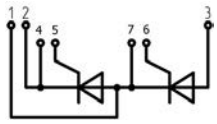
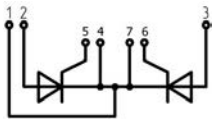
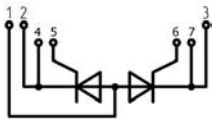
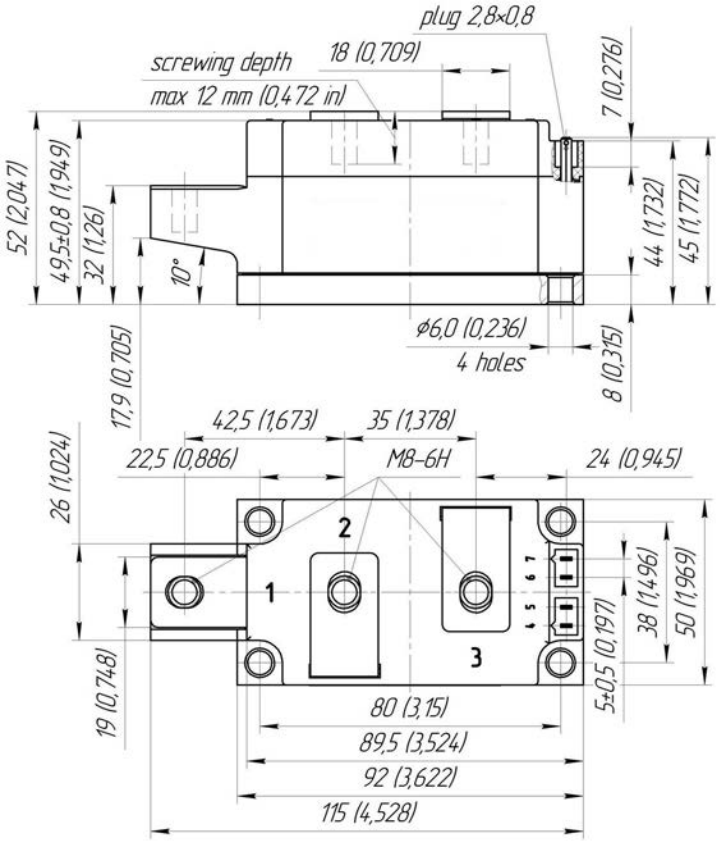
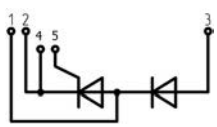
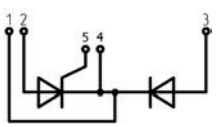
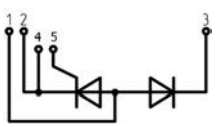
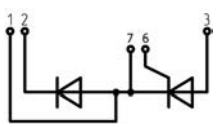
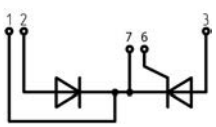
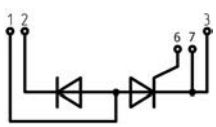
Thyristor Modules
MTx-200-28-C1

Mean on-state current		I_{TAV}	200 A
Repetitive peak off-state voltage		V_{DRM}	2600...2800 V
Repetitive peak reverse voltage		V_{RRM}	
Turn-off time		t_q	250 µs
V_{DRM}, V_{RRM}, V	2600		2800
Voltage code	26		28
T_j, °C	–40...+125		

MT3		MT4		MT5	
					



MT/D3	MT/D4	MT/D5	MD/T3	MD/T4	MD/T5
					

MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions	
ON-STATE					
I_{TAV}	Maximum allowable mean on-state current	A	200 305	T_c=101 °C; T_c=85 °C; 180° half-sine wave; 50 Hz	
I_{TRMS}	RMS on-state current	A	314	T_c=101 °C; 180° half-sine wave; 50 Hz	
I_{TSM}	Surge on-state current	kA	6.5 7.5	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 μs; di_G/dt≥1 A/μs
			7.0 8.0	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 μs; di_G/dt≥1 A/μs
I^2t	Safety factor	$A^2s{\cdot}10^3$	210 280	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 μs; di_G/dt≥1 A/μs
			200 260	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 μs; di_G/dt≥1 A/μs
BLOCKING					
V_{DRM}, V_{RRM}	Repetitive peak off-state and Repetitive peak reverse voltages	V	2600...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	2700...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	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/μs	1250	T_j=$T_{j\,max}$; V_D=$0.67{\cdot}V_{DRM}$; I_{TM}=1300 A; Gate pulse: I_G=2 A; t_{GP}=50 μs; di_G/dt≥2 A/μs	
THERMAL					
T_{stg}	Storage temperature	°C	–40...+50		
T_j	Operating junction temperature	°C	–40...+125		
$T_{c\,op}$	Operating temperature	°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 °C; I_{TM}= 785 A	
$V_{T(TO)}$	On-state threshold voltage, max	V	1.061	T_j=$T_{j\,max}$;	
r_T	On-state slope resistance, max	mΩ	0.772	0.5 π I_{TAV} < I_T < 1.5 π I_{TAV}	
I_L	Latching current, max	mA	700	T_j=25 °C; V_D=12 V; Gate pulse: I_G=2 A; t_{GP}=50 μs; di_G/dt≥1 A/μs	
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	50 2.50	T_j=$T_{j\,max}$ T_j= 25 °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=$T_{j\,max}$; V_D=0.67·V_{DRM}; Gate open	
TRIGGERING					
V_{GT}	Gate trigger direct voltage, max	V	3.00 2.00 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	250 150 150	T_j= $T_{j\,min}$ T_j= 25 °C T_j= $T_{j\,max}$	
V_{GD}	Gate non-trigger direct voltage, min	V	0.60	T_j=$T_{j\,max}$; V_D=0.67·V_{DRM}; Direct gate current	
I_{GD}	Gate non-trigger direct current, min	mA	35.00		
SWITCHING					
t_{gd}	Delay time, max	μs	1.85	T_j=25 °C; V_D=1500 V; I_{TM}=I_{TAV}; di/dt=200 A/μs; Gate pulse: I_G=2 A; V_G=20 V; t_{GP}=50 μs; di_G/dt=2 A/μs	
t_{gt}	Turn-on time, max	μs	9.00		
t_q	Turn-off time[2)], max	μs	250	dv_D/dt=50 V/μs; T_j=$T_{j\,max}$; I_{TM}= I_{TAV}; di_R/dt=-10 A/μs; V_R=100V; V_D=0.67 V_{DRM}	
Q_{rr}	Total recovered charge, max	μC	1170	T_j=$T_{j\,max}$; I_{TM}=200 A; di_R/dt=-10 A/μs; V_R=100 V	
t_{rr}	Reverse recovery time, max	μs	24		
I_{rr}	Reverse recovery current, max	A	97		
THERMAL					
R_{thjc}	Thermal resistance, junction to case			180° half-sine wave, 50 Hz	
	per module	°C/W	0.0400		
	per arm	°C/W	0.0800		
R_{thch}	Thermal resistance, case to heatsink				
	per module	°C/W	0.0200		
	per arm	°C/W	0.0400		
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 ± 15%	
M_2	Terminal connection torque (M8)[3)]	Nm	9.00	Tolerance ± 15%	
m	Weight, max	g	860		

PART NUMBERING GUIDE

MT	3	-	200	-	28	-	A2	M2	-	C1	-	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 V/μs)
7. Package Type (M.C1)
8. Ambient Conditions:
   N – Normal

NOTES

[1] Critical rate of rise of off-state voltage

Symbol of Group	P2	K2	E2	A2	T1	P1	M1
$(dv_D/dt)_{crit}$, V/μs	200	320	500	1000	1600	2000	2500

[2] Turn-off time (dv_D/dt=50 V/μs)

