IEC 61643-332

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INTERNATIONAL STANDARD

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Components for low-voltage surge protection – Part 332: Selection and application principles for metal oxide varistors (MOV)

Composants pour parafoudres basse tension – Partie 332: Choix et principes d'application des varistances à oxyde métallique (MOV)

IEC 61643-332:2024-04(en-fr)

IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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CONTENTS

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COMPONENTS FOR LOW-VOLTAGE SURGE PROTECTION –

Part 332: Selection and application principles for metal oxide varistors (MOV)

FOREWORD

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IEC 61643 has been prepared by subcommittee 37B: Components for low voltage surge protection, of IEC technical committee 37: Surge arresters. It is an International Standard.

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

Draft	Report on voting
37B/243/FDIS	37B/245/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 61643 series, published under the general title *Components for low-voltage surge protection*, 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

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- withdrawn, or
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COMPONENTS FOR LOW-VOLTAGE SURGE PROTECTION –

Part 332: Selection and application principles for metal oxide varistors (MOV)

1 Scope

This part of IEC 61643 describes the theory of operation, principles for the selection and application of MOVs to be connected to power lines or telecommunication or signalling circuits, up to 1 000 V AC or 1 500 V DC. These SPCs are designed to protect apparatus or personnel, or both, from high transient voltages.

This document applies to MOVs having two electrodes and voltage dependent elements with or without disconnectors. It does not apply to assemblies that include MOVs and their influence on the MOV's characteristics.

This standard specifically discusses the zinc-oxide type of MOVs.

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 60664-1:2020, *Insulation coordination for equipment within low-voltage supply systems – Part 1: Principles, requirements and tests*

IEC 61051-1:2018, *Varistors for use in electronic equipment – Part 1: Generic specification*

IEC 61051-2:2021, *Varistors for use in electronic equipment – Part 2: Sectional specification for surge suppression varistors*

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 61643-331:2020, *Components for low-voltage surge protection – Part 331: Performance requirements and test methods for metal oxide varistors (MOV)*

IEC 62368-1:2023, *Audio/video, information and communication technology equipment – Part 1: Safety requirements*

3 Terms, definitions, symbols and abbreviated terms

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

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

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

3.1 Terms and definitions

3.1.1 Ratings

3.1.1.1
rating
limiting capability or limiting condition beyond which damage to the MOV may occur

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

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

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

[SOURCE: IEC 61643-331:2020, 3.1.1.2]

3.1.1.3
nominal discharge current
I_n
crest value of the current through the MOV having a current waveshape of 8/20

[SOURCE: IEC 61643-331:2020, 3.1.1.3]

3.1.1.4
maximum continuous voltage
V_M
maximum voltage that may be applied continuously at a specified temperature

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

Note 2 to entry: See Figure 1.

[SOURCE: IEC 61643-331:2020, 3.1.1.7, modified (addition of "Maximum continuous operating voltage" to Note 1 to entry)]

3.1.1.5
maximum continuous AC voltage
$V_{M(AC)}$
maximum value of RMS power frequency voltage (less than 5 % total harmonic distortion) that may be applied continuously at a specified temperature

[SOURCE: IEC 61643-331:2020, 3.1.1.8]

3.1.1.6
maximum continuous DC voltage
$V_{M(DC)}$
maximum value of DC voltage that may be applied continuously at a specified temperature

[SOURCE: IEC 61643-331:2020, 3.1.1.9]

3.1.1.7
maximum discharge current
I_{max}
crest value of a current through the SPD having an 8/20 waveshape and magnitude according to the manufacturer's specification.

Note 1 to entry: I_{max} is equal to or greater than I_n.

[SOURCE: IEC 61643-11:2011, 3.1.48]

3.1.1.8
impulse discharge current for class I test
I_{imp}
crest value of a discharge current through the SPD with specified charge transfer *Q* and specified energy W/R in the specified time

[SOURCE: IEC 61643-11:2011, 3.1.10]

3.1.1.9
rated average dissipation power
P_M
maximum average dissipation power of repetitive pulses allowed to be applied to the varistors at ambient temperature of 25 °C

[SOURCE: IEC 61051-1:2018, 3.23]

3.1.2 Characteristics

3.1.2.1
characteristics
inherent and measurable properties of an MOV

[SOURCE: IEC 61643-331:2020, 3.1.2.1]

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.

[SOURCE: IEC 61643-331:2020, 3.1.2.2]

3.1.2.3
varistor voltage
V_V
voltage across the MOV measured at a specified current (typically 1 mA) for a specific duration

Note 1 to entry: The MOV manufacturer specifies the current. Otherwise, 1 mA DC for a duration of 20 to 100 ms is normally used.

Note 2 to entry: See Figure 1.

[SOURCE: IEC 61643-331:2020, 3.1.2.3]

