JEITA

Standard of Japan Electronics and Information Technology Industries Association

EIAJ ED-4701/001

Environmental and endurance test methods for semiconductor devices
(General)

Established in August, 2001

Prepared by

Technical Standardization Committee on Semiconductor Devices

Published by

Japan Electronics and Information Technology Industries Association

11, Kanda Surugadai 3-chome, Chiyoda-ku, Tokyo 101-0062, Japan

Printed in Japan

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Environmental and endurance test methods for semiconductor devices (General)

1. SCOPE OF APPLICATION

These standards provide for environmental test methods and endurance test methods aimed at evaluating the resistance and the endurance of discrete semiconductor devices and integrated circuits (hereinafter generically called semiconductor devices) used in electronic equipment mainly for general industrial applications and consumer applications, under the various environmental conditions of various kinds that occur during their use, storage and transportation.

2. DEFINITION OF TERMS

The definition of the technical terms used in these standards and in the relevant specifications are given in the followings.

(1) Specimen:

The semiconductor devices provided for the tests.

(2) Surface mounting semiconductor devices:

The semiconductor devices that are made with the object of being mounted on printed circuit boards by means of the surface mounting method. Hereinafter called SMD (Surface Mounting Devices).

(3) Equipment:

The equipment used to test the specimens.

(4) Materials:

The materials used to test the specimens.

(5) Steps of procedure:

The sequence according to which the various kinds of treatments, measurements, conditionings, inspections, etc., required for the sake of testing the specimens are carried out.

(6) Preliminary treatment:

The treatment which the specimens are submitted to before carrying out the initial measurements and tests.

(7) Humidity absorption:

The pre-treatment, equivalent to the humidity absorption which occurs during the storage period until the actual mounting by soldering, which the specimens are submitted to before the soldering process.

(8) Soldering heat:

The heating treatment, equivalent to the actual mounting by soldering, which the specimens are submitted to.

(9) Initial measurements:

The visual inspection and the electrical and optical measurements which the specimens are submitted to in the first place before carrying out the tests.

(10) Post treatment:

The treatment which the specimens are submitted to before carrying out the end-point measurements with the object eliminating all factors except the influence exerted by the tests in question.

(11) End-point measurements:

The visual inspection and the electrical and optical measurements that are carried out after finishing the tests.

(12) Ambient temperature

(a) When the specimen is not consuming power:

The temperature of the air surrounding the specimen.

(b) When the specimen is consuming power:

The temperature of the air at a place separated by a distance sufficient to neglect the influence of the heat radiation from the specimen, when it is cooled by natural convection. In conformity the relevant specifications when the specimen is cooled by forced convection.

(13) Storage temperature:

The ambient temperature when the specimen is stored in inoperative state.

(14) Operating temperature:

The ambient temperature in operating state.

(15) Junction temperature:

The junction temperature of the specimen. Indicates the value under ordinary operating conditions.

(16) Surface temperature (Case temperature):

The temperature on the surface of the specimen at the point specified in the relevant specifications.

(17) Reference point temperature:

The temperature at the reference point specified in the relevant specifications.

3. SPECIFICATION IN GENERAL CONDITION

(1) Environmental conditions

(a) Standard conditions:

The environmental conditions, consisting of ambient temperature of 15°C-35°C, relative humidity of 45%-75% and atmospheric pressure of 86kPa-106kPa, under which the preliminary treatment and the post treatment are carried out.

(b) Judgment conditions:

The environmental conditions, consisting of ambient temperature of 25°C±3°C, relative humidity of 45%-75% and atmospheric pressure of 86kPa-106kPa, under which the initial measurements and the end-point measurements are carried out.

(2) Directions of the specimen:

The directions of the specimen are defined as shown in **Figures 1** to **8**. When the specimen has outward appearance different from those ones shown in the figures, its directions are defined in the relevant specifications.

