SLOVENSKI STANDARD
oSIST prEN 50539-11:2011

01-oktober-2011

Nizkonapetostne naprave za zaščito pred prenapetostnimi udari - Naprave za zaščito pred prenapetostnimi udari za specifične aplikacije, vključno z enosmernimi - 11. del: Zahteve in preskusi za SPD v fotovoltaičnih aplikacijah

Low-voltage surge protective devices - Surge protective devices for specific application including d.c. - Part 11: Requirements and tests for SPDs in photovoltaic applications

Überspannungsschutzgeräte für Niederspannung - Überspannungsschutzgeräte für besondere Anwendungen einschließlich Gleichspannung - Teil 11: Anforderungen und Prüfungen für Überspannungsschutzgeräte für den Einsatz in Photovoltaik Installationen

Parafoudres basse tension - Parafoudres pour applications spécifiques incluant le courant continu - Partie 11: Exigences et essais pour parafoudres connectés aux installations photovoltaïques

Ta slovenski standard je istoveten z: **prEN 50539-11:2011**

ICS:

29.120.50	Varovalke in druga medtokovna zaščita	Fuses and other overcurrent protection devices

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Low-voltage surge protective devices - Surge protective devices for specific application including d.c. - Part 11: Requirements and tests for SPDs in photovoltaic applications

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This draft European Standard is submitted to CENELEC members for CENELEC enquiry.
Deadline for CENELEC: 2011-11-04.

It has been drawn up by CLC/TC 37A.

If this draft becomes a European Standard, CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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91 ## Foreword

92 This draft European Standard was prepared by the Technical Committee CENELEC TC 37A, Low voltage
93 surge protective devices. It is submitted to the second CENELEC enquiry.

94 _____

1 Scope

This European Standard defines the requirements and tests for SPDs intended to be installed on the d.c. side of photovoltaic installations to protect against induced and direct lightning effects. These devices are connected to d.c. power circuits of photovoltaic generators, rated up to 1 500 V.

It takes into account that photovoltaic generators

- behave like current generators,
- that their nominal current depends on the light intensity,
- that their short-circuit current is almost equal to the nominal current,
- are connected in series and/or parallel combinations leading to a great variety of voltages, currents and powers from a few hundreds of W (in residential installations) to several MW (photovoltaic fields).

The very specific electrical parameters of PV installations on the d.c. side require specific test requirements for SPDs.

SPDs with separate between input and output terminal(s) that contain a specific series impedance between these terminal(s) (so called two port SPDs according to IEC 61643-11) are currently not sufficiently covered by the requirements of this standard and require additional consideration

NOTE In general SPDs for PV applications do not contain a specific series impedance between the input/output terminals due to power efficiency considerations.

SPDs complying with this standard are exclusively dedicated to be installed on the d.c. side of photovoltaic generators. PV installation including batteries and other d.c. applications are not taken into account and additional requirements and tests may be necessary for such applications.

SPDs for which the manufacturers declares short circuit mode overload behaviour, shall require specific measures to ensure that such devices will not endanger the operator during maintenance and replacement due to possible d.c. arcing.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

HD 588.1 S1:1991, High-voltage test techniques – Part 1: General definitions and test requirements (IEC 60060-1:1989 + corrigendum Mar. 1990)

EN 60529:1991, Degrees of protection provided by enclosures (IP code) (IEC 60529:1989)

EN 61000-6-1:2007, Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity for residential, commercial and light-industrial environments (IEC 61000-6-1:2005)

EN 61000-6-3:2007, Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments (IEC 61000-6-3:2006)

EN 61180-1:1994, High-voltage test techniques for low voltage equipment – Part 1: Definitions, test and procedure requirements (IEC 61180-1:1992)

IEC 61643-11:2011 Low-voltage surge protective devices – Part 11: Surge protective devices connected to low-voltage power systems – Requirements and tests methods

3 Terms, definitions and abbreviations

For the purposes of this document, the following terms, definitions and abbreviations apply.

3.1 Terms and definitions

3.1.1
Surge Protective Device
SPD
device that contains at least one nonlinear component that is intended to limit surge voltages and divert surge currents

[IEC 61643-11:2011]

NOTE An SPD is a complete assembly, having appropriate connecting means.

3.1.2
one-port SPD
SPD having no intended series impedance

NOTE A one port SPD may have separate input and output connections.

[IEC 61643-11:2011]

3.1.3
voltage switching type SPD
SPD that has a high impedance when no surge is present, but can have a sudden change in impedance to a low value in response to a voltage surge

NOTE Common examples of components used in voltage switching type SPDs are spark gaps, gas tubes and thyristors. These are sometimes called "crowbar type" components.

