Fast Thyristor
Type TFI773-2000-25

Low switching losses
Low reverse recovery charge
Distributed amplified gate for high di_T/dt

Maximum allowable mean on-state current	I_{TAV}	2000 A
Repetitive peak off-state voltage	V_{DRM}	2000...2500 V
Repetitive peak reverse voltage	V_{RRM}	
Turn-off time	t_q	40.0, 50.0, 63.0 µs

V_{DRM}, V_{RRM}, V	2000	2200	2400	2500
Voltage code	20	22	24	25
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	2000 2249 3315	T_c=91 °C; Double side cooled; T_c=85 °C; Double side cooled; T_c=55 °C; Double side cooled; 180° half-sine wave; 50 Hz	
I_{TRMS}	RMS on-state current	A	3140	T_c=91 °C; Double side cooled; 180° half-sine wave; 50 Hz	
I_{TSM}	Surge on-state current	kA	45.0 52.0	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=I_{FGM}; V_G=20 V; t_{GP}=50 µs; di_G/dt=2 A/µs
			47.0 54.0	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=I_{FGM}; V_G=20 V; t_{GP}=50 µs; di_G/dt=2 A/µs
I^2t	Safety factor	$A^2s\cdot10^3$	10100 13500	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=I_{FGM}; V_G=20 V; t_{GP}=50 µs; di_G/dt=2 A/µs
			9100 12100	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=I_{FGM}; V_G=20 V; t_{GP}=50 µs; di_G/dt=2 A/µs
BLOCKING					
V_{DRM}, V_{RRM}	Repetitive peak off-state and Repetitive peak reverse voltages	V	2000...2500	$T_{j\,min}$< 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...2600	$T_{j\,min}$< 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	10	$T_j=T_{j\,max}$
V_{RGM}	Peak reverse gate voltage	V	5	
P_G	Gate power dissipation	W	8	$T_j=T_{j\,max}$ for DC gate current
SWITCHING				
$(di_T/dt)_{crit}$	Critical rate of rise of on-state current non-repetitive (f=1 Hz)	A/µs	2500	$T_j=T_{j\,max}$; $V_D=0.67 \cdot V_{DRM}$; $I_{TM}=8000$ A; 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	–60...+50	
T_j	Operating junction temperature	°C	–60...+125	
MECHANICAL				
F	Mounting force	kN	40.0...50.0	
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	2.15	$T_j=25$ °C; $I_{TM}=6280$ A	
$V_{T(TO)}$	On-state threshold voltage, max	V	1.265	$T_j=T_{j\,max}$; $0.5\,\pi\,I_{TAV} < I_T < 1.5\,\pi\,I_{TAV}$	
r_T	On-state slope resistance, max	mΩ	0.150		
I_H	Holding current, max	mA	1000	$T_j=25$ °C; $V_D=12$ V; Gate open	
BLOCKING					
I_{DRM}, I_{RRM}	Repetitive peak off-state and Repetitive peak reverse currents, max	mA	300	$T_j=T_{j\,max}$; $V_D=V_{DRM}$; $V_R=V_{RRM}$	
$(dv_D/dt)_{crit}$	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 3.00 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	0.35	$T_j=T_{j\,max}$; $V_D=0.67 \cdot V_{DRM}$; Direct gate current	
I_{GD}	Gate non-trigger direct current, min	mA	70.00		
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[2)], max	µs	2.50, 3.20, 4.00, 6.30		
t_q	Turn-off time[3)], max	µs	40.0, 50.0, 63.0	$dv_D/dt=50$ V/µs;	$T_j=T_{j\,max}$; $I_{TM}=I_{TAV}$; $di_R/dt=-10$ A/µs; $V_R=100$V; $V_D=0.67\,V_{DRM}$
			50.0, 63.0, 80.0	$dv_D/dt=200$ V/µs;	
Q_{rr}	Recovered charge, max	µC	1250	$T_j=T_{j\,max}$; $I_{TM}=1000$ A; $di_R/dt=-50$ A/µs; $V_R=100$ V	
t_{rr}	Reverse recovery time, max	µs	10		
I_{rr}	Reverse recovery current, max	A	250		

THERMAL					
R_{thjc}	Thermal resistance, junction to case, max	°C/W	0.0085	Direct current	Double side cooled
R_{thjc-A}			0.0187		Anode side cooled
R_{thjc-K}			0.0153		Cathode side cooled
R_{thck}	Thermal resistance, case to heatsink, max	°C/W	0.0020	Direct current	
MECHANICAL					
m	Weight, max	g	1200		
D_s	Surface creepage distance	mm (inch)	36.6 (1.441)		
D_a	Air strike distance	mm (inch)	16.2 (0.638)		

PART NUMBERING GUIDE

TFI	773	2000	25	A2	C3	C4	N
1	2	3	4	5	6	7	8

1. TFI — fast inverter thyristor
2. Design version
3. Mean 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. Group of turn-on time
8. 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-on time

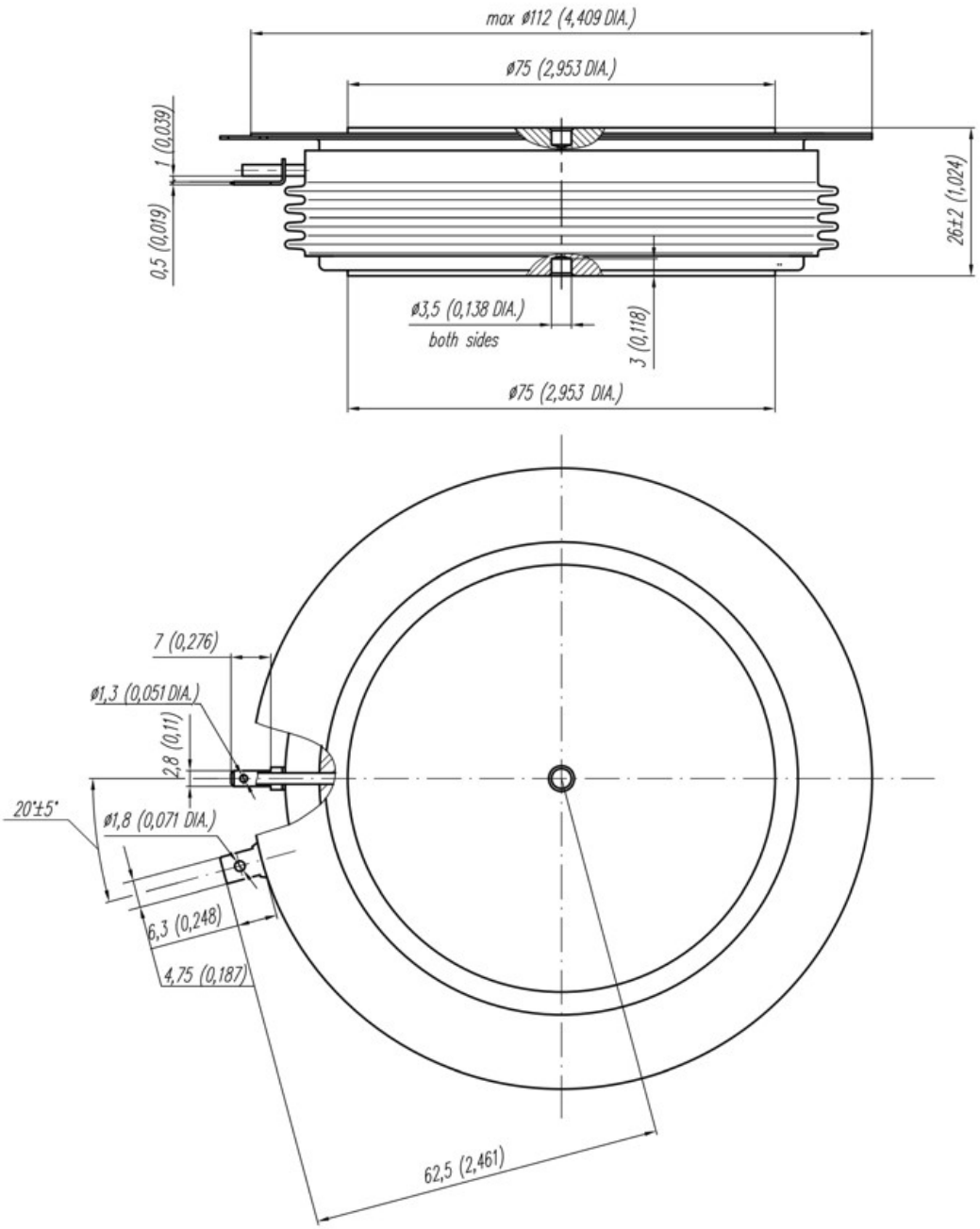
Symbol of group	M4	K4	H4	C4
t_{gt}, µs	2.50	3.20	4.00	6.30

3) Turn-off time (dv_D/dt=50 V/µs)

Symbol of group	H3	E3	C3
t_q, µs	40.0	50.0	63.0

OVERALL DIMENSIONS

Package type: T.F2



All dimensions in millimeters (inches)

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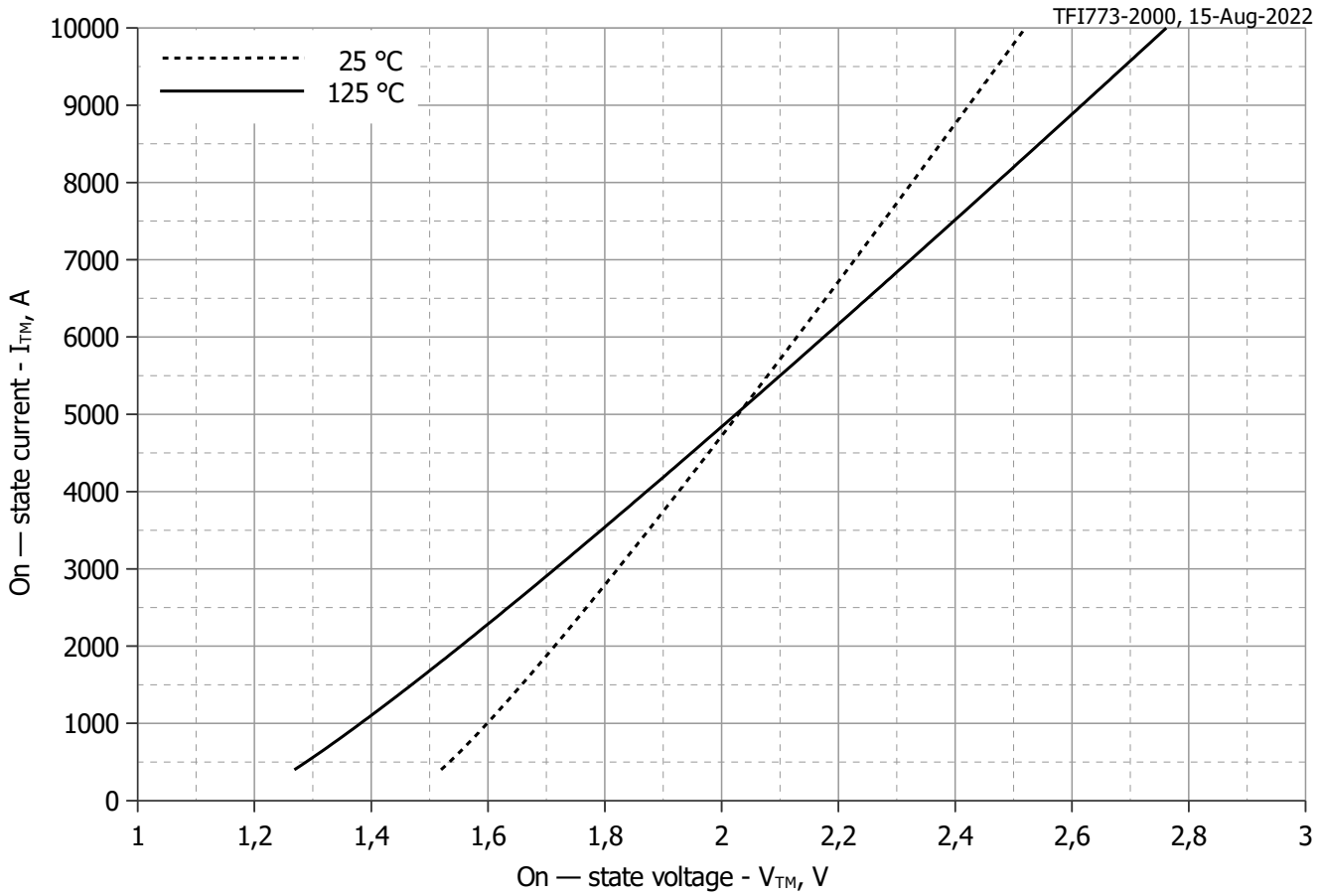

Fig 1 – On-state characteristics of Limit device

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	
	T_j = 25°C	$T_j = T_{j\,max}$
A	1.42507441	1.19417755
B	0.00008531	0.00012521
C	0.00289066	-0.00939487
D	0.00215361	0.00402084

On-state characteristic model (see Fig. 1).

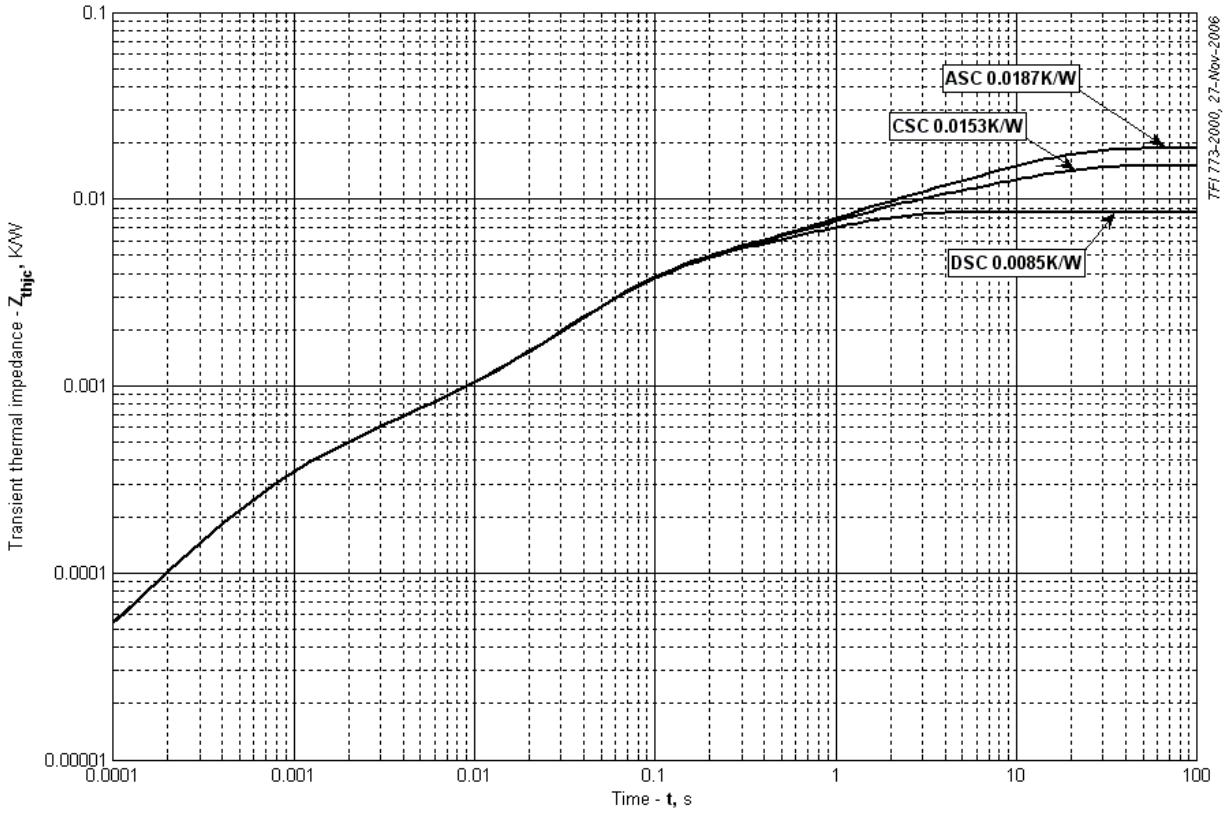

Fig 2 – Transient thermal impedance Z_{thjc} vs. time t

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 Double side cooled

i	1	2	3	4	5	6
R_i, K/W	0.00005221	0.002783	0.0002688	0.001171	0.0002371	0.003988
τ_i, s	1.920	0.06256	0.002215	0.120	0.0006005	0.9534

