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INTERNATIONAL STANDARD

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Components for low-voltage surge protective devices – Part 331: Performance requirements and test methods for metal oxide varistors (MOV)

IEC 61643-331:2017-12(en)

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COMPONENTS FOR LOW-VOLTAGE SURGE PROTECTIVE DEVICES –

Part 331: Performance requirements and test methods for metal oxide varistors (MOV)

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International Standard IEC 61643-331 has been prepared by subcommittee 37B: Specific components for surge arresters and surge protective devices, of IEC technical committee 37: Surge arresters.

This second edition cancels and replaces the first edition published in 2003. This edition constitutes a technical revision.

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

a) Update of the nominal varistor voltage test method;
b) Addition of thermally protected varistors – component symbol and test methods;
c) Addition of nominal discharge current – test methods;
d) Addition of voltage ratings for disc types (Table 1);

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e) Addition of test currents for clamping voltage of disc types (Table 2);

f) Addition of typical voltage ratings of SMD types (Table 3); and

g) Addition of Limited current and temporary overvoltage tests for thermally protected varistors.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
37B/160/FDIS	37B/164/RVD

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

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 61643 series, under the general title *Components for low-voltage surge protective devices,* can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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- withdrawn,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

A bilingual version of this publication may be issued at a later date.

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COMPONENTS FOR LOW-VOLTAGE SURGE PROTECTIVE DEVICES –

Part 331: Performance requirements and test methods for metal oxide varistors (MOV)

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1 Scope

This part of IEC 61643 is a test specification for metal oxide varistors (MOV), which are used for applications up to 1 000 V AC or 1 500 V DC in power line, or telecommunication, or signalling circuits. They are designed to protect apparatus or personnel, or both, from high transient voltages.

This specification applies to MOVs having two electrodes and hybrid overvoltage protection components. This specification also does not apply to mountings and their effect on the MOV's characteristics. Characteristics given apply solely to the MOV mounted only in the ways described for the tests.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60068-1:2013, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-20:2008, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60068-2-21:2006, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-78:2012, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 61643-11:2011, *Low-voltage surge protective devices – Part 11: Surge protective devices connected to low-voltage power systems – Requirements and test methods*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

3 Terms, definitions, symbols and abbreviated terms

For the purposes of this document, the following terms, definitions, symbols and abbreviated terms apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

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3.1 Ratings

3.1.1
absolute maximum ratings
limiting values of operating and environmental conditions applicable to a component, device, equipment or machine as defined by its published specification data, which should not be exceeded under the worst possible conditions

Note 1 to entry: A limiting condition may be either a maximum or a minimum or both.

[SOURCE: MODIFIED: IEC 62240-1:2013, Clause 3.1.1, modified ("any semiconductor device of a specific type" replaced by "a component, device, equipment or machine", addition of Note 1 to entry)]

3.1.2
single-impulse [transient] maximum current
I_{TM}
rated maximum value of current which may be applied for a single impulse of specified waveform

Note 1 to entry: For power distribution surge protective devices (SPDs), IEC 61643-11, Maximum Discharge Current I_{MAX} is used.

3.1.3
nominal discharge current
I_n
crest value of the current through the MOV having a current waveshape of 8/20

3.1.4
impulse life characteristic
graphical representation between impulse current peak (I), equivalent rectangular pulse width (T), and impulse numbers (n) for which the varistor can withstand

Note 1 to entry: Unless otherwise specified, the range of T shall be 20 µs to 10 ms, the range of n shall be 10^6, 10^5,10^4, 10^3, 10^2, 10^1 and 10^0 temperature derating curve.

3.1.5
temperature derating curve
graphical representation of parameter derating against temperature

Note 1 to entry: Typical parameters are rated voltage, impulse current, energy and average power dissipation.

3.1.6
single-pulse [transient] maximum energy
W_{TM}
rated maximum value which may be absorbed for a single pulse of a specified waveform

Note 1 to entry: Unless otherwise specified, 2 ms rectangular pulse is used (IEC 60060).

3.1.7
maximum continuous voltage
V_M
voltage that may be applied continuously at a specified temperature

Note 1 to entry: May also be called U_C or maximum continuous operating voltage (MCOV).

