



High power cycling capability
Low on-state and switching losses
Designed for traction and industrial applications

Phase Control Thyristor Type T173-2000-28

Maximum allowable mean on-state current				I_{TAV}	2000 A		
Repetitive peak off-state voltage				V_{DRM}	1600...2800 V		
Repetitive peak reverse voltage				V_{RRM}			
Turn-off time				t_q	500, 630, 800 μ s		
V_{DRM}, V_{RRM}, V	1600	1800	2000	2200	2400	2600	2800
Voltage code	16	18	20	22	24	26	28
$T_j, ^\circ C$	-60...+125						

MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions	
ON-STATE					
I _{TAV}	Maximum allowable mean on-state current	A	2000 2542	T _c =97 °C, Double side cooled T _c =85 °C, Double side cooled 180° half-sine wave; 50 Hz	
I _{TRMS}	RMS on-state current	A	3140	T _c =97 °C, Double side cooled 180° half-sine wave; 50 Hz	
I _{TSM}	Surge on-state current	kA	57.0 66.0	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≥1 A/μs
			60.0 69.0	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 ² t	Safety factor	A ² s·10 ³	16200 21700	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
			14900 19700	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	1600...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	1700...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·V _{DRM} 0.6·V _{RRM}	T _j =T _{j max} ; Gate open	

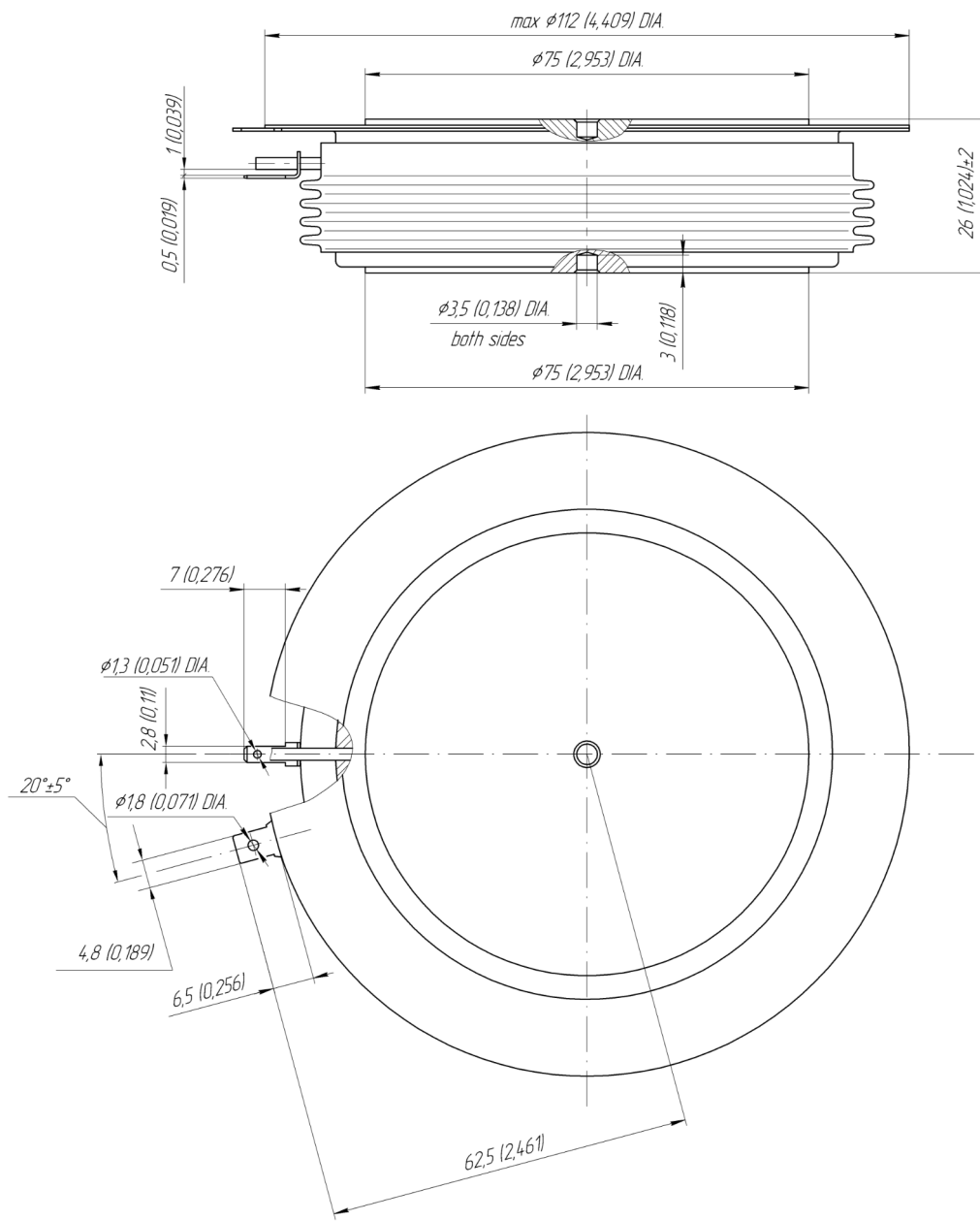
TRIGGERING				
I_{FGM}	Peak forward gate current	A	10	$T_j = T_{j\max}$
V_{RGM}	Peak reverse gate voltage	V	5	
P_G	Gate power dissipation	W	5	$T_j = T_{j\max}$ for DC gate current
SWITCHING				
$(di_T/dt)_{crit}$	Critical rate of rise of on-state current non-repetitive ($f=1$ Hz)	A/ μ s	2000	$T_j = T_{j\max}$; $V_D = 0.67 \cdot V_{DRM}$; $I_{TM} = 7000$ A; Gate pulse: $I_G = 2$ A; $t_{GP} = 50$ μ s; $di_G/dt \geq 2$ A/ μ s
THERMAL				
T_{stg}	Storage temperature	$^{\circ}$ C	-60...+50	
T_j	Operating junction temperature	$^{\circ}$ C	-60...+125	
MECHANICAL				
F	Mounting force	kN	40.0...50.0	
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	1.75	T _j =25 °C; I _{TM} =6280 A	
V _{T(TO)}	On-state threshold voltage, max	V	0.882	T _j =T _{j max} ;	
r _T	On-state slope resistance, max	mΩ	0.156	0.5 π I _{TAV} < I _T < 1.5 π 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 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	200	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/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 2.50 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	0.35	T _j =T _{j max} ; V _D =0.67·V _{DRM} ;	
I _{GD}	Gate non-trigger direct current, min	mA	35.00	Direct gate current	
SWITCHING					
t _{gd}	Delay time, max	μs	1.55	T _j =25 °C; V _D =1500 V; I _{TM} =I _{TAV} ; di/dt=200 A/μs;	
t _{gt}	Turn-on time, max	μs	6.00	Gate pulse: I _G =2 A; V _G =20 V; t _{GP} =50 μs; di _G /dt=2 A/μs	
t _q	Turn-off time ²⁾ , max	μs	500, 630, 800	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}	Recovered charge, max	μC	6500	T _j =T _{j max} ; I _{TM} =1000 A;	
t _{rr}	Reverse recovery time, max	μs	52	di _R /dt=-10 A/μs;	
I _{rr}	Reverse recovery current, max	A	250	V _R =100 V	

