PROTON-ELECTROTEX
RUSSIA

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

Phase Control Thyristor
Type T243-630-18

Mean on-state current	I_{TAV}	630 A
Repetitive peak off-state voltage	V_{DRM}	1000 ÷ 1800 V
Repetitive peak reverse voltage	V_{RRM}	
Turn-off time	t_q	250, 320, 400, 500 μs

V_{DRM}, V_{RRM}, V	1000	1100	1200	1300	1400	1500	1600	1800
Voltage code	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}	Mean on-state current	A	630 797	T_c=96 °C, Double side cooled T_c=85 °C, Double side cooled 180° half-sine wave; 50 Hz	
I_{TRMS}	RMS on-state current	A	989	T_c=96 °C, Double side cooled 180° half-sine wave; 50 Hz	
I_{TSM}	Surge on-state current	kA	13.5 16.0	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
			14.0 16.0	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	$A^2s·10^3$	910 1280	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
			810 1060	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	1000÷1800	$T_{j\ min}$< 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	1100÷1900	$T_{j\ min}$< 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	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 Hz)	A/µs	1250	$T_j=T_{j\,max}$; $V_D=0.67 \cdot V_{DRM}$; I_{TM}=2000 A; Gate pulse: I_G=2 A; t_{GP}=50 µs; $di_G/dt \geq 2$ A/µs
THERMAL				
T_{stg}	Storage temperature	°C	-60÷50	
T_j	Operating junction temperature	°C	-60÷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	1.65	T_j=25 °C; I_{TM}=1978 A	
$V_{T(TO)}$	On-state threshold voltage, max	V	0.966	$T_j=T_{j\,max}$; $0.5\,\pi\,I_{TAV} < I_T < 1.5\,\pi\,I_{TAV}$	
r_T	On-state slope resistance, max	mΩ	0.362		
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; $di_G/dt \geq 1$ 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	$T_j=T_{j\,max}$; $V_D=0.67 \cdot V_{DRM}$; 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	0.30	$T_j=T_{j\,max}$; $V_D=0.67 \cdot V_{DRM}$; 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; 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	3.00		
t_q	Turn-off time[2)], max	µs	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; $V_D=0.67 \cdot V_{DRM}$	
Q_{rr}	Total recovered charge, max	µC	1890	$T_j=T_{j\,max}$; I_{TM}=630 A; di_R/dt=-10 A/µs; V_R=100 V	
t_{rr}	Reverse recovery time, max	µs	25		
I_{rrM}	Peak reverse recovery current, max	A	151		

THERMAL					
R_{thjc}	Thermal resistance, junction to case, max	°C/W	0.0300	Direct current	Double side cooled
R_{thjc-A}			0.0660		Anode side cooled
R_{thjc-K}			0.0540		Cathode side cooled
R_{thck}	Thermal resistance, case to heatsink, max	°C/W	0.0060	Direct current	
MECHANICAL					
w	Weight, max	g	210		
D_s	Surface creepage distance	mm (inch)	7.86 (0.309)		
D_a	Air strike distance	mm (inch)	6.10 (0.240)		

PART NUMBERING GUIDE

T	243	630	18	A2	E2	N
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

NOTES

1) Critical rate of rise of off-state voltage

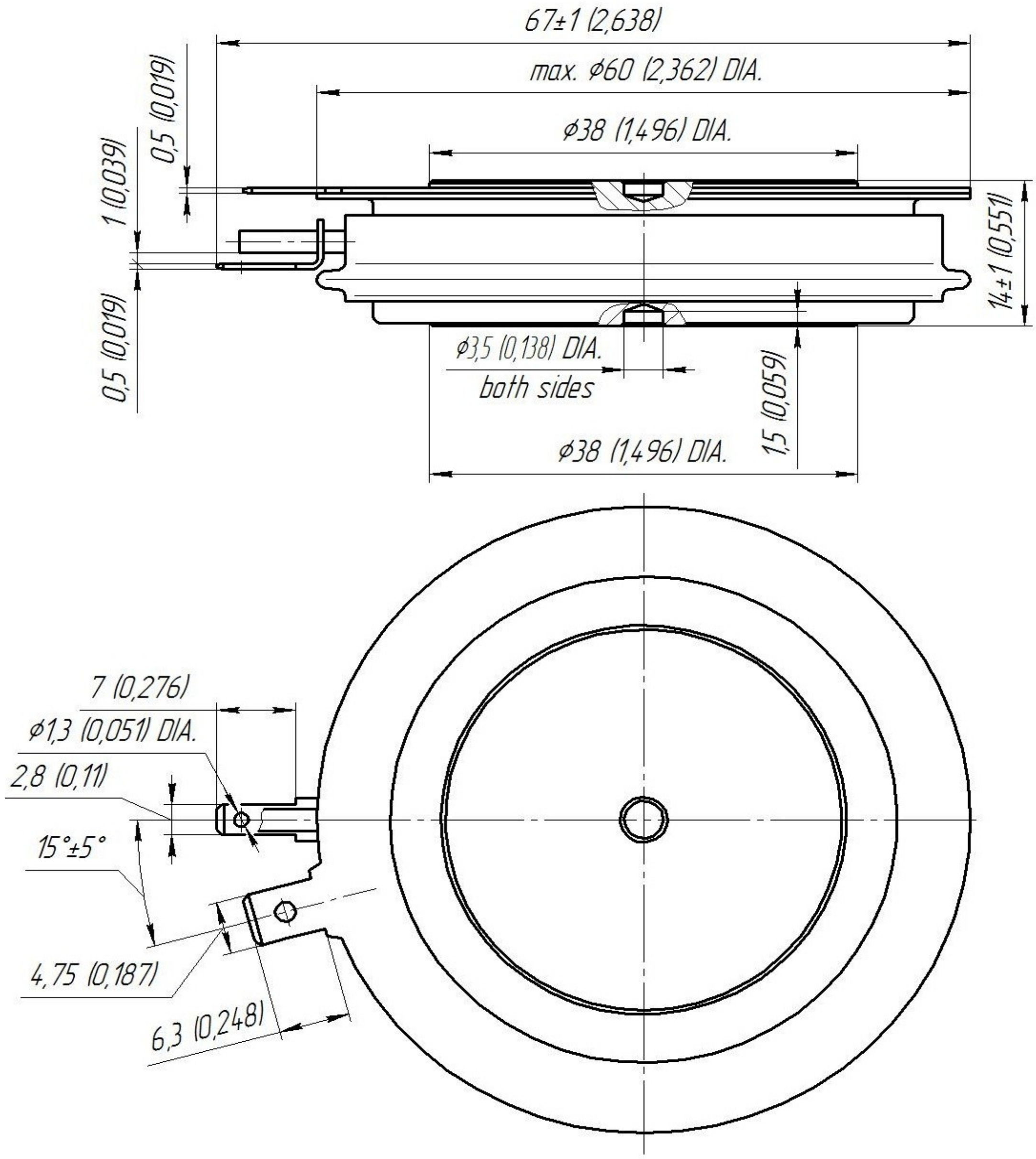
Symbol of Group	P2	K2	E2	A2	T1	P1	M1
$(dv_D/dt)_{crit}$, V/µs	200	320	500	1000	1600	2000	2500

