



Fast Thyristor Type TFI333-320-24

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

Maximum allowable mean on-state current		I_{TAV}	320 A
Repetitive peak off-state voltage		V_{DRM}	2000...2400 V
Repetitive peak reverse voltage		V_{RRM}	
Turn-off time		t_q	25.0, 32.0, 40.0, 50.0 μs
V_{DRM}, V_{RRM}, V	2000	2200	2400
Voltage code	20	22	24
$T_{ij}, ^\circ C$	-60...+125		

MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions	
ON-STATE					
I _{TAV}	Maximum allowable mean on-state current	A	320 470	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	502	T _c = 85 °C; Double side cooled; 180° half-sine wave; 50 Hz	
I _{TSM}	Surge on-state current	kA	6.3 7.0	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
			6.5 7.5	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	190 240	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
			170 230	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	2000...2400	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	2100...2500	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	6	$T_j = T_{j\max}$
V_{RGM}	Peak reverse gate voltage	V	5	
P_G	Gate power dissipation	W	3	$T_j = T_{j\max}$ for DC gate current
SWITCHING				
$(di_T/dt)_{crit}$	Critical rate of rise of on-state current non-repetitive ($f=1$ Hz)	A/ μ s	1600	$T_j = T_{j\max}$; $V_D = 0.67 \cdot V_{DRM}$; $I_{TM} = 2 I_{TAV}$; Gate pulse: $I_G = 2$ A; $V_G = 20$ V; $t_{GP} = 50$ μ s; $di_G/dt = 2$ A/ μ s
THERMAL				
T_{stg}	Storage temperature	$^{\circ}$ C	-60...+50	
T_j	Operating junction temperature	$^{\circ}$ C	-60...+125	
MECHANICAL				
F	Mounting force	kN	9.0...11.0	
a	Acceleration	m/s ²	50	Device clamped

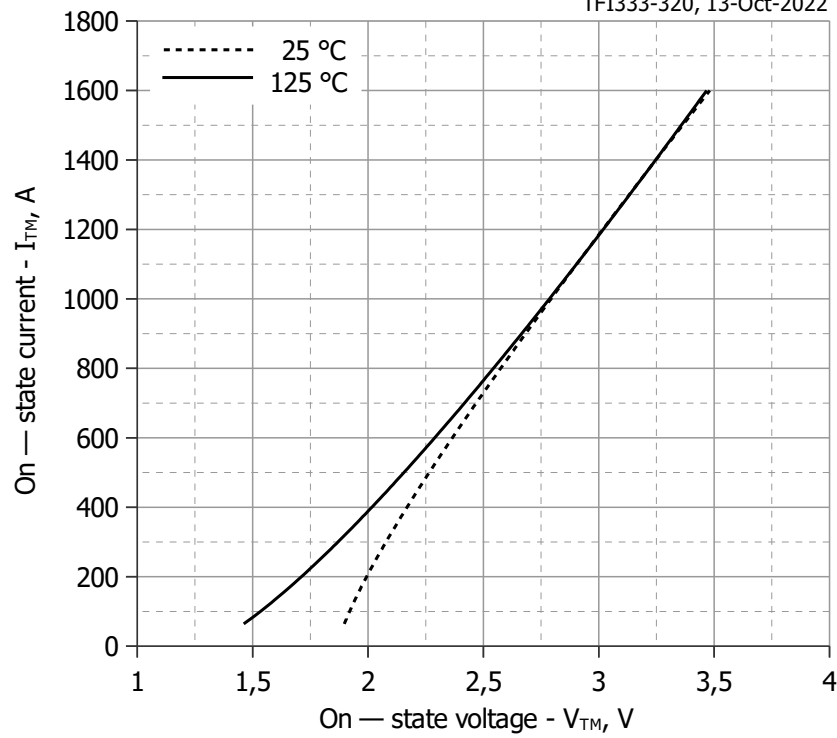
CHARACTERISTICS

Symbols and parameters		Units	Values	Conditions	
ON-STATE					
V _{TM}	Peak on-state voltage, max	V	2.80	T _j =25 °C; I _{TM} =1005 A	
V _{T(TO)}	On-state threshold voltage, max	V	1.50	T _j =T _{j max} ;	
r _T	On-state slope resistance, max	mΩ	1.250	0.5 π I _{TAV} < I _T < 1.5 π I _{TAV}	
I _H	Holding current, max	mA	500	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	150	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	T _j =T _{j max} ; V _D =0.67·V _{DRM} ; Gate open	
TRIGGERING					
V _{GT}	Gate trigger direct voltage, max	V	4.00 2.50 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	500 300 200	T _j = T _{j min} T _j = 25 °C T _j = T _{j max}	
V _{GD}	Gate non-trigger direct voltage, min	V	0.25	T _j =T _{j max} ; V _D =0.67·V _{DRM} ;	
I _{GD}	Gate non-trigger direct current, min	mA	10.00	Direct gate current	
SWITCHING					
t _{gd}	Delay time, max	μs	0.66	T _j =25 °C; V _D =1000 V; I _{TM} =I _{TAV} ; di/dt=200 A/μs;	
t _{gt}	Turn-on time ²⁾ , max	μs	1.60, 2.00, 2.50, 3.20	Gate pulse: I _G =2 A; V _G =20 V; t _{GP} =50 μs; di _G /dt=2 A/μs	
t _q	Turn-off time ³⁾ , max	μs	25.0, 32.0, 40.0, 50.0	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}
			32.0, 40.0, 50.0, 63.0	dv _D /dt=200 V/μs	
Q _{rr}	Recovered charge, max	μC	250	T _j =T _{j max} ; I _{TM} =320 A;	
t _{rr}	Reverse recovery time, max	μs	4.0	di _R /dt=-50 A/μs;	
I _{rr}	Reverse recovery current, max	A	130	V _R =100 V	

THERMAL					
R _{thjc}	Thermal resistance, junction to case, max	°C/W	0.0500	Direct current	Double side cooled
R _{thjc-A}			0.1100		Anode side cooled
R _{thjc-K}			0.0900		Cathode side cooled
R _{thck}	Thermal resistance, case to heatsink, max	°C/W	0.0060	Direct current	
MECHANICAL					
m	Weight, max	g	85		
D _s	Surface creepage distance	mm (inch)	10.30 (0.405)		
D _a	Air strike distance	mm (inch)	6.30 (0.248)		

PART NUMBERING GUIDE								NOTES				
TFI	333	320	24	A2	M3	T4	N	1) Critical rate of rise of off-state voltage				
1	2	3	4	5	6	7	8	Symbol of group	P2	K2	E2	A2
1. TFI — fast inverter thyristor								$(dv_D/dt)_{crit}$ V/ μs	200	320	500	1000
2. Design version								2) Turn-on time				
3. Mean on-state current, A								Symbol of group	T4	P4	M4	K4
4. Voltage code								t_{gt} μs	1.60	2.00	2.50	3.20
5. Critical rate of rise of off-state voltage								3) Turn-off time ($dv_D/dt=50$ V/ μs)				
6. Group of turn-off time ($dv_D/dt=50$ V/ μs)								Symbol of group	M3	K3	H3	E3
7. Group of turn-on time								t_{qr} μs	25.0	32.0	40.0	50.0
8. Ambient conditions: N – normal; T – tropical												





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	1.78462222	1.33243844
B	0.00148771	0.00071068
C	0.05693261	-0.04317084
D	-0.02759593	0.03292219

Fig. 1 On-state characteristics of Limit device

1 – $T_j = 25^\circ\text{C}$

2 – $T_j = 125^\circ\text{C}$

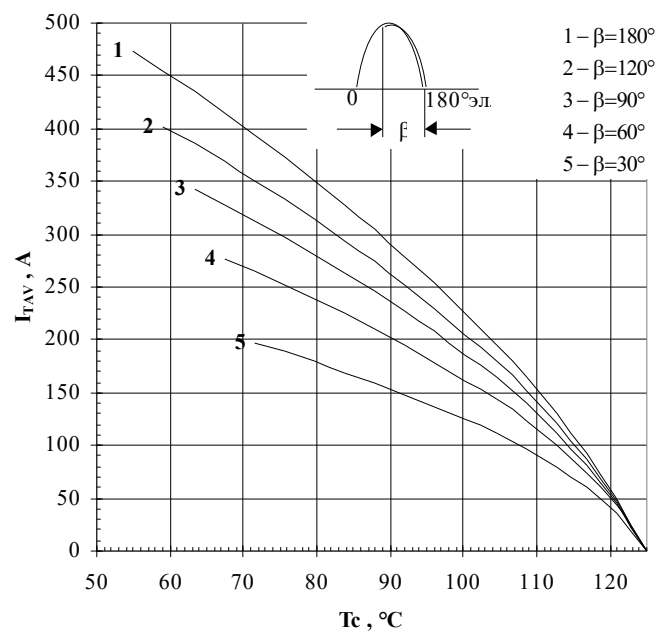


Fig. 2. Maximum allowable mean on-state current I_{TAV} vs. case temperature T_c for sinusoidal current waveforms, $f = 50\text{ Hz}$

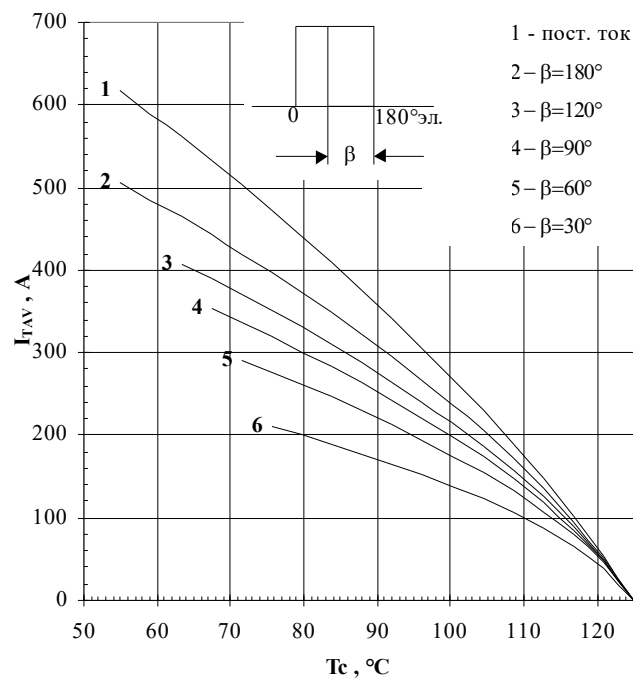


Fig. 3 Maximum allowable mean on-state current I_{TAV} vs. case temperature T_c for rectangular current waveforms and for DC, $f=50\text{Hz}$

