IEC 60393-5

Edition 3.0 2015-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Potentiometers for use in electronic equipment –
Part 5: Sectional specification – Single-turn rotary low-power wirewound and non-wirewound potentiometers

Potentiomètres utilisés dans les équipements électroniques –
Partie 5: Spécification intermédiaire – Potentiomètres de faible puissance, bobinés et non bobinés, rotatifs, monotour

IEC 60393-5:2015-12(en-fr)

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International Standard IEC 60393-5 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 1992 and constitutes a technical revision.

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

a) revision of the information on the assessment level EZ and FZ (zero nonconforming);
b) complete editorial revision.

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

FDIS	Report on voting
40/2408/FDIS	40/2423/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 International Standard is to be used in conjunction with IEC 60393-1:2008.

A list of all parts in the IEC 60363 series, published under the general title *Potentiometers for use in electronic equipment*, can be found on the IEC website.

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

The committee has decided that the contents of this publication will remain unchanged until the stability 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- withdrawn,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.

POTENTIOMETERS FOR USE IN ELECTRONIC EQUIPMENT –

Part 5: Sectional specification – Single-turn rotary low-power wirewound and non-wirewound potentiometers

1 General

1.1 Scope

This part of IEC 60393 applies to single-turn rotary low-power wirewound and non-wirewound potentiometers, with a rated dissipation less than to 10 W. These potentiometers are primarily intended for use in electronic equipment.

This part of IEC 60393 prescribes 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 standard gives the minimum performance requirements and test severities.

1.2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 60068-2-1:2007, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2:2007, *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 61193-2:2007, *Quality assessment systems – Part 2: Selection and use of sampling plans for inspection of electronic components and packages*

1.3 Information to be given in a detail specification

1.3.1 General

Detail specifications shall be derived from the relevant blank detail specification.

Detail specifications shall not specify requirements inferior to those of the generic, sectional or blank detail specification. When more severe requirements are included, they shall be listed in a subclause of the detail specification and indicated in the test schedules, for example by an asterisk.

The information given in 1.3.3 and 1.3.4 may, for convenience, be presented in tabular form.

The following information shall be given in each detail specification and the values quoted shall preferably be selected from those given in the appropriate clause of this sectional specification.

1.3.2 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.

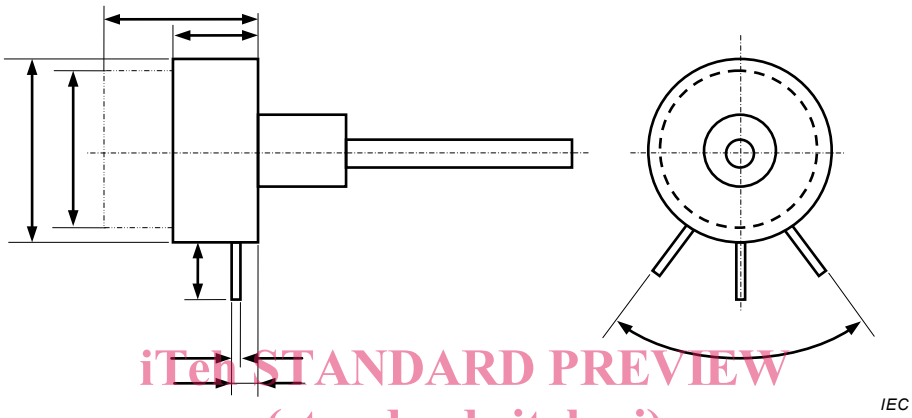

Figure 1 – Outline drawing and dimensions

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 switch angle (if applicable);
– the dimensions of the switch, if fitted, 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.

1.3.3 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 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 shock tests. For the latter tests the mounting shall be such that there shall be no parasitic vibration.

1.3.4 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.

1.3.5 Resistance law

See 2.1.6.

1.3.6 Ratings and characteristics

1.3.6.1 General

The ratings and characteristics shall be in accordance with the relevant clauses of this specification together with the following:

1.3.6.2 Nominal total resistance range

See IEC 60393-1:2008, 2.3.2

When products approved according to the detail specification have different ranges, the following statement should be added:

“The range of values available in each style is given in the register of approvals, available for example on the website http://www.iecq.org”.

The qualified products list “QPL” style is given in the register of approvals, available for example on the website stated above.

1.3.7 Marking

The detail specification shall specify the content of the marking on the potentiometer and on the package. Deviations from 1.4 of this sectional specification shall be specifically stated.

1.3.8 Ordering information

The detail specification shall indicate that the following information, in clear or in coded form, is required when ordering:

a) nominal total resistance and tolerance on nominal total resistance;

b) resistance law (if other than linear);

c) number and issue reference of the detail specification and style reference;

d) shaft and bush dimensions, if not implicit in the style reference.

1.3.9 Additional information

The detail specification may include information which is not required to be verified by the inspection procedure, such as circuit diagrams, curves, drawings and notes needed for the clarification of the detail specification.

1.4 Marking

1.4.1 General

When coding is used for nominal resistance, tolerance and date of manufacture, the method shall be selected from those given in IEC 60062.

