



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

Phase Control Thyristor Type T143-500-18

Mean on-state current							I _{TAV}			500 A						
Repetitive peak off-state voltage							V _{DRM}			400...1800 V						
Repetitive peak reverse voltage							V _{RRM}									
Turn-off time							t _q			160, 200, 250, 320, 400, 500 μs						
V _{DRM} , V _{RRM} , V	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1800		
Voltage code	4	5	6	7	8	9	10	11	12	13	14	15	16	18		
T _j , °C	−60...+125															

MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions	
ON-STATE					
I_{TAV}	Maximum allowable mean on-state current	A	500 751	$T_c=102\text{ }^{\circ}\text{C}$, Double side cooled $T_c=85\text{ }^{\circ}\text{C}$, Double side cooled 180° half-sine wave; 50 Hz	
I_{TRMS}	RMS on-state current	A	785	$T_c=102\text{ }^{\circ}\text{C}$, Double side cooled 180° half-sine wave; 50 Hz	
I_{TSM}	Surge on-state current	kA	13.0 15.0	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=10\text{ ms}$; single pulse; $V_D=V_R=0\text{ V}$; Gate pulse: $I_G=2\text{ A}$; $t_{GP}=50\text{ }\mu\text{s}$; $di_G/dt\geq 1\text{ A}/\mu\text{s}$
			14.0 16.0	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	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	$\text{A}^2\text{s}\cdot 10^3$	840 1120	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=10\text{ ms}$; single pulse; $V_D=V_R=0\text{ V}$; Gate pulse: $I_G=2\text{ A}$; $t_{GP}=50\text{ }\mu\text{s}$; $di_G/dt\geq 1\text{ A}/\mu\text{s}$
			810 1060	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	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	400...1800	$T_{j\text{ min}} < T_j < T_{j\text{ max}}$; 180° half-sine wave; 50 Hz; Gate open	
V_{DSM}, V_{RSM}	Non-repetitive peak off-state and Non-repetitive peak reverse voltages	V	500...1900	$T_{j\text{ min}} < T_j < T_{j\text{ max}}$; 180° half-sine wave; single pulse; Gate open	
V_D, V_R	Direct off-state and Direct reverse voltages	V	$0.6\cdot V_{DRM}$ $0.6\cdot V_{RRM}$	$T_j=T_{j\text{ max}}$; Gate open	

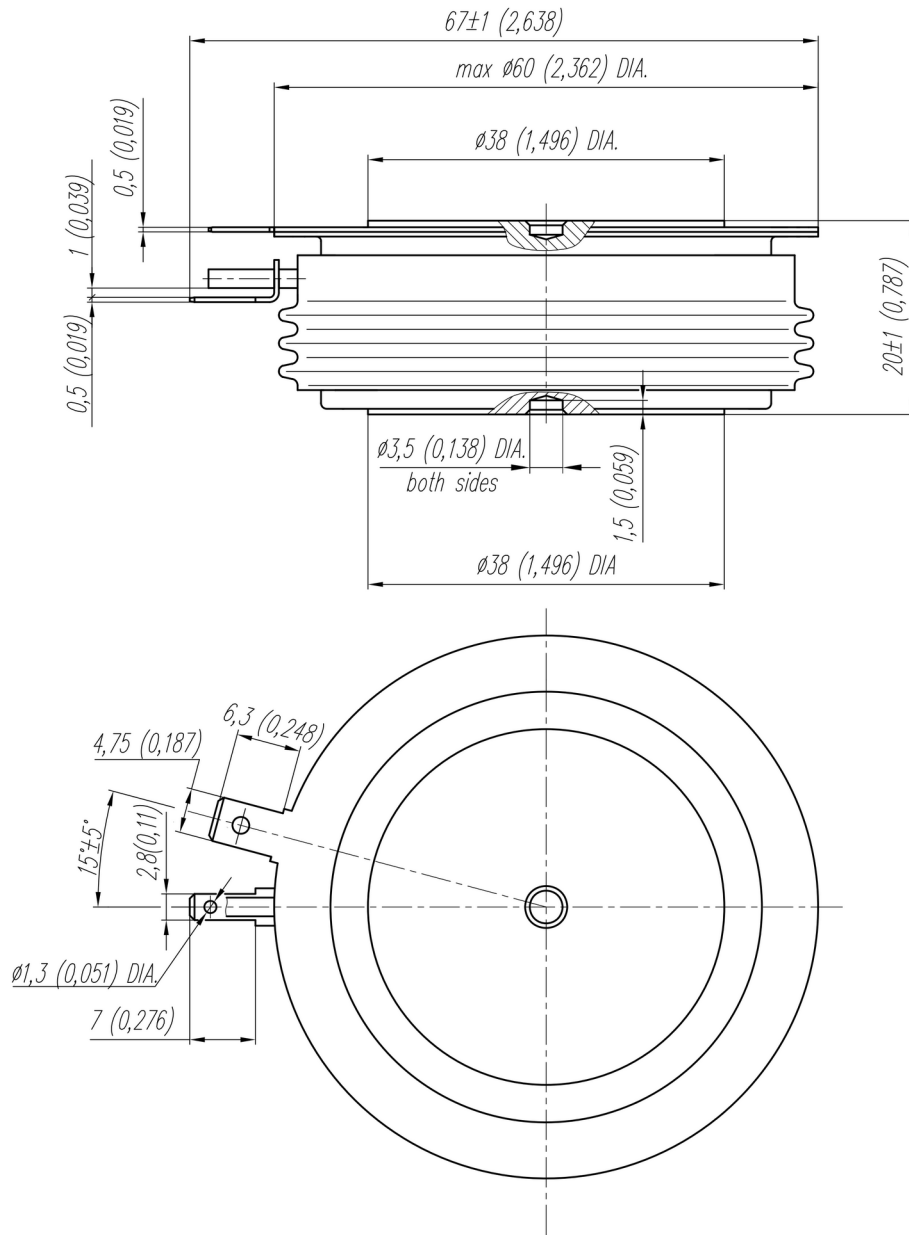
TRIGGERING				
I_{FGM}	Peak forward gate current	A	8	$T_j = T_{j\max}$
V_{RGM}	Peak reverse gate voltage	V	5	
P_G	Gate power dissipation	W	4	$T_j = T_{j\max}$ for DC gate current
SWITCHING				
$(di_T/dt)_{crit}$	Critical rate of rise of on-state current non-repetitive ($f=1\text{ Hz}$)	A/ μs	1250	$T_j = T_{j\max}$; $V_D = 0.67 \cdot V_{DRM}$; $I_{TM} = 2000\text{ A}$; Gate pulse: $I_G = 2\text{ A}$; $t_{GP} = 50\text{ }\mu\text{s}$; $di_G/dt \geq 2\text{ A}/\mu\text{s}$
THERMAL				
T_{stg}	Storage temperature	$^{\circ}\text{C}$	$-60 \dots +50$	
T_j	Operating junction temperature	$^{\circ}\text{C}$	$-60 \dots +125$	
MECHANICAL				
F	Mounting force	kN	14.0...16.0	
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	1.55	T _j =25 °C; I _{TM} =1570 A	
V _{T(TO)}	On-state threshold voltage, max	V	0.975	T _j =T _{j max} ;	
r _T	On-state slope resistance, max	mΩ	0.374	0.5 π I _{TAV} < I _T < 1.5 π I _{TAV}	
I _L	Latching current, max	mA	1000	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	100	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	0.30	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	0.80	T _j =25 °C; V _D =1000 V; I _{TM} =I _{TAV} ; di/dt=200 A/μs;	
t _{gt}	Turn-on time, max	μs	3.00	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	160, 200, 250, 320, 400, 500	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	1890	T _j =T _{j max} ; I _{TM} =500 A;	
t _{rr}	Reverse recovery time, max	μs	25	di _R /dt=-10 A/μs;	
I _{rr}	Reverse recovery current, max	A	151	V _R =100 V	

