Fast Thyristor
TFI353-700-30

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

Mean on-state current		I_{TAV}	700 A
Repetitive peak off-state voltage		V_{DRM}	3000 V
Repetitive peak reverse voltage		V_{RRM}	
Turn-off time		t_q	40.0, 50.0, 63.0 µs
V_{DRM}, V_{RRM}, V	3000		
Voltage code	30		
T_j, °C	– 60 ÷ 120		

MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions	
ON-STATE					
I_{TAV}	Mean on-state current	A	700 1125	T_c=87 °C; Double side cooled; T_c=55 °C; Double side cooled; 180° half-sine wave; 50 Hz	
I_{TRMS}	RMS on-state current	A	1100	T_c=87 °C; Double side cooled; 180° half-sine wave; 50 Hz	
I_{TSM}	Surge on-state current	kA	14.0 16.0	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=1 A/µs
			15.0 17.0	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=1 A/µs
I^2t	Safety factor	$A^2s\cdot10^3$	980 1280	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=1 A/µs
			930 1190	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=1 A/µs
BLOCKING					
V_{DRM}, V_{RRM}	Repetitive peak off-state and Repetitive peak reverse voltages	V	3000	$T_{j\,min}$< 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	3100	$T_{j\,min}$< 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	8	$T_j=T_{j\,max}$
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	2000	$T_j=T_{j\,max}$; $V_D=0.67 \cdot V_{DRM}$; $I_{TM}=2\ I_{TAV}$; 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	-60 ÷ 50	
T_j	Operating junction temperature	°C	-60 ÷ 120	
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	3.20 2.85	$T_j=T_{j\,max}$; $I_{TM}=3200$ A $T_j=25$ °C; $I_{TM}=2512$ A	
$V_{T(TO)}$	On-state threshold voltage, max	V	1.50	$T_j=T_{j\,max}$; $0.5\ \pi\ I_{TAV} < I_T < 1.5\ \pi\ I_{TAV}$	
r_T	On-state slope resistance, max	mΩ	0.500		
I_H	Holding current, max	mA	500	$T_j=25$ °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	$T_j=T_{j\,max}$; $V_D=0.67 \cdot V_{DRM}$; 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	500 300 200	$T_j=T_{j\,min}$ $T_j=25$ °C $T_j=T_{j\,max}$	
V_{GD}	Gate non-trigger direct voltage, min	V	0.25	$T_j=T_{j\,max}$; $V_D=0.67 \cdot V_{DRM}$; Direct gate current	
I_{GD}	Gate non-trigger direct current, min	mA	10.00		
SWITCHING					
t_{gd}	Delay time, max	µs	0.88	$T_j=25$ °C; $V_D=1500$ 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)]	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}	Total recovered charge, max	µC	770	$T_j=T_{j\,max}$; $I_{TM}=I_{TAV}$; $di_R/dt=-50$ A/µs; $V_R=100$ V	
t_{rr}	Reverse recovery time, typ	µs	7.0		
I_{rrM}	Peak reverse recovery current, max	A	220		

THERMAL					
R_{thjc}	Thermal resistance, junction to case, max	°C/W	0.0200	Direct current	Double side cooled
R_{thjc-A}			0.0440		Anode side cooled
R_{thjc-K}			0.0360		Cathode side cooled
R_{thck}	Thermal resistance, case to heatsink, max	°C/W	0.0040	Direct current	
MECHANICAL					
w	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

TFI	353	700	30	A2	H3	M4	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
$(dv_D/dt)_{crit}$, V/μs	200	320	500	1000

[2] Turn-on time

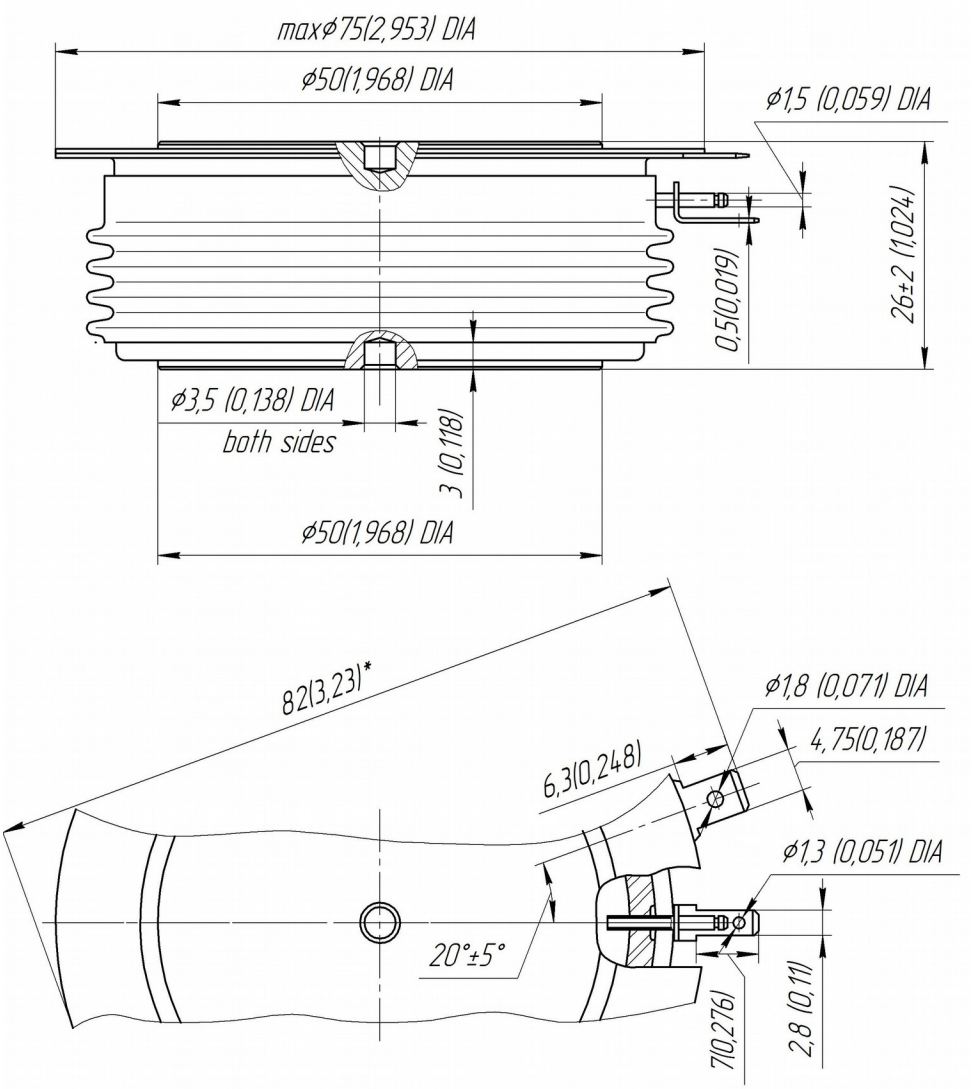
Symbol of group	M4	K4	H4	C4
t_{gt}, μs	2.50	3.20	4.00	6.30

[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.D5



All dimensions in millimeters (inches)

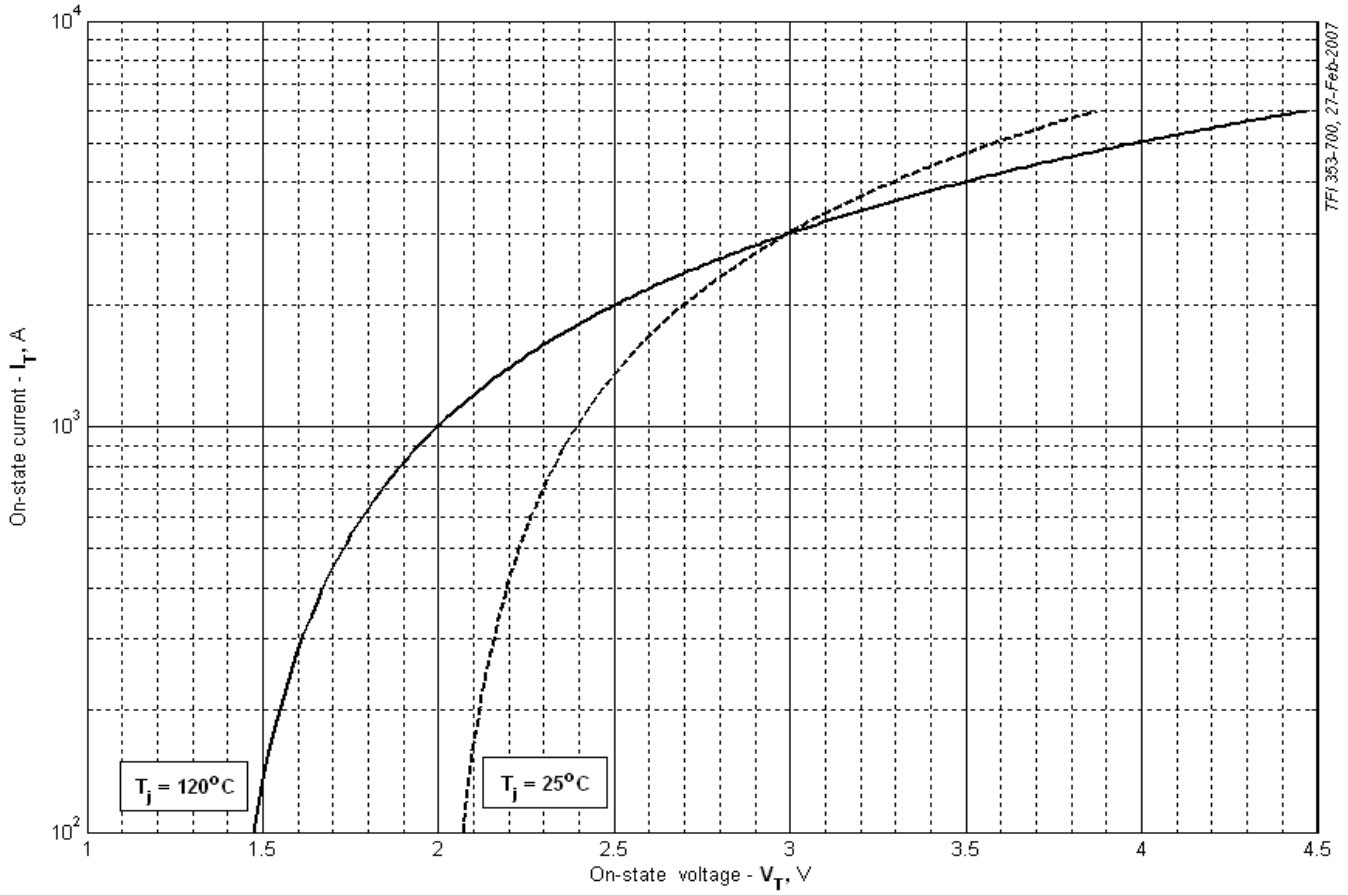


Fig 1 – On-state characteristics of Limit device

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	1.967194	1.329742
B	0.254400	0.439131
C	-0.166422	-0.222268
D	0.285964	0.381925

On-state characteristic model (see Fig. 1)

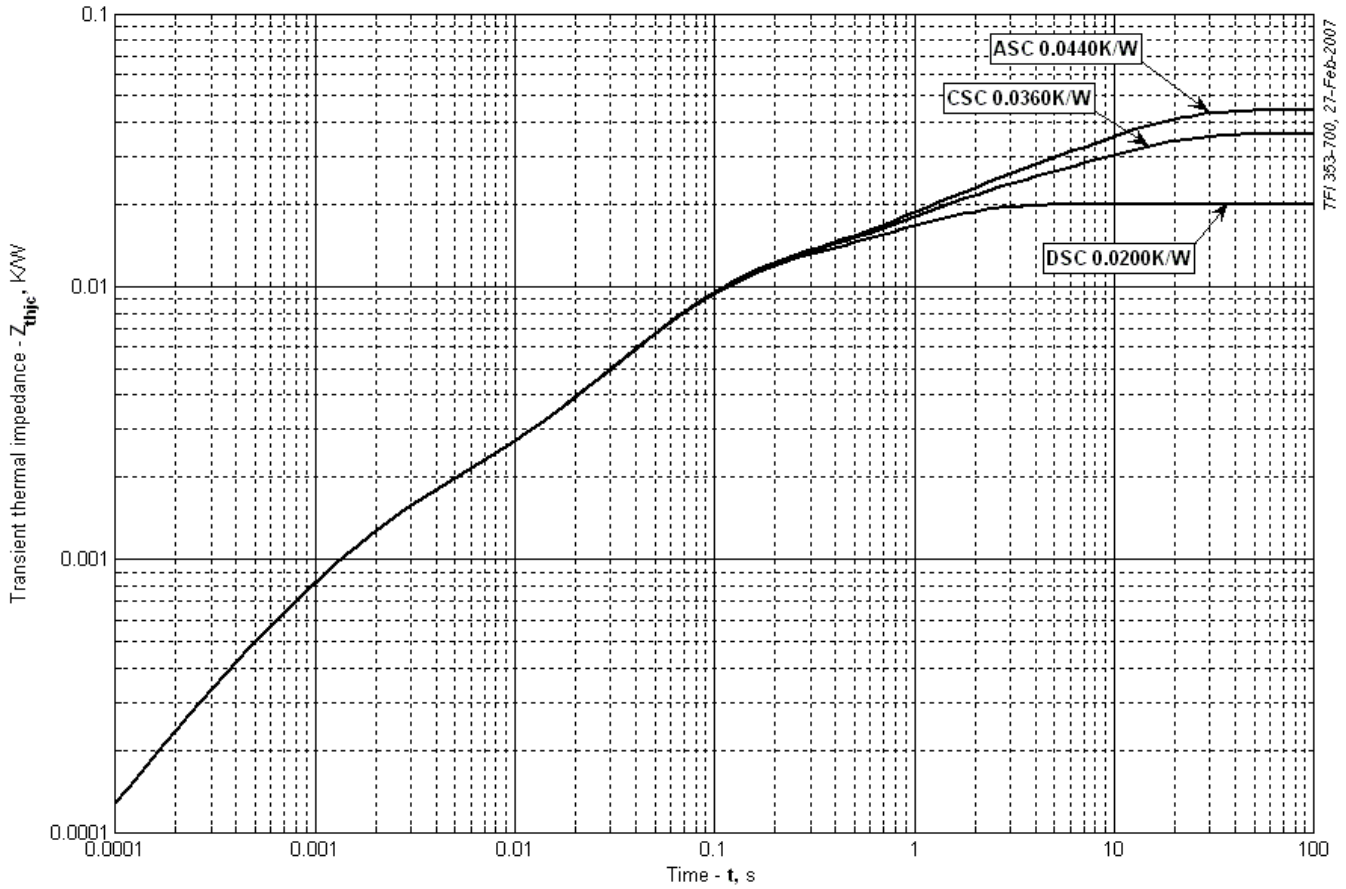


Fig 2 – Transient thermal impedance

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.

