

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Semiconductor devices –
Part 17: Magnetic and capacitive coupler for basic and reinforced insulation**

**Dispositifs à semiconducteurs –
Partie 17: Coupleur magnétique et capacitif pour l'isolation principale et renforcée**





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 It also gives information on projects, replaced and withdrawn publications.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.

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 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 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.

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.

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.

Glossaire IEC - std.iec.ch/glossary

67 000 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.

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Semiconductor devices –
Part 17: Magnetic and capacitive coupler for basic and reinforced insulation**

**Dispositifs à semiconducteurs –
Partie 17: Coupleur magnétique et capacitif pour l'isolation principale et renforcée**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 31.080.99

ISBN 978-2-8322-8924-2

**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
4 Electrical characteristics – Coupler logic and timing definitions	19
5 Coupler for protection against electrical shock	20
5.1 General	20
5.2 Type	20
5.3 Ratings	20
5.3.1 General	20
5.3.2 Safety limiting values	20
5.3.3 Functional ratings	20
5.3.4 Rated isolation voltages	20
5.4 Electrical safety requirements	20
5.5 Electrical, environmental and/or endurance test information	21
5.5.1 General	21
5.5.2 Routine test	23
5.5.3 Sample test	23
5.5.4 Maximum surge isolation voltage	23
5.5.5 Type test	24
6 Measuring methods for couplers	35
6.1 General	35
6.2 Isolation capacitance (C_{IO})	35
6.2.1 Purpose	35
6.2.2 Circuit diagram	35
6.2.3 Measurement procedure	36
6.2.4 Precautions to be observed	36
6.2.5 Special conditions	36
6.3 Isolation resistance between input and output, R_{IO}	36
6.3.1 Purpose	36
6.3.2 Circuit diagram	36
6.3.3 Precautions to be observed	37
6.3.4 Measurement procedure	37
6.3.5 Special conditions	37
6.4 Isolation test	37
6.4.1 Purpose	37
6.4.2 Circuit diagram	37
6.4.3 Test procedure	38
6.4.4 Requirements	38
6.5 Partial discharges of coupler	39
6.5.1 Purpose	39
6.5.2 Circuit diagram	39
6.5.3 Description of Figure 9 test circuit and requirements	39
6.5.4 Test procedure	40
6.5.5 Description of calibration circuit (see Figure 10)	40

6.5.6	Test methods.....	41
6.5.7	Specified conditions.....	41
6.5.8	Test voltage conditions.....	42
6.6	Switching times of couplers.....	42
6.6.1	Purpose.....	42
6.6.2	Circuit diagram.....	42
6.6.3	Measurement procedure.....	43
6.6.4	Specified conditions.....	44
6.7	Measuring methods of common-mode transient immunity (CMTI) for magnetic and capacitive couplers.....	44
6.7.1	Purpose.....	44
6.7.2	Circuit diagram.....	44
6.7.3	Precautions to be observed.....	45
6.7.4	Static CMTI measuring procedure.....	46
6.7.5	Specified conditions.....	47
6.7.6	Dynamic CMTI measuring procedure.....	47
Annex A (informative) Qualification guidance.....		48
Bibliography.....		51
Figure 1 – Time intervals for methods a and b of the test voltage.....		15
Figure 2 – 1,2/50 μ s surge pulse according 61000-4-5:2014 allowed as equivalent impulse for isolation testing.....		24
Figure 3 – Determination of time to failure (referring to method in 5.5.5.8).....		31
Figure 4 – Determination of working voltage (referring to method in 5.5.5.8 for exponential model).....		32
Figure 5 – Determination of working voltage (referring to method in 5.5.5.8 for non- linear model).....		33
Figure 6 – Isolation capacitance measurement circuit.....		36
Figure 7 – Isolation resistance measurement circuit.....		37
Figure 8 – Isolation voltage measurement circuit.....		38
Figure 9 – Partial discharge test circuit.....		39
Figure 10 – Connections for the calibration of the complete test arrangement.....		40
Figure 11 – Switching time test circuit.....		43
Figure 12 – Transition time waveform measurement.....		43
Figure 13 – Propagation delay time waveform measurement.....		44
Figure 14 – Static versus dynamic data source signal V_I		45
Figure 15 – Common-mode transient immunity (CMTI) test setup for both static and dynamic testing.....		45
Figure 16 – Static common-mode transient immunity (CMTI) and V_{CM} and low to high data transition waveform.....		47
Figure A.1 – Lifetime verification.....		49
Table 1 – Overview on characteristics and symbols.....		19
Table 2 – Datasheet characteristics.....		21
Table 3 – Tests and test sequence for coupler providing basic insulation and reinforced insulation for protection against electrical shock.....		22
Table 4 – Test conditions.....		23

Table 5 – Safety factor F	41
Table 6 – Specified conditions for method a and method b.....	42
Table A.1 – Front end process changes within component.....	49
Table A.2 – Front End Process Changes within SiO/SiN/imide-passivation	50
Table A.3 – Layout changes.....	50
Table A.4 – Backend changes.....	50

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SEMICONDUCTOR DEVICES –**Part 17: Magnetic and capacitive coupler
for basic and reinforced insulation****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 60747-17 has been prepared by subcommittee SC 47E: Discrete semiconductor devices, of IEC technical committee TC 47: Semiconductor devices.

This first edition cancels and replaces IEC PAS 60747-17:2011. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC PAS 60747-17:2011:

- a) introduced lifetime safety factors for improved life time consideration, to comply with widely recognized aging mechanisms of silicone dioxide (TDDB) and thin film polymer isolation layers;
- b) significantly improved "end of life testing" paragraph and statistical life time consideration by adding detailed description on process, safety factors, methods of generating data points and respective lifetime interpolations as well as being specific on minimum amount of samples required;

- c) introduced concept of certification by similarity, including Annex A, giving guidance on qualification considerations and required certification process;
- d) alternative pulse shape allowed for surge pulse testing, to avoid issues due to surge tester availability;
- e) various improvements throughout the standard: definitions, for example type of coupler have been improved, introduction of surge impulse V_{IMP} rating, usage of glass transition temperature, pre-conditioning have been redefined for improved usability and better compatibility with today's design and functionality of couplers, available mold compounds, etc.

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

FDIS	Report on voting
47E/711/FDIS	47E/715/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.

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 17: Magnetic and capacitive coupler for basic and reinforced insulation

1 Scope

This part of IEC 60747 specifies the terminology, essential ratings, characteristics, safety test and the measuring methods of magnetic coupler and capacitive coupler.

It specifies the principles and requirements of insulation and isolation characteristics for magnetic and capacitive couplers for basic insulation and reinforced insulation.

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

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

IEC 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-20:2008, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

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

IEC 60068-2-58:2015, *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 60068-2-67:1995, *Environmental testing – Part 2: Tests – Test Cy: Damp heat, steady state, accelerated test primarily intended for components*

IEC 60112:2003, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60216-1:2013, *Electrical insulating materials – Thermal endurance properties – 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*