BS EN IEC 60747-5-5:2020

BSI Standards Publication

Semiconductor devices

Part 5-5: Optoelectronic devices — Photocouplers

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National foreword

This British Standard is the UK implementation of EN IEC 60747-5-5:2020. It is identical to IEC 60747-5-5:2020. It supersedes BS EN 60747-5-5:2011+A1:2015, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/47, Semiconductors.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Amendments/corrigenda issued since publication

Date	Text affected

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN IEC 60747-5-5

September 2020

ICS 31.080.01; 31.260

Supersedes EN 60747-5-5:2011 and all of its amendments and corrigenda (if any)

English Version

Semiconductor devices - Part 5-5: Optoelectronic devices - Photocouplers (IEC 60747-5-5:2020)

Dispositifs à semiconducteurs - Partie 5-5 : Dispositifs optoélectroniques - Photocoupleurs (IEC 60747-5-5:2020)

Halbleiterbauelemente - Teil 5-5: Optoelektronische Bauelemente - Optokoppler (IEC 60747-5-5:2020)

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European foreword

The text of document 47E/706/FDIS, future edition 2 of IEC 60747-5-5, prepared by SC 47E "Discrete semiconductor devices" of IEC/TC 47 "Semiconductor devices" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60747-5-5:2020.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2021-05-24
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2023-08-24

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Endorsement notice

The text of the International Standard IEC 60747-5-5:2020 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60065	NOTE	Harmonized as EN 60065
IEC 60270:2000	NOTE	Harmonized as EN 60270:2001 (not modified)
IEC 60747-5-2	NOTE	Harmonized as EN 60747-5-2
IEC 60747-5-3	NOTE	Harmonized as EN 60747-5-3

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Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60068-1	2013	Environmental testing - Part 1: General and guidance	EN 60068-1	2014
IEC 60068-2-1	-	Environmental testing - Part 2-1: Tests - Test A: Cold	EN 60068-2-1	-
IEC 60068-2-2	-	Environmental testing - Part 2-2: Tests - Test B: Dry heat	EN 60068-2-2	-
IEC 60068-2-6	-	Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)	EN 60068-2-6	-
IEC 60068-2-14	-	Environmental testing - Part 2-14: Tests - Test N: Change of temperature	EN 60068-2-14	-
IEC 60068-2-17	-	Basic environmental testing procedures - Part 2-17: Tests - Test Q: Sealing	EN 60068-2-17	-
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	EN 60068-2-20	-
IEC 60068-2-27	-	Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock	EN 60068-2-27	-
IEC 60068-2-30	-	Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)	EN 60068-2-30	-
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)	EN 60068-2-58	-
IEC 60068-2-78	-	Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state	EN 60068-2-78	-
IEC 60112	-	Method for the determination of the proof and the comparative tracking indices of solid insulating materials	EN 60112	-

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Publication	Year	Title	EN/HD	Year
IEC 60216-1	-	Electrical insulating materials - Thermal endurance properties - Part 1: Ageing procedures and evaluation of test results	EN 60216-1	-
IEC 60216-2	-	Electrical insulating materials - Thermal endurance properties - Part 2: Determination of thermal endurance properties of electrical insulating materials - Choice of test criteria	EN 60216-2	-
IEC 60664-1	2007	Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests	EN 60664-1	2007
IEC 60672-2	-	Ceramic and glass insulating materials - Part 2: Methods of test	EN 60672-2	-
IEC 60695-11-5	-	Fire hazard testing - Part 11-5: Test flames - Needle-flame test method - Apparatus, confirmatory test arrangement and guidance	EN 60695-11-5	-
IEC 61000-4-5	-	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	EN 61000-4-5	-
IEC 62368-1	2018	Audio/video, information and communication technology equipment - Part 1: Safety requirements	EN IEC 62368-1	2020

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SEMICONDUCTOR DEVICES –

Part 5-5: Optoelectronic devices – Photocouplers

FOREWORD

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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.

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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.

