Surge protection for tele-communication connections

White Paper

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White Paper

Today and in the future, digital networked technologies will increasingly determine the quality of life and social participation for all sections of the population - both in their own smart homes and in the context of intelligent functional buildings. The areas of application are very diverse and can be designed individually, whether in the field of entertainment, energy management, building and home security or age- and health-related Ambient Assisted Living (AAL).
In this context, a demand-oriented broadband infrastructure using ITC (information and telecommunications cable) is the basic prerequisite for the modern building. At the same time, networking also means that the failure of individual, central components can lead to a standstill of the entire system. Lack of availability due to faults can cause enormous problems for users of telecommunications systems. Loss of image due to surge-induced faults in the telecommunications system, e.g. routers, is only one aspect. In addition to short-term high downtime costs (e.g. new acquisition, data loss, etc.), users encounter further problems due to lack of availability. The continuous provision of important services, communication for the home office or, even more importantly, communication with emergency services cannot be guaranteed. When it comes to deciding what is worthy of protection, it is therefore not just a question of protecting the hardware, but rather the permanent provision of an important data service.

Risks posed by lightning and surges

According to the damage statistics of insurance companies offering cover for electronic devices, the most frequent cause of damage is surges. According to the German Insurance Association (GDV), the sum of claims in 2018 was over 280 million euros. One of the major causes of surges is direct or remote lightning strikes. With more than 4 million registered lightning strikes annually (status 2017; BLIDS), overvoltage couplings are often to be expected in large-area networks such as the telecommunications infrastructure.
The German Federal Government has set itself the goal of driving forward the expansion of broadband and digitisation in Germany. In order to achieve the broadband targets of at least 50 MBit/s per household set by the federal government, the expansion of fibre optic networks is being stepped up in Germany. However, the fibre optic outdoor cables used for this purpose, with or without metal reinforcement for shielding or rodent protection measures, are currently being laid primarily in areas where other construction activities are already underway (e.g. in new development areas, road construction, etc.). In the case of existing residential areas, the high effort and expense and economic viability dictate that the existing copper infrastructure should be used where possible. This means that, for the most part, the network operator lays the fibre optic network architecture only up to the roadside DSLAM (Digital Subscriber Line Access Multiplexer) and uses the existing copper lines for the last few metres to the end customer (corresponds to the FTTB standard (Fibre-to-the-Board)).
In addition to the new technology with fibre optic lines, however, the lines from the network operator to the DSLAM are still often designed as copper cables with low shielding. On both lines (FTTB or pure copper cable) one must anticipate a rise in earth potential in the copper wires through galvanic or inductive coupling. Even if high and low-voltage lines are laid in parallel, switching overvoltages from the low-voltage network can cause faults in the customer's system.

Normative aspects

The minimum measures to protect incoming power supply lines against surges for buildings without external lightning protection systems are defined in the standard IEC 60364-4-44, which recommends surge protection measures for incoming

