Protective components for Type 1 and Type 2 Surge Protective Devices (SPDs)

Building Automation

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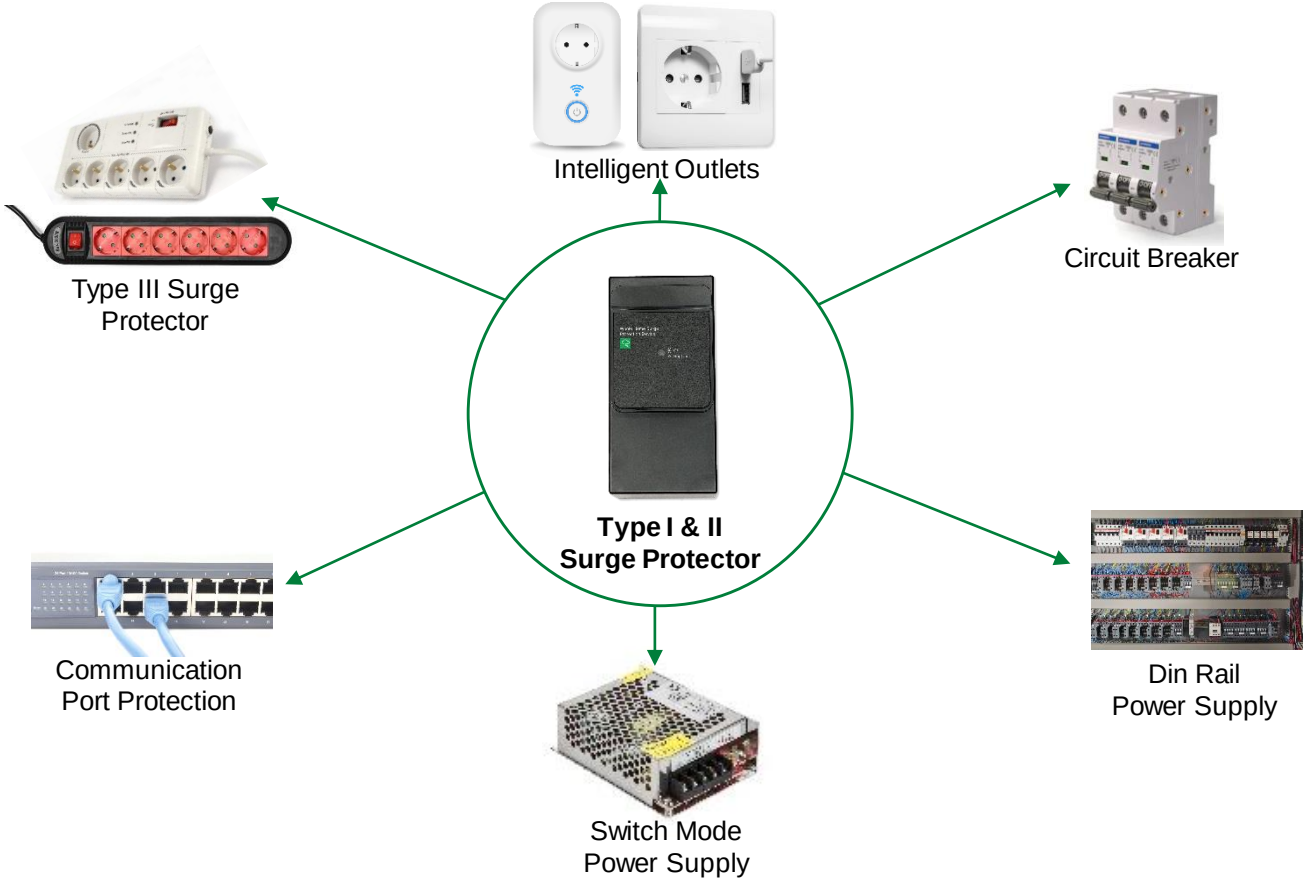
Other products which share similar architecture with Type 1 & 2 Surge Protective Devices



Surge Protective Devices (SPDs) for AC lines

Market Trends and Drivers

With intelligent devices propagating throughout homes and buildings surge protection has become even more important.

