App Note

Power Primer and Guide to UPS Terms

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Power Primer

A guide to power and UPS terms

The reliability of PC's and the Internet comes nowhere near the telephone system.

Power quality is an issue that all serious computer users should be concerned with. Why? The world is becoming more dependent on computers than ever before. The Internet is changing everything in ways that could not have been imagined just a few years ago. We are now using the Web to make travel reservations, buy and sell stocks, upload and download large files and to purchase many different products. Yet the reliability of PCs and the Internet comes nowhere near the telephone system. We are always expecting dial tone when we pick up the receiver to make a telephone call, and we would be quite surprised if the telephone company would have to reboot the digital switch used in the central office. We certainly would not accept if the telephone didn't work when there was a power outage. Somehow we seem to accept much less when we log on to the Web. In time the computer industry will figure out how to design reliable software, computers and data communications equipment. The good news is that it is quite inexpensive to do something about computer crashes caused by power interruptions. Most PCs can be adequately protected for less than $285.00 with a Flexible Series UPS from TSi Power Corporation.

The purpose of the Power Primer is to provide some basic information about the quality of utility power and how it affects the average computer user. First, a list of power anomalies and their effect on computers:

- **Power outage** (also known as blackout or power failure)—a complete loss of power, which causes the computer to crash and shut down.
- **Surge voltage** (also known as spike, transient or impulse)—a short-duration overvoltage, which can cause computer malfunction or failure, depending on the severity of the surge.
- **Sag** (also known as brownout or undervoltage)—a longer-term abnormal deviation from the nominal voltage of 120V (230V in many countries outside North-America), which can cause the computer to shut down or cause overheating of its internal power supply if the sag continues for a long time.
- **Swell** (also known as overvoltage)—a longer-term overvoltage, which can cause failure of the computers internal power supply or possible shut down for some computers.

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What is the cause of the above problems? The power provided by the local Power Company has to be generated and distributed to the user. This process and natural events like lightning cause most problems.

Using generators that are powered by hydro, fossil fuel or nuclear fission generates power. Future supply of power will be affected by the lack of available sources of hydro and concerns over pollution caused by the burning of fossil fuel—the situation will worsen because of the lack of enthusiasm for any expansion of nuclear plants. A number of US nuclear plants are being decommissioned while countries like Sweden have decided to decommission most of its nuclear plants. Thus, it is possible that there will not be enough power to satisfy future demand in the US. Many developing countries are already experiencing severe shortages of power and have been unable to arrange the financing necessary to build more power plants. A shortage of power will cause all of the above problems, as some users will be subject to momentary power outages when there is not enough power to satisfy demand.

Power is distributed over long distances using high-voltage overhead power lines — distribution voltages can be as high as one million volts. Power is distributed locally via lower voltages provided through a series of step-down transformers. Some local distribution networks are unable to provide the power required when many users demand power at the same time, which may cause local distribution transformers to fail and hence cause power outages. Many local distribution systems in the US use overhead power lines that are very sensitive to tree branches falling and thus causing power interruptions. Additionally, surge voltages will occur when power fails as the rapid interruption of power results in a surge voltage.

The deregulation trend may compound power interruptions and stability problems in the future as switching between different power grids becomes more frequent as sellers and buyers exchange power.

Power problems can also be caused by thunderstorms when surge voltages from lightning strikes are delivered via the power line to the computer. Additionally, lightning arresters on utility distribution lines can cause brief power interruptions as the momentarily short the power while diverting lightning voltages to ground.

Surge voltages can result as electrical equipment turns on and off inside buildings.

Helpful terminology when selecting a UPS

All computers and telecommunications key systems and PBXs have a voltage and current rating and requirement. Typically, such information is printed on the back planes of equipment (near serial number and product model information) and is also included in the User's Manual. Uninterruptible Power Systems are rated in Volt Amperes or "VA." It is a simple task to determine what size UPS a particular system requires just: *(Note, the information provided applies to equipment connected to a regular 120V or 230V outlet)*

