

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

AMENDMENT 2  
AMENDEMENT 2

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

**Parafoudres basse tension –  
Partie 21: Parafoudres connectés aux réseaux de signaux et de  
télécommunications – Prescriptions de fonctionnement et méthodes d’essais**





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IEC 61643-21

Edition 1.0 2012-07

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INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

PRICE CODE  
CODE PRIX

R

ICS 29.240; 29.240.10

ISBN 978-2-83220-198-5

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## FOREWORD

This amendment has been prepared by subcommittee 37A: Low-voltage surge protective devices, of IEC technical committee 37: Surge arresters.

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

FDIS	Report on voting
37A/236/FDIS	37A/237/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.

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- withdrawn,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
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**Table 1 – General SPD requirements**

Replace existing Table 1 with the following new table:

Test series <sup>d</sup>	Requirement – Test	Sub-clause	Type of SPD					
			SPD with only voltage-limiting function	SPD with both voltage-limiting and current-limiting functions	SPD with voltage-limiting function and linear component between its terminals	SPD having both voltage-limiting and current-limiting functions with enhanced transmission capabilities	SPD having only voltage-limiting function but intended for use in extended range environment	SPD having both voltage-limiting and current-limiting functions but intended for use in extended range environment
1	<b>General test</b>	6.1						
	Identification and documentation	6.1.1	A	A	A	A	A	A
	Marking	6.1.2	A	A	A	A	A	A
	<b>Transmission tests</b>	6.2.3						
	Capacitance	6.2.3.1	A	O	O	O	A	O
	Insertion loss	6.2.3.2	O	A	A	A	O	A
	Return loss	6.2.3.3	O	O	O	A	O	O
	Longitudinal balance	6.2.3.4	O	O	O	A	O	O
	Bit Error Ratio (BER)	6.2.3.5	O	O	O	O	O	O
	Near-end crosstalk (NEXT)	6.2.3.6	O	O	O	A	O	O
	<b>Mechanical tests</b>	6.3						
	Terminals and connectors	6.3.1	A	A	A	A	A	A
	General testing procedure	6.3.1.1	A	A	A	A	A	A
	Terminals with screws	6.3.1.2	A	A	A	A	A	A
	Screwless terminals	6.3.1.3	A	A	A	A	A	A
	Insulating pierced connections	6.3.1.4	A	A	A	A	A	A
	Pull-out-test on SPD terminals designed for single-core conductors	6.3.1.4.1	A	A	A	A	A	A
	Pull-out-test on SPD terminals designed for multi-core cables and cords	6.3.1.4.2	A	A	A	A	A	A
	Mechanical strength (mounting)	6.3.2	A	A	A	A	A	A

Table 1 (continued)

