# SLOVENSKI STANDARD
# SIST-TS CLC/TS 51643-32:2020

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**Nadomešča:**
**SIST-TS CLC/TS 50539-12:2014**

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**Nizkonapetostne naprave za zaščito pred prenapetostnimi udari - 32. del: Naprave za zaščito pred prenapetostnimi udari, priključene na enosmerno stran fotonapetostnih inštalacij - Izbira in načini uporabe**

Low-voltage surge protective devices - Part 32: Surge protective devices connected to the DC side of photovoltaic installations - Selection and application principles



**Ta slovenski standard je istoveten z:** **CLC/TS 51643-32:2020**

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**ICS:**

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| 27.160 | Sončna energija | Solar energy engineering |
| 29.120.50 | Varovalke in druga nadtokovna zaščita | Fuses and other overcurrent protection devices |

**SIST-TS CLC/TS 51643-32:2020** **en**

TECHNICAL SPECIFICATION

SPÉCIFICATION TECHNIQUE

TECHNISCHE SPEZIFIKATION

# CLC/TS 51643-32

July 2020

ICS 27.160; 29.120.50

Supersedes CLC/TS 50539-12:2013

English Version

# Low-voltage surge protective devices - Part 32: Surge protective devices connected to the DC side of photovoltaic installations - Selection and application principles

Parafoudres basse tension - Partie 32 : Parafoudres connectés au côté courant continu des installations photovoltaïques - Principes de choix et d'application

Überspannungsschutzgeräte für Niederspannung - Teil 32: Überspannungsschutzgeräte für den Einsatz auf der Gleichstromseite von Photovoltaik-Installationen - Auswahl und Anwendungsgrundsätze

This Technical Specification was approved by CENELEC on 2020-05-25.

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

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# Contents

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# European foreword

This document (CLC/TS 51643-32:2020) has been prepared by CLC/TC 37A ”Low-voltage surge protective devices".

This document supersedes CLC/TS 50539-12:2013 and all of its amendments and corrigenda (if any).

CLC/TS 51643-32:2020 includes the following significant technical changes with respect to CLC/TS 50539-12:2013:

— slight restructuring without impact on the content (such as changing the title of a clause by changing the text of one clause to another),

— deletion of the current branch concept of an SPD,

— referring to EN 61634-11:2019 instead of EN 50539-11:2013,

— referring to OCFM, SCFM instead of acronyms and concepts SCM and OCM,

— deletion of Annex C relating to the simplified risk assessment A,

— addition of a new annex dealing with telecommunication circuits.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

# Introduction

This document provides useful information for the selection of SPDs connected to photovoltaic installations.

This document does not address the fundamentals of SPDs that are addressed in CLC/TS 61643-12 which are necessary for its correct understanding and application.

This document provides information to evaluate, with reference to the documents listed in Clause 2, the additional needs for surge protective devices (SPDs) to be installed on the DC side and on the AC side of a photovoltaic (PV) system, to protect against induced and direct lightning effects. It gives guidance for selection, operation and installation of SPDs, including the selection of SPD type, surge current values and cross sections of bonding conductors.

The specific electrical parameters of a PV array or a PV source require specific SPDs on the DC side.

This document considers SPDs used in different locations and in different kinds of PV systems. It gives examples and provides a simplified and common approach to determine impulse discharge current values for the DC side of different PV installations.

# 1 Scope

This document describes the principles for selection, installation and coordination of SPDs intended for use in Photovoltaic (PV) systems up to 1500 V DC and for the AC side of the PV system rated up to 1000 V RMS 50/60 Hz.

The photovoltaic installation extends from a PV array or a set of interconnected PV-modules to include the associated cabling and protective devices and the converter up to the connection point in the distribution board or the utility supply point.

This document considers SPDs used in different locations and in different kinds of PV systems:

— PV systems located on the top of a building;

— PV systems located on the ground like free field power plants characterized by multiple earthing and a meshed earthing system.

