



Surge Protection for Uninterruptible Power Supplies

White Paper 95

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Uninterruptible Power Supplies (UPS) are commonly deployed to provide short-term backup power for information technology equipment and facilities. The following narrative explains how surge protection devices (SPDs) can be deployed to protect UPS equipment from damages that can be caused by excessive transient overvoltages.

UPS SUSCEPTABILITY TO SURGES

Lightning and other transient voltage-producing phenomena are harmful to sensitive electronics used in UPS equipment, and to the electronic load equipment it serves. For example, a transient overvoltage may reach load equipment following the unintentional activation of an unprotected static-switch bypass path around a UPS. This type of exposure can degrade solid state materials in the components of electronic equipment. Some examples of impacts include:

- event-related damage to semi-conductor materials in UPS components
- cumulative dielectric breakdown that can reduce UPS functionality and performance
- failed UPS components that may result in loss of customer loads

SURGE PROTECTION REQUIREMENTS IN CODES

Because electronic components are susceptible to damage from transient over voltages, surge protection is needed to ensure that vital equipment can be relied upon when needed. As a result, industry codes require that surge protection be provided in power equipment serving critical systems. In the National Electrical Code® (NEC®), specific requirements for providing SPDs include Articles 700.8, 645.18, and 708.20. The significance of the requirements is evaluated as follows.

Article 700 - Emergency Systems

Article 700 of the NEC applies to the installation of legally required emergency power systems that serve life-safety equipment that is required by governmental codes, such as the systems and devices that help people exit a building during an emergency. Because failure of these systems could result in injury or loss of life, they must be protected against threats to their reliable operation. Transient overvoltages can damage or degrade electronics in these systems, including those in a UPS serving life-safety equipment. Article 700.8 reads, *“A listed SPD shall be installed in or on all emergency systems switchboards and panelboards.”* Consequently, where a UPS supplies power to legally required emergency equipment or systems, the panels feeding the UPS must be fitted with SPDs.



Critical Operations Power Systems

are generally installed in vital infrastructure facilities that, if destroyed or incapacitated, would disrupt national security, the economy, public health or safety; and where enhanced electrical infrastructure for continuity of operation has been deemed necessary by governmental authority.

Article 708 - Critical Operations Power Systems

Some facilities serve purposes that are vital to public safety, security, or commerce. Examples include hospitals, 9-1-1 call centers, and data centers that process key financial transactions. NEC *Article 708 – Critical Operations Power Systems* requires that risk assessments be conducted on power systems in these facilities, and that responding measures be applied to mitigate risks that are not adequately addressed by the other NEC provisions. With regard to the power sources in these systems, Article 708.20(D) states that *“Surge protection devices shall be provided at all facility distribution voltage levels.”*

Article 645 - Information Technology Equipment

Most often, UPS are installed to provide interim power to data processing equipment and systems when short-term outages occur. These data systems include *“information technology equipment ... that requires continuous operation for reasons of public safety, emergency management, national security, or business continuity.”* The NEC is explicit regarding these systems; Article 645.18 states, *“Surge protection is required for critical operations data systems.”* Where UPS are used, they must be included in the scope of any surge protection strategy for these systems.

APPLYING SURGE PROTECTION

Because rectifiers, inverters, switches and other electronic UPS components can be highly susceptible to overvoltage transients, SPDs are necessary at UPS inputs and outputs to protect the components from transient overvoltages produced by upstream and downstream sources. Newer UPS may also offer an energy conservation mode that activates a bypass switch to reduce UPS power consumption and increase UPS efficiency. When present, bypass circuits (including any manual maintenance bypass circuit) can serve as a pathway for transients to reach load equipment. As a result, bypass circuits should be protected by installing SPDs. At a minimum, an effective Category B SPD should be used, as specified in IEEE Standard C62.41 - IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits. For these applications, low-impedance connections are necessary to maximize SPD effectiveness. Category C SPDs offer higher levels of protection and may better protect critical infrastructure.

If a UPS incorporates low energy Category A or B surge suppressors, the UPS and its connected load may not be sufficiently protected from the instantaneous and cumulative effects of large or frequent transients. The IEEE Standard 1100-2005 recognizes this problem. Section 8.6.5 of that document describes how applying SPDs to both a power system and its UPS can provide better protection. Figure 1 shows the location of SPDs in a single-source power system. Figure 2 shows a protection strategy for a UPS equipped with a bypass input for a separate source.

