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

Phase Control Thyristor
Type T253-1390-24

Mean on-state current	I_{TAV}	1390 A	
Repetitive peak off-state voltage	V_{DRM}	2000...2400 V	
Repetitive peak reverse voltage	V_{RRM}		
Turn-off time	t_q	160, 200, 250, 320, 320, 400, 500 µs	
V_{DRM}, V_{RRM}, V	2000	2200	2400
Voltage code	20	22	24
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	1390 1425	T_c=86 ºC, Double side cooled T_c=85 ºC, Double side cooled 180° half-sine wave; 50 Hz
I_{TRMS}	RMS on-state current	A	2182	T_c=86 ºC, Double side cooled 180° half-sine wave; 50 Hz
I_{TSM}	Surge on-state current	kA	29.0 33.0	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
			30.0 35.0	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	$A^2s·10^3$	4200 5400	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
			3700 5000	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	2000...2400	$T_{j\,min}$< 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	2100...2500	$T_{j\,min}$< 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	2000	$T_j = T_{j\ max}$; $V_D = 0.67 \cdot V_{DRM}$; $I_{TM} = 5000$ A; Gate pulse: $I_G = 2$ A; $t_{GP} = 50\ \mu$s; $di_G/dt \geq 2$ A/μs
THERMAL				
T_{stg}	Storage temperature	°C	−60...+50	
T_j	Operating junction temperature	°C	−60...+125	
MECHANICAL				
F	Mounting force	kN	24.0...28.0	
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	0.940	$T_j = T_{j\ max}$; 0.5 π I_{TAV} < I_T < 1.5 π I_{TAV}	
r_T	On-state slope resistance, max	mΩ	0.177		
I_L	Latching current, max	mA	1500	$T_j = 25$ °C; $V_D = 12$ V; Gate pulse: $I_G = 2$ A; $t_{GP} = 50\ \mu$s; $di_G/dt \geq 1$ 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	150	$T_j = T_{j\ max}$; $V_D = V_{DRM}$; $V_R = V_{RRM}$	
$(dv_D/dt)_{crit}$	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	500 300 150	$T_j = T_{j\ min}$ $T_j = 25$ °C $T_j = T_{j\ max}$	
V_{GD}	Gate non-trigger direct voltage, min	V	0.40	$T_j = T_{j\ max}$; $V_D = 0.67 \cdot V_{DRM}$; Direct gate current	
I_{GD}	Gate non-trigger direct current, min	mA	45.00		
SWITCHING					
t_{gd}	Delay time, max	μs	1.00	$T_j = 25$ °C; $V_D = 1000$ V; $I_{TM} = I_{TAV}$; di/dt=200 A/μs; Gate pulse: $I_G = 2$ A; $V_G = 20$ V; $t_{GP} = 50\ \mu$s; $di_G/dt = 2$ A/μs	
t_{gt}	Turn-on time, max	μs	6.00		
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; $V_R = 100$V; $V_D = 0.67 \cdot V_{DRM}$	
Q_{rr}	Total recovered charge, max	μC	3650	$T_j = T_{j\ max}$; $I_{TM} = I_{TAV}$; $di_R/dt = -10$ A/μs; $V_R = 100$ V;	
t_{rr}	Reverse recovery time, typ	μs	36		
I_{rr}	Reverse recovery current, max	A	203		

THERMAL

R_{thjc}	Thermal resistance, junction to case, max	°C/W	0.0180	Direct current	Double side cooled
R_{thjc-A}			0.0396		Anode side cooled
R_{thjc-K}			0.0324		Cathode side cooled
R_{thck}	Thermal resistance, case to heatsink, max	°C/W	0.0040	Direct current	

MECHANICAL

m	Weight, max	g	510	
D_s	Surface creepage distance	mm (inch)	30.38 (1.196)	
D_a	Air strike distance	mm (inch)	18.05 (0.710)	

PART NUMBERING GUIDE

T	253	1390	24	A2	T2	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

max⌀75(2,953) DIA

⌀50(1,968) DIA

⌀1,5 (0,059) DIA

26±2 (1,024)

0,5(0,019)

⌀3,5 (0,138) DIA
both sides

3 (0,118)

⌀50(1,968) DIA

82(3,23)*

⌀1,8 (0,071) DIA

4,75(0,187)

6,3(0,248)

⌀1,3 (0,051) DIA

20°±5°

7(0,276)

2,8 (0,11)
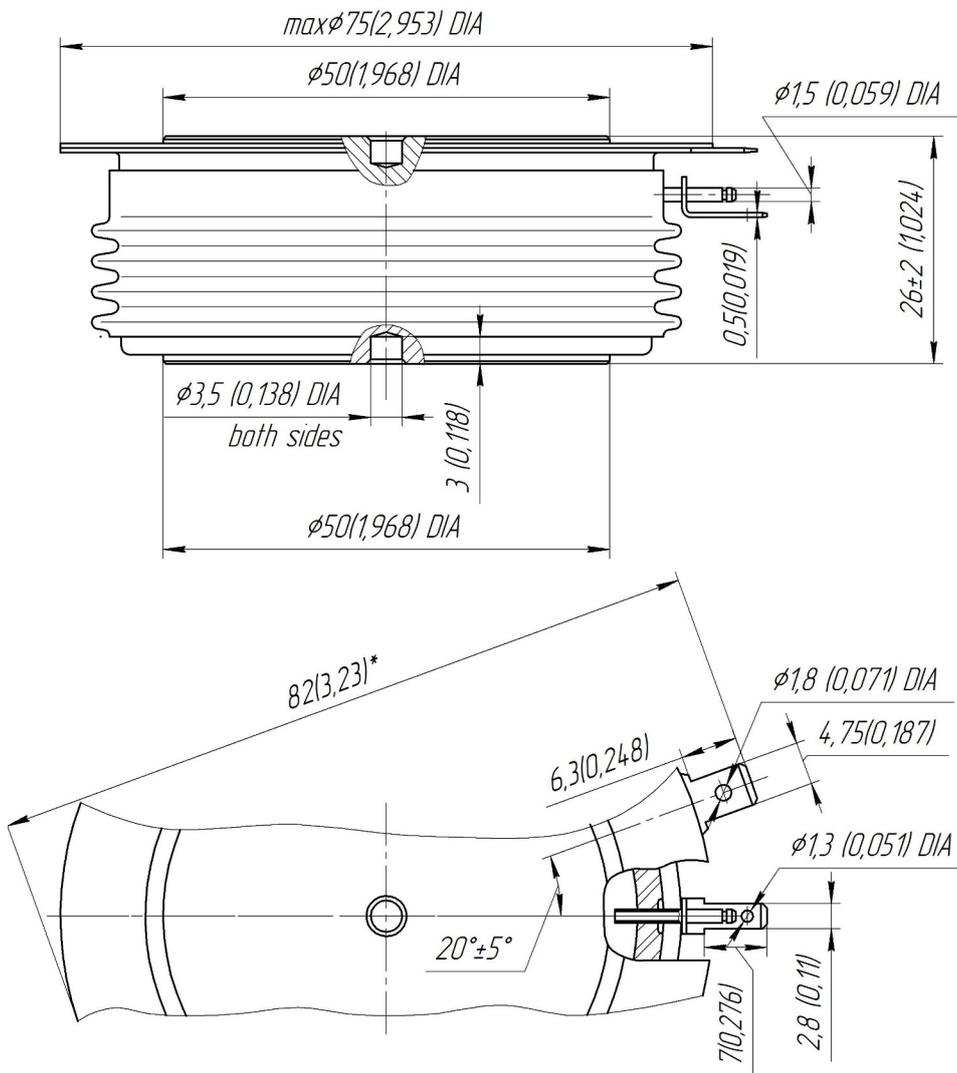
All dimensions in millimeters (inches)

On — state current - $\mathbf{I_{TM}}$, A (y-axis)
On — state voltage - $\mathbf{V_{TM}}$, V (x-axis)

