

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Potentiometers for use in electronic equipment –
Part 4: Sectional specification: Single-turn rotary power potentiometers**

**Potentiomètres utilisés dans les équipements électroniques –
Partie 4: Spécification intermédiaire: Potentiomètres rotatifs monotours à forte
dissipation**

[IEC 60393-4:2023](#)

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POTENTIOMETERS FOR USE IN ELECTRONIC EQUIPMENT –**Part 4: Sectional specification:
Single-turn rotary power potentiometers**

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IEC 60393-4 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment. It is an International Standard.

This third edition cancels and replaces the second edition published in 1992 and constitutes a technical revision.

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

- a) the document structure has been organized to follow new sectional specification structure decided in TC 40;
- b) the information on the assessment level EZ and FZ (zero nonconforming) has been revised.

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

Draft	Report on voting
40/3074/FDIS	40/3085/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 60393 series, published under the general title *Potentiometers for use in electronic equipment*, 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

- reconfirmed,
- withdrawn, or
- revised.

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POTENTIOMETERS FOR USE IN ELECTRONIC EQUIPMENT –

Part 4: Sectional specification: Single-turn rotary power potentiometers

1 Scope

This part of IEC 60393 is applicable to single-turn rotary power potentiometers wire-wound technology. Enamelled, cemented, moulded, enclosed.

This specification is applicable to rotary potentiometers with nominal dissipation in excess of 10 W, the resistive element of which consists of a wire or a wound tape. All the potentiometers specified by this specification are slider-driven without reduction. Their stroke less than 360° is limited by stops.

This document specifies preferred ratings and characteristics and selects from IEC 60393-1, appropriate quality assessment procedures, tests and measuring methods. It provides general performance requirements for this type of potentiometer.

This document gives the minimum performance requirements and test severities.

Annex A lists the letters and symbols used in the clauses of this document.

2 Normative reference

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 60062:2016, *Marking codes for resistors and capacitors*
IEC 60062:2016/AMD1:2019

IEC 60063, *Preferred number series for resistors and capacitors*

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

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60393-1:2008, *Potentiometers for use in electronic equipment – Part 1: Generic specification*

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 61439-1, *Low-voltage switchgear and control gear assemblies – General rules*

IEC 61193-2:2007, *Quality assessment systems – Part 2: Selection and use of sampling plans for inspection of electronic components and packages*

3 Terms and definitions

For this document, the terms and definitions given in IEC 60393-1, as well as the following, apply.

ISO and IEC maintain terminological 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

potentiometer

component for use as a voltage divider with three terminals of which two are connected to the ends of a resistive element and the third is connected to a moving contact which can be moved mechanically along the resistive element

3.2

rheostat

rheostat which is a variable resistor with two terminals

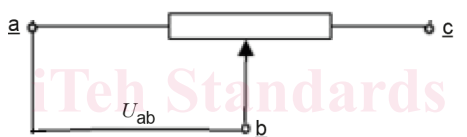


Figure 1 – Schematic view

3.3

total resistance

R_t

resistance between terminal a and c (R_{ac}) resistance value for which the variable resistor has been designed and which is generally marked upon the variable resistor

3.4

minimum resistance

resistance measured between the wiper terminal and any terminal with the shaft positioned to give the minimum value

3.5

end resistance

resistance measured between the wiper terminal and an end terminal with the shaft positioned at the corresponding end point

3.6

category dissipation

fraction of the rated dissipation exactly defined by the relevant specification, applicable at the upper category temperature, taking account of the derating curve determined by the relevant specification

3.7

nominal dissipation

P_n

power dissipated over the entire resistive element in continuous operation, at the rated service temperature

