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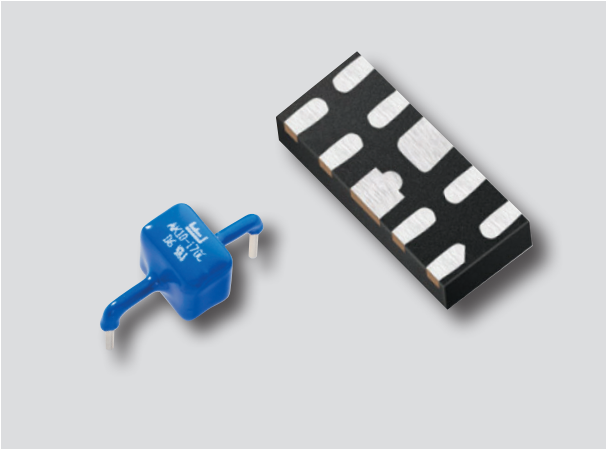
PROTECTION DEVICES

OVERVOLTAGE PROTECTION DEVICES



Protection Thyristors

SIDACtor® devices are designed to suppress overvoltage transients in telecom and datacom equipment, and are able to divert currents as high as 5000 A to ground within nanoseconds of reaching their breakover voltage. Littelfuse offers a wide range of configurations including DO-214AA, DO214AC, COMPAK (3-Pin DO-214), SOT23-5, QFN, MS-012 and modified MS-013 surface mount, TO-92, TO-218, DO-15, modified TO-220, and TO-220 through-hole package options designed to handle medium to high energy transients.

ESD Suppressors

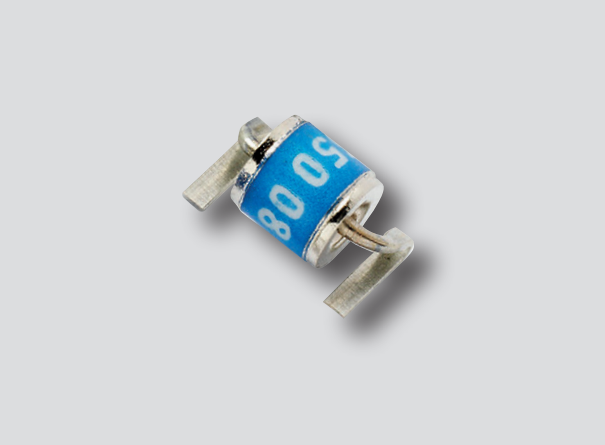
With a capacitance value as low as 0.04 pF, PulseGuard suppressors can protect high-speed digital I/O lines (HDMI, USB, eSata, ethernet) without causing signal distortion. Since today's fastest data buses are operating at speeds in excess of 5 Gbps, it is necessary that protection devices do not present a capacitive load to the bus in order to ensure signal integrity. With respect to ESD testing, PulseGuard suppressors are specified to protect against ESD transients per the IEC 61000-4-2 (Level 4) test method. Available in small surface mount form factors, they are lead-free and RoHS compliant.

TVS Diodes / TVS Diode Arrays

TVS diodes are used to protect semiconductor components from high-voltage transients. Their p-n junctions have a larger cross-sectional area than those of a normal diode, allowing them to conduct large currents to ground without sustaining damage. Littelfuse supplies TVS diodes with peak power ratings from 200 W ... 30 kW, and reverse standoff voltages from 5 ... 512 V. TVS diode arrays are designed to protect analog and digital signal lines from electrostatic discharge (ESD), electrical fast transients (EFT), and lightning-induced surge currents. Offering low dynamic resistance for improved clamping performance, TVS diode arrays are offered in a wide range of industry standard discrete and multi-channel SMD packages. Features of this portfolio include capacitance as low as 0.4 pF and enhanced ESD capability up to ±30 kV (contact discharge).

Gas Discharge Tubes (GDTs)

Available in small foot print leaded, surface mount and cartridge configurations, Littelfuse GDTs offer fast response time to transient overvoltage events. This fast response time translates into a reduced risk of equipment damage. Littelfuse GDTs have the ability to handle very high current surges – up to 40,000 A – while effectively suppressing overvoltage transients. Their low capacitance (typically 1 ... 2 pF), high insulation resistance (greater than 1 GW) and low leakage ensure virtually no effect on the protected system during normal (non-surge) operating conditions. Their electrical characteristics make them ideal for use in broadband cable, MDF (main distribution frame), and central office applications.