Legend:
- - - - - - 25 °C
———— 125 °C
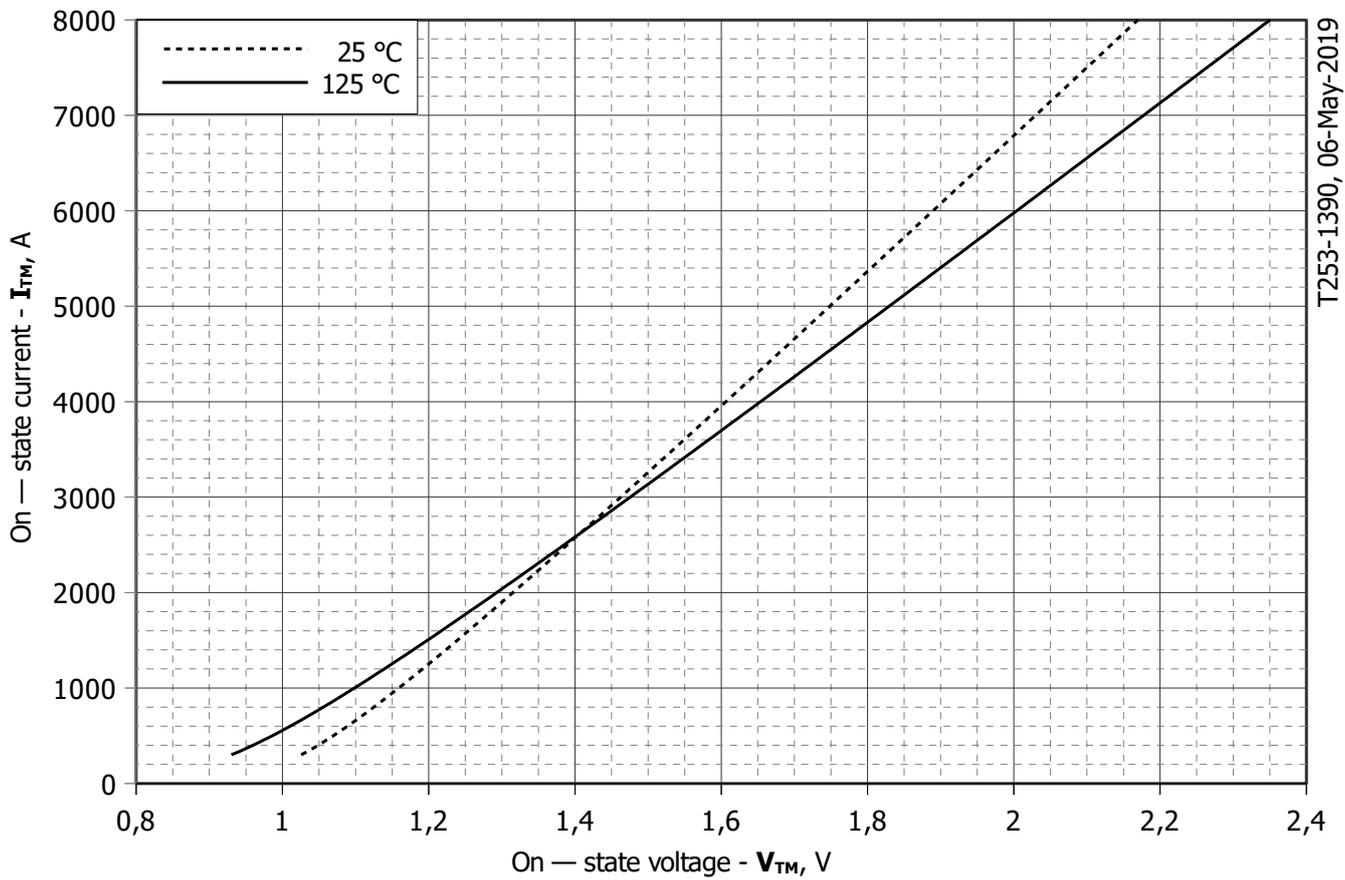
Fig 1 – On-state characteristics of Limit device

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	0.77554000	0.59679000
B	0.00013895	0.00017214
C	0.03876600	0.05265300
D	-0.00073627	-0.00108110

On-state characteristic model (see Fig. 1)
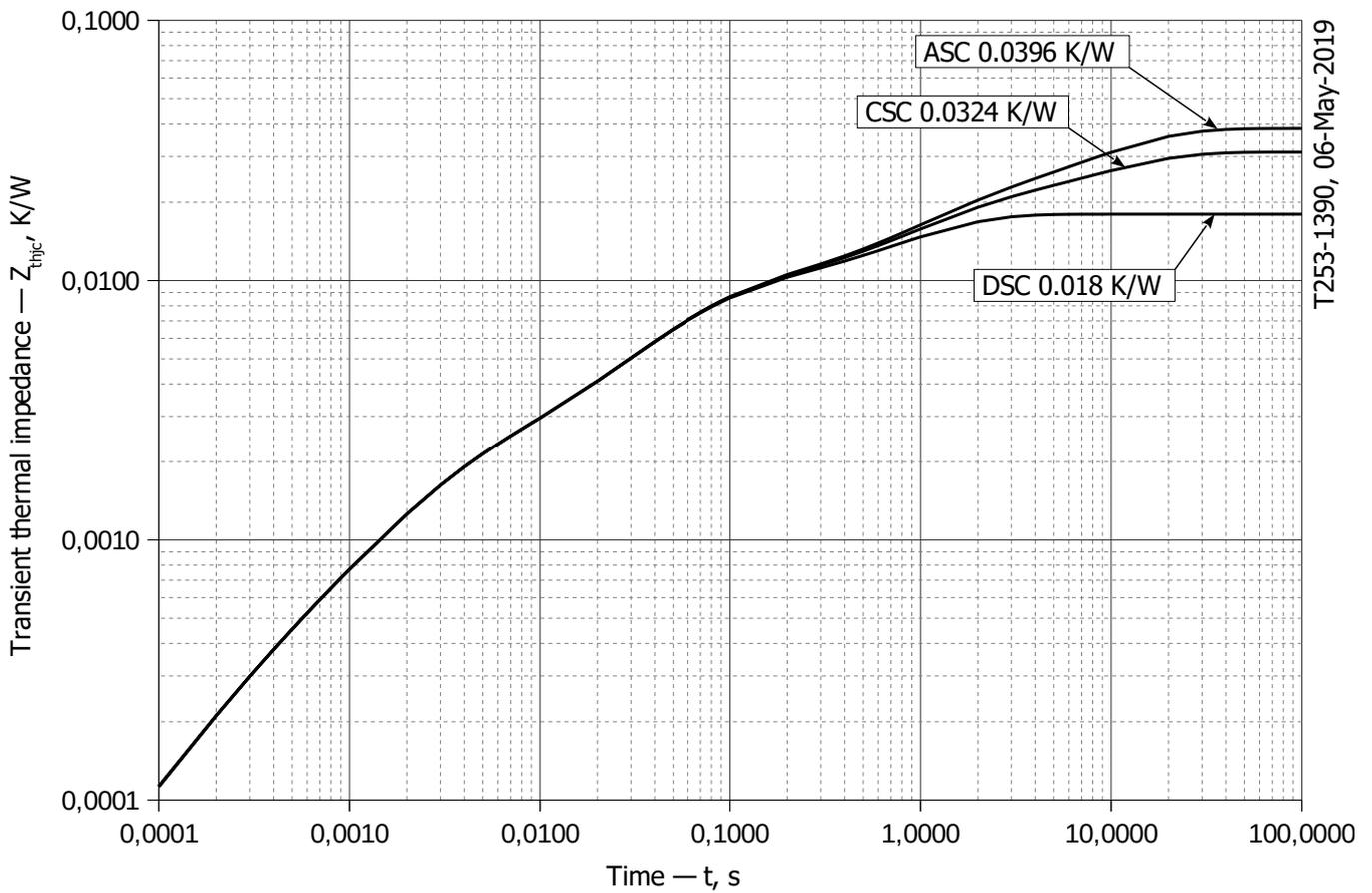
Fig 2 – Transient thermal impedance Z_{thjc} vs. time t

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	0.009241	0.006037	0.001231	0.001054	0.0003396	0.00009575
τ_i, s	0.9673	0.04967	0.002733	0.07734	0.001638	0.0002248

