SIEMENS

Cerberus® AlgoRex
Lightning and overvoltage protection for fire detection systems

Planning

Fire & Security Products

Siemens Building Technologies Group

Introduction

The increasing use of modern electronics in industry, business and the domestic sphere, inevitably leads to higher occurrences of faults and damage in equipment and systems caused by overvoltages from the effects of lightning. Similarly with fire detection systems, such interference and damage are, apart from the costs involved, annoying for customers, the fire department and insurers.
The planning and installation of lightning and overvoltage protection systems for electronic equipment and systems calls for specialist know-how.

Lightning is not a high frequency event!

In the first place, high overvoltages and overcurrents (in the kV or kA range) have to be diverted, which calls for high-performance protective devices.
Secondly, with the installation of protection devices, HF technology methods have to be used in order that they can achieve their protection capability.
The following guidelines are intended to help the installer of fire detection systems install the right protection devices professionally.

Definitions and abbreviations

BMA	Fire detection system
BML	Fire detection line
CC11	Fire detection system control unit
C-Bus	Local data bus (control unit, control panel, gateway)
D-Bus	Local fire detector bus
LON-Bus	Local data bus (floor indicator panel)
ÜSG	Overvoltage protection device
	Fire detector
	Basic protection
	Medial protection
	Ultimate protection
$L_{(1-3)}$	Phase conductor
N	Neutral conductor
PE 	Protection earth
PK	Potential free detection contact
	Earth

Due to strategic changes the overvoltage protection sector will be handled by the Leutron GmbH company.

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1 The effects of lightning

With lightning, we differentiate between remote, local and direct strokes.

1.1 Remote strokes of lightning

Remote strokes of lightning generate overvoltages which usually reach the fire detection system via the supply mains and remote transmission lines. The overcurrents thus generated are mainly below 100A and normally can be dealt with using a protective device with medium discharge capacity. Overvoltages and overcurrents from remote strokes of lightning can occur relatively frequently depending on the area (several times each year).

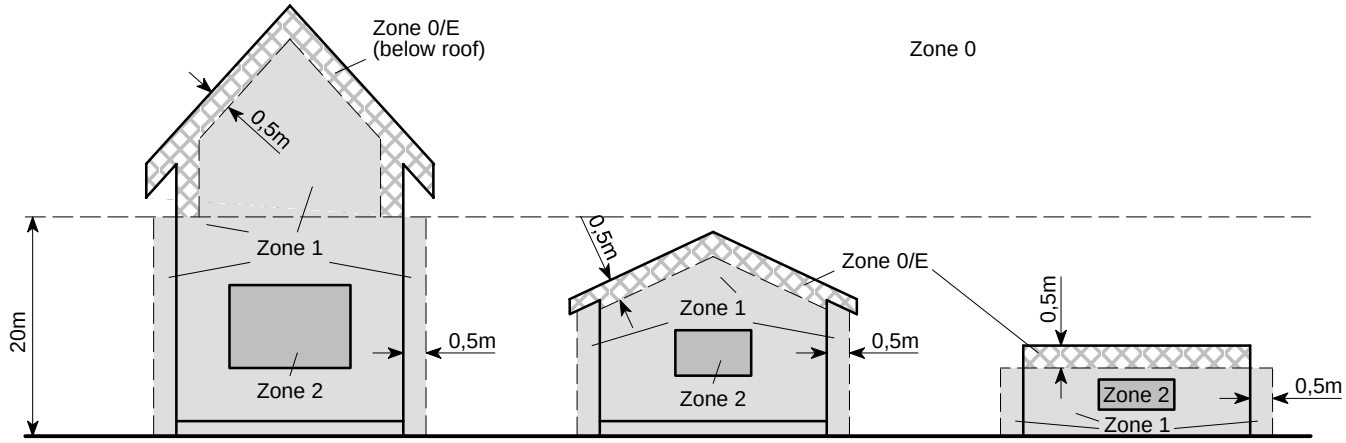
1.2 Local/direct strokes of lightning

Strokes of lightning which arise within 50m ... 100m of a building are known as local strokes. Direct strokes of lightning to a building usually happen in exposed, especially lightning hazard regions and with very high structures such as church towers, radio masts, castles etc.

Local and direct strokes of lightning are rather infrequent occurrences (once a year up to once every four years) but they do couple very high overvoltages with high currents of many kA into the line networks, which can result in correspondingly great damage. Thus, the cost of effective protection in fire detection and control lines would be disproportionately high.

→ Therefore fire detection and control lines are usually only optimally protected agains remote strokes of lightning.

2 Protection zones



Zone 0 (white)	outside the building
Zone 0/E (checked)	below the roof area (0.5m)
Zone 1 (light grey)	inside the building
Zone 2 (dark grey)	inside equipment

Fig. 1 Definition of the lightning protection zone concept

Zone definition

Zone 0
Lines and equipment which are installed outside the permanent building shell are assigned to zone 0 (e.g. outside applications).

Zone 0/E	
Buildings >20m high	Lines and equipment which are installed within 0.5m of the roof area and the outside walls are assigned to zone 0/E.
Buildings <20m high	Lines and equipment which are installed within 0.5m of the roof area are also assigned to zone 0/E.

