



Fast Thyristor
Type TFI143-400-15

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

Mean on-state current				I _{TAV}		400 A	
Repetitive peak off-state voltage				V _{DRM}		1000...1500 V	
Repetitive peak reverse voltage				V _{RRM}			
Turn-off time				t _q		10.0, 12.5, 16.0, 20.0 μs	
V _{DRM} , V _{RRM} , V	1000	1100	1200	1300	1400	1500	
Voltage code	10	11	12	13	14	15	
T _J , °C	-60...+125						

MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions	
ON-STATE					
I _{TAV}	Mean on-state current	A	400 465 688	T _c = 92 °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	628	T _c = 92 °C; Double side cooled; 180° half-sine wave; 50 Hz	
I _{TSM}	Surge on-state current	kA	9.5 11.0	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
			10.0 11.5	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 =I _{FGM} ; V _G =20 V; t _{GP} =50 μs; di _G /dt=1 A/μs
I ² t	Safety factor	A ² s·10 ³	450 600	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
			410 540	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	1000...1500	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...1600	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	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·V _{DRM} ; I _{TM} =3700 A; 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...+50	
T _j	Operating junction temperature	°C	−60...+125	
MECHANICAL				
F	Mounting force	kN	14.0...16.0	
a	Acceleration	m/s ²	50	Device clamped

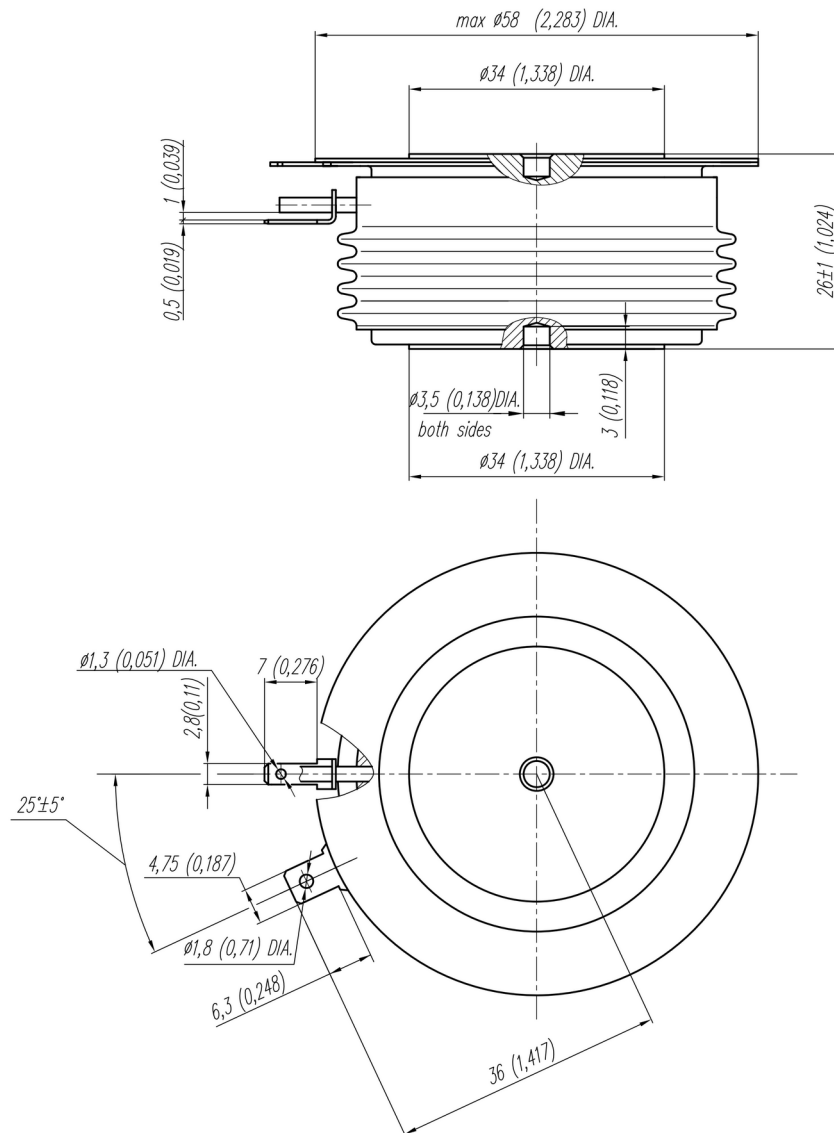
CHARACTERISTICS

Symbols and parameters		Units	Values	Conditions	
ON-STATE					
V _{TM}	Peak on-state voltage, max	V	2.85	T _j =25 °C; I _{TM} = 1256 A	
V _{T(TO)}	On-state threshold voltage, max	V	1.673	T _j =T _{j max} ;	
r _T	On-state slope resistance, max	mΩ	0.891	0.5 π I _{TAV} < I _T < 1.5 π I _{TAV}	
I _H	Holding current, max	mA	500	T _j =25 °C; V _b =12 V; Gate open	
BLOCKING					
I _{DRM} , I _{RRM}	Repetitive peak off-state and Repetitive peak reverse currents, max	mA	100	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·V _{DRM} ; Gate open	
TRIGGERING					
V _{GT}	Gate trigger direct voltage, max	V	3.00 2.50 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	0.40	T _j =T _{j max} ; V _D =0.67·V _{DRM} ;	
I _{GD}	Gate non-trigger direct current, min	mA	55.00	Direct gate current	
SWITCHING					
t _{gd}	Delay time, max	μs	0.95	T _j =25 °C; V _D =600 V; I _{TM} =I _{TAV} ; di/dt=200 A/μs;	
t _{gt}	Turn-on time ²⁾ , max	μs	2.00, 2.50, 3.20, 4.00	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 ³⁾ max	μs	10.0, 12.5, 16.0, 20.0	dv _D /dt=50 V/μs;	T _j =T _{j max} ; I _{TM} = I _{TAV} ; di _R /dt=-10 A/μs; V _R =100V; V _D =0.67·V _{DRM}
			12.5, 16.0, 20.0, 25.0	dv _D /dt=200 V/μs;	
Q _{rr}	Total recovered charge, max	μC	100	T _j =T _{j max} ; I _{TM} =400 A;	
t _{rr}	Reverse recovery time, typ	μs	3.2	di _R /dt=-50 A/μs;	
I _{rrM}	Peak reverse recovery current, max	A	80	V _R =100 V	

THERMAL					
R _{thjc}	Thermal resistance, junction to case, max	°C/W	0.0320	Direct current	Double side cooled
R _{thjc-A}			0.0704		Anode side cooled
R _{thjc-K}			0.0576		Cathode side cooled
R _{thck}	Thermal resistance, case to heatsink, max	°C/W	0.0060	Direct current	
MECHANICAL					
w	Weight, max	g	280		
D _s	Surface creepage distance	mm (inch)	27.60 (1.087)		
D _a	Air strike distance	mm (inch)	16.00 (0.630)		

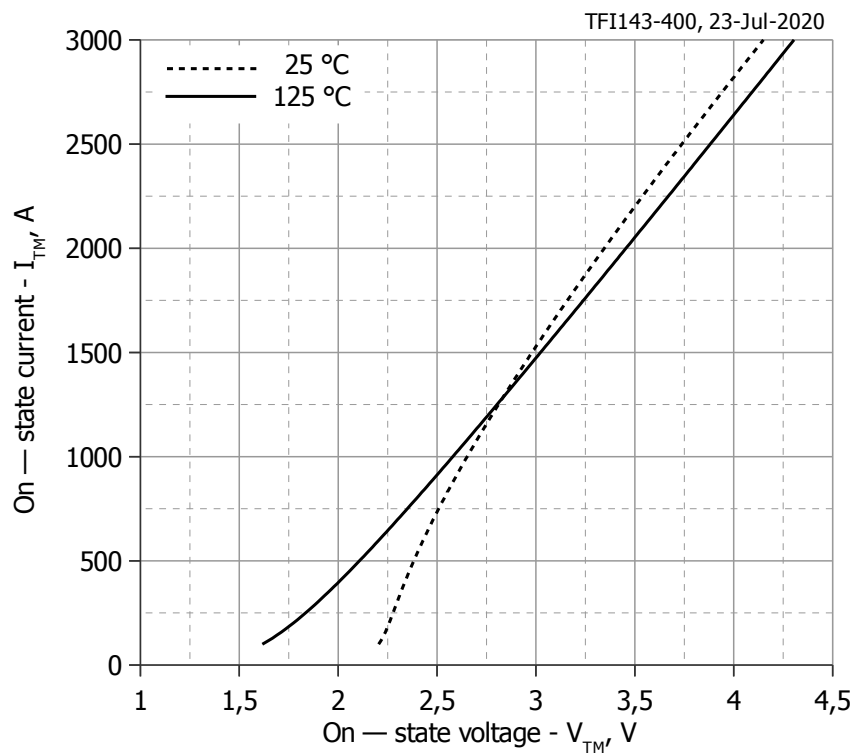
PART NUMBERING GUIDE							
TFI	143	400	15	A2	P3	H4	N
1	2	3	4	5	6	7	8
1. TFI — fast inverter thyristor							
2. Design version							
3. Mean on-state current, A							
4. Voltage code							
5. Critical rate of rise of off-state voltage							
6. Group of turn-off time (dv _D /dt=50 V/μs)							
7. 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	P4	M4	K4	H4			
t _{gt} , μs	2.00	2.50	3.20	4.00			
3)Turn-off time (dv _D /dt=50 V/μs)							
Symbol of group	A4	X3	T3	P3			
t _{gr} , μs	10.0	12.5	16.0	20.0			



All dimensions in millimeters (inches)

The information contained herein is confidential and protected by Copyright.
In the interest of product improvement, Proton-Electrotex reserves the right to change data sheet without notice.

