



CITEL

SURGE PROTECTION FOR DATACENTER





INTRODUCTION

Ever since the birth of modern computing in the mid-20th century, the need for storing, processing, and transmitting vast amounts of data has grown exponentially. From the first rudimentary mainframes to today's hyper-connected digital ecosystems, data has become the backbone of our global economy and daily lives. In 2024, the total global data volume is expected to exceed 180 zettabytes (180×10^{15} GB), with data centers playing a crucial role in managing this ever-expanding digital universe.

By 2025, there are more than 8 000 large-scale data centers worldwide, collectively accounting for nearly 2% of global electricity consumption — a number that continues to grow with the increasing importance of artificial intelligence, cloud computing, and edge technologies.

To ensure the seamless operation of these mission-critical facilities, careful planning, high-quality infrastructure, and advanced cooling and power management systems are essential. However, despite rigorous engineering, data centers face a range of

risks—including power outages, overheating, cyber threats, and hardware failures—that can lead to significant financial losses and service disruptions. Proactively identifying these risks and implementing robust mitigation strategies during the design and operational phases is vital to guaranteeing efficiency, security, and sustainability in the digital age.

Modern data centers form the backbone of global digital infrastructure, enabling cloud computing, AI-driven analytics, and real-time communication. With power demands soaring—averaging 32 megawatts per facility, equivalent to powering a town of 25 000 people—ensuring uninterrupted operations is non-negotiable. However, these facilities face escalating risks from electrical surges, lightning strikes, and grid instabilities, which threaten equipment longevity, data integrity, and operational continuity.

But how can potential sources of danger be identified? And above all: what measures can be taken to achieve optimum protection?

KEY STANDARDS

The IEC 62305 series – „Protection against lightning“ is an internationally recognized series of standards that defines the principles for protecting structures, electrical systems, and people from lightning effects. This standard provides the foundation for designing comprehensive lightning protection systems (LPS), including external and internal protection measures.

The IEC 61643 series – „Low-voltage surge protective devices“ focuses on the performance, testing, selection, and application of SPDs (Surge Protective Devices) used in low-voltage power and signaling systems. It includes requirements for devices protecting against transient overvoltages caused by lightning and switching events in AC, DC, PV, and telecommunication systems. This series of standards ensures coordinated surge protection across all levels of electrical installations.

PROTECTION STRATEGIES

One significant risk in Data Center is the negative impact of lightning strikes and electrical surges. While the likelihood of a direct lightning strike on the plant's structure (scenario S1 in Figure 1) is relatively low —depending on the location and exposure — such an event can still induce partial lightning currents of several thousand amperes into the system's wiring.

More commonly, lightning strikes occur in the vicinity of the power plant (S2), near overhead lines (S4), or within the upstream distribution grid (S3). In these cases, surge voltages can be fed into the system through inductive and/or resistive coupling or an increase in ground potential.