Zone 1	
Building section >20m	Zone 1 is inside the building shell up to 0.5m below the roof area as well as to within 0.5m of the inside of the outer wall.
Building section <20m	Zone1 befindet sich innerhalb der Gebäudehülle, bis >0,5m unter Dachbereich, sowie bis <0,5m Distanz an der Aussenseite der Aussenwand.

Zone 2
Zone 2 is inside equipment such as a control unit, terminal, detector etc.

3 Overvoltage protection devices (ÜSG)

Overvoltage protection devices serve to reduce induced overvoltages on the supply mains or signal lines to a level which is not harmful to the equipment connected. They consist of gas discharge diverters, inductors and varistors and must be able to withstand current surges of sometimes up to 100kA. The overvoltage protection devices are divided in three categories: basic, medial and ultimate protection devices.

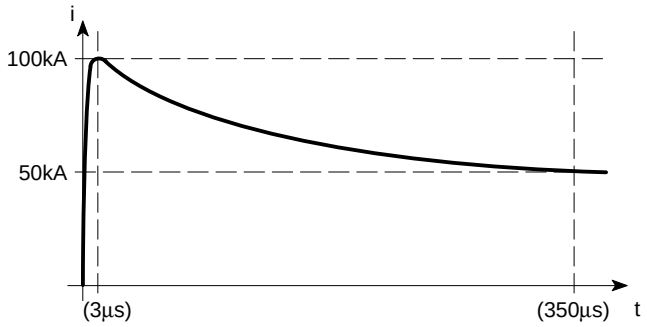


Fig. 2 Graph to show the development of a stroke of lightning

3.1 Basic protection devices (lightning conductors)

Basic protection devices (G) are installed between zone 0 and zone 0/E or between zone 0 and zone 1 and provide primary protection.

3.2 Medial protection devices (surge protectors) for the supply mains

Medial protection devices are installed at the junctions between zone 0/E and zone 1 as well as in lines which come from a basic protection zone. Our aim must always be to maintain adequate de-coupling between the basic, medial and ultimate protection devices (≥10m length of line or a corresponding inductor is necessary).

3.3 Medial protection devices (surge protectors) for telecommunications and data lines

Combinations of medial and ultimate protection devices are connected at the junctions between zone 0/E and zone 1, as well as in lines which come from a basic protection zone. The aim must always be to maintain adequate de-coupling between the basic, medial and ultimate protection devices (≥5m length of line or a corresponding inductor is necessary).

3.4 Ultimate protection devices (surge protectors)

Ultimate protection devices for the protection of telecommunication and data lines are usually already installed in electronic equipment and consist of Transzorb, suppressor and/or Zener diodes. Ultimate protection devices can only limit small overvoltages and overcurrents.
Purely ultimate protection devices are sufficient in lines which run exclusively through zones 1 and 2.