The information given in the marking is normally selected from the following list; the relative importance of each item is indicated by its position in the list:

a) nominal total resistance;
b) tolerance on nominal total resistance;
c) resistance law (if other than linear);
d) detail specification and style reference;
e) year and month (or week) of manufacture;
f) details of shaft and bush (if not implicit in d) above). This may be in code form;
g) manufacturer's name and/or trademark;
h) switch rated voltage (a.c. and d.c. ratings when appropriate);
i) switch rated current (a.c. and d.c. ratings when appropriate);
j) corresponding terminals (in the case of double pole switches), and terminals for connection to the mains supply;
k) manufacturer's type and designation.

1.4.2 Marking for potentiometers

The potentiometer shall be clearly marked with a) and b) of 1.4.1 and with as many of the remaining items as is practicable. Any duplication of information in the marking of the potentiometer should be avoided.

The switch, if fitted, shall be clearly marked with h), i) and j) of 1.4.1.

1.4.3 Marking for packaging

The package containing the potentiometer(s) shall be clearly marked with a) to g) and, if a switch is fitted to the potentiometer, with h) and i) of 1.4.1, and with the information below.

a) quantity
b) country origin

1.4.4 Additional marking

Any additional marking shall be so applied that no confusion can arise.

2 Preferred ratings, characteristics and test severities

2.1 Preferred characteristics

2.1.1 General

The values given in the detail specification shall preferably be selected from the following:

2.1.2 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 and +155 °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 60068-2-1:2007 and IEC 60068-2-2:2007. In this case the nearest preferred temperature within the actual temperature range of the potentiometer shall be chosen for this severity.

2.1.3 Temperature coefficients and temperature characteristics of resistance

The limits of change in resistance for the temperature characteristics of resistance test are given in Table 1 (for non-wirewound potentiometers) and in Table 2 (for wirewound potentiometers).

Each line in the table gives the preferred temperature coefficients and corresponding temperature characteristics for 20 °C to 70 °C and limits of resistance 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 2.1.2.

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

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

Table 1 – Temperature coefficients and temperature characteristics of resistance for non-wirewound potentiometers

Temperature coefficients of resistance 10^{-6}/K	Temperature characteristics of resistance %	Temperature characteristics of resistance (limits of resistance change in percentage) %								
		Reference temperature/ Lower category temperature °C					Reference temperature/ Upper category temperature °C			
20 °C/70 °C		+20/ –65	+20/ –55	+20/ –40	+20/ –25	+20/ –10	20/85 [a]	20/100	20/125	20/155
–800/ –2 500	–4/ –12,5	+6,8/ +21,3	+6/ +18,75	+4,8/ +15	+3,6/ +11,3	+2,4/ +7,5	–5,2/ –16,25	–6,4/ –20	–8,4/ –26,25	–10,8/ –33,75
–400/ –1 000	–2/ –5	+3,4/ +8,5	+3/ +7,5	+2,4/ +6	+1,8/ +4,5	+1,2/ +3	–2,6/ –6,5	–3,2/ –8	–4,2/ –10,5	–5,4/ –13,5
–150/ – 600	–0,75/ –3	+1,3/ +5,1	+1,13/ +4,5	+0,9/ +3,6	+0,68/ +2,7	+0,45/ +1,8	–0,98/ –3,9	–1,2/ –4,8	–1,58/ –6,3	–2,02/ –8,2
±1 000	±5	±8,5	±7,5	±6	±4,5	±3	±6,5	±8	±10,5	±13,5
±500	±2,5	±4,3	±3,75	±3	±2,25	±1,5	±3,25	±4	±5,25	±6,75
±250	±1,25	±2,15	±1,88	±1,5	±1,13	±0,75	±1,62	±2	±2,62	±3,38
±150	±0,75	±1,3	±1,15	±0,9	±0,68	±0,45	±0,98	±1,2	±1,6	±2,05
±100	±0,5	±0,85	±0,75	±0,6	±0,45	±0,3	±0,65	±0,8	±1,05	±1,35
±50	±0,25	±0,43	±0,375	±0,3	±0,23	±0,15	±0,325	±0,4	±0,525	±0,675

[a] Potentiometers having an upper category temperature of 85 °C need not be measured between 20 °C and 70 °C.

Table 2 – Temperature coefficients and temperature characteristics of resistance for wirewound potentiometers

Temperature coefficients of resistance 10^{-6}/K	Temperature characteristics of resistance %	Temperature characteristics of resistance (limits of resistance change in percentage) %								
		Reference temperature/ Lower category temperature °C					Reference temperature/ Upper category temperature °C			
20 °C/70 °C		+20/–65	+20/–55	+20/–40	+20/–25	+20/–10	20/85 [a]	20/100	20/125	20/155
+600/–200	–1/+3	–5,1/+1,7	–4,5/+1,5	–3,6/+1,2	–2,7/+0,9	–1,8/+0,6	+3,9/–1,3	+4,8/–1,6	+6,3/–2,1	+8,1/–2,7
±250	±1,25	±2,15	±1,88	±1,5	±1,13	±0,75	±1,62	±2	±2,62	±3,38
±150	±0,75	±1,3	±1,15	±0,9	±0,68	±0,45	±0,98	±1,2	±1,6	±2,05
±100	±0,5	±0,85	±0,75	±0,6	±0,45	±0,3	±0,65	±0,8	±1,05	±1,35
±50	±0,25	±0,43	±0,375	±0,3	±0,23	±0,15	±0,325	±0,4	±0,525	±0,675
±25	±0,125	±0,215	±0,188	±0,15	±0,113	±0,075	±0,162	±0,2	±0,262	±0,338

[a] Potentiometers having an upper category temperature of 85 °C need not be measured between 20 °C and 70 °C.

