



Thyristor Modules

MTx-125-28-F



Mean on-state current		I_{TAV}	125 A
Repetitive peak off-state voltage		V_{DRM}	2400...2800 V
Repetitive peak reverse voltage		V_{RRM}	
Turn-off time		t_q	250 μ s
V_{DRM}, V_{RRM}, V	2400	2600	2800
Voltage code	24	26	28
$T_j, ^\circ C$	-40...+125		

MT3		MT4			
MT/D3	MD/T3			MT/D5	

MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions
ON-STATE				
I_{TAV}	Maximum allowable mean on-state current	A	125 148	$T_c = 92\text{ }^\circ\text{C}$; $T_c = 85\text{ }^\circ\text{C}$; 180° half-sine wave; 50 Hz
I_{TRMS}	RMS on-state current	A	196	$T_c = 92\text{ }^\circ\text{C}$; 180° half-sine wave; 50 Hz
I_{TSM}	Surge on-state current	kA	3.8 4.5	$T_j = T_{j\max}$ $T_j = 25\text{ }^\circ\text{C}$ 180° half-sine wave; $t_p = 10\text{ ms}$; single pulse; $V_D = V_R = 0\text{ V}$; Gate pulse: $I_G = 2\text{ A}$; $t_{GP} = 50\text{ }\mu\text{s}$; $di_G/dt \geq 1\text{ A}/\mu\text{s}$
			4.0 4.5	$T_j = T_{j\max}$ $T_j = 25\text{ }^\circ\text{C}$ 180° half-sine wave; $t_p = 8.3\text{ ms}$; single pulse; $V_D = V_R = 0\text{ V}$; Gate pulse: $I_G = 2\text{ A}$; $t_{GP} = 50\text{ }\mu\text{s}$; $di_G/dt \geq 1\text{ A}/\mu\text{s}$
I^2t	Safety factor	$\text{A}^2\text{s}\cdot 10^3$	70 100	$T_j = T_{j\max}$ $T_j = 25\text{ }^\circ\text{C}$ 180° half-sine wave; $t_p = 10\text{ ms}$; single pulse; $V_D = V_R = 0\text{ V}$; Gate pulse: $I_G = 2\text{ A}$; $t_{GP} = 50\text{ }\mu\text{s}$; $di_G/dt \geq 1\text{ A}/\mu\text{s}$
			60 80	$T_j = T_{j\max}$ $T_j = 25\text{ }^\circ\text{C}$ 180° half-sine wave; $t_p = 8.3\text{ ms}$; single pulse; $V_D = V_R = 0\text{ V}$; Gate pulse: $I_G = 2\text{ A}$; $t_{GP} = 50\text{ }\mu\text{s}$; $di_G/dt \geq 1\text{ A}/\mu\text{s}$
BLOCKING				
V_{DRM}, V_{RRM}	Repetitive peak off-state and Repetitive peak reverse voltages	V	2400...2800	$T_{j\min} < T_j < T_{j\max}$; 180° half-sine wave; 50 Hz; Gate open
V_{DSM}, V_{RSM}	Non-repetitive peak off-state and Non-repetitive peak reverse voltages	V	2500...2900	$T_{j\min} < T_j < T_{j\max}$; 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	5	$T_j = T_{j\max}$
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 ($f = 1\text{ Hz}$)	$\text{A}/\mu\text{s}$	800	$T_j = T_{j\max}$; $V_D = 0.67 \cdot V_{DRM}$; $I_{TM} = 840\text{ A}$; Gate pulse: $I_G = 2\text{ A}$; $V_G = 20\text{ V}$; $t_{GP} = 50\text{ }\mu\text{s}$; $di_G/dt = 2\text{ A}/\mu\text{s}$
THERMAL				
T_{stg}	Storage temperature	$^\circ\text{C}$	-40...+50	
T_j	Operating junction temperature	$^\circ\text{C}$	-40...+125	
$T_{c\text{ op}}$	Operating temperature	$^\circ\text{C}$	-40...+125	
MECHANICAL				
a	Acceleration under vibration	m/s^2	50	

CHARACTERISTICS

Symbols and parameters		Units	Values	Conditions	
ON-STATE					
V_{TM}	Peak on-state voltage, max	V	1.80	$T_j=25\text{ }^\circ\text{C}; I_{TM}=500\text{ A}$	
$V_{T(TO)}$	On-state threshold voltage, max	V	1.246	$T_j=T_{j\text{ max}};$	
r_T	On-state slope resistance, max	m Ω	0.915	$0.5\pi I_{TAV} < I_T < 1.5\pi I_{TAV}$	
I_L	Latching current, max	mA	500	$T_j=25\text{ }^\circ\text{C}; V_D=12\text{ V};$ Gate pulse: $I_G=2\text{ A};$ $t_{GP}=50\text{ }\mu\text{s}; di_G/dt\geq 1\text{ A}/\mu\text{s}$	
I_H	Holding current, max	mA	250	$T_j=25\text{ }^\circ\text{C};$ $V_D=12\text{ V};$ Gate open	
BLOCKING					
I_{DRM}, I_{RRM}	Repetitive peak off-state and Repetitive peak reverse currents, max	mA	40 2.50	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^\circ\text{C}$	$V_D=V_{DRM}; V_R=V_{RRM}$
$(dv_D/dt)_{crit}$	Critical rate of rise of off-state voltage ¹⁾ , min	V/ μs	200, 320, 500, 1000, 1600, 2000, 2500	$T_j=T_{j\text{ max}};$ $V_D=0.67\cdot V_{DRM};$ Gate open	
TRIGGERING					
V_{GT}	Gate trigger direct voltage, max	V	3.00 2.50 1.50	$T_j= T_{j\text{ min}}$ $T_j=25\text{ }^\circ\text{C}$ $T_j= T_{j\text{ max}}$	$V_D=12\text{ V}; I_D=3\text{ A};$ Direct gate current
I_{GT}	Gate trigger direct current, max	mA	400 250 150	$T_j= T_{j\text{ min}}$ $T_j= 25\text{ }^\circ\text{C}$ $T_j= T_{j\text{ max}}$	
V_{GD}	Gate non-trigger direct voltage, min	V	0.45	$T_j=T_{j\text{ max}};$ $V_D=0.67\cdot V_{DRM};$	
I_{GD}	Gate non-trigger direct current, min	mA	35.00	Direct gate current	
SWITCHING					
t_{gd}	Delay time, max	μs	0.90	$T_j=25\text{ }^\circ\text{C}; V_D=1500\text{ V}; I_{TM}=I_{TAV};$ $di/dt=200\text{ A}/\mu\text{s};$	
t_{gt}	Turn-on time, max	μs	3.00	Gate pulse: $I_G=2\text{ A}; V_G=20\text{ V};$ $t_{GP}=50\text{ }\mu\text{s}; di_G/dt=2\text{ A}/\mu\text{s}$	
t_q	Turn-off time ²⁾ , max	μs	250	$dv_D/dt=50\text{ V}/\mu\text{s}; T_j=T_{j\text{ max}}; I_{TM}=I_{TAV};$ $di_R/dt=-10\text{ A}/\mu\text{s}; V_R=100\text{ V};$ $V_D=0.67 V_{DRM};$	
Q_{rr}	Recovered charge, max	μC	1080	$T_j=T_{j\text{ max}}; I_{TM}=I_{TAV};$	
t_{rr}	Reverse recovery time, max	μs	24	$di_R/dt=-10\text{ A}/\mu\text{s};$	
I_{rr}	Reverse recovery current, max	A	90	$V_R=100\text{ V}$	
THERMAL					
R_{thjc}	Thermal resistance, junction to case				
	per module	$^\circ\text{C}/\text{W}$	0.0850	180° half-sine wave, 50 Hz	
	per arm	$^\circ\text{C}/\text{W}$	0.1700		
	per module	$^\circ\text{C}/\text{W}$	0.0800	DC	
per arm	$^\circ\text{C}/\text{W}$	0.1600			
R_{thch}	Thermal resistance, case to heatsink				
	per module	$^\circ\text{C}/\text{W}$	0.0300		
	per arm	$^\circ\text{C}/\text{W}$	0.0600		
INSULATION					
V_{ISOL}	Insulation test voltage	kV	3.00	Sine wave, 50 Hz; RMS	t=60 sec
			3.60		t=1 sec
MECHANICAL					
M_1	Mounting torque (M6) ³⁾	Nm	6.00	Tolerance $\pm 15\%$	
M_2	Terminal connection torque (M6) ³⁾	Nm	6.00	Tolerance $\pm 15\%$	
m	Weight, max	g	350		