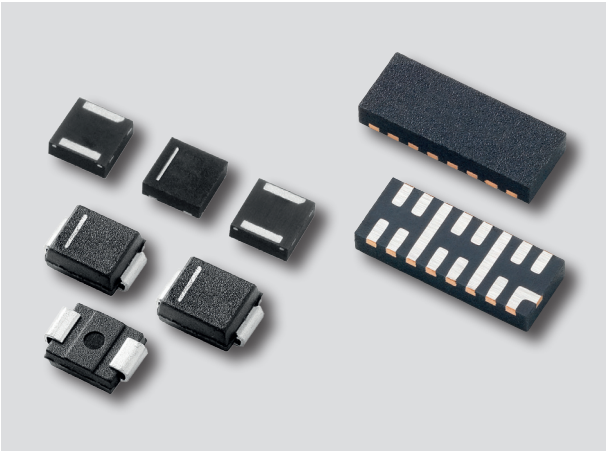
OVERVOLTAGE PROTECTION DEVICES

Varistors

MOVs – Metal Oxide Varistors (MOVs) are designed to suppress transient voltages such as lightning and other high level transients found in industrial, AC line application or lower level transients found in automotive DC line applications. With peak current ratings ranging from 40 ... 70,000 A and peak energy from 0.1 ... 10,000 J, varistors are available in radial leaded, axial leaded, surface mount and bare-disk options. MLVs – multilayer varistors (MLVs) are designed for applications requiring protection from low to medium energy transients in the computer, handheld device, industrial and automotive markets. Available in miniature surface mount options as small as 0201 size, MLVs offer a low voltage range (5.5 ... 135 VDC) and enhanced performance and filtering characteristics in a small package. Peak current ratings range from 4 ... 500 A and peak energy 0.02 ... 2.5 J.

Surge Protection Modules

Surge protection modules are designed to provide transient overvoltage protection for outdoor and commercial LED lighting fixtures. Assembled with thermally protected varistors, they provide robust surge current handling capability. A built-in thermal disconnect function provides additional protection from catastrophic failures and fire hazards, even under the extreme circumstances of varistor end of life or sustained overvoltage conditions. The series-connected version cuts luminaire power off to provide a clearly visible indication that the modul should be replaced. The modul is available with either parallel or serial connections. The parallel-connected version includes an indicator wire which can activate a LED to tell maintenance personnel when to replace the modul in order to ensure the luminaire remains protected.



PLED Light-Emitting Diode (LED) Protectors

PLED devices provide added reliability to LED lighting strings. Designed to minimize the impact of losing an entire LED string due to a single LED failure, PLED devices provide a switching function that will bypass LEDs that go open circuit, and allow current to flow to the remaining LEDs in the string. PLED devices also offer LED protection against electrostatic discharge (ESD) and accidental reverse power connection (PLED5 devices only). Designed to serve the needs of high brightness outdoor LED lighting applications (advertising and traffic signs, roadway/pathway/runway lighting, aircraft and emergency lighting, etc), PLED devices help assure reliability and lower maintenance costs.

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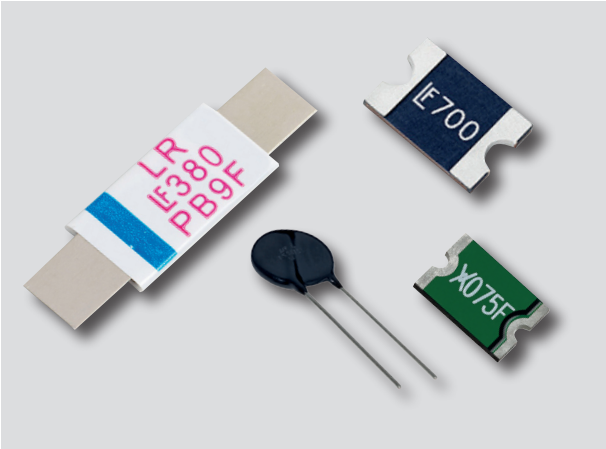
CIRCUIT PROTECTION TECHNOLOGIES