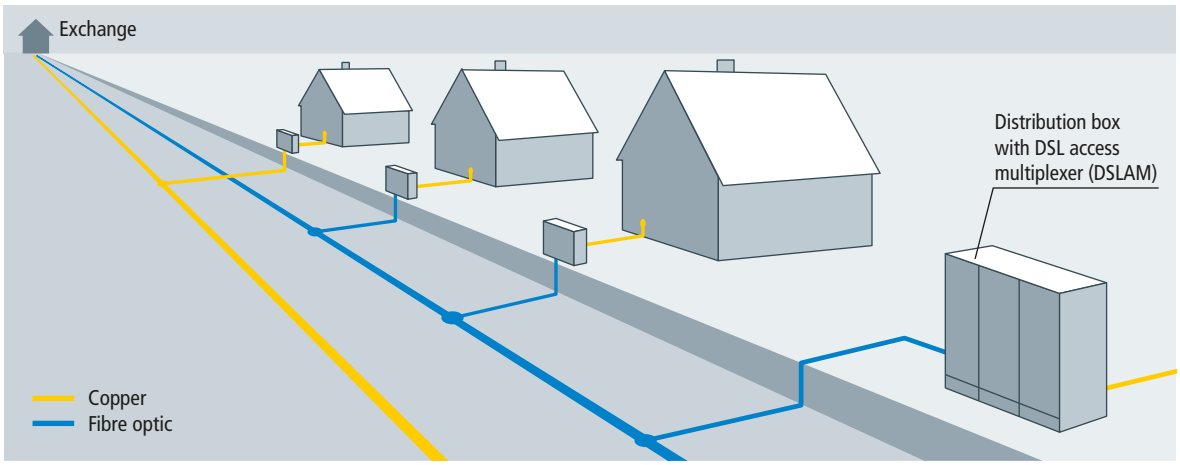

Figure 1 Illustration of different telecommunication infrastructures

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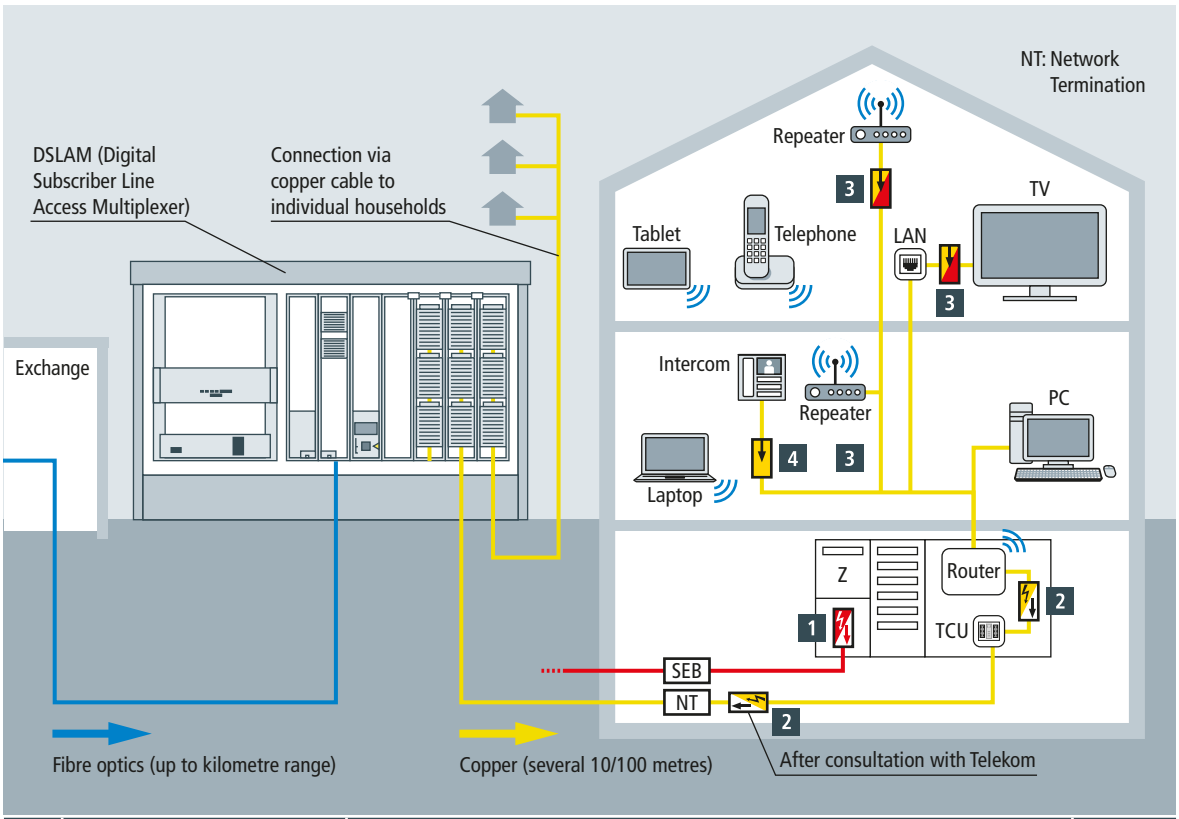
metallic broadband cables and internet and telephone lines. In buildings with an external lightning protection system, all incoming cables, both power and information technology cables, must be included in the lightning equipotential bonding according to IEC 62305.

