Low voltage surge arresters - LOVOS

ABB Poland PTHV Division
Branch in Przasnysz

Overvoltage protection in low-voltage supply networks

An overvoltage protection is needed due to:

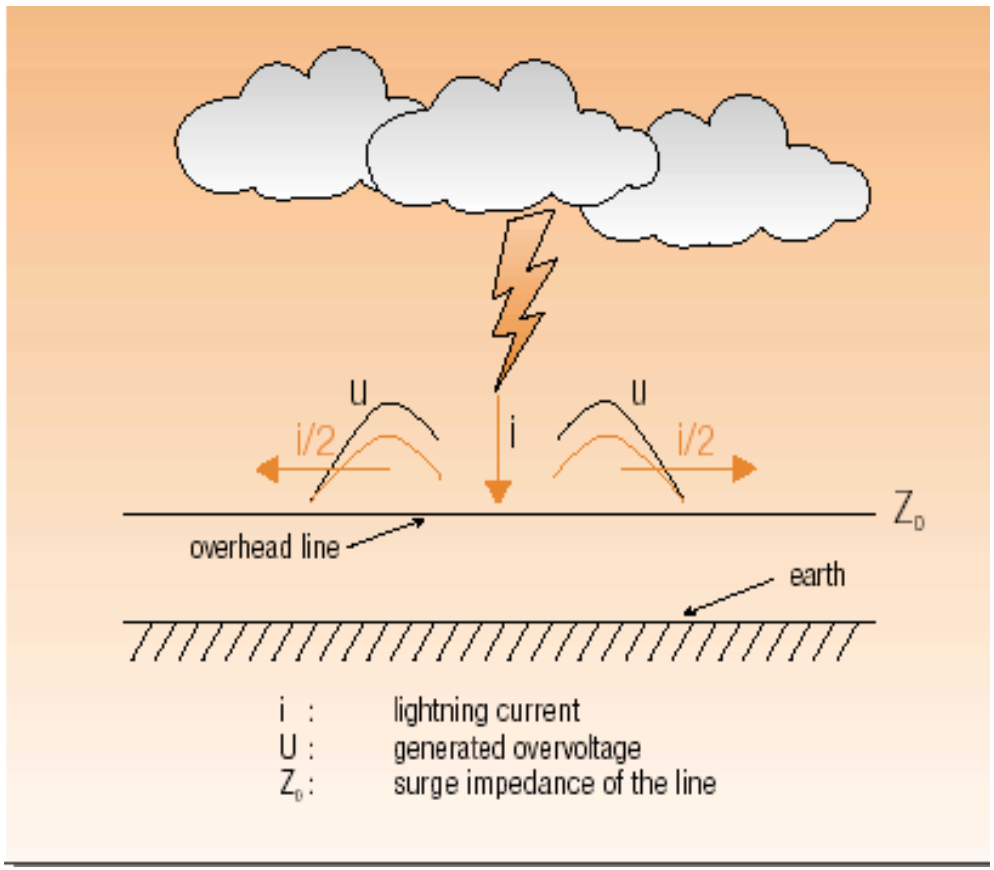
- Lightning strokes
- Switching actions

It is needed for:

- ❑ Distribution transformers
- ❑ Motors and systems
- ❑ Electricity supply

Overvoltages in low-voltage supply networks

Overvoltages due to direct flashes



$$U = Z_0 \times i/2$$

- Assuming $Z_0 = 450\ \Omega$
  $i = 20$ kA
  overvoltage $U = 4500$ kV

- Assuming $Z_0 = 10\ \Omega$
  $i = 10$ kA
  overvoltage $U = 100$ kV

Overvoltages in low-voltage supply networks

Induced overvoltages -

due to a lightning stroke at some distance from an overhead line

$$U_{max} = Z_0 \times I_{max} \times H/D$$

I_{max} – lighting current (peak

Z_0 – effective impendence (assumed 30 Ω)

H - height of the line

D - distance of the flash location from the line

Considering:

H = 5m,

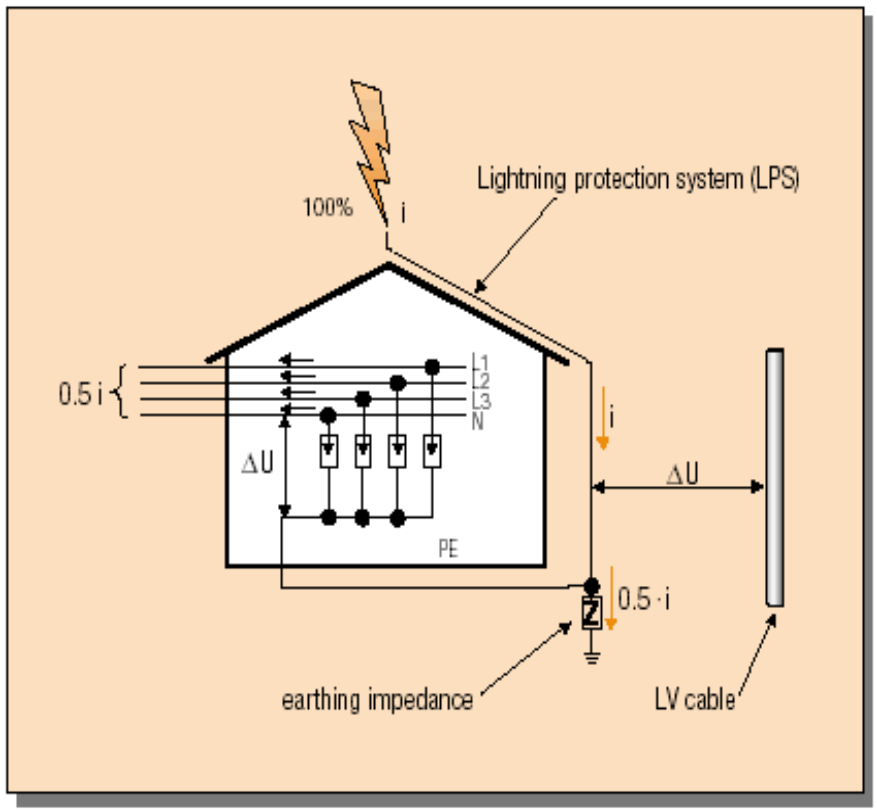
I_{max} = 20 kA,

D = 100 m

→ U_{max} = 30 kV

Overvoltages in low-voltage supply networks

Overvoltages due to coupling

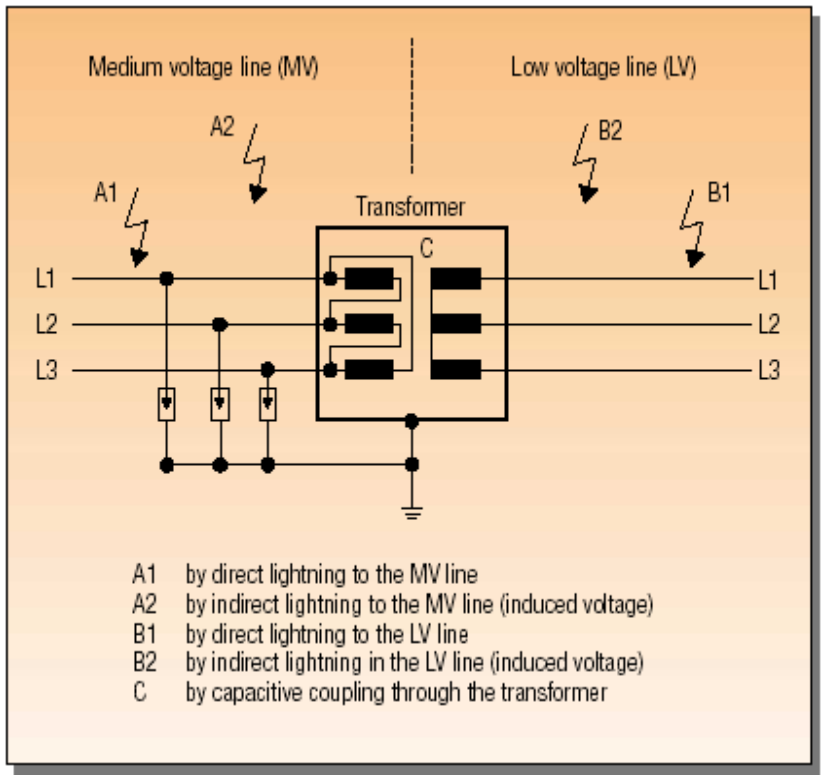


Inductive and capacitive coupling due to electromagnetic fields caused by the lightning current

Due to a potential rise of the earthing system, high voltage is generated between the earthing system and installations in vicinity

Overvoltages in low-voltage supply networks

Transfered overvoltages through transformers

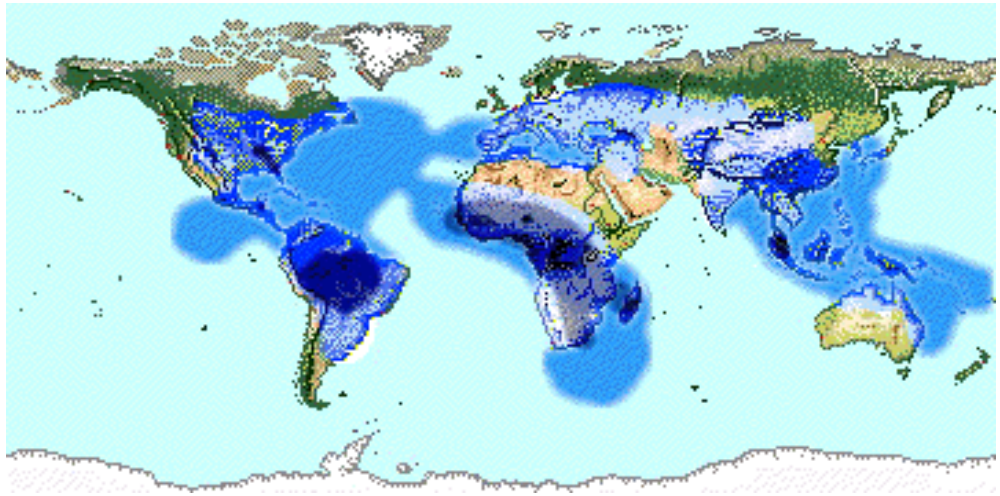


