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Semiconductor devices –
Part 6: Discrete devices – Thyristors

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Dispositifs à semiconducteurs –
Partie 6: Dispositifs discrets – Thyristors

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CONTENTS

FOREWORD.....	7
1 Scope.....	9
2 Normative references.....	9
3 Terms and definitions	9
3.1 General.....	9
3.2 Terms and definitions related to ratings and characteristics: currents	10
3.3 Terms and definitions related to ratings and characteristics: gate voltages and currents.....	11
3.4 Terms and definitions related to ratings and characteristics: power and energy dissipation	12
3.4.1 General	12
3.4.2 Instantaneous power during a cycle.....	12
3.4.3 Mean power dissipation.....	14
3.4.4 Energy dissipation.....	15
3.5 Terms and definitions related to ratings and characteristics: recovery times and other characteristics	16
3.5.1 On-state	16
3.5.2 Recovery times	16
3.5.3 Times and rates of rise characterizing gate-controlled turn-on.....	18
3.5.4 Times and rates of rise characterizing gate-controlled turn-off.....	19
3.5.5 Recovered charges	22
3.6 Mechanical ratings	22
4 Letter symbols.....	23
4.1 General.....	23
4.2 Additional general subscripts.....	23
4.3 List of letter symbols	23
5 Ratings and characteristics for thyristors.....	26
5.1 Ratings (limiting values)	26
5.1.1 Storage temperatures (T_{stg}).....	26
5.1.2 Junction temperature ($T_{vj(min)}$, $T_{vj(m)}$).....	26
5.1.3 Operating ambient or case temperature (T_a or T_c)	26
5.1.4 Total power dissipation (P_{tot} or P_C).....	26
5.1.5 Gate power dissipation.....	26
5.1.6 Frequency ratings	26
5.1.7 Special requirements for mounting	26
5.1.8 Principle anode-cathode voltages	27
5.1.9 Gate voltages	27
5.1.10 Principal anode cathode currents	28
5.1.11 Peak forward gate current (I_{FGM})	35
5.2 Characteristics	35
5.2.1 General	35
5.2.2 Reverse current (I_R)	35
5.2.3 Reverse conducting voltage (V_{RC}) (for reverse conducting thyristors).....	35
5.2.4 Continuous (direct) off-state current (I_D)	35
5.2.5 On-state voltage (V_T).....	35
5.2.6 On-state characteristics (where appropriate).....	35

5.2.7	Peak sinusoidal on-state voltage (V_{TM})	36
5.2.8	Threshold voltage ($V_{T(TO)} / V_{TO}$)	36
5.2.9	On-state slope resistance (r_T)	36
5.2.10	Holding current (I_H)	36
5.2.11	Latching current (I_L)	36
5.2.12	Repetitive peak off-state current (I_{DRM})	36
5.2.13	Repetitive peak reverse current (I_{RRM})	36
5.2.14	Gate-trigger current (I_{GT}) and gate-trigger voltage (V_{GT})	37
5.2.15	Gate non-trigger current (I_{GD}) and gate non-trigger voltage (V_{GD})	37
5.2.16	Sustaining gate current (I_{FGSUS}) for GTO only	38
5.2.17	Peak gate turn-off current (I_{RGQM}) for GTO only	38
5.2.18	Peak tail current (I_{ZM}) for GTO only	38
5.2.19	Characteristic time intervals	39
5.2.20	Total power dissipation	41
5.2.21	Turn-on energy dissipation (E_{ON}) for GTO preferably	42
5.2.22	On-state energy dissipation (E_T) for GTO preferably	42
5.2.23	Turn-off energy dissipation (E_Q) for GTO preferably	43
5.2.24	Recovered charge (Q_r) (where appropriate)	43
5.2.25	Peak reverse recovery current (I_{rrm})(where appropriate)	43
5.2.26	Reverse recovery time (t_{rr}) (where appropriate)	43
5.2.27	Thermal resistance junction to ambient ($R_{th(j-a)}$)	43
5.2.28	Thermal resistance junction to case ($R_{th(j-c)}$)	43
5.2.29	Thermal resistance case to heat sink ($R_{th(c-s)}$)	43
5.2.30	Thermal resistance junction to heat sink ($R_{th(j-s)}$)	44
5.2.31	Transient thermal impedance junction to ambient ($Z_{th(j-a)}$)	44
5.2.32	Transient thermal impedance junction to case ($Z_{th(j-c)}$)	44
5.2.33	Transient thermal impedance junction to heat sink ($Z_{th(j-s)}$)	44
6	Measuring and test methods	44
6.1	General	44
6.2	Measuring methods for electrical characteristics	44
6.2.1	On-state voltage (V_T)	44
6.2.2	Repetitive peak reverse current (I_{RRM})	47
6.2.3	Latching current (I_L)	48
6.2.4	Holding current (I_H)	50
6.2.5	Off-state current (I_D)	51
6.2.6	Repetitive peak off state current (I_{DRM})	52
6.2.7	Gate trigger current or voltage (I_{GT}), (V_{GT})	53
6.2.8	Gate non-trigger voltage (V_{GD}) and gate non-trigger current (I_{GD})	54
6.2.9	Gate controlled delay time (t_d) and turn-on time (t_{gt})	56
6.2.10	Circuit commutated turn-off time (t_q)	58
6.2.11	Critical rate of rise of off-state voltage ($dv/dt_{(cr)}$)	61
6.2.12	Critical rate of rise of commutating voltage of triacs ($dv/dt_{(com)}$)	63
6.2.13	Recovered charge (Q_r) and reverse recovery time (t_{rr})	69
6.2.14	Circuit commutated turn-off time (t_q) of a reverse conducting thyristor	73
6.2.15	Turn-off behaviour of turn-off thyristors (for GTO)	75
6.2.16	Total energy dissipation during one cycle (for fast switching thyristors)	78
6.3	Verification test methods for ratings (limiting values)	79
6.3.1	Non-repetitive peak reverse voltage (V_{RSM})	79
6.3.2	Non-repetitive peak off-state voltage (V_{DSM})	80

