



# Over Voltage Category III Power Supplies

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14 juni 2018  
1931 Congrescentrum Den Bosch

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## Agenda

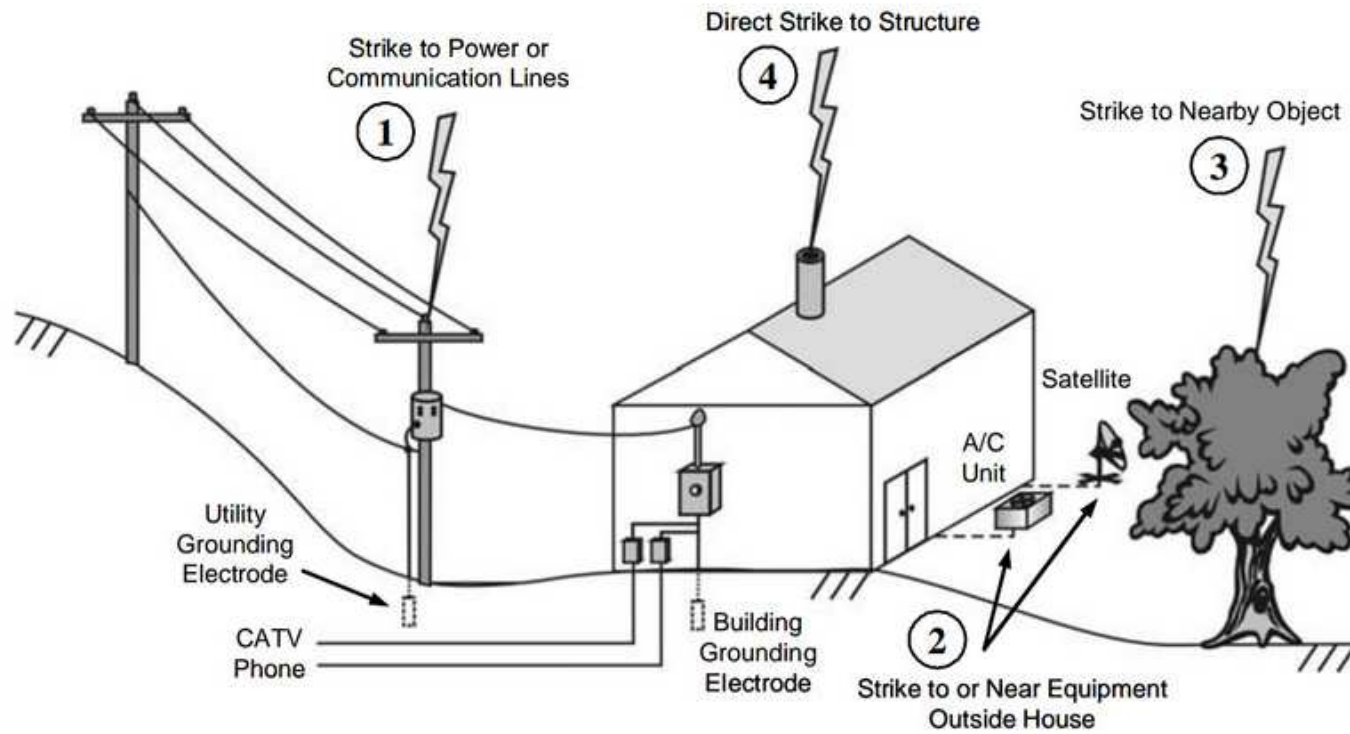
- Lighting Types
- Lighting Waveforms
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- How to use OVC II PSU in OVC III Applications
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# Lighting Types



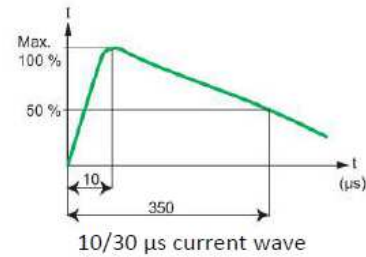
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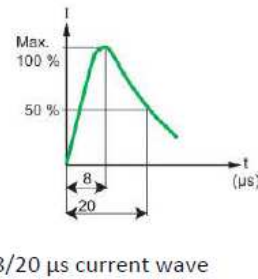
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## Lighting Waveforms

- (1) 10/350  $\mu\text{s}$  wave to characterise current wave from a direct lightning strike (i.e. 10 $\mu\text{s}$  rise time and 350  $\mu\text{s}$  voltage surge duration).

