Industrial Controllers (PLC) & Communication Infrastructure

Industrial

Littelfuse®

Expertise Applied | Answers Delivered

Key elements of Industry 4.0 IoT infrastructure

Key elements of Industry 4.0

The ***Programmable Logic Controller (PLC)*** is the main building block that processes data coming from input devices and controls outputs. It also enables connectivity to various fieldbuses, including PROFIBUS, Modbus and CAN open, industrial Ethernet such as Profinet, EtherCAT, wireless technologies, and the backplane bus of the system.

Fieldbus and industrial Ethernet: In Industrial IoT applications, wired communication technology is continuously growing and is evolving from traditional fieldbus to Ethernet-based bus in order to connect human-machine interfaces, PLCs, machines, I/Os, etc.

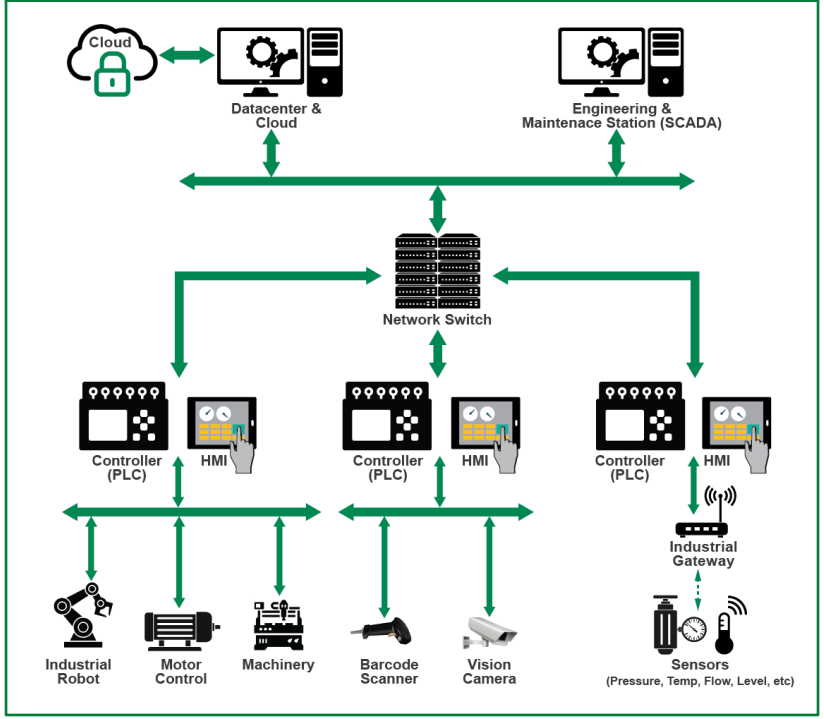
Industrial IoT Gateway plays a critical role in collecting data from multiple wired or wireless sensor nodes and transmitting them to cloud applications or central condition monitoring systems, to enable process data analysis.

Datacenter and cloud are the backbone of the Industrial IoT network for data storage and analytics and are individually configured for on-site use in manufacturing. The system includes important core components, such as high-performance computing, network, back-up and disaster recovery, process data archiving, and security.

Human-Machine Interface (HMI) is a display used to effectively control equipment as well as make decisions based on machine feedback.

Input/Output (I/O) modules collect data from input devices, including proximity, pressure, and temperature sensors and push buttons, and control actuators, such as valves, relays, and lamps (output devices). These modules can either be added to a PLC control cabinet or be integrated into manufacturing equipment on the factory floor.

Industrial IoT (IIoT) infrastructure



Littelfuse solutions for industrial controller (PLC) and communication infrastructure

1 Programmable Logic Controller

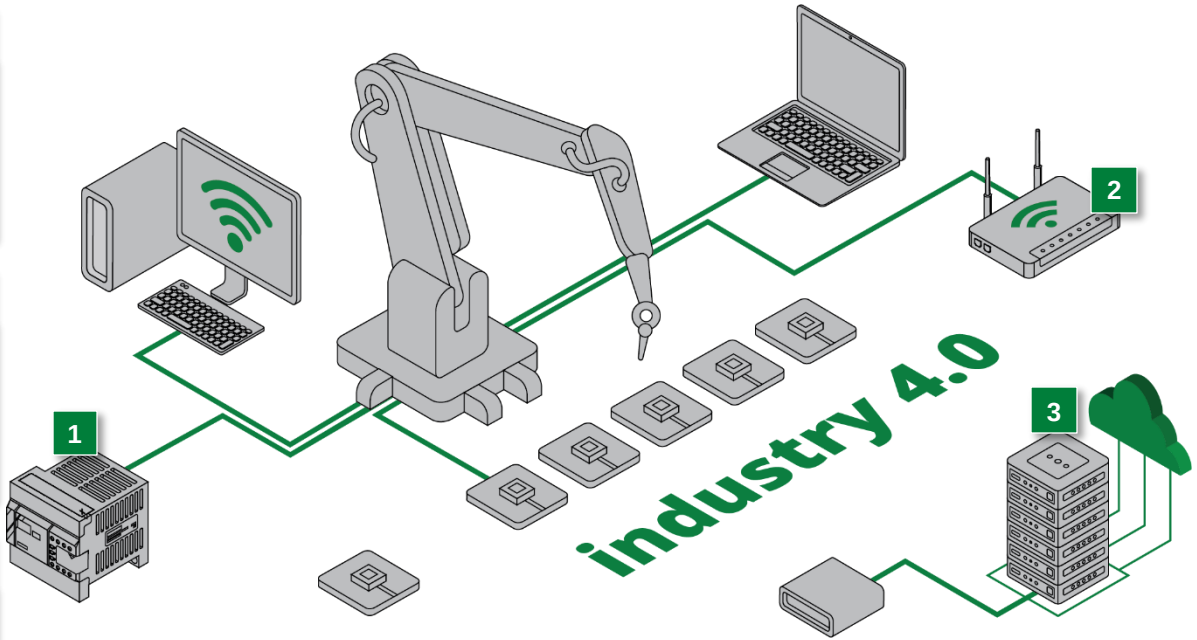
- Fuse
- PPTC
- eFuse
- SIDACtor® + MOV
- MOSFET
- Si/SiC Diode
- Schottky Diode
- Solid State Relay
- TVS Diode
- TVS Diode Array

2 Industrial IoT Gateway

- Fuse
- PPTC
- eFuse
- SIDACtor®
- GDT
- TVS Diode
- TVS Diode Array

3 Datacenter & Cloud

- Fuse
- MOV, SPD
- Protection Relay
- TVS Diode
- Reed Sensor
- Bipolar Module
- IGBT or MOSFET
- IGBT Module
- Gate Driver
- Temp. Sensor



