



# Circuit Protection Products

## Selection Guide

A guide to selecting the right protection components for your applications



## Design with Confidence

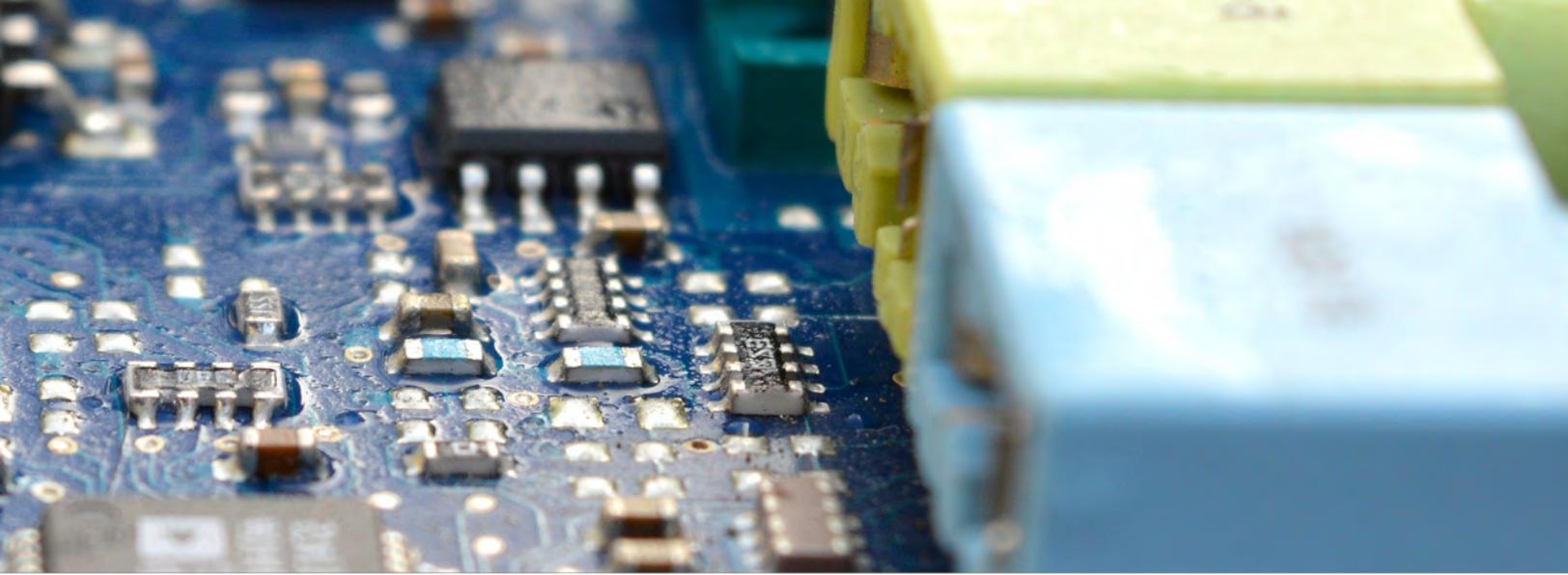
Supported by our Deep Application Expertise and Extensive Portfolio

### About this guide

This guide provides a summary of key circuit protection consideration factors, descriptions of the technologies Littelfuse offers, and product selection tables. It is designed to help you quickly find a protection solution appropriate to your application.

Topic	Page
Littelfuse Circuit Protection Technologies	4-5
Overcurrent Protection Solutions	6
Overvoltage Protection Solutions	7
ESD Suppression Solutions	8
Applications	9-11
Common Circuit Threats and Protection Solutions	12-13
Fuses	14-16
Fuseholders	17
Surface Mount PPTC Devices	18-19
Radial Leaded PPTC Devices	19-20
Battery PPTC Devices	20
Battery Mini-Breakers (Thermal Cutoff Devices)	21
Telecom PPTC Devices	22
Varistors	23-24
Gas Discharge Tubes	24-26
PulseGuard® ESD Suppressors	26
TVS Diode Arrays	27-29
TVS Diodes	29-31
PLED Bypass Protectors	32-33
SIDACtor® Protection Thyristors	33-35

Specifications, descriptions, and illustrative material in this literature are as accurate as known at the time of publication, but are subject to changes without notice. Visit [Littelfuse.com](https://www.littelfuse.com) for more information.



## Littelfuse: Everywhere, Every Day

Founded in 1927, Littelfuse has become the world's most respected circuit protection brand, with well-established and growing platforms in power control and sensing technologies. Today, we are a global company, offering a diverse and extensive product portfolio—fuses, semiconductors, polymers, ceramics, relays, sensors, and more—serving the electronics, automotive, and industrial markets. Each is manufactured to exacting quality standards and backed by an unwavering commitment to technical support and customer service.

Our history of innovation, combined with our customer-first culture, drives us to collaborate with you to develop safer, more reliable products that are energy efficient and compliant with global regulations. We will partner with you to solve complex problems wherever electrical energy is used, bringing design, engineering, and technical expertise to deliver business results.

## Why Choose Littelfuse

Littelfuse is the global leader in circuit protection solutions. We are the only company to offer all of the pertinent circuit protection technologies, with products that can be used in virtually everything that uses electrical energy. Complementing our wide portfolio of circuit protection products is a global network of design and technical support expertise. We offer decades of design experience to help you address application challenges and achieve regulatory compliance.

### Your Single Source

Littelfuse offers an extensive circuit protection product line. We design forward-thinking, application-specific solutions to provide assurance that your most demanding requirements will be met. Our goal is to provide the most complete range of options so that you will not have to compromise.

### Testing Support

Littelfuse can help ensure that your products will withstand most common threats repeatedly and will fail safely under extreme circumstances. We can serve as an independent source to provide assistance as you design by offering lab testing capabilities for customer applications. This testing includes industry-specific required power fault and Electrostatic Discharge (ESD) / Electrically Fast Transients (EFT) / lightning surge conditions.

### Application Knowledge

For over 90 years, Littelfuse has maintained a focus on circuit protection, and we will continue to adapt as technologies evolve. Engineers and circuit designers around the world have come to rely on Littelfuse products and application knowledge to support their designs.

### Global Support

Littelfuse stays close to customers. With manufacturing, lab, and design facilities located around the globe, application knowledge and technical support are locally available. Also, we offer a network of regional customer support offices and hundreds of independent authorized distributor contacts to assist you. Visit [Littelfuse.com/contact-us](https://www.littelfuse.com/contact-us) to find local support near you.

### Standards Compliance Expertise

Most Littelfuse products comply with a wide range of applicable industry and government guidelines as well as our own rigorous quality and reliability criteria. We continually look forward and adapt to changing requirements so that our products will comply with industry-specific national and international standards, such as CCC, CSA, IEC, IEEE, ISO, ITU, Meti, RoHs, Telcordia, TIA, and many more.

### Operational Excellence

With our global manufacturing footprint, Littelfuse is firmly committed to manufacturing quality products at a competitive price. We build quality into our products and services, striving for zero defects in everything we do, thereby reducing cost and increasing your total satisfaction. We strive to exceed your expectations every day.

### Quality Assurance

Our global manufacturing facilities abide by strict quality assurance requirements and hold the following quality management system registrations:

- ISO 9001
- ISO14001
- IATF 16949

# Circuit Protection Technologies

Technology	Key Features and Protection Characteristics	When / Where Typically Used	Surge Energy Rating Range	Typical Voltage Clamping Speeds	Typical Capacitance/ Insertion Loss	Mounting/Size/ Packaging Options
<b>Overcurrent Protection Technologies</b>						
<a href="#">Fuses</a>	Completely stops current flow, which helps to identify faults; Wide range of options	Ultimate protection for sensitive/expensive/critical components	Low through Very High	Not applicable	Series impedance measured in nH	Very Extensive Range of Options
<a href="#">PPTC Devices</a>	Resettable; No device replacement needed after most common overcurrent events	Where overcurrent events may occur often, and continuous uptime desired	Low through High	Not applicable	Series resistance measured in ohms	Surface Mount, Radial Leaded, Axial Strap
<b>Overvoltage Suppression Technologies</b>						
<a href="#">Multi-Layer Varistors (MLVs)</a>	Compact and capable of handling significant surges for their size	ESD <sup>(1)</sup> and EFT <sup>(2)</sup> suppression in smaller and portable electronics	Low through Medium	Moderate	High	Miniature Surface Mount
<a href="#">Metal-Oxide Varistors (MOVs)</a>	Capable of withstanding very high energy transients; Wide range of options	Appliance, industrial, and very high energy suppression applications	Medium through Very High	Moderate	High	Radial Leaded, Industrial Terminal
<a href="#">GDTs</a>	Switches that turn to on state and shunt overvoltage to ground using a contained inert gas as an insulator	Protection of telecom equipment from lightning surges	Medium through High	Fast	Low	Surface Mount, Axial Leaded, 2/3 Lead Radial
<a href="#">PulseGuard® ESD Suppressors</a>	Extremely low capacitance; Fast response time; Compact size	ESD suppression; Ultra-fast reaction; Low signal distortion	Low	Moderate	Low	Miniature Surface Mount
<a href="#">PLED LED Protectors</a>	Shunt function bypasses open LEDs; ESD and reverse power protection	High brightness outdoor LED lighting applications	Low	Very Fast	Medium	Miniature Surface Mount
<a href="#">TVS Diode Arrays</a>	Low capacitance/ low clamping voltage; Compact size	ESD suppression; Low distortion; Ideal for I/O interfaces and digital and analog signal lines	Low through Medium	Very Fast	Low	Extensive range of surface mount options
<a href="#">TVS Diodes</a>	Fast response to fast transients; Wide range of options; No wear out mechanism	Semiconductor protection; Telecom I/O interfaces, electronics, industrial equipment, and automotive electronics	Medium through High	Fast	Medium	Axial Leaded, Radial Leaded, Surface Mount
<a href="#">SIDACTor® Protection Thyristors</a>	Designed to comply with stringent telecom/datacom networking and industrial AC power surge protection standards; No wear out mechanism, precise trigger voltage, and very low Vt	Telecom/datacom and networking applications, industrial equipment	Medium through High	Very Fast	Medium - Low	Extensive range of surface mount and through-hole options

- (1) ESD – Electrostatic Discharge  
(2) EFT – Electrical Fast Transient

## Fuses and Holders

**Fuses** – Full range including surface mount, axial, glass or ceramic, thin-film or Nano<sup>2</sup>® style, fast-acting or Slo-Blo<sup>®</sup> fuse.

**Clips** – Used in applications that require a fuse to be easily mounted to a Printed Circuit Board (PCB), but real estate is scarce. Clips are also ideal for high-current applications, allowing for better heat management of the fuse. They are the most economical solution.

**Blocks** – An alternative solution to clips but with easier placement on the PC board during manufacturing. In some instances, blocks may provide insulation to the side ears of the clips. In addition to being through-hole, blocks can also be screwed or riveted in place.

**Holders** – The ideal solutions for those applications that require the cartridge fuse to be protected, providing a shock-safe environment. Panel-mount holders allow for easy replacement of the fuse from outside of the appliance, perfect for applications that require replacing the fuse without opening the appliance enclosure.



## PulseGuard<sup>®</sup> ESD Suppressors

PulseGuard suppressors use polymer composite materials to suppress fast-rising ESD transients while adding virtually no capacitance to the circuit. PulseGuard suppressors are best suited for low-voltage, high-speed applications such as protection for high-speed protocols like USB 2.0, IEEE1394, HDMI, and Digital Visual Interface (DVI), where low capacitance is important.



## Varistors

Varistors are available in multiple forms, from Metal Oxide Varistors (MOVs) and Thermally Protected MOV (TMOV<sup>®</sup> varistors) that suppress lightning transient voltages to Multi-Layer Varistors (MLVs) designed for applications requiring protection from various ESD and EFT transients. They are often used in computers and handheld devices as well as in industrial and automotive applications.



## PolySwitch<sup>®</sup> PPTC Devices

PolySwitch Polymeric Positive Temperature Coefficient (PPTC) devices help protect against damage caused by harmful overcurrent surges and overtemperature faults. Like traditional fuses, these devices limit the flow of dangerously high current during fault conditions. The PolySwitch PPTC device, however, resets after the fault is cleared and power to the circuit is removed, thereby helping to reduce warranty, service and repair costs. PolySwitch PPTC devices are typically used in consumer electronics, automotive, industrial, home appliance, HVAC, and telecommunications applications.



## Gas Discharge Tubes

Gas Discharge Tubes (GDTs) dissipate voltage transients through a contained plasma gas. They have high insulation resistance plus low capacitance and leakage to ensure minimal effect on normal operation of equipment. GDT's fast response to transient over-voltage events, and ability to dissipate large amounts of energy, translate into reduced risk of equipment damage. The amount of energy dispersed by GDTs makes them a good choice for lightning surge protection, particularly for telecom equipment located in outdoor structures.



## TVS Diodes

The Transient Voltage Suppressor diode (TVS Diode) is a protection diode designed to protect electronic circuits from very fast and often damaging voltage transients, such as lightning and Electrostatic Discharge (ESD). TVS Diodes are silicon avalanche devices typically chosen for their fast response time (low clamping voltage), lower capacitance, and low leakage current. TVS Diodes are ideal for applications in computer, industrial, telecom, and automotive markets.



## PLED Bypass Protectors

PLED Bypass Protectors are specialty silicon devices that enable LED lighting strings to continue to function if any single LED fails as an open circuit, and they also offer ESD and reverse power protection. PLED are often incorporated into the circuit designs of high-power LEDs in applications such as roadway lights and outdoor LED advertising display signs.



## TVS Diode Arrays

TVS Diode Arrays are designed to protect electronics against transients and overvoltage threats, such as Electrically Fast Transients (EFT) and Electrostatic Discharge (ESD). Because of their lower capacitance and low leakage current, they offer an ideal protection solution for I/O interfaces and digital and analog signal lines, in computer and consumer portable electronics markets.



## SIDACTor<sup>®</sup> Protection Thyristors

SIDACTor components use a patented ion implant technology that ensures effective protection within nanoseconds, up to 5000 A surge current ratings. SIDACTors are designed to suppress overvoltage transient surge in the telecom/ datacom applications, and they are also used to protect industrial AC/DC powering terminals.





## Fuses

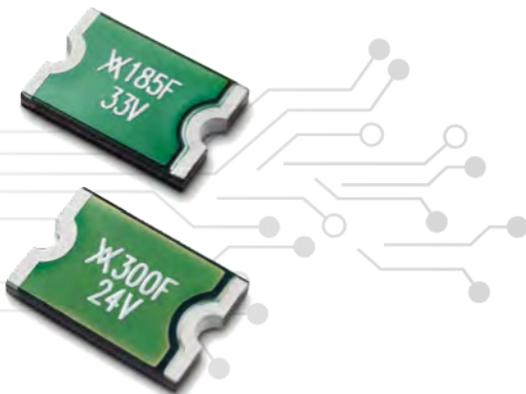
Fuses have been referred to as “one time” devices, in that the fuse will provide protection from the overload by opening only once and then need to be replaced. The heart of a typical fuse is a length of wire that is heated to its melting point by the excessive current. The circuit current flow decreases to zero as the wire melts open.

### Benefits

- It is the most cost-effective form of protection
- Operation of a fuse is simple, and no complexity is involved
- A fuse's inverse time current characteristic allows it to be used for overload protection

### Applications

- Fuses completely stop current in fault condition; this may be more desired if safety or avoidance of downstream circuit equipment is a premium concern
- Fuses are also helpful for diagnostic purposes, aiding equipment designers and users in tracing the origin of the overcurrent faults



## PolySwitch® PPTC Devices

PolySwitch Polymer Positive Temperature Coefficient (PPTC) devices offer a resettable overcurrent protection alternative, thereby reducing warranty, service, and repair costs. PPTCs increase resistance as temperature increases due to increased flow. The components are designed to limit unsafe currents while allowing constant safe current levels. Resistance will “reset” automatically when the fault is removed and temperature returns to safe levels. The ability of the PPTCs to reset themselves after exposure to a fault current makes them ideal within circuits that are not easily accessible. PPTCs are typically used as circuit protection in applications where sensitive components are at constant risk of damage from overcurrent conditions. The components are also ideal for situations where frequent overcurrent conditions occur or constant uptime is required.

