Littelfuse®

Expertise Applied | Answers Delivered

CIRCUIT
PROTECTION
SOLUTIONS

Electronics Circuit Protection Product Selection Guide

A guide to selecting Littelfuse circuit protection components for electronic applications.

Broadest and Deepest Portfolio of Product Backed by Unparalleled Circuit Protection Expertise

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.

WHY CHOOSE CIRCUIT PROTECTION

Circuit protection devices interrupt overcurrent events and divert overvoltage surges. They increase safety and enable end products to survive harsh conditions.

Most electrical and electronic equipment require circuit protection devices. In many cases they must be installed to comply with safety standards before the end products can be sold or used.

Beyond this, strategically-selected protection devices will:

- Improve end-product uptime, sustainability and reliability
- Assure low warranty return, repair and replacement costs
- Minimize fire and shock risks and larger damage potential
- Minimize operating dangers and potential liabilities

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 make compromises.

Testing Support

Littelfuse can help assure that your products will withstand most common threats repeatedly and will fail safely under extreme circumstances. We can serve as an independent source to assist as you design.

Application Knowledge

For over 80 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 products, application knowledge and technical support are available around the globe. We offer a network of regional customer support offices and hundreds of independent authorized distributor contacts to assist you. Visit www.littelfuse.com/contact to find local support near you.

Standards Compliance Expertise

Most Littelfuse products comply to 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 Telcordia, UL, ISA, ANSI, ISO, ICC, IEC, ITU, METI, CSA, DVE, RoHS, TIA and many others.

FOR FURTHER GUIDANCE

Littelfuse product representatives will work with you to find circuit protection technologies that will meet your requirements.

Please contact a representative near you (www.littelfuse.com/contact) to address your requirements or questions in detail.

For reference diagrams, technical articles, and other application guidance materials to assist in your design processes, please visit www.littelfuse.com/designsupport

For detailed selection of Littelfuse circuit protection technologies and their common applications, please visit www.littelfuse.com/products

For a library of detailed application guides, please visit www.littelfuse.com/application-design-center

To find particular product series that may serve your requirements, please go to www.littelfuse.com/series/(Series Name).html

To download the most current edition of this brochure, please visit www.littelfuse.com/catalogs

Common Circuit Threats and Protection Solutions

Threat or Circuit Action What is the threat or circuit action that may damage sensitive electronics?	Typical Applications What are the typical end products that require protection from this damage?	Principal Protection Criteria What are the characteristics required of the circuit protection technology?	Littelfuse Protection Technologies 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	PulseGuard® ESD Suppressors, SPA™ Silicon Protection Arrays, Multi-Layer Varistors (MLVs)
Electrical Fast Transients (EFT)	Any system that has inductive loads	Fast rise time and recovery for repetitive pulses	TVS Diodes, Varistors (MLVs and MOVs)
Inductive Load Switching and Commutative Spikes	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	SPA™ Silicon Protection Arrays, SIDACtor® Protection Thyristors
Current Switching / Diversion	Wide range of electrical and electronic circuits	Proper blocking voltage and current carrying capacity	Switching Thyristors

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 possible fire, electrocution or explosion. Sources 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 positive temperature coefficient (PTC) 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.

PTCs offer the ability to re-set for withstanding most minor, common and recurring overcurrent events. They will allow safe levels of current to pass continuously, and during major overcurrent events, 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 SPA™ Silicon Protection Array products designed to suppress these types of events (see page 13).

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. Littelfuse Metal Oxide Varistor (MOV), TVS Diode and GDT products are typically used to protect against these events. Look to Littelfuse SIDACtor® and SPA™ products for Telecom/ Datacom requirements (page 8).

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.

Littelfuse 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:						
Fuses	Completely stop current flow, which helps to identify faults; Wide range of options	Ultimate protection for sensitive/expensive/critical components	Low thru Very High	Not applicable	Series impedance measured in nH	Very Extensive Range of Options
PTCs	Resettable; No device replacement after most common overcurrent events	Where overcurrent events may occur often, and continuous uptime desired	Low thru High	Not applicable	Series resistance measured in ohms	Surface Mount, Radial Leaded, Axial Strap
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 equipment from lightning surges	Medium thru 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 thru Medium	Moderate	High	Miniature 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 thru Very High	Moderate	High	Radial Leaded, Industrial Terminal
PulseGuard® ESD Suppressors	Extremely low capacitance; Fast response time; Compact size	ESD suppression; Ultra fast reaction; Low signal distortion	Low	Moderate	Low	Miniature Surface Mount
Silicon Protection Arrays (SPAs)	Low capacitance / low clamping voltage; Compact size	ESD suppression; Low distortion; Ideal for I/O interfaces and digital & analog signal lines	Low thru 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, electronics, industrial equipment	Medium thru High	Fast	High	Axial Leaded, Radial Leaded
SIDACtor® Protection Thyristors	Specifically designed to serve stringent telecom/ networking standards	Telecom and networking applications	Medium thru High	Very Fast	Low	Extensive range of surface mount and thru-hole options
Switching Technologies:						
Power Thyristors	Solid state switches that switch to low "on" state and control the flow of current	Home appliances, power tools, outdoor equipment	Not applicable	Not applicable	Not applicable	Extensive range of surface mount and thru-hole options

OVERVOLTAGE SUPPRESSION TECHNOLOGIES (1-6)

1. TVS Diodes — Suppress overvoltage transients such as Electrical Fast Transients (EFT), inductive load switching and lightning in a wide variety of applications in the computer, industrial, telecom and automotive markets (Page 19).

2. Varistors — Multiple forms, from Metal Oxide Varistors (MOVs) that suppress transient voltages to Multi-Layer Varistors (MLVs) designed for applications requiring protection from various transients in computers and handheld devices as well as industrial and automotive applications (Page 14).

3. SIDACtor® Devices — Complete line of protection thyristor products specifically designed to suppress overvoltage transients in a broad range of telecom and datacom applications (Pages 16-17).

4. Gas Discharge Tubes (GDTs) — Available in small footprint leaded and surface mount configurations, Littelfuse GDTs respond fast to transient overvoltage events, reducing the risk of equipment damage (Page 15).

5. Silicon Protection Arrays — Designed specifically to protect analog and digital signal lines from electrostatic discharge (ESD) and other overvoltage transients (Pages 13, 18).

6. PulseGuard® ESD Suppressors — Available in various surface mount form factors to protect high-speed digital lines without causing signal distortion (Page 13).

OVERCURRENT PROTECTION TECHNOLOGIES (7-8)

7. Positive Temperature Coefficient Devices (PTCs) — Provide resettable overcurrent protection for a wide range of applications (Page 12).

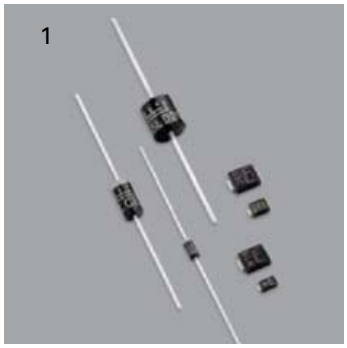
8. Fuses — Full range including surface mount, axial, glass or ceramic, thin-film or Nano²® style, fast-acting or Slo-Blo®, as well as a wide selection of fuse holder devices (Pages 10-11).

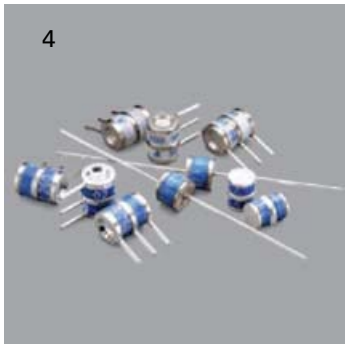
SWITCHING TECHNOLOGIES

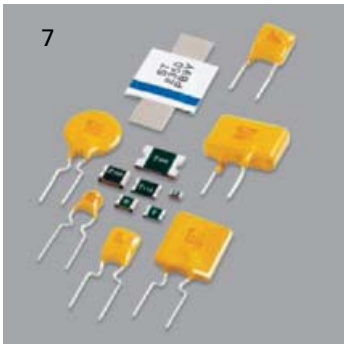
9. Switching Thyristors — Solid-state switches used to control the flow of electrical current in applications, capable of withstanding rated blocking/off-state voltage until triggered to the on-state (Pages 20-21).

