



PROTON-ELECTROTEX RUSSIA

Optimum power handling
Low on-state and switching losses
Designed for traction and industrial applications

Avalanche Stud Thyristor Type TA271-320-12

Mean on-state current				I _{TAV}		320 A	
Repetitive peak off-state voltage				V _{DRM}		600...1200 V	
Repetitive peak reverse voltage				V _{RRM}			
Turn-off time				t _q		160 μs	
V _{DRM} , V _{RRM} , V	600	700	800	900	1000	1100	1200
Voltage code	6	7	8	9	10	11	12
T _j , °C	-60...+140						

MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions	
ON-STATE					
I _{TAV}	Maximum allowable mean on-state current	A	320	T _c = 97 °C; 180° half-sine wave; 50 Hz	
I _{TRMS}	RMS on-state current	A	502	T _c = 97 °C; 180° half-sine wave; 50 Hz	
I _{TSM}	Surge on-state current	kA	9.0 10.5	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
			9.5 11.0	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	400 550	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
			370 500	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	600...1200	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	700...1300	T _{j min} < T _j < T _{j max} ; 180° half-sine wave; single pulse; Gate open	
V _(BR)	Breakdown voltage	V	850...1700	T _{j min} < T _j < T _{j max} ; I _{RRM} = 100 mA; 180° half-sine wave; single pulse; Gate open	

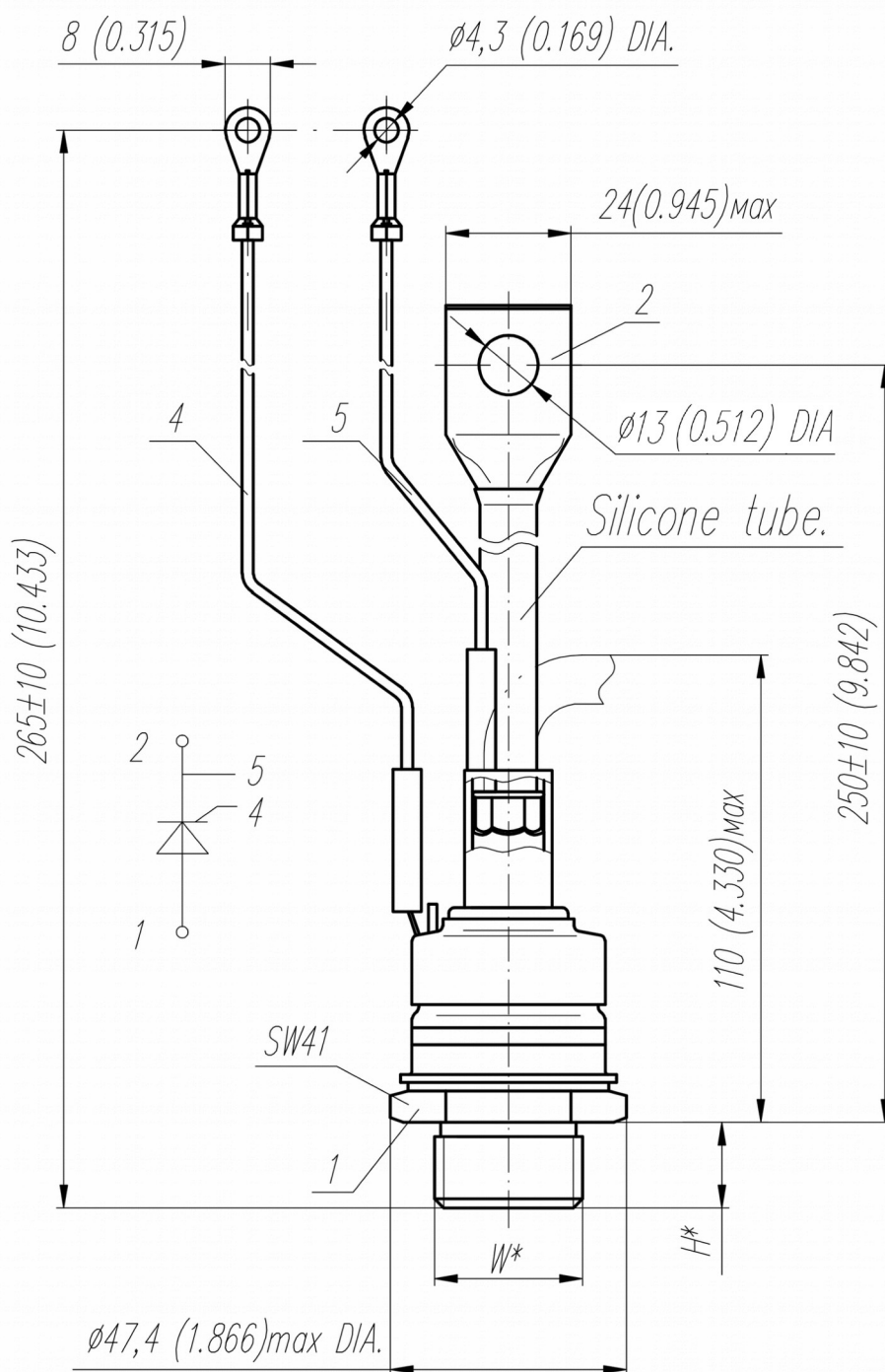
V_{D_r}, V_R	Direct off-state and Direct reverse voltages	V	$0.6 \cdot V_{DRM}$ $0.6 \cdot V_{RRM}$	$T_j = T_{j \max}$; Gate open
P_{RSM}	Surge reverse power dissipation	kW	16	$T_j = T_{j \max}$; $t_p = 100 \mu s$; 180° half-sine wave; single pulse
TRIGGERING				
I_{FGM}	Peak forward gate current	A	6	$T_j = T_{j \max}$
V_{RGM}	Peak reverse gate voltage	V	5	
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	800	$T_j = T_{j \max}$; $V_D = 0.67 \cdot V_{DRM}$; $I_{TM} = 3000$ A; Gate pulse: $I_G = 2$ A; $t_{GP} = 50 \mu s$; $di_G/dt \geq 2$ A/ μs
THERMAL				
T_{stg}	Storage temperature	$^\circ C$	$-60 \dots +50$	
T_j	Operating junction temperature	$^\circ C$	$-60 \dots +140$	
MECHANICAL				
M	Tightening torque	Nm	25...35	
a	Acceleration	m/s ²	100	

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} = 1005 A	
V _{T(TO)}	On-state threshold voltage, max	V	1.012	T _j =T _{j max} ;	
r _T	On-state slope resistance, max	mΩ	0.717	0.5 π I _{TAV} < I _T < 1.5 π I _{TAV}	
I _L	Latching current, max	mA	700	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	35	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	320 500 1000	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	0.60	T _j =T _{j max} ; V _D =0.67·V _{DRM} ;	
I _{GD}	Gate non-trigger direct current, min	mA	30.00	Direct gate current	
SWITCHING					
t _{gd}	Delay time, max	μs	1.25	T _j =25 °C; V _D =600 V; I _{TM} =I _{TAV} ; di/dt=200 A/μs;	
t _{gt}	Turn-on time, max	μs	4.00	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	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	490	T _j =T _{j max} ; I _{TM} =320 A;	
t _{rr}	Reverse recovery time, max	μs	13.0	di _R /dt=-10 A/μs;	
I _{rr}	Reverse recovery current, max	A	75.0	V _R =100 V	

