

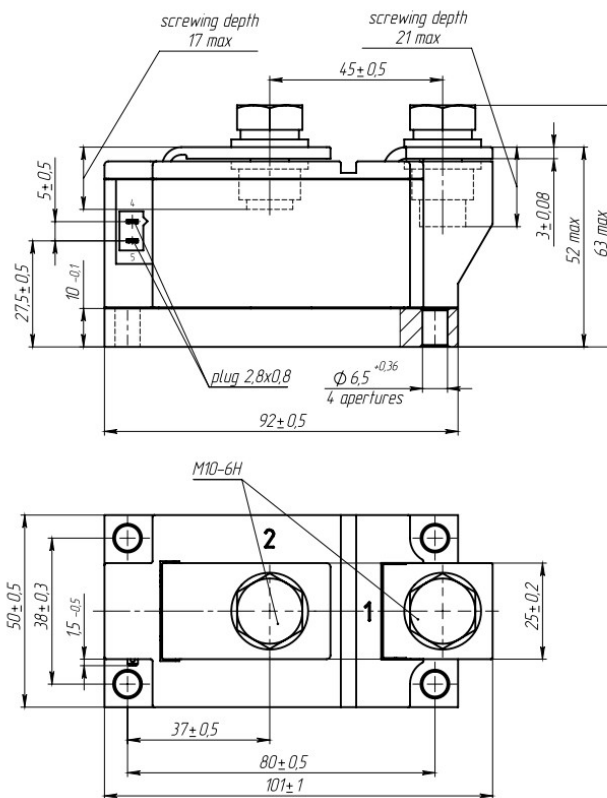
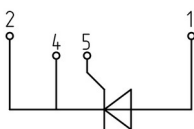


Electrically isolated base plate
Industrial standard package
Simplified mechanical design, rapid assembly
Pressure contact

Single Thyristor Module For Phase Control MT1-400-28-B0

Mean on-state current	I_{TAV}	400 A
Repetitive peak off-state voltage	V_{DRM}	2600...2800 V
Repetitive peak reverse voltage	V_{RRM}	
Turn-off time	t_q	250, 320, 400, 500 μs
V_{DRM}, V_{RRM}, V	2600	2800
Voltage code	26	28
$T_j, ^\circ C$	-40...+125	

MT1



All dimensions in millimeters (inches)

MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions	
ON-STATE					
I_{TAV}	Maximum allowable mean on-state current	A	400 417	$T_c=87\text{ }^{\circ}\text{C};$ $T_c=85\text{ }^{\circ}\text{C};$ 180° half-sine wave; 50 Hz	
I_{TRMS}	RMS on-state current	A	628	$T_c=87\text{ }^{\circ}\text{C};$ 180° half-sine wave; 50 Hz	
I_{TSM}	Surge on-state current	kA	11.0 13.0	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=10\text{ ms}$; single pulse; $V_D=V_R=0\text{ V};$ Gate pulse: $I_G=2\text{ A};$ $t_{GP}=50\text{ }\mu\text{s}; di_G/dt\geq 1\text{ A}/\mu\text{s}$
			12.0 14.0	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=8.3\text{ ms}$; single pulse; $V_D=V_R=0\text{ V};$ Gate pulse: $I_G=2\text{ A};$ $t_{GP}=50\text{ }\mu\text{s}; di_G/dt\geq 1\text{ A}/\mu\text{s}$
I^2t	Safety factor	$\text{A}^2\text{s}\cdot 10^3$	600 840	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=10\text{ ms}$; single pulse; $V_D=V_R=0\text{ V};$ Gate pulse: $I_G=2\text{ A};$ $t_{GP}=50\text{ }\mu\text{s}; di_G/dt\geq 1\text{ A}/\mu\text{s}$
			590 810	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=8.3\text{ ms}$; single pulse; $V_D=V_R=0\text{ V};$ Gate pulse: $I_G=2\text{ A};$ $t_{GP}=50\text{ }\mu\text{s}; di_G/dt\geq 1\text{ A}/\mu\text{s}$
BLOCKING					
V_{DRM}, V_{RRM}	Repetitive peak off-state and Repetitive peak reverse voltages	V	2600...2800	$T_{j\text{ min}} < T_j < T_{j\text{ max}};$ 180° half-sine wave; 50 Hz; Gate open	
V_{DSM}, V_{RSM}	Non-repetitive peak off-state and Non-repetitive peak reverse voltages	V	2700...2900	$T_{j\text{ min}} < T_j < T_{j\text{ max}};$ 180° half-sine wave; single pulse; Gate open	
V_D, V_R	Direct off-state and Direct reverse voltages	V	$0.6\cdot V_{DRM}$ $0.6\cdot V_{RRM}$	$T_j=T_{j\text{ max}};$ Gate open	
TRIGGERING					
I_{FGM}	Peak forward gate current	A	8	$T_j=T_{j\text{ max}}$	
V_{RGM}	Peak reverse gate voltage	V	5		
P_G	Gate power dissipation	W	4	$T_j=T_{j\text{ max}}$ 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	$T_j=T_{j\text{ max}}; V_D=0.67\cdot V_{DRM}; I_{TM}=2000\text{ A};$ Gate pulse: $I_G=2\text{ A};$ $t_{GP}=50\text{ }\mu\text{s}; di_G/dt\geq 2\text{ A}/\mu\text{s}$	
THERMAL					
T_{stg}	Storage temperature	$^{\circ}\text{C}$	-40...+50		
T_j	Operating junction temperature	$^{\circ}\text{C}$	-40...+125		
$T_{c\text{ op}}$	Operating temperature	$^{\circ}\text{C}$	-40...+125		
MECHANICAL					
a	Acceleration under vibration	m/s ²	50		