THERMAL					
R _{thjc}	Thermal resistance, junction to case, max	°C/W	0.0085	Direct current	Double side cooled
R _{thjc-A}			0.0187		Anode side cooled
R _{thjc-K}			0.0153		Cathode side cooled
R _{thck}	Thermal resistance, case to heatsink, max	°C/W	0.0020	Direct current	
MECHANICAL					
m	Weight, max	g	1200		
D _s	Surface creepage distance	mm (inch)	36.60 (1.441)		
D _a	Air strike distance	mm (inch)	16.20 (0.638)		

PART NUMBERING GUIDE							NOTES									
T	173	2000	28	A2	B2	N	1) Critical rate of rise of off-state voltage									
1	2	3	4	5	6	7										
1. Phase Control Thyristor 2. Design version 3. Mean on-state current, A 4. Voltage code 5. Critical rate of rise of off-state voltage, V/μs 6. Turn-off time (dv _D /dt=50 V/μs) 7. Ambient conditions: N – normal; T – tropical							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		E2		C2		B2	
							t _q , μs		500		630		800			



All dimensions in millimeters (inches)

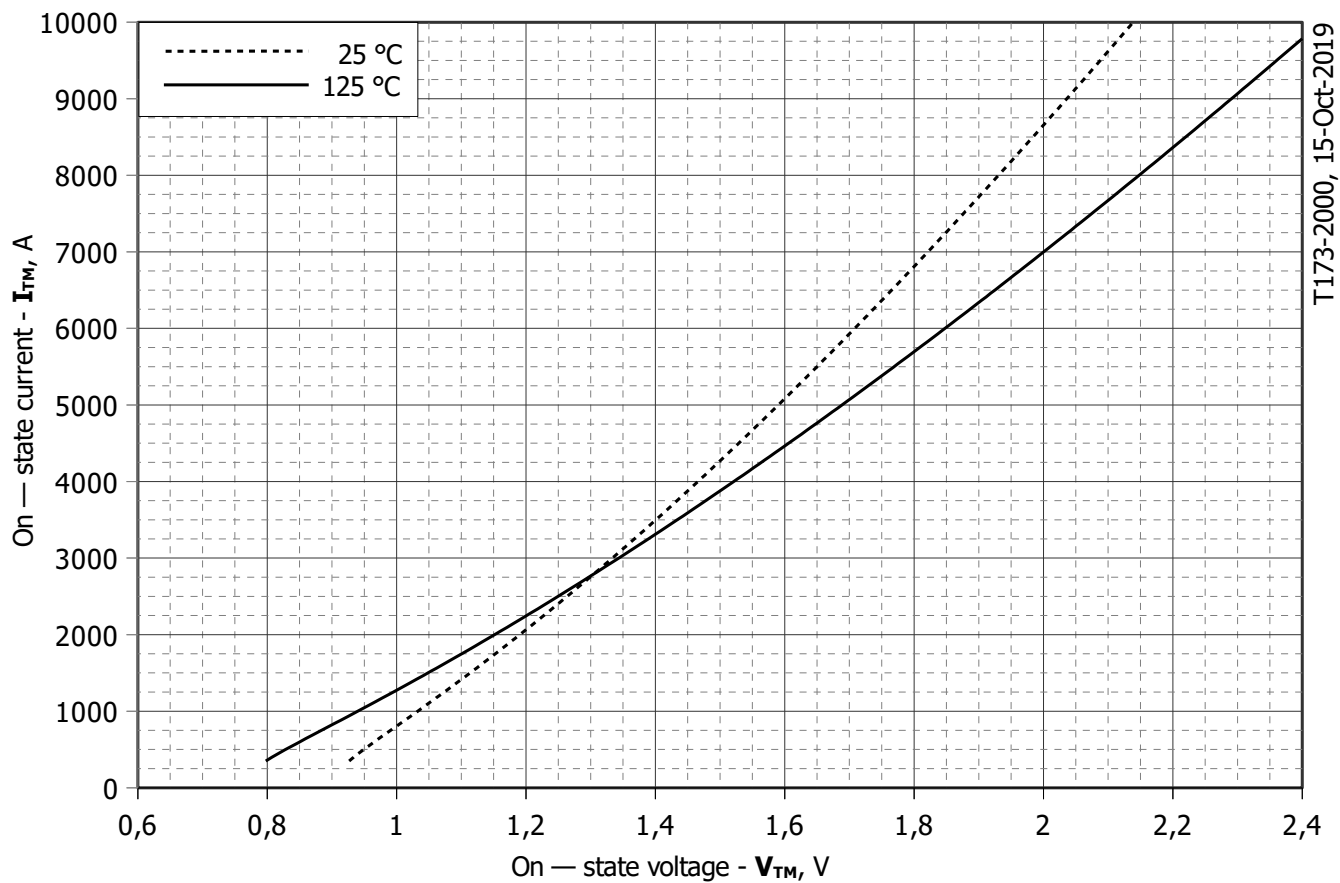


Fig 1 – On-state characteristics of Limit device

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	
	$T_j = 25^\circ\text{C}$	$T_j = T_{j\max}$
A	1.2300000	1.1900000
B	0.0000398	0.0000567
C	-0.0998000	-0.1300000
D	0.0143000	0.0187000

On-state characteristic model (see Fig. 1)