The term PV installation is used to refer to both kinds of PV systems. The term PV power plant is only used for extended free-field multi-earthed power systems located on the ground.

For PV installations including batteries additional requirements could be necessary.

NOTE 1 The HD 60364 series, EN 62305 series and CLC/TS 61643-12 also apply.

NOTE 2 This document deals only with SPDs and not with surge protective components integrated inside equipment (e.g. inverters, (PCE) power conversion equipment).



# 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.



HD 60364-5-534:2016, *Low-voltage electrical installations - Part 5-53: Selection and erection of electrical equipment - Isolation, switching and control - Clause 534: Devices for protection against transient overvoltages (IEC 60364-5-53:2001/A2:2015, modified)*

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

EN 61000-4-5, *Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test (IEC 61000-4-5)*

CLC/TS 61643-12, *Low-voltage surge protective devices - Part 12: Surge protective devices connected to low-voltage power distribution systems - Selection and application principles (IEC 61643-12)*

EN 61643-31:2019, *Low-voltage surge protective devices - Part 31: Requirements and test methods for SPDs for photovoltaic installations (IEC 61643-31:2018)*

ITU-T K.20, *Resistibility of telecommunication equipment installed in a telecommunications centre to overvoltages and overcurrents*

ITU-T K.21, *Resistibility of telecommunication equipment installed in customer premises to overvoltages and overcurrents*

## 3 Terms and definitions

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

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

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

**3.1**
**PV array**
assembly of electrically interconnected PV modules, PV strings or PV sub-arrays

Note 1 to entry: For the purposes of this document, a PV array is all components up to the DC input terminals of the PCE or other power conversion equipment or DC loads. A PV array does not include its foundation, tracking apparatus, thermal control and other such components.

Note 2 to entry: A PV array may consist of a single PV module, a single PV string, or several parallel-connected strings, or several parallel-connected PV sub-arrays and their associated electrical components. For the purposes of this standard, the boundary of a PV array is the output side of the PV array disconnecting device.

[SOURCE: HD 60364-7-712:2016, 712.3.3]

**3.2**
**PV module**
smallest complete environmentally protected assembly of interconnected cells



[SOURCE: HD 60364-7-712:2016, 712.3.1]



**3.3**
**PV string**
circuit of one or more series-connected modules

[SOURCE: HD 60364-7-712:2016, 712.3.2]

**3.4**
**PV installation**
erected equipment of a PV power supply installation

[SOURCE: HD 60364-7-712:2016, 712.3.14]

**3.5**
**origin of the installation**
point at which the electric energy is delivered to the electrical installation

[SOURCE: IEC 60050-826:2004, 826-10-02]

**3.6**
**lightning protection system**
**LPS**
complete system used to reduce physical damage due to lightning flashes to a structure

Note 1 to entry: It consists of both external and internal lightning protection systems.

[SOURCE: EN 62305-1:2011, 3.42]

**3.7**
**external LPS isolated from the structure to be protected**
LPS with an air-termination system and down conductor system installed in such a way that the path of the lightning current has no contact with the structure to be protected

Note 1 to entry: In an isolated LPS, dangerous sparks between the LPS and the structure are avoided

[SOURCE: EN 62305-3:2011, 3.3]

**3.8**
**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: EN 61643-11:2012, 3.1.1]

**3.9**
**separation distance**
**s**
distance between two conductive parts at which no dangerous sparking can occur

[SOURCE: EN 62305-3:2011, 3.28]



**3.10**
**bonding bar**
metal bar on which metal installations, external conductive parts, electric power and telecommunication lines, and other cables can be bonded to an LPS



[SOURCE: EN 62305-3:2011, 3.24]

**3.11**
**bonding conductor**
conductor connecting separated conductive parts to LPS

[SOURCE: EN 62305-3:2011, 3.25]

**3.12**
**standard test conditions**
**STC**
standard set of reference conditions used for the testing and rating of photovoltaic cells and modules

Note 1 to entry: See product standards (e.g. EN 61215).

