Littelfuse®

Expertise Applied | Answers Delivered

EV Charging Solutions

EV Infrastructure

REV0624

Types of electric vehicle charging stations

AC Level 1

- 120 V AC, 1-phase, 12 A or 16 A max. continuous current

AC Level 2

- 208 V–240 V AC, 1-phase, ≤ 80 A max. continuous current

DC Fast Charger

- 380 V–600 V AC, 3-phase input; DC output

US

Rest of World

Mode 1 (AC)

- 250 V AC, 1-phase, 16 A max. -OR- 480 V AC, 3-phase, 16 A max.
- Cord with no pilot or auxiliary connections

Mode 2 (AC)

- 250 V AC, 1-phase, 32 A max. -OR- 480 V AC, 3-phase, 32 A max.
- Cord with control pilot & shock protection

- Delivers AC power from the wall socket to vehicle's on-board charger
- Typically takes 8–12 hours* to charge fully depleted battery

Mode 3 (AC)

- 250 V AC, 1-phase, 32 A max. -OR- 480 V AC, 3-phase, 63 A max.
- Permanently connected to AC supply with control pilot & shock protection

- Delivers AC power from the electrical supply to vehicle's on-board charger
- Typically takes 4–6 hours* to charge fully depleted battery

Mode 4 (DC)

- AC or DC input supply, cord or permanently connected, with control pilot & shock protection

- Delivers DC power, bypassing the vehicle's on-board charger
- Typically provides 80% charge of fully depleted battery within 15 to 30 minutes*

As defined by SAE J1772
As defined by IEC 61851-1

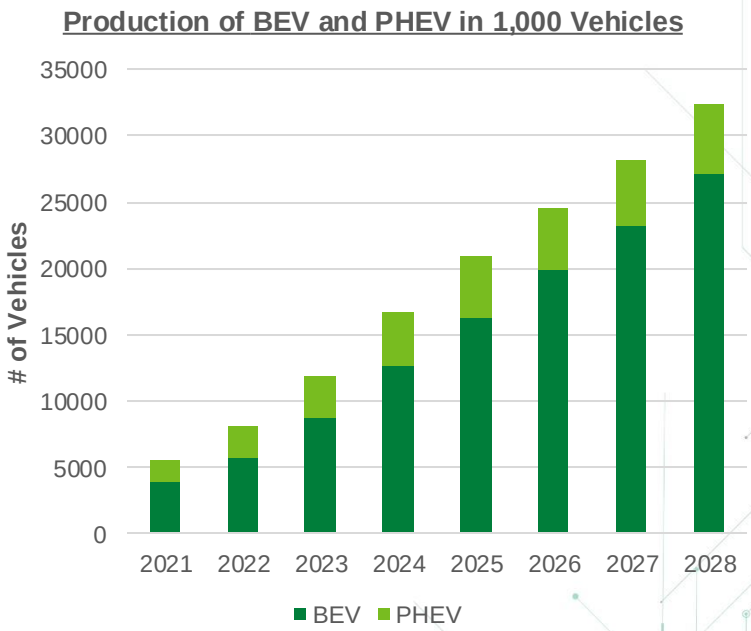
** Charge time dependent on vehicle's battery capacity and charge acceptance rate*

Global electric vehicle charging equipment market

Market trends and drivers

Increasing production of electrified vehicles: an estimated 5.5 million vehicles in 2021 growing to 33 million vehicles in 2028 ⇨ need for higher efficiency
7.3 million chargers are active across the world (as of 2019), of which, nearly 6.5 million are private chargers, 0.6 million are public slow chargers and 0.26 million are public fast chargers
Currently, more than 70% of the charging is done at home. Convenience, cost efficiency, and a variety of support policies are the main drivers.
Majority of charging to occur at home or workplace during a span of several hours (AC charging) ⇨ bidirectional topologies are needed for smart grid
Limited charging grid capacity in most regions ⇨ emergence of combo ESS+PV with DC charger
Increasing voltage and power output of DC chargers for fast charging ⇨ 500 V to 800 V
Low-power DC charging solution in residential/campus settings will replace the AC charging solution to make charging faster (20 kW DC versus 7 kW AC)
DC chargers create a need for improved safety and additional components, such as advanced liquid-cooled cables, substations, and energy storage systems

Rapid growth of EV at ~25% CAGR



Source: IHS Report and Littelfuse estimates

Littelfuse
Expertise Applied | Answers Delivered

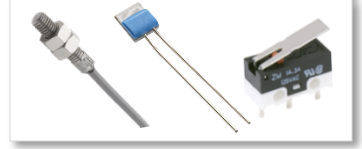
Acronyms:
PV: Photovoltaic
ESS: Energy Storage System
HEV: Battery-Powered Electric Vehicle
PHEV: Plug-In Hybrid Electric Vehicle

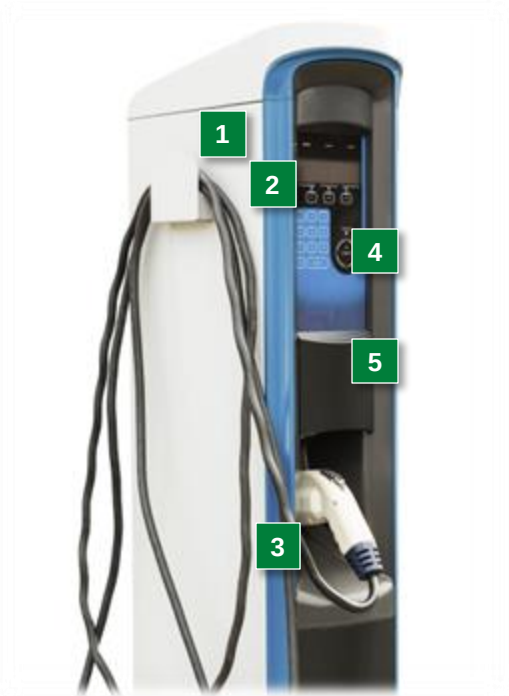
AC charging station

1 Power Board
Fuse, MOV, Circuit Breakers
Mechanical Relay

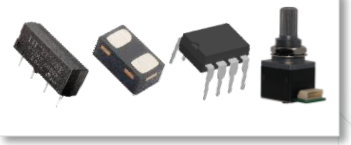
2 Charging Controller
Residual Current Monitoring,
EV Charging Controller Eval Board

