Fast Thyristor
Type TFI393-2500-28

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

Mean on-state current	I_{TAV}	2500 A	
Repetitive peak off-state voltage	V_{DRM}	2400 ÷ 2800 V	
Repetitive peak reverse voltage	V_{RRM}		
Turn-off time	t_q	50.0 μs	
V_{DRM}, V_{RRM}, V	2400	2600	2800
Voltage code	24	26	28
T_j, °C	– 60 ÷ 125		

MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions	
ON-STATE					
I_{TAV}	Mean on-state current	A	2500 4350	T_c=93 °C; Double side cooled; T_c=55 °C; Double side cooled; 180° half-sine wave; 50 Hz	
I_{TRMS}	RMS on-state current	A	3925	T_c=93 °C; Double side cooled; 180° half-sine wave; 50 Hz	
I_{TSM}	Surge on-state current	kA	75.0 86.0	T_j=$T_{j\,max}$ T_j=25 °C	180° half-sine wave; 50 Hz (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
			79.0 91.0	T_j=$T_{j\,max}$ T_j=25 °C	180° half-sine wave; 60 Hz (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	$A^2s \cdot 10^3$	28125 36980	T_j=$T_{j\,max}$ T_j=25 °C	180° half-sine wave; 50 Hz (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
			25900 34365	T_j=$T_{j\,max}$ T_j=25 °C	180° half-sine wave; 60 Hz (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	2400÷2800	$T_{j\,min}$< 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	2500÷2900	$T_{j\,min}$< T_j <$T_{j\,max}$; 180° half-sine wave; 50 Hz;single pulse; Gate open	
V_D, V_R	Direct off-state and Direct reverse voltages	V	0.75·V_{DRM} 0.75·V_{RRM}	T_j=$T_{j\,max}$; Gate open	

Advance Data

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	1000	$T_j=T_{j\,max}$; $V_D=0.67 \cdot V_{DRM}$; $I_{TM}=2\ I_{TAV}$; Gate pulse: $I_G=I_{FGM}$; $V_G=20$ V; $t_{GP}=50$ μs; $di_G/dt=2$ A/μs
THERMAL				
T_{stg}	Storage temperature	°C	-60 ÷ 125	
T_j	Operating junction temperature	°C	-60 ÷ 125	
MECHANICAL				
F	Mounting force	kN	70.0 ÷ 90.0	
a	Acceleration	m/s^2	50 100	Device unclamped 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; $I_{TM}=6300$ A	
$V_{T(TO)}$	On-state threshold voltage, max	V	1.40	$T_j=T_{j\,max}$; $0.5\ \pi\ I_{TAV} < I_T < 1.5\ \pi\ I_{TAV}$	
r_T	On-state slope resistance, max	mΩ	0.120		
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	1000	$T_j=T_{j\,max}$; $V_D=0.67 \cdot V_{DRM}$; Gate open	
TRIGGERING					
V_{GT}	Gate trigger direct voltage, max	V	5.00 3.00 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	1000 600 400	$T_j=T_{j\,min}$ $T_j=25$ °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	15.00		
SWITCHING					
t_{gt}	Turn-on time	μs	2.5	$T_j=25$ °C; $V_D=0.4 \cdot V_{DRM}$; $I_{TM}=2000$ A; Gate pulse: $I_G=I_{FGM}$; $V_G=20$ V; $t_{GP}=50$ μs; $di_G/dt=2$ A/μs	
t_q	Turn-off time[2)], max	μs	50.0	$dv_D/dt=50$ V/μs;	$T_j=T_{j\,max}$; $I_{TM}=2000$ A; $di_R/dt=-10$ A/μs; $V_R=100$ V; $V_D=0.67\ V_{DRM}$
			63.0	$dv_D/dt=200$ V/μs;	
Q_{rr}	Total recovered charge(linear), max	μC	1200	$T_j=T_{j\,max}$; $I_{TM}=2000$ A; $di_R/dt=-50$ A/μs; $V_R=100$ V	
t_{rr}	Reverse recovery time, max	μs	8.6		
I_{rrM}	Peak reverse recovery current, max	A	280		
THERMAL					
R_{thjc}	Thermal resistance, junction to case, max	°C/W	0.0060	Direct current	Double side cooled
R_{thjc-A}			0.0132		Anode side cooled

Advance Data

R_{thjc-K}			0.0108		Cathode side cooled
R_{thck}	Thermal resistance, case to heatsink, max	°C/W	0.0010	Direct current	
MECHANICAL					
w	Weight, typ	g	2700		
D_s	Surface creepage distance	mm (inch)	62.09 (2.444)		
D_a	Air strike distance	mm (inch)	23.40 (0.921)		

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	E3
t_q, μs	50.0

PART NUMBERING GUIDE

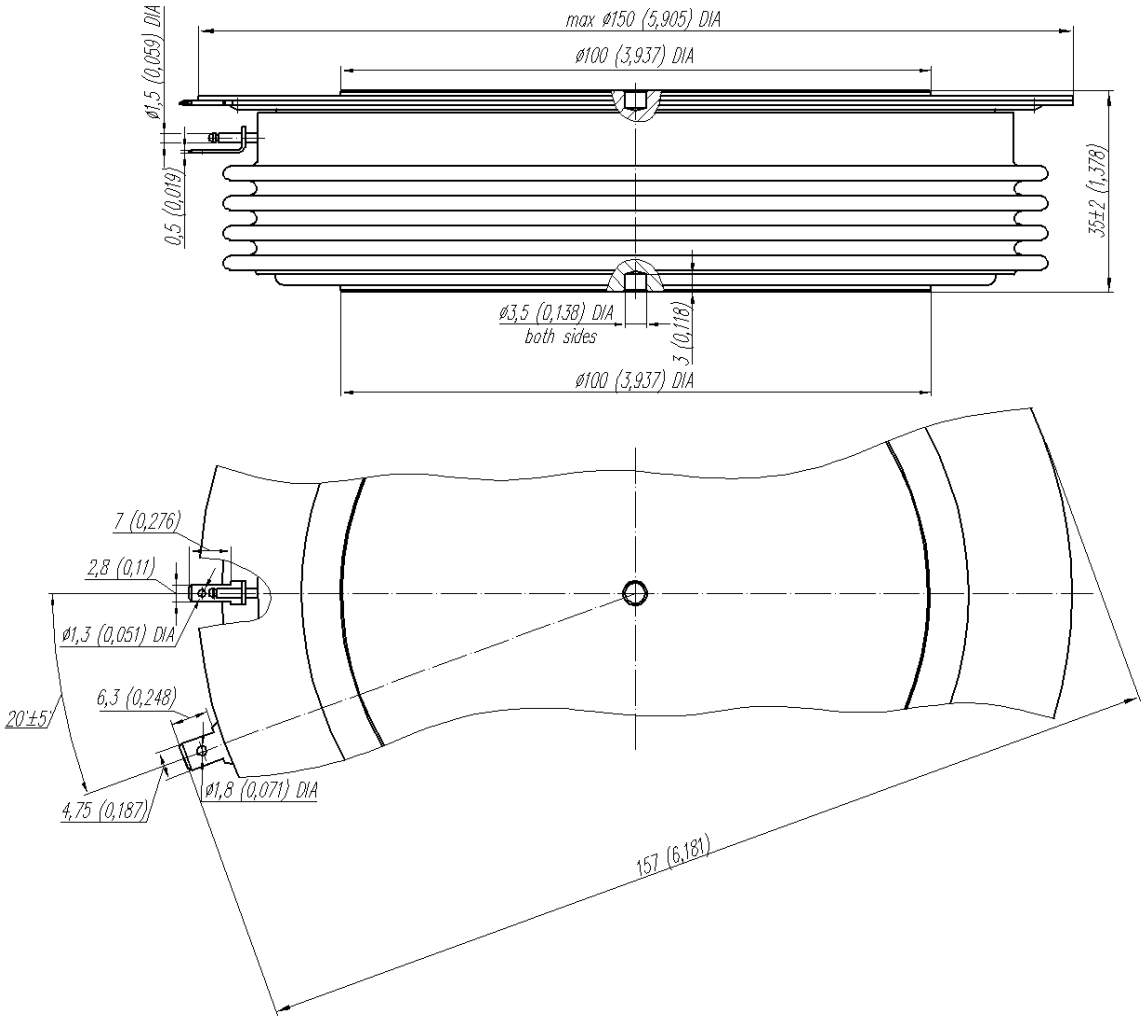
TFI	393	2500	28	A2	E3	N
1	2	3	4	5	6	7

1. TFI — Fast Thyristor
   TFIS — Fast Thyristor with Distributed Amplified Gate
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. Ambient conditions: N – normal; T – tropical

Advance Data

OVERALL DIMENSIONS

Package type: T.G6



All dimensions in millimeters (inches)

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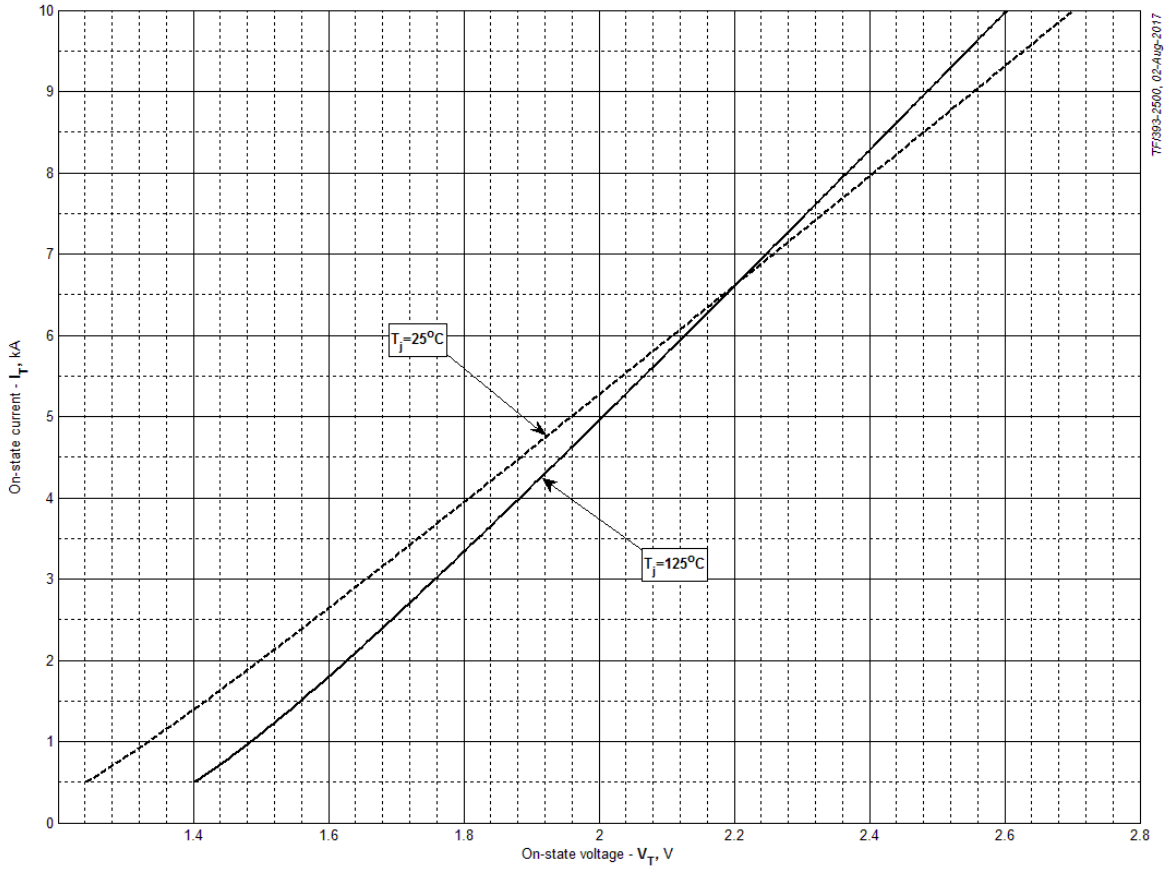

Fig 1 – On-state characteristics of Limit device

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 for max curves	
	T_j = 25°C	T_j = $T_{j\,max}$
A	1.060003	1.198378
B	0.117746	0.078535
C	-0.163288	-0.218083
D	0.270001	0.360605

On-state characteristic model (see Fig. 1)

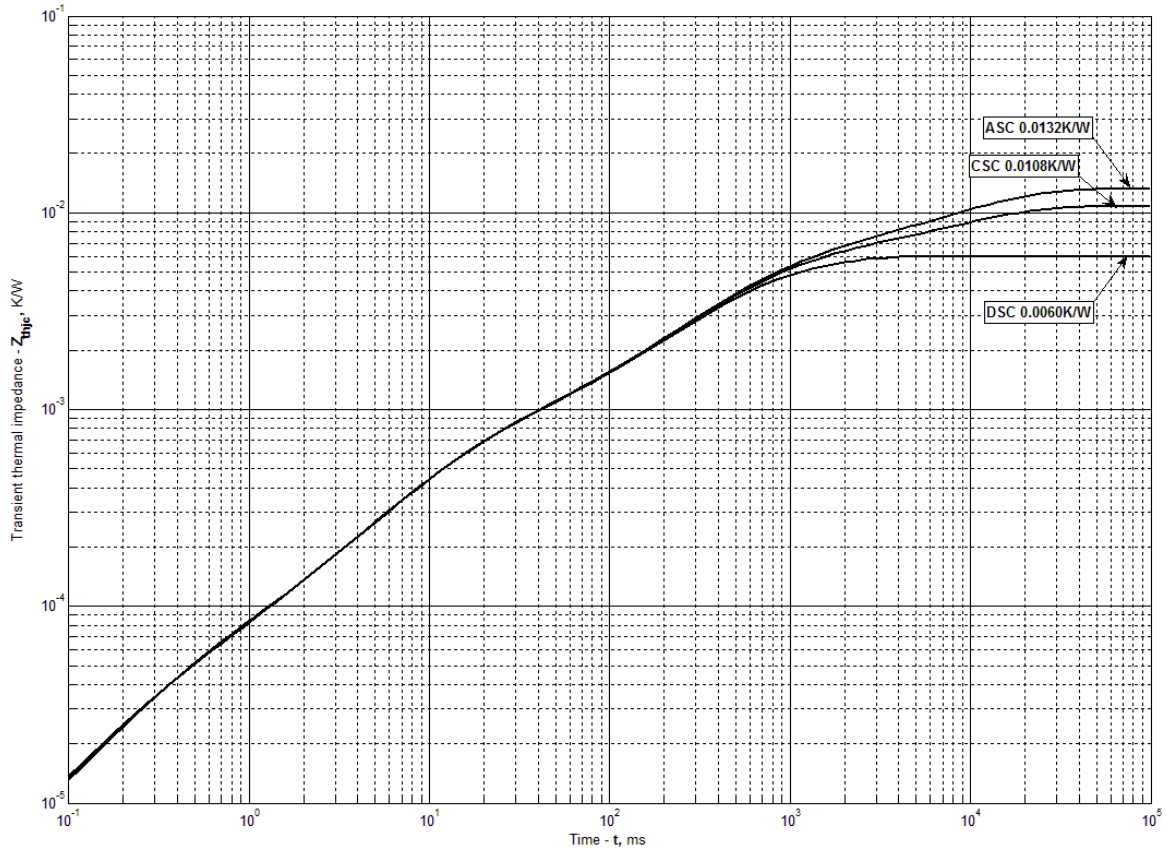

Fig 2 – Transient thermal impedance

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.

