

# INTERNATIONAL STANDARD



**Directly heated negative temperature coefficient thermistors –  
Part 2: Sectional specification – Surface mount negative temperature coefficient  
thermistors**

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**DIRECTLY HEATED NEGATIVE TEMPERATURE  
COEFFICIENT THERMISTORS –****Part 2: Sectional specification –  
Surface mount negative temperature coefficient thermistors**

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International Standard IEC 60539-2 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 2003 and Amendment 1:2010. This edition constitutes a technical revision.

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

- a) revision for the structure in accordance with ISO/IEC Directives, Part 2:2016 (seventh edition) to the extent practicable, and for harmonizing with IEC 60539-1:2016;
- b) the upper category temperatures of 175 °C, 200 °C, 250 °C, 315 °C, 400 °C in Table 1 have been added;
- c) the dimensions of 0402M in Annex A have been added.

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

FDIS	Report on voting
40/2672/FDIS	40/2680/RVD

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

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

A list of all parts in the IEC 60539 series, published under the general title *Directly heated negative temperature coefficient thermistors*, 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 "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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## DIRECTLY HEATED NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS –

### Part 2: Sectional specification – Surface mount negative temperature coefficient thermistors

#### ~~1~~ **General**

#### **1 Scope**

This part of IEC 60539 is applicable to surface mount directly heated negative temperature coefficient thermistors, typically made from transition metal oxide materials with semiconducting properties. These thermistors have metallized connecting pads or soldering strips and are intended to be mounted directly on to substrates for hybrid circuits or on to printed boards.

#### **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 60068-2-2:~~1974~~2007, *Environmental testing – Part 2-2: Tests – Tests B: Dry heat*  
~~Amendment 1 (1993)~~  
~~Amendment 2 (1994)~~

IEC 60539-2:2019

~~IEC 60068-2-14:1984~~2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*  
~~Amendment 1 (1986)~~

~~IEC 60068-2-30:1980, Environmental testing – Part 2: Tests – Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle)~~  
~~Amendment 1 (1985)~~

IEC 60068-2-58:~~1999~~2015, *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 60068-2-58:2015/AMD1:2017

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

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

IEC 60539-1:~~2002~~2016, *Directly heated negative temperature coefficient thermistors – Part 1: Generic specification*

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 the purposes of this document, the terms and definitions given in IEC 60539-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

### 4 Information to be given in a detail specification

#### 4.1 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 1.9 of the detail specification and indicated in the test schedules, for example, by an asterisk.

**NOTE** The information given in 4.2 may for convenience, be presented in tabular form.

The information in 4.2 to 4.4 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.

#### 4.2 Outline drawing and dimensions

There shall be an illustration of the thermistor as an aid to easy recognition and for comparison with others. Dimensions and their associated tolerances, which affect interchangeability and mounting, shall be given in the detail specification. 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.

Normally, the numerical values shall be given for the length, width and height of the body. When necessary, for example when a number of items are covered by a detail specification, the dimensions and their associated tolerances shall be placed in a table below the drawing.

When the configuration is other than described above, the detail specification shall state such dimensional information as will adequately describe the thermistor.

#### 4.3 Mounting

The detail specification shall give guidance on methods of mounting for normal use. Mounting for test and measurement purposes (when required) shall be in accordance with ~~4.27 of~~ IEC 60539-1:2016, 5.4.

#### 4.4 Ratings and characteristics

##### 4.4.1 Particular characteristics

Additional characteristics may be listed when they are considered necessary to specify the component adequately for design and application purposes.

##### 4.4.2 Marking

See ~~2.4 of~~ IEC 60539-1:2016, 4.3.

#### ~~1.4 Terminology~~

~~See 2.2 of IEC 60539-1.~~

### 5 Preferred ratings and characteristics

#### 5.1 Tolerances on rated zero-power resistance

Preferred values of tolerances on zero-power resistance are:

$\pm 0,5 \%$ ,  $\pm 1 \%$ ,  $\pm 2 \%$ ,  $\pm 3 \%$ ,  $\pm 5 \%$ ,  $\pm 10 \%$ .