[IEC 61643-11:2011]

3.1.4
voltage limiting type SPD
SPD that has a high impedance when no surge is present, but will reduce it continuously with increased surge current and voltage

NOTE Common examples of components used in voltage limiting type SPDs are varistors and avalanche breakdown diodes. These are sometimes called "clamping type" components.

[IEC 61643-11:2011]

3.1.5
combination type SPD
SPD that incorporates both, voltage switching components and voltage limiting components. The SPD may exhibit voltage switching, limiting or both

[IEC 61643-11:2011]

3.1.6
modes of protection
an intended current path between terminals, that contains one or more protective components, for which the manufacturer declares a protection level, e.g. + to -, + to earth, - to earth

NOTE Additional terminals may be included within this current path.

[IEC 61643-11:2011, modified]

3.1.7
current branch of an SPD
an intended current path, between two nodes that contains one or more protective components

NOTE 1 A current branch of an SPD may be identical with a mode of protection of a SPD.

NOTE 2 This intended current path does not include additional terminals.

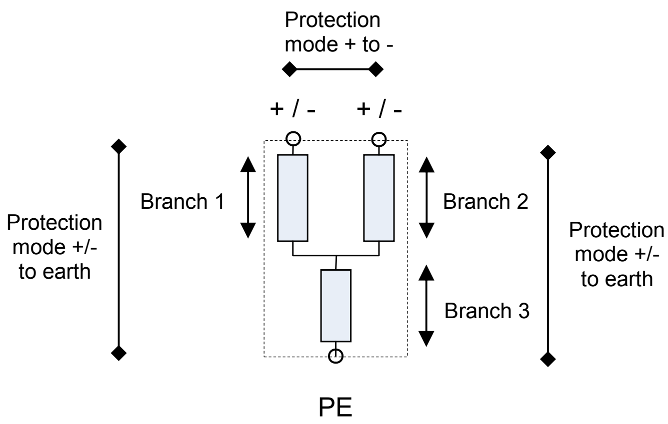


Figure 1 – Current branches vs. modes of protection of an SPD

3.1.8
nominal discharge current
I_n
crest value of the current through the SPD having a current waveshape of 8/20

[IEC 61643-11:2011]

3.1.9
impulse discharge current for class I test
I_{imp}
crest value of a discharge current through the SPD with specified charge transfer *Q* and specified energy *W/R* in the specified time

[IEC 61643-11:2011]

3.1.10
maximum discharge current
I_{max}
crest value of a current through the SPD having an 8/20 waveshape and magnitude according to the manufacturers specification. I_{max} is equal to or greater than I_n

[IEC 61643-11:2011]

3.1.11
maximum continuous operating voltage for PV application
U_{CPV}
maximum d.c. voltage which may be continuously applied to the SPDs mode of protection

3.1.12
continuous operating current for PV application
I_{CPV}
current flowing between active lines of the SPD when energized at U_{CPV}, when connected according to the manufacturer's instructions

3.1.13
residual current
I_{PE}
current flowing through the PE terminal of the SPD while energized at U_{CPV} when connected according to the manufacturer's instructions

[IEC 61643-11:2011, modified]

3.1.14
follow current
I_f
peak current supplied by the electrical power system and flowing through the SPD after a discharge current impulse

NOTE The follow current is significantly different from the continuous operating current I_{CPV}.

[IEC 61643-11:2011, modified]

3.1.15
rated load current
I_L
maximum continuous rated d.c. current that can be supplied to a resistive load connected to the protected output of an SPD

[IEC 61643-11:2011, modified]

3.1.16
voltage protection level
U_p
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

NOTE The voltage protection level is given by the manufacturer and should not be exceeded by the measured limiting voltage, determined for front-of-wave sparkover (if applicable) and the measured limiting voltage, determined from the residual voltage measurements at amplitudes up to I_n and/or I_{imp} for test classes I and II.

[IEC 61643-11:2011, modified]

3.1.17
measured limiting voltage
highest value of voltage that is measured across the terminals of the SPD during the application of impulses of specified waveshape and amplitude

[IEC 61643-11:2011]

3.1.18
residual voltage
U_{res}
crest value of voltage that appears between the terminals of an SPD due to the passage of discharge current

[IEC 61643-11:2011]

3.1.19
1,2/50 voltage impulse
voltage impulse with a nominal virtual front time of 1,2 µs and a nominal time to half-value of 50 µs

NOTE Clause 6 of HD 588.1 S1:1991defines the voltage impulse definitions of front time, time to half-value and waveshape tolerance.

