PROTON-ELECTROTEX
RUSSIA

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

Double Thyristor Module For Phase Control MTx-201-18-F

Mean on-state current				I_{TAV}		201 A	
Repetitive peak off-state voltage				V_{DRM}		1000...1800 V	
Repetitive peak reverse voltage				V_{RRM}			
Turn-off time				t_q		125 μs	
V_{DRM}, V_{RRM}, V	1000	1100	1200	1300	1400	1500	1600	1800
Voltage code	10	11	12	13	14	15	16	18
T_j, °C	−40...+130							

MT3	MT4	

MT/D3	MD/T3		MT/D5

MAXIMUM ALLOWABLE RATINGS

	Symbols and parameters	Units	Values	Test conditions	
ON-STATE					
I_{TAV}	Maximum allowable mean on-state current	A	201	T_c=85 °C; 180° half-sine wave; 50 Hz	
I_{TRMS}	RMS on-state current	A	315		
I_{TSM}	Surge on-state current	kA	6.0 7.0	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
			6.5 7.5	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	$A^2s \cdot 10^3$	180 240	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
			170 230	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	1000...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	1100...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·V_{DRM} 0.6·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	500	T_j=$T_{j\,max}$; V_D=0.67·V_{DRM}; I_{TM}=2 I_{TAV}; Gate pulse: I_G=2 A; V_G=20 V; t_{GP}=50 µs; di_G/dt=2 A/µs	
THERMAL					
T_{stg}	Storage temperature	°C	−40...+50		
T_j	Operating junction temperature	°C	−40...+130		
$T_{c\,op}$	Operating temperature	°C	−40...+125		
MECHANICAL					
a	Acceleration under vibration	m/s²	50		

CHARACTERISTICS

Symbols and parameters		Units	Values	Conditions		
ON-STATE						
V_{TM}	Peak on-state voltage, max	V	1.40	T_j=25 °C; I_{TM}= 500 A		
$V_{T(TO)}$	On-state threshold voltage, max	V	0.80	T_j=$T_{j\,max}$;		
r_T	On-state slope resistance, max	mΩ	0.970	$0.5\,\pi\,I_{TAV} < I_T < 1.5\,\pi\,I_{TAV}$		
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≥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	30 2.50	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	1000	T_j=$T_{j\,max}$; V_D=0.67·V_{DRM}; Gate open		
TRIGGERING						
V_{GT}	Gate trigger direct voltage, max	V	4.00 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	0.25	T_j=$T_{j\,max}$; V_D=0.67·V_{DRM}; Direct gate current		
I_{GD}	Gate non-trigger direct current, min	mA	10.00			
SWITCHING						
t_{gd}	Delay time, max	μs	2.00	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 μs; di_G/dt=2 A/μs		
t_q	Turn-off time[2], max	μs	125	dv_D/dt=50 V/μs; T_j=$T_{j\,max}$; I_{TM}=200 A; di_R/dt=-10 A/μs; V_R=100V; V_D=0.67 V_{DRM};		
Q_{rr}	Total recovered charge, max	μC	720	T_j=$T_{j\,max}$; I_{TM}= 200 A; di_R/dt=-10 A/μs; V_R=100 V		
t_{rr}	Reverse recovery time, max	μs	16			
I_{rr}	Reverse recovery current, max	A	90			
THERMAL						
R_{thjc}	Thermal resistance, junction to case					
	per module	°C/W	0.0900	180° half-sine wave, 50 Hz		
	per arm	°C/W	0.1800			
	per module	°C/W	0.0850	DC		
	per arm	°C/W	0.1700			
R_{thch}	Thermal resistance, case to heatsink					
	per module	°C/W	0.0300			
	per arm	°C/W	0.0600			
INSULATION						
V_{ISOL}	Insulation test voltage	kV	3.00	Sine wave, 50 Hz; RMS	t=60 sec	
			3.60		t=1 sec	
MECHANICAL						
M_1	Mounting torque (M6)[3]	Nm	6.00	Tolerance ± 15%		
M_2	Terminal connection torque (M6)[3]	Nm	6.00	Tolerance ± 15%		
m	Weight, max	g	350			

PART NUMBERING GUIDE

MT	3	-	201	-	18	-	A2	X2	-	F	-	N
1	2		3		4		5	6		7		8

1. Thyristor module (MT)
   Thyristor – Diode module (MT/D)
   Diode – Thyristor module (MD/T)
2. Circuit Schematic:
3. Average On-state Current, A
4. Voltage Code
5. Critical rate of rise of off-state voltage
6. Group of turn-off time ($dv_D/dt=50$ V/μs)
7. Package Type (M.F)
8. Ambient Conditions:
   N – Normal

NOTES

[1] Critical rate of rise of off-state voltage

Symbol of group	A2
$(dv_D/dt)_{crit}$, V/μs	1000

[2] Turn-off time ($dv_D/dt=50$ V/μs)

Symbol of group	X2
t_q, μs	125

[3] The screws must be lubricated

UL certified file-No. E255404
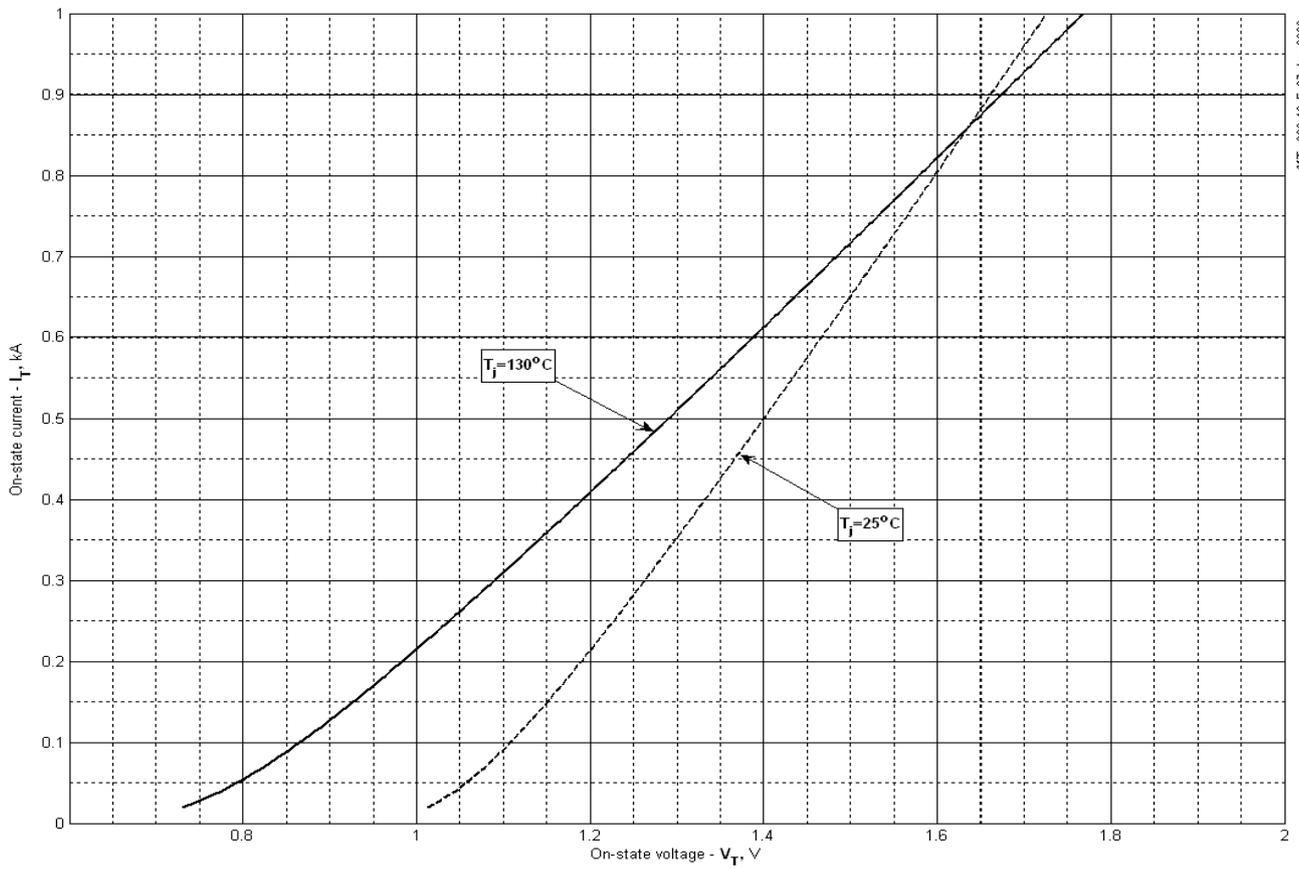
Fig 1 – On-state characteristics of Limit device

