

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Semiconductor devices –
Part 2: Discrete devices – Rectifier diodes
(standards.iteh.ai)

Dispositifs à semiconducteurs –
Partie 2: Dispositifs discrets – Diodes de redressement
IEC 60747-2:2016
<https://standards.iteh.ai/catalog/standards/sist/60606-7e05-4b7b-914b-c3d4232fb22a/iec-60747-2-2016>



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2016 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
Fax: +41 22 919 03 00
info@iec.ch
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 corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

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

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

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

65 000 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.

IEC Customer Service Centre - 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: csc@iec.ch.

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.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

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

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

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 15 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

65 000 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.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Semiconductor devices – Rectifier diodes
Part 2: Discrete devices – Rectifier diodes
(standards.iteh.ai)

Dispositifs à semiconducteurs – Diodes de redressement
Partie 2: Dispositifs discrets – Diodes de redressement
IEC 60747-2:2016
4b7b-914b-
c3d4232fb22a/iec-60747-2-2016

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 31.080.10

ISBN 978-2-8322-3295-8

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.....	5
1 Scope.....	7
2 Normative references.....	7
3 Terms and definitions	7
3.1 General terms and definitions	7
3.2 Voltages	8
3.3 Currents.....	9
3.4 Power dissipation.....	10
3.5 Switching characteristics	11
4 Letter symbols.....	14
4.1 General.....	14
4.2 List of letter symbols	14
4.2.1 Voltages	14
4.2.2 Currents	14
4.2.3 Powers	15
4.2.4 Switching.....	15
5 Essential ratings and characteristics	16
5.1 General.....	16
5.2 Ratings (limiting conditions).....	16
5.2.1 Storage temperature (T_{stg})	16
5.2.2 Operating ambient or heatsink or case or junction temperature (T_a or T_s or T_c or T_j).....	16
5.2.3 Non-repetitive peak reverse voltage (V_{RSM}).....	16
5.2.4 Repetitive peak reverse voltage (V_{RRM}) (where appropriate).....	16
5.2.5 Continuous (direct) reverse voltage (V_R) (where appropriate).....	16
5.2.6 Mean forward current ($I_{F(AV)}$).....	16
5.2.7 R.M.S forward current ($I_{F(R.M.S.)}$).....	16
5.2.8 Repetitive peak forward current (I_{FRM}) (where appropriate)	16
5.2.9 Non-repetitive surge forward current (I_{FSM})	16
5.2.10 Continuous (direct) forward current (I_F).....	17
5.2.11 Peak case non-rupture current (I_{RSMC}) (where appropriate)	17
5.2.12 Non-repetitive surge reverse power dissipation (P_{RSM}) (for avalanche rectifier diodes).....	17
5.2.13 Repetitive peak reverse power dissipation (P_{RRM}) (for avalanche rectifier diodes).....	17
5.2.14 Mean reverse power dissipation ($P_{R(AV)}$) (for avalanche rectifier diodes) 17	17
5.2.15 Mounting torque (M) (where appropriate).....	17
5.2.16 Clamping force (F) for disc type diodes (where appropriate).....	17
5.3 Characteristics	17
5.3.1 General	17
5.3.2 Forward voltage (V_F).....	17
5.3.3 Peak forward voltage (V_{FM}) (where appropriate)	18
5.3.4 Breakdown voltage ($V_{(BR)}$) (of an avalanche rectifier diode)	18
5.3.5 Continuous (direct) reverse current ($I_{R(D)}$).....	18
5.3.6 Repetitive peak reverse current (I_{RRM}) (where appropriate)	18
5.3.7 Recovered charge (Q_r) (where appropriate).....	18

