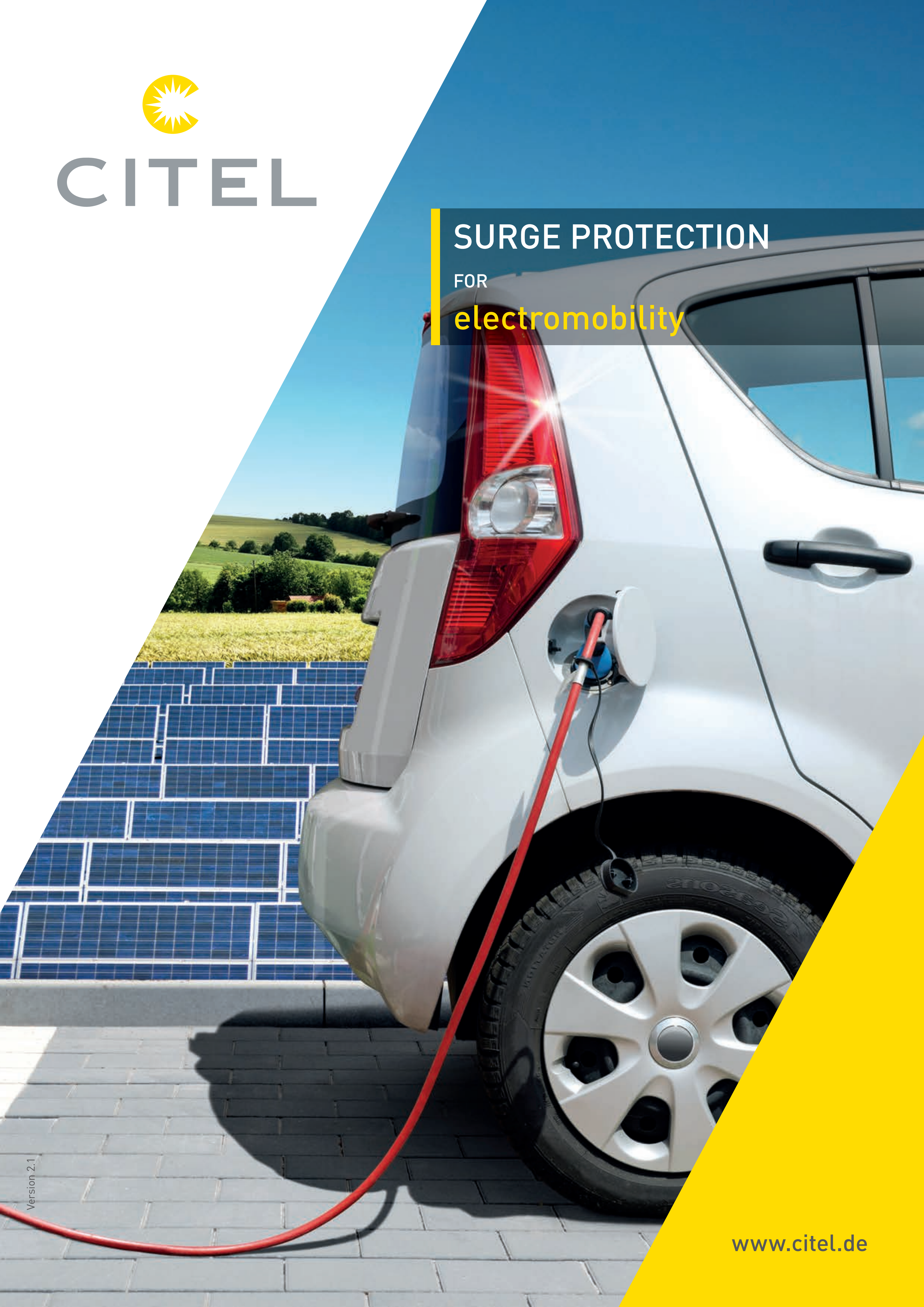
CITEL

SURGE PROTECTION FOR electromobility



Version 2.1

www.citel.de

ELECTROMOBILITY ... how it all started

The beginnings of e-mobility go back to the year 1821. The English physicist Michael Faraday discovered electromagnetic rotation (magnetic poles revolve around live electric conductors), a fundamental property for the later development of the electric motor. The invention of rechargeable lead accumulators in 1859 finally paved the way for the practical implementation of the first electric vehicle, which the French physicist Gustave Trouvé presented to the public in 1881 in the form of a three-wheeled vehicle equipped with 6 lead accumulators and 2 electric motors. Electric vehicles dominated the market around 1900. In the USA their share was as high as 38%.

... the leap into the 21st century

Although in 2018 we were looking back on 130 years of electromobility in Germany, it was not until the 1990s that it experienced a renaissance. Dwindling fossil energy sources (keyword "oil crisis"), progress in battery technology, but especially environmental considerations through active use of the synergies of renewable energies have stimulated the market of electromobility.

Topics such as the charging infrastructure are moving to the forefront of the sustainability and acceptance of electromobility. The availability and security of modern "electricity filling stations" has been recognized as one of the elementary keys. A widespread network of charging points is considered as indispensable prerequisite for broad acceptance.

The vast majority of charging stations work according to the principle of conductive, i.e. cable-bound charging. This rather simple procedure has prevailed over wireless charging based on the induction principle and the concept of battery changing stations on the market.

If cars are regarded as a safe place to stay during thunderstorms because of their metal bodywork (principle of the Faraday cage) and the electronics isolated from the mains are also relatively safe from hardware damage, the conditions for conductive charging change, as the vehicle electronics are now connected to the power electronics, which in turn are fed by the power supply system. Overvoltages can now also be coupled into the vehicle via this galvanic connection.

