

# Lightning & Surge Protection

2016 edition



# Company Profile



Hakel Ltd. since its establishment in 1994 is a major producer of surge protection devices in Europe. The company obtained ISO 9001 certificate in 1997. The production of surge protection devices is a specific and technical area with great demands on professional knowledge of the company's management as well as the production and research staff. Introduction of new technologies and using the latest testing equipment enables engineers to extend their technical knowledge. The use of surge protection devices is becoming a common necessity nowadays. Large power systems, which are operated by complicated electronics are more and more sensitive to electromagnetic and overvoltage damage. Failure of electronic equipment owing to surges can cause reduction of orders or even company's bankruptcy. Surge protection devices produced by Hakel company can be easily applied in every industry, domestic, commercial and industrial. Hakel company also passes its experience on to college and university students and helps them to acquaint with new solutions in electromagnetic compatibility. Experience obtained from working with power electronics in industry are closely related to the company's market leading position in the Czech Republic. Hakel exports products worldwide through its partner companies which it has helped to train and develop their mutual businesses. The surge protection product range offered by Hakel enables customers to easily apply the products in every industrial, commercial and domestic situation. The continual investment in new technologies and product development helps Hakel to achieve higher standards and better technical solutions than its competitors. That is one of the reasons why Hakel is a world market leader in the field of surge protection. All Hakel products are tested according to the most up to date international and European standards which include EN61643-11 and IEC61643-1.



Hakel Ltd. produces and exports to countries on all continents important safety products Insulation monitoring devices, these enable users to improve their safety in ungrounded IT power supply systems, railway, engineering, shipbuilding, hospitals and transport facilities.

## sales map



- |           |           |             |             |             |               |
|-----------|-----------|-------------|-------------|-------------|---------------|
| UAE       | Estonia   | Iran        | Hungary     | Portugal    | Switzerland   |
| Australia | Finland   | Ireland     | Macedonia   | Austria     | Thailand      |
| Belgie    | France    | Italy       | Malaysia    | Russia      | Tunisia       |
| Belarus   | Ghana     | Japan       | Mexico      | Greece      | Turkey        |
| Brazil    | Hollandia | South Korea | Germany     | North Korea | Ukraine       |
| Bulgaria  | Croatia   | Canada      | Nigeria     | Singapore   | United States |
| Tchai-wan | India     | Kenya       | Norway      | Slovakia    | Great Britain |
| Denmark   | Indonesia | Lithuania   | New Zealand | Spain       | Vietnam       |
| Egypt     | Iraq      | Latvia      | Poland      | Sweden      |               |

## General distribution of lightning current when an object is thunderstruck, principle of LV power system protection thanks to cascaded 3-stage protection

Protection system of LV power system composed of lightning current arresters and surge arresters SPD must be able to discharge lightning currents or their substantial parts without their damage. It is generally recommended to come out from the ohmic resistance of the building earthing, pipeline, power distribution system and so on for the purposes of establishing current distribution going through SPD in case of direct lightning stroke into a building protected by the outside lightning system. The following figure shows a typical example of lightning current distribution in an object hit by direct lightning stroke. Where an individual evaluation is not possible, it can be assumed that:

- 50% of the total lightning current  $I_{imp} = 200kA (10/350)$ ....

$I_{s1} = 100kA (10/350)$  enters the earth termination system of the LPS (lightning protection system) of the structure considered

- 50% of  $I_{imp} = 200kA (10/350)$   $I_{s2} = 100kA (10/350)$  is distributed among the services entering the structure (external conductive parts, electrical power, communication lines, etc.) The value of the current flowing in each service  $I_i$  is given by  $I_s/n$ , where  $n$  is the number of the above mentioned services (see the below figure)

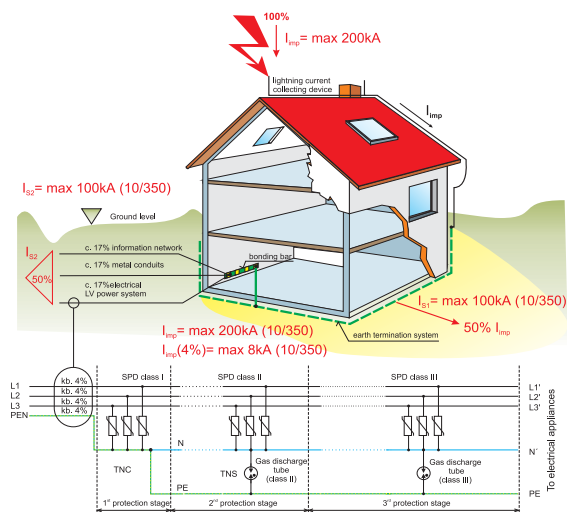
For evaluating the current  $I_v$  in individual conductors in unscreened cables, the cable current  $I_i$  is divided by  $m$ , the number of conductors, i.e.  $I_v = I_i/m$ .

For shielded cables, the current will flow along the shield.

Requirement on dimensioning of protective system SPD in the most usual connection of the building and LV power system

(TNC - system 230/400V/50Hz) results from this reasoning:

For maximum lightning current size  $I_{imp} = 200kA (10/350)$  it is enough to dimension the protective cascade of each phase conductor entering the object on approx. 4%  $I_{imp}$  that is on approx. 8kA (10/350) in most cases.



## Distribution of protected area into the lightning protection zones

The standard IEC 13 12-1 and IEC 62 305 defines the lightning protection zones LPZ from the respect of the direct even indirect lightning effect. These zones are characteristic thanks to fundamental breaks of the electromagnetic conditions in their limited zones.

### LPZ 0<sub>A</sub>:

Zone where items are subject to direct lightning strokes, and therefore may have to carry up to the full lightning current; the unattenuated electromagnetic field occurs here.

### LPZ 0<sub>B</sub>:

Zone where items are not subject to direct lightning strokes, but the unattenuated electromagnetic field occurs.

### LPZ 1:

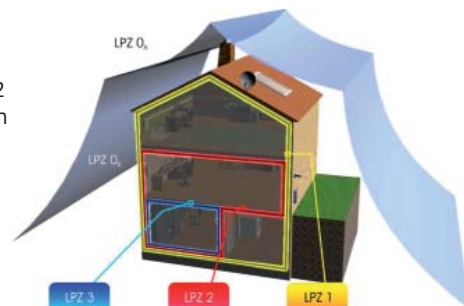
Zone where items are not subject to direct lightning strokes and where currents on all conductive parts within this zone are further reduced compared with zones 0<sub>B</sub>. In this zone the electromagnetic field may also be attenuated depending on the screening measure.

### The subsequent zones (LPZ 2 and so on):

If a further reduction of conducted currents and/or electromagnetic field is required, subsequent zones shall be introduced. The requirement for those zones shall be selected according to the required environmental zones of the system to be protected. In general, the higher the number of the zones, the lower the electromagnetic environment parameters. At the boundary of the individual zones, bonding of all metal penetrations shall be provided and screening measures might be installed.

**Note:** Bonding at the boundary between LPZ0<sub>A</sub>, LPZ0<sub>B</sub> and LPZ 1 is defined in IEC 13 12-1 & IEC 62 305. The electromagnetic fields inside a structure are influenced by opening windows, by currents on metal conductors (e.g. bonding bars, cable shields and tubes), and by cable routing.

The following figure shows an example for dividing a structure into several zones. There all electric power and signal lines enter the protected volume (LPZ 1) at one point, and are bonded to bonding bar 1 at the boundary of LPZ 0<sub>A</sub>, LPZ 0<sub>B</sub>, and LPZ 1. In addition, the lines are bonded to the internal bonding bar 2 at the boundary of LPZ 1 and LPZ 2. Furthermore, the outer shield 1 of the structure is bonded to bonding bar 1 and the inner shield 2 to bonding bar 2. Where cables pass from one LPZ to another, the bonding must be executed at each boundary. LPZ 2 is constructed in such a way that partial lightning currents are not transferred into this volume and cannot pass through it.



The above described segmentation of the protected object into protection zones gives possibilities of active protection of the LV power system thanks to insertion of the protective SPDs (usually at the zone boundary LPZ 0 → 1 and LPZ 1 → 2) and other protective SPDs at the zone boundary LPZ → 3. Standardly it is recommended to insert so-called 1<sup>st</sup> stage protection - surge arrester class I tested by lightning current  $I_{imp} (10/350)$  at the zone boundary LPZ 0 → 1. It is recommended to insert 2<sup>nd</sup> stage protection - surge arrester class II tested by testing impulse  $I_{max} (8/20)$  at the boundary zone LPZ 1 → 2. At the boundary of LPZ 2 → 3 and subsequently along the consequential circuit there is also recommended to shoulder after every cca 10m by so called 3<sup>rd</sup> stage protection class III also tested by testing impulse  $I_{max} (8/20)$  or  $U_{oc}$ . For extra important protected equipment it is recommended to secure it by a quality continuous surge protection class III with high-frequency filter at the boundary of LPZ 2 → 3. If there are adjacent structures between which power and communication cables pass, the earthing system shall be interconnected, and it is beneficial to have many parallel paths to reduce current in the cables. A meshed earthing system fulfills this requirement. The lightning currents are further reduced, e.g. by enclosing all the cables in metal conduits of gridlike reinforced concrete ducts, which must be integrated into the meshed earthing system.

