

# Thyristor T453-1000-24



Mean on-state current	$I_{TAV}$						1000 A					
Repetitive peak off-state voltage	$V_{DRM}$						1000 - 2400 V					
Repetitive peak reverse voltage	$V_{RRM}$											
Turn-off time	$t_q$						160, 200, 250, 320, 400, 500 $\mu$ s					
$V_{DRM}, V_{RRM}, V$	1000	1100	1200	1300	1400	1500	1600	1800	2000	2200	2400	
Voltage code	10	11	12	13	14	15	16	18	20	22	24	
$T_j, ^\circ C$	-60 ÷ 125											

## MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions
<b>ON-STATE</b>				
$I_{TAV}$	Mean on-state current	A	1000 1243	$T_c=95^\circ C$ , Double side cooled $T_c=85^\circ C$ , Double side cooled 180° half-sine wave; 50 Hz
$I_{TRMS}$	RMS on-state current	A	1570	$T_c=95^\circ C$ , Double side cooled 180° half-sine wave; 50 Hz
$I_{TSM}$	Surge on-state current	kA	25.0 29.0	$T_j=T_{jmax}$ $T_j=25^\circ C$ 180° half-sine wave; $t_p=10$ ms; single pulse; $V_D=V_R=0$ V; Gate pulse: $I_G=2$ A; $t_{GP}=50$ ms; $di_G/dt \geq 1$ A/ms
			26.0 30.0	$T_j=T_{jmax}$ $T_j=25^\circ C$ 180° half-sine wave; $t_p=8.3$ ms; single pulse; $V_D=V_R=0$ V; Gate pulse: $I_G=2$ A; $t_{GP}=50$ ms; $di_G/dt \geq 1$ A/ms
$I^2t$	Safety factor	$A^2s \cdot 10^3$	3100 4200	$T_j=T_{jmax}$ $T_j=25^\circ C$ 180° half-sine wave; $t_p=10$ ms; single pulse; $V_D=V_R=0$ V; Gate pulse: $I_G=2$ A; $t_{GP}=50$ ms; $di_G/dt \geq 1$ A/ms
			2800 3700	$T_j=T_{jmax}$ $T_j=25^\circ C$ 180° half-sine wave; $t_p=8.3$ ms; single pulse; $V_D=V_R=0$ V; Gate pulse: $I_G=2$ A; $t_{GP}=50$ ms; $di_G/dt \geq 1$ A/ms
<b>BLOCKING</b>				
$V_{DRM}, V_{RRM}$	Repetitive peak off-state and Repetitive peak reverse voltages	V	1000 - 2400	$T_{jmin} < T_j < T_{jmax}$ ; 180° half-sine wave; 50 Hz; Gate open
$V_{DSM}, V_{RSM}$	Non-repetitive peak off-state and Non-repetitive peak reverse voltages	V	1100 - 2500	$T_{jmin} < T_j < T_{jmax}$ ; 180° half-sine wave; single pulse; Gate open
$V_D, V_R$	Direct off-state and Direct reverse voltages	V	$0.6V_{DRM}$ $0.6V_{RRM}$	$T_j=T_{jmax}$ ; Gate open

TRIGGERING				
$I_{FGM}$	Peak forward gate current	A	8	$T_j = T_{j\max}$
$V_{RGM}$	Peak reverse gate voltage	V	5	
$P_G$	Gate power dissipation	W	4	$T_j = T_{j\max}$ for DC gate current
SWITCHING				
$(di_T/dt)_{crit}$	Critical rate of rise of on-state current non-repetitive (f=1 Hz)	A/ms	2000	$T_j = T_{j\max}$ ; $V_D = 0.67 \cdot V_{DRM}$ ; $I_{TM} = 6000$ A; Gate pulse: $I_G = 2$ A; $t_{GP} = 50$ ms; $di_G/dt \geq 2$ A/ms
THERMAL				
$T_{stg}$	Storage temperature	°C	-60...50	
$T_j$	Operating junction temperature	°C	-60...125	
MECHANICAL				
F	Mounting force	kN	24.0...28.0	
a	Acceleration	m/s <sup>2</sup>	50	Device clamped

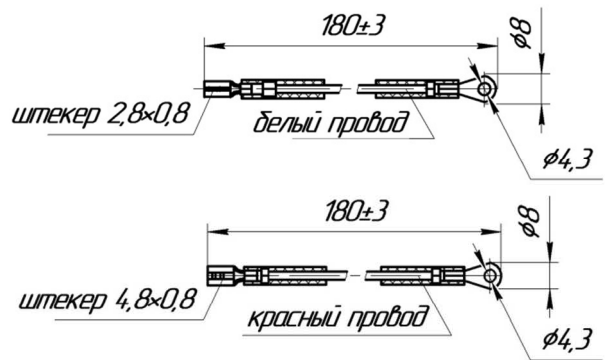
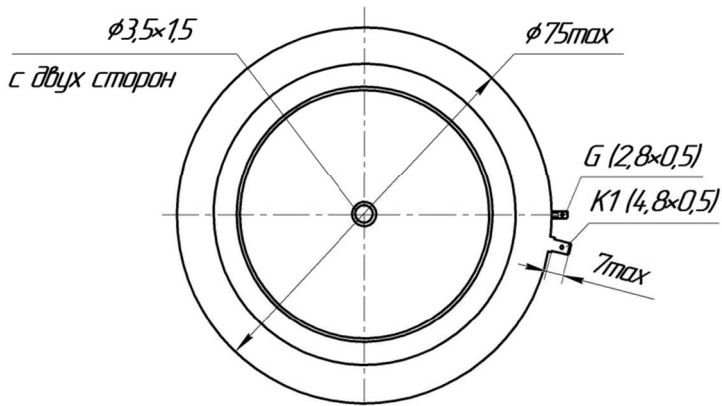
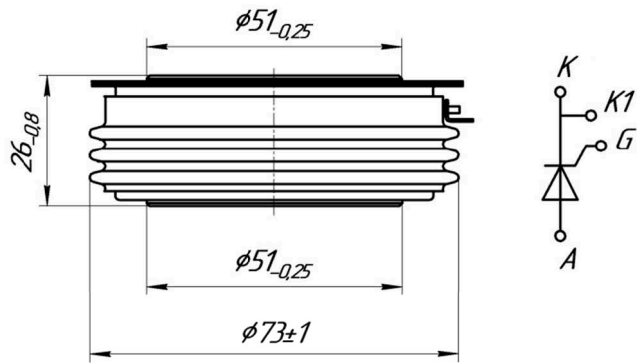
## CHARACTERISTICS