PART NUMBERING GUIDE								NOTES																				
MT	3	-	125	-	28	-	A2 M2	-	F	-	N																	
1	2	3	4	5	6	7	8																					
1. Thyristor module (MT) Thyristor – Diode module (MT/D) Diode – Thyristor module (MD/T) 2. Circuit Schematic: 3. Average On-state Current, A 4. Voltage Code 5. Critical rate of rise of off-state voltage 6. Group of turn-off time ($dv_D/dt=50 \text{ V}/\mu\text{s}$) 7. Package Type (M.F) 8. Ambient Conditions: N – Normal								1) Critical rate of rise of off-state voltage <table border="1"> <thead> <tr> <th>Symbol of Group</th> <th>P2</th> <th>K2</th> <th>E2</th> <th>A2</th> <th>T1</th> <th>P1</th> <th>M1</th> </tr> </thead> <tbody> <tr> <td>$(dv_D/dt)_{crit}, \text{ V}/\mu\text{s}$</td> <td>200</td> <td>320</td> <td>500</td> <td>1000</td> <td>1600</td> <td>2000</td> <td>2500</td> </tr> </tbody> </table> 2) Turn-off time ($dv_D/dt=50 \text{ V}/\mu\text{s}$) <table border="1"> <thead> <tr> <th>Symbol of group</th> <th>M2</th> </tr> </thead> <tbody> <tr> <td>$t_q, \mu\text{s}$</td> <td>250</td> </tr> </tbody> </table> 3) The screws must be lubricated	Symbol of Group	P2	K2	E2	A2	T1	P1	M1	$(dv_D/dt)_{crit}, \text{ V}/\mu\text{s}$	200	320	500	1000	1600	2000	2500	Symbol of group	M2	$t_q, \mu\text{s}$	250
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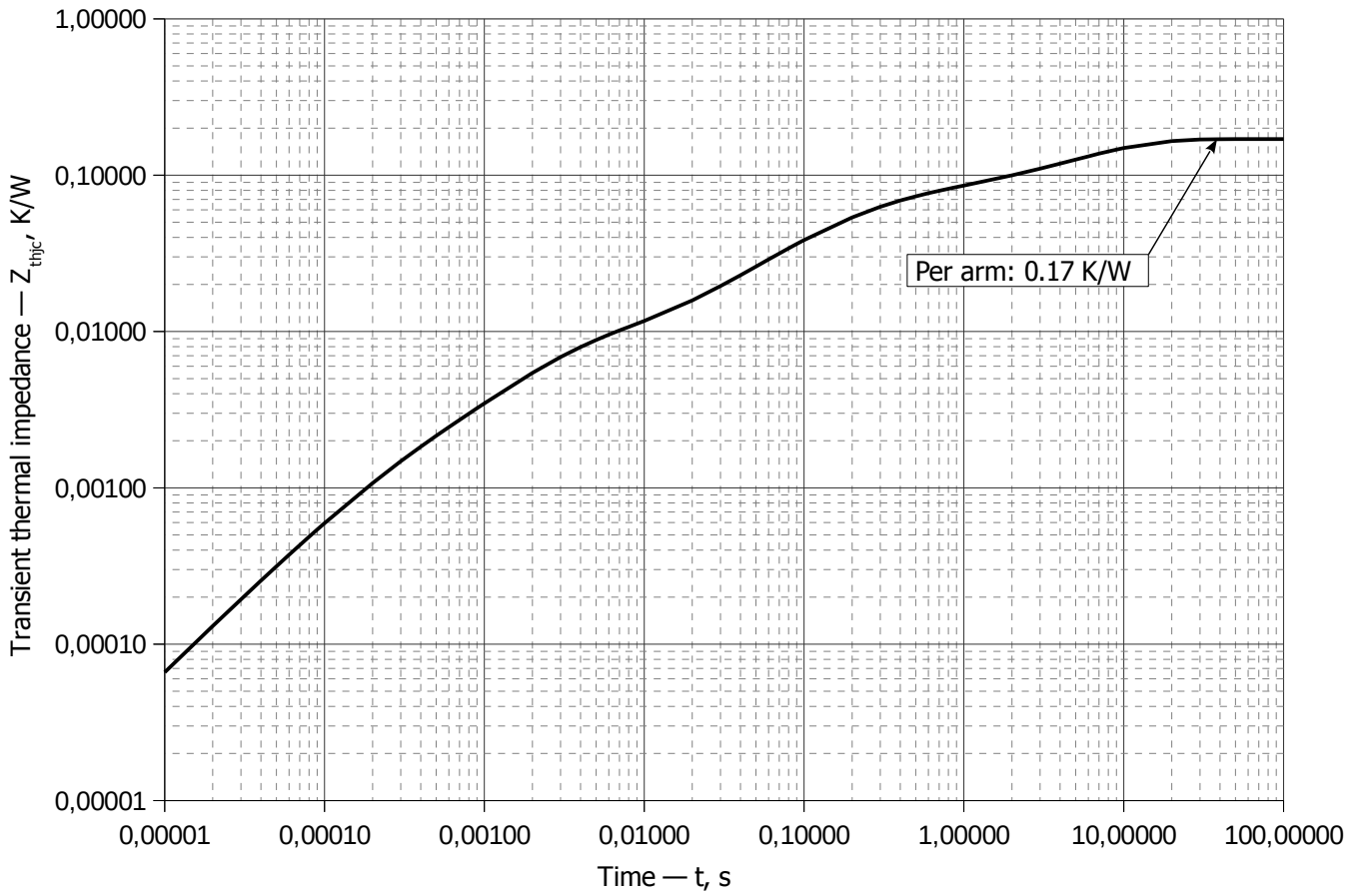


Fig 1 – Transient thermal impedance Z_{thjc} vs. time t

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.

τ_i = Time constant of r_{th} term.

i	1	2	3	4	5	6
R_i K/W	0.0007228424	0.0066399867	0.0153862565	0.0389709604	0.0142906115	0.09398934
τ_i s	0.0002111	0.002366	0.06905	0.1909	0.6646	6.64

Transient thermal impedance junction to case Z_{thjc} model (see Fig. 1)