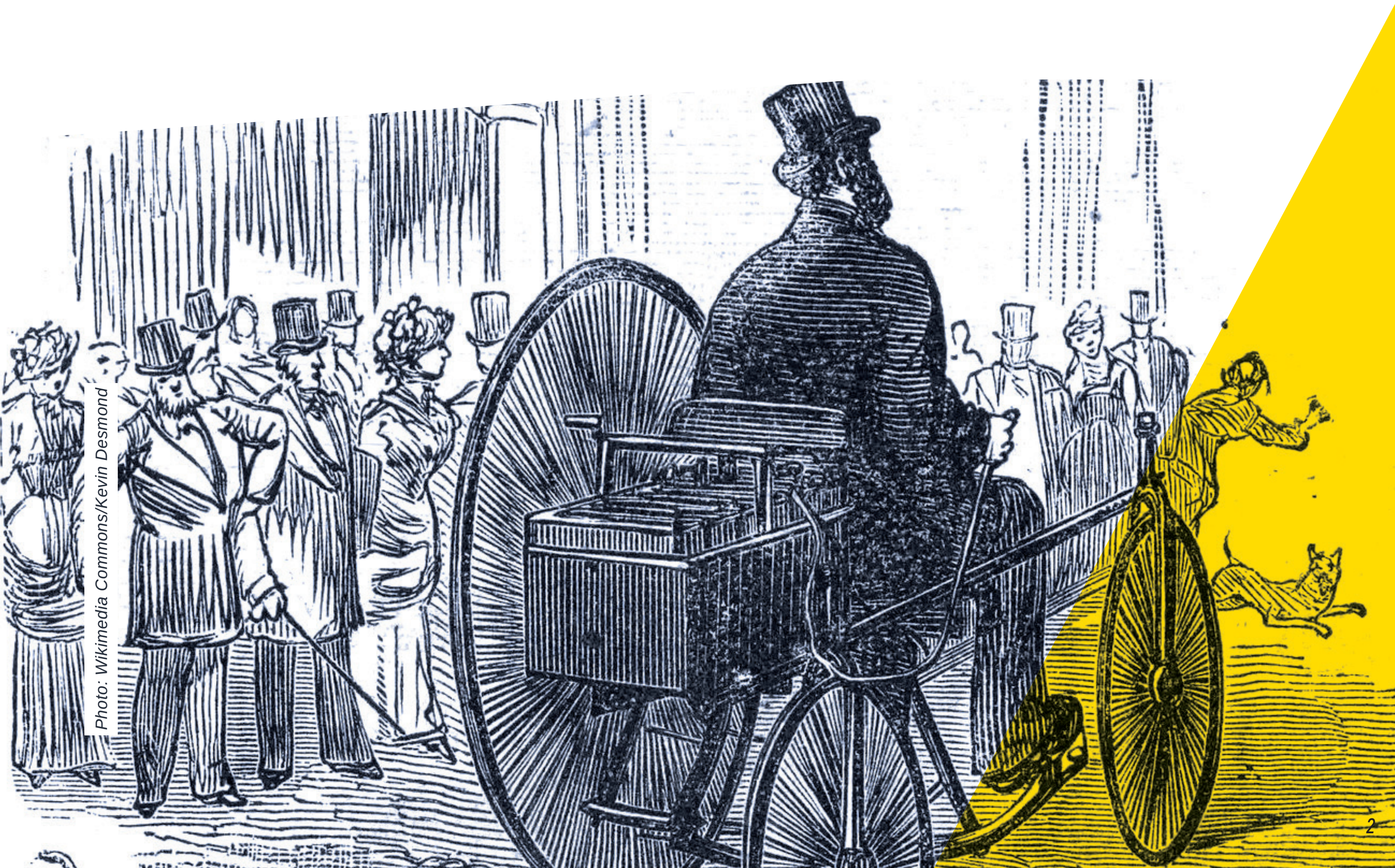


Photo: Wikimedia Commons/Kevin Desmond

DANGER FROM SURGES

On the one hand, there are the lightning discharges (LEMP - Lightning ElectroMagnetic Pulse), which cause extremely high transient overvoltages due to direct or indirect lightning strikes and are considerably more energetic than other overvoltages, and on the other hand the switching operations (SEMP - Switching ElectroMagnetic Pulse), caused e.g. by short-circuits in the power supply system and the associated triggering of fuses.

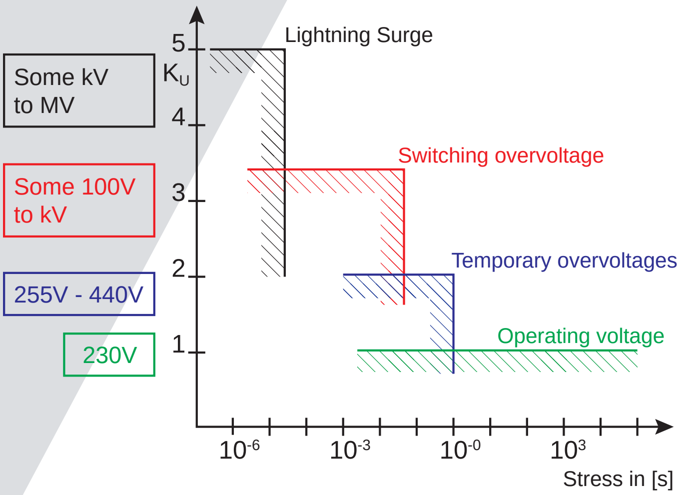


Fig. 1: Voltage level in the power supply system

Normative specifications for the use of surge protection


VdS
Publikation der deutschen Versicherer zur Schadenverhütung
Ladestationen für Elektrostraßenfahrzeuge

As early as mid-2015, the GDV, the German Insurance Association, had dedicated a separate section to the subject of surge protection in its publication "Ladestationen für Elektrostraßenfahrzeuge" (Charging Stations for Electric Road Vehicles) (VDS 3471), referring to both DIN VDE 0100-443 and DIN VDE 0100-722. The section on "Charging Pedelecs and E-Bikes", which was already included at the time, deserves special attention.

DIN VDE 0100-722 (VDE 0100-722): 2019-06

"Requirements for special installations or locations - Supplies for electric vehicles"

	DIN VDE 0100-722 (VDE 0100-722)	DIN
	Diese Norm ist zugleich eine **VDE-Bestimmung** im Sinne von VDE 0022. Sie ist nach Durchführung des vom VDE-Präsidium beschlossenen Genehmigungsverfahrens unter der oben angeführten Nummer in das VDE-Vorschriftenwerk aufgenommen und in der „etz Elektrotechnik + Automation“ bekannt gegeben worden.	VDE

Vervielfältigung – auch für innerbetriebliche Zwecke – nicht gestattet.

ICS 43.120; 29.160.40

Ersatz für
DIN VDE 0100-722
(VDE 0100-722):2016-10
Siehe Anwendungsbeginn

**Errichten von Niederspannungsanlagen –
Teil 7-722: Anforderungen für Betriebsstätten, Räume und Anlagen besonderer Art –
Stromversorgung von Elektrofahrzeugen
(IEC 60364-7-722:2018, modifiziert);
Deutsche Übernahme HD 60364-7-722:2018**

This part of the DIN VDE 0100 series of standards covers specific aspects for the power supply of electric vehicles on the low-voltage grid. For example, Section 722.443 mentions the need for surge protection against transient overvoltages due to atmospheric influences or during switching operations. This is explicitly required for loading points in publicly accessible facilities. It is also important to note that a separate circuit must be provided to transfer energy from/to the electric vehicle.

This standard also deals with protective measures such as requirements for residual current protective devices to be provided and protection against DC residual currents.

DIN VDE 0100-443 (VDE 0100-433): 2016-10

"Protection against transient overvoltages of atmospheric origin or due to switching"

	DIN VDE 0100-443 (VDE 0100-443)	DIN
	Diese Norm ist zugleich eine **VDE-Bestimmung** im Sinne von VDE 0022. Sie ist nach Durchführung des vom VDE-Präsidium beschlossenen Genehmigungsverfahrens unter der oben angeführten Nummer in das VDE-Vorschriftenwerk aufgenommen und in der „etz Elektrotechnik + Automation“ bekannt gegeben worden.	VDE

Vervielfältigung – auch für innerbetriebliche Zwecke – nicht gestattet.

