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GUIDELINE
SURGE PROTECTION

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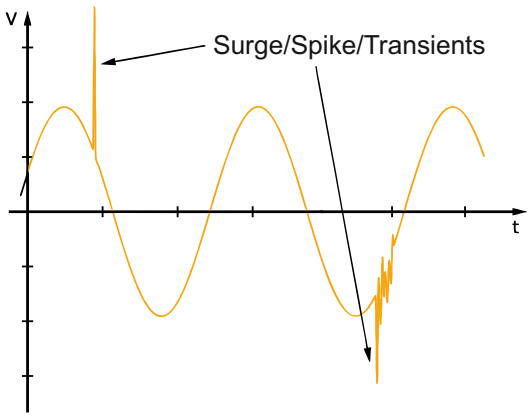
Surge Protection for LED Lighting Systems

Overview:

A surge is a sudden increase in voltage lasting three nanoseconds or more, while a spike typically refers to short-lived power increases. While both phenomena can be disruptive and cause considerable damage, voltage surges are generally considered more harmful due to the longer duration of the excessive power.
Despite their brief nature, voltage surges carry significant energy and can cause serious issues for electronics connected to the power grid.

Voltage surges or spikes can severely damage electronic equipment, such as LED lighting systems. They can cause LED drivers and panels to degrade prematurely, leading to frequent lighting failures. Surges from lightning strikes, for instance, can damage protective components in lighting panels.

There are several reasons for voltage surges. For example, when lightning strikes a building's power lines or lightning rod, it generates powerful electrical fields that create high voltage surges in nearby electrical equipment. Additionally, long external power lines are prime targets for lightning, and the large electrical currents from the strikes can travel through them. Even everyday events, such as switching off large machines or operations within electrical panels, can trigger voltage spikes that interfere with sensitive electronic devices.



Surge over-voltages can propagate in two ways: between live wires and ground, or between the live wires themselves. To mitigate these over-voltages, a surge protection device (SPD) should be used. When a surge occurs, the SPD directs the excess power to the ground, keeping the voltage at a safe level for connected devices. SPDs can be installed in two ways: in-line (like a fuse) to protect downstream equipment from further damage, or in parallel, where the lighting system continues functioning even if the SPD is damaged.

Outdoor lights are exposed to weather conditions, making continuous operation critical.
Implementing surge protection can extend the lifespan of lighting systems, improve service reliability, and reduce maintenance costs.

Protecting Against Surge Over-Voltages

A Surge Protection Device (SPD) works like a switch that activates in response to voltage. When the surge voltage is below the threshold needed to trigger the SPD, it remains inactive. However, when the surge exceeds this threshold, the SPD activates and diverts the excess voltage away, preventing damage to connected equipment.

When selecting an SPD, it's important to consider both the level of lightning activity in the area and the amount of voltage the system can safely handle. For large lighting setups, the best approach is to implement multiple layers of protection, much like stacking shields. Each layer is designed to absorb a specific level of surge energy and voltage. Since every setup is unique, SPD solutions should be tailored to the particular needs of the installation, including appropriate lightning protection and grounding.

There are two primary causes of surges that can affect a lighting system:
- **Direct lightning strikes** to power lines (surge energy traveling through the wires).
- **Nearby lightning strikes** to a building, causing surges to spread into the electrical system.

To effectively protect the system, surge protection devices should be placed near the main circuit breaker within the distribution panel. This placement ensures the SPD works alongside the main system to channel the surge energy safely into the ground, preventing harmful voltage spikes from reaching downstream equipment.

To provide maximum protection for lighting equipment, the distance between the light fixtures and the surge protection device should be as short as possible. Effective earth ground connections are crucial for the SPD to function properly. These connections must meet industry electrical standards and be robust enough to efficiently conduct surge energy into the ground.

Protection for LED Lighting Systems:

1. Basic Protection: According to IEC 61547, all lighting systems must be protected from surges of up to 1 kV in one direction and 2 kV in another. This level of protection is typically provided using Type 3 (Class III) devices.

2. Enhanced Protection: When designing installations, it’s wise to assess the likelihood of lightning in the area. If the risk is high, adding an extra layer of protection capable of handling up to 10 kV is recommended. This requires additional protection alongside the basic light-level safeguards. Type 2 (Class II) devices are suitable for this level of protection.

3. Comprehensive Protection: For highly vulnerable areas, devices can be placed at the point of power entry to protect against high-energy surges (up to 40 kA) and power disturbances. These devices are typically Type 1 (Class I) SPDs.

Installation / Selecting Surge Protection Devices (SPDs)

Always adhere to the installation instructions and best practices provided by the SPD manufacturer.

Choose a certified SPD that provides protection for both the branch circuit and the connected equipment. Be sure to comply with local electrical codes.

Ensure that the SPD can protect against both common-mode (Line-Earth, Neutral-Earth) and differential-mode (Line-Neutral) surges.

Select an SPD specifically designed for the nominal operating voltage of your installation. Using an SPD rated for a higher voltage will not necessarily offer better protection.

Focus on selecting an SPD with a low let-through voltage or voltage protection rating (VPR). Recommended targets are:

- Common Mode (L-Earth or N-Earth): ≤1500V (lower is preferable)Differential Mode (L-N or L-L),
- Preferred: ≤1000V (lower is better)
- Differential Mode (L-N or L-L), Acceptable: ≤1200V (lower is better)
- Note: The L-L specification applies when single-phase loads are connected without a neutral wire (e.g., 208V circuits in a 120/208V system).

Consider the surge voltage/current ratings of the SPD. Higher ratings mean the SPD is likely to have a longer service life and be able to handle larger surges.

Certified SPDs are typically equipped with a failure indicator (e.g., a light or flag). This allows maintenance personnel to quickly verify whether the SPD is still functional. Regular inspections are essential. If the indicator shows the SPD is not operational, it should be replaced immediately.

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