IEC 61643-22

Edition 2.0 2015-06

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

colour inside

## Low-voltage surge protective devices – Part 22: Surge protective devices connected to telecommunications and signalling networks – Selection and application principles



## Parafoudres basse tension – Partie 22: Parafoudres connectés aux réseaux de signaux et de télécommunications – Principes de choix et d'application

IEC 61643-22:2015-06(en-fr)

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# LOW-VOLTAGE SURGE PROTECTIVE DEVICES –

## Part 22: Surge protective devices connected to telecommunications and signalling networks – Selection and application principles

## FOREWORD

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International Standard IEC 61643-22 has been prepared by subcommittee 37A: Low-voltage surge protective devices, of IEC technical committee 37: Surge arresters.

This second edition cancels and replaces the first edition published in 2004. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) Update the use of multiservice SPDs (Article 8)
b) Comparison between SPD classification of IEC 61643-11 and IEC 61643-21 (7.3.3)
c) Consideration of new transmission systems as PoE (Annex F)
d) EMC requirements of SPDs (Annex G)

e) Maintenance cycles of SPDs (Annex I)

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

| FDIS | Report on voting |
|---|---|
| 37A/273/FDIS | 37A/277/RVD |

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

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

The committee has decided that the contents of this amendment and the base 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- withdrawn,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.



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# INTRODUCTION

This International Standard is a guide for the application of SPDs to telecommunications and signalling lines and those SPDs which have telecom or signalling SPDs in the same enclosure with power line SPDs (so called multiservice SPDs). Definitions, requirements and test methods are given in IEC 61643-21. The decision to use SPDs is based on an analysis of the risks that are seen by the network or system under consideration. Because telecommunications and signalling systems may depend on long lengths of wire, either buried or aerial, the exposure to overvoltages from lightning, power line faults and power line/load switching, can be significant. If these lines are unprotected, the resultant risk to information technology equipment (ITE) can also be significant. Other factors that may influence the decision to use SPDs are local regulators and insurance stipulations. This standard provides indications for evaluating the need for SPDs, the selection, installation and dimensioning of SPDs and for achieving coordination between SPDs and between SPDs and ITE installed on telecommunication and signal lines.

Coordination of SPDs assures that a proper interaction between them, as well as between an SPD and the ITE to be protected will be realized. Coordination requires that the voltage protection level, $U_p$, and let-through current, $I_p$, of the initial SPD does not exceed the resistibility of subsequent SPDs or the ITE.

In general, the SPD closest to the source of the impinging surge diverts most of the surge: a downstream SPD will divert the remaining or residual surge. The coordination of SPDs in a system is affected by the operation of the SPDs and the equipment to be protected as well as the characteristics of the system to which the SPDs are connected.



The following variables should be reviewed when attempting to attain proper coordination:

- waveshape of the impinging surge (impulse or AC);
- ability of the equipment to withstand an overvoltage/overcurrent without damage;
- installation, e.g. distance between SPDs and between SPDs and ITE;
- SPD voltage-protection levels.



The performance of an SPD and its coordination with other SPDs can be affected by exposure to previous transients. This is especially true for transients which approach the limit of the capacity of the SPD. If there is considerable doubt concerning the number and severity of the surges handled by the SPDs under consideration, it is suggested that SPDs with higher capabilities be used.

One of the direct effects of poor coordination may be bypassing of the SPD closest to the surge source, with the result that the following SPD will be forced to handle the entire surge. This can result in damage to that SPD.

Lack of proper coordination can also lead to equipment damage and, in severe cases, may lead to a fire hazard.

There are several technologies used in the design of the SPDs covered in this standard. These are explained in the main text and also in informative Annexes A and B.

# LOW-VOLTAGE SURGE PROTECTIVE DEVICES –

# Part 22: Surge protective devices connected to telecommunications and signalling networks – Selection and application principles

## 1 Scope

This part of IEC 61643 describes the principles for the selection, operation, location and coordination of SPDs connected to telecommunication and signalling networks with nominal system voltages up to 1 000 V r.m.s. a.c. and 1 500 V d.c.

This standard also addresses SPDs that incorporate protection for signalling lines and power lines in the same enclosure (so called multiservice SPDs).