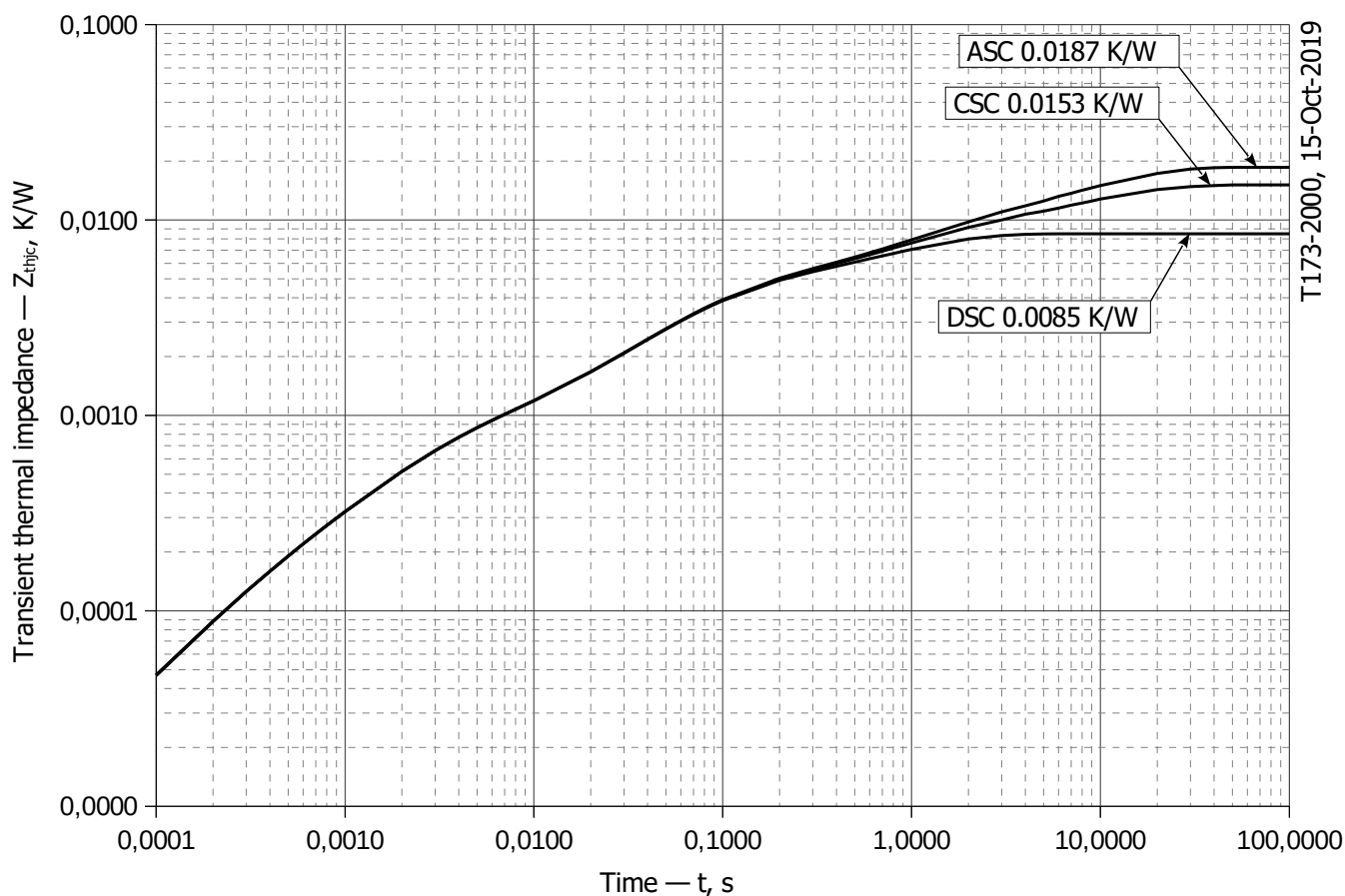


Fig 2 – Transient thermal impedance Z_{thjc} vs. time t

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 constant of r_{th} term.

DC Double side cooled

i	1	2	3	4	5	6
R_i , K/W	0.00007989	0.002973	0.0005936	0.000846	0.00005975	0.003948
τ_i , s	1.688	0.06219	0.002329	0.138	0.0003243	0.9533

DC Anode side cooled

i	1	2	3	4	5	6
R_i , K/W	0.01013	0.004062	0.0009401	0.002853	0.0005963	0.00005641
τ_i , s	9.747	1.058	0.1304	0.06179	0.002313	0.0003013

DC Cathode side cooled

i	1	2	3	4	5	6
R_i , K/W	0.006619	0.004034	0.0008595	0.002956	0.0005965	0.00005689
τ_i , s	9.744	1.025	0.1394	0.06237	0.002318	0.0003037

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

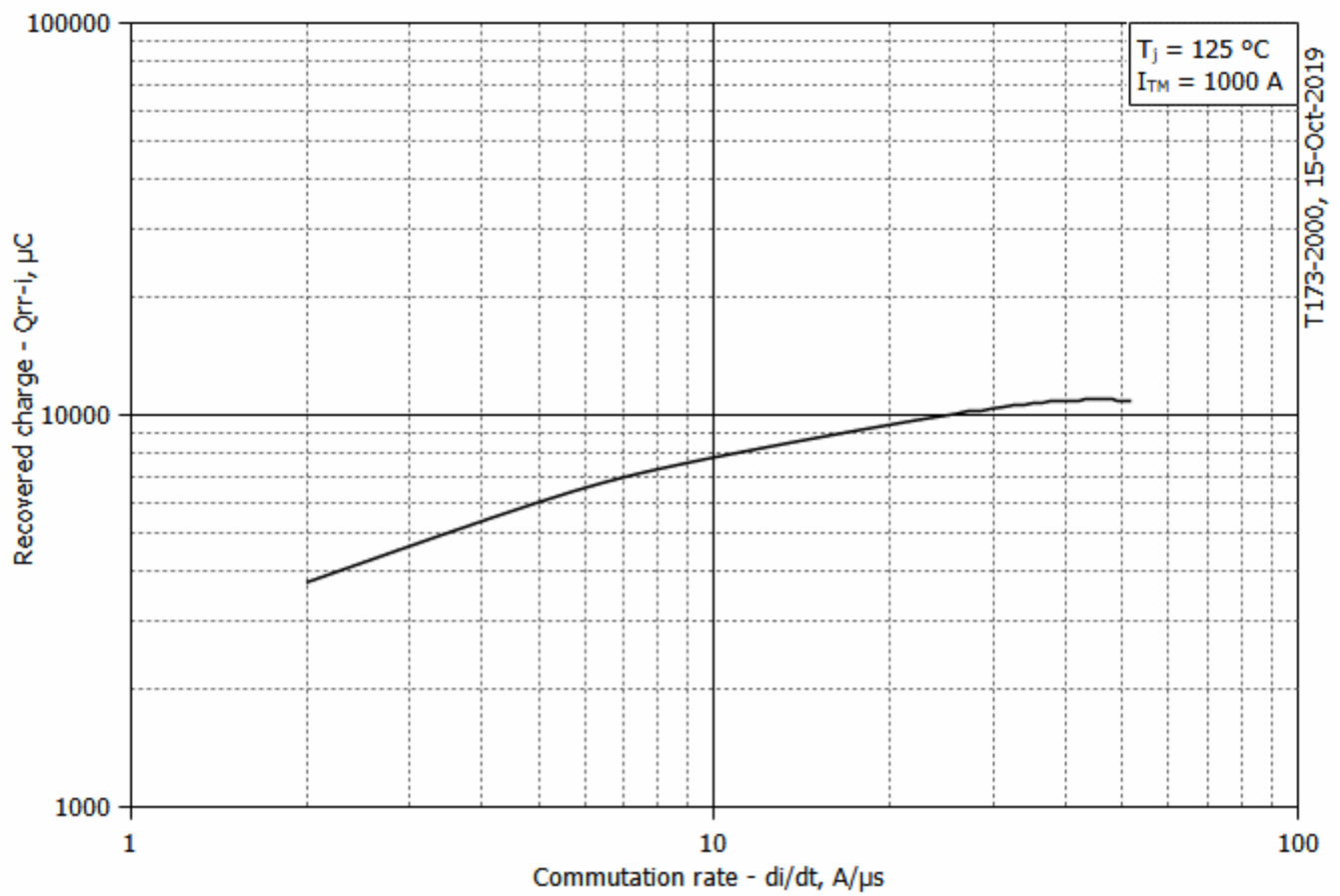


Fig 3 – Maximum recovered charge Q_{rr-i} (integral) vs. commutation rate di_R/dt

