PROTON-ELECTROTEX
RUSSIA

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

Phase Control Stud Thyristor
Type T261-160-18

Mean on-state current							I_{TAV}			160 A							
Repetitive peak off-state voltage							V_{DRM}			100÷1800 V							
Repetitive peak reverse voltage							V_{RRM}										
Turn-off time							t_q			125, 160, 200, 250, 320, 400, 500 µs							
V_{DRM}, V_{RRM}, V	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1800
Voltage code	1	2	3	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}	Mean on-state current	A	160 186	T_c= 92 °C; T_c= 85 °C; 180° half-sine wave; 50 Hz	
I_{TRMS}	RMS on-state current	A	251	T_c= 92 °C; 180° half-sine wave; 50 Hz	
I_{TSM}	Surge on-state current	kA	4.5 5.0	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
			4.5 5.0	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	$A^2s \cdot 10^3$	100 120	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
			80 100	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	100÷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	110÷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	$0.6 \cdot V_{DRM}$ $0.6 \cdot V_{RRM}$	T_j=$T_{j\,max}$; Gate open	

TRIGGERING				
I_{FGM}	Peak forward gate current	A	5	$T_j=T_{j\,max}$
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}=640 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				
M	Tightening torque	Nm	20÷30	
a	Acceleration	m/s²	100	

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}= 502 A	
$V_{T(TO)}$	On-state threshold voltage, max	V	0.85	$T_j=T_{j\,max}$; $0.5\,\pi\,I_{TAV} < I_T < 1.5\,\pi\,I_{TAV}$	
r_T	On-state slope resistance, max	mΩ	1.278		
I_L	Latching current, max	mA	500	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	250	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	50	$T_j=T_{j\,max}$; $V_D=V_{DRM}$; $V_R=V_{RRM}$	
$(dv_D/dt)_{crit}$	Critical rate of rise of off-state voltage[1], min	V/µs	200, 320, 500, 1000	$T_j=T_{j\,max}$; $V_D=0.67{\cdot}V_{DRM}$; 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	0.70	$T_j=T_{j\,max}$; $V_D=0.67{\cdot}V_{DRM}$; Direct gate current	
I_{GD}	Gate non-trigger direct current, min	mA	65.00		
SWITCHING					
t_{gd}	Delay time, max	µs	1.10	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	125, 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; $V_D=0.67{\cdot}V_{DRM}$	
Q_{rr}	Total recovered charge, max	µC	725	$T_j=T_{j\,max}$; I_{TM}=160 A; di_R/dt=-10 A/µs; V_R=100 V	
t_{rr}	Reverse recovery time, max	µs	17		
I_{rrM}	Peak reverse recovery current, max	A	85		

THERMAL				
R_{thjc}	Thermal resistance, junction to case, max	°C/W	0.1500	Direct current
MECHANICAL				
w	Weight, max	g	260	
D_s	Surface creepage distance	mm (inch)	12.40 (4.882)	
D_a	Air strike distance	mm (inch)	12.40 (4.882)	

PART NUMBERING GUIDE

T	261	160	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

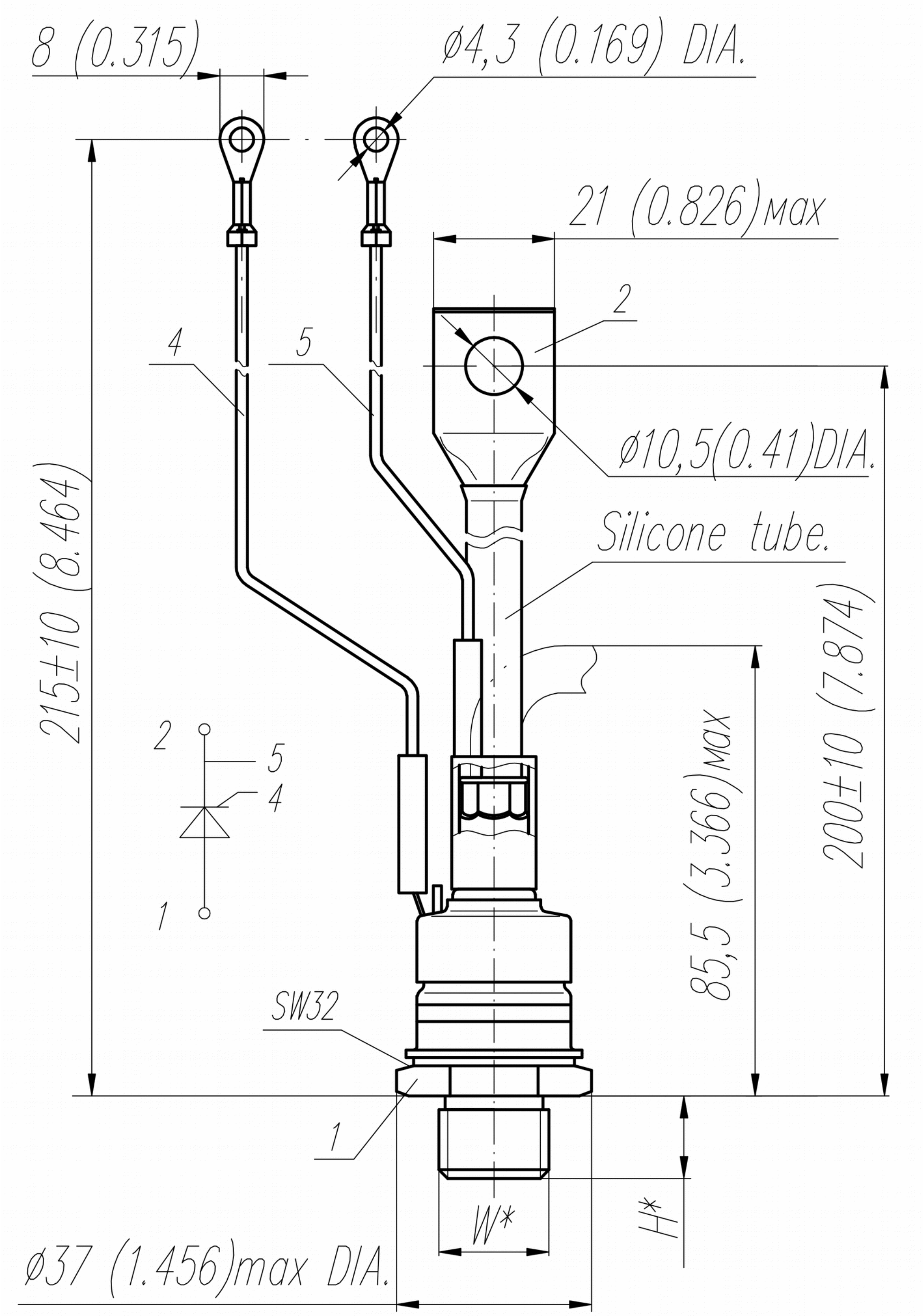
Symbol of Group	P2	K2	E2	A2
$(dv_D/dt)_{crit}$, V/μs	200	320	500	1000

