Lightning and surge protection for yachts

White Paper

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Lightning and surge protection for yachts

White Paper

Yachts at sea, at anchor and ashore (e.g. in a dry dock) are vulnerable to lightning strikes. The probability of a lightning strike depends on the local ground flash density N_g which specifies how many lightning discharges occur per km^2 and year. The closer the yacht approaches equatorial waters, the higher the risk to be struck by lightning at sea. In general, the ground flash density is frequently higher ashore (at anchor) than at sea.

If lightning strikes the mast of a yacht, lightning currents travel to the deck. Since several cables are routed on the mast, e.g. to navigation lights, the radio antenna or the anemometer, the lightning current enters the inside of the ship through these cables and spreads over the entire cabling of the on-board system supplying the depth sounder and log. This can damage these systems and result in the ingress of water since these devices are located under the water level. While the ingress of water is noticed at sea and can be eliminated, this often remains unnoticed when the yacht is at anchor in winter and the yacht may sink.

To determine potential points of strike, the electro-geometric model (rolling sphere method) is used. It describes the flash (centre of the rolling sphere) which strikes an object after a certain distance (radius). The smaller the radius, the more effectively lightning strikes are intercepted. In the lightning protection standards, different radii r are assigned to classes of LPS I to IV. Class of LPS I provides maximum protection from lightning strikes. In this case, the system safely handles 99 % of all lightning strikes with impulse currents lower than 200 kA and higher than 3 kA.

Class of LPS III is often used for yachts (see example in **Figure 1**). This figure allows to assess the risk of a lightning strike to the mast. The information provided below also applies to multi-masted yachts. The points where the rolling sphere touches the yacht are potential points of strike and must be protected.

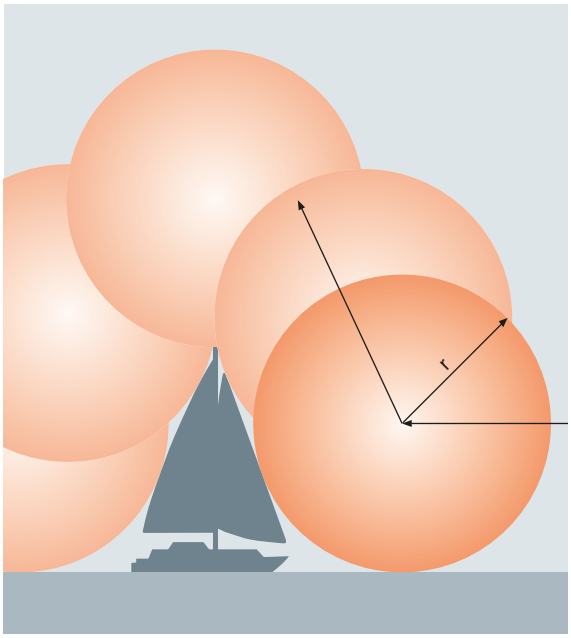

Figure 1 Determination of the lightning risk for a yacht using the rolling sphere method in case of class of LPS III

Lightning protection

To implement lightning protection measures, a distinction must be made between metal and non-metal masts / bodies of the yacht.

Metal yacht

If the yacht has a metal body which is conductively connected to a metal mast, no additional measures for discharging the lightning current must be taken. If lightning strikes the mast of such a yacht, most of the lightning current is discharged via the mast and partial lightning currents are passed through the stays to the body / bottom and to the water (**Figure 2**).

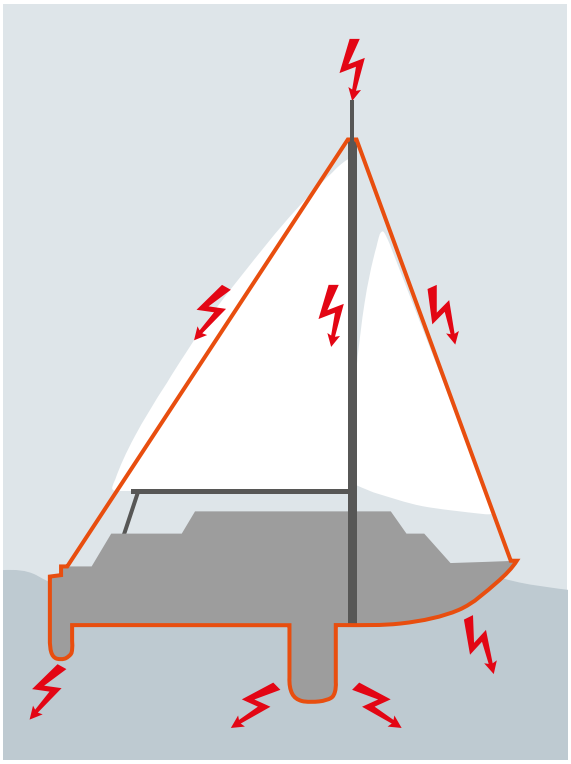

Figure 2 Lightning current distribution on a yacht following a lightning strike to the mast

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Non-metal yacht

Yachts with a wooden or GRP body require additional lightning protection measures.

