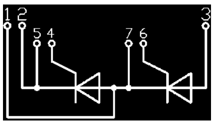
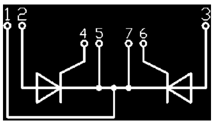
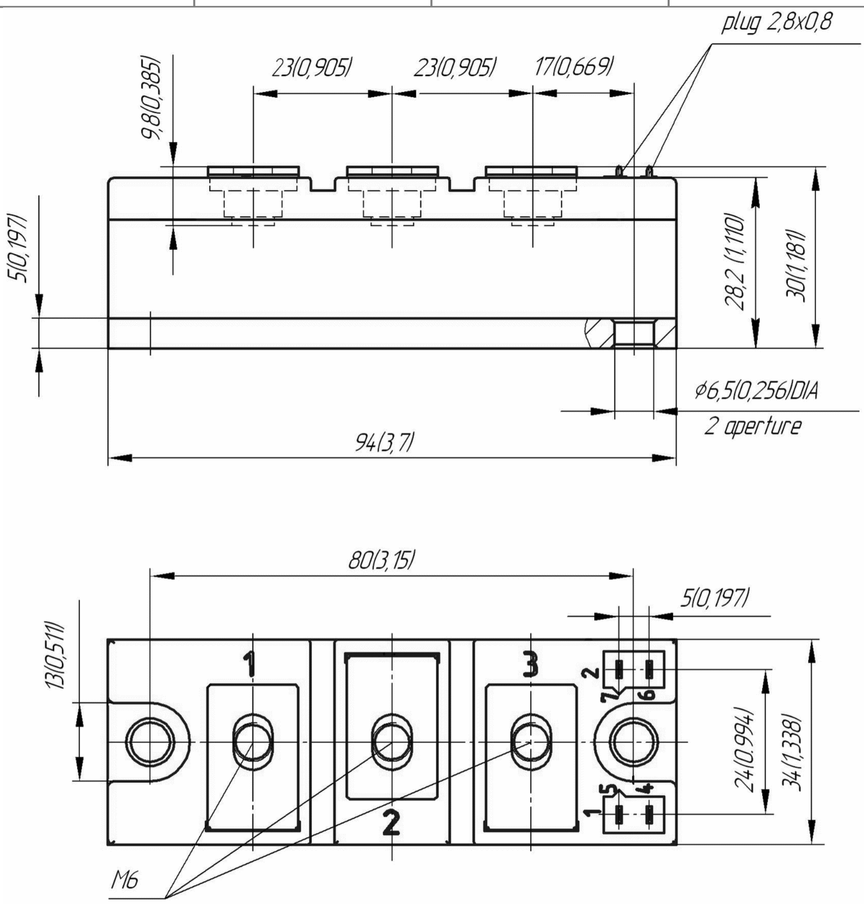
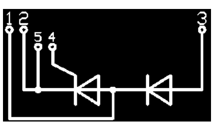
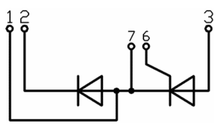
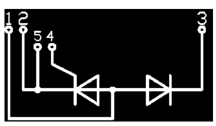
Thyristor Modules
MTx-115-36-F

Mean on-state current	I_{TAV}	115 A
Repetitive peak off-state voltage	V_{DRM}	3000...3600 V
Repetitive peak reverse voltage	V_{RRM}	
Turn-off time	t_q	400 μs

V_{DRM}, V_{RRM}, V	3000	3200	3400	3600
Voltage code	30	32	34	36
T_j, °C	–40...+125			

MT3		MT4			
					
					
					
MT/D3	**MD/T3**			**MT/D5**	

MAXIMUM ALLOWABLE RATINGS

Symbols	Parameters	Units	Values	Test conditions
ON-STATE				
I_{TAV}	Maximum allowable mean on-state current	A	115	T_c= 85 °C; 180° half-sine wave; 50 Hz
I_{TRMS}	RMS on-state current	A	180	T_c= 85 °C; 180° half-sine wave; 50 Hz
I_{TSM}	Surge on-state current	kA	2.8 3.0	$T_j=T_{j\,max}$ 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 μs; $di_G/dt \geq 1$ A/μs
			3.0 3.5	$T_j=T_{j\,max}$ 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; $di_G/dt \geq 1$ A/μs
I^2t	Safety factor	$A^2s \cdot 10^3$	30 40	$T_j=T_{j\,max}$ 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; $di_G/dt \geq 1$ A/μs
			30 50	$T_j=T_{j\,max}$ 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; $di_G/dt \geq 1$ A/μs
BLOCKING				
V_{DRM}, V_{RRM}	Repetitive peak off-state and Repetitive peak reverse voltages	V	3000...3600	$T_{j\,min} < T_j < T_{j\,max}$; 180° half-sine wave; 50 Hz; Gate open
V_{DSM}, V_{RSM}	Non-repetitive peak off-state and Non-repetitive peak reverse voltages	V	3100...3700	$T_{j\,min} < T_j < T_{j\,max}$; 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	$T_j=T_{j\,max}$
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	200	$T_j=T_{j\,max}$; $V_D=0.67 \cdot V_{DRM}$; I_{TM}=230 A; Gate pulse: I_G=2 A; V_G=20 V; 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	2.20	T_j=25 °C; I_{TM}= 500 A	
$V_{T(TO)}$	On-state threshold voltage, max	V	1.102	$T_j=T_{j\,max}$; 0.5 π I_{TAV} < I_T < 1.5 π I_{TAV}	
r_T	On-state slope resistance, max	mΩ	3.172		
I_L	Latching current, max	mA	500	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	250	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 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	$T_j=T_{j\,max}$; $V_D=0.67 \cdot V_{DRM}$; 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	0.60	$T_j=T_{j\,max}$; $V_D=0.67 \cdot V_{DRM}$; Direct gate current	
I_{GD}	Gate non-trigger direct current, min	mA	40.00		
SWITCHING					
t_{gd}	Delay time, max	μs	1.10	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	4.00		
t_q	Turn-off time[2], max	μs	400	dv_D/dt=50 V/μs; $T_j=T_{j\,max}$; I_{TM}=200 A; di_R/dt=-10 A/μs; V_R=100V; V_D=0.67 V_{DRM};	
Q_{rr}	Recovered charge, max	μC	920	$T_j=T_{j\,max}$; $I_{TM}=I_{TAV}$; di_R/dt=-5 A/μs; V_R=100 V	
t_{rr}	Reverse recovery time, max	μs	31		
I_{rr}	Reverse recovery current, max	A	59		
THERMAL					
R_{thjc}	Thermal resistance, junction to case				
	per module	°C/W	0.0850	180° half-sine wave, 50 Hz	
	per arm	°C/W	0.1700		
	per module	°C/W	0.0800	DC	
	per arm	°C/W	0.1600		
R_{thch}	Thermal resistance, case to heatsink				
	per module	°C/W	0.0300		
	per arm	°C/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 ± 15%	
M_2	Terminal connection torque (M6)[3]	Nm	6.00	Tolerance ± 15%	
m	Weight, max	g	350		

PART NUMBERING GUIDE	NOTES
MT 3 - 115 - 36 - A2 H2 - 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 V/μs) 7. Package Type (M.F) 8. Ambient Conditions: N – Normal	[1] Critical rate of rise of off-state voltage [2] Turn-off time (dv_D/dt=50 V/μs) [3] The screws must be lubricated