ICS 29.120.50; 91.140.50

Ersatz für
DIN VDE 0100-443
(VDE 0100-443):2007-06
Siehe Anwendungsbeginn

**Errichten von Niederspannungsanlagen –
Teil 4-44: Schutzmaßnahmen – Schutz bei Störspannungen und elektromagnetischen Störgrößen –
Abschnitt 443: Schutz bei transienten Überspannungen infolge atmosphärischer Einflüsse oder von Schaltvorgängen
(IEC 60364-4-44:2007/A1:2015, modifiziert);
Deutsche Übernahme HD 60364-4-443:2016**

This VDE regulation is the basis for determining requirements.

It deals with the protection of electrical systems in case of transient overvoltages due to atmospheric influences transmitted via the power supply network, including direct lightning strikes into the supply lines and transient overvoltages due to switching operations.

RELIABILITY IN SURGE PROTECTION

SURGE EVENTS vs. DIELECTRIC STRENGTH

Even though modern charging points and wall boxes generally withstand overvoltages of up to 4 kV (overvoltage category III), this is often not sufficient, as can be seen from the following figure. Exceeding the insulation strength of the charging device without active surge protection usually means its failure with undefined consequences for the contacted vehicle electronics during an active charging process.

The decisive advantage of active surge protection devices is that they work almost independently of the surge level. Important for the selection is the size of the maximum energy absorption. Therefore, when selecting surge protection, attention should be paid to the type, the installation situation and the risk to the system or person.

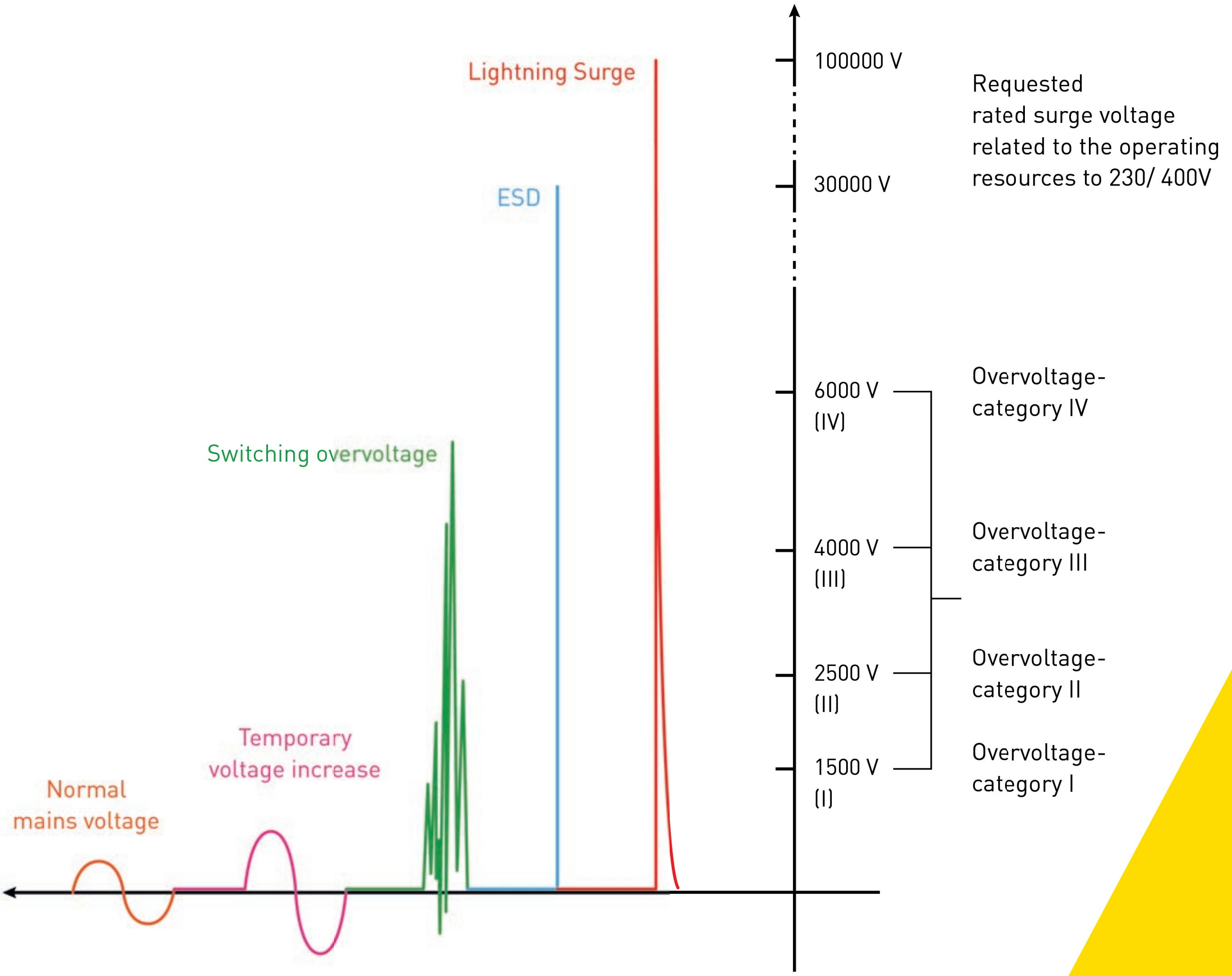


Fig. 2: *Types of overvoltage and their amplitudes*

PASSIVE vs. ACTIVE SURGE PROTECTION (SPD)

Passive protection

Fig. 3 shows the design of an unaffected overvoltage. If, for example, a wallbox without active surge protection is loaded with such a voltage amplitude above its insulation strength, this very probably leads to a failure of the terminal equipment; in the case of contacted vehicle electronics, this is also significantly at risk.

Active protection

If an active protective element is installed, it is primarily no longer the maximum voltage that is decisive, but the energy of the interfering impulse. The voltage limitation (Fig. 4) of the protective element protects the wallbox from excessive voltages. If the pulse energy exceeds the discharge capacity of the protective element, the latter may be overloaded, but the wallbox is still protected in this case.

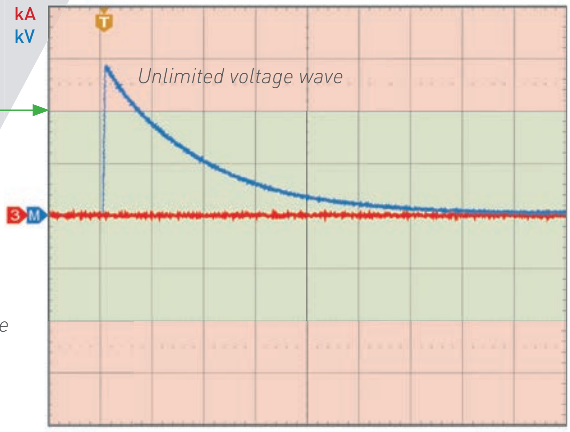


Fig. 3: *(1.2/50µs) Pulse voltage*

Fig. 4: *Voltage limitation and discharge current (8/20µs) through the SPD*

CITEL test laboratory Reims

DIN VDE 0100-534 (VDE 0100-534): 2016-10

"Selection and erection of electrical equipment – Isolation, switching and control – Devices for protection against transient overvoltages"

	DIN VDE 0100-534 (VDE 0100-534)	DIN
	Diese Norm ist zugleich eine **VDE-Bestimmung** im Sinne von VDE 0022. Sie ist nach Durchführung des vom VDE-Präsidium beschlossenen Genehmigungsverfahrens unter der oben angeführten Nummer in das VDE-Vorschriftenwerk aufgenommen und in der „etz Elektrotechnik + Automation" bekannt gegeben worden.	VDE

Vervielfältigung – auch für innerbetriebliche Zwecke – nicht gestattet.

