

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE



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

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

IEC 60747-5-5:2007

<https://standards.iteh.ai/standards/iec/4e695f8e-c7d6-4bfc-b754-7e068ca61d1e/iec-60747-5-5-2007>



**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 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.

#### Useful links:

IEC publications search - [www.iec.ch/searchpub](http://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](http://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](http://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](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 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](http://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](http://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](http://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](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 – Discrete devices –  
Part 5-5: Optoelectronic devices – Photocouplers**

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

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

ICS 31.080.01; 31.260

ISBN 978-2-8322-0814-4

**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.....	6
1 Scope.....	8
2 Normative references .....	8
3 Photocoupler .....	9
3.1 Semiconductor material.....	9
3.2 Details of outline and encapsulation .....	9
3.2.1 IEC and/or national reference number of the outline drawing.....	9
3.2.2 Method of encapsulation: glass/metal/plastic/other .....	9
3.2.3 Terminal identification and indication of any connection between a terminal and the case .....	9
3.3 Type of photocouplers .....	9
3.3.1 DC input photocoupler .....	9
3.3.2 AC input photocoupler .....	9
3.3.3 Phototransistor photocoupler .....	9
3.3.4 Photodarlington photocoupler .....	9
3.3.5 Photothyristor photocoupler.....	9
3.3.6 Phototriac photocoupler.....	10
3.3.7 IC photocoupler .....	10
3.3.8 FET photocoupler .....	10
3.3.9 Photodiode photocoupler.....	10
3.3.10 IC input photocoupler .....	10
3.3.11 Solid state opto relay.....	10
4 Terms related to ratings and characteristics for photocouplers .....	10
4.1 Current transfer ratio.....	10
4.1.1 Static value of the (forward) current transfer ratio $h_{F(ctr)}$ .....	10
4.1.2 Small-signal short-circuit (forward) current transfer ratio $h_{f(ctr)}$ .....	10
4.2 Cut-off frequency $f_{co}$ .....	10
4.3 Input-to-output capacitance $C_{IO}$ .....	10
4.4 Isolation resistance $R_{IO}$ .....	10
4.5 Isolation voltage .....	10
4.5.1 DC isolation voltage $V_{IO}$ .....	11
4.5.2 Repetitive peak isolation voltage $V_{IORM}$ .....	11
4.5.3 Surge isolation voltage $V_{IOSM}$ .....	11
4.6 Terms related to photocouplers with phototriac output and/or solid state opto-relay with triac output .....	11
4.6.1 Repetitive peak voltage .....	11
4.6.2 Repetitive peak off-state voltage $V_{DRM}$ .....	11
4.6.3 Repetitive peak reverse voltage $V_{RRM}$ .....	11
4.6.4 RMS on-state current $I_{T(RMS)}$ .....	11
4.6.5 Peak off-state current $I_{DRM}$ .....	11
4.6.6 Peak on-state voltage $V_{TM}$ .....	11
4.6.7 DC off-state current $I_{BD}$ .....	11