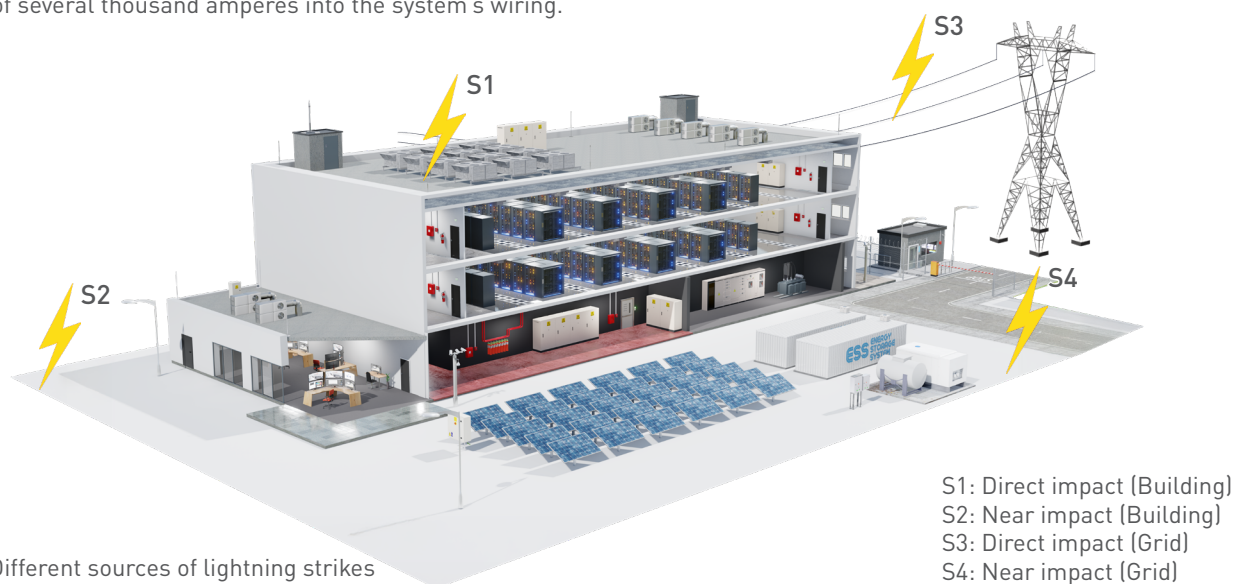


Figure 1: Different sources of lightning strikes

LIGHTNING PROTECTION ZONES

In the framework of IEC 62305, a comprehensive lightning protection system is organized into clearly defined zones that work together to shield a data center from both direct strikes and secondary surge effects. The outer protection zone establishes a perimeter around the facility using air terminals and the rolling sphere method; this zone intercepts the full force of a lightning strike, directing the high-energy surge safely to ground and preventing the strike from reaching the building's structure. Just inside this boundary lies the intermediate (or inner) zone, where the intensity of a lightning event is reduced yet

still capable of inducing electromagnetic pulses and transient overvoltages. In this inner zone, additional measures—such as secondary surge protective devices, proper grounding, and bonding practices—are employed to attenuate any residual energy before it can affect sensitive electronic systems within the data center. Together, these layers provide a coordinated defense: the outer zone handles the most severe surges at the entry point, while the intermediate zone mitigates remaining disturbances to ensure the uninterrupted operation and safety of critical IT infrastructure.

Outer zone LPZ 0

LPZ 0_A: Hazard due to direct lightning strikes

LPZ 0_B: Protected against direct lightning strikes

Inner zones

LPZ 1: Surge currents are limited by current sharing or SPDs at the zones

LPZ 2: Surge currents are further limited by current sharing or SPDs at the zones

LPZ 3: Only low-energy residual voltage peaks remain, which are filtered out at this transition.