τ_i = Time constant of r_{th} term.

DC Double side cooled

i	1	2	3	4	5	6
R_i, K/W	0.002454	0.002872	0.00006413	0.0005704	0.00001283	0.00002624
τ_i, s	1.059	0.3837	0.06838	0.01357	0.001434	0.0002953

DC Cathode side cooled

i	1	2	3	4	5	6
R_i, K/W	0.004886	0.002703	0.002285	0.00003557	0.0002855	0.0005877
τ_i, s	10.26	0.9859	0.3986	0.0003998	0.201	0.01372

DC Anode side cooled

i	1	2	3	4	5	6
R_i, K/W	0.0072	0.002582	0.00276	0.00003401	0.00007448	0.0005515
τ_i, s	10.61	1.145	0.3917	0.0003784	0.04391	0.01306

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

Advance

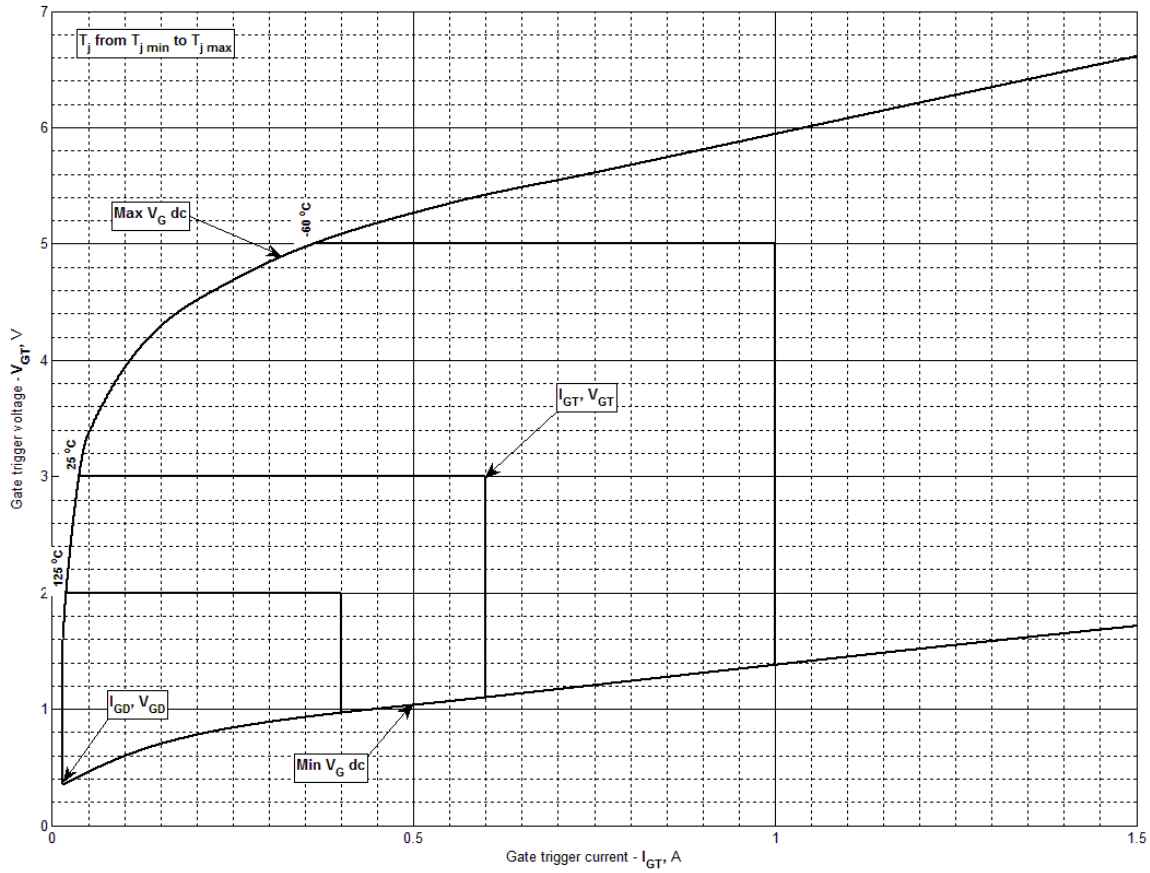

Fig 3 – Gate characteristics – Trigger limits

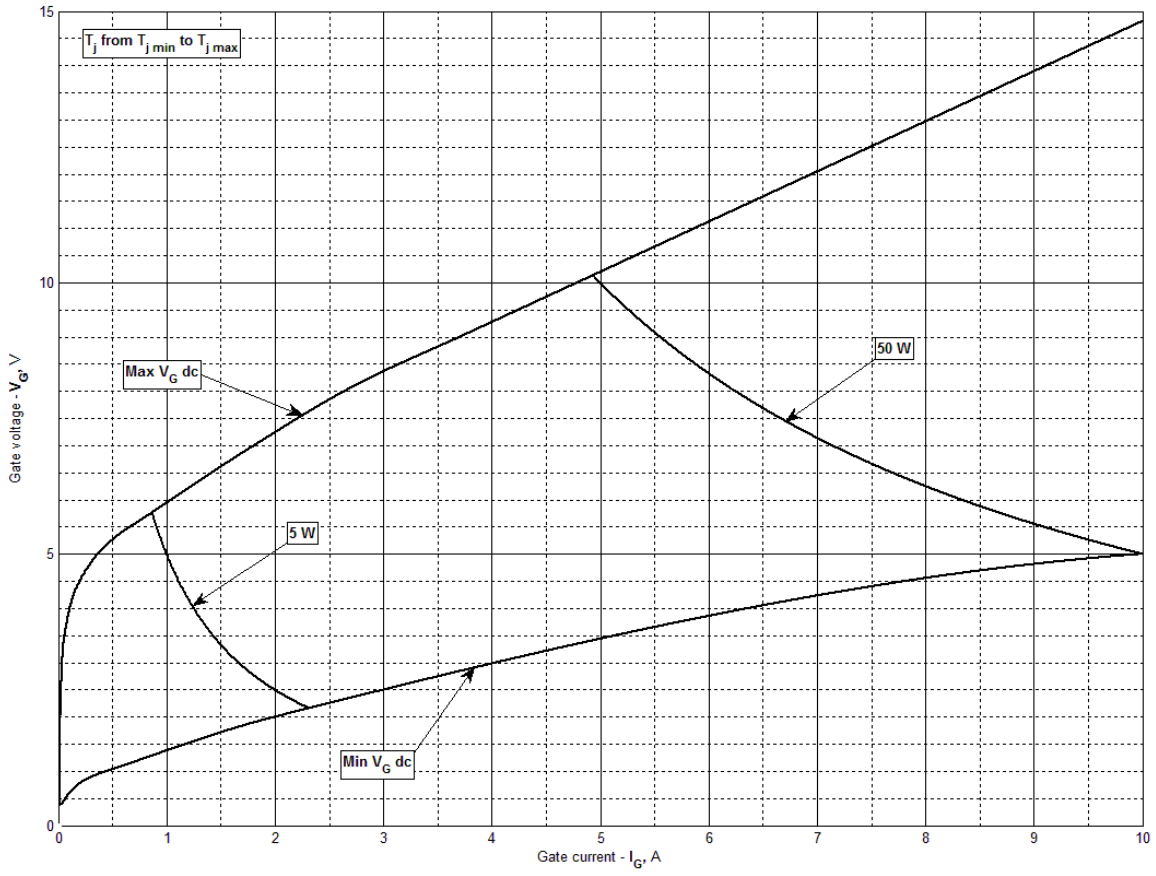

Fig 4 - Gate characteristics – Power curves

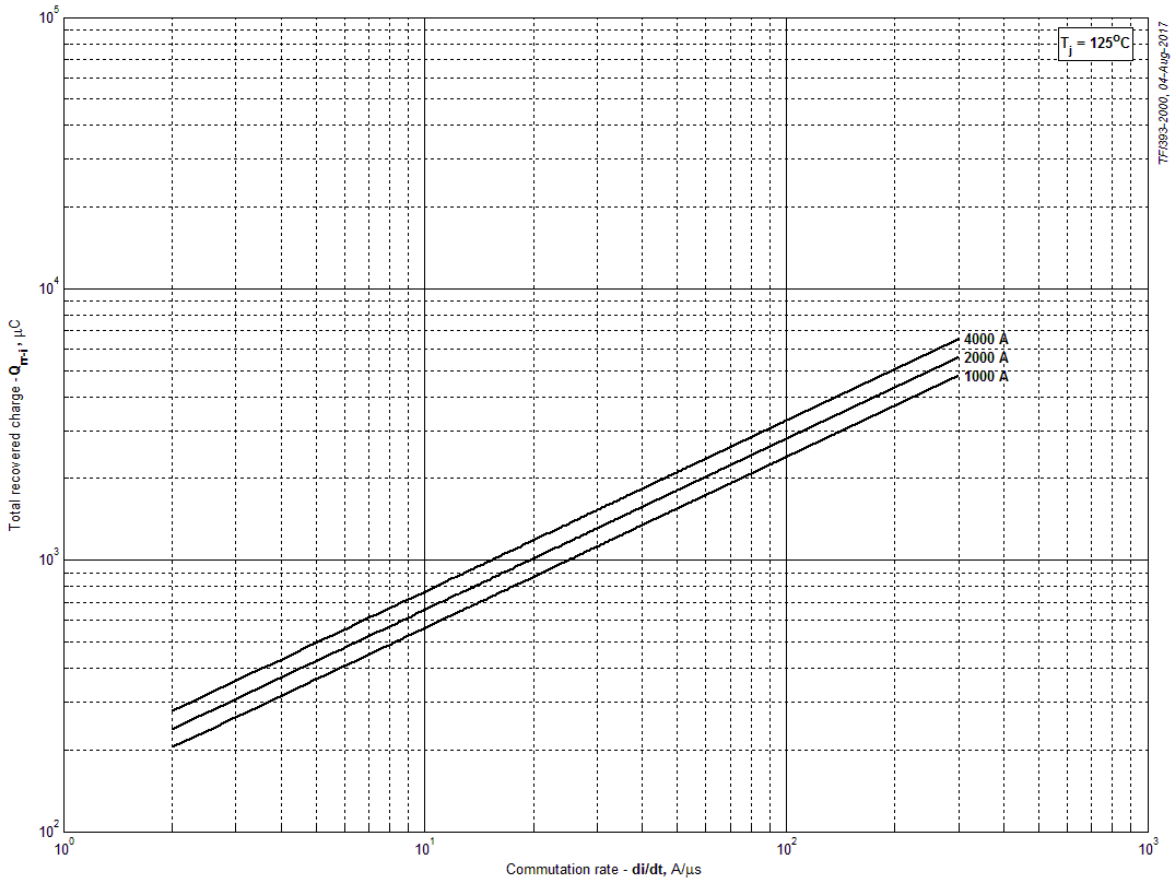

Fig 5 - Total recovered charge, Q_{rr-i} (integral)

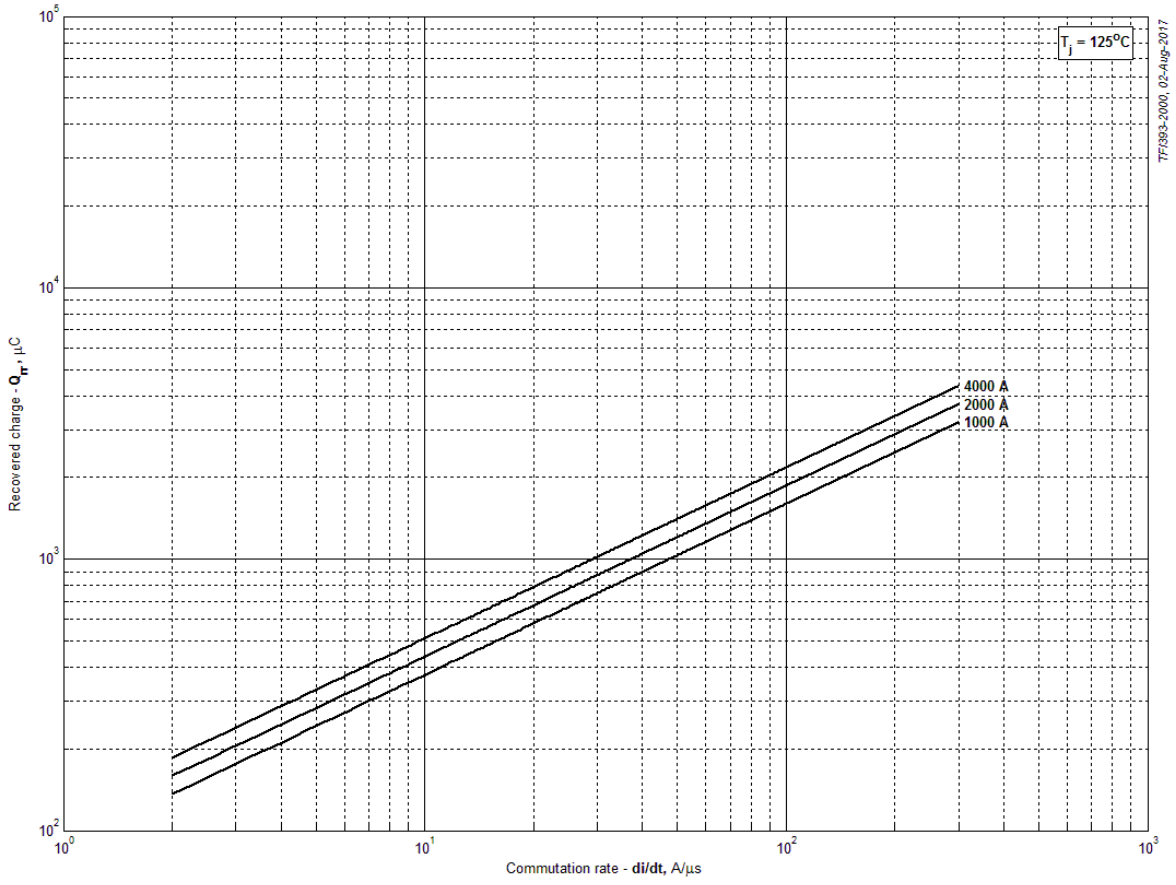

Fig 6 - Recovered charge, Q_{rr} (linear)

