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Semiconductor devices - Mechanical and climatic test methods - Part 24: Accelerated moisture resistance - Unbiased HAST

Dispositifs à semiconducteurs - Méthodes d'essais mécaniques et climatiques - Partie 24: Résistance à l'humidité accélérée - HAST sans polarisation

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Semiconductor devices - Mechanical and climatic test methods - Part 24: Accelerated moisture resistance - Unbiased HAST

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

a) rearrangement of clauses to reposition requirements;
b) addition of two notes to the post-test electrical procedures.

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

Draft	Report on voting
47/2957/FDIS	47/2974/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

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/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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

– reconfirmed,
– withdrawn, or
– revised.

1 Scope

This part of IEC 60749 specifies unbiased highly accelerated stress testing (HAST). HAST is performed for the purpose of evaluating the reliability of non-hermetically packaged solid-state devices in humid environments.

It is a highly accelerated test which employs temperature and humidity under non-condensing conditions 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. Bias is not applied in this test to ensure that the failure mechanisms potentially overshadowed by bias can be uncovered (e.g. galvanic corrosion).

This test is used to identify failure mechanisms internal to the package and 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 60749-5, *Semiconductor devices - Mechanical and climatic test methods - Part 5: Steady-state temperature humidity bias life test*

IEC 60749-33, *Semiconductor devices - Mechanical and climatic test methods - Part 33: Accelerated moisture resistance - Unbiased autoclave*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

– ISO Online browsing platform: available at https://www.iso.org/obp
– IEC Electropedia: available at https://www.electropedia.org

4 Test requirements

This test method applies primarily to moisture resistance evaluations and robustness testing and may be used as an alternative to unbiased autoclave.

Samples are subjected to a non-condensing, humid atmosphere, as described in IEC 60749-33, but with a higher temperature and without bias. For the temperature limits defined by this procedure, the test will typically generate the same failure mechanisms as those in an unbiased "85 °C/85 % RH" steady-state humidity life test, but caution should be exercised if higher temperatures are considered, since non-realistic failure modes can be generated. In the case where both this test and that of IEC 60749-33 are performed, the results of this unbiased HAST test takes precedence over the results of the unbiased autoclave test.

The use of a non-condensing environment avoids many irrelevant external failures, e.g. pin-to-pin leakage or lead corrosion. However, because absorbed moisture typically decreases glass transition temperature for most polymeric materials, the combination of high humidity and high temperature (> T_g) can produce unrealistic material failures. Thus, caution is needed if unbiased HAST is used for reliability or qualification purposes. The condition of 85 °C/85 % RH is considered equivalent but with less of an acceleration factor. Unbiased HAST can show failures that are due to the HAST accelerated conditions. In this case, unbiased 85 °C/85 % RH is considered the reference condition as it correlates better with use conditions. Test method IEC 60749-5, used without bias, is the reference test method.

5 Test apparatus

5.1 Test chamber

The test requires a chamber capable of maintaining a specified temperature and relative humidity under pressure during ramp-up to, and ramp-down from, the specified test conditions.

5.2 Records

A permanent record of the temperature profile for each test cycle is recommended. Calibration records shall verify that the equipment avoids condensation on devices under test (DUTs) hotter than 50 °C during ramp-up and ramp-down for conditions of maximum thermal mass loading. Calibration records shall verify that, for steady-state conditions and maximum thermal mass loading, test conditions are maintained within the tolerances specified in Clause 6.

5.3 Devices under stress

Devices under stress shall be placed in the chamber to minimize temperature gradients. Devices under stress shall be no closer than 30 mm from internal chamber surfaces and shall not be subjected to direct radiant heat from heaters. If devices are mounted on boards, the boards should be oriented to minimize interference with vapor circulation.

5.4 Ionic contamination

Care is needed in the choice of any materials introduced into the chamber in order to minimize release of contamination and minimize degradation due to corrosion and other mechanisms. Ionic contamination of the test apparatus needs to be controlled to avoid inducing erroneous failure mechanisms.

5.5 Distilled or deionized water

The supply water shall be distilled or deionized water with a minimum resistivity of 1×10^4 Ωm (1 MΩ-cm) at room temperature shall be used.

6 Test conditions

Test conditions consist of a given temperature, relative humidity, and duration (see Table 1).