



## Understanding Power Disturbances

Your electrical utility company usually provides safe and reliable energy. However, due to the nature of electricity, disruptions and irregularities do occur. Severe storms, lightning, high winds, equipment failures, cars hitting poles, and even animals climbing on utility wires can cause power line disturbances. Electrical equipment within a neighboring facility can also cause power irregularities.

Fortunately, most pieces of conventional electrical equipment can tolerate short-term power variances without any noticeable effects, but others cannot. Some solid-state or electrical equipment like computers, industrial process controls, cash registers, security, telephone and fax systems are more sensitive.

Power disturbances can cause data or memory losses, altered data and other functional errors, as well as equipment damage. These, in turn may cause scheduling problems, downtime and expensive troubleshooting.

When care of electrical equipment is your responsibility, understanding the causes and cures for power problems is the first step to its protection.

### Causes of Disturbances

There are several types of irregularities that affect electrical power: **sags**, **surges**, **transients**, **noises**, and **power outages**.

**Sags** are short-term voltage fluctuations below normal voltage levels. They are the most common form of electrical power disturbance and can result from momentary supply circuit overloads, ground faults, utility switching, or the starting of large loads such as air conditioners and equipment motors.

**Surges** are short-term voltage fluctuations above normal voltage levels. Surges are less common than sags, but often more damaging to electronic equipment. They may be seen more frequently in facilities with rapidly varying electrical loads, often caused by the switching on / off of electric motors (inductive load switching). Air conditioners, electrical power tools, furnace igniters or ignition systems, arc welders, electrostatic copy machines and elevators are most likely to create surges.

(The same equipment that causes sags when turned on can often cause surges when turned off. Sometimes sags and surges can be detected by the visible flickering or dimming of lights. They can result in electronic equipment



malfunctions and damage. In computers, they can also cause erroneous readings and data losses. )

**Transients** are short duration, sharp impulses that cause a sudden change in voltage. Although much briefer in duration than a sag or surge, a transient voltage may exceed the normal voltage level by five or ten times.

Transients can be caused by a lightning strike, even several miles away, that shows up as a transient voltage all along the line, affecting many customers. Transients can also be caused by the normal operation of electrical equipment such as switching on / off electrical motors.

In computers, transient voltages can alter / erase data stored in memories, creating output errors, and / or equipment damage which will reduce equipment service life. Normally, the presence of transient voltages can only be detected with special monitoring equipment.

**Noises** are interferences that can be generated by any electrical equipment. However, defective or improperly installed electrical equipment is usually the main source of noise. This equipment may include: radio transmitters, fluorescent lights, computers, business machines and even simple devices such as light sockets, wall receptacles, plugs and loose electrical connections. These types of disturbances can result in computer errors.

**Power outages**, total losses of power, can be momentary or last for extended periods of time. Outages are often caused by electrical load switching in utility power stations or your own facility. Electrical equipment malfunctions or faults in a facility's power system can also cause power outages.

Even a momentary outage, of only a fraction of a second, will affect a computer and can result in data loss and the need for data re-entry or reprogramming.

## **What Can You Do?**

One way to minimize power disturbances is to be certain wiring is properly installed, therefore avoiding poor grounds and other circuit problems.

Another way is to connect each piece of sensitive equipment to a dedicated circuit (one serving no other electrical load). Dedicated circuits help minimize sags and / or surges which may result when starting other electrical equipment in your facility. In addition, they may provide improved voltage regulation to your equipment.



Various safeguards are also available that can intercept and eliminate most disturbances in your electrical supply. These safeguard devices utilize incoming power as an energy source to create “new” power (**power synthesizers**) or modify incoming power through a “filtering” process (**power enhancers**).

These safeguards are offered as built-in options on some sensitive equipment or can be purchased and installed on your equipment’s power input. They can prevent specific irregularities or, in conjunction with each other, prevent a variety of disturbances. The price of these safeguard devices depends on equipment sophistication and load requirements.

## **Power Synthesizers**

Uninterruptible Power Supplies (UPSs) are the most sophisticated power synthesis systems available and the most effective method of protecting equipment against interruptions in power continuity. A UPS system will eliminate virtually all types of line disturbances and interruptions. Usually no other power synthesis or enhancement equipment is needed.

UPSs are available in various configurations with rectifier / chargers, batteries, inverters and bypass circuits. The rectifier / charger converts incoming alternating current (AC) power to (DC) direct current and maintains the battery at full charge. The battery, in turn, supplies DC power into the precise AC power required. Therefore, if incoming AC power is lost, the battery will provide power to the inverter. The duration of power depends on the battery capacity of each UPS.

Voltage Regulating Transformers are composed of transformers, inductors and capacitors that reconstruct the desired AC output. They free AC output from almost all power line disturbances, except a total power outage, since a voltage regulating transformer is not an uninterruptible power supply.

## **Power Enhancers**

Transient (“Spike”) Suppressors greatly reduce high voltage impulses, can cope effectively with most transients, but they allow sags and surges to pass through to electrical equipment. Each transient suppressor’s actual capability depends on the design and quality of the unit, and where it is located in the circuit.

Power line filters are a widely-used method for reducing high frequency electrical noise, each designed to handle the noise at varying levels and ranges.



Voltage Regulators maintain voltage output to equipment within narrow limits despite fluctuations (sags or surges) in the equipment's power supply.

Isolation Transformers are specifically designed to prevent electrical noise on a power line from being passed through to equipment, but cannot totally prevent normal mode noise (line to line).

Power Conditioners combine two or three types of protection in one device. The cost of power conditioners is usually less than the combination of individual power enhancement devices.

### **How to Determine Which Safeguards Are Needed**

First, research the sensitivity of each system component and determine what degree of voltage variation it can handle and still have the capability to "ignore" some or all power irregularities.

Next, analyze any problems you have actually experienced: Loss of data? Output errors? Computer "crashes"? Equipment damage?

Evaluate the actual cost of equipment damage and / or downtime caused by electrical disturbances. How much money did you lose and how many labor hours did it take to get your system back online?

Then, make a decision regarding the level of protection needed in your facility, if any, and the estimated cost of this protection.

### **What Can D & B Power Associates, Inc. Do For You?**

If you are experiencing power problems in your facility, D & B can help by providing a complete equipment and facility survey. We can monitor your incoming power, help analyze your situation and find the sources of these disturbances. We can identify power irregularities and separate them from other problems with similar symptoms: software flaws, loose cables, dirty connectors, and so on. Sometimes simply identifying the cause of the power disturbance can point to a low or no-cost solution.

D & B Power Associates, Inc. provides all the technical knowledge, hardware and service you need to safeguard your equipment or solve your specific power problem.

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