How to Prevent Power Surges: The Leading Cause of Serial Device Server Failures

Jasmine Lin

Product Manager, Moxa Inc

Voltage spikes are brief events that rarely last more than a few microseconds, but all it takes is one snowball to set off an avalanche. In complex systems, even seemingly small events can have serious consequences. This is definitely true of industrial automation systems, in which many different devices need to work together in order to maintain normal operations. Computers and communications equipment are essential components of many modern automation systems; however, they are also particularly susceptible to power surges from voltage and current spikes because they typically have low dielectric strength. In these systems, serial device servers are key communications gateways that connect the broader Ethernet network with specific serial devices. A power surge that damages this vital communications link will bring the entire process to a halt.

What Causes Power Surges?

The two most common causes of power surges are lightning and switching surges.

A voltage spike is a momentary extreme burst of electricity in an electrical circuit. This energy spike may be short-lived, but could still be strong enough to seriously damage the electronics. Voltage spikes cause corresponding spikes in the current impulse.

Released on June 8, 2010

Moxa manufactures one of the world's leading brands of device networking solutions. Products include industrial embedded computers, industrial Ethernet switches, serial device servers, multiport serial boards, embedded device servers, and remote I/O solutions. Our products are key components of many networking applications, including industrial automation, manufacturing, POS, and medical treatment facilities.

How to contact Moxa

Tel: 1-714-528-6777
Fax: 1-714-528-6778
Web: www.moxa.com
Email: info@moxa.com

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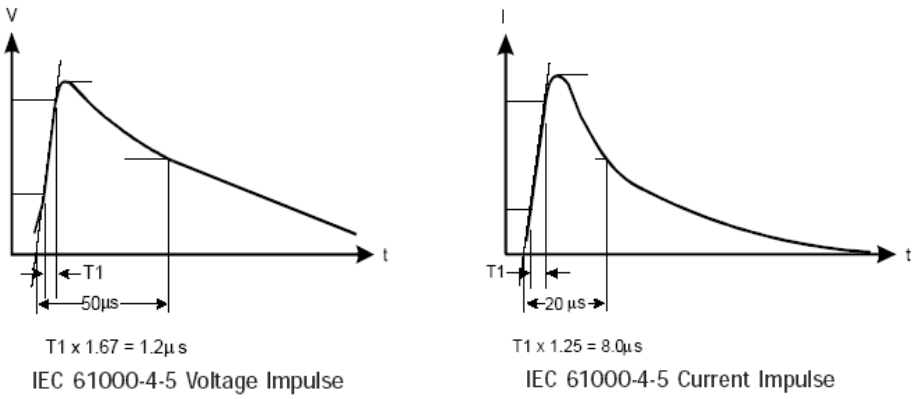


IEC 61000-4-5 voltage/current impulse waveforms

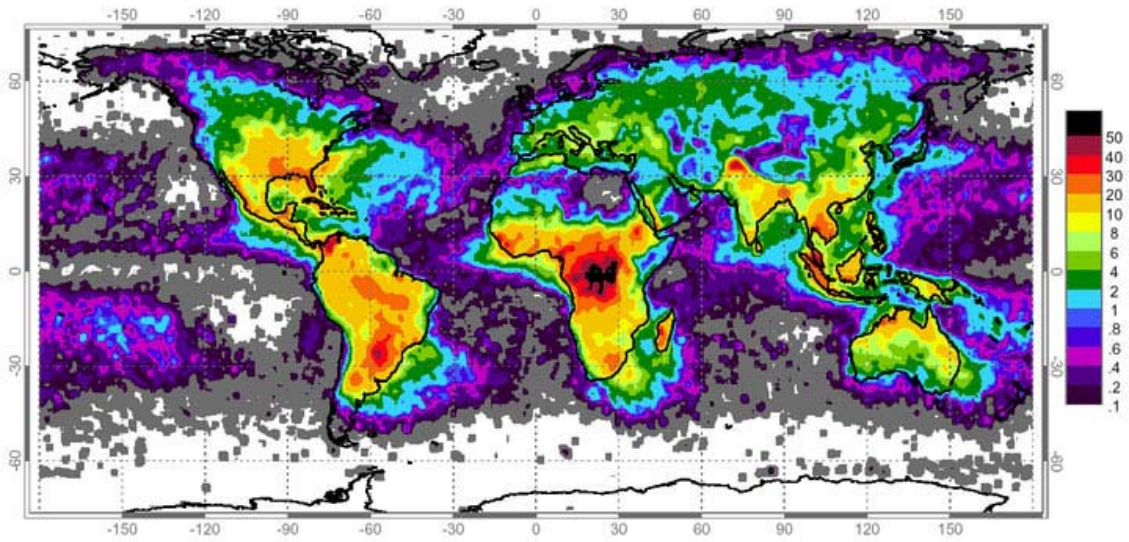
There are many potential sources of power surges. Two of the most common are spikes from lightning and switching surges:

Lightning causes electric discharge that is a surge threat even if it does not directly strike your building.