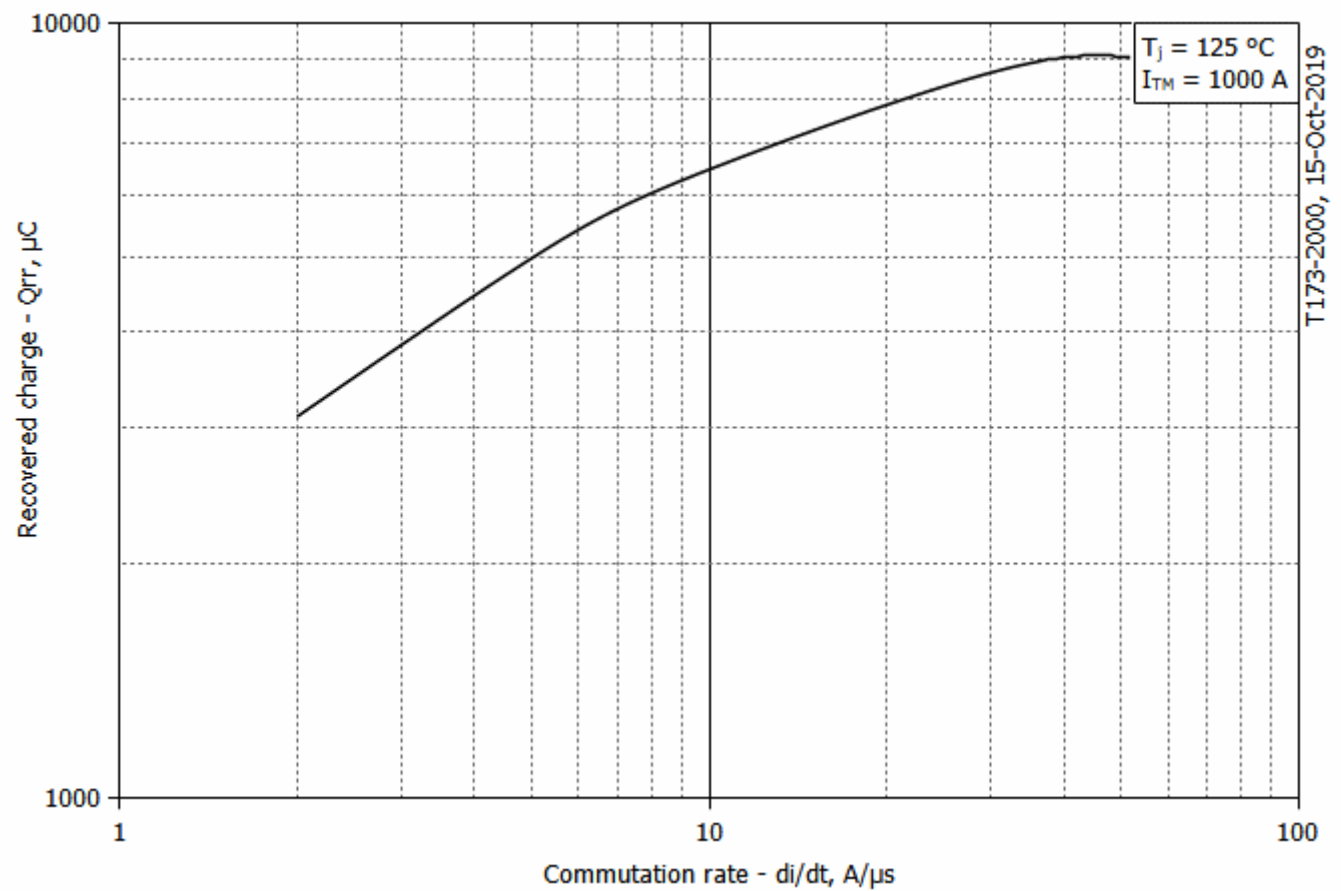


Fig 4 – Maximum recovered charge Q_{rr} vs. commutation rate di_R/dt (25% chord)

