



**Fast Thyristor  
Type TFI873-1600-40**

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

Mean on-state current	$I_{TAV}$	1600 A
Repetitive peak off-state voltage	$V_{DRM}$	3800 ÷ 4000 V
Repetitive peak reverse voltage	$V_{RRM}$	
Turn-off time	$t_q$	125 $\mu$ s
$V_{DRM}, V_{RRM}, V$	3800	4000
Voltage code	38	40
$T_j, ^\circ C$	- 60 ÷ 125	

**MAXIMUM ALLOWABLE RATINGS**

Symbols and parameters		Units	Values	Test conditions
<b>ON-STATE</b>				
$I_{TAV}$	Mean on-state current	A	1600 2600	$T_c=91^\circ C$ ; Double side cooled; $T_c=55^\circ C$ ; Double side cooled; 180° half-sine wave; 50 Hz
$I_{TRMS}$	RMS on-state current	A	2512	$T_c=91^\circ C$ ; Double side cooled; 180° half-sine wave; 50 Hz
$I_{TSM}$	Surge on-state current	kA	32.0 37.0	$T_j=T_{jmax}$ $T_j=25^\circ C$ 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; $t_{GP}=50$ $\mu$ s; $di_G/dt=2$ A/ $\mu$ s
			34.0 39.0	$T_j=T_{jmax}$ $T_j=25^\circ C$ 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; $t_{GP}=50$ $\mu$ s; $di_G/dt=2$ A/ $\mu$ s
$I^2t$	Safety factor	$A^2s \cdot 10^3$	5100 6800	$T_j=T_{jmax}$ $T_j=25^\circ C$ 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; $t_{GP}=50$ $\mu$ s; $di_G/dt=2$ A/ $\mu$ s
			4700 6300	$T_j=T_{jmax}$ $T_j=25^\circ C$ 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; $t_{GP}=50$ $\mu$ s; $di_G/dt=2$ A/ $\mu$ s
<b>BLOCKING</b>				
$V_{DRM}, V_{RRM}$	Repetitive peak off-state and Repetitive peak reverse voltages	V	3800÷4000	$T_{jmin} < T_j < T_{jmax}$ ; 180° half-sine wave; 50 Hz; Gate open
$V_{DSM}, V_{RSM}$	Non-repetitive peak off-state and Non-repetitive peak reverse voltages	V	3900÷4100	$T_{jmin} < T_j < T_{jmax}$ ; 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 $V_{RRM}$	$T_j=T_{jmax}$ ; Gate open

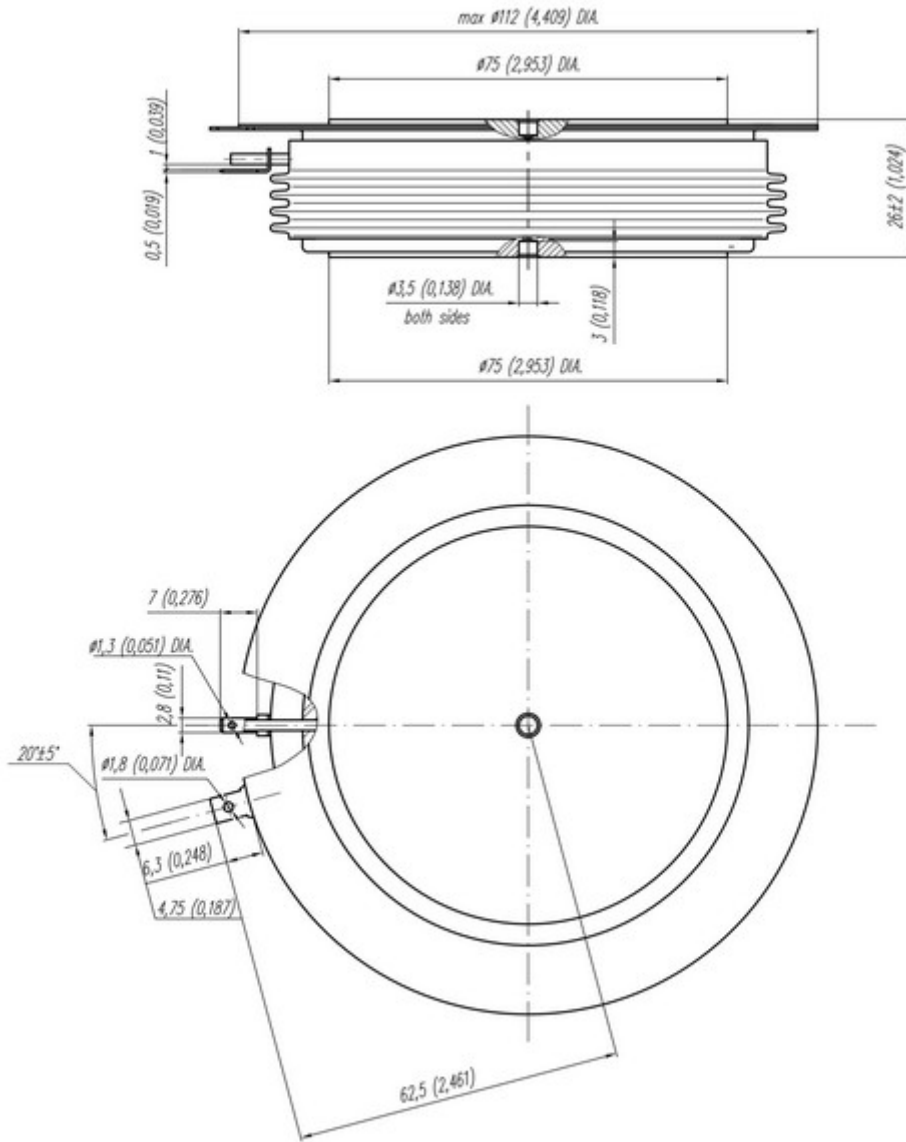
<b>TRIGGERING</b>				
$I_{FGM}$	Peak forward gate current	A	10	$T_j = T_{j\max}$
$V_{RGM}$	Peak reverse gate voltage	V	5	
$P_G$	Gate power dissipation	W	8	$T_j = T_{j\max}$ for DC gate current
<b>SWITCHING</b>				
$(di_T/dt)_{crit}$	Critical rate of rise of on-state current non-repetitive ( $f=1$ Hz)	A/ $\mu$ s	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; $t_{GP} = 50$ $\mu$ s; $di_G/dt = 2$ A/ $\mu$ s
<b>THERMAL</b>				
$T_{stg}$	Storage temperature	$^{\circ}$ C	-60 $\div$ 50	
$T_j$	Operating junction temperature	$^{\circ}$ C	-60 $\div$ 125	
<b>MECHANICAL</b>				
F	Mounting force	kN	40.0 $\div$ 50.0	
a	Acceleration	m/s <sup>2</sup>	50	Device clamped

## CHARACTERISTICS

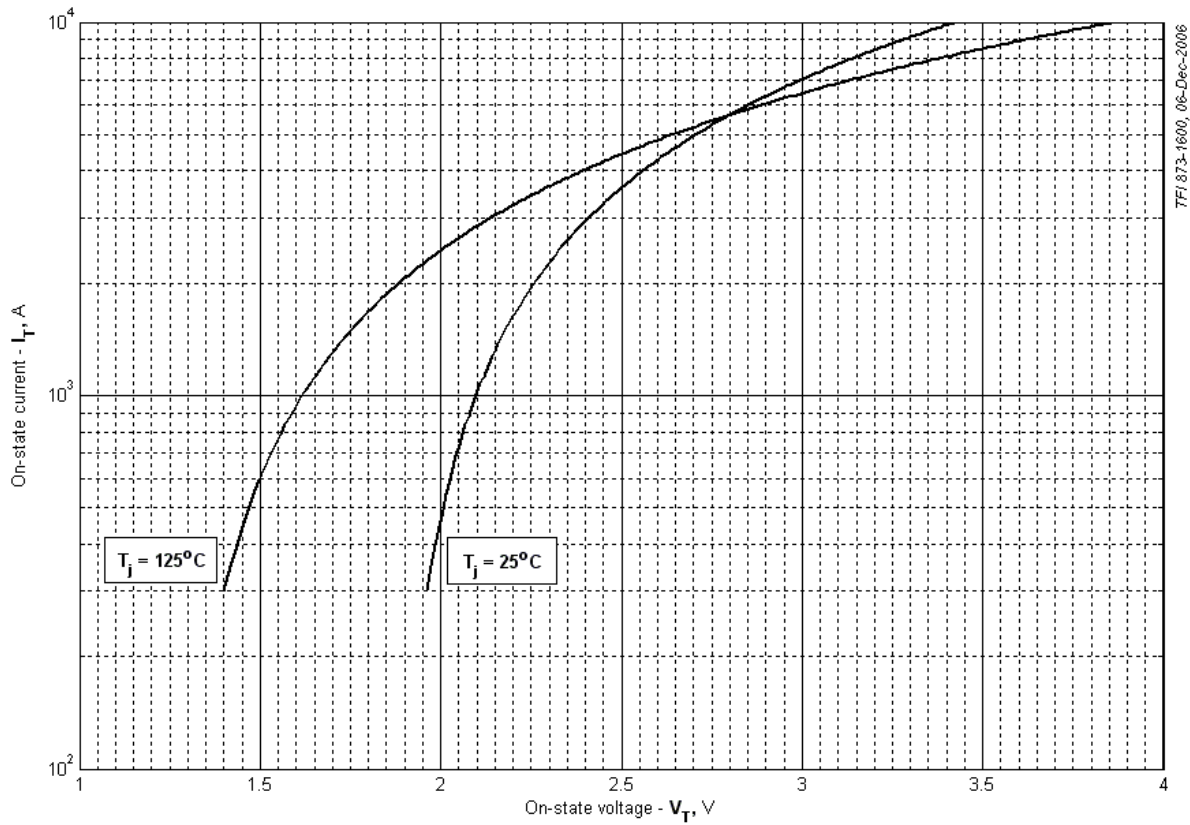
Symbols and parameters		Units	Values	Conditions	
<b>ON-STATE</b>					
$V_{TM}$	Peak on-state voltage, max	V	2.40 2.70	$T_j = T_{j\max}$ ; $I_{TM} = 4000$ A $T_j = 25$ $^{\circ}$ C; $I_{TM} = 5024$ A	
$V_{T(TO)}$	On-state threshold voltage, max	V	1.44	$T_j = T_{j\max}$ ;	
$r_T$	On-state slope resistance, max	m $\Omega$	0.270	$0.5 \pi I_{TAV} < I_T < 1.5 \pi I_{TAV}$	
$I_H$	Holding current, max	mA	1000	$T_j = 25$ $^{\circ}$ C; $V_D = 12$ V; Gate open	
<b>BLOCKING</b>					
$I_{DRM}, I_{RRM}$	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 <sup>1)</sup> , min	V/ $\mu$ s	200, 320, 500, 1000	$T_j = T_{j\max}$ ; $V_D = 0.67 \cdot V_{DRM}$ ; Gate open	
<b>TRIGGERING</b>					
$V_{GT}$	Gate trigger direct voltage, max	V	5.00 3.00 2.00	$T_j = T_{j\min}$ $T_j = 25$ $^{\circ}$ 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	$T_j = T_{j\min}$ $T_j = 25$ $^{\circ}$ C $T_j = T_{j\max}$	
$V_{GD}$	Gate non-trigger direct voltage, min	V	0.35	$T_j = T_{j\max}$ ; $V_D = 0.67 \cdot V_{DRM}$ ;	
$I_{GD}$	Gate non-trigger direct current, min	mA	15.00	Direct gate current	
<b>SWITCHING</b>					
$t_{gd}$	Delay time, max	$\mu$ s	1.22	$T_j = 25$ $^{\circ}$ C; $V_D = 1500$ V; $I_{TM} = I_{TAV}$ ; $di/dt = 200$ A/ $\mu$ s;	
$t_{gt}$	Turn-on time <sup>2)</sup>	$\mu$ s	4.00, 6.30, 8.00, 10.0	Gate pulse: $I_G = 2$ A; $V_G = 20$ V; $t_{GP} = 50$ $\mu$ s; $di_G/dt = 2$ A/ $\mu$ s	
$t_q$	Turn-off time <sup>3)</sup> , max	$\mu$ s	125	$dv_D/dt = 50$ V/ $\mu$ s;	$T_j = T_{j\max}$ ; $I_{TM} = I_{TAV}$ ; $di_R/dt = -10$ A/ $\mu$ s; $V_R = 100$ V; $V_D = 0.67 V_{DRM}$
			160	$dv_D/dt = 200$ V/ $\mu$ s;	
$Q_{rr}$	Total recovered charge(linear), max	$\mu$ C	3000	$T_j = T_{j\max}$ ; $I_{TM} = 2000$ A;	
$t_{rr}$	Reverse recovery time, max	$\mu$ s	14	$di_R/dt = -50$ A/ $\mu$ s;	
$I_{rrM}$	Peak reverse recovery current, max	A	430	$V_R = 100$ V	

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					
w	Weight, typ	g	1170		
$D_s$	Surface creepage distance	mm (inch)	36.6 (1.441)		
$D_a$	Air strike distance	mm (inch)	16.2 (0.638)		