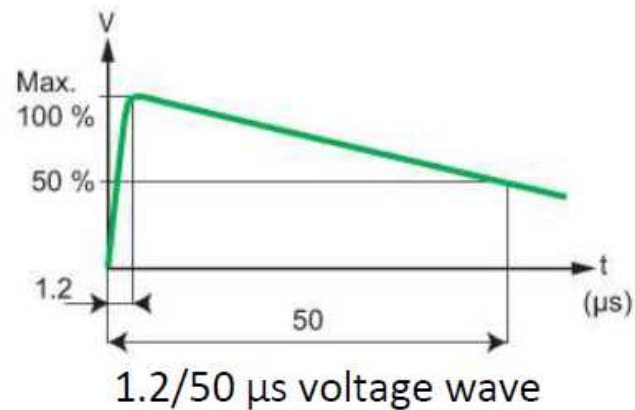


- (2) 8/120  $\mu\text{s}$  wave to characterise current waves from an indirect lightning strike (i.e. 8 $\mu\text{s}$  rise time and 120  $\mu\text{s}$  voltage surge duration).



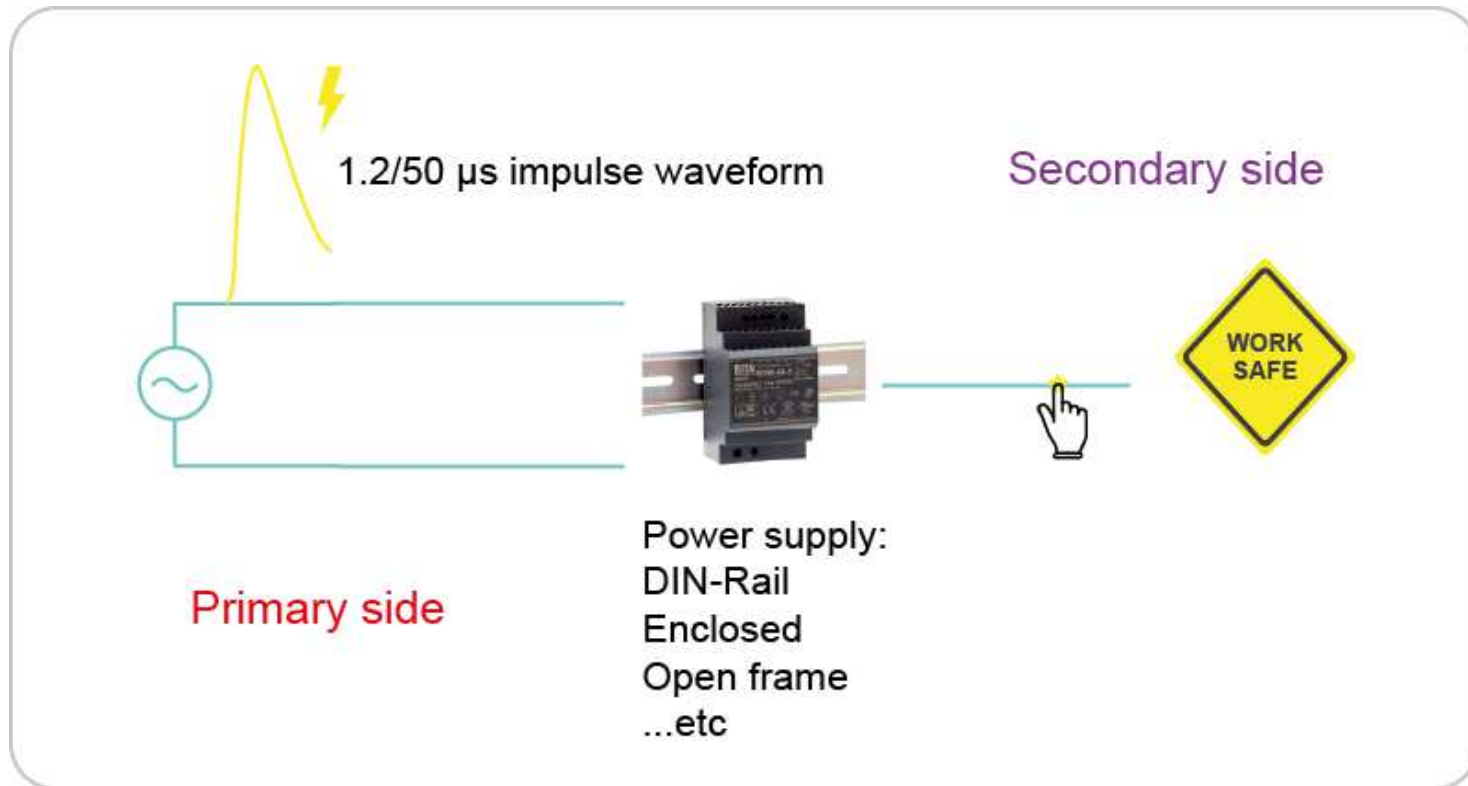
