IEC 61051-1

Edition 2.0 2007-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Varistors for use in electronic equipment – Part 1: Generic specification

Varistances utilisées dans les équipements électroniques – Partie 1: Spécification générique

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VARISTORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 1: Generic specification

FOREWORD

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International Standard IEC 61051-1 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This second edition cancels and replaces the first edition published in 1991 and constitutes a minor revision related to tables, figures and references.

This bilingual version (2012-06) corresponds to the monolingual English version, published in 2007-04.

The text of this standard is based on the following documents:

CDV	Report on voting
40/1775/CDV	40/1841/RVC

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

The French version of this standard has not been voted upon.

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

The list of all the parts of the IEC 61051 series, under the general title *Varistors for use in electronic equipment*, can be found on the IEC website.

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

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- withdrawn,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

VARISTORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 1: Generic specification

1 General

1.1 Scope

This part of IEC 61051 is applicable to varistors with symmetrical voltage-current characteristics for use in electronic equipment.

1.2 Object

The object of this standard is to establish standard terms, inspection procedures and methods of test for use in sectional and detail specifications for Qualification Approval and for Quality Assessment Systems for electronic components.

1.3 Normative references

The following referenced documents are indispensable for the application 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 60027 (all parts), *Letter symbols to be used in electrical technology*

IEC 60050 (all parts), *International Electrotechnical Vocabulary (IEV)*

IEC 60060-2:1994, *High-voltage test techniques – Part 2: Measuring systems*

IEC 60062:2004, *Marking codes for resistors and capacitors.*

IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*
Amendment 1 (1992)

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

IEC 60068-2-2:1974, *Environmental testing – Part 2: Tests – Tests B: Dry heat*
Amendment 1 (1993)
Amendment 2 (1994)

IEC 60068-2-6:1995, *Environmental testing – Part 2: Tests – Test Fc and guidance: Vibration (Sinusoidal)*

IEC 60068-2-13:1983, *Environmental testing – Part 2: Tests – Test M: Low air pressure*

IEC 60068-2-14:1984, *Environmental testing – Part 2: Tests – Test N: Change of temperature*
Amendment 1 (1986)

IEC 60068-2-20:1979, *Environmental testing – Part 2: Tests – Test T: Soldering*
Amendment 2 (1987)

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

IEC 60068-2-27:1987, *Environmental testing – Part 2: Tests – Test Ea and guidance: Shock*

IEC 60068-2-29:1987, *Environmental testing – Part 2: Tests – Test Eb and guidance: Bump*

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db and guidance: Damp heat, cyclic (12 h + 12-hour cycle)*

IEC 60068-2-45:1980, *Environmental testing – Part 2: Tests – Test XA and guidance – Immersion in cleaning solvents*

IEC 60068-2-54:2005, *Environmental testing – Part 2-54: Tests – Test Ta: Solderability testing of electronic components by the wetting balance method*

IEC 60068-2-58:2004, *Environmental testing – Part 2-58: Tests – Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*

IEC 60068-2-69:1995, *Environmental testing – Part 2: Tests – Test Te: Solderability testing of electronic components for surface mount technology by the wetting balance method*

IEC 60068-2-78:2001, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60294:1969, *Measurement of the dimensions of a cylindrical component having two axial terminations*

IEC 60410:1973, *Sampling plans and procedures for inspection by attributes*

IEC 60617:2007, *Graphical symbols for diagrams*

IEC 60695-11-5:2004, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

IEC 60717:1981, *Method for the determination of the space required by capacitors and resistors with unidirectional terminations*

IEC 61249-2-7:2002, *Materials for printed boards and other interconnecting structures – Part 2-7: Reinforced base materials clad and unclad – Epoxide woven E-glass laminated sheet of defined flammability (vertical burning test) copper-clad*

IEC QC 001002-3, see http://www.iecq.org

ISO 1000:1992, *SI units and recommendations for the use of their multiples and of certain other units*
Amendment 1 (1998)

2 Technical data

2.1 Units, symbols and terminology

Units, graphical symbols, letter symbols and terminology shall, whenever possible be taken from the following publications:

IEC 60027

IEC 60050

IEC 60617

ISO 1000

When further items are required they shall be derived in accordance with the principles of the documents listed above.

2.2 Terms and definitions

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

2.2.1
type
group of components having similar design features and the similarity of whose manufacturing techniques enables them to be grouped together either for qualification approval or for quality conformance inspection

They are generally covered by a single detail specification.

NOTE Components described in several detail specifications may, in some cases, be considered as belonging to the same type and may therefore be grouped together for approval and quality conformance inspection.

2.2.2
style
subdivision of a type, generally based on dimensional factors which may include several variants, generally of a mechanical order

2.2.3
varistor (voltage dependent resistor, VDR) (graphical symbol Z)
component, whose conductance, at a given temperature, increases rapidly with voltage. This property is expressed by either of the following formulae:

$$U = \mathrm{C} I^{\beta} \tag{1}$$

or

$$I = \mathrm{A} U^{\gamma} \tag{2}$$

where

I	is the current flowing through the varistor;
U	is the voltage applied across the varistor;
β	is the current index;
γ	is the voltage index;
A and C	are constants.

2.2.4
non-linearity current index β
starting from formula (1) of 1.5.3, it is defined by the formula:

$$\beta = \frac{I}{U} \times \frac{\mathrm{d}U}{\mathrm{d}I} \tag{3}$$

For the convenience of calculation, the following formula may be used:

$$\beta = \frac{\lg(U_1/U_2)}{\lg(I_1/I_2)} \tag{4}$$

β is always less than 1.