### Benefits

- Improved system reliability
- Lower warranty cost and service
- Reduced system downtime
- Lower voltage drop
- Ruggedness prevents breakage during manufacturing and shipment
- Shock & vibration resistance eliminates need for calibration

### Applications

- Port protection on personal computers (USB, firewire, keyboard/mouse, and serial ports)
- Peripherals (hard drives, video cards, and hubs)
- Cell phones
- Battery packs
- Industrial controls
- Lighting ballast
- Motor controls

# Overvoltage Protection Solutions

The four most commonly used technologies for overvoltage protection are as follows:

- SIDACtor® Devices
- Gas Discharge Tubes (GDTs)
- Metal Oxide Varistors (MOVs)
- TVS Diodes

All four technologies are connected in parallel with the circuit being protected, and all exhibit a high off-state impedance when biased with a voltage less than their respective blocking voltages.

## SIDACtor® Protection Thyristors

A SIDACtor device is a PNP device that can be thought of as a thyristor device without a gate. Upon exceeding its peak off-state voltage (VDRM), a SIDACtor device will clamp a transient voltage to within the device's switching voltage (VS) rating. Then, once the current flowing through the SIDACtor device exceeds its switching current, the device will crowbar and simulate a short-circuit condition. When the current flowing through the SIDACtor device is less than the device's holding current (IH), the SIDACtor device will reset and return to its high off-state impedance.

### Benefits

Advantages of the SIDACtor device include its fast response time, stable electrical characteristics, long term reliability, and low capacitance. Also, because the SIDACtor device is a crowbar device, it cannot be damaged by voltage.

### Restrictions

Because the SIDACtor device is a crowbar device, it cannot be used directly across the AC line; it must be placed behind a load. Failing to do so will result in exceeding the SIDACtor device's maximum on-state current rating, which may cause the device to enter a permanent short-circuit condition.

### Applications

Although found in other applications, SIDACtor devices are primarily used as the principle overvoltage protector in telecommunications and data communications circuits.

## Gas Discharge Tubes

Gas Discharge Tubes (GDTs) are either glass or ceramic packages filled with an inert gas and capped on each end with an electrode. When a transient voltage exceeds the DC breakdown rating of the device, the voltage differential causes the electrodes of the gas tube to fire, resulting in an arc, which in turn ionizes the gas within the tube and provides a low impedance path for the transient to follow. Once the transient drops below the DC holdover voltage and current, the gas tube returns to its off state.

### Benefits

Gas Discharge Tubes have high surge current and low capacitance ratings. Current ratings can be as high as 20 kA, and capacitance ratings can be as low as 1 pF with a zero-volt bias.

### Applications

Gas Discharge Tubes are typically used for primary protection due to their high surge rating. However, their low interference for high-frequency components make them a candidate for high-speed data links.

## Metal Oxide Varistors

Metal Oxide Varistors (MOVs) are two-leaded, through-hole components typically shaped in the form of discs. Manufactured from sintered oxides and schematically equivalent to two back-to-back PN junctions, MOVs shunt transients by decreasing their resistance as voltage is applied.

### Benefits

Since MOVs' surge capabilities are determined by their physical dimensions, high surge current ratings are available. Also, because MOVs are clamping devices, they can be used as transient protectors in secondary AC power line applications.

### Applications

Although MOVs' are restricted from use in many telecom applications (other than disposable equipment), they are useful in AC applications where a clamping device is required and tight voltage tolerances are not.

## TVS Diodes

Transient Voltage Suppressor (TVS) diodes are clamping voltage suppressors that are constructed with back-to-back PN junctions. During conduction, TVS diodes create a low impedance path by varying their resistance as voltage is applied across their terminals. Once the voltage is removed, the diode will turn off and return to its high off-state impedance.

### Benefits

Because TVS diodes are solid-state devices, they do not fatigue nor do their electrical parameters change as long as they are operated within their specified limits. TVS diodes effectively clamp fast-rising transients and are well suited for low-voltage applications that do not require large amounts of energy to be shunted.

### Applications

Due to their low power ratings, TVS diodes are not used as primary interface protectors, but they can be used as secondary protectors that are embedded within a circuit.

## Overshoot Levels Versus dv/dt

Figure 1.1 below shows a peak voltage comparison between SIDACtor® devices, Gas Discharge Tubes (GDT), Metal-Oxide Varistors (MOVs), and TVS diodes, all with a nominal stand-off voltage rating of 230 V. The X axis represents the dv/dt (rise in voltage with respect to time) applied to each protector, and the Y axis represents the maximum voltage drop across each protector.

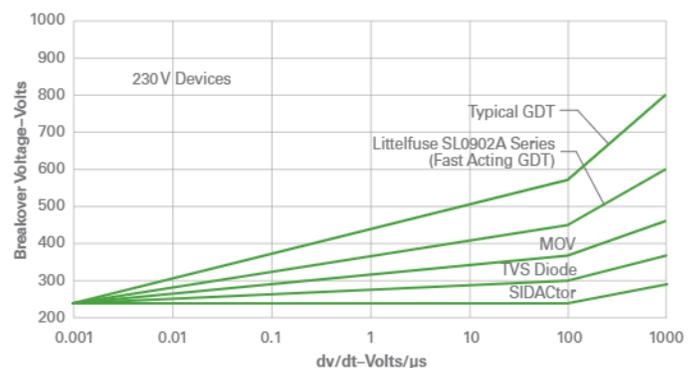
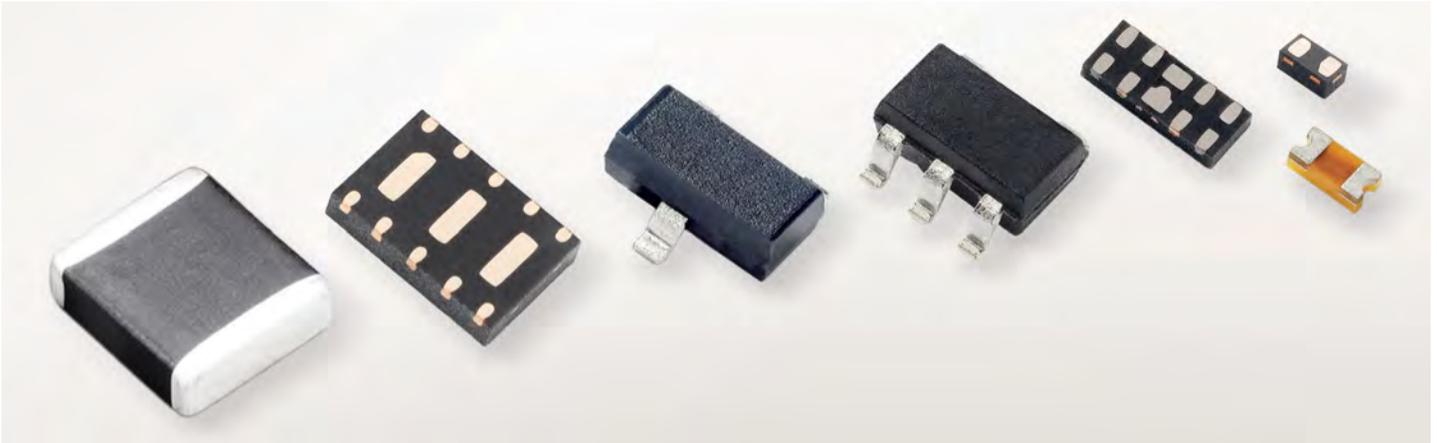


Figure 1.1 Overshoot Levels versus dv/dt



## MLV

A Multi-Layer Varistor (MLV) is a voltage suppression device that filters and clamps transients in an electrical circuit. It is a compact, surface-mountable chip that is voltage dependent, nonlinear, and bidirectional. MLVs are chosen when:

- Surge currents or energy beyond Electrostatic Discharge (ESD) is expected in the application—Electrical Fast Transient (EFT), lightning
- Added capacitance is desirable for Electromagnetic Interference (EMI) filtering (3pF – 6000pF)
- Power supply line or low-to-medium speed data and signal lines are to be protected
- The operating voltage is above silicon or PulseGuard® ESD suppressor ratings

### Benefits

- Leadless chip makes it compact in size
- Robust construction makes it ideally suitable to endure the thermal stresses encountered during soldering, assembling, and manufacturing
- Low cost

### Applications

MLVs are connected near the I/O port to clamp the ESD or surge event with a Surface Mount Device (SMD) package and wide capacitance range to as low as 3pF. MLVs are widely used in audio, control, and dataline communication such as USB2.0.

## TVS Diode Arrays

TVS Diode Arrays are designed to protect electronics from very fast and often damaging voltage transients, such as lightning and electrostatic discharge (ESD). They offer a high level of protection (up to 30kV per IEC 61000-4-2) with very low capacitance, leakage current, and clamp voltage for more robust applications.

Designers choose TVS Diode Arrays when:

- The device being protected requires the lowest possible clamp voltage, low capacitance (0.1pF – 400pF), and low leakage (0.01μA – 10μA)
- Board space is at a premium and space-savings multi-line protection is needed
- Transients other than ESD, such as EFT or lightning, must also be considered

### Benefits

- Low capacitance
- Low clamping voltage and leakage current
- Small package size offers space savings and also enables mounting close to input ports for optimal protection

### Applications

TVS diode arrays offer an ideal protection solution for I/O interfaces and digital and analog signal lines, such as USB and HDMI, in computer and consumer portable electronics markets. Typical applications include:

- Parallel port (LPT) printer scanner
- Computer inputs and peripheral devices, such as PDA, PMP, cell phone, digital camera, and game controller ports
- Digital video recorder, hard disk drive, video editing system, scanner, desktop, and laptop

## PulseGuard® ESD Suppressors

PulseGuard® ESD Suppressors offer extremely low capacitance, which makes them ideal for use in high-speed data circuits (IEEE 1394, USB 2.0, HDMI, DVI, etc.). Available in single-line and multi-line packages, they provide ESD protection while ensuring that signal integrity is maintained. Designers choose Pulse-Guard over other ESD solutions when:

- The application tolerates very little added capacitance, (high-speed data lines or RF circuits)
- ESD is the only transient threat
- Protection is required on data, signal, and control lines (not power supply lines)

### Benefits

- Ultra-low capacitance
- Low leakage current
- Fast response time
- Withstands multiple ESD strikes

### Applications

- HDTV hardware
- Laptop/desktop computer
- Network hardware
- Computer peripherals
- Digital camera
- External storage
- Set-top box
- Antenna

# Applications

For more than 90 years, Littelfuse has been the leader in circuit protection, and we continue to develop new solutions as customer applications evolve. We offer a broad portfolio of protection technologies for a wide range of applications.

*We offer a broad portfolio of **protection technologies.***



# Overcurrent Protection

## Application Matrix

Overcurrent Protection												
Vertical Markets	Applications	Cartridge Fuses	Pico Fuses	TR/TE/Micro Fuses	Nano Fuses	Thin Film Chip Fuses	Industrial Fuses	Automotive Fuses	Radial Leaded Resettable PPTCs	Battery Strap Resettable PPTCs	Surface Mount Resettable PPTCs	Telecom Fuses
Datacenter and Cloud	Servers: Computing	•	-	•	•	•	-	-	•	-	•	•
	Switches	-	•	•	•	•	-	-	•	-	•	•
	Routers	-	•	•	•	•	-	-	•	-	•	•
	Mobile Network: 4G/5G Indoor	-	-	-	-	-	-	-	-	-	-	-
	Mobile Network: 4G/5G Outdoor	•	•	•	•	•	-	-	•	-	•	•
Consumer Electronics	TVs and Displays	•	•	•	•	•	-	-	•	•	•	-
	Speakers & A/V Equipment	•	•	•	•	•	-	-	•	-	•	-
	Printers & Scanners	•	•	•	•	•	-	-	•	-	•	-
	Desktop Computers	-	•	•	•	•	-	-	•	-	•	-
	Power Supplies	•	•	•	•	•	-	-	•	-	•	-
Appliances	Major Appliances	•	-	•	•	•	-	-	•	-	•	-
	Small Appliances	•	•	•	•	•	-	-	•	-	•	-
	Battery Powered	•	-	•	•	•	-	-	•	•	•	-
	Robotic Appliances	•	-	•	•	•	-	-	•	•	•	-
	Power Tools	•	-	•	•	•	-	•	-	-	•	-
Building Automation	GFCI/AFCI & USB Receptacles	•	•	•	•	•	-	-	•	•	•	-
	Environmental & Building Control	-	-	•	•	•	-	-	-	-	•	-
	Security & Access Control	•	•	•	•	•	-	-	•	•	•	-
	HVAC & Elevator Drives	•	-	-	•	-	-	-	•	-	-	-
	Smart Meters	•	-	•	-	•	-	-	•	•	•	-
Industrial	UPS	•	•	•	•	•	•	-	•	-	•	-
	Lighting	•	•	•	•	•	-	-	•	•	•	-
	Robotics	•	•	•	•	•	•	-	•	-	•	-
	Motor Control	•	•	•	•	•	•	•	•	•	•	-
Renewable Energy	Solar PV	•	-	•	•	•	•	-	•	-	•	-
	Large Inverters	•	-	•	•	•	•	-	•	-	•	-
	Micro Inverters	•	-	•	•	•	-	-	•	-	•	-
	Energy Management	•	-	•	•	•	•	-	•	-	•	-
Transportation/Automotive	E-Mobility (Onboard Charger, BMS)	•	-	•	•	•	•	•	•	-	•	-
	Connectivity & Autonomous Driving	•	-	•	•	•	•	•	•	-	•	-
	Engine and Ignition Systems	-	-	-	-	-	-	-	-	-	-	-
	E-Motorcycle (EV 2-3 Wheelers)	•	-	•	•	•	-	-	•	-	•	-
Mobile and Wearables	Gaming Controllers	-	-	-	•	•	-	-	-	-	•	-
	Smart Watches	-	-	-	•	•	-	-	-	-	•	-
	Smart Phones	-	-	-	•	•	-	-	-	-	•	-
	Chargers	•	•	•	•	•	-	-	•	-	•	-
	Notebooks	-	•	•	•	•	-	-	•	•	•	-
EV-Infrastructure	AC Charging	•	-	-	-	-	•	-	-	-	•	-
	DC Charging	•	-	-	-	-	•	-	•	-	•	-
	Wireless Charging	•	-	-	-	-	•	-	•	-	•	-

# Overvoltage Protection

## Application Matrix

Overvoltage Protection									
Vertical Markets	Applications	MLVs	MOVs and TMOVs	GDTs	ESD Suppressors	PLED LED Protectors	TVS Diode Arrays	TVS Diodes	SIDACtors
Datacenter & Cloud	Servers -Computing	•	•	•	•	-	•	•	•
	Switches	•	•	•	•	-	•	•	•
	Routers	•	•	•	•	-	•	•	•
	Mobile Network: 4G/5G Indoor	-	-	-	-	-	•	•	•
	Mobile Network: 4G/5G Outdoor	•	•	•	•	-	•	•	•
Consumer Electronics	TVs and Displays	•	•	-	•	-	•	•	•
	Speakers & A/V Equipment	•	•	-	•	-	•	•	-
	Printers & Scanners	•	•	-	•	-	•	•	•
	Desktop Computers	•	•	-	•	-	•	•	•
	Power Supplies	•	•	-	•	-	•	•	•
Appliances	Major Appliances	•	•	-	•	-	•	•	•
	Small Appliances	•	•	-	•	-	•	•	•
	Battery Powered	•	-	-	•	-	•	•	-
	Robotic Appliances	•	•	-	•	-	•	•	•
	Power Tools	-	•	-	•	-	•	•	•
Building Automation	GFCI/AFCI & USB Receptacles	•	•	•	•	-	•	•	•
	Environmental & Building Control	•	•	-	•	-	•	•	•
	Security & Access Control	•	•	•	•	-	•	•	•
	HVAC & Elevator Drives	•	•	-	-	-	-	•	•
	Smart Meters	•	•	-	•	-	•	•	•
Industrial	UPS	•	•	•	•	•	-	•	-
	Lighting	•	•	•	•	-	•	•	•
	Robotics	•	•	•	•	-	•	•	•
	Motor Control	•	•	•	•	-	•	•	•
Renewable Energy	Solar PV	•	•	•	•	-	•	•	•
	Large Inverters	•	•	•	•	-	•	•	•
	Micro Inverters	•	•	•	•	-	•	•	•
	Energy Management	•	•	•	•	-	•	•	•
Transportation/ Automotive	E-Mobility (Onboard Charger, BMS)	•	•	•	•	•	•	•	•
	Connectivity & Autonomous Driving	•	•	•	•	•	•	•	•
	Engine and Ignition systems	-	-	-	-	-	-	•	-
	E-Motorcycle (EV 2-3 Wheelers)	•	•	-	•	•	•	•	-
Mobile and Wearables	Gaming Controllers	•	•	-	-	-	•	•	-
	Smart Watches	•	•	-	-	-	•	•	-
	Smart Phones	•	•	-	-	-	•	•	-
	Chargers	•	•	-	-	-	•	•	-
	Notebooks	•	•	-	-	-	•	•	-
EV- Infrastructure	AC Charging	-	•	•	•	-	•	•	-
	DC Charging	-	•	•	•	-	•	•	-
	Wireless Charging	-	•	•	•	-	•	•	-

Design smarter  
by identifying  
key **threats** and  
**solutions** at the  
onset of new  
development.