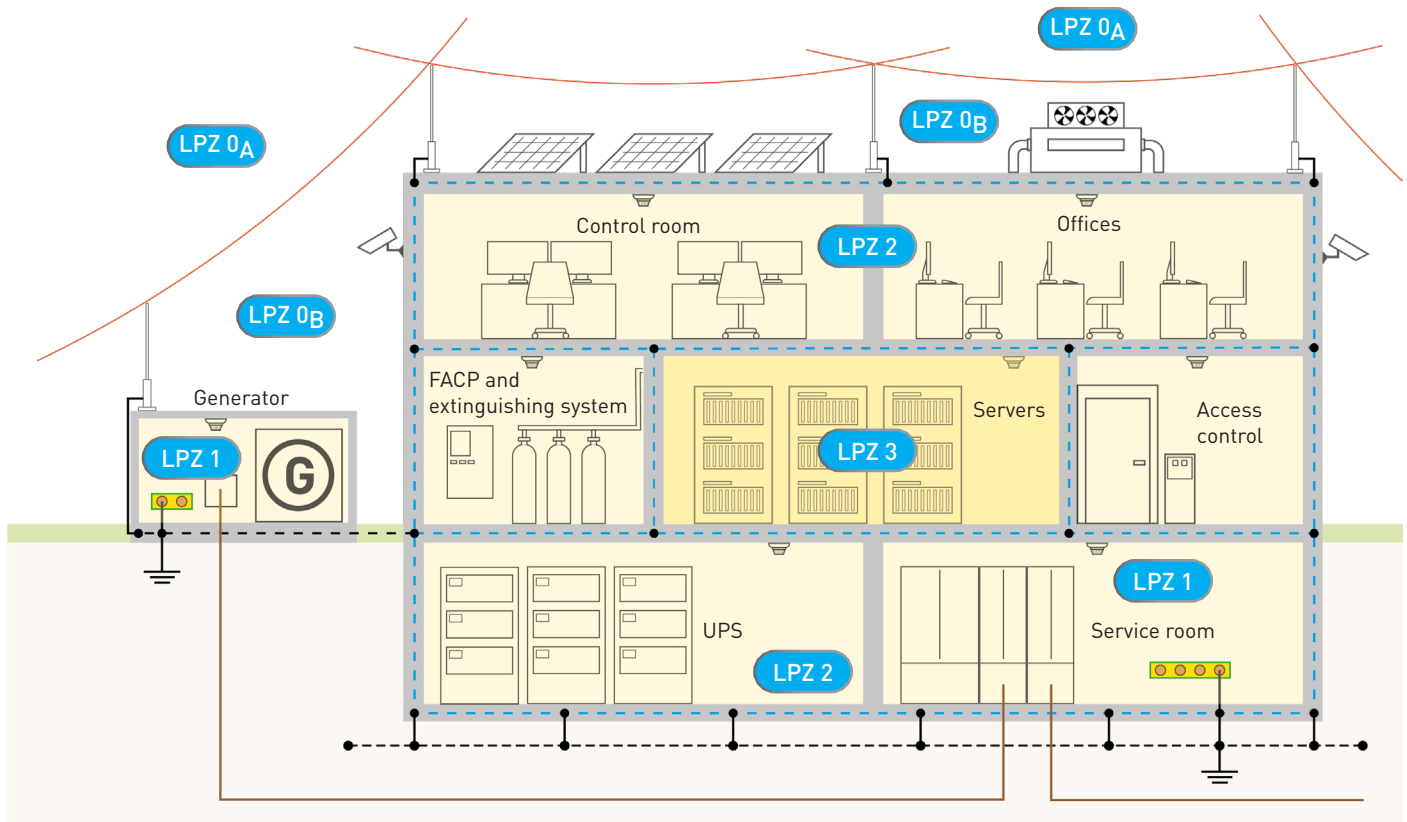


Figure 2: Lightning protection zone concept

GUIDELINES

The design, construction, and operation of data centers are governed by a comprehensive framework of international and regional standards to ensure reliability, security, and efficiency. These standards define essential requirements for power infrastructure, environmental controls, telecommunications, and overall risk management, helping operators to mitigate potential threats to uptime and service continuity.

Data centers must be designed to withstand the risks associated with lightning strikes and surge events. The IEC 62305 series provide a globally recognized framework for lightning protection, ensuring the safety and operational continuity of critical IT infrastructure under extreme conditions.

The IEC 61643 standard defines the requirements, testing, and application of Surge Protective Devices (SPDs) across multiple electrical and electronic systems, including AC power, photovoltaic (PV) installations, DC networks, and telecommunications. SPDs are essential for protecting sensitive equipment from transient overvoltages caused by lightning strikes, switching operations, and grid disturbances. Compliance with IEC 61643 is crucial for ensuring system reliability, equipment longevity, and

operational continuity, reducing downtime and preventing costly failures in critical infrastructures.

IEC 61643 SPD Classification by Lightning Protection Zones (LPZ):

- LPZ 0/1:

Type 1 SPD (T1): Handles direct/indirect lightning currents, tested with a 10/350µs impulse, with impulse discharge capability (I_{imp}) rating, used for AC, PV, DC systems. For data lines: SPD classification D1.