# Lightning Current Arrester

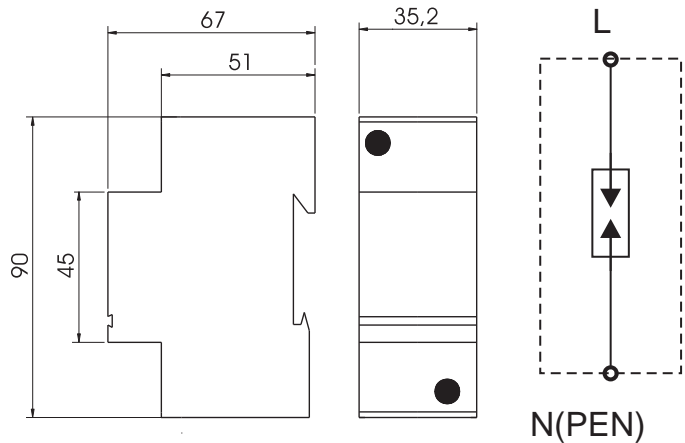
## TYPE 1 / CLASS I



HS50-50i



HS50-50i LED

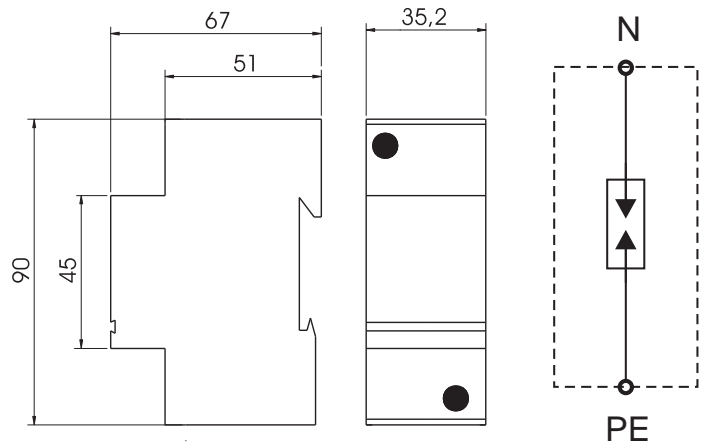


HS50-50i and HS50-50i LED are the lightning current arresters type 1 & class 1 according to EN 61643-11 and IEC 61643-1. These are recommended for use in the Lightning Protection Zones Concept at the boundaries of LPZ 0 – 1 (according to IEC 1312-1 and EN 62305), where they provide the equipotential bonding and discharge of both, the lightning current and the switching surge, which are generated in power supply systems entering the building. The lightning current arresters are constructed as the encapsulated, non-exhaust, multiple spark gaps, which do not have any special requirements for installation in the main switchboards in terms of the gas exhaustion generated during the passage of the lightning current. They are mainly intended for use in the power lines, which are operated as a system TN-C. For TNS and TT systems it is necessary to combine these arresters with single spark gap lightning arrester HS100i. The main usage of the HS lightning arresters is in those objects, which belong according to EN 62305 to the protective level LPL I.

Type		HS50-50i	HS50-50i LED
Test class according to EN 61643-11 ed.2 and IEC 61643-1		TYPE 1, CLASS I	
Nominal Voltage	$U_N$	230 V	
Max. continuous operating voltage	$U_C$	320 V AC	
Lightning impulse current (10/350)	$I_{imp}$	50 kA	
- charge	Q	25 As	
- specific energy	W/R	600 kJ/ $\Omega$	
Nominal discharge current (8/20)	$I_n$	50 kA	
Voltage protection level at $I_{imp}$	$U_p$	< 1.3 kV	
Temporary overvoltage (TOV)	$U_T$	425 V/5 s	
Response time	$t_A$	< 100 ns	
Follow current extinguishing capacity at $U_C$	$I_{fi}$	25 kA <sub>rms</sub>	
Max. back-up fuse		500 AgL/gG	
Short-circuit withstand capability at max. back-up fuse	$I_p$	25 kA <sub>rms</sub>	
LPZ		0-1	
Housing material		Polyamid PA6, UL94 V-0	
Protection type		IP20	
Operating temperature range	J	-40 °C ... +80 °C	
Cross-section of the connected conductors (at tightening moment of clamps 4 Nm)		10 - 35 mm <sup>2</sup> (solid) 10 - 25 mm <sup>2</sup> (flexible) 10 - 25 mm <sup>2</sup> (multi-wire)	
Mounting on		DIN rail 35 mm	
Operating Indication (LED)		Green-Ok/Red-Fault	
Weight	m	225	230
Article number		10 091	10 591

# Lightning Current Arrester

## TYPE 1 / CLASS I



**HS100i**

HS100i is the lightning current arrester type 1 & class 1 according to EN 61643-11 and IEC 61643-1. These are recommended for use in the Lightning Zones Concept at the boundaries of LPZ 0 - 1 (according to IEC 1312-1 and EN 62305), where they provide the equipotential bonding and discharge of both, the lightning current and the switching surge, which are generated in power supply systems entering the building. The lightning arresters are constructed as the encapsulated, non-exhaust, multiple spark gaps, which do not have any special requirements for installation in the main switchboards in terms of the gas exhaustion generated during the passage of the lightning current. They are intended for use in TN-S and TT systems. HS100i is to be installed only between N and PE in modifications of 3+1 or 1+1.

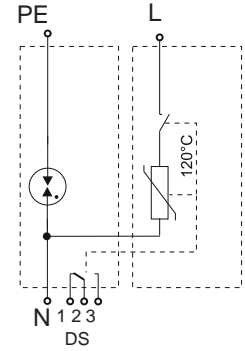
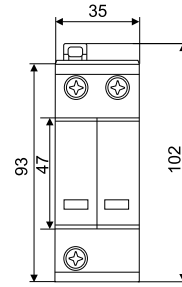
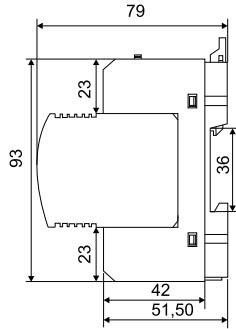
Type		HS100i
Test class according to EN 61643-11 ed.2 and IEC 61643-1		TYPE 1, CLASS I
Max. continuous operating voltage	$U_C$	255 V AC
Lightning impulse current (10/350)	$I_{imp}$	100 kA
- charge	Q	50 As
- specific energy	W/R	2500 kJ/Ω
Nominal discharge current (8/20)	$I_n$	100 kA
Voltage protection level at $I_{imp}$	$U_P$	< 1.3 kV
Temporary overvoltage (TOV)	$U_T$	1200 V/0.2 s
Response time	$t_A$	< 100 ns
Follow current extinguishing capacity at $U_C$	$I_{fi}$	100 A <sub>rms</sub>
Max. back-up fuse		500 AgL/gG
Short-circuit withstand capability at max. back-up fuse	$I_p$	25 kA <sub>rms</sub>
LPZ		0-1
Housing material		Polyamid PA6, UL94 V-0
Protection type		IP20
Operating temperature range	J	-40 °C ... +80 °C
Cross-section of the connected conductors (at tightening moment of clamps 4 Nm)		10 - 35 mm <sup>2</sup> (solid) 10 - 25 mm <sup>2</sup> (flexible) 10 - 25 mm <sup>2</sup> (multi-wire)
Mounting on		DIN rail 35 mm
Weight	m	230
Article number		10 200

# Lightning Current and Surge Arrester

## TYPE 1+2 / CLASS I+II



PIVM7-320/1+1  
PIVM7-320 DS/1+1



PIVM7-320/1+1 V series is a two-pole, metal oxide varistor lightning current and surge arrester, combined with gas discharge tube Type 1+2 & Class I+II according to EN 61643-11 and IEC 61643-1. These arresters are recommended for use in the Lightning Protection Zones Concept at the boundaries of LPZ 0 – 1 (according to IEC 1312-1 and EN 62305 ed.2), where they provide the equipotential bonding and discharge of both, the lightning current and the switching surge, which are generated in power supply systems entering the building. The use of the lightning current arresters PIVM7-320/1+1 V series is mainly in the power supply lines, which are operated as TN-S and TT systems. The main use of PIVM7-320/1+1 V series arrester is in structures of LPL III – IV according to EN 62305 ed.2. The marking M specifies a type of construction with removable module. The marking of DS specifies a version with remote monitoring.

