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White Paper

Machine Control Power Quality & Surge Protection

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You may not be able to see them, but power anomalies that originate within your automated control system are costing you expensive downtime. Your automated production equipment has a low tolerance for poor power quality, especially if it is controlled by a PLC(s).

Improper grounding can account for up to 40 percent of power-related problems, including costly damage and downtime. In addition, if not adequately suppressed, surges (a high voltage spike or impulse of very short duration) can account for another 40 percent. Surges can be produced by lightning and utility companies switching feeders or capacitor banks. The most common surges are produced within your facility by equipment cycling on or off (or speeding up or slowing down). These surges, lasting only a short period of time (microseconds), are injected onto power and data circuits causing equipment damage and safety hazards.

Problems like these can be avoided by implementing a single-point grounding system that follows the NEC (National Electrical Code) for installation and by the use of properly selected and designed surge suppressors.

Most people do not think about power quality issues like surges until they have a storm. However, the factory environment itself can be an automated control system's worst enemy. The automotive assembly line depicted in Figure 1 is a good example of an environment that has a constant fluxof surges. Production equipment, such as robotic welders and conveyor system motors are constantly cycling on and off, causing a signifcant back current (a common type of surge) to be induced into the power system.

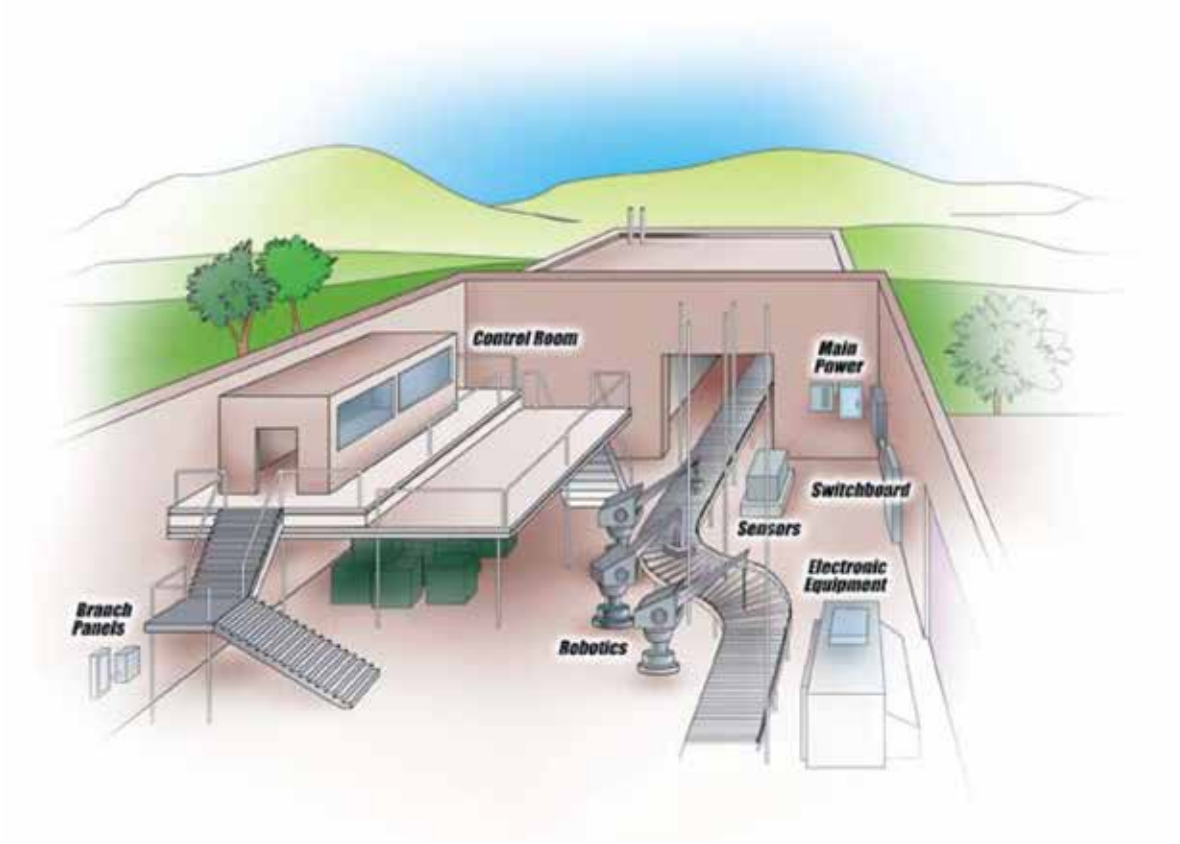

Figure 1

A VFD (variable frequency drive) itself generates disruptive harmonics within its internal switch-mode power supply and drive circuits that reflectback into the branch circuits. Even state-of-the-art systems designed to isolate the VFD from the distribution are plagued by EMF (electromotive force) induction surges. These transients interrupt data transmissions between the PLC and its I/O as well as plant communications. Electronic control components and data protocols are prone to damage from the very same motors that are under their control. They are perpetrators of problems that will potentially cause your system to be out of sync, produce defective products or stop your production line from running.

