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

berspannungsschutzgerte fr Niederspannung -- Teil 22: berspannungsschutzgerte fr den Einsatz in Telekommunikations- und signalverarbeitenden Netzwerken - Auswahl- und Anwendungsprinzipien

Parafoudres basse tension -- Partie 22: Parafoudres connects aux rseaux de signaux et de tlcommunications - Principes de choix et d'application

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Parafoudres basse tension
Partie 22: Parafoudres connectés aux réseaux de signaux et de télécommunications -
Principes de choix et d'application
(CEI 61643-22:2004, modifiée)

Überspannungsschutzgeräte für Niederspannung
Teil 22: Überspannungsschutzgeräte für den Einsatz in Telekommunikations- und signalverarbeitenden Netzwerken -
Auswahl- und Anwendungsprinzipien
(IEC 61643-22:2004, modifiziert)

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CENELEC

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Foreword

The text of the International Standard IEC 61643-22:2004, prepared by SC 37A, Low-voltage surge protective devices, of IEC TC 37, Surge arresters, together with common modifications prepared by the Technical Committee CENELEC TC 37A, Low voltage surge protective devices, was submitted to the formal vote and was approved by CENELEC as CLC/TS 61643-22 on 2005-09-10.

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Contents

Introduction **6**
1 Scope **7**
2 Normative references **7**
3 Terms and definitions **7**
4 Description of technologies **8**
4.1 Voltage-limiting devices 8
4.1.1 Clamping-type 8
4.1.2 Switching-type 8
4.2 Current-limiting devices 8
4.2.1 Current-interrupting type 8
4.2.2 Current-reducing type 9
4.2.3 Current-diverting type 9
5 Parameters for selection of SPDs and appropriate tests from EN 61643-21 ..... **9**
5.1 Controlled and uncontrolled environments 9
5.1.1 Controlled environments 9
5.1.2 Uncontrolled environments 9
5.2 SPD parameters that may affect normal system operation 10
6 Risk management **10**
6.1 Risk analysis 11
6.2 Risk identification 11
6.3 Risk treatment 11
7 Application of SPDs **13**
7.1 General 13
7.2 Coupling mechanisms 13
7.3 Application, selection and installation of surge protective devices (SPDs) 15
7.3.1 Application requirements for SPDs 15
7.3.2 SPD installation cabling considerations 20
8 Multiservice surge protective devices **23**
9 Coordination of SPDs/ITE **23**
Annex A (informative) **Voltage-limiting devices** **25**
A.1 Voltage-clamping devices 25
A.1.1 Metal oxide varistor (MOV) 25
A.1.2 Silicon semiconductors 25
A.2 Voltage-switching devices 27
A.2.1 Gas discharge tube (GDT) 27
A.2.2 Air gaps 27
A.2.3 Thyristor surge suppressor (TSS) – Fixed voltage types (self-gating) 28
A.2.4 Thyristor surge suppressor (TSS) – Gated types 28

Annex B (informative) **Current-limiting devices** ... **29**
B.1 Current-interrupting devices ... 29
B.1.1 Fusible resistor ... 29
B.1.2 Fuses ... 30
B.1.3 Thermal fuses ... 30
B.2 Current-reducing devices ... 30
B.2.1 Polymer PTC (positive temperature coefficient resistor) ... 31
B.2.2 Ceramic PTC ... 31
B.2.3 Electronic current limiters ... 31
B.3 Current-diverting devices ... 31
B.3.1 Heat coils ... 32
B.3.2 Gated thyristor, current operated ... 32
B.3.3 Thermal switch ... 33
Annex C (informative) **Risk management** ... **34**
C.1 Risk due to lightning discharges ... 34
C.1.1 Risk assessment ... 34
C.1.2 Risk analysis ... 34
C.1.3 Risk evaluation ... 35
C.1.4 Risk treatment ... 36
C.2 Risk due to power line faults ... 36
C.2.1 AC power systems ... 36
C.2.2 DC power systems ... 37
C.3 Earth potential rise ... 37
Annex D (informative) **Transmission characteristics related to IT systems** ... **38**
D.1 Telecommunications systems ... 38
D.2 Signalling, measurement and control systems ... 39
D.3 Cable TV systems ... 39
Annex E (informative) **Coordination of SPDs/ITE** ... **40**
E.1 Determination of UIN and IIN ... 40
E.2 Determine the output protective voltage and current waveforms for SPD 1 ... 40
E.3 Compare SPD 1 and SPD 2 values ... 41
E.4 Necessity of verification of the coordination by testing ... 42