CHARACTERISTICS

Symbols and parameters		Units	Values	Conditions	
ON-STATE					
V _{TM}	Peak on-state voltage, max	V	1.80	T _j =25 °C; I _{TM} =1256 A	
V _{T(TO)}	On-state threshold voltage, max	V	1.056	T _j =T _{j max} ;	
r _T	On-state slope resistance, max	mΩ	0.668	0.5 π I _{TAV} < I _T < 1.5 π I _{TAV}	
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≥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 3.00	T _j =T _{j max} T _j =25 °C	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·V _{DRM} ; Gate open	
TRIGGERING					
V _{GT}	Gate trigger direct voltage, max	V	3.00 2.50 2.00	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	400 250 200	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·V _{DRM} ;	
I _{GD}	Gate non-trigger direct current, min	mA	60.00	Direct gate current	
SWITCHING					
t _{gd}	Delay time, max	μs	0.55	T _j =25 °C; V _D =1500 V; I _{TM} =I _{TAV} ; di/dt=200 A/μs;	
t _{gt}	Turn-on time, max	μs	5.00	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	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 V _{DRM} ;	
Q _{rr}	Total recovered charge, max	μC	2000	T _j =T _{j max} ; I _{TM} =400 A;	
t _{rr}	Reverse recovery time, max	μs	28	di _R /dt=-10 A/μs;	
I _{rr}	Reverse recovery current, max	A	143	V _R =100 V	
THERMAL					
R _{thjc}	Thermal resistance, junction to case			180° half-sine wave, 50 Hz	
	per module	°C/W	0.0550		
R _{thch}	Thermal resistance, case to heatsink				
	per module	°C/W	0.0100		
INSULATION					
V _{ISOL}	Insulation test voltage	kV	3.00	Sine wave, 50 Hz; RMS	t=1 min
			3.60		t=1 sec
MECHANICAL					
M ₁	Mounting torque (M6) ³⁾	Nm	6.00	Tolerance ± 15%	
M ₂	Terminal connection torque (M10) ³⁾	Nm	12.00	Tolerance ± 15%	
m	Weight, max	g	900		

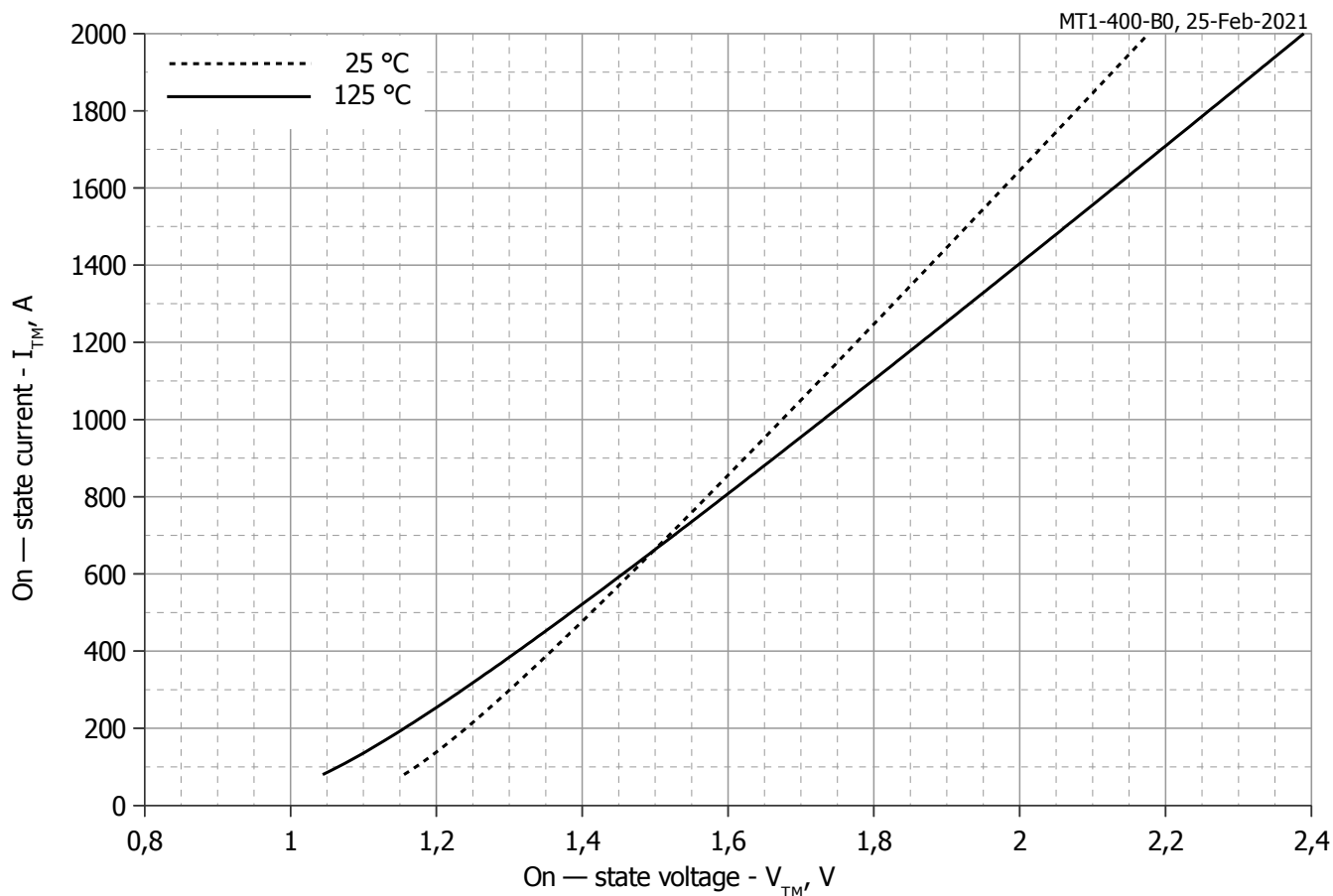


Fig 1 – On-state characteristics of Limit device

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	
	$T_j = 25^\circ\text{C}$	$T_j = T_{j\max}$
A	0.98819634	0.84496379
B	0.00047996	0.00060784
C	0.02898057	0.02950212
D	0.00018630	0.00233982

On-state characteristic model (see Fig. 1)