Symbol of Group	M2
t_q, μs	250

[3] The screws must be lubricated

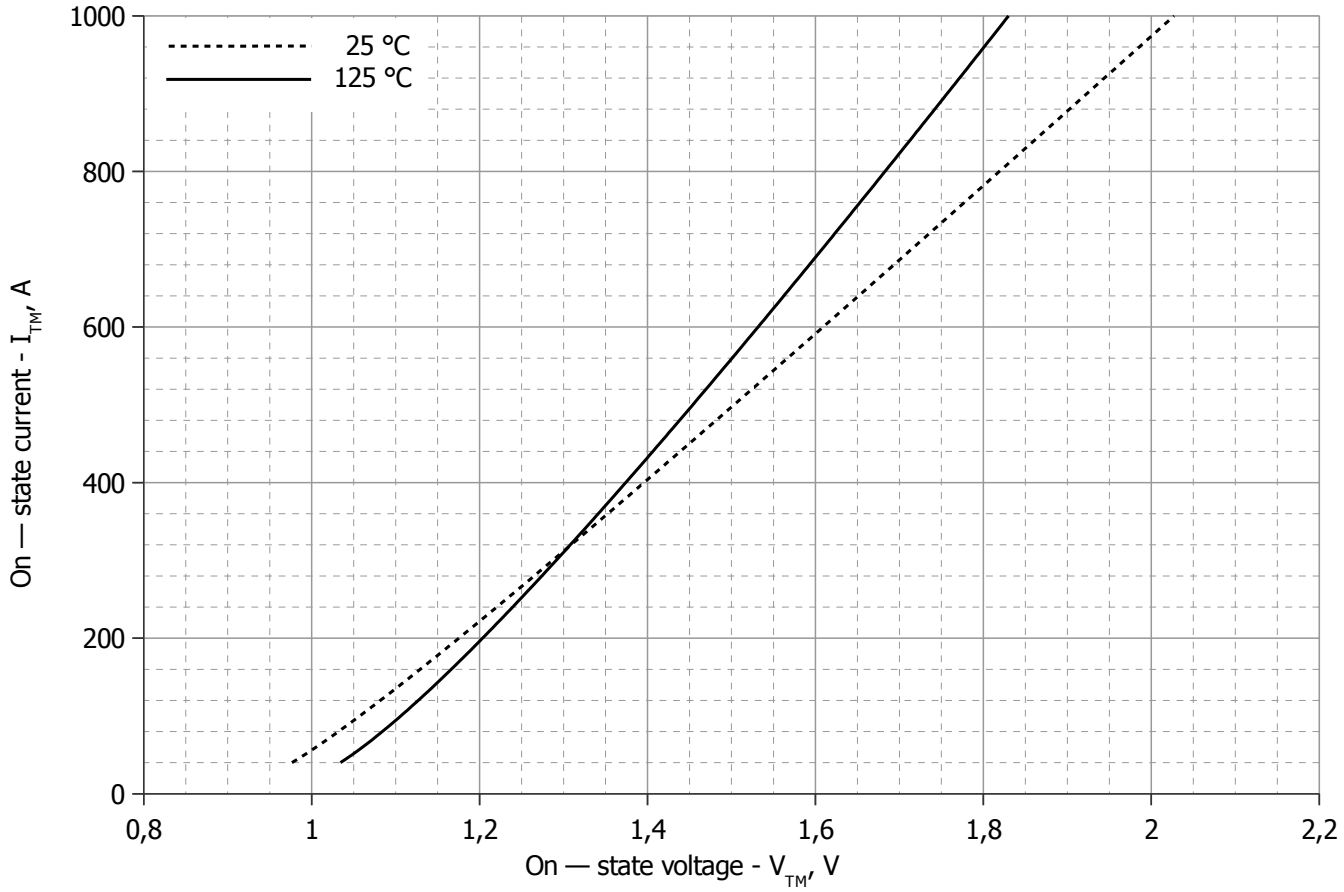


Fig 1 – On-state characteristics of Limit device

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 = 25ºC	$T_j = T_{j\,max}$
A	0.86800379	0.93018191
B	0.00098693	0.00059893
C	0.01484991	0.00857857
D	0.00220103	0.00764154

On-state characteristic model (see Fig. 1)

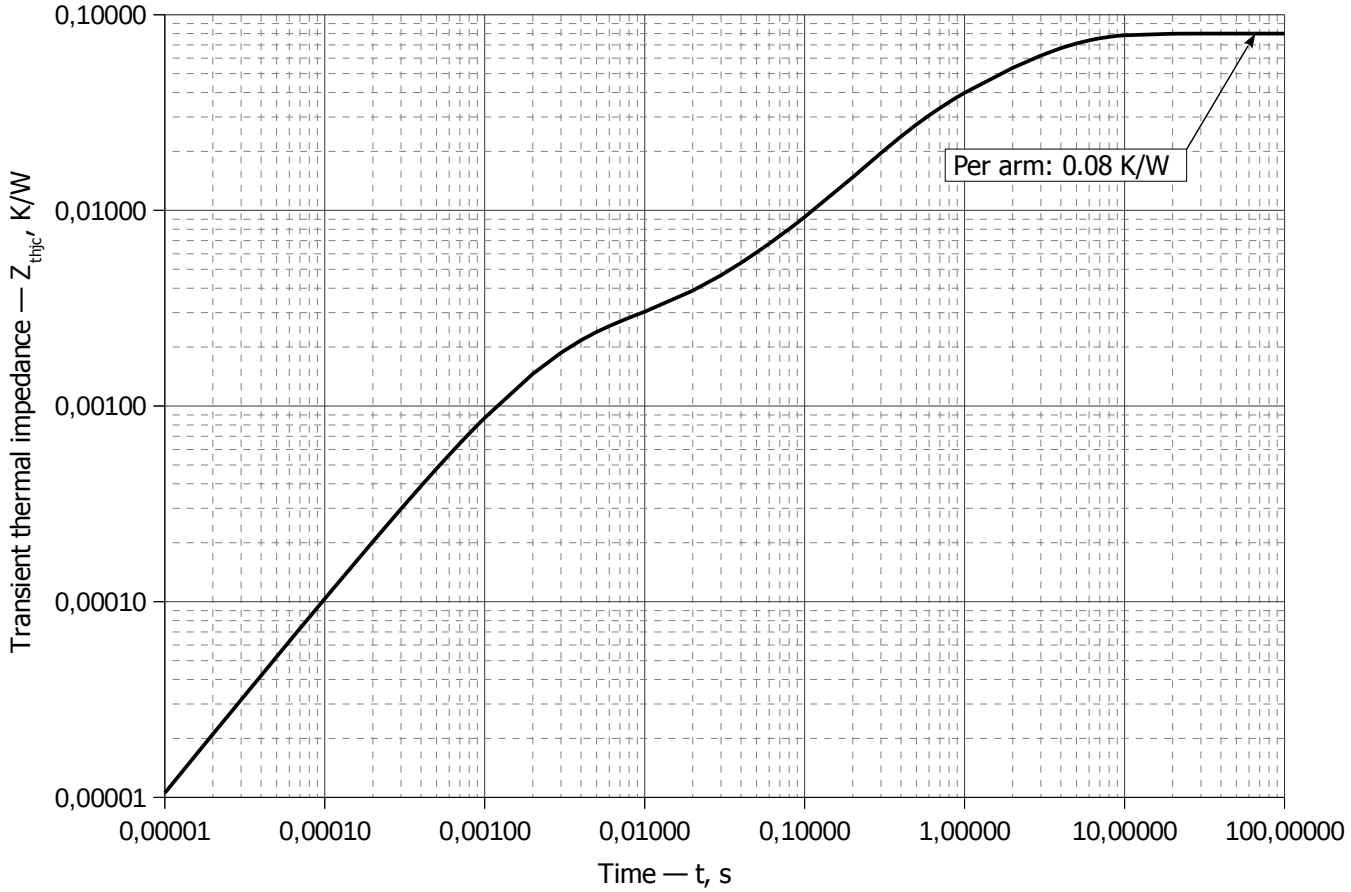


Fig 2 – Transient thermal impedance Z_{thjc} vs. time t

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.