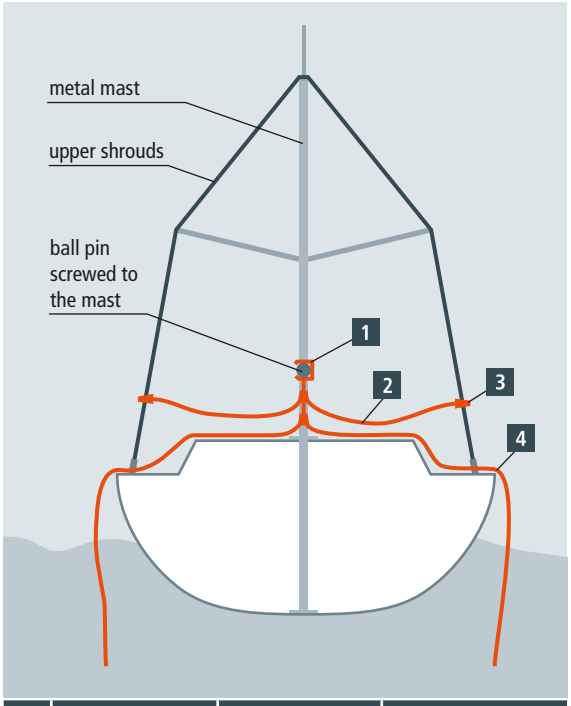
If the mast is made of e.g. wood, an air-termination rod with a thickness of at least 12 mm must protrude at least 300 mm from the mast. The down conductor routed down the mast can be made of copper and should have a minimum cross-section of 70 mm^2. It must be routed in the outdoor area of the yacht and connected to the earth plate. The earth plate must have a surface of at least 0.25 m^2 and must be made of copper or another saltwater-proof material. In case of large yachts, different earth plates may have to be used for the lightning protection and power supply system. In this case, a sufficient distance must be maintained between these earth plates to prevent flashover.

If lightning strikes the air-termination rod on the non-metal mast, the lightning currents must be discharged to the earth plate via the down conductor on the mast and via the shrouds, stays and chain plates. To this end, the mast, shrouds, stays and chain plates must be connected to the earth plate. The copper connecting conductors must have a minimum cross-section of 16 mm^2. All lightning current carrying connections may only be established by screwing, riveting or welding.

Mobile lightning protection in case of a metal mast

A cost-effective mobile lightning protection system, which is frequently used for occasional charters of a yacht, can be easily implemented. To this end, the lower part of the aluminium mast is fitted with a ball pin, which is used as down conductor. A lightning current carrying terminal, which is connected to two other terminals and two braided copper strips of several metres, is screwed to the ball pin. The terminals are connected to the upper shrouds to use them as down conductor. The free ends of both braided copper strips must be immersed at least 1.5 m in the water (**Figure 3**).

All components and the relevant connections must be capable of carrying lightning currents and must be corrosion-proof. This protection measure can be quickly implemented when a thunderstorm approaches and provides a certain protection against lightning strikes. It is not entirely clear to what extent mobile lightning protection systems provide protection for yachts since the normative requirements for equipotential bonding (personal protection), separation distances, etc. are not observed. It can only be assumed that lightning damage such as punctures of the body can be prevented since most of the lightning current flows through the braided copper strips into the water. Therefore, a fixed lightning protection system always has to be preferred.



	Component	Type/material	Part No.
1	Universal earthing clamp	UEK 25 HG	774 234
2	Multipole earthing cable	e.g. V6TZ3N8	Can be configured via the DEHN earthing and short-circuiting configurator
3	Earthing tongs	Stainless steel	546 001
4	Braided copper strip	Copper	377 007

Figure 3 Mobile lightning protection for a yacht with a metal mast

Power supply system

The IEC 60364-7-709 (HD 60364-7-709) standard (marinas and similar locations) describes the special requirements for power supply circuits (shoreside power supply system) of water sport vehicles and house boats supplied by public utilities. Water sport vehicles include boats, ships, yachts, motor launches and house boats which are exclusively used for sports and leisure activities.

The information provided only refers to single-phase alternating current power supply systems in a 230 V/50 Hz system (it can be also used for three-phase power supply systems in a modified form). The relevant socket outlets up to 63 A must comply with the IEC 60309-2 (EN 60309-2) standard (CEE design, "blue").

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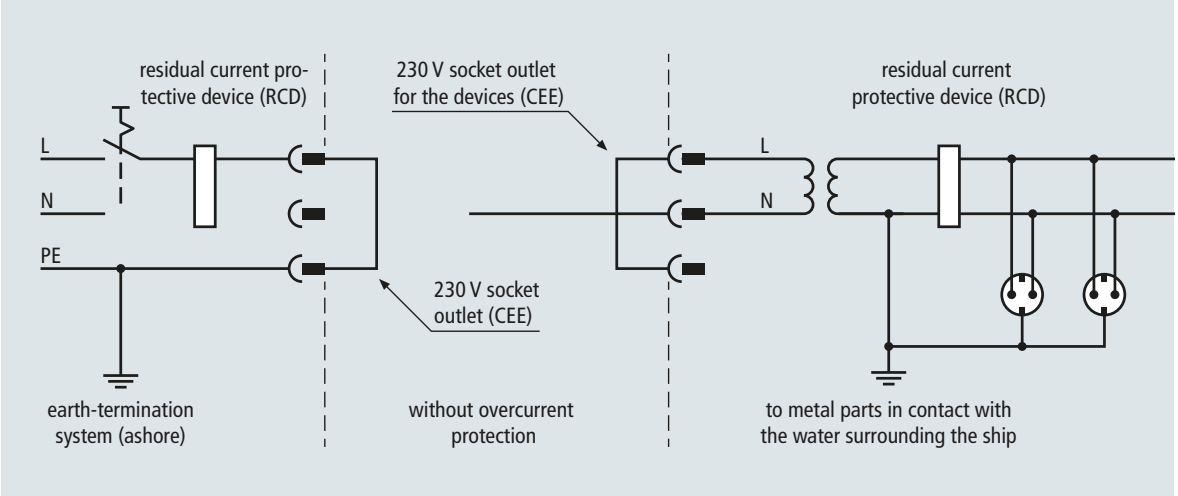

Figure 4 Use of an isolation transformer to prevent corrosion

For corrosion protection reasons, the protective conductor of the shoreside power supply system must not be connected to the earthed metal parts of the water vehicle. The protective conductor of the shoreside power supply system is not required to protect persons on the yacht against electric shock since an isolation transformer on the yacht ensures protection against electric shock in connection with a residual current protective device (**Figure 4**).

