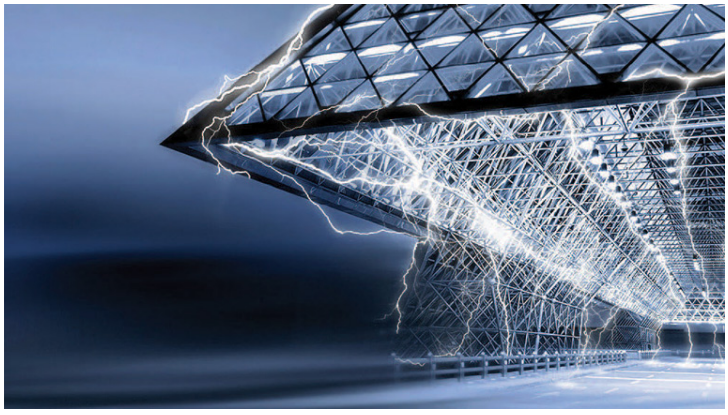
Articles

All-Round ESD and Heat Protection

LED lighting systems require high-performance ESD and overtemperature protection if they are to live up to their potential in terms of lifetime, low maintenance costs and overall reliability. Protection components provide effective and cost-efficient protection for the LED arrays, their power supplies and control circuits.



LEDs make a decisive contribution to reducing the energy consumption of lamps for indoor and outdoor use. Not only do LEDs consume much less power than conventional lighting sources, such as fluorescent and HID lamps, they also have a much longer maximum operating life – up to 80,000 hours and even more under ideal conditions.

As a result, the lamps of conventional lighting systems would have to be replaced several times during the normal service life of an LED lamp. This translates into lower maintenance costs and lower overall system operating costs.

The key threats to the reliability of LED lighting systems are:

- ESD events, including lightning
- Transient overcurrent events and surges
- Current and voltage spikes during hot swapping
- Reverse voltage effects
- Overtemperature

Therefore, if LED lighting systems are to be as reliable and long-lived as the LEDs themselves, all of the components and subsystems must be protected effectively against these dangers, which are encountered during assembly, maintenance, and operation.

Architecture of LED lighting systems

An LED luminaire consists of the LED engine (the LED arrays, their LED driver and control units), the LED power supply and the connection to the grid. Companies and facility managers are increasingly deploying smart networked lighting systems in order to maximize the efficiency and quality of lighting, determine the status of luminaire, and enable remote control and maintenance. This means communication power supplies and interfaces can also be integrated in the luminaires.

The energy level of the ESD events and surges, to which each of these subsystems is exposed, determines which protection devices are needed to ensure overall system reliability.

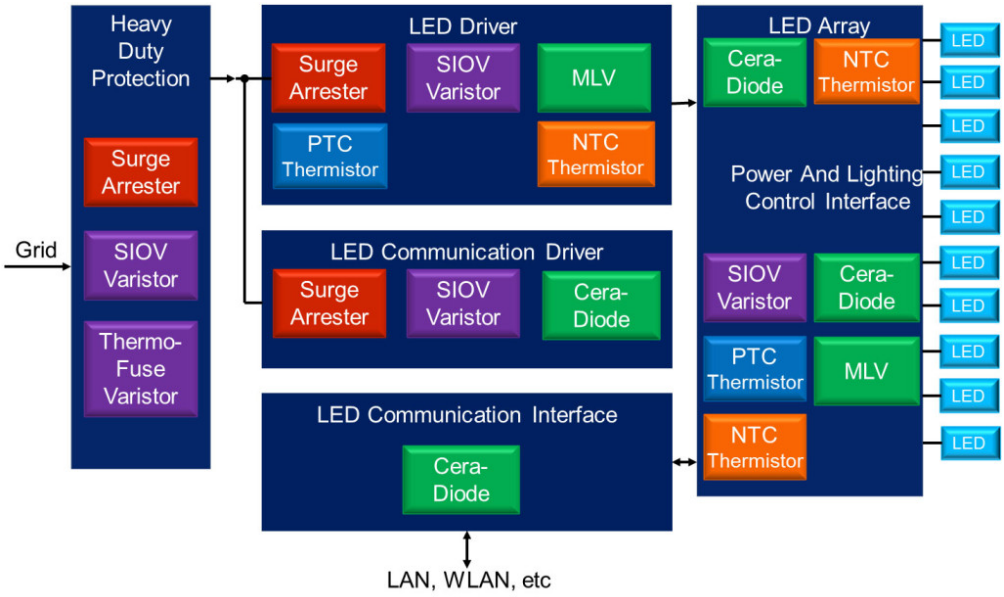


Figure 1: Overview of the subsystems and their suitable protection devices.

Protection against low energy ESD

Traditionally, TVS diodes were employed to protect circuits against ESD events below 25 J. ESD protection requirements, however, are becoming more demanding with respect to miniature size and insertion height, reliable performance over a wide temperature range, and fast response times. Multilayer varistors offer crucial advantages over the traditional TVS diodes and are increasingly becoming the solution of choice for ESD and surge protection in this energy range.

Thanks to their extremely low parasitic capacitance, MLVs (multilayer varistors) are also the best choice for the ESD protection of data lines for the control of luminaires. Since it is not unusual for networks to be reconfigured with items being moved, taken out of service or replaced, hot swapping situations are quite common, which can cause ESD events and spikes.

Proper ESD protection throughout the total system with multilayer varistors is required to ensure that the devices remain fully functional for their entire specified lifetimes.

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Effective temperature protection

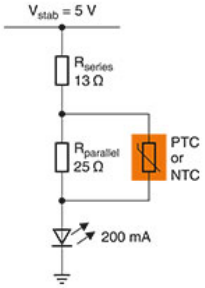

Figure 2: Temperature-compensated LED driver without an IC

The LEDs require a constant current in order to deliver a constant luminance, so their temperature must be controlled precisely within narrow limits. NTC and PTC thermistors in SMD packages are designed to protect the LED arrays against overheating and control their temperature profile for the best possible lumen efficiency. This is performed by automatically adjusting the current to the LEDs.

In simpler LED driver designs without ICs, PTC thermistors can also be used to reduce the LED forward current at high temperatures by placing them in series to the LED (Figure 2). Leaded or large SMD PTC thermistors are recommended for such applications.

Passive components protect on multiple fronts

MLVs and PTC/NTC thermistors are essential components for reliability in LED lighting systems. With advantages over traditional TVS diodes, MLVs protect circuits against low-energy ESD. Moreover, because of their extremely low parasitic capacitance, MLVs also provide ESD protection of data lines for control of luminaires. Thermistors offer dual protections as well. NTC and PTC thermistors in SMD packages protect LED arrays against overheating and control their temperature profile for optimum efficiency. In addition, when placed in series to the LED, PTC thermistors reduce the LED forward current at high temperatures. The benefits of using these components in LED lighting systems are increased reliability, longer lifetime, and reduced maintenance costs.

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