## Lighting Waveforms

The overvoltages created by lightning strikes are characterised by a 1.2/50  $\mu\text{s}$  voltage wave

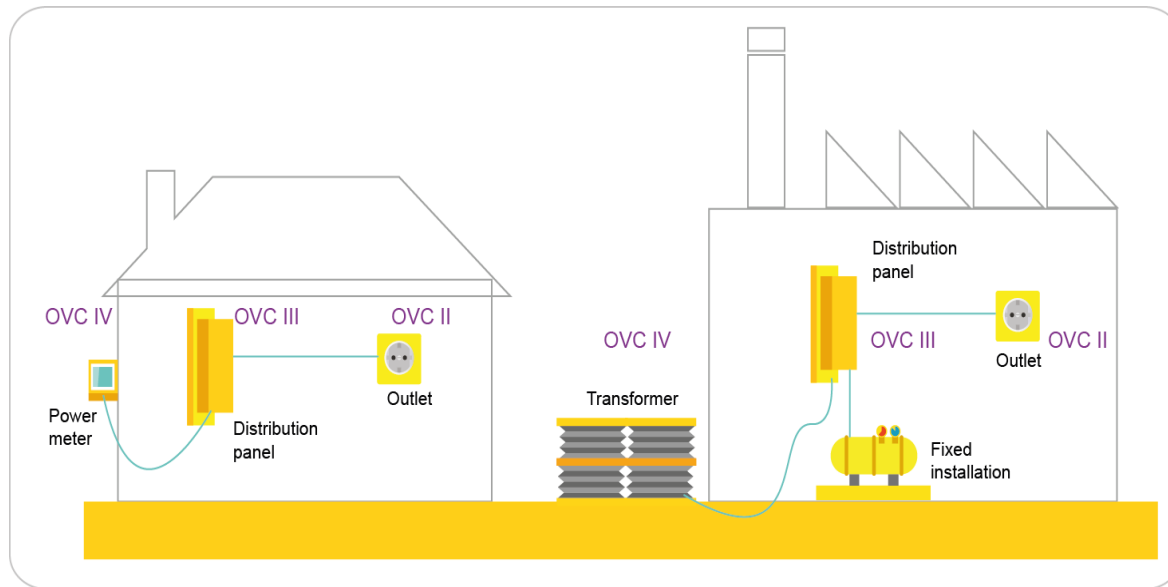


This type of voltage wave is used to verify equipments ability to withstand voltages of an atmospheric origin.