2) Turn-off time (dv_D/dt=50 V/μs)

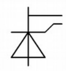
Symbol of Group	X2	T2	P2	M2	K2	H2	E2
t_q, μs	125	160	200	250	320	400	500

OVERALL DIMENSIONS

Package type: T.SA1



Type of screw	W	H
Metric Screw Type A (upon request)	M16x1,5 – 8g	13
Metric Screw Type B	M20x1,5 – 8g	15

Polarity	Example of code designation	Reference designation	Colors		
			Anode	Cathode	Gate
Anode to stud	T261-160-16		-	Red tube	White

All dimensions in millimeters (inches)

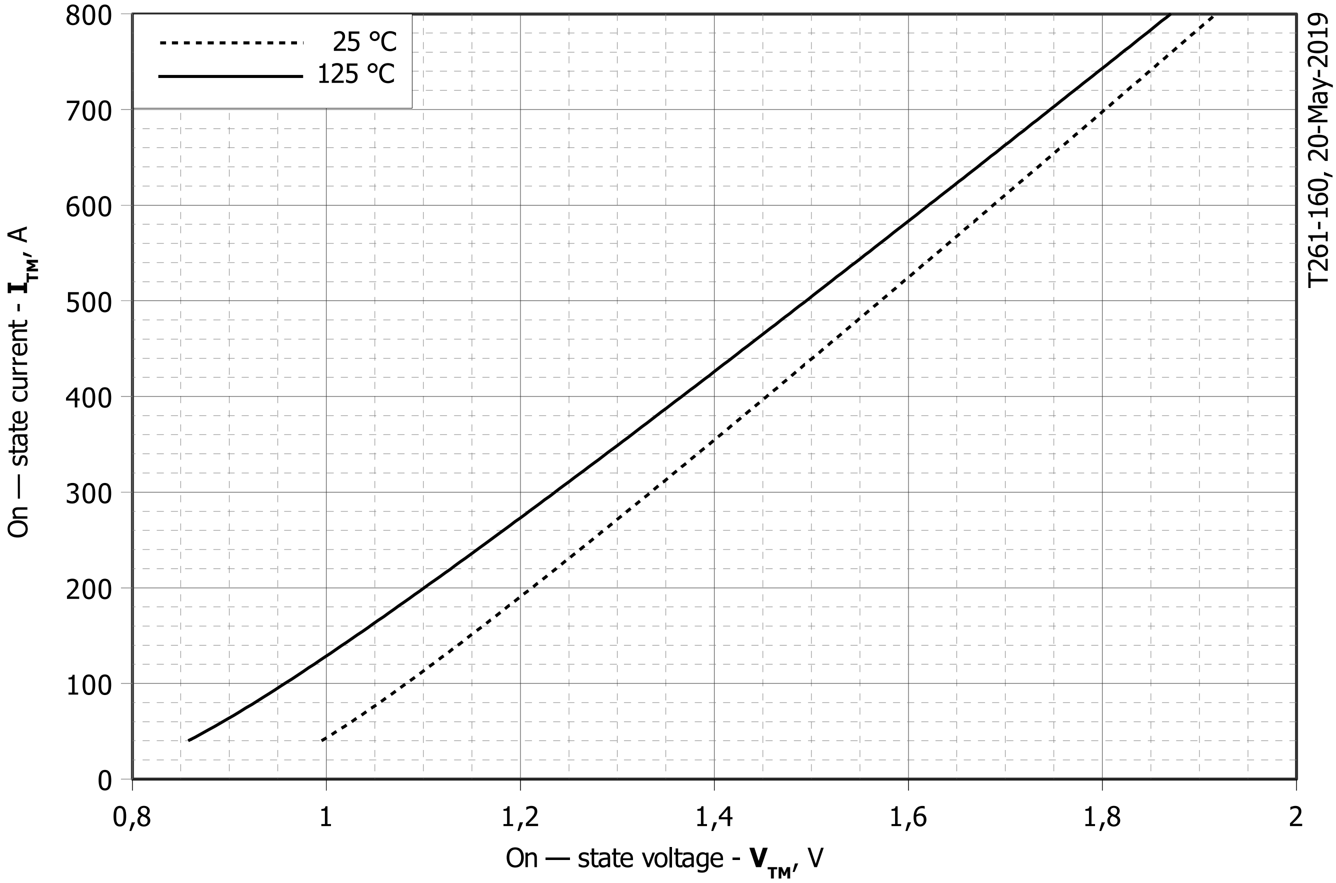


Fig 1 – On-state characteristics of Limit device

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	0.8884751	0.7217978
B	0.0010585	0.0011412
C	0.0105564	0.0168277
D	0.0039369	0.0043603

On-state characteristic model (see Fig. 1)

