Transient Voltage Surge Suppression (TVSS) Equipment for Fire Alarm System Circuits

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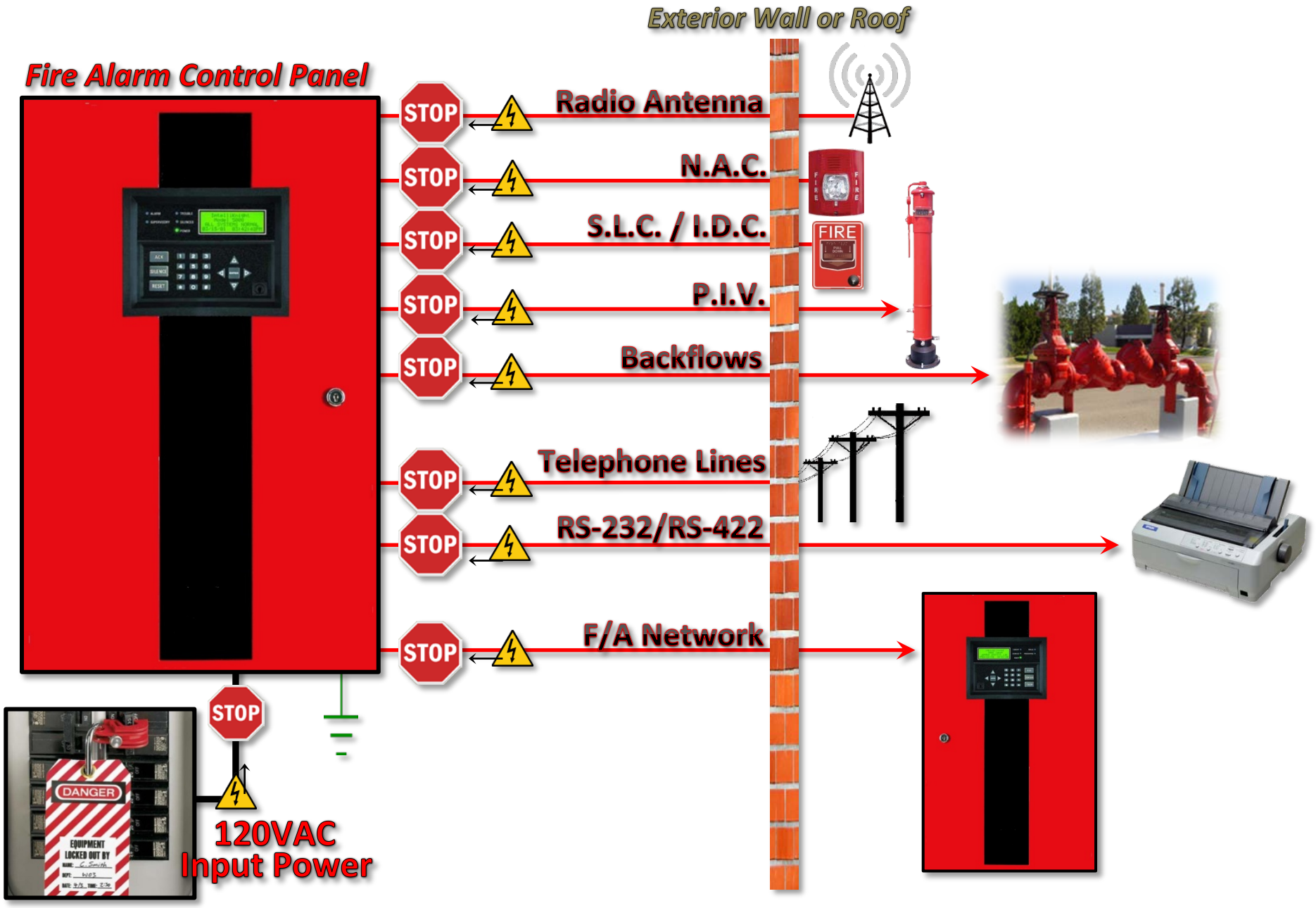

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General Information

Transient surges result in one of three things…Destruction, Degradation and Downtime. Destruction ("It's broken") is erroneously, most people's main concern. The gradual degradation of equipment causes more frequent replacement and those annoying "glitches" so prevalent in electronics today. Downtime is easily the most expensive result of a spike.

A properly designed surge protection system can protect electronics from most incoming and internally generated surges. In reality the design of the system and the quality of the installation can be more important than the protector itself. The reason for this is because of how most surge protection works. A surge protector sits on a line, basically invisible, until it "sees" voltage above its rated level. It then goes into a low impedance state opening a path to ground. A surge, like all electricity (and water, for that matter), tries to find the "path of least resistance" to ground. This is why installation and grounding are such critical components of a surge protection system. Once the transient is safely diverted to ground, the protector resets to its passive state and waits for the next event.

Most solid-state surge devices will shunt thousands of voltage spikes without suffering any damage. When a protector does self-sacrifice, it will stay in the shunt to ground mode until disconnected and replaced. There are really only two things that can damage TVSS equipment. The first is a major transient surge larger than the device's capacity. The second, as mentioned before, is a "continuous" over-voltage situation. In either event, the protector needs to be replaced.

System Design

Lightning is perceived to be the most common cause of power surges but in actuality, your local power company is the biggest culprit. Also responsible for voltage spikes are local industrial facilities and even the machines, motors and condensers in your own building. The "2-98" rule states that roughly 2% of the surge related damage to electronics is caused by direct lightning. The remaining 98% comes from other sources.

