

Quick Reference Guide

Light Emitting Diode (LED) Lighting Applications

APPLICATIONS

- Power input protection from voltage and current transients
- Emergency lighting battery protection from overcurrent and heat
- Liquid Crystal Display (LCD) screen protection from short circuit and overloading of LED backlighting devices
- High-voltage protection for Class 2 power supplies used for low voltage LED lighting fixtures
- High-temperature protection to extend LED life in AC LED lighting products
- Electrostatic Discharge (ESD) protection of LEDs

FEATURES / BENEFITS

- Helps to protect against damage caused by device malfunctions that can lead to fire or injury
- Helps LED lighting manufacturers meet international safety standards
- Coordinated overcurrent, overvoltage, and high-temperature circuit protection for LED lighting applications
- Many product form factors give engineers more design flexibility
- Compatible with high volume electronics assembly
- Device characteristics tuned to lighting electronics needs
- RoHS and ELV compliant

Light Emitting Diode (LED) Lighting Applications

Of all the technologies under development in the lighting world, LED technology is the one that will radically change the market in the immediate future. This technology is not new. Improved chip designs and materials have allowed for brighter and longer-lasting light sources that can be used in a wide spectrum of applications.

Though LEDs hold the promise of longer life spans, you must take into account that LED lifespan depends on a number of factors. The lifespan of an LED is a function of the junction

temperature, operating voltage, and operating current. Product designers need to take extra steps to ensure that these new lighting products are properly protected from an excess of any of these factors.

And to ensure that this new technology enjoys the same level of acceptance and consumer confidence as other lighting technologies, product designers need to take extra steps to ensure that their LED lighting products meet international safety standards.

