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colour inside

Low-voltage surge protective devices –
Part 31: Requirements and test methods for SPDs for photovoltaic installations

Parafoudres basse tension –
Partie 31: Parafoudres pour usage spécifique y compris en courant continu – Exigences et méthodes d'essai des parafoudres pour installations photovoltaïques

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LOW-VOLTAGE SURGE PROTECTIVE DEVICES –

Part 31: Requirements and test methods for SPDs for photovoltaic installations

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International Standard IEC 61643-31 has been prepared by subcommittee 37A: Low-voltage surge protective devices, of IEC technical committee 37: Surge arresters.

The text of this standard is based on the following documents:

FDIS	Report on voting
37A/306/FDIS	37A/310/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 61643 series can be found, under the general title *Low-voltage surge protective devices*, on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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INTRODUCTION

This part of IEC 61643 addresses safety and performance tests for surge protective devices (SPDs) to be installed on the DC side of photovoltaic installations to protect against induced and direct lightning effects.

There are three classes of tests:

1) The Class I test is intended to simulate partial conducted lightning current impulses. SPDs subjected to Class I test methods are generally recommended for locations at points of high exposure, e.g., line entrances to buildings protected by lightning protection systems.
2) SPDs tested to Class II or Class III test methods are subjected to impulses of shorter duration.
3) SPDs are tested on a “black box” basis as far as possible.

Tests take into account that photovoltaic generators:

- behave like current generators,
- that their output current depends on the incident light intensity and temperature,
- that their short-circuit current is slightly higher than the operating output 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).

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

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IEC 61643-32 addresses the selection and application principles of SPDs in practical situations for PV application (work in progress).

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LOW-VOLTAGE SURGE PROTECTIVE DEVICES –

Part 31: Requirements and test methods for SPDs for photovoltaic installations

1 Scope

This part of IEC 61643 is applicable to Surge Protective Devices (SPDs), intended for surge protection against indirect and direct effects of lightning or other transient overvoltages. These devices are designed to be connected to the DC side of photovoltaic installations rated up to 1 500 V DC.

These devices contain at least one non-linear component and are intended to limit surge voltages and divert surge currents. Performance characteristics, safety requirements, standard methods for testing and ratings are established.

SPDs complying with this standard are exclusively dedicated to be installed on the DC side of photovoltaic generators and the DC side of inverters.

SPDs for PV systems with energy storage (e.g. batteries, capacitor banks) are not covered.

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SPDs with separate input and output terminals that contain specific series impedance between these terminal(s) (so called two-port SPDs according to IEC 61643-11:2011) are not covered.

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SPDs compliant with this standard are designed to be permanently connected where connection and disconnection of fixed SPDs can only be done using a tool. This standard does not apply to portable SPDs

NOTE 1 In general SPDs for PV applications do not contain a specific series impedance between the input/output terminals due to power efficiency considerations.

NOTE 2 Wherever reference is made to the electric power system or the power system within this document, this refers to the DC side of the photovoltaic installation.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

IEC 60060-1:2010, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60068-2-78:2012, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

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

IEC 61180-1, *High-voltage test techniques for low-voltage equipment – Part 1: Definitions, test and procedure requirements*

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

IEC 62475:2010, *High-current test techniques – Definitions and requirements for test currents and measuring systems*

3 Terms, definitions, acronyms and symbols

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

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3.1 Terms and definitions

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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

Note 1 to entry: An SPD is a complete assembly, having appropriate connecting means.

[SOURCE: IEC 61643-11:2011, 3.1.1]

3.1.2
one-port SPD
SPD having no intended series impedance

Note 1 to entry: A one-port SPD may have separate input and output connections

Note 2 to entry: Overcurrent protection devices e.g fuses or circuit breakers are not considered as specific intended series impedance.

[SOURCE: IEC 61643-11:2011, 3.1.2, modified (Note 2 to entry added)]

3.1.3
voltage-switching 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 1 to entry: Common examples of components used in voltage-switching SPDs are spark gaps, gas tubes and thyristors. These are sometimes called "crowbar-type" components.

[SOURCE: IEC 61643-11:2011, 3.1.4, modified (original term referred to "voltage switching type SPD")]

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

Note 1 to entry: Common examples of components used in voltage-limiting SPDs are varistors and avalanche breakdown diodes. These are sometimes called "clamping-type" components.

[SOURCE: IEC 61643-11:2011, 3.1.5, modified (original term referred to "voltage limiting type SPD")]

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

[SOURCE: IEC 61643-11:2011, 3.1.6, modified (original term referred to "combination type SPD")]

3.1.6
mode of protection
an intended current path between terminals, that contains one or more protective components, for which the manufacturer declares a protection level

Note 1 to entry: Additional terminals may be included within this current path.