THERMAL				
R_{thjc}	Thermal resistance, junction to case, max	$^{\circ}\text{C/W}$	0.0850	Direct current
MECHANICAL				
m	Weight, max	g	450	
D_s	Surface creepage distance	mm (inch)	12.4 (4.882)	
D_a	Air strike distance	mm (inch)	12.4 (4.882)	

PART NUMBERING GUIDE							NOTES						
TA	271	320	12	A2	T2	N	1) Critical rate of rise of on-state current non-repetitive						
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 on-state current non-repetitive, V/μs 6. Turn-off time (dv _D /dt=50 V/μs) 7. Ambient conditions: N – normal; T – tropical							Symbol of Group				K2	E2	A2
							(dv _D /dt) _{crit} , V/μs				320	500	1000
							2) Turn-off time (dv _D /dt=50 V/μs)						
							Symbol of Group				T2		
							t _q , μs				160		



Type of screw	W	H
Metric Screw Type C	M24x1,5 – 8g	19
Metric Screw Type B (upon request)	M20x1,5 – 8g	15

Polarity	Example of code designation	Reference designation	Colors		
			Anode	Cathode	Gate
Anode to stud	TA271-320-12		-	Red tube	White

All dimensions in millimeters (inches)

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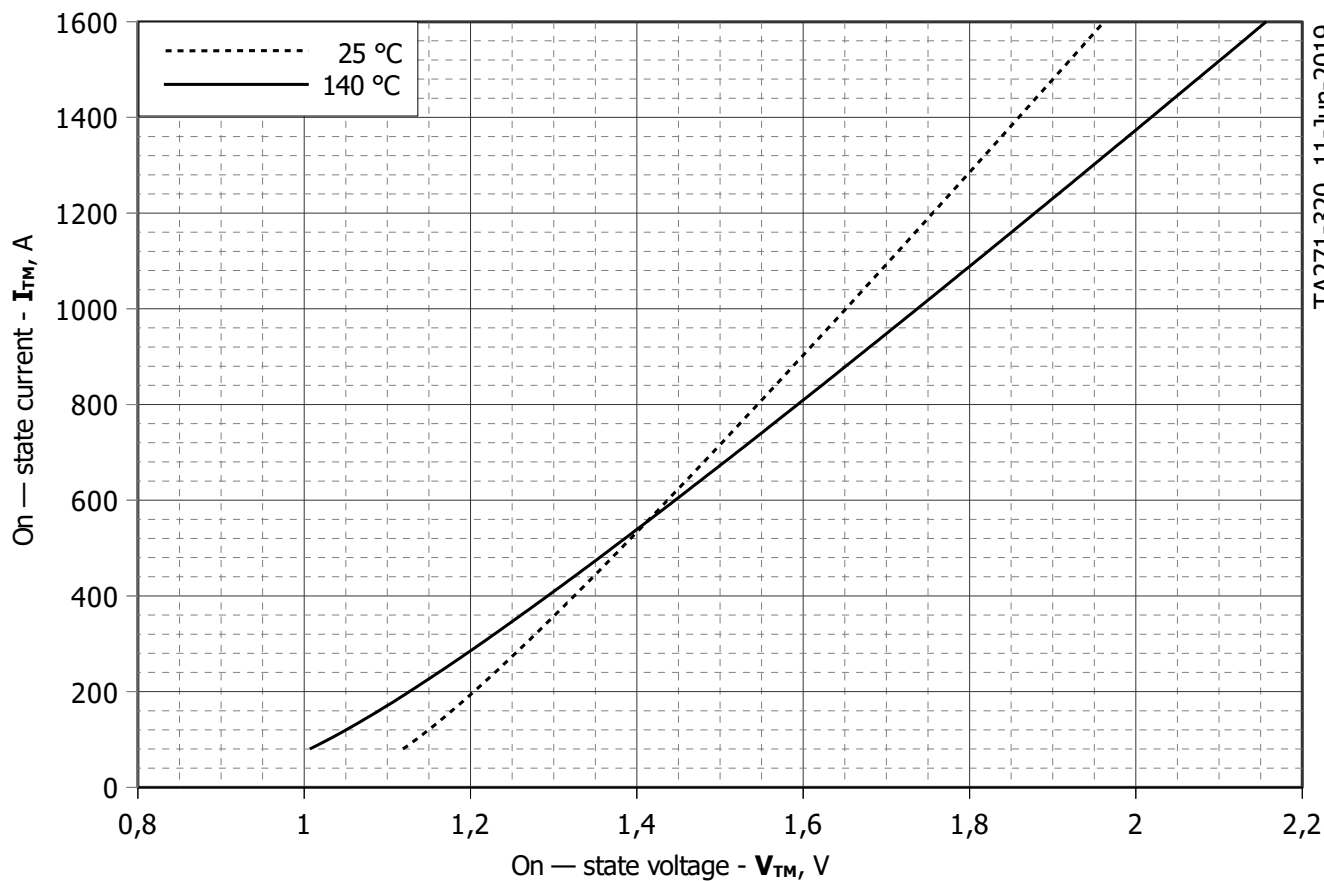


Fig 1 – On-state characteristics of Limit device

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	
	$T_j = 25^{\circ}\text{C}$	$T_j = T_{j\text{ max}}$
A	0.98158000	0.80402000
B	0.00046847	0.00062301
C	0.01752800	0.02673300
D	0.00253380	0.00396620

On-state characteristic model (see Fig. 1)