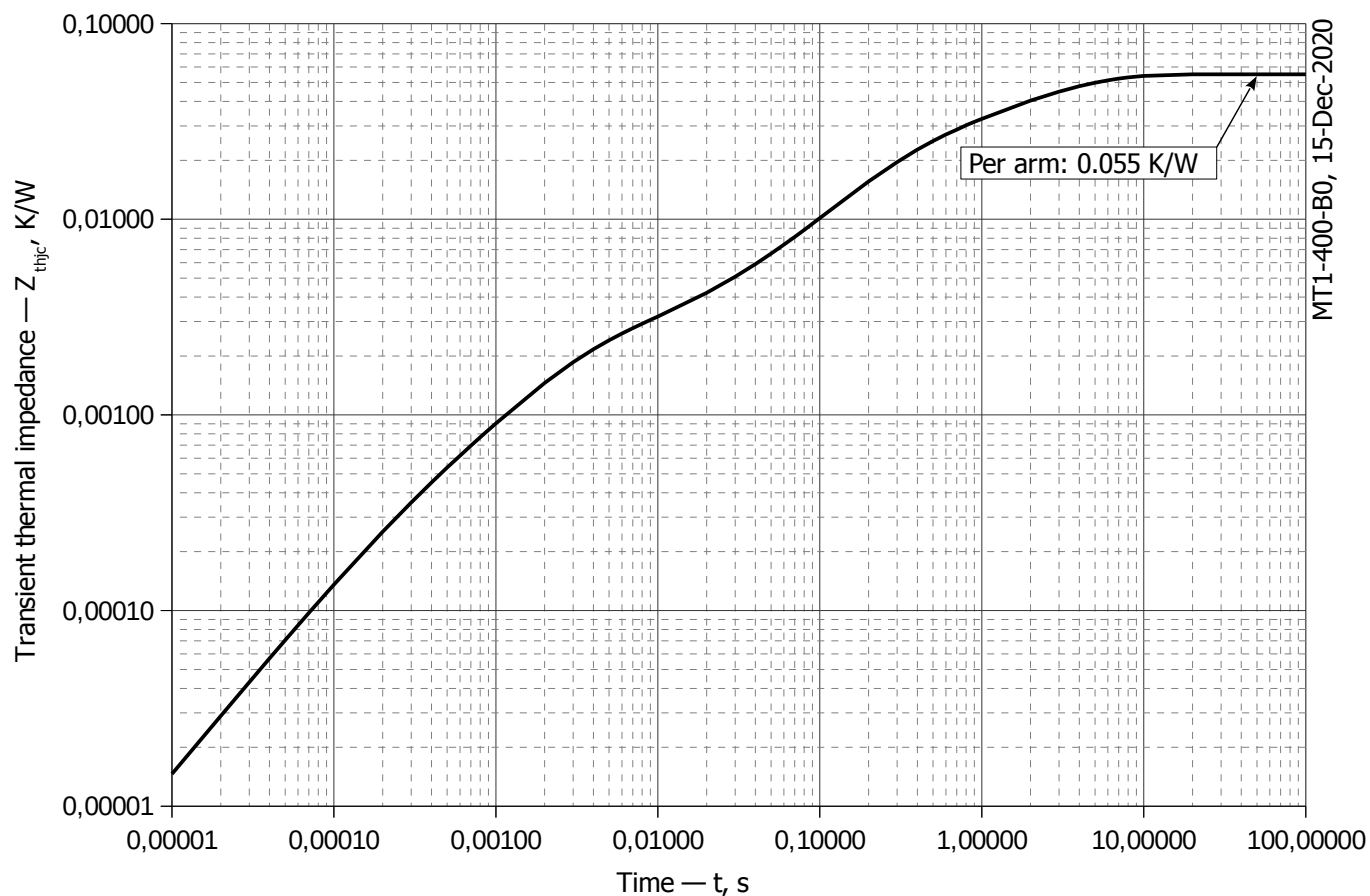


Fig 2 – Transient thermal impedance Z_{thjc} vs. time t

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.

i	1	2	3	4	5	6
R_i , K/W	0.0249	0.0112	0.01635	0.0006528	0.001791	0.0001363
τ_i , s	3.132	1.000	0.2335	0.01038	0.002348	0.0002448

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

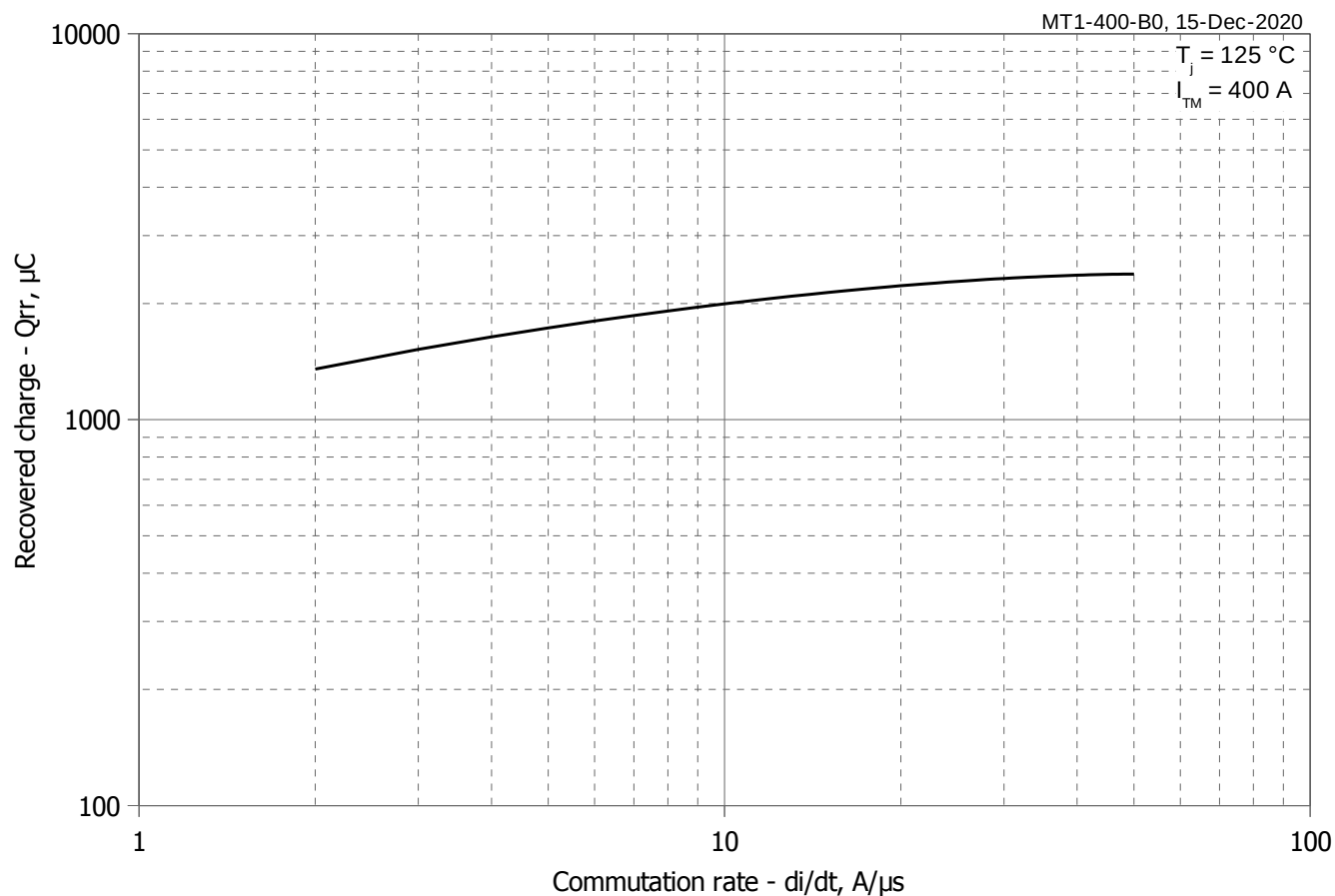


Fig 3 – Maximum recovered charge Q_{rr} vs. commutation rate di_R/dt (25% chord)

