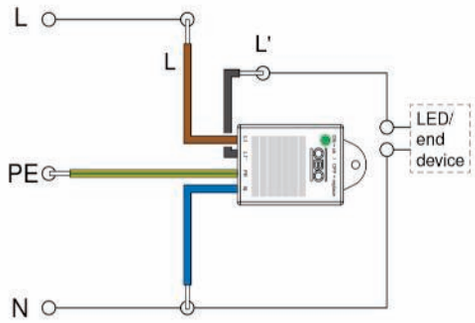


Guide

Surge protection for LED lighting systems
for street, interior and exterior lighting

Building Connections

OBO BETTERMANN

Contents

This guide is based on the currently known and valid rules and regulations and on our experience.
The contents are not legally binding and make no claim to completeness.

1. Basic principles

Surge voltages in power supply systems can be triggered by various causes and lead to damage or the failure of LED lighting systems. Lightning and switching operations generally cause surge voltages of up to several ten of thousands of volts, which is considerably higher than the named rated surge voltage resistances of LED luminaires.

Street luminaires are directly exposed to close and distant lightning strikes and surge voltages, on account of their exposed position. Neon lighting and exterior lighting are subject to the same dangers, depending on the lightning protection zone. These loads can lead to a reduction in the luminous intensity or to the destruction of the luminaires.

In industrial and sports halls, the luminaires are installed at a great height. In the event of damage, the minimum required illuminance may not be achieved if the luminaires fail, which can lead to danger or even accidents. This must be rectified immediately. The replacement of the defective components, alongside the hardware costs, also incurs high costs through the use of elevating platforms and personnel.

In order to prevent this damage and thus ensure the operation of the systems, suitable surge protection devices (SPDs) must be used.

Furthermore, the IEC 60364-1 requires protection against lightning and surge voltages for people, livestock and property. The protection requirement against the effects of lightning can be determined through a risk analysis according to the lightning protection standard IEC 62305.

The luminaire standard IEC 60598-1 Luminaires – Part 1: "General Requirements and Tests", Point 4.32 specifies: "Surge protection devices must meet IEC 61643-11." Of decisive importance for the protection action is that the protection level of the surge protective device is below the surge voltage resistance of the lights and the LED driver.

LED lighting

1 Street lighting

2 Exterior lighting – neon lighting

3 Exterior lighting – car park

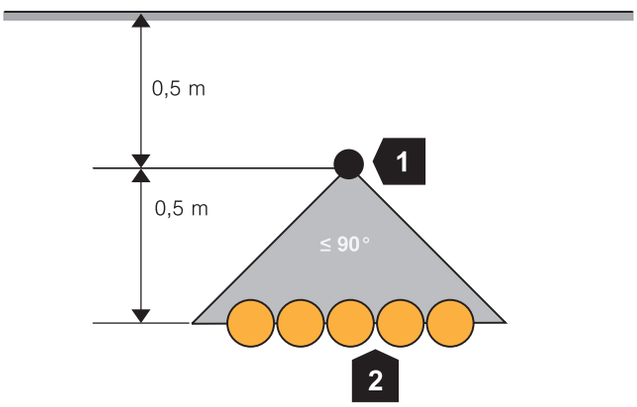
4 Internal lighting

2. LED street lighting

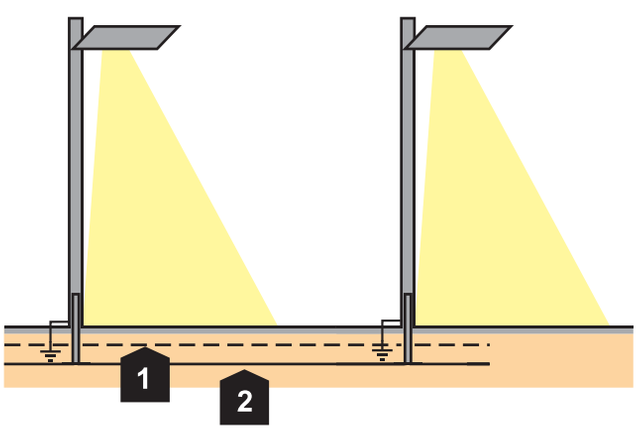
Street and car park lighting: Creation of the earthing systems

In a new installation, the supply cable can be protected against destruction from lightning currents in the earth by an optional earthing cable above it. According to the current lightning protection standard VDE 0185-305-3 German supplement 2 (IEC 62305-3), this earthing cable must be located 0.5 metres above the supply cable. The earthing cable compensates potential differences and minimises arcing to the supply cable. The protection angle of the earthing cable must not exceed 90°.

