estel®	**ESTEL ELEKTROONIKA** ESTONIA	**April 2005**

Series
TFI243-500

High Frequency Inverter grade Capsule Thyristor Type TFI243-500

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

Maximum mean on-state current	I_{TAV}	**500 A**
Maximum repetitive peak off-state and reverse voltage	U_{DRM} U_{RRM}	**800 ÷1500 V**
Turn-off time	**tq**	**12,5; 16; 20; 25 µs**

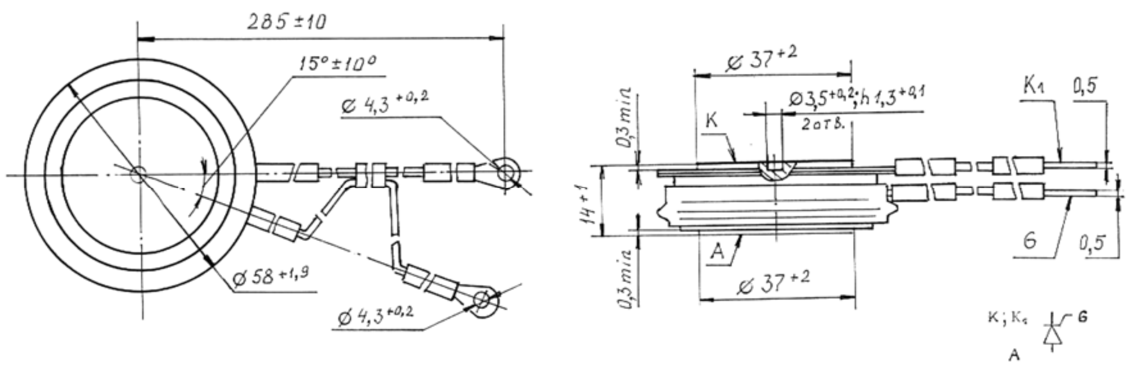
U_{DRM}, U_{RRM}, V	800	900	1000	1100	1200	1300	1400	1500
Voltage code	8	9	10	11	12	13	14	15
Tvj, °C	- 60 ÷ 125							

MAXIMUM ALLOWABLE RATINGS				
Symbols and parameters		Units	TFI243-500	Conditions
I_{TAV}	Mean on-state current	A	500 780	Tc=85 °C, Tc=55 °C, 180° half-sine wave, 50 Hz
I_{TRMS}	RMS on-state current	A	785	Tc=85 °C
I_{TSM}	Surge on-state current	kA	10,0 11,0	Tvj=125°C Tvj=25°C; tp=10 ms, U_R=0
I^2t	Limiting load integral	kA^2s	500 605	Tvj=125°C Tvj=25°C; tp=10 ms, U_R=0
U_{DRM},U_{RRM}	Repetitive peak off-state and reverse voltage	V	800÷1500	Tj min≤Tvj≤TjM 180° half-sine wave, 50 Hz Gate open
U_{DSM},U_{RSM}	Non-repetitive peak off-state and reverse voltage	V	880÷1600	Tj min≤Tvj≤TjM 180° half-sine wave tp=10 ms, Single pulse Gate open
(di_T/dt) crit	Critical rate of rise of on-state current : non - repetitive repetitive	A/µs	 2000 1250	Tvj=125°C ; U_D=0,67 U_{DRM}, Gate pulse : 10V,5 Ω, 1µs rise time, 10 µs
U_{RGM}	Peak reverse gate voltage	V	5	Tj min≤Tvj≤TjM
Tstg	Storage temperature	°C	-60÷80	
Tvj	Junction temperature	°C	-60÷125	
CHARACTERISTICS				
U_{TM}	Peak on-state voltage	V	2,4	Tvj=25°C, I_{TM}=3,14 I_{TAV}
$U_{T(TO)}$	Threshold voltage	V	1,45	Tvj=125°C 1,57 I_{TAV}< I_T <4,71 I_{TAV}
R_T	On-state slope resistance	mΩ	0,7	
I_{DRM} I_{RRM}	Repetitive peak off-state and reverse current	mA	70 70	Tvj=125°C, U_D = U_{DRM} U_R= U_{RRM}

CHARACTERISTICS				
Symbols and parameters		Units	TFI243-500	Conditions
I_L	Latching current	A	8	Tvj=25°C,U_D=12V Gate pulse : 10V, 5Ω, 1 µs rise time, 10µs
I_H	Holding current	A	0,5	Tvj=25°C,U_D=12V, Gate open
U_{GT}	Gate trigger direct voltage	V	2,5 5,0	Tvj=25°C, Tvj=-60°C; U_D=12V
I_{GT}	Gate trigger direct current	A	0,3 0,85	Tvj=25°C, Tvj=-60°C; U_D=12V
U_{GD}	Gate non-trigger direct voltage	V	0,25	Tvj=125°C, U_D = 0,67 U_{DRM}
I_{GD}	Gate non-trigger direct current	мA	10	Direct gate current
tgd	Delay time	µs	1,6	Tvj=25°C,U_D=500V I_{TM} = 500 A Gate pulse : 10V, 5Ω, 1 µs rise time, 10µs
tgt	Turn-on time	µs	2,5	
tq	Turn-off time	µs	12,5÷25 16÷32	Tvj=125°C, I_{TM} =500 A di_R/dt =10 A/µs, U_R=100V U_D = 0,67 U_{DRM} du_D/dt=50 V/µs du_D/dt=200 V/µs
Qrr	Recovered charge	µC	230	Tvj=125°C, I_{TM} =500 A di_R/dt =50 A/µs, U_R=100V
trr	Reverse recovery time	µs	4,0	
I_{RRM}	Peak reverse recovery current	A	115	
$(du_D/dt)_{crit}$	Critical rate of rise of off-state voltage	V/µs	500 1000	Tvj=125°C, U_D = 0,67 U_{DRM} Gate open
Rthjc	Thermal resistance junction to case	°C/W	0,032	Direct current, double side cooled

ORDERING								
	TFI	**243**	**500**	**14**	**7**	**7**	**3**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	

1. Fast thyristor with interdigitated gate structure.
2. Design version.
3. Mean on-state current, A.
4. Voltage code (14=1400V).
5. Critical rate of rise of off-state voltage (6 ≥ 500 V/µs, 7 ≥1000 V/µs)
6. Group of turn-off time (du_D/dt=50 V/µs, 5≤ 25 µs , 6 ≤ 20 µs, 7 ≤ 16 µs)
7. Group of turn-on time (3 ≤ 2,5 µs)



Mouting force : 13÷19 kN
Weight : 210 grams

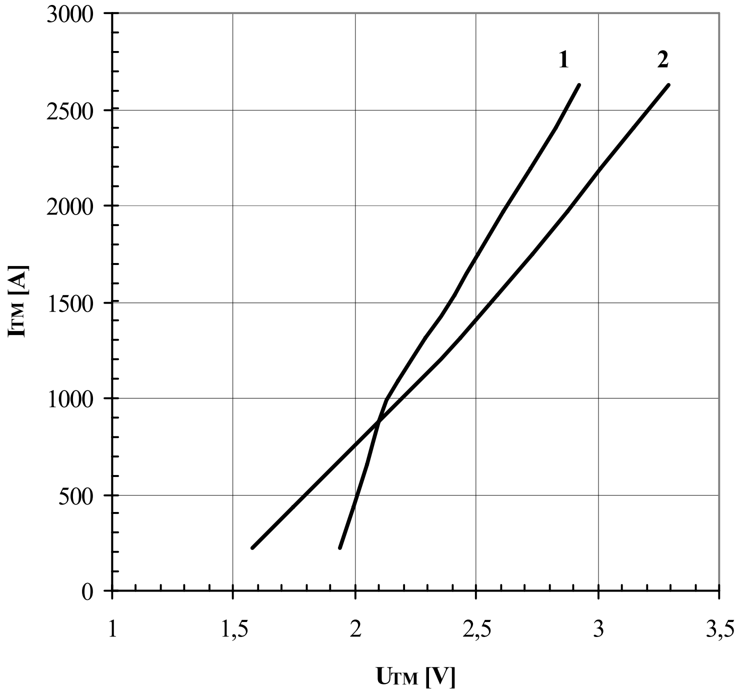
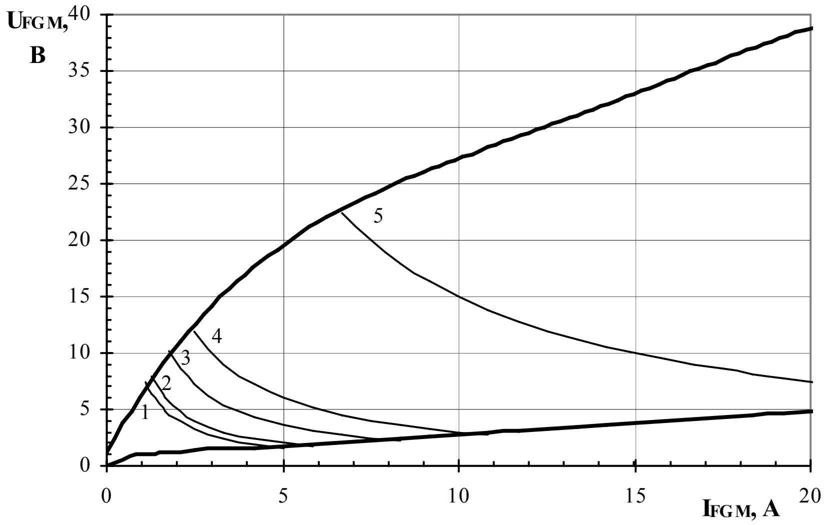