Most systems incorporate AC protection on the front end of the control panel, but fail to install it on other surge paths. PLC input devices (proximity sensors, photo-eyes, intelligent vision systems, etc.) offer surges a back door path to the PLC. Other connections such as remote I/O, Field bus, RS 485/232, Ethernet, ControlNet and DeviceNet are also paths for surges to the PLC.

A surge introduced by any I/O connected component can damage control equipment or cause system failure. Each connection between PLCs, input devices and each AC motor system require protection.

Designing a system that has only front end surge protection is like trying to secure your home by locking the front door while leaving other doors and windows open.

To establish a robust system, adequate surge protection of all connections is paramount. Improving power quality for your sensitive electronic equipment will decrease the number of seemingly inexplicable glitches in your production line. You can decrease downtime and production defects by investing in the appropriate surge protection.

The oscilloscope image in Figure 2 illustrates normal run conditions of the motor with a current draw around 26 amps.

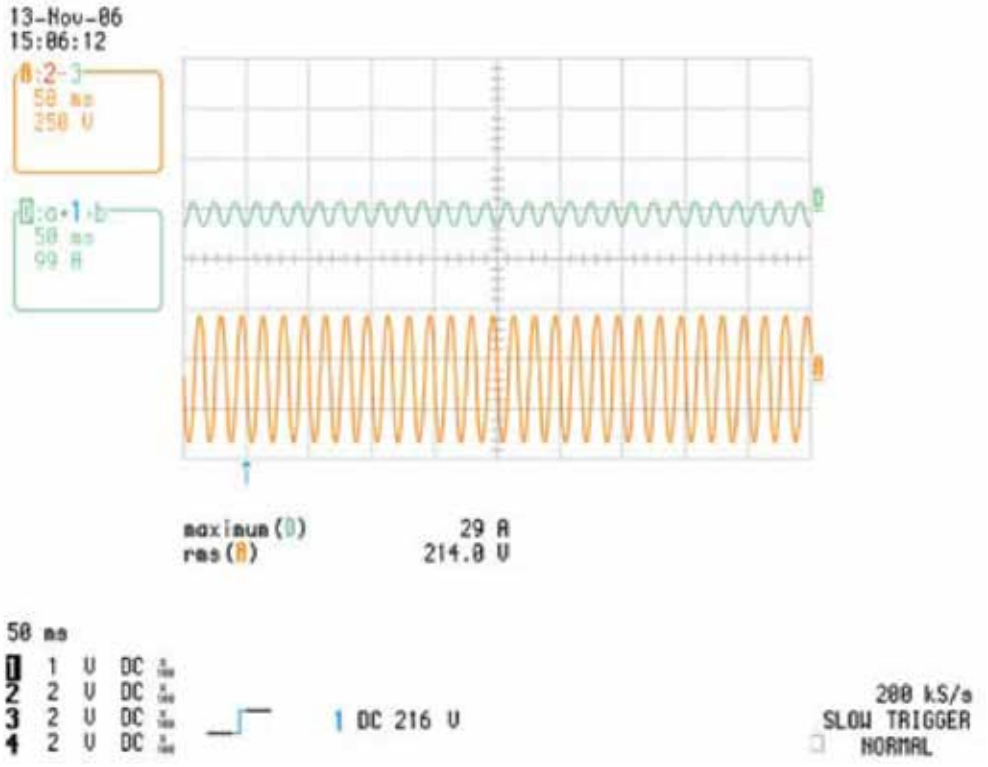

Figure 2

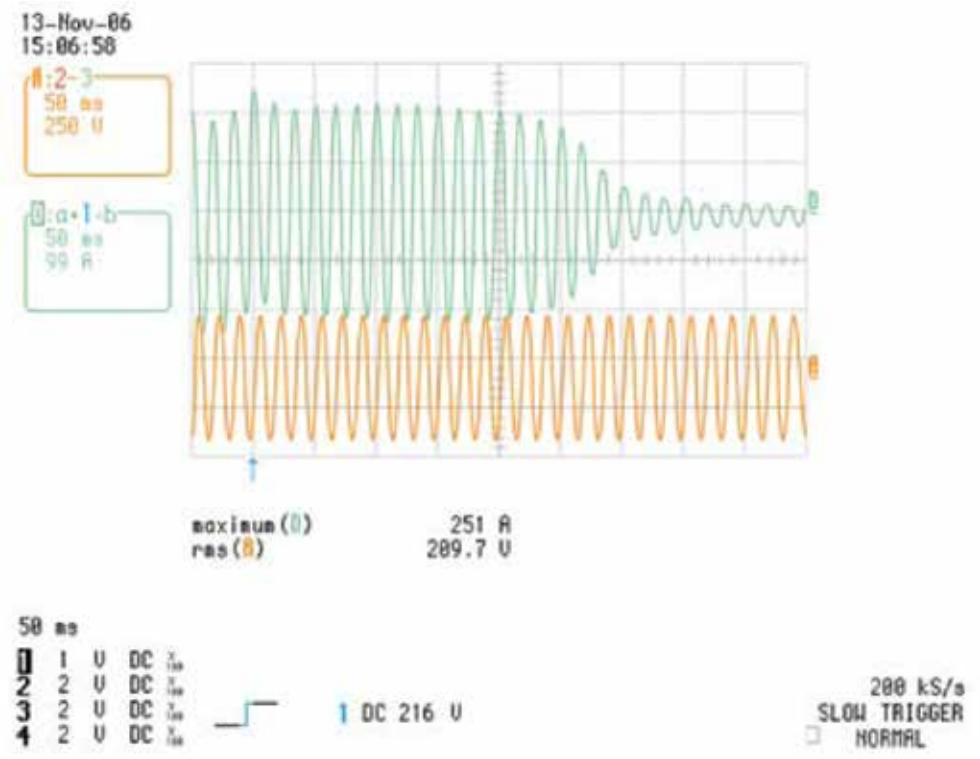

Figure 3