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	0.956132	0.652386
B	0.635427	0.934386
C	-0.365344	-0.494072
D	0.388161	0.524930

On-state characteristic model (see Fig. 1)
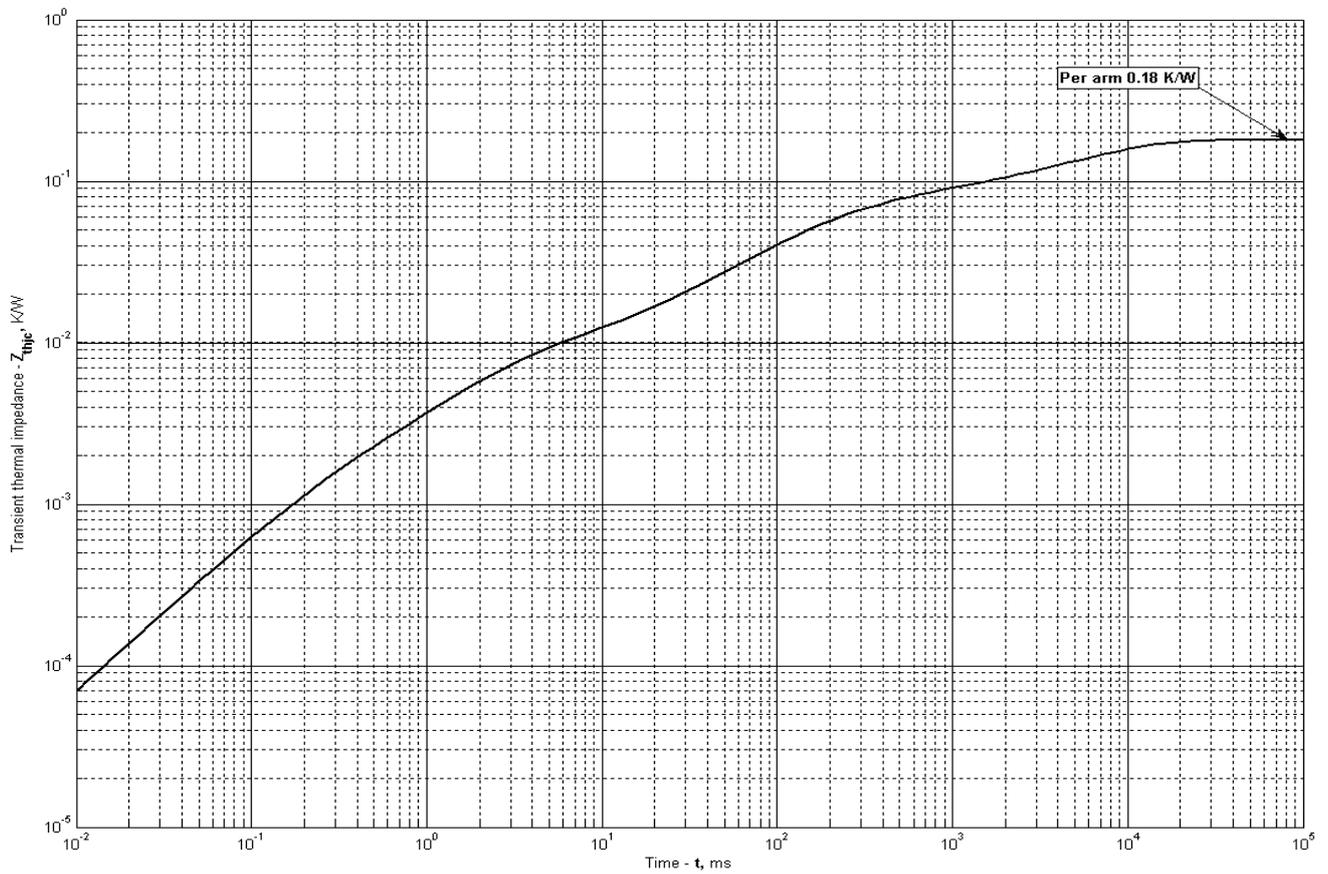
Fig 2 – Transient thermal impedance

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.

    t_i = Time constatnt of r_{th} term.

i	1	2	3	4	5	6
R_i, K/W	0.0007653	0.00703	0.01629	0.04126	0.01513	0.09951
τ_i, s	0.0002111	0.002366	0.06905	0.1909	0.6646	6.64