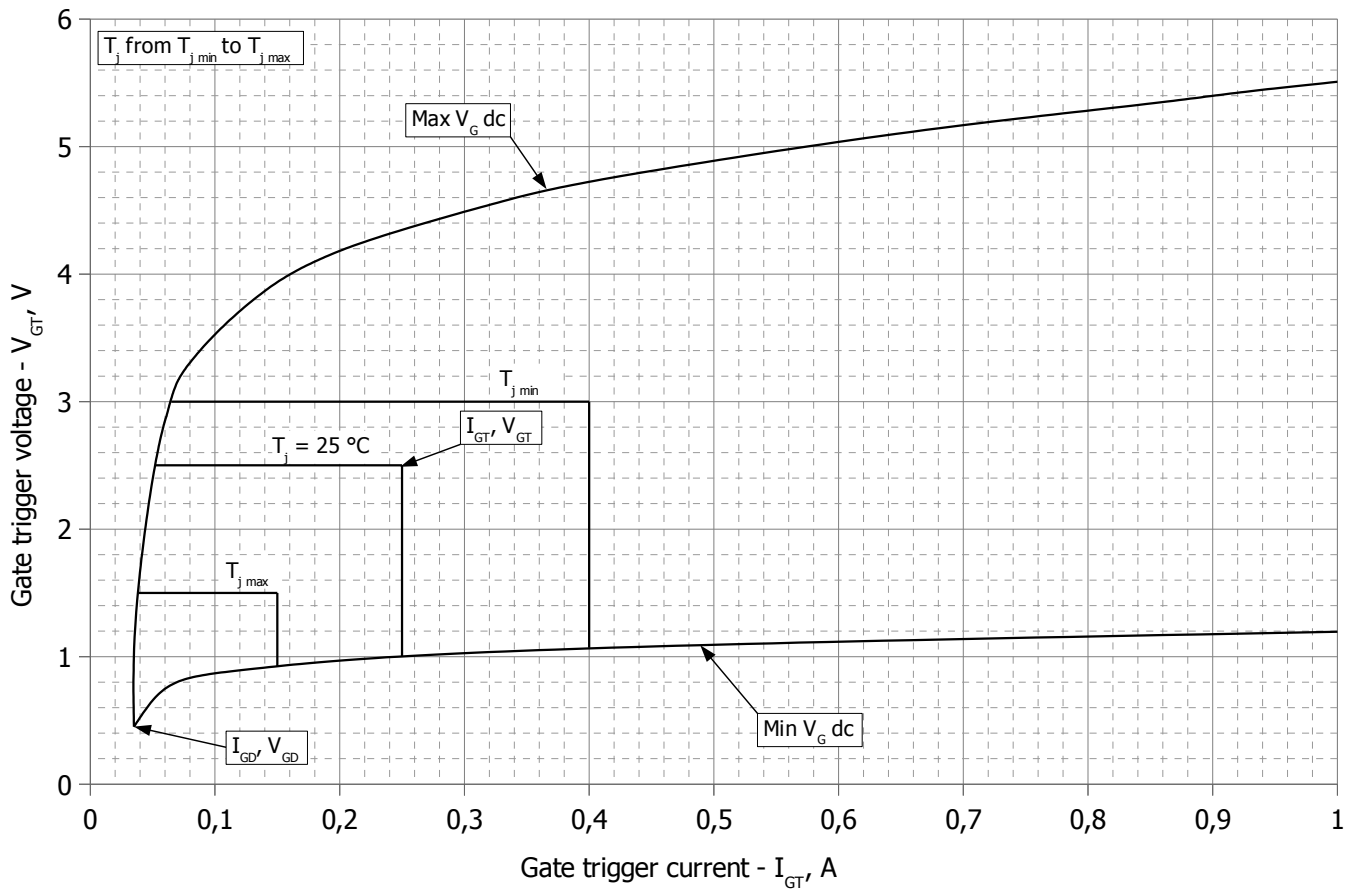


Fig 2 – Gate characteristics – Trigger limits

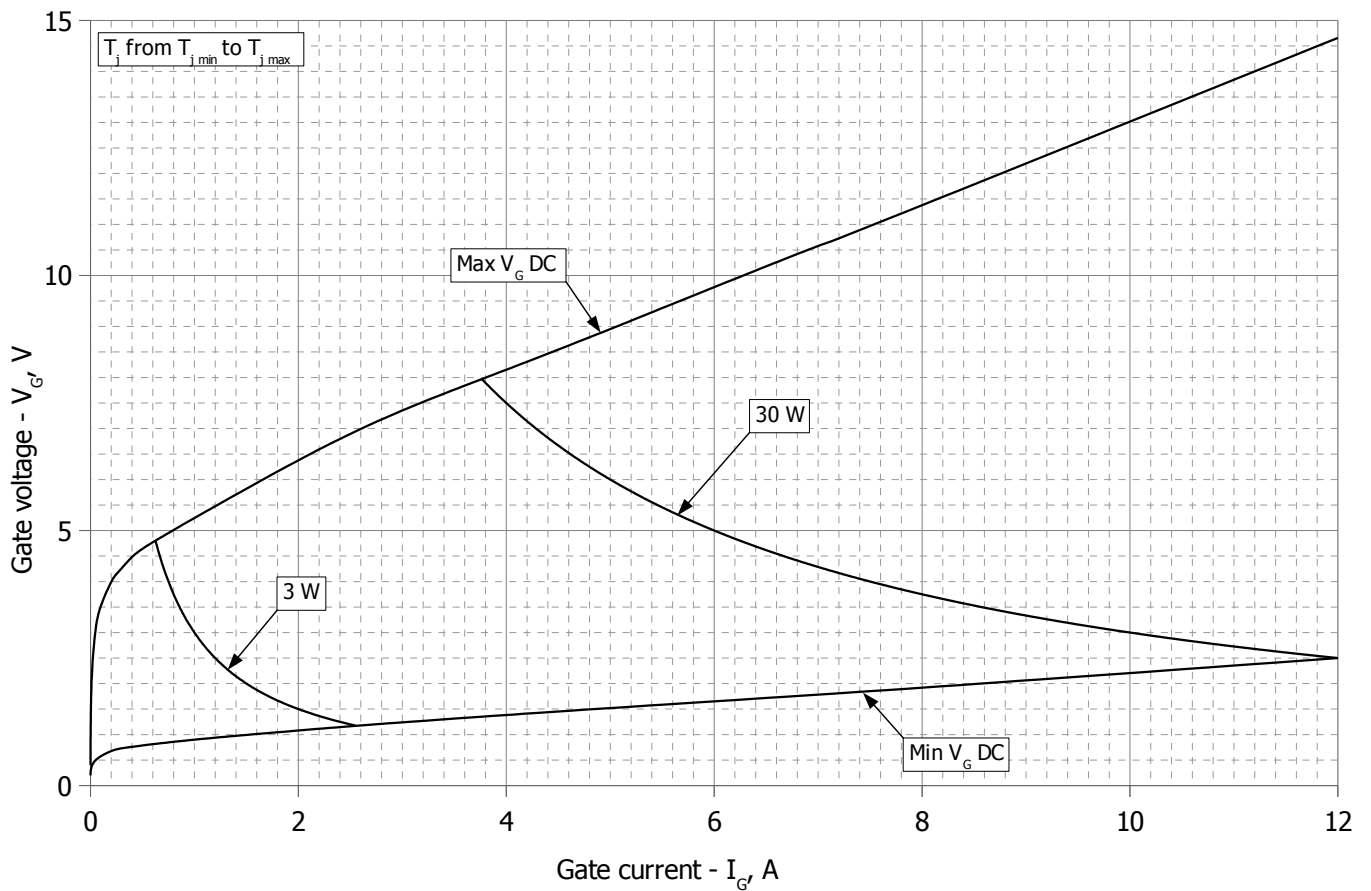


Fig 3 - Gate characteristics – Power curves

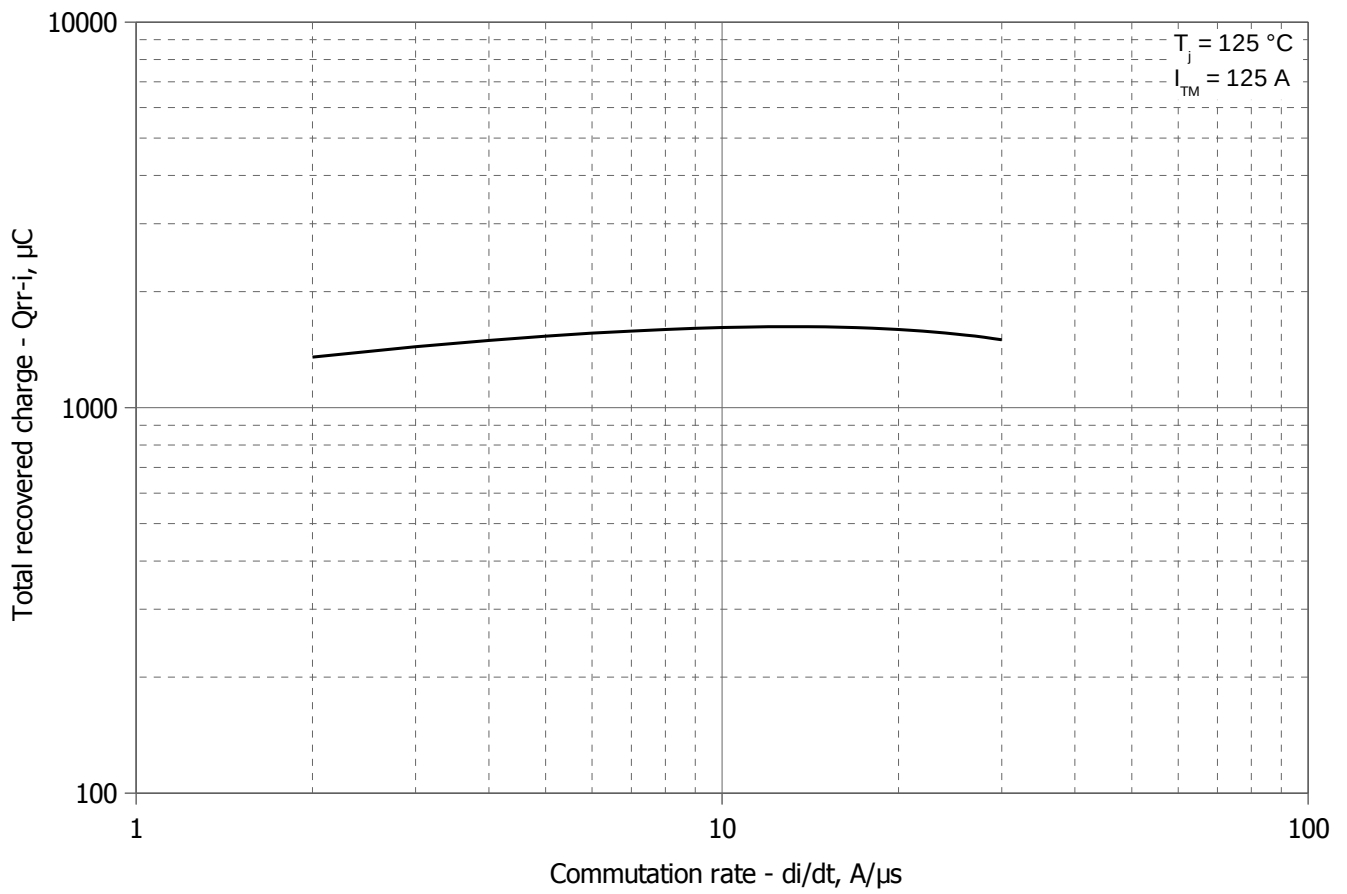