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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*

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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 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 62368-1:2018, *Audio/video, information and communication technology equipment – Part 1: Safety requirements*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses: ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
photocoupler
optoelectronic device designed for the transfer of electrical signals by utilizing optical radiation to provide coupling with electrical isolation between the input and the output

Note 1 to entry: Different types of photocouplers include ambient-rated or case-rated photocouplers, for signal-isolation applications.

3.1.1
DC input photocoupler
photocoupler consisting at the input of a photoemitter to which DC current is applied

3.1.2
AC input photocoupler
photocoupler consisting at the input of antiparallel photoemitters to which AC current is applied

3.1.3
phototransistor output photocoupler
photocoupler whose photosensitive element is a phototransistor

Note 1 to entry: 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.

3.1.4
photothyristor photocoupler
photocoupler whose photosensitive element is a photothyristor

Note 1 to entry: Photothyristor is a thyristor that is designed to be triggered by optical radiation.

Note 2 to entry: Gate terminal may or may not be provided.

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3.1.5
phototriac output photocoupler
photocoupler whose photosensitive element is a phototriac and photocoupler whose photosensitive element is a phototriac and output is triac

Note 1 to entry: A phototriac is a triac that is designed to be triggered by optical radiation.

3.1.6
IC photocoupler
photocoupler whose photosensitive element is a photodiode/phototransistor and an integrated circuit

3.1.7
FET photocoupler
photocoupler with one or more field-effect transistors (FETs) in the output stage

Note 1 to entry: A FET is activated by photoemitter by direct optical radiation from a photoemitter.

3.1.8
photodiode photocoupler
photocoupler whose photosensitive element is a photodiode or photodiode array

3.1.9
IC input photocoupler
photocoupler whose input element consists of an integrated circuit and a photoemitter

3.1.10
solid state opto-relay
photocoupler whose output switches digitally without requiring a supply voltage

Note 1 to entry: The term "solid state opto-relay" includes photorelay, photothyristor photocoupler, phototriac photocoupler and FET/IGBT photocoupler.

3.1.11
current transfer ratio
$H_{\mathrm{f(ctr)}}$
ratio of the DC output current to the DC input current, the output voltage being held constant

Note 1 to entry: The abbreviated term CTR (DC) is sometimes used instead of a symbol.

3.1.12
small-signal short-circuit forward current transfer ratio
$h_{\mathrm{f(ctr)}}$
ratio of the AC output current to the AC input current, the output being short-circuited to AC

Note 1 to entry: The abbreviated term CTR (AC) is sometimes used instead of a symbol.

3.2
cut-off frequency
f_{co}
frequency at which the modulus of the small-signal current transfer ratio has decreased to $1/\sqrt{2}$ of its low-frequency value

3.3
input-to-output capacitance
C_{IO}
total capacitance between all input terminals or pins connected together and all output terminals or pins connected together

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3.4
isolation resistance
R_{IO}
resistance between all input terminals or pins connected together and all output terminals or pins connected together

3.4.1
repetitive peak off-state voltage for phototriac output and/or solid state opto-relay with triac output
V_{DRM}
maximum applicable repetitive peak reverse voltage between anode and cathode in off-state under specified gate conditions

3.4.2
peak off-state current
I_{DRM}
forward leakage current between the off-state output terminals under specified conditions

3.4.3
peak on-state voltage
V_{TM}
peak forward voltage between on-state output terminals under specified conditions

3.4.4
DC off-state current
I_{BD}
forward leakage current between off-state output terminals under specified conditions

3.4.5
DC on-state voltage
V_T
DC forward voltage between on-state output terminals under specified conditions, when the specified forward current is applied between on-state output terminals

3.4.6
holding current
I_H
minimum on-state current in output to maintain the on-state under specified conditions

3.4.7
critical rate of rise of off-state voltage
dV/dt
rate of rise of off-state voltage just before the transition from off-state to on-state under the specified operating conditions

3.4.8
trigger input current
I_{FT}
minimum input forward current to switch from off-state to on-state in output under specified conditions