2) Turn-off time (dv_D/dt=50 V/µs)

Symbol of Group	M2	K2	H2	E2
t_q, µs	250	320	400	500

OVERALL DIMENSIONS

Package type: T.C1



All dimensions in millimeters (inches)

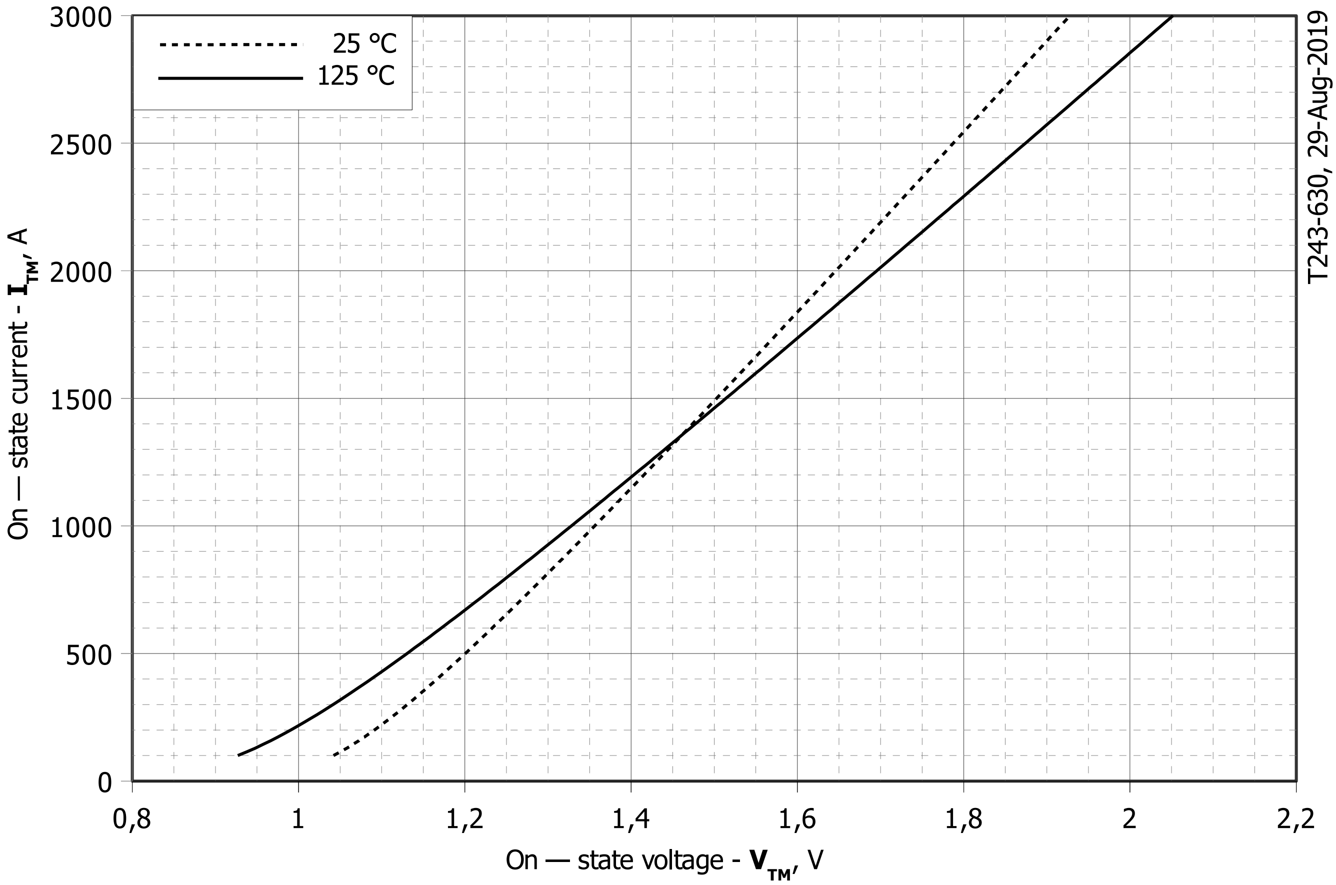


Fig 1 – On-state characteristics of Limit device

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	
	$T_j = 25°C$	$T_j = T_{j\,max}$
A	0.85846000	0.68224000
B	0.00027309	0.00034593
C	0.03507100	0.04743500
D	-0.00056132	-0.00087862

On-state characteristic model (see Fig. 1)

