

# Power quality — basics

## Commercial buildings

HSB, a Munich Re company, is a technology-driven company built on a foundation of specialty insurance, engineering, and technology, all working together to drive innovation in a modern world.

### Introduction

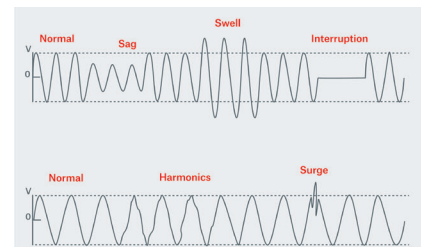
Power quality is a general term used to describe the compatibility between connected equipment and its electrical supply. The supply system can be affected by changes to the frequency or amplitude of the voltage, the balance between phases on a three-phase system, and distortion levels of the original signals. The characteristics that are important and what can be tolerated by the connected equipment can vary from facility to facility.

Most electro-mechanical equipment is robust and can handle minor power quality related issues with little or no effect on operations. Electronic equipment is very susceptible to power quality related issues. Due to the shift in the type of loads from electro-mechanical to electronic, power quality is a real concern in all types of applications. This includes hospitals, universities, commercial buildings, and industrial facilities.

### Poor power quality

An ideal power source offers a continuous, smooth sinusoidal voltage. Typical power quality issues include:

- Voltage transients (surges)
- Harmonics
- Voltage sags
- Voltage swells
- Voltage interruptions



The effects of poor power quality are based on the length, magnitude, and timing of the issue as well as the sensitivity of the connected equipment. Poor power quality can result in process interruptions, data corruption, data loss, malfunctioning of computer controlled equipment, and overheating of electrical equipment.

## Causes of poor power quality

You might think that poor power quality is primarily the result of weather and utility-related disturbances. However, studies have shown that issues such as lightning, other natural phenomena, and utility operations, account for only a small portion of all electrical disturbances.

A large portion of electrical disturbances are from internal sources or from neighboring businesses that share the same building or are in close proximity. Internal sources can be fax machines, copiers, air conditioners, elevators, and variable frequency drives.

The conditions below are considered warning signs for potential power quality issues in a building. These conditions do not guarantee a problem; however, a building with these conditions will have an increased likelihood of having power quality issues.

- History of power-related issues
- Poorly maintained electrical system
- Failure of surge protection equipment
- Weather and utility disturbances are common
- High concentration of electronic equipment
- Infrared surveys which identify excessive current flow (heat) on grounding conductors and/or system neutrals
- Repeated and random equipment malfunctions, failures, tripped breakers, or blown fuses with no identified causes

- Overheated equipment
- Frequent switching to backup power systems
- Lost data or data corruption
- Premature equipment failures

## Solutions

Each type of business will have a different sensitivity level to poor power quality and will have different sources of poor power quality. However, common to all businesses is the importance of a well-maintained electrical distribution and grounding system. The importance of these systems cannot be overstated. When addressing potential or actual power quality issues, the power and grounding system should be the first item addressed. This will improve personnel safety, allow for the proper operation of surge protection devices, minimize the potential for currents on neutral conductors, and provide a common reference plane for electronic equipment.

Once the power and grounding system deficiencies have been addressed, the next steps include power quality inspections, surveys, and the selection and installation of appropriate mitigation equipment.

Inspections are a means to understand a facility from a power quality standpoint. This understanding can be gained by noting:

- Type of equipment installed
- Concentration of computer and electronic equipment
- Presence of welders, power factor correction capacitors, or variable frequency drives

- Heat discoloration of electrical equipment
- Communication and control wiring in close proximity to power wiring
- Condition of the grounding system
- Presence of surge protection installed on power and data lines

Surveys typically involve monitoring and recording the electrical system of a building or a specific area of a building. Reviewing and analyzing the data from the survey helps to determine if a problem exists. The types and severity of problems will dictate the appropriate power quality mitigation strategy.

Power quality inspections and surveys should only be completed by competent power quality professionals.

In many commercial or light industrial businesses, only a few loads are affected by power quality issues. By identifying the most vulnerable loads during a survey, targeted mitigation techniques can be applied.

A wide variety of power quality correction products is available utilizing a range of technologies to correct power quality issues. Common mitigation techniques include surge protection devices, isolation transformers, voltage regulators, motor-generators, standby power supplies, uninterruptible power supplies, and harmonic filters. Each technique has advantages and disadvantages, and should be applied based on its ability to solve a problem identified in the power quality survey and analysis.