Transient thermal impedance junction to case Z_{thjc} model (see Fig. 2)
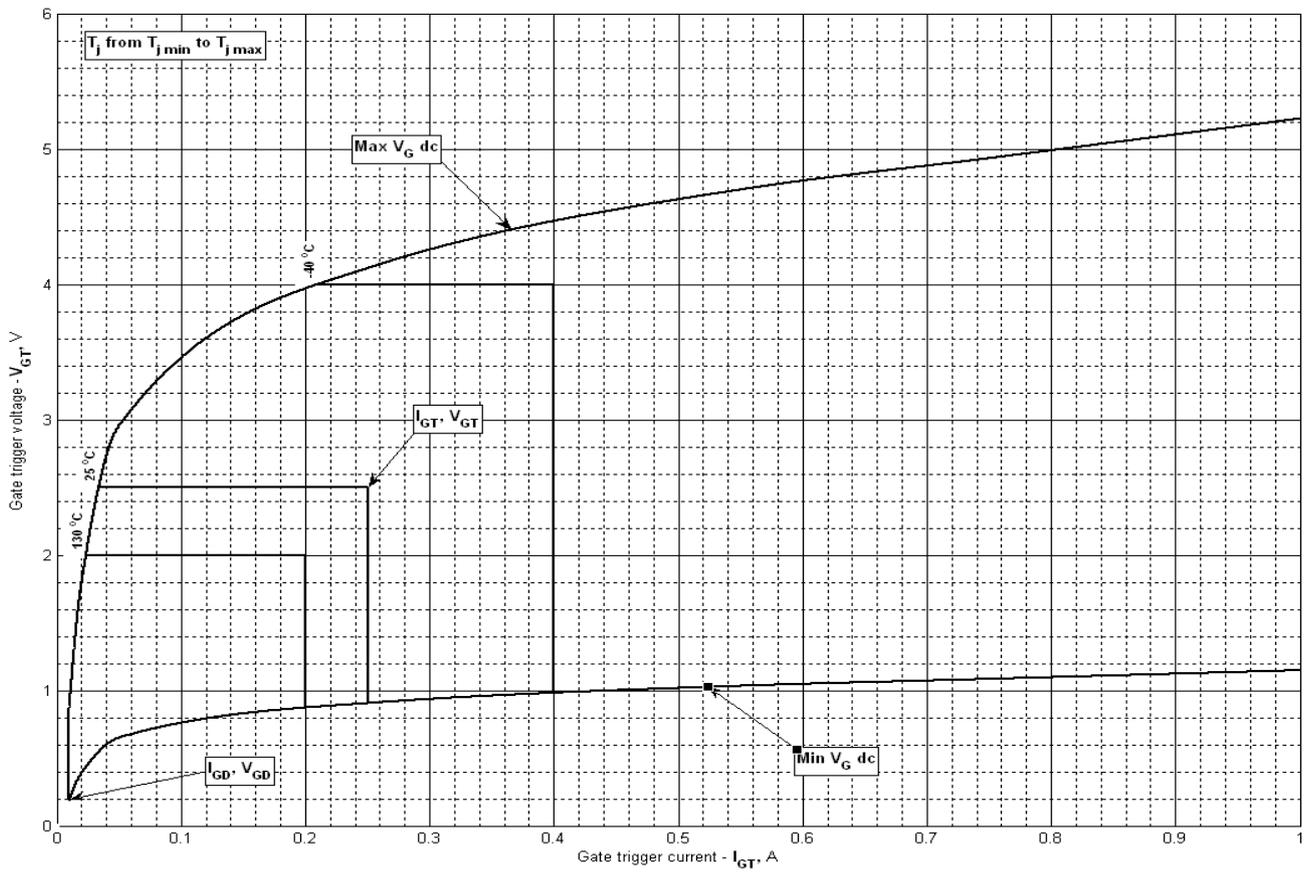
Fig 3 – Gate characteristics – Trigger limits
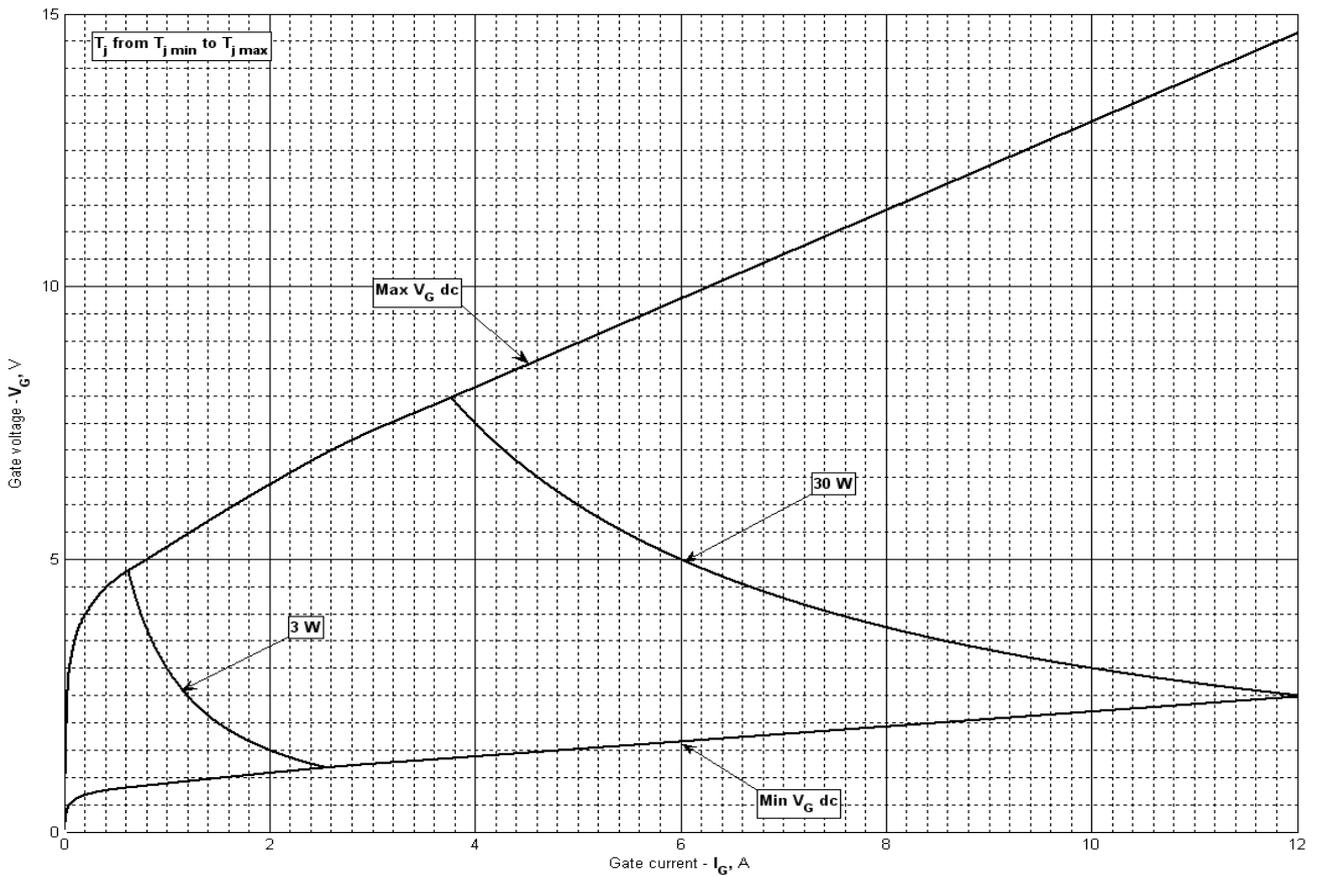
