АС ЭНЕРГИЯ

Тиристор низкочастотный
Т933-160-44

<table>
<tr><td colspan="2">Mean on-state current</td><td>I_{TAV}</td><td colspan="2">160 A</td></tr>
<tr><td colspan="2">Repetitive peak off-state voltage</td><td>V_{DRM}</td><td colspan="2" rowspan="2">3800 - 4400 V</td></tr>
<tr><td colspan="2">Repetitive peak reverse voltage</td><td>V_{RRM}</td></tr>
<tr><td colspan="2">Turn-off time</td><td>t_q</td><td colspan="2">500, 630, 800 µs</td></tr>
<tr><td>V_{DRM}, V_{RRM}, V</td><td>3800</td><td>4000</td><td>4200</td><td>4400</td></tr>
<tr><td>Voltage code</td><td>38</td><td>40</td><td>42</td><td>44</td></tr>
<tr><td>T_j, °C</td><td colspan="4">-60 ÷ 125</td></tr>
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MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions	
ON-STATE					
I_{TAV}	Mean on-state current	A	160 290	T_c=108 °C, Double side cooled T_c=85 °C, Double side cooled 180° half-sine wave; 50 Hz	
I_{TRMS}	RMS on-state current	A	251	T_c=108 °C, Double side cooled 180° half-sine wave; 50 Hz	
I_{TSM}	Surge on-state current	kA	3.5 4.0	T_j=$T_{j\ max}$ T_j=25 °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≥1 A/ms
			3.5 4.0	T_j=$T_{j\ max}$ T_j=25 °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≥1 A/ms
I^2t	Safety factor	$A^2s\cdot10^3$	60 80	T_j=$T_{j\ max}$ T_j=25 °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≥1 A/ms
			50 60	T_j=$T_{j\ max}$ T_j=25 °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≥1 A/ms
BLOCKING					
V_{DRM}, V_{RRM}	Repetitive peak off-state and Repetitive peak reverse voltages	V	3800 - 4400	$T_{j\ min}$< T_j <$T_{j\ max}$; 180° half-sine wave; 50 Hz; Gate open	
V_{DSM}, V_{RSM}	Non-repetitive peak off-state and Non-repetitive peak reverse voltages	V	3900 - 4500	$T_{j\ min}$< T_j <$T_{j\ max}$; 180° half-sine wave; single pulse; Gate open	
V_D, V_R	Direct off-state and Direct reverse voltages	V	$0.6\cdot V_{DRM}$ $0.6\cdot V_{RRM}$	T_j=$T_{j\ max}$; Gate open	

TRIGGERING				
I_{FGM}	Peak forward gate current	A	6	$T_j=T_{j\,max}$
V_{RGM}	Peak reverse gate voltage	V	5	
P_G	Gate power dissipation	W	3	$T_j=T_{j\,max}$ for DC gate current
SWITCHING				
$(di_T/dt)_{crit}$	Critical rate of rise of on-state current non-repetitive (f=1 Hz)	A/ms	400	$T_j=T_{j\,max}$; $V_D=0.67\cdot V_{DRM}$; I_{TM}=500 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	9.0 - 11.0	
a	Acceleration	m/s^2	50	Device clamped

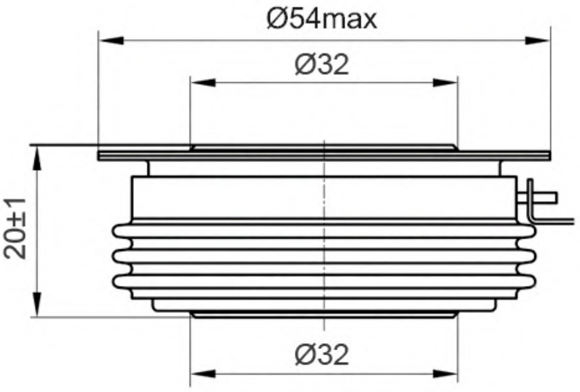
CHARACTERISTICS

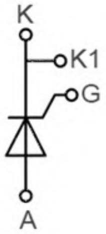
Symbols and parameters		Units	Values	Conditions
ON-STATE				
V_{TM}	Peak on-state voltage, max	V	2.15	T_j=25 °C; I_{TM}=502 A
$V_{T(TO)}$	On-state threshold voltage, max	V	1.597	$T_j=T_{j\,max}$; 0.5 p I_{TAV} < I_T < 1.5 p I_{TAV}
r_T	On-state slope resistance, max	mW	2.592	
I_L	Latching current, max	mA	700	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	70	$T_j=T_{j\,max}$; $V_D=V_{DRM}$; $V_R=V_{RRM}$
$(dv_D/dt)_{crit}$	Critical rate of rise of off-state voltage[1], 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	400 250 150	$T_j= T_{j\,min}$ T_j= 25 °C $T_j= T_{j\,max}$
V_{GD}	Gate non-trigger direct voltage, min	V	0.55	$T_j=T_{j\,max}$; $V_D=0.67\cdot V_{DRM}$; Direct gate current
I_{GD}	Gate non-trigger direct current, min	mA	35.00	
SWITCHING				
t_{gd}	Delay time, max	ms	3.10	T_j=25 °C; V_D=1500 V; $I_{TM}=I_{TAV}$; di/dt=200 A/ms; Gate pulse: I_G=2 A; V_G=20 V; t_{GP}=50 ms; di_G/dt=2 A/ms
t_{gt}	Turn-on time, max	ms	25.0	
t_q	Turn-off time[2], max	ms	500, 630, 800	dv_D/dt=50 V/ms; $T_j=T_{j\,max}$; $I_{TM}= I_{TAV}$; di_R/dt=-5 A/ms; V_R=100V; $V_D=0.67\cdot V_{DRM}$
Q_{rr}	Total recovered charge, max	mC	1200	$T_j=T_{j\,max}$; I_{TM}=160 A; di_R/dt=-5 A/ms; V_R=100 V
t_{rr}	Reverse recovery time, max	ms	30	
I_{rrM}	Peak reverse recovery current, max	A	80	

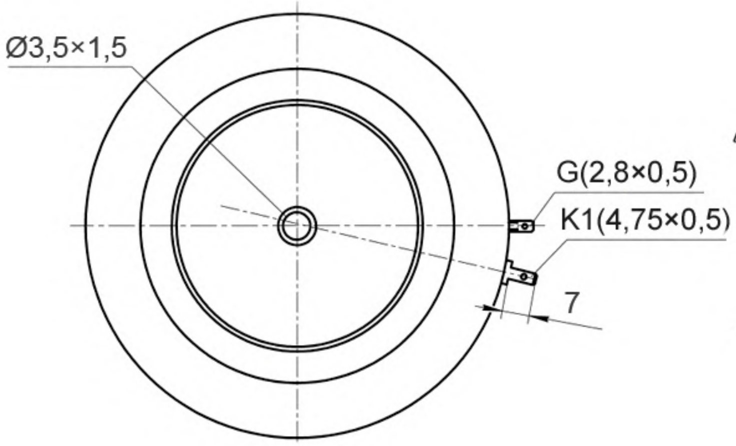
THERMAL					
R_{thjc}	Thermal resistance, junction to case, max	°C/W	0.040	Direct current	Double side cooled
R_{thjc-A}			0.088		Anode side cooled
R_{thjc-K}			0.072		Cathode side cooled
R_{thck}	Thermal resistance, case to heatsink, max	°C/W	0.008	Direct current	
MECHANICAL					
w	Weight, max	g	180		
D_s	Surface creepage distance	mm (inch)	19.44 (0.765)		
D_a	Air strike distance	mm (inch)			