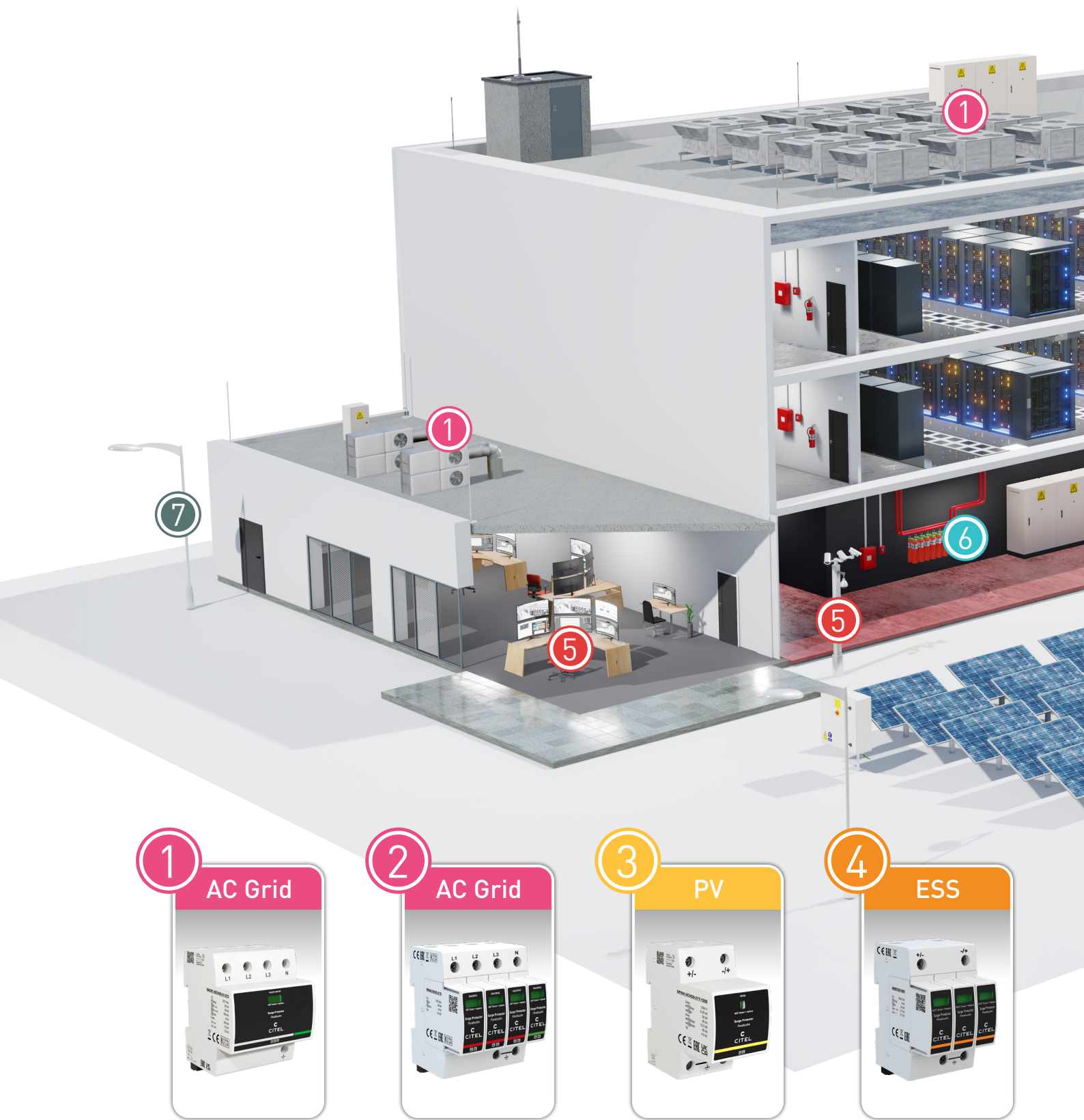
- LPZ 1/2:

Type 2 SPD (T2): Protects against coupled surges from switching or nearby strikes, tested with an 8/20µs impulse, rated by Nominal discharge capability (I_n), used for AC, PV, DC. For data lines: SPD classification C2.

