JEDEC STANDARD

Cycled Temperature-Humidity-Bias Life Test

JESD22-A100C

(Revision of JESD22-A100-B, April 2000)

OCTOBER 2007

JEDEC SOLID STATE TECHNOLOGY ASSOCIATION

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Published by
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TEST METHOD A100-B

CYCLED TEMPERATURE-HUMIDITY-BIAS LIFE TEST

(From JEDEC Board Ballot JCB-99-80 and JCB-07-77, formulated under the cognizance of JC-14.1 Committee on Reliability Test Methods for Packaged Devices.)

1 Scope

The Cycled Temperature-Humidity-Bias Life Test is typically performed on cavity packages (e.g. MQUADs, lidded ceramic pin grid arrays, etc.) as an alternative to JESD22-A101 or JESD22-A110.

The Cycled Temperature-humidity –Biased Life Test is performed for the purpose of evaluating the reliability of non-hermetic, packaged solid state devices in humidity environments when surface condensation is likely. It employs conditions of bias, temperature cycling and high humidity that will cause condensation to occur on the device surface. It is useful to determine device surface susceptibility to corrosion and/or dendritic growth.

For most applications test method JESD22-A110 “Highly Accelerated Temperature and Humidity Stress Test (HAST)” or JESD22-A101 “Steady State Temperature, Humidity, Biased Life Test” is preferred.

2 Apparatus

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

2.1 Temperature and relative humidity

The chamber must be capable of providing controlled conditions of temperature and relative humidity as described in clause 3, Test Conditions.

2.2 Recording device

A recording device (e.g. a chart recorder or a computer) with an interface to suitable chamber monitoring instrumentation shall be provided for continuous recording of chamber temperature and relative humidity.

2.3 Devices under stress

Devices under stress must be physically located to minimize temperature gradients.

2.4 Minimize release of contamination

Care must 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.

2 Apparatus (cont'd)

2.5 Ionic contamination

Ionic contamination of the test apparatus (card cage, test boards, sockets, wiring, storage containers, etc.) shall be controlled to avoid test artifacts.

2.6 Deionized water

Deionized water with a minimum resistivity of 1 megohm-cm at room temperature shall be used.

3 Test Conditions

The test condition consists of a temperature, relative humidity, and duration used in conjunction with an electrical bias configuration specific to the device.

3.1 Temperature and relative humidity

The devices under test shall be subjected to the temperature and humidity conditions shown in Figure 1. Unless otherwise specified in an applicable procurement document or specification sheet, the test duration shall be 1008 (-24, +168) hours.

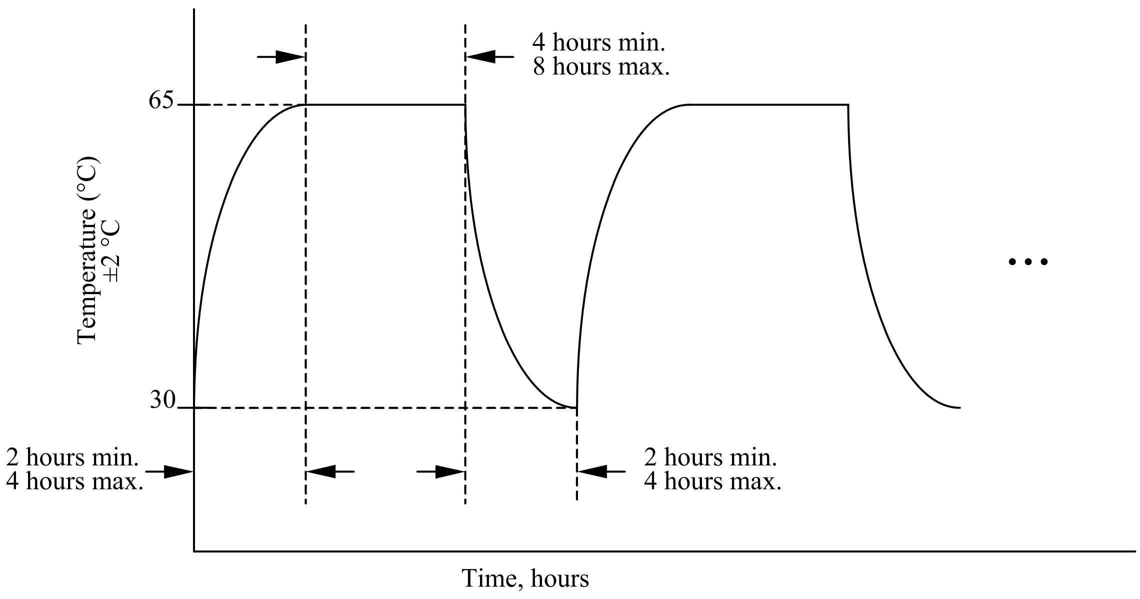

Figure 1 — Temperature Profile (90% to 98% Relative Humidity)