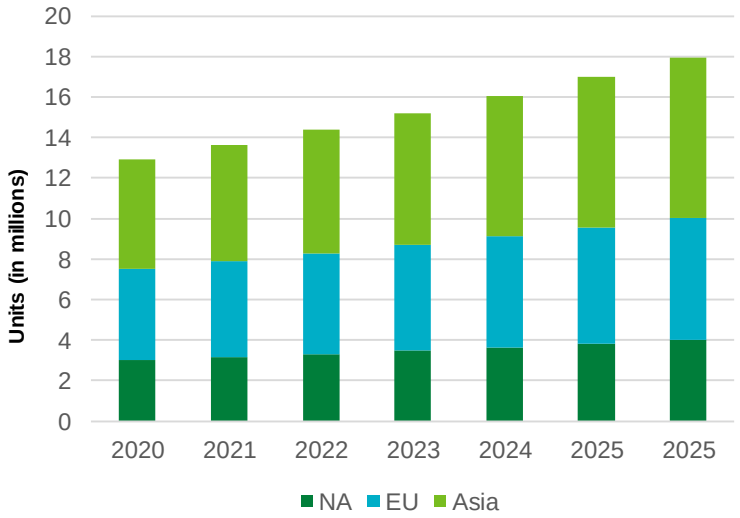
Voltage surges come from various sources, including lightning strikes, switching of large motors or switch gear, coupling, and electrostatic discharge.

A commercial or industrial facility will have surge protection devices at the incoming AC line, at power distribution, and near critical electrically powered equipment.

Global warming is projected to increase lighting strikes by 12% per degree Celsius of global warming and about 50% over this century. Source: Science Magazine.

NEC2020 requires all new homes in the US to have Type 1 or Type 2 SPDs. Seventy percent adoption of this code is expected by 2021. NEC claims that $15,000 of electrical equipment can be damaged in the home.

Type 1 and 2 SPD growing at a CAGR of 5.5%*

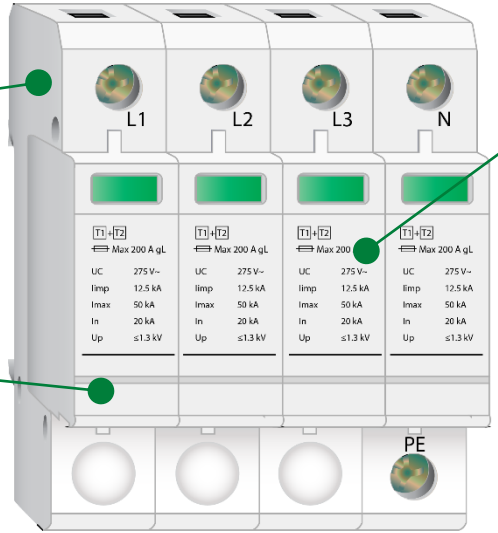


Source: **CAGR from Market & Markets & Grandview Research average*

Littelfuse components are core for Type 1 and 2 SPDs

Overcurrent protection
- Fuse

Overvoltage protection
- MOV
- TMOV



Overvoltage protection
- GDT

- SPDs come in different configurations depending on operating voltage, AC line type, and protection requirements.
- Fuses can be integrated within SPDs or external.