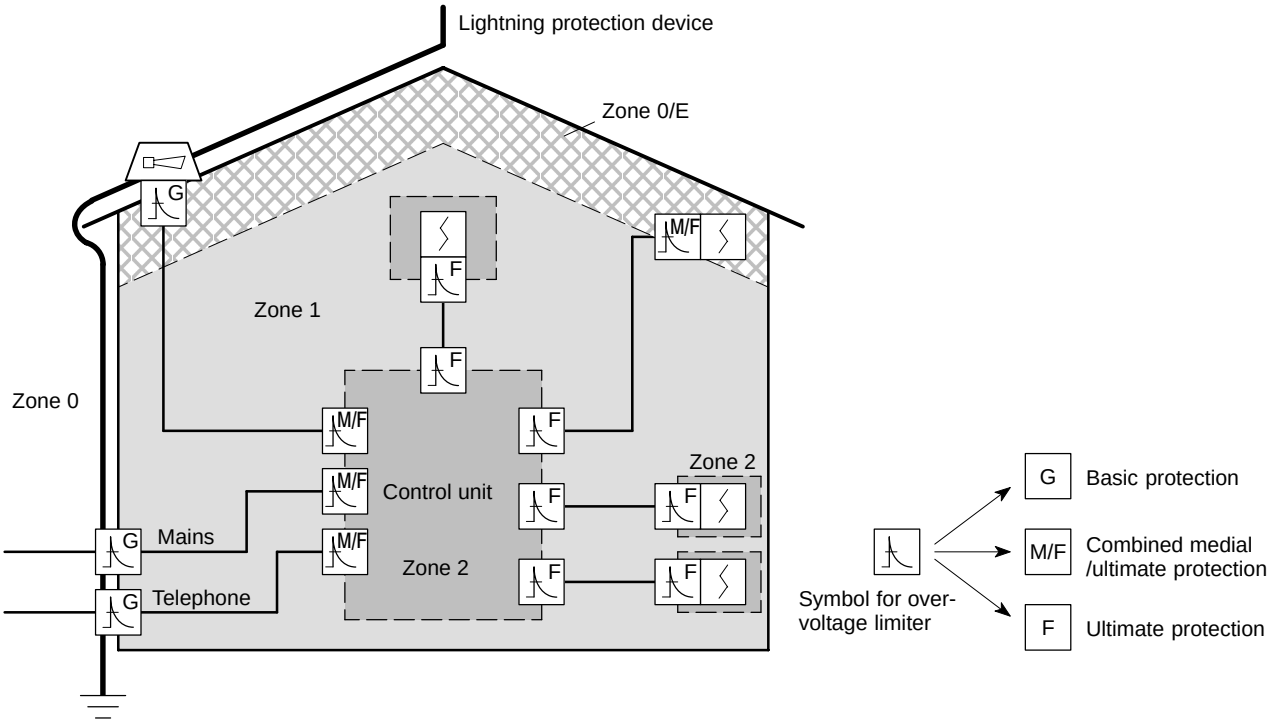


Fig. 3 Choice of suitable overvoltage limiters

4 Overvoltage protection devices (ÜSG) for Cerberus fire detection systems (BMA)

4.1 Supply mains

- The main danger to the fire detection system comes via the supply mains.
- In lightning hazard regions, therefore, the supply mains must be equipped with appropriate basic, medial and ultimate protection.

4.2 Telecommunication and data lines

- As telecommunications and data lines also usually exit a building, these lines also belong to high danger areas.
- Therefore in lightning hazard regions telecommunications and data lines must be equipped with basic and medial protection.
- Overvoltage protection devices must be chosen in compliance with the specifications for telecommunications or data lines.
- In general detection lines may be classified as telecommunication and data lines.

4.3 Fire detection lines

- Ultimate protection must be installed in all D-Bus users as well as in the corresponding line interface cards.
- Fire detection lines which leave buildings must also be equipped with basic and medial protection.
- Fire detection lines in church towers, parts of towers or castles are also endangered inside the same building.
- Fire detection lines are also endangered in roof areas and on outer walls as well as in long loop lines (>1000m).
- Loop lines need in the outgoing and return conductors corresponding overvoltage protection devices.

4.4 Protection measures for fire detection lines

We differentiate between the following protection measures:

Medial protection
Medial protection is usually adequate for very long loop lines, installations in the roof area or on outer walls, inside the same building.

With medial protection, the proposed protection measures are limited to the control unit, whereby the overvoltage protection device must be installed at the control unit input.

Simple basic protection
Simple basic protection is useful for tower constructions and church towers, or if devices have to be installed in the open air or on roofs.

With simple basic protection, in addition to medial protection, the junction with the zone 0/E must also be protected with a surge protection device.

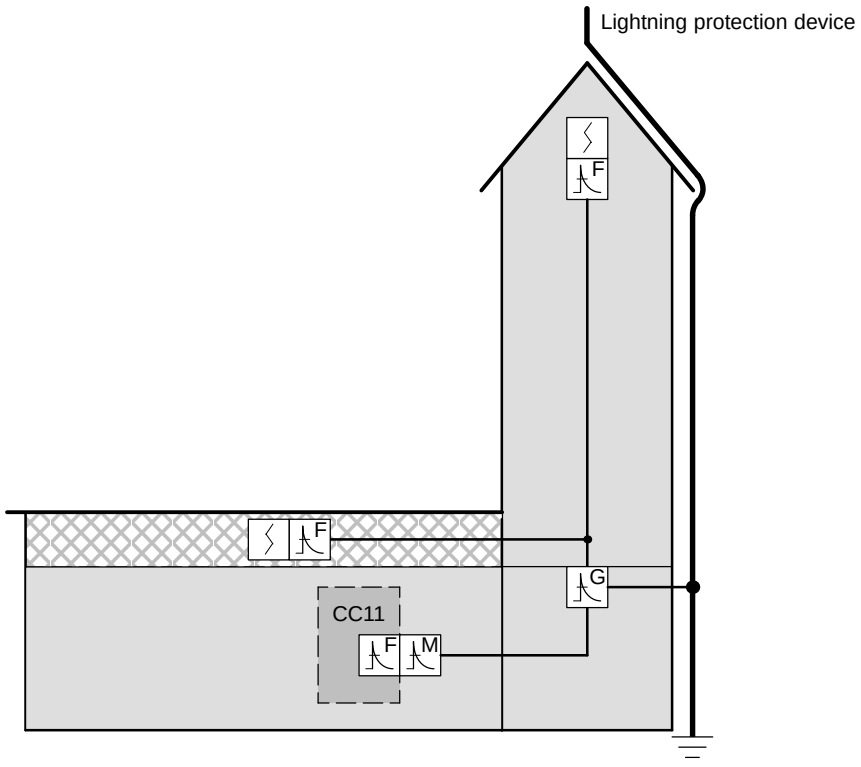


Fig. 4 Simple basic protection

Double basic protection

- Double basic protection is necessary for junctions to other buildings if the buildings are more than 50m apart.

→ With double basic protection, in addition to medial protection, an overvoltage protection device must be installed at each building entrance and exit.

Where possible avoid using overhead lines. However, if an overhead line has to be used, double basic protection is always essential.