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[SOURCE: IEC 61643-11:2011, 3.1.8, modified (original term referred to "mode of protection of an SPD", Note 1 to entry added)]

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3.1.7
nominal discharge current
I_n
crest value of the current through the SPD having a current waveshape of 8/20

[SOURCE: IEC 61643-11:2011, 3.1.9, modified (original term referred to "nominal discharge current for class II test)]

3.1.8
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

[SOURCE: IEC 61643-11:2011, 3.1.10]

3.1.9
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

Note 1 to entry: I_{max} is equal to or greater than I_n.

[SOURCE: IEC 61643-11:2011, 3.1.48]

3.1.10
maximum continuous operating voltage for PV application
U_{CPV}
maximum DC voltage which may be continuously applied to the SPD's mode of protection

3.1.11
continuous current for PV application
I_{CPV}
current flowing through the plus and minus terminals of the SPD while energized at U_{CPV}

3.1.12
residual current
I_{PE}
current flowing through the PE-terminal of the SPD while energized at U_{CPV}

[SOURCE: IEC 61643-11:2011, 3.1.4,modified (different reference test voltage referred to)]

3.1.13
follow current
I_f
peak current supplied by the electrical power system and flowing through the SPD after a discharge current impulse

Note 1 to entry: The follow current is significantly different from the continuous current I_{CPV}.

[SOURCE: IEC 61643-11:2011, 3.1.12, modified (Note 1 to entry added)]

3.1.14
rated load current
I_L
maximum continuous rated DC current that can be supplied through the input/output terminals of an SPD

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[SOURCE: IEC 61643-11:2011, 3.1.13, modified (modified definition)]

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3.1.15
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 1 to entry: The voltage protection level is given by the manufacturer and may 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} respectively for test classes II and / or I;

– the measured limiting voltage determined for the combination wave measurements up to U_{OC} for test class III.

[SOURCE: IEC 61643-11:2011, 3.1.14, modified (modified Note 1 to entry)]

3.1.16
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

[SOURCE: IEC 61643-11:2011, 3.1.15]

3.1.17
residual voltage
U_{res}
crest value of voltage that appears between the terminals of an SPD due to the passage of discharge current

[SOURCE: IEC 61643-11:2011, 3.1.16]

3.1.18
1,2/50 voltage impulse
voltage impulse with a nominal virtual front time of 1,2µs and a nominal time to half-value of 50µs.

Note 1 to entry: Clause 8 of IEC 60060-1: 2010 defines the voltage impulse definitions of front time, time to half value and waveshape. IEC 61643-1 defines specific tolerance values.

[SOURCE: IEC 61643-11:2011, 3.1.20]

3.1.19
8/20 current impulse
current impulse with a nominal virtual front time of 8µs and a nominal time to half-value of 20µs

Note 1 to entry: Clause 10 of IEC 62475: 2010 defines the current impulse definitions of front time, time to half value and waveshape. IEC 61643-11 defines specific tolerance values.

[SOURCE: IEC 61643-11:2011, 3.1.21]

3.1.20
combination wave
wave characterized by defined voltage amplitude (U_{OC}) and waveshape under open-circuit conditions and a defined current amplitude (I_{CW}) and waveshape under short-circuit conditions

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Note 1 to entry: The voltage amplitude, current amplitude and waveform that is delivered to the SPD are determined by the combination wave generator (CWG) impedance Z_f and the impedance of the DUT.

[SOURCE: IEC 61643-11:2011, 3.1.22]

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3.1.21
open-circuit voltage
U_{OC}
open-circuit voltage of the combination wave generator at the point of connection of the device under test

[SOURCE: IEC 61643-11:2011, 3.1.23]

3.1.22
combination wave generator short-circuit current
I_{CW}
prospective short-circuit current of the combination wave generator, at the point of connection of the device under test

Note 1 to entry: When the SPD is connected to the combination wave generator, the current that flows through the device is generally less than I_{CW}.

[SOURCE: IEC 61643-11:2011, 3.1.24]

3.1.23
thermal stability
state of an SPD 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

[SOURCE: IEC 61643-11:2011, 3.1.25]

3.1.24
degradation (of performance)
undesired permanent departure in the operational performance of equipment or a system from its intended performance

[SOURCE: IEC 61643-11:2011, 3.1.26]

3.1.25
short-circuit current rating of the SPD
I_{SCPV}
maximum prospective short-circuit current from the power system for which the SPD, in conjunction with the disconnector specified, is rated

[SOURCE: IEC 61643-11:2011, 3.1.27, modified (term originally referred to as I_{SCCR})]

3.1.26
SPD disconnector (disconnector)
device for disconnecting an SPD, or part of an SPD, from the power system in the event of SPD failure

Note 1 to entry: 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.

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[SOURCE: IEC 61643-11:2011, 3.1.28]

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3.1.27
degree of protection of enclosure
IP

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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

[SOURCE: IEC 61643-11:2011, 3.1.29]

3.1.28
type test
conformity test made on one or more items representative of the production

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

3.1.29
routine test
test made on each SPD or on parts and materials as required to ensure that the product meets the design specifications

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

3.1.30
acceptance tests
contractual test to prove to the customer that the item meets certain conditions of its specification

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