DC Anode side cooled

i	1	2	3	4	5	6
R_i, K/W	0.01013	0.004065	0.001093	0.002843	0.0002657	0.0002413
τ_i, s	9.747	1.057	0.1241	0.06353	0.002255	0.0006066

DC Cathode side cooled

i	1	2	3	4	5	6
R_i, K/W	0.00662	0.004037	0.000959	0.002999	0.0002632	0.0002447
τ_i, s	9.743	1.024	0.1336	0.06442	0.002287	0.0006116

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

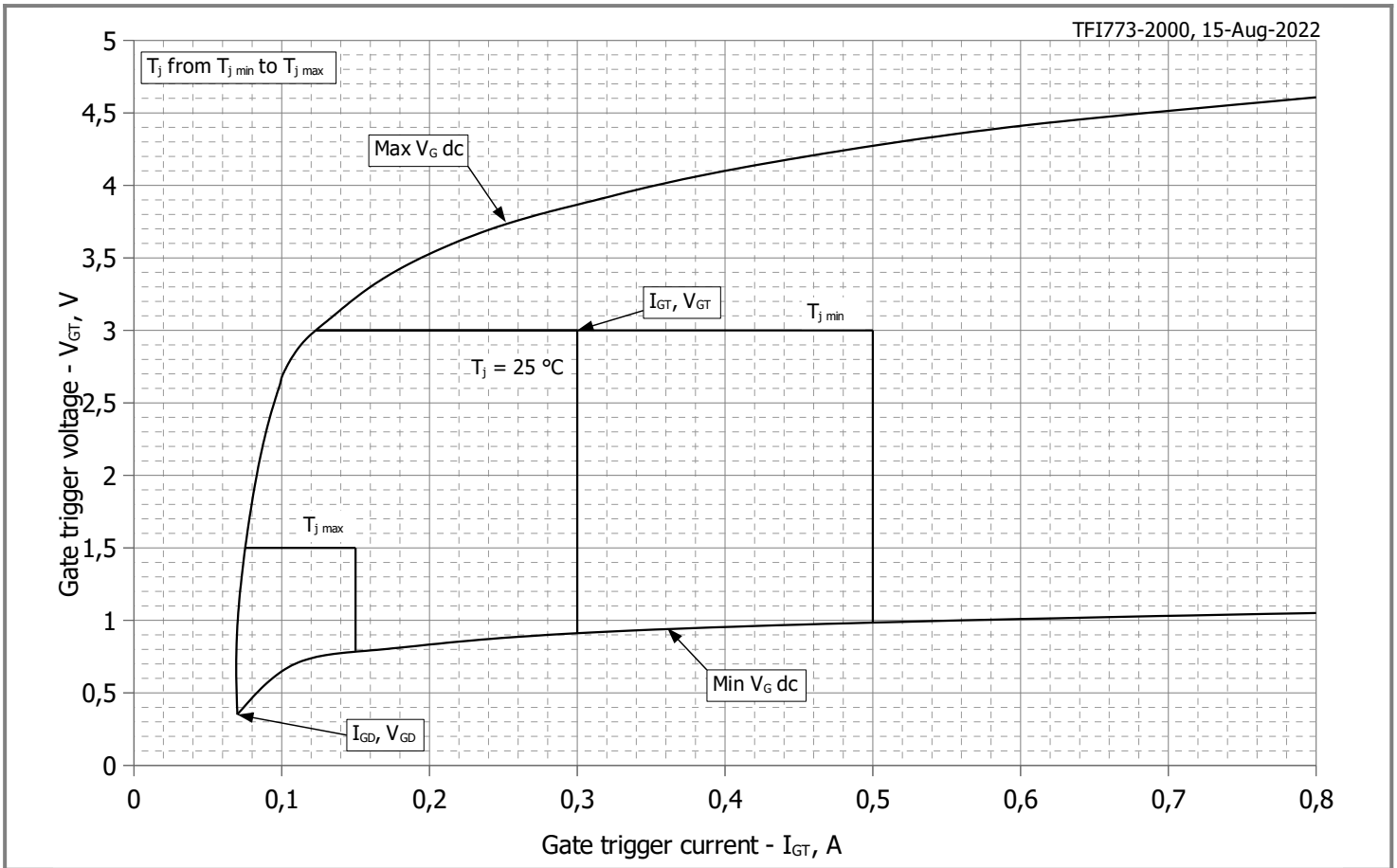

Fig 3 – Gate characteristics – Trigger limits

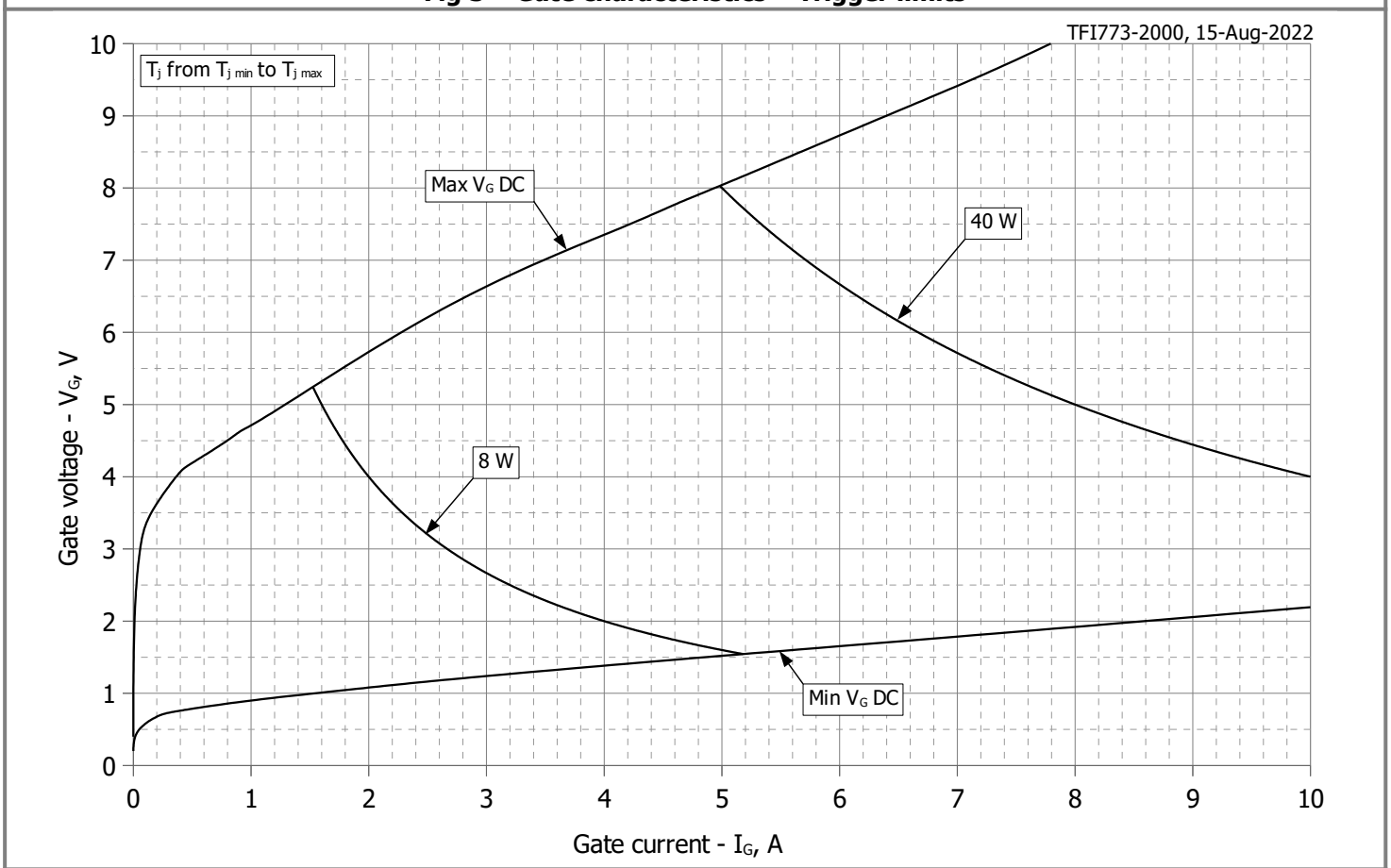

Fig 4 - Gate characteristics –Power curves

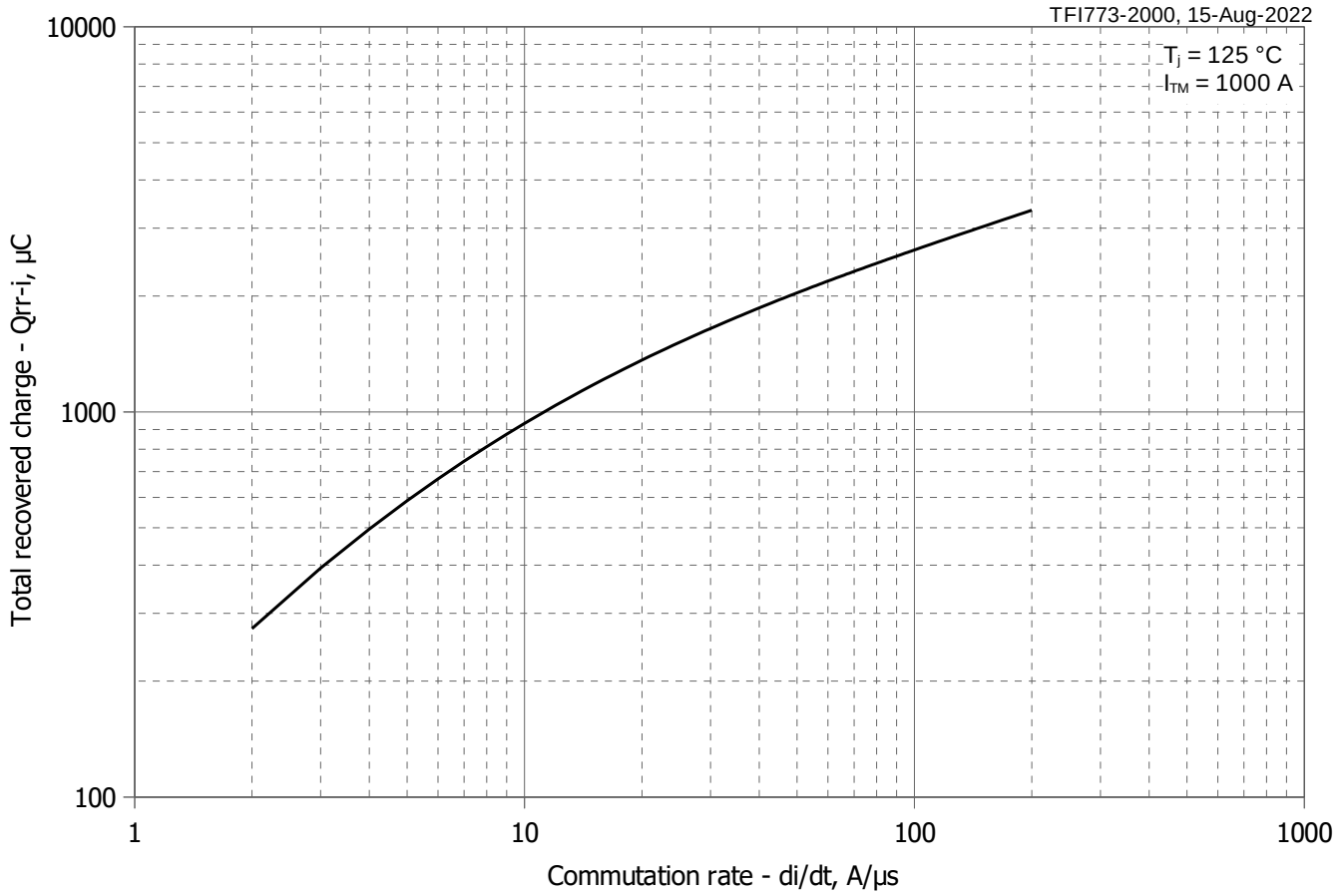

Fig 5 – Maximum recovered charge $Q_{rr\text{-}i}$ (integral) vs. commutation rate di_R/dt

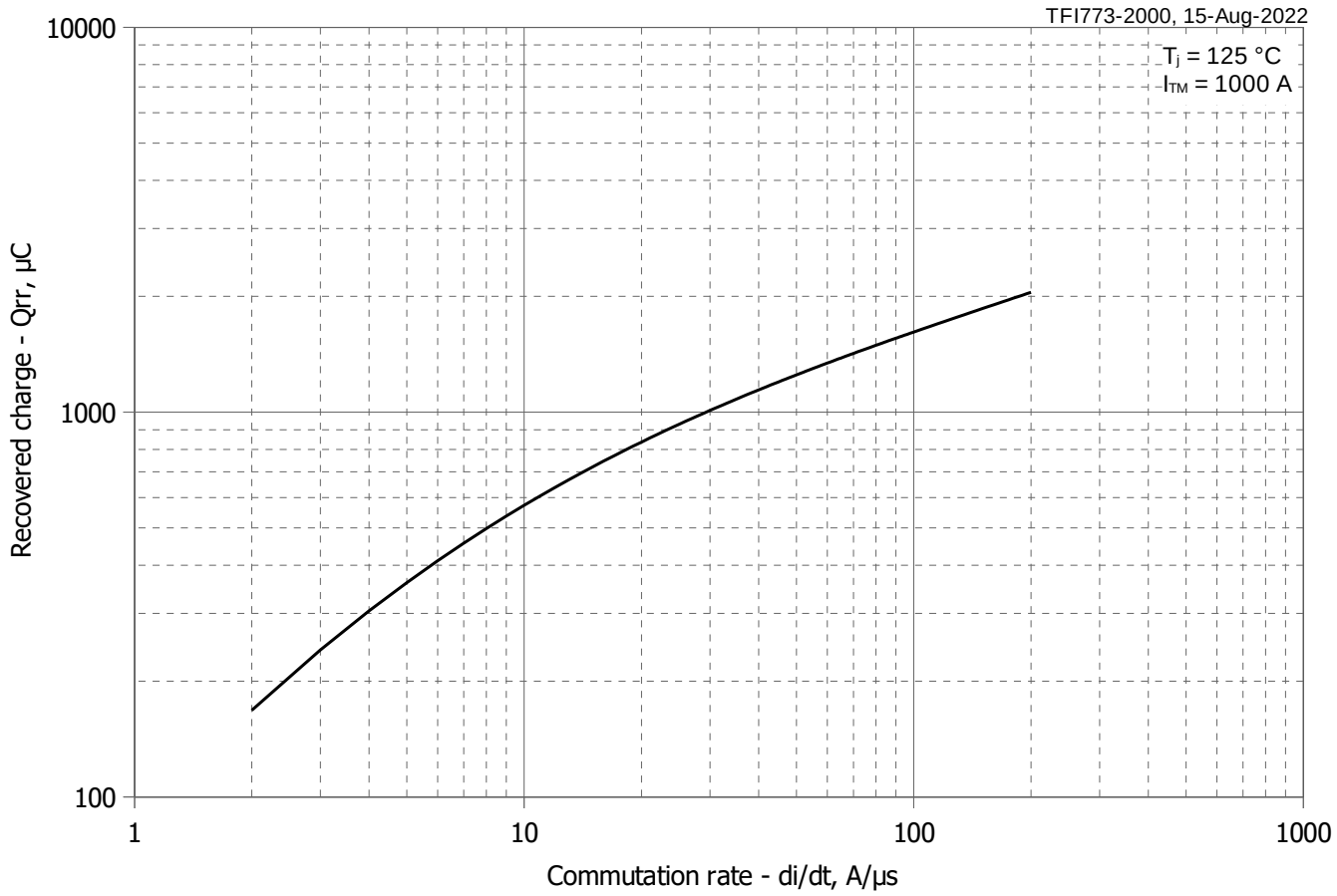

Fig 6 – Maximum recovered charge Q_{rr} vs. commutation rate di_R/dt (25% chord)