Lightning: Lightning creates substantial electric discharge at the location it strikes. Lightning that directly strikes a building can clearly endanger its electrical system, but there are other ways for lightning strikes to cause a power surge. For example, when lightning strikes a power transmission line, the effects can cause an equally dangerous voltage spike miles away.

Lightning strikes can cause current levels to reach 20-150 kA

Lightning is an ever-present threat to sensitive electronic systems. At this very moment there are 2000 lightning storms in progress, and there is an average of 5000 lightning storms a day. Of course, lightning strikes are more common in some regions than others. Nevertheless, even in locations with infrequent lightning strikes, lightning poses a significant risk and its consequences must be mitigated.



Distribution of lightning strikes worldwide (NASA)

Short circuits, tripped circuit breakers, power transitions, and similar events in the power infrastructure can also cause power surges.

Switching Surge: There are many malfunctions in electrical equipment that can lead to power surges. Tripped circuit breakers, short circuits, or even power transitions can all create switching surges. These electrical irregularities may be man-made but can cause just as much damage as lightning. A large power substation that regularly cycles on and off generates enough switching surges to threaten sensitive electronic devices.

Gaps in Existing Power Surge Protection

The serial line is often the vulnerable chink in a serial device server's surge protection armor.

Industrial automation operators generally understand that power surges pose a serious threat to their systems and take steps to reduce this threat. Not only do power surges damage and destroy equipment, they cause costly interruptions. In the case of serial-to-Ethernet communications, irreplaceable historical data could be lost if the serial or Ethernet ports suffer a power surge.

For a serial device server, there are three major points of weakness that could be damaged by a power surge: the serial line, the Ethernet line, and the power line. Many serial device servers offer surge protection on the Ethernet and power lines to protect against this threat. However, most serial device

servers leave the serial line unprotected. As a consequence, the serial line is often the vulnerable chink in a serial device server's surge protection armor.

Electric Substation Automation: A Surge Vulnerability Case Study

Substation automation facilities are at particular risk for power surges because they are highly susceptible to both major sources of voltage spikes. As outdoor facilities, substations are more exposed to lightning strikes. As electric facilities that perform electric transformation and switching, switching surges are also a danger. At the same time, electric substations need reliable serial communications in order to perform essential tasks such as reading power meters. If surge damage occurs on a serial line, then any meter data on the associated line will be lost. This combination of increased risk profile and greater consequences means that robust products with industry-certified surge protection are a must for electric substations.

Full Spectrum Surge Protection

A serial device server is not truly protected against power surges unless it has complete surge protection on all three lines: power, Ethernet, and serial.

Surge protection is not an option for vulnerable communications links. Effective and comprehensive surge protection reduces downtime and increases system stability by eliminating the most common cause of failure. IEC 61000-4-5 testing is imperative to verify that a device has sufficient surge protection to withstand voltage spikes. IEC 61000-4-5 Level 1 testing is intended for a device that operates in partly protected electrical environments, while IEC 61000-4-5 Level 2 and higher testing certifies that a device can operate in highly electrical environments.

	Description	Certification
Class 1	Partly protected electrical environment	IEC 61000-4-5 Level 1
Class 2	Electrical environment with well-separated cables	IEC 61000-4-5 Level 2
Class 3	Electrical environment with parallel cables	IEC 61000-4-5 Level 3

Many manufacturers offer serial device servers with IEC 61000-4-5 rated surge protection on the power and Ethernet lines. However, the same level of integrated surge protection is rare for the serial line. In order to acquire serial line surge protection, device servers are often deployed with additional external surge protection devices. However, this retrofit adds complexity, increases space requirements, imposes additional maintenance costs, and complicates support cases. Industrial automation systems can be complicated enough as it is without an additional requirement to deploy, maintain, and support yet another device just to provide serial line surge protection.

Moxa's NPort® A Series: Closing the Gaps in Surge Protection

Moxa's new NPort® A series of serial device servers sets itself apart from other solutions with built-in IEC 61000-4-5 rated surge protection on the serial line in addition to Ethernet and power line surge protection. This provides a reliable, resilient serial device server solution in a convenient all-in-one package. With built-in serial line protection, it is no longer necessary to find, test, and deploy an external serial surge protection product.

Surge immunity on the serial, Ethernet, and power lines grants the compact, IEC 61000-4-5 certified Nport® A series reliability and full-spectrum protection against voltage spikes and electrical noise. To request price information, view product specifications, or learn how Moxa applied leading-edge surge immunity to the Nport® A, visit www.moxa.com/Event/Tech/2010/NPort_A_Series/surge.htm.