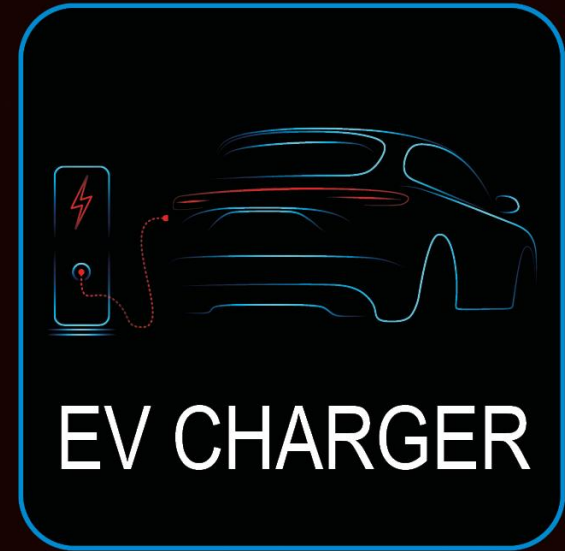
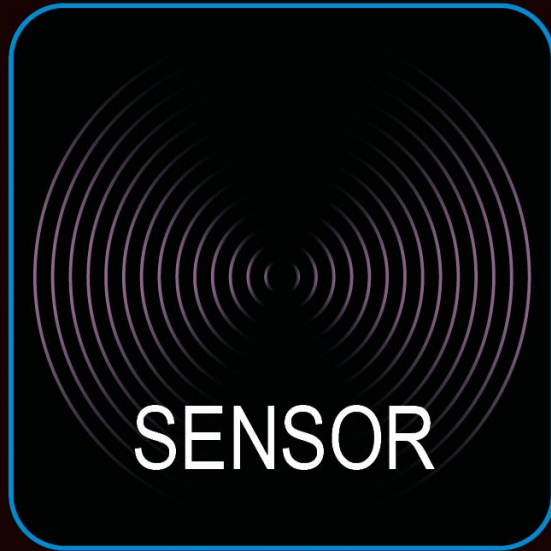


RUTRONIK TECHTALK MEETS



08.06. - 10.06.2021 | **ONLINE**


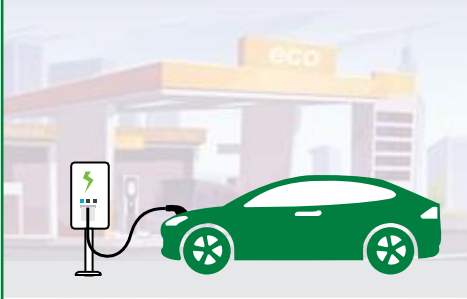
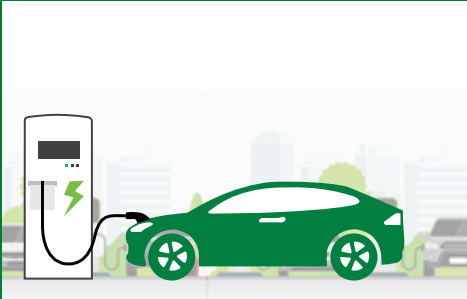

EV (DC Fast) Charging Stations Circuit Protection

Philippe Di Fulvio

EMEA FAE Core Business Manager



Types of electric vehicle charging stations

AC Level 1*	AC Level 2*	DC Fast Charger*	Wireless Charger‡
			
Basic home installation (Mode 1 or Mode 2)**	Home and public installation (Mode 3)**	Public and commercial installation (Mode 4)**	Home and public installation
Voltage 120 V AC, 1-phase 250 V AC, 1-phase 480 V AC, 3-phase	Voltage 208 V–240 V AC, 1-phase 250 V AC, 1-phase 480 V AC, 3-phase	Voltage 380 V–600 V AC, 3-phase	Power levels WPT1 – 3.7 kW WPT2 – 7.7 kW WPT3 – 11 kW
Current rating 12 A–16 A	Current rating 12 A–80 A	Current rating DC output (up to 400 A)	Grid to battery efficiency 94% at a 10" ground clearance
Charging time 8–12 hours***	Charging time 4–6 hours***	Charging time 30 mins***	Vehicle ground clearance 100–250 mm (3.9" to 9.8")

DC charging station

Service Access Panel

- Reed Sensor

User Interface

- TVS Diode Array
- Polymer ESD Suppressor

Communication

- TVS Diode Array

Rectification & PFC

- SiC/Si MOSFET
- Rectifier Diode/Module
- Gate Driver
- Temperature Sensor

High-frequency Converter

- SiC/Si MOSFET
- Rectifier Diode/Module
- Gate Driver
- Temperature Sensor

Power Distribution Unit

- Fuse

Input Protection

- Fuse
- Surge Protection Device
- TVS Diode

DC Output Protection

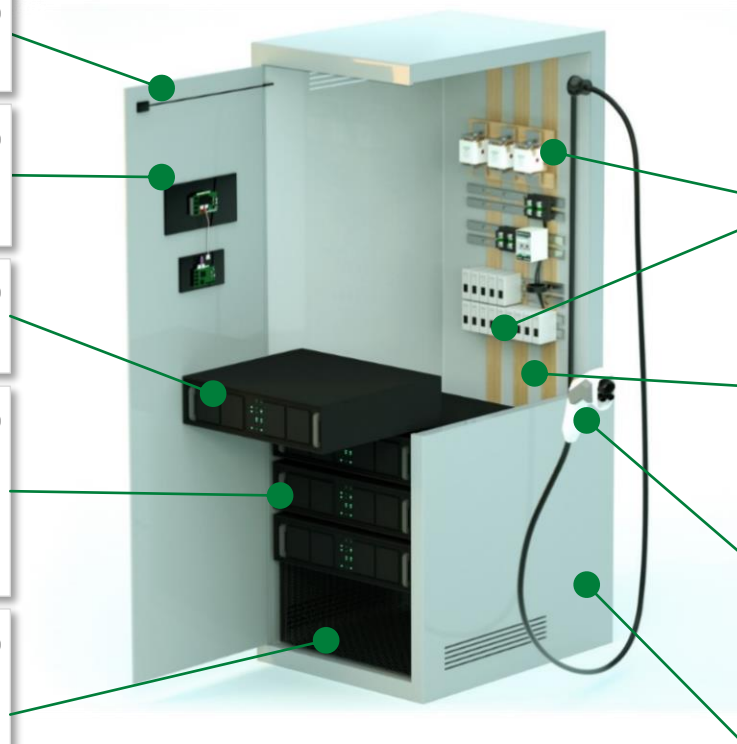
- DC Fuse
- HVDC Contactor
- Earth Fault Relay