$\mathbf{Z_{thjc}}$ = 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
$\mathbf{R_i}$, **K/W**	-1.888e-006	0.009096	0.009331	0.0001969	0.001089	0.000289
τ_i, **s**	9.752	0.9752	0.06926	0.02587	0.00197	0.0004773

DC Cathode side cooled

i	1	2	3	4	5	6
$\mathbf{R_i}$, **K/W**	0.01613	0.008994	0.00918	0.0004987	0.001111	0.0002592
τ_i, **s**	9.752	1.077	0.06877	0.2401	0.001906	0.0004449

DC Anode side cooled

i	1	2	3	4	5	6
$\mathbf{R_i}$, **K/W**	0.02418	0.009264	0.00939	3.212e-007	0.001074	0.0003088
τ_i, **s**	9.752	1.078	0.07024	0.2399	0.00201	0.0005003

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

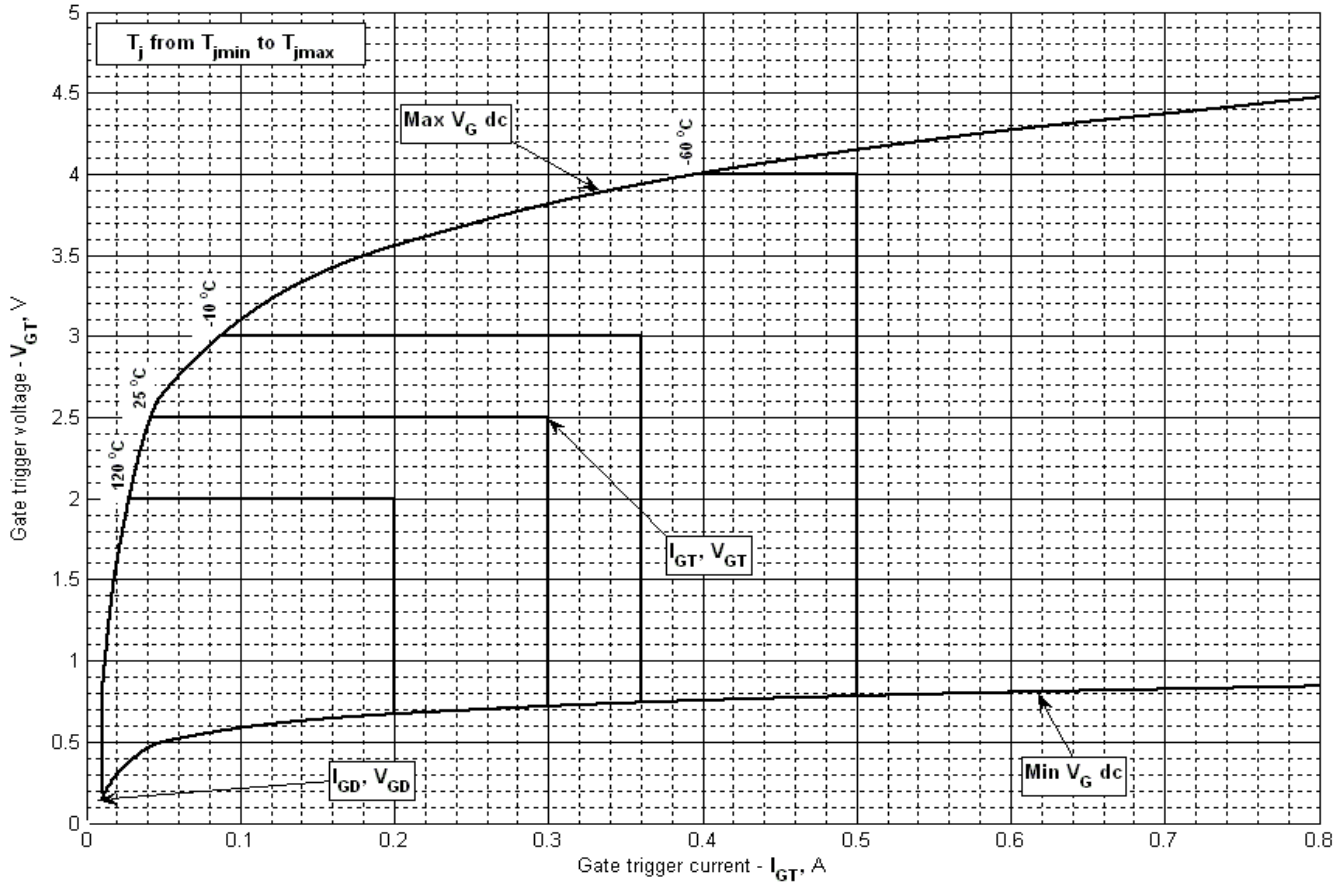


Fig 3 – Gate characteristics – Trigger limits

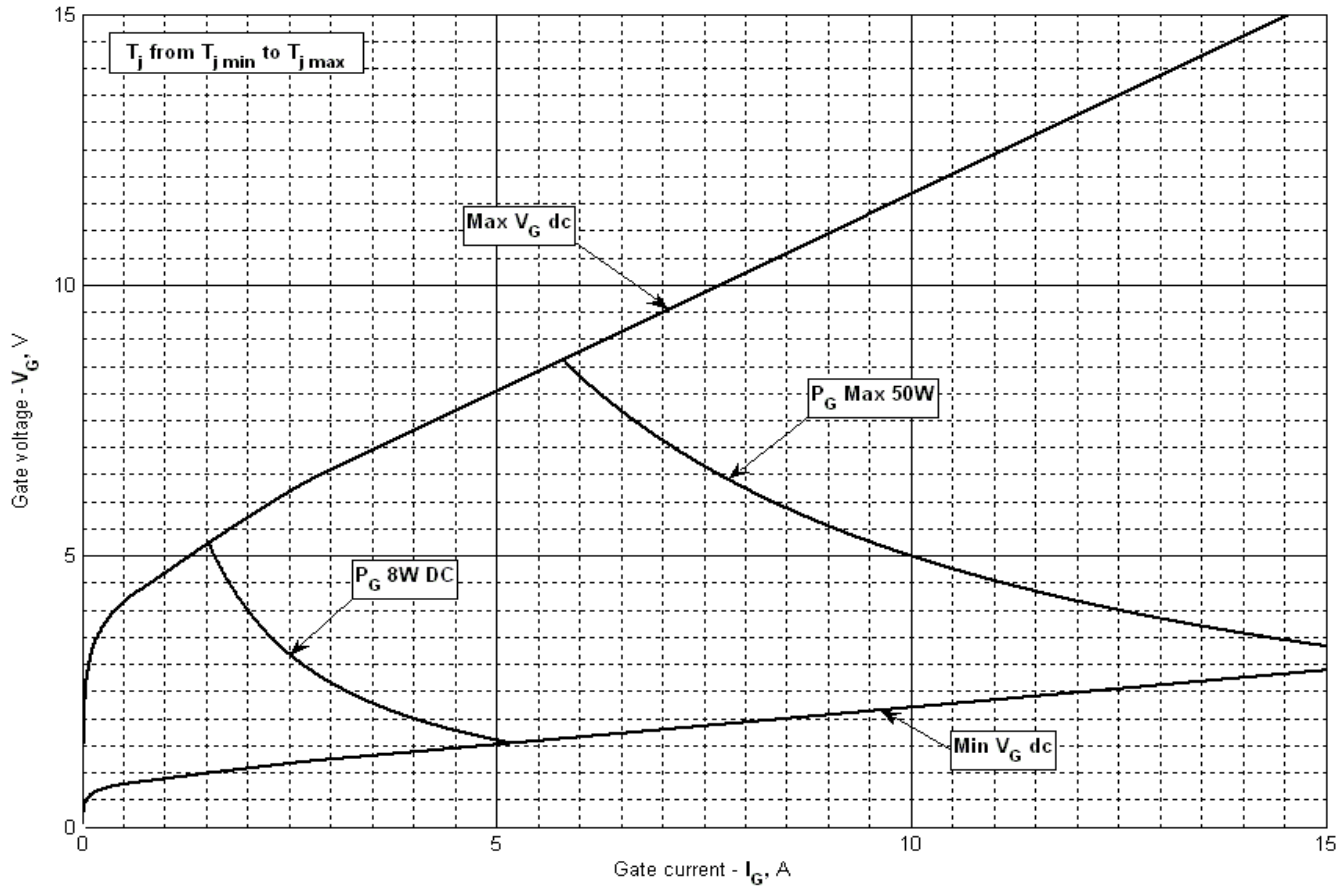


Fig 4 - Gate characteristics – Power curves

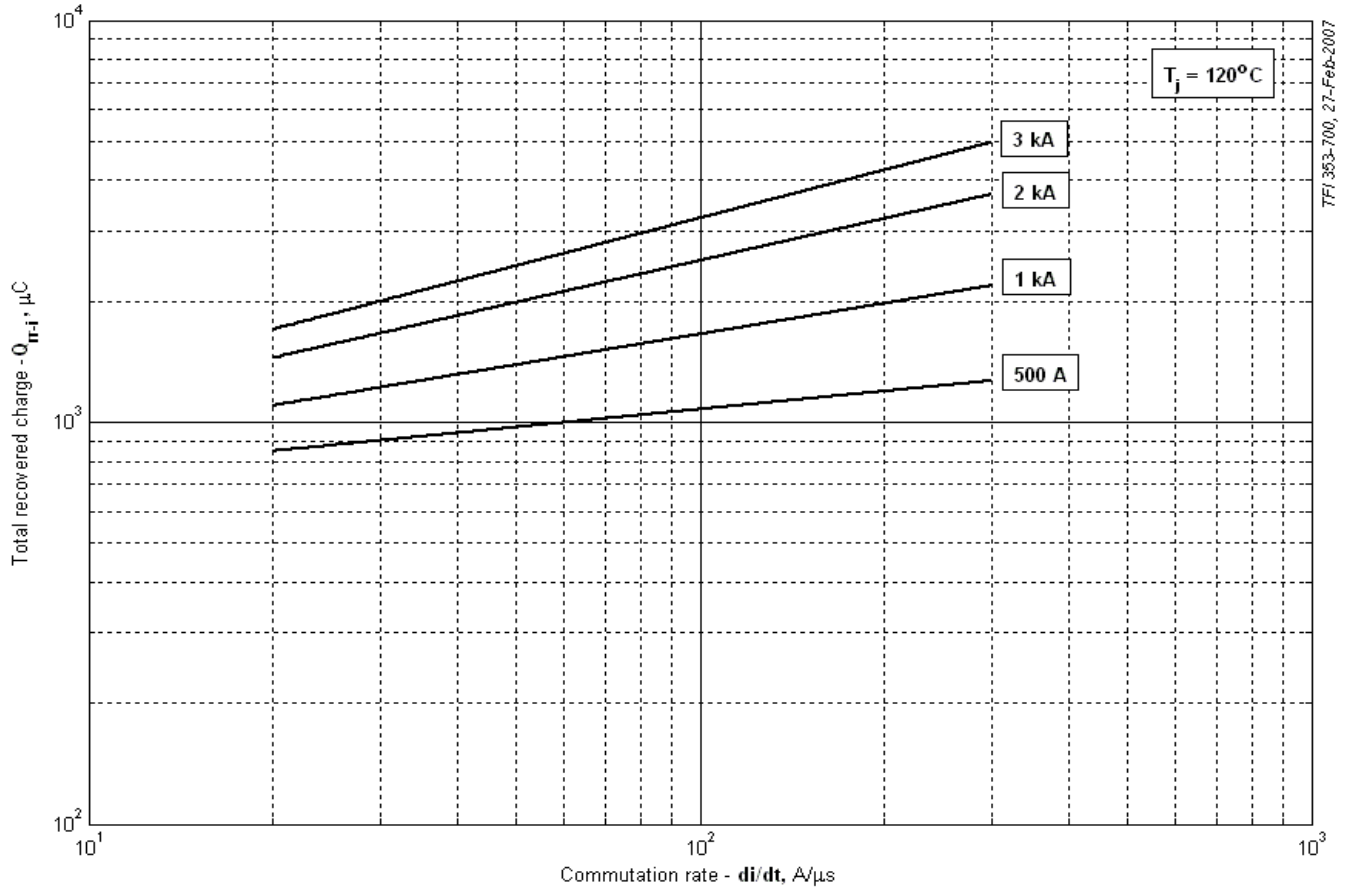


Fig 5 - Total recovered charge, Q_{rr-i} (integral)

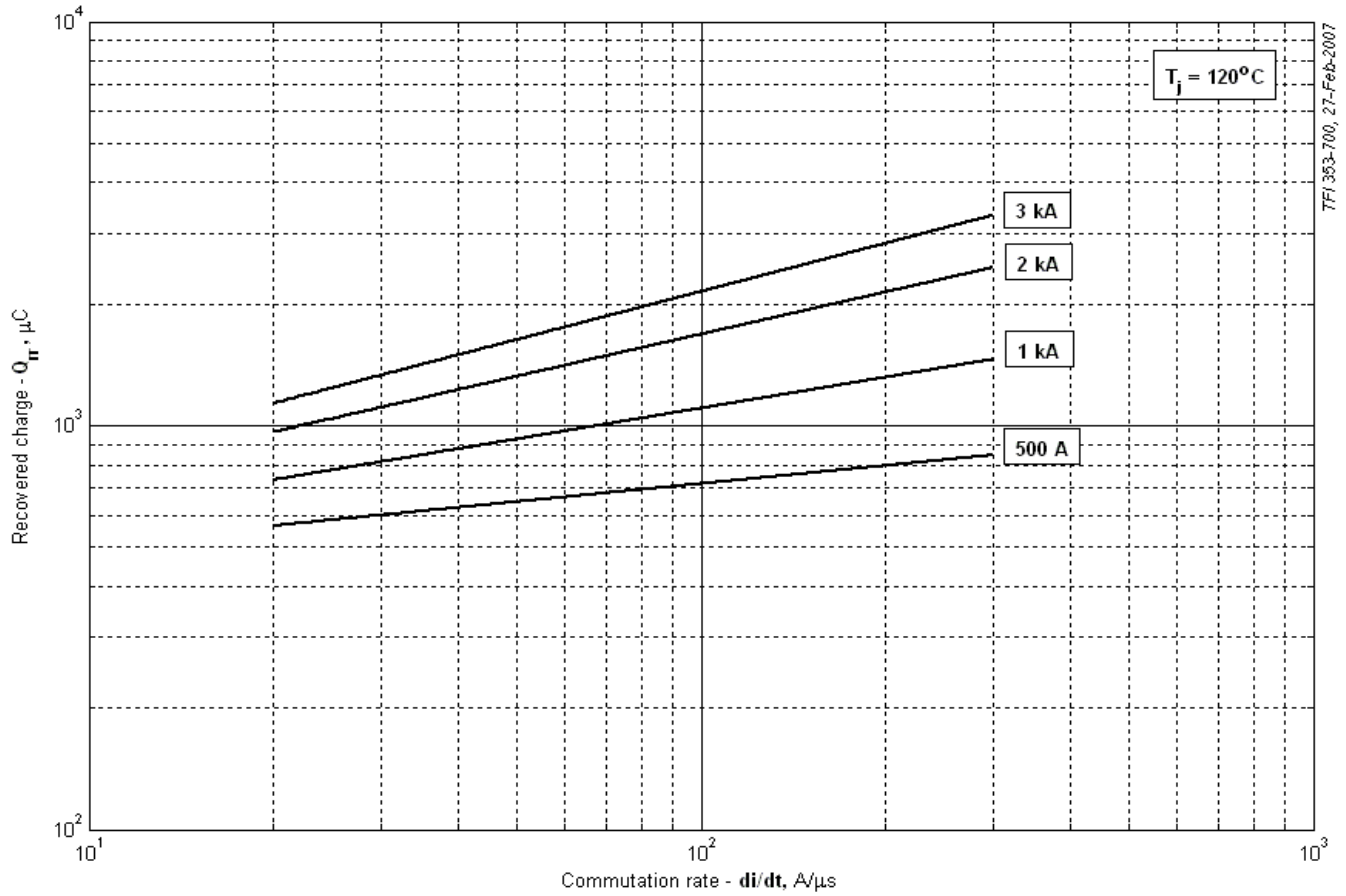


Fig 6 - Recovered charge, Q_{rr} (25% chord)