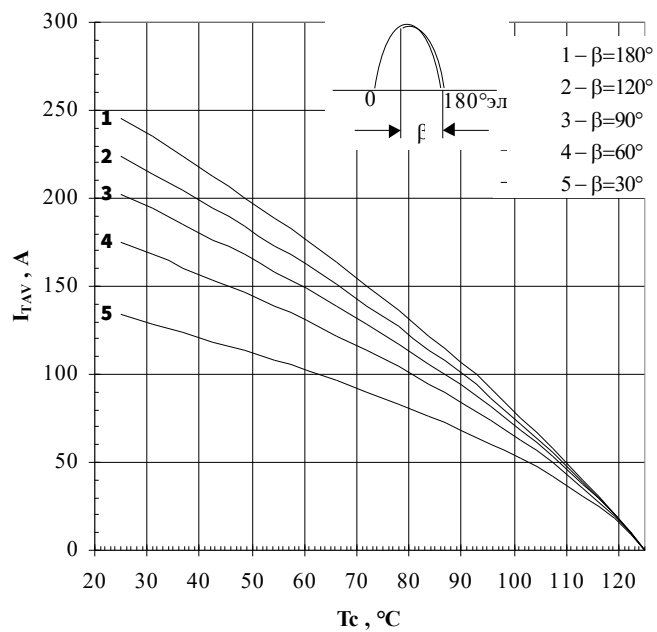


Fig. 4 Maximum allowable mean on-state current I_{TAV} vs. cooling temperature T_a for cooling air force 6 m/s, heatsink O143 and sinusoidal current waveforms at different conduction angles, $f=50\text{Hz}$

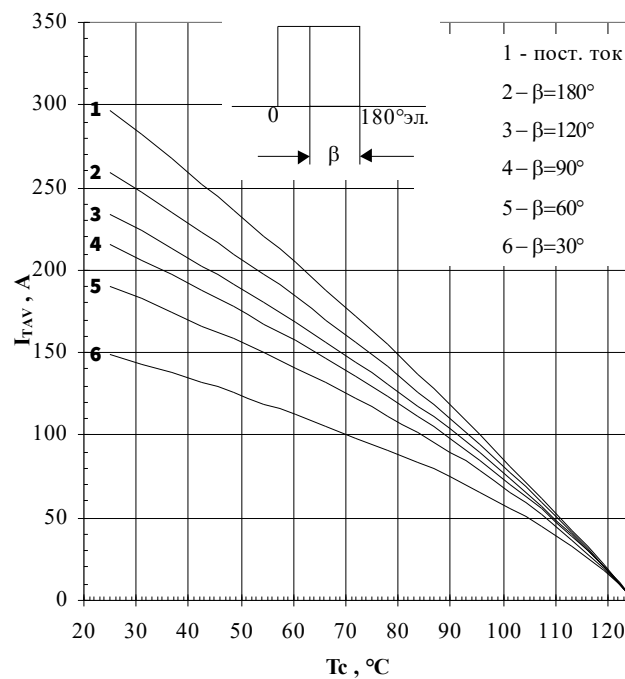


Fig. 5 Maximum allowable mean on-state current I_{TAV} vs. cooling temperature T_a for cooling air force 6 m/s, heatsink O143 and rectangular current waveforms at different conduction angles, $f=50\text{Hz}$

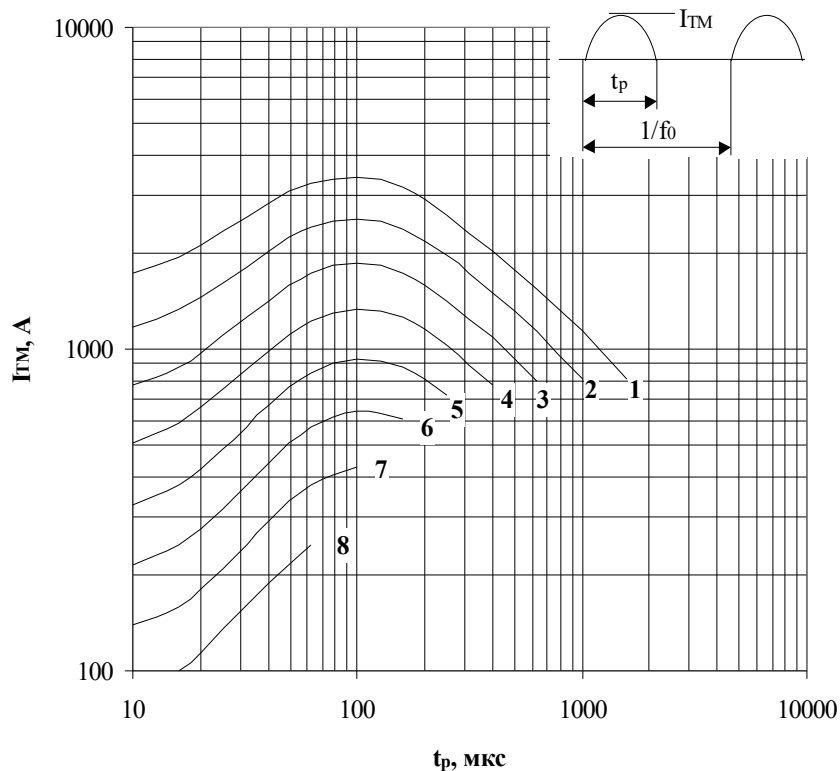


Fig. 6 Maximum allowable mean on-state current I_{TAV} of sinusoidal current waveform vs. pulse duration t_p for case temperature $T_c=65^\circ\text{C}$ at high frequency.

- 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: $V_D=0,67 \cdot V_{DRM}$; $V_R=0,67 \cdot V_{RRM}$.

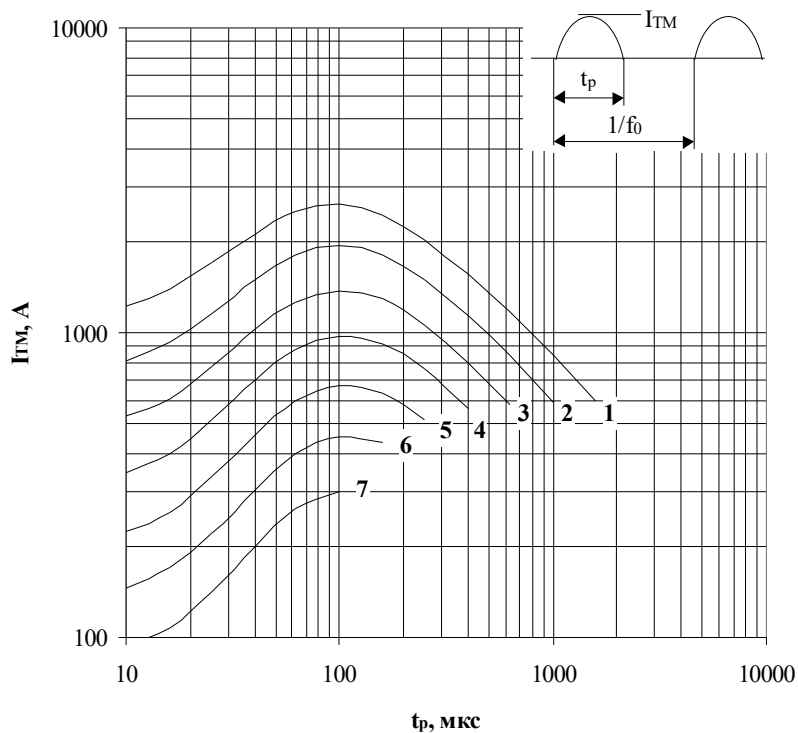


Fig. 7 Maximum allowable mean on-state current I_{TAV} of sinusoidal current waveform vs. pulse duration t_p for case temperature $T_c=85\text{ }^{\circ}\text{C}$ at high frequency.

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

Conditions: $V_D=0,67V_{DRM}$; $V_R=0,67V_{RRM}$.

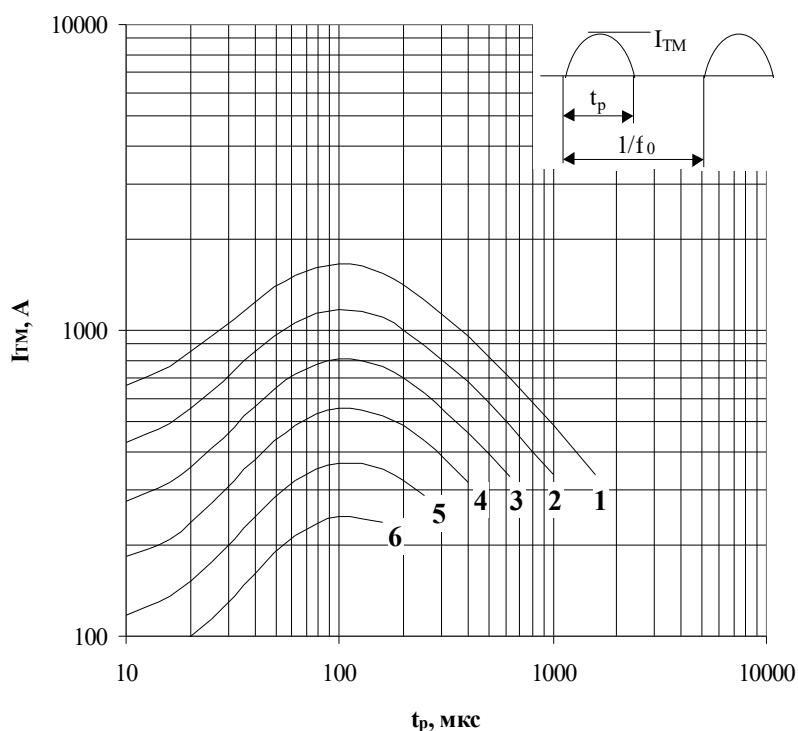


Fig. 8 Maximum allowable mean on-state current I_{TAV} of sinusoidal current waveform vs. pulse duration t_p for case temperature $T_c=105\text{ }^{\circ}\text{C}$ at high frequency

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

Conditions: $V_D=0,67V_{DRM}$; $V_R=0,67V_{RRM}$.