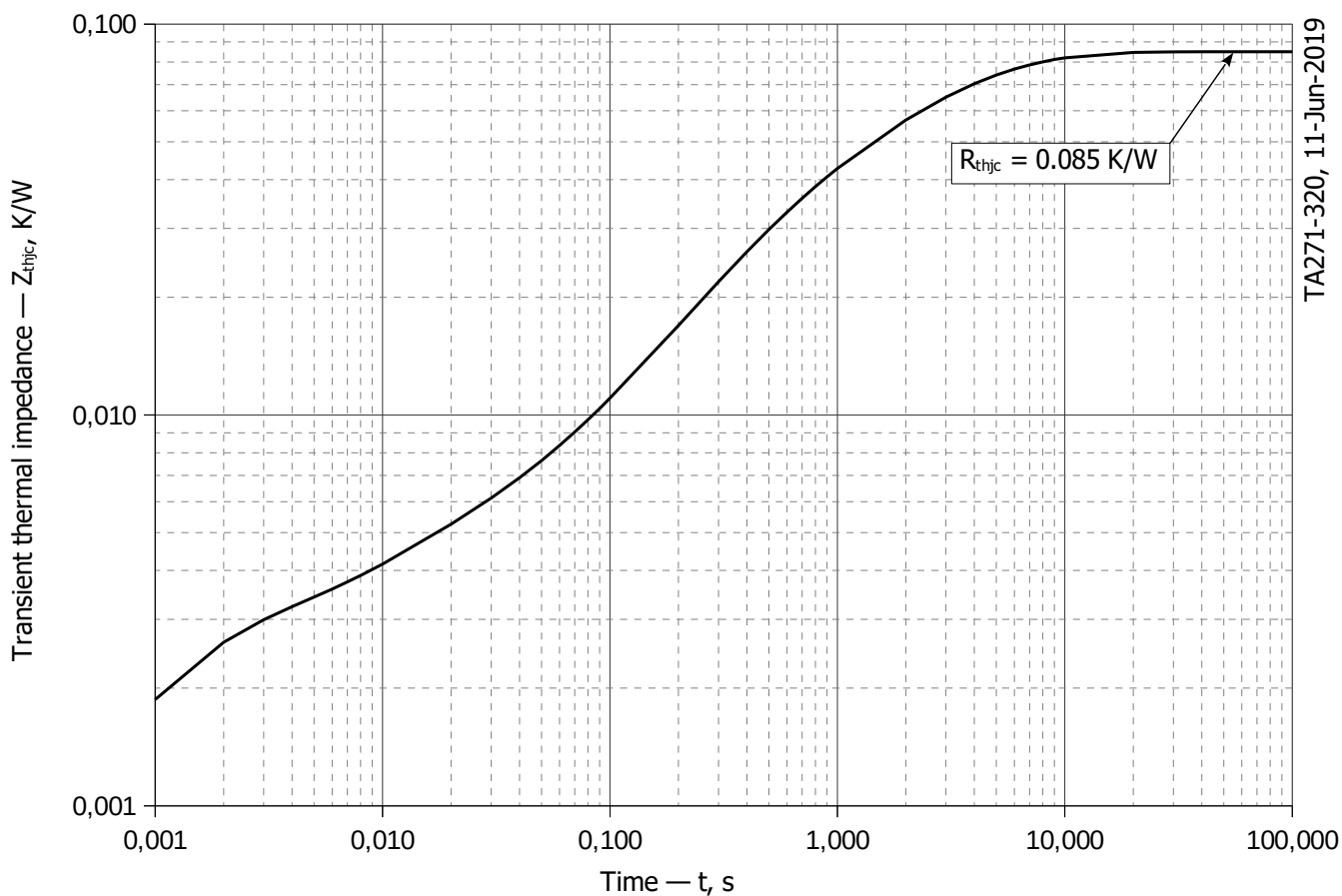


Fig 2 – Transient thermal impedance Z_{thjc} vs. time t

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

i	1	2	3	4	5	6
R_i K/W	0.023357	0.02733	0.01495	0.001445	0.002488	0.01543
τ_i s	4.627	2.249	0.3406	0.01043	0.0009112	0.9081

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

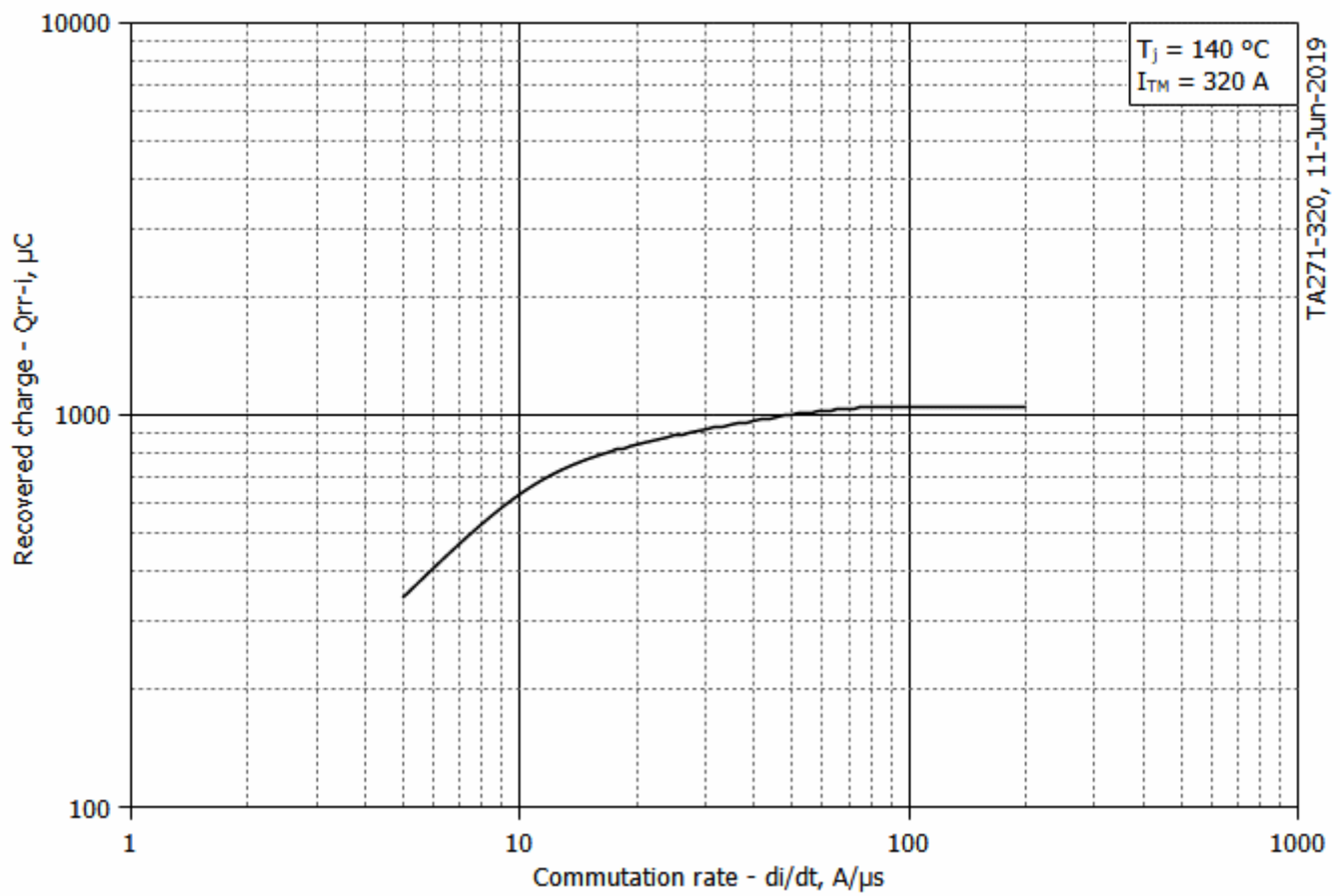


Fig 3 – Maximum recovered charge Q_{rr-i} (integral) vs. commutation rate di_R/dt

