PHILIPS

Outdoor SPD

Surge Protector
Class-I and II

Design-in Guide

Protect your outdoor luminaires against damaging spikes and transients

March 2019

Contents

Introduction to this guide

Thank you for choosing the Philips Surge Protector. These products will help protect your Outdoor luminaires against destructive spikes and transients, including high voltage and high current surges caused by indirect lightning strikes. This Design-in Guide provides instructions on how to install the Surge Protector in your luminaire.

Information or support

If you require any further information or support please consult your local Philips office or visit:

Support
www.philips.com/support
Xitanium drivers
www.philips.com/xitanium
OEM general info
www.philips.com/technology

Attention points

Warning:

- Before installation or maintenance, switch off the power
- Avoid touching live parts

- Do not use damaged or defective contacts or housings.
- Do not use damaged products.
- Do not service the Surge Protector when the mains voltage is connected.
- The luminaire manufacturer is responsible for its own luminaire design, this has to comply with all relevant safety standards.
- The Surge Protector is intended for built-in use and should not be exposed to the elements such as snow, water and ice. It is the luminaire manufacturer's responsibility to prevent exposure.
- Do not mount the Surge Protector Class-I in an Insulation Class II luminaire and vice-versa.
- Do not swap mains input and mains output on the Surge Protector Serial versions.
- Do not connect the Surge Protector GND connector to ungrounded accessible (luminaire) parts.

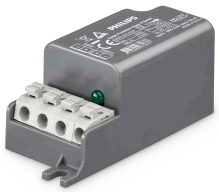
Design-in support is available; please contact your Philips sales representative.

Surge Protector Class-I and Class-II

Xtreme Surge Protector I
Surge Protector Class-I

Philips Surge Protector Class-II

Philips Surge Protector Class-I Serial



Philips Surge Protector Class-II Serial

Types

The Philips Surge Protector is available in five different types:

- Xtreme Surge Protector I
- Surge Protector Class-I
- Surge Protector Class-II
- Surge Protector Class-I Serial
- Surge Protector Class-II Serial

The Serial type will disconnect the load from the power grid in case the Surge Protector has reached its end of life whereas the load will remain connected in case the non-serial type has reached its end of life.

Types of surge protection devices

The International Electrotechnical Commission (IEC) standard IEC/EN61643-11:2011 recognizes three types of surge protection devices:

Type 1

- Type 1 is recommended in specifically for service-sector and industrial buildings. The device is protected by a lightning protection system or a mesh cage. It protects electrical installations against quasi-direct lightning strikes. Type 1 is characterized by a 10/350 µs current wave.

Type 2

- Type 2 is a common protection system for all low-voltage electrical installations. Installed in an electrical switchboard, this device prevents the spread of spikes and transients in electrical installations and protects the loads. Type 2 is characterized by an 8/20 µs current wave.

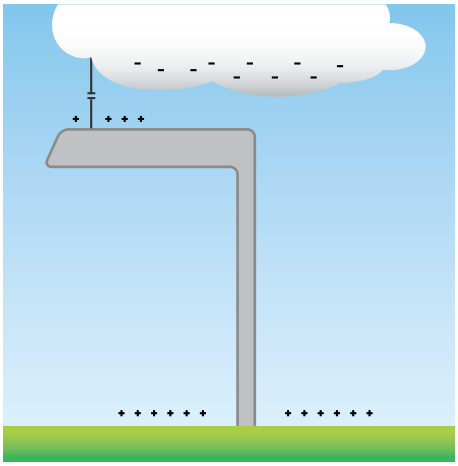
Type 3

- Type 3 is characterized by a combination of voltage waves (1.2/50 µs) and current waves (8/20 µs) and is intended mainly for local protection of sensitive equipment.