- Capacitive and magnetic coupling through the MV/LV transformer
- By earth coupling

Probability of overvoltages

The frequency of lightning flashes to an overhead line depends on:

- Local flash density
- Line type
- Shielding effects



Dark blue areas cover regions with a Keraunic level of 80 to 180
Light blue areas cover regions with a Keraunic level of 20 to 80

Direct flashes

$$N = A \times N_g \times 10^{-6}$$

$$A = 6 \times H \times L$$

A = effective area for direct lightning to the line (in $m^{2)}$

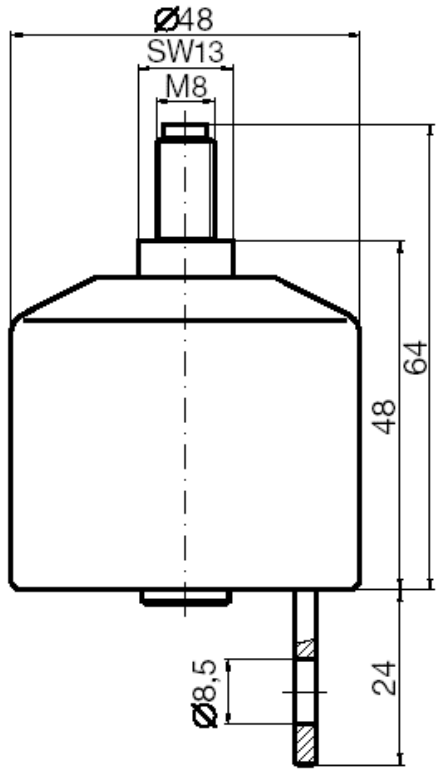
H = height of the line (in m)