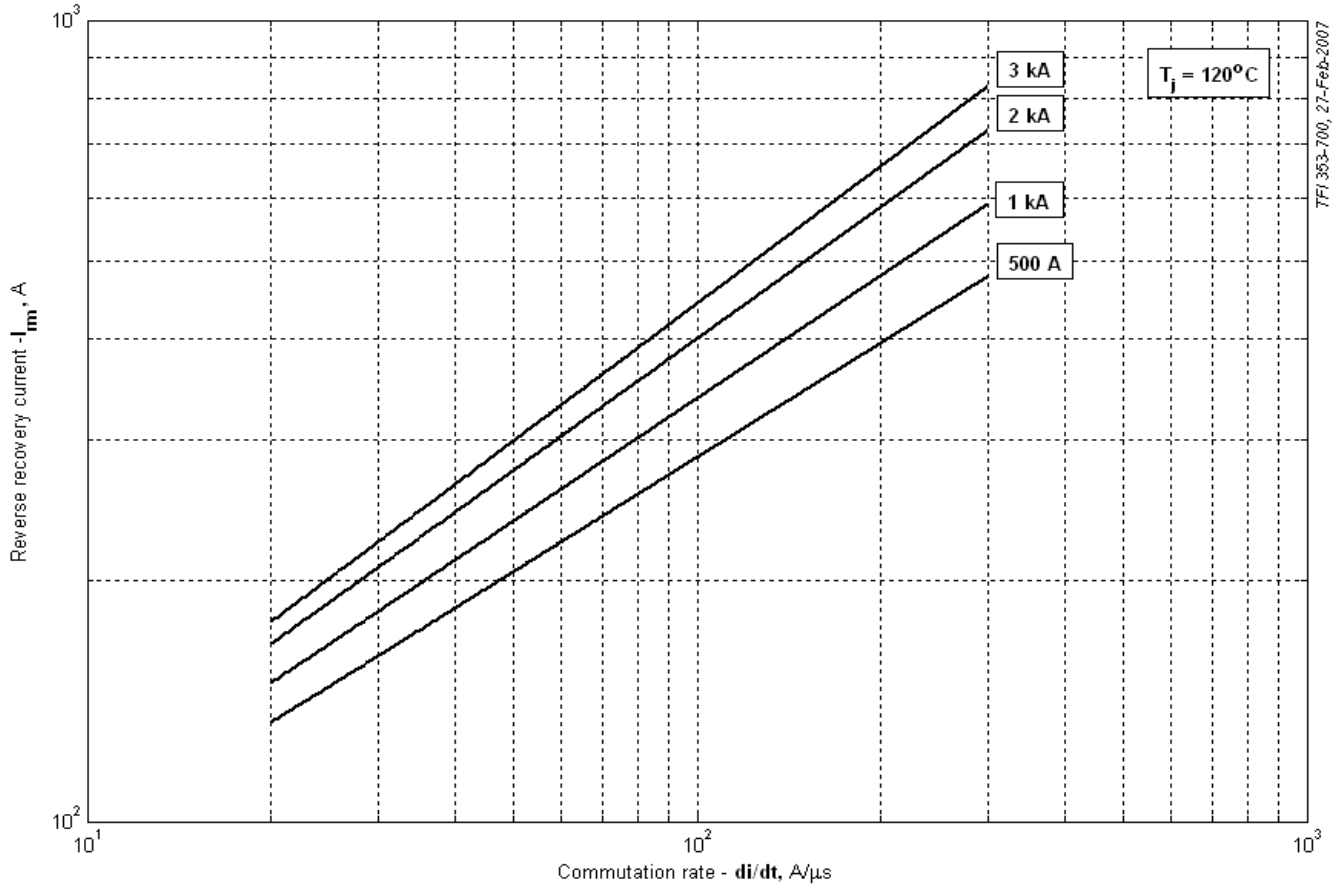


Fig 7 - Peak reverse recovery current, I_{rm}

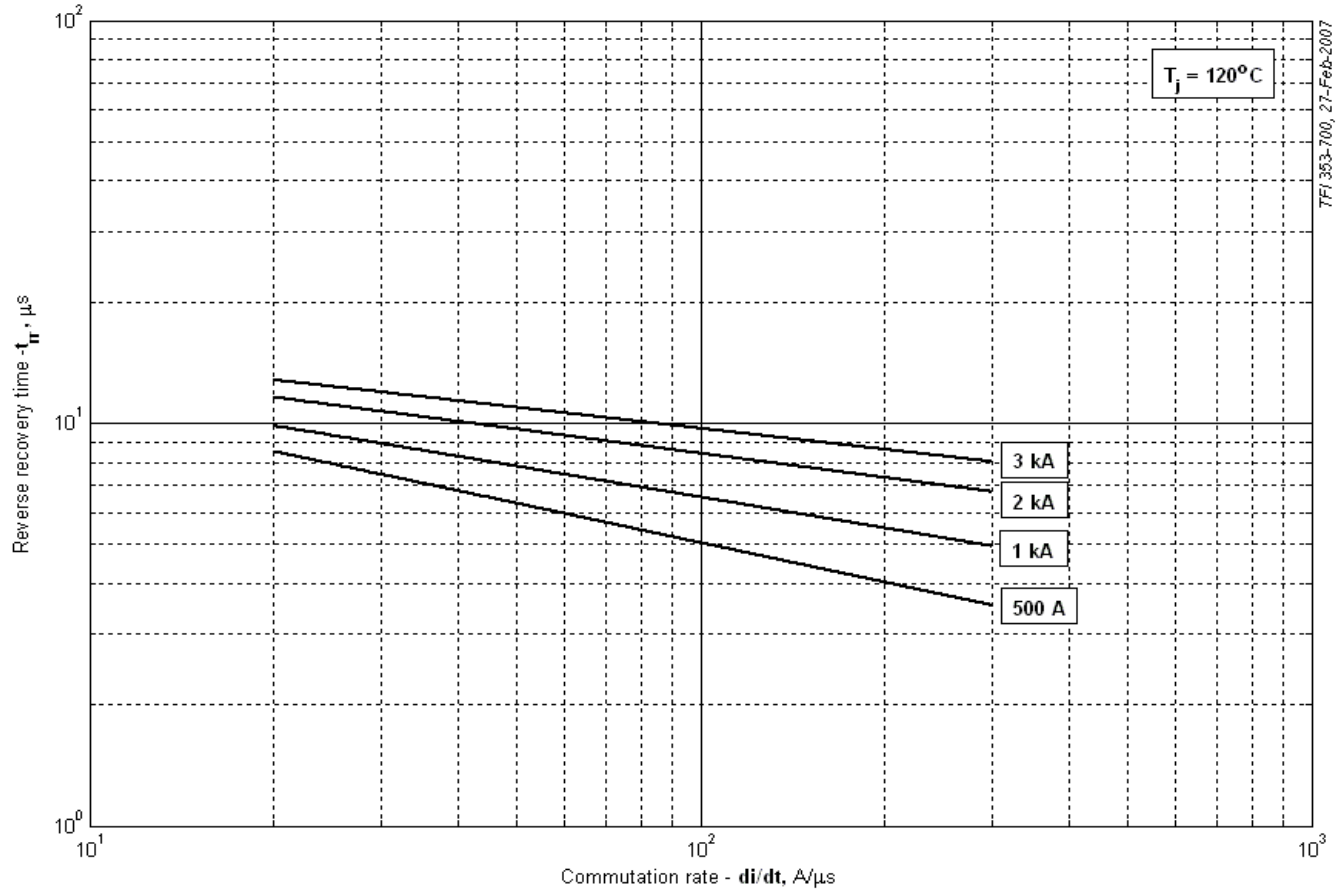


Fig 8 - Maximum recovery time, t_{rr} (25% chord)