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
OVERCURRENT PROTECTION TECHNOLOGIES:						
PTCs	Resettable No device replacement after most common overcurrent events	Where overcurrent events may occur often and continuous uptime desired	Low to high	Not applicable	Series resistance measured in ohms	Surface mount Radial leaded Axial strap
Fuses	Completely stop current flow, which helps to identify faults Wide range of options	Ultimate protection for sensitive/expensive/critical components	Low to very high	Not applicable	Series impedance measured in nH	Very extensive range of options
Power Thermistors	Limit inrush currents; based on NTC (Negative temperature coefficient) thermistor technology	Designed for power applications Initial higher resistancey prevents large current flow at turn-on	High	Not applicable		Radial Leaded
Current Regulative Diodes (CRDs)	Constant current supply even when voltage/load fluctuations occur	Current stabilization & limiting of sensor, PLC and LED lighting applications	Low	Not applicable		Surface mount Radial leaded
OVERVOLTAGE SUPPRESSION TECHNOLOGIES:						
GDTs	Switches that turn to on state and shunt overvoltage to ground using a contained inert gas as an insulator	Protection of telecom equip-ment from lightning s urges	Medium to high	Fast	Low	Surface mount Axial leaded 2/3 lead radial
Multi-Layer Varistors (MLVs)	Compact and capable of handling significant surges for their size	ESD and EFT suppression in smaller and portable electronics	Low to medium	Moderate	High	Surface mount
Metal-Oxide Varistor (MOVs)	Capable of withstanding very high energy transients Wide range of options	Appliance, industrial and very high energy suppression applications	Medium to very high	Moderate	High	Radial leaded, industrial terminal
PLED LED Protectors	Shunt function bypasses open LEDs ESD and reverse power protection	High brightness outdoor LED lighting applications	Low	Very fast	Medium	Surface mount
ESD Suppressors	Extremely low capacitance Fast response time Compact size	ESD suppression Ultra fast reaction Low signal distortion	Low	Moderate	Low	Surface mount
TVS Diode Arrays	Low capacitance/low clamping voltage Compact size	ESD suppression Low distortion Ideal for I/O interfaces and digital & analog signal lines	Low to medium	Very fast	Low	Extensive range of surface mount options
TVS Diodes	Fast response to fast transients Wide range of options	Semiconductor protection Telecom I/O interfaces, elec-tronics, industrial equipment	Medium to high	Fast	High	Axial leaded Radial leaded
Protection Thyristors	Specifically designed to serve stringent telecom/ networking standards	Telecom and networking applications	Medium to high	Very fast	Low	Extensive range of surface mount and thru-hole options

OVERCURRENT PROTECTION DEVICES

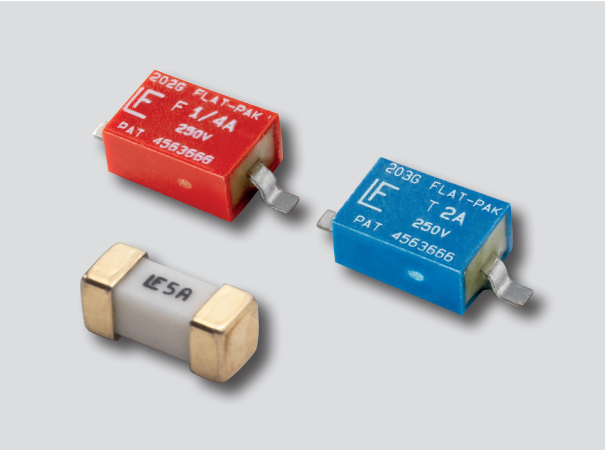


Fuses

Endrich offers fuses from the world leader in the design and manufacturing of fuses for the automotive, industrial, handheld, computer and telecom markets. Whether you're looking for surface mount or axial; glass or ceramic; thinfilm or Nano2® style; fast-acting or Slow-Blow fuses; we have the part to meet your need. Operating characteristics of our electronics application fuses include current ranges from 10 ... 40 A, maximum voltage ranges from 24 ... 600 V, and interrupting ratings from 24 ... 50,000 A. Our comprehensive line of lead-free and RoHS devices, are perfect for your environmentally friendly design. Enable easy fuse installation and replacement with our comprehensive line of fuse blocks,fuse holders, and fuse accessories for automotive, electronic, and industrial applications.

Power Thermistor

A power thermistor, also called Power NTC or inrush current limiter, is an electronical component which suppresses inrush currents of electric circuits. Switching power supplies, AC motors, and lighting ballasts can induce an inrush current of more than 100 times of the nominal current when the circuit is switched on. The power thermistor heats up when an inrush current passes through it. The heat up causes a dramatic decrease in resistance and protects electric equipment from being damaged. The offered power thermistors are leaded devices which are offered with zero-power resistances from 5 ... 47 Ohm and maximum currents of 0.3 ... 8 A.