THERMAL					
R _{thjc}	Thermal resistance, junction to case, max	°C/W	0.0320	Direct current	Double side cooled
R _{thjc-A}			0.0704		Anode side cooled
R _{thjc-K}			0.0576		Cathode side cooled
R _{thck}	Thermal resistance, case to heatsink, max	°C/W	0.0060	Direct current	
MECHANICAL					
m	Weight, max	g	235		
D _s	Surface creepage distance	mm (inch)	19.44 (0.765)		
D _a	Air strike distance	mm (inch)	12.10 (0.476)		

PART NUMBERING GUIDE							NOTES																						
T	143	500	18	A2	E2	N	1) Critical rate of rise of off-state voltage																						
1	2	3	4	5	6	7	<table><tr><td>Symbol of Group</td><td>P2</td><td>K2</td><td>E2</td><td>A2</td><td>T1</td><td>P1</td><td>M1</td></tr><tr><td>(dv_D/dt)_{crit}, V/μs</td><td>200</td><td>320</td><td>500</td><td>1000</td><td>1600</td><td>2000</td><td>2500</td></tr></table>							Symbol of Group	P2	K2	E2	A2	T1	P1	M1	(dv _D /dt) _{crit} , V/μs	200	320	500	1000	1600	2000	2500
Symbol of Group	P2	K2	E2	A2	T1	P1	M1																						
(dv _D /dt) _{crit} , V/μs	200	320	500	1000	1600	2000	2500																						
1. Phase Control Thyristor							2) Turn-off time (dv _D /dt=50 V/μs)																						
2. Design version							<table><tr><td>Symbol of Group</td><td>T2</td><td>P2</td><td>M2</td><td>K2</td><td>H2</td><td>E2</td></tr><tr><td>t_q, μs</td><td>160</td><td>200</td><td>250</td><td>320</td><td>400</td><td>500</td></tr></table>							Symbol of Group	T2	P2	M2	K2	H2	E2	t _q , μs	160	200	250	320	400	500		
Symbol of Group	T2	P2	M2	K2	H2	E2																							
t _q , μs	160	200	250	320	400	500																							
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																													



All dimensions in millimeters (inches)

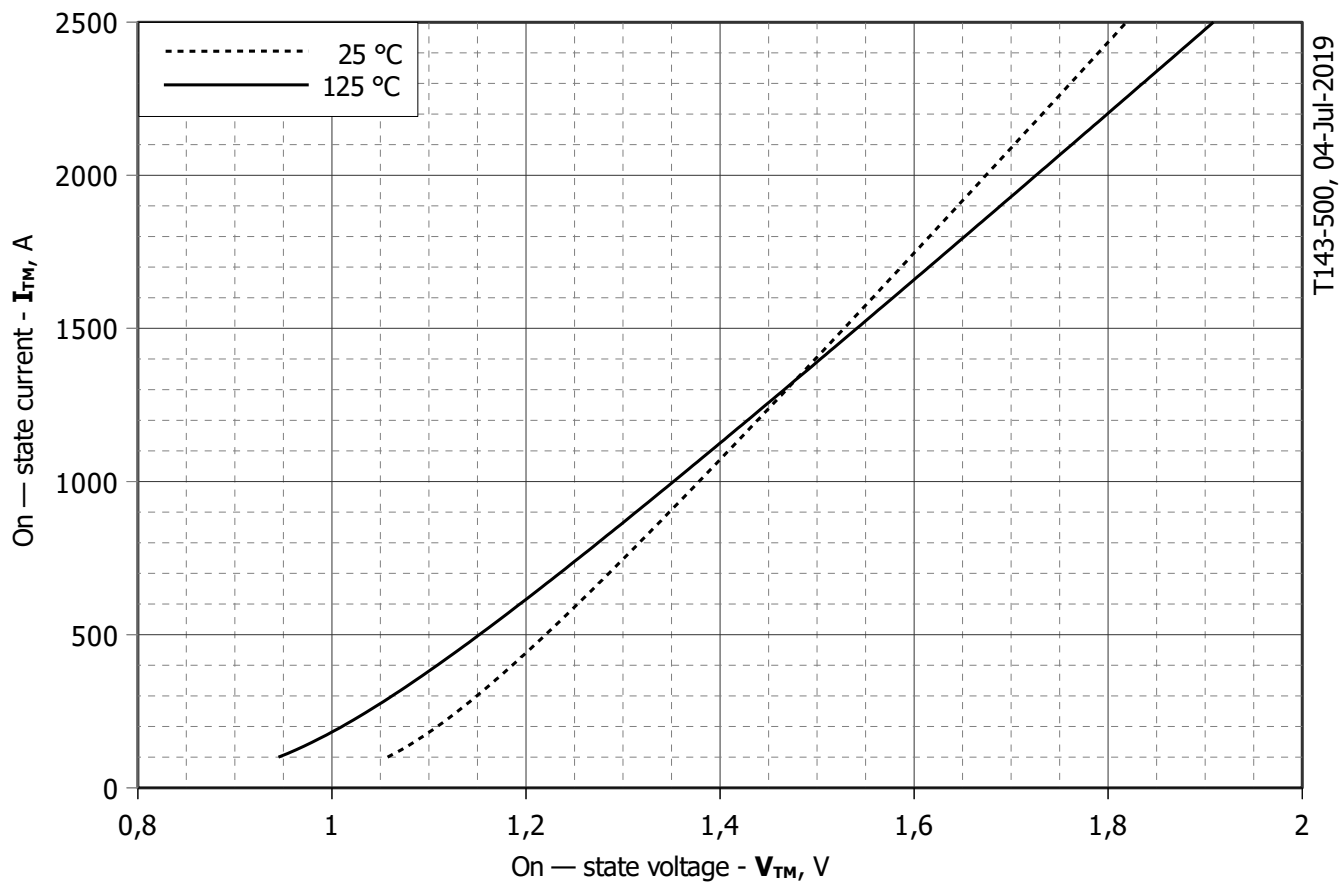


Fig 1 – On-state characteristics of Limit device

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	0.84659000	0.67505000
B	0.00028902	0.00036433
C	0.04323400	0.05538400
D	-0.00177060	-0.00221270

On-state characteristic model (see Fig. 1)