Note 2 to entry: See Figure 1.

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3.1.8
maximum continuous AC voltage
$V_{M(AC)}$
value of rms. power frequency voltage (less than 5 % total harmonic distortion) that may be applied continuously at a specified temperature

3.1.9
maximum continuous DC voltage
$V_{M(DC)}$
DC voltage that may be applied continuously at a specified temperature

3.1.10
Mean Time To Failure
MTTF
basic measure of reliability for non-repairable items, the total number of life units of an item divided by the total number of failures within that population, during a particular measurement interval under stated conditions

3.2 Characteristics

3.2.1
characteristic
inherent and measurable property of an MOV

3.2.2
standby current
I_D
current passing through MOV at maximum continuous voltage V_M

Note 1 to entry: The current passing through the MOV at less than V_M is called leakage current.

3.2.3
nominal varistor voltage
V_N
voltage across the MOV measured at a specified current of specific duration

Note 1 to entry: See Figure 1.

3.2.4
clamping voltage
V_C
peak voltage across the MOV measured under conditions of a specified peak pulse current (I_P) and specified waveform

Note 1 to entry: See Figure 1.

Note 2 to entry: Unless otherwise specified, a typical value of this parameter is measured with a pulsed current 8/20 waveform.

Note 3 to entry: Clamping voltage, V_C, is referred to as Measured Limiting Voltage in IEC 61643-11.

3.2.5
capacitance
C_V
capacitance across the MOV measured at a specified frequency, voltage and time

3.2.6
metal oxide varistor
MOV
component whose conductance, at a given temperature, increases rapidly with voltage

Note 1 to entry: This is also known as a voltage dependant resistor (VDR).

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3.2.7
thermally protected metal oxide varistor
varistor which includes a series non-resettable element that will disconnect the MOV when it is overheated due to excessive dissipation

