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

Phase Control Thyristor
Type T143-1000-10

Mean on-state current	I_{TAV}	1000 A
Repetitive peak off-state voltage	V_{DRM}	1000 V
Repetitive peak reverse voltage	V_{RRM}	
Turn-off time	t_q	160, 200, 250, 320, 400, 500 µs
V_{DRM}, V_{RRM}, V	1000	
Voltage code	10	
T_j, °C	-60 ÷ 150	

MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions	
ON-STATE					
I_{TAV}	Mean on-state current	A	1000 1408	T_c=109 °C, Double side cooled T_c=85 °C, Double side cooled 180° half-sine wave; 50 Hz	
I_{TRMS}	RMS on-state current	A	1570	T_c=109 °C, Double side cooled 180° half-sine wave; 50 Hz	
I_{TSM}	Surge on-state current	kA	21.5 25.0	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
			23.0 26.0	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; $di_G/dt \geq 1$ A/µs
I^2t	Safety factor	$A^2s \cdot 10^3$	2300 3100	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
			2100 2800	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	1000	$T_{j\,min}$< 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	$T_{j\,min}$< 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	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	800	$T_j=T_{j\,max}$; $V_D=0.67 \cdot V_{DRM}$; $I_{TM}=3500$ 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÷150	
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	1.50	$T_j=25$ °C; $I_{TM}=3140$ A
$V_{T(TO)}$	On-state threshold voltage, max	V	0.878	$T_j=T_{j\,max}$; $0.5\,\pi\,I_{TAV} < I_T < 1.5\,\pi\,I_{TAV}$
r_T	On-state slope resistance, max	mΩ	0.191	
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 voltage1), 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	0.55	$T_j=T_{j\,max}$; $V_D=0.67 \cdot V_{DRM}$; Direct gate current
I_{GD}	Gate non-trigger direct current, min	mA	70.00	
SWITCHING				
t_{gd}	Delay time, max	µs	0.85	$T_j=25$ °C; $V_D=600$ 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 time2), 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; $V_R=100$V; $V_D=0.67 \cdot V_{DRM}$
Q_{rr}	Total recovered charge, max	µC	1100	$T_j=T_{j\,max}$; $I_{TM}=1000$ A; $di_R/dt=-10$ A/µs; $V_R=100$ V
t_{rr}	Reverse recovery time, max	µs	18	
I_{rrM}	Peak reverse recovery current, max	A	122	

THERMAL					
R_{thjc}	Thermal resistance, junction to case, max	°C/W	0.030	Direct current	Double side cooled
R_{thjc-A}			0.066		Anode side cooled
R_{thjc-K}			0.054		Cathode side cooled
R_{thck}	Thermal resistance, case to heatsink, max	°C/W	0.006	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	143	1000	10	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

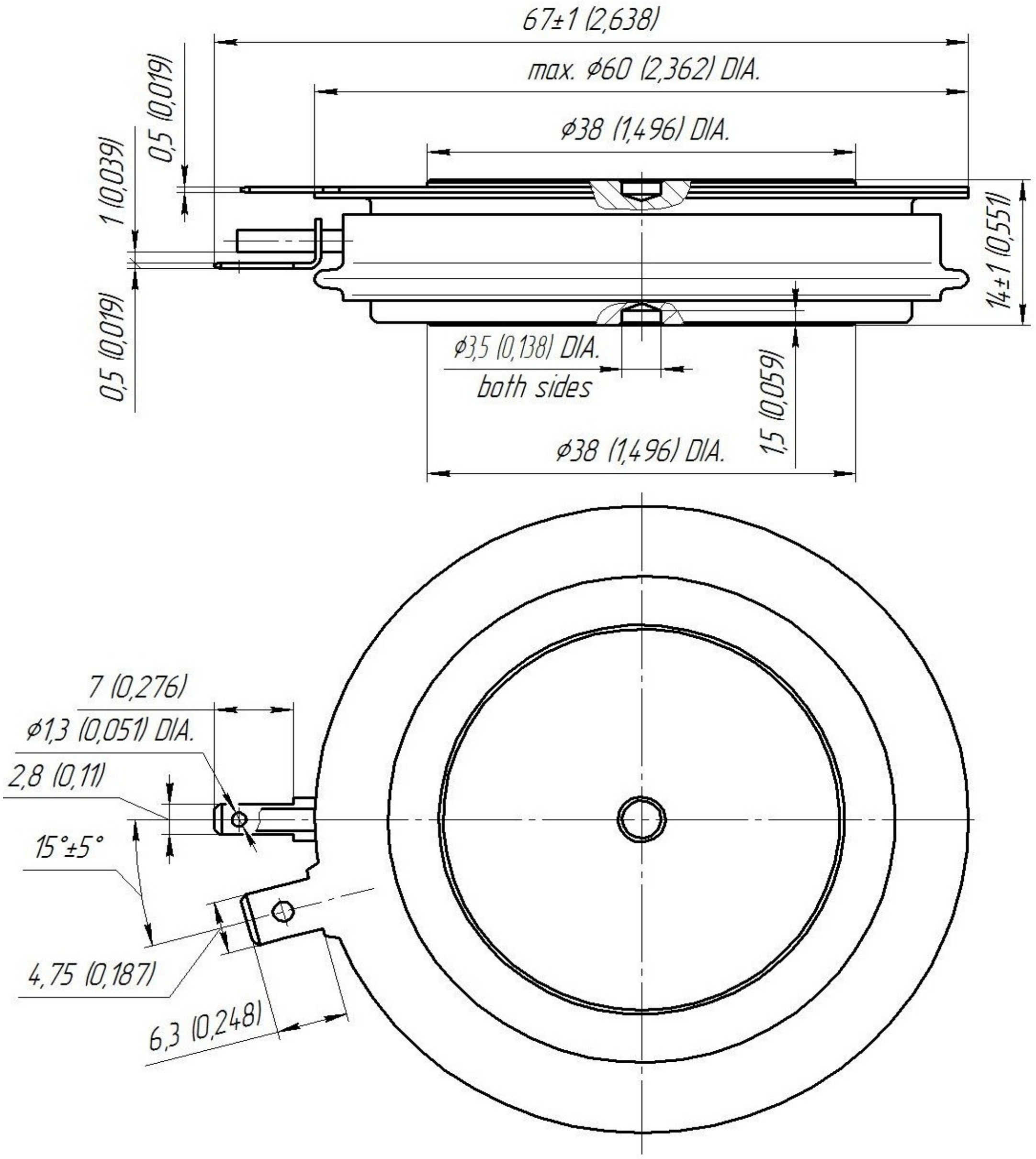
Symbol of Group	P2	K2	E2	A2	T1	P1	M1
$(dv_D/dt)_{crit}$, V/μs	200	320	500	1000	1600	2000	2500

[2] Turn-off time (dv_D/dt=50 V/μs)

