

IEEE Standard for Test Methods and Preferred Values for Silicon PN-Junction Clamping Diodes

IEEE Power and Energy Society

Developed by the
Surge Protective Devices Committee

IEEE Std. C62.59™-2019

Currently in preview, click buy full version

IEEE Standard for Test Methods and Preferred Values for Silicon PN-Junction Clamping Diodes

Developed by the

Surge Protective Devices Committee
of the
IEEE Power and Energy Society

Approved 5 September 2019

IEEE-SA Standards Board

Currently in preview, click buy full version

Abstract: The basic electrical parameters to be met by silicon PN junction voltage clamping components used for the protection of telecommunications equipment or lines from surges are defined in this standard. It is intended that this standard be used for the harmonization of existing or future specifications issued by PN diode surge protective component manufacturers, telecommunication equipment manufacturers, administrations, or network operators.

Keywords: avalanche breakdown, electrical characteristics, electrical ratings, foldback, forward conduction, IEEE C62.59™, overvoltage protection, punch-through, surge protective component (SPC), test methods, Zener breakdown

The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

Copyright © 2019 by The Institute of Electrical and Electronics Engineers, Inc.
All rights reserved. Published 31 October 2019. Printed in the United States of America.

IEEE is a registered trademark in the U.S. Patent & Trademark Office, owned by The Institute of Electrical and Electronics Engineers, Incorporated.

PDF: ISBN 978-1-5044-6119-1 STD23860
Print: ISBN 978-1-5044-6120-7 STDPD23860

IEEE prohibits discrimination, harassment, and bullying.

For more information, visit <http://www.ieee.org/web/aboutus/whatis/policies/p9-26.html>.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

Important Notices and Disclaimers Concerning IEEE Standards Documents

IEEE documents are made available for use subject to important notices and legal disclaimers. These notices and disclaimers, or a reference to this page, appear in all standards and may be found under the heading “Important Notices and Disclaimers Concerning IEEE Standards Documents.” They can also be obtained on request from IEEE or viewed at <https://standards.ieee.org/ipr/disclaimers.html>.

Notice and Disclaimer of Liability Concerning the Use of IEEE Standards Documents

IEEE Standards documents (standards, recommended practices, and guides), both full-use and trial-use, are developed within IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (“IEEE SA”) Standards Board. IEEE (“the Institute”) develops its standards through a consensus development process, approved by the American National Standards Institute (“ANSI”), which brings together volunteers representing varied viewpoints and interests to achieve the final product. IEEE Standards are documents developed through scientific, academic, and industry-based technical working groups. Volunteers in IEEE working groups are not necessarily members of the Institute and participate without compensation from IEEE. While IEEE administers the process and establishes rules to promote fairness in the consensus development process, IEEE does not independently evaluate, test, or verify the accuracy of any of the information or the soundness of any judgments contained in its standards.

IEEE Standards do not guarantee or ensure safety, security, health, or environmental protection, or ensure against interference with or from other devices or networks. Implementers and users of IEEE Standards documents are responsible for determining and complying with all appropriate safety, security, environmental, health, and interference protection practices and all applicable laws and regulations.

IEEE does not warrant or represent the accuracy or content of the material contained in its standards, and expressly disclaims all warranties (express, implied and statutory) not included in this or any other document relating to the standard, including, but not limited to, the warranties of: merchantability; fitness for a particular purpose; non-infringement; and quality, accuracy, effectiveness, currency, or completeness of material. In addition, IEEE disclaims any and all conditions relating to: results; and workmanlike effort. IEEE standards documents are supplied “AS IS” and “WITH ALL FAULTS.”

Use of an IEEE standard is wholly voluntary. The existence of an IEEE standard does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the IEEE standard. Furthermore, the viewpoint expressed at the time a standard is approved and issued is subject to change from time to time about through developments in the state of the art and comments received from users of the standard.

In publishing and making its standards available, IEEE is not suggesting or rendering professional or other services for, or on behalf of, any person or entity nor is IEEE undertaking to perform any duty owed by any other person or entity to another. Any person utilizing any IEEE Standards document, should rely upon his or her own independent judgment in the exercise of reasonable care in any given circumstances or, as appropriate, seek the advice of a competent professional in determining the appropriateness of a given IEEE standard.

IN NO EVENT SHALL IEEE BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO: PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE PUBLICATION, USE OF, OR RELIANCE UPON ANY STANDARD, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE AND REGARDLESS OF WHETHER SUCH DAMAGE WAS FORESEEABLE.

