INSTITUTION OF LIGHTING PROFESSIONALS

GUIDANCE NOTE 13/26

SURGE PROTECTION FOR EXTERIOR LIGHTING INSTALLATIONS

Guidance Note

GN13/26

Surge Protection for Exterior Lighting Installations

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Introduction

Public lighting installations play a critical role in ensuring safety, accessibility, and functionality in urban and rural environments. From illuminating streets and pedestrian pathways to providing visibility in tunnels and enhancing road safety through signage, these systems are vital to modern infrastructure. However, the ever-changing climate and environmental conditions, including increased instances of severe weather such as storms and lightning, pose significant challenges to their reliability and longevity.

One of the greatest threats to public lighting systems is voltage surges, which can result from atmospheric events like lightning or electrical network disturbances. These surges can cause premature wear to LED drivers, damage distribution panels, and disrupt service continuity, leading to increased maintenance costs and potential safety risks for the public.

This document explores the causes and impacts of overvoltage on public lighting systems, examines the regulatory frameworks surrounding their protection, and provides actionable solutions to mitigate risks. By investing in robust protection measures, including the use of Surge Protection Devices, organizations can extend the lifespan of lighting installations, reduce operating costs, and ensure uninterrupted service. While complete immunity from overvoltage events is unattainable, implementing effective protective systems can significantly enhance the resilience of public lighting infrastructure in an increasingly unpredictable climate.

The guidance covers the revision to BS7671 Amendment 2 which clarifies the need for surge protection and consequences of its non-provision.

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Scope

This Guidance Note has been produced to assist the competent specifier, designer and installer involved with low voltage electrical exterior lighting infrastructure systems, and is based around the requirements of BS7671: 2018+A2:2022 'Requirements for Electrical Installations', sometimes known in United Kingdom as the 'Wiring Regulations' and specifically deals with Surge Protection Devices (SPDs) in the following two Chapters:

i) Chapter 44 'Protection against voltage disturbances and electromagnetic disturbances' in particular Section 443, which deals with protection against overvoltages of atmospheric origin, or due to switching.

ii) Chapter 53 'Protection, isolation, switching, control and monitoring', in particular, Section 534, Devices for protection against overvoltage.

The focus of this publication will be on informing and enabling, to produce an exterior lighting scheme that will, if required, be at reduced risk from both indirect lightning strike, and switching surges from the external supply cable network, serving electrical and electronic equipment.

This publication does not purport to include all the necessary requirements to fully protect a system from high energy phenomena. If electronic equipment installed outside is hit by a direct lightning strike, it is highly likely that the equipment will be damaged. Lightning produces mega-joules of energy, and this compares with the milli-joules of energy required to damage sensitive equipment.

In this document lightning protection systems are mentioned, but not considered in any detail. It will provide measures using a simplified approach, to determine whether an installation requires protection against external influences. It does not replace the full, detailed risk assessment necessary at the design stage, where detailed information may not be available.

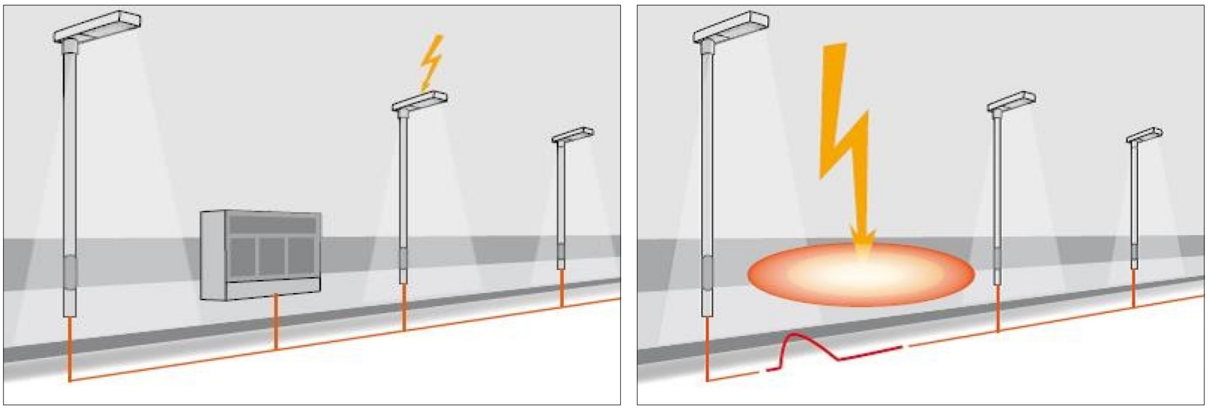
Background

Traditional High Intensity Discharge (HID) luminaires used robust magnetic control gear, having a high tolerance to temperature and transient voltages and currents. However, the introduction of legislation aimed at improved energy efficiency, whilst maintaining light efficacy, has ended the use of new magnetic control gear in favour of electronic controls, devices and control gear.

Current BS7671 18th Edition State regulation 443.4.1 : Serious injury to, or loss of, human life, Protection against transient over voltage shall be provided where the consequence caused by the over voltage could result Failure of safety service as defined in part 2, significant financial or data loss.

Electronic equipment installed in an outside environment can be reasonably protected against an indirect ground strike to the structure, causing a Lightning Electromagnetic Pulse (LEMP). LEMP is the term given to the overall electromagnetic effects of lightning, including conducted surges (transient overvoltage and currents), and radiated electromagnetic field effects, demonstrated in Figure 1.