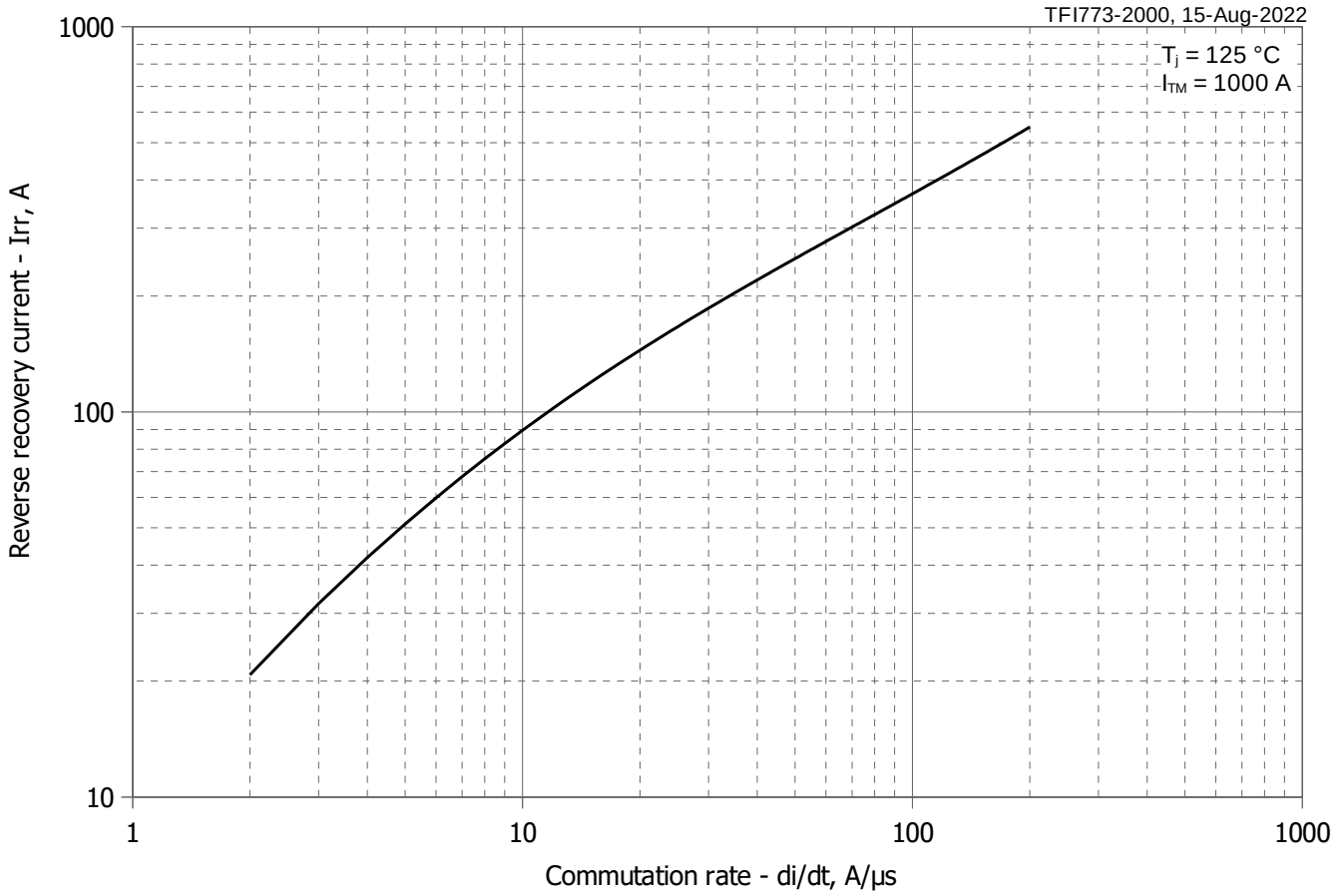

Fig 7 – Maximum reverse recovery current I_{rr} vs. commutation rate di_R/dt

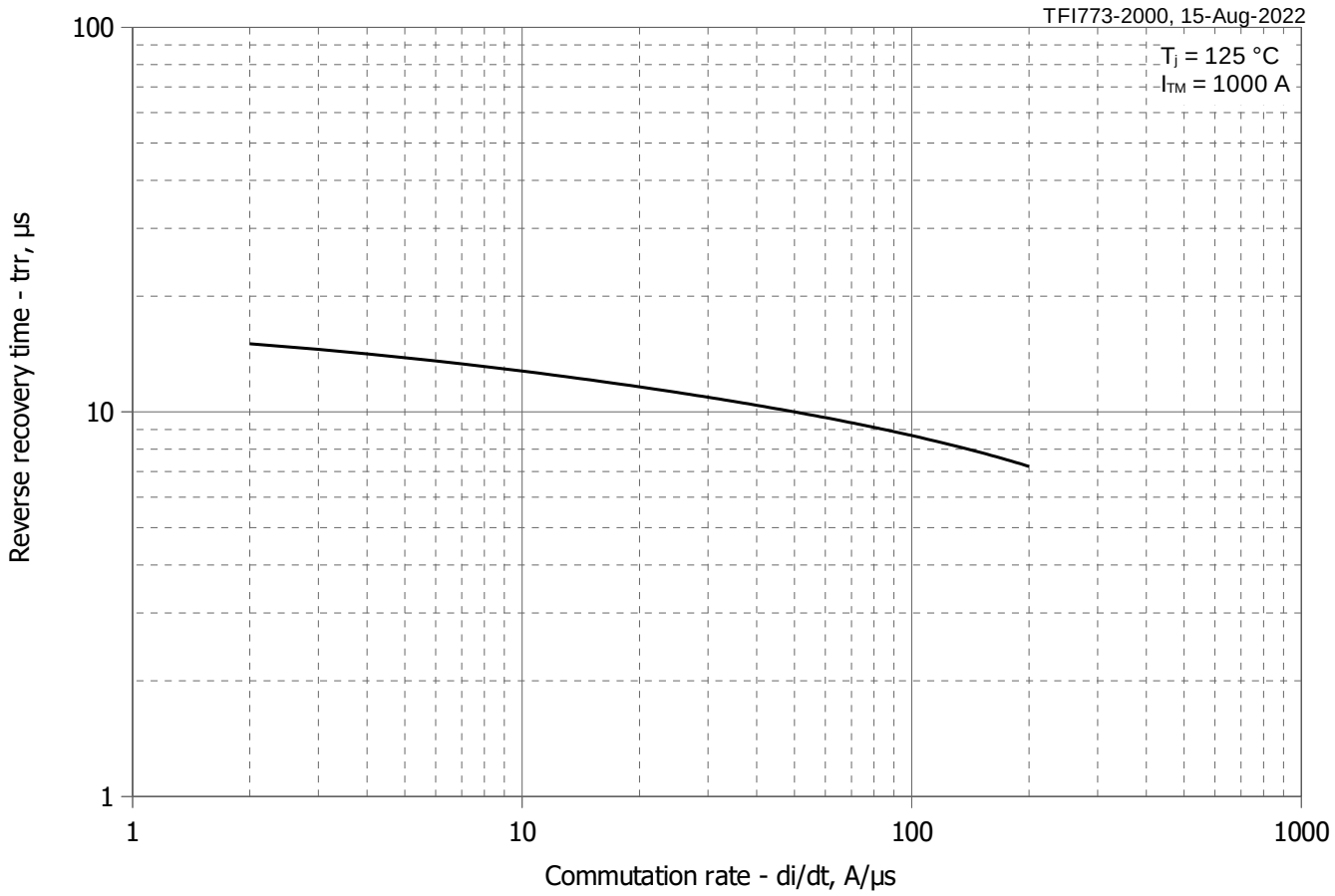

Fig 8 – Maximum recovery time t_{rr} vs. commutation rate di_R/dt (25% chord)

