IEC 60393-3

Edition 3.0 2023-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Potentiometers for use in electronic equipment –
Part 3: Sectional specification: Rotary precision potentiometers

Potentiomètres utilisés dans les équipements électroniques –
Partie 3: Spécification intermédiaire: Potentiomètres de précision rotatifs

IEC 60393-3:2023-08(en-fr)

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POTENTIOMETERS FOR USE IN ELECTRONIC EQUIPMENT –

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FOREWORD

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IEC 60393-3 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. This edition constitutes a technical revision.

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

a) revised all parts of the document based on the ISO/IEC Directives, Part 2:2018 (eighth edition) and harmonized with other similar kinds of documents;
b) the document structure has been organized to follow new sectional specification structure decided in TC 40;
c) revision of the information on the assessment level EZ (zero nonconforming).

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

Draft	Report on voting
40/3058/FDIS	40/3071/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.

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.

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.

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- withdrawn,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

POTENTIOMETERS FOR USE IN ELECTRONIC EQUIPMENT –

Part 3: Sectional specification: Rotary precision potentiometers

1 Scope

This part of IEC 60393 applies to rotary precision potentiometers for use in electronic equipment.

The object of this document is to prescribe preferred ratings and characteristics and to select from IEC 60393-1, the appropriate quality assessment procedures, tests and measuring methods and to give general performance requirements for this type of potentiometer.

This document gives the minimum performance requirements and test severities.

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 60062, *Marking codes for resistors and capacitors*

IEC 60068-1:2013, *Environmental testing – Part 1: General and guidance*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions of IEC 60393-1:2008 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

4 Preferred characteristics

4.1 General

The values given in detail specifications should be selected from the content of 4.2 to 4.10.

4.2 Style and dimensions

4.2.1 Style

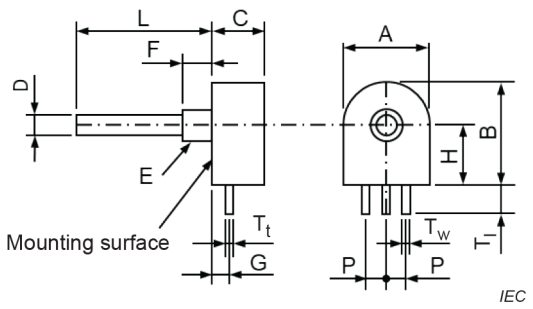
See IEC 60393-1:2008, 2.2.2.

The style shall be presented by a double-letter code, e.g. AB, which is arbitrarily chosen for each detail specification.

The style designation, therefore, has no meaning unless the number of the detail specification is also given.

4.2.2 Outline drawing and dimensions

The detail specification shall incorporate an illustration of the potentiometer being specified. Where space is insufficient to show the detail dimensions required for inspection purposes, such dimensions shall appear on a drawing forming an annex to the detail specification, as shown in Figure 1.



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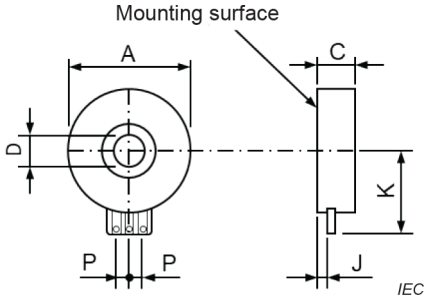
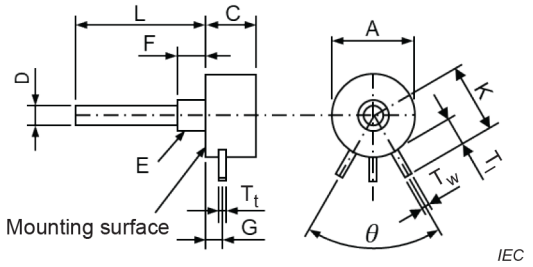
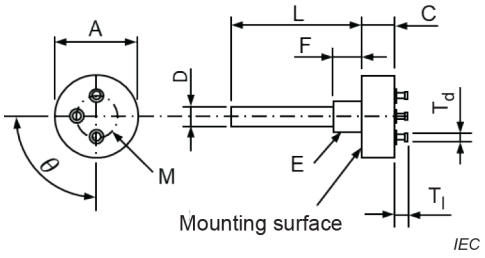


Style code: HS



Style code: PM-ST



Style code: PM-RT

Key:

A Body wide or diameter
B Body height
C Body length
D Shaft diameter
E Bushing diameter or thread size
F Bushing length
G Distance from the mounting surface to the terminal centre
H Distance from shaft centre to the board surface
J Distance from mounting surface to terminal board
K Distance from shaft centre to terminal tip
L Shaft length
M Pitch circle diameter of terminals
P Distance between terminals
T_d Terminal diameter
T_l Terminal length
T_t Terminal thickness
T_w Terminal width
θ Terminal mounting angle

Figure 1 – 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 terminals;
– 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 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 in accordance with 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:	−55 °C, −40 °C and −10 °C.
Upper category temperature:	+85 °C, +100 °C and +125 °C.
Duration of the damp heat, steady-state test:	21 days 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

IEC 60393-1:2008, 2.3.2.

