

INTERNATIONAL STANDARD

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

**Composants pour parafoudres basse tension –
Partie 331: Exigences de performance et méthodes d'essai pour les varistances
à oxyde métallique (MOV)**



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IEC 61643-331

Edition 3.0 2020-03

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INTERNATIONAL
ELECTROTECHNICAL
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ICS 31.040.20

ISBN 978-2-8322-8558-9

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COMPONENTS FOR LOW-VOLTAGE SURGE PROTECTION –**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: Components for low-voltage surge protection, of IEC technical committee 37: Surge arresters.

This third edition cancels and replaces the second edition published in 2017. This edition constitutes a technical revision.

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

- a) a Varistor MCOV rating assurance test;
- b) an energy rating test (2ms);
- c) revised Dielectric strength and insulation resistance tests.

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

FDIS	Report on voting
37B/211/FDIS	37B/214/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

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COMPONENTS FOR LOW-VOLTAGE SURGE PROTECTION –

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

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 lines, or telecommunication, or signalling circuits. They are designed to protect apparatus or personnel, or both, from high transient voltages.

This document applies to MOVs having two electrodes and hybrid surge protection components. This document 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 60068-2-6:2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*
- IEC 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*
- 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 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*
- IEC 60068-2-52:2017 *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*
- 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 and definitions 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>

3.1 Terms and definitions

3.1.1 Ratings

3.1.1.1

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: IEC 62240-1:2013, 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)]

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3.1.1.2

single-impulse [transient] maximum current

I_{TM}

rated maximum value of current which may be applied for a single impulse of specified waveform

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

3.1.1.3

nominal discharge current

I_n

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

3.1.1.4

impulse life characteristic

graphical representation between impulse current peak (I), equivalent rectangular pulse width (T), and impulse numbers (n) which the MOV can withstand

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

3.1.1.5

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.

3.1.1.6

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).

3.1.1.7 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 MCOV.

Note 2 to entry: See Figure 1.

3.1.1.8 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

3.1.1.9 maximum continuous DC voltage

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

3.1.1.10 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

3.1.2 Characteristics

3.1.2.1 **characteristic** <https://standards.iteh.ai/catalog/standards/sist/c12137df-94f0-4536-b70f-6354f4d0cc-61643-331-2020>
inherent and measurable properties of an MOV

3.1.2.2 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.

3.1.2.3 varistor voltage

V_V
voltage across the MOV measured at a specified current (typically 1 mA) for a specific duration

3.1.2.4 varistor test current

I_N
test current (typically 1 mA) to determine the varistor voltage V_V

Note 1 to entry: See Figure 1.