Equipotential bonding

In general, all protective conductors of the board electronics and all metal parts of yachts must be connected to the common equipotential bonding / earth-termination system of the power supply system. This measure prevents dangerous touch voltage / sparking. The copper protective bonding conductors, which do not carry lightning currents, must have a minimum cross-section of 6 mm^2. For this purpose, stranded, solid or flexible conductors must be used. Flexible conductors should be preferred due to vibrations. In this context, it must be observed that the conductors can be damaged by the corrosive environment (saline, moist) and the capillary effect. Therefore, the cable lug at the ends of the flexible conductors must be sheathed with a heat shrinkable sleeve.

Internal lightning protection / surge protection

A combined arrester, which is directly installed in the power supply system, is one of the most important protection measures (**Figure 5**). The necessity of such an arrester is shown based on the following two scenarios.

If lightning strikes the air-termination rod or the metal mast of the yacht at anchor which is supplied with electricity, the potential of this yacht is raised above the connection of the shoreside power supply system. A part of the lightning current is passed to the water and flashover to the power cable of the shoreside power supply system will occur depending on the conductivity of the water. This flashover can damage the cables / equipment on the yacht and cause fire. However, it is even more likely that a yacht at anchor, which is supplied with electricity, is threatened by a shoreside lightning strike. In this case, the lightning current flows in the direction of the yacht and causes the damage described above.

If a type 1 combine arrester is installed, it must be ensured that the connection of the earth-termination / equipotential bonding system of the yacht to the protective conductor of the shoreside power supply system does not cause corrosion. The surge protective devices shown in **Figure 6** consider that the polarity (L, N) is changed, which is typical of earthed socket outlets (not standard-compliant, but may be the case). In this case, the phase conductor (L) and the neutral conductor (N) are twisted until they reach the L and N connections of the on-board supply system. The increased voltage protection level is sufficient for the electric strength of the primary winding.

Irrespective of whether a yacht is made of metal or non-metal material, there is the risk that lightning hits, for example, marine radio antennas or wind sensors installed on the mast, which can damage these pieces of equipment and downstream radio or evaluation devices. Since these pieces of equipment are located in the protected volume (air-termination tip on the

Lightning and surge protection for yachts

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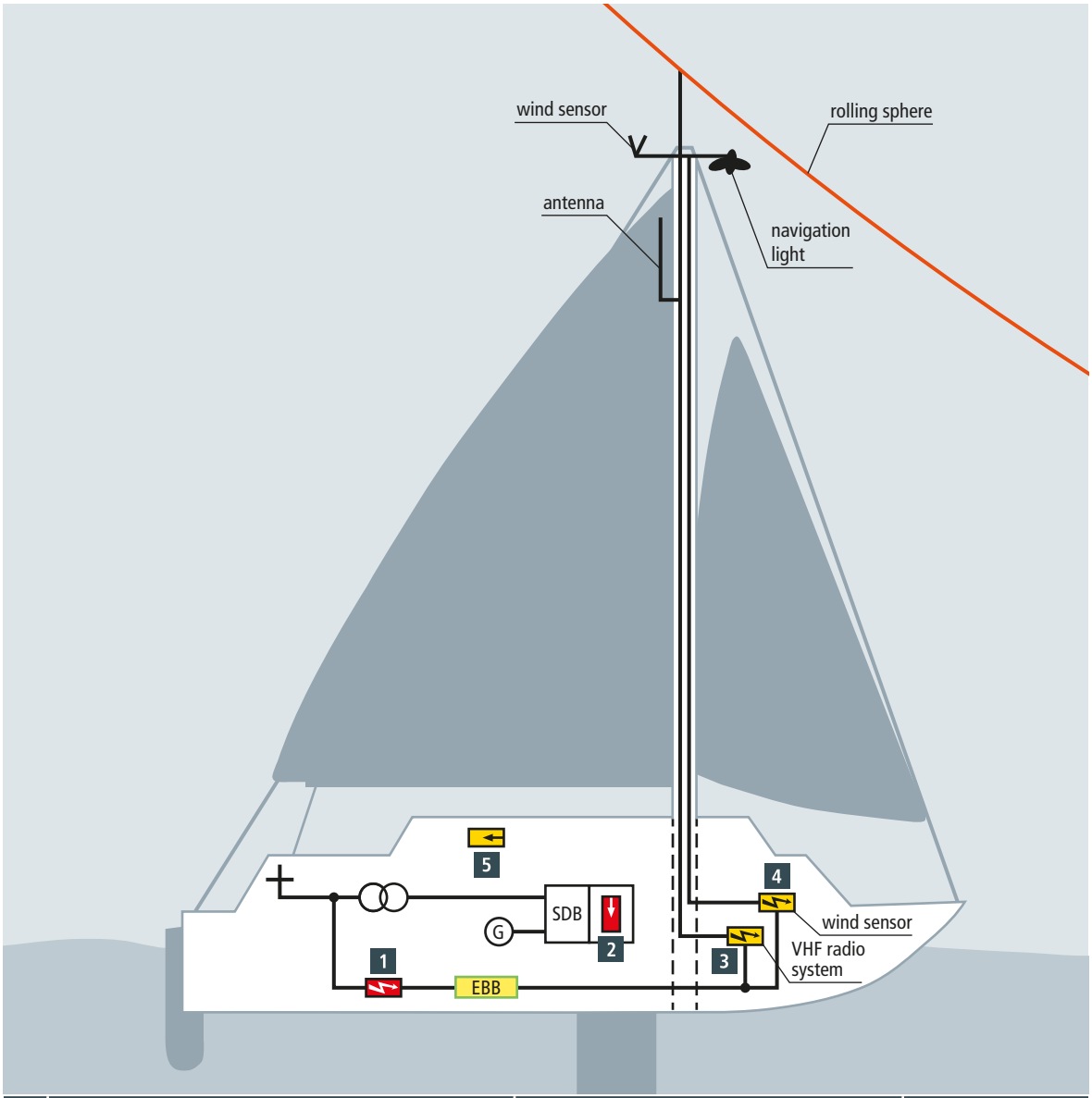