4.6 Tolerances on nominal total resistance

The preferred tolerances on nominal total resistance are:

±10 %, ±5 %, ±3 %, ±2 %, ±1 % and ±0,5 %.

4.7 Rated dissipation

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

0,1 W; 0,125 W; 0,25 W; 0,5 W; 0,75 W; 1 W; 1,5 W; 2,0 W; 2,5 W; 4 W; and 6,3 W.

The derated values of dissipation at temperatures in excess of 70 °C shall be as indicated by the curve as shown in Figure 2.

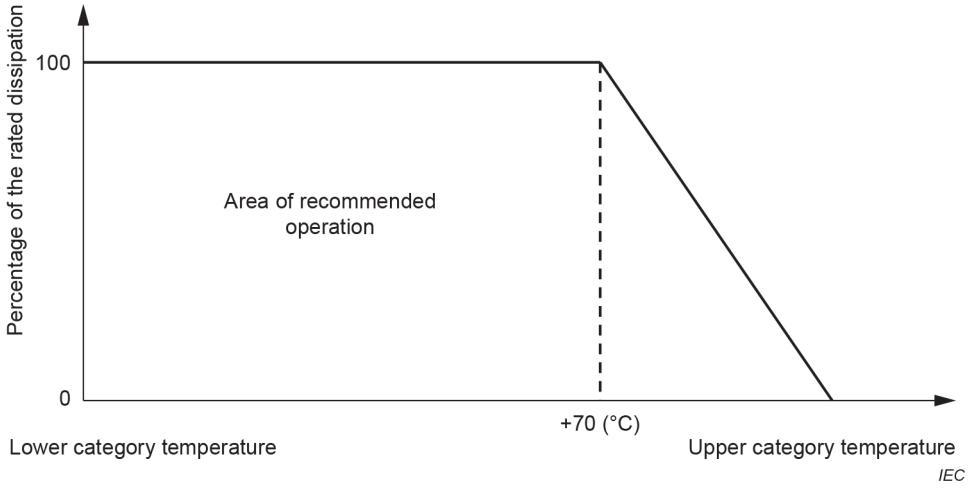


Figure 2 – Rated dissipation curve

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 3.

In certain circumstances, the rated dissipation can continue up to the upper category temperature.

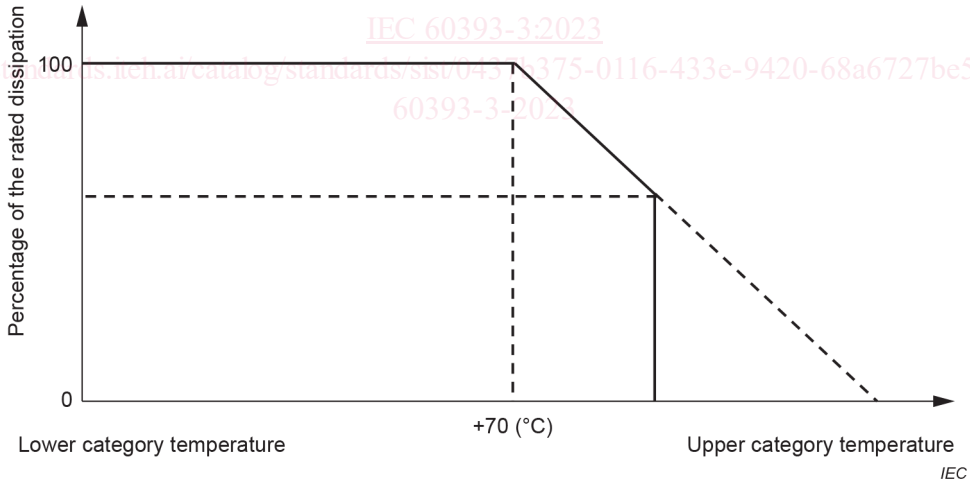


Figure 3 – Rated dissipation curve (examples of lager area)

4.8 Limiting element voltage

The preferred values of DC or AC RMS limiting element voltage are taken from the R5 series of preferred numbers of ISO 3:

100 V, 160 V, 250 V, 400 V, 630 V and 1 000 V.

4.9 Insulation voltage

The detail specification shall prescribe 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: ≥ 1,42 times the limiting element voltage;
– low air pressure (at 8 kPa): ≥ two-thirds the value at normal air pressure.

4.10 Resolution (when applicable)

The resolution shall be stated in the detail specification.

5 Test and test severities

5.1 General

Test severities given in the detail specification should be selected from the content of 5.2 to 5.10.

5.2 Mounting

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 bump or shock tests. The potentiometers shall be mounted by their normal means, but the design may 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 bump or shock tests. For the latter tests, the mounting shall be such that there shall be no parasitic vibration.