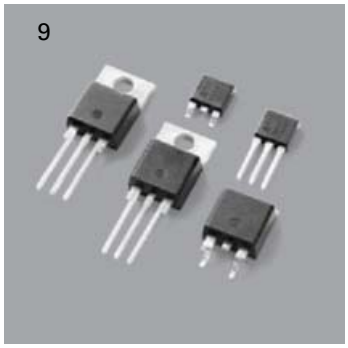
SPECIAL APPLICATION PRODUCTS

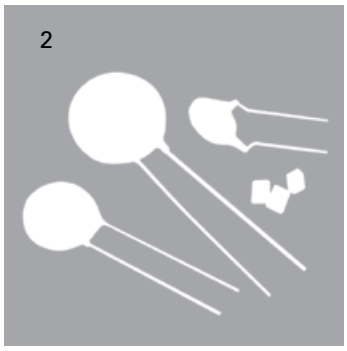
10. PLED® Protectors — Specialty silicon devices that enable LED lighting arrays to continue to function if any single LED fails (Page 13).

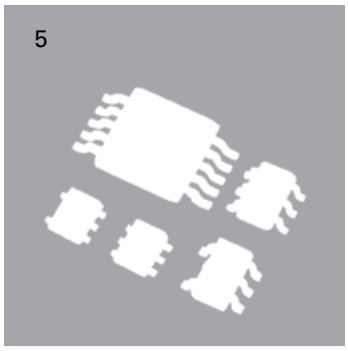


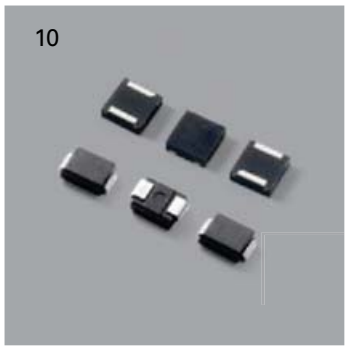


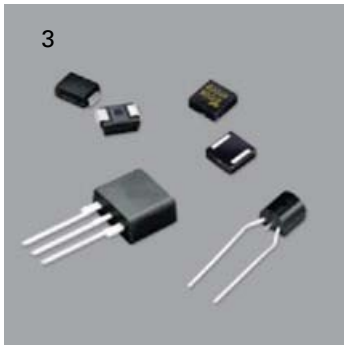


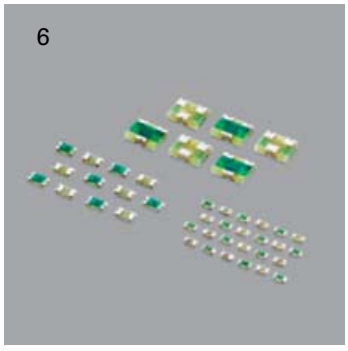












Application Solutions by Circuit Type and Related Threat

CONSUMER ELECTRONIC PRODUCT APPLICATIONS

Computers—Server, Desktop, Notebook, Netbook
Peripherals—Scanner, Printer, Monitor, Disk Drive
Handheld Portables—Cell Phone/Smart Phone/PDA, PND/GPS, MP3/PMP, Digital Camera/Camcorder, e-Book
Video Equipment—LCD/PDP TV, DVD, DVR/set top box

Circuit Type	Function or Threat	Standards	Littelfuse Product Series	
Medium/Low-Speed Data Interfaces: USB 1.1, Ethernet, RS-232, RS-485, Keypads, Audio, Analog Video	ESD, EMI, EFT	IEC61000-4-2 IEC61000-4-4	SPA™ Devices	SP05x, SP72x, SP10xx, SP03-xx
			Varistor (MLV)	ML, MLE, MLN, MHS
			TVS Diodes	SMBJ, P6SMB
	Overcurrent		PTCs	0805L, 1206L, 1210L, 1812L
High-Speed Data Interfaces: USB 2.0 / 3.0, IEEE 1394, HDMI, eSATA, InfiniBand, DisplayPort, RF antenna	ESD, EMI, EFT	IEC61000-4-2, IEC61000-4-4	PulseGuard® ESD	PGB1, PGB2
			SPA™ Devices	SP10xx, SP30xx
	Overcurrent		PTCs	0805L, 1206L, 1210L, 1812L
Power Inputs: 120/240 VAC	Lightning	IEC61000-4-5	TVS Diode	SMAJ, SMBJ, SMCJ, SMDJ
			Varistor (MOV)	LA, UltraMOV, C-III, TMOV
	Overcurrent		Fuse	SMD: Nano Fuse, Pico SMD fuse Leaded: 2AG, 3AG, 5x20, 3.6x10, TR-5/TE-5
Power Inputs: Low Voltage DC	Lightning / ESD	IEC61000-4-2, IEC61000-4-5	TVS Diode	SMAJ, SMBJ, SMCJ, SMDJ
			Varistor (MLV)	ML, MLE
			Varistor (MOV)	ZA
	Overcurrent		Fuse	SMD -Thin Film, Ceramic Chip, Nano (1206 size)
			PTC	SMD - xxxxL series Radial - 30R / 60R series Battery Strap

POWER MAINS / AC LINE PROTECTION*

Circuit Type	Function or Threat	Littelfuse Product Series	
Type 1 (Power before the panel)			
Power Meter	Lightning	Varistor (MOV)	C-III
Type 2 (Permanently connected devices after the panel)			
Uninterruptible Power Supply (commercial/industrial) **TVSS Protection Modules** (building level equipment)	Lightning, Switching Transients	Varistor (MOV)	TMOV®, UltraMOV™, LA, C-III, HA, HB34, HF34, HG34
		TVS Diode	5KP, 15KPA, 20KPA, AK6, AK10, 30KPA
		GDT	AC120, AC240
Power Inverters	Power Fault / Short Circuit and other themal events	Fuse	Powr Gard Midget fuses LVSP series (MOV protection)
Type 3 (Plug-in equipment after the panel)			
Uninterruptible Power Supply (consumer/residential) **External Power Supplies** (chargers, peripheral devices, etc) **Consumer Electronics** **AC Appliances** **AC Power Strips** **Switch Mode Power Supplies**	Lightning, Switching Transients	Varistor (MOV)	TMOV®, UltraMOV™, LA, C-III, HA, HB34, HF34, HG34
		TVS Diode	5KP, 15KPA, 20KPA, AK6, AK10, 30KPA
		GDT	CG3 4.0
	Power Fault / Short Circuit and other themal events	Fuse	Thru Hole: TR-5/TE-5, 2AG, 3AG, 5x20, 3.6x10 Surface Mount: Nano, Pico SMD

LIGHTING SYSTEMS

Circuit Type	Function or Threat	Littelfuse Product Series	
LED Lighting Systems	Open LED protection	PLED devices	PLEDxx
	Power Supply (Lightning, Inductive Load Switching)	Varistor (MOV)	TMOV, UltraMOV, CH, LA, C-III
		TVS Diode	SMBJ, P6KE, 1.5KE, 5KP, 15KPA, 30KPA, AK6, AK10
	Power Fault / Short Circuit and other themal events	Fuse	Thru Hole: TR-5/TE-5, 2AG, 3AG, 5x20, 3.6x10 Surface Mount: Nano, Pico SMD (High Voltage DC) 477 series, 505 series
Light Dimmers	Phase Control	Thyrsitor	Triacs / Alternistor Triacs: Q6010Lx, Q6016Lx, Q6025Lx Quadracs: Q6010LT, Q6015LT
	Trigger Function	Thyristor	Diacs: HT-32B, HT-34B
	Overcurrent (Europe)	Fuse	3.6x10
Electronic Fluorescent Lighting Ballasts	Trigger Function	Thyristor	Diac: HT-32B
	Lightning	Varistor (MOV)	LA
	Overcurrent	Fuse	383 TE-5 series / 369 TR-5 series, 446/447 EBF fuse
Compact Fluorescent Lamps (CFL)	Overcurrent	Fuse	3.6x10
Metal Halide Lighting	Lamp Ignition	Thyristor	Multipulse Sidac: K2401G
High Pressure Sodium Lighting	Lamp Ignition	Thyristor	Sidac: K1200G

ELECTRIC MOTORS*

Circuit Type	Function or Threat	Littelfuse Product Series	
Universal / DC Motors (intermittant use)	Speed Control	Thyristor	Triac: Q6016LH4 SCR: S6025L Rectifier: D6025L
AC Induction Motors (continuous use)	Speed Control	Thyristor	Triac: Q6012LH4
	Thyristor Overvoltage Protection	Varistor (MOV)	LA
		TVS Diode	SMBJ, P6KE, 1.5KE

* Littelfuse offers protection solutions to serve a wide range of electric motors, controllers and power systems. Please consult with your Littelfuse products representative for detailed discussion about your requirements. For higher power and industrial applications, please refer to our POWR-Gard® division product catalogs (www.littelfuse.com/catalogs).