[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	H2
t_q, μs	400

[3] The screws must be lubricated

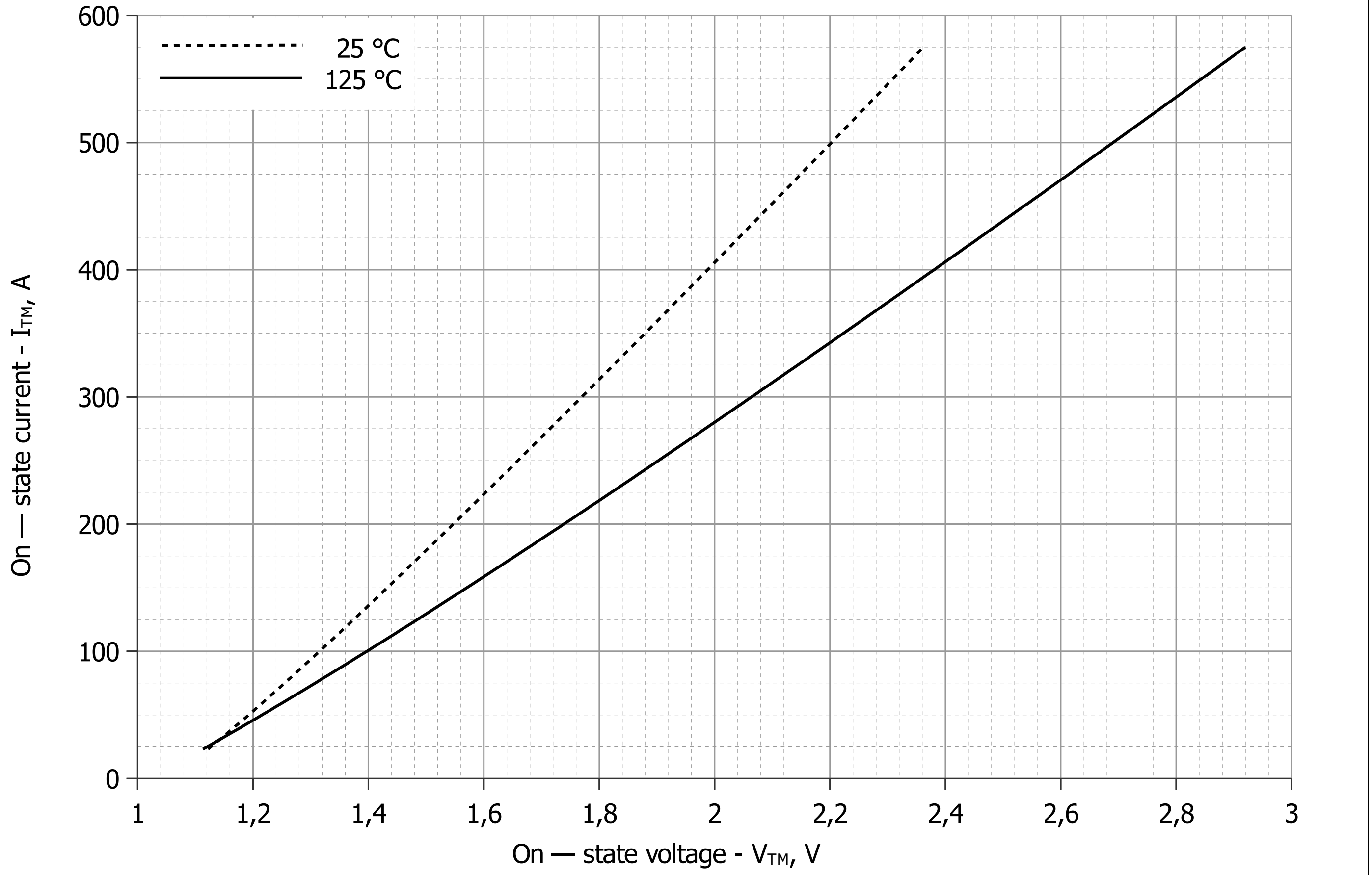


Fig 1 – On-state characteristics of Limit device

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 = 25°C	$T_j = T_{j\,max}$
A	1.05551609	1.04275622
B	0.00187338	0.00253738
C	-0.01178378	-0.03749362
D	0.01267796	0.02737256

On-state characteristic model (see Fig. 1)

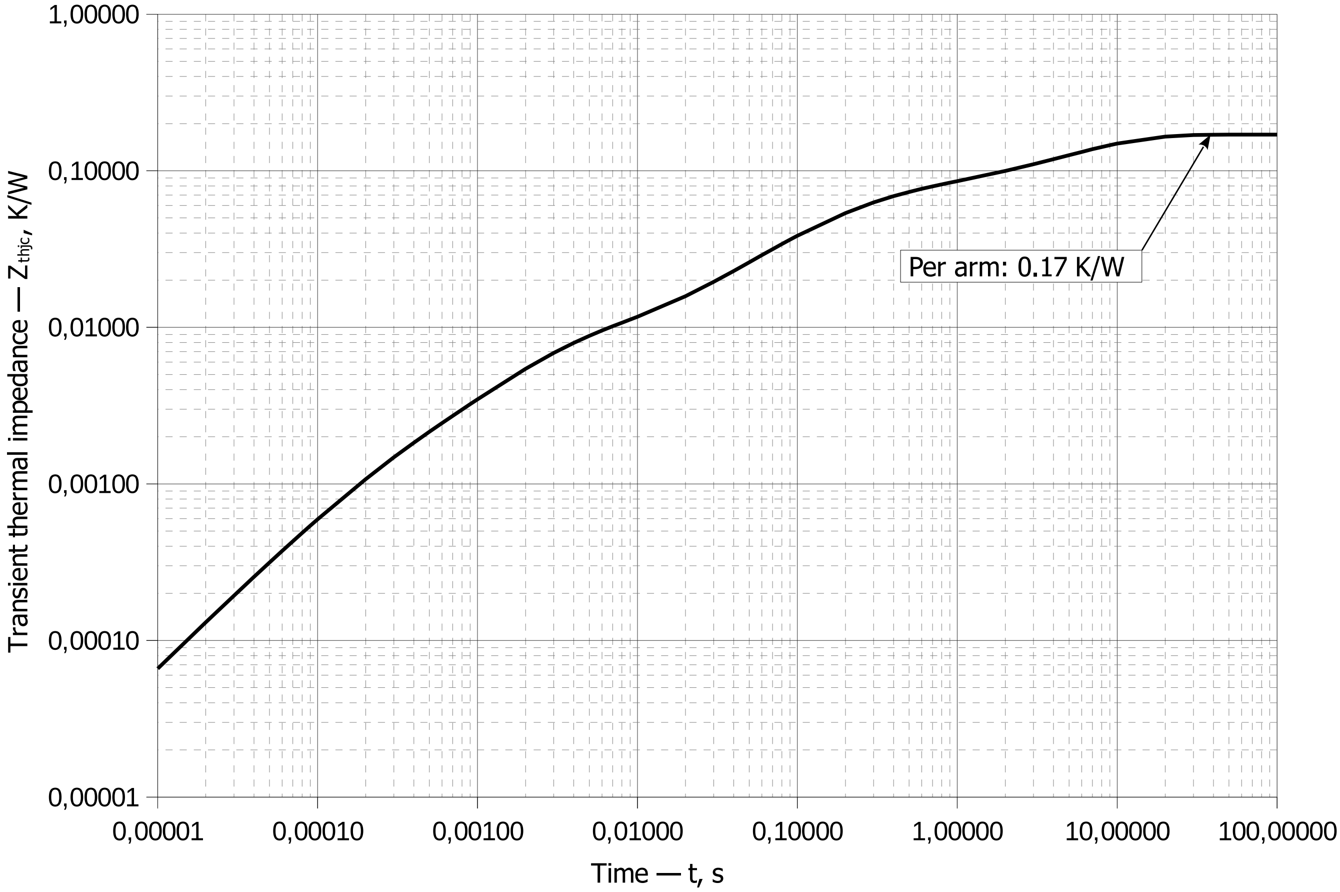


Fig 2 – Transient thermal impedance Z_{thjc} vs. time t

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.

$\mathbf{Z_{thjc}}$ = Thermal resistance at time t.