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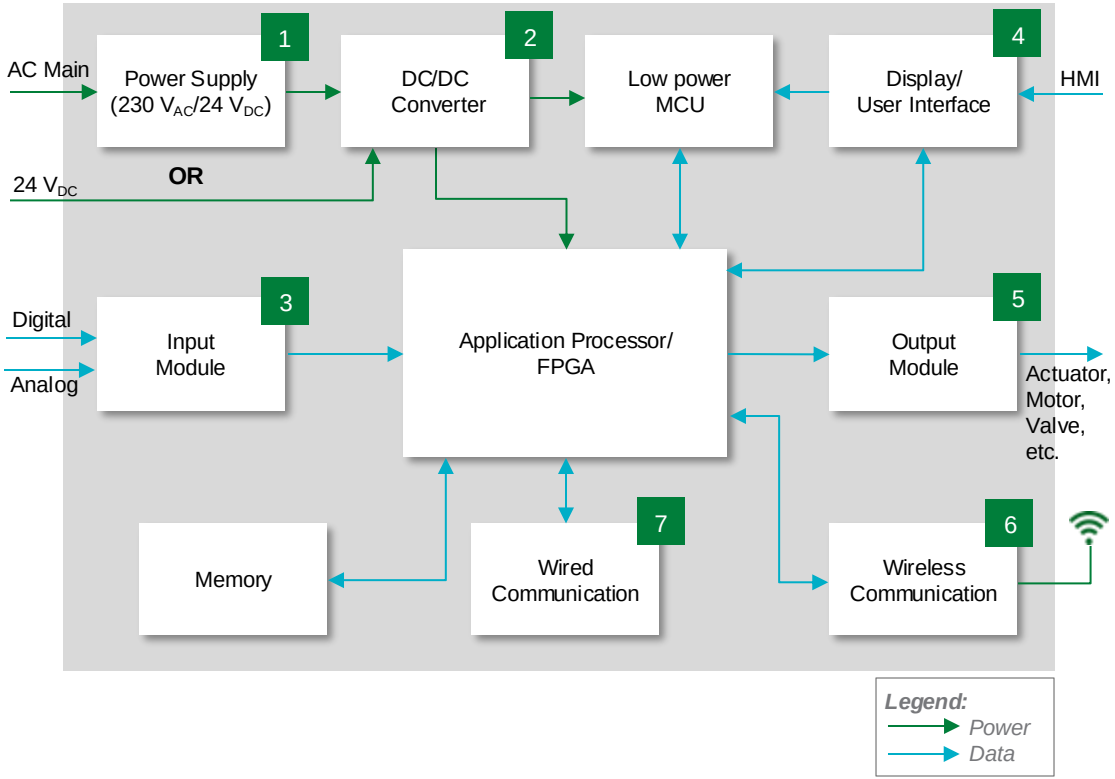
Programmable Logic
Controller (PLC) Unit Solutions

Functional block diagram of Programmable Logic Controller (PLC)

Click on the product series in the table below for more info



	Technology	Series
1	Fuse	875, 807, 373
	MOV	C-III, TMOV
	SIDACtor® + MOV	Pxxx0ME + V10E300P
	TVS Diode	P6KE, P6SMB, 8.0SMDJ, 1.5SMB
	MOSFET	650 V-X2 Class, 650 V-X3 Class
	Si/SiC Diode	LSIC2SD065XX, DSEI, DSEP, DPG
	Schottky Diode	MBR, DST
	PPTC	Low Rho
2	Fuse	477, 505
	TVS Diode	SMDJ, SMF
	eFuse	LS2406
3	TVS Diode	SMBJ, SMCJ, SMDJ
4	TVS Diode Array	SP3213-01UTG
5	Solid State Relay	CPC19xx
6	TVS Diode Array	SP3213-01UTG
	Polymer ESD	PESD
7	High-speed Communication protection solutions	

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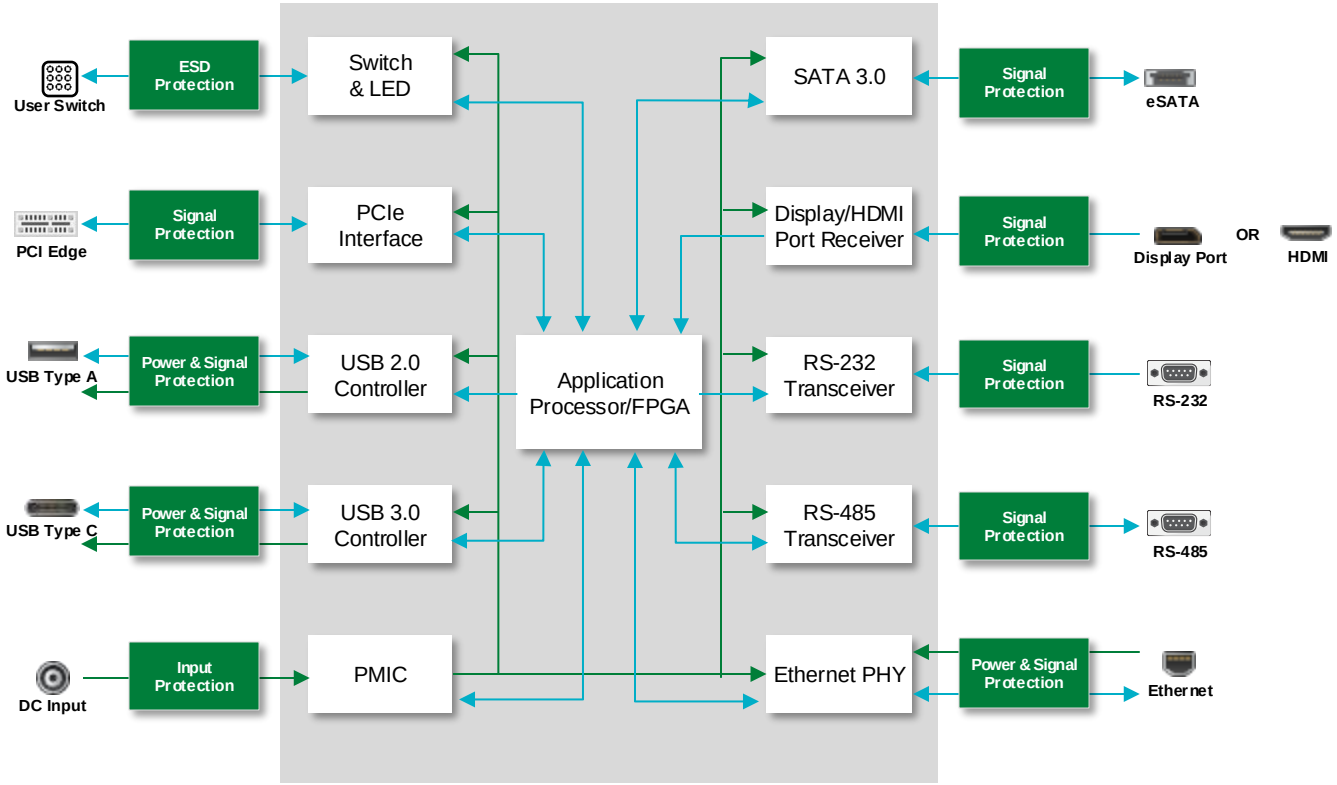
Click on the product series in the table below for more info