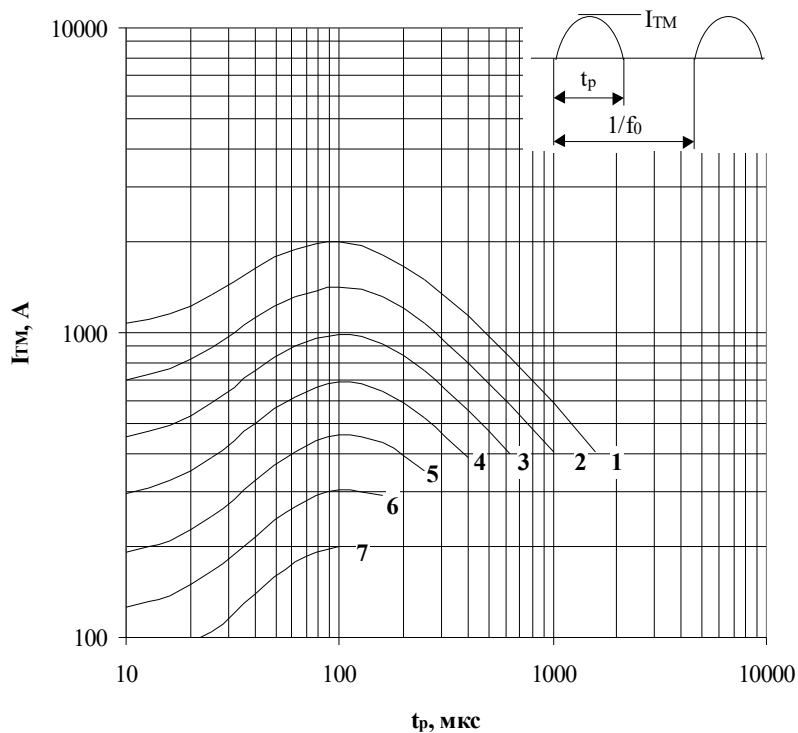


Fig. 9 Maximum allowable mean on-state current I_{TAV} of sinusoidal current waveform vs. pulse duration t_p for cooling temperature $T_a=40\text{ }^\circ\text{C}$, cooling air force 6 m/s, heat sink 0143 at high frequency.

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

Conditions: $V_D=0,67 \cdot V_{DRM}$; $V_R=0,67 \cdot V_{RRM}$.

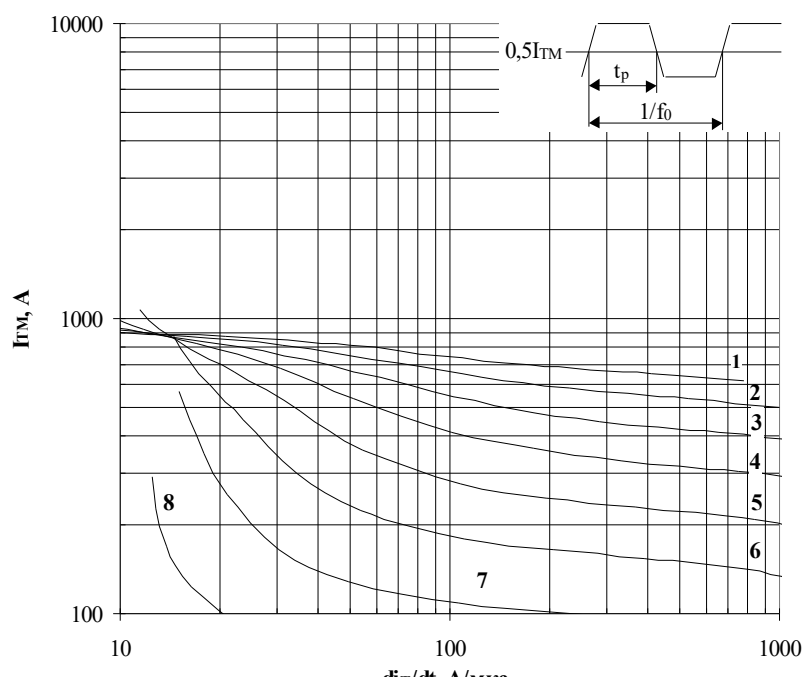


Fig. 10 Maximum allowable mean on-state current I_{TM} of trapeze current waveform vs. mean on-state current di_T/dt , pulse duration $t_p=1/2f_0$ and case temperature $T_c=65\text{ }^\circ\text{C}$.

- | | |
|--------------|---------------|
| 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: $V_D=0,67 \cdot V_{DRM}$; $V_R=0,67 \cdot V_{RRM}$

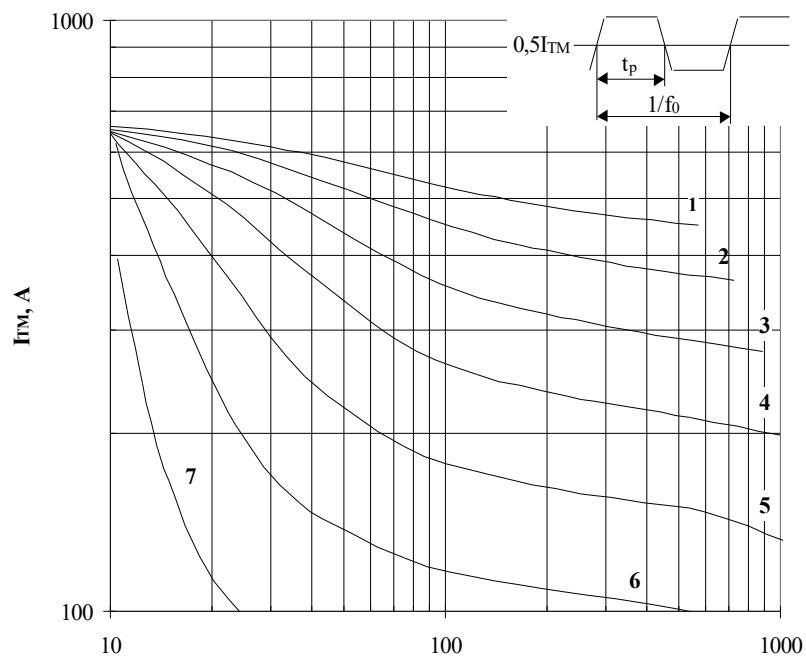


Fig. 11 Maximum allowable mean on-state current I_{TM} of trapeze current waveform vs. on-state current rise rate di_T/dt for pulse duration $t_p=1/2f_0$ and case temperature $T_c=85\text{ }^{\circ}\text{C}$ at high frequency.

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

Conditions: $V_D=0,67\cdot V_{DRM}$; $V_{CR}=0,67\cdot V_{RRM}$

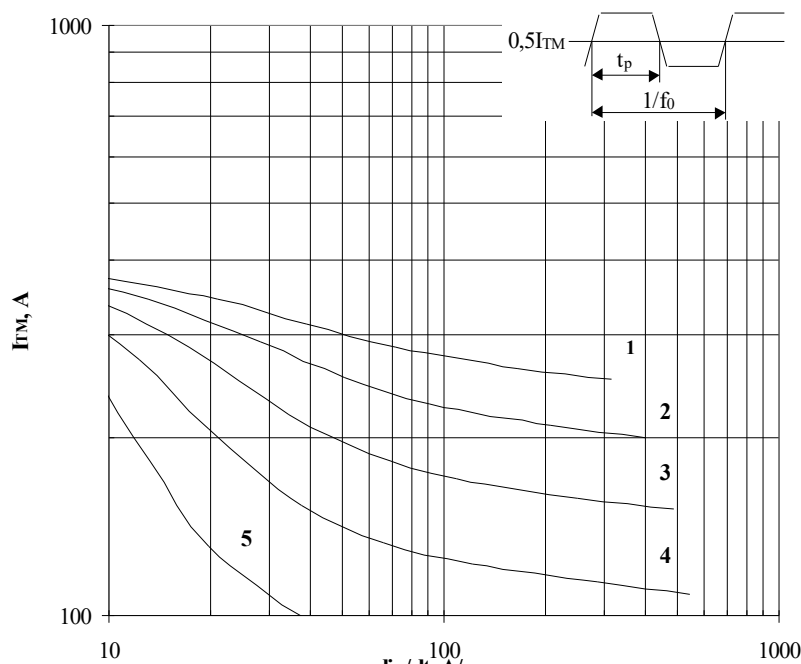


Fig. 12 Maximum allowable mean on-state current I_{TM} of trapeze current waveform vs. on-state current rise rate di_T/dt for pulse duration $t_p=1/2f_0$ and case temperature $T_c=105\text{ }^{\circ}\text{C}$ at high frequency.

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

Conditions: $V_D=0,67\cdot V_{DRM}$; $V_R=0,67\cdot V_{RRM}$

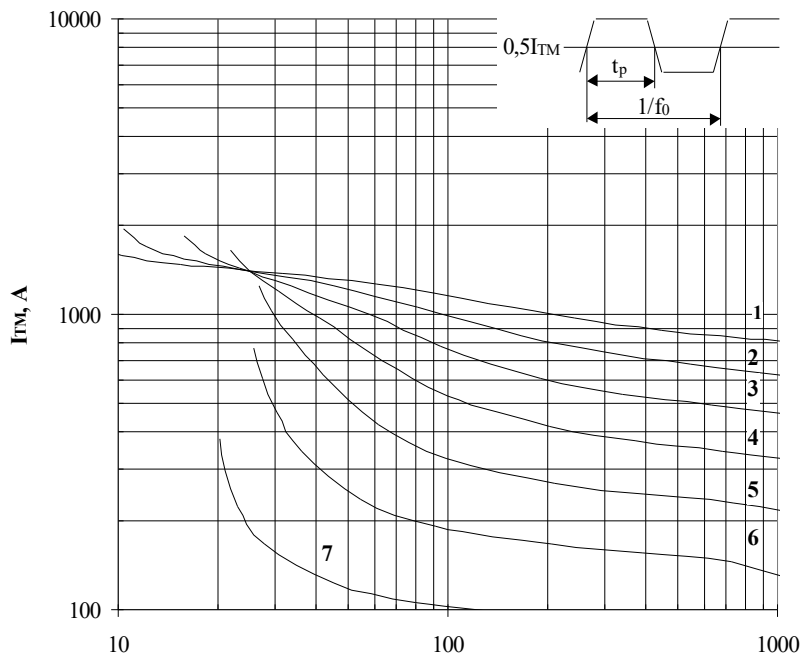


Fig. 13 Maximum allowable mean on-state current I_{TM} of trapeze current waveform vs. on-state current rise rate di_T/dt for pulse duration $t_p=1/4f_0$ and case temperature $T_c=65\text{ }^{\circ}\text{C}$ at high frequency.

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

Conditions: $V_D=0,67\cdot V_{DRM}$; $V_R=0,67\cdot V_{RRM}$

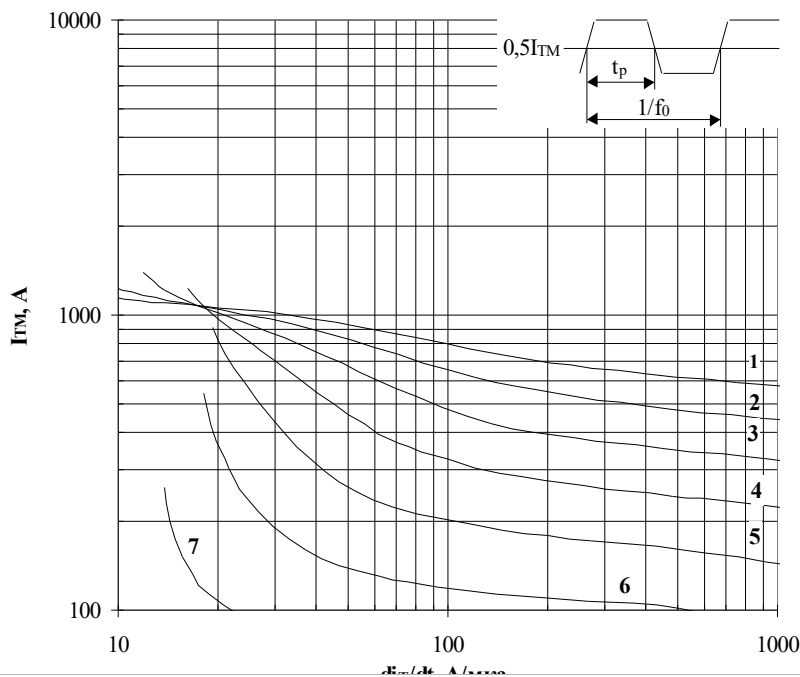


Fig. 14 Maximum allowable mean on-state current I_{TM} of trapeze current waveform vs. on-state current rise rate di_T/dt for pulse duration $t_p=1/4f_0$ and case temperature $T_c=85\text{ }^{\circ}\text{C}$ at high frequency.