τ_i = Time constatnt of r_{th} term.

i	1	2	3	4	5	6
R_i, K/W	0.0507	0.007806	0.02226	-0.007688	0.00471	0.00217
τ_i, s	2.801	1.283	0.3281	0.09408	0.0572	0.002255

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

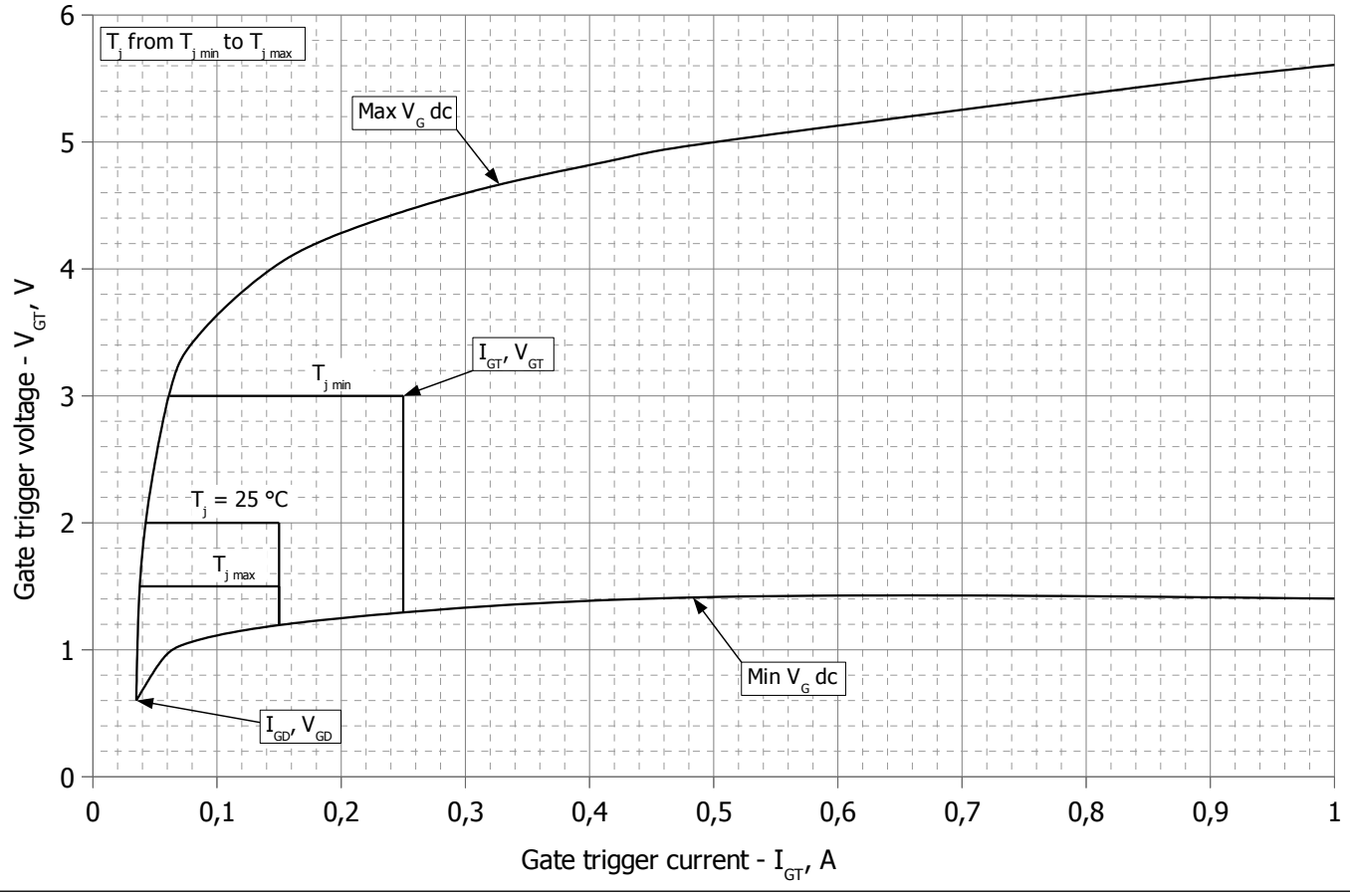


Fig 3 – Gate characteristics – Trigger limits