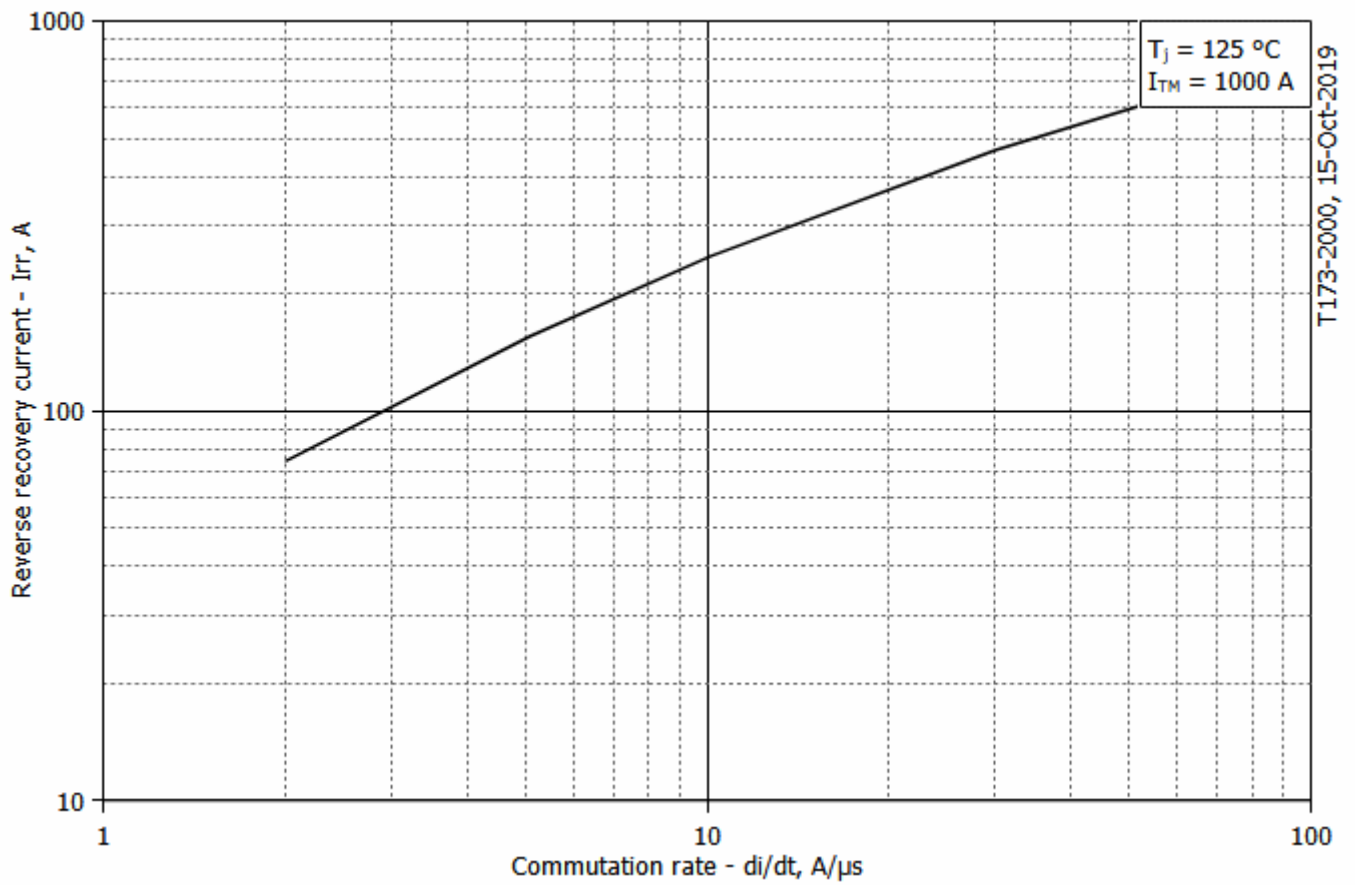


Fig 5 – Maximum reverse recovery current I_{rr} vs. commutation rate di_R/dt