Symbol of Group	T2	P2	M2	K2	H2	E2
t_q, μs	160	200	250	320	400	500

OVERALL DIMENSIONS

Package type: T.C1



All dimensions in millimeters (inches)

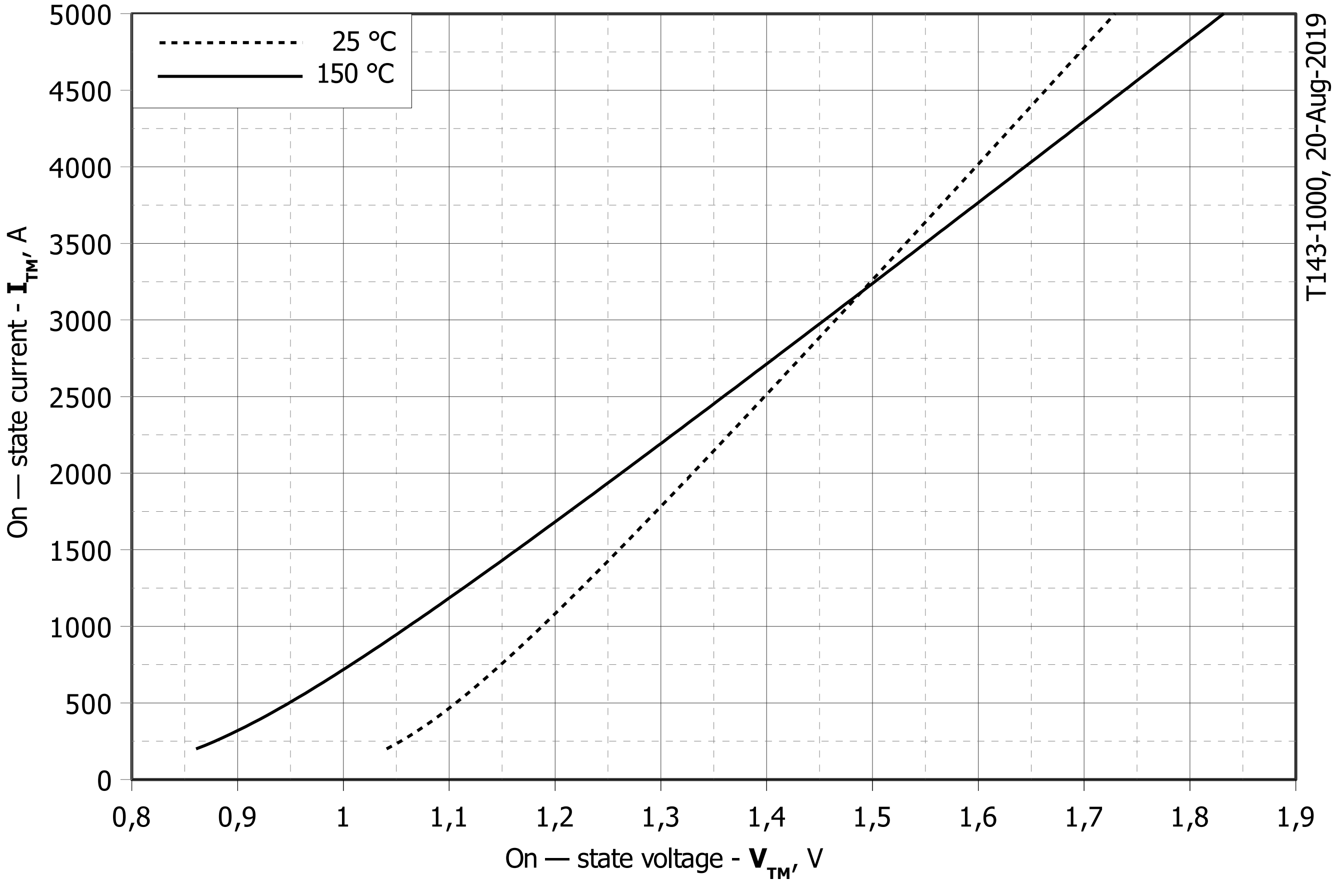


Fig 1 – On-state characteristics of Limit device

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	0.81475000	0.58154000
B	0.00013371	0.00019089
C	0.04170100	0.05053300
D	-0.00154560	-0.00190030

On-state characteristic model (see Fig. 1)