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

τ_i = Time constatnt of r_{th} term.

i	1	2	3	4	5	6
$\mathbf{R_i}$, **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. 2)

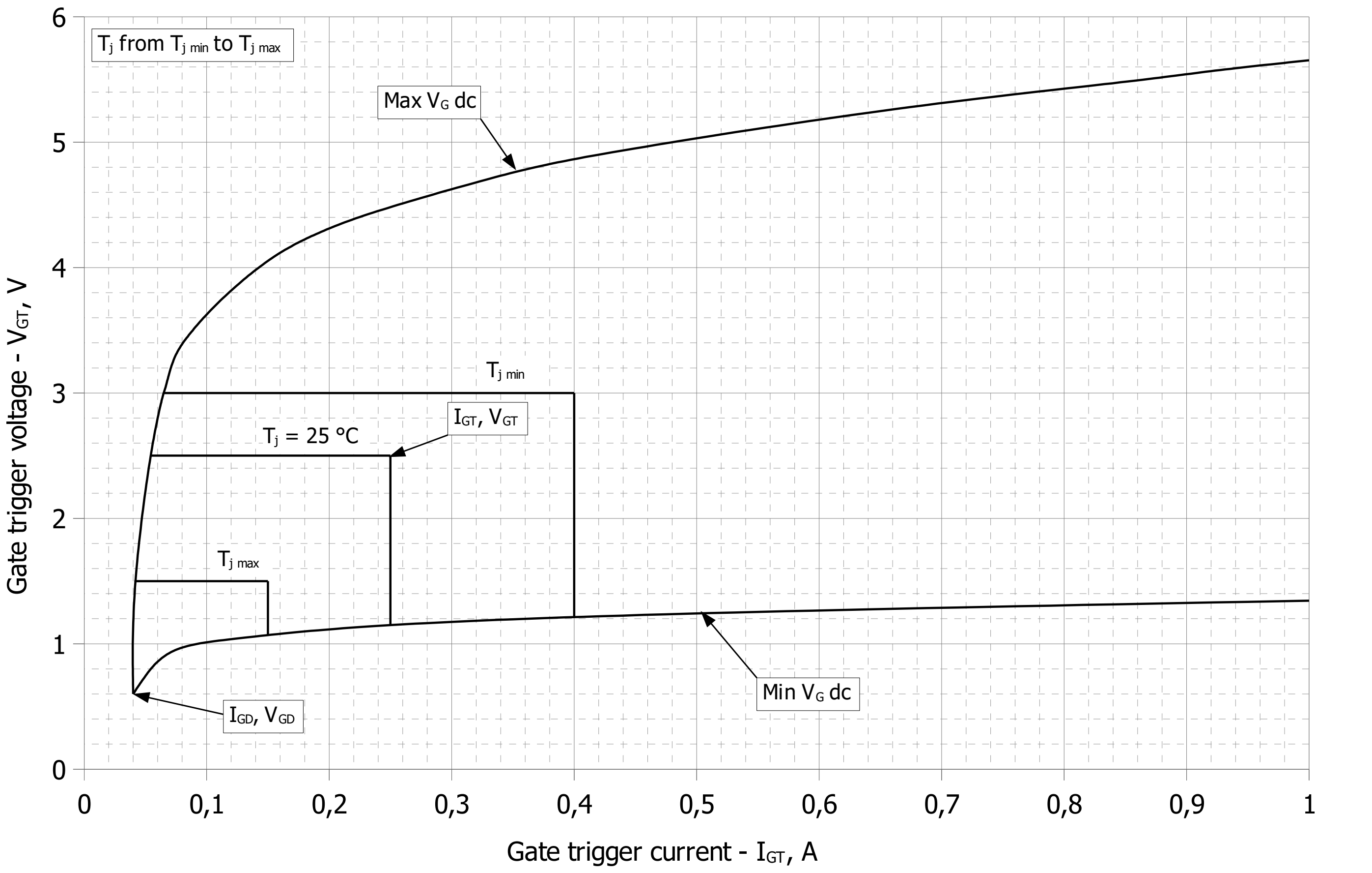


Fig 3 – Gate characteristics – Trigger limits

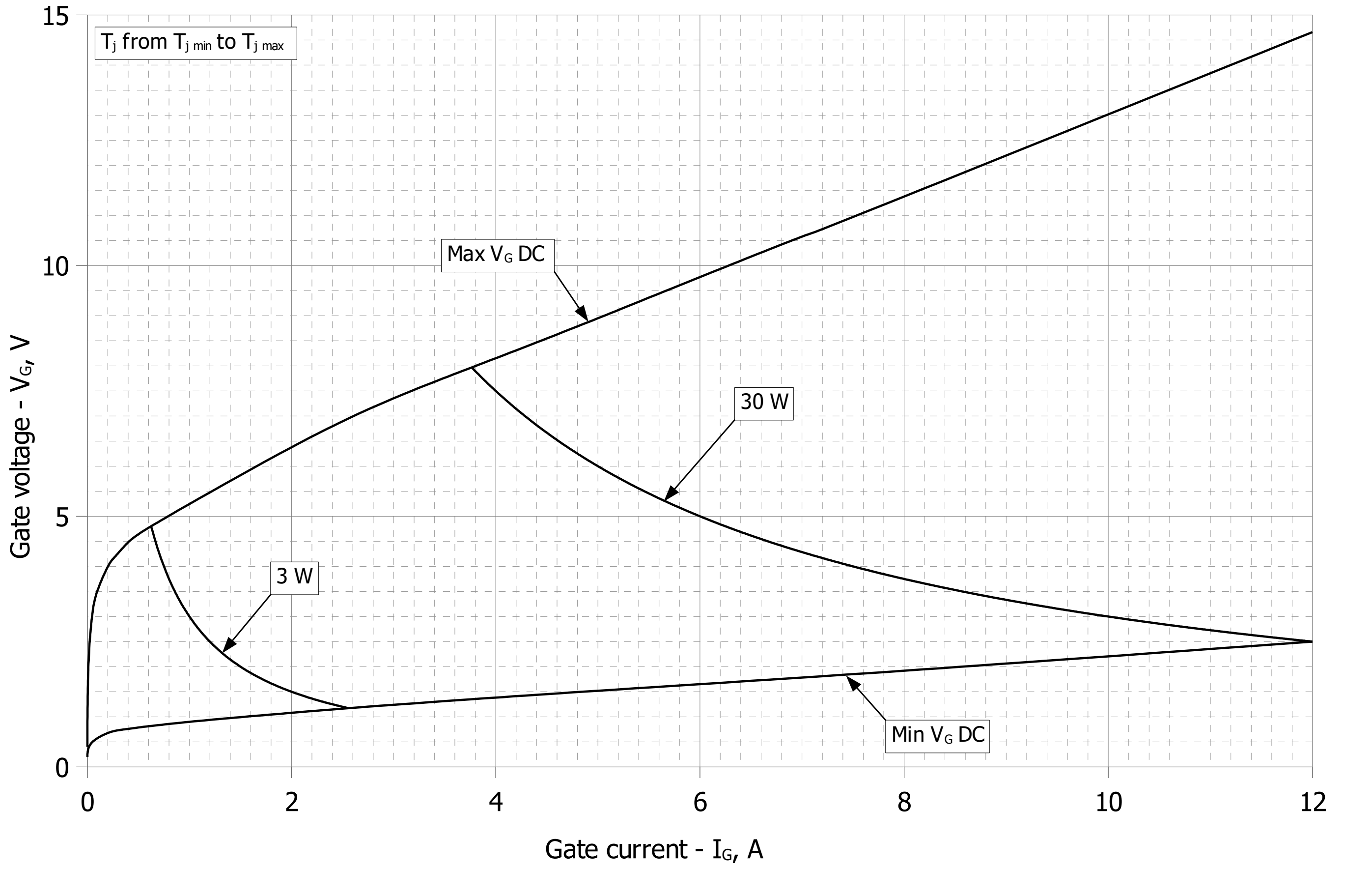


