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Expertise Applied | Answers Delivered

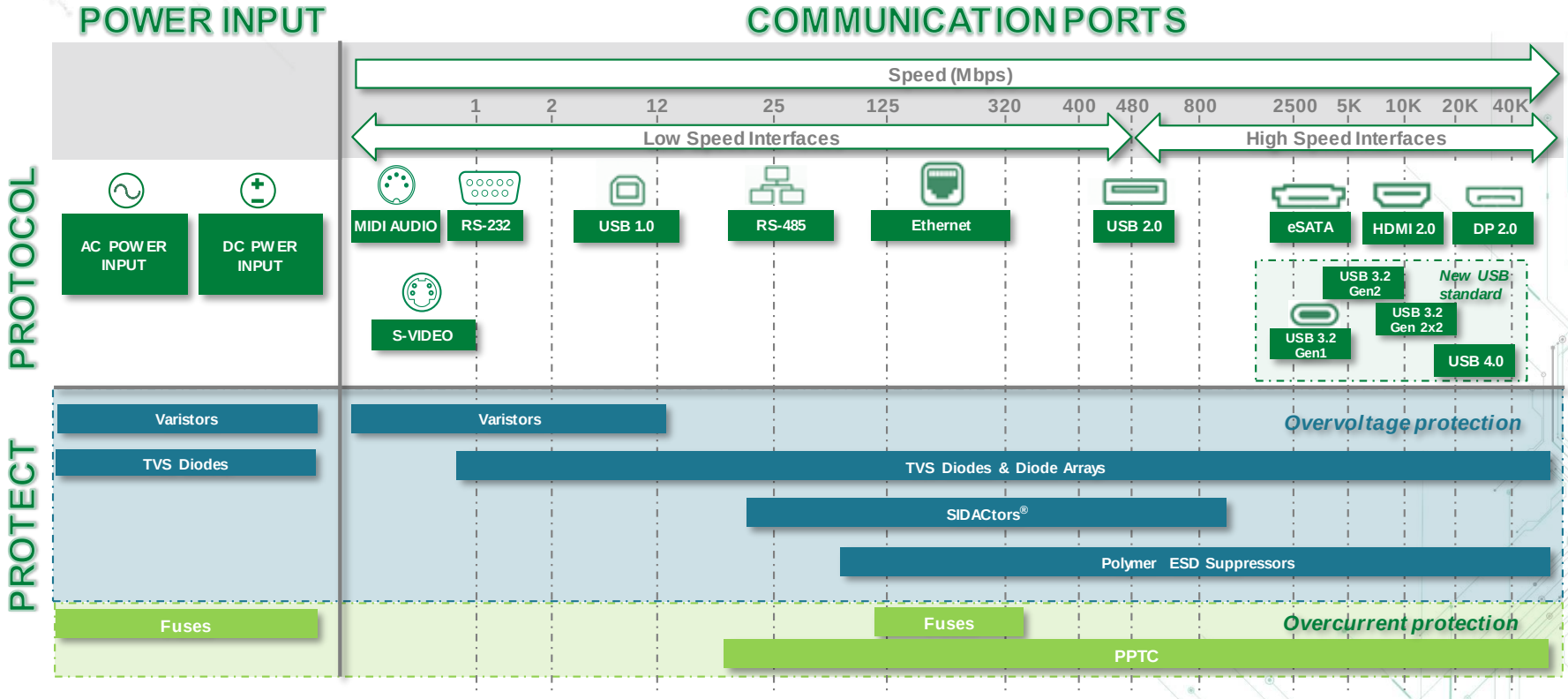
General port protection

- Automotive
- Datacenter & cloud
- Building automation
- Industrial
- Consumer electronics
- Mobile & wearables

REV0120

Index

Wide array of Littelfuse circuit protection solutions for power and communication ports



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Power over Ethernet (PoE)

Evolution from PoE to PoE+ and PoE++

		PoE	PoE+	PoE++ (NEW)	
Year		**2003**	**2009**	**2018**	
Standard		**IEEE 802.3af**	**IEEE 802.3at**	**IEEE 802.3bt**	
Power (supply, PSE)	Max Power	15.4 W	30 W	60 W	90 W
	Max Current	350 mA	600 mA	600 mA	960 mA
	Type	Type 1	Type 2	Type 3	Type 4
Power (receive, PD)		12.95 W	25.5 W	51 W	71.3 W
# of pairs used for power delivery		2 pairs		4 pairs	
Distance		100 m Cat5e			

Higher current and more twisted pairs are used on PoE++ to reach 90 W

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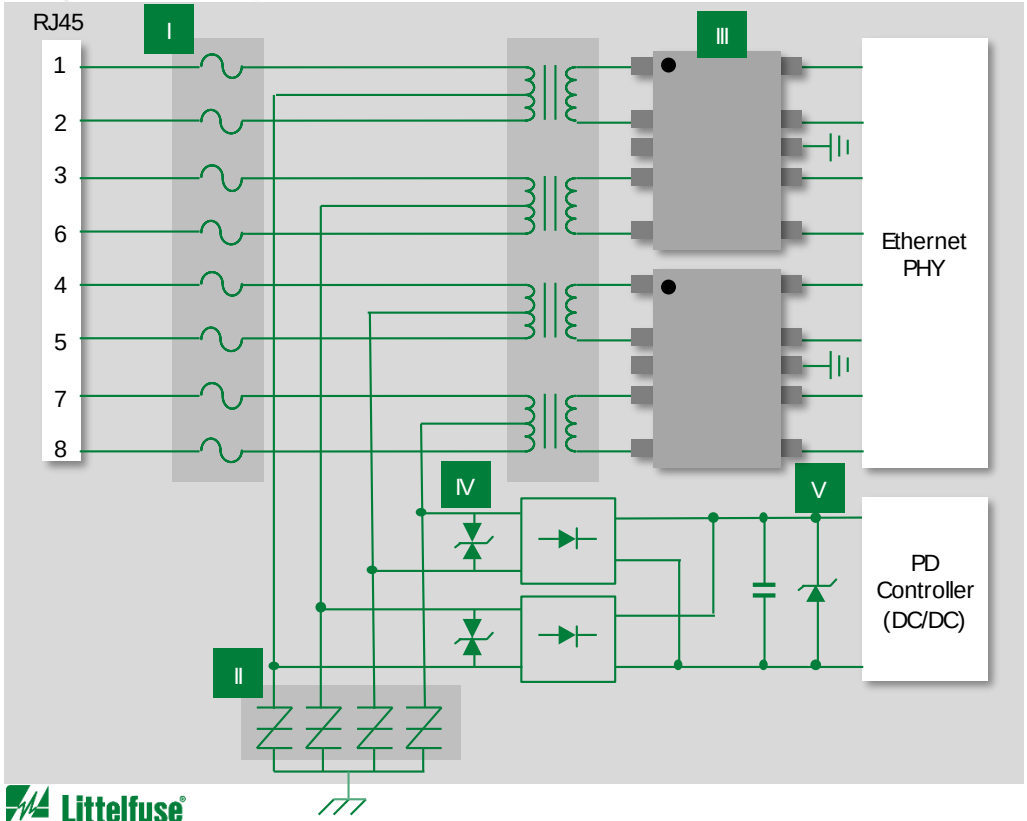
Lightning, ESD, and power fault protection – PoE++