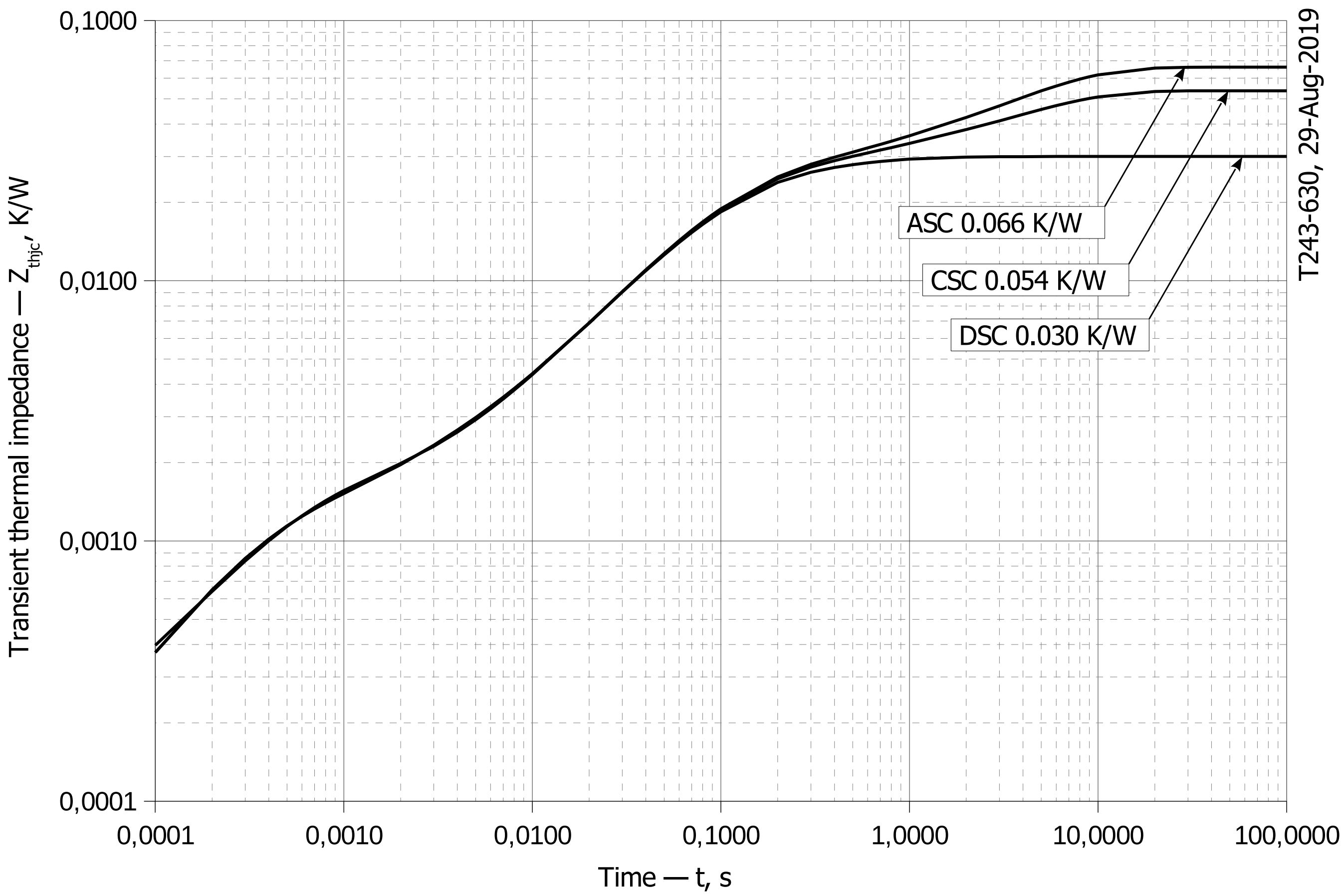


Рис. 2 – Зависимость переходного теплового сопротивления Z_{thjc} от времени t

Аналитическая зависимость переходного теплового сопротивления переход — корпус:

$$Z_{thjc} = \sum_{i=1}^{n} R_i \left(1 - e^{-\frac{t}{\tau_i}} \right)$$

Где ***i*** = 1 to ***n***, ***n*** – число суммирующихся элементов.

t = продолжительность импульсного нагрева в секундах.

$\mathbf{Z_{thjc}}$ = Тепловое сопротивление за время t.

$\mathbf{R_i, \tau_i}$ = расчетные коэффициенты, приведенные в таблице.

Постоянный ток, двустороннее охлаждение

i	1	2	3	4	5	6
R_i, К/ВТ	0.0007052	0.01986	0.001443	0.006652	0.001253	0.00009733
τ_i, с	1.200	0.083	0.0205	0.350	0.0004173	0.000001

Постоянный ток, охлаждение со стороны анода

i	1	2	3	4	5	6
R_i, К/Вт	0.03615	0.006266	0.0178	0.004365	0.0004912	0.001067
τ_i, с	4.713	0.5062	0.09497	0.04557	0.002123	0.0002807

Постоянный ток, охлаждение со стороны катода

i	1	2	3	4	5	6
R_i, К/Вт	0.001065	0.0004934	0.004583	0.01764	0.006202	0.0237
τ_i, с	0.0002798	0.002114	0.04598	0.09501	0.4891	4.712

Модель переходного теплового сопротивления переход - корпус (см. Рис. 2)

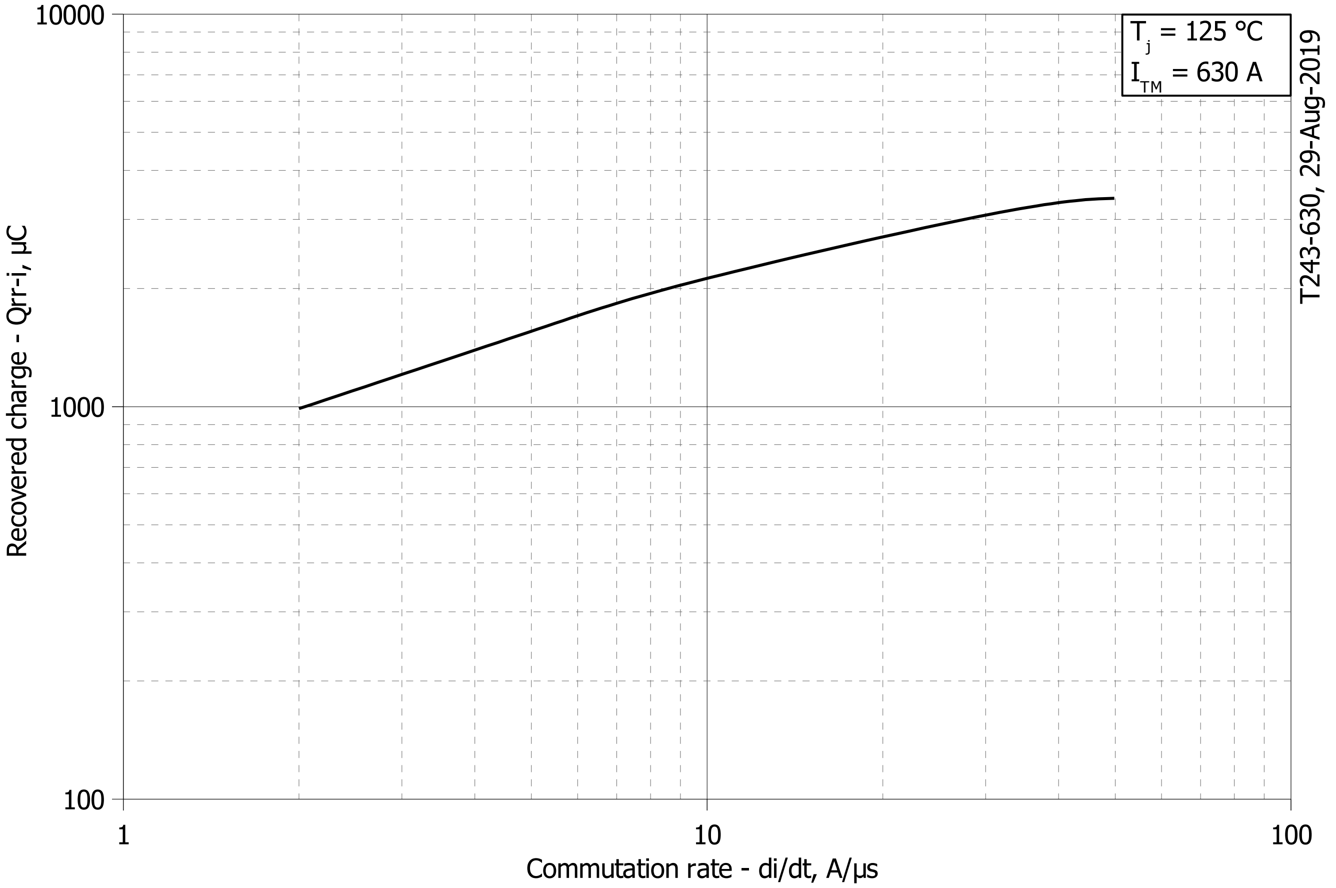


Fig 3 – Maximum recovered charge Q_{rr-i} (integral) vs. commutation rate di_R/dt