Fig 4 – Maximum recovered charge Q_{rr-i} (integral) vs. commutation rate di_R/dt

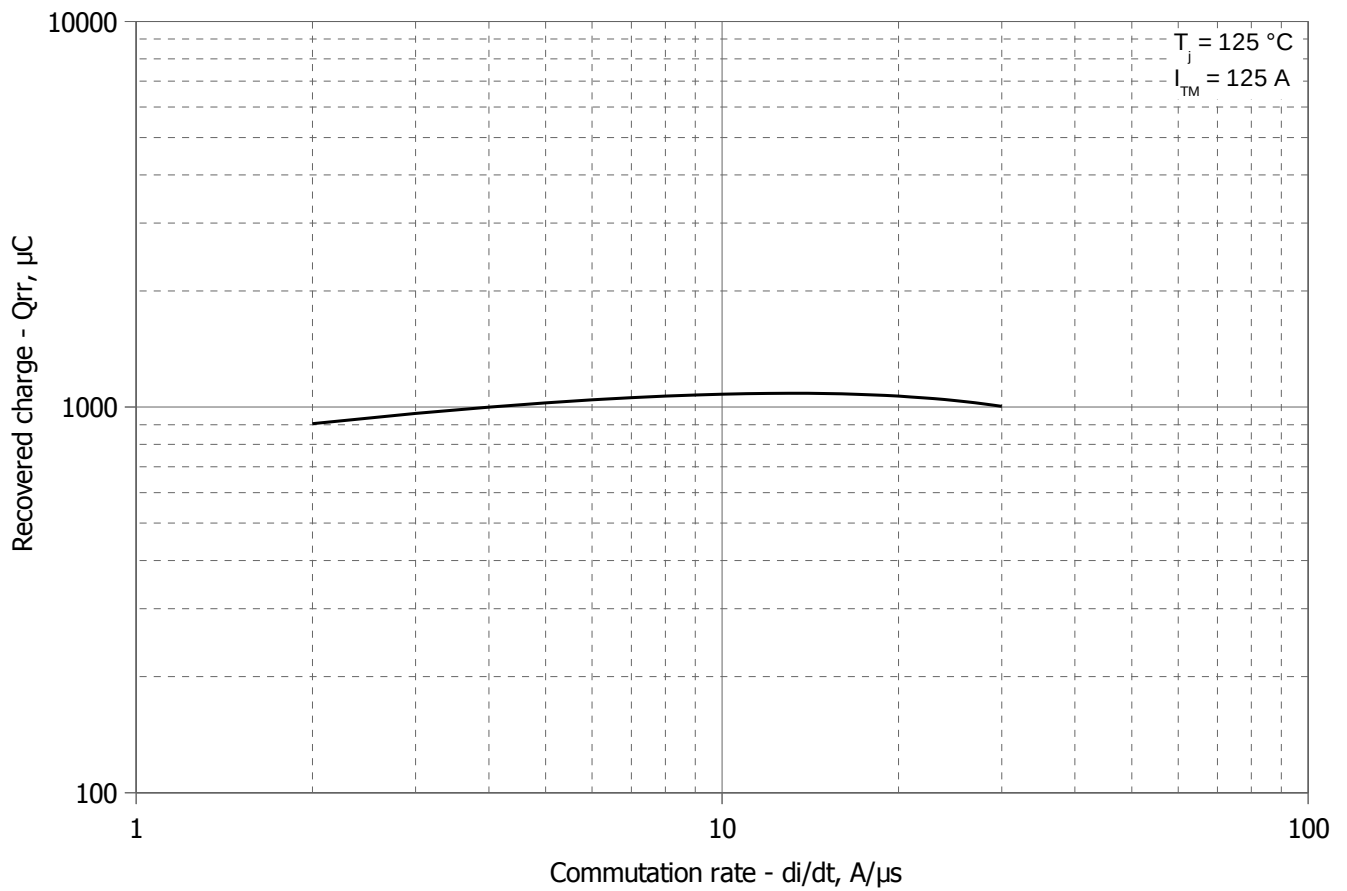


Fig 5 – Maximum recovered charge Q_{rr} vs. commutation rate di_R/dt (25% chord)