L = length of the line (in m)

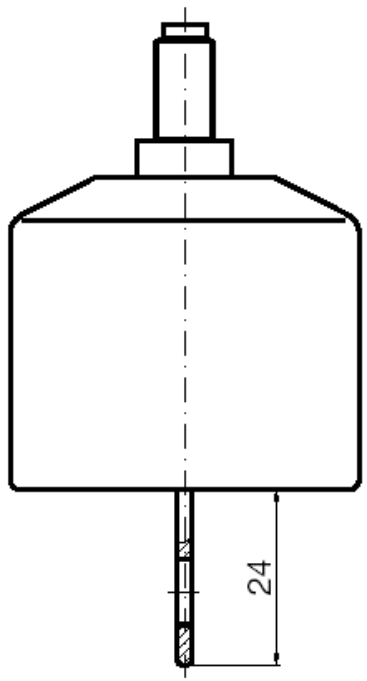
N_g = local flash density per km^2 per year

- Switching operations

LOVOS



1 – surge arrester with disconnector



2 – surge arrester without disconnector

U_c	**280- 440-660 V AC**
I_n (8/20us)	**5/10 kA**
Maximum discharge current	**25/40 kA**
Energy absorption	**2.5/3.9 kJ/kV_{Uc}**
Classification acc. IEC 61643-1	**class II**

A metal oxide surge arrester

- LOVOS-5 and LOVOS-10 are a new generation of LV surge arresters without spark gaps, with varistors of latest metal-oxide technology
- LOVOS provide protection along LV overhead lines, cables for motors, switches etc., from LV side of distribution transformer up to measuring instruments
- LOVOS is meant for high quality energy supply
- LOVOS is tested according to the new international IEC 61643-1, 1998-02 standard and DIN/VDE 0675/6

Technology

LOVOS with disconnecting device, with insulated angle bracket (top) and flat earth terminal (bottom)

LOVOS without disconnecting device, with flat terminal for uninsulated lines (top) and flat earth terminal (bottom)

- **LOVOS** includes a varistor enclosed in a cover made by direct polyamide injection
- In case of overstress **LOVOS** with a disconnecting device automatically ejects an earth terminal which remains hanging. Red colour of an earth terminal makes a failure visible from a distance of 10 m
- **LOVOS** is offered with wide range of top and bottom accessories

Service conditions

- Outdoor application
- For use in altitudes up to 2000 m above the sea level
- UV resistant, moisture proof and self-extinguishing housing
- Accepts different climatic conditions: ambient temperatures from –40°C up to +70°C and humidity up to 90%

The view after an overload

LOVOS can be equipped with an automatic fault indicator.

The disconnector - after an overload

Advantages are:

- allows to avoid short-circuits

- allows to identify after-operation faults from a distance

Technical data

- For system voltages up to 1000 V
- Frequency up to 62Hz
- Nominal discharge current I_n 8/20 µs 5kA or 10kA
- Maximum discharge current I_{max} 8/20 µs 25 or 40 kA
- High current impulse 4/10 µs 40 or 65 kA*
- Classification acc. IEC 61643-1 class II
- Classification acc. DIN/VDE 0675/6 class A
- Tested according to new international standard IEC 61643-1, 1998-02 and DIN/VDE 0675/6

IEC 61643-1 -„Surge protective devices connected to low-voltage power distribution systems Part 1: Performance requirements and testing methods”
DIN/VDE 0675/6 (Überspannungableiter zur Verwendung in Wechselstromnetzen mit Nennspannungen zwischen 100 V und 1000 V)
***** - acc. IEC 600099-4

Guaranteed data

Guaranteed data for LOVOS 5/10 kA

Typ	Uc Continous operating voltage Vrms	Minimum reference voltage at the current $1mA_{peak}$ Vrms	Up Voltage protection level Vpeak	Energy absorption capability J
LOVOS– 5 In = 5 kA	280 440 660	350 550 825	1150 1800 2700	700 1100 1600
LOVOS–10 In = 10 kA	280 440 660	350 550 825	1150 1800 2700	1100 1750 2600