Fig 4 - Gate characteristics – Power curves
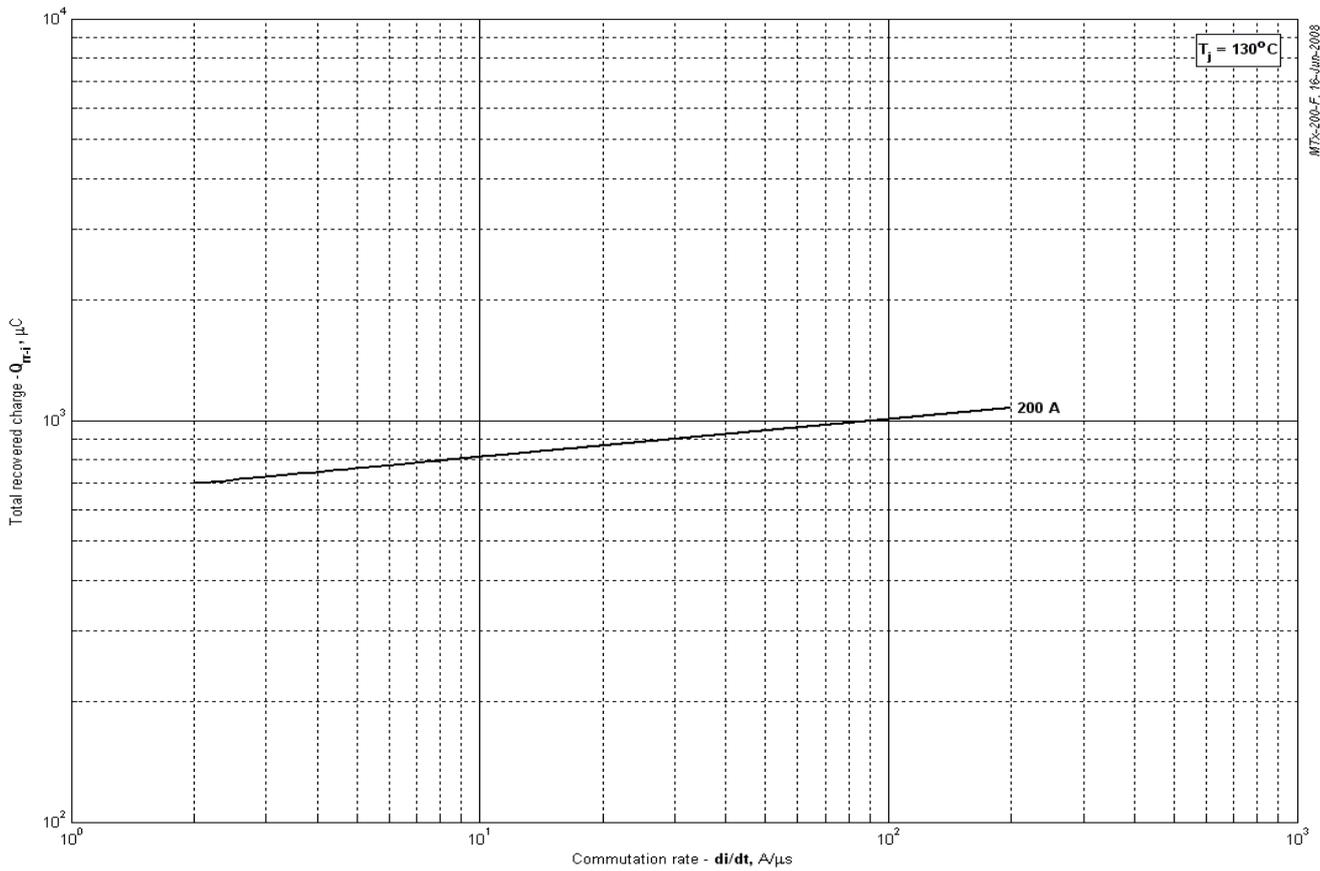
**Fig 5 - Total recovered charge, Q_{rr-i} (integral)**
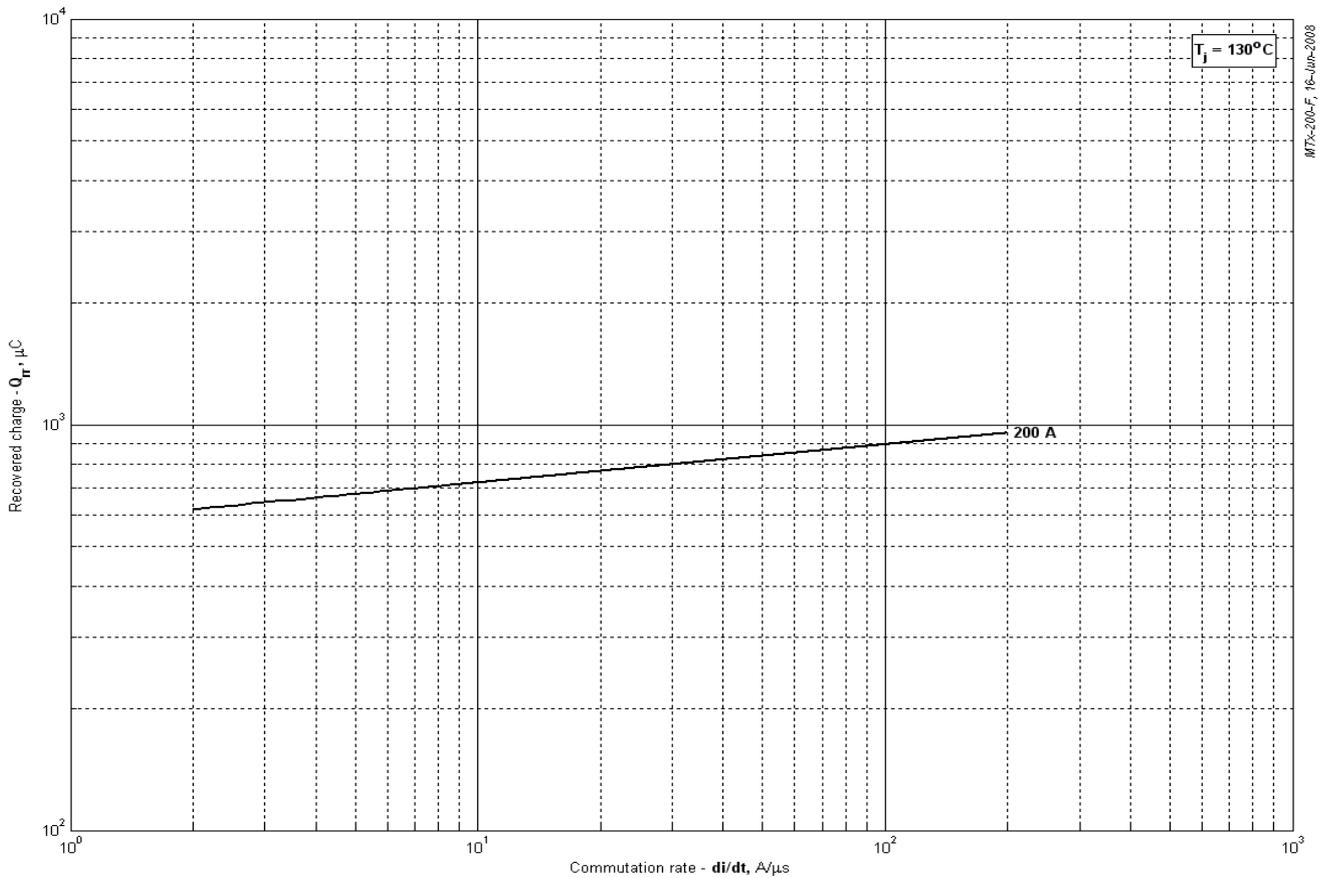