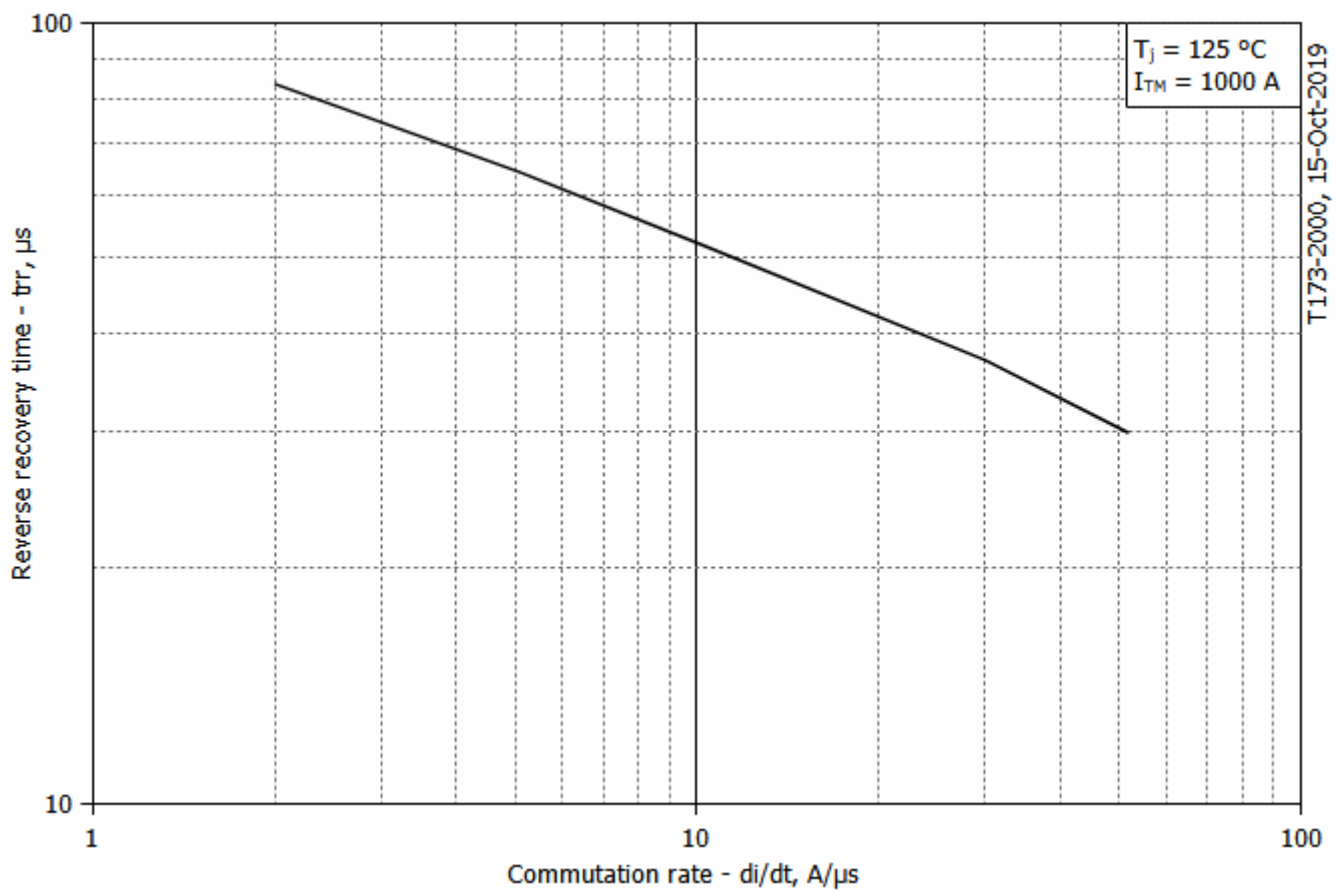
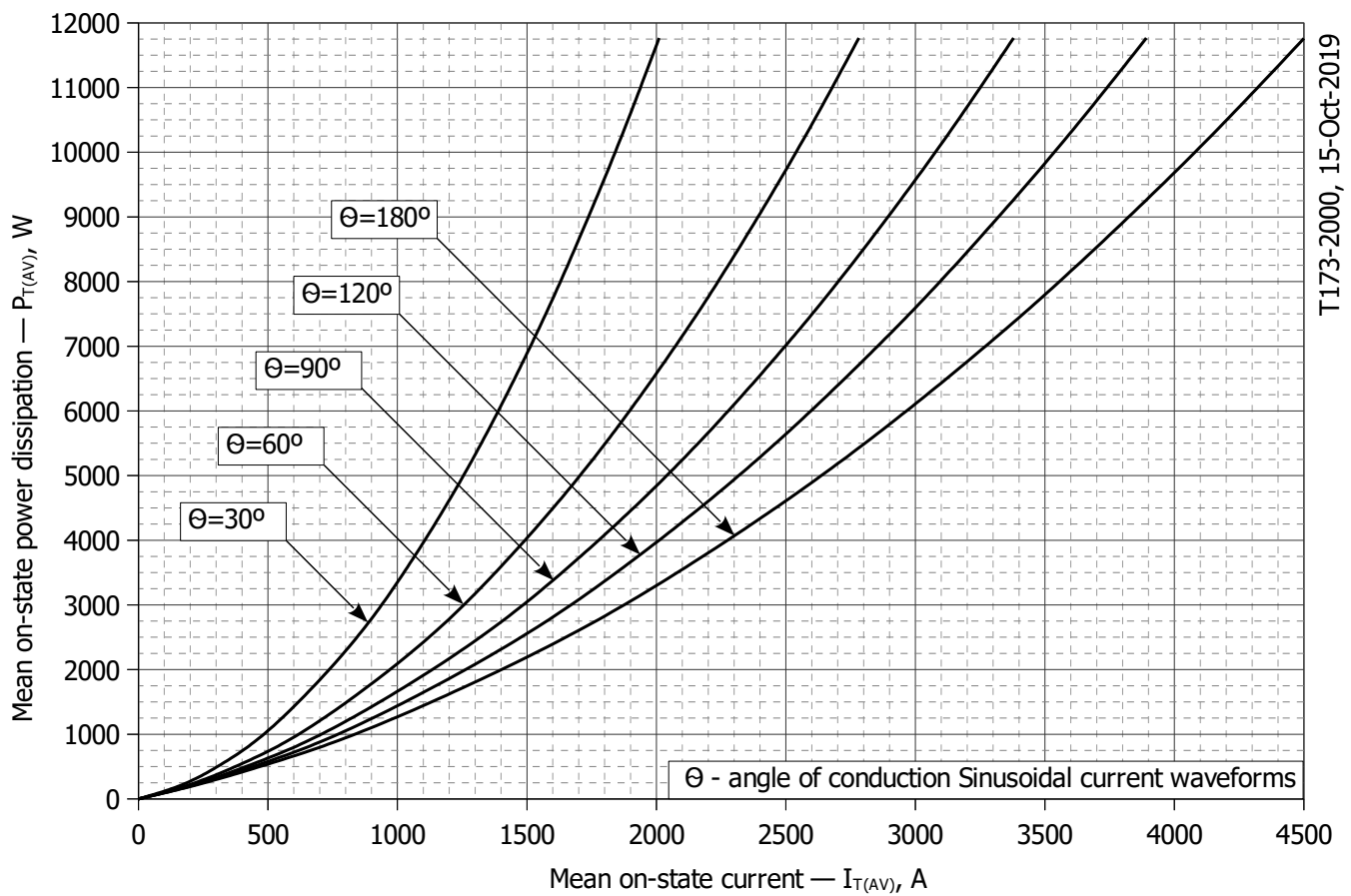
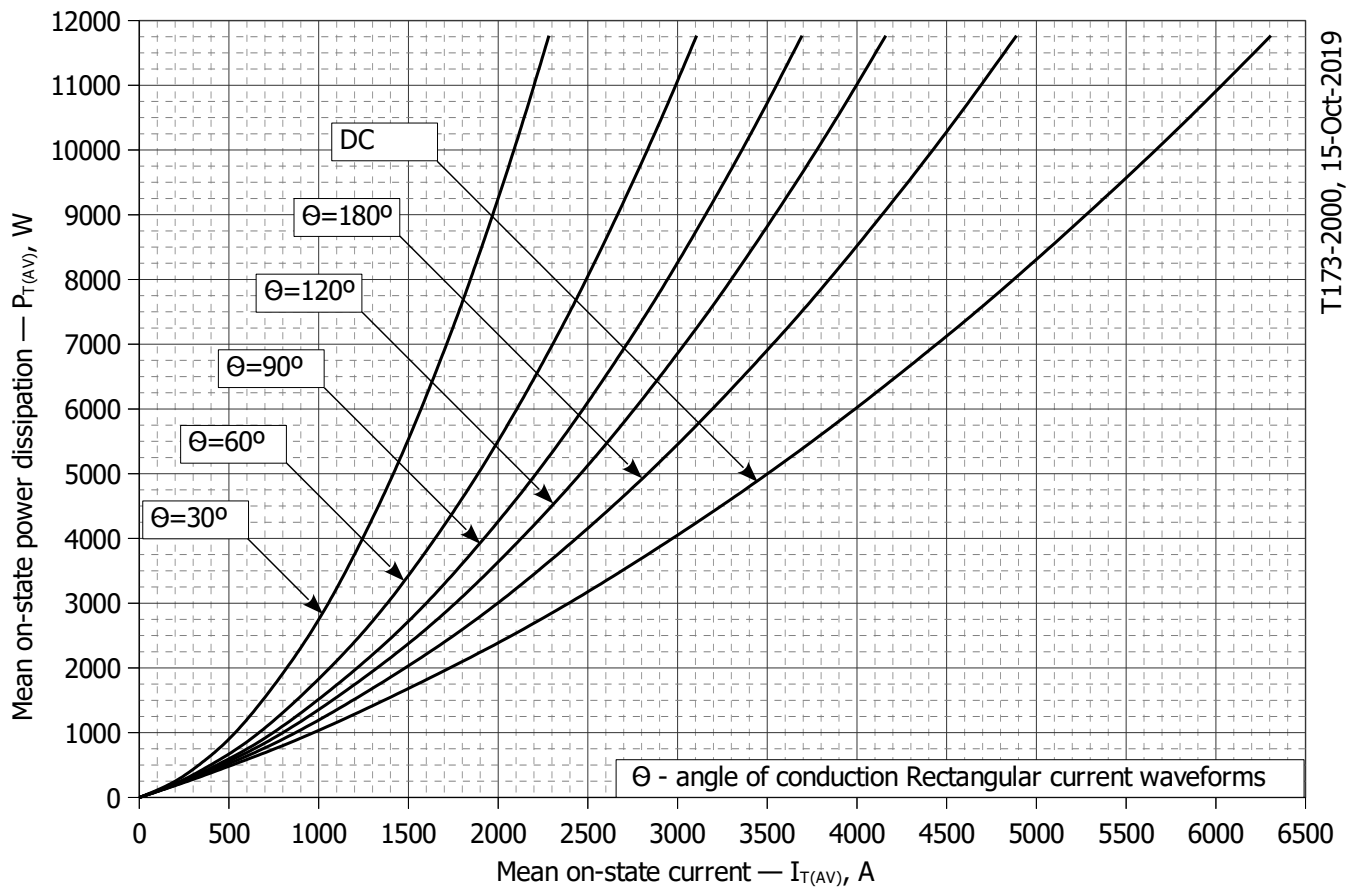