## Common **Circuit Threats** and Protection Solutions

<b>Type of Electrical Fault or Transient</b> What is the threat or circuit action that may damage sensitive electronics?	<b>Systems or Modules Affected</b> What are the typical end products that require protection from this damage?	<b>Principal Protection Criteria</b> What are the characteristics required of the circuit protection technology?	<b>Littelfuse Protection Technologies</b> Which circuit protection technologies best serve these types of situations?
Overcurrent / Ground Faults	Systems that are grounded and/or in near proximity to AC power lines	Proper interrupting rating, current carrying capability and voltage rating	Fuses and/or PPTCs
Lightning	Any electronic or electrical equipment with connections to the outside environment	Fast response, proper switching threshold, and surge current rating	SIDACTor® Protection Thyristors, Varistors (MOVs), TVS Diodes, TVS Diode Arrays, Gas Discharge Tubes (GDTs)
Electrostatic Discharge (ESD)	Any electronic equipment with a human interface	Fast response, and high peak voltage rating	PulseGuard® ESD Suppressors, TVS Diode Arrays, Multi-Layer Varistors (MLVs) PLED Bypass Protectors
Electrical Fast Transients (EFT)	Any system that has inductive loads	Fast rise time and recovery for repetitive pulses	TVS Diodes, Varistors (MLVs and MOVs), TVS Diode Arrays
Inductive Load Switching and Commutative Spikes	Large motors, pumps, compressors, relays, and AC distribution	High energy rating	Varistors (MOVs and MLVs), GDTs, TVS Diodes, TVS Diode Arrays
Data and Communication Line Voltage Transients	Ethernet, xDSL, data bus, telecom, etc.	Fast response and low load capacitance	TVS Diodes, TVS Diode Arrays, SIDACTor® Protection Thyristors
Current Switching / Diversion	Wide range of electrical and electronic circuits	Proper blocking voltage and current carrying capacity	Switching Thyristors, PLED Bypass Protectors



## Overcurrent Events

Excessive current events can lead to catastrophic failures in electronic circuits. These failures can result in safety hazards such as fire, shock, or explosion. Common types of overcurrent threats include:

### Overload

Overloads occur when more current is allowed to flow through a circuit path than it was designed to carry. This excess current can generate and accumulate heat and result in complete circuit destruction and possibly fire, electrocution, or explosion. Causes of overload can include:

- Construction hazards cutting across power mains
- Equipment failure in the power grid
- Environmental hazards on the power grid
- Short spikes of energy within the circuit as a result of turning equipment on or off

### Short Circuit

Short circuits occur when one conducting path comes in contact with another conducting path or with ground, such as may occur due to a loose wire, insulation breakdown, or contact with water. These conditions can increase the likelihood of arcs, shock, or fire hazards.

The principal forms of protection against overcurrent conditions include fuses and resettable polymeric positive temperature coefficient (PPTC) thermistors.

Their function is to limit current to acceptable levels and prevent catastrophic events, and during acceptable conditions act dormant with a minimal amount of resistance to the circuit.

Fuses will completely stop the flow of current when opened, which may be desired with sensitive, expensive, or critical applications.

PPTCs offer the ability to reset for withstanding most minor, common, and recurring overcurrent events. They will allow safe levels of current to pass continuously, and during major overcurrent events, they increase in resistance as they heat to restrict the flow of current. When the overcurrent event ends, the device resets to its normal operating state.

## Voltage Transient Events

Voltage transients are short-duration surges or spikes. Unsuppressed, they may damage circuits and components and result in complete system failure. Below are descriptions of common types of voltage transients, and technologies to reduce their effects:

### Electrostatic Discharge (ESD)

Damage from ESD is generally caused by the transfer of static electrical charge from a body to an electronic circuit. It may result in faulty circuit operation, latent defects, and even catastrophic failure of sensitive components. ESD suppressors must have very fast response times and handle high peak voltages and currents for short durations. Littelfuse offers a range of PulseGuard® ESD suppressors, Multi-Layer Varistors (MLVs), and TVS Diode Arrays that are designed to suppress these types of events.

### Inductive Load Switching

Switching of inductive loads, such as those that occur with transformers, generators, motors, and relays, can create transients up to hundreds of volts and amps, and can last as long as 400 milliseconds, affecting both AC and DC circuits. For these applications, commonly used suppressor devices include Metal Oxide Varistors (MOVs), Gas Discharge Tubes (GDTs), and Transient Voltage Suppression (TVS) Diodes.

### Lightning Induced Transient

Most transients induced by nearby lightning strikes result in an electromagnetic disturbance on electrical and communication lines connected to electronic equipment. Devices that protect against these transients must have a fast response time and must be able to dissipate a large amount of energy. Metal Oxide Varistors (MOV), TVS Diodes, and GDTs are typically used to protect against these events. Look to Littelfuse SIDACTor® Protection Thyristors and TVS Diode Arrays for telecom/datacom requirements.

### Automotive Load Dump

Load dump refers to what happens to the supply voltage in a vehicle when a load is removed. If a load is removed rapidly (such as when the battery is disconnected while the engine is running), the voltage may spike before stabilizing and damage electronic components. In a typical 12V circuit, load dump can rise as high as 120V and take 400 ms to decay—more than enough to cause serious damage. Littelfuse offers a wide range of TVS Diode and Multi-Layer Varistor (MLV) products designed to protect against these types of events.



## Surface Mount Fuses

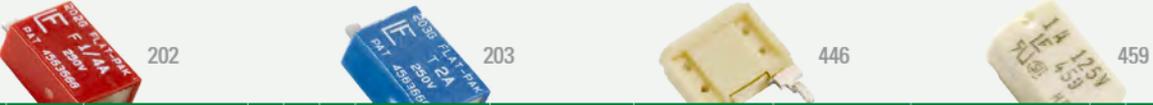
Surface Mount Type	Series Name <sup>1</sup>	Size <sup>2</sup>	Time Lag	Fast Acting	Very Fast Acting	Device Range <sup>3</sup> (Operating Current Options in Amps)	Max. Voltage Rating <sup>3</sup> (Volts)	Interrupting Rating at Max. Voltage Rating <sup>3</sup> (Amps)	Operating Temperature Range	Agency Approvals <sup>3</sup>					Halogen Free	RoHS Compliant	Lead Free	TUV	VDE	CQC
										UL	UR	CSA	PSE	UMF						
Ceramic Chip	437	1206	-	•	-	0.25 - 8	125/63/32	50	-55°C to +150°C	-	•	•	-	-	•	•	•	-	-	-
	438	0603	-	•	-	0.25 - 6	32/24/63	50	-55°C to +150°C	-	•	-	-	-	•	•	•	-	-	-
	440	1206	-	•	-	0.25 - 8	32/125/63/50	50	-55°C to +150°C	-	•	•	-	-	•	•	•	-	-	-
	441	0603	-	•	-	2 - 6	32	50	-55°C to +150°C	-	•	•	-	-	•	•	•	-	-	-
	469	1206	•	-	-	2 - 8	24/32/63	60	-55°C to +150°C	-	•	•	-	-	•	•	•	-	-	-
Thin Film	501	1206	-	•	-	10, 12, 15, 20	32	150	-55°C to +150°C	-	•	•	-	-	•	•	•	-	-	-
	466	1206	-	-	•	0.125 - 5	125/63/32	50	-55°C to +90°C	-	•	•	-	-	•	•	•	-	-	-
	429	1206	-	-	•	7	24	35	-55°C to +90°C	-	•	•	-	-	•	•	•	-	-	-
	468	1206	•	-	-	0.5 - 3	63/32	35 - 50	-55°C to +90°C	-	•	•	-	-	•	•	•	-	-	-
	467	0603	-	-	•	0.25 - 5	32	35 - 50	-55°C to +90°C	-	•	•	-	-	•	•	•	-	-	-
Nano <sup>®</sup> Fuse	494	0603	-	•	-	0.25 - 5	32	35 - 50	-55°C to +90°C	-	•	•	-	-	•	•	•	-	-	-
	435	0402	-	-	•	0.25 - 5	32	35	-55°C to +90°C	-	•	•	-	-	•	•	•	-	-	-
	448	2410	-	-	•	0.062 - 15	125/85	35 - 50	-55°C to +125°C	-	•	•	•	-	•	•	•	-	-	-
	449	2410	•	-	-	0.375 - 5	125	50	-55°C to +125°C	-	•	•	•	-	•	•	•	-	-	-
	451 / 453	2410	-	-	•	0.062 - 20	125/65	35 - 50	-55°C to +125°C	•	•	•	•	-	•	•	•	-	-	-
	452 / 454	2410	•	-	-	0.375 - 12	125/75	50	-55°C to +125°C	-	•	•	•	-	•	•	•	-	-	-
	456	4012	-	-	•	20, 25, 30, 40	125/72	100 - 180	-55°C to +125°C	-	•	•	•	-	•	•	•	-	-	-
	458	1206	-	•	-	1.0 - 10	75/63	50	-55°C to +125°C	-	•	-	-	-	•	•	•	-	-	-
	443	4012	•	-	-	0.5 - 5	250	50	-55°C to +125°C	-	•	-	•	-	•	•	•	-	-	-
	464	4818	-	•	-	0.5 - 6.3	250	100	-55°C to +125°C	-	-	-	•	•	•	•	•	-	-	-
	465	4818	•	-	-	1 - 6.3	250	100	-55°C to +125°C	-	-	-	•	•	•	•	•	-	-	-
	462	4118	•	-	-	0.500 - 5	250	100 - 150	-40°C to +85°C	•	•	-	•	•	•	•	•	-	-	•
	Telelink <sup>®</sup> Fuse	476	2410	-	•	-	1 - 15	250 VAC up to 5 A 125 VAC for 6.3-15 A	100 @ 250 VAC 100 @ 125 VAC	-55°C to +125°C	-	•	•	•	-	•	•	•	-	-
485		4818	-	•	-	1 - 3.15	600	100	-55°C to +125°C	-	•	•	-	-	•	•	•	-	-	-
881		12.5 x 10 mm	-	•	-	60 - 100	75	1500 @ 75 VDC	-55°C to +100°C	-	•	•	-	-	•	•	•	-	-	-
885		10.86 x 4.78 mm	•	-	-	1 - 5	500	100 @ 500 VDC 1500 @ 350 VDC	-40°C to +105°C	-	•	•	-	-	•	•	•	•	-	-
461		4012	-	-	-	0.5 - 2.0	600	60	-55°C to +125°C	-	•	•	-	-	•	•	•	-	-	-
OMNI-BLOK <sup>®</sup> Fuseholder	461E	4012	-	-	-	1.25	600	60	-55°C to +125°C	-	•	-	-	-	•	•	•	-	-	-
	154	3820	-	-	•	0.062 - 10.0	125	35 - 50	-55°C to +125°C	-	•	-	•	-	•	•	•	-	-	-
Fuse and Clip Assemblies	154T	3820	•	-	-	0.375 - 7	125	50	-55°C to +125°C	-	•	-	•	-	•	•	•	-	-	-
	157	2615	-	-	•	0.062 - 10	125	35 - 50	-55°C to +125°C	-	•	-	-	-	•	•	•	-	-	-
	157I	2615	•	-	-	0.375 - 5	125	50	-55°C to +125°C	-	•	-	-	-	•	•	•	-	-	-
	159	4319	-	-	-	0.5 - 2	600	60	-55°C to +125°C	-	•	-	-	-	•	•	•	-	-	-
PiCO <sup>®</sup> SMF Fuse	160	4319	•	-	-	0.5 - 5	250	50	-55°C to +125°C	-	•	-	-	-	•	•	•	-	-	-
	459	7.24 x 4.32 mm	-	-	•	0.062 - 5	125	50 - 300	-55°C to +125°C	-	•	•	-	-	-	-	-	-	-	-
	460	7.24 x 4.32 mm	•	-	-	0.5 - 5	125	50	-55°C to +125°C	-	•	•	-	-	-	-	-	-	-	-

(1) Detailed information about product series listed here can be found on our website.

(2) Size for these surface mount items refers to common industry length and width dimensions of the device surface area. Example: 0402 = .04" x .02"

(3) In some cases for these categories, the ratings, agency approvals, and specifications vary by part number and are presented here as ranges representing the whole series. Please refer to product data on [Littelfuse.com](http://Littelfuse.com) and in our data sheets for detailed information by part number.

# Surface Mount Fuses (continued)



Surface Mount Type	Series Name <sup>1</sup>	Size (mm)	Time Lag	Fast Acting	Very Fast Acting	Device Range <sup>2</sup> (Operating Current Options in Amps)	Max. Voltage Rating <sup>2</sup> (Volts)	Interrupting Rating at Max. Voltage Rating <sup>2</sup> (Amps)	Operating Temperature Range	Agency Approvals <sup>2</sup>					Halogen Free	RoHS Compliant	Lead Free	TUV	VDE	CQC
										UL	UR	CSA	PSE	UMF						
Flat Pak	202	13.00 x 6.35 x 7.62	-	•	-	0.062 - 5	250	50	-55°C to +125°C	-	•	•	-	-	-	-	-	-	-	
	203	13.00 x 6.35 x 7.62	•	-	-	0.25 - 5	250	50	-55°C to +125°C	-	•	•	-	-	-	-	-	-	-	
EBF	446	10.92 x 4.06 x 14.35	-	•	-	2.0 - 10.0	350	100	-40°C to +125°C	-	•	•	-	-	-	-	-	-	-	
	447	10.92 x 4.06 x 14.35	-	•	-	2.0 - 10.0	350	100	-40°C to +125°C	-	•	•	-	-	-	-	-	-	-	

# Radial Leaded/Socket Fuses



Surface Mount Type	Series Name <sup>1</sup>	Size (mm)	Time Lag	Fast Acting	Very Fast Acting	Device Range <sup>2</sup> (Operating Current Options in Amps)	Max. Voltage Rating <sup>2</sup> (Volts)	Interrupting Rating at Max. Voltage Rating <sup>2</sup> (Amps)	Operating Temperature Range	Agency Approvals <sup>2</sup>					Halogen Free	RoHS Compliant	Lead Free	TUV	VDE	CQC
										UL	UR	CSA	PSE	UMF						
Micro <sup>™</sup> Fuse / TR3 Fuse	262/268	6 x 8	-	-	-	0.002 - 5	125	10,000	-55°C to +125°C	-	•	•	-	-	-	-	-	-	-	
	269		-	-	-	0.002 - 5	125	10,000	-55°C to +125°C	-	•	•	-	-	-	-	-	-	-	
	272/278		-	-	-	0.002 - 5	125	10,000	-55°C to +125°C	-	•	•	-	-	-	-	-	-	-	
	273/279		-	-	-	0.002 - 5	125	10,000	-55°C to +85°C	-	•	•	-	-	-	-	-	-	-	
	274		-	-	-	0.002 - 5	125	10,000	-55°C to +85°C	-	•	•	-	-	-	-	-	-	-	
	303		•	•	•	0.5 - 5.0 to 0.05 - 5.0	125	50	-55°C to +70°C	•	-	•	-	-	-	•	•	-	-	
TR5 <sup>®</sup> Fuse	370	8.5 x 8	-	-	-	0.4 - 6.3 to 0.04 - 6.3	250	35 - 63	-40°C to +85°C	-	•	•	-	-	•	•	-	-		
	372		•	-	-	0.04 - 6.3	250	35 - 50	-40°C to +85°C	-	•	•	-	-	•	•	-	-		
	373		-	-	•	0.05 - 10	250	50	-40°C to +85°C	•	-	•	-	-	•	•	-	-		
	374		•	-	-	0.05 - 10	250	50	-40°C to +85°C	•	-	•	-	-	•	•	-	-		
	382		•	-	-	1 - 10	250	100	-40°C to +85°C	-	•	•	-	-	•	•	-	-		
	383		•	-	-	1 - 10	300	50 - 100	-40°C to +85°C	-	•	•	-	-	•	•	-	-		
TE5	389	8.5 x 8	•	-	-	0.8 - 6.3	300	50	-40°C to +85°C	-	•	•	-	-	•	•	-	-		
	385		•	-	-	0.35 - 1.5	125	50	-40°C to +85°C	-	•	•	-	-	•	•	-	-		
	391		-	-	•	0.125 - 4	65	50	-40°C to +85°C	-	•	•	-	-	•	•	-	-		
	392		•	-	-	0.280 - 6.3	250	25 - 63	-40°C to +85°C	-	•	•	-	-	•	•	-	-		
	395		-	-	•	0.05 - 6.3	125	100	-40°C to +85°C	•	-	•	-	-	•	•	-	-		
	396		•	-	-	0.05 - 6.3	125	100	-40°C to +85°C	•	-	•	-	-	•	•	-	-		
	397		•	-	-	0.35 - 1.5	125	50	-40°C to +85°C	•	-	•	-	-	•	•	-	-		
	398		-	•	-	0.125 - 4	65	50	-40°C to +85°C	-	•	•	-	-	•	•	-	-		
	399		•	-	-	0.125 - 4	65	50	-40°C to +85°C	-	•	•	-	-	•	•	-	-		
	400		-	-	-	0.5 - 6.3	250	130	-40°C to +85°C	-	•	•	-	-	•	•	-	-		
TE7	808	8.9 x 8.9	-	-	•	2 - 5	250	100	-40°C to +85°C	-	•	•	-	-	•	•	-	-		
	804	12.4 x 9.2 x 6.4	•	-	-	0.8 - 6.3	250	150	-40°C to +125°C	-	-	-	•	•	-	-	•	•		
	807	12.4 x 9.2 x 6.4	•	-	-	0.8 - 6.3	300	100	-40°C to +125°C	•	•	•	•	-	-	•	•	-		

(1) Detailed information about product series listed here can be found on our website.  
 (2) In some cases for these categories, the ratings, agency approvals, and specifications vary by part number and are presented here as ranges representing the whole series.