The additional earthing of the lamp mast should be undertaken in areas with an increased number of people, e.g. in car parks or at transport stops (lighting class CE0 to CE5).



Carried earthing cable



Cable routing and earthing on the luminaire mast

Earthing on the lamp mast, e.g. lighting class CE5

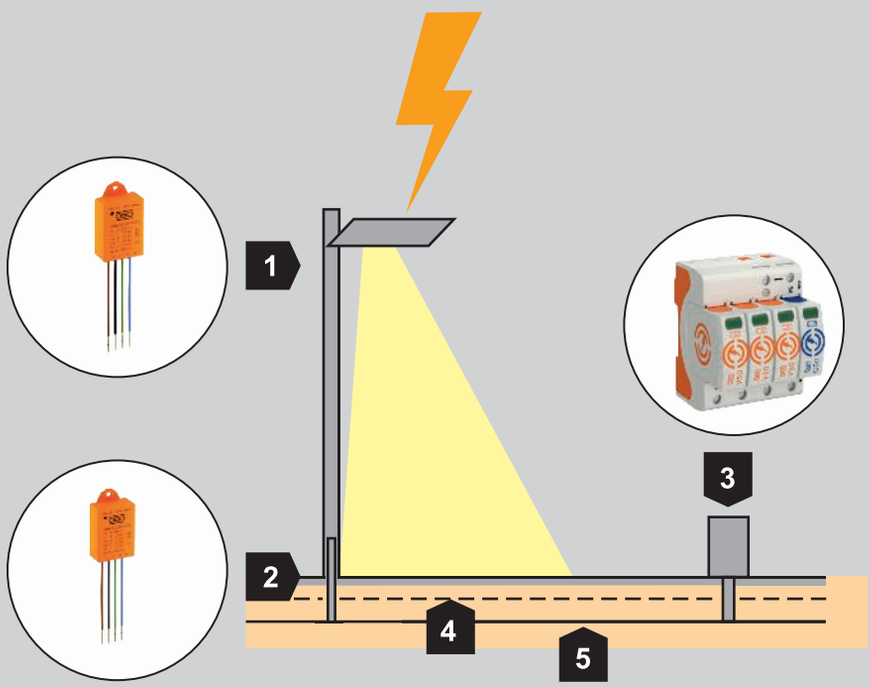
1	Earthing cable, uninsulated
2	Supply cable

Streetlights: Surge protection

Streetlights are supplied from the control cabinet or the street's main distributor. Surge voltages from the supply network can be tapped centrally here before they reach the individual luminaires. Surge protection as a barrier in this distributor is an economically sensible investment. Using additional SPDs as close as possible to the luminaire also increases availability and service life. Installation in the mast connection compartment, in contrast to installation in the lamp head, offers simple device mounting, maintenance and, if necessary, easy replacement.

Direct lightning strike

If there is a lightning strike in the mast luminaire, a large portion of the lightning current will flow directly into the earth, creating a potential difference to the supply cable. In this case, a combination arrester with high lightning current carrying capacity in the control cabinet can dissipate these powerful currents and protect any downstream luminaires. Because the direct lightning strike can only be tackled with an insulated air-termination system, the failure of directly affected luminaires is often consciously accepted. Surge protective devices (SPDs) in the mast, control cabinet and main distributor minimise the spread of surge voltages and reduce further damage.



	Installation location	Description	Protective device	Item no.
1	Lamp head with LED system, before the LED driver	Surge protection type 2 + 3	ÜSM-20-230I1P+PE	5092431
2	Connection compartment of the mast luminaire (recommended)	Surge protection type 2 + 3	ÜSM-20-230I1P+PE	5092431
3	Control cabinet with electronics, 1-phase/3-phase supply	Surge protection type 1 + 2	V50-1+NPE-280 V50-3+NPE-280	5093522 5093526
4	Earthing cable, uninsulated	Flat or round conductor	Flat conductor, stainless steel Round conductor, stainless steel	5018730 5021640
5	Supply cable			