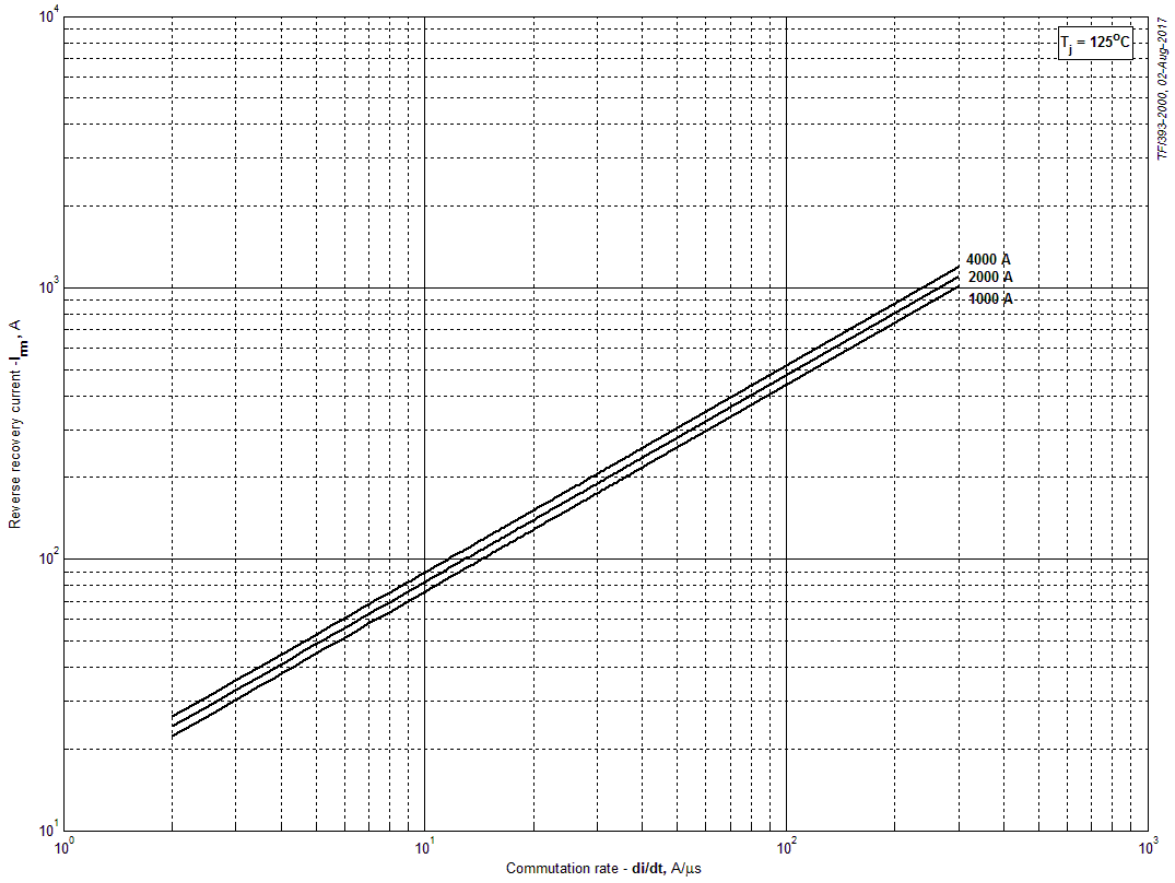

Fig 7 - Peak reverse recovery current, I_{rm}

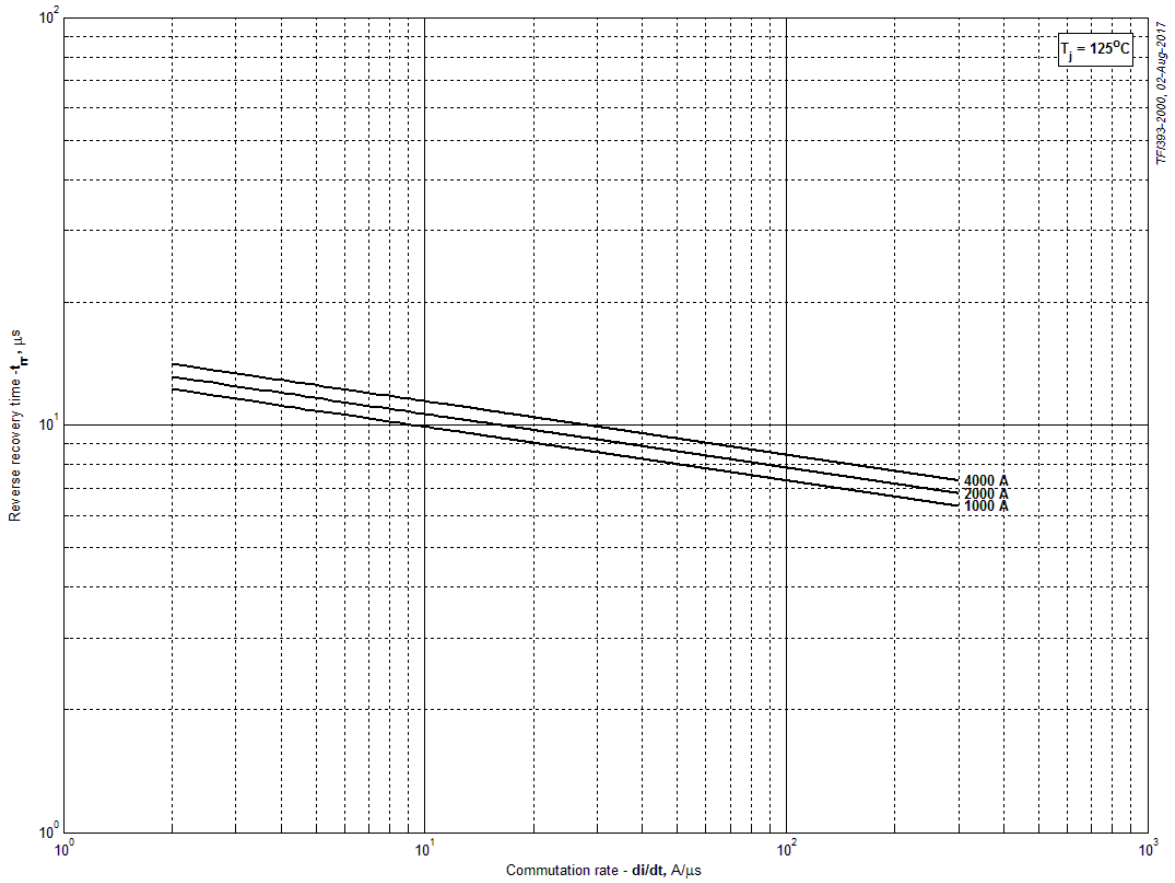

Fig 8 - Recovery time, t_{rr} (50% chord)