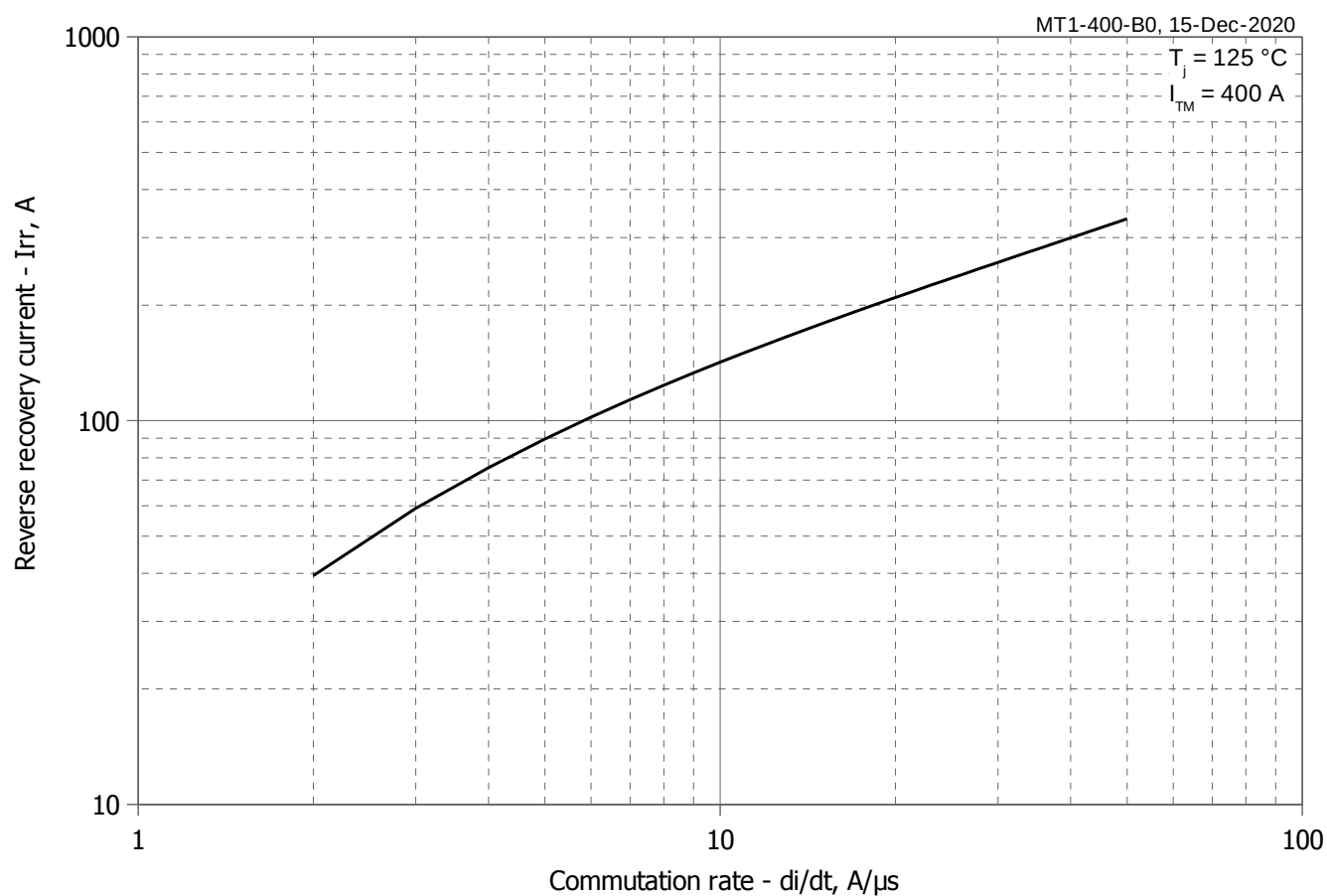


Fig 4 – Maximum reverse recovery current I_{rr} vs. commutation rate di_R/dt

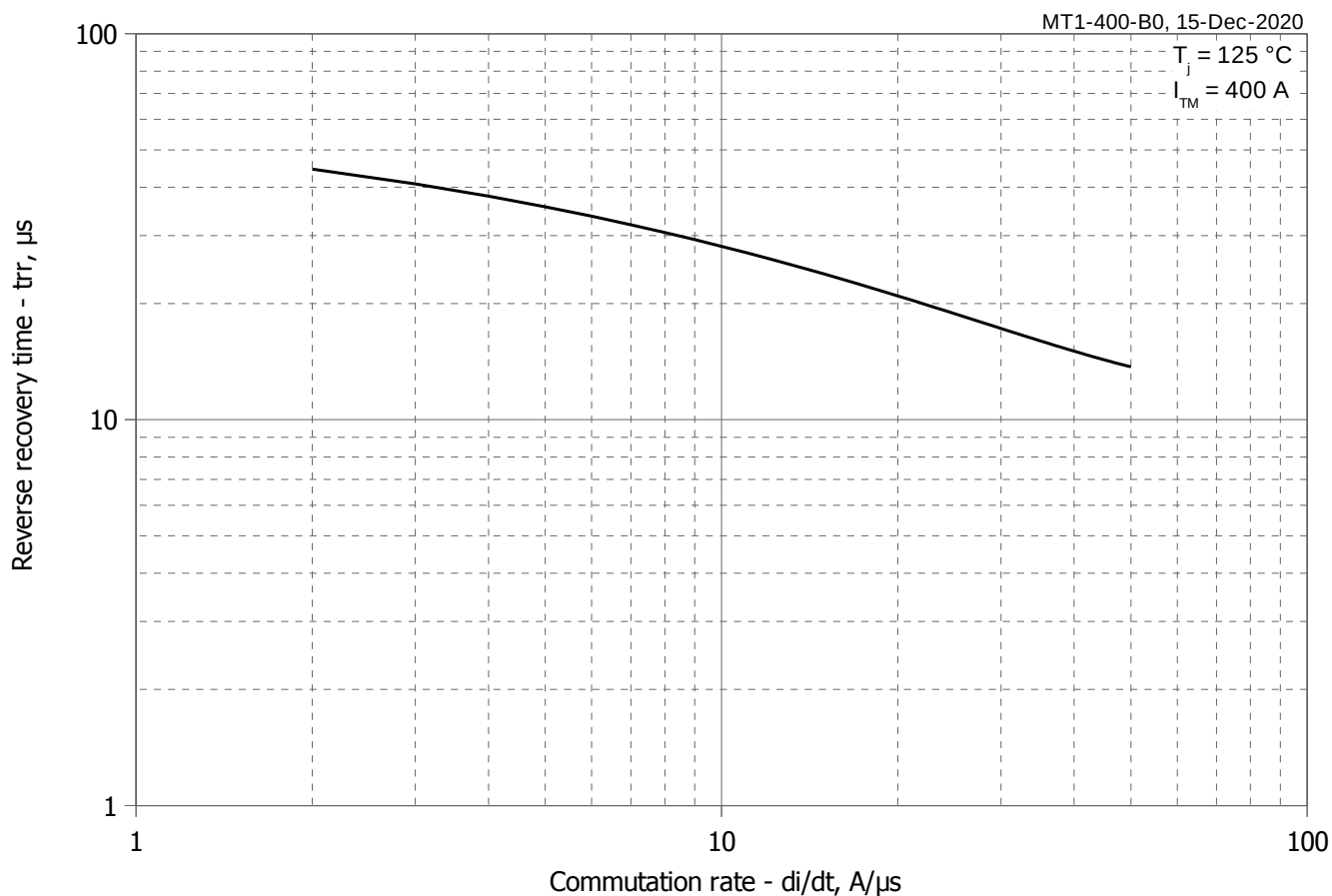


Fig 5 – Maximum recovery time t_{rr} vs. commutation rate di_R/dt (25% chord)