3.5
common mode transient immunity
CMTI
maximum tolerable rate of rise (or fall) of a common mode voltage (V_{CM}), the specification of which should include the amplitude of the common mode pulse (V_{CM}), which is applied across the two grounds of the photocoupler and should not exceed the maximum rated transient isolation voltage specification of the photocoupler as defined by the V_{IOTM}

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3.6
photocoupler providing protection against electric shock
photocoupler which has been subjected to operating conditions (safety ratings) that exceed the specified ratings (limiting values) for normal operation

3.6.1
safety rating
<of a photocoupler> electrical, thermal, and mechanical operating conditions that exceed the specified ratings for reinforced isolation (limiting values) for normal operation, and to which the specified safety requirements refer

3.6.2
electrical safety requirement
<of a photocoupler> electrical requirements for reinforced or double insulation that have to be met and maintained after the photocoupler has been subjected to specified safety ratings, to ensure protection against electrical shock

Note 1 to entry: The photocoupler may become permanently inoperative when safety ratings are applied.

Note 2 to entry: For the definition of double and reinforced insulation, see 3.17.4 and 3.17.5 of IEC 60664-1:2007.

3.6.3
partial discharge
p_{d}
localized electrical discharge which occurs in the insulation between input and output terminals of the photocoupler

Note 1 to entry: For the technical details of partial discharge, see 3.1 of IEC 60270:2000.

3.6.4
apparent charge
q
electrical charge caused by a partial discharge in the photocoupler

3.6.5
threshold apparent charge
q_{TH}
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 to entry: A threshold apparent charge of 5 pC was found to be a practicable criterion for a photocoupler. Otherwise it should be defined on each individual device design. Smaller values are desirable but are not viable at this time.

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

Note 3 to entry: The term "specified discharge magnitude" (see 3.18.2 of IEC 60664-1:2007) is synonymous with "threshold apparent charge".

3.6.6
partial discharge test voltage
V_{m}
isolation voltage applied during the partial discharge test period

Note 1 to entry: Figure 1 and Figure 2 illustrate the related terms and letter symbols for methods a and b respectively.

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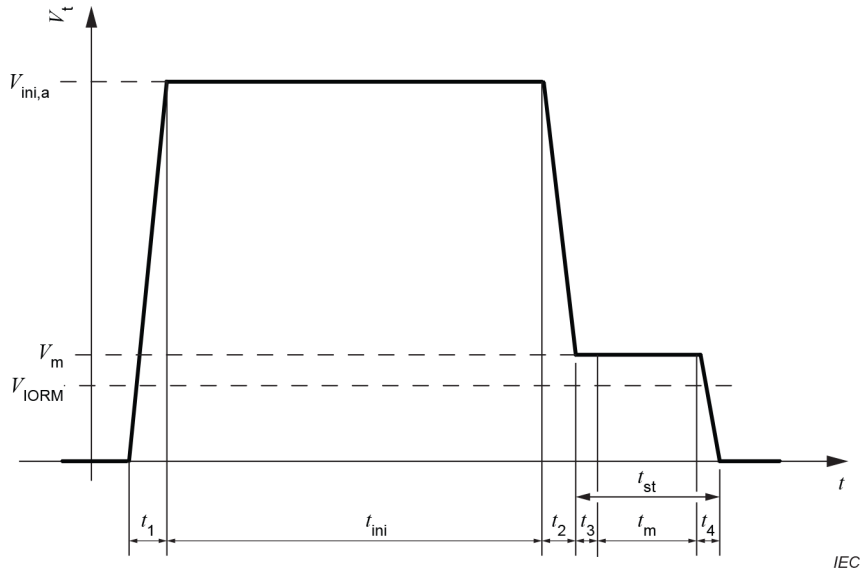

t_{ini}	initial time (method a) only)
t_{st}	(partial-discharge) stress time
t_m	(partial-discharge) measuring time
t_1, t_2, t_3, t_4	settling times

Figure 1 – Time intervals for method a)