Transmission technologies

Various DSL extensions have been developed in order to avoid having to replace cables on the so-called "last mile" from DSLAM to the end customer.

VDSL2 Vectoring / Super Vectoring

With VDSL 17a vectoring (VVDSL), a data rate of up to 100 MBit/s can be transmitted. The data rate arriving at the end customer is significantly reduced by increased line length and an unfavourable infrastructure. VDSL 35b Super Vectoring (SVVDSL) is an extension of the somewhat older vectoring technology, which minimises interference in the lines and thus increases the data transmission rate. SVVDSL was developed to reduce interference from so-called crosstalk, which occurs in main telephone cables when the wires of the various connections are close together.



	Type	Info	Part No.
1	DEHNshield B TT 255 FM	Combined lightning current and surge arrester for TT / TNS networks, mounted on DIN rail; version for residential buildings without external lightning protection	941 316
2	DEHNbox TC B 180	Combined arrester for telecommunication connections for mounting directly after NT or in the multimedia field	922 220
3	DEHNprotector 230 LAN 100	Terminal device protection as socket adapter for the power and data side	909 321
4	DEHNpatch M CLE RJ45B 48	Surge arrester for Ethernet applications with RJ45 connection technology	929 121

Figure 2 Schematic diagram of a communication network in a residential building

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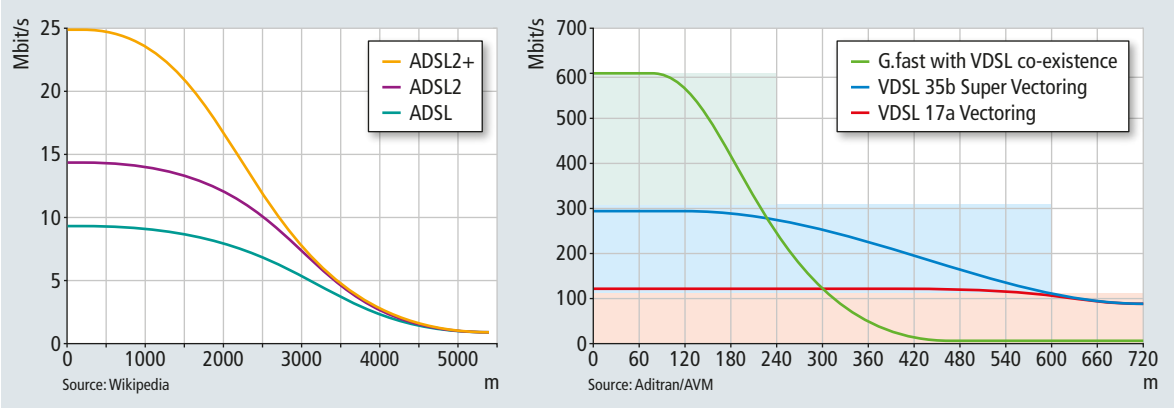


Figure 3 Performance per line pair with different transmission technologies

To put it simply, each connection is measured to see what other connections it might affect. Its signal is then derived from the signal of these other connections making it possible to transmit a higher data rate. This technology increases the maximum data rate to up to 300 Mbit/s. However, here too, in order to maintain the full 300 Mbit/s, the maximum line length from the DSLAM to the end customer is limited to 300 m, or even shorter if the infrastructure is unfavourable.

G.fast

The successor of the VDSL2 standards is G.fast. With G.fast, the maximum data rate can be increased still further. However, the advantage of the very high data rate transmitted is strongly influenced by the line length with this technology, too. In principle, G.fast is only suitable for short distances. **Figure 3** shows the behaviour of the transmission standards as the line length increases.