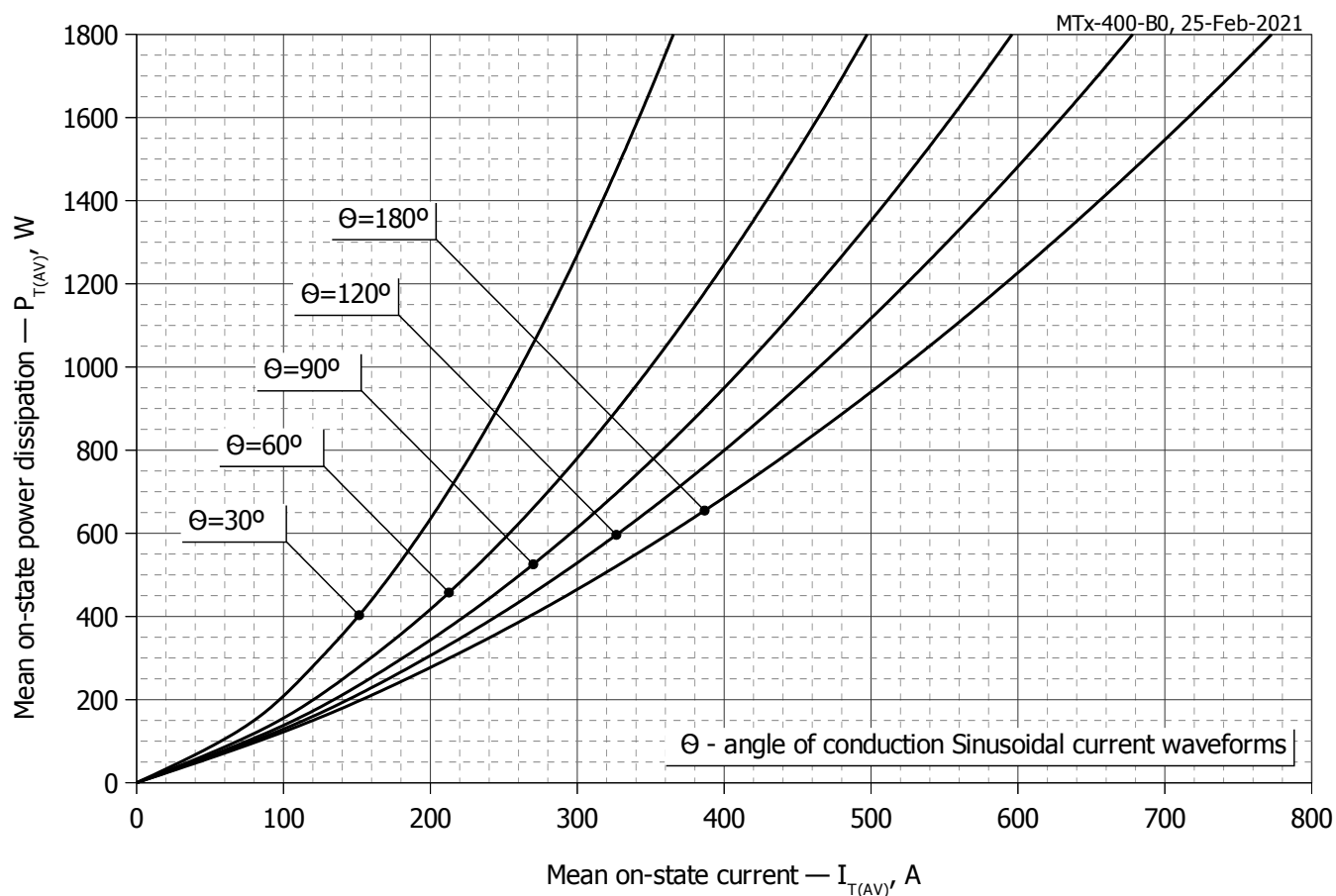


Fig. 6 - Mean on-state power dissipation P_{TAV} vs. mean on-state current I_{TAV} for sinusoidal current waveforms at different conduction angles ($f=50\text{Hz}$, DSC)

