

**Series**  
**TFI133S-400**

## High Frequency Inverter grade Capsule Thyristor Type TFI133S-400

Strong distributed amplified gate  
and low turn-off time thyristor for  
high frequency applications to 20 kHz

Maximum mean on-state current					$I_{TAV}$	<b>400 A</b>	
Maximum repetitive peak off-state and reverse voltage					$U_{DRM}$	<b>600 ÷ 1200 V</b>	
Turn-off time					$U_{RRM}$		
					$t_q$	<b>5; 6,3 <math>\mu</math>s</b>	
$U_{DRM}, U_{RRM}, V$	600	700	800	900	1000	1100	1200
Voltage code	6	7	8	9	10	11	12
$T_{vj}, ^\circ C$	- 60 ÷ 125						

### MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	TFI133S-400	Conditions
$I_{TAV}$	Mean on-state current	A	400 560	$T_c=81^\circ C$ , $T_c=55^\circ C$ , 180° half-sine wave, 50 Hz
$I_{TRMS}$	RMS on-state current	A	628	$T_c=81^\circ C$
$I_{TSM}$	Surge on-state current	kA	6,5 7,0	$T_{vj}=125^\circ C$ $T_{vj}=25^\circ C$ tp=10 ms
$I^2t$	Limiting load integral	kA <sup>2</sup> s	211 245	$T_{vj}=125^\circ C$ $T_{vj}=25^\circ C$ UR=0
$U_{DRM}, U_{RRM}$	Repetitive peak off-state and reverse voltage	V	600÷1200	$T_j \min \leq T_{vj} \leq T_{jm}$ 180° half-sine wave, 50 Hz Gate open
$U_{DSM}, U_{RSM}$	Non-repetitive peak off-state and reverse voltage	V	660÷1300	$T_j \min \leq T_{vj} \leq T_{jm}$ 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/ $\mu$ s	1600 1000	$T_{vj}=125^\circ C$ ; $U_D=0,67 U_{DRM}$ , Gate pulse : 10V, 5 $\Omega$ , 1 $\mu$ s rise time, 10 $\mu$ s
$U_{RGM}$	Peak reverse gate voltage	V	5	$T_j \min \leq T_{vj} \leq T_{jm}$
$T_{stg}$	Storage temperature	$^\circ C$	-60÷80	
$T_{vj}$	Junction temperature	$^\circ C$	-60÷125	

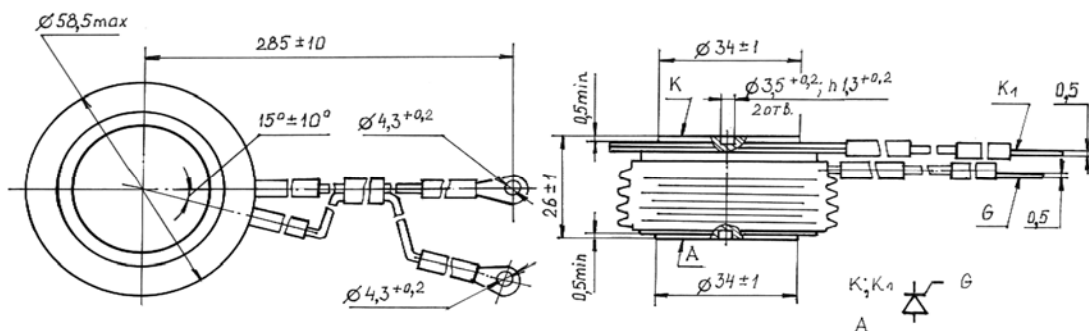
### CHARACTERISTICS

$U_{TM}$	Peak on-state voltage	V	3,0	$T_{vj}=25^\circ C$ , $I_{TM}=3,14 I_{TAV}$
$U_{T(To)}$	Threshold voltage	V	1,8	$T_{vj}=125^\circ C$
$R_T$	On-state slope resistance	m $\Omega$	0,95	1,57 $I_{TAV} < I_T < 4,71 I_{TAV}$
$I_{DRM}$ $I_{RRM}$	Repetitive peak off-state and reverse current	mA	50 50	$T_{vj}=125^\circ C$ , $U_D = U_{DRM}$ $U_R = U_{RRM}$