Direct Strike *Indirect Strike*



https://www.luxreview.com/2015/08/31/how-to-protect-exterior-lighting-from-power-surges-and-lightning/

Figure 1 – Direct and indirect lightning strikes

Transient Overvoltage of Atmospheric Origin or Due to Switching

Manufactured surges or spikes superimposed on the supply cables, can be generated by large grid-connected equipment. These surges or spikes can travel along transmission lines and underground cable networks, adversely affecting unprotected installations. When high inductive loads, such as large motors, switch on or off, transient spikes are generated. These spikes are usually not as destructive, but are far more frequent than a lightning strike.

The resultant outcome of these effects, for example on an unprotected exterior lighting installation, could be degradation, damage, disruption, downtime and significant financial cost. Exterior lighting now relies on electronic devices, components and systems that support the infrastructure, making them particularly vulnerable to damage from electrical surges. Sensitive electronic components are typical in items of exterior lighting equipment such as:

- Luminaires
- Signs and bollards
- Photo electric cells
- Solar panels
- Central management systems and remote monitoring systems, including tele-management, smart cities devices
- Passive safety controls

All this equipment will at some point connect to a privately owned cable network and/or the DNO/IDNO supply cables.

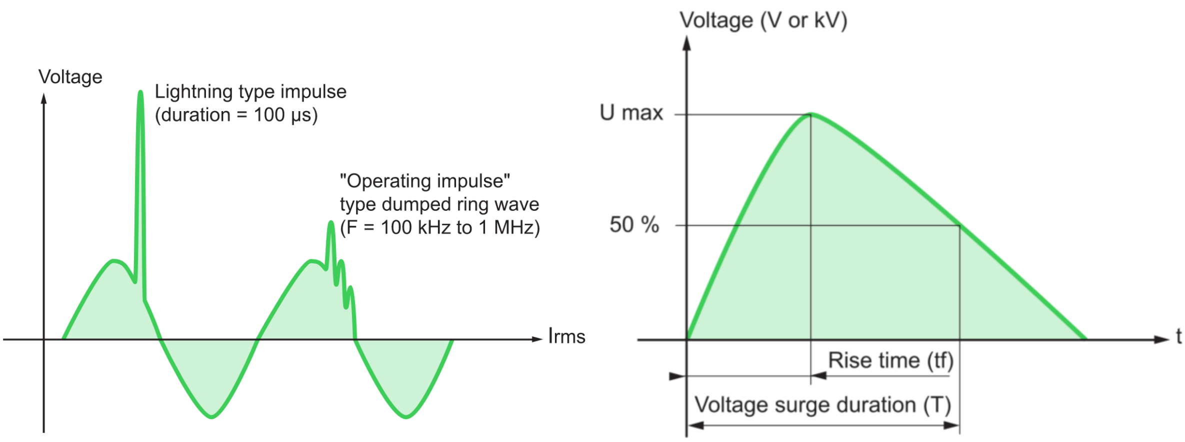
The characteristics of transient overvoltage will depend on the nature of the supply distribution system, both underground and overhead, and voltage level of the supply system. A transient overvoltage surge or spike is a short duration increase in voltage, that lasts for a few microseconds/milliseconds of time.

Transient voltage spikes can reach many thousands of volts in an electrical installation, with devastating results. Electrical components are designed to manage a specific range of voltages and where these voltages are exceeded, damage can occur. A spike within the supply can affect one or more electronic items of an exterior lighting installation. As the voltage rises within the equipment, excessive heat is produced, which can cause damage, or certainly degradation. Figure 2 shows on the left an ac voltage waveform with transient spikes, and on the right are the main characteristics of overvoltage over time.

Listed below are typical causes of overvoltage:

- Switching surges: high-frequency overvoltages or burst disturbance (See Figure 2) caused by a switching operation in an electrical network.

- Power-frequency overvoltages: which would be overvoltages of the same frequency as the network (50, 60, or 400 Hz), caused by a permanent change of state in the network due to a fault or breakdown of the neutral conductor.
- Overvoltages: caused by electrostatic discharge: short duration, for a few nanoseconds, and extremely high frequency caused by electrostatic discharge with a voltage of several thousand volts (kilovolts).
- Overvoltages: of atmospheric origin (lightning strike) see Figure 1.



https://www.lsp-international.com/lightning-current-surge-and-overvoltage-protection/

Figure 2 – Transient spikes and types of overvoltage

These types of overvoltage can cause damage or failure within an exterior lighting installation, for example the internal fuse, printed circuit board tracks, internal MOV[1], photocell, LEDs, and destruction of other internal electronic components. The risk of damage is dependent on the environment, prevalence and intensity of lightning strikes and surge values generated within the supply network.

[1] An MOV, or Metal Oxide Varistor; voltage suppression device that clamps a transient in an electrical circuit. It is also called a Varistor, or variable resistor, because its resistance changes with applied voltage. Sometimes referred to as a VDR, or Voltage Dependant Resistor.

Surge Protective Devices (SPDs)

To effectively use SPDs, the causes of transient overvoltage need to be understood and assessment made of where to fit the additional protection, to prevent damage to equipment. Figure 3 sets out the types of transient overvoltages and their effects on equipment.