Symbols and parameters		Units	Values	Conditions	
ON-STATE					
$V_{TM}$	Peak on-state voltage, max	V	1.75	$T_j = 25$ °C; $I_{TM} = 3140$ A	
$V_{T(TO)}$	On-state threshold voltage, max	V	0.967	$T_j = T_{j\max}$ ;	
$r_T$	On-state slope resistance, max	mW	0.269	$0.5 \text{ p } I_{TAV} < I_T < 1.5 \text{ p } I_{TAV}$	
$I_L$	Latching current, max	mA	1500	$T_j = 25$ °C; $V_D = 12$ V; Gate pulse: $I_G = 2$ A; $t_{GP} = 50$ ms; $di_G/dt \geq 1$ A/ms	
$I_H$	Holding current, max	mA	300	$T_j = 25$ °C; $V_D = 12$ V; Gate open	
BLOCKING					
$I_{DRM}, I_{RRM}$	Repetitive peak off-state and Repetitive peak reverse currents, max	mA	150	$T_j = T_{j\max}$ ; $V_D = V_{DRM}$ ; $V_R = V_{RRM}$	
$(dv_D/dt)_{crit}$	Critical rate of rise of off-state voltage <sup>1)</sup> , min	V/ms	200, 320, 500, 1000, 1600, 2000, 2500	$T_j = T_{j\max}$ ; $V_D = 0.67 \cdot V_{DRM}$ ; Gate open	
TRIGGERING					
$V_{GT}$	Gate trigger direct voltage, max	V	3.00 2.50 1.50	$T_j = T_{j\min}$ $T_j = 25$ °C $T_j = T_{j\max}$	$V_D = 12$ V; $I_D = 3$ A; Direct gate current
$I_{GT}$	Gate trigger direct current, max	mA	500 300 150	$T_j = T_{j\min}$ $T_j = 25$ °C $T_j = T_{j\max}$	
$V_{GD}$	Gate non-trigger direct voltage, min	V	0.45	$T_j = T_{j\max}$ ;	
$I_{GD}$	Gate non-trigger direct current, min	mA	70.00	$V_D = 0.67 \cdot V_{DRM}$ ; Direct gate current	
SWITCHING					
$t_{gd}$	Delay time, max	ms	1.00	$T_j = 25$ °C; $V_D = 1000$ V; $I_{TM} = I_{TAV}$ ; $di/dt = 200$ A/ms;	
$t_{gt}$	Turn-on time, max	ms	5.00	Gate pulse: $I_G = 2$ A; $V_G = 20$ V; $t_{GP} = 50$ ms; $di_G/dt = 2$ A/ms	
$t_q$	Turn-off time <sup>2)</sup> , max	ms	160, 200, 250, 320, 400, 500	$dv_D/dt = 50$ V/ms; $T_j = T_{j\max}$ ; $I_{TM} = I_{TAV}$ ; $di_R/dt = -10$ A/ms; $V_R = 100$ V; $V_D = 0.67 \cdot V_{DRM}$	
$Q_{rr}$	Total recovered charge, max	mC	2700	$T_j = T_{j\max}$ ; $I_{TM} = 2000$ A; $di_R/dt = -10$ A/ms; $V_R = 100$ V;	
$t_{rr}$	Reverse recovery time, max	ms	30		
$I_{rrm}$	Peak reverse recovery current, max	A	180		

<b>THERMAL</b>					
$R_{thjc}$	Thermal resistance, junction to case, max	°C/W	0.0180	Direct current	Double side cooled
$R_{thjc-A}$			0.0396		Anode side cooled
$R_{thjc-K}$			0.0324		Cathode side cooled
$R_{thck}$	Thermal resistance, case to heatsink, max	°C/W	0.0040	Direct current	
<b>MECHANICAL</b>					
w	Weight, max	g	550		
$D_s$	Surface creepage distance	mm (inch)	31.60 (1.244)		
$D_a$	Air strike distance	mm (inch)	16.50 (0.649)		

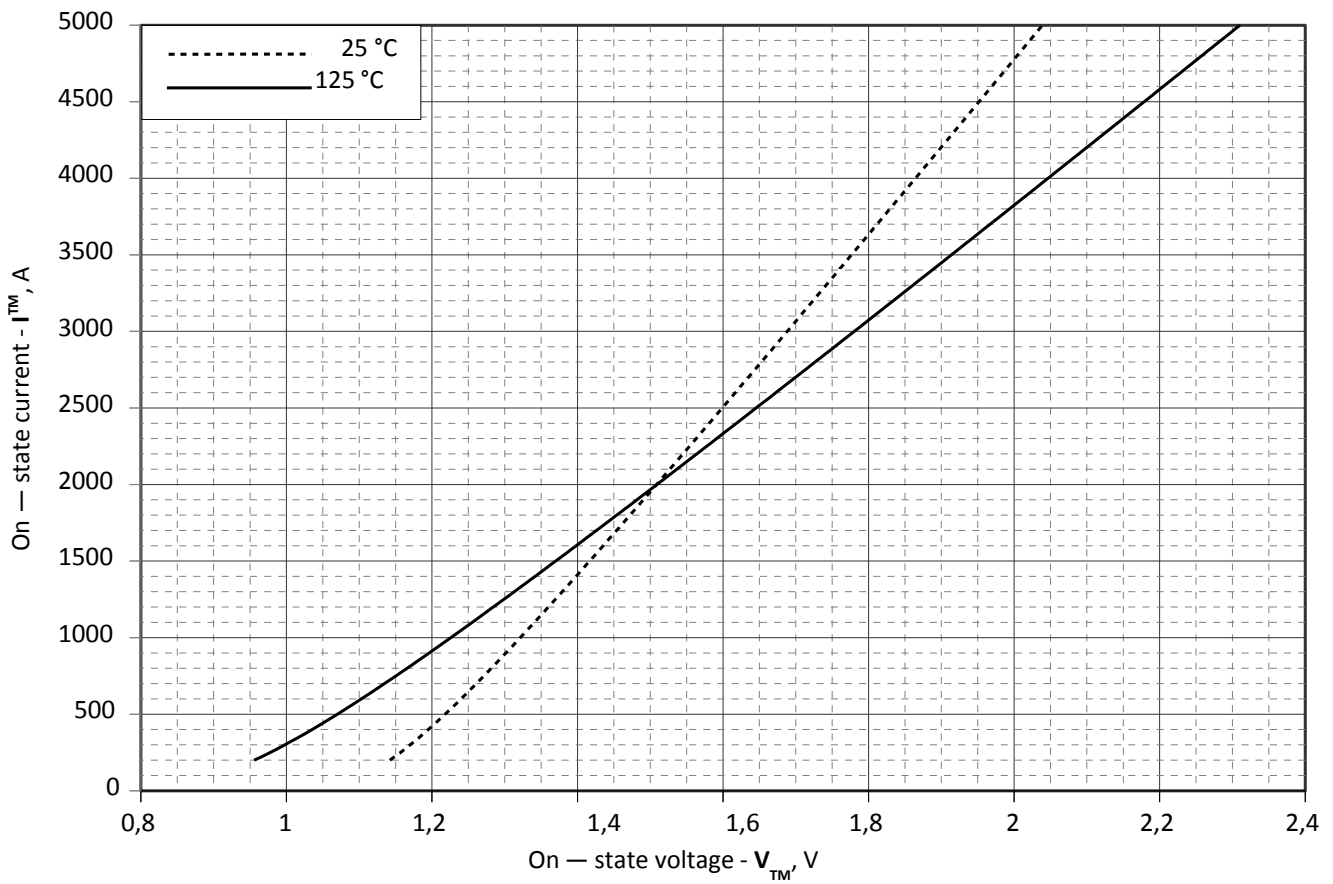
OVERALL DIMENSIONS

Package type: PT53



- K – cathode;
- A – anode;
- K1 – auxiliary cathode;
- G – gate;

All dimensions in millimeters



**Fig 1 – On-state characteristics of Limit device**

Analytical function for On-state characteristic:

$$V_T = A + B \cdot i_T + C \cdot \ln(i_T + 1) + D \cdot \sqrt{i_T}$$

	Coefficients for max curves	
	$T_j = 25^\circ\text{C}$	$T_j = T_{j\text{max}}$
<b>A</b>	0.956310000	0.681670000
<b>B</b>	0.000169160	0.000254930
<b>C</b>	0.029034000	0.042284000
<b>D</b>	-0.000147910	-0.000086298