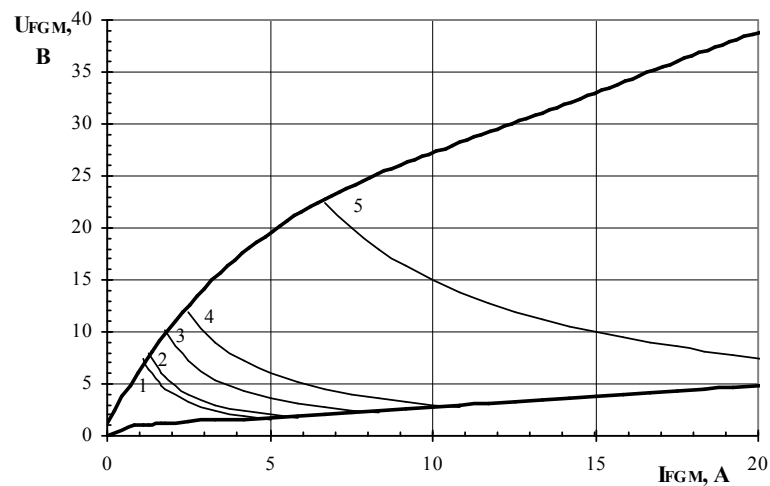


Analytical function for On-state characteristic:

$$V_T = A + B \cdot i_T + C \cdot \ln(i_T + 1) + D \cdot \sqrt{i_T}$$

	Coefficients for max curves	
	$T_j = 25^\circ\text{C}$	$T_j = T_{j\max}$
A	1.53529589	1.00378110
B	0.00130630	0.00082807
C	0.24627785	0.12081582
D	-0.05980358	-0.00275318

Fig. 1 On-state characteristics of Limit device



Maximum peak gate power loss

Position	On-Off time ratio	Gate pulse length, ms	Gate Pulse Power, W
1	1	DC	8
2	2	10	10
3	20	1	18
4	40	0.5	30
5	200	0.1	150

Fig. 2 Gate characteristics

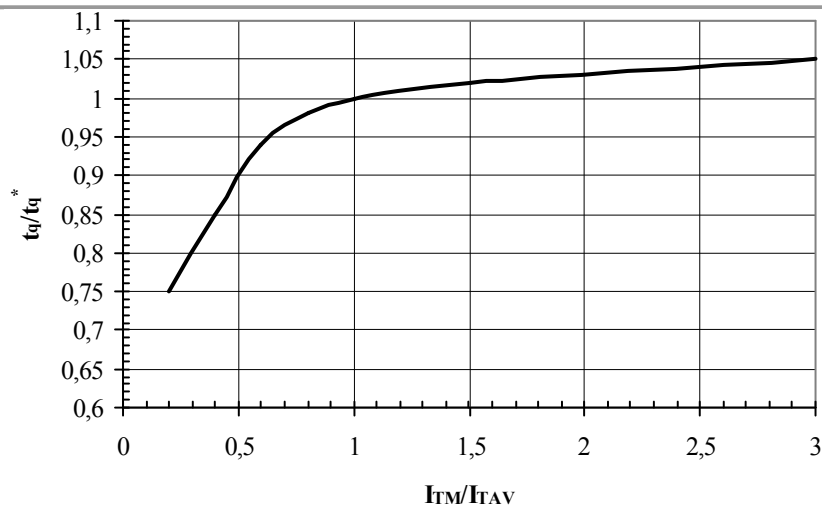


Fig. 3 Turn-off time t_q vs. On-state peak current I_{TM}

Conditions: $T_j = T_{j\ max}$; $di_R/dt = 10\ A/\mu s$; $V_R = 100\ V$; $dv_D/dt = 50\ V/\mu s$; $V_D = 0.67 \cdot V_{DRM}$

Typical changes of t_q are normalized to the t_q^* (t_q^* – see data sheet, $dv_D/dt = 50\ V/\mu s$)

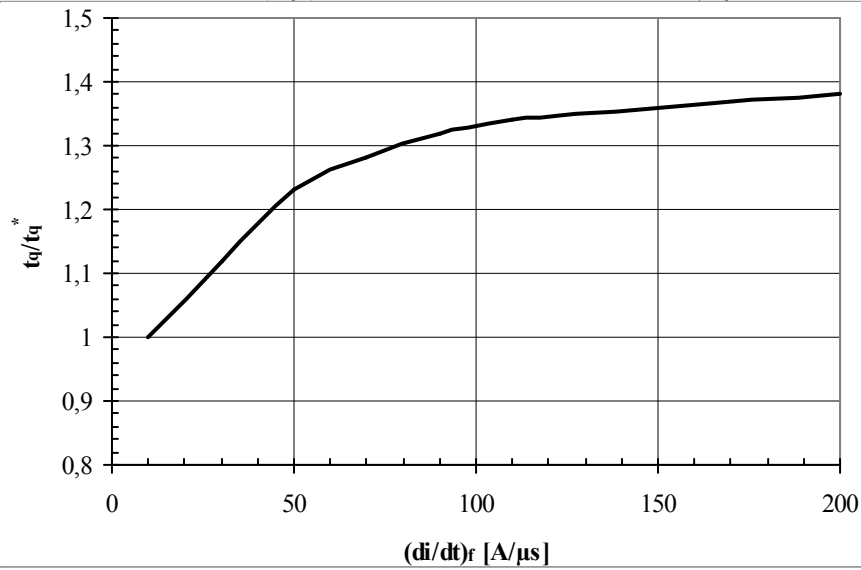


Fig. 4 Turn-off time t_q vs. Rate of fall of on-state current di_R/dt

Conditions: $T_j = T_{j\ max}$; $I_{TM} = I_{TAV}$; $V_R = 100\ V$; $dv_D/dt = 50\ V/\mu s$; $V_D = 0.67 \cdot V_{DRM}$

Typical changes of t_q are normalized to the t_q^* (t_q^* – see data sheet, $dv_D/dt = 50\ V/\mu s$)

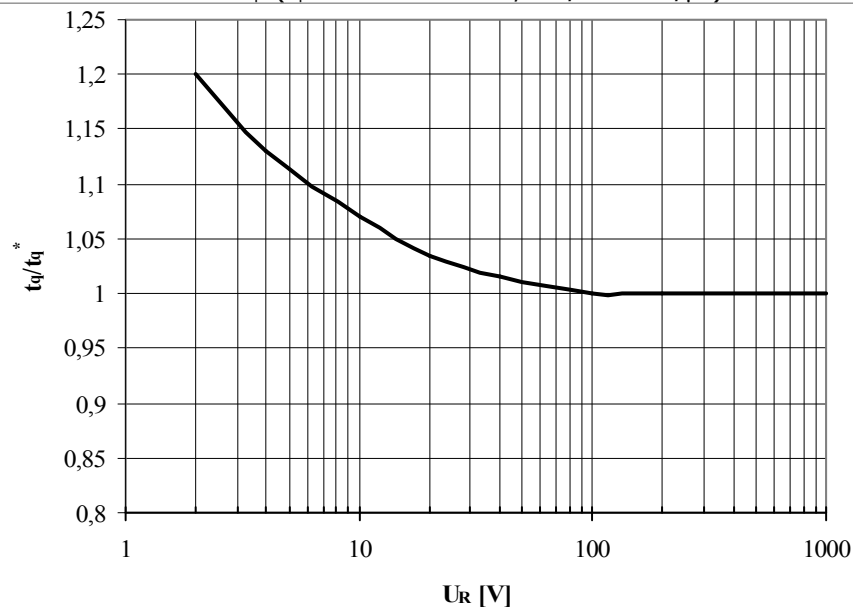


Fig. 5 Turn-off time t_q vs. Reverse voltage V_R

Conditions: $T_j = T_{j\ max}$; $I_{TM} = I_{TAV}$; $di_R/dt = 10\ A/\mu s$; $dv_D/dt = 50\ V/\mu s$; $V_D = 0.67 \cdot V_{DRM}$

Typical changes of t_q are normalized to the t_q^* (t_q^* – see data sheet, $dv_D/dt = 50\ V/\mu s$)

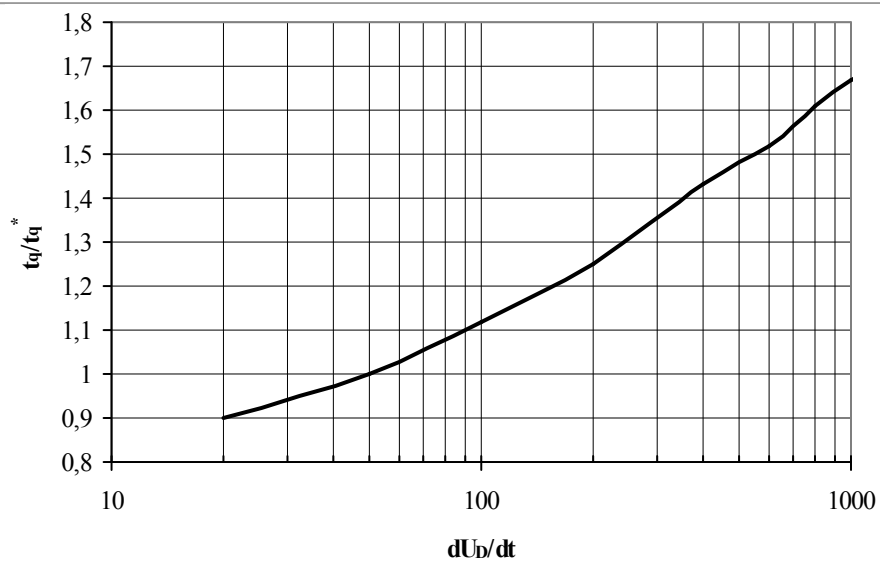


Fig. 6 Turn-off time t_q vs. Rate of rise of commutating voltage dv_D/dt

Conditions: $T_j = T_{j\max}$; $I_{TM} = I_{TAV}$; $di_R/dt = 10 \text{ A}/\mu\text{s}$; $V_R = 100 \text{ V}$; $V_D = 0.67 \cdot V_{DRM}$