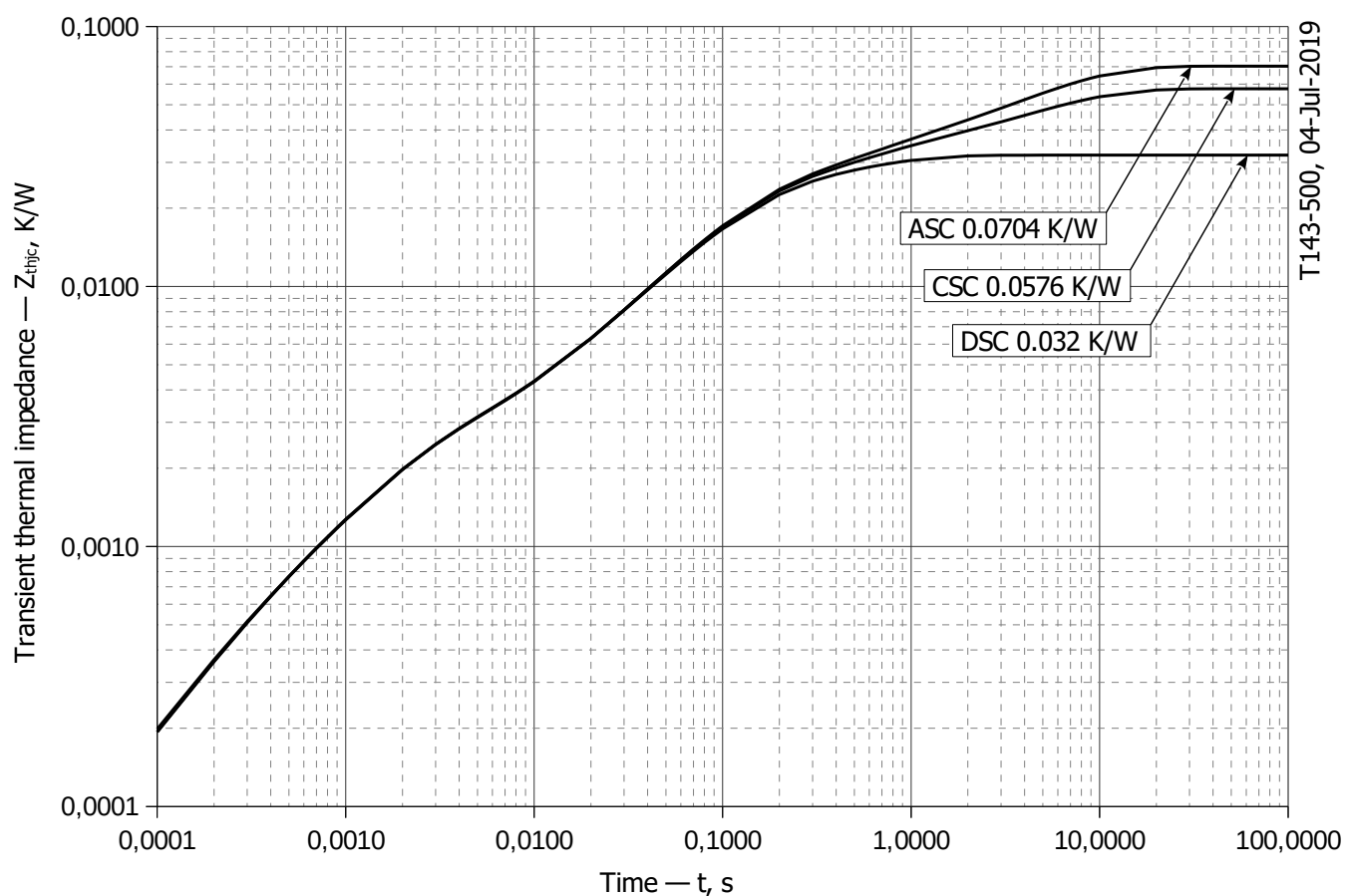


Fig 2 – Transient thermal impedance Z_{thjc} vs. time t

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	0.000005619	0.01031	0.01922	0.0004148	0.001895	0.0001521
τ_i , s	7.790	0.5094	0.09719	0.01725	0.0016	0.0002257

DC Anode side cooled

i	1	2	3	4	5	6
R_i , K/W	0.0381	0.008681	0.01867	0.001961	0.0001787	0.002771
τ_i , s	5.351	0.4584	0.09325	0.001734	0.0002174	0.9059

DC Cathode side cooled

i	1	2	3	4	5	6
R_i , K/W	0.02561	0.001472	0.01786	0.001926	0.0001928	0.01052
τ_i , s	5.328	0.1832	0.09031	0.001714	0.0002598	0.525

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

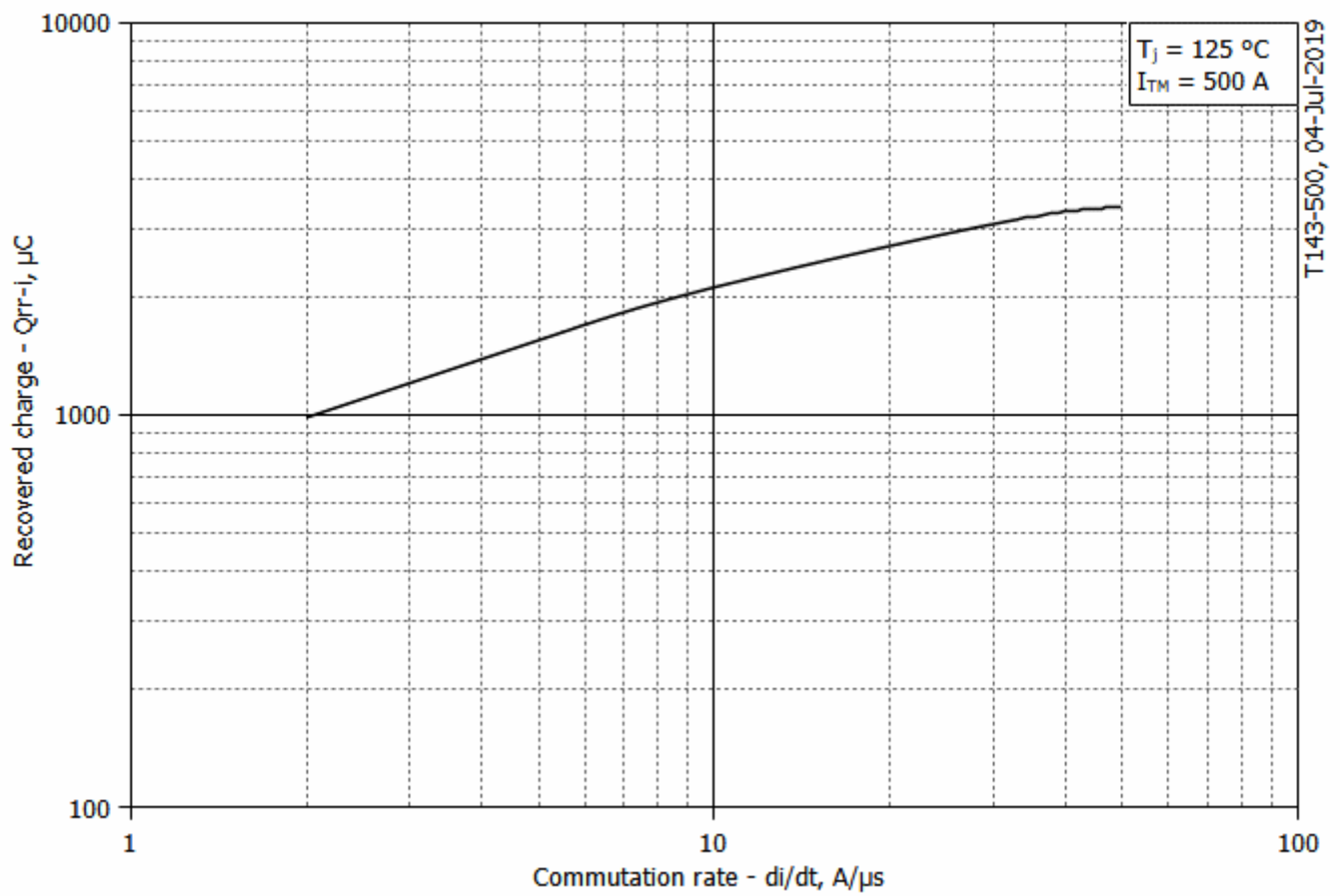


Fig 3 – Maximum recovered charge Q_{rr-i} (integral) vs. commutation rate di_R/dt

