a fan or pump and inefficiently controlling flow output through a damper or valve, the motor speed can be varied to directly control the rate of flow. VFDs also have soft start capabilities that reduce peak current draws and wear on electrical and mechanical parts.

These devices are also known as Variable Speed Drives, Adjustable Frequency Drives, or Inverter Drives.

How does a VFD Work?

A 'drive' refers specifically to the voltage and frequency converter that controls the output to the motor. A complete system generally includes a drive converter, an AC motor, and a configuration and control interface.

The drive converter takes an Alternating Current (AC) input and rectifies it to Direct Current (DC). This intermediate DC voltage is changed again to AC at a desired frequency and amplitude using a switching inverter stage. This voltage is output to a motor and the frequency and amplitude varied by a microcontroller to control speed.

The motor is typically a three-phase induction motor, although other configurations are possible.

The configuration and control interface for the VFD system can be a Human Machine Interface (HMI), a setpoint input or a module for interfacing to a communications bus, such as PROFIBUS DP.

What are the steps to minimize EMC issues from VFDs?

The operating function of VFDs causes electromagnetic noise. The high-speed switching of the inverter stage can emit significant radio frequency energy. Without mitigation, this energy can interfere with other nearby electrical equipment.

Process control and sensor instrumentation is often found in the same area of a factory or process as VFDs. Some of this equipment can be sensitive to interference from electromagnetic sources and this can cause performance degradation ranging from incorrect measurements to disabled instruments. Precise and reliable measurements require careful installation and configuration.

Some general installation recommendations will apply in all cases where instrumentation and VFDs are mounted near each other.

- Install Electromagnetic Compatibility (EMC) filters on the line side of the drive converter.
  This will prevent noise from traveling back through the mains and affecting other equipment.
- Use shielded motor feed cables as recommended by the VFD manufacturer.
  The manufacturer will know the characteristics of the energy from the drive and will know the optimum cable specifications to keep this energy contained.
- The length of feed cables between the drive and the motor should be as short as possible.
  This will reduce line losses and will also reduce cost.
- Instrumentation cables and drive components should be as far apart as possible.
  Doubling the separation distance will reduce power of the radiated energy to one quarter of its previous value.
- Avoid parallel runs of drive cables and instrumentation cables.
  Cables run in parallel can allow radio frequency energy from one to be induced in the other.
- If an instrumentation cable must cross a drive cable, it must do so at a 90 degree angle.
  This will provide a minimum area of coupling between the cables.
- Use shielded and/or twisted pairs for instrumentation cables.
  These types of cables are designed to both contain and resist Radio Frequency (RF) emissions.
- Install cables close to metal surfaces to avoid creating an antenna effect.
  Cables raised off metal surfaces can increase the amount of electromagnetic energy transmitted or received by the cable.
- Keep signal cables away from motors and transformers, as they can generate large magnetic fields.
  Magnetic fields can induce currents into nearby cables.
- Follow all grounding recommendations from the VFD and instrumentation supplier.
  Grounding is important for both safety and noise suppression.
- Follow all guidelines for installing wireless communication products and antennas.
  Incorrect grounding or orientation of antennas can severely reduce their effectiveness and noise immunity.
- Use quality instrumentation that has the CE or FCC mark.
  Equipment with this designation has been designed, tested and certified to withstand normal levels of electromagnetic interference.

Standards Governing Electromagnetic Compatibility (EMC) of VFDs

The specifics of electromagnetic compatibility and standards are beyond the scope of this document, but an overview is provided. Contact the drive manufacturer for specific details and regional requirements.

In Europe, VFDs are covered under EMC product standard EN or IEC 61800-3 for Power Drive Systems. This standard covers the complete system including drive, interface, motor, and cables.

In the United States, VFD systems are covered in a general manner by FCC CFR Title 47, Part 15, but there are no specific product requirements or test procedures.

The manufacturer of the drive is not responsible for guaranteeing the EMC performance of the fully installed drive and motor, but they will provide information on the EMC characteristics, use, and installation of the device as part of a drive system.

Generally, the manufacturer can also supply optional filters and other equipment that will improve EMC performance.