Typical changes of t_q are normalized to the t_q^* (t_q^* – see data sheet, $dv_D/dt = 50 \text{ V}/\mu\text{s}$)

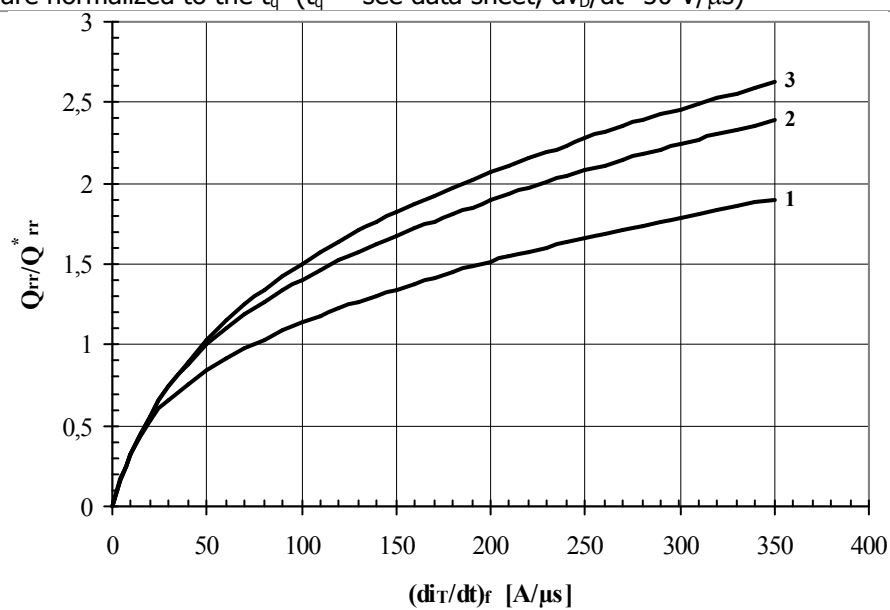


Fig. 7 Reverse recovery charge Q_{rr} vs. Rate of fall of on-state current di_R/dt

1 – $I_{TM} = 0.5 \cdot I_{TAV}$

2 – $I_{TM} = I_{TAV}$

3 – $I_{TM} = 1.5 \cdot I_{TAV}$

Conditions: $T_j = T_{j\max}$; $V_R = 100 \text{ V}$

Typical changes of Q_{rr} are normalized to the Q_{rr}^* (Q_{rr}^* – see data sheet)

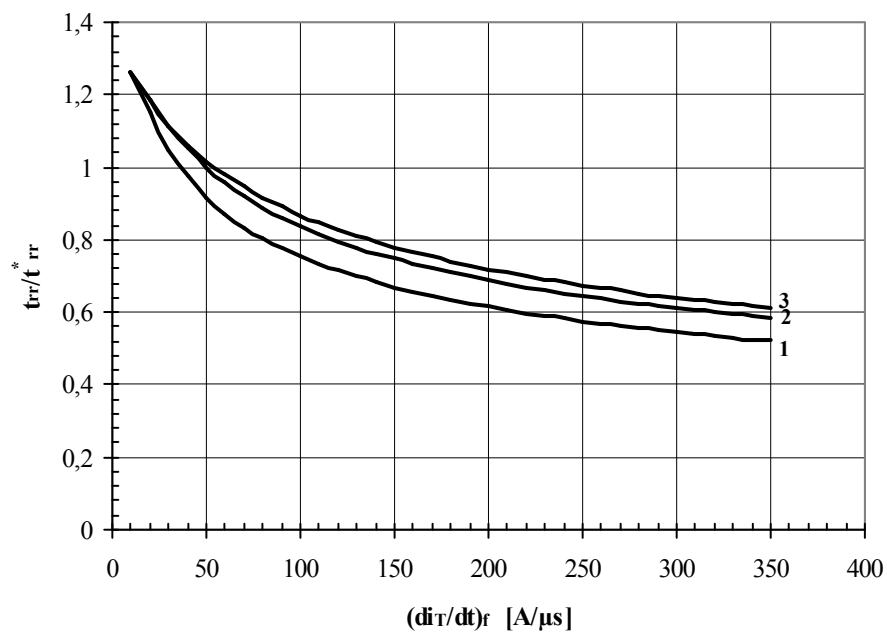


Fig. 8 Reverse recovery time t_{rr} vs. Rate of fall of on-state current di_R/dt

1 – $I_{TM} = 0.5 I_{TAV}$

2 – $I_{TM} = I_{TAV}$

3 – $I_{TM} = 1.5 I_{TAV}$

Conditions: $T_j = T_{j\max}$; $V_R = 100$ V

Typical changes of t_{rr} are normalized to the t_{rr}^* (t_{rr}^* – see data sheet)

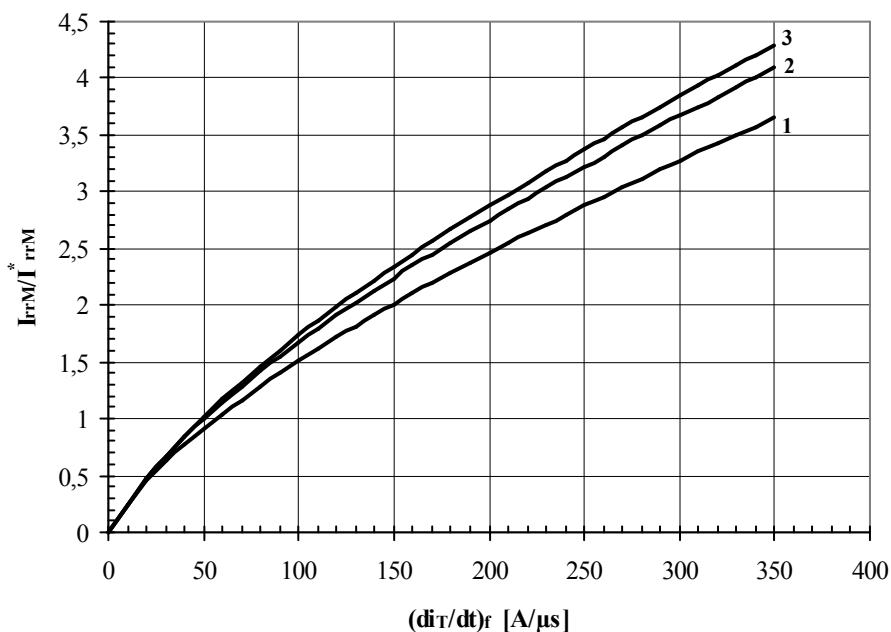


Fig. 9 Peak reverse recovery current I_{rrM} vs. Rate of fall of on-state current di_R/dt

1 – $I_{TM} = 0.5 I_{TAV}$

2 – $I_{TM} = I_{TAV}$

3 – $I_{TM} = 1.5 I_{TAV}$

Conditions: $T_j = T_{j\max}$; $V_R = 100$ V

Typical changes of I_{rrM} are normalized to the I_{rrM}^* (I_{rrM}^* – see data sheet)

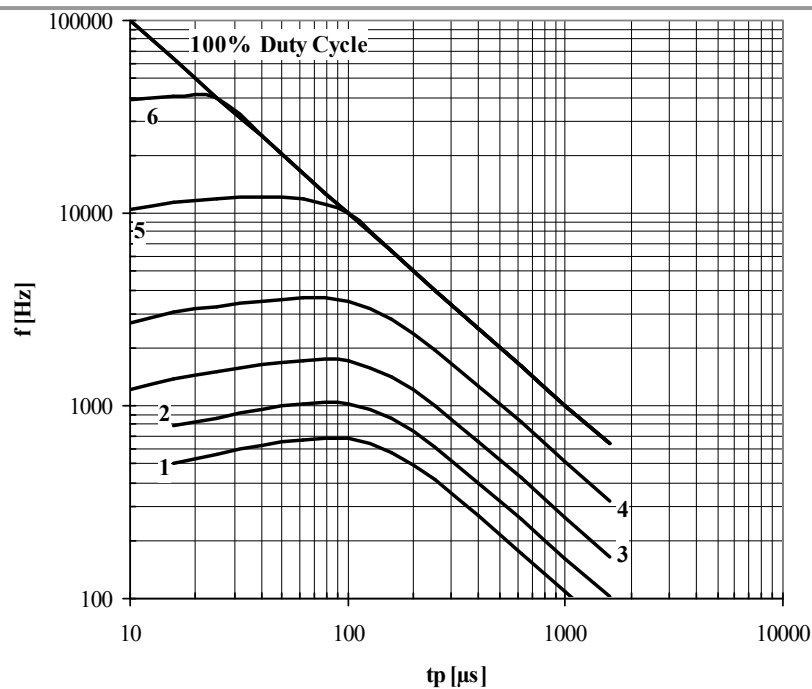


Fig. 10 Sine wave frequency ratings

- 1 – $I_{TM} = 5000$ A
- 2 – $I_{TM} = 4000$ A
- 3 – $I_{TM} = 3000$ A
- 4 – $I_{TM} = 2000$ A
- 5 – $I_{TM} = 1000$ A
- 6 – $I_{TM} = 500$ A