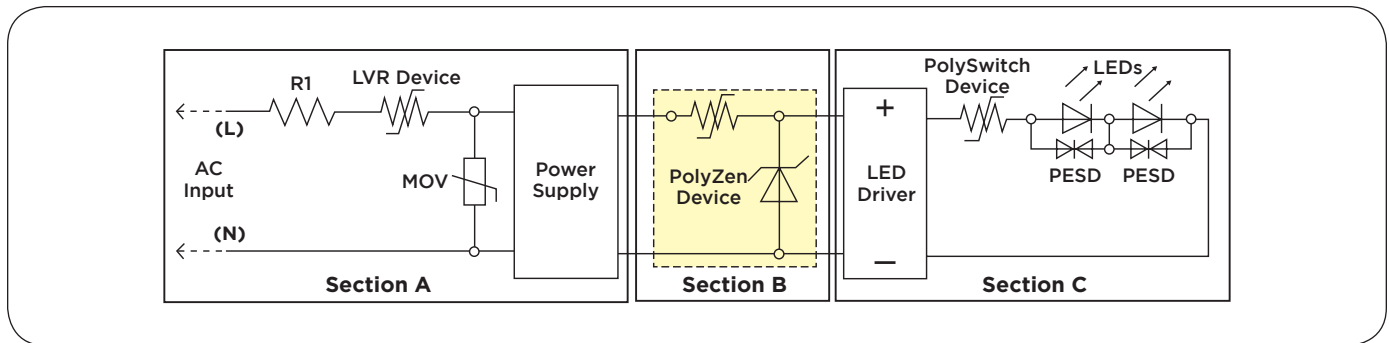


Figure 1

PROTECT THE LED

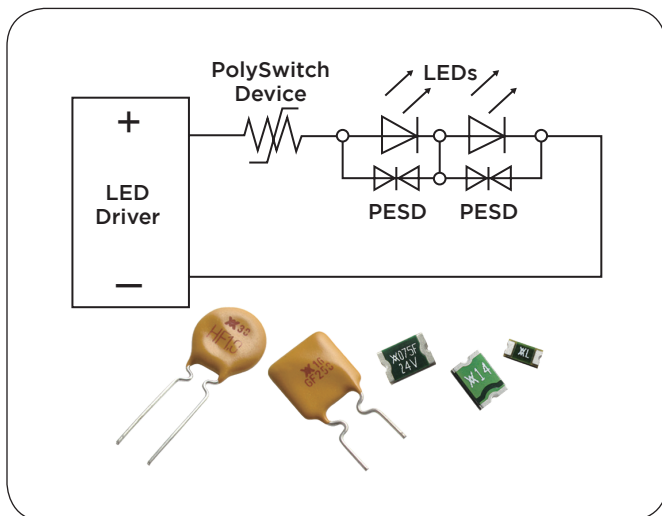


Figure 2

LED HEAT MANAGEMENT

Problem: LEDs Generate Heat

Most of the electrical energy supplied to an LED is changed to heat, not light. If not dealt with, the heat will reduce the LED's life and alter the quality of the light that is produced.

Solution: PolySwitch Devices

Connect a PolySwitch device in series with the LED to provide overcurrent protection. In addition to overcurrent protection, the PolySwitch device can provide overtemperature protection if it is thermally bonded to the metal core circuit board or LED heat sink.

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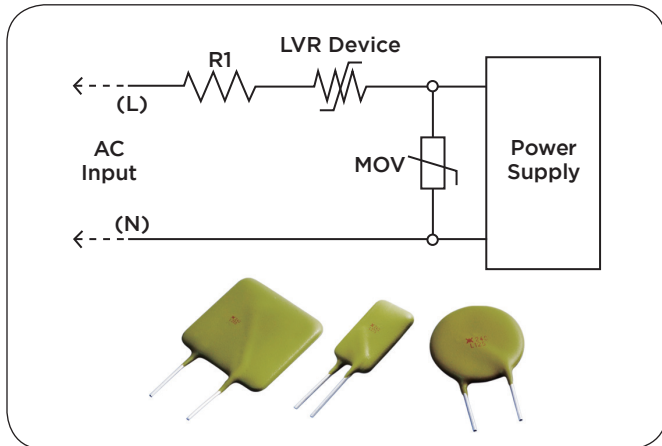


Figure 3

POWER INPUT PROTECTION

Problem: Power Line Coupled Transients and Surges Reduce LED Life

Various high voltage events in LED environments will significantly reduce LED lifetime.

Solution: PolySwitch LVR Devices and MOV Metal Oxide Varistors

A Metal Oxide Varistor (MOV) placed across the input helps provide overvoltage protection in the LED modules.

Note: An LVR device could be placed before or after the MOV. Figure 3 is an example of placing an LVR device before the MOV. Many equipment manufacturers prefer protection circuits combining resettable PolySwitch devices with upstream fail-safe protection. R1 in this example is a ballast resistor that forces the worst-case fault current to remain within the specified limits of the LVR. R1 is not a fail-safe protection device. A fuse would be an example of fail-safe protection.

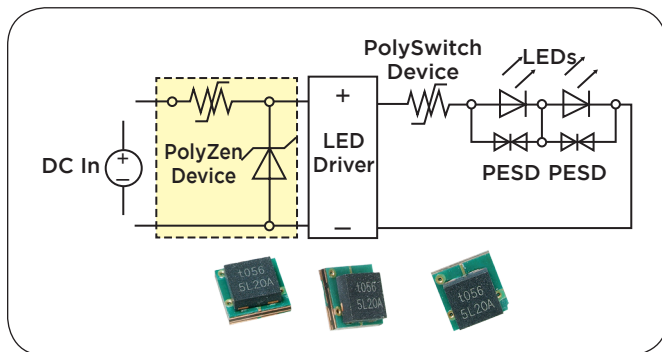


Figure 4

LED DRIVER INPUT PROTECTION

Problem: LED Drivers Connected to Improper DC Supply

Many LED drivers are susceptible to destruction by improper DC voltage levels and polarity.

Solution: PolyZen Devices

Placing a PolyZen device on the input of the LED driver helps protect your driver from inadvertent exposure to overvoltage and reverse polarity events.