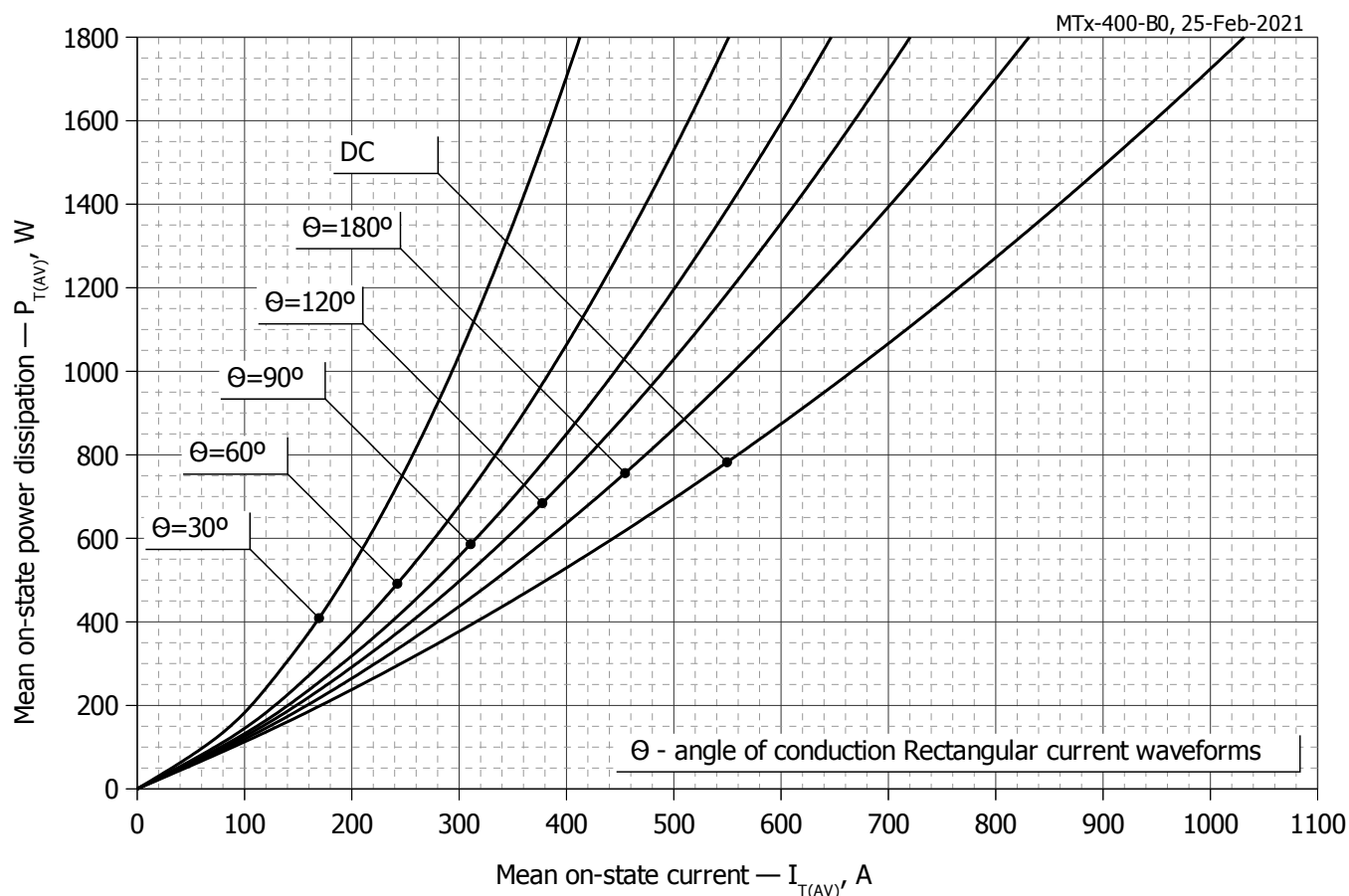


Fig. 7 – Mean on-state power dissipation P_{TAV} vs. mean on-state current I_{TAV} for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