## How is the Surface Mount Fuse Used Here?

### 881 Series High-Current SMD Fuse

Provides a single-fuse solution for applications up to 75 Vdc. Current ratings from 60 A to 100 A, eliminates the need to parallel multiple lower-rated fuses or over-spec industrial-type fuses. Applications included blade servers, server chassis, backplane boards, and line cards.





# Fuse Holders

Fuseholder Type		In-Line Fuseholders	Panel Mount Fuse Enclosures	Circuit Board Mount Fuse Enclosures		Fuse Blocks	Fuse Clips
Circuit Connection Method		Wire	Wire Connector Terminals	TH= Through-Hole	SM= Surface Mount	CT= Wire Connector Terminal	QC= Quick Connect
Fuse Type	Fuse Series <sup>1</sup>						
4.5x14.5 mm (2AG)	<a href="#">208 / 209</a> <a href="#">225 / 229</a>	150274 150300 150307	3452 Series Int. Shocksafe 345 Series Int. Shocksafe (old) 245001 Solder QC 245002 NEMA QC 286377 Flip Top			CT 254 011 - 008 TH 254 101, 254 121 TH 254 131 QC 254 201 - 208	TH 111501 SM 111505 TH 111506 TH 111510 TH 111512 TH 52100001009 TH 51900001009 TH 51800001009 TH 523 Series TH 445 Series
5x20 mm	<a href="#">213 / 215</a> <a href="#">216 / 217</a> <a href="#">218 / 219XA</a> <a href="#">232 / 233</a> <a href="#">234 / 235</a> <a href="#">239 / 285</a> <a href="#">377 / 477</a> 617 / 618	150274 150300 150307 150315 150316 150317 150318 150319 PTF0080M FH503	345 Shocksafe 3455 Int. Shocksafe 286677 Flip Top 800 / 801 / 802 / 821 Series 823 Series Snap-in 824 / 824 - 20 / 850 / 851 / 860 Series 870 Series Medical Grade 820 / 820-20 Series Mini Shocksafe PTF030 / PTF035 / PTF040 PTF055 / PTF070	TH 345121 High Voltage Series TH 810 / 811 / 813 / 814 TH 830 / 831 / 834 TH 852 / 853 / 862 TH PTF045 / PTF050		TH 445073 TH 520 002, 520 101 QC 520 003, 520 005 CT 520 004 TH 646 / 649 / 656 CT 647 SM 658 TH PTF015 / PTF065 TH PTF075 / PTF077 PTF078 FB55 / FB58	TH 100 / 111 Series TH 04450001 / 00300210 TH 5200001 TH 52000001009 TH NY61AP TH FC51
6.3x32 mm (3AB/3AG)	<a href="#">312</a> <a href="#">313</a> <a href="#">314</a> <a href="#">322</a> <a href="#">326</a> <a href="#">332</a> <a href="#">373</a> <a href="#">505</a> <a href="#">506</a> <a href="#">508</a> 605	155 Series 150312 150322 150603 445004 445005 PTF080 FH602 / FH604 150603	3453 Series Int. Shocksafe 345 High Voltage Series 342 Series Traditional 342006 Watertight 344 Series Snap / Panel Mount 348 Series Snap Mount 340 Series RF Shielded / Watertight 346877 Flip Top 342021 (FHN26W) Watertight 342024 (FHN26G2) Drip Proof 342025 (FHN20G) Drip Proof 800 Series Shocksafe 803-01 Series 860 Series	TH 345101 High Voltage Series TH 810 Series TH 811 Series TH 813 Series TH 814 Series TH 862 Series		CT 354 Series QC 35406 Series QC 35407 Series QC 35408 Series QC 35409 Series QC 354701 Series CT 356 Series CT 359 Series QC OMN002 QC OMN004 QC OMN006 QC FB65 / FB66	CT 101001 / 101002 CT 101003 / 102064 CT 121001 / 121002 CT 121003 / 121004 TH 102071 TH 102076 / 102078 TH 102079 / 102080 TH 122083 / 122087 TH 122088 / 122093 TH 122090 / 100058 TH 51800001009 CT 101010 TH 102074 TH 10207101009
TE5/TR5 <sup>®</sup> Fuse	<a href="#">303 / 369</a> <a href="#">370 / 372</a> <a href="#">373 / 374</a> <a href="#">382 / 383</a> <a href="#">385 / 392</a> <a href="#">395 / 396</a> <a href="#">397 / 398</a> <a href="#">400 / 662</a> <a href="#">663 / 664</a> <a href="#">665 / 804</a> <a href="#">807 / 808</a>		570 Series	TH 571 Series TH 559 / 560 / 562 Series SM 564 Series TH 576 Series TH 556 / 557 Series			
Micro™ Fuse / TR3	<a href="#">262 / 268</a> <a href="#">269 / 272</a> <a href="#">273 / 274</a> <a href="#">278 / 279</a>		282001 Front Mount Neoprene 282007 Front Mount Conductive 282002 Rear Mount Neoprene 282008 Rear Mount Conductive 280004 32V Indicating	TH 281005 Vertical Silver TH 281007 Horizontal Silver TH 281008 Vertical Tin TH 281010 Horizontal Tin			

(1) Detailed information about product series listed here can be found on our website.

# Surface Mount PPTC Devices

PolySwitch®/POLY-FUSE® Standard SMD											
 FemtoSMD  MicroSMD  1206L  1812L  2920L											
Series Name <sup>1</sup>	Size <sup>2</sup>	Hold Current (I <sub>HOLD</sub> )	Max Voltage (V <sub>MAX</sub> )	Max Fault current (I <sub>MAX</sub> )	Operating Temperature Range	Agency Approvals			Halogen Free	RoHS	Lead Free
						cUR	UR	TUV			
femtoSMDC	0603	0.05 - 0.35	15	40	-40°C to 85°C	•	•	•	•	•	•
picoSMDC	0805	0.1 - 1.1	15	100	-40°C to 85°C	•	•	•	•	•	•
nanoSMDC	1206	0.1 - 2.0	60	100	-40°C to 85°C	•	•	•	•	•	•
microSMD	1210	0.05 - 2.0	30	100	-40°C to 85°C	•	•	•	•	•	•
miniSMDC	1812	0.1 - 3.0	60	100	-40°C to 85°C	•	•	•	•	•	•
midSMD	2018	0.3 - 2.0	60	40	-40°C to 85°C	•	•	•	•	•	•
SMDC	2920	0.3 - 3.1	60	50	-40°C to 85°C	•	•	•	•	•	•
SMD	2920	0.3 - 3.0	60	50	-40°C to 85°C	•	•	•	•	•	•
SMD2	3425	1.5 - 2.5	33	70	-40°C to 85°C	•	•	•	•	•	•
LoRho PTC (Low Resistance)	0402	0.1 - 0.5	6	40	-40°C to 85°C	•	•	•	•	•	•
	0603	0.5 - 1.75	6	50	-40°C to 85°C	•	•	•	•	•	•
	0805	0.75 - 3.0	6	50	-40°C to 85°C	•	•	•	•	•	•
	1206	0.75 - 4.5	12	50	-40°C to 85°C	•	•	•	•	•	•
	1210	1.75 - 4.5	6	50	-40°C to 85°C	•	•	•	•	•	•
	1812	1.9 - 3.7	6	50	-40°C to 85°C	•	•	•	•	•	•
2920	7.0	6	50	-40°C to 85°C	•	•	•	•	•	•	
0603L	0603	0.04 - 0.5	24	40	-40°C to 85°C	•	•	•	•	•	•
0805L	0805	0.05 - 1.1	30	100	-40°C to 85°C	•	•	•	•	•	•
1206L	1206	0.05 - 2.0	60	100	-40°C to 85°C	•	•	•	•	•	•
1210L	1210	0.05 - 2.0	30	100	-40°C to 85°C	•	•	•	•	•	•
1812L	1812	0.1 - 3.0	60	100	-40°C to 85°C	•	•	•	•	•	•
2016L	2016	0.3 - 5.0	60	100	-40°C to 85°C	•	•	•	•	•	•
2920L	2920	0.3 - 7.0	60	50	-40°C to 85°C	•	•	•	•	•	•
250S	3729	0.13	250 / 60	3	-40°C to 85°C	•	-	•	•	•	•

PolySwitch® Automotive SMD											
 FemtoASMD  PicoASMD  ASMD  NanoASMDCH											
Series Name <sup>1</sup>	Size <sup>2</sup>	Hold Current (I <sub>HOLD</sub> )	Max Voltage (V <sub>MAX</sub> )	Max Fault current (I <sub>MAX</sub> )	Operating Temperature Range	Agency Approvals			Halogen Free	RoHS	Lead Free
						cUR	UR	TUV			
femtoASMD	0603	0.05 - 0.1	15	10	-40°C to 85°C	-	-	-	•	•	•
picoASMD	0805	0.1 - 0.12	15	20	-40°C to 85°C	-	-	-	•	•	•
picoASMDCH	0805	0.1	16	40	-40°C to 125°C	-	-	-	•	•	•
nanoASMD	1206	0.1 - 0.5	60	100	-40°C to 85°C	-	-	-	•	•	•
nanoASMDCH	1206	0.16 - 0.5	30	50	-40°C to 125°C	-	-	-	•	•	•
microASMD	1210	0.05 - 0.5	30	40	-40°C to 85°C	-	-	-	•	•	•
miniASMD	1812	0.1 - 2.6	60	100	-40°C to 85°C	-	-	-	•	•	•
ASMD	2920	0.3 - 3.0	60	40	-40°C to 85°C	-	-	-	•	•	•
AHS	2018-3425	0.8 - 3.0	16	70	-40°C to 125°C	-	-	-	•	•	•
ASMD	2920-3425	0.23 - 1.97	60	40	-40°C to 85°C	-	-	-	•	•	•

(1) Detailed information about most product series listed here can be found on our website.

(2) Size for these surface mount items refers to common industry length and width dimensions of the device surface area. Example: 0402 = .04" x .02"

## Surface Mount PPTC Devices (Continued)

PolySwitch® Oil Resistant SMD											
 NanoSMDCH  MicroSMDCH  SMDCH											
Series Name <sup>1</sup>	Size <sup>2</sup>	Hold Current (I <sub>HOLD</sub> )	Max Voltage (V <sub>MAX</sub> )	Max Fault current (I <sub>MAX</sub> )	Operating Temperature Range	Agency Approvals			Halogen Free	RoHS	Lead Free
						cUR	UR	TUV			
NANOSMDCH	1206	0.1 - 0.75	30	10	-40°C to 125°C	-	•	-	•	•	•
MICROSMDCH	1210	0.1 - 0.5	30	10	-40°C to 125°C	-	-	-	•	•	•
SMDCH	2920	0.5 - 2.0	24	20	-40°C to 125°C	-	•	-	•	•	•

## Radial Leaded PPTC Devices

PolySwitch®/POLY-FUSE® Standard R-Line											
 RUEF  RXEF  RUSBF  RGEF  RHEF											
Series Name <sup>1</sup>	Size (mm)	Hold Current (I <sub>HOLD</sub> )	Max Voltage (V <sub>MAX</sub> )	Max Fault current (I <sub>MAX</sub> )	Operating Temperature Range	Agency Approvals			Halogen Free	RoHS	Lead Free
						cUR	UR	TUV			
RUEF	7.4 x 12.2 to 24.1 x 29.0	0.90 - 9.0	30	100 / 70	-40°C to 85°C	•	•	•	•	•	•
RKEF	7.1 x 11.43 to 24.1 x 29.0	0.50 - 5.0	60	40	-40°C to 85°C	•	•	•	•	•	•
RXEF	8.0 x 8.3 to 27.2 x 31.8	0.05 - 0.17 / 0.20 - 3.75	60 / 72	40	-40°C to 85°C	•	•	•	•	•	•
RUSBF	6.9 x 11.4 to 11.4 x 18.3	0.90 - 2.5 / 0.75 - 1.55	16 / 6	40	-40°C to 85°C	•	•	•	•	•	•
RGEF	7.1 x 11.0 to 23.5 x 27.9	2.5 - 14.0	16	100	-40°C to 85°C	•	•	•	•	•	•
RHEF	6.9 x 10.8 to 23.5 x 28.7	0.50 - 1.0 / 2.0 - 15.0	30 / 16	40 / 100	-40°C to 125°C	•	•	•	•	•	•
USBR	6.9 x 11.4 to 11.4 x 18.3	0.75 - 2.50	6 / 16	40	-40°C to 85°C	•	•	•	•	•	•
16R	7.1 x 11.0 to 23.5 x 27.9	2.50 - 14.00	16	100	-40°C to 85°C	•	•	•	•	•	•
30R	7.4 x 12.2 to 24.1 x 31.6	0.90 - 9.00	30	40	-40°C to 85°C	•	•	•	•	•	•
60R	7.4 x 11.7 to 26.3 x 31.1	0.10 - 3.75	60	40	-40°C to 85°C	•	•	•	•	•	•
72R	7.4 x 11.7 to 26.3 x 31.1	0.20 - 3.75	72	40	-40°C to 85°C	•	•	•	•	•	•
250R	5.8 x 9.9 to 9.5 x 12	0.08 - 0.18	250	3 / 10	-40°C to 85°C	•	•	•	•	•	•
600R	9.0 x 12.5 to 16.0 x 12.6	0.15 - 0.16	600	3	-40°C to 85°C	•	•	•	•	•	•

PolySwitch® Automotive R-Line											
 AGRF  AHEF  AHRF											
Series Name <sup>1</sup>	Size (mm)	Hold Current (I <sub>HOLD</sub> )	Max Voltage (V <sub>MAX</sub> )	Max Fault current (I <sub>MAX</sub> )	Operating Temperature Range	Agency Approvals			Halogen Free	RoHS	Lead Free
						cUR	UR	TUV			
AGRF	8.9 x 14.1 to 23.5 x 28.7	4.0 - 14.0	16	100	-40°C to 85°C	-	-	-	•	•	•
AHRF	6.9 x 10.8 to 23.5 x 28.7	0.5 - 1.0 / 2.0 - 15.0	30 / 16	40 / 100	-40°C to 125°C	-	-	-	•	•	•
AHEF	6.9 x 10.8 to 23.5 x 27.9	0.5 - 10.0	32	100	-40°C to 125°C	-	-	-	•	•	•

(1) Detailed information about most product series listed here can be found on our website.

