Series
TFI333-320

High Frequency Inverter grade Capsule Thyristor Type TFI333-320

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

Maximum mean on-state current Maximum repetitive peak off-state and reverse voltage Turn-off time					ITAV UDRM URRM tq		**320 A** **1200 ÷2200 V** **20; 25; 32 µs**	
UDRM , URRM , V	1200	1300	1400	1500	1600	1800	2000	2200
Voltage code	12	13	14	15	16	18	20	22
Tvj, °C	- 60 ÷ 125							

MAXIMUM ALLOWABLE RATINGS				
Symbols and parameters		Units	TFI333-320	Conditions
ITAV	Mean on-state current	A	320 480	Tc=85 °C, Tc=55 °C, 180° half-sine wave, 50 Hz
ITRMS	RMS on-state current	A	502	Tc=85 °C
ITSM	Surge on-state current	kA	6,3 7,0	Tvj=125°C Tvj=25°C; tp=10 ms, UR=0
I^2t	Limiting load integral	kA^2s	198 245	Tvj=125°C Tvj=25°C; tp=10 ms, UR=0
UDRM,URRM	Repetitive peak off-state and reverse voltage	V	1200÷2200	Tj min≤Tvj≤TjM 180° half-sine wave, 50 Hz Gate open
UDSM,URSM	Non-repetitive peak off-state and reverse voltage	V	1300÷2300	Tj min≤Tvj≤TjM 180° half-sine wave tp=10 ms, Single pulse Gate open
(diT/dt) crit	Critical rate of rise of on-state current : non - repetitive repetitive	A/µs	 1600 800	Tvj=125°C ; UD=0,67 UDRM, Gate pulse : 10V,5 Ω, 1µs rise time, 10 µs
URGM	Peak reverse gate voltage	V	5	Tj min≤Tvj≤TjM
Tstg	Storage temperature	°C	-60÷80	
Tvj	Junction temperature	°C	-60÷125	
CHARACTERISTICS				
UTM	Peak on-state voltage	V	2,6	Tvj=25°C, ITM=3,14 ITAV
UT(TO)	Threshold voltage	V	1,6	Tvj=125°C 1,57 ITAV< IT <4,71 ITAV
RT	On-state slope resistance	mΩ	1,25	
IDRM IRRM	Repetitive peak off-state and reverse current	mA	50 50	Tvj=125°C, UD = UDRM UR= URRM

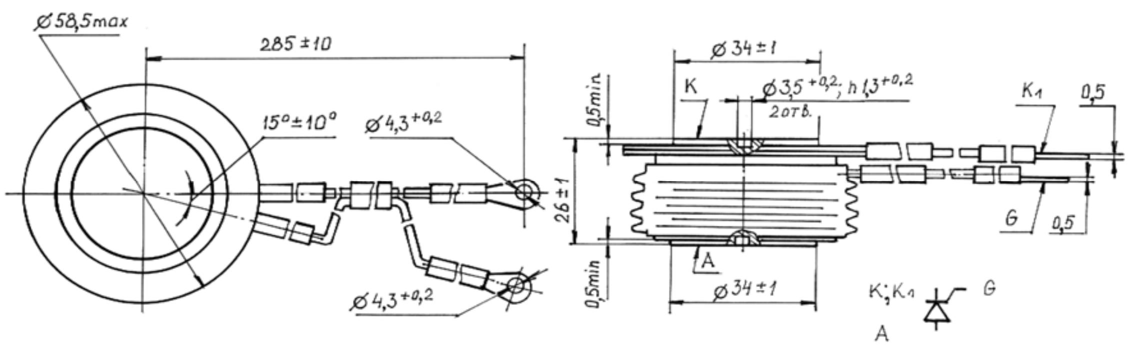
CHARACTERISTICS

Symbols and parameters		Units	TFI333-320	Conditions
I_L	Latching current	A	5	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} Direct gate current
I_{GD}	Gate non-trigger direct current	mA	10	
tgd	Delay time	μs	1,6	Tvj=25°C,U_D=500V I_{TM} = 320 A Gate pulse : 10V, 5Ω, 1 μs rise time, 10μs
tgt	Turn-on time	μs	2,5	
tq	Turn-off time	μs	20÷32 25÷40	Tvj=125°C, I_{TM} =320A 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	300	Tvj=125°C, I_{TM} =320 A di_R/dt =50 A/μs, U_R=100V
trr	Reverse recovery time	μs	4,6	
I_{RRM}	Peak reverse recovery current	A	130	
(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	0,045	Direct current, double side cooled

ORDERING

	TFI	**333**	**320**	**20**	**7**	**6**	**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 (20=2000V).
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, 4 ≤ 32 μs , 5 ≤ 25 μs, 6 ≤ 20 μs)
7. Group of turn-on time (3 ≤ 2,5 μs).



Mouting force : 10÷15 kN
Weight : 250 grams

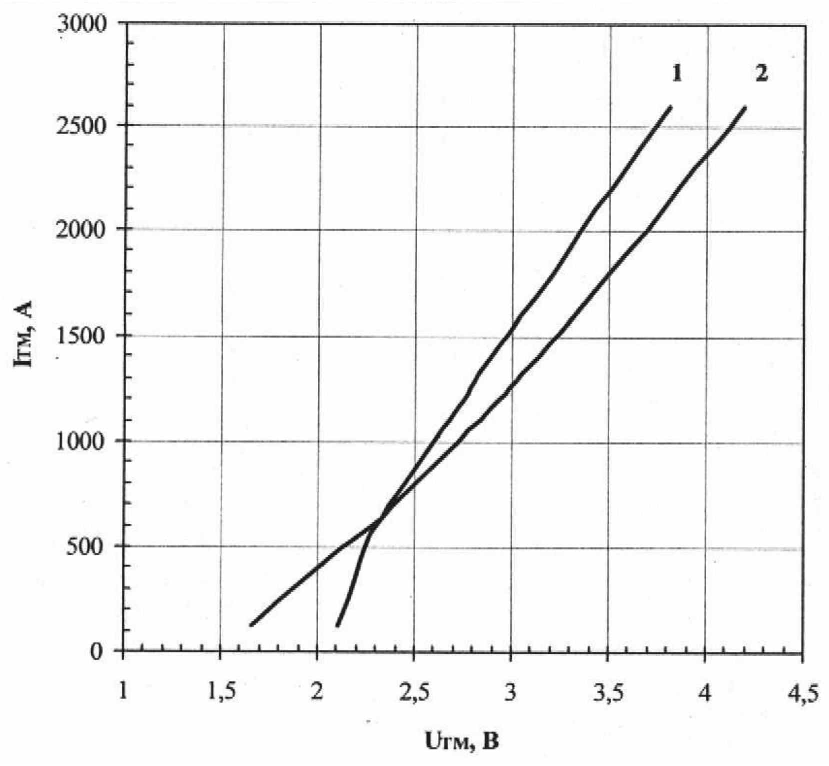
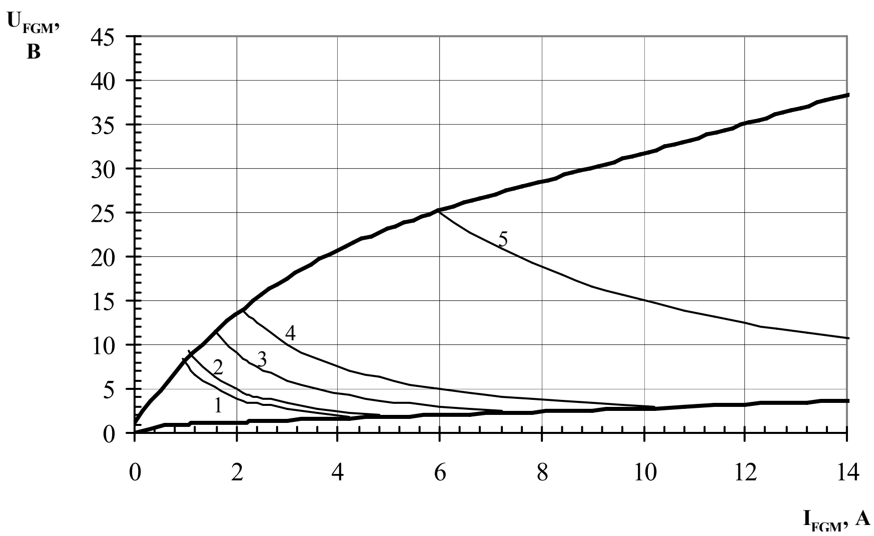