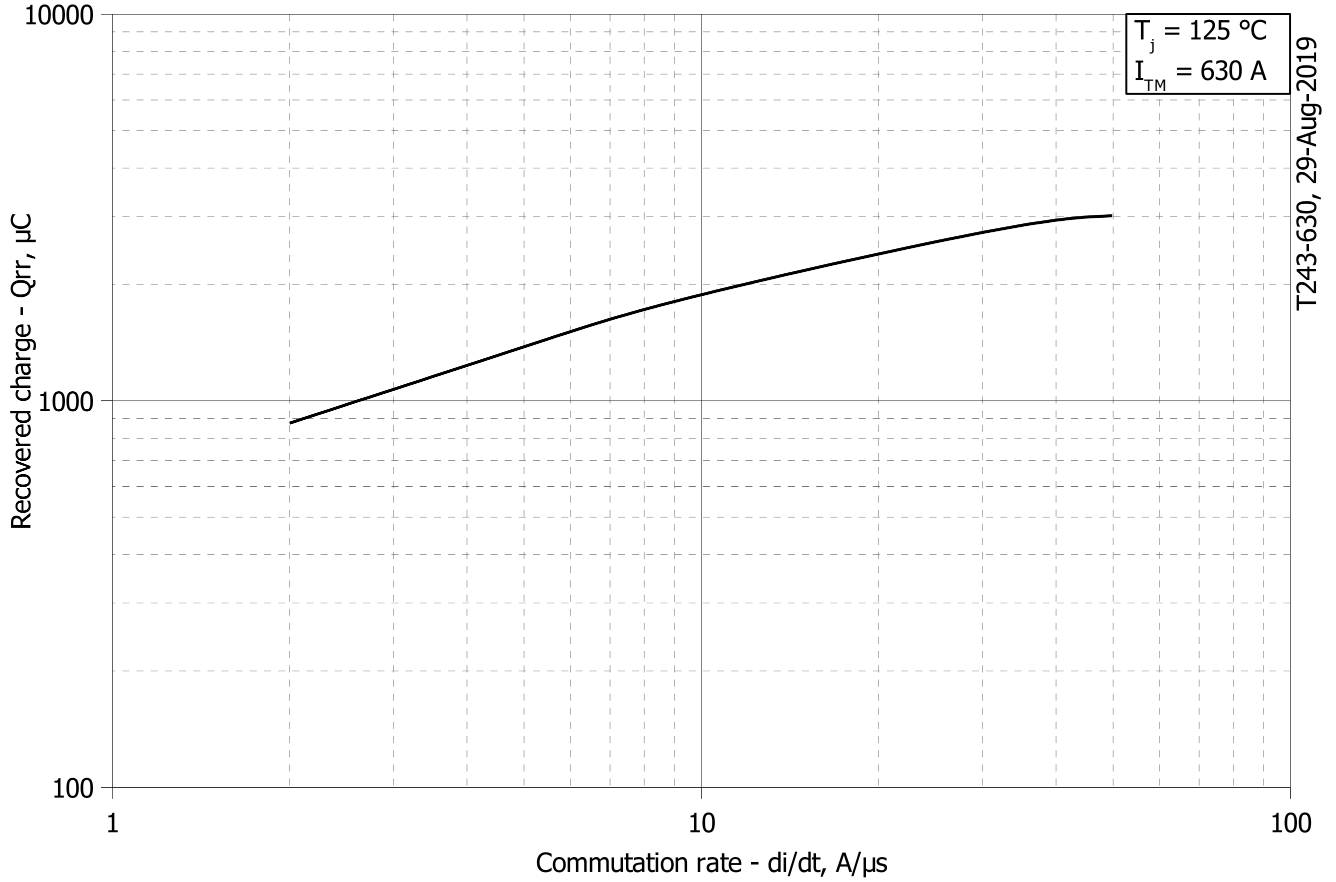


Fig 4 – Maximum recovered charge Q_{rr} vs. commutation rate di_R/dt (25% chord)