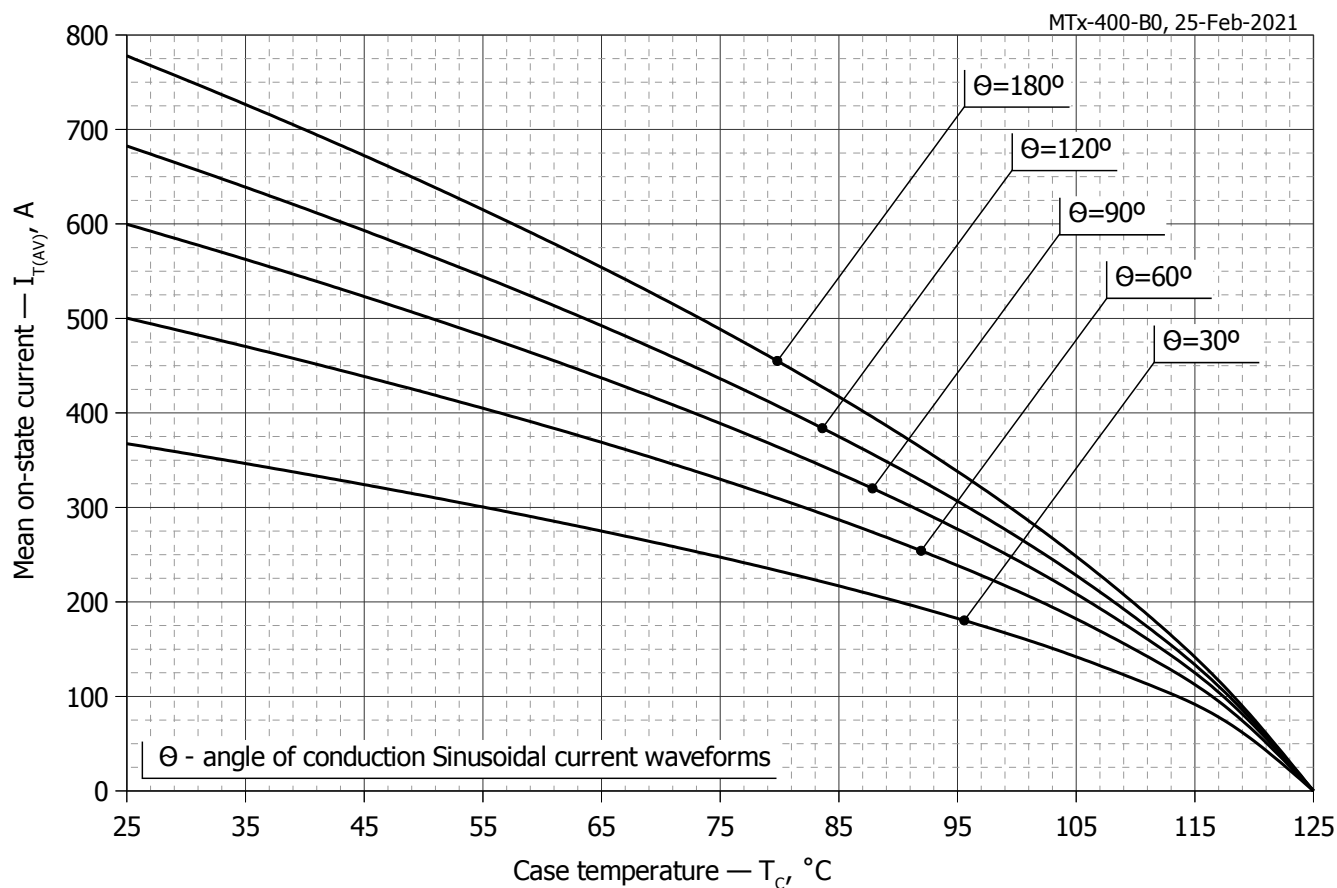


Fig. 8 – Mean on-state current I_{TAV} vs. case temperature T_c for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

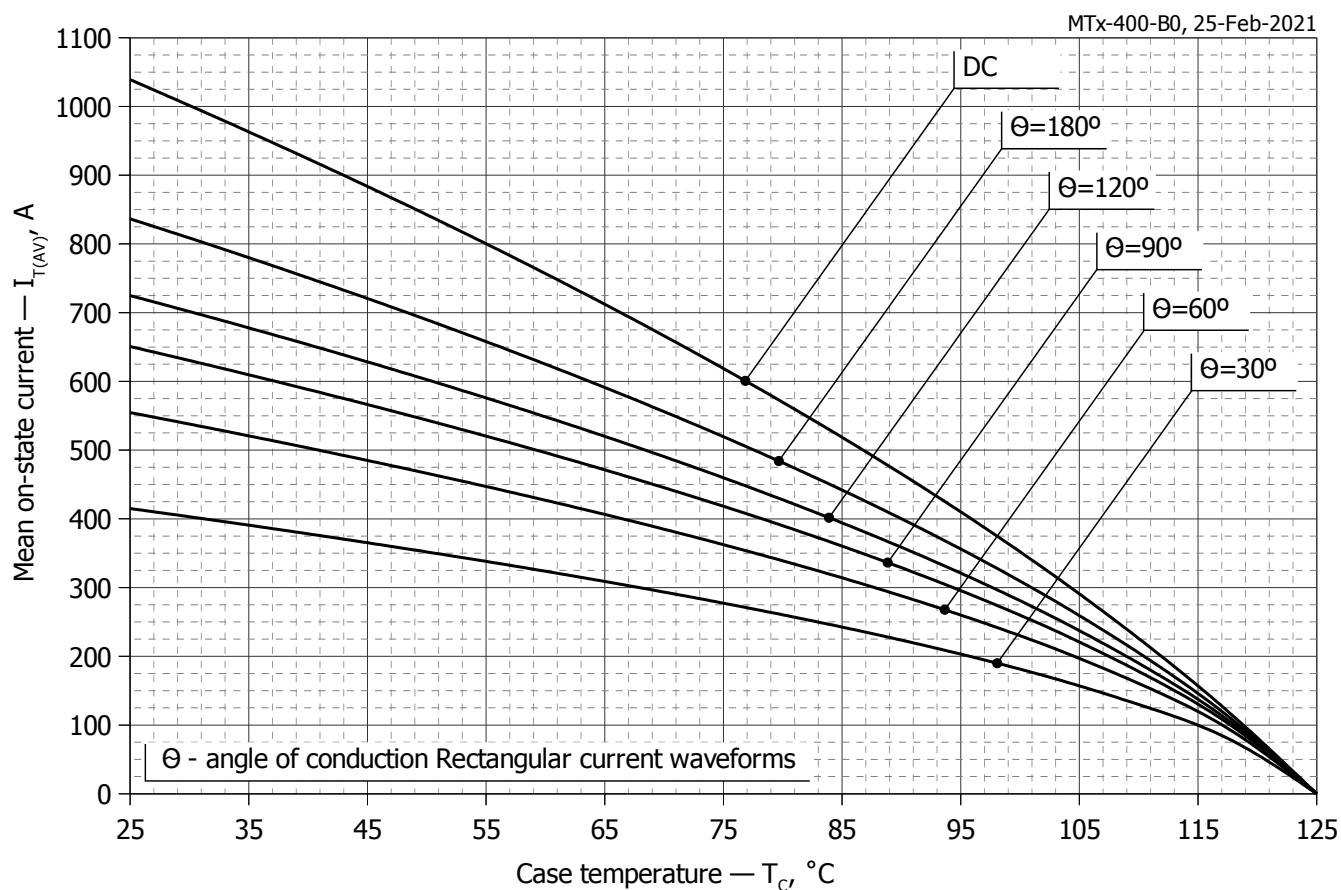


Fig. 9 - Mean on-state current I_{TAV} vs. case temperature T_C for rectangular current waveforms at different conduction angles and for DC ($f=50\text{Hz}$, DSC)