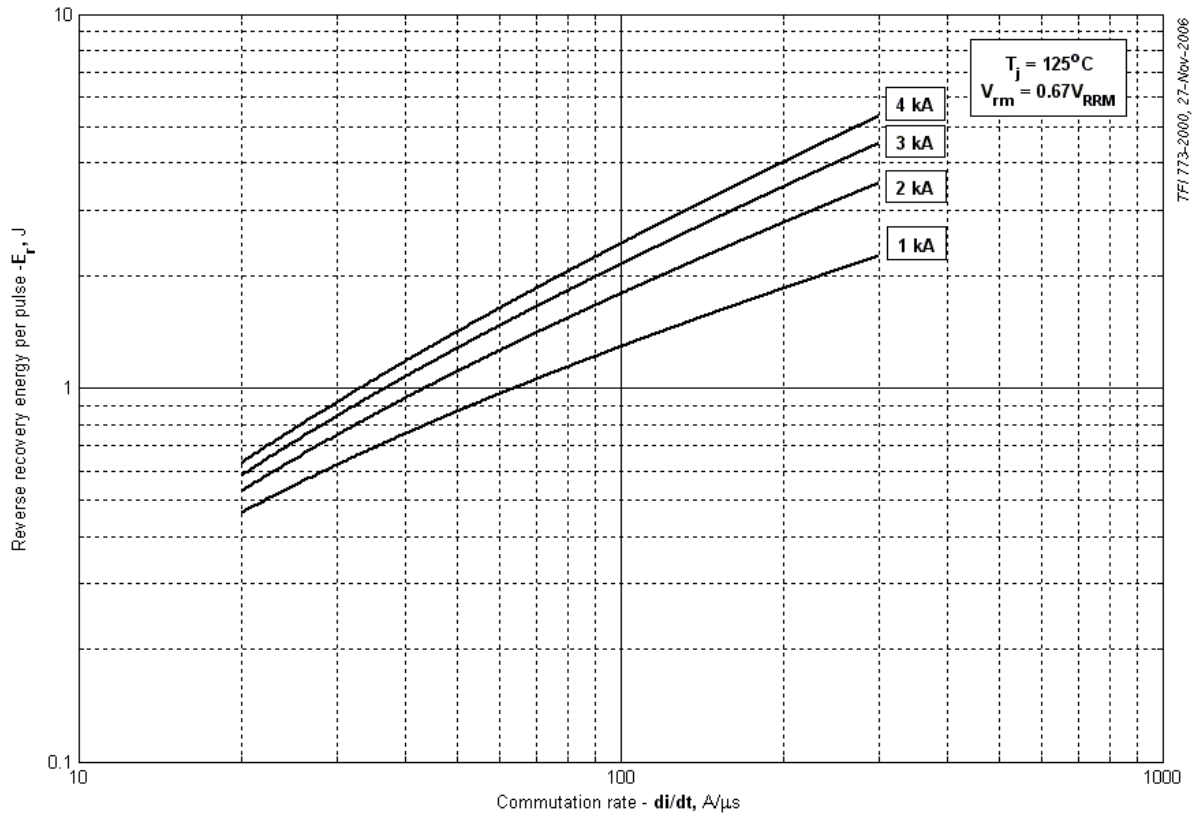

Fig 9 – Reverse recovery energy per pulse

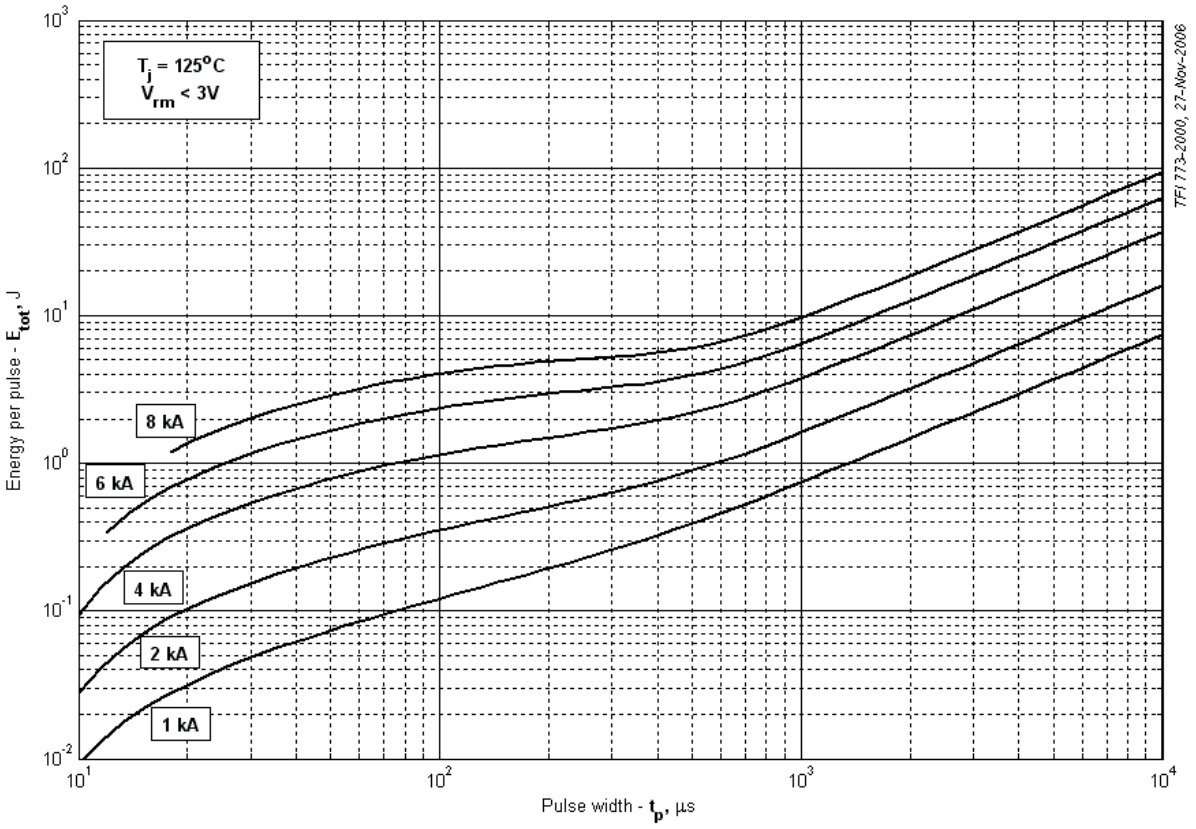

Fig 10 – Sine wave energy per pulse

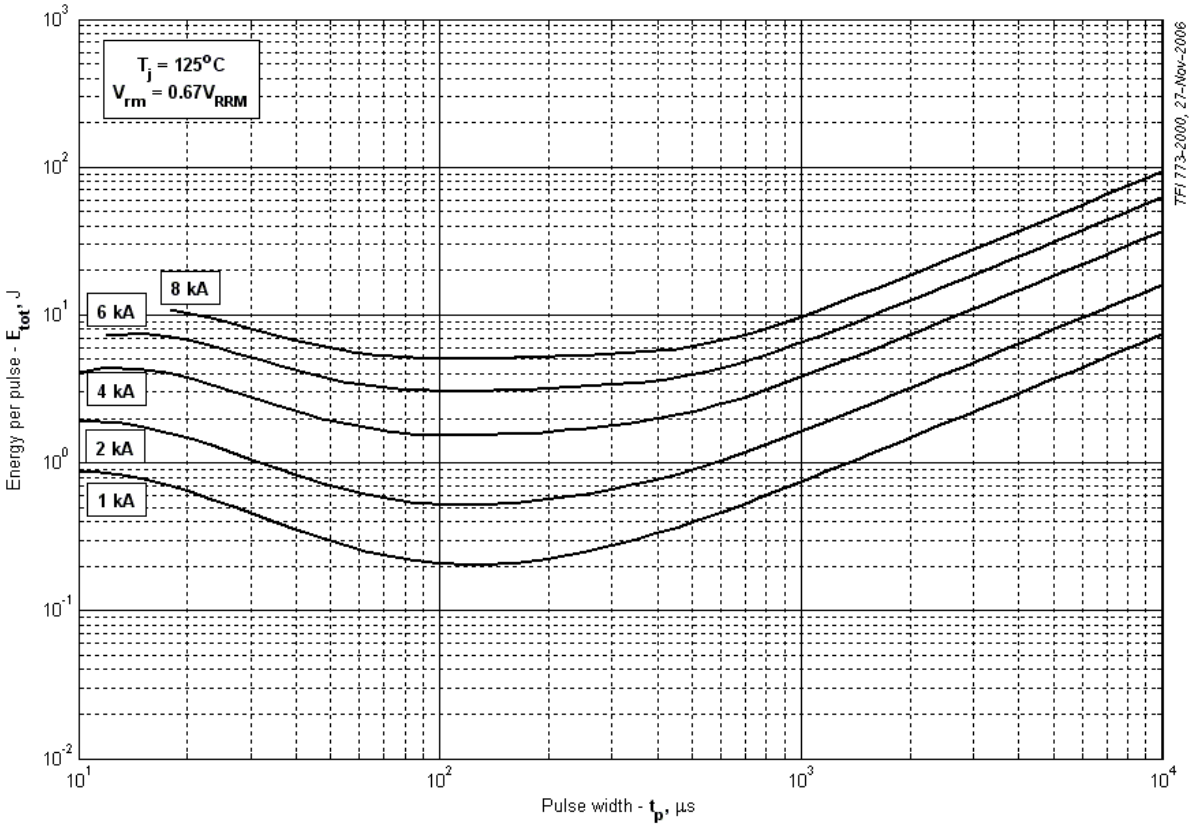

Fig 11 – Sine wave energy per pulse

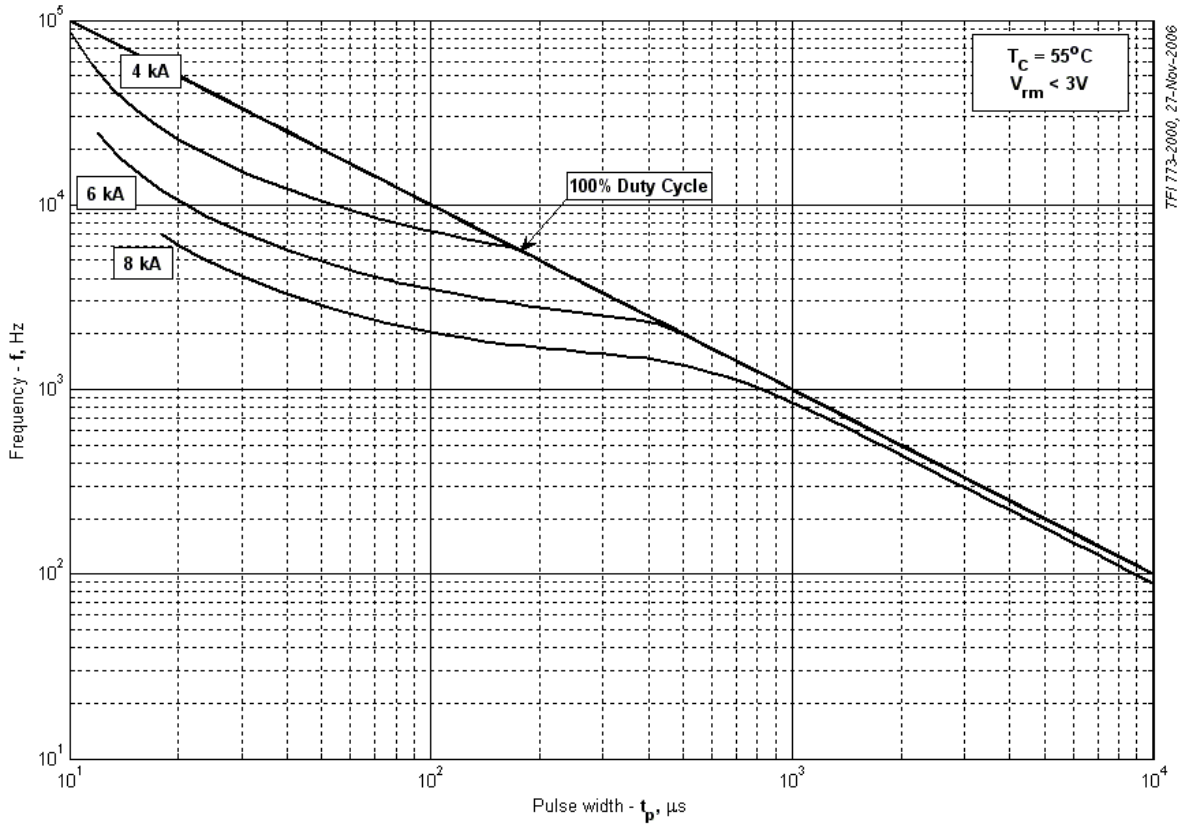

Fig 12 – Sine wave frequency ratings

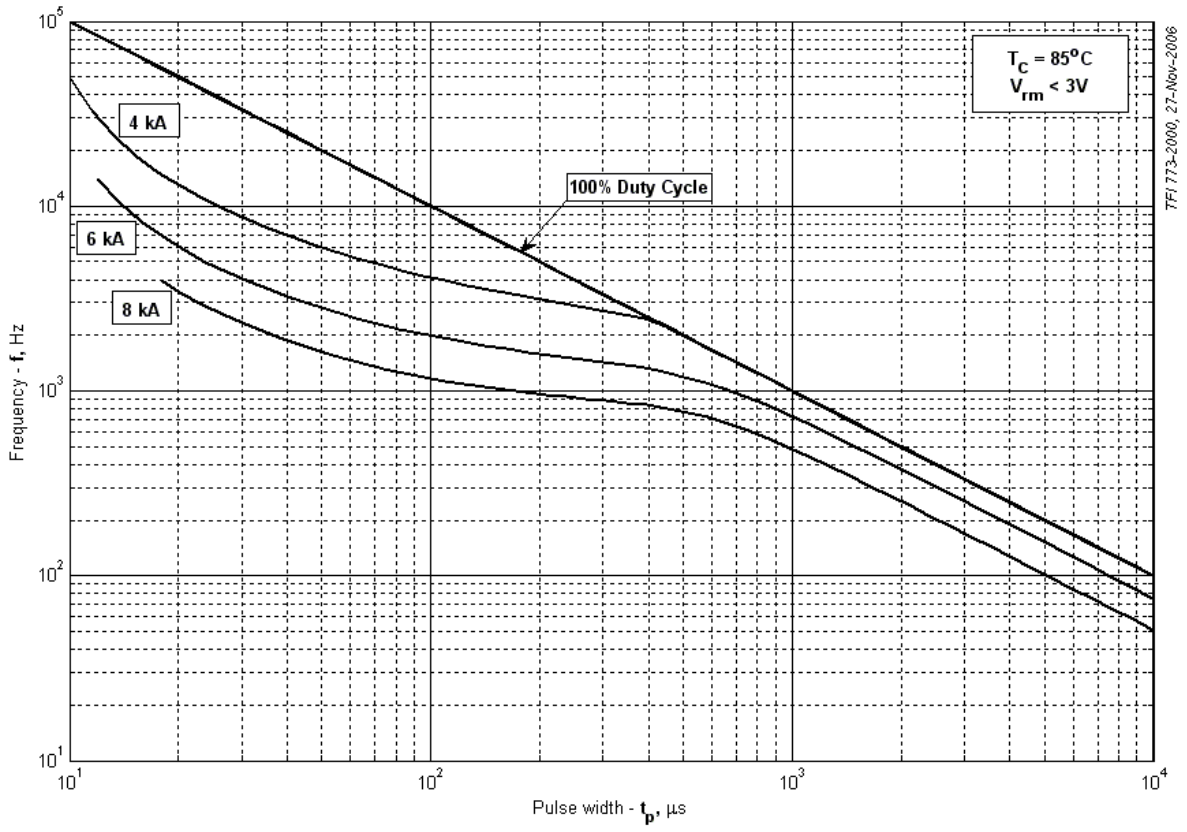

Fig 13 – Sine wave frequency ratings

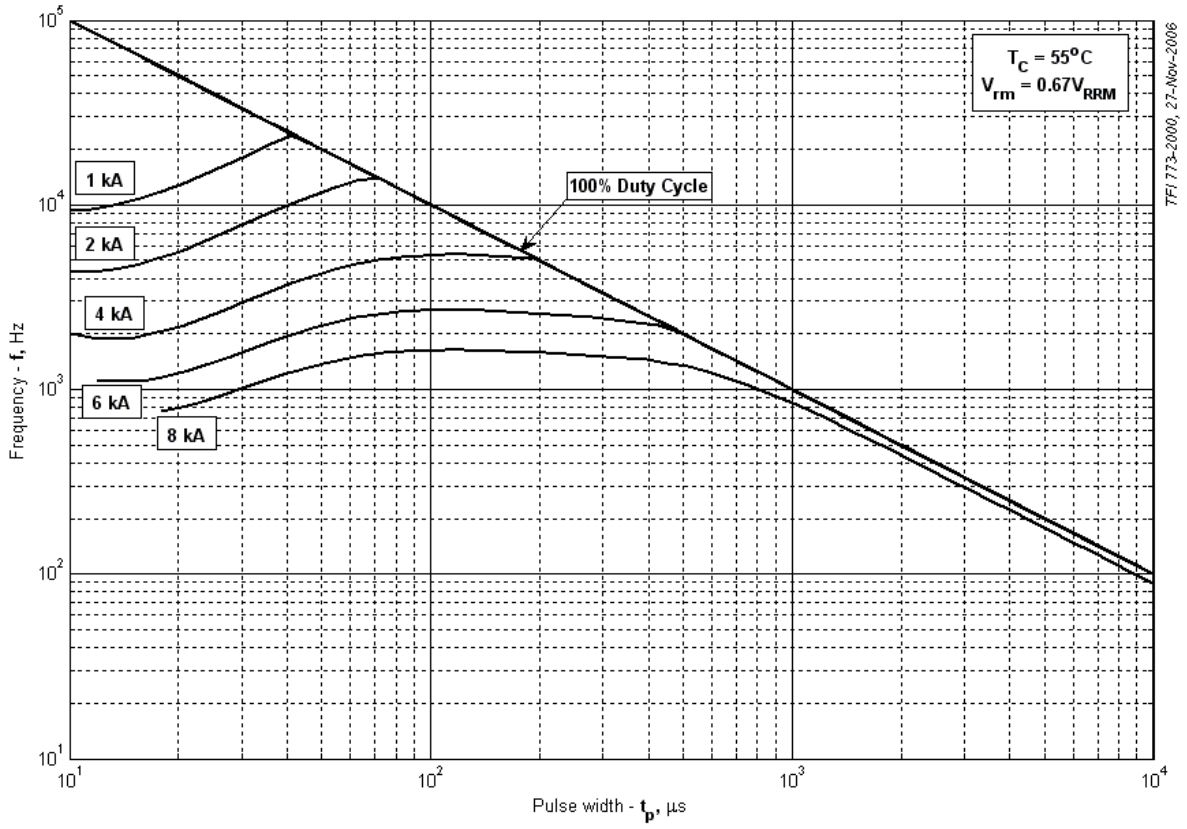

Fig 14 – Sine wave frequency ratings

