

# 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**



**THIS PUBLICATION IS COPYRIGHT PROTECTED**  
**Copyright © 2008 IEC, Geneva, Switzerland**

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester.  
If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de la CEI ou du Comité national de la CEI du pays du demandeur.  
Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

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

Tel.: +41 22 919 02 11  
Fax: +41 22 919 03 00  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://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.

#### Useful links:

IEC publications search - [www.iec.ch/searchpub](http://www.iec.ch/searchpub)

The advanced search enables you 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It also gives information on projects, replaced and withdrawn publications.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](http://webstore.iec.ch/justpublished)

Stay up to date on all new IEC publications. Just Published details all new publications released. Available on-line and also once a month by email.

Electropedia - [www.electropedia.org](http://www.electropedia.org)

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary (IEV) on-line.

Customer Service Centre - [webstore.iec.ch/csc](http://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](mailto:csc@iec.ch).

### A propos de la CEI

La Commission Electrotechnique Internationale (CEI) 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 CEI

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

#### Liens utiles:

Recherche de publications CEI - [www.iec.ch/searchpub](http://www.iec.ch/searchpub)

La recherche avancée vous permet de trouver des publications CEI 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.

Just Published CEI - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Restez informé sur les nouvelles publications de la CEI. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - [www.electropedia.org](http://www.electropedia.org)

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (VEI) en ligne.

Service Clients - [webstore.iec.ch/csc](http://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](mailto:csc@iec.ch).

# 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

PRICE CODE  
CODE PRIX



ICS 31.040.30

ISBN 978-2-88912-902-7

**Warning! Make sure that you obtained this publication from an authorized distributor.  
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

## CONTENTS

FOREWORD.....	4
1 General.....	6
1.1 Scope.....	6
1.2 Normative references .....	6
2 Technical data.....	8
2.1 Units, symbols and terminology.....	8
2.2 Terms and definitions .....	8
2.3 Preferred values.....	16
2.4 Marking.....	16
3 Quality assessment procedures.....	17
3.1 General.....	17
3.2 Primary stage of manufacture.....	17
3.3 Structurally similar components.....	17
3.4 Qualification approval procedures .....	18
3.5 Quality conformance inspection.....	18
3.6 Certified test records of released lots.....	18
3.7 Delayed delivery.....	19
3.8 Release for delivery under qualification approval before the completion of group B tests.....	19
3.9 Alternative test methods.....	19
3.10 Unchecked parameters.....	19
4 Test and measurement procedures.....	19
4.1 General.....	19
4.2 Standard atmospheric conditions for testing .....	19
4.3 Drying and recovery .....	20
4.4 Mounting (for surface mount thermistors only).....	20
4.5 Visual examination and check of dimensions.....	21
4.6 Zero-power resistance.....	22
4.7 <i>B</i> -value or resistance ratio.....	22
4.8 Insulation resistance (for insulated types only) .....	23
4.9 Voltage proof (for insulated types only) .....	26
4.10 Resistance/temperature characteristic.....	26
4.11 Dissipation factor ( $\delta$ ).....	26
4.12 Thermal time constant by ambient temperature change ( $\tau_a$ ) .....	28
4.13 Thermal time constant by cooling after self-heating ( $\tau_c$ ).....	28
4.14 Robustness of terminations (not applicable to surface mount thermistors).....	29
4.15 Resistance to soldering heat .....	30
4.16 Solderability .....	31
4.17 Rapid change of temperature .....	32
4.18 Vibration.....	32
4.19 Bump .....	33
4.20 Shock.....	33
4.21 Free fall (if specified in the detail specification) .....	33
4.22 Thermal shock (if specified in the detail specification) .....	34
4.23 Cold (if required by the sectional specification) .....	34

