

INVERSINE™ Advanced Universal Sine-wave Filter



Key Features

- Low insertion loss and voltage drop (<2% of rated voltage)
- No damping resistors required
- Power delivered to motor >96%
- Efficiency >98%
- Improves Power Factor of the motor near unity
- Reactive power compensation
- Prevents transient overvoltages at motor terminals
- Reduces motor noise
- Filters out high frequency currents while allowing lower fundamental currents to pass
- Reliable and proven performance

Inversine Applications

- When Motor does not have adequate insulation for ASD duty
- Using a number of parallel motors
- Long Motor cable length
- When Step-up/Step-down transformer is used between ASD and motor
- There are specific requirements for peak voltage level and dV/dt rise time
- Motor noise needs to be reduced
- Maximum safety and reliability is needed in hazardous environments
- Submersible pumps with long motor cables used in the oil & gas industry

Problems Associated with PWM Inverter Operation

Pulse Width Modulated (PWM) output voltage waveform of inverter equipped Adjustable Speed Drive (ASD) systems can greatly stress a standard induction motor. This is primarily due to the rapid change in voltage (high dV/dT) produced by the inverter's switching action.

High dV/dT combined with a mismatch between cable and motor surge impedance can result in reflective wave phenomenon back at the motor terminals. Voltages can increase by as much as 2 to 3 times nominal peak levels possibly exceeding the insulation rating of the feeder cables and motor magnetic wire leading to insulation stress, partial discharges and eventual failure. This problem can result with short cable runs but becomes magnified with long cable runs.

Typical problems experienced can include motor and winding failure, motor noise, cable insulation degradation, premature ASD failure, common-mode and reflected wave phenomenon and high EMI/RFI.

INVERSINE Differential Mode

The Inversine Advanced Universal Sine-wave Filter (AUSF) is designed to address the problems resulting from pulse width modulation. It is a low pass filter with cutoff frequency well below the switching frequency of the inverter.

The AUSF is much more than a simple dV/dT filter and will:

- substantially reduce voltage rise time (dV/dt)
- convert output voltage to near sinusoidal waveform (<3%)
- prevent transient overvoltages at motor terminals
- lower harmonic losses in the motor
- reduce motor noise
- reduce motor and cable insulation stress
- extend life of the motor and ASD

INVERSINE Common-mode Option

Common-mode is the phase-to-ground voltage that appears as a result of the instantaneous sum of the 3-phase voltages of the PWM inverter not being zero even when the sum of the average 3-phase voltages is zero. Common-mode voltages will induce common-mode currents to flow through parasitic capacitance in the motor and motor feeder cable. High frequency capacitive coupling exists across the motor bearings and between the feeder conductor or motor winding and ground. Common-mode currents can lead to premature motor bearing failure.

The Inversine Common-mode Filter option will:

- Reduce shaft voltage and bearing currents
- Reduce cable leakage currents
- Reduce common-mode voltages throughout power system