**Fig 6 - Recovered charge, Q_{rr} (25% chord)**
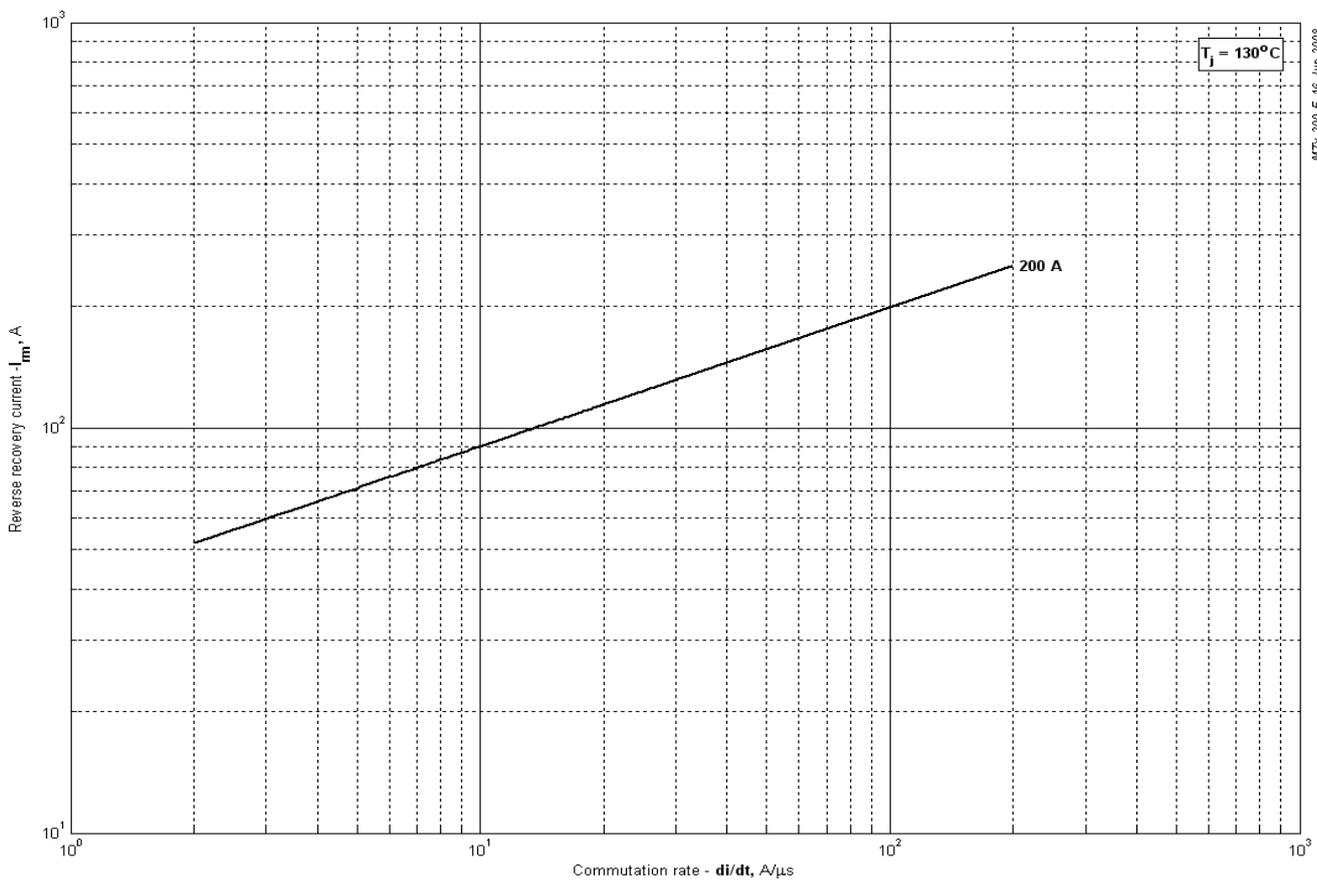
**Fig 7 - Peak reverse recovery current, I$_{rr}$**
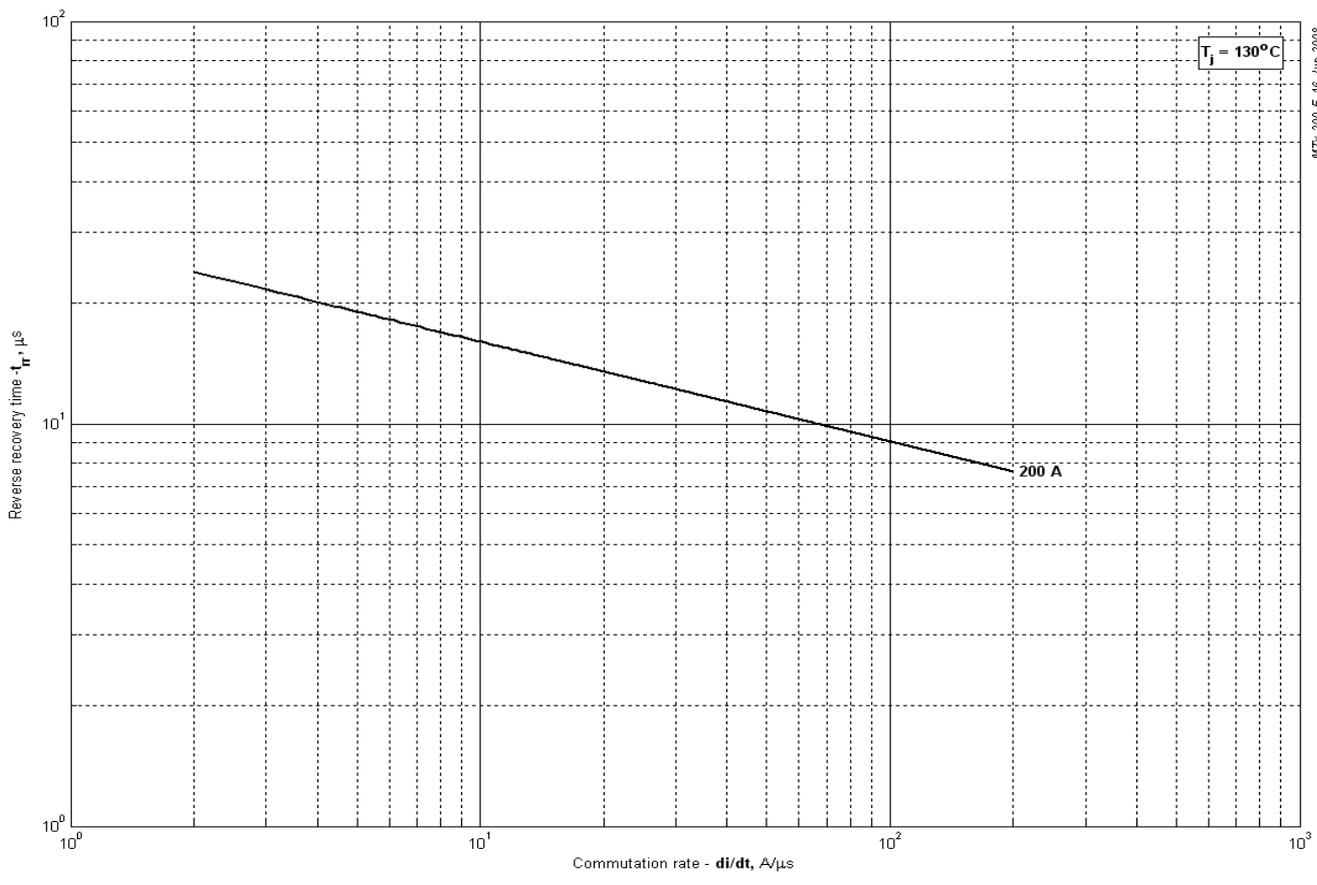