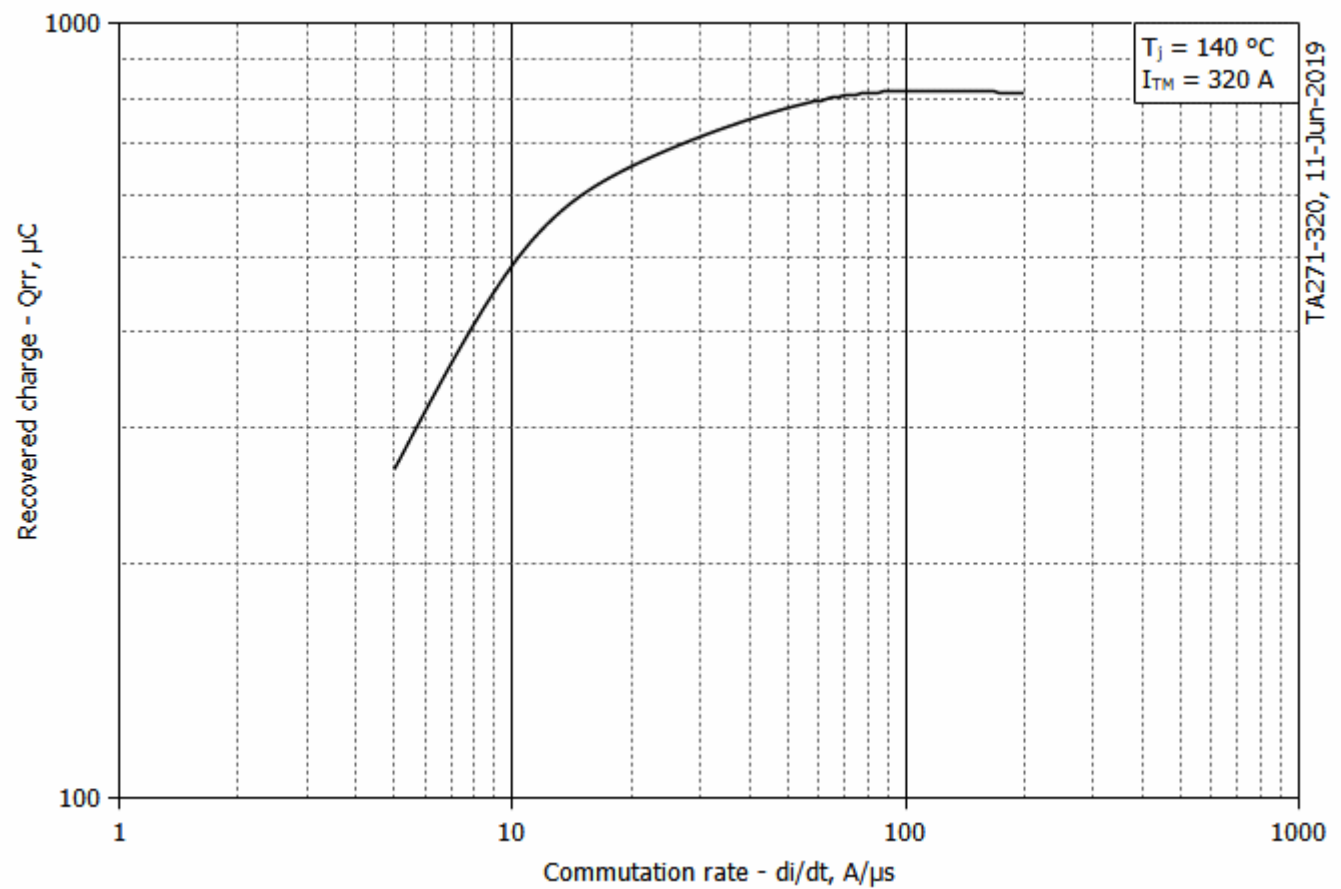


Fig 4 – Maximum recovered charge Q_{rr} vs. commutation rate di_R/dt (25% chord)