Charging Plug

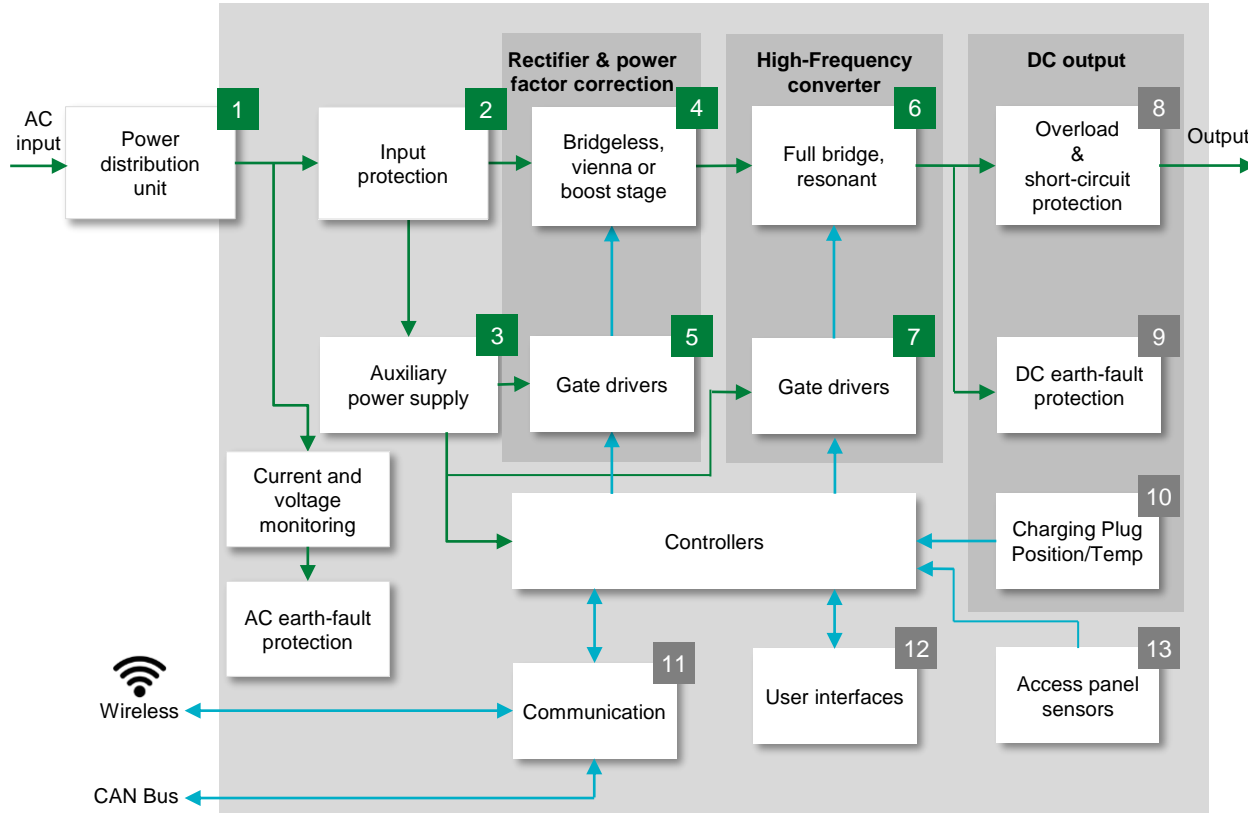
- Temperature Sensor
- Reed Sensor Magnet

Auxiliary Power Supply

- Fuse
- MOV, GDT
- Si MOSFET
- Rectifier Diode



DC charger functional block diagram



Note: Power converter topologies may differ based on design-specific requirements.

