IEC 60747-3

Edition 2.0 2013-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour
inside

Semiconductor devices –
Part 3: Discrete devices: Signal, switching and regulator diodes

Dispositifs à semiconducteurs –
Partie 3: Dispositifs discrets: Diodes de signal, diodes de commutation et diodes régulatrices

IEC 60747-3:2013

This document is a preview generated by EVS

THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2013 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 la CEI ou du Comité national de la CEI du pays du demandeur.
Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

IEC Central Office
3, rue de Varembé
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.

Useful links:

IEC publications search - www.iec.ch/searchpub

The advanced search enables you 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It also gives information on projects, replaced and withdrawn publications.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 on-line and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary (IEV) on-line.

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 la CEI

La Commission Electrotechnique Internationale (CEI) 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 CEI

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

Liens utiles:

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

La recherche avancée vous permet de trouver des publications CEI 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.

Just Published CEI - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications de la CEI. 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 au monde de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (VEI) en ligne.

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.

This document is a preview generated by EVS

IEC 60747-3

Edition 2.0 2013-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour
inside

Semiconductor devices –
Part 3: Discrete devices: Signal, switching and regulator diodes

Dispositifs à semiconducteurs –
Partie 3: Dispositifs discrets: Diodes de signal, diodes de commutation et diodes régulatrices

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX V

ICS 31.080.10

ISBN 978-2-8322-0897-7

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.

® Registered trademark of the International Electrotechnical Commission
Marque déposée de la Commission Electrotechnique Internationale

This document is a preview generated by EVS

CONTENTS

FOREWORD 4
1 Scope 6
2 Normative references 6
3 Terms, definitions and graphical symbols 6
  3.1 Signal and switching diodes 6
  3.2 Voltage reference diodes and voltage regulator diodes 7
  3.3 Current-regulator diodes 8
4 Letter symbols 9
  4.1 General 9
  4.2 Signal and switching diodes 9
    4.2.1 Subscripts 9
    4.2.2 List of letter symbols 9
  4.3 Voltage reference diodes and voltage regulator diodes 10
    4.3.1 Subscripts 10
    4.3.2 List of letter symbols 10
  4.4 Current-regulator diodes 10
    4.4.1 Subscripts 10
    4.4.2 List of letter symbols 11
5 Essential ratings and characteristics 11
  5.1 General 11
  5.2 Signal and switching diodes 11
    5.2.1 Ratings (limiting values) 11
    5.2.2 Characteristics 11
  5.3 Voltage reference diodes and voltage regulator diodes 14
    5.3.1 Ratings (limiting values) 14
    5.3.2 Characteristics 14
  5.4 Current-regulator diodes 16
    5.4.1 Ratings (limiting values) 16
    5.4.2 Characteristics 16
6 Measuring methods 17
  6.1 General 17
  6.2 Signal and switching diodes 17
    6.2.1 Reverse current I_R 17
    6.2.2 Forward voltage V_F 17
    6.2.3 Total capacitance C_{tot} 18
    6.2.4 Forward recovery time t_{fr} and peak forward recovery voltage V_{FRM} 19
    6.2.5 Reverse recovery time (t_{rr}) and recovered charge (Q_r) 20
    6.2.6 Detector voltage efficiency η_V 21
    6.2.7 Detector power efficiency η_p 22
    6.2.8 Noise V_n, I_n 23
  6.3 Voltage reference diodes and voltage regulator diodes 24
    6.3.1 Working voltage V_Z 24
    6.3.2 Differential resistance in the working current range r_z 25
    6.3.3 Temperature coefficient of working voltage α_{VZ} 25
    6.3.4 Reverse current I_R 26
    6.3.5 Forward voltage V_F 26

