
Polprevodniški elementi - Mikroelektromehanski elementi - 11. del: Preskusna metoda za koeficiente linearnega toplotnega raztezanja samostojnih materialov za mikroelektromehanske sisteme (IEC 62047-11:2013)

Semiconductor devices - Micro-electromechanical devices - Part 11: Test method for coefficients of linear thermal expansion of free-standing materials for micro-electromechanical systems

Halbleiterbauelemente - Bauelemente der Mikrosystemtechnik - Teil 11: Prüfverfahren für lineare thermische Ausdehnungskoeffizienten für freistehende Werkstoffe der Mikrosystemtechnik

Dispositifs à semiconducteurs - Dispositifs microélectromécaniques - Partie 11: Méthode d'essai pour les coefficients de dilatation thermique linéaire des matériaux autonomes pour systèmes microélectromécaniques

Ta slovenski standard je istoveten z: EN 62047-11:2013

ICS:

31.080.01	Polprevodniški elementi (naprave) na splošno	Semiconductor devices in general
-----------	--	----------------------------------

SIST EN 62047-11:2014**en**

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 62047-11:2014](#)

<https://standards.iteh.ai/catalog/standards/sist/15195584-d448-4b77-b17e-7b269645d503/sist-en-62047-11-2014>

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 62047-11

September 2013

ICS 31.080.99

English version

**Semiconductor devices -
Micro-electromechanical devices -
Part 11: Test method for coefficients of linear thermal expansion
of free-standing materials for micro-electromechanical systems
(IEC 62047-11:2013)**

Dispositifs à semiconducteurs -
Dispositifs microélectromécaniques -
Partie 11: Méthode d'essai pour les
coefficients de dilatation thermique
linéaire des matériaux autonomes pour
systèmes microélectromécaniques
(CEI 62047-11:2013)

Halbleiterbauelemente -
Bauelemente der Mikrosystemtechnik -
Teil 11: Prüfverfahren für lineare
thermische Ausdehnungskoeffizienten für
freistehende Werkstoffe der
Mikrosystemtechnik
(IEC 62047-11:2013)

(standards.iteh.ai)

SIST EN 62047-11:2014

This European Standard was approved by CENELEC on 2013-08-21. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B - 1000 Brussels

Foreword

The text of document 47F/154/FDIS, future edition 1 of IEC 62047-11, prepared by IEC/TC 47F "Microelectromechanical systems" of IEC/TC 47 "Semiconductor devices" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62047-11:2013.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2014-05-21
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2016-08-21

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 62047-11:2013 was approved by CENELEC as a European Standard without any modification.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 62047-11:2014](https://standards.iteh.ai/catalog/standards/sist/15195584-d448-4b77-b17e-7b269645d503/sist-en-62047-11-2014)

<https://standards.iteh.ai/catalog/standards/sist/15195584-d448-4b77-b17e-7b269645d503/sist-en-62047-11-2014>

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 62047-3	-	Semiconductor devices - Micro-electromechanical devices - Part 3: Thin film standard test piece for tensile-testing	EN 62047-3	-

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 62047-11:2014](https://standards.iteh.ai/catalog/standards/sist/15195584-d448-4b77-b17e-7b269645d503/sist-en-62047-11-2014)

<https://standards.iteh.ai/catalog/standards/sist/15195584-d448-4b77-b17e-7b269645d503/sist-en-62047-11-2014>

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 62047-11:2014](#)

<https://standards.iteh.ai/catalog/standards/sist/15195584-d448-4b77-b17e-7b269645d503/sist-en-62047-11-2014>



IEC 62047-11

Edition 1.0 2013-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Semiconductor devices – Micro-electromechanical devices –
Part 11: Test method for coefficients of linear thermal expansion of free-standing
materials for micro-electromechanical systems**

**Dispositifs à semiconducteurs – Dispositifs microélectromécaniques –
Partie 11: Méthode d'essai pour les coefficients de dilatation thermique linéaire
des matériaux autonomes pour systèmes microélectromécaniques**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