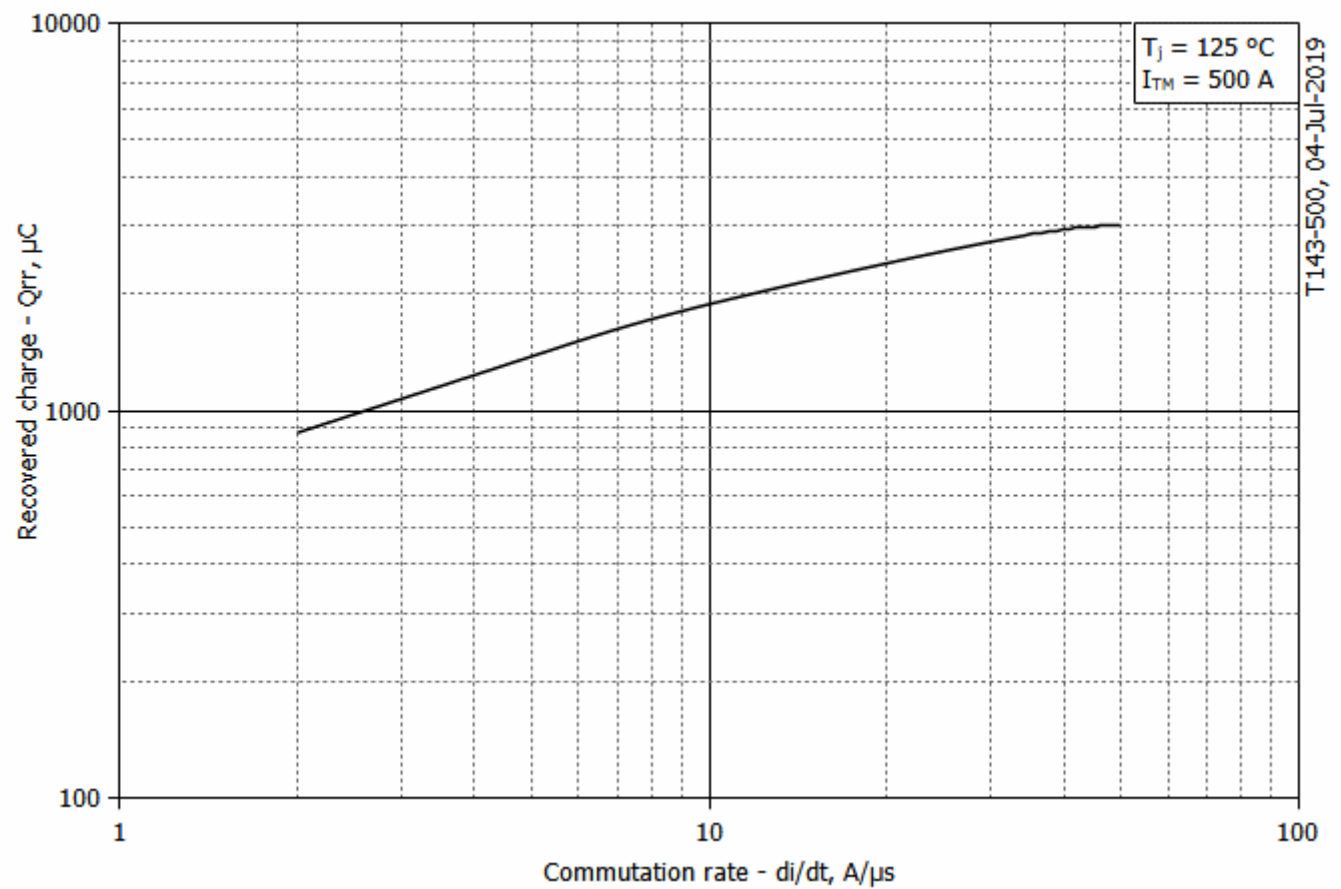


Fig 4 – Maximum recovered charge Q_{rr} vs. commutation rate di_R/dt (25% chord)