Translations

The IEEE consensus development process involves the review of documents in English only. In the event that an IEEE standard is translated, only the English version published by IEEE should be considered the approved IEEE standard.

Official statements

A statement, written or oral, that is not processed in accordance with the IEEE SA Standards Board Operations Manual shall not be considered or inferred to be the official position of IEEE or any of its committees and shall not be considered to be, or be relied upon as, a formal position of IEEE. At lectures, symposia, seminars, and educational courses, an individual presenting information on IEEE standards shall make it clear that his or her views should be considered the personal views of that individual rather than the formal position of IEEE.

Comments on standards

Comments for revision of IEEE Standards documents are welcome from any interested party, regardless of membership affiliation with IEEE. However, IEEE does not provide consulting information or advice pertaining to IEEE Standards documents. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments. Since IEEE standards represent a consensus of concerned interests, it is important that any responses to comments and questions also receive the concurrence of a balance of interests. For this reason, IEEE and the members of its societies and Standards Coordinating Committees are not able to provide an instant response to comments or questions except in those cases where the matter has previously been addressed. For the same reason, IEEE does not respond to interpretation requests. Any person who would like to participate in revisions to an IEEE standard is welcome to join the relevant IEEE working group.

Comments on standards should be submitted to the following address:

Secretary, IEEE-SA Standards Board
445 Hoes Lane
Piscataway, NJ 08854 USA

Laws and regulations

Users of IEEE Standards documents should consult all applicable laws and regulations. Compliance with the provisions of any IEEE Standards document does not imply compliance to any applicable regulatory requirements. Implementers of the standard are responsible for observing or referring to the applicable regulatory requirements. IEEE does not, by the publication of its standards, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Copyrights

IEEE draft and approved standards are copyrighted by IEEE under US and international copyright laws. They are made available by IEEE and are adopted for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of engineering practices and methods. By making these documents available for use and adoption by public authorities and private users, IEEE does not waive any rights in copyright to the documents.

Photocopies

Subject to payment of the appropriate fee, IEEE will grant users a limited, non-exclusive license to photocopy portions of any individual standard for company or organizational internal use or individual, non-commercial use only. To arrange for payment of licensing fees, please contact Copyright Clearance Center, Customer Service, 222 Rosewood Drive, Danvers, MA 01923 USA; +1 978 750 8400. Permission to photocopy portions of any individual standard for educational classroom use can also be obtained through the Copyright Clearance Center.

Updating of IEEE Standards documents

Users of IEEE Standards documents should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of amendments, corrigenda, or errata. An official IEEE document at any point in time consists of the current edition of the document together with any amendments, corrigenda, or errata then in effect.

Every IEEE standard is subjected to review at least every 10 years. When a document is more than 10 years old and has not undergone a revision process, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art. Users are cautioned to check to determine that they have the latest edition of any IEEE standard.

In order to determine whether a given document is the current edition and whether it has been amended through the issuance of amendments, corrigenda, or errata, visit IEEE Xplore at <https://ieeexplore.ieee.org> or contact IEEE at the address listed previously. For more information about the IEEE SA or IEEE's standards development process, visit the IEEE SA Website at <http://standards.ieee.org>.

Errata

Errata, if any, for IEEE standards can be accessed via <https://standards.ieee.org/standard/index.html>. Search for standard number and year of approval to access the web page of the published standard. Errata links are located under the Additional Resources Details section. Errata are also available in IEEE Xplore: <https://ieeexplore.ieee.org/browse/standards/collection/ieee/>. Users are encouraged to periodically check for errata.

Patents

Attention is called to the possibility that implementation of this standard may require use of subject matter covered by patent rights. By publication of this standard, no position is taken by the IEEE with respect to the existence or validity of any patent rights in connection therewith. If a patent holder or patent applicant has filed a statement of assurance via an Accepted Letter of Assurance, then the statement is listed on the IEEE SA Website at <https://standards.ieee.org/about/sasb/patcom/patents.html>. Letters of Assurance may indicate whether the submitter is willing or unwilling to grant licenses under patent rights without compensation or under reasonable rates, with reasonable terms and conditions that are demonstrably free of any unfair discrimination to applicants desiring to obtain such licenses.

Essential Patent Claims may exist for which a Letter of Assurance has not been received. The IEEE is not responsible for identifying Essential Patent Claims for which a license may be required, for conducting inquiries into the legal validity or scope of Patents Claims, or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of this standard are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility. Further information may be obtained from the IEEE Standards Association.