PART NUMBERING GUIDE								NOTES						
TFI	873	1600	40	A2	X2	H4	N	1) Critical rate of rise of off-state voltage						
1	2	3	4	5	6	7	8	Symbol of group	P2	K2	E2	A2		
1. TFI — Fast Thyristor TFIS — Fast Thyristor with Distributed Amplified Gate. 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 ( $dv_D/dt=50\text{ V}/\mu\text{s}$ ) 7. Group of turn-on time 8. Ambient conditions: N – normal; T – tropical								$(dv_D/dt)_{crit}, \text{ V}/\mu\text{s}$	200	320	500	1000		
								2) Turn-on time						
								Symbol of group	H4	C4	B4	A4		
								$t_{gt}, \mu\text{s}$	4.00	6.30	8.00	10.0		
								3) Turn-off time ( $dv_D/dt=50\text{ V}/\mu\text{s}$ )						
								Symbol of group	X2					
								$t_{qr}, \mu\text{s}$	125					



All dimensions in millimeters (inches)



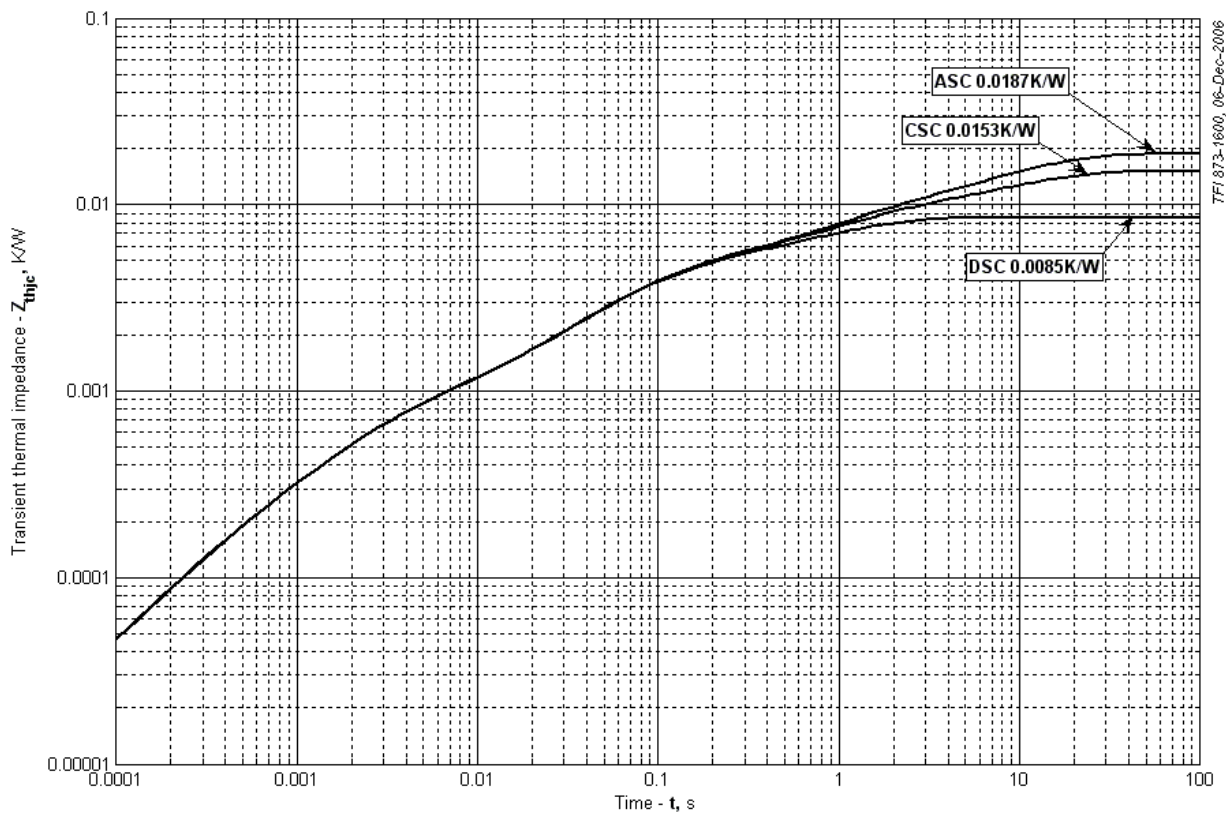
**Transient thermal impedance junction to case  $Z_{thjc}$  model (see Fig. 2).**

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	
	$T_j = 25^\circ\text{C}$	$T_j = T_{j\max}$
<b>A</b>	1.799223	1.165741
<b>B</b>	0.106392	0.195115
<b>C</b>	-0.227901	-0.304378
<b>D</b>	0.350140	0.467637

**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.

$\tau_i$  = Time constant of  $r_{th}$  term.

DC Double side cooled

$i$	1	2	3	4	5	6
$R_i$ , K/W	0.00007989	0.002973	0.0005936	0.000846	0.00005975	0.003948
$\tau_i$ , s	1.688	0.06219	0.002329	0.138	0.0003243	0.9533

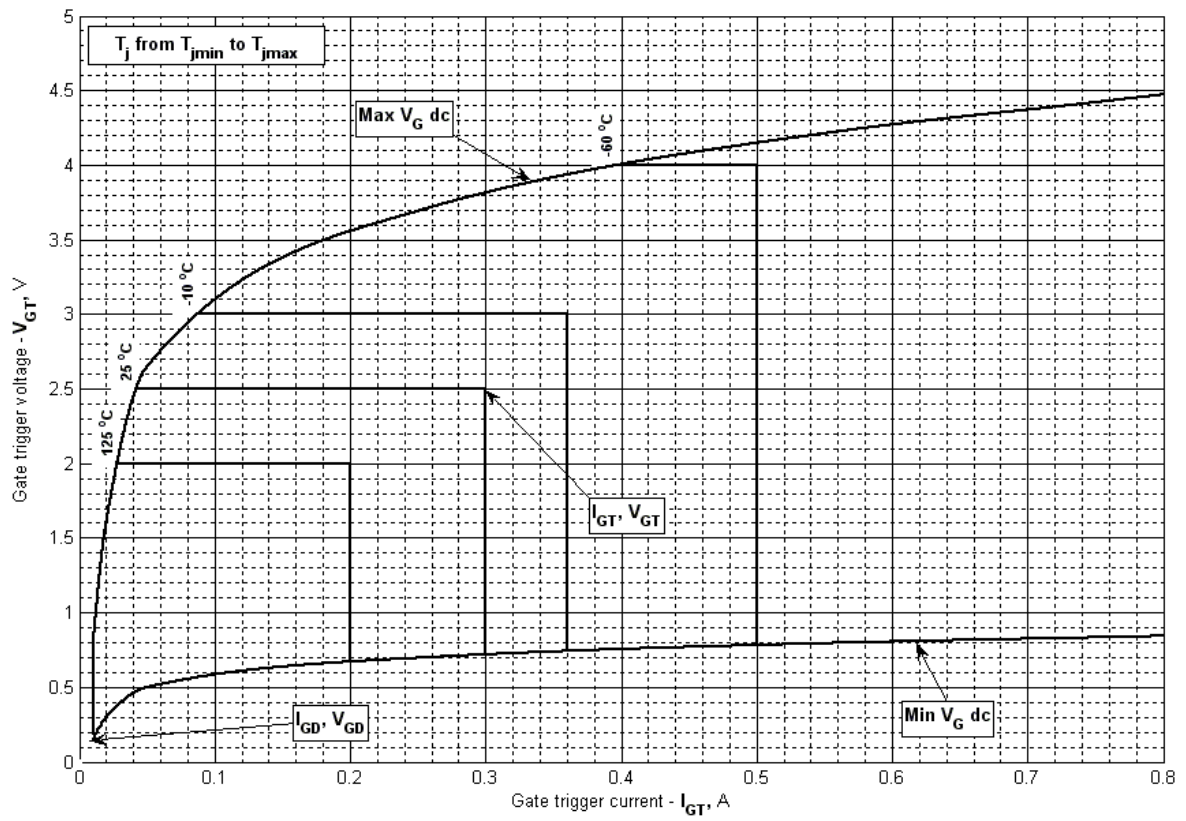
DC Anode side cooled

$i$	1	2	3	4	5	6
$R_i$ , K/W	0.01013	0.004062	0.0009401	0.002853	0.0005963	0.00005641
$\tau_i$ , s	9.747	1.058	0.1304	0.06179	0.002313	0.0003013

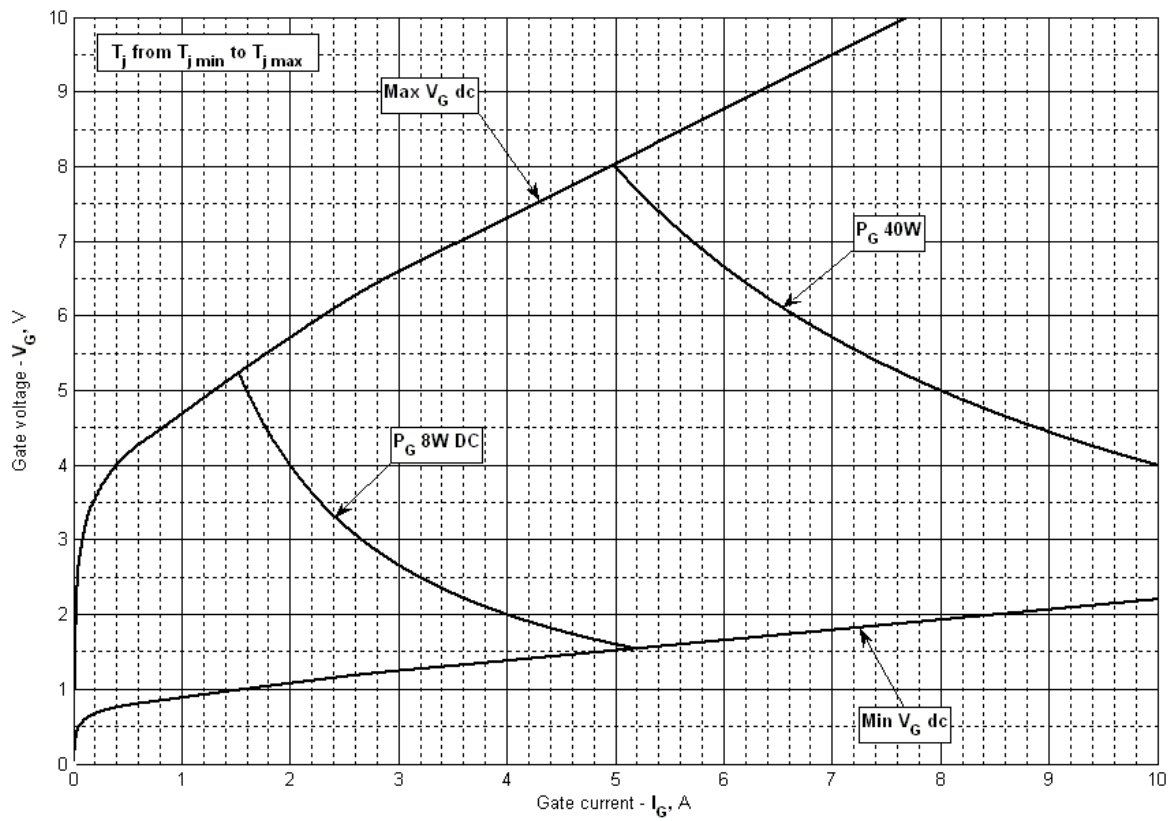
DC Cathode side cooled

$i$	1	2	3	4	5	6
$R_i$ , K/W	0.006619	0.004034	0.0008595	0.002956	0.0005965	0.00005689
$\tau_i$ , s	9.744	1.025	0.1394	0.06237	0.002318	0.0003037