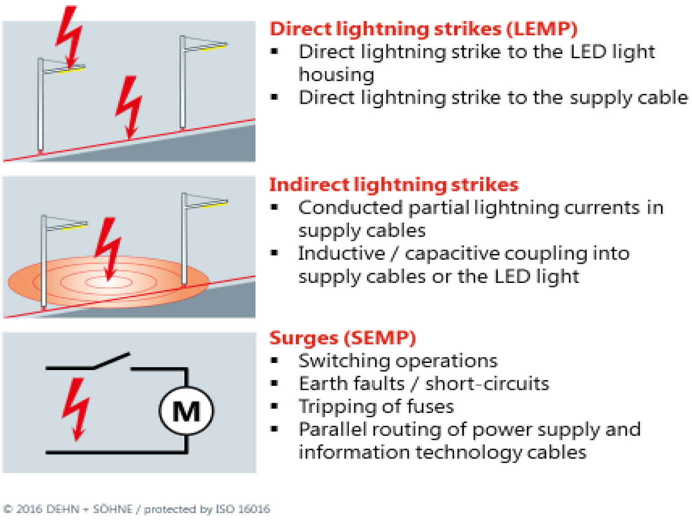


Figure 3 – Causes of overvoltage

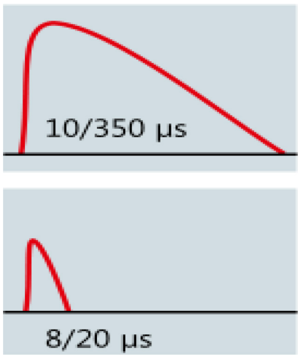


Figure 4 – Lightning and switching event waveforms

Figure 4 demonstrates the 10/350 µs, the waveform used to ascertain the degree of protection from lightning strike, and 8/20 µs waveform used to ascertain the degree of protection from induction occurrences, such as switching events.

Electrical/electronic equipment in exterior lighting may be mounted at varying heights, for example from a 5m column up to a 60m high mast. Equipment may also be mounted on a structure, for example a gantry straddling a motorway, steel structure within a stadium, or on a building. The columns, masts, gantries and buildings that support this electrical/electronic equipment are also vulnerable to lightning strikes and surges.

Some individual items of equipment with electronic circuits, for example an LED luminaire, will now generally have an integrated SPD (typically 10kV/5kA), which limits the amplitude of voltage and current flow. However, care should be taken to ensure the whole electrical installation, and other associated equipment is adequately protected when used within any specific risk environment. Other locations within the installation where SPDs would be used could, for example, be the base of the column, and in the associated feeder pillar.

There is a figure often mentioned within the exterior lighting industry of 2kV, and up to 10kV on the LED driver units, to demonstrate a level of robustness or surge immunity value. What this 10kV means is that the control gear, or driver will withstand up to a 10kV surge before being damaged. If the driver has these inbuilt overvoltage components, then this is called inherent overvoltage control.

A SPD is designed to limit transient overvoltages of atmospheric origin, and divert current waves to earth, to limit the amplitude of this overvoltage to a value that is not hazardous for sensitive electronic components. The SPD eliminates overvoltages and in the event of an overvoltage exceeding the operating threshold, the SPD will deal with these overvoltages as follows:

- In common mode, between phase and neutral or earth, the SPD will conduct the energy to earth.
- In differential mode, between phase and neutral, the SPD distributes the energy to the other live conductors.

All three types of SPD in low voltage installations will tend to be modular, so that they can be installed within distribution boards of feeder pillars, in cut outs, luminaires etc.

SPD Consideration for Exterior Lighting

SPD's must be considered for every installation, that does not mean they must be installed. A failure in a supply of a public service such as street lighting, traffic signals, CMS equipment and communications apparatus, could be caused by surges and transient damage. The consequences of a single road lighting luminaire failing, compared to a traffic signal controller, have significantly different consequences. Designers will need to consider what the risks are to the equipment from overvoltage and surge and whether additional surge protection is required above that which may already be provided by the equipment manufacturer. A discussion is encouraged between the electrical designer and the client to ensure that no unacceptable losses occur from overvoltage.

Where to fit SPDs and what level of protection should be specified

One of the most common misconceptions is that:

> *"My driver has an SPD fitted, so am I covered?"*

The answer is 'not necessarily', because electrical and electronic equipment may be supplied with protection that is less than the minimum required. If, for example, an electronic driver within a luminaire has an SPD rated at 10kV, this means that voltage spikes of beyond 10kV will be allowed to pass through and may cause damage to the driver. The 10kV figure is the voltage at which the SPD cable insulation etc. would begin to break down, leading to arcing or short circuiting, then to failure.

The SPD may be at the main point of connection to the DNO/IDNO supply. In the event of a private cable network, this would usually be within the feeder pillar. Where a local authority has a DNO/IDNO supply into the lighting column, the point of connection could be housed within the secondary isolator, above the DNO/IDNO cut-out.

Most road lighting luminaires normally now have an SPD fitted within luminaires, if there is a Type 2 SPD in the cut-out that has a maximum U_p value (see Figure 8 SPD specification terms) of 1.5kV, the worst-case scenario being due to oscillation with the cable, the surge could double to a maximum of the initial U_p value. A driver that has a protection of 3kV or higher you will be protected; if it is not, the additional fitting of an SPD will be required. The main point to consider is that this 10m rule (the distance between devices) is not just dependent on the performance of the SPD, but the SPDA, the SPD Assembly, or installation. The focus of BS7671 section 534 is about achieving the best performance of the installed SPD, hence the points about short cables and other mitigating measures to reduce voltage rise in the SPD circuit.