(2) Size for these surface mount items refers to common industry length and width dimensions of the device surface area. Example: 0402 = .04" x .02"

## Radial Leaded PPTC Devices (Continued)

PolySwitch® Line Voltage											
 LVB  LVR											
Series Name¹	Size (mm)	Hold Current (I <sub>HOLD</sub> )	Max Voltage (V <sub>MAX</sub> )	Max Fault current (I <sub>MAX</sub> )	Operating Temperature Range	Agency Approvals			Halogen Free	RoHS	Lead Free
						cUR	UR	TUV			
LVR	6.9 x 9.9 to 24.9 x 34.8	0.05 - 2.0	240	1 - 20	-20°C to 85°C	•	•	•	-	•	•
LVB	25.2 x 27.2	1.25	240	12.5	-40°C to 85°C	-	•	-	-	•	•

## Battery PPTC Devices

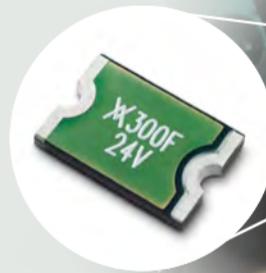
PolySwitch® Straps											
 VLR  VLP  VTP  LR4  SRP											
Series Name¹	Size (mm)	Hold Current (I <sub>HOLD</sub> )	Max Voltage (V <sub>MAX</sub> )	Max Fault Current (I <sub>MAX</sub> )	Operating Temperature Range	Agency Approvals			Halogen Free	RoHS	Lead Free
						cUR	UR	TUV			
VLR	23.2 X 3.9 to 23.1 x 5.3	1.70 - 2.30	12	100	-40°C to 85°C	•	•	•	•	•	•
VLP	11.8 x 4.6 to 23.1 x 5.3	1.20 - 2.70	16	60	-40°C to 85°C	•	•	•	•	•	•
VTP	25.6 x 2.9 to 23.1 x 5.3	1.10 - 2.10	16	100	-40°C to 85°C	•	•	•	•	•	•
LR4	22.1 x 5.5 to 66.5 x 10.0	1.90 - 13.0	15/20	100	-40°C to 85°C	•	•	•	•	•	•
SRP	22.1 x 5.2 to 32.4 x 13.6	1.20 - 4.20	15/30	100	-40°C to 85°C	•	•	•	•	•	•

PolySwitch® LowRho Straps											
 MXP  MGP  RSD											
Series Name¹	Size (mm)	Hold Current (I <sub>HOLD</sub> )	Max Voltage (V <sub>MAX</sub> )	Max Fault Current (I <sub>MAX</sub> )	Operating Temperature Range	Agency Approvals			Halogen Free	RoHS	Lead Free
						cUR	UR	TUV			
MXP/MGP (Low Resistance)	10.0 x 2.6 to 16.5 x 3.26	1.80 - 5.0	6	50	-40°C to 85°C	-	•	•	•	•	•
RSD	10.3 x 2.95	3.1 - 4.2	6	50	-40°C to 85°C	-	•	-	•	•	•

## How is the PPTC Used Here?

### ASMD & miniASMD Surface Mount Resettable PPTCs

Resettable PPTC overcurrent protection helps prevent system breakdowns and enhances safety. Surface-mounted automotive PPTCs safeguard a wide range of functions such as powered antennas, CANbus, touchscreens, USB ports, HDMI ports, and I/O lines.



## Battery PPTC Devices (Continued)

POLY-FUSE® LoRho SMD											
 1206  1210  2920											
Series Name <sup>1</sup>	Size <sup>2</sup>	Hold Current (I <sub>HOLD</sub> )	Max Voltage (V <sub>MAX</sub> )	Max Fault Current (I <sub>MAX</sub> )	Operating Temperature Range	Agency Approvals			Halogen Free	RoHS	Lead Free
						cUR	UR	TUV			
LoRho	0402	0.1 - 0.5	6	40	-40°C to 85°C	•	•	•	•	•	•
	0603	0.5 - 1.75	6	50	-40°C to 85°C	•	•	•	•	•	•
	0805	0.75 - 3.0	6	50	-40°C to 85°C	•	•	•	•	•	•
	1206	0.75 - 4.5	12	50	-40°C to 85°C	•	•	•	•	•	•
	1210	1.75 - 4.5	6	50	-40°C to 85°C	•	•	•	•	•	•
	1812	1.9 - 3.7	6	50	-40°C to 85°C	•	•	•	•	•	•
	2920	7.0	6	50	-40°C to 85°C	•	•	•	•	•	•

## Battery Mini-Breakers (Thermal Cutoff Devices)

Battery Mini-Breakers (Thermal Cutoff Devices)													
 MHP-TAC  MHP-TAM6  MHP-TAT18													
Series Name <sup>1</sup>	Size (mm)	Operation Temperature	Reset Temperature	Hold Current @25°C (I <sub>HOLD</sub> )	Contact Rating	Max Breaking Current	Operating Temperature Range	Agency Approvals			Halogen Free	RoHS	Lead Free
								cUR	UR	CB			
MHP-TAM6	5.80 x 3.80 x 1.15 <sub>MAX</sub>	72-90°C	≥40°C	6A	DC 9V/12A, 6000 Cycles	DC 5V/40A, 100 Cycles	-30 to 100°C	•	•	•	•	•	•
MHP-TAM15	5.80 x 3.80 x 1.15 <sub>MAX</sub>	72-90°C	≥40°C	15A	DC 9V/25A, 6000 Cycles	DC 5V/80A, 100 Cycles	-30 to 100°C	•	•	•	•	•	•
MHP-TAT18	5.80 x 3.80 x 1.15 <sub>MAX</sub>	72-90°C	≥40°C	18A	DC 9V/30A, 6000 Cycles	DC 5V/80A, 100 Cycles	-30 to 100°C	•	•	•	•	•	•
MHP-TAC6	4.75 x 2.80 x 0.85 <sub>MAX</sub>	72-90°C	≥40°C	6A	DC 12V/12A, 6000 Cycles	DC 5V/40A, 100 Cycles	-30 to 100°C	•	•	•	•	•	•
MHP-TAC15	4.75 x 2.80 x 0.85 <sub>MAX</sub>	72-90°C	≥40°C	15A	DC 12V/25A, 6000 Cycles	DC 5V/80A, 100 Cycles	-30 to 100°C	•	•	•	•	•	•

(1) Detailed information about most product series listed here can be found on our website.

(2) Size for these surface mount items refers to common industry length and width dimensions of the device surface area. Example: 0402 = .04" x .02"

## How is the Mini-Breaker Used Here?

### MHP-TA Metal Hybrid PPTC Devices

Mini-breakers provide resettable overtemperature and overcurrent protection in high-capacity Li-ion polymer and prismatic cells. They are capable of handling the high battery-discharge currents in notebook PCs, gaming PCs, ultra-books, tablets, smartphones, and other small portable electronic devices.



# Telecom PPTC Devices

## PolySwitch® Surface Mount & Chips



Series Name <sup>1</sup>	Size (mm)	Hold Current (I <sub>HOLD</sub> )	Max Voltage (V <sub>MAX</sub> )	Max Fault current (I <sub>MAX</sub> )	Operating Temperature Range	Agency Approvals			Halogen Free	RoHS	Lead Free
						cUR	UR	TUV			
<a href="#">TCF250</a>	4.9 x 4.9 x 2.3 to 7.1 x 7.1 x 1.6	0.09 - 0.18	250	3	-40°C to 85°C	-	•	-	•	•	•
<a href="#">TSL250</a>	7.9 x 5.3	0.08 - 0.13	250	3	-40°C to 85°C	•	•	•	•	•	•
<a href="#">TS250</a>	9.4 x 7.4	0.13	250	3	-40°C to 85°C	•	•	•	•	•	•
<a href="#">TSM250</a>	8.9 x 8.6	0.13	250	3	-40°C to 85°C	-	•	-	•	•	•
<a href="#">TSV250</a>	6.1 x 6.9	0.13	250	3	-40°C to 85°C	•	•	•	•	•	•
<a href="#">TS600</a>	19.4 x 8.3	0.17 - 0.4	600	3	-40°C to 85°C	•	•	-	•	•	•
<a href="#">TSM600</a>	17.6 x 11.2	0.25 - 0.4	600	3	-40°C to 85°C	•	•	-	•	•	•

## PolySwitch® Radial Leaded



Series Name <sup>1</sup>	Size (mm)	Hold Current (I <sub>HOLD</sub> )	Max Voltage (V <sub>MAX</sub> )	Max Fault current (I <sub>MAX</sub> )	Operating Temperature Range	Agency Approvals			Halogen Free	RoHS	Lead Free
						cUR	UR	TUV			
<a href="#">TRF250</a>	4.8 x 9.3 to 9.0 x 12.0	0.055 - 0.184	250	3	-40°C to 85°C	•	•	•	•	•	•
<a href="#">TRF600</a>	9.0 x 12.5 to 16.0 x 12.6	0.15 - 0.4	600	3	-40°C to 85°C	•	•	•	•	•	•
<a href="#">TR600</a>	13.5 x 12.6	0.15	600	3	-40°C to 85°C	-	-	-	•	•	•

(1) Detailed information about most product series listed here can be found on our website.

## How is the Varistor Used Here?

### TMOV20RP460EL2T7 Thermally Protected Varistor

The aging and degradation of conventional MOVs can lead to catastrophic failure, smoke, and fire. In contrast, this TMOV enhances safety and extends smart meter reliability.



# Varistors

## Surface Mount MLV / MOV



Series Name <sup>1</sup>	Technology Type	Operating AC Voltage Range	Operating DC Voltage Range	Peak Current Range <sup>2</sup> (A)	Peak Energy Range (J)	Operating Temperature Range	Lines Protected	Mount/Form Factor	Disc Size	Agency Approvals					RoHS	Lead Free	Halogen Free
										UR	cURus	VDE	CECC	OPL			
MHS	Multi-Layer Zinc Oxide (MLV)	-	9 - 42	-	-	-55 to +125°C	1	Surface Mount	Not Applicable	-	-	-	-	-	•	•	•
MLE		-	18	-	-	-55 to +125°C	1			-	-	-	-	-	•	•	•
MLA		2.5 - 107	3.5 - 120	4 - 1000	0.02 - 4.5	-55 to +125°C	1			-	-	-	-	-	•	•	•
MLA AUTO		2.5 - 107	3.5 - 120	4 - 1000	0.02 - 4.5	-55 to +125°C	1			-	-	-	-	-	•	•	•
AUML		-	18 - 68	-	-	-55 to +125°C	1			-	-	-	-	-	•	•	•
MLN		18	5.5 - 18	30	0.05 - 0.10	-55 to +125°C	4			-	-	-	-	-	•	•	•
CH	Metal Oxide Varistor (MOV)	14 - 275	18 - 369	100 - 250	1.0 - 8.0	-55 to +125°C	1			•	-	-	-	-	•	•	•
SMZ		115 - 510	369 - 675	1200	23 - 40	-55 to +85°C	1			•	-	-	-	-	•	•	•
SM20		20 - 320	26 - 420	6500	165	-55 to +85°C	1	•	-	-	-	-	•	•	•		

## Radial Leaded MOV



Series Name <sup>1</sup>	Technology Type	Operating AC Voltage Range	Operating DC Voltage Range	Peak Current Range <sup>2</sup> (A)	Peak Energy Range (J)	Operating Temperature Range	Lines Protected	Mount/Form Factor	Disc Size	Agency Approvals					RoHS	Lead Free	Halogen Free
										UR	cURus	VDE	CECC	OPL			
UltraMOV <sup>2</sup> Varistor	Metal Oxide Varistor	130 - 625	170 - 825	1750 - 10000	12.5 - 400	-55 to +85°C	1	Radial Leaded	7, 10, 14, 20mm	-	•	•	•	-	•	•	•
UltraMOV <sup>2</sup> 25S Varistor		115 - 750	150 - 970	22000	230 - 890	-55 to +85°C	1		25mm	-	•	•	-	-	•	•	•
C-III		130 - 1000	-	3500 - 1000	40 - 530	-55 to +85°C	1		10, 14, 20mm	-	•	•	•	-	•	•	•
LA		130 - 1000	175 - 1200	1200 - 6500	11 - 360	-55 to +85°C	1		7, 10, 14, 20mm	-	•	•	•	-	•	•	•
ZA		4 - 460	5.5 - 615	50 - 6500	0.1 - 52	-55 to +85°C	1		5, 7, 10, 14, 20mm	-	•	•	•	-	•	•	•
LV UltraMOV		11-95	14-125	500-10000	0.8-150	-55 to +85°C epoxy coated ; -55 to +125°C phenolic coated	1		5, 7, 10, 14, 20mm	-	•	-	-	-	•	•	•
AUMOV		14-625	16-825	400-10000	1-490	-55 to +85°C epoxy coated ; -55 to +125°C phenolic coated	1		5, 7, 10, 14, 20mm	•	-	-	-	-	•	•	•
HMOV		11-625	14-825	1500-10000	4.2-900	-55 to +125°C	1		10, 14, 20mm	-	•	-	•	-	•	•	•

## Specialty Application MOV



Series Name <sup>1</sup>	Technology Type	Operating AC Voltage Range	Operating DC Voltage Range	Peak Current Range <sup>2</sup> (A)	Peak Energy Range (J)	Operating Temperature Range	Lines Protected	Mount/Form Factor	Disc Size	Agency Approvals					RoHS	Lead Free	Halogen Free
										UR	cURus	VDE	CECC	OPL			
MA	Metal Oxide Varistor	9 - 264	13 - 365	40 - 100	0.06 - 1.7	-55 to +85°C	1	Axial Leaded	Not Applicable	-	-	-	-	-	•	•	•
RA		4 - 275	5.5 - 369	150 - 6500	0.4 - 160	-55 to +125°C	1	Inline Radial Leads	Not Applicable	-	•	-	-	-	•	•	-
High Reliability		130 - 510	4 - 675	100 - 6500	0.4 - 190	-55 to +85°C	1	(Varies)	(Varies)	-	-	-	-	•	-	-	-

## Varistors (Continued)

Industrial High-Energy Terminal MOV																	
 BA/BB  DA/DB  HA  HB34  CA																	
Series Name <sup>1</sup>	Technology Type	Operating AC Voltage Range	Operating DC Voltage Range	Peak Current Range <sup>2</sup> (A)	Peak Energy Range (J)	Operating Temperature Range	Lines Protected	Mount/Form Factor	Disc Size	Agency Approvals					RoHS	Lead Free	Halogen Free
										UR	cURus	VDE	CECC	OPL			
BA/BB	Metal Oxide Varistor	130 - 2800	175 - 3500	50000 70000	450 - 10000	-55 to +85°C	1	Screw / Clip Terminals	60mm	•	-	-	-	-	•	-	-
DA/DB		130 - 750	175 - 970	40000	270 - 1050	-55 to +85°C	1	Clip Terminals	40mm	•	-	-	-	-	•	•	-
HA		110 - 750	148 - 970	25000 40000	160 - 1050	-55 to +85°C	1	Industrial Packaged Radial Leads	32, 40mm	-	•	-	-	-	•	•	•
HB34, HG34, HF34		110 - 750	148 - 970	40000	220 - 1050	-55 to +85°C	1		34mm	-	•	-	-	-	•	•	•
DHB34		110 - 750	148 - 970	40000	220 - 10000	-55 to +85°C	1		34mm	-	•	-	-	-	•	•	•
CA		250 - 2800	330 - 3500	50000 70000	880 - 10000	-55 to +85°C	1		Bare Disc	60mm	-	-	-	-	-	•	-