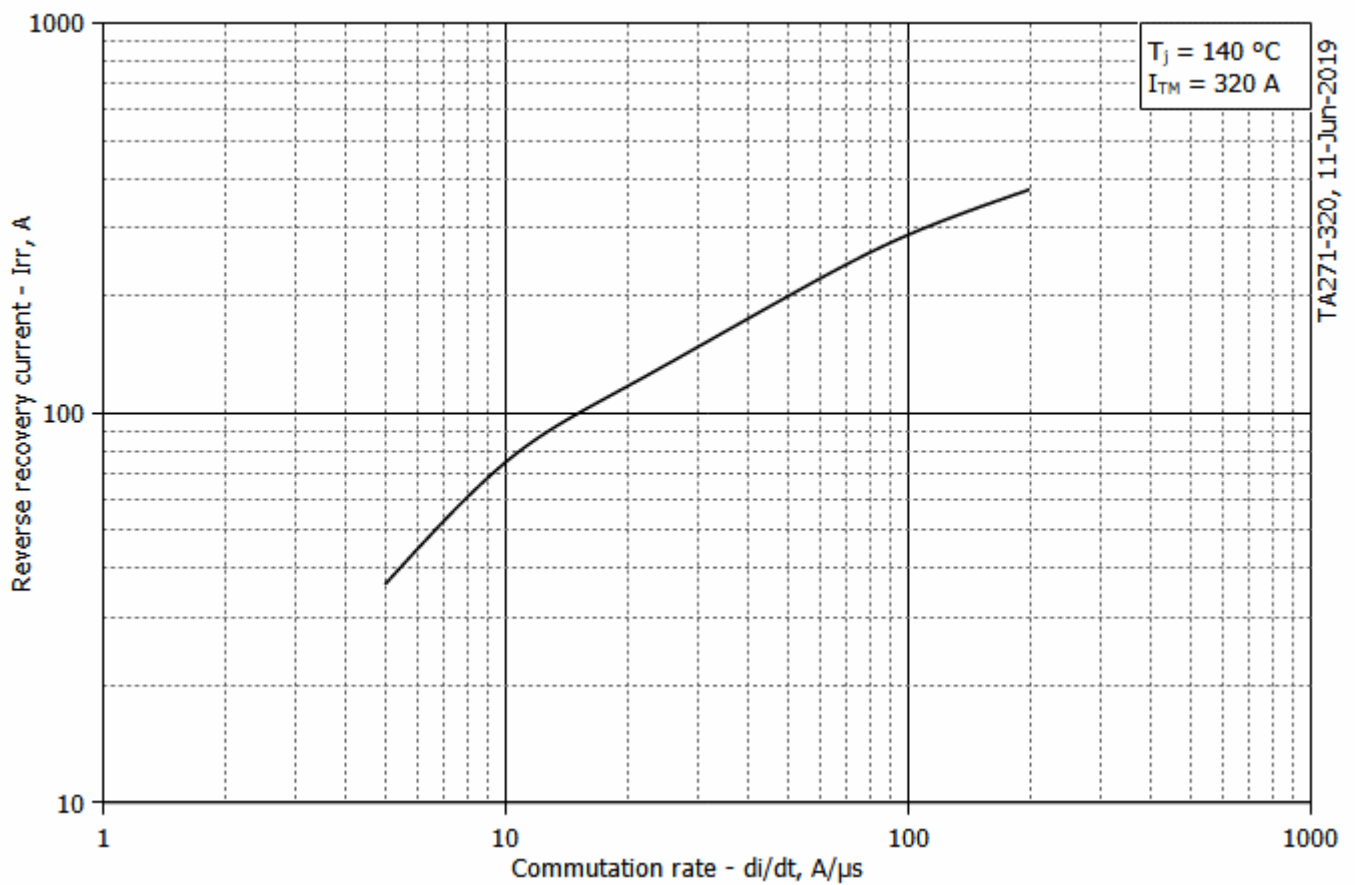


Fig 5 – Maximum reverse recovery current I_{rr} vs. commutation rate di_R/dt