In practice during a surge event, the first SPD in the feeder pillar will take care of the pillar itself and anything within 10m. The first column, and all columns on the private cable network, will require an SPD in the base if the LED driver is to possibly endure surges on the supply. The addition of an SPD in the LED head will be dependant on a cost benefit analysis. As the surge can double in value again after the upstream SPD, consideration needs to be given to whether the driver has sufficient withstand for the expected surge, and the cost benefit analysis of not installing an SPD, against the cost of replacing the components that are being protected. Traffic management costs will vary significantly between a Motorway and a cul-de-sac, and should be considered as part of the cost benefit of providing SPDs.

The designer will be aware that the standard requires an SPD because the regulation 443.5 has been deleted by BS 7671: 2018 + A2:2022, requiring SPDs. The designer will be aware of the withstand of the driver but needs to ascertain if that withstand voltage can be exceeded. If there is any doubt regarding the withstand of the driver, then SPDs will be located closer to the LED driver as described in section 534.

Illustration below shows a private cable network with Surge Protection Devices installed in the luminaire, the column cut-out and within the supply pillar, which has a DNO/IDNO supply.

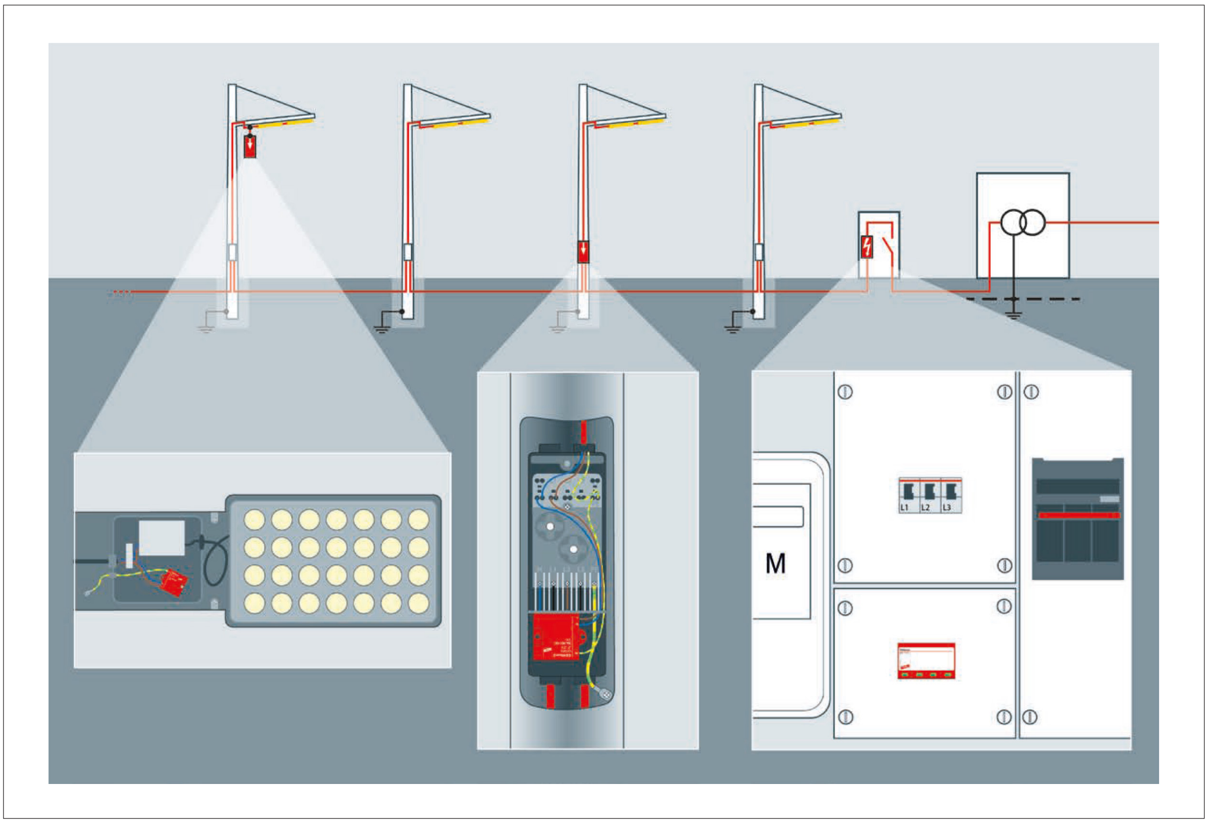


Figure 5 – Typical exterior lighting installation showing the location of SPDs

Section 534 and Figure 534.2 of BS7671: 2018 gives an example of the installation of Type 1, Type 2, and Type 3 SPDs.

Types of SPD

A simple analogy, to demonstrate how the different types of SPDs work, is a rugby match. The rugby player is attempting a run and wants to score a try, but as they are tackled by each opposing player, their energy and speed is diminished and hopefully, they will be unable to reach the try line because finally one player will bring them down. So, the important point here is that the surge or spike will be diminished and unable to damage the sensitive equipment. The cascading effect of each SPD when it reaches the sensitive equipment will always stay below the critical level.

SPDs fitted at the source or origin of the installation would be Type 1 or Type 2, as these are more robust. SPDs fitted closer to sensitive exterior lighting equipment, for example a luminaire, would be Type 3.