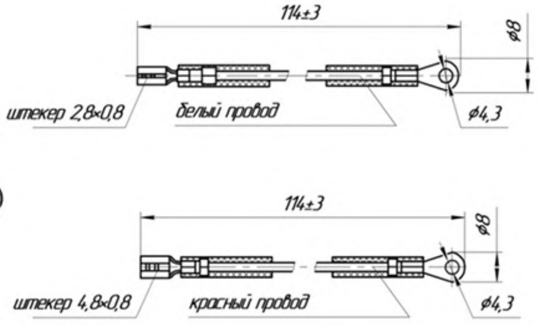
OVERALL DIMENSIONS

Package type: T.B3









All dimensions in millimeters

K – cathode;

A – anode;

K1 – auxiliary cathode;

G – gate;

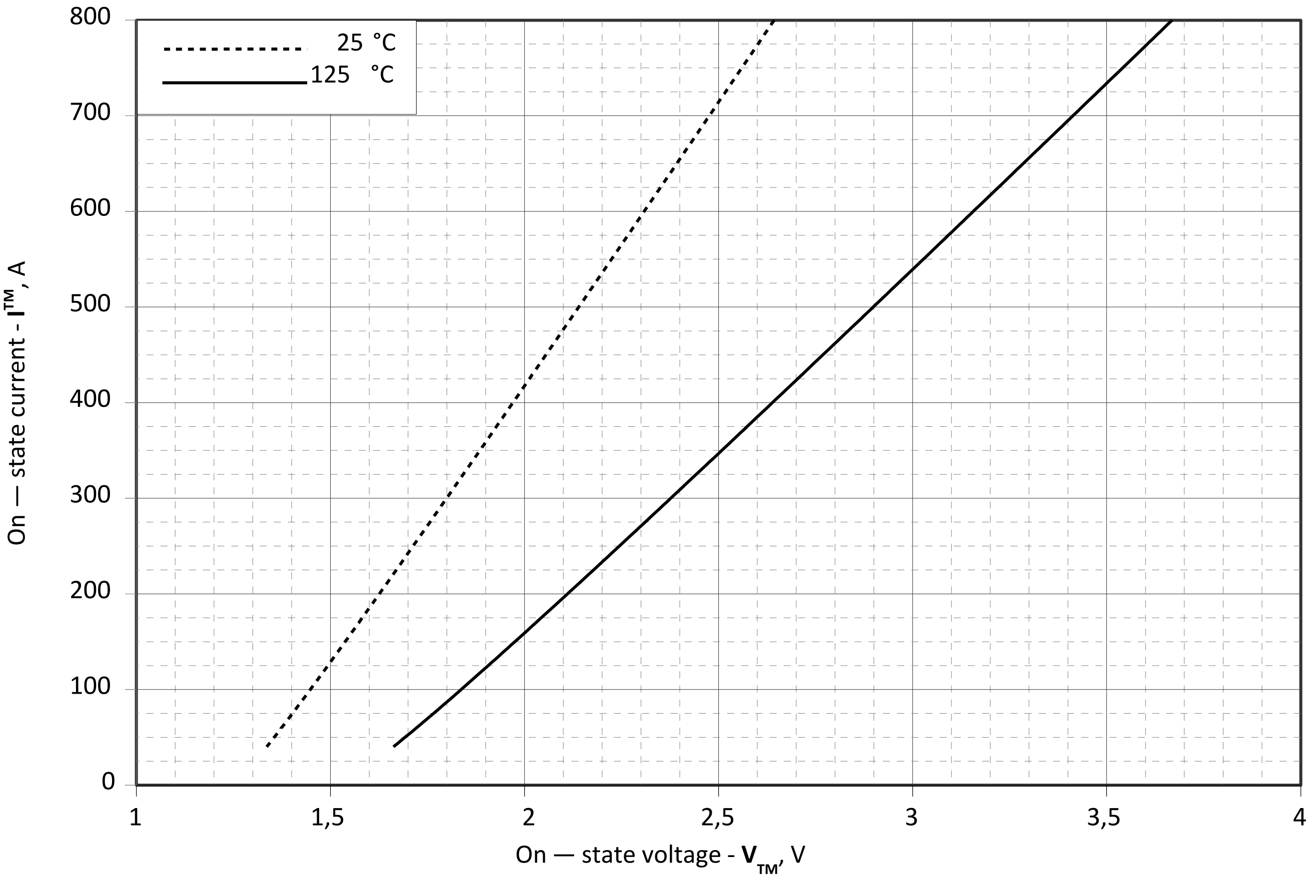


Fig 1 – On-state characteristics of Limit device

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°C	$T_j = T_{j\,max}$
A	1.2395302	1.5039434
B	0.0015926	0.0024269
C	0.0016184	0.0050187
D	0.0042040	0.0067078

On-state characteristic model (see Fig. 1)