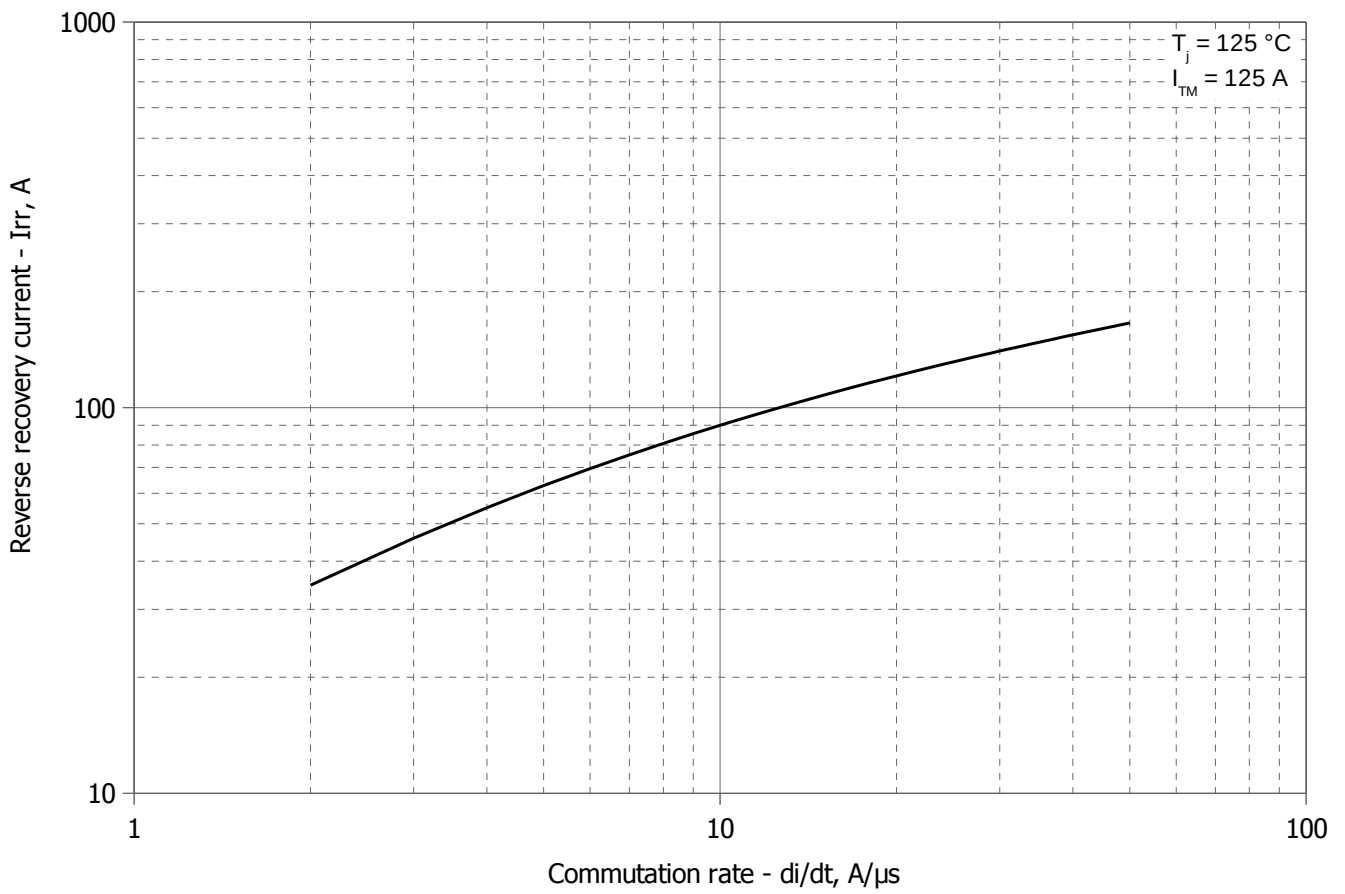


Fig 6 – Maximum reverse recovery current I_{rr} vs. commutation rate di_R/dt

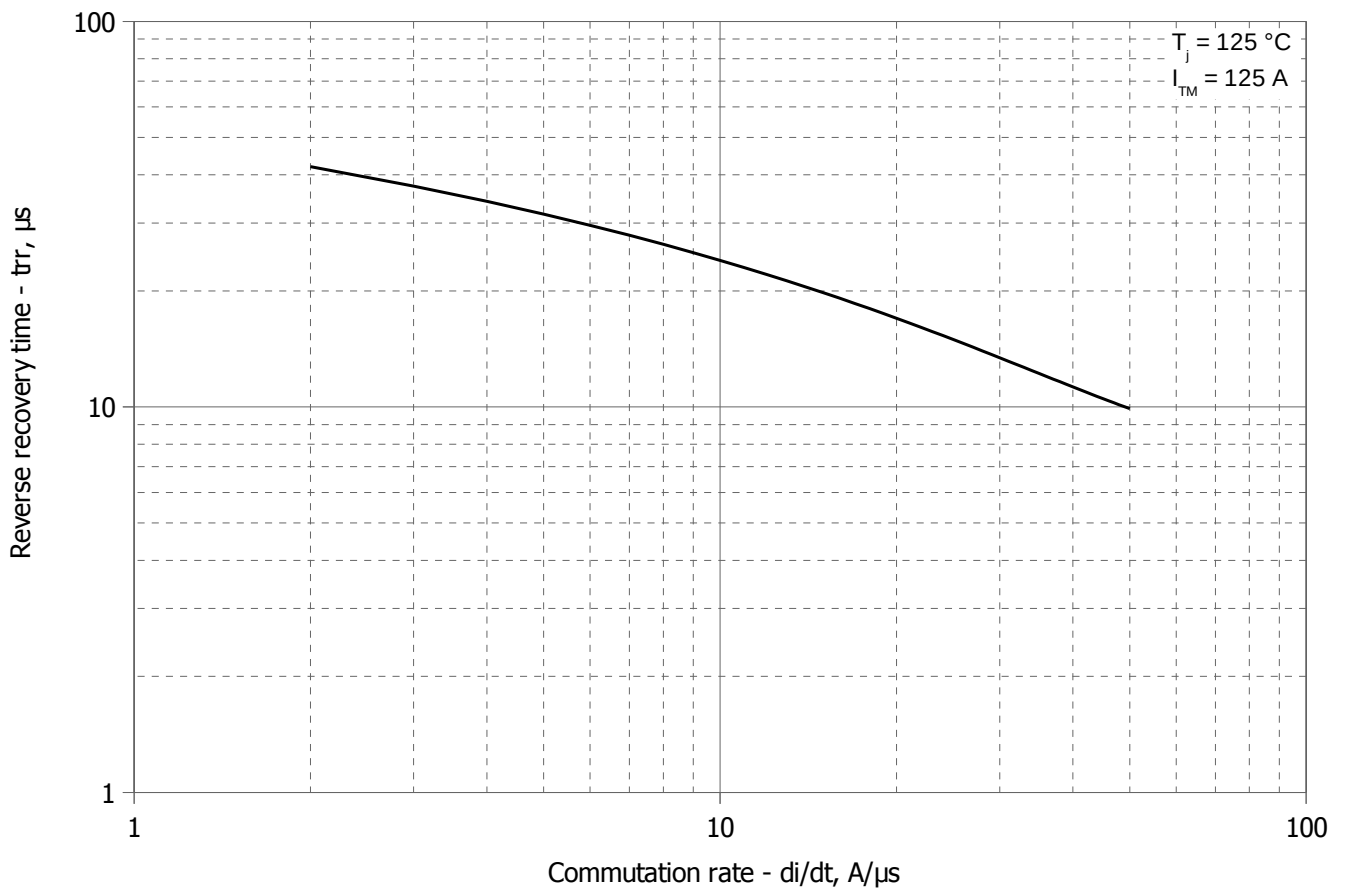


Fig 7 – Maximum recovery time t_{rr} vs. commutation rate di_R/dt (25% chord)