Fig. 1 On-state characteristics of Limit device
1 – T_j=25 °C
2 – T_j=125 °C



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

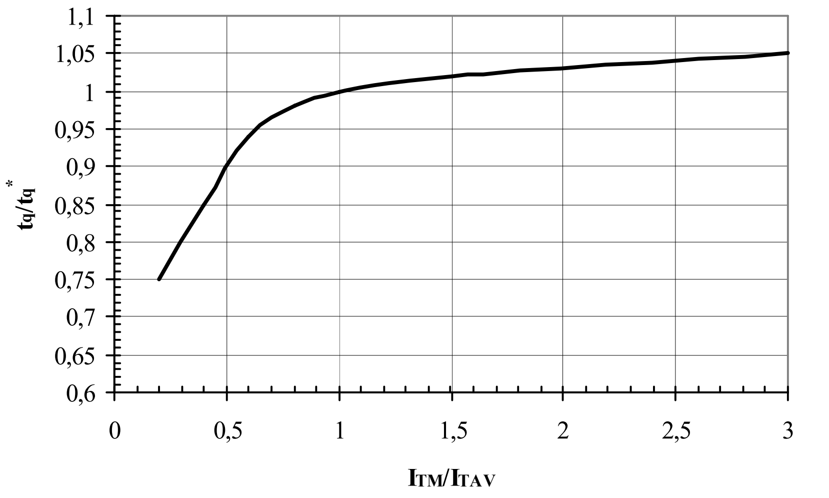


Fig. 3 Turn-off time t_q vs. On-state peak current I_{TM}

Conditions: T_j=$T_{j\ max}$; di_R/dt=10 A/µs; V_R=100 V; dv_D/dt=50 V/µs; V_D=0.67·V_{DRM}
Typical changes of t_q are normalized to the t_q^* (t_q^* – see data sheet, dv_D/dt=50 V/µs)

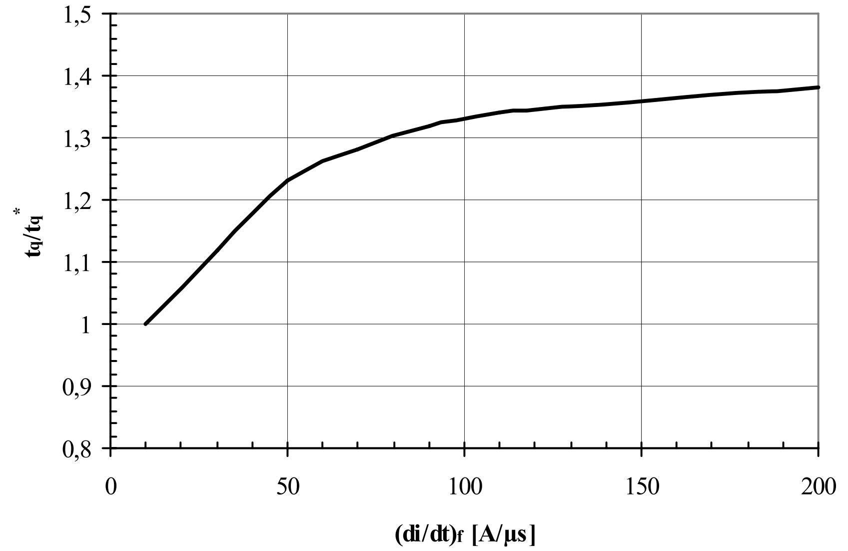


Fig. 4 Turn-off time t_q vs. Rate of fall of on-state current di_R/dt

Conditions: T_j=$T_{j\ max}$; I_{TM}=I_{TAV}; V_R=100 V; dv_D/dt=50 V/µs; V_D=0.67·V_{DRM}
Typical changes of t_q are normalized to the t_q^* (t_q^* – see data sheet, dv_D/dt=50 V/µs)

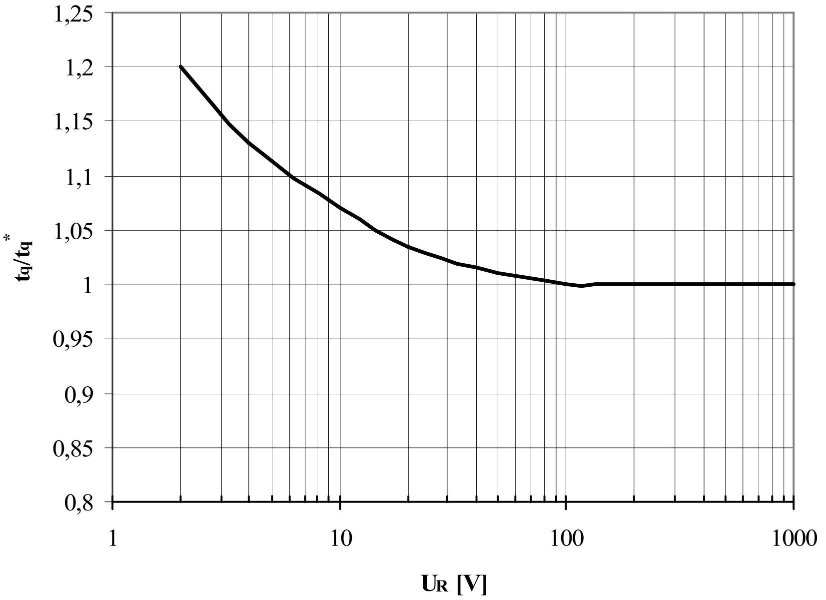


Fig. 5 Turn-off time t_q vs. Reverse voltage V_R

Conditions: $T_j=T_{j\,max}$; $I_{TM}=I_{TAV}$; $di_R/dt=10$ A/µs; $dv_D/dt=50$ V/µs; $V_D=0.67{\cdot}V_{DRM}$
Typical changes of t_q are normalized to the t_q^* (t_q^* – see data sheet, $dv_D/dt=50$ V/µs)

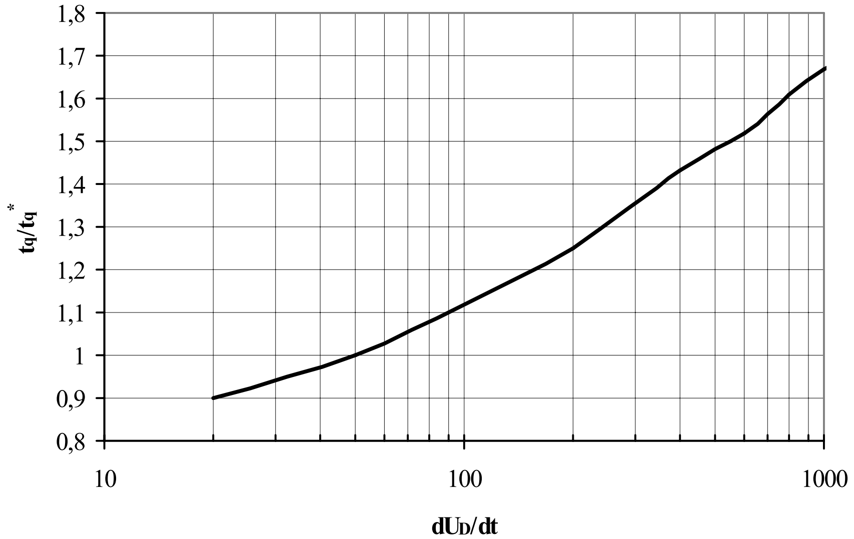


Fig. 6 Turn-off time t_q vs. Rate of rise of commutating voltage dv_D/dt

Conditions: $T_j=T_{j\,max}$; $I_{TM}=I_{TAV}$; $di_R/dt=10$ A/µs; $V_R=100$ V; $V_D=0.67{\cdot}V_{DRM}$
Typical changes of t_q are normalized to the t_q^* (t_q^* – see data sheet, $dv_D/dt=50$ V/µs)