**On-state characteristic model (see Fig. 1)**

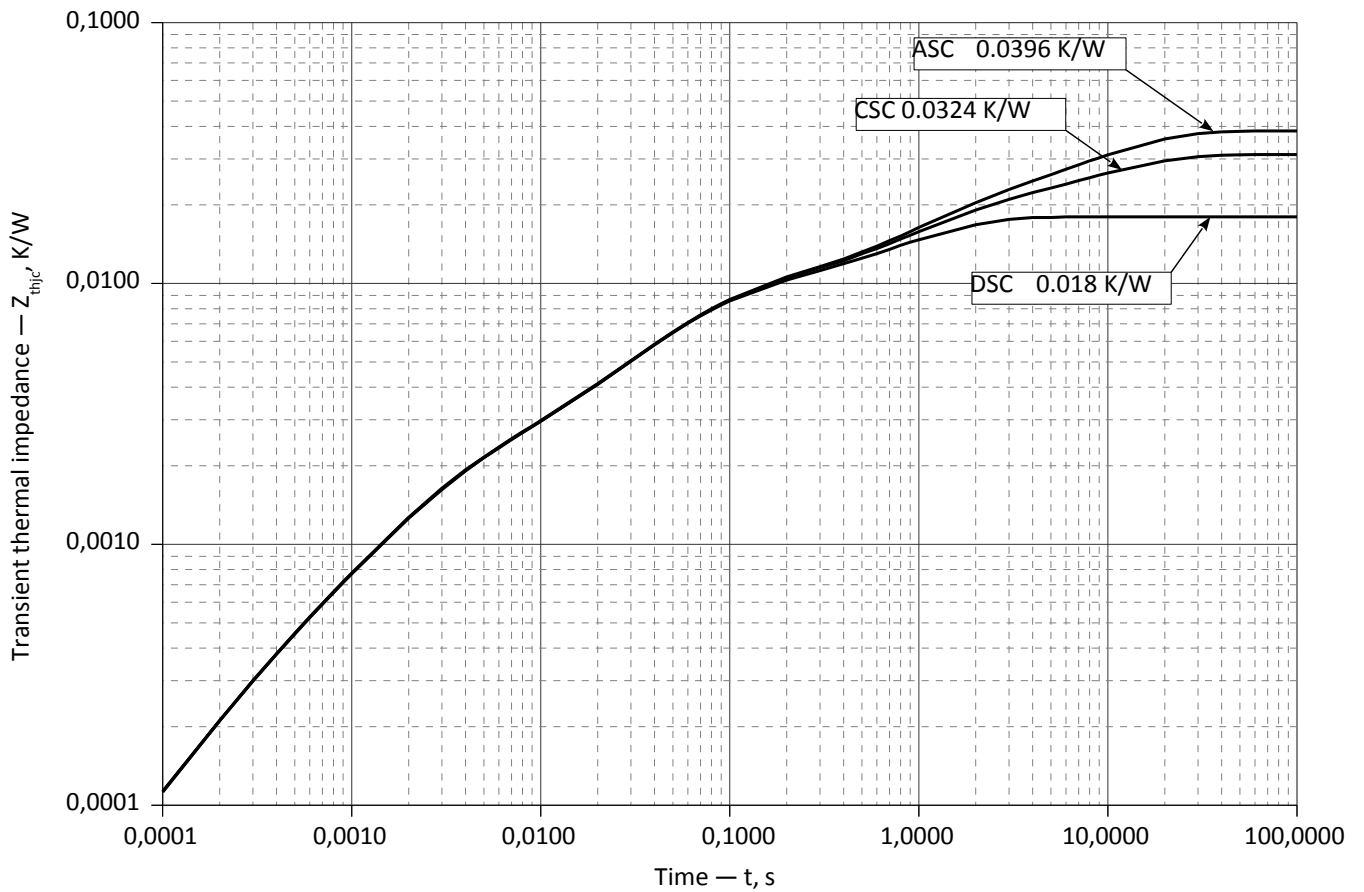


Fig 2 – Transient thermal impedance  $Z_{thjc}$  vs. time  $t$

Analytical function for Transient thermal impedance junction to case  $Z_{thjc}$  for DC:

$$Z_{thjc} = \sum_{i=1}^n R_i \left( 1 - e^{-\frac{t}{\tau_i}} \right)$$

Where  $i = 1$  to  $n$ ,  $n$  is the number of terms in the series.

$t$  = Duration of heating pulse in seconds.  $Z_{thjc}$

= Thermal resistance at time  $t$ .

$R_i$  = Amplitude of  $p_{th}$  term.

$\tau_i$  = Time constant of  $r_{th}$  term.

DC Double side cooled

$i$	1	2	3	4	5	6
$R_i$ , K/W	0.009241	0.006037	0.001231	0.001054	0.0003396	0.00009575
$\tau_i$ , s	0.9673	0.04967	0.002733	0.07734	0.001638	0.0002248

