

Technical Note

Title:	VeriSafe Absence of Voltage Tester installation considerations in electrical systems with variable frequency drives
Document No.:	C11729
Revision:	0
Authors:	Stephen Penley

Revision History

Revision Number	ECN	Date	Editor	Summary of Change
0	GAECN05255	4/30/2018	STMP	Initial Release

VeriSafe Absence of Voltage Tester (AVT) and Electro-Magnetic Compatibility (EMC)

The VeriSafe is an absence of voltage tester (AVT) for use on 3-phase or single-phase AC power systems operating at 50 or 60 Hz up to 600 Volts rms. The function of the VeriSafe AVT is to verify a circuit is de-energized prior to opening an electrical enclosure.

The appropriate termination location will vary depending on the design of the electrical system but, generally the best location for installation will be at a point near the power entry into the cabinet being serviced, typically connected to the incoming phase wires at or near the disconnect (see figure 1).

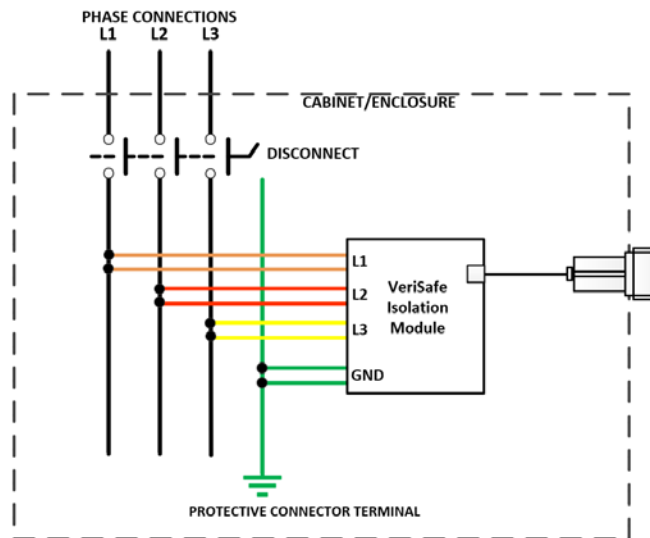


Figure '1', Typical Connection

Technical Note

As with any device installed in an electrical system, the VeriSafe AVT has the potential to be exposed to electro-magnetic energy present on the conductors and originating from other components in the system. The VeriSafe AVT has been tested and verified to withstand electromagnetic interference, both radiated and conducted, within the EMC guidelines defined by the International Electrotechnical Commission (IEC). The basic standard is: *IEC 61326-3-1:2008 - Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-1: Immunity Requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General Industrial applications. Generic standards – Immunity for industrial environments*

This standard requires the tested device not to be affected adversely by:

- Conducted Radio frequency energy - 10 Volts rms, amplitude modulated 80% at 1kHz, ranging from 150KHz to 80MHz.
- Electrical Fast Transients/Burst – 3kV pulse with a waveform of 5/50ns, repeating at a frequency of 5kHz
- Surges – 4kV 1.2/50µS waveform, individual pulses

The purpose of requiring certification to this standard is to ensure that the AVT can properly operate and not malfunction when exposed to electro-magnetic-interference (EMI) that is likely to occur in an industrial environment.

In general, electronic devices can be adversely affected when exposed to electromagnetic fields, surges, power spikes and incidences of electrical voltage outside of the intended operating range. Exposure to high levels of EMI can cause unintended operation and/or interfere with normal operation. If the energy is high enough it can cause damage to the device.

Variable Frequency Drives

A variable frequency drive (VFD) provides control of motor speed and torque by taking the incoming fixed frequency AC power, converting it and generating an output that varies in voltage and frequency (see figure 2). This frequency conversion process allows very good control of the motor speed and torque.

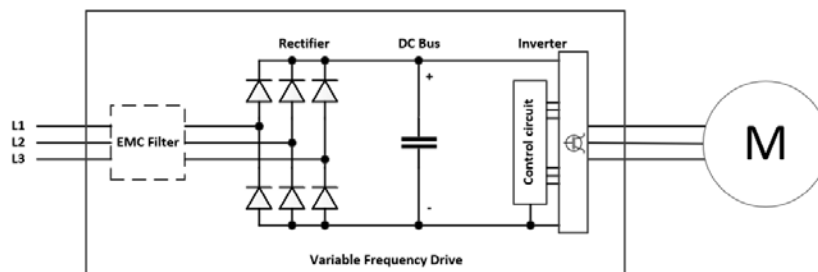


Figure '2', VFD Block Diagram

Technical Note

The incoming AC voltage is rectified and filtered to create DC voltage. This DC voltage is then switched using electronic controls to create the variable output to drive the motor. VFD's switch on and off large amounts of current during operation. This switching is a source of electrical noise internally to the VFD as well as externally. With some VFD's, that EMI can far exceed the limits defined by the IEC 61326-3-1:2008 standard. Some VFD's include internal filtering circuits to limit the amount of generated EMI. Other VFD's require the use of external filters, line reactors or isolation transformers to prevent generated EMI from affecting other equipment. The design of the system incorporating the VFD will determine the need for the external filtering.