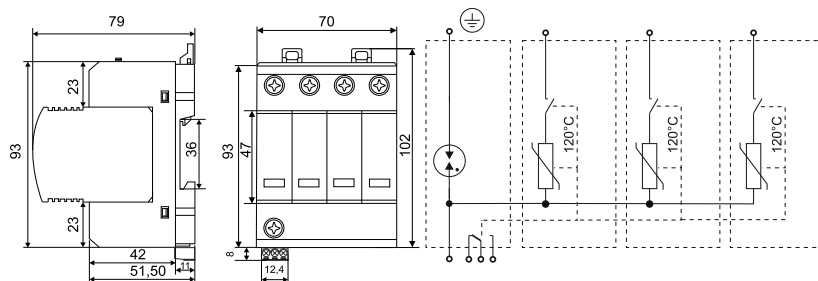
Type		PIVM7-320/1+1, PIVM7-320 DS/1+1
Test class according to EN 61643-11 ed.2 and IEC 61643-1		TYPE 1+2, CLASS I+II
Nominal Voltage	$U_N$	230 V
Max. continuous operating voltage	$U_C$	320 V AC / 350 V DC
Max. discharge current (8/20)	$I_{max}$	50 kA
Lightning impulse current (10/350) L/N	$I_{imp}$	7 kA
- charge	Q	3.5 As
- specific energy	W/R	12 kJ/Ω
Lightning impulse current (10/350) N/PE	$I_{imp}$	25 kA
- charge	Q	12.5 As
- specific energy	W/R	156 kJ/Ω
Total lightning current (10/350) L1+N/PE	$I_{total}$	25 kA
Nominal discharge current (8/20)	$I_n$	30 kA
Voltage protection level	$U_p$	< 1.3 kV
Temporary overvoltage (TOV) L/N	$U_T$	335 V/5 s
Temporary overvoltage (TOV) N/PE	$U_T$	1200 V/0,2 s
Response time L/N	$t_A$	< 25 ns
Response time N/PE	$t_A$	< 100 ns
Max. back-up fuse		160 AgL/gG
Short-circuit withstand capability LPZ	$I_p$	60 kA <sub>rms</sub> 0-1
Housing material		Polyamid PA6, UL94 V-0
Protection type		IP20
Operating temperature range	J	-40 °C ... +80 °C
Cross-section of the connected conductors (at tightening moment of clamps 4 Nm)		2.5 - 25 mm <sup>2</sup> (solid) 2.5 - 16 mm <sup>2</sup> (flexible) 2.5 - 16 mm <sup>2</sup> (multi-wire)
Mounting on		DIN rail 35 mm
Failure signalisation		green - ok / red - failure
Potential free signal contact (DS) (recommended cross-section of remote monitoring max.1 mm <sup>2</sup> )		AC: 250 V / 0.5 A, DC: 250 V / 0.1 A
Weight	m	171 g
Article number		
PIVM7-320/1+1		16 014
PIVM7-320 DS/1+1		16 015
Varistor-based spare module		
PIVM7-320/M		16 037
GDT spare module		
B25M/M		16 041

# Lightning Current and Surge Arrester

## TYPE 1+2 / CLASS I+II



PIVM7-320/3+1  
PIVM7-320 DS/3+1



PIVM7-320/3+1 Vseries is a four-pole, metal oxide varistor lightning current and surge arrester, combined with gas discharge tube Type 1+2 & Class I+II according to EN 61643-11 and IEC 61643-1. These arresters are recommended for use in the Lightning Protection Zones Concept at the boundaries of LPZ 0 – 1 (according to IEC 1312-1 and EN 62305 ed.2), where they provide the equipotential bonding and discharge of both, the lightning current and the switching surge, which are generated in power supply systems entering the building. The use of the lightning current arresters PIVM7-320/3+1 Vseries is mainly in the power supply lines, which are operated as TN-S and TT systems. The main use of PIVM7-320/3+1 Vseries arrester is in structures of LPL III – IV according to EN 62305 ed.2. The marking M specifies a type of construction with removable module. The marking of DS specifies a version with remote monitoring.

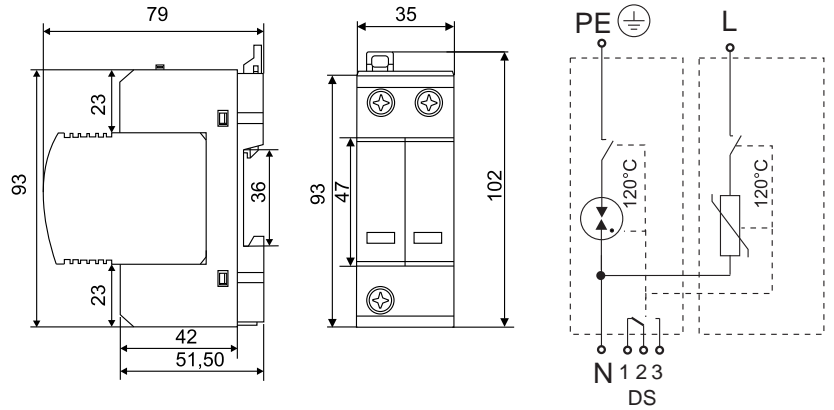
Type	PIVM7-320/3+1, PIVM7-320 DS/3+1	
Test class according to EN 61643-11 ed.2 and IEC 61643-1	TYPE 1+2, CLASS I+II	
Nominal Voltage	$U_N$	230 V
Max. continuous operating voltage	$U_C$	320 V AC / 350 V DC
Max. discharge current (8/20)	$I_{max}$	50 kA
Lightning impulse current (10/350) L/N	$I_{imp}$	7 kA
- charge	Q	3.5 As
- specific energy	W/R	12 kJ/Ω
Lightning impulse current (10/350) N/PE	$I_{imp}$	25 kA
- charge	Q	12.5 As
- specific energy	W/R	156 kJ/Ω
Total lightning current (10/350) L1+N/PE	$I_{total}$	25 kA
Nominal discharge current (8/20)	$I_n$	30 kA
Voltage protection level	$U_p$	< 1.3 kV
Temporary overvoltage (TOV) L/N	$U_T$	335 V/5 s
Temporary overvoltage (TOV) N/PE	$U_T$	1200 V/0.2 s
Response time L/N	$t_A$	< 25 ns
Response time N/PE	$t_A$	< 100 ns
Max. back-up fuse		160 AgL/gG
Short-circuit withstand capability	$I_p$	60 kA <sub>rms</sub>
LPZ		0-1
Housing material		Polyamid PA6, UL94 V-0
Protection type		IP20
Operating temperature range	J	-40°C ... +80°C
Cross-section of the connected conductors (at tightening moment of clamps 4 Nm)		2.5 - 25 mm <sup>2</sup> (solid) 2.5 - 16 mm <sup>2</sup> (flexible) 2.5 - 16 mm <sup>2</sup> (multi-wire)
Mounting on		DIN rail 35 mm
Failure signalisation		green - ok / red - failure
Potential free signal contact (DS) (recommended cross-section of remote monitoring max. 1 mm <sup>2</sup> )		AC: 250 V / 0.5 A, DC: 250 V / 0.1 A
Weight	m	536 g
Article number		
PIVM7-320/3+1		16 020
PIVM7-320 DS/3+1		16 021
Varistor-based spare module		
PIVM7-320/M		16 037
GDT spare module		
B25M/M		16 041

# Surge Arrester

## TYPE 2 / CLASS II



PIIIM-320/1+1  
PIIIM-320 DS/1+1



PIIIM-320/1+1 V series is a two-pole, metal oxide varistor surge arrester combined with gas discharge tube, Type 2 & Class II according to EN 61643-11 and IEC 61643-1. These arresters are recommended for use in the Lightning Protection Zones Concept at the boundaries of LPZ 1-2 (according to IEC 1312-1 and EN 62305), where they provide the equipotential bonding and discharge of the switching overvoltage, which is generated in power supply systems entering the building. The main use of PIIIM-320/1+1 V series arrester is in all kinds of industry, residential and administration buildings. They are to be placed into the subsidiary switchboards or control boxes. The marking **M** specifies a type of construction with removable module. The marking of **DS** specifies a version with remote monitoring.