5.3 Drying

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

5.4 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, or 10 Hz to 2 000 Hz.
amplitude:	0,75 mm or acceleration 100 m/s^2 (whichever is the less severe)
sweep endurance:	total duration: 6 h

The detail specification shall prescribe the mounting method to be used (see 5.2).

5.5 Bump

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

acceleration:	400 m/s^2
number of bumps:	4 000 (total)

The detail specification shall prescribe the mounting method to be used (see 5.2).

5.6 Shock

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

pulse shape:	half-sine
acceleration:	300 m/s^2 or 500 m/s^2
pulse duration:	11 ms
severity:	3 successive shocks to be applied in each of the three directions (total 3 shocks)

The detail specification shall prescribe the mounting method to be used (see 5.2).

5.7 Solderability

5.7.1 Solder bath method (Method 1)

5.7.1.1 Test conditions, with Sn/Ag/Cu solder

See IEC 60393-1:2008, 4.32.2, with the following details:

solder alloy:	Sn/Ag/Cu;
bath temperature:	245 °C ± 5 °C;
immersion time:	3 s ± 0,3 s.

5.7.1.2 Test conditions, with Sn/Pb solder

See IEC 60393-1:2008, 4.32.2, with the following details:

solder alloy:	Sn/Pb;
bath temperature:	235 °C ± 5 °C;
immersion time:	2 s ± 0,5 s.

5.7.2 Soldering iron method (Method 2)

See IEC 60393-1:2008, 4.32.3, with the following details:

temperature of the soldering iron:	350 °C ± 10 °C (at start of test);
bit size:	3 mm (size B);
duration:	3 s.

5.8 Linearity

Linearity measurement shall be done by mounting of the device as in normal use and by moving the rotating part by external actuation. The device shall be energized with a constant voltage or current source of sufficient capacity within the maximum operating voltage. The number of output measurements to be collected, shall be corresponding to each one of the minimum 100 equidistant points of the effective electrical angle.

5.9 Angle of effective travel

For non-wirewound potentiometers, the construction near the end terminals makes it difficult to ascertain the exact angle of effective rotation. Therefore, the following definition shall be used.

Measurements of output are made from either end at very small steps of not more than 1 / 1 000 parts of the nominal angle of rotation. When the slope of 7 successive measuring points exceeds 75 % of the nominal value of the slope of the potentiometer, the first point of occurrence of increasing slope is to be considered as the start point of the effective electrical angle. The angular distance between these two rising and falling end points is the angle of effective electrical travel.

5.10 Dither

The potentiometer shall be mounted in its normal position and orientation.

The dither test is carried out by moving the rotation part of the potentiometer with an actuating device. The moving part is adjusted to approximately 50 % value. The rotation is made through the angle ±0,5° to ±2,5° at 10 Hz to 25 Hz. The angle can be verified by the measurement of the output voltage of the potentiometer. At the end of the test, the CRV and linearity should be below 150 % of the initial value, but still comply with the nominal value.

6 Preferred characteristics

6.1 General

Test severities and requirements given in the 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 stated in the detail specifications, following the prescriptions of the generic specification IEC 60393-1 and Clause 5 of this sectional specification.

6.2 Temperature coefficients of resistance

The limits of change in resistance for the preferred temperature characteristic of resistance test are given in Table 1.

Each line in Table 1 gives the preferred temperature coefficients and corresponding temperature coefficients for 20 °C to 70 °C and limits of change in resistance for the measurement of the temperature characteristics of resistance (see IEC 60393-1:2008, 4.14) on the basis of the category temperature ranges of 4.3.

Different portions of the resistance range may be covered by different temperature coefficients of resistance, although they appear in a single detail specification.

If measurements at additional temperatures are required, they shall be specified in the detail specification.

Table 1 – Temperature coefficients

Temperature coefficient of resistance	Limits of percentage change in resistance					
10^{-6}/ K	%					
	Reference temperature / Lower category temperature			Reference temperature / Upper category temperature		
	°C			°C		
	+20 / −55	+20 / −40	+20 / −10	+20 / +85	+20 / +100	+20 / +125
± 1 000	± 7,5	± 6	± 3	± 6,5	± 8	± 10,5
± 500	± 3,75	± 3	± 1,5	± 3,25	± 4	± 5,25
± 250	± 1,88	± 1,5	± 0,75	± 1,62	± 2	± 2,62
± 150	± 1,15	± 0,9	± 0,45	± 0,98	± 1,2	± 1,6
± 100	± 0,75	± 0,6	± 0,3	± 0,65	± 0,8	± 1,05
± 50	± 0,375	± 0,3	± 0,15	± 0,325	± 0,4	± 0,525
± 25	± 0,188	± 0,15	± 0,075	± 0,162	± 0,2	± 0,262
± 10	± 0,075	± 0,06	± 0,03	± 0,065	± 0,08	± 0,105