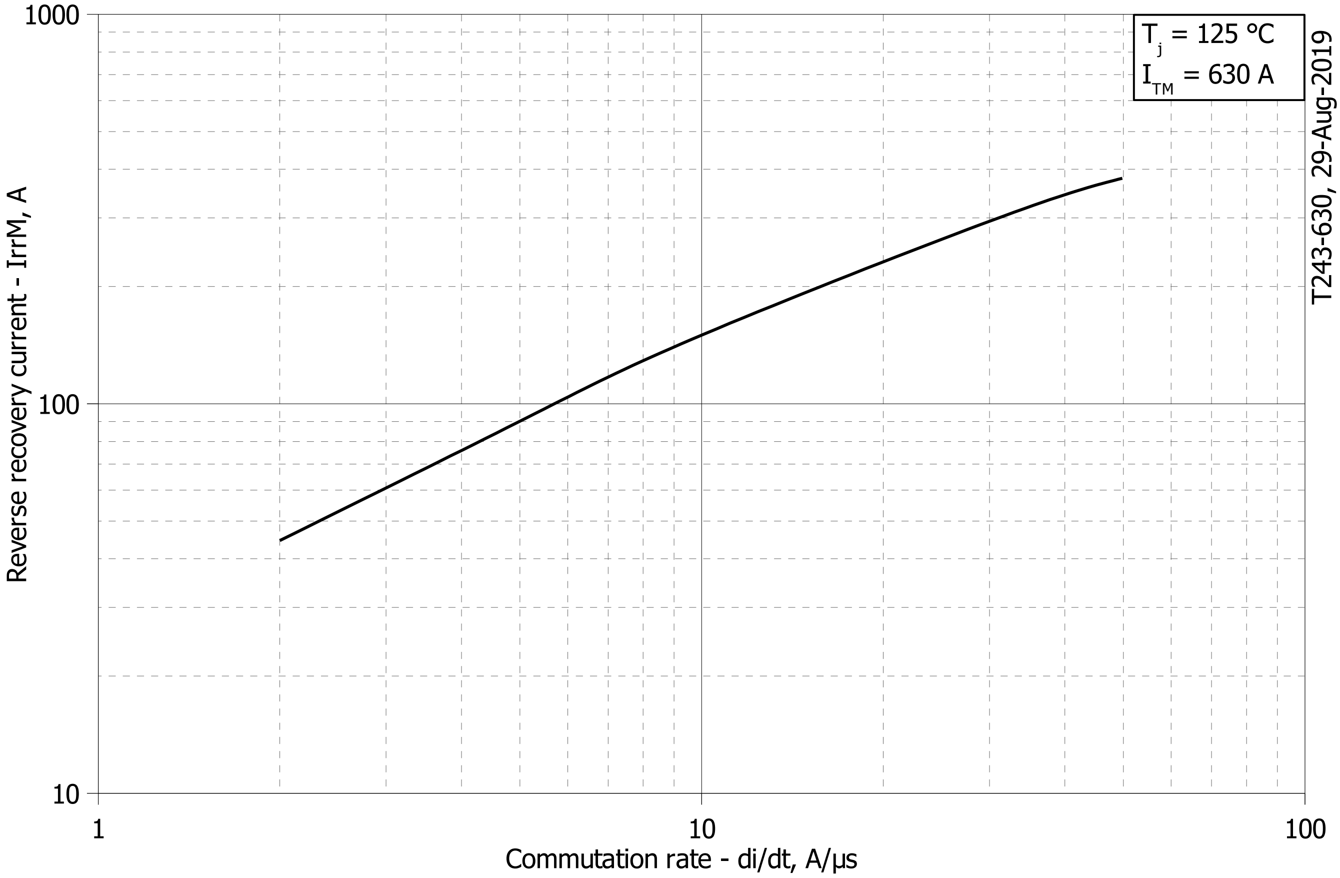


Fig 5 – Maximum reverse recovery current I_{rrM} vs. commutation rate di_R/dt

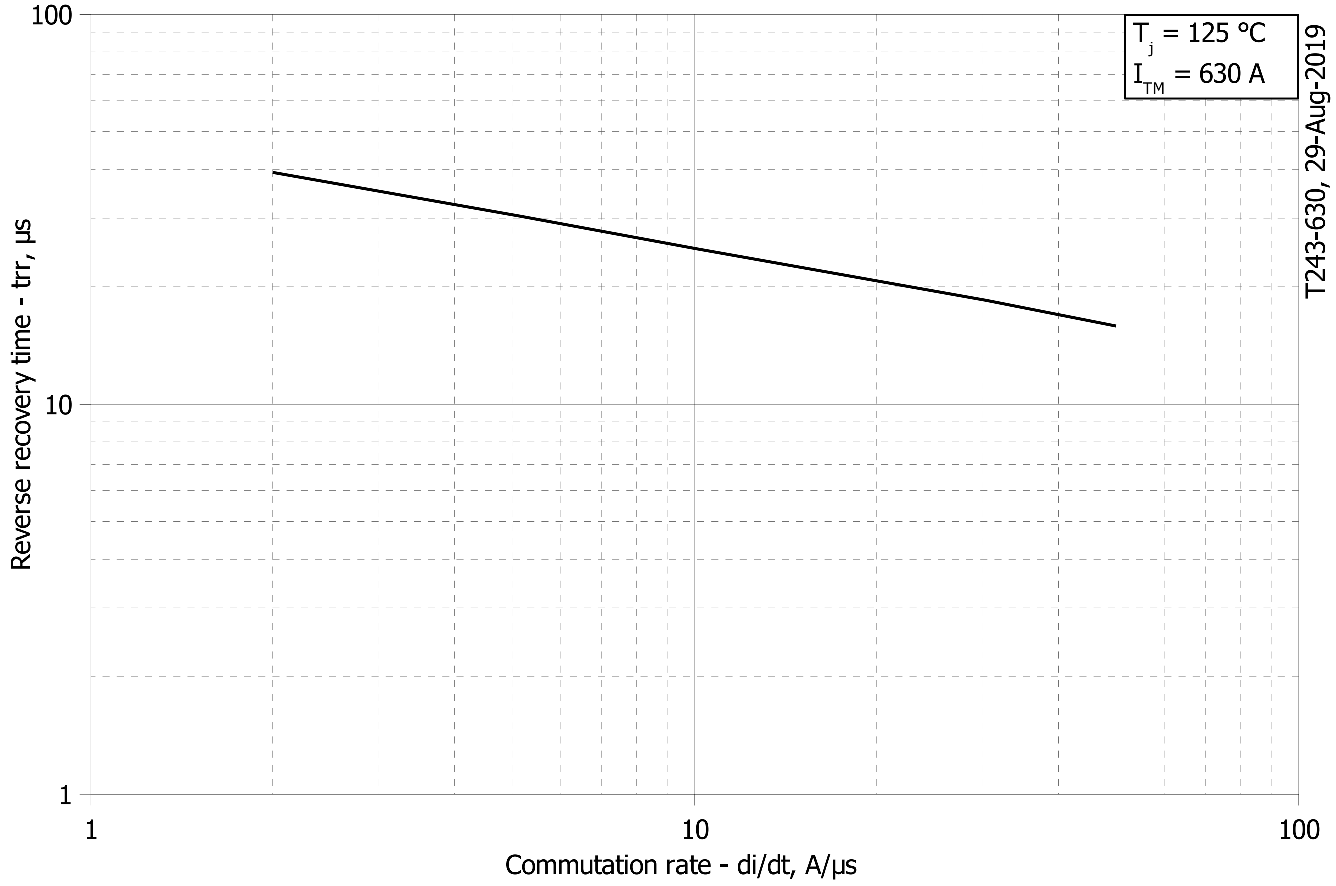


Fig 6 – Maximum recovery time t_{rr} vs. commutation rate di_R/dt (25% chord)