Type		PIIIM-320/1+1, PIIIM-320 DS/1+1
Test class according to EN 61643-11 ed.2 and IEC 61643-1		TYPE 2, CLASS II
Max. continuous operating voltage	$U_c$	320 V AC / 420 V DC
Max. discharge current (8/20)	$I_{max}$	50 kA
Nominal discharge current (8/20) L/N	$I_n$	20 kA
Nominal discharge current (8/20) N/PE	$I_n$	20 kA
Voltage protection level	$U_p$	< 1.45 kV
Lightning impulse current (10/350) N/PE	$I_{imp}$	20 kA
Temporary overvoltage (TOV) L/N	$U_T$	335 V/5 s
Temporary overvoltage (TOV) N/PE	$U_T$	1200 V/0.2 s
Response time L/N	$t_A$	< 25 ns
Response time N/PE	$t_A$	< 100 ns
Max. back-up fuse		160 AgL/gG
Short-circuit withstand capability	$I_p$	60 kA <sub>rms</sub>
LPZ		1-2
Housing material		Polyamid PA6, UL94 V-0
Protection type		IP20
Operating temperature range	J	-40 °C ... +80 °C
Cross-section of the connected conductors (at tightening moment of clamps 4 Nm)		2.5 - 25 mm <sup>2</sup> (solid) 2.5 - 16 mm <sup>2</sup> (flexible) 2.5 - 16 mm <sup>2</sup> (multi-wire)
Mounting on		DIN rail 35 mm
Failure indication		green - ok / red - failure
Potential free signal contact (DS) (recommended cross-section of remote monitoring max. 1 mm <sup>2</sup> )		AC: 250 V / 0.5 A, DC: 250 V / 0.1 A
Weight	m	166 g
Article number		
PIIIM-320/1+1		27 018
PIIIM-320 DS/1+1		27 019
Varistor-based spare module		
PIIIM-320/M		27 045
GDT spare module		
B20M/M		27 049

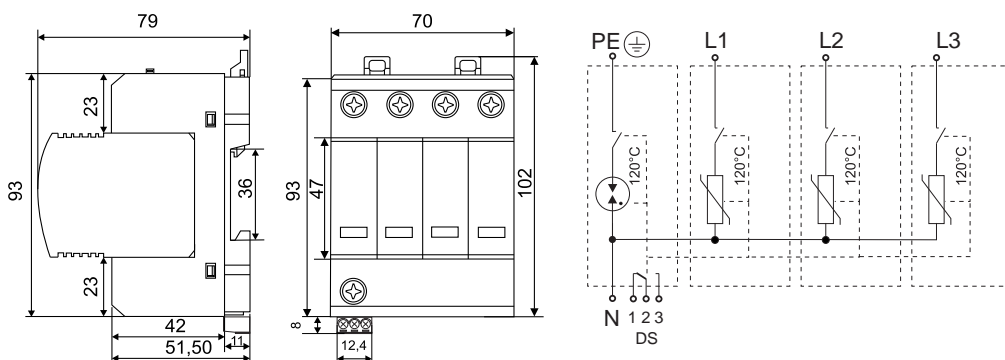


# Surge Arrester

## TYPE 2 / CLASS II



PIIIM-320/3+1  
PIIIM-320 DS/3+1



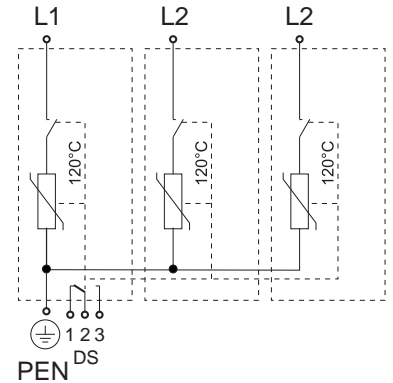
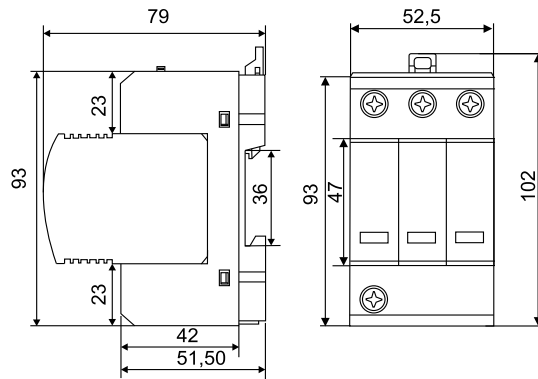
PIIIM-320/3+1 V series is a four-pole, metal oxide varistor surge arrester combined with gas discharge tube, Type 2 & Class II according to EN 61643-11 and IEC 61643-1. These arresters are recommended for use in the Lightning Protection Zones Concept at the boundaries of LPZ 1-2 (according to IEC 1312-1 and EN 62305), where they provide the equipotential bonding and discharge of the switching overvoltage, which is generated in power supply systems entering the building. The main use of PIIIM-320/3+1 V series arrester is in all kinds of industry, residential and administration buildings. They are to be placed into the subsidiary switchboards or control boxes. The marking **M** specifies a type of construction with removable module. The marking of **DS** specifies a version with remote monitoring.

Type	PIIIM-320/3+1, PIIIM-320 DS/3+1	
Test class according to EN 61643-11 ed.2 and IEC 61643-1	TYPE 2, CLASS II	
Max. continuous operating voltage	$U_C$	320 V AC / 420 V DC
Max. discharge current (8/20)	$I_{max}$	50 kA
Nominal discharge current (8/20) L/N	$I_n$	20 kA
Nominal discharge current (8/20) N/PE	$I_n$	20 kA
Voltage protection level	$U_p$	< 1.45 kV
Lightning impulse current (10/350) N/PE	$I_{imp}$	20 kA
Temporary overvoltage (TOV) L/N	$U_T$	335 V/5 s
Temporary overvoltage (TOV) N/PE	$U_T$	1200 V/0.2 s
Response time L/N	$t_A$	< 25 ns
Response time N/PE	$t_A$	< 100 ns
Max. back-up fuse		160 AgL/gG
Short-circuit withstand capability	$I_p$	60 kA <sub>rms</sub>
LPZ		1-2
Housing material	Polyamid PA6, UL94 V-0	
Protection type	IP20	
Operating temperature range	J	-40°C ... +80 °C
Cross-section of the connected conductors (at tightening moment of clamps 4 Nm)	2.5 - 25 mm <sup>2</sup> (solid) 2.5 - 16 mm <sup>2</sup> (flexible) 2.5 - 16 mm <sup>2</sup> (multi-wire)	
Mounting on	DIN rail 35 mm	
Failure indication	green - ok / red - failure	
Potential free signal contact (DS) (recommended cross-section of remote monitoring max. 1 mm <sup>2</sup> )	AC: 250 V / 0.5 A, DC: 250 V / 0.1 A	
Weight	m	346 g
Article number		
PIIIM-320/3+1		27 026
PIIIM-320 DS/3+1		27 027
Varistor-based spare module		
PIIIM-320/M		27 045
GDT spare module		
B20M/M		27 049

# Surge Arrester TYPE 2 / CLASS II



**PIIIM-320/3+0**  
**PIIIM-320 DS/3+0**

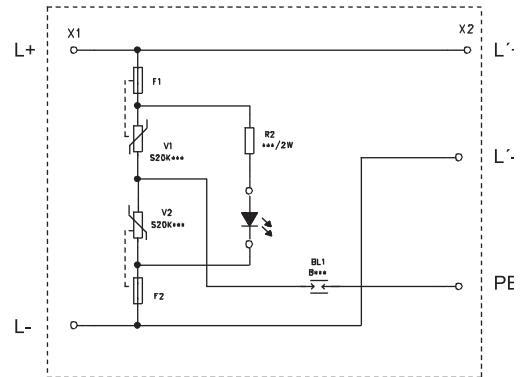
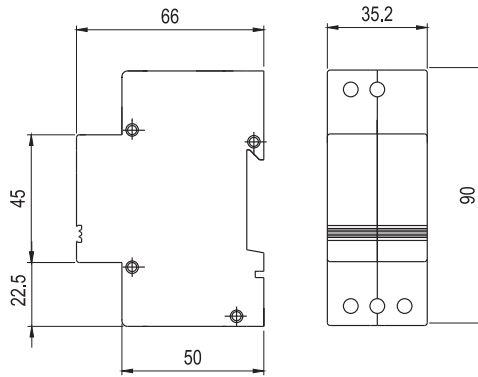


PIIIM-320/3+0 V series is a three-pole, metal oxide varistor surge arrester Type 2 & Class II according to EN 61643-11 and IEC 61643-1. These arresters are recommended for use in the Lightning Protection Zones Concept at the boundaries of LPZ 1-2 (according to IEC 1312-1 and EN 62305), where they provide the equipotential bonding and discharge of the switching overvoltage, which is generated in power supply systems entering the building. The main use of PIIIM-320/3+0 Vseries arrester is in all kinds of industry, residential and administration buildings. They are to be placed into the subsidiary switchboards or control boxes. The marking M specifies a type of construction with removable module. The marking of DS specifies a version with remote monitoring.