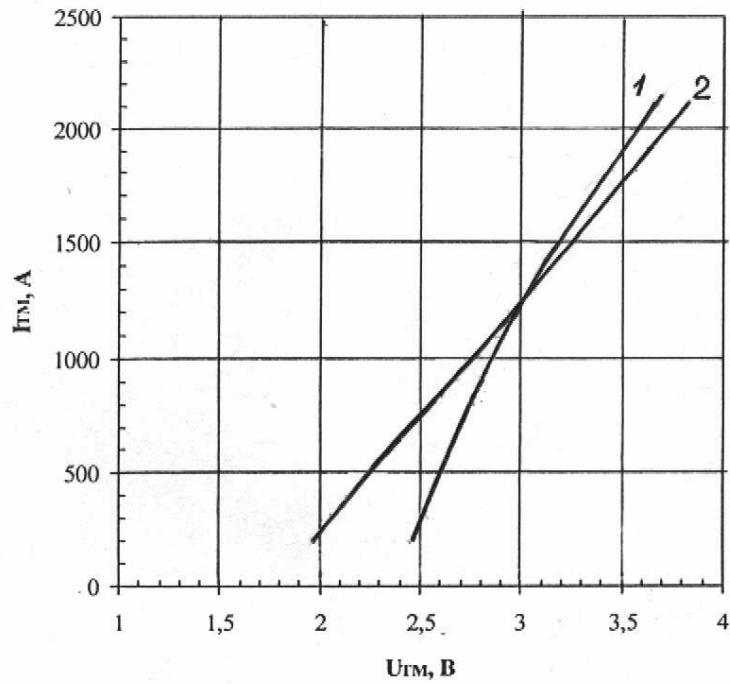
CHARACTERISTICS				
Symbols and parameters		Units	TFI133S-400	Conditions
$I_L$	Latching current	A	12	$T_{vj}=25^{\circ}\text{C}, U_D=12\text{V}$ Gate pulse : 10V, 5 $\Omega$ , 1 $\mu\text{s}$ rise time, 10 $\mu\text{s}$
$I_H$	Holding current	A	0,5	$T_{vj}=25^{\circ}\text{C}, U_D=12\text{V}$ , Gate open
$U_{GT}$	Gate trigger direct voltage	V	2,5 5,0	$T_{vj}=25^{\circ}\text{C}$ , $T_{vj}=-60^{\circ}\text{C}$ $U_D=12\text{V}$
$I_{GT}$	Gate trigger direct current	A	0,4 0,9	$T_{vj}=25^{\circ}\text{C}$ , $T_{vj}=-60^{\circ}\text{C}$
$U_{GD}$	Gate non-trigger direct voltage	V	0,25	$T_{vj}=125^{\circ}\text{C}, U_D = 0,67 U_{DRM}$ Direct gate current
$I_{GD}$	Gate non-trigger direct current	mA	10	
$t_{gd}$	Delay time	$\mu\text{s}$	1,6	$T_{vj}=25^{\circ}\text{C}, U_D=500\text{V}$ $I_{TM} = 400\text{ A}$
$t_{gt}$	Turn-on time	$\mu\text{s}$	2,5	Gate pulse : 10V, 5 $\Omega$ , 1 $\mu\text{s}$ rise time, 10 $\mu\text{s}$
$t_q$	Turn-off time	$\mu\text{s}$	5,0 ; 6,3 6,3 ; 8,0	$T_{vj}=125^{\circ}\text{C}, I_{TM}=400\text{ A}$ $di_R/dt = 10\text{ A}/\mu\text{s}, U_R=100\text{V}$ $U_D = 0,67 U_{DRM}$ $du_D/dt=50\text{ V}/\mu\text{s}$ $du_D/dt=200\text{ V}/\mu\text{s}$
$Q_{rr}$	Recovered charge	$\mu\text{C}$	60	
$t_{rr}$	Reverse recovery time	$\mu\text{s}$	1,85	$T_{vj}=125^{\circ}\text{C}, I_{TM}=400\text{ A}$
$I_{rrm}$	Peak reverse recovery current	A	65	$di_R/dt = 50\text{ A}/\mu\text{s}, U_R=100\text{V}$
$(du_D/dt)_{crit}$	Critical rate of rise of off-state voltage	$\text{V}/\mu\text{s}$	500 1000	$T_{vj}=125^{\circ}\text{C}, U_D = 0,67 U_{DRM}$ Gate open
$R_{thjc}$	Thermal resistance junction to case	$^{\circ}\text{C}/\text{W}$	0,04	Direct current, double side cooled