	Technology	Series
I*	Fuse (x8)	0461002
II	SIDACtor® (x4)	P0640SALRP
III	Diode Array (x2)	SP2555NUTG
IV*	TVS Diode (x2)	SMCJ58CA
V	TVS Diode (x1)	SMCJ58A

I — TeleLink® fuses can help protect power fault overcurrent. These fuses are designed specifically for high-speed telecom applications.

IV — A single TVS diode (bi-directional) across the center tap data pair and second TVS diode across the center tap spare pair. The TVS diode can be chosen based on surge requirements for 400 W, 600 W, 1500 W, or 3000 W.

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ESD: Electrostatic Discharge
EFT: Electrical Fast Transient
CDE: Cable Discharge Events

TVS: Transient Voltage Suppression
PHY: Physical Layer
PoE: Power over Ethernet

Features & benefits of Littelfuse components in PoE++

	Technology	Function in application	Product series	Benefits	Features
I	Fuse (x8)	Overcurrent protection from power cross and lightning surges.	0461002	Enables compliance with regulatory standards likeIEC-60950, Telcordia GR-1089 and FCC 47 part 68 Surge Specifications.	Surface mount; surge tolerant fuse designed specifically for high speed telecom applications.
II	SIDACtor® (x4)	Designed to protect baseband equipment against damaging overvoltage transients.	P0640SALRP	Enables to comply with global regulatory standards; does not degrade surge capability after multiple surge events.	Low voltage overshoot; low on-state voltage, and low capacitance.
III	Diode Array (x2)	Designed to provide protection against ESD, CDE ,EFT, and lightning induced surges for high-speed data lines.	SP2555NUTG	Package optimized for high-speed data line routing; minimizes signal distortion; reduces voltage overshoot, and provides a simplified PCB design.	µDFN-10 package; low leakage current (0.1 µA) & low clamping voltage; protect up to 4 channels up to 45 A
IV	TVS Diode (x2)	Protect sensitive electronic equipment from voltage transients induced by lightning and other transient voltage events.	SMCJ58CA	Improves system reliability by clamping the voltage at safe levels during transients.	1500 W peak pulse capability; compatible with the lead-free solder reflow temperature profile
V	TVS Diode (x1)		SMCJ58A		

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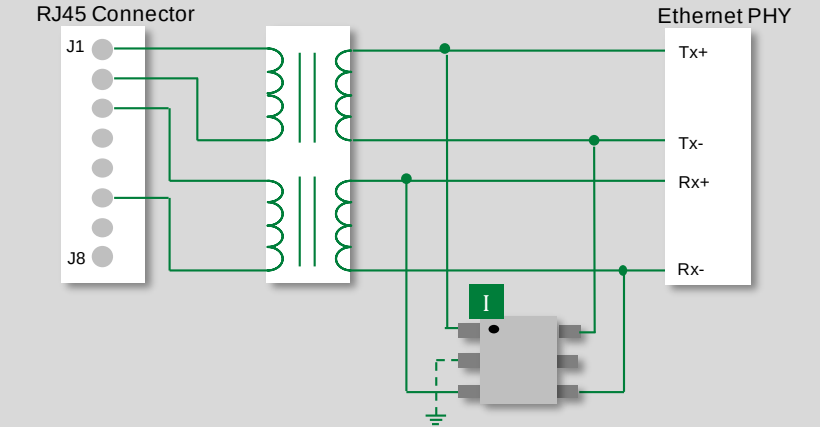
ESD: Electrostatic Discharge
EFT: Electrical Fast Transient
CDE: Cable Discharge Events

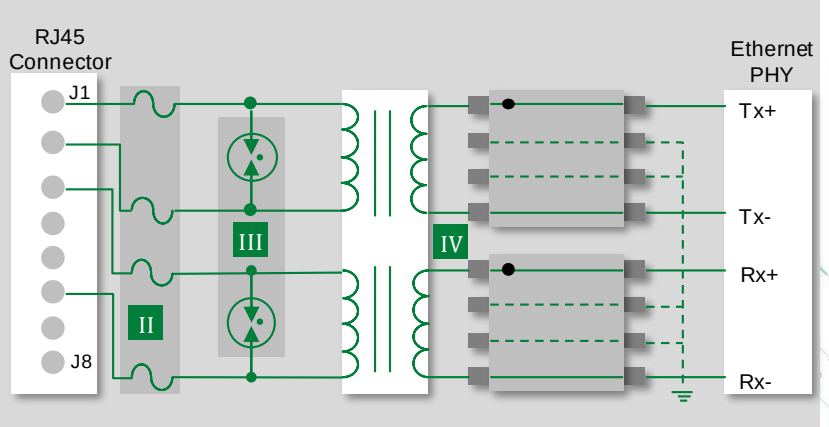
TVS: Transient Voltage Suppression
PHY: Physical Layer
PoE: Power over Ethernet

Circuit protection solutions for Ethernet port

Intra-building



Outdoor and harsh environment



Note: *1Gbps or greater will require an additional two twisted pair and the diode array solution should be replicated.*

	Technology	Function in application	Series	Benefits	Features
I	Diode Array	Protection from ESD and EFT	SRV05-04HTG-D	Ensures design meets with all regulatory requirements; preserves signal integrity	Low capacitance; low leakage current; small design; four lines of protection
II	Fuse	Overcurrent protection	0461xxx	Ensures design meets with all regulatory requirements; compact design	Surface mount; surge tolerant fuse designed specifically for high-speed telecom applications.
III	GDT	Lightning protection uses GDT with diode array to meet standard requirements	SG, CG6, CG5	Ensures safety and reliability of the equipment and helps design meet regulatory requirements	High surge rating; low capacitance; UL recognized
IV	Diode Array		LC03xx, SP40xx		Low capacitance; and low leakage current

ESD: Electrostatic Discharge
EFT: Electrical Fast Transient
CDE: Cable Discharge Events