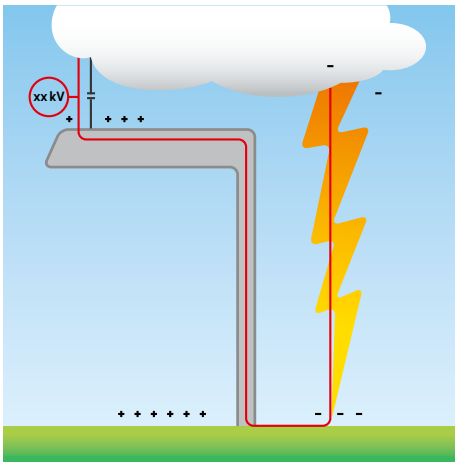
The Philips Surge Protectors Class-I and Class-II versions are classified as **Type 3** products.

Compatibility with other products

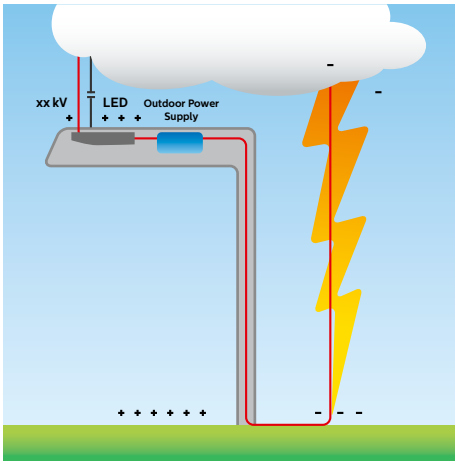
The Philips Surge Protector can be used in combination with various electronic control gears for different lamp types (e.g. LED, HID and fluorescent lamps). It adds additional surge protection to a gear which has its own built-in surge protection. In this design-in guide the focus will be only on LED applications.



Charge build-up



Large currents caused by indirect lightning hit



Surge currents damage to the luminaire

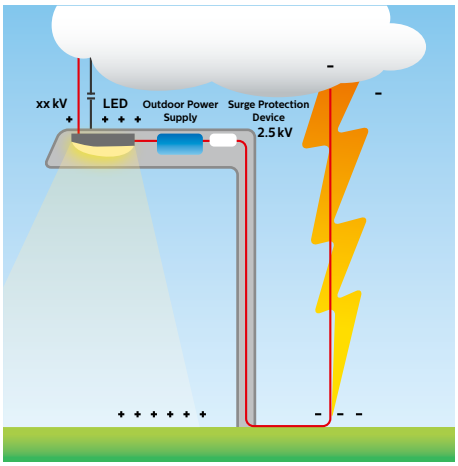
Challenge for Outdoor lighting

Outdoor luminaires are used in various types of applications, such as street and road lighting, parking areas and tunnels. In many of these installations there is a risk of extreme surges (e.g. those caused by lightning strikes). A direct hit will most likely destroy the electrical components in a luminaire. Even an indirect hit near the lighting installation might cause severe damage.

Charge is built up between the cloud and earth, until the potential difference between cloud and earth is high enough to initiate a lightning strike. Following the strike, the charge on the luminaire is returned from the luminaire via line & neutral back to the cloud (red line) since current always flows in a closed loop back to its origin.

A voltage between the L and N terminals of the driver (differential mode) as well as between the driver terminals and the luminaire (common mode) is being built up and an electrical breakdown between mains wiring and the luminaire will occur. The resulting surge voltage and surge current of this electrical breakdown can reach critical levels which can destroy the driver and/or LED module. The path of the surge current can go through the LED module and the driver (shown in the red line) or through the driver only as shown in third figure on the left.

Alternatively, in a TT distribution system where a insulation Class I luminaire is applied, a lightning strike at some distance may cause high common mode energy surge on the mains lines where the local earth connection forms the return path. In that situation, a high common mode voltage will stress the driver and LED module.



Surge currents are diverted from the LED module and driver via the Surge Protector, protecting the luminaire.