	Surge protective device	Protection for	Part No.
1	DEHNventil DV M TN 255 DEHNgap DGP M 255	Power supply system	951 200 961 101
2	DEHNguard DG M TT 2P 275	Sub-distribution board	952 110
3	DEHNgate DGA AG N	VHF radio system	929 045
4	BLITZDUCTOR BXT ML4 BE 24 + BXT BAS base part	Wind sensor for the navigation system	920 324 + 920 300
5	BLITZDUCTOR BXT ML4 BE 36 + BXT BAS base part	Power supply system of the navigation system	920 336 + 920 300

Figure 5 Basic surge protection for a yacht (observe the technical data of the manufacturer of the surge protective devices)

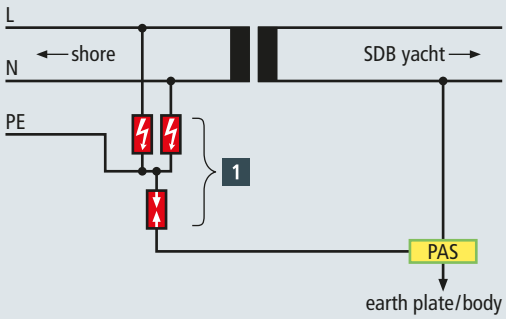
mast), it is not to be expected that lightning strikes them. Adequate surge protective devices are shown in **Figure 5**.
The effects of induced surges and switching overvoltages caused by board generators and UPS systems must also be observed. In this case, it is advisable to use type 2 surge arresters in the distribution board (**Figure 6**).

Personal protection

The equipotential bonding measures for all connections listed in the above "Equipotential bonding" chapter reduce the risk for persons on the yacht. In the event of a thunderstorm, persons should therefore

- Not stay on deck since potential differences, which present a risk in conjunction with wet skin, can occur due to wet surfaces
- Not touch shrouds, rods or other metal objects
- Check the lightning protection system at regular intervals and do not wait until thunderstorm occurs. In this context, it is important to check whether the equipotential bonding system, namely the connection of all conductive metal devices on board to the lightning protection system, is in good order and condition.

More detailed information can be found in the "Blitzschutz für Yachten" [Lightning protection for yachts] book by Michael Hermann, Palstek Verlag, Hamburg, 2011 (German).



	Surge protective device		Part No.
1	DEHNventil DEHNgap	DV M TN 255 DGP M 255	951 200 961 101

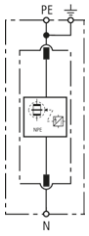
Figure 6 Detailed view of the shoreside power supply system with a lightning current carrying type 1 combined arrester

DEHNgap

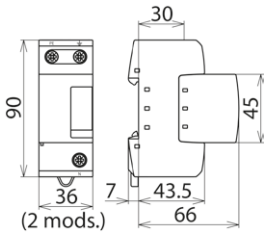
DGP M 255 (961 101)

- Discharge capacity up to 100 kA (10/350 µs)
- Total current arrester specifically designed for installation in "3+1" and "1+1" circuits of TT systems according to IEC 60364-5-53 between neutral conductor N and protective conductor PE
- Creepage discharge spark gap technology

Figure without obligation



Basic circuit diagram DGP M 255



Dimension drawing DGP M 255

Coordinated and modular single-pole N-PE lightning current arrester for U_C = 255 V; also available with remote signalling contact for the monitoring system (floating changeover contact).

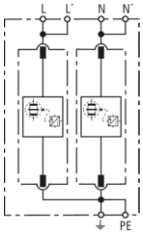
Type Part No.	DGP M 255 961 101
SPD according to EN 61643-11 / IEC 61643-11	type 1 / class I
Max. continuous operating a.c. voltage (U_C)	255 V (50 / 60 Hz)
Lightning impulse current (10/350 µs) (I_{imp})	100 kA
Specific energy (W/R)	2.50 MJ/ohms
Voltage protection level (U_P)	≤ 1.5 kV
Follow current extinguishing capability a.c. (I_{fi})	100 A_{rms}
Response time (t_A)	≤ 100 ns
Temporary overvoltage (TOV) (U_T) – Characteristic	1200 V / 200 ms – withstand
Operating temperature range (parallel connection) (T_{UP})	-40 °C ... +80 °C
Operating temperature range (series connection) (T_{US})	-40 °C ... +60 °C
Operating state / fault indication	green / red
Number of ports	1
Cross-sectional area (N, PE, ⏚) (min.)	10 mm^2 solid / flexible
Cross-sectional area (N, PE) (max.)	50 mm^2 stranded / 35 mm^2 flexible
Cross-sectional area (⏚) (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	2 module(s), DIN 43880
Approvals	VDE, KEMA, UL
Weight	315 g
Customs tariff number	85363010
GTIN	4013364118676
PU	1 pc(s)