Type		PIIIM-320/3+0, PIIIM-320 DS/3+0
Test class according to EN 61643-11 ed.2 and IEC 61643-1		TYPE 2, CLASS II
Max. continuous operating voltage	$U_c$	320 V AC / 420 V DC
Max. discharge current (8/20)	$I_{max}$	50 kA
Nominal discharge current (8/20)	$I_n$	20 kA
Voltage protection level	$U_p$	< 1.3 kV
Temporary overvoltage (TOV)	$U_T$	335 V/5 s
Response time	$t_A$	< 25 ns
Max. back-up fuse		160 AgL/gG
Short-circuit withstand capability	$I_p$	60 kA <sub>rms</sub>
LPZ		1-2
Housing material		Polyamid PA6, UL94 V-0
Protection type		IP20
Operating temperature range	J	-40°C ... +80 °C
Cross-section of the connected conductors (at tightening moment of clamps 4 Nm)		2.5 - 25 mm <sup>2</sup> (solid) 2.5 - 16 mm <sup>2</sup> (flexible) 2.5 - 16 mm <sup>2</sup> (multi-wire)
Mounting on		DIN rail 35 mm
Failure signalisation		green - ok / red - failure
Potential free signal contact (DS) (recommended cross-section of remote monitoring max.1 mm <sup>2</sup> )		AC: 250 V / 0.5 A, DC: 250 V / 0.1 A
Weight	m	270 g
Article number		
PIIIM-320/3+0		27 032
PIIIM-320 DS/3+0		27 033
Varistor-based spare module		

# Surge Arrester

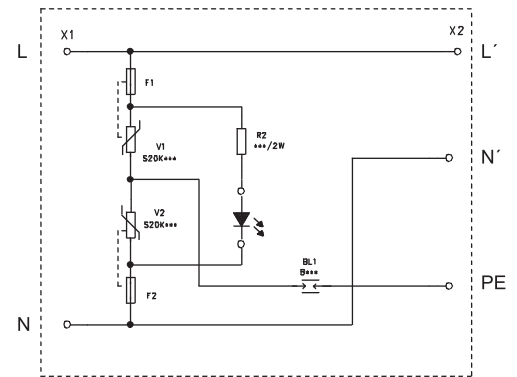
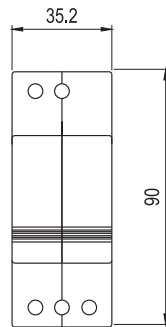
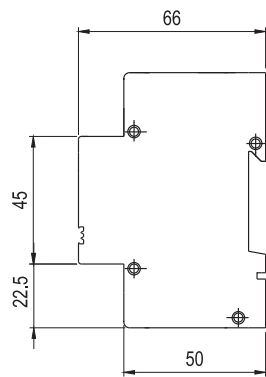
## TYPE 3 / CLASS III / DC



**P-k16/12 DC, P-k16/24 DC, P-k16/48 DC**  
**P-k16/60 DC, P-k16/110 DC**

P-k16\*DC is designed for protection of electronic appliances in L.V. power supply DC systems against the impulse surge effects. They are constructed for mounting on DIN rail 36mm for rated load currents 16A according to IEC 61643-1, EN 61643-11 and EN 62305 standards (arrester class III - 3rd stage protection). Right function of the in-built protective elements, MOV varistors, is signaled by green light on the front panel of the equipment.

Type		P-K16/12 DC	P-K16/24 DC	P-K16/48 DC	P-K16/60 DC	P-K16/110 DC
Test class according to EN 61643-11 ed.2 and IEC 61643-1		TYPE 3, CLASS III				
Network		DC				
Nominal voltage	$U_N$	12 V =	24 V =	48 V =	60 V =	110 V =
Max. continuous operating voltage	$U_C$	14.4 V =	28.8 V =	57.6 V =	72 V =	132 V =
Rated load current	$I_L$	16 A				
Combined impulse	$U_{OC}$	2 kV				6 kV
Voltage protection level at $U_{OC}$	$U_p$	< 130 V (L+/L-)	< 200 V (L+/L-)	< 370 V (L+/L-)	< 400 V (L+/L-)	< 680 V (L+/L-) < 800 V (L/PE)
Response time	$t_A$	< 25 ns (L+/L-) < 100 ns (L/PE)				
Back-up fuse		16 A				
LPZ		2-3				
Housing material		Polyamid PA6, UL94 V-0, UL94 V-0				
Protection type		IP20				
Operating temperature range	J	-40 °C ... +80 °C				
Cross-section of the connected conductors		2.5 mm <sup>2</sup> Cu				
Mounting on		DIN rail 35 mm				
Failure signalisation		light on - ok / light off - failure				
Weight	m	95 g				
Article number		30 001	30 002	30 014	30 018	30 020



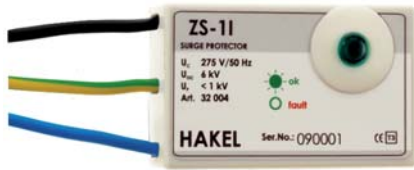
**P-k16/110 AC**  
**P-k16/230 AC**

P-k16\*AC is designed for protection of electronic appliances in L.V. power supply AC systems against the impulse surge effects. They are constructed for mounting on DIN rail 36mm for rated load currents 16A according to IEC 61643-1, EN 61643-11 and EN 62305 standards (arrester class III - 3rd stage protection). Right function of the in-built protective elements, MOV varistors, is signaled by green light on the front panel of the equipment.

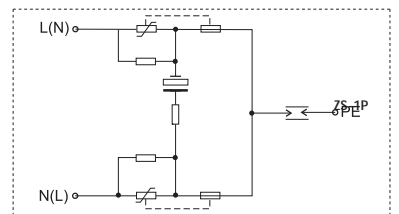
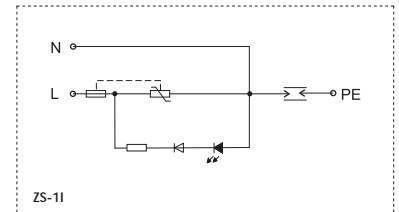
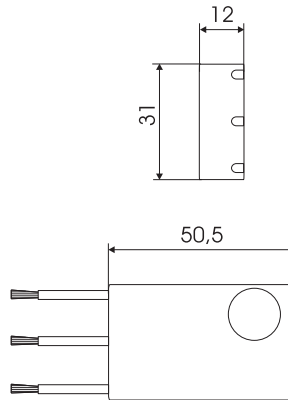
Type		P-K16/110 AC	P-K16/230 AC
Test class according to EN 61643-11 ed.2 and IEC 61643-1		TYPE 3, CLASS III	
Network		AC	
Nominal voltage	$U_N$	110 V AC	230 V AC
Max. continuous operating voltage	$U_C$	132 V AC	275 V AC
Rated load current	$I_L$	16 A	
Combined impulse	$U_{OC}$	6 kV	
Voltage protection level at $U_{OC}$	$U_P$	< 850 V (L/N) < 800 V (L,N/PE)	< 1300 V (L/N) < 1200 V (L,N/PE)
Response time	$t_A$	< 25 ns (L/N) < 100 ns (L,N/PE)	
Back-up fuse		16 A	
Temporary overvoltage (TOV)	$U_T$	-	335 V / 5 s (L/N) 1200 V + $U_0$ / 0.2 s (L/PE)
LPZ		2-3	
Housing material		Polyamid PA6, UL94 V-0, UL94 V-0	
Protection type		IP20	
Operating temperature range	J	-40°C ... +80 °C	
Cross-section of the connected conductors		2.5 mm <sup>2</sup> Cu	
Mounting on		DIN rail 35 mm	
Failure signalisation		light on - ok / light off - failure	
Weight	m	95 g	
Article number		30 015	30 008

# Surge Arrester

## TYPE 3 / CLASS III



ZS-11  
ZS-1P

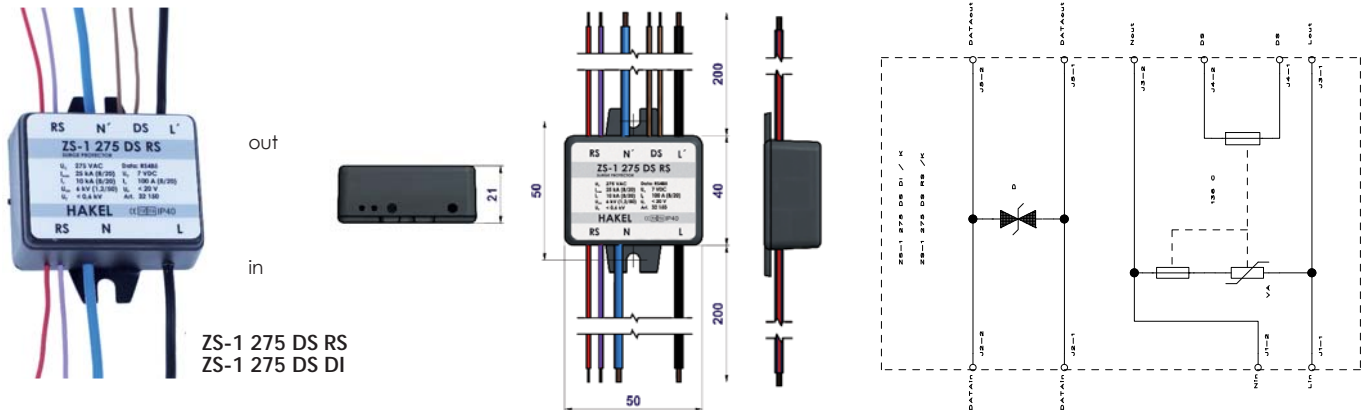


ZS-11, ZS-1P are the surge arresters type 3 & Class III according to EN 61643-11 and IEC 61643-1 and IEC 61643-1 designed for installation into electrical installation systems, e.g.: cable ducts and flush-mounted sockets as an additional protection. These devices are suitable supplements of socket distribution which are protected by PI-k protector. The right function of ZS-11 type is indicated by green LED diode. When the indicator is dark, the device must be replaced or technically checked. ZS-1P contains an acoustic fault indicator (buzzer).

