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INTERNATIONAL STANDARD

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

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FOREWORD

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International Standard IEC 60393-1 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This third edition cancels and replaces the second edition published in 1989 and constitutes a technical revision, including minor revisions related to tables, figures and references.

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

- implementation of Annex H which replaces Section 3 of the previous edition.

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

FDIS	Report on voting
40/1897/FDIS	40/1914/RVD

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

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

A list of all the parts of the IEC 60393 series, under the general title *Potentiometers for use in electronic equipment*, can be found on the IEC web site.

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- withdrawn,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.

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

POTENTIOMETERS FOR USE IN ELECTRONIC EQUIPMENT –

Part 1: Generic specification

1 General

1.1 Scope

This part of IEC 60393 is applicable to all types of resistive potentiometers, including lead-screw actuated types, presets, multi-turn units, etc. to be used in electronic equipment.

It establishes standard terms, inspection procedures and methods of test for use in sectional and detail specifications of electronic components for quality assessment or any other purpose.

It has been mainly written, and the test methods described, to conform to the widely used single-turn rotary potentiometer with an operating shaft.

For other types of potentiometers:

- the angle of rotation may be several turns;
- the reference to an operating shaft shall apply to any other actuating device;
- the angular rotation shall be taken to mean mechanical travel of the actuating device;
- a value for force shall be prescribed instead of a value for torque if the actuating device moves in a linear instead of a rotary manner.

These alternative prescriptions will be found in the sectional or detail specification.

When a component is constructed as a variable resistor, i.e. as a two-terminal device, the detail specification shall prescribe the modifications required in the standard tests.

1.2 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 60027-1, *Letter symbols to be used in electrical technology – Part 1: General*

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

IEC 60062, *Marking codes for resistors and capacitors*

IEC 60063:1963, *Preferred number series for resistors and capacitors*
Amendment 1 (1967)
Amendment 2 (1977)

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

IEC 60068-2-1:1990, *Environmental testing – Part 2: Tests – Tests A: Cold*
Amendment 1 (1993)
Amendment 2 (1994)

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

IEC 60068-2-6, *Environmental testing – Part 2: Tests – Test Fc : Vibration (sinusoidal)*

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

IEC 60068-2-14:1994, *Environmental testing – Part 2: Tests – Test N: Change of temperature*
Amendment 1 (1986)

IEC 60068-2-17, *Environmental testing – Part 2: Tests – Test Q: Sealing*

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

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

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

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

IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test dB : 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*
Amendment 1 (1993)

IEC 60068-2-58, *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 60068-2-78, *Environmental testing – Part 2-78 – Test Cab: Damp heat, steady state*

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

IEC 60617, *Graphical symbols for diagrams*

IEC 60915, *Capacitors and resistors for use in electronic equipment – Preferred dimensions of shaft ends, bushes and for the mounting of single-hole, bush-mounted, shaft-operated electronic components*

IEC 61249-2-7, *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*

IECQ 001002-3, *IEC Quality Assessment System for Electronic Components (IECQ) – Rules of procedure – Part 3: Approval procedures*

IECQ 001005, see www.iecq.org\certificates for relevant information

ISO 1000, *SI units and recommendations for the use of their multiples and of certain other units*

ISO 9000, *Quality management systems – Fundamentals and vocabulary*

2 Technical data

2.1 Units and symbols

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

– IEC 60027-1;
– IEC 60050;
– IEC 60617;
– ISO 1000.

When further items are required they should be derived in accordance with the principles of the publications 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 for quality conformance inspection. They are generally covered by a single detail specification

NOTE 1 Components described in several detail specifications may, in some cases, be considered as belonging to the same type and may therefore be grouped for quality assessment purpose.

NOTE 2 Mounting accessories are ignored provided they have no significant effect upon the test results.

NOTE 3 Ratings are to be given in the detail specification.

