PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES EFFECTS: COORDINATION BETWEEN EXTERNAL AND INTERNAL DEFENSIVE MEANS

GEWISS

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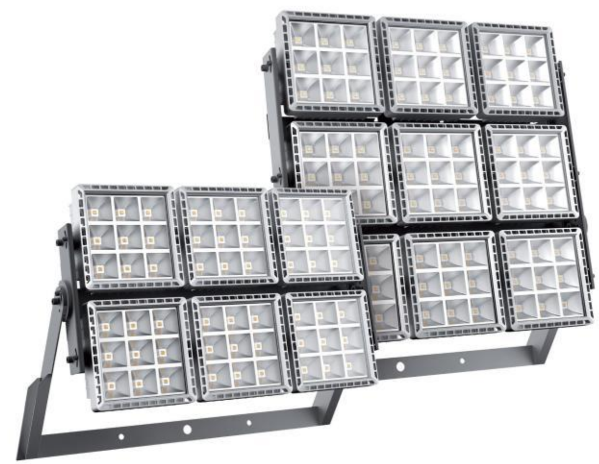
PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Programme of works

- **Problem to be fixed**
- **Overvoltages: types and origins**
- **Level of protection of luminaires against overvoltages**
- **Is it necessary to install external protective means ?: Risk analysis**
- **Main parameters for a proper evaluation and installation of the SPDs**
- **Final conclusions**



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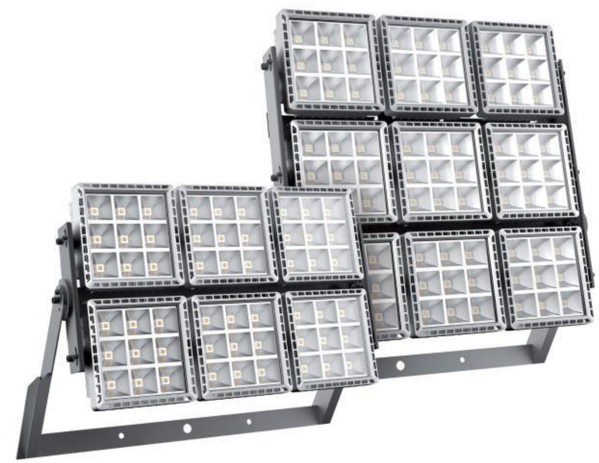


PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Problem connected with the use of LED technology

The increasingly vast use of LED technology within lighting devices has led to the need to ensure adequate protection against overvoltages in the network.

Indeed those devices are rather more sensitive against those stresses than the luminaires based on the traditional technologies.

The characteristics of transient overvoltages of atmospheric origin depend **at least** on the type of:

- line that supplies the luminaires (**underground** and/or **overhead**) and
- the area of installation (**Ng**= average annual ground flash density in lighting flashes per km^2 per year)

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

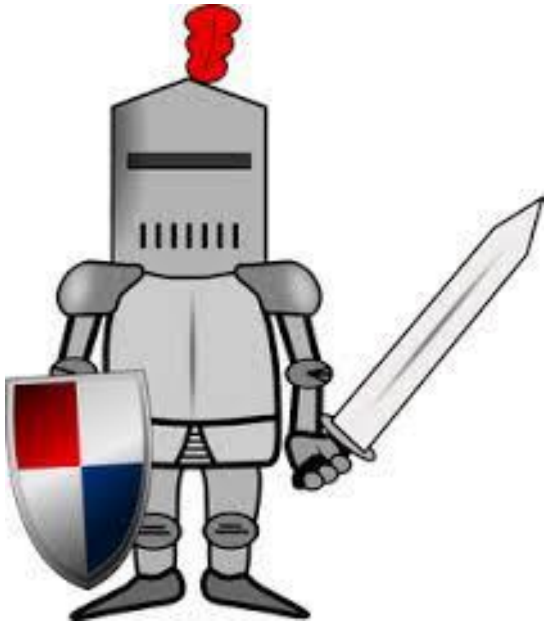
Coordination between the protection means

it is therefore important to evaluate the means by which it is possible to increase the level of service by either/both the use of:

- luminaires providing a **greater resistance** to such phenomena

and/or, where this is not possible

- **External SPDs** coordinated with the immunity level of the luminaires themselves.



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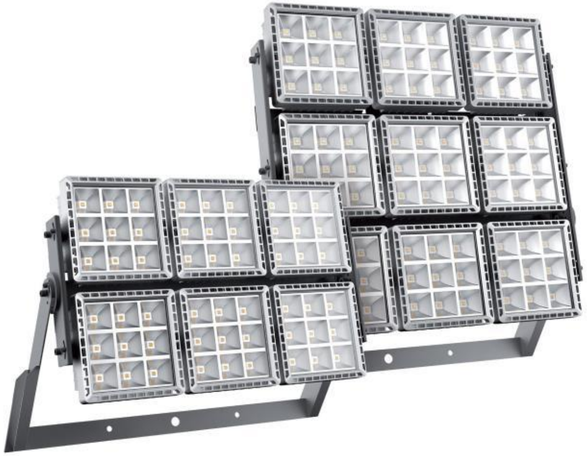

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Overvoltages from switching operations

There are two possible phenomena that would lead to overvoltage:

- Switching operations
- Lighting strikes

and two possible classifications for those events:

- Common mode
- Differential mode

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PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Overvoltages from switching operations

The overvoltages due to switching operations could be cause by:

- Disturbances connected to the switching operations of capacitive loads (e.g. accumulators);
- Strong and sudden changes in the loads (e.g. introduction of new heavy loads);
- Resonance phenomenon connected to switching devices;
- Faults such as short circuits or electric arcs affecting the installation's earth connection system.

These are phenomena characterized by:

- a **lower energy** content,
- **higher** frequency

and therefore could lead to a **progressive deterioration** of the luminaires.

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Overvoltages from lighting strikes

Lightning strikes are classified as follows**:**

- Directly affecting the power supply line of the devices by injecting high currents (up to 250 kA) capable of producing overvoltages through the earth resistance or line impedance;

- Indirectly disturbing the supply line (e.g affecting the ground nearby) and producing overvoltages through electromagnetic coupling phenomena;

- Indirectly affecting the supply line and producing overvoltages through the common earth connection system (e.g of the poles).

These are phenomena marked by:

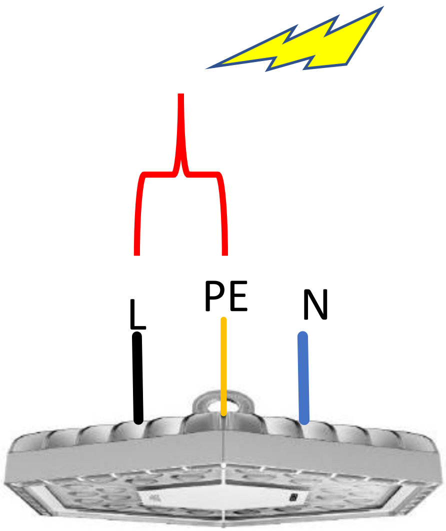
- an **extreme high energy** content,
- **lower** frequency

and therefore could cause sudden and permanent malfunctioning of the luminaires .