ICS 29.120.50; 91.140.50

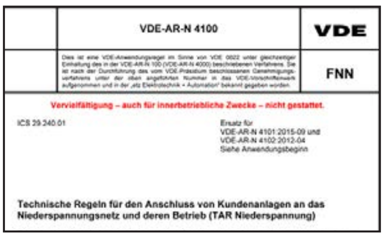
Ersatz für
DIN VDE 0100-534
(VDE 0100-534):2009-02
Siehe Anwendungsbeginn

**Errichten von Niederspannungsanlagen –
Teil 5-53: Auswahl und Errichtung elektrischer Betriebsmittel – Trennen, Schalten und Steuern –
Abschnitt 534: Überspannungs-Schutzeinrichtungen (SPDs)
(IEC 60364-5-53:2001/A2:2015, modifiziert);
Deutsche Übernahme HD 60364-5-534:2016**

This standard essentially contains requirements for the selection and installation of surge protection devices, their applicable circuit variants with regard to the network system as well as specifications for cable lengths, cross-sections to be taken into account and installation instructions. The effective protection range of surge protection devices (SPDs) is also mentioned there. This will be discussed in more detail later in this paper.

VDE-AR-N 4100: 2019-04

"Technical rules for the connection and operation of customer installations to the low voltage network (TAR low voltage)"



	VDE-AR-N 4100	VDE
	Dies ist eine VDE-Anwendungsregel im Sinne von VDE 0022 unter gleichzeitiger Einhaltung des in der VDE-AR-N 100 (VDE-AR-N 4000) beschriebenen Verfahrens. Sie ist nach der Durchführung des vom VDE-Präsidium beschlossenen Genehmigungsverfahrens unter der oben angeführten Nummer in das VDE-Vorschriftenwerk aufgenommen und in der „etz Elektrotechnik + Automation" bekannt gegeben worden.	FNN

Vervielfältigung – auch für innerbetriebliche Zwecke – nicht gestattet.

ICS 29.240.01

Ersatz für
VDE-AR-N 4101:2015-09 und
VDE-AR-N 4102:2012-04
Siehe Anwendungsbeginn

Technische Regeln für den Anschluss von Kundenanlagen an das Niederspannungsnetz und deren Betrieb (TAR Niederspannung)

In addition to general principles, this VDE application rule describes special requirements for the operation of charging equipment for electric vehicles. A separate chapter is also devoted to surge protection. In this regard, we refer to our article "Technische Regeln für den Anschluss von Kundenanlagen an das Niederspannungsnetz und deren Betrieb (TAR Niederspannung)" (SPD in the main power supply system), which refers specifically to this section of the VDE application rule.

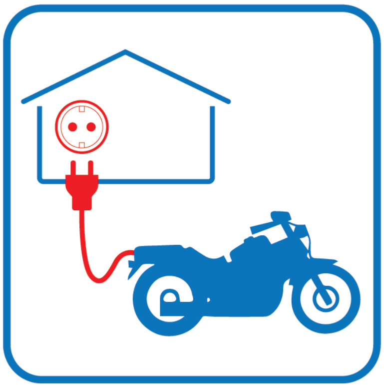
CHARGING INFRASTRUCTURE
CHARGING MODES

Charging infrastructure

In general, a distinction is made in conductive, i.e. cable-bound charging between charging with single- or three phase alternating current (AC charging) and charging with direct current (DC charging). The latter has the advantage that the charging rectifier becomes part of the charging station and the safety functions are also taken over from the charging station. "High Power Charging" with charging capacities of up to 350 kW is now standard practice in the expansion of the rapid charging infrastructure. At the same time, such charging stations – equipped with appropriate intelligence – contribute to grid stabilization by providing reactive power as needed.

The standardized European Combined Charging System combines rapid charging with, by definition according to the EU directive, more than 22 kW charging power with normal charging in a single system. Normatively, a distinction is made between four different charging modes.