3 Charging Gun
Reed Sensor, Temperature Sensor,
Snap Switch

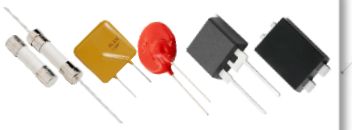




4 Control Board
Reed Relay, TVS Diode, Solid State Relay,
Rotary Switch



5 Auxiliary Power Supply
Fuse, PPTC, MOV,
SIDACtor®, Schottky Diode



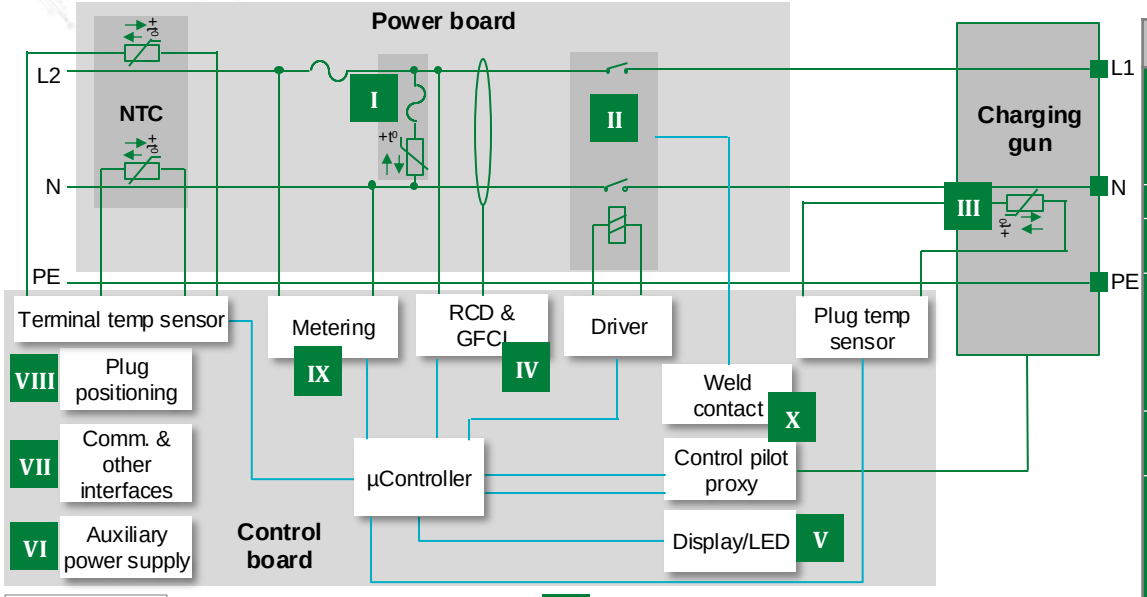
Littelfuse
Expertise Applied | Answers Delivered

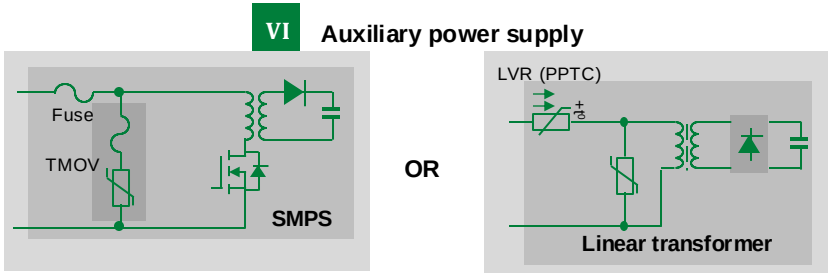
MOV: metal-oxide varistor
AC: alternate current
TVS: transient voltage suppression

PPTC: polymer positive temperature coefficient
SPD: surge protection device

Click the product series in the table below for more info

AC charging functional block diagram





	Technology	Series
I	Fuse	606, 505, 607, JLLN
	Circuit Breaker	N-series
	MOV	TMOV, Xtreme, SPDx, SM10
II	Mechanical Relay	EVR
III	Temperature Sensor	PPG, USW, Glass Coated Thermistor
IV	Residual Current Monitor	RCM14-01, RCM14-03, RCM14-04, RCM01-02, RCM20-01, RCMP20-01 RCMP20-03
	Reed Relay	HE3600
V	TVS Diode Polymer ESD	SP1026 XGD10402
VI	Fuse + Varistor or PPTC + Varistor	215, 443E, TMOV, SM10 or LVR + MOV, SM10
	SIDACtor + MOV	Pxxx0FNL + UltraMOV
	Schottky Diode	DST, DSA, DSB
VII	TVS Diode Array	AQ24CAN, SM712
	Switch	Rotary Switch
VIII	Reed Sensor	59060, 59045
	Switch	Snap Switch
IX	Linear Optocoupler	LOC110ST
X	Solid State Relay	CPC1390GRTR, CPC1006NTR, CPC1017

Littelfuse
Expertise Applied | Answers Delivered

Click the product series in the table below for more info

Features and benefits of Littelfuse solutions

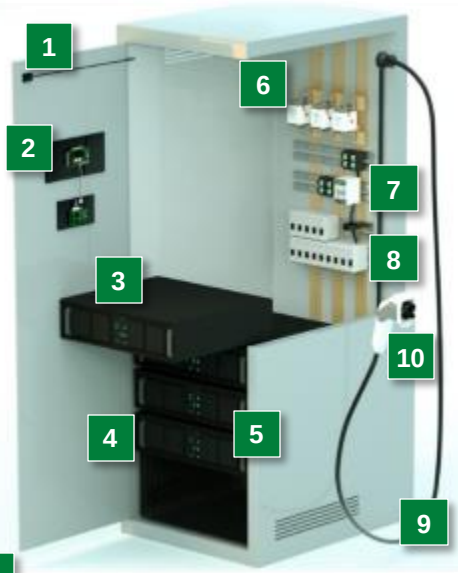
	Technology	Function in application	Product series	Benefits	Features
I	Fuse	Primary overcurrent protection of EV equipment	606, 505, 607, JLLN	Enables robust yet compact design; can operate in extreme temperature environment	Rated voltage @ 500 VAC; 40−63 A rating available; small footprint
	Circuit Breaker	Resettable primary overcurrent protection	N-series	Innovative low-profile design; easier installation in tight spaces; remote outlet metering of power usage to facilitate more accurate and efficient billing	UL 489, TUV certified to IEC/EN 60947-2; maximum 30 A; 20 A for single pole; maximum 120/240 VAC; up to 277 VAC for single pole; maximum interrupting capacity: 22,000 A; 10,000 A for single pole
	MOV	Protects from power fluctuations or surges	TMOV, Xtreme, SPDx, SM10	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
II	Mechanical Relay	Safety cutoff on the grid (power network) to prevent abnormal current supply	EVR	Compact size creates a smaller footprint than two single-pole relays for similar current rating, adding design flexibility; enables compliance with all EV charging infrastructure standards such as IEC 62955, IEC 62752 and UL 2231	Compact form factor; low contact resistance provides low temperature rise at rated current; contact rating up to 40 A is suitable for Mode 2 and Mode 3 EV charging
III	Temperature Sensor	DC contacts hotspot detection	PPG, USW, Glass Coated Thermistor	Offers high accuracy; high reliability; excellent stability at high temperatures	Linear relationship between temp and resistance; temp range -50 °C to +500 °C
IV	Residual Current Monitor	Detects DC and AC residual currents to the earth in 50 Hz / 60 Hz AC installations	RCM14-01, RCM14-03, RCM14-04, RCM01-02, RCM20-01, RCMP20-01 RCMP20-03	Compact solution designed to be panel mounted or PCB mounted	Operates from a 12-24V DC Supply; fully compliant with the detection requirements of UL2231, IEC62955, and IEC62752
	Reed Relay	Low power switching with up to 2500 V isolation	HE3600	Low power consumption; galvanic isolation; immune to environmental effects	Miniature single in-line package; external magnetic shield option
V	TVS Diode Array Polymer ESD	Protects ICs from ESD through display	SP1026 XGD10402	Smaller form-factor and multi-line protection enables ease of design	SP1026 has high ESD robustness for touchpads; XGD10402 has ultra-low capacitance for I/O

