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Edition 3.0 2016-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Semiconductor devices –
Part 6: Discrete devices – Thyristors

Dispositifs à semiconducteurs –
Partie 6: Dispositifs discrets – Thyristors

IEC 60747-6:2016-04(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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International Standard IEC 60747-6 has been prepared by subcommittee 47E: Discrete semiconductor devices, of IEC technical committee 47: Semiconductor devices.

This third edition cancels and replaces the second edition, published in 2000. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) Clauses 3, 4, 5, 6, and 7 were amended with some deletions of information no longer in use or already included in other parts of the IEC 60747 series, and with some necessary additions;
b) some parts of Clause 8 and Clause 9 were moved and added to Clause 7 of this third edition;
c) Clause 8 and 9 were deleted in this third edition;
d) Annex A was deleted.

This International Standard is to be used in conjunction with IEC 60747-1:2006 and Amendment 1:2010.

The text of this standard is based on the following documents:

FDIS	Report on voting
47E/532/FDIS	47E/538/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication 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 publication will remain unchanged until the stability date indicated on the IEC website 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- withdrawn,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.

SEMICONDUCTOR DEVICES –

Part 6: Discrete devices – Thyristors

1 Scope

This part of IEC 60747 provides standards for the following types of discrete semiconductor devices:

– reverse-blocking triode thyristors;
– reverse-conducting (triode) thyristors;
– bidirectional triode thyristors (triacs);
– turn-off thyristors.

If no ambiguity is likely to occur, any of the above may be referred to as thyristors.

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 60747-1:2006, *Semiconductor devices – Part 1: General*
IEC 60747-1:2006/AMD1:*2010*

IEC 60749-23, *Semiconductor devices – Mechanical and climatic test methods– Part 23: High temperature operating life*

IEC 60749-25, *Semiconductor devices – Mechanical and climatic test methods – Part 25: Temperature cycling*

IEC 60749-34:2010, *Semiconductor devices – Mechanical and climatic test methods – Part 34: Power cycling*

3 Terms and definitions

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

3.1 General

3.1.1
triac
bidirectional triode thyristor
three-terminal thyristor having substantially the same switching behaviour in the first and third quadrants of the current-voltage characteristic

[SOURCE: IEC 60050-521:2002, 521-04-67]

3.1.2
GTO
gate-turn-off thyristor
turn-off thyristor
thyristor which can be switched from the on-state to the off-state and vice versa by applying control signals of appropriate polarity to the gate terminal

Note 1 to entry: This note applies to the French languange only.

[SOURCE: IEC 60050-521:2002, 521-04-68]

3.2 Terms and definitions related to ratings and characteristics: currents

3.2.1
overload reverse-conducting current
$I_{RC(OV)}$
reverse-conducting current whose continuous application would cause the maximum rated virtual junction temperature to be exceeded

3.2.2
surge reverse-conducting current
I_{RCSM}
peak non-repetitive reverse current pulse of short duration and specified wave shape

3.2.3
reverse leakage current
I_R
reverse current that occurs when applying reverse voltage to the device

3.2.4
overload on-state current
$I_{T(OV)}$
on-state current whose continuous application would cause the maximum-rated virtual junction temperature to be exceeded

Note 1 to entry: See Figure 1.