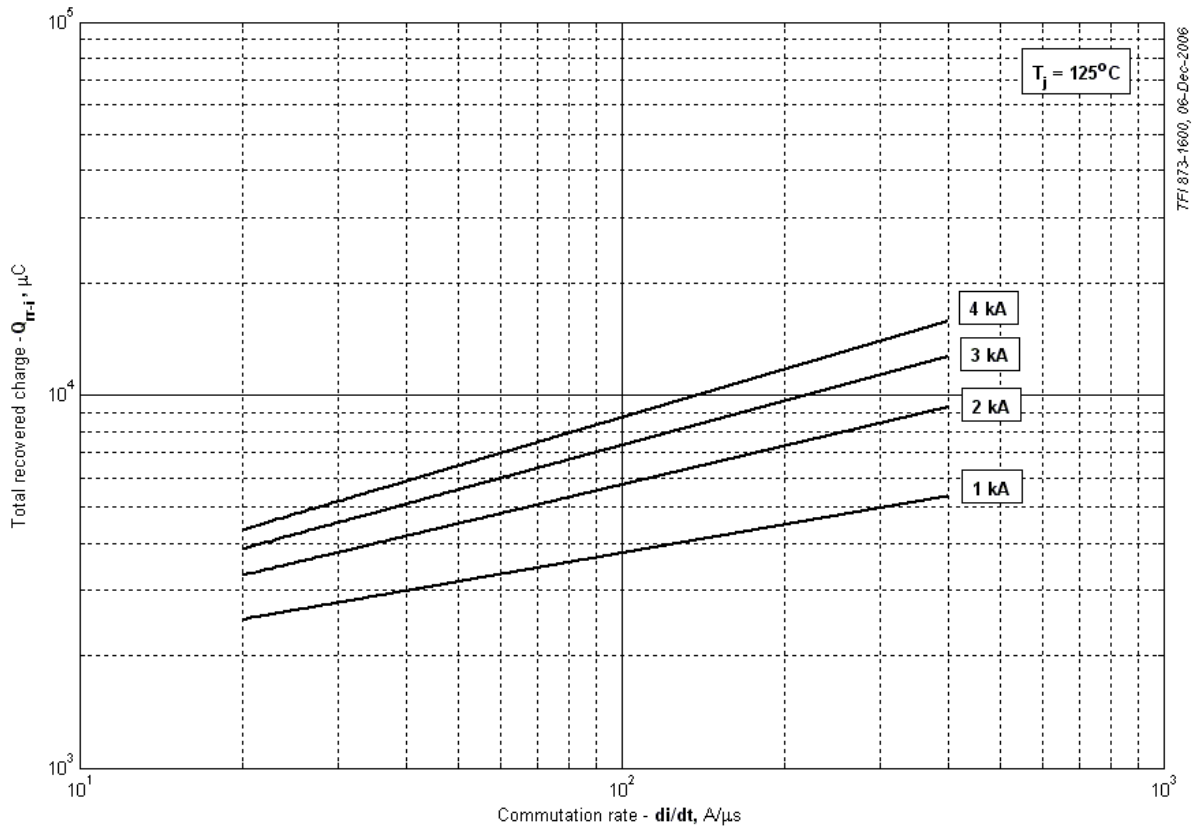
**Transient thermal impedance junction to case  $Z_{thjc}$  model (see Fig. 2).**



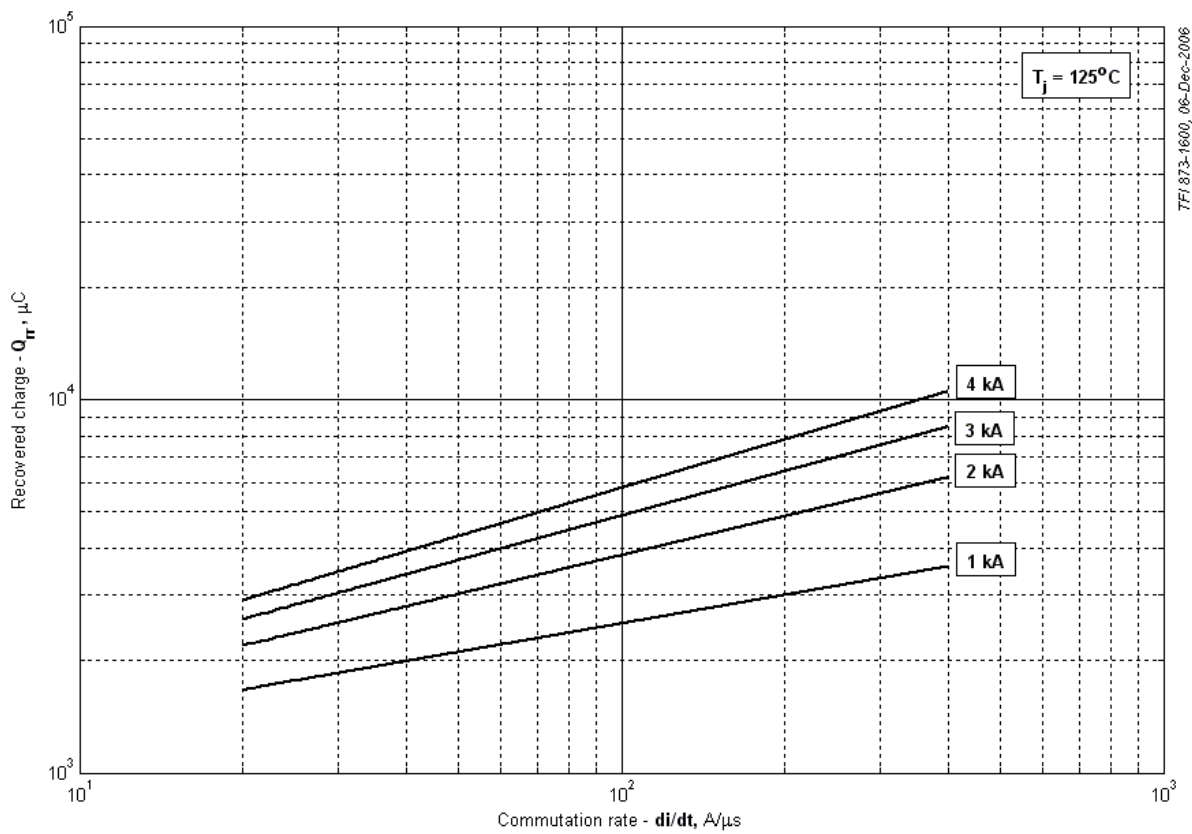
**Fig 3 – Gate characteristics – Trigger limits**