Type 1 SPD

The Type 1, SPD which can discharge partial lightning current with a typical waveform 10/350 µs current wave, shown in Figure 4, usually employs spark gap technology which protects electrical installations against direct lightning strikes. It can discharge the back-current from a lightning protection system spreading from the earth conductor to the network conductors, where a lightning protection system has been installed within 50 metres.

Lightning Protection Systems

A lightning protection system includes a network of air terminals [2], bonding conductors, and ground electrodes, designed to provide a low impedance path to ground for potential direct lightning strikes. Lightning protection systems are used to prevent lightning strike damage to structures.

The function of an external lightning protection system is to intercept, conduct and disperse a lightning strike safely to earth. Without such a system a building's structure, electronic systems and the people working around, or within it, are all at risk.

Type 2 SPD

The Type 2 SPD is the main protection system for all low voltage electrical installations. Installed in each electrical distribution board, it can prevent the spread of overvoltages in the electrical installations, and protects equipment connected to it. It usually employs MOV technology and is characterised by an 8/20 µs current wave shown in Figure 4.

[2] An air terminal, also known as a, lightning rod, franklin rod, finial, lightning protection mast, or air termination rod, is a pointed tip rod made from conductive material such as copper or aluminium and is positioned above all other metallic objects on a building or structure to provide external protection from direct lightning strike when grounded through a suitable conductor.

Type 1/2 SPD

The Type 1/2 SPD combines the Type 1 and Type 2 into a single unit for ease of installation.

Type 3 SPD

These SPDs have a low discharge capacity. They must therefore be installed as a supplement to Type 2 SPD and near sensitive loads. The Type 3 SPD is characterised by a combination of voltage waves (1.2/50 µs) and current waves (8/20 µs), shown in Figure 4.

Usually there is a SPD built into most LED drivers. These are typically 8kV CM 6kV DM and 3kA. Let through voltage is not always specified. In practice, where the LED driver has this SPD, the secondary external SPD should be considered for location in the base of the lighting column, even if the column is 12m or 15m (i.e. exceeds the recommended 10m). Potentially, there is a risk of strike to the side of the column, or induction through the air from a nearby lightning strike to the ground, but in practice a steel or aluminium lighting column will provide a faraday cage protection to the supply cable routed inside the column, and so the length of the cable inside the column is less critical to the design of the SPD protection.

Type 3 SPD is characterised by a combination of voltage waves (1.2/50 µs) and current waves (8/20 µs). LED luminaires have a Type 3 surge protection device fitted to mitigate the damage from overvoltage, illustrated in Figure 6.

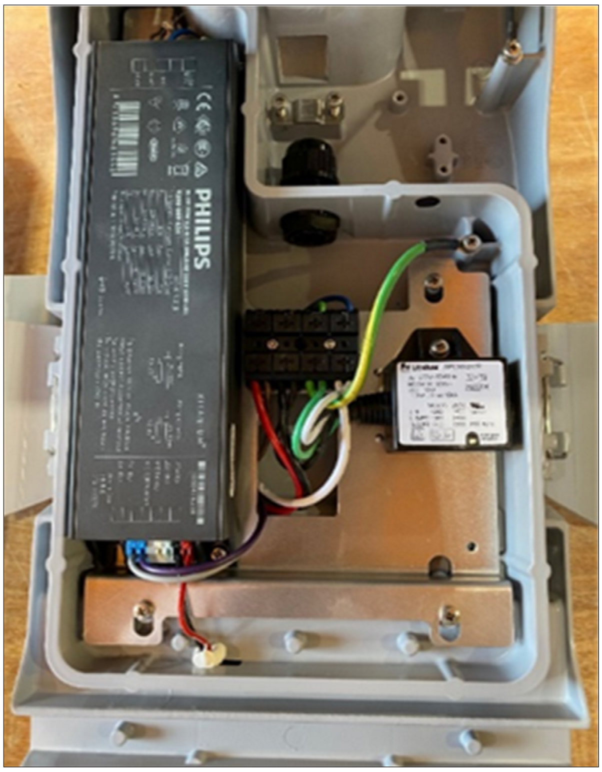


Figure 6 – Typical Type 3 SPD in an LED lantern control gear compartment

Co-Ordination of Devices

For exterior lighting installations to avoid damage, a lightning protection system with lightning conductors would be required for every item of equipment. This would not be cost effective or appropriate. However, a lightning surge which is the effect from a lightning strike, is less destructive and protection is possible. This is because the lightning strike starts to dissipate energy, thereby reducing in magnitude as it travels from the point of impact with the ground.

If lightning strikes the ground, the impulse surge generated will dissipate into the ground (demonstrated in Figure 7), the surge would then be less destructive when entering adjacent underground or overhead power lines, networks, and equipment. There is a relationship between the resultant magnitude of the impact strike and distance. Further away from the strike, the magnitude of the surge decreases. Equipment may be affected, but to a lesser extent up to a kilometre away from the source of the strike.

Figure 7 – Effect of a lightning ground strike

Voltage surges and spikes passing along underground cable networks and overhead lines can be caused by high power using equipment, for example large industrial motors, or high-capacity switching. Surges and spikes can also occur when high winds cause power lines to clash, causing a short circuit or line collapse.

Rated Impulse Voltage (U_W)

Required Rated Impulse Voltage of equipment is used for the purpose of insulation coordination, to classify equipment energised directly from the low voltage electrical installation into these overvoltage categories.

