The MPTS Tames Harmonic Problems Caused by Variable Frequency Drives

Variable Frequency Drives, VFDs, are widely used in industry to control the operation of induction motors. They allow the operator of the motor to control it's speed, torque, and starting current. These useful properties of VFDs come at a cost, namely a small loss of efficiency and the generation of significant harmonics back onto the power mains, which often causes problems in the operation of other equipment in the facility housing the VFD.

Harmonics are voltages that are integer multiples of the basic power line frequency, which is 60Hz in the USA, Canada and Mexico, and 50HZ in most of the rest of the world. A common measure of the harmonic content on a electric power line is Total Harmonic Distortion(THD). THD is a mathematical composite of all the harmonic voltages or harmonic currents on a power line. THD is a measure of the percentage of voltage or current distortion on a power line. Harmonics are produced by some types of loads, non-linear loads, that are connected to the power mains. Examples of these harmonic producing non-linear loads are switching power supplies, AC and DC motor drives, and VFDs.

High levels of harmonics can produce excessive heating in transformers, capacitors, and motors. They can cause problems with telephone equipment, computers, and process control equipment, to name just a few. The problem is so serious that the IEEE has developed standard 519-1992, "IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems" to assist in dealing with harmonics. This standard recommends limits on the allowable THD on power mains for various types of industrial, and consumer environments. For hospitals and airports, activities involving safety of

life, THD should not exceed 3%. For general commercial systems 5% is the recommended THD upper bound and for heavy industrial applications up to 10% THD is acceptable.

A VFD takes in 3-phase AC power, converts it to DC power for use by it's electronics in order to produce an output waveform that controls the speed and torque of an attached induction motor. In the process of converting the AC power to DC, some VFDs can produce harmonic distortion, THD, as high as 25%! If there are many VFDs operating at a facility, their combined harmonics can raise the levels on the power mains well above the limits in IEEE 519-1992. To reduce the level of harmonics that a common 6-pulse rectifier VFD produces, VFD manufacturers have developed more sophisticated 12-pulse and 18-pulse rectifier VFDs. This added complexity comes with a steep price multiplier of 400% to 500% per VFD. These VFDs are also typically larger in size to accommodate the extra rectifiers and specialized transformers. Unfortunately, if the current flow in any of the 3 phases is not within 3% balance with the other phases, almost all of the harmonic mitigation will be negated!

The MPTS acts as a partial short circuit for the harmonic voltages and current on the power mains that it is attached to. In one case study the THD was reduced from 10+% to 2.5-3.0%. This was accomplished without expensive custom designed filters and without altering the operation of any of the equipment at the case study facility. When the operations of the facility change, due to environmental changes or expansion of programs, the MPTS adapts to the changes "on-the-fly" in real-time. Clearly, custom designed harmonic filters are

not as agile and adaptive as the MPTS. The MPTS offers a dynamic solution to the power conditioning requirements in today's high tech commercial and industrial environments.