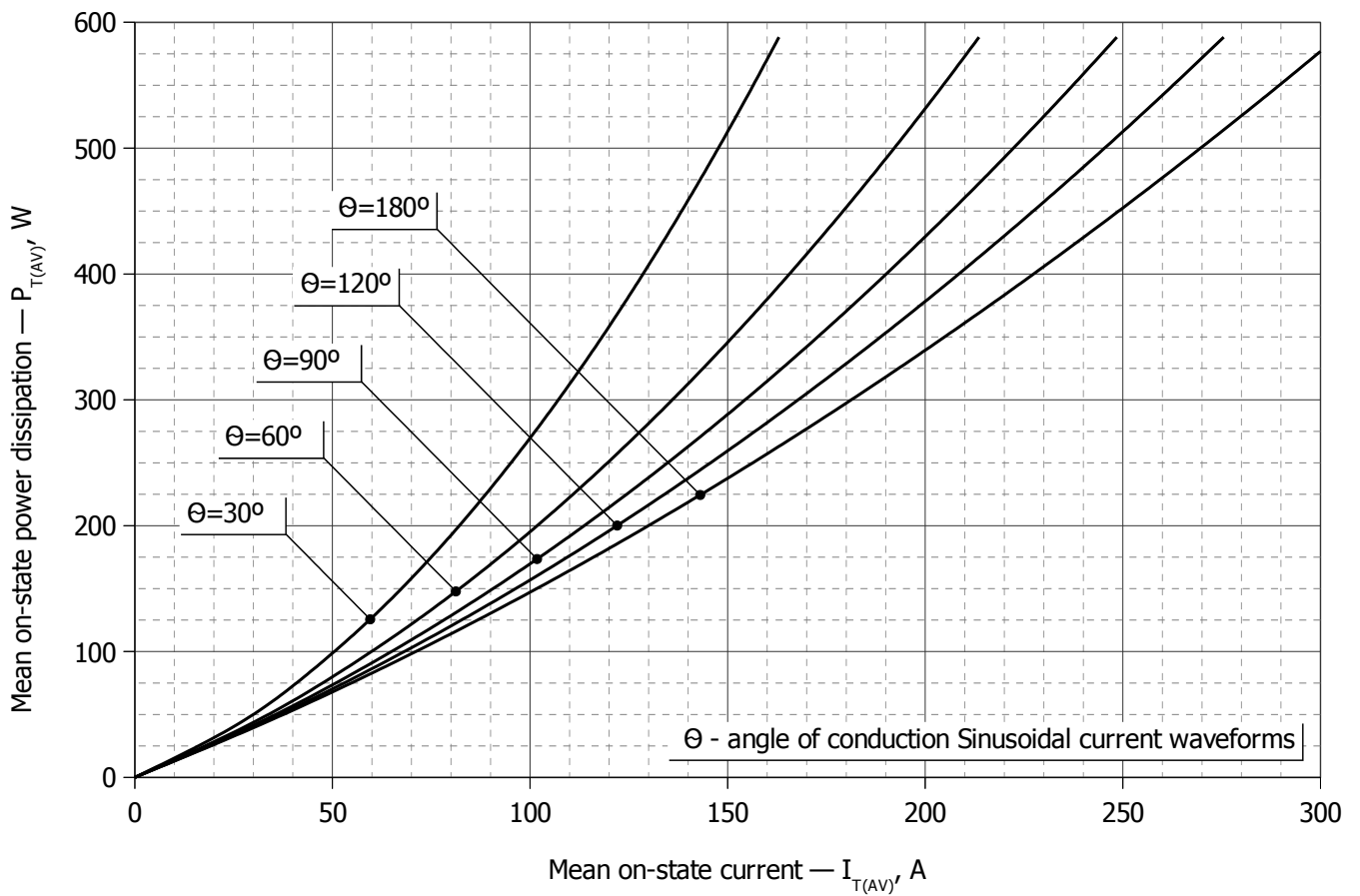


Fig. 8 - Mean on-state power dissipation P_{TAV} vs. mean on-state current I_{TAV} for sinusoidal current waveforms at different conduction angles ($f=50\text{Hz}$)

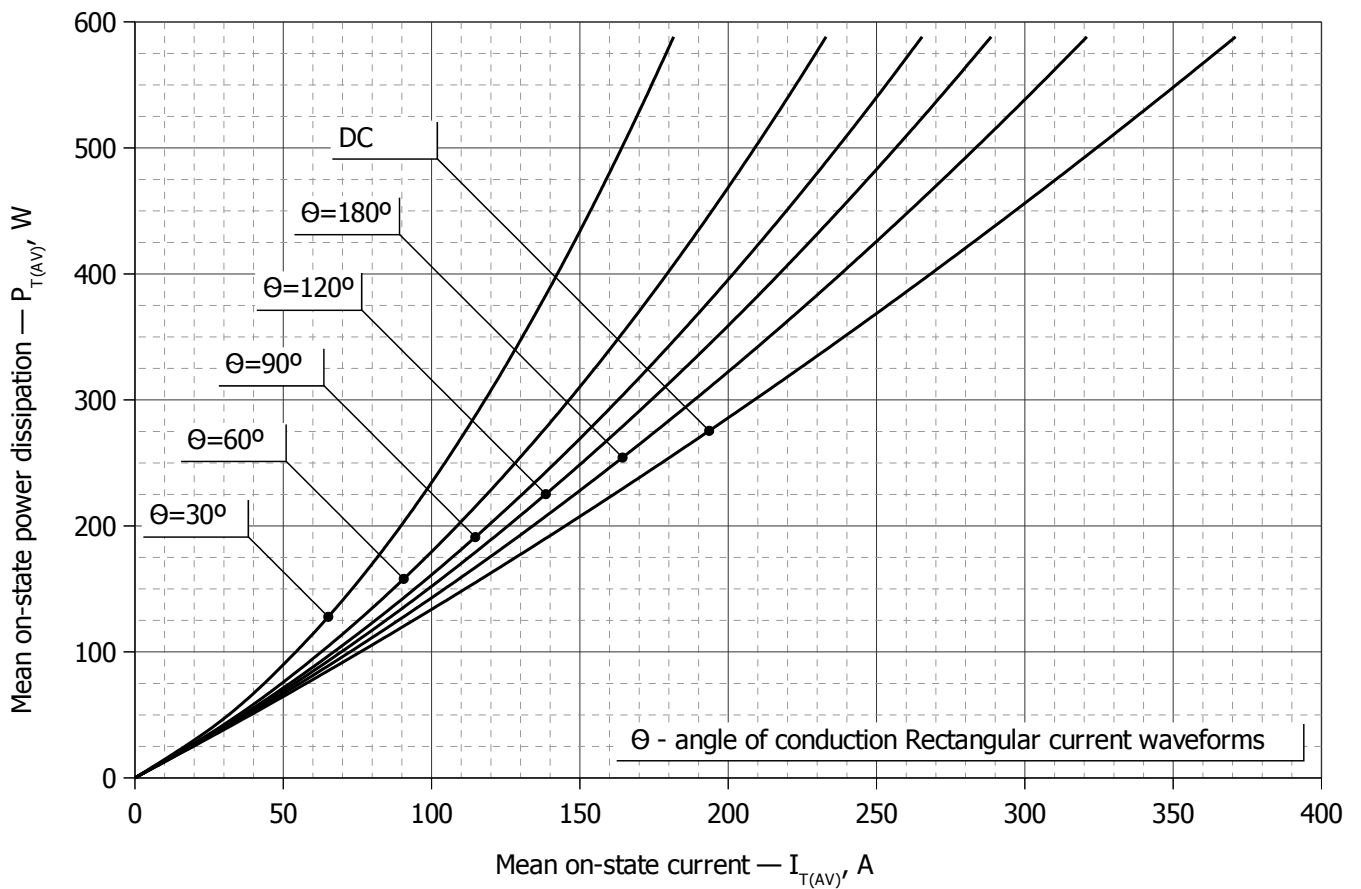


Fig. 9 - Mean on-state power dissipation P_{TAV} vs. mean on-state current I_{TAV} for rectangular current waveforms at different conduction angles and for DC ($f=50\text{Hz}$)