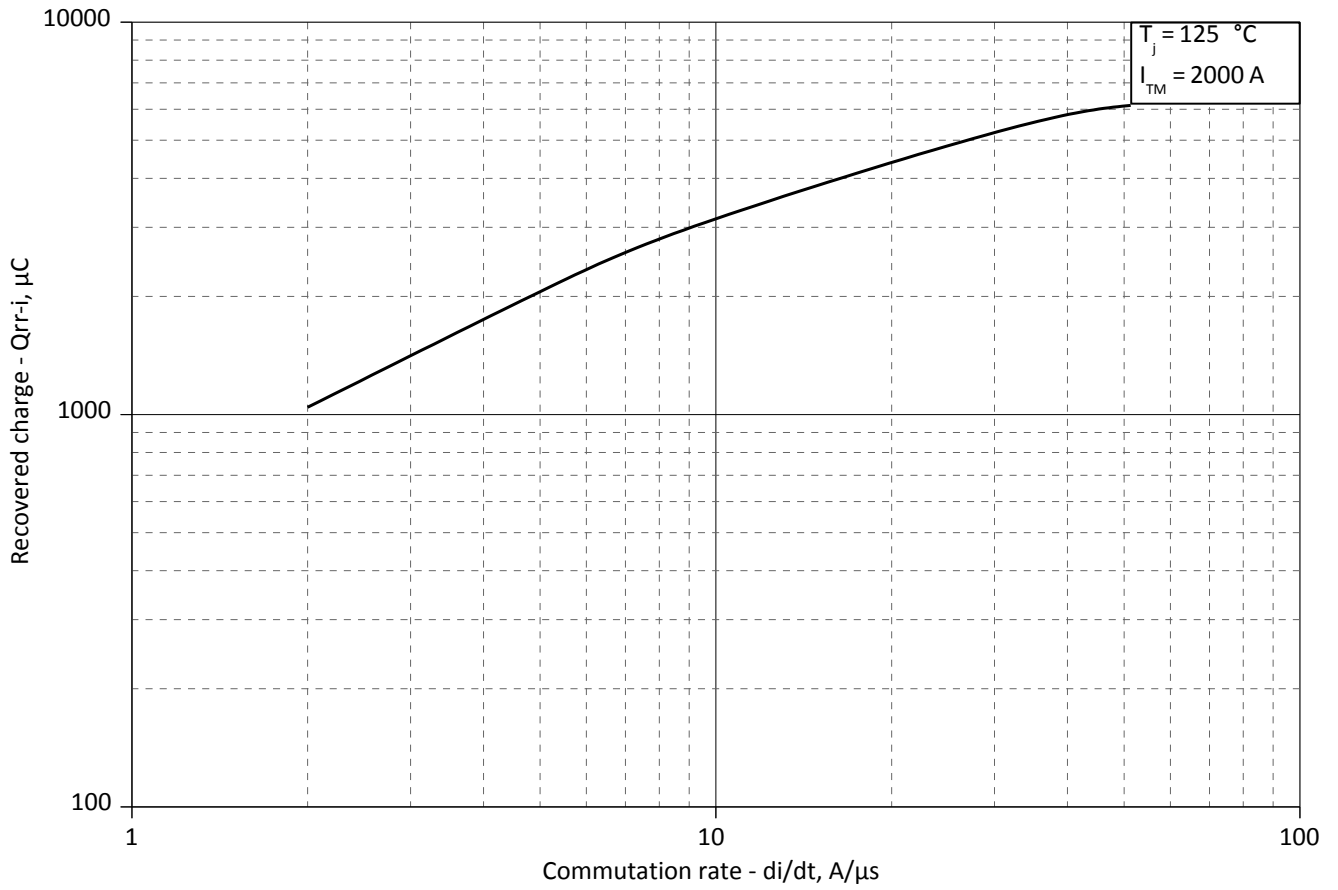
DC Anode side cooled

$i$	1	2	3	4	5	6
$R_i$ , K/W	0.01318	0.009281	0.006055	0.001018	0.001535	0.0001182
$\tau_i$ , s	9.745	1.028	0.05591	0.03732	0.002468	0.0002687

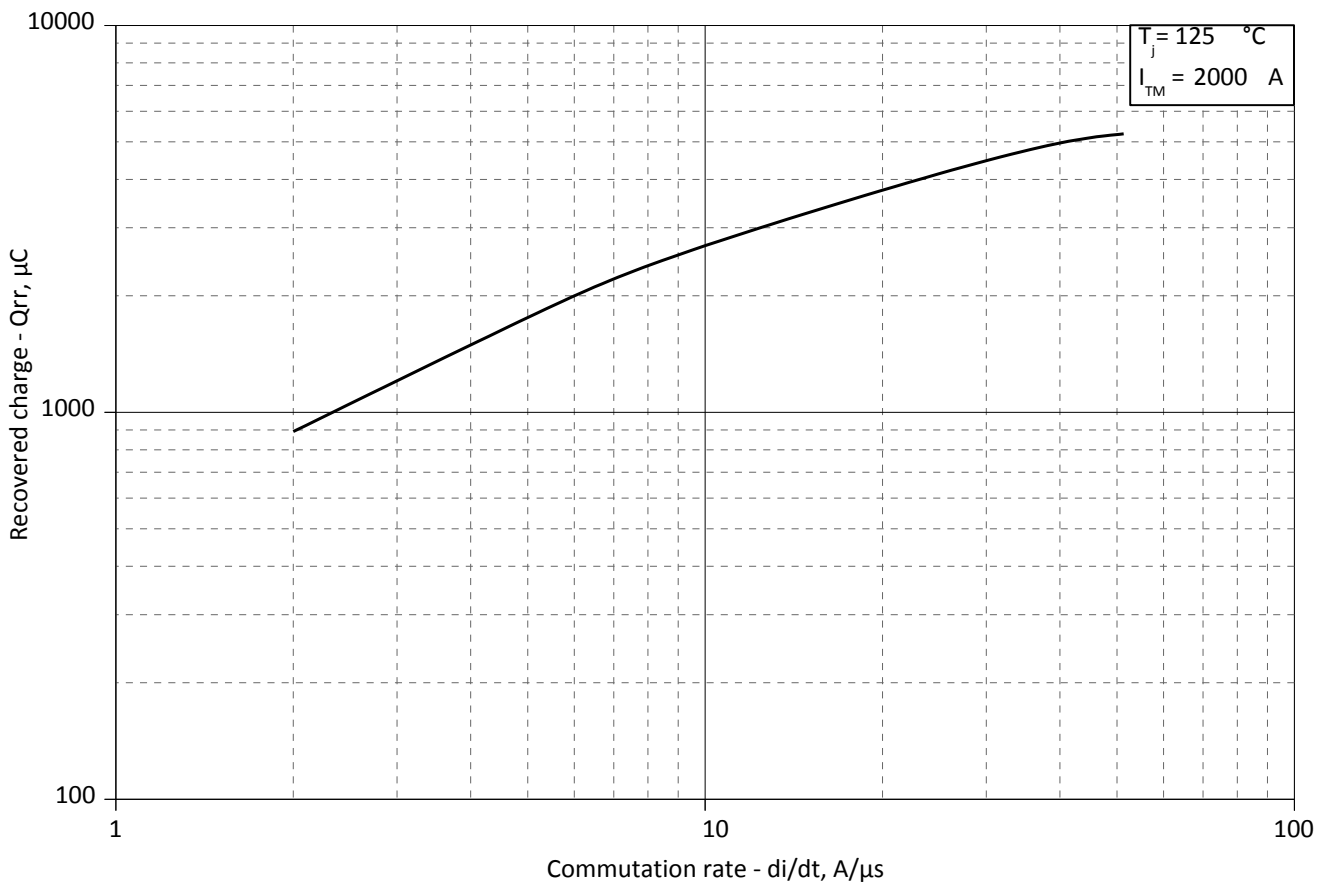
DC Cathode side cooled

$i$	1	2	3	4	5	6
$R_i$ , K/W	0.02041	0.009325	0.006949	0.0001252	0.001516	0.0001119
$\tau_i$ , s	9.752	1.065	0.05344	0.01407	0.002421	0.0002554

Transient thermal impedance junction to case  $Z_{thjc}$  model (see Fig. 2)