Conditions: $V_R \leq 3$ V; $T_C = 55$ °C

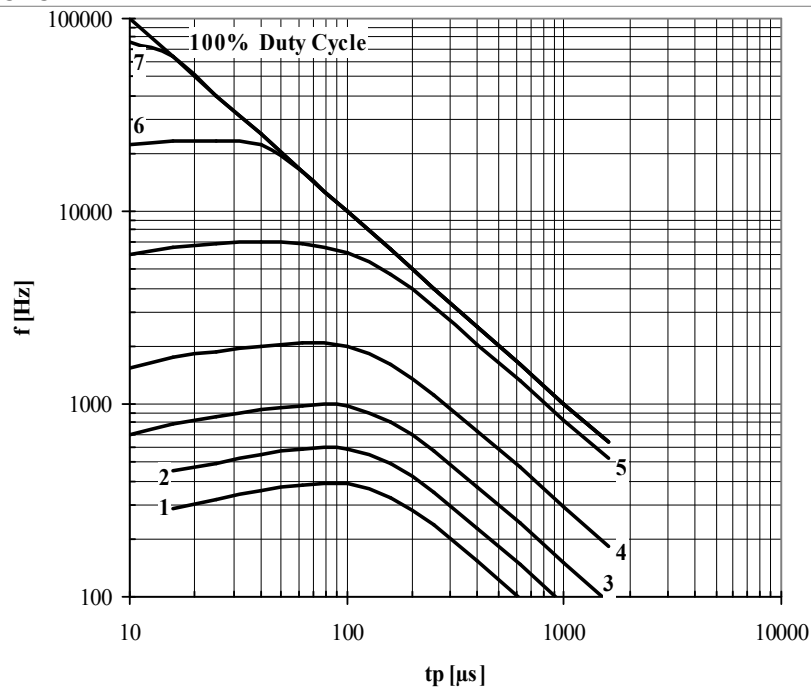


Fig. 11 Sine wave frequency ratings

- 1 – $I_{TM} = 5000$ A
- 2 – $I_{TM} = 4000$ A
- 3 – $I_{TM} = 3000$ A
- 4 – $I_{TM} = 2000$ A
- 5 – $I_{TM} = 1000$ A
- 6 – $I_{TM} = 500$ A
- 7 – $I_{TM} = 250$ A

Conditions: $V_R \leq 3$ V; $T_C = 90$ °C

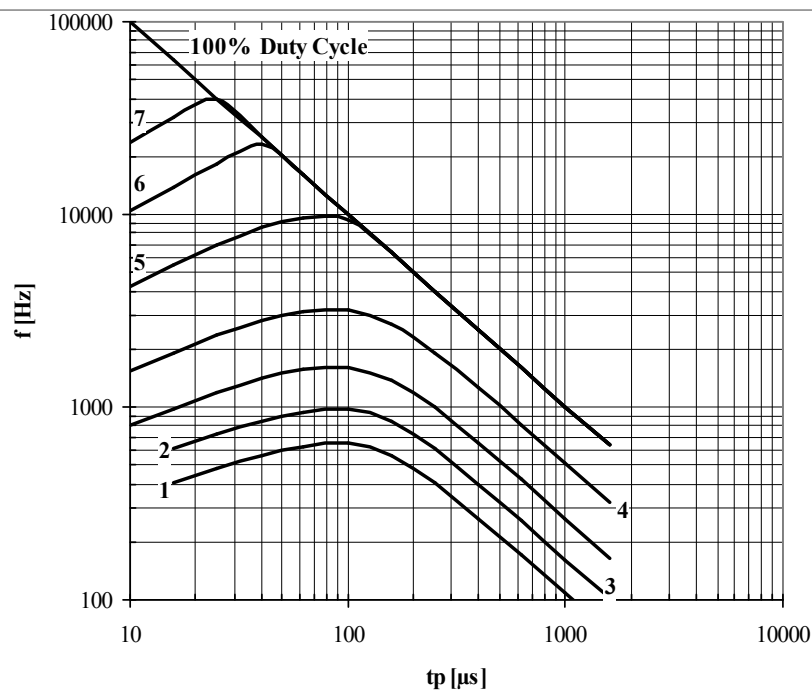


Fig. 12 Sine wave frequency ratings

- 1 – $I_{TM} = 5000 \text{ A}$
- 2 – $I_{TM} = 4000 \text{ A}$
- 3 – $I_{TM} = 3000 \text{ A}$
- 4 – $I_{TM} = 2000 \text{ A}$
- 5 – $I_{TM} = 1000 \text{ A}$
- 6 – $I_{TM} = 500 \text{ A}$
- 7 – $I_{TM} = 250 \text{ A}$

Conditions: $V_R = 0.67 \cdot V_{RRM}$; $T_C = 55 \text{ }^\circ\text{C}$

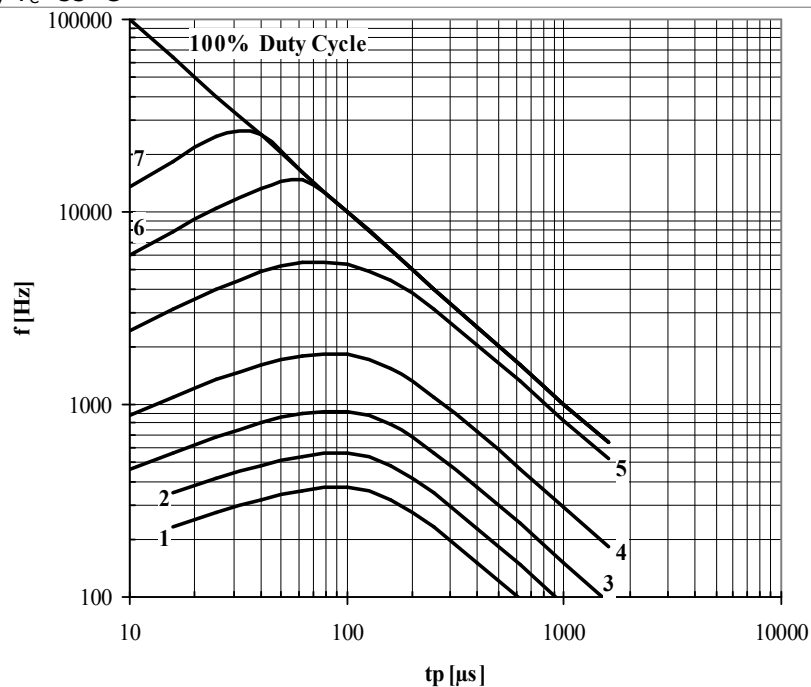


Fig. 13 Sine wave frequency ratings

- 1 – $I_{TM} = 5000 \text{ A}$
- 2 – $I_{TM} = 4000 \text{ A}$
- 3 – $I_{TM} = 3000 \text{ A}$
- 4 – $I_{TM} = 2000 \text{ A}$
- 5 – $I_{TM} = 1000 \text{ A}$
- 6 – $I_{TM} = 500 \text{ A}$
- 7 – $I_{TM} = 250 \text{ A}$

Conditions: $V_R = 0.67 \cdot V_{RRM}$; $T_C = 90 \text{ }^\circ\text{C}$

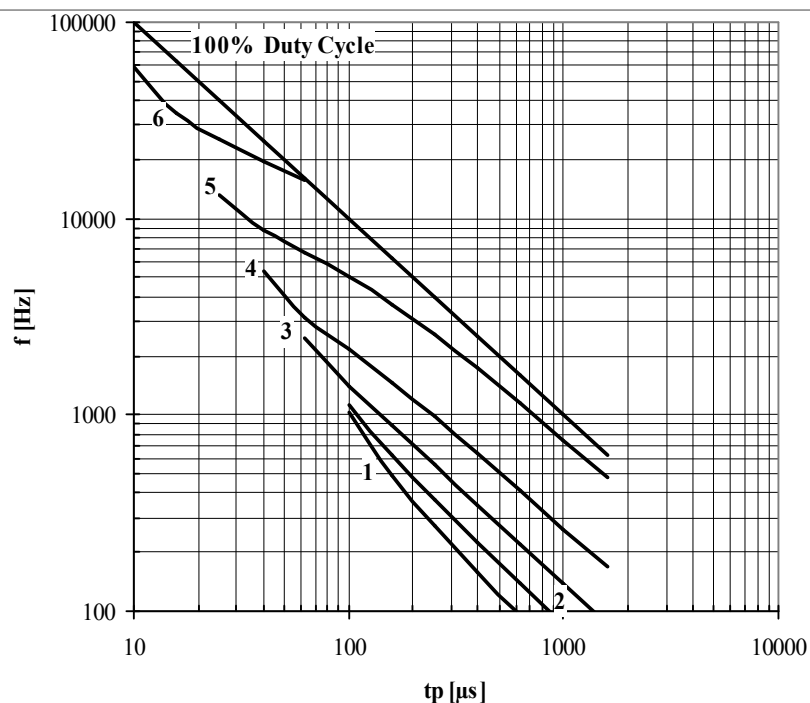


Fig. 14 Square wave frequency ratings

- 1 – $I_{TM} = 5000$ A
- 2 – $I_{TM} = 4000$ A
- 3 – $I_{TM} = 3000$ A
- 4 – $I_{TM} = 2000$ A
- 5 – $I_{TM} = 1000$ A
- 6 – $I_{TM} = 500$ A