DEHNventil

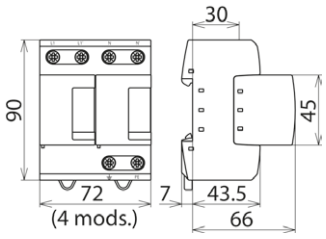
DV M TN 255 (951 200)

- Prewired spark-gap-based type 1 and type 2 combined lightning current and surge arrester consisting of a base part and plug-in protection modules
- Maximum system availability due to RADAX Flow follow current limitation
- Capable of protecting terminal equipment

Figure without obligation



Basic circuit diagram DV M TN 255



Dimension drawing DV M TN 255

Modular combined lightning current and surge arrester for single-phase TN systems.

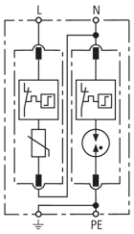
Type Part No.	DV M TN 255 951 200
SPD according to EN 61643-11 / IEC 61643-11	type 1 + type 2 / class I + class II
Energy coordination with terminal equipment (≤ 5 m)	type 1 + type 2 + type 3
Nominal a.c. voltage (U_N)	230 V (50 / 60 Hz)
Max. continuous operating a.c. voltage (U_C)	264 V (50 / 60 Hz)
Lightning impulse current (10/350 µs) [L+N-PE] (I_{total})	50 kA
Specific energy [L+N-PE] (W/R)	625.00 kJ/ohms
Lightning impulse current (10/350 µs) [L, N-PE] (I_{imp})	25 kA
Specific energy [L,N-PE] (W/R)	156.25 kJ/ohms
Nominal discharge current (8/20 µs) [L/N-PE]/[L+N-PE] (I_n)	25 / 50 kA
Voltage protection level [L-PE]/[N-PE] (U_P)	≤ 1.5 / ≤ 1.5 kV
Follow current extinguishing capability a.c. (I_{fi})	50 kA_{rms}
Follow current limitation / Selectivity	no tripping of a 20 A gL/gG fuse up to 50 kA_{rms} (prosp.)
Response time (t_A)	≤ 100 ns
Max. backup fuse (L) up to I_K = 50 kA_{rms}	315 A gG
Max. backup fuse (L-L')	125 A gG
Temporary overvoltage (TOV) [L-N] (U_T) – Characteristic	440 V / 120 min. – withstand
Operating temperature range [parallel] / [series] (T_U)	-40 °C ... +80 °C / -40 °C ... +60 °C
Operating state / fault indication	green / red
Number of ports	1
Cross-sectional area (L, L', N, N', PE, ⏚) (min.)	10 mm^2 solid / flexible
Cross-sectional area (L, N, PE) (max.)	50 mm^2 stranded / 35 mm^2 flexible
Cross-sectional area (L', N', ⏚) (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	KEMA, VDE, UL, VdS
Extended technical data:	Use in switchgear installations with prospective short-circuit currents of more than 50 kA_{rms} (tested by the German VDE)
– Max. prospective short-circuit current	100 kA_{rms} (220 kA_{peak})
– Limitation / Extinction of mains follow currents	up to 100 kA_{rms} (220 kA_{peak})
– Max. backup fuse (L) up to I_K = 100 kA_{rms}	315 A gL/gG
Weight	724 g
Customs tariff number	85363030
GTIN	4013364108097
PU	1 pc(s)

DEHNguard

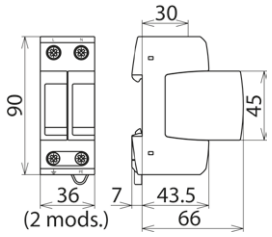
DG M TT 2P 275 (952 110)

- Prewired complete unit consisting of a base part and plug-in protection modules
- High discharge capacity due to heavy-duty zinc oxide varistors / spark gaps
- High reliability due to "Thermo Dynamic Control" SPD monitoring device

Figure without obligation



Basic circuit diagram DG M TT 2P 275



Dimension drawing DG M TT 2P 275

Modular surge arrester for use in single-phase TT and TN systems ("1+1" circuit).

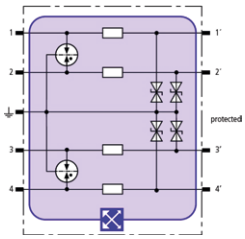
Type Part No.	DG M TT 2P 275 952 110
SPD according to EN 61643-11 / IEC 61643-11	type 2 / class II
Nominal a.c. voltage (U_N)	230 V (50 / 60 Hz)
Max. continuous operating a.c. voltage [L-N] (U_C)	275 V (50 / 60 Hz)
Max. continuous operating a.c. voltage [N-PE] (U_C)	255 V (50 / 60 Hz)
Nominal discharge current (8/20 µs) (I_n)	20 kA
Max. discharge current (8/20 µs) (I_{max})	40 kA
Lightning impulse current (10/350 µs) [N-PE] (I_{imp})	12 kA
Voltage protection level [L-N] (U_P)	≤ 1.5 kV
Voltage protection level [L-N] at 5 kA (U_P)	≤ 1 kV
Voltage protection level [N-PE] (U_P)	≤ 1.5 kV
Follow current extinguishing capability [N-PE] (I_{fi})	100 A_{rms}
Response time [L-N] (t_A)	≤ 25 ns
Response time [N-PE] (t_A)	≤ 100 ns
Max. mains-side overcurrent protection	125 A gG
Short-circuit withstand capability for max. mains-side overcurrent protection (I_{SCCR})	50 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) [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 (min.)	1.5 mm^2 solid / flexible
Cross-sectional area (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	2 module(s), DIN 43880
Approvals	KEMA, VDE, UL, VdS
Weight	242 g
Customs tariff number	85363030
GTIN	4013364108417
PU	1 pc(s)