Benefits of Littelfuse components in power supply unit

	Technology	Function in application	Series	Benefits	Features
1	Fuse	Protects the power stage from overcurrent events	875, 807, 373	Reduces customer qualification time by complying with third-party safety standards, such as UL/IEC	Compliance with third-party safety standards, such as UL/IEC; low internal resistance; shock-safe
	MOV	Protects the power supply unit from voltage transients and lightning	C-III, TMOV	Reduces customer qualification time by complying with third-party safety standards, such as UL/IEC	High energy absorption capability: 40–530 J (2 ms); integrated thermal protection
	SIDACtor® + MOV	Low clamp protection for AC power	Pxxx0ME + V10E300P	Lower clamping provides robust protection to downstream components	Lower clamping voltage; lower leakage current
	TVS Diode	Protects the power supply unit from voltage transients	P6KE, P6SMB, 8.0SMDJ, 1.5SMB	Improves system reliability by protecting downstream components from transients	600 W peak pulse capability; glass passivated chip junction
	MOSFET	For PFC circuit and high-frequency switching	650 V-X2 Class, 650 V-X3 Class	High power density; easy to mount; space savings	Lowest on-resistance $R_{DS(ON)}$ and gate charge Q_g; fast soft recovery body diode; dv/dt ruggedness
	Si/SiC Diode	Boosts diodes in PFC	LSIC2SD065XX, DSEI, DSEP, DPG	Excellent surge capability; extremely fast, temperature-independent switching behavior	Low leakage current; very short recovery time; low Irm values
	Schottky Diode	Rectification and blocking in power supply units	MBR, DST	Enables the design of high efficiency power supplies	Ultra-low forward voltage drop; high-frequency operation
	PPTC	Provides overcurrent protection	Low Rho	Less power dissipation; compact design	Ultralow internal resistance; very thin profile
2	Fuse	Overcurrent protection	477, 505	Reduces damage to equipment; compact design	Small footprint with high breaking capacity
	TVS Diode	Protects against voltage transients	SMDJ, SMF	Improves system reliability by protecting downstream components from transients	Excellent clamping capability
	eFuse	Overcurrent and overvoltage protection	LS2406	Integrated solution for overload, short circuit, input voltage surge, excessive inrush current, over-temperature and reverse current protections	28V 6A rated current limit switch; integrate a 24mΩ ultra low on protection switch; external adjustable current limit, input OVP threshold & soft-start time
3	TVS Diode	Voltage transient protection	SMBJ, SMCJ, SMDJ	Helps protect the most sensitive parts of design from surge events	Multiple sizes and surge capabilities
4	TVS Diode Array	Protects touchscreen ICs from user-induced ESD events	SP3213-01UTG	Absorbs repetitive ESD	Low capacitance of 1.0 pF per I/O
5	Solid State Relay	Switches output loads, such as valve, motor, etc.	CPC19xx	Precise switching AC loads; low EMI and RFI generation; high noise immunity	Load currents up to 3 A; blocking voltage up to 800 V; zero cross/rapid turn-on
6	TVS Diode Array	Protects ICs from ESD	SP3213-01UTG	Absorbs repetitive ESD	Low capacitance of 1.0 pF per I/O
	Polymer ESD	Protects ICs from ESD	PESD	Supports passing agency requirements	Low leakage current

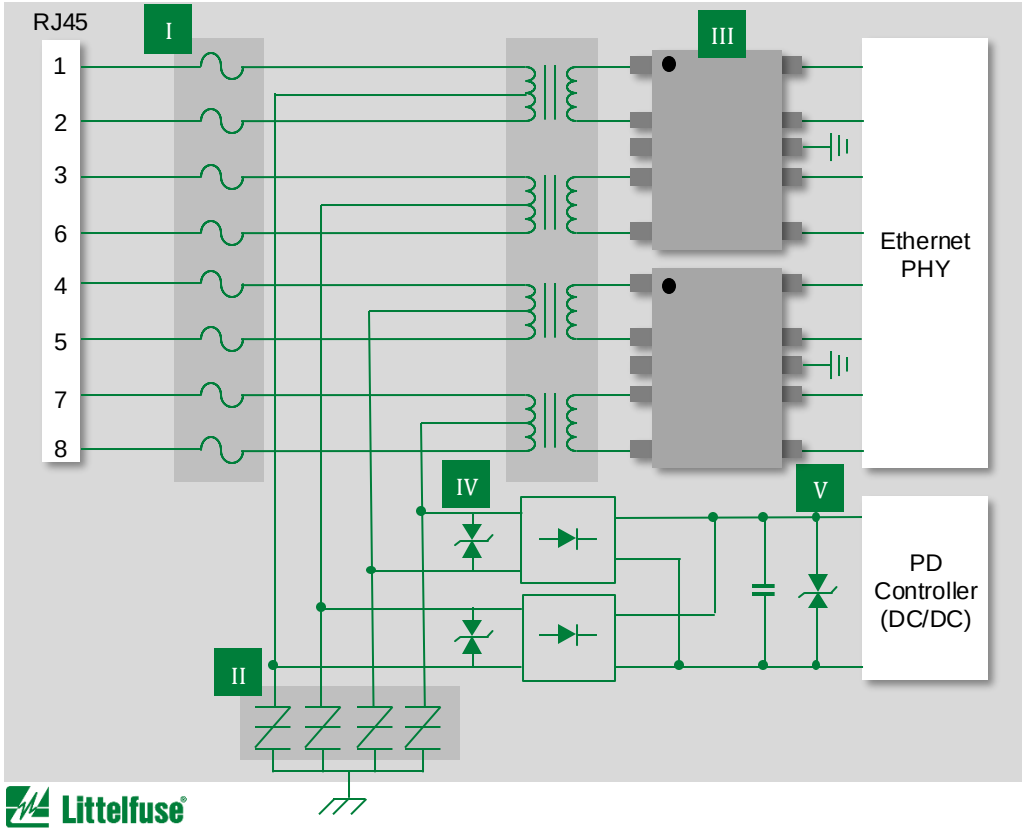
Industrial IoT Gateway & High-speed communication protection solutions

Common high-speed communication protocols in industrial communication infrastructure



Click on the product series in the table below for more info

PoE++ protection



	Technology	Series
I*	Fuse (x8)	0461002
II	SIDACtor® (x4)	P4500SCLRP
III	TVS Diode Array (x2)	SP2555NUTG
IV*	TVS Diode (x2)	SMCJ58CA
V*	TVS Diode (x1)	SMCJ58CA

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

IV Use 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.

V For outdoor facing ports, consider a higher surge protection device, such as the 5.0SMDJ.