Inherent overvoltage control based only on rated impulse voltage of the equipment in accordance with BS EN 60664-1 is **NOT sufficient where:**

- Transient overvoltage and current within distribution systems are not significantly attenuated (reduced in amplitude/strength) downstream.
- NOTE: Insulation coordination can be achieved in the whole installation by transient overvoltage protection of the equipment corresponding to the classified rated impulse voltage, thereby reducing the risk of failure to an acceptable level.
- Surge currents and partial lightning currents are distributed through underground cables.
- Equipment is connected to multiple services, for example power, telecommunications, and data lines.

Insulation coordination can be achieved in the whole installation by installing surge protection devices, which will reduce the risk of system failure from transient overvoltage to an acceptable risk level.

Table 1 re-produced from BS 7671: 2018 Table 443.2, sets out the rated impulse voltage of equipment (U_W) within four categories of overvoltage (I, II, III, IV). BS 7671: 2018 states that each category shall have a rated impulse voltage not less than the value stated in Table 1.

Category I Reduced rated impulse voltage: equipment is only suitable for use in the fixed installation where SPD's are installed outside the equipment, to limit transient overvoltage to the specified level.

Category II Normal rated impulse voltage: equipment is suitable for connection to the fixed insulation, providing a degree of availability normally required for current using equipment.

Category III High rated impulse voltage: equipment is suitable for use in the fixed installation downstream of, and including, the main distribution board, providing a high degree of availability.

Category IV Very high rated impulse voltage: equipment is suitable for use at, or in the proximity of, the origin of the electrical installation, for example, upstream of the main distribution board. Equipment of category IV provides a high degree of reliability.

Table 1 – Rated impulse voltage of equipment (U_W)

Nominal Voltage of the installation V [a]	**Voltage line to neutral derived from nominal voltage AC or DC up to and including V**	**Required rated impulse voltage of equipment** [b] **kV**			
		Overvoltage **Category IV** (equipment with **very high** rated impulse voltage) For example, energy meter, telecontrol systems	Overvoltage **Category III** (equipment with **high** rated impulse voltage) For example, distribution boards, switches, socket outlets	Overvoltage **Category II** (equipment with **normal** rated impulse voltage) For example, domestic appliances, tools	Overvoltage **Category I** (equipment with **reduced** rated impulse voltage) For example, sensitive electronic equipment such as alarm panels, computers, and home electronics
120/208	150V	4kV	205kV	105kV	0.8kV
240/400 [c] **277/690**	300V	6kV	4kV	2.5kV	1.5kV
400/690	600V	8kV	6kV	4kV	2.5kV
1000	1000V	12	8kV	6kV	4kV
1500DC	1500DC	—	—	—	—

[a] According to BS EN 60038: 2019 'CENELEC Standard Voltages' (Nominal voltage is a suitable approximate value of voltage used to designate or identify a system)

[b] The rated impulse voltages applied between live conductors and PE

[c] For IT systems operating at 220/240 V, the 230/400 row should be used, due to the voltage to earth at the earth fault on one line.

SPD Manufacturer Data

For the purpose of designing and applying optimum surge protection, one of the essential points is to take into account the energy coordination between cascaded SPDs and it is important to obtain an acceptable sharing of the energy stress between two cascaded SPDs. Another commonly used component is the spark gap. Its chopping action on the waveform lets through far less energy compared to the MOV, so that components can be placed very close to the sensitive end equipment, so coordination is ensured and the equipment will survive.

Common terms used in manufacturer data sheets are described in Figure 8 SPD specification terms

I_{imp}	Impulse current of 10/350 μs waveform associated with Type 1 SPDs
I_n	Surge current of 8/20 μs waveform associated with Type 2 SPDs
U_p	The residual voltage that is measured across the terminals of the SPD when I_n is applied
U_c	The maximum voltage which may be continuously applied to the SPD without it conducting

Figure 8 – SPD specification terms

SPD Installation

BS 7671 section 534 (devices for protection against overvoltage) details the provisions for correct selection of devices against overvoltage.

Regulation 534.4.1.1 where SPDs are required: SPDs installed at the origin of the electrical installation shall be Type 1 or Type 2 SPDs installed close to sensitive equipment to further protect against switching transients originating within the building shall be Type 2 or Type 3.

Installers to provide an information notice (label) at or near to the distribution board or consumer unit, indicating that the installation contains overvoltage protective devices.

The notes to this regulation give further guidance, stating that a Type 1 or a Type 2 SPD may be used at the origin, whilst Type 2 and Type 3 are also suitable for locations close to the protected equipment.

Type 1 SPDs are often referred to as equipotential bonding SPDs, and are fitted at the origin. A lightning protection system employing these devices only, offers no effective protection against failure of sensitive electrical and electronic systems. To achieve this, additional coordinated devices will have to be employed. In summary, a Type 1 SPD is used at the origin of the installation, a Type 2 SPD can also be used at the source and used at distribution boards, or a lighting column base, and a Type 3 SPD is used near terminal equipment. Confirmation is required that the pass-through voltage is of a level to safeguard the led driver SPD. Ideally, collect all remaining supply cable surges at the base of the column using a Type 3 (with, for example, a pass-through voltage of 275V) to deal with mains borne transients, SEMP and indirect LEMP. Then use the SPD in the LED driver to protect from indirect LEMP surges induced in the trailing lead (lantern to cut-out) and any SEMP surges that pass through to the lantern.