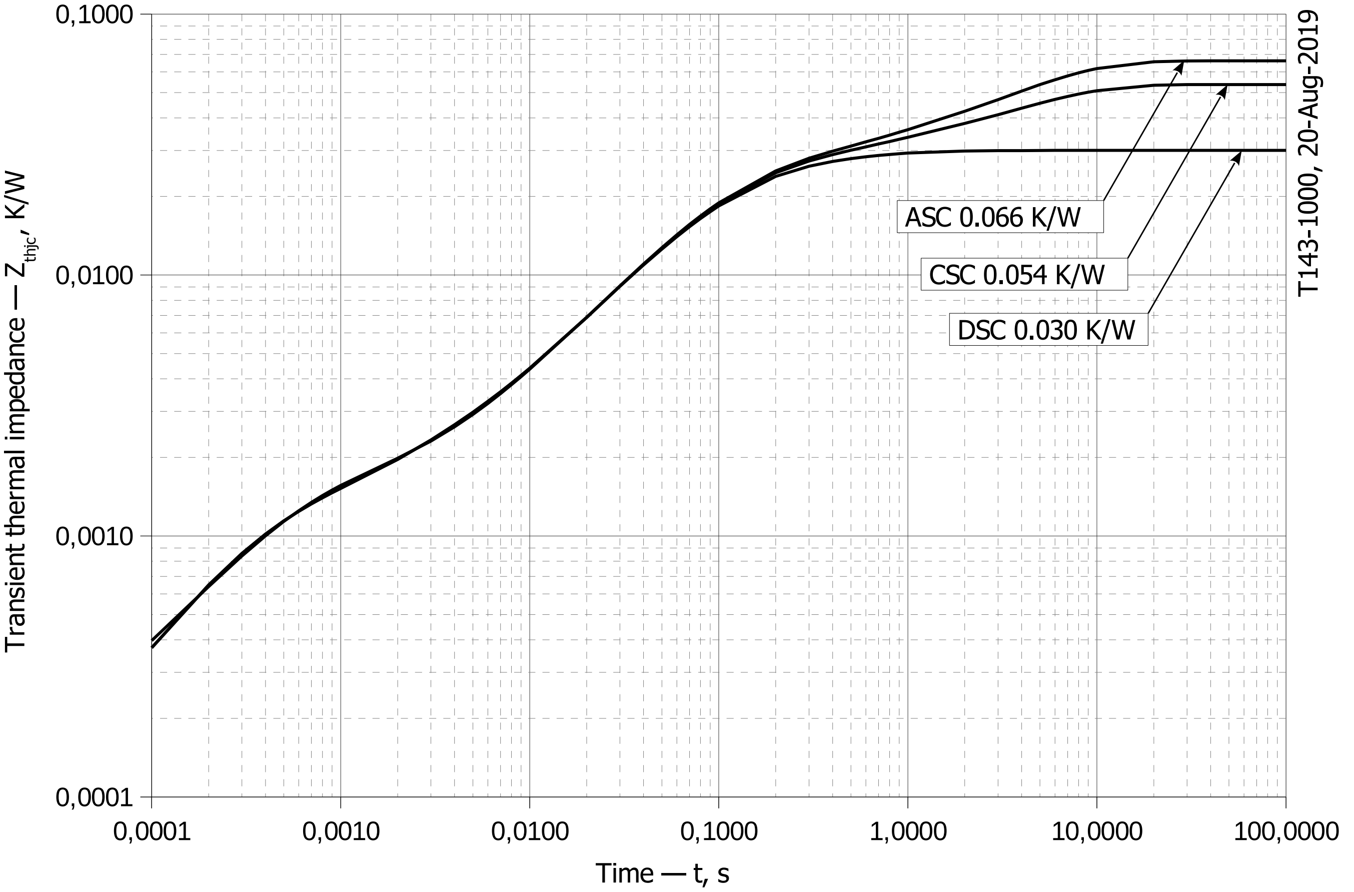


Fig 2 – Transient thermal impedance Z_{thjc} vs. time t

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.

DC Double side cooled

i	1	2	3	4	5	6
R_i, K/W	0.0007052	0.01986	0.001443	0.006652	0.001253	0.00009733
τ_i, s	1.200	0.083	0.0205	0.350	0.0004173	0.000001

DC Anode side cooled

i	1	2	3	4	5	6
R_i, K/W	0.03615	0.006266	0.0178	0.004365	0.0004912	0.001067
τ_i, s	4.713	0.5062	0.09497	0.04557	0.002123	0.0002807

DC Cathode side cooled

i	1	2	3	4	5	6
R_i, K/W	0.001065	0.0004934	0.004583	0.01764	0.006202	0.0237
τ_i, s	0.0002798	0.002114	0.04598	0.09501	0.4891	4.712

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

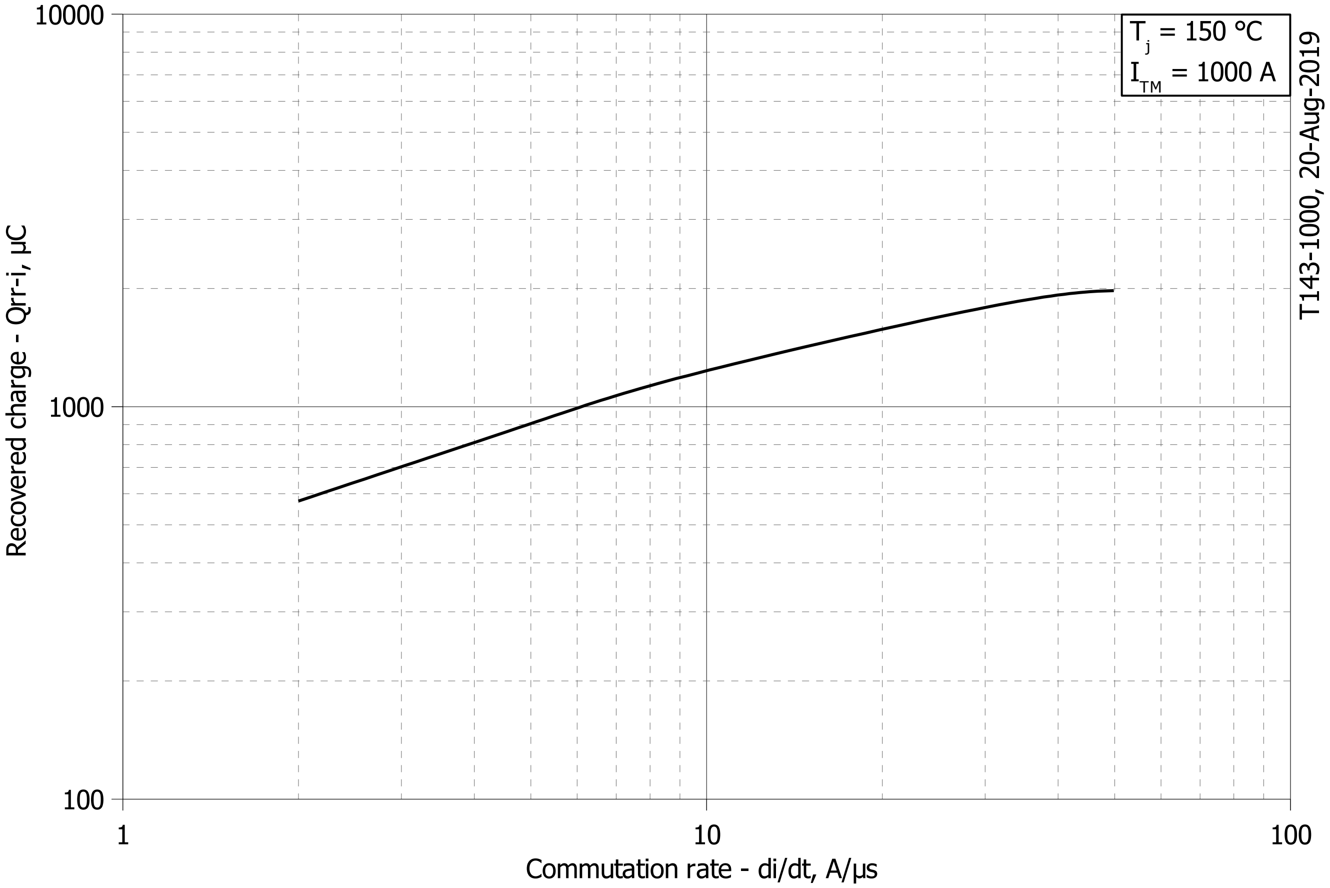


Fig 3 – Maximum recovered charge $Q_{rr\text{-}i}$ (integral) vs. commutation rate di_R/dt