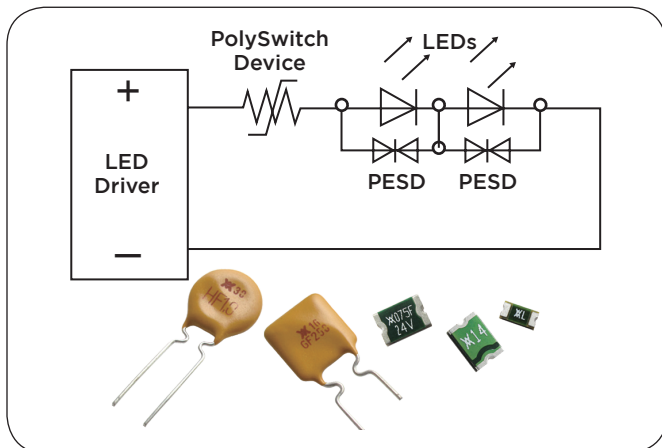


Figure 5

LED DRIVER CIRCUIT OUTPUT PROTECTION

Problem: LED Driver Output Faults

LED driver outputs may be damaged or destroyed if inadvertently shorted.

Solution: PolySwitch Devices

In the event the driver circuit does not require input protection the driver output can still be protected from short circuit or other load anomalies. PolySwitch devices may be used to help protect driver outputs from inadvertent short circuits or other load anomalies.

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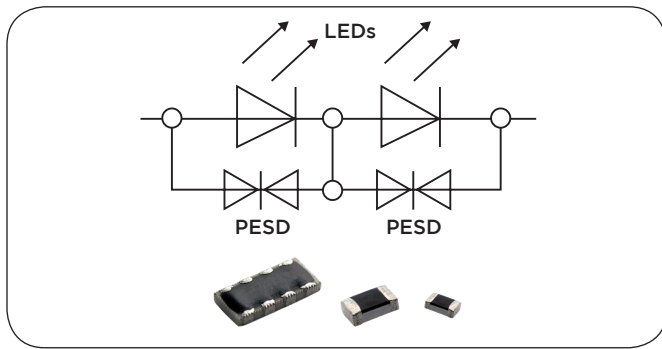


Figure 6

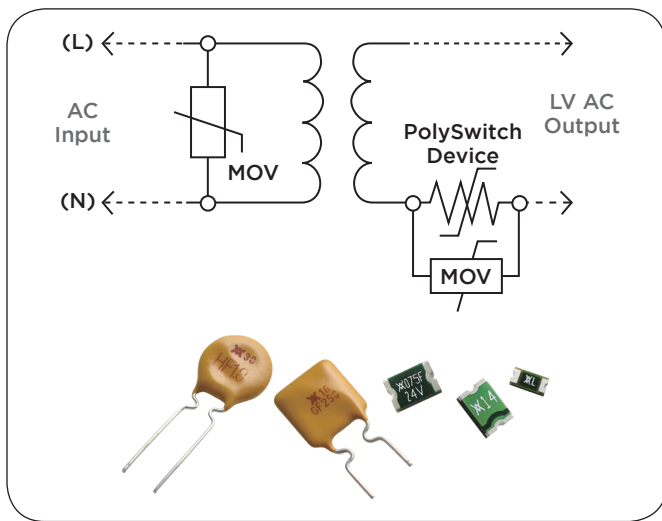


Figure 7



Figure 8

LED ELECTROSTATIC DISCHARGE PROTECTION

Problem: LEDs Subject to ESD (Electrostatic Discharge)

ESD damage to an LED can cause premature failure.

Solution: PESD Protection Device

If an LED does not have built-in ESD protection, a PESD protection device placed in parallel with the LED can help protect against ESD damage.

LOW VOLTAGE LUMINAIRES

Problem: Assuring Class 2 Power Supplies Meet Safety Standards

Using a Class 2 power source in a lighting system can be an important factor for reducing the cost and improving the flexibility of a lighting system.