Figure 1 Directions of the specimen (Dual in-line package)

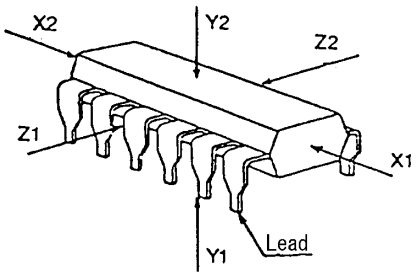


Figure 2 Directions of the specimen (Flat package)

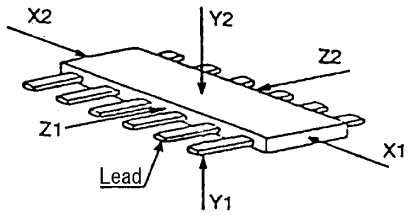


Figure 3 Directions of the specimen (SOP)

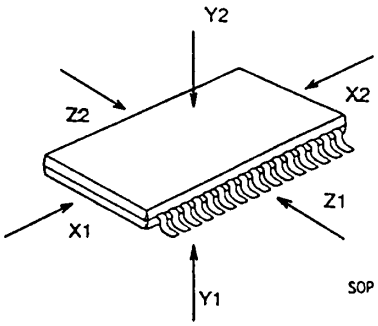


Figure 4 Directions of the specimen (QFP)

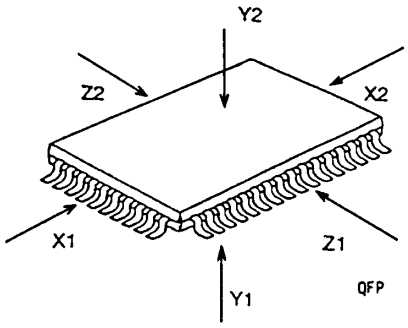


Figure 5 Directions of the specimen (QFJ)

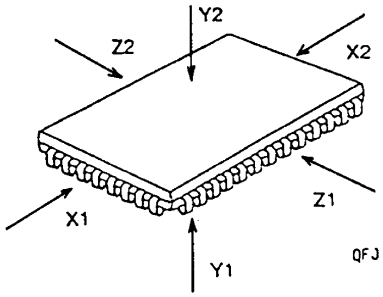


Figure 6 Directions of the specimen (Cylindrical package)

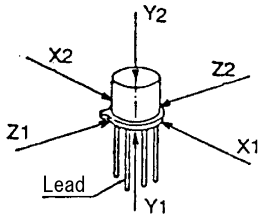


Figure 7 Directions of the specimen (Non-cylindrical discrete semiconductor devices)