4.6.8	DC on-state voltage $V_T$ .....	11
4.6.9	Holding current $I_H$ .....	11
4.6.10	Critical rate of rise of off-state voltage $dV/dt$ .....	11
4.6.11	Trigger input current $I_{FT}$ .....	12
4.7	Common mode transient immunity CMTI .....	12
5	Terms for photocoupler providing protection against electrical shock .....	12
5.1	Safety ratings of a photocoupler for reinforced isolation .....	12
5.2	Electrical safety requirements of a photocoupler for reinforced isolation .....	12
5.2.1	Partial discharge $p_d$ .....	12
5.2.2	Apparent charge $q_{pd}$ , $q$ .....	12
5.2.3	Threshold apparent charge $q_{pd(TH)}$ , $q_{TH}$ .....	12
5.2.4	Test voltages for the partial-discharge test of a photocoupler .....	12
5.2.5	Test voltage $V_{pd(t)}$ , $V_t$ .....	12
5.2.6	Partial discharge test voltage $V_{pd(t)}$ .....	13
5.2.7	Initial test voltage $V_{pd(ini)}$ , $V_{ini}$ .....	13
5.2.8	Apparent charge measuring voltage $V_{pd(m)}$ , $V_m$ .....	13
5.2.9	Partial-discharge inception voltage $V_{pd(i)}$ , $V_i$ .....	13
5.2.10	Partial-discharge extinction voltage $V_{pd(e)}$ , $V_e$ .....	13
5.2.11	Time intervals of the test voltage .....	13
5.3	Isolation voltages and isolation test voltages for photocouplers providing protection against electrical shock .....	16
5.3.1	Rated isolation voltage .....	16
5.4	Limiting values (absolute maximum system) over the operating temperature range, unless otherwise stated .....	16
5.4.1	Minimum and maximum storage temperatures $T_{stg}$ .....	16
5.4.2	Minimum and maximum ambient or reference-point operating temperatures $T_{amb}$ or $T_{ref}$ .....	16
5.4.3	Maximum soldering temperature $T_{sld}$ .....	16
5.4.4	Maximum continuous (direct) reverse input voltage $V_R$ .....	16
5.4.5	Maximum collector-emitter voltage, with the base open-circuited $V_{CEO}$ .....	16
5.4.6	Maximum collector-base voltage, where an external base connection is present, with the emitter open-circuited $V_{CBO}$ .....	16
5.4.7	Maximum emitter-base voltage, where an external base connection is present, with the collector open-circuited $V_{EBO}$ .....	16
5.4.8	Maximum emitter-collector voltage, where no external base connection is present $V_{ECO}$ .....	16
5.4.9	Maximum continuous (direct) or repetitive peak isolation voltage $V_{IO}$ or $V_{IORM}$ .....	16
5.4.10	Where appropriate, maximum surge isolation voltage $V_{IOSM}$ .....	16
5.4.11	Maximum continuous collector current $I_C$ .....	17
5.4.12	Maximum continuous forward input current $I_F$ at an ambient or reference-point temperature of 25 °C and derating curve or derating factor .....	17
5.4.13	Maximum peak forward input current $I_{FM}$ at an ambient or reference-point temperature of 25 °C and under specified pulse conditions .....	17

5.4.14	Maximum power dissipation $P_{trn}$ of the output transistor at an ambient or reference-point temperature of 25 °C and a derating curve or derating factor .....	17
5.4.15	Maximum total power dissipation of the package $P_{tot}$ at an ambient or reference-point temperature of 25 °C and derating curve or derating factor .....	17
6	Electrical characteristics .....	17
6.1	Phototransistor output photocoupler .....	17
6.2	Phototriac output photocoupler or solid state opto-relay .....	19
7	Photocouplers providing protection against electrical shock.....	19
7.1	Type.....	19
7.2	Ratings (have to be mentioned in a special section in the manufacturer's data sheet).....	19
7.2.1	Safety ratings .....	19
7.2.2	Functional ratings.....	19
7.2.3	Rated isolation voltages .....	19
7.3	Electrical safety requirements .....	20
7.4	Electrical, environmental and/or endurance test information (supplementary information).....	20
8	Measuring methods for photocouplers .....	27
8.1	Current transfer ratio $h_{F(ctr)}$ .....	27
8.2	Input-to-output capacitance $C_{IO}$ .....	28
8.3	Isolation resistance between input and output $R_{IO}$ .....	29
8.4	Isolation test.....	30
8.5	Partial discharges of photocouplers.....	31
8.6	Collector-emitter saturation voltage $V_{CE(sat)}$ of a photocoupler .....	34
8.6.1	Collector-emitter saturation voltage (d.c. method).....	34
8.6.2	Collector-emitter saturation voltage (pulse method).....	35
8.7	Switching times $t_{on}$ , $t_{off}$ of a photocoupler .....	36
8.8	Peak off-state current $I_{DRM}$ .....	37
8.9	Peak on-state voltage $V_{TM}$ .....	39
8.10	DC off-state current $I_{BD}$ .....	41
8.11	DC on-state voltage $V_T$ .....	42
8.12	Holding current $I_H$ .....	43
8.13	Critical rate of rise of off-state voltage $dV/dt$ .....	43
8.14	Trigger input current $I_{FT}$ .....	46
8.15	Measuring methods of common mode transient immunity (CMTI) for photocoupler .....	47
9	Testing methods of electrical rating for phototriac coupler .....	49
9.1	Repetitive peak off-state voltage $V_{DRM}$ .....	49
9.2	DC off-state voltage $V_{BD}$ .....	50
	Annex A (normative) Input/output safety test .....	51
	Bibliography.....	52