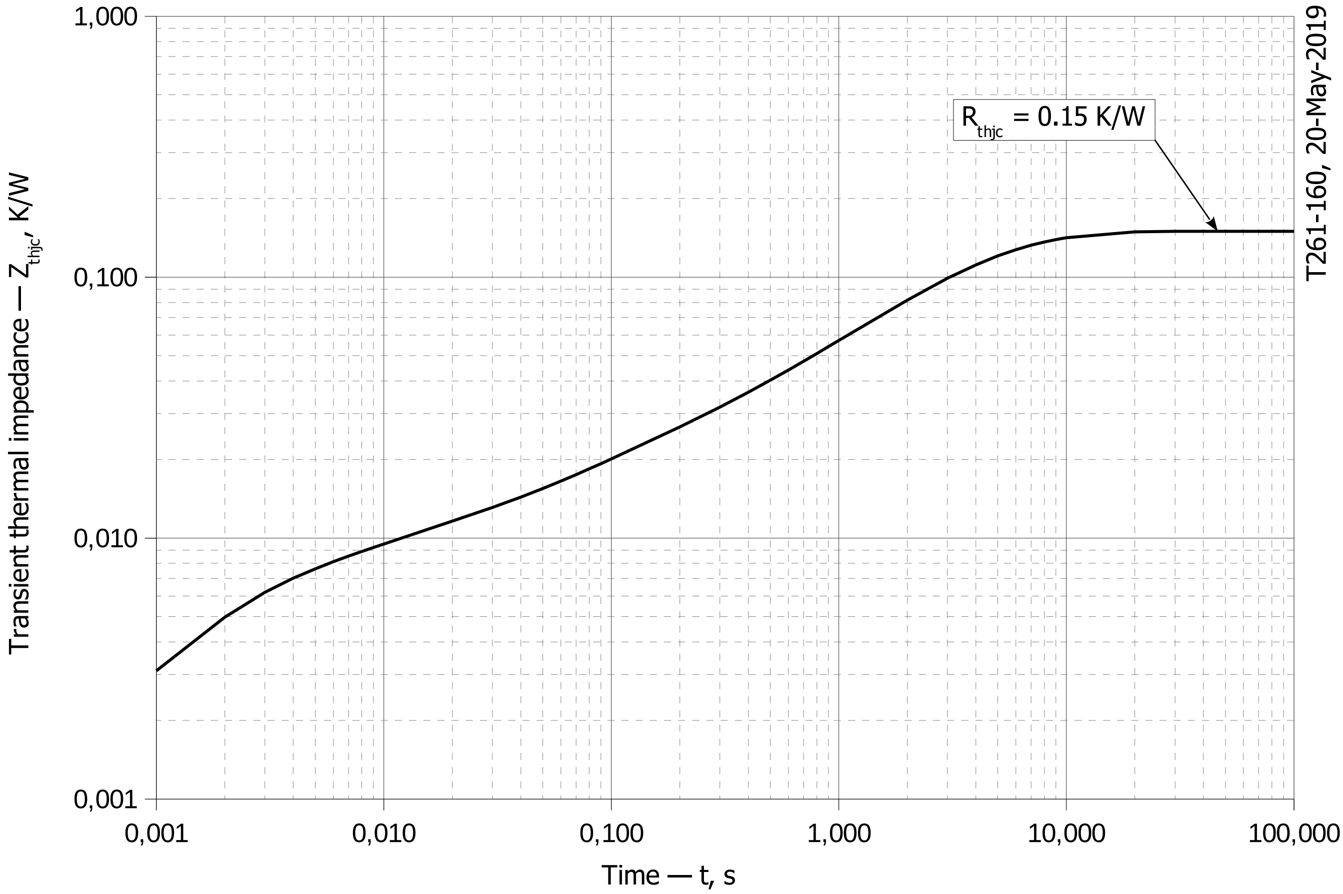


Fig 2 – Transient thermal impedance Z_{thjc} vs. time t

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.

$\mathbf{Z_{thjc}}$ = Thermal resistance at time t.

$\mathbf{R_i}$ = Amplitude of p_{th} term.

τ_i = Time constatnt of r_{th} term.

DC

i	1	2	3	4	5	6
R_i, K/W	0.07504	0.0516	0.007369	0.006977	0.003512	0.005502
τ_i, s	4.409	2.183	0.3382	0.07307	0.008189	0.001615

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

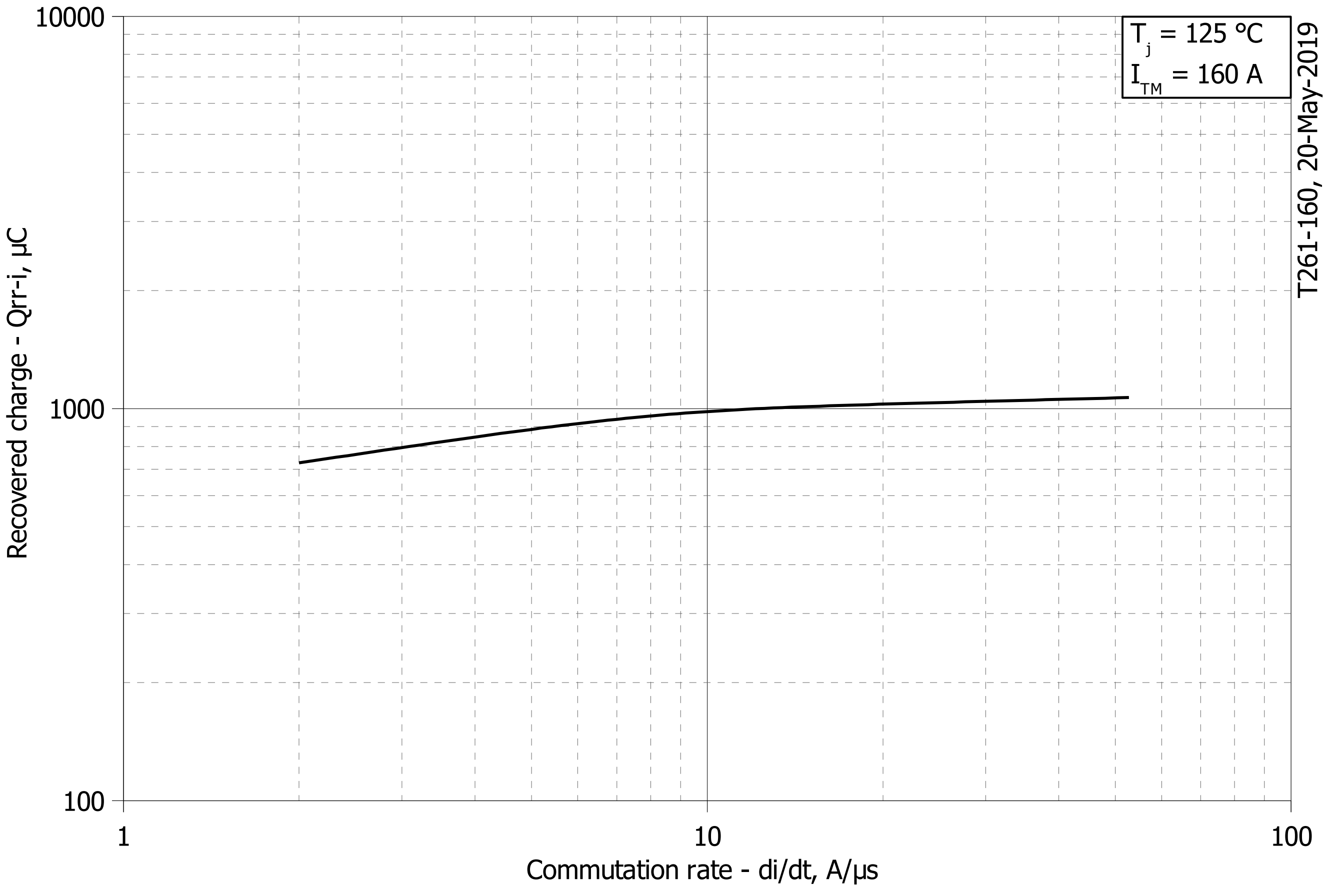


Fig 3 – Maximum recovered charge Q_{rr-i} (integral) vs. commutation rate di_R/dt