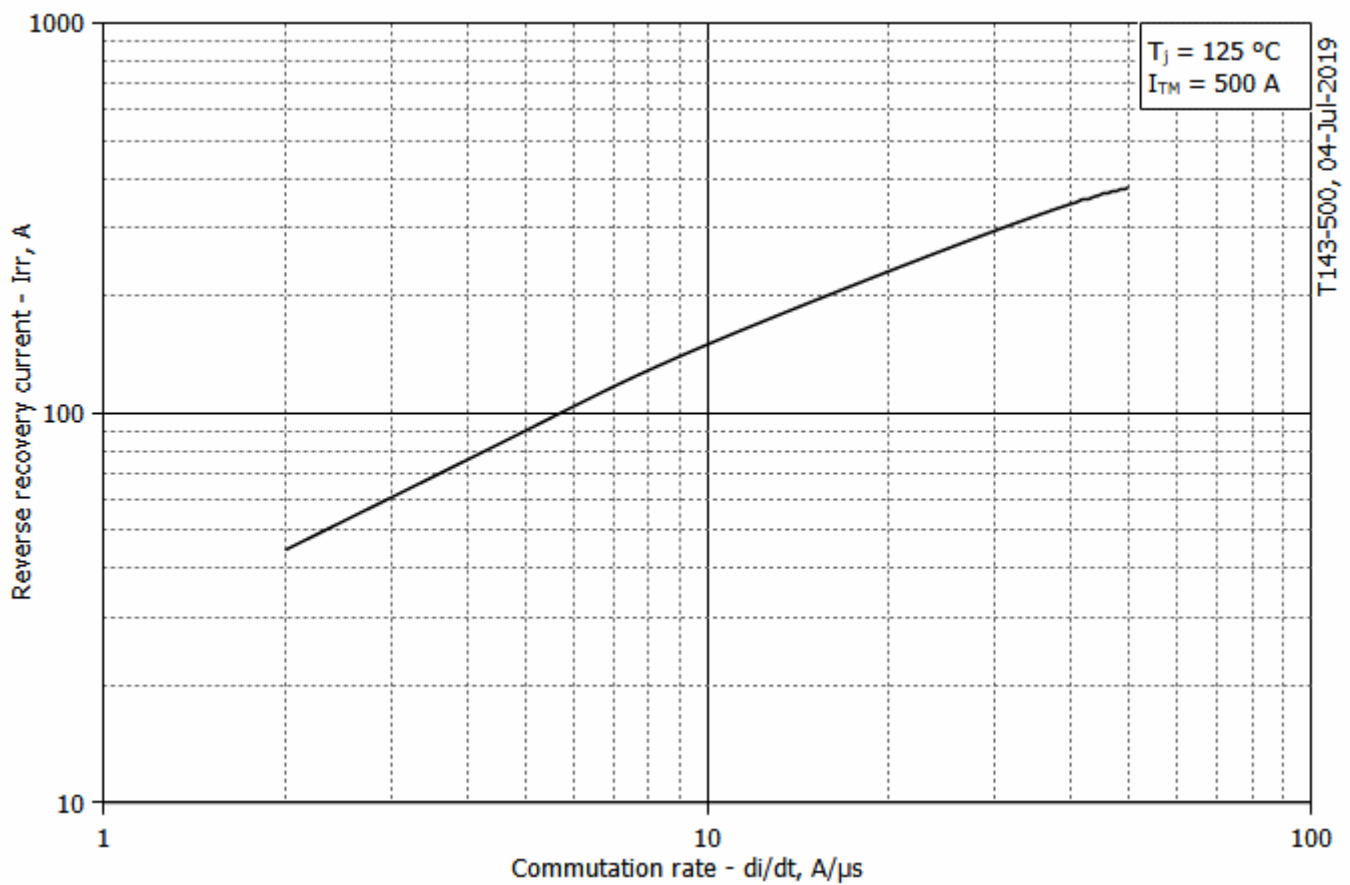


Fig 5 – Maximum reverse recovery current I_{rr} vs. commutation rate di_R/dt

