

SURGE-TRAP[®] AND THE DIFFERENT KA RATINGS

SURGE PROTECTION NOTE 2

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INTRODUCTION

Power surges occur daily and the equipment within your own facility accounts for roughly 80% of all disturbances. As a result, Surge Protective Devices (SPD) are being used at more facilities to protect sensitive control equipment. However, there is some confusion when trying to understand certain ratings. Three ratings that are commonly confused or misunderstood are “Max Surge Rating” (I_{max}), “Nominal Discharge Current” (I_n), and “Short Circuit Current Rating” (SCCR). Because all three of these ratings use the same unit of measure (kA), they are easily confused with one another. This tech topic will compare and explain the differences and recommend baseline values.

PROBABILITY OF SURGES APPEARING:

First let's start by defining what a voltage surge is and how it causes damage. A voltage surge is a voltage level that is short in duration and is several times greater than the system's normal operating voltage (see figure 1).

There are three ways in which a surge will cause damage:

- **Disruptive:** A surge enters an electronic component which interprets this as a valid logic command. The result: System lock-up, machine malfunction leading to faulty output, or corrupted files.
- **Dissipative:** A repetitive, pulsing of short duration energy. The result: Long-term machine or system degradation leading to system replacement at earlier intervals.
- **Destructive:** A high-level energy surge that immediately results in equipment failure or destruction.

TERMS

- **SPD:** Surge Protective Device
- **MOV:** Metal Oxide Varistor
- **SCCR:** Short circuit current rating
- **MCOV:** Maximum rms voltage that may be applied to the SPD for each connected mode
- **8/20 μ s wave shape:** Wave shape with a virtual front time of 8 μ s and a time to half-value of 20 μ s

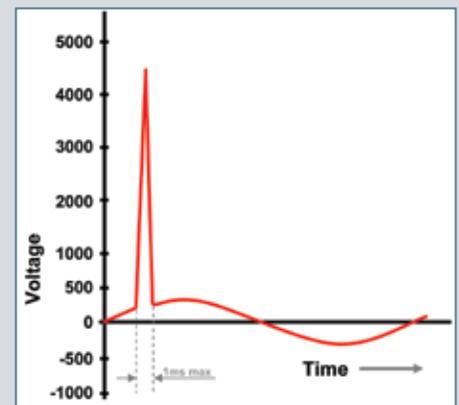


Figure 1: A typical voltage surge

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When comparing SPDs it is important to verify that the devices are tested and approved by the same third-party organization and standard such as Underwriters Laboratories (UL) standard 1449 3rd edition. UL 1449 3rd edition defines exact test parameters and measuring techniques which results in data that is truly comparable. I_{max} is not a UL defined value; UL 1449 3rd edition defines I_n and SCCR.

- **I_{max} also known as surge rating, max discharge current, or kA rating:** The maximum single surge capability usually specified by an 8/20 μ s waveshape. This means that the SPD can withstand a single surge at this level but it will degrade the SPD and will need to be replaced over time. A good analogy is a gas tank: the bigger the surge, the more “gas” used.
- **Nominal Discharge Current (I_n):** The peak value of the current, selected by the manufacturer, that can be passed through the SPD having a waveshape of 8/20 μ s where the SPD remains functional after 15 surges.
- **Short Circuit Current Rating (SCCR) OF SPD:** The suitability of an SPD for use on an AC power circuit that is capable of delivering not more than a declared rms symmetrical current at a declared voltage during a short circuit condition.

Since most SPDs on the market use a metal oxide varistor (MOV) as the main limiting device, we can explore how/why higher I_{max} are achieved. If a MOV is rated for 10kA and sees a 10kA surge, it would

use 100% of its capacity. If a different SPD has two 10kA MOVs in parallel, it would have an I_{max} of 20kA. Theoretically, the MOVs will split the 10kA surge evenly, so each would take 5kA. In this case, each MOV has only used 50% of their capacity which degrades the MOV much less (leaving more left in the “tank” for future surges).

Depending on the type of SPD, it is up to the manufacturer to choose a nominal discharge current (I_n) of either 3 kA, 5 kA, 10 kA, or 20 kA. UL 1449 3rd edition states: 15 surges, at the select I_n are applied to the device in sets of 3, but first the SPD is tested to measure the clamping voltage and then the rated voltage (MCOV) is applied for 60 seconds. Next 5 surges at the selected I_n are applied 1 second apart and then the SPD must rest for up to 30 minutes, this is repeated two more times. To prove the SPD is still fully functional, after the 15th surge the rated voltage is re-applied for at least 15 minutes and then the clamping voltage is tested again to ensure there is no more than a 10% deviation.

SCCR is different from the other ratings in the fact that it has nothing to do with the surge capability of the SPD. It is the maximum amount of current the SPD will be able to safely withstand during a short circuit event. The SCCR must be equal to or greater than the circuit’s available short circuit current, otherwise the SPD could be damaged.

When selecting an SPD, how do you know what type of ratings you need? To a certain degree bigger is better with all three of these ratings, but at some point there is no real benefit, only added cost.

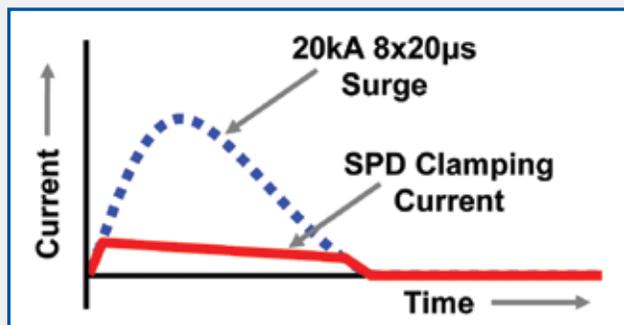


Figure 2: Single I_n surge

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As stated above the common method for increasing I_{max} is to have multiple MOVs which increases the longevity of the SPD. However, using an SPD with an I_{max} of 200kA (or higher) for every application is not recommended because of the increased cost. As explained in the IEEE C62.41 standard, a realistic estimation of the largest surge that can enter a building's wiring is 10kA. Mersen makes the following recommendations for I_{max} rating based on location:

- **Service Entrance:** 200kA is recommended because it will most likely see the largest surges and a large scale outage is required to replace the SPD.
- **Distribution Panel:** 100kA is recommended because it will most likely see medium surges and a smaller scale outage is required to replace the SPD.
- **End Use Equipment:** 50kA is recommended because it will most likely see the smallest surges and only power to that piece of equipment is required to be turned off to replace the SPD.

Since I_n is the value of surge current, the SPD must withstand for 15 pulses and remain functional; this is a straight “bigger is better” rating. However, UL 1449 3rd edition limits this to 20kA, so Mersen recommends an I_n of 20kA when available to ensure your SPD remains functional after larger repetitive surges.

The required SCCR will depend on your facility and where the SPD will be installed within the electrical system. Most facilities in the US have fault currents below 200kA, so selecting and SCCR of 200kA will ensure the SPD is suitable for most installations. When selecting an SPD first you must make sure it is tested to the most current safety standards, currently UL 1449 3rd edition. The recommendations above serve as a good baseline for selecting the correct cost effective SPD for your application. Contact Mersen Technical Services at technicalservices.nby@mersen.com for additional information on selecting the correct SPD.

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ADDITIONAL RESOURCES

Surge Protection Note 1: Introduction to Specifying Surge Protection

Surge Protection Note 3: TPMOV Construction and Operation

These and other Tech Topics are available on ep.mersen.com.