Fig. 1 On-state characteristics of Limit device

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

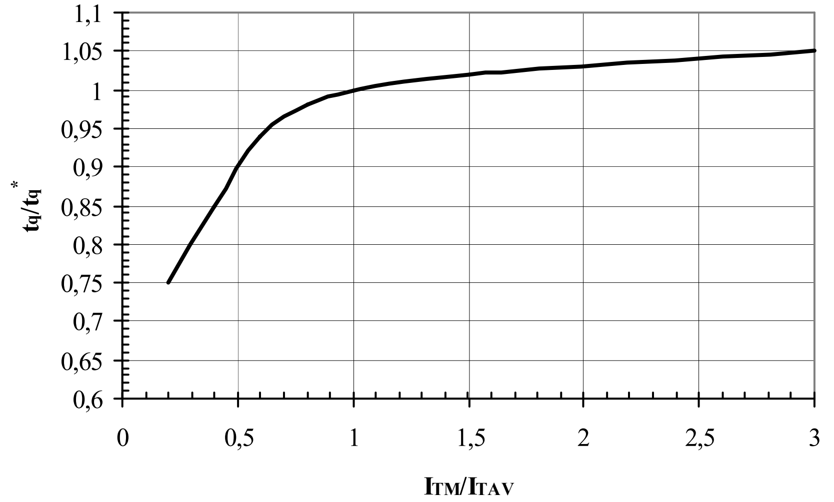


Fig. 3 Turn-off time t_q vs. On-state peak current I_{TM}

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

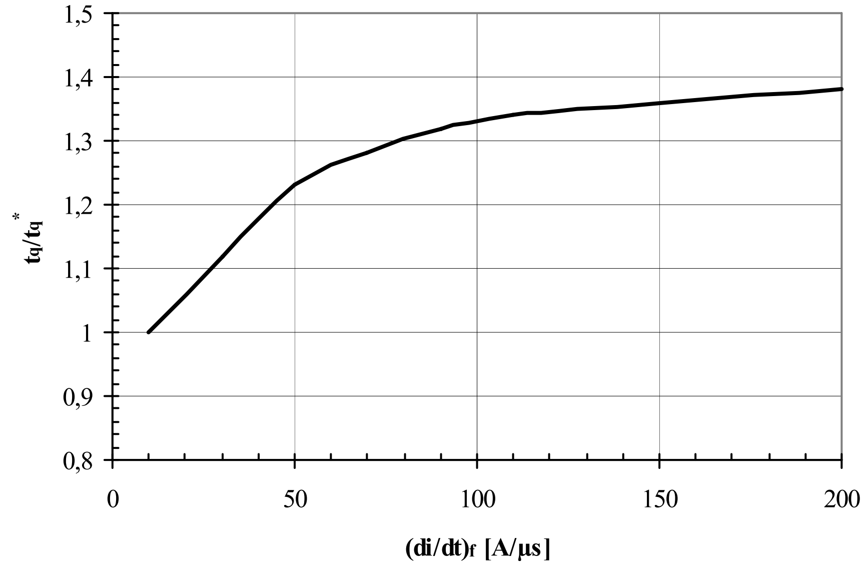


Fig. 4 Turn-off time t_q vs. Rate of fall of on-state current di_R/dt

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

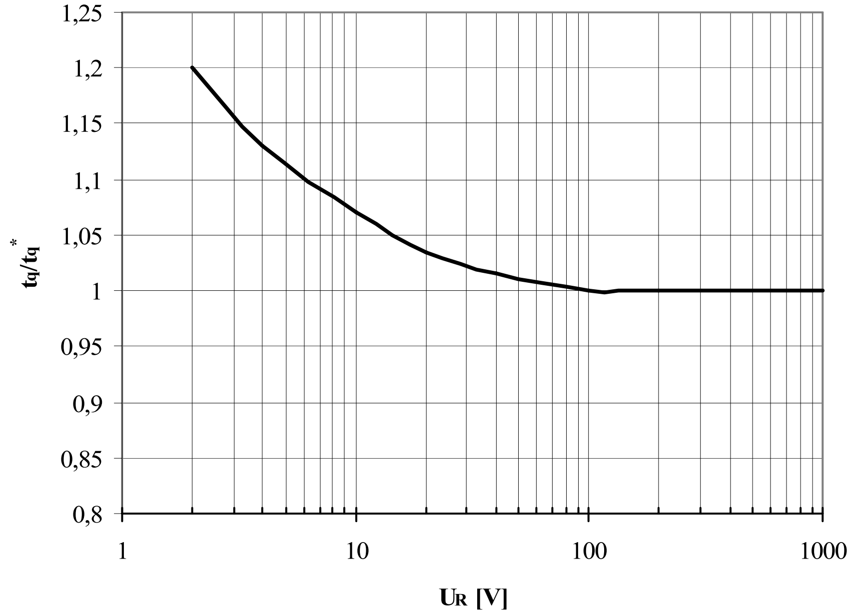


Fig. 5 Turn-off time t_q vs. Reverse voltage V_R

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)