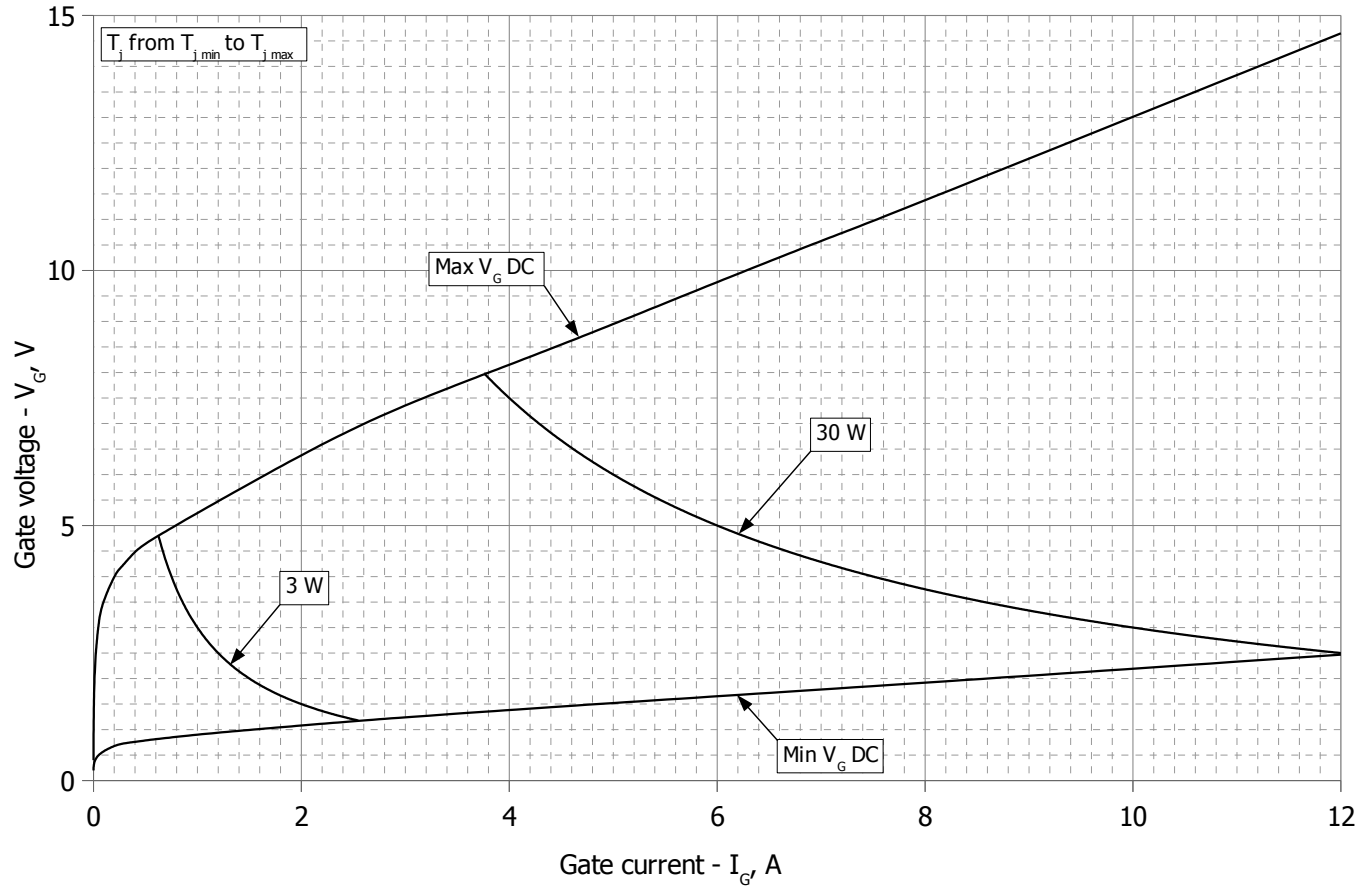


Fig 4 - Gate characteristics – Power curves

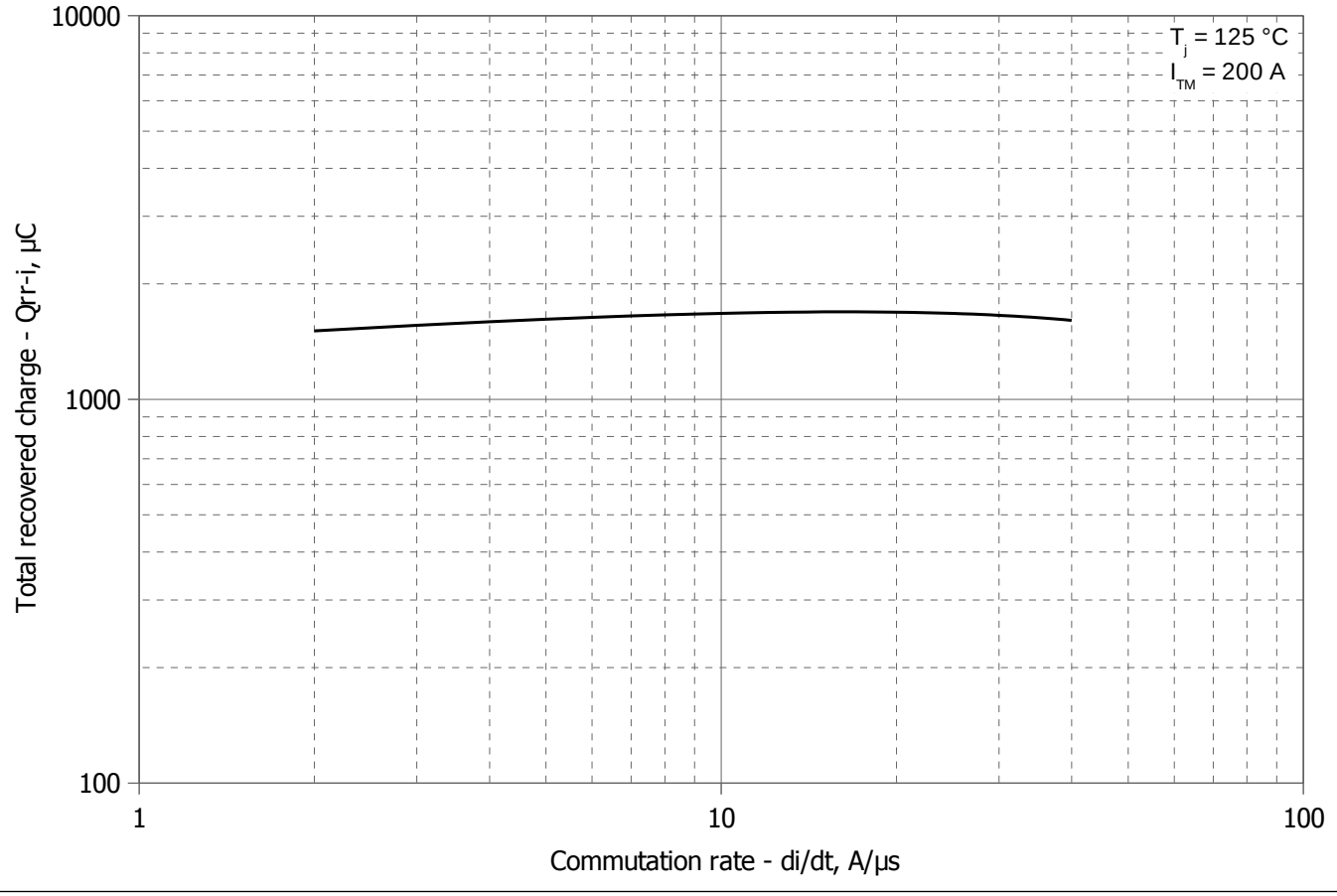


Fig 5 – Maximum recovered charge Q_{rr-i} (integral) vs. commutation rate di_R/dt

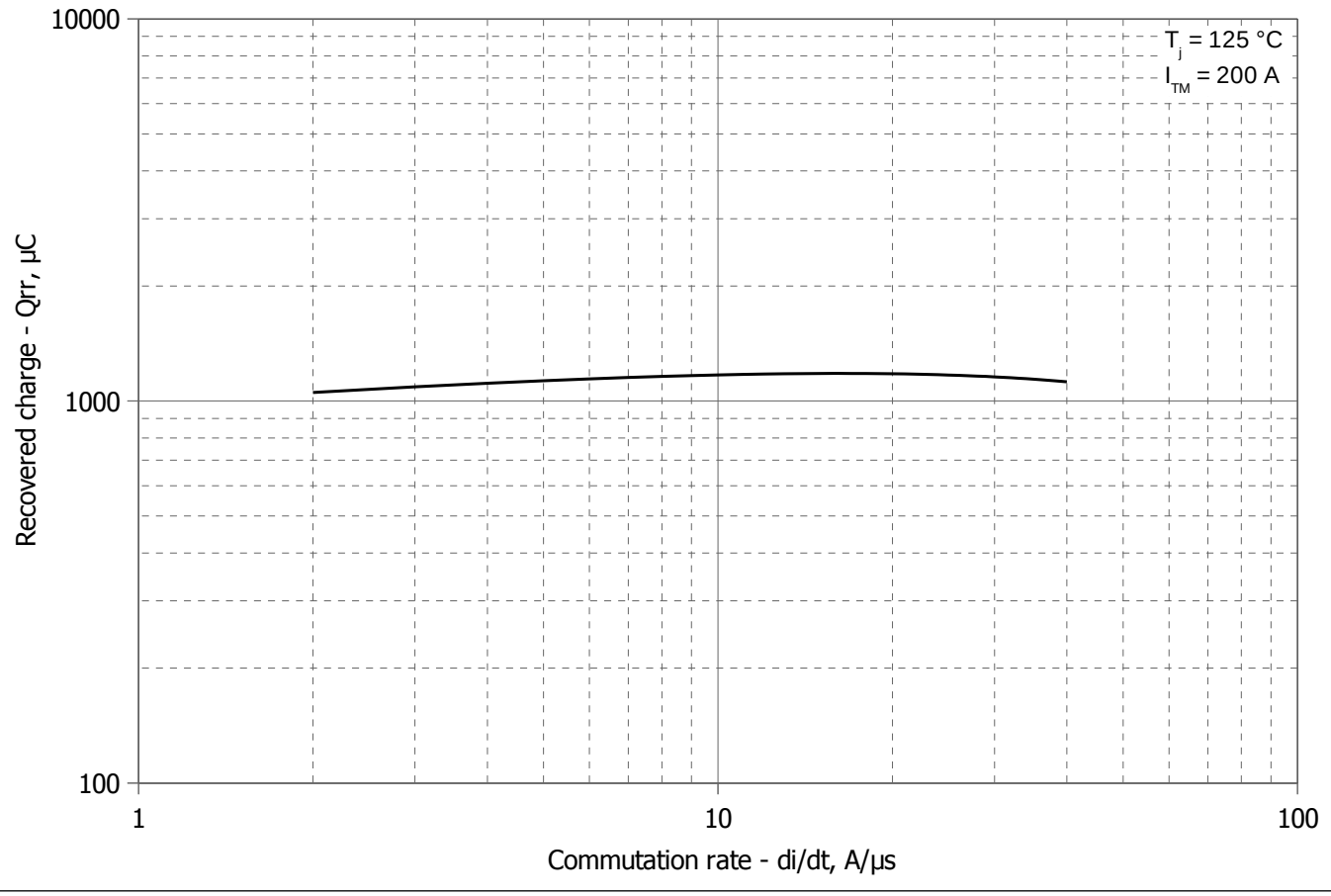


Fig 6 – Maximum recovered charge Q_{rr} vs. commutation rate di_R/dt (25% chord)

