IEC 61643-11

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# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

colour inside

## Low-voltage surge protective devices –
## Part 11: Surge protective devices connected to low-voltage power systems – Requirements and test methods

## Parafoudres basse tension –
## Partie 11: Parafoudres connectés aux systèmes basse tension – Exigences et méthodes d'essai



IEC 61643-11:2011

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

# LOW-VOLTAGE SURGE PROTECTIVE DEVICES –

## Part 11: Surge protective devices connected to low-voltage power systems – Requirements and test methods

## FOREWORD

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International Standard IEC 61643-11 has been prepared by subcommittee 37A: Low-voltage surge protective devices, of IEC technical committee 37: Surge arresters.

This first edition of IEC 61643-11 cancels and replaces the second edition of IEC 61643-1 published in 2005. This edition constitutes a technical revision.

The main changes with respect of the second edition of IEC 61643-1 are the complete restructuring and improvement of the test procedures and test sequences.

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

| FDIS | Report on voting |
|---|---|
| 37A/229/FDIS | 37A/232/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 web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

NOTE The attention of National Committees is drawn to the fact that equipment manufacturers and testing organizations may need a transitional period following publication of a new, amended or revised IEC publication in which to make products in accordance with the new requirements and to equip themselves for conducting new or revised tests.



It is the recommendation of the committee that the content of this publication be adopted for national implementation not earlier than 12 months from the date of publication.



**IMPORTANT – The "colour inside" logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this publication using a colour printer.**

# INTRODUCTION

This part of IEC 61643 addresses safety and performance tests for surge protective devices (SPDs).

There are three classes of tests:

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.

SPDs tested to Class II or III test methods are subjected to impulses of shorter duration.

SPDs are tested on a “black box” basis as far as possible.

IEC 61643-12 addresses the selection and application principles of SPDs in practical situations.

# LOW-VOLTAGE SURGE PROTECTIVE DEVICES –

# Part 11: Surge protective devices connected to low-voltage power systems – Requirements and test methods

## 1 Scope

This part of IEC 61643 is applicable to devices for surge protection against indirect and direct effects of lightning or other transient overvoltages. These devices are packaged to be connected to 50/60 Hz a.c. power circuits, and equipment rated up to 1 000 V r.m.s. Performance characteristics, standard methods for testing and ratings are established. These devices contain at least one nonlinear component and are intended to limit surge voltages and divert surge currents.

## 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.



IEC 60060-1:1989, *High-voltage test techniques – Part 1: General definitions and test requirements*



IEC 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

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 60695-2-11:2000, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products*

IEC 61000 (all parts), *Electromagnetic compatibility (EMC)*

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

## 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

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.

**3.1.3**
**two-port SPD**
SPD having a specific series impedance connected between separate input and output connections

**3.1.4**
**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.

**3.1.5**
**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.

**3.1.6**
**combination type SPD**
SPD that incorporates both, voltage switching components and voltage limiting components. The SPD may exhibit voltage switching, limiting or both

**3.1.7**
**short-circuiting type SPD**
SPD tested according to Class II tests which changes its characteristic to an intentional internal short-circuit due to a surge current exceeding its nominal discharge current $I_n$

**3.1.8**
**mode of protection of an SPD**
an intended current path, between terminals that contains protective components, e.g. line-to-line, line-to-earth, line-to-neutral, neutral-to-earth.

**3.1.9**
**nominal discharge current for class II test**
$I_n$
crest value of the current through the SPD having a current waveshape of 8/20

**3.1.10**
**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

**3.1.11**
**maximum continuous operating voltage**
**$U_C$**
maximum r.m.s. voltage, which may be continuously applied to the SPD's mode of protection

NOTE The $U_C$ value covered by this standard may exceed 1 000 V.

**3.1.12**
**follow current**
**$I_f$**
peak current supplied by the electrical power system and flowing through the SPD after a discharge current impulse

**3.1.13**
**rated load current**
**$I_L$**
maximum continuous rated r.m.s. current that can be supplied to a resistive load connected to the protected output of an SPD



**3.1.14**
**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 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 corresponding to $I_n$ and/or $I_{imp}$ respectively for test classes II and/or I;
- the measured limiting voltage at $U_{OC}$, determined for the combination wave for test class III.

**3.1.15**
**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

**3.1.16**
**residual voltage**
**$U_{res}$**
crest value of voltage that appears between the terminals of an SPD due to the passage of discharge current

**3.1.17**
**temporary overvoltage test value**
**$U_T$**
test voltage applied to the SPD for a specific duration $t_T$, to simulate the stress under TOV conditions

**3.1.18**
**load-side surge withstand capability for a two-port SPD**
ability of a two-port SPD to withstand surges on the output terminals originating in circuitry downstream of the SPD

**3.1.19**
**voltage rate-of-rise of a two-port SPD**
rate of change of voltage with time measured at the output terminals of a two port SPD under specified test conditions

**3.1.20**
**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 The Clause 6 of IEC 60060-1 (1989) defines the voltage impulse definitions of front time, time to half-value and waveshape tolerance.

**3.1.21**
**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 IEC 60060-1 (1989) defines the current impulse definitions of front time, time to half-value and waveshape tolerance.

**3.1.22**
**combination wave**
a 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



NOTE 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.



**3.1.23**
**open circuit voltage**
$U_{OC}$
open circuit voltage of the combination wave generator at the point of connection of the device under test

**3.1.24**
**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 When the SPD is connected to the combination wave generator, the current that flows through the device is generally less than $I_{CW}$.

**3.1.25**
**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

**3.1.26**
**degradation (of performance)**
undesired permanent departure in the operational performance of equipment or a system from its intended performance

**3.1.27**
**short-circuit current rating**
$I_{SCCR}$
maximum prospective short-circuit current from the power system for which the SPD, in conjunction with the disconnector specified, is rated