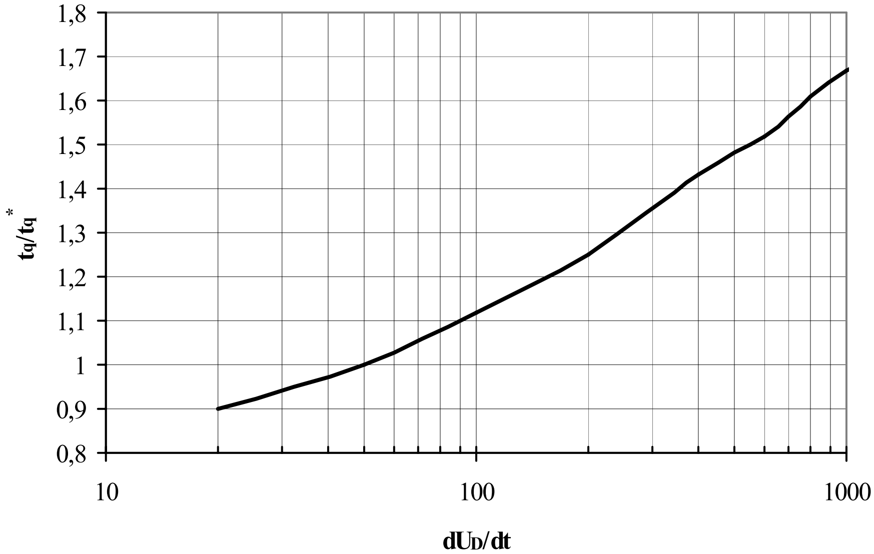


Fig. 6 Turn-off time t_q vs. Rate of rise of commutating voltage dv_D/dt

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

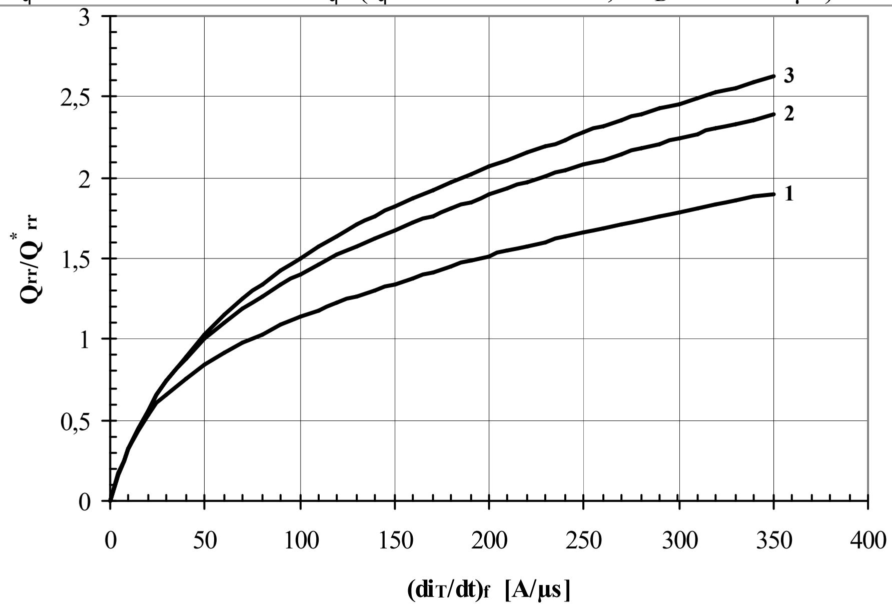


Fig. 7 Reverse recovery charge Q_{rr}, vs. Rate of fall of on-state current di_R/dt
1 – I_{TM} = 0.5·I_{TAV}
2 – I_{TM} = I_{TAV},
3 – I_{TM} = 1.5·I_{TAV}

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

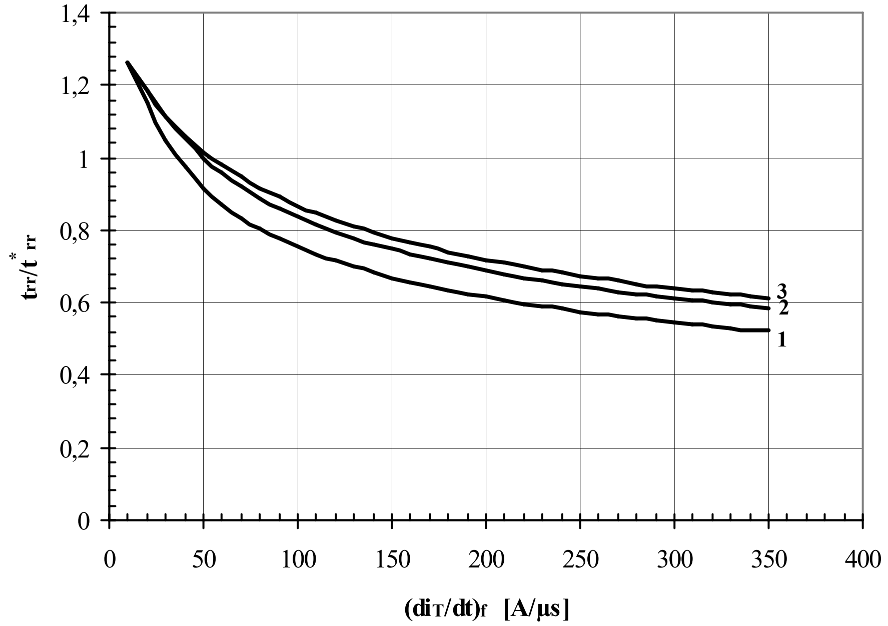


Fig. 8 Reverse recovery time t_{rr} vs. Rate of fall of on-state current di_R/dt
1 – $I_{TM} = 0.5 \cdot I_{TAV}$
2 – $I_{TM} = I_{TAV}$,
3 – $I_{TM} = 1.5 \cdot I_{TAV}$

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)

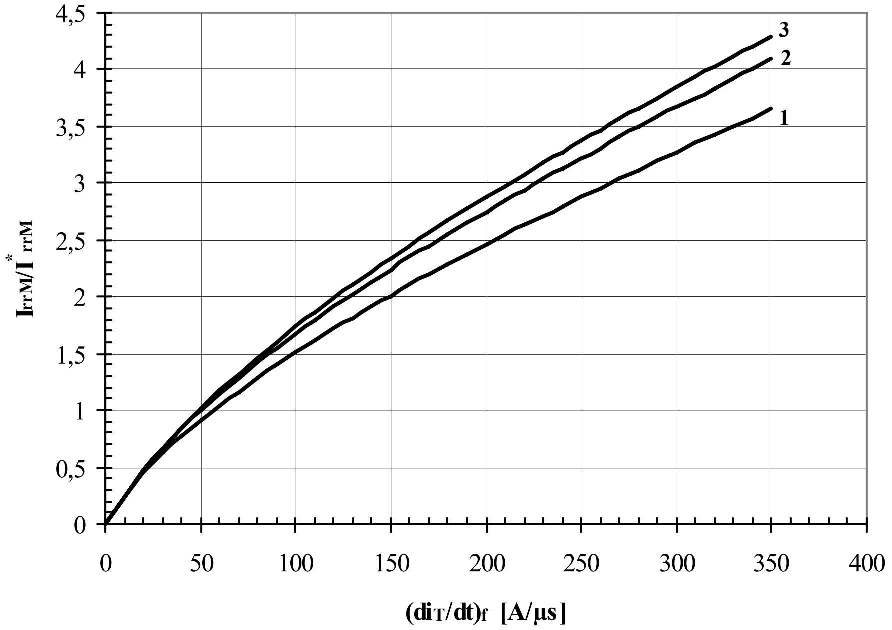


Fig. 9 Peak reverse recovery current I_{rrM} vs. Rate of fall of on-state current di_R/dt
1 – $I_{TM} = 0.5 \cdot I_{TAV}$
2 – $I_{TM} = I_{TAV}$,
3 – $I_{TM} = 1.5 \cdot I_{TAV}$

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)