Fig 6 – Maximum recovery time t_{rr} vs. commutation rate di_R/dt (25% chord)



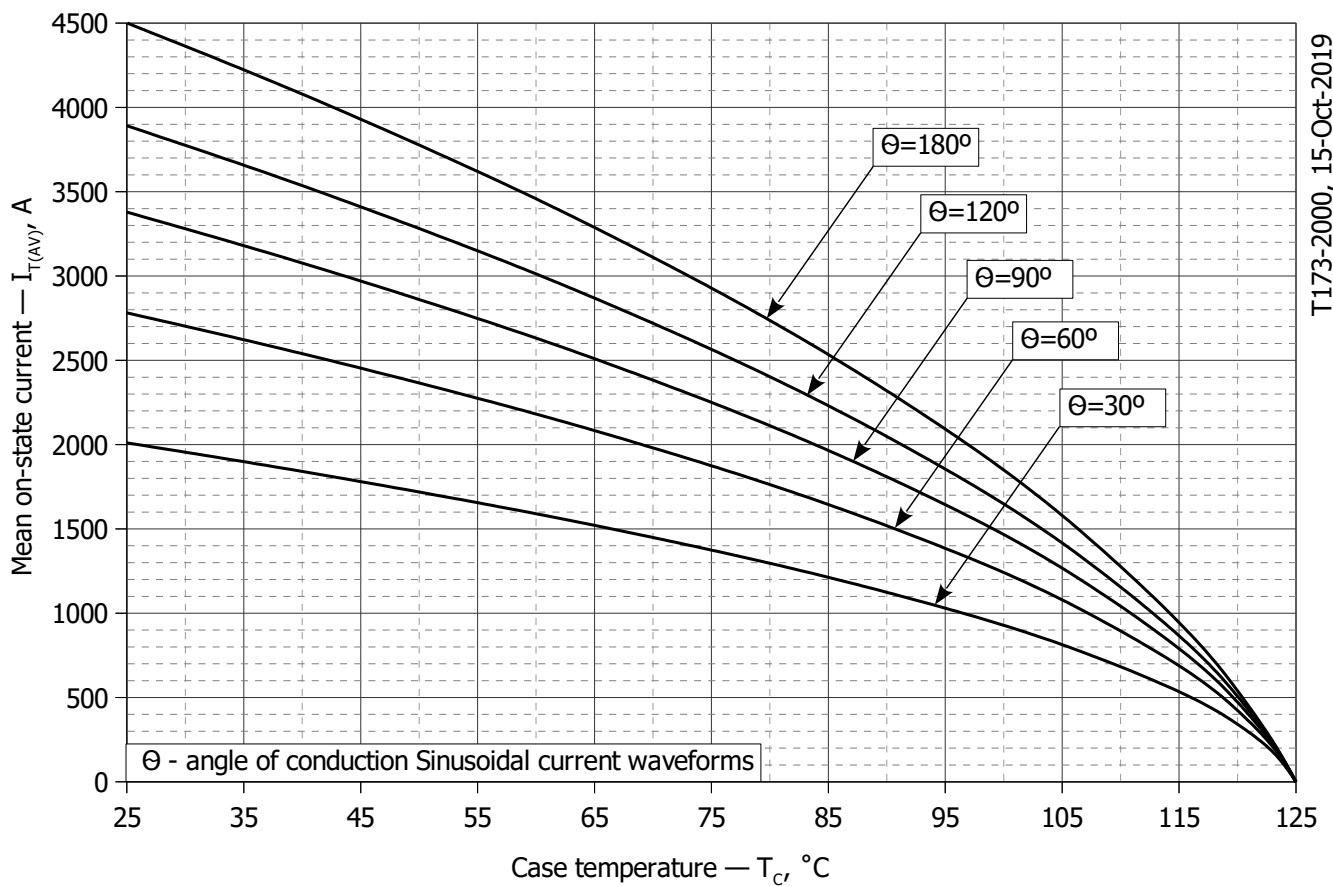
T173-2000, 15-Oct-2019

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)



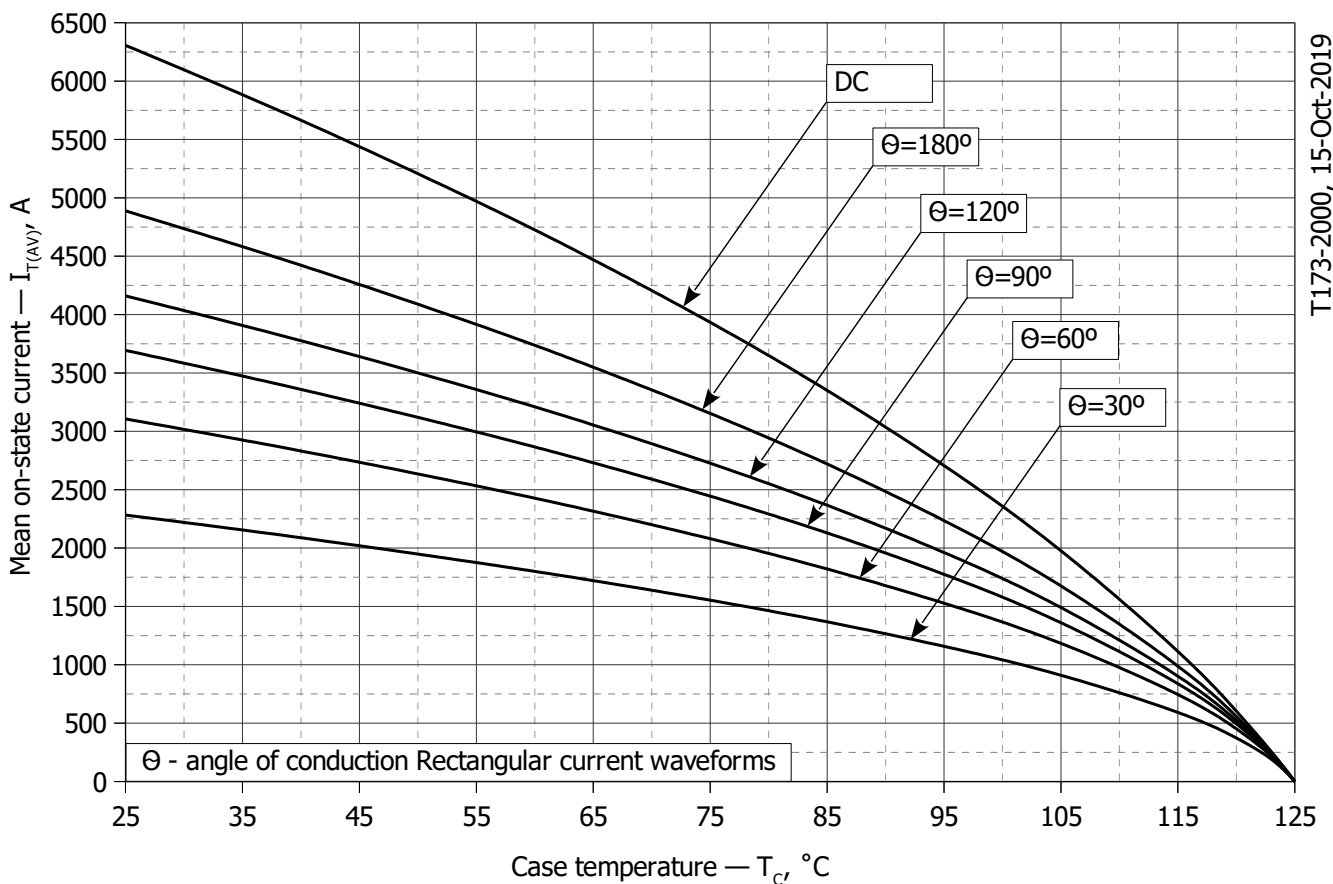
T173-2000, 15-Oct-2019

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)