VFDs have the potential to induce EMI in the form of harmonics back into the input power source. Power line harmonics have the potential to cause problems for other equipment connected to the same power source as the equipment generating the harmonics (see figure3).

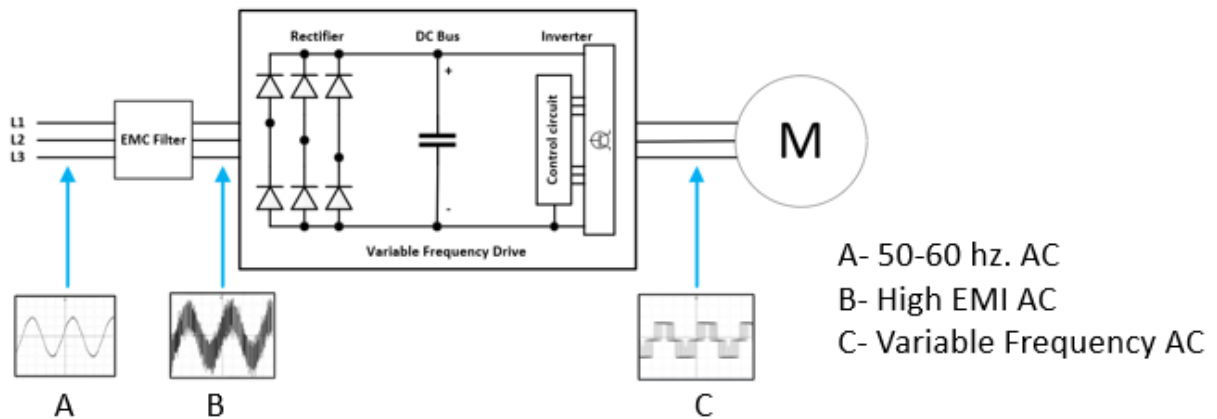


Figure '3', VFD Waveforms

Problems caused by power line harmonics:

- Equipment failure and mis-operation
- Control malfunction
- Overheating/ failure
- Breaker tripping
- Deterioration of insulation
- Power losses and inefficiencies in the operation of equipment

Mitigation methods for reducing Generated Harmonics include the use of:

- Line reactors
- Passive filters
- Active filters
- Isolation transformers
- Harmonic mitigating transformers
- Regenerative VFDs

Technical Note

The design of the system incorporating the VFD will determine the proper methods and types of filtering that may be required.

VeriSafe Installation in Electrical Systems Including Variable Frequency Drives

The VeriSafe AVT is designed for operation in 50/60Hz systems up to 600V. Although it has been certified to withstand expected EMI and transients that may occur in an industrial environment, there is a potential for the device to overheat and to be damaged if exposed to high levels of emissions which exceed the levels in IEC 61326-3-1:2008.

Care must be taken when installing the VeriSafe AVT into a VFD system or any other system that includes components capable of modifying the frequency or producing electromagnetic energy beyond the levels defined by the IEC 61326-3-1:2008 standard. The VeriSafe AVT should always be installed per the Instruction Manual, connected either immediately before or after the electrical disconnect and not after any type of equipment or device whose purpose is to provide filtering for a VFD (see figure 4).

If there are any EMC filters installed in the system external to the VFD the VeriSafe AVT should be connected to the line before the filtering components. The VeriSafe AVT should not be installed between the filter and the drive, it should also not be connected between the drive and the motor being driven.

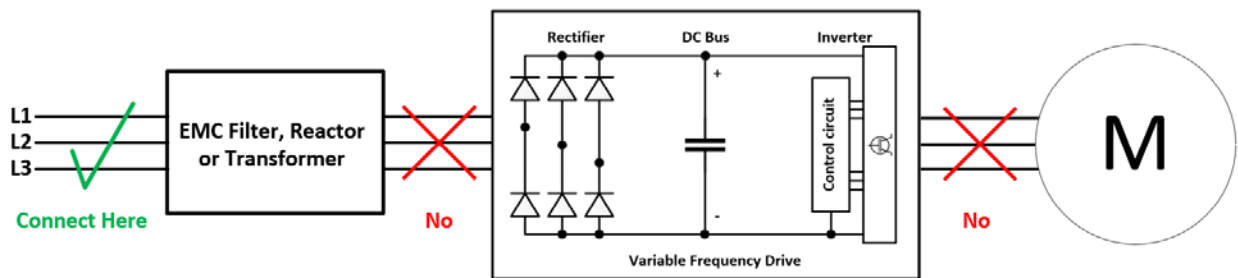


Figure '4', VeriSafe Installation Location in a System Containing a VFD