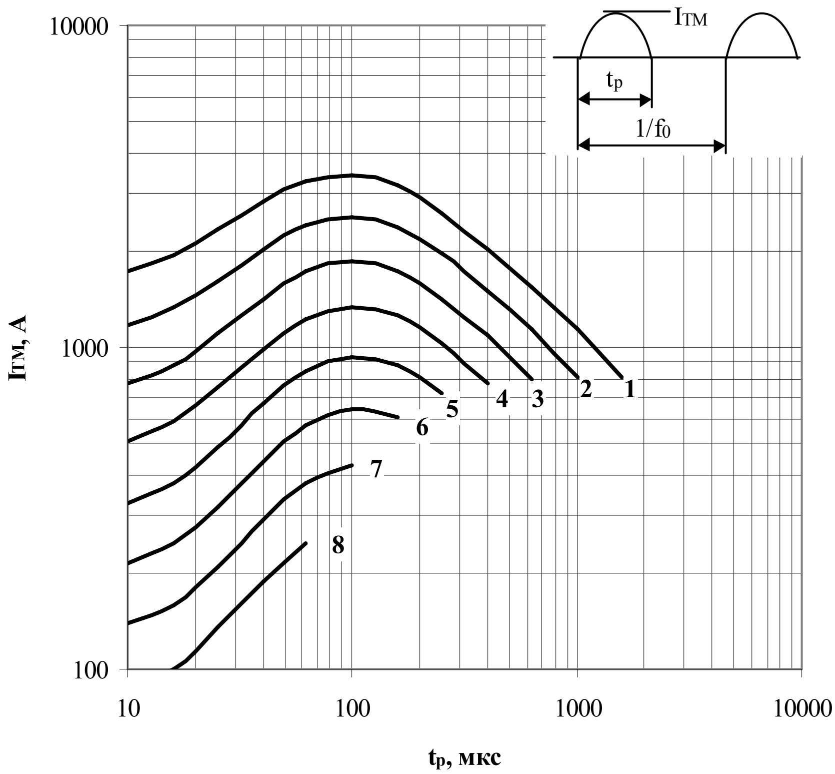


Fig. 10 Sine wave frequency ratings

1 – 630 Hz; 5 – 4000 Hz;
2 – 1000 Hz; 6 – 6300 Hz;
3 – 1600 Hz; 7 – 10000 Hz;
4 – 2500 Hz; 8 – 16000 Hz.

Conditions: $U_D=0{,}67 \cdot U_{DRM}$; $U_R=0{,}67 \cdot U_{RRM}$; $T_c=65$ °C.

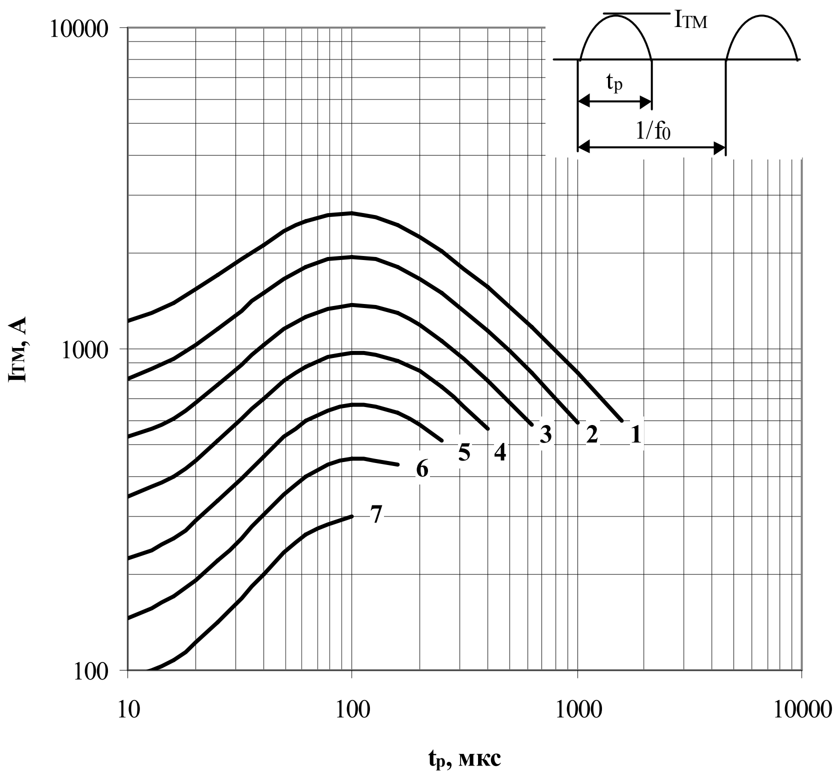


Fig. 11 Sine wave frequency ratings

1 – 630 Hz; 5 – 4000 Hz;
2 – 1000 Hz; 6 – 6300 Hz;
3 – 1600 Hz; 7 – 10000 Hz.
4 – 2500 Hz;

Conditions: $U_D=0{,}67 \cdot U_{DRM}$; $U_R=0{,}67 \cdot U_{RRM}$; $T_c=85$ °C.

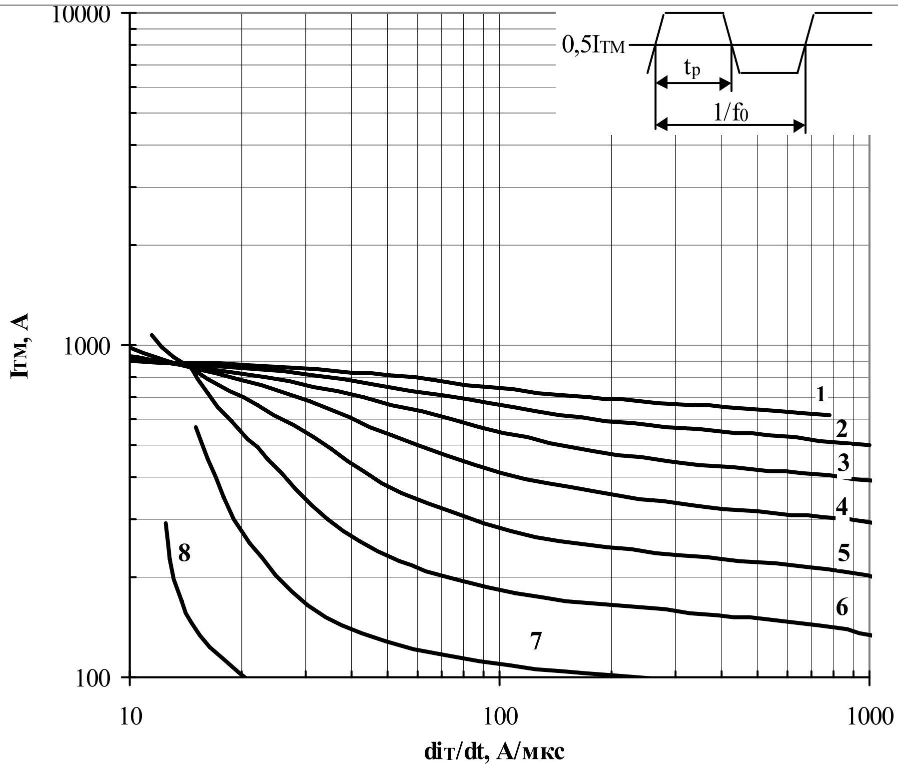


Fig. 12 Square wave frequency ratings

1 – 630 Hz;
2 – 1000 Hz;
3 – 1600 Hz;
4 – 2500 Hz;
5 – 4000 Hz;
6 – 6300 Hz;
7 – 10000 Hz;
8 – 16000 Hz.

Conditions: U_D=0,67·U_{DRM}; U_R=0,67·U_{RRM} ;T_c=65 °C t_p=1/2f_0.