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

Conditions: $V_D=0,67\cdot V_{DRM}$; $V_R=0,67\cdot V_{RRM}$

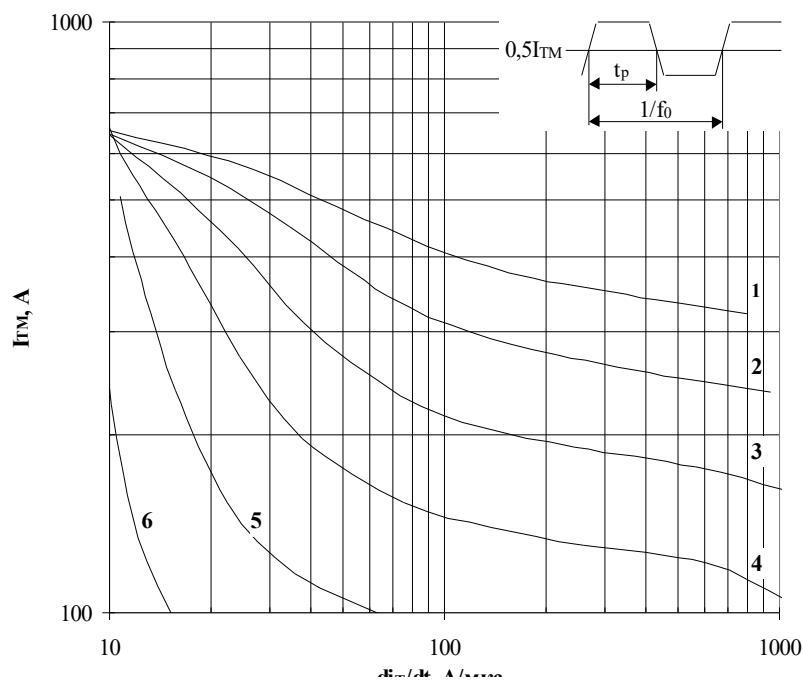


Fig. 15 Maximum allowable mean on-state current I_{TM} of trapeze current waveform vs. on-state current rise rate di_T/dt for pulse duration $t_p=1/4f_0$ and case temperature $T_c=105\text{ °C}$ at high frequency.

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

Conditions: $V_D=0,67\cdot V_{DRM}$; $V_R=0,67\cdot V_{RRM}$

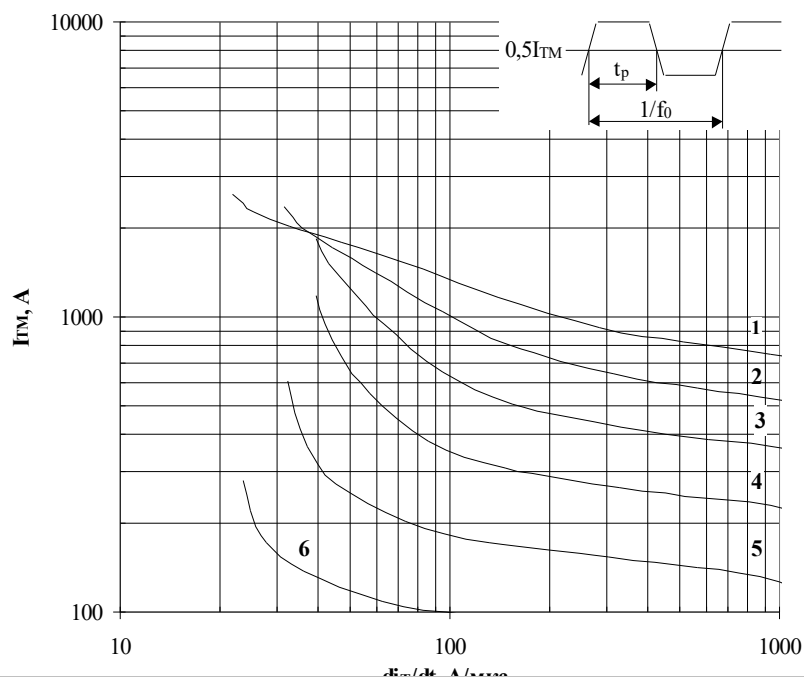


Fig. 16 Maximum allowable mean on-state current I_{TM} of trapeze current waveform vs. on-state current rise rate di_T/dt for pulse duration $t_p=1/10f_0$ and case temperature $T_c=85\text{ °C}$ at high frequency.

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

Conditions: $V_D=0,67\cdot V_{DRM}$; $V_R=0,67\cdot V_{RRM}$

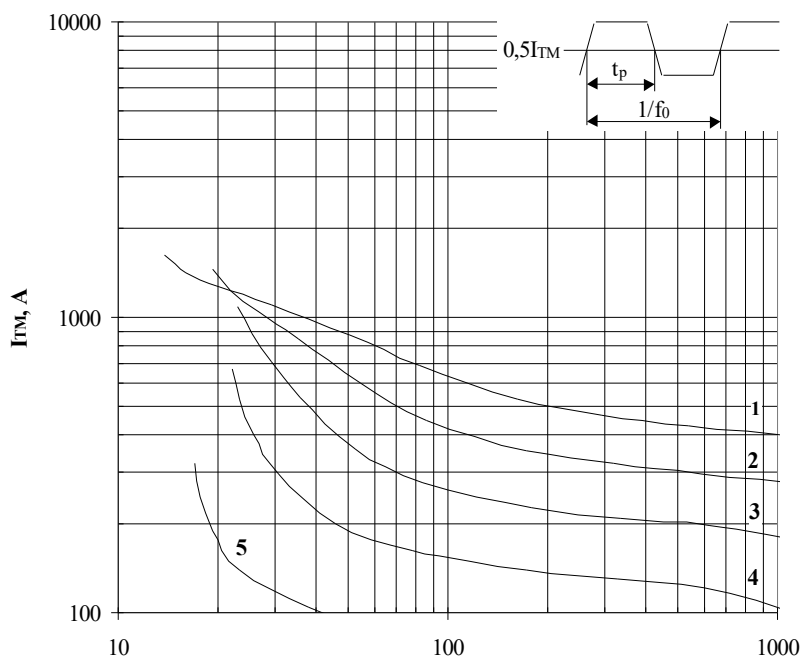


Fig. 17 Maximum allowable mean on-state current I_{TM} of trapeze current waveform vs. on-state current rise rate di_T/dt for pulse duration $t_p=1/10f_0$ and case temperature $T_c=105\text{ °C}$ at high frequency.

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

Conditions: $V_D=0,67\cdot V_{DRM}$; $V_R=0,67\cdot V_{RRM}$

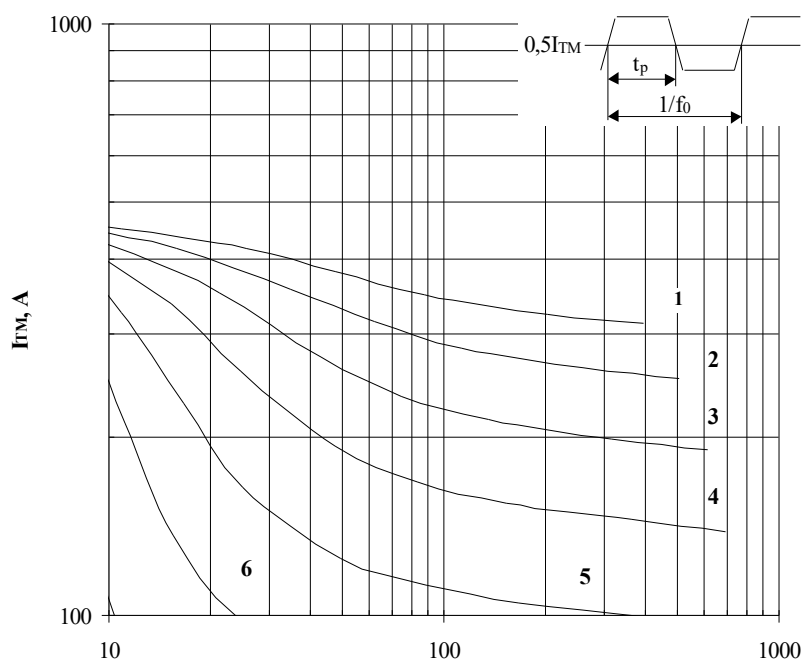


Fig.18 Maximum allowable mean on-state current I_{TAV} of trapeze current waveform vs. on-state current rise rate di_T/dt for pulse duration $t_p=1/2f_0$, cooling temperature $T_a=40\text{ °C}$, cooling air force 6 m/s, heat sink 0143 at high frequency.

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

Conditions: $V_D=0,67\cdot V_{DRM}$; $V_R=0,67\cdot V_{RRM}$

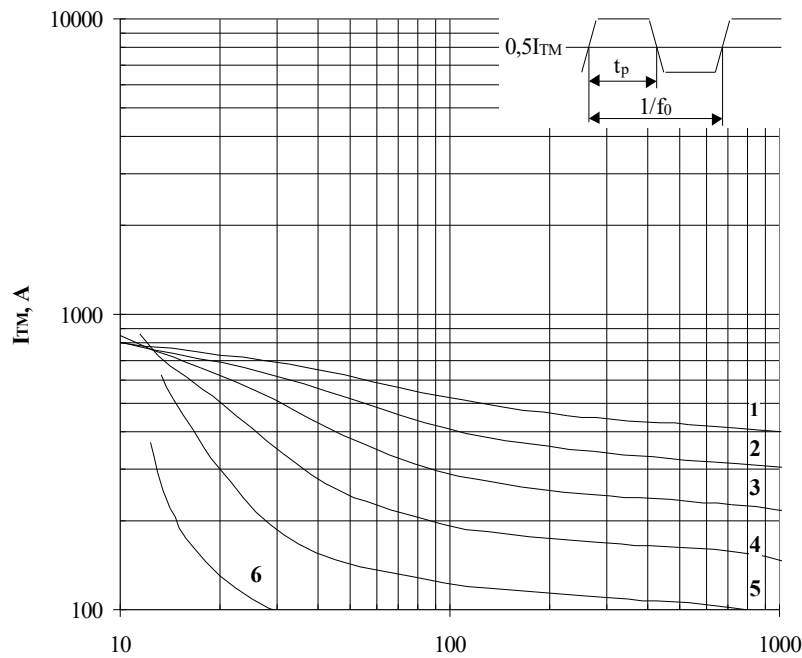


Fig. 19 Maximum allowable mean on-state current I_{TAV} of trapeze current waveform vs. on-state current rise rate di_T/dt for pulse duration $t_p=1/4f_0$, cooling temperature $T_a=40$ °C, cooling air force 6 m/s, heatsink 0143 at high frequency.