Conditions: $V_R \leq 3$ V; $T_C = 55$ °C; $di_F/dt = di_R/dt = 100$ A/ μ s

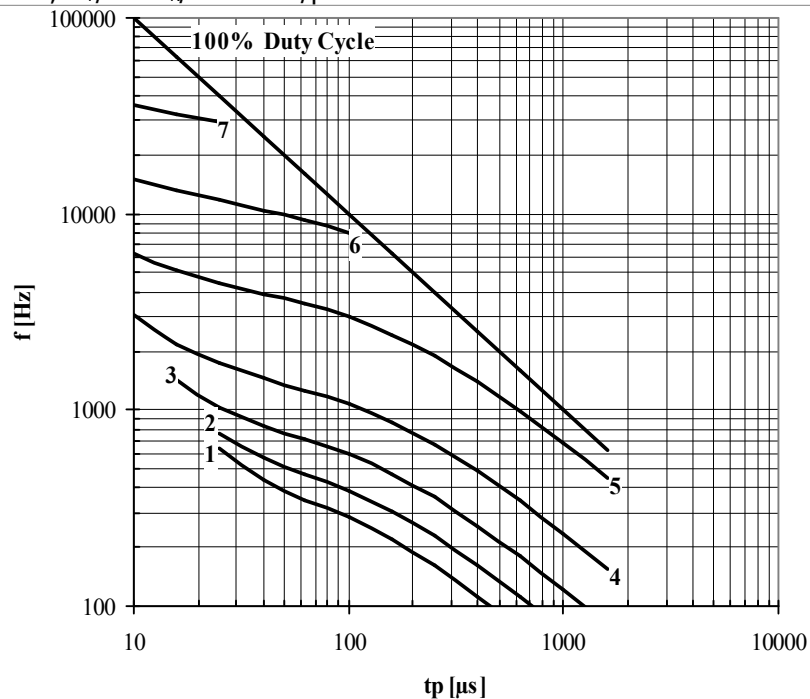


Fig. 15 Square wave frequency ratings

- 1 – $I_{TM} = 5000$ A
- 2 – $I_{TM} = 4000$ A
- 3 – $I_{TM} = 3000$ A
- 4 – $I_{TM} = 2000$ A
- 5 – $I_{TM} = 1000$ A
- 6 – $I_{TM} = 500$ A
- 7 – $I_{TM} = 250$ A

Conditions: $V_R \leq 3$ V; $T_C = 55$ °C; $di_F/dt = di_R/dt = 500$ A/ μ s

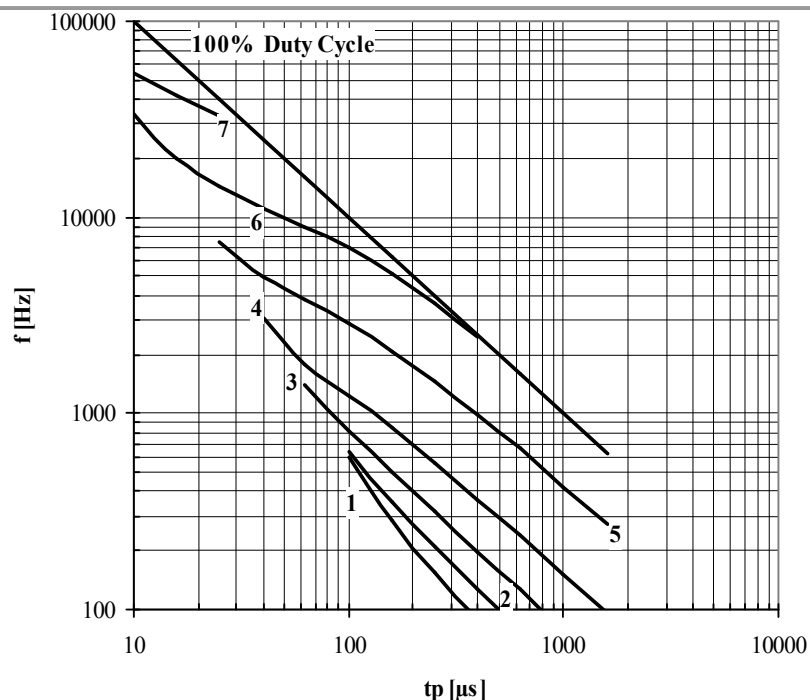


Fig. 16 Square wave frequency ratings

- 1 – $I_{TM} = 5000 \text{ A}$
- 2 – $I_{TM} = 4000 \text{ A}$
- 3 – $I_{TM} = 3000 \text{ A}$
- 4 – $I_{TM} = 2000 \text{ A}$
- 5 – $I_{TM} = 1000 \text{ A}$
- 6 – $I_{TM} = 500 \text{ A}$
- 7 – $I_{TM} = 250 \text{ A}$

Conditions: $V_R \leq 3 \text{ V}$; $T_C = 90 \text{ }^\circ\text{C}$; $di_F/dt = di_R/dt = 100 \text{ A}/\mu\text{s}$

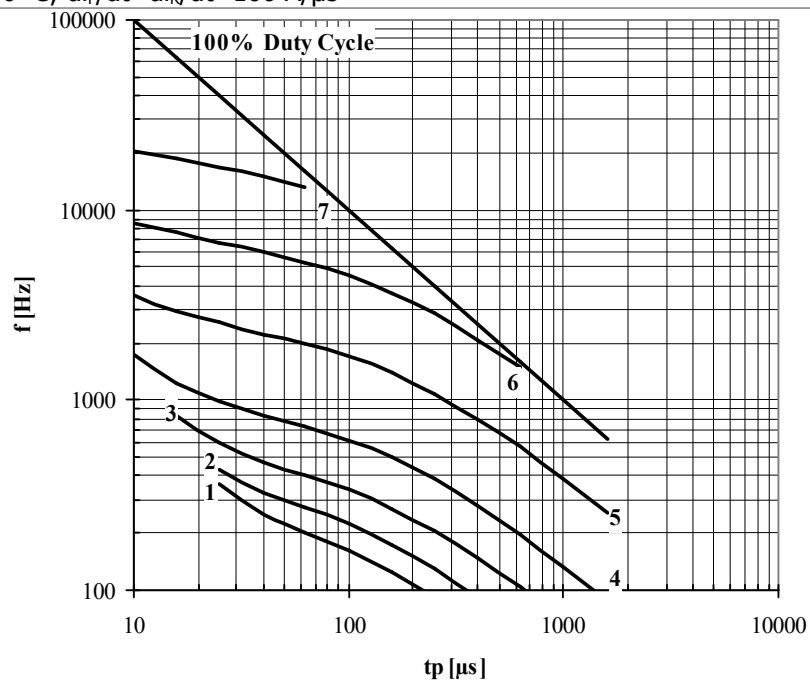


Fig. 17 Square wave frequency ratings

- 1 – $I_{TM} = 5000 \text{ A}$
- 2 – $I_{TM} = 4000 \text{ A}$
- 3 – $I_{TM} = 3000 \text{ A}$
- 4 – $I_{TM} = 2000 \text{ A}$
- 5 – $I_{TM} = 1000 \text{ A}$
- 6 – $I_{TM} = 500 \text{ A}$
- 7 – $I_{TM} = 250 \text{ A}$

Conditions: $V_R \leq 3 \text{ V}$; $T_C = 90 \text{ }^\circ\text{C}$; $di_F/dt = di_R/dt = 500 \text{ A}/\mu\text{s}$

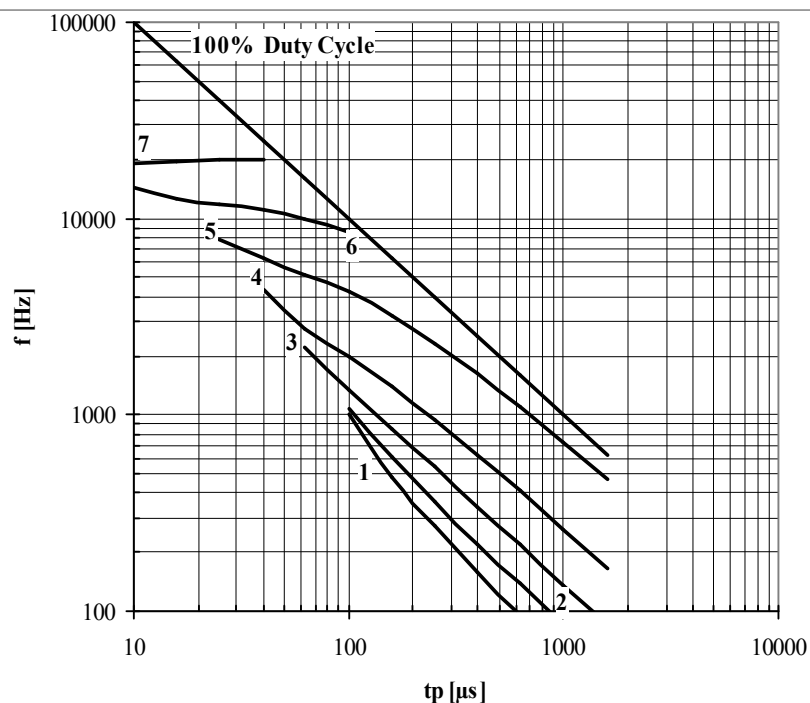


Fig. 18 Square wave frequency ratings

- 1 – $I_{TM} = 5000 \text{ A}$
- 2 – $I_{TM} = 4000 \text{ A}$
- 3 – $I_{TM} = 3000 \text{ A}$
- 4 – $I_{TM} = 2000 \text{ A}$
- 5 – $I_{TM} = 1000 \text{ A}$
- 6 – $I_{TM} = 500 \text{ A}$
- 7 – $I_{TM} = 250 \text{ A}$

Conditions: $V_R = 0.67 \cdot V_{RRM}$; $T_C = 55^\circ \text{C}$; $di_F/dt = di_R/dt = 100 \text{ A}/\mu\text{s}$

