

Semiconductor devices — Mechanical and climatic test methods —

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

The European Standard EN 60749-20:2003 has the status of a
British Standard

ICS 31.080.01

National foreword

This British Standard is the official English language version of EN 60749-20:2003. It is identical with IEC 60749-20:2002. It partially supersedes BS EN 60749:1999 which will be withdrawn on 2005-10-01.

The UK participation in its preparation was entrusted to Technical Committee EPL/47, Semiconductors, which has the responsibility to:

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- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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**Semiconductor devices -
Mechanical and climatic test methods
Part 20: Resistance of plastic-encapsulated SMDs to the combined effect
of moisture and soldering heat
(IEC 60749-20:2002)**

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 soudage
(CEI 60749-20:2002)

Halbleiterbauelemente -
Mechanische und klimatische Prüfverfahren
Teil 20: Beständigkeit kunststoffverkappter
oberflächenmontierbarer Bauelemente
(SMD) gegenüber der kombinierten
Beanspruchung von Feuchte und Lötwärme
(IEC 60749-20:2002)

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

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CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of the International Standard IEC 60749-20:2002 was approved by CENELEC as EN 60749-20 on 2002-09-24.

The text of this International Standard was reproduced from IEC 60749:1996, chapter 2, subclause 2.3 without change. Therefore, it has not been submitted to vote a second time and is still based on document 47/1574/FDIS.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2004-01-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2005-10-01

Each test method governed by this standard and which is part of the series is a stand-alone document, numbered EN 60749-2, EN 60749-3, etc. The numbering of these test methods is sequential, and there is no relationship between the number and the test method (i.e. no grouping of test methods). The list of these tests will be available in the CENELEC internet site and in the catalogue.

Updating of any of the individual test methods is independent of any other part.

Annexes designated "normative" are part of the body of the standard.
In this standard, annex ZA is normative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60749-20:2002 was approved by CENELEC as a European Standard without any modification.

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INTRODUCTION

Activity within IEC technical committee 47, working group 2, includes the generation, coordination and review of climatic, electrical (of which only ESD, latch-up and electrical conditions for life tests are considered), mechanical test methods, and associated inspection techniques needed to assess the quality and reliability of the design and manufacture of semiconductor productors and processes.

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 and object

This part of IEC 60749 applies to semiconductor devices (discrete devices and integrated circuits).

This test method provides a means of assessing the resistance to soldering heat of plastic-encapsulated surface mount devices (SMDs). This test is destructive.

NOTE This test is identical to the test method contained in 2.3 of chapter 2 of IEC 60749 (1996), amendment 2, apart from the addition of this clause and clause 2 and the subsequent renumbering.

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 60068-2-20:1979, *Environmental testing – Part 2: Tests – Test T: Soldering*

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

3 General description

Package cracking and electrical failure in plastic-encapsulated SMDs can result when soldering heat raises the vapour pressure of moisture which has been absorbed into SMDs during storage. These problems are assessed. In this test method, SMDs are evaluated for heat resistance after being soaked in an environment which simulates moisture being absorbed while under storage in a warehouse or dry pack.

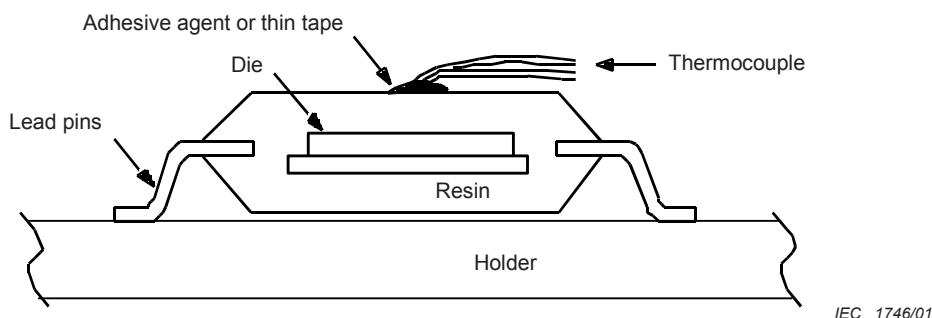
4 Test apparatus and materials

a) Humidity chamber

The humidity chamber shall provide an environment complying with the temperature and relative humidity defined in item c) of clause 5.

b) Reflow soldering apparatus

The infra-red convection, the convection and the vapour-phase reflow soldering apparatus shall provide temperature profiles complying with the conditions of soldering heat defined in items d)1) and d)2) of clause 5. The settings of the reflow soldering apparatus shall be adjusted by temperature profiling of the top surface of the specimen while it is undergoing the soldering heat process, measured as shown in figure 1.



NOTE The adhesive agent or thin tape should have good thermal conductivity.

