The Locomotive

Protecting Communication and Sensitive Electronic Equipment From Lightning and Voltage Surges

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Introduction - We All Depend on Communications
Operating a business in the Information Age of the 1990s requires a reliable and efficient means of communication and data processing. As stronger competition surfaces from every direction, a company’s dependency on fast, accurate and convenient transmission of information increases dramatically. Businesses make great investments in state-of-the-art telephone systems, computer networks and expert diagnostic equipment in order to compete in the high-tech marketplace that exists in every industry today.

So, how would your business be affected if it lost the use of these systems for an extended period of time? Or even for a day? Suppose the computer system you use to communicate with financial institutions is fried from a lightning surge. How big of an impact would this have on your operation? How long would it take to repair or replace a key piece of machinery or equipment that has been subjected to a voltage surge and rendered useless? Are you prepared if it does happen?

Lightning Strikes Without Warning
Recent claims show a wide range of damage being attributed to lightning or voltage surges. Lightning has caused damage to computer terminals, printers, motors, controllers, high-tech instrumentation and telephone communication systems. Unexpectedly, these businesses find themselves trying to rebound from losses costing upward of a few thousand dollars.

One loss in Atlanta, for example, saw lightning knock out an auto dealer’s main telephone system and computer network. The equipment was damaged beyond repair and had to be replaced. After a $1,000 deductible, the claim paid more than $26,000.

One of the greatest hazards to communication systems or any system that employs sensitive electronic equipment is a voltage surge. It’s a fairly common occurrence and damage usually can be avoided. But it still accounts for millions of dollars in lost revenue and repair costs each year nationwide. How can you protect your equipment investment from a damaging and costly voltage surge?

What is a Voltage Surge?
Voltage surges are disturbances in the normal pattern of a power system’s supply voltage. Usually, this is thought of as a sudden spike that raises the voltage level above the limit which equipment was designed to handle. While there are other types of surges, or transients, we will limit our discussion to overvoltage conditions.
Voltage surges can be grouped into two categories: those caused by circuit switching and those due to the environment. Circuit switching surges happen when a sudden change to an electrical circuit occurs. A simple example of such a change is when you turn a light switch on or pull an electrical cord from a receptacle (while the appliance is still running).

More dramatic types of switching surges occur when the utility company energizes or de-energizes its equipment, or when overhead power lines slap together or are broken and fall to the earth. A third type of switching surge results from arcing due to loose connections or ground faults.

The most evident type of environmental surge is lightning. People often discuss lightning and voltage surges as two distinct phenomena, when in fact lightning is just one type of surge. One other form of environmental surge is common electrostatic discharge, which can be particularly damaging to sensitive electronic equipment.

How Can You Protect Your System?
The simplest means of protecting your telecommunications system or other sensitive electronic equipment can be summed up in three words — single continuous ground. Let’s look at these words in reverse order.

Proper Grounds
Electrically grounding equipment means providing a direct, low-resistance path for electrical current to return to earth. The most important concept to understand about electricity when dealing with surges such as lightning is that current always takes the path of least resistance to ground. As end users of electricity, we have virtually no control in preventing surges from occurring. But what we can do is direct the current flow when the surge does occur — by ensuring all equipment is properly grounded.

Continuous Grounds
In order to be effective, the grounding system must be continuous. This means that grounding conductors should never be spliced or brought to a terminal strip. All ground connections should be made by an exothermic weld (Cadweld). In addition, the electrical grounding system (including metallic conduits and raceways) should be bonded to the building structural steel to provide maximum protection.

The neutral conductor should never be connected to the grounding conductor except at the service panel or source. Also, never use the grounding conductor as a neutral. This effectively eliminates your grounding system and any protection it affords you.

Single Grounds
Finally, there should be only one grounding system. All building systems, including electric, telephone, lightning, antenna, and underground metallic piping systems, should be connected together and bonded to the building grounding system.

Surge Suppression
In addition to a single, continuous grounding system, the proper use of surge suppression devices is the best means of protecting your telephone and computer systems. When a voltage surge occurs, a Transient Voltage Surge Suppressor (TVSS) provides a low resistance path to ground that bypasses the surge until the system voltage returns to normal. Therefore, the voltage to which the electrical equipment is exposed to is limited to a level much below that of the surge.
Ideally, a TVSS should be installed at the main service entrance equipment for the building to protect surges from entering the premises through the power system. In addition, local TVSS protection should be provided within the building for terminal equipment, computers and other sensitive equipment such as computer-driven instrumentation.

**Special Note on Isolated Grounds**

One of the most abused concepts is that of an "isolated ground." Often, "experts" in the field of computers or harmonics suggest the installation of a separate ground for computer or diagnostic systems as a means of eliminating noise or harmonic problems.

A separate ground is not an isolated ground. Having an equipment ground separate from the system ground may appear to correct the problem at hand, but it is a direct violation of the National Electric Code and creates a potentially life threatening situation. Consult a professional engineer or licensed electrician if you suspect you may have a condition involving a separate ground.

**Prevention is the Key**

Don’t neglect a proper grounding system for your equipment. Lightning and voltage surges can cause extensive damage and shut down your business. That can be costly, not only to the financial well being of your company, but to your reputation for reliability and customer service.

**About the Author**

Matthew Glennon is a registered Professional Engineer in New Jersey with over 12 years of experience in electric power engineering and construction. He is a magna cum laude graduate of Manhattan College where he earned a bachelor’s degree in electrical engineering. In addition, he holds a Master of Engineering degree in electric power engineering from Rensselaer Polytechnic Institute (RPI) in Troy, NY. He is a member of the Institute of Electrical and Electronics Engineers, the National Fire Protection Association and the National Society of Professional Engineers, as well as a Correspondent to the National Academy of Forensic Engineers.