This document is a preview generated by EVS

6.3.6 Junction capacitance C_{tot} 26
6.3.7 Noise voltage V_n 26
6.4 Current-regulator diodes 27
6.4.1 Regulator current I_S 27
6.4.2 Temperature coefficient of regulator current α_{IS} 27
6.4.3 Regulator current variation ΔI_S 28
6.4.4 Limiting voltage V_L 28
6.4.5 Small-signal regulator conductance g_s 29
6.4.6 Knee conductance g_k 31
7 Acceptance and reliability 31
7.1 Acceptance-defining characteristics 31
7.2 Electrical endurance tests 33

Figure 1 – Current-regulator diode graphical symbol 8
Figure 2 – Current-regulator diode characteristic with symbol identification 10
Figure 3 – Reverse recovery current waveform 12
Figure 4 – Current and voltage waveforms 13
Figure 5 – Circuit diagram for the measurement of I_R 17
Figure 6 – Circuit diagram for the measurement of V_F 18
Figure 7 – Circuit diagram for the measurement for C_{tot} 18
Figure 8 – Circuit diagram for the measurement of t_{fr} and V_{FRM} 19
Figure 9 – Circuit diagram for the measurement of t_{rr} 20
Figure 10 – Circuit diagram for the measurement of η_v 21
Figure 11 – Circuit diagram for the measurement of η_p 22
Figure 12 – Circuit diagram for the measurement of noise current 23
Figure 13 – Circuit diagram for the measurement of V_Z 24
Figure 14 – Circuit diagram for the measurement of V_n 26
Figure 15 – Circuit diagram for the measurement of I_S 27
Figure 16 – Circuit diagram for the measurement of g_s (two-voltmeter method) 29
Figure 17 – Circuit diagram for the measurement of g_s (two-terminal bridge method) 30

Table 1 – Preferred reference diode working voltages – Voltages in the E24 series 14
Table 2 – Preferred reference diode working voltages – Voltages in the E12 series 15
Table 3 – Acceptance-defining characteristics for acceptance after endurance tests 32
Table 4 – Test circuits and conditions for the endurance tests 33

This document is a preview generated by EVS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SEMICONDUCTOR DEVICES –

Part 3: Discrete devices: Signal, switching and regulator 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.

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 60747-3 has been prepared by subcommittee 47E: Discrete semiconductor devices, of IEC technical committee 47: Semiconductor devices.

This second edition cancels and replaces the first edition published in 1985, Amendment 1:1991 and Amendment 2:1993. This edition constitutes a technical revision.

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

a) All clauses were re-edited to latest IEC publication format and style with all contents from previous publication.

b) All clauses have been amended by suitable additions and deletions.

This standard is to be read in conjunction with IEC 60747-1:2006 and its Amendment 1 (2010).

This document is a preview generated by EVS

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

FDIS	Report on voting
47E/453/FDIS	47E/455/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 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.

This document is a preview generated by EVS

SEMICONDUCTOR DEVICES –

Part 3: Discrete devices: Signal, switching and regulator diodes

This document is a preview generated by EVS

1 Scope

This part of IEC 60747 gives the requirements for the following devices:

- signal diodes (excluding diodes designed to operate at frequencies above several hundred MHz);
- switching diodes (excluding high power rectifier diodes);
- voltage-regulator diodes;
- voltage-reference diodes;
- current-regulator 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 (all parts), *International Electrotechnical Vocabulary*
(available at <http://www.electropedia.org>)

IEC 60747-1:2006, *Semiconductor devices – Part 1: General*
Amendment 1:2010

3 Terms, definitions and graphical symbols

For the purposes of this document, the terms and definitions given in IEC 60050-521, IEC 60050-702 and IEC 60747-1, and the following, apply.

3.1 Signal and switching diodes

3.1.1
forward recovery voltage
v_{FR}
forward voltage occurring during the forward recovery time after switching from zero or a reverse voltage to a forward current

3.1.2
detector voltage efficiency
η_{V}
ratio of the d.c. load voltage to the peak sinusoidal input voltage under specified circuit conditions