

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Semiconductor devices –
Part 5-5: Optoelectronic devices – Photocouplers**

**Dispositifs à semiconducteurs –
Partie 5-5: Dispositifs optoélectroniques – Photocoupleurs**



THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2020 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
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 corrigendum or an amendment might have been published.

IEC publications search - 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 It also gives information on projects, replaced and withdrawn publications.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 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 once a month by email.

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: sales@iec.ch.

IEC online collection - oc.iec.ch

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

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

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.

Recherche de publications IEC - webstore.iec.ch/advsearchform

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 une fois par mois par email.

Service Clients - webstore.iec.ch/csc

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

IEC online collection - oc.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Semiconductor devices –
Part 5-5: Optoelectronic devices – Photocouplers**

**Dispositifs à semiconducteurs –
Partie 5-5: Dispositifs optoélectroniques – Photocoupleurs**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 31.080.01; 31.260

ISBN 978-2-8322-1001-4

**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	8
3.7 Symbols for limiting values (absolute maximum system) over the operating temperature range, unless otherwise stated.....	16
4 Electrical characteristics.....	16
4.1 Phototransistor output photocoupler.....	16
4.2 Phototriac output photocoupler or solid state opto-relay.....	7
5 Photocouplers providing protection against electric shock	18
5.1 General.....	18
5.2 Type	18
5.3 Ratings	18
5.3.1 Datasheet ratings	18
5.3.2 Safety ratings	18
5.3.3 Functional ratings.....	18
5.3.4 Rated isolation voltages	18
5.4 Electrical safety requirements	18
5.5 Electrical, environmental and/or endurance test information (supplementary information)	19
5.5.1 Test and test sequence	19
5.5.2 Routine test.....	19
5.5.3 Sample test	20
5.5.4 Type test	20
6 Measuring methods for photocouplers	27
6.1 Current transfer ratio $H_{f(ct)}$	27
6.2 Input-to-output capacitance C_{IO}	28
6.3 Isolation resistance between input and output R_{IO}	29
6.4 Isolation test.....	30
6.5 Partial discharges of photocouplers	31
6.6 Collector-emitter saturation voltage $V_{CE(sat)}$ of a photocoupler.....	34
6.6.1 Collector-emitter saturation voltage (DC method).....	34
6.6.2 Collector-emitter saturation voltage (pulse method)	34
6.7 Switching times t_{on} , t_{off} of a photocoupler.....	35
6.8 Peak off-state current I_{DRM}	37
6.9 Peak on-state voltage V_{TM}	39
6.10 DC off-state current I_{BD}	41
6.11 DC on-state voltage V_T	42
6.12 Holding current I_H	42
6.13 Critical rate of rise of off-state voltage dV/dt	43
6.14 Trigger input current I_{FT}	46
6.15 Measuring methods of common mode transient immunity (CMTI) for photocouplers	47
7 Testing methods of electrical ratings for phototriac couplers.....	49
7.1 Repetitive peak off-state voltage V_{DRM}	49

7.2	DC off-state voltage V_{BD}	50
Annex A (normative)	Input/output safety test	51
A.1	Purpose	51
A.2	Circuit diagram	51
A.3	Circuit description	51
A.4	Precautions to be observed	51
A.5	Measurement procedure	51
A.6	Specified conditions	51
Bibliography	52
Figure 1	– Time intervals for method a)	12
Figure 2	– Time intervals for method b)	13
Figure 3	– Test voltage	15
Figure 4	– Measurement circuit	27
Figure 5	– Measurement circuit for input to output capacitance	29
Figure 6	– Measurement circuit for isolation resistance	29
Figure 7	– Test circuit for withstanding isolation voltage	30
Figure 8	– Partial discharge test circuit	31
Figure 9	– Complete test arrangement connections for calibration	32
Figure 10	– DC measurement circuit	34
Figure 11	– Pulse measurement circuit	35
Figure 12	– Switching time measurement circuit	36
Figure 13	– Switching times	37
Figure 14	– Measurement circuit for peak off-state current	38
Figure 15	– Waveforms of the peak off-state voltage and current	39
Figure 16	– Measurement circuit for peak on-state voltage	40
Figure 17	– Waveforms of the peak on-state voltage and current	41
Figure 18	– Measurement circuit for DC off-state current	41
Figure 19	– Measurement circuit for DC on-state voltage	42
Figure 20	– Measurement circuit for holding current	43
Figure 21	– Measurement circuit for critical rate of rise of off-state voltage	44
Figure 22	– Exponential waveform of the off-voltage (V_D)	45
Figure 23	– Linear pulse form of the off-voltage (V_D)	45
Figure 24	– Measurement circuit for the trigger input current	46
Figure 25	– Output terminal voltage versus input forward current	46
Figure 26	– Common mode transient immunity (CMTI) measurement circuit for photocoupler	47
Figure 27	– Typical waveforms of the common mode pulse (V_{CM}) and photocoupler output (V_O)	49
Figure A.1	– Circuit diagram	51
Table 1	– Phototransistor electrical characteristics	16
Table 2	– Phototriac electrical characteristics	17
Table 3	– Datasheet characteristics	19

Table 4 – Tests and test sequence for photocoupler providing protection against electrical shock 26

Table 5 – Test conditions 27

Table 6 – Specified conditions for methods a) and b) 33

Currently in preview, click buy full version

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SEMICONDUCTOR DEVICES –

Part 5-5: Optoelectronic devices –
Photocouplers

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 60747-5-5 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 2007 and Amendment 1:2013. This edition constitutes a technical revision.

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

- a) optional data sheet basic insulation rating in accordance with IEC 60664-1:2007, 6.1.3.5;
- b) editorial corrections on the use of V_{IORM} ;
- c) editorial corrections on Figure 2: Time intervals for method b);
- d) addition of an alternative surge pulse V_{IOSM} test method.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
47E/706/FDIS	47E/714/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document 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 document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

SEMICONDUCTOR DEVICES –

Part 5-5: Optoelectronic devices – Photocouplers

1 Scope

This part of IEC 60747 specifies the terminology, essential ratings, characteristics, safety tests, as well as the measuring methods for photocouplers.

NOTE The term "optocoupler" can also be used instead of "photocoupler".

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-1:2013, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-17, *Basic environmental testing procedures – Part 2-17: Tests – Test Q: Sealing*

IEC 60068-2-20, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-58, *Environmental testing – Part 2-58: Tests – Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60216-1, *Electrical insulating materials – Thermal endurance properties – Part 1: Ageing procedures and evaluation of test results*