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Introduction

You don't think twice about insuring your car, health, and home but what about providing protection for your facilities automation equipment, sensors, servers and microprocessor-based controls and systems? All those are subject to power quality disturbances that cost American manufacturers \$26 billion[®] annually in damaged machinery, work stoppage, lost data, and other losses. The good news is understanding the causes allows you to take some simple steps to help manage the problems.

When designing a power system for load sensitive equipment, the main rule is to make power quality the first consideration, not the last. Threats to load sensitive equipment come from inside and outside the facility. These can range from impulses, voltage sags, swells and noise, to interruptions due to utility brownouts and total blackouts. This whitepaper addresses ways to protect against those threats.

Some Sources of Power Disturbances

Outside the facility, disturbances account for approximately twenty percent of recorded power quality events. Including utility brownouts and blackouts, lightning strikes create high energy, transient voltage spikes that can disrupt power. Don't forget the utility power factor correction capacitors that can

cause problems as well. As will re-closures when the utility is clearing faults or switching power. Add in mother nature, high winds that blow tree branches into power lines or ice storms that can bring AC lines into contact with the ground or cause a short between phases. External sources of power quality problems exist everywhere wreaking havoc on your facility.

Internally, on the other side of the electrical meter is your facility infrastructure. Eighty percent of power problems are due to issues from inside your own walls. In an average factory, power problems primarily involve surges (62%) and sags (29%), with the balance being impulses, harmonics and the loss of AC line voltage altogether. Culprits may be electrical noise from a variable frequency drive, or a high inrush current from a motor or spot welder, or an electric arc furnace drawing several times its full load current when starting. Add to that other factors that can threaten power, improper grounding, improper routing, or even an undersized distribution panel. Whatever the source, poor power quality jeopardizes machine and facility availability and ultimately, profits.

Throughout your facility, there exists mission-critical equipment, each interdependent on one other, complicating your electrical system. Power quality problems can bring any one of these operations or controls to a grinding halt at any time, usually at the worst possible moment. Power

Transient Related Problems Cost Companies in Many Ways

- High Facility Maintenance Costs
- Equipment Failure
- Long-term System Degradation
- Process Disruptions
- Data Loss or Corruption
- Costly Downtime

Transient Surges: 20% External

- Lightning
- Capacitor Switching
- Short Circuits



Transient Surges: 80% Internal

- Load Switching
- Short Circuits
- Capacitor Switching
- Imaging Equipment
- VS Drives
- Arc Welders
- Light Dimmers

quality disturbances occur at varying magnitudes and rates, depending on the utility power at the service entrance and the electrical/power infrastructure on the plant floor. Plus, different types of equipment are sensitive to different types of loads. Microprocessors are highly sensitive to impulses, like motors or HVAC compressors. Lighting systems are susceptible to sags, swells or brownouts. Computer based controls, data storage, alarms and safety equipment are easily damaged by power interruptions. The truth is, even the most ideally installed and maintained equipment in a perfectly engineered facility can introduce power quality problems as the equipment ages.

To keep your facility up and running efficiently, you need to determine the costs of prevention and remediation, and then compare those to the costs of poor power quality interrupting or damaging your facility or systems usually resulting in downtime and lost productivity.

Think: Total Power Quality Solutions

You need to understand and implement a means to stabilize, control and manage your power equipment needs — from the service entrance down through the branch distribution panels, including all critical points of use, as well as controls, communications and data lines. You need a comprehensive Total Power Quality Solution.

Emerson's Solution

Emerson developed a four part approach to providing our customers a Total Power Quality Solution to improve machine availability, ensure data reliability, increase production flexibility, and dedicated SolaHD customer support.

Control Power Solutions for Point of Use

To prevent premature wear on machines and computer equipment, you also need to protect them from momentary losses of line voltage, which are the most frequent of power quality disturbances found in industrial facilities. You need to enable your electrical system to safeguard almost any equipment application with a complete line of switching and linear power supply technologies. Properly sized power supplies ensure the right voltages are getting to your equipment or controls, regardless of voltage sags.