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

Conditions: $V_D=0,67 \cdot V_{DRM}$; $V_R=0,67 \cdot V_{RRM}$

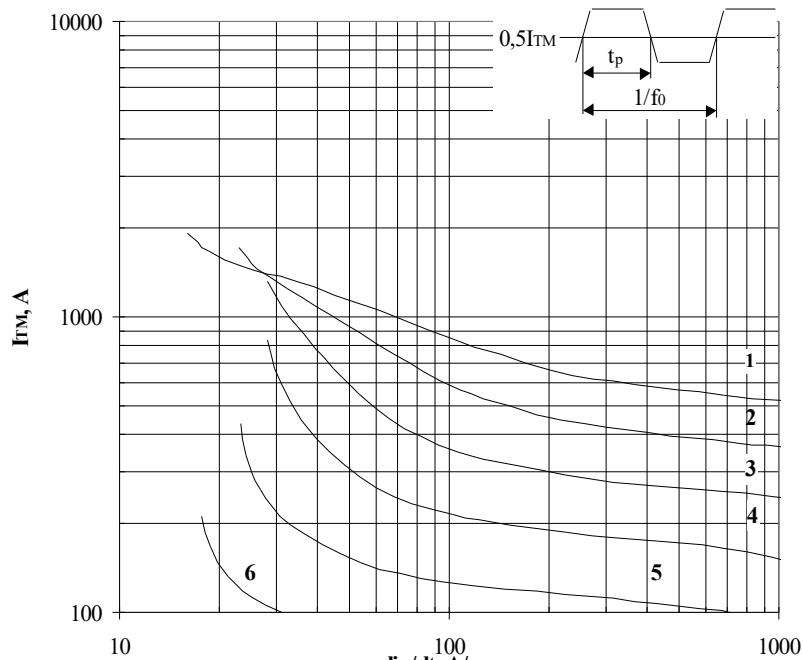


Fig. 20 Maximum allowable mean on-state current I_{TAV} of trapeze current waveform vs. on-state current rise rate di_T/dt for pulse duration $t_p=1/10f_0$, cooling temperature $T_a=40$ °C, cooling air force 6 m/s, heatsink 0143 at high frequency.

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

Conditions: $V_D=0,67 \cdot V_{DRM}$; $V_R=0,67 \cdot V_{RRM}$

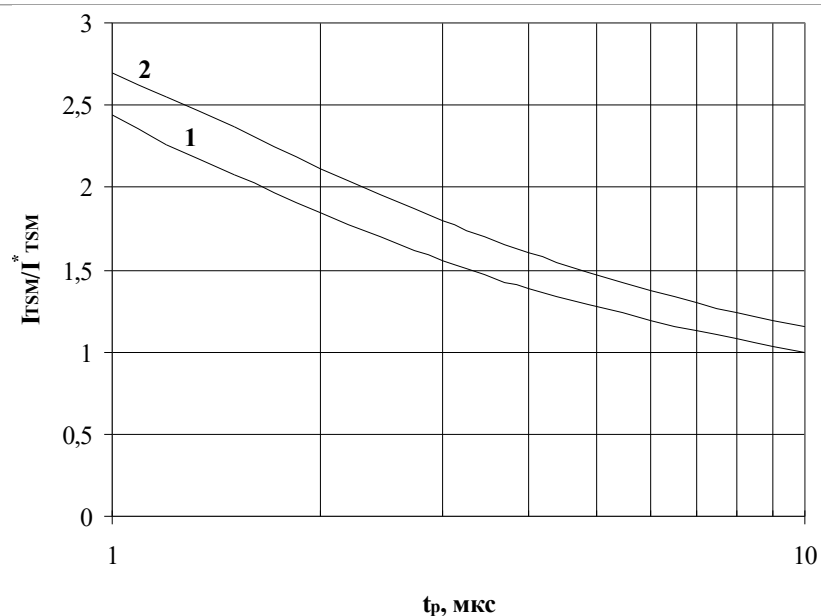


Fig. 21 Maximum allowable surge on-state current I_{TM} vs. pulse duration t_p .
 1 – $T_j=125$ °C
 2 – $T_j=25$ °C

Conditions: $V_R=0$.

Typical changes are normalized to I_{TSM}^* – maximum allowable surge on-state current for $t_p = 10$ ms, $V_R = 0$, junction temperature 125 °C.

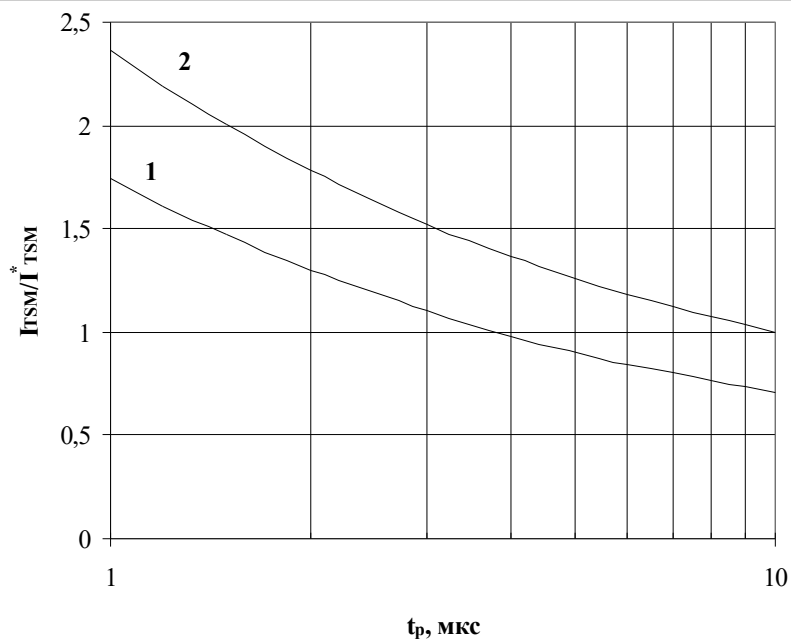


Fig. 22 Maximum allowable surge on-state current I_{TM} vs. pulse duration t_p for initial junction temperature:
 1 – $T_j=125$ °C
 2 – $T_j=25$ °C

Conditions: $V_R=0,8 \cdot V_{RRM}$

Typical changes are normalized to I_{TSM}^* – maximum allowable surge on-state current for $t_p = 10$ ms, $V_R = 0$, junction temperature 125 °C.

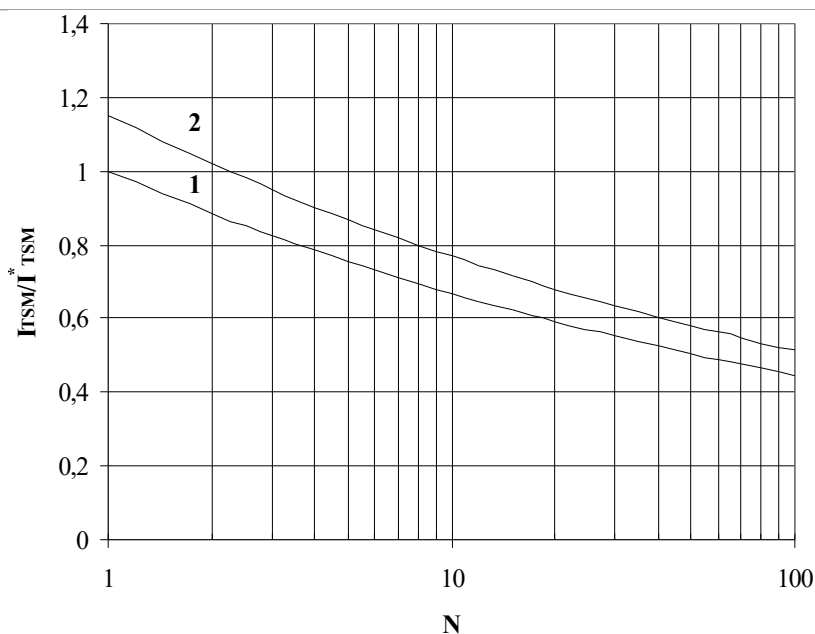


Fig. 23 Maximum allowable surge on-state current I_{TM} vs. pulse quantity of overload current N
 1 – $T_j = 125^\circ\text{C}$
 2 – $T_j = 25^\circ\text{C}$

Conditions: sinusoidal pulse waveform, duration $t_p = 10\text{ ms}$, $f = 50\text{ Hz}$, on-off time ratio $V_R = 0$.
 Typical changes are normalized to I_{TSM}^* – maximum allowable single pulse surge on-state current for $t_p = 10\text{ ms}$, $V_R = 0$, junction temperature 125°C .

