IEC/PAS 60747-17

Edition 1.0 2011-11

PUBLICLY AVAILABLE SPECIFICATION

PRE-STANDARD

Semiconductor devices – Discrete devices –
Part 17: Magnetic and capacitive coupler for basic and reinforced isolation

IEC/PAS 60747-17:2011(E)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE W

ICS 31.080.99

ISBN 978-2-88912-792-4

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Part 17: Magnetic and capacitive coupler for basic and reinforced isolation

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IEC-PAS 60747-17 has been processed by subcommittee 47E: Discrete semiconductor devices, of IEC technical committee 47: Semiconductor devices.

The text of this PAS is based on the following document:	This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document
Draft PAS	**Report on voting**
47E/412/PAS	47E/423/RVD

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SEMICONDUCTOR DEVICES – DISCRETE DEVICES –

Part 17: Magnetic and capacitive coupler for basic and reinforced isolation

1 Scope

This PAS gives the terminology, essential ratings, characteristics, safety test and the measuring methods of magnetic and capacitive couplers.

It specifies the principles of magnetic and capacitive coupling across an isolation barrier and the related requirements for basic isolation and reinforced insulation.

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.

IEC 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60068-1:1988, *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 60068-2-67, *Environmental testing – Part 2-67: Tests – Test Cy: Damp heat, steady state, accelerated test primarily intended for components*

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 60068-2-17:1994, *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 + 12 h cycle)*

IEC 60068-2-58:2004, *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, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

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

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

IEC 60270:2000, *High-voltage test techniques – Partial discharge measurements*

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

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

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

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-9, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 9: Pulse magnetic field immunity test*

IEC 62539, *Guide for the statistical analysis of electrical insulation breakdown data*

3 Magnetic and Capacitive Coupler

Magnetic and capacitive couplers consist of a transmitter stage and a receiver stage on either side of a galvanic insulation barrier. The device transmits a signal across the insulation boundary where a receiver stage is able to detect the transmitted signal and uses the information to generate the electrical output signal.

In this PAS, magnetic and capacitive couplers are referred to as “coupler”.

This PAS can only be applied to magnetic and capacitive couplers listed under 3.3 ‘Type of coupler’.

3.1 Semiconductor material

Input: Silicon, etc.

Output: Silicon, etc.

3.2 Details of outline and encapsulation

3.2.1 Outline drawing

For details, see the relevant IEC standards.

3.2.2 Method of encapsulation

The materials of encapsulation shall be given e.g. glass/metal/plastic/other

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

3.3 Type of coupler

Ambient-rated or case-rated coupler device for signal-isolation applications with input(s) and output(s) in one package.

3.3.1 SIO2 Isolators

Isolators with an internal insulation construction utilizing Silicon Dioxide or Silica based material.

3.3.2 Thin film Polymer Isolators

Isolators with an internal insulation construction, utilising a thin film polymer insulation layer spin coated onto a base substrate.

NOTE A package also may be a molded module.

4 Terms related to ratings and characteristics for a coupler

4.1 Isolation sides

All Terminals of the first side are isolated from all terminals of the second side by an isolation barrier forming a two-terminal device.

4.2 Isolation capacitance: C_{IO}

The total capacitance between the terminals on a first side of the isolation barrier connected together and the terminals on a second side of the isolation barrier connected together forming a two-terminal device.

4.3 Isolation resistance: R_{IO}

The resistance between the terminals on a first side of the isolation barrier connected together and all the terminals on a second side of the isolation barrier connected together forming a two-terminal device.

4.4 Isolation voltage

The voltage between any specified terminal on the first side of the isolation barrier and any terminal on the second side of the isolation barrier.

4.5 Logic state match

The condition in which an output logic state matches the associated input logic state.

4.6 Logic state transition match

The condition in which an output logic state change follows the associated input logic state change.

4.7 Common mode transient immunity (CMTI)

Common mode transient immunity (CMTI) is the maximum tolerable rate-of-rise (or fall) of a common-mode voltage. It is given in volts per second. CMTI should include the amplitude of the common-mode voltage that can be tolerated.

4.8 Magnetic field immunity (MFI)

4.8.1 Static magnetic field immunity (SMFI)

The maximum tolerable magnetic field density regardless of component orientation under which the coupler maintains its specified performance.

4.8.2 Variable magnetic field immunity (VMFI)

The maximum tolerable magnetic field density change or the maximum tolerable magnetic field amplitude at defined frequency regardless of component orientation under which the coupler maintains its specified performance.

4.9 Propagation Delay: t_{pLH} or t_{pHL}

The duration from the presence of an input signal to the time at which the output matches the associated state of the input signal.

4.10 Further terms and abbreviations

– V_{DD} or V_{CC} Supply voltage
– IC Input or output integrated circuit of a coupler
– I/O Input/Output terminal(s) of an integrated circuit
– GND Ground reference for an integrated circuits
– V_I Input voltage, either V_{IL} or V_{IH}
– V_O Output voltage, either V_{OL} or V_{OH}

5 Terms for couplers providing protection against electrical shock

Terms for a coupler designed to maintain protection against electrical shock 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 couplers for reinforced insulation

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 couplers for basic and reinforced insulation

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

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

Dielectric Strength

If an enclosure of material is depended upon to serve as electrical insulation, it shall have a dielectric strength in the use thickness at 16 Hz – 100 Hz:

in case of basic insulation:

of 1,3 × VIOSM, rms, 1 s, Tamb,max

in case of reinforced insulation

of at least 10 000 V, rms,1 s Tamb,max or 1,6 × VIOSM, rms, 1 s, Tamb,max respectively – if 1,6 × VIOSM, rms, is higher than 10 000V –

In both cases, after conditioning for 96 h to moist air having a relative humidity of 90 % ± 5 % at a temperature of 85,0 °C ± 2,0 °C.

Resistivity

The resistivity of the isolator material shall not be less than:

10^9 Ω at V_{IO} = 500 V for 1 min after conditioning for 40 h at 23,0 °C ± 2,0 °C and 50 % ± 5 % percent relative humidity.

5.2.1 Partial discharge (pd)

Localized electrical discharge which occurs in the insulation between all terminals of the first side and all terminals of the second side of the coupler.

5.2.2 Apparent charge: q_{pd}

Electrical discharge caused by a partial discharge in the coupler.

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

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 couplers. Otherwise it should be defined on each individual device design. Smaller values are desirable but are not viable.

NOTE 2 In actual testing, 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 60664-1:2007) is synonymous with "threshold apparent charge".

5.2.4 Test voltages and time intervals for the partial-discharge test of couplers

See Figures 1 and 2.

All applicable test voltages in this PAS are peak voltages, unless otherwise stated.

5.2.4.1 Test voltage: $V_{pd(t)}$

The voltage applied during the test period of the partial discharge test between all terminals of the first side (connected together) and all terminals of the second side (connected together) to the coupler under test.

5.2.4.2 Initial test voltage: $V_{pd(ini)}$

The test voltage applied during the initial test time t_{ini}.

5.2.4.2.1 Initial test voltage: $V_{pd(ini),a}$

(See 4.3.3.3 and Table F.1 of IEC 60664-1:2007 for minimum voltages, interpolation is possible). The value of the voltage applied at the beginning of the measurement, for a specified time t_{ini}, is intended to simulate the occurrence of a transient over-voltage. Refer to Figure 1.