ORDERING									
	<b>TFI</b>	<b>133</b>	<b>S</b>	<b>400</b>	<b>10</b>	<b>7</b>	<b>C4</b>	<b>3</b>	
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	

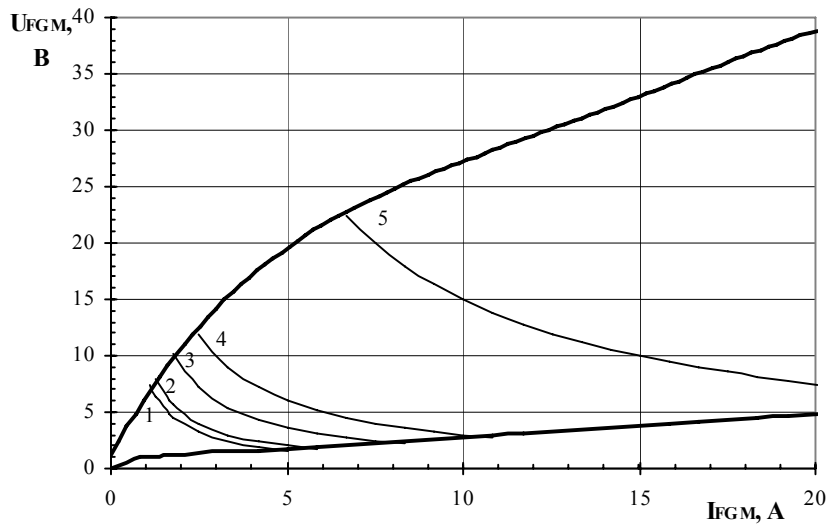
1. Fast thyristor with interdigitated gate structure.
2. Design version.
3. Strong distributed amplified gate
4. Mean on-state current, A.
5. Voltage code (10=1000V).
6. Critical rate of rise of off-state voltage ( $6 \geq 500\text{ V}/\mu\text{s}$ ,  $7 \geq 1000\text{ V}/\mu\text{s}$ )
7. Group of turn-off time ( $du_D/dt=50\text{ V}/\mu\text{s}$ ,  $C4 \leq 6,3\ \mu\text{s}$ ,  $E4 \leq 5\ \mu\text{s}$ )
8. Group of turn-on time ( $3 \leq 2,5\ \mu\text{s}$ ).