DC Anode side cooled

i	1	2	3	4	5	6
R_i, K/W	0.01318	0.009281	0.006055	0.001018	0.001535	0.0001182
τ_i, s	9.745	1.028	0.05591	0.03732	0.002468	0.0002687

DC Cathode side cooled

i	1	2	3	4	5	6
R_i, K/W	0.02041	0.009325	0.006949	0.0001252	0.001516	0.0001119
τ_i, s	9.752	1.065	0.05344	0.01407	0.002421	0.0002554

Transient thermal impedance junction to case Z_{thjc} model (see Fig. 2)
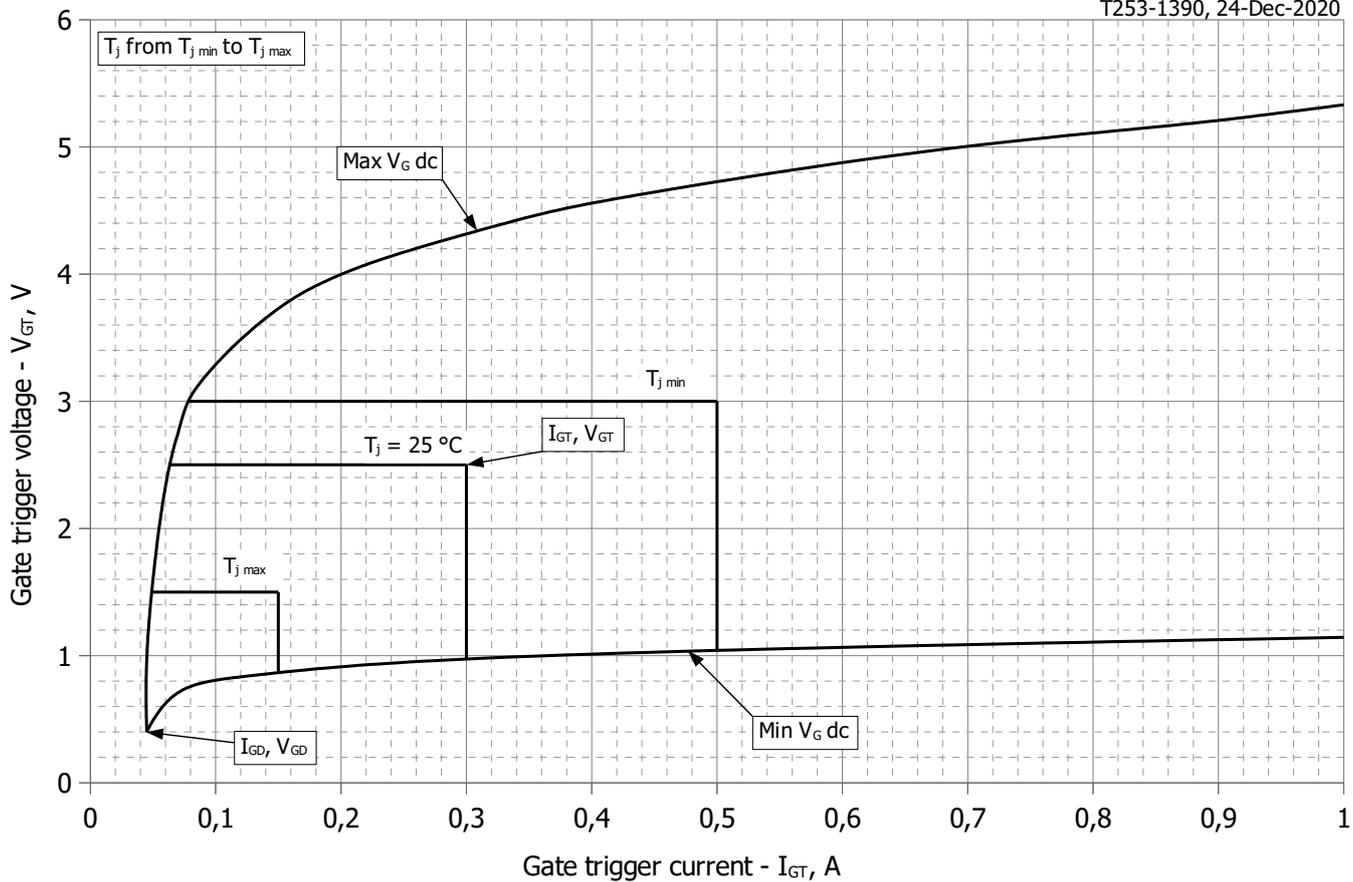
Fig 3 − Gate characteristics − Trigger limits
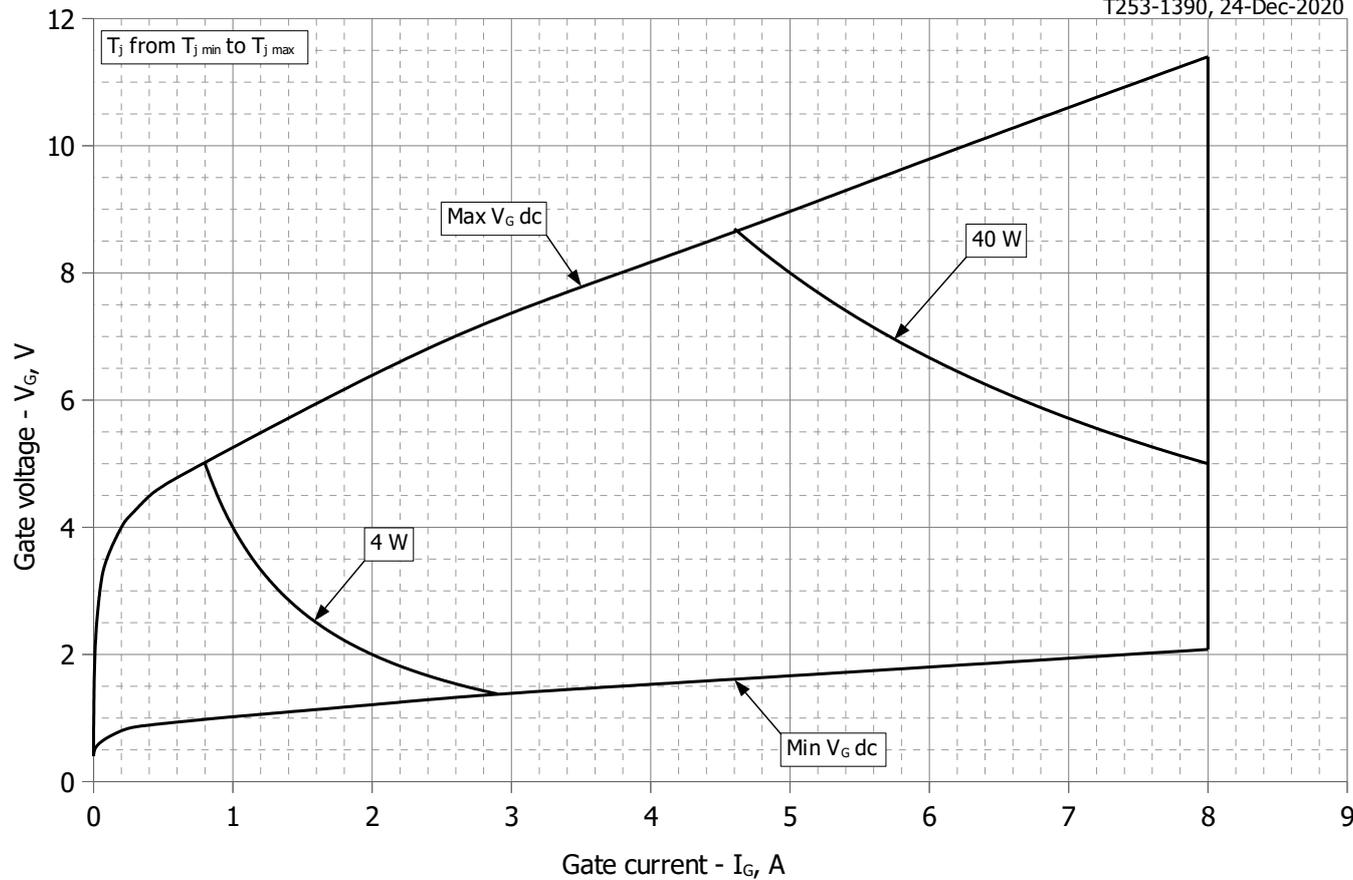
**Fig 4 - Gate characteristics − Power curves**
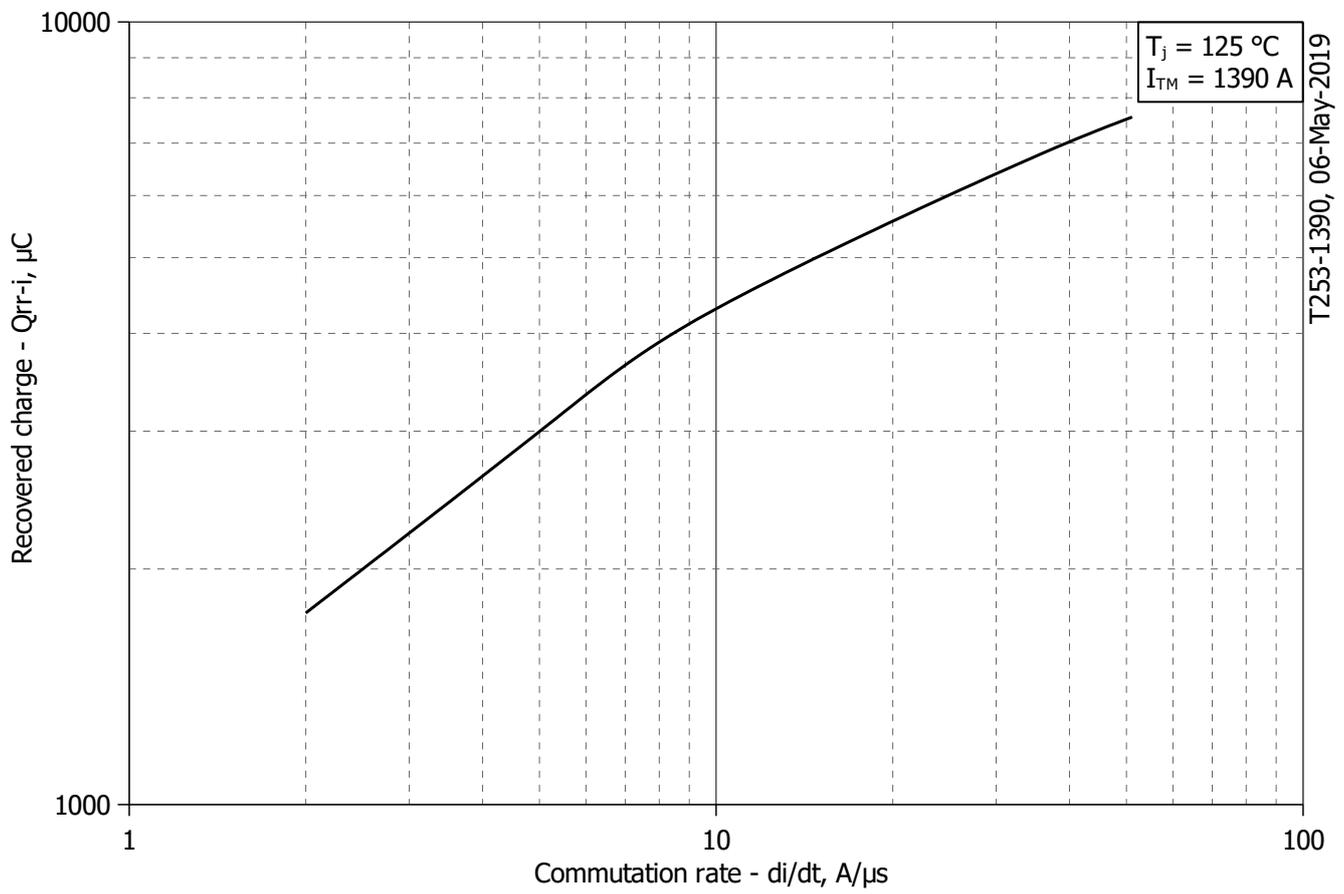
**Fig 5 – Maximum recovered charge $Q_{rr\text{-}i}$ (integral) vs. commutation rate di_R/dt**
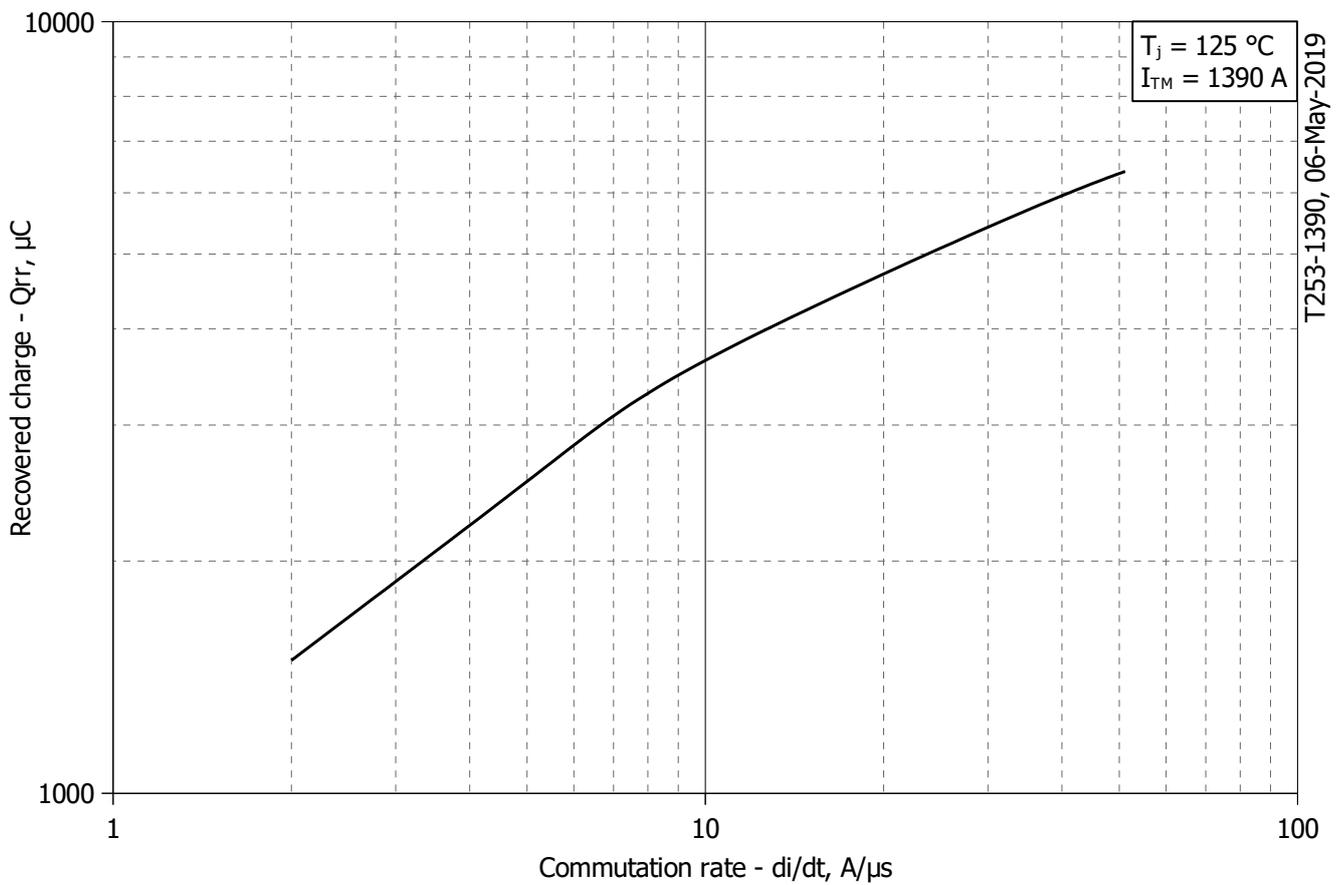
Fig 6 – Maximum recovered charge Q_{rr} vs. commutation rate di_R/dt (25% chord)
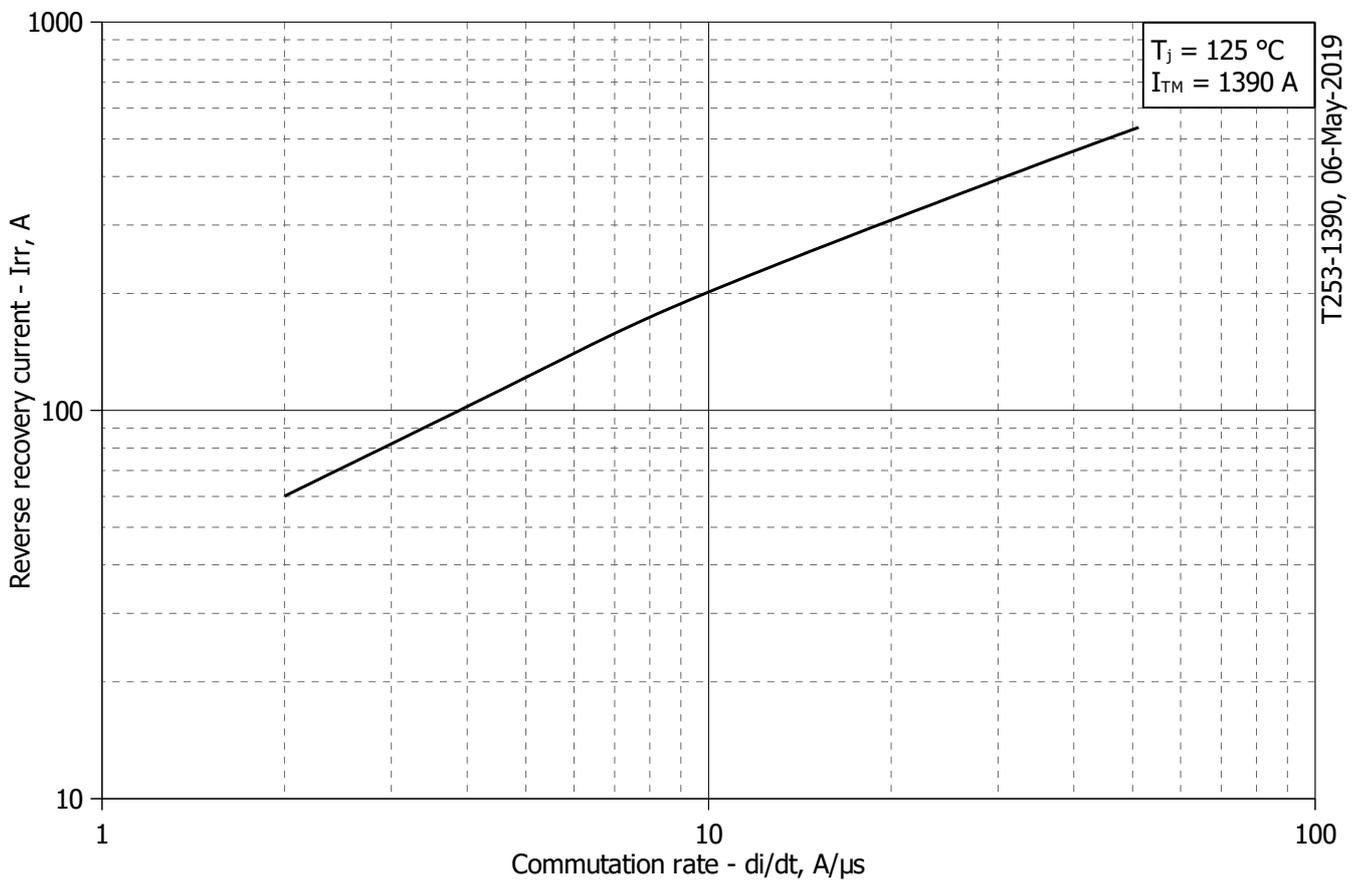
**Fig 7 – Maximum reverse recovery current I$_{rr}$ vs. commutation rate di$_R$/dt**
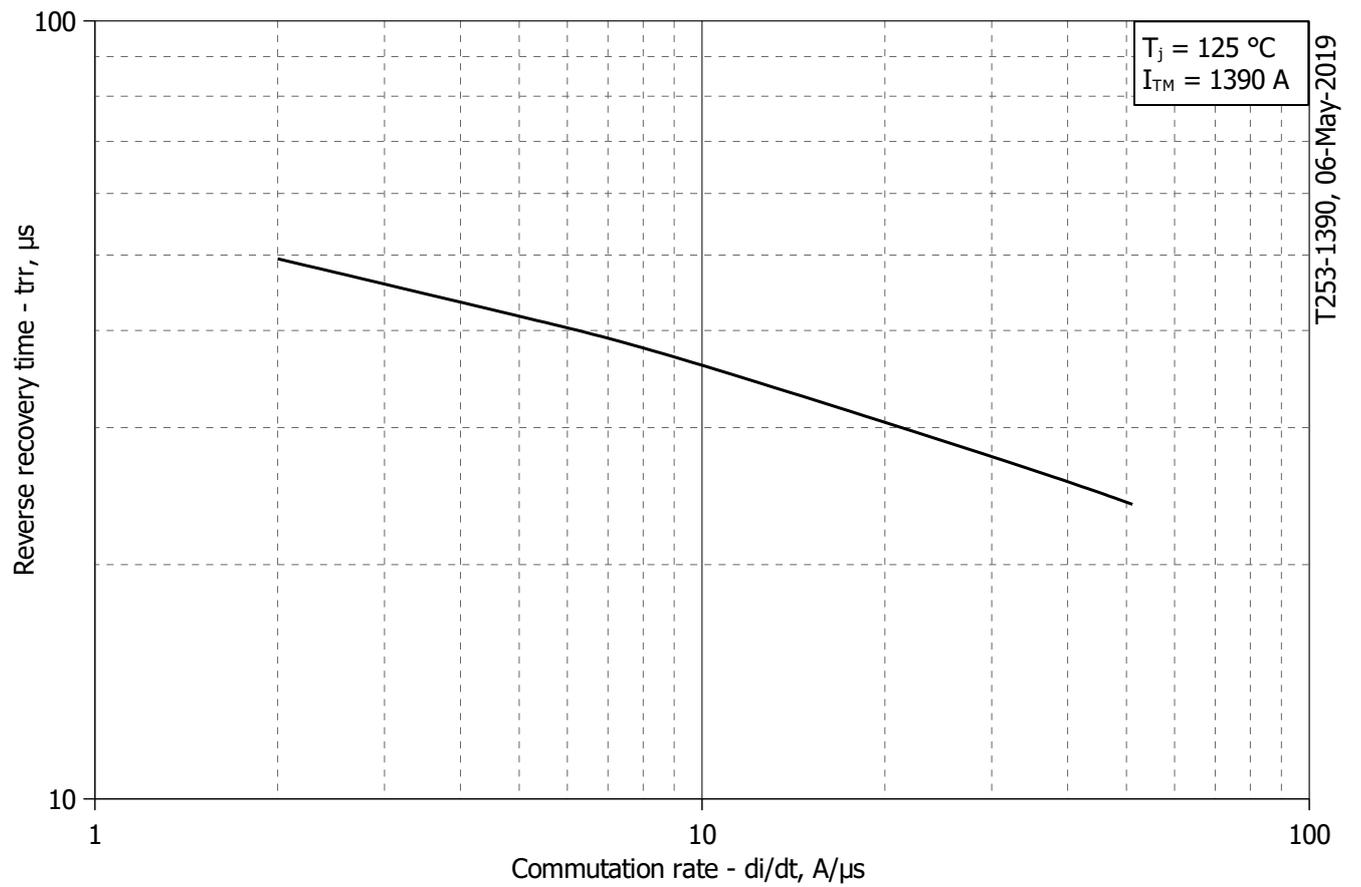