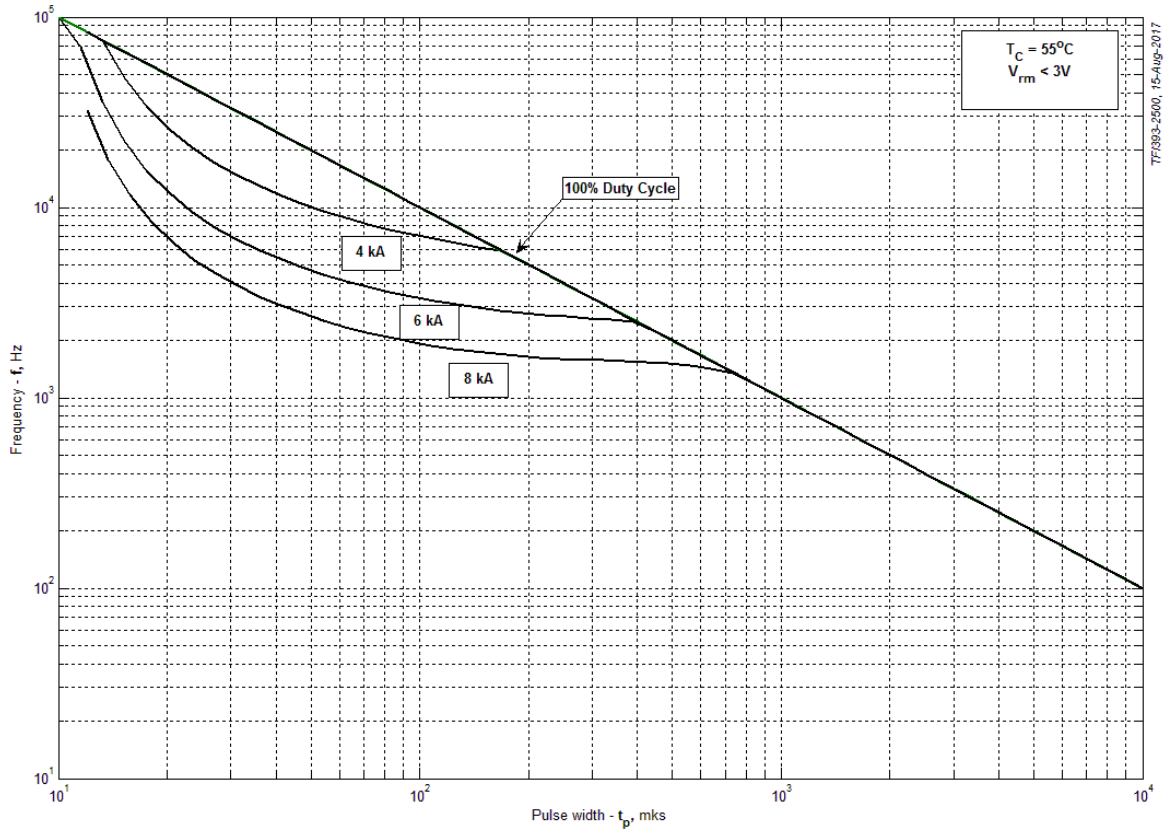

Fig 9 - Sine wave frequency ratings

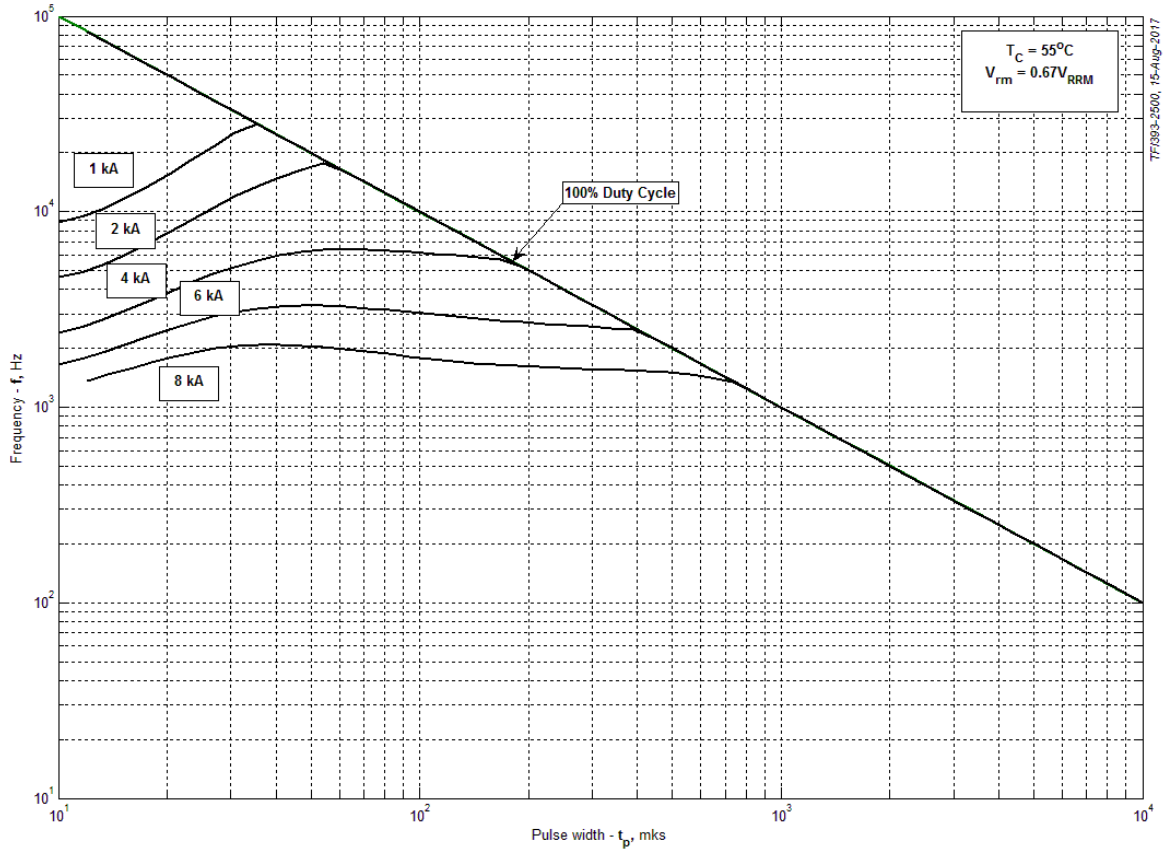

Fig 10 - Sine wave frequency ratings

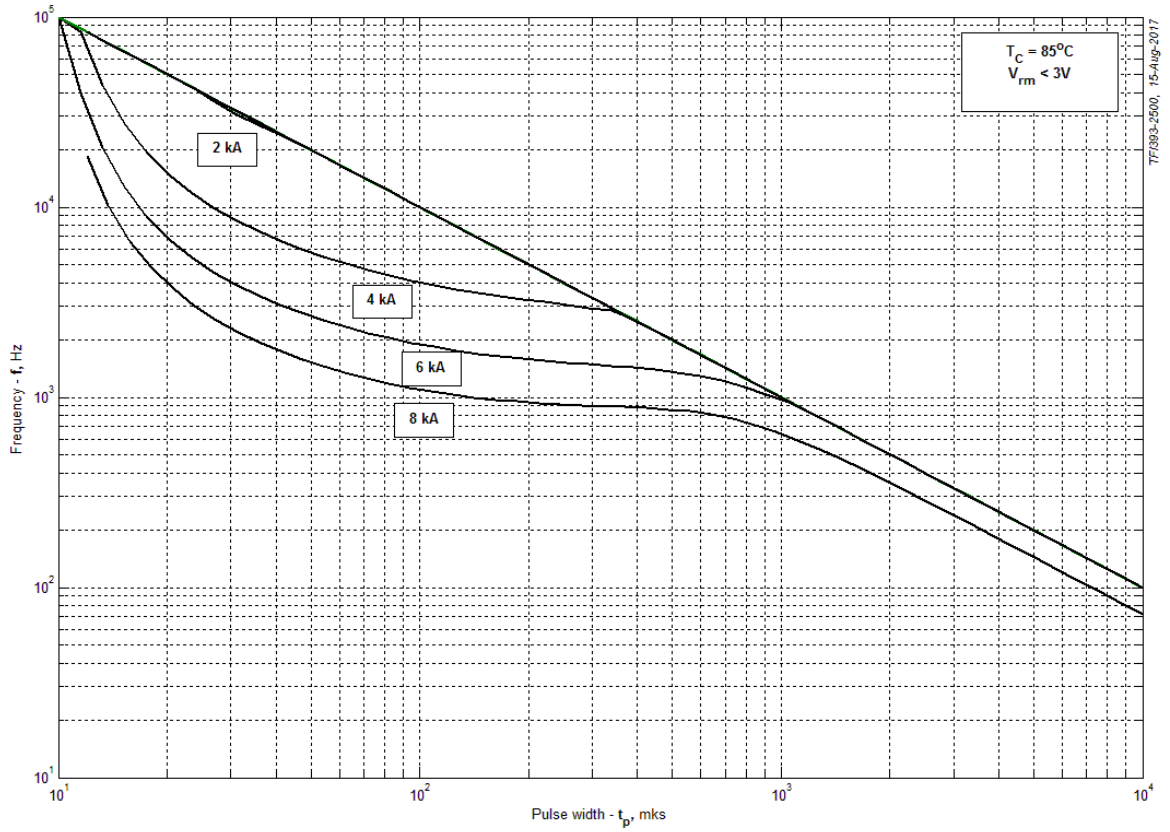

Fig 11 - Sine wave frequency ratings

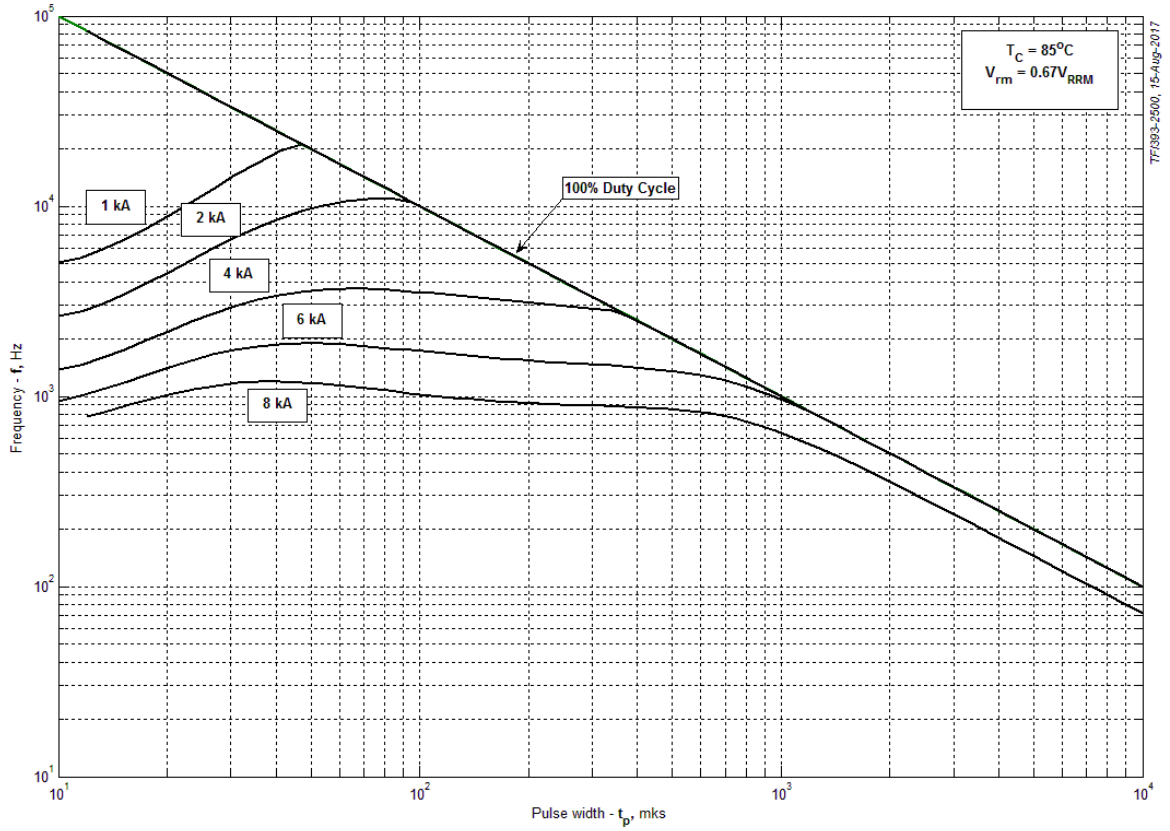

Fig 12 - Sine wave frequency ratings

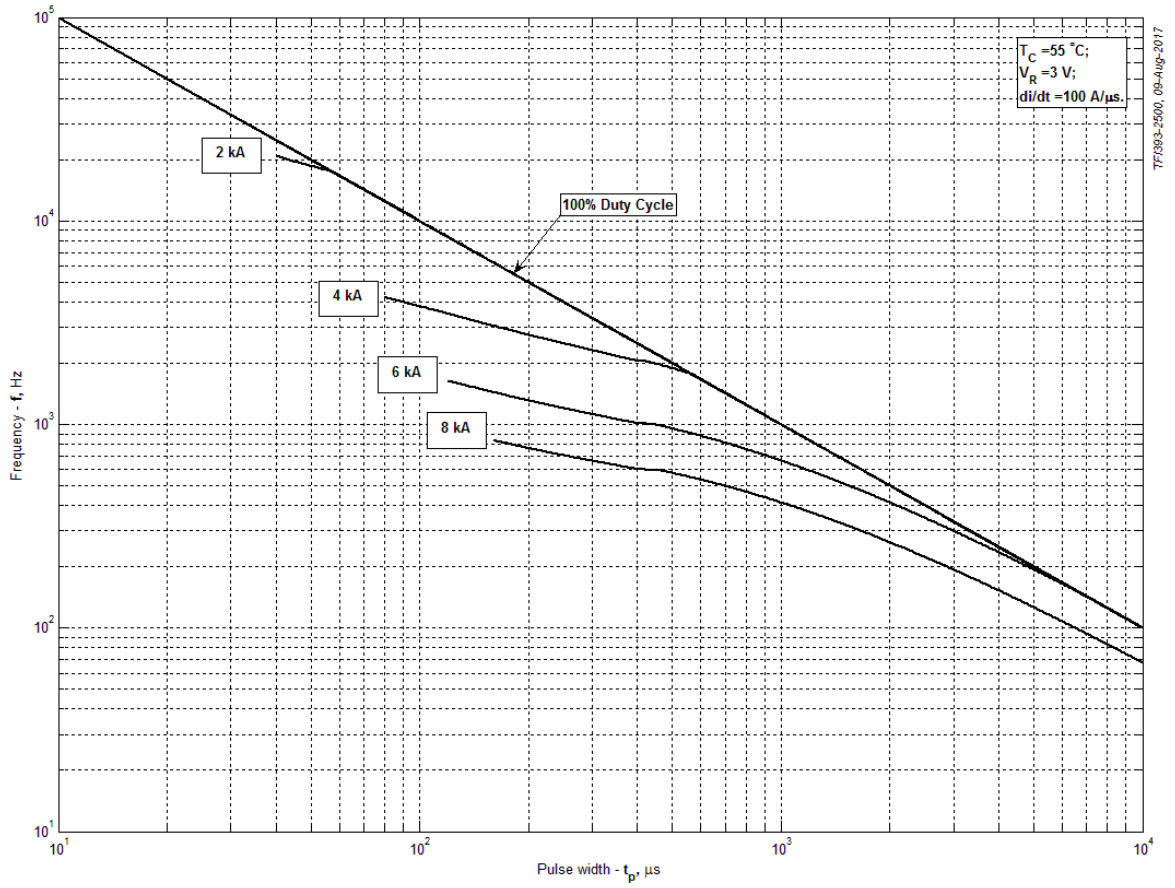

Fig 13 - Square wave frequency ratings

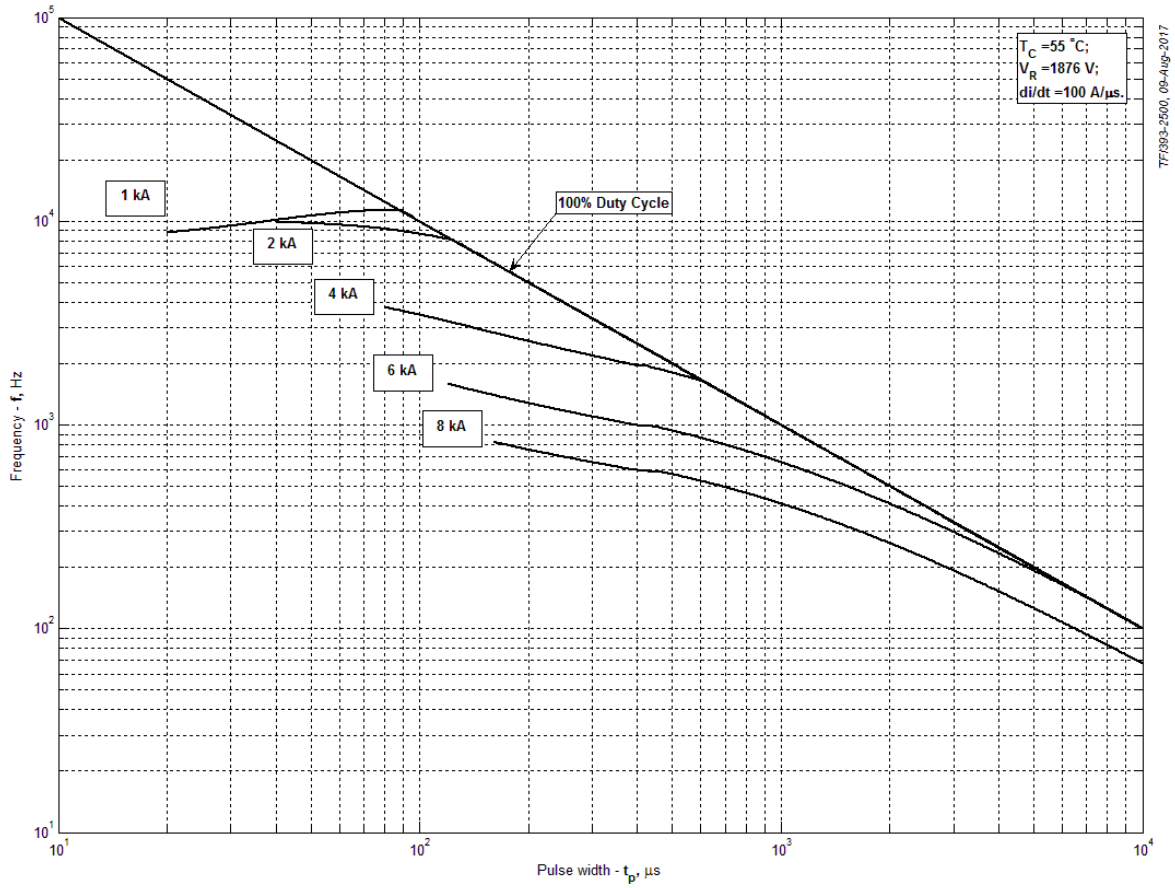