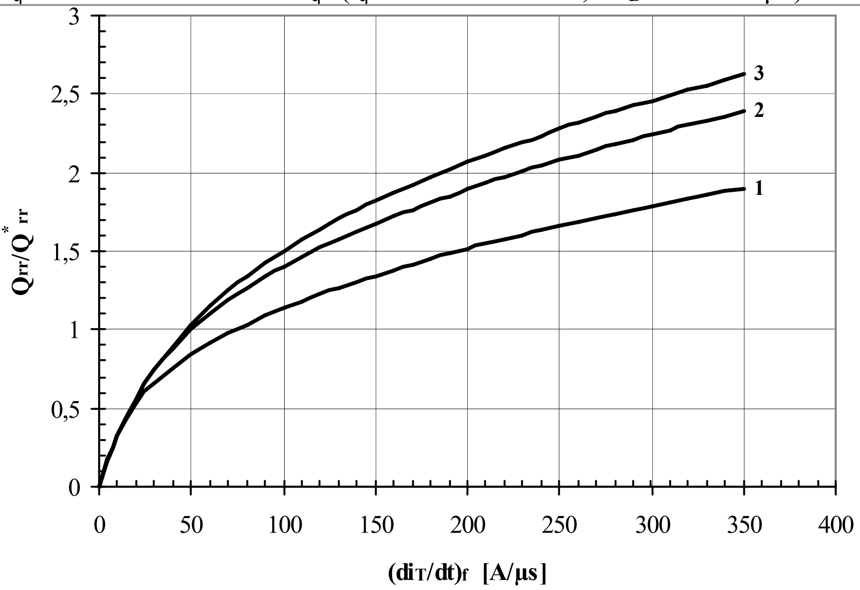


Fig. 7 Reverse recovery charge Q_{rr}, vs. Rate of fall of on-state current di_R/dt
1 – $I_{TM} = 0.5{\cdot}I_{TAV}$
2 – $I_{TM} = I_{TAV}$,
3 – $I_{TM} = 1.5{\cdot}I_{TAV}$

Conditions: $T_j=T_{j\,max}$; $V_R=100$ V
Typical changes of Q_{rr} are normalized to the Q_{rr}^* (Q_{rr}^* – see data sheet)

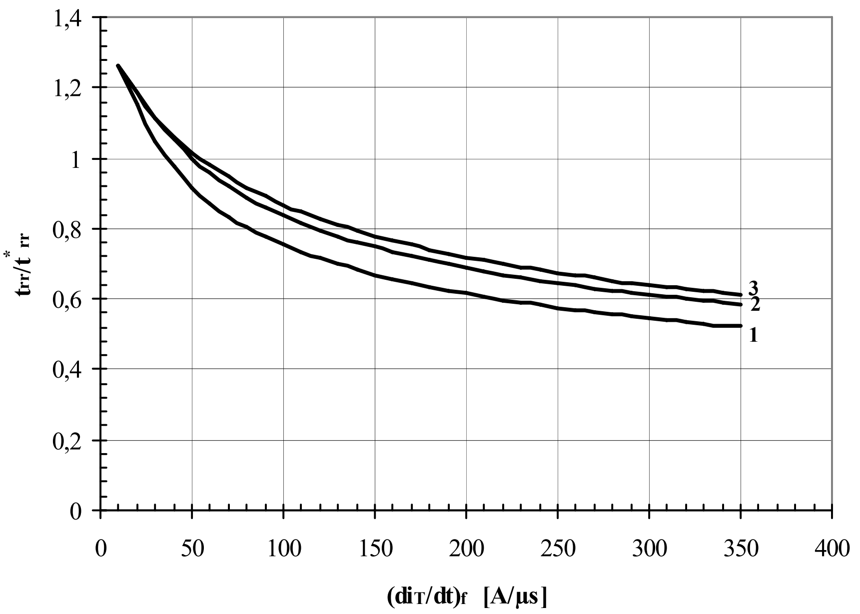


Fig. 8 Reverse recovery time t_{rr} vs. Rate of fall of on-state current di_R/dt

1 – $I_{TM} = 0.5 \cdot I_{TAV}$

2 – $I_{TM} = I_{TAV}$,

3 – $I_{TM} = 1.5 \cdot I_{TAV}$

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

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

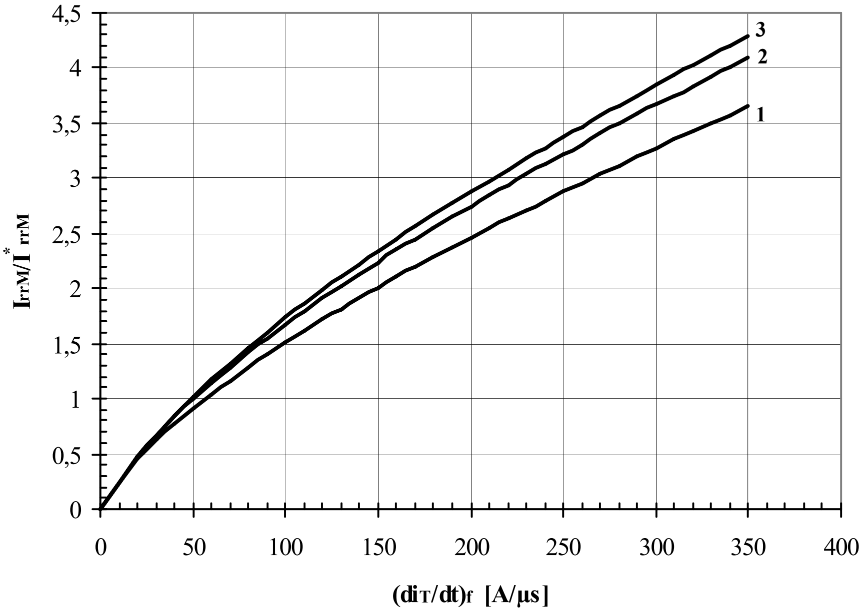


Fig. 9 Peak reverse recovery current I_{rrM} vs. Rate of fall of on-state current di_R/dt

1 – $I_{TM} = 0.5 \cdot I_{TAV}$

2 – $I_{TM} = I_{TAV}$,

3 – $I_{TM} = 1.5 \cdot I_{TAV}$

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

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

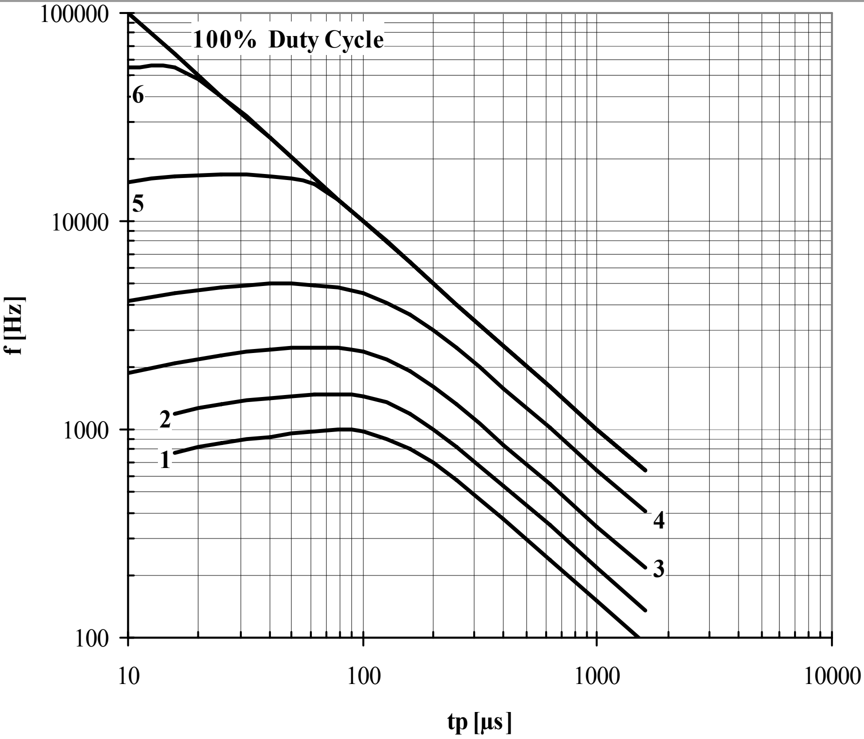


Fig. 10 Sine wave frequency ratings
1 – I_{TM} = 5000 A
2 – I_{TM} = 4000 A
3 – I_{TM} = 3000 A
4 – I_{TM} = 2000 A
5 – I_{TM} = 1000 A
6 – I_{TM} = 500 A