3 Test Conditions (cont'd)

3.2 Biasing guidelines

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

3.2.2 Either of two kinds of bias may be used to satisfy these guidelines, whichever is more severe:

a) Continuous bias – the dc bias shall be applied continuously. Continuous bias is more severe than cycled bias when the die temperature is less than or equal to 10 °C higher than the chamber ambient temperature, or if the die temperature is not known when the heat dissipation of the device under test (DUT) is less than 200 mW. If the heat dissipation of the DUT exceeds 200 mW, then the die temperature should be calculated. If the die temperature exceeds the chamber ambient temperature by more than 5 °C, then the die temperature rise above the chamber ambient should be included in reports of test results since the acceleration of failure mechanisms will be affected.

b) 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 the device power dissipation does not occur. Cycling the DUT bias with one hour on and one hour 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.

3 Test Conditions (cont'd)

3.2 Biasing guidelines (cont'd)

3.2.3 Choosing and reporting

Choosing 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 1.

Table 1 — Cyclical Bias and Reporting ΔTja

ΔTja	Cyclical Bias?	Report ΔTja?
ΔTja < 5 °C, or Power per DUT < 200 mW	No	No
(ΔTja ≥ 5 °C, or Power per DUT ≥ 200 mW) and ΔTja < 10 °C	No	Yes
ΔTja ≥ 10 °C	Yes	Yes

4 Procedures

The test devices shall be mounted in a manner that exposes them to the specified temperature and humidity with a specified electrical biasing condition. The test devices shall be placed in the test chamber with the sample and chamber at room ambient temperature and humidity. Care shall be taken to minimize the occurrence of condensation on devices and electrical fixtures.

4.1 Ramp-up and ramp-down

During ramp-up and ramp-down, ensure that the test chamber (dry bulb) temperature exceeds the wet bulb temperature at all times. The rate of temperature change shall not exceed 10 °C/minute. At all interim and final endpoint measurements, the chamber humidity and temperature shall be reduced to room ambient conditions before removing the devices from the chamber.

4.2 Transition periods

During the transition periods from 65 °C to 30 °C and back up to 65 °C, the relative humidity may drop as low as 80%. The chamber shall be vented to avoid artificial pressurization.

4.3 Test clock

The test clock starts at the beginning of the initial ramp-up and stops at the end of the final ramp-down.

4.4 Bias

Bias shall be verified after devices are loaded, prior to the start of the test clock. Bias shall also be verified after the test clock stops, but before the devices are removed from the chamber.

4 Procedures (cont'd)

4.5 Readout

Electrical test shall be performed not later than 48 hours after the end of ramp-down. Note: For intermediate readouts, devices shall be returned to the stress within 96 hours of the end of ramp-down. The rate of moisture loss from devices after removal from the chamber can be reduced by placing the devices in sealed moisture barrier bags without desiccant. When the devices are placed in sealed bags, the "test window clock" runs at 1/3 of the rate of devices exposed to the laboratory ambient. Thus, the test window can be extended to as much as 144 hours, and the time to return to stress to as much as 288 hours by enclosing the devices in moisture-proof bags.

4.6 Handling

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

5 Failure criteria

A device will be considered to have failed the Cycled Temperature-humidity-bias Life Test if parametric limits are exceeded, or if functionality cannot be demonstrated under nominal and worst-case conditions as specified in the applicable procurement document or data sheet.

6 Safety

Follow equipment manufacturer's recommendations and local safety regulations.

7 Summary

The following details shall be specified in the applicable procurement document:

a) Test duration, if other than as specified in 3.1

b) Measurement after test

c) Biasing configuration

d) Temperature of die during test if it is more than 5 °C above the chamber ambient

e) Frequency and duty cycle of bias if cycled bias is to be used

Annex A (informative) Differences between JESD22-A100C and JESD22-A100-B

This table briefly describes most of the changes made to entries that appear in this standard, JESD22-A100C, compared to its predecessor, JESD22-A100-B (April 2000). If the change to a concept involves any words added or deleted (excluding deletion of accidentally repeated words), it is included. Some punctuation changes are not included.

Page	**Description of change**
ALL	Renumbered document to conform to the guidelines set forth in JM7, JEDEC Style Manual
1	Combined Purpose and Scope, reworded
4	In 4.1; removed “condensation shall be avoided by” because it cannot be avoided in this test.

Standard Improvement Form **JEDEC JESD22-A100C**

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1. I recommend changes to the following:
   - [ ] Requirement, clause number ________
   - [ ] Test method number ________ Clause number ________

   The referenced clause number has proven to be:
   - [ ] Unclear [ ] Too Rigid [ ] In Error
   - [ ] Other ________

2. Recommendations for correction:

____

3. Other suggestions for document improvement:

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