Surge protection needs to be selected such that their voltage protection level (U_p) is lower than the impulse withstand capability of the equipment to be protected. Regulation suggests that this value should be referred to Category II. This for a 230/400V installation suggests that the value should not exceed 2.5kV. However, regulation suggests that to protect sensitive and critical equipment, consideration should be given to reduce this value to that required for Category I equipment (i.e., 1.5kV).

Type 1 devices need to be selected such that the value of I_{imp} is not less than that which shall be calculated in accordance with BS EN 62305-4. However, if this cannot be calculated, then this value shall be not less than 12.5kA. Also, due to the connection method, the value of I_{imp} between the neutral conductor and the protective conductor shall be not less than 50kA for three phase systems and 25kA for single phase, where the value cannot be calculated.

For Type 2 devices the value of I_n shall be not less than 5kA and the value between the neutral and protective conductor shall be not less than 20kA for three phase systems and 10kA for single phase. Larger values may be required as classified in BS EN 61643-11.

Practical Solutions for Surge Protection in Exterior Lighting Equipment

BS7671: 2018 has now made the deployment of SPDs much clearer, requiring the competent specifier, designer, or installer to carry out a risk assessment in accordance with Regulation 443.4.1.

Regulation 443.4.1 of BS7671: states that protection against transient overvoltages shall be provided where the consequence caused by overvoltage could:

i. Result in serious injury to, or loss of human life, or

ii. Result in failure of a safety service, as defined in part 2, or

iii. Result in significant financial loss or data loss.

For all other cases SPDs shall be fitted to protect against transient overvoltages, unless the owner of the installation declines such protection and wishes to accept the risk of damage to both wiring and equipment as tolerable.

The next paragraph of Regulation 443.4 goes on to say that for all other cases, a risk assessment shall be performed to determine if protection against transient overvoltage is required.

For exterior lighting installations, two typical risk factors associated with fitting/not fitting surge protection devices would be:

i. Financial - damage to the equipment and replacement costs

ii. Time - temporary loss of system/lighting causing delays and disruption to the client, public and road user.

For exterior lighting, determining where to use SPDs will depend on the factors listed above and the nature of the installation, supply source, location, and the external environment. Decisions on using SPDs for exterior lighting will be determined by assessing whether the lighting remaining in service is critical.

Below are a list of supply types and equipment which will all influence assessment and selection of SPDs.

Supply Types

- Supply authority connection
- Supply authority connection and private cable
- Single Phase
- Three Phase

Equipment

- High Mast
- Column and luminaire (varying mounting heights)
- Illuminated sign
- Feeder pillar
- Bollard
- Passively safe electrical monitoring system
- Central management system

Figure 9 demonstrates how SPDs could be installed in a distribution board.

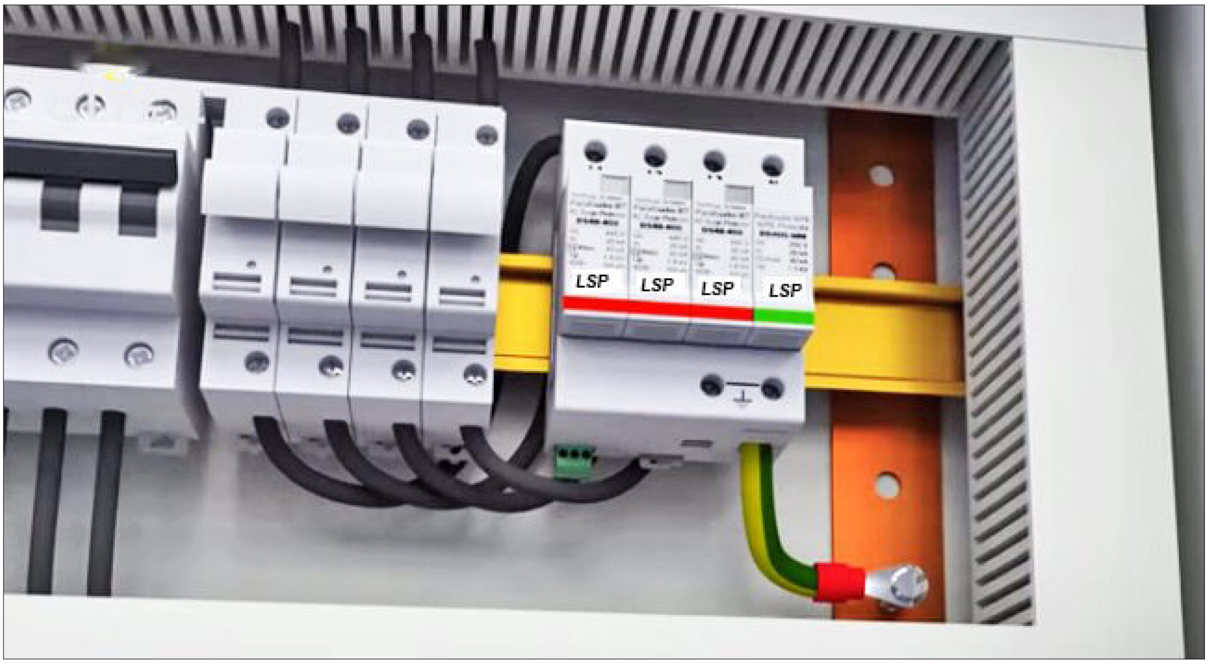


Figure 9 – Typical installation of SPDs in a distribution board

High Masts

For high masts equipped with lightning protection, Regulation 534.4.1.3 applies where a Type 1 SPD should be installed as close as possible to the origin of the electrical installation. For high masts not equipped with lightning protection, Regulation 534.4.1.4 applies where a Type 2 SPD should be installed as close as possible to the origin of the electrical installation. All individual luminaires on the mast should be protected using a Type 3 SPD (usually fitted by the manufacturer).