Click the product series in the table below for more info

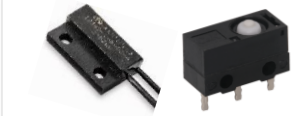
Features and benefits of Littelfuse solutions

	Technology	Function in application	Product series	Benefits	Features
VI	Fuse + Varistor	Protects SMPS from damages due to mech overloads, overheating, etc.	215, 443E, TMOV, SM10 or LVR + MOV, SM10	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
	PPTC + Varistor	Protects linear transformers from damages due to mech overloads, overheating, etc.	DST, DSA, DSB	Fast time to trip; offers boards space savings; reduces customer qual time by complying with UL/IEC	Line voltage ratings of 120 and 240 VAC; low resistance; holding current up to 2 A; compact size
	SIDACtor + MOV	Enhancing surge protection for auxiliary power supply	Pxxx0FNL + UltraMOV	Good clamping and fast response time for high-energy transient protection	3 kA, 8/20 µs surge capability to help protect AC lines from harmful transient surges
	Schottky Diode	Secondary rectification	DST, DSA, DSB	Improves power supply unit efficiency	Low forward voltage drop; high-frequency operation; high junction temperature
VII	TVS Diode Array	Protects CAN, Ethernet, RS-485 bus from ESD, EFT, and voltage transient	AQ24CAN, SM712	Ensures reliability of the equipment without performance degradation	Meets ESD protection levels specified under IEC 61000-4-2; ISO10605; low leakage current and clamping voltage
	Switch	Single-phase and three-phase selection	Rotary Switch	Board space saving on PCBs; maximum design flexibility	Variety of indexing options for applications ranging from 10 mA to 12 A; miniature and subminiature designs for PCBs
VIII	Reed Sensor	Access panel for position sensing	59060, 59045	Robust in end application; mount directly into PCB; no standby power requirement	Well suited for usage in high-moisture and contaminated environments; molded stand-off to allow board washing
	Switch	Detects locking/unlocking of charging gun and EV receptacle	Snap Switch	Reliable snap-acting mechanism; long electrical and mechanical life; compact size	Broad range of switches in variety of actuator configurations; customization options available
IX	Linear Optocoupler	Isolated main voltage sensing in the system	LOC110ST	High gain stability; low input/output capacitance; low power consumption	LED operating range: 2–10 mA; isolation: 3750 V_{RMS}
X	Solid State Relay	Controls board isolation	CPC1390GRTR, CPC1006NTR, CPC1017	High reliability; low drive current; no EMI/RFI generation	Isolation voltage up to 5000 V_{RMS}; low off-state leakage; SMD package

DC charging station



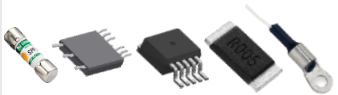
1 Service Access Panel
Reed Sensor, Snap Switch



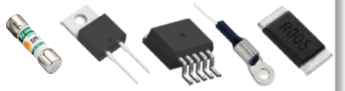
2 User Interface
TVS Diode Array, Polymer ESD
Tactile Switch

3 Communication
TVS Diode Array

4 Rectification and PFC
Fuse, SiC/Si MOSFET, Current Sensor
Gate Driver, Temperature Sensor



5 DC–DC Conversion
Fuse, SiC/Si MOSFET,
Gate Driver, Temperature Sensor



6 Power Distribution Unit
AC Contactor, AC Fuse

7 Input Protection
Surge Protection Device

8 DC Output Protection
DC Fuse, HVDC Contactor
Earth Fault Relay, SPD

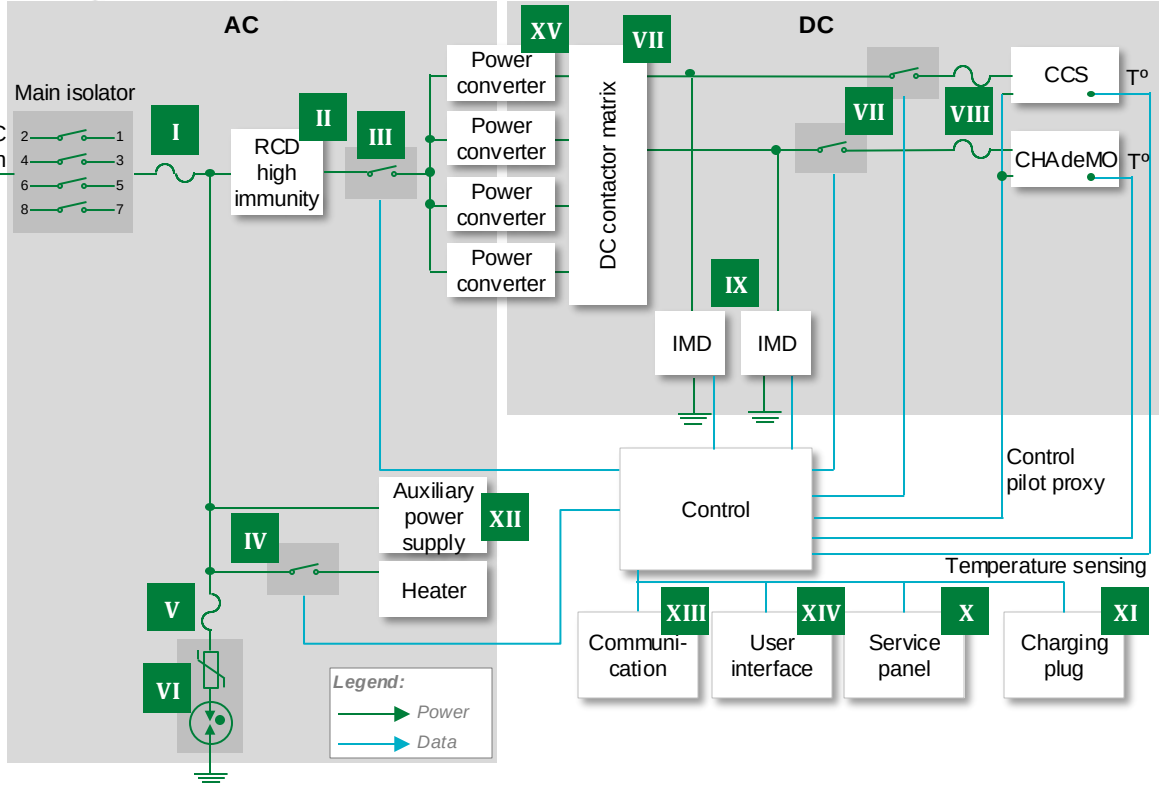
9 Auxiliary Power Supply
Fuse, TMOV,
SIDACtor, Schottky Diode, Si MOSFET