LED surge protection for direct lightning strike to the mast luminaire

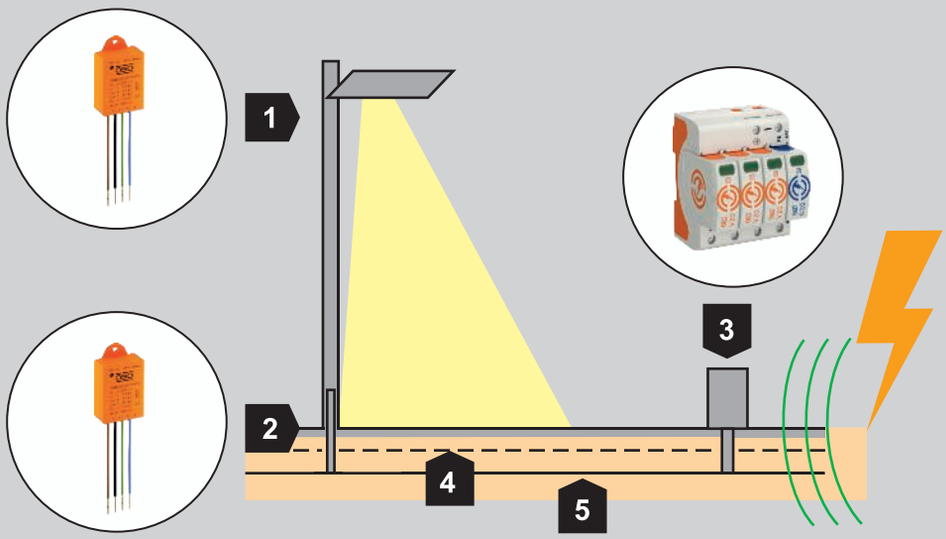
Remote strike and inductive coupling

A lightning strike within 2 km generates a surge voltage that reaches the luminaire via the supply cable. These surge voltages have less energy than the direct lightning strike, but can still destroy electronic components. The surge voltage pulses along cables from the supply network can also be diverted centrally by a surge arrester in the control cabinet. In this case, the luminaire is directly protected by surge protection in the mast connection compartment, which is easily accessible and easy to check. Inductive couplings are considerably reduced through a metallic mast and a luminaire with a metallic housing.

Surge protection for stringent requirements

The cast protective device ÜSM-20-230I1PE65, which has the IP 65 protection rating, can be used when refitting the LED surge protection in harsh environmental conditions. Due to the high protection rating, the device can also be installed outside the distributor box.

The different connection options for all devices are shown in Chapter 5, "Connecting protective devices".



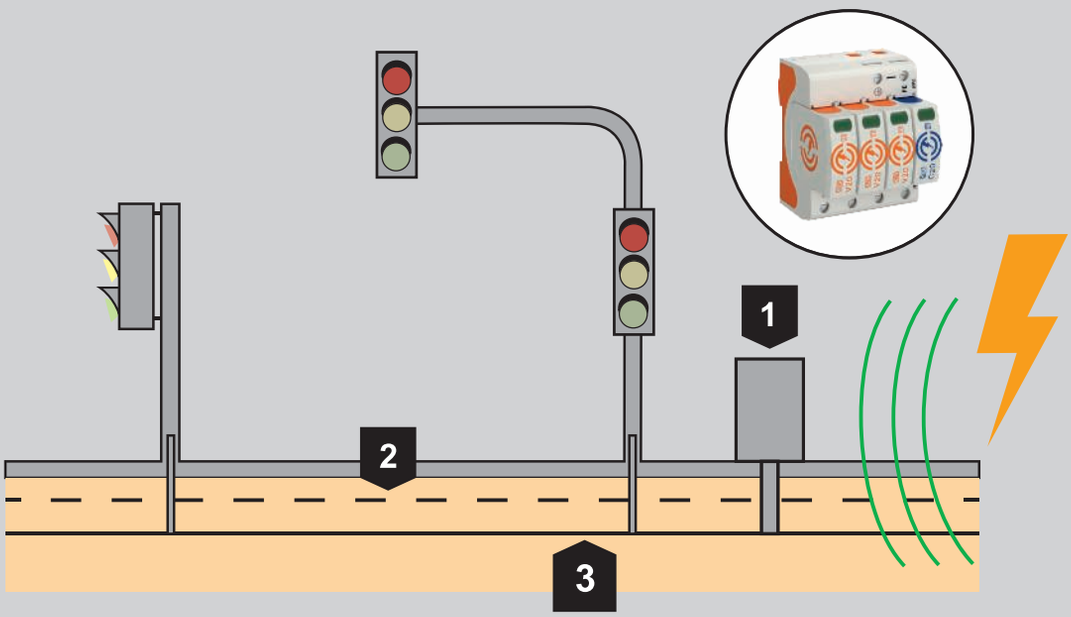
	Installation location	Description	Protective device	Item no.
1	Lamp head with LED system, before the LED driver	Surge protection type 2 + 3	ÜSM-20-230I1P+PE	5092431
2	Connection compartment of the mast luminaire (recommended)	Surge protection type 2 + 3	ÜSM-20-230I1P+PE	5092431
3	Control cabinet with electronics, 1-phase/3-phase supply	Surge protection type 2	V20 1+NPE-280 V20 3+NPE-280	5095251 5095253
4	Earthing cable, uninsulated	Flat or round conductor	Flat conductor, stainless steel Round conductor, stainless steel	5018730 5021640
5	Supply cable			