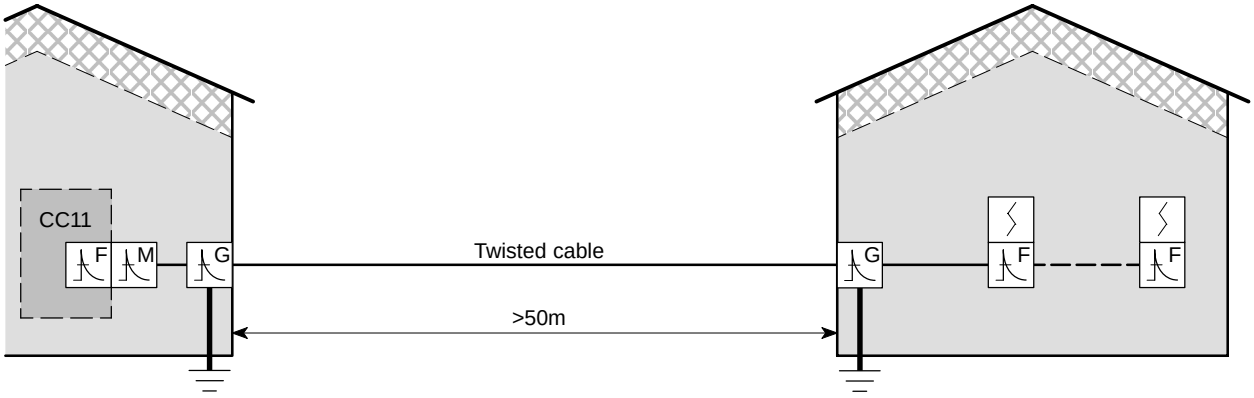


Fig. 5 Double basic protection

5 Requirements overvoltage protection devices and other filters must comply with when used for fire detection systems

5.1 Limit values of the overvoltage protection devices for different line types for fire detection systems

Bus type ▶ / Data ▼	AnalogPLUS lineInteractive line	Collective line	Supply lead 24V		LON-Bus
Capacitance	max. 10% of the max. permissible line capacitance	not critical	not critical	max. 1.4nF	max. 100nF
Inductance	≤1mH	not critical	not critical	max. 17µH	not permissible
Longitudinal resistance	must be calculated in with the max. line resistance	must be calculated in with the max. line resistance	must be calculated in with the max. line resistance	only cable resistance admissible	only cable resistance admissible
Nominal voltage	min. 36V	min. 36V	min. 36V	min. 20V	min. 20V
Continuous current	≥160mA	≥160mA	min. corresponding with the connected consumers	–	–
Pass frequency	0....≥20kHz	0....≥20kHz	not critical	–	–
Recommended filter type for medial protection	DataPro 2x1-36V/36V-Tr	DataPro 2x1-36V/36V-Tr	Choice dependent on current consumption (no recommendation)	Transzorb diode bidirectional 39V / 1.5kW/ms	Transzorb diode bidirectional 39V / 1.5kW/ms
Recommended filter type for basic protection	IsoProData 150V/150V-Tr	IsoProData 150V/150V-Tr	Choice dependent on current consumption (no recommendation)	Overvoltage protection device 90V / 20kA / 8/20µs	Overvoltage protection device 90V / 20kA / 8/20µs

5.2 Specification of overvoltage protection devices for the application of Siemens Building Technologies Cerberus Division fire detection systems

→ Overvoltage protection devices from the assortment of Leutron GmbH, D-70771 Leinfelden-Echterdingen