## 2 Normative references

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



IEC 61643-21:2012, *Low voltage surge protective devices – Part 21: Surge protective devices connected to telecommunications and signalling networks – Performance requirements and testing methods*



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

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

IEC 62305-1:2010, *Protection against lightning – Part 1: General principles*

IEC 62305-2:2010, *Protection against lightning – Part 2: Risk management*

IEC 62305-3:2010, *Protection against lightning – Part 3: Physical damage to structures and life hazard*

IEC 62305-4:2010, *Protection against lightning – Part 4: Electrical and electronic systems within structures*

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

## 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**
**resistibility**
ability of telecommunication equipment or installations to withstand, in general, without damage, the effects of overvoltages or overcurrents, up to a certain specified extent, and in accordance with a specified criterion

Note 1 to entry: This definition is derived from ITU-T K.44 [24][1].

**3.1.2**
**multiservice surge protective device**
**MSPD**
surge protective device providing protection for two or more services such as power, telecommunications and signalling in a single enclosure in which a reference bond is provided between services during surge conditions

### 3.2 Abbreviations

| | |
|---|---|
| MSPD | Multiservice Surge Protective Device |
| POTS | Plain Old Telephone Service |
| VDSL | Very High Speed Digital Subscriber Line |
| ADSL | Asymmetric Digital Subscriber Line |
| PoE | Power over Ethernet |



## 4 Description of technologies

### 4.1 General

The following is a short description of various surge protection component technologies. More details are available in Annexes A and B.

### 4.2 Voltage-limiting components

#### 4.2.1 General

These shunt-connected SPD components are non-linear elements that limit overvoltages that exceed a given voltage by providing a low impedance path to divert currents. The continuous operating voltage ($U_c$), of the SPD is chosen to be greater than the maximum peak system voltage in normal operation. At the maximum system operating voltage, the SPD's leakage current shall not interfere with normal system operation.

Multiple components may be used to form assemblies. Connecting voltage-limiting surge protective components in series may results in higher voltage protection levels. Parallel component connection may increase the surge current capability of the assembly. For example, switching components will not share current, however clamping components may.

Some technologies, e.g. metal oxide varistors, have voltage-current characteristics that are inherently symmetrical for positive and negative voltage polarities. Such components are classified as symmetrical bi-directional. Components having positive and negative current-voltage characteristics with the same basic shape, but with significantly different characteristic values are classified as asymmetrical bi-directional.

Other technologies, e.g. PN semi-conductor components, typically have symmetrical voltage-current characteristics.

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1 Numbers in square brackets refer to the Bibliography.

#### 4.2.2 Clamping components

These SPD components have continuous voltage-current characteristics. Generally, this will mean that the protected equipment will be exposed to a voltage above the SPD's threshold level for most of the voltage impulse duration. As a result, these SPD components will dissipate substantial energy during the overvoltage.

#### 4.2.3 Switching components

These SPD components have a discontinuous current-voltage characteristic. At a designed voltage, they switch to a low-voltage state. In this low-voltage state, the energy absorbed is low compared to that of other SPDs that ”clamp” the voltage at a specific protection level. As a result of this switching action, protected equipment will be subjected to a voltage above the normal system voltage for only a very short time. If the system's operating voltage and current exceed the reset characteristics of the switching-type component, these components remain in the conducting state. Appropriate SPD selection and circuit design will allow the SPD to recover to a high resistance state under normal system voltage and currents.

### 4.3 Current-limiting components

#### 4.3.1 General

To limit an overcurrent, the protection componenthas to stop or reduce the current flowing to the protected load. There are three possible methods: interruption, reduction or diversion. The majority of the technologies used for overcurrent protection are thermally activated, resulting in relatively slow response operating times. Until the overcurrent protection operates, the load, and possibly the SPDs, have to be capable of withstanding the surge.



#### 4.3.2 Current-interrupting components



These components open the circuit path for the surge current to the SPD or ITE, (see Figure B.1). Sudden opening of a current-carrying circuit usually results in arcing, particularly if the current is at its peak. This arcing has to be controlled to prevent a safety hazard. After interruption, maintenance is required to restore service. One example of a current-interrupting component is a fuse.