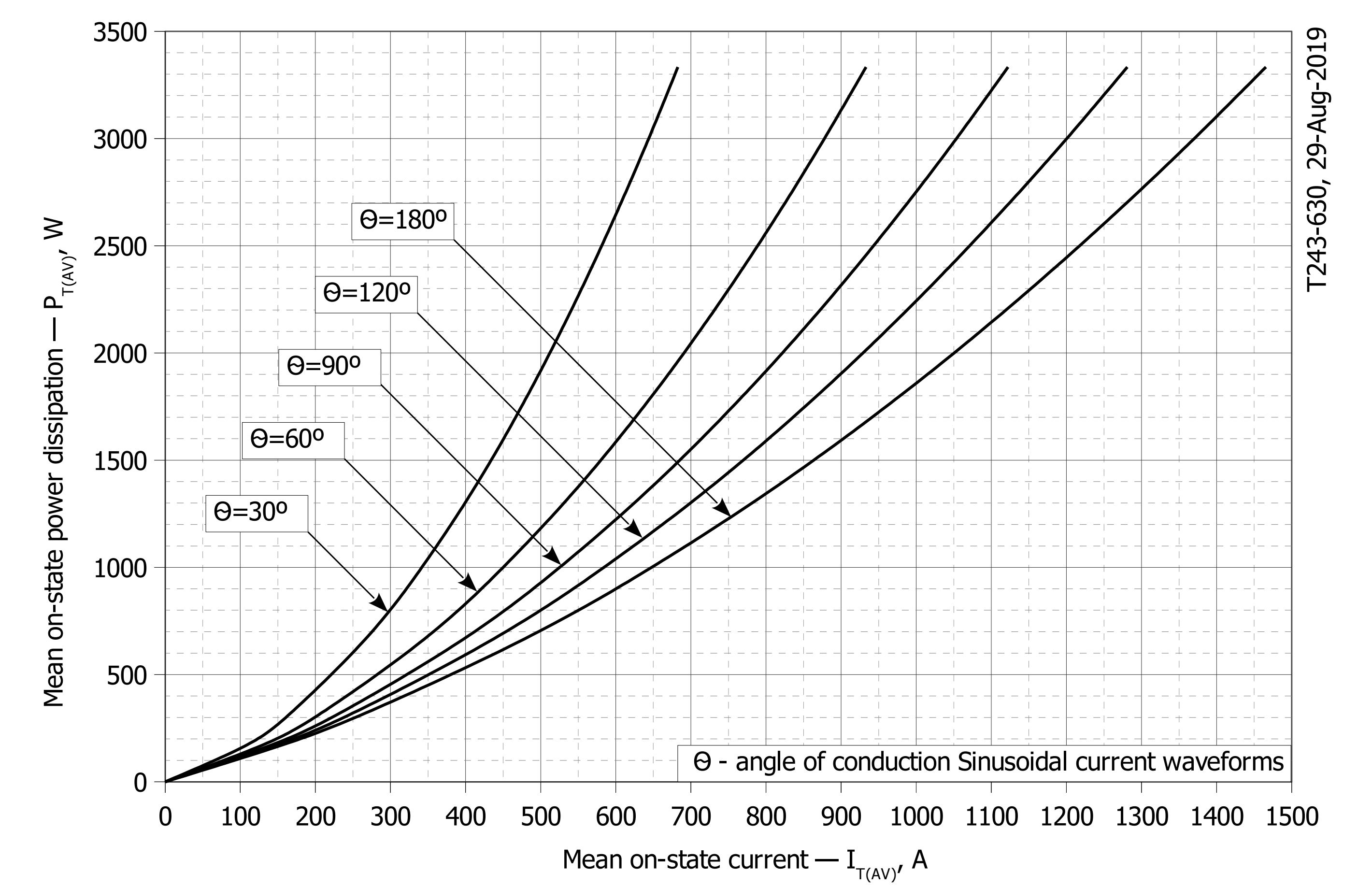


Fig. 7 - Mean on-state power dissipation P_{TAV} vs. mean on-state current I_{TAV} for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

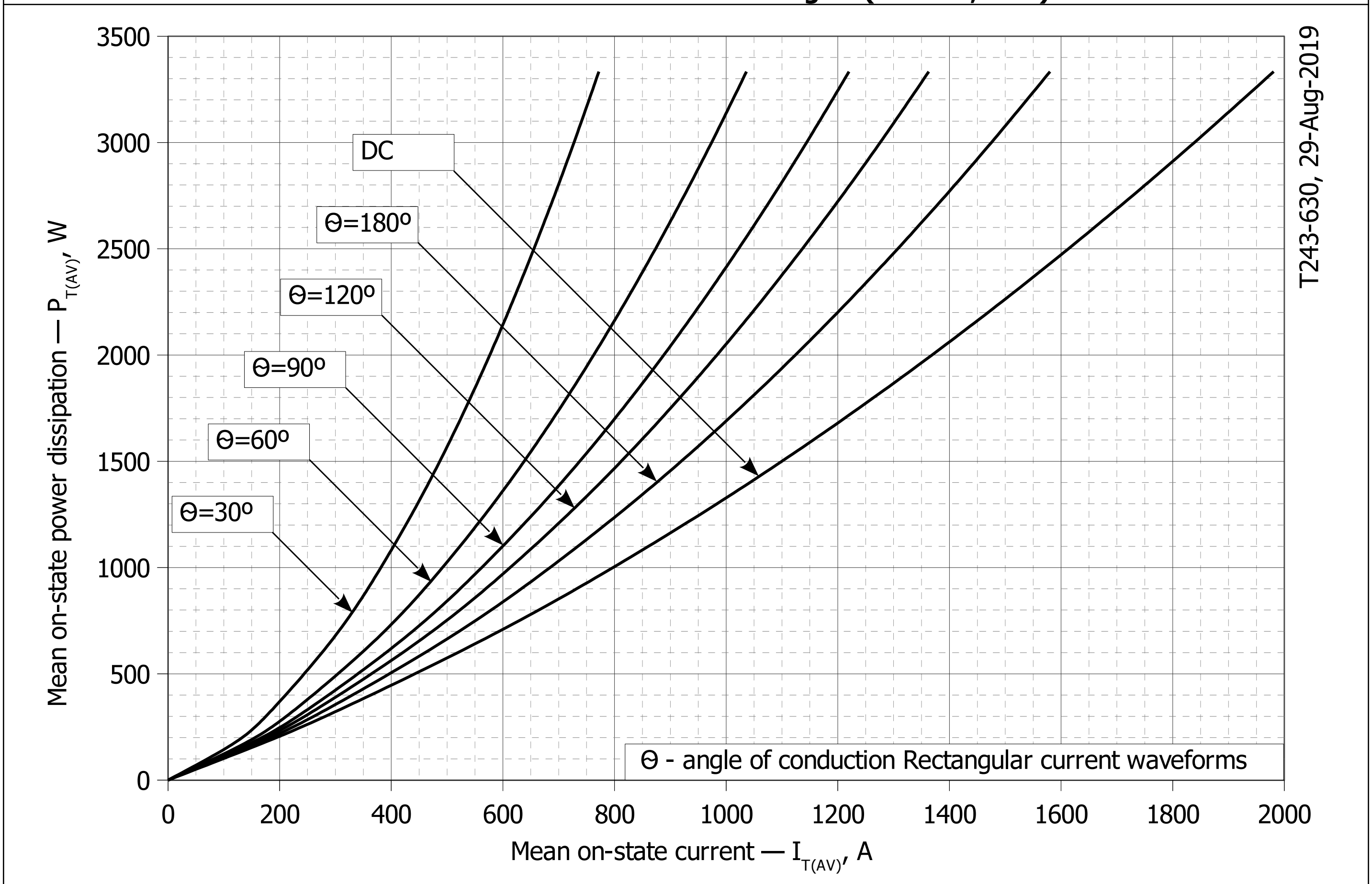


Fig. 8 – Mean on-state power dissipation P_{TAV} vs. mean on-state current I_{TAV} for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