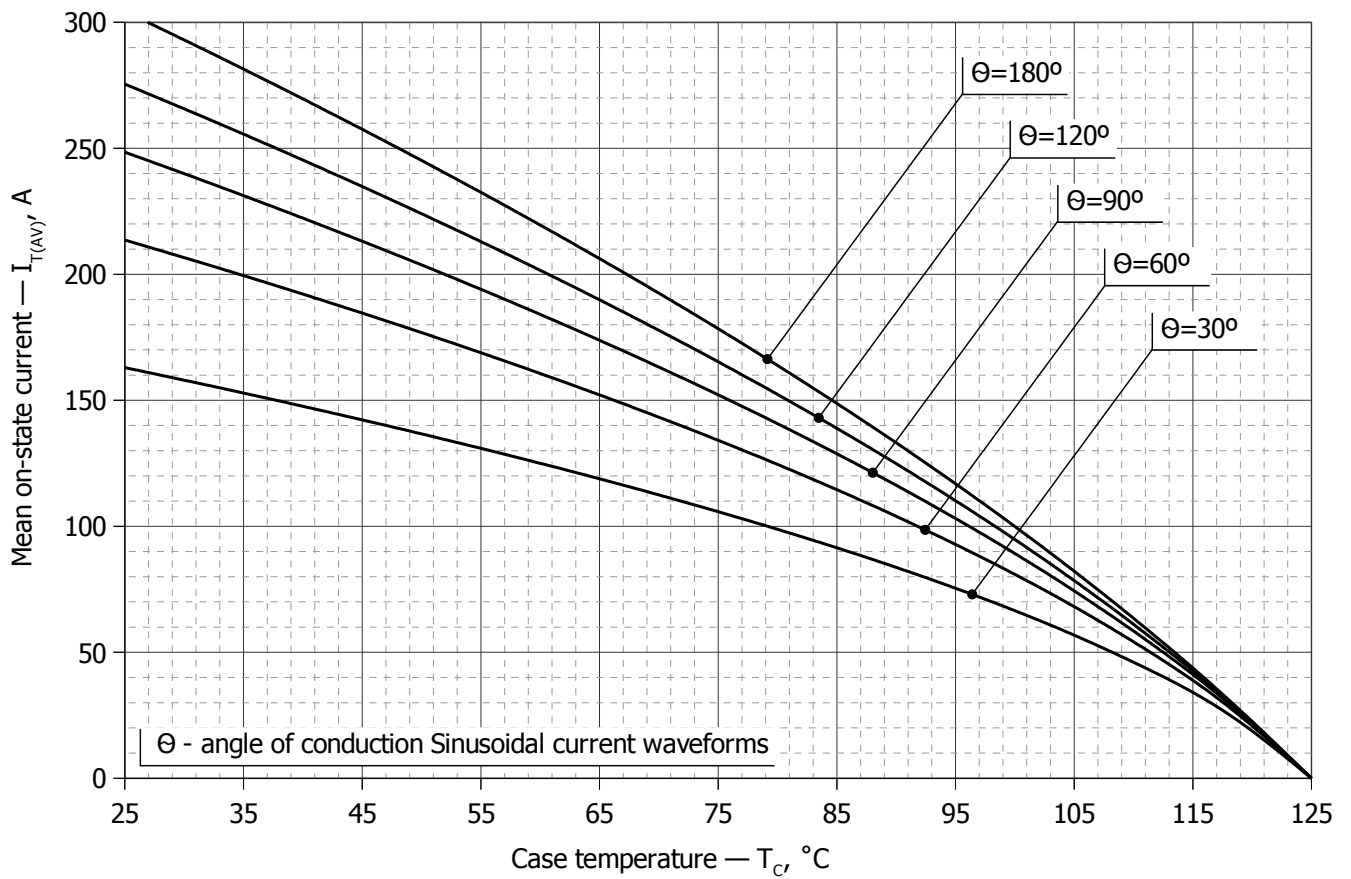


Fig. 10 – Mean on-state current I_{TAV} vs. case temperature T_c for sinusoidal current waveforms at different conduction angles ($f=50\text{Hz}$)

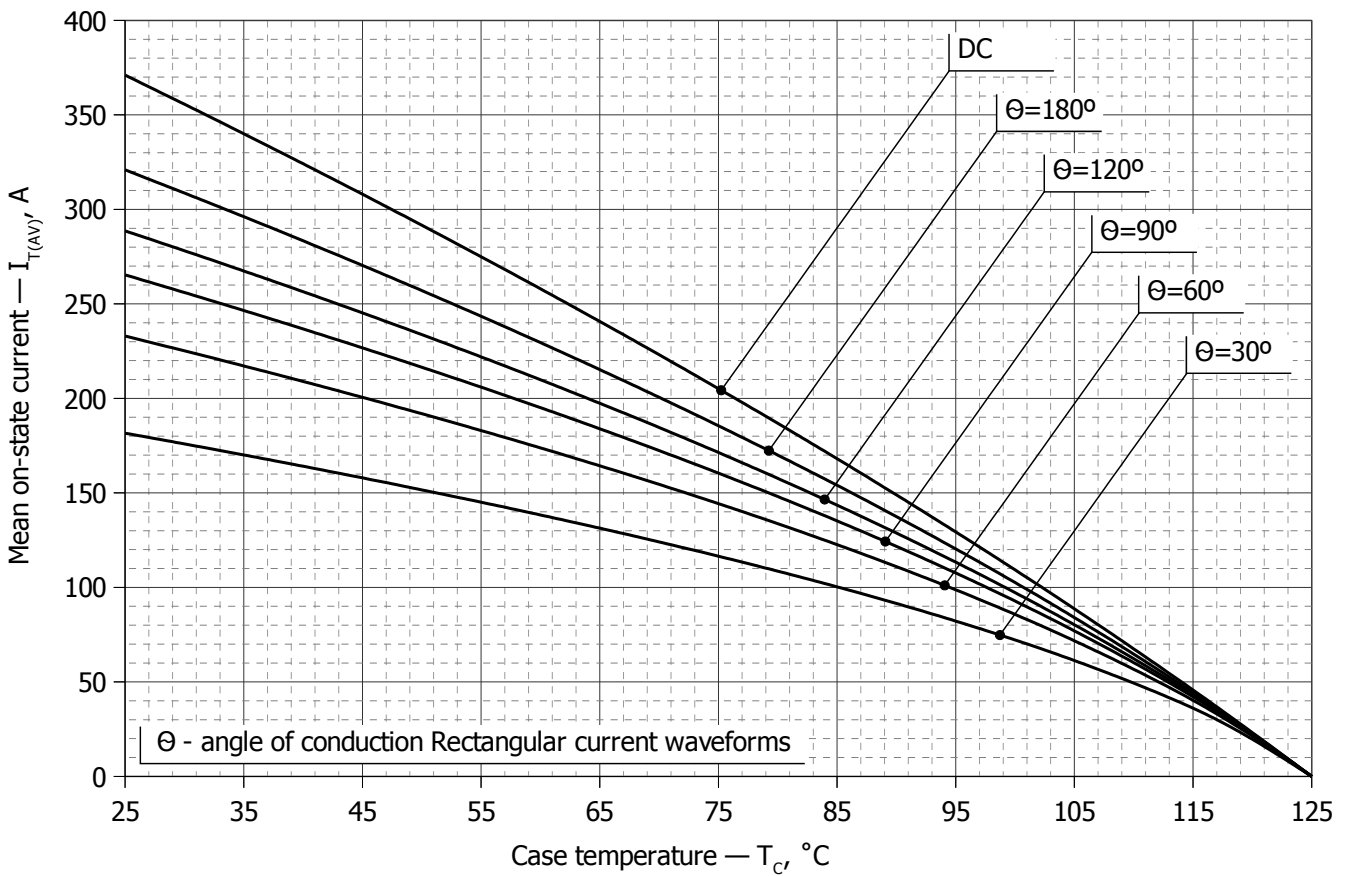


Fig. 11 - Mean on-state current I_{TAV} vs. case temperature T_c for rectangular current waveforms at different conduction angles and for DC ($f=50\text{Hz}$)