Surge protection concepts

Due to this sensitive technology, care should be taken when selecting protective devices against the effects of lightning and surges to ensure that these do not, or only minimally, reduce the customer's bandwidth. To avoid so-called intermodulation distortions on the line, the protective device used must consist of linear components. Arresters which are equipped with non-linear components such as semiconductors can reduce the data rate at the end customer, in some cases significantly. In order to be able to use future transmission technologies (VDSL2 Vectoring, VDSL Super Vectoring or G.fast) without any such loss, the new DEHNbox TC B 180 was developed. It is precisely the arrester technologies commonly used today that often cause a significant loss of speed, as these are still designed for transmission technologies such as the outdated ADSL standard. Therefore, the DBX TC B 180 offers many other advantages besides the optimal protection of terminal equipment against surges:

- Loss-free protective circuit for highest transmission performance (suitable for use with VVDSL, SVVDSL and G.fast; tested by Deutsche Telekom)
- Visual function display on the device
- Dual tool-free connection technology (RJ45 and push-in technology)
- Mounting / side-by-side mounting of several devices possible by means of the plug-in technology of the enclosures
- PE connection up to 4 mm^2
- Signal availability even after arrester overload (fail-open technology).

Conclusion

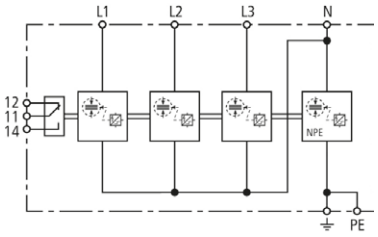
Due to the progressive digitalisation in residential and functional buildings, an optimal connection to the telecommunications network and the availability of the terminal equipment connected to it is necessary. The DEHNbox TC B 180 not only serves to protect terminal equipment in case of harmful lightning and overvoltage influences, its design also ensures attenuation-free data transmission. Devices and systems in smart homes and smart buildings are thus reliably available even when lightning currents and surges occur.

DEHNshield

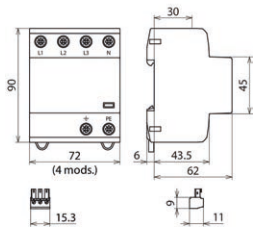
DSH B TT 255 FM (941 316)

- Application-optimised and prewired spark-gap-based type 1 and type 2 combined lightning current and surge arrester
- Compact design due to space-saving spark gap technology with a width of only 1 module / pole
- Meets the minimum requirements according to IEC 60364-5-53 concerning the nominal discharge capacity I_n and the lightning current discharge capacity I_{imp} in case of overhead line supply

Figure without obligation



Basic circuit diagram DSH B TT 255 FM



Dimension drawing DSH B TT 255 FM

Application-optimised and prewired combined lightning current and surge arrester for TT and TN-S systems for use in the main power supply system (3+1 circuit) in case of residential buildings without external lightning protection system (also in case of buildings supplied by overhead lines); with floating remote signalling contact.

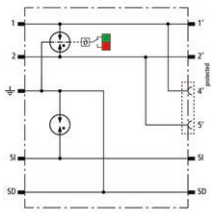
Type Part No.	DSH B TT 255 FM 941 316
SPD according to EN 61643-11 / IEC 61643-11	type 1 + type 2 / class I + class II
Energy coordination with terminal equipment (≤ 10 m)	type 1 + type 2 + type 3
Nominal voltage (a.c.) (U_N)	230 / 400 V (50 / 60 Hz)
Max. continuous operating voltage (a.c.) (U_C)	255 V (50 / 60 Hz)
Lightning impulse current (10/350 µs) [L1+L2+L3+N-PE] (I_{total})	30 kA
Lightning impulse current (10/350 µs) [L-N]/[N-PE] (I_{imp})	7.5 / 30 kA
Nominal discharge current (8/20 µs) [L-N]/[N-PE] (I_n)	12.5 / 50 kA
Voltage protection level [L-N]/[N-PE] (U_P)	≤ 1.5 / ≤ 1.5 kV
Follow current extinguishing capability [L-N]/[N-PE] (I_{fi})	25 kA_{rms} / 100 A_{rms}
Follow current limitation / Selectivity	no tripping of a 32 A gG fuse up to 25 kA_{rms} (prosp.)
Response time (t_A)	≤ 100 ns
Max. mains-side overcurrent protection	160 A gG
Temporary overvoltage (TOV) [L-N] (U_T) – Characteristic	440 V / 120 min. – withstand
Temporary overvoltage (TOV) [N-PE] (U_T) – Characteristic	1200 V / 200 ms – withstand
Operating temperature range (T_U)	-40 °C ... +80 °C
Operating state / fault indication	green / red
Number of ports	1
Cross-sectional area (L1, L2, L3, N, PE, ⏚) (min.)	1.5 mm^2 solid / flexible
Cross-sectional area (L1, L2, L3, N, PE, ⏚) (max.)	35 mm^2 stranded / 25 mm^2 flexible
For mounting on	35 mm DIN rails acc. to EN 60715
Enclosure material	thermoplastic, red, UL 94 V-0
Place of installation	indoor installation
Degree of protection	IP 20
Capacity	4 module(s), DIN 43880
Approvals	VDE
Type of remote signalling contact	changeover contact
Switching capacity (a.c.)	250 V / 0.5 A
Switching capacity (d.c.)	250 V / 0.1 A; 125 V / 0.2 A; 75 V / 0.5 A
Cross-sectional area for remote signalling terminals	max. 1.5 mm^2 solid / flexible
Extended technical data:	----------
Voltage protection level [L-PE] (U_P)	2.0 kV
Weight	450 g
Customs tariff number (Comb. Nomenclature EU)	85363090
GTIN	4013364328075
PU	1 pc(s)