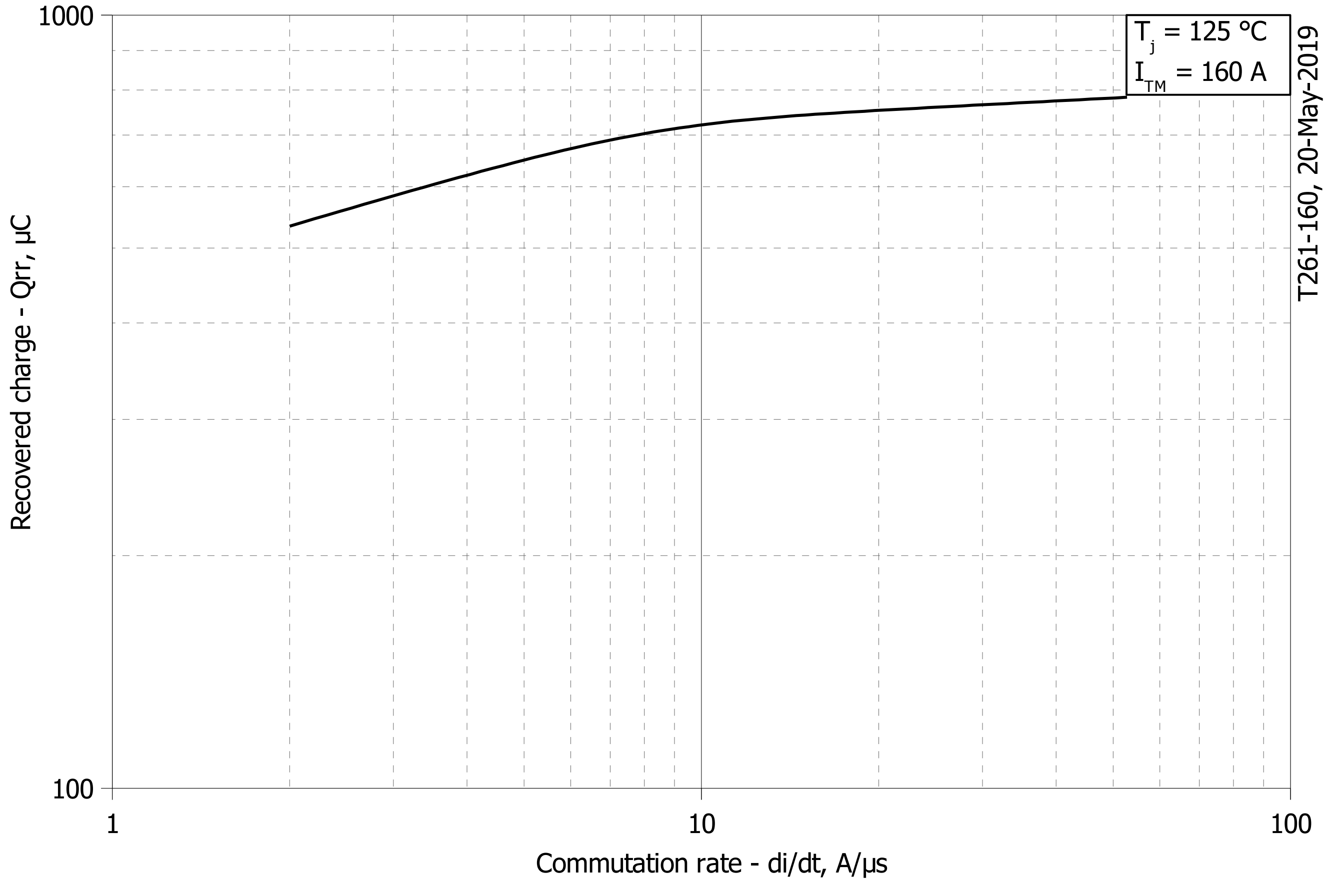


Fig 4 – Maximum recovered charge Q_{rr} vs. commutation rate di_R/dt (25% chord)

