



Uninterruptible Power Supplies (UPS) and the Need for Secondary Surge Suppression

Application Note

Why a UPS Alone Does Not Provide Adequate Secondary Surge Protection

The advantages of installing a Surge Protective Device (SPD) on a facility's service entrance are well documented and acknowledged as being essential in protecting sensitive electronic equipment from outside sources of transient voltages such as lightning strikes and utility company switching. For surge protection to be most effective, however, not only is it essential to install a primary SPD at your facility's service entrance, it is also important to install a secondary SPD on branch panels and other downstream critical equipment.

If a UPS is part of your power distribution system, it can be assumed that the equipment being powered by the UPS is critical to your facility's operation. So why not fully protect the equipment connected to the UPS, and the UPS itself, from the damaging effect of voltage transients by installing the most effective surge protection system possible?

Is the surge protection provided by a UPS adequate? The answer is NO! The surge protection provided by most UPS units is limited, and often does not contain EMI/RFI filtering, which lowers the let-through voltage provided by MOVs alone.

IEEE Emerald Book Recommendations

Surge Protective Devices (SPDs) must be properly installed to ensure that critical equipment is fully protected. The IEEE Emerald Book recommends the following:

"... For large surge currents (transient) diversion is best accomplished in two stages: the first diversion should be performed at the service entrance to the building. Then, any residual voltage resulting from the action (of the suppression device) can be dealt with by a second protective device at the power panel of the computer room (or other critical load). In this manner, the wiring inside the building is required to carry the large surge current to and from the diverter at the end of a branch circuit."

And what about UPS surge protection? Again quoting the IEEE Emerald Book:

"Lightning and other transient voltage producing phenomena are harmful to most UPS equipment and to sensitive electronic load equipment (e.g., via an unprotected static-switch bypass path around a UPS). Therefore, it

is recommended practice that both the rectifier-charger input circuit to the UPS and the associated UPS bypass circuits (including the manual maintenance bypass circuit) be equipped with effective Category "B" TVSS protection as specified in IEEE Std C62.41-1991 [9]."

Don't be Confused by Joule Ratings

Most UPS devices advertise a level of surge protection measured in Joules. A high Joule rating, however, does not always mean better protection. The IEEE, IEC and NEMA do not recommend using Joule ratings when specifying or comparing surge suppressors because they often provide misleading and conflicting information. For example, in a 120 V system, a 150 or 175 V MOV could be used. And even though the 175 V MOV has a higher Joule rating, the 150 V MOV has a much lower let-through voltage and offers better surge protection.

The industry standard method of classifying SPDs is by their maximum surge current per phase expressed as kA/phase. Surge current per phase is the maximum amount of surge current that can be shunted through each phase of the SPD without failure.

So when comparing the level of surge protection, don't be confused by misleading Joule ratings. Use the industry standard measurement method of kA/phase.

Advantages of a Downstream SPD

The following bullet points highlight the reasons why placing a SPD downstream of a UPS provides surge protection that a UPS alone cannot provide:

- During periods of maintenance when an unprotected static-switch is used to bypass a UPS, equipment on the load side of the UPS is no longer adequately protected. A secondary SPD installed on a panelboard downstream of the UPS eliminates this problem as recommended by the IEEE Emerald Book.
- Up to 80% of all transients in a facility are generated by load switching occurring in the facility. The turning ON and OFF of cooling fans, light dimmers, computer power supplies, and other equipment can generate transients that over time can cause damage to other equipment connected to the same panel. An SPD installed downstream of the UPS keeps these load generated transients from damaging neighboring equipment.

- UPS devices with internal surge protection may only have category "B" level protection, while a dedicated SPD provides category "C" protection. The table below shows the peak values of voltage and current that a dedicated SPD is designed to safely withstand for each ANSI/IEEE C62.41-1991 category location.

Surge Current Ratings per Location Category

Location Category	System Exposure	Peak Values		
		Voltage (kV)	Current (kA)	Effective Impedance (Ohms)
A1	Low	2	0.07	30
A2	Medium	4	0.13	30
A3	High	6	0.20	30
B1	Low	2	0.17	12
B2	Medium	4	0.33	12
B3	High	6	0.50	12
C1	Low	6	3	2
C2	Medium	10	5	2
C3	High	20	10	2

- SPDs typically cost much less than a UPS and provide better surge protection, and are therefore a more effective use of resources to protect your costly UPS.
- SPDs typically have a 5–10 year free replacement warranties. If the surge protection built into a UPS fails, the entire UPS must be replaced.
- Transients originating on the load side of the UPS could, over time, deplete the surge protection installed in the UPS, thus damaging the UPS itself.

Therefore, not only does a downstream SPD protect the loads, it also protects the UPS.

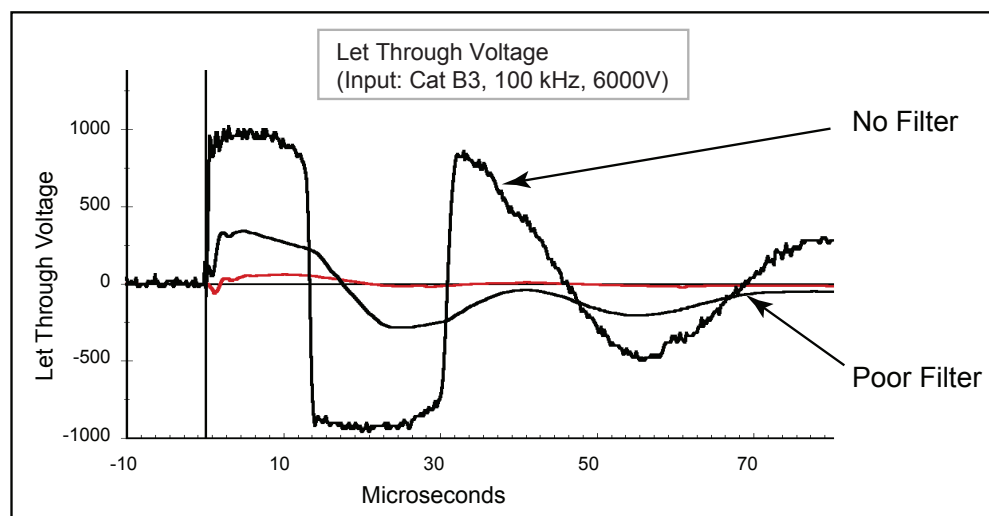
- SPDs contain a visual method of indicating the status of its protection circuitry. Unlike a UPS that normally does not provide notification of when its surge protection circuitry has failed.
- Finally, noise generating loads are found in almost every facility, and a UPS usually cannot attenuate this noise. A quality SPD contains EMI/RFI filtering that provides at least -50 dB of attenuation at 100 kHz (as specified by Mil-Std-220), which helps ensure the system maintains computer-grade power.

Noise on the load side may also cause a standby type UPS to unnecessarily switch to battery power due to the noise being interpreted as a power line disturbance. By eliminating noise on the load side, the UPS stays in standby, thus increasing battery life.

The graph below shows the effect of filtering on a test waveform of 6,000 volts, 500 A at 100 kHz (IEEE B3 Ringwave).

Summary

The equipment protected by a UPS is always critical to a company's operation and should be fully protected from the damaging effects of transients. The system should be designed to ensure the equipment is protected by a cascading approach under all operating circumstances. As previously described, these claims are verified by the IEEE Emerald Book. In conclusion, the installation of a SPD both up and downstream of the UPS provides the superior protection to keep all critical equipment safe from damaging surges.



EMI/RFI Filter Ringwave Suppression Capabilities

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