LED surge protection for remote strike and inductive coupling

3. LED light signal systems

In addition to street lighting, light signal systems are also at risk from lightning and surge voltages. Systems in urban areas or in the immediate vicinity of tall buildings are mainly at risk from surge voltages from switching operations or inductive coupling of remote lightning strikes. Since light signal systems are controlled and supplied by a main street distributor, it is possible to prevent surge voltages reaching the LED luminaires of the light signal system right at this point. For this purpose, a surge protective device of at least type 2 should be used in the control cabinet. Alternatively, a combination arrester type 1+2 can also be used.

For light signal systems with a remote maintenance system, it is recommended to use SPDs with a remote signalling contact that can be integrated into the system. This means that a defective device is recognised immediately and can be replaced promptly. The system is then optimally protected at all times.

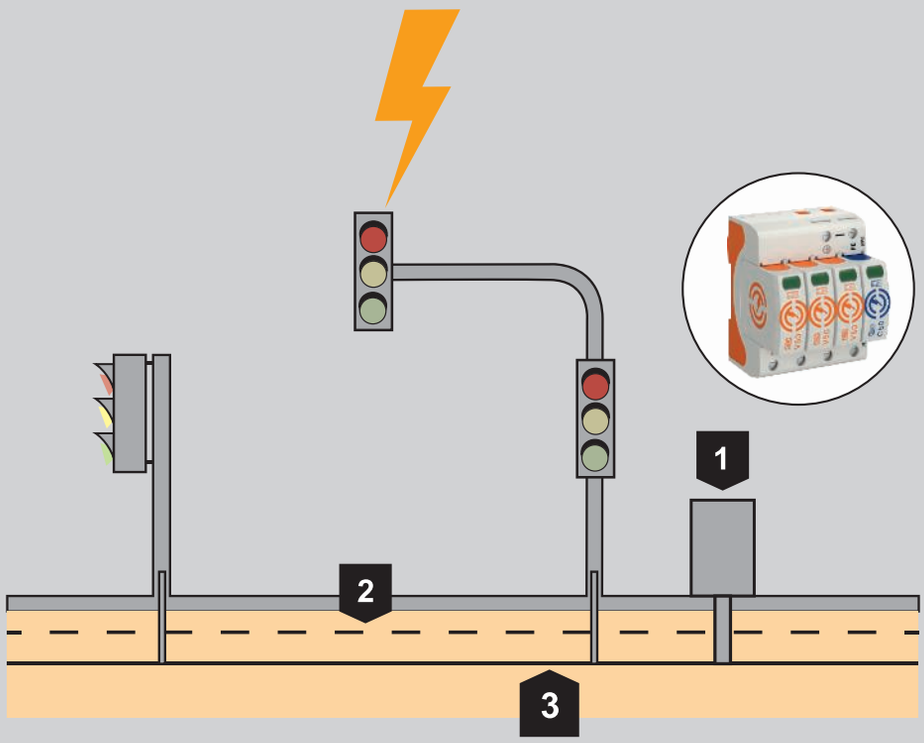


	Installation location	Description	Protective device	Item no.
1	Control cabinet (urban)	Surge protection type 2	V20-1+NPE V20-3+NPE V20-1+NPE+FS V20-3+NPE+FS	5095251 5095253 5095331 5095333
2	Earthing cable, uninsulated	Flat or round conductor	Flat conductor, stainless steel Round conductor, stainless steel	5018730 5021640
3	Supply cable			

LED surge protection for light signal systems in urban areas

Direct lightning strike
Direct lightning strikes mainly affect systems in open spaces without surrounding buildings.

Since protection against direct strikes can be time-consuming to implement and is associated with high costs, damage to the affected mast is often accepted. In order to effectively minimise the further spread of surge voltages, an appropriate surge protection device of at least type 1, but preferably type 1+2, should be used in this system in the control cabinet.