5.3.8	Total capacitive charge (Q_C) (where appropriate)	18
5.3.9	Peak reverse recovery current (I_{RRM}) (where appropriate)	18
5.3.10	Reverse recovery time (t_{rr}) (where appropriate)	19
5.3.11	Reverse recovery energy (E_{rr}) (where appropriate)	19
5.3.12	Forward recovery time (t_{fr}) (where appropriate)	19
5.3.13	Peak forward recovery voltage (V_{FRM}) (where appropriate)	19
5.3.14	Reverse recovery softness factor (S_{rr}) (where appropriate)	19
5.3.15	Thermal resistance (R_{th})	19
5.3.16	Transient thermal impedance ($Z_{th}(t)$) (where appropriate)	19
6	Measuring and test methods	19
6.1	Measuring methods for electrical characteristics	19
6.1.1	General	19
6.1.2	Forward voltage (V_F , V_{FM})	20
6.1.3	Breakdown voltage ($V_{(BR)}$) of avalanche rectifier diodes	23
6.1.4	Reverse current (I_R)	23
6.1.5	Repetitive peak reverse current (I_{RRM})	24
6.1.6	Recovered charge, reverse recovery time, reverse recovery energy and softness factor (Q_r , t_{rr} , E_{rr} , S_{rr})	25
6.1.7	Forward recovery time (t_{fr}) and peak forward recovery voltage (V_{frm})	30
6.1.8	Total capacitive charge (Q_C)	32
6.2	Measuring methods for thermal characteristics	33
6.2.1	General	33
6.2.2	Thermal resistance ($R_{th(j-r)}$) and transient thermal impedance ($Z_{th(j-r)}(t)$)	33
6.3	Verification test methods for ratings (limiting values)	35
6.3.1	Surge (non-repetitive) forward current (I_{FSM})	35
6.3.2	Non-repetitive peak reverse voltage (V_{RSM})	36
6.3.3	Peak reverse power (repetitive or non-repetitive) (P_{RRM} , P_{RSM}) of avalanche rectifier diodes	38
6.3.4	Peak case non-rupture current (I_{RSCM})	41
7	Requirements for type tests, routine tests and endurance tests; marking of rectifier diodes	43
7.1	Type tests	43
7.2	Routine tests	43
7.3	Measuring and test methods	44
7.4	Marking of rectifier diodes	44
7.5	Endurance test	44
7.5.1	List of endurance tests	44
7.5.2	Conditions for endurance tests	44
7.5.3	Acceptance-defining characteristics and acceptance criteria for endurance tests	44
7.5.4	Acceptance-defining characteristics and acceptance criteria for reliability tests	45
	Figure 1 – Voltage waveform during forward recovery, specification method I	11
	Figure 2 – Voltage waveform during forward recovery, specification method II	11
	Figure 3 – Current waveform during reverse recovery	12
	Figure 4 – Diode turn-off, voltage, current and recovered charge	13
	Figure 5 – Reverse voltage ratings	14

Figure 6 – Forward current ratings	15
Figure 7 – Recovered charge Q_r , peak reverse recovery current I_{rrm} , reverse recovery time t_{rr} (idealized characteristics).....	18
Figure 8 – Circuit diagram for the measurement of forward voltage (d.c. method).....	20
Figure 9 – Circuit diagram for the measurement of forward voltage (oscilloscope method).....	21
Figure 10 – Graphic representation of on-state voltage versus current characteristic.....	21
Figure 11 – Circuit diagram for forward voltage measurement (pulse method)	22
Figure 12 – Circuit diagram for breakdown voltage measurement.....	23
Figure 13 – Circuit diagram for reverse current measurement	24
Figure 14 – Circuit diagram for peak reverse current measurement.....	25
Figure 15 – Circuit diagram for recovered charge measurement, half sinusoidal wave method.....	26
Figure 16 – Current waveform through the diode D during recovered charge measurement, half sinusoidal wave method.....	26
Figure 17 – Circuit diagram for recovered charge measurement, rectangular wave method.....	28
Figure 18 – Current waveform through the diode D recovered charge measurement, rectangular wave method.....	28
Figure 19 – Circuit diagram for forward recovery time measurement.....	30
Figure 20 – Current waveform forward recovery time measurement	30
Figure 21 – Voltage waveform forward recovery time measurement	31
Figure 22 – Circuit diagram for total capacitive charge measurement.....	32
Figure 23 – Circuit diagram for thermal impedance measurement.....	33
Figure 24 – Calibration curve showing a typical variation of the forward voltage V_F at a low measuring current I_2 with the case temperature T_C (when heated from outside, i.e. $T_C = T_{vj}$)	34
Figure 25 – Circuit diagram for surge forward current measurement.....	35
Figure 26 – Circuit diagram for peak reverse voltage measurement.....	37
Figure 27 – Circuit to verify peak reverse power of avalanche rectifier diodes	38
Figure 28 – Triangular reverse current waveform.....	39
Figure 29 – Sinusoidal reverse current waveform.....	39
Figure 30 – Rectangular reverse current waveform.....	40
Figure 31 – Verification of P_{RSM} reverse power versus breakdown.....	41
Figure 32 – Circuit diagram for case non-rupture current measurement.....	42
Figure 33 – Waveform of the reverse current i_R through the diode under test.....	42
Table 1 – Minimum type and routine tests for rectifier diodes	44
Table 2 – Acceptance-defining characteristics for acceptance after endurance tests.....	45