Mounting force : 10÷15 kN  
Weight : 250 grams



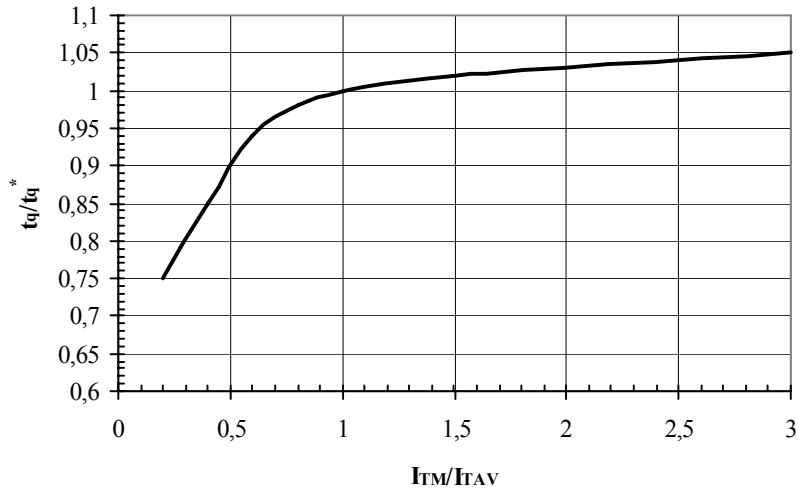
**Fig. 1** On-state characteristics of Limit device  
 1 –  $T_j = 25\text{ °C}$   
 2 –  $T_j = 125\text{ °C}$



Maximum peak gate power loss

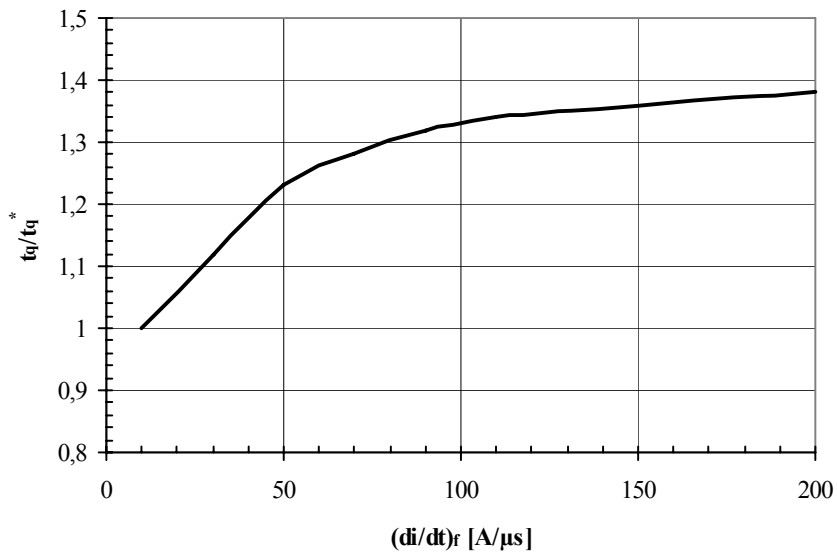
Position	On-Off time ratio	Gate pulse length, ms	Gate Pulse Power, W
1	1	DC	8
2	2	10	10
3	20	1	18
4	40	0.5	30
5	200	0.1	150

**Fig. 2** Gate characteristics



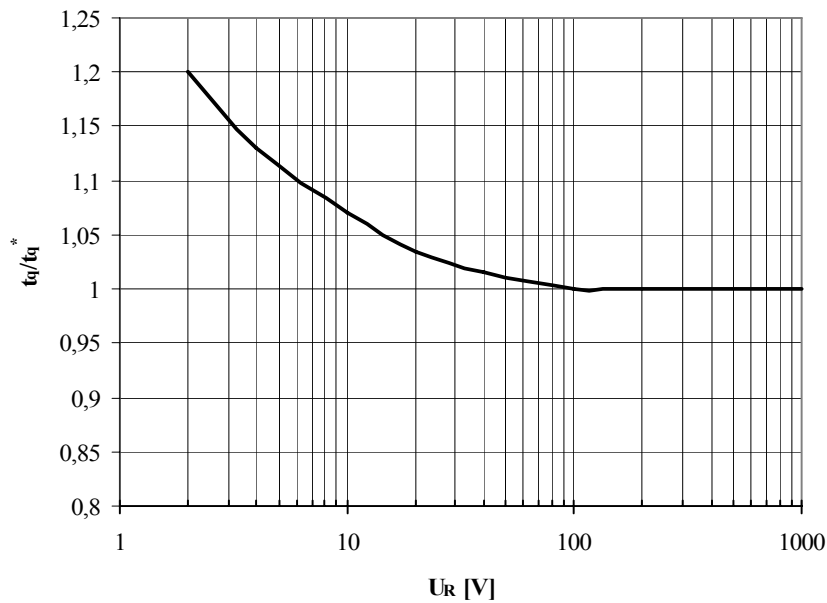
**Fig. 3** Turn-off time  $t_q$  vs. On-state peak current  $I_{TM}$