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Common mode

Common mode overvoltages occur between the line conductors (phase or neutral) and the earth:



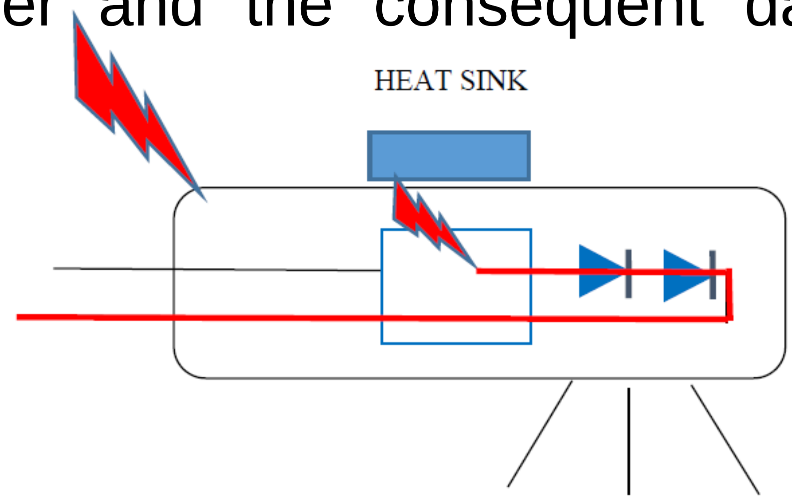
This type of stress causes an overvoltage between the conductors that assume the same voltage with respect to the earth and/or the metal casing of the device and is such that, when it becomes sufficiently high, it could be transferred by a flashover to the secondary directly affecting the **LED module.**

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Common mode

The reason for the **higher sensibility** of the luminaires based on LED technology against overvoltages is due to the need to guarantee sufficient heat dissipation which, in fact, lead the LED module (**PCB**) to be placed near suitable metal heat sinks.

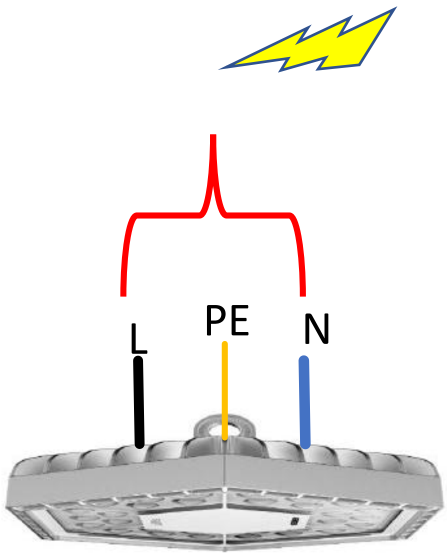
Therefore, there would be an insufficient distance to protect it against such phenomena and thus, an excessive overvoltage could cause a flashover and the consequent damage to the module.



Differential mode

Differential mode overvoltages occurs between the supply conductors (phase-neutral and/or phase-phase).

These normally affect the **driver** causing its possible damage but, if they assume high values, they could also affect the LED modules.



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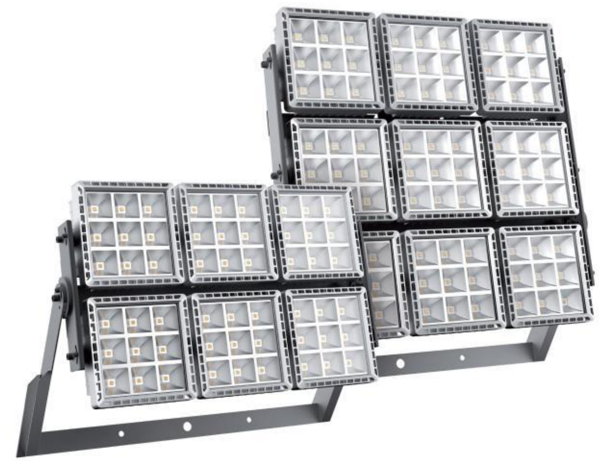

Measurement of the withstand voltage against the surges (**Usurge**).

In order to provide adequate protection against such phenomena, it is therefore necessary to verify that the devices are able to guarantee an adequate protection against both types of stresses.

The parameter to be considered for this purpose essentially consists of the **withstand voltage against the surges** (**Usurge**).

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Measurement of the withstand voltage against the surges (**Usurge**).

The main parameter to be taken into consideration is the level of immunity of the luminaires against surges (**U_{surge}**) which is evaluated by the specific test according to the standard **IEC 61000-4-5.**

This test evaluates the luminaire's operational immunity capabilities and is performed with a combination wave generator (1,2/50, 8/20) to establish where a malfunction, error or failure can occur during the **luminaire normal operations**.

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Measurement of the withstand voltage against the surges (**U_{surge}**).

In case of a.c. devices, five positive and five negative impulses each at 0º, 90º, 180º and at 270º by a generator able to provide the following combined waves:

	Front time T_f µs	Duration T_d µs
Open-circuit voltage	$T_f = 1{,}67 \times T = 1{,}2 \pm 30$ %	$T_d = T_w = 50 \pm 20$ %
Short-circuit current	$T_f = 1{,}25 \times T_r = 8 \pm 20$ %	$T_d = 1{,}18 \times T_w = 20 \pm 20$ %

IEC 6100-4-5

When the generator output is connected to the luminaire, the waveform of the voltage and current is a function of the luminaire input impedance.

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Type of performances according to IEC 61000-4-5

According to the behavior of the luminaires both during and after the tests, the following criterions are given:

- **Performance criterion A:** The device **must** continue to operate **as intended**;
- **Performance criterion B: temporary** loss or degradation of the performance is permitted as long as they disappear **autonomously** at the end of the stresses;
- **Performance criterion C: temporary** loss or degradation of performance is permitted, functional characteristics restored only **by a manual operation**;
- **Performance criterion D: permanet** loss or degradation in performance is permissible. This criterion is not permitted in the case of luminaires.

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Current level of **Usurge** according to IEC 61547

The standard IEC 61547 provides all the EMC immunity tests and the relevant minimum levels to be fulfilled by luminaires

Regarding surges the following minimum levels of immunity are provided:

Type of protection	Test levels for lighting devices	
	Input power	
	≤ 25 W	>25 W
Differential	± 0.5 kV	± 1.0 kV
Common	± 1.0 kV	± 2,0 kV

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Possibile solutions

This type of problem, linked to the greater sensitivity towards the impulsive phenomena of drivers and LED modules compared to the "traditional" ones, is leading to an evolution of the IEC 61547 standard with a consequent increase in the aforementioned values.