Thermally Protected MOV																	
 SMOV25S  SMOV34S  TMOV25S  TMOV34S  iTMOV																	
Series Name <sup>1</sup>	Technology Type	Operating AC Voltage Range	Operating DC Voltage Range	Peak Current Range <sup>2</sup> (A)	Peak Energy Range (J)	Operating Temperature Range	Lines Protected	Mount/Form Factor	Disc Size	Agency Approvals					RoHS	Lead Free	Halogen Free
										UR	cURus	VDE	CECC	OPL			
SMOV <sup>®</sup> 25S Varistor	Metal Oxide Varistor	115 - 750	150 - 970	20000	170 - 670	-45 to +75°C	1	Industrial Packaged Radial Leads	25mm	•	-	-	-	-	•	•	-
SMOV <sup>®</sup> 34S Varistor		115 - 750	150 - 970	40000	280 - 1200	-45 to +75°C	1		34mm	•	-	-	-	-	•	•	-
TMOV <sup>®</sup> 25S Varistor		115 - 750	150 - 970	20000	170 - 670	-55 to +85°C	1	Radial Leaded	25mm	-	•	•	•	-	•	•	•
TMOV <sup>®</sup> 34S Varistor		115 - 750	150 - 970	40000	280 - 1200	-55 to +85°C	1	Industrial Packaged Radial Leads	34mm	-	•	•	•	-	•	•	•
iTMOV <sup>®</sup> Varistor / iTMOV <sup>®</sup> Varistor		115 - 750	150 - 970	6000 - 10000	35 - 480	-55 to +85°C	1	Radial Leaded	14, 20mm	-	•	•	•	-	•	•	•

(1) Detailed information about product series listed here can be found on our website.  
 (2) Not an applicable parameter for Crowbar devices

## Gas Discharge Tubes

High-Voltage GDTs												
 AC  CG3  CG4												
Series Name <sup>1</sup>	DC Sparkover Voltage @ 100V/s ±20% Tolerance (V)	Max AC Surge (A)	Max Impulse Discharge Current 8x20µs, 10 hits (kA)	Max Capacitance (pF)	Operation Temperature	Agency Approvals			Halogen Free	RoHS	Lead Free	
						cUR	UR	TUV				
CG3/AC	285-7500	NA	5	1.5	-40°C to +90°C	•	•	-	-	•	•	
CG4	800-3000	3	3	0.8	-40°C to +90°C	•	•	-	-	•	•	
GTCX28-XXXM-R20	75-350	20	20	1.5	-40°C to +90°C	-	•	-	-	•	•	

# Gas Discharge Tubes (Continued)

## Low- to Medium-Surge GDTs



CG5



SH



SL1002A

Series Name <sup>1</sup>	DC Sparkover Voltage @ 100V/s ±20% Tolerance (V)	Max AC Surge (A)	Max Impulse Discharge Current 8x20us, 10 hits (KA)	Max Capacitance (pF)	Operation Temperature	Agency Approvals			Halogen Free	RoHS	Lead Free
						cUR	UR	TUV			
CG5/SL0902A	90-600	5	5	1.5	-40°C to +90°C	•	•	-	-	•	•
CG6	75-600	3	3	0.3	-40°C to +90°C	•	•	-	-	•	•
CG7	75-470	1	1	0.3	-40°C to +90°C	•	•	-	-	•	•
SH	75-600	5	5	0.7	-40°C to +90°C	•	•	-	-	•	•
SL1002A	75-600	5	5	1.2	-40°C to +90°C	•	•	-	-	•	•
SL1003A	90-500	10	10	1.5	-40°C to +90°C	•	•	-	-	•	•
SL1011A	75-600	5	5	1.5	-40°C to +90°C	•	•	-	-	•	•
SL1010A	75-470	NA	5-10	1.5	-40°C to +90°C	•	•	-	-	•	•
GTCX25-XXXM-R02	75-600	2.5	2.5	1	-40°C to +90°C	-	•	-	-	•	•
GTCX25-XXXM-R05	75-230	5	5	1	-40°C to +90°C	-	•	-	-	•	•
GTCX26-XXXM-R05	75-600	5	5	1	-40°C to +90°C	-	•	-	-	•	•
GTCX28-XXXM-R05	75-600	5	5	1	-40°C to +90°C	-	•	-	-	•	•
GTCX35-XXXM-R05	75-600	5	5	1	-40°C to +90°C	-	•	-	-	•	•
GTCX36-XXXM-R05	75-600	5	5	1	-40°C to +90°C	-	•	-	-	•	•

## Medium- to High-Surge GDTs



CG/CG2



SG



SE

Series Name <sup>1</sup>	DC Sparkover Voltage @ 100V/s ±20% Tolerance (V)	Max AC Surge (A)	Max Impulse Discharge Current 8x20us, 10 hits (KA)	Max Capacitance (pF)	Operation Temperature	Agency Approvals			Halogen Free	RoHS	Lead Free
						cUR	UR	TUV			
CG/CG2	75-1000	20	20 (10 for 800 & 1000V)	1.5	-40°C to +90°C	•	•	-	-	•	•
SG	75-600	2.5	1-2	1	-40°C to +90°C	•	•	-	-	•	•
SE	75-600	NA	0.5	0.5	-40°C to +90°C	•	•	-	-	•	•
SL1021A	90-600	10	10	1.5	-40°C to +90°C	-	-	-	-	-	-
SL1411A	75-600	10	10	1.5	-40°C to +90°C	•	•	-	-	•	•
SL1122A	90-260	10	5	1	-40°C to +90°C	•	•	-	-	•	•
GTCX23-XXXM-R01	75-400	NA	1	0.5	-40°C to +90°C	•	•	-	-	•	•
GTCX28-XXXM-R10	75-600	10	10	1	-40°C to +90°C	•	•	-	-	•	•
GTCX38-XXXM-R10	75-600	10	10	1	-40°C to +90°C	-	•	-	-	•	•
GTCX36-XXXM-R10	75-600	10	10	1	-40°C to +90°C	-	•	-	-	•	•
GTCX37-XXXM-R10	75-600	10	10	1	-40°C to +90°C	-	•	-	-	•	•

(1) Detailed information about product series listed here can be found on our website.

## Gas Discharge Tubes (Continued)

Very-High-Surge GDTs												
Series Name <sup>1</sup>	DC Sparkover Voltage @ 100V/s ±20% Tolerance (V)	Max AC Surge (A)	Max Impulse Discharge Current 8x20us, 10 hits (kA)	Max Capacitance (pF)	Operation Temperature	Agency Approvals			Halogen Free	RoHS	Lead Free	
						cUR	UR	TUV				
<a href="#">SL1021B</a>	75-500	10	20	1.5	-40°C to +90°C	•	•	-	-	•	•	
<a href="#">SL1026</a>	275-700	10	20	NA	-40°C to +90°C	-	-	-	-	•	•	
<a href="#">GTCA28-XXXM-R03</a>	800-4000	5	3 (5 for 800V)	1	-40°C to +90°C	-	•	-	-	•	•	

## PulseGuard® ESD Suppressors

PulseGuard® ESD Suppressors												
Series Name <sup>1</sup>	Surface Mount	Through Hole	Working Voltage (V)	Array Package (No. of lines)	Single Line Package	Typical Capacitance (pF)	Typical Leakage Current	Rated Immunity to IEC 61000-4-2 level 4	Bidirectional (transients of either polarity)	Halogen Free	RoHS	Lead Free
<a href="#">PGB1</a>	•	-	0-24	SOT23 (2)	0402 0603	0.04-0.12	<1nA	•	•	-	•	•
<a href="#">PGB2</a>	•	-	0-12	NA	0402	0.07	<1nA	•	•	•	•	•
<a href="#">XGD</a>	•	-	0-32	-	0402 0603	0.04-0.09	<1nA	•	•	•	•	•
<a href="#">AXGD</a>	•	-	0-32	-	0402 0603	0.04-0.09	<1nA	•	•	•	•	•
<a href="#">PESD0402</a>	•	-	0-24	-	0402	0.25	<0.01µA	•	•	•	•	•
<a href="#">PESD0603</a>	•	-	0-24	-	0603	0.25	<0.01µA	•	•	•	•	•
<a href="#">PESD1206</a>	•	-	0-24	-	1206	0.25	<0.01µA	•	•	•	•	•

(1) Detailed information about product series listed here can be found on our website.

## How is the ESD Device Used Here?

### AXGD10402KR ESD Suppressor

This ESD suppressor provides reliable protection for USB ports, data communication ports, HDMI ports, audio interfaces, on-screen display interfaces, push button switches, and LVDS.



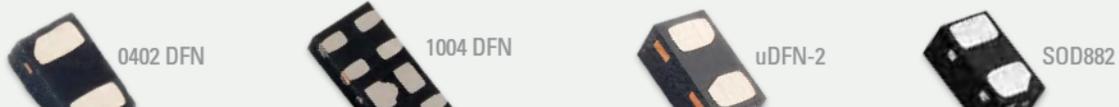
# TVS Diode Arrays

## General Purpose ESD Protection



Series Name <sup>1</sup>	Package Type	Breakdown Voltage (V)	Capacitance (pF)	Channel	ESD Contact (V)	Clamping Voltage (tp = 8/20µs)	Max. Surge Rating (tp = 8/20µs) (A)	RoHS	AEC-Q101 Qualified
<a href="#">SD</a>	SOD323	6-40	50-350	1	±30	8.5-52V	5-30	•	•
<a href="#">SD-C</a>	SOD323	6-40	30-200	1	±30	10-50V	5-30	•	•
<a href="#">SM</a>	SOT23-3	6-40	50-400	2	±30	9.8-52V	5-24	•	•
<a href="#">SP1003</a>	SOD723 / SOD882	7	35	1	±30	12.0V	7	•	•
<a href="#">SP1005</a>	SOD882 / 0201 Flipchip	7	35	1	±30	10V	8-10	•	•
<a href="#">SP1006</a>	uDFN-2	7	30	1	±30	8.3V	5	•	•
<a href="#">SP1026</a>	µDFN-2 (0201)	7.8	15	1	±30	12.0V	5.0	•	•
<a href="#">SP1103C</a>	uDFN-2	3.8	130	1	±30	9.0V@80A	80.0	•	•
<a href="#">SP11xx</a>	uDFN-2	6.0-26.7	130-630	1	±30	9.8-45V	20-80	•	•
<a href="#">SP1124T</a>	uDFN-2	26.7	130	1	±30	29.0V@1A	20.0	•	•
<a href="#">SP1233</a>	SOD882	4.2	35	1	±30	6.1V@1A	20	•	•
<a href="#">SP1305</a>	SOT23-3	7	30	2	±30	8.6V	5	•	•
<a href="#">SP1326</a>	SOD523	7.8	15	1	±30	12V@1A	4	•	•
<a href="#">SP3019</a>	SOT23-6	8.2	0.3	4	+22/-10	10.5V@1A	2.5	•	•
<a href="#">SP712</a>	SOT23-3L	9	75	2	±30	17V	20	•	•
<a href="#">SP720 Lead-Free/Green</a>	SOIC-16 / PDIP-16	-	3	14	±4	-	3	•	-
<a href="#">SP721 Lead-Free/Green</a>	SOIC-8 / PDIP-8	-	3	6	±4	-	3	•	-
<a href="#">SP723 Lead-Free/Green</a>	SOIC-8 / PDIP-8	-	5	6	±8	-	7	•	-
<a href="#">SP724 Lead-Free/Green</a>	SOT23-6	-	3	4	±8	-	3	•	-
<a href="#">SP725</a>	MSOP-10L / SOIC-8	-	5	-	±8	-	9	•	-
<a href="#">SPHV</a>	SOD882	13.3-40	25-60	1	±15±30	19-52 @ 1A	2-8.0	•	•
<a href="#">SPHV-C</a>	SOD882	13.3-40	13-30	1	±15±30	19-52 @ 1A	2-8.0	•	•

## Ultra-Low Capacitance



Series Name <sup>1</sup>	Package Type	Breakdown Voltage (V)	Capacitance (pF)	Channel	ESD Contact (V)	Clamping Voltage (tp = 8/20µs)	Max. Surge Rating (tp = 8/20µs) (A)	RoHS	AEC-Q101 Qualified
<a href="#">Enhanced ESD Discrete TVS</a>	0201 DFN / 0402 DFN	8.8-9.6	0.15-0.3	1	±22	13-14V@2.5A	2.5	•	•
<a href="#">Ultra-Low Capacitance Discrete TVS</a>	0201 DFN / 0402 DFN	9-9.8	0.1-0.2	1	±20	9.2-10V@2.0A	2.0	•	•
<a href="#">Enhanced ESD Diode Arrays</a>	0402 DFN array	8	0.3	2	±22	13V@2.2A	2.2	•	•
<a href="#">Ultra-Low Capacitance Diode Arrays</a>	0402 DFN array / 1004 DFN	9	0.2	2	±20	9.2V@2.0A	2.0	•	•
<a href="#">SP3213</a>	uDFN-2	7.5	0.09	1	±12	12V	2	•	•
<a href="#">SP3522</a>	SOD882 / 0201 DFN	9.2	0.15	1	±22	14.5V@2.5A	2.5	•	•
<a href="#">SP3530</a>	SOD882 / 0201 DFN	8.2	0.3	1	±22	11.8V@2.5A	2.5	•	•

## How Is the TVS Diode Array Used Here?

**SP3522, SP3530 Series, SP1005-01ETG / SP1003-01ETG / AQ3400-02UTG, AQHVxx-01LTG / AQHVxx-01LTG-C Diode Arrays**

High-speed data lines require robust ESD protection that does not interfere with the signal. Littelfuse TVS Diode Arrays offer low clamping and low leakage, with certain models (SP3522, SP3530 Series and AQ3400-02UTG) featuring low capacitance.



## TVS Diode Arrays (continued)

### Lightning Surge Protection



uDFN-10



SOD323



MSOP-10



uDFN-12



SOT143

Series Name <sup>1</sup>	Package Type	Breakdown Voltage (V)	Capacitance (pF)	Channel	ESD Contact (V)	Clamping Voltage (tp = 8/20µs)	Max. Surge Rating (tp = 8/20µs) (A)	RoHS	AEC-Q101 Qualified
<a href="#">SP2525NUTG</a>	uDFN-10L	7	1.7	4	±30	9V@30A	30	•	-
<a href="#">SP2555NUTG</a>	uDFN-10	4	2.5	4	±30	17V@40A	40	•	•
<a href="#">SP3374NUTG</a>	uDFN-10	5.07	3.5	4	±30	5.5A	40	•	•
<a href="#">SP3384NUTG</a>	uDFN-10	6.5	0.5	4	±30	4A	15	•	•
<a href="#">SP3025</a>	SOT23-6L	7	1.7	4	±30	9V@30A	30	•	-
<a href="#">SP4020</a>	SOD323	3.5	2.5	1	±30	6.6V @ 1A	30	•	•
<a href="#">SP4021</a>	SOD323	6.3	2.5	1	±30	9.3V @ 1A	25	•	•
<a href="#">SP4022</a>	SOD323	13.3	2	1	±30	19.0V@1A	15	•	•
<a href="#">SP4023</a>	SOD323	16	2	1	±30	23.0V@1A	12	•	•
<a href="#">SP4024</a>	SOD323	26	2	1	±30	34.0V@1A	7	•	•
<a href="#">SP4044</a>	MSOP-10	4.3	1.5	4	±30	5.2V@1A	24	•	•
<a href="#">SP4045</a>	MSOP-10	4.3	1.5	4	±30	6.0V@1A	24	•	•
<a href="#">SP4050</a>	uDFN12	4.3	4.4	12	±30	13.2V@20A	20	•	-
<a href="#">SP4208</a>	SOD323	9.5	3	1	±30	11.5V@1A	30	•	•
<a href="#">SR05</a>	SOT143	6	10	2	±30	9.8V @ 1A	25	•	-
<a href="#">SR70</a>	SOT143-4	0.7	3	2	±30	1.4V @ 1A	40	•	-

### Low-Capacitance ESD Protection



SOD882



uDFN-6



uDFN-10



uDFN-14



SOT23-6

Series Name <sup>1</sup>	Package Type	Breakdown Voltage (V)	Capacitance (pF)	Channel	ESD Contact (V)	Clamping Voltage (tp = 8/20µs)	Max. Surge Rating (tp = 8/20µs) (A)	RoHS	AEC-Q101 Qualified
<a href="#">SP1255P</a>	uDFN-6	4.5	0.6	3	30	6.6V@1A	4	•	•
<a href="#">SP3022</a>	SOD882	6	0.5	1	±20	12.0V@1A	3.0	•	•
<a href="#">SP3030</a>	SOD882	6	0.6	1	±20	9.2V @ 1A	3	•	•
<a href="#">SP3400</a>	uDFN-6	6.5	0.5	2	±25	6.6V@1A	10	•	•
<a href="#">SP3401</a>	uDFN-6	6.5	0.8	2	±18	4V	10	•	•
<a href="#">SP3420</a>	uDFN-10	6.5	0.32	4	±12	2.7V	6	•	•
<a href="#">SP3422</a>	5FC-uDFN	6.7	0.2	4	+20/-10	13.5V@1A	2.0	•	•
<a href="#">SP4010</a>	SOT23-6L	12.5	0.48	2	±30	27.5V	23	•	-
<a href="#">SP8008</a>	uDFN-14	6	0.3	8	+30/-23	12.45V@4A	4.0	•	•
<a href="#">SRV05-04HTG-D</a>	SOT23-6	6	1	4	±30	11.7V	10	•	•
<a href="#">SM24CANB</a>	SOT23-3	26.7	40	2	±30	34.0V@1A	10.0	•	•