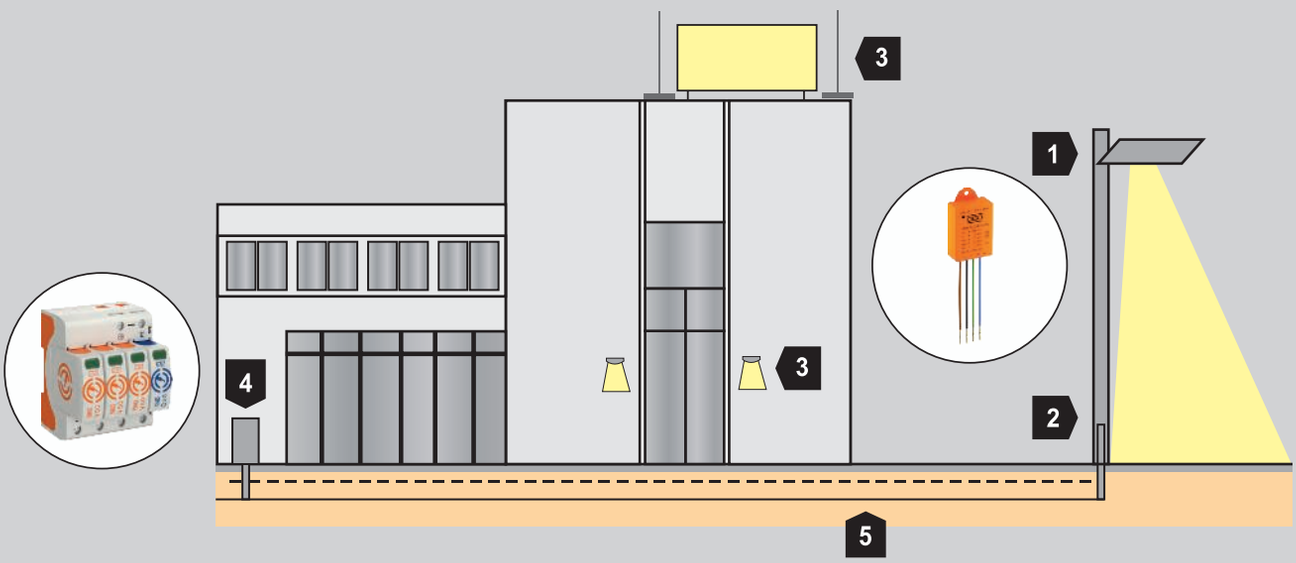


	Installation location	Description	Protective device	Item no.
1	Control cabinet (urban)	Surge protection type 1+2	V50-1+NPE V50-3+NPE V50-1+NPE+FS V50-3+NPE+FS	5093522 5093526 5093531 5093533
2	Earthing cable, uninsulated	Flat or round conductor	Flat conductor, stainless steel Round conductor, stainless steel	5018730 5021640
3	Supply cable			

4. LED exterior lighting

In order to minimise the damage caused by surge voltages, surge protection must be provided at the building entry in accordance with IEC 60364-4-44. If the building has an external lightning protection system or if streets are electrically supplied from buildings, then equipotential bonding using combination arrester with suitable lightning current carrying capacity must be carried out at the building entry. For buildings with lightning protection systems, it must also be ensured that the LED exterior lightning is located in the protection angle of the lightning protection system. A risk analysis according to IEC 62305 can be used to determine whether an external lightning protection system is required or not.

To protect the LED luminaires, a further surge protective device should be installed directly in front of luminaires if the cable is longer than 10 m.



	Installation location	Description	Protective device	Item no.
1	Lamp head with LED system, before the LED driver	Surge protection type 2 + 3	ÜSM-20-230I1P+PE	5092431
2	Connection compartment of the mast luminaire (recommended)	Surge protection type 2 + 3	ÜSM-20-230I1P+PE	5092431
3	Before the LED driver	Surge protection type 2 + 3	ÜSM-20-230I1P+PE	5092431
4	Infeed point	Surge protection type 1 + 2	V50-3+NPE-280	5093526
5	Supply cable			