How a Surge Protective Device (SPD) works

Figure 1: SPD during normal operation

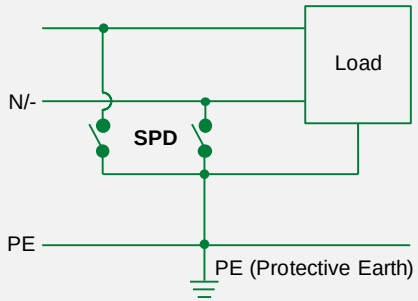
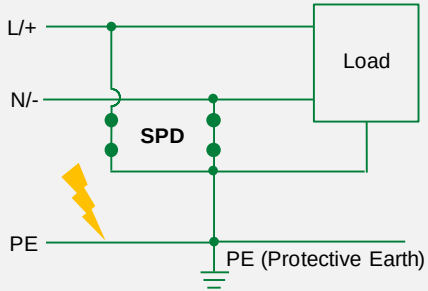


Figure 2: SPD activated by voltage surge



SPD function:

- SPDs limit the surge voltage amplitude to a defined level so dielectric strength of equipment is not exceeded. During voltage surge the SPD discharges the associated surge currents.
- An example of a circuit with common mode[1] protection is shown in Figure 1.
- When a voltage surge occurs the SPD switch is closed as shown in Figure 2. Voltage surge sources can include lightning, induced power surges, industrial and switching surges, and nuclear electromagnetic pulses.
- This closure only lasts for the duration of the surge voltage which is typically a few microseconds.
- The equipment is safeguarded and continues to operate.

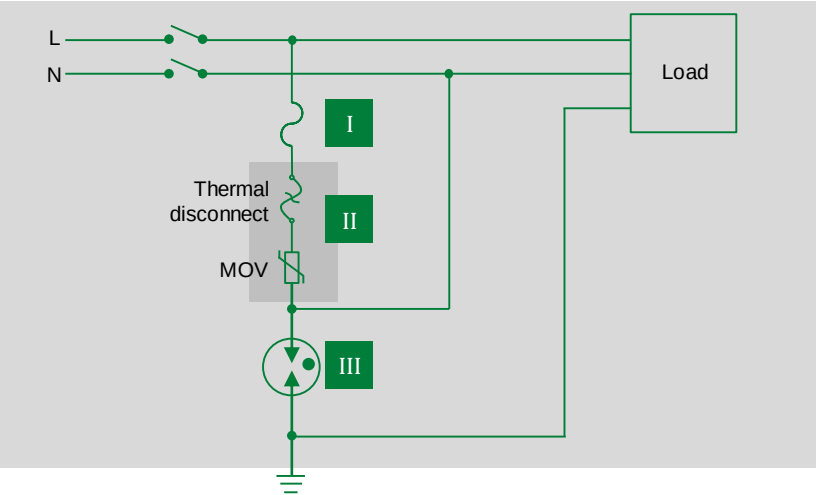
1. *Common mode is shown in the example protects between active lines and protective conductor. SPD could also be placed between active lines for normal (differential) mode voltage protection.*

There are many different SPD product types, different AC line configurations, and customer protection needs.

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

Littelfuse components for single phase SPDs

Single phase load protection



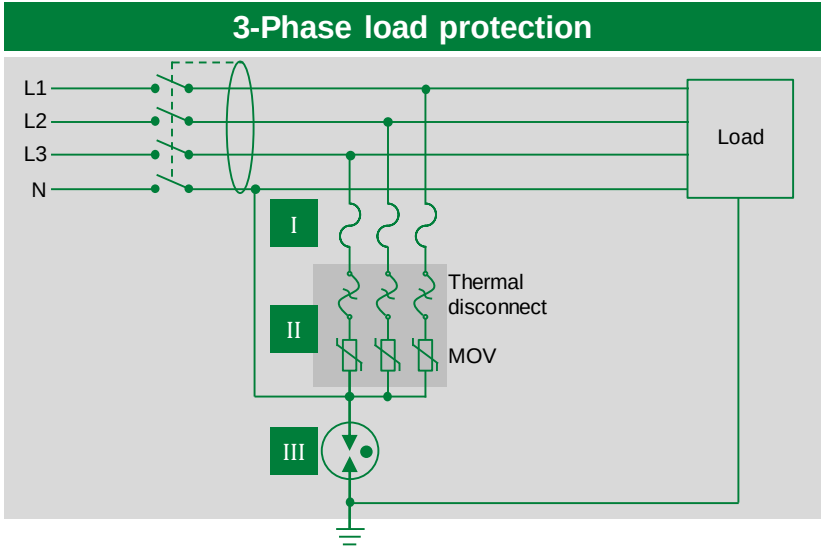
SPD Notes:

- The latest SPDs can offer features such as voltage surge data and protection status through WiFi. ESD protection is available with TVS Diode Array, AQ1003-01LTG
- GDTs are often used between neutral and ground to minimize leakage current.
- Spark gap technology is sometimes used for IEC Class 1 (EN Type 1) applications

	Technology	Function in Application	Series	Benefits	Features
I	Fuse	Overcurrent protection specifically for SPD products	LVSP	Designed to survive surges caused by lightning as described in IEC and UL standards	Complements Littelfuse MOVs and AK TVS diodes
II	MOV	Voltage surge protection with thermal disconnect	TMOV, LST	Same footprint for 50 kA and 75 kA I_{max} for same PCB layout (LST)	Normally open and normally closed options for remote indication
III	GDT	Voltage surge protection with no significant leakage current	CG2, CG3	Surge protection for AC lines	Rugged ceramic-metal construction

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

Littelfuse components for 3-phase SPDs



SPD Notes:

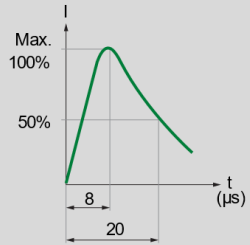
- The latest SPDs can offer features such as voltage surge data and protection status through WiFi. ESD protection is available with TVS Diode Array, AQ1003-01LTG
- GDTs are often used between neutral and ground to minimize leakage current.
- In industrial and commercial buildings, a system approach is needed to optimize protection.
- Spark gap technology is sometimes used for IEC Class 1 (EN Type 1) applications

	Technology	Function in Application	Series	Benefits	Features
I	Fuse	Overcurrent protection specifically for SPD products	LVSP	Designed to survive surges caused by lightning as described in IEC and UL standards	Complements Littelfuse MOVs and AK TVS diodes
II	MOV	Voltage surge protection with thermal disconnect	TMOV, LST	Same footprint for 50kA and 75 kA I_{max} for same PCB layout (LST)	Normally open and normally closed options for remote indication
III	GDT	Voltage surge protection with no significant leakage current	CG2, CG3	Surge protection for AC lines	Rugged ceramic-metal construction

Terminology for OEM product with IEC and UL

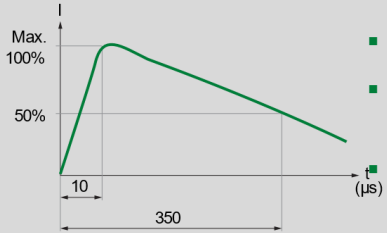
IEC 61643-11	Description	UL 1449
I_{imp}	Maximum surge current rating for an SPD subjected to a 10 x 350 µs wave shape	Not used
I_{max}	Maximum surge current rating for an SPD subjected to an 8 x 20 µs wave shape	Not used
I_n	Nominal surge discharge current 8 x 20 µs wave shape	I_n
I_{SCCR}	Short Circuit Current Rating- withstand capability	SCCR
U_P	Voltage Protection Level, Max let thru voltage level of the SPD subjected to a test surge	VPR
U_C	Maximum Continuous Operating Voltage the SPD can be exposed	MCOV
Not used	Nominal operational voltage, or application voltage	Operational voltage

8 x 20 µs pulse (IEC 61643-11 & UL 1449)



- For UL Type 1 & Type 2
- For IEC Class II test (EN[1] Type 2)
- I_{max} and I_n tested with this pulse shape