Surge protection as solution

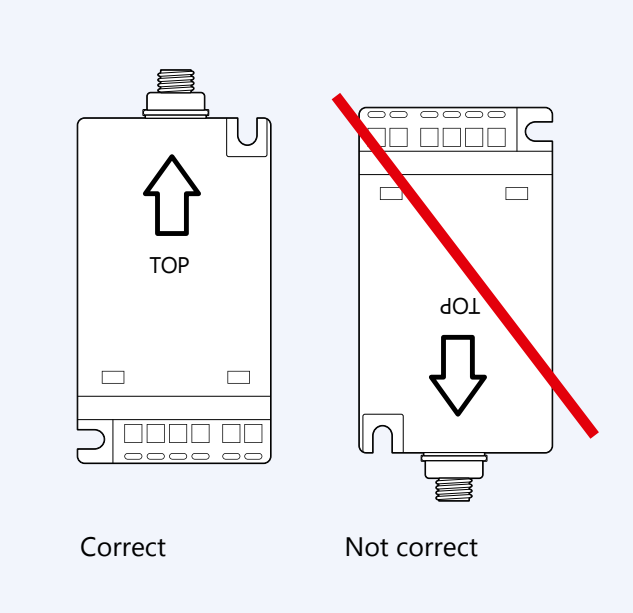
A reliable way to increase the outdoor luminaire protection against excessive surges is to use the Philips Surge Protector. The Insulation Class of the luminaire per IEC60598-1 defines which Surge Protector type should be chosen: Class-I or Class-II type. In Insulation Class I applications the Surge Protector I will limit the differential and common-mode surge voltage build-up inside the luminaire while at the same time offering a diversion path with a lower breakdown voltage. The energy of the voltage surge is returned as a surge current, via the Surge Protector, to ground and eventually back to the cloud. As such, it will protect both the driver and LED module against damaging surge stress. See the figure on the left.

The Surge Protector I ground terminal must be connected to the protective earth connection of the luminaire.

In an Insulation Class II luminaire for which no Protective Earth is present, only the use of the Surge Protector Class-II is allowed. In this case, the Surge Protector will limit the differential-mode surge voltage build-up inside the luminaire and will thus protect both the driver and the LED module against damaging surge stress. The Surge Protector Class-II does not provide a ground terminal since connection to accessible insulation Class II parts is not allowed per luminaire standard IEC60598-1. The use of the Surge Protector Class-II in an Insulation Class I luminaire is not recommended since it cannot provide protection against common-mode surge voltages.

Please refer to Electrical design for more information.

Mechanical design



Mounting direction

Casing

The Philips Surge Protector is suitable for use in all outdoor luminaires. Thermally protected Voltage Dependent Resistors (VDR) and surge arresters are used internally for surge protection. The design assures good thermal stability of the device over lifetime and a low case temperature even if the device is used beyond its end of life.

The Philips Surge Protector has been tested for thermal stability and is compliant with standards IEC/ EN61643-11.

Installation

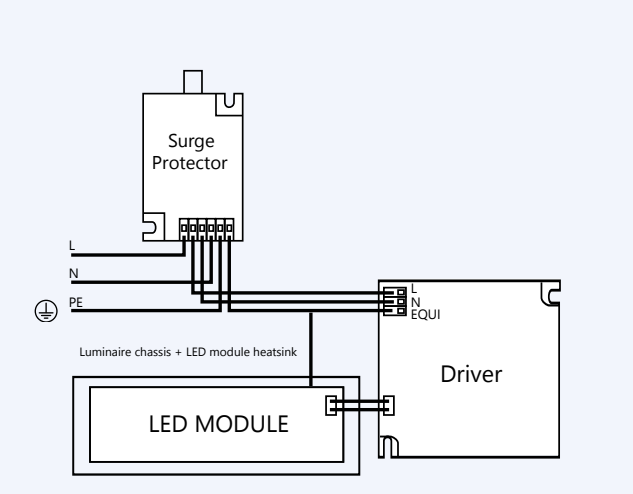
The Surge Protector is released as a built-in device and is intended for mounting inside a luminaire. Remote mounting of the Surge Protector such as in a pole or switching cabinet is not recommended since it may reduce its surge protection effectiveness and it may be subject to ingress of water and dirt.

On the label you will find an arrow indicating the mounting position of the product. It is important to mount the device with the connection terminals facing downward to prevent any damage resulting from water entering the product.