GDT: Gas Discharge Tubes
PHY: Physical layer
PoE: Power over Ethernet

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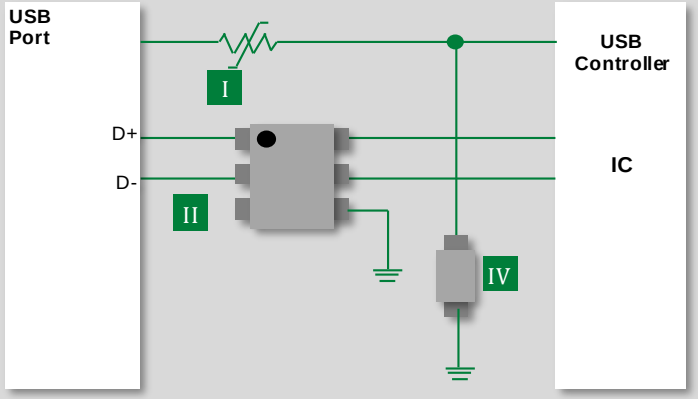
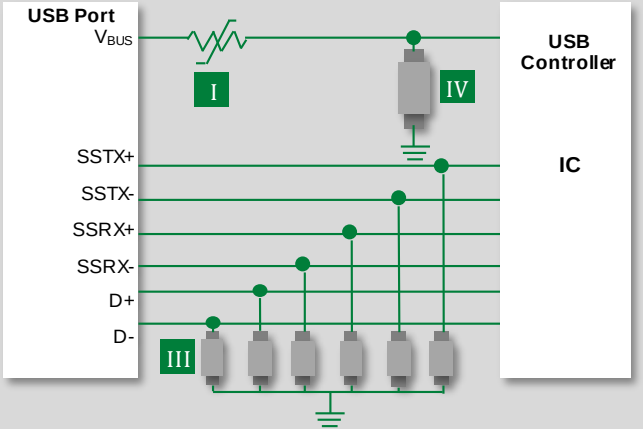
High-speed interfaces

Circuit protection solutions for USB Type A and Type B

USB 2.0 (480 Mbps)



USB 3.2 Gen 1x1 (5 Gbps)



	Technology	Function in application	Series	Benefits	Features
I	Resettable PPTC	Protect 5 VDC power supply from over current & over temperature	LoRho	Offers fast response to over current events; suitable for compact portable devices;	Ultra-low internal resistance; higher current holding in smallest SMD package
II	Diode Array	Protection of data lines against ESD	SP3019-04HTG; SP3400-02UTG	Clamp transient to a safe level preventing catastrophic failure; compact design	Low capacitance 0.3 pF & leakage current (0.01 µA); small form factor µDFN
III	Diode Array (6x)	Protection of data lines against ESD	SP3213-01UTG	Low capacitance ideal for USB; small form factor allows designers layout flexibility	Very low capacitance of 0.09 pF; small form factor µDFN
IV	Diode Array	Protection of power bus against ESD	SP1006-01UTG	Ensure safety of equipment from repetitive ESD strikes without performance degradation	Low leakage current of 100 nA; small form factor

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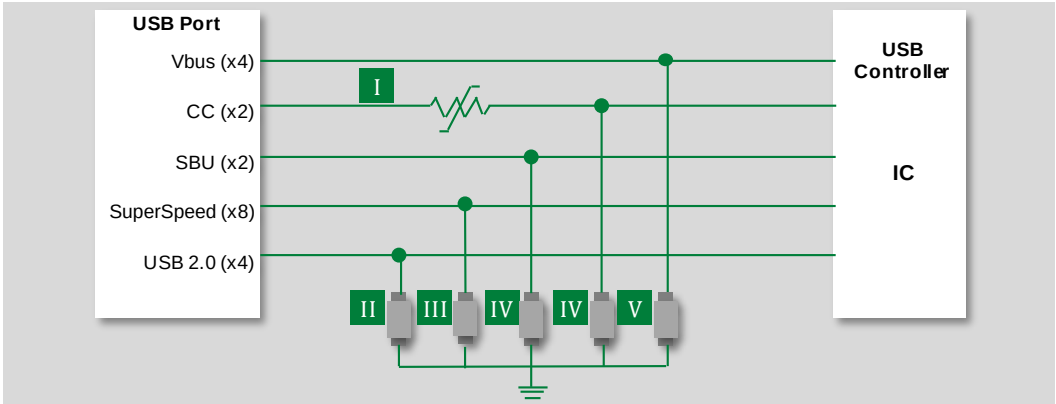
ESD: Electrostatic Discharge
EFT: Electrical Fast Transient
CDE: Cable Discharge Events

TVS: Transient Voltage Suppression
PPTC: Polymer Positive Temperature Coefficient
USB: Universal Serial Bus

Circuit protection solutions for USB Type C

USB 3.2 Gen 2x1 (10 Gbps), USB 3.2 Gen 2x2 (20 Gbps) & USB 4.0 (40 Gbps)



	Technology	Function in application	Series	Benefits	Features
I	Digital Temperature Indicator	Protect cable-connectors against overheating	setP™	Reliable over-heating protection, regardless of power being delivered	Fully compliant with USB Type-C plugs
II	Diode Array	Protect against ESD on USB 2.0 speed data lines	SP3530-01UTG	Space efficient; reliable ESD protection	0201 footprint; extremely low dynamic resistance
III	Diode Array	Protect against ESD on high speed data lines	SP3213-01UTG	Maintain signal integrity of high-speed data lines; reliable ESD protection	Low parasitic capacitance
IV	Diode Array	Protect against ESD	SP1006-UTG	Space efficient	AEC-Q101 qualified; small footprint
V	Diode Array	Protect power bus against ESD	SPHV24-01ETG	Reliably protect charge controller	AEC-Q101 qualified; low dynamic resistance

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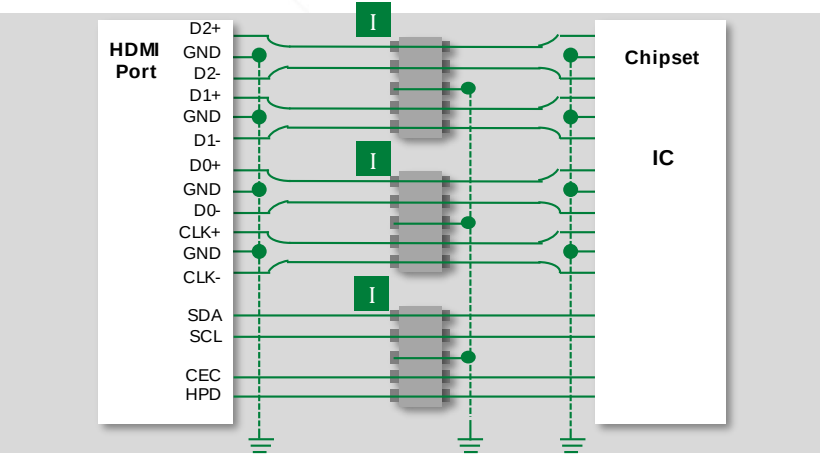
ESD: Electrostatic Discharge
USB: Universal Serial Bus
Vbus: Voltage bus power, Pins A4, A9, B4, B9
CC: Configuration channel, Pins A5, B5