**Fig 3 – Maximum recovered charge  $Q_{rr-i}$  (integral) vs. commutation rate  $di_r/dt$**



**Fig 4 – Maximum recovered charge  $Q_{rr}$  vs. commutation rate  $di_r/dt$  (25% chord)**

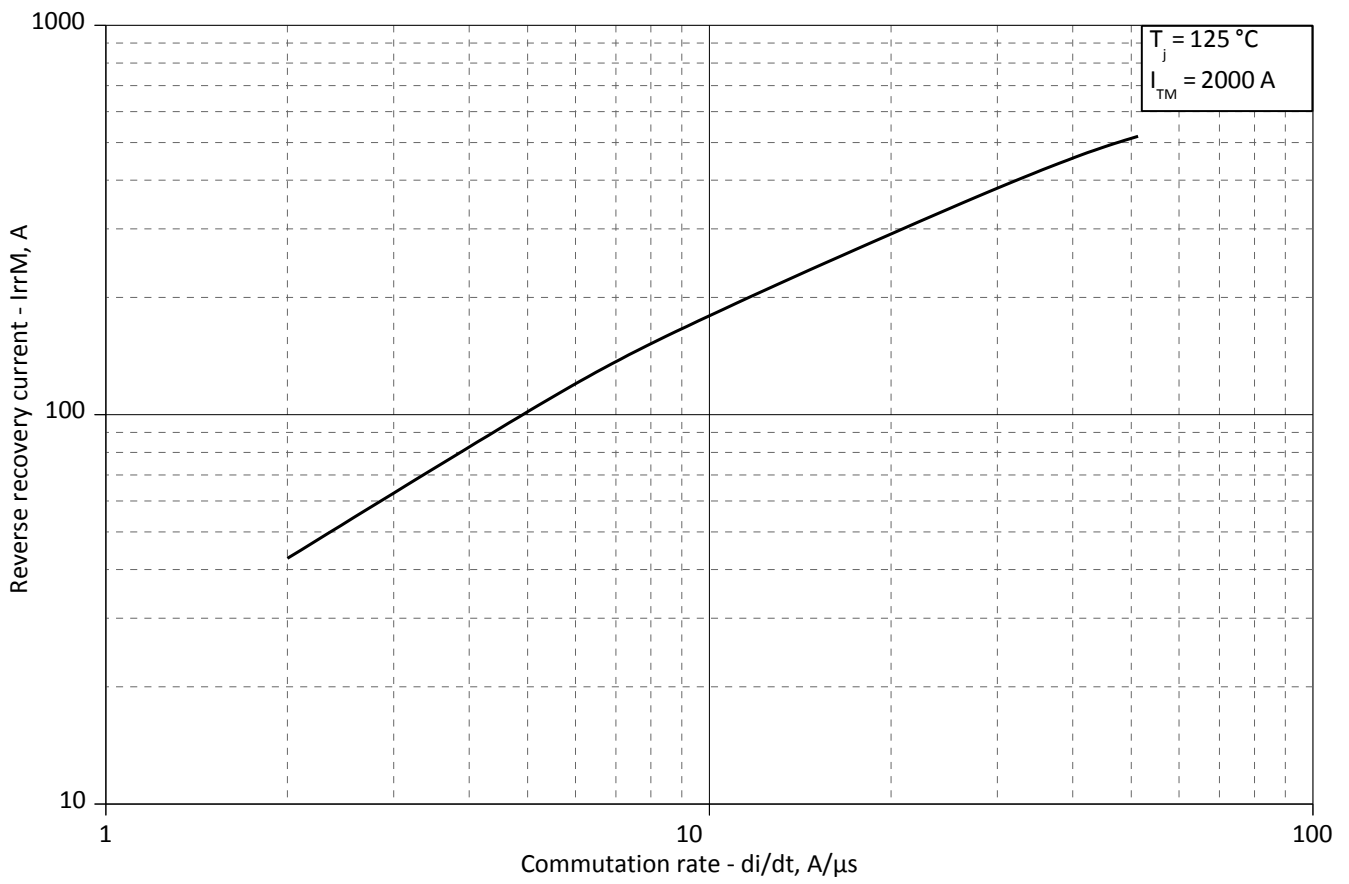


Fig 5 – Maximum reverse recovery current  $I_{rM}$  vs. commutation rate  $di_r/dt$

