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Semiconductor devices - Mechanical and climatic test methods - Part 16: Particle impact noise detection (PIND) (IEC 60749-16:2003)

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Semiconductor devices - Mechanical and climatic test methods Part 16: Particle impact noise detection (PIND)

(IEC 60749-16:2003)

Dispositifs à semiconducteurs - Méthodes d'essais mécaniques et climatiques Partie 16: Détection de bruit d'impact de particules (PIND) (CEI 60749-16:2003)

Halbleiterbauelemente - Mechanische und klimatische Prüfverfahren Teil 16: Nachweis des Teilchen-Aufprallgeräusches (PIND) (IEC 60749-16:2003)

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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

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Foreword

The text of document 47/1662/FDIS, future edition 1 of IEC 60749-16, prepared by IEC TC 47, Semiconductor devices, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60749-16 on 2003-03-01.

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)	2003-12-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2006-03-01

Endorsement notice

The text of the International Standard IEC 60749-16:2003 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

IEC 61340-5-1	NOTE	Harmonized as EN 61340-5-1:2001 (not modified).

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Méthodes d'essais mécaniques et climatiques –

Partie 16:
Détection de bruit d'impact de particules (PIND)

Semiconductor devices –
Mechanical and climatic test methods –

Part 16:
Particle impact noise detection (PIND)

International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch

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SEMICONDUCTOR DEVICES – MECHANICAL AND CLIMATIC TEST METHODS –

Part 16: Particle impact noise detection (PIND)

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60749-16 has been prepared by IEC technical committee 47: Semiconductor devices.

The text of this standard is based on the following documents:

FDIS	Report on voting
47/1662/FDIS	47/1679/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until 2007. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

SEMICONDUCTOR DEVICES – MECHANICAL AND CLIMATIC TEST METHODS –

Part 16: Particle impact noise detection (PIND)

1 Scope

The purpose of this part of IEC 60749 is to detect the presence of loose particles inside a cavity device such as, for example, chips of ceramic, pieces of bonding wire or solder balls (prills).

The test of particle impact noise detection is classified as non-destructive.

2 Terms and definitions

For the purposes of this part of IEC 60749, the following definitions apply.

2.1
run
test of all the individual devices of the lot under test which passed the previous run

NOTE The first run includes all the devices of the lot under test, the subsequent runs will include only the devices which passed the previous run(s) and will exclude all the devices which failed.

3 General remarks

An acoustic transducer is attached to the test specimen via an acoustic coupling medium and its output fed via a suitable amplifier to an audio/visual monitoring system. The test specimen is subjected to sinusoidal vibration and a series of controlled mechanical shocks by a suitable mechanical shaker and shock mechanism/impact tool. As a result of this mechanical stimulation, loose particles within the cavity of the test specimen will impact the internal walls of the cavity, producing noise which will be detected by the acoustic transducer and indicated by the monitoring system.

4 Equipment

The following equipment and/or materials (or their equivalents) is required:

a) Vibration shaker (sinusoidal).

Output: 200 m/s^2 peak at 40 Hz – 250 Hz.

b) Mechanical shock mechanism/tool.

Shock pulse: 10 000 m/s^2 ± 2 000 m/s^2 peak.

Main shock duration: 100 µs maximum.

NOTE 1 The application of vibration and shock is most practical through the use of an integral vibration/shock system (co-test system). Where a co-test system is used the interruption to the vibration source during the mechanical shock should not exceed 250 ms from initiation of the last shock pulse in the sequence; and the duration of this shock test should be measured at the 50 ± 5 % points.

c) Impact sensor (acoustic transducer - acoustically coupled to the device under test).
Peak sensitivity: –77,5 dB ± 3 dB with respect to 10 V/Pa at a point in the range 150 kHz – 160 kHz.

d) Impact sensor amplifier (connected to the output of the impact sensor).

Gain: 60 dB ± 2 dB (centred at peak sensitivity frequency of the acoustic transducer, in item c) above).

Output noise: 10 mV peak maximum.

e) Threshold detector (connected to the output of the impact sensor amplifier).

Threshold voltage: 20 mV ± 1 mV peak absolute, reference to system ground and including audio output/oscilloscope output (optional).

NOTE 2 Total system noise generated by items c), d), and e): 20 mV peak to peak maximum as observed over a period of 30–60 s.

f) Attachment medium (to provide good acoustic coupling between item c) above and the device under test).

Examples of suitable attachment media:

- water solvent soluble acoustic couplant,
- water soluble ultrasonic couplant,
- double-sided adhesive tape.

g) Sensitivity test unit, comprising a d.c. source capable of producing an output of 250 µV + 20 % connected to the input of an acoustic transducer (of the same type as in item c) above).

5 Test procedure

NOTE ESD precautions in accordance with IEC 61340-5-1 should be adopted to protect devices under test.

a) Adjust vibration shaker frequency/amplitude to the specified conditions (see Table 1).

b) Adjust shock pulse generator for 10 000 m/s^2 ± 2 000 m/s^2 peak.

c) Verify noise detection equipment operation with the sensitivity test unit attached to the impact sensor, using the same attachment medium that will be used with the actual devices to be tested.

d) Verify system noise is within the specification limits given in item e) of Clause 4.

e) Attach the test specimen directly to the shaker with the largest flat surface centered against the surface of the transducer with the attachment medium.

Where more than one large surface exists, attach the thinnest and most uniform thickness surface against the surface of the transducer.

Where unusual specimen shapes are encountered, special holding fixtures may be required and should be constructed with the following considerations:

- low mass,
- high acoustic transmission,
- full transducer surface contact,
- no moving parts,
- suitable for attachment medium mounting.

f) Start test sequence, of which one cycle comprises the following:
   - 3 pre-test shocks
   - vibration 3 s ± 1 s
   - 3 shocks
   - vibration 3 s ± 1 s
   - 3 shocks
   - vibration 3 s ± 1 s
   - 3 shocks
   - vibration 3 s ± 1 s
   - accept or reject.

g) Measurements – each test cycle shall be continuously monitored: the period during the shocks and up to 250 ms after the shocks shall not be included in the failure criteria analysis.

6 Failure criteria

Any noise detected by the monitoring system during the measurement period which exceeds the total system noise defined in Item e) of Clause 4 will be noise resulting from particle impact noise and shall therefore constitute a failure.

7 Lot acceptance (for guidance)

Where an inspection lot (or sub-lot) is submitted to a 100 % PIND testing, it is recommended that the test is performed a maximum of five times. When using this regime, PIND prescreening shall not be performed. The lot may be accepted on any of the five runs if the percentage of defective devices is less than 1 %. All defective devices shall be removed after each run. Lots which do not meet the 1 % PDA[1] on the fifth run, or exceed 25 % of the cumulated defectives shall be rejected and resubmission is not allowed.

8 Detail specification

The detail specification shall prescribe test conditions in accordance with Table 1.

Table 1 — Shaker frequencies

Internal cavity height (average[a]) mm	Frequency Hz
≤1,00	130
1,01 – 1,25	120
1,26 – 1,50	110
1,51 – 1,75	100
1,76 – 2,00	90
2,01 – 2,25	80
2,26 – 2,50	70
>2,50	60

[a] The average internal cavity height is measured from the internal package base to the internal lid or cap surface.

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1 PDA: Percentage defective allowable.