Legend:
 Power
 Data/Signal

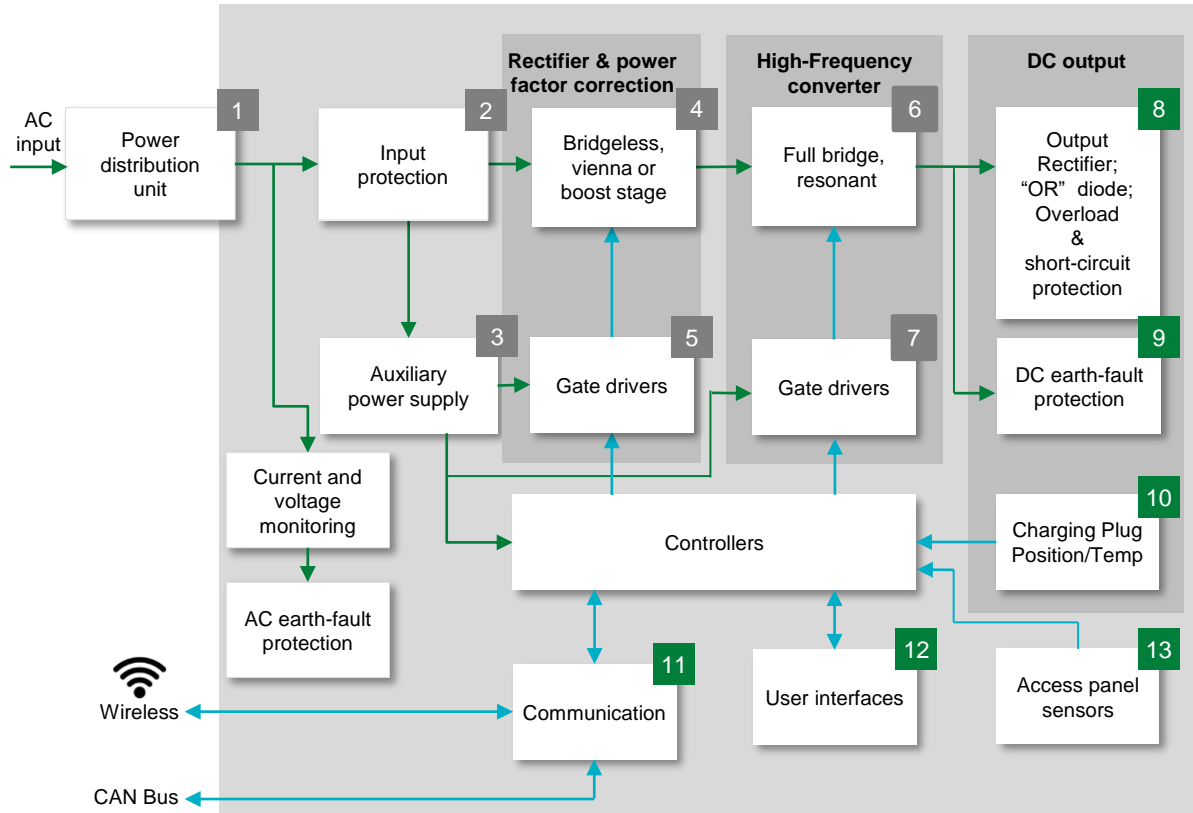
	Technology	Product
1	AC Fuse (PDU level)	JLLS , JLLN
	Overcurrent protection (Primary protection)	PSR , L50QS , L75QS
2	Surge protection (Primary protection)	SPD Type 2
	TVS Diode	AK6 , 1.5SMC
3	Si MOSFET	Polar™
	Rectifier and Schottky Diode	DMA , DST , DSA , DSB
	AC Fuse (Secondary protection)	314 , 324
	Metal-Oxide Varistor	TMOV , UltraMOV
	Gas Discharge Tube	CG2 , CG3
4,6	Rectifier Diode	DMA
	Rectifier Module	MDD , VUQ , MDNA
	SiC/Si MOSFET/ Discrete IGBT	LSIC1MO/X2-Class/XPT
	Fast Diodes	LSIC2SD , DHG , DSEI
	Temperature Sensor	USUR1000 , KC
5,7	Gate Driver	IXDN609 , IX4351NE

Note: Other Littelfuse solutions may be suitable depending on design-specific requirements.

Features and benefits of Littelfuse solutions

	Technology	Function in application	Product series	Benefits	Features
1	AC Fuse (PDU Level)	Provide fast-acting overload and short circuit protection.	JLLS , JLLN	Reduces damage to equipment caused by heating and magnetic effects of short circuit currents;	Extremely current-limiting; Small footprint 200 kA interrupting rating
2	Overcurrent protection (Primary protection)	Protects semiconductor devices	PSR , L50QS , L75QS	Lower I ² t performance allows for quick response to protect devices from higher heat energy	550–1300 V _{AC} , 500–1000 V _{DC} , 40–2000 A
	Surge protection (Primary protection)	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
	TVS Diode	Protects power line from transient surge transient	AK6 , 1.5SMC	Good clamping and fast response time for high-energy transient protection	High power TVS 8/20 μs rating from 1 kA to 20 kA in axial-lead or SMT form factor
3	Si MOSFET	High-speed switching	X-Class ; Polar™	Easy to mount; space-savings; high power density	Low R _{DS(ON)} and Qg; avalanche rated; international standard packages; low package inductance
	Rectifier and Schottky Diode	Provides output rectification in auxiliary power supply	DMA , DST , DSA , DSB	Improves power supply unit efficiency	Low forward voltage drop; high-frequency operation; high junction temperature
	AC Fuse (Secondary protection)	Overcurrent protection of auxiliary power supply	314 , 324	Reduces customer qualification time by complying with third-party safety standards such as UL/IEC	In accordance with UL Standard 248-14; available in cartridge and axial lead format
	MOV	GDT in series with TMOV protects the auxiliary power supply unit from voltage transients induced by lightning	TMOV , UltraMOV	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
4, 6	Rectifier Diode	Converts AC line voltage supplied to the drive to DC	DMA	Small footprint; multiple package options (high voltage, isolated, and standard packages)	Low leakage current and forward voltage drop; improved thermal behavior; high robustness
	Rectifier Module	Converts AC line voltage supplied to the drive to DC.	MDD , VUO , MDNA	Compact design, better electrical isolations	Package with DCB ceramic; very low forward voltage drop and low leakage current
	SiC/Si MOSFET/ Discrete IGBT	Boost converter for high-frequency switching in the PFC circuit	LSIC1MO/X2-Class/XPT	Optimized for high-frequency applications	Ultra-low output capacitance and on-resistance
	Diode		LSIC2SD , DHG , DSEI	Reduces switching losses; increases efficiency	High surge capability; negligible I _{RR} ; T _j 175 °C
	Temperature Sensor	Semiconductor Temperature Measurement	USUR1000 , KC	Rapid thermal response and long-time reliability	UL recognized; wide range of temperature: -40 °C to 125 °C
5, 7	Gate Driver	Controls the switching MOSFETs/IGBTs	IXDN609 , IX4351NE	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

DC charger functional block diagram



Note: Power converter topologies may differ based on design-specific requirements.

	Technology	Product
8	DC Fuse	PSR , SFPJ
	Fast /SiC Diodes	DHG , DSEI , LSIC2SD , DCG ; MEA , MEE , MEK
	"OR" Rectifier diode	DMA
	Temperature sensor	USUR1000 , KC
	HV DC Contactor	DCNxx
9	DC Earth-Fault Relay	SE-601
	Earth Reference Module	SE-GRM
10	Temperature Sensor	PPG , USW , Glass Coated Thermistor
	Reed Sensor & magnet	59060 , 59045
11	TVS Diode Array	AQ24CAN , SM24CANx
12	TVS Diode Array Polymer ESD	SP1026 , XGD10402
13	Reed Sensor & magnet	59060 , 59045

Note: Other Littelfuse solutions may be suitable depending on design-specific requirements.