**Fig 4 - Gate characteristics –Power curves**

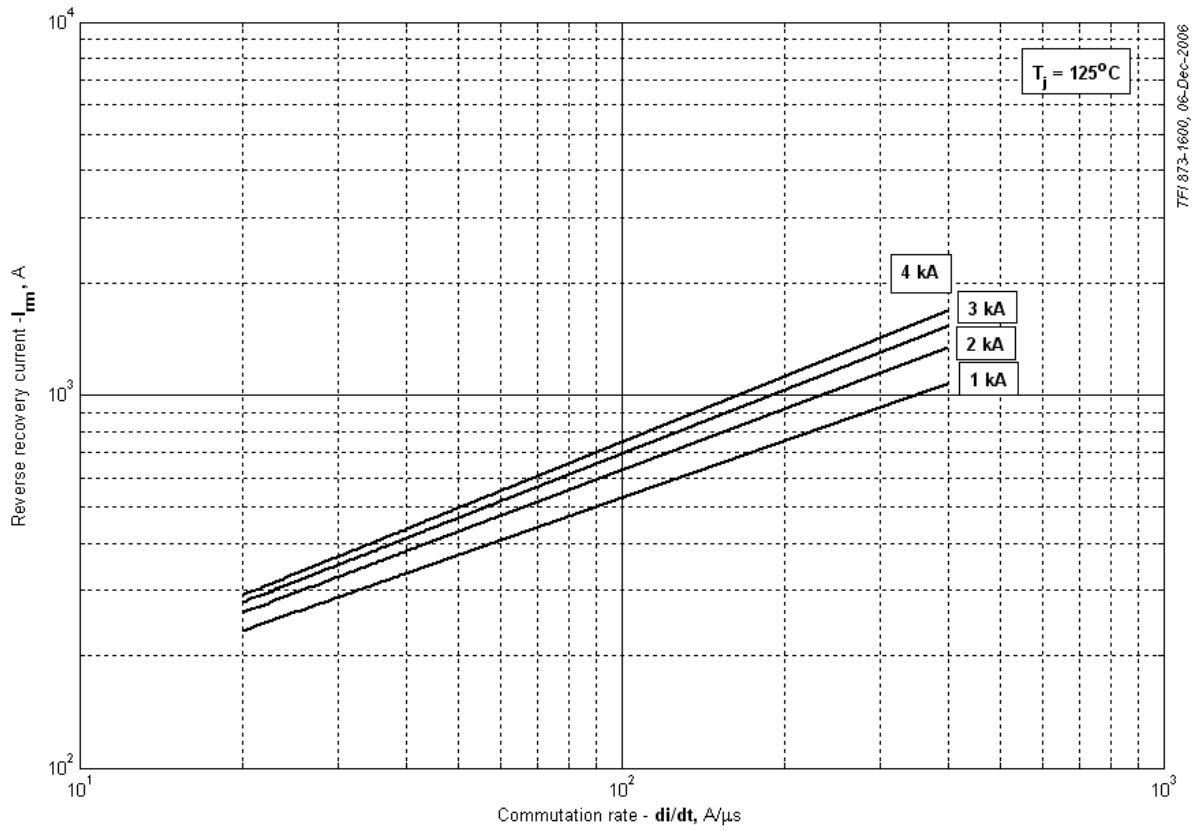


**Fig 5 – Total recovered charge,  $Q_{rr-i}$  (integral)**

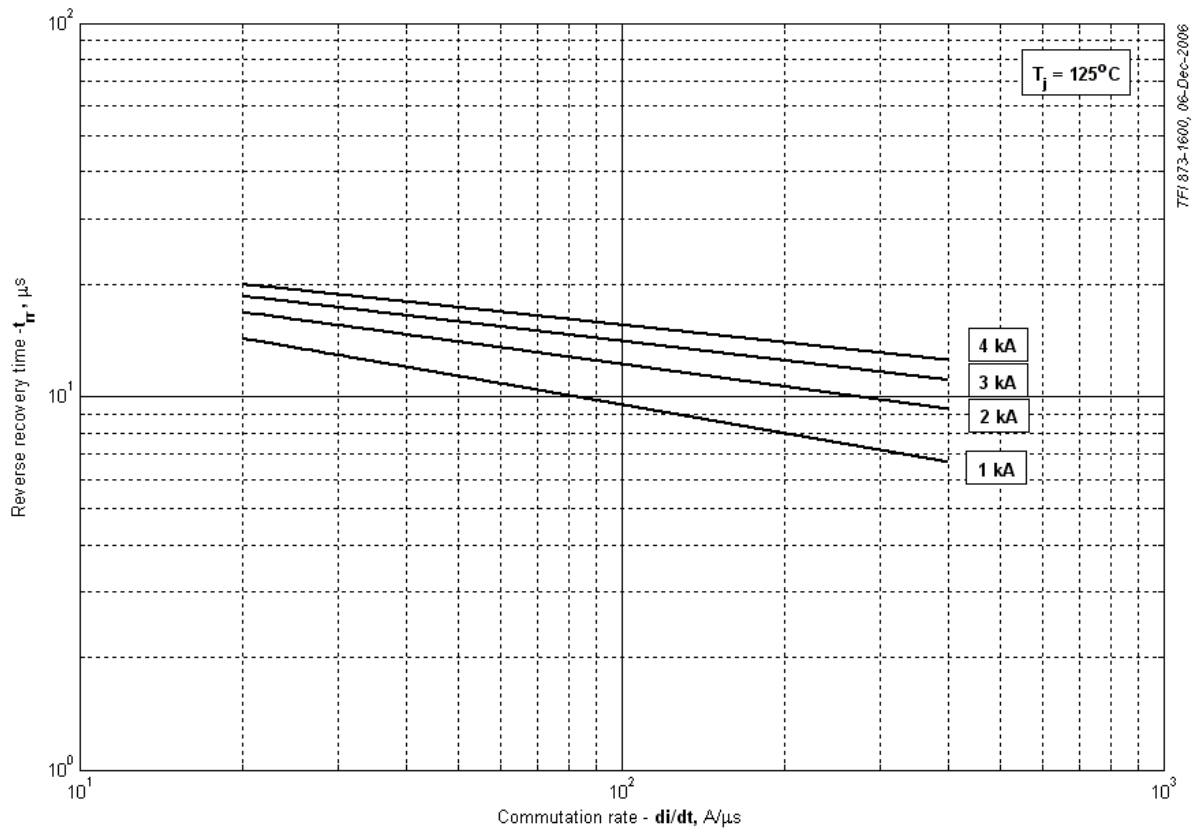


**Fig 6 - Recovered charge,  $Q_{rr}$  (25% chord)**

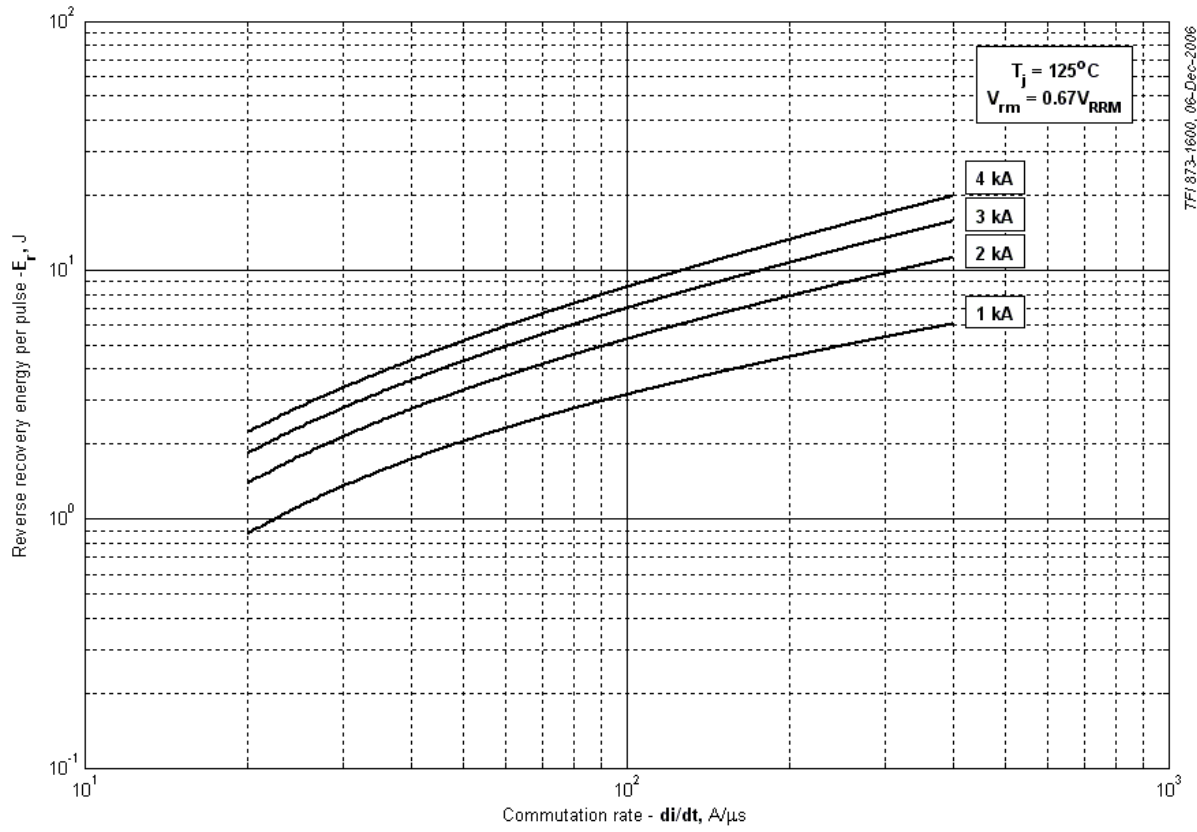




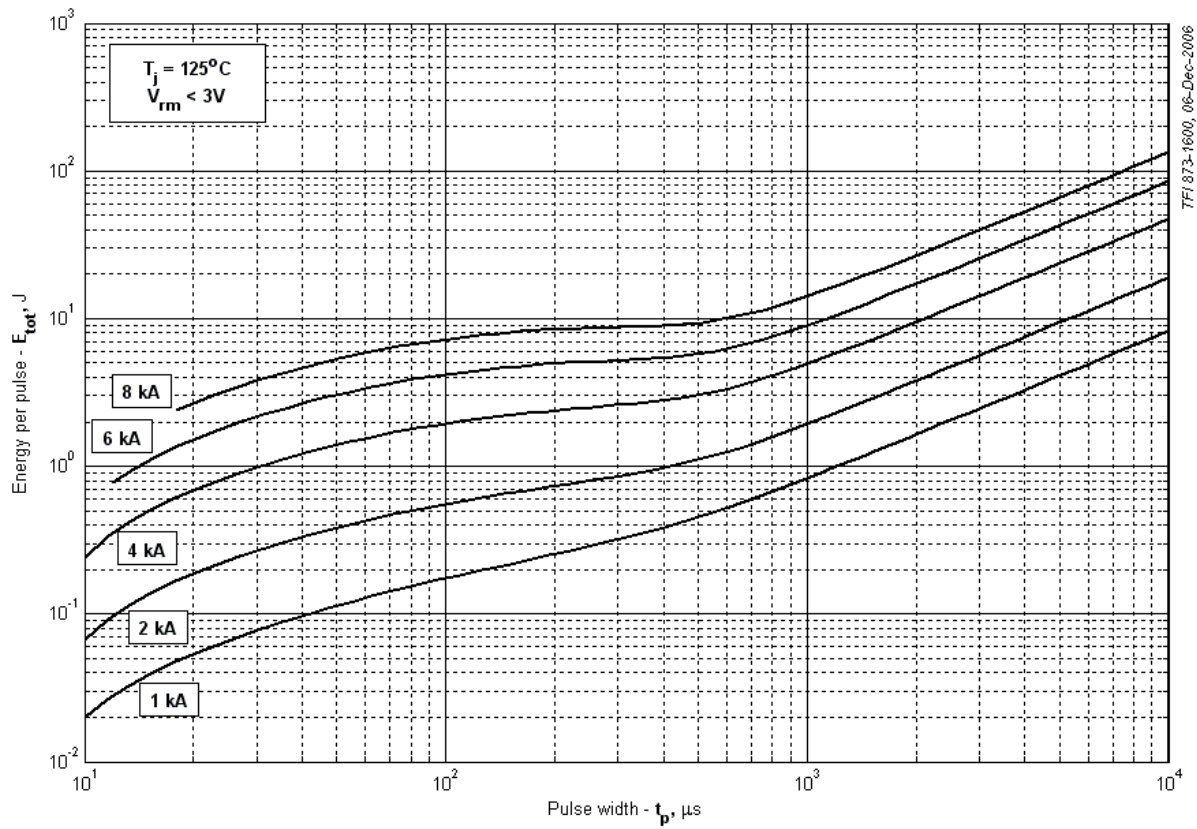
**Fig 7 – Peak reverse recovery current,  $I_{rm}$**



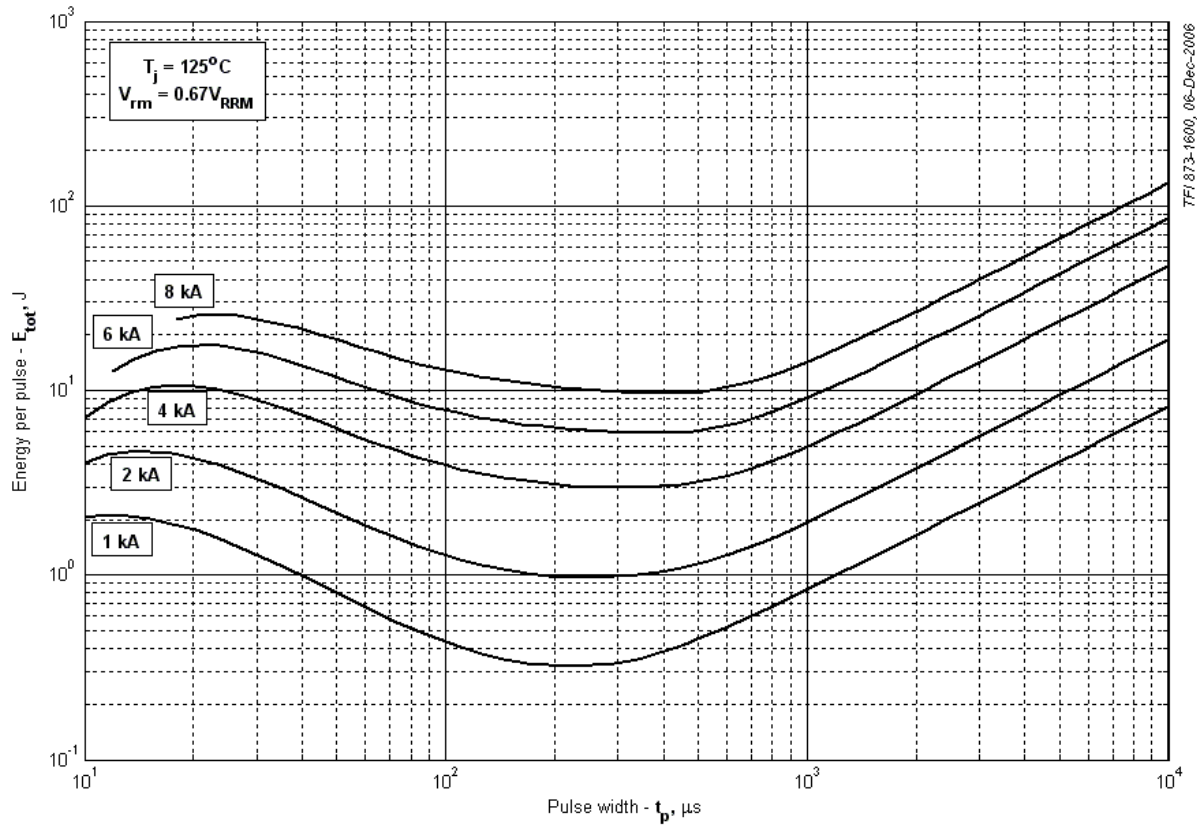
**Fig 8 – Maximum recovery time,  $t_{tr}$  (25% chord)**



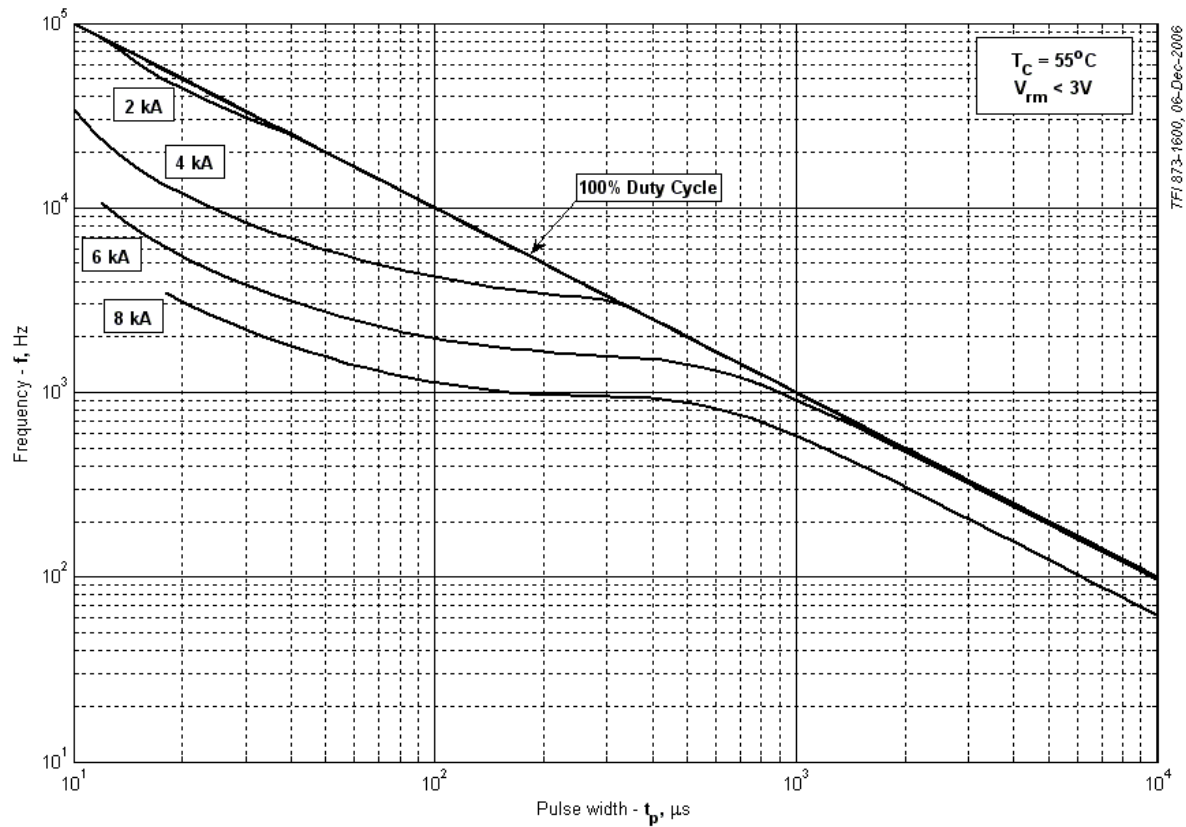
**Fig 9 – Reverse recovery energy per pulse**