4.24	Dry heat (if required by the sectional specification)	34
4.25	Damp heat, steady state	35
4.26	Endurance	35
4.27	Shear (adhesion) test	40
4.28	Substrate bending test	40
4.29	Component solvent resistance	41
4.30	Solvent resistance of marking	41
4.31	Salt mist (if required by the sectional specification)	41
4.32	Sealing (if required by the sectional specification)	41
4.33	Composite temperature/humidity cycle (if required by the sectional specification)	41
	Annex A (normative) Interpretation of sampling plans and procedures as described in IEC 60410 for use within the IEC quality assessment system for electronic components (IECQ)	43
	Annex B (normative) Rules for the preparation of detail specifications for capacitors and resistors for electronic equipment	44
	Annex C (informative) Typical examples of mountings for measurements of directly heated thermistors	45
	Figure 1 – Typical resistance-temperature characteristic for NTC thermistors	10
	Figure 2 – Decreased power dissipation curve	12
	Figure 3 – Maximum current derating	14
	Figure 4 – Zero-power resistance measuring basic circuit	22
	Figure 5 – Test method 1	23
	Figure 6 – Test method 2	24
	Figure 7 – Test method 2	24
	Figure 8 – Test method 3	25
	Figure 9 – Test method 4	25
	Figure 10 – Example of test chamber	27
	Figure 11 – Dissipation factor measuring circuit	27
	Figure 12 – Thermal time constant measuring circuit	29
	Figure 13 – Endurance at room temperature with $I_{\max 25}$ evaluating circuit	36
	Figure 14 – Maximum permissible capacitance test circuit (method 1)	39
	Figure 15 – Maximum permissible capacitance test circuit (method 2)	39
	Figure C.1 – Mounting for measurements of surface mount thermistors	45
	Table 1 – Upper and lower category temperatures and duration of the damp-heat test	16
	Table 2 – Tensile force	30

## 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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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 second edition cancels and replaces the first edition published in 2002 and constitutes a minor revision related to tables, figures and references.

This bilingual version (2012-01) corresponds to the monolingual English version, published in 2008-02.

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

FDIS	Report on voting
40/1878A/FDIS	40/1895/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.

The French version of this standard has not been voted upon.

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

IEC 60539 consists of the following parts, under the general title *Directly heated negative temperature coefficient thermistors*:

Part 1: Generic specification

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

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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.

Withdrawing

# DIRECTLY HEATED NEGATIVE TEMPERATURE COEFFICIENT THERMISTORS –

## Part 1: Generic specification

### 1 General

#### 1.1 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.

#### 1.2 Normative references

The following referenced documents are indispensable for the application 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 60027-1, *Letter symbols to be used in electrical technology – Part 1: General*

IEC 60050, *International Electrotechnical Vocabulary (IEV)*

IEC 60062, *Marking codes for resistors and capacitors*

IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*  
Amendment 1 (1992)

IEC 60068-2-1:2007, *Environmental testing – Part 2-1: Tests – Tests A: Cold*

IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Tests B: Dry heat*

IEC 60068-2-6:1995, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-11:1981, *Environmental testing – Part 2-11: Tests – Test Ka: Salt mist*

IEC 60068-2-14:1984, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

Amendment 1 (1986)

IEC 60068-2-17:1994, *Environmental testing – Part 2-17: Tests – Test Q: Sealing*

IEC 60068-2-20:1979, *Environmental testing – Part 2-20: Tests – Test T: Soldering*  
Amendment 2 (1987)

IEC 60068-2-21:2006, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-27:1987, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-29:1987, *Environmental testing – Part 2-29: Tests – Test Eb and guidance: Bump*

IEC 60068-2-32:1975, *Environmental testing – Part 2-32: Tests – Test Ed: Free fall*  
Amendment 2 (1990)

IEC 60068-2-38:1974, *Environmental testing – Part 2-38: Tests – Test Z/AD: Composite temperature/humidity cyclic test*

IEC 60068-2-45:1980, *Environmental testing – Part 2-45: Tests – Test XA and guidance: Immersion in cleaning solvents*  
Amendment 1 (1993)

IEC 60068-2-52:1996, *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*

IEC 60068-2-54:2006, *Environmental testing – Part 2-54: Tests – Test Ta: Solderability testing of electronic components by the wetting balance method*

IEC 60068-2-58:2004, *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 60068-2-69:2007, *Environmental testing – Part 2-69: Tests – Test Te: Solderability testing of electronic components for surface mounting devices (SMD) by the wetting balance method*

IEC 60068-2-78:2001, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

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

IEC 60410, *Sampling plans and procedures for inspection by attributes*

IEC 60617, *Graphical symbols for diagrams*

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*

IECQ 001002-3, *IEC Quality Assessment System for Electronic Components (IECQ) – Rules of procedure – Part 3: Approval procedures*

ISO 1000, *SI units and recommendations for the use of their multiples and of certain other units*