Features and benefits of Littelfuse solutions

	Technology	Function in application	Product series	Benefits	Features
6	SiC or Si MOSFET	High-frequency switching; synchronous rectification, bidirectional	LSiC1MO , X-Class , X2-Class , HiPerFET™	Optimized for high-frequency applications, high current handling	Ultra-low output capacitance and on-resistance; isolated packages, low thermal resistance
	Temperature Sensor	Semiconductor temperature measurement	USUR1000 , KC	Rapid thermal response and long-time reliability	UL recognized; wide range of temperature: -40° C to 125° C
7	Gate Driver	Controls the switching MOSFETs	IXDN609 , IX4351NE	Quick turn-on and turn-off of MOSFETs; eliminates the need for separate supply	9 A peak current; low propagation delay time; low output impedance
8	DC Fuse	Protects semiconductor devices	PSR , SFPJ	Lower I ² t performance allows for quick response to protect devices from higher heat energy	550–1300 V _{AC} , 500–1000 V _{DC} , 40–2000 A
	Fast/SiC Diodes and modules	High frequency AC rectification to DC	DHG , DSEI , LSiC2SD , DCG , MEA/MEE/MEK	Compact design; low turn-on loss; lower power dissipation	High voltage options; Silicon discretes and modules: SiC in SOT227B, SMD and through hole options
	HV DC Contactors	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 10's of amps to 100's of amps, and 10's of volts to 1000's of volts
9	DC Earth-Fault Relay	Offers low-level ground-fault protection. Ground-fault current is sensed using a Ground-Reference Module	SE-601	Provides a wide range of low-level protection; adjustable trip delay allows quick protection or delayed response	Adjustable pickup (1–20 mA); adjustable time delay (50 ms–2.5 s); CSA certified, UL Listed (E340889), CE (European Union), C-Tick
	Earth Reference Module	Sense resistor network for the SE-601	SE-GRM		
10	Temperature Sensor	Temperature sensing	SE-GRM	Offers high accuracy; high reliability; excellent stability at high temperature	Linear relationship between temp and resistance; temp range -50° C to +500° C
	Reed Sensor	Charging plus position sensing	PPG , USW , Glass Coated Thermistor	Robust design; well suited for usage in high-moisture and contaminated environment	Hermetically sealed, magnetically operated contacts. Certified for use in NA and Europe
11	TVS Diode Array	Protects CAN bus from ESD, EFT, and voltage transient	59060 , 59045	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
12	TVS Diode Array Polymer ESD	Protects ICs from ESD through display	AQ24CAN , SM24CANx	Smaller form-factor and multi-line protection enables ease of design	Low capacitance of 1.0 pF per I/O
13	Reed Sensor	Access panel for position sensing	SP1026 , XGD10402	Robust design; well-suited for usage in high-moisture and contaminated environment	Hermetically sealed; magnetically operated contacts; certified for use in NA and Europe



Product Highlights

 **Littelfuse®**
Expertise Applied | Answers Delivered

SPD2 series surge protection devices

Problem/Solution

According to the Electrical Safety Foundation International, sixty to eighty percent of transient overvoltage or surges are caused by equipment being turned on or off within a facility. Littelfuse SPD2 series surge protection devices safeguard components from transient overvoltage or surges by limiting the fault current to a load or the unit being protected to mitigate damage to equipment or downtime.

Technical resources:



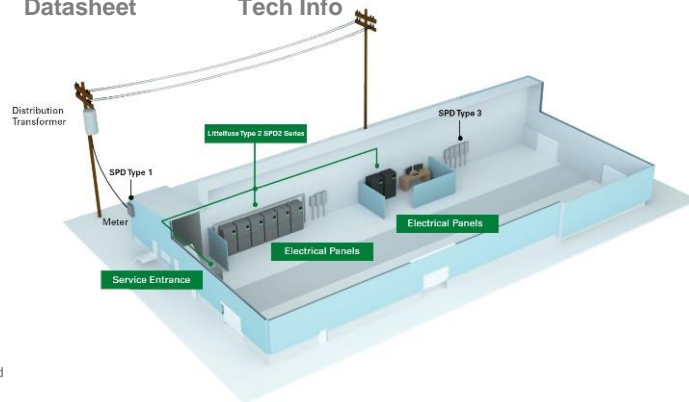
Series Page



Datasheet



Tech Info



Benefits

- Ensures low-residual voltage during high-energy surge events
- Higher nominal discharge current to prevent disruption, downtime, and degradation or damage to equipment
- One component can be utilized globally, reducing inventory needs and simplifying allocation of parts
- Provides panel design flexibility
- Eliminates catastrophic failure



Features

- Capability to clamp and withstand high-energy transients
- UL and IEC compliant in a single part number
- Compact footprint
- Thermal protection

Markets/Applications

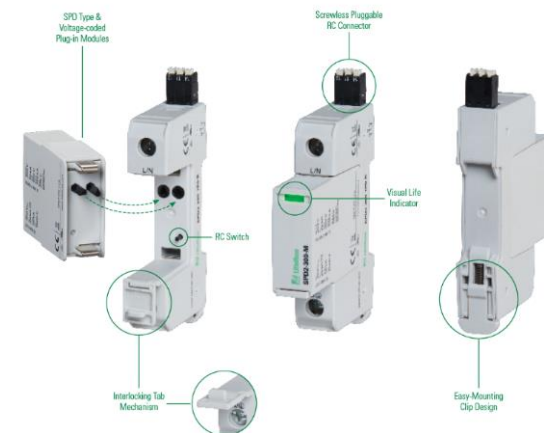
- Power distribution
- EV charging systems
- Industrial Controls
- Computers and Communications
- HVAC or Medical Equipment



