

Recommendation **ITU-T K.155 (11/2024)**

SERIES K: Protection against interference

**Performance requirements and test methods
for surge protective modules used in AC power
ports of telecommunication equipment**

Recommendation ITU-T K.155

Performance requirements and test methods for surge protective modules used in AC power ports of telecommunication equipment

Summary

The purpose of Recommendation ITU-T K.155 is to address terms, classifications, electrical/mechanical/environmental and material requirements and test methods for surge protective modules (SPMs) used in AC power ports of telecommunication equipment with voltages up to AC 1000 V, to mitigate overvoltage surges.

This Recommendation provides special technical requirements and test methods considering the characteristics of SPMs.

History*

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Table of Contents

	Page
1 Scope	1
2 References.....	1
3 Definitions	2
3.1 Terms defined elsewhere	2
3.2 Terms defined in this Recommendation.....	3
4 Abbreviations and acronyms	4
5 Conventions	4
6 Service conditions.....	4
6.1 Frequency	4
6.2 Voltage	5
6.3 Air pressure and altitude.....	5
6.4 Working temperature and humidity.....	5
6.5 Storage temperature range, T_{stgmin} to T_{stgmax}	5
6.6 Lead soldering temperature, T_{lmax}	6
7 Classification	6
7.1 Number of ports.....	6
7.2 SPM design.....	6
7.3 Type of SPM.....	6
7.4 Location of disconnecter (including overcurrent protection).....	6
7.5 Microclimate.....	6
8 Requirements	6
8.1 General requirements.....	6
8.2 Marking and information about status indicator	7
8.3 Electrical requirements	8
8.4 Mechanical requirements.....	9
8.5 Environmental and material requirements.....	9
8.6 Additional tests if declared by the manufacturer.....	10
9 Type tests	10
9.1 General testing procedures	10
9.2 Indelibility of markings	12
9.3 Electrical tests.....	12
9.4 Mechanical tests	15
9.5 Environmental and material tests	15
9.6 Additional tests if declared by the manufacturer.....	18
Appendix I – Differences between this Recommendation and [IEC 61643-11]	19
Appendix II – Information about the application for SPMs in AC power port of telecommunication equipment.....	21
II.1 Background.....	21

	Page
II.2 Requirements for the application of SPMs.....	21
II.3 Consideration for the requirements of air clearances and creepage distances	22
Bibliography.....	24

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1 Scope

This Recommendation addresses terms, classifications, electrical / mechanical / environmental and material requirements and test methods for surge protective modules (SPMs) used in AC power ports of telecommunication equipment with voltages up to AC 1000 V, to mitigate overvoltage surges. These SPMs contain at least one nonlinear component and are intended to limit surge voltages and divert surge currents.

This Recommendation is not applicable to single or combination type surge protective components, such as metal oxide varistors or gas discharge tubes, without corresponding safety failure measures.

This Recommendation provides the special technical requirements and test methods considering the characteristics of SPMs, which include:

- identification and marks;
- operating duty test under microclimate conditions;
- thermal stability;
- air clearances and creepage distances;
- solderability;
- and environmental requirements' compliance to its applications.

For the convenience of the user, some general requirements and test methods in accordance with [IEC 61643-11] are also included in this Recommendation in the manner of reference. The list of differences between this Recommendation and [IEC 61643-11] on test items is given in Appendix I.

NOTE 1 – It should be noted that an SPM is not a surge protective device (SPD) according to the definition in [IEC 61643-11] and it is not intended to be compliant with [IEC 61643-11] as a standalone module.

NOTE 2 – The use of an SPM inside telecommunication equipment will require additional considerations related to the appropriate protection of the equipment during power network temporary overvoltages (TOVs), short circuit behaviour and SPM end of life conditions. Furthermore, the conduction of surge currents inside telecommunication equipment will introduce overvoltage conditions, which will stress the insulation and the equipment shall be able to withstand them.

NOTE 3 – The components used inside an SPM shall comply with the requirements of relevant IEC safety standards.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[IEC 60068-2-1] IEC 60068-2-1:2007, *Environmental testing – Part 2: Tests – Test A: Cold*.

[IEC 60068-2-2] IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*.

[IEC 60068-2-6]	IEC 60068-2-6:2007, <i>Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)</i> .
[IEC 60068-2-14]	IEC 60068-2-14:2023, <i>Environmental testing –Part 2-14: Tests–Test N: Change of temperature</i> .
[IEC 60068-2-20]	IEC 60068-2-20:2021, <i>Environmental testing – Part 2-20: Tests – Test Ta and Tb: Test methods for solderability and resistance to soldering heat of devices with leads</i> .
[IEC 60068-2-27]	IEC 60068-2-27:2008, <i>Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock</i> .
[IEC 60068-2-30]	IEC 60068-2-30:2005, <i>Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)</i> .
[IEC 60364 series]	IEC 60364 series, <i>Low-voltage electrical installations series</i> .
[IEC 60664-1]	IEC 60664-1:2020, <i>Insulation coordination for equipment within low-voltage systems – Part 1: principles, requirements and tests</i> .
[IEC 60695-2-11]	IEC 60695-2-11:2021, <i>Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods - Glow-wire flammability test method for end products (GWEPT)</i> .
[IEC 60747-1]	IEC 60747-1:2010, <i>Semiconductor devices – Part 1: General</i> .
[IEC 60749]	IEC 60749 series, <i>Semiconductor devices – Mechanical and climatic test methods</i> .
[IEC 61643-11]	IEC 61643-11:2025, <i>Low-voltage surge protective devices – Part 11: Surge protective devices connected to low-voltage power distribution systems – Requirements and test methods</i> .

