

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE



---

**Device embedded substrate –  
Part 1-1: Generic specification – Test methods**

**Substrat avec appareil(s) intégré(s) –  
Partie 1-1: Spécification générique – Méthodes d'essai**



## THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2015 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 l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC 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.

#### IEC Catalogue - [webstore.iec.ch/catalogue](http://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](http://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](http://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](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 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

#### IEC Glossary - [std.iec.ch/glossary](http://std.iec.ch/glossary)

More than 60 000 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](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 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](http://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](http://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](http://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](http://www.electropedia.org)

Le premier dictionnaire en ligne 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 15 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

#### Glossaire IEC - [std.iec.ch/glossary](http://std.iec.ch/glossary)

Plus de 60 000 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](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



**Device embedded substrate –  
Part 1-1: Generic specification – Test methods**

**Substrat avec appareil(s) intégré(s) –  
Partie 1-1: Spécification générique – Méthodes d'essai**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

ICS 31.180; 31.190

ISBN 978-2-8322-2674-2

**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.....	5
1 Scope.....	7
2 Normative references .....	7
3 Terms, definitions and abbreviations .....	7
3.1 Terms and definitions.....	7
3.2 Abbreviations.....	7
4 Test methods.....	8
4.1 General.....	8
4.2 Visual inspection and micro-sectioning.....	8
4.2.1 General .....	8
4.2.2 Visual inspection .....	8
4.2.3 Micro-sectioning .....	8
4.2.4 Lack of conductor and residue of conductor.....	10
4.2.5 Land dimension and land width (annular ring).....	10
4.3 Electrical tests .....	13
4.3.1 Conductor resistance.....	13
4.3.2 Through hole and build-up via .....	14
4.3.3 Withstanding current of embedded device connection.....	15
4.3.4 Withstanding voltage in embedded boards.....	17
4.3.5 Insulation resistance.....	19
4.3.6 Conduction and insulation of circuit.....	20
4.4 Mechanical tests .....	20
4.4.1 Pulling strength of conductor.....	20
4.4.2 Pulling strength of un-plated through hole.....	21
4.4.3 Pulling strength of plated through hole.....	22
4.4.4 Pulling strength of pad of land pattern .....	22
4.4.5 Adhesivity of plated foil.....	23
4.4.6 Adhesivity of solder resist and symbol mark.....	24
4.4.7 Hardness of painted film (solder resist and symbol mark).....	28
4.5 Environmental tests .....	29
4.5.1 General .....	29
4.5.2 Vapour phase thermal shock .....	30
4.5.3 High temperature immersion tests .....	30
4.5.4 Resistance to humidity.....	31
4.6 Mechanical environmental test – Resistance to migration .....	34
4.6.1 General .....	34
4.6.2 Equipment .....	34
4.6.3 Specimen .....	35
4.6.4 Test condition .....	35
5 Shipping inspection .....	36
5.1 General.....	36
5.2 Electrical test.....	37
5.2.1 General .....	37
5.2.2 Test of conductor pattern not connected to an embedded component.....	38
5.2.3 Test on the pattern having a passive component and a conductor pattern.....	40