Fig 8 - Maximum recovery time, t$_{rr}$ (25% chord)
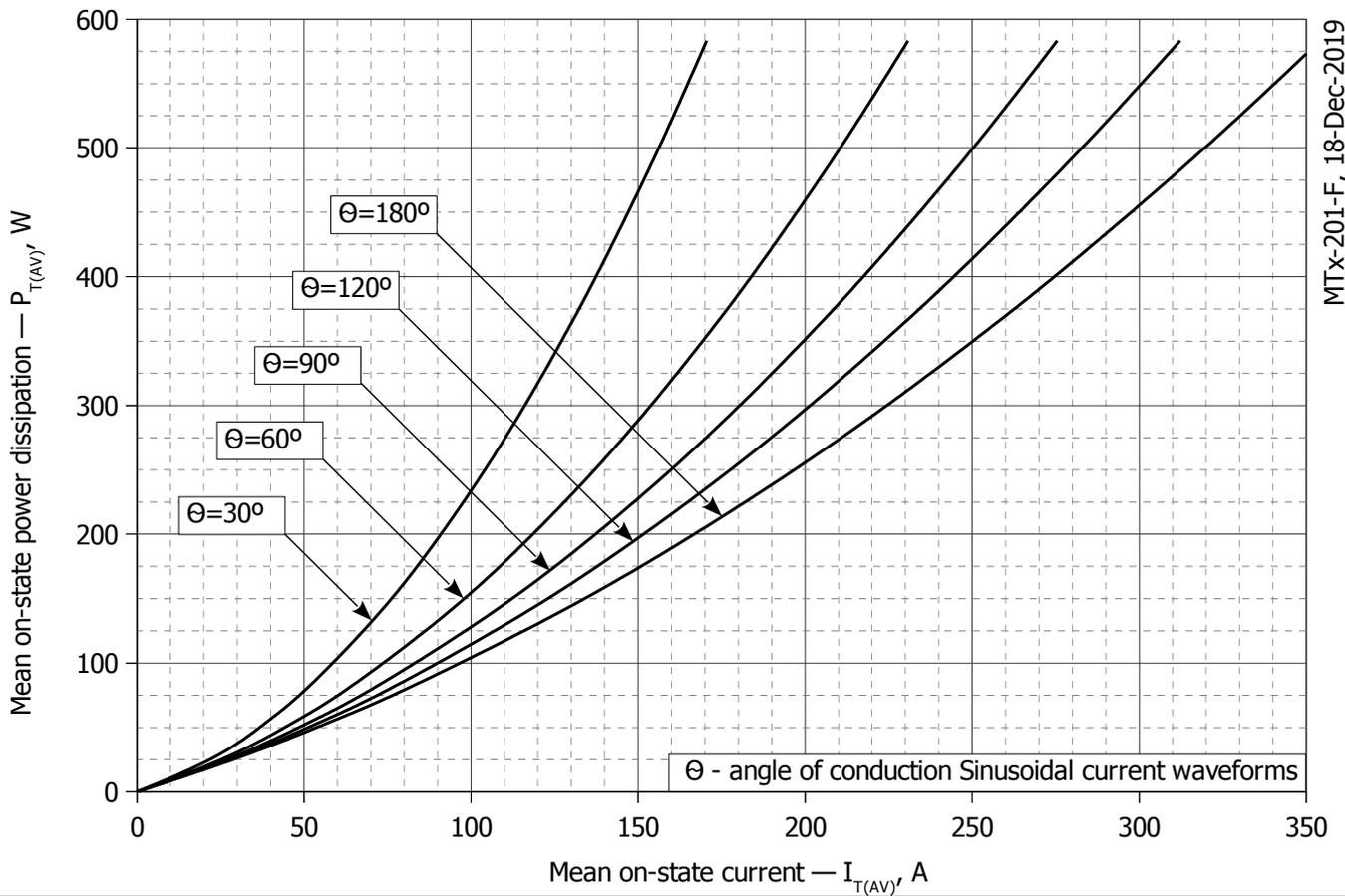
Fig 9 – On-state power loss (sinusoidal current waveforms)
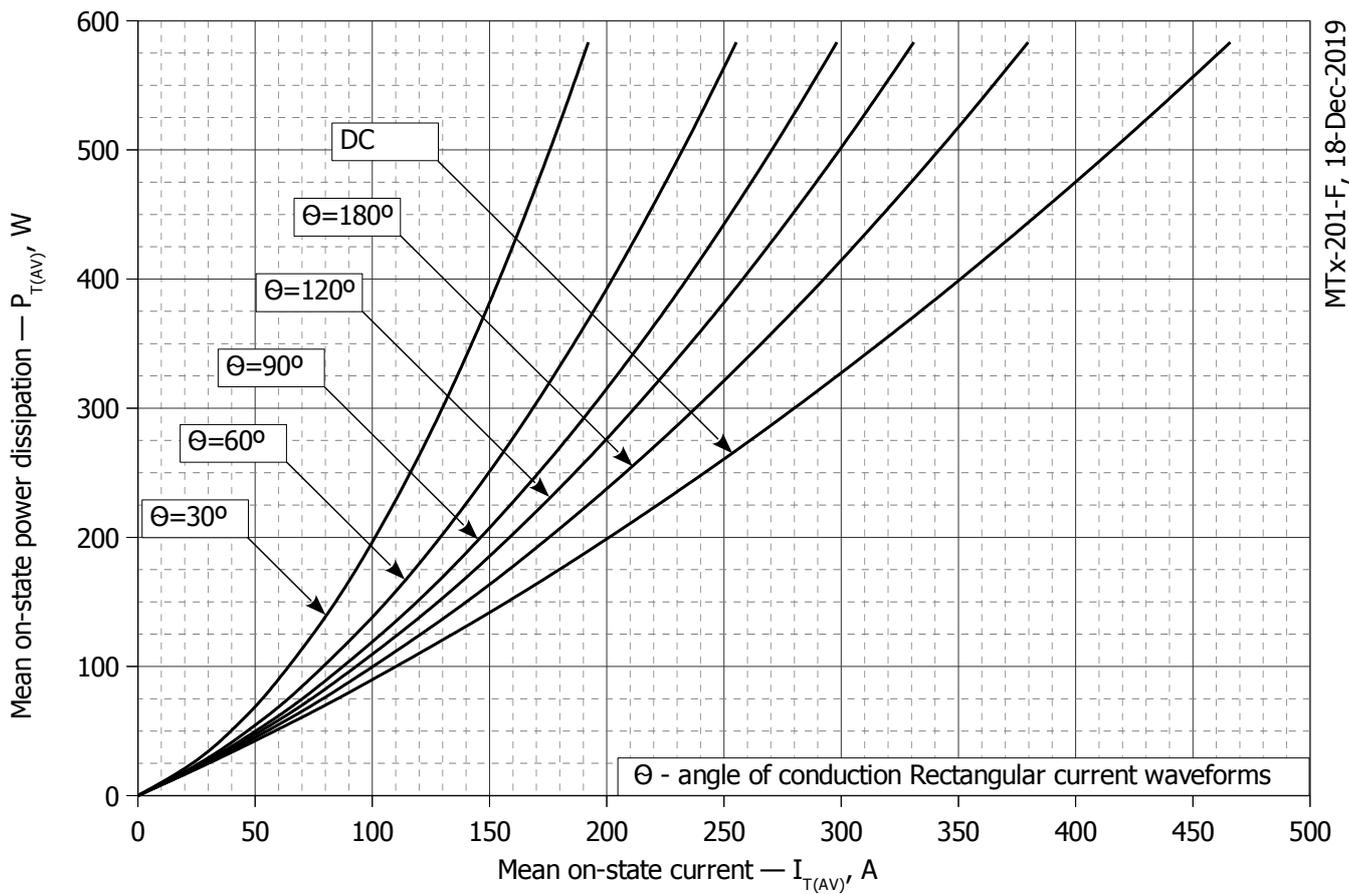