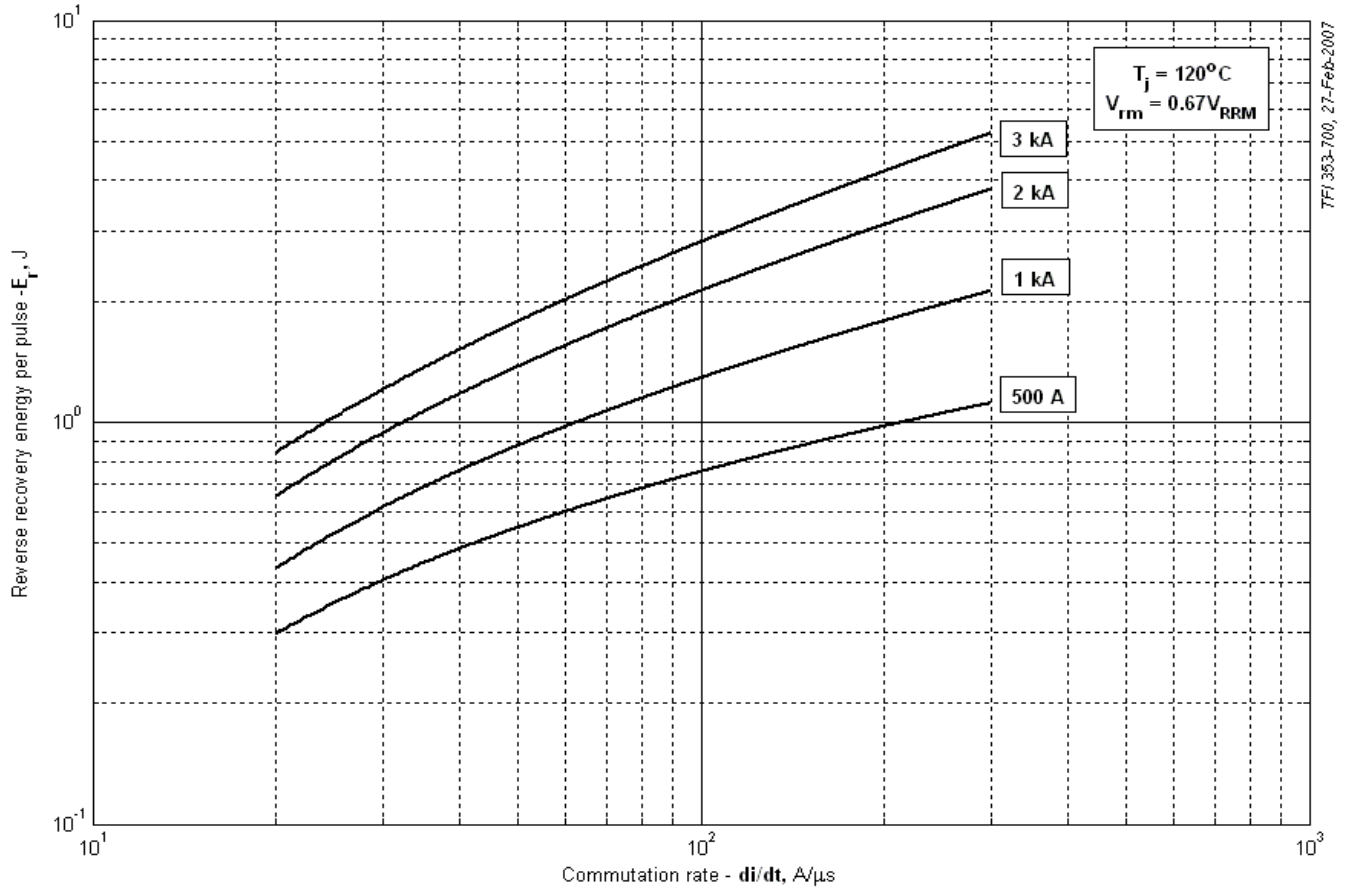


Fig 9 – Reverse recovery energy per pulse

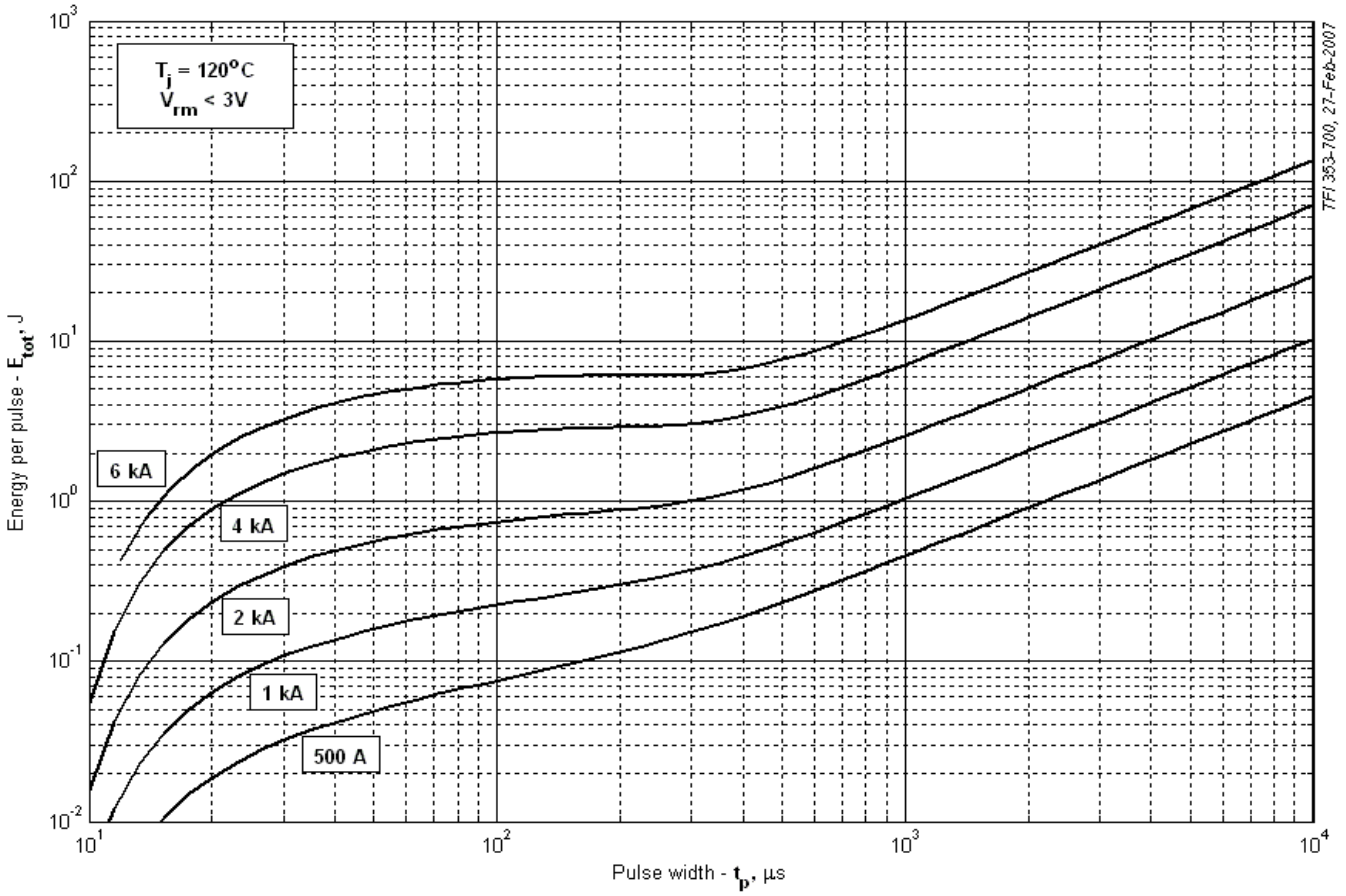


Fig 10 – Sine wave energy per pulse

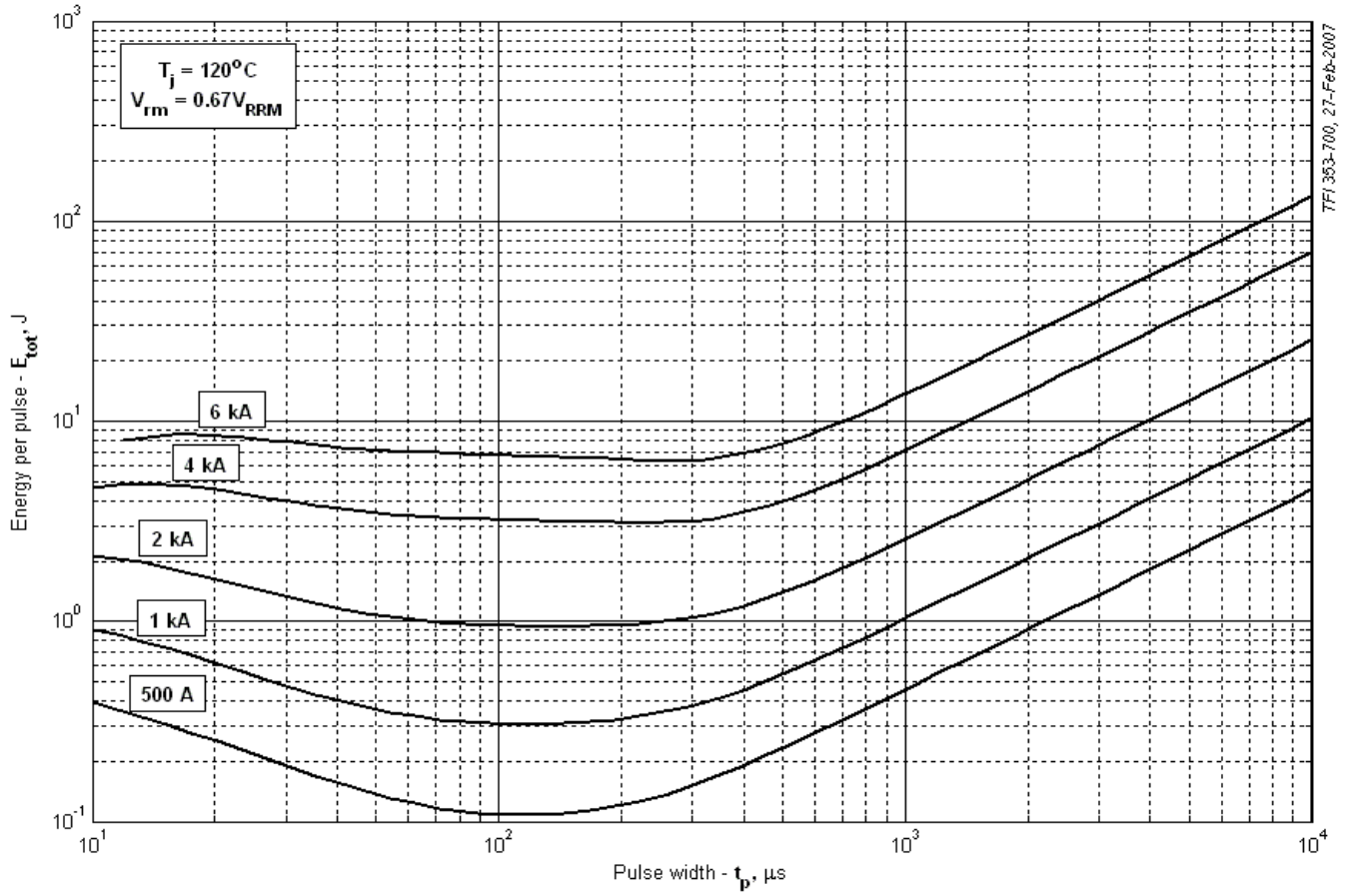


Fig 11 – Sine wave energy per pulse

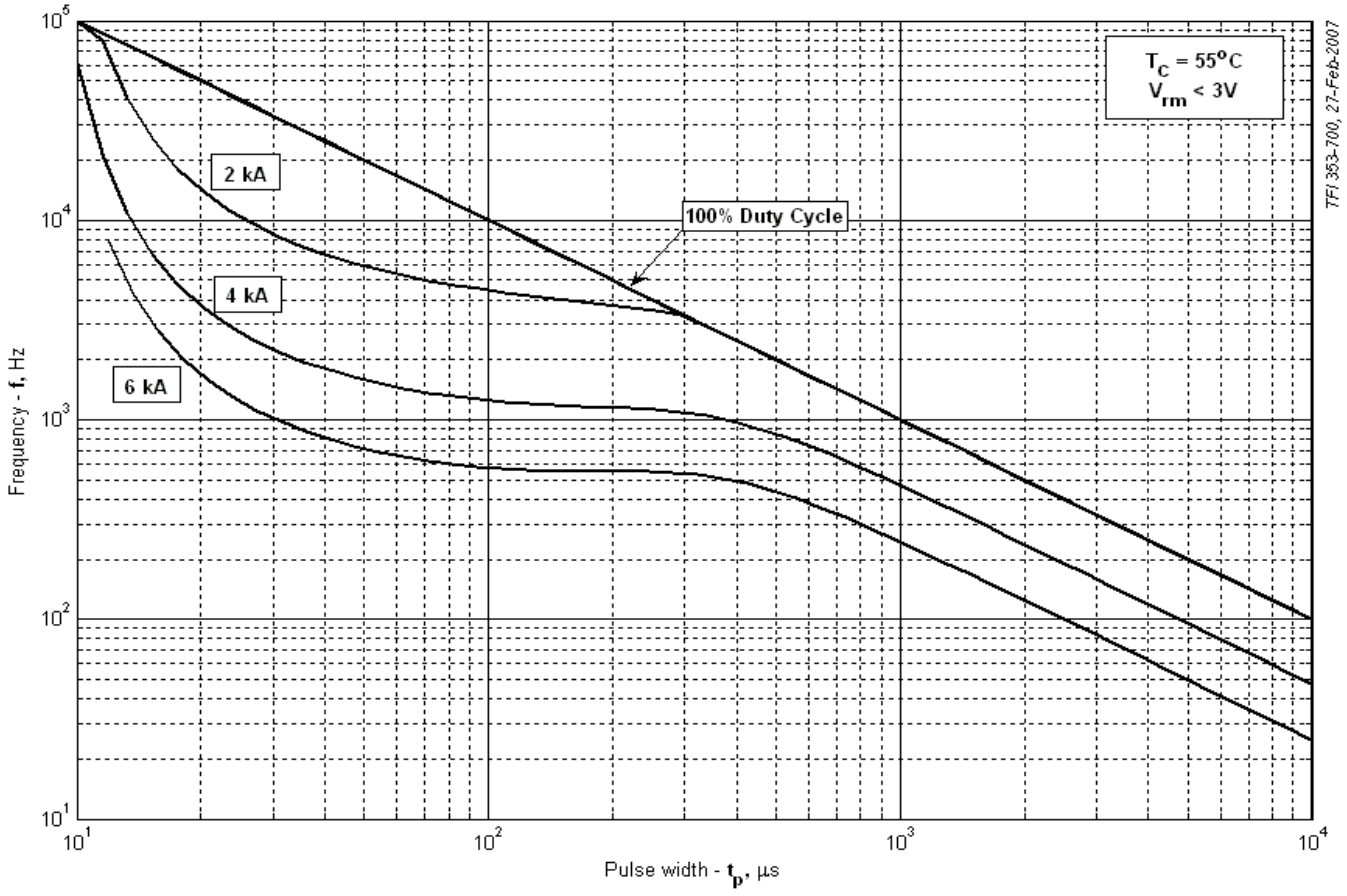


Fig 12 – Sine wave frequency ratings