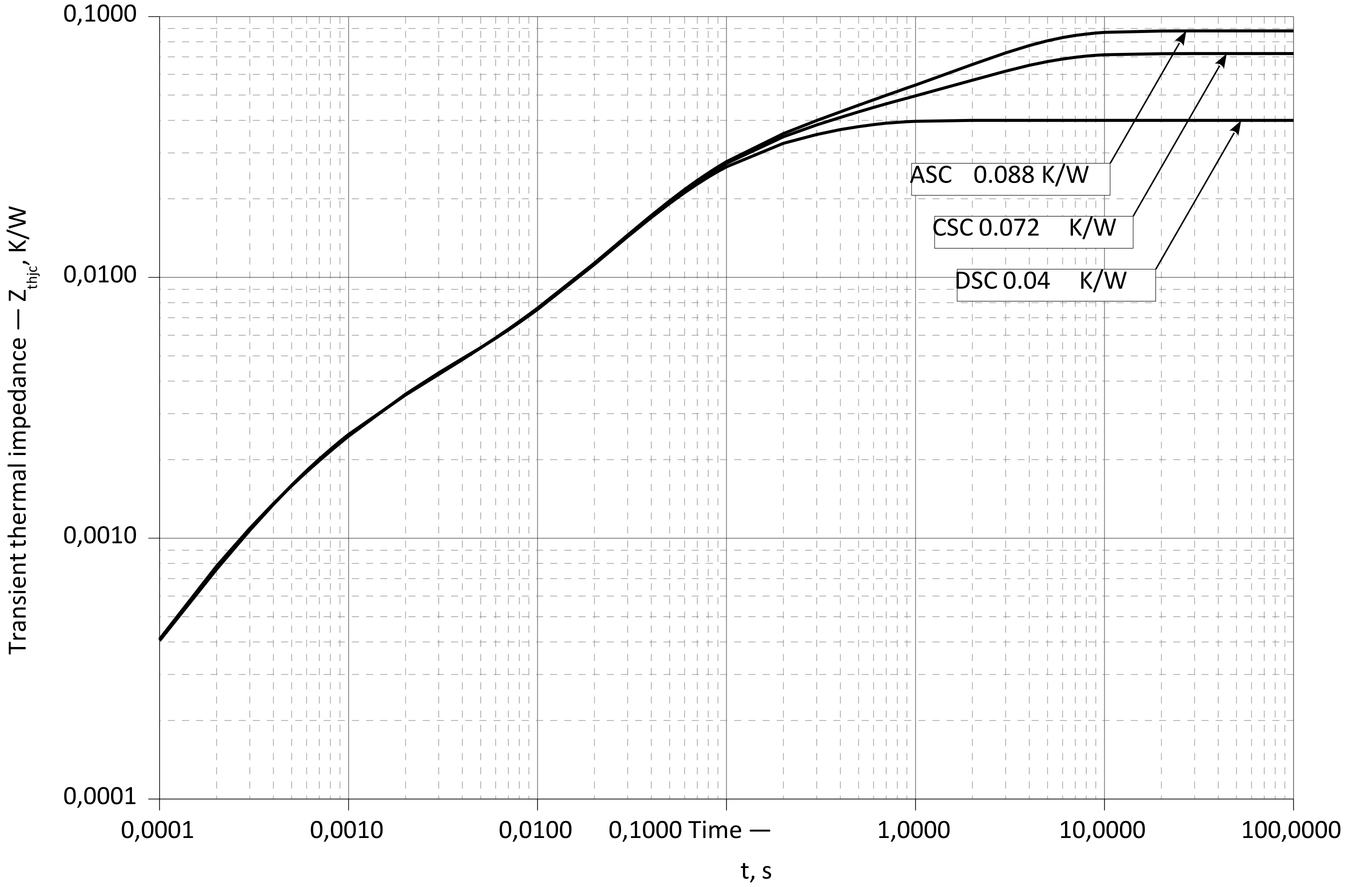


Fig 2 – Transient thermal impedance Z_{thjc} vs. time t

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.

t_i = Time constatnt of r_{th} term.

DC Double side cooled

i	1	2	3	4	5	6
R_i, K/W	0.01423	0.01906	0.003576	0.002535	-4.666e-005	0.0006479
t_i, s	0.265	0.05901	0.03499	0.001252	0.000001	0.0002488

DC Anode side cooled

i	1	2	3	4	5	6
R_i, K/W	0.04804	0.001789	0.01342	0.02147	0.001374	0.001945
t_i, s	2.651	0.4195	0.2622	0.05451	0.002585	0.0005847

DC Cathode side cooled

i	1	2	3	4	5	6
R_i, K/W	0.03216	0.01306	0.002934	0.02064	0.001493	0.001786
t_i, s	2.647	0.2831	0.1455	0.05284	0.002255	0.0005519

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

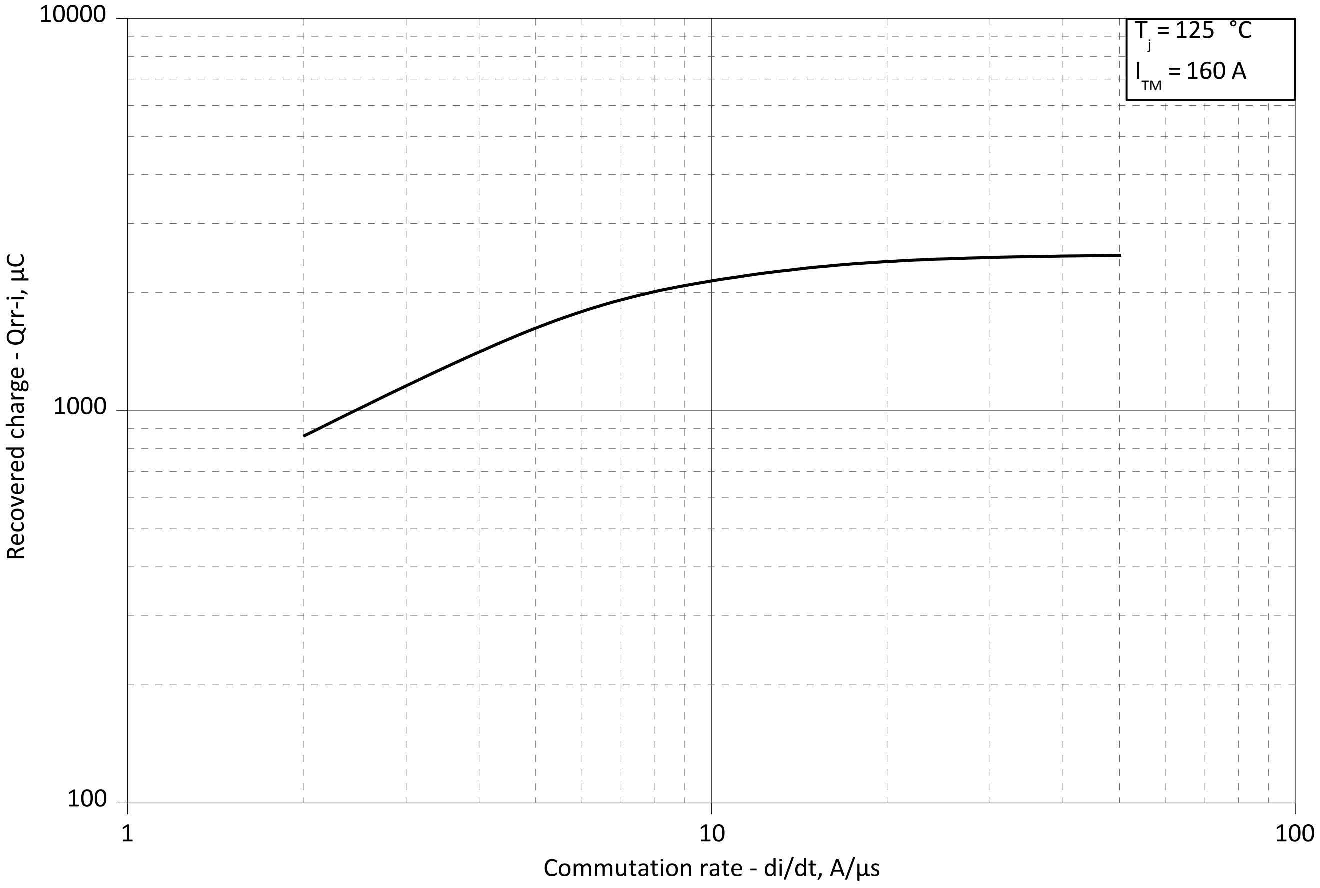


Fig 3 – Maximum recovered charge Q_{rr-i} (integral) vs. commutation rate di_R/dt