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



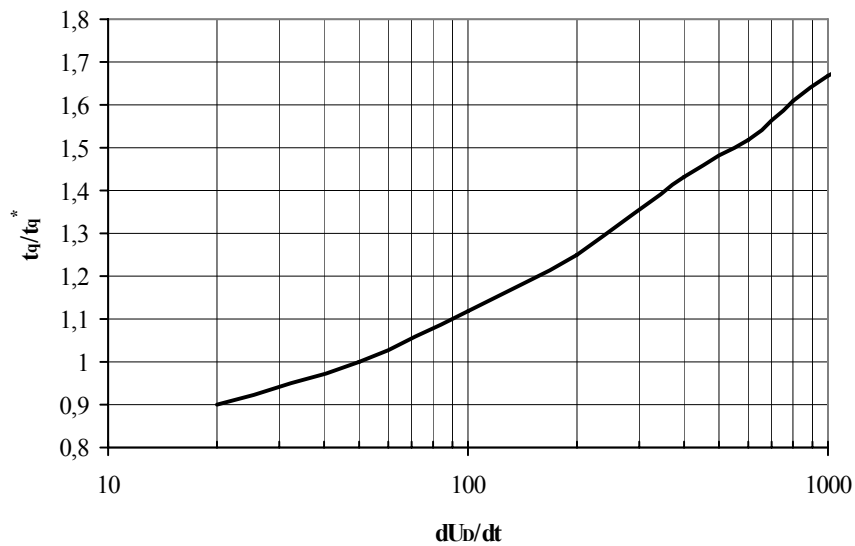
**Fig. 4** Turn-off time  $t_q$  vs. Rate of fall of on-state current  $di_R/dt$

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,  $dv_D/dt = 50\ V/\mu s$ )



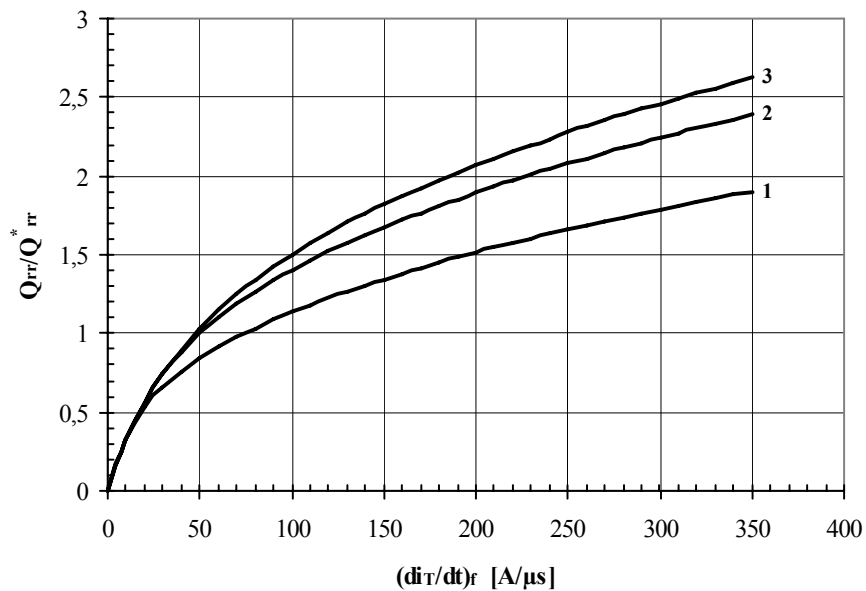
**Fig. 5** Turn-off time  $t_q$  vs. Reverse voltage  $V_R$