Figure 1 – SPD installation in telecommunications and signalling networks ... 12
Figure 2 – Coupling mechanisms ... 14
Figure 3 – Example of a configuration of the lightning protection concept ... 16
Figure 4 – Example of a configuration according to the zones(Figure 2) ... 18
Figure 5 – Example of protecting measures against common-mode voltages and differential mode voltages of the data (f) and supply voltage input (g) of an ITE ... 19
Figure 6 – Influence of the voltages U_{L1} and U_{L2} on the protection level U_P caused by the inductance of the leads ... 20

Figure 7 – Removal of the voltages U_{L1} and U_{L2} from the protector unit by connecting leads to a common point. 21
Figure 8 – Necessary installation conditions of a three, five or multi-terminal SPD with an ITE for minimizing the interference influences on the protection level 22
Figure 9 – Coordination of two SPDs 23
Figure A.1 – Circuit for voltage-clamping devices 25
Figure A.2 – Circuit for voltage-switching devices 27
Figure B.1 – Circuit for interrupting devices 29
Figure B.2 – Circuit for current-reducing devices 30
Figure B.3 – Circuit for current-diverting devices 32
Figure C.1 – Risk evaluation procedure 35
Figure E.1 – Coordination verification process 41

Table 1 – Responsibility for managing the protective measures 11
Table 2 – Coupling mechanisms 15
Table 3 – Selection aid for rating SPDs for the use in (zone) interfaces according to IEC 61312-1 and EN 61000-4-5 17
Table C.1 – AC overhead power systems 36
Table C.2 – AC underground electric cables 37
Table C.3 – DC overhead power systems 37
Table C.4 – DC underground electric cables 37
Table D.1 – Transmission characteristics for telecommunications systems in access networks 38
Table D.2 – Transmission characteristics of IT systems in customer premises 39
Table D.3 – Transmission characteristics of cable TV-systems 39

Introduction

This TS 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. Definitions, requirements and test methods are given in EN 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 TS 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 the 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-limiting levels and response times.

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 TS. These are explained in the main text and also in informative Annexes A and B.

1 Scope

This TS 61643-22 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 TS also addresses SPDs that incorporate protection for signalling lines and power lines in the same enclosure.

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.

EN 61000-4-5:1995, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test* (IEC 61000-4-5:1995)

EN 61643-11:2002, *Low-voltage surge protective devices – Part 11: Surge protective devices connected to low-voltage power systems - Requirements and tests* (IEC 61643-1:1998 + corr. Dec. 1998, mod.)

EN 61643-21:2001, *Low-voltage surge protective devices – Part 21: Surge protective devices connected to telecommunications and signalling networks – Performance requirements and testing methods* (IEC 61643-21:2000 + corr. Mar. 2001)

IEC 61312-1:1995, *Protection against lightning electromagnetic impulse – Part 1: General principles*

IEC 61312-2:1999, *Protection against lightning electromagnetic impulse (LEMP) – Part 2: Shielding of structures, bonding inside structures and earthing*

ITU-T K.31:1993, *Bonding configurations and earthing of telecommunication installations inside a subscriber's building*

3 Terms and definitions

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

3.1
resistibility
ability of an SPD or information technology equipment (ITE) to withstand an overvoltage or overcurrent event without damage

NOTE This definition is derived from EN 61663-2 [1] 1) and is modified for this application. The equipment can lose some function during the overvoltage/overcurrent, but works correctly after the application of the overvoltage/ overcurrent.