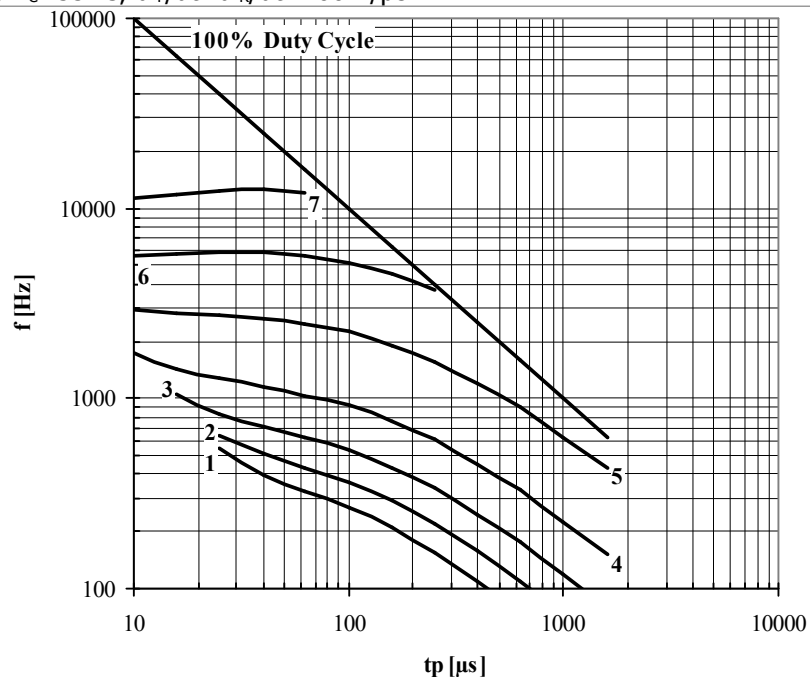


Fig. 19 Square wave frequency ratings

- 1 – $I_{TM} = 5000 \text{ A}$
- 2 – $I_{TM} = 4000 \text{ A}$
- 3 – $I_{TM} = 3000 \text{ A}$
- 4 – $I_{TM} = 2000 \text{ A}$
- 5 – $I_{TM} = 1000 \text{ A}$
- 6 – $I_{TM} = 500 \text{ A}$
- 7 – $I_{TM} = 250 \text{ A}$

Conditions: $V_R = 0.67 \cdot V_{RRM}$; $T_C = 55^\circ \text{C}$; $di_F/dt = di_R/dt = 500 \text{ A}/\mu\text{s}$

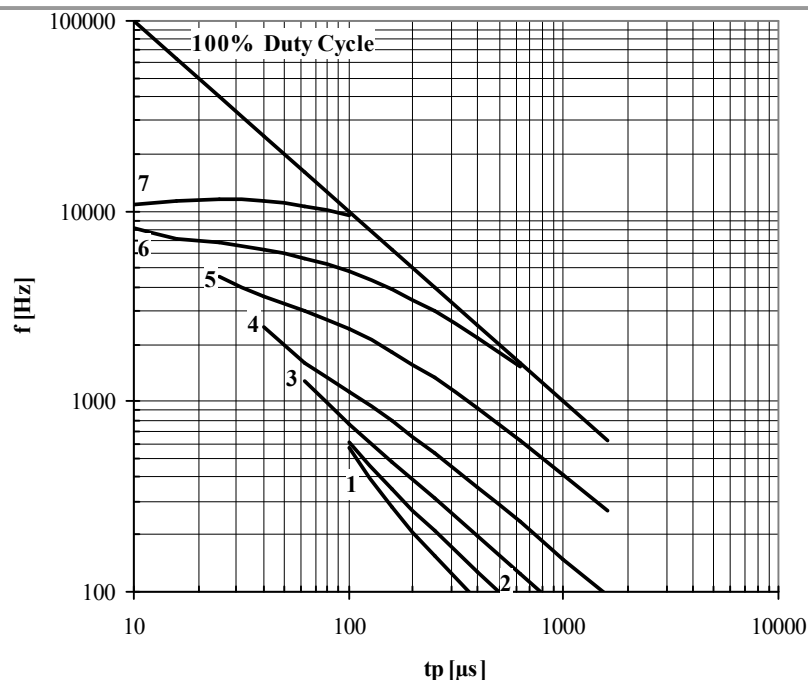


Fig. 20 Square wave frequency ratings

- 1 – $I_{TM} = 5000$ A
- 2 – $I_{TM} = 4000$ A
- 3 – $I_{TM} = 3000$ A
- 4 – $I_{TM} = 2000$ A
- 5 – $I_{TM} = 1000$ A
- 6 – $I_{TM} = 500$ A
- 7 – $I_{TM} = 250$ A

Conditions: $V_R = 0.67 \cdot V_{RRM}$; $T_C = 90$ °C; $di_F/dt = di_R/dt = 100$ A/μs

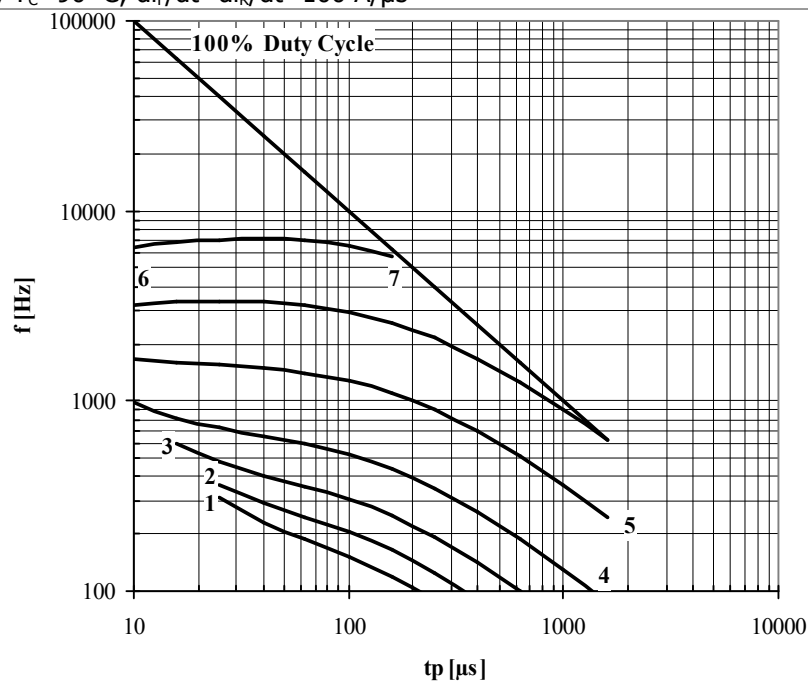


Fig. 21 Square wave frequency ratings

- 1 – $I_{TM} = 5000$ A
- 2 – $I_{TM} = 4000$ A
- 3 – $I_{TM} = 3000$ A
- 4 – $I_{TM} = 2000$ A
- 5 – $I_{TM} = 1000$ A
- 6 – $I_{TM} = 500$ A
- 7 – $I_{TM} = 250$ A

Conditions: $V_R = 0.67 \cdot V_{RRM}$; $T_C = 90$ °C; $di_F/dt = di_R/dt = 500$ A/μs

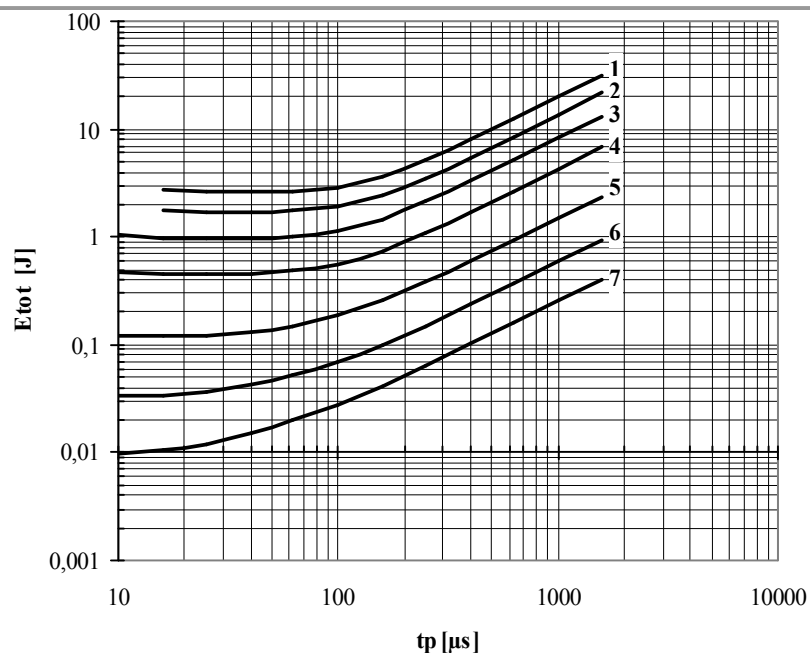


Fig. 22 Sine wave loss energy per pulse

- 1 – $I_{TM} = 5000 \text{ A}$
- 2 – $I_{TM} = 4000 \text{ A}$
- 3 – $I_{TM} = 3000 \text{ A}$
- 4 – $I_{TM} = 2000 \text{ A}$
- 5 – $I_{TM} = 1000 \text{ A}$
- 6 – $I_{TM} = 500 \text{ A}$
- 7 – $I_{TM} = 250 \text{ A}$