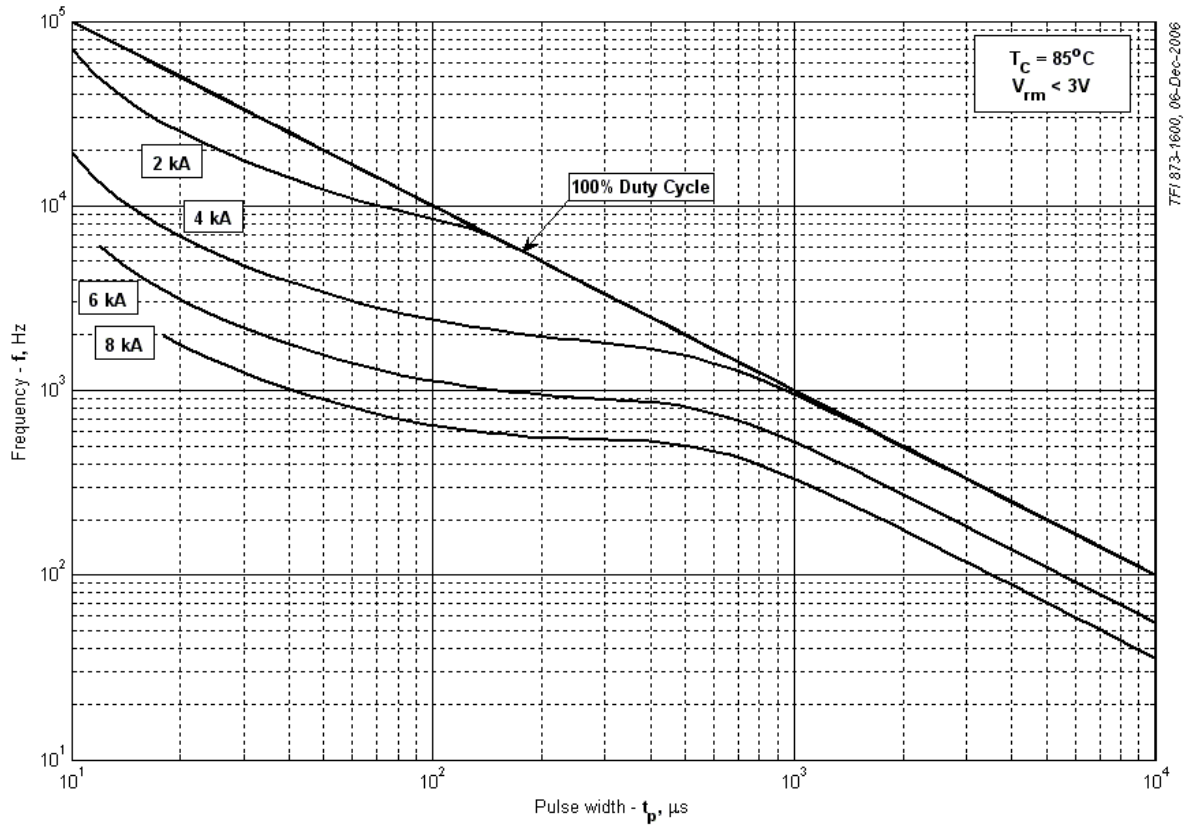
**Fig 10 – Sine wave energy per pulse**



**Fig 11 – Sine wave energy per pulse**

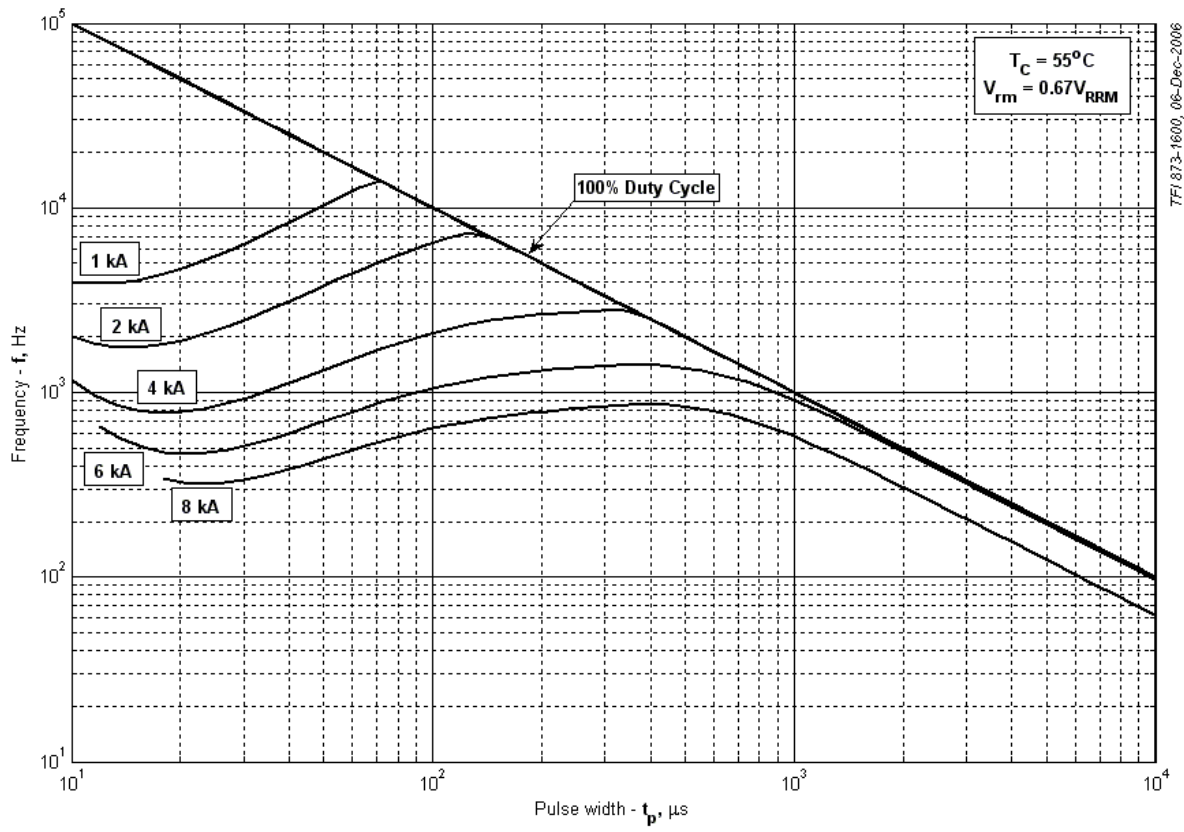


**Fig 12 – Sine wave frequency ratings**



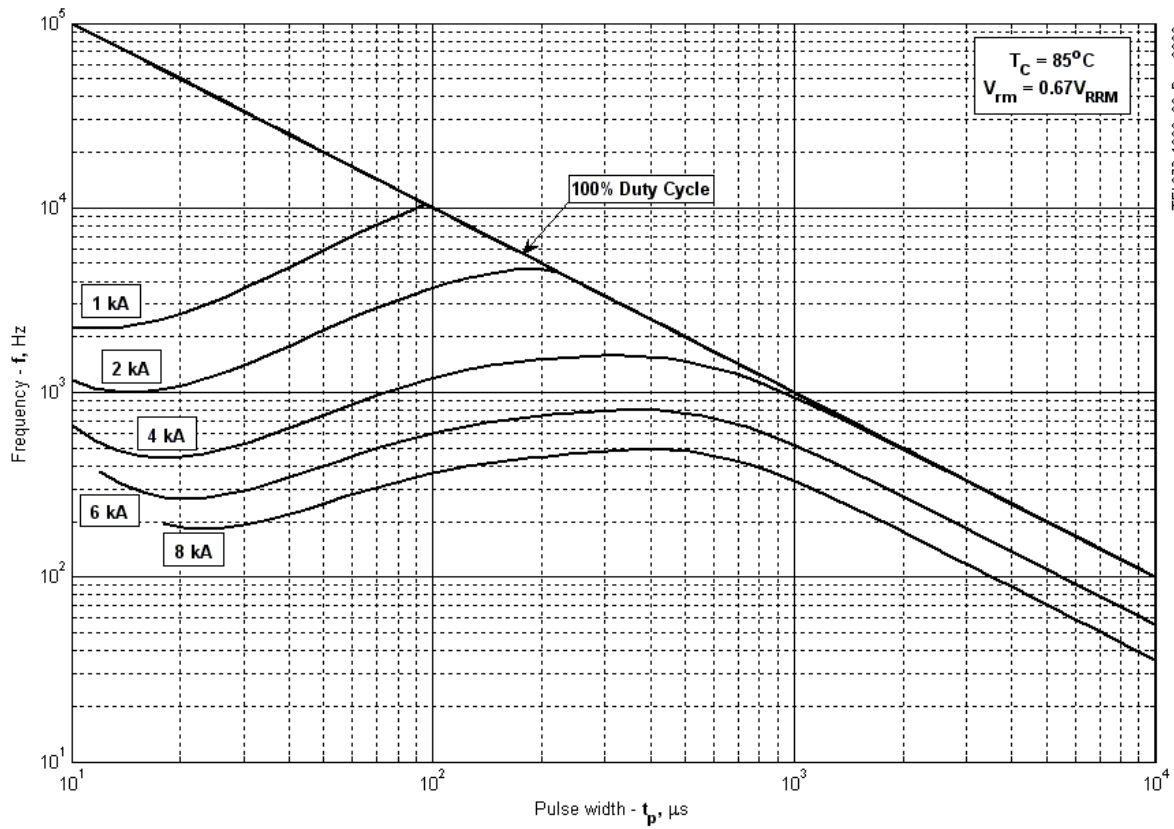
TFI 873-1600, 06-Dec-2006

**Fig 13 – Sine wave frequency ratings**



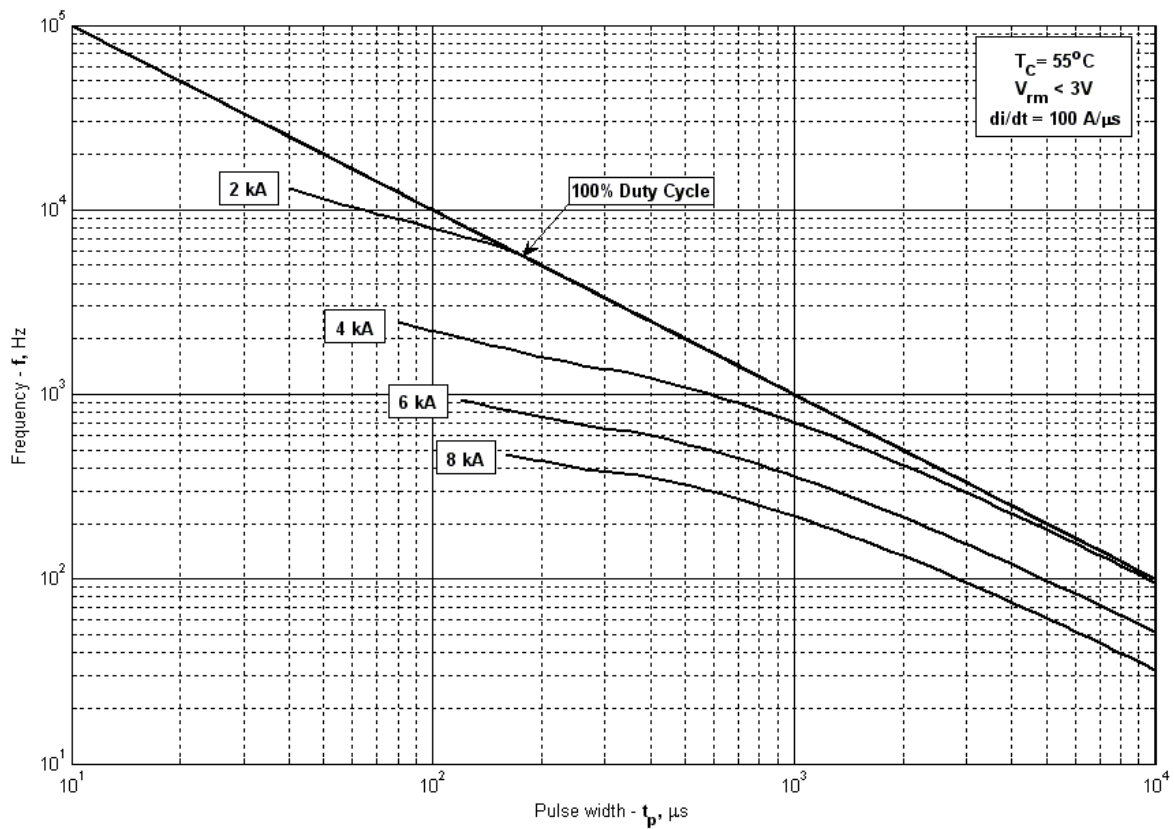
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**Fig 14 – Sine wave frequency ratings**



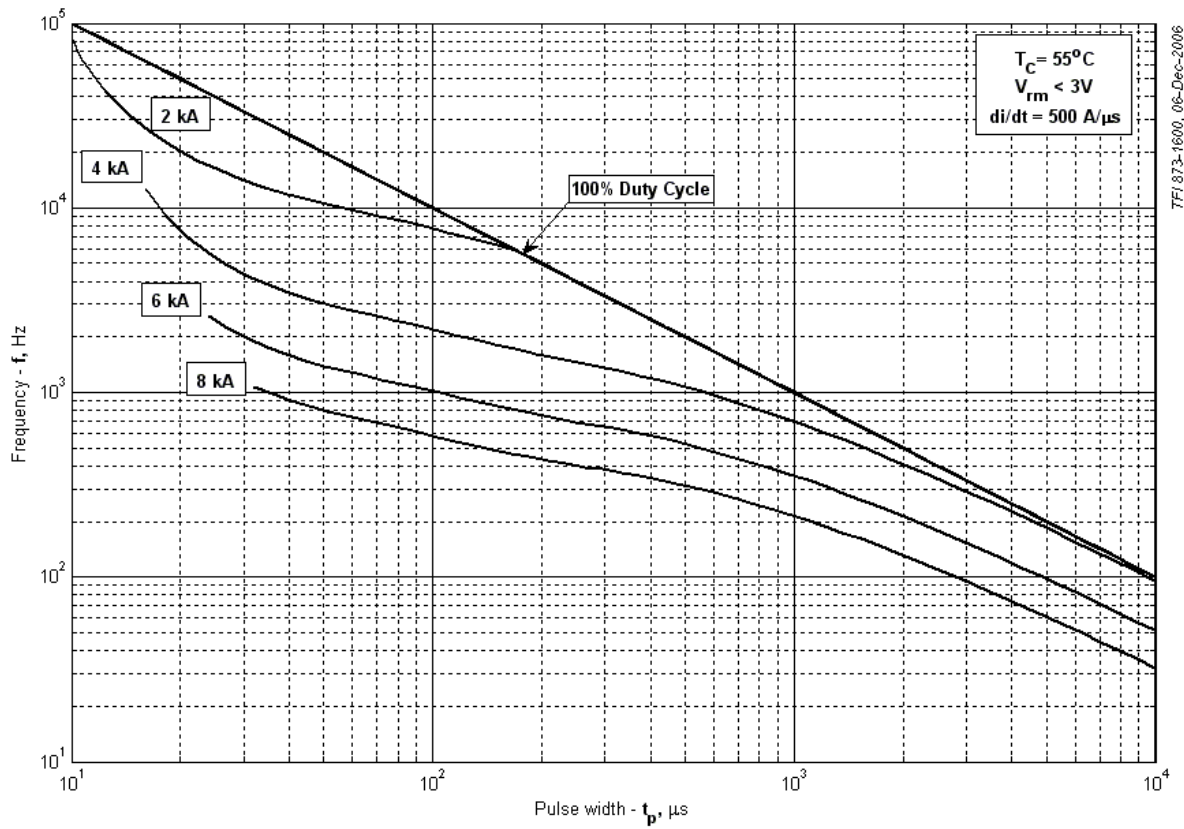
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**Fig 15 – Sine wave frequency ratings**