## TVS Diode Arrays (continued)

### Automotive Qualified



SOD323



SOD523



uDFN-6L



SOT23-3



0201 DFN

Series Name <sup>1</sup>	Package Type	Breakdown Voltage (V)	Capacitance (pF)	Channel	ESD Contact (V)	Clamping Voltage (tp = 8/20µs)	Max. Surge Rating (tp = 8/20µs) (A)	RoHS	AEC-Q101 Qualified
<a href="#">AQxx-01FTG/AQxx-01LTG</a>	SOD323/SOD523	6-40	5-30	1	±30	9.8-34V @ 1A	7-30	•	•
<a href="#">AQxxC-01FTG/AQxxC-01LTG</a>	SOD323/SOD523	6-40	5-30	1	±30	10.0-36V @ 1A	7-30	•	•
<a href="#">AQ1003-01ETG/AQ1003-01LTG</a>	SOD882/SOD523	7.8	30	1	±30	11.4V@6A/ 12.0V@7A	7.0	•	•
<a href="#">AQ1005</a>	SOD882	8.5	30	1	±30	9.3V@1A/10V@2A/ 15.6V@10A	8.0	•	•
<a href="#">AQ3041</a>	SOD882	7.8	0.3	1	±20	9.2V@1A	3.0	•	•
<a href="#">AQ3045</a>	SOD882	7.8	0.35	1	±30	12V@1A	3.0	•	•
<a href="#">AQ3118</a>	SOD882	20	0.75	1	±10	31.0V@1A/34.0V@2A	2.0	•	•
<a href="#">AQ3130</a>	SOD882	30	0.3	1	±10	39.0V@1A/42.0V@2A	2.0	•	•
<a href="#">AQ3400</a>	uDFN-6L	7.8	3	2	±30	9.2V@1A	2.0	•	•
<a href="#">AQ24CANA</a>	SOT23-3L	28	15	2	±27	34V@1A	5.0	•	•
<a href="#">SM24CANB</a>	SOT23-3	26.7	30	2	±30	34.0V@1A	10.0	•	•
<a href="#">AQ24CANFD</a>	SOT23-3	28	11.5	2	±21	33V@1A	3.0	•	•
<a href="#">AQ2555NUTG</a>	uDFN-10	4	2.5	4	±30	17V@40A	45.0	•	•
<a href="#">SESD Ultra-Low Capacitance Discrete TVS</a>	0201 DFN / 0402 DFN	9-9.8	0.1-0.2	1	±20	9.2-10.0V@2A	2.0	-	•
<a href="#">SESD Enhanced ESD Discrete TVS</a>	0201 DFN / 0402 DFN	8.8-9.6	0.15-0.3	1	±22	13-14V@2.5A	2.5	•	•
<a href="#">SESD Ultra-Low Capacitance Diode Arrays</a>	0402 DFN Array / 0802 DFN Array / 1004 DFN Array / 1103 DFN Array	9	0.2	2/4/6	±20	10.0V@2.2A	2.0	-	•
<a href="#">SESD Enhanced ESD Diode Arrays</a>	0402 DFN Array / 1004 DFN Array	8	0.3	2/4	±22	13V	2.2-2.5	•	•

(1) Detailed information about product series listed here can be found on our website.

## TVS Diodes

### Surface Mount High Power



SMDJ



SMTAK3



LTKAK3

Series Name <sup>1</sup>	Package Type	Reverse Standoff Voltage (VR)	Peak Pulse Power Range (PPP 10/1000µs)	Peak Pulse Current (IPP 8x20µs)	Operating Temperature	Halogen Free	RoHS	UL Recognized
<a href="#">SMDJ</a>	DO-214AB	5.0-440	3000W	21.5A-1630.5A (max)	-65°C - 150°C	•	•	•
<a href="#">4.0SMDJ</a>	DO-214AB	24	4000W	650A (max)	-65°C - 150°C	•	•	•
<a href="#">5.0SMDJ</a>	DO-214AB	12-170	5000W	136.5A-1890A (max)	-65°C - 150°C	•	•	•
<a href="#">5.0SMDJxxS</a>	DO-214AB	6.0-58	5000W	267.5A-2669.7A (max)	-65°C - 150°C	•	•	•
<a href="#">8.0SMDJ</a>	DO-214AB	12-110	8000W	293.8A-2613.7A (max)	-65°C - 150°C	•	•	•
<a href="#">SMTAK3</a>	SMTAK	15-76	-	3KA	-55°C - 125°C	•	•	•
**LTKAK1	SMT0-218	380	-	1KA	-55°C - 125°C	•	•	•
**LTKAK2	SMT0-218	150-170	-	2KA	-55°C - 125°C	•	•	•
<a href="#">LTKAK3</a>	SMT0-218	66	-	3KA	-55°C - 125°C	•	•	•
<a href="#">LTKAK6</a>	SMT0-218	58-76	-	6KA	-55°C - 125°C	•	•	•
<a href="#">LTKAK10</a>	SMT0-218	58-86	-	10KA	-55°C - 125°C	•	•	•

## TVS Diodes (continued)

### Surface-Mount Standard Application (200W-3000W)



Series Name <sup>1</sup>	Package Type	Reverse Standoff Voltage (VR)	Peak Pulse Power Range (PPP 10/1000µs)	Peak Pulse Current (IPP 8x20µs)	Operating Temperature	Halogen Free	RoHS Compliant	UL Recognized
<a href="#">SMF4L</a>	SOD-123FL	5.0-250	400W	-	-55°C - 150°C	•	•	•
<a href="#">SMF3.3</a>	SOD-123FL	3.3	200W	-	-55°C - 150°C	•	•	•
<a href="#">SMF</a>	SOD-123	5.0-250	200W	-	-65°C - 150°C	•	•	•
<a href="#">SMAJ</a>	DO-214AC	5.0-440	400W	-	-65°C - 150°C	•	•	•
<a href="#">SMAJ-E</a>	DO-214AC	300-850	400W	-	-65°C - 150°C	•	•	*
<a href="#">P4SMA</a>	DO-214AC	5.8-468	400W	-	-65°C - 150°C	•	•	•
<a href="#">P4SMA-E</a>	DO-214AC	300-850	400W	-	-65°C - 150°C	•	•	*
<a href="#">SMA6J</a>	DO-214AC	5.0-130	600W	-	-65°C - 150°C	•	•	•
<a href="#">SMA6L</a>	DO-221AC	5.0-250	600W	-	-65°C - 150°C	•	•	•
<a href="#">SACB</a>	DO-214AA	5.0-50	500W	-	-65°C - 150°C	•	•	•
<a href="#">SMBJ</a>	DO-214AA	5.0-440	600W	-	-65°C - 150°C	•	•	•
<a href="#">SMBJ-E</a>	DO-214AA	300-850	600W	-	-65°C - 150°C	•	•	*
<a href="#">P6SMB</a>	DO-214AA	5.8-512	600W	-	-65°C - 150°C	•	•	•
<a href="#">P6SMB-E</a>	DO-214AA	300-850	600W	-	-65°C - 150°C	•	•	*
<a href="#">1KSMB</a>	DO-214AA	5.8-153	1000W	-	-65°C - 150°C	•	•	•
<a href="#">1.5SMB</a>	DO214-AA	17.1-85.5	1500W	-	-65°C - 150°C	•	•	•
<a href="#">SMCJ</a>	DO-214AB	5.0-440	1500W	-	-65°C - 150°C	•	•	•
<a href="#">1.5SMC</a>	DO-214AB	5.8-512	1500W	-	-65°C - 150°C	•	•	•
<a href="#">3.0SMC</a>	DO-214AB	20-33	-	365-570A	-65°C - 150°C	•	•	*

\*UR approval is pending

### Axial-Leaded Standard Application (400W-1500W)



Series Name <sup>1</sup>	Package Type	Reverse Standoff Voltage (VR)	Peak Pulse Power Range (PPP 10/1000µs)	Peak Pulse Current (IPP 8x20µs)	Operating Temperature	Halogen Free	RoHS Compliant	UL Recognized
<a href="#">P4KE</a>	DO-41	5.8-468	400W	-	-	•	•	•
<a href="#">SA</a>	DO-15	5.0-180	500W	-	-	•	•	•
<a href="#">SAC</a>	DO-15	5.0-50	500W	-	-	•	•	•
<a href="#">P6KE</a>	DO-15	5.8-512	600W	-	-	•	•	•
<a href="#">1.5KE</a>	DO-201	5.8-512	1500W	-	-	•	•	•
<a href="#">LCE</a>	DO-201	6.5-90	1500W	-	-	•	•	•

## How is the TVS Diode Used Here?

### 8.0SMDJ or AK-Y High-Power TVS Diode

Outdoor and industrial communications systems applications require robust circuit protection, especially at DC output. The 8.0SMDJ TVS Diode protects against surges up to 8kW and features a compact surface-mount package (DO-214AB). If needed, AK-Y TVS Diodes provide even higher levels of surge protection.



## TVS Diodes (continued)

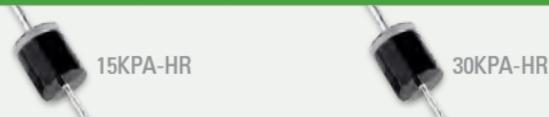
### Axial Leaded High Power



Series Name <sup>1</sup>	Package Type	Reverse Standoff Voltage (VR)	Peak Pulse Power Range (PPP 10/1000µs)	Peak Pulse Current (IPP 8x20µs)	Operating Temperature	Halogen Free	RoHS Compliant	UL Recognized
<a href="#">15KPA</a>	P600	17-280	15000W	-	-55°C - +175°C	•	•	•
<a href="#">20KPA</a>	P600	20-300	20000W	-	-55°C - +175°C	•	•	•
<a href="#">30KPA</a>	P600	28-360	30000W	-	-55°C - +175°C	•	•	•
<a href="#">AK1</a>	Axial Lead	76-430	-	1000A	-55°C - +125°C	•	•	•
<a href="#">AK3</a>	Axial Lead	15-430	-	3000A	-55°C - +125°C	•	•	•
<a href="#">AK6</a>	Axial Lead	30-430	-	6000A	-55°C - +125°C	•	•	•
<a href="#">AK10</a>	Axial Lead	15-530	-	10000A	-55°C - +125°C	•	•	•
<a href="#">AK15</a>	Axial Lead	58-190	-	15000A	-55°C - +125°C	•	•	•
<a href="#">AK1-Y</a>	Axial Lead	76-430	-	1000A	-55°C - +125°C	•	•	•
<a href="#">AK3-Y</a>	Axial Lead	15-430	-	3000A	-55°C - +125°C	•	•	•
<a href="#">AK6-Y</a>	Axial Lead	30-430	-	6000A	-55°C - +125°C	•	•	•
<a href="#">AK10-Y</a>	Axial Lead	15-530	-	10000A	-55°C - +125°C	•	•	•
<a href="#">AK15-Y</a>	Axial Lead	58-190	-	15000A	-55°C - +125°C	•	•	•
<a href="#">AK20-Y</a>	Axial Lead	16-76	-	20000A	-55°C - +125°C	•	•	*
<a href="#">5KP</a>	P600	5.0-350	5000W	-	-55°C - +125°C	•	•	•

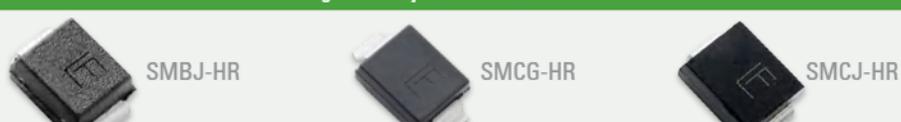
\*UR approval is pending

### High-Reliability Axial Lead



Series Name <sup>1</sup>	Package Type	Reverse Standoff Voltage (VR)	Peak Pulse Power Range (PPP 10/1000µs)	Peak Pulse Current (IPP 8x20µs)	Operating Temperature	Halogen Free	RoHS Compliant	UL Recognized
<a href="#">5KPA-HR/5KPA-HRA</a>	P600	5.0-220	5000W	-	-55 to 175°C	•	•	-
<a href="#">15KPA-HR/15KPA-HRA</a>	P600	17-280	15kW	-	-55 to 175°C	•	•	•
<a href="#">30KPA-HR/30KPA-HRA</a>	P600	28-345	30kW	-	-55 to 175°C	•	•	•
<a href="#">TLP/TLPA</a>	P600	10-40	5000W	-	-55 to 175°C	•	•	-

### High-Reliability Surface Mount



Series Name <sup>1</sup>	Package Type	Reverse Standoff Voltage (VR)	Peak Pulse Power Range (PPP 10/1000µs)	Peak Pulse Current (IPP 8x20µs)	Operating Temperature	Halogen Free	RoHS Compliant	UL Recognized
<a href="#">SMBJ-HR/SMBJ-HRA</a>	D0-214AA	5.0-170	600W	-	-65 to 150°C	•	•	-
**SMBLCE-HR/HRA	D0-214AA	6.5-70	600W	-	-65 to 150°C	•	•	-
<a href="#">SMCG-HR/SMCG-HRA</a>	D0-215AB	5.0-120	1500W	-	-65 to 150°C	•	•	•
<a href="#">SMCJ-HR/SMCJ-HRA</a>	D0-214AB	5.0-170	1500W	-	-65 to 150°C	•	•	•
<a href="#">SMDJ-HR/SMDJ-HRA</a>	D0-214AB	5.0-150	3000W	-	-65 to 150°C	•	•	•

(1) Detailed information about product series listed here can be found on our website.

\*\* Series are still under development. Please contact the local Littelfuse sales for more details.

# Automotive TVS Diodes

Automotive Axial Lead								
Series Name <sup>1</sup>	Package Type	Reverse Standoff Voltage (VR)	Peak Pulse Power Range (PPP 10/1000µs)	Operating Temperature	Halogen Free	RoHS Compliant	UL Recognized AEC-Q101 Compliant	AEC-Q101 Compliant
<a href="#">SLD</a>	P600	11-60	2200W	-55 to 175°C	•	•	•	•
<a href="#">TP1.5KE</a>	DO-201	10.20-40.20	1500W	-55 to 150°C	•	•	•	•
<a href="#">TP5KP</a>	P600	11-60	5000W	-55 to 150°C	•	•	•	•
<a href="#">TP6KE</a>	DO-204AC	11.10-77.80	600W	-55 to 175°C	•	•	•	•

Automotive Surface Mount								
Series Name <sup>1</sup>	Package Type	Reverse Standoff Voltage (VR)	Peak Pulse Power Range (PPP 10/1000µs)	Operating Temperature	Halogen Free	RoHS Compliant	UL Recognized AEC-Q101 Compliant	AEC-Q101 Compliant
<a href="#">SLD8S</a>	SMT0-263	14-57	2200W	-55 to 175°C	•	•	•	•
<a href="#">SZ1.5SMC</a>	DO-214AB	5.8-77.8	1500W	-65 to +150°C	•	•	•	•
<a href="#">SZ1SMA</a>	DO-214AC	5.0-78	400W	-65 to +150°C	•	•	-	•
<a href="#">SZ1SMB</a>	DO-214AA	5.0-170	600W	-65 to +150°C	•	•	•	•
<a href="#">SZ1SMC</a>	DO-214AB	5.0-78	1500W	-65 to +150°C	•	•	•	•
<a href="#">SZP6SMB</a>	DO-214AA	5.8-171	600W	-65 to +150°C	•	•	•	•
<a href="#">SZSME</a>	SOD-123FL	5-58	200W	-55 to 150°C	•	•	-	•
<a href="#">TPSMAGL</a>	DO-221AC	5.0-85	600W	-65 to +150°C	•	•	•	•
<a href="#">TPSMB</a>	DO-214AA	6.40-553.00	600W	-65 to +150°C	•	•	•	•
<a href="#">TPSMB-VR</a>	DO-214AA	6.5-440.0	600W	-65 to +150°C	•	•	•	•
<a href="#">TPSMC</a>	DO-214AB	10.20-77.80	1500W	-65 to +150°C	•	•	•	•
<a href="#">TPSMC-VR</a>	DO-214AB	11.0-85.0	1500W	-65 to +150°C	•	•	•	•
<a href="#">TPSMD</a>	DO-214AB	10.0-85.0	1500W	-65 to +150°C	•	•	•	•
<a href="#">TPSMF4L</a>	SOD-123FL	5.0-85	400W	-55 to 150°C	•	•	•	•

# PLED Bypass Protectors

PLED Bypass Protectors								
Series Name <sup>1</sup>	QFN3X3	DO-214	SOD-123	VBR breakdown Volts	IH mAmps	IS mAmps Max	IT@VT Amps Max	VT and IT Volts Max
<a href="#">PLED</a>	•	•	-	6 - 18	5	100	1	1.2
<a href="#">PLEDxUx</a>	•	•	-	6 - 35	30	50	1	1.2
<a href="#">PLEDxN</a>	-	-	•	6	12	70	1	1.2
<a href="#">PLED Ultra Low</a>	-	•	-	64 - 480	21	800	1	2
<a href="#">PLEDxUSxA</a>	-	•	-	6 - 9	5	100	1	1.2

(1) Detailed information about product series listed here can be found on our website.

