

# INTERNATIONAL STANDARD

---

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





**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.

IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
[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 corrigendum or an amendment might have been published.

**IEC publications search - [webstore.iec.ch/advsearchform](http://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 It also gives information on projects, replaced and withdrawn publications.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](http://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](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: [sales@iec.ch](mailto:sales@iec.ch).

**Electropedia - [www.electropedia.org](http://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](http://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.



IEC 60747-17

Edition 1.0 2020-09

# INTERNATIONAL STANDARD

---

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

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

---

ICS 31.080.99

ISBN 978-2-8322-8801-6

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## 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 $\mu$ 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 VI.....		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*