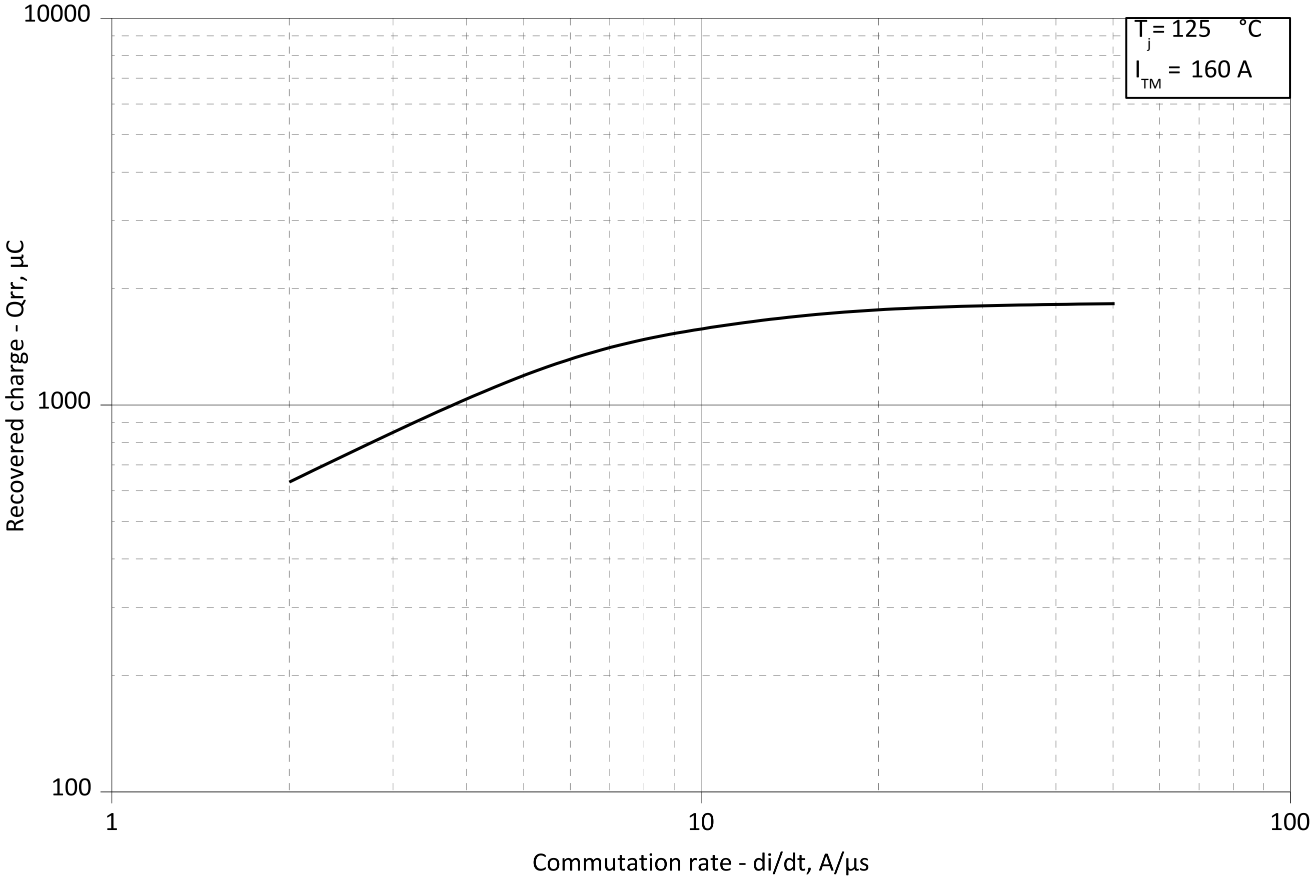


Fig 4 – Maximum recovered charge Q_{rr} vs. commutation rate di_R/dt (25% chord)