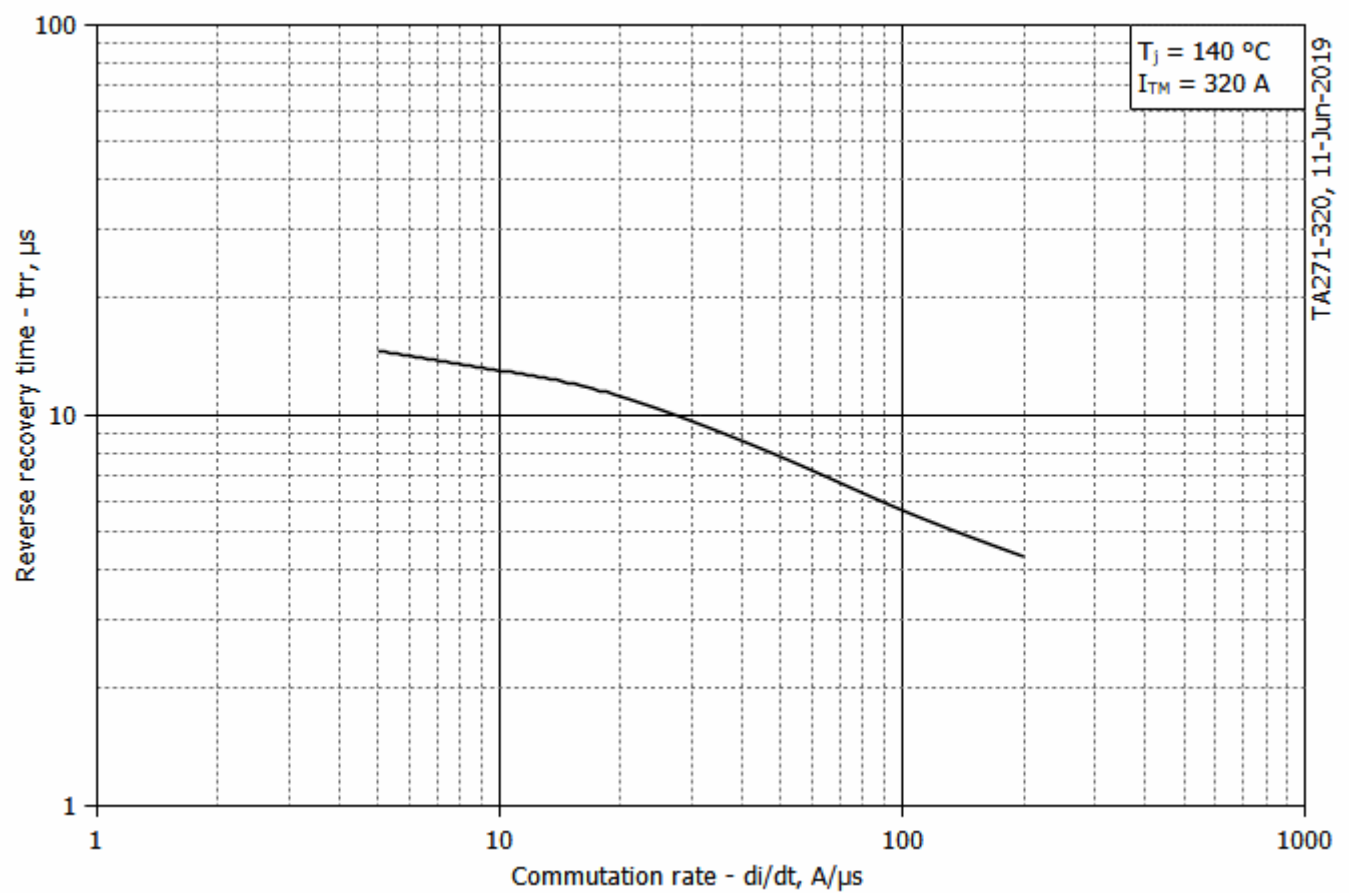
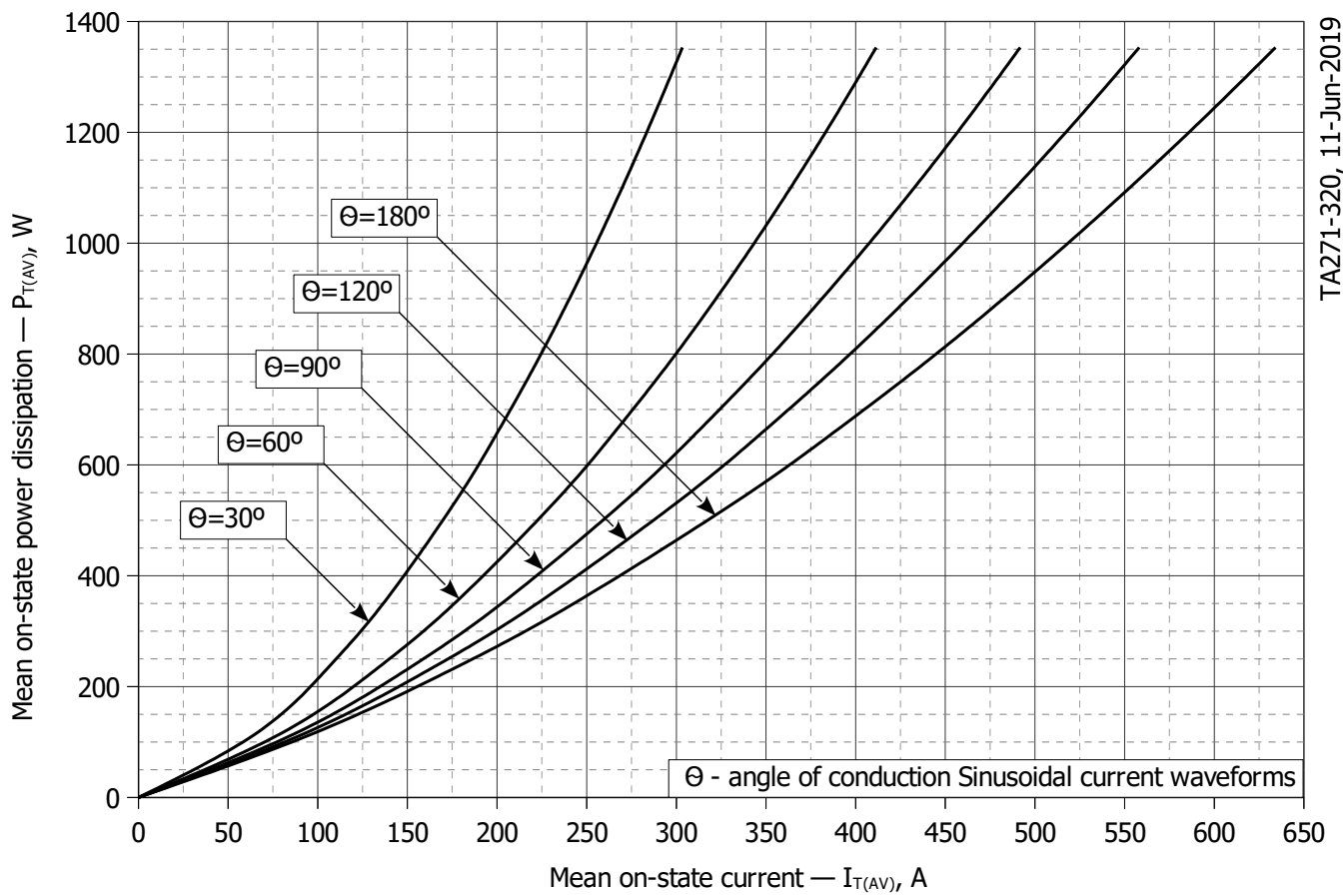
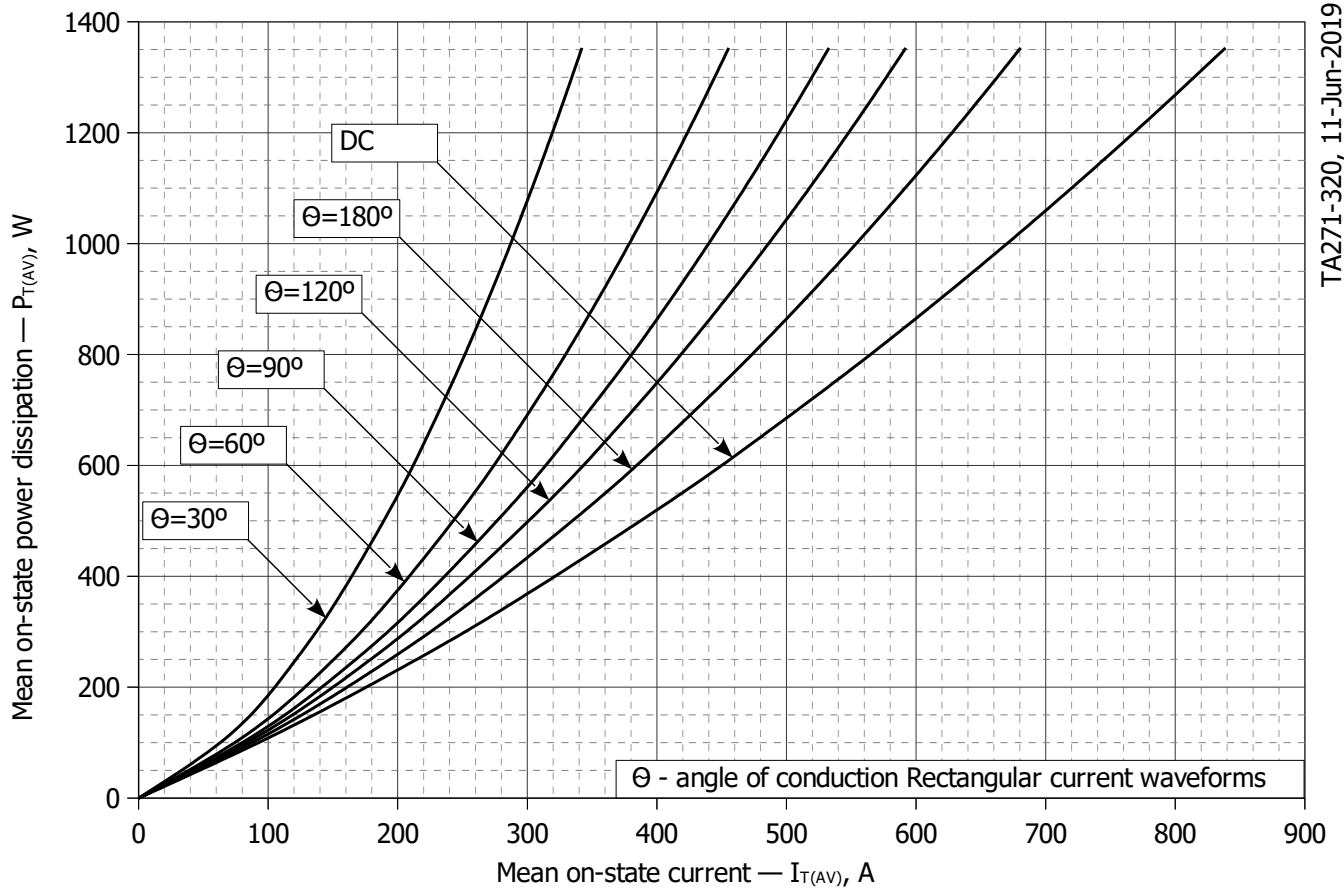


