

Power Quality is a technical term that has practical implications for your business and your equipment. When power is generated, it has very predictable characteristics. It energizes all electrical equipment equally and satisfactorily. However, as the power travels through the wires and energizes the equipment, the various pieces of equipment it energizes can change the quality of the power, making it less suitable for the next application. These changes in power quality are especially common in large industrial and commercial complexes and include increases and decreases in voltage, momentary power outages, and “noise” on the electrical system. At its most extreme, poor power quality can even cause equipment to malfunction.

Why Do You Need Power Quality Protection?

While power disturbances occur on all electrical systems, the sensitivity of today’s electronics make them more susceptible to them. For some sensitive devices, a momentary disturbance can cause scrambled data, interrupted communications, a frozen mouse, system crashes and equipment failure. A power voltage spike can damage valuable components. Power quality issues can cause business problems such as:

- Lost productivity and idle people and equipment
- Lost orders, good will, customers and profits
- Lost transactions and orders not being processed
- Revenue and accounting problems such as invoices not prepared, payments held up, and early payment discounts missed
- Customer and/or management dissatisfaction
- Overtime required to make up for lost work time

According to *Electric Light and Power* magazine, 30 to 40 percent of all business downtime is related to power quality problems. Businesses have a lot invested in office and production equipment, and power quality protection is an inexpensive insurance policy against incidents.

Common Power Disturbances

Common power quality disturbances include surges, spikes and sags in power source voltage and harmonics (or “noise”) on the power line. Each of these occurrences is discussed briefly below.

Surge – A rapid short-term increase in voltage. Surges often are caused when high power demand devices such as air conditioners turn off and the extra voltage is dissipated through the power line. Since sensitive electronic devices require a constant voltage, surges stress delicate components and cause premature failure.

Spike – An extremely high and nearly instantaneous increase in voltage with a very short duration measured in microseconds. Spikes are often caused by lightning or by events such as power coming back on after an outage. A spike can damage or destroy sensitive electronic equipment. Turn the equipment off during a power outage. Wait a few minutes after power is restored before turning it on, then turn on one device at a time.

Sag – A rapid short-term decrease in voltage. A sag typically is caused by simultaneous high power demand of many electrical devices such as motors, compressors and so on. The effect of a sag is to “starve” electronic equipment of power

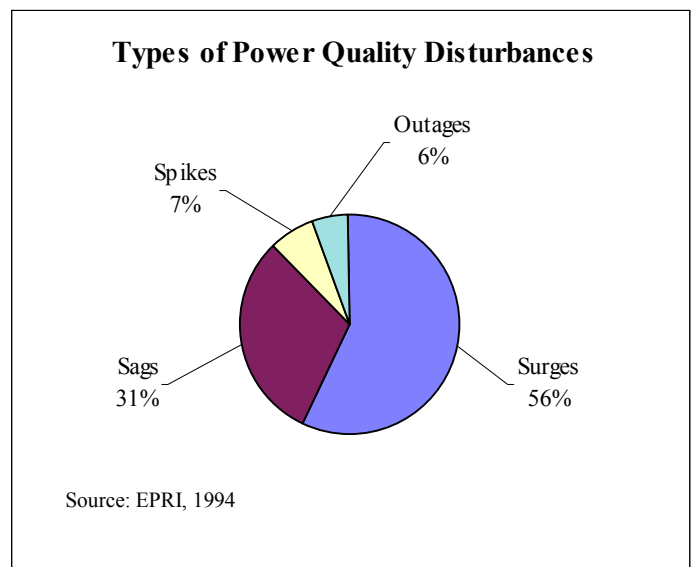
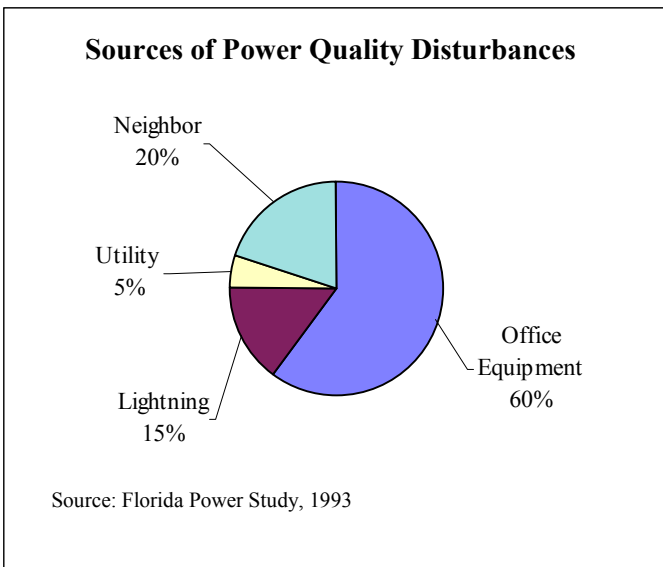
causing unexpected crashes and lost or corrupted data. Sags also reduce the efficiency and life span of equipment such as electric motors.

Noise – A disturbance in the smooth flow of electricity. Often technically referred to as electro-magnetic interference (EMI) or radio frequency interference (RFI). “Harmonics” are a special category of power line noise that causes distortions in electrical voltage. Noise can be caused by motors and electronic devices in the immediate vicinity or far away. Noise can affect performance of some equipment and introduce glitches and errors into software programs and data files.

Outage – Total loss of power for some period of time. Outages are caused by excessive demands on the power system, lightning strikes and accidental damage to power lines. In addition to shutting down all types of electrical equipment, outages cause unexpected data loss.

What Causes Power Quality Problems?