10 Charging Plug
Temperature Sensor,
Reed Sensor, Snap Switch

Littelfuse
Expertise Applied | Answers Delivered

Click the product series in the table below for more info

DC Charger cabinet level protection



	Technology	Series
I	Fuse x 3	PSR, L50QS, L75QS, JLLS
II	Ground Fault Relay	SE-704, SE-CS30
III	AC Contactor	HCD
IV	AC Relay	SC0x*
V	Fuse + Fuseholder	LVSP + LPSM
VI	Surge Protection Device	SPD Type 2
VII	DC Contactor Relay	DCNxx
VIII	Fuse	SFPJ, PSR
IX	Solid State Relay	CPC1981Y
X	Reed Sensor	59060, 59045
	Switch	Snap Switch
XI	Reed Sensor	59060, 59045
	Switch	Snap Switch
	Temperature Sensor	PPG, USW, Glass Coated Thermistor
XII	Fuse + Varistor or PPTC + Varistor	215, 443F, TMOV or LVR + MOV, SM10
	SIDACtor® + MOV	Pxxx0FNL + UltraMOV, SM10
	HV MOSFET	High Voltage Series
	Schottky Diode	DST, DSA, DSB
XIII	TVS Diode Array	AQ24CAN, SM24CANx
XIV	TVS Diode Array, Polymer ESD	SP1026, XGD10402
	Switch	Tactile Switch
XV	Varistor	SM10

Acronyms:
IMD: insulation monitoring device
RCD: residual current device
CCS: constant current source

PLC: power line communication interface
CHAdeMO: DC charging protocol currently enabling EV charging with power from 6 kW to 400 kW with 900 kW in preparation

** Please contact Littelfuse Associates for details*

Click the product series in the table below for more info

Features and benefits of Littelfuse solutions

	Technology	Function in application	Product series	Benefits	Features
I	Fuse x 3	Protects semiconductor devices	PSR, L50QS, L75QS, JLLS	Lower I^2t performance allows for quick response to protect devices from higher heat energy	550–1300 V_{AC}, 500–1000 V_{DC}, 40–2000 A
II	Current Transformer	Offers ground-fault detection and protection	SE-704	Specifically designed for low-level detection; flux conditioner is included to prevent saturation	Turns ratio 600:1 and current rating 30:0.05 A
	AC Earth-Fault Relay		SE-CS30	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)
III	AC Contactor	Safety cutoff on the grid (power network) to prevent abnormal current supply	HCD	Predetermined life cycle for application to minimize cost; high electrical and thermal conductivity; good resistance to oxidation for longer life	Long electrical life; high surge capability; certified for use in North America, Europe, and Asia
IV	AC Relay		SC0x*	PCB mount capable; higher flexibility for designers; compact design	Low heat generation and low coil power consumption; performance to meet regulatory UL/IEC compliance
V	Fuse + Fuseholder	This is an optional surge suppression fuse (+ fuse holder) intended to protect surge protection devices	LVSP + LPSM	Very current limiting under AC short-circuit conditions; available in multiple mounting configurations (cartridge, bolt-in, PC board mount)	Survive the 8x20 µs lightning surges described in various standards (UL 1449, IEC 61000-4-5, and IEEE C62.41) without opening
VI	Surge Protection Device	Protects from power fluctuations or surges	SPD Type 2	Withstands high-energy transients to prevent disruption, downtime, and degradation	20 kA nominal interrupting rating and 50 kA maximum interrupting rating
VII	DC Contactor Relay x 2	The main contactors connect and disconnect the DC charging unit	DCNxx	Allows a low-voltage signal to switch the contacts for a high-voltage signal	Wide range of capabilities–can switch from tens of amps to thousands of amps and tens of volts to thousands of volts
VIII	Fuse x 3	Protects semiconductor devices	SFPJ, PSR	Lower I^2t performance allows for quick response to protect devices from higher heat energy	500–1000 V_{DC}, 40–2000 A
IX	Solid State Relay	DC leakage current detection	CPC1981Y	High reliability; low drive power requirements; no EMI/RFI generation	2500–5000 V_{RMS} input/output isolation; handle load currents up to 0.25 A; power SIP & SMD package