Fig 8 – Maximum recovery time t$_{rr}$ vs. commutation rate di$_R$/dt (25% chord)
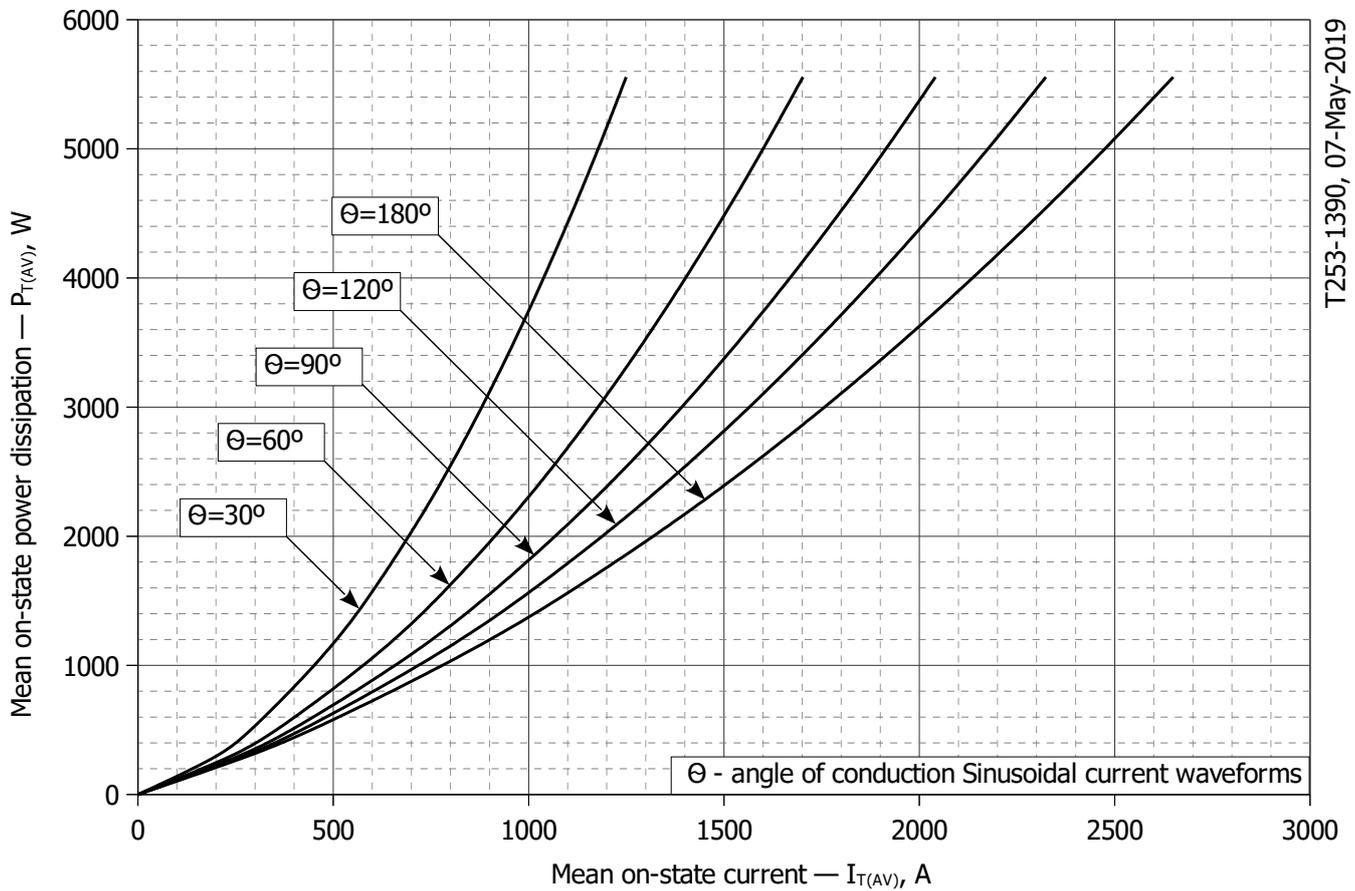
Fig. 9 - Mean on-state power dissipation P$_{TAV}$ vs. mean on-state current I$_{TAV}$ for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)
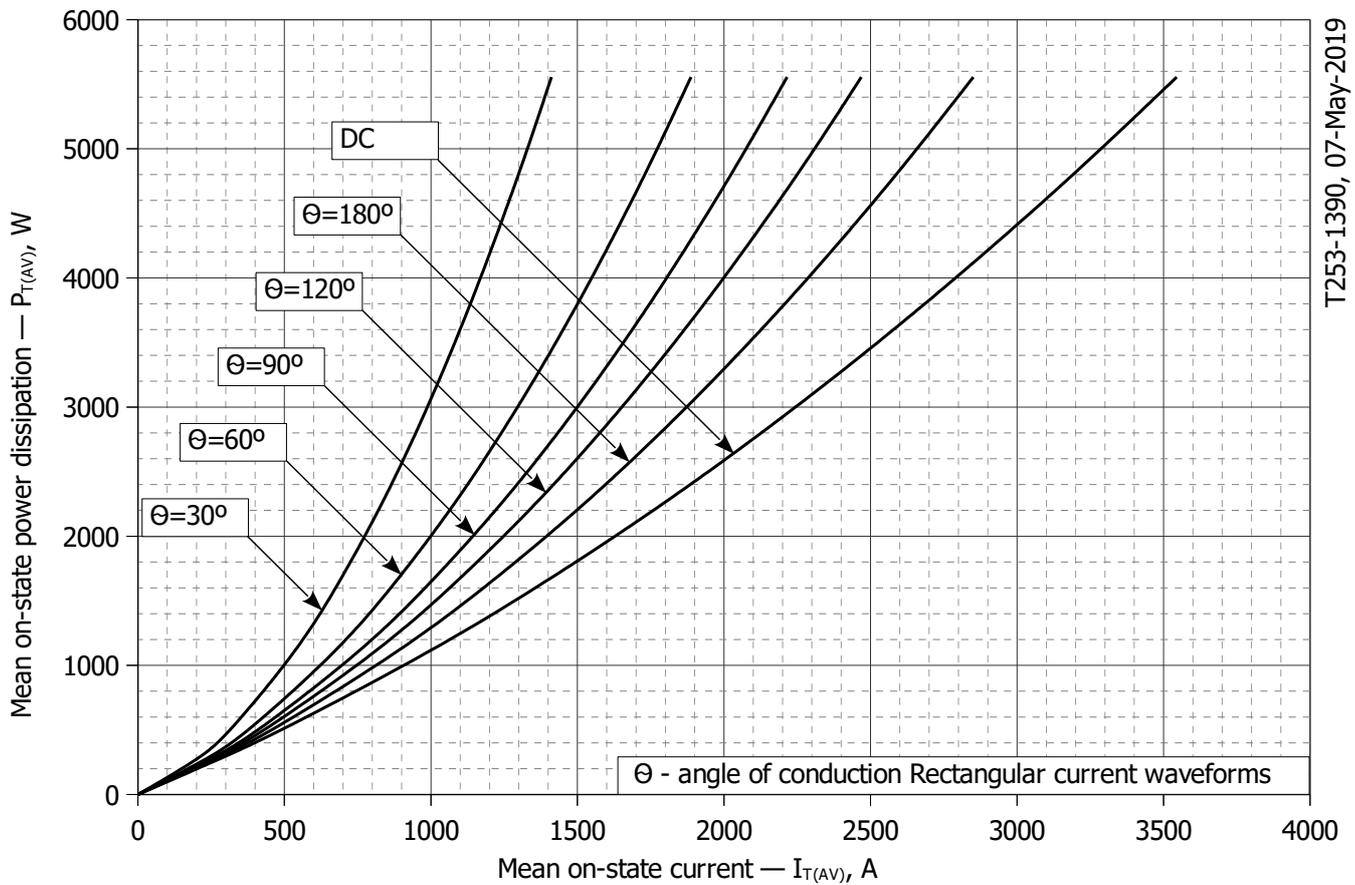