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  $dv_D/dt$

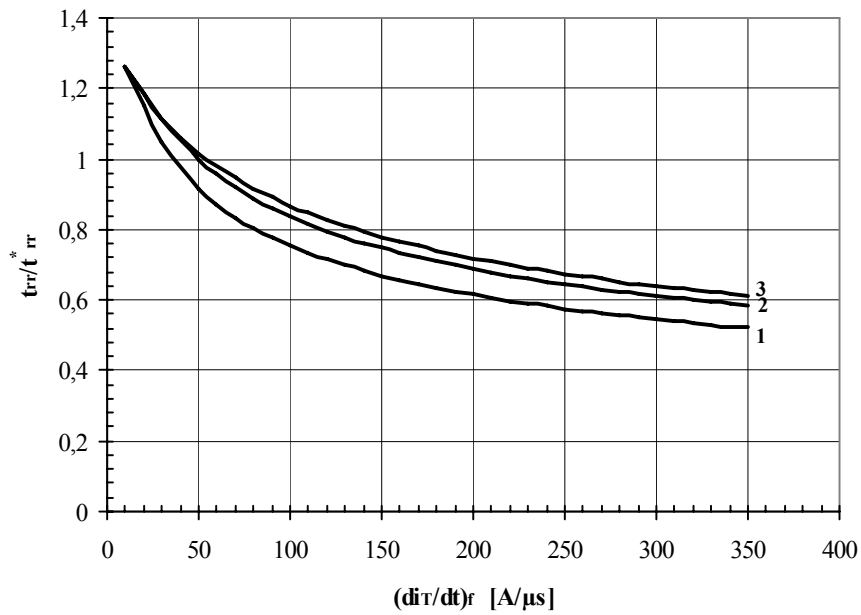
Conditions:  $T_j = T_{j\max}$ ;  $I_{TM} = I_{TAV}$ ;  $di_R/dt = 10 \text{ A}/\mu\text{s}$ ;  $V_R = 100 \text{ V}$ ;  $V_D = 0.67 \cdot V_{DRM}$   
 Typical changes of  $t_q$  are normalized to the  $t_q^*$  ( $t_q^*$  – see data sheet,  $dv_D/dt = 50 \text{ V}/\mu\text{s}$ )