Resettable PTCs

Endrich offers a full range of surface mount, radial leaded and axial leaded (battery strap) PTC resettable overcurrent suppression devices. Surface mount PTCs are available with broad range of hold current from 0.05 ... 7.0 A while footprint various from 0402 ... 2920. Radial PTCs are rated from 6 ... 600 VDC respectively, and are designed for use in higher voltage appli-cations that require minimal maintenance and are subject to repetitive overcurrent conditions. Axial PTCs are rated from 6 ...30 VDC, and are designed for use in battery pack applications that require thermal protection against overcurrent fault condi-tions. All PTC devices are recognized under the Components Program of Underwriters Laboratory for both the US and Canada as well as being certified by TUV. All devices are lead-free and RoHS compliant.

Current Regulative Diodes (CRDs)

The CRD (Current Regulative Diode) of the manufacturer Semitec is a diode which supplies constant current to an electric circuit, even when power supply voltage fluctuations or load impedance fluctuations occur. Therefore CRDs are used for current stabilization and current limiting of PLCs (programmable logic controller), sensor applications and LED control circuits. The CRDs are designed in a very small SOD-123FLX package and are available in rated currents of 0.1 ... 22 mA.

SOLUTION MATRIX

Applications		Fuses	Resettable PTCs	Varistors	GDTs	TVS Diode	TVS Diode Arrays	ESD Suppressors	Power Thermistor	LED Protector	CRD
Consumer electronics	LCD TV	•	•	•		•	•	•	•		
	Refrigerator	•		•		•					
	Room AC	•		•		•			•		
	Washing machine	•		•		•					
	Instant water heater	•		•							
	Gas igniter										
	Bluetooth headset	•	•	•			•	•			
	Cell phone	•	•	•			•	•			
	E-book	•	•	•			•	•			
	PMP (portable media player)	•	•	•			•	•			
	Small appliance	•	•	•		•					
	DVD	•	•	•		•	•	•	•		
Power supply	Telecom power	•	•	•	•	•					
	Adapter / charger	•	•	•							
	Industrial power	•	•	•		•					
	UPS	•	•	•	•	•					
	SMPS	•	•	•		•			•		
	Li-Ion battery pack	•	•				•				
Commercial systems	DVR (digital video recorder)	•	•	•	•	•	•	•			
	IP camera		•		•	•	•				
	Detector		•	•		•					
	POS	•	•	•		•	•	•			
	Solar power system	•	•	•			•				
Lighting	Electronic ballast	•		•		•					
	Dimmer			•							
	LED lighting	•		•	•	•				•	
	HID lighting	•		•	•	•					
Industrial & instrumentation	GFCI/AFCI			•						•	
	Smart power meter	•	•	•		•	•			•	
	Power tools	•	•	•		•				•	
	Elevator	•	•	•	•	•	•	•		•	
	Sewing machine	•	•	•		•	•			•	
	Sensor					•	•				•
	PLC	•	•			•	•	•			•
Medical	Portable medical device	•	•	•	•	•	•	•		•	
	Medical diag./anal. devices	•	•	•	•	•	•			•	
Communications	SLIC line card	•	•		•	•	•			•	
	Ethernet router				•	•	•	•		•	
	DSL modem router	•			•	•	•			•	
	Phone / FAX / printer	•	•	•	•	•	•	•	•	•	
	Set top box	•	•	•	•	•	•	•		•	
	T1/T3 line driver	•	•		•	•	•			•	
	Central office/CPE splitter	•	•		•	•	•	•		•	
Computer	Desktop / notebook	•	•	•		•	•	•	•	•	
	Server	•	•	•			•	•	•	•	
Automotive electronics		•	•	•		•	•	•			

COMMON CIRCUIT THREATS AND PROTECTION SOLUTIONS

THREAT OR CIRCUIT ACTION	TYPICAL APPLICATIONS	PRINCIPAL PROTECTION CRITERIA	PROTECTION TECHNOLOGIES
What is the threat or circuit action that may damage sensitive electronics?	**What are the typical end products that require protection from this damage?**	**What are the characteristics required of the circuit protection technology?**	**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 PTCs
Lightning	Any electronic or electrical equipment with connections to the outside environment	Fast response, proper switching threshold, surge current rating	SIDACtor® protection thyristors, Varistors (MOVs), TVS diodes, Gas discharge tubes (GDTs)
Electrostatic discharge (ESD)	Any electronic equipment with a human interface	Fast response, high peak voltage rating	ESD suppressors, TVS diode array, 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 array
Inductive load switching and	Large motors, pumps, compressors, relays and AC distribution	High energy rating	Varistors (MOVs and MLVs), GDTs, TVS diodes
Data and communication line voltage transients	Ethernet, xDSL, data bus, telecom, etc.	Fast response, low load capacitance	TVS Diode array, protection thyristors
Current switching / diversion	Wide range of electrical and electronic circuits	Proper blocking voltage and current carrying capacity	Switching thyristors, PLED bypass protectors