Fig. 10 – Mean on-state power dissipation P$_{TAV}$ vs. mean on-state current I$_{TAV}$ for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)
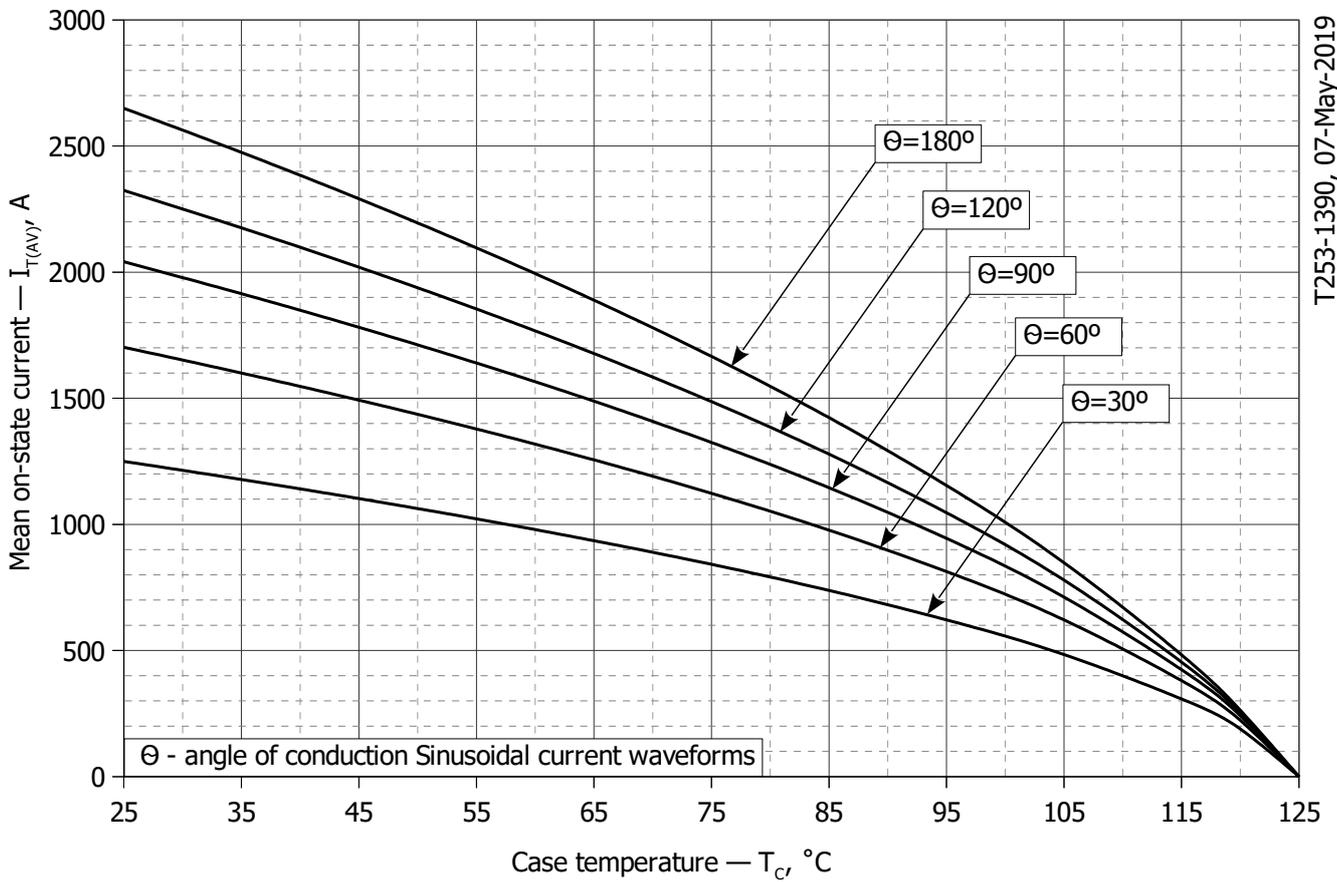
Fig. 11 – Mean on-state current I_TAV vs. case temperature T_C for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)
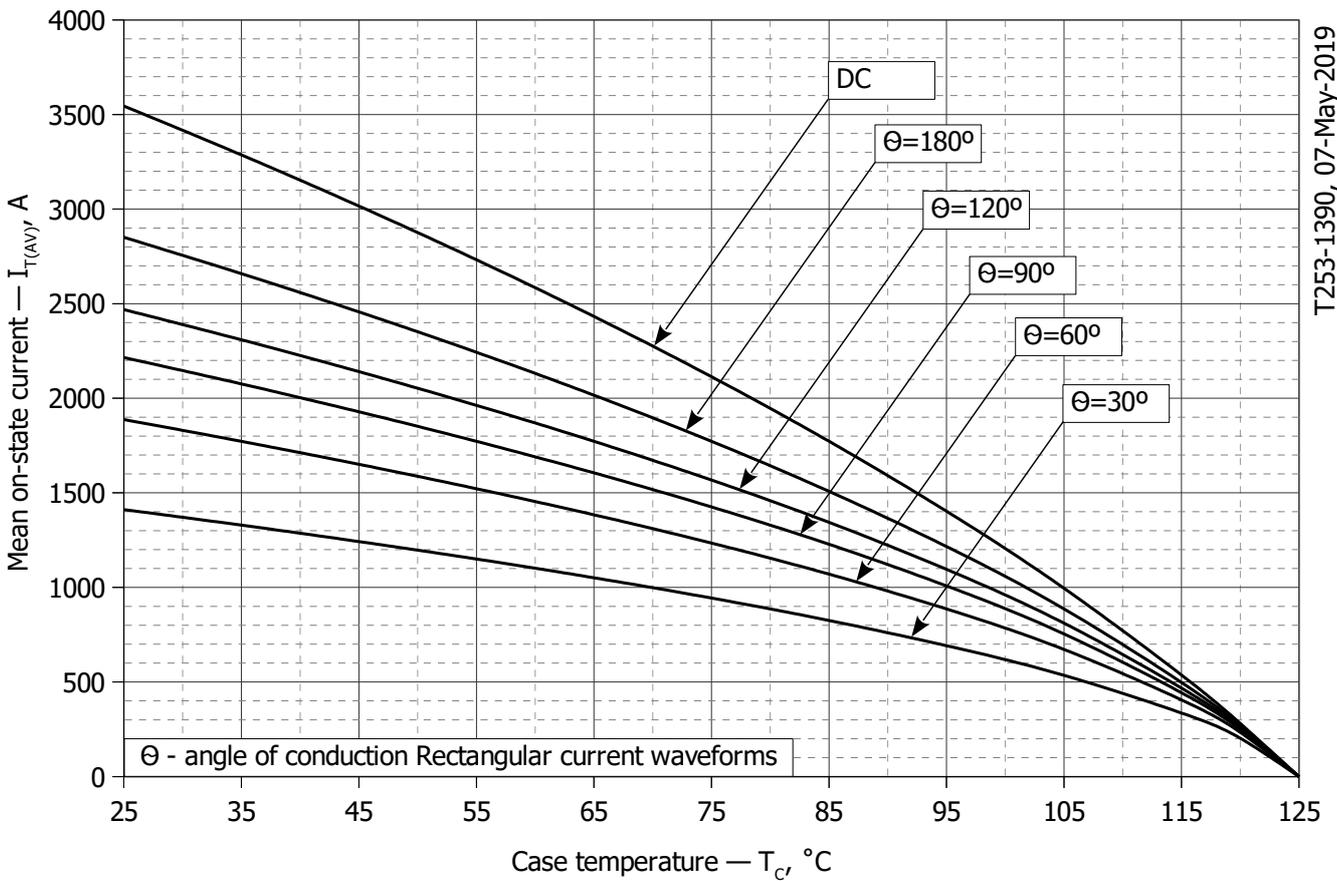

