

# INTERNATIONAL STANDARD

COMMENTED VERSION

**Semiconductor devices - Mechanical and climatic test methods -  
Part 26: Electrostatic discharge (ESD) sensitivity testing - Human body model  
(HBM)**

Document Preview

[IEC 60749-26:2025](https://standards.iteh.ai/standards/iec/bcbe5a2c-9adc-4eb5-9d36-9c970fcf73a5/iec-60749-26-2025)

<https://standards.iteh.ai/catalog/standards/iec/bcbe5a2c-9adc-4eb5-9d36-9c970fcf73a5/iec-60749-26-2025>



**THIS PUBLICATION IS COPYRIGHT PROTECTED**  
**Copyright © 2025 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.

IEC Secretariat  
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 It also gives information on projects, replaced and withdrawn publications.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 Products & Services Portal - [products.iec.ch](http://products.iec.ch)**

Discover our powerful search engine and read freely all the publications previews, graphical symbols and the glossary. With a subscription you will always have access to up to date content tailored to your needs.

**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.

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

The world's leading online dictionary on electrotechnology, containing more than 22 500 terminological entries in English and French, with equivalent terms in 25 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

**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).

[IEC 60749-26:2025](https://standards.iteh.ai/catalog/standards/iec/bcbe5a2c-9adc-4eb5-9d36-9c970fcf73a5/iec-60749-26-2025)

<https://standards.iteh.ai/catalog/standards/iec/bcbe5a2c-9adc-4eb5-9d36-9c970fcf73a5/iec-60749-26-2025>

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

FOREWORD.....	5
1 Scope.....	7
2 Normative references .....	7
3 Terms and definitions .....	7
4 Apparatus and required equipment.....	11
4.1 Waveform verification equipment.....	11
4.2 Oscilloscope .....	12
4.3 Additional requirements for digital oscilloscopes .....	12
4.4 <del>Current transducer (inductive current probe)</del> Current probe.....	12
4.5 Evaluation loads.....	12
4.6 Attenuator.....	13
4.7 Human body model simulator .....	13
4.8 HBM test equipment parasitic properties.....	13
5 Stress test equipment qualification and routine verification .....	14
5.1 Overview of required HBM tester evaluations.....	14
5.2 Measurement procedures .....	14
5.2.1 Reference pin pair determination.....	14
5.2.2 Waveform capture with current probe .....	14
5.2.3 Determination of waveform parameters.....	15
5.2.4 High voltage discharge path test.....	19
5.3 HBM tester qualification .....	19
5.3.1 HBM ESD tester qualification requirements.....	19
5.3.2 HBM tester qualification procedure.....	20
5.4 Test fixture board qualification for socketed testers.....	20
5.5 Routine waveform check requirements.....	21
5.5.1 Standard routine waveform check description .....	21
5.5.2 Waveform check frequency .....	21
5.5.3 Alternate routine waveform capture procedure .....	22
5.6 High voltage discharge path check .....	22
5.6.1 Relay testers .....	22
5.6.2 Non-relay testers .....	22
5.7 Tester waveform records.....	23
5.7.1 Tester and test fixture board qualification records.....	23
5.7.2 Periodic waveform check records .....	23
5.8 Safety.....	23
5.8.1 Initial set-up.....	23
5.8.2 Training .....	23
5.8.3 Personnel safety .....	23
6 Classification procedure .....	23
6.1 Devices for classification.....	23
6.2 Parametric and functional testing.....	23
6.3 Device stressing.....	24
6.3.1 Device stressing methods .....	24
6.3.2 No connect pins .....	25
<del>6.4 Pin categorization .....</del>	<del>25</del>
<del>    6.4.1 General .....</del>	<del>25</del>