3 Definitions

3.1 Terms defined elsewhere

In this Recommendation, definitions already introduced by IEC 61643 series or others are used to maintain conformity.

This Recommendation uses the following terms defined elsewhere:

3.1.1 combination type surge protective components [IEC 61643-11]: Surge protective components that incorporates both voltage switching components and voltage limiting components. The surge protective components may exhibit voltage switching, limiting or both.

3.1.2 microclimate [b-IEC 60721-3-9]: The climatic conditions of the components installed inside the product.

NOTE – Only air temperature and humidity are considered in this Recommendation.

3.1.3 open circuit voltage U_{oc} [IEC 61643-11]: Open circuit voltage of the combination wave generator at the point of connection of the device under test.

3.1.4 voltage for clearance determination U_{max} [IEC 61643-11]: Highest measured voltage during surge applications according to clause 9.4.1 for clearance determination.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 combination type surge protective module: A surge protective module (SPM) that incorporates both voltage switching components and voltage limiting components. The SPM may exhibit voltage switching, limiting or both.

3.2.2 follow current I_f : Peak current supplied by the electrical power system and flowing through the SPM after a discharge current impulse.

3.2.3 maximum continuous operating voltage, U_c : Maximum r.m.s. voltage, which may be continuously applied to the SPM's mode of protection.

NOTE – The U_c value covered by this standard may exceed 1000 V.

3.2.4 modes of protection of a surge protective module: An intended current path between terminals that contain protective components, e.g., line-to-line, line-to-earth, line-to-neutral, neutral-to-earth.

3.2.5 multipole surge protective module: Type of surge protective module (SPM) with more than one mode of protection or a combination of electrically interconnected SPMs offered as a unit.

3.2.6 nominal discharge current for class II test, I_n : Crest value of the current through the SPM with a current waveshape of 8/20.

3.2.7 nominal discharge current under microclimate conditions, I_{nm} : Crest value of an 8/20 current impulse through an SPM's mode of protection under microclimate conditions declared by the manufacturer.

3.2.8 open circuit voltage under microclimate conditions, U_{ocm} : Open circuit voltage of the combination wave generator at the point of connection of the device under test under microclimate conditions declared by the manufacturer.

3.2.9 residual current, I_{PE} : Current flowing through the protective earthing (PE) terminal of the SPM while energized at the reference test voltage (U_{REF}) when connected according to the manufacturer's instructions.

3.2.10 residual voltage, U_{res} : Crest value of voltage that appears between the terminals of an SPM due to the passage of discharge current.

3.2.11 short-circuit current rating, I_{scrr} : Maximum prospective short-circuit current from the power system for which the SPM, in conjunction with the disconnector specified, is rated.

3.2.12 surge protective module (SPM): Surge protective means that include certain safety features which allow them to be installed as a module on a printed circuit board.

NOTE 1 – SPMs possess at least one non-linear component that is never replaced.

NOTE 2 – Although an SPM is installed as a component on a printed circuit board, it functions in a similar way as a surge protective device (SPD), providing surge attenuation and adapted safety features, in a manner that differs from that of a surge protective component. Unlike SPDs, which are installed either inside or outside equipment cabinets, SPMs are installed on the printed circuit board inside the equipment itself and are only required to comply with a subset of the safety tests detailed in [IEC 61643-11].

NOTE 3 – In practical applications, valid coordination with upstream SPDs is necessary to provide sufficient protection for telecommunication equipment against lightning. More information is given in [b-IEC 62305-4].

3.2.13 voltage limiting type SPM: An SPM that has a high impedance when no surge is present but will reduce it continuously with increased surge current and voltage.

3.2.14 voltage protection level, U_P : Maximum voltage to be expected at the SPM terminals due to an impulse stress with defined voltage steepness and an impulse stress with a discharge current with a 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.

3.2.15 voltage switching type SPM: An SPM that has a high impedance when no surge is present but which can have a sudden change in impedance to a low value in response to a voltage surge.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AAU	Active Antenna Unit
ABD	Avalanche Breakdown Device
AC	Alternating Current
DC	Direct Current
DUT	Device Under Test
L	Line
N	Neutral Line
PCB	Printed Circuit Board
PE	Protective Earthing conductor
RCD	Residual Current Device
RRU	Remote Radio Unit
SPC	Surge Protective Component
SPD	Surge Protective Device
SPM	Surge Protective Module
T1	Test Classes I
T2	Test Classes II
T3	Test Classes III
TN-S	Type of power distribution system
TOV	Temporary Overvoltage
TT	Type of power distribution system

5 Conventions

None.

6 Service conditions

6.1 Frequency

Frequency range is from 47 Hz to 63 Hz AC.