Participants

At the time this IEEE standard was completed, the 3.6.2 Low Voltage Solid State Surge Protective Components Working Group had the following membership:

Michael J. Maytum, Chair

Albert Martin, Vice Chair

Tim Ardley
Robert Ashton
Frank Basciano
Leonard Drewes

Ernest Gallo
Phillip Havens
Bogdan Klobassa
Peter Kobsa

Wolfgang Oertel
Thomas Tran

The following members of the individual balloting committee voted on this standard. Balloters may have voted for approval, disapproval, or abstention.

Frank Basciano
Demetrio Bucaneg Jr.
Randall Groves
Raymond Hill

Werner Hoelzl
Albert Martin
Wolfgang Oertel
James Timperley

John Vergis
Matthew Williams
Lisa Ward

When the IEEE-SA Standards Board approved this standard on 5 September 2019, it had the following membership:

Gary Hoffman, Chair

Ted Burse, Vice Chair

Jean-Philippe Faure, Past Chair

Konstantinos Karachalios, Secretary

Masayuki Ariyoshi
Stephen D. Dukes
J. Travis Griffith
Guido Hiertz
Christel Hunter
Thomas Koshy
Joseph L. Koepfinger*
John D. Kulick

David J. Law
Joseph Leary
Howard Lee
Xiaohu Liu
Kevin Lu
Daleep Mohla
Andrew Myles
Annette D. Reilly

Dorothy Stanley
Sha Wei
Phil Wennblom
Philip Winston
Howard Wolfman
Feng Wu
Jingyi Zhou

*Member Emeritus

Introduction

This introduction is not part of IEEE Std C62.59–2019, IEEE Standard for Test Methods and Preferred Values for Silicon PN-Junction Clamping Diodes.

IEEE Std C62.35™-2010 covered only voltage clamping components using avalanche breakdown PN-junctions. This standard covers all the voltage clamping technology types: Zener, avalanche, foldback, and punch-through, implemented by using PN-junctions. The content is structured to harmonize with the document structure of recent IEC diode standards, IEC 60747-2:2016 and IEC 69747-3:2013. The companion guide standard to this test standard is IEEE Std C62.42.3™-2017.

Currently in preview, click buy full versi

Contents

1. Overview	9
1.1 Scope	9
1.2 Word usage	9
2. Normative references	10
3. Definitions, acronyms, and abbreviation	10
3.1 Definitions	10
3.2 Acronyms and abbreviations	14
4. Conventions	15
4.1 Letter symbols	15
4.2 Component graphical symbols	16
4.3 IEEE Std C62.42.3-2017	18
5. Environments	18
5.1 General	18
5.2 Normal service conditions	18
5.3 Storage temperature range, T_{stgmin} to T_{stgmax}	18
5.4 Lead soldering temperature, T_{lmax}	19
6. Essential characteristics and ratings	19
6.1 General	19
6.2 Electrical characteristics	19
6.3 Thermal ratings	22
6.4 Electrical ratings	22
7. Measuring and test methods	22
7.1 Mounting and ambient conditions	22
7.2 Test circuits	23
7.3 Measuring methods for electrical characteristics	24
7.4 Measuring methods for thermal characteristics	28
7.5 Verification test methods for ratings (limiting values)	29
8. Identification	30
8.1 Marking	30
8.2 Documentation	30
Annex A (informative) Bibliography	32
Annex B (normative) Preferred values and parameter variation	34
Annex C (informative) Component qualification	37

IEEE Standard for Test Methods and Preferred Values for Silicon PN-Junction Clamping Diodes

1. Overview

1.1 Scope

This standard sets terms, test methods, test circuits, measurement procedures and preferred result values for diodes with one or more silicon PN-junctions used for surge voltage clamping in low-voltage systems.

The technology types covered are:

- Forward biased diodes
- Zener breakdown diodes
- Avalanche breakdown diodes
- Punch-through diodes
- Foldback diodes

This standard does not cover thyristor surge protective components; see IEEE Std C62.37 [B18].¹

1.2 Word usage

The word *shall* indicates mandatory requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted (shall equals is required to).^{2,3}

The word *should* indicates that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required (should equals is recommended that).

The word *may* is used to indicate a course of action permissible within the limits of the standard (may equals is permitted to).

¹The numbers in brackets correspond to those of the bibliography in [Annex A](#).

²The use of the word *must* is deprecated and cannot be used when stating mandatory requirements, *must* is used only to describe unavoidable situations.

³The use of *will* is deprecated and cannot be used when stating mandatory requirements, *will* is only used in statements of fact.