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Edition 2.0 2019-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Semiconductor devices – Mechanical and climatic test methods – Part 18: Ionizing radiation (total dose)

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

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SEMICONDUCTOR DEVICES – MECHANICAL AND CLIMATIC TEST METHODS –

Part 18: Ionizing radiation (total dose)

FOREWORD

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International Standard IEC 60749-18 has been prepared by IEC technical committee 47: Semiconductor devices.

This second edition cancels and replaces the first edition published in 2002. This edition constitutes a technical revision.

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

a) updates to subclauses to better align the test method with MIL-STD 883J, method 1019, including the use of enhanced low dose rate sensitivity (ELDRS) testing;
b) addition of a Bibliography, which includes ASTM standards relevant to this test method.

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

FDIS	Report on voting
47/2539/FDIS	47/2554/RVD

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

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

A list of all parts in the IEC 60749 series, published under the general title *Semiconductor devices – Mechanical and climatic test methods*, can be found on 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 "http://webstore.iec.ch" in the data related to the specific document. At this date, the document 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- withdrawn,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}Co) gamma ray source. Other suitable radiation sources can be used.

There are four tests presented in this procedure:

a) a standard room temperature irradiation test;

b) an irradiation at elevated temperature/cryogenic temperature test;

c) an accelerated annealing test;

d) an enhanced low dose rate sensitivity (ELDRS) test.

The accelerated annealing test estimates how dose rate ionizing radiation effects on devices is important for low dose rate or certain other applications in which devices can exhibit significant time-dependent effects. The ELDRS test determines if devices with bipolar linear components exhibit sensitivity to enhanced radiation-induced damage at low dose rates.

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

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

This document can produce severe degradation of the electrical properties of irradiated devices and thus is considered a destructive test.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

3.1
ionizing radiation effects, pl
changes in the electrical parameters of a device or integrated circuit resulting from radiation-induced charge

Note 1 to entry: These are also referred to as total dose effects.

3.2
in-flux test
electrical measurements made on devices during irradiation exposure

3.3
internal dose pattern
logic condition of all elements within a logic circuit during radiation exposure

3.4
non in-flux test
electrical measurements made on devices at any time other than during irradiation

3.5
remote test
electrical measurements made on devices that are physically removed from the radiation location

3.6
time-dependent effect
TDE
significant degradation in electrical parameters caused by the growth or annealing, or both, of radiation-induced trapped charge after irradiation

Note 1 to entry: Similar effects also take place during irradiation.

Note 2 to entry: This note applies to the French language only.

3.7
accelerated annealing test
procedure utilizing elevated temperature to accelerate time-dependent effects

3.8
enhanced low dose rate sensitivity
ELDRS
part that shows enhanced radiation-induced damage at dose rates below 0,5 Gy(Si)/s

Note 1 to entry: This note applies to the French language only.

3.9
overtest
factor that is applied to the specification dose to determine the test dose level that the samples have to pass to be acceptable at the specification level

Note 1 to entry: An overtest factor of 1,5 means that the parts should be tested at 1,5 times the specification dose.

3.10
parameter delta design margin
PDDM
design margin that is applied to the radiation-induced change in an electrical parameter

Note 1 to entry: For a PDDM of 2 the change in a parameter at a specified dose from the pre-irradiation value is multiplied by two and added to the pre-irradiation value to see if the sample exceeds the post-irradiation parameter limit. For example, if the pre-irradiation value of base current I_b is 30 nA and the post-irradiation value at 200 Gy(Si) is 70 nA (change in I_b is 40 nA), then for a PDDM of 2 the post-irradiation value would be 110 nA (30 nA + 2 x 40 nA). If the allowable post-irradiation limit is 100 nA, the part would fail.