Fig 4 - Gate characteristics – Power curves

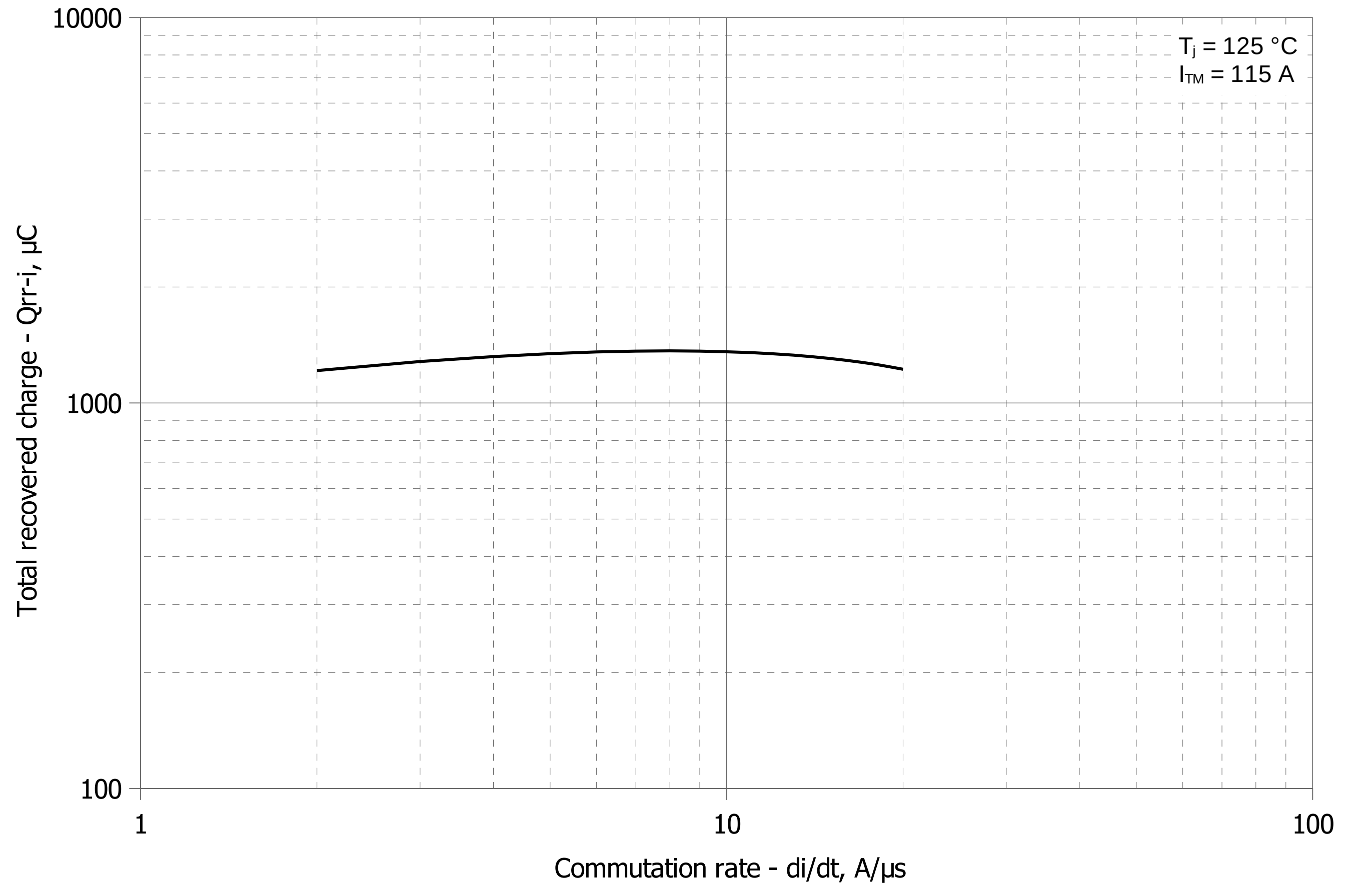


Fig 5 – Maximum recovered charge Q_{rr-i} (integral) vs. commutation rate di_R/dt

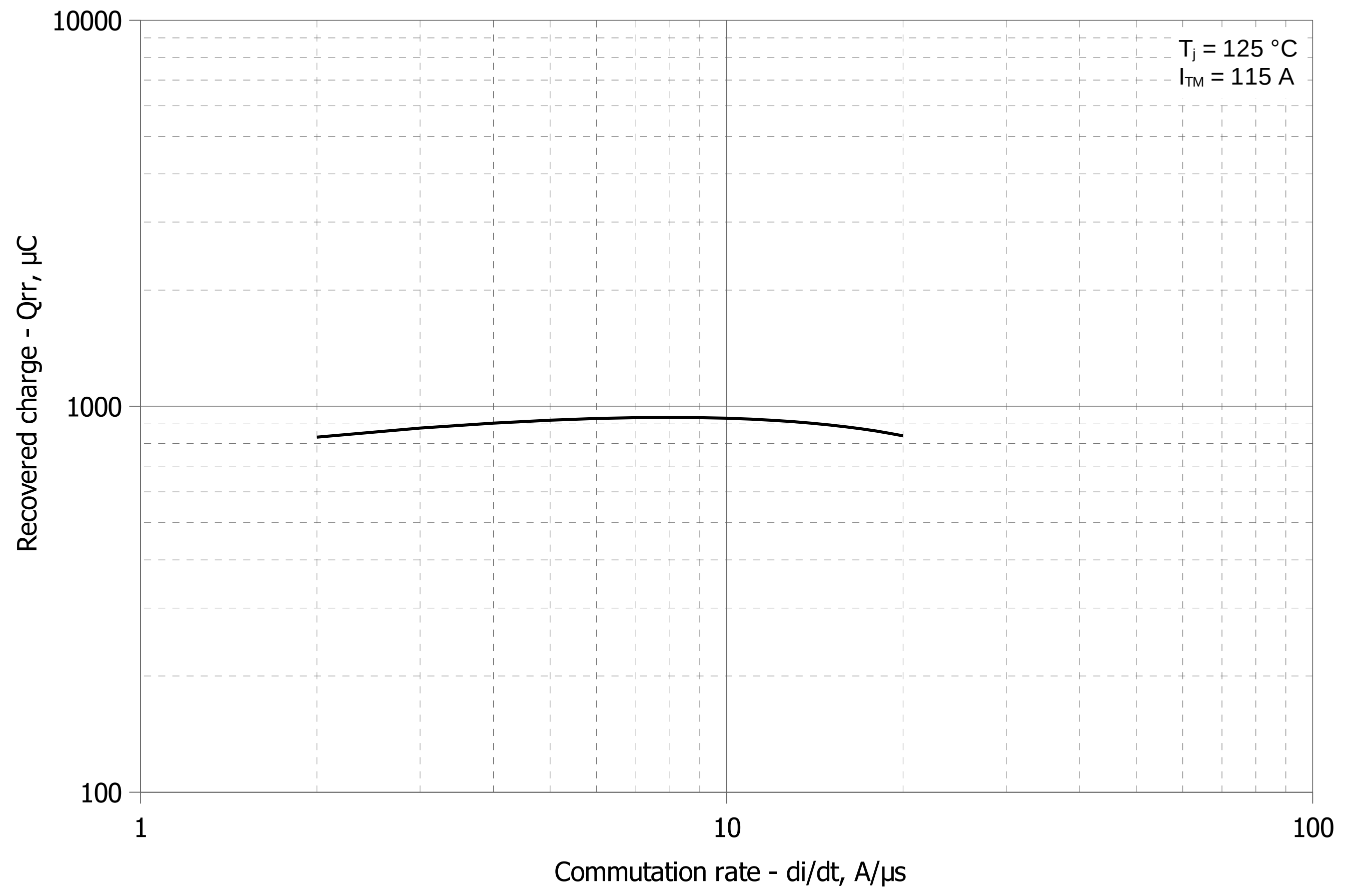


Fig 6 – Maximum recovered charge Q_{rr} vs. commutation rate di_R/dt (25% chord)