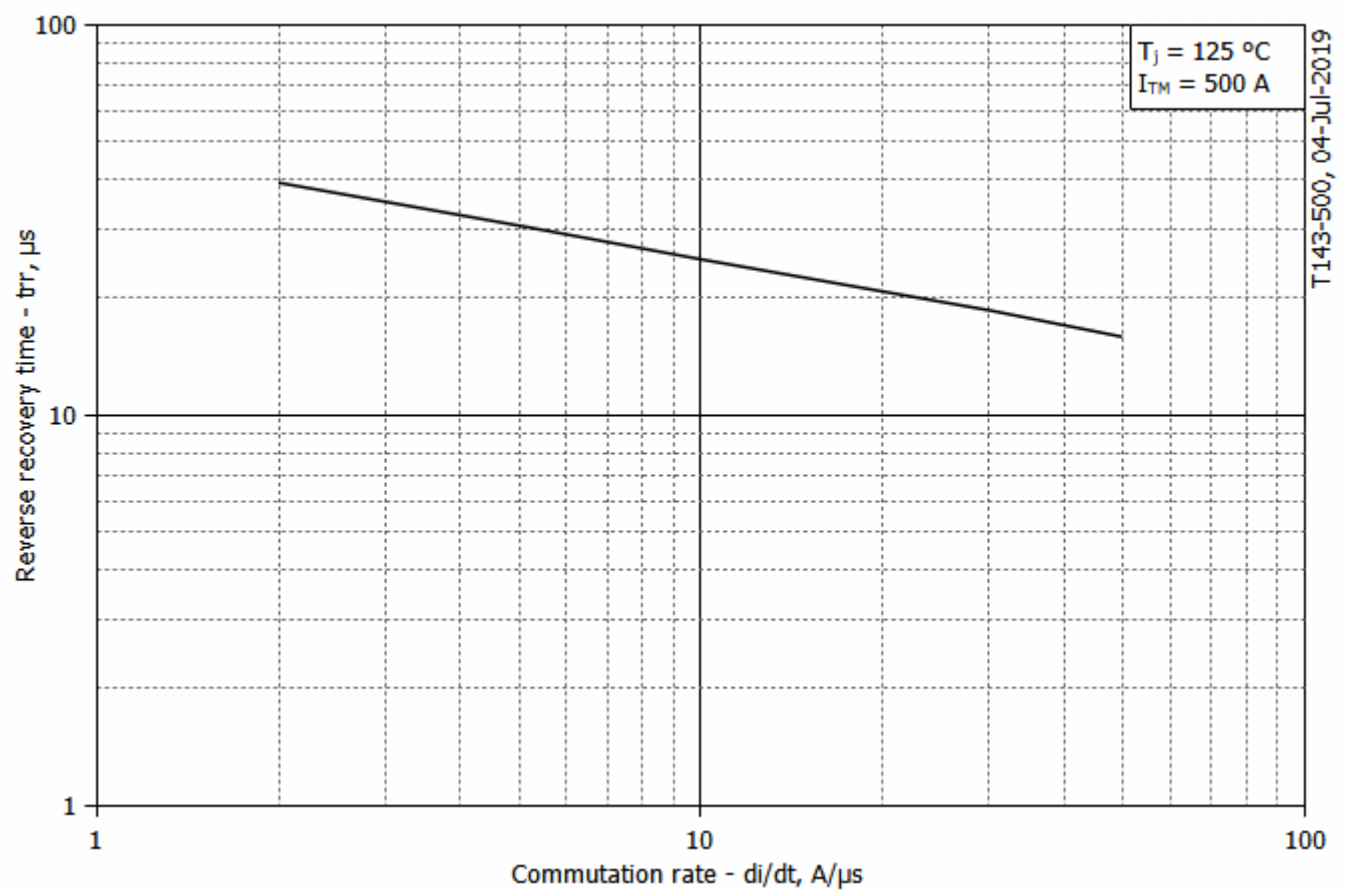
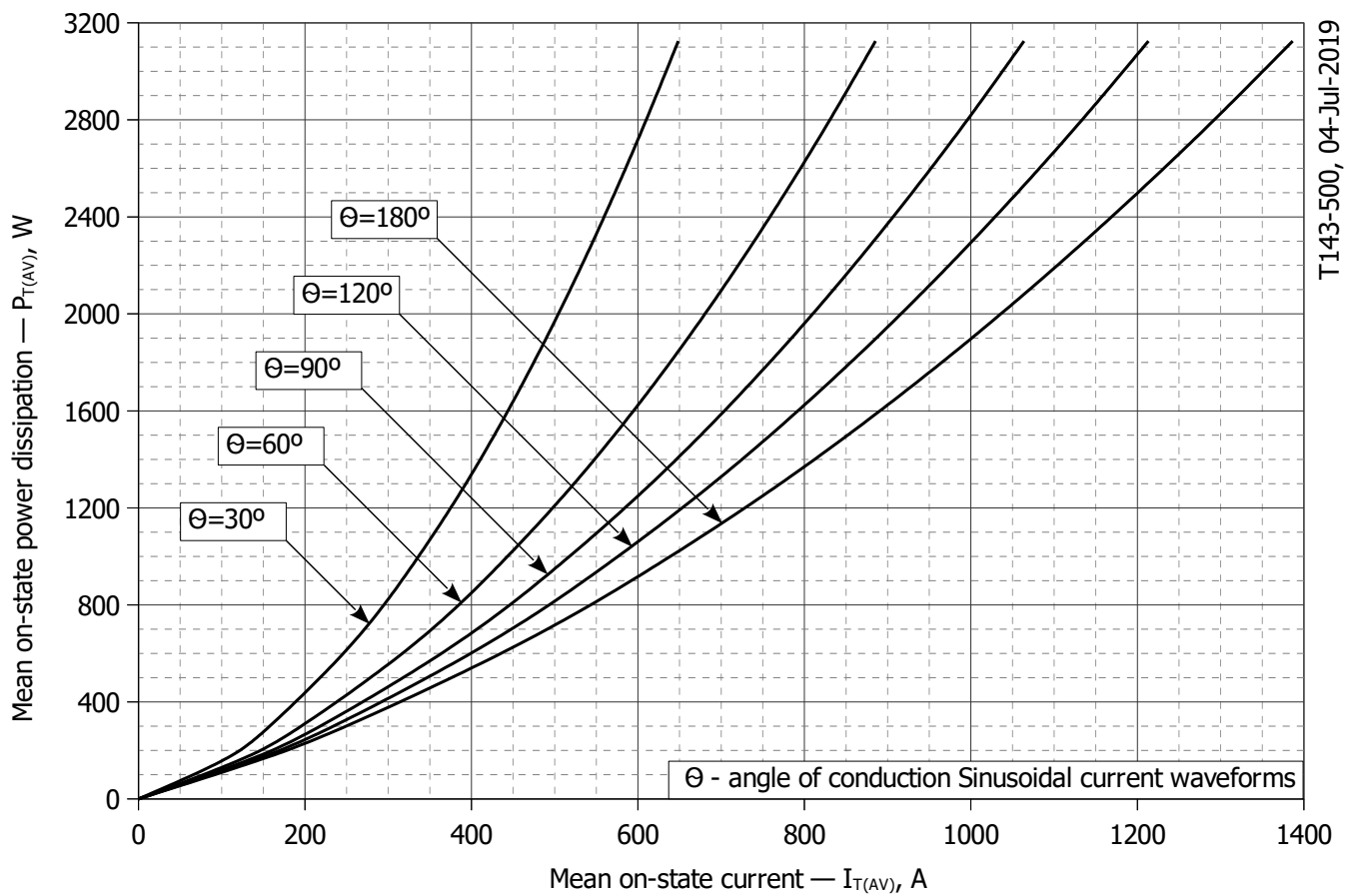
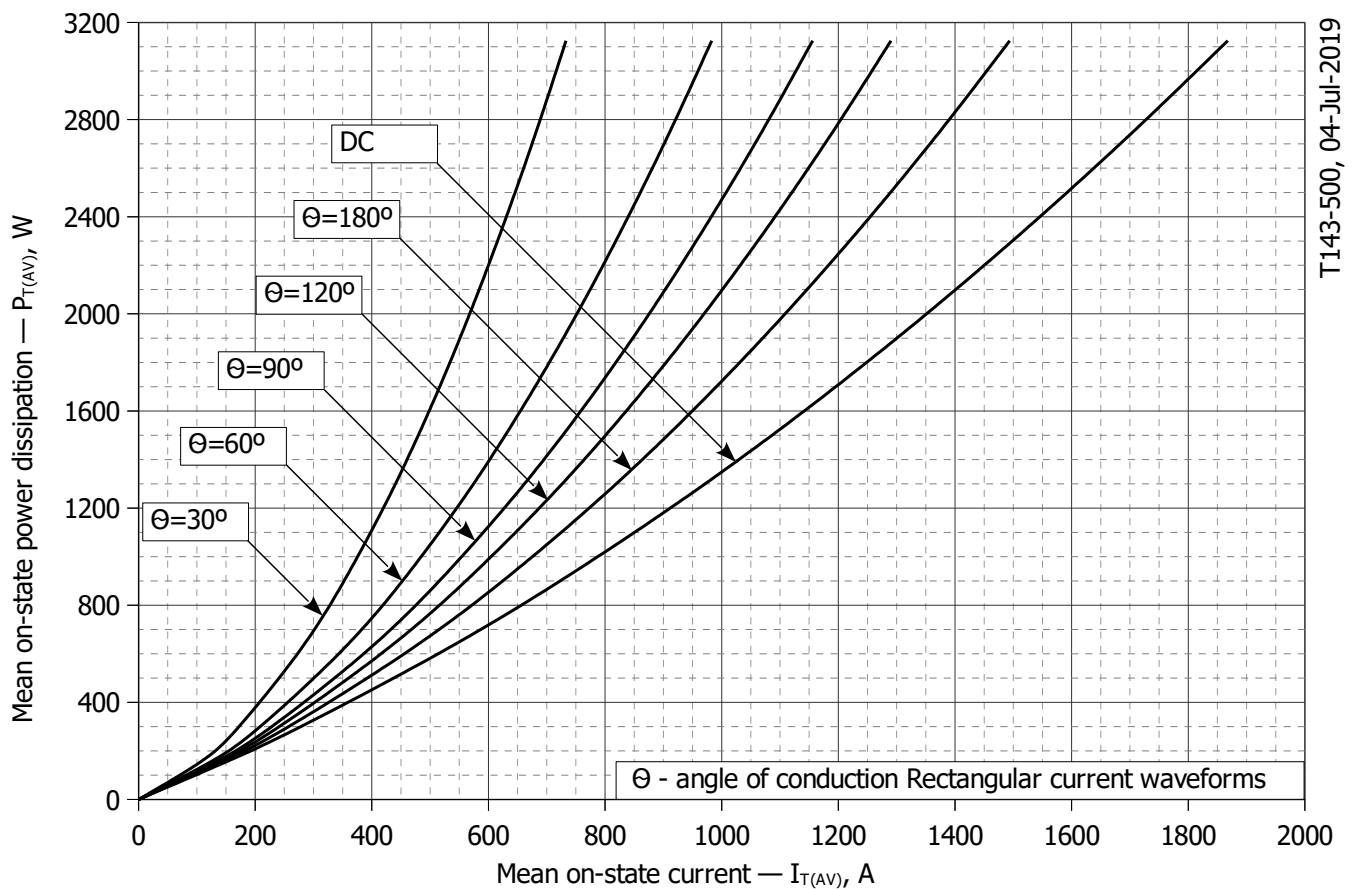