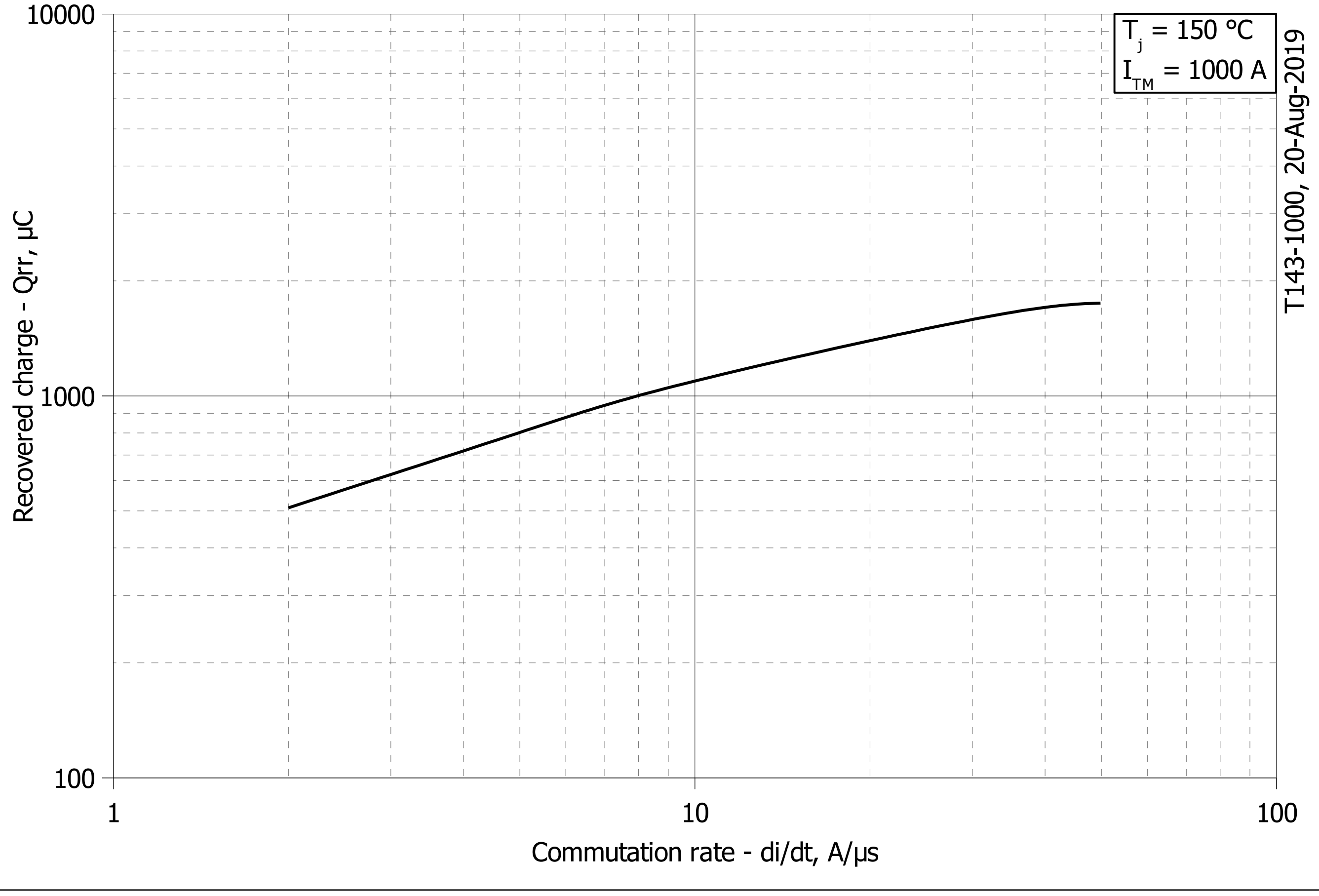


Fig 4 – Maximum recovered charge Q_{rr} vs. commutation rate di_R/dt (25% chord)