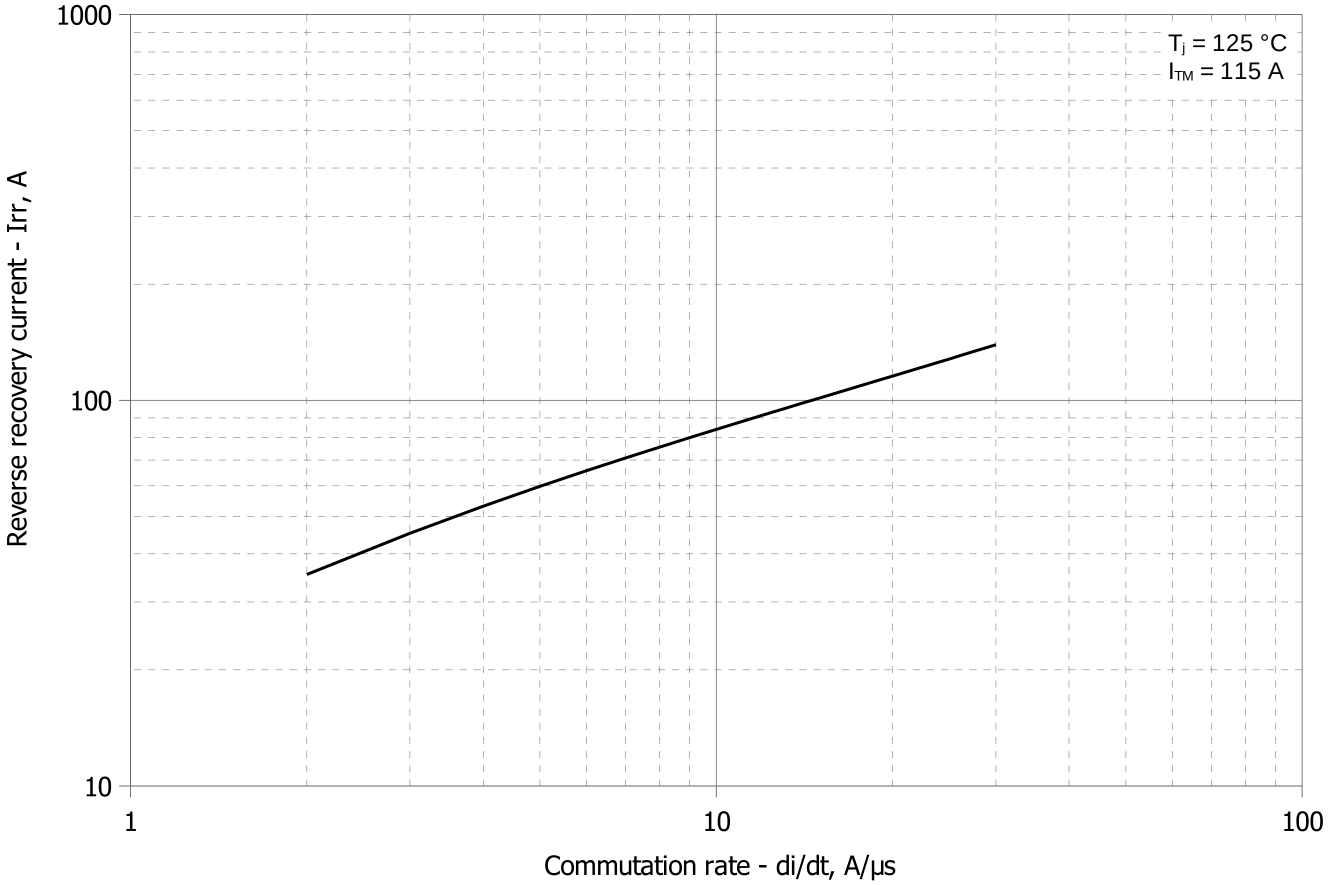


Fig 7 – Maximum reverse recovery current I_{rr} vs. commutation rate di_R/dt

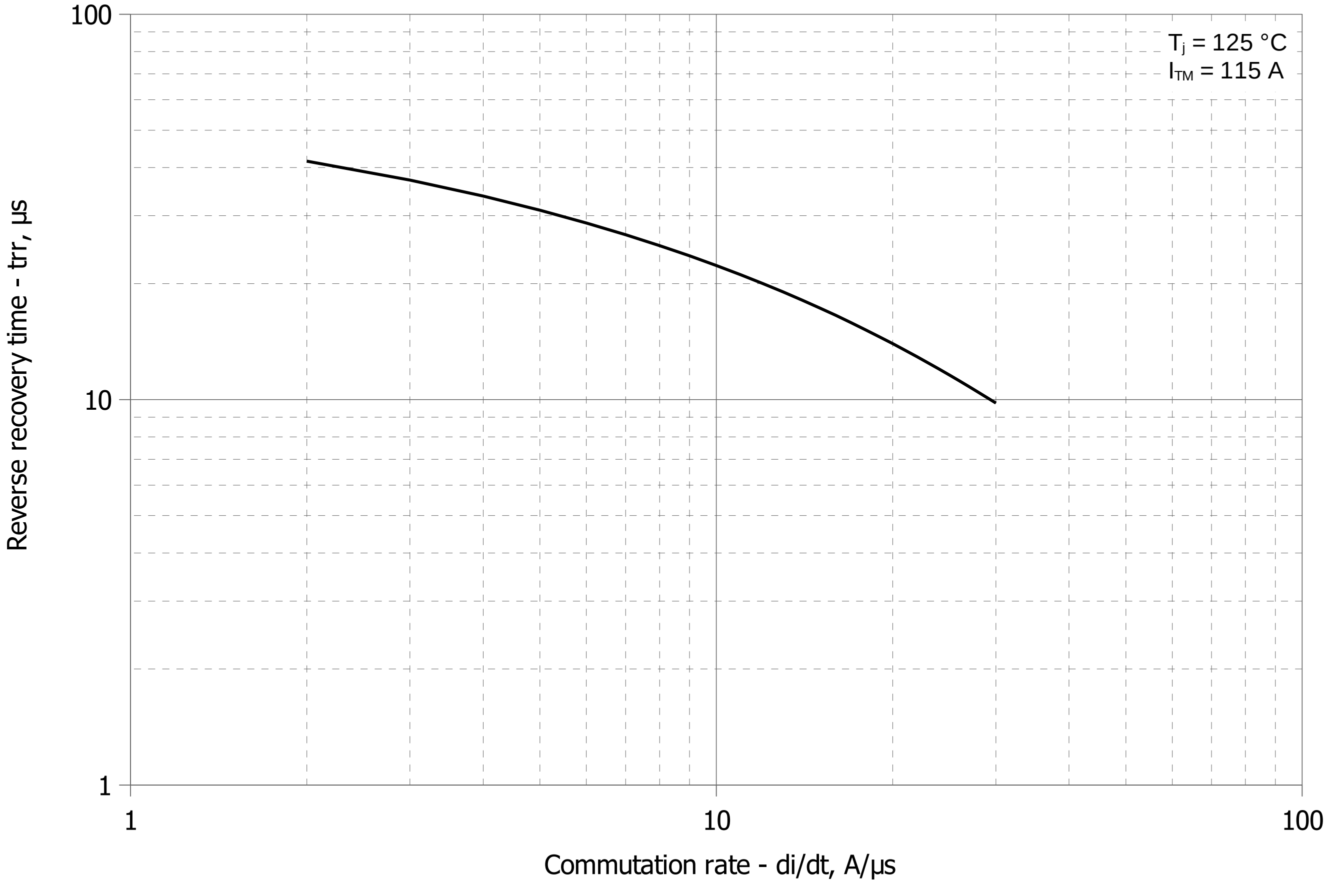


Fig 8 – Maximum recovery time t_{rr} vs. commutation rate di_R/dt (25% chord)

