

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

---

**Semiconductor devices –  
Part 5-7: Optoelectronic devices – Photodiodes and phototransistors**

**Dispositifs à semiconducteurs –  
Partie 5-7: Dispositifs optoélectroniques – Photodiodes et phototransistors**



## 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](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 corrigenda or an amendment might have been published.

#### IEC Catalogue - [webstore.iec.ch/catalogue](http://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](http://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](http://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](http://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](http://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](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: [csc@iec.ch](mailto: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](http://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](http://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](http://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](http://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](http://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](http://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](mailto:csc@iec.ch).

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

---

**Semiconductor devices –  
Part 5-7: Optoelectronic devices – Photodiodes and phototransistors**

**Dispositifs à semiconducteurs –  
Partie 5-7: Dispositifs optoélectroniques – Photodiodes et phototransistors**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

---

ICS 31.080.99

ISBN 978-2-8322-3189-0

**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
1 Scope.....	5
2 Normative references.....	5
3 Terms relating to physical concepts .....	5
4 Terms relating to types of devices .....	6
5 General terms.....	6
6 Terms relating to ratings and characteristics .....	9
6.1 Switching times.....	9
6.2 Photosensitive devices characteristics.....	11
7 Essential ratings and characteristics for photodiodes.....	14
8 Essential ratings and characteristics for phototransistors.....	15
9 Measuring methods for photosensitive devices.....	17
Annex A (informative) Cross-references index .....	22
Bibliography .....	23
Figure 1 – Optical port for devices with pigtail (emitter or detector).....	7
Figure 2 – Optical port for packaged devices (emitter or detector), without pigtail.....	8
Figure 3 – Optical port for non-packaged devices (emitter or detector) without pigtail.....	9
Figure 4 – Switching times .....	11
Figure 5 – Fibre-input sensitivity $S_{FD}$ .....	12
Figure 6 – Sensitivity diagram and related characteristics.....	14
Figure 7 – Block diagram for the measurement of the current under optical radiation.....	17
Figure 8 – Phototransistor and photodiode circuit diagrams .....	18
Figure 9 – Circuit diagrams .....	19
Figure 10 –Circuit diagram.....	20
Table 1 – Optical and electrical characteristics of photodiodes.....	15
Table 2 – Optical and electrical characteristics of phototransistors.....	16
Table A.1 – Cross references index.....	22

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SEMICONDUCTOR DEVICES –****Part 5-7: Optoelectronic devices –  
Photodiodes and phototransistors**

## 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, accept 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 60747-5-7 has been prepared by subcommittee 47E: Discrete semiconductor devices, of IEC technical committee 47: Semiconductor devices.

This standard replaces the clauses for photodiodes and phototransistors described in IEC 60747-5-1, IEC 60747-5-2 and IEC 60747-5-3 including their amendments.

IEC 60747-5-1, IEC 60747-5-2 and IEC 60747-5-3, including their amendments, are replaced by the publications of IEC 60747-5-4, IEC 60747-5-5, IEC 60747-5-6<sup>1</sup> and IEC 60747-5-7 as a result of reconstruction.

<sup>1</sup> To be published.

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

CDV	Report on voting
47E/471/CDV	47E/502/RVC

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.

## SEMICONDUCTOR DEVICES –

### Part 5-7: Optoelectronic devices – Photodiodes and phototransistors

#### 1 Scope

This part of IEC 60747 specifies the terminology, the essential ratings and characteristics as well as the measuring methods of photodiodes (hereinafter referred to as “PDs”) and phototransistors (hereinafter referred to as “PTs”).

#### 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.

None.

#### 3 Terms relating to physical concepts

##### 3.1 electromagnetic radiation radiation

- 1) emission or transfer of energy in the form of electromagnetic waves with the associated photons
- 2) these electromagnetic waves or these photons

[SOURCE: IEC 60050-845:1987, 845-01-01, modified – The note has been deleted.]

##### 3.2 optical radiation

electromagnetic radiation of wavelengths between the region of transition to X-rays ( $\lambda \approx 1$  nm) and the region of transition to radio waves ( $\lambda \approx 1$  nm)

[SOURCE: IEC 60050-845:1987, 845-01-02]

##### 3.3 visible radiation

any optical radiation capable of causing a visual sensation directly

NOTE to entry: There are no precise limits for the spectral range of visible radiation since they depend upon the amount of radiant power reaching retina and the responsivity of the observer. The lower limit is generally taken between 360 nm and 400 nm and the upper limit between 760 nm and 830 nm.

[SOURCE: IEC 60050-845:1987, 845-01-03]

##### 3.4 infrared radiation

optical radiation for which the wavelengths are longer than those for visible radiation

[SOURCE: IEC 60050-845:1987, 845-01-04, modified – The note has been deleted.]