

INTERNATIONAL STANDARD



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

(<https://standards.iteh.ai>)

Document Preview

IEC 61643-331:2017

<https://standards.iteh.ai/catalog/standards/iec/161643-331-2017>



THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2017 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

IEC 61643-331:2017

<https://standards.iteh.ai/en/standards/iec/1643-331-2017>

INTERNATIONAL STANDARD



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

<https://standards.iteh.ai/standards/iec/161643-331-2017>

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 31.040.20

ISBN 978-2-8322-5095-2

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

CONTENTS	2
FOREWORD	5
1 Scope	7
2 Normative references	7
3 Terms, definitions, symbols and abbreviated terms	7
3.1 Ratings	8
3.2 Characteristics	9
3.3 Symbols	10
3.4 Abbreviated terms	11
4 Service conditions	11
4.1 Operating and storage temperature ranges	11
4.2 Altitude or atmospheric pressure range	11
4.3 Relative Humidity	11
5 Mechanical requirements and materials	12
5.1 Robustness of terminations	12
5.2 Solderability	12
5.3 Marking	12
6 General	12
6.1 Failure rates	12
6.2 Test standard atmospheric conditions	12
7 Electrical requirements	12
7.1 Nominal varistor voltage	12
7.2 Maximum AC (DC) continuous operating voltage	13
7.3 Standby current I_{DC}	13
7.4 Capacitance	13
7.5 Clamping voltage	13
7.6 Electrostatic discharge (ESD) (for SMD type MOV)	15
7.7 Rated impulse energy (W_{TM})	15
7.8 Nominal discharge current I_{η}	15
7.9 Endurance	15
7.10 Limited current temporary overvoltage	15
8 Standard design test criteria	15
8.1 General	15
8.2 Ratings	15
8.2.1 Single-impulse maximum current (I_{TM})	15
8.2.2 Next Impulse	16
8.2.3 Continuous rated voltage (V_M)	16
8.3 Electrical characteristics	16
8.3.1 Clamping voltage (V_C)	16
8.3.2 Standby current (I_D)	17
8.3.3 Nominal varistor voltage (V_N)	17
8.3.4 Capacitance (C_V)	17
8.4 Endurance	18
8.5 ESD Test Method	18
9 Nominal discharge current and limited current temporary overvoltage	18

9.1	Thermally protected varistors – Sequence of tests	18
9.2	Temperature and humidity cycle conditioning	18
9.3	Nominal discharge current $I(n)$ test description	19
9.3.1	General	19
9.3.2	Pass/fail criteria	21
9.4	Limited current temporary overvoltage test description and procedure for thermally protected varistors	21
9.4.1	General	21
9.4.2	Sample preparation	21
9.4.3	Test conditions	21
9.4.4	Pass/fail criteria	22
9.5	Dielectric testing	24
9.5.1	Test conditions	24
9.5.2	Setup from foil to leads	24
9.5.3	Pass criteria	24
Annex A (informative)	MOV testing according to IEC 61643-11:2011 – Surge protective devices for the Class I, II and III	25
A.1	General	25
A.2	MOV selection	25
A.3	Cross reference list of abbreviations, descriptions and definitions	25
A.4	Operating duty test	26
A.4.1	General	26
A.4.2	Measured limiting voltage	28
A.4.3	Class I and II operating duty tests (8.3.4.3)	31
A.4.4	Additional duty test for test class I	31
A.4.5	Class III operating duty tests	32
A.4.6	Pass criteria for all operating duty tests and for the additional duty test for test class I	33
A.4.7	Preferred parameters of impulse discharge current I_{imp} used for Class I additional duty tests	33
A.4.8	Preferred values of impulse discharge current I_n used for Class I and Class II residual voltage and operating duty tests	33
A.4.9	Preferred values of combination waveshape used for Class III tests	34
Annex B (informative)	IEC 61051 Varistors for use in electronic equipment	36
Annex C (informative)	Accelerated endurance screening test	37
C.1	Accelerated endurance screening test	37
C.2	Preparation of sample	37
C.3	Test conditions	37
C.4	Pass criteria	38
Annex D (informative)	Proposed test method for determination of mean time to failure (MTTF)	39
D.1	Sampling plans	39
D.2	Total test hours	39
D.3	Samples	39
D.4	Intermediate measurements	40
D.5	Failure criteria	40
D.6	Acceptance criteria	40
Bibliography	41