Fig 6 – Maximum recovery time t_{rr} vs. commutation rate di_R/dt (25% chord)



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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 ($f=50\text{Hz}$)



TA271-320, 11-Jun-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 ($f=50\text{Hz}$)

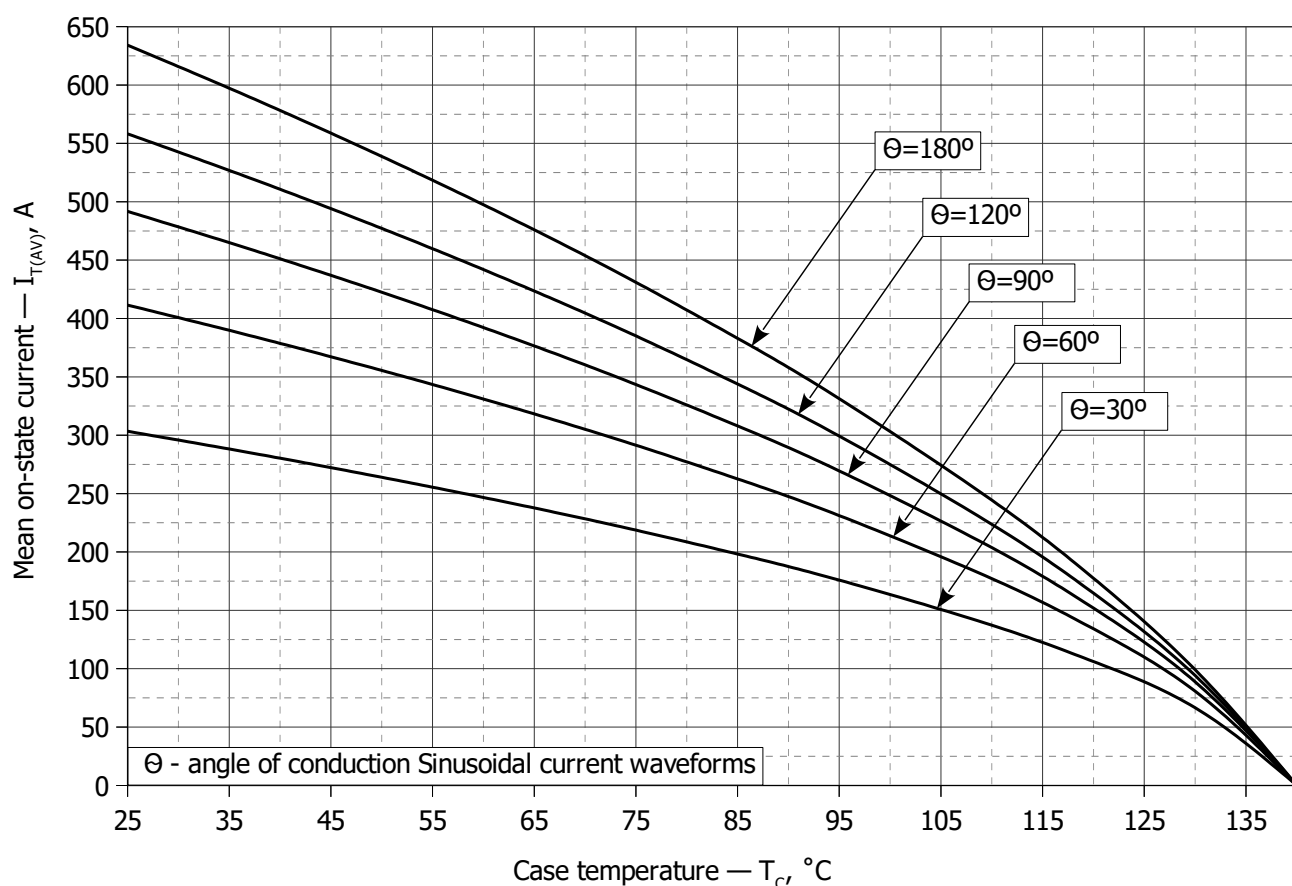


Fig. 9 – Mean on-state current I_{TAV} vs. case temperature T_c for sinusoidal current waveforms at different conduction angles ($f=50\text{Hz}$)

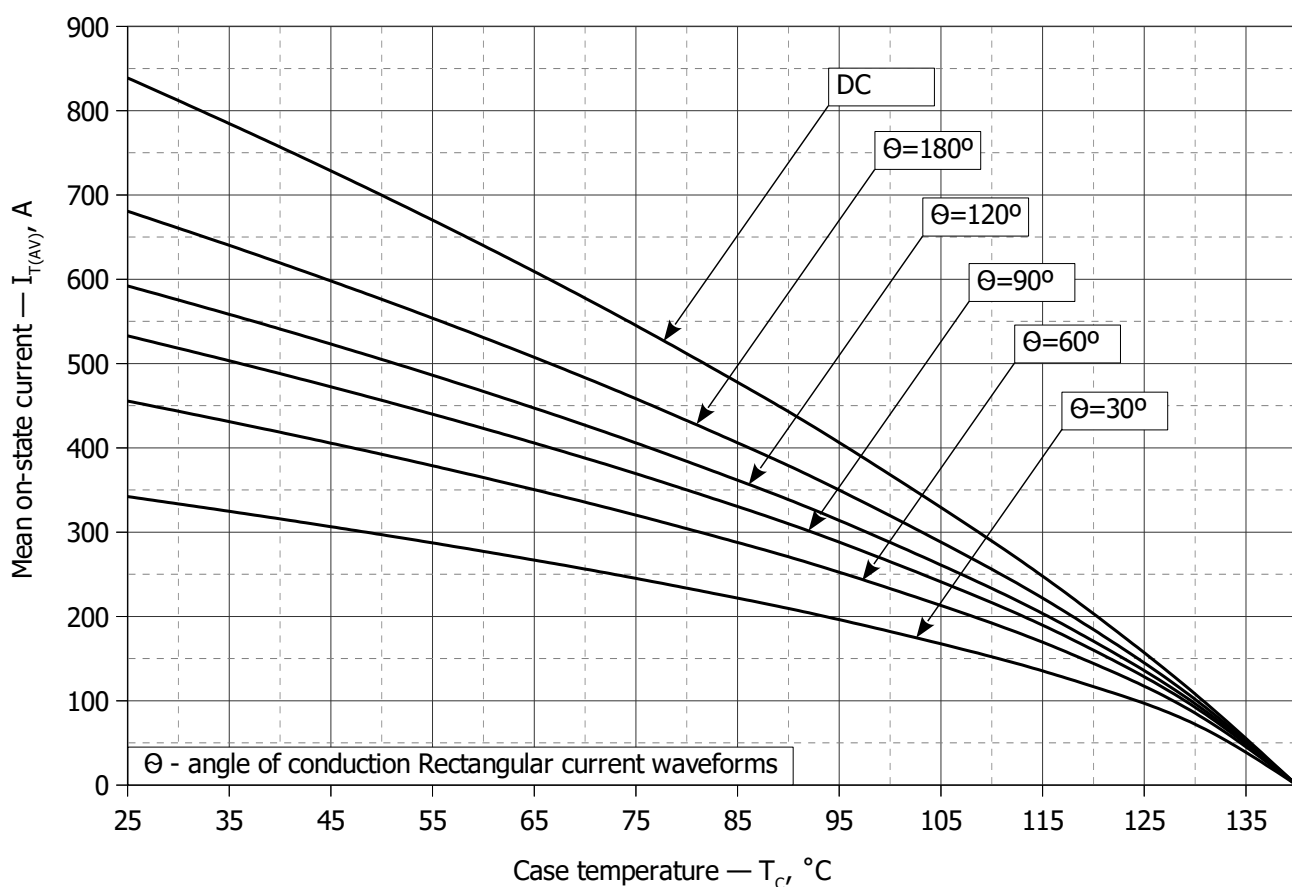


Fig. 10 - Mean on-state current I_{TAV} vs. case temperature T_c for rectangular current waveforms at different conduction angles and for DC ($f=50\text{Hz}$)