## PLED Bypass Protectors (continued)

PLED Bypass Protectors									
Series Name <sup>1</sup>	QFN3X3	DO-214	SOD-123	VDRM Volts	VS Volts	IH mAmps	IS mAmps Max	IT@VT Amps Max	VT and IT Volts Max
<a href="#">PLEDxS-A</a>	-	•	-	6 - 18	27-55	5	100	1	1.2
<a href="#">PLEDxUx-A</a>	-	•	-	6 - 35	27-83	30	50	1	1.2

## SIDACtor® Protection Thyristors

Broadband-Optimized Protection									
Series Name <sup>1</sup>	Package Type	Surge Rating	Standoff (working) Voltage (VDRM)	Switching Voltage (VS)	Peak Pulse Rating			RoHS Compliant	UL Recognized
					2/10µs	10/1000µs	8/20µs		
<a href="#">MC</a>	DO-214AA	A	6 - 25	25 - 40	150A	45A	150A	•	•
		C	6 - 320	25 - 400	500A	100A	400A		
	TO-92	C	6 - 320	25 - 400	500A	100A	400A		
		Modified TO-220	A	Pin 1-2, 3-2: 6-275 Pin 1-3: 12-550	Pin 1-2, 3-2: 25-350 Pin 1-3: 50-700	150A	45A		
<a href="#">Balanced MC</a>	Modified TO-220	C	Pin 1-2, 3-2, 1-3: 130-420	Pin 1-2, 3-2, 1-3: 180-600	500A	100A	400A	•	•
<a href="#">OZL</a>	3x3 QFN	A	6 - 320	25 - 400	150A	45A	150A	•	•
		B			250A	80A	250A		
	3.3x3.3 QFN	C			500A	100A	400A		
<a href="#">MC Multiport</a>	MS-013	C	6 - 320	25 - 400	500A	100A	400A	•	•
<a href="#">TwinChip® Protectors</a>	DO-214AA	A	220 - 640	300 - 800	150A	45A	150A	•	•
		B			250A	80A	250A		
	DO-15	A	220 - 320	300 - 400	-	50A	-		
		B			-	80A	-		
<a href="#">SDP0240T023G6RP</a>	SOT23-6L	G	19	20	-	-	30A	•	•
<a href="#">SDP</a>	3x3 QFN	F	8 - 24	15 - 35	-	-	50A	•	•
	SOT23 - 5	B	58 - 320	77 - 400	250A	80A	250A	•	•
<a href="#">DSL P</a>	SOT23-6L	G	8 - 36	18 - 48	-	-	35A	•	•
<a href="#">SDP Biased</a>	5x6 QFN	C	6 - 320	25 - 400	500A	100A	400A	•	•
<a href="#">SEP Biased</a>	5x6 QFN	C	6 - 75	25 - 98	500A	100A	400A	•	•
<a href="#">P0080T023G5</a>	SOT 23 - 5	G	8	15	45A	18A	50A	•	•
<a href="#">PxxxS4xL RP</a>	SOD-123FL	B	6	25	150A	50A	150A	•	-
<a href="#">Pxxx0SxL-A</a>	SOD-123FL	B	6	25	150A	50A	150A	•	-
<a href="#">Pxxx0SxLHL</a>	SOD-123FL	B	6	25	150A	50A	150A	•	-

(1) Detailed information about product series listed here can be found on our website.

# SIDACtor® Protection Thyristors (continued)

## Subscriber Line Interface Circuit (SLIC) Protection



Modified DO-214AA



MS-012



QFN3.3x3.3



DO-214AA



MS-013

Series Name <sup>1</sup>	Package Type	Surge Rating	Standoff (working) Voltage (VDRM)	Switching Voltage (VS)	Peak Pulse Rating			RoHS Compliant	UL Recognized
					2/10µs	10/1000µs	8/20µs		
Fixed Voltage	DO-214AA	A	58 - 160	77 - 200	150A	45A	150A	•	•
		C			500A	100A	400A		
Fixed Voltage Twin SLIC	Modified DO-214AA	A	58 - 160	77 - 200	150A	45A	150A	•	•
Fixed Voltage Q2L	QFN 3.3x3.3	C	58 - 160	77 - 200	500A	100A	400A	•	•
Fixed Voltage Single Port	MS-012	F	58 - 95	77 - 130	120A	30A	100A	•	•
Fixed Voltage Enhanced Single	MS-012	F	58 - 160	77 - 200	120A	30A	100A	•	•
Fixed Voltage Multiport	MS-013	A	58 - 160	77 - 200	150A	45A	150A	•	•
		C			500A	100A	400A		
Batrax® Protectors Positive/Negative	Modified DO-214AA	A	Programmable up to -200 V to 110 V	Programmable up to -210 V to 120 V	150A	45A	150A	•	•
		C			500A	100A	400A		
Batrax® Protectors Single Port Negative	MS-013	C	Programmable up to -200 V to 0 V	Programmable up to -210 V to -10 V	500A	100A	400A	•	•
Batrax® Protectors Single Port Positive/Negative	MS-013	C	Programmable up to -200 V to 110 V	Programmable up to -210 V to 120 V	500A	100A	400A	•	•
Batrax® Protectors Dual Port Negative	MS-013	C	Programmable up to -200 V to 0 V	Programmable up to -210 V to -10 V	500A	100A	400A	•	•

## Line Circuit Access Switch (LCAS) Protection



MS-013



DO-214AA

Series Name <sup>1</sup>	Package Type	Surge Rating	Standoff (working) Voltage (VDRM)	Switching Voltage (VS)	Peak Pulse Rating:			RoHS Compliant	UL Recognized
					2/10µs	10/1000µs	8/20µs		
Asymmetrical Multiport	MS-013	A	These products have asymmetric trigger voltages. See data sheet.		150A	45A	150A	•	•
		C			500A	100A	400A		
Custom LCAS Discrete	DO-214AA	A	100 - 230	130 - 290	150A	45A	150A	•	•
		B			250A	80A	250A		
		C			500A	100A	400A		

## How is the SIDACtor® Device Used Here?

### PxxxxS4xLRP Series SIDACtor® Protection Thyristor

Overvoltage transients can damage sensitive telecommunications equipment, including Composite Video Blanking Sync (CVBS) signal lines and ports.

The new component with 100A 5/310µs surge peak current capability and a low junction capacitance rating offers robust protection from these transients.



# SIDACtor® Protection Thyristors (continued)

Broadband Protection (Voice-DS1)									
 DO-214AA  DO214AC (SMA)  TO-92  DO-15  Modified TO-220									
Series Name <sup>1</sup>	Package Type	Surge Rating	Standoff (working) Voltage (VDRM)	Switching Voltage (VS)	Peak Pulse Rating:			RoHS Compliant	UL Recognized
					2/10µs	10/1000µs	8/20µs		
SIDACtor® Protection Thyristors	DO-214AA	A	6 - 320	25 - 400	150A	45A	150A	•	•
		B			250A	80A	250A		
		C			500A	100A	400A		
	DO-214AC (SMA)	A	6 - 320	25 - 400	150A	50A	150A	•	•
		B			250A	80A	250A		
		C			500A	100A	400A		
	TO-92	A	6 - 320	25 - 400	150A	45A	150A	•	•
		B			250A	80A	250A		
		C			500A	100A	400A		
	DO-15	A	90 - 320	130 - 400	-	45A	-	•	•
		B			-	80A	-		
	Modified TO-220	A	Pins 1-2,3-2: 25-275 Pins 1-3: 50-550	Pins 1-2,3-2: 40-350 Pins 1-3: 80-700	150A	45A	150A	•	•
B		250A			80A	250A			
C		400A			100A	400A			
SIDACtor® Protection Thyristors, Multiport	MS-013	A	Pins 1-2,3-2,4-5,6-5: 6-320 Pins 1-3,4-6: 12-640	Pins 1-2,3-2,4-5,6-5: 25-400 Pins 1-3,4-6: 50-800	150A	45A	150A	•	•
		C			500A	100A	400A		
SIDACtor® Protection Thyristors, Balanced	Modified TO-220	A	Pins 1-2, 3-2: 130-420 Pins 1-3: 130-420	Pins 1-2, 3-2: 180-600 Pins 1-3: 180-600	150A	45A	150A	•	•
		B			250A	80A	250A		
		C			400A	100A	400A		
SIDACtor® Protection Thyristors, Balanced Multiport	MS-013	A	Pins 1-2,2-3,4-5,5-6: 170-400 Pins 4-6,1-3: 50-270	Pins 1-2,2-3,4-5,5-6: 250-550 Pins 4-6,1-3: 80-340	150A	45A	150A	•	•
		B			250A	80A	250A		
		C			500A	100A	400A		
		Asym. A6			150A	45A	150A		
		Asym. B6			250A	80A	250A		
		Asym. C6			500A	100A	400A		
T10A	DO-15	A	50 - 245	84 - 370	-	50A	100A	•	•
T10B	DO-201	B	80 - 275	120 - 360	-	100A	250A	•	•

High-Exposure Surge Protection									
 Modified TO-220  TO-262M  TO-218  DO-214AA									
Series Name <sup>1</sup>	Package Type	Surge Rating	Standoff (working) Voltage (VDRM)	Switching Voltage (VS)	Peak Pulse Rating:			RoHS Compliant	UL Recognized
					2/10µs	10/1000µs	8/20µs		
Primary Protection	Modified TO-220	C	Pins 1-2,3-2: 25-275 Pins 1-3: 50-550	Pins 1-2,3-2: 40-350 Pins 1-3: 80-700	500A	100A	400A	•	•
Primary Protection Balanced	Modified TO-220	C	Pins 1-2, 3-2: 130-420 Pins 1-3: 130-420	Pins 1-2, 3-2: 180-600 Pins 1-3: 180-600	500A	100A	400A	•	•
3kA (Pxxx0FNL)	TO-262M	N	58 - 350	77 - 430	-	-	3000A	•	•
5kA	TO-218	E	140 - 450	180 - 600	-	1100A	5000A	•	•
High Surge Current	DO-214AA	D	6 - 320	25 - 400	1000A	200A	800A	•	•

(1) Detailed information about product series listed here can be found on our website.

## Protect. Control. Sense.

Littelfuse offers leading technologies in circuit protection, power control, and sensing. We continue to expand our broad and diverse portfolio of products into adjacent markets, including Power Semiconductors, heavy-duty Switches, Magnetic, Optical, Electromechanical, and Temperature Sensors as well as other products that provide safe control and distribution of electrical power.

In addition to the circuit protection products found in this selection guide, we offer a wide variety of product technologies.

### Power Semiconductors

- Bipolar Devices
- IGBTs
- MOSFETs
- Switching Thyristors
- Silicon Carbide Technology
- Power Semiconductors and ICs
- Discrete and Module Solutions
- Bare Die Devices
- Power Control
- TRIAC Thyristors
- Fully Engineered Subsystems

### Integrated Circuits and Solid-State Relays

- High-Voltage ICs
- Solid-State Relays
- Gate Drivers

### Magnetic Sensing

- Reed Switches
- Reed Sensors
- Reed Relays
- Hall Effect Sensors
- Magnetic Actuators

### Temperature Sensing

- Thermistors
- RTDs
- Digital Temperature Indicators

## Global Footprint

At Littelfuse, our mission is to develop innovative circuit protection, power control, and sensing solutions that meet our customers' unique needs. This customer-focused philosophy has helped us become the top circuit protection brand in the world.

Our industry-leading product portfolio includes reliable circuit protection, power control, and sensing products that are designed for a variety of markets and applications. We have assembled unparalleled expertise and developed a global footprint that puts our facilities close to our customers and target markets. As our global manufacturing and R&D teams objectively recommend the best circuit protection, power control, or sensing solution for each customer application, they form partnerships that will lead to the development of the next generation of advanced products.

### Littelfuse provides:

- Application Expertise
- Global Support
- Operational Excellence
- Technology Innovation
- Collaboration
- Customer Focus



Reed Switches



Thermistors



Gas Discharge Tubes



Power Semiconductors



Metal Oxide Varistors



Multi-Layer Varistors



Radial Leaded Fuses



## Additional Resources



**Sensing Products Selection Guide**  
This guide provides an overview of magnetic and temperature sensing technologies, key consideration factors, descriptions of technologies Littelfuse offers, and product selection tables to help you quickly find the sensing solution appropriate for your application.

Scan or click to download



**Power Semiconductor Catalog**  
This catalog represents the powerful combination of IXYS: A Littelfuse Technology. It offers a comprehensive portfolio of advanced power semiconductor technologies, including silicon and wide bandgap solutions in discrete and module packages.

Scan or click to download



**Protection Relays and Controls Catalog**  
This catalog includes a comprehensive line of motor and pump protection relays, arc-flash relays, ground fault relays, feeder protection, pump controllers, time delay relays, flashers and tower lighting, and more to minimize electrical safety hazards, limit equipment damage, improve productivity, and safeguard personnel from injury due to electrical faults.

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Technical information is only a click away. The Littelfuse Technical Resources page contains datasheets, product manuals, white papers, application guides, demos, on-line design tools, and more.

## An Extension of Your Team

Littelfuse engineers are a phone call away to help identify potential issues and provide product recommendations to solve problems.

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**Asia Technical Support: +86 512 67613189**

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**South America Technical Support: +55 11 2844-4395**

**Europe Technical Support: +49 421 82 87 3 147**

### Application and Field Support

Our experienced product and application engineers work step by step with customers from design to installation to determine the best solution. Contact us today:

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# Global Lab Capabilities



You need to be certain that your products live up to the highest standards for performance, reliability, safety, and regulatory compliance. Working with Littelfuse, you have access to dedicated application engineers who partner with you to provide expert design consultation, perform comprehensive tests simulating the harshest environments, and confidentially evaluate the results in consultation with you.

## TESTING CAPABILITIES

### Environmental

- Autoclave
- Dust
- H3TRB
- HAST
- High- & Low-Temperature Storage
- High-Temperature Loading
- Ingress Protection (IP)
- HTGB
- HTRB
- Temperature & Humidity
- Temperature Cycling
- Thermal Shock
- Salt Fog

### Physical-Mechanical Characteristics

- Acceleration
- Die Shear
- Leak Detection
- Mechanical Shock
- Resistance to Soldering Heat (Dip, Reflow, Wave)
- Resistance to Solvents
- Solderability
- Terminal Strength (Push, Pull, Bend)
- Vibration
- Wetting Balance
- Wire Pull

### Electrical

- BCI
- Capacitance
- EFT
- ESD
- Impedance
- Insulation Resistance
- I-V
- Life
- Lightning Surge
- Overload
- Parametric Tests
- Power-Cross
- Power Cycling
- Ring Wave
- R-T
- S-Parameter Measurements (Insertion Loss, Isolation, Reflection)
- Short Circuit
- Step Current
- Surface Resistivity
- Surge
- TDR (Eye Diagram)
- Telecom
- Thermal Cut-Off
- Time-to-Trip
- TLP
- Transient
- Trip Cycle
- Trip Endurance
- Voltage Drop



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# LOCAL RESOURCES FOR A GLOBAL MARKET



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