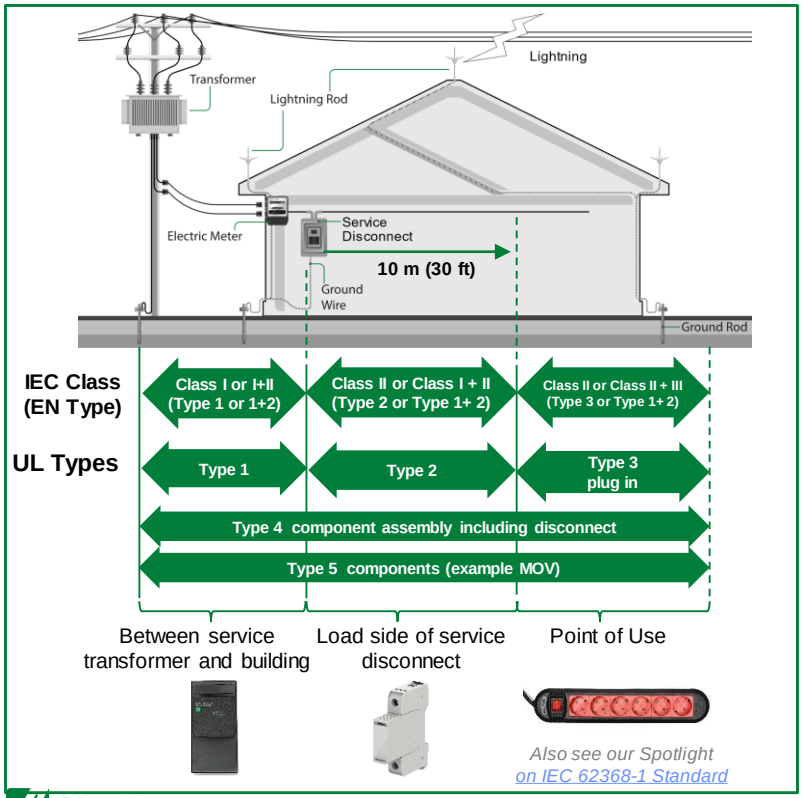
10 x 350 µs pulse (IEC 61643-11 only)



- For IEC Class I (EN Type 1)
- SPD must survive 5 pulses increasing in magnitude to max_{Iimp}
- There is no equivalent test in the UL 1449

1. European Norm. Type is most often used by European OEMs instead of Class

IEC & UL Class and Type



Also see our Spotlight on IEC 62368-1 Standard

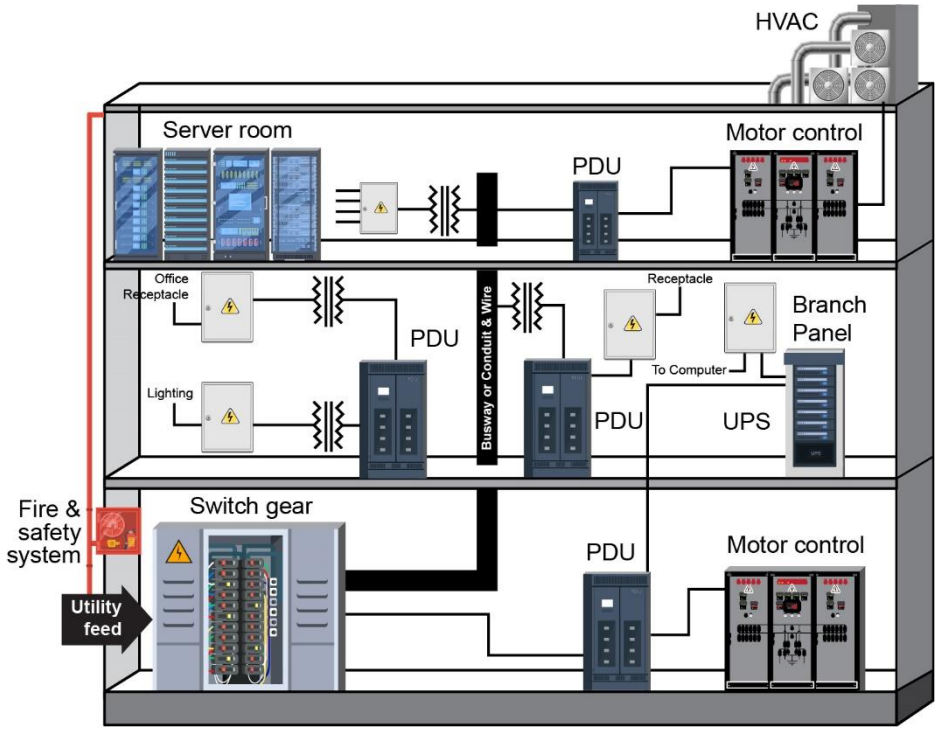
Electrical and electronic equipment and transients