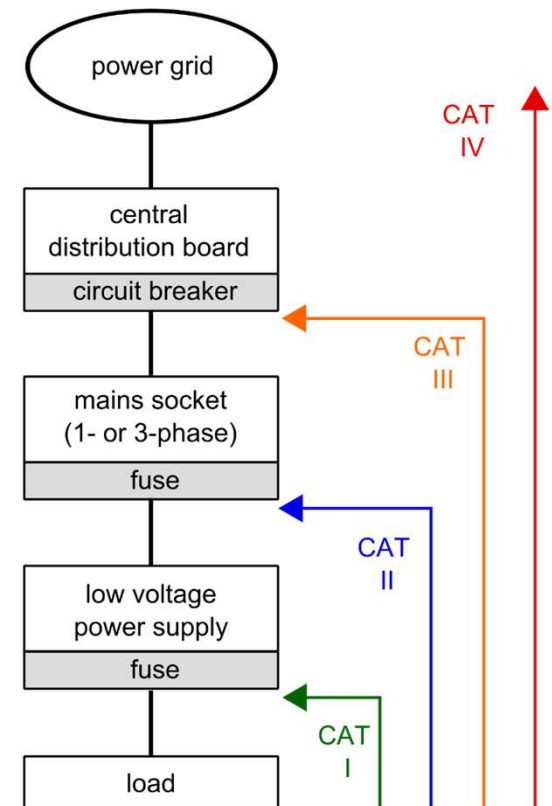
## Over Voltage Category Definition in Power Supplies



## Over Voltage Category Definition



OVC III Equipment is downward compatible with OVC II, I application and environment.



## Over Voltage Category Definition

- I. Equipment of **Overvoltage Category I (OVC I)** is equipment for connection to circuits in which measures are taken to limit transient or short duration overvoltage to an appropriately low level.
  - The typical application is equipment containing electronic circuits protected to this level.
- II. Equipment of **Overvoltage Category II (OVC II)** is energy-consuming equipment to be supplied from the fixed installation.
  - The typical application is appliances, portable tools and other household similar loads.
- III. Equipment of **Overvoltage Category III (OVC III)** is equipment in fixed installations and for cases where the reliability and the availability of the equipment is subject to special requirements.
  - The typical application is switch(es) in the fixed installation and equipment for industrial use with permanent connection to the fixed installation.
- IV. Equipment of **Overvoltage Category IV (OVC IV)** is for use at the origin of the installation.
  - The typical application is electricity meter(s) and primary overcurrent protection equipment.



## Over Voltage Category Testing Table

Voltage line to neutral derived from nominal voltage AC or DC up to and including (V)	Rated impulse voltage (V)			
	Overvoltage category			
	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

Table 1 shows only the level for basic insulation.

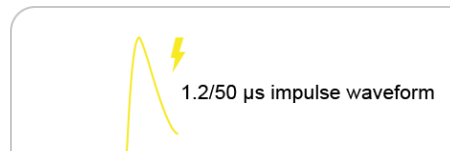
In case the power supply is designed to double or reinforced insulation, the voltage should consider one level higher.

**For example:**

For unit operating at 300Vac

- OVC II is tested @ 2500V for basic and 4000 for double (SELV)

## Impulse vs Withstand



OVC Impulse voltage from table is the Peak Value

Withstand voltage is RMS value

The peak of withstand voltage is  $\sqrt{2} \times V_{RMS} = 1.414 \times V_{RMS}$

	<b>OVER VOLTAGE CATEGORY</b>	III; Compliance to EN61558, EN50178, EN60664-1, EN62477-1; altitude up to 2000 meters		
	<b>SAFETY STANDARDS</b>	UL60950-1, TUV EN60950-1, EN60335-1, EN61558-1/-2-16, CCC GB4943 approved		
<b>SAFETY &amp; EMC</b>	<b>WITHSTAND VOLTAGE</b>	I/P-O/P:4KVAC	I/P-FG:2KVAC	O/P-FG:1.25KVAC
	<b>ISOLATION RESISTANCE</b>	I/P-O/P, I/P-FG, O/P-FG:100M Ohms / 500VDC / 25°C / 70% RH		

Withstand voltage test is 1 min continuous -> [Withstand voltage test is tougher than impulse voltage test!](#)