3.2
multiservice surge protective device
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

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1) Figures in square brackets refer to the bibliography.

4 Description of technologies

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

4.1 Voltage-limiting devices

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. This voltage, U_{c1}, 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 should not interfere with normal system operation.

Multiple components may be used to form assemblies. Connecting voltage-limiting surge protective components in series results in higher voltage protection levels. Parallel component connection will increase the surge current capability of the assembly. However, care should be taken to assure current sharing between the parallel components.

Some technologies, e.g. metal oxide varistors, have voltage-current characteristics that are inherently symmetrical for positive and negative voltage polarities. Such devices are classified as symmetrical bi-directional. Devices 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 semiconductor junctions, have voltage-current characteristics that are inherently different for positive and negative voltage polarities.

4.1.1 Clamping-type

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 absorb substantial energy during the overvoltage.

4.1.2 Switching-type

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 device, these devices 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.

4.2 Current-limiting devices

To limit an overcurrent, the protection device has 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.

4.2.1 Current-interrupting type

These devices 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 device is a fuse.

4.2.2 Current-reducing type

These devices reduce the current flow by effectively inserting a large series resistance with the load (see Figure B.2). 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, which results in the thermistor's temperature exceeding its threshold temperature (typically 120 °C). Consequently, this causes a thermistor resistance 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. If the system's operating voltage and current do not exceed the PTC reset characteristics, the PTC thermistor will cool and return to a low resistance value after the surge.

4.2.3 Current-diverting type

These devices effectively place a short-circuit across the network at the point of installation (see Figure B.3). 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 EN 61643-21

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, should be performed using the tests and methods described in EN 61643-21.

5.1 Controlled and uncontrolled environments

The SPD parameters should be suitable for the intended environment.

5.1.1 Controlled environments

- Temperature range: -5 °C to 40 °C
- Humidity range: 10 % RH to 80 % RH
- Air pressure range: 80 kPa to 106 kPa

The controlled environment is one within the managed environment of a building or other infrastructure. This controlled environment will be at the very least naturally heated and cooled but will be protected against the extremes of the natural environment.

5.1.2 Uncontrolled environments

- Temperature range: -40 °C to 70 °C
- Humidity range: 5 % RH to 96 % RH
- Air pressure range: 80 kPa to 106 kPa

5.2 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 should 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 EN 61643-21. Annex D provides information about information technologies and some of their transmission characteristics that have to be taken into account when applying SPDs to these systems.

6 Risk management

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 should 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 should 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 should analyse these two values. For the network outside the structure, the network operator should 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), the following Table 1 gives a general overview of the responsibility for managing the protective measures.

Table 1 – Responsibility for managing the protective measures

Information Technology system	Responsibility
Installation inside the structure; private network	Customer
Installation outside the structure; operator's network	Network operator
Interconnection between operator's network and private network (NT)	Network operator or customer
Information technology equipment ITE	Customer (see NOTE)
Additional protective measures based on risk assessment	Customer
NOTE Resistibility requirements of telecommunications equipment are given in the ITU-T K series as referenced in IEC 61663-2 [1], they are implemented by the ITE manufacturer.	

6.1 Risk analysis

Risk analysis takes into consideration the following electromagnetic phenomena:

– power induction;

– lightning discharges;

– earth potential rise;

– power contact.

6.2 Risk identification

Risk identification takes into account economic aspects such as

– costs (high repair costs of inadequately protected equipment versus no repair costs of adequately protected equipment, probability of occurrence of damaging electromagnetic phenomena),

– intended application,

– the protective measures in installations,

– continuity of the service,

– serviceability of the equipment (equipment installed in difficult-to-reach places, e.g. high mountains).

6.3 Risk treatment

Risk treatment considers reduction of damage to the whole of the communication network, i.e. all types of networks, public and private, including all kinds of transmission or terminal equipment. The installation of SPDs can be subject to requirements and/or restrictions given by the network operator, network authority and system manufacturer (see Figure 1). For further information concerning risk management see Annex E.