Test series <sup>d</sup>	Requirement – Test	Sub-clause	Type of SPD					
			SPD with only voltage-limiting function	SPD with both voltage-limiting and current-limiting functions	SPD with voltage-limiting function and linear component between its terminals	SPD having both voltage-limiting and current-limiting functions with enhanced transmission capabilities	SPD having only voltage-limiting function but intended for use in extended range environment	SPD having both voltage-limiting and current-limiting functions but intended for use in extended range environment
	Resistance to ingress of solid objects and to harmful ingress of water	6.3.3	A	A	A	A	A	A
	Protection against direct contact	6.3.4	A	A	A	A	A	A
	Fire resistance	6.3.5	A	A	A	A	A	A
	<b>Environmental tests</b>	6.4						
	High temperature and humidity endurance	6.4.1	O	O	O	O	A	A
	Environmental cycling with impulse surges	6.4.2	O	O	O	O	A	A
	Environmental cycling with AC surges	6.4.3	O	O	O	O	A	A
2	<b>Voltage limiting tests</b>	6.2.1						
	Maximum continuous operating voltage (U <sub>c</sub> )	6.2.1.1	A	A	A	A	A	A
	Insulation resistance	6.2.1.2	A	A	A	A	A	A
	Impulse durability for voltage limiting function <sup>a</sup>	6.2.1.6	A	A	A	A	A	A
	Impulse-limiting voltage <sup>b</sup>	6.2.1.3	A	A	A	A	A	A
	Impulse reset switching types	6.2.1.4	A	A	A	A	A	A
	AC durability for voltage limiting function <sup>a</sup>	6.2.1.5	O	O	O	O	O	O
	Blind spot test multi stage SPD	6.2.1.8	A	A	A	A	A	A
	Overstressed fault mode	6.2.1.7	O	O	O	O	O	O
3	<b>Current limiting tests</b>	6.2.2						
	Rated current	6.2.2.1	A <sup>e</sup>	A	A	A	A <sup>e</sup>	A
	Series resistance	6.2.2.2	N.A.	A	A	A	N.A.	A
	Current response time	6.2.2.3	N.A.	A	N.A.	A <sup>c</sup>	N.A.	A <sup>c</sup>
	Current reset time	6.2.2.4	N.A.	A	N.A.	A <sup>c</sup>	N.A.	A <sup>c</sup>
	Maximum interrupting voltage	6.2.2.5	N.A.	A	N.A.	A <sup>c</sup>	N.A.	A <sup>c</sup>
	Operating duty test	6.2.2.6	N.A.	A	N.A.	A <sup>c</sup>	N.A.	A <sup>c</sup>
	AC durability for current limiting function <sup>a</sup>	6.2.2.7	N.A.	A	N.A.	A <sup>c</sup>	N.A.	A <sup>c</sup>
	Impulse durability for current limiting function <sup>a</sup>	6.2.2.8	N.A.	A	N.A.	A <sup>c</sup>	N.A.	A <sup>c</sup>
4	<b>Acceptance tests</b>	6.5	O	O	O	O	O	O

**Table 1 (continued)**

A	Applicable.
N.A.	Not applicable.
O	Optional.
<sup>a</sup>	For each category of test impulse a new set of samples can be used.
<sup>b</sup>	It is admissible to measure the impulse-limiting voltage 6.2.1.3 while testing impulse durability 6.2.1.6.
<sup>c</sup>	Test not applicable if there is a linear component between its terminals.
<sup>d</sup>	Each test series is carried out on three samples.
<sup>e</sup>	Applicable only for 4/5 terminal SPD (see fig. 1d and 1e)

## 2 Normative references

Replace the existing reference to IEC 60999-1:1999 with the following:

IEC 60999-1, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm<sup>2</sup> up to 35 mm<sup>2</sup> (included)*

Replace the existing reference to ITU-T Recommendation K.30:1993 with the following:

ITU-T Recommendation K.82, *Characteristics and ratings of solid-state, self-restoring overcurrent protectors for the protection of telecommunications installations*

Add the following new references:  
<https://standards.itec.ai/catalog/standards/sist/9ecd6edd-3280-45a2-9ee9-f2788e60c41d/iec-61643-21-2000-amd2-2012>

IEC 61643-11:2011, *Surge protective devices connected to low-voltage power distribution systems – Part 1: Performance requirements and testing methods*

ITU-T Recommendation K.44: 2011, *Resistibility tests for telecommunication equipment exposed to overvoltages and overcurrents – Basic Recommendation*

Delete the reference to ITU-T Recommendation K.65

## 3 Definitions

Replace the existing definition 3.11 with the following:

### 3.11

#### **total discharge current $I_{Total}$**

current which flows through the earthing terminal (common terminal C) of a multi-terminal SPD during the total discharge current test.

NOTE This may also be called “Total surge current”.

Add the following new definitions:

### 3.33

#### **nominal discharge current $I_n$**

crest value of the current through the SPD having a current waveshape of 8/20

**3.34****rated surge current  $I_{SM}$** 

maximum value of SPD impulse current with a defined waveshape

**3.35****impulse discharge current  $I_{imp}$** 

crest value of a discharge current (10/350) through the SPD

**4.2 Test temperature and humidity**

*Replace the existing first paragraph with the following:*

The SPDs shall be tested at a temperature of  $25\text{ °C} \pm 10\text{ °C}$  with relative humidity from 25 % to 75 %.

If required by the manufacturer or customer, the SPDs shall be tested at the extreme temperatures of the service temperature range selected for the intended application. The selected temperature range may be narrower than the full range of 4.1 depending on the application.