TELECOM/DATACOM

Circuit	Threat	Standards	Littelfuse Product Series	
Medium/Low-Speed Data Interfaces: USB 1.1, Ethernet, RS-232, RS-485	ESD, EMI, EFT	IEC61000-4-2 IEC61000-4-4	SPA™ Devices	SP05x, SP72x, SP10xx, SP03-xx
			Varistor (MLV)	ML, MLE, MLN, MHS
			TVS Diodes	SMBJ, P6SMB
	Overcurrent		PTCs	0805L, 1206L, 1210L, 1812L
High-Speed Data Interfaces: USB 2.0 / 3.0, IEEE 1394, RF antenna	ESD, EMI, EFT	IEC61000-4-2, IEC61000-4-4	PulseGuard® ESD	PGB1, PGB2
			SPA™ Devices	SP10xx, SP30xx
	Overcurrent		PTCs	0805L, 1206L, 1210L, 1812L
SLICs (Subscriber Line Interface Circuits): CO sites, Remote Cabinets/Terminals, VoIP systems, FXS ports	Lightning	GR-1089, TIA-968-A, ITU K.20/.21, UL/EN/IEC 60950-1, UL 497B, IEC 61000-4-5, YD/T-993	SIDACtor® Devices	Pxxx1 Fixed Voltage SLIC Protectors Bxxxx Battrax® Programmable SLIC Protectors
	Power Fault		Fuses	TeleLink 461
			PTCs	600R150
Telecom Low-Speed Circuits: Voice, Fax, Modem, FXO / DAA	Lightning	GR-1089, TIA-968-A, ITU K.20/.21, UL/EN/IEC 60950-1, UL 497B, IEC 61000-4-5, YD/T-993	SIDACtor® Devices	Pxxxx SIDACtor Protectors SDP series low profile SIDACtor Protectors
			GDTs	SL0902, SL1002, SL1003, SL1011, SL1024
	Power Fault		Fuses	TeleLink 461
			PTCs	600R150
Telecom Medium-Speed Circuits: T1/E1/J1/DS1, T3/E3/DS3, 10BaseT, ADSL, HDSL	Lightning	GR-1089, TIA-968-A, ITU K.20/.21, UL/EN/IEC 60950-1, UL 497B, IEC 61000-4-5, YD/T-993, IEEE 802.3	SIDACtor® Devices	PxxxxxxMCL SIDACtor Protectors Pxxx2xxMCL TwinChip® Protectors PxxxxQxx QFN SIDACtor Protectors SDP, SEP series low profile SIDACtor Protectors
			GDTs	SL0902, SL1002, SL1003, SL1011, SL1024
	Power Fault		Fuses	TeleLink 461 / 461E
			PTCs	600R150
Telecom High-Speed Circuits: ADSL2, ADSL2++, shdsl, VDSL, VDSL2, 100BaseT, 1000BaseT	Lightning	GR-1089, TIA-968-A, ITU K.20/.21, UL/EN/IEC 60950-1, UL 497B, IEC 61000-4-5, YD/T-993, IEEE 802.3	SIDACtor® Devices	SDP, SEP series low profile SIDACtor Protectors
			GDTs	SL0902, SL1002, SL1003, SL1011, SL1024
	Power Fault		Fuses	TeleLink 461 / 461E
			PTCs	600R150
Telecom Medium/ High-Speed Driver Circuits: xDSL, Ethernet	Lightning	GR-1089, TIA-968-A, ITU K.20/.21, IEC 61000-4-5, YD/T-993, IEEE 802.3	SIDACtor® Devices	SDP0242Q12F QFN protector SEP series low profile SIDACtor Protectors
			SPA™ Devices	SP03-xx, SP3050-04HTG
Telecom Primary Protection	Lightning and Power Fault	UL497 GR-974 UL/EN/IEC 60950-1	GDT	SL1002, SL1003, SL0902, SL1411 SL1011, SL1021, SL1022, SL1024
Power Inputs: 120/240 VAC, up to 120 VDC	Lightning		TVS Diode	P6KE, 1.5KE, AK6, AK10
			Varistor (MOV)	CH, ZA, UltraMOV
	Fault Current		Fuse	Midget Series (SFE, KIK, KLKD, BLS, BLN, FLQ, FLM, FLA, KLQ) Fast Acting: 435, 431/434, 429/433, 271, 446, 445, 452/453, 456, 459 Slo-Blo: 430, 452/454, 456, 436, 461, Pico 2

AUTOMOTIVE ELECTRONICS*

Engine/Body/Chassis Controllers — Anti-lock brake / steering / air bag / seat belt / collision control and other safety systems and sensors, lighting / signalling controls, instrument cluster, engine / emission controllers, window / wipers controls, door lock / security controls, seating sensors and controllers

Multimedia/Information Systems — In-dash stereo / GPS / climate control electronics, portable GPS, portable CD/DVD/media players, audio / video / data / power docks and inputs

Circuit Type	Function or Threat	Standards	Littelfuse Product Series	
High-Speed Interfaces: USB 2.0, IEEE 1394	ESD	—	PulseGuard® ESD	PGB1, PGB2
			SPA™ Devices	SP300x
Medium/Low-Speed Interfaces: USB 1.1, CAN	ESD, EMI	—	SPA™ Devices	SP05x, SP72x, SP100x
			Varistor (MLV)	ML, MLE, MLN, MHS
Power Inputs: Up to 42 VDC	Fault Currents	RoHS; ISO 7637; GM 9105; Various UL, CSA, IEC, MITI	Fuse	Blade / Terminal Fuse Series: 257, 297, 298, 299, 495, 498 (see automotive products catalogs)
	Load Dump and Inductive Switching	—	Varistor (MLV)	AUML
			TVS Diode	P6KE, P6SMB, 5KP, 1KSMB, SLD
			Varistor (MOV)	CH, ZA

* Littelfuse offers a wide range of solutions designed to serve the requirements of automotive, truck, and off-road vehicle applications. Please refer to our automotive products catalogs (www.littelfuse.com/catalogs) and your Littelfuse products representative for detailed discussion about your requirements.