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SEMICONDUCTOR DEVICES –

Part 2: Discrete devices – Rectifier diodes

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.
<https://standards.iteh.ai/catalog/standards/sis/615b00b-7eb3-4b7b-814b-412222222222/iec-60747-2-2016>
- 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 60747-2 has been prepared by subcommittee 47E: Discrete semiconductor devices, of IEC technical committee 47: Semiconductor devices.

This third edition cancels and replaces the second edition published in 2000. This edition constitutes a technical revision.

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

- a) Schottky barrier diodes and its properties are added;
- b) Clauses 3, 4, 5 and 7 were amended with some deletions of information no longer in use or already included in other parts of the IEC 60747 series, and with some necessary additions;
- c) Clause 6 was moved and added to Clause 7 of this third edition;
- d) some parts of Clause 7 were moved and added to Clause 7 of this third edition;

e) Annex A was deleted.

This standard is to be used in conjunction with IEC 60747-1:2006 and Amendment 1: 2010.

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

FDIS	Report on voting
47E/531/FDIS	47E/537/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 in the IEC 60747 series, published under the general title *Semiconductor devices*, can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

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 [IEC 60747-2:2016](http://standards.iteh.ai/catalog/standards/sist/6fd5b00b-7eb3-4b7b-914b-c3d4232fb22a/iec-60747-2-2016)
- amended. <https://standards.iteh.ai/catalog/standards/sist/6fd5b00b-7eb3-4b7b-914b-c3d4232fb22a/iec-60747-2-2016>

iteh STANDARD PREVIEW
(standards.iteh.ai)

SEMICONDUCTOR DEVICES –

Part 2: Discrete devices – Rectifier diodes

1 Scope

This part of IEC 60747 provides standards for the following categories or sub-categories of rectifier diodes, including:

- line rectifier diodes;
- avalanche rectifier diodes;
- fast-switching rectifier diodes;
- Schottky barrier diodes.

2 Normative references

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

IEC 60050-521, *International Electrotechnical Vocabulary – Part 521: Semiconductor devices and integrated circuits* (available at <http://www.electropedia.org>)

IEC 60747-1:2006, *Semiconductor devices – Part 1: General*

IEC 60747-1:2006/AMD1: 2010

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

IEC 60749-34, *Semiconductor devices – Mechanical and climatic test methods – Part 34: Power cycling*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60747-1, in IEC 60050-521 (except for definitions 521-05-18, 521-05-25, 521-05-26) and the following apply.

3.1 General terms and definitions

3.1.1

forward direction

direction of the flow of continuous (direct) current in which a semiconductor diode has the lower resistance

3.1.2

reverse direction

direction of the flow of continuous (direct) current in which a semiconductor diode has the higher resistance

3.1.3**anode terminal**

<semiconductor rectifier diode> terminal to which forward current flows from the external circuit

3.1.4**cathode terminal**

<semiconductor rectifier diode> terminal from which forward current flows to the external circuit

3.2 Voltages**3.2.1****forward voltage** V_F

voltage across the terminals which results from the flow of current in the forward direction

3.2.2**peak forward voltage**

crest forward voltage

 V_{FM}

voltage across the terminal which results from a π times higher current than the specified mean current

3.2.3**forward recovery voltage** V_{fr}

varying voltage occurring during the forward recovery time after instantaneous switching from zero or a specified reverse voltage to a specified forward current

3.2.4**reverse voltage** V_R

constant voltage applied to a diode in the reverse direction

3.2.5**repetitive peak reverse voltage** V_{RRM}

highest instantaneous value of the reverse voltage, including all repetitive transient voltages, but excluding all non-repetitive transient voltages

Note 1 to entry: See Figure 5.