Conditions: $V_R \leq 3$ V; $T_C = 55\ ^oC$

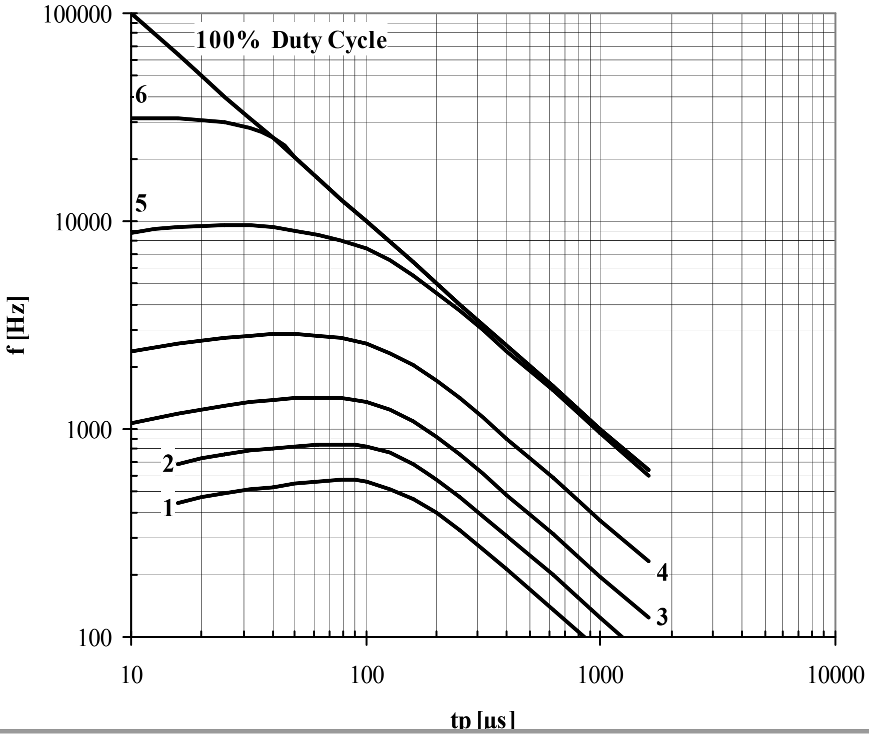


Fig. 11 Sine wave frequency ratings

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=85 °C

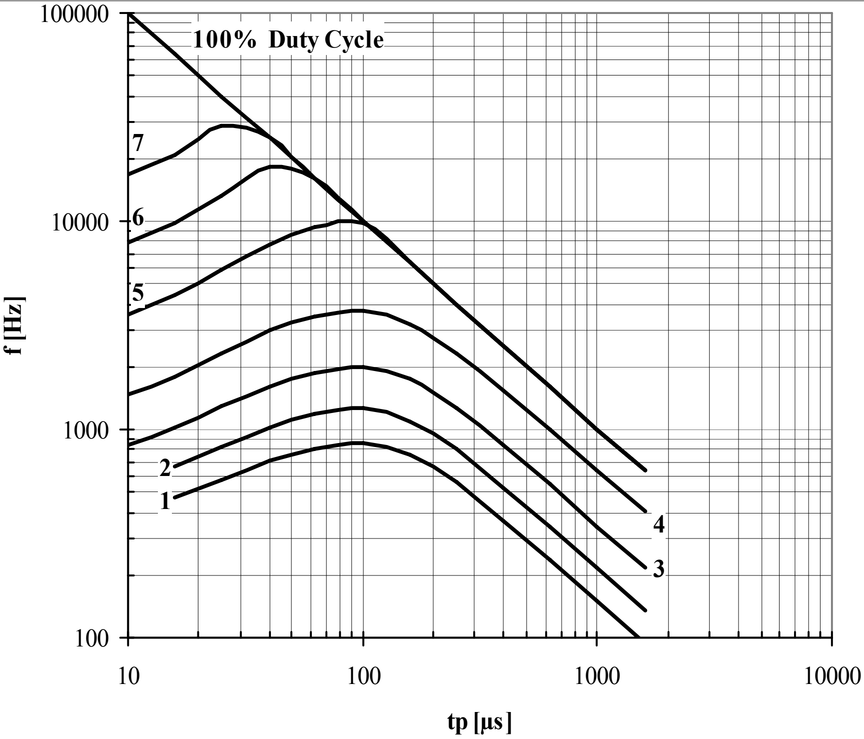


Fig. 12 Sine wave frequency ratings

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=0.67·V_{RRM}; T_C=55 °C

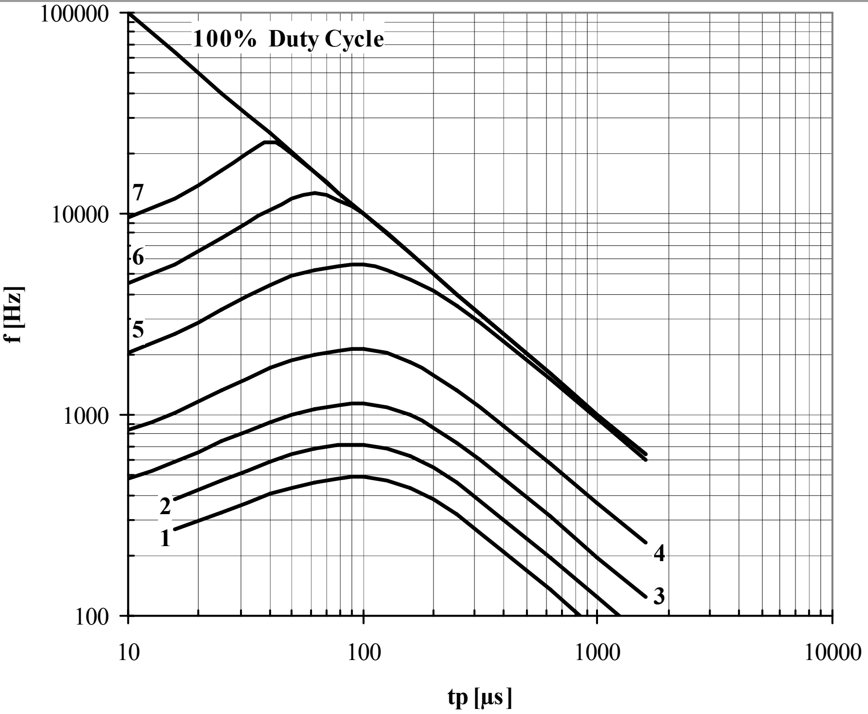


Fig. 13 Sine wave frequency ratings
1 – I_{TM} = 5000 A
2 – I_{TM} = 4000 A
3 – I_{TM} = 3000 A
4 – I_{TM} = 2000 A
5 – I_{TM} = 1000 A
6 – I_{TM} = 500 A
7 – I_{TM} = 250 A

Conditions: V_R=0.67·V_{RRM}; T_C=85 °C

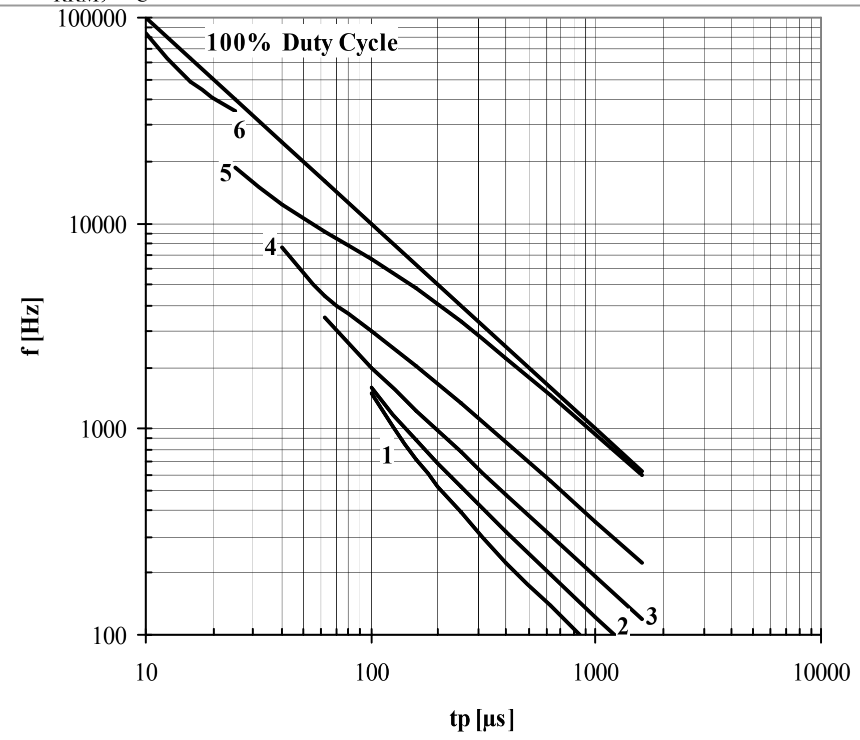


Fig. 14 Square wave frequency ratings
1 – I_{TM} = 5000 A
2 – I_{TM} = 4000 A
3 – I_{TM} = 3000 A
4 – I_{TM} = 2000 A
5 – I_{TM} = 1000 A
6 – I_{TM} = 500 A