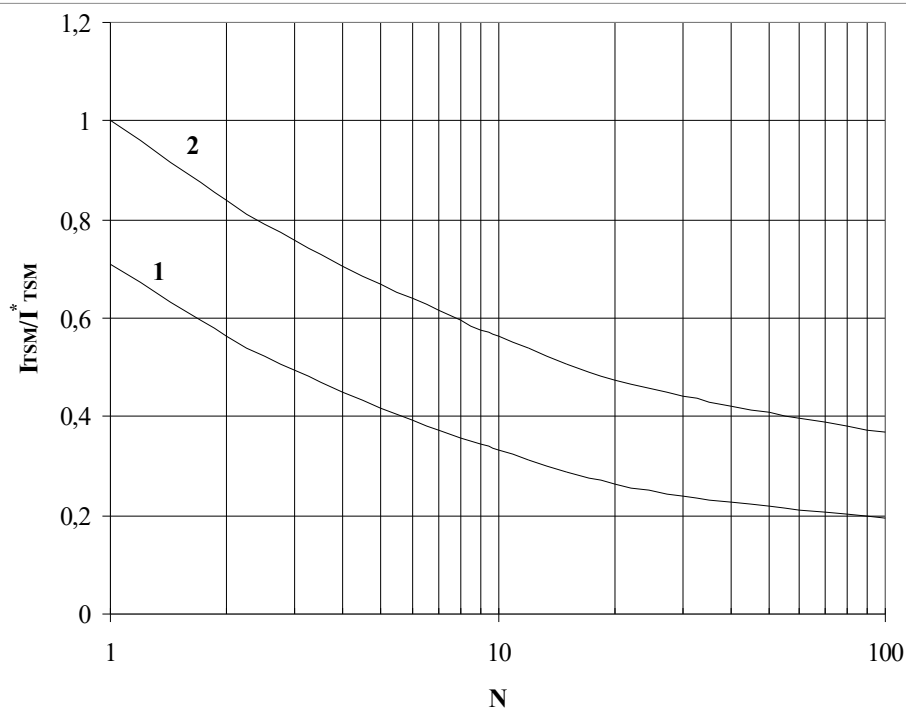
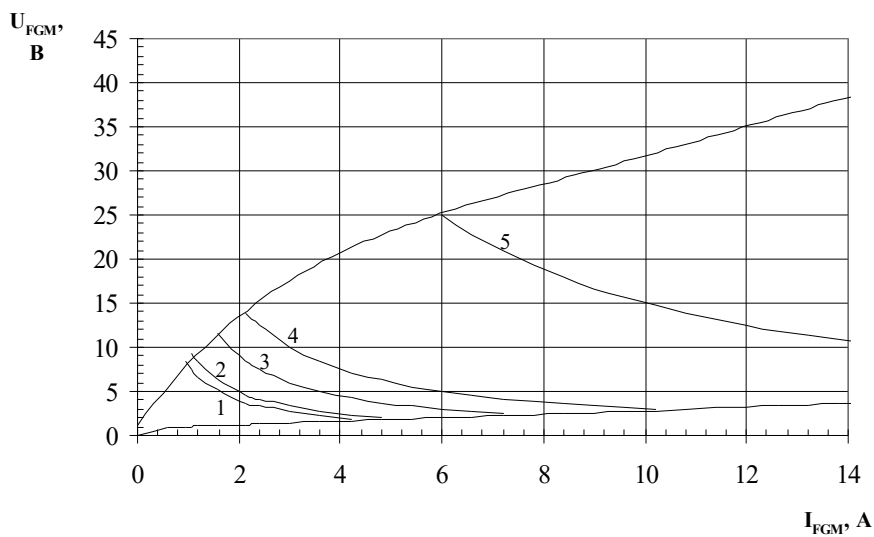


Fig. 24 Maximum allowable surge on-state current I_{TM} vs. pulse quantity of overload current N .
 1 – $T_j = 125^\circ\text{C}$
 2 – $T_j = 25^\circ\text{C}$

Conditions: sinusoidal pulse waveform, duration $t_p = 10\text{ ms}$, $f = 50\text{ Hz}$, on-off time ratio 2, $V_R = 0,8 \cdot V_{RRM}$.

Typical changes are normalized to I_{TSM}^* – maximum allowable surge on-state current for $t_p = 10\text{ ms}$, $V_R = 0$, junction temperature 125°C .



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. 25 Gate characteristics.

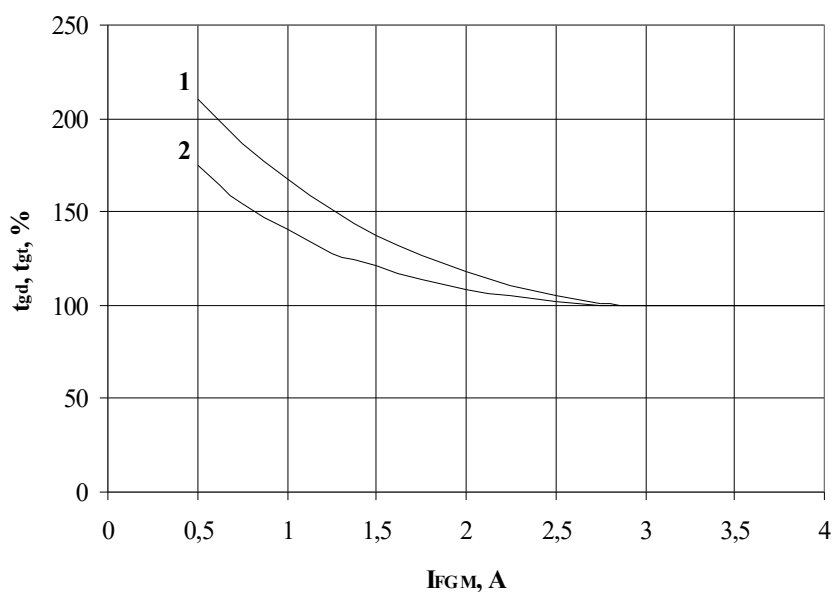


Fig. 26 Delay time t_{gd} (1) and turn-off time t_{gt} (2) vs. gate puls current I_{FGM}

Conditions: $T_j=25\text{ }^{\circ}\text{C}$, $V_D=500\text{ V}$, $di_G/dt=1\text{ A}/\mu\text{s}$, $t_G=10\text{ }\mu\text{s}$, $I_T=I_{TAV}$.

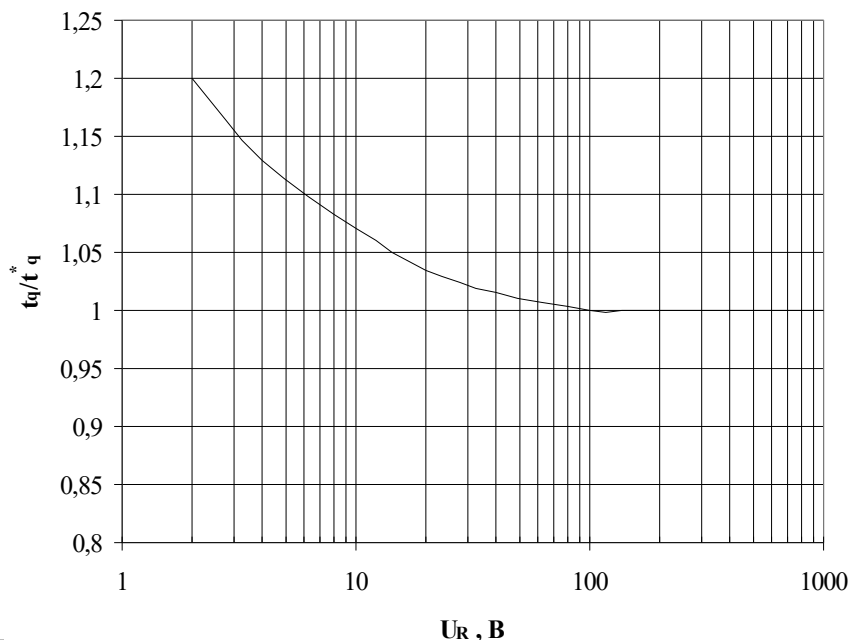


Fig. 27 Turn-on time t_q vs. reverse voltage V_R .

Conditions: $T_j=125\text{ }^\circ\text{C}$, $I_T=I_{TAV}$, $(di_T/dt)_f=10\text{ A}/\mu\text{s}$, $dU_D/dt=50\text{ V}/\mu\text{s}$, $V_D=0,67\cdot V_{DRM}$.

Typical changes are normalized to the turn-off time t_q^* for $T_j = 125\text{ }^\circ\text{C}$, $I_T=I_{TAV}$, $(di_T/dt)_f=10\text{ A}/\mu\text{s}$, $V_R=100\text{ V}$, $dV_D/dt=50\text{ V}/\mu\text{s}$, $V_D=0,67\cdot V_{DRM}$

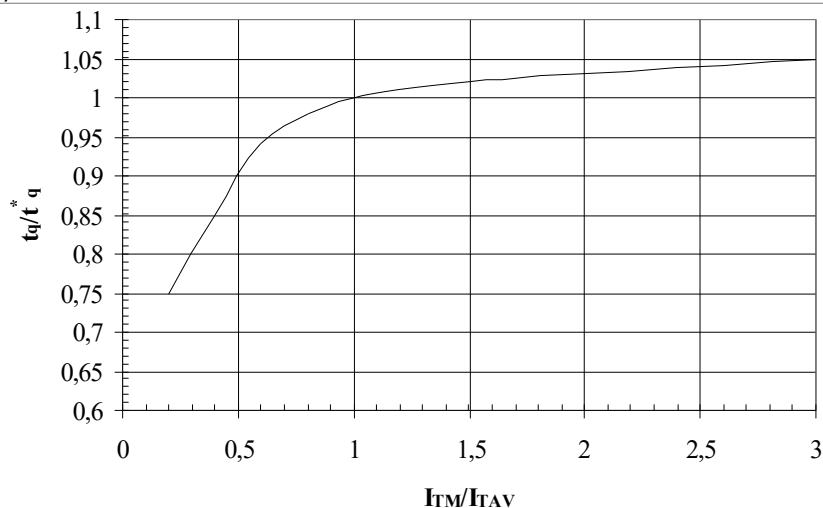


Fig. 28 Turn-off time t_q vs. mean on-state current I_T/I_{TAV} .

Conditions: $T_j=125\text{ }^\circ\text{C}$, $(di_T/dt)_f=10\text{ A}/\mu\text{s}$, $V_R=100\text{ B}$, $dV_D/dt=50\text{ V}/\mu\text{s}$, $V_D=0,67\cdot V_{DRM}$.

Typical changes are normalized to the turn-off time t_q^* for $T_j = 125\text{ }^\circ\text{C}$, $I_T=I_{TAV}$, $(di_T/dt)_f=10\text{ A}/\mu\text{s}$, $V_R=100\text{ V}$, $dV_D/dt=50\text{ V}/\mu\text{s}$, $V_D=0,67\cdot V_{DRM}$

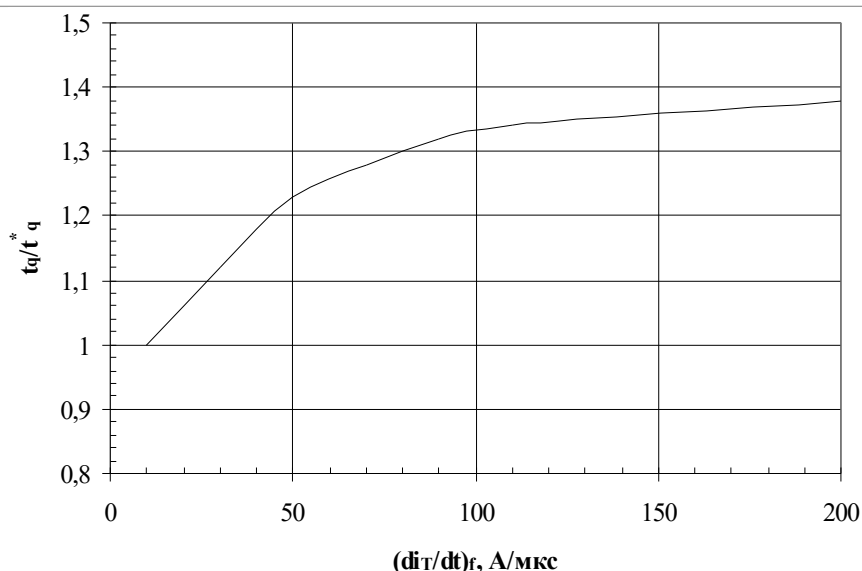


Fig. 29 Turn-on time t_q vs. rate of fall of on-state current $(di_T/dt)_f$.