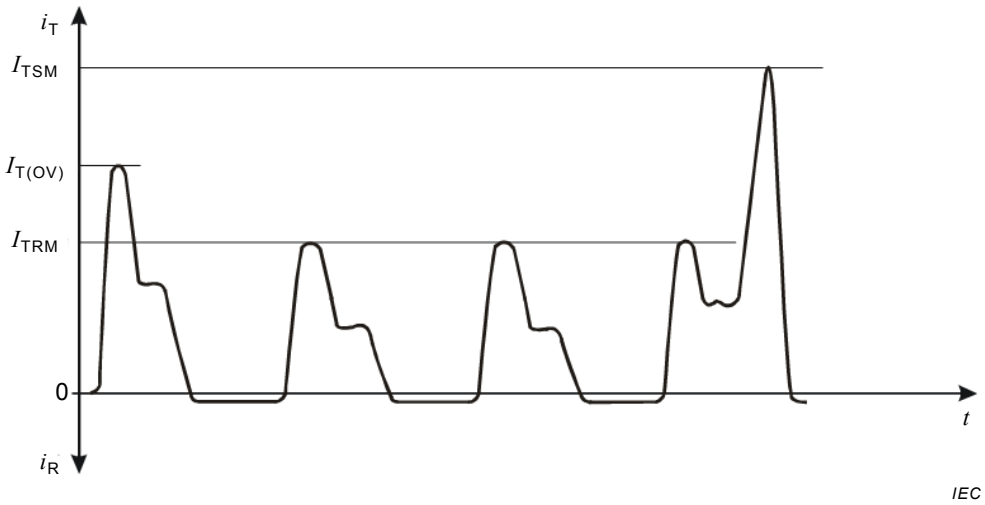


Figure 1 – Peak values of on-state currents

3.2.5
surge on-state current
I_{TSM}
on-state current pulse of short duration and specified wave shape

Note 1 to entry: Occurrence of I_{TSM} causes or would cause the maximum rated virtual junction temperature to be exceeded, but which is assumed to occur rarely and with a limited number of such occurrences during the service life of the device and to be a consequence of unusual circuit conditions (e.g., a fault) (see Figure 1).

3.2.6
tail current
I_Z
<turn-off thyristor> anode current that flows during the tail time

Note 1 to entry: See Figure 8.

3.2.7
peak tail current
I_{ZM}
<turn-off thyristor> peak value of tail current that occurs shortly after the beginning of the tail time

Note 1 to entry: See Figure 8.

3.2.8
peak case non-rupture current
I_{RSMC}
peak value of current that will not cause bursting of the case or the emission of a plasma beam

3.3 Terms and definitions related to ratings and characteristics: gate voltages and currents

3.3.1
sustaining gate current
I_{FGsus}
<turn-off thyristor> minimum forward gate current required ensuring that, if the anode current drops below the value required to keep all the subdivided cathode areas in conduction, they will all return to conduction when the anode current is increased again

3.3.2
turn-off gate voltage
V_{RGQ}
<turn-off thyristor> reverse gate voltage during the time interval within which the thyristor is turning off

3.3.3
peak turn-off gate voltage
V_{RGQM}
<turn-off thyristor> peak value of the turn-off gate voltage at the end of its rapid rise after the peak value of turn-off gate current (I_{RGQM}) has been reached

3.3.4
turn-off gate bias voltage
V_{RGQB}
<turn-off thyristor> essentially constant value of the turn-off gate voltage that occurs towards the end of the turn-off process, in the case where the gate-control circuit supports this process by maintaining the turn-off gate voltage at a value that is higher than the off-state gate bias voltage

3.3.5
off-state gate bias voltage
V_{RGB}
<turn-off thyristor> reverse gate voltage which is applied after the thyristor was turned off

3.3.6
on-state gate bias current
I_{FGB}
forward gate current flowing after the thyristor has been turned on

3.3.7
turn-off gate current
I_{RGQ}
<turn-off thyristor> reverse gate current during the time interval within which thyristor is turning off

3.3.8
turn-off gate bias current
I_{RGQB}
<turn-off thyristor> gate current associated with the turn-off gate bias voltage V_{RGQB}

3.3.9
peak turn-off gate current
I_{RGQM}
<turn-off thyristor> peak value of the reverse gate current reached at the end of its rapid rise in the beginning of the turn-off process

Note 1 to entry: Specifications refer to the minimum value of I_{RGQM} that the gate turn-off pulse generator is capable of supplying as a function of the peak on-state current to be switched off under specified conditions.

