SIST

SLOVENSKI STANDARD
oSIST prEN IEC 60749-5:2022

01-november-2022

Polprevodniški elementi - Mehanske in klimatske preskusne metode - 5. del: Preskus življenjske dobe v dinamičnem ravnotežju vlažnosti in pri ustaljeni temperaturi

Semiconductor devices - Mechanical and climatic test methods - Part 5: Steady-state temperature humidity bias life test

Halbleiterbauelemente - Mechanische und klimatische Prüfverfahren - Teil 5: Lebensdauerprüfung bei konstanter Temperatur und Feuchte unter elektrischer Beanspruchung

Dispositifs à semiconducteurs - Méthodes d'essais mécaniques et climatiques - Partie 5: Essai continu de durée de vie sous température et humidité avec polarisation

Ta slovenski standard je istoveten z: **prEN IEC 60749-5:2022**

ICS:

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

oSIST prEN IEC 60749-5:2022 **en**

IEC

47/2770/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER: **IEC 60749-5 ED3**	
DATE OF CIRCULATION: **2022-09-09**	CLOSING DATE FOR VOTING: **2022-12-02**
SUPERSEDES DOCUMENTS: **47/2769/RR**	

IEC TC 47 : SEMICONDUCTOR DEVICES	
SECRETARIAT: Korea, Republic of	SECRETARY: Mr Cheolung Cha
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☒ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY	
☒ SUBMITTED FOR CENELEC PARALLEL VOTING **Attention IEC-CENELEC parallel voting** The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

TITLE:

Semiconductor devices - Mechanical and climatic test methods - Part 5: Steady-state temperature humidity bias life test

PROPOSED STABILITY DATE: 2028

NOTE FROM TC/SC OFFICERS:

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

____

SEMICONDUCTOR DEVICES – MECHANICAL AND CLIMATIC TEST METHODS –

Part 5: Steady-state temperature humidity bias life test

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.

IEC 60749-5 has been prepared by IEC technical committee 47: Semiconductor devices. It is an International Standard.

This third edition, based on JEDEC document JESD22-A101D.01, cancels and replaces the second edition published in 2017. It is used with permission of the copyright holder, JEDEC Solid State Technology Association. This edition constitutes a technical revision.

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

a) the need to minimize relative humidity gradients and maximize air flow between devices.;
b) the avoidance of condensation on devices and electrical fixtures;
c) replacement of references to 'virtual junction' with 'die'.

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

FDIS	Report on voting
47/XX/FDIS	47/XX/RVD

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts of the IEC 60749 series, under the general title *Semiconductor devices – Mechanical and climatic test methods*, can be found in 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 5: Steady-state temperature humidity bias life test

1 Scope

This part of IEC 60749 provides a steady-state temperature and humidity bias life test to evaluate the reliability of non-hermetic packaged semiconductor devices in humid environments.

This test method is considered 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 60749-4, *Semiconductor devices – Mechanical and climatic test methods – Part 4: Damp heat, steady-state, highly accelerated stress test (HAST)*

3 Terms and definitions

No terms and definitions are listed in this document.

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

4 General

Temperature, humidity and bias conditions are applied to accelerate the penetration of moisture through the external protective material (encapsulant or seal) or along the interface between the external protective material and the metallic conductors which pass through it.

Where both this steady-state, humidity bias test and the damp heat, highly accelerated stress test (HAST) of IEC 60749-4 are performed, the results of this 85 °C/85 % RH steady-state test will take priority over the results of the HAST test, which is an accelerated test designed to activate the same failure mechanisms.

5 Equipment

5.1 Equipment summary

The test requires a temperature-humidity test chamber capable of maintaining a specified temperature and relative humidity continuously, while providing electrical connections to the devices under test in a specified biasing configuration.

5.2 Temperature and relative humidity

The chamber shall be capable of providing controlled conditions of temperature and relative humidity during ramp-up to, and ramp-down from the specified test conditions.

Care shall be taken to ensure that the test chamber dry bulb temperature exceeds the wet bulb temperature at all times.

5.3 Devices under stress

Devices under stress shall be physically located to minimize temperature gradients. Care shall be taken to minimize relative humidity gradients and maximize air flow between devices.

5.4 Minimizing release of contamination

Care shall be exercised in the choice of board and socket materials, to minimize release of contamination, and to minimize degradation due to corrosion and other mechanisms.

5.5 Ionic contamination

Care shall be taken to avoid ionic contamination of the test devices by the test apparatus (card cage, test boards, sockets, wiring, storage containers, etc.).

5.6 Deionized water

Deionized water with a minimum resistivity of 1×10^4 Ωm at room temperature shall be used.

6 Test conditions

6.1 Test conditions summary

Test conditions consist of a temperature, relative humidity, and duration used in conjunction with an electrical bias configuration specific to the device.

6.2 Temperature, relative humidity and duration

Unless otherwise required by the detail specification, the temperature, relative humidity and test duration as shown in Table 1 shall be applied.

Table 1 – Temperature, relative humidity and duration

Temperature (dry bulb) °C	Relative humidity [a] %	Temperature [b] (wet bulb) °C	Vapour pressure [b] kPa	Duration [c] h
85 ± 2	85 ± 5	81,0	49,1	$1\,000^{-24}_{+168}$

[a] Tolerances apply to the entire useable test area.