While waiting for the standard to be modified in this sense, manufacturers have started offering devices able to withstand overvoltages of higher values through the use of various technical solutions, such as for example:

- **Internal surge protection device** (SPD);
- Protected **drivers** through the use of appropriate input filters to increase the differential mode resistance;
- Suitable **reinforcement** of the **insulation** of the luminaires or by **patented technical solutions.**

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Possibile solutions

ELECTROMAGNETIC COMPATIBILITY LABORATORY

IMQ

IMQ S.p.A. - Società con Socio Unico
Via Quintiliano, 43 I-20138 MILANO
tel 0250731 - info@imq.it - www.imq.it

TEST REPORT
No. AI16-0001421-01

SURGE IMMUNITY TEST

performed in accordance with

☐ IEC 61000-4-5:2005
☒ EN 61000-4-5:2006
☐ CEI EN 61000-4-5:2007

PRODUCT	LED luminaire
MODEL TESTED	GWR5216M
TRADE MARK	GEWISS
APPLICANT	GEWISS S.p.A. - I - 24069 Cenate Sotto Via A. Volta, 1 (BG)

Tested by	Giordano Carcano *[Laboratory technician]*	
Approved by	Giovanni Di Turi *[Laboratory manager]*	

Revision Sheet

Release No.	Date	Revision Description
Rev. 0	2016-09-07	First edition Digital signed - AI16-0001421-01_TR EN61000-4-5_Electronic led appliance_GEWISS_GWR5216M

EXAMPLE OF TESTS (ROAD 5 RANGE) **12 kV**

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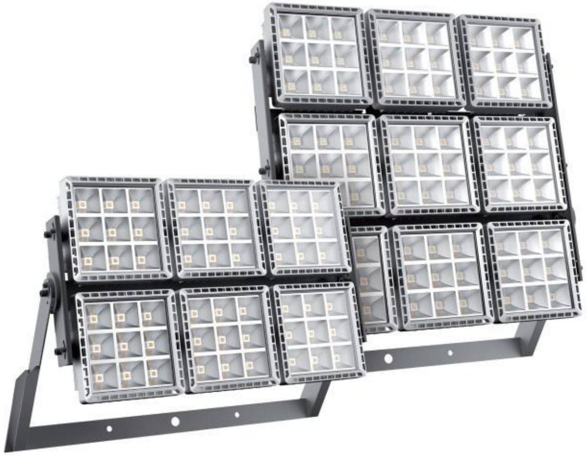

Risk calculation

Where it is still necessary to guarantee a higher resistance value than that guaranteed by the device, it may become necessary to foresee the installation of SPDs on the system.

This assessment can be made by comparing the **expected** level frequency of damages (F) and the **tolerated** level of damages (FT).

In order to calculate those values some parameters have to be taken into consideration.

Risk calculation: main parameters to be taken into consideration

Group A – Environmental

- **Lightning incidence and severity**

The base for the calculation is the parameter Ng is the annual ground flash density, which is the number of strikes/km^2/year.

- **Power-switching incidence and severity**

Luminaires near to, or on the same circuit as power-switching equipment, may suffer damage or degradation due to load-created transients.
Additionally, transients may be generated due to either power utility switching, system faults or internal disturbances at the load.

- **Topography**
    - Installation in a rural areas;
    - Installation on a top of mountains/hills.

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Risk calculation: main parameters to be taken into consideration

Group B – Equipment and facilities

- **Luminaire impulse withstand category (U$_{surge}$ and immunity level U$_{w}$)**

- **Earthing systems**
  - Earth resistance and impedance;
  - Layout and proximity;
  - Links to other earthing systems.

The most important thing is to get earth equipotential bonding by galvanic or SPD bonding.
Separated earthing systems shall be considered with care

- **Power system layout**
  - Overhead;
  - Underground;
  - both.

Although buried LV power cables offer lower risk than overhead power lines, direct lightning strikes in the vicinity of buried cables can cause substantial overvoltages, especially in case of **high resistivity soils.**

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Risk calculation: main parameters to be taken into consideration

Group C – Economics and service interruption

- **Service degradation or loss of service**

Disruption and damage causes operational difficulties to business (e.g. luminaires in production areas) . Service degradation may have a qualitative element that is additional to direct financial losses

- .**Repair or replacement of equipment or facilities**

Expected time to repair and restore operations will depend upon the availability of staff, spares, procedures, and information.

- **Emergency services**

Damage of equipment or injury to people may necessitate use of emergency services such as fire, ambulance, police, etc. which have an expense to a firm, person, or community.

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Risk calculation: main parameters to be taken into consideration

Group D – Safety

If safety risks to people exist from the dielectric breakdown of the luminaires (e.g. area with an high density of people, heavy traffic road) then use of SPDs should be considered.

Personnel safety is a key issue for designers and installers.

Occupational health and safety rules relevant to each country need be observed.

Group E – Cost of protection

- Design of installation
- Material and devices
- Installation of SPDs

Cost of protection includes SPDs, engineering design and supervision, and electrical installation.

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Risk calculation: main parameters to be taken into consideration

In case:

F >FT

it is necessary to reduce the level of F by using external SPDs according to the level of lightning protection levels (LPL) as calculated by the risk analysis method defined by the IEC 62305-2.

A simplified method is also provided by the IEC 60364-4-44.

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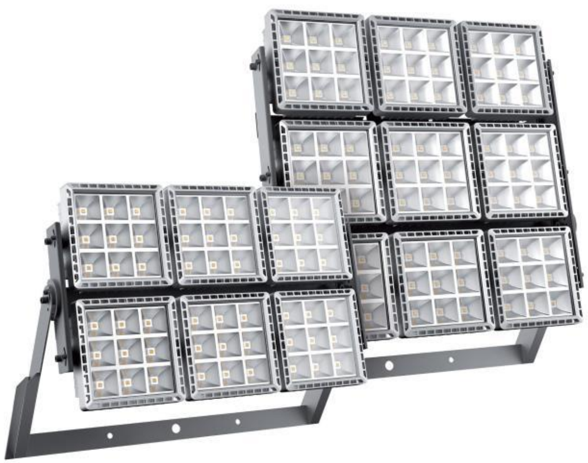


Main parameters

In order to make a correct choice of the SPD, the following parameters should be at least taken into considerations:

- **SPD type**
- **I_{imp} current Impulse discharge (10/350**
- **I_n nominal discharge current (8/20)**
- **SPD technologies**
- **U_p voltage protection level**
- **$U_{p/f}$ effective voltage protection level**

Class I SPDs

Type I SPDs are intended to be subjected to the lightning current impulses.

They are in most cases recommended for locations at points of high exposure, e.g., **main panel board or the base of the pole.**

They are tested with a 10/350 wave current to verify the **current Impulse discharge** $\mathbf{I}_{Imp}$.