Fig 14 - Square wave frequency ratings

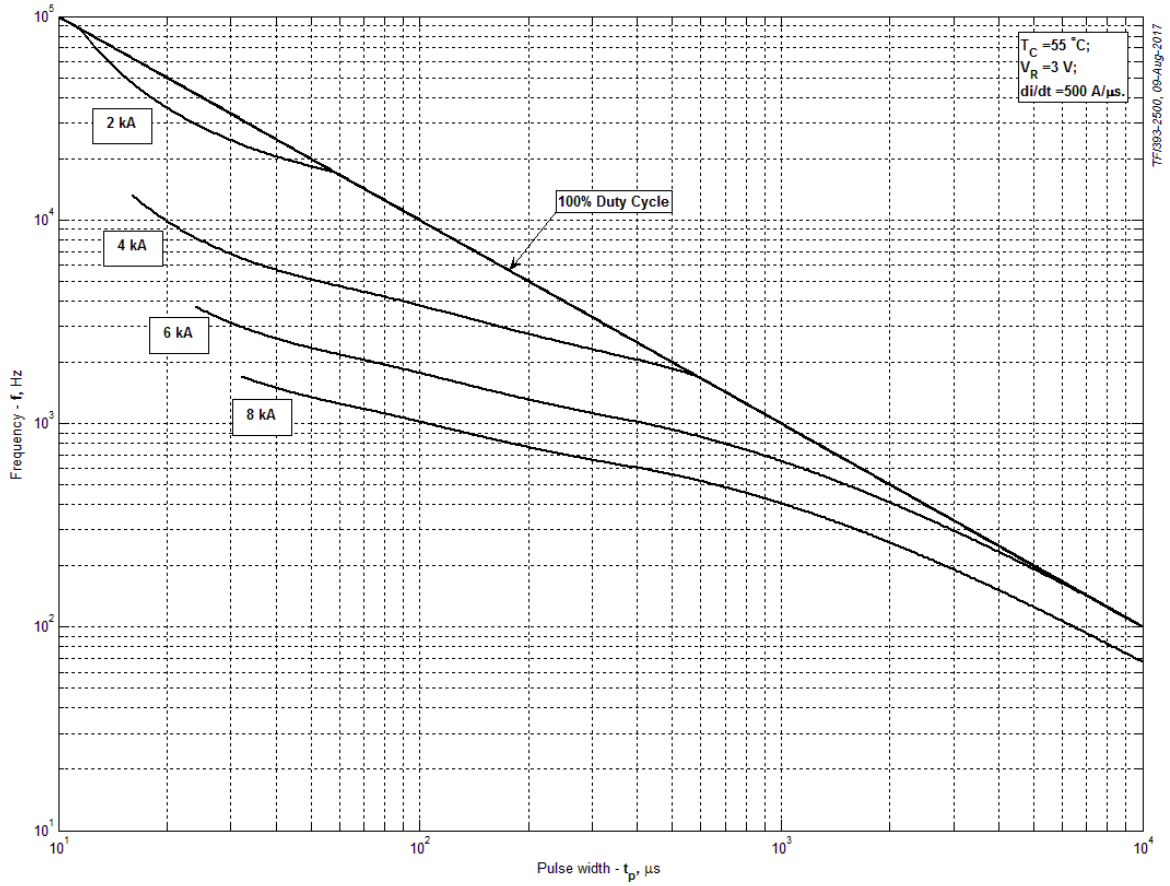

Fig 15 - Square wave frequency ratings

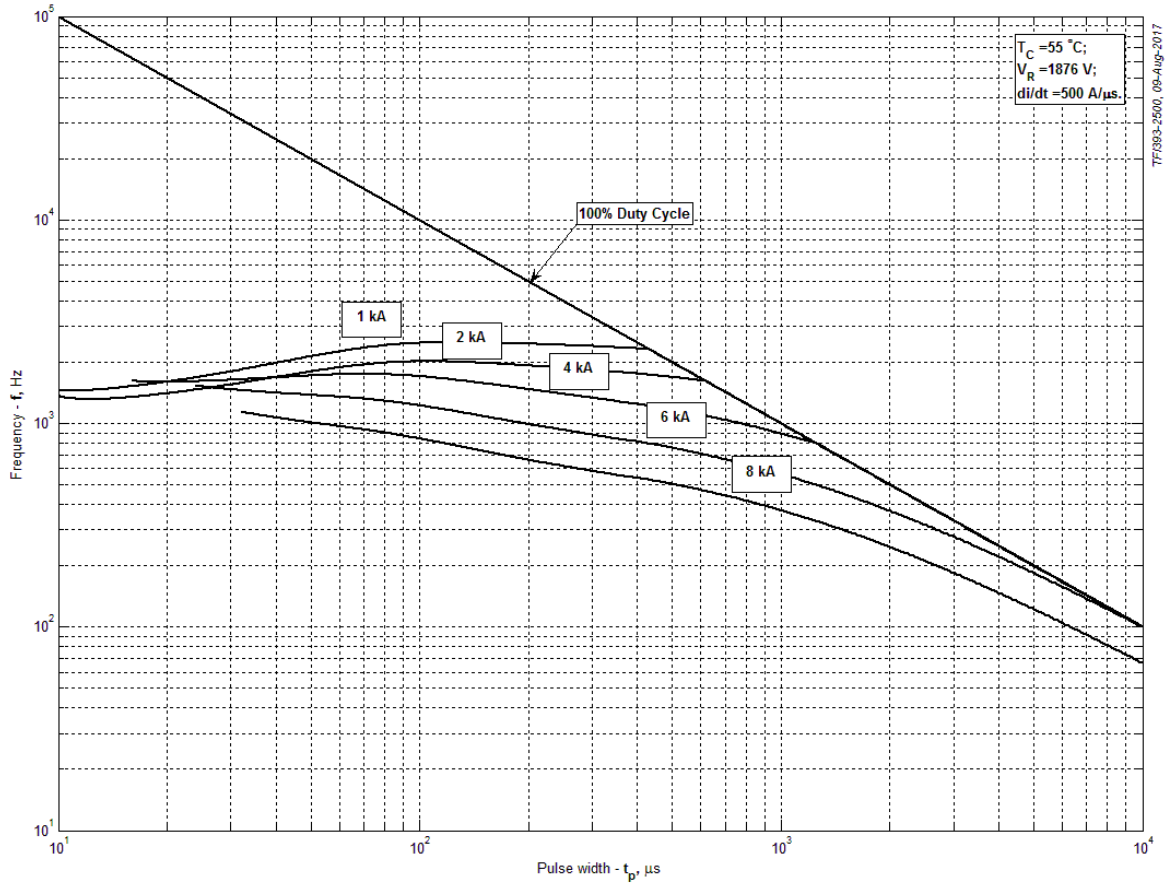

Fig 16 - Square wave frequency ratings

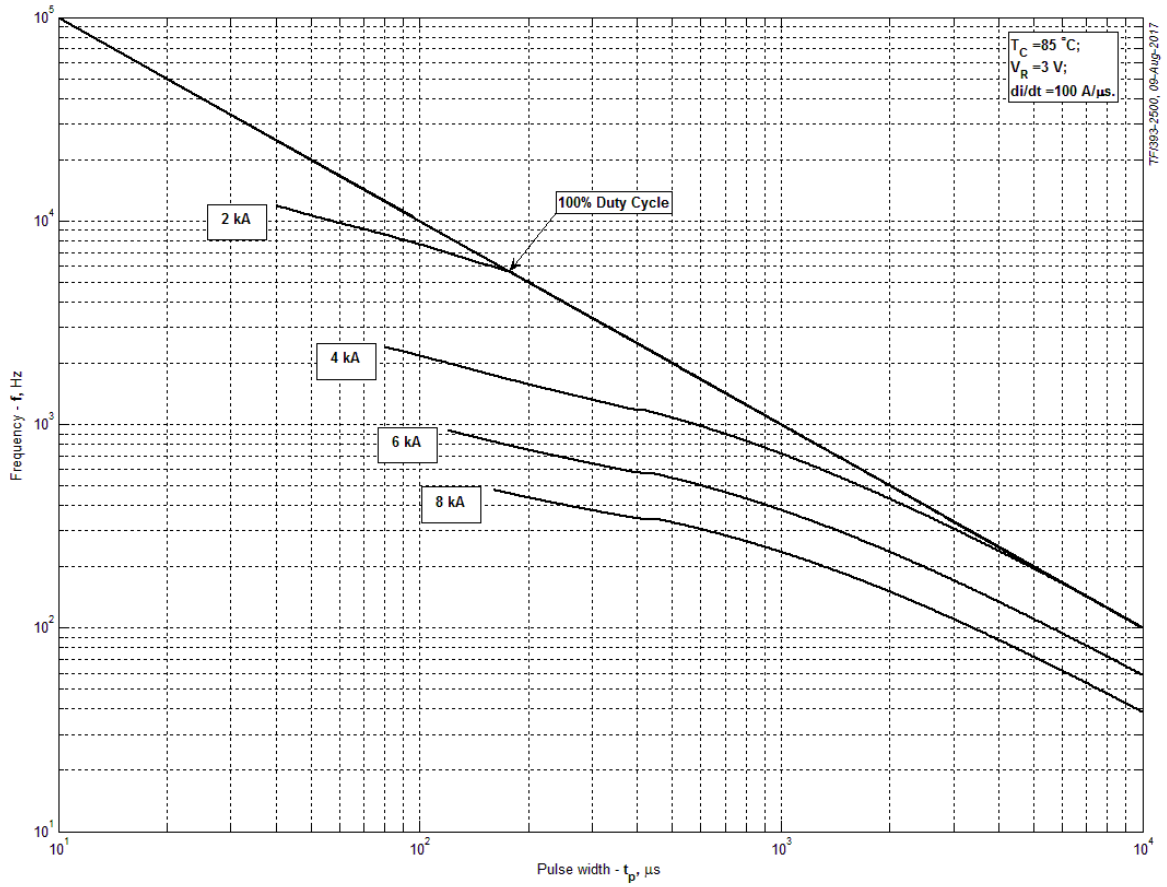

Fig 17 - Square wave frequency ratings

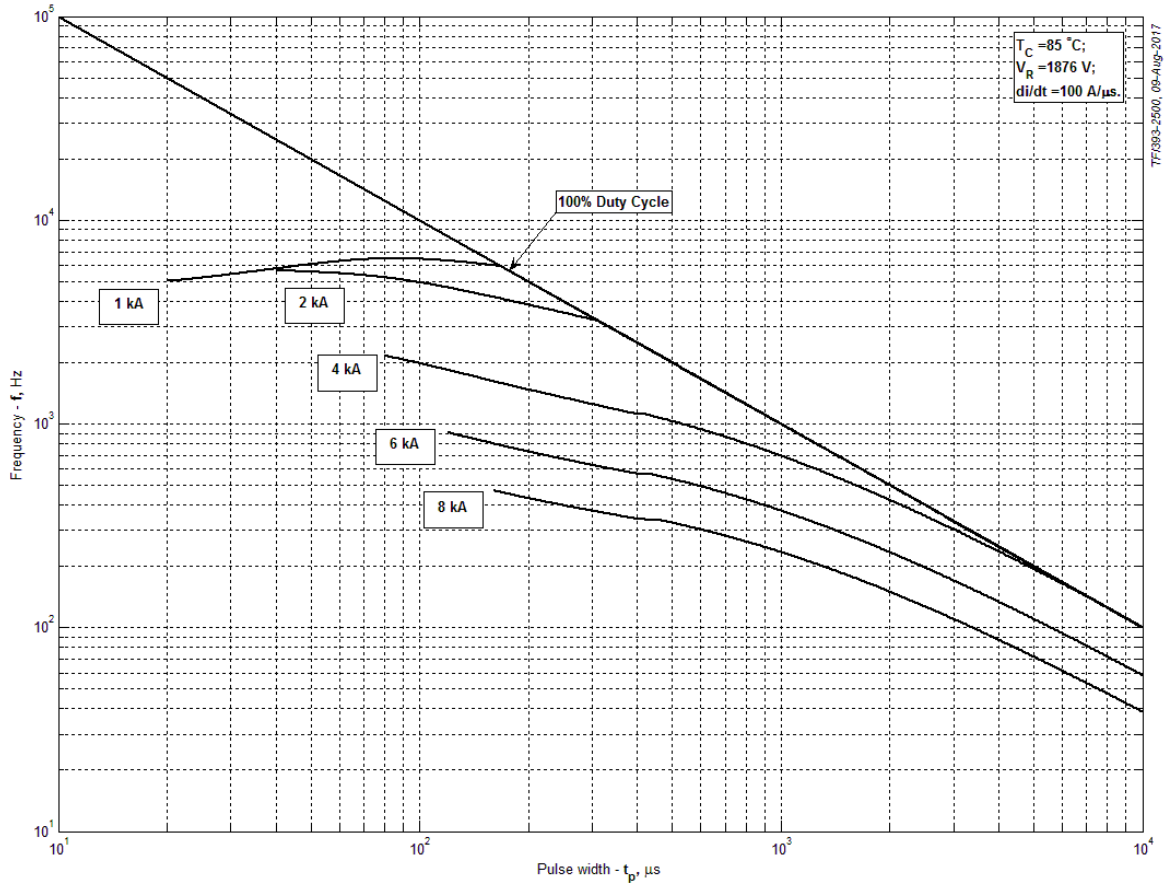

Fig 18 - Square wave frequency ratings

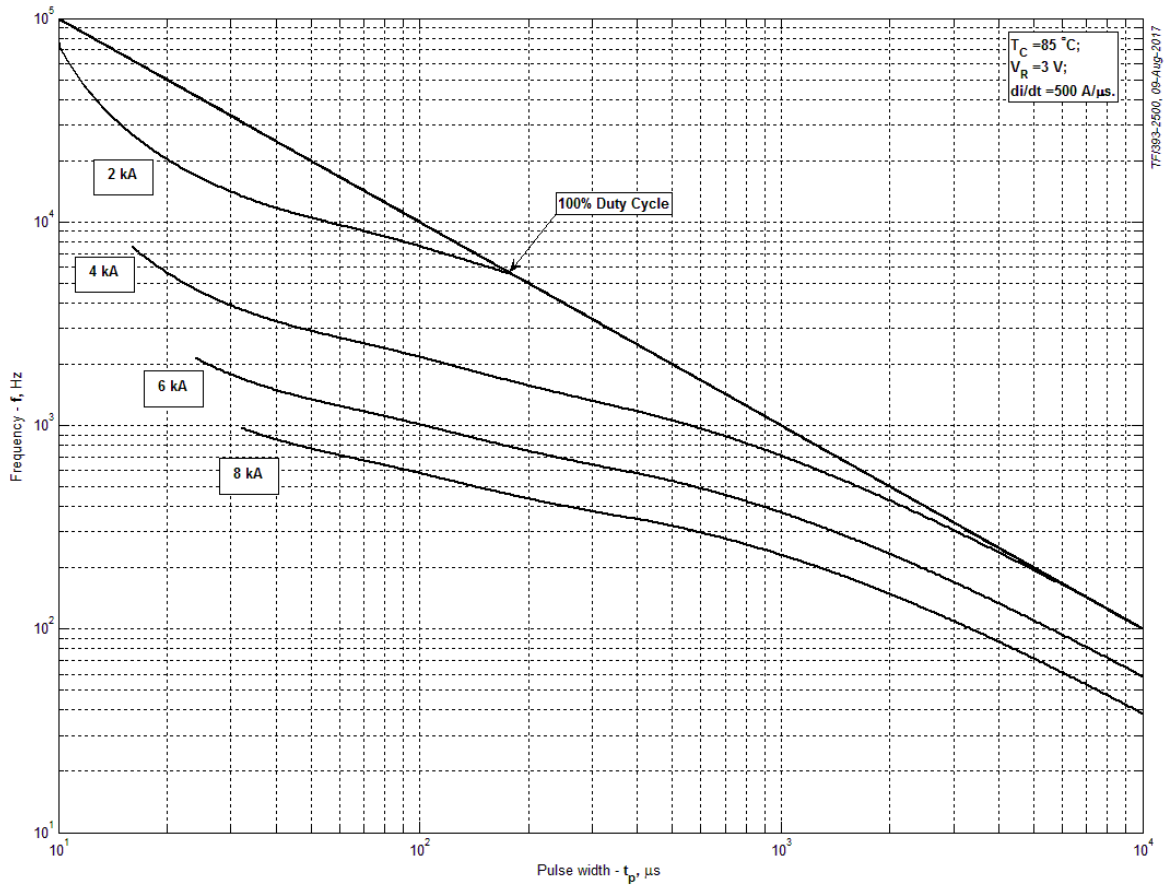