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Features and benefits of Littelfuse components in PoE++

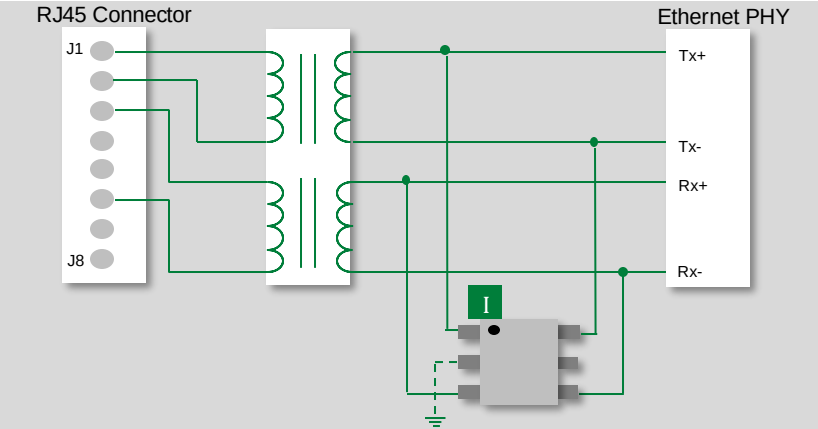
Click on the product series in the table below for more info

	Technology	Function in application	Product series	Benefits	Features
I	Fuse (x8)	Provides overcurrent protection from power cross and lightning surges	0461002	Enables compliance with regulatory standards, such as IEC-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)	Protects baseband equipment against damage from overvoltage transients	P4500SCLRP	Enables compliance with global regulatory standards; does not degrade surge capability after multiple surge events	Low-voltage overshoot; low on-state voltage; low capacitance
III	TVS Diode Array (x2)	Protects from ESD, CDE, EFT, and lightning-induced surges or 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) and low clamping voltage; protects up to four channels up to 45 A
			SMCJ58CA		µDFN-10 package; low-capacitance and low clamping voltage; protection of four channels up to 30 A
			SMCJ58CA		SOT23-6L package; low-capacitance and low clamping voltage; protection of four channels up to 30 A
IV	TVS Diode (x2)	Protects sensitive electronic equipment from voltage transients induced by lightning and other transient voltage events	0461002	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)		P4500SCLRP		

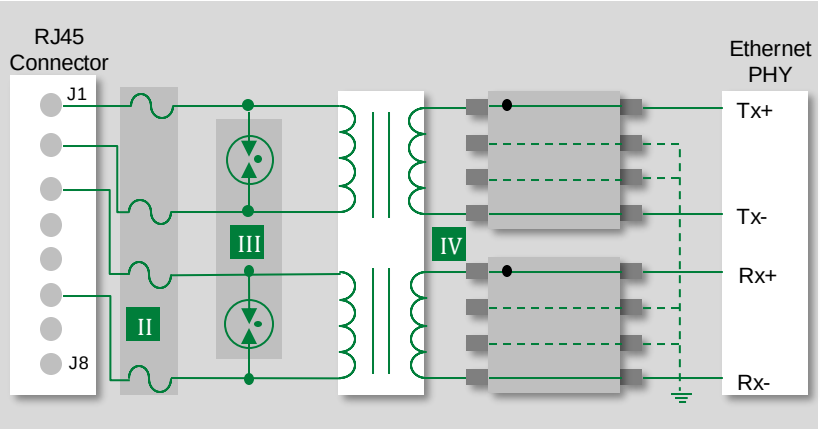
Click on the product series in the table below for more info

Ethernet port protection

Intra-building



Outdoor and harsh environment



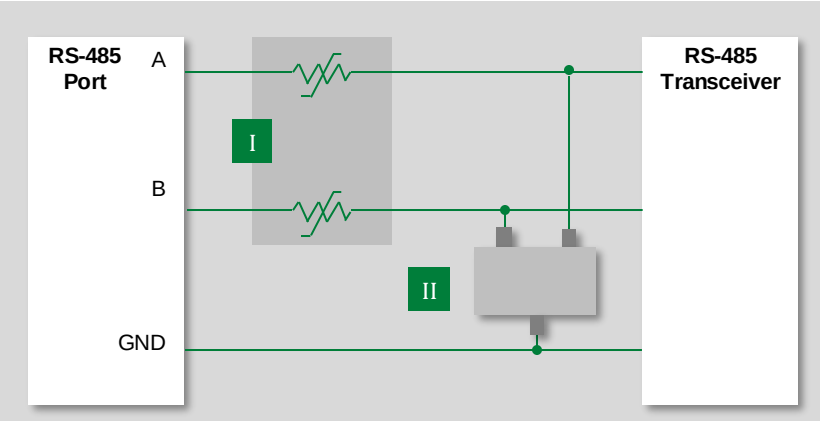
Note: *A rate of 1 Gbps or greater will require an additional two twisted pairs, and the diode array solution should be replicated.*

	Technology	Function in application	Series	Benefits	Features
I	TVS 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	0461002	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	TVS Diode Array		LC03xx, SP40xx		Low capacitance; low leakage current

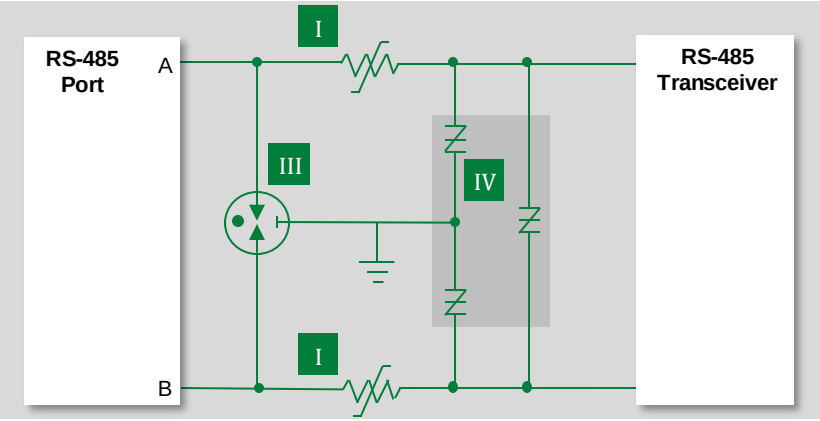
Click on the product series in the table below for more info

Circuit protection solutions for RS-485 port

Intra-building



Outdoor and harsh environment



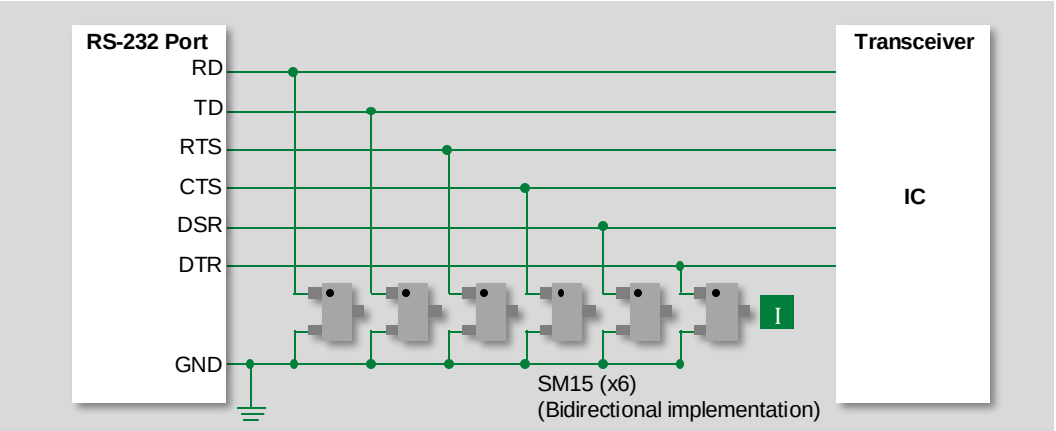
	Technology	Function in application	Series	Benefits	Features
I	Resettable PPTC	Protects equipment from short circuit and power cross	TSV250	Product choices give engineers increased design flexibility; helps improve line balance	Available in various form factors; low parasitic capacitance
II*	TVS Diode Array	Protects from ESD, EFT, and lightning-induced surges	SP712	Greatly reduces clamping voltages; robust surge and enhanced ESD protection	Specifically designed for RS-485 with asymmetrical working voltages−7 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 + PxxxxS4xLRP	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.*