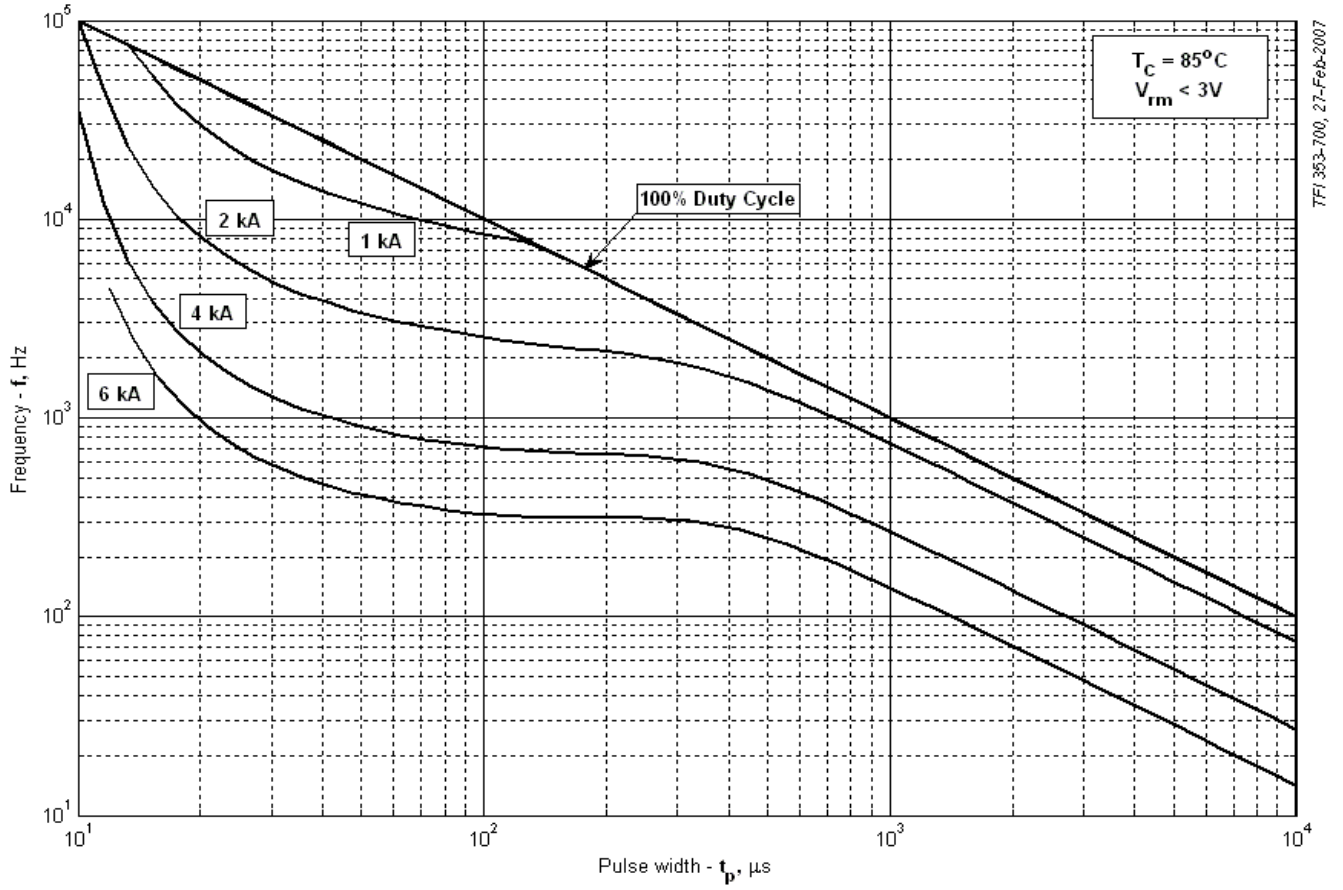


Fig 13 – Sine wave frequency ratings

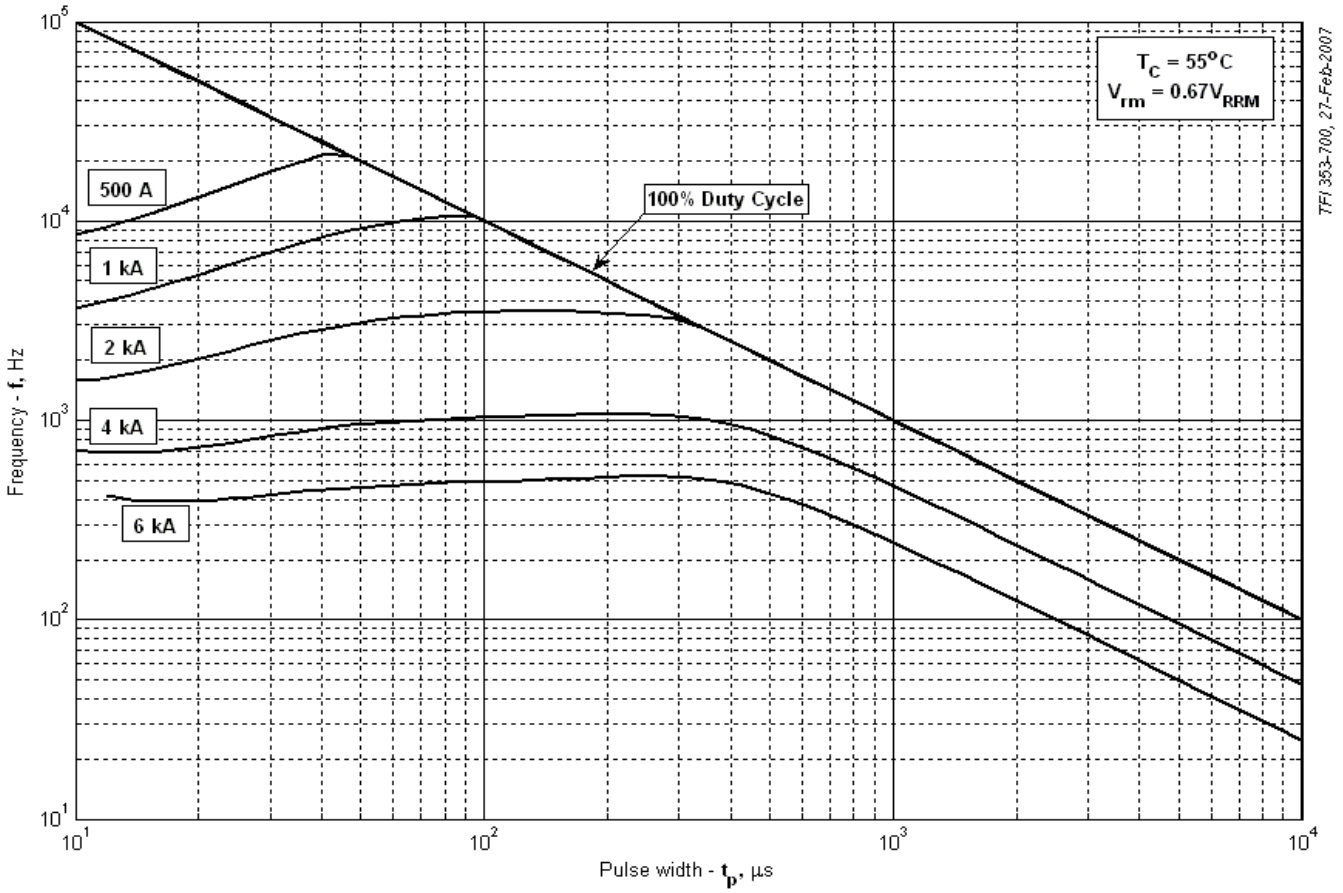


Fig 14 – Sine wave frequency ratings

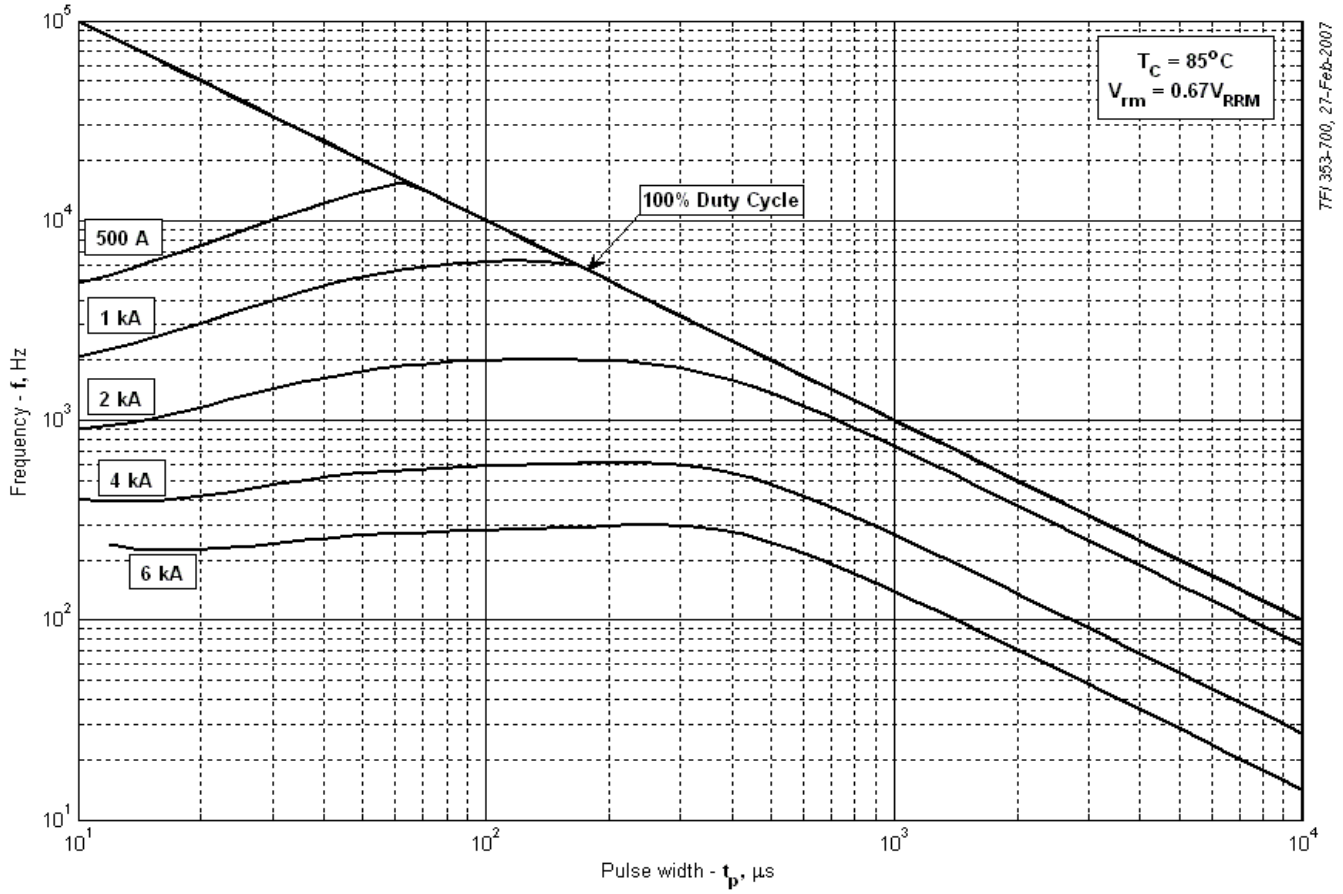


Fig 15 – Sine wave frequency ratings

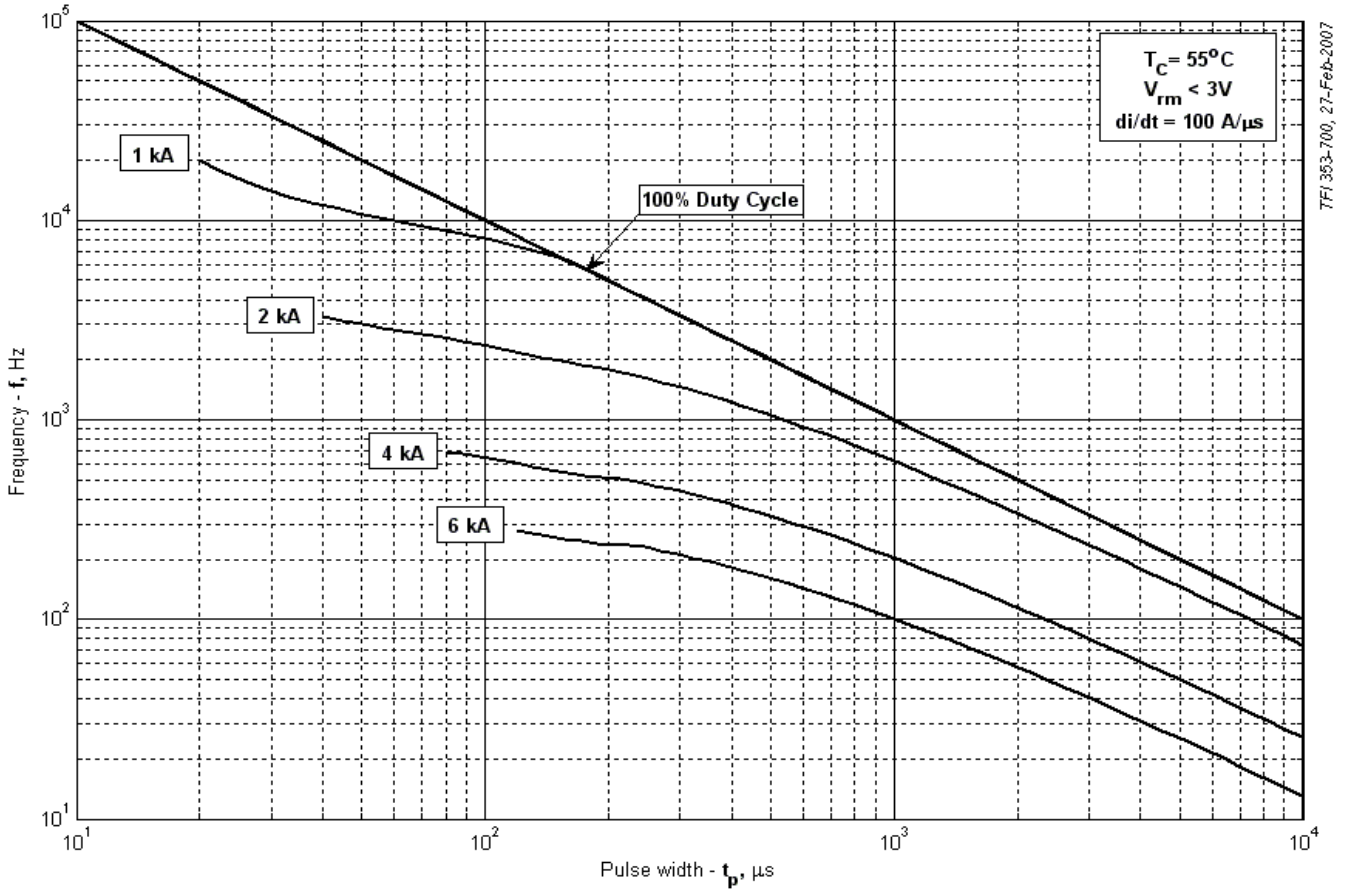


Fig 16 – Square wave frequency ratings

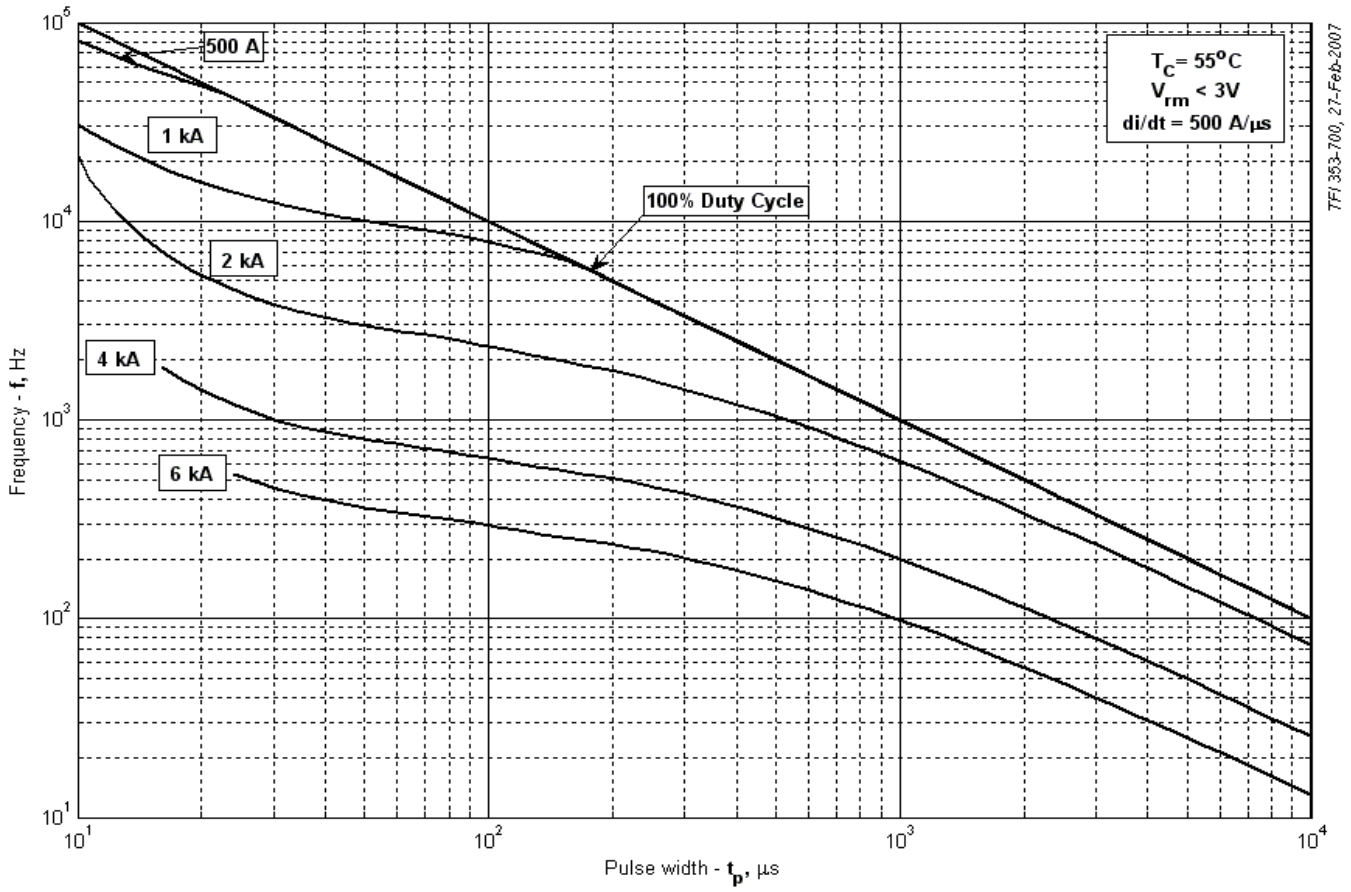