2.1.4 Limits for change in resistance or output voltage ratio

The preferred combinations of limits for change in resistance or output voltage ratio in each of the tests listed in the heading of Table 3 are as indicated in the lines of the table.

Table 3 – Preferred combination of limits

Stability class %	4.38 Climatic sequence 4.39 Damp heat, steady state 4.40 Mechanical endurance 4.43.2 Electrical endurance at 70 °C 4.43.3 Electrical endurance at upper category temperature	4.34 Change of temperature	4.30 Robustness of terminals 4.33 Resistance to soldering heat 4,35 Vibration 4.37 Shock	4.22 Thrust and pull on shaft 4.34 Change of temperature	4.35 Vibration 4.37 Shock
	ΔR between terminals a and c [b]			$\Delta \frac{U_{ab}}{U_{ac}}$ [a]	$\Delta \frac{U_{ab}}{U_{ac}}$ [a]
	Non-wirewound potentiometers				
20	±(20 % R + 0,5 Ω)	±(5 % R + 0,1 Ω)	±(5 % R + 0,1 Ω)	±5 %	±5 %
15	±(15 % R + 0,5 Ω)	±(5 % R + 0,1 Ω)	±(3 % R + 0,1 Ω)	±3 %	±3 %
10	±(10 % R + 0,5 Ω)	±(3 % R + 0,1 Ω)	±(2 % R + 0,1 Ω)	±2 %	±2 %
5	±(5 % R + 0,1 Ω)	±(2 % R + 0,1 Ω)	±(1 % R + 0,1 Ω)	±1 %	±1 %
2	±(2 % R + 0,1 Ω)	±(1 % R + 0,05 Ω)	±(0,5 % R + 0,05 Ω)	±0,5 %	±0,5 %
	Wirewound potentiometers				
5	±(5 % R + 0,1 Ω)	±(2 % R + 0,1 Ω)	±(1 % R + 0,1 Ω)	±1 %	±1 %
3	±(3 % R + 0,1 Ω)	±(2 % R + 0,1 Ω)	±(1 % R + 0,05 Ω)	±1 %	±1 %
2	±(2 % R + 0,1 Ω)	±(1 % R + 0,1 Ω)	±(0,5 % R + 0,05 Ω)	±0,5 %	±0,5 %

The subclause numbers in the table refer to IEC 60393-1:2008.

[a] The change in the output voltage ratio $\Delta \frac{U_{ab}}{U_{ac}}$ shall be expressed in percent of the total applied voltage.

[b] ΔR indicates the value of change in resistance.

2.1.5 Limits for insulation resistance

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

2.1.6 Limits for resistance law

The preferred measuring points and associated values of the output ratio for resistance laws are as follows:

a) non-wirewound potentiometers, see Table 4.

Table 4 – Preferred measuring points and values of output ratio for non-wirewound potentiometers

Resistance law	% of effective electrical travel	Output ratio $\frac{U_{ab}}{U_{ac}}$ %
linear(B)	47 to 53	$R < 0{,}22$ MΩ: 40 to 60 $R \geq 0{,}22$ MΩ: 35 to 65
logarithmic (A)	30 to 36 64 to 70	1,5 to 8 10 to 40
reverse logarithmic (C)	30 to 36 64 to 70	60 to 90 92 to 98,5

b) wirewound potentiometers, see Table 5.

Table 5 – Preferred measuring points and values of output ratio for wirewound potentiometers

Resistance law	% of effective electrical travel ±1°	Output ratio $\frac{U_{ab}}{U_{ac}}$ %
linear (B)	33 1/3 50 66 2/3	33 1/3 ± 2,5 50 ± 2,5 66 2/3 ± 2,5
logarithmic (A)	25 50	12,5 ± 5 29 ± 5
reverse logarithmic (C)	25 50	37,5 ± 5 70,5 ± 5

2.1.7 Limits for starting torque

Limits for starting torque are as follows.

a) At the standard conditions for test:
   - without shaft seal: 3,5 mN·m to 50 mN·m
   - with shaft seal: 3,5 mN·m to 100 mN·m

b) At lower category temperature:
   - without shaft seal: 3,5 mN·m to 150 mN·m
   - with shaft seal: 3,5 mN·m to 300 mN·m

2.1.8 Limits for switch torque

Limits for starting torque are as follows.

a) At the standard conditions for test:
   a maximum of 200 mN·m.

b) At lower category temperature:
   a maximum of 400 mN·m.

2.2 Preferred values of ratings

2.2.1 General

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