Conditions: $V_R \leq 3 \text{ V}$

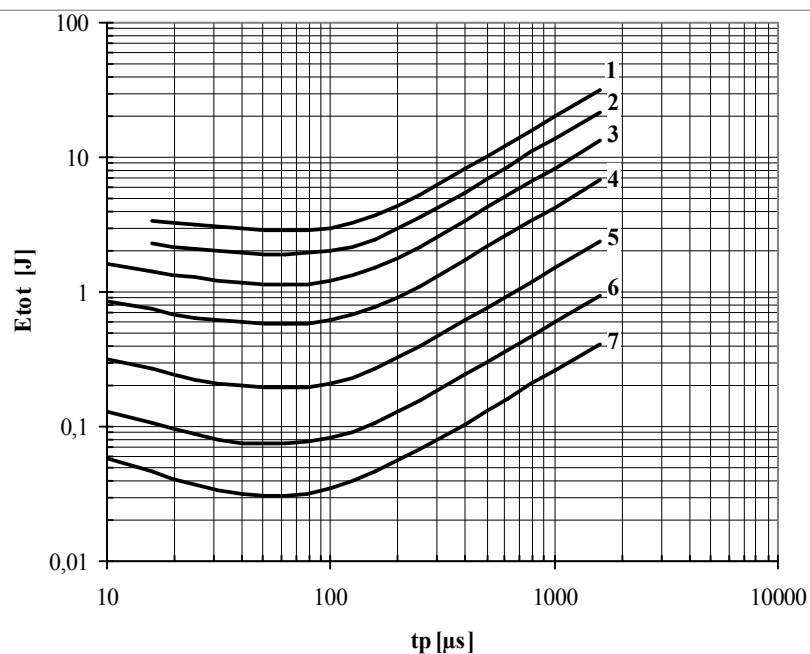


Fig. 23 Sine wave loss energy per pulse

- 1 – $I_{TM} = 5000 \text{ A}$
- 2 – $I_{TM} = 4000 \text{ A}$
- 3 – $I_{TM} = 3000 \text{ A}$
- 4 – $I_{TM} = 2000 \text{ A}$
- 5 – $I_{TM} = 1000 \text{ A}$
- 6 – $I_{TM} = 500 \text{ A}$
- 7 – $I_{TM} = 250 \text{ A}$

Conditions: $V_R = 0.67 \cdot V_{RRM}$

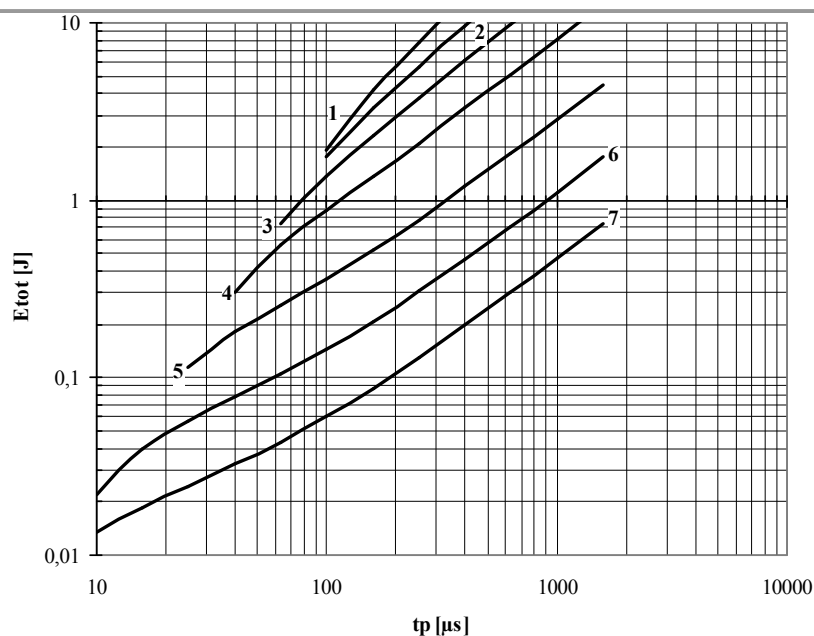


Fig. 24 Square wave loss energy per pulse

- 1 – $I_{TM} = 5000$ A
- 2 – $I_{TM} = 4000$ A
- 3 – $I_{TM} = 3000$ A
- 4 – $I_{TM} = 2000$ A
- 5 – $I_{TM} = 1000$ A
- 6 – $I_{TM} = 500$ A
- 7 – $I_{TM} = 250$ A

Conditions: $V_R \leq 3$ V; $di_F/dt = di_R/dt = 100$ A/ μ s

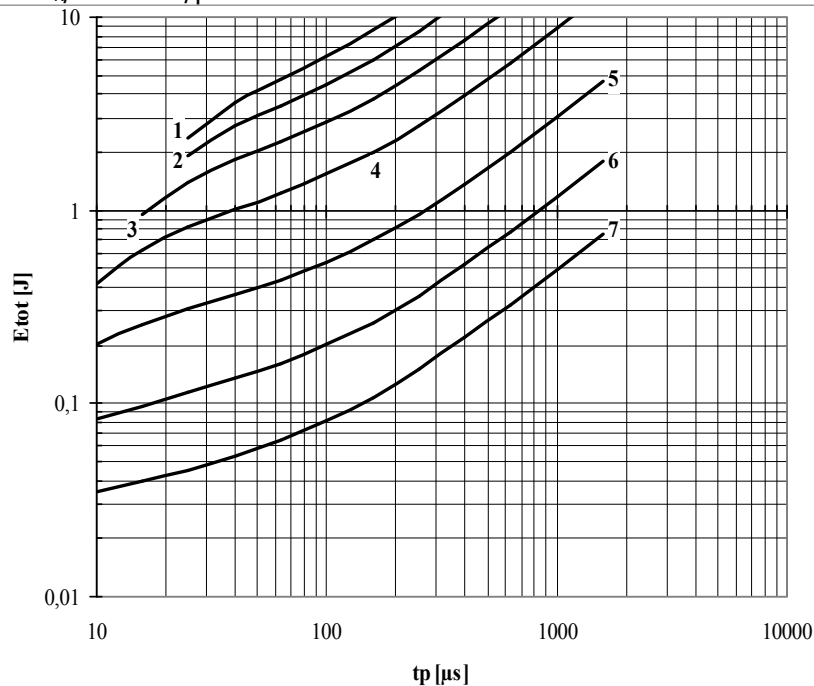


Fig. 25 Square wave loss energy per pulse

- 1 – $I_{TM} = 5000$ A
- 2 – $I_{TM} = 4000$ A
- 3 – $I_{TM} = 3000$ A
- 4 – $I_{TM} = 2000$ A
- 5 – $I_{TM} = 1000$ A
- 6 – $I_{TM} = 500$ A
- 7 – $I_{TM} = 250$ A

Conditions: $V_R \leq 3$ V; $di_F/dt = di_R/dt = 500$ A/ μ s

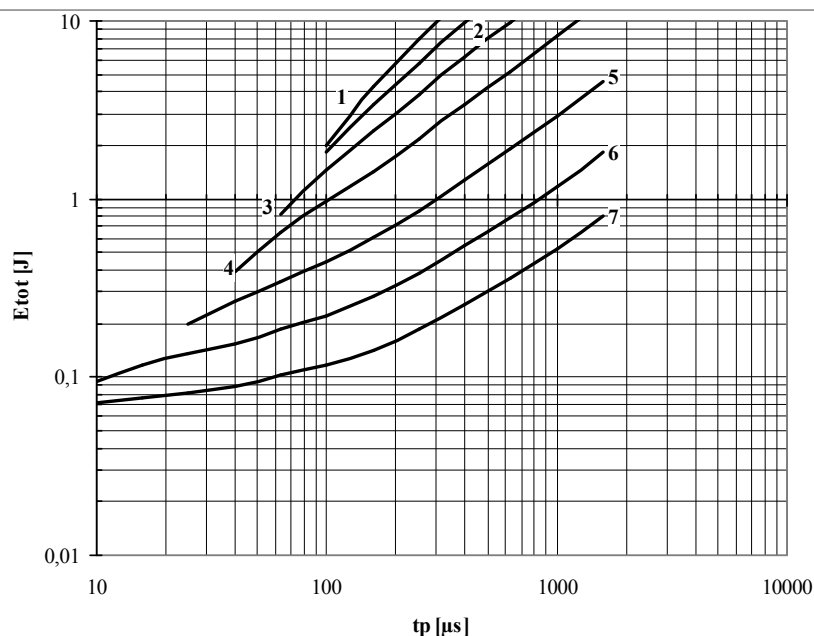


Fig. 26 Square wave loss energy per pulse

- 1 – $I_{TM} = 5000$ A
- 2 – $I_{TM} = 4000$ A
- 3 – $I_{TM} = 3000$ A
- 4 – $I_{TM} = 2000$ A
- 5 – $I_{TM} = 1000$ A
- 6 – $I_{TM} = 500$ A
- 7 – $I_{TM} = 250$ A

Conditions: $V_R = 0.67 \cdot V_{RRM}$; $di_F/dt = di_R/dt = 100$ A/ μ s

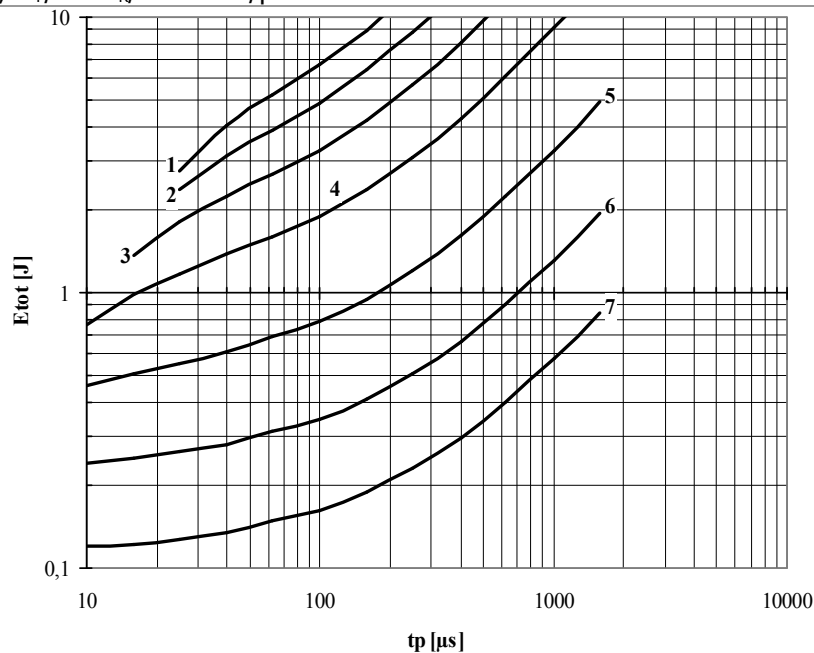


Fig. 27 Square wave loss energy per pulse

- 1 – $I_{TM} = 5000$ A
- 2 – $I_{TM} = 4000$ A
- 3 – $I_{TM} = 3000$ A
- 4 – $I_{TM} = 2000$ A
- 5 – $I_{TM} = 1000$ A
- 6 – $I_{TM} = 500$ A
- 7 – $I_{TM} = 250$ A