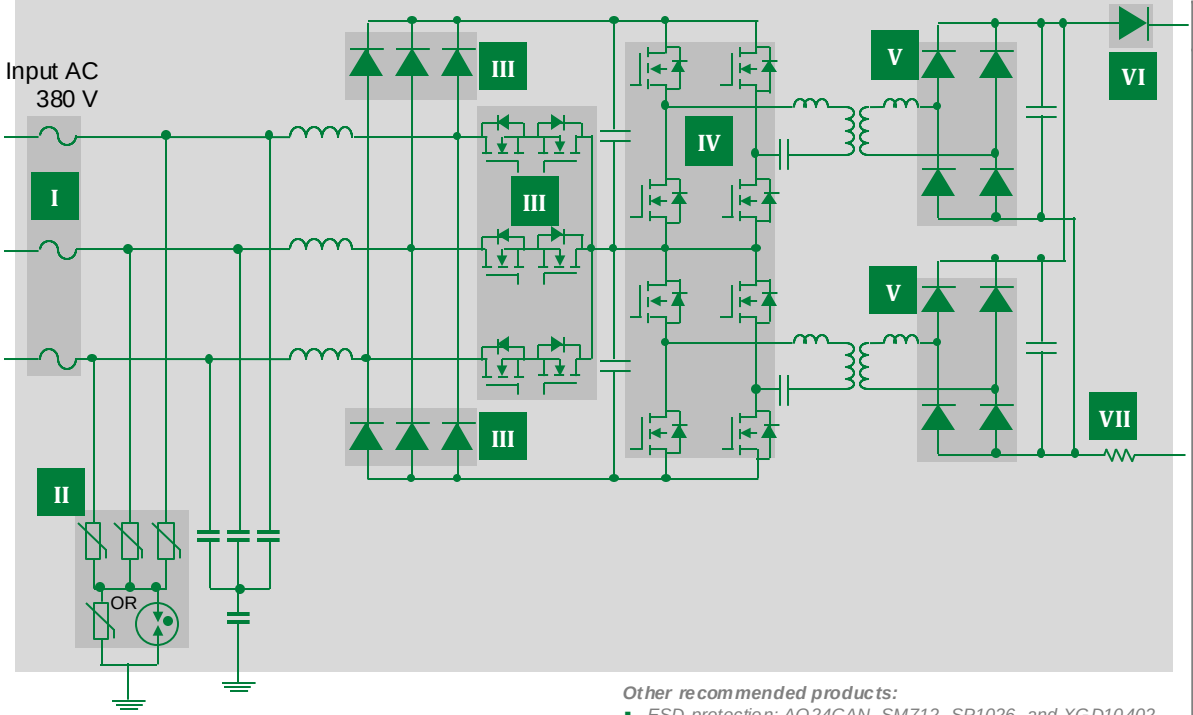
Click the product series in the table below for more info

Features and benefits of Littelfuse solutions

	Technology	Function in application	Product series	Benefits	Features
X	Reed Sensor	Access panel for position sensing	59060, 59045	Robust in end application; mount directly into PCB; no standby power requirement	Well suited for usage in high-moisture and contaminated environments; molded stand-off to allow board washing
	Switch	Single-phase and three-phase selection	Snap Switch	Board space saving on PCBs; maximum design flexibility	Variety of indexing options for applications ranging from 10 mA to 12 A; miniature and subminiature designs for PCBs
XI	Reed Sensor	Positioning sensing for the EV plug	59060, 59045	Robust in end application; mount directly into PCB; no standby power requirement	Well suited for usage in high-moisture and contaminated environments; molded stand-off to allow board washing
	Switch	Detects locking/unlocking of charging gun and EV receptacle	Snap Switch	Reliable snap-acting mechanism; long electrical and mechanical life; compact size	Broad range of switches in variety of actuator configurations; customization options available
	Temperature Sensor	DC contacts hotspot detection	PPG, USW, Glass Coated Thermistor	Offers high accuracy; high reliability; excellent stability at high temperatures	Linear relationship between temp and resistance; temp range -50 °C to +500 °C
XII	Fuse + Varistor or PPTC + Varistor	Protects SMPS from damages due to mech overloads, overheating, etc.	215, 443E, TMOV or LVR + MOV, SM10	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
	SIDACtor + MOV	Enhancing surge protection for auxiliary power supply	Pxxx0FNL + UltraMOV, SM10	Good clamping and fast response time for high-energy transient protection	3 kA, 8/20 µs surge capability to help protect AC lines from harmful transient surges
	HV MOSFET	Switch Mod Power Supply	High Voltage Series	Space savings; High power density	High voltage (upto 1500 V); Fast switching time; Ultra-low $R_{DS(on)}$
	Schottky Diode	Secondary rectification	DST, DSA, DSB	Improves power supply unit efficiency	Low forward voltage drop; high-frequency operation; high junction temperature
XIII	TVS Diode Array	Protects CAN bus from ESD, EFT, and voltage transient	AQ24CAN, SM24CANx	Ensures reliability of the equipment without performance degradation	Meets ESD protection levels specified under IEC 61000-4-2; ISO 10605; low leakage current and clamping voltage
XIV	TVS Diode Array Polymer ESD	Protects ICs from ESD through display	SP1026 XGD10402	Smaller form-factor and multi-line protection enables ease of design	Low capacitance of 1.0 pF per I/O
	Switch	Provides user inputs	Tactile Switch	Board space saving on PCBs; maximum design flexibility; long electrical and mechanical life	Broad range of miniature, ultra-miniature, and micro miniature tactile switches; IP67; Detects and SPDT versions
XV	Varistor	Protects against voltage transients induced by lightning	SM10	Saves PCB surface space; saves PCB surface space	High operating temperature:125 °C; surface mount; High surg energy / current absorption withstanding capability (130 Vac–230 Vac:15 pulses of 6 kV / 3kA) (250 Vac–625 Vac: 40 pulses of 6 kV / 3 kA)

Click the product series in the table below for more info

Unidirectional DC charger subunit power converter



	Technology	Series
I	Fuse	606, 505, 607
II	MOV (Secondary protection)	TMOV, UltraMOV, SM10
	GDT (Secondary protection)	CG2, CG3
	SIDACtor® + MOV (Secondary protection)	Pxxx0FNL + UltraMOV
III	Diode	DSEPxx, DSEI
	MOSFET	X2-Class, X3-Class
	Gate Driver	IXD_6xx, IX4352NE
IV	Discrete MOSFET/ SiC SMPD	X-Class, X2-Class, HiPerFET™, MCL10P1200LB
	Gate Driver	IXD_6xx, IX4352NE
V	Diode	DSEPxx, DHG, DSEI
VI	Diode	DLAxx, DMA, DSIxx
VII	Current Sensing Resistor	WPB, WPC, SSA

Other recommended products:

- *ESD protection: AQ24CAN, SM712, SP1026, and XGD10402*
- *Temperature sensing: USUR1000 and KC*