6.3.3	Surge (non-repetitive) on-state current (I_{TSM}).....	81
6.3.4	On-state current ratings of fast-switching thyristors.....	83
6.3.5	Critical rate of rise of on-state current ($di/dt_{(cr)}$)	94
6.3.6	Peak case non-rupture current (I_{RSMC})	97
6.4	Measuring methods for thermal characteristics	98
6.4.1	General	98
6.4.2	Measurement of the case temperature.....	98
6.4.3	Measuring methods for thermal resistance (R_{th}) and transient thermal impedance (Z_{th}).....	99
6.4.4	Measurement method of thermal resistance and impedance (Method A).....	99
6.4.5	Measurement method of thermal resistance and impedance (Method B).....	102
6.4.6	Measurement method of thermal resistance and impedance (Method C, for GTO thyristors only).....	113
6.4.7	Measurement method of thermal resistance and impedance (Method D, for GTO thyristors only).....	117
7	Requirements for type tests and routine tests, marking of thyristors and endurance tests.....	120
7.1	Type tests	120
7.2	Routine tests.....	120
7.3	Measuring and test methods.....	121
7.4	Marking of thyristors.....	121
7.5	Endurance tests.....	121
7.5.1	General requirements.....	121
7.5.2	Specific requirements.....	122
7.5.3	Acceptance-defining characteristics and criteria for endurance tests	122
7.5.4	Acceptance-defining characteristics and criteria for reliability tests.....	122
7.5.5	Procedure in case of a testing error.....	122
	Bibliography	124
	Figure 1 – Peak values of on-state currents.....	10
	Figure 2 – Partial power (dissipation) of turn-off thyristors at absolute long on-state period.....	13
	Figure 3 – Components of dynamic on-state energy dissipation of turn-off thyristors at absolute short on-state period.....	15
	Figure 4 – Reverse recovery time.....	16
	Figure 5 – Off-state recovery time	17
	Figure 6 – Circuit-commutated turn-off time	18
	Figure 7 – Gate-controlled turn-on times	19
	Figure 8 – Gate-controlled turn-off times	21
	Figure 9 – Recovered charge Q_r	22
	Figure 10 – Application of gate voltages for thyristors	28
	Figure 11 – Peak sinusoidal currents and typical waveforms at higher frequencies	32
	Figure 12 – Peak trapezoidal currents and typical waveforms at higher frequencies	34
	Figure 13 – Forward gate voltage versus forward gate current	38
	Figure 14 – Examples of current and voltage wave shapes during turn-off of a thyristor under various circuit conditions	39
	Figure 15 – Curves with total energy dissipation E_p as parameter and sinusoidal current pulse	41