- **IEC 61643-11 Class (EN Type)**
  - Class (EN Type) defined by surge current pulse shape used to test voltage limiting SPD function
    - Class I uses 10/350 µs pulse shape
    - Class II uses 8/20 µs pulse shape
      - SPD can be classified as Class I & II
    - Class III have low discharge capacity and must be installed as supplement to Type II SPD
  - EN stands for European Norm and term “Type” is used by most European OEMs instead of Class

- **UL 1449 Types**
  - Types 1, 2, and 3 defined by location
  - Type 1 are connected between service transformer and building line side
  - Type 2 are connected on load side of service disconnect or integrated in electrical panel
  - Type 3 are point of use and plug in
  - Type 4 are component assemblies with one or more Type 5 components including disconnect. Examples: LST or TMOV
  - Type 5 are discrete component surge suppressors such as MOVs that may be on printed circuit board.

- IEC Class III and UL Type 3 not included in this material.

SPD locations for industrial or commercial buildings

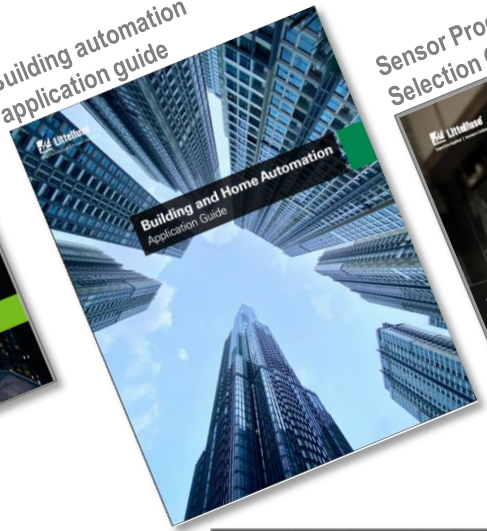


SPD location	Protected equipment examples
Main distribution protection	▪ UPS ▪ Motor Control Centers (MCCs) ▪ Backup Power ▪ Switchgear ▪ Transfer switch
Sub-distribution protection	▪ Local backup power ▪ Switchgear ▪ Generators ▪ HVAC ▪ Fire alarm systems ▪ Security systems ▪ Building management systems ▪ Power Distribution Unit (PDU)
Equipment level protection	▪ Motor drives ▪ Soft starts ▪ Medical equipment ▪ Life support equipment ▪ Test equipment ▪ Printers ▪ Communication systems ▪ Escalators/elevator ▪ Parking lot lighting ▪ Computer servers

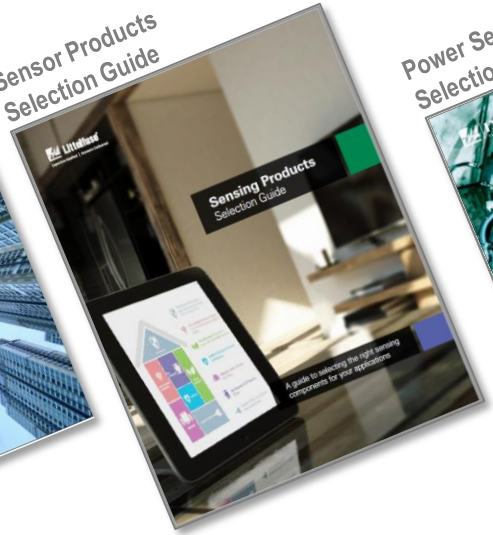
Additional information can be found on Littelfuse.com