BLITZDUCTOR XT

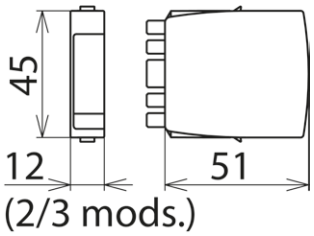
BXT ML4 BE 24 (920 324)

- LifeCheck SPD monitoring function
- Optimal protection of four single lines
- For installation in conformity with the lightning protection zone concept at the boundaries from 0_A – 2 and higher

Figure without obligation



Basic circuit diagram BXT ML4 BE 24



Dimension drawing BXT ML4 BE 24

Space-saving combined lightning current and surge arrester module with LifeCheck feature for protecting four single lines sharing a common reference potential as well as unbalanced interfaces. If LifeCheck detects thermal or electrical overload, the arrester has to be replaced. This status is indicated contactlessly by the DEHNrecord LC / SCM / MCM reader.

Type Part No.	BXT ML4 BE 24 920 324
SPD monitoring system	LifeCheck
SPD class	TYPE 1 P1
Nominal voltage (U_N)	24 V
Max. continuous operating d.c. voltage (U_C)	33 V
Max. continuous operating a.c. voltage (U_C)	23.3 V
Nominal current at 45 °C (I_L)	0.75 A
D1 Total lightning impulse current (10/350 µs) (I_{imp})	10 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_{imp} D1 (U_p)	≤ 102 V
Voltage protection level line-PG for I_{imp} D1 (U_p)	≤ 66 V
Voltage protection level line-line at 1 kV/µs C3 (U_p)	≤ 90 V
Voltage protection level line-PG at 1 kV/µs C3 (U_p)	≤ 45 V
Series resistance per line	1.8 ohm(s)
Cut-off frequency line-PG (f_G)	6.8 MHz
Capacitance line-line (C)	≤ 0.5 nF
Capacitance line-PG (C)	≤ 1.0 nF
Operating temperature range (T_U)	-40 °C ... +80 °C
Degree of protection (plugged-in)	IP 20
Pluggable into	BXT BAS / BSP BAS 4 base part
Earthing via	BXT BAS / BSP BAS 4 base part
Enclosure material	polyamide PA 6.6
Colour	yellow
Test standards	IEC 61643-21 / EN 61643-21, UL 497B
SIL classification	up to SIL3 *)
ATEX approvals	DEKRA 11ATEX0089 X: II 3 G Ex nA IIC T4 Gc
IECEx approvals	DEK 11.0032X: Ex nA IIC T4 Gc
CSA & USA Hazloc approvals (1)	2516389: Class I Div. 2 GP A, B, C, D T4
CSA & USA Hazloc approvals (2)	2516389: Class I Zone 2, AEx nA IIC T4
Approvals	CSA, VdS, UL, GOST
Weight	38 g
Customs tariff number	85363010
GTIN	4013364109056
PU	1 pc(s)

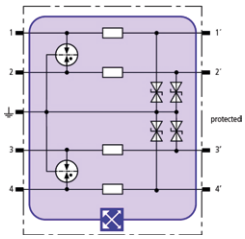
*) For more detailed information, please visit www.dehn-international.com.

BLITZDUCTOR XT

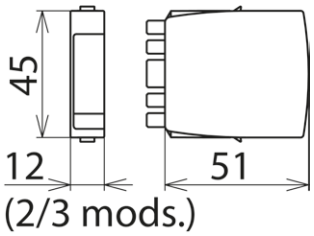
BXT ML4 BE 36 (920 336)

- LifeCheck SPD monitoring function
- Optimal protection of four single lines
- For installation in conformity with the lightning protection zone concept at the boundaries from 0_A – 2 and higher

Figure without obligation



Basic circuit diagram BXT ML4 BE 36



Dimension drawing BXT ML4 BE 36

Space-saving combined lightning current and surge arrester module with LifeCheck feature for protecting four single lines sharing a common reference potential as well as unbalanced interfaces. If LifeCheck detects thermal or electrical overload, the arrester has to be replaced. This status is indicated contactlessly by the DEHNrecord LC / SCM / MCM reader.