Fig 19 - Square wave frequency ratings

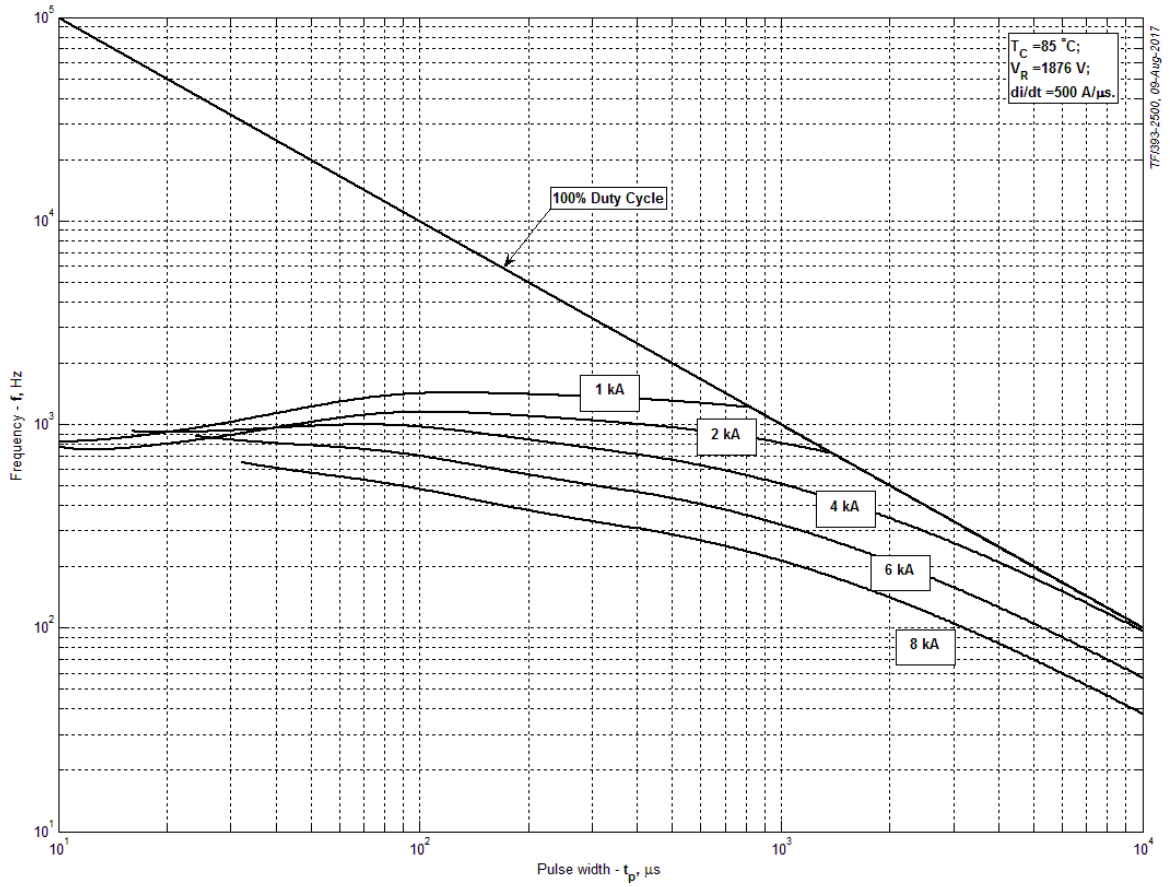

Fig 20 - Square wave frequency ratings

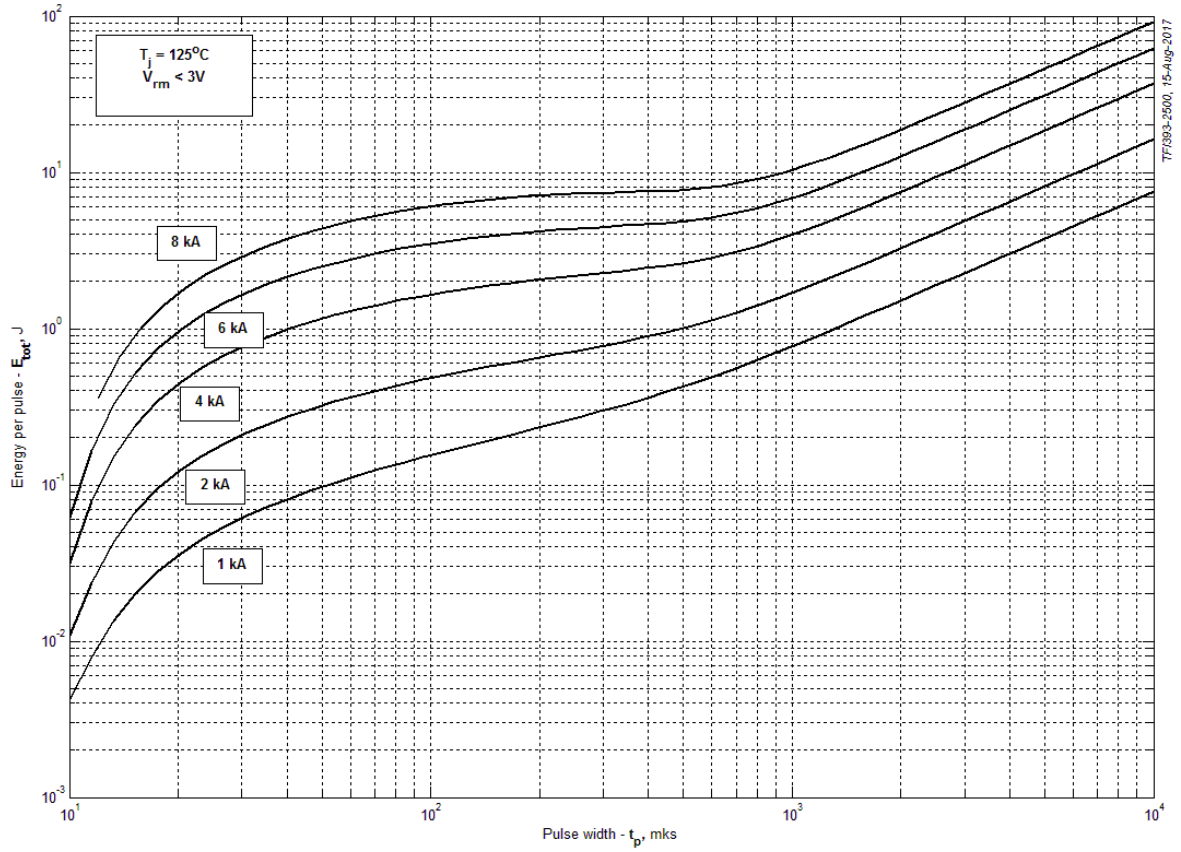

Fig 21 - Sine wave loss energy per pulse

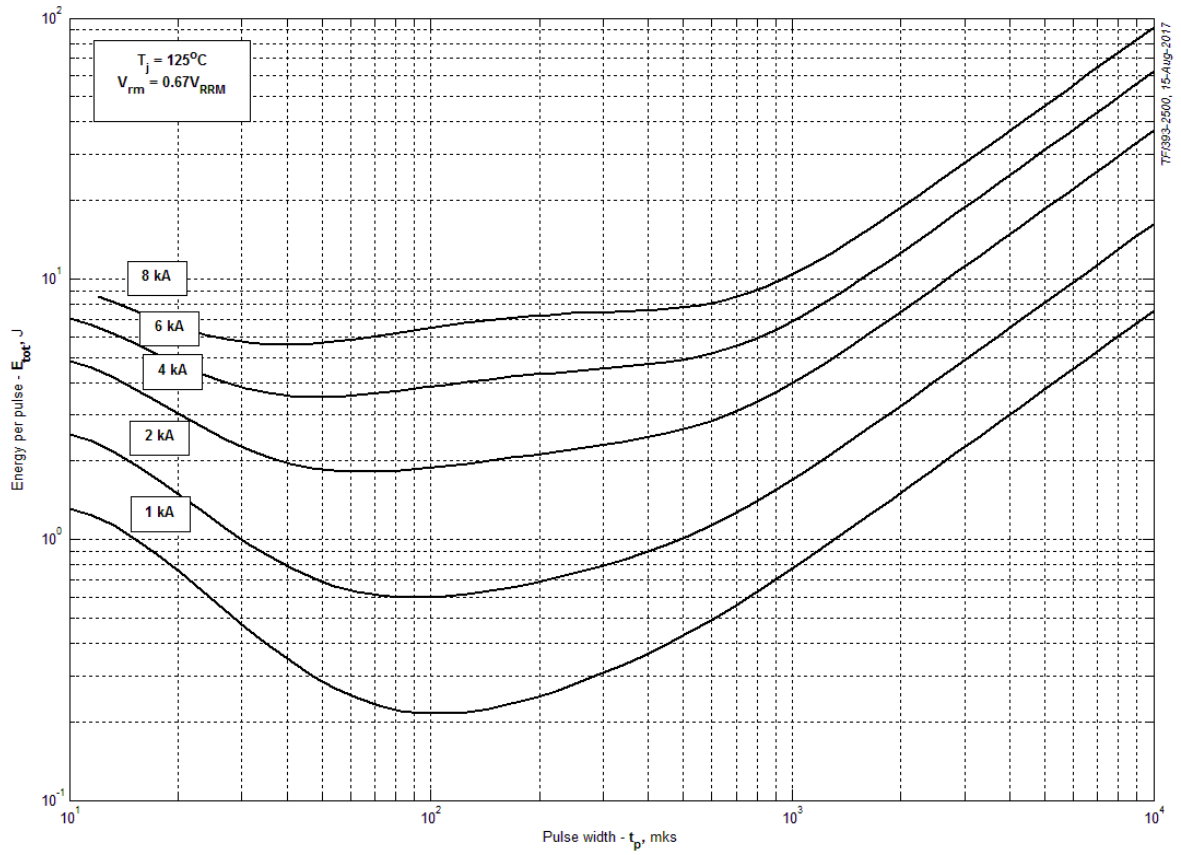

Fig 22 - Sine wave loss energy per pulse

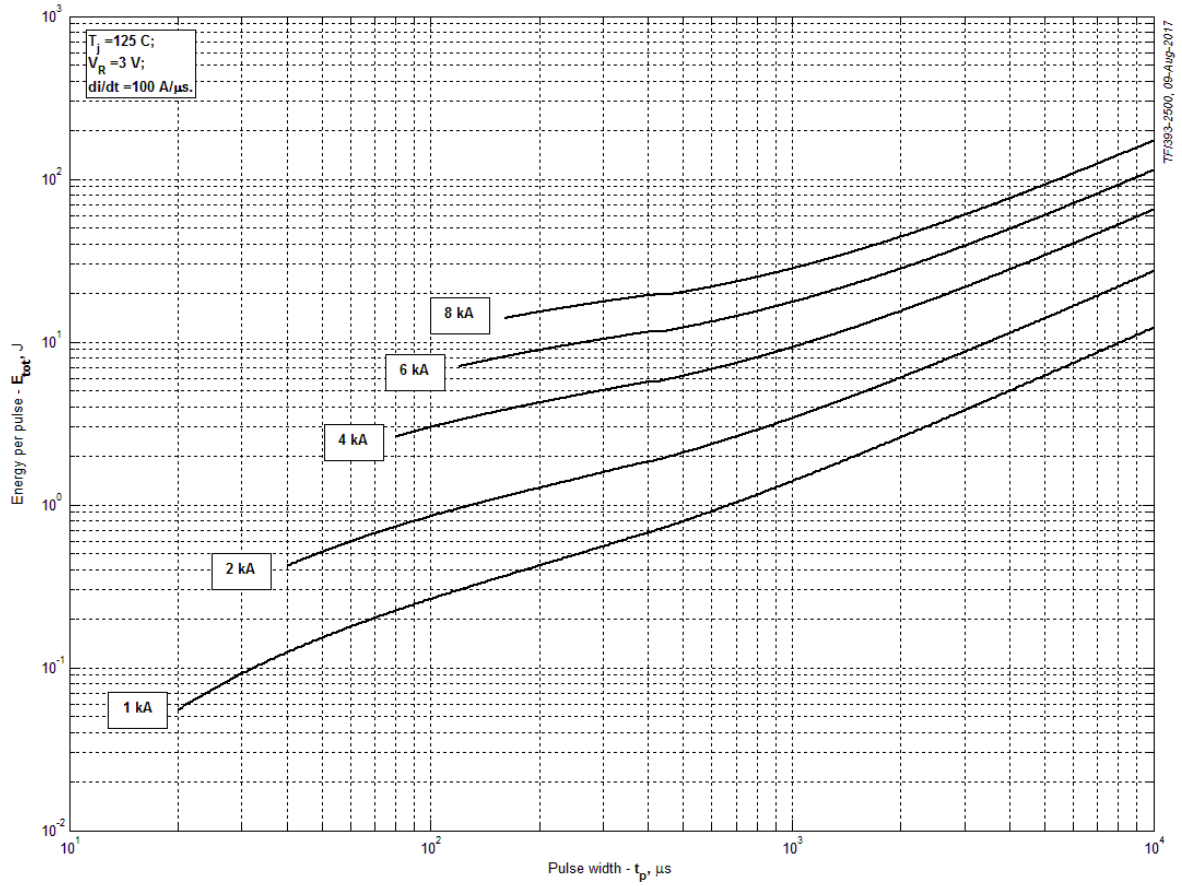

Fig 23 - Square wave loss energy per pulse

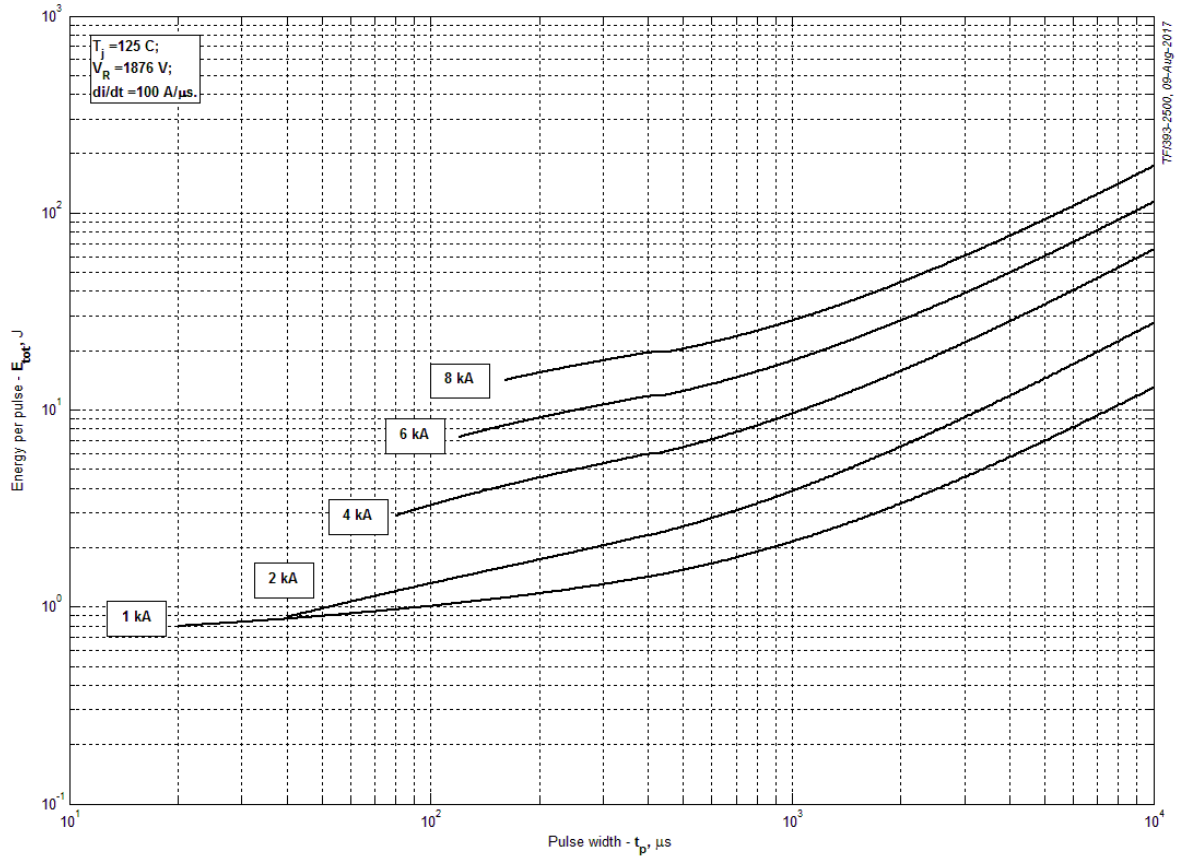