Figure 1 – Method of measuring the temperature profile of a specimen

c) Holder

Unless otherwise detailed in the relevant specification, any board material, such as epoxy fibreglass or polyimide, may be used for the holder. The specimen shall be placed on the holder by the usual means and in a position as shown in figure 1. If the position of the specimen, as shown in figure 1, necessitates changing the shape of terminations and results in subsequent electrical measurement anomalies, a position that avoids changing the shape of terminations may be chosen, and this shall be specified in the relevant specification.

d) Wave-soldering apparatus

The wave-soldering apparatus shall comply with conditions given in item d)3) of clause 5. Molten solder shall usually be flowed.

e) Solvent for vapour-phase reflow soldering

Perfluorocarbon (perfluoroisobutylene) shall be used.

f) Flux

Unless otherwise detailed in the relevant specification, the flux shall consist of 25 % by weight of colophony in 75 % by weight of isopropyl alcohol, both as specified in appendix C of IEC 60068-2-20.

g) Solder

Solder of composition as specified in appendix B of IEC 60068-2-20 shall be used.

5 Procedure

a) Initial measurements

1) Visual inspection

Visual inspection, as specified in IEC 60749-3, shall be performed before the test. Special attention shall be paid to external cracks and swelling, which will be looked for under a magnification of 40×.

2) Electrical measurement

Electrical testing shall be performed as required by the relevant specification.

3) Internal inspection by acoustic tomography

Unless otherwise detailed in the relevant specification, internal cracks and delamination in the specimen shall be inspected by acoustic tomography in accordance with annex A.

b) Drying

Unless otherwise detailed in the relevant specification, the specimen shall be baked at $125\text{ °C} \pm 5\text{ °C}$ for at least 24 h.

c) Moisture soak

Unless otherwise detailed in the relevant specification, moisture soak conditions shall be selected on the basis of the packing method of the specimen (see B.1.1). If baking the specimen before soldering is detailed in the relevant specification, the specimen shall be baked instead of being subject to moisture soak.

1) Moisture soak for dry-packed SMDs

Moisture soak conditions for dry-packed SMDs may be used as specified in method A, table 1, or method B, table 2. Moisture soak conditioning for dry-packed SMDs consists of two stages. The first stage of conditioning is intended to simulate moisturizing SMDs before opening the dry pack/dry cabinet. The second stage of conditioning is to simulate moisturizing SMDs during storage after opening the dry pack for soldering (floor life). Moisture soak conditioning for dry-packed SMDs shall be selected from method A or B. Method A shall be used when the relative humidity in the dry pack or dry cabinet is specified by the manufacturer as being between 10 % and 30 %. Method B shall be used when the relative humidity in the dry pack or dry cabinet is specified by the manufacturer as being below 10 %.

i) Method A

Unless otherwise detailed in the relevant specification, the first stage of conditioning A1, as shown in table 1, shall be performed. Subsequently, the second stage of conditioning A2, as shown in table 1, shall be performed within 4 h of finishing the first stage of conditioning (see B.1.2.2).

Table 1 – Moisture soak conditions for dry-packed SMDs (method A)

Condition		Moisture soak conditions	Permissible storage conditions in the dry pack and the dry cabinet	Condition of floor life
First-stage conditioning	A1	$(85 \pm 2) ^\circ\text{C}$, $(30 \pm 5) \% \text{ RH}$, 168 $\frac{24}{-0}$ h	$<30 ^\circ\text{C}$, 30 % RH, 1 year	–
Second-stage conditioning	A2	$(30 \pm 2) ^\circ\text{C}$, $(70 \pm 5) \% \text{ RH}$, 168 $\frac{24}{-0}$ h	–	$<30 ^\circ\text{C}$, 70 % RH, 168 h
RH: Relative humidity.				

NOTE 1 The first stage of conditioning represents storage conditions in the dry pack and the dry cabinet, as well as increasing relative humidity in the dry pack, by repacking the SMDs at the distributor's facility and the user's inspection facility. When condition A1 is applied, the SMDs must be packed into a moisture-proof bag with IC trays and desiccants within a few weeks of drying. They may then be subjected to multiple temporary openings of the moisture-proof bag (for several hours at a time). Repack and inspection of SMDs are possible while the humidity indicator in the dry pack indicates less than 30 % RH since SMDs will recover the initial condition of absorbed moisture within a few days of repacking. In this case, the moisture content measurement of SMDs (see clause B.2) is not needed as a moisture control of the dry pack. A check of the moisture indicator is sufficient for moisture control.

NOTE 2 When moisture soak of the first-stage conditioning does not result in saturation, the soak time is extended to 336 h, because SMDs in a dry pack or dry cabinet will become saturated with moisture during long-term storage. When the moisture soak of the first stage of conditioning reaches saturation, the soak time is shortened.