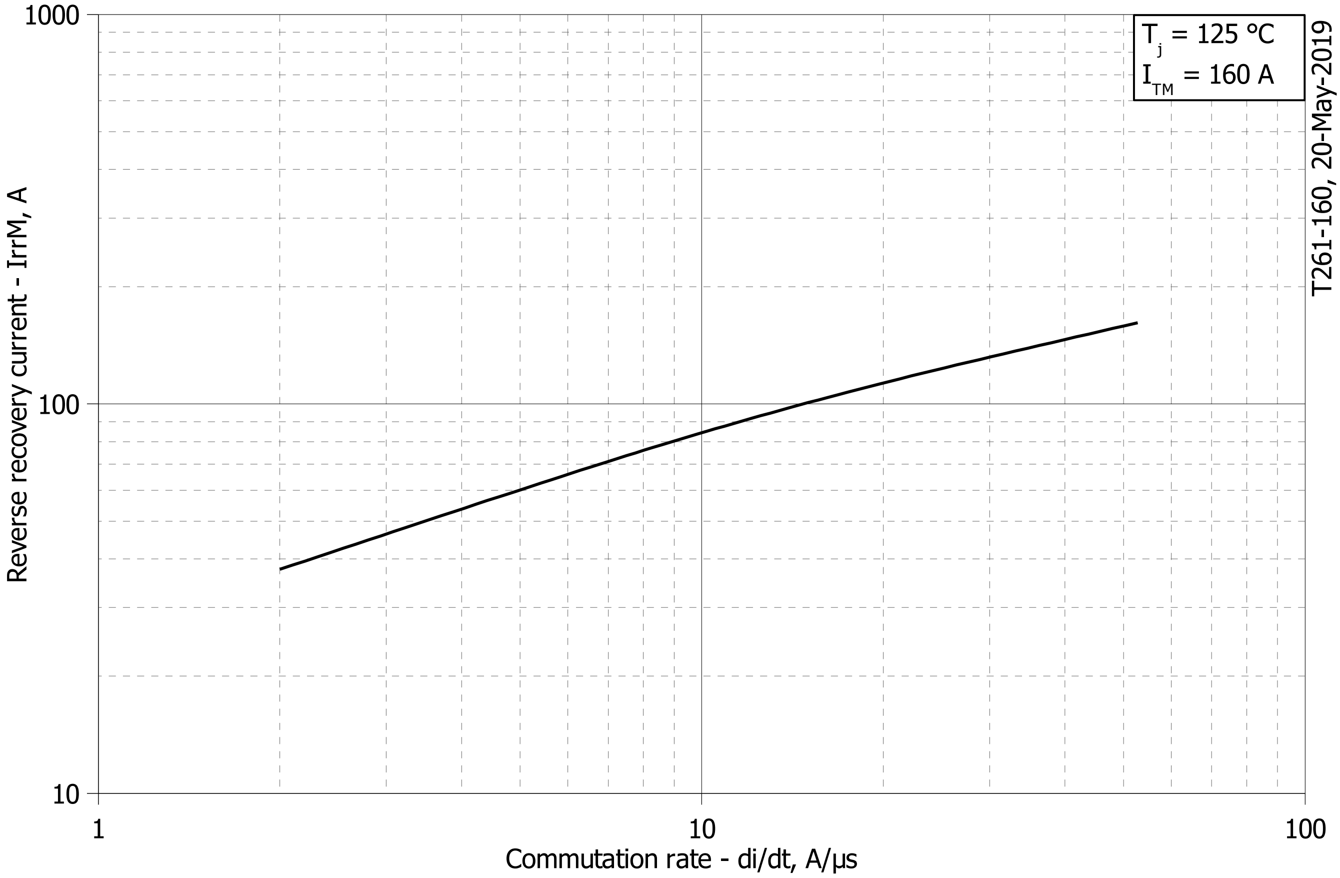


Fig 5 – Maximum reverse recovery current I_{rrM} vs. commutation rate di_R/dt

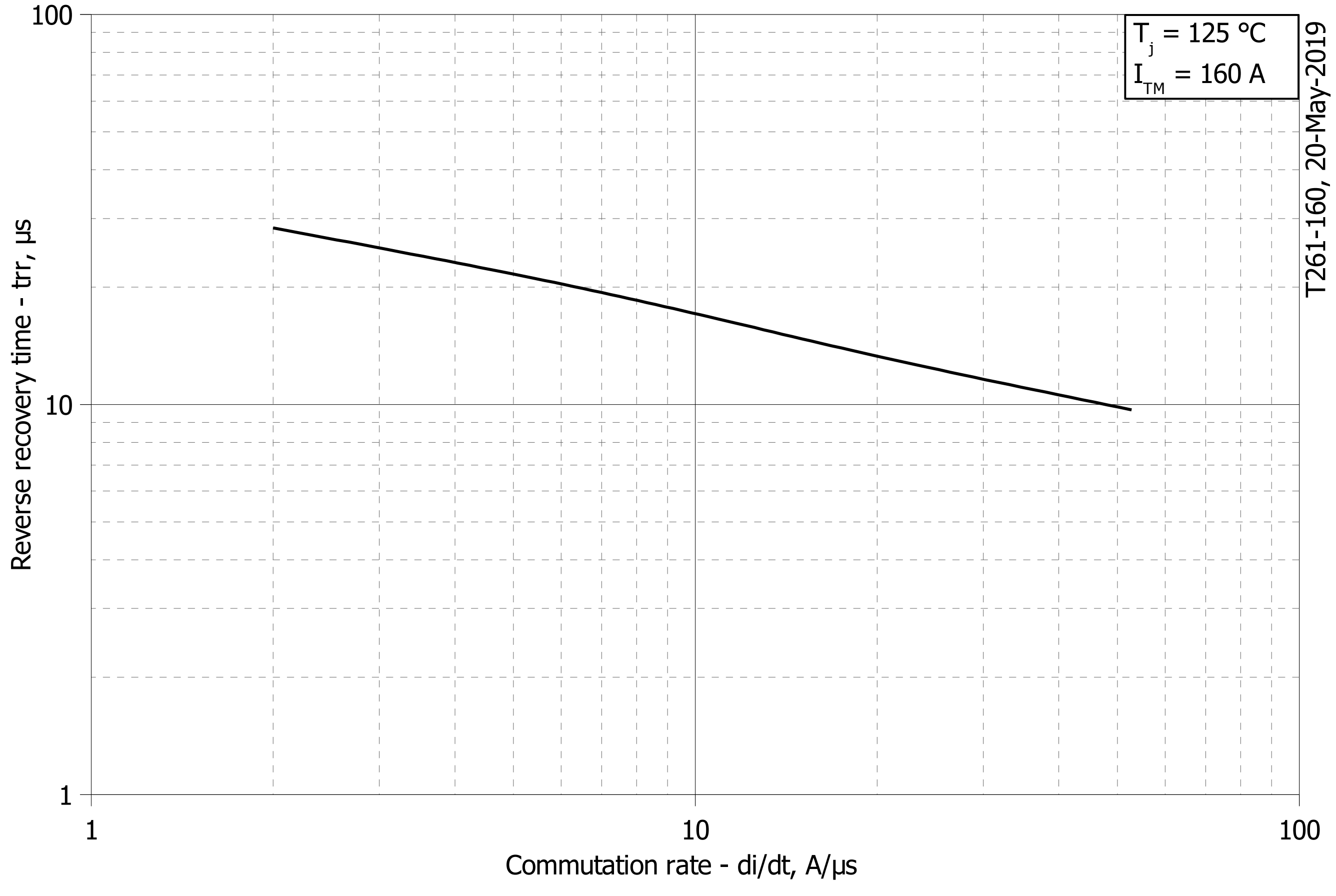


Fig 6 – Maximum recovery time t_{rr} vs. commutation rate di_R/dt (25% chord)

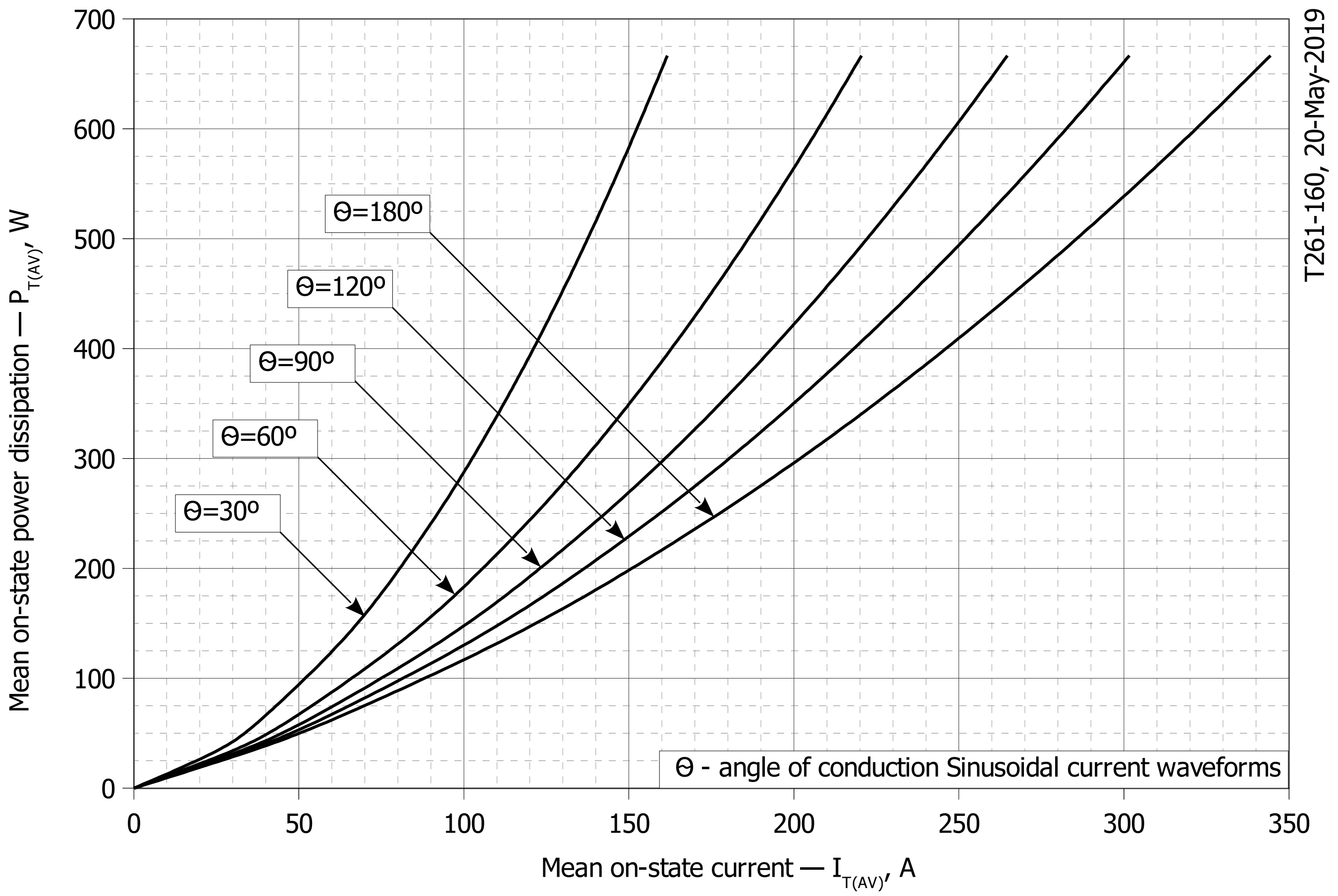


Fig. 7 - Mean on-state power dissipation P_{TAV} vs. mean on-state current I_{TAV} for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