Fig 24 - Square wave loss energy per pulse

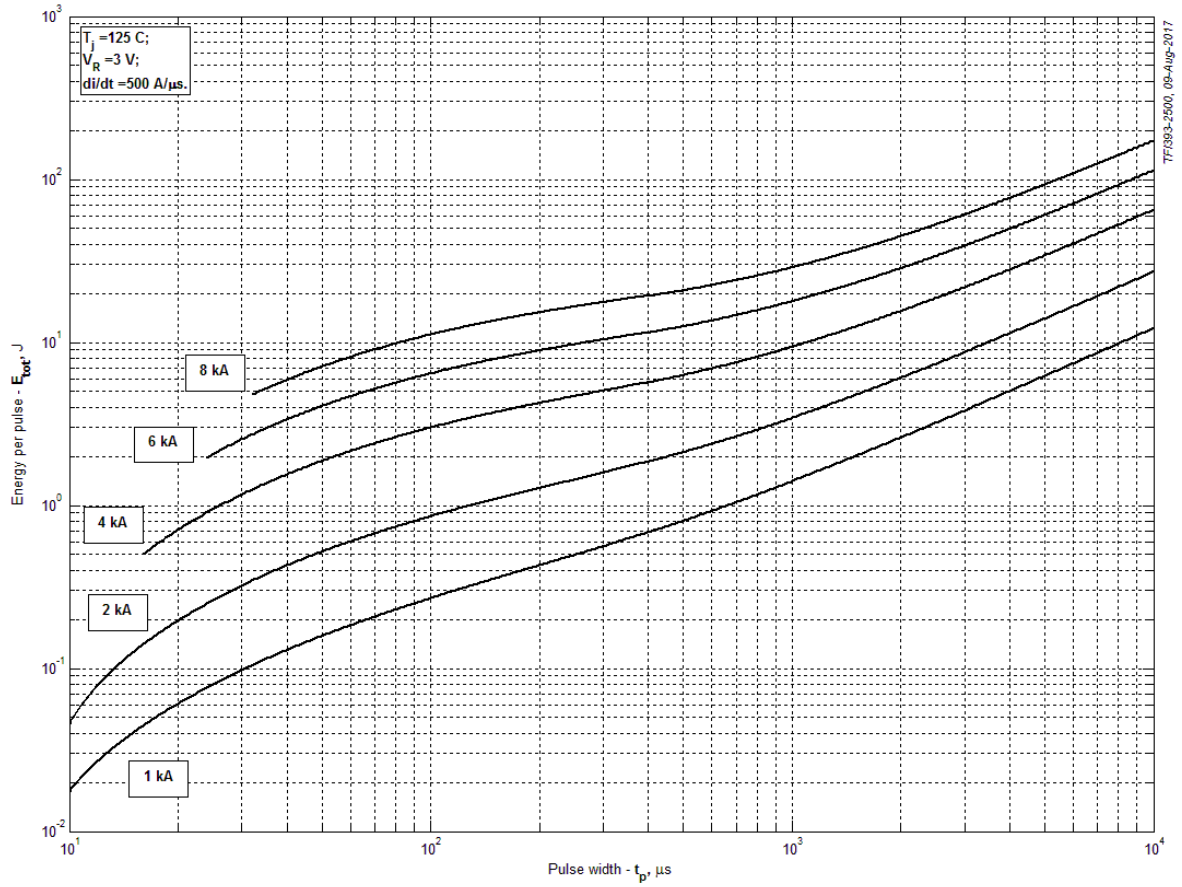

Fig 25 - Square wave loss energy per pulse

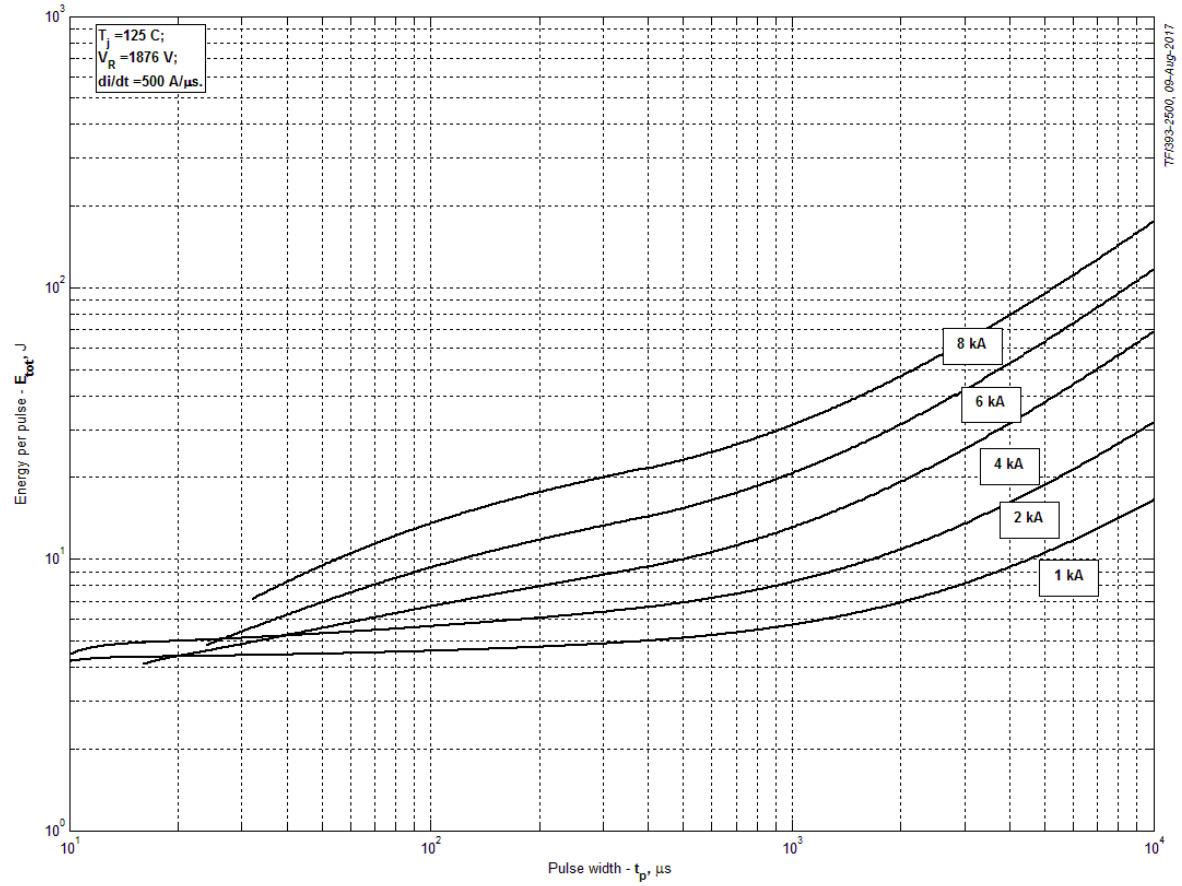

Fig 26 - Square wave loss energy per pulse

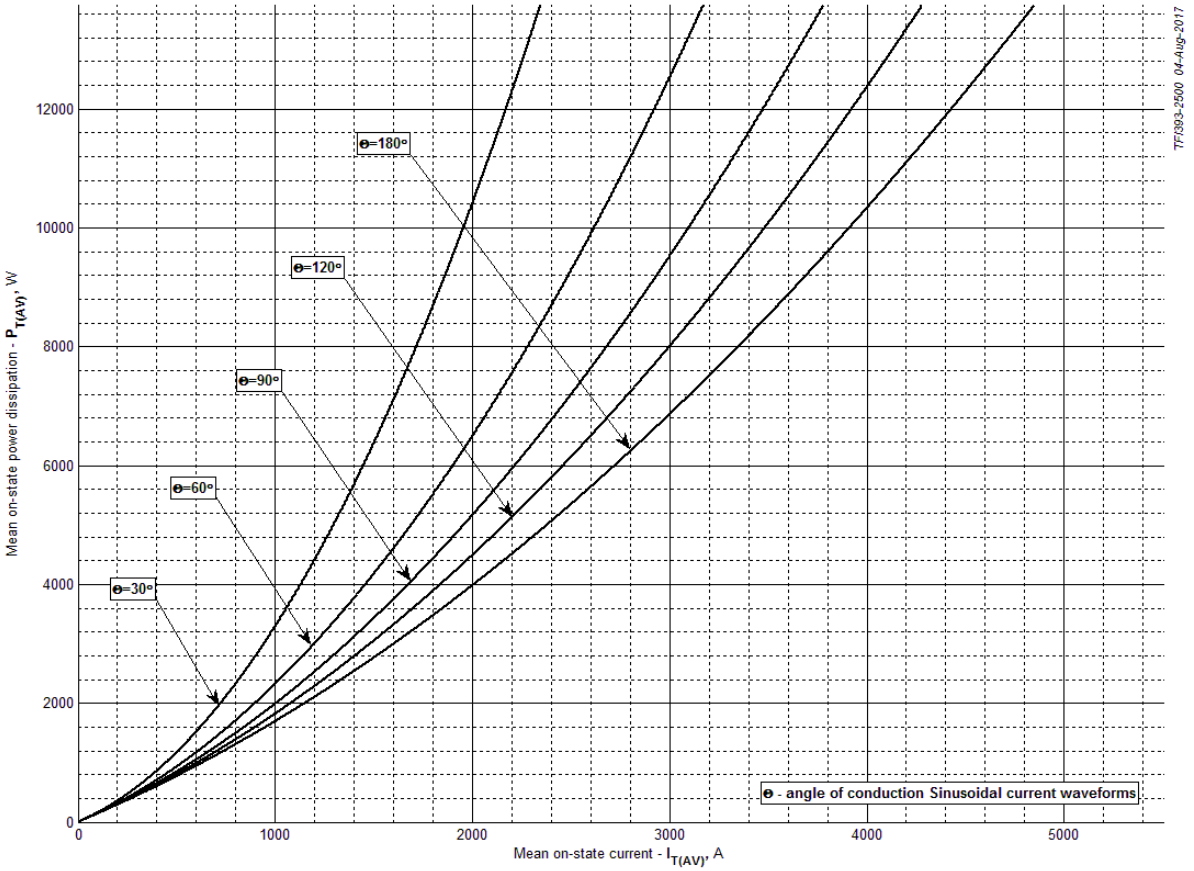

Fig 27 – On-state power loss (sinusoidal current waveforms)

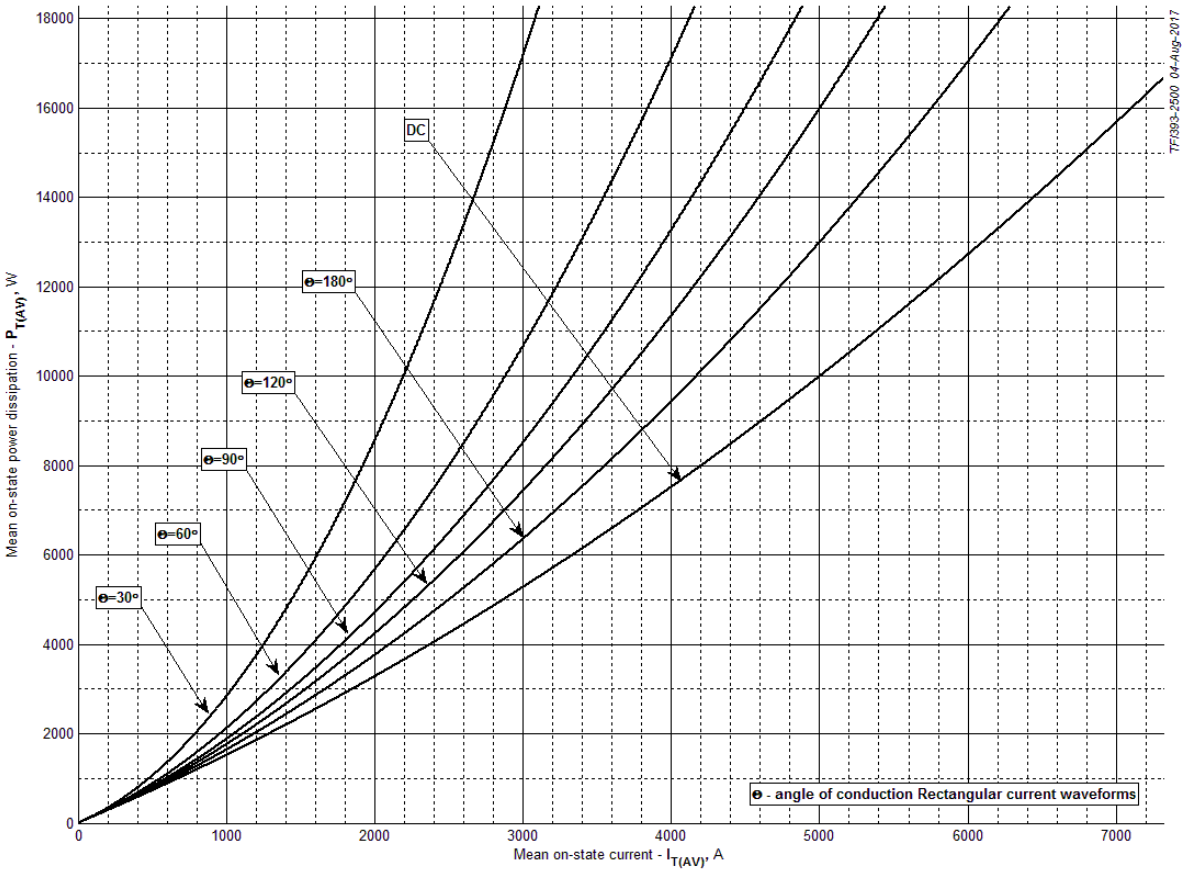

Fig 28 - On-state power loss (rectangular current waveforms)