Type Part No.	BXT ML4 BE 36 920 336
SPD monitoring system	LifeCheck
SPD class	TYPE 1 P1
Nominal voltage (U_N)	36 V
Max. continuous operating d.c. voltage (U_C)	45 V
Max. continuous operating a.c. voltage (U_C)	31 V
Nominal current at 45 °C (I_L)	1.8 A
D1 Total lightning impulse current (10/350 µs) (I_{imp})	10 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_{imp} D1 (U_p)	≤ 140 V
Voltage protection level line-PG for I_{imp} D1 (U_p)	≤ 85 V
Voltage protection level line-line at 1 kV/µs C3 (U_p)	≤ 112 V
Voltage protection level line-PG at 1 kV/µs C3 (U_p)	≤ 56 V
Series resistance per line	0.43 ohm(s)
Cut-off frequency line-PG (f_G)	3.8 MHz
Capacitance line-line (C)	≤ 0.8 nF
Capacitance line-PG (C)	≤ 1.6 nF
Operating temperature range (T_U)	-40 °C ... +80 °C
Degree of protection (plugged-in)	IP 20
Pluggable into	BXT BAS / BSP BAS 4 base part
Earthing via	BXT BAS / BSP BAS 4 base part
Enclosure material	polyamide PA 6.6
Colour	yellow
Test standards	IEC 61643-21 / EN 61643-21
SIL classification	up to SIL3 *)
ATEX approvals	DEKRA 11ATEX0089 X: II 3 G Ex nA IIC T4 Gc
IECEx approvals	DEK 11.0032X: Ex nA IIC T4 Gc
CSA & USA Hazloc approvals (1)	2516389: Class I Div. 2 GP A, B, C, D T4
CSA & USA Hazloc approvals (2)	2516389: Class I Zone 2, AEx nA IIC T4
Approvals	VdS, UL, GOST
Weight	40 g
Customs tariff number	85363010
GTIN	4013364118539
PU	1 pc(s)

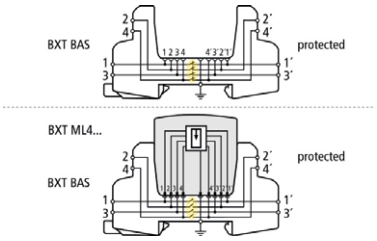
*) For more detailed information, please visit www.dehn-international.com.

BLITZDUCTOR XT

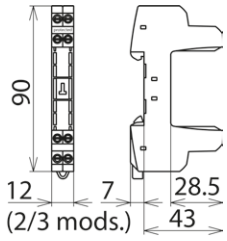
BXT BAS (920 300)

- Four-pole version for universal use with all types of BSP and BXT / BXTU protection modules
- No signal interruption if the protection module is removed
- Universal design without protection elements

Figure without obligation



Basic circuit diagram with and without plugged-in module



Dimension drawing BXT BAS

The BLITZDUCTOR XT base part is a very space-saving and universal four-pole feed-through terminal for the insertion of a protection module without signal interruption if the protection module is removed. The snap-in mechanism at the supporting foot of the base part allows the protection module to be safely earthed via the DIN rail. Since no components of the protective circuit are situated in the base part, only the protection modules must be maintained.

Type Part No.	BXT BAS 920 300
Operating temperature range (T_U)	-40 °C ... +80 °C
Degree of protection	IP 20
For mounting on	35 mm DIN rails acc. to EN 60715
Connection (input / output)	screw / screw
Signal disconnection	no
Cross-sectional area, solid	0.08-4 mm^2
Cross-sectional area, flexible	0.08-2.5 mm^2
Tightening torque (terminals)	0.4 Nm
Earthing via	35 mm DIN rails acc. to EN 60715
Enclosure material	polyamide PA 6.6
Colour	yellow
ATEX approvals	DEKRA 11ATEX0089 X: II 3 G Ex nA IIC T4 Gc *)
IECEx approvals	DEK 11.0032X: Ex nA IIC T4 Gc *)
Approvals	CSA, VdS, UL, GOST
Weight	34 g
Customs tariff number	85369010
GTIN	4013364109179
PU	1 pc(s)

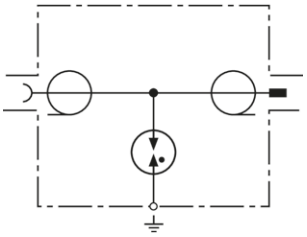
*) only in connection with an approved protection module

DEHNgate

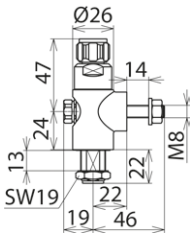
DGA AG N (929 045)

- Large-area contact surface for connecting gas discharge tubes
- Longevity due to minimum contact erosion at the inner conductor
- For installation in conformity with the lightning protection zone concept at the boundaries from 0_A – 1 and higher

Figure without obligation



Basic circuit diagram DGA AG N



Dimension drawings DGA AG N

Arrester suitable for remote supply with exchangeable gas discharge tube. Long endurance due to minimum contact erosion resulting from the large-area contact surface of the gas discharge tube.

Type Part No.	DGA AG N 929 045
SPD class	TYPE 1
Max. continuous operating d.c. voltage (U_C)	180 V
Nominal current (I_L)	6 A
Max. transmission capacity	150 W
D1 Lightning impulse current (10/350 µs) (I_{imp})	5 kA
C2 Nominal discharge current (8/20 µs) (I_n)	20 kA
Voltage protection level for I_n C2 (U_P)	≤ 850 V
Frequency range	0-2.5 GHz
Insertion loss	< 0.2 dB
Return loss	≥ 20
Characteristic impedance (Z)	50 ohms
Operating temperature range (T_U)	-40 °C ... +85 °C
Degree of protection	IP 65
Connection	N socket / N plug
Earthing via	bushing (Ø16.1 mm) or earthing screw
Enclosure material	brass, refined surface with trimetal plating
Colour	bare surface
Exchangeable gas discharge tube	yes
Test standards	IEC 61643-21 / EN 61643-21
Approvals	GOST
Weight	266 g
Customs tariff number	85366910
GTIN	4013364091061
PU	1 pc(s)