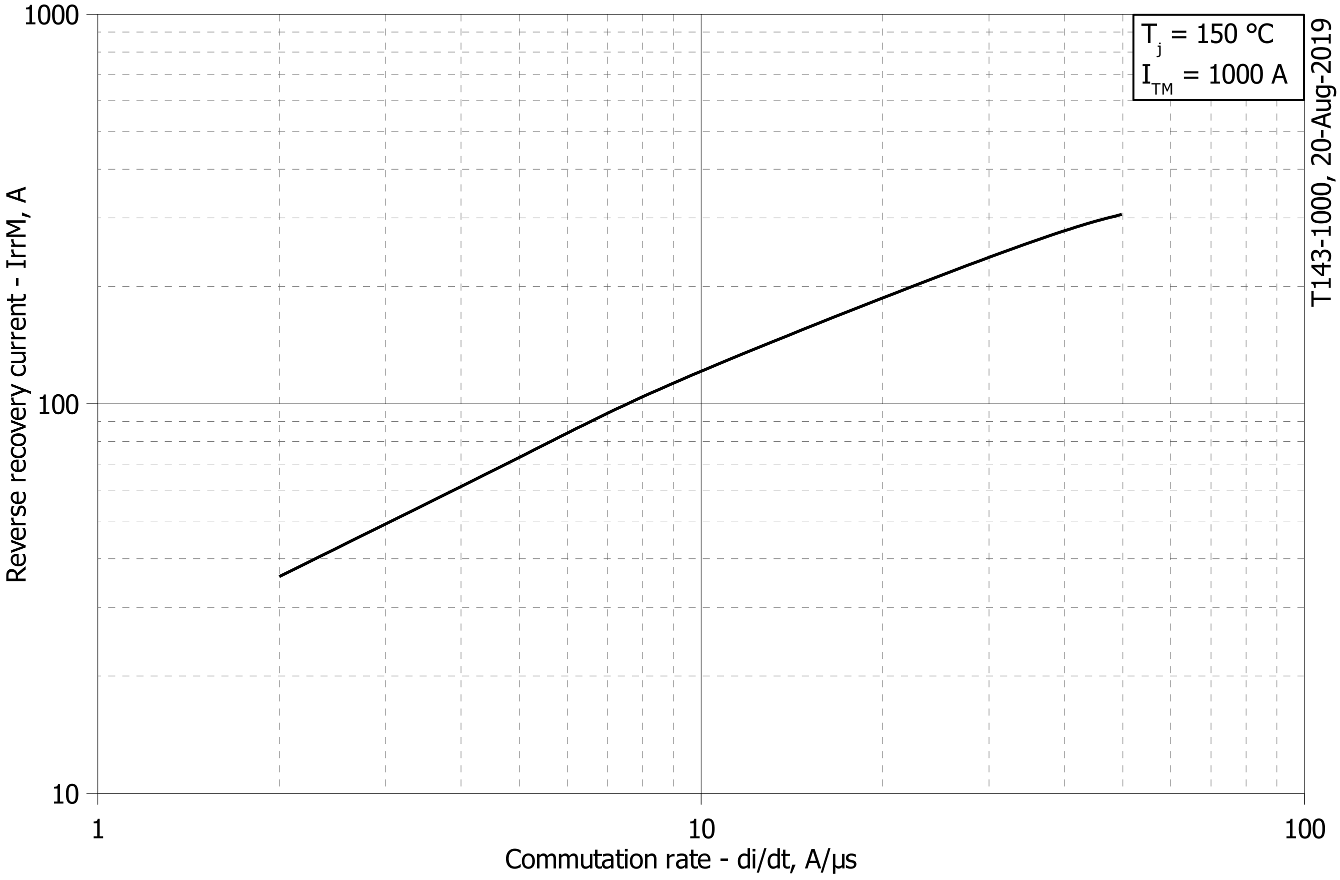


Fig 5 – Maximum reverse recovery current I_{rrM} vs. commutation rate di_R/dt

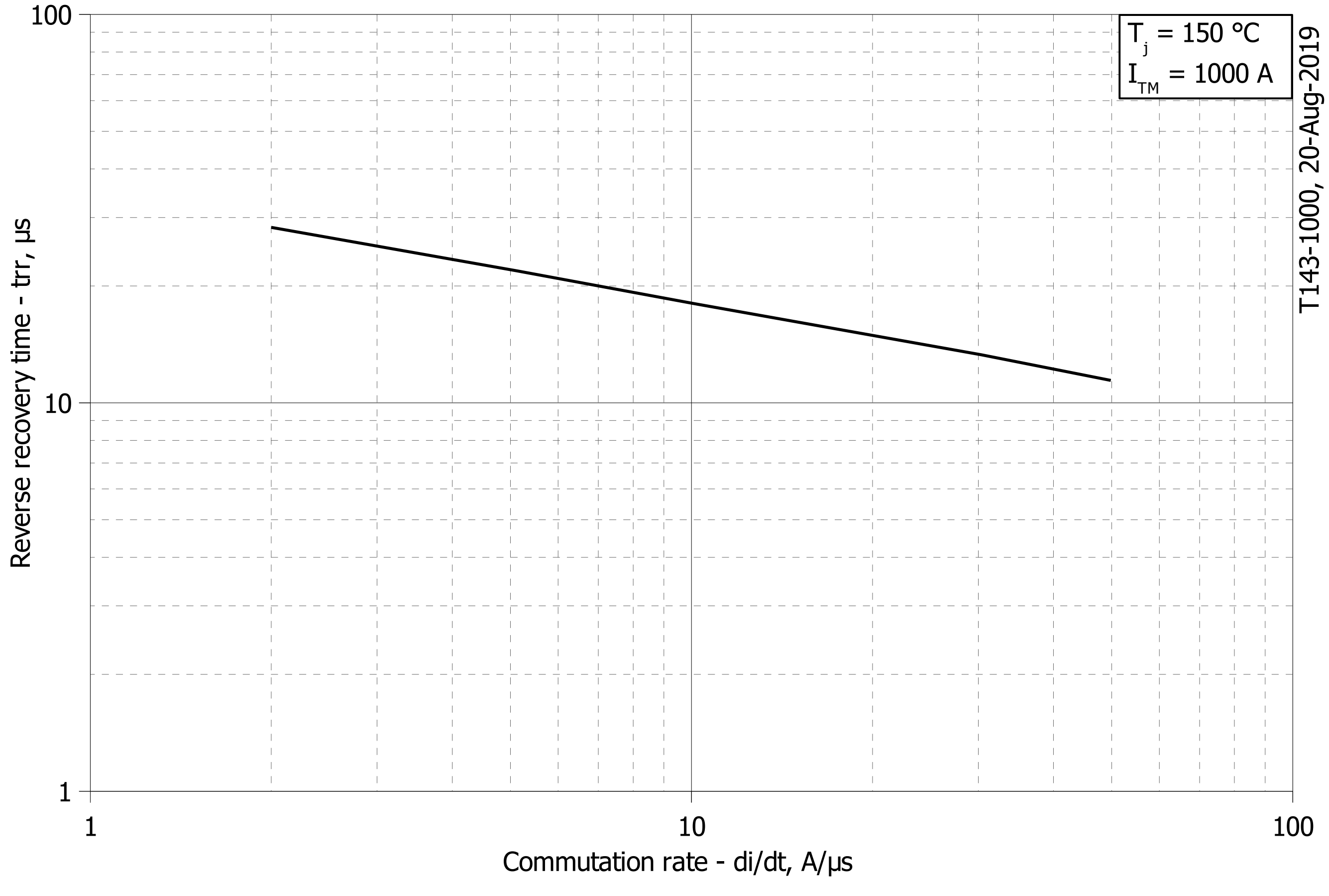


Fig 6 – Maximum recovery time t_{rr} vs. commutation rate di_R/dt (25% chord)

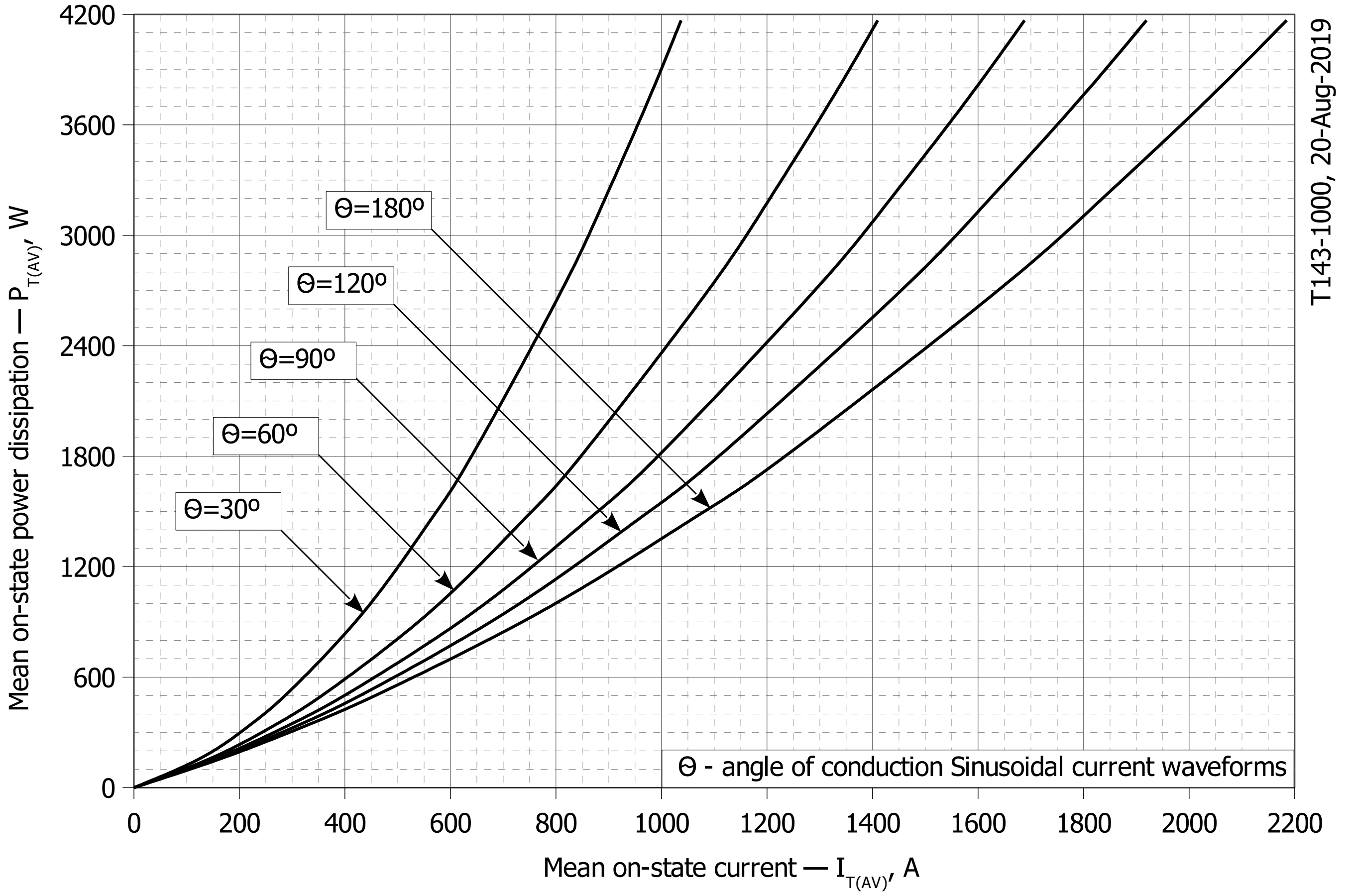


Fig. 7 - Mean on-state power dissipation P_{TAV} vs. mean on-state current I_{TAV} for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