Fig 17 – Square wave frequency ratings

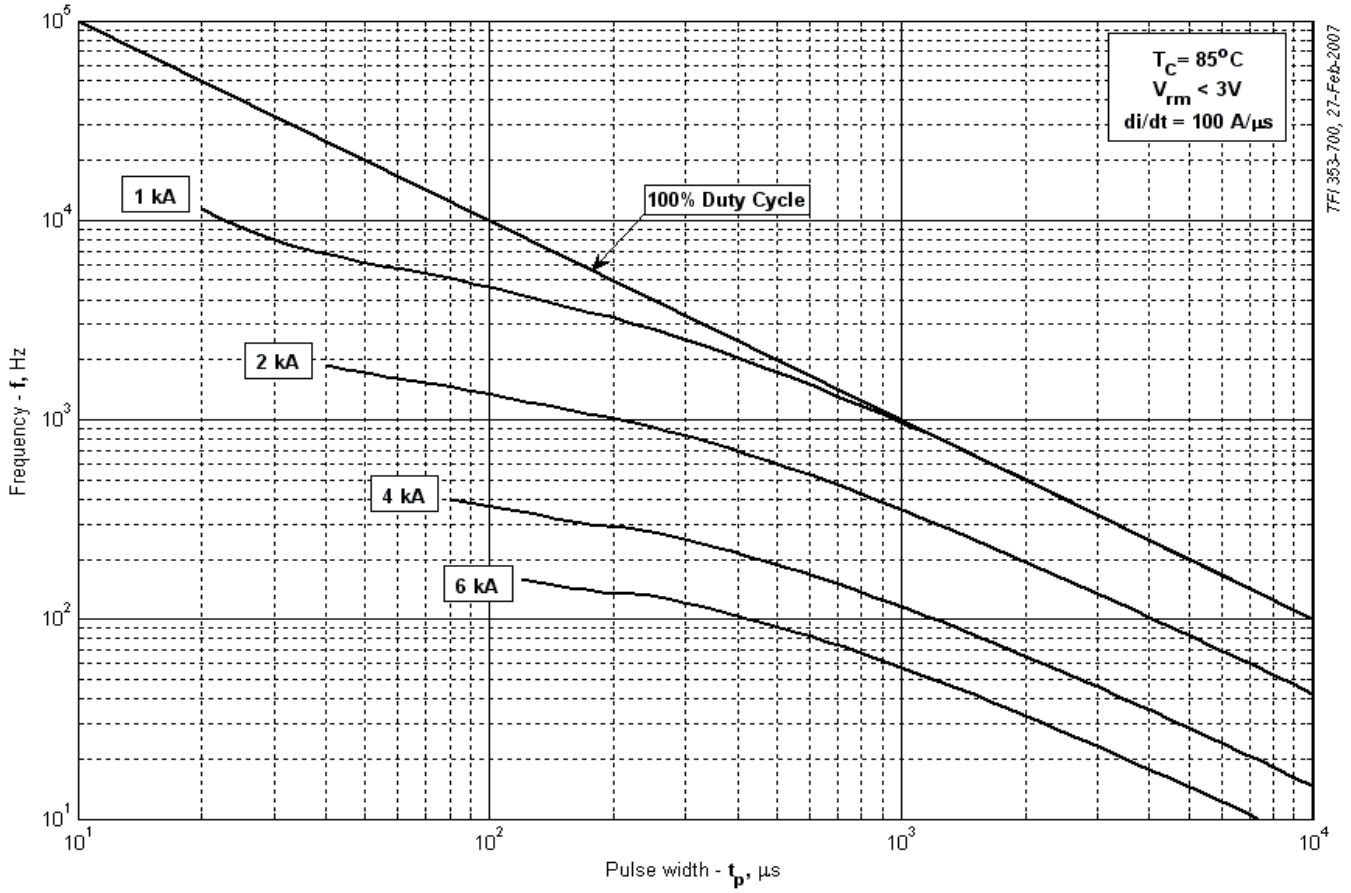


Fig 18 – Square wave frequency ratings

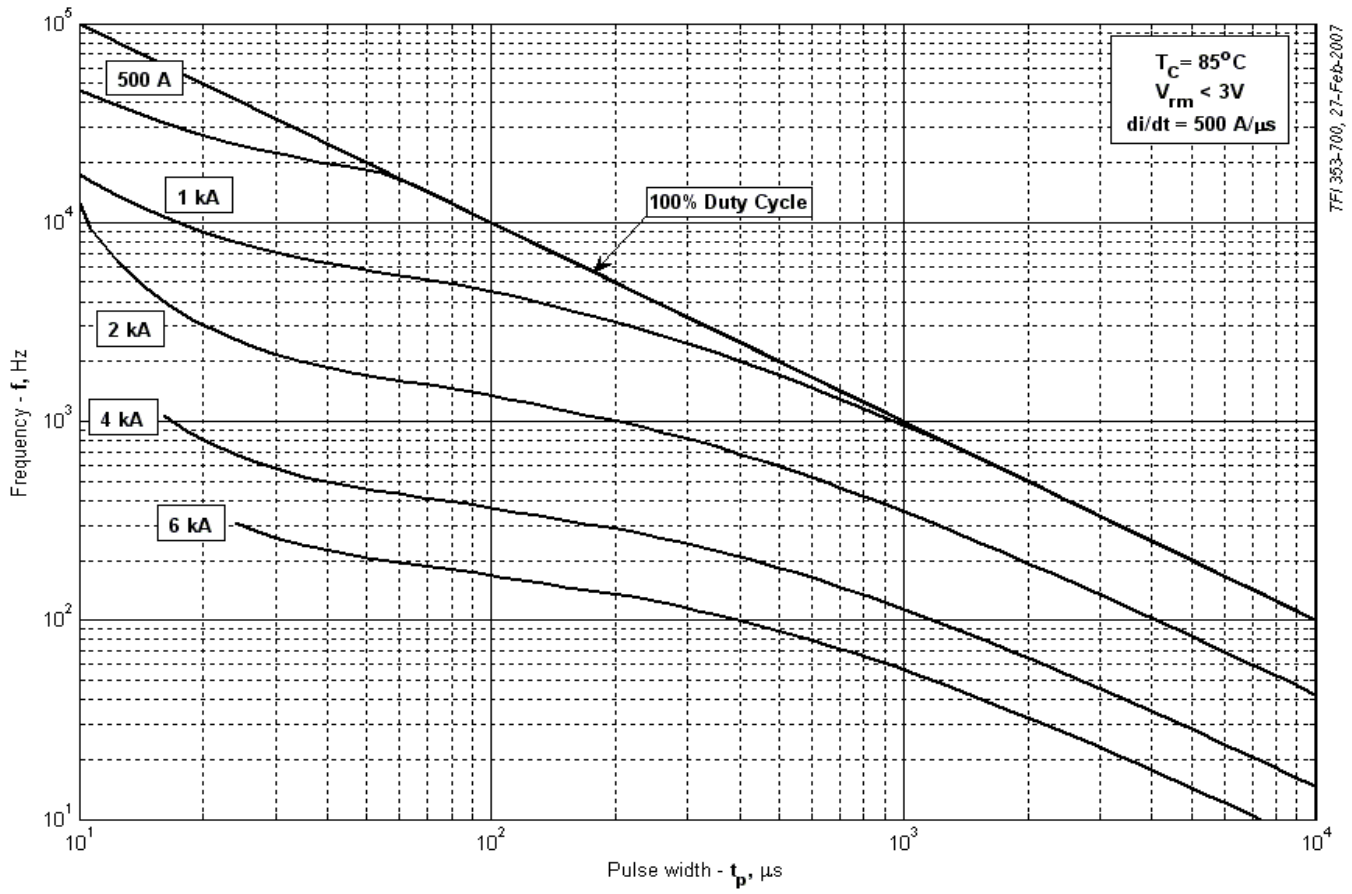


Fig 19 – Square wave frequency ratings

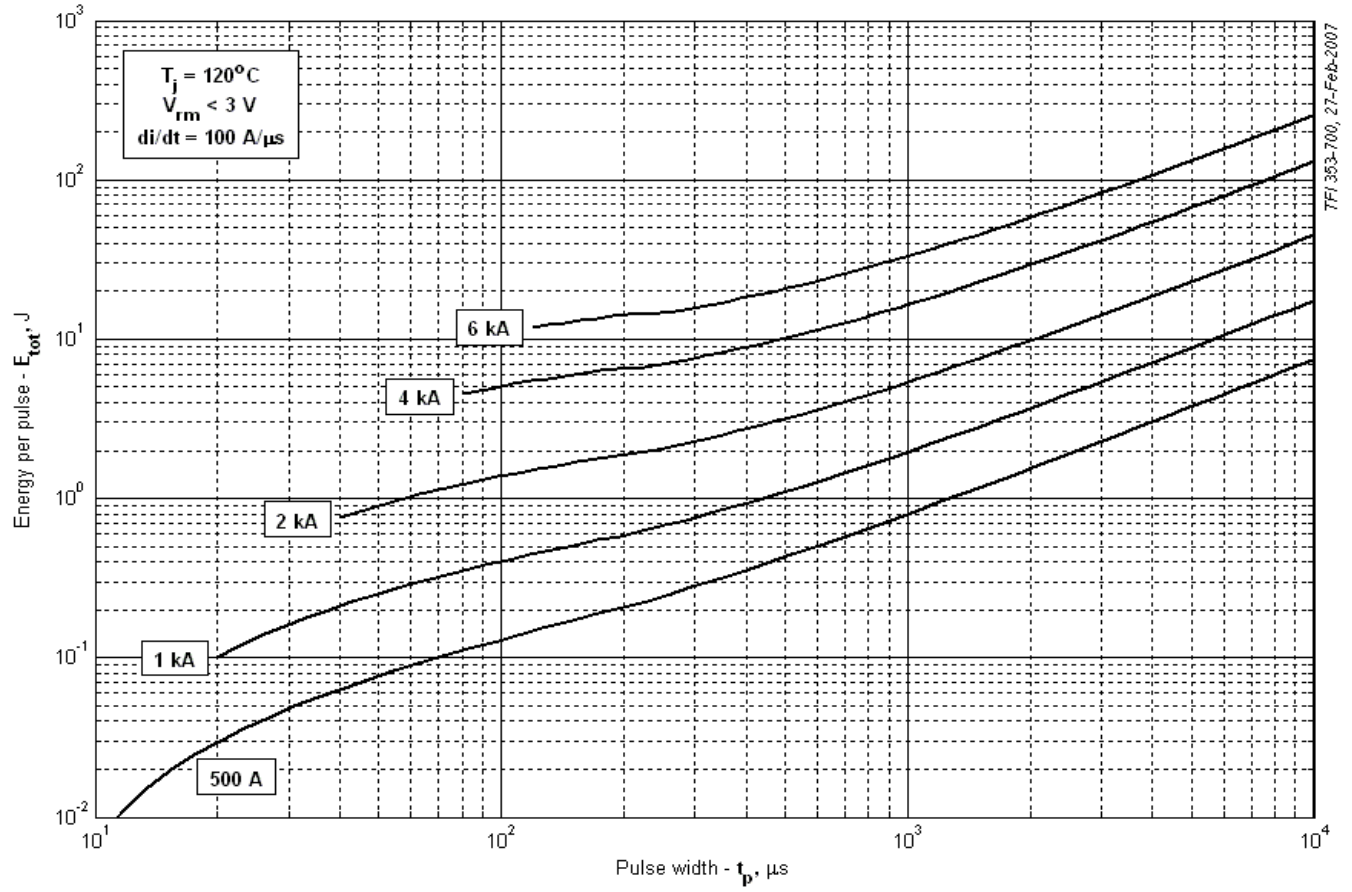


Fig 20 – Square wave energy per pulse

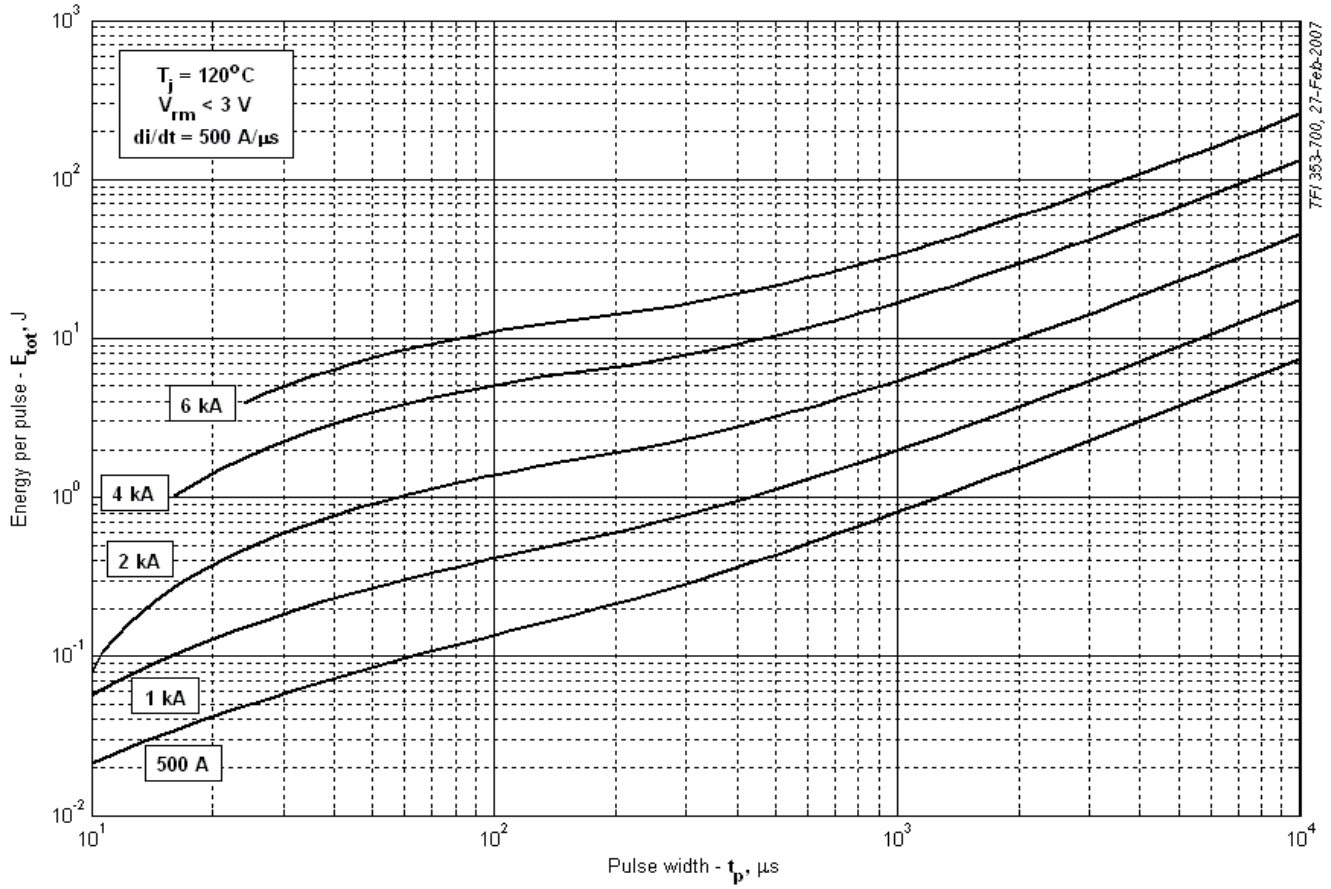