**4.3 SPD testing**

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*Replace the existing third paragraph with the following:*

When a base is used for testing, the measurements shall be made as close as possible to the terminals of the SPD base (termination module) intended for external connections. Waveform recorders used for measurements shall have a minimum performance in accordance with IEC 61083-1 with respect to the specific measurement.

NOTE For waveform recorders settings, see Annex D.

*Replace the existing fourth paragraph with the following:*

SPDs of Figures 1c, 1e and 1f may have a common current path (including protective components or just internal connections) that conducts the total impulse current  $I_{Total}$ . The manufacturer shall state the maximum value of impulse current for this current path. This value of impulse current may be less than  $n$  times the maximum current capability of each line terminal, where  $n$  equals the number of line terminals.

*Delete the 5th paragraph of 4.3.*

**5.1.1 Identification and documentation**

*Replace items e), j), l) and m) with the following:*

e) Maximum continuous operating voltage  $U_c$  (AC and/or DC)



- j) Impulse rating (according to Table 3 - category and corresponding parameters e.g. C2: 2k V/ 1kA)
- l) Transmission characteristics (appropriate to the intended SPD use)
- m) Additional information, where applicable:
  - replaceable components,
  - the use of radioisotopes,
  - 'i<sub>n</sub>' and 'AC overstress current' when impulse overstress test (6.2.1.7) is required
  - surge currents as I<sub>SM</sub>, I<sub>n</sub>, I<sub>imp</sub>, I<sub>Total</sub>

Add the following item to the end of the list:

- o) (SPD-) Category and rating (if the category is printed on the SPD it is recommended to frame the category in a square. Example: C2)

### 5.1.2 Marking

Replace the existing first paragraph with the following:

The SPDs shall be clearly marked with 5.1.1 items: a) the manufacturer's name or trademark, b) manufacturing traceability, c) model number, and e) the maximum continuous operating voltage. The marking material shall be wipe resistant and resistant to solvents normally used in the SPD application. The location can be under a cover of the enclosure, but shall be easily accessible by the end user (e.g. no tools). Any notes for special handling shall be included in the documentation or on the packaging. Compliance is checked in accordance with 6.1.2.

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### 6.2.1 Voltage-limiting tests

Add the following text immediately after the subheading 6.2.1 Voltage-limiting tests:

If not otherwise specified, for all tests where a power supply at  $U_c$  or at the maximum interrupting voltage is required, the voltage tolerance for testing shall be +0/-5 %. When DC is used the maximum ripple shall not exceed 5 %. When AC is used tests shall be performed at 50 Hz or 60 Hz, except if otherwise specified by the manufacturer.

At all voltage-limiting tests it is required to test the common mode (X1-C, X2-C). Testing of the differential mode (X1-X2) is optional.

NOTE Basic configurations for measuring  $U_p$  are listed in informative Annex F.

#### 6.2.1.2 Insulation resistance

Replace the existing text with the following:

Insulation resistance shall be measured in both polarities at one pair of terminals at a time. The test voltage shall be equal to  $U_c$ . If  $U_c$  of the SPD has AC and DC values, this device shall be tested with DC. If  $U_c$  of this SPD has only an AC value this device shall be tested with DC. At this the DC voltage is calculated as  $U_{dc} = U_{c\ ac} \cdot \sqrt{2}$ . For polarised (polarity dependent) constructions of DC SPDs the test shall be carried out in one polarity only. The current conducted between the tested terminals shall be measured.

The insulation resistance is equal to the applied test voltage at the device terminals divided by the measured current and shall be higher than or equal to the value stated by the manufacturer.

### 6.2.1.3 Impulse-limiting voltage

*Replace the existing first paragraph with the following:*

The SPDs shall be tested using one impulse selected from category C of Table 3 and applied to the appropriate terminals. The current level shall be selected based on the current carrying capability of the SPD as determined in the impulse durability test (see 6.2.1.6). Both impulse-limiting voltage and impulse durability tests shall be performed with the same impulse. Values listed in Table 3 are minimum requirements, other surge current ratings can be found in standards e.g. ITU-T K. series recommendations.