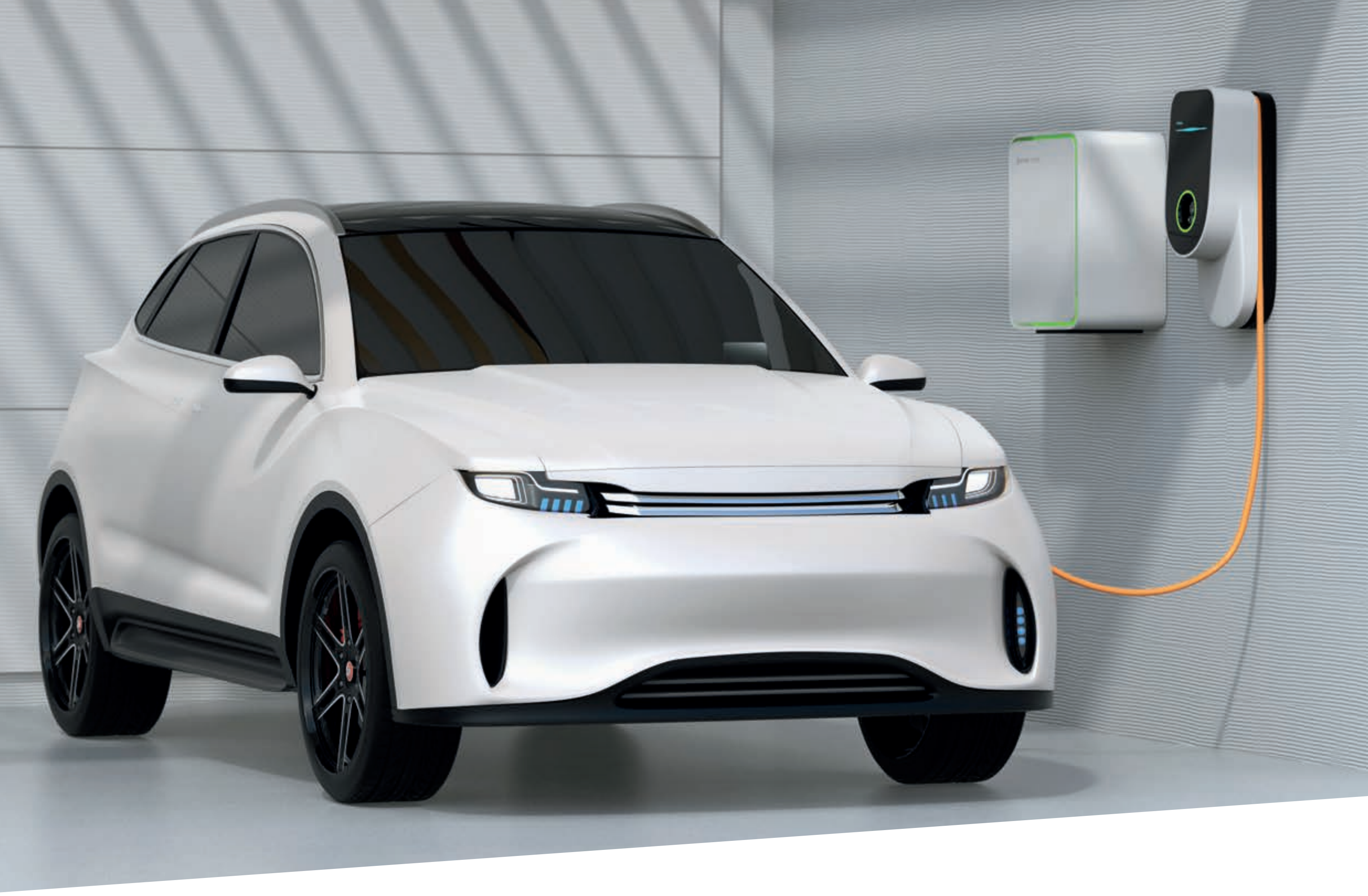
Charging mode 1



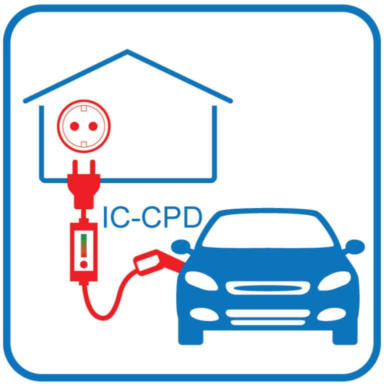
The electric vehicle is charged directly from a conventional mains socket without communication between the vehicle and the infrastructure. Here the vehicle becomes a current-limiting element, i.e. upstream protective devices may trip unintentionally.

However, this charging mode is not recommended, particularly because of the residual current protection device, which is not always guaranteed in existing installations, but is absolutely necessary for safety reasons. Only very few vehicle manufacturers therefore support this charging mode.

The charging modes are based on the system standard DIN EN 61851-1 (VDE 0122-1)



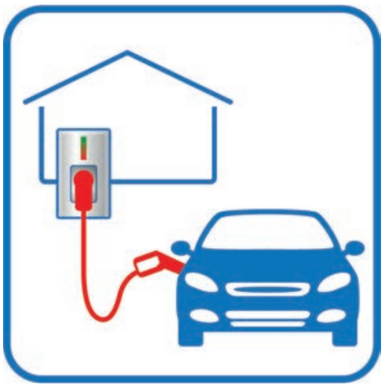
Charging mode 2



Here the electric vehicle is charged via a standard domestic or CEE industrial socket. The difference to charging mode 1 is the charging cable, which contains a control and protection device, a so-called In Cable - Control and Protection Device. This device protects against insulation faults and monitors the protective conductor connection, among other things.

For new installations, modifications and extensions of electrical systems, the presence of a residual current protection device in the infrastructure is mandatory. The communication that takes place also allows the state of charge to be checked.

Charging mode 3



The electric vehicle is charged via a permanently installed charging station. The charging power usually ranges from 11 kW (230 / 400V 3ph~ 16A) up to 43 kW (230 / 400V 3ph~ 63A). Mechanically, these charging stations are designed as so-called wallboxes or charging stations. In public areas, the connection is made via type 1 or type 2 charging sockets, in private areas preferably via permanently connected mode 3 charging cables. The charging station itself may have several charging points.

According to the VDE-AR-N 4100 application rule, charging devices for electric vehicles with rated power ≥ 3.6 kVA must be registered with the grid operator. Charging stations with a rated power of > 4.6 kVA must be connected in the three-phase system.

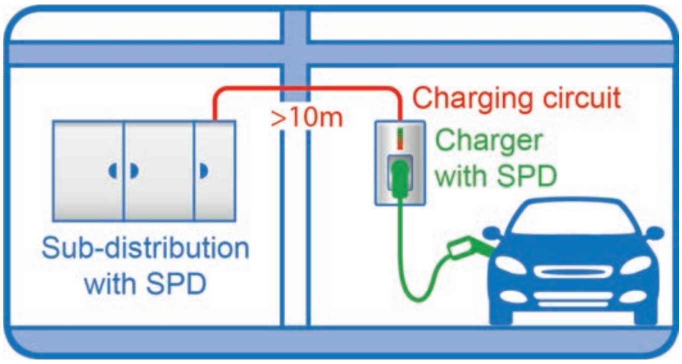
SURGE PROTECTION (SPD) for the CONDUCTIVE CHARGING PROCESS

SPD for charging modes 1 and 2

Charging modes 1 and 2 use conventional safety sockets or CEE plugs. It is not a grid connection explicitly designated for the connection of electric vehicles only. However, in contrast to e.g. a washing machine, an electric vehicle is permanently charged at the maximum load capacity of the plug and socket device, so special care is required here (danger of overheating, fire hazard). Here, the surge protection must follow the typical building installation. The AC selection guide generated by CITEL already takes into account a large number of installation environments and provides a good overview of the components to be selected (see www.citel.de "DOWNLOADS").

SPD for charging mode 3

A typical installation location for such charging stations is often in the private environment in the garages of private homes or in the underground car park, often coupled with intelligent load management. What they all have in common is the fact that the charging station is part of the building and therefore follows the typical building installation when considering surge protection (see above). Long cable routes to the garage/wallbox may require additional surge protection. DIN VDE 0100-534 (IEC 60364-5-53) also deals with the effective protection range of surge protection devices (SPD):



"If the cable length between the surge protective device (SPD) and the equipment to be protected (Note CITEL: the charging station) is more than 10 meters, additional protective measures should be taken, such as installing an additional surge protective device (SPD) as close as possible to the equipment to be protected. ..."

This is where the extremely compact yet pluggable arresters of the latest CITEL generation come in. Universally suitable for both TN-S and TT networks, this space-saving type 2 surge arrester often finds room for installation in the wallbox. In order to avoid interfering with the hardware of the wallbox, this SPD can be installed in a small distribution box close to the wallbox.

Especially for manufacturers and PCB designers of compact modern wall boxes, CITEL also offers Type 2 SPDs for PCB mounting.

Compact DACC series Type 2 for din rail mounting

If the charging stations are installed outside of the building, the required lightning and surge protection have to be selected according to the installation location.

The application of the lightning protection zone concept according to DIN EN 62305-4 (VDE 0185-305-4) provides further important information on the correct design of lightning and surge arresters.