R

ICS 31.080.99

ISBN 978-2-8322-0965-3

**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.....	3
1 Scope.....	5
2 Normative References	5
3 Symbols and designations	5
4 Test piece	6
4.1 General	6
4.2 Shape of test piece	6
4.3 Test piece thickness.....	6
4.4 In-plane type test piece	7
4.5 Out-of-plane type test piece	7
5 Testing method and test apparatus.....	7
5.1 Measurement principle	7
5.1.1 General	7
5.1.2 In-plane method	8
5.1.3 Out-of-plane method.....	8
5.2 Test apparatus	9
5.2.1 General	9
5.2.2 In-plane method	9
5.2.3 Out-of-plane method.....	9
5.3 Temperature measurement.....	9
5.4 In-plane test piece handling.....	9
5.5 Thermal strain measurement.....	10
5.6 Heating speed	10
5.7 Data analysis	10
5.7.1 General	10
5.7.2 Terminal-based calculation	10
5.7.3 Slope calculation by linear least squares method.....	10
6 Test report.....	10
Annex A (informative) Test piece fabrication	12
Annex B (informative) Test piece handling example	13
Annex C (informative) Test piece releasing process.....	14
Annex D (informative) Out-of-plane test setup and test piece example.....	15
Annex E (informative) Data analysis example in in-plane test method	16
Annex F (informative) Data analysis example in out-of-plane test method	17
Bibliography.....	19
Figure 1 – Thin film test piece.....	6
Figure 2 – CLTE measurement principles.....	8
Figure A.1 – Schematic test piece fabrication process	12
Figure B.1 – Auxiliary jigs and a specimen example.....	13
Figure C.1 – Schematic illustration showing the test piece releasing process.....	14
Figure D.1 – Example of test setup and test piece	15
Figure E.1 – Example of CLTE measurement with an aluminium test piece	16
Figure F.1 – Example of CLTE measurement with a gold test piece	18
Table 1 – Symbols and designations.....	5

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SEMICONDUCTOR DEVICES –
MICRO-ELECTROMECHANICAL DEVICES –**

**Part 11: Test method for coefficients of linear thermal expansion
of free-standing materials for micro-electromechanical systems**

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 62047-11 has been prepared by subcommittee 47F: Micro-electromechanical systems, of IEC technical committee 47: Semiconductor devices.

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

FDIS	Report on voting
47F/154/FDIS	47F/161/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 62047 series, published under the general title *Semiconductor devices – Micro-electromechanical devices*, 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 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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST EN 62047-11:2014](#)

<https://standards.iteh.ai/catalog/standards/sist/15195584-d448-4b77-b17e-7b269645d503/sist-en-62047-11-2014>

SEMICONDUCTOR DEVICES – MICRO-ELECTROMECHANICAL DEVICES –

Part 11: Test method for coefficients of linear thermal expansion of free-standing materials for micro-electromechanical systems

1 Scope

This part of IEC 62047 specifies the test method to measure the linear thermal expansion coefficients (CLTE) of thin free-standing solid (metallic, ceramic, polymeric etc.) micro-electro-mechanical system (MEMS) materials with length between 0,1 mm and 1 mm and width between 10 μm and 1 mm and thickness between 0,1 μm and 1 mm, which are main structural materials used for MEMS, micromachines and others. This test method is applicable for the CLTE measurement in the temperature range from room temperature to 30 % of a material's melting temperature.

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.

SIST EN 62047-11:2014
<http://standards.iteh.ai/catalog/standards/sist-en-62047-11-2014>

IEC 62047-3, *Semiconductor devices – Micro-electromechanical devices – Part 3: Thin film standard test piece for tensile testing*

3 Symbols and designations

Symbols and corresponding designations are given in Table 1.

Table 1 – Symbols and designations

Symbol	Unit	Designation
g	μm	Gauge length
L_0	μm	Initial length of a test piece
L_T	μm	Length of a test piece at temperature T
T	$^{\circ}\text{C}$	Temperature
t	μm	Thickness of a test piece
w	μm	Width of a test piece
α_{av}	$1/^{\circ}\text{C}$	Average coefficient of thermal expansion of a test piece
α_S	$1/^{\circ}\text{C}$	Average coefficient of thermal expansion of a substrate
δ_T	μm	Thermal deformation
ε_T	1	Thermal strain