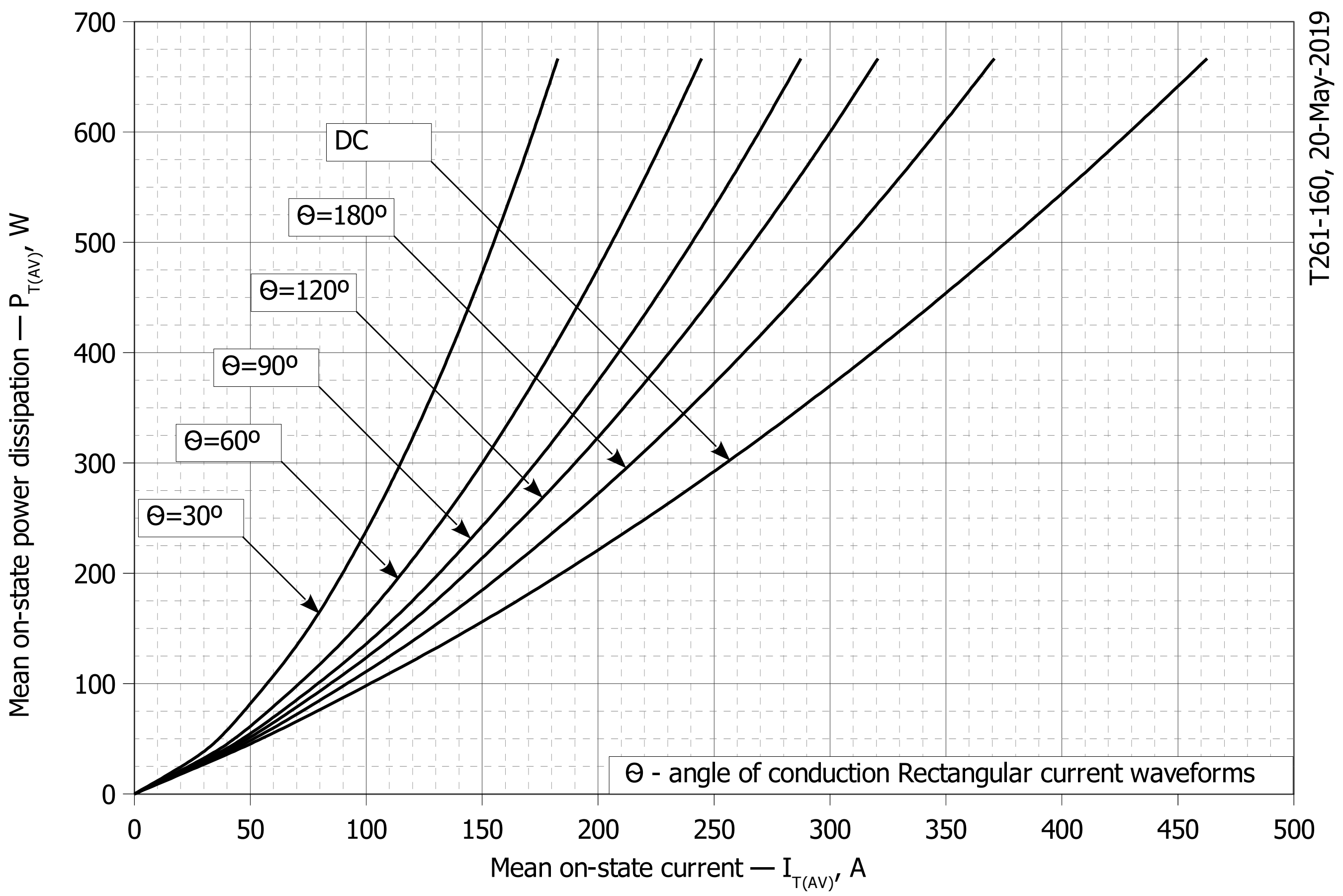


Fig. 8 – Mean on-state power dissipation P_{TAV} vs. mean on-state current I_{TAV} for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