Fig 10 - On-state power loss (rectangular current waveforms)
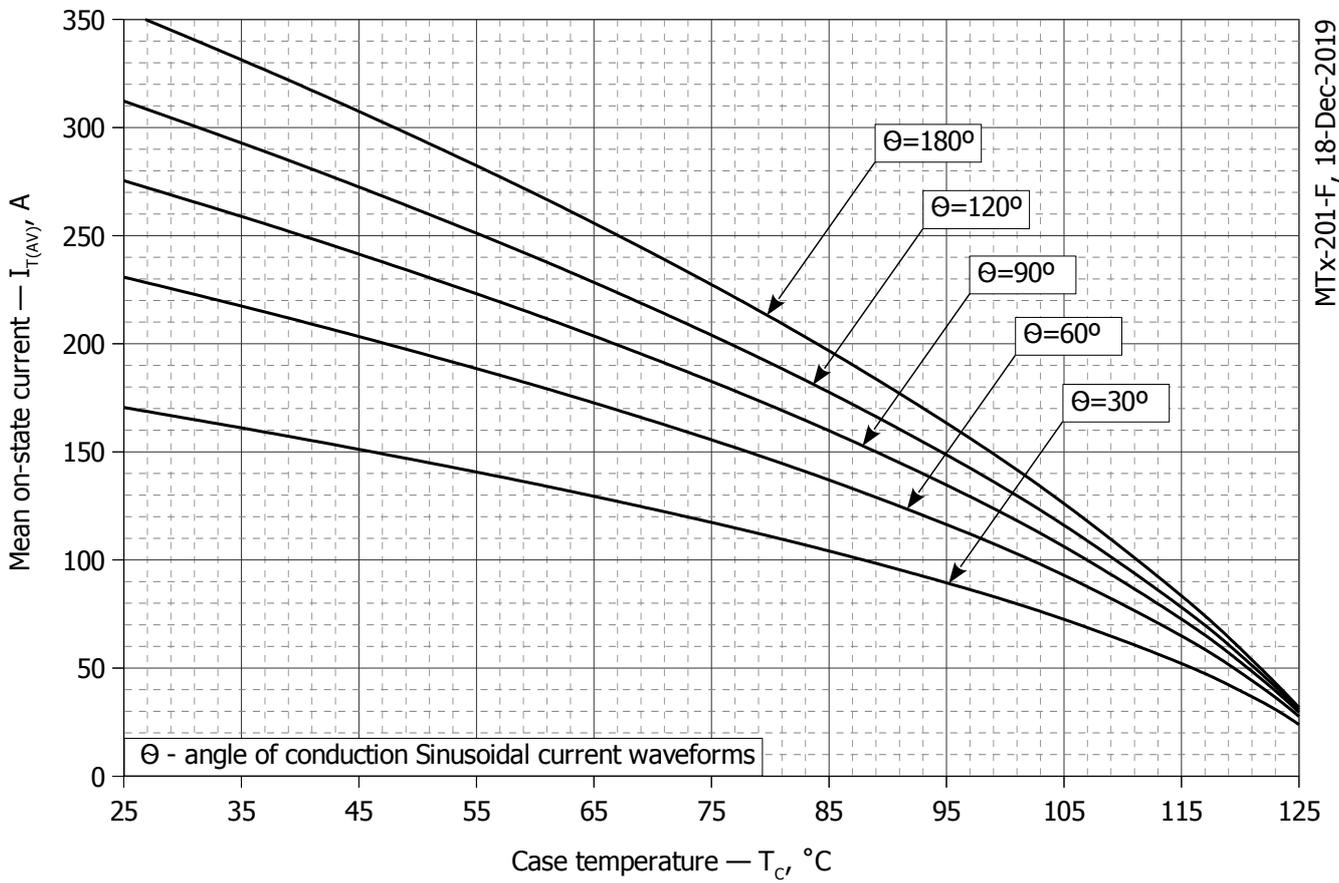
**Fig 11 – Maximum case temperature (sinusoidal current waveforms)**
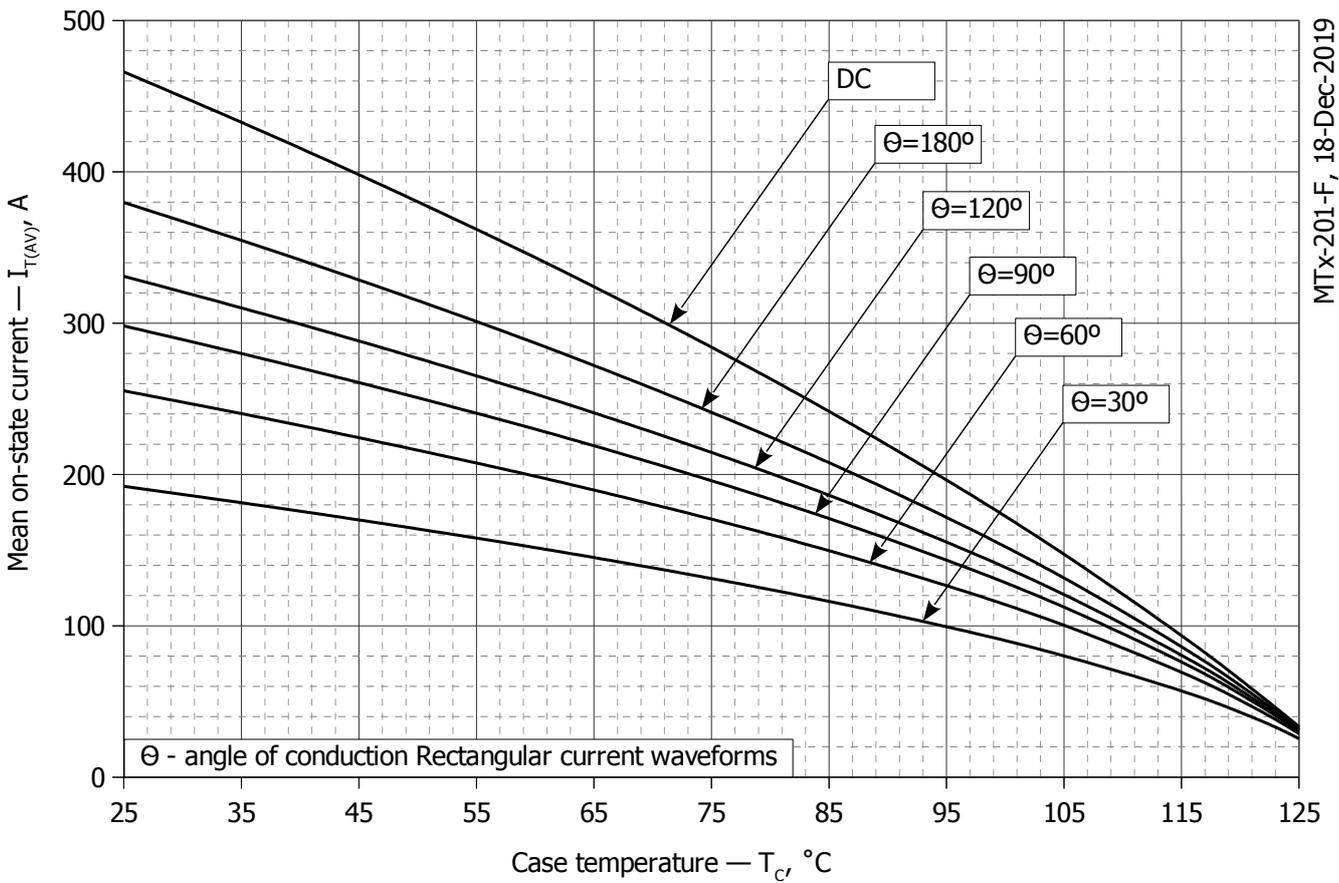
**Fig 12 - Maximum case temperature (rectangular current waveforms)**