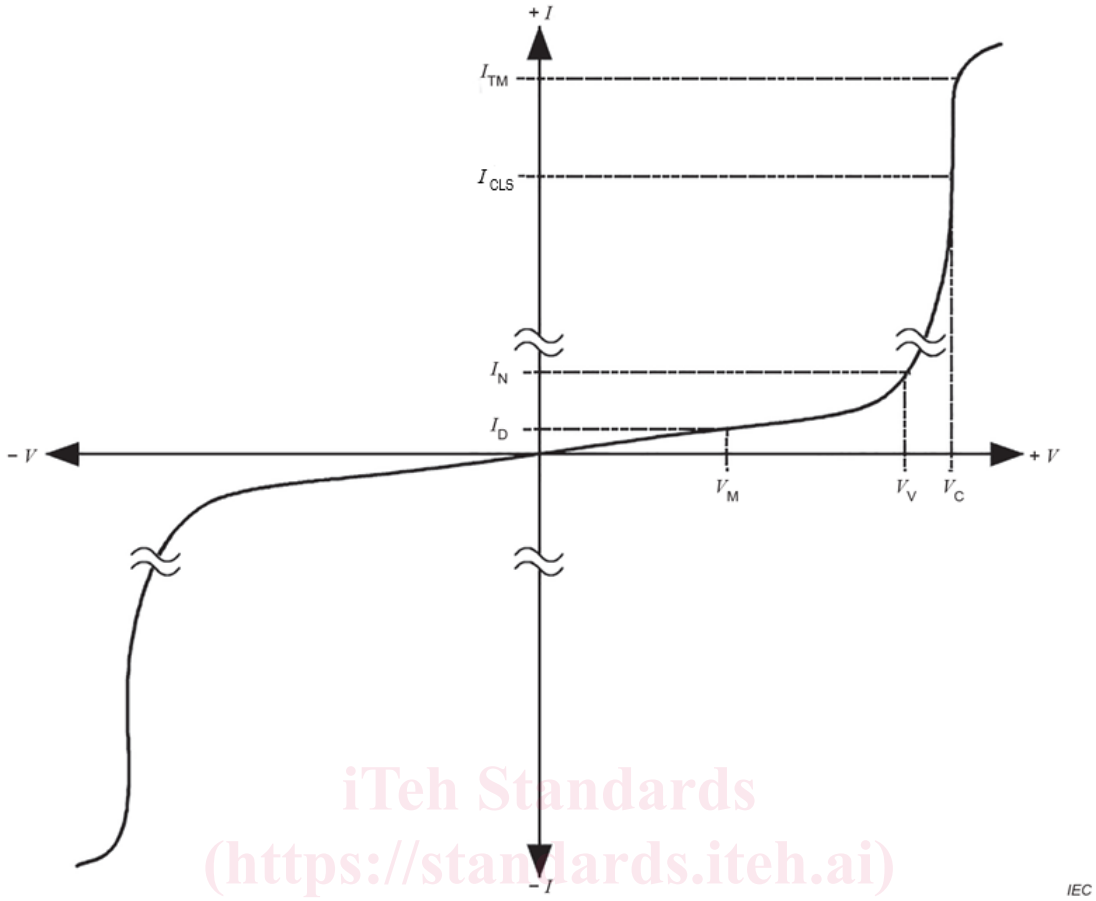

Figure 1 – *V-I* characteristic of an MOV

3.1.2.4
Clamping voltage
V_C
peak voltage across the MOV measured under conditions of a class current (I_{CLS}) and specified waveform

3.1.2.5
class current
I_{CLS}
peak value of current, which is 1/10 of the maximum peak current for 100 pulses for the 8/20 current pulse with a time interval of 30 s

[SOURCE: IEC 61051-1:2018, 3.21]

3.1.2.6
Capacitance
C_V
capacitance across the MOV measured at a specified frequency, voltage and time

[SOURCE: IEC 61643-331:2020, 3.1.2.6]

3.1.2.7
SPD
device that contains at least one nonlinear component that is intended to limit surge voltages and divert surge currents

[SOURCE: IEC 61643-11 Clause 3.1.1]

3.1.2.8
SPC
discrete component whose primary function is to divert or limit excessive voltage and current surges to protect sensitive equipment and circuits from potential damage. Examples of SPCs are MOVs, GDTs, SITs, ABDs, and thyristors.

3.1.2.9
metal oxide varistor (MOV)
non-linear resistor made of a sintered mixture of metal oxides whose conductance, at a given temperature, increases rapidly with voltage

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

[SOURCE: IEC 61643-331:2020, 3.1.2.7]

3.1.2.10
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

[SOURCE: IEC 61643-331:2020, 3.1.2.8]

3.1.2.11
nonlinearity current index
β
starting from Formula (1) of 3.3, it is defined by the formula

$$\beta = \frac{I}{U} \times \frac{\mathrm{d}U}{\mathrm{d}I} \tag{1}$$

Note 1 to entry: For the convenience of calculation, the following formula may be used:

$$\beta = \frac{\log_{10}(U_1/U_2)}{\log_{10}(I_1/I_2)} \tag{2}$$

β is always less than 1.

[SOURCE: IEC 61051-1:2018, 3.4]

3.1.2.12
non-linearity voltage index
γ
reciprocal of non-linearity current index β

Note 1 to entry: γ is always greater than 1.

Note 2 to entry: In varistor industry and literature, the non-linearity voltage index is usually denoted by α rather than γ.

[SOURCE: IEC 61051-1:2018, 3.5]

3.1.2.13
AC standby current
I_{AC}
current passing through MOV at maximum continuous voltage AC $V_{M(AC)}$

3.1.2.14
DC standby current
I_{DC}
current passing through MOV at maximum continuous voltage DC $V_{M(DC)}$

[SOURCE: IEC 61643-331:2020, 3.1.2.9]

3.2 Symbols and abbreviated terms

3.2.1 Symbols

Figure 2 and Figure 3 show the symbols for an MOV and a thermally protected MOV, respectively.

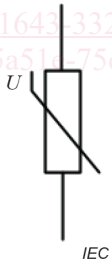

Figure 2 – Symbol for an MOV

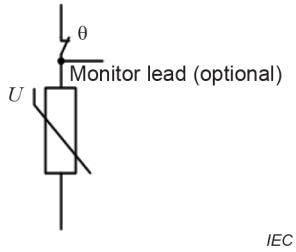

Figure 3 – Symbol for a thermally protected MOV

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.