Fig 6 – Maximum recovery time t_{rr} vs. commutation rate di_R/dt (25% chord)



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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)



T143-500, 04-Jul-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)

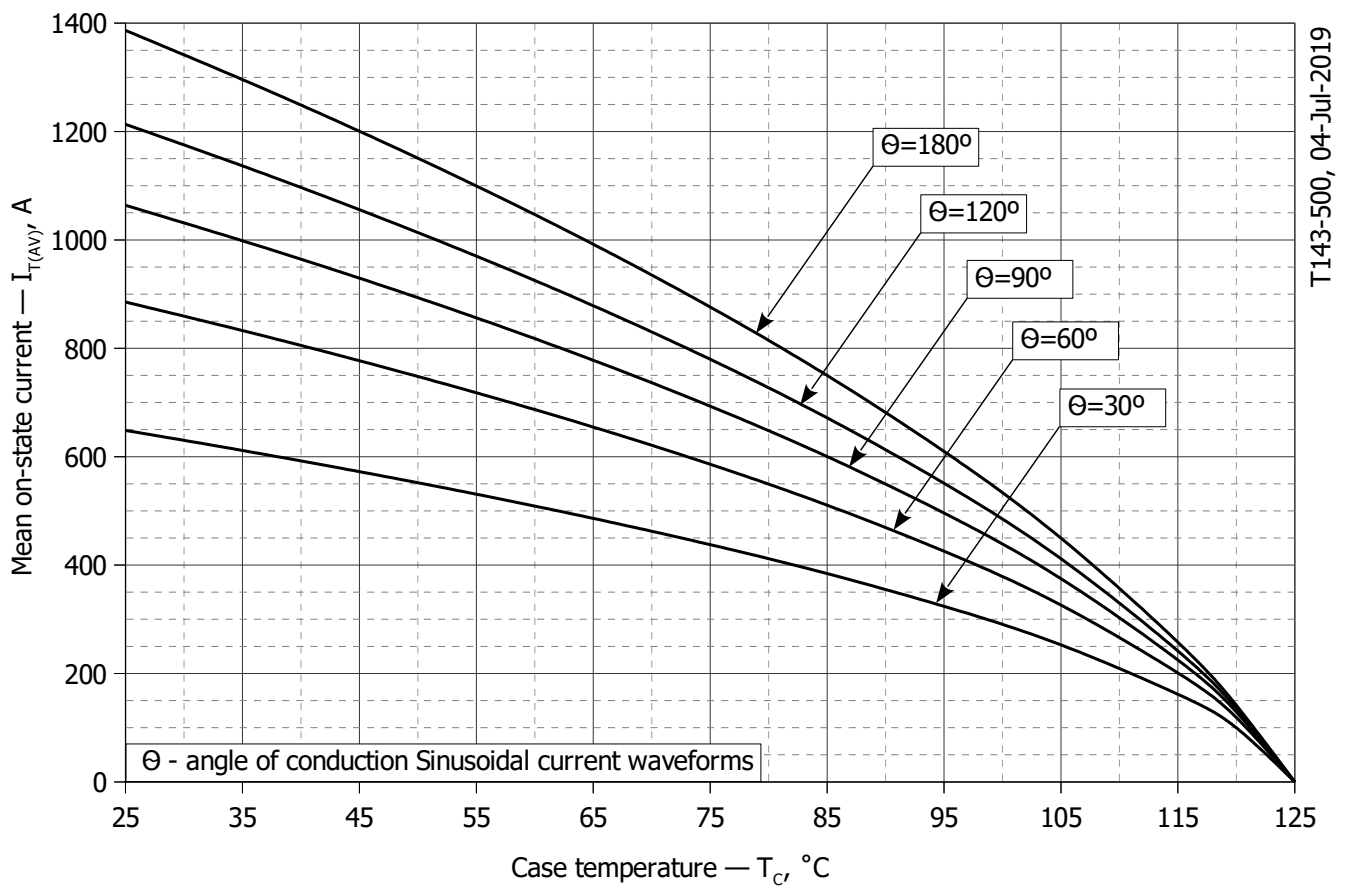


Fig. 9 – Mean on-state current I_{TAV} vs. case temperature T_C for sinusoidal current waveforms at different conduction angles ($f=50\text{Hz}$, DSC)

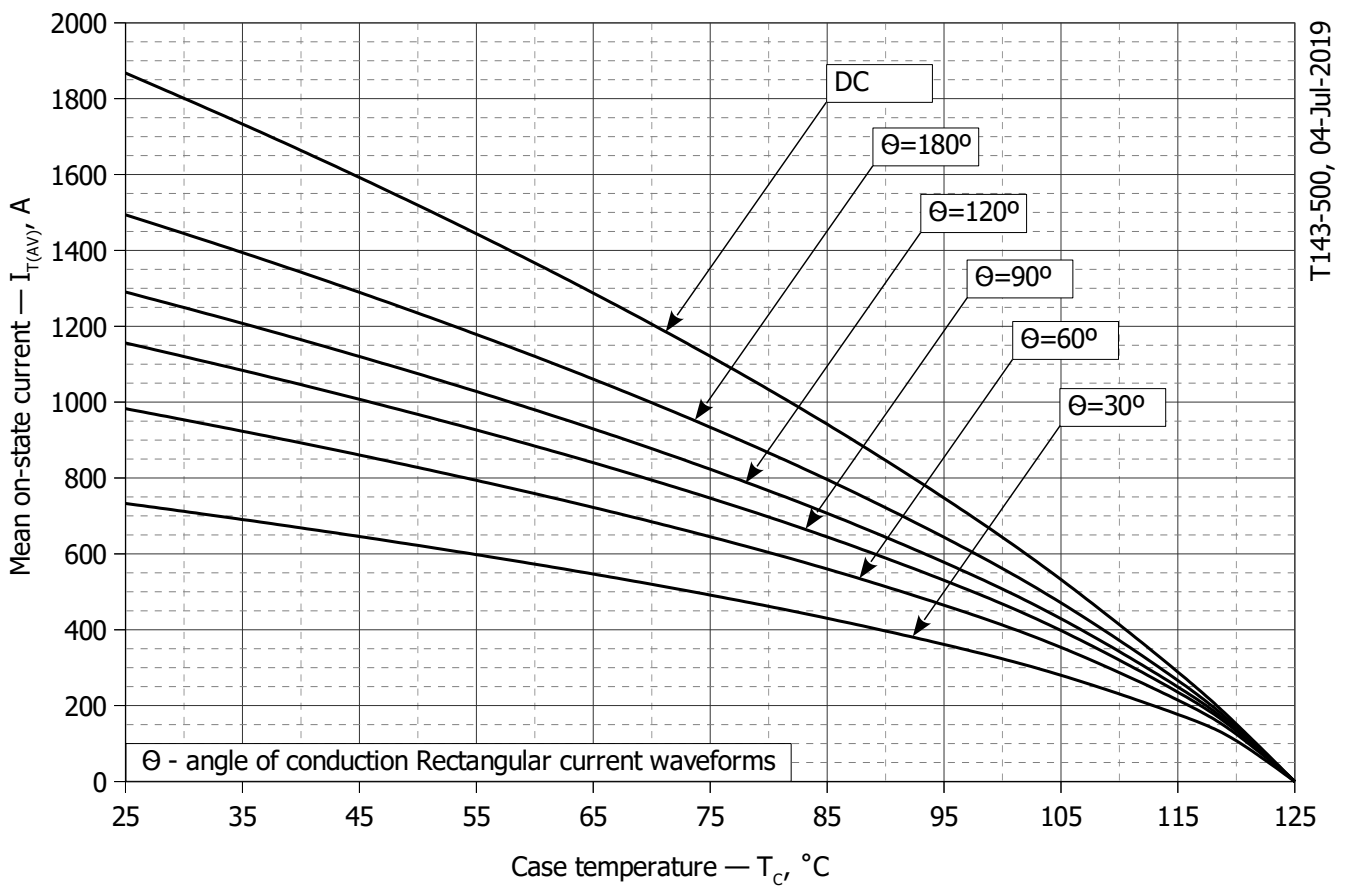


Fig. 10 - Mean on-state current I_{TAV} vs. case temperature T_C for rectangular current waveforms at different conduction angles and for DC ($f=50\text{Hz}$, DSC)