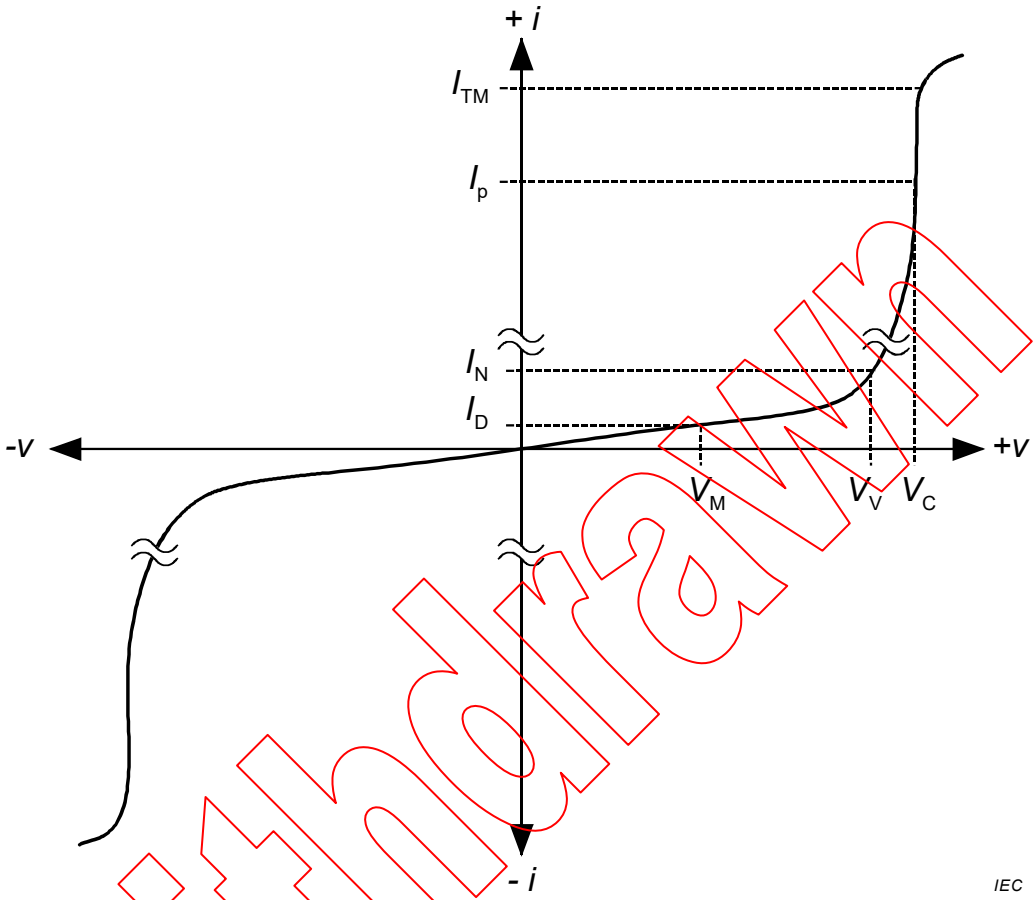

Figure 1 – *V-I* characteristic of an MOV

3.3 Symbols

Figures 2 and 3 represent the IEC 60617 symbols for MOV and thermally protected MOV, respectively.

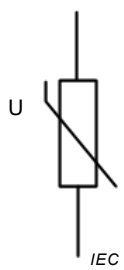

Figure 2 – Symbol for MOV

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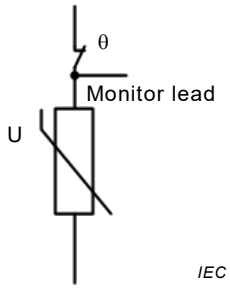

Figure 3 – Symbol for thermally protected MOV

NOTE IEC 60027 recommends the letters V and v only as reserve symbols for voltage; however, in the field of MOV components, these are so widely used that in this publication they are preferred to U and u.

3.4 Abbreviated terms

DUT	Device Under Test
ESD	Electrostatic Discharge
MCOV	Maximum Continuous Operating Voltage
MOV	Metal Oxide Varistor
MTTF	Mean Time To Failure
SMD	Surface Mount Device
SPD	Surge Protective Device
VDR	Voltage Dependent Resistor

4 Service conditions

4.1 Operating and storage temperature ranges

Operating range

– Normal: –5 °C to +55 °C
– Extended: –40 °C to +85 °C

Storage range MOV

– Normal: –40 °C to +85 °C
– Extended: –40 °C to +125 °C

Storage range thermally protected MOV

– Normal: –40 °C to +85 °C
– Extended: –40 °C to +85 °C

4.2 Altitude or atmospheric pressure range

The altitude of air pressure is within 80 kPa to 106 kPa (refer to IEC 60068-1).

4.3 Relative Humidity

Normal range: 5 % to 95 % at 25 °C (refer to IEC 60068-1 and IEC 60068-2-78).

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5 Mechanical requirements and materials

5.1 Robustness of terminations

If applicable, the user shall specify a suitable test from IEC 60068-2-21.

5.2 Solderability

Solder terminations shall meet the requirements of IEC 60068-2-20, test Ta, method 1.

5.3 Marking

Legible and permanent marking shall be applied to the MOV as necessary to ensure that the user can determine the following information by inspection:

Each MOV shall be marked with the following information:

Date of manufacture or batch number

Manufacturer name or trademark

Part number

Safety approval markings

NOTE 1 The necessary information can also be coded.

When the space is not sufficient for printing this data, it should be provided in the technical documentation after agreement between the manufacturer and the purchaser.

6 General

6.1 Failure rates

Sampling size, electrical characteristics to be tested, etc. should be covered by the quality assurance requirements, which are not covered by this document.

6.2 Test standard atmospheric conditions

The following tests shall be performed on the MOVs as required by the application. Unless otherwise specified, ambient test conditions shall be as follows:

- temperature: 15 °C to 35 °C;
- relative humidity: 25 % to 75 %;

MOVs of various types should have the characteristics listed in Table 1 when tested in accordance with Clause 8.

7 Electrical requirements

7.1 Nominal varistor voltage

When tested according to 8.3.3, varistor voltage should be within the specified manufacturer's limits. Table 1 shows the nominal varistor voltages of high voltage and low voltage disc types that are commonly used; their allowable tolerances are ±10 %.

The nominal varistor voltages and tolerances listed in Table 2 are typical for surface mount Device (SMD) types.

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