R1906

SPD2 Series Features & Benefits

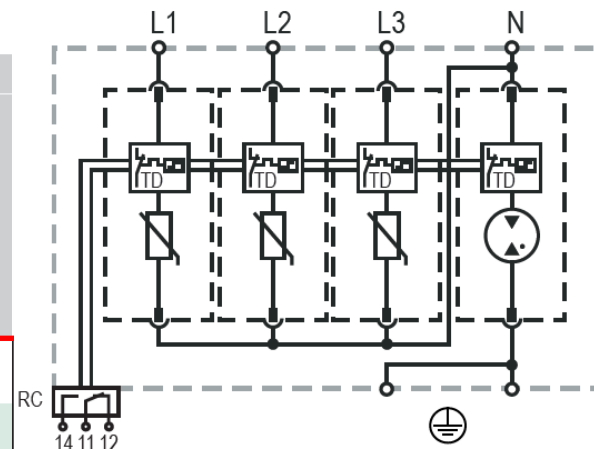
Features	Benefits
Capability to clamp and withstand high-energy transients	Ensures low-residual voltage during high-energy surge events and higher nominal discharge current to prevent disruption, downtime, and degradation or damage to equipment
UL and VDE-IEC compliant in single part number	One component can be utilized globally, reducing inventory needs and simplifying allocation of parts
Interlocking tab mechanism	Secures module to withstand vibration
No additional overcurrent protection devices required in UL applications	Reduces the number of components & costs required for protection
SPD type and voltage-coded plug-in module	Prevents specific SPD/voltage module from being plugged into wrong base. Eliminates risk of improper protection. Fast and simple to replace, minimizing maintenance and downtime. No tools required
Visual life indicator	Quick visual determines module replacement status to avoid loss of protection
Thermal protection	Eliminates catastrophic failure



- **MCOV of 75 to 600V**
- **In = 20kA**
- **I_{max} = up to 50kA**
- **UP to 200kA SCCR**

SPD suggestion for DC Fast Charging

Ordering Number	IEC Electrical										UL Electrical			
	Nominal AC Voltage (50/60Hz) (U_n)	Maximum Continuous Operating AC Voltage (L-N / N-PE U_c)	Nominal Discharge Current (8/20 μ s) (L-N / N-PE I_n)	Maximum Discharge Current (8/20 μ s) (L-N / N-PE I_{max})	Voltage Protection Level (L-N / N-PE U_p)	Follow Current Interrupt Rating (N-PE I_f)	Short-Circuit AC Current Rating (L-N I_{scCR})	TOV Withstand 5 s (L-N U_T)	TOV 120 min (L-N U_T) / Mode	TOV Withstand 200 ms (N-PE U_T)	Maximum Continuous AC Operating Voltage (L-N / N-PE MCOV)	Voltage Protection Rating (L-N / N-PE VPR)	Nominal Discharge Current (8/20 μ s) (L-N / N-PE I_n)	Short-Circuit Current Rating (L-N SCCR)
SPD2-300-3P1-R	240 V	300 V/ 305 V	20 kA/ 40 kA	50 kA/ 65 kA	1500 V/ 1500 V	100 A _{RMS}	25 kA/ 50 kA	337 V	442 V/ Safe Fail	1200 V	300 V/ 305 V	900 V/ 1000 V	20 kA/ 20 kA	150 kA
SPD2-350-3P1-R	277 V	350 V/ 305 V	20 kA/ 40 kA	50 kA/ 65 kA	1750 V/ 1500 V	100 A _{RMS}	25 kA/ 50 kA	403 V	529 V/ Safe Fail	1200 V	350 V/ 305 V	1000 V/ 1000 V	20 kA/ 20 kA	200 kA



Mode of Protection L-N, N-PE

Suitable for IT, TT, TN-S Power Distribution network

PSR series: High-speed(semiconductor) fuses designed to protect power electronics devices

Problem/Solution

The PSR series is part of the POWR-SPEED® line of high-speed (semiconductor) fuses and are designed for modern day sensitive power electronics devices that require superior protection against overcurrent. They offer extreme current limiting protection, balanced performance for longevity, and are available in direct bus-bar mount flush-end and blade designs to meet the needs of a global market.

Technical resources (Click on below icons to learn more)



Series Page



DIN Blade Datasheet



Bolted Blade Datasheet



Product flyer



Expertise Applied | Answers Delivered

Benefits

- Reduces peak let-through current and let-through energy (I^2t)
- Less energy wasted during operation
- Laser etched resistance values eliminate labels that erode over time
- Better energy efficiency and improved protection levels



Features

- Extremely current limiting
- Low watt loss
- Universal blade mounting
- Optimized design
- RoHS and REACH Compliant
- Optimized performance

Markets/Applications

- Industrial Electronics
- Renewable Energy
- EV Infrastructure
- Power conversion devices



PSR Series: Increased DC performance

Product Series	PSR03_	PSR07_
Voltage Rating	AC: 690/700Vac or less DC: 600Vdc or less	AC: 1250/1300Vac or less DC: 1000Vdc or less
Ampere Rating	40A to 2000A	50A to 700A
Interrupting Rating	AC: 200kAIC DC: 150kAIC	AC: 100kAIC DC: 150kAIC
Case Size	30, 31, 32 and 33	70, 71, 72 and 73
Material	Body: Ceramic Terminals: Silver plated Brass Filler: "Stone-Sand"	
Agency Approvals	C-UL-US, IEC 60269-4, CCC, CE	
Mounting Options	Flush End - Direct Bus-bar Mounting Studs: Metric, Inches Thread Options Available	
Typical Application	Power Converters, Soft Starters, DC Systems, UPS, Variable Speed Drives	