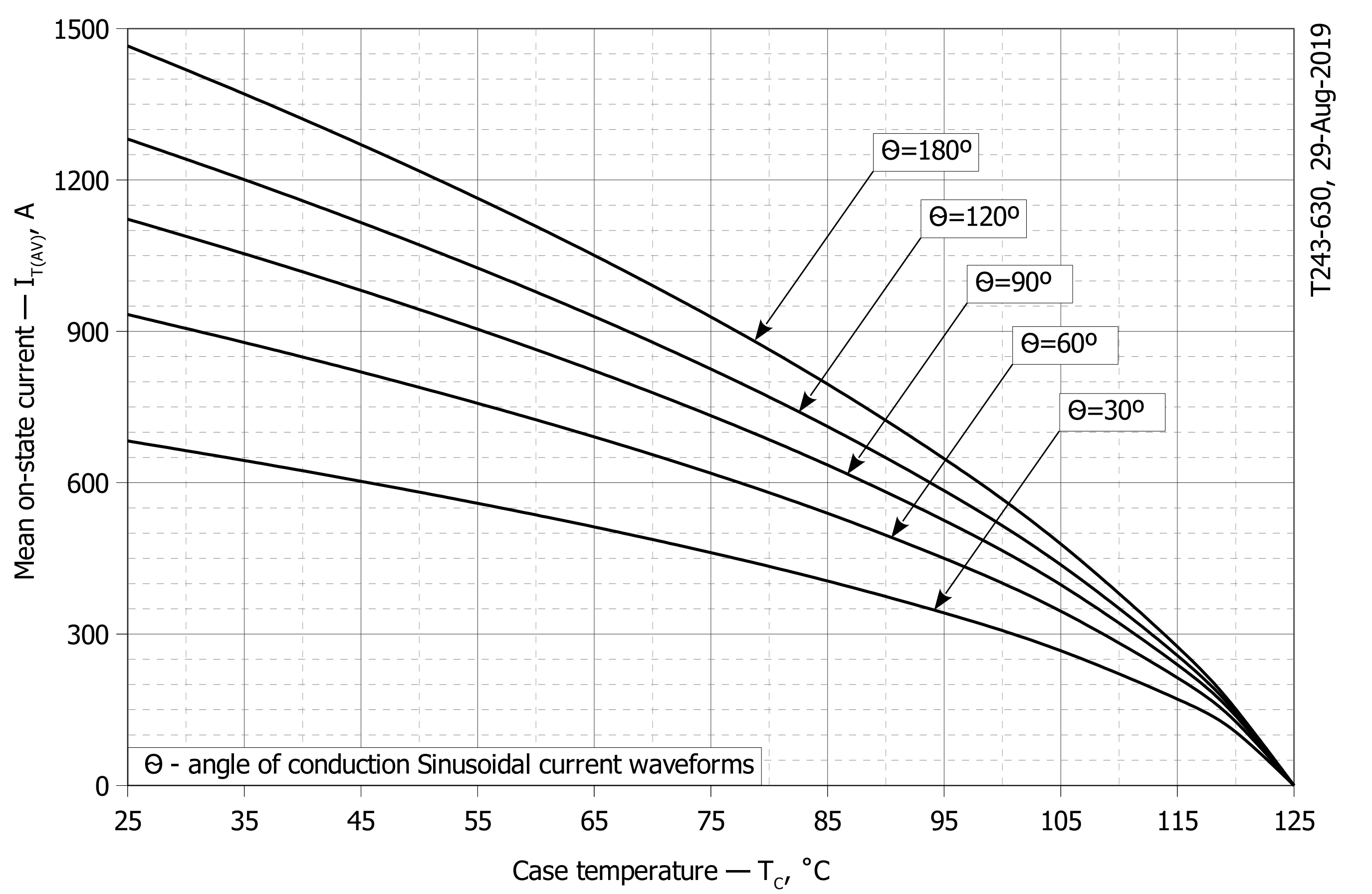


Fig. 9 – Mean on-state current I_{TAV} vs. case temperature T_C for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

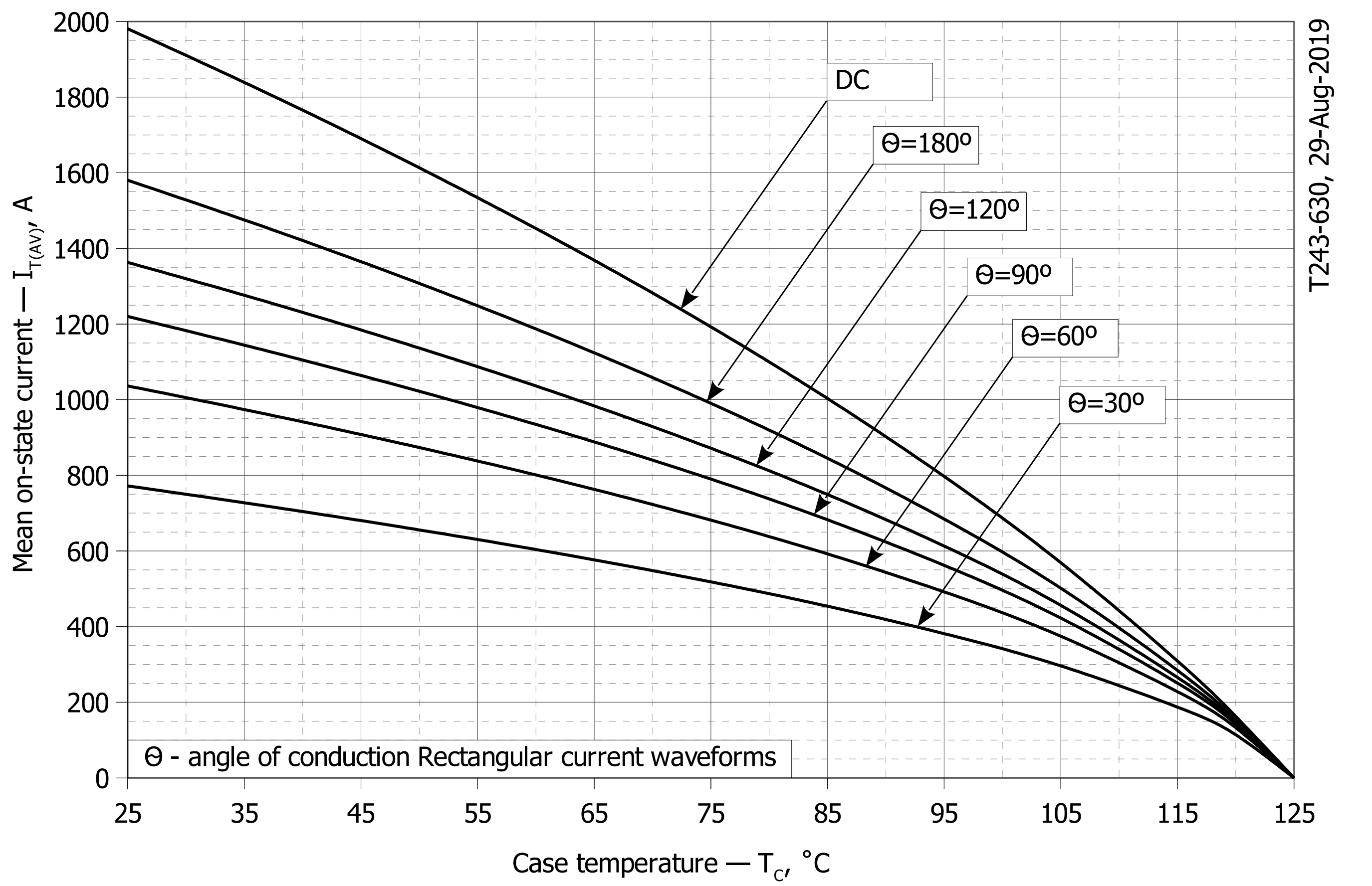


Fig. 10 - Mean on-state current I_{TAV} vs. case temperature T_C for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