3.2.6**non-repetitive peak reverse voltage**

peak transient reverse voltage

 V_{RSM}

highest instantaneous value of any non-repetitive transient reverse voltage

Note 1 to entry: The repetitive voltage is usually a function of the circuit and increases the power dissipation of the device. A non-repetitive transient voltage is usually due to an external cause and it is assumed that its effect has completely disappeared before the next transient arrives.

3.2.7**breakdown voltage** $V_{(BR)}$

voltage in the region where breakdown occurs

3.3 Currents

3.3.1

forward current

I_F
current flowing through the diode in forward direction

3.3.2

mean forward current

$I_{F(AV)}$
value of the forward current averaged over the full cycle

3.3.3

r.m.s. forward current

$I_{F(R.M.S.)}$
r.m.s value of the forward current over one complete cycle of the operating frequency

Note 1 to entry: Where no ambiguity arises, $I_{F(RMS)}$ may be used.

3.3.4

peak forward current

I_{FM}
maximum value of forward current time function

3.3.5

repetitive peak forward current

I_{FRM}
peak value of the forward current including all repetitive transient currents

Note 1 to entry: See Figure 6.

[IEC 60747-2:2016](https://standards.iteh.ai/catalog/standards/sist/6fd5b00b-7eb3-4b7b-914b-c3d4232fb22a/iec-60747-2-2016)

<https://standards.iteh.ai/catalog/standards/sist/6fd5b00b-7eb3-4b7b-914b-c3d4232fb22a/iec-60747-2-2016>

3.3.6

non-repetitive surge forward current

I_{FSM}
forward current pulse of short time duration and specified waveshape, whose application causes or would cause the maximum rated junction temperature to be exceeded, but which is assumed to occur rarely and with a limited number of such occurrences during the service life of the device and to be a consequence of unusual circuit conditions (for example a fault)

Note 1 to entry: See Figure 6.

3.3.7

reverse current

I_R
current flowing through the diode when reverse voltage is applied

3.3.8

reverse recovery current

I_{rr}
part of the reverse current which occurs during the reverse recovery until quasi static conditions have been reached

3.3.9

I^2t value

integral of the square of a surge forward current over the duration of the current surge

3.3.10 peak case non-rupture current

I_{RSMC}

peak value of reverse current that should not be exceeded in order to avoid bursting of the case or the emission of a plasma beam under specified conditions of current, waveshape and time

Note 1 to entry: This definition implies that a fine crack in the case might be found in a device subjected to the peak case non-rupture current, provided that no plasma beam was emitted. Parts of the case shall not break away, nor shall the device melt externally or burst into flames.

3.4 Power dissipation

3.4.1 total power dissipation

P_{tot}

sum of the dissipations due to current in the forward and reverse direction and during switching

3.4.2 forward power dissipation

P_{F}

power dissipation due to the flow of forward current

3.4.3 mean forward power dissipation

$P_{\text{F(AV)}}$

mean value of the product of the instantaneous forward voltage and the instantaneous forward current averaged over a full cycle

3.4.4 reverse power dissipation

P_{R}

power dissipation resulting from the flow of reverse current

3.4.5 forward recovery dissipation

P_{fr}

power dissipated within the diode during the change between reverse voltage and forward current when the diode is switched from a reverse voltage to a forward current

3.4.6 reverse recovery dissipation

P_{rr}

power dissipated within the diode during the change between forward current and reverse voltage when the diode is switched from a forward current to a reverse voltage

3.4.7 surge reverse power dissipation

P_{RSM}

<avalanche rectifier diodes> power which is dissipated within the diode resulting from surges occurring when it is operating in the reverse direction

3.4.8 repetitive peak reverse power dissipation

P_{RRM}

<avalanche rectifier diodes> power which is dissipated within the diode resulting from repetitive peak currents when it is operating in the reverse direction

3.4.9 mean reverse power dissipation

$P_{R(AV)}$
<avalanche rectifier diodes> power which is dissipated within the diode resulting from constant reverse current or as a mean value of a periodical function when it is operating in the reverse direction

3.5 Switching characteristics

3.5.1 forward recovery time

t_{fr}
time interval between the instant when the forward voltage rises through a specified first value and the instant when it falls from its peak value V_{frm} to a specified second value close to the final stable value of forward voltage (as shown in Figure 1), or when the extrapolated forward voltage reaches zero (as shown in Figure 2), upon the application of a specified step of forward current following a zero-voltage or other specified reverse-voltage condition