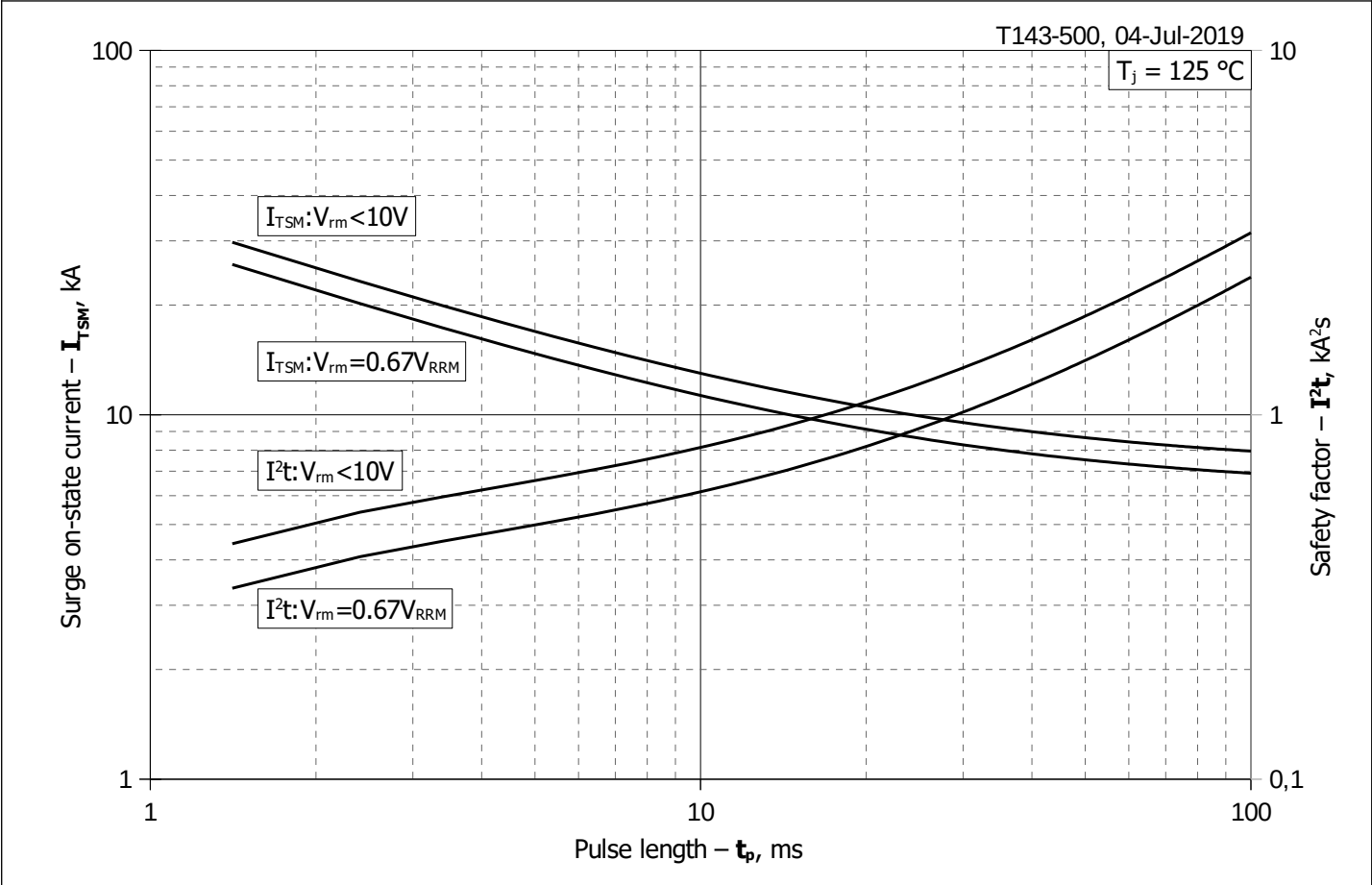


Fig. 11 – Maximum surge on-state current I_{TSM} and safety factor I^2t vs. pulse length t_p

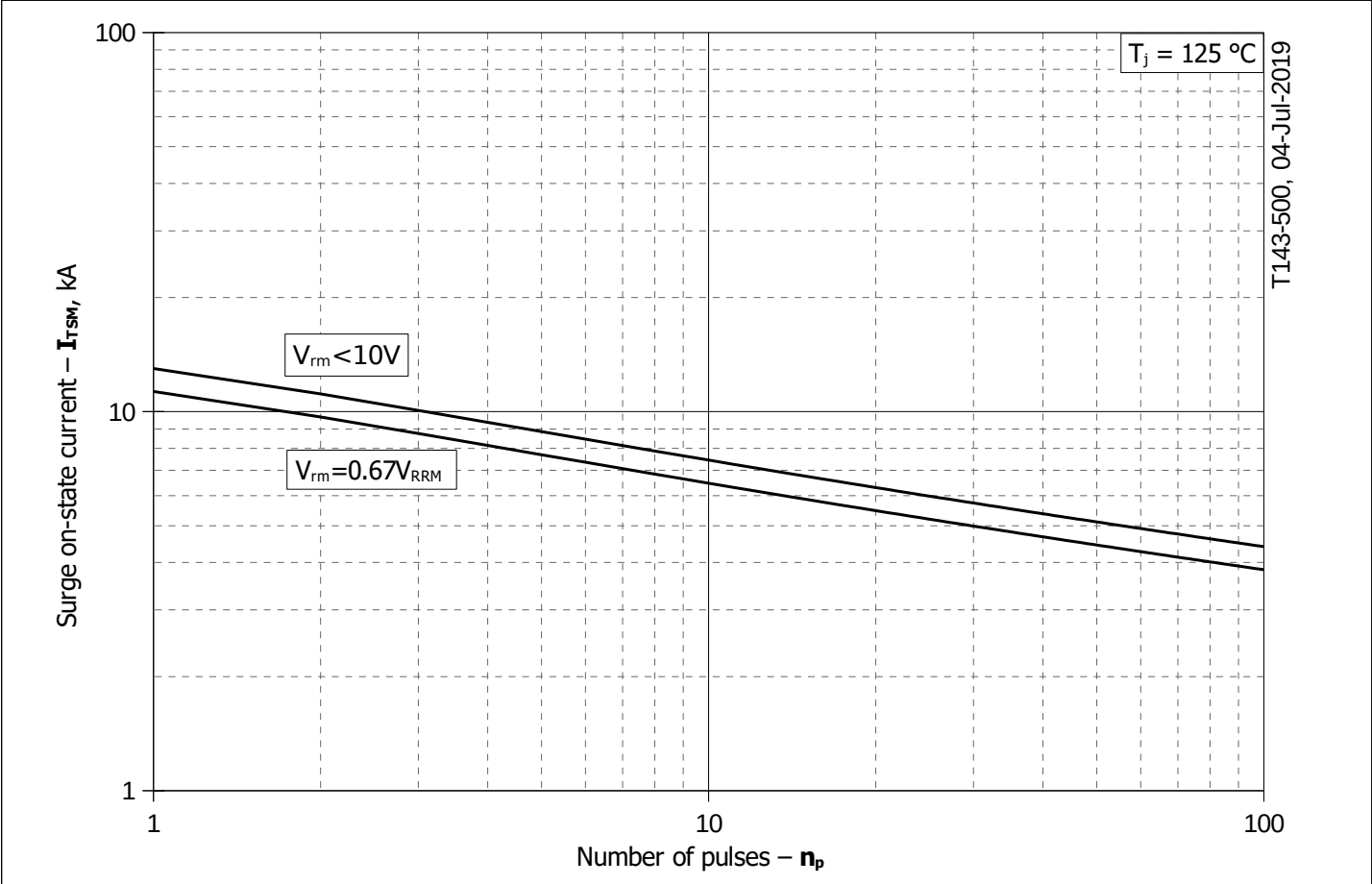


Fig. 12 - Maximum surge on-state current I_{TSM} vs. number of pulses n_p