

## Overview

The increased use of variable frequency drives (VFDs) coupled with increased usage of precision electronics has resulted in challenges for industry. A particularly onerous problem in the waste-water industry relates to running motor protective sensor wires in the same conduit or wireways as the power wiring of VFD driven motors. Formerly this made no difference when wiring was connected to electromechanical relays. But when high frequency drive circuits are combined with precision electronic monitoring, an unsatisfactory condition may arise.

Magnetic induction and capacitive coupling between parallel drive and sensor wiring can result in noise at a level of  $\pm 250$  volts. This voltage "rides" on the low voltage DC signal and is not random. Due to its high frequency it may not register on a simple voltmeter and only register 10-40 volts on a high quality RMS digital voltmeter. But it is real and has the potential to cause damage to pump protection sensing circuitry.

The best solution to the problem is to maintain adequate spacing between power and sensor wiring and have them cross only at right angles. But on some applications – particularly retrofits – this is not practical.

The MVF-2 is an effective alternate solution on these and similar applications where low voltage sensor wiring is affected by the high-frequency, high-energy noise from VFDs.

## Operational Description

The MVF-2 consists of two identical, independent filter channels each of which is made up of two identical lines of filtering. Each of the lines may be used for such applications as PLC inputs or many other monitoring devices with the exception of RTD circuits.

On page 2 there are wiring diagrams for the MOS series of pump protection relays manufactured by MTS. Other controllers with electronic pump protection inputs, such as the Xylem Multi-Smart® controller can likewise benefit from the MVF-2.

The MVF-2 passes a DC signal with only a minimal resistance, but effectively filters out the high-frequency noise component. For example, at 6 kHz, the noise is attenuated by about a factor of about one thousand. Contact MTS for a graph of attenuation versus frequency.

## Assessing the Need

Not all systems with VFDs will require the MVF-2. The severity of the problem is related to wiring lengths, geometry of wiring within a harness or wireway, and pump drive characteristics. Without rigorous testing with an oscilloscope it is impossible to quantify the risks precisely. However the procedure below can be used as a practical determinant.

(1) Ensure proper grounding of the system. Pump protection relays are typically designed to be earth grounded at only a single point. If a relay uses earth ground as a return from a pump sensor, no other ground is necessary or desirable. Multiple grounds introduce the potential for a ground loop.

Note: For MOS applications with two isolated circuits, pin 4 of the MOS should be earth grounded.

(2) If possible set the carrier frequency of the VFD to the lowest setting possible. The negative consequence of this is increased motor noise—hardly a problem for submersible pumps. This lower frequency will substantially minimize induced voltage on the sensor wires.

## A Simple Test

Remove all sensor wires from the pump protection module or other device. Using wire-nuts, attach a 1 k-ohm, 1/4 watt resistor across each sensor pair. Using a true RMS digital voltmeter, measure the AC voltage across each pair with the VFD both off and on with its normal load.

With the motor OFF, the reading should be zero or no more than 100 millivolts. If the voltage measured when the motor is ON is greater than 1.75 VAC, then the system is likely at risk and the MVF-2 should be considered.

## Installation of the MOS series of Pump Protection Relays

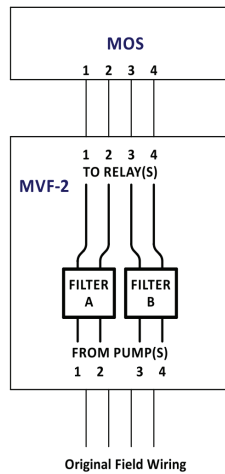


Figure 1. MOS 4-wire Installation  
Remove field wires from the MOS and attach to corresponding pins on the MVF-2.

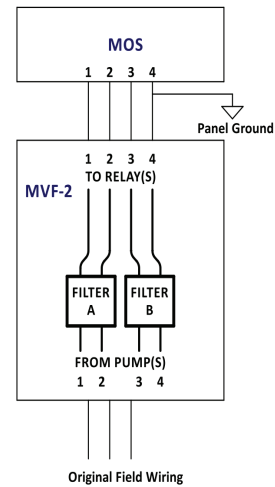
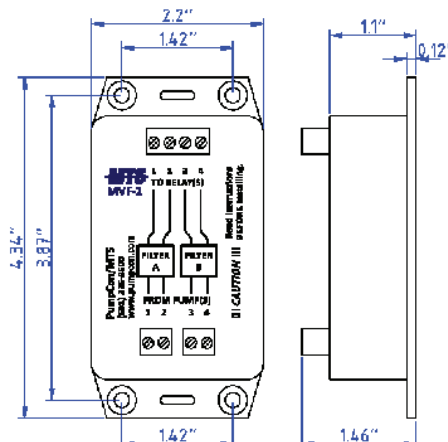


Figure 2. MOS 3-wire Installation  
When seal fail circuit uses a single return, ground pin 4 on the MOS. Note all 4 leads must be connected.

## Mechanical



## Agency Approvals

The MVF-2 is a low voltage, passive circuit and does not require agency listings. It is an energy storing device and may not be used in hazardous locations.