Figure 16 – Curves with total energy dissipation E_p as parameter and trapezoidal current pulse	42
Figure 17 – Recovered charge Q_r , peak reverse recovery current I_{rrm} , reverse recovery time t_{rr} (idealized characteristics).....	43
Figure 18 – Circuit for measurement of on-state voltage (d.c. method)	45
Figure 19 – Circuit for measurement of on-state voltage (oscilloscope method)	45
Figure 20 – Graphic representation of on-state voltage versus current characteristic (oscilloscope method)	46
Figure 21 – Circuit diagram for measurement of on-state voltage (pulse method)	46
Figure 22 – Circuit diagram for measuring peak reverse current.....	48
Figure 23 – Circuit diagram for measuring latching current.....	49
Figure 24 – Waveform of the latching current	50
Figure 25 – Circuit diagram for measuring holding current	51
Figure 26 – Circuit diagram for measuring off-state current (d.c. method).....	52
Figure 27 – Circuit diagram for measuring peak off-state current.....	52
Figure 28 – Circuit diagram for measuring gate trigger current and/or voltage	53
Figure 29 – Circuit diagram for measuring gate non-trigger current and/or voltage.....	55
Figure 30 – Circuit diagram for measuring the gate controlled delay time and turn-on time ..	56
Figure 31 – On-state current waveform of a thyristor.....	57
Figure 32 – Off-state voltage and current waveform of a thyristor.....	58
Figure 33 – Thyristor switching waveforms.....	59
Figure 34 – Diagram of basic circuit	60
Figure 35 – Circuit diagram for measuring critical rate of rise of off-state voltage	61
Figure 36 – Waveform.....	61
Figure 37 – Measurement circuit for exponential rate of rise	62
Figure 38 – Measurement circuit for critical rate of rise of commutating voltage.....	64
Figure 39 – Waveforms	65
Figure 40 – Circuit diagram for high current triacs	66
Figure 41 – Waveforms with high and low di/dt	67
Figure 42 – Circuit diagram for recovered charge and reverse recovery time (half sine wave method).....	69
Figure 43 – Current waveform through the thyristor T	70
Figure 44 – Circuit diagram for recovered charge and reverse recover time (rectangular wave method).....	71
Figure 45 – Current waveform through the thyristor T	72
Figure 46 – Circuit diagram for measuring circuit commutated turn-off time of reverse conducting thyristor	73
Figure 47 – Current and voltage waveforms of commutated turn-off time of reverse conducting thyristor	74
Figure 48 – Circuit diagram to measure turn-off behaviour of turn-off thyristors	76
Figure 49 – Voltage and current waveforms during turn-off	76
Figure 50 – Circuit diagram for measuring non-repetitive peak reverse voltage rating	79
Figure 51 – Circuit diagram for measuring non-repetitive peak off-state voltage rating.....	80
Figure 52 – Circuit diagram for measuring surge (non-repetitive) on-state current rating.....	82

Figure 53 – Basic circuit and test waveforms for sinusoidal on-state current with reverse voltage	84
Figure 54 – Extended circuit diagram for measuring sinusoidal on-state current with reverse voltage	85
Figure 55 – Basic circuit and test waveforms for sinusoidal on-state current with reverse voltage suppressed.	87
Figure 56 – Extended circuit diagram for measuring sinusoidal on-state current with reverse voltage suppressed	88
Figure 57 – Basic circuit diagram and test waveforms for trapezoidal on-state current with reverse voltage applied	90
Figure 58 – Basic circuit and test waveforms for trapezoidal on-state current with reverse voltage suppressed	92
Figure 59 – Circuit diagram for measuring critical rate of rise of on-state current	94
Figure 60 – On-state current waveform for di/dt rating	96
Figure 61 – Circuit diagram for measuring peak case non-rupture current	97
Figure 62 – Waveform of the reverse current i_R through the thyristor under test.....	97
Figure 63 – Basic circuit diagram for the measurement of R_{th} (Method A)	100
Figure 64 – Basic circuit diagram for the measurement of $Z_{th}(t)$ (Method A)	101
Figure 65 – Superposition of the reference current pulse on different on-state currents	103
Figure 66 – Waveforms for power dissipation and virtual junction temperature (general case)	104
Figure 67 – Calibration curve	106
Figure 68 – Basic circuit diagram for the measurement of R_{th} (Method B)	108
Figure 69 – Waveforms for measuring thermal resistance	109
Figure 70 – Basic circuit diagram for the measurement of $Z_{th}(t)$ (Method B)	111
Figure 71 – Waveforms for measuring transient thermal impedance	111
Figure 72 – Basic circuit diagram for the measurement of R_{th} (Method C)	114
Figure 73 – Waveforms for measuring thermal resistance	114
Figure 74 – Basic circuit diagram for the measurement of $Z_{th}(t)$ (Method C)	116
Figure 75 – Waveforms for measuring the transient thermal impedance of a gate turn-off thyristor	116
Figure 76 – Calibration and measurement arrangement for the heat flow method	118
Table 1 – Additional general subscripts	23
Table 2 – Principal voltages, anode-cathode voltages	24
Table 3 – Principal currents, anode currents, cathode currents	24
Table 4 – Gate voltages	24
Table 5 – Gate currents	24
Table 6 – Time quantities	25
Table 7 – Power dissipation	25
Table 8 – Sundry quantities	25
Table 9 – Minimum type and routine tests for reverse-blocking triode thyristors	121
Table 10 – Acceptance-defining characteristics after endurance tests	122
Table 11 – Conditions for endurance tests	123