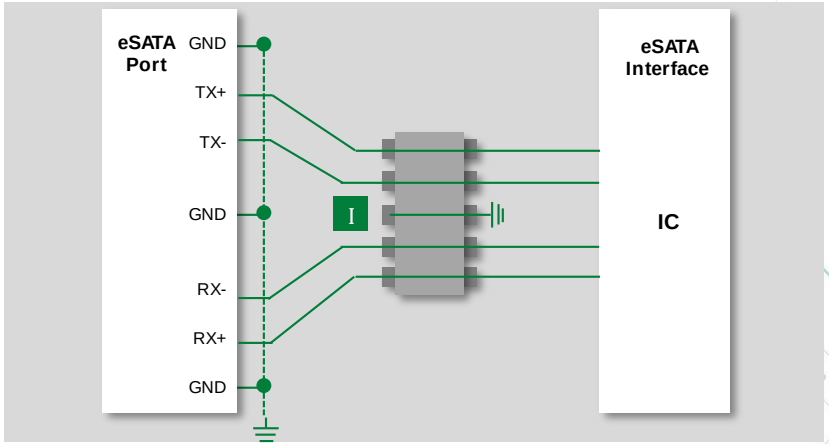
SBU: Sideband use, Pins A8, B8
SuperSpeed: Pins A2, A3, A10, A11, B11, B10, B3, B2
USB 2.0: Pins A6, A7, B7, B6

Circuit protection solutions for HDMI port, DisplayPort, and eSATA port

HDMI & DisplayPort



eSATA



	Technology	Function in application	Series	Benefits	Features
I	Diode Array	Protection of data signal lines from ESD	SP1004U-ULC-04UTG	Low capacitance makes it ideal for high-speed interfaces such as HDMI & eSATA; small form factor allows designers layout flexibility	Low capacitance of 0.2 pF; low clamping voltage of 9.2 V @ IPP=2.0 A (t_P=8/20 µs); industry standard DFN footprint

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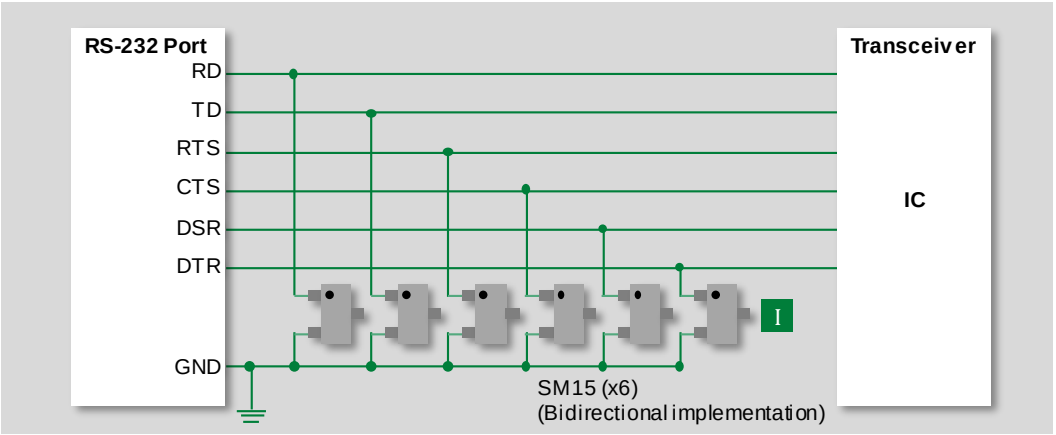
ESD: Electrostatic Discharge
EFT: Electrical Fast Transient
CDE: Cable Discharge Events

TVS: Transient Voltage Suppression
HDMI: High-Definition Multimedia Interface
eSATA: External Serial Advanced Technology Attachment

Circuit protection solution for RS-232 port

RS-232 port



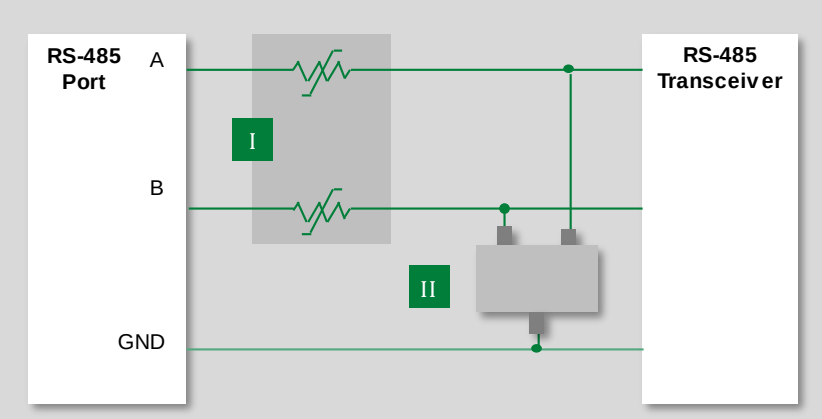
	Technology	Function in application	Series	Benefits	Features
I	Diode Array	Protection of data signal line from ESD	SM15-02HTG	Greatly reduces clamping voltages; 25% higher power handling capability; 2-3 times higher ESD withstand capability	Very low dynamic resistance 0.30 Ω; Low leakage current & clamping voltage

ESD: Electrostatic Discharge
EFT: Electrical Fast Transient
CDE: Cable Discharge Events