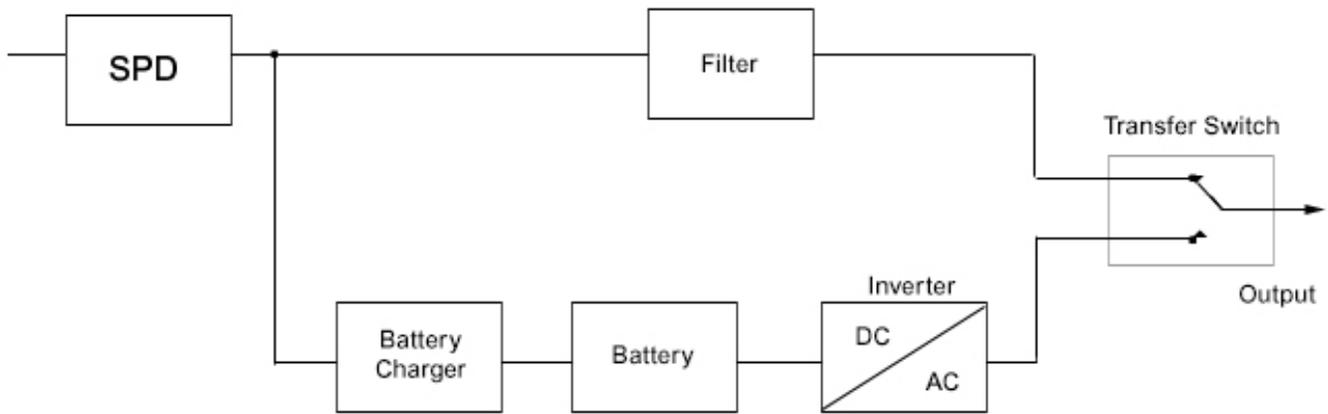


Figure 1: Location of SPD in a single-source power system

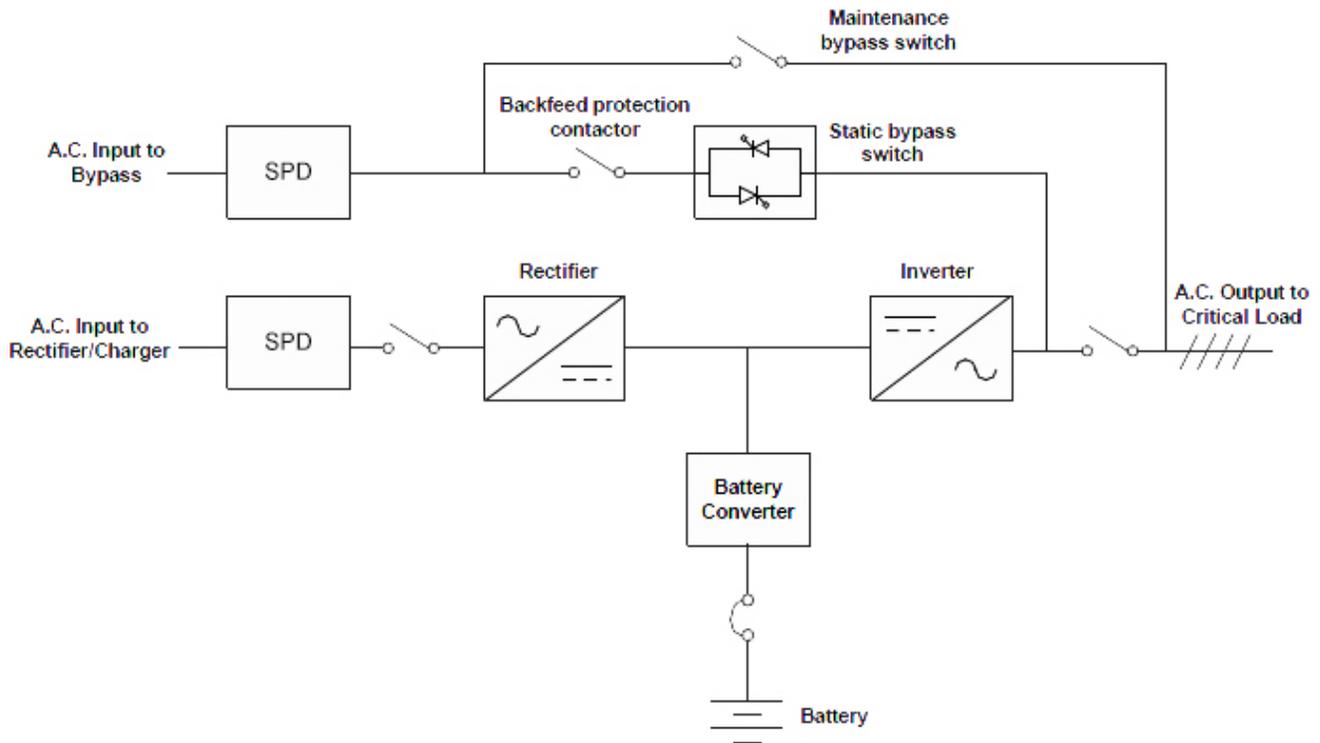


Figure 2: Protection strategy for a UPS equipped with a bypass input for a separate source



AMOUNT OF SURGE PROTECTION

To ensure that selected SPDs will provide adequate protection, users should carefully review IEEE's recommended guidelines for cascading. This includes upstream locations, which will ensure proper protection of key critical point of use equipment, like a UPS system. For assistance in selecting surge protective devices, contact a local ASCO representative.

Like other electrical devices, SPDs must be protected from overcurrent events. Manufacturers commonly equip many types of SPDs with internal, component-level, overcurrent protection. In premium SPDs, overcurrent protection is provided by component-level fuses. However, even with this protection in place, an SPD should be equipped with a means to disconnect it so that the SPD can be replaced or repaired when necessary. Typically, this is done using a disconnect switch within a surge protector, or a breaker upstream of the SPD, usually at the upstream panel board. Figure 3 shows an SPD with a service disconnect switch.

Figure 3: ASCO Model 560 with disconnect switch

SUMMARY

Uninterruptible power supplies provide backup power to critical infrastructure equipment and systems. UPS systems, like other devices containing sensitive electronic components, are susceptible to transient overvoltages from lightning or switching-related events. IEEE 1100 provides recommendations for protecting UPS equipment from associated risks. For complete protection, IEEE recommends SPDs be applied on UPS inputs and bypass switch inputs. The selected SPDs should offer premium protection, meet or exceed the short circuit current rating of the associated electrical circuits, and provide protection meeting or exceeding UPS manufacturer recommendations.

REFERENCES

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