WHITE GOODS / APPLIANCES

Circuit Type	Function or Threat	Littelfuse Product Series	
AC Induction Motor	On / Off / Speed Control	Switching Thyristor	Alternistor Triac
AC Shaded Pole Motor Fan	On / Off / Speed Control	Switching Thyristor	EV Series Triac
AC Solenoid Valve / Lock	On / Off	Switching Thyristor	EV Series Triac
	Spike Suppression	Varistor (MOV)	LA
Brushless DC Motor Drive	DC Supply Protection	TVS Diode	1.5KE / 1.5SMC
Display / Touchscreen	ESD Protection	Varistor (MLV)	ML
Gas Ignitor	Free-Running Oscillator	Switching Thyristor	K2xxxyH Series SIDAC
	Micro-controller Fired	Switching Thyristor	EC Series SCR
Heating Element	On / Off / Variable	Switching Thyristor	HQ Series High Temp Triac
Incandescent Bulb	On / Off / Dim	Switching Thyristor	L-Series Triac
LED Indicator / Light	ESD Protection	Varistor (MLV)	ML
MicroController I/O	ESD Protection	Varistor (MLV)	ML
Sensor	ESD Protection	Varistor (MLV)	ML
Switch-Mode Power Supply	AC Input Overcurrent	Fuse	Cartridge, PICO II, Nano
	Input Overvoltage	Varistor (MOV)	LA
	Output Overcurrent	Fuse	477, 505 HV DC Cartridge
	Output Overvoltage	TVS Diode	1.5KE / 1.5SMC
Touch Keypad	ESD Protection	Varistor (MLV)	ML
Triac Control	Overvoltage Protection	TVS Diode	1.5KE / 1.5SMC
		Varistor (MOV)	LA
Wax Motor Latch / Lock	On / Off	Switching Thyristor	EV Series Triac

Product Specifications and Selection Guide

FUSE PRODUCTS www.littelfuse.com/fuse

Fuses provide protection by completely stopping the flow of energy to sensitive circuits. If current exceeds the fuse's operating range, the metal wire or strip melts safely within an enclosure. Littelfuse offers the most extensive range of fuses available, and for easy replacement of cartridge fuses Littelfuse offers a wide selection of fuse holders including panel mount, in-line, and surface and thru-hole circuit board mount devices. Please visit www.littelfuse.com for fuse holder selection.

		Series Name[1]	Size[2]	Time Lag (Slo-Blo®)	Fast Acting	Very Fast Acting	Device Range[3] (Operating Current Options in Amps)	Max. Voltage Rating[3] (Volts)	Interrupting Rating at Max. Voltage Rating[3] (Amps)	Operating Temperature Range	Agency Approvals[3]					Halogen Free	RoHS Compliant	Lead Free
											UL	UR	CSA	PSE	UMF			
Surface Mount:																		
Ceramic Chip		437	1206		•		0.25 - 8	125 / 63 / 32	50	-55°C to +150°C		•				•	•	•
		438	0603		•		0.25 - 6	32 / 24	50			•				•	•	•
		501	1206		•		15, 20	24	150			•				•	•	•
Thin Film		466	1206			•	0.125 - 5	125 / 63 / 32	50	-55°C to +90°C		•	•			•	•	
		429	1206			•	7	24	35			•	•				•	•
		468	1206	•			0.5 - 3	63 / 32	35 - 50			•	•			•	•	•
		467	0603			•	0.25 - 5	32	35 - 50			•	•			•	•	•
		435	0402			•	0.25 - 5	32	35			•	•			•	•	•
Nano²®		448	2410			•	0.062 - 15	125 / 65	35 - 50	-55°C to +125°C		•	•	•			•	
		449	2410	•			0.375 - 5	125	50			•		•			•	
		451 / 453	2410			•	0.062 - 15	125 / 65	35 - 50		•	•	•	•		•	•	
		452 / 454	2410	•			0.375 - 5	125	50			•	•	•		•	•	
		456	4012	•			20, 30	125	100			•		•		•	•	•
		458	1206		•		1.0 - 10	63	50			•				•	•	•
		443	4012	•			0.5 - 5	250	50			•				•	•	•
		464	4818		•		0.5 - 6.3	250	100					•	•	•	•	
		465	4818	•			1 - 6.3	250	100					•	•	•	•	
Telelink®		461	4012				0.5 - 2.0	600	60	-55°C to +125°C		•	•			•	•	
		461E	4012				1.25	600	60			•				•	•	
OMNI-BLOK®		154	*			•	0.062 - 10.0	125	35 - 50	-55°C to +125°C		•		•		•	•	
		154T	*	•			0.375 - 5	125	50			•		•		•	•	
Fuse and Clip Assemblies		157	*			•	0.062 - 10	125	35 - 50	-55°C to +125°C		•		•		•	•	
		157T	*	•			0.375 - 5	125	50			•		•		•	•	
		159	*				0.5 - 2	600	60			•				•	•	
PICO® SMF		459	*			•	0.062 - 5	125	50 - 300	-55°C to +125°C		•	•					
		460	*	•			0.5 - 5	125	50			•	•					
Flat Pak		202	*		•		0.062 - 5	250	50	-55°C to +125°C		•	•					
		203	*	•			0.25 - 5	250	50			•	•					
EBF		446	*		•		2.0 - 10.0	350	100	-40°C to +125°C		•	•					
		447	*		•		2.0 - 10.0	350	100			•	•					

(1) Detailed information about most product series listed here can be found on our web site by entering www.littelfuse.com/series/(Series Name).html
(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 www.littelfuse.com and in our data sheets for detailed information by part number.
* Please refer to data sheet for detailed specifications.

Radial Leaded / Socket:

		Series Name[1]	Time Lag (Slo-Blo®)	Medium Acting	Fast Acting	Very Fast Acting	Device Range[3] (Operating Current Options in Amps)	Max. Voltage Rating[3] (Volts)	Interrupting Rating at Max Voltage Rating[3] (Amps)	Operating Temperature Range	Agency Approvals[3]													RoHS Compliant	Lead Free
											Americas				Europe					Asia					
											UL	UR	CSA	QPL	CE	VDE	TUV	BSI	Semko	PSE	K	CCC	CQC		
Micro™ / TR3®		262/268/269				•	0.002 - 5	125	10,000	-55°C to +125°C		•	•	•										•	
		272/278				•	0.002 - 5	125	10,000	-55°C to +125°C		•	•	•										•	
		273/274/279				•	0.002 - 5	125	10,000	-55°C to +85°C															
		303			•		0.5 - 5	125	50	-55°C to +70°C	•		•											•	•
TR5®		370			•		0.4 - 6.3	250	35 - 50	-40°C to +85°C		•				•			•	•		•		•	•
		372	•				0.4 - 6.3	250	35 - 50			•				•			•	•	•	•	•	•	•
		373			•		0.5 - 10	250	50		•		•											•	•
		374	•				0.5 - 10	250	50		•		•											•	•
		382	•				1 - 10	250	100			•				•			•	•	•	•	•	•	•
		383	•				1 - 10	300	50 - 100			•				•				•				•	•
TE5®		369	•				1 - 6.3	300	50	-40°C to +85°C		•								•				•	•
		385	•				0.35 - 1.5	125	50			•												•	•
		391			•		0.125 - 4	65	50			•												•	•
		392	•				0.8 - 6.3	250	25 - 63			•				•			•	•	•		•	•	•
		395			•		0.05 - 6.3	125	100		•									•				•	
		396	•				0.05 - 6.3	125	100		•									•				•	•
		397	•				0.35 - 1.5	125	50		•													•	•
		398		•			0.125 - 4	65	50			•												•	•
		399	•				0.125 - 4	65	50			•												•	•
		400	•				0.5 - 6.3	250	130			•				•				•				•	•

Axial Leaded / Cartridge:

PICO / PICO II Axial		251/253				•	0.062 - 15	125	300DC / 50AC	-55°C to +125°C		•	•	•			•			•				•	
		275				•	20 - 30	32	300DC / 50AC			•	•											•	
		263				•	0.062 - 5	250	50			•	•							•				•	
		471	•				0.5 - 5	125	50			•	•							•				•	
		472	•				0.5 - 5	125	50			•												•	
		473	•				0.375 - 7	125	50			•	•							•				•	
		265/266/267				•	0.062 - 15	125	300DC / 50AC			•	•	•										•	
		316				•	0.5 - 5	125	50													•		•	
3.6x10 mm		874				•	0.1 - 10	250	50	-55°C to +125°C	•													•	•
		875	•				0.1 - 10	250	50		•													•	•
		876				•	0.125 - 5	250	35 - 50			•				•								•	•
		877	•				2 - 6.3	250	35 - 63			•				•								•	•
4.5x14.5 mm (2AG)		208			•		0.125 - 10	350	100	-55°C to +125°C		•			•					•				•	•
		209	•				0.25 - 1	350	100			•			•					•				•	•
		224/225			•		0.1 - 10	250 / 125	35 - 500		•	•	•		•					•				•	•
		229/230	•				0.25 - 7	250 / 125	35 - 400		•	•	•		•					•				•	•
5x20 mm		217			•		0.032 - 15	250	35 - 150	-55°C to +125°C		•	•		•	•		•	•	•	•	•		•	•
		218	•				0.032 - 16	250	35 - 100			•	•		•	•		•	•	•	•	•		•	•
		213	•				0.2 - 6.3	250	35 - 63			•	•		•	•		•	•	•		•		•	•
		219XA	•				0.4 - 6.3	250	150			•	•		•	•		•	•	•		•		•	•
		216			•		0.05 - 16	250	750 - 1500			•	•		•	•		•	•	•	•	•		•	•
		215	•				0.125 - 25	250	300 - 1500			•	•		•	•		•	•	•	•	•		•	•
		232		•			1 - 10	250 / 125	300 / 10,000						•					•	•			•	•
		235			•		0.1 - 7	250 / 125	35 - 10,000		•		•		•					•	•			•	•
		233		•			1 - 10	125	10,000		•		•		•					•	•			•	•
		234		•			1 - 10	250	100 - 200		•		•		•					•	•			•	•
		239	•				0.08 - 7	250 / 125	35 - 10,000		•		•		•					•	•			•	•
		477	•				0.5 - 16	400DC / 500AC	100 - 1500			•							•	•	•			•	•
6.3x32 mm (3AG/3AB)		312/318			•		0.01 - 35	250 / 125 / 32	35 - 300	-55°C to +125°C	•	•	•		•					•	•			•	•
		313/315	•				0.01 - 30	250 / 125 / 32	35 - 300		•	•	•		•					•	•			•	•
		314/324			•		0.125 - 40	250	35 - 1000		•	•	•		•					•	•			•	•
		322				•	1 - 30	250 / 65	100 - 1000			•			•					•				•	•
		325/326	•				0.01 - 30	250 / 125	100 - 600		•	•	•		•					•	•			•	•
		388			•		1 - 30	250	100						•					•	•			•	•
		505			•		10 - 30	450 / 500	20,000 - 50,000			•			•									•	•

PTC PRODUCTS www.littelfuse.com/ptc

PTCs (positive temperature coefficient thermistors) increase resistance as temperature increases. They are designed to prevent unsafe levels of current while allowing constant safe current levels, and their resistance will "reset" automatically when the current and temperature returns to a safe level. PTCs are typically used in applications where automatic reset is desired.

Series Name[1]		Size[2]	Hold Current (I_{HOLD})	Max voltage (V_{MAX})	Max fault current (I_{MAX})	Operating Temperature Range	Agency Approvals		Halogen Free	RoHS Compliant	Lead Free
							cURus	TUV			
Surface Mount:											
0603L		0603 (1608)	0.10 - 0.35 A	6 - 15 V	40 A	-40°C to 85°C	•	•	•	•	•
0805L		0805 (2012)	0.10 - 1.10 A	6 - 15 V	100 / 40 A		•	•	•	•	•
1206L		1206 (3216)	0.125 - 1.50 A	6 - 30 V	100 A		•	•	•	•	•
1210L		1210 (3225)	0.05 - 1.50 A	6 - 30 V	10 / 100 A		•	•	•	•	•
1812L		1812 (4532)	0.10 - 2.60 A	6 - 60 V	10 / 20 / 100 A		•	•	•	•	•
2016L		2016 (5041)	0.30 - 2.00 A	6 - 60 V	20 / 40 A		•	•	•	•	•
2920L		2920 (7351)	0.30 - 3.00 A	6 - 60 V	10 / 40 A		•	•	•	•	•
SL*		0805 1206 1210 1812	1.1 A 1.1 - 1.5 A 2.0 A 1.9 A	6 V	50 A		•	•	•	•	•
250S		see data sheet	0.13 A	60 V	3 A		Pending		•	•	•
Radial Leaded:											
USBR		see data sheet	0.75 - 2.50 A	6 / 16 V	40 A	-40°C to 85°C	•	•		•	•
16R			2.50 - 14.00 A	16 V	100 A		•	•		•	•
30R			0.90 - 9.00 A	30 V	40 A		•	•		•	•
60R			0.10 - 3.75 A	60 V	40 A		•	•		•	•
72R			0.20 - 3.75 A	72 V	40 A		•	•		•	•
250R			0.08 - 0.18 A	250 V	3 / 10 A		•	•		•	•
600R			0.15 - 0.16 A	600 V	3 A		•	•		•	•
Battery Strap:											
LR		see data sheet	1.90 - 7.30 A	15 / 20 V	100A	-40°C to 85°C	•	•		•	•
LT			0.70 - 3.40 A	15 / 24 V			•	•		•	•
ST			1.20 - 4.20 A	15 / 30 V			•	•		•	•
VL			1.70 - 2.30 A	12 V			•	•		•	•
VT			1.70 - 2.40 A	16 V			•	•		•	•

(1) Detailed information about most product series listed here can be found on our web site by entering www.littelfuse.com/series/(Series Name).html
(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"
* Scheduled for availability by June 2009

ESD SUPPRESSOR SELECTION GUIDE www.littelfuse.com/esd

Littelfuse offer three product families for ESD suppression. Each provide distinct attributes for compatibility to specific circuit requirements.

PulseGuard® ESD Suppressors offer extremely low capacitance 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.

SPA™ Silicon Protection Arrays 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, SP03-xx and SP30xx devices are available for EFT and Lightning transient threats per IEC-61000-4-4/5.

Multi-Layer Varistors (MLVs) provide board level protection against ESD, EFT, and other transients that occur on power supply, data and control lines. Single line devices are available in popular industry standard formats, and for more efficient board space usage, four-line devices are also available. Some MLVs also offer low band-pass filtering characteristics that filter high frequency noise from the circuit.

Series Name		Surface Mount	Through-Hole	Technology Type	Working Voltage	Array Package (No. of Lines)	Single Line Package	Typical Device Capacitance	Leakage Current	Rated Immunity to IEC 61000-4-2 level 4	Also Rated for EFT or Lightning	Bidirectional (transients of either polarity)	Performs Low Pass Filtering
PulseGuard® ESD Suppressors:													
PGB1		•		Voltage Variable Material	0–24VDC	SOT23 (2)	0402, 0603	0.04–0.12pF	<1nA	•		•	
PGB2		•		Voltage Variable Material	0–12VDC	NA	0402	0.07pF	<1nA	•		•	
SPA™ Silicon Protection Arrays: (Please refer to page 18 for additional information)													
SP72x		•	•	Silicon Controlled Rectifier/Diode	0–35VDC	PDIP, SOIC (6, 14) SOT23 (4)	NA	3–5pF	<20nA	•	•	•	
SP03-xx		•		Silicon TVS Rail Clamp Array	0–8VDC	SOIC	NA	16pF	<25µA	•	•	•	
SP05x		•		Silicon TVS Avalanche Diode	0–5.5VDC	SOT23 (2, 4, 5), S0T143 (3), MSOP (6), SC70 (2, 4, 5)	NA	30pF	<10µA	•		•	
SP100x		•		Silicon TVS Diode Arrays	0–6VDC	SC70, SOT5x3, SOT953, µDFN	SOD723	12pF	<0.5µA	•	•	•	
SP30xx		•		Silicon TVS Rail Clamp Arrays	0–6VDC	SC70, SOT5x3, SOT23, MSOP10, µDFN	NA	0.8pF	<0.5µA	•	•	•	
Multi-Layer Varistors (MLVs): (Please refer to page 14 for additional information)													
ML		•		MLV ZnO	0–120VDC range by type	NA	0402–1210	40–6000pF	<25µA	•	•	•	•
MLE		•		MLV ZnO	0–18VDC	NA	0402–1206	40–1700pF	<25µA	•	•	•	•
MHS		•		MLV ZnO	0–42VDC	NA	0402, 0603	3–22pF	<5µA	•	•	•	•
MLN		•		MLV ZnO	0–18VDC	0805 (4), 1206 (4)	NA	45–430pF	<5µA	•	•	•	•

Terms:
EFT: Electrical Fast Transient
TVS: Transient Voltage Suppressor

PLED LIGHT-EMITTING DIODE (LED) PROTECTORS www.littelfuse.com/pled

The new Littelfuse PLED Series provides added reliability to LED array lighting designs. Designed to minimize the impact of loss of an entire array of LEDs due to a single LED failure, PLED devices provide a switching electronic shunt path that bypasses the bad LED when it goes open circuit, and allows current to flow to the remaining LEDs in the string.