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SEMICONDUCTOR DEVICES –

Part 6: Discrete devices – Thyristors

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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:

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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.

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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 language 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

$I_{T(OV)}$

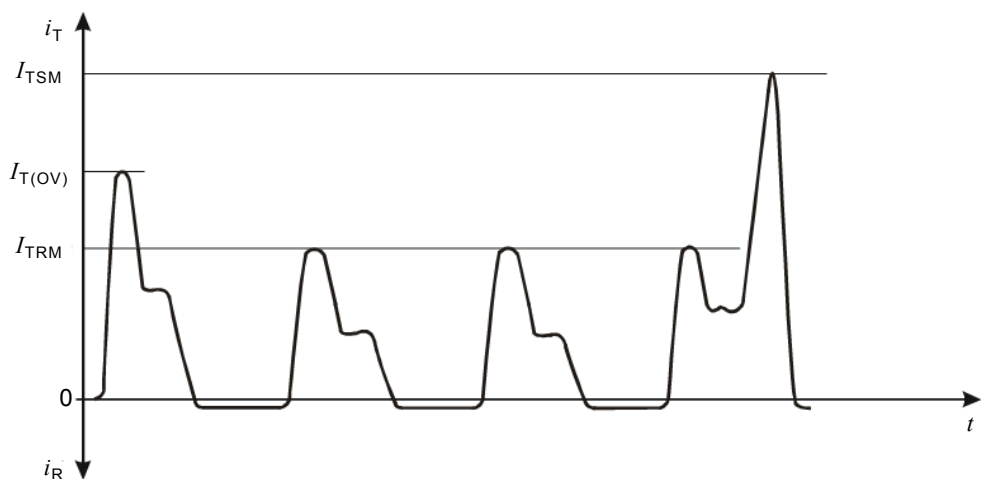
on-state current whose continuous application would cause the maximum-rated virtual junction temperature to be exceeded

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Note 1 to entry: See Figure 1.



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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

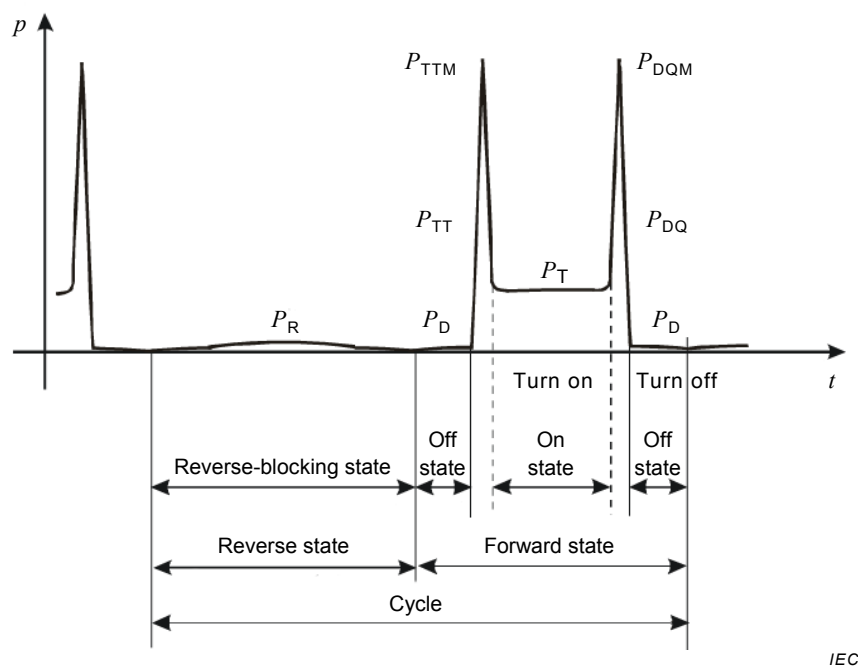
3.4.1 General

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

<https://standards.iteh.ai/catalog/standards/sist/6020647c-311e-4978-8a96-21d3546e981d/iec-60747-6-2016>

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