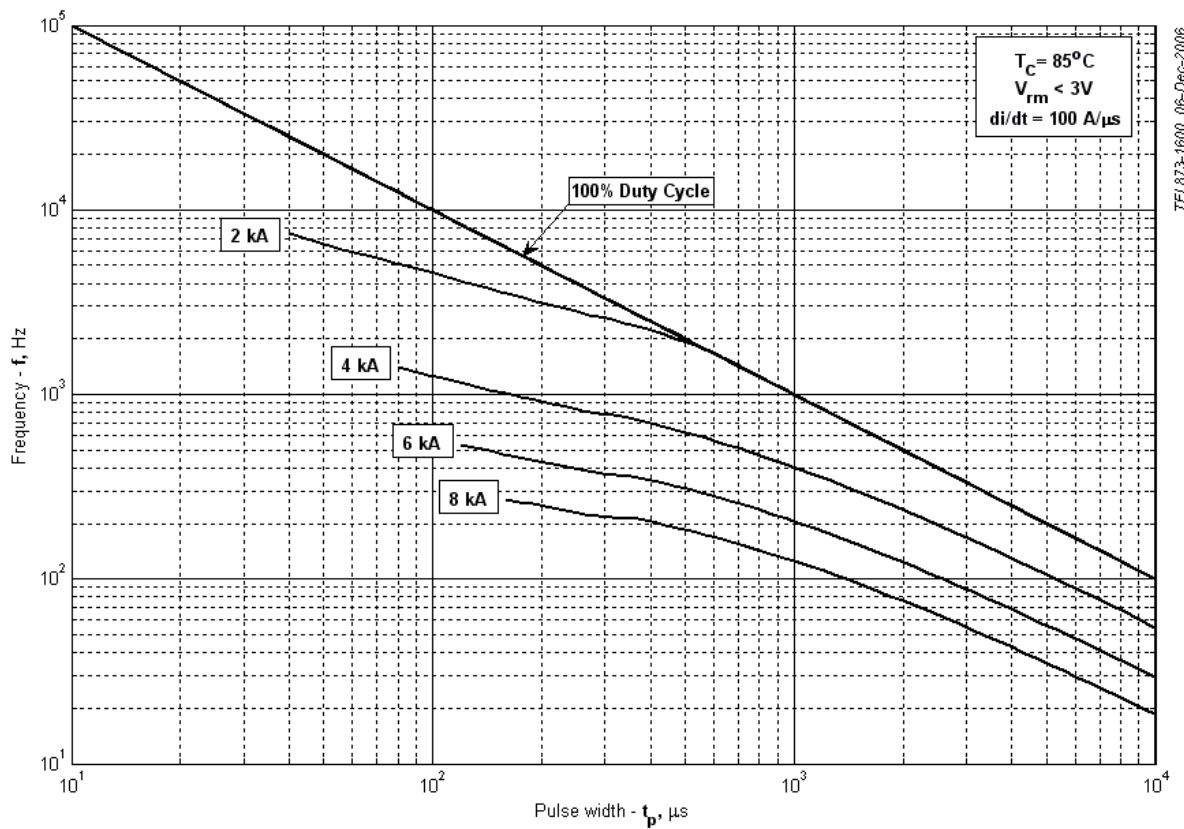


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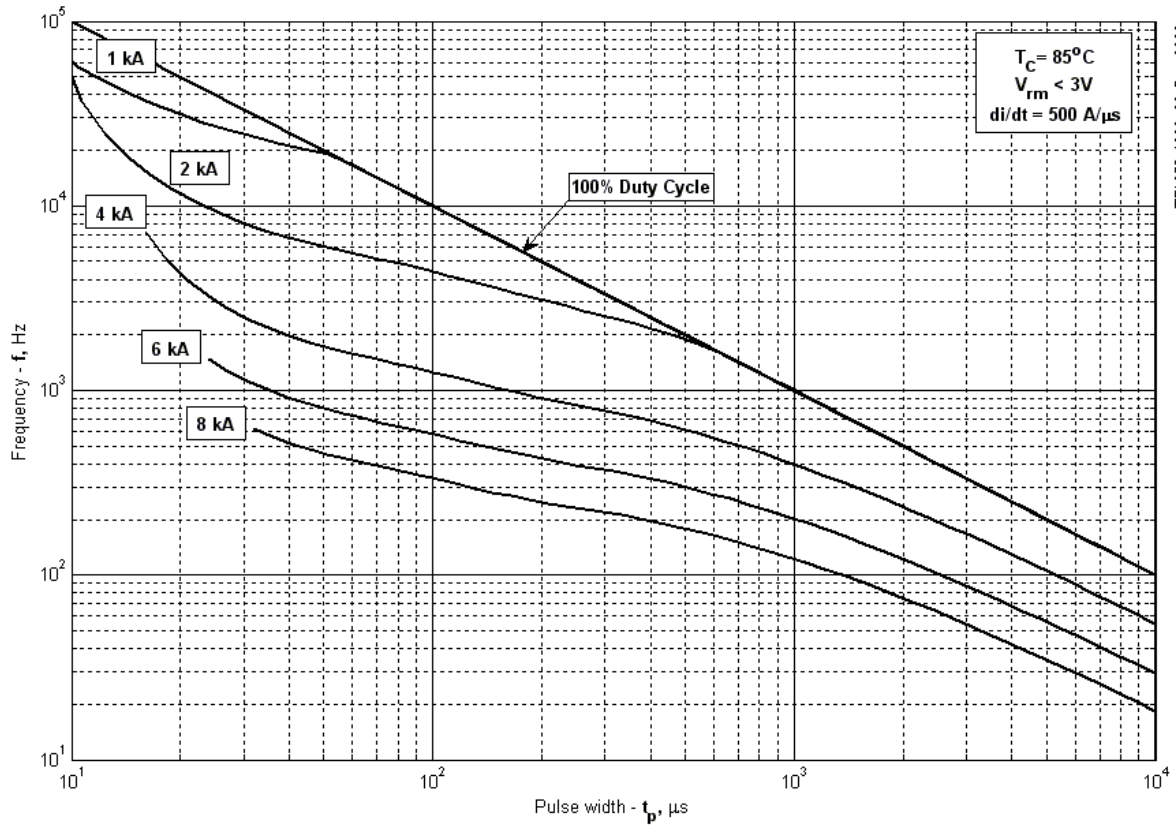
**Fig 16 – Square wave frequency ratings**



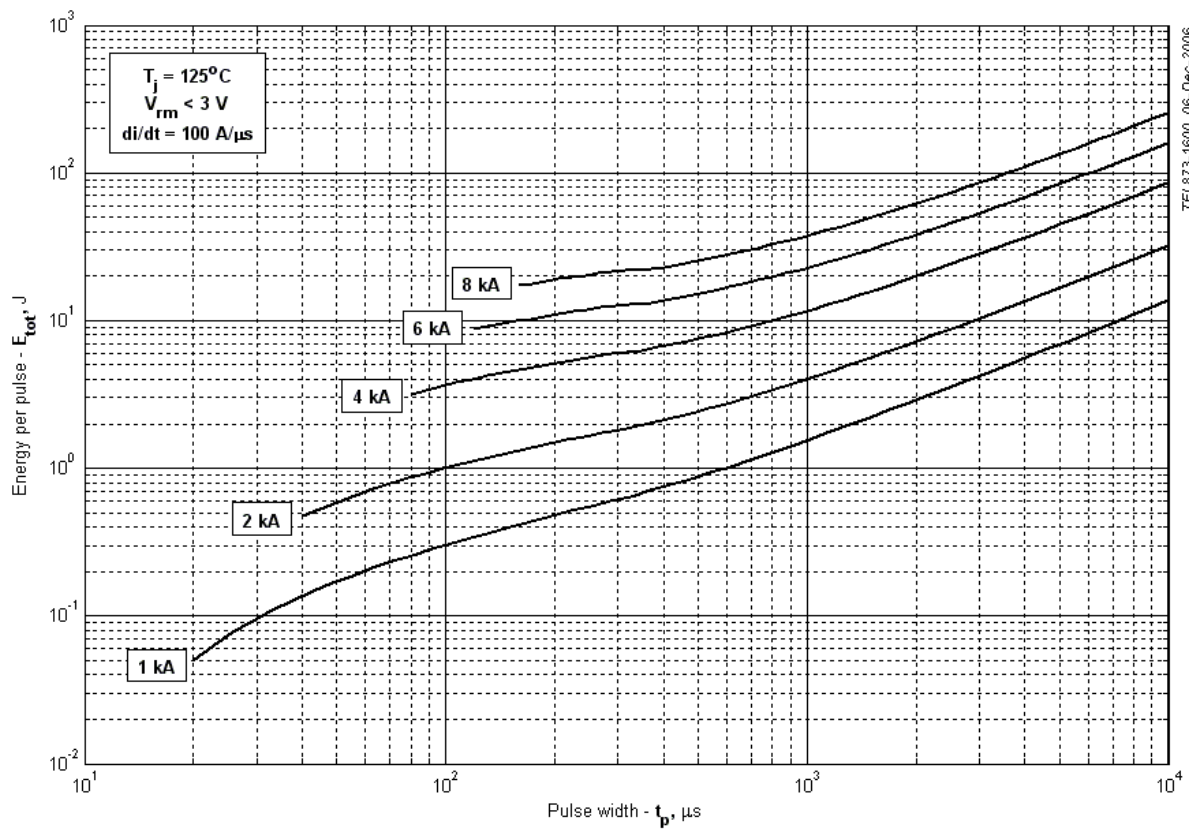
**Fig 17 – Square wave frequency ratings**



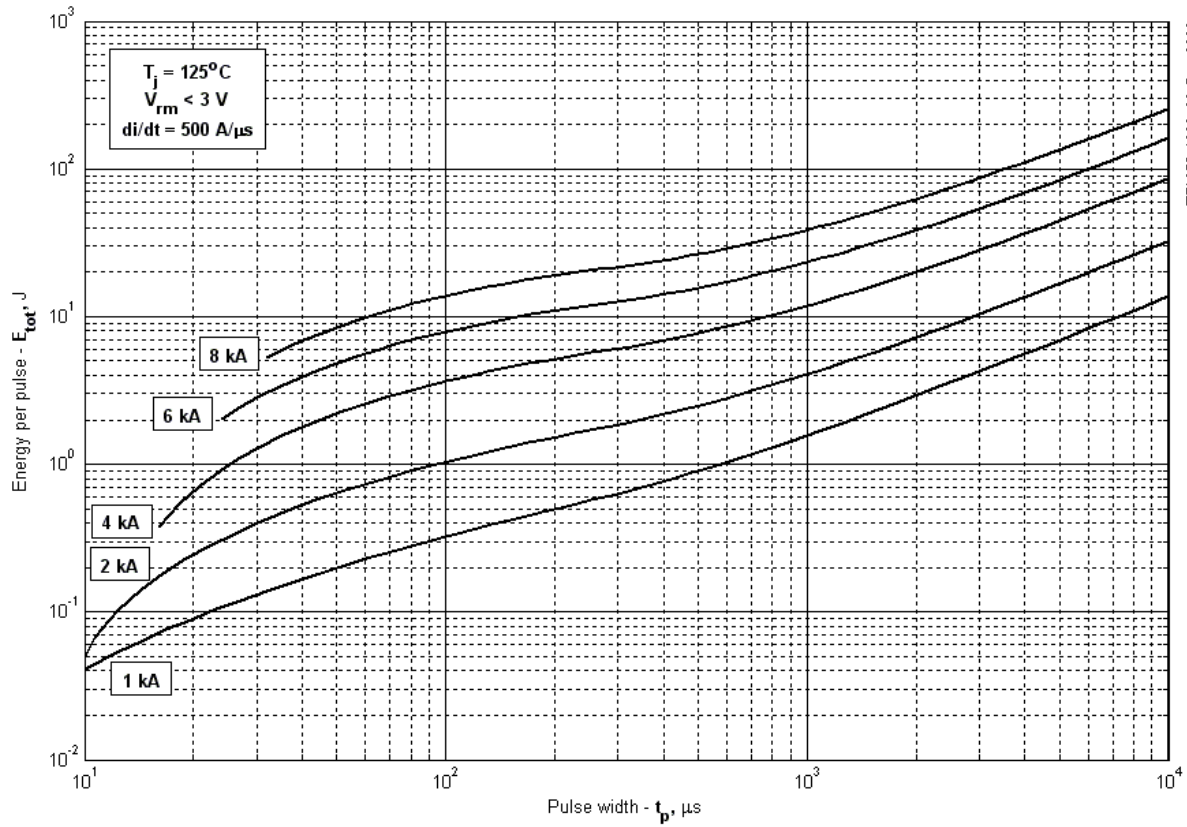
**Fig 18 – Square wave frequency ratings**