Fig. 12 - Mean on-state current I_TAV vs. case temperature T_C for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

T_j = 125 °C

Surge on-state current − $\mathbf{I_{TSM}}$, kA

Safety factor − $\mathbf{I^2t}$, kA²s

$I_{TSM}:V_{rm}<10V$

$I_{TSM}:V_{rm}=0.67V_{RRM}$

$I^2t:V_{rm}<10V$

$I^2t:V_{rm}=0.67V_{RRM}$
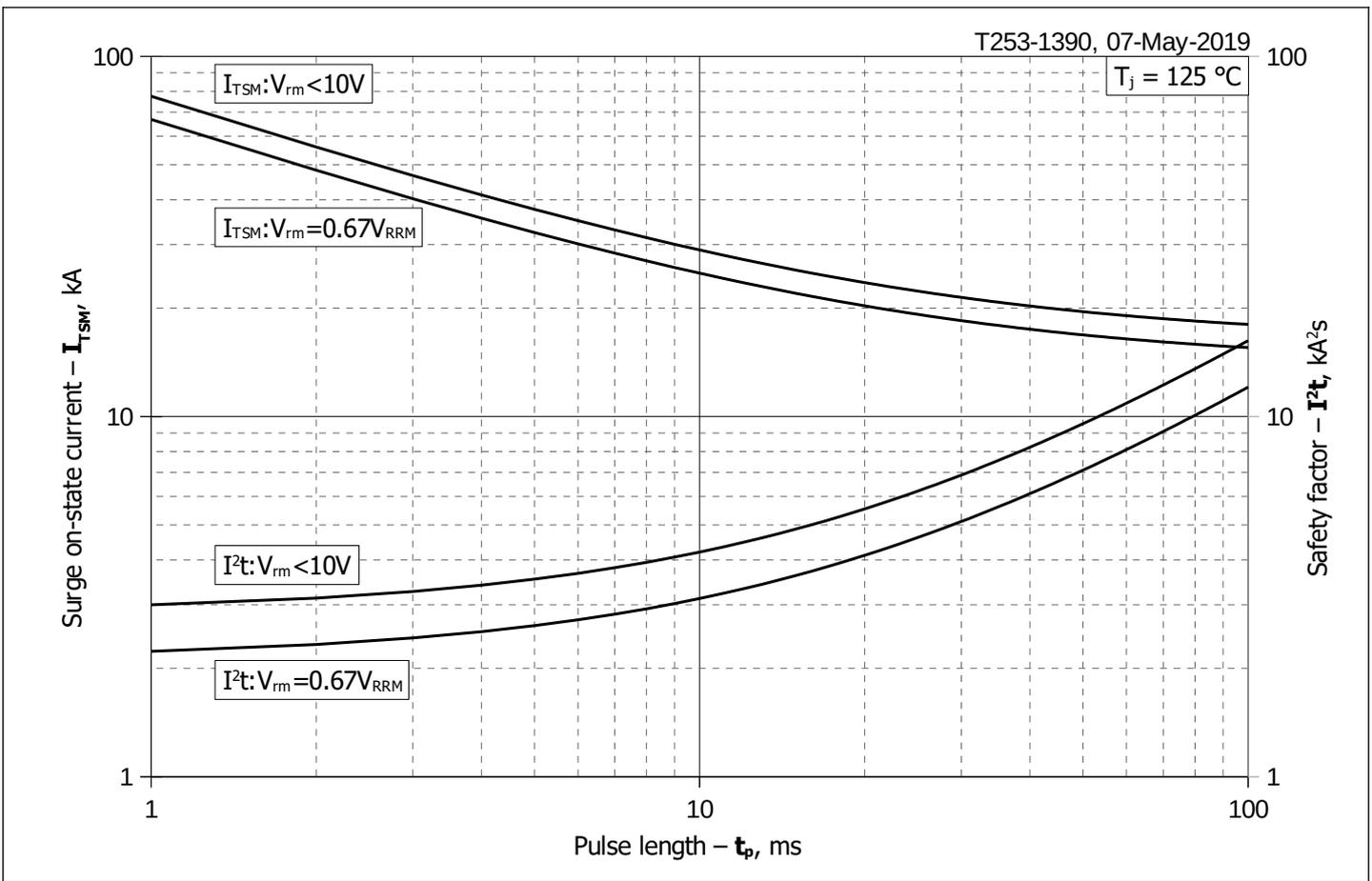
Pulse length − $\mathbf{t_p}$, ms

Fig. 13 − Maximum surge on-state current I_{TSM} and safety factor I^2t vs. pulse length t_p

T_j = 125 °C

T253-1390, 07-May-2019

$V_{rm}<10V$

$V_{rm}=0.67V_{RRM}$

Surge on-state current − $\mathbf{I_{TSM}}$, kA
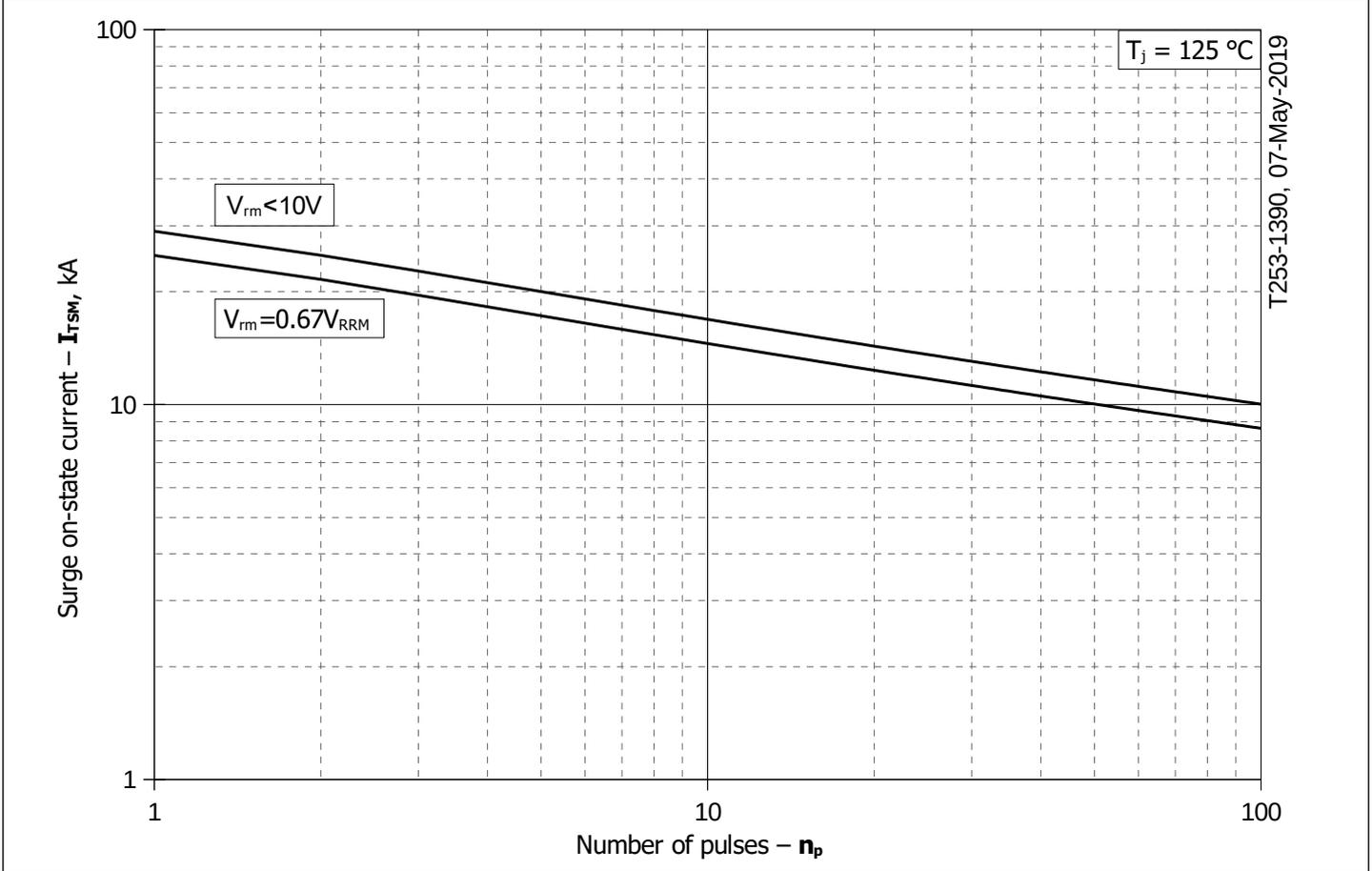
Number of pulses − $\mathbf{n_p}$

Fig. 14 - Maximum surge on-state current I_{TSM} vs. number of pulses n_p