DEHNbox

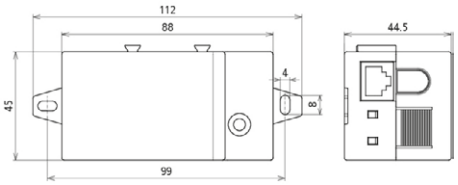
DBX TC B 180 (922 220)

- Arrester monitoring and integrated status indication
- Two-pole wall-mounted arrester for optimal protection of telecommunication interfaces
- For installation in conformity with the lightning protection zone concept at the boundaries from LPZ 0_A to 2 and higher

Figure without obligation



Basic circuit diagram DBX TC B 180



Dimension drawing DBX TC B 180

Space-saving, compact surge arrester in a surface-mounted plastic enclosure with push-in connection technology and status indication for protecting one pair of unearthed balanced interfaces, particularly telecommunication interfaces up to VVDSL and G.fast (up to 1 G.Bit/s). Direct / indirect shield earthing possible. Connection of a pair or a patch cable with RJ45 plug at the output.

Scheduled delivery date May 2020!!

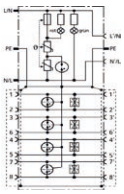
Type Part No.	DBX TC B 180 922 220
SPD class	TYPE 1 P2
Impulse category	D1, C1, C2, C3
Nominal voltage (U_N)	180 V
Max. continuous operating voltage (d.c.) (U_C)	180 V
Max. continuous operating voltage (a.c.) (U_C)	127 V
Nominal current (I_L)	1 A
D1 Total lightning impulse current (10/350 µs) (I_{imp})	7.5 kA
D1 Lightning impulse current (10/350 µs) per line (I_{imp})	2.5 kA
C2 Total nominal discharge current (8/20 µs) (I_n)	20 kA
C2 Nominal discharge current (8/20 µs) per line (I_n)	10 kA
Voltage protection level line-line for I_n C2 (U_p)	≤ 700 V
Voltage protection level line-PG for I_n C2 (U_p)	≤ 550 V
Voltage protection level line-line at 1 kV/µs C3 (U_p)	≤ 620 V
Voltage protection level line-PG at 1 kV/µs C3 (U_p)	≤ 550 V
Series resistance per line	0 ohms
Cut-off frequency (f_G)	425 MHz
Capacitance line-line (C)	≤ 10 pF
Capacitance line-PG (C)	≤ 20 pF
Operating temperature range (T_U)	-25 °C ... +80 °C
Operating state / fault indication	green / red
Degree of protection	IP 20
Cross-sectional area (solid)	0.2-1.5 mm^2
Cross-sectional area (flexible)	0.25-1.5 mm^2
Cross-sectional area of the earth terminal	0.08-4 mm^2
Enclosure material	polyamide PA 6.6
Connection (input)	push-in
Connection (output)	push-in / RJ45
Colour	yellow
Test standards	IEC 61643-21 / EN 61643-21
Approvals	EAC
Weight	74 g
Customs tariff number (Comb. Nomenclature EU)	85363030
GTIN	4013364433953
PU	1 pc(s)