## OVC III and Altitude

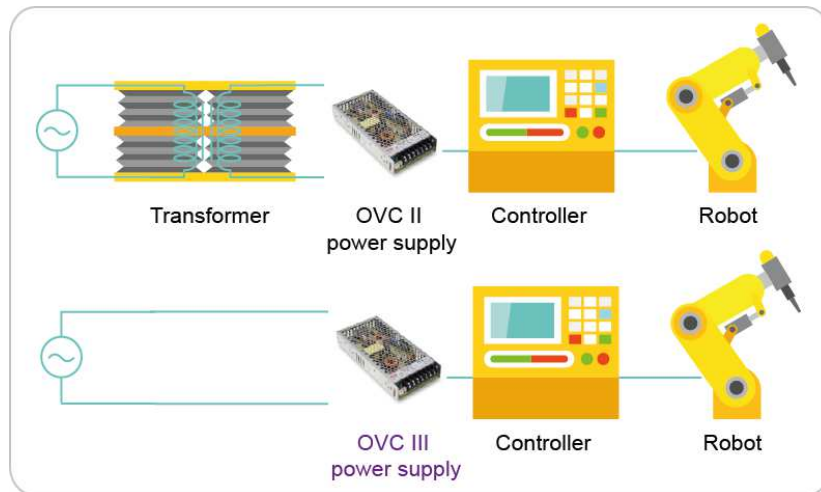
The most important environmental parameters are as follows:

- for clearances:
  - air pressure,
  - temperature, if it has a wide variation;
- for creepage distances:
  - pollution,
  - relative humidity,
  - condensation;
- for solid insulation:
  - temperature,
  - relative humidity.

Table A.2 – Altitude correction factors

Altitude m	Normal barometric pressure kPa	Multiplication factor for clearances
2 000	80,0	1,00
3 000	70,0	1,14
4 000	62,0	1,29
5 000	54,0	1,48
6 000	47,0	1,70
7 000	41,0	1,95
8 000	35,5	2,25
9 000	30,5	2,62
10 000	26,5	3,02
15 000	12,0	6,67
20 000	5,5	14,5

## OVC III Applications



Some robot controller products to meet the IEC60204-1 standard need an additional AC transformer in series between the power grid and power supply

### Name

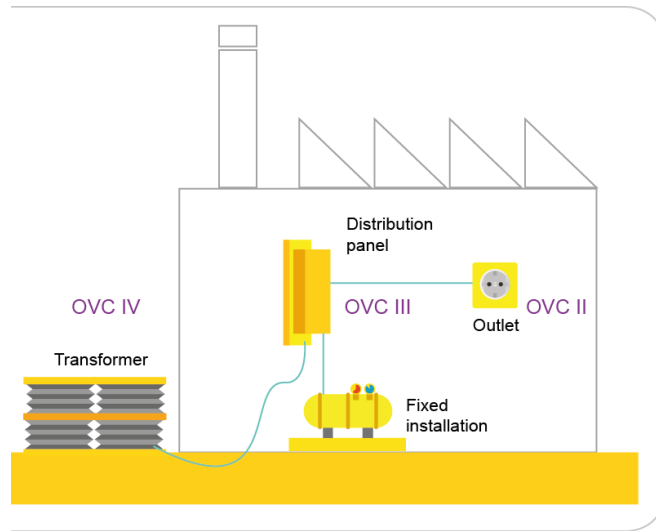
IEC/EN50178	Electronic equipment for use in power installations
IEC 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
IEC 62103	Electronic equipment for use in power installations (replaced by IEC 62477-1)
IEC/EN62477-1	Safety requirements for power electronic converter systems and equipment - Part 1: General

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## OVC III Applications



OVC III is equipment in fixed installations and for cases where the **reliability** and the availability of the equipment is subject to special requirements.



The typical application is switch(es) in the fixed installation and equipment for industrial use with permanent connection to the fixed installation.

## MW Products meeting OVC III

- With EN61558 certificate:
  - LRS-35/50/75/100/150/150F
  - RSP-75/100/150
  - HDR-15/30/60/100
  - KNX-20E
  - OWA series
  - UHP-200/350 with design refer to 61558

	<b>OVER VOLTAGE CATEGORY</b>	III; Compliance to EN61558, EN50178, EN60664-1, EN62477-1; altitude up to 2000 meters
	<b>SAFETY STANDARDS</b>	UL60950-1, TUV EN60950-1, EN60335-1, EN61558-1/-2-16, CCC GB4943 approved
<b>SAFETY &amp; EMC</b>	<b>WITHSTAND VOLTAGE</b>	I/P-O/P:4KVAC I/P-FG:2KVAC O/P-FG:1.25KVAC
	<b>ISOLATION RESISTANCE</b>	I/P-O/P, I/P-FG, O/P-FG:100M Ohms / 500VDC / 25°C / 70% RH

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Modified products to meet OVC III

Only Medical(EN60601) OVC II product has chance to meet OVC III of 61558.