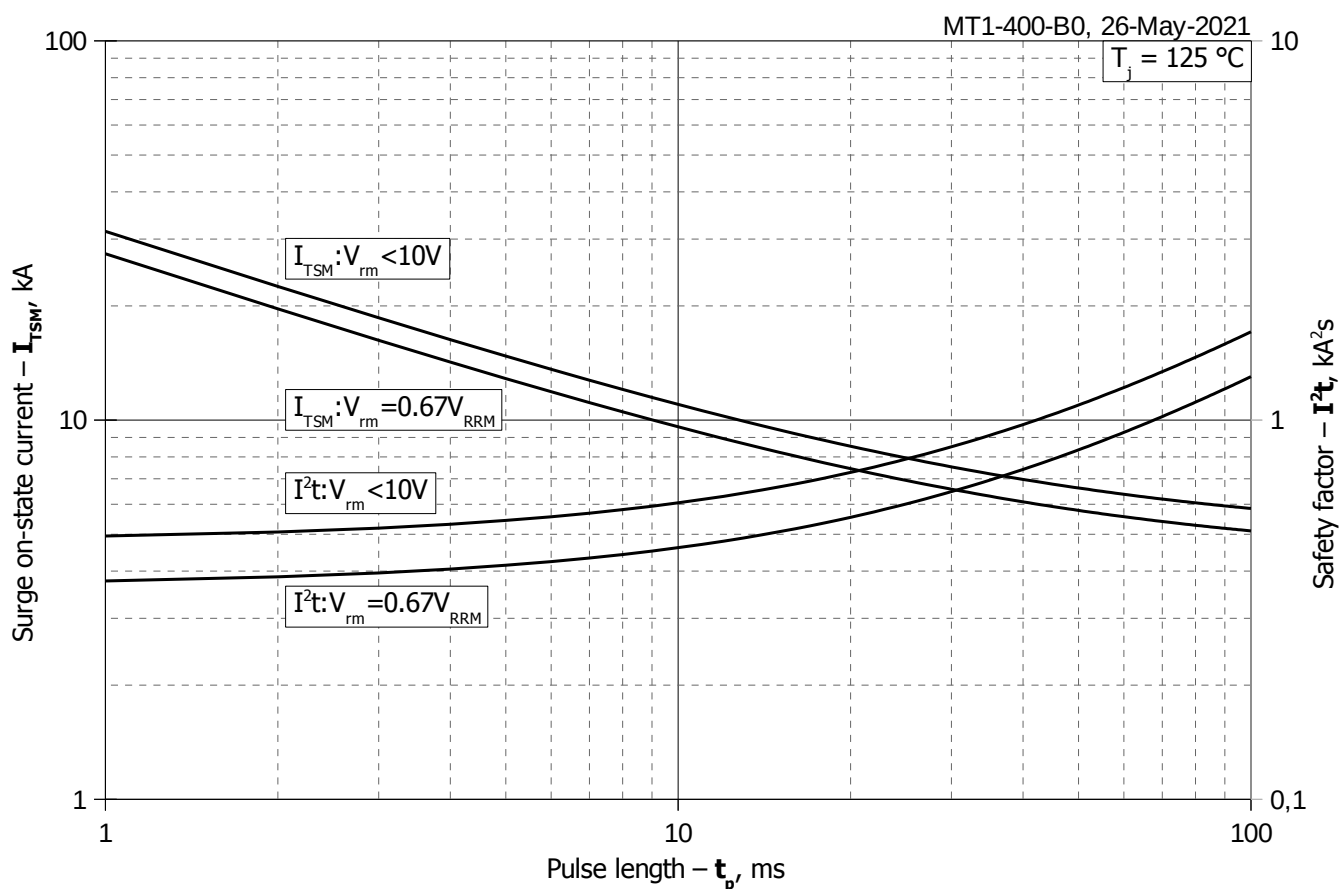


Fig. 10 – Maximum surge on-state current I_{TSM} and safety factor I^2t vs. pulse length t_p

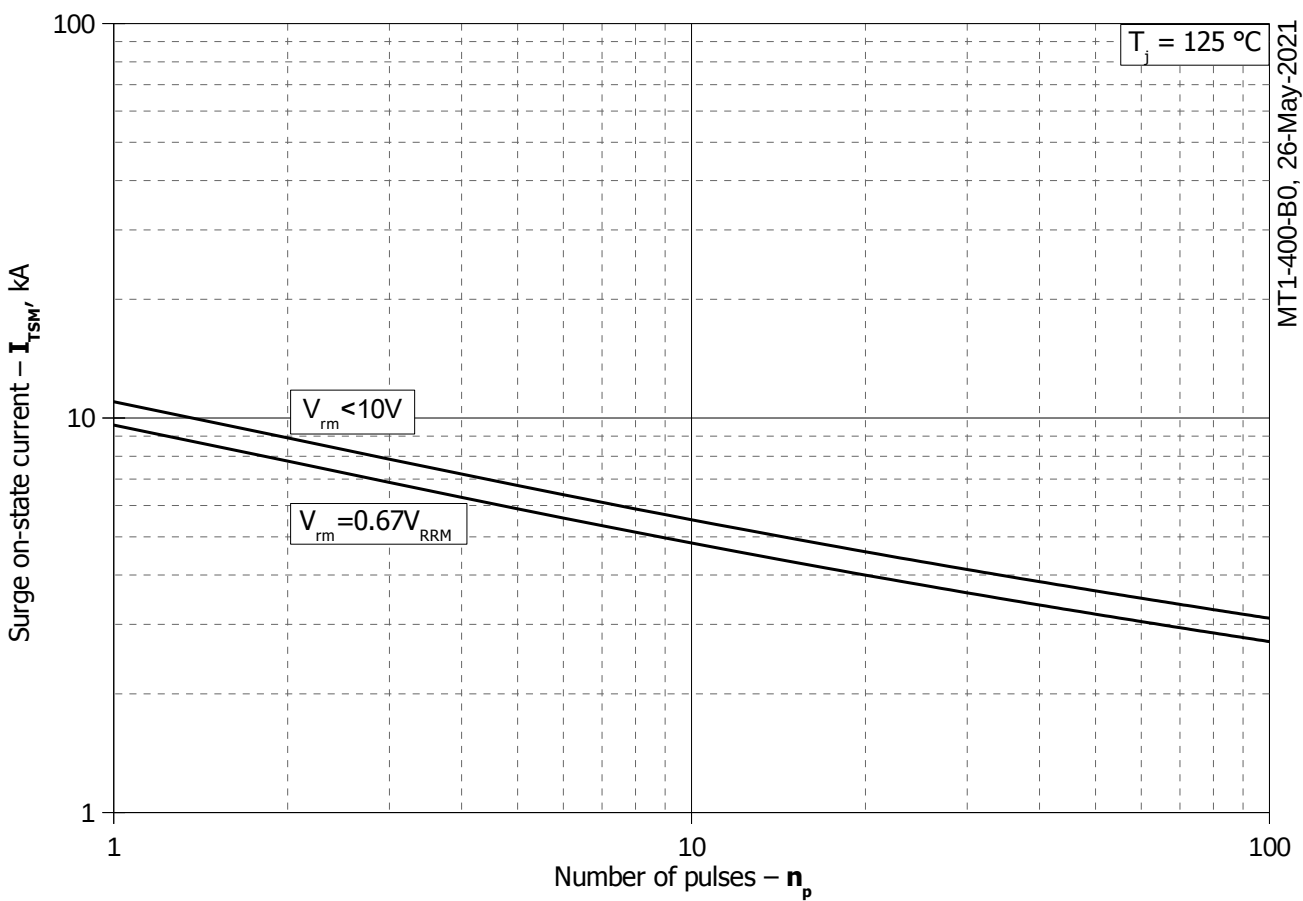


Fig. 11 - Maximum surge on-state current I_{TSM} vs. number of pulses n_p