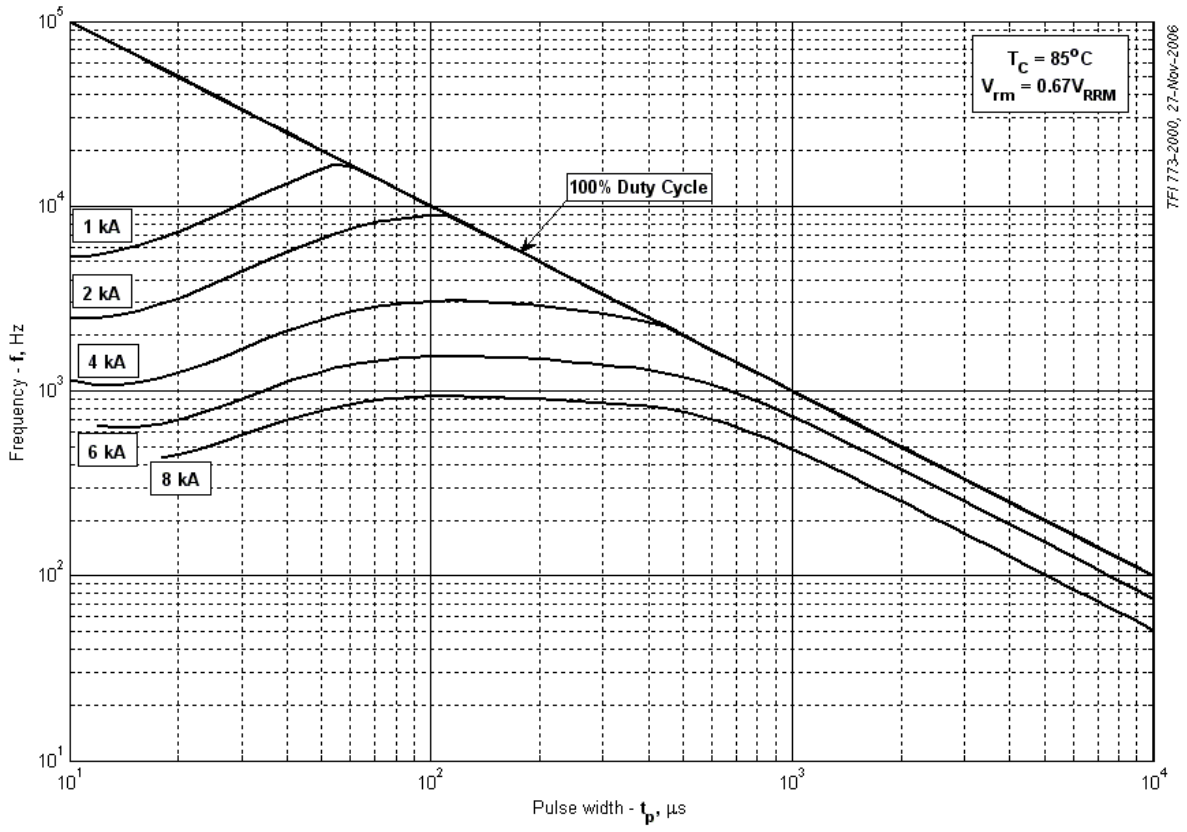

Fig 15 – Sine wave frequency ratings

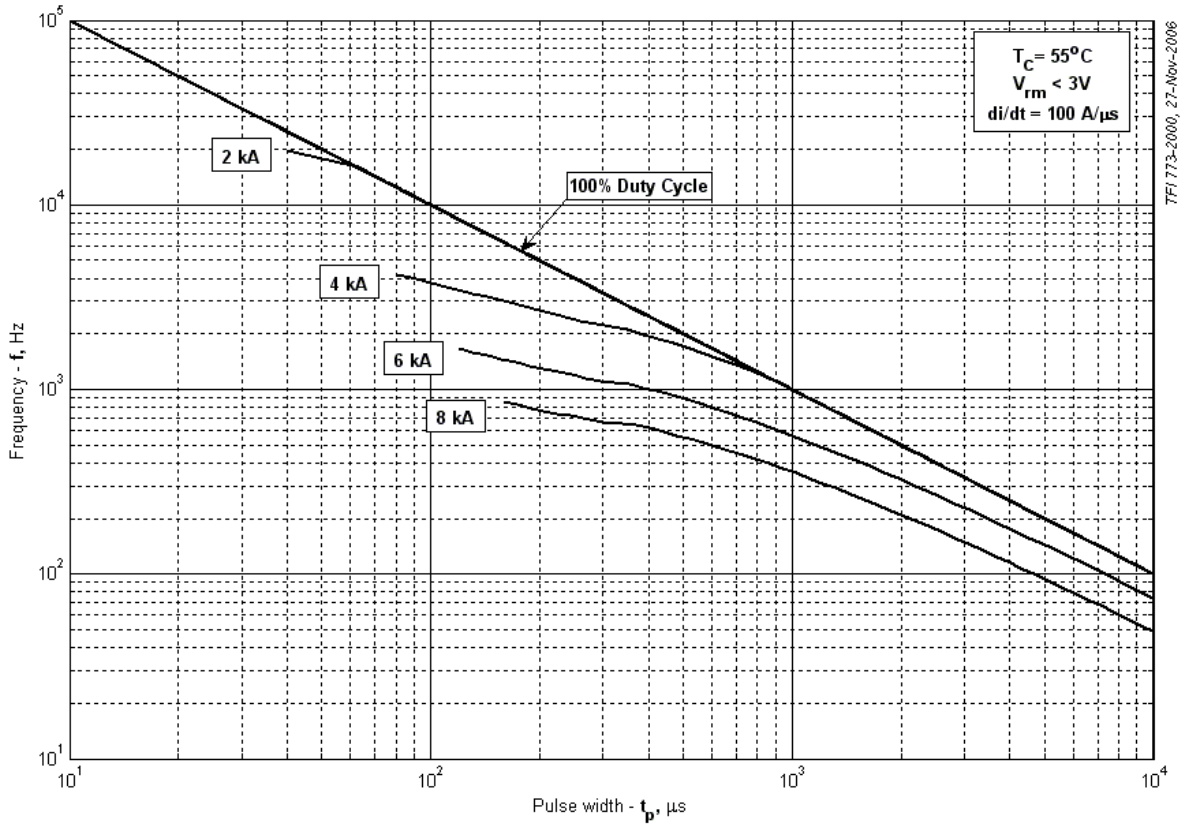

Fig 16 – Square wave frequency ratings

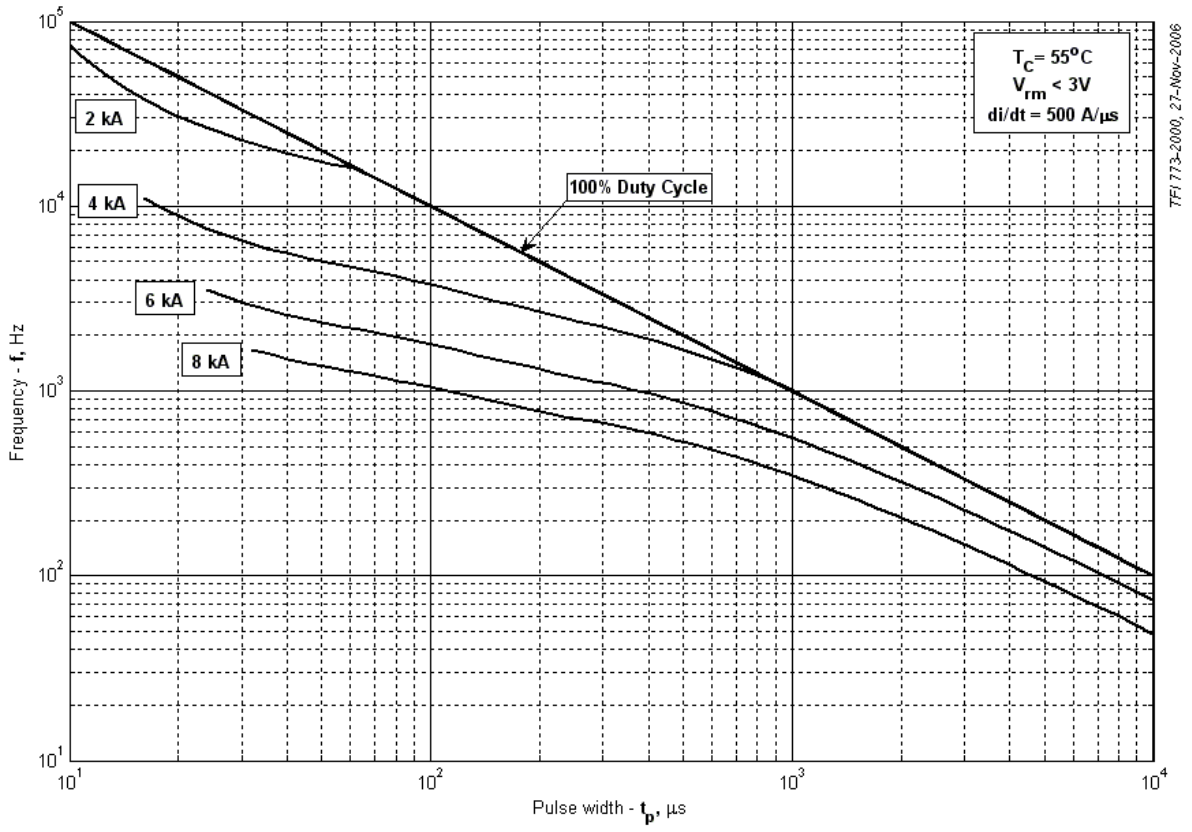

Fig 17 – Square wave frequency ratings

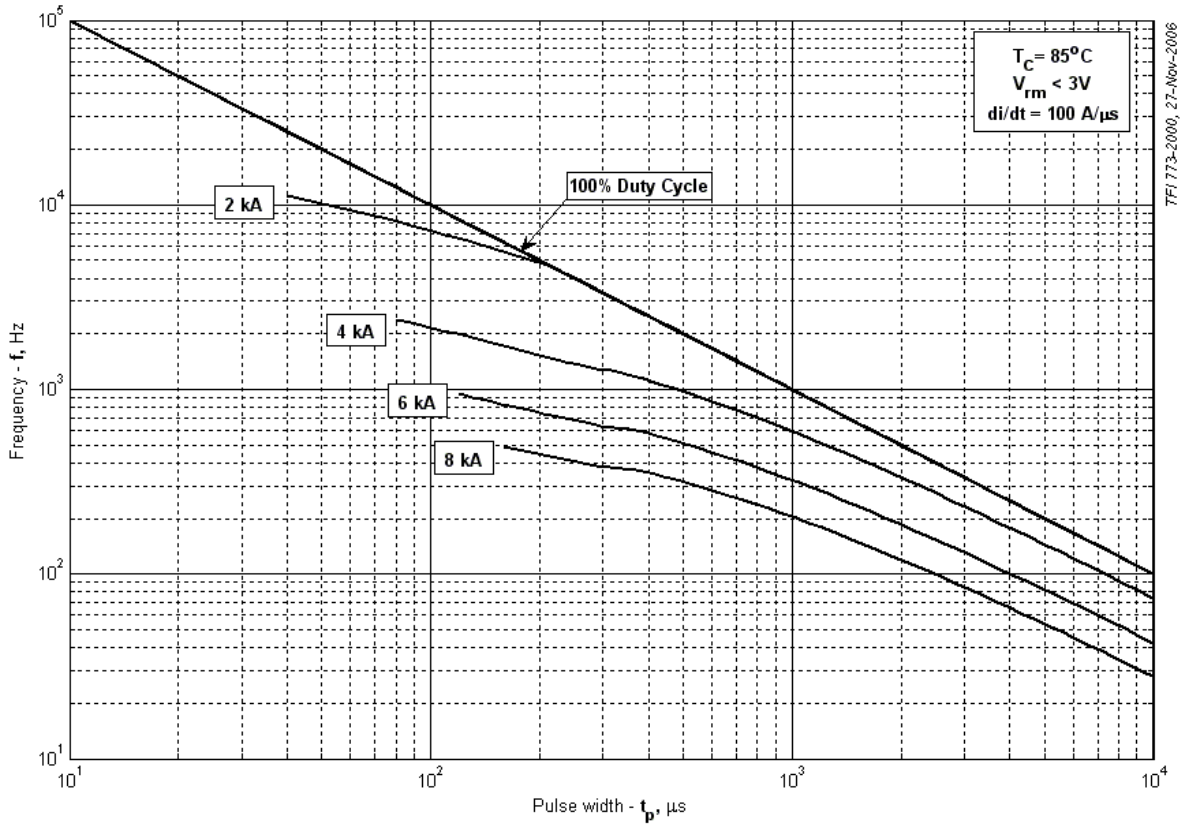

Fig 18 – Square wave frequency ratings

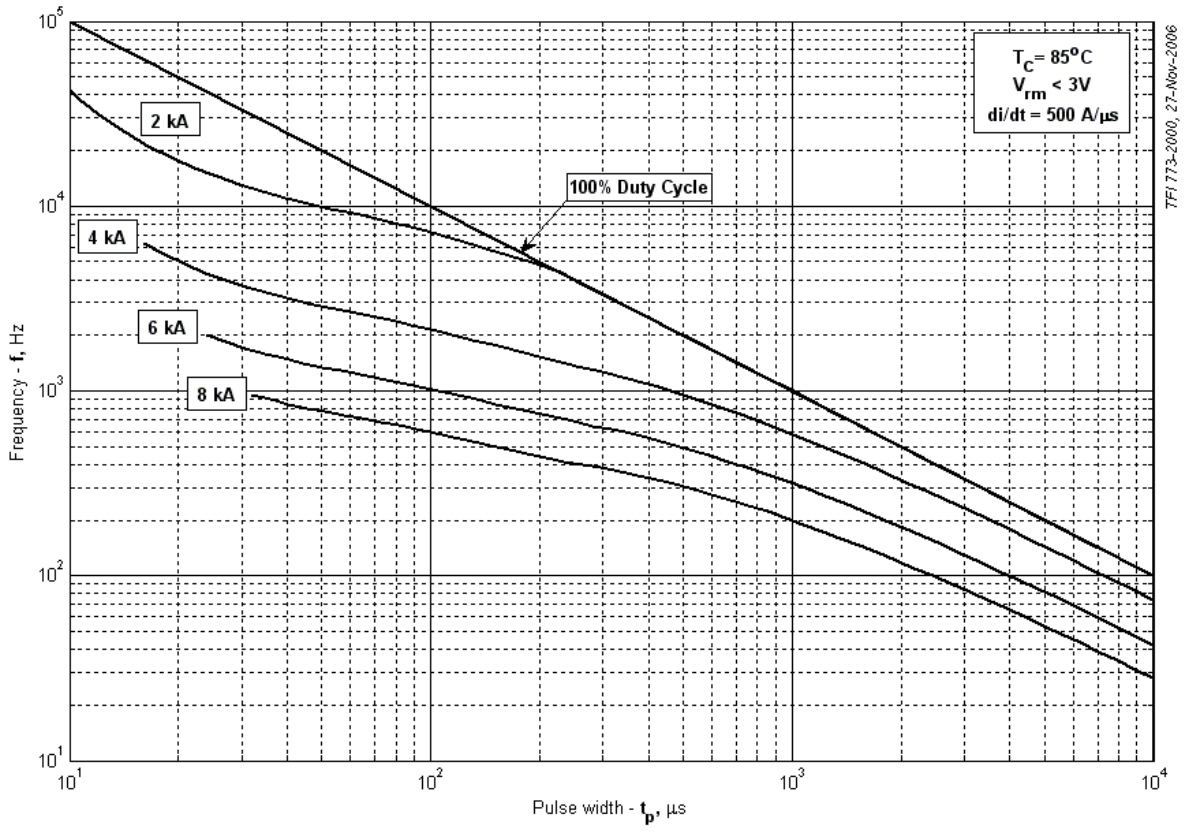

Fig 19 – Square wave frequency ratings

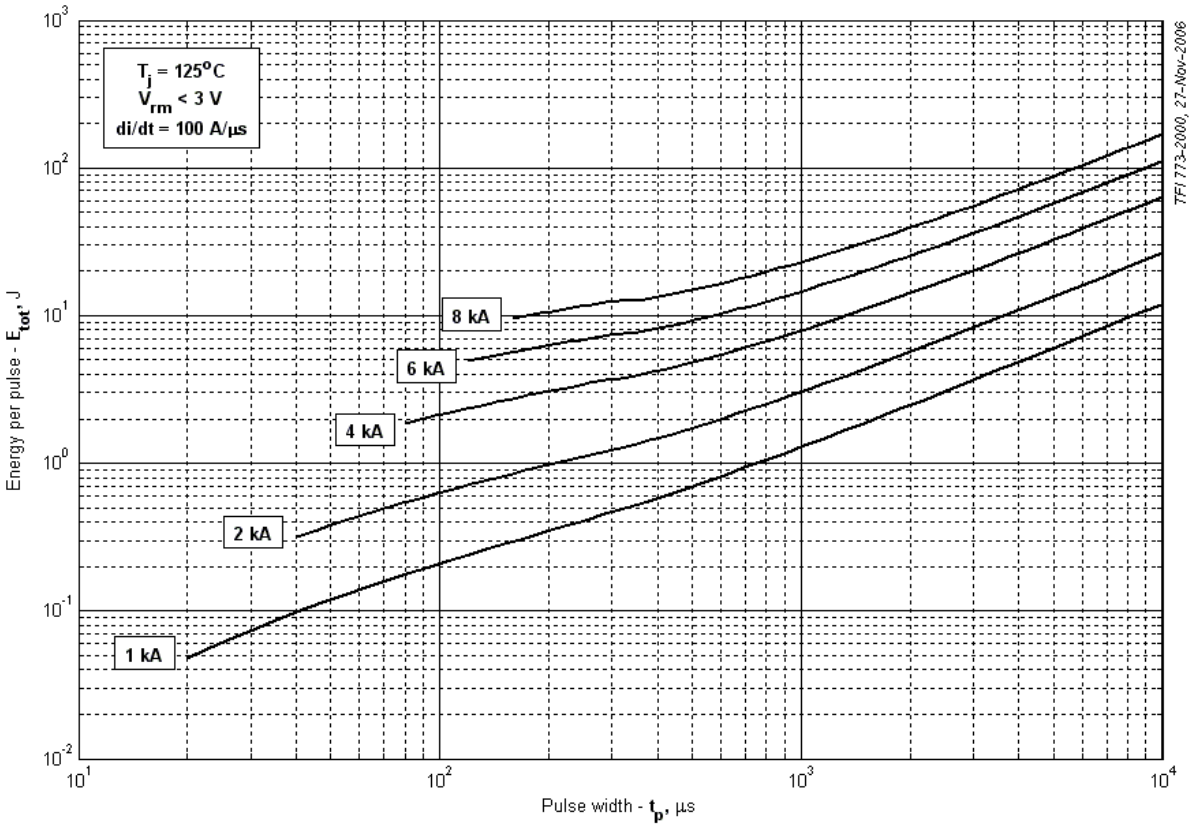

Fig 20 – Square wave energy per pulse