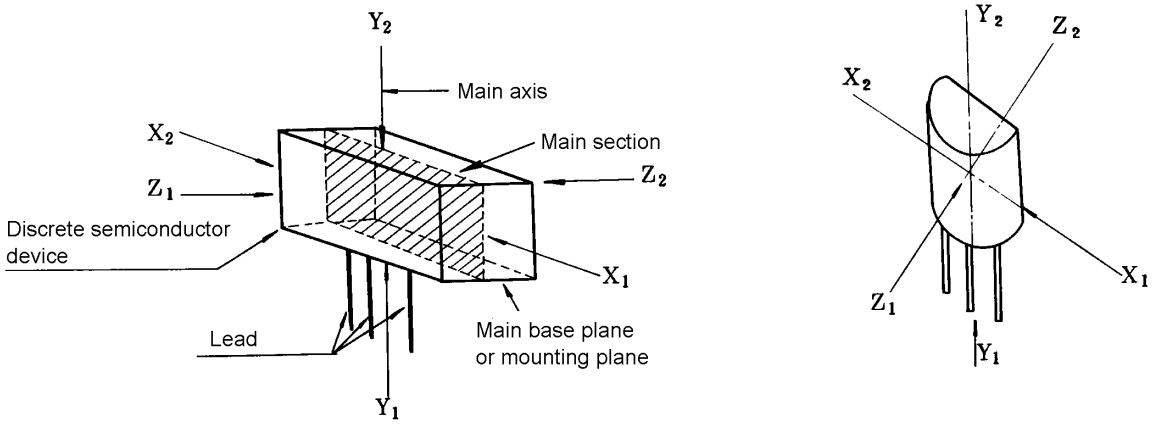
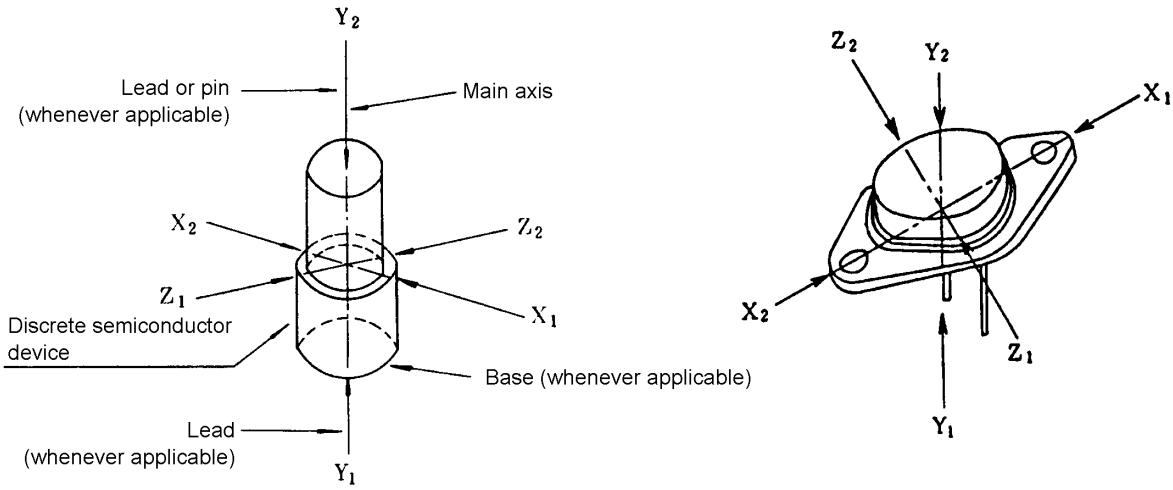


Figure 8 Directions of the specimen
(Discrete semiconductor devices with cylindrical shape)



4. PRECAUTIONS

(1) The specimens should not be applied to conditions in which the transient voltages and currents could exceed the maximum ratings. Moreover, during the electrical measurements, the measurement conditions should not exceed the maximum ratings.

(2) When connecting the specimen with a power supply, special attention should be paid to the sequences of connection of the lead wires, as well as application and disconnection of the power supply. In particular, utmost attention should be paid to the precautions indicated in the detail specifications.

(3) Special attention should be paid during storage and/or test of the specimen in fields exposed to X-ray, neutron or other radiations with strong energy.

(4) Precautions when handling the specimens

(a) A11 equipment must be properly grounded before connecting the specimen with the equipment in question for the sake of electric test. Moreover, attention should be paid also to the grounding of the human body (resistor of the order of 250kΩ to 1MΩ should be connected in series for the protection of the human body).

(b) It is recommendable to keep the specimens in a conductive container when storing and testing them.

(c) During the high-temperature reverse bias test and the like the voltage should be kept applied until the specimen temperature reach the standard state.

5. TEST METHODS

Each test methods is due to the specific test methods. Standard diagram and category are shown in **Figure 9**, and **Table 1**.