5.2.4	Test of a circuit having both active component(s) and a conductor pattern.....	43
5.2.5	Test of a circuit having connections of both individual passive component(s) and conductor pattern.....	46
5.2.6	Test of a circuit having an embedded component which cannot be checked from the surface and a conductor pattern.....	47
5.3	Internal transparent test.....	47
5.4	Visual test.....	47
Annex A (informative) Related test methods .....		49
Bibliography.....		52
Figure 1 – Measuring items of the micro-sectioned through hole structure .....		9
Figure 2 – Measuring items of the micro-sectioned device embedded board with build-up structure .....		9
Figure 3 – Measurement of land dimension.....		11
Figure 4 – Build-up land measurement.....		12
Figure 5 – Conductor resistance measurement .....		14
Figure 6 – Relationship between current, conductor width and thickness and temperature rise .....		17
Figure 7 – Adhesivity of plated film .....		24
Figure 8 – Single cutting tool .....		25
Figure 9 – Cutter knife .....		25
Figure 10 – Multiple blade cutter.....		26
Figure 11 – Equal-distance spacer with guide .....		26
Figure 12 – Cutting using a single cutting tool or a cutting knife.....		27
Figure 13 – Cross-cut test.....		28
Figure 14 – Coated film hardness test.....		29
Figure 15 – Temperature and humidity cycles .....		33
Figure 16 – Device embedded board for shipping inspection.....		36
Figure 17 – Typical circuit construction of device embedded board.....		37
Figure 18 – Examples of evaluation levels of electrical test.....		39
Figure 19 – Circuit construction not connected to embedded component .....		39
Figure 20 – Circuit construction which is capable of independent check.....		40
Figure 21 – Circuit construction for parallel connection of passive components.....		42
Figure 22 – Circuit construction for series connection of passive components.....		43
Figure 23 – Circuit construction of embedded diode.....		44
Figure 24 – Circuit construction of transistor circuit.....		44
Figure 25 – Circuit construction of a conductor pattern with embedded IC and LSI .....		45
Figure 26 – Circuit construction composed of a passive component and an active component.....		46
Figure 27 – Circuit construction of embedded components having no connection terminal on the surface .....		47
Table 1 – Test items, characteristics and observations of micro-sectioned specimens .....		9
Table 2 – Test method for coplanarity around the land pattern .....		12
Table 3 – Characteristics and test methods for conductor resistance .....		15

Table 4 – Withstanding current and test methods.....	16
Table 5 – Withstanding voltage and test methods .....	18
Table 6 – Criteria and test methods for insulation resistance .....	20
Table 7 – Characteristics and test method of pulling strength of conductor .....	21
Table 8 – Dimensions of land, hole and conductor .....	22
Table 9 – Characteristics and test methods of pulling strength of plated through hole .....	22
Table 10 – Specification and test method of pad pulling strength of land pattern.....	23
Table 11 – High and low temperature characteristics and tests .....	30
Table 12 – Thermal shock characteristics and test methods.....	30
Table 13 – Thermal shock (high temperature immersion test) .....	31
Table 14 – Measuring environment .....	31
Table 15 – Thermal shock (high temperature immersion tests).....	31
Table 16 – Resistance to humidity characteristics and test methods .....	34
Table 17 – Resistance to migration characteristics and test methods.....	35
Table 18 – Applicable items of shipping inspection .....	37
Table A.1 – Related test methods .....	49

Currently in preview, click buy full version

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## DEVICE EMBEDDED SUBSTRATE –

## Part 1-1: Generic specification – Test methods

## 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 62878-1-1 has been prepared by IEC technical committee 91: Electronics assembly technology.

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

FDIS	Report on voting
91/1248/FDIS	91/1260/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.

A list of all parts in the IEC 62878, published under the general title *Device embedded substrate*, 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.

**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.

## DEVICE EMBEDDED SUBSTRATE –

### Part 1-1: Generic specification – Test methods

#### 1 Scope

This part of IEC 62878 specifies the test methods of passive and active device embedded substrates. The basic test methods of printed wiring substrate materials and substrates themselves are specified in IEC 61189-3.

This part of IEC 62878 is applicable to device embedded substrates fabricated by use of organic base material, which include for example active or passive devices, discrete components formed in the fabrication process of electronic wiring board, and sheet formed components.

The IEC 62878 series neither applies to the re-distribution layer (RDL), nor to the electronic modules defined as an M-type business model in IEC 62421.

#### 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 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

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

IEC 60194, *Printed board design, manufacture and assembly – Terms and definitions*

IEC 61189-3, *Test methods for electrical materials, printed boards and other interconnection structures and assemblies – Part 3: Test methods for interconnection structures (printed boards)*

IEC TS 62878-2-4:2015, *Device embedded substrate – Part 2-4 – Guidelines – Test element groups (TEG)*

#### 3 Terms, definitions and abbreviations

##### 3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60194 apply.

##### 3.2 Abbreviations

AABUS as agreed between user and supplier

AOI automated optical inspection

LSI large scale integration