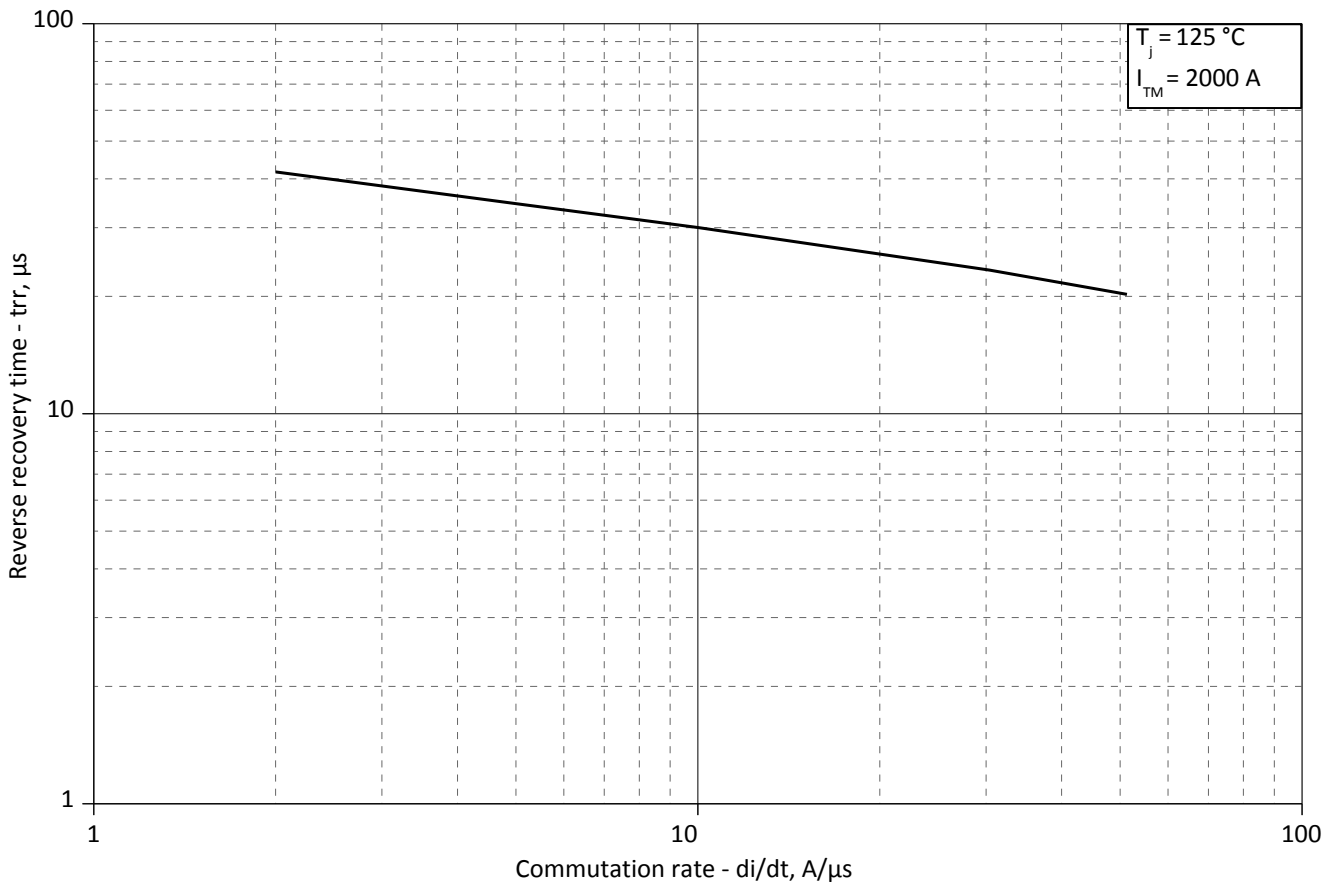
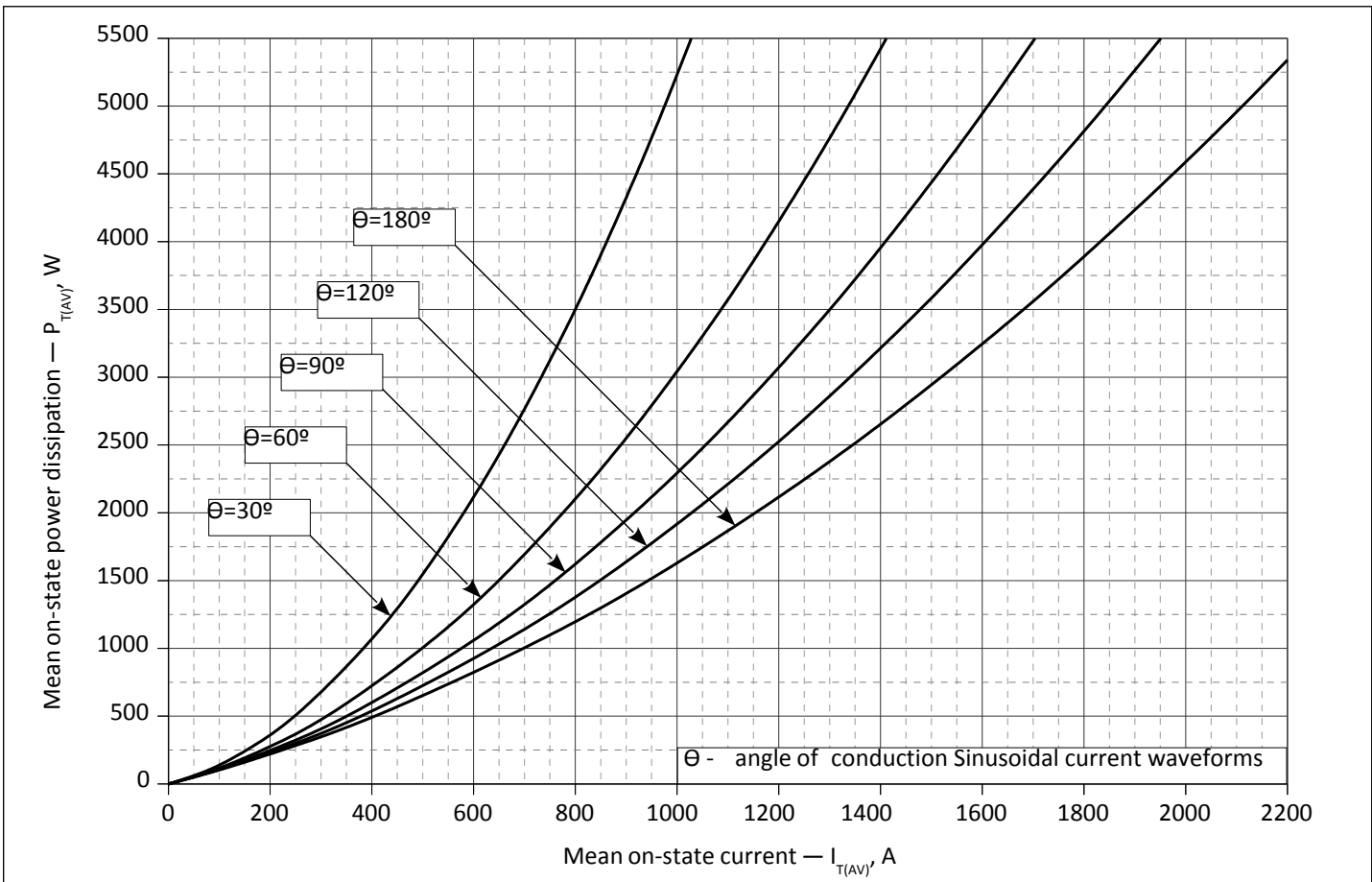
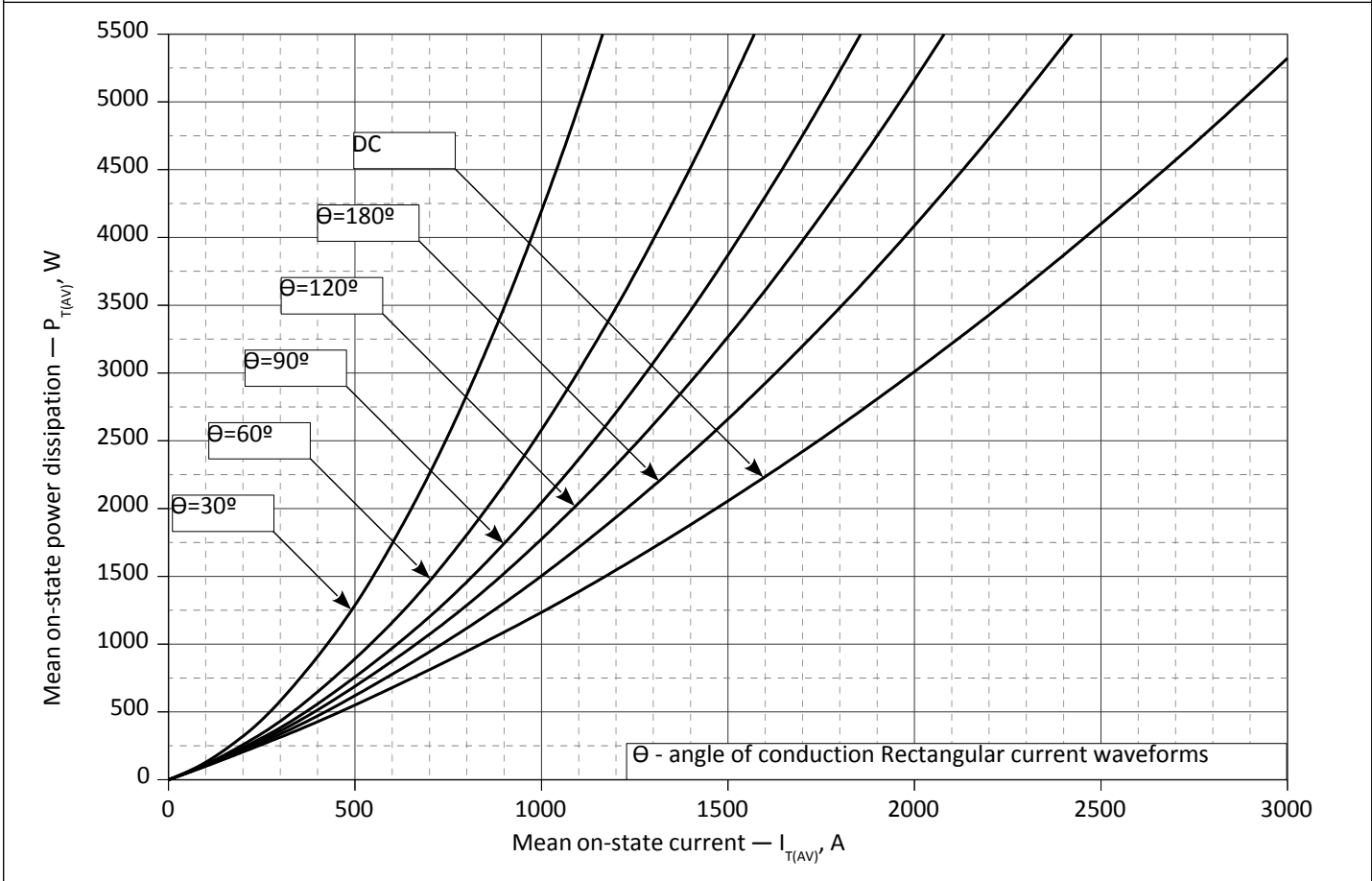


Fig 6 – Maximum recovery time  $t_r$  vs. commutation rate  $di_r/dt$  (25% chord)