Fig 21 – Square wave energy per pulse

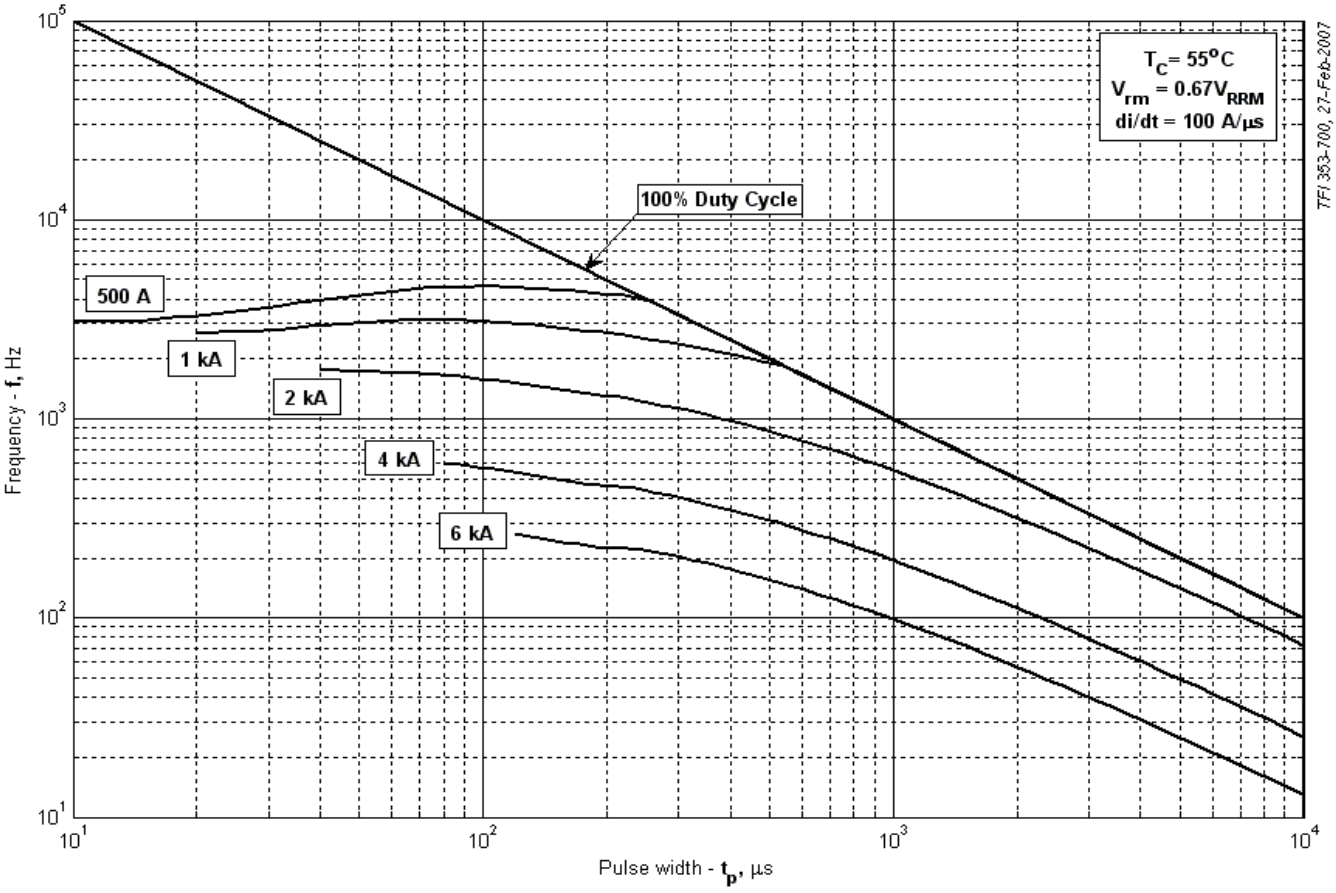


Fig 22 – Square wave frequency ratings

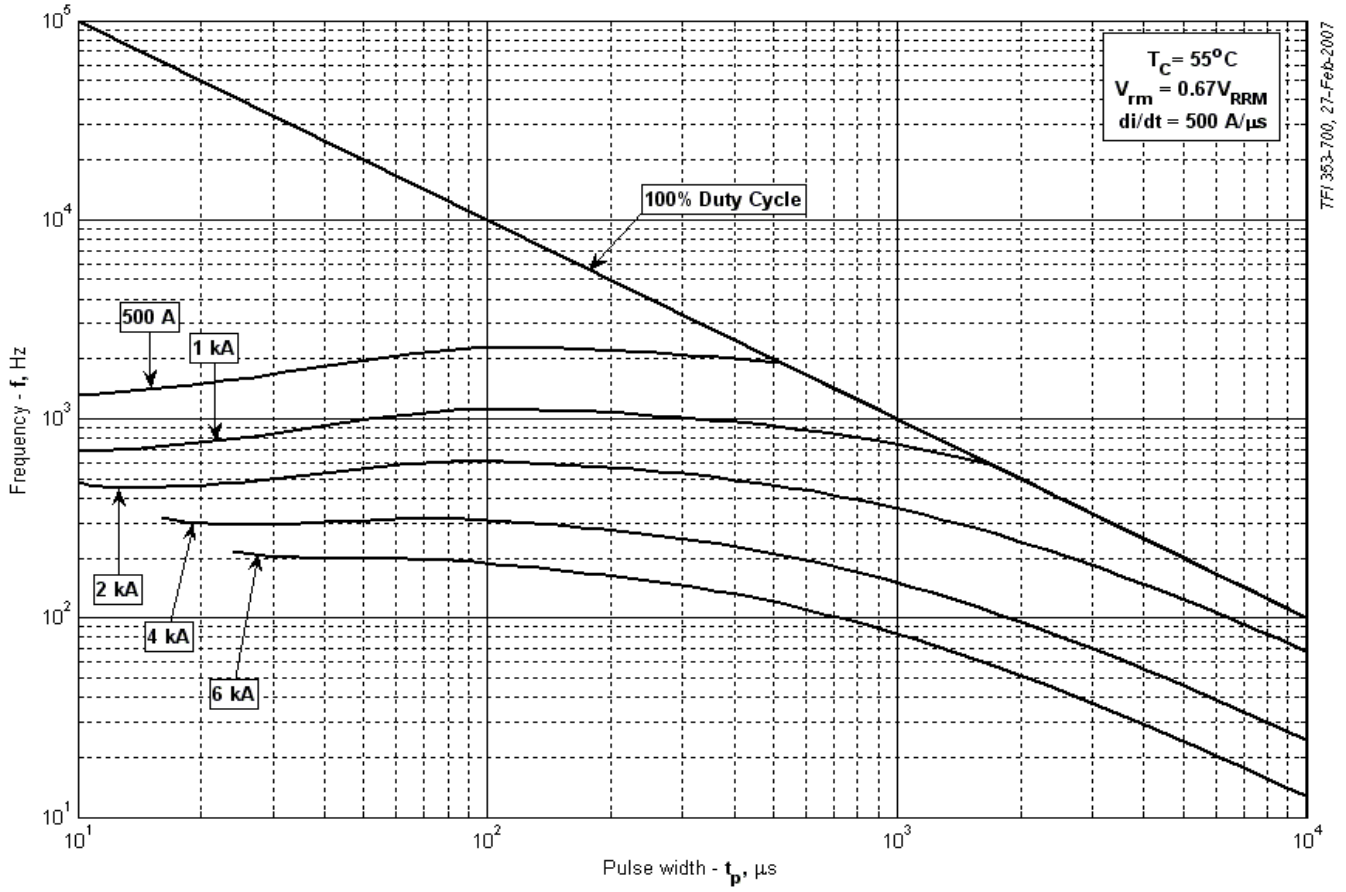


Fig 23 – Square wave frequency ratings

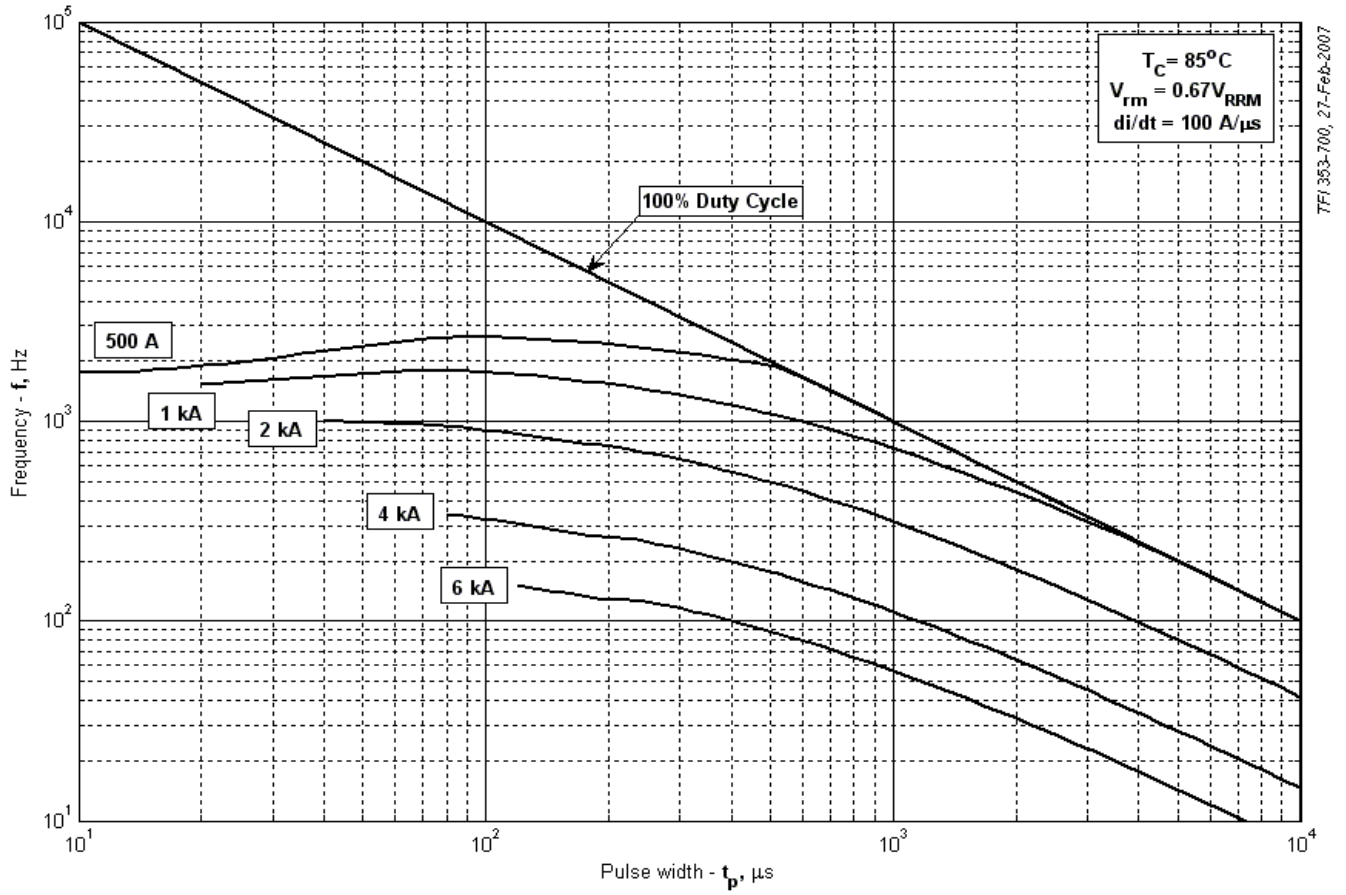


Fig 24 – Square wave frequency ratings

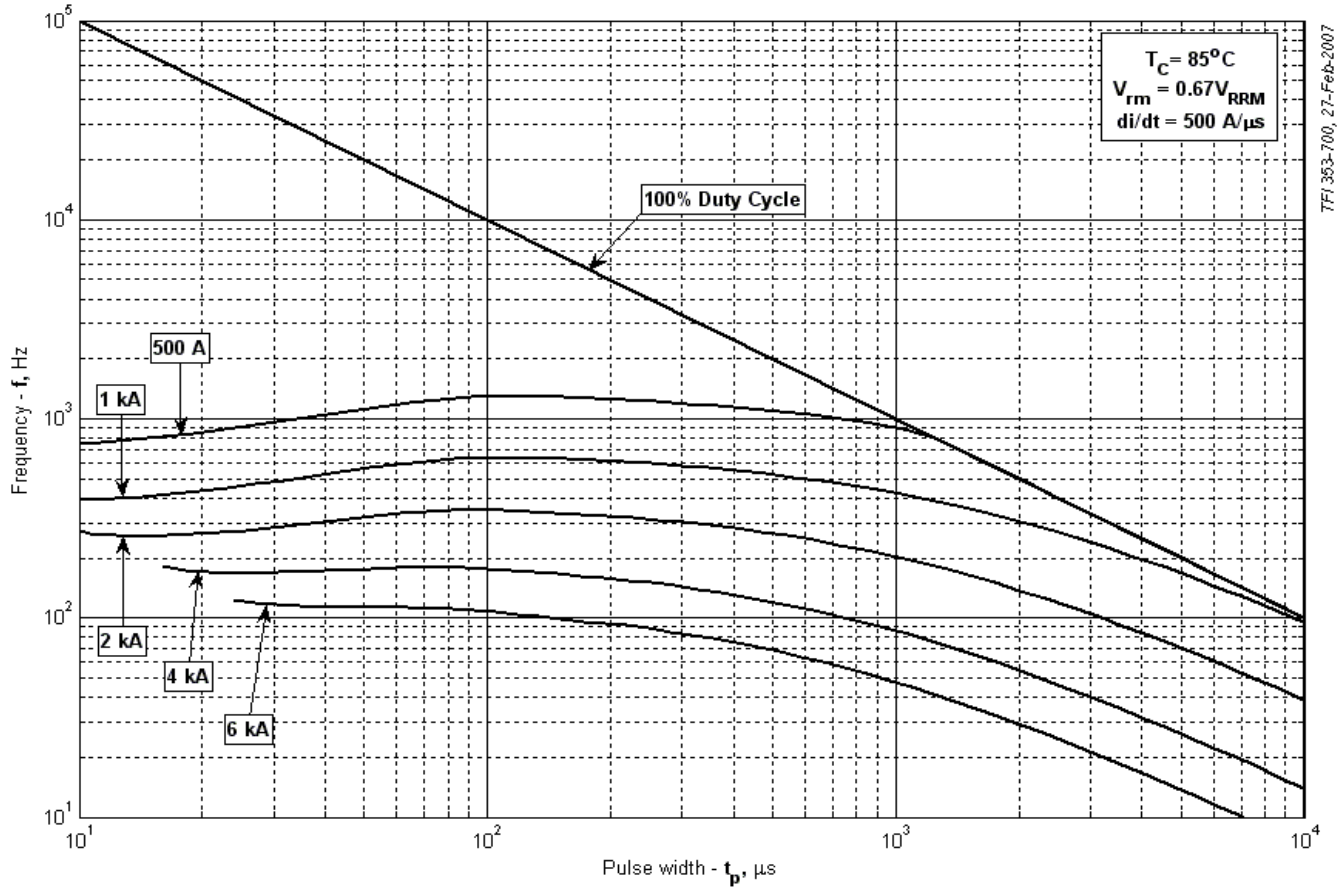