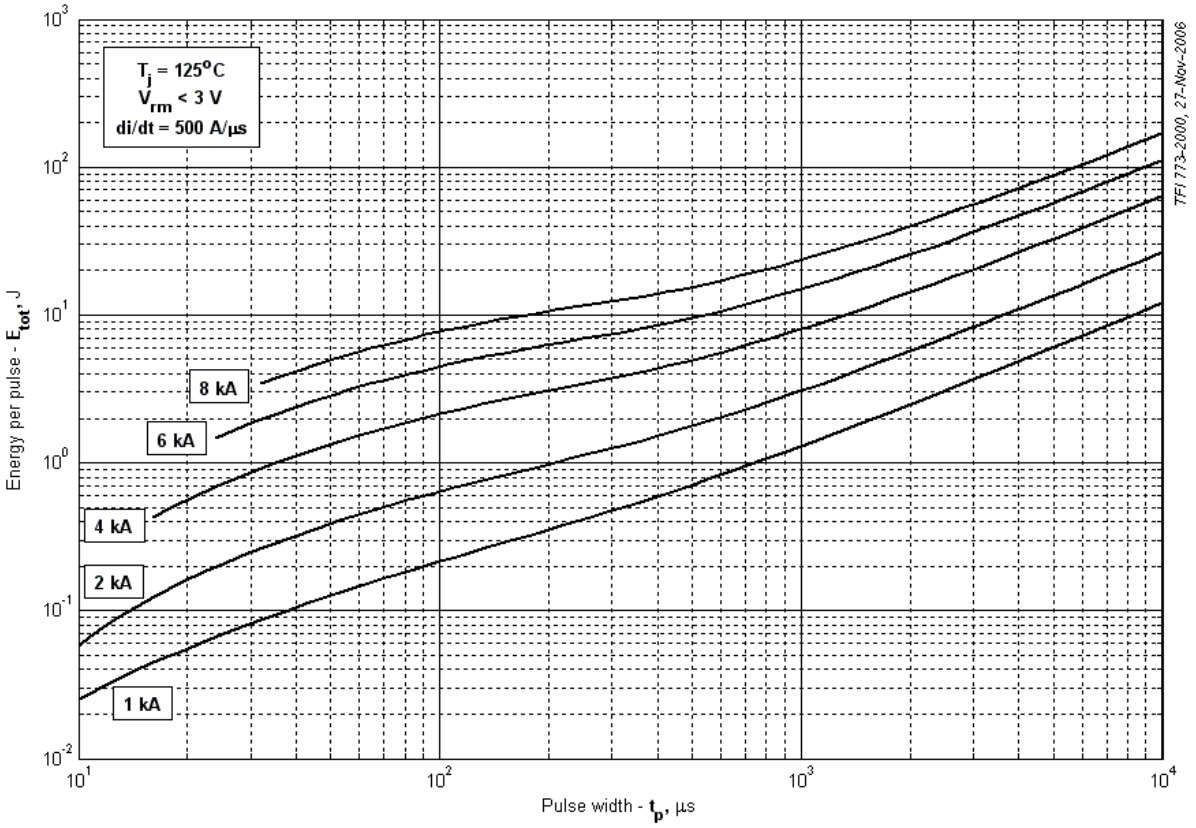

Fig 21 – Square wave energy per pulse

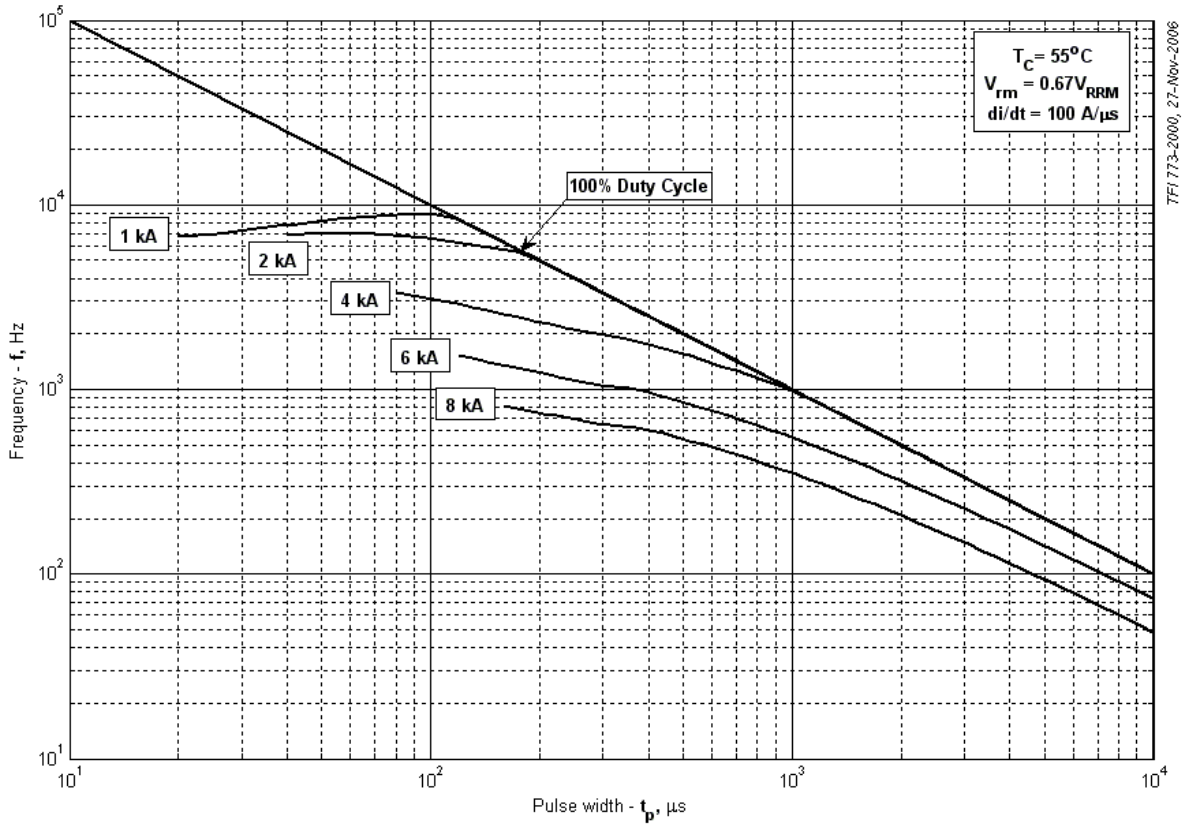

Fig 22 – Square wave frequency ratings

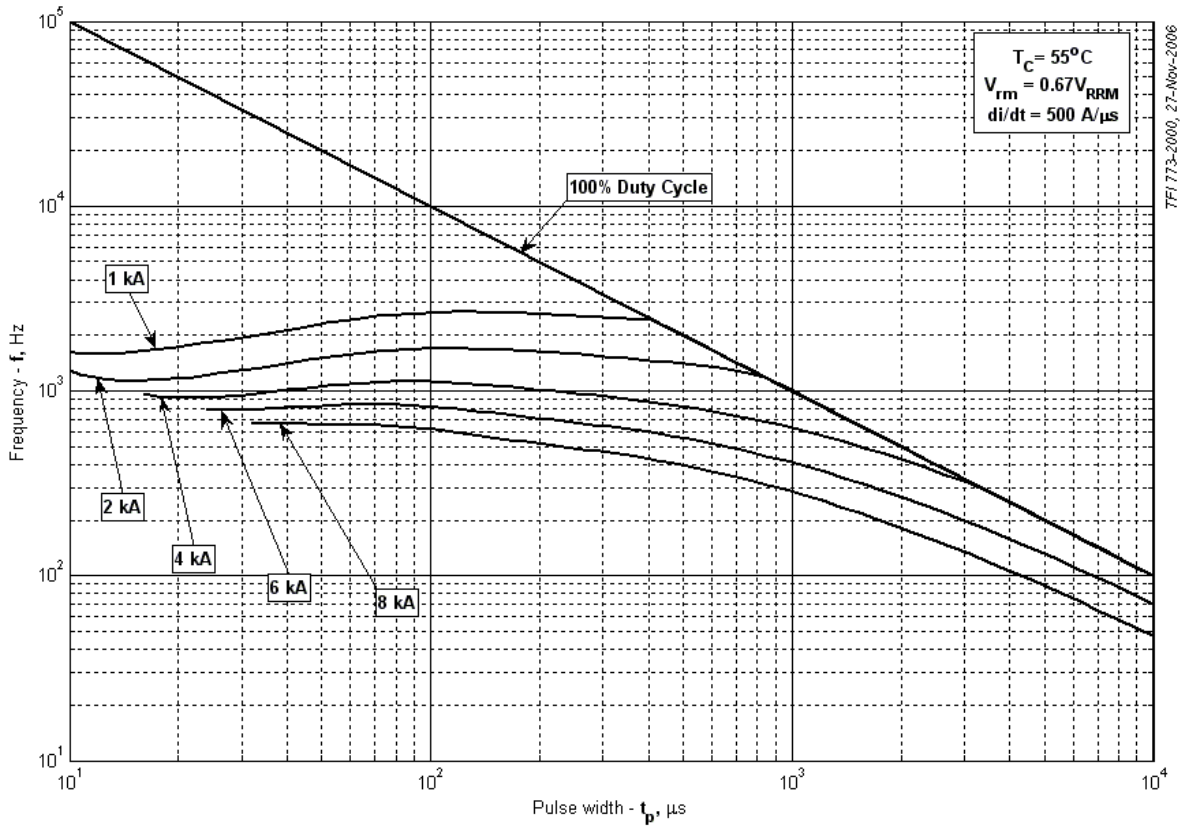

Fig 23 – Square wave frequency ratings

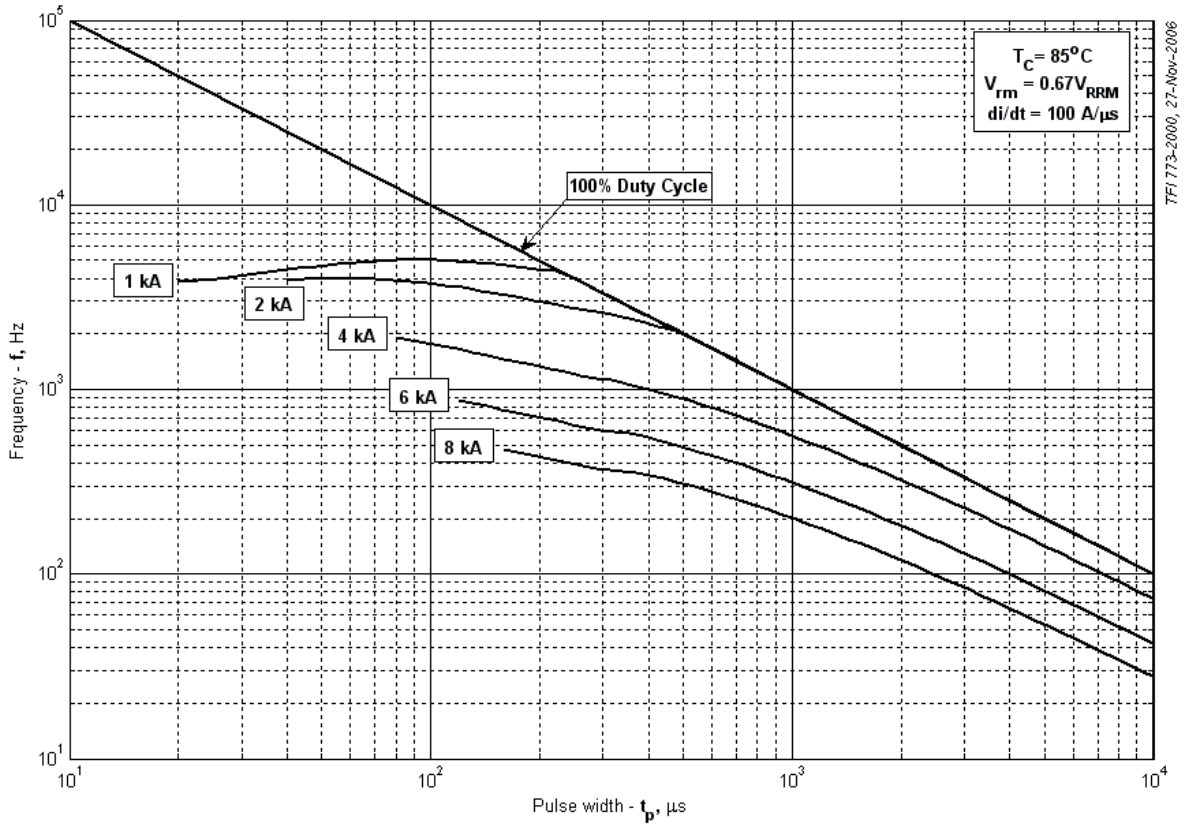

Fig 24 – Square wave frequency ratings

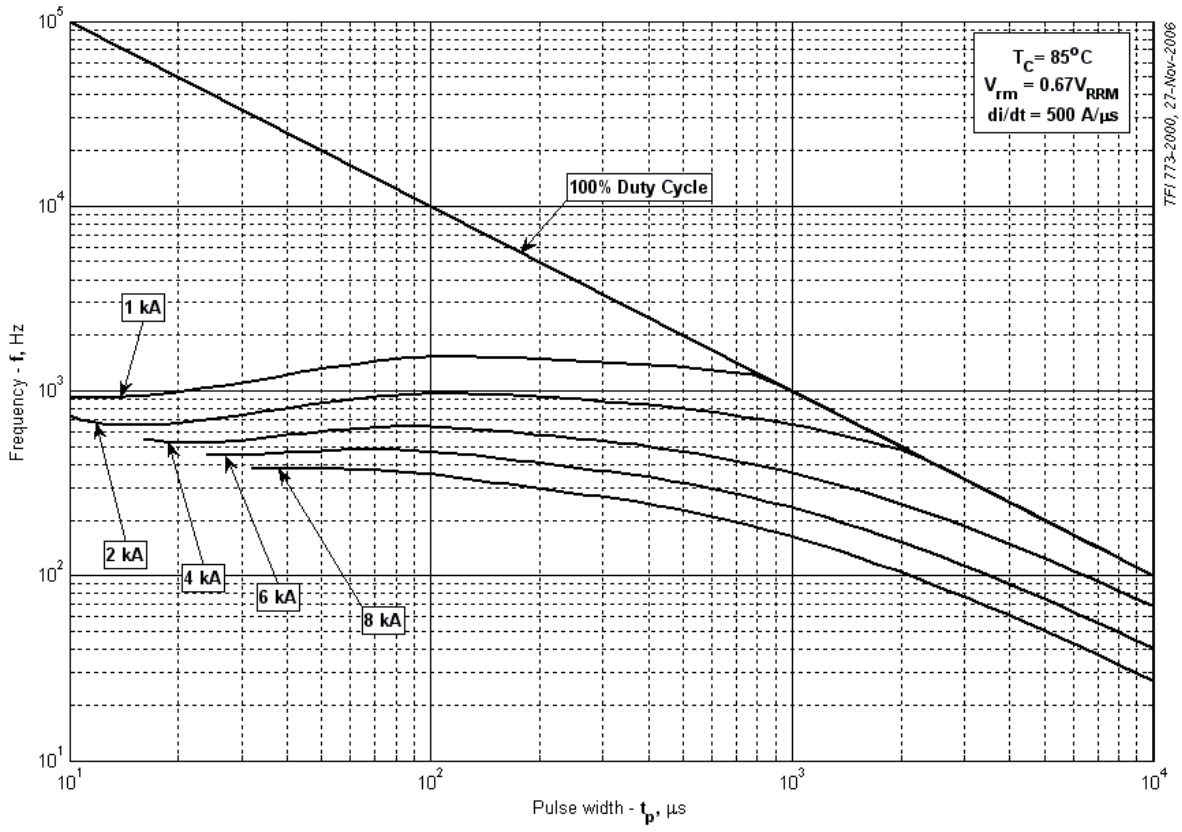

Fig 25 – Square wave frequency ratings

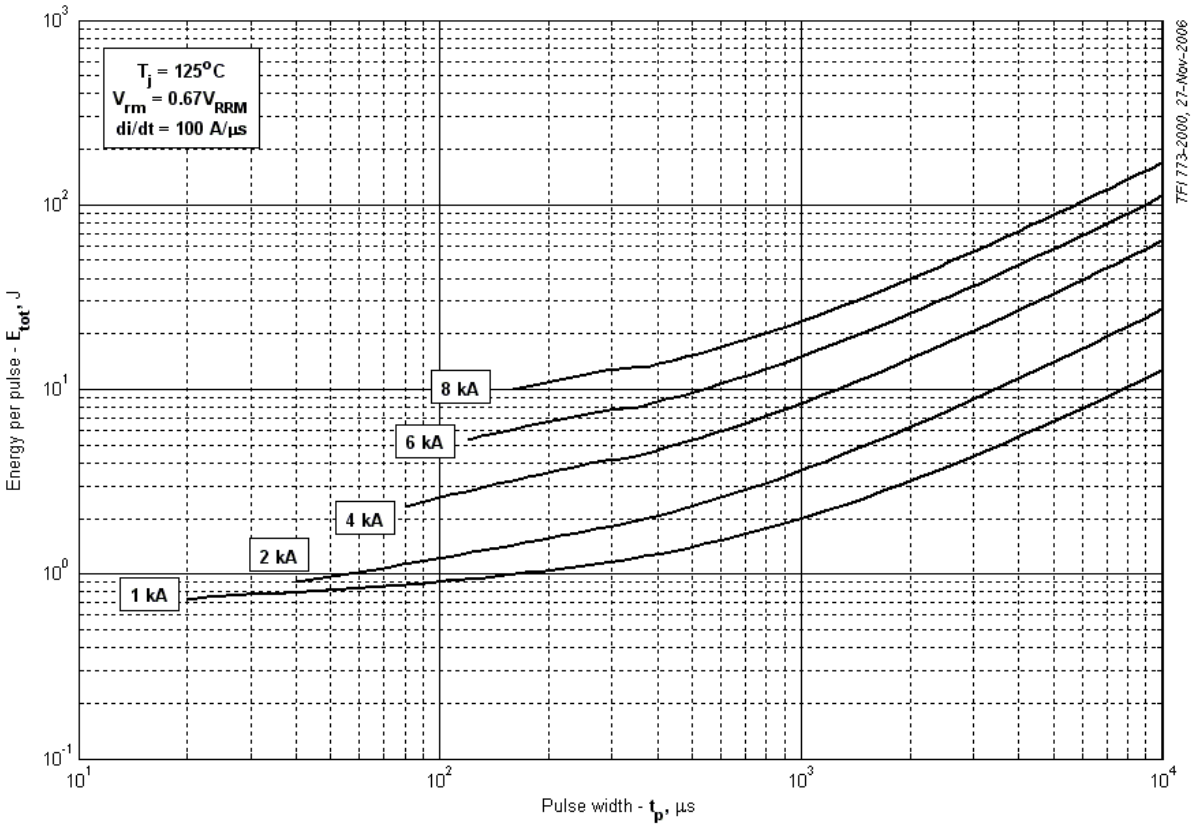