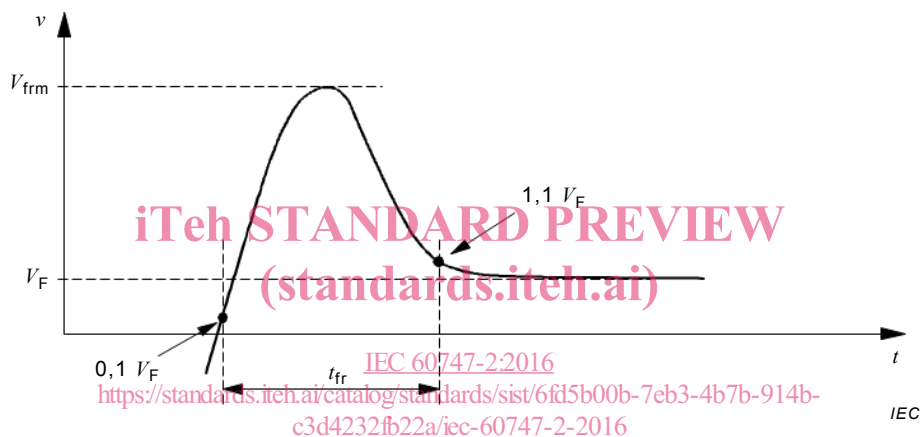


Figure 1 – Voltage waveform during forward recovery, specification method I

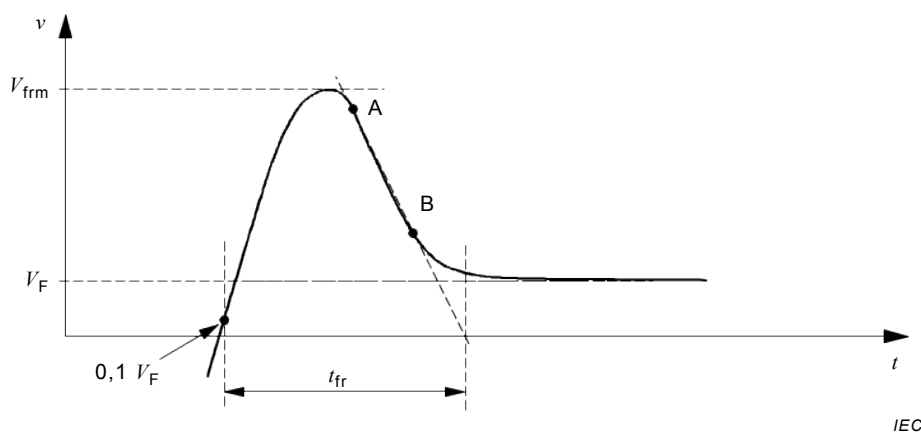


Figure 2 – Voltage waveform during forward recovery, specification method II

Note 1 to entry: Specification method I: The specified first and second values referred to in the definition are usually 10 % and 110 %, respectively, of the final stable value (V_F in Figure 1).

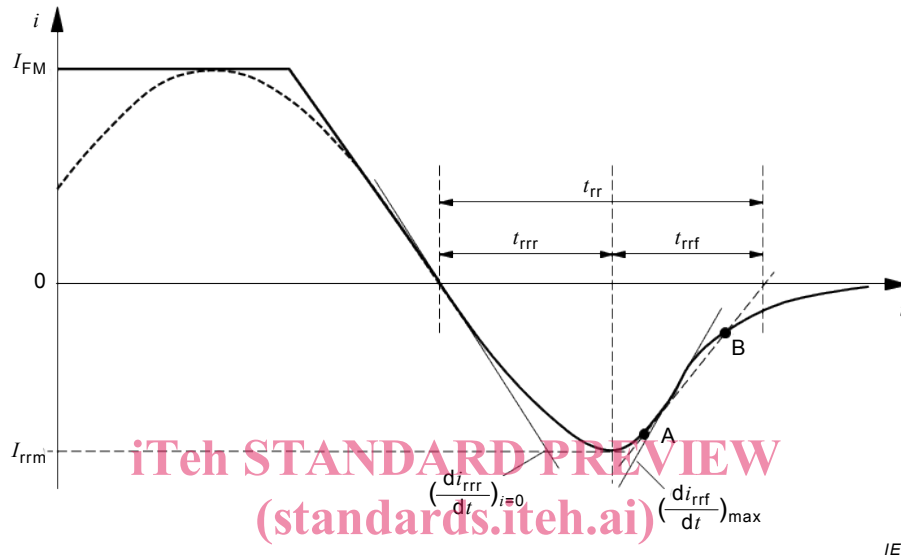
Note 2 to entry: Specification method II: The extrapolation is carried out with respect to specified points A and B where A and B are usually 90 % and 50 % of V_{frm} as shown in generalized form in Figure 2.