**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  $di_R/dt$

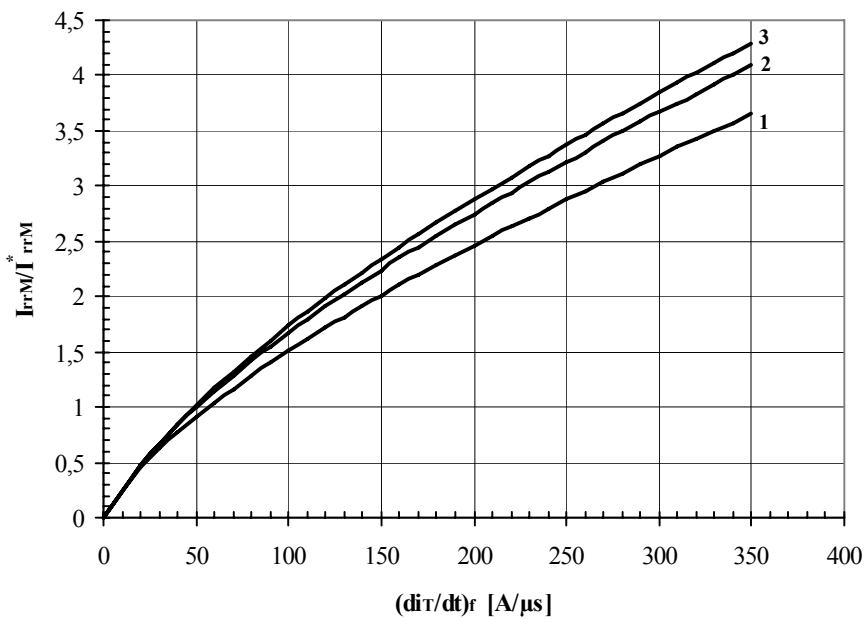
1 -  $I_{TM} = 0.5 I_{TAV}$

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  $di_R/dt$

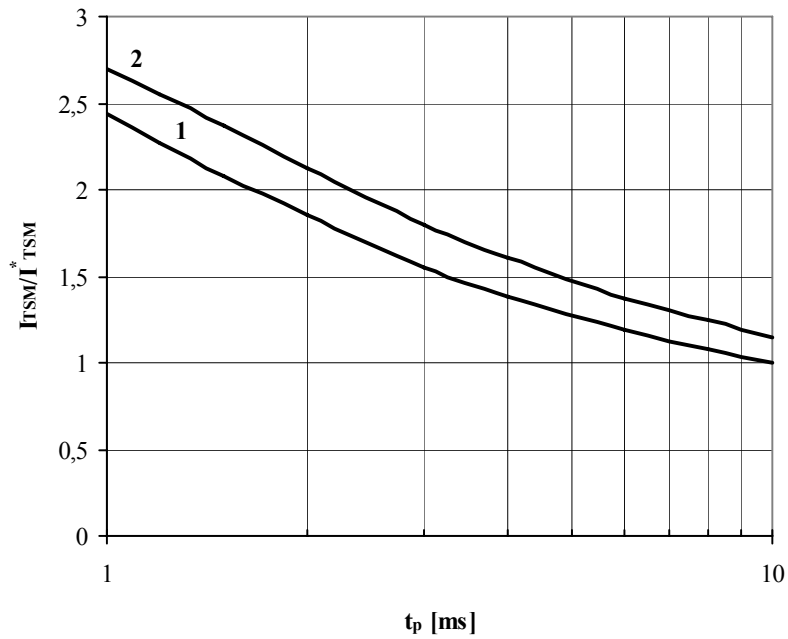
1 -  $I_{TM} = 0.5 I_{TAV}$

2 -  $I_{TM} = I_{TAV}$ ,

3 -  $I_{TM} = 1.5 I_{TAV}$

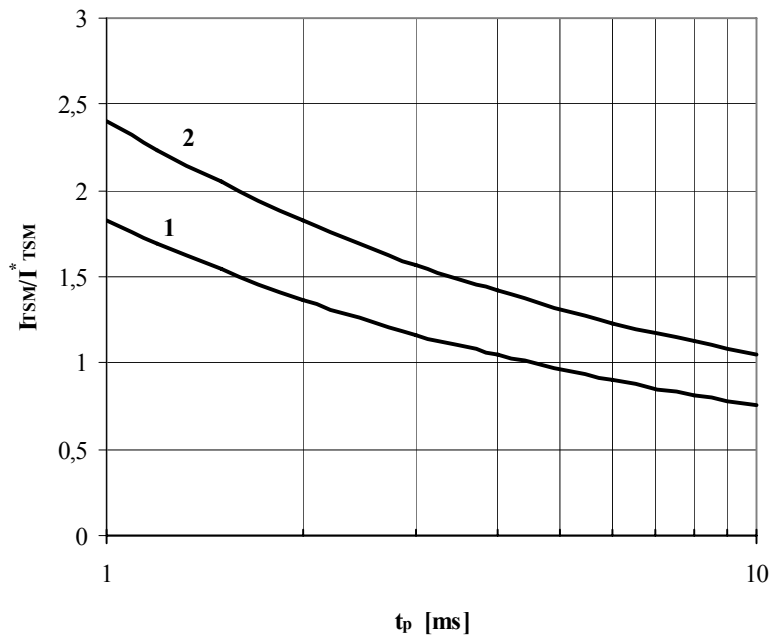
Conditions:  $T_j = T_{j \max}$ ;  $V_R = 100$  V