2.2.5
non-linearity voltage index γ
starting from formula (2) of 1.5.3, it is defined by the formula:

$$\beta = \frac{U}{I} \times \frac{dI}{dU} \qquad (5)$$

For the convenience of calculation, the following formula may be used:

$$\gamma = \frac{lg\,(I_1/I_2)}{lg\,(U_1/U_2)} \qquad (6)$$

γ is always greater than 1.

2.2.6
maximum continuous a.c. voltage
maximum a.c. r.m.s. voltage of a substantially sinusoidal waveform (less then 5 % total harmonic distortion) which can be applied to the component under continuous operating conditions at 25 °C. At temperatures greater than 25 °C the detail specification must give full information on derating requirements.

Normally this voltage value shall be 1,1 times the supply voltage.

2.2.7
maximum continuous d.c. voltage
maximum d.c. voltage (with less than 5 % ripple) which can be applied to the component under continuous operating conditions at an ambient temperature of 25 °C. At temperatures greater than 25 °C the detail specification must give full information on derating requirements.

2.2.8
supply voltage
voltage by which the system is designated and to which certain operating characteristics of the system are referred

2.2.9
nominal varistor voltage
voltage, at specified d.c. current, used as a reference point in the component characteristic

2.2.10
voltage-under-pulse conditions
peak value of the voltage, which appears at the terminations of the varistor, when a specified current pulse is applied to it

2.2.11
clamping voltage
peak voltage developed across the varistor terminations under standard atmospheric conditions, when passing an 8/20 class current pulse (see 1.5.15)

2.2.12
isolation voltage (applicable only to insulated varistors)
maximum peak voltage, which may be applied under continuous operating conditions between the varistor terminations and any conducting mounting surface

2.2.13
leakage current
current passing through the varistor at the maximum d.c. voltage and at a temperature of 25 °C or at any other specified temperature

2.2.14
maximum peak current
maximum current per pulse, which may be passed by a varistor at an ambient temperature of 25 °C, for a given number of pulses

2.2.15
class current
peak value of current, which is 1/10 of the maximum peak current for 100 pulses at two per minute for the 8/20 pulse

2.2.16
pulse or impulse
unidirectional wave of voltage or current without appreciable oscillations

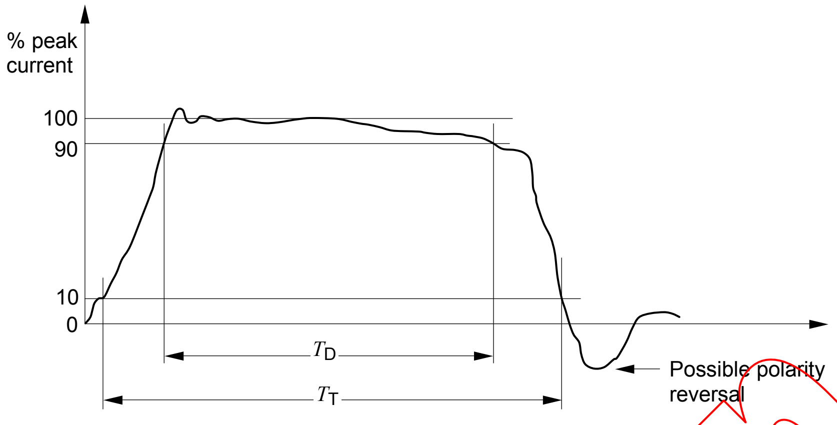
NOTE In IEC 60060-2, the word "impulse" is used; however, for this specification, only the word "pulse" is used.

2.2.17
pulse currents
two types of pulse currents are used:

1. The first type has a shape which increases from zero to a peak value in a short time, and thereafter decreases to zero either approximately exponentially or in the manner of a heavily damped sine curve. This type is defined by the virtual front time T_1 and the virtual time to half-value T_2; see Figure 1. The pulse voltage of combination pulse (see 2.2.29) has a similar shape.

Figure 1 – Shape of pulse current type 1

2. The second type has an approximately rectangular shape and is defined by the virtual duration of the peak and the virtual total duration; see Figure 2.



T_D Virtual duration of peak current

T_T Virtual total duration

Figure 2 – Shape of pulse current type 2

2.2.18
value of the pulse current
pulse current is normally defined by its peak value. With some test circuits, overshoot or oscillations may be present on the current. The pulse current shall be defined by a smooth curve drawn through the oscillations provided the peaks of the oscillations comply with 4.6.2

2.2.19
virtual front time T_1
virtual front time T_1 of a pulse current is 1,25 times the interval between the instants when the pulse is 10 % and 90 % of its peak value. The virtual front time T_1 of a pulse voltage is 1,67 times the interval between the instants when the pulse is 30 % and 90 % of its peak value

2.2.20
virtual origin O_1
virtual origin O_1 of a pulse current is the instant preceding at which the current is 10 % of its peak value by a time 0,1 × T_1. The virtual origin O_1 of a pulse voltage is the instant preceding that at which the voltage is 30 % of its peak value by a time 0,3 × T_1.

For oscillograms having linear time sweeps, this is the intersection with the X-axis of a straight line drawn through the 10 % (30 %, in case of pulse voltage) and 90 % reference points on the front

2.2.21
virtual time to half-value T_2
virtual time to half-value T_2 of a pulse current or pulse voltage is the time interval between the virtual origin and the instant on the tail at which the current has first decreased to half its peak value

2.2.22
virtual duration of peak of a rectangular pulse current t_d
time during which the current is greater than 90 % of its peak value