Proper protection should be divided into two environments: Power and Data/Telecom. When recommending surge protection for electrical power, focus should be placed on the most recognized standard in the industry (ANSI/IEEE C62.41-1991 – Application Guidelines for Transient Voltage Surge Suppression). This standard divides a building into three categories (A,B,C). Category C is defined as the service entrance or main disconnect. Category B is at the distribution and sub-panel environment and Category A is at individual equipment or wall outlets. Maximum protection requires a surge suppressor at each one of these locations (A,B,C) and minimum protection requires a surge suppressor at two of the locations which feed the sensitive load.

Using a basic approach, start at the sensitive equipment and work backwards. For example, if the sensitive equipment is located in an x-ray room and fed from a 225A panel; we would recommend a Category B device on the 225A panel. The voltage configuration will vary depending on the service voltage coming into the panel. If the 225A panel is fed from a 1200A main distribution panel, we would recommend a Category C device at the 1200A panel. The theory involves the Category C device dissipating the majority of the transient, at the main distribution panel. The Category B device will dissipate transient let-through from the Category C device and also, any internally generated transients, such as from inductive load switching. The transient letthrough can be dissipated even further by installing a Category A device (plug-in or hard-wire suppressor) at the equipment; however, with two stages of panel protection, clamp levels can be achieved below 300 volts for 120/208 volt applications.

Nothing can give a 100% guarantee of safety when dealing with transient surges. Lightning does not follow UL approved waveforms, and when an open neutral event occurs at your local utility, line voltage can remain at more than twice nominal for several minutes.

Grounding

1. "ABC RULE" – WHENEVER POSSIBLE, THE CONDUCTOR LENGTH TO EARTH GROUND SHOULD BE LESS THAN THE CONDUCTOR LENGTH FROM THE TVSS TO THE PROTECTED EQUIPMENT.

2. "PARALLEL CONNECTION RULE" – WHEN CONNECTING A PARALLEL TVSS DEVICE TO A SYSTEM (I.E. A D75 CONNECTED TO A BREAKER IN A HOUSE PANEL) THE LEADS FROM THE TVSS SHOULD BE AS SHORT AND STRAIGHT AS POSSIBLE.

3. "GROUND RESISTANCE RULE" – THE GROUND SYSTEM SHOULD HAVE A MAXIMUM RESISTANCE OF 25 OHMS. 5 OHMS, OR LESS, IS THE PREFERRED LEVEL FOR OPTIMUM PERFORMANCE OF THE TVSS. BEST BETS FOR GOOD GROUND ARE…
    a. GROUNDED BUILDING STEEL
    b. ELECTRICAL SERVICE GROUND
    c. DEDICATED DRIVEN ROD
    d. LOCAL ELECTRICAL GROUND

4. "SINGLE POINT GROUND RULE" – IN A SYSTEM WITH MULTIPLE GROUND RODS THE RODS SHOULD BE DIRECTLY CONNECTED WITH NO EQUIPMENT IN THE GROUND PATH.

5. PMI – PREVENTATIVE MAINTENANCE INSPECTIONS SHOULD BE MONTHLY AND IMMEDIATELY FOLLOWING LOCAL LIGHTNING STRIKES.

Summary of applicable UL and IEEE standards for surge protection devices

TABLE 1. STANDARD DESCRIPTIONS

Standard (Current revision date)	Purpose of standard/comments
UL 1449 (1987) Transient voltage surge suppressors	1. Safety test (constructed of approved components in a safe manner). 2. Suppressed voltage rating (let-through voltage using the IEEE C62.41 C1 test wave). Other IEEE recommended waveforms such as the C3 and B3 Ringwave are not tested by UL.*
UL 1449 (2nd Edition 1996)	1. Additional safety tests. Test for other standards used to improve safety of products. 2. Surge test. Let-through voltage tested at lower current than 1st Edition 0kA (IEEE Cat C3) used for first time; however, it was only use to see if products fail safely.
UL 1449 (2nd Edition 2007)	1. Stringent new safety requirements. New tests subject TVSS units to prolonged AC overvoltage conditions to ensure safe failure modes. 2. UL label changes to the wording of the short circuit current rating. 3. New Testing at 10, 100, 500 and 1000A and system voltage were added to ensure the units fail in a safe manner.
ULS 1449 (3rd Edition 2009)	1. TVSS will now be referred to as SPD (surge protective devices). 2. UL 1449 is now ANSI/UL 1449 3. Addition of four types of SPDs to cover surge arrestors, TVSS, surge strips and component SPDs.
UL 1283 (1996) – Electromagnetic interference filters	This safety standard covers EMI filters connected to 600V or lower circuits. The UL 1283 is a safety standard and does not include performance tests such as MIL-STD-220A insertion loss or Cat. B3 Ringwave let-through voltage tests.
UL 497, 497A, 497B	Safety standard for primary telephone line protectors, isolated signal loops and surge protection used on communication/data lines. No performance tests conducted for data/communication lines.
IEEE C62.41.1 (2002)	*IEEE Guide on the Surge Environments in Low-Voltage AC Power Circuits*. This is a guide describing the surge voltage, surge current, and temporary overvoltages (TOV) environment in low-voltage [up to 1000V root mean square (Rms)] AC power circuits.
IEEE C62.41.2 (2002)	IEEE-recommended practice on characterization of surges in low-voltage AC power circuits. This document defines the test waves for SPDs.
IEEE C62 45 (2002)	Guide on surge testing for low voltage equipment (ANSI). This document describes the test methodology for testing SPDs.
IEEE Emerald Book	Reference manual for the operation of electronic loads (includes grounding, power requirements, and so on). NEMAT LS-1 NEMA Technical Committee guide for the specification of surge protection devices including physical and operating parameters
NCET	National Electrical Code Articles 245, 680 and 800.
NFPAT 780	Lightning protection code recommendations for the use of surge protection devices at a facility service entrance.

*C UL 1449 does not require a maximum surge current test.