Click on the product series in the table below for more info

Circuit protection solution for RS-232 port

RS-232 port

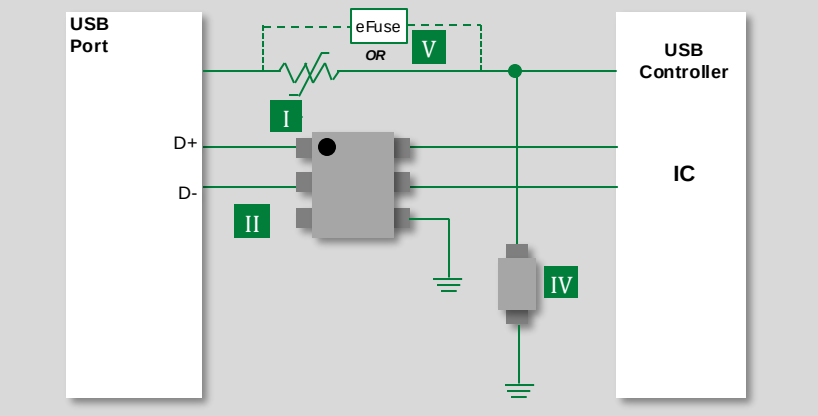


	Technology	Function in application	Series	Benefits	Features
I	TVS Diode Array	Protection of data signal line from ESD	SM15-02HTG	Greatly reduces clamping voltages; 25% higher power handling capability; two to three times higher ESD withstand capability	Very low dynamic resistance of 0.30 Ω; low leakage current and clamping voltage
			SD15C-01FTG		Very low dynamic resistance of 0.46 Ω; low leakage current and clamping voltage

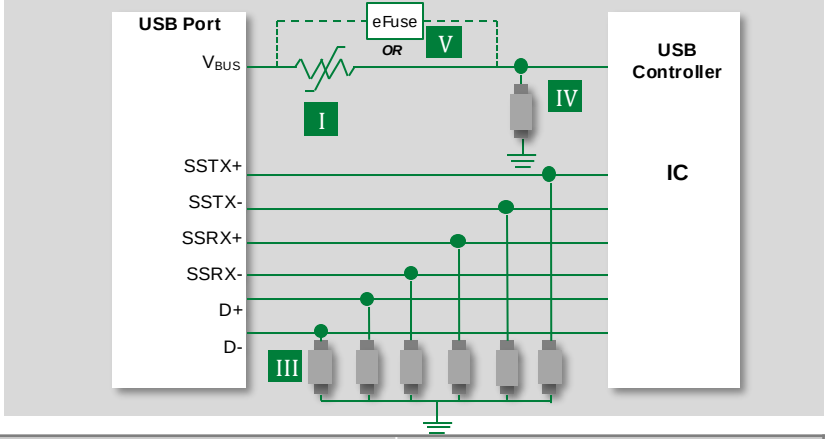
Click on the product series in the table below for more info

USB Type A and Type B protection

USB 2.0 (480 Mbps)



USB 3.2 Gen 1x1 (5 Gbps)

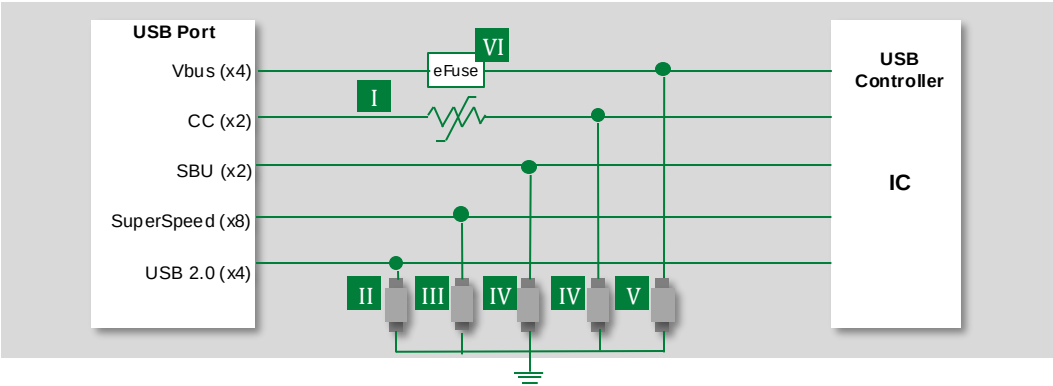


	Technology	Function in application	Series	Benefits	Features
I	Resettable PPTC	Protection of 5 VDC power supply from overcurrent and overheating	Low Rho	Offers fast response to overcurrent events; suitable for compact portable devices	Ultra-low internal resistance; higher current holding in smallest SMD package
II	TVS 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 of 0.3 pF and leakage current of 0.01 µA; small form factor µDFN
III	TVS Diode Array (6x)	Protection of data lines against ESD	SP3213-01UTG, SP00R6, SP33R6	Low capacitance; ideal for USB; small form factor allows designers layout flexibility	Very low capacitance of 0.09 pF; small form factor µDFN
IV	TVS 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
V	eFuse	Overcurrent and overvoltage protection	LS0505EVD22	Integrated solution with features like current limit protection, thermal shutdown, internal soft-start	5 V, 5 A eFuse with 30 Vmax and OVP / OCP