Conditions: $T_j=125\text{ }^\circ\text{C}$, $I_T=I_{TAV}$, $V_R=100\text{ V}$, $dV_D/dt=50\text{ V/μs}$, $U_D=0,67\cdot U_{DRM}$.

Typical changes are normalized to the turn-off time t_q^* for $T_j = 125\text{ }^\circ\text{C}$, $I_T=I_{TAV}$, $(di_T/dt)_f=10\text{ A/μs}$, $V_R=100\text{ V}$, $dV_D/dt=50\text{ V/μs}$, $V_D=0,67\cdot V_{DRM}$.

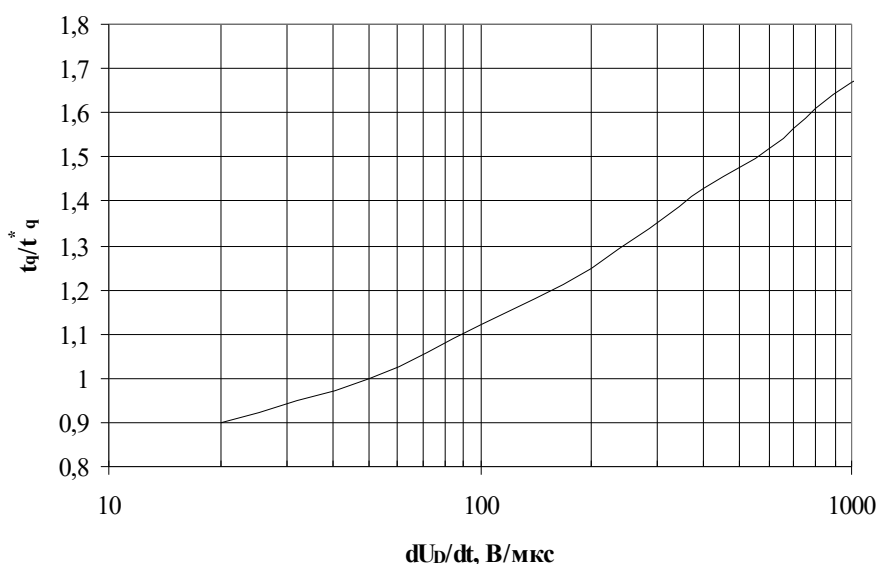


Fig. 30 Turn-on time t_q vs. rate of rise of off-state voltage $(di_T/dt)_f$.

Conditions: $T_j=125\text{ }^\circ\text{C}$, $I_T=I_{TAV}$, $(di_T/dt)_f=10\text{ A/μs}$, $V_R=100\text{ V}$, $V_D=0,67\cdot V_{DRM}$.

Typical changes are normalized to the turn-off time t_q^* for $T_j = 125\text{ }^\circ\text{C}$, $I_T=I_{TAV}$, $(di_T/dt)_f=10\text{ A/μs}$, $V_R=100\text{ V}$, $dV_D/dt=50\text{ V/μs}$, $V_D=0,67\cdot V_{DRM}$.

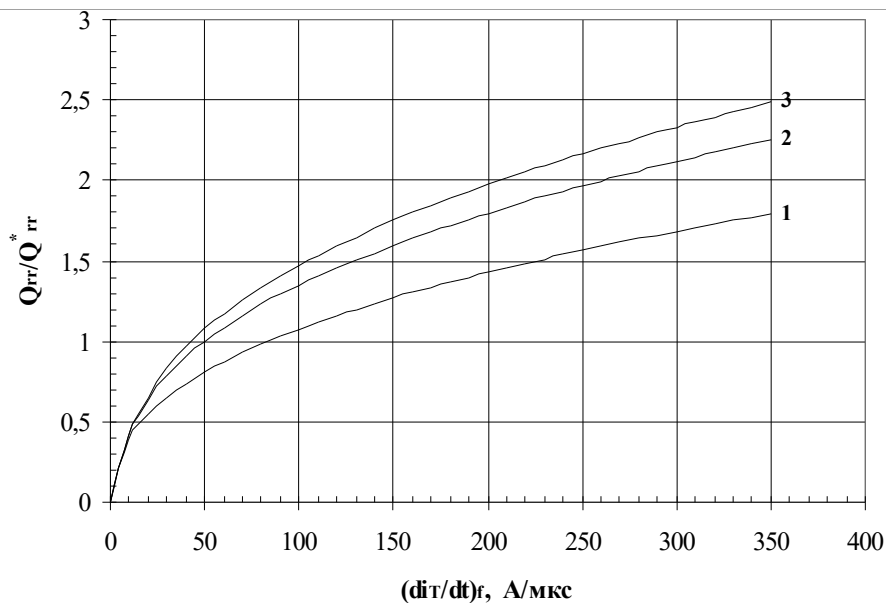


Fig. 31 Reverse recovery charge Q_{rr} vs. rate of fall of on-state current $(di_T/dt)_f$.

- 1 - $I_T = 0,5 I_{TAV}$;
- 2 - $I_T = I_{TAV}$;
- 3 - $I_T = 1,5 I_{TAV}$.

Conditions: $T_j = 125^\circ\text{C}$, $V_R = 100\text{ V}$.

Typical changes are normalized to the reverse recovery charge Q_{rr}^* for $T_j = 125^\circ\text{C}$, $I_T = I_{TAV}$, $(di_T/dt)_f = 50\text{ A}/\mu\text{s}$, $V_R = 100\text{ V}$.

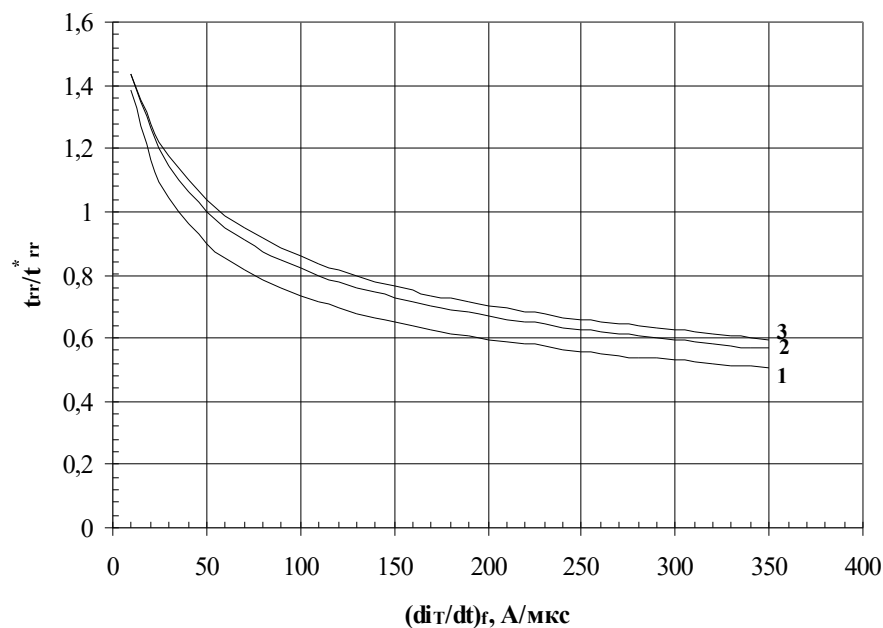


Fig. 32 Typical reverse recovery charge t_{rr} vs. rate of fall of on-state current $(di_T/dt)_f$.

- 1 - $I_T = 0,5 I_{TAV}$;
- 2 - $I_T = I_{TAV}$;
- 3 - $I_T = 1,5 I_{TAV}$.

Conditions: $T_j = 125^\circ\text{C}$, $V_R = 100\text{ V}$.

Typical changes are normalized to the reverse recovery charge t_{rr}^* for $T_j = 125^\circ\text{C}$, $I_T = I_{TAV}$, $(di_T/dt)_f = 50\text{ A}/\mu\text{s}$, $V_R = 100\text{ V}$.

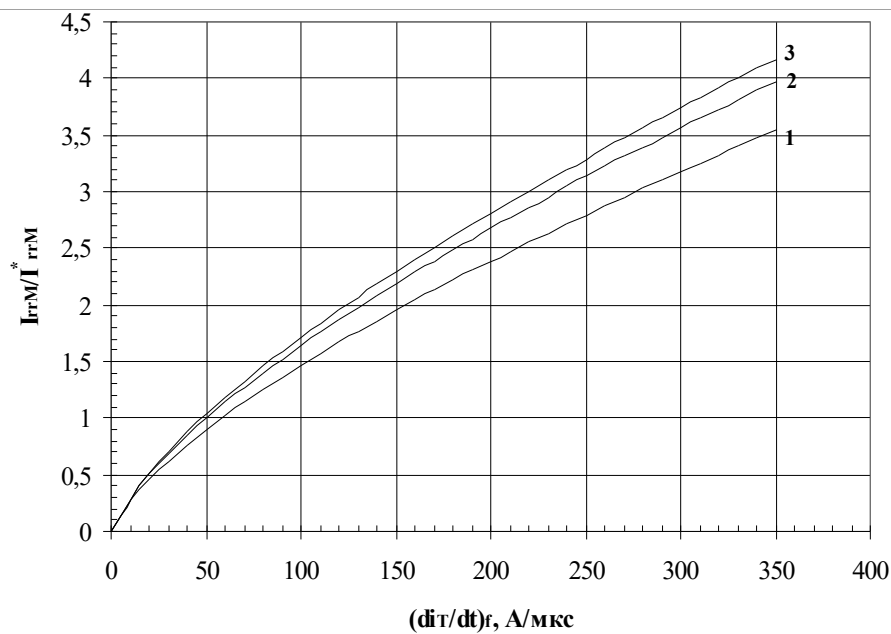


Fig. 33 Typical reverse recovery current I_{rr} vs. rate of fall of on-state current $(di_T/dt)_f$.

1 - $I_T = 0,5 I_{TAV}$;

2 - $I_T = I_{TAV}$;

3 - $I_T = 1,5 I_{TAV}$.

Conditions: $T_j = 125\text{ }^{\circ}\text{C}$, $V_R = 100\text{ V}$.

Typical changes are normalized to the reverse recovery current I_{rr} for $T_j = 125\text{ }^{\circ}\text{C}$, $I_T = I_{TAV}$, $(di_T/dt)_f = 50\text{ A}/\mu\text{s}$, $V_R = 100\text{ V}$.