Fig 26 – Square wave energy per pulse

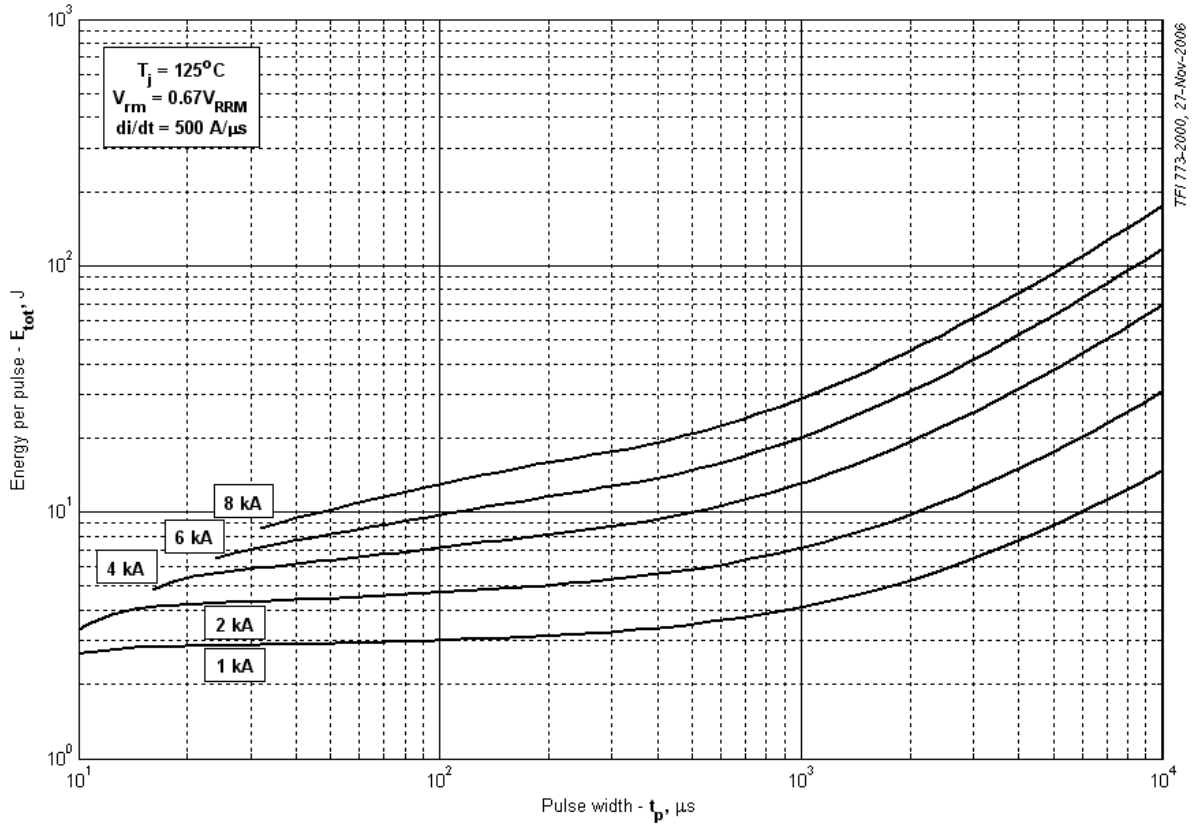

Fig 27 – Square wave energy per pulse

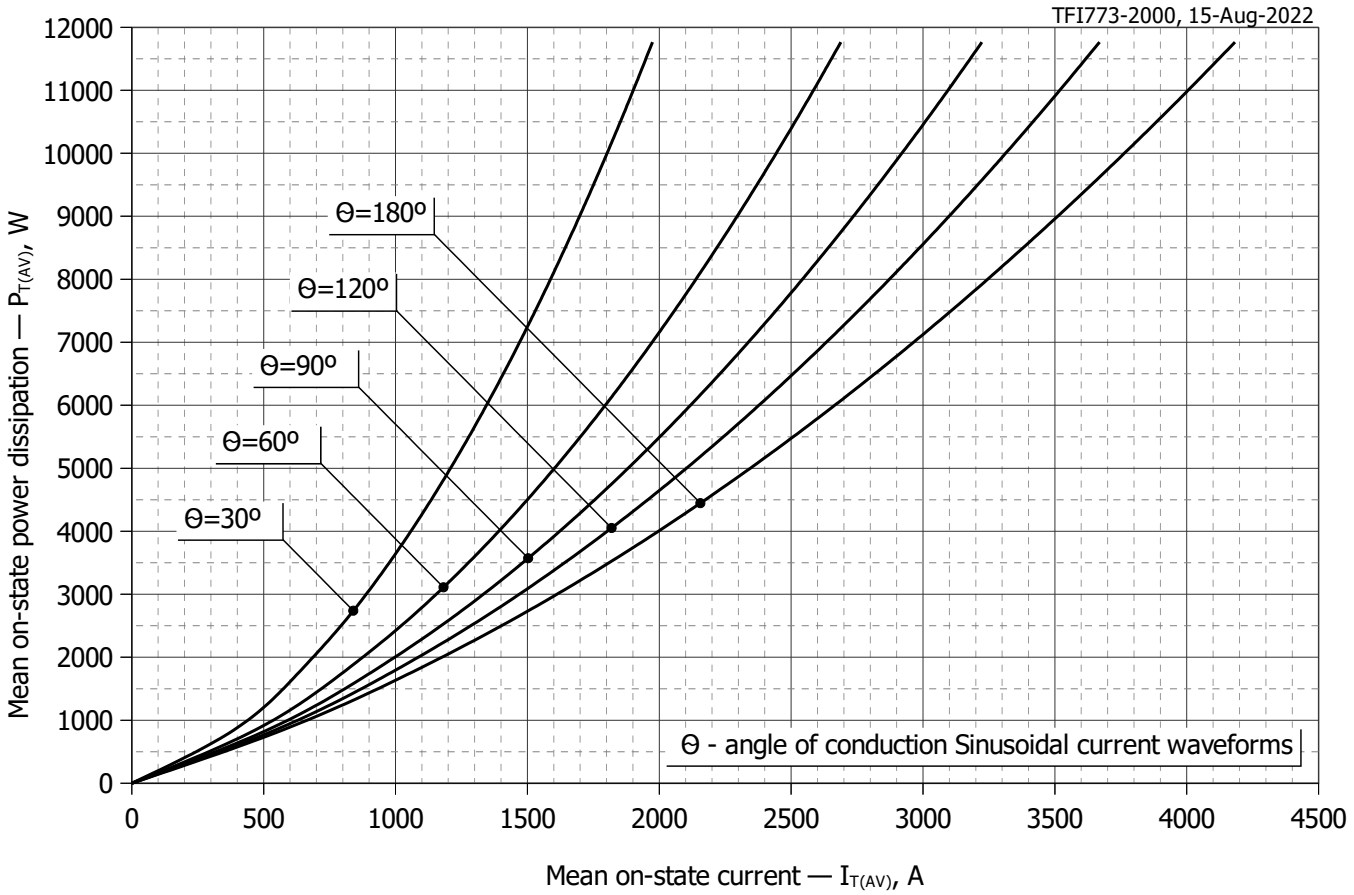

Fig 28 - Mean on-state power dissipation P_{TAV} vs. mean on-state current I_{TAV} for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

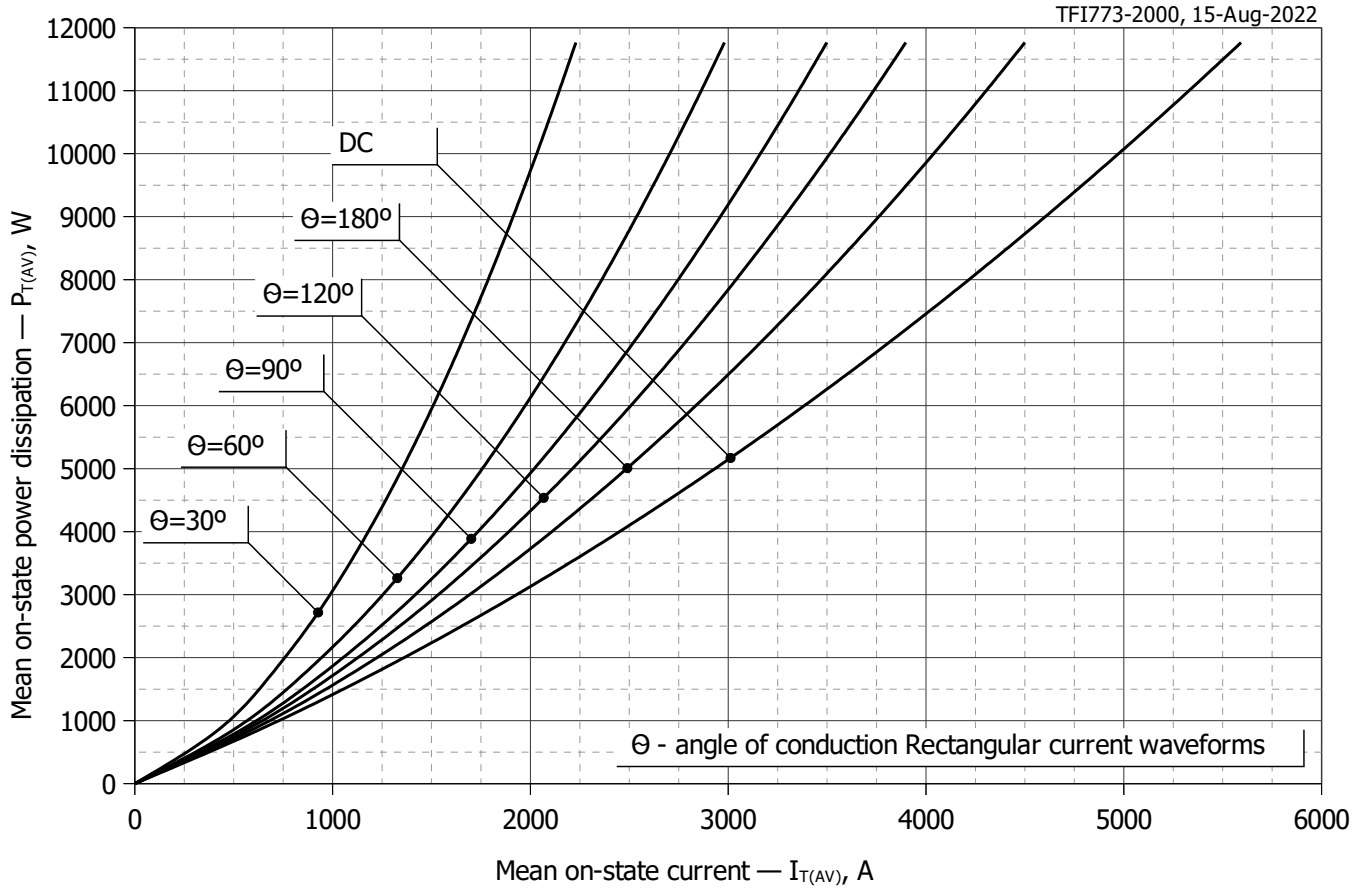

Fig 29 – Mean on-state power dissipation P_{TAV} vs. mean on-state current I_{TAV} for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