[IEC 61643-11:2011]

3.1.20
8/20 current impulse
current impulse with a nominal virtual front time of 8 µs and a nominal time to half-value of 20 µs

NOTE The Clause 8 of HD 588.1 S1:1991defines the current impulse definitions of front time, time to half-value and waveshape tolerance.

[IEC 61643-11:2011]

3.1.21
thermal runaway
operational condition when the sustained power dissipation of an SPD exceeds the thermal dissipation capability of the SPD component, housing and connection, leading to a cumulative increase in the temperature of the internal elements and resulting in failure

[IEC 61643-11:2011]

3.1.22
thermal stability
SPD is thermally stable if, after heating up during the operating duty test, its temperature decreases with time while energized at specified maximum continuous operating voltage and at specified ambient temperature conditions

[IEC 61643-11:2011]

3.1.23
degradation (of performance)
undesired permanent departure in the operational performance of equipment or a system from its intended performance

[IEC 61643-11:2011]

3.1.24
short-circuit current rating
I_{SCPV}
maximum prospective short-circuit current from the power system for which the SPD, in conjunction with the disconnectors specified, is rated

[IEC 61643-11:2011, modified]

3.1.25
SPD disconnector (disconnector)
device for disconnecting an SPD, or part of an SPD, from the power system in the event of SPD failure

NOTE This disconnecting device is not required to have isolating capability for safety purposes. It is to prevent a persistent fault on the system and is used to give an indication of an SPD's failure. Disconnectors can be internal (built in) or external (required by the manufacturer). There may be more than one disconnector function, for example an over-current protection function and a thermal protection function. These functions may be in separate units.

[IEC 61643-11:2011, modified]

3.1.26
degree of protection of enclosure
IP
classification preceded by the symbol IP indicating the extent of protection provided by an enclosure against access to hazardous parts, against ingress of solid foreign objects and possibly harmful ingress of water

[IEC 61643-11:2011, modified]

3.1.27
type test
conformity test made on one or more items representative of the production

[IEC 60050-151:2001, 151-16-16]

3.1.28
routine test
test made on each SPD or on parts and materials as required to ensure that the product meets the design specifications

[IEC 60050-151:2001, 151-16-17, modified]

3.1.29
acceptance tests
contractual test to prove to the customer that the item meets certain conditions of its specification

[IEC 60050-151:2001, 151-16-23]

3.1.30
Impulse test classification

3.1.30.1
class I test
test carried out with the impulse discharge current I_{imp}, with an 8/20 current impulse with a crest value equal to the crest value of I_{imp}, and with a 1,2/50 voltage impulse

[IEC 61643-11:2011

3.1.30.2
class II test
test carried out with the nominal discharge current I_n, and the 1,2/50 voltage impulse

[IEC 61643-11:2011]

3.1.31
sparkover voltage or trigger voltage of a voltage switching SPD
maximum voltage value at which the sudden change from high to low impedance starts for a voltage switching SPD

[IEC 61643-11:2011]

3.1.32
specific energy for class I test
W/R
energy dissipated by a unit resistance of 1 Ω with the impulse discharge current I_{imp}

NOTE This is equal to the time integral of the square of the current ($W/R = \int i^2 dt$).

[IEC 61643-11:2011]

3.1.33
prospective short-circuit current of a power supply
***I*P**
current which would flow at a given location in a circuit if it were short-circuited at that location by a link of negligible impedance
[IEC 61643-11:2011]

3.1.34
status indicator
device that indicates the operational status of an SPD, or a part of an SPD.

NOTE Such indicators may be local with visual and/or audible alarms and/or may have remote signalling and/or output contact capability.

[IEC 61643-11:2011]

3.1.35
output contact
contact included in a circuit separate from the main circuit of an SPD, and linked to a disconnector or status indicator

[IEC 61643-11:2011]

3.1.36
multipole SPD
type of SPD with more than one mode of protection, or a combination of electrically interconnected SPDs offered as a unit

[IEC 61643-11:2011]

3.1.37
total discharge current
***I*Total**
current which flows through the earth conductor of a multipole SPD during the total discharge current test

NOTE 1 The aim is to take into account cumulative effects that occur when multiple modes of protection of a multipole SPD conduct at the same time.

NOTE 2 I_{Total} is particularly relevant for SPDs tested according to test class I, and is used for the purpose of lightning protection equipotential bonding according to EN 62305 series.

[IEC 61643-11:2011, modified]

3.1.38
maximum prospective short-circuit current from battery
***I*SCbat**
maximum prospective d.c. short circuit current that may be delivered in a PV system incorporating batteries to an SPD

NOTE This short circuit current may be much higher than the I_{SCPV}.