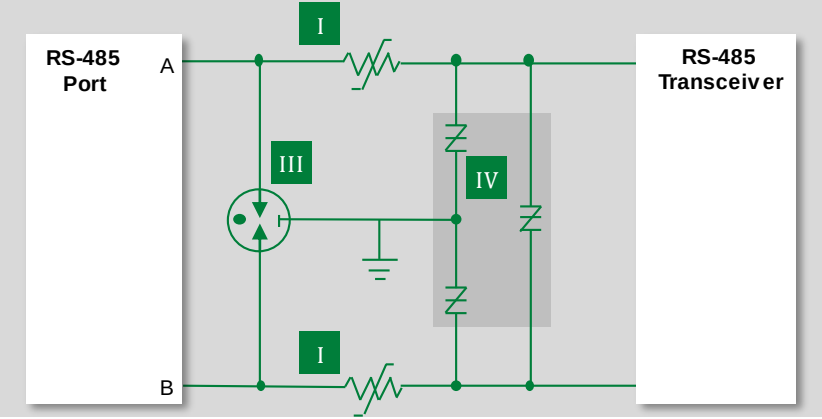
TVS: Transient Voltage Suppression

Circuit protection solutions for RS-485 port

Intra-building



Outdoor and harsh environment



	Technology	Function in application	Series	Benefits	Features
I	Resettable PPTC	Protect equipment from short circuit and power cross.	TSV250	Product choices give engineers increased design flexibility; helps improve line balance	Available in various form factors; Low parasitic capacitance
II*	TVS Diode	Protect from ESD, EFT, and lightning induced surges	SM712	Greatly reduces clamping voltages; robust surge and enhanced ESD protection	Specifically designed for RS-485 with asymmetrical working voltages -7 V to 12 V
III IV	GDT + SIDACtor®	Lightning protection utilizing a GDT with SIDACtor; when lightning occurs the SIDACtor will react first ,causing voltage to increase across PPTC until GDT fires.	GTCxx, Pxxx0s	Coordinated protection against high surge levels; low clamping voltage	Wide range of voltages and form factors; low capacitance and insertion loss Low voltage overshoot, low on-state voltage

Note: Pulse-Guard ESD Suppressors type PGB/XGD are an alternative solution*

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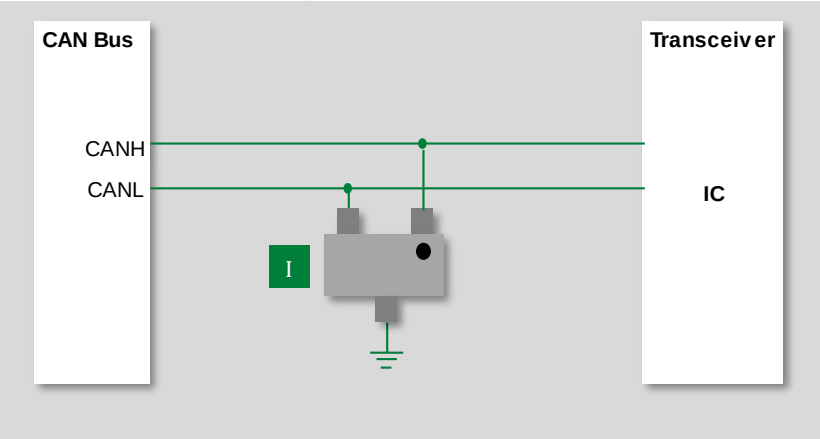
ESD: Electrostatic Discharge
EFT: Electrical Fast Transient
CDE: Cable Discharge Events

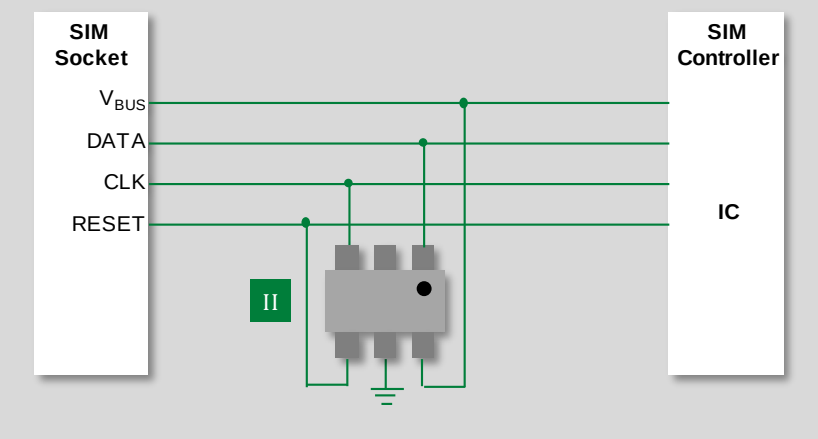
TVS: Transient Voltage Suppression
GDT: Gas Discharge Tubes
PPTC: Polymer Positive Temperature Coefficient

Circuit protection solutions for CAN/LIN bus and SIM/µSIM socket

CAN/LIN Bus



SIM/µSIM socket



	Technology	Function in application	Series	Benefits	Features
I	Diode Array	Protect against ESD and surge transients	AQ24CANA-02HTG	Ensures safety of the equipment without performance degradation	AEC-Q101 qualified; low clamping voltage & leakage current
II	Diode Array	Protection against ESD	SP1001-05VTG	Small form factor suitable for compact designs	Low line capacitance 8 pF; high ESD withstand capability; AEC-Q101 qualified; SMD package

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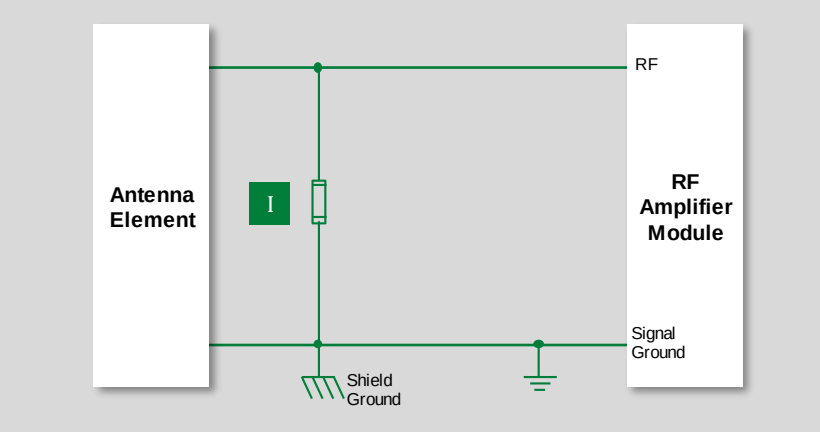
ESD: Electrostatic Discharge
EFT: Electrical Fast Transient
CDE: Cable Discharge Events