Click on the product series in the table below for more info

USB Type C protection

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

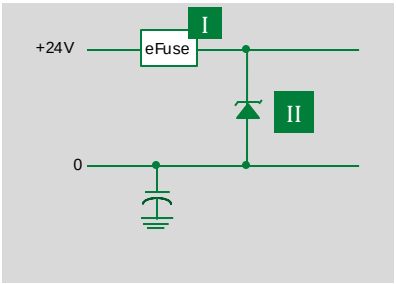


	Technology	Function in application	Series	Benefits	Features
I	Digital Temperature Indicator	Protect cable-connectors against overheating	setP™	Reliable overheating protection regardless of power being delivered	Fully compliant with USB Type-C plugs
II	TVS Diode Array	Protect against ESD on USB 2.0 speed data lines	SP3530-01UTG	Space efficient; reliable ESD protection	0201 footprint; extremely low dynamic resistance
III	TVS Diode Array	Protect against ESD on high-speed data lines	SP3213-01UTG, SP00R6, SP33R6	Maintain signal integrity of high-speed data lines; reliable ESD protection	Low parasitic capacitance
IV	TVS Diode Array	Protect against ESD	SP1006-01UTG	Space efficient	AEC-Q101 qualified; small footprint
V	TVS Diode Array	Protect power bus against ESD	SPHV24-01ETG	Reliably protect charge controller	AEC-Q101 qualified; low dynamic resistance
VI	eFuse	Overcurrent and overvoltage protection	LS2406ERQ23	Integrated solution for overload, short circuit, input voltage surge, excessive inrush current, over-temperature and reverse current protections	28 V 6 A rated current limit switch; integrate a 24 mΩ ultra low on protection switch; adjustable current limit, input OVP threshold and soft-start time

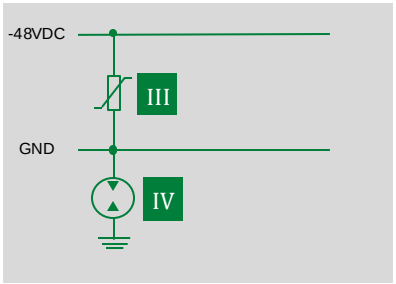
Click on the product series in the table below for more info

Circuit protection for DC input

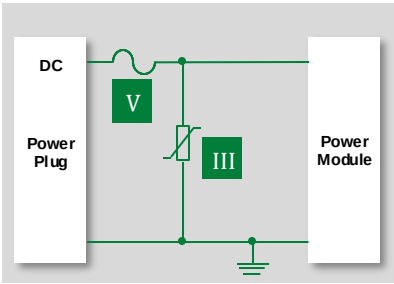
DC Input 12 V / 24 V DC



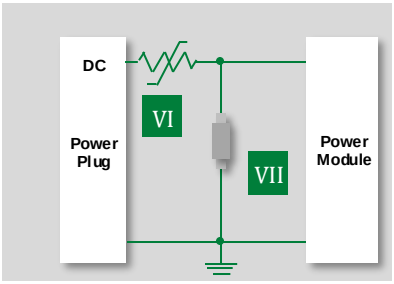
DC Input 48 V DC



DC Input (PFC circuit)



DC Input (portable devices)



	Technology	Function in application	Series	Benefits	Features
I	eFuse	Overcurrent and overvoltage protection	LS1205EVD33, LS2406ERQ23	Integrated solution with features like current limit protection, thermal shutdown, internal soft-start	12 V / 5 V / 3.3 V eFuse with Programmable OCP/OVP; 28 V, 6 A eFuse with Reverse Current Blocking
II	TVS Diode	Protects against voltage transients	SMDJ, SMF	Improves system reliability by protecting downstream components from transients on power lines	Excellent clamping capability
III	Varistor	Protects against voltage transients	LV Ultra MOV	Increased long-term reliability; more board space; higher surge handling density	High peak surge current rating; high operating temperature range of up to 125 °C
IV	GDT	Ground isolation protection	CG	Extremely low leakage current to ground	High peak-surge current ratings; wide operating voltage range
V	Fuse	Overcurrent protection	477, 505	Reduces damage to equipment; compact design	Small footprint with high breaking capacity
VI	Resettable PPTC	Protects against short circuit and overload current conditions	Low Rho	Offers fast response to overcurrent events; suitable for compact portable devices	Ultra-low internal resistance; higher current holding in smallest SMD package
VII	TVS Diode Array	Surge and ESD protection	SP11xx	Ensures safety of equipment from repetitive ESD strikes without performance degradation	Low leakage current of 100 nA; small form factor; multiple voltages available

Datacenter and Cloud Solutions

Protection products for power distribution & controls required in data center

Click on the product series in the table below for more info

	Technology	Product series
1	Fuse	CCMR, FLNR, FLSR, JLLN, JLLS, JTD
	Fuseholder	LF, LFJ, LFT
2	Power Distribution Box	LD
3	Arc Flash Relay	AF0100, PGR-8800
4	Time Delay Relay	TMV, TRU
5	Surge Protection Devices	SPD2
6	Ground Fault Relay	SE-704, SE-701
7	Temperature Control	TCR9C
8	NGR Monitor	SE-330

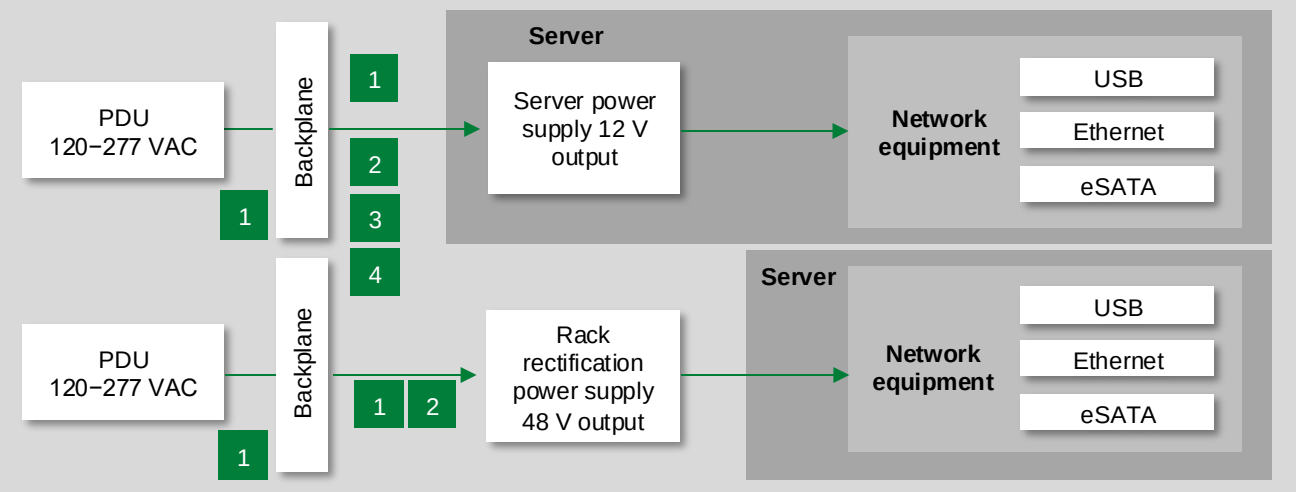
Click on the product series in the table below for more info