Solution: PolySwitch Devices and MOV Metal Oxide Varistors

Inherently limited power sources - a transformer, power supply, or battery - may have protective devices as long as they are not relied upon to limit the output of the Class 2 supplies. Non-inherently limited power sources by definition, have a discrete protective device that automatically interrupts the output when the current and energy output reaches a prescribed limit. Littelfuse provides designers with a wide range of circuit protection devices that help ensure safe operation of Class 2 power sources for LED lighting applications. As an example, in Figure 7, the addition of an MOV in coordination with a PolySwitch device on an output circuit branch enables a power supply to meet the requirements of UL 1310 paragraph 35.1 overload test on switches and controls.

LED BACKLIGHTING FOR LCD SCREENS

Problem: Thermal Runaway

If the cooling vents in a monitor become blocked, the heat generated by the LED backlighting can increase and lead to thermal runaway if the LED driver circuit is a constant voltage or constant luminous flux type.

Solution: PolySwitch Devices

Careful consideration must be used to determine an appropriate location to thermally bond the PolySwitch device in the optimum location to interrupt the current in the event the LCD is operated when the vents are blocked in the LCD housing.

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INDOOR LED LIGHTING FUSE GUIDE

Power Source	Products	Region	Voltage Surge Requirement	TE Fuse Recommendation	
AC	<ul style="list-style-type: none"> A Type E Type PAR Type Down Lighting G-globe Candelabra R-reflector MR Type 	North America (USA)	EPA Energy Star Program Requirements for Integral LED Lamps (Version 1.4) per IEEE C.62.41.2-2002 Category A - 2.5kV Ring Wave	2410SFV1.00FM/125-2 2410SFV2.00FM/125-2	
		Europe/Asia/Australia	IEC61547 Equipment for General Lighting Purposes per IEC61000-4-5	<25W Light Bulb - 500V/250A	2410SFV1.00FM/125-2
				>25W Light Bulb - 1kV/500A	2410SFV2.00FM/125-2
DC	<ul style="list-style-type: none"> MR Type T8/T5 Tube Power Supply - DC Output (UL1310 Class 2 Power Unit) <ul style="list-style-type: none"> - Troffer - MR Type 	Global	No Requirement	0603SFP200F/32-2 0603SFP250F/32-2 0603SFP300F/32-2 1206SFP200F/63-2 1206SFP250F/32-2 1206SFP300F/32-2	

LED LIGHTING APPLICATION SOLUTION GUIDE

	Overcurrent Circuit Protection			Overvoltage Circuit Protection			Hybrid Protection		
	PolySwitch Devices	Slow-Blow Chip Fuses	Fast-Acting Chip Fuses	GDT	PESD	SESD	PolySwitch Devices	2Pro Devices	PolyZen Devices

LUMINAIRES

Luminaires	X								
• Low Voltage	X	X	X		X	X	X		X
• AC Voltage	X			X			X		
Recessed Lighting	X	X	X				X		X
Track Lighting	X	X	X	X	X	X	X		X
Underwater	X		X		X	X			
RV	X	X	X		X	X	X		X
Portable Luminaires	X	X	X		X	X	X		X
Dimmer	X				X	X	X	X	

SIGNS

Channel Letter	X	X	X		X	X	X		X
Changing Message	X	X	X		X	X	X		X
Sign Accessories	X	X	X				X	X	X
• LED Power Supplies	X	X	X				X		X
• LED Drivers	X	X	X				X		X

ACCENT LIGHTING

Indoor	X	X	X				X	X	X
Outdoor	X	X	X				X		X

IT EQUIPMENT

Back-lit Monitors	X	X	X				X		X
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DISPLAY TECHNOLOGY

LCD TV	X	X	X		X	X	X		
LCD Computer Monitor	X	X	X		X	X	X		

INDUSTRIAL AND COMMERCIAL PRODUCTS

Stage and Studio	X	X	X				X	X	
Emergency	X	X	X				X	X	X

Notice:

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