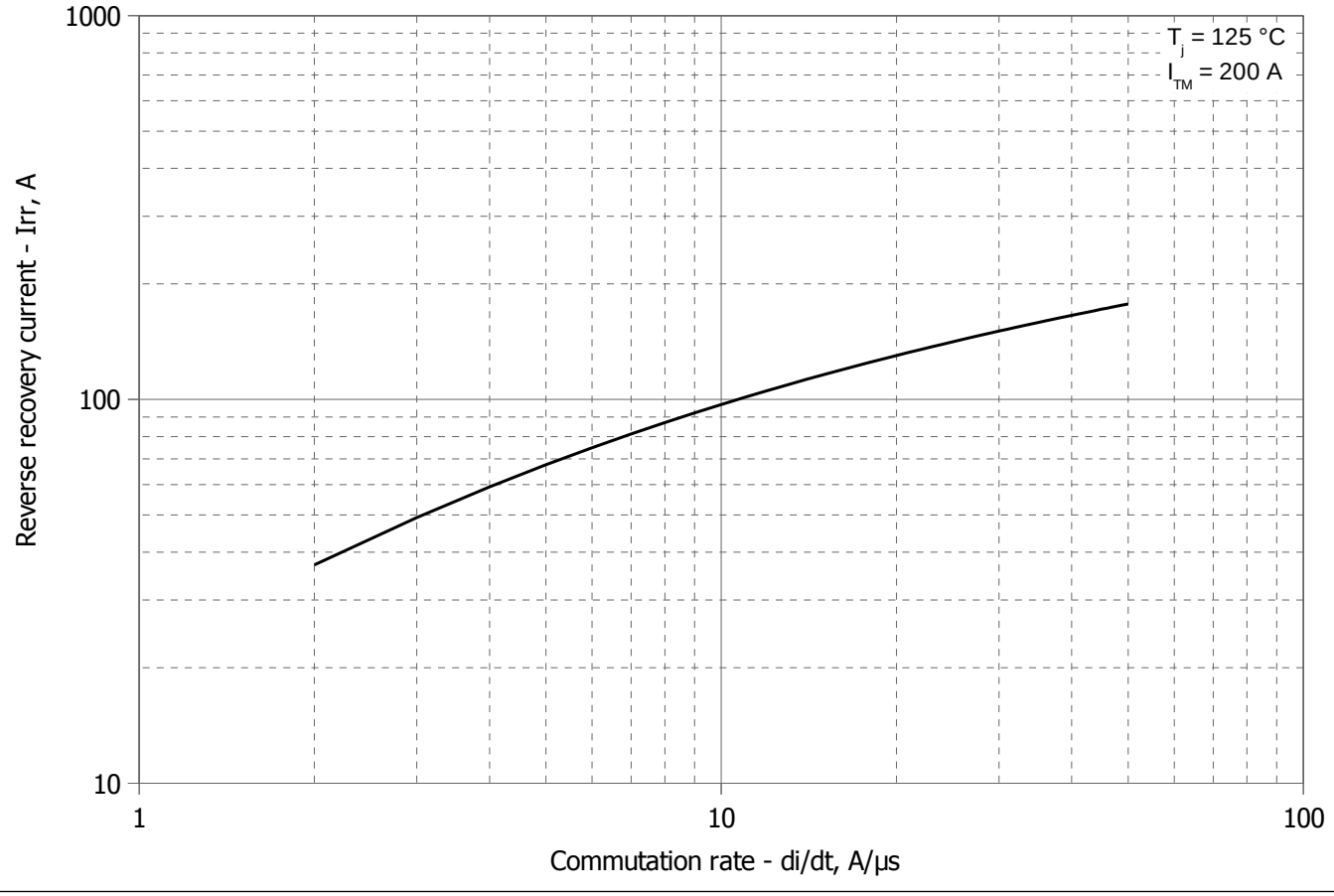


Fig 7 – Maximum reverse recovery current I_{rr} vs. commutation rate di_R/dt

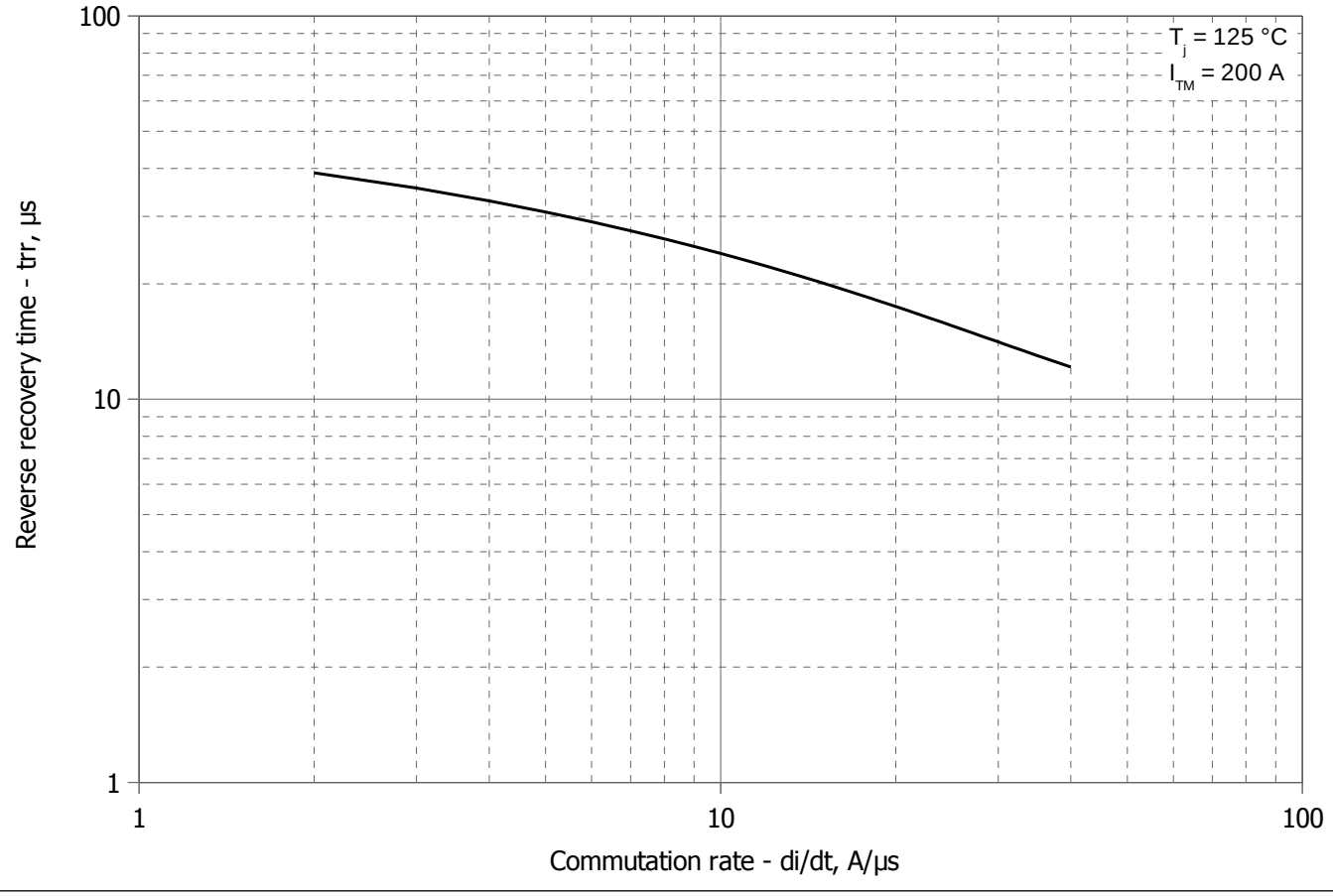


Fig 8 – Maximum recovery time t_{rr} vs. commutation rate di_R/dt (25% chord)