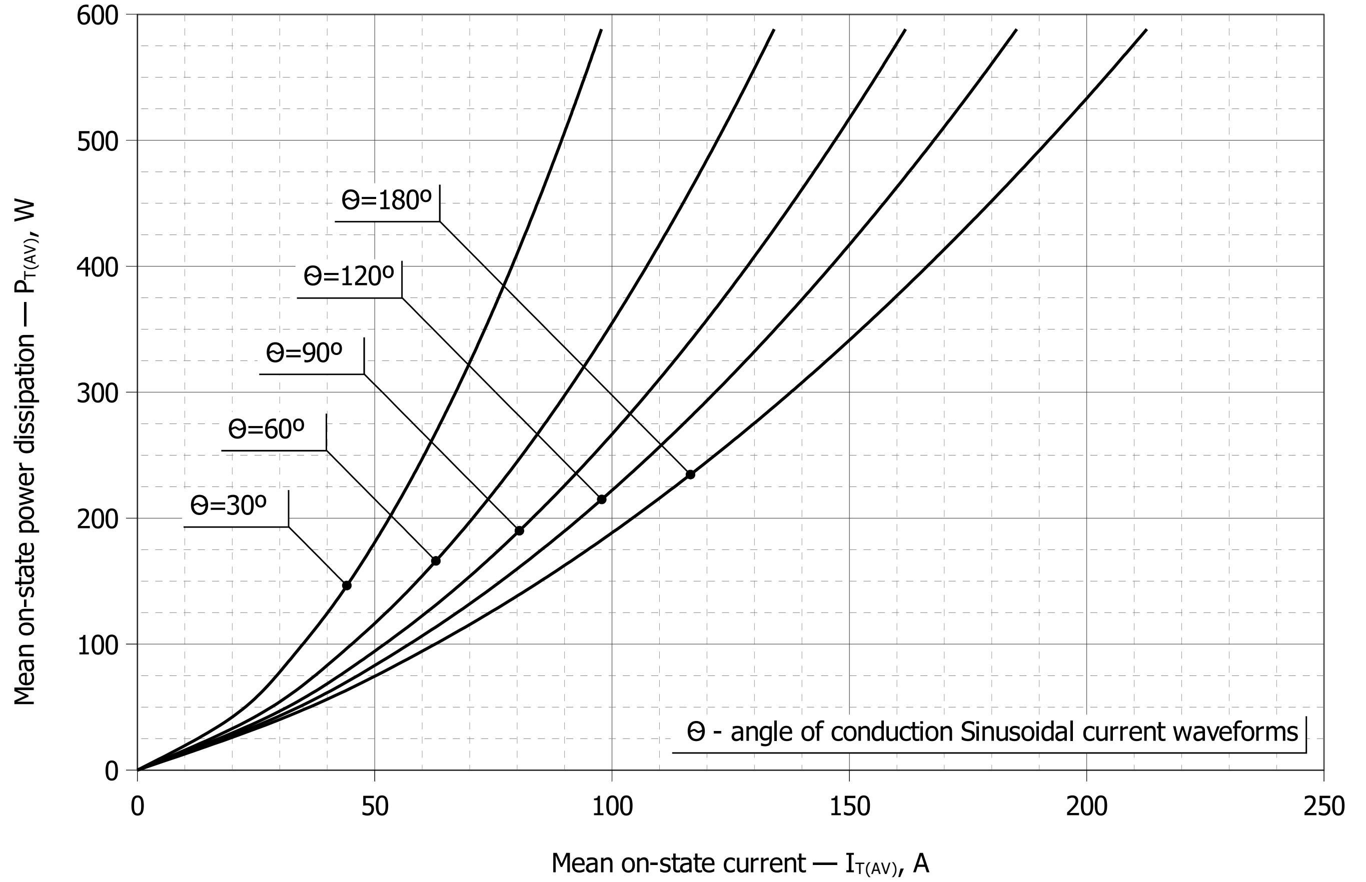


Fig. 9 - Mean on-state power dissipation P_{TAV} vs. mean on-state current I_{TAV} for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

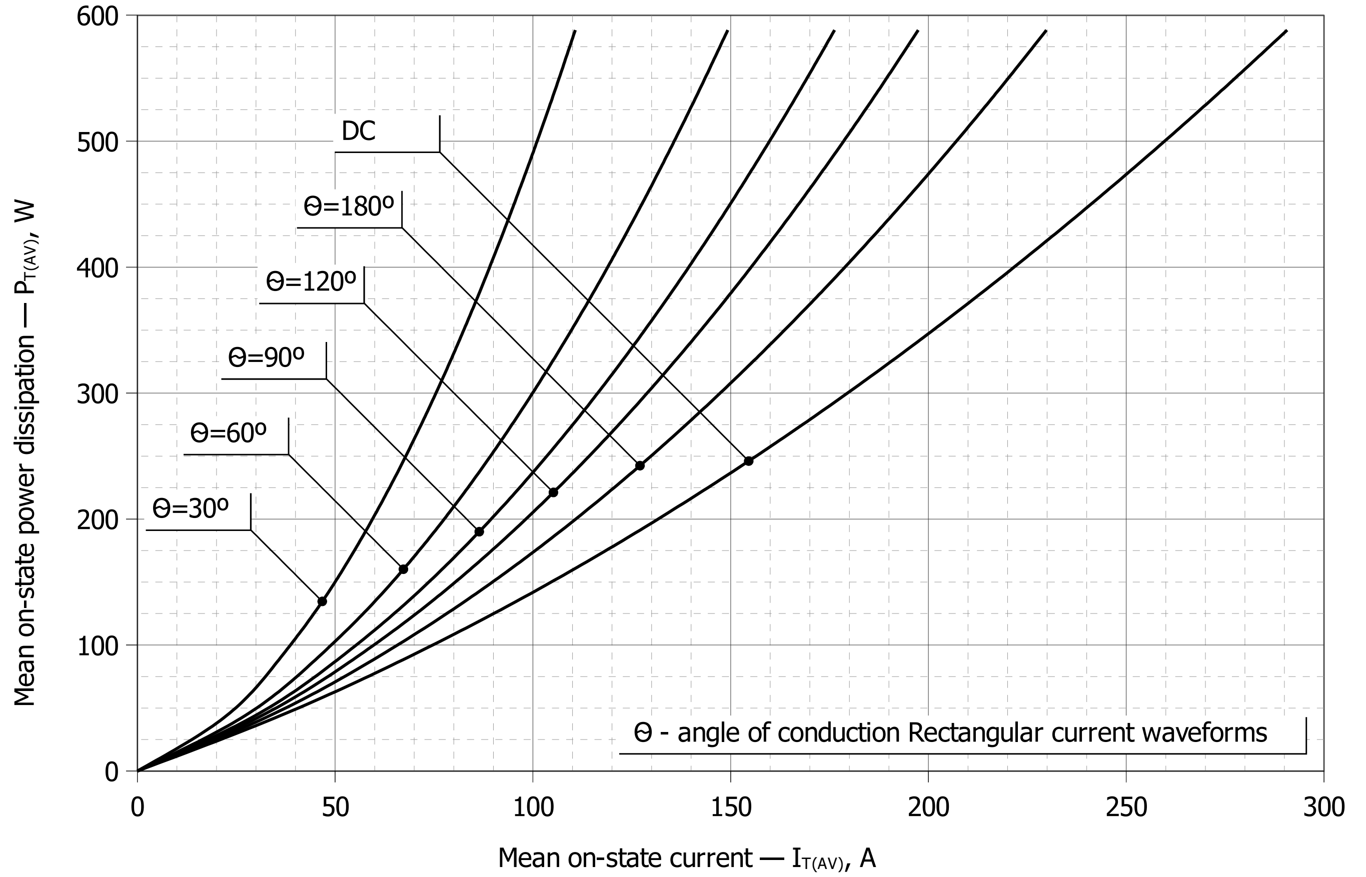


Fig. 10 – Mean on-state power dissipation P_{TAV} vs. mean on-state current I_{TAV} for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