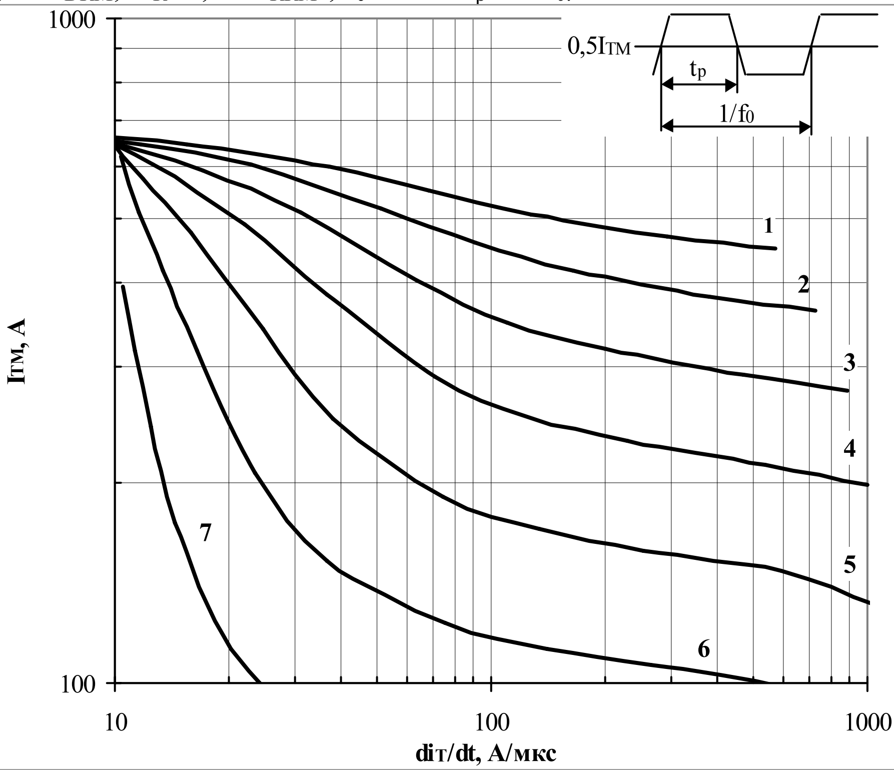


Fig. 13 Square wave frequency ratings

1 – 630 Hz;
2 – 1000 Hz;
3 – 1600 Hz;
4 – 2500 Hz;
5 – 4000 Hz;
6 – 6300 Hz;
7 – 10000 Hz.

Conditions: $U_D=0{,}67 \cdot U_{DRM}$; $U_R=0{,}67 \cdot U_{RRM}$; $T_c=85$ °C; $t_p=1/2f_0$

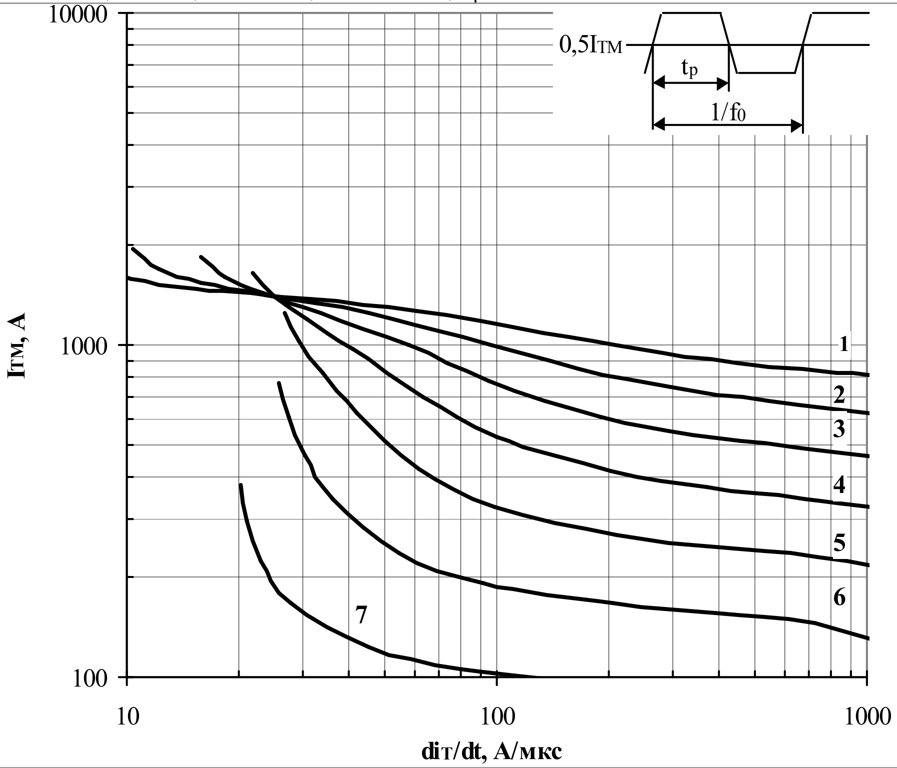


Fig. 14 Square wave frequency ratings

1 – 630 Hz;
2 – 1000 Hz;
3 – 1600 Hz;
4 – 2500 Hz;
5 – 4000 Hz;
6 – 6300 Hz;
7 – 10000 Hz.

Conditions: $U_D=0{,}67 \cdot U_{DRM}$; $U_R=0{,}67 \cdot U_{RRM}$; $T_c=65$ °C; $t_p=1/4f_0$

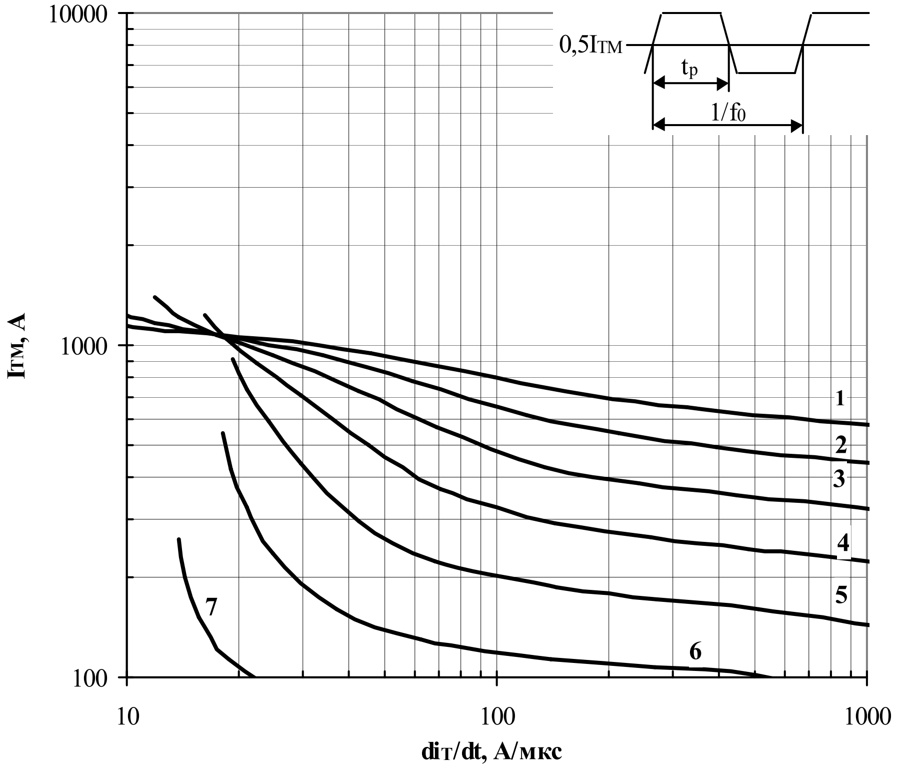


Fig.15 Square wave frequency ratings

1 – 630 Hz;
2 – 1000 Hz;
3 – 1600 Hz;
4 – 2500 Hz;
5 – 4000 Hz;
6 – 6300 Hz;
7 – 10000 Hz.