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

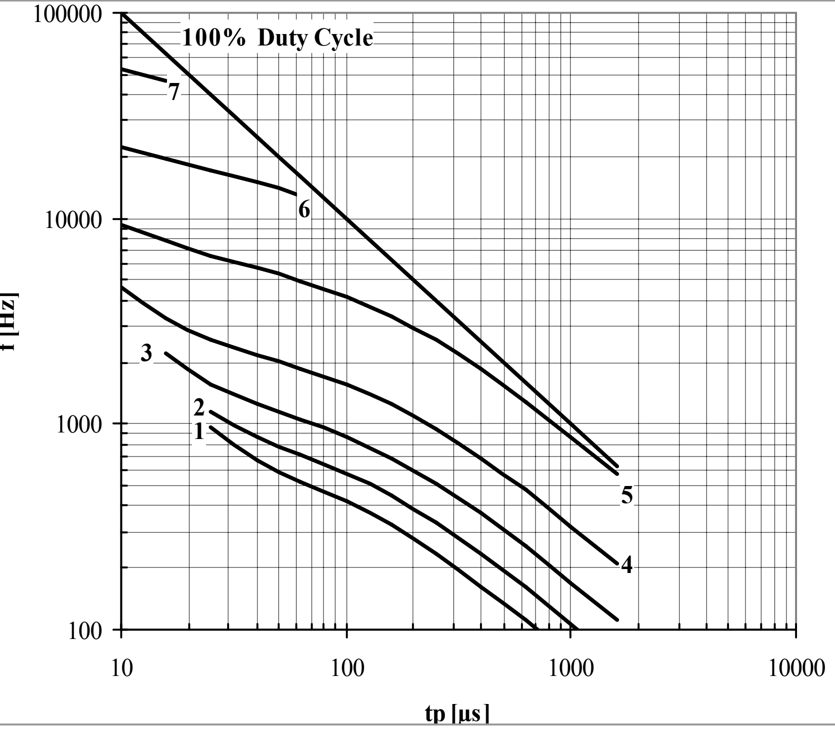


Fig. 15 Square wave frequency ratings

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/µs

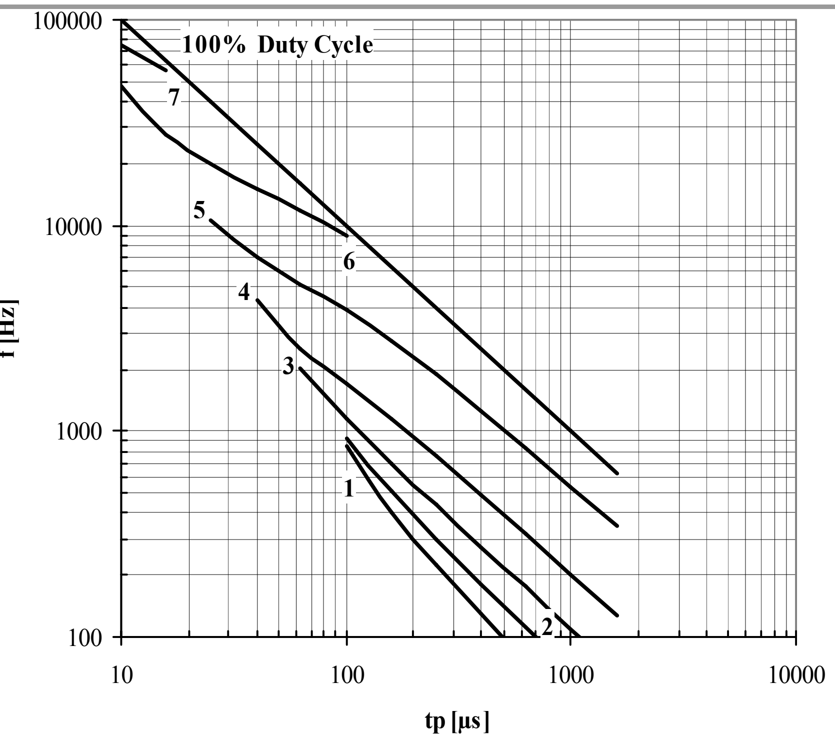


Fig. 16 Square wave frequency ratings

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≤3 V; T_C=85 °C; $di_F/dt=di_R/dt$=100 A/µs

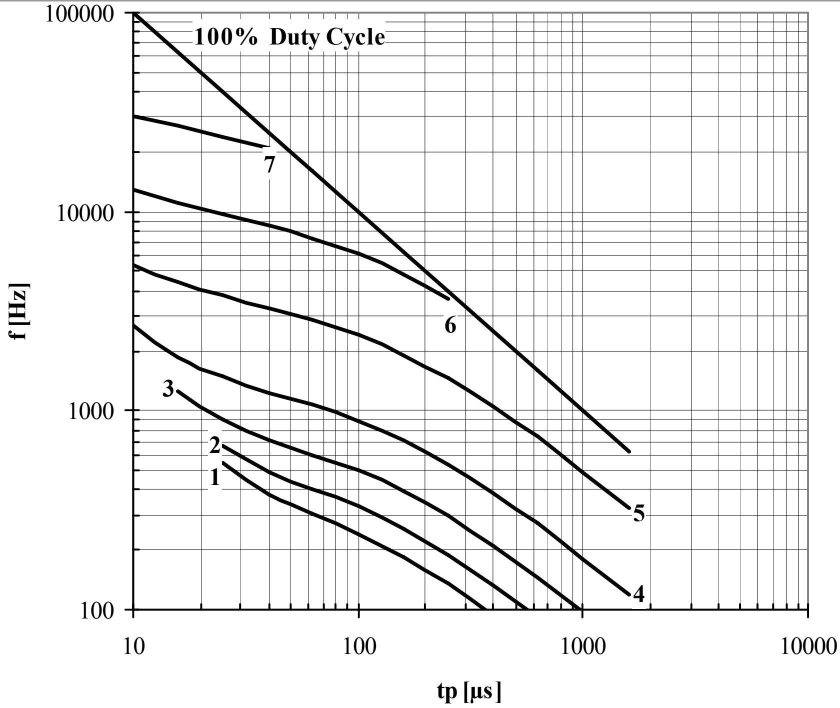


Fig. 17 Square wave frequency ratings

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≤3 V; T_C=85 °C; $di_F/dt=di_R/dt$=500 A/µs

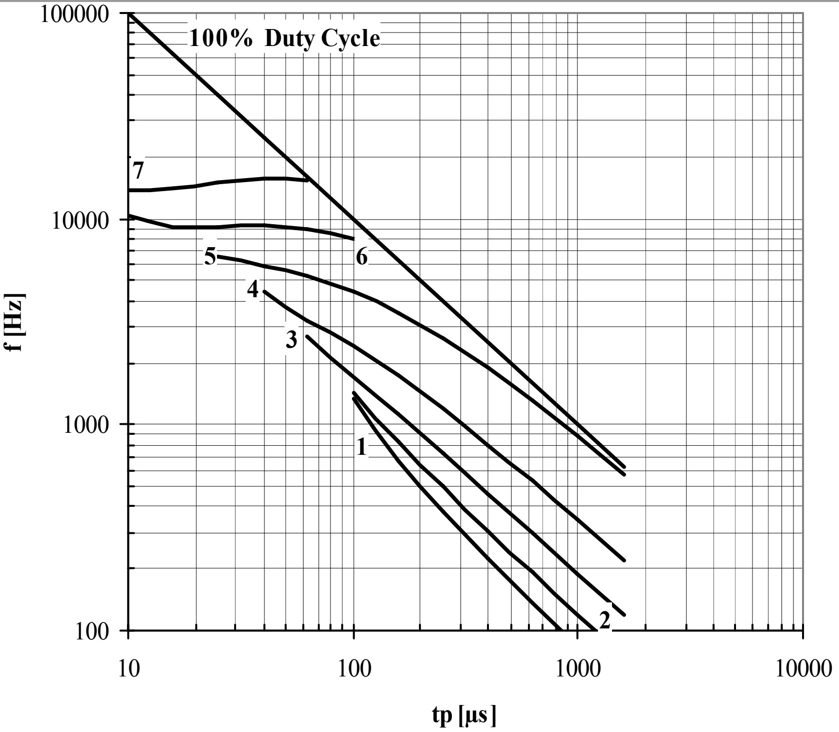


Fig. 18 Square wave frequency ratings
1 – I_{TM} = 5000 A
2 – I_{TM} = 4000 A
3 – I_{TM} = 3000 A
4 – I_{TM} = 2000 A
5 – I_{TM} = 1000 A
6 – I_{TM} = 500 A
7 – I_{TM} = 250 A

Conditions: V_R=0.67·V_{RRM}; T_C=55 °C; di_F/dt=di_R/dt=100 A/µs

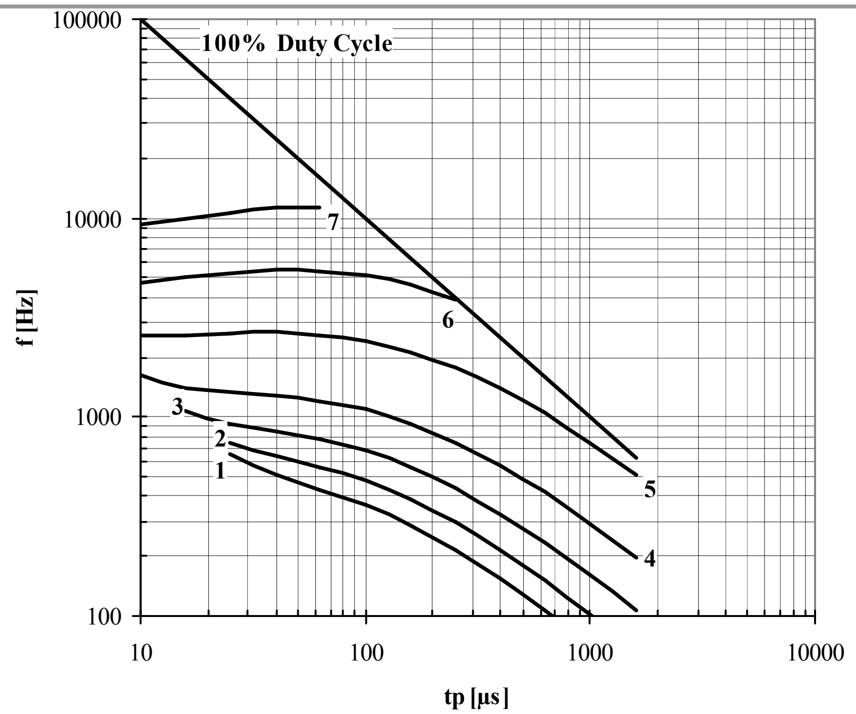


Fig. 19 Square wave frequency ratings
1 – I_{TM} = 5000 A
2 – I_{TM} = 4000 A
3 – I_{TM} = 3000 A
4 – I_{TM} = 2000 A
5 – I_{TM} = 1000 A
6 – I_{TM} = 500 A
7 – I_{TM} = 250 A