Figure 1 – V - I characteristic of a MOV	10
Figure 2 – Symbol for MOV	10
Figure 3 – Symbol for thermally protected MOV	11
Figure 4 – Test circuit for impulse peak current clamping voltage (V_C) at peak impulse current (I_P)	16
Figure 5 – Test circuit for measuring leakage current	17
Figure 6 – Test circuit for measuring nominal varistor voltage (V_V)	17
Figure 7 – Nominal Discharge Current Flowchart	20
Figure 8 – Sequence of the I_n Test	21
Figure 9 – Temporary Overvoltage Limited Current test procedure Flowchart	23
Figure A.1 – Flow chart of the operating duty test	27
Figure A.2 – Test set-up for operating duty test	28
Figure A.3 – Flow chart of testing to determine the measured limiting voltage	30
Figure A.4 – Operating duty test timing diagram for test classes I and II	31
Figure A.5 – Additional duty test timing diagram for test class I	32
Figure A.6 – Operating duty test timing diagram for test class III	32
Figure C.1 – Circuit of accelerated ageing test	37
Figure D.1 – Test Circuit of MTTF	40
Table 1 – Voltage ratings for disc types	13
Table 2 – Typical Voltage Ratings for SMD types	14
Table A.1 – Comparison of IEC 61643-11 and IEC 61643-311	26
Table A.2 – Preferred parameters for class I test	33
Table A.3 – Preferred values for class I and class II tests	34
Table A.4 – Preferred values for class III tests	35
Table D.1 – Sampling plans	39

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMPONENTS FOR LOW-VOLTAGE SURGE PROTECTIVE DEVICES –**Part 331: Performance requirements and test methods
for metal oxide varistors (MOV)**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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);

- 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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

COMPONENTS FOR LOW-VOLTAGE SURGE PROTECTIVE DEVICES –

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 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>

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 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 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.

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).

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

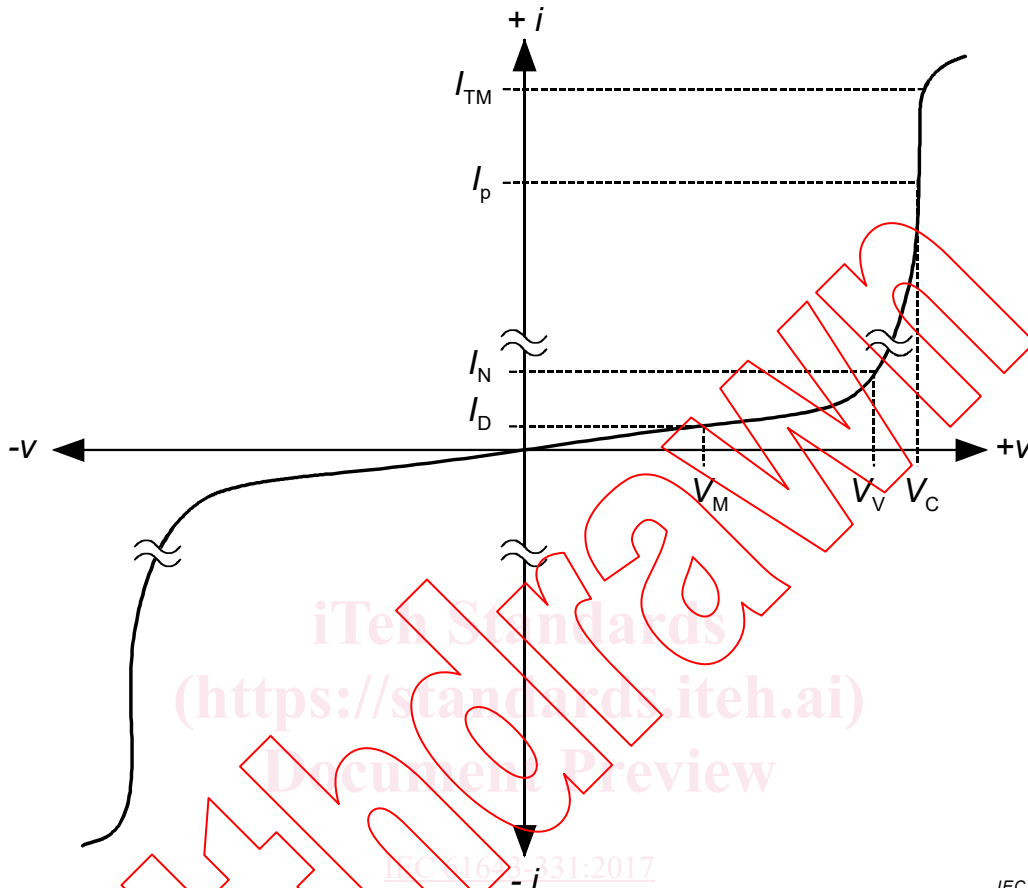


Figure 1 – V-I characteristic of an MOV

3.3 Symbols

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

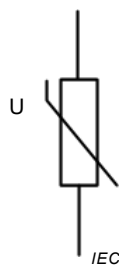


Figure 2 – Symbol for MOV