<del>6.4.2</del>	<del>No connect pins</del>	<del>25</del>
6.4	Pin combination stressing	25
6.4.1	Pin combination stressing options	25
6.4.2	No connect pins	26
6.4.3	Supply pins	26
6.4.4	Non-supply pins	26
6.5	Pin groupings	27
6.5.1	Supply pin groups	27
6.5.2	Partitioning supply pin groups	27
6.5.3	Supply pins connected by package plane	27
6.5.4	Supply pins connected by an above-passivation layer	28
6.5.5	Shorted non-supply pin groups	28
6.6	Pin stress combinations	28
6.6.1	Pin stress combination categorization	28
6.6.2	Non-supply and supply to supply combinations (1, 2, ... $N$ )	30
6.6.3	Non-supply to non-supply combinations	31
<del>6.7</del>	<del>HBM stressing with a low parasitic simulator</del>	<del>32</del>
<del>6.7.1</del>	<del>Low parasitic HBM simulator</del>	<del>32</del>
<del>6.7.2</del>	<del>Requirements for low parasitics</del>	<del>32</del>
6.7	Pin-pair stressing	32
6.8	Low-parasitic HBM simulator allowance	32
6.9	Testing after stressing	32
7	Failure criteria	32
8	Component classification	32
Annex A	( <del>normative</del> informative) Cloned non-supply (I/O) pin sampling test method	34
A.1	Purpose and overview	34
A.2	Pin sampling overview and statistical details	34
A.3	IC product selections	36
A.4	Randomly selecting and testing cloned I/O pins	36
A.5	Determining if sampling can be used with the <del>supplied</del> Excel spreadsheet	36
A.5.1	Using the Excel spreadsheet	36
A.5.2	Without using the Excel spreadsheet	36
A.6	HBM testing with a sample of cloned I/O pins	37
A.7	Examples of testing with sampled cloned I/Os	37
A.7.1	Example 1	37
A.7.2	Example 2	38
Annex B	(informative) Determination of withstand thresholds for pin or pin-combination subsets	41
B.1	Overview	41
B.2	Testing procedures	41
B.3	Restrictions	42
B.4	Example of using subset withstand threshold data	42
Annex C	(informative) HBM test equipment parasitic properties	43
C.1	Optional trailing pulse detection equipment <del>for</del> apparatus	43
C.2	Optional pre-pulse voltage rise detection test equipment	45
C.3	Optional pre-HBM current spike detection equipment	46
C.4	Open-relay tester capacitance parasitics	48

C.5	Test to Determine if an HBM Simulator is <del>a low-parasitic simulator</del> an <i>N</i> -channel Low-Parasitic Simulator .....	48
<del>Annex C (informative) Example of testing a product using Table 2, Table 3, or Table 2 with a two-pin HBM tester .....</del>		
<del>C.1 General .....</del>		
<del>C.2 Procedure A (following Table 2): .....</del>		
<del>C.3 Alternative procedure B (following Table 3): .....</del>		
<del>C.4 Alternative procedure C (following Table 2): .....</del>		
<del>Annex D (informative) Examples of coupled non-supply pin pairs .....</del>		
Annex D (informative)	HBM test method flow chart .....	50
Annex E (informative)	Failure window detection testing methods .....	62
E.1	Methodology .....	62
E.2	Combined withstand threshold method and window search .....	62
E.3	Failure window detection with a known withstand threshold .....	62
Bibliography .....		64
List of comments .....		65
Figure 1	– Simplified HBM simulator circuit with loads .....	13
Figure 2	– Current waveform through shorting wires .....	16
Figure 3	– Current waveform through a 500 Ω resistor .....	17
Figure 4	– Peak current short circuit ringing waveform .....	19
Figure A.1	– SPL, $V_1$ , <del><math>V_M</math>, and <math>z</math></del> and $V_M$ with the Bell shape distribution pin failure curve .....	35
Figure A.2	– I/O sampling test method flow chart .....	40
Figure C.1	– Diagram of trailing pulse measurement setup .....	43
Figure C.2	– Positive stress at 4 000 V .....	44
Figure C.3	– Negative stress at 4 000 V .....	44
Figure C.4	– Illustration of measuring voltage before HBM pulse with a Zener diode or a device .....	45
Figure C.5	– Example of voltage rise before the HBM current pulse across a 9,4 V Zener diode .....	46
Figure C.6	– Optional pre-current pulse detection equipment or apparatus .....	47
Figure C.7	– Positive stress at 1 000 V .....	47
Figure C.8	– Diagram of a 10-pin shorting test device showing current probe .....	49
Figure D.1	– HBM test method flow chart .....	55
<del>Figure C.1 – Example to demonstrate the idea of the partitioned test .....</del>		
Table 1	– Waveform specification .....	21
Table 2	– Preferred pin combinations sets .....	29
Table 3	– Alternative pin combinations sets .....	29
Table 4	– HBM ESD component classification levels .....	33

Table B.1 – Inclusion of lower ESD level high-speed pin data ESD information for handling of ESDS in an ESD protected area (required) .....	42
<del>Table C.1 – Product testing in accordance with Table 2 .....</del>	<del>.....</del>
<del>Table C.2 – Product testing in accordance with Table 3 .....</del>	<del>.....</del>
<del>Table C.3 – Alternative product testing in accordance with Table 2 .....</del>	<del>.....</del>

**iTeh Standards**  
**(<https://standards.iteh.ai>)**  
**Document Preview**

[IEC 60749-26:2025](#)

<https://standards.iteh.ai/catalog/standards/iec/bcbe5a2c-9adc-4eb5-9d36-9c970fcf73a5/iec-60749-26-2025>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**Semiconductor devices -  
Mechanical and climatic test methods -  
Part 26: Electrostatic discharge (ESD) sensitivity testing -  
Human body model (HBM)**

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) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

This commented version (CMV) of the official standard IEC 60749-26:2025 edition 5.0 allows the user to identify the changes made to the previous IEC 60749-26:2018 edition 4.0. Furthermore, comments from IEC TC 47 experts are provided to explain the reasons of the most relevant changes, or to clarify any part of the content.

A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.

This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.