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



## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SEMICONDUCTOR DEVICES –  
DISCRETE 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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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.

**This consolidated version of IEC 60747-5-5 consists of the first edition (2007) [documents 47E/332/FDIS and 47E/340/RVD] and its amendment 1 (2013) [documents 47E/437/CDV and 47E/451/RVC]. It bears the edition number 1.1.**

**The technical content is therefore identical to the base edition and its amendment and has been prepared for user convenience. A vertical line in the margin shows where the base publication has been modified by amendment 1. Additions and deletions are displayed in red, with deletions being struck through.**



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

This standard replaces the clauses for photocouplers (or optocouplers) described in IEC 60747-5-1, IEC 60747-5-2 and IEC 60747-5-3, including their amendments.

The contents for phototransistors and photothyristors in IEC 60747-5-1, IEC 60747-5-2 and IEC 60747-5-3, including their amendments, will be considered obsolete as of the effective date of publication of this standard.

NOTE Photocouplers that are certified to the previous version of the photocoupler standard, namely IEC 60747-5-1/2/3, are to be considered in compliance with the requirements and provisions of IEC 60747-5-5.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of the parts in the IEC 60747 series, under the general title *Semiconductor devices – Discrete devices*, can be found on the IEC website.

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the maintenance result 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.

**IMPORTANT – The “colour inside” logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this publication using a colour printer.**

## SEMICONDUCTOR DEVICES – DISCRETE DEVICES –

### Part 5-5: Optoelectronic devices – Photocouplers

#### 1 Scope

This part of IEC 60747 gives the terminology, essential ratings, characteristics, safety tests as well as the measuring methods for photocouplers (or optocouplers).

NOTE The word “optocoupler” can also be used instead of “photocoupler”.

#### 2 Normative references

The following referenced documents are indispensable for the application 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 60065:2001, *Audio, video and similar electronic apparatus – Safety requirements*

IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-1:2007, *Environmental testing – Part 2: Tests – Tests A: Cold*

IEC 60068-2-2:2007, *Environmental testing – Part 2: Tests – Tests B: Dry heat*

IEC 60068-2-78:2001, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60068-2-6:—, *Environmental testing – Part 2: Tests – Test Fc: Vibration (sinusoidal)*<sup>1</sup>

IEC 60068-2-14:1984, *Environmental testing – Part 2: Tests – Test N: Change of temperature*

IEC 60068-2-17:1994, *Basic environmental testing procedures – Part 2: Tests – Test Q: Sealing*

IEC 60068-2-27:—, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock and bump*<sup>2</sup>

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-58:2005, *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 60112:2003, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

<sup>1</sup> To be published (replacing the sixth edition)

<sup>2</sup> To be published (replacing the third edition)

IEC 60216-1:2001, *Electrical insulating materials – Properties of thermal endurance – Part 1: Ageing procedures and evaluation of test results*

IEC 60216-2:2005, *Electrical insulating materials – Thermal endurance properties – Part 2: Determination of thermal endurance properties of electrical insulating materials – Choice of test criteria*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60672-2:1999, *Ceramic and glass insulating materials – Part 2: Methods of test*

IEC 60695-11-5:2004, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

### 3 Photocoupler

Optoelectronic device designed for the transfer of the electrical signals by utilizing optical radiation to provide coupling with electrical isolation between the input and the output

NOTE Different types of photocouplers include ambient-rated or case-rated photocouplers, for signal-isolation applications.