$T_j = 130^{\circ}C$

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

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

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

$I^2t:V_{rm}=0.67V_{RRM}$

Surge on-state current - I_{TSM}, kA

Safety factor - I^2t, kA²s

Pulse length - t_p, ms
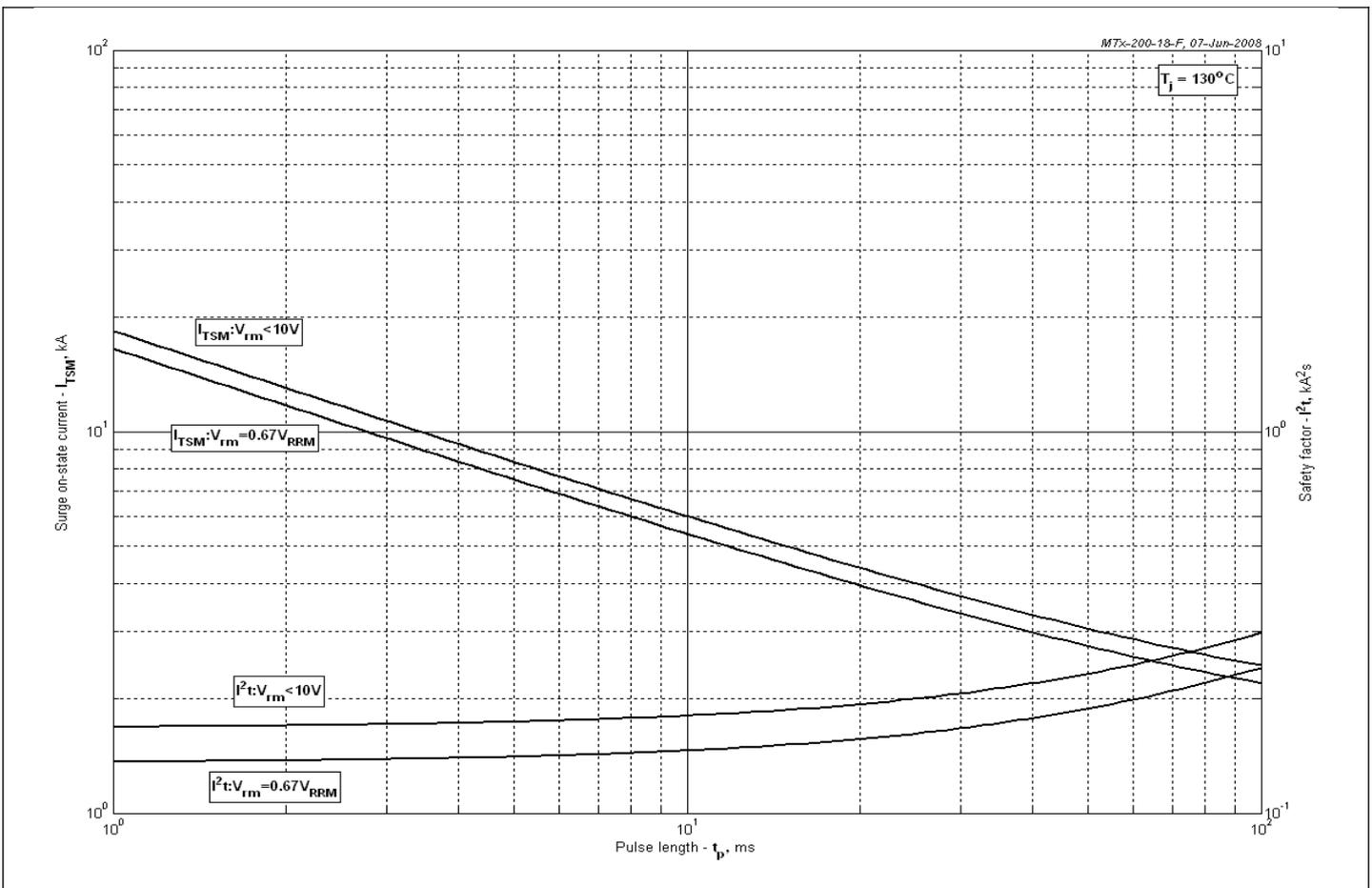
Fig 13 – Maximum surge and I²t ratings

$T_j = 130^{\circ}C$

$V_{rm} < 10\ V$

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

Surge on-state current - I_{TSM}, kA

Number of pulses - n_p
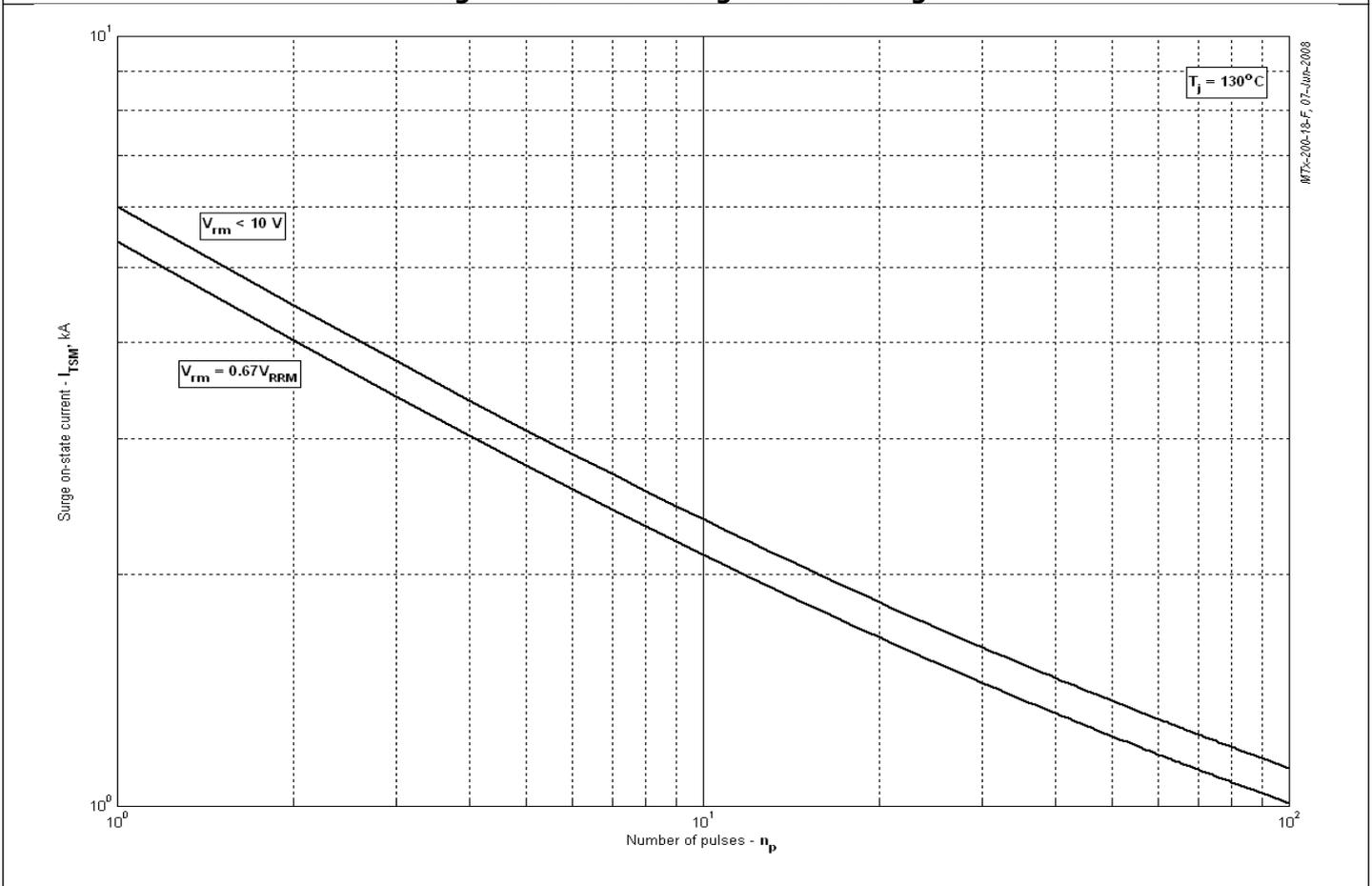
Fig 14 - Maximum surge ratings