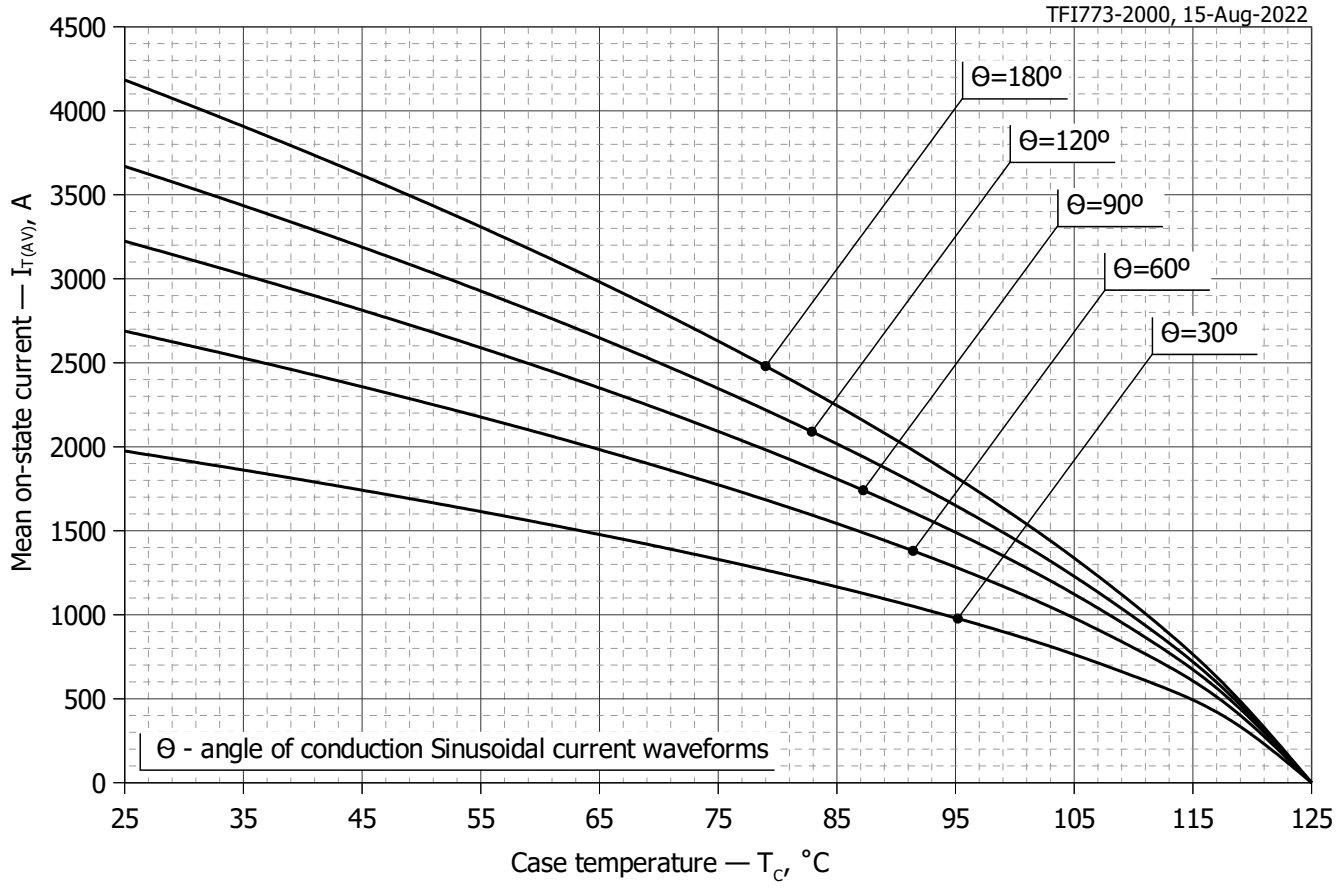

Fig 30 – Mean on-state current I_{TAV} vs. case temperature T_C for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

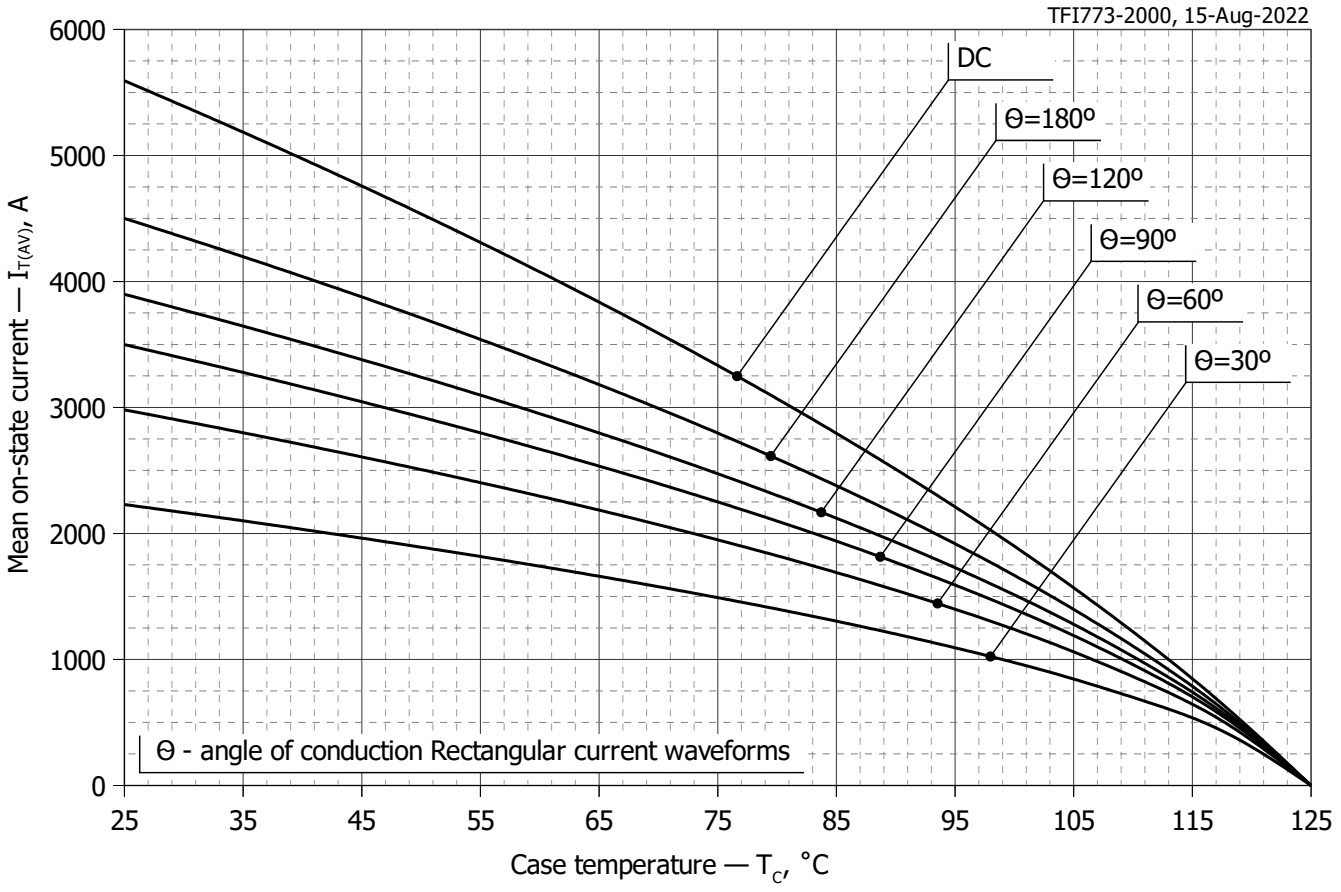

Fig 31 - Mean on-state current I_{TAV} vs. case temperature T_C for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

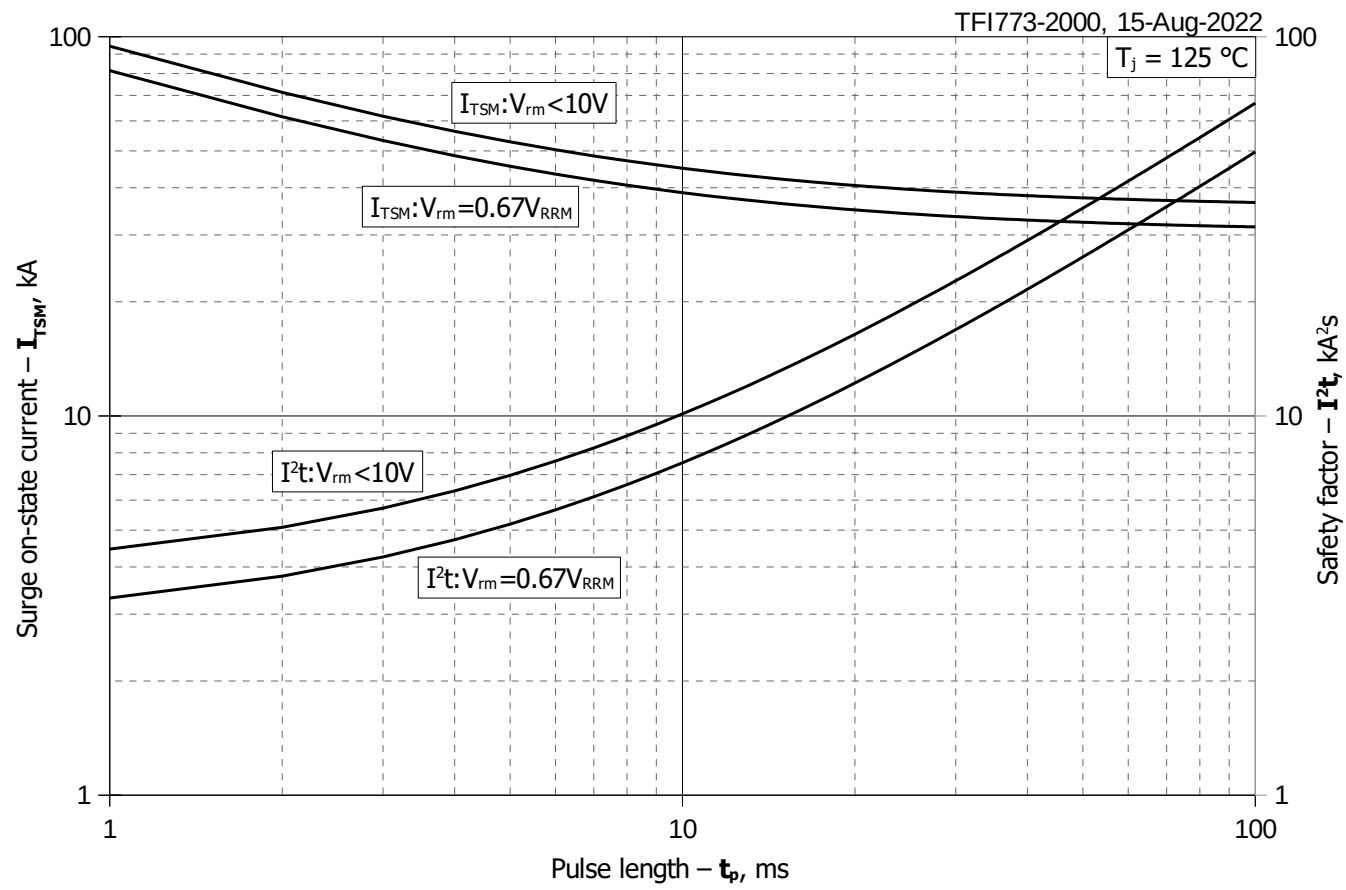

Fig 32 – Maximum surge on-state current I_{TSM} and safety factor I^2t vs. pulse length t_p

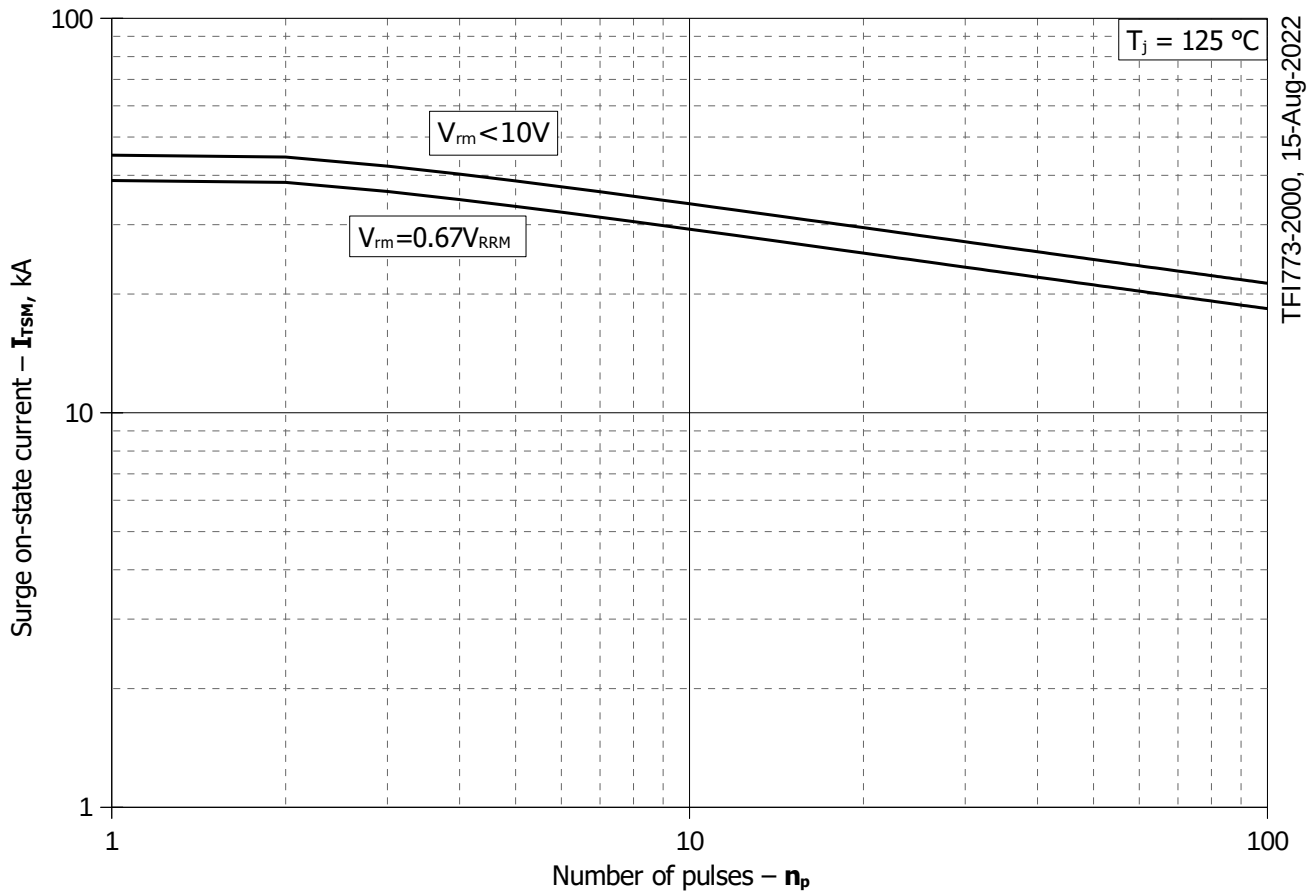

Fig 33 - Maximum surge on-state current I_{TSM} vs. number of pulses n_p