#### 5.2 Climatic categories

The upper and lower category temperatures and the duration of the damp-heat steady-state test shall be selected from Table 1.

**Table 1 – Upper and lower category temperatures and duration of the damp heat test**

Lower category temperature °C	-55, -40, -25, -10, -5, +5
Upper category temperature °C	70, 85, 100, 105, 125, 150, 155, 175, 200, 250, 315, 400
Damp heat, steady state days	21, 42, 56

The detail specification shall prescribe the appropriate category.

### 6 Quality assessment procedures

#### ~~3.1 Primary stage of manufacture~~

~~The primary stage of manufacture is defined as the initial mixing process of ingredients.~~

#### ~~3.2 Structurally similar components~~

~~Surface mount thermistors may be grouped as structurally similar for the purpose of forming inspection lots provided that the requirements of 3.1 of IEC 60539-1 are met, with the following addition:~~

~~For the shear test and the substrate bending test, devices may be grouped if they have been made on the same production line, have the same dimensions, internal structure and external finish.~~

#### ~~3.3 Qualification approval procedures~~

~~3.3.1 The manufacturer shall comply with 3.4 of IEC 60539-1.~~

#### ~~3.4 Quality conformance inspection~~

~~Blank detail specifications associated with this specification shall prescribe the test schedule for quality conformance inspection.~~

~~This schedule shall also specify the grouping, sampling and periodicity for the lot-by-lot and periodic inspection.~~

~~Inspection levels and sampling plans shall be selected from those given in IEC 60410.~~

~~If required, more than one test schedule may be specified.~~

### ~~3.4.1 Qualification approval on the basis of the fixed sample size procedure~~

#### ~~a) Sampling~~

~~The sample shall be representative of the range of thermistors for which approval is sought. This may or may not be the complete range covered by the detail specification.~~

~~The sample shall consist of specimens having the lowest, highest and middle-rated zero-power resistance of each case size.~~

~~Per value, three spare specimens are permitted and may be used as replacements for specimens which are defective because of incidents not attributable to the manufacturer.~~

#### ~~b) Tests~~

~~The complete series of tests specified in Table 2 are required for the approval of thermistors covered by one detail specification. The tests of each group shall be carried out in the order given.~~

~~The whole sample shall be subjected to the tests of Group "0" and then divided for the other groups.~~

~~Specimens found defective during the tests of Group "0" shall not be used for the other groups.~~

~~"One defective" is counted when a thermistor has not satisfied the whole or a part of the tests of a group.~~

~~Approval is granted when the number of non-conformances does not exceed the specified number of permissible defects for each group or subgroup.~~

~~The conditions of test and performance requirements for the fixed sample size schedule shall be identical to those described in the detail specification for quality conformance inspection.~~

**Table 2 — ~~Fixed sample size test schedule for qualification approval of surface mount negative temperature coefficient thermistors~~**  
**Assessment level-EZ**