Control transformers are installed to convert the available voltage to accommodate electrical circuit or equipment requirements. They are designed and built in a vast range of configurations to meet requirements for variables such as power, heat, voltage and environmental conditions.

Emerson's Solution

Emerson's highly-efficient, compact power supplies come in a wide range of voltages and available features, including PowerBoost™ overload circuitry, hazardous location certifications and optional redundant accessories. Products range from the SolaHD SDN-D High Performance DIN Rail Series – with one of the highest efficiencies available in the market today – to the SolaHD SVL Series – for high volume, controlled environment applications. If you need standalone power supply, the IP67 SCP-X Series mounts directly on your machine.

Emerson offers a variety of control transformers. They provide voltage regulation and isolation with a high degree of secondary voltage stability during a brief period of inrush current. Our products exceed NEMA ratings for inrush and regulations to ensure control systems are powered correctly. Whether your system requires an open style or an encapsulated model, our SBE, SMT or ICE International Series are suitable for use in your control panel. If your application requires outside of the panel mounting, the HSZ Series is available in a range of kVA sizes.

Power Quality Solutions

Protecting critical data on network devices from surges and noise is critical to production. Adding surge protection devices is an essential line of defense in protecting your production line and facility. They focus on limiting high-voltage spikes to a level that is acceptable to most electronic equipment. Choose components that are placed in parallel with the line and serve as a clamping mechanism for high-energy impulses. Tracking filters are an ideal solution for microprocessor-based products to provide clean AC power at the equipment level avoiding damaging degradation or “electronic rust” over time. Finally, data/signal line products can be used to protect your point of use equipment from high-energy impulses protecting controls and critical data you need for your operation.

Emerson's Solution

Multi-stage protection involves clamping the initial high-energy surge, filtering any remaining noise or transients to the protected sensitive equipment and finally, protecting the data/signal lines entering or leaving the control panel or the factory floor. To safeguard your electrical system, Emerson provides a wide selection of SolaHD surge protective devices (SPDs), tracking filters and data/signal line protection devices.

One of the most effective means for optimizing and protecting production efficiencies is with dedicated power conditioning solution. Power conditioners insulate equipment from damaging transients and noise, voltage surges, harmonics and changing voltage conditions that cause 95% of all power quality issues, except a total loss of power.

Emerson's Solution

Emerson's power conditioning solutions deliver tightly regulated voltage with superior noise attenuation. Additionally, our units are maintenance-free and built for harsh electrical environments. Superior voltage regulation of $\pm 1\%$ sets the SolaHD CVS Series apart from other power conditioning technologies on the market because of our ferroresonant transformer technology. The SolaHD MCR Series provides excellent noise filtering and surge protection to protect connected equipment from damage, degradation, or mis-operation.

Because you cannot always control a complete power loss, uninterruptible power supplies (UPS) can be installed alternatively to ensure continuous operation and/or data protection during a power interruption. Certain UPS prevents power interruptions from affecting production and seamlessly switching to back-up battery power the instant it detects a voltage irregularity.

Emerson's Solution

Emerson offers a full range of Off-Line, Line-Interactive and On-Line UPS systems to prevent production mishaps, damaged equipment, and lost data. Whether you require a DIN Rail or tower, AC or DC model, we have an on-line or off-line model for your application. The SolaHD SDU AC – B Series is ideal for those who need reliable power, higher efficiencies, and extensive hazardous or offshore location certifications. The SolaHD SLN and SPS Series are ideal for industrial environments as well as point of sale and office applications. The SolaHD SSW Series are ideal for workstations, PLCs, robotics and process control, industrial automation systems, and automatic service and dispensing equipment.

Power Distribution Solutions

Reliably converting the voltage coming into facilities is essential. Facilities are challenged in procuring the transformer that can safely, efficiently, and reliably deliver the proper voltage for their specific needs. There are a broad range of transformers available for applications across manufacturing facilities, most can be manufactured standard or depending on the application specifically configured for your needs. This means they are designed and built to meet requirements from normal to harsh environments with power, heat, voltage, and environmental conditions in mind.