Circuit Protection Selection Guide

Building automation application guide



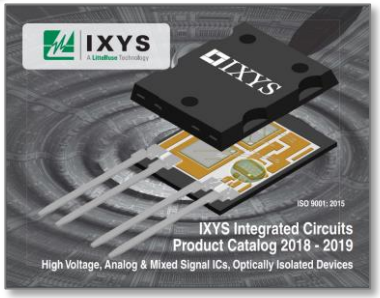
Sensor Products Selection Guide



Power Semiconductor Selection Guide

Click on images to open the catalog

Integrated Circuits Product Catalog



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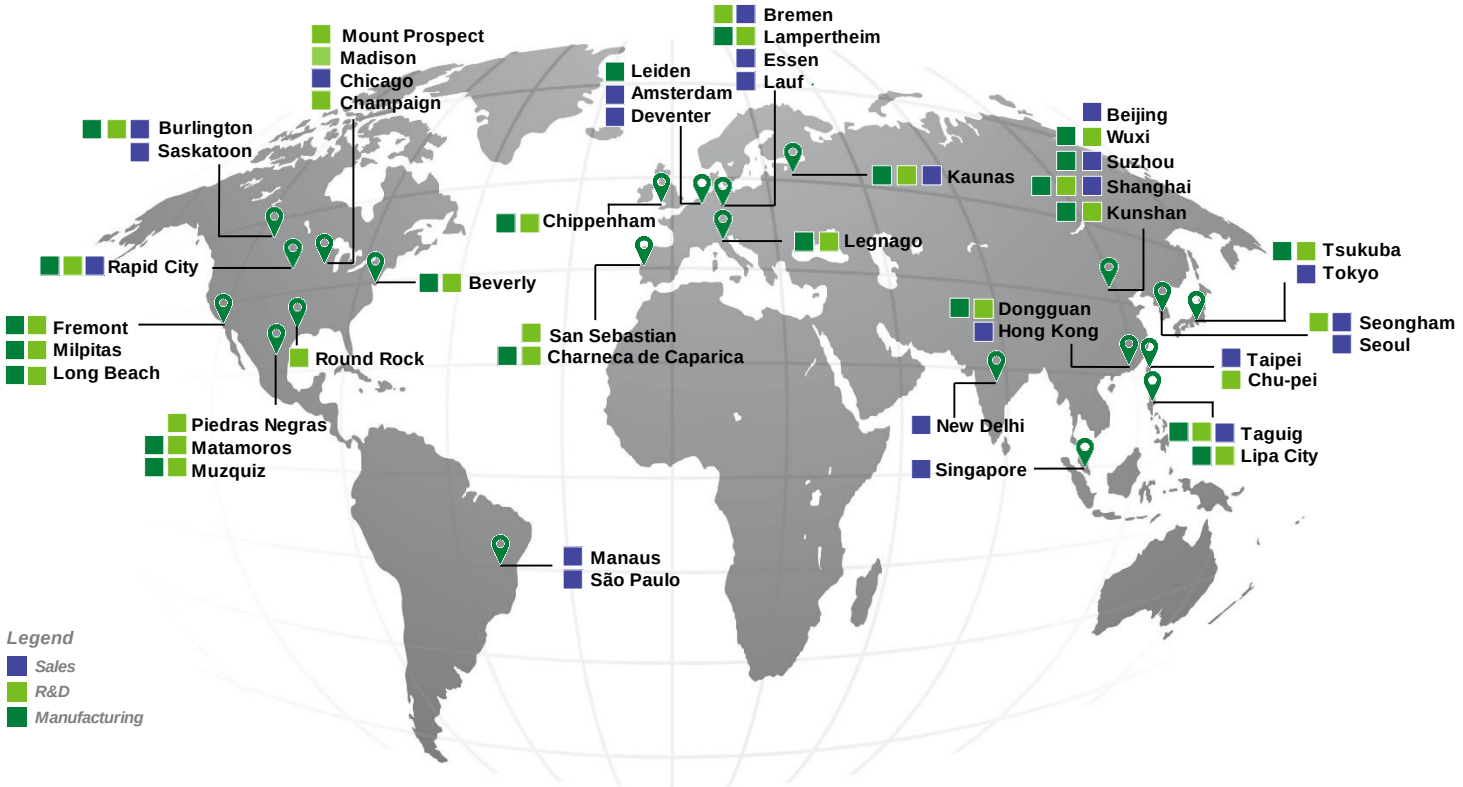
Local resources supporting our global customers