**Fig 19 – Square wave frequency ratings**

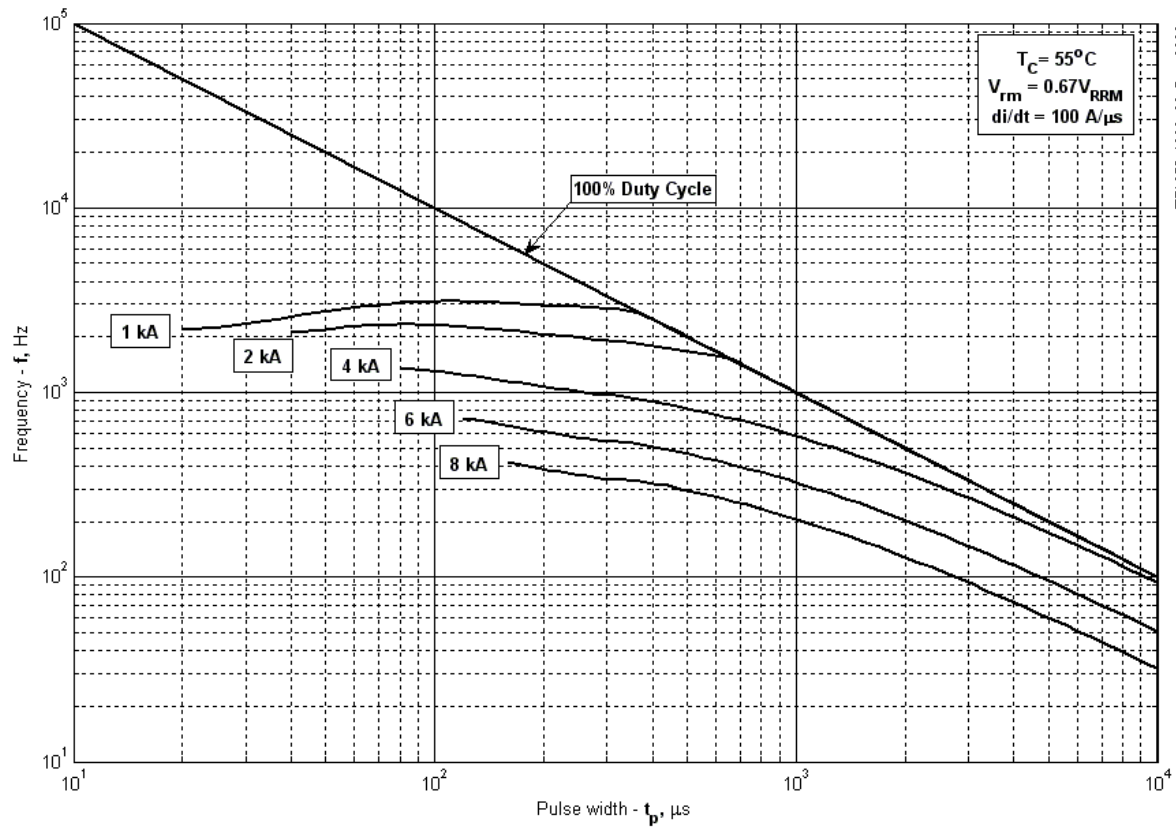


**Fig 20 – Square wave energy per pulse**



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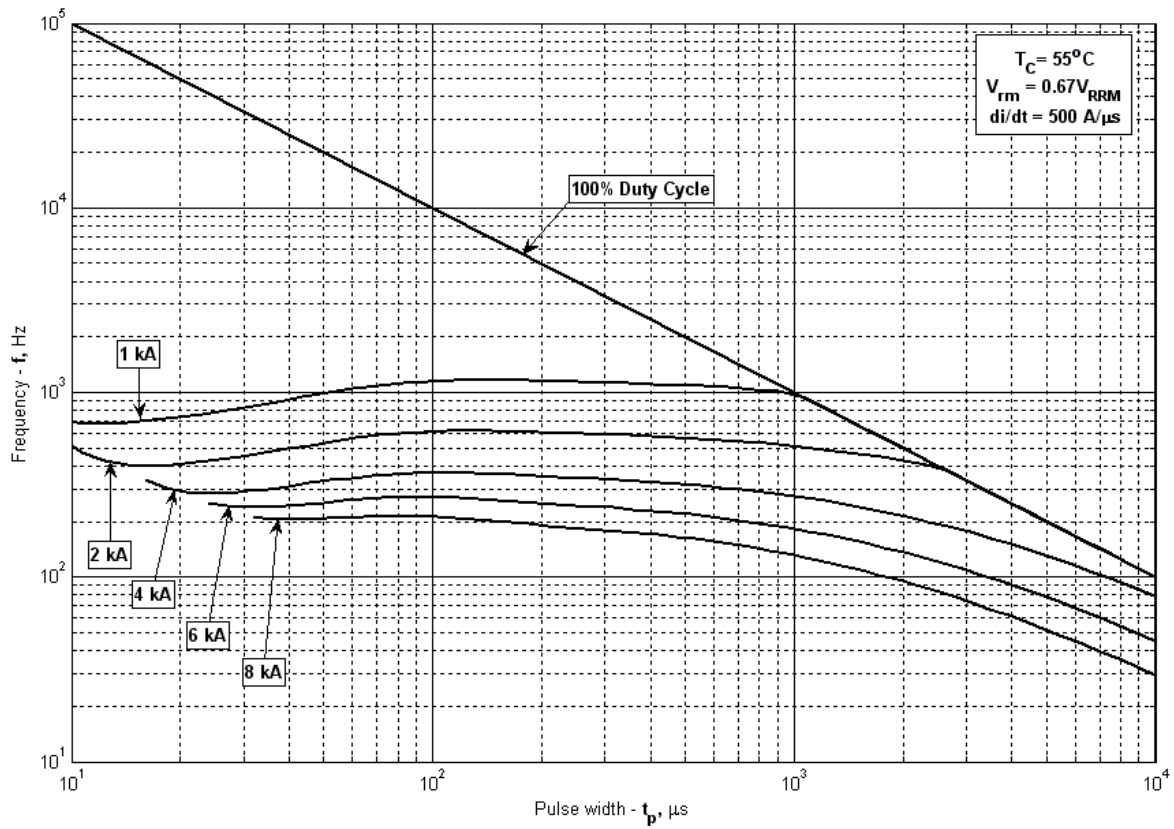
**Fig 21 – Square wave energy per pulse**



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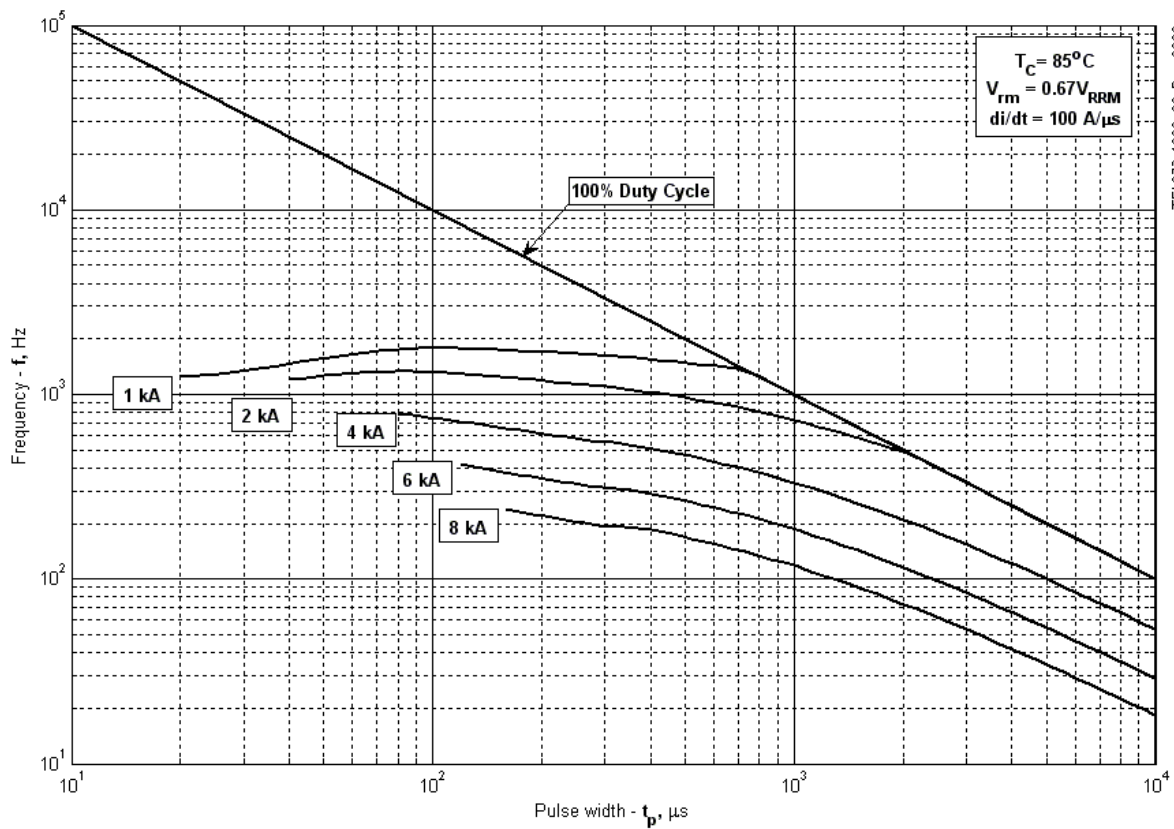
**Fig 22 – Square wave frequency ratings**