Columns

A single lighting column installation, fed directly from the DNO/IDNO supply network, where the luminaire has a manufacturer fitted Type 3 SPD, consideration should be given to whether the additional cost of a SPD at the source of the supply is justified and/or necessary. This consideration would be in the form of a risk assessment, where the cost of installing, access to and maintenance of the additional equipment is considered against the loss of amenity (the lighting being out), and the consequences of the loss, such as additional accidents or increased crime.

Where there is a group of columns supplied through a private cable network from a DNO/IDNO source (e.g. a feeder pillar) they would need to be assessed to determine the risk to the public, and cost, if the installed equipment was damaged by a transient overvoltage. This type of installation may or may not require SPDs, but a risk assessment would be required. Other factors to consider would be maintenance access, traffic management cost and road user disruption. This needs to be balanced against the cost of installing and maintaining the SPDs.

If it is considered SPDs are needed, they should be co-ordinated to comply with Section 534 of BS 7671: 2018. This would require SPDs with co-ordinated ratings at the source (Type 1 or 2), column (Type 2), and luminaire (Type 3).

Signs, Bollards and Variable Message Signs (VMS)

For traffic signs, bollards, and VMS signs, the cost for protection will need to be compared with the value of the equipment, along with the location and the consequences of failure. For example, if a VMS sign possibly costing thousands of pounds located in an area where there was a prevalence of adverse weather, an assessment of the cost of protection compared to the cost of the potential damage would be required. In this situation SPDs would be used to protect this type of equipment. However, the cost of replacing a sign lighting unit where there are no access issues may not warrant the cost of installing SPDs other than the Type 3 in the sign light.

Central Management Systems and Passively Safe Monitoring

For Central Management Systems and Passive Safety Equipment, SPDs would probably need to be installed. These installations will employ a considerable amount of electrical and electronic equipment. The costs associated with system damage and potential risk of a large area of lighting being lost for a considerable length of time would justify SPDs at the source (Type 1 or 2) and column (Type 2). Other equipment such as CMS nodes, collectors and luminaires would be supplied with Type 3, fitted during manufacture.

Cut-outs

The second line of protection would be to fit a Type 2 SPD within the cut-out unit in the base compartment of a lighting column. The advantage of having the SPD within the cut-out unit is ease of access. The unit can be easily replaced, often without the need for a mobile elevated work platform, costly lane closures and traffic management.

There are two methods of connecting these SPDs – in Series or Parallel.

> **SERIES:** Priority to protection, if the SPD gets to its end of life, the luminaire is disconnected.

PARALLEL: Priority to continuity of service, if the SPD gets to its end of life, visual indication of the SPD status becomes red, but the luminaire remains on. There are options on some for no volt contacts to be fitted that could be used to alert its status through, for example, a central management system.

The advantage of the Series connection is that on disconnection, the asset will not be subject to further surges. Where the Parallel type is used, the luminaire would continue to operate, though without the SPD safeguard. It may not be obvious that the Parallel type of SPD has failed, so the use of a red/green indicator will assist determining its condition.

Earth Bonding within the lighting column is essential to provide the path for surge discharge.

Overhead supplies not bonded to a lightning protection system

If the installation has no effects of direct lightning impulse currents down the supply because it is not overhead, and the installation is not bonded to a lightning protection system, then a Type 2 SPD can be fitted. Attention is drawn to the size of cables and fuse rating of the required overcurrent protective device (circuit breaker or fuse), by referring to the manufacturer's instructions. Typically, the overcurrent protective device for Type 2 SPDs is required if the supply is over 125 Amps. Small distribution boards may not need the overcurrent protective device in the SPD circuit. However, should one be used, care should be taken that its rupture capacity does not de-rate the SPD. An isolator can be used for test and inspection purposes if the SPD cannot easily be removed during this operation. Figure 10 shows typical Type 2 SPDs.

Figure 10 – Type 2 SPDs

Vulnerable Equipment

It is recommended that further surge protection is installed closer to vulnerable/ sensitive equipment such as CMS nodes and base stations, LED drivers and luminaires.

Relevant Publications and Standards

British Standards

BS 7671: 2018 Requirements for Electrical Installations. (IET Wiring Regulations)

BS EN 62305: 2012 Protection against lightning - Risk management

BS EN 60038: 2011 CENELEC standard voltages

BS EN 61643-11: 2012 + A11: 2018 Low-voltage surge protective devices - Surge protective devices connected to low-voltage power systems. Requirements and test methods

BS EN IEC 61643-331: 2020 Components for low-voltage surge protection - Performance requirements and test methods for metal oxide varistors (MOV)

Other Publications

BEAMA Guide to Surge Protection Devices (SPDs): Selection, application and theory

NB: These notes are intended as guidance only. The application of the values given in the various tables should be given due consideration, along with all other factors in the lighting design. Lighting is a complex subject with both objective and subjective criteria to be considered. The notes are therefore no substitute for professionally assessed and designed lighting, undertaken and assessed by a competent lighting professional, where the various and maybe conflicting visual requirements need to be balanced.

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