Features and benefits of Littelfuse solutions

	Technology	Function in application	Product series	Benefits	Features
1	Fuse	Protects HVAC system from overload and short circuit	CCMR, FLNR, FLSR, JLLN, JLLS, JTD	Chosen over breakers due to their higher amperages; quicker response time; easy coordination; and no calibration required	Voltage range 0–600 V and current ratings from 1–1200 A
	Fuseholder	Supports fuse protection	LF, LFJ, LFT	DIN rail mountable	Low resistance connection
2	Power Distribution Box	Safe, convenient way of splicing cables; protects against accidental shorting and personnel protection	LD	Offers integral DIN-Rail mount and an optional hinged safety cover	Voltage rating: 600 V; current rating: Based on NEC Table 310.16, using 75 °C copper wire; UL/CSA recognized
3	Arc Flash Relay	Reduces damage by detecting the light from an arc flash and rapidly tripping	AF0100, PGR-8800	Fits into a wide range of arc-flash applications; monitor two arc-flash sensors; compact design	Input voltage: 100-240 VAC/VDC, 24-48 VDC, dual sensor input; surface mounting DIN RAIL
4	Time Delay Relay	Delays the blower from turning on or off after the demand has been met	TMV, TRU	Provides flexibility for use in all systems; quick and easy installation for old and new systems	Universal AC-DC operating voltage, solid state output and total encapsulation for protection against shock, vibration, and humidity
5	Surge Protection Devices	Protects from power fluctuations or surges	SPD2	Withstands high-energy transients to prevent disruption, downtime, and degradation or damage to equipment	20 kA nominal interrupting rating and 50 kA maximum interrupting rating
6	Ground Fault Relay	Offers ground-fault detection and protection	SE-704, SE-701	No calibration; low-level protection and system coordination; low maintenance	Microprocessor-based; adjustable pickup (10 mA–5 A); adjustable time delay (30 ms–2 s)
7	Temperature Control	Low-cost modular approach to accurate control of temperature	TCR9C	NTC thermistor sensing for low cost setpoint control; solid-state output to control resistive heaters; small package	Input voltage: 120–240 V_{AC}; high power output is available in 6, 10, and 20 amperes
8	NGR Monitor	Advanced ground-fault and neutral-grounding resistor monitoring relay	SE-330	Detects resistor failure within seconds; reduces transient-overvoltage risk; removes risk of ground-fault-detection failure	Continuous NGR monitoring & Ground-fault detection; analog output 4-20 mA; adjustable pickup (2–100%) & time delay (0.1–10 s)

Click on the product series in the table below for more info

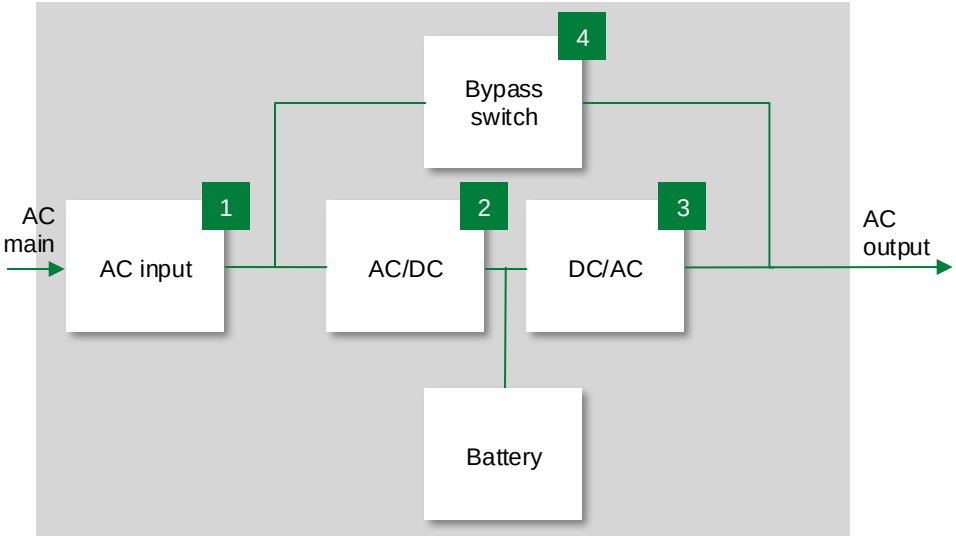
Circuit protection for power supply (12 V and 48 V)



	Technology	Function in application	Series	Benefits	Features
1	Fuse	Overcurrent protection	881F, TLS, 456SD, 456SDE	Reduces customer qualification time by complying with safety standards; compact design	Third-party compliance, such as UL/IEC; low internal resistance; surface mountable
2	Varistor	Surge protection	UltraMOV	Reduces customer qualification time by complying with third-party safety standards	High energy absorption capability; small package; high operating temp of up to 125 °C
3	TVS Diode	ESD protection	SMDJ	Ensures safety of equipment from repetitive ESD strikes without performance degradation	1500 W peak pulse capability; fast response time; excellent clamping capability
4	Reed Sensor	Enclosure open/close status	59150, 59020	suited for high-moisture and contaminated environments; simple installation and adjustment	Customer-defined sensitivity; rated for high-temperature applications of up to 105 °C

Click on the product series in the table below for more info

UPS Block Diagram



	Technology	Product series
1	Fuse II	PSR, JLLS, 505, 607
	MOV III	TMOV, Xtreme
	SIDACtor® + MOV	Pxxx0ME + LA
2	Rectifier Module IV	MDD, VUO, MDMA
	IGBT and MOSFET	XPT and Ultra junction X-Class
	Gate Driver V	IXD_6xx
	Temperature Sensor	USP10976
3	IGBT Module	MIXA, MIXG
	Gate Driver V	IXD_6xx
	Temperature Sensor	USP10976
4	Thyristor Module	MCC, MCMA

Notes:

I. The double conversion on the line UPS diagram is used as a representative model. Other topologies will have similar solution needs at common power levels.

II. Many other fuse options are available based on system attributes, such as current, voltage, available fault current, surge withstand, and sensitivity of semiconductors.

III. For a faster response, consider P6KE or a combination of a SIDACtor® and an MOV (P3500SCLRP + LA series).

IV. Rectifier diodes can potentially be substituted with active rectification through IGBT for improved functionality.

V. Gate drivers may require an isolator. Contact the factory for recommendations.

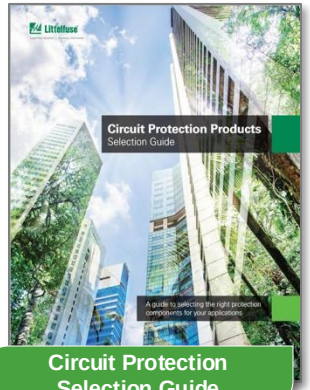
Click on the product series in the table below for more info