Littelfuse
Expertise Applied | Answers Delivered

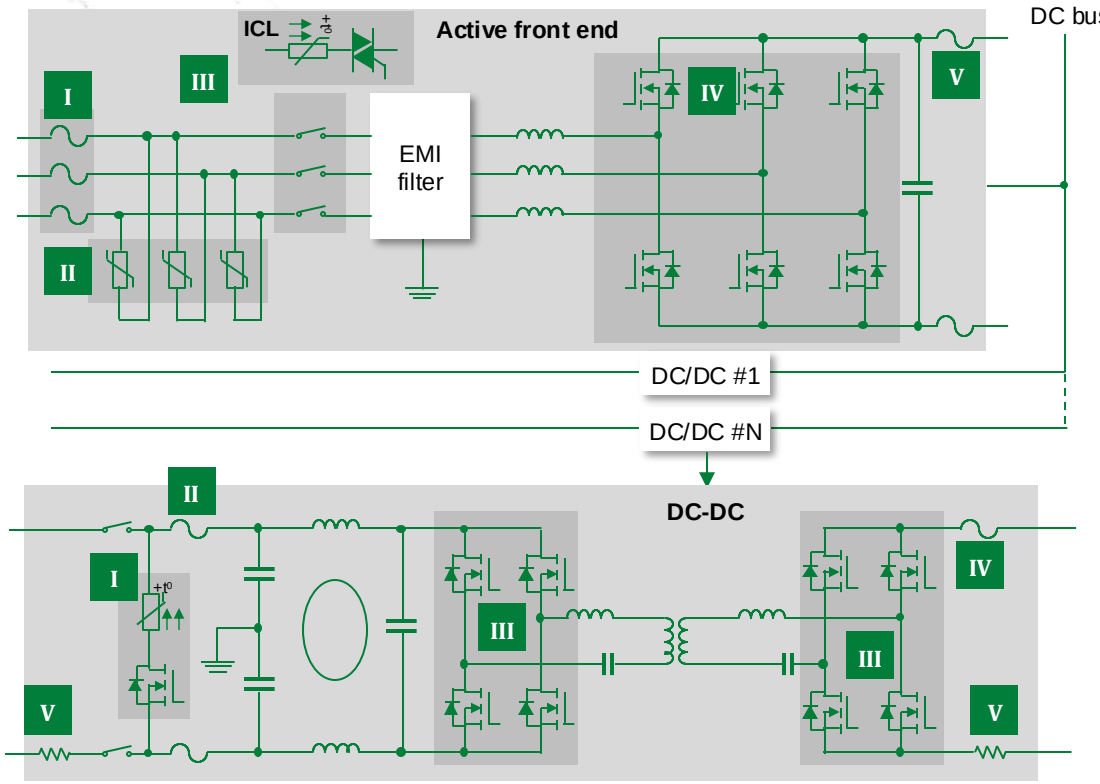
Click the product series in the table below for more info

Features and benefits of Littelfuse solutions

	Technology	Function in application	Product series	Benefits	Features
I	Fuse	Overcurrent protection of auxiliary power supply	606, 505, 607	Enables robust yet compact design; can operate in extreme temperature environment	Rated voltage @ 500 VAC; 40–63 A rating available; small footprint
II	MOV	GDT in series with TMOV protects the auxiliary power supply unit from voltage transients induced by lightning	TMOV, UltraMOV, SM10	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
	GDT		CG2, CG3	Small form factor allows for compact system design	High energy absorption capability; small form factor; low leakage current
	SIDACtor + MOV	Enhancing surge protection for auxiliary power supply	Pxxx0FNL + UltraMOV	Good clamping and fast response time for high-energy transient protection	3 kA, 8/20 µs surge capability to help protect AC lines from harmful transient surges.
III	Diode	Vienna rectifier	DSEPxx, DSEI	Improves power supply unit efficiency	Low forward voltage drop; high-frequency operation; high junction temperature
	MOSFET		X2-Class, X3-Class	Optimized for high-frequency applications	Ultra-low output capacitance and on-resistance
	Gate Driver	Controls the switching MOSFETs	IXD_6xx, IX4352NE	Quick turn-on and turn-off of MOSFETs/IGBTs; eliminates the need for separate supply	9 A peak current; low propagation delay time; low output impedance; internal charge pump controller; thermal shutdown; under voltage lockout
IV	Discrete MOSFET/ SiC SMPD	Primary side of the DC-DC converter	X-Class, X2-Class, HiPerFETTM, MCL10P1200LB	Optimized for high-frequency applications	Ultra-low on-resistance $R_{DS(ON)}$ and gate charge Qg; dv/dt ruggedness
	Gate Driver	Controls the switching MOSFETs	IXD_6xx, IX4352NE	Quick turn-on and turn-off of MOSFETs/IGBTs; eliminates the need for separate supply	9 A peak current; low propagation delay time; low output impedance; internal charge pump controller; thermal shutdown; under voltage lockout
V	Diode	Secondary side output rectification of DC-DC converter	DSEPxx, DHG, DSEI	Reduces switching losses; increases efficiency	High surge capability; negligible I_{RR}; Tj 175 °C
VI	Diode	Redundant diode for secondary protection	DLAxx, DMA, DSIxx	Compact design; low turn-on loss; lower power dissipation	High voltage options; very low forward voltage drop; small form factor
VII	Current Sensing Resistor	Provides an optimal, low-cost solution for measuring current flow to provide control and overcurrent protection	WPB, WPC, SSA	Cost effective solution; same device works in both AC and DC applications; compact size	Power rating up to 2~3 W; high precision and stability; low temperature coefficient of resistance; SMD form factor

Click the product series in the table below for more info

Bidirectional DC charger subunit power converter



Acronyms:
ICL: inrush current limiters

Active front end

	Technology	Series
I	Fuse	606, 505, 607
II	MOV	MOV, Xtreme, SM10
III	Discrete Thyristor	SCR
IV	SiC MOSFET or Phase Leg IGBT	LSIC
		SMPD
V	Fuse	SPF, 526, 607, 828

DC–DC converter

	Technology	Series
I	Discrete MOSFET	IXTA 1200V TO263
II	Fuse	SPF
III	SiC MOSFET or Phase Leg IGBT	LSIC
		SMPD
IV	Fuse	SPF, 526, 607, 828
V	Current Sensing Resistor	WPB, WPC, SSA

Littelfuse
Expertise Applied | Answers Delivered

Click the product series in the table below for more info

Features and benefits of Littelfuse solutions

Active front end

	Technology	Function in application	Product series	Benefits	Features
I	Fuse	Overcurrent protection of auxiliary power supply	606, 505, 607	Enables robust yet compact design; can operate in extreme temperature environment	Rated voltage @ 500 VAC; 40–63 A rating available; small footprint
II	MOV	Protects from power fluctuations or surges	MOV, Xtreme, SM10	Reduces customer qualification time by complying with third-party safety standards such as UL/IEC	High energy absorption capability: UL/IEC approved voltage rating: 130 VAC–680 VAC
III	Discrete Thyristor	Inrush current limiter	SCR	Protects the body diode of the rectification circuitry	Broadest portfolio of low- and medium-voltage SCR devices; multiple package options
IV	SiC MOSFET or Phase Leg IGBT	Active rectification	LSIC	Optimized for high-frequency applications	Ultra-low output capacitance and on-resistance
			SMPD	Board space savings; offers more design flexibility	Ultra-low and compact package profile; low package inductance; excellent thermal capability; high power cycling capability
V	Fuse	Protects semiconductor devices	SPF, 526, 607, 828	Lower I^2t performance allows a quick response to protect devices from higher heat energy	500–1000 V_{DC}, 1 A–63 A; compact size (10x32 mm or 10x38 mm); interrupt rating: 10–50 kA