Conditions: V_R=0.67·V_{RRM}; T_C=55 °C; di_F/dt=di_R/dt=500 A/µs

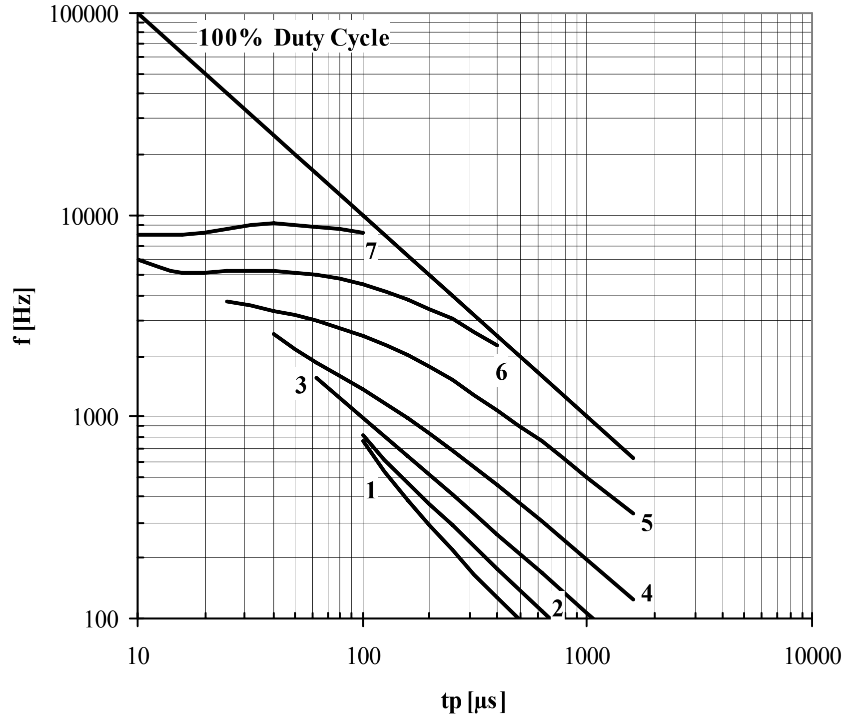


Fig. 20 Square wave frequency ratings
1 – I_{TM} = 5000 A
2 – I_{TM} = 4000 A
3 – I_{TM} = 3000 A
4 – I_{TM} = 2000 A
5 – I_{TM} = 1000 A
6 – I_{TM} = 500 A
7 – I_{TM} = 250 A

Conditions: V_R=0.67·V_{RRM}; T_C=85 °C; $di_F/dt=di_R/dt$=100 A/µs

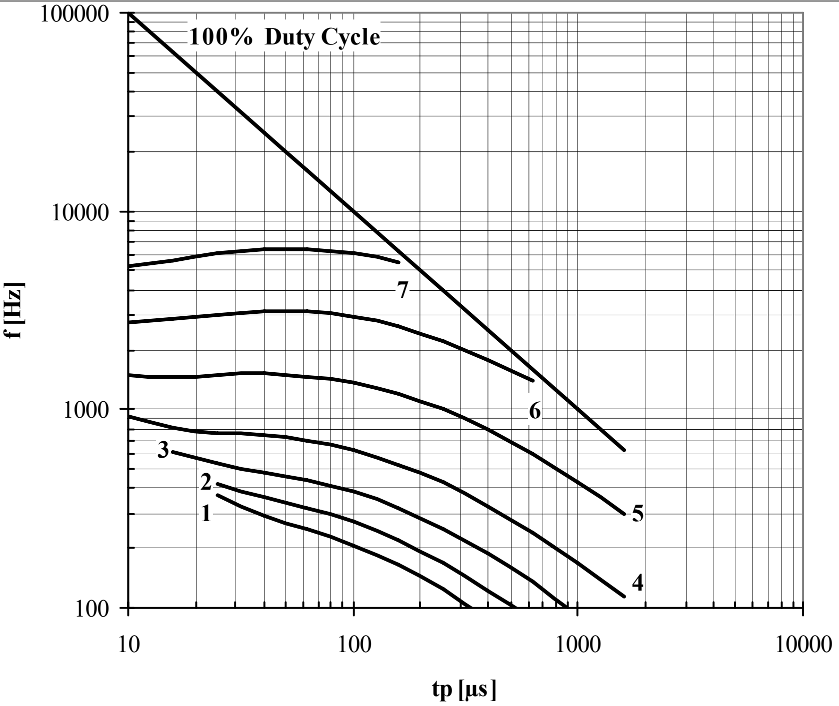


Fig. 21 Square wave frequency ratings
1 – I_{TM} = 5000 A
2 – I_{TM} = 4000 A
3 – I_{TM} = 3000 A
4 – I_{TM} = 2000 A
5 – I_{TM} = 1000 A
6 – I_{TM} = 500 A
7 – I_{TM} = 250 A