- **Determine required VA rating for each piece of equipment** to be connected to the UPS (e.g. computer, monitor, modem, etc).
  Multiply volts (V) and amps (A) for each piece of equipment and obtain VA per device. Then add the total and obtain total VA rating.
  Example: Computer 120V x 2A = 240 VA; Monitor 120V x 1A = 120 VA; Modem 120V x 0.1A = 12 VA. Thus, total VA is 240VA + 120VA + 12VA = 372 VA. Note, if only watts are given: multiply watts by 1.35 to obtain VA rating.
- **Select a UPS that is the same rating or larger** than the above calculated load. For example, a UPs-400 provides 400 VA of power and would provide at least 8 minutes of backup. If more backup is required or if more equipment will be connected to the UPS in the future, a larger UPS should be selected. A UPs-600 would provide longer backup than a UPs-400, typically 15 minutes or more. TSi Power Quality Products can provide longer backup times.

A guide to UPS terms

Transfer time

This describes the amount of time it takes from the initial loss of ac power to the time the UPS takes over the load. The importance of time for the computer translates into the computer locking up or freezing and thereby losing any unsaved information. Instantaneous transfer time means that the computer would not even notice that its power source had switched from one input to another.

Isolation from line

A characteristic of a UPS in which the output is completely electrically disconnected from the input. Power is coupled from input to output by magnetic fields in a transformer. Because there is no connection from input to output, transients cannot cross the
magnetics thereby eliminating any transients in the ac output.

Neutral to ground bond

The neutral to ground bond provides protection from transients on the neutral line which could feedback into sensitive electronic equipment.

EMI/RFI noise filtering

EMI refers to electro-magnetic interference which is unwanted electrical noise present on the power line. This noise may "leak" from the power lines and affect equipment that is not even connected to the power line. Such "leakage" is called a magnetic field. Magnetic fields are formed when unwanted noise voltages give rise to noise currents. Such noise may adversely affect electronic equipment and cause intermittent data problems. EMI protection is provided by noise filters placed on the ac power line. The filter reduces the noise voltage on the protected line, and by doing so eliminates the magnetic fields of noise generated by the protected line. Noise signals that act over a significant distance are called Radio Frequency Interference (RFI). Equipment power cords and building wiring often act as antennas to receive RFI and convert it to EMI.

Surge/spike protection

This category is fairly self explanatory. The higher your protection, the better your equipment is insulated from momentary increases in voltage on the ac line.

Output voltage regulation

Voltage regulation, especially in areas where the power quality is low, is essential to equipment performance. Computer equipment will identify if the voltage is within the operating parameters and if it falls below those parameters, the computer will shut down and will lose any unsaved information. Furthermore, with a constant voltage, the internal components in the computer will run more efficiently and will extend the life of the computer's hardware substantially.

Inverter Waveform

Sine wave inverter waveform is the best. Pseudo-sine wave (typically modified square wave) is suitable for computers and other switchmode power supply driven equipment, but not motors or fans.

Energy efficiency

The ratio of output power to input power as expressed as a percent. For example, if a UPS has an efficiency of 80%, then 20% of the input energy in lost as heat.

Source impedance

Small engine generators (1kW to 10kW range) have very high source impedance, which means output voltage will drop as more load is connected to the output. This is the reason for oversizing a generator.

Operating environment

An overall description of the ac environment which includes in its definition frequency of transients (i.e. surges, spikes, sags), blackouts, and voltage fluctuations to name a few. Often contributing factors can be industrial growth, poor utility maintenance, poor power management or erratic weather. The areas in which your computers are operating are easily described as poor ac environments.

Unit surge voltage withstand

This denotes the amount of voltage surge the UPS itself can handle before damage and failure of the unit. If the UPS fails, the computer equipment becomes vulnerable to the transients on the ac line.

Price

The range of prices, as you've discovered, is widely disparate because the standby UPS is using the cheapest but least reliable technology, whereas the ferroresonant, and on-line technologies are very high quality and durable.

About the author

Mr. Peter Nystrom has been active in the power protection industry since 1979 and is the founder of two companies. He has also been active as a consultant to major telecommunication equipment manufacturers for several years. Since 1998, he has been the CEO of TSi Power Corporation (located in Wisconsin, USA), a manufacturer of indoor and outdoor UPS, isolation transformer line conditioners, precision automatic voltage regulators, and dc to ac inverter systems designed to meet the challenging international power conditions.

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