NOTE 1 Testing of the Impulse limiting voltage " $U_p$ " is not necessary for test categories A, B and D.

*Delete the second paragraph.*

*Replace the existing third paragraph with the following:*

Apply five negative and five positive impulses. The generator used shall have its open-circuit voltage and short-circuit current selected from Table 3.

*Replace the existing fifth paragraph with the following note:*

NOTE 2 Detailed information about impulse recorder settings can be found in Annex D.

*Replace the existing eighth paragraph with the following:*

For SPDs that have a common current path (refer to 4.3), the voltage on the line terminals where no impulse is applied shall be measured during the test and shall not exceed  $U_p$ .

**Table 3 – Voltage and current waveforms for impulse-limiting voltage**

Replace Table 3 with the following:

**Table 3 – Voltage and current waveforms for impulse-limiting voltage and impulse durability**

Category	Type of test	Open-circuit voltage <sup>a</sup>	Short-circuit current	Minimum number of applications	Terminals to be tested
A1	Very slow rate of rise AC	≥ 1 kV Rate of rise from 0,1 kV/s to 100 kV/s	10 A,  ≥ 1 000 μs (duration)	Not applicable (NA)	X1 – C X2 – C X1 – X2 <sup>b</sup>
A2		Select a test from Table 5	Single cycle		
B1	Slow rate of rise	1 kV 10/1000	100 A, 10/1000	300	
B2		1 kV to 4 kV 10/700	25 A to 100 A 5/320	300	
B3		≥ 1 kV 100 V/μs	10 A to 100 A 10/1 000	300	
C1	Fast rate of rise	0,5 kV to 2 kV 1,2/50	0,25 kA to 1 kA 8/20	300	
C2		2 kV to 10 kV 1,2/50	1 kA to 5 kA 8/20	10	
C3		≥ 1 kV 1 kV/μs	10 A to 100 A 10/1 000	300	
D1	High energy	≥ 1 kV	0,5 kA to 2,5 kA, 10/350	2	
D2		≥ 1 kV	0,6 kA to 2,0 kA 10/250	5	

<sup>a</sup> An open-circuit voltage different from 1 kV may be used as long as the SPD under test operates.

<sup>b</sup> X1 – X2 terminals are tested only if required.

For the verification of  $U_p$ , only one impulse waveform of category C is mandatory. Apply 5 positive and 5 negative impulses.

For impulse durability measurement, one impulse waveform of category C is mandatory and A1, B and D are optional.

B1, B2, C1, C2 and D2 are voltage driven tests and therefore the column "Short-circuit current" shows the prospective short-circuit current at the DUT connection point. Categories B3, C3 and D1 are current driven tests, therefore the required test current is adjusted through the DUT. The max. waveform tolerances as listed in table 2 shall not be exceeded. For the voltage driven tests the effective output impedance of the generators used shall be 10 Ohms for Category B1, 40 Ohms for Category B2 and 2 Ohms for Categories C1, C2 and D2.

NOTE Values listed in Table 3 are minimum requirements.

Delete the existing text below Table 3 (including Figure 16).

#### 6.2.1.4 Impulse reset

Replace the existing first paragraph with the following:

The SPD shall be connected as shown in Figure 2. The impulse reset voltage and current values shall be taken from the manufacturer's datasheet or shall be based on the voltage/current combinations listed in Table 4 following the manufacturer's instructions. These power sources represent commonly used system values. AC SPDs have to be tested with AC, DC SPDs have to be tested with DC, and AC/DC SPDs have to be tested with DC. Depending on the construction of DC SPDs the test can be carried out only in one polarity. If an AC test is performed the impulse generator must be synchronized with the phase of the AC voltage (typically at a phase angle between 30° and 60°).

*Replace the existing second paragraph with the following:*

For the impulse voltage and current waveform either Category B1 or C1 shall be selected from Table 3. The peak open-circuit voltage shall be sufficient to ensure that the voltage-switching component(s) of the SPD operates. The polarity of the impulse voltage shall be the same as the polarity of the voltage source. The reset time is defined as the time from application of the impulse to the return of the SPD to its high-impedance state.