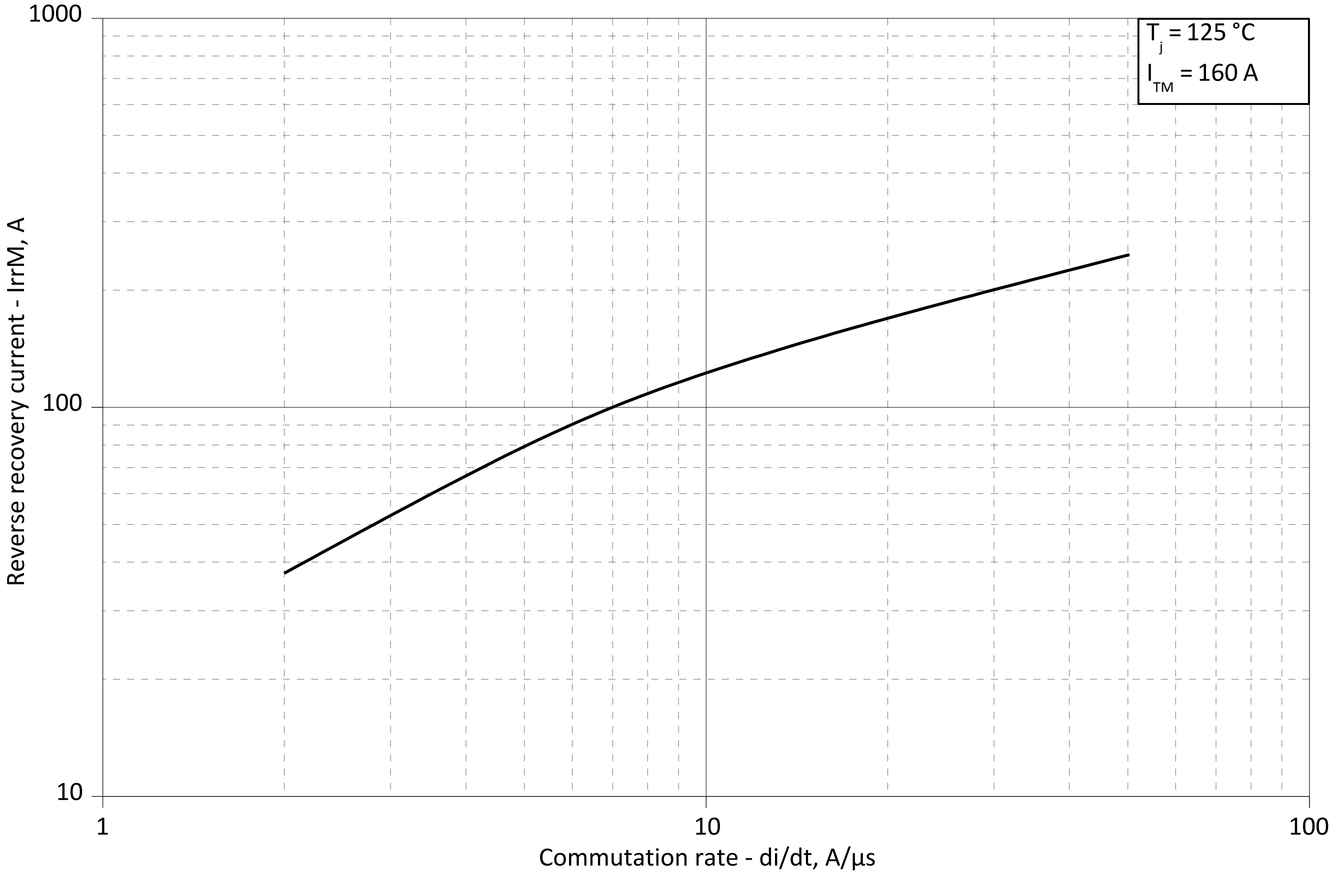


Fig 5 – Maximum reverse recovery current I_{rrM} vs. commutation rate di_R/dt

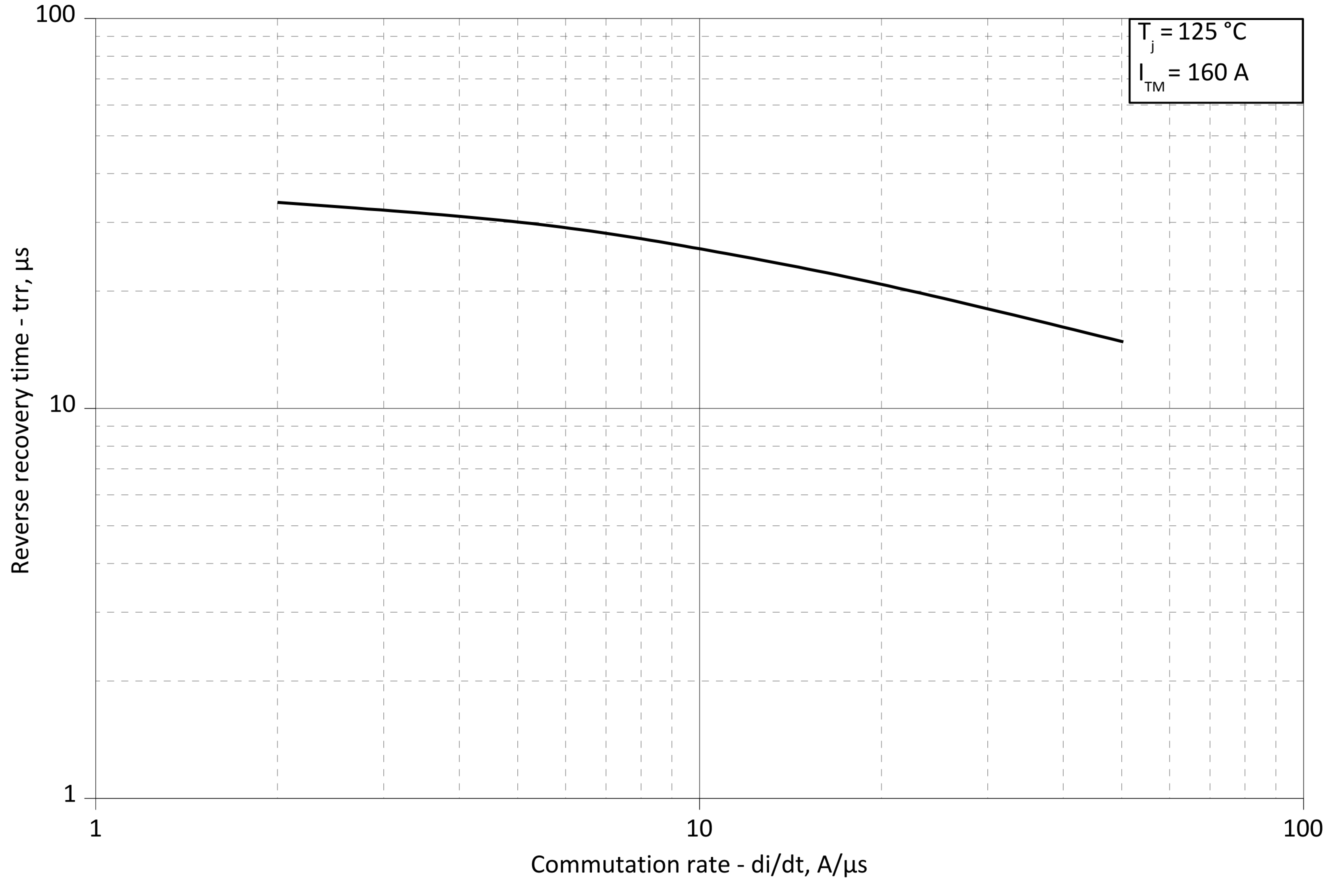


Fig 6 – Maximum recovery time t_{rr} vs. commutation rate di_R/dt (25% chord)

