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Article
Power conditioning – Tackling voltage problems – what they are and how to fix them

Rolling brownouts, voltage sags, spikes, electrical noise and harmonic distortion. If you haven't experienced any of these power problems yet, you will. In today's market, you can't take the power from your local utility for granted. The growing use of microprocessors in appliances, office equipment and process controls has made us all aware of power quality demands from equipment and the environment, and the unpredictability of its supply.

Industry in developed countries with modern power networks is not immune from voltage problems. Although utilities do their best to supply reliable, high-quality power, minimizing complete outage events, periodic sags and surges on utility lines will continue to be a fact of life. With modern industry using more and more automation, the sensitivity of processes to power quality events is increasing. Furthermore, equipment and machinery can be damaged or even fail when subjected to power anomalies. One or two seconds of outage or a surge can bring your business down for hours or days. No matter where you are, spikes, surges, brownouts and other power issues are potential problems.

Many businesses now realize that power is not an unlimited resource. Part of the problem that utilities face is that they cannot produce enough power to supply growing needs, and it can take years to build additional power plants.

What is a voltage sag?

A voltage sag is not a complete interruption of power; it is a temporary drop below 90 percent of the nominal voltage level. Most voltage sags do not go below 50 percent of the nominal voltage, and they normally last from two to 10 cycles or from 40 to 200 milliseconds.

Voltage sags are probably the most significant power quality problem facing industrial customers today, and they can be a significant issue for large commercial customers as well. There are two sources of voltage sags: external, on the utility's transmission and distribution lines, and internal, within the customer's facility.

High winds can blow tree branches into power lines, connecting the line with the ground and the line to the line. A series of sags will occur as the branches repeatedly touch the power lines. Snow and ice build-up on power lines can cause flash overs on the insulators. Other external causes are traffic accidents, construction works and animals impacting the power lines.

While utility power can be unpredictable, what happens inside your building can also play havoc with your business's operations. As well as external environmental factors affecting power quality, a range of other issues are caused inside a facility – from inadequate building wiring or incorrect grounding, to large loads sharing the same circuits. These problems can be compounded by starting, running and stopping large machinery and other business-critical systems. If your building is more than 15 years old, it probably wasn't designed to meet the demands of today's high power equipment. The systems supporting your organization's key functions may be overloading the wiring and causing power problems and failures that can harm valuable data and equipment. Even a short event of a few milliseconds can cause processes to unexpectedly stop, potentially resulting in product damage, wastage and production shortages.

The result of a voltage sag

Whether or not a voltage sag causes a problem will depend on the magnitude and duration of the sag and on the sensitivity of your equipment. Many types of electronic equipment are sensitive to voltage sags, including variable speed drive controls, motor starter contactors, robotics, programmable logic controllers, controller power supplies, and control relays. Much of this equipment is used in applications that are critical to an overall process, which can lead to very expensive downtime when voltage sags occur.

Utilities continuously strive to provide the most reliable and consistent electric power possible. In the course of normal utility operations, however, many things can cause voltage sags. Table one indicates the most common causes of voltage inconsistencies.

How to tackle these issues

Businesses today are implementing power conditioning solutions into their facility plans, in order to ensure power quality is at optimal levels. A good power conditioner will filter and clean incoming AC power and dramatically improve your equipment's performance. Power conditioning solutions will increase the longevity of your connected components, since contaminated AC adds wear and tear to power supplies and other internal circuits.

Voltage Disturbance	Typical Symptoms	Typical Causes
Sags and Swells	Shrinking computer displays (the image doesn't fill the whole screen) or lights that are overly bright or dim	Brief reductions or increases in voltage that occur when a major appliance or other piece of equipment switches on or off A short circuit
Transient Voltage (also known as impulses or spikes, these problems occur when there are sudden increases in voltage)	Processing errors, data loss or burned circuit boards	Lightning strike Starting or stopping major equipment
Radio/Television Interference	Loss of radio/television reception Poor-quality sound or picture that is interrupted by static Popping sounds, crackles, rolling horizontal lines, wavy lines, snow, ghosting or other reception problems	Signals from other equipment, usually within your home or building or that of a neighbor Possible home sources include doorbell transformers, toaster ovens, electric blankets, ultrasonic pest controls, fans, refrigerators, heating pads, light dimmers, touch-controlled lamps, fluorescent lights, aquarium or waterbed heaters, furnace controls, computers or video games At times, the interference may be generated by utility equipment, such as loose hardware, or dirty or damaged insulators
Harmonic Distortion	Appliance or equipment problems, such as communication errors, overheating or electrical hardware damage	Certain electronic equipment, such as computers, monitors, and laser printers, video games, touch-controlled lamps and fluorescent lights, may use electricity in a way that causes distortion of the normal electrical wave pattern Contrary to popular belief, harmonic distortion is not caused by a utility company sending out distorted electrical current

Table 1: Common voltage problems, the symptoms and causes

Therefore, a good power conditioner protects your equipment from damaging AC events such as surges, spikes, lightning and high voltage.