5.2.1 Medial protection

DataPro2x1-36V/36V-Tr

Mounted on U-shaped section according to DIN 5002

U nominal	36V/36V
I per core	300mA
R per core	4.1Ω
L per core	40µH

Transzorb diode, bidirectional

Type	1N6285A
Part number	478 632
U nominal	39V
Power	1.5kW/ms

5.2.2 Basic protection

IsoProData-150V/150V-Tr

Mounted on U-shaped section according to DIN EN 50022

U nominal	150V/150V
I per core	1.5A
R per core	0.3Ω
L per core	56µH

5.2.3 Block diagram / Dimensions

Overvoltage protection devices DataPro and IsoProData for Cerberus detector bus

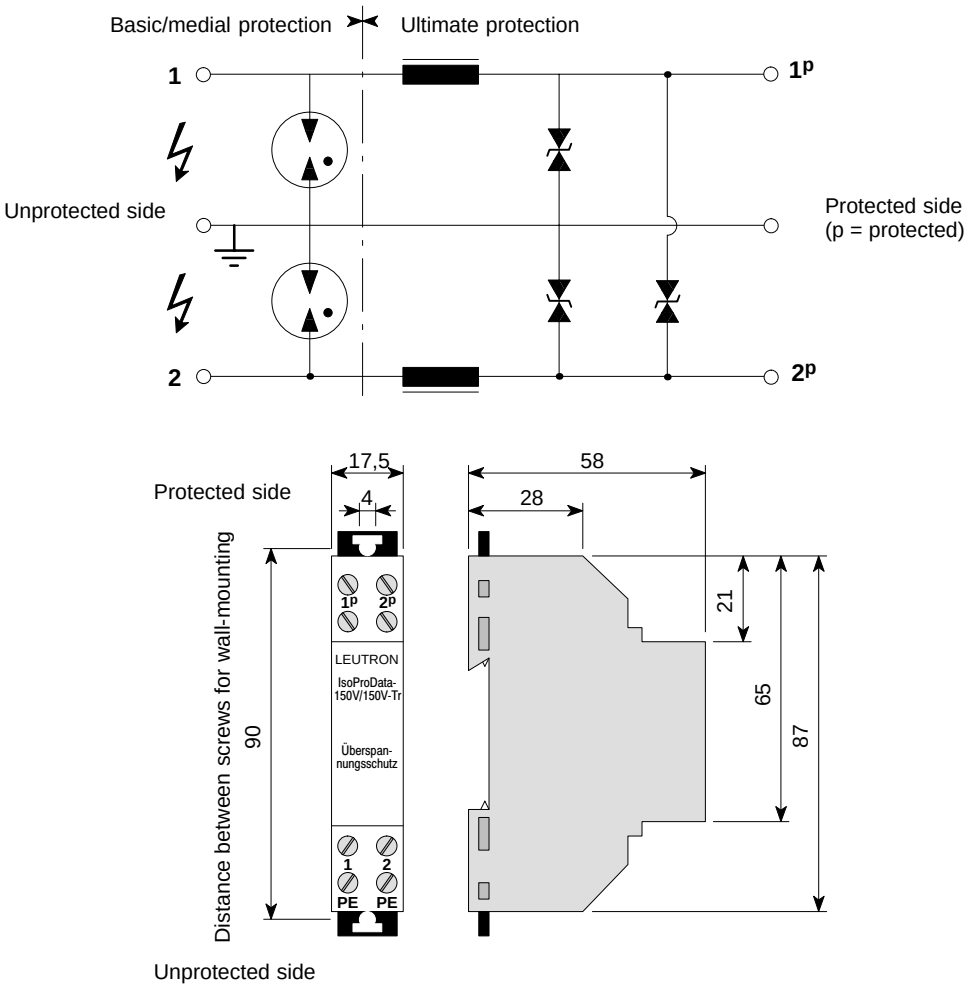


Fig. 6 Basic diagram and dimensions of the IsoProData-150V/150V-Tr voltage surge protectors

Voltage surge protectors and Transzorb diodes for C-Bus and LON-Bus

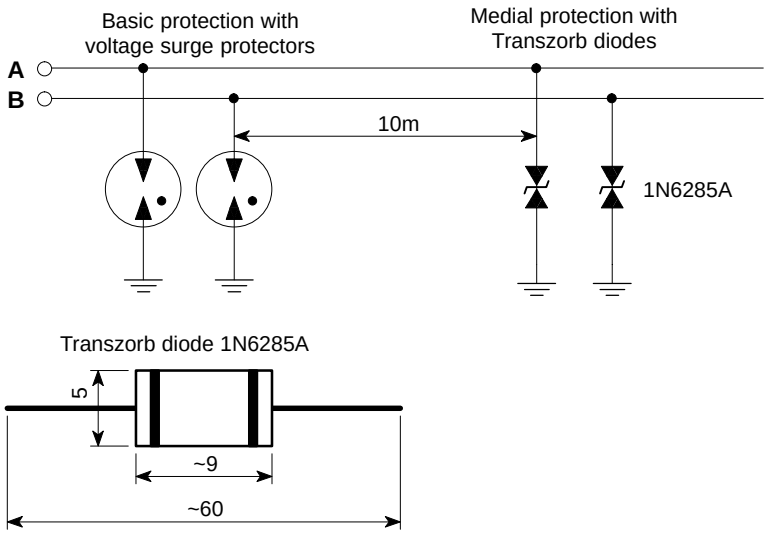


Fig. 7 Basic protection with voltage surge protectors and medial protection with Transzorb diodes

5.3 Mains leads

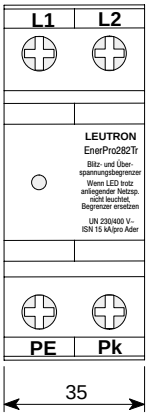
5.3.1 Medial protection

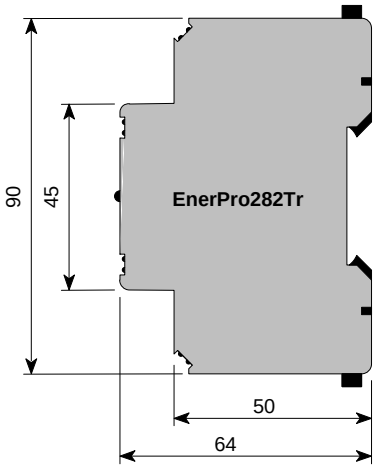
1x EnerPro282-Tr for single phase and neutral
2x EnerPro282-Tr for three phases and neutral
1x EnerPro283-Tr for three phases
➜ See also information in the control unit documents e1076 and e1260.

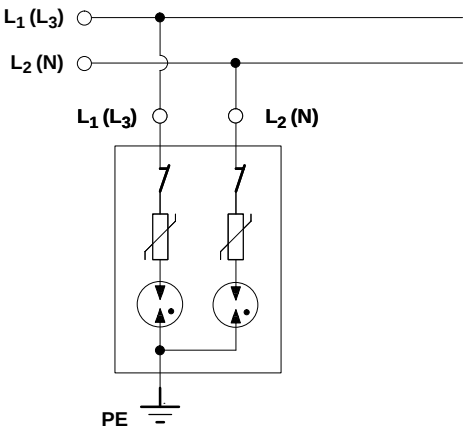
5.3.2 Basic protection

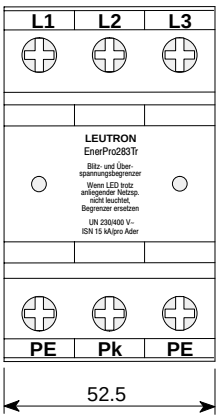
2x IsoPro230/400Tr/60kA for single phase and neutral
4x IsoPro230/400Tr/60kA for three phases and neutral