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

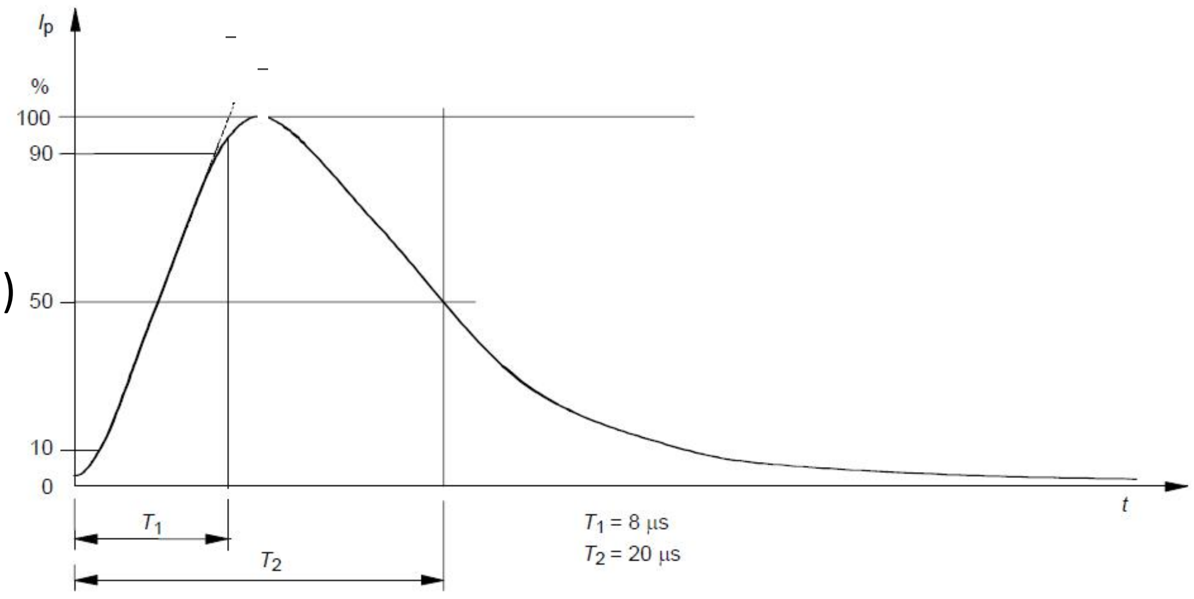
Shapes of the waves of the impulses

8/20 – Current from indirect lighting strikes

10/350 – Current from direct lighting strikes

1,2/50 – Overvoltages from lighting strikes

1st number = Front time in µs (T_1)
2nd number= Half value time in µs (T_2)



Class II SPDs

Class II SPDs are intended to simulate partial conducted lightning current impulses.

They are subjected to impulses of shorter duration and are intended to be installed **near the luminaires, e.g. near the luminaires to be protected.**

They are tested to establish the nominal discharge current I_n (8/20).

SPD technologies

The main protective components used in SPDs can be classified into the following types:

- **voltage-limiting components:** metal oxide varistors (MOV), avalanche breakdown diodes (ABD) or suppressor diodes, etc.;
- **voltage-switching components:** air gaps, gas discharge tubes, thyristor surge suppressors (TSS), triacs, etc.;
- A combination of the above mentioned types.

Up voltage protection level (IEC 61643)

maximum voltage to be expected at the SPD terminals due to an impulse stress with defined voltage steepness and an impulse stress with a discharge current with given amplitude and waveshape

it is equal to or greater than, the highest value of the measured limiting voltage.

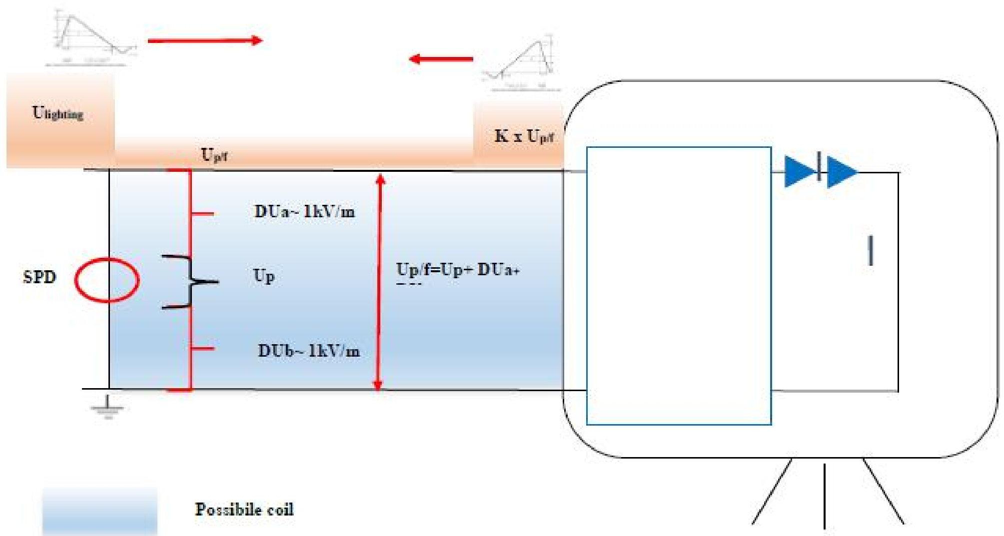
*U*p/f effective voltage protection level (IEC 61643)

voltage at the connection point of the SPD assembly resulting from the voltage protection level of the SPD with possible disconnector and the wiring voltage drop in the leads/connections

Calculation of the $U_{p/f}$

In any case, the following issues shall be also considered:

- The connection circuit from the main line to the SPDs terminals;
- The oscillation phenomenon which could cause an overvoltage up to twice the original value;
- Possible loop between the SPD line and the luminaires to be protected.



PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Influence of the length of the connections

In order to achieve a proper protection, the length of the conductors connecting the SPDs shall be as short as possible. Long connection conductors would degrade the effectiveness of the protection offered by the SPD.

Therefore, it may be necessary to select an SPD with a lower voltage protection level, in order to provide efficient protection.

Influence of the length of the connections

The residual voltage transferred to equipment will be in the worst case the sum of the residual of the SPD and the inductive voltage drop along the connection (~ 1 kV/m).

This voltage is called ***Up/f*** and can be estimated with the following formula:

$$\Delta U = 0.1 \times I_{SPD} \times L \ (kV)$$

where:

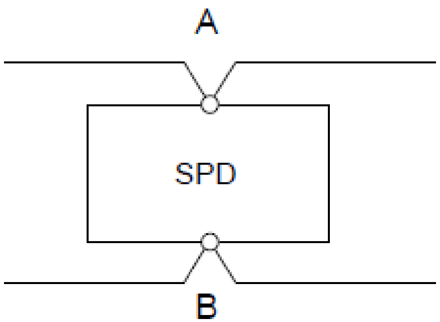
- I_{SPD} is the current flowing through the SPD (kA);
- L is the length of connecting leads (m) (in general ≤ 0.5 m).

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Influence of the length of the connections

In order to reduce this problem, the following solutions would be adopted:

- Connect the SPD to the metallic frame of the board or pole (class I)
- Use a V connection (preferred)



IEC 61463-12

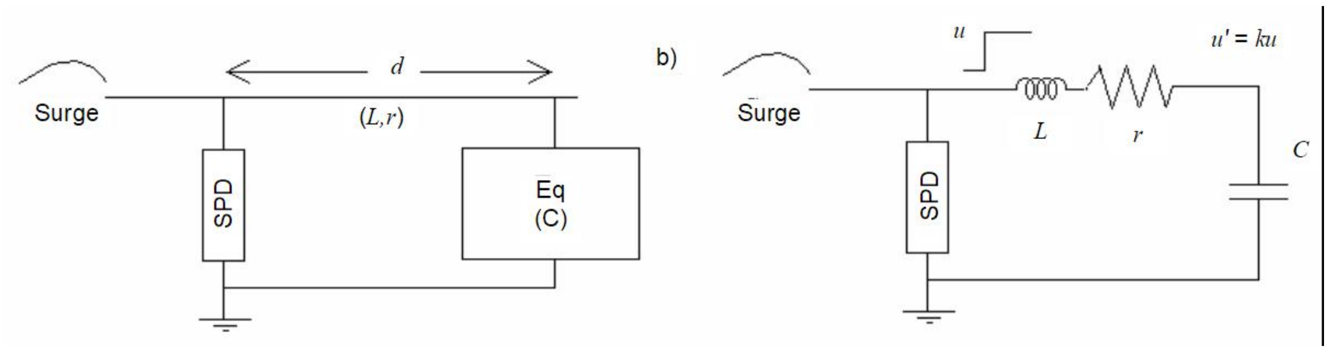
- Use twisted conductors.