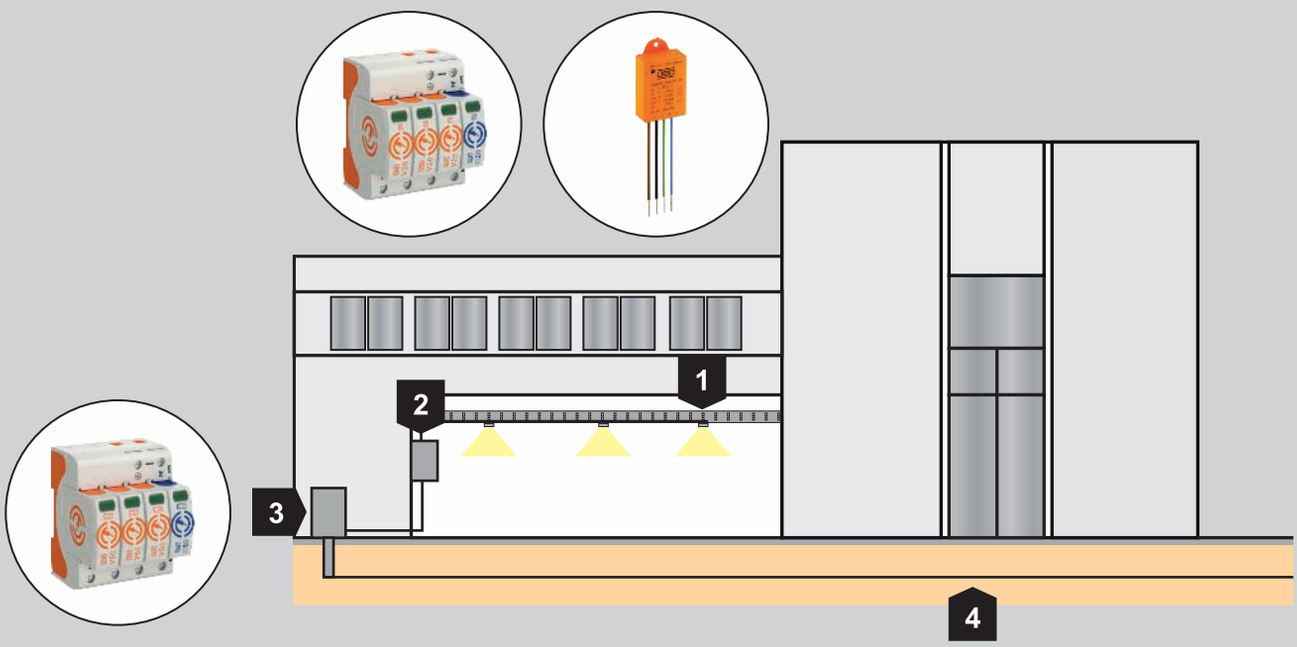
LED surge protection for buildings with an external lightning protection system and LED exterior lighting

5. LED interior lighting

LED lighting systems in industrial plants and administrative buildings are usually destroyed by high voltages, coupled inductively or by switching operations.

Therefore, surge protection must be installed for the entire lighting system. The usually very long supply lines from the main distributor to the sub-distributor for the lighting have a high potential for the inductive coupling of surge voltages. Type 2 surge protective devices must therefore be used in the sub-distributor to be supplied.

However, the luminaires are often more than 10 m from this distributor. To protect the LED drivers and the light, a protective device is then required directly in front of the electronic components. If the luminaires are, for example, mounted directly beneath the cable support systems, then the surge protection can also be inserted in a junction box in front of the luminaires. To use the shielding function of the metallic cable support systems, these must be included in the equipotential bonding on both sides.



	Installation location	Description	Protective device	Item no.
1	Lamp head with LED system, before the LED driver	Surge protection type 2+3	ÜSM-20-230I1P+PE	5092431
2	Subdistributor	Surge protection type 2	V20-3+NPE-280	5095253
3	Infeed point/main distributor	Surge protection type 1	V50-3+NPE-280	5093526
4	Supply cable			

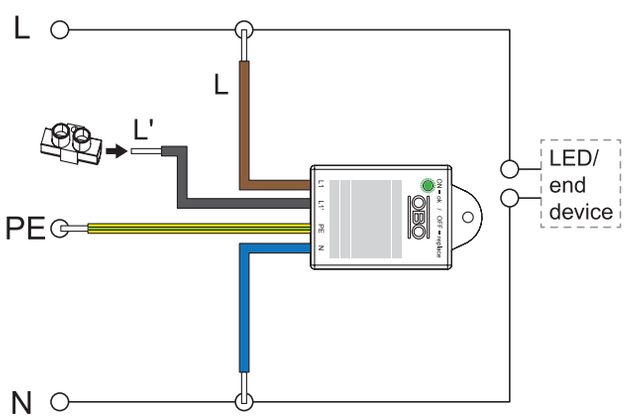
LED surge protection for buildings with an external lightning protection system and LED interior lighting