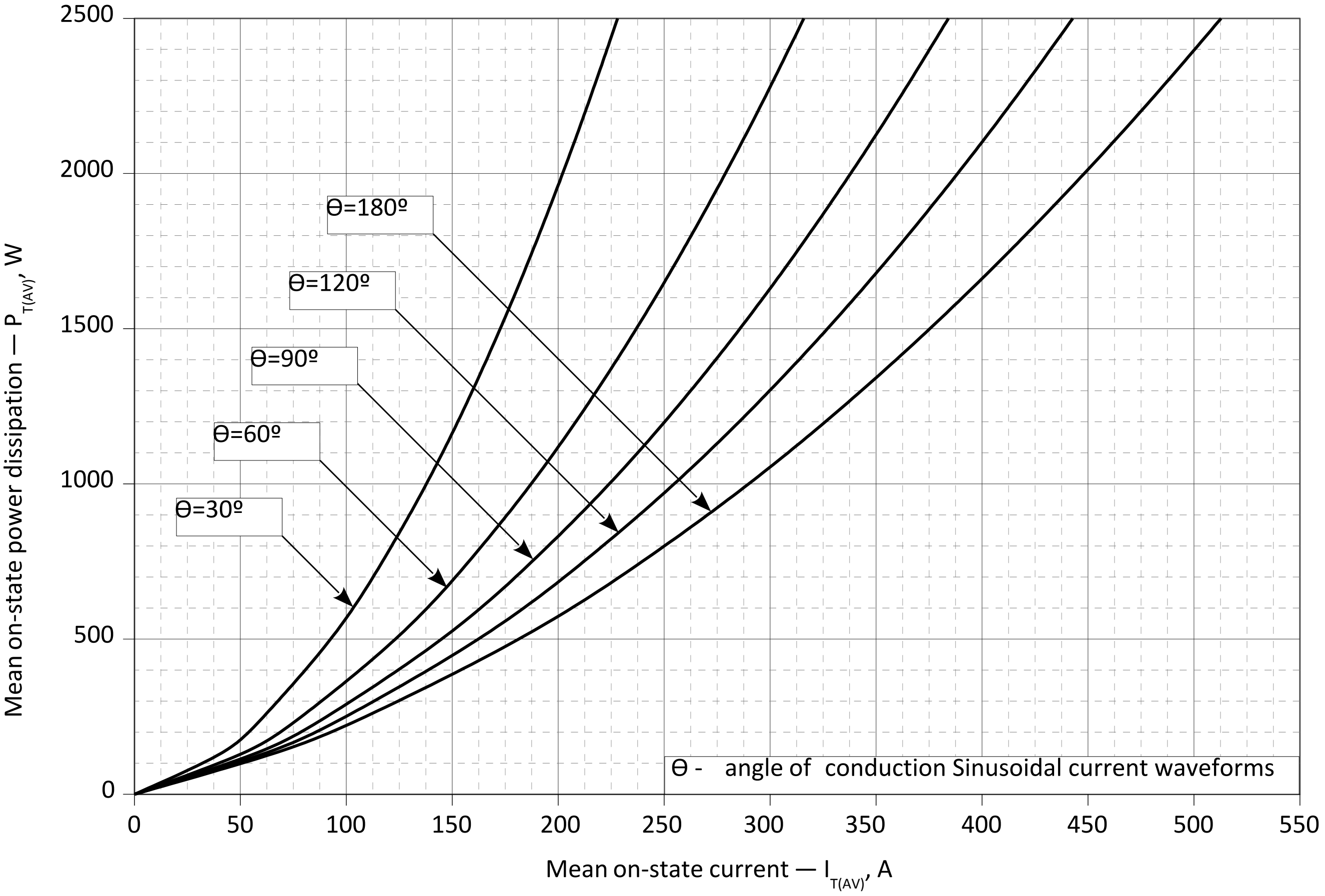


Fig. 7 - Mean on-state power dissipation P_{TAV} vs. mean on-state current I_{TAV} for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

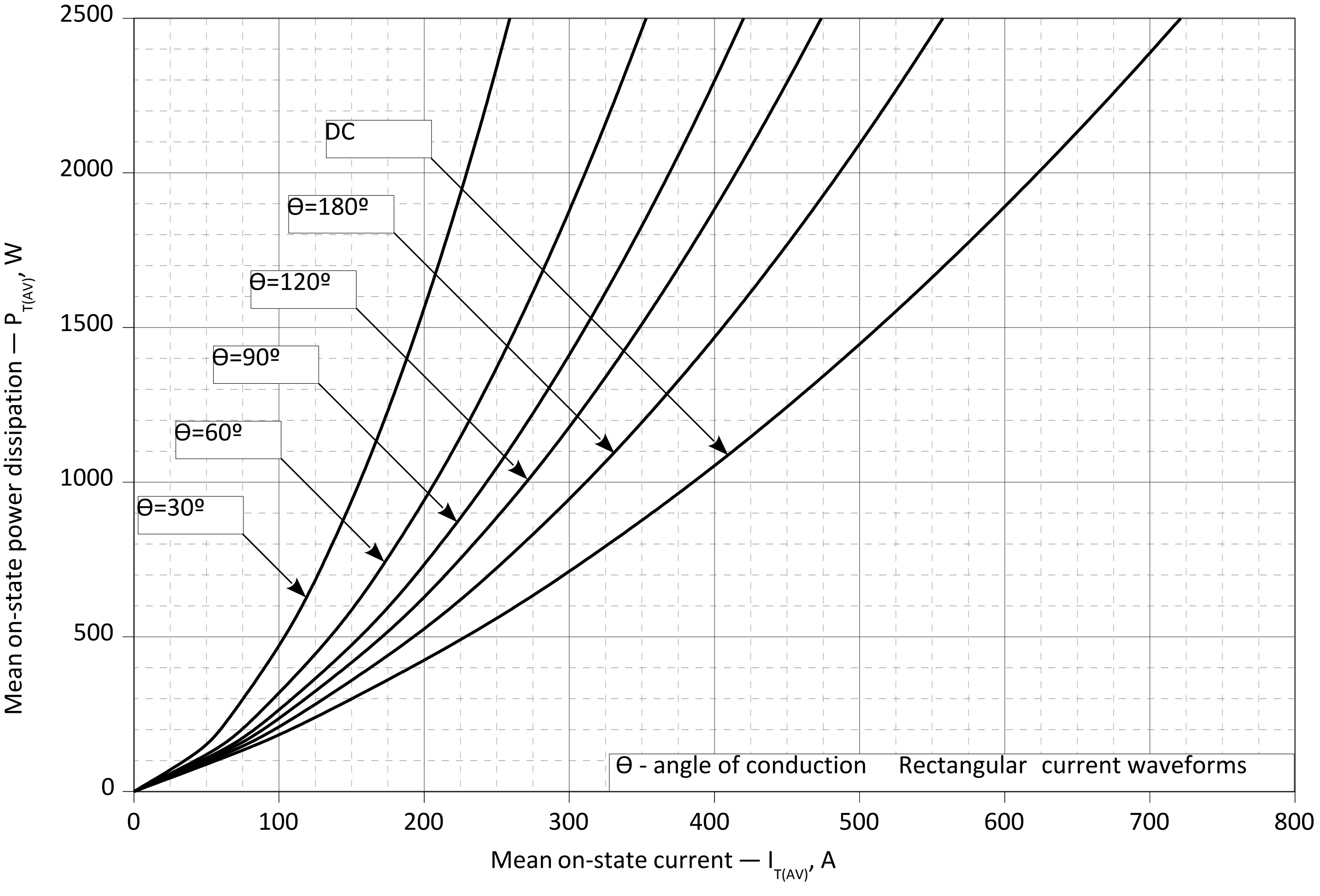


Fig. 8 – Mean on-state power dissipation P_{TAV} vs. mean on-state current I_{TAV} for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

