

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Semiconductor devices – Mechanical and climatic test methods –
Part 20: Resistance of plastic encapsulated SMDs to the combined effect of
moisture and soldering heat**

**Dispositifs à semiconducteurs – Méthodes d’essais mécaniques
et climatiques –
Partie 20: Résistance des CMS à boîtier plastique à l’effet combiné
de l’humidité et de la chaleur de brasage**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2020 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
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 corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

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 It also gives information on projects, replaced and withdrawn publications.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 once a month by email.

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: sales@iec.ch.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 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.

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.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

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 une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

67 000 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.

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Semiconductor devices – Mechanical and climatic test methods –
Part 20: Resistance of plastic encapsulated SMDs to the combined effect of
moisture and soldering heat**

**Dispositifs à semiconducteurs – Méthodes d'essais mécaniques
et climatiques –
Partie 20: Résistance des CMS à boîtier plastique à l'effet combiné
de l'humidité et de la chaleur de brasage**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 31.080.01

ISBN 978-2-8322-8727-9

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 Scope	6
2 Normative references	6
3 Terms and definitions	6
4 General description	7
5 Test apparatus and materials	7
5.1 Humidity chamber	7
5.2 Reflow soldering apparatus	8
5.3 Holder	8
5.4 Wave-soldering apparatus	8
5.5 Solvent for vapour-phase reflow soldering	8
5.6 Flux	8
5.7 Solder	8
6 Procedure	9
6.1 Initial measurements	9
6.1.1 Visual inspection	9
6.1.2 Electrical measurement	9
6.1.3 Internal inspection by acoustic tomography	9
6.2 Drying	9
6.3 Moisture soak	9
6.3.1 General	9
6.3.2 Conditions for non-dry-packed SMDs	9
6.3.3 Moisture soak for dry-packed SMDs	10
6.4 Soldering heat	11
6.4.1 General	11
6.4.2 Method of heating by infrared convection or convection reflow soldering	12
6.4.3 Method of heating by vapour-phase reflow soldering	13
6.4.4 Method of heating by wave-soldering	13
6.5 Recovery	14
6.6 Final measurements	15
6.6.1 Visual inspection	15
6.6.2 Electrical measurement	15
6.6.3 Internal inspection by acoustic tomography	15
7 Information to be given in the relevant specification	15
Annex A (informative) Details and description of test method on resistance of plastic encapsulated SMDs to the combined effect of moisture and soldering heat	17
A.1 Description of moisture soak	17
A.1.1 Guidance for moisture soak	17
A.1.2 Considerations on which the condition of moisture soak is based	17
A.2 Procedure for moisture content measurement	22
A.3 Soldering heat methods	23
A.3.1 Temperature profile of infrared convection and convection reflow soldering	23
A.3.2 Temperature profile of vapour-phase soldering	25
A.3.3 Heating method by wave-soldering	26

Figure 1 – Method of measuring the temperature profile of a specimen.....	8
Figure 2 – Heating by wave-soldering	14
Figure A.1 – Process of moisture diffusion at 85 °C, 85 % RH.....	18
Figure A.2 – Definition of resin thickness and the first interface	18
Figure A.3 – Moisture soak time to saturation at 85 °C as a function of resin thickness.....	18
Figure A.4 – Temperature dependence of saturated moisture content of resin	19
Figure A.5 – Dependence of moisture content of resin at the first interface on resin thickness under various soak conditions	20
Figure A.6 – Dependence of moisture content of resin at the first interface on resin thickness related to method A of moisture soak	20
Figure A.7 – Dependence of the moisture content of resin at the first interface on resin thickness related to method B of moisture soak	21
Figure A.8 – Dependence of moisture content of resin at the first interface on resin thickness related to condition B2 of method B of moisture soak	22
Figure A.9 – Temperature profile of infrared convection and convection reflow soldering for Sn-Pb eutectic assembly	23
Figure A.10 – Temperature profile of infrared convection and convection reflow soldering for lead-free assembly	24
Figure A.11 – Classification profile.....	25
Figure A.12 – Temperature profile of vapour-phase soldering (condition II-A)	25
Figure A.13 – Immersion method into solder bath	26
Figure A.14 – Relation between the infrared convection reflow soldering and wave-soldering.....	27
Figure A.15 – Temperature in the body of the SMD during wave-soldering.....	27
Table 1 – Moisture soak conditions for non-dry-packed SMDs	9
Table 2 – Moisture soak conditions for dry-packed SMDs (method A)	10
Table 3 – Moisture soak conditions for dry-packed SMDs (method B)	11
Table 4 – SnPb eutectic process – Classification reflow temperatures (T_C)	12
Table 5 – Pb-free process – Classification reflow temperatures (T_C)	13
Table 6 – Heating condition for vapour-phase soldering.....	13
Table 7 – Immersion conditions for wave-soldering	14
Table A.1 – Comparison of actual storage conditions and equivalent moisture soak conditions before soldering heat	19
Table A.2 – Classification profiles	24

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SEMICONDUCTOR DEVICES –
MECHANICAL AND CLIMATIC TEST METHODS –****Part 20: Resistance of plastic encapsulated SMDs to
the combined effect of moisture and soldering heat**

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 60749-20 has been prepared by IEC technical committee 47: Semiconductor devices.

This third edition cancels and replaces the second edition published in 2008. This edition constitutes a technical revision.

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

- a) incorporation of a technical corrigendum to IEC 60749-20:2008 (second edition);
- b) inclusion of new Clause 3;
- c) inclusion of explanatory notes.

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

FDIS	Report on voting
47/2634/FDIS	47/2646/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 60749 series, published under the general title *Semiconductor devices – Mechanical and climatic test methods*, 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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

SEMICONDUCTOR DEVICES – MECHANICAL AND CLIMATIC TEST METHODS –

Part 20: Resistance of plastic encapsulated SMDs to the combined effect of moisture and soldering heat

1 Scope

This part of IEC 60749 provides a means of assessing the resistance to soldering heat of semiconductors packaged as plastic encapsulated surface mount devices (SMDs). This test is destructive.

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 60068-2-20:2008, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60749-3, *Semiconductor devices – Mechanical and climatic test methods – Part 3: External visual examination*

IEC 60749-30, *Semiconductor devices – Mechanical and climatic test methods – Part 30: Preconditioning of non-hermetic surface mount devices prior to reliability testing*

IEC 60749-35, *Semiconductor devices – Mechanical and climatic test methods – Part 35: Acoustic microscopy for plastic encapsulated electronic components*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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>

3.1

acoustic tomography

determination of the physical qualities of a known substance by measuring how long it takes sound to travel through it

3.2

classification reflow temperature

T_c

maximum body temperature for which the component moisture sensitivity level (MSL) is verified by the component manufacturer and as noted on the caution and/or bar code label