IEC 60539-1

Edition 3.0 2016-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Directly heated negative temperature coefficient thermistors – Part 1: Generic specification

Thermistances à coefficient de température négatif à chauffage direct – Partie 1: Spécification générique

IEC 60539-1:2016-04(en-fr)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue
The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org
The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

A propos de l'IEC
La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC
Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue
Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub
La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,…). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished
Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org
Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 15 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary
65 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc
Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

IEC 60539-1

Edition 3.0 2016-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Directly heated negative temperature coefficient thermistors – Part 1: Generic specification

Thermistances à coefficient de température négatif à chauffage direct – Partie 1: Spécification générique

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 31.040.30

ISBN 978-2-8322-3307-8

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

DIRECTLY HEATED NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS –

Part 1: Generic specification

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60539-1 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 2008. This edition constitutes a technical revision. Tables, figures and references have been revised.

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

FDIS	Report on voting
40/2430/FDIS	40/2457/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 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 publication will remain unchanged until the stability date indicated on the IEC website 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.

The contents of the corrigendum of September 2017 have been included in this copy.

DIRECTLY HEATED NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS –

Part 1: Generic specification

1 Scope

This part of IEC 60539 is applicable to directly heated negative temperature coefficient thermistors, typically made from transition metal oxide materials with semiconducting properties.

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.

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

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

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

IEC 60068-2-11, *Basic environmental testing procedures – Part 2-11: Tests – Test Ka: Salt mist*

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-17, *Basic environmental testing procedures – Part 2-17: Tests – Test Q: Sealing*

IEC 60068-2-20, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

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 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-31, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60068-2-38, *Environmental testing – Part 2-38: Tests – Test Z/AD: Composite temperature/humidity cyclic test*

IEC 60068-2-45:1980, *Basis Environmental testing procedures – Part 2-45: Tests – Test XA and guidance: Immersion in cleaning solvents*
IEC 60068-2-45:1980/AMD1:1993

IEC 60068-2-52, *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*

IEC 60068-2-54, *Environmental testing – Part 2-54: Tests – Test Ta: Solderability testing of electronic components by the wetting balance method*

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 60068-2-69, *Environmental testing – Part 2-69: Tests – Test Te: Solderability testing of electronic components for surface mounting devices (SMD) by the wetting balance method*

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

IEC 60294, *Measurement of the dimensions of a cylindrical component with axial terminations*

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

IEC 60717, *Method for the determination of the space required by capacitors and resistors with unidirectional terminations*

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*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
type
group of products having similar design features manufactured by the same techniques and falling within the manufacturer's usual range of ratings for these products

Note 1 to entry: Mounting accessories are ignored, provided they have no significant effect on the test results.

Note 2 to entry: Ratings cover the combination of

- electrical ratings,
- sizes, and
- climatic category.

Note 3 to entry: The limits of the range of ratings should be given in the detail specification.

3.2
style
variation within a type having specific nominal dimensions and characteristics

3.3
thermistor
thermally sensitive semiconducting resistor whose primary function is to exhibit an important change in electrical resistance with a change in body temperature

3.4
negative temperature coefficient thermistor
NTC thermistor
thermistor in which the resistance decreases with increasing temperature

Note 1 to entry: In general, the term 'NTC thermistor' is used.

3.5
directly heated negative temperature coefficient thermistor
thermistor which obtains its resistance variation by the changes of physical conditions.

Note 1 to entry: Physical conditions include the current through the thermistor, ambient temperature, humidity, wind velocity, gas, etc.

3.6
indirectly heated negative temperature coefficient thermistor
thermistor which obtains its resistance variation primarily by the change of temperature of the thermistor, due to the change of a current through a separate heater which is in close contact with, but electrically insulated from, the thermistor element

Note 1 to entry: The temperature of the thermistor can also be changed by the changes of physical conditions such as current through the thermistor element itself, ambient temperature, humidity, wind velocity, gas, etc.

Note 2 to entry: This term is for information only.

3.7
positive temperature coefficient thermistor
PTC thermistor
thermistor in which the resistance increases with increasing temperature

Note 1 to entry: In general, the term 'PTC thermistor' is used.

Note 2 to entry: This term is for information only.

3.8
thermistor with wire terminations
thermistor provided with wire terminations

3.9
thermistor without wire terminations
thermistor provided only with two metallized faces, to be used as electrical contacts

Note 1 to entry: This term is for information only.