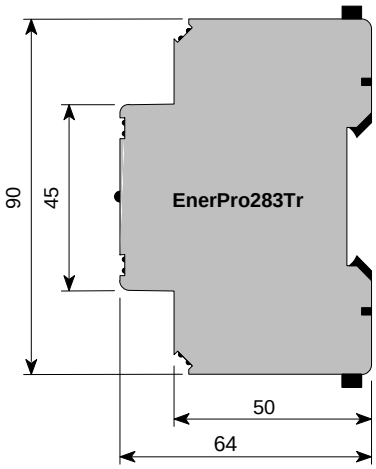
5.3.3 Block diagram / Dimensions

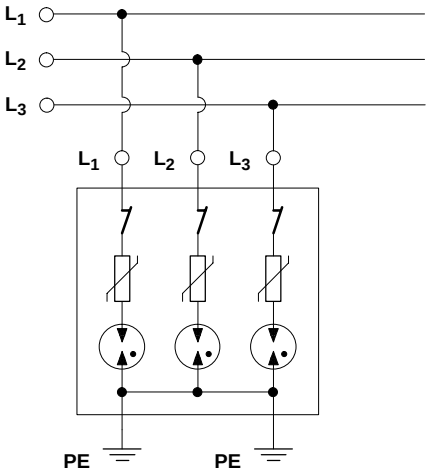


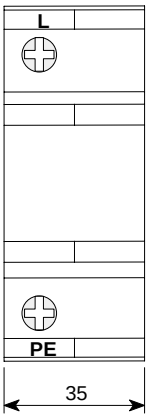


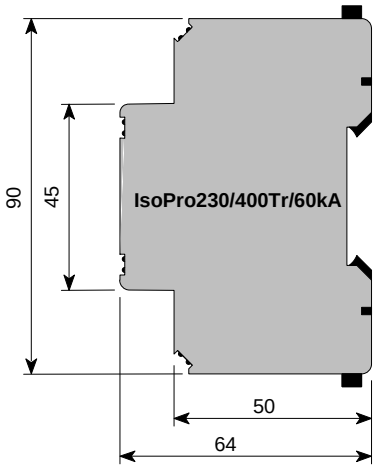


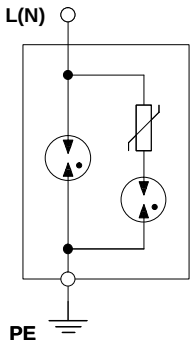












5.4 NEMP filters

NEMP filters may be used if their data lie within the limit values shown under section 6.1.

6 Installation instructions

Effective lightning and overvoltage protection can only be achieved using methods of HF technology. In addition to the choice of suitable overvoltage limiters, correct installation and earthing are of special importance.

6.1 Installation instructions for basic protection devices

The basic protection device must be installed as close as possible to where lines enter the building.
Earth conductors for basic protection devices of detection or signal lines in the extended zone 1, or in church or radio masts should be connected using a 6mm^2 copper lead to the equipotential bonding earth of the building or the lightning protection device.

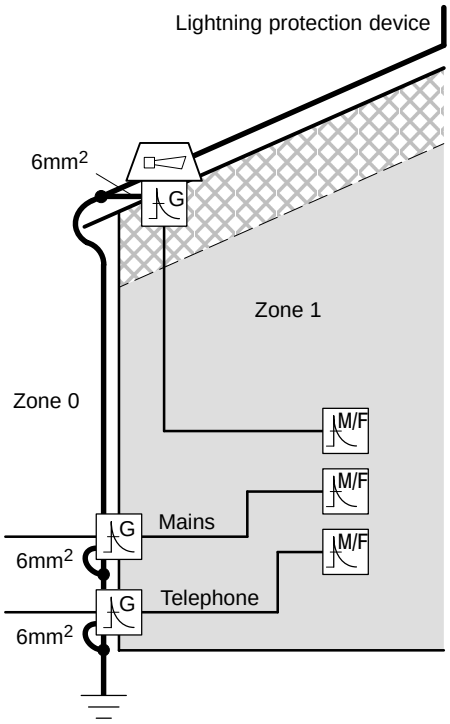


Fig. 8 Cross section of the earthing conductor: Copper wire min. 6mm^2

6.2 Installation instructions for medial and ultimate protection devices for telecommunication and data lines

Medial and ultimate protection devices must be installed close to the equipment to be protected (e.g. control unit).
Ensure that the control unit and overvoltage limiters have a single common discharge earth which is connected to the power line earth by a wire at least 1.5mm^2.