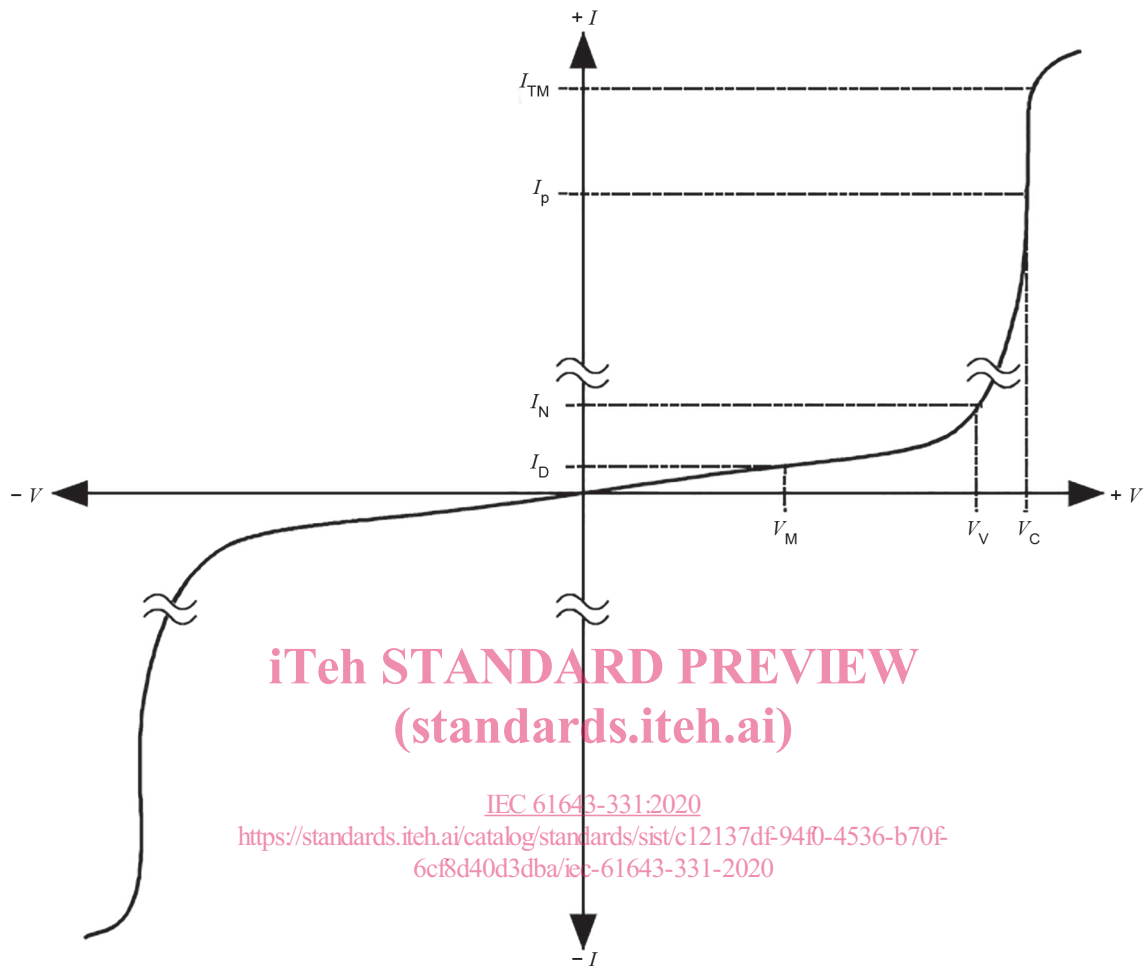
3.1.2.5 clamping voltage

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.



IEC

Figure 1 – V-I characteristic of an MOV

3.1.2.6 capacitance

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

3.1.2.7 metal oxide varistor (MOV)

component whose conductance during static state, at a given temperature, increases rapidly with increasing voltage

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

3.1.2.8 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

3.1.2.9 DC standby current

I_{DC}
current passing through MOV at maximum continuous voltage DC $V_{M(DC)}$

3.2 Symbols and abbreviated terms used in this document

3.2.1 Symbols

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



Figure 2 – Symbol for MOV

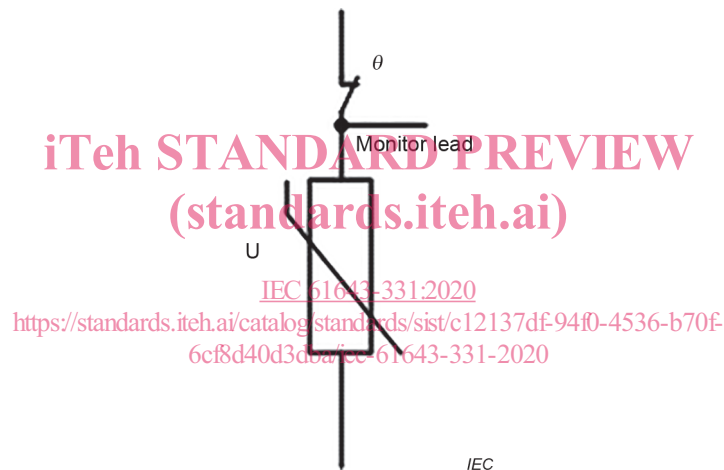


Figure 3 – Symbol for thermally protected MOV

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 document they are preferred to U and u.

3.2.2 Abbreviated terms

CUT	Component 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

NOTE Temperature range (operating or storage) could be different than the normal or extended values shown above.

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.

NOTE 2 When the space is not sufficient for printing this data, it could be provided on the smallest unit container in which the product is packaged or as agreed upon 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 Varistor voltage (V_V)

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

The varistor voltages and tolerances listed in Table 2 are typical for SMD types.

7.2 Maximum AC (DC) continuous voltage ($V_{M(AC)}$ / $V_{M(DC)}$)

Unless otherwise specified, MOVs shall have a maximum AC (DC) continuous voltage $V_{M(AC)}$ / ($V_{M(DC)}$) as given in Table 1 and Table 2, the conformity shall be evaluated according to 8.2.3.

NOTE Maximum AC (DC) continuous voltage $V_{M(AC)}$ / ($V_{M(DC)}$) is sometimes referred to as U_C .

7.3 Standby current (I_D)

When tested according to 8.3.2, the standby current I_{DC} under maximum continuous DC voltage $V_{M(DC)}$, shall be less than the maximum value specified by the manufacturer and there shall be no upward drifting during the application of the test voltage $V_{M(DC)}$.

7.4 Capacitance (C_V)

When tested according to 8.3.4, the measured value of capacitance shall not exceed the value specified by the manufacturer.

7.5 Clamping voltage (V_C)

The measured clamping voltage (see 8.3.1) at a specified impulse current shall be no more than the specified values or the values indicated in Table 1. Unless otherwise specified, an 8/20 impulse current having the peak as specified shall be used.

NOTE Clamping voltage V_C is referred to as Measured Limiting Voltage in IEC 61643-11.