Emerson's Solution

Emerson's distribution and automation transformers cover general purpose, low temperature rise, K-Factor, copper wound, hazardous location, buck-boost, drive isolation and industrial control applications with proven technologies and industry standard certifications. Picking the right transformer from this group depends on the load, temperature, space, or usage conditions. The SolaHD Low Voltage General Purpose Transformers provide distributed power in the most demanding environments. SolaHD K-Factor Transformers are designed to reduce the heating effects of harmonic currents. The SolaHD Automation, Non-Ventilated Transformers are encapsulated, rated for use in hazardous locations as well as harsh industrial environments. SolaHD Buck-Boost Transformers are small, single phase, dry type distribution transformers that are designed as insulating/isolating transformers. Their dual voltage primary and secondary that can be connected for a wide range of voltage combinations.

Service and Support

Selecting the proper Power Quality Solution for your application can be tricky. Choose a manufacturer with experienced and dedicated sales representatives, along with available online tools, to help you make the right choice, every time and providing the support when you need it.

Emerson's Solution

Emerson is here to partner with you and help you meet your customers' needs with solutions, service, and knowledge. For additional information about SolaHD Power Quality Solutions contact your local authorized distributor or our SolaHD Technical Support Team at solahd.technicalservices@emerson.com.

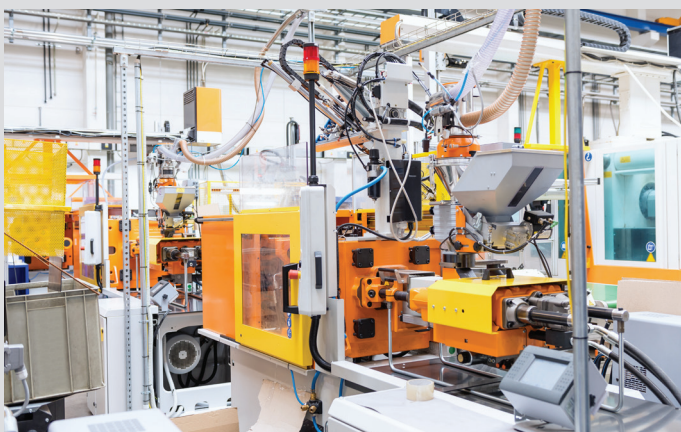
Typical hazardous and industrial environments where protecting equipment against poor power quality and disturbances is essential to ensure clean, uninterrupted power for your facility.



Chemical and Petrochemical Plants and Refineries



Water and Wastewater Treatment Plants



Industrial and Hazardous Manufacturing Facilities

Conclusion

Understanding power quality may seem abstract, but as facility managers and equipment owners know, good power quality can boost both productivity and profits, while poor power quality can drain the bottom line due to malfunctioning equipment, downtime, idled workers, energy costs and product scrap.

Given their relative costs versus the cost of doing nothing against poor power quality, the devices that improve power quality within industrial and automation settings by OEMs are worth their upfront costs. Devices that are integrated or bundled within new equipment or control cabinets offer a competitive advantage for the manufacturer's equipment. For a facility owner, the cost of downtime will hurt revenues and there is a need to protect bottom line.

The market for power quality devices within the MRO, industrial and commercial market spaces all have similar goals. Understanding that there is a potential for a return on your investment to prevent a major shutdown or damage to equipment is important. When a production line or a facility goes down, it typically requires fast attention. However, you can be prepared in advance, or even prevent, with some simple strategies, or applying total power quality solutions, no matter what kind of facility you have.

Emerson's Solution

Emerson's power quality specialists are serious about your system performance. SolaHD has been a trusted name in power conversion and power quality since 1915. We provide innovative and reliable products with proven technologies to help control your equipment or facility's efficiency, productivity, and longevity. Our SolaHD products meet strict global requirements and new efficiency standards. Emerson delivers total power quality solutions to drive your system reliability, your return on investment (ROI) and your customer satisfaction.

① Source: *Insurance Institute for Business and Home Safety*

Protecting Equipment Against Poor Power Quality and Disturbances

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