3.8**shaft**

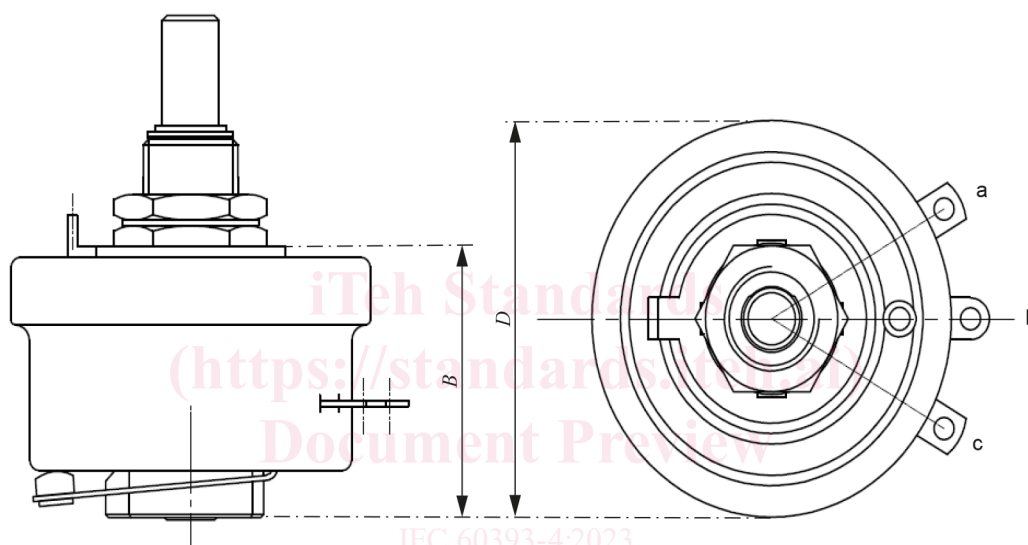
mechanical input element of the variable resistor

4 Preferred characteristics**4.1 General**

The values given in detail specifications shall preferably be selected from the following.

4.2 Style and dimensions

The dimensions of potentiometer are shown in Figure 2.



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Figure 2 – Outline drawing and dimensions

The drawing shall give the following details:

- the dimensions of the shaft and bush. These may be given either on the outline drawing or by reference to IEC 60915;
- any locating devices;
- the total mechanical travel;
- the effective electrical travel;
- the angle of ineffective mechanical travel;
- the dimensions and the location of terminations;
- the dimensions which shall be measured in accordance with IEC 60393-1:2008, 4.4.2;
- any other dimensional information which will adequately describe the potentiometer.

All dimensions shall preferably be stated in millimetres, however, when the original dimensions are given in inches, the converted metric dimensions in millimetres shall be added.

When the potentiometer is not designed for use on printed boards, this shall be clearly indicated in the detail specification.

4.3 Preferred climatic categories

The potentiometers covered by this specification are classified into climatic categories according to the general rules given in IEC 60068-1:2013, Annex A.

The lower and upper category temperature and the duration of the damp heat, steady state test shall be chosen from the following:

Lower category temperature:	-65 °C, -55 °C, -40 °C, -25 °C and -10 °C.
Upper category temperature:	+70 °C, +85 °C, +100 °C, +125 °C, +155 °C, +175 °C and +200 °C
Duration of the damp heat, steady state test:	4, 10, 21 and 56 days.

The severities for the cold and dry heat tests are the lower and upper category temperatures respectively. Because of the construction of some potentiometers, these temperatures will occur between two of the preferred temperatures given in IEC 60068-2-1 and IEC 60068-2-2. In this case, the nearest preferred temperature within the actual temperature range of the potentiometer shall be chosen for this severity.

4.4 Resistance law

See 6.5.

4.5 Nominal total resistance

See IEC 60393-1:2008, 2.3.2.

4.6 Tolerances on nominal total resistance

The preferred tolerances on nominal total resistance shall be taken from the series specified in IEC 60063 (E24 – E12 – E6) $\pm 20\%$, $\pm 10\%$, $\pm 5\%$.

4.7 Rated dissipation

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The preferred values of rated dissipation at 70 °C, are:

10 W, 16 W, 25 W, 40 W, 50 W, 63 W, 80 W, 100 W, 125 W, 160 W, 250 W, 315 W, 400 W, 500 W, 630 W, 800 W and 1 000 W.

The derated values of dissipation at temperatures in excess of 70 °C shall be as indicated by the curve as shown in Figure 3.