*Replace the existing third paragraph with the following:*

One positive and one negative impulse shall be applied at an interval not greater than 1 min, and the reset time shall be measured for each impulse.

NOTE The polarity of the diodes in a decoupling device (figure 2) must be reversed when the polarity of the DC power supplies and surge generator are reversed.

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**Table 4 – Source voltages and currents for impulse reset test**

[IEC 61643-21:2000/AMD2:2012](https://standards.iteh.ai/catalog/standards/sist/9ecd6edd-3280-45a2-9ee9-f2788e60c41d/iec-61643-21-2000-amd2-2012)

*Replace Note b of Table 4 with the following:*

<sup>b</sup> Tolerance (including ripple) +/- 1%

### 6.2.1.5 AC durability for voltage limiting function

*Replace the existing first paragraph with the following:*

The SPD shall be connected as shown in Figure 3. The AC short-circuit current shall be selected from Table 5. Apply the currents for the specified number of applications with time between applications sufficient to prevent accumulation of heat in the device under test. The applied AC test voltage shall be of sufficient magnitude to cause a full conduction of the voltage limiting component(s) of the SPD. Prior to testing and after completion of the required number of AC applications, the SPD shall meet the requirements of 5.2.1.2, 5.2.1.3, 5.2.1.4 (if applicable) and 5.2.2.2.

*Replace the existing third paragraph with the following:*

If required by the manufacturer or customer, the currents may be applied additionally to terminals X1 – X2 of SPDs shown in figures 1c), 1e) and 1f).

*Replace the existing fourth paragraph with the following:*

For tests on the SPDs shown in figures 1c), 1e) and 1f), each pair of terminals (X1 – C and X2 – C) may be tested separately.

*Replace the existing fifth paragraph with the following:*

For SPDs that have a common current path, refer to 4.3. Otherwise, for multi-terminal SPDs test each line terminal to common terminal separately.

#### 6.2.1.6 Impulse durability for voltage limiting function

*Replace the existing fourth paragraph with the following:*

For tests on the SPDs shown in Figures 1c) and 1e), each pair of terminals (X1 – C and X2 – C) may be tested separately. For tests on the SPD shown in Figure 1f) it is sufficient to select two terminals as a representative sample, provided all terminals have the same protective circuit to terminal C.

*Delete the 5th paragraph*

*Add the following new subclause:*

##### 6.2.1.6.1 Additional test for Multi-terminal SPDs

If the manufacturer declares a total impulse current the test according 6.2.1.6 shall be repeated with the following modification and additions.

This test is not required if the SPD's total impulse current capability is equal to the single line impulse current capability (e.g. total impulse current = 10 kA, single line impulse current = 10 kA).

Multi-terminal SPDs (fig. 1c, 1f, 1e) may have the total impulse current ( $I_{Total}$ ) flowing through common components and connections to the earthing terminal. Two examples are shown in Figure 16. All the protected lines shall have an impulse current equal to the total impulse current divided by the number of lines, applied simultaneously to verify that the common current path has sufficient current capability. After this test the SPD shall not be degraded. This test also verifies that the internal connections of the SPD have sufficient current capability.

The coupling network shall not substantially influence the test impulse. The permissible deviation from the 8/20 waveform of the test impulse for categories C1 and C2 shall not exceed an 8/25 waveform with a tolerance of +/- 30% for both the front time and the time to half value.

NOTE If it is not possible to reach the above waveform parameters the test may be performed with modified SPDs provided by the manufacturer, where every "individual protective element" (1) of the star protection circuit shown in Figure 16 is short circuited. During the test all input terminals X1 to Xn are connected together.

#### 6.2.1.7 Overstressed fault mode

*Replace the existing second paragraph with the following:*

Insulation resistance, voltage-limiting and series resistance tests shall be performed as applicable to determine if the SPD has reached an acceptable overstressed fault mode as described in 3.3. The SPD shall reach its overstressed fault mode in a safe manner without causing a fire hazard, an explosion hazard, an electrical hazard or emission of toxic fumes.

NOTE 1 For multistage SPDs different fault modes are allowed. (e.g. X1 - C could have a mode 2 and the X1 – X2 could have mode 1)

*Add the following note after the fourth paragraph:*