Studies show that up to 80 percent of most small business’ power quality problems are caused by disturbances created inside of a facility or business. (See the chart below.) When large power users in a building, such as fans and air conditioning equipment, cycle on and off, they can cause power “dips” and surges that affect other equipment in the building. Lightning is another major source of disturbance, accounting for more than 10 percent of power disturbances. That’s why it is important to have power quality protection at the incoming utility meter **and** at each piece of sensitive electronic equipment throughout your facility.



How Costly Is Downtime Caused by Power Disturbances?

According to Contingency Planning Research Company’s annual study, downtime caused by power disturbance results in major financial losses. Here are a few examples of the **hourly losses** experienced by a few businesses:

- Airline reservation centers: \$67,000 - \$112,000
- ATM network and service fees: \$12,000 - \$17,000
- Brokerage (retail): \$5.6 – \$7.3 million
- Credit card sales authorizations: \$2.2 – \$3.1 million
- Telephone ticket sales: \$56,000 – \$82,000
- Catalog sales centers (large retailers): \$60,000 - \$120,000.

Power Quality Solutions for Small Business

There are two primary ways of protecting your business against power quality problems: 1) surge suppressors, and 2) uninterruptible power supplies (UPS)

Surge suppressors – Surge suppressors are designed to reduce or eliminate potentially damaging short-duration power spikes or surges and electrical “noise.” Different types of surge suppressors include:

- **Service entrance surge suppressors.** These devices protect against disturbances in the incoming power supply at the utility meter. They can be inserted at the utility meter socket or hard-wired depending on the application.
- **Plug-in surge suppressors.** These portable wall plug surge suppressors are used at each individual piece of equipment and provide additional protection against disturbances that arise inside the facility.
- **Telephone/cable/modem line suppressors.** These protect against “back door” disturbances introduced through telephone, cable and modem lines. Often they are included as an integral part of a surge suppressor power strip.

Uninterruptible power supplies – UPS equipment contains a battery power supply to provide back-up power to equipment in case of a sudden power failure. They provide continuous power to equipment and protect against even momentary outages or power failures. Systems can be designed to provide enough power for computers and other equipment to be properly shut down without damage or loss of data. Power conditioning UPS can protect against other disturbances such as spikes and noise.

Power Quality Solutions		
Type of Disturbance	Solution	
	Power Conditioning UPS	Surge Suppressor
Surge	✓	✓
Spike	✓	✓
Sag	✓	
Noise	✓	✓
Outage	✓	

Note: This table provides general guidelines only. Be sure to check with the manufacturer or your power quality solutions provider about the features of any particular power quality device and the its ability to protect your

Am I Protected If I Have a “Power Strip” Connected to My Computer?

Most “power strip” type surge suppressers sold at retail electronics stores offer very limited protection against disturbances, and some are little more than a multi-outlet extension cord. Many inexpensive power strips will be damaged after one voltage spike, and fail to protect equipment after the first incident often leaving the consumer unaware that the equipment is unprotected. Consumers should look for power strips that offer a test circuit and diagnostic light that will indicate if the unit is working properly. Surge suppressors are rated according to the size of voltage spike that they can handle, so look for units with a high enough “Joules” rating to protect your equipment. In addition, look for products that offer a warranty against damage to the equipment connected to them. Features to consider when shopping for power strip surge suppressors include:

- Does it handle high voltage disturbances (above 1000 Joules) and 54,000 peak amps without failing?
- Peak surge current for plug-in surge protectors.
- A test circuit that indicates the unit is working properly?
- Telephone/modem line protection
- A manufacturer’s warranty on products and connected electrical equipment
- A listing or rating by the Institute of Electrical and Electronics Engineers (IEEE) and/or Underwriters Laboratories (UL)

Assess Your Power Quality Needs

While it is best to have a detailed assessment of your risk of problems from power quality disturbances conducted by a trained power quality professional, you can take the first step by completing the self-assessment included below.

1. Does your business have electronic equipment that is especially sensitive to power quality disturbances (power surges, outages, etc.) including computers, cash registers, laserprinters, telephone switches, fax machines, copiers, and medical office equipment?
2. Is your building or facility more than 10 years old? Older facilities were not designed to handle the electrical demands of today's business equipment. Because up to 80 percent of power quality disturbances originate inside a facility, these older facilities tend to experience more problems.
3. Do you have electronic equipment that operates 24 hours a day? Summer lightning storms in the Phoenix area tend to occur most frequently between 6pm-12am. Lightning strikes are responsible for more than 10 percent of outages and other power quality disturbances.
4. Do you have a modem line or coaxial cable entering your facility? These lines can introduce "back-door" power disturbances into your facility.
5. Does your business have more than five users on a computer network system? The larger a computer network grows, the more susceptible a system becomes to power disturbances.
6. Have you experienced any power outages or other disturbances in the past two years? Past experience is a good indicator that you are at risk for future problems.
7. Does your facility lack adequate protection against power quality disturbances? Adequate protection includes service entrance protection, modem/coaxial and telephone line protection, and point-of-use surge suppressers and uninterruptible power supplies for critical equipment.

If you answered "yes" to three or more of the questions above, your business has a higher risk of experiencing power quality problems.

For More Information on Power Quality Issues and Solutions

Contact the Web sites of the Institute of Electrical and Electronics Engineers (IEEE), Underwriters Laboratories (UL), the Electric Power Research Institute (EPRI) or the Edison Electric Institute (EEI).

For general information regarding electric service for your business, call the APS Business Center at 602-371-6767 or 1-800-253-9407. For an online analysis of your business energy use visit the APS Web site and take the Energy Survey at http://www.aps.com/aps_services/energysurvey/Default_BUSRES.html?type=b.