Conditions : U_D=0,67·U_{DRM}; U_R=0,67·U_{RRM}; T_c=85 °C; t_p=1/4f_0

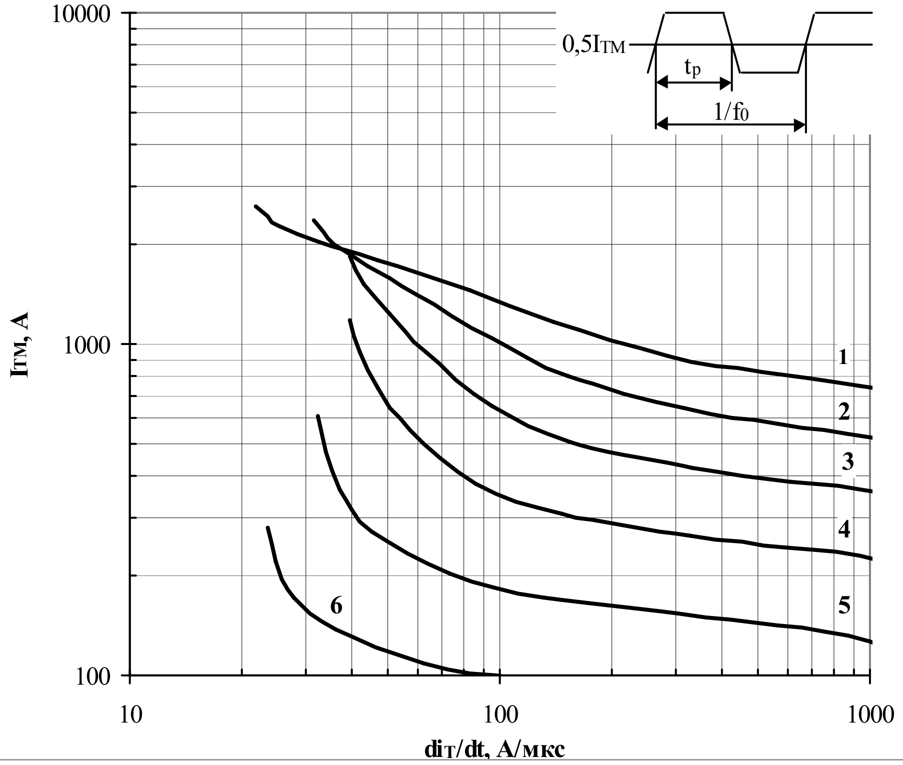


Fig. 16 Square wave frequency ratings

1 – 630 Hz;
2 – 1000 Hz;
3 – 1600 Hz;
4 – 2500 Hz;
5 – 4000 Hz;
6 – 6300 Hz.

Conditions: U_D=0,67·U_{DRM}; U_R=0,67·U_{RRM}; T_c=85 °C; t_p=1/10f_0

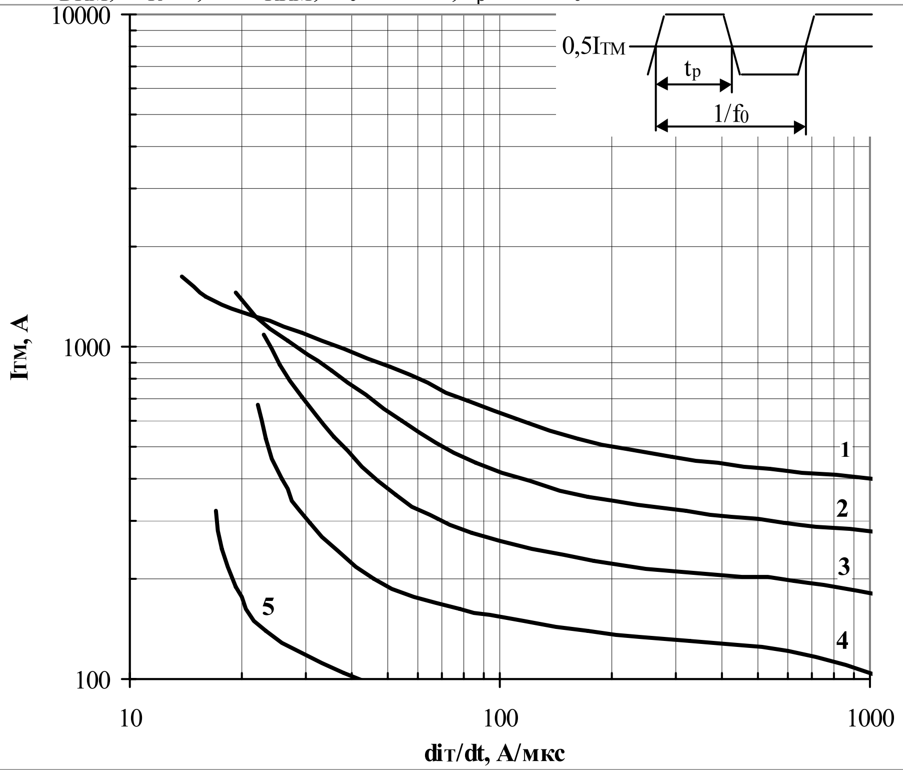


Fig. 17 Square wave frequency ratings

1 – 630 Hz;
2 – 1000 Hz;
3 – 1600 Hz;
4 – 2500 Hz;
5 – 4000 Hz.

Conditions: U_D=0,67·U_{DRM}; U_R=0,67·U_{RRM}; T_c=105 °C; t_p=1/10f_0

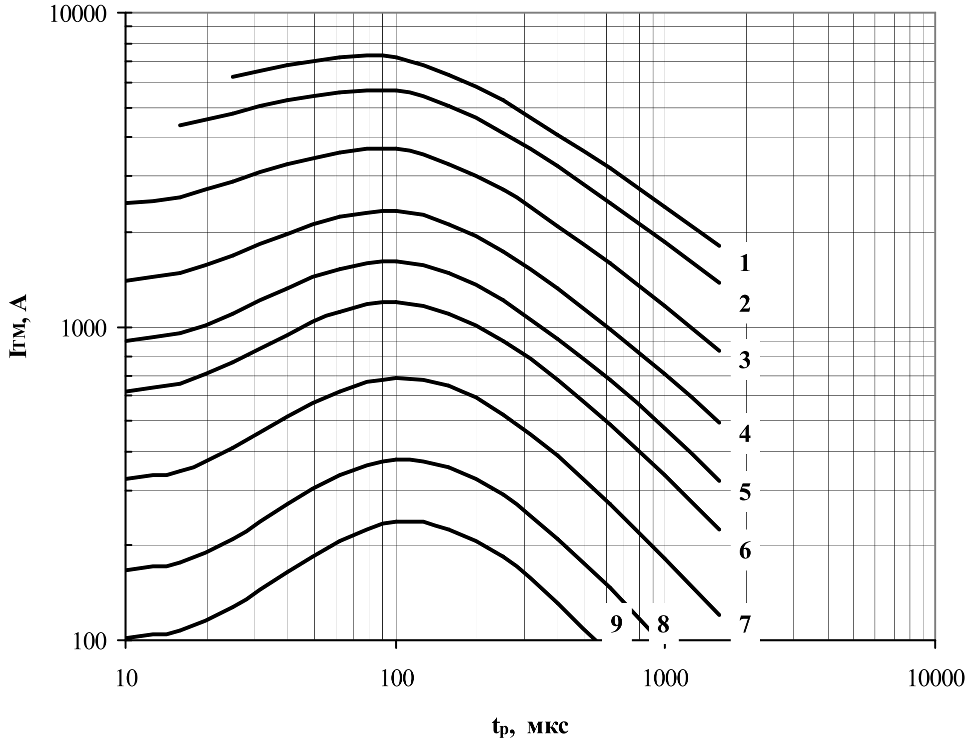


Fig. 18 Sine wave loss energy per pulse

1 – 6 J;
2 – 4 J;
3 – 2 J;
4 – 1 J;
5 – 0,6 J;
6 – 0,4 J;
7 – 0,2 J;
8 – 0,1 J;
9 – 0,06 J.