- LPZ 2/3:

Type 3 SPD (T3): Provides fine protection for sensitive devices, tested with 1.2/50µs (voltage) and 8/20µs (current) combined waveforms, rated by open-circuit voltage (U_{oc}), for AC, PV, DC. For data lines: SPD classification C1.

EXEMPLARY STRUCTURE OF A MODERN DATA CENTER.





PRODUCT SELECTION - AC



DACN1-25CVG series

AC Combined SPD Type 1+2+3

- „VG-Technology“
- Optimized to TOV
- No ageing due to operating and leakage currents (VG-Technology)
- No follow current
- Remote signaling
- Surge counter (optional)
- IEC 61643-11 and EN 61643-11 certified

Item descr.	DACN1-25CVGS-31-275	DACN1-25CVGS-31-275/SC
Uc	275 Vac	275 Vac
Iimp / Pole	25 kA	25 kA
Iimp total	100 kA	100 kA
In / Pole	25 kA	25 kA
Up	< 1,5 kV	< 1,5 kV
Item code	64135	64136



DAC50VG series

AC Combined SPD Type 2+3

- Optimized TOV
- Thermal disconnecter
- No ageing due to operating and leakage currents (VG-Technology)
- No follow current
- Pluggable modules
- Remote signaling
- IEC 61643-11 and EN 61643-11 certified

Item descr.	DAC50VG-11-275	DAC50VG-31-275	DAC50S-40-440
Uc	275 Vac	275 Vac	440 Vac
In / Pole	20 kA	20 kA	20 kA
I _{max} / Pole	50 kA	50 kA	50 kA
Up	< 1,5 kV	< 1,5 kV	< 2 kV
Item code	821110242	821110244	821110424



DAC40CS series

AC SPD Type 2

- 5 Years warranty
- Very compact
- Thermal disconnecter
- No follow current
- Pluggable module
- Remote signaling
- IEC 61643-11 and EN 61643-11 certified

Item descr.	DAC40CS-11-275	DAC40CS-31-275	DAC40CS-40-440
Uc	275 Vac	275 Vac	440 Vac
In / Pole	20 kA	20 kA	20 kA
I _{max} / Pole	40 kA	40 kA	40 kA
Up	< 1,5 kV	< 1,5 kV	< 1,8 kV
Item code	821520221	821520222	821510422



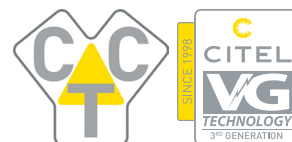
LSCM-D series

Smart SPD Monitoring Device

- Front display for access to recorded events and device parameters
- Peak current and time stamping recording of the surge currents
- RS485 communication interface / MODBUS protocol
- Monitoring features : 2 inputs (SPD or disconnector status) / 1 output
- IEC 62561-6 compliant

Item descr.	LSCM-D/24/P300	LSCM-D/230AC/P1000
Uc	24 Vac/dc	275 Vac
I _{tc}	300 A	1000 A
I _{mcw}	0.3-50 kA (8/20µs) 0.3-25 kA (10/350 µs)	1-100 kA (8/20µs) 1-50 kA (10/350 µs)
Item code	793531	793534

PRODUCT SELECTION - PV



DPVN1-6CVG-21Y-1200
DPVN1-6CVG-21Y-1500

DC combined SPD type 1+2+3

- „CTC-Technology“
- Galvanic isolation
- No ageing due to operating and leakage currents (VG-Technology)
- Remote signaling optional
- IEC 61643-31 and EN 61643-31 certified

Item descr.	DPVN1-6CVG-21Y-1200	DPVN1-6CVG-21Y-1500
U_{cpv}	1200 Vdc	1500 Vdc
I_{imp} / Pole	6,25 kA	6,25 kA
I_{max} / Pole	40 kA	40 kA
U_p (In)	< 4,3 kV	< 4,8 kV
Item code	65222102	65221103