Conditions: $V_R = 0.67 \cdot V_{RRM}$; $di_F/dt = di_R/dt = 500$ A/ μ s

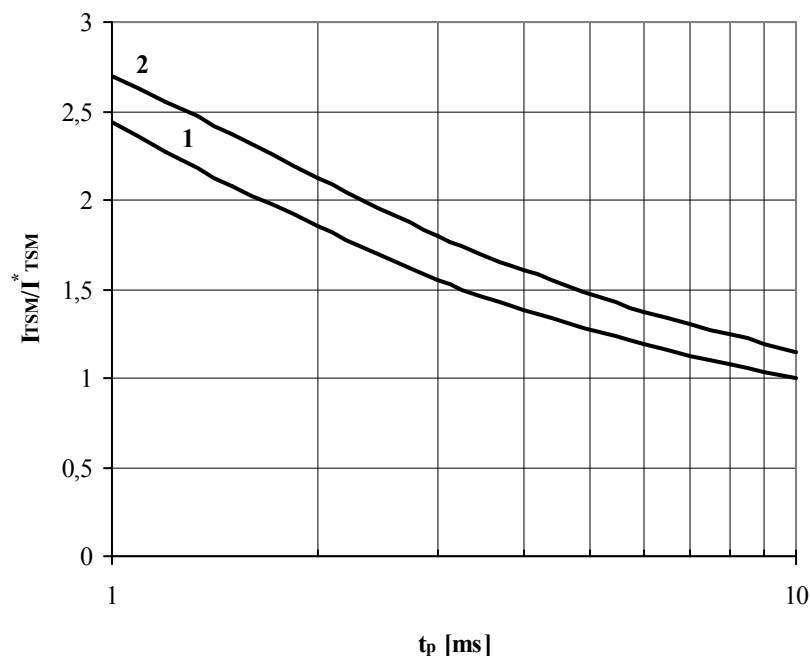


Fig. 28 The surge current I_{TSM} vs. Duration of surge t_p for a half-sine wave

1 – $T_j = 125^\circ\text{C}$

2 – $T_j = 25^\circ\text{C}$

Conditions: $V_R = 0\text{ V}$ – the peak value of reverse voltage which is applied immediately after the surge current
Typical changes of I_{TSM} are normalized to the I_{TSM}^* (I_{TSM}^* – see data sheet, $T_j = T_{j\text{ max}}$)

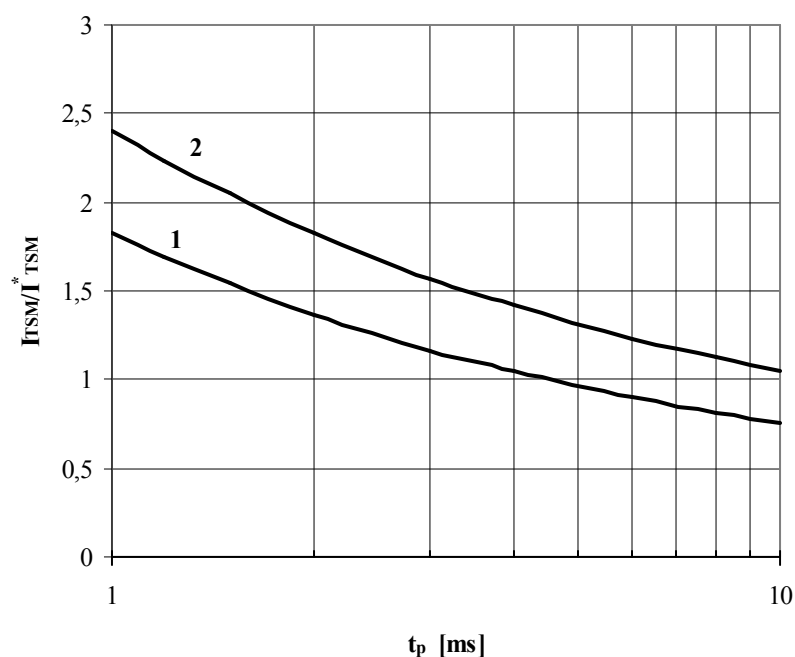


Fig. 29 The surge current I_{TSM} vs. Duration of surge t_p for a half-sine wave

1 – $T_j = 125^\circ\text{C}$

2 – $T_j = 25^\circ\text{C}$

Conditions: $V_R = 0.8 V_{RRM}$ – the peak value of reverse voltage which is applied immediately after the surge current
Typical changes of I_{TSM} are normalized to the I_{TSM}^* (I_{TSM}^* – see data sheet, $T_j = T_{j\text{ max}}$)

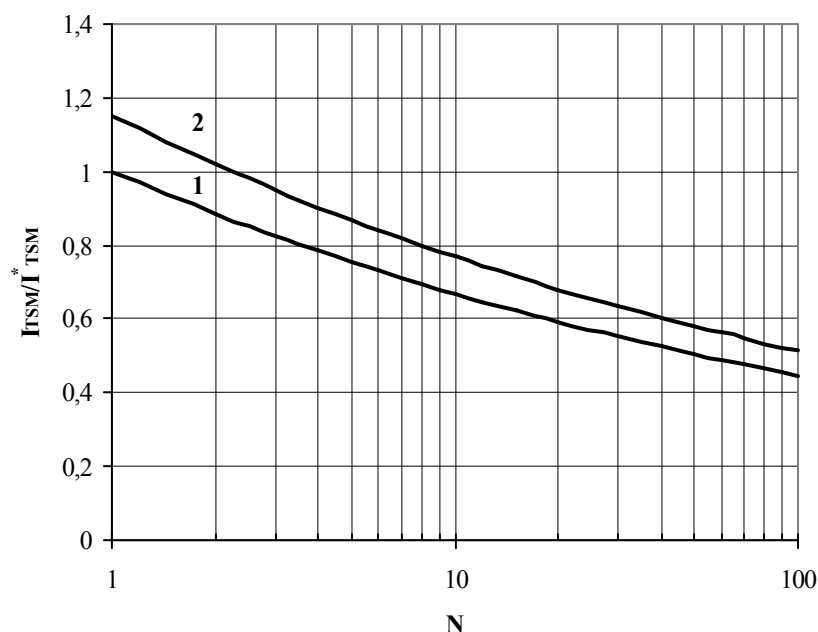


Fig. 30 The surge current I_{TSM} vs. Number of half-sine waves at 50 Hz

1 – $T_j = 125^\circ\text{C}$

2 – $T_j = 25^\circ\text{C}$

Conditions: $V_R = 0\text{ V}$ – the peak value of reverse voltage which is applied immediately after the surge current
Typical changes of I_{TSM} are normalized to the I_{TSM}^* (I_{TSM}^* – see data sheet, $T_j = T_{j\max}$)

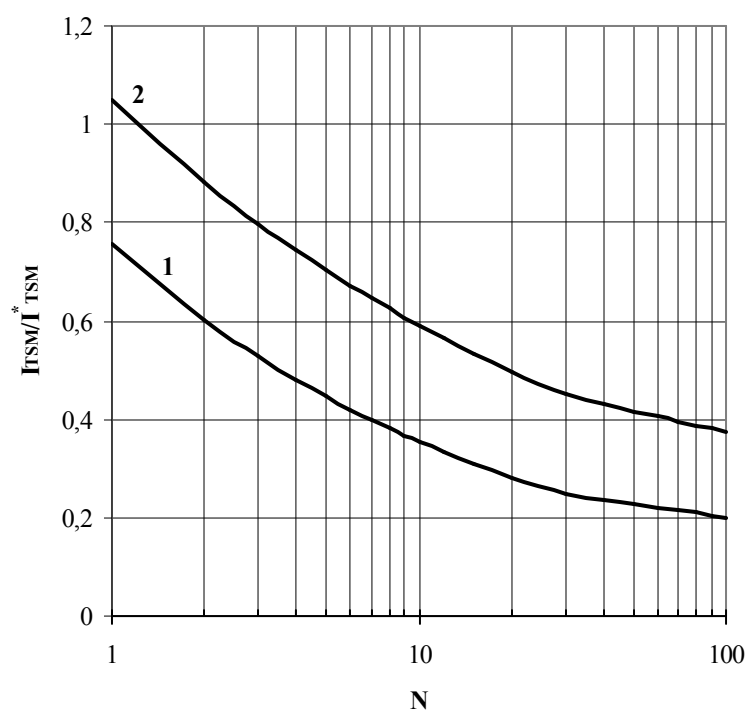


Fig. 31 The surge current I_{TSM} vs. Number of half-sine waves at 50 Hz

1 – $T_j = 125^\circ\text{C}$

2 – $T_j = 25^\circ\text{C}$

Conditions: $V_R = 0.8 \cdot V_{RRM}$ – the peak value of reverse voltage which is applied immediately after the surge current
Typical changes of I_{TSM} are normalized to the I_{TSM}^* (I_{TSM}^* – see data sheet, $T_j = T_{j\max}$)