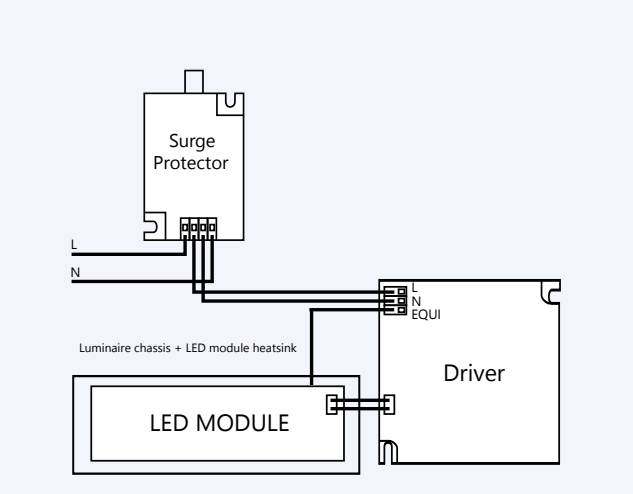
CAD drawings

3D CAD drawings are available at www.philips.com/technology or available via your local sales representative.

Electrical design



Recommended Surge Protector connection with PE available (Insulation Class I)



Recommended Surge Protector connection with no PE available (Insulation Class II)

Surge Protector connections and recommendations

The Surge Protector is equipped with push-in connectors and will accept both solid-core and stranded wires. For more wiring and specific connection details please check the datasheet of the applicable Surge Protector.

The Surge Protector should be connected as illustrated on the left in order to achieve optimal surge protection:

- The wire length between the Surge Protector and driver must be kept as short as possible.

- The wire length betwee the Surge Protector GND connector and PE and/or luminaire chassis and LED module heatsink must be kept as short as possible.

- The wire length between the driver EQUI connector and PE and/or luminaire chassis and LED module heatsink must be kept as short as possible.

- The incoming mains wires must first be routed to the Surge Protector and from there on to the driver.

Warning:

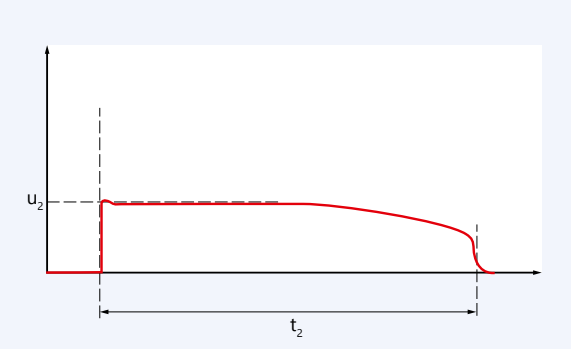
Note that it is **not** allowed to swap the mains input and output in case the Serial type is used.

The ground connector (GND) of the Class-I SPD is **only** allowed to be connected to protective earth (PE) and grounded accessible (luminaire) parts.

Failure indicator

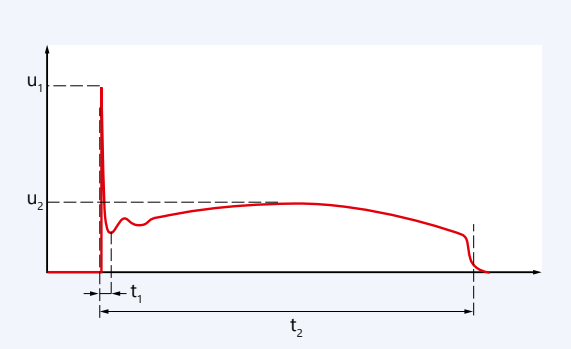
The Surge Protector is equipped with an optical failure indicator by means of a green indicator light. If mains voltage is applied and the indicator light is off then the device needs to be replaced.

Protection level U_p



Differential mode L-N

Protection level U_p (Class-I type only)



Common mode (L/N – GND, L+N - GND

Warning:

- Before installation or maintenance, switch off the power
- Avoid touching live parts

Protection levels

The figures on the left show the clamped 1.2/50 µs surge voltage differential mode and common mode waveforms and its protection levels U_p as function of clamped 8/20 µs surge current I_c. The corresponding voltage protection levels U_p as function of clamped surge current I_c can be found in the datasheet. The initial common mode clamping voltage U_1 has an extreme short duration (approx. 50-100 ns) and will be completely absorbed by the driver; it will not result in significant surge stress to the connected LED module and can therefore be ignored.

