Faulty Drive Operation? Check Grounding And Wiring First

By Ray Waggoner, Consulting Editor

If you are faced with unexpected variable-speed drive shutdown, where is the first place you look to troubleshoot the problem? The drive internally or maybe its power source? Think again; the problem may stem from something as mundane as the drive's grounding and wiring.

Looking in all the wrong places

A facility engineer in a food processing plant asked us for help in finding the cause of faulty operation of the plant's process lines. It seems the conveyor system motors, powered by recently installed variable-speed drives, stopped unexpectedly, causing considerable problems and reductions in production levels. Every time a conveyor stopped, the electrical maintenance crew had to manually restart it.

At first, the engineer firmly believed a harmonic interaction somewhere in the electrical distribution system was the culprit. With his input, we began our investigation, inquiring about drive systems used as well as their sizes. The conveyor system consisted of three 5-hp motors, each driven from an appropriately sized drive. Although a few other drives existed in the plant, only these three conveyor drives experienced unexpected shutdowns. Moreover, they were the only “sensitive” equipment in the processing area. We also noted the 3000kVA building service.

Based on this information, we found it extremely doubtful that a harmonics interaction problem existed. After all, the amount of non-linear loads on-line, relative to the size of the electrical distribution system, was minimal. Nevertheless, we took voltage and current measurements at the building service using a true-rms sensing DMM and found they fell within normal operating parameters.

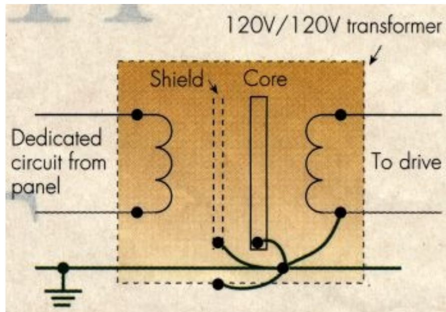
To fully discount the harmonic interaction theory, we hooked up a harmonic analyzer at the service. As suspected, the THD (total harmonic distortion) was less than 2%, and the individual harmonic distortions in current (for the odd harmonics up to the 21^{st}) each was less than 3%.

Next, we evaluated the utility system's operation for the past three months and found no “events” that could be associated with the problems.

Moving into the drives themselves, we looked specifically at wiring. Each drive, with its own dedicated power circuit from a subpanel, we fed through a 120V/120V, single-Phase, electrostatically shielded transformer mounted near it. At first glance, it appeared sufficient thought had been given to the installation.

Surprise, surprise

To verify the installation did, in fact, control electrical noise and establish a solid ground reference, we took a voltage measurement between a drive's case and the power feed neutral. Obviously, we expected a reading of zero. Boy, were we wrong: our true-rms sensing DMM read 35V. Measurements at the other two drives were similar.



Single-point grounding is just that: Tying all components that should be bonded together at a single point so you have just one ground reference.

This prompted us to check the wiring of the shielded isolation transformers. Proper wiring for this installation, shown in the diagram above, requires the incoming ground, shield, core, and secondary neutral and ground all to bond at one point. This configuration is a *single-point ground*.

However, we found the secondary neutral *not* bonded to the single-point ground, and the transformer *not* locally grounded to the building ground systems.

A happy ending

We reconfigured the wiring to comply with single-point grounding and took voltage measurements again. Now, the neutral-to-case ground voltage reading was zero, as it should be. With this done on each drive's isolation transformer, the unexplained process line interruptions disappeared.

The moral of this story: While there are many exotic aspects of troubleshooting power quality problems, look at the more mundane items like grounding and wiring first.

At a glance

For an electrical drive to operate properly, it must have proper grounding and wiring. Using isolation transformers having electrostatic shields will help. But to ensure electrical noise rejection and a stable ground reference, you must have a single-point ground. This grounding configuration prevents unwanted ground loops by providing only one conducting path between it and all external grounds.