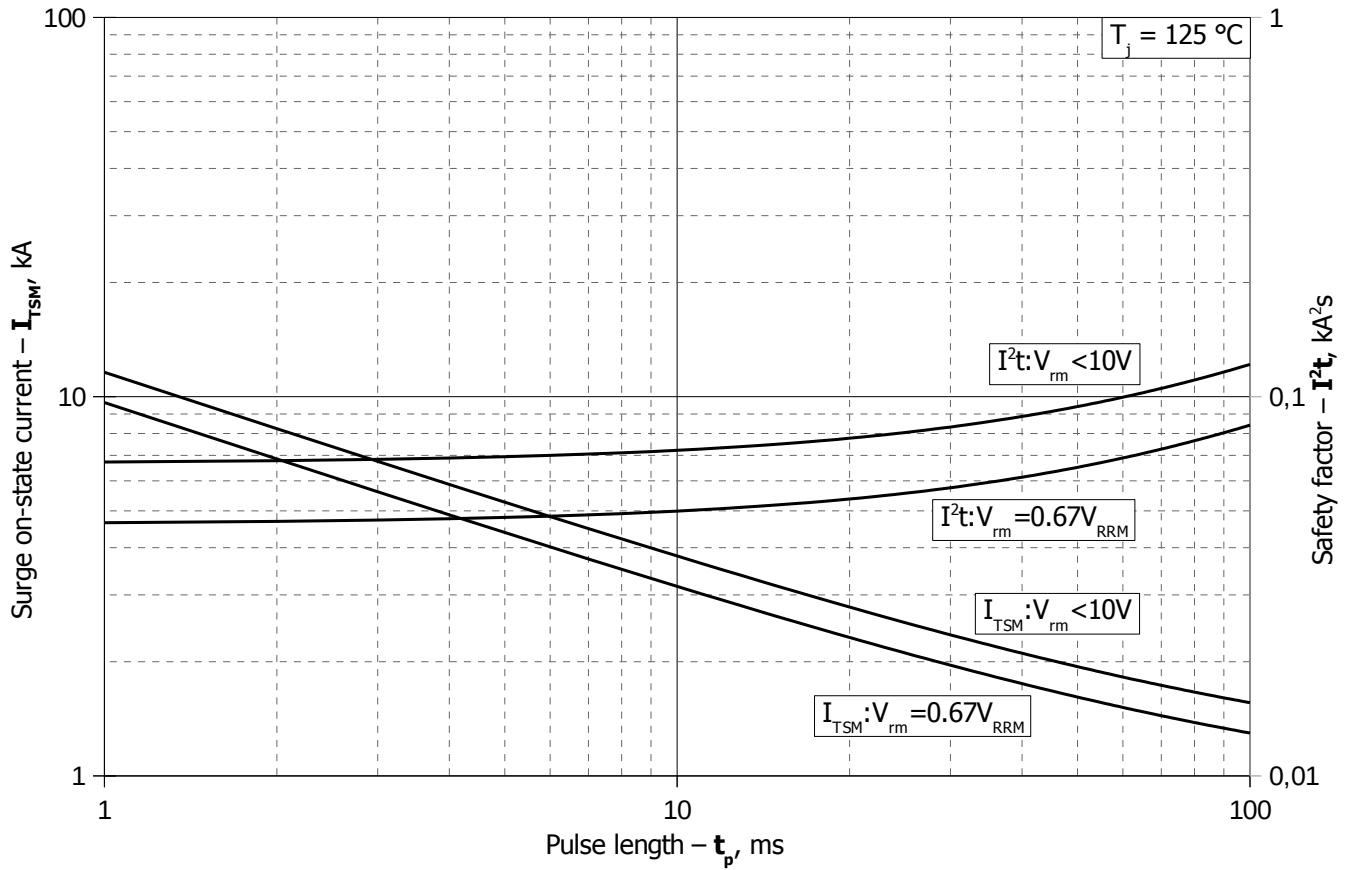


Fig. 12 – Maximum surge on-state current I_{TSM} and safety factor I^2t vs. pulse length t_p

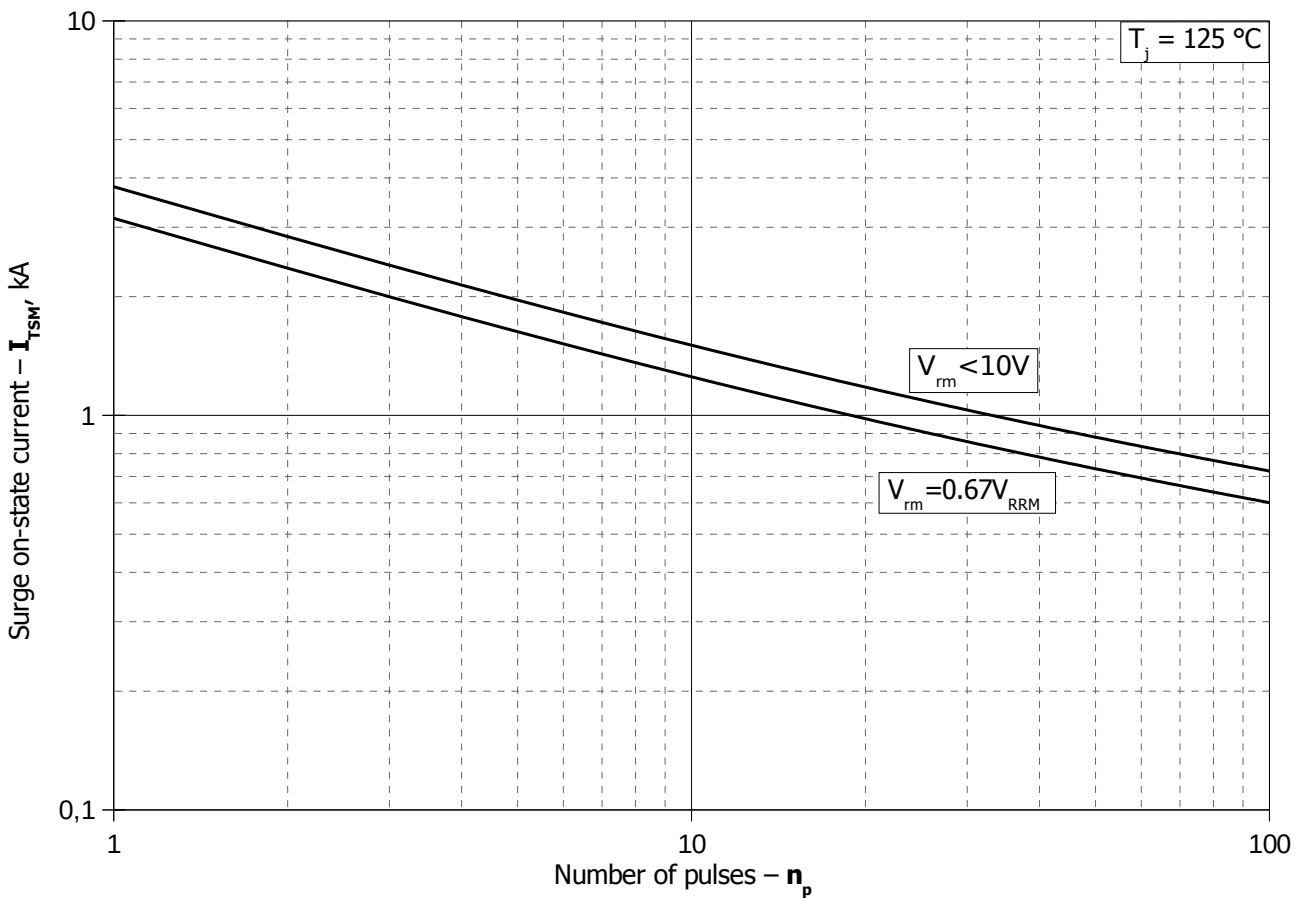


Fig. 13 - Maximum surge on-state current I_{TSM} vs. number of pulses n_p