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Oscillation phenomena

The acceptable distance (called **protective distance**) depends on SPD type, type of system, steepness (dU/dt) and waveform of the incoming surge and the connected loads.

In particular, this doubling is possible if the equipment has a high impedance, is acting as a capacitor or if the equipment is internally disconnected.



IEC 61463-12

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Oscillation phenomena

When an SPD is used to protect specific equipment inside the installation, SPDs should be installed **as close as possible** to the equipment to be protected.

If the distance between the SPD and the equipment to be protected is too great (e.g in case of SPD installed in a main board supplying a lighting line) oscillations could lead to a voltage:

$$DU = K \times U_p \quad (1 \leq k \leq 2)$$

This can cause a failure of the luminaires being protected, **despite the installation of a SPD.**

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Oscillation phenomena

In general, oscillations may be disregarded for distances:

$$L \leq 10 \text{ m}$$

Sometimes the equipment has internal protective components (for example varistors), that will significantly reduce oscillations even at longer distances. In this last case, care is necessary to avoid coordination problems between the SPD and the protective component inside the equipment.

Voltage induced in the installation

This phenomena is due to the voltage directly induced by the lightning current in the circuit loop existing between the SPD and equipment to be protected.

The induced voltage is mainly due to the size of the loop and it can be neglected by:

- Installed the cables inside **metallic** enclosures (e.g. **poles);**
- Using **twisted or shielded cables**.

Calculation of the **Up/f**

Therefore the theoretical maximum voltage Up/f at the luminaires voltage is calculated as follows:

$$U_{p/f} = U_p + D_a + D_b + k\,(U_p + D_a + D_b) + U_{coil}$$

$U_{p/f}$ is the proper value to be compared with the immunity level of the luminaire.

Difference between **Uw** and **Usurge**

Please note that:

$$U_w \neq U_{surge}$$

U_w value: the luminaires are tested switched off and only with the pre-set generator side test voltage. IEC 60664-1 is concerned with insulation coordination for equipment within low voltage systems (**insulation categories**).

U_{surge}: the luminaires are tested working by forcing the form of both the voltage (open circuit 1.2/50 μs) and the test current (short circuit 8/20 μs).

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Choice of the Up

In principle, the Up/f value offered by the SPDs should be at least lower than the impulse resistance value Uw of the lighting device unless it is necessary to guarantee an adequate performance of the devices during and/or after overvoltage: in this case the appropriate reference must be the Usurge.

$U_{p/f} \geq U_{surge}$ **Safety+ Performances**

$U_{p/f} \geq U_{w}$ **Safety**

SPD position

Main board:

Scope: to protect the equipment inside the board and to reduce the stresses from the supply lines (MV or LV)

Type: Type I (since it is subjected directly to the lighting currents

LPL/Pspd	I_{imp}
I / 0,01	10 kA
II / 0,02	7,5 kA
III-IV/ 0,02	5,0 kA

I_{imp}

Connection	Oscillation	Loop
No using V-connection or L≤ 0,5 m	No due to the extremely short connection	
DU=0,2 Up	k=1	Ui=0

Additional contributions to the SPD original Up

$$U_p < 0.8 \times U_W \,(U_{surge})$$

SPD position

Base of the pole

Scope: to protect the luminaires

Type: Class I (since it is subjected to the lighting currents in case the lighting would hit the line between the main board and the pole)

LPL/Pspd	I_{imp}
I / 0,01	10 kA
II / 0,02	7,5 kA
III-IV/ 0,02	5,0 kA

I_{imp}

Connection	Oscillation	Loop
No using V-connection	Yes	No the SPD is installed inside a metallic pole or if twisted or shielded cables are used
DU=0,2 Up	k=2	Ui=0

Additional contributions to the SPD original Up

$$U_p < 0.5 \times U_W (U_{surge})$$

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SPD position

Top of the pole

Scope: to protect the luminaires in case the formula $\mathbf{U_p < 0.5 \times} \boldsymbol{U_W (U_{surge})}$ is not fulfilled by the SPD installed at the base of the pole

Type: Class II

LPL/Pspd	I_n
I / 0,01	5 kA
II / 0,02	3,5 kA
III-IV/ 0,02	2,5 kA

I_n

Connection	Oscillation	Loop
No using V-connection	Yes	No the SPD is installed inside a metallic pole or if twisted or shielded cables are used
DU=0,2 Up	k=2	Ui=0

Additional contributions to the SPD original Up

$$\mathbf{U_p < 0.8 \times} \boldsymbol{U_W (U_{surge})}$$

Maintenance of the installation

It is important to note that the installation of SPDs at the top of the pole near the luminaires **has to be limited** due to the problems connected with the necessity to check and maintain those devices over the installation life.

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Need for additional SPDs

It is possible to avoid to install an additional SPDs near the luminaires in the following cases:

CASE 1:

The length of the SPD connection **does not exceed** 0,5 m

the distance between SPD and equipment is **shorter** than 10 m

$U_p < 0.8 \times U_W (U_{surge})$

CASE 2:

The length of the SPD connection **does not exceed** 0,5 m

the distance between SPD and equipment is **greater** than 10 m

$2 X U_p < U_W (U_{surge})$

CASE 3:

The length of the SPD connection **exceed** 0,5 m

the distance between SPD and equipment is **shorter** than 10 m

$U_{p/f} < U_W (U_{surge})$

CASE 4:

The length of the SPD connection **exceed** 0,5 m

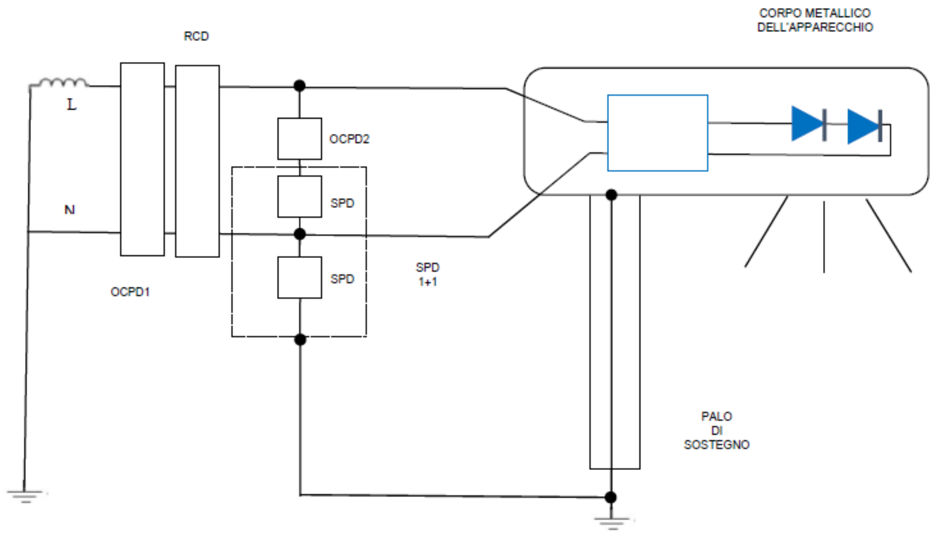
the distance between SPD and equipment is **greater** than 10 m