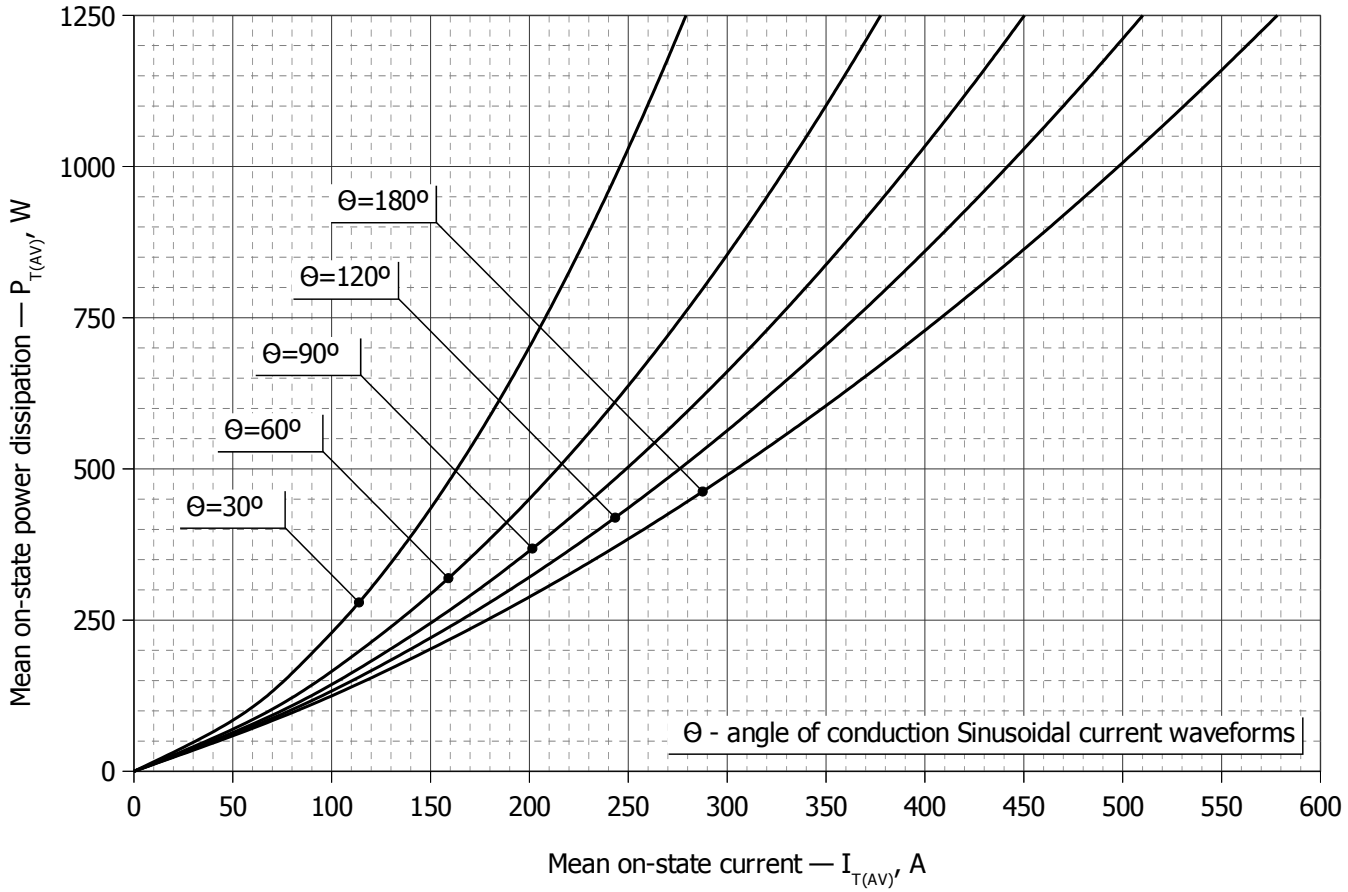


Fig. 9 - Mean on-state power dissipation P_{TAV} vs. mean on-state current I_{TAV} for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

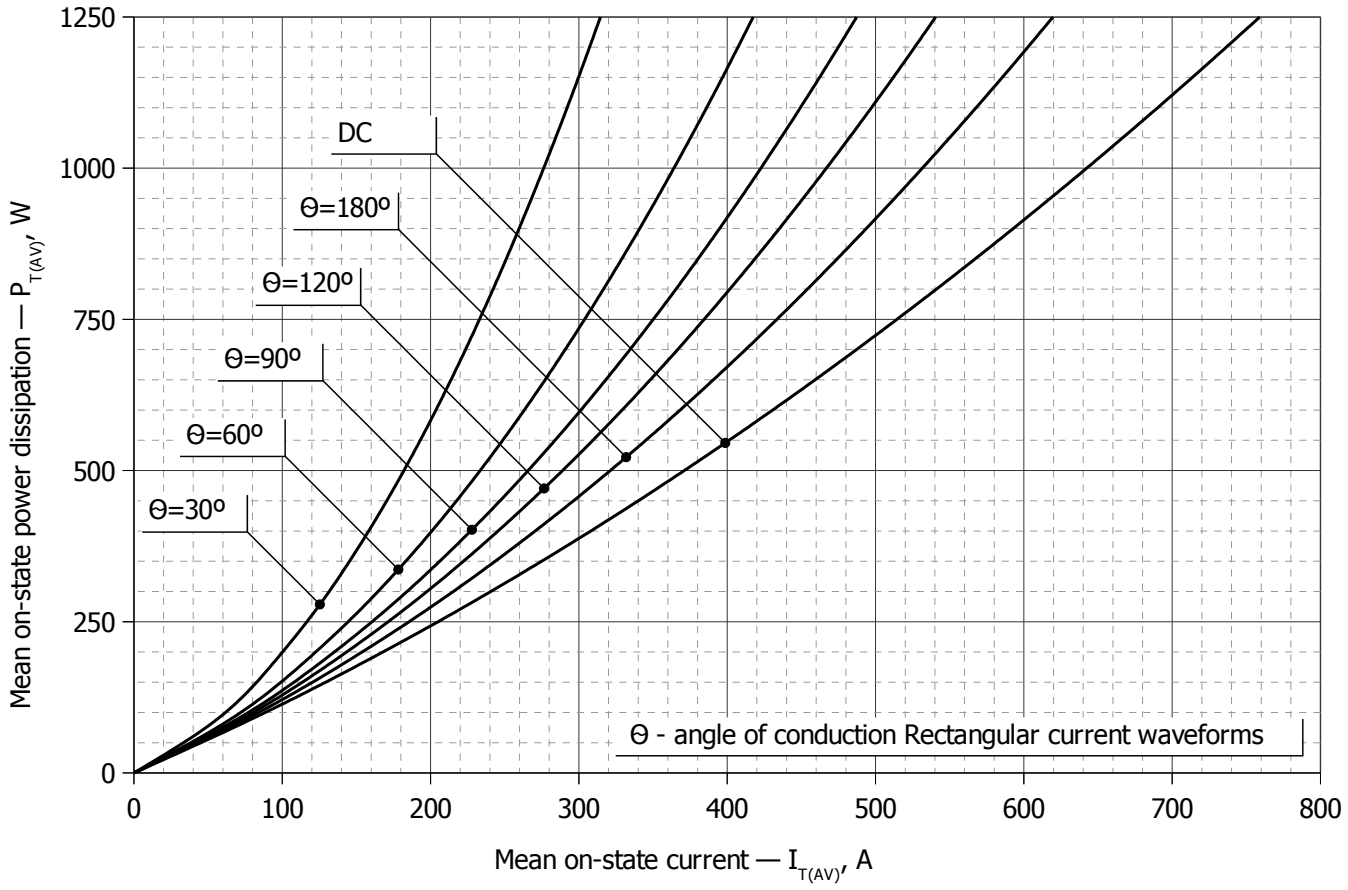


Fig. 10 – Mean on-state power dissipation P_{TAV} vs. mean on-state current I_{TAV} for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