Fig 25 – Square wave frequency ratings

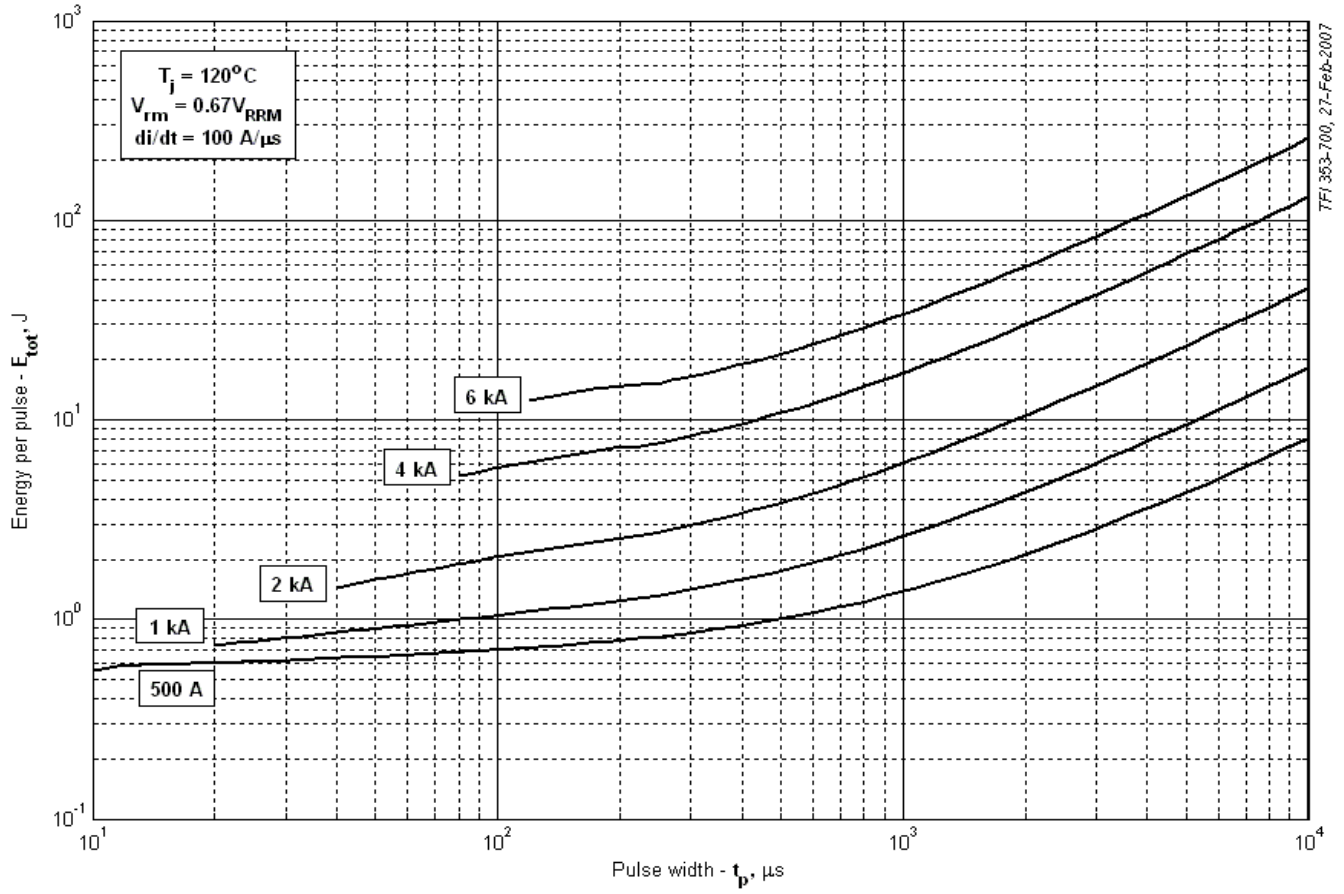


Fig 26 – Square wave energy per pulse

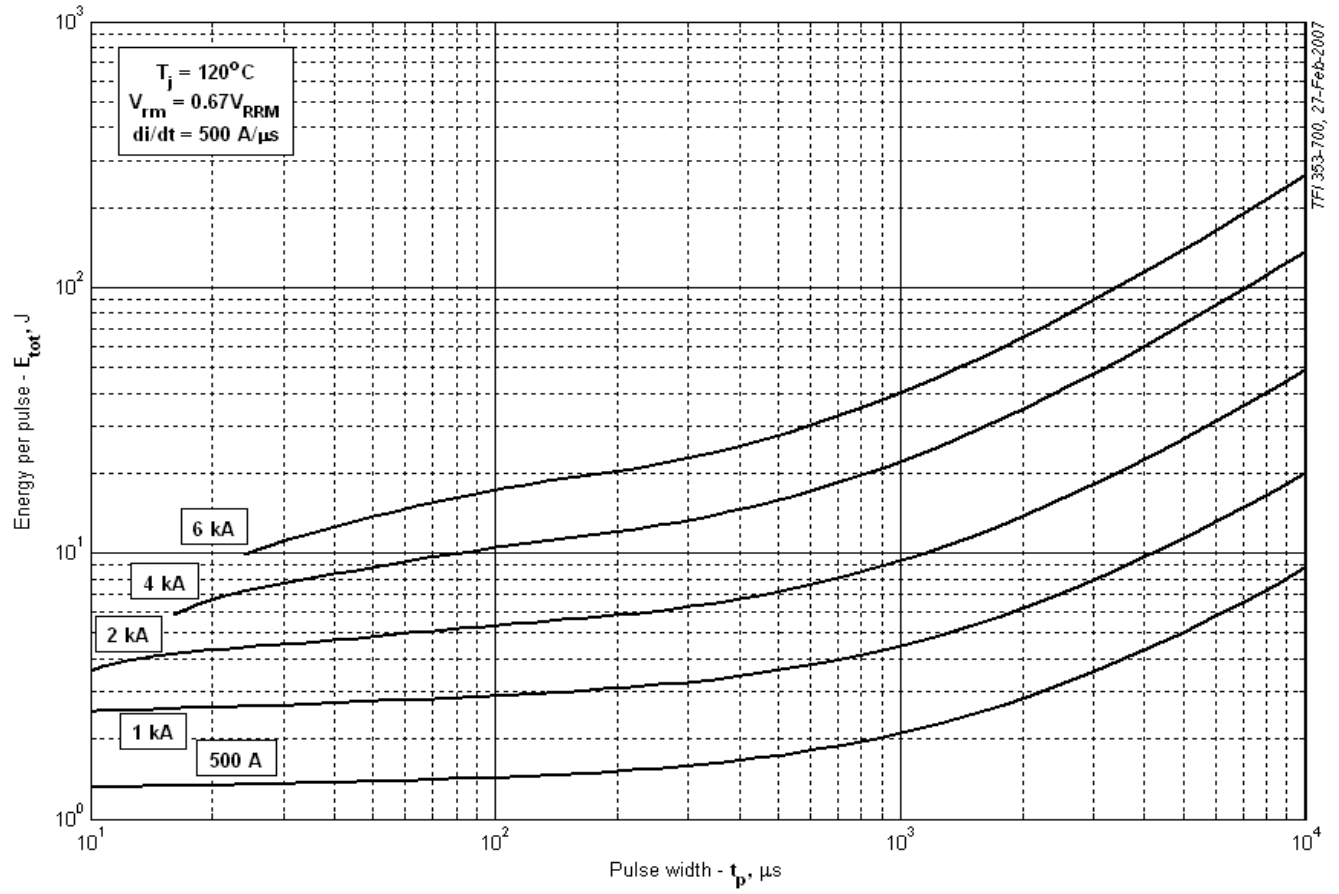


Fig 27 – Square wave energy per pulse

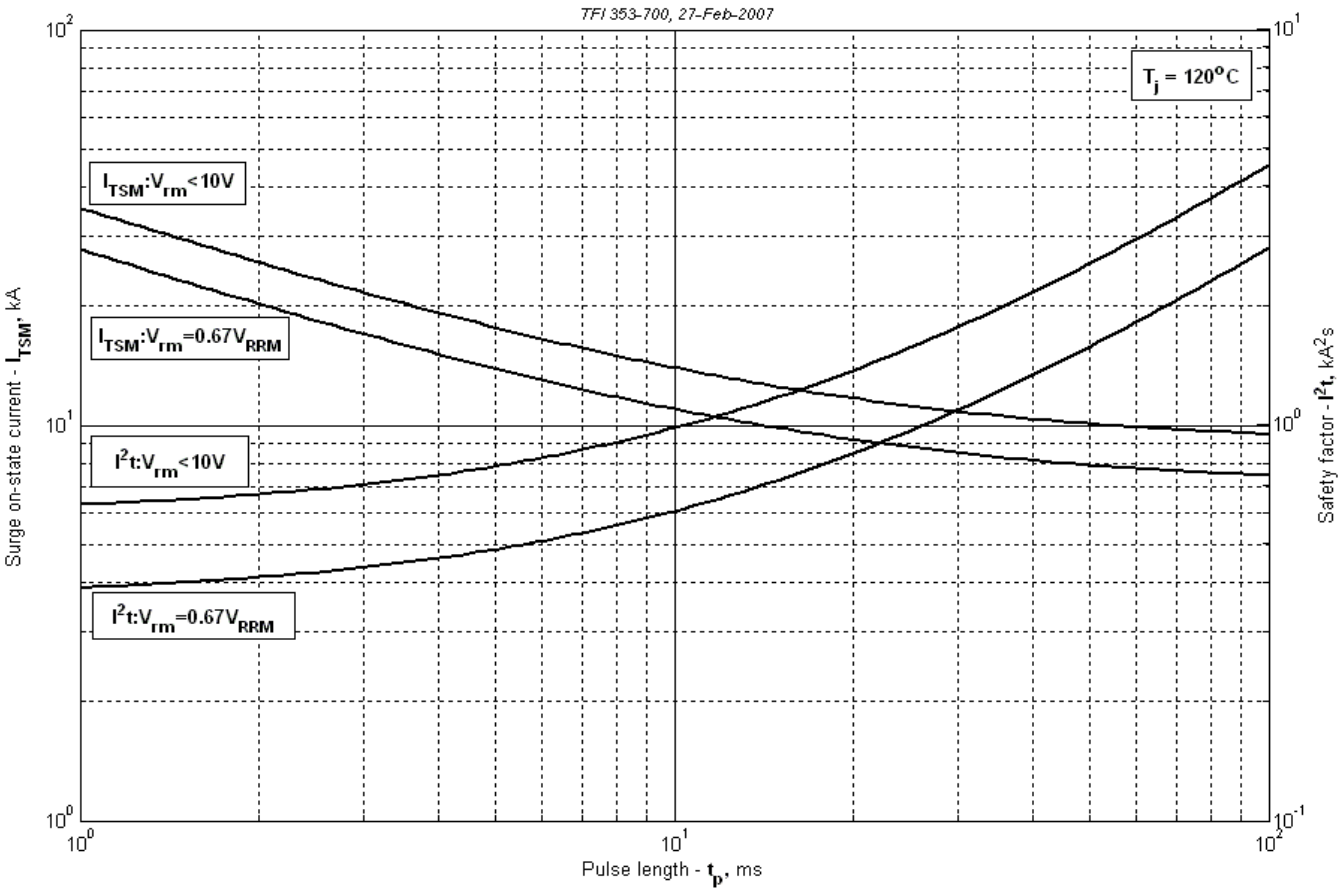


Fig 29 – Maximum surge and I^2t ratings

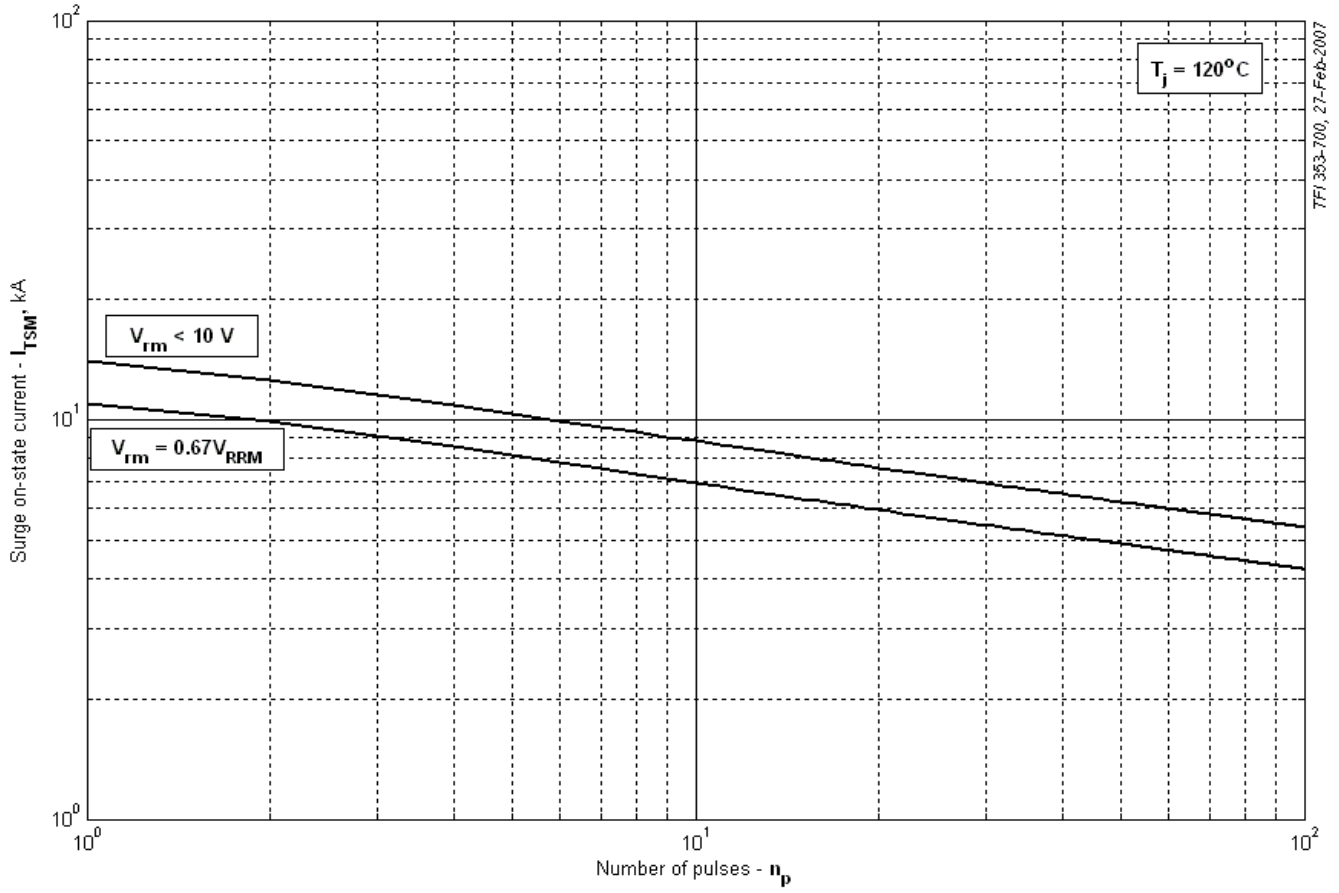


Fig 30 – Maximum surge ratings