PAC series Type 2 for PCB mounting

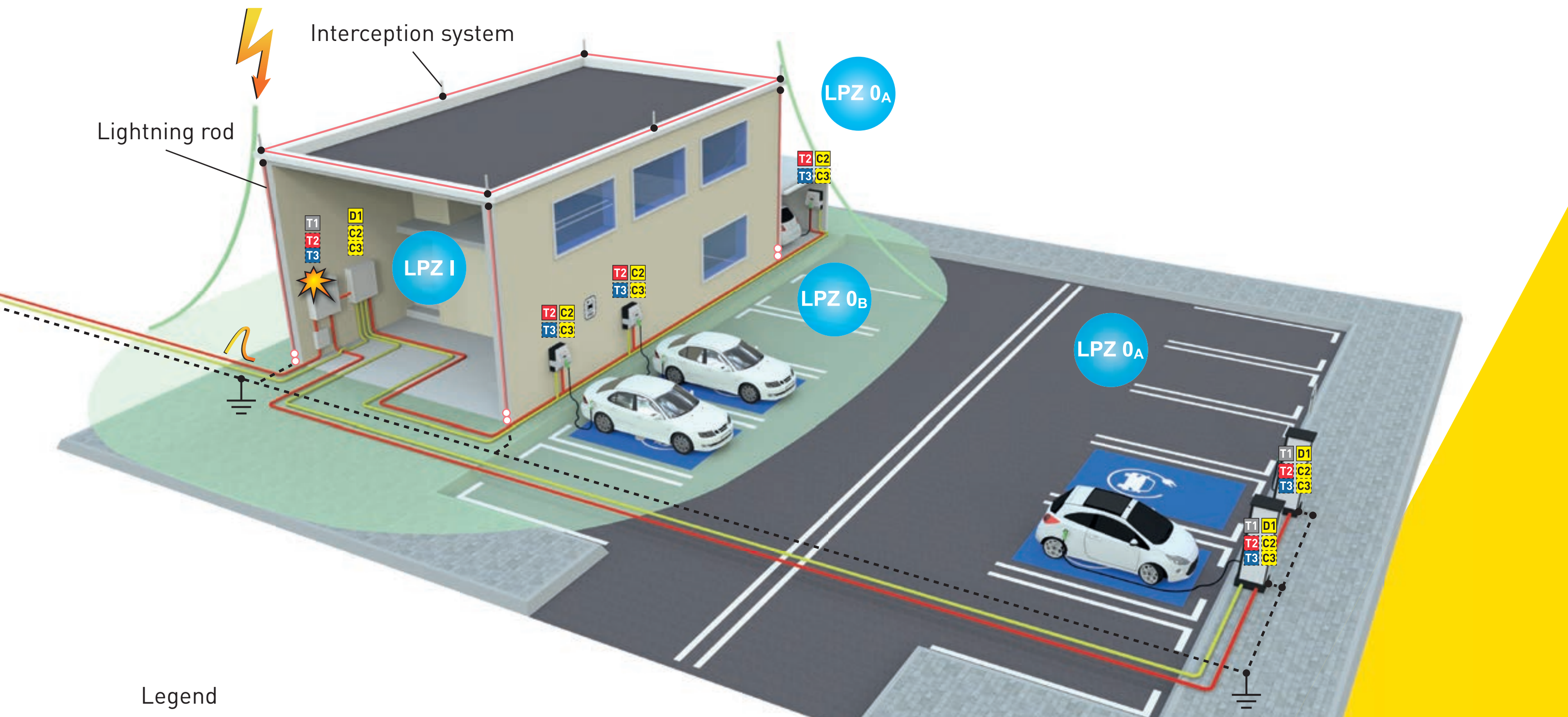
LIGHTNING PROTECTION ZONE CONCEPT

The lightning protection zone concept described in the standard includes external and internal lightning protection. Protection zones with decreasing hazard potential are defined, so-called Lightning Protection Zones (LPZ). The Surge Protective Devices are installed at the zone transitions of the internal lightning protection.

The external lightning protection zone LPZ 0 is divided into the zones LPZ 0_A and LPZ 0_B. The latter is protected against direct lightning strikes, but the internal systems are exposed to partial lightning currents. This is one of the reasons why, if an external lightning protection system is present or installed, an internal lightning protection system including an SPD type 1 must always be installed. This reduces the overvoltage to a level that is not dangerous for the installed equipment. The lightning current discharge capability I_{imp} of the arrester is selected according to the classification of the building into the lightning protection classes I to IV.

This risk level is usually determined by a lightning protection specialist. If no risk analysis was performed the DIN VDE 0100-534 stipulates that the type 1 arrester must have a minimum lightning current discharge capability I_{imp} of 12.5 kA per pole. The arrester shall be placed as close as possible to the building infeed.

If the charging station is now located outside the building, but still in the highly recommended zone LPZ 0_B, a type 2 surge arrester is sufficient here, since the high-energy couplings were intercepted by the SPD type 1 in the infeed. If, on the other hand, the charging station is located in the unprotected area of zone LPZ 0_A, an SPD of type 1 is required again, analogous to the building infeed. This is exactly what DIN VDE 0100-443 confirms with its requirement for a SPD type 1 for protection against direct lightning strikes into the supply mains.



Legend

Energy supply	Information technology system	Earthing
T1 T2 T3 — Lightning protection equipotential bonding Lightning current arrester (SPD Type 1) preferably T1+T2+T3	D1 C2 C3 — Lightning protection equipotential bonding Lightning current arrester (SPD Type 1)	LPZ — Lightning protection zone
T2 T3 — Local potential equalisation Surge arrester (SPD Type 2, SPD Type 3)	C2 C3 — Local potential equalisation Surge arrester (SPD Type 2, SPD Type 3)	Electromagnetic switching pulse

CITEL

LIGHTNING STRIKES

Direct and indirect lightning strikes into the building

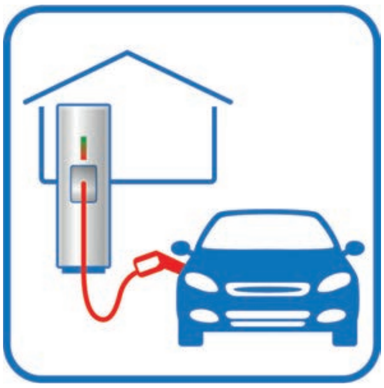
According to a study by the German Insurance Association (GDV), inductive coupling and potential displacement causes damages for a distance of up to 2000 meters.

DIN EN 62305-2 (VDE 0185-305-2) provides information for the assessment of risk components due to

- Lightning strikes into the building structure (source of damage S1)
- Lightning strikes next to the building (S2)
- Lightning strikes into a supply line connected to the building (S3)
- Lightning strikes next to a supply line connected to the building (S4)

These overvoltages are lower in energy than direct lightning strikes, but can also destroy electronic components. CITEL therefore recommends the use of an SPD type 1.

Charging mode 4



Here the electric vehicle is charged directly with direct current (DC); the charging cable is permanently attached to the charging station. The charging power starts at 24 kW, but is often significantly higher (up to 350 kW). Such charging stations are primarily found in public areas. A PWM signal enables high-level communication.