DPVN40CVG-21Y-1200
DPVN40CVG-21Y-1500

DC combined SPD type 2+3

- „CTC-Technology“
- Galvanic isolation
- No ageing due to operating and leakage currents (VG-Technology)
- Remote signaling optional
- IEC 61643-31 and EN 61643-31 certified

Item descr.	DPVN40CVG-21Y-1200	DPVN40CVG-21Y-1500
U_{cpv}	1200 Vdc	1500 Vdc
I_{max} / Pole	40 kA	40 kA
U_p (In)	< 4,3 kV	< 4,8 kV
Item code	65121102	65121103

PRODUCT SELECTION - ESS



DDC50S series

DC power Type 2 SPD

- Specially developed for Energy Storage and EV Charging Systems
- Pluggable modules
- Remote signaling
- prIEC 61643-41 compliant

Item descr.	DDC50S-21Y-500	DDC50S-21Y-1200	DDC50S-21Y-1500
U_c DC	500 Vdc	1200 Vdc	1500 Vdc
I_n / Pole	20 kA	20 kA	20 kA
I_{max} / Pole	50 kA	50 kA	50 kA
U_p (In)	2,1 kV	3,6 kV	5,1 kV
Item code	828511263	828511563	828511663



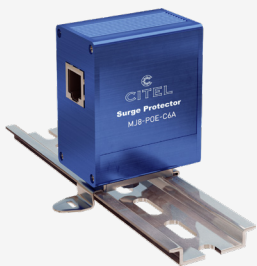
SFD series

SPD Fusing Disconnecter for short circuit protection of SPD

- For energy storage systems
- Type: NH1XL
- In combination with CITEL SPD DDC50-21Y
- Remote signaling and status signaling
- IEC 60269-6 compliant

Item descr.	SFD50S-10-1500DC
U_c DC	1500 Vdc
Rated AC current	50 A gBat
Breaking capacity	100 000 A
Item code	64137

PRODUCT SELECTION - ETHERNET



MJ8 series

SPD for Ethernet, POE, data and telecommunications technology

- High-quality shielded housing with 2 RJ45 ports
- 2-stage protection circuit
- IEEE 802.3bt
- IEC 61643-21 and EN 61643-21 compliant

Item descr.	MJ8-C6A	MJ8-POE-C6A
Network	10 Gigabit Ethernet	10 Gigabit Ethernet POE++
Connection	RJ45	RJ45
Uc	8 Vdc	60 Vdc
C2 (In) L/PE	2 kA	2 kA
D1 (Imp)	500 A	500 A
C3 (Up) Ad./Ad.	< 20 V	< 70 V
Item code	581540	581541



CWMJ8-POE-6A

Outdoor Cat6A-PoE++ SPD

- POE++ Compatible (IEEE 802.3bt) -10Gb (5-100m) with Cat6A S/FTP cabling
- Shielded RJ45 connectors
- Outdoor applications, IP66 (NEMA 4/4X)
- Plastic enclosure, UL94-V0
- IEC 61643-21 and EN 61643-21 compliant

Item descr.	CWMJ8-POE-6A
Application	10Gb PoE++ Ethernet
Uc	60 Vdc
D1 (Imp)	500 A
C2 (In) Ad./PE	2 kA
C3 (Up) L/PE	70 V
Item code	581544



PL series

SPD for Ethernet, POE, data and telecommunications technology

- High-quality shielded housing with 12 or 24 RJ45 ports
- 2-stage protection circuit
- IEEE 802.3bt
- IEC 61643-21 and EN 61643-21 compliant

Item descr.	PL12-CAT6	PL24-CAT6
Network	1 Gigabit Ethernet	1 Gigabit Ethernet
Connection	RJ45	RJ45
Uc	8 Vdc	8 Vdc
C2 (In) L/PE	2 kA	2 kA
D1 (Imp)	500 A	500 A
C3 (Up).	< 20 V	< 20 V
Item code	581534	581515