Figure 9. Standard diagram

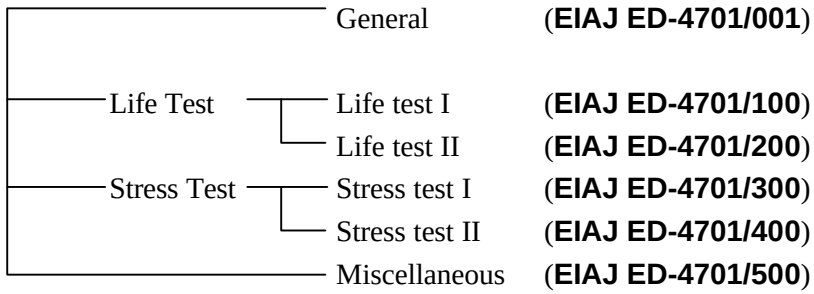


Table 1 Category

CATEGORY	TITLE	SPEC. NO. (TEST NO.)
Life Test	Life Test I	**EIAJ ED-4701/100**
	Steady state operating life	(Test method 101)
	Temperature humidity bias (THB)	(Test method 102)
	Temperature humidity storage	(Test method 103)
	Moisture soaking and soldering heat stress series test	(Test method 104)
	Temperature cycle	(Test method 105)
	Intermittent operating life	(Test method 106)
	Life Test II	**EIAJ ED-4701/200**
	High temperature storage	(Test method 201)
	Low temperature storage	(Test method 202)
	Moisture resistance (Cyclic)	(Test method 203)
	Salt mist	(Test method 204)
Stress Test	Stress Test I	**EIAJ ED-4701/300**
	Resistance to soldering heat for surface mounting devices (SMD)	(Test method 301)
	Resistance to soldering heat (excluding for surface mounting devices)	(Test method 302)
	Solderability	(Test method 303)
	Human body model electrostatic discharge (HBM/ESD)	(Test method 304)
	Charged device model electrostatic discharge (CDM/ESD)	(Test method 305)
	Latch-up	(Test method 306)
	Thermal shock	(Test method 307)
	Stress Test II	**EIAJ ED-4701/400**
	Terminal strength	(Test method 401)
	Mounting strength	(Test method 402)
	Vibration (Sinusoidal)	(Test method 403)
	Shock	(Test method 404)
	Acceleration (Steady state)	(Test method 405)
Miscella-neous		**EIAJ ED-4701/500**
	Permanence of marking	(Test method 501)
	Flammability tests of plastic-encapsulated devices (externally induced)	(Test method 502)
	Seal	(Test method 503)
	Low air pressure	(Test method 504)

COMMENTS

1. PURPOSE AND PROCESS OF THE REVISION

The original standards of **EIAJ ED-4701** had been published by the Electronic Industrial Association of Japan (hereinafter abbreviated as EIAJ) in 1970's. The standards related to integrated circuits (**IC-121-1985** and separate volume **Appendix2-1988**) had been published, and the standards related to discrete devices (**SD-121-1984** separate volume **Appendix1-1985** and separate volume **Appendix2-1986**) had been published. Those standards and Appendixes had been unified and published in Feb/1992. This standard was called **EIAJ ED-4701**. This time, **EIAJ ED-4701** was revised for **EIAJ ED-4701/XXX**, because the period of revision had been once per 5 years, and 4 Appendixes had been published. The 4 Appendixes confused the newest specification searching. Example, too many times and a few mistaking between the newest version and old version.

Electronic Industries Association of Japan (EIAJ) and The Japan Electronic Industry Development Association (JEIDA) have merged effective November 1,2000, the Japan Electronics and Information Technology Industries Association (JEITA).

Main revision points are as follow.

(1) It was changed from one volume to 6 separate volumes.

(2) It was changed to 6 classifications regardless of the **EIAJ ED-4701** classification. The life tests and the strength tests was subdivided according to the revision frequency. A new and old classification method is shown in Comment **Table 1**.

Electronic Industries Association of Japan (EIAJ) and The Japan Electronic Development Association (JEIDA) have merged effective November 1,2000, the Japan Electronics and Information Technology Industries Association (JEITA).