If these charging stations are fed directly from the public grid, the use of a SPD in the pre-metering area is recommended. In this case, surge protectors with CITEL's patented VG-Technology are recommended, a single certified SPD (type 1+2+3) for the protection of all components in the charging station, free from any mains follow currents that could cause upstream fuses to blow. Further technical advantages of this exclusive functional principle can be found in the separate CITEL brochure "VG-Technology".

In the higher power range with up to 350 kW per charging point, the connection to the medium-voltage grid is usually made by a transformer station. Here, DIN VDE 0100-443 recommends additional protective measures on the medium-voltage side of the transformer for protection in the event of lightning-related overvoltages.

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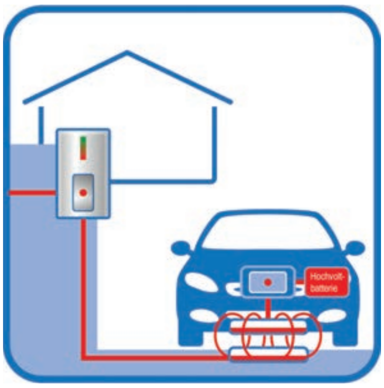
Inductive charging principle



Here, the principle of electromagnetic induction is used for contactless transfer of electrical energy from the charging infrastructure to the electric vehicle.

Surge protection devices are fitted in the same way as in charging mode 3. Particularly, the extremely compact arresters of the DACC series demonstrate their product-specific advantages. Alternatively, CITEL offers the PAC series for direct PCB mounting.

Communication

The charging infrastructure will in future be equipped with considerably more sensor technology, so reliable communication is absolutely essential. Although DIN VDE 0100-443 and VDE-AR-N 4100 only recommend additional surge protection of the communication devices to the AC system, it would be fatal not to take into account the overvoltage that may be coupling in via the data lines. Apart from the threat of hardware damage, availability is the key criterion here.

CITEL offers a wide range of arresters in various configurations. Predominantly pluggable, there are also versions with status display or remote signaling, mechanically with screw or spring-cage terminal.

For the protection of Ethernet networks, there are various solutions in a robust metal housing with shielded RJ45 jacks, which can be mounted in a variety of ways.

LIGHTNING AND SURGE PROTECTION for ELECTROMOBILITY APPLICATIONS

MLPC1-230L-V
SPD type 2+3 for protection of LED lighting systems

Art. no. 831221

DS98L-400
SPD type 2+3 for protection of the charging station

Art. no. 3519011

SINCE 1998 CITEL VG TECHNOLOGY 3RD GENERATION

DAC1-13VGS-31-275
SPD type 1+2+3 for protection of the charging station

Art. no. 821730244

or

SINCE 1998 CITEL VG TECHNOLOGY 3RD GENERATION

DAC50VGS-31-275
SPD type 2+3 for protection of the charging station

Art. no. 821130244

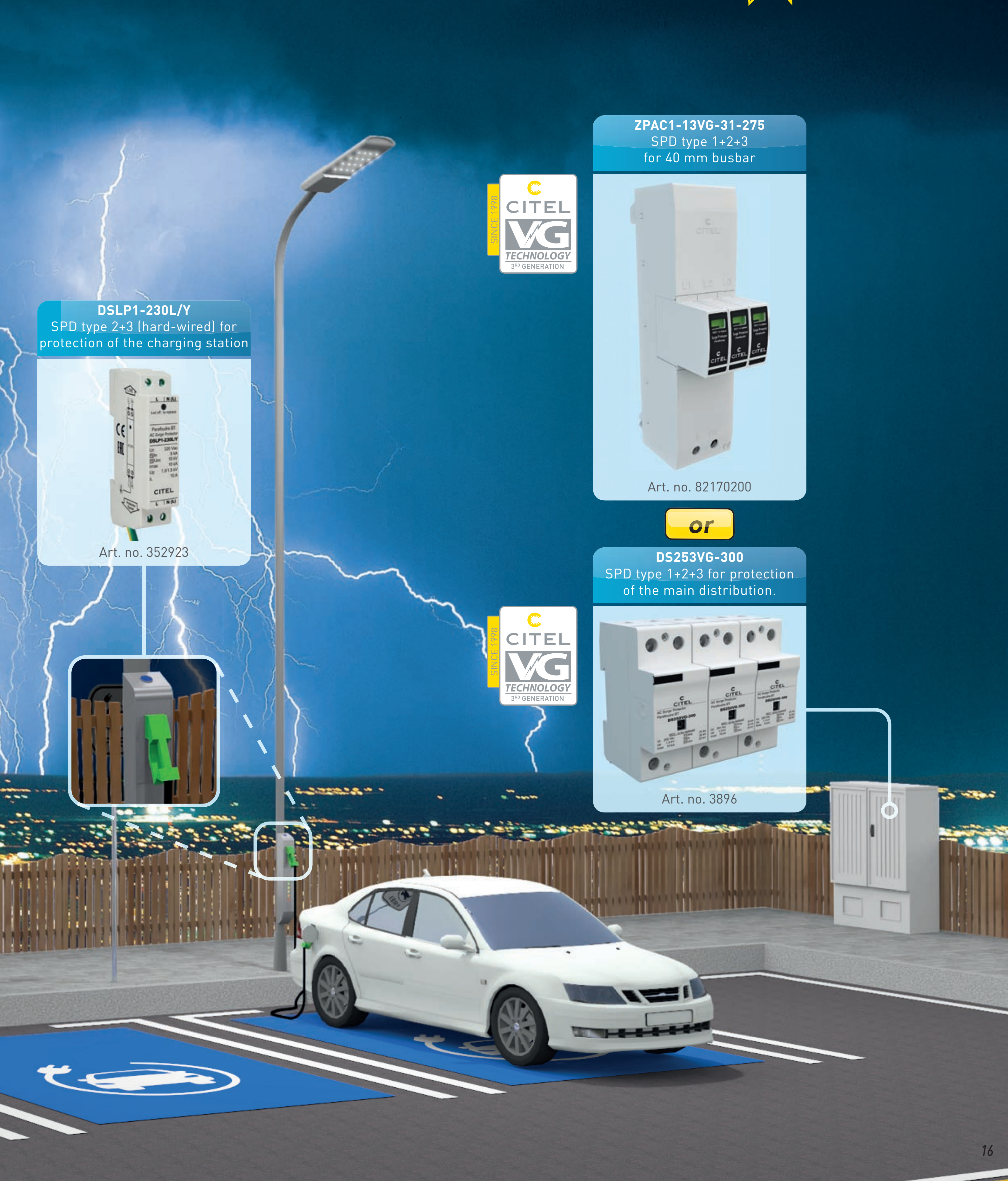
or

DAC40CS-31-275
4-pole SPD type 2; 2TE only for protection of the charging station

Art. no. 821520222

CITEL

SINCE 1937



PRODUCT SELECTION (exemplary)
Surge protectors (SPD)

