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Semiconductor devices - Mechanical and climatic test methods - Part 18: Ionizing radiation (total dose) (IEC 60749-18:2002)

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EUROPEAN STANDARD

**EN 60749-18**

NORME EUROPÉENNE

EUROPÄISCHE NORM

February 2003

ICS 31.080.01

English version

**Semiconductor devices –  
Mechanical and climatic test methods  
Part 18: Ionizing radiation (total dose)  
(IEC 60749-18:2002)**

Dispositifs à semiconducteurs –  
Méthodes d'essais mécaniques  
et climatiques  
Partie 18: Rayonnements ionisants  
(dose totale)  
(CEI 60749-18:2002)

Halbleiterbauelemente –  
Mechanische und klimatische  
Prüfverfahren  
Teil 18: Ionisierende Strahlung  
(Gesamtdosis)  
(IEC 60749-18:2002)

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SIST EN 60749-18:2004

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This European Standard was approved by CENELEC on 2003-02-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

**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**

### Foreword

The text of document 47/1657/FDIS, future edition 1 of IEC 60749-18, prepared by IEC TC 47, Semiconductor devices, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60749-18 on 2003-02-01.

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) 2003-11-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2006-02-01

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### Endorsement notice

The text of the International Standard IEC60749-18:2002 was approved by CENELEC as a European Standard without any modification.

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NORME  
INTERNATIONALE  
INTERNATIONAL  
STANDARD

CEI  
IEC

60749-18

Première édition  
First edition  
2002-12

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**Dispositifs à semiconducteurs –  
Méthodes d'essais mécaniques et climatiques –**

**Partie 18:  
Rayonnements ionisants (dose totale)**

iTeh STANDARD PREVIEW

**Semiconductor devices –  
Mechanical and climatic test methods –**

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**Part 18:  
Ionizing radiation (total dose)**

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Commission Electrotechnique Internationale  
International Electrotechnical Commission  
Международная Электротехническая Комиссия

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PRICE CODE

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

SEMICONDUCTOR DEVICES –  
MECHANICAL AND CLIMATIC TEST METHODS –

**Part 18: Ionizing radiation (total dose)**

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.
- 2) The formal decisions or agreements of the 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 National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
- 5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60749-18 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
47/1657/FDIS	47/1666/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 18: Ionizing radiation (total dose)

### 1 Scope

This part of IEC 60749 provides a test procedure for defining requirements for testing packaged semiconductor integrated circuits and discrete semiconductor devices for ionizing radiation (total dose) effects from a cobalt-60 ( $^{60}\text{Co}$ ) gamma ray source.

This standard provides an accelerated annealing test for estimating low dose rate ionizing radiation effects on devices. This annealing test is important for low dose rate or certain other applications in which devices may exhibit significant time-dependent effects.

This standard addresses only steady-state irradiations, and is not applicable to pulse type irradiations.

It is intended for military- and space-related applications.

This standard may produce severe degradation of the electrical properties of irradiated devices and thus should be considered a destructive test.

### 2 Terms and definitions

[SIST EN 60749-18:2004](https://standards.iteh.ai/catalog/standards/sist/c10c560d-6b8c-480a-a177-b28220363cc/sist-en-60749-18-2004)

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

#### 2.1

##### **ionizing radiation effects**

changes in the electrical parameters of a device or integrated circuit resulting from radiation-induced charge

NOTE These are also referred to as total dose effects.

#### 2.2

##### **in-flux test**

electrical measurements made on devices during irradiation exposure

#### 2.3

##### **non in-flux test**

electrical measurements made on devices at any time other than during irradiation

#### 2.4

##### **remote tests**

electrical measurements made on devices that are physically removed from the radiation location



## 2.5

### **time-dependent effects**

significant degradation in electrical parameters caused by the growth or annealing or both of radiation-induced trapped charge after irradiation

NOTE Similar effects also take place during irradiation.

## 2.6

### **accelerated annealing test**

procedure utilizing elevated temperature to accelerate time-dependent effects

## 3 Test apparatus

The apparatus shall consist of the radiation source, electrical test instrumentation, test circuit board(s), cabling, interconnect board or switching system, an appropriate dosimetry measurement system, and an environmental chamber (if required for time-dependent effects measurements). Adequate precautions shall be observed to obtain an electrical measurement system with sufficient insulation, ample shielding, satisfactory grounding, and suitable low noise characteristics.

### 3.1 Radiation source

The radiation source used in the test shall be the uniform field of a  $^{60}\text{Co}$  gamma ray source. Uniformity of the radiation field in the volume where devices are irradiated shall be within  $\pm 10\%$  as measured by the dosimetry system, unless otherwise specified. The intensity of the gamma ray field of the  $^{60}\text{Co}$  source shall be known with an uncertainty of no more than  $\pm 5\%$ . Field uniformity and intensity can be affected by changes in the location of the device with respect to the radiation source and the presence of radiation absorption and scattering materials.

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### 3.2 Dosimetry system

[be28aa0363cc/sist-en-60749-18-2004](https://standards.iteh.ai/catalog/standards/sist/c10c560d-6b8c-480a-a177-be28aa0363cc/sist-en-60749-18-2004)

An appropriate dosimetry system shall be provided that is capable of carrying out the measurements called for in 4.2.

### 3.3 Electrical test instruments

All instrumentation used for electrical measurements shall have the stability, accuracy, and resolution required for accurate measurement of the electrical parameters. Any instrumentation required to operate in a radiation environment shall be appropriately shielded.

### 3.4 Test circuit board(s)

Devices to be irradiated shall either be mounted on or connected to circuit boards together with any associated circuitry necessary for device biasing during irradiation or for in situ measurements. Unless otherwise specified, all device input terminals and any others which may affect the radiation response shall be electrically connected during irradiation, i.e. not left floating.

The geometry and materials of the completed board shall allow uniform irradiation of the devices under test. Good design and construction practices shall be used to prevent oscillations, minimize leakage currents, prevent electrical damage and obtain accurate measurements. Only sockets that are radiation resistant and do not exhibit significant leakages (relative to the devices under test) shall be used to mount devices and associated circuitry to the test board(s).