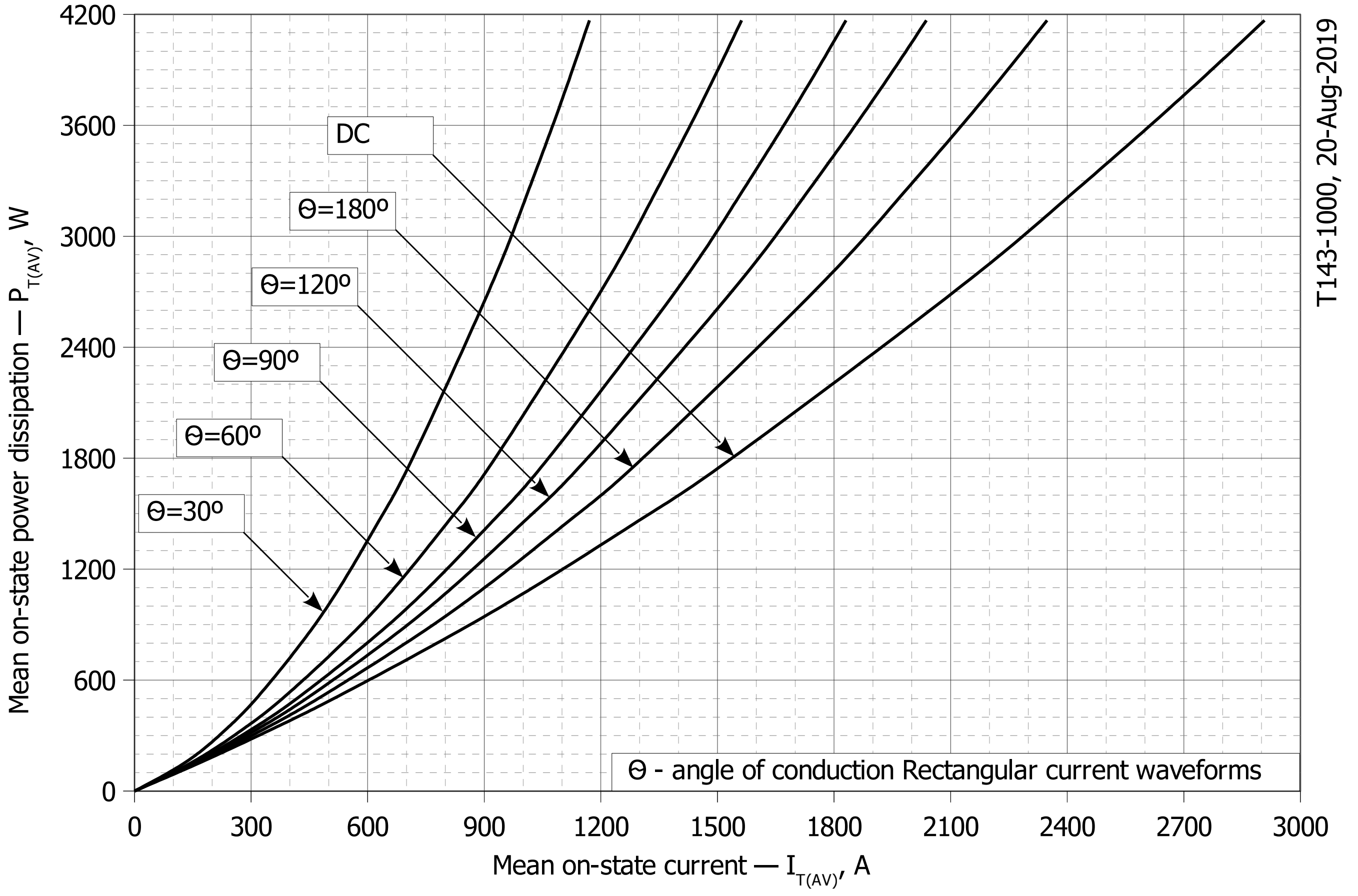


Fig. 8 – Mean on-state power dissipation P_{TAV} vs. mean on-state current I_{TAV} for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