The average surge suppressor or power strip offers little in the way of protection and doesn't filter or clean contaminated power at all. However, ABB power conditioning solutions always offer the highest level of protection and lowest total cost of ownership, whilst having a small footprint in design. Ensuring the continuous operation of small and medium to large businesses is what ABB's power conditioning solutions do best.

The PCS100 portfolio is a unique line-up of low and medium voltage power conversion technologies consisting of static frequency converters, UPSs and voltage and power conditioners that demonstrate highly reliable and cost-effective performance. The product portfolio offers efficient power conversion solutions that are specifically designed to solve power quality problems, such as voltage sags, and stabilize networks.

Covering applications from data centers through to complete industrial plant protection, micro grid systems and shore-to-ship supply, ABB has the power conversion technology for every need, starting from a few kVA to many MVA and a wide range of supply voltages.

I need back-up power

UPS systems offer a reliable solution for a wide range of power-related problems. These systems can provide continuous power to critical loads in the event of an interruption or a total loss of utility power. Additionally, the systems can filter out many of the common electrical disturbances that interfere with the operation of sensitive electronic equipment.

UPS systems offer a way to improve the operating reliability of critical building components. They can eliminate many of the problems brought on by disturbances in utility-supplied power. They can also allow for continued operation when utility power goes down. And as long as systems are properly matched to the building's requirements, they can provide this level of reliability without breaking the budget.

The first step in selecting a UPS system is identifying the need. Local and state requirements will stipulate certain loads that are critical to the operation of the facility, even during a power outage. Examine each of these loads to determine which ones cannot tolerate even a momentary outage in power, as well as those easily damaged by power disturbances. Loads that do not meet either requirement can be connected to a standby generator system instead.

For each load, consider the impact that the loss of utility power will have on operations, including momentary losses. Identify loads that are critical with respect to power outages or damage from power disturbances.

For each of these loads, determine what type of delay would result from even a momentary outage, and how that delay would affect operations. For example, some computer-based control systems may take as long as 10 minutes to reset after a temporary loss of power.

If the length of the delay for a particular load is unacceptable, that load is a candidate for connection to a UPS.

Product Line	Typical Applications	Product
Industrial UPS	Utility deep sag and surge correction Utility outage protection	PCS100 UPS-I Industrial UPS PCS100 MV UPS Medium Voltage Industrial UPS
Voltage conditioning	Utility sag and surge correction Load voltage regulation	PCS100 AVC-40 Active Voltage Conditioner for sag correction **PCS100 AVC-20** Active Voltage Conditioner for voltage regulation
Reactive power conditioning	Load created sag correction Power Factor correction Harmonic mitigation Unbalance correction	PCS100 RPC Reactive Power Conditioner
Frequency conversion	50/60 Hz conversion Frequency fluctuation	PCS100 SFC Static Frequency Converter

Table 2: ABB's PCS100 portfolio, designed to eliminate and condition power quality issues

I don't need back-up power

Many businesses require voltage or power conditioning rather than battery back-up power. In those cases where back-up power is unnecessary, a voltage conditioner can provide superior protection. These devices provide voltage regulation and one or more additional power quality-related functions, such as protecting against over/undervoltage, voltage fluctuations, sags and dips, line noise and swells, phase imbalance, short circuits, brownouts and surges.

Combining solutions for optimal performance

Businesses can also adopt a combination of power conditioning systems to enable a more robust power protection solution, especially in large energy user situations. Today, voltage conditioners are also used in conjunction with UPS units. Using voltage conditioning in tandem with UPS provides enhancements such as extending UPS capabilities, increasing UPS efficiency, protecting the UPS system, conditioning the UPS bypass, and protecting HVAC systems.

Power quality problems can occur anywhere, anytime. Evidence of these problems can be as obvious as electrical components that are damaged or fail prematurely, or as subtle as equipment that randomly malfunctions. But the real problem with poor power is the cost of damaged equipment, lost productivity, scraps or missed schedules. Implementing power conditioning systems will help your business override common power quality issues, achieve increased production output and protect crucial operations.

To find out more about ABB's power protection solutions:
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