Comment Table 1. Comparison EIAJ ED-4701 and ED-4701/XXX

Classification of **EIAJ ED-4701**	Classification of **EIAJ ED-4701/XXX**
1. CONTENTS 2. APPENDIX (1) Environmental test (applicable to all devices) A : Mechanical test methods B : Climatic test methods C : Miscellaneous test methods (2) Endurance tests (Test by devices) D : Test methods for integrated circuits and discrete devices	1. General (**EIAJ ED-4701/001**) 2. Life tests I (**EIAJ ED-4701/100**) High Freq. Rev. Group 3. Life tests II (**EIAJ ED-4701/200**) Low Freq. Rev. Group 4. Stress tests I (**EIAJ ED-4701/300**) High Freq. Rev. Group 5. Stress tests II (**EIAJ ED-4701/400**) Low Freq. Rev. Group 6. Miscellaneous (**EIAJ ED-4701/500**)

2. EVOLUTION OF THE REVISION

The council of revision started at Apr/2000. Initial planing was the 4 separate volumes according to 4 classification (A = Mechanical test methods, B = Climatic test methods, C = Miscellaneous test methods, and D = Endurance test) of **ED-4701**. Individual specifications on each test methods had been proposed in considering process, but this proposal was not realized. The final revision planing was decided to above-mentioned 6 separate volumes.

3. DESCRIPTION REVISED

ED-4701/XXX was compiled to select the newest specification version in **EIAJ ED-4701** and 4 amendments.

But, following matters was described with equal contents

(1) **ED-4701/XXX** have GENERAL that was content described in main text of **EIAJ ED-4701**.

(2) All matters corresponding to the specific test methods in main text has been compiled to each test methods.

(3) All units had been changed to SI unit.

(4) Endurance test methods by device were 21 specifications in **EIAJ ED-4701**. But, the new endurance test methods become to 2 kinds of specific test methods that are endurance test and intermittent operation life test.

(5) Unsaturated pressure vapor has been unified into temperature humidity bias.

(6) Test method of charged device model electrostatic discharge (CDM/ESD) has been considering to revise **EIAJ EDX-4702** which lost effect in June, 1999, therefore the contents of this specification has been equal to **EIAJ EDX-4702**.

4. REMARKS

4.1 REFERRENCES

(1)	**EIAJ ET-9001**(Sep/1990)	Rule for drafting and presentation of EIAJ Standards
(2)	REFERRENCES (July/1999)	Guideline of Quality Conformance Tests for ICs. *
(3)	**EIAJ ED-4702** (June/1998)	Mechanical stress test methods for semiconductor surface mounting devices
(4)	**EIAJ ED-4703** (June/1994)	In-line evaluation methods and structural analysis methods for semiconductor devices
(5)	**EIAJ ED-4704** (May/2000)	Failure mechanism driven reliability test methods for LSIs
(6)	**EIAJ EDR-4701B** (Mar/1996)	Handling guidance for Semiconductor Devices
(7)	**EIAJ EDR-4702** (Mar/1996)	Standards comparison table of quality and reliability test methods for semiconductor devices
(8)	**EIAJ EDR-4703** (May/1999)	Quality Assurances Guidelines for Bare Die including KGD
(9)	**EIAJ EDR-4704** (May/2000)	Guideline for accelerated endurance testing of semiconductor devices

* This is not translated to English version.

4.2 THE TENDENCY OF IEC 60749

IEC 60749 has been considering for revision. The each specific test methods of **EIAJ ED-**

4701/XXX must be checked the difference points between **IEC 60749** publication and **EIAJ ED-4701/XXX**, and the council in JEITA must consider to revise the difference points.

5. DELIBERATING MEMBERS

Deliberation of this standard has been made by "Sub-Committee on Semiconductor Devices Reliability" of the Technical Standardization Committee on Semiconductor Devices/Semiconductor Devices Reliability Group.

Below are listed the members of deliberation of this standard.

<Technical Standardization Committee on Semiconductor Devices/Semiconductor Devices Reliability Group>

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<Semiconductor Devices Reliability Group>

Chairman	Kazutoshi Miyamoto	Mitsubishi Electric Corp.

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