

<b>STN</b>	<b>Polovodičové súčiastky Mechanické a klimatické skúšobné metódy Časť 41: Štandardné metódy testovania spoľahlivosti nezávislých pamäťových zariadení</b>	<b>STN EN IEC 60749-41</b>  35 8799
------------	--	---

Semiconductor devices - Mechanical and climatic test methods - Part 41: Standard reliability testing methods of non-volatile memory devices

Táto norma obsahuje anglickú verziu európskej normy.  
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 11/20

Obsahuje: EN IEC 60749-41:2020, IEC 60749-41:2020

**132011**

EUROPEAN STANDARD

**EN IEC 60749-41**

NORME EUROPÉENNE

EUROPÄISCHE NORM

September 2020

ICS 31.080.01

English Version

Semiconductor devices - Mechanical and climatic test methods -  
Part 41: Standard reliability testing methods of non-volatile  
memory devices  
(IEC 60749-41:2020)

Dispositifs à semiconducteurs - Méthodes d'essais  
mécaniques et climatiques - Partie 41: Méthodes d'essai  
normalisées pour la fiabilité des dispositifs à mémoire non  
volatile  
(IEC 60749-41:2020)

Halbleiterbauelemente - Mechanische und klimatische  
Prüfverfahren - Teil 41: Standardisierte Prüfverfahren für  
die Zuverlässigkeit von nichtflüchtigen Speicher-  
Bauelementen  
(IEC 60749-41:2020)

This European Standard was approved by CENELEC on 2020-08-26. 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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

**EN IEC 60749-41:2020 (E)****European foreword**

The text of document 47/2631/FDIS, future edition 1 of IEC 60749-41, prepared by IEC/TC 47 "Semiconductor devices" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60749-41:2020.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2021-05-26
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2023-08-26

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

**Endorsement notice**

The text of the International Standard IEC 60749-41:2020 was approved by CENELEC as a European Standard without any modification.

## **Annex ZA** (normative)

### **Normative references to international publications with their corresponding European publications**

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: [www.cenelec.eu](http://www.cenelec.eu).

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60749-6	-	Semiconductor devices - Mechanical and climatic test methods - Part 6: Storage at high temperature	EN 60749-6	-
IEC 60749-23	-	Semiconductor devices - Mechanical and climatic test methods - Part 23: High temperature operating life	EN 60749-23	-
JESD47	-	Stress-Test-Driven Qualification of Integrated Circuits	-	-
JESD94	-	Application Specific Qualification Using Knowledge Based Test Methodology	-	-



IEC 60749-41

Edition 1.0 2020-07

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

**Semiconductor devices – Mechanical and climatic test methods –  
Part 41: Standard reliability testing methods of non-volatile memory devices**

**Dispositifs à semiconducteurs – Méthodes d’essais mécaniques  
et climatiques –  
Partie 41: Méthodes d’essai normalisées pour la fiabilité des dispositifs  
à mémoire non volatile**



**THIS PUBLICATION IS COPYRIGHT PROTECTED****Copyright © 2020 IEC, Geneva, Switzerland**

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

**About the IEC**

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

**About IEC publications**

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

**IEC publications search - [webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)**

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

**IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)**

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

**IEC Customer Service Centre - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)**

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: [sales@iec.ch](mailto:sales@iec.ch).

**Electropedia - [www.electropedia.org](http://www.electropedia.org)**

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

**IEC Glossary - [std.iec.ch/glossary](http://std.iec.ch/glossary)**

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

**A propos de l'IEC**

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

**A propos des publications IEC**

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

**Recherche de publications IEC -****[webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)**

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

**IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)**

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

**Service Clients - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)**

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: [sales@iec.ch](mailto:sales@iec.ch).

**Electropedia - [www.electropedia.org](http://www.electropedia.org)**

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

**Glossaire IEC - [std.iec.ch/glossary](http://std.iec.ch/glossary)**

67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.