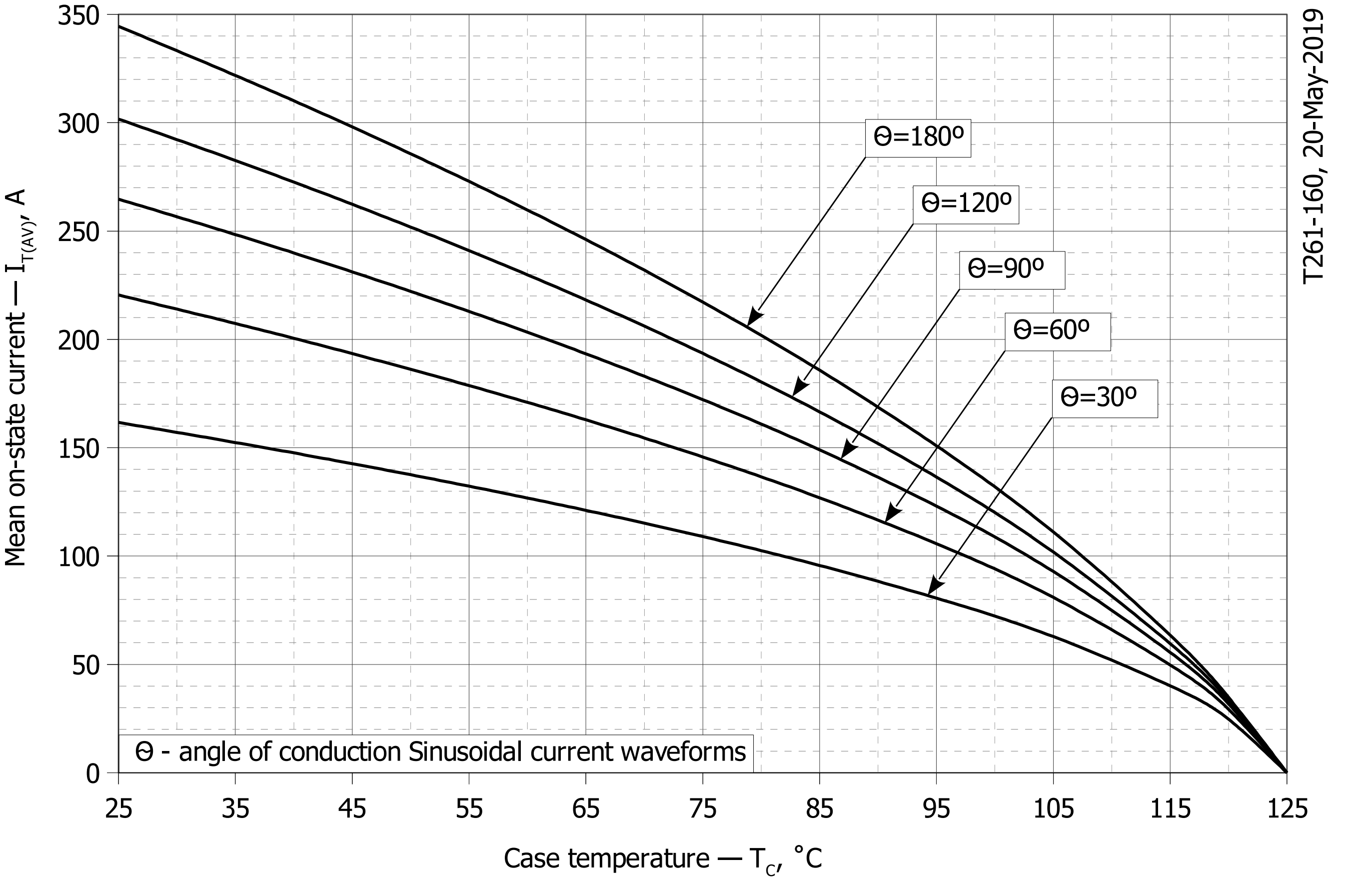


Fig. 9 – Mean on-state current I_{TAV} vs. case temperature T_C for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

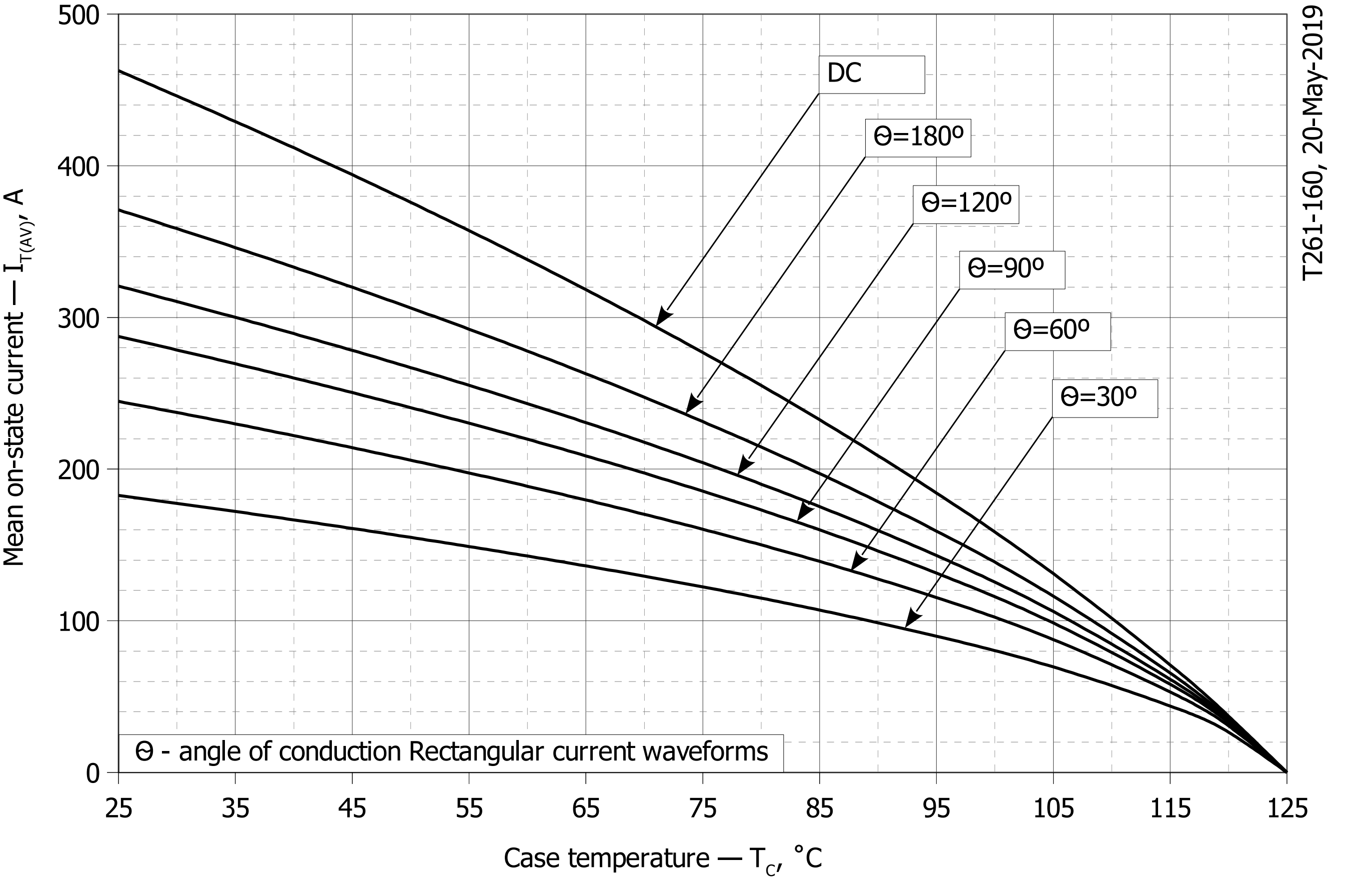


Fig. 10 - Mean on-state current I_{TAV} vs. case temperature T_C for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