DS252VG-300

AC surge protector type 1+2+3 based on a gas-filled spark gap

- 10 year warranty
- Safe disconnector
- Generates no (grid) follow current
- Free of operating and leakage current
- Fulfills the VDN guideline for use in the pre-meter area
- Remote signaling as standard
- Complies with standards IEC 61643-11 and EN 61643-11

Art. des.	DS252VG-300	DS253VG-300	DS254VG-300	DS254VG-300/G
System type	TN (2+0)	TNC (3+0)	TNS (4+0)	TT (3+1), TNS
limp / pole	25 kA	25 kA	25 kA	25 kA
limp total	50 kA	75 kA	100 kA	100 kA
In / pole	30 kA	30 kA	30 kA	30 kA
Up	< 1.5 kV	< 1.5 kV	< 1.5 kV	< 1.5 kV
Ipe	none	none	none	none
If	none	none	none	none
Art. No.	3469	3896	3713	2756

DAC1-13VGS-31-275

AC surge protector type 1+2+3 based on a gas-filled spark gap

- 10 year warranty
- Safe disconnector
- Generates no (grid) follow current
- Free of operating and leakage current
- Fulfills the VDN guideline for use in the pre-meter area
- Pluggable protection modules
- Remote signaling as standard
- Complies with standards IEC 61643-11 and EN 61643-11

Art. des.	DAC1-13VGS-20-275	DAC1-13VGS-30-275	DAC1-13VGS-40-275	DAC1-13VGS-31-275
System type	TN (2+0)	TNC (3+0)	TNS (4+0)	TT (3+1), TNS
limp / pole	12.5 kA	12.5 kA	12.5 kA	12.5 kA
limp total	25 kA	37.5 kA	50 kA	50 kA
In / pole	20 kA	20 kA	20 kA	20 kA
Up	< 1.5 kV	< 1.5 kV	< 1.5 kV	< 1.5 kV
Ipe	none	none	none	none
If	none	none	none	none
Art. No.	821730222	821730223	821730224	821730244

ZPAC1-13VG-31-275

AC surge protector type 1+2+3 based on a gas-filled spark gap

- 10 year warranty
- Safe disconnector
- Generates no (grid) follow current
- Free of operating and leakage current
- Fulfills the VDN guideline for use in the pre-meter area
- Pluggable protection modules
- Remote signaling as standard
- Complies with standards IEC 61643-11 and EN 61643-11

Art. des.	ZPAC1-13VG-31-275	ZPAC1-8VG-31-275
System type	TT, TNS	TT, TNS
limp / pole	12.5 kA	8 kA
limp total	50 kA	32 kA
In / pole	20 kA	20 kA
Up	< 1.5 kV	< 1.5 kV
Ipe	none	none
If	none	none
Art. No.	64004	64006

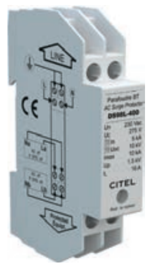
DAC50VGS-31-275

AC surge protector type 2+3 based on a gas-filled spark gap

- 10 year warranty
- Safe disconnector
- Generates no (grid) follow current
- Free of operating and leakage current
- Pluggable protection modules
- Remote signaling as standard
- Complies with standards IEC 61643-11 and EN 61643-11

Art. des.	DAC50VGS-20-275	DAC50VGS-30-275	DAC50VGS-40-275	DAC50VGS-31-275
System type	TN (2+0)	TNC (3+0)	TNS (4+0)	TT (3+1), TNS
In / pole	20 kA	20 kA	20 kA	20 kA
Imax / pole	50 kA	50 kA	50 kA	50 kA
Up	< 1.5 kV	< 1.5 kV	< 1.5 kV	< 1.5 kV
Ipe	none	none	none	none
If	none	none	none	none
Art. No.	821130222	821130223	821130224	821130244

PRODUCT SELECTION (exemplary)
Surge protectors (SPD)



DS98L-400

2-pole - SPD type 2+3

- Compact 2-pole SPD type 2+3
- Connection in series or parallel
- Safe disconnector
- Optional circuit separation at end of service life (DS98L)
- Optionally with remote signaling contact (DS98S)
- Protection for 2 phases + N (DS98L-230G/2L)
- Complies with standards IEC 61643-11 and EN 61643-11

Art. des.	DS98-400	DS98S-400	DS98L-400	DS98L-230G/2L
System type	TT, TN	TT, TN	TT, TN	TT, TN
In / pole	5 kA	5 kA	5 kA	5 kA
Imax / pole	10 kA	10 kA	10 kA	10 kA
Up	< 1.5 kV	< 1.5 kV	< 1.5 kV	< 1.5 kV
Ipe	none	none	none	none
If	none	none	none	none
Art. No.	3509011	3539011	3519011	351933

DAC40CS-31-275

4-pole SPD type 2

- Compact 4-pole SPD type 2
- Safe disconnector
- The smallest type 2 arrester available on the market
- Pluggable protection modules
- Remote signaling as standard
- Complies with standards IEC 61643-11 and EN 61643-11

Art. des.	DAC40CS-31-275
System type	TT (3+1), TNS (4+0)
In / pole	20 kA
Imax / pole	40 kA
Up	< 1.5 kV
Ipe	none
If	none
Art. No.	821520222

5 years WARRANTY

DS50VGPVS-1500G/51

DC SPD type 2 based on a gas-filled spark gap

- 10 year warranty
- Double safe disconnector
- Generates no (grid) follow current
- Free of operating and leakage current
- Pluggable protection modules
- Error-resistant, reverse polarity protected Y-circuit
- Remote signaling as standard
- Complies with standards IEC 61643-11, EN 61643-11 and EN 50539-11 and 12, UTE C61-740-51 and VDE 0185-305-3 Supplement 5

Art. des.	DS50VGPVS-1500G/51
Ucpv	1500 Vdc
In / pole	15 kA
Imax / pole	40 kA
Up	< 3.4 kV
Ipe	none
If	none
Art. No.	481511

SINCE 1998 CITEL VG TECHNOLOGY 3RD GENERATION

10 years WARRANTY

DLA Series

SPD for ICA & data technology

- Only 13mm (DLA) or 18mm (DLA2)
- For all MSR, telecommunications and data technology applications
- Protected shield connection
- Pluggable protection modules
- Earthing via top-hat rail
- Complies with standards IEC 61643-21 and VDE 0845-3-1

Art. des.	DLA-12D3	DLA2-24D3	DLAS-48D3	DLA-12-IS
Appl.	RS232, RS485	4-20 mA current loop	ISDN-S0 48 V	RS232, RS485
Config.	1 twin wire + shield	2 twin wires + shield	1 twin wire + shield	1 twin wire + shield
Un	12 V	24 V	48 V	12 V
Uc AC / DC	10 Vac/15 Vdc	20 Vac/28 Vdc	37 Vac/53 Vdc	10 Vac/15 Vdc
Up	30 V	40 V	70 V	30 V / < 640V*
Iimp (D1)	5 kA	5 kA	5 kA	5 kA
Imax (C2)	20 kA	20 kA	20 kA	20 kA
Art. No.	6402011	640311	641304	640152

* Up for indirect shield grounding

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