IEC 60749-41

Edition 1.0 2020-07

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

**Semiconductor devices – Mechanical and climatic test methods –  
Part 41: Standard reliability testing methods of non-volatile memory devices**

**Dispositifs à semiconducteurs – Méthodes d’essais mécaniques  
et climatiques –  
Partie 41: Méthodes d’essai normalisées pour la fiabilité des dispositifs  
à mémoire non volatile**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

ICS 31.080.01

ISBN 978-2-8322-8640-1

**Warning! Make sure that you obtained this publication from an authorized distributor.  
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

## CONTENTS

FOREWORD.....	3
INTRODUCTION.....	5
1 Scope.....	6
2 Normative references .....	6
3 Terms and definitions .....	6
4 Apparatus.....	9
5 Procedure.....	9
5.1 Qualification specifications.....	9
5.2 Program/erase endurance.....	10
5.2.1 Test setup .....	10
5.2.2 Data cycling.....	11
5.2.3 Electrical test verification.....	14
5.3 Data retention .....	14
5.3.1 Data programming .....	14
5.3.2 Electrical testing and pattern verification (excluding any EEPROM program/erase testing).....	15
5.3.3 Data retention stress .....	15
5.3.4 Electrical testing and pattern verification .....	15
5.4 Precautions.....	15
5.5 Measurements .....	15
5.5.1 Electrical measurements.....	15
5.5.2 Required measurements .....	15
5.5.3 Measurement conditions .....	16
6 Failure criteria and calculation .....	16
6.1 Failure definition .....	16
6.2 Handling of transient failures .....	16
6.3 Separation of failures into data errors and device failures .....	16
6.4 Calculation of UBER .....	17
6.4.1 UBER definition calculation.....	17
6.4.2 Calculation of UBER in the ideal case.....	17
6.4.3 Calculation of UBER in other cases .....	18
7 Summary .....	18
Annex A (informative) Supplementary test condition .....	19
Bibliography.....	20
Figure 1 – Schematic flow.....	10
Figure A.1 – Endurance-retention testing model.....	19
Figure A.2 – Test concept of data retention bake as a function of endurance .....	19



## INTERNATIONAL ELECTROTECHNICAL COMMISSION

---

**SEMICONDUCTOR DEVICES –  
MECHANICAL AND CLIMATIC TEST METHODS –**
**Part 41: Standard reliability testing methods  
of non-volatile memory devices**

## FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). 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. 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 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 IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60749-41 has been prepared by IEC technical committee 47: Semiconductor devices. This standard is based on JEDEC Standard 22-A117. It is used with permission of the copyright holder, JEDEC Solid State Technology Association.

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

FDIS	Report on voting
47/2631/FDIS	47/2643/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 publication 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 publication will remain unchanged until the stability date indicated on the IEC website 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.

**IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

## INTRODUCTION

The stress tests described in this part of IEC 60749 are intended to determine the ability of an EEPROM integrated circuit or an integrated circuit with an EEPROM module (such as a microprocessor) to sustain repeated data changes without failure (program/erase endurance) and to retain data for the expected life of the EEPROM (data retention).

The program/erase endurance and data retention test for qualification and monitoring, using the parameter levels specified in JESD47, is considered destructive. The data retention stress can be used as a proxy to replace the high temperature storage life test when the temperature and time meet or exceed qualification requirements. Cross-temperature testing for writing and reading across the data sheet temperature range can be considered when there are demonstrated sensitivities for programming at low and reading at high temperatures or vice versa. Lesser test parameter levels (e.g., of temperature, number of cycles, retention bake duration) can be used for screening as long as these parameter levels have been verified by the device manufacturer to be nondestructive; this can be performed anywhere from wafer level to finished device.

## **SEMICONDUCTOR DEVICES – MECHANICAL AND CLIMATIC TEST METHODS –**

### **Part 41: Standard reliability testing methods of non-volatile memory devices**

#### **1 Scope**

This part of IEC 60749 specifies the procedural requirements for performing valid endurance, retention and cross-temperature tests based on a qualification specification. Endurance and retention qualification specifications (for cycle counts, durations, temperatures, and sample sizes) are specified in JESD47 or are developed using knowledge-based methods such as in JESD94.

#### **2 Normative references**

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60749-6, *Semiconductor devices – Mechanical and climatic test methods – Part 6: Storage at high temperature*

IEC 60749-23, *Semiconductor devices – Mechanical and climatic test methods – Part 23: High temperature operating life*

JESD47, *Stress-Test-Driven Qualification of Integrated Circuits*

JESD94, *Application Specific Qualification Using Knowledge Based Test Methodology*

**koniec náhľadu – text ďalej pokračuje v platenej verzii STN**