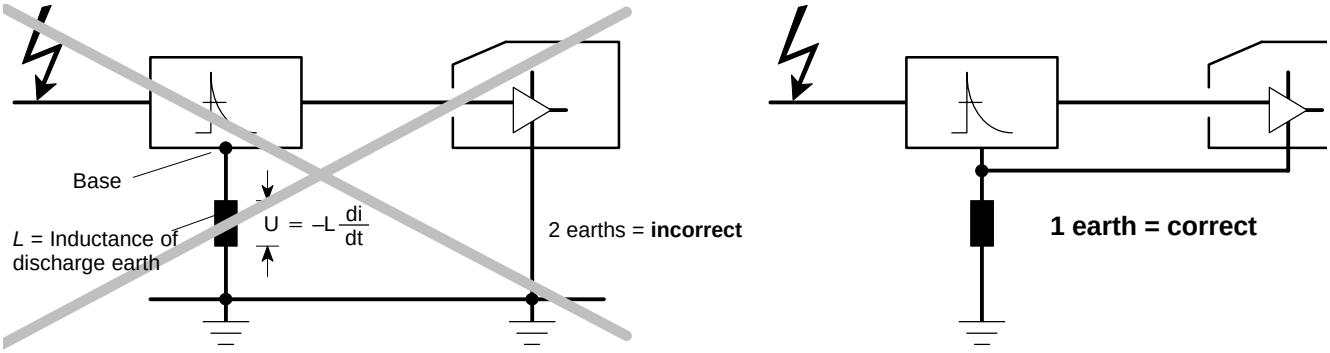


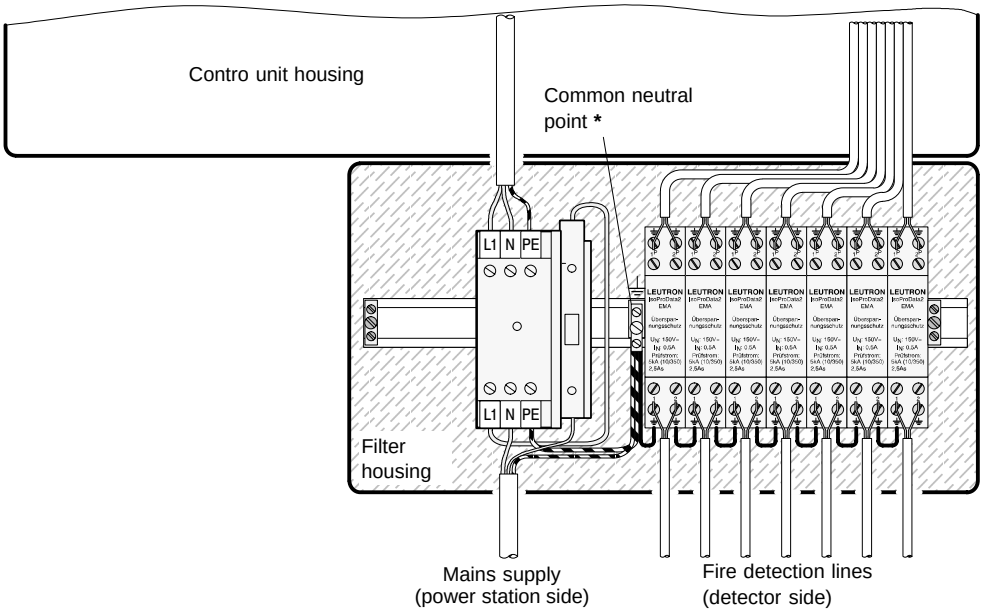
Fig. 9 In an arrangement using two separate discharge earths (drawing left) an overvoltage occurs at the equipment input which can lead to the destruction of the equipment
In an arrangement with **one** discharge earth for the overvoltage limiter and the equipment to be protected (drawing right) this effect is prevented

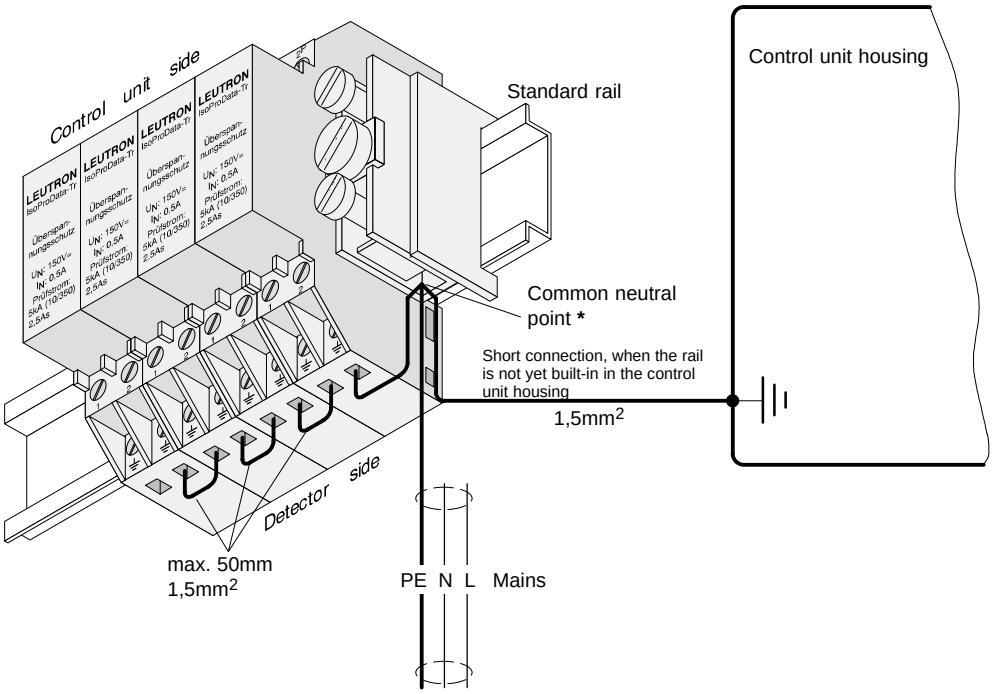
De-coupling is necessary between the basic and medial protection devices, which is achieved if the length of line between them is at least 10m. If the overvoltage protection device (IsoProData...Tr) is used, the corresponding de-coupling elements are already built in.
Upon the discharge of a partial lightning current, the discharge earth represents an inductive resistor *L* at which a voltage *U* drops. If installation is incorrect with two separate earths, an overvoltage arises at the equipment input which can lead to the destruction of the equipment.
All earth connections from medial and ultimate protection devices for each zone must have the same earth potential and therefore be located close together so that the inductance occurring can be kept low (<1µH).
Discharge earths must have a cross sectional area of at least 1.5mm^2 and should not be longer than 5cm. All earth conductors must be grouped together at the same neutral point. The U-shaped sections are not provided as earth connectors. The overvoltage protection devices mounted on the U-shaped section should not be more than 25cm apart. The earth conductor of the overvoltage protection devices can be connected together so that only 1 conductor need be fed to the neutral point.
Protected and unprotected lines must not be carried in the same bunch of cables, i.e. the overvoltage protection device input and output lines must never come together anywhere in the entire installation.