DEHNprotector

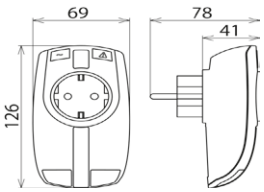
DPRO 230 LAN100 (909 321)

- Surge protective device for Ethernet components (1000 BASE-T) with an elegant design
- For installation in conformity with the lightning protection zone concept at the boundaries from 2 – 3 and higher

Figure without obligation



Basic circuit diagram DPRO 230 LAN100



Dimension drawing DPRO 230 LAN100

Combined surge protection for the power side and data input for protecting LAN components. Protection of all pairs for Ethernet pin assignment. It meets the requirements for channel class D in accordance with EN 50173 and is thus suitable for 1000 Base-T (Gigabit Ethernet). With visual operating state and fault indication and integrated child lock.

Protection of the data side

Type Part No.	DPRO 230 LAN100 909 321
SPD class	TYPE 2 P1
Max. continuous operating voltage (d.c.) (U_C)	58 V
Lightning impulse current (10/350 µs) per line D1 (I_{imp})	1 kA
C2 Nominal discharge current (8/20 µs) line-line (I_n)	30 A
C2 Nominal discharge current (8/20 µs) line-PE (I_n)	2.5 kA
C2 Total nominal discharge current (8/20 µs) (I_n)	10 kA
Voltage protection level line-line for I_n C2 (U_p)	≤ 100 V
Voltage protection level line-PE for I_n C2 (U_p)	≤ 500 V
Voltage protection level line-line at 1 kV/µs C3 (U_p)	90 V
Voltage protection level line-PE at 1 kV/µs C3 (U_p)	≤ 500 V
Cut-off frequency (f_G)	120 MHz
Operating temperature range (T_U)	-25 °C ... +40 °C
Degree of protection	IP 20
Connection (input / output)	shielded RJ45 socket / shielded RJ45 socket
Pinning	1/2, 3/6, 4/5, 7/8
Earthing via	protective conductor connection
Enclosure material	thermoplastic, UL 94 V-2
Colour	pure white
Test standards	IEC 61643-21 / EN 61643-21

Protection of the power side

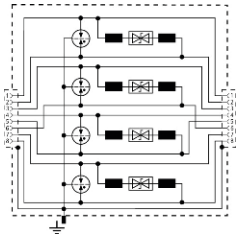
Type Part No.	DPRO 230 LAN100 909 321
SPD according to EN 61643-11 / IEC 61643-11	type 3 / class III
Nominal voltage (a.c.) (U_N)	230 V (50 / 60 Hz)
Max. continuous operating voltage (a.c.) (U_C)	255 V (50 / 60 Hz)
Nominal load current (a.c.) (I_L)	16 A
Nominal discharge current (8/20 µs) (I_n)	3 kA
Total discharge current (8/20 µs) [L+N-PE] (I_{total})	5 kA
Combination wave (U_{oc})	6 kV
Combination wave [L+N-PE] ($U_{oc\ total}$)	10 kV
Voltage protection level [L-N] (U_p)	≤ 1.25 kV
Voltage protection level [L/N-PE] (U_p)	≤ 1.5 kV
Response time [L-N] (t_A)	≤ 25 ns
Response time [L/N-PE] (t_A)	≤ 100 ns
Max. mains-side overcurrent protection	B 16 A
Short-circuit withstand capability for mains-side overcurrent protection (I_{SCCR})	1 kA_{rms}
Temporary overvoltage (TOV) [L-N] (U_T) – Characteristic	335 V / 5 sec. – withstand
Temporary overvoltage (TOV) [L-N] (U_T) – Characteristic	440 V / 120 min. – safe failure
Temporary overvoltage (TOV) [L/N-PE] (U_T) – Characteristic	335 V / 120 min. – withstand
Temporary overvoltage (TOV) [L/N-PE] (U_T) – Characteristic	440 V / 5 sec. – withstand
Temporary overvoltage (TOV) [L+N-PE] (U_T) – Characteristic	1200 V + U_{REF} / 200 ms – safe failure
Fault indication	red indicator light
Operating state indication	green indicator light
Number of ports	1
For mounting on	earthed socket outlets DIN 49440 / DIN 49441
Test standards	EN 61643-11
Weight	222 g
Customs tariff number (Comb. Nomenclature EU)	85363010
GTIN	4013364126152
PU	1 pc(s)