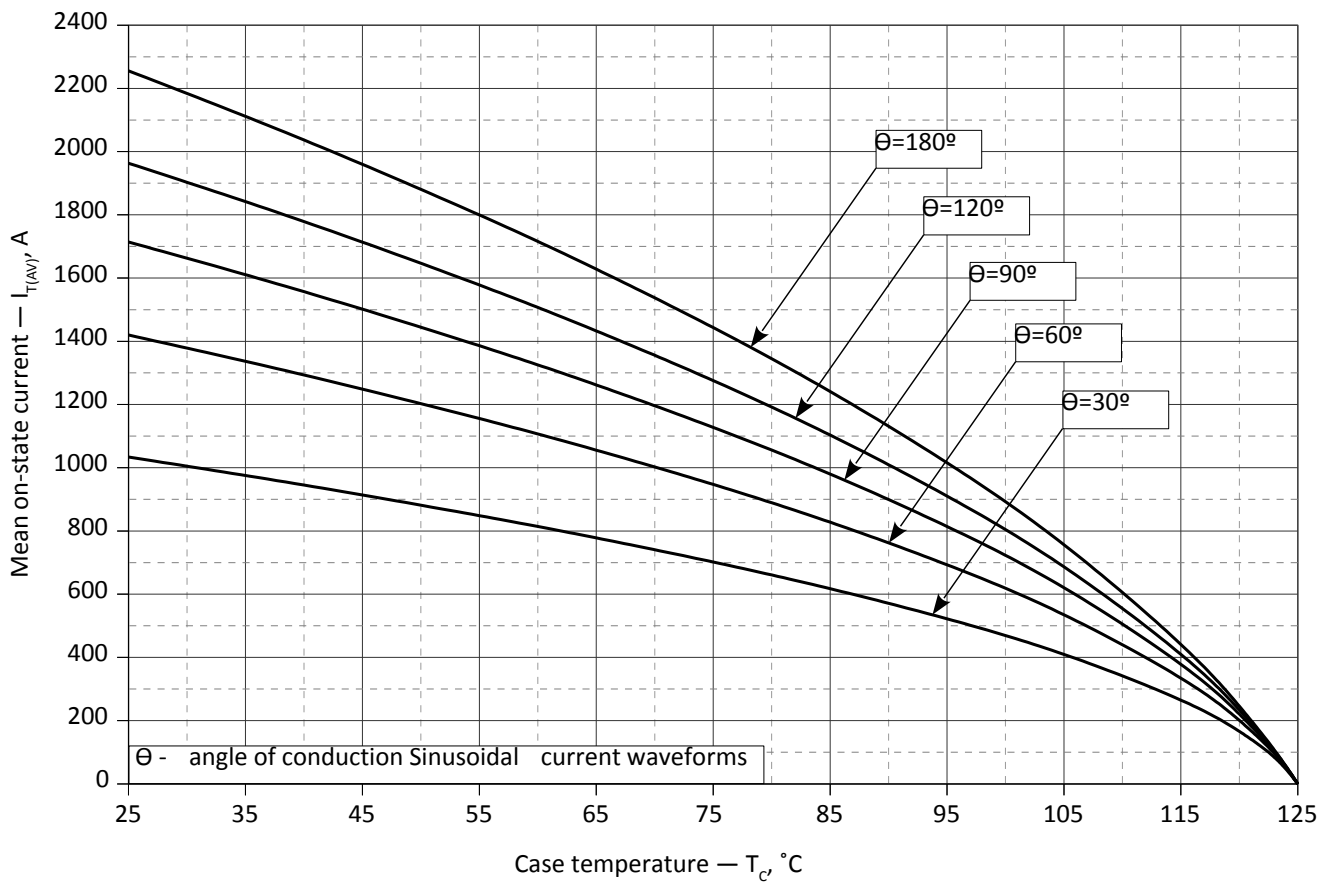




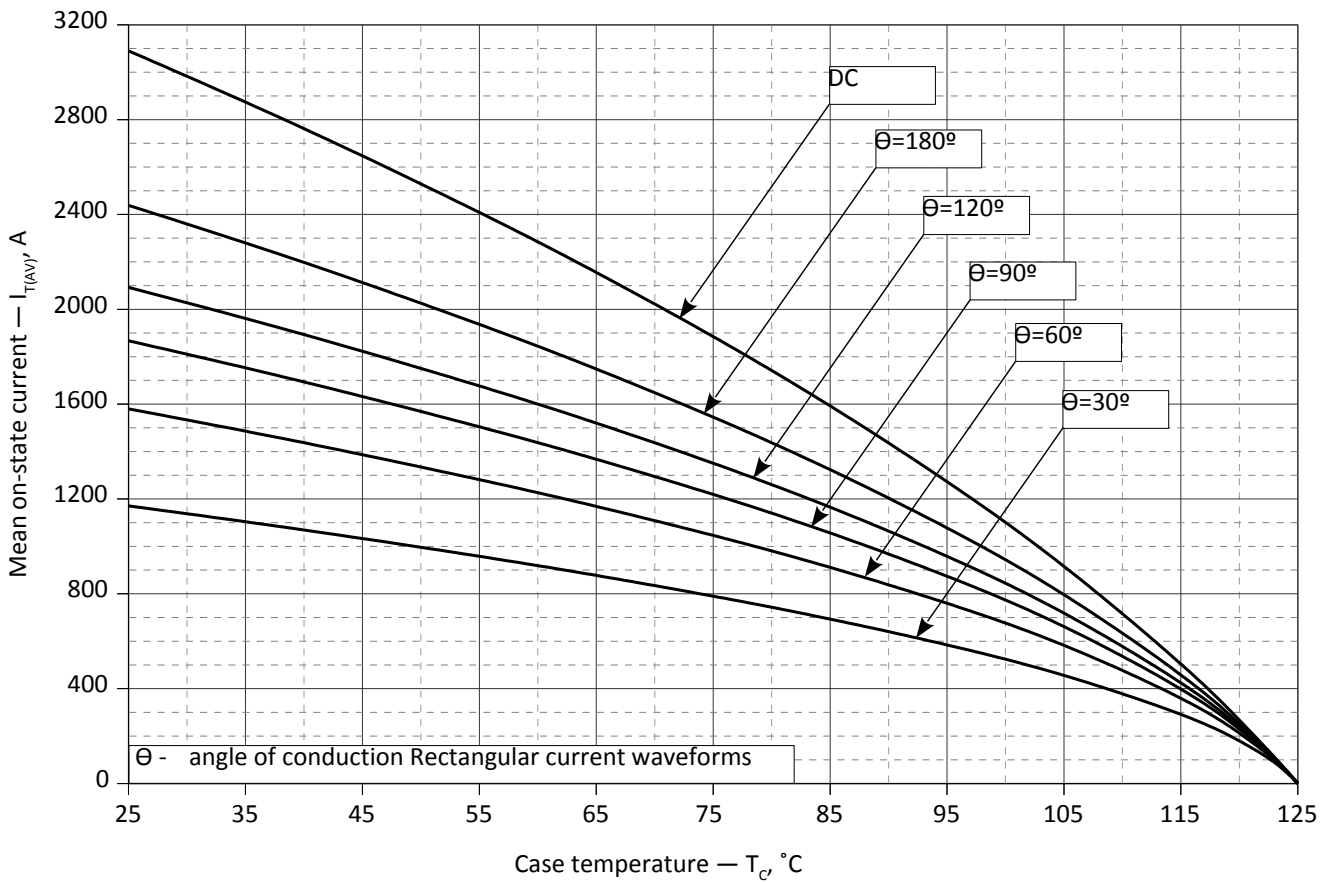
**Fig. 7 - Mean on-state power dissipation  $P_{TAV}$  vs. mean on-state current  $I_{TAV}$  for sinusoidal current waveforms at different conduction angles ( $f=50\text{Hz}$ , DSC)**



**Fig. 8 - Mean on-state power dissipation  $P_{TAV}$  vs. mean on-state current  $I_{TAV}$  for rectangular current waveforms at different conduction angles and for DC ( $f=50\text{Hz}$ , DSC)**



**Fig. 9 – Mean on-state current  $I_{T(AV)}$  vs. case temperature  $T_c$  for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)**



**Fig. 10 - Mean on-state current  $I_{T(AV)}$  vs. case temperature  $T_c$  for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)**