Wiring

Achieving the specified protection levels on page 10 is possible if:

- incoming mains wires are routed first to the Surge Protector and from there on to the driver input.
- mains wires between the Surge Protector and driver are kept as short as possible.
- ground wire between the Surge Protector and the luminaire housing / LED module heatsink is kept as short as possible.

It is therefore not recommended to remotely mount the device such as in a pole or remote distribution box. In cases remote mounting is the only option, it is necessary to perform additional measurements in the luminaire to define the maximum achievable protection levels.

When connecting the Surge Protector, it is strongly advised to adhere to the following EMC guidelines:

- keep all wires short
- keep wiring loop areas small
- ensure that mains wires are kept separate from low-voltage signal circuit wires.

Respecting these rules, will minimize the distance and wire length between the device and the mains voltage entry point.

Insulation Class I and Class II luminaires

The main differences between an insulation Class I and insulation Class II luminaire are about its failsafe construction with respect to electrical safety.

In a Class I luminaire, electrical safety is achieved by a combination of basic insulation between live parts and accessible parts and establishing a protective earth connection (PE) to accessible parts (luminaire housing). Luminaire insulation strength is based on basic system insulation requirements.

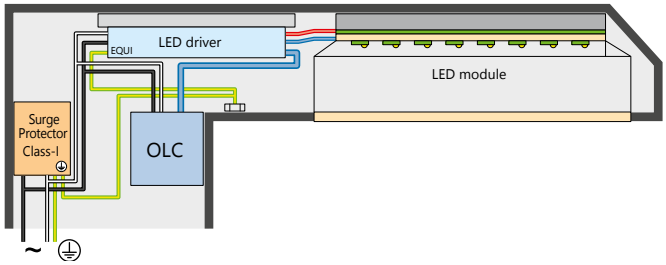
A Class II luminaire does not have a protective earth. In this case, electrical safety is achieved by providing double or reinforced insulation which are subject to elevated insulation strength requirements.

Integration in an Insulation Class I luminaire

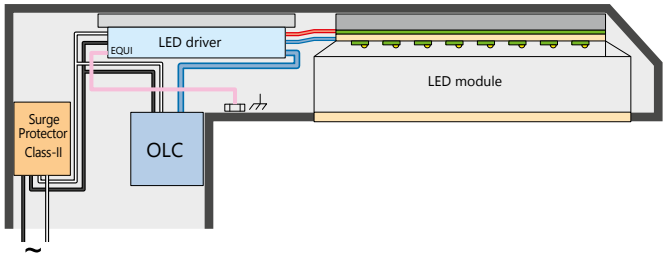
In an insulation Class I luminaire, technically both Surge Protector Class-I and II are allowed to be used. However, the Class-II types cannot provide common-mode surge protection. Therefore, it is highly recommended to use the Class-I type instead: this configuration offers compliance with product safety as well as optimal protection against high differential-mode as well as common-mode surges.

Integration in an Insulation Class II luminaire

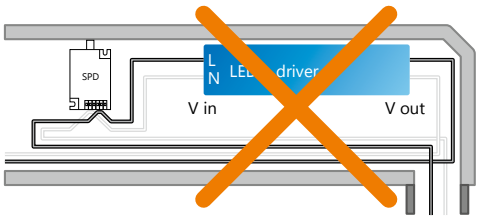
In an Insulation Class II luminaire only the Surge Protector Class-II is allowed to be used. This configuration offers product safety as well as optimal protection against high differential-mode surges.