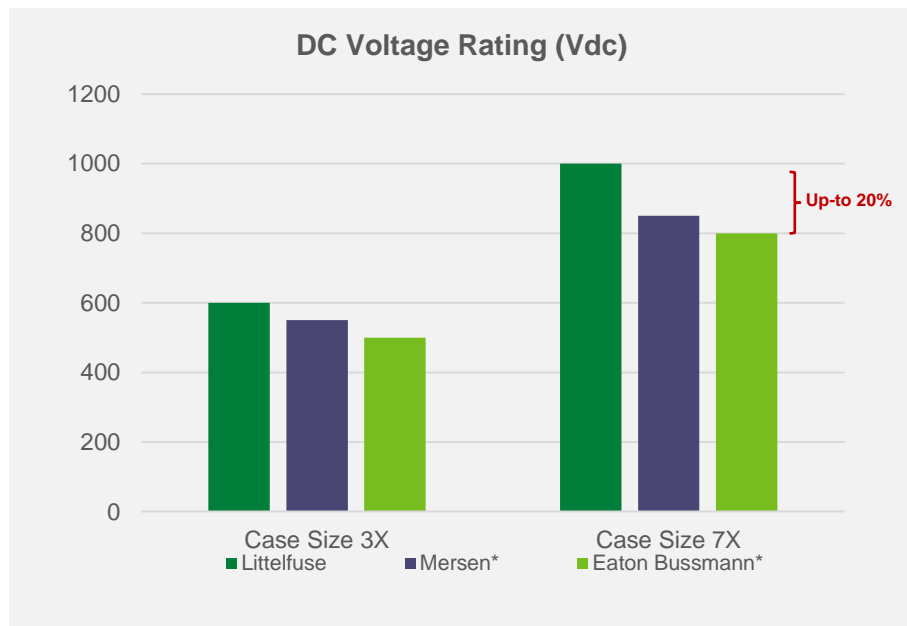


MS3H100C (Case Size: 30 to 33) MS7H1500C (Case Size: 70 to 73)

Suitable micro-switches for remote indication

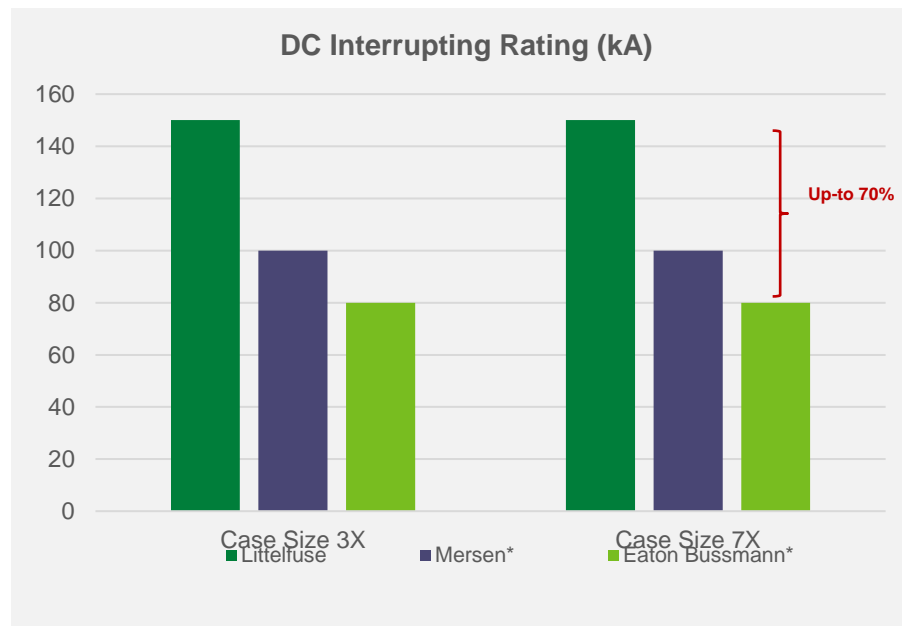
PSR Series: best-in-class DC performance

Up-to 20% higher rated DC voltage for similar case size compared with competition products: 150 kA at (L/R = 10 ms)



* Based on limited published DC information, available on public domain

Up-to 70% higher DC interrupting rating levels compared with competition products



High voltage DC Contactor series overview

Resin Design Relays

Littelfuse Resin Design High Voltage DC Contactor Relays have an epoxy resin at the stud end of the assembly for a true, hermetic sealing of the entire relay. These relays are IP67 sealed to keep moisture out of the assembly. Resin Design Relays also have a remarkably simple manufacturing process which results in a relatively low overall cost.

30A-50A	Series Name	DCNSEV30		DCNLEV50															
	Amperage	30A Continuous Carry		50A Continuous Carry															
	Nom. Coil Voltage	12V DC	24V DC	12V DC				24V DC				48V DC				900V DC			
	Voltage Rating	900V DC	900V DC	900V DC				900V DC				900V DC				900V DC			
	Mounting Type	Bottom	Bottom	Bottom		Side		Bottom		Side		Bottom		Side		Bottom		Side	
	Auxiliary Circuit	N	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
	Terminals	P	P	P	NP	P	NP	P	NP	P	NP	P	NP	P	NP	P	NP	P	NP
	Part Number Su ffix	-B	-C	-BA	-BAN	-B	-BN	-BAS	-BASN	-BS	-BSN	-CA	-CAN	-C	-CN	-CAS	-CASN	-CS	-CSN



100A	Series Name	DCNLEV100															
	Amperage	100A Continuous Carry				100A Continuous Carry				100A Continuous Carry				100A Continuous Carry			
	Nom. Coil Voltage	12V DC				24V DC				48V DC				750V DC			
	Voltage Rating	750V DC				750V DC				750V DC				750V DC			
	Mounting Type	Bottom		Side		Bottom		Side		Bottom		Side		Bottom		Side	
	Auxiliary Circuit	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
	Terminals	P	NP	P	NP	P	NP	P	NP	P	NP	P	NP	P	NP	P	NP
	Part Number Su ffix	-BA	-BAN	-B	-BN	-BAS	-BASN	-BS	-BSN	-CA	-CAN	-C	-CN	-CAS	-CASN	-CS	-CSN



150A-250A	Series Name	DCNEV150				DCNEV250							
	Amperage	150A Continuous Carry				250A Continuous Carry							
	Nom. Coil Voltage	12V DC				12-24V DC		48-72V DC		72V DC		900V DC	
	Voltage Rating	900V DC				900V DC		900V DC		900V DC		900V DC	
	Mounting Type	Bottom		Bottom		Bottom		Bottom		Bottom		Bottom	
	Auxiliary Circuit	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
	Terminals	P	NP	P	NP	P	NP	P	NP	P	NP	P	NP
	Part Number Su ffix	-MA	-MAN	-M	-MN	-GA	-GAN	-G	-GN	-FA	-FAN	-F	-FN



High voltage DC Contactor series overview

Ceramic Design Relays

Littelfuse Ceramic Design High Voltage DC Contactor Relays have a more sophisticated, ceramic arc chamber. The ceramic arc chamber is soldered, hermetically sealing the chamber in a superior manner to the Resin Design Relays.