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Partner for tomorrow's electronic systems

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

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Supplementary slides

Schneider Homeline Plug-on Neutral SPD

Schneider Homeline Plug-on Neutral SPD

Model number & specification	
Name	The Square D Homeline Plug-on Neutral Surge Protective Device
Model Number	HOM250PSPD
Description	Residential Surge Protective Devices
Specifications	Voltage rating: 120/240 V MOCV: 150 V L-N, 300 V L-L
Other manufacturers of similar products	ABB, Rockwell, Eton, Ditek, Denh
Littelfuse opportunities	TMOV: LST1520EL2NT2

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

Schneider Homeline Plug-on Neutral SPD teardown

TPMOV
Make: Mersen
LFUS: LST1505

LED

Technology	Function in application	Series	Benefits	Features
TMOV	Protects subsequent household equipment from voltage surges such as lighting other transients	LST	Same footprint for 50 kA and 75 kA I_{max} for same PCB layout (LST)	Normally open and normally closed options for remote indication

Phoenix Contact–Type 2 SPD

Phoenix Contact
Type 2 SPD

Model number & specification	
Name	Phoenix Contact
Model Number	VAL-SEC-T2-3S-350/40
Description	Pluggable surge protective device, in accordance with Type 2/Class II, for 3-phase power supply networks with separate N and PE (5-conductor system: L1, L2, L3, N, PE), with remote indication contact. With 40 kA discharge capacity in accordance with the requirements of VDE 0100-534:2016-10 relating to SPDs at the system feed point.
Specifications	Height: 97.9 mm Width: 49.2 mm Depth: 74.5 mm (incl. DIN rail 7.5 mm) Horizontal pitch: 2.7 Div Operating voltage: 5 V AC ... 250 V AC 125 V DC (200 mA DC Operating current: 5 mA AC ... 1 A AC 1 A DC (30 V DC)
Other manufacturers of similar products	ABB, Mersen, Schneider, Eaton, DEHN, OBO, Phoenix, Hager
Littelfuse opportunities	MOV: Custom, GDT: Custom

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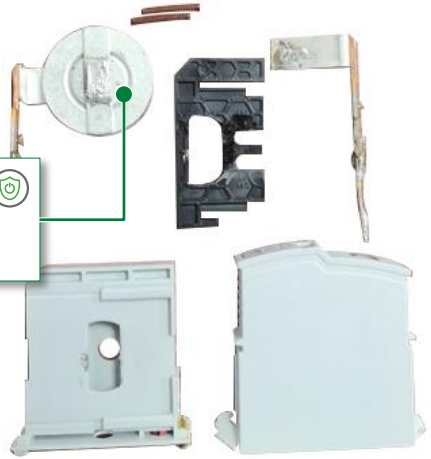
Click on the product series in the table below for more info

Phoenix Contact–Type 2 MOV & GDT module teardown

GDT module



800 V Fat GDT
Make: TDK (Epcos)
LFUS: Custom – Contact Product Manager

MOV module

Varistor, 517 V, Disc 33.8 mm
Make: TDK (Epcos)
LFUS: Custom- Contact Product Manager

Technology	Function in Application	Series	Benefits	Features
MOV	Voltage surge protection with thermal disconnect	Custom	Flexibility to offer component that aligns with OEMs needs	High surge current withstanding and energy absorption capabilities
GDT	Voltage surge protection with no significant leakage current	Custom	Surge protection for AC lines	Rugged ceramic/metal construction

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