Note 2 to entry: The standard test conditions given in EN 61215 for PV modules are:

a) PV cell temperature of 25 °C

b) Irradiance in plane of the PV cell or module of 1000 W/m2

c) Light spectrum corresponding to an atmospheric air mass of 1,5

[SOURCE: HD 60364-7-712:2016, 712.3.13]

**3.13**
**open-circuit voltage under standard test conditions**
**$U_{OC\ STC}$**
voltage under standard test conditions across an unloaded (open) PV module, PV string or PV array, or on the DC side of the PV-inverter or power conversion equipment

[SOURCE: HD 60364-7-712:2016, 712.3.14, modified (addition of "-inverter or power conversion equipment")]

**3.14**
**open-circuit maximum voltage**
**$U_{OC\ MAX}$**
maximum voltage across an unloaded (open) PV module, PV string or PV array, or on the DC side of the PV-inverter or power conversion equipment

Note 1 to entry: Calculation of $U_{OC\ MAX}$ is performed in Annex B.

[SOURCE HD 60364-7-712:2016, 712.3.15 MOD]

**3.15**
**short-circuit current under standard test conditions**
**$I_{SC\ STC}$**
short-circuit current of a PV module, PV string or PV array under standard test conditions

[SOURCE: HD 60364-7-712:2016, 712.3.16]



**3.16**
**short-circuit maximum current**
**$I_{SC\ MAX}$**
maximum short-circuit current of a PV module, PV string or PV array



Note 1 to entry: Calculation of $I_{SC\ MAX}$ is performed in Annex B.

[SOURCE: HD 60364-7-712:2016, 712.3.17]

**3.17**
**maximum continuous operating voltage for PV application**
**$U_{CPV}$**
maximum DC voltage which may be continuously applied to the SPD´s mode of protection

Note 1 to entry: The $U_{CPV}$ values covered by this standard may exceed 1 500 V.

[SOURCE: EN 61643-31:2019, 3.1.10 modified (Notes to entry)]

**3.18**
**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

Note 1 to entry: This value is equal to or greater than $I_{SC\ MAX}$.

[SOURCE: EN 61643-31:2019, 3.1.25]

**3.19**
**open-circuit failure mode**
**OCFM**
failure behaviour whereby an SPD changes to a permanent high impedance or open circuit state under certain conditions

Note 1 to entry: A low impedance intermediate state is possible for a limited time until the final failure mode is reached.

[SOURCE: EN 61643-31:2019, 3.1.40]

**3.20**
**short-circuit failure mode**
**SCFM**
failure behaviour whereby an SPD changes to a permanent low impedance or short circuit state under certain conditions

[SOURCE: EN 61643-31:2019, 3.1.41]

**3.21**
**rated impulse voltage**
**$U_W$**
impulse withstand voltage value assigned by the manufacturer to the equipment or to a part of it, characterizing the specified withstand capability of its insulation against transient overvoltages



Note 1 to entry: For the purpose of this standard only withstand voltages between live conductors and earth is considered.

Note 2 to entry: $U_W$ is measured with a 1,2/50 µs voltage impulse wave shape.



Note 3 to entry: In some other standards also called $U_{imp}$.

[SOURCE: EN 60664-1:2007, 3.9.2, modified (addition of Notes to entry)]

**3.22**
**total discharge current**
**$I_{Total}$**
current which flows through the earth conductor of a multipole SPD during the total discharge current test

Note 1 to entry: 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 to entry: $I_{Total}$ is particularly relevant for SPDs tested according to the Type 1 SPD test, and is used for the purpose of lightning protection equipotential bonding according to EN 62305 series.

[SOURCE: EN 61643-11:2012, 3.1.44, modified (“PE or PEN conductor” replaced by “earth conductor”)]

## 4 Systems and equipment to be protected

Equipment within a PV installation that may require protection includes:

— The inverter, i.e. both the AC interface with the AC LV power system and the DC interface;

— The PV array;

— The wiring (installation itself);