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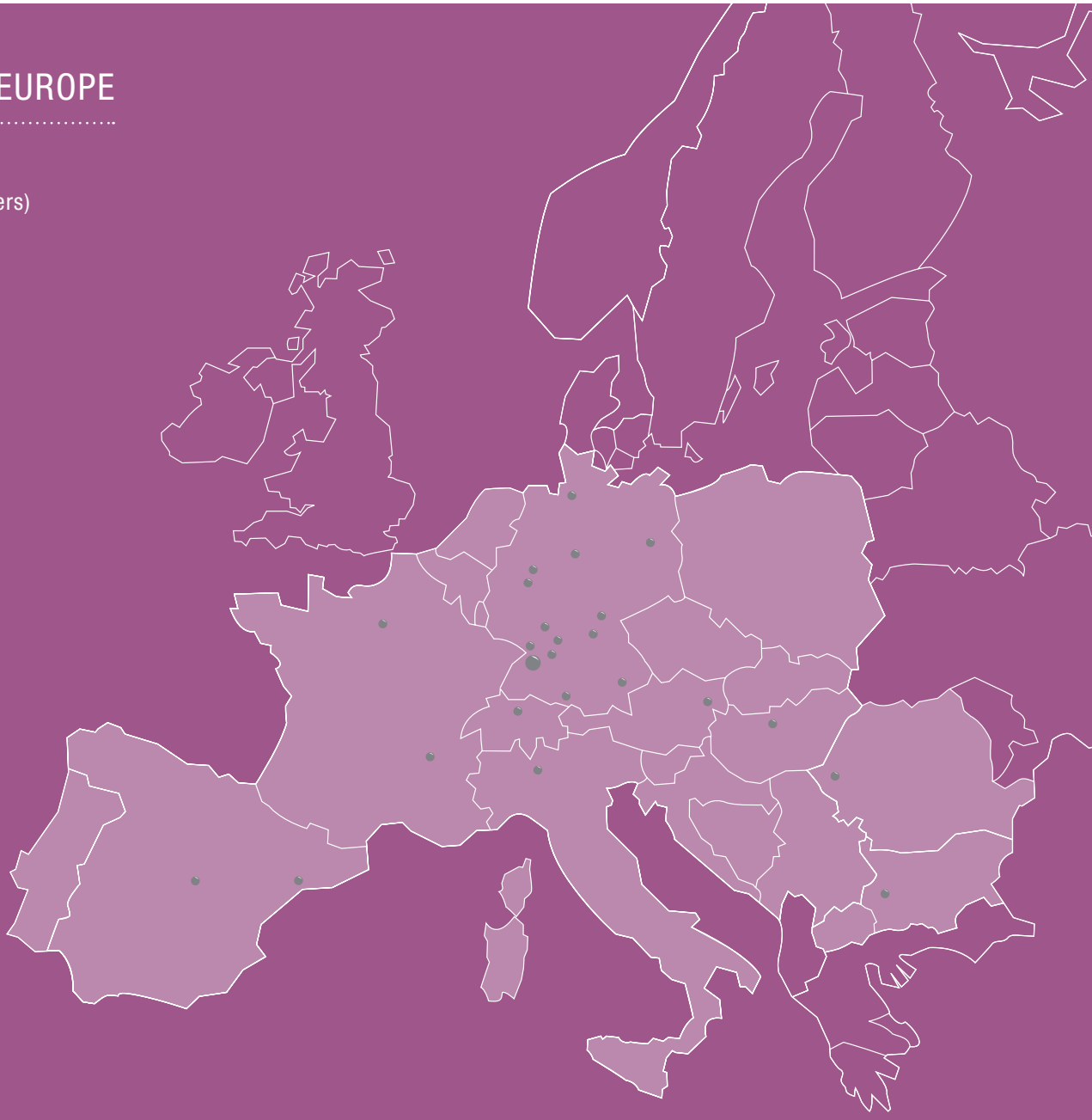

www.endrich.com

ENDRICH Bauelemente Vertriebs GmbH · P.O.Box 1251 · D-72192 Nagold
Tel.: +49 (0) 7452 6007-0 · Fax: +49 (0) 7452 6007-70 · endrich@endrich.com · www.endrich.com

NOVITRONIC AG · Thurgauerstrasse 74 · CH-8050 Zürich
Tel.: +41 (0)44 306 91 91 · Fax +41 (0)44 306 91 81 · info@novitronic.ch · www.novitronic.ch

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