Type		ZS-11	ZS-1P
Test class according to EN 61643-11 ed.2 and IEC 61643-1		TYPE 3, CLASS III	
Nominal voltage	$U_N$	230 V AC	
Max. continuous operating voltage	$U_C$	275 V AC	
Nominal discharge current $I_n(8/20)$	$I_n$	3 kA (L/N), L(N)/PE	
Combined impulse	$U_{OC}$	6 kV (L/N,L(N)/PE)	
Voltage protection level at $U_{OC}$	$U_P$	< 1 kV (L/N) < 1.2 kV (L(N)/PE)	< 1.3 kV (L/N) < 1 kV (L(N)/PE)
Response time	$t_A$	< 25 ns (L/N) < 100 ns (L/PE, N/PE)	
Back-up fuse		16 A	
Temporary overvoltage (TOV)	$U_T$	335 V / 5 s (L/N) 1200 V + $U_0$ / 200 ms (L/PE)	
LPZ		2-3	
Housing material		Polyamid PA6, UL94 V-0	
Protection type		IP20	
Operating temperature range	J	-40 °C ... +80 °C	
Failure signalisation		light on - ok / light off - failure	inbuilt piezosiren
Weight	m	20 g	30 g
Article number		32 004	32 006

# Surge Arrester for LED Lighting

## TYPE 2 + 3 / CLASS II+III



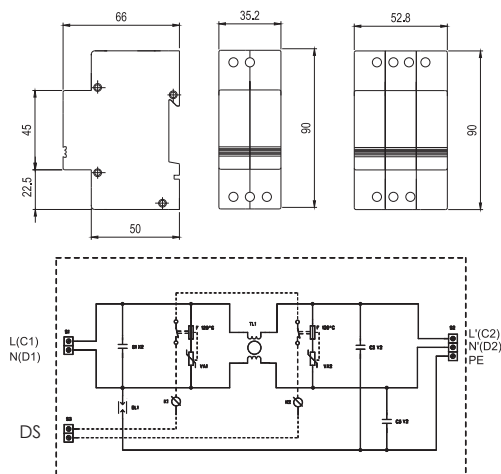
**ZS-1 275 DS RS and ZS-1 275 DS DI** are surge arresters Type 2+3 & Class II + III (TYPE 3 protects the device only to 5m lead) according to EN 61643-11 and EN 62305 designed for LED lighting protection for installations largely e.g. in tunnels, properties and premises, street lights etc. Efficiently protect both the input supply voltage and the data communication lines for the remote control of lighting fixture (protocol RS485 eventually DALI (DI) ). Both types are equipped with the internal disconnecting signal contacts (DS), which are activated when the inbuilt varistor overheats above 136 °C. The way to connect to a given application is by the pull-wire terminals.

Type		ZS-1 275 DS RS	ZS-1 275 DS DI
Nominal voltage	$U_N$		230 V AC
Max. continuous operating voltage	$U_C$		275 V AC
Max. discharge current (8/20)	$I_{max}$		25 kA
Nominal discharge current (8/20)	$I_n$		10 kA
Combined impulse	$U_{OC}$		6 kV
Voltage protection level at $I_n$	$U_p$		< 0.65 kV
Voltage protection level at $U_{OC}$	$U_p$		< 0.6 kV
Response time	$t_A$		< 25 ns
Max. backup fuse			16 A
Temporary overvoltage TOV	$U_T$		335V/5 s
Fault indication (DS)		potential free contact max. 230 V AC/0.5 A 230VAC/0.5 A	
IP code		IP45 (standard) IP65 (only on special request)	
Data part			
- max. continuous operating voltage	$U_C$	7 VDC	28 VDC
- max. discharge current	$I_{FSM}$	200 A/8.3 ms	200 A/8.3 ms
- Nominal discharge current (8/20)	$I_n$	100 A	100 A
- Voltage protection level at $I_n$	$U_p$	< 20 V	< 40 V
- Protocol of data transmission		RS 485	DALI
Weight	m	55 g	
Length of supply lead	l	200 mm (conductor 1.5 mm <sup>2</sup> and conductor 0.35 mm <sup>2</sup> )	
Recommended working/position		any	
Mounting on		wall mounted or plate mounted by two screws o 4 mm	
Article number (IP45 version)		32 150	32152
Article number (IP65 version)		32 154	32155

# Surge Arrester TYPE 3 / CLASS III



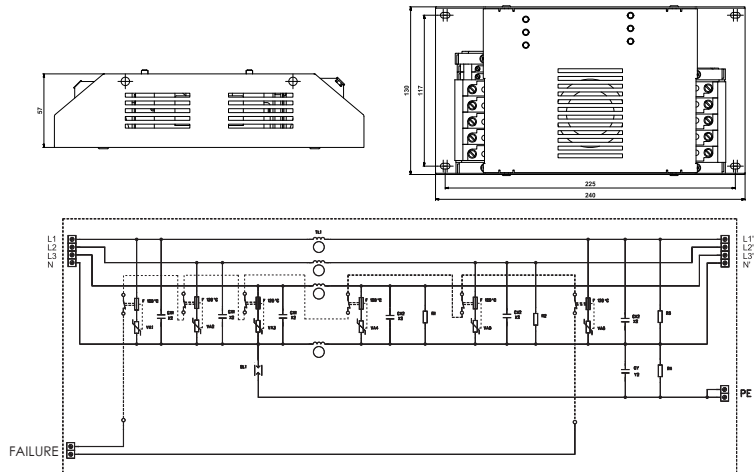
PI-k8  
PI-k8 DS



PI-k8 is a single-phase surge arrester type 3 & Class III, which is equipped with high-frequency filter, according to EN 61643-11 and IEC 61643-1. It is intended for use in the power supply lines, which are operated as TN-S system. The arrester PI-k8 is constructed for mounting on DIN rail 35mm and designed for protection of single-phase electronic appliances in L.V. power supply systems against the transient surge and high-frequency disturbance. The type PI-k8 is fitted with a light indicator signalling the right function (green LED diode), type PI-k8 DS indicates the failure by target disconnection of mechanical thermal fuse. They can be manufactured in a comprehensive range of the Nominal voltages  $U_N = 6, 12, 24, 48, 60, 80, 110, 120, 130, 160$  and 230V (AC/DC). Wide range of surge filters are manufactured - 8A, 16A, 25A, 32A, 50A, 63A, 80A, 120A, 150A, etc.

Type		PI-k8, PI-k8 DS
Test class according to EN 61643-11 ed.2 and IEC 61643-1		TYPE 3, CLASS III
Nominal voltage	$U_N$	230 V AC
Max. continuous operating voltage	$U_C$	275 V AC
Rated load current	$I_L$	8 A
Nominal discharge current $I_n(8/20)$	$I_n$	3 kA (L/N, L/PE), 5 kA (N/PE)
Combined impulse	$U_{OC}$	6 kV (L/N,L/PE), 10 kV (N/PE)
Voltage protection level at $U_{OC}$	$U_p$	< 850 V (L/N) < 1.5 kV (L/PE) < 1.2 kV (N/PE)
Asymmetrical attenuation of filter (band-stop filter)		min. 80 dB at 4 MHz min. 40 dB (0.15 - 30 MHz)
Filters constants	$C_x$ $C_y$ $L$	150 nF 22 nF 1.2 mH
Power loss at winding temp. 20 °C		< 2.2 W
Response time	$t_A$	< 25 ns (L/N) < 100 ns (L/PE, N/PE)
Back-up fuse		8 A
LPZ		2-3
Housing material		Polyamid PA6, UL94 V-0
Protection type		IP20
Operating temperature range	J	-40 °C ... +55 °C
Cross-section of the connected conductors		2.5 mm <sup>2</sup> Cu
Mounting on		DIN rail 35 mm
Failure signalisation PI-k8		light on - ok / light off - failure
Failure signalisation PI-k8 DS		pushed in - ok / pushed out - failure
Potential free release contact (DS) (recommended cross-section of remote monitoring max.1 mm <sup>2</sup> )		AC: 250 V / 0.5 A, DC: 250 V / 0.1 A
Weight	m	130 g, 170 g
Article number		
PI-k8		30 080
PI-k8 DS		30 082