DC–DC converter

	Technology	Function in application	Product series	Benefits	Features
I	Discrete MOSFET	Discharges circuit (prevents electrical hazards during maintenance)	IXTA 1200V TO263	Easy to mount; space savings; high power density	HV package; fast intrinsic diode; avalanche rated; high blocking voltage
II	Fuse	Protects output semiconductor devices	SPF	Lower I^2t performance allows a quick response to protect devices from higher heat energy	1000 V_{DC}, 1–30 A ratings available; UL & IEC approved
III	SiC MOSFET or Phase Leg IGBT	Active rectification	LSIC	Optimized for high-frequency applications	Ultra-low output capacitance and on-resistance
			SMPD	Board space savings; offers more design flexibility	Ultra-low and compact package profile; low package inductance; excellent thermal capability; high power cycling capability
IV	Fuse	Protects input semiconductor devices	SPF, 526, 607, 828	Lower I^2t performance allows a quick response to protect devices from higher heat energy	500–1000 V_{DC}, 1 A–63 A; compact size (10x32 mm or 10x38 mm); interrupt rating: 10–50 kA
V	Current Sensing Resistor	Provides an optimal, low-cost solution for measuring current flow to provide control and over-current protection	WPB, WPC, SSA	Cost effective solution; same device works in both AC and DC applications; compact size	Power rating up to 2~3 W; high precision and stability; low temperature coefficient of resistance; SMD form factor

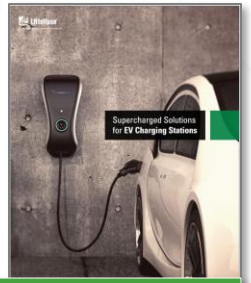
Select standards for EV charging equipment

Standard	Title	General Scope	Region
IEC 61851 Series	Electric Vehicle Conductive Charging System	Various parts of this standard cover general requirements, along with AC chargers and DC chargers specifically	Global
IEC 62196 Series	Plugs, Socket Outlets, Vehicle Connectors, and Vehicle Inlets– Conductive Charging of Electric Vehicles	Standards for charging plugs, sockets, and connectors	Global
IEC 61980 Series	Electric Vehicle Wireless Power Transfer (WPT) Systems	Various parts of this standard cover general requirements for wireless charging systems, along with specific technology-based requirements	Global
GB/T 18487 Series	Electric Vehicle Conductive Charging System	Various parts of this standard cover general requirements, along with AC chargers and DC chargers specifically	China
GB/T 20234 Series	Connection Set for Conductive Charging of Electric Vehicles	Standards for charging plugs in China	China
SAE J1772*	Electric Vehicle and Plug-in Hybrid Electric Vehicle Conductive Charge Coupler	Physical, electrical, functional, and performance standard for charging plugs in North America	North America
SAE J2954*	Wireless Power Transfer for Light-Duty Plug-In/Electric Vehicles and Alignment Methodology	Interoperability, electromagnetic compatibility, EMF, minimum performance, safety, and testing for wireless chargers in North America	North America
UL 2594	Standard for Electric Vehicle Supply Equipment	Safety standard for supply equipment (charging stations, cord sets, power outlets, etc.) in North America. Tri-national standard for the U.S., Canada, and Mexico (known as CAN/CSA C22.2 No. 280 in Canada and NMX-J-677-ANCE in Mexico)	North America
UL 2202	Standard for Electric Vehicle (EV) Charging System Equipment	Safety standard for electric vehicle charging equipment	U.S.

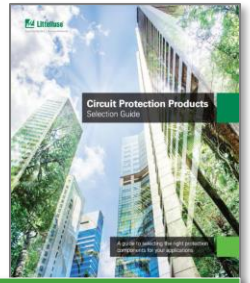
** J1772™ and J2954™ are registered trademarks of SAE International*

Additional information can be found at Littelfuse.com

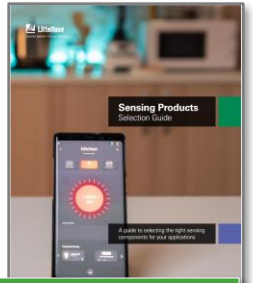
Explore the world of Littelfuse products and applications with ecatalogs (ecatalogs.littelfuse.com)



EV Charging Brochure



Circuit Protection Selection Guide



Sensor Selection Guide

Power Semiconductor Catalog

C&K Automotive Switch Flyer

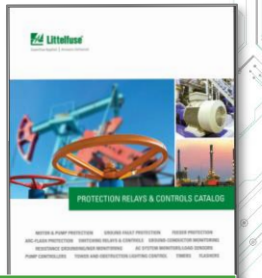
Click on the images for more information

Integrated Circuit Selection Guide

Surge Protection Devices Catalog

Scan the code to learn more!