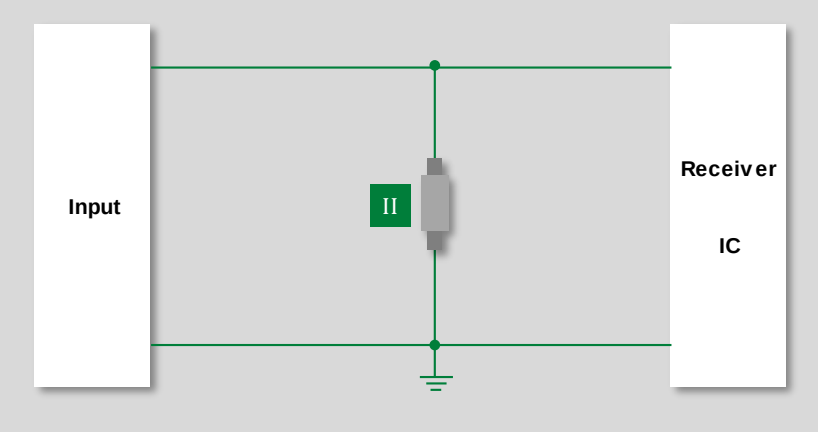
CAN: Controller Area Network
LIN: Local Interconnect Network
SIM: Subscriber Identity Module

Circuit protection solutions for antenna and sensor inputs

Antenna



Sensor input



	Technology	Function in application	Series	Benefits	Features
I	Polymer ESD Suppressor	Protection against ESD	XGD10603	Preserve signal integrity; withstand high levels of ESD	Extremely low capacitance (0.09 pF); high ESD withstand rating (30 kV)
II	Diode Array	Protection against ESD	SP3522-01ETG	Small form factor suitable for compact designs	High ESD withstand rating; low leakage current; AEC-Q101 qualified parts available

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ESD: Electrostatic Discharge
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TVS: Transient Voltage Suppression

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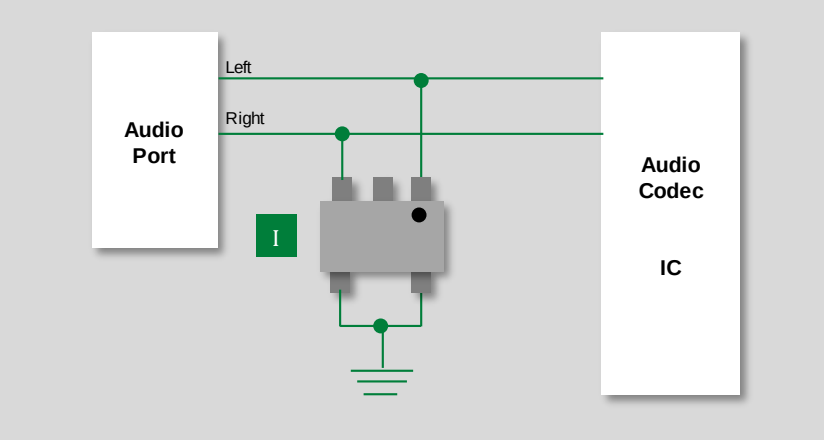
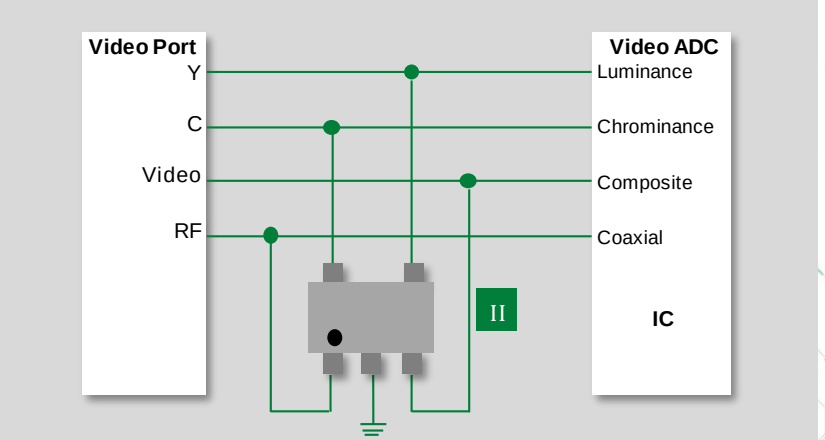
Low speed applications

Circuit protection solutions for audio and video lines

Audio line



Video line



	Technology	Function in application	Series	Benefits	Features
I	Diode Array	Protect audio codec from damaging ESD	SP1002	Absorb repetitive ESD strikes at the max level without system performance degradation; compact design	Low capacitance of 5 pF; low leakage current of 0.5 µA; small package
II	Diode Array	Prevent video analog-to-digital converter from damaging ESD	SP3019-04HTG	Absorb repetitive ESD strikes at the max level without system performance degradation; compact design	Low capacitance of 0.3 pF; low leakage current

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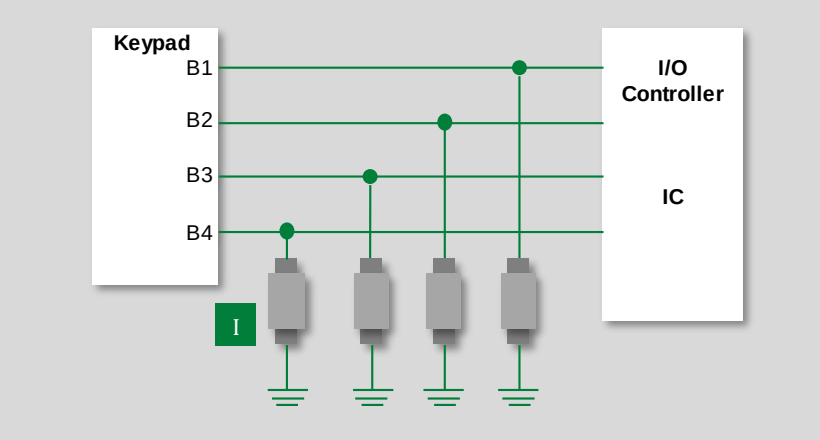
ESD: Electrostatic Discharge
EFT: Electrical Fast Transient
CDE: Cable Discharge Events