$2 X U_{p/f} < U_W (U_{surge})$

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

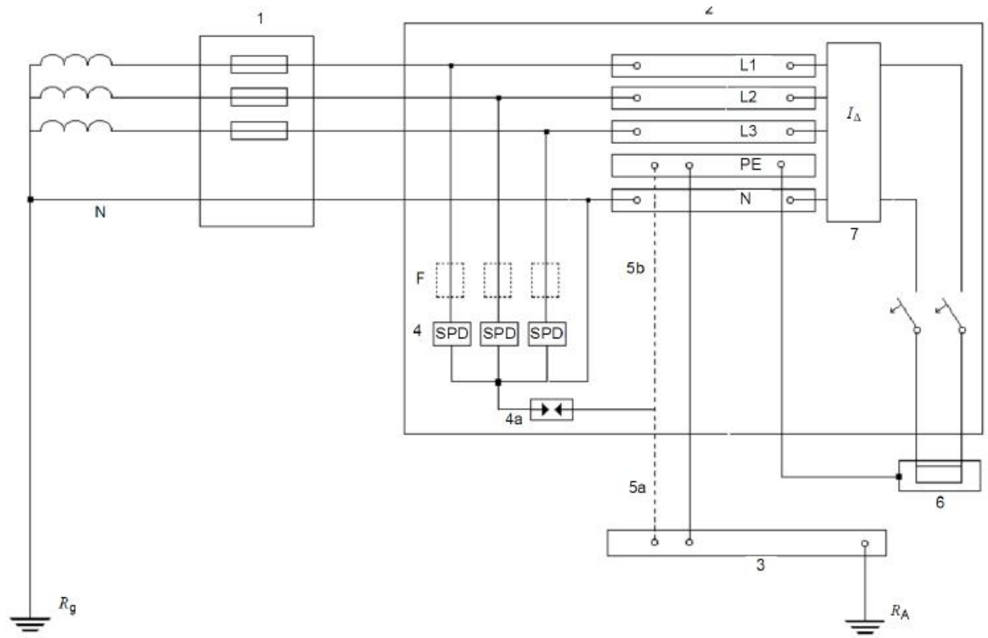
Class I TT System

In the case of a TT distribution network that supplies electrical systems, whose protection is carried out through the automatic opening of the power supply, overvoltage limiters should be provided for both the line and the neutral conductors unless the latter is effectively earthed



Class I TT System

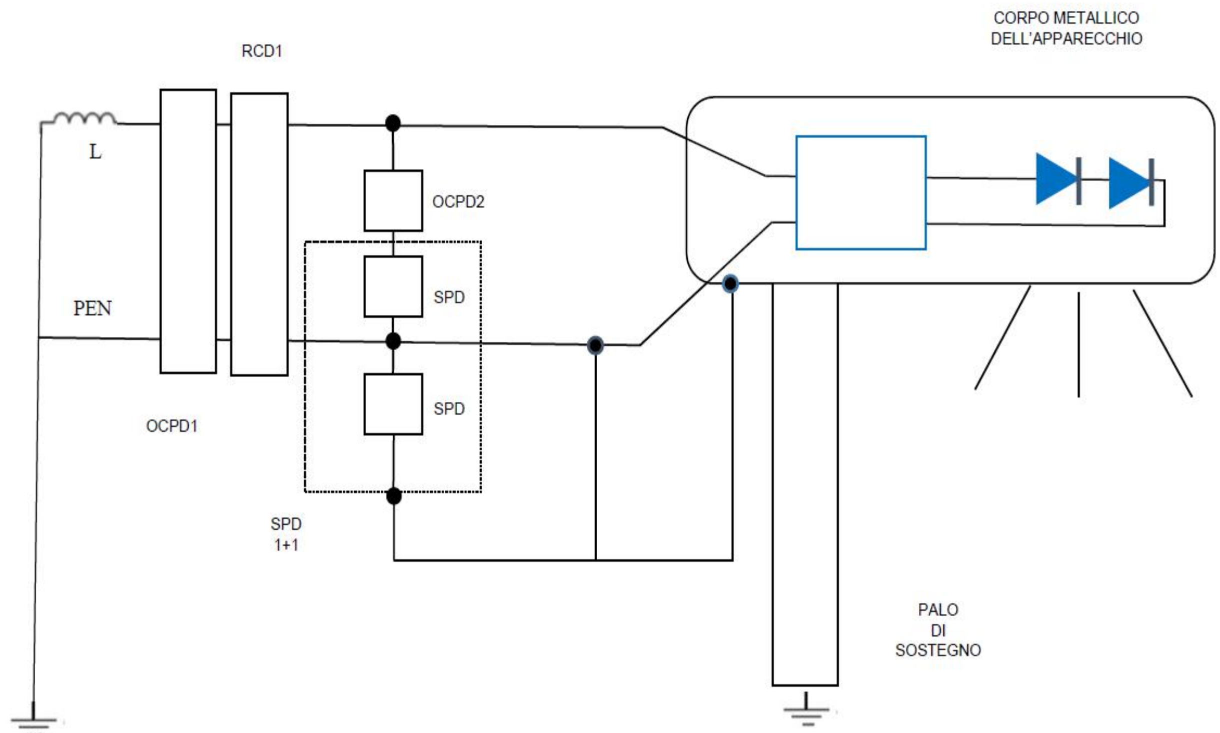
In the case of a TT distribution network, it is possible to install the SPD upstream the Residual Current Device by using the so called 1+1 (3+1) configuration.



IEC 61463-12

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

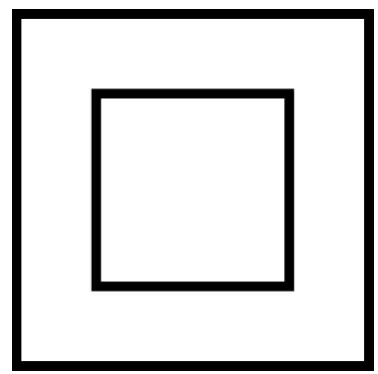
Class I TN System



PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Class II luminaires

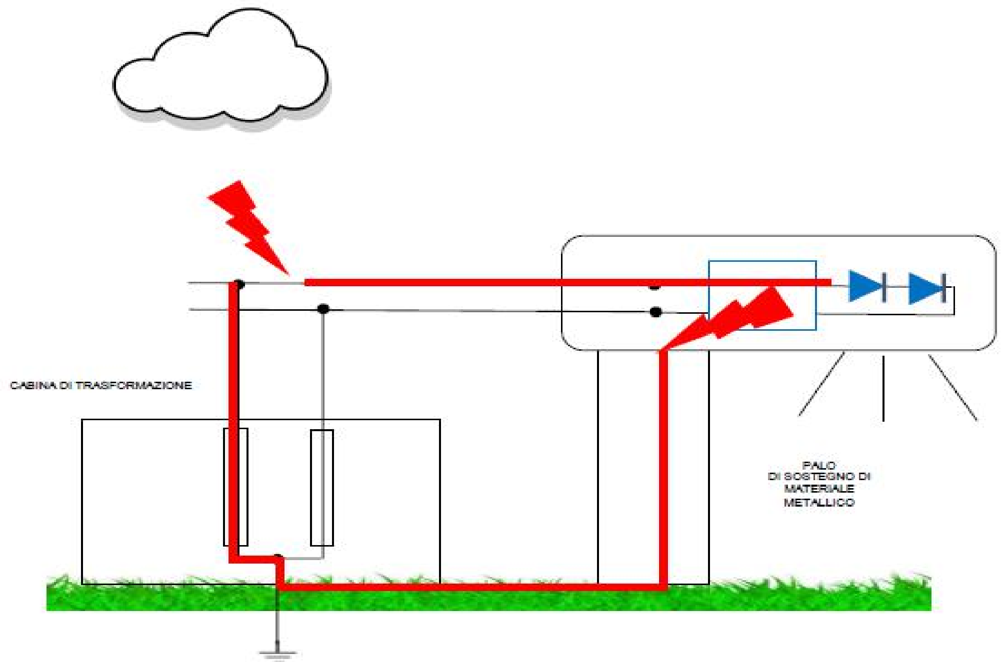
If , from the point of view of protection against the differential mode overvoltages, there are no particular application differences compared to what has been previously illustrated for class I devices, the protection of class II devices and systems is more complex if the **common mode** is considered.



PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Class II common mode protection

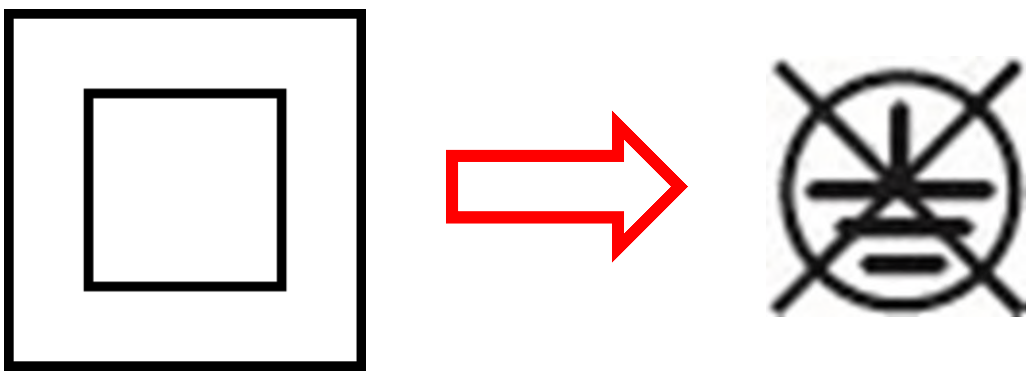
Although theoretically immune from this type of problems due to the fact that the external metal casing of the devices is not earthed, the use of metal poles on the ground and connected by means of supports to the luminaires, takes the situation to a similar condition, "de facto" to that which occurs in the case of class I devices connected to earth by the protective conductor.



Prohibition to connect Class II equipment to earth

In particular in case of class II installations, it is generally **forbidden to use SPDs for the common mode protection of devices and system.**

This prohibition derives from the impossibility of connecting the accessible conductive parts of class II components to earth, a prohibition that can be inferred from two different normative sources, depending on the fact that reference is made to the devices and/or the external system.



PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Prohibition to connect Class II equipment to earth

In the first case, it is the standard of the lighting devices itself (IEC 60598-1) that in chapter 4.32 defines the following requirement:

The overvoltage protection devices must comply with the IEC 61643-11. The overvoltage protection devices external to the power supply unit and connected to earth must only be used in fixed lighting devices and ***connected only to the protective earth***

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Prohibition to connect Class II equipment to earth

Likewise, this prohibition can derive from the system regulations, for example the document IEC 60364-7-714:

Exposed-conductive-parts and intermediate parts shall not be connected to a protective conductor unless specific provision for this is made in the specifications for the equipment concerned

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Prohibition to connect Class II equipment to earth

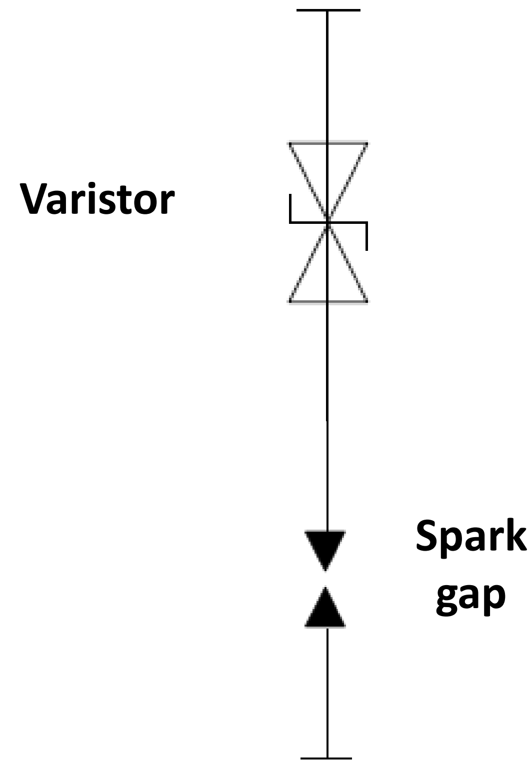
This prohibition derives from the observation that the risk that an exposed conductive part of a Class II device may become live due to the failure of the double and/or reinforced insulation of the device itself presents a considerably lower probability with respect to that the conductive part can assume a dangerous voltage due to a fault in another point of the system.

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

1+1 Configuration

The configuration generally defined as 1+1 is normally used for this type of application, consisting of the use of two devices connected to each other and constituted respectively by a varistor in series with a spark gap connected between neutral and earth.

This configuration avoids the problem deriving from the simple use of varistors if they are unable to interrupt the subsequent current at 50 Hz and, in this way, when the overvoltage ceases, the insulation to earth is restored.

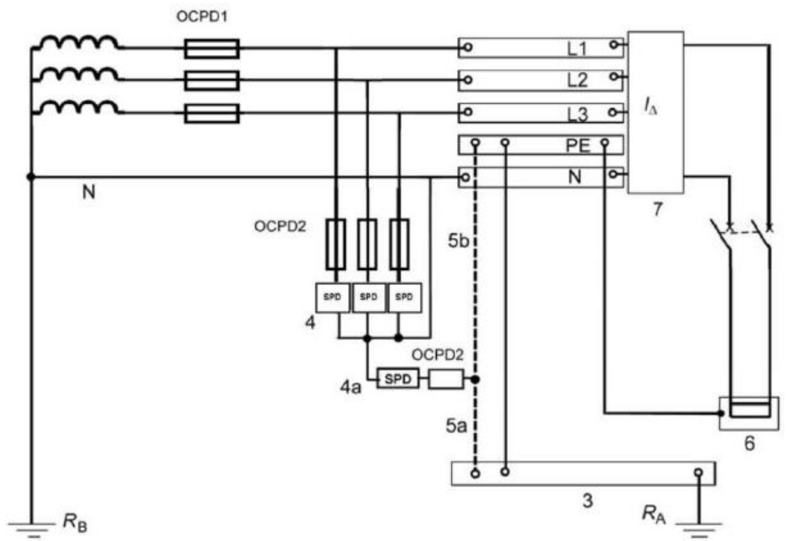


IEC 61643-12

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

1+1 Configuration

This type of solution is normally used when it is necessary to install SPDs upstream of the main residual current circuit breaker (e.g. in the case of internal LPSs), thus avoiding the formation of a permanent earth fault that could not be interrupted in any way by the residual current circuit breaker.