#### 3.1 Semiconductor material

- Input diode: Gallium Arsenide, Gallium Aluminium Arsenide, etc.
- Output: Silicon, etc.

#### 3.2 Details of outline and encapsulation

##### 3.2.1 IEC and/or national reference number of the outline drawing

##### 3.2.2 Method of encapsulation: glass/metal/plastic/other

##### 3.2.3 Terminal identification and indication of any connection between a terminal and the case

#### 3.3 Type of photocouplers

##### 3.3.1 DC input photocoupler

Photocoupler consisting at the input of a photoemitter to which d.c. current is applied

##### 3.3.2 AC input photocoupler

Photocoupler consisting at the input of antiparallel photoemitters to which a.c. current is applied

##### 3.3.3 Phototransistor photocoupler

Photocoupler whose photo sensitive element is a phototransistor

NOTE Phototransistor is a transistor in which the current produced by the photoelectric effect in the neighbourhood of the emitter-base junction acts as base current, which is amplified.

##### 3.3.4 Photodarlington photocoupler

Photocoupler whose photo sensitive element is a Darlington phototransistor

NOTE A base terminal may or may not be provided.

##### 3.3.5 Photothyristor photocoupler

Photocoupler whose photo sensitive element is a photothyristor

NOTE 1 Photothyristor is a thyristor that is designed to be triggered by optical radiation.

NOTE 2 Gate terminal may or may not be provided.

### 3.3.6 Phototriac photocoupler

Photocoupler whose photo sensitive element is a phototriac.

NOTE A phototriac is a triac that is designed to be triggered by optical radiation.

### 3.3.7 IC photocoupler

Photocoupler whose photo-sensitive element is a photodiode/phototransistor and an integrated circuit

### 3.3.8 FET photocoupler

Photocoupler with one or more field-effect transistors (FETs) in the output stage

NOTE A FET is activated by photo emitter by direct optical radiation.

### 3.3.9 Photodiode photocoupler

Photocoupler whose photosensitive element is a photodiode

### 3.3.10 IC input photocoupler

Photocoupler whose input element consists of an integrated circuit and an photoemitter.

### 3.3.11 Solid state opto relay

Photocoupler whose photo sensitive element is phototriac and output is triac.

## 4 Terms related to ratings and characteristics for photocouplers

### 4.1 Current transfer ratio

#### 4.1.1 Static value of the (forward) current transfer ratio $h_{F(ctr)}$

The ratio of the d.c. output current to the d.c. input current, the output voltage being held constant.

NOTE The abbreviation CTR (d.c.) is sometimes used instead of a symbol.

#### 4.1.2 Small-signal short-circuit (forward) current transfer ratio $h_{f(ctr)}$

The ratio of the a.c. output current to the a.c. input current, the output being short-circuited to a.c.

NOTE The abbreviation CTR (a.c.) is sometimes used instead of a symbol.

### 4.2 Cut-off frequency $f_{co}$

The frequency at which the modulus of the small-signal current transfer ratio has decreased to  $1/\sqrt{2}$  of its low-frequency value.

### 4.3 Input-to-output capacitance $C_{IO}$

The total capacitance between all input terminals connected together and all output terminals connected together.

### 4.4 Isolation resistance $R_{IO}$

The resistance between all input terminals connected together and all output terminals connected together.

### 4.5 Isolation voltage

The voltage between any specified input terminal and any specified output terminal.

#### 4.5.1 DC isolation voltage $V_{IO}$

The value of the constant isolation voltage

#### 4.5.2 Repetitive peak isolation voltage $V_{IORM}$

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

NOTE A repetitive transient voltage is usually a function of the circuit. 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 non-repetitive voltage transient arrives.

#### 4.5.3 Surge isolation voltage $V_{IOSM}$

The highest instantaneous value of an isolation voltage pulse of specified wave shape with short time duration

#### 4.6 Terms related to photocouplers with phototriac output and/or solid state opto-relay with triac output

##### 4.6.1 Repetitive peak voltage

##### 4.6.2 Repetitive peak off-state voltage $V_{DRM}$

Maximum applicable repetitive peak forward voltage between anode and cathode in off-state under specified gate conditions.