Features and benefits of Littelfuse solutions for UPS

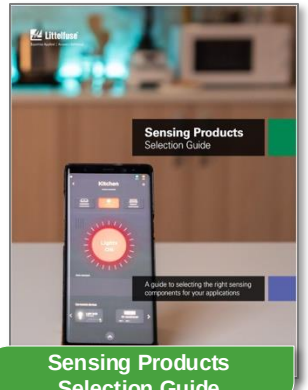
	Technology	Function in application	Product series	Benefits	Features
1	Fuse	Overcurrent fault protection	PSR, JLLS, 505, 607	Fast opening to protect the power conversion semiconductor components	Compact design; 200 kA interrupting rating; available with PCB mounts
	MOV	Surge voltage protection	TMOV, Xtreme	Promotes robust operation	Thermally protected; high peak surge current rating of up to 10 kA; wave solderable
	SIDACtor® + MOV		Pxxx0ME + LA	Lower clamping provides robust protection to downstream components, such as capacitors, bridge, and other electronics	Lower clamping voltage; lower leakage current (NA level)
2	Rectifier Module	Rectifies AC to DC	MDD, VUO, MDMA	High-efficiency system operation with low heat generation	Improved temperature and power cycling; very low forward voltage drop; very low leakage current
	IGBT and MOSFET	Power factor correction	XPT and Ultra junction X-Class	Low power consumption; high-efficiency system operation	Ultra low on-resistance $R_{DS(ON)}$ and gate charge Q_g; fast body diode dv/dt ruggedness
	Gate Driver	Controls the IGBT/MOSFET	IXD_6xx	Dual outputs provide space-efficient design; high immunity to latch-up; rise/fall times less than 10 ns	Tight tolerance; small form factor; fast thermal response
	Temperature Sensor	Monitoring rectifier for optimal performance	USP10976	Enables robust system operation	Tight tolerance; wide range of temperature sensing
3	IGBT Module	Inverts DC to AC	MIXA, MIXG	Low power loss; high-efficiency operation	Very low gate charge; low EMI; fast and soft reverse recovery; low operating forward voltage
	Gate Driver	Controls the IGBT inverter	IXD_6xx	Dual outputs provide space-efficient design; high immunity to latch-up; rise/fall times less than 10 ns	Tight tolerance; small form factor; fast thermal response
	Temperature Sensor	Monitoring inverter for optimal performance	USP10976	Enables robust system operation	Tight tolerance; wide range of temperature sensing
4	Thyristor Module	Switching power source	MCC, MCMA	Space saving; low thermal loss; high-efficiency operation	Low forward voltage drop; leads suitable for PCB soldering; improved temperature and power cycling

Additional information can be found on Littelfuse.com

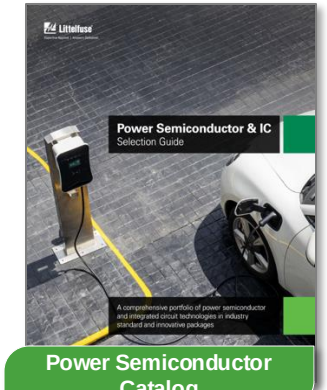
Explore the world of Littelfuse with the electronics eCatalogs (electronicscatalogs.littelfuse.com)



Circuit Protection Selection Guide



Sensing Products Selection Guide

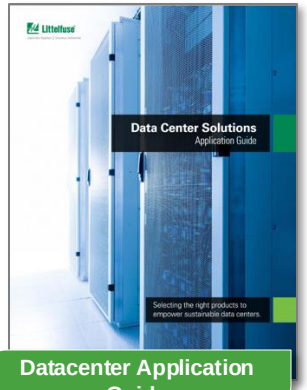


Power Semiconductor Catalog

Integrated Circuit Selection Guide

Industrial Fuses Catalog

Click on images for more information



Datacenter Application Guide

General Port Protection

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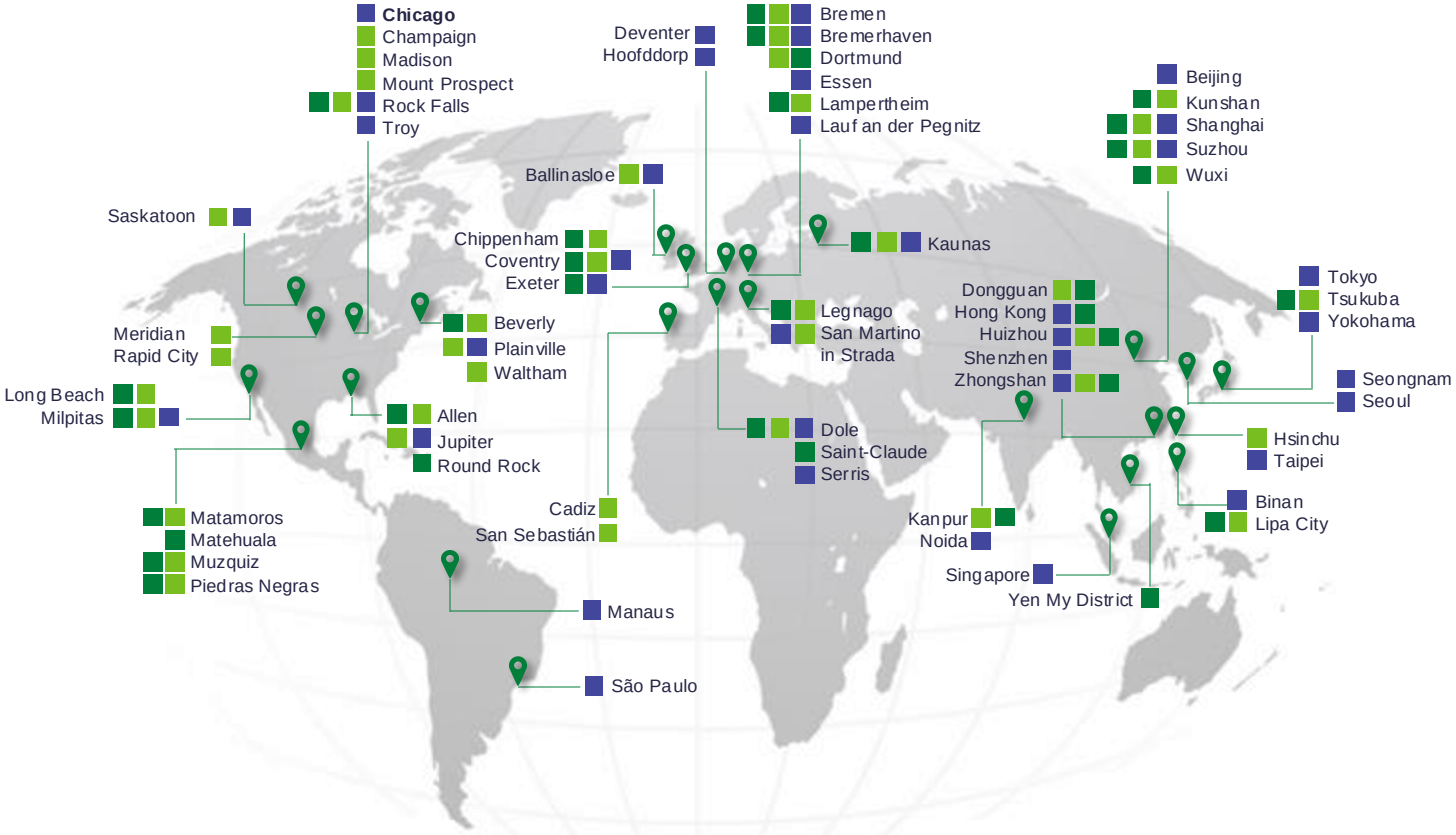

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