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
grade
term indicating additional general characteristics concerning the intended application, for example, long-life applications which may only be used in combination with one or more words (for example, long-life grade) and not by a single letter or number. Figures to be added after the term “grade” should be Arabic numerals

2.2.4
variant
subdivision within a style having specific dimensions for some part of its construction, for example, terminals, shaft flats or length (see Annex F)

2.2.5
family (of electronic components)
group of electronic components which predominantly displays a particular physical attribute and/or fulfils a defined function

2.2.6
subfamily (of electronic components)
group of components within a family manufactured by similar technological methods

2.2.7
category temperature range
range of ambient temperatures for which the potentiometer has been designed to operate continuously; this is defined by the temperature limits of its appropriate category

2.2.8
upper category temperature
maximum ambient temperature for which a potentiometer has been designed to operate continuously at that portion of the rated dissipation which is indicated in the category dissipation (see 2.2.13)

2.2.9
lower category temperature
minimum ambient temperature for which a potentiometer has been designed to operate continuously

2.2.10
critical resistance
resistance value at which the rated voltage is equal to the limiting element voltage. Below the critical resistance the maximum voltage which may be applied across the terminals of a potentiometer is the rated voltage. Above that value the maximum voltage is the limiting element voltage (see 2.2.12, 2.2.14 and 2.2.15)

2.2.11
nominal total resistance
resistance value for which the potentiometer has been designed and which is generally marked upon the potentiometer

2.2.12
rated dissipation
maximum allowable dissipation between terminals a and c (see 2.2.29) of a potentiometer at an ambient temperature of 70 °C under the conditions of the electrical endurance test at 70 °C which will result in a change in resistance not greater than that specified for that test

NOTE 1 In practice, the dissipation is modified by the following conditions.

NOTE 2 For high values of resistance, the limiting element voltage (see 2.2.15) may prevent the rated dissipation being attained

NOTE 3 For the dissipation at temperatures other than 70 °C, reference should be made to the rating graphs in the relevant detail specification

NOTE 4 For situations where only terminals a and b or b and c are being used and the control shaft is set at an angle less than 100 % of the effective electrical travel, the limiting moving contact current (see 2.2.17) should also be taken into account.

2.2.13
category dissipation
maximum allowable dissipation under continuous load at an ambient temperature equal to the upper category temperature, normally expressed as a percentage of the rated dissipation

NOTE The category dissipation may be zero.

2.2.14
rated voltage
d.c. or a.c. r.m.s. voltage calculated from the square root of the product of the nominal total resistance and the rated dissipation

NOTE At high values of resistance, the rated voltage may not be applicable because of the size and construction of the potentiometer (see 2.2.10, 2.2.12 and 2.2.15).

2.2.15
limiting element voltage
maximum d.c. or a.c. r.m.s. voltage which may be applied across the element of a potentiometer

NOTE 1 When the term “a.c. r.m.s. voltage” is used in this specification, the peak voltage should not exceed 1,42 times the r.m.s. value.

NOTE 2 This voltage should only be applied to potentiometers when the resistance value is equal to, or higher than, the critical value.

2.2.16
insulation voltage
maximum peak voltage under continuous operating conditions which may be applied between the potentiometer terminals and other external conducting parts connected together

NOTE The value of the insulation voltage should be not less than 1,42 times the limiting element voltage at normal air pressure. Under conditions of low air pressure, the value of the insulation voltage will be less and should be given in the detail specifications.

2.2.17
limiting moving contact current
maximum current that may be passed between the resistance element and the moving contact

2.2.18
variation of resistance and voltage output ratio with temperature
can be expressed either as a temperature characteristic or as a temperature coefficient as defined below

2.2.18.1
temperature characteristic of resistance
maximum reversible variation of resistance produced over a given temperature range within the category temperature range, expressed normally as a percentage of the resistance related to a reference temperature of 20 °C

2.2.18.2
temperature coefficient of resistance (α_r)
relative variation of resistance between two given temperatures (mean coefficient), divided by the difference in temperature producing it, preferably expressed in parts per million per °C (10^{-6}/K)

NOTE It should be noted that use of the term does not imply that any degree of linearity for this function, nor should any be assumed.

2.2.18.3
temperature coefficient of output ratio (α_o)
relative variation of voltage output ratio between two given temperatures (mean coefficient) at fixed values of setting and load of the moving contact, divided by the difference in temperature producing it, preferably expressed in parts per million per °C

NOTE 1 The value of α_0 may be different for different settings of the output ratio.

NOTE 2 It should be noted that the use of the term does not imply that the function exhibits any degree of linearity, nor should any be assumed.

2.2.19
visible damage
damage which reduces the usability of the potentiometer for its intended purpose