Conditions: $U_D=0{,}67 \cdot U_{DRM}$; $U_R=0{,}67 \cdot U_{RRM}$.

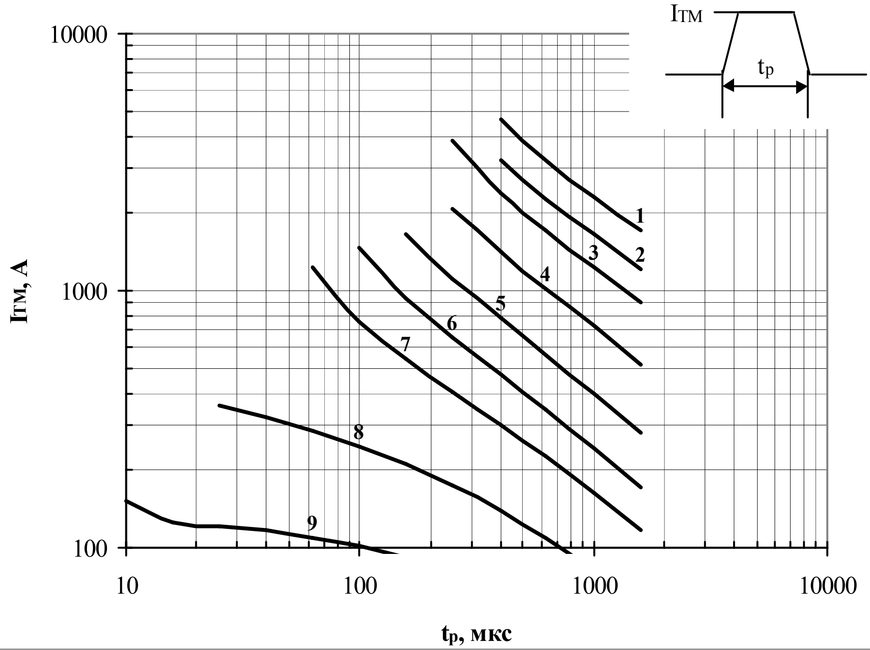


Fig. 19 Sguare wave loss energy per pulse

1 – 10 J; 6 – 0,6 J;

2 – 6 J; 7 – 0,4 J;
3 – 4 J; 8 – 0,2 J;
4 – 2 J; 9 – 0,1 J.
5 – 1 J;

Conditions: di_T/dt = 50 A/мкс; $U_D=0{,}67 \cdot U_{DRM}$; $U_R=0{,}67 \cdot U_{RRM}$.

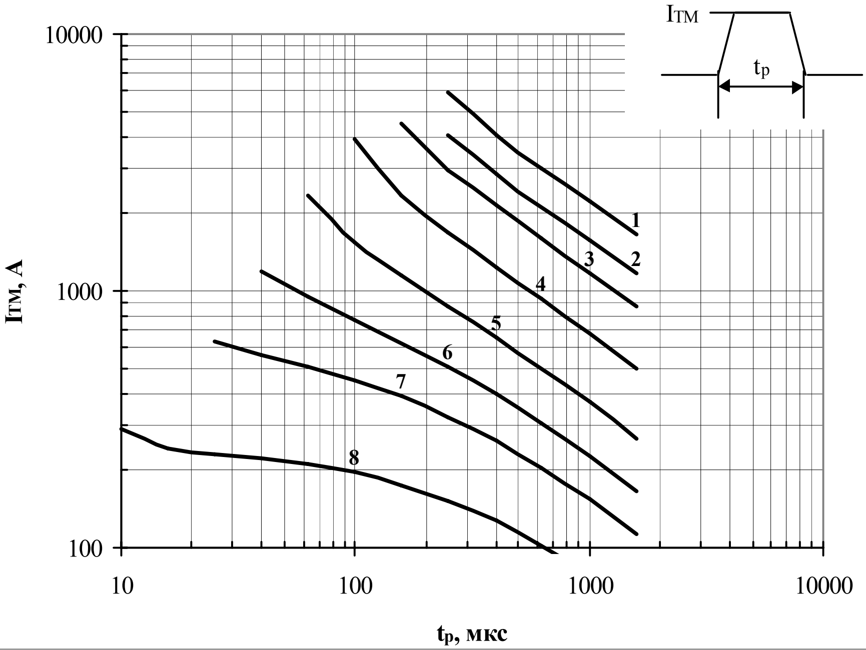


Fig. 20 Sguare wave loss energy per pulse

1 – 10 J;
2 – 6 J;
3 – 4 J;
4 – 2 J;
5 – 1 J;
6 – 0,6 J;
7 – 0,4 J;
8 – 0,2 J.

Conditions: di_T/dt = 100 A/мкс; $U_D=0{,}67 \cdot U_{DRM}$; $U_R=0{,}67 \cdot U_{RRM}$.

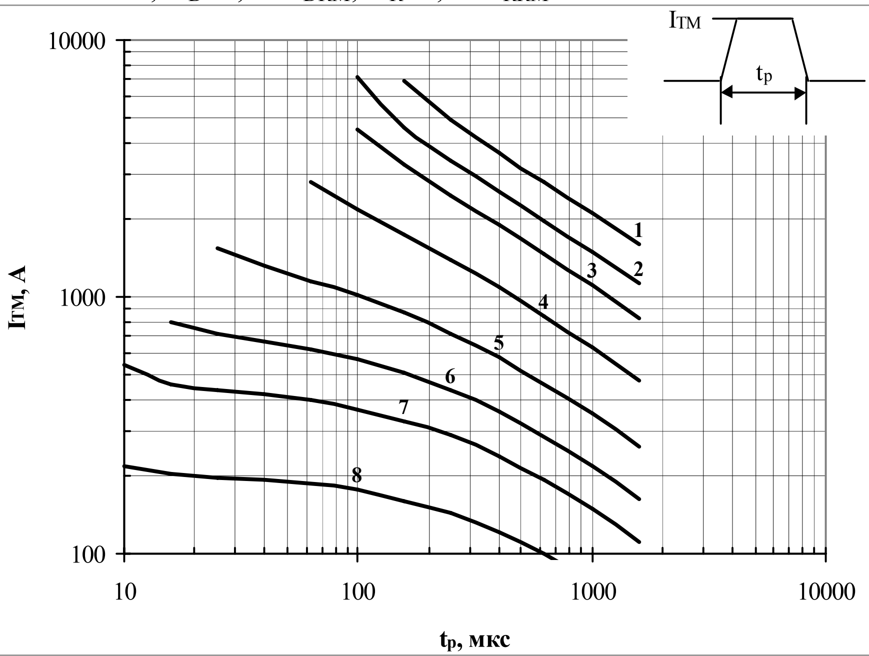


Fig. 21 Sguare wave loss energy per pulse

1 – 10 J;

2 – 6 J; 3 – 4 J; 4 – 2 J; 5 – 1 J; 6 – 0,6 J; 7 – 0,4 J; 8 – 0,2 J.
Conditions: di_T/dt = 200 A/мкс; $U_D=0,67 \cdot U_{DRM}$; $U_R=0,67 \cdot U_{RRM}$.