~~60950 (OVC II)~~  
~~61347 (OVC II)~~  
~~60335 (OVC II)~~

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61558 and OVC III

## IEC 61558-1: 2005 + AMD1: 2009

### 26 Creepage distances, clearances and distances through insulation

**26.1 Creepage distances, clearances** and distances through insulation shall not be less than the values shown in Table 13 for insulating materials of group IIIa (see IEC 60664-1).

*Compliance is checked by measurements under the provisions of 26.2 and 26.3.*

NOTE 1 For materials of groups I and II, see Annexes C and D.

NOTE 2 Table 13, Table C.1 and Table D.1 are applicable only for frequencies up to and including 30 kHz.

**Creepage distances** and **clearances** are measured, using the supply cable and cords for connection to fixed wiring and those for **type X attachment** with maximum and minimum size conductors corresponding to the rated connecting capacity of the terminal. For **type X** with a special cord, **Y** or **Z attachments**, the supply cable and cords as delivered are used.

Where layers of serrated tapes are used, the value for **creepage distances** and **clearances** are determined as if the layers of serration coincided with one another.

NOTE 4 Diagrams showing some examples of the methods of measurement of **creepage distances** and **clearances** are found in Annex A.

NOTE 5 Diagrams showing some examples of points of measurement of **creepage distances** and **clearances** are given in Annex P.

NOTE 6 Details of the tests necessary to determine the separation of material groups are given in Annex G.

NOTE 7 Table 13, Table C.1 and Table D.1 take into consideration over voltage category II for **basic insulation** and over voltage category III for **double or reinforced insulation**.

Next version (third edition) of IEC 61558-1 will clearly specify the OVC test difference among categories to improve the information provide by current release of standard.

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## OVC III and Altitude

PSU with 61558 OVC III  $\leq$  2000m  
<2000m then downgrade to OVC II

	<b>OVER VOLTAGE CATEGORY</b>	III; Compliance to EN61558, EN50178, EN60664-1, EN62477-1; altitude up to 2000 meters
	<b>SAFETY STANDARDS</b>	UL60950-1, TUV EN60950-1, EN60335-1, EN61558-1/-2-16, CCC GB4943 approved
<b>SAFETY &amp; EMC</b>	<b>WITHSTAND VOLTAGE</b>	I/P-O/P:4KVAC I/P-FG:2KVAC O/P-FG:1.25KVAC
	<b>ISOLATION RESISTANCE</b>	I/P-O/P, I/P-FG, O/P-FG:100M Ohms / 500VDC / 25°C / 70% RH

Although the product has reserved the enough clearance distance for 5000m (1.48 factor larger than 2000m one), but the product also needs to be subjected to the corresponding impulse voltage test according to IEC61558.

New product for industrial application will have it (at least design refer to)