- These relays are IP54 dust and water splash protected to greatly reduce foreign contaminants and moisture in the contactor.
- Ceramic Design Relays have higher contact voltage capacity and can withstand higher pressures and temperatures longer.



150A-500A	Series Name	DCNEVT150				DCNEVT350				DCNEVT400				DCNEVT500			
	Amperage	150AContinuous Carry				350AContinuous Carry				400AContinuous Carry				500AContinuous Carry			
	Nom. Coil Voltage	12V DC		24V DC		12V DC		24V DC		12V DC		24V DC		12V DC		24V DC	
	Voltage Rating	450V DC		450V DC		1800V DC		1800V DC		1800V DC		1800V DC		1800V DC		1800V DC	
	Mounting Type	Bottom	Side	Bottom	Side	Bottom		Bottom		Bottom		Bottom		Bottom		Bottom	
	Auxiliary Circuit	N	N	N	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
	Terminals	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
	Part Number Suffix	-B	-BS	-C	-CS	-BA	-B	-CA	-C	-BA	-B	-CA	-C	-BA	-B	-CA	-C

P = Polarized NP = Non- Polarized





AC & DC Ground Fault Relays

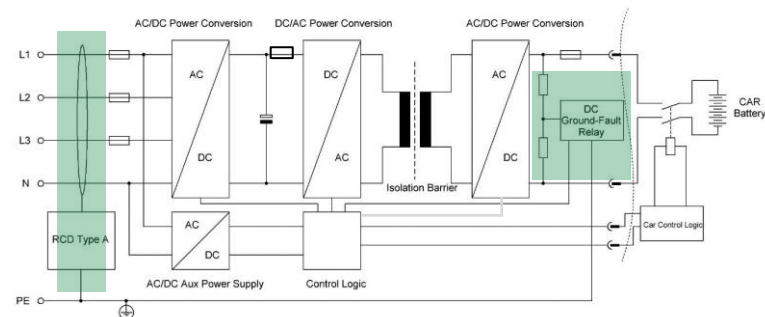
Features

- The SE-704, SE-601 are microprocessor-based ground-fault relay
- Very sensitive ground-fault detection AC, DC or Both
- The output contacts can be connected for use in protective tripping circuits or in alarm indication circuits.