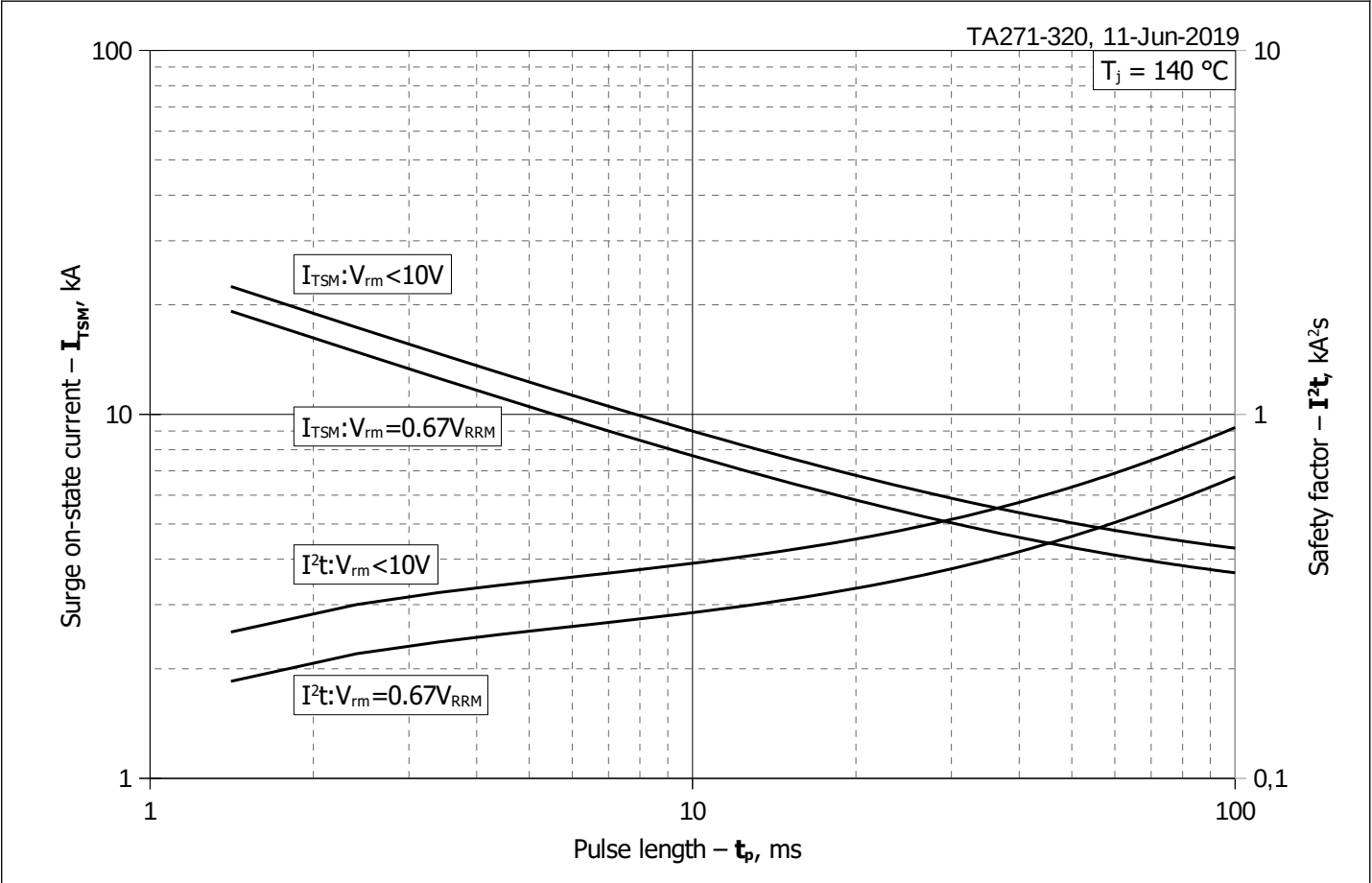


Fig. 11 – Maximum surge on-state current I_{TSM} and safety factor I^2t vs. pulse length t_p

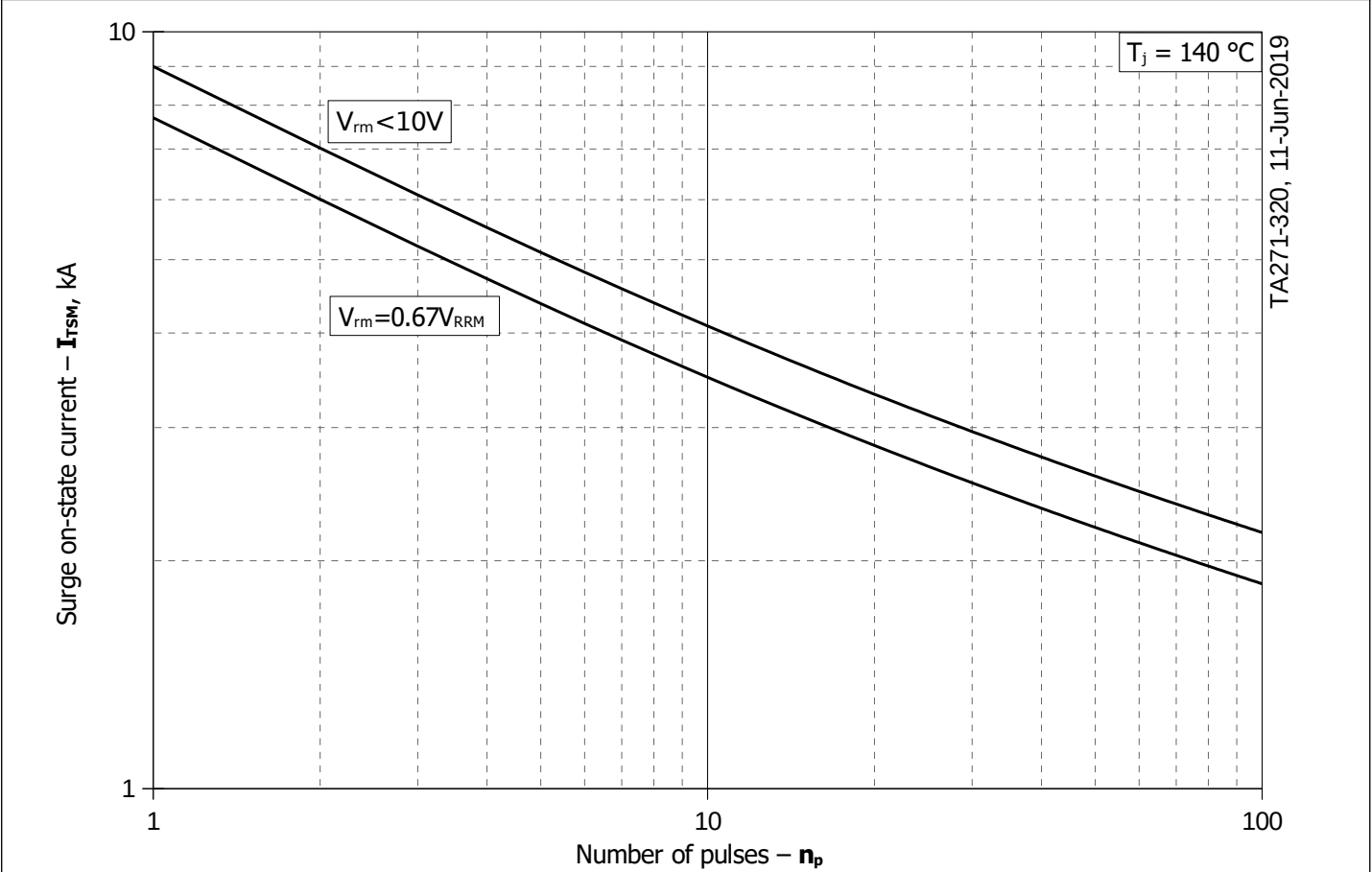


Fig. 12 - Maximum surge on-state current I_{TSM} vs. number of pulses n_p