

INTERNATIONAL STANDARD

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**Semiconductor devices – Micro-electromechanical devices –
Part 12: Bending fatigue testing method of thin film materials using resonant
vibration of MEMS structures**

**Dispositifs à semiconducteurs – Dispositifs microélectromécaniques –
Partie 12: Méthode d'essai de fatigue en flexion des matériaux en couche mince
utilisant les vibrations à la résonance des structures à systèmes
microélectromécaniques (MEMS)**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SEMICONDUCTOR DEVICES – MICRO-ELECTROMECHANICAL DEVICES –

Part 12: Bending fatigue testing method of thin film materials using resonant vibration of MEMS structures

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

FDIS	Report on voting
47F/80/FDIS	47F/90/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.

A list of all parts of IEC 62047 series, under the general title *Semiconductor devices – Microelectromechanical devices*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

SEMICONDUCTOR DEVICES – MICRO-ELECTROMECHANICAL DEVICES –

Part 12: Bending fatigue testing method of thin film materials using resonant vibration of MEMS structures

1 Scope

This part of IEC 62047 specifies a method for bending fatigue testing using resonant vibration of microscale mechanical structures of MEMS (micro-electromechanical systems) and micromachines. This standard applies to vibrating structures ranging in size from 10 μm to 1 000 μm in the plane direction and from 1 μm to 100 μm in thickness, and test materials measuring under 1 mm in length, under 1 mm in width, and between 0,1 μm and 10 μm in thickness.

The main structural materials for MEMS, micromachine, etc. have special features, such as typical dimensions of a few microns, material fabrication by deposition, and test piece fabrication by means of non-mechanical machining, including photolithography. The MEMS structures often have higher fundamental resonant frequency and higher strength than macro structures. To evaluate and assure the lifetime of MEMS structures, a fatigue testing method with ultra high cycles (up to 10^{12}) loadings needs to be established. The object of the test method is to evaluate the mechanical fatigue properties of microscale materials in a short time by applying high load and high cyclic frequency bending stress using resonant vibration.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62047-3:2006, *Semiconductor devices – Micro-electromechanical devices – Part 3: Thin film standard test piece for tensile testing*

ISO 12107, *Metallic materials – Fatigue testing – Statistical planning and analysis of data*

3 Terms and definitions

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

3.1

amplitude

one-half the algebraic difference between the maximum value and minimum value in a loading cycle

3.2

load ratio

algebraic ratio of the maximum value and minimum value of the load of a cycle

3.3

S-N curve

plot of stress or strain (S) against the number of cycles (N) to failure