Group No.	Test	Subclause of this publication	Conditions of test and requirements	n <sup>a)</sup>	c <sup>b)</sup>			
0	Visual examination	4.3.1	See 4.3.1 to 4.3.2	90	0			
	Marking	4.3.3						
	Dimensions (gauging)	4.3.4	For requirements, see Table A.1					
	Zero-power resistance	4.4.1						
1	Dimensions (detail)	4.3.4	For requirements, see Table A.1	10	0			
	B-value or resistance ratio	4.4.2	Choice to be made in the detail specification					
	Resistance/temperature characteristic	4.4.3	Measuring temperatures to be defined in the detail specification					
	Resistance to soldering heat — dissolution of metallization	4.6	See 4.6					
2	Solderability	4.7	See 4.7.1 to 4.7.3	10	0			
	Solvent resistance of marking	4.16						
3	Resistance to soldering heat — dewetting	4.6	See 4.6.1 to 4.6.4	10	0			
4	Mounting	4.1		60	0			
	Visual examination	4.3.1						
	Zero-power resistance	4.4.1						
	4.1	Dissipation factor	4.5.1				10	0
		Thermal time constant by cooling after self-heating ( $\tau_c$ )	4.5.2					
	4.2	Shear test	4.13				10	0
		Rapid change of temperature	4.8					
		Climatic sequence	4.10					
	4.3	Damp heat, steady state	4.11				10	0
	4.4	Endurance at $\theta_2$ and $P_{max}$	4.12.1				10	0
	4.5	Endurance at upper category temperature	4.12.2				10	0
	5	Substrate bending test	4.14				10	0
<sup>a)</sup> <del>Number of specimens to be tested.</del>								
<sup>b)</sup> <del>Permissible numbers of non-conforming items.</del>								

### 3.5 — ~~Quality conformance inspection~~

#### 3.5.1 — ~~Formation of inspection lots~~

##### a) ~~Groups A and B inspection~~

~~These tests shall be carried out on a lot-by-lot basis.~~

~~A manufacturer may aggregate the current production into inspection lots subject to the following safeguards:~~

##### a) ~~the inspection lot shall consist of structurally similar thermistors (see 3.2);~~

- ~~b) for Group A the sample tested shall consist of each of the values and each of the dimensions contained in the inspection lot
 
  - ~~— in relation to their number;~~
  - ~~— with a minimum of five of any one value;~~~~
- ~~c) if there are less than five of any one value in the sample, the basis for the drawing of samples shall be agreed upon between the manufacturer and the National Supervising Inspectorate;~~
- ~~d) Group C inspection.~~

~~These tests shall be carried out on a periodic basis.~~

~~Samples shall be representative of the current production of the specified periods and shall be divided into small, medium and large sizes. In order to cover the range of approvals in any period, one rated zero power resistance value shall be tested per group of sizes. In subsequent periods, other sizes and rated zero power values in production shall be tested with the aim of covering the whole range.~~

~~3.5.2 Test schedule~~

~~The schedule for the lot by lot and periodic tests for quality conformance inspection is given in Clause 2, Table 4 of the blank detail specification.~~

~~3.5.3 Delayed delivery~~

~~When, according to the procedures of 3.7 of IEC 60539-1, re-inspection has to be made, solderability and zero power resistance shall be checked as specified in Group A and Group B inspection.~~

~~3.5.4 Assessment level~~

~~The assessment level(s) given in the blank detail specification shall preferably be selected from Tables 3 and 4.~~

**Table 3 – Lot-by-lot inspection**

Inspection subgroup <sup>d)</sup>	EZ		
	<i>IL</i> <sup>a)</sup>	<i>n</i> <sup>a)</sup>	<i>c</i> <sup>a)</sup>
A0	100 % <sup>b)</sup>		
A1	S-4	e)	0
A2	H	e)	0
B1	S-3	e)	0
B2	S-2	e)	0

<sup>a)</sup> ~~*IL* = inspection level;  
~~*n* = sample size;  
~~*c* = permissible number of non-conforming items.~~~~~~

<sup>b)</sup> ~~100 % testing shall be followed by re-inspection by sampling in order to monitor outgoing quality level by non-conforming items per million (ppm). The sampling level shall be established by the manufacturer. For the calculation of ppm values, any parametric failure shall be counted as a non-conforming item. In case one or more non-conforming items occur in a sample, this lot shall be rejected.~~

<sup>e)</sup> ~~Number to be tested: sample size as directly allotted to the code letter for *IL* in Table IIA of IEC 60410 (single sampling plan for normal inspection).~~

<sup>d)</sup> ~~The content of the inspection subgroup is described in Clause 2 of the relevant blank detail specification.~~