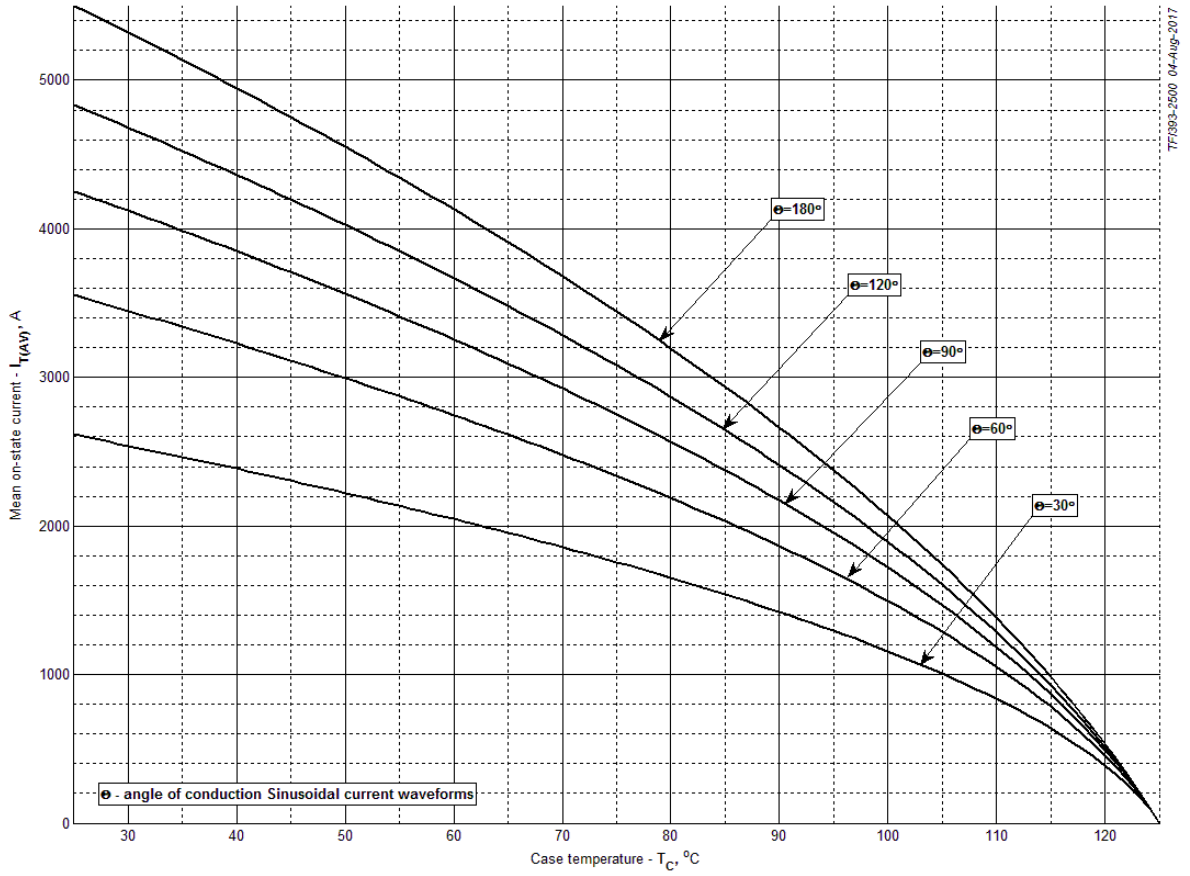

Fig 29 – Maximum case temperature (sinusoidal current waveforms)

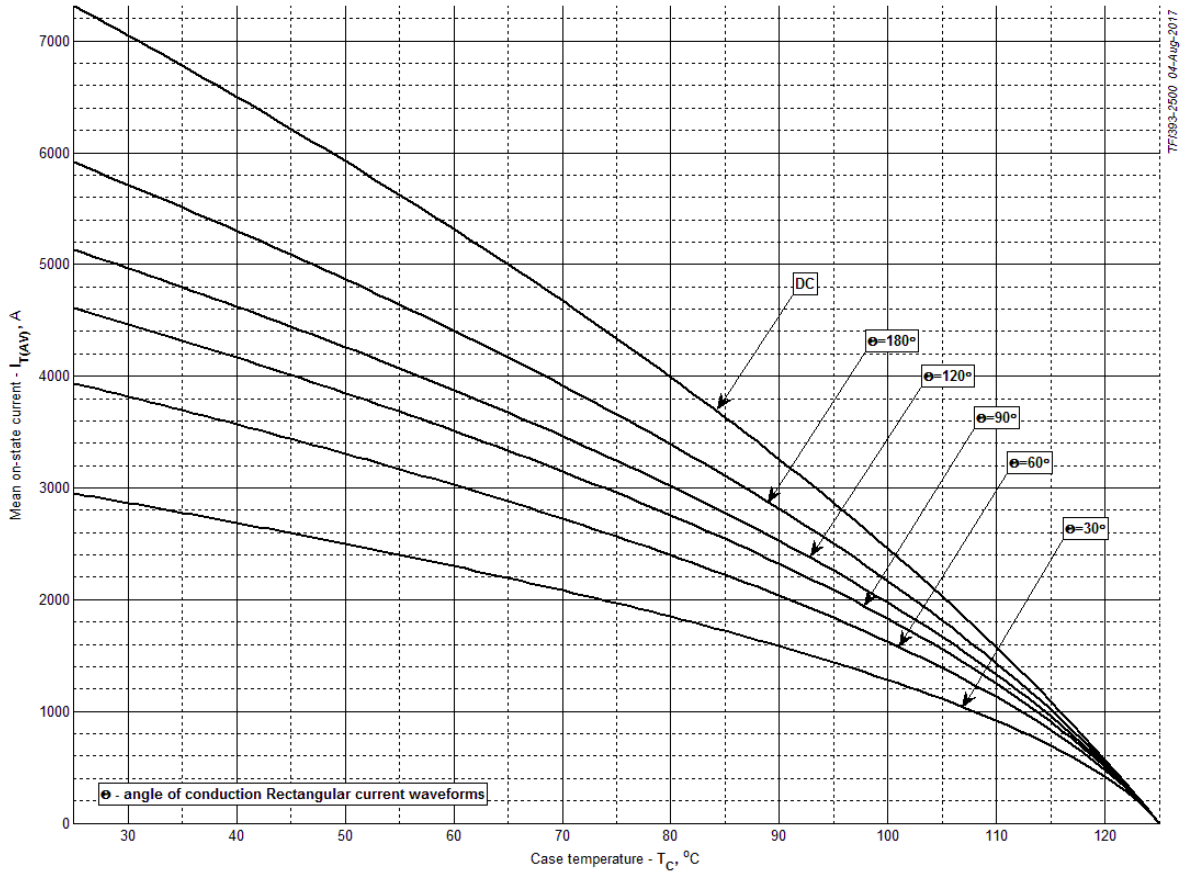

Fig 30 - Maximum case temperature (rectangular current waveforms)

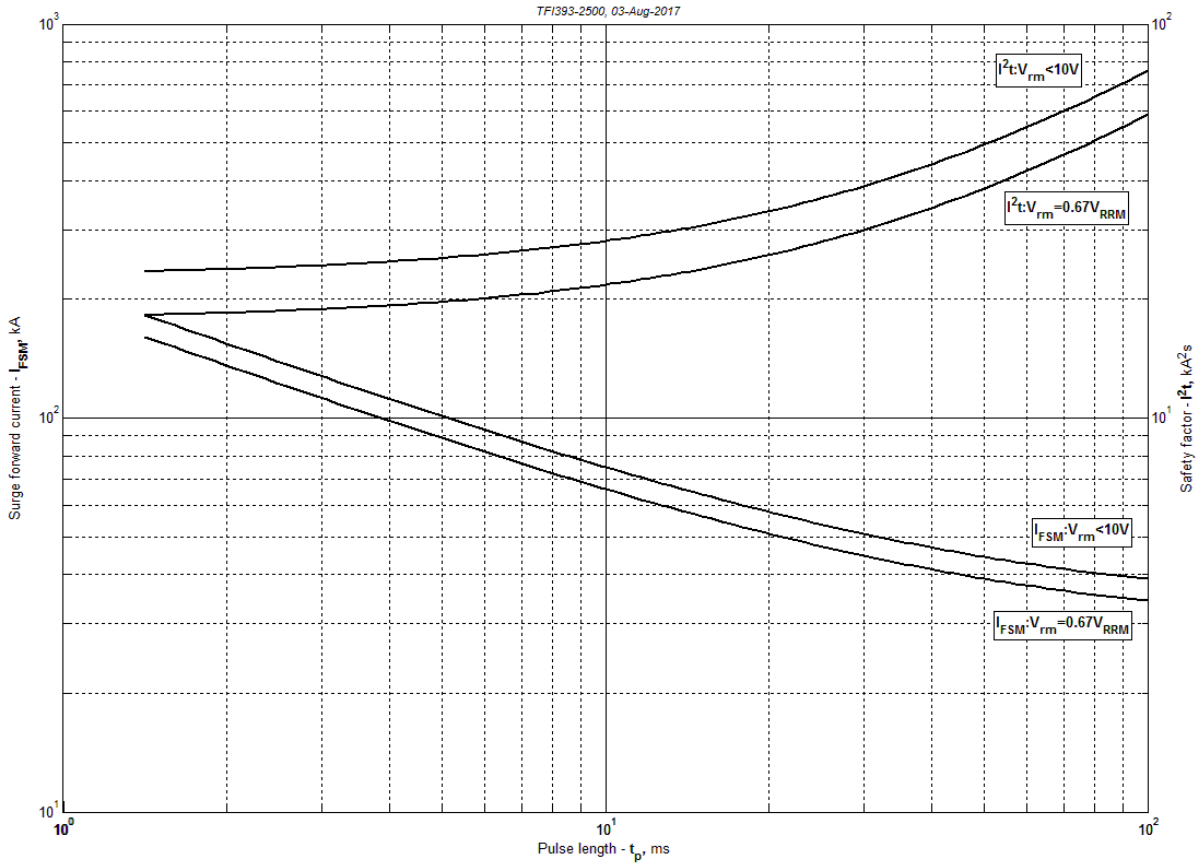

Fig 31 – Maximum surge and I^2t ratings

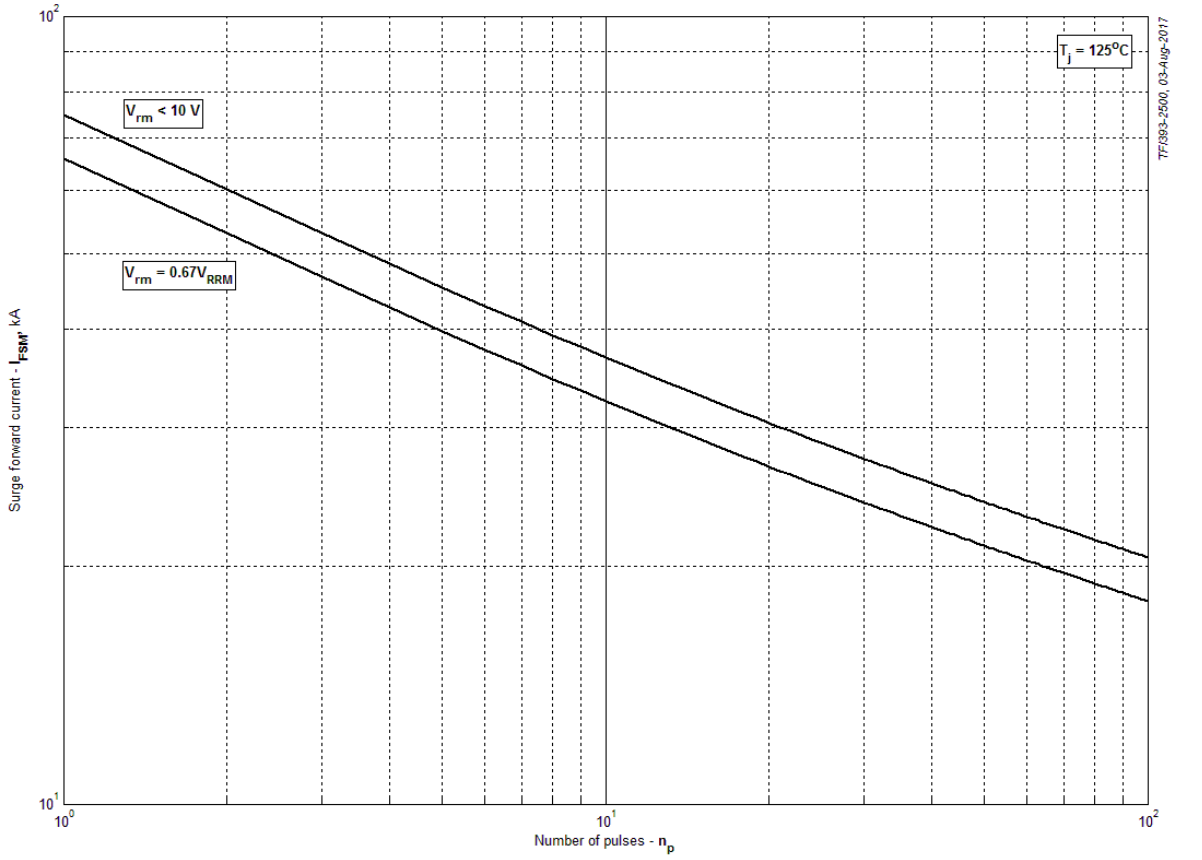

Fig 32 - Maximum surge ratings