IEC 61463-12

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Equivalence with class II protection

The problem therefore arises of understanding if this type of solution is able to guarantee a degree of insulation equivalent to that guaranteed by double or reinforced insulation.

For obvious reasons, an SPD is clearly not able to pass the impulse voltage tests used to verify the adequacy of a double or reinforced insulation since specifically designed to intervene in the event that it is affected by overvoltage.

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Possibile alternative solution

The discussion about the feasibility of this type of solution is still ongoing: a possible alternative solution is represented by the use of class II luminares able **to guarantee, by construction, a considerable level of resistance to common-mode overvoltages** (even up to 12 kV).

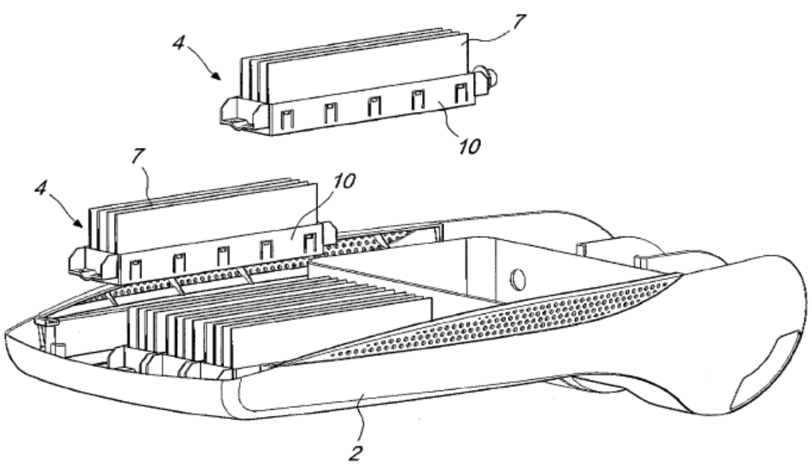


Fig. 2

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Possibile alternative solution

Both Class I or Class II luminaires offering both advantages and possible drawbacks and the choice shall be made according to the specific circumstances:

	Class I luminaires	Class II luminaires	Class II «reinforced»
Need to chek the RCDs and the earth resitance	**Yes**	**No**	**No**
Protection in case of differential mode OV	**Yes by internal/external SPDs or using reinforced driver**	**Yes by internal/external SPDs or using reinforced driver**	**Yes by internal/external SPDs or using reinforced driver**
Protection in case of common mode OV	**Yes by internal/external SPDs or using reinforced**	**?**	**Yes**
Need to check the SPDs correct operation	**Yes (common and/or differential mode)**	**Yes (differential mode)**	**No (only if the level of Usurge is not necessary)**

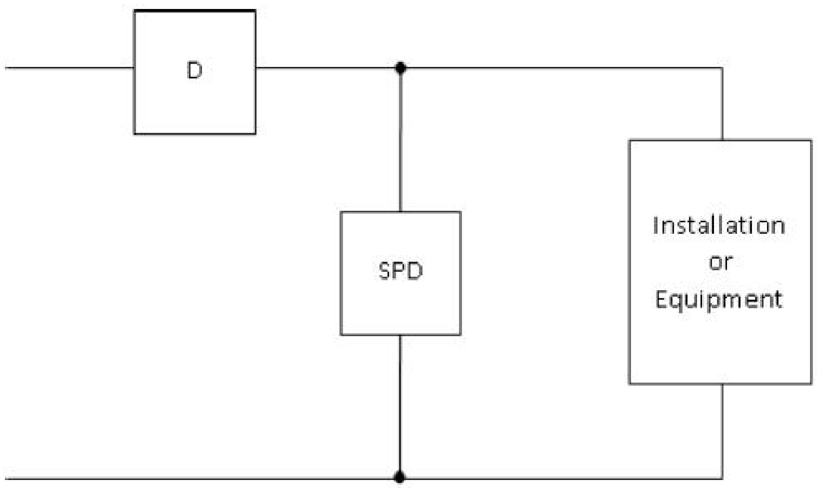
GEWISS

PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Position of the protettive devices

The protective devices may be installed at the beginning of the circuit in series with the luminaires:

- **Plus:** the protection against overvoltages is not affected in case the protective device would trip.
- **Minus:** lower level of the service since the tripping of the protective device would switch the whole line off.

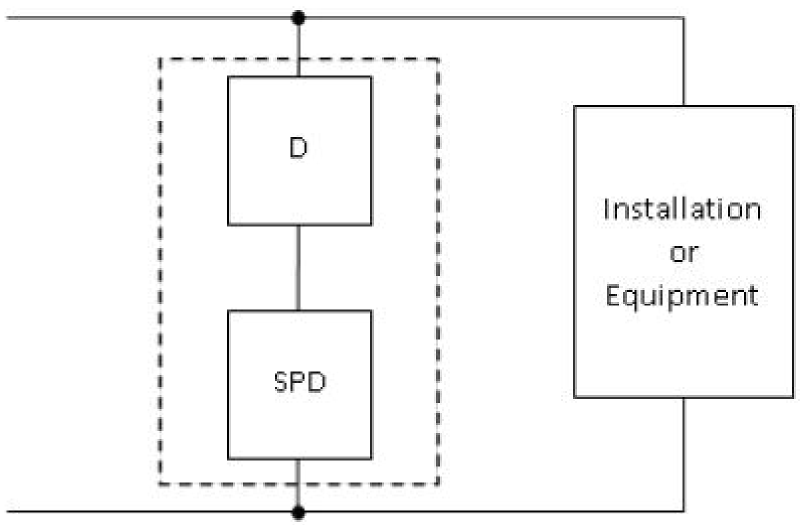


PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Position of the protettive devices

The protective devices may be installed in series with the SPD:

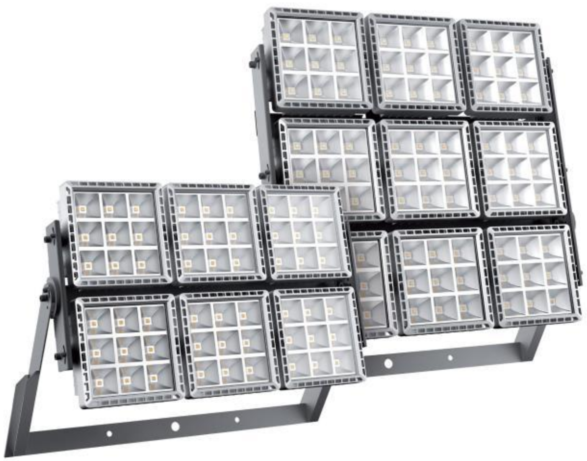
- **Minus:** higher level of service since the tripping of the protective device would switch off only the SPD.
- **Plus:** the protection against overvoltages is affected in case the protective device would trip.



PROTECTION OF LUMINAIRES AGAINST THE OVERVOLTAGES

Programme of works

- **Problem to be fixed**
- **Overvoltages: types and origins**
- **Level of protection of luminaires against overvoltages**
- **Is it necessary to install external protective means ?: Risk analysis**
- **Main parameters for a proper evaluation and installation of the SPDs**
- **Final conclusions**



Final conclusion

The huge use of luminaires based on LED technology requires designers, installers and user to take the necessary measures in order to prevent them to failure to overvoltages stresses.

It can be made either/both by selecting luminaires with an high immunity and/or by setting a proper external protection means.

Thank you for the attention