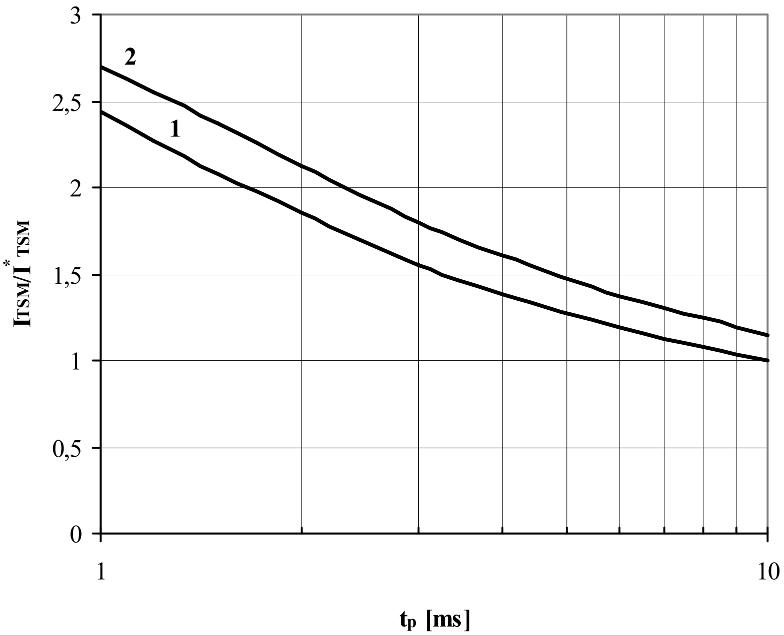


Fig. 22 The surge current I_{TSM} vs. Duration of surge t_p for a half-sine wave

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, $T_j=T_{j\,max}$)

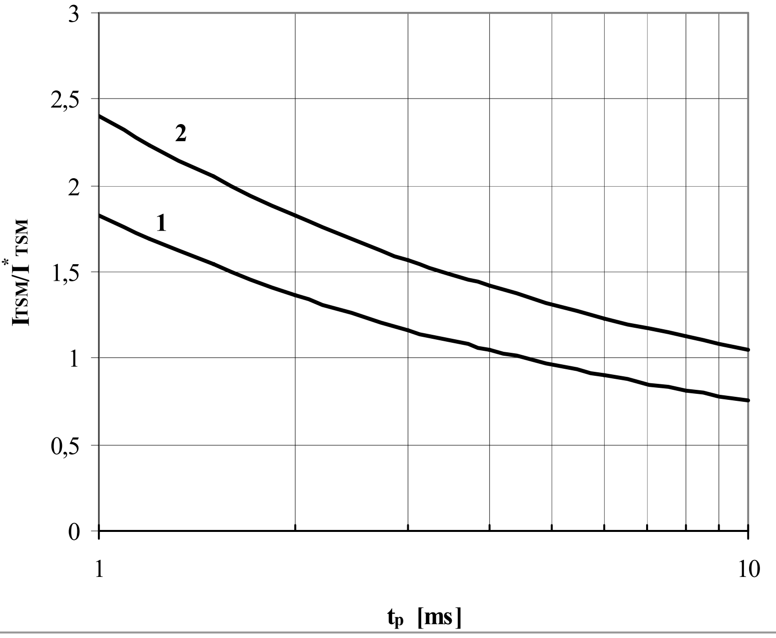


Fig. 23 The surge current I_{TSM} vs. Duration of surge t_p for a half-sine wave

1 – T_j=125 °C

2 – T_j=25 °C

Conditions: $V_R=0.8 \cdot V_{RRM}$ – 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, $T_j=T_{j\,max}$)

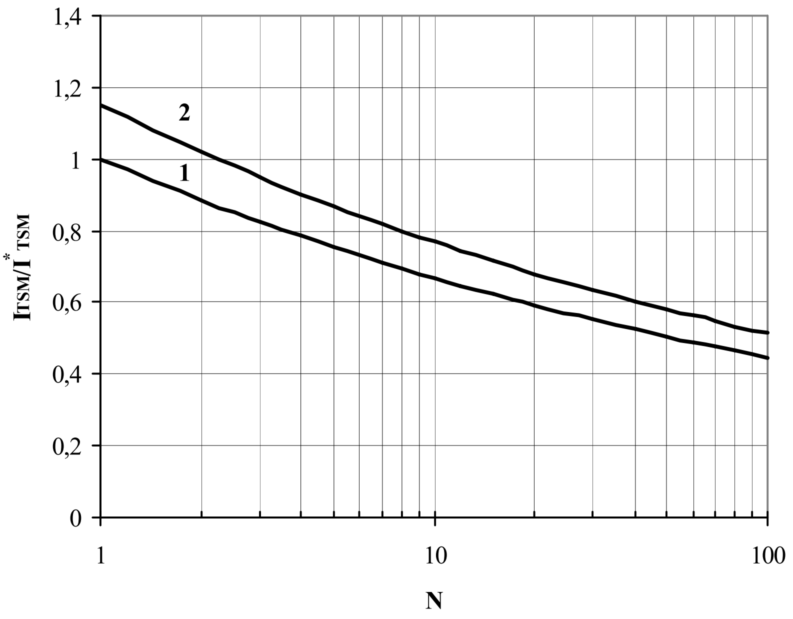


Fig. 24 The surge current I_{TSM} vs. Number of half-sine waves at 50 Hz
1 – T_j=125 °C
2 – T_j=25 °C

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=$T_{j\,max}$)

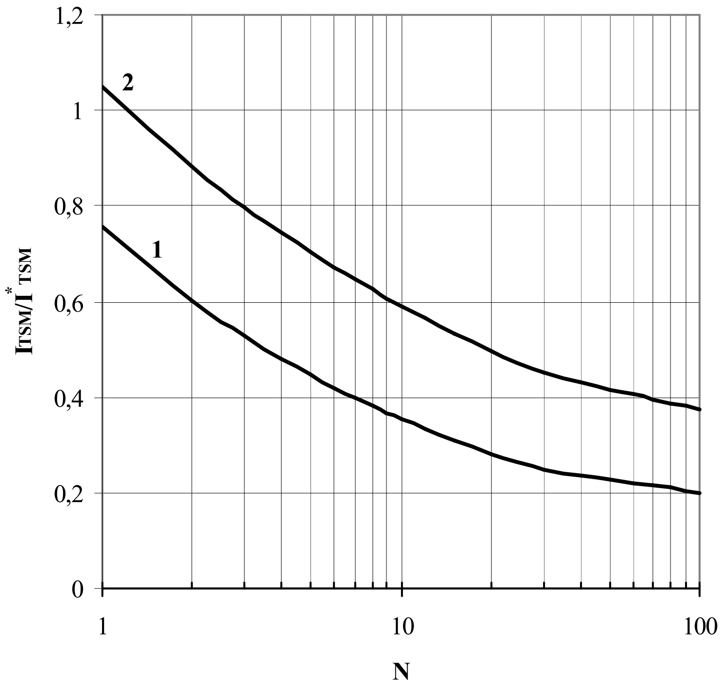


Fig. 25 The surge current I_{TSM} vs. Number of half-sine waves at 50 Hz
1 – T_j=125°C
2 – T_j=25°C

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=$T_{j\,max}$)