[b] For information only.

[c] The test conditions are to be applied continuously, except during any interim readouts, when the devices should be returned to stress within the time specified in 7.6.

6.3 Biasing guidelines

Apply bias according to the following guidelines:

a) Minimize power dissipation.
b) Alternate pin bias as much as possible.
c) Distribute potential differences across chip metallization as much as possible.

d) Maximize voltage within operating range.

NOTE 1 The priority of the above guidelines depends on the mechanism and specific device characteristics.

e) Either of two kinds of bias can be used to satisfy these guidelines, whichever is more severe:

1) Continuous bias

The DC bias shall be applied continuously.

Continuous bias is more severe if the die temperature(T_j) is <10 °C higher than the chamber ambient temperature.

If the die temperature is not known, and the heat dissipation of the device under test (DUT) is less than 200 mW the die temperature is assumed to be less than 10 °C above ambient temperature.

If the heat dissipation of the DUT exceeds 200 mW, the die temperature should be calculated or measured.

If the die temperature exceeds the chamber ambient temperature by more than 5 °C the die temperature rise above the chamber ambient should be included in reports of test results since acceleration of failure mechanisms will be affected.

2) Cycled bias

The DC voltage applied to the devices under test shall be periodically interrupted with an appropriate frequency and duty cycle. If the biasing configuration results in a temperature rise above the chamber ambient, ΔT_{ja}, exceeding 10 °C, then cycled bias, when optimized for a specific device type, will be more severe than continuous bias. Heating as a result of power dissipation tends to drive moisture away from the die and thereby hinders moisture-related failure mechanisms. Cycled bias permits moisture collection on the die during the off periods when device power dissipation does not occur. Cycling the DUT bias with 1 h on and 1 h off is optimal for most plastic-encapsulated microcircuits. The die temperature, as calculated on the basis of the known thermal impedance and dissipation should be quoted with the results whenever it exceeds the chamber ambient by 5 °C or more.

6.4 Biasing choice and reporting

Criteria for choosing continuous or cyclical bias, and whether or not to report the amount by which the die temperature exceeds the chamber ambient temperature, are summarized in Table 2.

Table 2 – Criteria for choosing continuous or cyclical bias

ΔT_{ja}	Continuous or cyclical bias	Include value of ΔT_{ja} in test report?
ΔT_{ja} < 5 °C or power per DUT < 200 mW	Continuous	No
(ΔT_{ja} ≥ 5 °C or power per DUT ≥ 200 mW), and ΔT_{ja} < 10 °C	Continuous	Yes
ΔT_{ja} ≥ 10 °C	Cyclical [a]	Yes
[a] Cycling the DUT bias with one hour on and one hour off is optimal for most plastic-encapsulated microcircuits.		

7 Procedures

7.1 Mounting

The test devices shall be mounted in such a way as to expose them to a specified condition of temperature and humidity as given in Table 1 with a specified electrical biasing condition. Exposure of devices to excessively hot conditions, dry ambient conditions or conditions that result in condensation on devices and electrical fixtures shall be avoided, particularly during ramp-up and ramp-down. Appropriate attention should also be made to avoid any water dripping on the devices under stress.

7.2 Ramp-up

The time to reach stable temperature and relative humidity conditions shall be less than 3 h. Condensation on the devices under stress and/or fixtures/hardware shall be avoided at all times by ensuring that their temperature is always higher than the dew point temperature.

7.3 Ramp-down

Ramp-down shall not exceed 3 h. Condensation shall be avoided by ensuring that the test chamber (dry bulb) temperature exceeds the wet-bulb temperature at all times during ramp down.

NOTE For a DUT with a cavity in the package, condensation can occur due to the length of the ramp down time.

7.4 Test clock

The test clock starts when the temperature and relative humidity reach the set points, and stops at the beginning of ramp-down.

7.5 Bias

Bias application during ramp-up and ramp-down is optional. Bias should be verified after devices are loaded, prior to the start of the test clock. Bias should also be verified after the test clock stops, but before devices are removed from the chamber.

7.6 Read-out

An electrical test shall be performed not later than 48 h after the end of ramp-down.

For intermediate read-outs, devices shall be returned to stress within 96 h of the end of ramp-down. Moisture loss can be reduced by placing the device in sealed moisture barrier bags (without desiccant). When devices are placed in sealed bags, the “test window clock” runs at one-third of the rate of devices exposed to laboratory ambient conditions. Thus the test window can be extended to as much as 144 h, and the time to return to stress to as much as 288 h by enclosing the devices in moisture-proof bags.

The electrical test parameters should be chosen to preserve any defect (i.e. by limiting the applied test current)

Additional time-to-test delay or the return-to-stress delay time is allowed if justified by technical data.

7.7 Handling

Suitable hand-covering shall be used to manage devices, boards and fixtures. Contamination control is important in any accelerated moisture stress test.

8 Failure criteria

A device shall be considered to have failed if it does not pass the specified end point tests or if its functionality cannot be demonstrated under nominal and worst-case conditions as specified in the applicable procurement document or data sheet.

9 Safety

The equipment manufacturer’s recommendations and local safety regulations shall be followed.