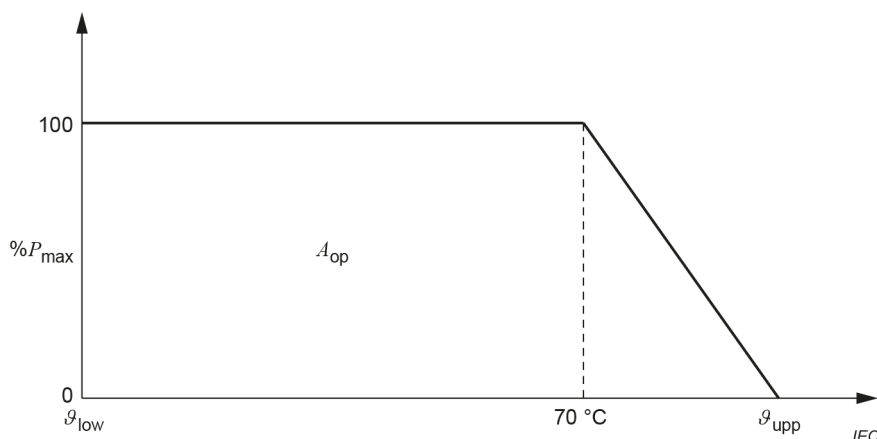


Figure 3 – Rated dissipation curve

A larger area of operation may be given in the detail specification, provided it includes all the area given above. In this event, the detail specification shall state the maximum allowable dissipation at temperatures other than 70 °C. All break points on the curve shall be verified by test.

An example of a derating curve having a larger area of operation is given in Figure 4. In certain circumstances, the rated dissipation may continue up to the upper category temperature.

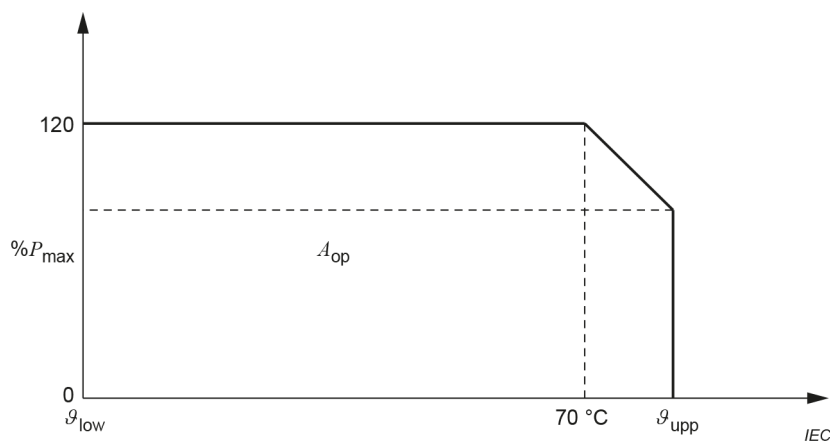


Figure 4 – Rated dissipation curve (example of larger area)

4.8 Limiting element voltage

The preferred values of DC or AC r.m.s. limiting element voltage U_{\max} are:

160 V; 250 V; 400 V; 630 V; 1 000 V and 1 600 V.

4.9 Insulation voltage

The detail specification shall determine the value of the insulation voltage, rounded off to the nearest 10 V. The numerical value of the insulation voltage shall be:

- Normal air pressure: $\geq 1,42$ times the limiting element voltage
- Low air pressure (at 8 kPa): \geq two-thirds the value at normal air pressure

4.10 Number of cycles of operation

The preferred numbers of cycles of operation are:

Single turn/continuous rotation: $1,25 \times 10^5$, $2,5 \times 10^5$ or 5×10^5

4.11 Shaft rotational speed

The preferred shaft rotational speeds in revolutions per minute (r.p.m.) are:

- 40 ± 5

5 Tests and test severities

5.1 General

The detail specification shall specify the method of mounting to be applied for the voltage proof and the insulation resistance tests and for the application of the vibration and shock tests.