Advantages

- ABB brand, high technological level
- Disconnecting device
- A failure indicator visible from 10 m distance
- UV resistant and self extinguishing housing
- Wide range of accessories
  Easy mounting and connection
- No special mounting tools required

Arrester selection (Uc, Up, energy withstand capability)

Selection of U_c

Considering an upper tolerance in the system voltages of 10%

$U_C \geq 1{,}1\ U_N$ **- if connected line-to-line**

$U_C \geq 1{,}1 \times U_N/\sqrt{3}$ **- if connected line-to-neutral or line-to-earth**

For: 220/380 V, 230/400 V, 240/415 V systems following values are proposed:

Uc = 280 V **for TT and TN systems (phase to neutral, phase to earth)**

Uc = 440 V **for IT systems (phase to neutral or phase to earth)**

Uc = 440 V **for protection phase to phase in TT, TN IT systems (phase to phase)**

Arrester selection (Uc, Up, energy withstand capability)

Selection of U_p

- Up ≤ voltage withstand capability of the equipment to be protected
- 20% safety margin as a general rule
- The lower the Up/Uc of an arrester the higher provided protection level

Voltage line-to-neutral derived from nominal voltages a.c. or d.c. up to and including	Rated impulse voltage for equipment V			
	Insulation category			
V	I	II	III	IV
50	330	500	800	1500
100	500	800	1500	2500
150	800	1500	2500	4000
300	1500	2500	4000	6000
600	2500	4000	6000	8000
1000	4000	6000	8000	12000

Arrester selection (Uc, Up, energy withstand capability)

Selection of the energy capability

Negative downward						
Percentage	98%	95%	80%	50%	20%	5%
Current peak value	> 4kA	> 6kA	> 20 kA	> 34 kA	> 55 kA	>90 kA

The energy capability of an arrester is defined by it's I_{max}

Considering a lightning of I_{max} = 20 kA (80% probability)

I_{max} = 90 kA (5% probability)

The lightning current on each phase can be divided by 6

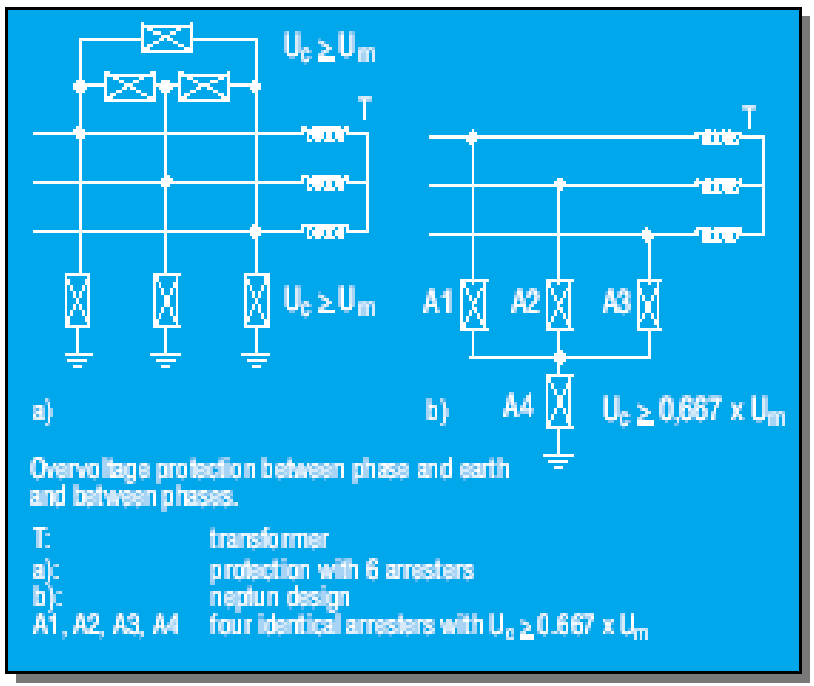
A wave of 3.3 kA or 15 kA will travel in both directions