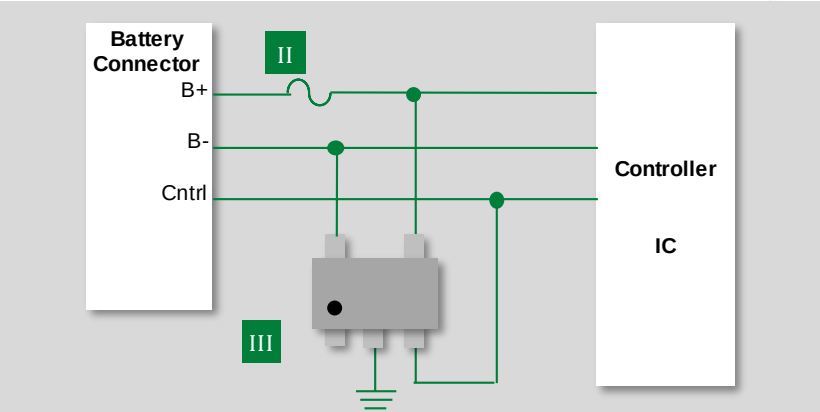
TVS: Transient Voltage Suppression

Circuit protection solution for keypads, buttons, switches, and battery packs

Circuit protection for keypads



Circuit protection for battery packs



	Technology	Function in application	Series	Benefits	Features
I	Varistor	Protect ICs and other components at the circuit board level against ESD	V5.5MLA0402	Provides design flexibility using discrete single-channel devices	AEC-Q200 compliant; standard low capacitance
II	Fuse	Overcurrent protection for power bus	435	Small form factor suitable for compact designs	35 A interrupt rating at 32 VDC; compact footprint (0402)
III	Diode Array	ESD protection for power bus and control line	SP3019-04HTG	Maintain signal integrity with reliable protection	AEC-Q101 Qualified; low Input capacitance; fast response time (< 1 ns)

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ESD: Electrostatic Discharge
EFT: Electrical Fast Transient
CDE: Cable Discharge Events

TVS: Transient Voltage Suppression
MLV: Multilayer Varistor

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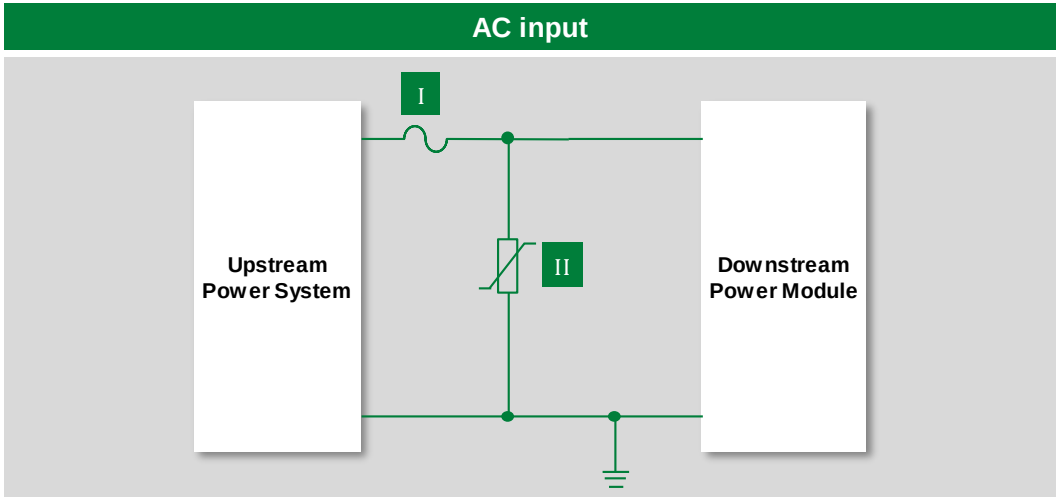
Power inputs

Circuit protection solutions for AC input



	Technology	Function in application	Series	Benefits	Features
I	Fuse	Protection against short circuit and overload conditions	313	Reduces damage to equipment compact design; energy efficiency protection	Third-party compliance; low internal resistance
II*	Varistor	Protection against severe surge transients	UltraMOV	Reduces customer qualification time by complying with third-party safety standards	High energy absorption capability; small package; high operating temperature range up to 125° C

Note: High power TVS Diodes (AK Series) are an alternative solution*

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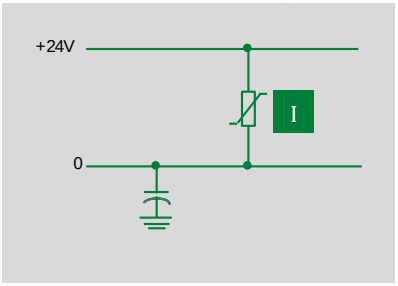
ESD: Electrostatic Discharge
EFT: Electrical Fast Transient
CDE: Cable Discharge Events

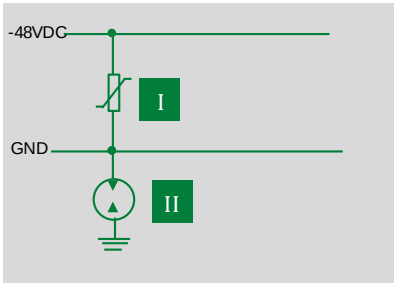
AC: Alternate Current
MOV: Metal-oxide Varistor

Circuit protection for DC input

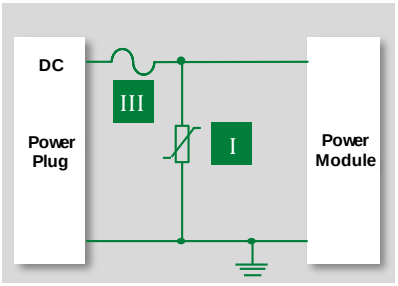
DC Input 12 V/24 V DC



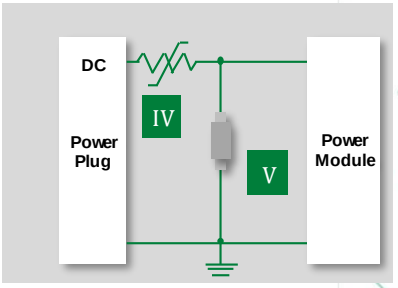
DC Input 48 V DC



DC Input (PFC circuit)



DC Input (portable devices)



	Technology	Function in application	Series	Benefits	Features
I	Varistor	Protect against voltage transients	CIII, LV Ultra MOV, LA	Increased long-term reliability; more board space; higher surge handling density	High peak surge current rating; high operating temperature range up to 125° C
II	GDT	Ground isolation protection	CG	Extremely low leakage current to ground	High peak surge current ratings; wide operating voltage range
III	Fuse	Overcurrent protection	477, 505	Reduces damage to equipment; compact design	Small footprint with high breaking capacity;
IV	Resettable PPTC	Protection against short circuit and overload current conditions	LoRho	Offers fast response to over current events; suitable for compact portable devices;	Ultra-low internal resistance; higher current holding in smallest SMD package
V	TVS Diode	Surge and ESD protection	SP11xx	Ensure safety of equipment from repetitive ESD strikes without performance degradation	Low leakage current of 100 nA; small form factor; multiple voltages available