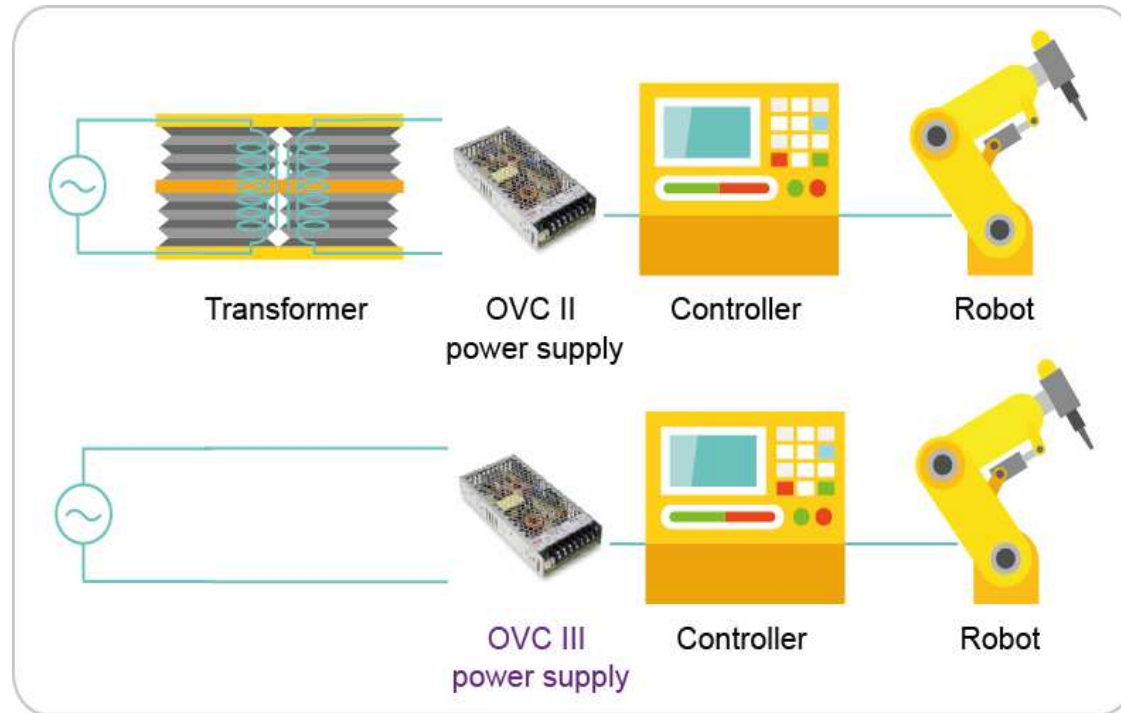
Impulse test of unit is done at 6KV(double insulation) for up to 2000m

>2000m there is not defined in the standard.

So move back to OVCII where the test voltage is 4KV(double insulation)

Then 5000m should be tested  $4 \times 1.48 = 5.92KV$  -> NO problem!!

## How to use OVC II PSU in OVC III Applications

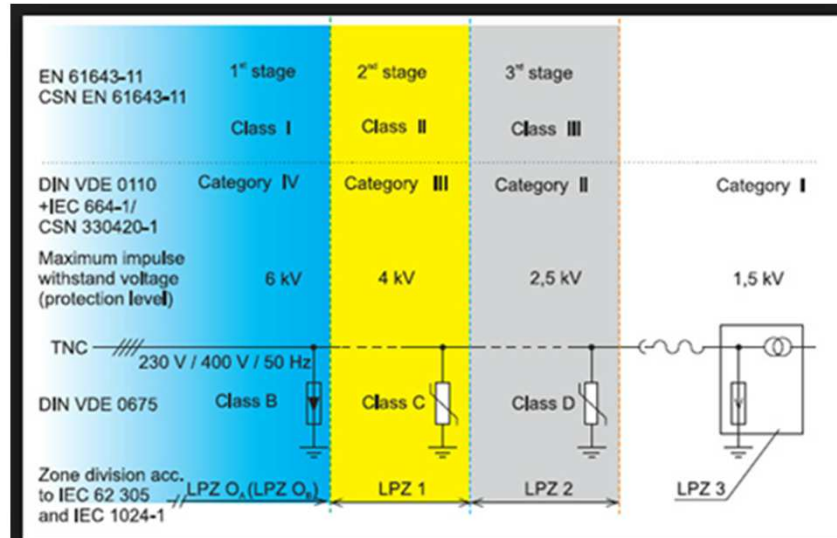


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## How to use OVC II PSU in OVC III Applications



	Direct lightning stroke	Indirect lightning stroke	
IEC 61643-1	Class I test	Class II test	Class III test
IEC 61643-11/2007	Type 1: T1	Type 2 : T2	Type 3 : T3
EN/IEC 61643-11	Type 1	Type 2	Type 3
Former VDE 0675v	B	C	D

## Conclusions

- Power Supply in the market generally refer to OVC II
- If a PSU comply with EN61558 certificate (or design refer to), we can be sure it is a OVC III unit
- OVC III PSU can be used in OVC II & I application
- MEAN WELL support its customers with PSUs designed to support OVC III
- Where to find OVC info?
  - Check the spec about the OVC III or 61558

	<b>OVER VOLTAGE CATEGORY</b>	III; Compliance to EN61558, EN50178, EN60664-1, EN62477-1; altitude up to 2000 meters		
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