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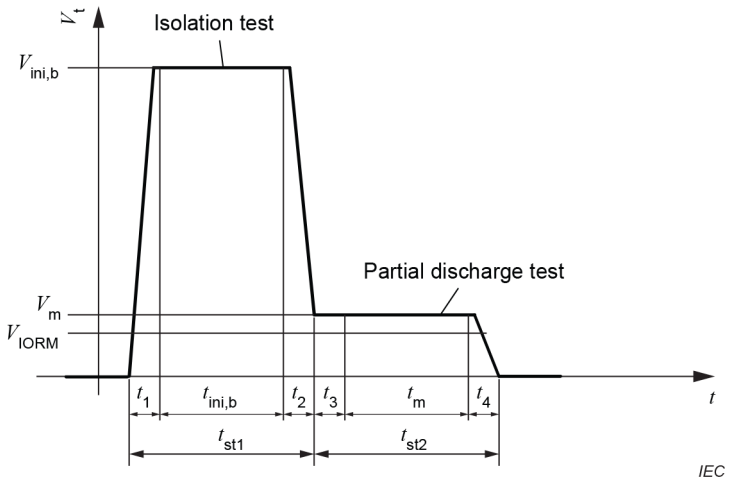
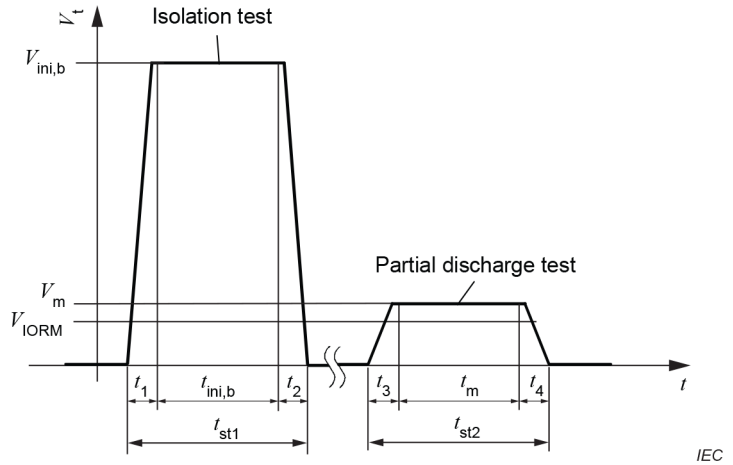
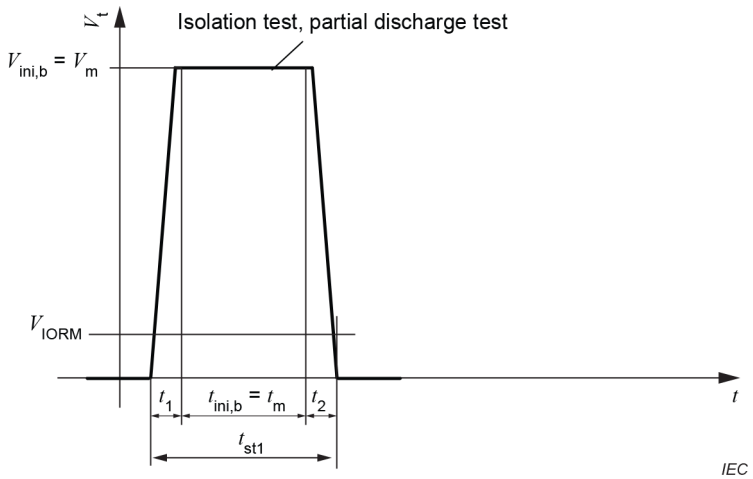


Method b1)



Method b2)



Method b3)

$t_{ini,b}$	isolation test time (method b) only)	t_{st1}	isolation test stress time (method b) only)
t_{st2}	(partial-discharge) stress time	t_m	(partial-discharge) measuring time
t_1, t_2, t_3, t_4	settling times		

Figure 2 – Time intervals for method b)

Documents
Document Sharing Hub
Full document details: BS EN IEC 60747-5-5:2020