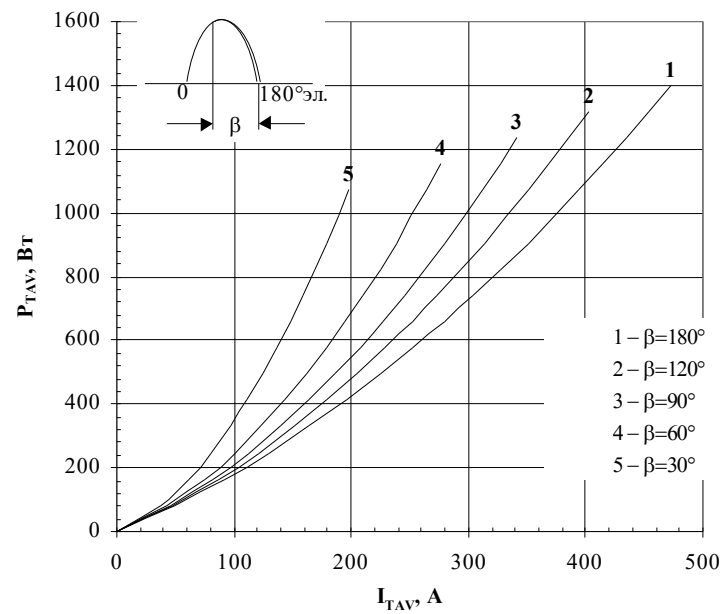


Fig. 34 Mean on-state power dissipation P_{TAV} vs. mean on-state current for sinusoidal current waveforms at different conduction angles, $f = 50\text{ Hz}$

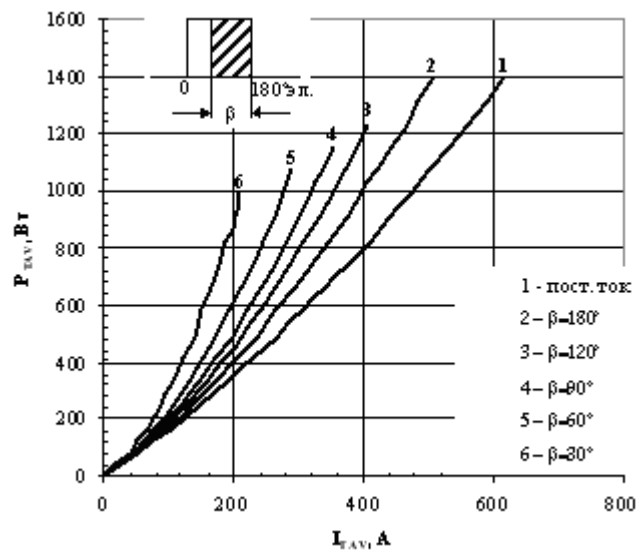


Fig. 35 Mean on-state power dissipation P_{TAV} vs. mean on-state current for rectangular current waveforms at different conduction angles, $f=50\text{Hz}$ and DC.

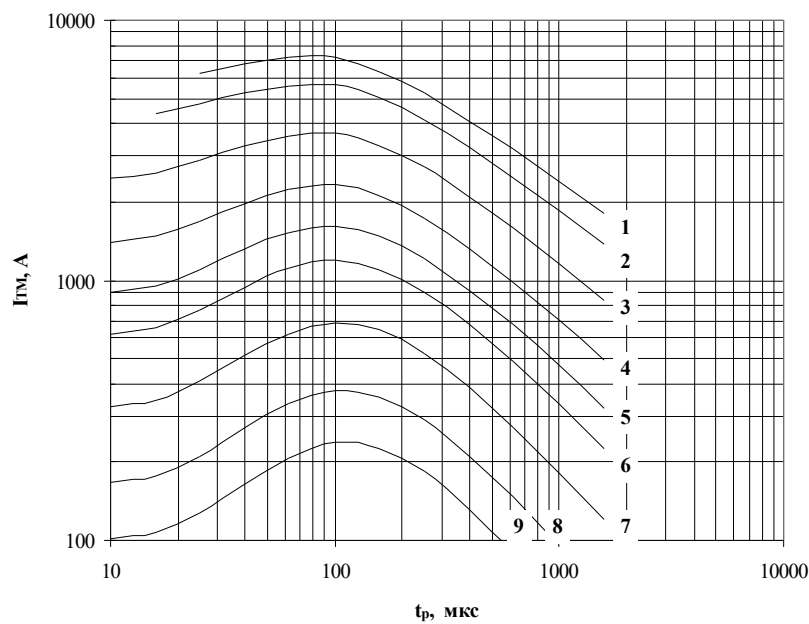


Fig. 36 Total power loss of one sinusoidal on-state current pulse vs. pulse duration t_p and current I_{TM}

Total power loss:

- 1 - 6 G;
- 2 - 4 G;
- 3 - 2 G;
- 4 - 1 G;
- 5 - 0,6 G;
- 6 - 0,4 G;
- 7 - 0,2 G;
- 8 - 0,1 G;
- 9 - 0,06 G.

Conditions: $V_D=0,67 \cdot V_{DRM}$; $V_R=0,67 \cdot V_{RRM}$.

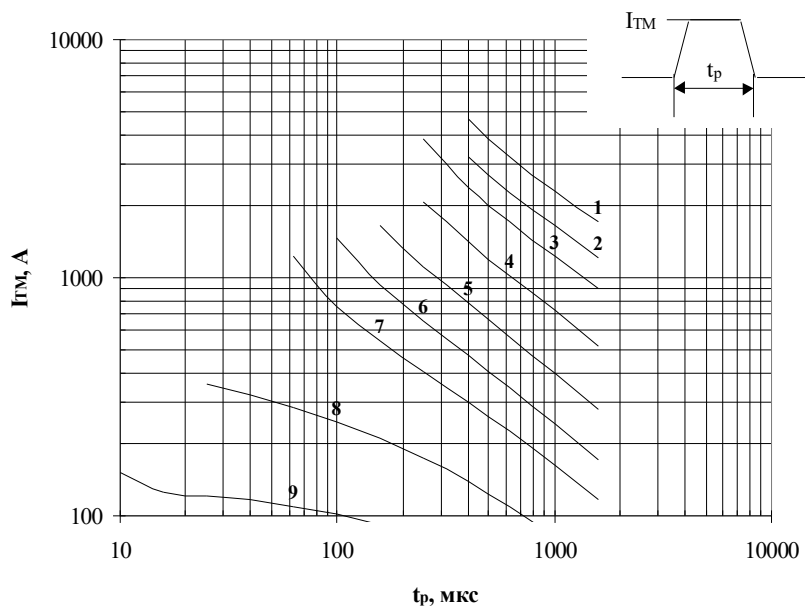


Fig. 37 Total power loss of one trapeze on-state current pulse vs. pulse duration t_p and current I_{TM}

Total power loss:

- | | |
|-----------|------------|
| 1 – 10 G; | 6 – 0,6 G; |
| 2 – 6 G; | 7 – 0,4 G; |
| 3 – 4 G; | 8 – 0,2 G; |
| 4 – 2 G; | 9 – 0,1 G. |
| 5 – 1 G; | |

Conditions: $di_T/dt = 50 \text{ A}/\mu\text{s}$; $V_D = 0,67 \cdot V_{DRM}$; $V_R = 0,67 \cdot V_{RRM}$.

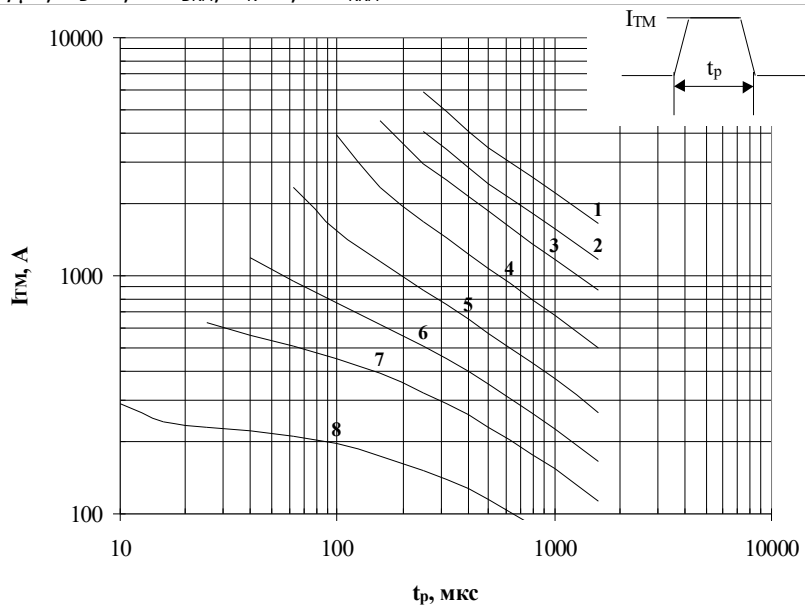


Fig. 38

Total power loss of one trapeze on-state current pulse vs. pulse duration t_p and current I_{TM}

Total power loss:

- | |
|------------|
| 1 – 10 G; |
| 2 – 6 G; |
| 3 – 4 G; |
| 4 – 2 G; |
| 5 – 1 G; |
| 6 – 0,6 G; |
| 7 – 0,4 G; |
| 8 – 0,2 G. |

Conditions: $di_T/dt = 100 \text{ A}/\mu\text{s}$; $V_D = 0,67 \cdot V_{DRM}$; $V_R = 0,67 \cdot V_{RRM}$.

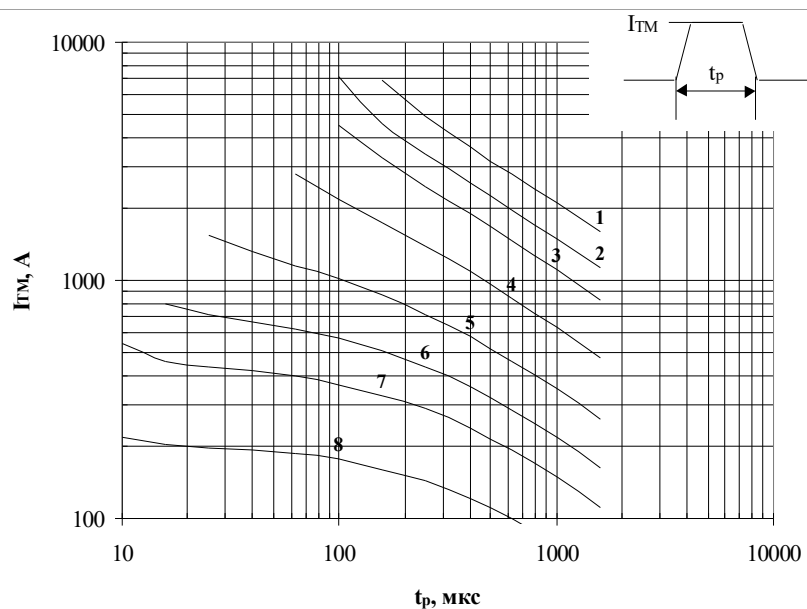


Fig. 39 Total power loss of one trapeze on-state current pulse vs. pulse duration t_p and current I_{TM}

Total power loss:

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

Conditions: $di_T/dt = 200 \text{ A}/\mu\text{s}$; $V_D = 0,67 \cdot V_{DRM}$; $V_R = 0,67 \cdot V_{RRM}$.