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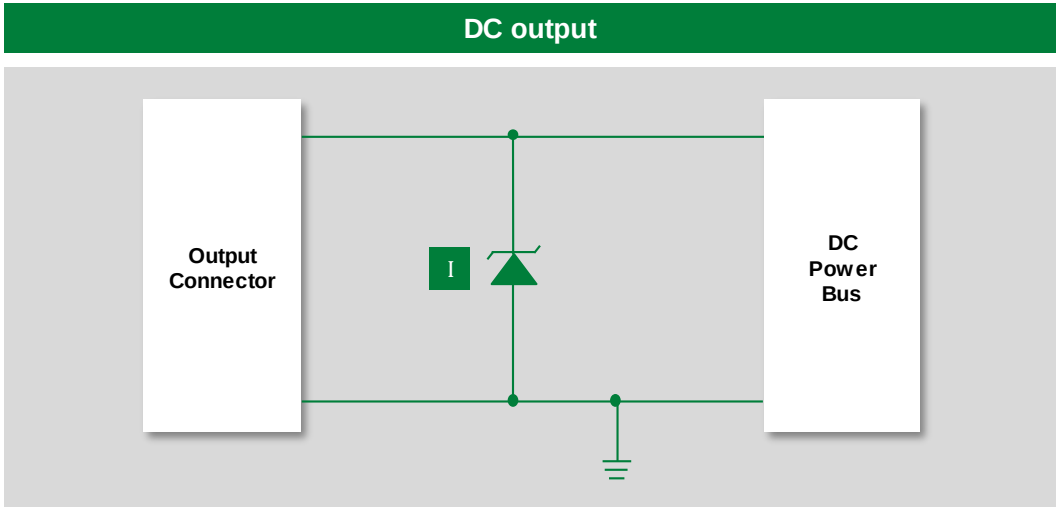
ESD: Electrostatic Discharge
EFT: Electrical Fast Transient
CDE: Cable Discharge Events

DC: Direct Current
MOV: Metal-oxide Varistor
GDT: Gas Discharge Tube

Circuit protection solution for DC output



	Technology	Function in application	Series	Benefits	Features
I	TVS Diode	Overvoltage surge protection	SMBJ	Improves system reliability by protecting downstream components from transients on power lines	Excellent clamping capability

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ESD: Electrostatic Discharge
EFT: Electrical Fast Transient
CDE: Cable Discharge Events

AC: Alternate Current
TVS: Transient Voltage Suppression

Additional information can be found on littelfuse.com

Circuit Protection Selection Guide

ESD Protection Design Guide

ESD Suppression Design Guide

Ethernet Protection Selection Guide

USB Type-C ESD Protection Solution

Circuit Protection for USB applications

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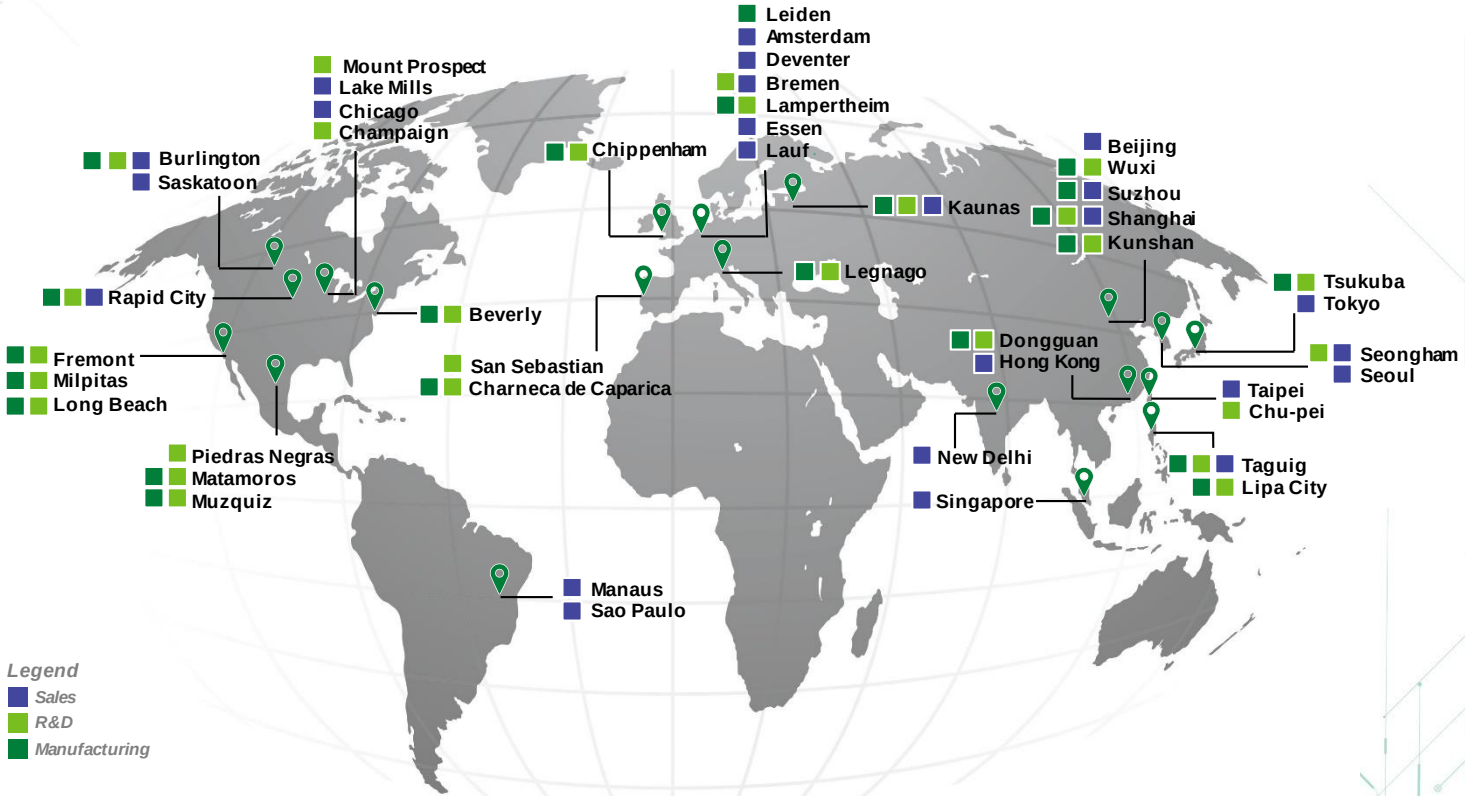
Local resources for a global market



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Why choose Littelfuse?

- A global leader with a broad product portfolio, covering every aspect of protection, sensing, and control
- Application expertise combined with product designed guidelines to help you determine the best component for your application
- Testing capabilities and assistance to support confirmation of your product selection
- Standards compliance expertise, including product compliance to many standards and approval support
- High-volume manufacturing that is committed to the highest quality standards
- A global company with local support

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