3.10
insulated thermistor
thermistor coated with materials such as resin, glass or ceramic, capable of meeting the requirements of the insulation resistance and voltage proof tests when specified in the test schedule

3.11
non-insulated thermistor
thermistor with or without coating materials for surfacing of elements but not intended to meet the requirements of the insulation resistance and voltage proof tests when specified in the test schedule

3.12
surface mount thermistor
thermistor whose small dimensions and nature or shape of terminations make it suitable for use in hybrid circuits and on printed board

3.13
assembled thermistor
probe
thermistor encapsulated in different materials such as tubes, plastic and metal housing and/or assembled with cables and/or connectors

Note 1 to entry: This term is for information only.

3.14
thermistor for sensing
thermistor which responds to temperature changes and therefore is used for temperature sensing and control

3.15
inrush current limiting thermistor
thermistor which limits the inrush current just after switching on the power

3.16
residual resistance
<inrush current-limiting thermistors> value of the d.c. resistance of a thermistor when its thermal stability is reached with the maximum current passing

Note 1 to entry: This term is for information only.

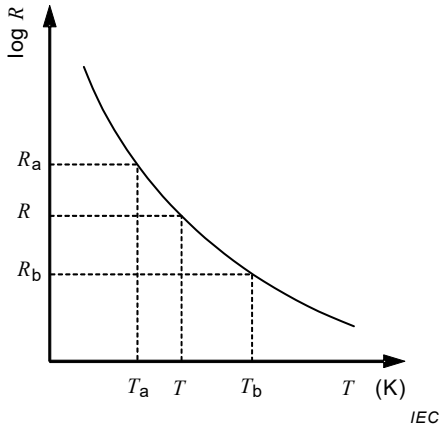
3.17
maximum permissible capacitance
<inrush current-limiting thermistors> maximum permissible capacitance value of a capacitor which can be connected to a thermistor under loading

3.18
zero-power resistance
R_T
value of the d.c. resistance of a thermistor, when measured at a specified temperature, under such conditions that the change in resistance due to the internal generation of heat is negligible with respect to the total error of measurement

3.19
nominal zero-power resistance
nominal value of zero-power resistance at the standard reference temperature of 25 °C, unless otherwise specified

3.20
resistance-temperature characteristic
relationship between the zero-power resistance and the body temperature of a thermistor

Note 1 to entry: Typical resistance-temperature characteristic for NTC thermistors is shown in Figure 1.



NOTE Slightly downward convexed curve when the temperature range is large.

Figure 1 – Typical resistance-temperature characteristic for NTC thermistors

Note 2 to entry: The resistance law follows approximately the formula:

$$R = R_a \times e^{B\left(\frac{1}{T} - \frac{1}{T_a}\right)}$$

where

R is the zero-power resistance (Ω) at absolute temperature T (K);

R_a is the zero-power resistance (Ω) at absolute temperature T_a (K);

B is the thermal sensitivity index (see 3.22).

This formula is only applicable for representing the resistance variation over a restricted temperature range. For more precise representation of the R/T-curve, a resistance/temperature relation should be specified in tabulated form in the detail specification.

3.21
resistance ratio
ratio of the zero-power resistance of a thermistor measured at the reference temperature of 25 °C to that measured at 85 °C, or at such other pairs of temperatures as may be prescribed in the detail specification

3.22
***B*-value**
index of the thermal sensitivity expressed by the formula

$$B = [(T_a \times T_b)/(T_b - T_a)] \times \ln(R_a/R_b)$$

where

B is the B-value (K);

R_a is the zero-power resistance (Ω) at temperature T_a (K);

R_b is the zero-power resistance (Ω) at temperature T_b (K)

Note 1 to entry: The B-value can also be expressed by the following formula (common logarithm):

$$B = 2{,}303 \times [(T_a \times T_b)/(T_b - T_a)] \times \log(R_a/R_b).$$

Note 2 to entry: The preferred values for T_a and T_b are 298,15 K and 358,15 K, respectively. These values are equivalent to +25 °C and +85 °C, respectively.

Note 3 to entry: Where the detail specification prescribes that the B-value should be measured at other temperatures, the specified values (in kelvins) shall be used for T_a and T_b in the calculation in place of the preferred values and the B-value may be expressed by $B_{a/b}$.