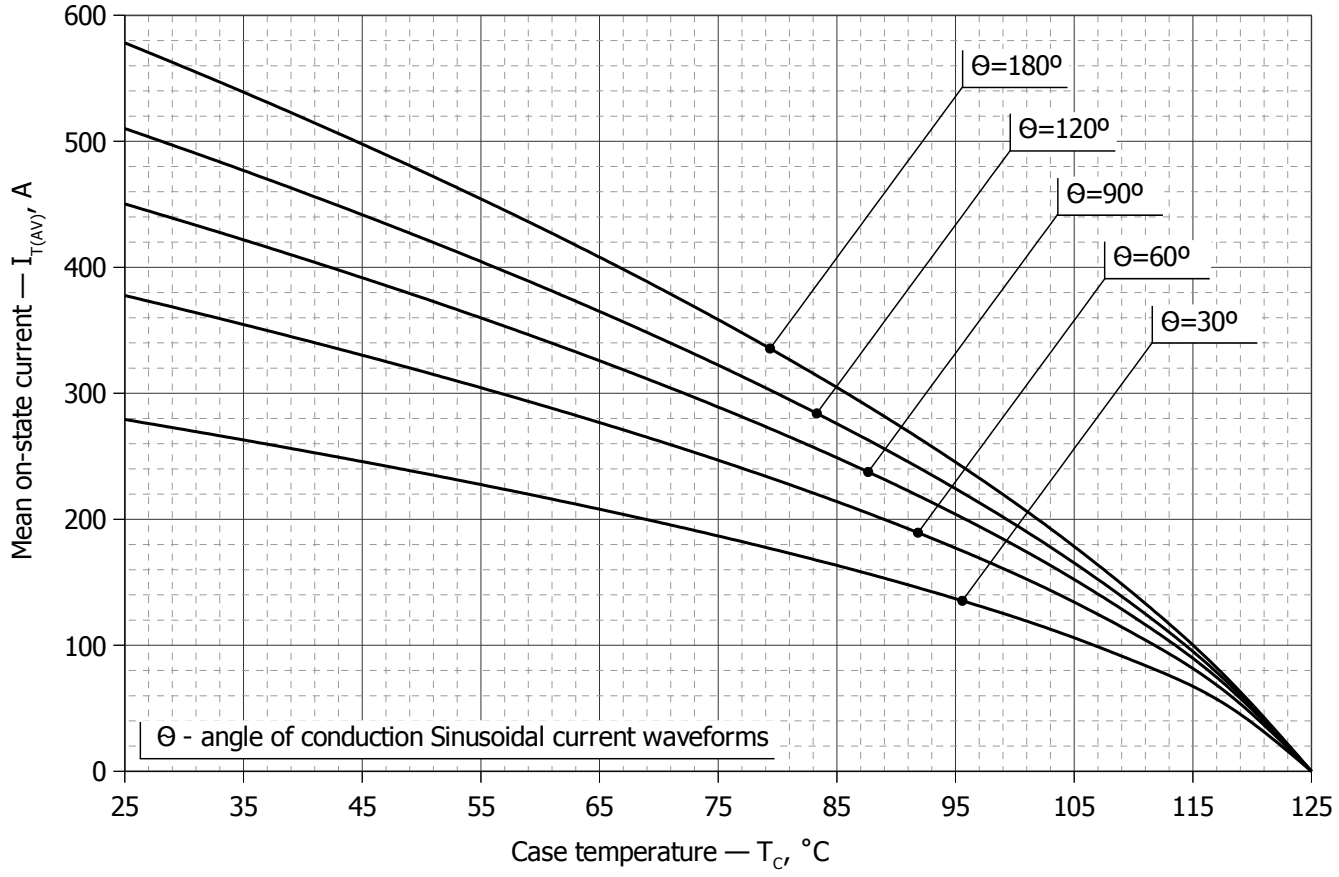


Fig. 11 – Mean on-state current I_{TAV} vs. case temperature T_C for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

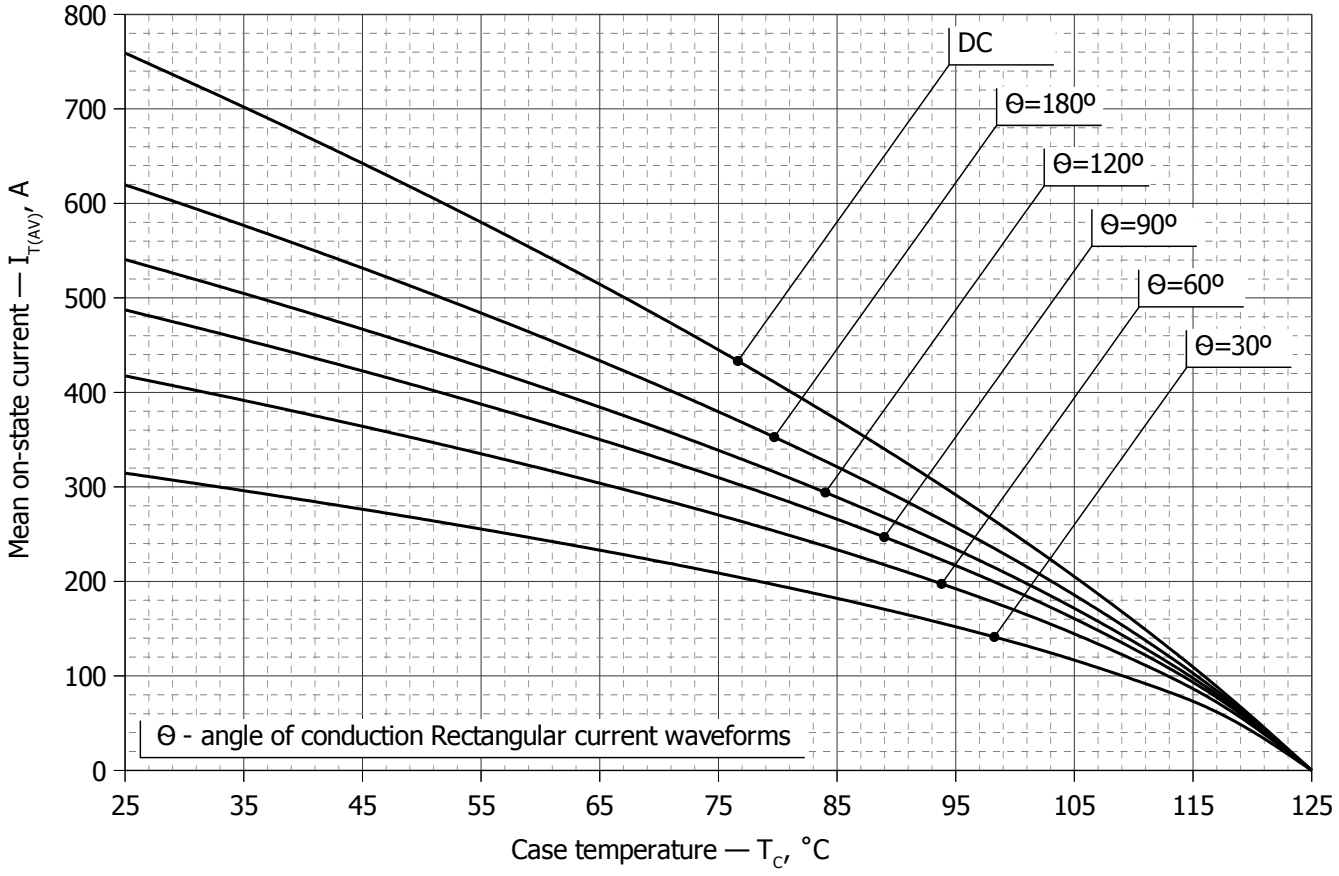


Fig. 12 - Mean on-state current I_{TAV} vs. case temperature T_C for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