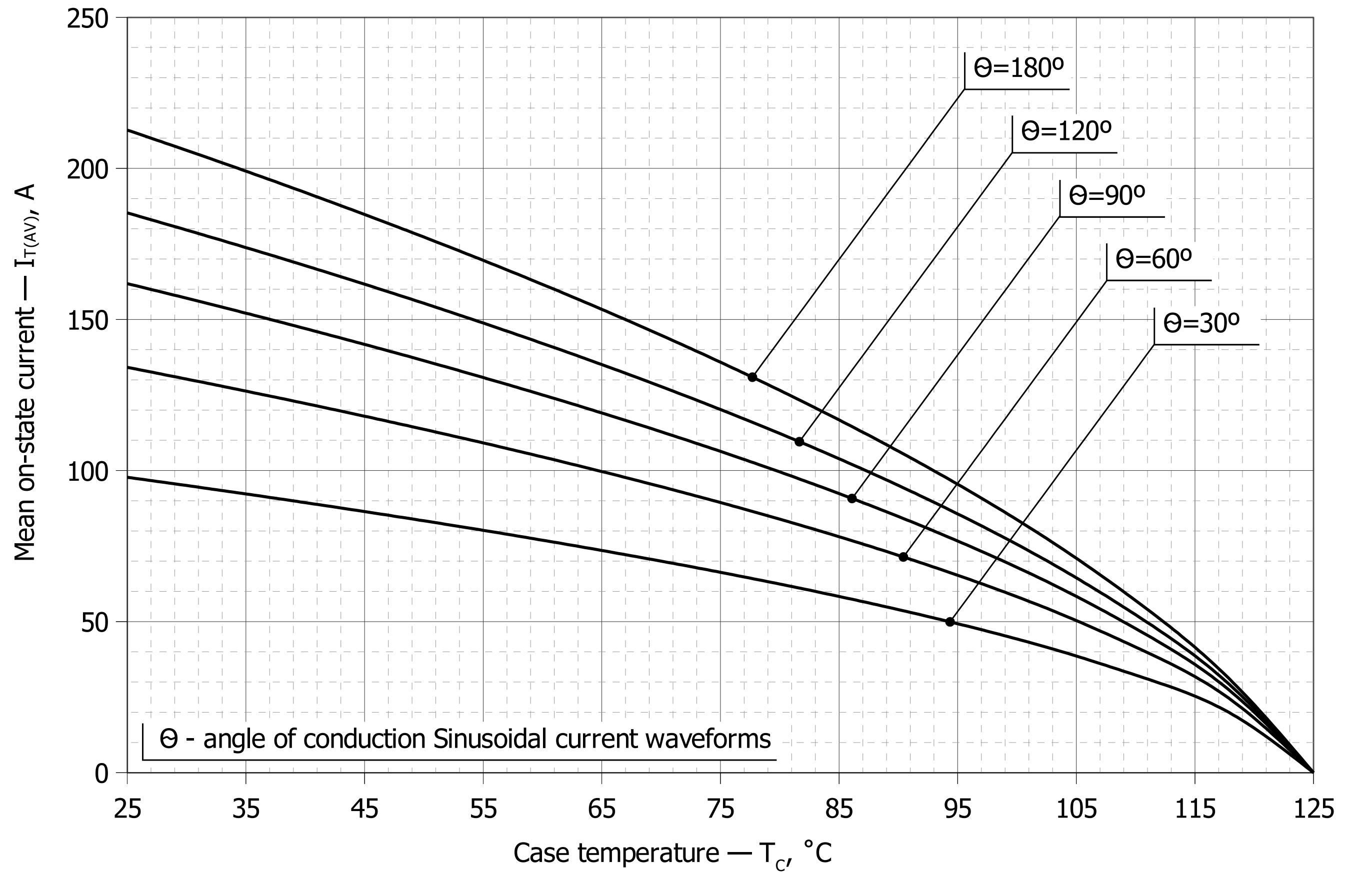


Fig. 11 – Mean on-state current I_{TAV} vs. case temperature T_C for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

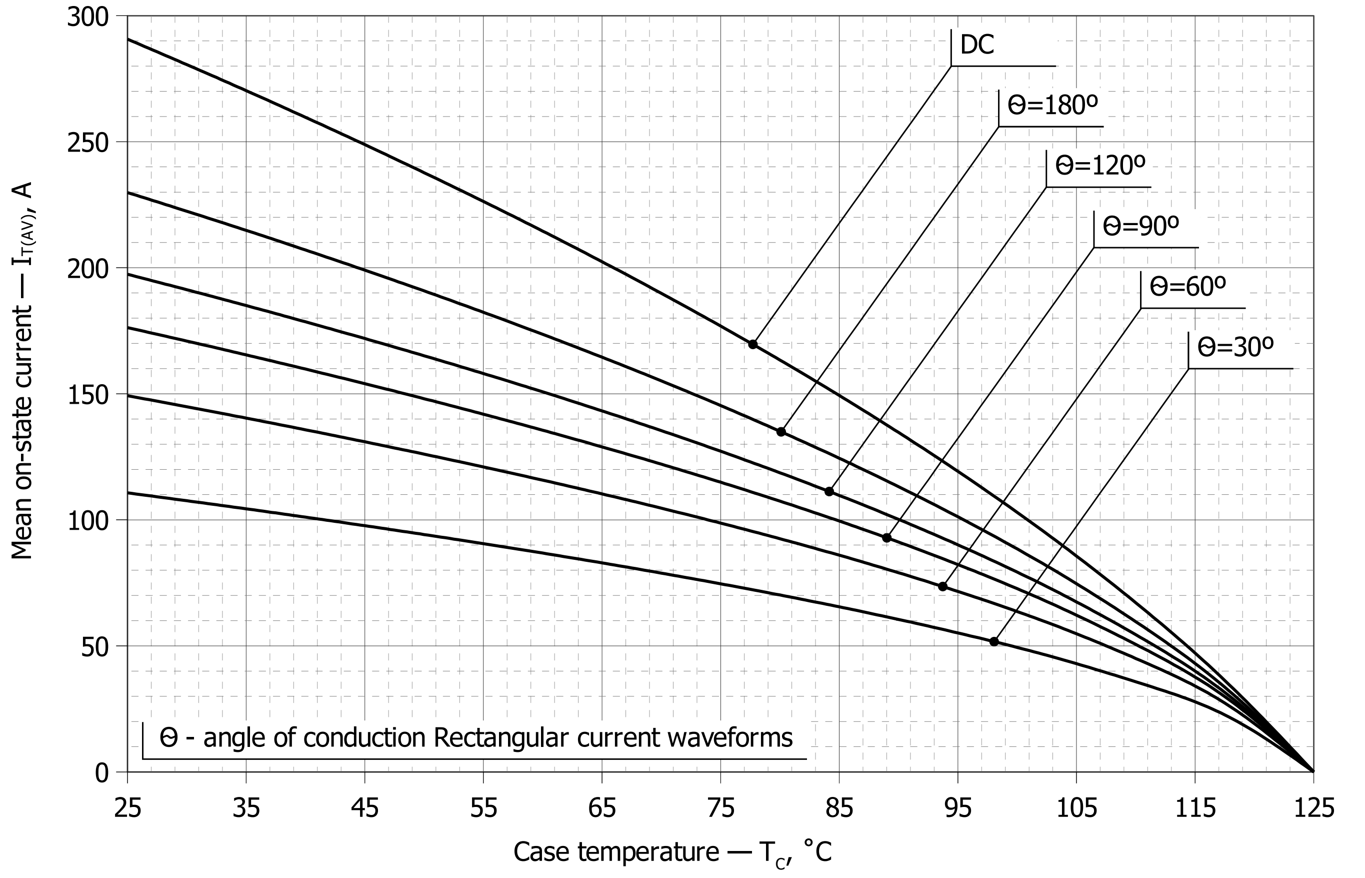


Fig. 12 - Mean on-state current I_{TAV} vs. case temperature T_C for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