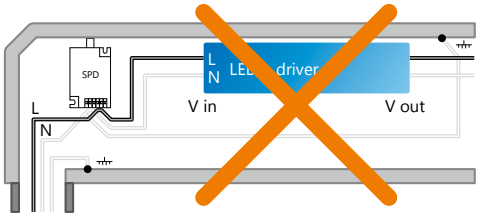
Correct wiring in an insulation Class I luminaire



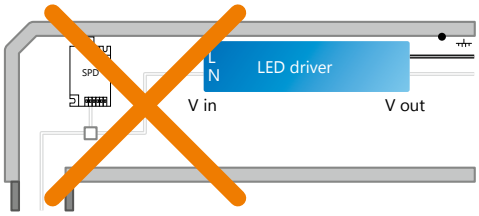
Correct wiring in an insulation Class II luminaire



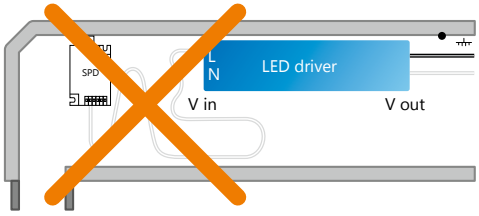
Example of Incorrect wiring



Example of Incorrect wiring



Example of Incorrect wiring



Example of Incorrect wiring

Incorrect wiring

If the Surge Protector is not wired correctly then it will not be able to protect up to the specified protection levels and damage to the luminaire may result. Examples of incorrect wiring include:

- Installing unprotected wires (wires which are not routed through the Surge Protector) in parallel with the protected output wires of the driver
- Crossing of mains and output wires or mains and output wires bundled together.
- Crossing of unprotected and protected wires
- Not connecting the input and output wires as a star point to the Surge Protector
- Unnecessary long wiring between the Surge Protector and the driver.
- Unnecessary long ground wiring between the Surge Protector and protective earth or luminaire chassis.

Fusing and mains power distribution system

Standard outdoor applications require fusing to protect the installation. Fusing above the value as specified in the datasheet is not allowed when applying the Surge Protector. Lower fusing values are allowed but may require shorter fusing servicing intervals since lower fusing values can handle less surge events before tripping. The Surge Protector has an extremely low power consumption and does not impact the inrush current so luminaire fusing is not affected by the Surge Protector.

In a TN mains power distribution system the neutral conductor (N) is connected to the earthed star point of a distribution transformer and is either connected to the star point via a separate conductor (TN-S) or it is (partly) combined with the protective earth conductor (TN-C, TN-C-S). The Protective Earth (PE) wire is also connected to the same star point and part of the distribution wiring to the end user.

In a TT mains power distribution system, the PE conductor is not part of the distribution wiring to the end user. Protective earth is locally sourced at the end user by means of an earth pin.

Please refer to the Surge Protector datasheet to find out which power grid versions are supported.

Quality / Testing

Compliance testing during luminaire release and manufacturing

The guidelines below describe how to test a Class I luminaire with the Philips Surge Protector Class-I.

Type testing of luminaire (at Certified Body):

Overvoltage protective devices which are connected to earth or a ground point shall be used only in fixed luminaires. A fixed luminaire is a luminaire that cannot be easily moved from one place to another, either because the fixing is such that it can only be removed with the aid of a tool, or because it is intended for use out of arm's reach.

Overvoltage protective devices which comply with IEC 61643 can be disconnected from the circuit for the dielectric strength test of IEC60598-1 sub clause 10.2.2, but only for fixed luminaires.

Factory testing (100%)

The ENEC 303 advises routine testing for luminaire manufactures to test electric insulation strength of insulation Class I luminaires as described in clause 1.3 (also known as high-pot test). Due to the nature of the Philips Surge Protector Class-I, an insulation strength test would automatically result in a failure as the trigger level of the device is below the testing voltage. In such a case, the note described in clause 1.3 allows that the insulation test may be carried out applying 500 VDC for 1 sec, with the insulation resistance of not less than 2 MΩ.

Sustainability

All components and materials used in the Surge Protectors are RoHS / REACH compliant.

Standards

Standard	Description
IEC61643-11	Surge protective devices connected to low-voltage power distribution systems
SPD specified for test class	T3

System Disposal

We recommend that the Surge Protector is disposed of in an appropriate way at the end of its (economic) lifetime. The Surge Protector is in effect a normal piece of electronic equipment containing components that are currently not considered to be harmful to the environment. We therefore recommend that this part is disposed of as normal electronic waste, in accordance with local regulations.

March 28, 2019 v2
Data subject to change.

www.philips.com/oem