Conditions: V_R=0.67·V_{RRM}; T_C=85 °C; $di_F/dt=di_R/dt$=500 A/µs

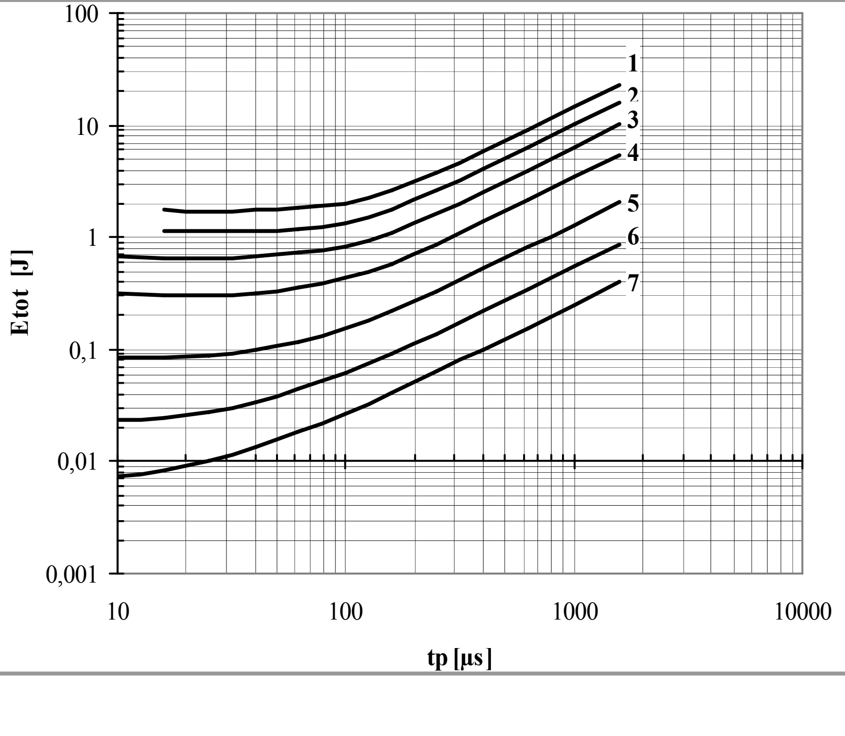


Fig. 22 Sine wave loss energy per pulse

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

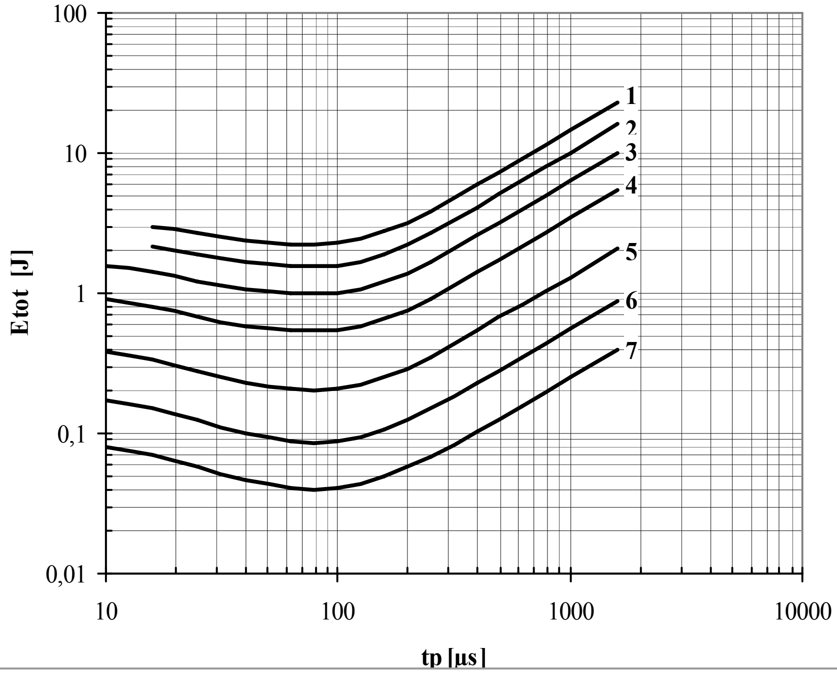


Fig. 23 Sine wave loss energy per pulse

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

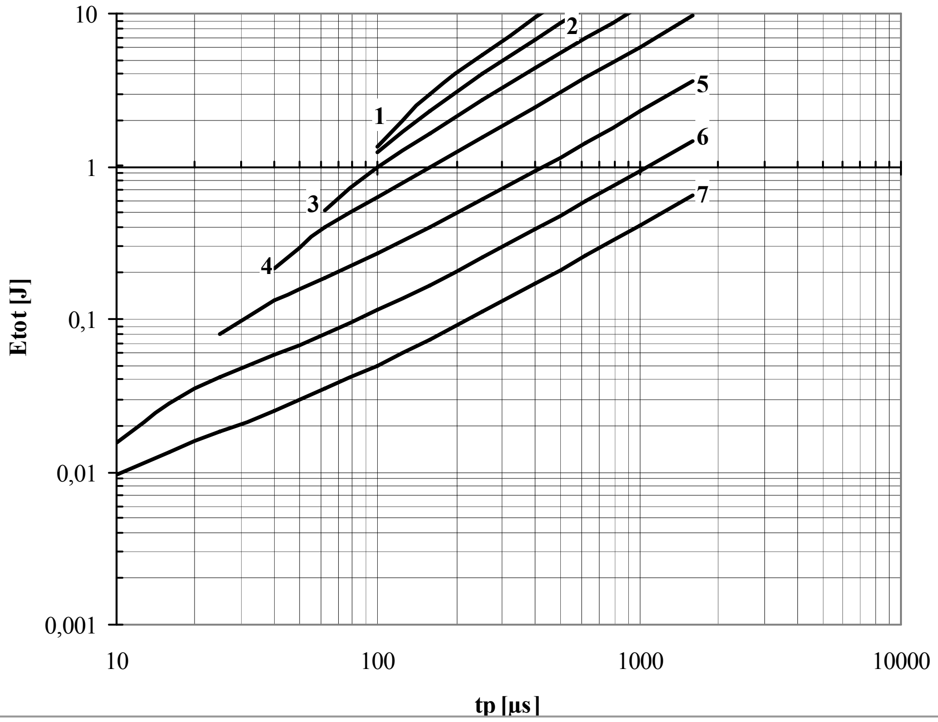


Fig. 24 Square wave loss energy per pulse

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≤3 V; $di_F/dt=di_R/dt$=100 A/µs

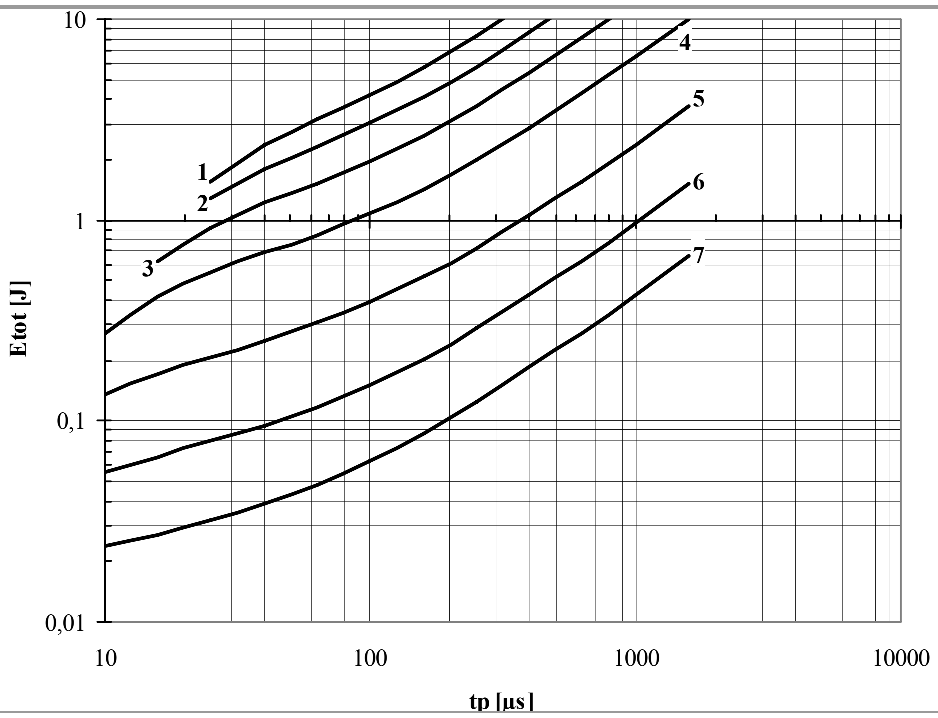


Fig. 25 Square wave loss energy per pulse

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/µs

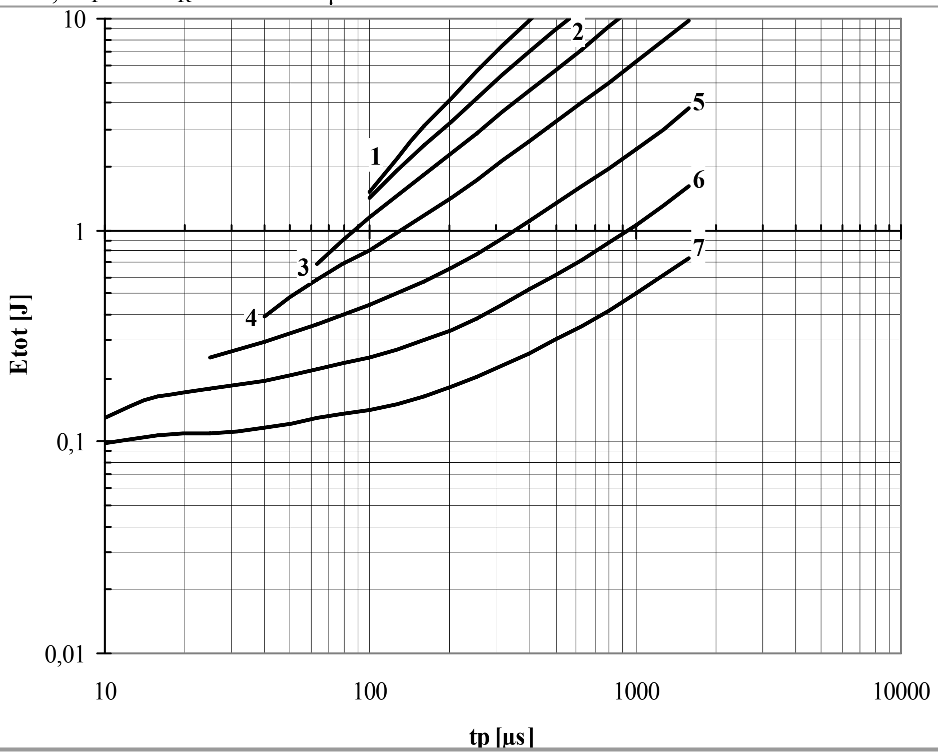


Fig. 26 Square wave loss energy per pulse

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·V_{RRM}; di_F/dt=di_R/dt=100 A/µs