5.2 Mounting

The potentiometers shall be mounted by their normal means, but the design can be such that special mounting fixtures are required. In this case, the detail specification shall describe the mounting fixtures that shall be used for the voltage proof and the insulation resistance tests and for the application of the vibration and shock tests. For the latter tests, the mounting shall be such that there shall be no parasitic vibration.

5.3 Tests

5.3.1 Drying

See IEC 60393-1:2008, 4.3, Procedure 1 shall be used.

5.3.2 Resistance measurement

The methods described in IEC 60393-1:2008, 4.6 and 4.7 shall be used.

5.3.3 Vibration

See IEC 60393-1:2008, 4.35, with the following details:

Frequency range: 10 Hz to 55 Hz, or
10 Hz to 500 Hz.

Amplitude: 0,75 mm or acceleration 98 m/s² (whichever is the less severe)

Sweep endurance: Total duration: 6 h

The detail specification shall determine the mounting method to be used (see IEC 60393-1:2008).

5.3.4 Bump

See IEC 60393-1:2008, 4.36, with the following details:

Acceleration: 400 m/s²

Number of bumps: 4 000 (total)

Or

Acceleration: 98 m/s²

Number of bumps: 1 000 (total)

The detail specification shall determine the appropriate mounting method to be used (see IEC 60393-1:2008, 4.3).

5.3.5 Shock

IEC 60393-1:2008, 4.37 applies with the following details:

Pulse shape: Half-sine

Acceleration: 490 m/s²

Pulse duration: 11 ms

Severity: 3 successive shocks to be applied in each of the three directions (total 3 shocks)

The detail specification shall determine the mounting method to be used (see IEC 60393-1:2008, 4.3).

5.3.6 Temperature coefficients and temperature characteristics of resistance

The measurement of temperature coefficient, or temperature characteristics of resistance is not applicable to this type of potentiometer.

6 Performance requirements

6.1 General

Test severities and requirements specified by detail specifications referring to this sectional specification shall be of equal or superior performance level. Inferior performance levels are not permitted.

The severities for the tests shall be determined by the detail specifications, following the requirements of the generic specification IEC 60393-4 and Clause 5 of this sectional specification.

Table 1 – Limits for change in resistance or output voltage ratio

(The subclause numbers in the heading of the table refer to IEC 60393-1:2008).					
Stability class	4.38 Climatic sequence	4.34 Change of temperature	4.30 Robustness of the terminals	4.22 Thrust and pull on the shaft	4.35 Vibration (If applicable)
	4.39 Damp heat, steady state		4.33 Resistance to soldering heat	4.34 Change of temperature	4.37 Shock
	4.40 Mechanical endurance		4.35 Vibration		
	4.43.2 Electrical endurance at 70 °C		4.36 Bump		
	4.43.3 Electrical endurance at upper category temperature		4.37 Shock		
ΔR between terminations <u>a</u> and <u>c</u> ^a					
10	$\pm(10 \% R + 0,5 \Omega)$	$\pm(5 \% R + 0,1 \Omega)$	$\pm(5 \% R + 0,1 \Omega)$	$\pm(5 \% R + 0,1 \Omega)$	$\pm(5 \% R + 0,1 \Omega)$
5	$\pm(5 \% R + 0,1 \Omega)$	$\pm(2 \% R + 0,1 \Omega)$	$\pm(2 \% R + 0,1 \Omega)$	$\pm(2 \% R + 0,1 \Omega)$	$\pm(2 \% R + 0,1 \Omega)$
3	$\pm(3 \% R + 0,1 \Omega)$	$\pm(1 \% R + 0,1 \Omega)$	$\pm(1 \% R + 0,1 \Omega)$	$\pm(1 \% R + 0,1 \Omega)$	$\pm(1 \% R + 0,1 \Omega)$
^a ΔR indicates the value of change in resistance.					

6.2 Limits for change in resistance or output voltage ratio

The preferred combinations of limits for change in resistance or output ratio in each of the tests listed in the heading of Table 1 are as indicated in the lines of the table.

6.3 Limits for insulation resistance

The preferred limits for insulation resistance shall be 1 GΩ minimum or, after humidity tests, 100 MΩ.