VFD Installation Guidelines

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This document offers *suggestions* for proper installation of Variable Frequency Drives commonly deployed in industrial environments. Most of the information contained is compiled from research from drive and filter manufacturer's web sites as well as our own industrial control field experience. Logix assumes no responsibility for the accuracy or suitability of any portion of this document. In particular, all local and national electrical codes must be strictly followed. Ultimately, it is the installer's responsibility to insure proper precautions and techniques are followed. We strongly suggest that the VFD installer work closely with the drive manufacturer as well as a reputable VFD filter manufacturer to derive a suitable installation scheme.

VFD RFI/EMI Problems

The output waveform of a typical VFD Pulse Width Modulated (PWM) drive consists of relatively high frequency components (typically up to 500 kHz) and if not properly installed will cause interference with electronic devices including industrial control systems, security and fire systems, sensor readings, communication links and computer networks. This type of interference is known as Radio Frequency Interference (RFI) or Electro-Magnetic Interference (EMI). High frequency energy such as RFI/EMI behaves much differently than common 60 cycle power. RFI/EMI can easily pass through air between two insulated wires simply laying close to one another. Circuits that are adequate for 60 cycle power are not necessarily suitable for use with high frequency power. Long wire runs between the VFD and motor can lead to premature motor failure due to the "reflected wave" phenomena, with waveform voltage overshoot that can be 1400 Volts or higher. The high voltage stresses and eventually causes motor insulation failure. Fortunately, RFI/EMI reduction techniques also reduce this reflected wave greatly reducing motor insulation stress and failure.

It is not uncommon to experience interference in which harmonic distortion is assumed to be the cause, when in fact it is an EMI/RFI issue caused by improper installation practices or the absence of EMI/RFI filters in the VFD. It is important to understand that VFDs generate high frequency noise on the output (due to the PWM waveform) and that harmonics (low frequency noise, typically 300-660 Hz) are generated by the input of the VFD. It is vastly easier to eliminate the source of the interference at the VFD itself than to attempt to minimize the affects of the interference at each electronic device.

Additionally, the quality of VFD units varies. Often, an inexpensive drive will generate more RFI/EMI than a more expensive better designed drive.

General Wiring Guidelines

When connecting the VFD's power and control wiring, the following guidelines should be followed:

1. Install the input AC power wiring in its own rigid steel conduit.
2. Install the output motor wiring in its own rigid steel conduit. In some cases, it may be necessary to use special VFD rated insulated metallic conduit such as that manufactured by Zero Ground (www.zero-ground.com).
3. Install the control wiring in its own rigid steel conduit. Low voltage DC control wiring and 120 VAC control wiring should be in separate conduits.

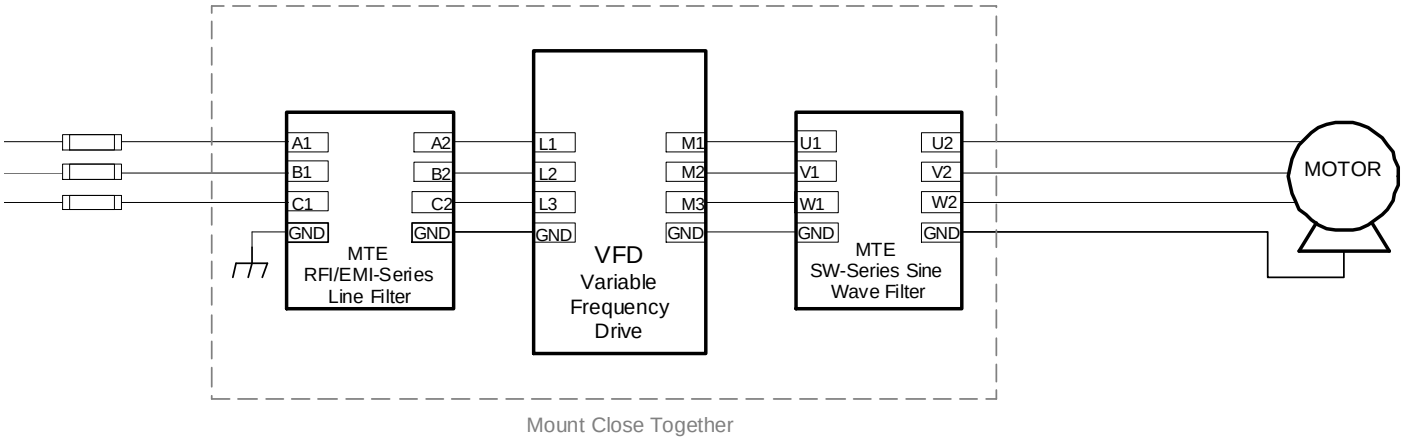
4. Do not utilize wiring tray for any portion of the VFD installation.
5. Keep control wiring (including control wiring in conduit) at least 36" away from all VFD power/motor wiring. If they must cross, cross only at 90 degree angle.
6. Make sure that all ground connections are tight and properly earth grounded. The ground between the VFD and motor is particularly important.

NOTE: In installations with multiple VFD Drives, the input power wiring for all of the VFD's can be in the same conduit, and the control wiring can be in the same conduit, but the output wiring for each motor MUST be in a separate conduit. However, if one VFD is used to operate multiple motors, the output wiring for all of the motors can be in the same conduit. To avoid the vast majority of EMI/RFI issues, there must be three separate conduit entrances to the VFD: for incoming power, motor power, and control (low voltage) wiring. PVC conduits and wire troughs are the most common source of high frequency electrical noise interference problems as they do not provide any shielding for the motor wiring.

Proper VFD RFI/EMI Filtering

Both a RFI/EMI line filter and a Sine-Wave type load filter should be utilized to minimize both electrical interference and reduce risk of premature motor failure.

Typical VFD Line/Load Filtering



MTE Corporation (www.mtecorp.com) is one of several suppliers of these types of devices.

Harmonic Line/Load Reactors

Line/Load Reactors typically deployed with VFDs only minimally reduce RFI/EMI type interference. Both line and load reactors may also be required to meet IEEE 519 harmonic requirements. 5% impedance reactors are best for reducing harmonic currents and frequencies and should be utilized to comply with IEEE 519, reducing both motor electrical interference (EMI/RFI) and motor operating temperature. Some drives have these devices built-in, other do not. Again, MTE Corporation (www.mtecorp.com) is one of several suppliers of these types of devices.