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



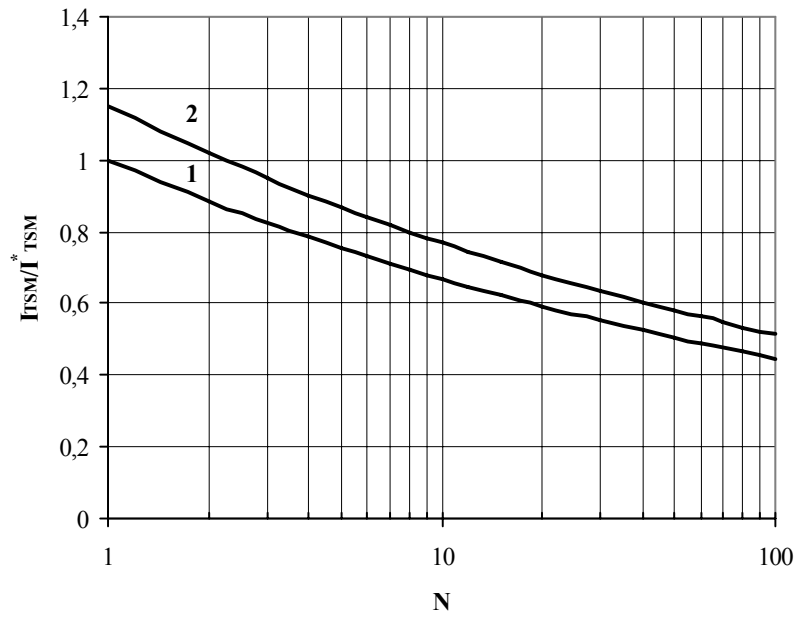
**Fig. 10** The surge current  $I_{TSM}$  vs. Duration of surge  $t_p$  for a half-sine wave  
 1 –  $T_j=125\text{ }^\circ\text{C}$   
 2 –  $T_j=25\text{ }^\circ\text{C}$

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



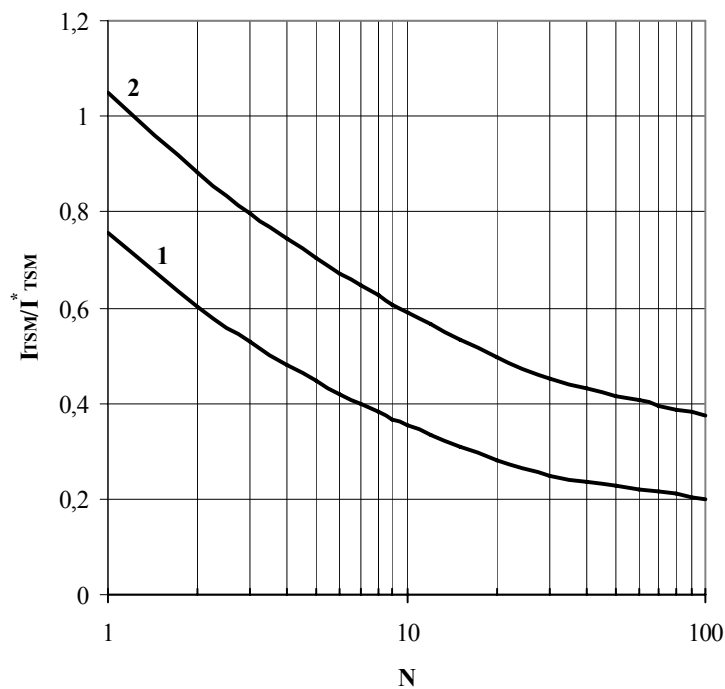
**Fig. 11** The surge current  $I_{TSM}$  vs. Duration of surge  $t_p$  for a half-sine wave  
 1 –  $T_j=125\text{ }^\circ\text{C}$   
 2 –  $T_j=25\text{ }^\circ\text{C}$

Conditions:  $V_R=0.8V_{RRM}$  – 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. 12** 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,  $T_j = T_{j\text{max}}$ )



**Fig. 13** 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,  $T_j = T_{j\text{max}}$ )