3.4 Terms and definitions related to ratings and characteristics: power and energy dissipation

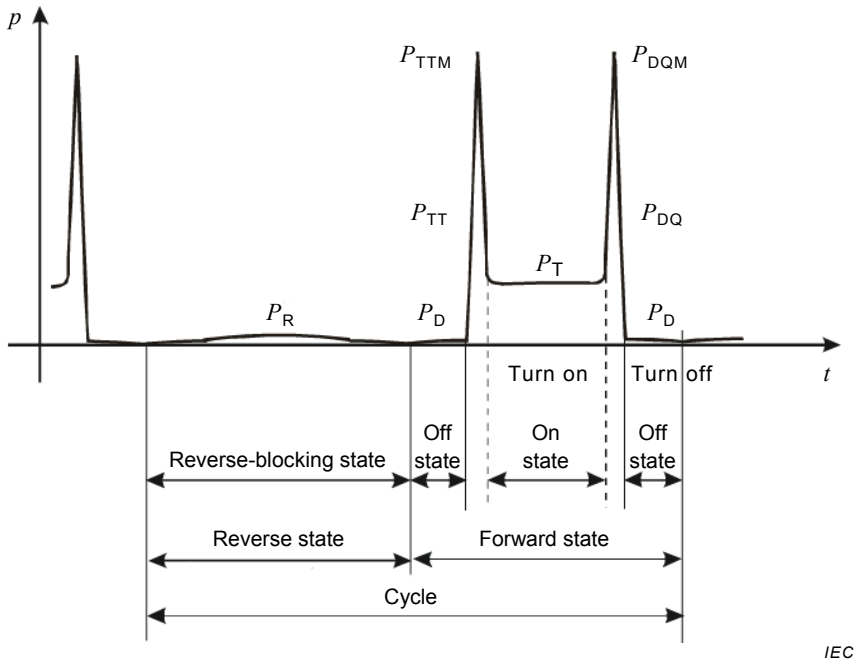
3.4.1 General

All definitions are written in terms of triode thyristors. Where appropriate, they apply also to diode thyristors. All definitions for power and power dissipation refer, if not otherwise specified, to the product of anode or principal current and anode or principal voltage. The definitions are general. They do not consider that the beginning and ending of the particular time interval should be identified in order to make specifications for the derived characteristics “mean partial power dissipation” and “partial energy dissipation” meaningful. However, guidance for the specification of these times is given in the relevant notes.

3.4.2 Instantaneous power during a cycle

3.4.2.1
reverse power
P_R
power when the thyristor is in the reverse-blocking state

Note 1 to entry: If not otherwise specified, the term refers to the power in the time interval between the ending of the turn-off time and the change from the reverse blocking state to the off state (either I = 0 or V = 0) (see Figure 2).



Key

P_R	reverse power	P_T	on-state power
P_D	off-state power	P_{TT}	turn-on power
P_{DQ}	turn-off power		

Figure 2 – Partial power (dissipation) of turn-off thyristors at absolute long on-state period

3.4.2.2
reverse-conducting power
P_{RC}
<reverse-conducting thyristor> power while the thyristor is in the reverse-conducting state

Note 1 to entry: If not otherwise specified, the term refers to the power in the time interval between the ending of the turn-off time and the change from the reverse conducting state to the off state (either I = 0 or V = 0).

3.4.2.3
off-state power
P_D
power while the thyristor is in the off state

Note 1 to entry: If not otherwise specified, the term refers to the power generated during the time interval between the crossing of the origin from the reverse blocking (or conducting) state to the off state (I = 0 or V = 0) and the beginning of the turn-on time; with turn-off thyristors, in addition, during the time interval between the ending of the turn-off time and the crossing of the origin from the off state to the reverse-blocking (or conducting) state.

3.4.2.4
turn-on power
P_{TT}
power in the time interval during which the thyristor is turning on

Note 1 to entry: If not otherwise specified, this time interval corresponds to the turn-on time.

3.4.2.5
turn-off power
P_{RQ}
power in the time interval during which the thyristor is turning off