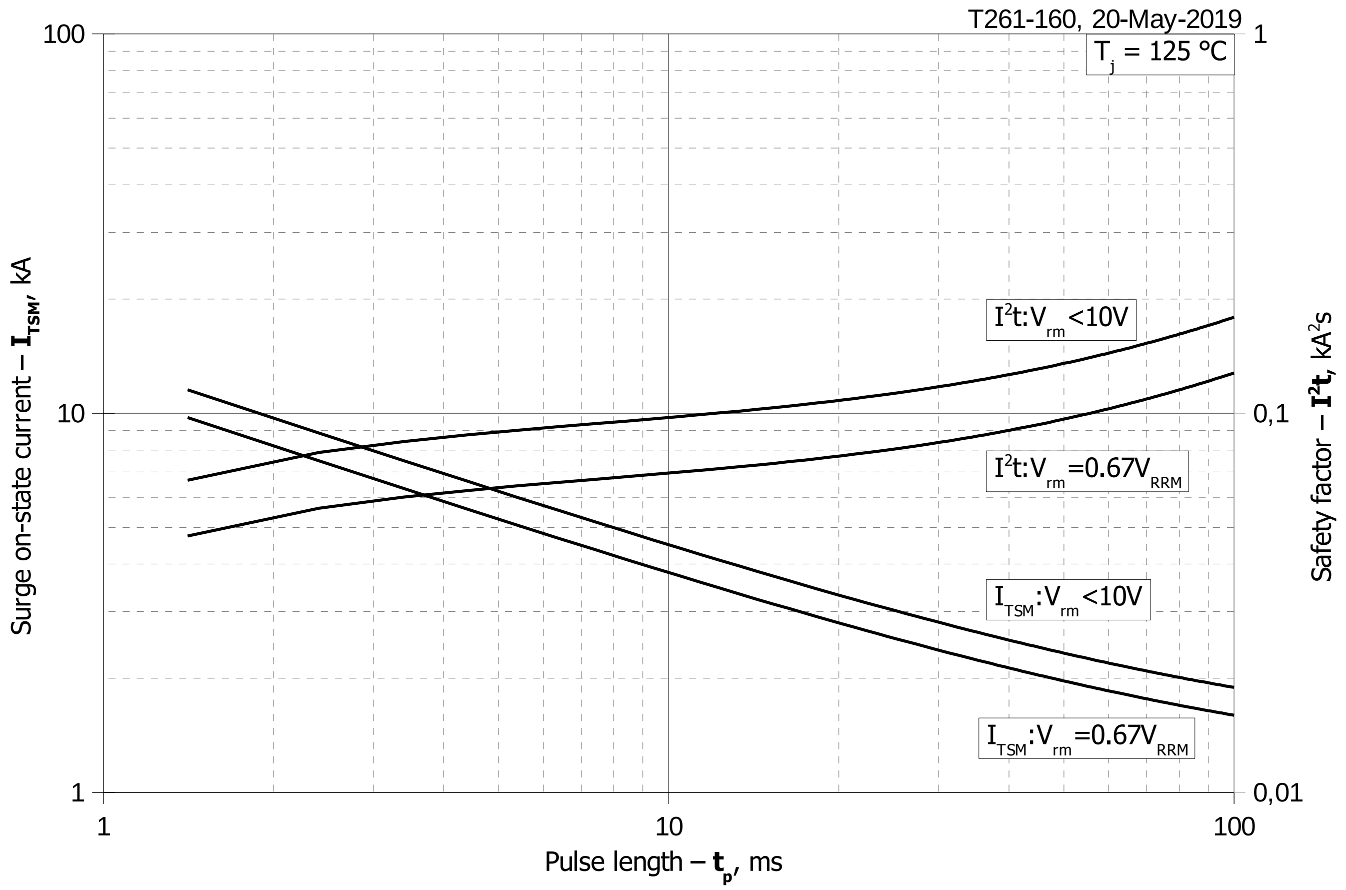


Fig. 11 – Maximum surge on-state current I_{TSM} and safety factor I^2t vs. pulse length t_p

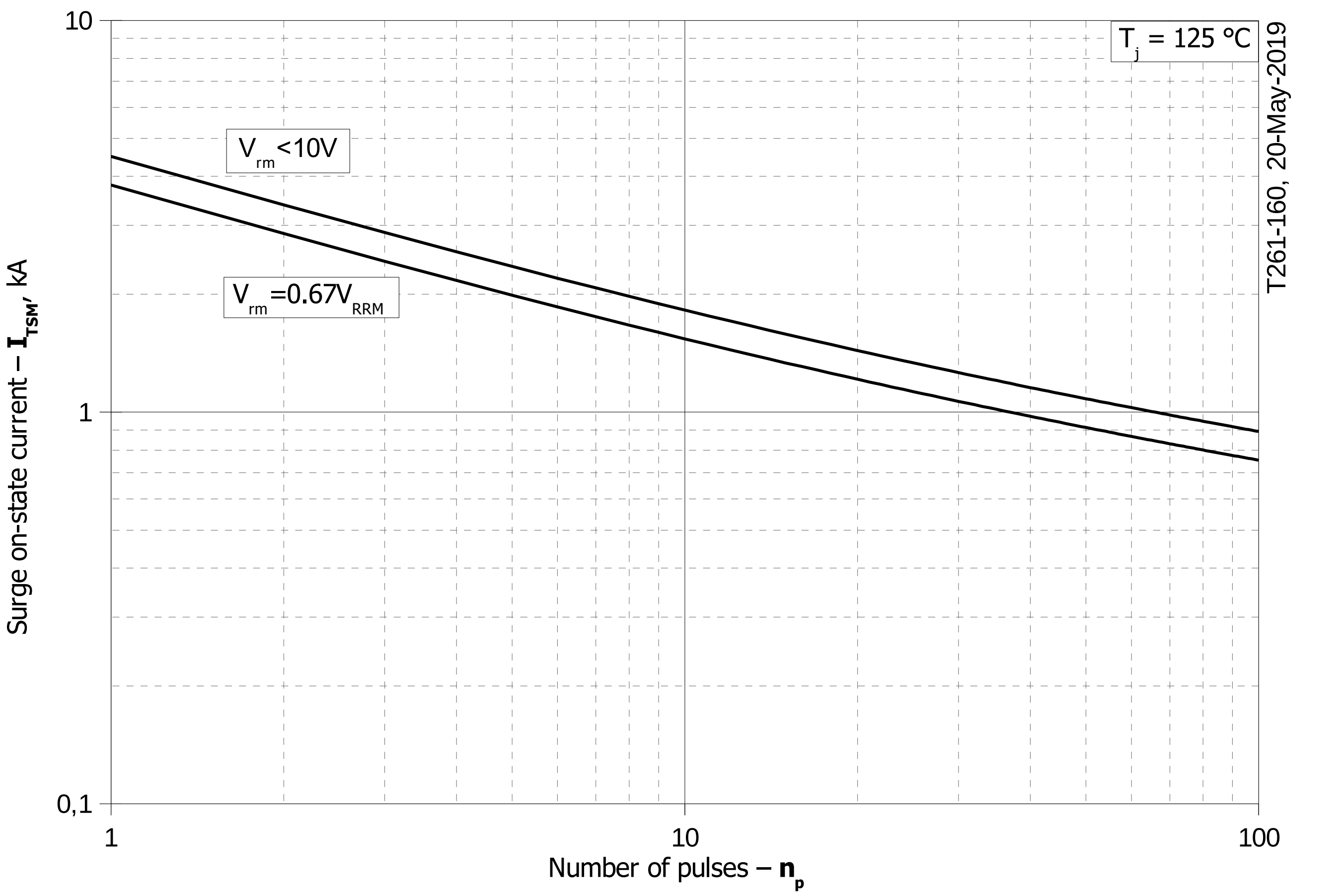


Fig. 12 - Maximum surge on-state current I_{TSM} vs. number of pulses n_p