# Surge Arrester + EMC / EMI Filter TYPE 3 / CLASS III



PI-3k32, PI-3k50  
PI-3k63, PI-3k80

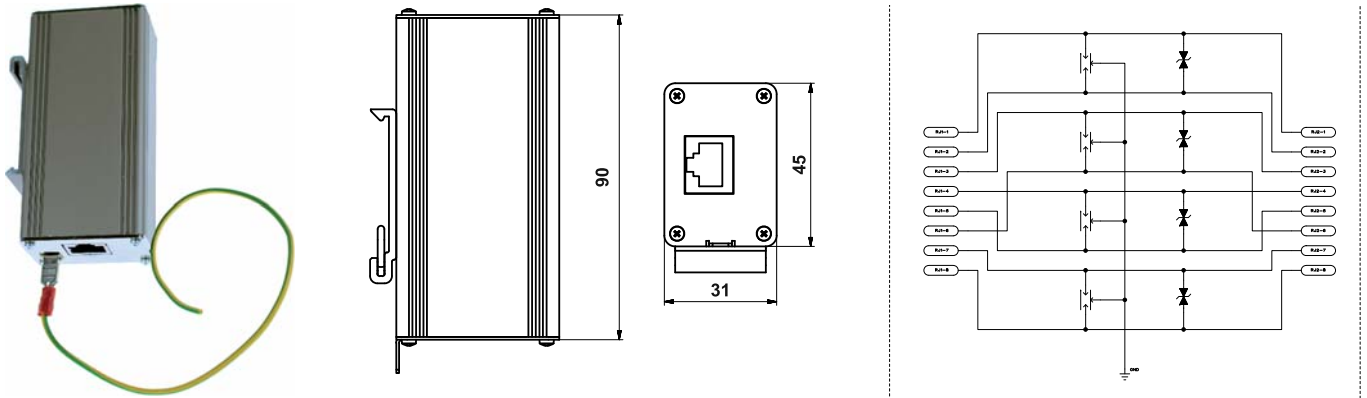
PI-3k is a three-phase surge arrester type 3 & Class III, which is equipped with high-frequency filter, according to EN 61643-11 and IEC 61643-1. It is intended for use in the power supply lines, which are operated as TN-S system. PI-3k120 is designed for protection of three-phase electronic appliances in L.V. power supply systems against the transient overvoltage and high-frequency disturbance. The function failure of varistors is indicated by target disconnection of mechanical thermal fuses which react to the varistors overheating above 120 °C. They can be manufactured in a comprehensive range of 16A, 25A, 32A, 50A, 63A, 80A, 120A, 250A, 400A, etc.

Type		PI-3k32	PI-3k50	PI-3k63	PI-3k80
Test class according to EN 61643-11 ed.2 and IEC 61643-1		TYPE 3, CLASS III			
Nominal voltage	$U_N$	3 x 230 / 400 V AC			
Max. continuous operating voltage	$U_C$	3 x 275 / 480 V AC			
Rated load current	$I_L$	32 A	50 A	63 A	80 A
Nominal discharge current $I_n(8/20)$	$I_n$	3 kA (L/N, L/PE), 5 kA (N/PE)			
Combined impulse	$U_{OC}$	6 kV (L/N, L/PE), 10 kV (N/PE)			
Voltage protection level at $U_{OC}$	$U_p$	< 850 V (L/N) < 1.5 kV (L/PE) < 1.2 kV (N/PE)			
Asymmetrical attenuation of filter (band-stop filter)		min. 80 dB at 2 MHz min. 40 dB (0.15 - 30 MHz)	min. 80 dB at 1.5 MHz min. 40 dB (0.15 - 30 MHz)	min. 80 dB at 2 MHz min. 40 dB (0.15 - 30 MHz)	min. 80 dB at 1.5 MHz min. 40 dB (0.15 - 30 MHz)
Filters constants	$C_{x1}$ $C_{x2}$ $C_y$ L			M15 M68 2 x 47 nF	
Power loss at winding temp. 20 °C		< 8 W	< 9 W	< 8 W	< 15 W
Response time	$t_A$	< 25 ns (L/N), < 100 ns (L/PE, N/PE)			
Back-up fuse		32 A	50 A	63 A	80 A
LPZ		2-3			
Housing material		metal plate 0.8 mm			
Protection type		IP20			
Operating temperature range	J	-40 °C ... +55 °C			
Cross-section of the connected conductors		6 mm <sup>2</sup> Cu	10 mm <sup>2</sup> Cu	16 mm <sup>2</sup> Cu	25 mm <sup>2</sup> Cu
Mounting on		DIN rail 35 mm or by screws M4 on chassis			
Failure signalisation		pushed in - ok / pushed out - failure			
Potential free release contact (DS) (recommended cross-section of remote monitoring max. 1 mm <sup>2</sup> )		AC: 250 V / 0.5 A, DC: 250 V / 0.1 A			
Weight	m	1500 g	1600 g	1600 g	1730 g
Article number		30 301	30 305	30 303	30 302



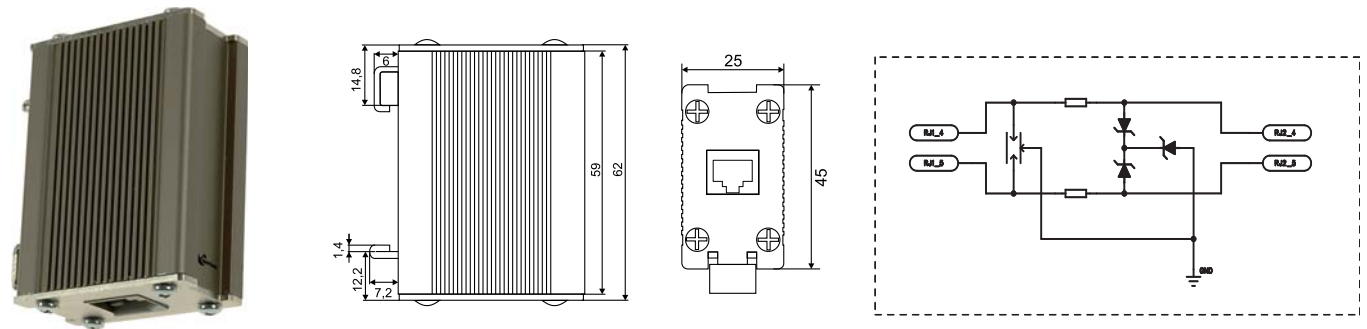
# Surge Protection Devices for Information Technology Systems

## HT-NET PoE 6cat X series



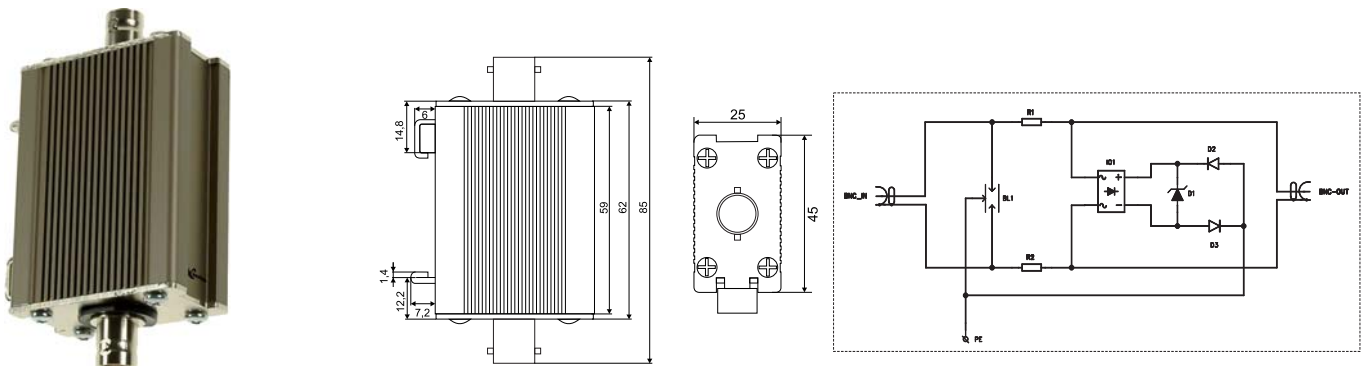
These surge protection devices intended for computer networks are specially designed for securing a faultless data transfer within computer networks category 6. They protect input electronic circuits of network cards against damage caused by surge effects in the Lightning Protection Zones Concept at the boundaries of LPZ 1-2 according to EN 62305. It is recommended to use these protection devices at the input of protected equipment.