6.2.1 **Several filters** (5 upwards)

Install preferably in their own steel sheet housing flanged to the control unit housing (e.g. terminal box, part no. 433 224)
or
build into a compartment of the control unit housing separated by a metal dividing wall.

The common neutral point should basically be the earth terminal of the overvoltage protection device.





6.3 Cable with shielding

The cable shielding must be connected through each detector ***not earthed***, but connected on the control unit side to the protective earth direct. The other end of the shielding must be earthed locally via a high performance surge protector.

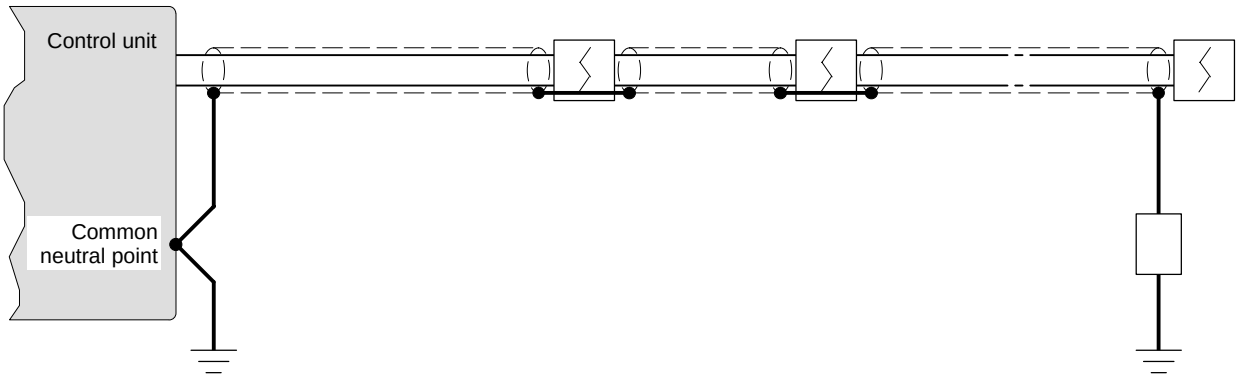


Fig. 10 Example: Stub line

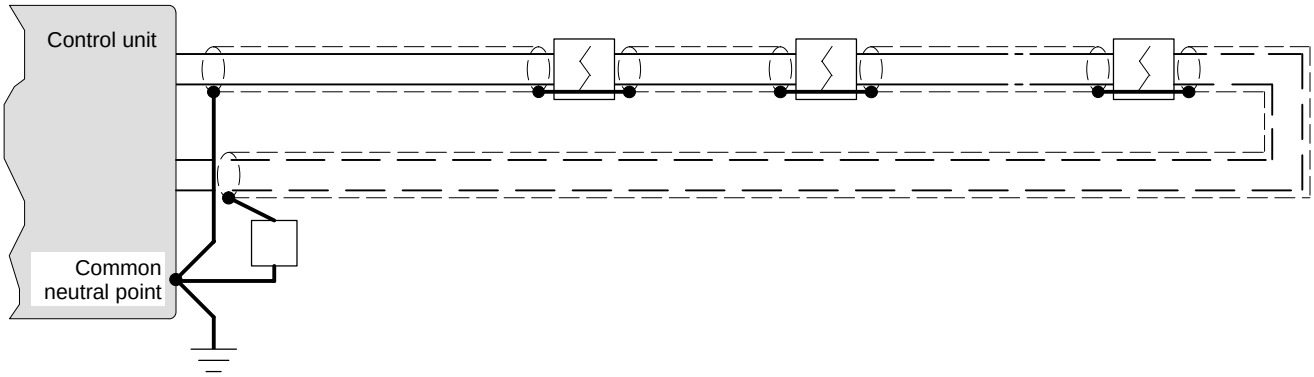


Fig. 11 Example: Loop line

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