Series Name		QFN	DO-214	V_{BR} breakdown		I_H	I_S	$I_T@V_T$	$V_T @ I_T = 1$ Amp	Critical rate of rise dV/dt
				Volts Min	Volts Max	mAmps Min	mAmps	Amps	Volts Max	Volts Max
PLED6		•	•	6	16	5	600	1.0	3	250V/µS
PLED9		•	•	9	18	5	600	1.0	3	250V/µS
PLED13		•	•	13	26	5	600	1.0	3	250V/µS

VARISTOR PRODUCTS www.littelfuse.com/varistor

Shorthand for "Variable Resistors," Varistors possess characteristics that divert transient currents away from sensitive components. Littelfuse offers two types: Miniature surface mount Multi-Layer Varistors (MLVs) for small electronics applications and Metal Oxide Varistors (MOV) for higher energy applications.

Series Name[1]		Technology Type	Operating AC Voltage Range	Operating DC Voltage Range	Peak Current Range[2] (A)	Peak Energy Range (J)	Operating Temperature Range	Lines Protected	Mount/ Form Factor	Disc Size	Agency Approvals					RoHS	Lead Free
											UL	CSA	VDE	CECC	QPL		
Surface Mount MLV / MOV:																	
MHS		Multi-Layer Zinc Oxide (MLV)	9-42	30 -135	300		-55 to +125°C	1	Surface Mount	Not Applicable						•	
MLE			18	18	22-28											•	
ML			2.7-107	5.5-120	4-500	0.02-2.5										•	
AUML				18												•	
MLN			18	5.5-18	30	0.05-0.10		4								•	
CH		Zinc Oxide (MOV)	14-275	18-369	100-250	1.0 - 8.0		1			•					•	
Radial Leaded MOV:																	
TMOV®/ iTMOV®		Zinc Oxide	115-750		6000-10000	35-480	-55 to +85°C	1	Radial Leaded	14, 20mm	•	•	•	•		•	•
TMOV® 25S			115-750		20000	170-670				25mm	Pending					•	•
UltraMOV™			130-625	170-825	1750-10000	12.5-720				7, 10, 14 20mm	•	•	•	•		•	•
UltraMOV™ 25S			115-750	150-970	22000	230-890				25mm	•	•	•	•		•	•
C-III			130-660		3500-9000	40-530				10, 14, 20mm	•	•	•			•	•
LA			130-1000	175-1200	1200-6500	11-360				7, 10, 14 20mm	•	•	•	•		•	•
ZA			4-460	5.5-615	50-6500	0.1-52				5, 7, 10, 14, 20mm	•		•	•		•	•
Industrial High Energy Terminal MOV:																	
BA/BB		Zinc Oxide	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				40mm	•					•	•
HA			130-750	175-970	25000 40000	200-1050			Industrial Packaged Radial Leads	32, 40mm	•	•				•	•
TMOV34S®			115-750		40000	235-1050				34mm	•					•	•
HB34, HG34, HF34			130-750	175-970	40000	270-1050				34mm	•	•				•	•
DHB34			250-2800	330-3500	20000 70000	330-10000				34mm						•	
CA			250-2800	330-3500	20000 70000	330-10000			Bare Disc	60mm						•	
Specialty Application MOV:																	
MA		Zinc Oxide	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	100-6500	0.4-160	-55 to +125°C		Inline Radial Leads	Not Applicable	•	•				•	•
High Reliability			130-510	4-675	100-6500	0.4-190	-55 to +85°C		(Varies)	(Varies)					•		

(1) Detailed information about most product series listed here can be found on our web site by entering www.littelfuse.com/series/(Series Name).html
(2) Not an applicable parameter for Crowbar devices

GDT (GAS DISCHARGE TUBE) PRODUCTS www.littelfuse.com/gdt

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. Littelfuse devices offer a small footprint and are available in leaded and surface mount configurations, with high surge handling capability. Their fast response to transient over-voltage events, and ability to dissipate large amounts of energy, translates into reduced risk of equipment damage. The amount of energy they can dissipate makes them a good choice for lightning surge protection, particularly for telecomm equipment located in outdoor structures.

Series Name[1]		DC Breakover Voltage Range (Nom V_{BO})	Max AC Surge Rating	Peak Pulse Current (8x20µs)	Max Capacitance	Operating Temperature Range	# Terminals	Mounting Options					RoHS Compliant	Lead Free
								Mini Tube	Surface	Axial Lead	Radial Lead	Clip		
High Voltage GDTs														
AC		365 - 570	NA	4000A	<1pF	-40°C to +90°C	2			•			•	
CG3		1000 - 5000		5000A	1pF		2			•			•	
Low to Medium Surge GDTs														
SL0902A		90 - 600	2.5A	2500A	1pF	-40°C to +90°C	2	•	•				•	•
SL1002A		90 - 600	5A	5000A	1.2pF		2	•	•				•	•
SL1003A		90 - 500	10A*	10,000A	1.2pF		3	•	•		•		•	•
CG5		90 - 600	5A	5000A	1pF		2	•	•	•			•	
SL1011A		75 - 600	5A	5000A	1.5pF		2		•	•			•	•
Medium to High Surge GDTs														
SL1122A		90 - 450	5A*	10000A*	100-200pF	-40°C to +90°C	3				•		•	
SL1021A		90 - 600	10A*	10000A*	1.5pF		3		•		•		•	•
SL1024A		90 - 600	10A*	10000A*	1.5pF		3		•		•		•	•
SL1011B		75 - 350	10A	10000A	1.5pF		2		•	•			•	•
PMT3		90 - 500	20A*	20000A*	1pF		3		•		•		•	
PMT8		90 - 400	10A*	20000A*	1pF		3		•		•		•	•
SL1411A		75 - 600	10A	10000A	<1pF		2		•	•			•	•
CG/CG2		75 - 1000	20A	20000A	1pF		2	•	•	•			•	
Very High Surge GDTs														
SL1021B		90 - 500	10A*	20000A*	1.5pF	-40°C to +90°C	3		•		•		•	•
SL1024B		90 - 500	10A*	20000A*	1.5pF		3		•		•		•	•

(1) Detailed information about most product series listed here can be found on our web site by entering www.littelfuse.com/series/(Series Name).html
* Total current through center (ground) terminal

SIDACtor® PROTECTION THYRISTORS www.littelfuse.com/sidactor

SIDACtor® devices are designed to suppress overvoltage transients in telecom and datacom equipment, and are able to divert currents as high as 5000A to ground within nanoseconds of reaching their breakover voltage. Littelfuse offers a wide range of configurations including DO-214AA, COMPAK (3-Pin DO-214), 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.

Series Name		Package Type	Type	Standoff (working) Voltage (V_{DRM})	Switching Voltage (V_S)	Peak Pulse Rating:			RoHS Compliant
						2x10µs	10x1000µs	8X20µs	
Broadband Optimized Protection:									
MC Series		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	150A	
			C			500A	100A	500A	
Balanced MC Series		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	•
Q2L Series		3x3 QFN	A	6-320	25-400	150A	45A	150A	
			B			250A	80A	250A	•
		3.3x3.3 QFN	C			500A	100A	400A	
MC Multiport Series		MS-013	C	6-320	25-400	500A	100A	400A	•
TwinChip™ Series		DO-214AA	A	220 - 640	300 - 800	150A	45A	150A	
			B			250A	80A	250A	
		DO-15	A	220-320	300-400		50A		•
			B				80A		
SDP TwinChip™ Series		3x3 QFN	F	16	43	100	30A	80A	•
SPD Series		5x6 QFN	B	58-320	77-400	250A	80A	250A	•
SDP Biased Series		5x6 QFN	C	6-320	25-400	500A	100A	400A	•
SEP Biased Series		5x6 QFN	C	6-75	25-98	500A	100A	400A	•
Subscriber Line Interface Circuit (SLIC) Protection:									
Fixed Voltage Series		DO-214AA	A	58 - 160	77 - 200	150A	45A	150A	
			C			500A	100A	400A	•
Fixed Voltage Twin SLIC Series		Modified DO-214AA	A	58 - 160	77 - 200	150A	45A	150A	•
Fixed Voltage Q2L Series		QFN 3.3x3.3	C	58 - 160	77 - 200	500A	100A	400A	•
Fixed Voltage Single Port Series		MS-012	F	58 - 95	77 - 130	120A	30A	100A	•
Fixed Voltage Enhanced Single Port Series		MS-012	F	58 - 160	77 - 200	120A	30A	100A	•
Fixed Voltage Multiport Series		MS-013	A	58 - 160	77 - 200	150A	45A	150A	
			C			500A	100A	400A	•
Battrax® Series Positive/Negative		Mod DO-214AA	A	These devices track their reference voltages. Please refer to data sheets in SIDACtor products catalog or www.littelfuse.com for detailed information.		150A	45A	150A	
			C			500A	100A	400A	•
Battrax® Series Single Port Negative		MS-013	C			500A	100A	400A	•
Battrax® Series Single Port Positive/Negative		MS-013	C			500A	100A	400A	•
Battrax® Series Dual Port Negative		MS-013	C			500A	100A	400A	•