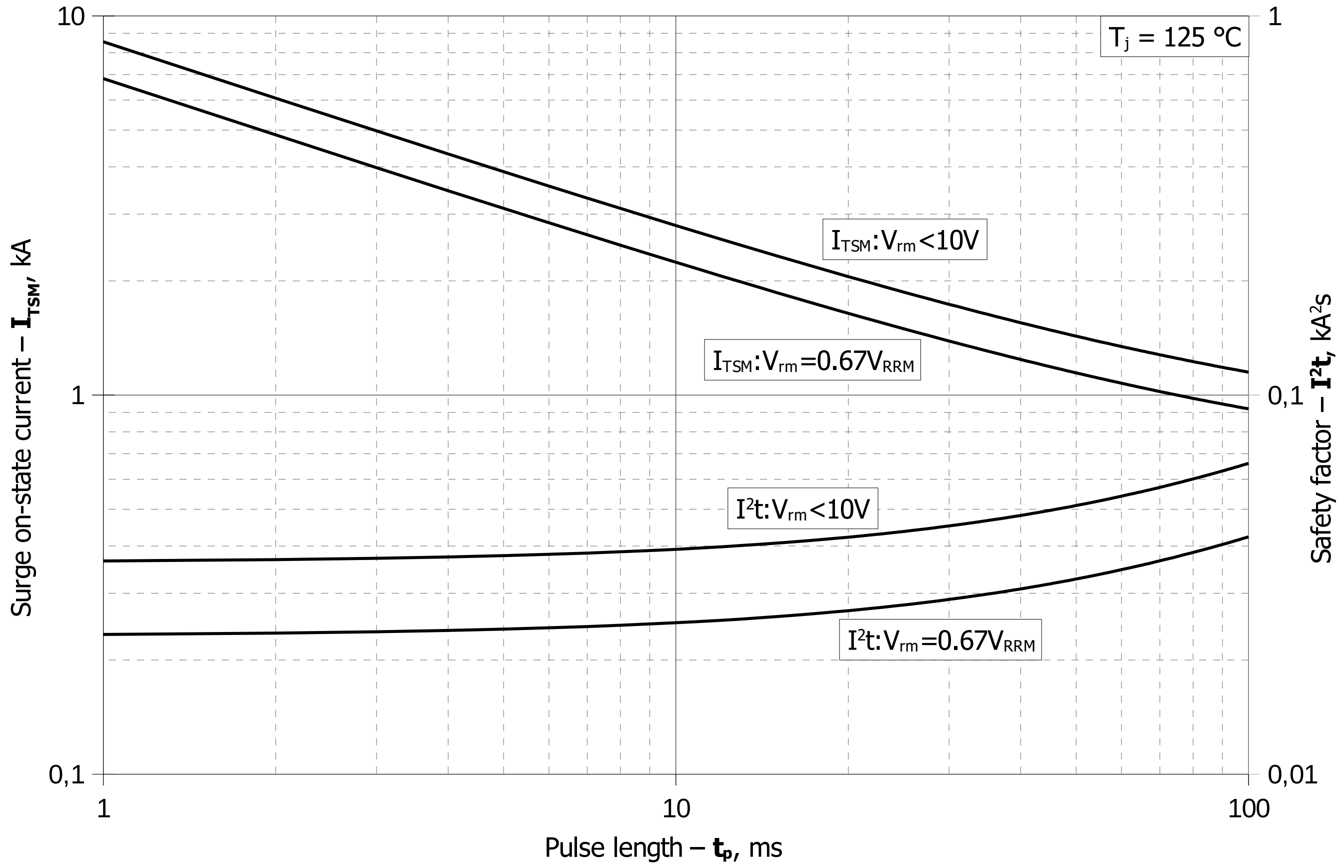


Fig. 13 – Maximum surge on-state current I_{TSM} and safety factor I^2t vs. pulse length t_p

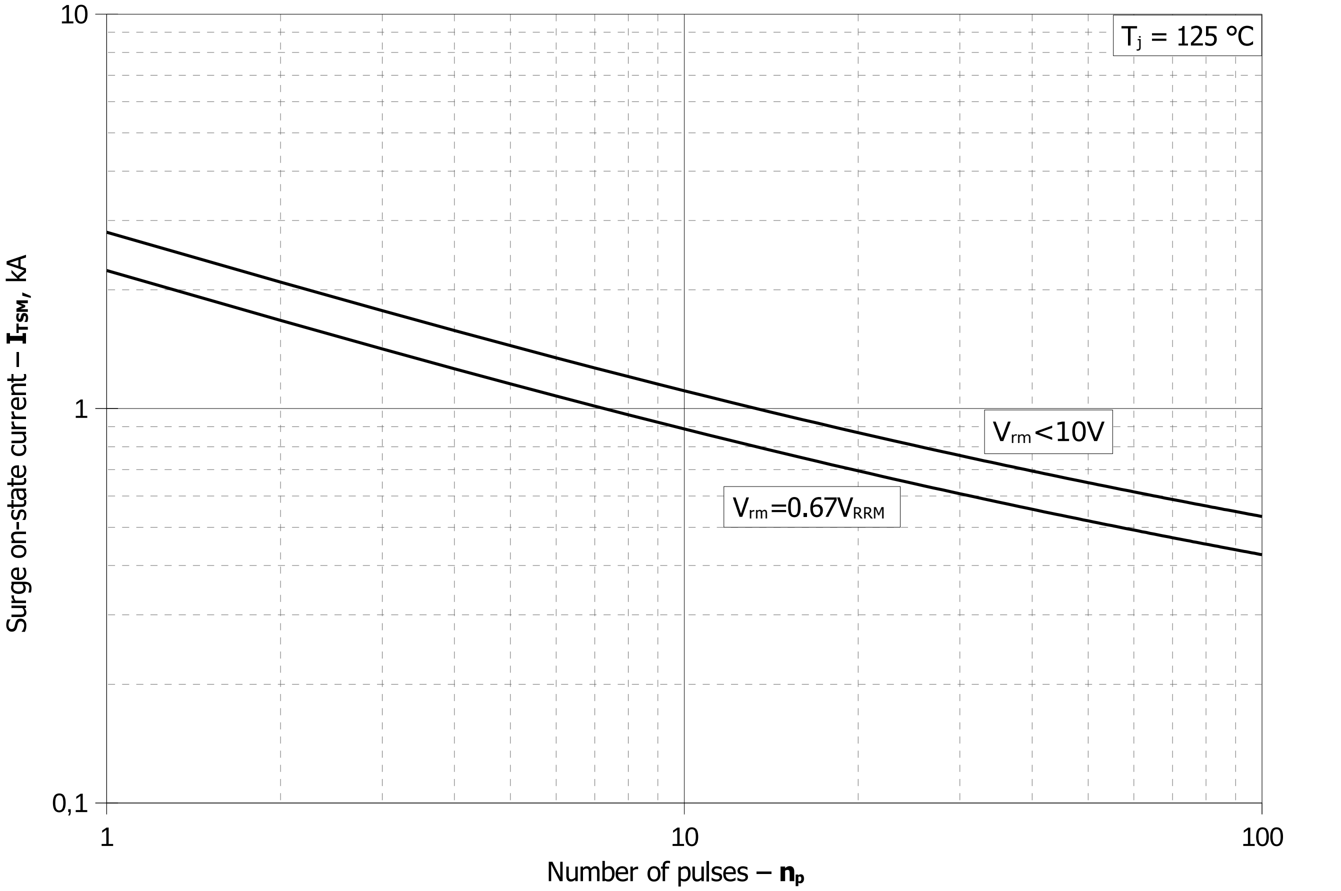


Fig. 14 - Maximum surge on-state current I_{TSM} vs. number of pulses n_p