DEHNpatch

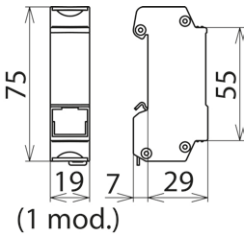
DPA M CLE RJ45B 48 (929 121)

- Ideally suited for retrofitting, protection of all lines
- Cat. 6 in the channel (class E)
- Power over Ethernet IEEE 802.3 compliant (up to PoE++ / 4PPoE)
- For installation in conformity with the lightning protection zone concept at the boundaries from 0_B –2 and higher

Figure without obligation



Basic circuit diagram DPA M CLE RJ45B 48



Dimension drawing DPA M CLE RJ45B 48

Universal arrester for Industrial Ethernet, Power over Ethernet (IEEE 802.3 compliant up to PoE++ / 4PPoE) and similar applications in structured cabling systems according to class E up to 250 MHz. Protection of all pairs by means of powerful gas discharge tubes and one adapted filter matrix per pair. Fully shielded type with sockets for DIN rail mounting (up to 1 Gbit Ethernet).

Type Part No.	DPA M CLE RJ45B 48 929 121
SPD class	TYPE 2 P1
Nominal voltage (U_N)	48 V
Max. continuous operating voltage (d.c.) (U_c)	48 V
Max. continuous operating voltage (a.c.) (U_c)	34 V
Max. continuous operating voltage (d.c.) pair-pair (PoE) (U_c)	57 V
Nominal current (I_L)	1 A
D1 Lightning impulse current (10/350 µs) per line (I_{imp})	0.5 kA
C2 Nominal discharge current (8/20 µs) line-line (I_n)	150 A
C2 Nominal discharge current (8/20 µs) line-PG (I_n)	2.5 kA
C2 Nominal discharge current (8/20 µs) total (I_n)	10 kA
C2 Nominal discharge current (8/20 µs) pair-pair (PoE) (I_n)	150 A
Voltage protection level line-line for I_n C2 (U_P)	≤ 180 V
Voltage protection level line-PG for I_n C2 (U_P)	≤ 500 V
Voltage protection level line-line for I_n C2 (PoE) (U_P)	≤ 600 V
Voltage protection level line-line at 1 kV/µs C3 (U_P)	≤ 180 V
Voltage protection level line-PG at 1 kV/µs C3 (U_P)	≤ 500 V
Voltage protection level pair-pair at 1 kV/µs C3 (PoE) (U_P)	≤ 600 V
Cut-off frequency (f_G)	250 MHz
Insertion loss at 250 MHz	≤ 3 dB
Capacitance line-line (C)	≤ 30 pF
Capacitance line-PG (C)	≤ 25 pF
Operating temperature range (T_U)	-40 °C ... +80 °C
Degree of protection	IP 10
For mounting on	35 mm DIN rails acc. to EN 60715
Connection (input / output)	RJ45 socket / RJ45 socket
Pinning	1/2, 3/6, 4/5, 7/8
Earthing via	35 mm DIN rail acc. to EN 60715
Enclosure material	zinc die-casting
Colour	bare surface
Test standards	IEC 61643-21 / EN 61643-21 / UL 497B
Approvals	CSA, UL, GHMT, EAC
External accessories	fixing material
Weight	109 g
Customs tariff number (Comb. Nomenclature EU)	85363010
GTIN	4013364118935
PU	1 pc(s)

Surge Protection
Lightning Protection
Safety Equipment
DEHN protects.

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