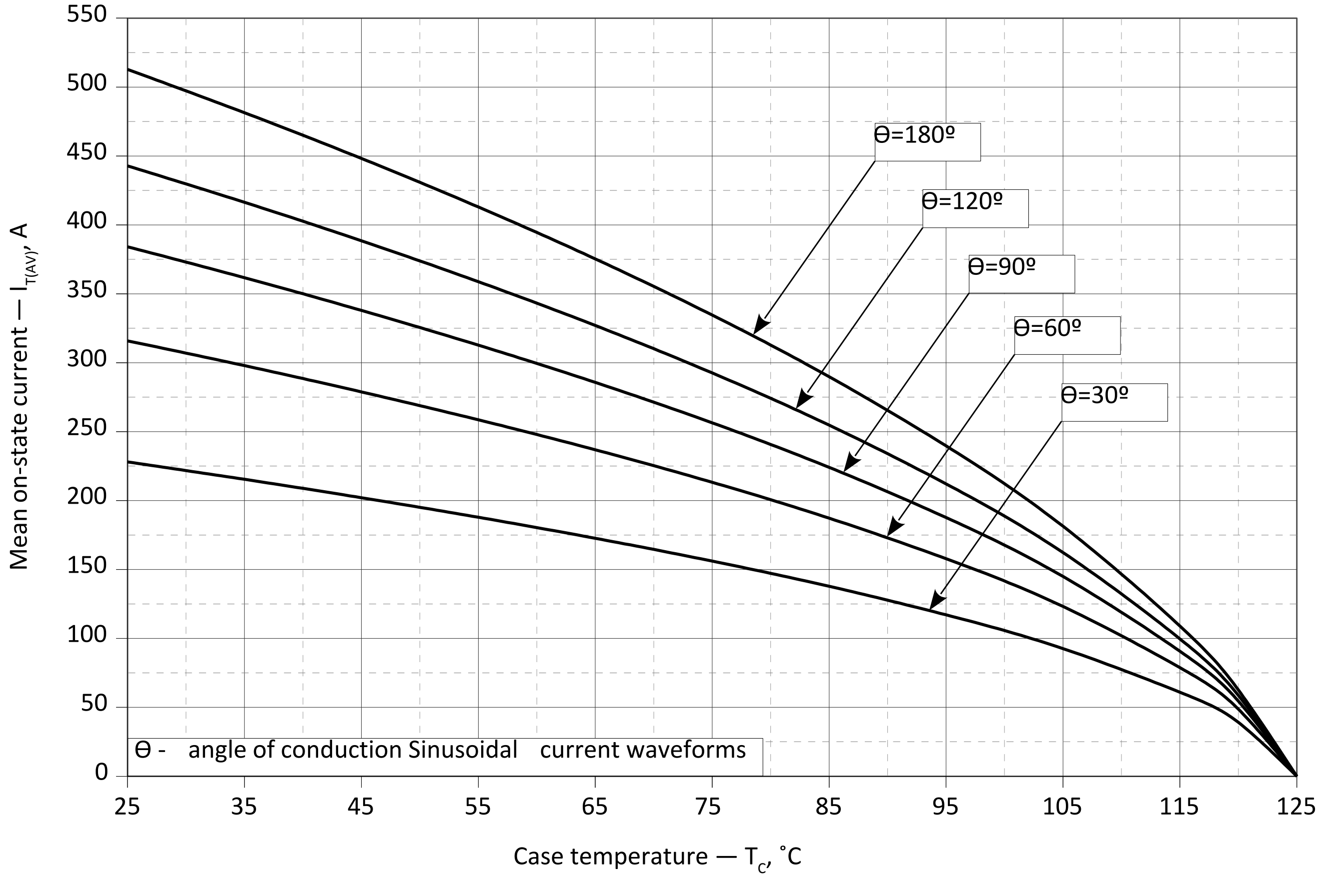


Fig. 9 – Mean on-state current I_{TAV} vs. case temperature T_C for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

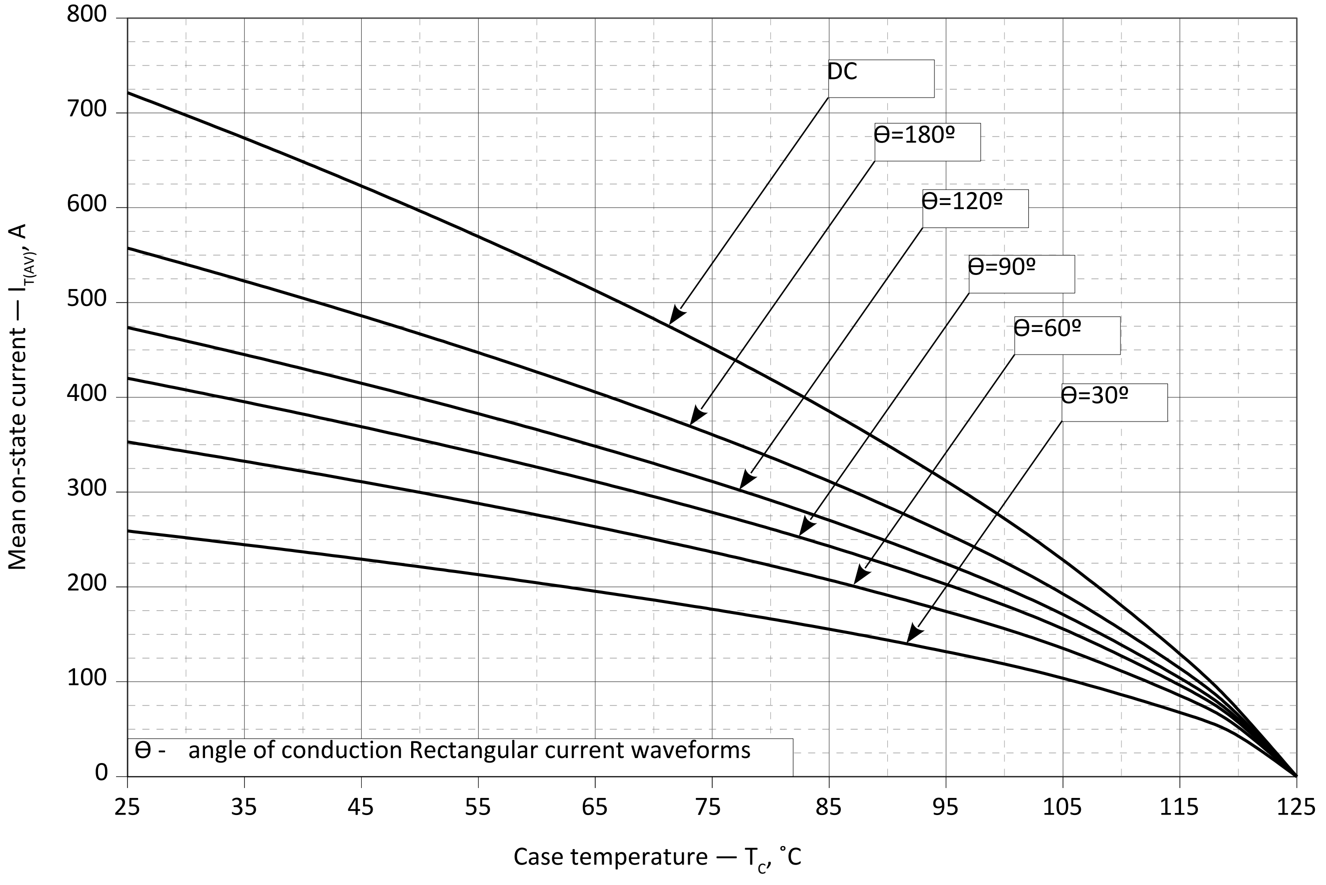


Fig. 10 - Mean on-state current I_{TAV} vs. case temperature T_C for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