3.1.39
voltage for clearance determination
U_{max}
highest measured voltage during surge applications according to 7.3.4 for clearance determination
[IEC 61643-11:2011]

3.2 Abbreviations

The Table 1 below provides the list of abbreviations used in this document.

Table 1 – List of Abbreviations

Abbreviation	Description	Definition/clause
General abbreviations		
DUT	device under test	General
IP	degree of protection of enclosure	3.1.26
SPD	surge protective device	3.1.1
W/R	specific energy for class I test	3.1.32
T1, T2	product marking for test classes I and II	6.1.1
Abbreviations related to Voltage		
U_{CPV}	maximum continuous operating voltage	3.1.11
U_p	voltage protection level	3.1.16
U_{res}	residual voltage	3.1.18
U_{max}	voltage for clearance determination	3.1.39
Abbreviations related to Current		
I_{imp}	impulse discharge current for class I test	3.1.9
I_{max}	maximum discharge current	3.1.10
I_n	nominal discharge current for class II test	3.1.8
I_f	follow current	3.1.14
I_L	rated load current	3.1.15
I_{SCPV}	short-circuit current rating	3.1.24
I_P	prospective short-circuit current of the power supply	3.1.33
I_{PE}	residual current at U_{CPV}	3.1.13
I_{Total}	total discharge current for multipole SPD	3.1.37

4 Service conditions

4.1 Voltage

the voltage applied continuously between the terminals of the Surge Protective Device (SPD) shall not exceed its maximum continuous operating voltage U_{CPV}.

4.2 Air pressure and altitude

Air pressure is 80 kPa to 106 kPa. These values represent an altitude of +2 000 m to -500 m respectively.

4.3 Temperatures

- normal range: –5 °C to +40 °C

NOTE This range addresses SPDs for indoor use in weather protected locations having neither temperature nor humidity control and corresponds to the characteristics of external influences code AB4 in HD 60364-5-51.

- extended range: –40 °C to +70 °C

NOTE This range addresses SPDs for outdoor use in non weather protected locations.

4.4 Humidity

- normal range: 5 % to 95 %

NOTE This range addresses SPDs for indoor use in weather protected locations having neither temperature nor humidity control and corresponds to the characteristics of external influences code AB4 in HD 60364-5-51.

- extended range: 5 % to 100 %

NOTE This range addresses SPDs for outdoor use in non weather protected locations.

5 Classification

The manufacture shall classify the SPDs in accordance with the following parameters.

5.1 SPD design

5.1.1 Voltage switching

5.1.2 Voltage limiting

5.1.3 Combination

5.2 Types 1 and 2 SPDs- Class I and II tests

Information required for class I and class II tests is given in Table 2.

Table 2 – Tests of types 1 and 2 SPDs

Type of SPD	Tests	Required information	Test procedures (see subclauses)
Type 1	Class I	I_{imp}	7.1.1; 7.1.2; 7.1.3
Type 2	Class II	I_n	7.1.2; 7.1.3

5.3 Location

5.3.1 Indoor

SPDs intended for use in enclosures and/or inside buildings or shelters.

SPDs installed in outdoor enclosures or shelters are considered for indoor use.

5.3.2 Outdoor

SPDs intended for use without enclosures and outside of buildings or shelters.

5.4 Accessibility

5.4.1 Accessible

An SPD which can be fully or partly touched by an unskilled person, without the use of a tool to open any covers or enclosures, once installed.

410 **5.4.2 Inaccessible**

411 An SPD which cannot be touched by an unskilled person either due to being mounted out of reach (e.g.
412 mounted on overhead lines) or due to being located within enclosures which can only be opened by using a
413 tool, once installed.

414 **5.5 Disconnectors (including overcurrent protection)**

415 **5.5.1 Location**

416 **5.5.1.1 Internal**

417 **5.5.1.2 External**

418 **5.5.1.3 Both (one part internal and one part external)**

419 **5.5.2 Protection functions**

420 **5.5.2.1 Thermal**

421 **5.5.2.2 Leakage current**

422 **5.5.2.3 Overcurrent**

423 **5.6 Degree of protection provided by enclosures**

424 **5.7 Temperature and humidity range**

425 **5.7.1 Normal**

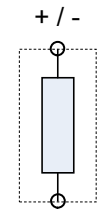
426 **5.7.2 Extended**

427 **5.8 Multipole SPD**

428 **5.9 Connection configuration**

429 NOTE Each doted rectangle represents one or more components connected in parallel and/or in series.

430 **5.9.1 I configuration**



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432 **Figure 2 – I configuration**