T173-2000, 15-Oct-2019

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



T173-2000, 15-Oct-2019

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

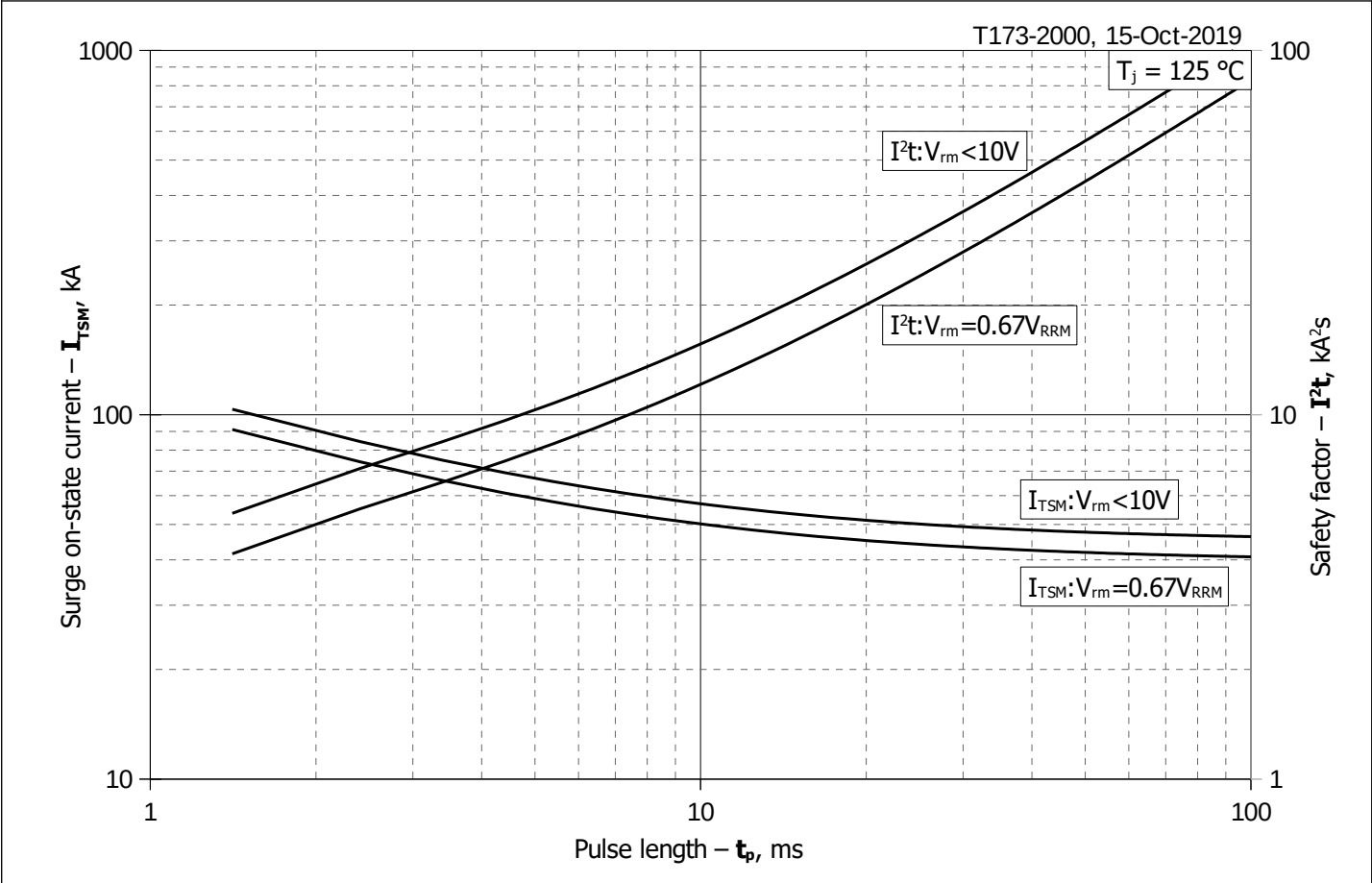


Fig. 11 – Maximum surge on-state current I_{TSM} and safety factor I^2t vs. pulse length t_p

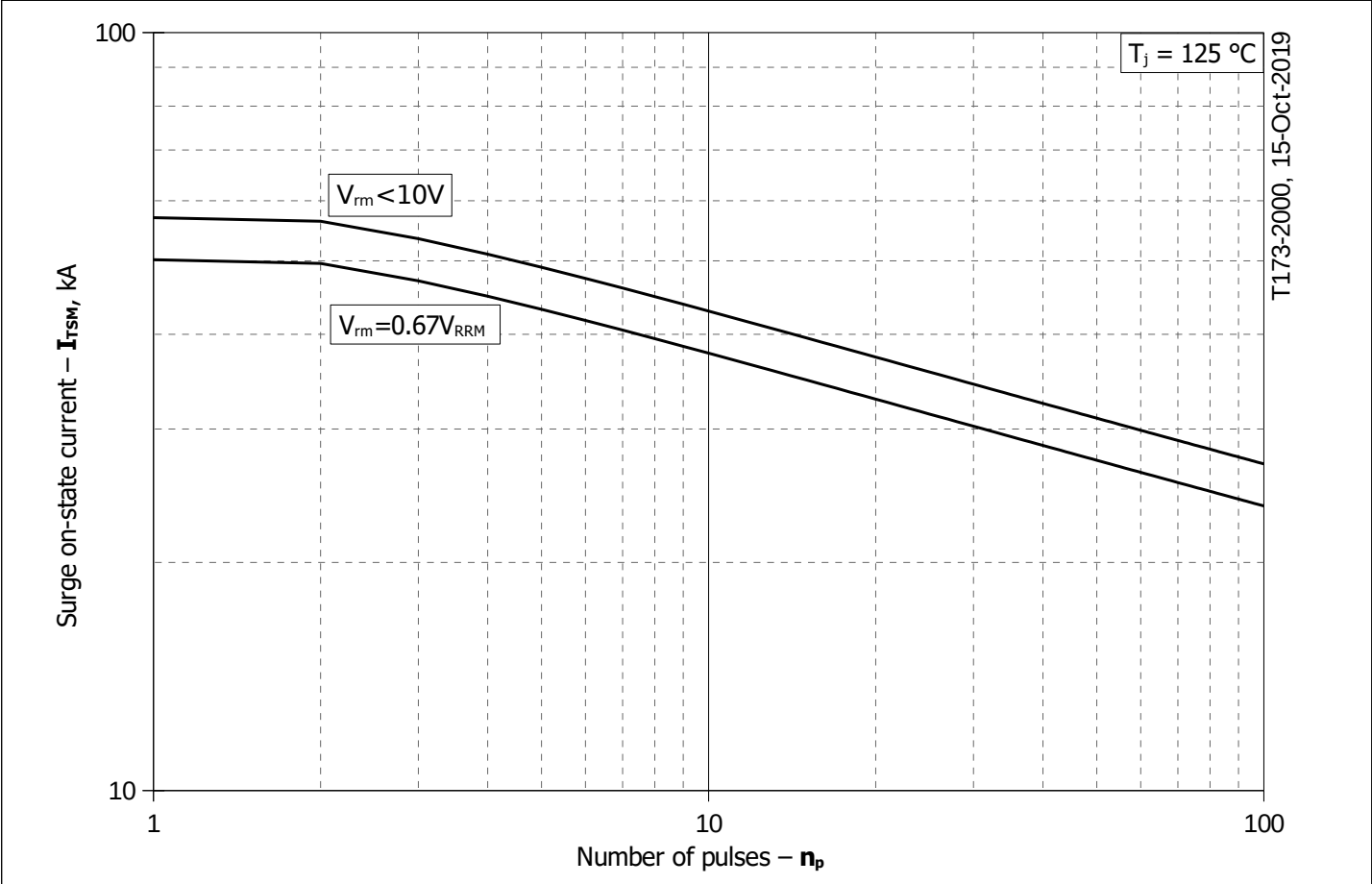


Fig. 12 - Maximum surge on-state current I_{TSM} vs. number of pulses n_p