Note 3 to entry: Method I is preferred for V_{frm} values up to about 10 V; method II for values considerably higher.

[SOURCE: IEC 60050-521:2002, 521-05-25, modified — revised to relate only to forward voltage; notes to entry and figures added]

3.5.2 reverse recovery time

t_{rr}
time interval between the instant when the current passes through zero, when changing from the forward direction to the reverse direction, and the instant when the extrapolated reverse current reaches zero (as shown in Figure 3)



IEC

IEC 60747-2:2016
Figure 3 – Current waveform during reverse recovery

Note 1 to entry: The extrapolation is carried out with respect to specified points A and B as shown in generalised form in Figure 3. Point A is often specified at 90 % of I_{rrm} , and point B at 25 % of I_{rrm} .

[SOURCE: IEC 60050-521:2002, 521-05-26, modified — revised to relate only to current with specified limits of the time function; notes to entry and figures added]

3.5.3 reverse recovery current rise time

t_{rrr}
time interval between the beginning of the reverse recovery time and the instant when the reverse recovery current reaches its peak value after instantaneous switching from a specified forward current to a specified reverse voltage

3.5.4 reverse recovery current fall time

t_{rrf}
time interval between the instant when the reverse recovery current reaches its peak value and the end of reverse recovery time after instantaneous switching from a specified forward current to a specified reverse voltage

3.5.5 recovered charge

Q_r
total charge recovered from the diode during a specified integration time after switching from a specified forward current condition to a specified reverse condition:

$$Q_r = \int_{t_0}^{t_0+t_i} i \cdot dt$$

where

t_0 is the instant when the current passes through zero;

t_i is the specified integration time from t_0 to a time where i_{rr} has fallen to 2 % of I_{rrm} (as shown in Figure 4).

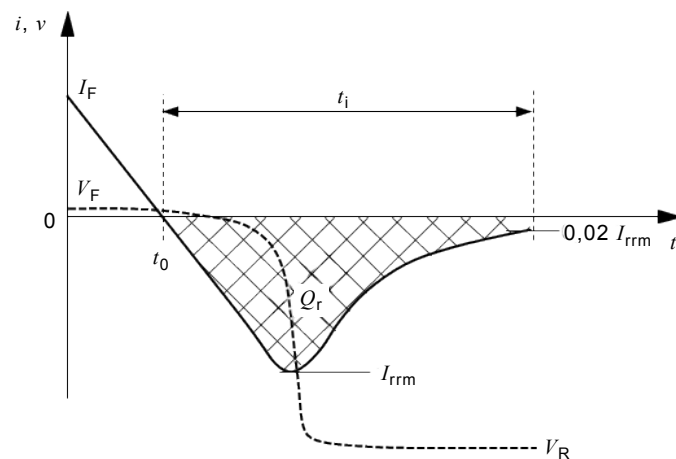


Figure 4 – Diode turn-off, voltage, current and recovered charge

Note 1 to entry: This charge includes components due to both carrier storage and depletion layer capacitance.

[SOURCE: IEC 60050-521:2002, 521-05-18, modified — revised to relate only to diode and added integration time; formula and figure added]

3.5.6 capacitive charge

Q_C

<Schottky barrier diodes> the charge required to raise the cathode-anode voltage from zero to a specified value

3.5.7 reverse recovery energy

E_{rr}

switching energy which results from the integration of the product from device voltage and current during the integration time t_i of recovered charge

Note 1 to entry: t_i is shown in Figure 4.

3.5.8 reverse recovery softness factor

S_{rr}

absolute value of the ratio of the rate of rise of the reverse recovery current when passing through zero to the maximum rate of fall of the recovery current

$$S_{rr} = \left| \frac{(di_{rr}/dt)_{i=0}}{(di_{rr}/dt)_{max}} \right|$$

Note 1 to entry: (di_{rr}/dt) and (di_{rr}/dt) are shown in Figure 3.