PD CLC/TS 51643-32:2020

BSI Standards Publication

Low-voltage surge protective devices

Part 32: Surge protective devices connected to the DC side of photovoltaic installations — Selection and application principles

bsi.

National foreword

This Published Document is the UK implementation of CLC/TS 51643-32:2020. It supersedes PD CLC/TS 50539-12:2013, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/37/1, Surge Arresters - Low Voltage.

A list of organizations represented on this committee can be obtained on request to its committee manager.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Published by BSI Standards Limited 2020

ISBN 978 0 539 11924 4

ICS 29.120.50; 27.160

Compliance with a British Standard cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 August 2020.

Amendments/corrigenda issued since publication

Date	Text affected

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.

CENELEC members are required to announce the existence of this TS in the same way as for an EN and to make the TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Ref. No. CLC/TS 51643-32:2020 E

CLC/TS 51643-32:2020 (E)

Contents

Page

European foreword 5
Introduction 6
1 Scope 7
2 Normative references 7
3 Terms and definitions 8
4 Systems and equipment to be protected 11
5 Overvoltages in a PV installation 12
6 Selection and erection of SPDs 12
6.1 General 12
Table 1 — Selection of SPD type and cross section of bonding conductor 13
6.2 Requirements for different PV installations 13
6.2.1 General 13
6.2.2 PV installation without an external LPS 14
Figure 1 — Installation of SPDs in the case of a building without an external LPS 14
6.2.3 PV installation with an external LPS when the separation distance (*s*) is maintained (excluding multi-earthed solar systems, such as PV power plants) 14
Figure 2 — Installation of SPDs in the case of a PV installation with an external LPS where the separation distance (*s*) is maintained 15
6.2.4 PV installation with an external LPS where the separation distance (*s*) cannot be maintained (including multi-earthed systems, such as PV power plants) 16
Figure 3 — Installation of SPDs in the case of a PV-installation with an external LPS where the separation distance (s) cannot be maintained 16
6.2.5 PV installation including communication and signalling circuits 16
6.3 Selection and erection of SPDs installed on the AC side 17
6.3.1 General 17
6.3.2 Selection of SPDs with regard to nominal discharge current I_n and impulse current I_{imp} 17
6.3.3 Selection of SPDs with regard to voltage protection level U_p 17
6.3.4 Installation of SPDs on the AC side 17
Figure 4 — Installation of SPDs on the AC side with a short distance between the origin of the installation and the PV inverter (E < 10 m) 18
Figure 5 — Installation of SPDs on the AC side with a long distance between the origin of the installation and the PV inverter (E ≥ 10 m) 18
6.4 Selection and erection of SPDs installed on the DC side 19
6.4.1 General 19
6.4.2 Selection of SPDs with regard to nominal discharge current I_n and impulse current I_{imp} 19
6.4.3 Selection of U_{CPV} of SPDs on the DC side 19
6.4.4 Selection of SPDs with regard to its leakage current I_{PE} 19
6.4.5 Selection of SPDs with regard to voltage protection level U_p 19
Table 2 — Rated impulse voltage U_W for equipment between PV array and inverter (where no other information is available) 20
6.4.6 Installation of SPDs on the DC side 20

Figure 6 — Example of overvoltage protection on the DC side of a PV installation 21
6.4.7 Cross-sections of connecting conductors for SPDs on the DC side 21
6.4.8 Connection schemes of assemblies of SPDs on the DC side. 22
Figure 7 — Example of connections (Y, D and U) on the DC side of a PV source. 23
Figure 8 — Example of connections (L and I) on the DC side of a reliable earthed PV source when distance between SPDs and the reliable earthing is less than 1 m. 23
6.4.9 Selection of I_{SCPV} of SPDs on the DC side 23
6.5 Coordination of SPDs 24
7 Earthing Arrangement 24
8 Requirements for the installation of surge protective devices (SPDs) in a PV system 25
9 Maintenance 25
Annex A (normative) Determination of the value of I_{imp} or I_n for SPDs according to the simplified approach for different structures protected by an LPS 26
A.1 Introduction 26
A.2 Building with a PV installation on the roof according to 6.2.4 27
Figure A.1 — Example of a structure with two external down conductors to determine the value of the discharge current for the selection of SPDs 29
Table A.1 — Values of I_{imp} ($I_{10/350}$) and I_n ($I_{8/20}$) for voltage limiting SPDs on the DC side of a PV installation mounted on the roof of a building with an external LPS if the separation distance is not maintained. 29
Table A.2 — Values of I_{imp} ($I_{10/350}$) for voltage switching SPDs on the DC side of a PV installation mounted on the roof of a building with an external LPS, if the separation distance is not maintained. 30
A.3 Free- field PV power plant 30
Figure A.2 — Example of the structure of an extended PV installation — A PV power plant with multiple earthing and a meshed earthing system 32
Table A.3 — Values of I_{imp} ($I_{10/350}$) and I_n ($I_{8/20}$) for SPDs used on the DC side in PV power plants with a central inverter, multiple earthing and a meshed earthing system 33
A.4 Selection of Type 1 SPDs impulse current I_{imp} when A.2 or A.3 cannot be applied. 34
Annex B (informative) Characteristics of a PV source 35
B.1 PV source characteristics 35
Figure B.1 — Equivalent circuit diagram of a PV current source 35
Figure B.2 — I/U characteristics of a PV source at different conditions 36
Figure B.3 — Comparison of I/U characteristics of a PV source at different radiation conditions and linear DC sources for SPD testing. 37
B.2 Calculation of $U_{OC\ MAX}$ 38
B.3 Calculation of $I_{SC\ MAX}$ 38
Annex C (informative) Additional information to Clause 6: Selection and erection of SPDs and to Clause 7: Earthing Arrangement 39
C.1 PV installation including communication and signalling circuits 39
Figure C.1 — Example of SPDs installed on a PV system protected by an external LPS where the separation distance (s) is maintained – Installation includes data acquisition and control system 40
C.2 PV installation and dimensions of equipotential bonding conductors 41

Figure C.2 — Example of a building with an external LPS – Dimensions of equipotential bonding conductors when the separation distance (s) is maintained, or an isolated LPS is used 41

Figure C.3 — Example of a building with an external LPS – Dimensions of equipotential bonding conductors when the separation distance (s) is not maintained. 42

Bibliography 43

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*