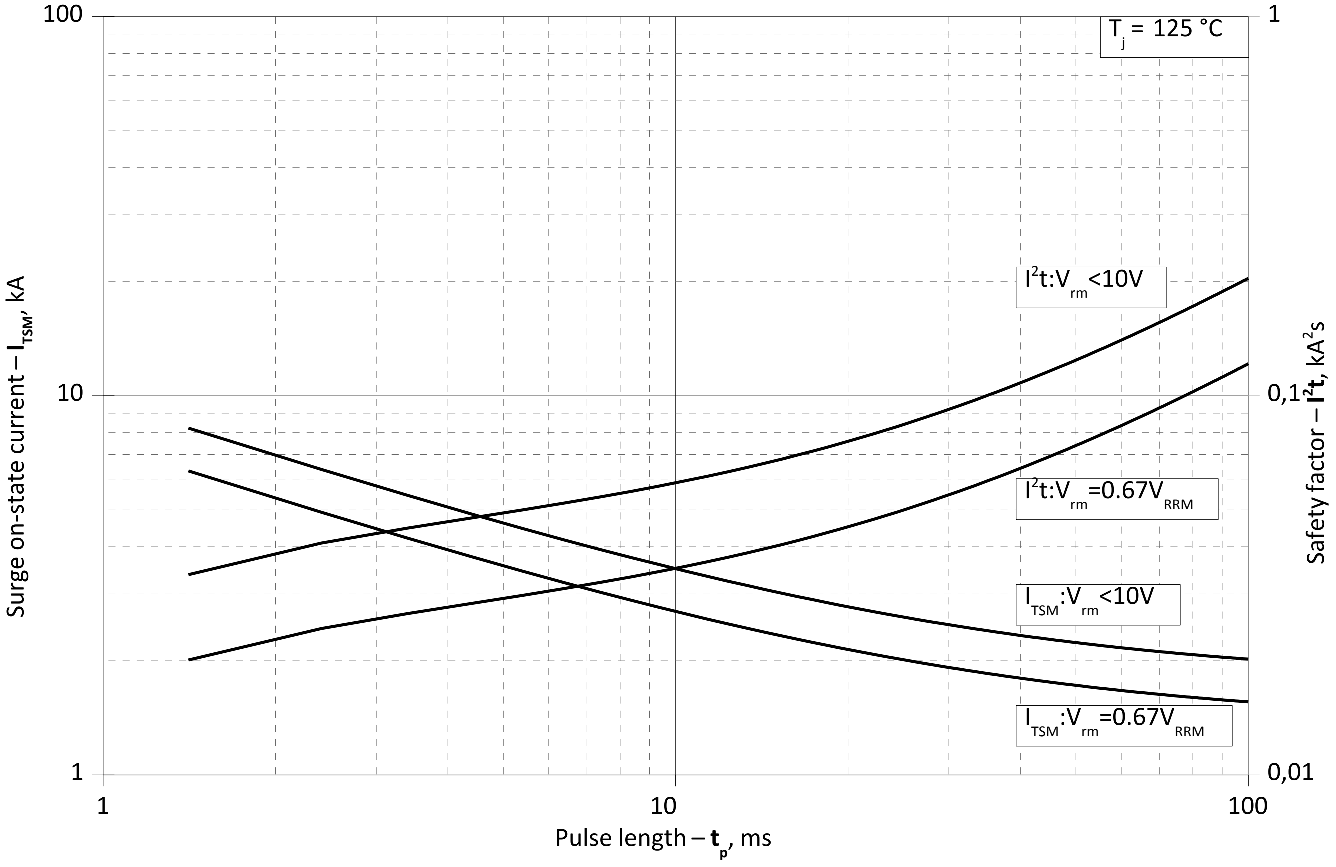


Fig. 11 – Maximum surge on-state current I_{TSM} and safety factor I^2t vs. pulse length t_p

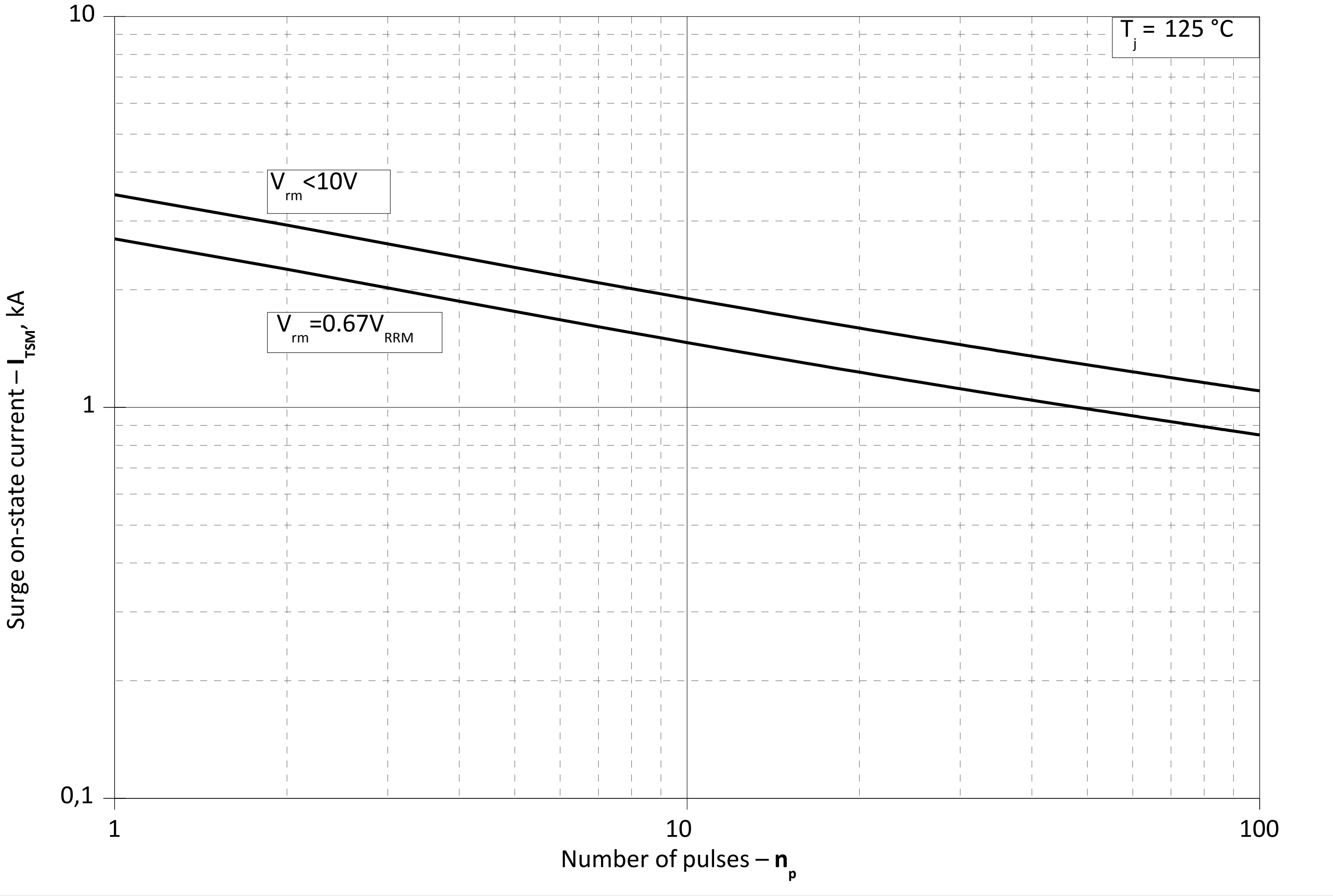


Fig. 12 - Maximum surge on-state current I_{TSM} vs. number of pulses n_p