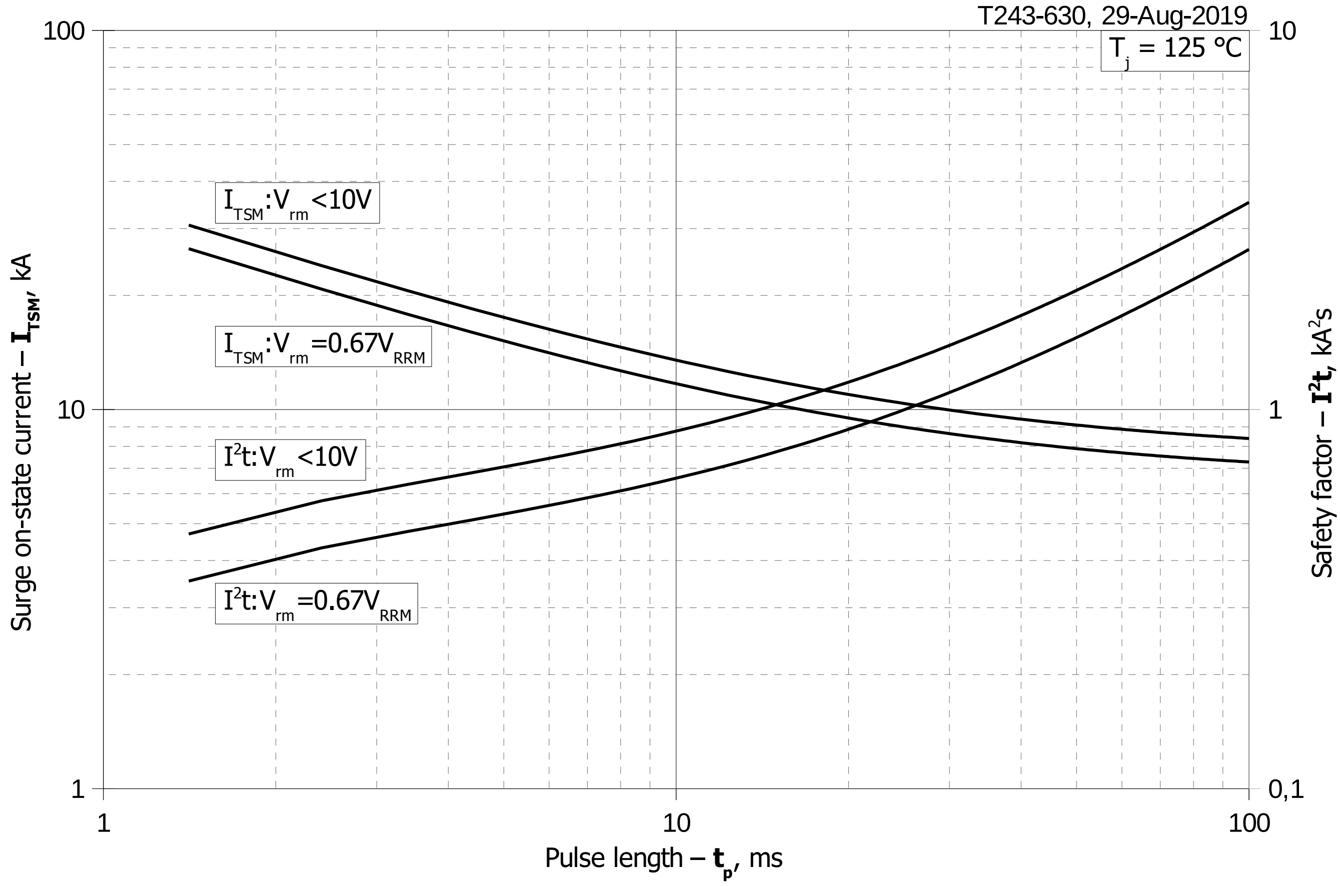


Fig. 11 – Maximum surge on-state current I_{TSM} and safety factor I^2t vs. pulse length t_p

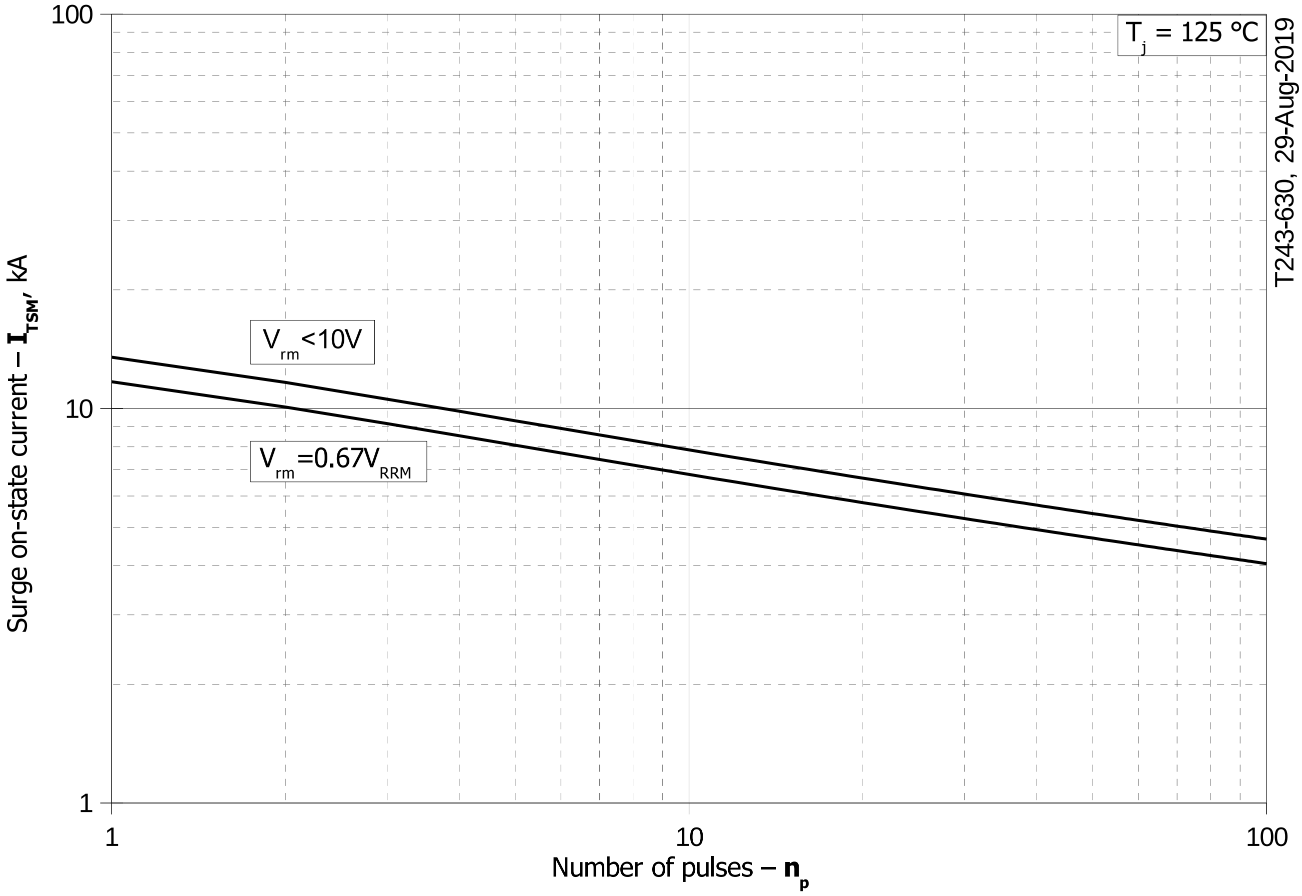


Fig. 12 - Maximum surge on-state current I_{TSM} vs. number of pulses n_p