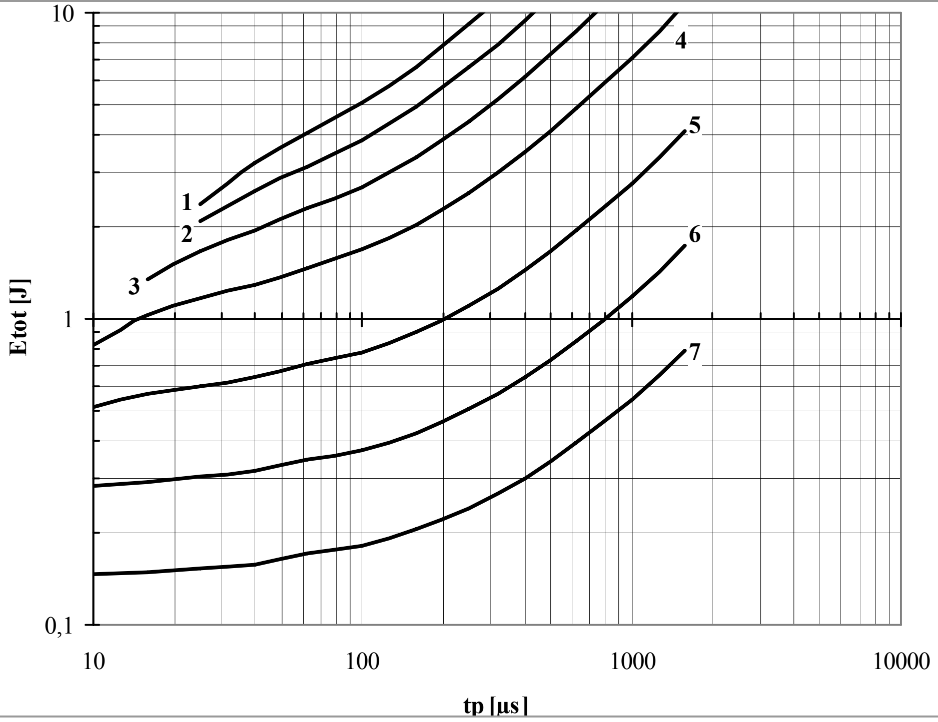


Fig. 27 Square wave loss energy per pulse

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·V_{RRM}; di_F/dt=di_R/dt=500 A/µs

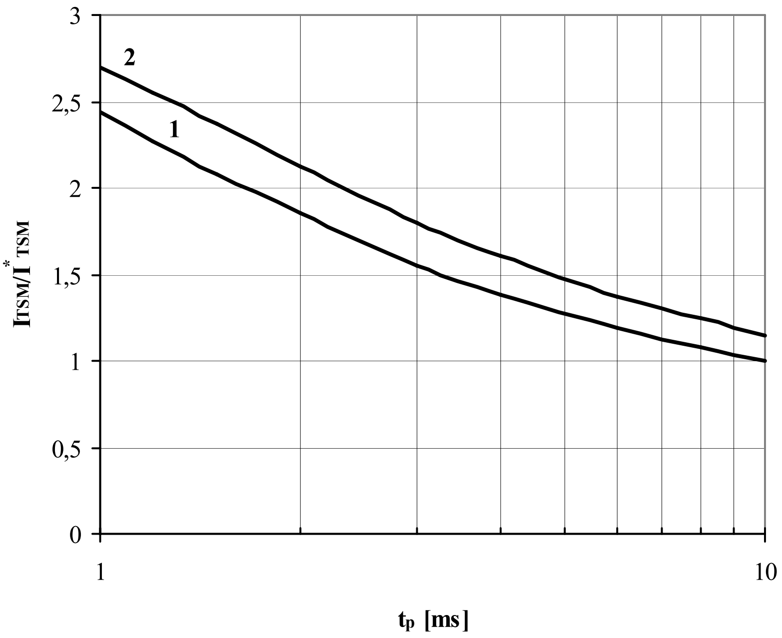


Fig. 28 The surge current I_{TSM} vs. Duration of surge t_p for a half-sine wave 1 – T_j=125 °C 2 – T_j=25 °C
Conditions: V_R=0 V – the peak value of reverse voltage which is applied immediately after the surge current Typical changes of I_{TSM} are normalized to the I_{TSM}^* (I_{TSM}^* – see data sheet, T_j=$T_{j\,max}$)

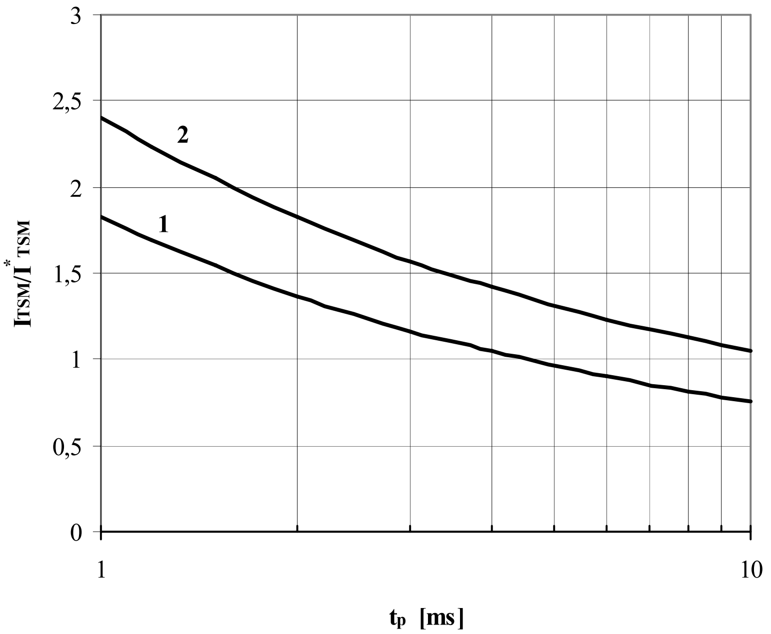


Fig. 29 The surge current I_{TSM} vs. Duration of surge t_p for a half-sine wave 1 – T_j=125 °C 2 – T_j=25 °C
Conditions: V_R=0.8·V_{RRM} – the peak value of reverse voltage which is applied immediately after the surge current Typical changes of I_{TSM} are normalized to the I_{TSM}^* (I_{TSM}^* – see data sheet, T_j=$T_{j\,max}$)

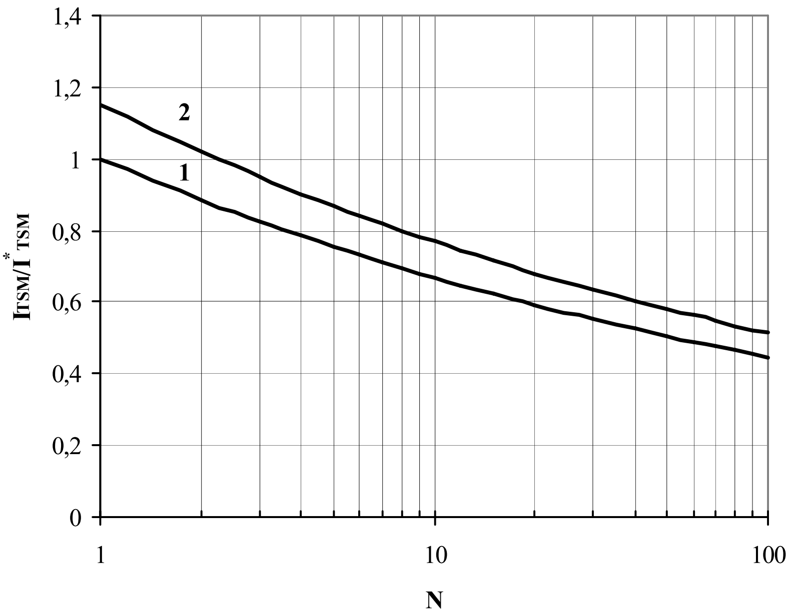


Fig. 30 The surge current I_{TSM} vs. Number of half-sine waves at 50 Hz
1 – T_j=125 °C
2 – T_j=25 °C

Conditions: V_R=0 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=$T_{j\,max}$)

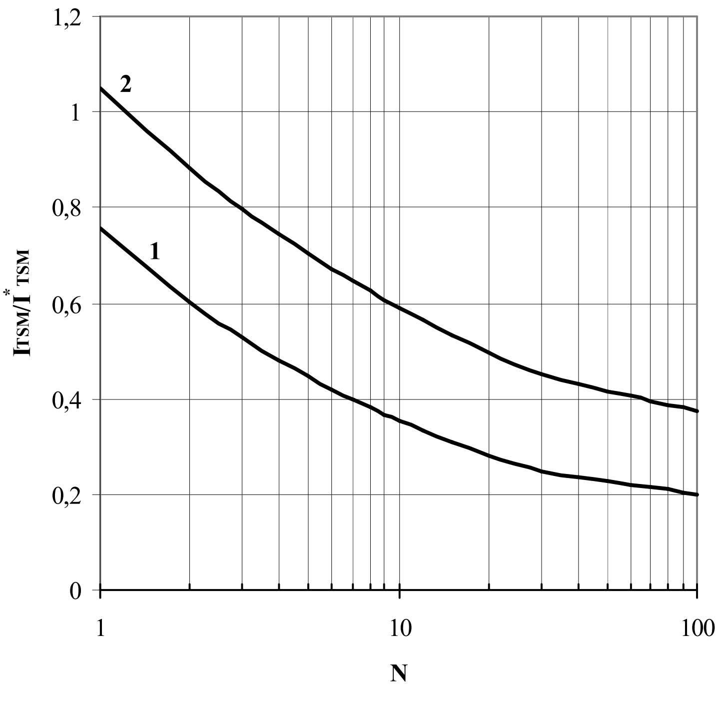


Fig. 31 The surge current I_{TSM} vs. Number of half-sine waves at 50 Hz
1 – T_j=125°C
2 – T_j=25°C

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=$T_{j\,max}$)