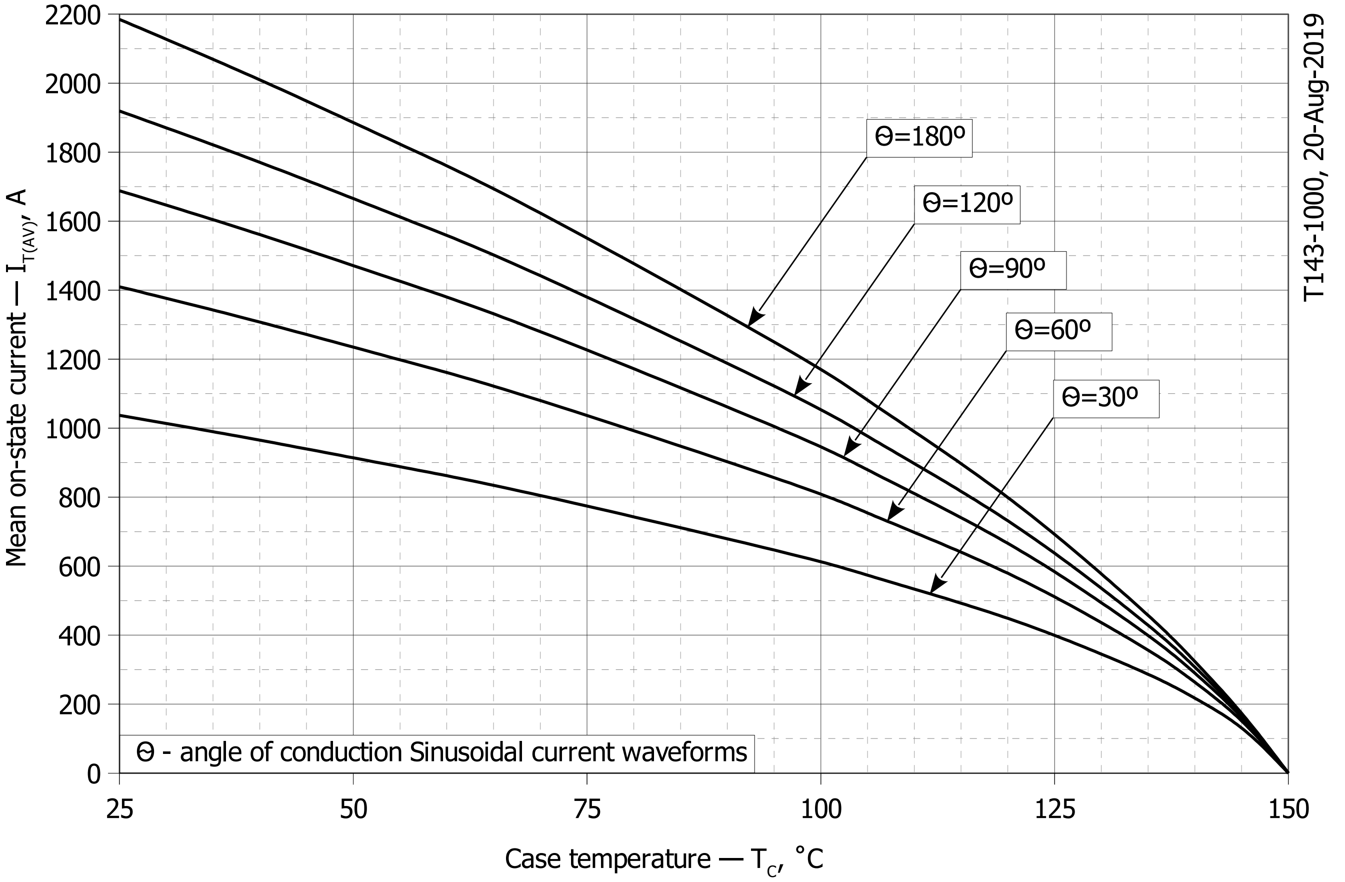


Fig. 9 – Mean on-state current I_{TAV} vs. case temperature T_C for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

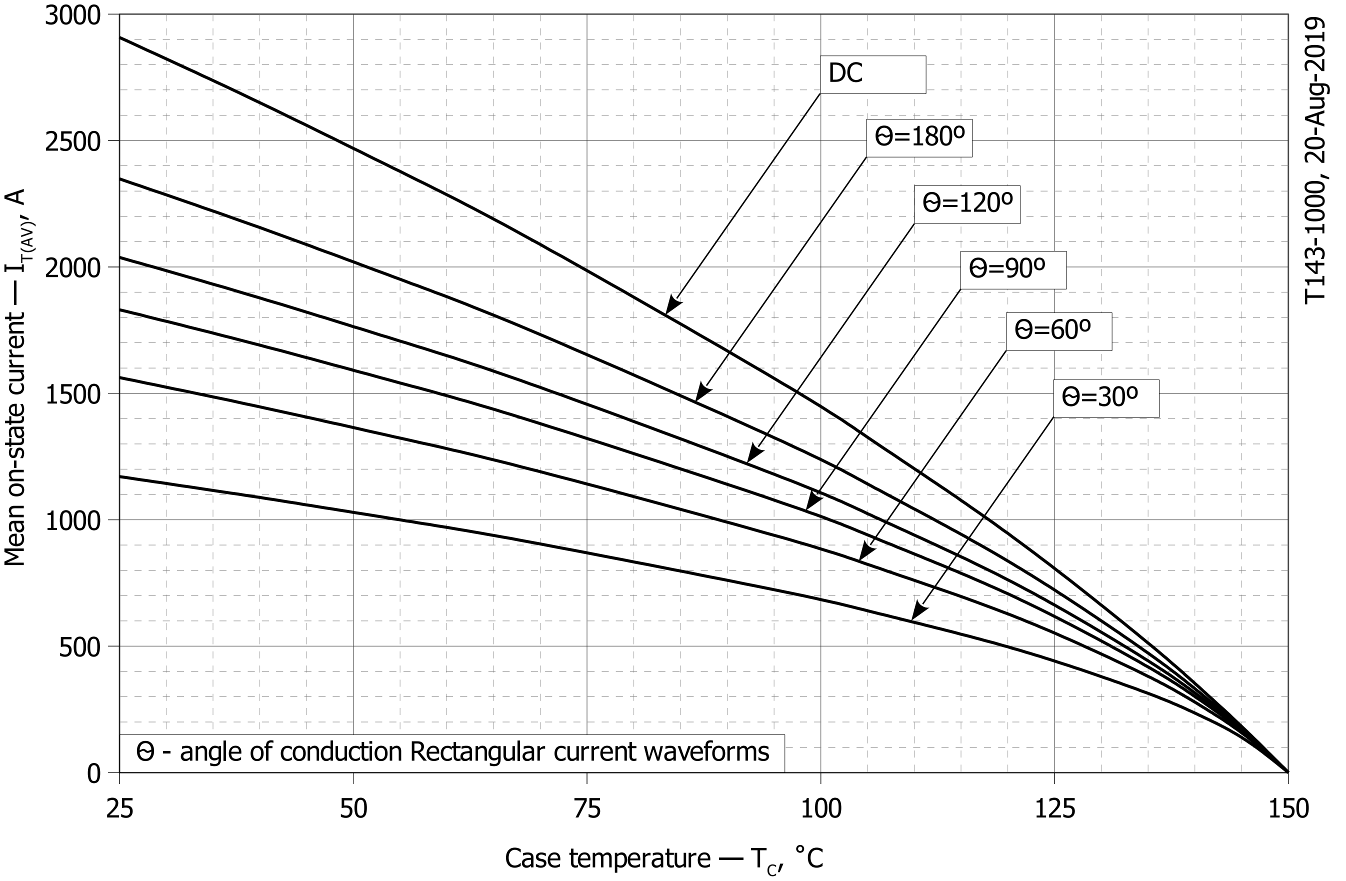


Fig. 10 - Mean on-state current I_{TAV} vs. case temperature T_C for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