Figure 3 shows the EMF back current transients and harmonic distortion coming from both the motor itself and the VFD power supplies. The oscilloscope image shows the peak current amplitude reaching 300 amps, with a decay time of approximately 350 milliseconds. A PLC operating in this environment of continuous surges will suffer from data corruption and premature failure. With the proper combination of surge protection and fltering, the PLC's power sources can be effectively protected from upset or damage from these sources.

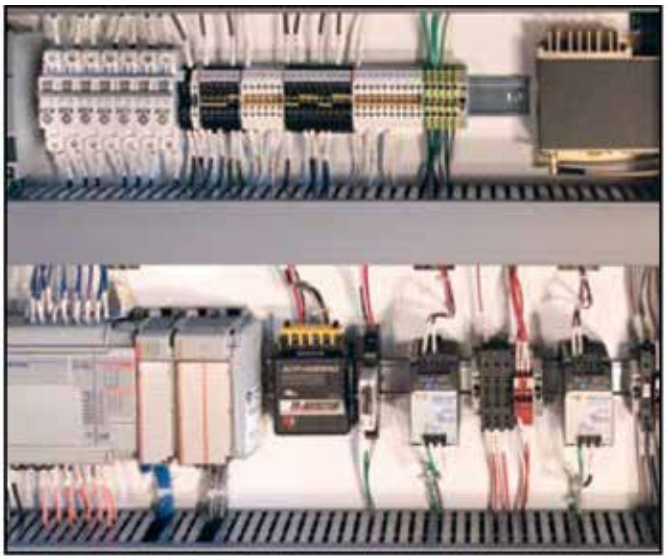

Figure 4

Figure 4 shows the control cabinet and incoming power which require AC surge protection. All suppression products should be mounted as close as possible to the equipment it is designed to protect.

In addition, a single-point grounding system, where all connections to the ground come to a single point in the facility before referencing the earth, is essential for the installation. This is accomplished by connecting all grounds back to the original neutral-ground bond in the building or the secondary neutral-ground bond of an associated step-down or isolation transformer.

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With all of these considerations, it is benefcial to select a surge protection partner with appropriate expertise in power and grounding issues. A qualifed supplier will offer a plan for power quality of the complete system rather than pieces of the whole.

So what type of surge protection do you need?

Please contact us for questions or further information on this topic.

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