## HT-TEL X series



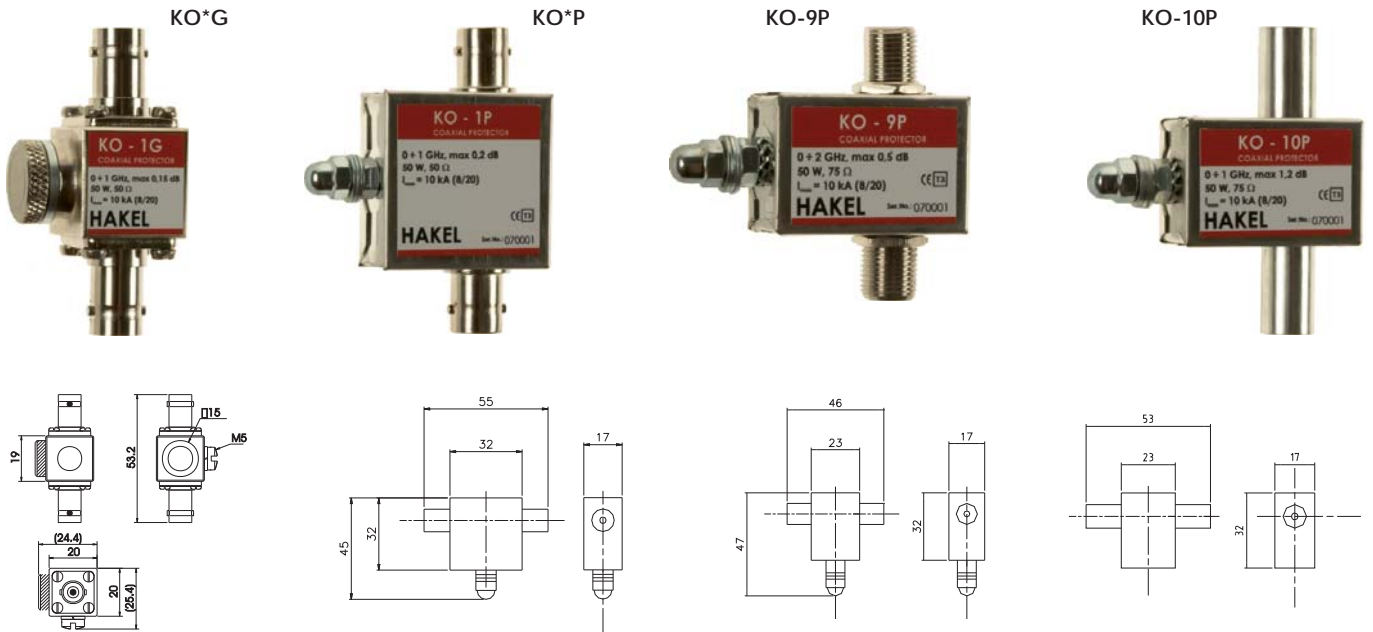
Hakel Transmition-TEL is designed to protect telecommunications equipment. The casing of this protector is made out of light alloy, which ensures high mechanical and thermal resistance.  $I_{max} = 2 \text{ kA}$ . It is recommended for use in the Lightning Protection Zones Concept at the boundaries of LPZ 1-2-3 according to EN 62305.

## HT-CCTV 6 X series HT-CCTV 12 X series



Hakel Transmition-CCTV is designed to protect video transmission equipment, which process the transferred video signal. The casing of this protector is made out of light alloy, which ensures high mechanical and thermal resistance.  $I_{max} = 5 \text{ kA}$ . It is recommended for use in the Lightning Protection Zones Concept at the boundaries of LPZ 1-2-3 according to EN 62305.

# Coaxial Surge Arrester



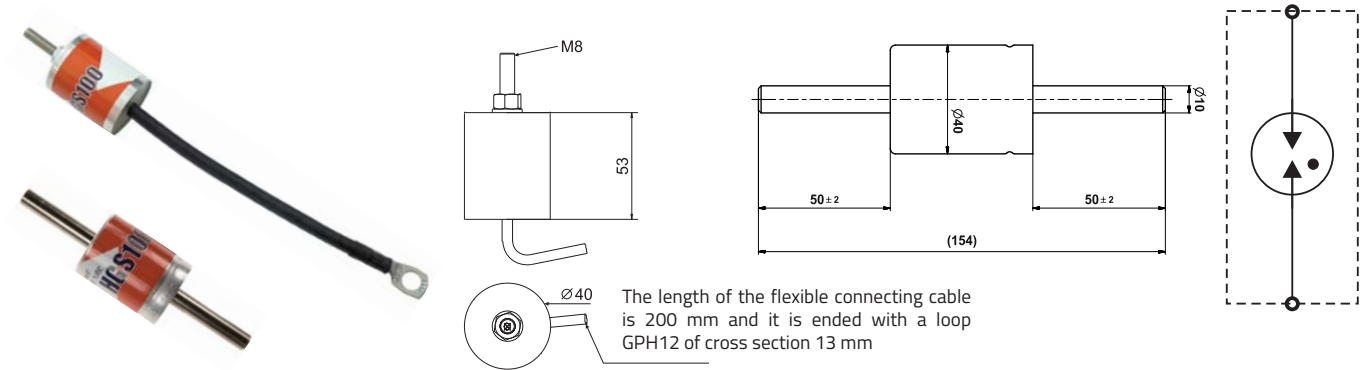
KO\* is an innovated coaxial high-frequency protection range designed for protection of equipment connected to an aerial system by means of coaxial cables. Special gas discharge tubes with maximum discharge current  $I_{max}(8/20) = 10kA$  (or 20 kA in case of KO-5GN) ensure a reliable protection of the receiving and transmitting systems even against a lightning stroke nearby. Hakel company offers a wide range of coaxial protectors for various connector types and transmission power grades enabling usage in many applications. These coaxial protectors are recommended for use in the Lightning Protection Zones Concept at the boundaries of LPZ  $O_{A(B)}$  -1 and higher according to EN 62305.



KO\* is an innovated coaxial high-frequency protection range designed for protection of equipment connected to an aerial system by means of coaxial cables. Special gas discharge tubes with maximum discharge current  $I_{max}(8/20) = 10kA$  (or 20 kA in case of KO-5GN) ensure a reliable protection of the receiving and transmitting systems even against a lightning stroke nearby. Hakel company offers a wide range of coaxial protectors for various connector types and transmission power grades enabling usage in many applications. These coaxial protectors are recommended for use in the Lightning Protection Zones Concept at the boundaries of LPZ  $O_{A(B)}$  -1 and higher according to EN 62305.

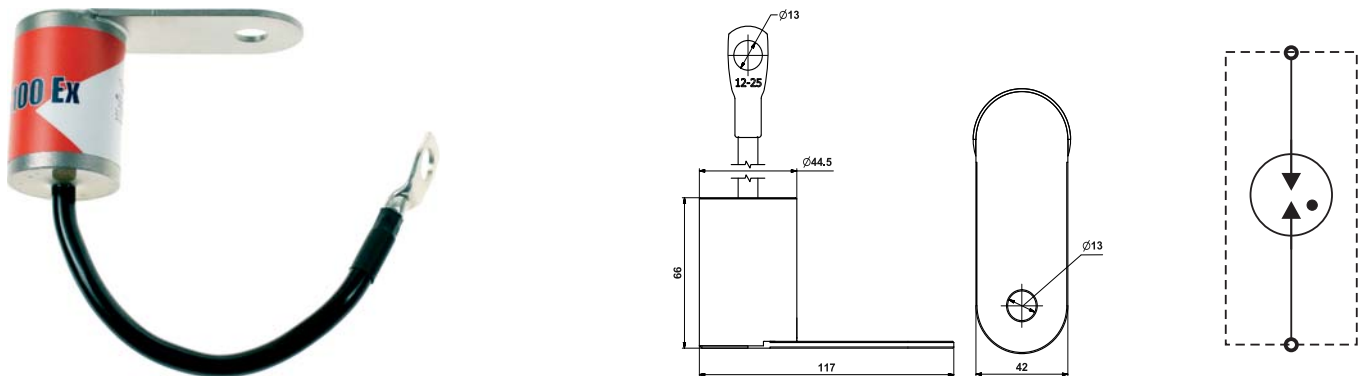
## Surge Protection Device for Equipotential Bonding

HGS100  
HGS100 EB



HGS100 and HGS100 EB are a separating high power gas discharge tubes intended for equipotential bonding of an installation parts of buildings, which are not interconnected. In case of origin of p.d. (potential difference) between those parts, the high power gas discharge tube ignites and interconnects both parts for a transient time (typical value of internal resistance at startup of HGS100 is 0,001 - 0,002  $\Omega$ ). Recommended installation is inside of the buildings, outdoors, in the damp rooms as well as in the subterraneous areas. For lightning protection equipotential bonding in accordance with IEC 61024-1 as well as for the use in IT - installations in accordance with IEC 60364-5-54.

HGS100 Ex



HGS100 Ex - Separating high power gas discharge tube HGS100 Ex for use in explosion hazards areas. It is intended for equipotential bonding of the installation parts of buildings or technological entities which are not interconnected operationally. In case of p.d. (potential difference) origin between those parts, the high power gas discharge tube ignites and interconnects both parts for a transient time (typical value of internal resistance at startup of HGS100 Ex is 0,001 - 0,002  $\Omega$ ). Recommended installation is inside of the buildings, outdoors, in the damp rooms as well as in the subterraneous areas.

It is an explosion-proof gas discharge tube with flexible connecting cable for equipotential bonding acc. to IEC 61024-1 and also for the use in IT installations acc. to IEC 60364-5-54. It complies with EN 50014 and EN 50028 standards. It is recommended for insulated flanges and insulated screw joints bridging in cathodic protected parts of industrial technology.



# ISOLGUARD<sup>®</sup>

insulation monitoring device

Hakel is a dynamic company since 1994 has quickly developed in terms of turnover and the product assortment. This dynamism can also be observed in the approach to developing the quality of the manufacturing products.

Hakel experience in the use of power electronics in industry, is related to its leading position in the Czech Republic and Europe. Hakel produces and exports to all countries and all continents.

The insulation monitoring devices offered by the company are used for easy application in ungrounded IT power supply systems in metallurgy, civil engineering, shipbuilding, in hospitals and the transport environment.

for more information please visit: [www.isolguard.com](http://www.isolguard.com)



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