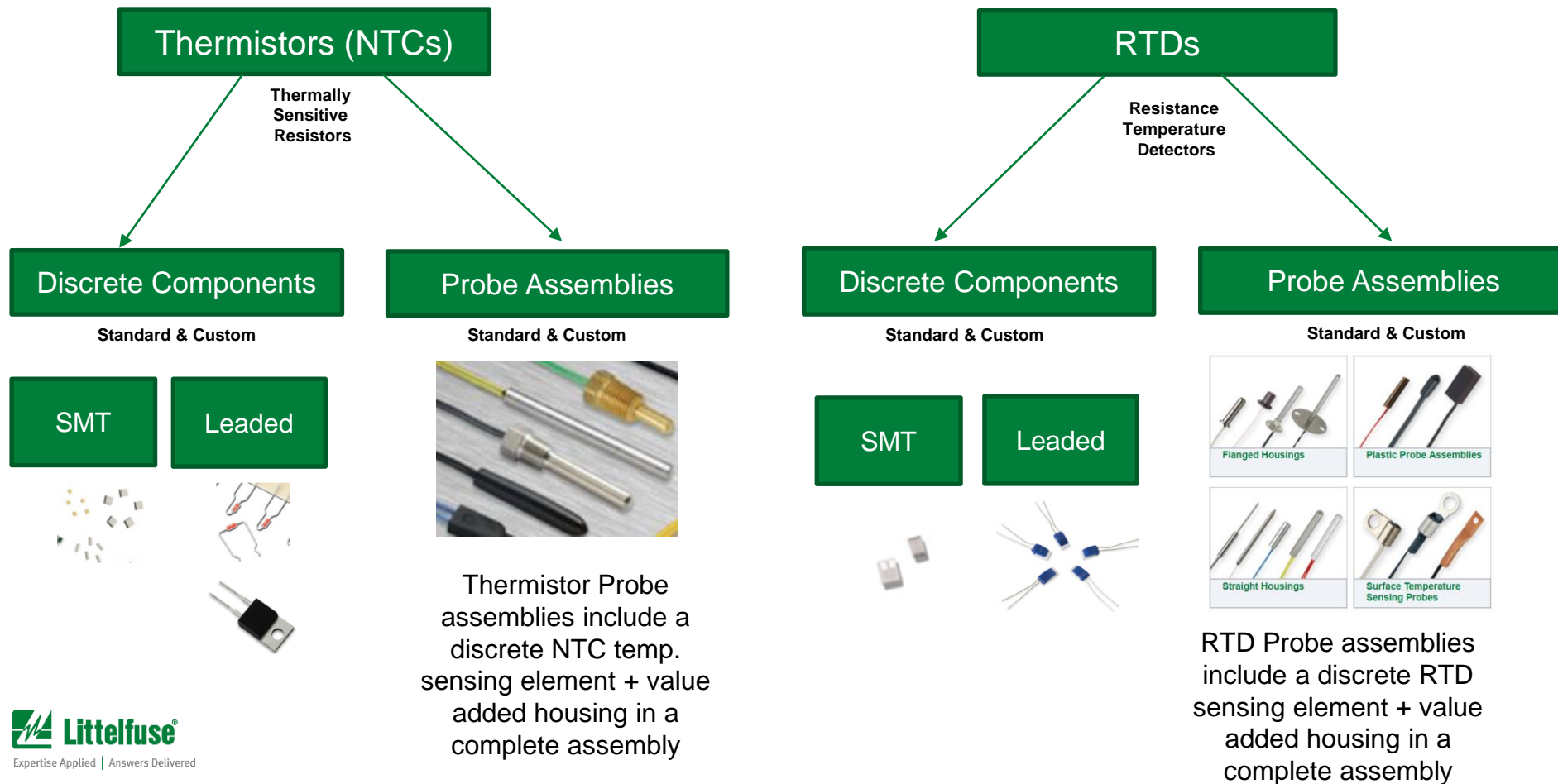
Advantages

- Accurate AC and DC fault level settings
- Programmable response time
- Universal power supply
- -40°C to 60°C operating temperature
- Front panel and remote reset
- Latching and non latching operation
- UV or SH trip operation

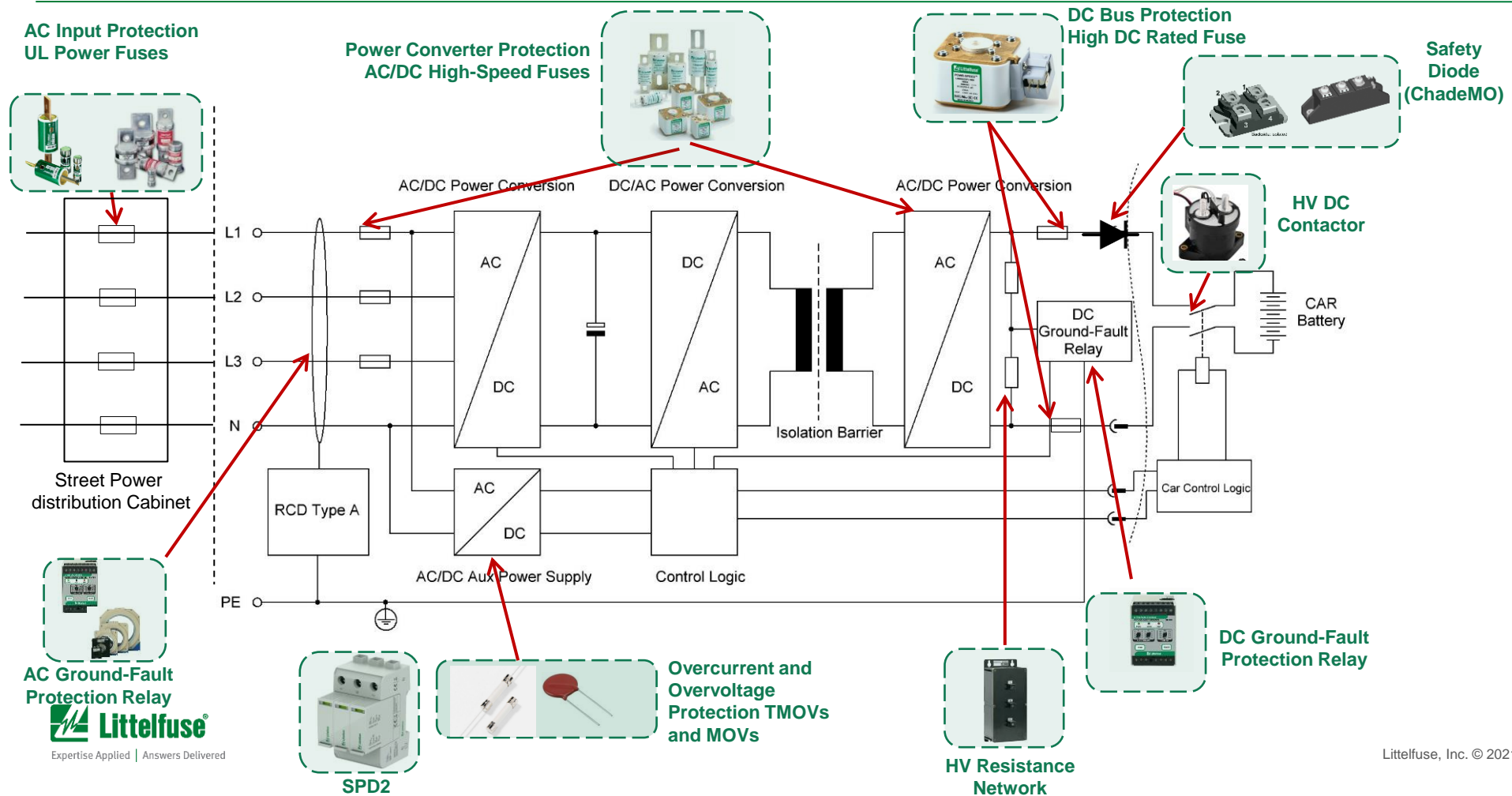
Products	Features	Application	Case
SE-704 series	AC: 10mA to 5000 mA Fault Settings 30 to 2000 ms time delay setting range	AC Ground Fault Detection	
SE-CS30 series	CT: Current Transformer		
SE-601 Serie	DC: ground fault settings from 1-20 mA ground-fault trip times from .05-2.5 s	DC Ground-Fault Monitor	
SE-GRM SERIES	Resistor network that limits ground-fault current to 25 mA		



Littelfuse Temperature Sensors Product Offering



EV (DC Fast) Charging Stations Circuit Protection



Broad product portfolio

A global leader with a broad product portfolio, covering every aspect of protection, sensing, and control

Application expertise

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

Global customer service

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

Compliance & regulatory expertise

We help customers in the design process to account for requirements set by global regulatory authorities

Testing capabilities

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

Global manufacturing

We offer high-volume manufacturing that is committed to the highest quality standards



EV Charging Application Guide



Circuit Protection Selection Guide



Sensor Products Selection Guide



Power Semiconductor Selection Guide



Click on images to
open the catalog

Integrated Circuits Product Catalog



Industrial Fuses Catalog



Power Relay & Control Catalog