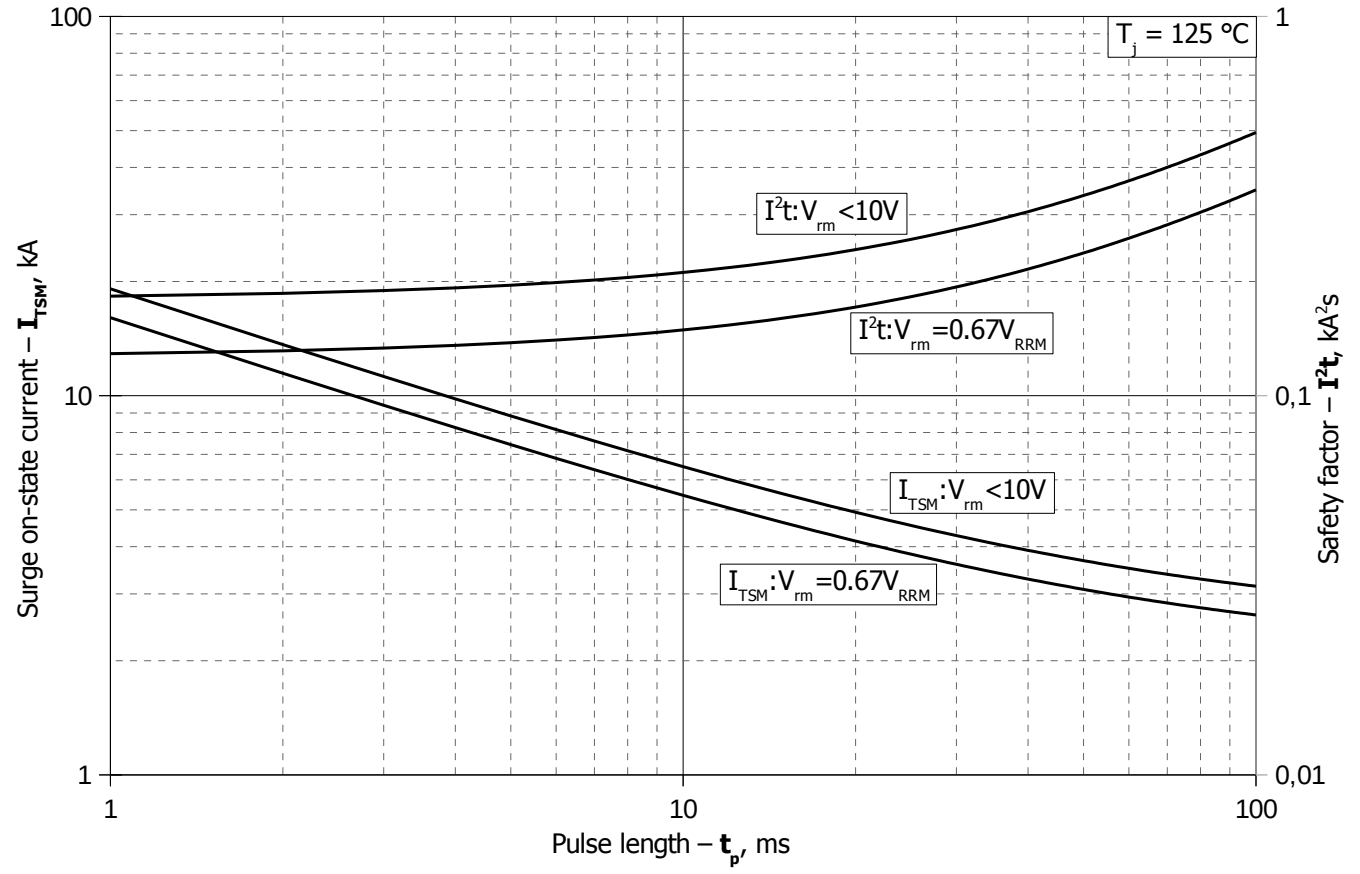


Fig. 13 – Maximum surge on-state current I_{TSM} and safety factor I^2t vs. pulse length t_p

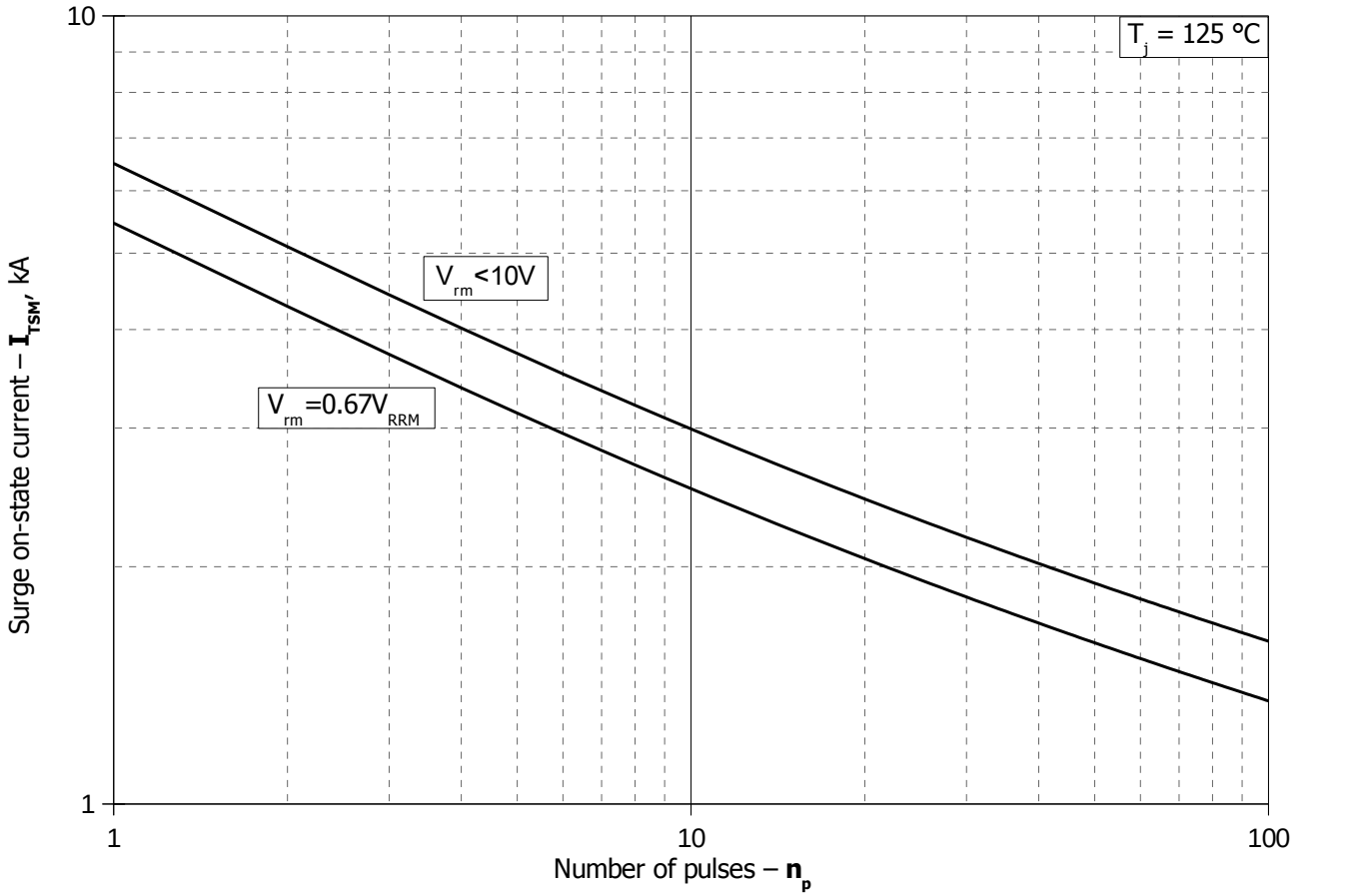


Fig. 14 - Maximum surge on-state current I_{TSM} vs. number of pulses n_p