Earth connecting element

UEK 25 HG (774 234)

- Earthing and short-circuiting devices can be configured online via the earthing and short-circuiting configurator

Figure without obligation

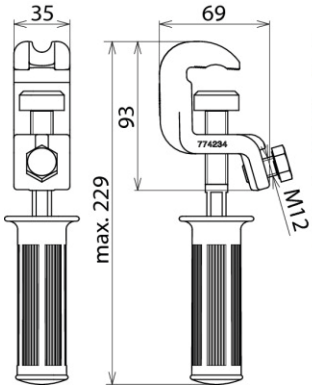


Figure without obligation

*) Clamping range and maximum cable cross-section of universal clamps used for:

Fixed ball point Ø	Phase T pin collar width	Rd / Fl clamping range	Cable cross-section
20/25/30 mm	15/18 mm	20/30 mm	16 mm²
20/25/30 mm	15/18 mm	20/30 mm	25 mm²
20/25/30 mm	15/18 mm	20/30 mm	35 mm²
20/25/30 mm	15/18 mm	20/30 mm	50 mm²
20/25/30 mm	15/18 mm	20/30 mm	70 mm²
20/25/30 mm	15/18 mm	–	95 mm²
–/25/30 mm	–	–	120 mm²
–	–	–	150 mm²

Type Part No.	UEK 25 HG 774 234
For fixed ball point Ø	20 / 25 mm
For T pins with a collar width of	15 mm
Rd / Fl clamping range	20 mm
Anti-rotation cable lug	PK1
For cable cross-sections	16 ... 120*) mm²
Max. short-circuit current I_k 0.5 s	33.5 kA
Max. short-circuit current I_k 1 s	23.7 kA
Standard	EN/IEC 61230 (DIN VDE 0683-100)
Temperature range	–25 °C ... +55 °C
Material (clamp body)	Copper alloy/gal Sn
Material (shaft)	Copper alloy/gal Sn
Material (pressure plate)	St/gal Zn
Weight	772 g
Customs tariff number	85389099
GTIN	4013364114593
PU	1 pc(s)

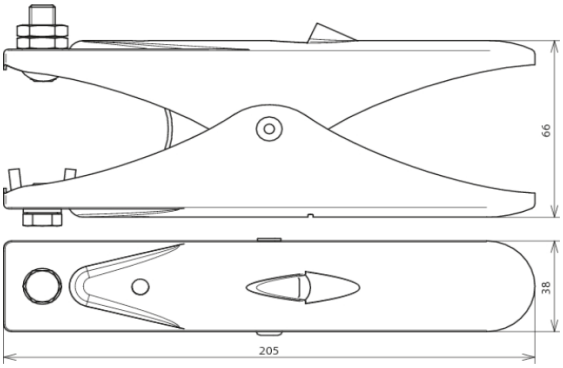
*)See table for clamping ranges and maximum cable cross-sections of universal clamps

The clamps must have the same maximum short-circuit current as the earthing and short-circuiting cables!

Earthing tong

EZ 55 FL45 ASM10 V2A (546 001)

Figure without obligation



Part No.	546 001
Material of tongs	StSt
Clamping range Rd / Fl	up to Ø55 / up to 45 mm
Length	205 mm
Connection nut	M10
Material of screw	StSt
Weight	470 g
Customs tariff number	85359000
GTIN	4013364019973
PU	1 pc(s)

Bridging braid

UEBB L180 B10.5 B5.2 CU (377 007)

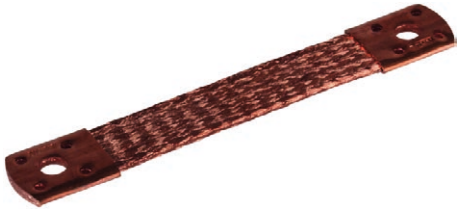
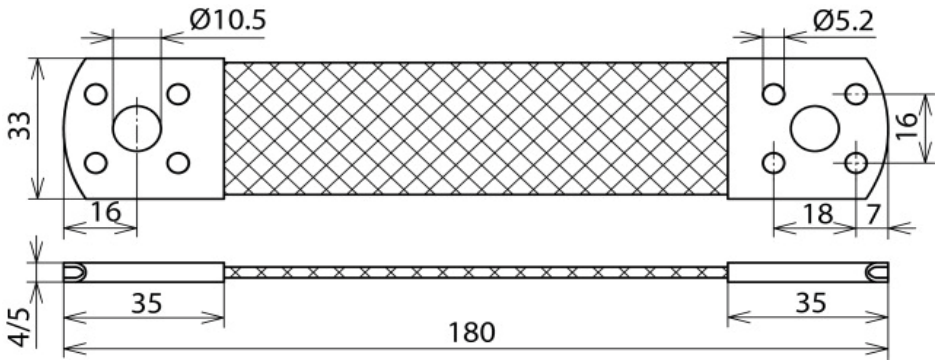


Figure without obligation



Part No.	377 007
Material	Cu
Length	180 mm
Cross-section	50 mm²
Fixing	[8x] Ø5.2 / [2x] Ø10.5 mm
Application note	according to DIN EN 62305-3 Supplement 1, materials ≥ 0.5mm thick shall be connected by 4 rivets Ø5mm
Fixing possibility	blind rivets / screws
Standard	EN 62561-1
Weight	107 g
Customs tariff number	85389099
GTIN	4013364092686
PU	10 pc(s)

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