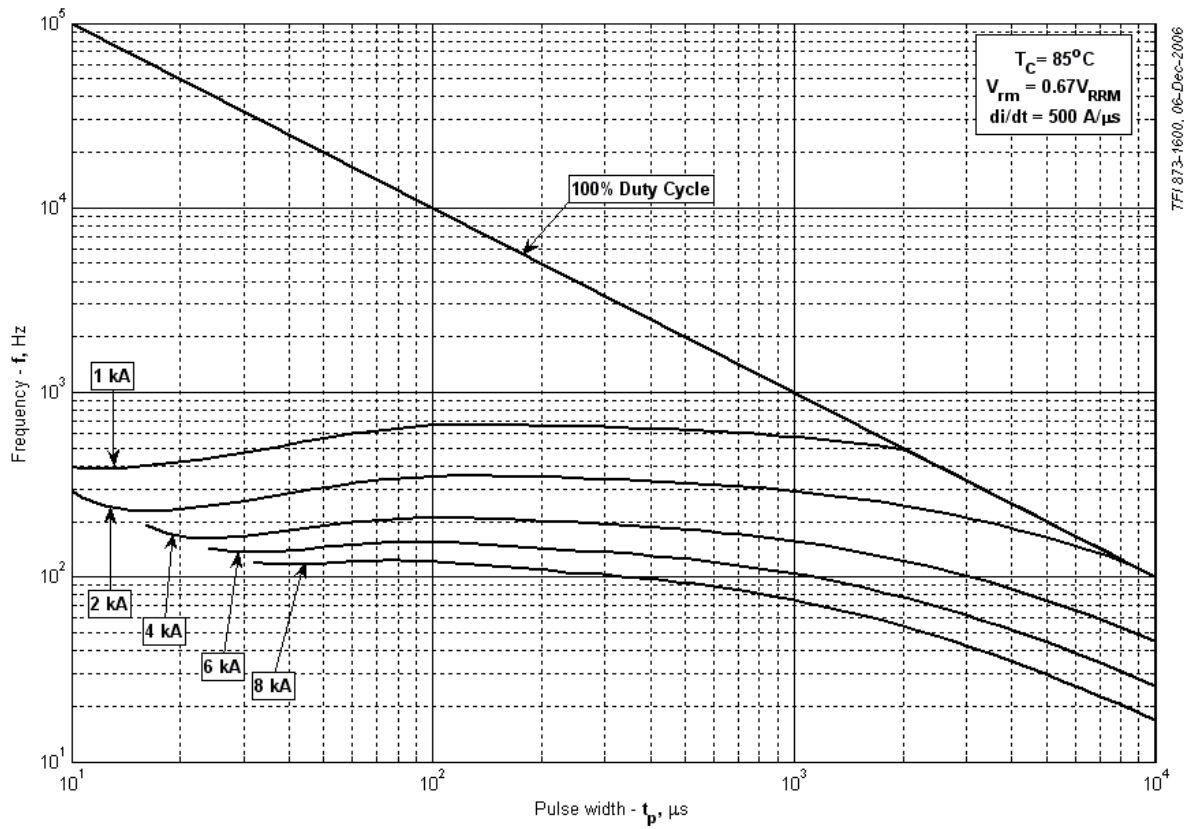
TFI873-1600, 06-Dec-2006

**Fig 23 – Square wave frequency ratings**

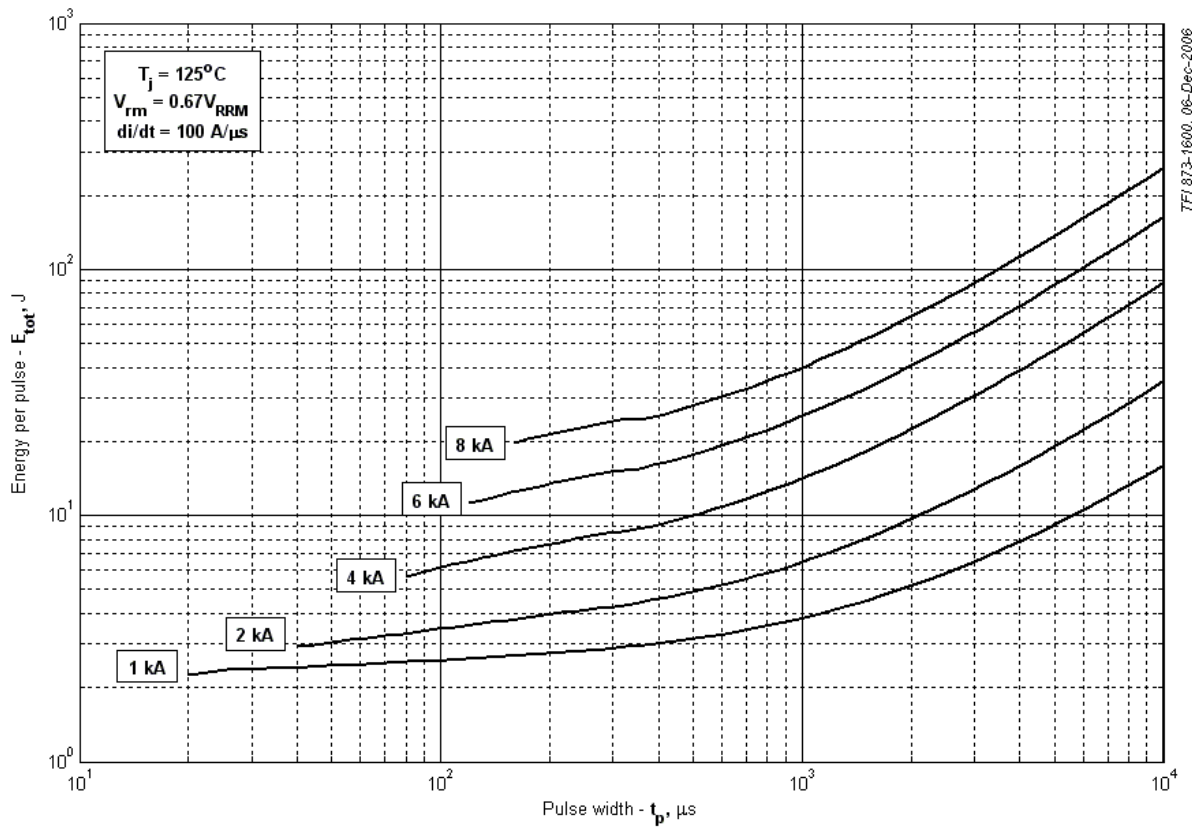


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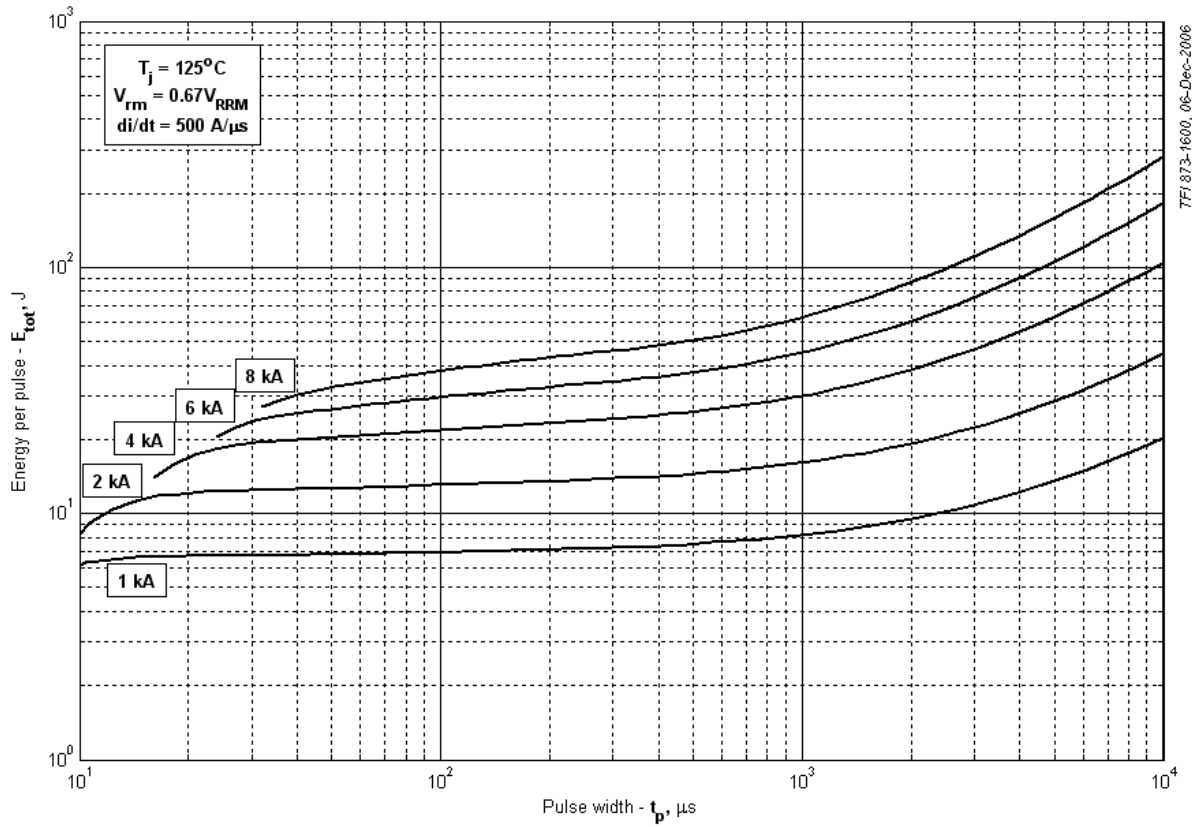
**Fig 24 – Square wave frequency ratings**



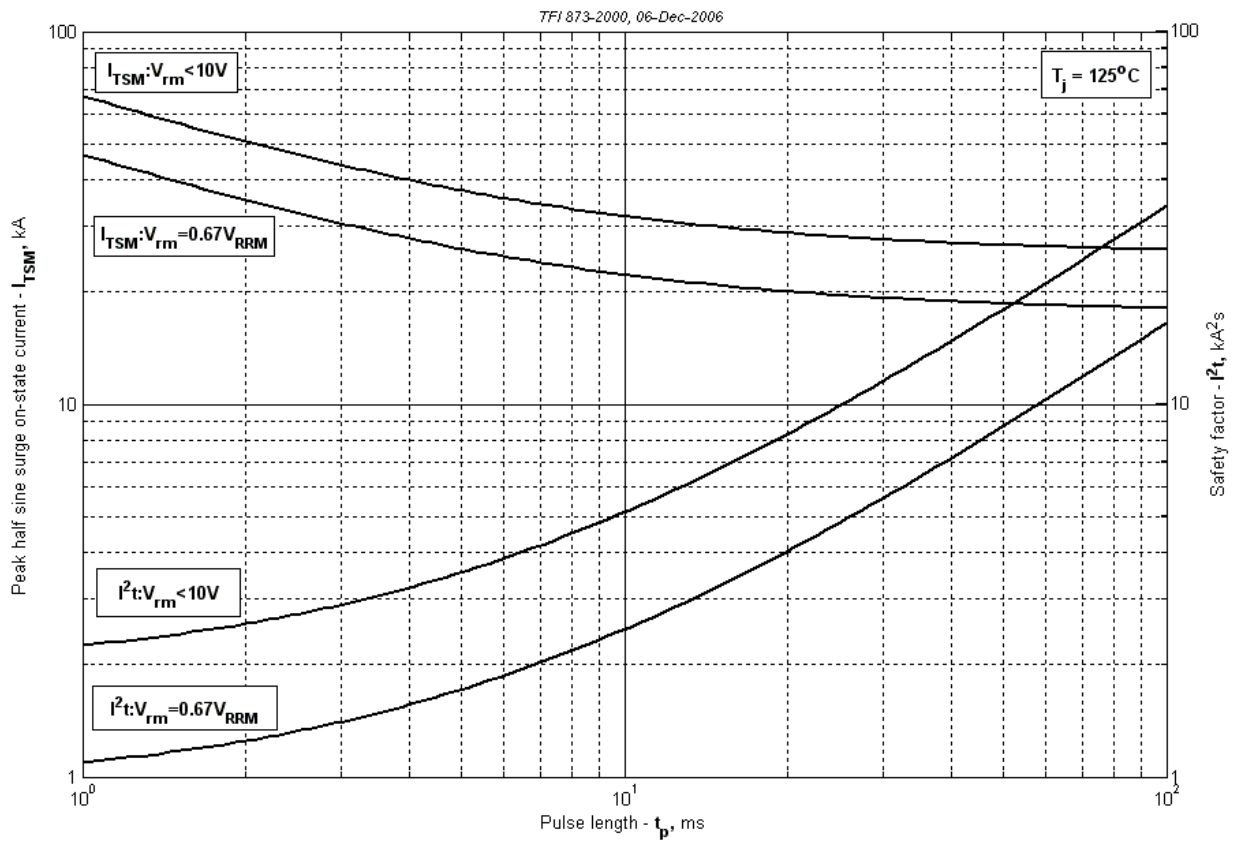
**Fig 25 – Square wave frequency ratings**



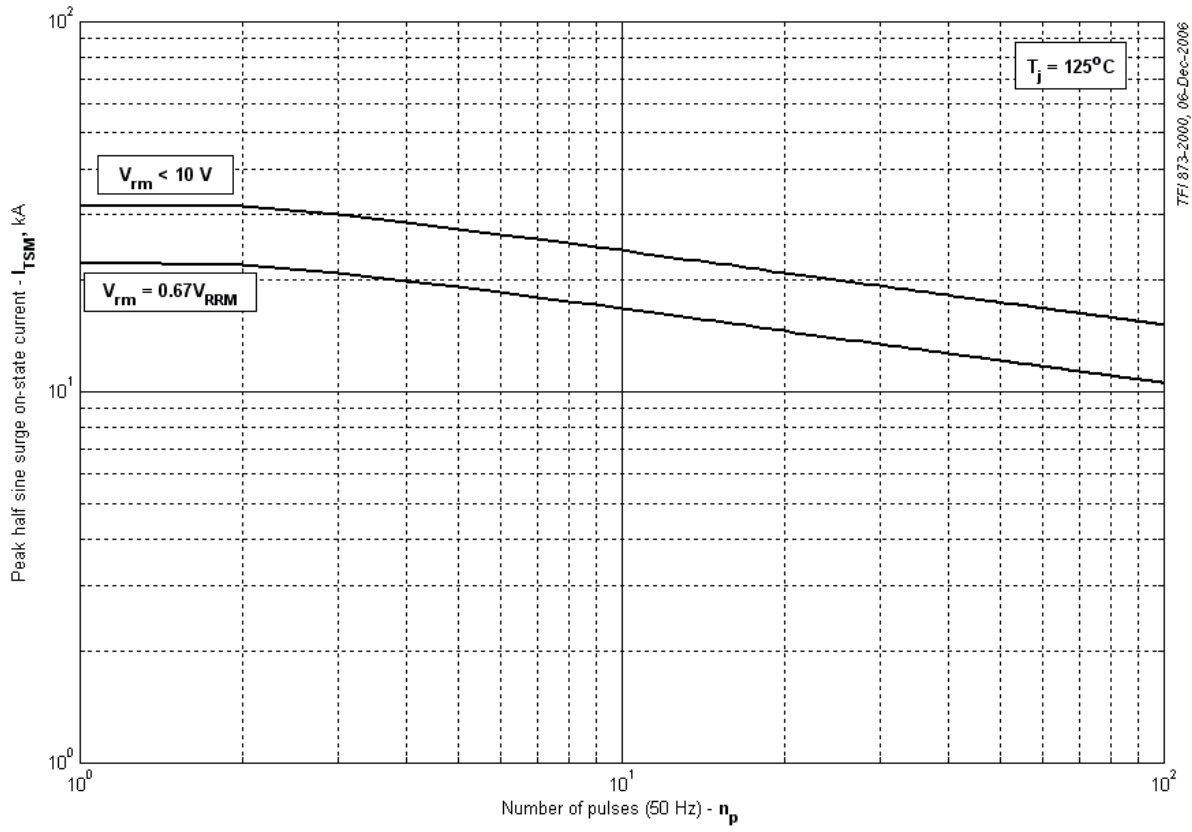
**Fig 26 – Square wave energy per pulse**



**Fig 27 – Square wave energy per pulse**



**Fig 28 – Maximum surge and  $I^2t$  ratings**



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**Fig 29 – Maximum surge ratings**