LOVOS with I_n = 5 kA (covering the 80 % of the events) and I_{max} = 25 kA (covering the very rare 5 % values) is therefore proposed as standard

Installation into a system

Possible modes of the protection

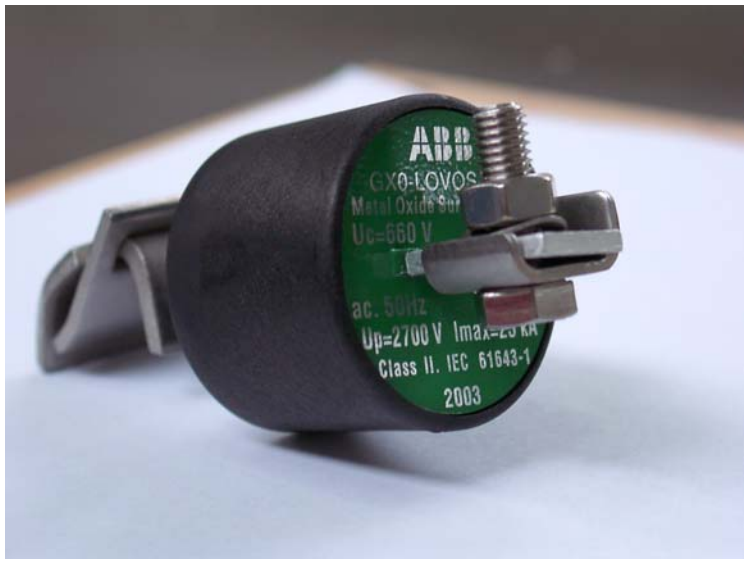
LOVOS connected between:	Power system type			
	TT	TN-C	TN-S	IT
Line and neutral	x		x	x*
Line and PE	x		x	x
Line and PEN		x		
Neutral and PE	x		x	x*
Line to line	x	x	x	x
*When the neutral is distributed				



The installation mode depends on on the earthling practice in the low voltage network

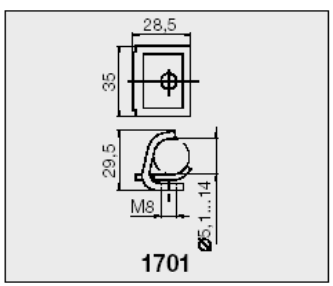
In case of a line to line connection two installation patterns are possible

Accessories

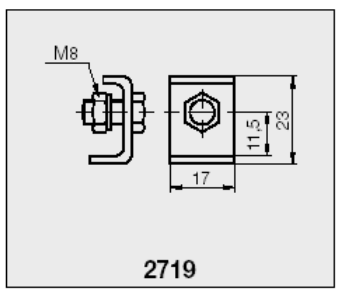


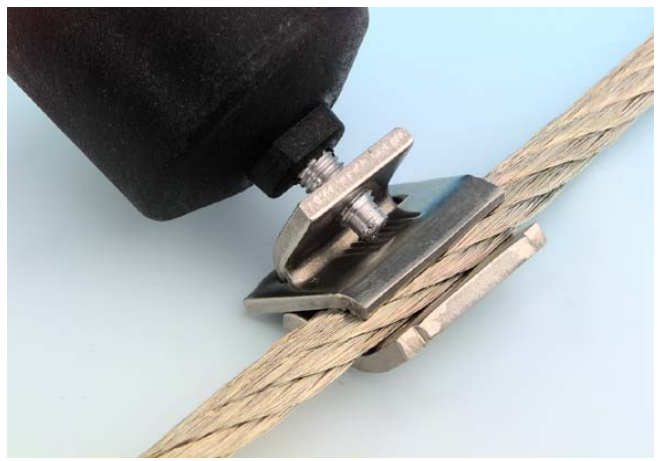
- **The arresters may be also equipped with a range of top and bottom terminals. All terminals are made of non-corroding material.**
- **For an easy and reliable mounting you can choose from our selection of accessories.**

Top accessories



Bottom accessories





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