NOTE The repetitive voltage has a slew rate of less than the specified critical rate of rise of off-state voltage (dv/dt).

##### 4.6.3 Repetitive peak reverse voltage $V_{RRM}$

Maximum applicable repetitive peak reverse voltage between anode and cathode in off-state under specified gate conditions.

##### 4.6.4 RMS on-state current $I_{T(RMS)}$

Maximum applicable root-mean-square forward current between anode and cathode in on-state under specified gate conditions.

##### 4.6.5 Peak off-state current $I_{DRM}$

Forward leakage current between the off-state output terminals under specified conditions

##### 4.6.6 Peak on-state voltage $V_{TM}$

Peak forward voltage between on-state output terminals under specified conditions

##### 4.6.7 DC off-state current $I_{BD}$

Forward leakage current between off-state output terminals under specified conditions

##### 4.6.8 DC on-state voltage $V_T$

The d.c. forward voltage between on-state output terminals under specified conditions, when the specified forward current is applied between on-state output terminals

##### 4.6.9 Holding current $I_H$

The minimum on-state current in output to maintain the on-state under specified conditions

##### 4.6.10 Critical rate of rise of off-state voltage dV/dt

The rate of rise of off-state voltage just before the transition from off-state to on-state under the specified operating conditions

#### 4.6.11 Trigger input current $I_{FT}$

The minimum input forward current to switch from off-state to on-state in output under specified conditions

#### 4.7 Common mode transient immunity CMTI

The common mode transient immunity (CMTI), also sometimes referred to as the common mode rejection (CMR) or the common mode rejection ratio (CMRR), is the maximum tolerable rate-of-rise (or fall) of a common mode voltage ( $V_{CM}$ ). The CMTI specification or the CMR or CMRR specification should include the amplitude of the common mode pulse ( $V_{CM}$ ). This common mode pulse ( $V_{CM}$ ) that is applied across the two grounds across the optocoupler should not exceed the maximum rated transient isolation voltage specification of the photocoupler as defined by the  $V_{IOTM}$ .

### 5 Terms for photocoupler providing protection against electrical shock

This clause covers terms for a photocoupler after it has been subjected to operating conditions (safety ratings) that exceed the specified ratings (limiting values) for normal operation.

#### 5.1 Safety ratings of a photocoupler for reinforced isolation

Electrical, thermal, and mechanical operating conditions that exceed the specified ratings (limiting values) for normal operation, and to which the specified safety requirements refer.

#### 5.2 Electrical safety requirements of a photocoupler for reinforced isolation

Electrical requirements that have to be met and maintained after the photocoupler has been subjected to specified safety ratings, to ensure protection against electrical shock.

NOTE The photocoupler may become permanently inoperative when safety ratings are applied.

##### 5.2.1 Partial discharge $p_d$

Localized electrical discharge which occurs in the insulation between input and output terminals of the photocoupler

##### 5.2.2 Apparent charge $q_{pd}$ , $q$

Electrical charge caused by a partial discharge in the photocoupler

##### 5.2.3 Threshold apparent charge $q_{pd(TH)}$ , $q_{TH}$

A specified value of apparent charge that is as small as technically feasible and to which measured values of the partial-discharge inception voltage or extinction voltage, respectively, refer.

NOTE 1 A threshold apparent charge of 5 pC was found to be a practicable criterion for photocouplers. Otherwise it should be defined on each individual device design. Smaller values are desirable but are not viable at this time.

NOTE 2 In actual tests, this criterion applies to the apparent charge pulse with the maximum value.

NOTE 3 The term "specified discharge magnitude" (see 3.18.2 of IEC 60664-1) is synonymous with threshold apparent charge.

##### 5.2.4 Test voltages for the partial-discharge test of a photocoupler

See Figure 1a and Figure 1b. All voltages used are a.c. peak voltages.

##### 5.2.5 Test voltage $V_{pd(t)}$ , $V_t$

The voltage applied during the test period between the input terminals (connected together) and the output terminals (connected together) of the photocoupler under test