Series Name		Package Type	Type	Standoff (working) Voltage (V_{DRM})	Switching Voltage (V_S)	Peak Pulse Rating: 2x10µs	10x1000µs	8X20µs	RoHS Compliant
Line Circuit Access Switch (LCAS) Protection:									
Asymmetrical Multiport Series		MS-013	A	These products have asymmetric trigger voltages. See data sheet.		150A	45A	150A	•
			C			500A	100A	400A	
Custom LCAS Discrete Series		DO-214AA	A	100-230	130-290	150A	45A	150A	•
			B			250A	80A	250A	
			C			500A	100A	400A	
Baseband Protection (Voice-DS1):									
SIDACtor® Series		DO-214AA	A	6-320	25-400	150A	45A	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® Multiport Series		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® Balanced Series		MS-013	C	130-420	180-600	500A	100A	400A	•
		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® Balanced Multiport Series		MS-013	A	130-420	180-600	150A	45A	150A	•
			B			250A	80A	250A	
			C			500A	100A	400A	
			Asym. A6	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	
			Asym. B6			250A	80A	250A	
			Asym. C6			500A	100A	400A	
T10A Series		DO-15	A	50-245	84-370		50A	100A	•
T10B Series		DO-201	B	80-275	120-360		100A	250A	•
High Exposure Surge Protection:									
Primary Protection Series		Cell	C	25-320	40-400	500A	100A	400A	•
		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 Series		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	•
5kA Series		TO-218	E	140-180	180-260			5000A	•
High Surge Current Series		DO-214AA	D	6-320	25-400	1000A	200A	800A	•

SPA™ SILICON PROTECTION ARRAYS www.littelfuse.com/spa

SPA devices are designed to protect analog and digital signal lines from electrostatic discharge (ESD) and other overvoltage transients. Offering low dynamic resistance for improved clamping performance, SPA devices are offered in a wide range of industry standard discrete and multi-channel SMD packages. Features of this portfolio include capacitance as low as 0.65 pF and enhanced ESD capability up to 25kV (contact discharge).

Series Name[1]		Package Type	Working Voltage	Capacitance	Number of Channels	ESD Rating (Contact Discharge, IEC61000-4-2)	VCLAMP (8/20)	8/20 Rating	Green Series	Lead Free	RoHS Compliant
SCR (silicon controlled rectifier) **/ Diode Arrays:**											
SP720		PDIP, SOIC	2-30V	3pF	14	4kV		3 A	•	•	•
SP721		PDIP, SOIC	2-30V	3pF	6	4kV		3 A	•	•	•
SP723		PDIP, SOIC	2-30V	5pF	6	8kV		7 A	•	•	•
SP724		SOT23	1-20V	3pF	4	8kV		3 A	•	•	•
SP725		SOIC	2-30V	5pF	4	8kV		14 A	•	•	•
TVS (transient voltage suppression) **Discretes and Arrays:**											
SP05		SC70 SOT23, SOT143 MSOP	5.5V	30pF	2 / 3 / 4 / 5 / 6	20kV			•	•	•
SP1001		SC70 SOT553 SOT563	6V	8pF	2 / 4 / 5	8kV	8.0V@1A	2 A	•	•	•
SP1002		SC70	6.5V	5pF	1	8kV	9.2V@1A	2 A	•	•	•
SP1003*		SOD723	5V	30pF	1	25kV	12.5V@1A	7 A	•	•	•
SP1004*		SOT953	6V	4pF	4	8kV	Pending	1 A	•	•	•
SP1010*		µDFN (1.25 x 1mm)	6V	3.5pF	4	8kV	Pending	1 A	•	•	•
Low Capacitance Rail Clamp Diode Arrays:											
SP3050*		SOT23	6V	2pF	4	20kV	8.8V@1A	10 A	•	•	•
SP3001		SC70	6V	0.65pF	4	8kV	9.5V@1A	2.5 A	•	•	•
SP3002		SC70, SOT23*, µDFN*	6V	0.85pF	4	12kV	9.5V@1A	4.5 A	•	•	•
SP3003		SC70, SOT5x3, MSOP10	6V	0.65pF	2 / 4	8kV	10.0V@1A	2.5 A	•	•	•
SP3004		SOT563	6V	0.85pF	4	12kV	10.0V@1A	4 A	•	•	•
High Surge Arrays for Broadband Protection:											
SP03-3.3		SO-8	3.3V	16pF	2	30kV	18V@100A	150 A	•	•	•
SP03-6		SO-8	6V	16pF	2	30kV	20V@100A	150 A	•	•	•
SP03-8		SO-8	8V	15pF	2	30kV	22V@100A	150 A	•	•	•

(1) Detailed information about most product series listed here can be found on our web site by entering www.littelfuse.com/series/(Series Name).html
*Products scheduled for availability by July 2009.

TRANSIENT VOLTAGE SUPPRESSION (TVS) DIODES

www.littelfuse.com/tvsdiode

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 400W to 15kW, and reverse standoff voltages from 5V to 376V.

Series Name[1]		Package Type	Reverse Standoff Voltage (V_R)	Peak Pulse Power Range [2] (P_{PP})	Peak Pulse Current (I_{PP} 8x20µs)	Operating Temperature	Halogen Free	RoHS Compliant
Surface Mount - Standard Applications (400-5000W):								
SMAJ		DO-214AC	5.0-440	400W	Not Applicable	-85° to +302° F (-65° to +150° C)	•	•
P4SMA		DO-214AC	5.8-495	400W			•	•
SACB		DO-214AA	5.0-50	500W			•	•
SMBJ		DO-214AA	5.0-440	600W			•	•
P6SMB		DO-214AA	5.8-495	600W			•	•
1KSMB		DO-214AA	5.8-136	1000W			•	•
SMCJ		DO-214AB	5.0-440	1500W			•	•
1.5SMC		DO-214AB	5.8-495	1500W			•	•
SMDJ		DO-214AB	5.0-170	3000W			•	•
5.0SMDJ		DO-214AB	12-170 (uni-directional) 12-45 (bi-directional)	5000W			•	•
Axial Leaded - Standard Applications (400-5000W):								
P4KE		DO-41	5.8-495	400W	Not Applicable	-85° to +302° F (-55° to +175° C)	•	•
SA		DO-15	5.0-180	500W			•	•
SAC		DO-15	5.0-50	500W			•	•
P6KE		DO-15	5.8-512	600W			•	•
1.5KE		DO-201	5.8-495	1500W			•	•
LCE		DO-201	6.5-90	1500W			•	•
3KP		P600	5.0-220	3000W			•	•
5KP		P600	5.0-250	5000W			•	•
Axial Leaded - High Power:								
15KPA		P600	17-280	15000W	Not Applicable	-85° to +302° F (-55° to +175° C)	•	•
20KPA		P600	20.0-300	20000W			•	•
30KPA		P600	28.0-288	30000W			•	•
AK6		Radial Lead	58-430	NA	6000A	-67° to +347° F (-55° to +150° C)	•	•
AK10		Radial Lead	58-430	NA	10000A		•	•
Automotive Applications:								
SLD		P600	10-24	2200 based on 1µs/150ms pulse	NA	-85° to +302° F (-65° to +175° C)	•	•

(1) Detailed information about most product series listed here can be found on our web site by entering www.littelfuse.com/series/(Series Name).html
(2) For Maximum Clamping Voltage (V_C) please refer to electrical characteristics table within each series data sheet

SWITCHING THYRISTORS www.littelfuse.com/thyristor

Switching Thyristors are solid state switches that are normally open circuits (very high impedance), capable of withstanding rated blocking/off-state voltage until triggered to on state. Often used for circuit (current) control applications to protect from voltage transients, Littelfuse offers DIAC, TRIAC, QUADRAC, and other configurations for a wide range of currents and rated blocking/off-state voltages.