PRODUCT SELECTION - FIRE DETECTION



DDCCS series

Compact DC SPD Type 2

- Very compact
- Thermal disconnecter
- No follow current
- Remote signaling
- prIEC 61643-41 and IEC 61643-11 compliant

Item descr.	DDC20CS-20-24	DDC20CS-20-38	DDC30CS-20-65
Uc DC	24 Vdc	38 Vdc	65 Vdc
In / Pole	10 kA	10 kA	15 kA
I _{max} / Pole	20 kA	20 kA	30 kA
Up	250 V	250 V	300 V
Item code	828210321	828210421	828310121



DACN1x series

Compact single-phase type 2 (or 3) SPD

- Cost effective single-phase surge protector
- Type 2 or 3 monobloc compact
- 2-port configuration (series mounting)
- Remote signaling
- IEC 61643-11 and EN 61643-11 compliant

Item descr.	DACN10S-21YG-275	DACN15S-P11-275
Uc DC	275 Vdc	275 Vdc
In / Pole	5 kA	5 kA
I _{max} / Pole	10 kA	15 kA
Up	1,5 kV	1,5 kV
Item code	70114022	70146022



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PRODUCT SELECTION - LED LIGHTING



MLPC-VG series

Type 2 (or 3) surge protectors for LED

- „VG-Technology“
- Available for Class 1 or 2
- Very compact
- Spring terminal connection
- Status indicator
- Disconnection AC end of life
- IEC 61643-11 and EN 61643-11 compliant

Item descr.	MLPC-VG1-230L-R	MLPC-VG2-230L-R
U_c	275 Vac	275 Vac
I_n / Pole	5 kA	5 kA
I_L	10 A	10 A
U_p	1,5 kV	1,5 kV
Item code	836211	837211



MLPM series

Type 2 (or 3) surge protectors for LED

- Available for Class 1 or 2
- Very compact
- Spring terminal connection
- Mechanical status indicator
- Disconnection AC end of life
- ENEC / KEMA certified
- IEC 61643-11 and EN 61643-11 certified

Item descr.	MLPM1-230L-R	MLPM2-230L-R
U_c	275 Vac	275 Vac
I_n / Pole	5 kA	5 kA
I_L	10 A	10 A
U_p	1,5 kV	1,5 kV
Item code	841211	842211



PRODUCT SELECTION - DATA

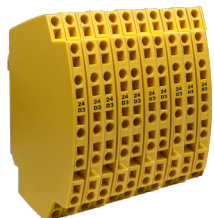


DLA series

SPD for RS232, RS485, Current loop 4-20 mA, ADSL2 & VDSL2 etc.

- For all I&C, telecommunications and data technology applications
- Protected shield connection
- Pluggable protection module
- Earthing via DIN-hat rail
- IEC 61643-21 and EN 61643-21 compliant

Item descr.	DLA-12D3	DLA-24D3	DLA-170
Application	RS232 RS485	Current loop 4-20 mA	Analog
Config.	1 twin wire + shield	1 twin wire + shield	1 twin wire + shield
U_c	15 V	28 V	170 V
D1 (I_{imp})	5 kA	5 kA	5 kA
C2 (I_n)	5 kA	5 kA	5 kA
C3 (U_p) L/PE	20 V	40 V	220 V
Item code	6402011	6403011	6406011



DLC series

SPD for RS232, RS485, Current loop 4-20 mA, ADSL2 & VDSL2 etc.

- For all I&C, telecommunications and data technology applications
- Protected shield connection
- Pluggable protection module
- Earthing via DIN-hat rail
- IEC 61643-21 and EN 61643-21 compliant

Item descr.	DLC-12D3	DLC-24D3	DLC-170
Application	RS232 RS485	Current loop 4-20 mA	Analog
Config.	1 twin wire + shield	1 twin wire + shield	1 twin wire + shield
U_c	15 V	28 V	170 V
D1 (I_{imp})	2,5 kA	2,5 kA	2,5 kA
C2 (I_n)	5 kA	5 kA	5 kA
C3 (U_p)	30 V	40 V	220 V
Item code	641102	641103	641105



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