6. Connecting protective devices

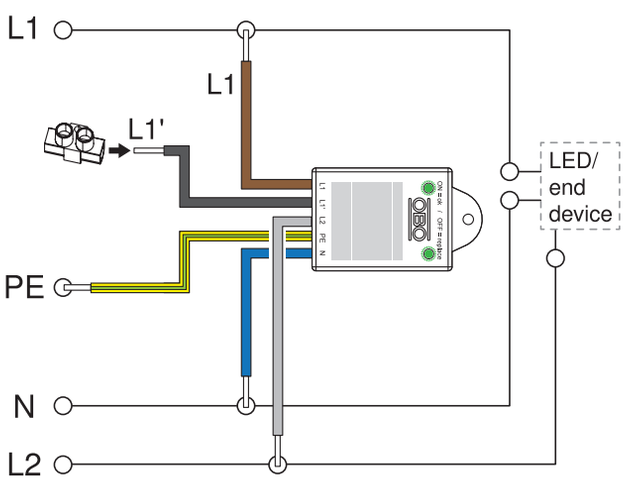
The surge protective devices must correspond to the testing standard IEC 61643-11 and must be able to arrest surge currents of several thousand amps multiple times without destruction. According to the testing standard, each protective device must have thermal monitoring and must be isolated safely if there is a defect. The ÜSM protective devices can be connected in series or parallel to the luminaires. The differing connection can be used to maximise availability (parallel connection) or to switch off the luminaire if there is a defect on the protective device (serial connection). For LED protective devices with two phase connections, the second connection can be used to protect a control phase for the luminaires, for example. Luminaires that are directly supplied with two phases are protected with only one device.

Parallel connection
The surge protective device is located upstream of the LED luminaire.

If the ÜSM fails, the LED display goes out. The surge protection is disconnected. However, the LED luminaire remains lit without protection.



Parallel connection with 1 phase



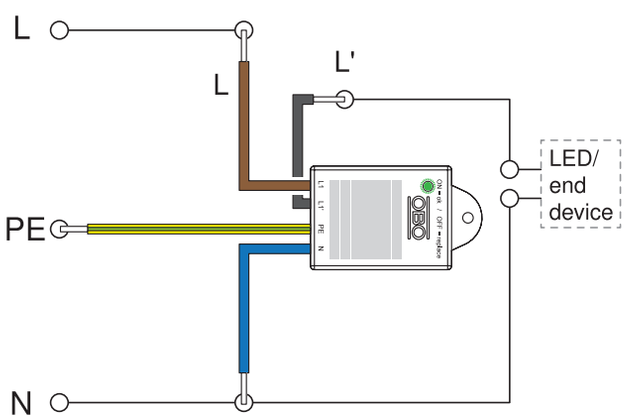
Parallel connection with 2 phases

L	Phase feed line
L`	Phase from the protective device (switch-off in case of failure)
PE	Earth
N	Neutral conductor
LED	Luminaire

L1	Phase feed line
L1`	Phase from the protective device (switch-off in case of failure)
L2	Control phase
PE	Earth
N	Neutral conductor
LED	Luminaire

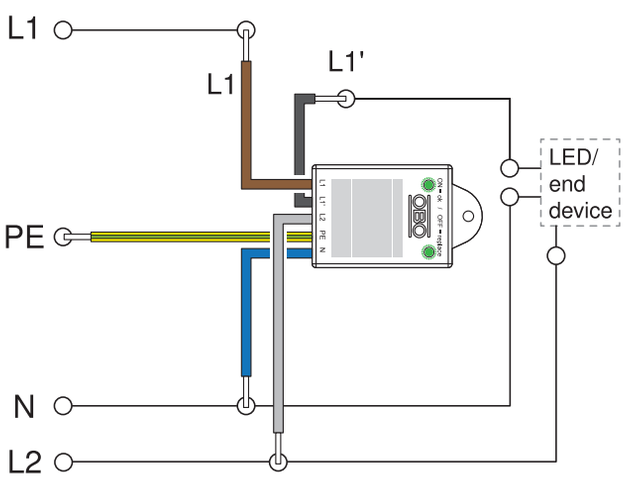
Serial connection
The surge protection is switched in series to the LED luminaire.

If the ÜSM fails, the LED display goes out. The surge protection and the circuit (L') are disconnected. The failure of the SPD is signalled by the luminaire going out. This means it is immediately apparent that repair or replacement is necessary. The safe operation of the luminaire is then guaranteed again and the service life, and thus also the investment, are secured.



Serial connection with 1 phase

L	Phase feed line
L`	Phase from the protective device (switch-off in case of failure)
PE	Earth
N	Neutral conductor
LED	Luminaire