Through-Hole Packages:

DO-15 | DO-35 | TO-92 | TO-218 | TO-218x | TO-220 | Mod. TO-220 | TO-251 V-Pak

Surface Mount Packages: **Other:**

SOD-80 Minimelf | SOT89 | DO-214 | Compak | SOT223 | TO-252 D-Pak | TO-263 D²Pak | TO-3 Fastpak

Series Name[1]			Thru-Hole								Surface Mount				$I_{T(RMS)}$	V_{DRM}/V_{RRM}	$I_{GT\ (Q1)}$
Standard	Sensitive	Alternistor	TO-3	TO-92	TO-218 Isl	TO-218 Non-Isl	TO-218X Isl	TO-220 Isl.	TO-220 Non-Isl	TO-251	Compak	SOT-223	TO-252	TO-263			
Triac:																	
QxX8Ex QxXx	LxX8Ex, LxXx			•							•				0.8 A		3 - 25 mA
	LX8			•								•			0.8 A	400 - 600 V	3 - 5 mA
Qx01Ex, QxNx	Lx01Ex, LxNx			•							•				1.0 A		3 - 25 mA
	L01			•								•			1.0 A	400 - 800 V	3 - 10 mA
Qxx04xx	Lxx04xx							•	•	•			•		4 A		3 - 25 mA
Qxx06xx	Lxx06xx	Qxx06xHx						•	•	•			•	•	6 A		5 - 50 mA
Qxx08xx	Lxx08xx	Qxx08xHx						•	•	•			•	•	8 A		5 - 50 mA
Qxx10xx		Qxx10xHx						•	•					•	10 A	400 - 1000 V	25 - 50 mA
		Qxx12xHx						•	•					•	12 A		10 - 50 mA
Qxx15xx		Qxx16xHx						•	•					•	15 & 16 A		10 - 80 mA
Qxx25xx		Qxx25xHx	•		•		•	•	•					•	25 A		50 - 80 mA
		HQ6025xH5			•			•	•					•	25 A	600 V	50 mA
Qxx35xx		Qxx35xHx	•					•	•					•	30 & 35 A	400 - 800 V	50 mA
		Qxx40xx			•		•								40 A	400 - 1000 V	80 - 100 mA
Quadrac:																	
QxxxxLT		QxxxxLTH						•							4 - 15 A	400 - 600 V	

SCR:

Series Name[1]		Thru-Hole						Surface Mount					$I_{T(RMS)}$	V_{DRM}/V_{RRM}	$I_{GT (Q1)}$
Standard	Sensitive	TO-92	TO-218X	TO-218AC	TO-220 Isl	TO-220 Non-Isl	TO-251	Compak	SOT-89	SOT-223	TO-252	TO-263			
	EC103xx SxSx	•						•					0.8 A	400 - 600 V	12 - 500 µA
	SxX8xSx	•							•	•			0.8 A	400 - 800 V	5 - 200 µA
Sx01E SxN1		•						•					1 A	400 - 600 V	10 mA
	TCR22-x	•											1.5 A		200 µA
	Sx02xS	•								•			1.5 A		200 µA
	Sxx04xSx						•				•		4 A		50 - 500 µA
Sxx06x	Sxx06xSx				•	•	•				•		6 A	400 - 1000 V	0.2 - 15 mA
Sxx08x	Sxx08xSx				•	•	•				•		8 A		0.2 - 15 mA
Sxx10x	Sxx10xSx				•	•	•				•		10 A		0.2 - 15 mA
Sxx12x						•	•				•		12 A		20 mA
Sxx15x Sxx16x					•	•						•	15 & 16 A		30 mA
Sxx20x Sxx25x					•	•						•	20 & 25 A		30 - 35 mA
Sxx35x			•	•									35 A		40 mA
Sxx40x						•						•	40 A		40 mA
Sxx55x			•	•		•						•	55 A		40 mA
Sxx65x & Sxx70x			•	•									65 & 70 A		50 mA

SIDAC:

Series Name[1]			Thru-Hole	Surface Mount	Switching Vbo	V_{BO} Symmetry	V_{BB}	I_H	I_{TSM}	static dv/dt	di/dt	T_J
Standard	High Energy	Multipulse										
Kxxxzy			DO-15, TO-92	DO-214	79 - 330 V			150 mA	20 A	1500 V/µs	150 A/µs	-40 to +125 °C
	Kxxx0yH		DO-15, TO-92	DO-214	190 - 280 V			150 mA				
		Kxxx1G	DO-15		200 - 380 V			160 mA typ				

DIAC:

HTxxx HTMxxx STxxx			DO-35	SOD-80 Minimelf, DO-214	27 - 70 V	down to 1 V	up to 10 V					-40 to +125 °C

Rectifiers:

Series Name[1]	Thru-Hole	$I_{F(RMS)}$ RMS forward current	$I_{F(AV)}$ Average forward current	I_{FSM} Peak non-repetitive surge current		I^2t I^2t Value for fusing	T_{stg} Storage temperature range	T_J
Dxx15L Dxx20L Dxx25L	TO-220 Isl.	15 - 25A	9.5 to 15.9A	single half cycle; f = 50Hz; T_J (initial) = 25°C 188 - 300A	single half cycle; f = 60Hz; T_J (initial) = 25°C 225 - 350A	210 - 508 A^2s	-40 to +150 °C	-40 to +125 °C

(1) Detailed information about most product series listed here can be found on our web site by entering www.littelfuse.com/series/(Series Name).html

As the world's #1 brand in circuit protection, Littelfuse offers the broadest and deepest portfolio of circuit protection products and a global network of technical support backed by more than 80 years of application design expertise. Visit our design support center to access:

- > Reference Designs
- > Application Notes
- > Application Testing
- > SPICE Models
- > Local Technical Support
- > Product Samples
- > Technical Articles
- > Certification Documents
- > Data Sheets

WWW.LITTELFUSE.COM/DESIGNSUPPORT

Littelfuse offers technologies that protect sensitive electronics and their users against electrostatic discharge (ESD), load switching surges, lightning strike effects, overloads, short circuits, power faults, ground faults and other threats.

Overcurrent protection products:

Fuses Littelfuse offers the world's broadest range of fuse types and ratings, including cartridge, leaded, surface mount and thin film designs

PTCs Positive Temperature Coefficient thermistor technology provides resettable current-limiting protection

Overvoltage protection products:

Varistors Littelfuse offers surface mount Multi-Layer Varistors (MLVs) and industrial Metal Oxide Varistors (MOVs) to protect against transients

GDTs Gas Discharge Tubes (GDTs) to dissipate voltage through a contained plasma gas

Thyristors Littelfuse's solid state switches control the flow of current in a wide range of appliances, tools and equipment

SIDACtor® Devices Overvoltage protection specifically designed for legacy telecom and today's broadband connections

TVS Diodes Silicon Transient Voltage Suppression (TVS) devices

SPA™ Silicon Protection Arrays designed for analog and digital signal line protection

PulseGuard® ESD Suppressors Small, fast-acting Electrostatic Discharge (ESD) suppressors

To request catalogs for the Littelfuse portfolio of circuit protection technologies, please contact your authorized Littelfuse product representative or visit our web site at **www.littelfuse.com/catalogs**

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