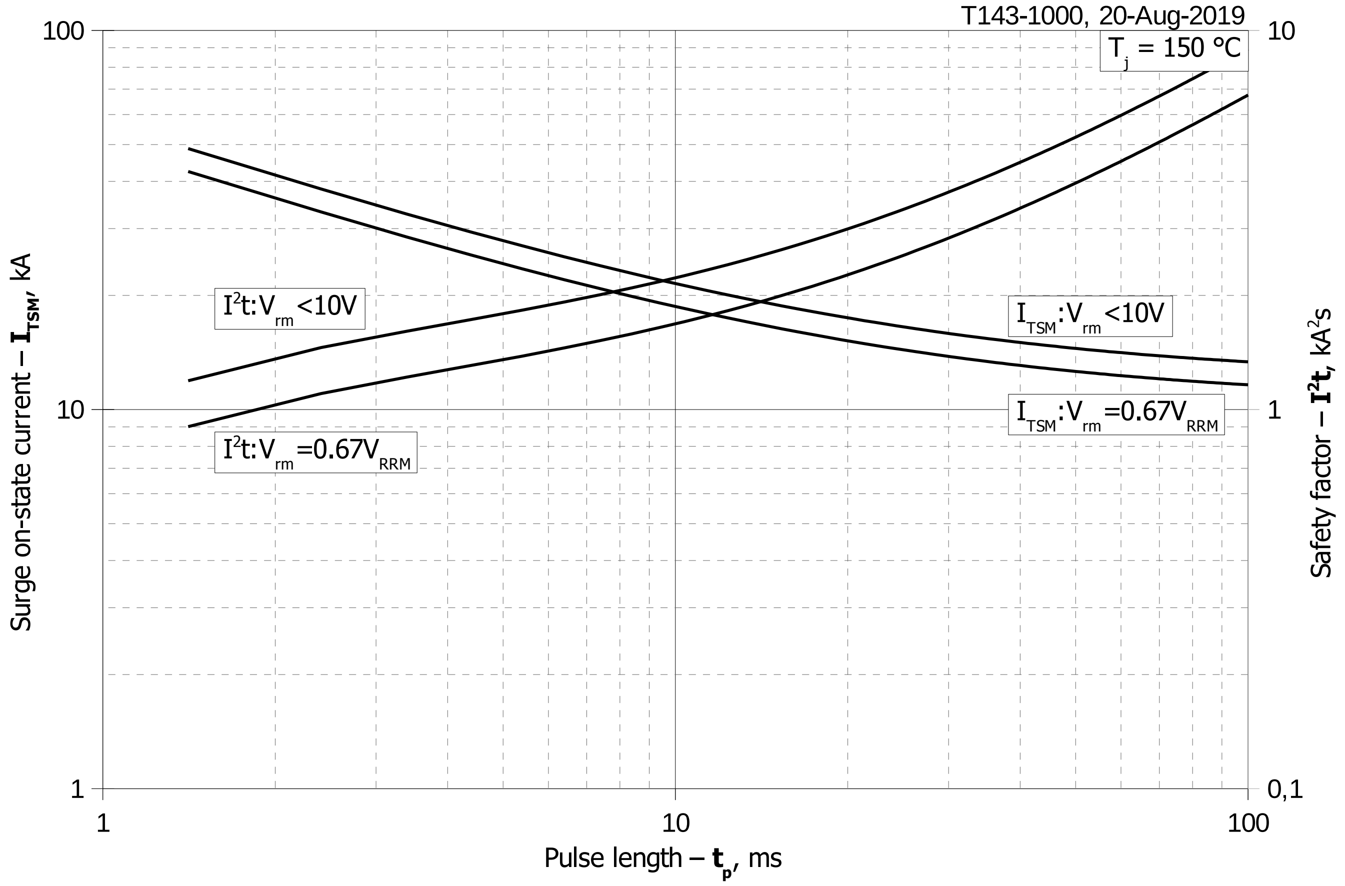


Fig. 11 – Maximum surge on-state current I_{TSM} and safety factor I^2t vs. pulse length t_p

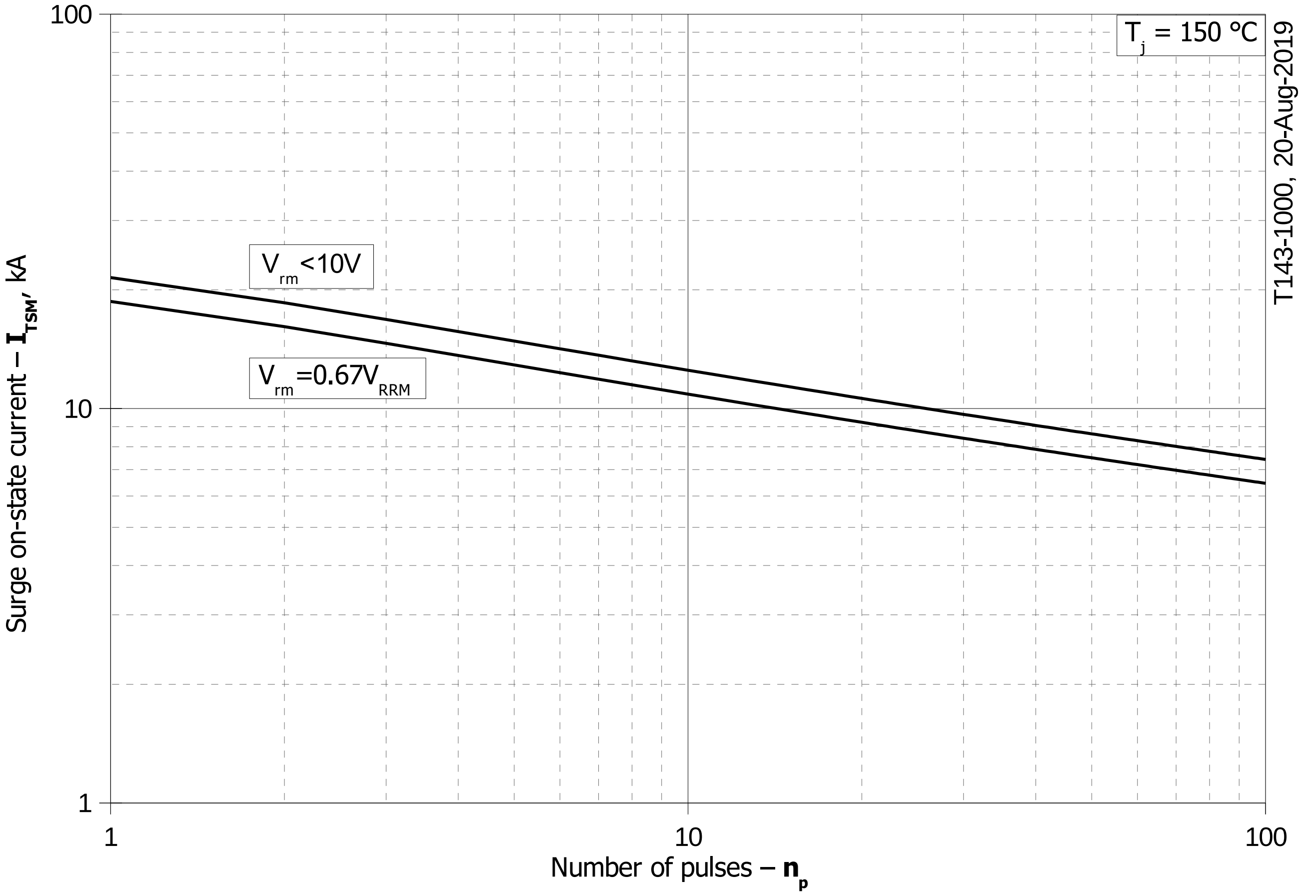


Fig. 12 - Maximum surge on-state current I_{TSM} vs. number of pulses n_p