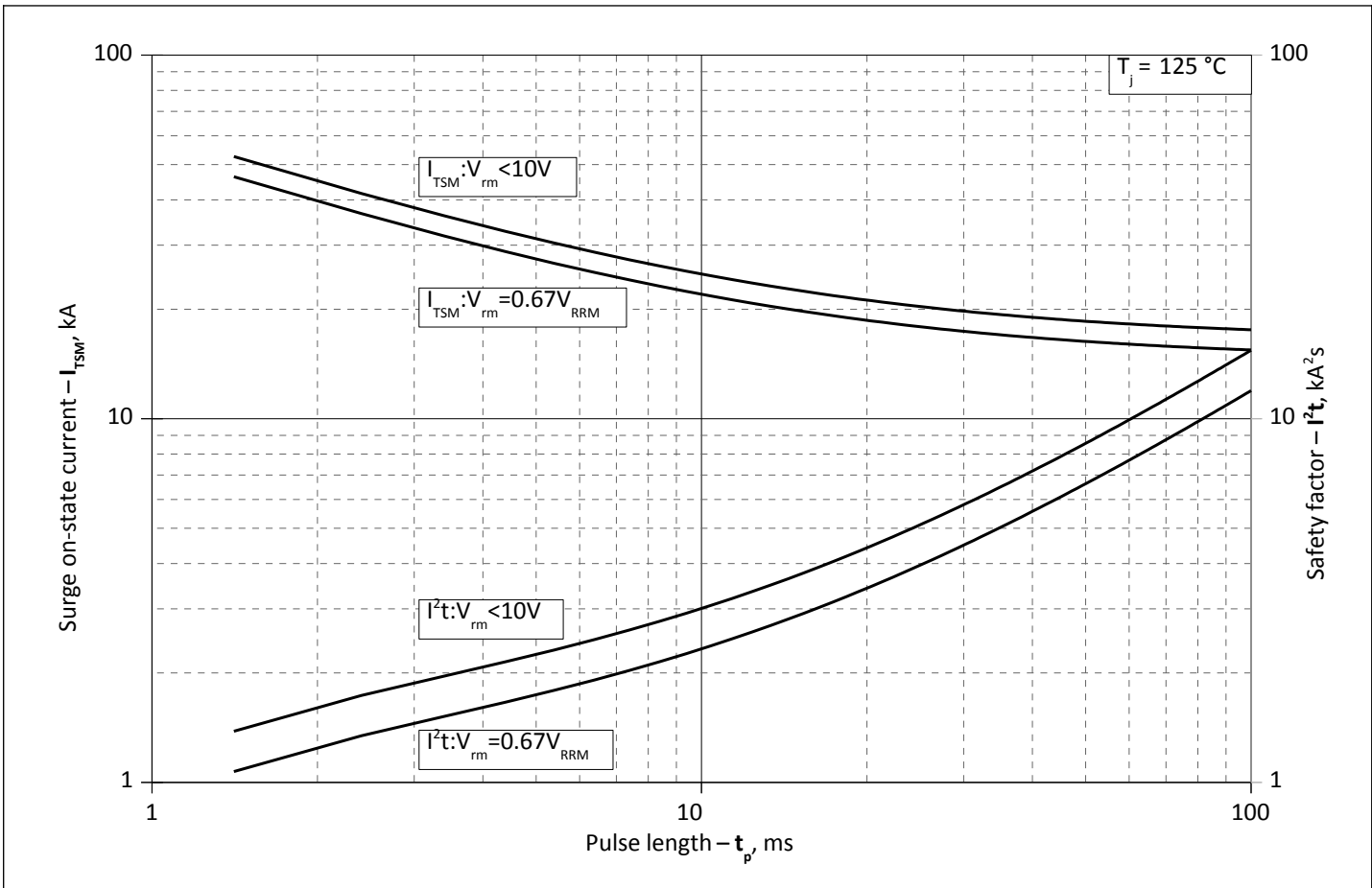


Fig. 11 – Maximum surge on-state current  $I_{TSM}$  and safety factor  $I^2t$  vs. pulse length  $t_p$

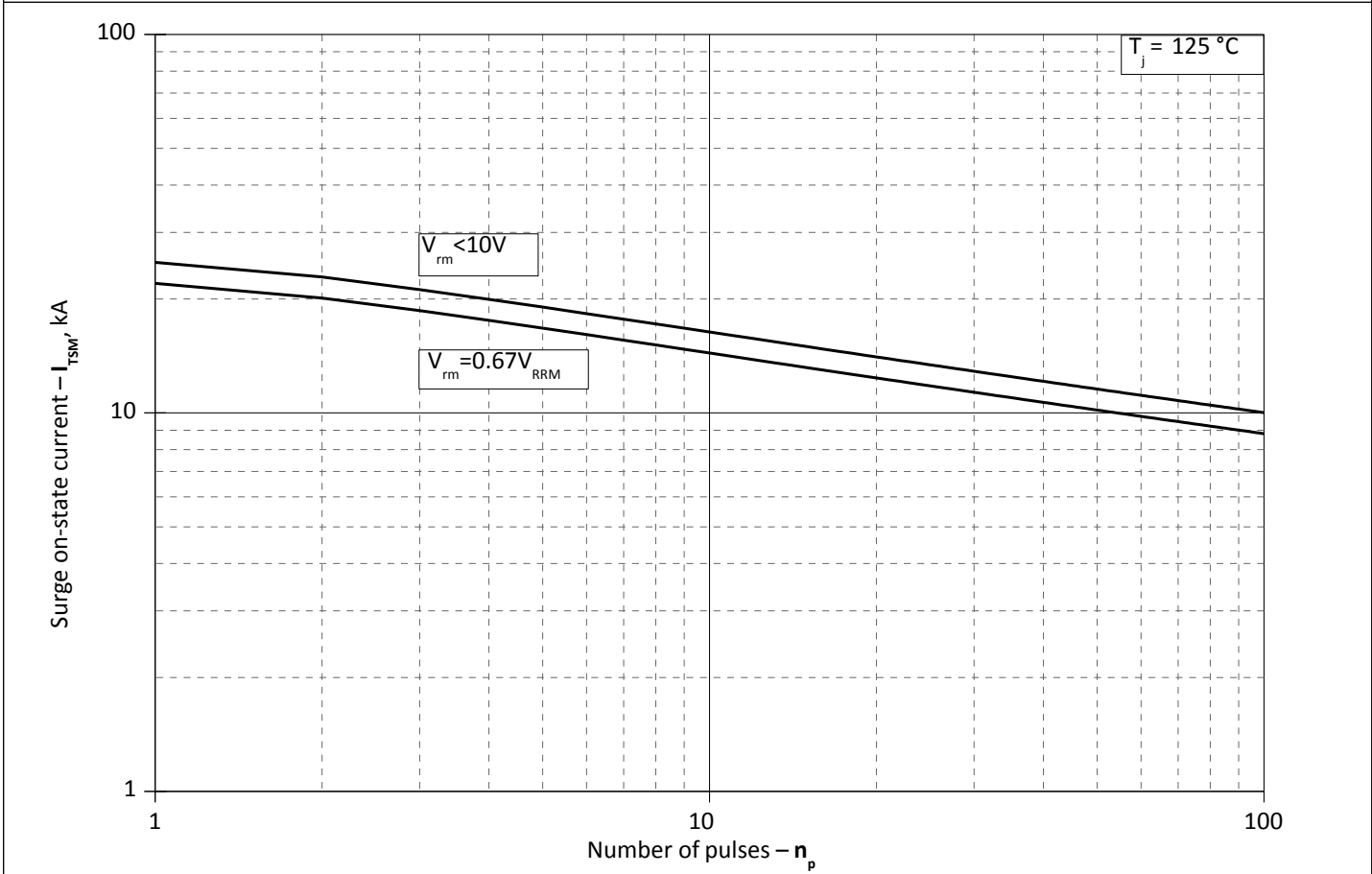


Fig. 12 - Maximum surge on-state current  $I_{TSM}$  vs. number of pulses  $n_p$