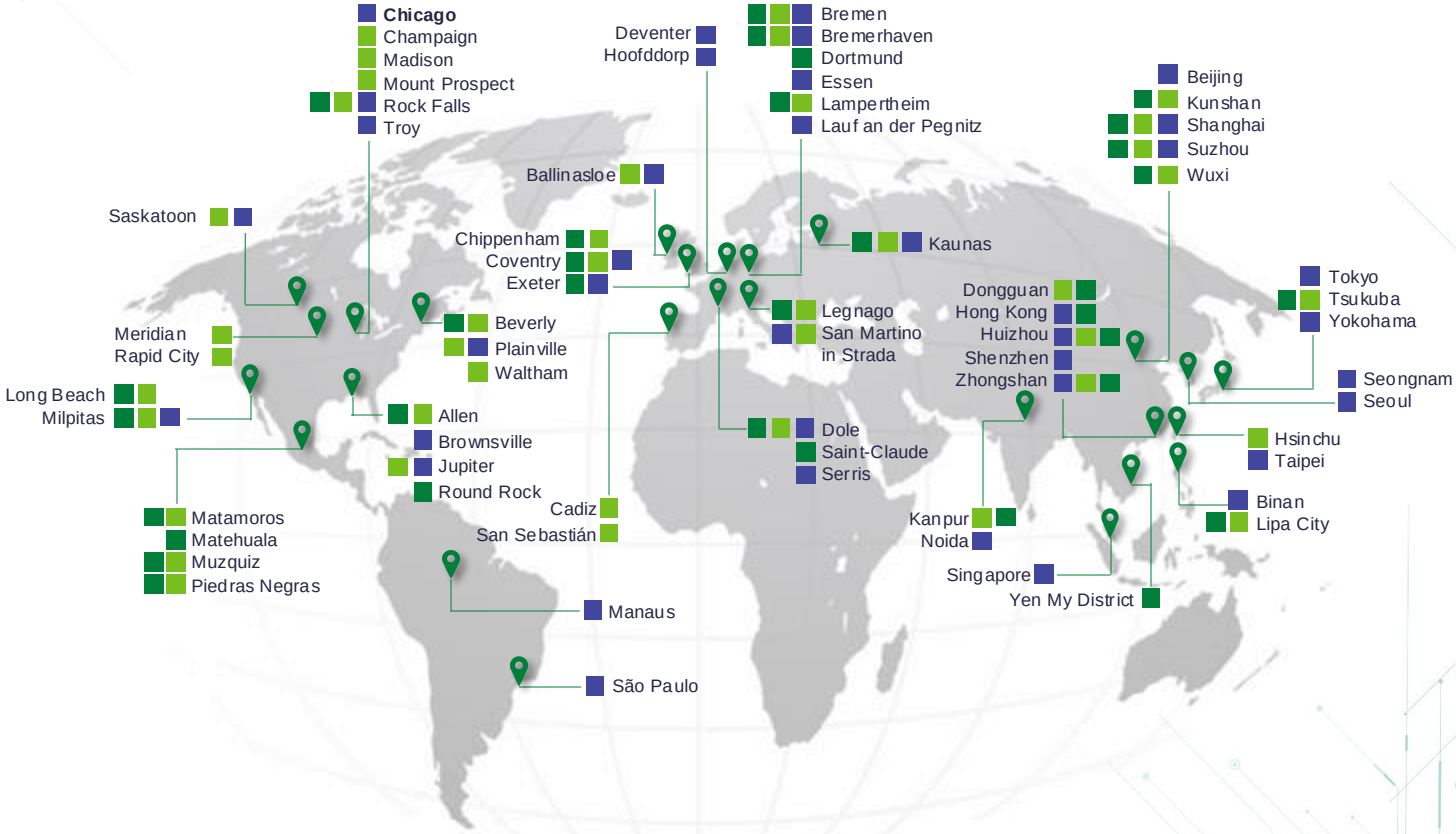
Industrial Fuses Catalog



Power Relay & Control Catalog

Littelfuse
Expertise Applied | Answers Delivered

Local resources supporting our global customers



Legend

- ***Sales***
- ***R&D***
- ***Manufacturing***

Littelfuse

Expertise Applied | Answers Delivered

Littelfuse global labs and manufacturing footprints

Location	Country	Manufacturing facility	Global labs & testing	Product technology	Lab details	Quality certifications				
						ISO 9001	ISO 14001	IATF 16949	AS/EN 9100	Miscellaneous
Beverly	United States	⊙	⊙	Gate Drivers & SSRs,		⊙	⊙	⊙		
Brownsville	United States	⊙		Carling Technologies		⊙	⊙	⊙		
Champaign	United States		⊙		High Power					
Long Beach	United States	⊙		High Power (Discrete, Module), Stack		⊙				
Milpitas	United States	⊙	⊙	MOSFETs & IGBT	Material/Application/Reliability	⊙				
Mount Prospect	United States		⊙		Semiconductor/Material/Application					
Matamoros	Mexico	⊙	⊙	Temperature sensors, Hartland Controls	Product Eval. & Reliability	⊙	⊙	⊙		
Matehuala	Mexico	⊙		Carling Technologies		⊙	⊙	⊙		
Muzquiz	Mexico	⊙		Commercial vehicle products			⊙	⊙		
Piedras Negras	Mexico	⊙	⊙	Fuses & Relays	Material/Application/Reliability	⊙	⊙	⊙		
Rock Falls	United States	⊙		Hartland Controls	Product Eval. & Reliability	⊙				
Round Rock	United States	⊙	⊙	SiC MOSFET/SiC Schottky Diode	Application/Reliability	⊙				
Bremerhaven	Germany	⊙		Wire harnesses (aerospace)		⊙	⊙		⊙	
Bremen	Germany		⊙		Product Eval./Reliability/Application					
Chippenham	United Kingdom	⊙		High Power (Discrete, Module), Stack		⊙	⊙			ISO 45001
Dole	France	⊙	⊙	C&K Switches & Interconnects			⊙	⊙	⊙	ISO 50001
Exeter	United Kingdom	⊙		Carling Technologies		⊙		⊙		
Lampertheim	Germany	⊙		Medium power (Diode, Thyristor, IGBT)		⊙	⊙	⊙		ISO 50001, OHSAS 18001
Legnago	Italy	⊙	⊙	CVP products	Product Eval./Reliability/Application	⊙	⊙	⊙		ISO 45001
Kaunas	Lithuania	⊙	⊙	Sensors	Product Eval./Reliability/Application	⊙	⊙	⊙		ISO 45001
Dongguan	China	⊙	⊙	Varistors	Product Eval./Reliability/Application	⊙	⊙	⊙		UL certified
Hong Kong	China	⊙		Carling Technologies		⊙		⊙		
Huizhou	China	⊙		C&K Switches		⊙	⊙	⊙		
Hanoi	Vietnam	⊙		C&K Switches		⊙	⊙			
Kanpur	India	⊙		Wire harnesses (Aerospace)		⊙	⊙		⊙	
Kunshan	China	⊙		PolySwitch®		⊙	⊙	⊙		
Lipa City	Philippines	⊙	⊙	Module (Bipolar IGBT/MOSFET)	Product Eval./Reliability/Application	⊙	⊙	⊙		UL/TUV certified
Shanghai	China	⊙	⊙	PolySwitch®	High-Power/Material/Reliability/Application	⊙	⊙	⊙		UL/TUV certified
Suzhou	China	⊙	⊙	Fuse, Sensor, Hartland Controls	Product Eval./Reliability/Material	⊙	⊙	⊙		
Tsukuba	Japan	⊙	⊙	Circuit protection	Product Eval./Reliability/ Material/Application	⊙	⊙	⊙		ISO 45001, UL/TUV certified
Wuxi	China	⊙	⊙	Diode, Thyristor, TVS Diode	Semiconductor/Material	⊙	⊙	⊙	⊙	ISO 45001, IECQ
Zhongshan	China	⊙		Carling Technologies		⊙	⊙	⊙		

Partner for tomorrow’s electrical & electronic systems

Broad Product Portfolio

An industrial technology manufacturing company empowering a sustainable, connected, and safer world

Testing Capabilities

We help customers get products to market faster, and we offer certification testing to global regulatory standards

Application Expertise

Our engineers partner directly with customers to help speed up product design and meet their unique needs

Compliance and Regulatory

We help customers during the design process to consider requirements set by global regulatory authorities

Global Customer Service

Our global customer service team is with you to anticipate your needs and ensure a seamless experience

Global Manufacturing

High-volume manufacturing committed to the highest quality standards

Littelfuse
Expertise Applied | Answers Delivered

Expertise Applied | Answers Delivered

Littelfuse.com