#### 4.3.3 Current-reducing components

These components reduce the current flow by effectively inserting a large series resistance with the load (see Figure B.4). An example of a current-reducing type used for this action is a self-heating positive temperature coefficient (PTC) thermistor. Overcurrents cause resistive heating of the PTC thermistor. When the thermistor's temperature exceeds its threshold temperature (typically 120 °C), this causes the thermistor resistance to change from Ohms to hundreds of kilo-Ohms, thereby reducing the current. The lower current, after changing to a high resistance, maintains the PTC thermistor's temperature, forcing the PTC thermistor to remain in the high resistance state. A thermistor dissipation of typically about 1 W is needed to maintain the temperature, e.g. 5 mA from a 200 V a.c. overvoltage. After the surge, the PTC thermistor cools and returns to a low resistance value (resets). Current reducing Electronic Current Limiters (see B.3.1.2) operate when the current exceeds a predetermined threshold and respond to lightning surges as well as a.c.

#### 4.3.4 Current-diverting components

Current-diverting components effectively create a low impedance path in parallel with the load (see Figure B.2). Activation occurs due to temperature rise of the voltage-limiting type or load current sensing. Although the load is protected, the surge current in the network feed is the same or greater. After operation, maintenance may be required to restore service.

# 5 Parameters for selection of SPDs and appropriate tests from IEC 61643-21

## 5.1 General

This clause discusses the parameters of SPDs and their relevance to the operation of the SPDs and the normal operation of the networks to which they are connected. These parameter values can be used to form the basis for comparison amongst SPDs and also to provide guidance in their selection for signalling and power systems. Values for these parameters are available from SPD manufacturers and suppliers. Verification of the values, or obtaining them when not provided by suppliers, shall be performed using the tests and methods described in IEC 61643-21.

## 5.2 Normal service conditions

### 5.2.1 General

The SPD parameters shall be suitable for the intended environment.

### 5.2.2 Air pressure and altitude

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

### 5.2.3 Ambient temperature



Ambient temperature falls within the following ranges:

- normal range: -5 °C to + 40 °C

NOTE 1 This range normally addresses SPDs for indoor use. This corresponds to code AB4 in IEC 60364-5-51 [51].



- extended range: -40 °C t o +70 °C

NOTE 2 This range normally addresses SPDs for outdoor use in non weather-protected locations, class 3K7 in IEC 60721-3-3 [52].

- storage range: -40 °C to +70 °C

NOTE 3 Values outside this range will be specified by the manufacturer.

### 5.2.4 Relative humidity

Relative humidity falls within the following ranges:

- normal range: 5 % to 95 %

NOTE 1 This range normally addresses SPDs for indoor use. This corresponds to code AB4 in IEC 60364-5-51.

- extended range: 5 % to 100 %

NOTE 2 This range normally addresses SPDs for outdoor use in non weather-protected locations (e.g. SPD outside enclosure).

### 5.2.5 Abnormal service conditions

Exposure of the SPD to abnormal service conditions may require special consideration in the design or application of the SPD, and shall be called to the attention of the manufacturer.

## 5.3 SPD parameters that may affect normal system operation

The essential characteristics for the operation of SPDs having voltage-limiting or both voltage-limiting and current-limiting functions used in protecting telecommunication and signalling systems are as follows:

- maximum continuous operating voltage $U_c$;
- voltage protection level $U_p$;
- impulse reset;
- insulation resistance (leakage current);
- rated current.

SPDs shall conform to application-specific requirements. Some SPD parameters can influence the transmission characteristics of the network. These are listed below, as follows:

- capacitance;
- series resistance;
- insertion loss;
- return loss;
- longitudinal balance;
- near-end cross-talk (NEXT).

Therefore, SPDs may need to be tested using selected tests from IEC 61643-21. Annex D provides information about IT systems and some of their transmission characteristics that have to be taken into account when applying SPDs to these systems.

## 6 Risk management



### 6.1 General

The need for protective measures (e.g. protection with SPDs) for Information Technology Systems should be based on a risk assessment, considering the probability of overvoltage and overcurrent. The assessment of all parts of the Information Technology System shall attain a well coordinated protection of the whole network. This takes into account the consequences of the loss of service for the customer and network operator, the importance of the system (e.g. hospitals, traffic control), the electromagnetic environment at the particular site (probability of damages) and cost related to repair.



The decision to install protective measures shall be assessed based on

- the risk of damage to the network outside or inside the structure,
- the tolerable risk of damage.

For the structure and network inside the structure, the customer shall analyse these two values. For the network outside the structure, the network operator shall analyse them. As the weighting of risk components can lead to different protection results at the interconnection between the operator's network and private network (see Figure 1, “NT”-point), Table 1 gives a general overview of the responsibility for managing the protective measures.