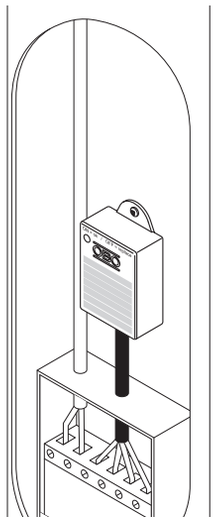


Serial connection with 2 phases

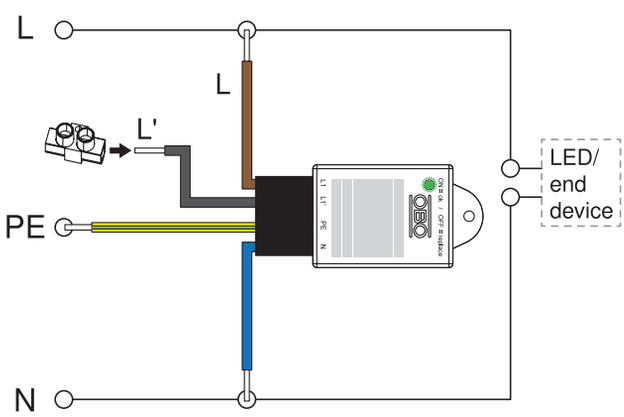
L1	Phase feed line
L1`	Phase from the protective device (switch-off in case of failure)
L2	Control phase
PE	Earth
N	Neutral conductor
LED	Luminaire

Connecting and installing in a distributor box

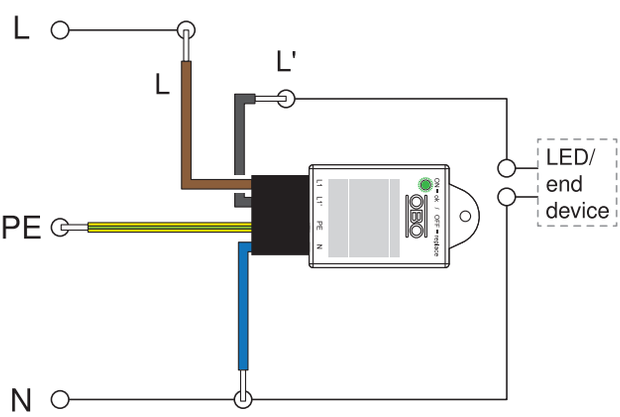
The cast protective device ÜSM-20-230I1PE65, which has the IP 65 protection rating, can be used in harsh environmental conditions due to its high protection rating. In addition, it can also be mounted outside the distributor box in the mast if there is no more space left, for example in the case of refitting. The connection in the distributor box can also be made either as a serial or parallel connection with one phase.



Installation of the ÜSM-20-230I1PE65 outside the distribution box



Parallel connection



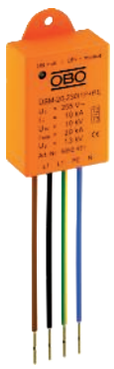
Serial connection

L	Phase feed line
L`	Phase from the protective device (switch-off in case of failure)
PE	Earth
N	Neutral conductor
LED	Luminaire

L	Phase feed line
L`	Phase from the protective device (switch-off in case of failure)
PE	Earth
N	Neutral conductor
LED	Luminaire

7. ÜSM surge protection module variants

High arresting capacity – ÜSM-20-230I1P+PE

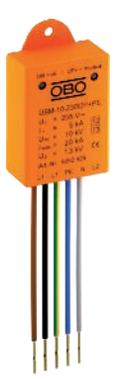


Version	1-pole + NPE for PC I
SPD to EN 61643-11	Type 2 + 3
Maximum continuous voltage	255 V (AC)
Maximum discharge current	20 kA
Nominal discharge surge current	10 kA
Idle voltage	10 kV
Protection level	1.3 kV
Protection type	IP 20
Item no.	5092431

Water-resistant – ÜSM-20-230I1PE65

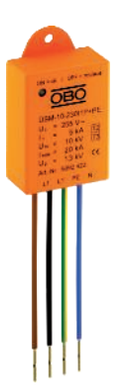
Version	1-pole + NPE for PC I
SPD to EN 61643-11	Type 2 + 3
Maximum continuous voltage	255 V (AC)
Maximum discharge current	20 kA
Nominal discharge surge current	10 kA
Idle voltage	10 kV
Protection level	1.5 kV
Protection type	IP 65
Item no.	5092433

Standard 2-pole – ÜSM-10-230I2P+PE



Version	2-pole + NPE for PC I
SPD to EN 61643-11	Type 2 + 3
Maximum continuous voltage	255 V (AC)
Maximum discharge current	10 kA
Nominal discharge surge current	5 kA
Idle voltage	10 kV
Protection level	1.3 kV
Protection type	IP 20
Item no.	5092426

Standard 1-pole – ÜSM-10-230I1P+PE



Version	1-pole + NPE for PC I
SPD to EN 61643-11	Type 2 + 3
Maximum continuous voltage	255 V (AC)
Maximum discharge current	10 kA
Nominal discharge surge current	5 kA
Idle voltage	10 kV
Protection level	1.3 kV
Protection type	IP 20
Item no.	5092422

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Building Connections