High-end Power Semiconductor Manufacturer

# KK800A 3000-3400V

## Fast Switching Thyristor

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

| | | |
|---|---|---|
| Mean on-state current | $I_{TAV}$ | 800 A |
| Repetitive peak off-state voltage | $V_{DRM}$ | 3000 – 3400 V |
| Repetitive peak reverse voltage | $V_{RRM}$ | |
| Turn-off time | $t_q$ | 63.0; 80.0; 100.0 μs |

| | | | |
|---|---|---|---|
| $V_{DRM}$, $V_{RRM}$, V | 3000 | 3200 | 3400 |
| Voltage code | 30 | 32 | 34 |
| $T_j$, °C | – 60 – 125 | | |

## MAXIMUM ALLOWABLE RATINGS

| Symbols and parameters | | Units | Values | Test conditions | |
|---|---|---|---|---|---|
| **ON-STATE** | | | | | |
| $I_{TAV}$ | Mean on-state current | A | 800<br>1200 | $T_c$=85°C; Double side cooled;<br>180° half-sine wave; 50 Hz | |
| $I_{TRMS}$ | RMS on-state current | A | 1256 | $T_c$=85°C; Double side cooled;<br>180° half-sine wave; 50 Hz | |
| $I_{TSM}$ | Surge on-state current | kA | 16.0<br>18.0 | $T_j$=$T_{j\,max}$<br>$T_j$=25 °C | 180° half-sine wave; 50 Hz ($t_p$=10 ms); single pulse;<br>$V_D$=$V_R$=0 V;<br>Gate pulse:$I_G$=$I_{FGM}$; $V_G$=20 V;<br>$t_{GP}$=50 μs; $di_G/dt$=1 A/μs |
| | | | 17.0<br>20.0 | $T_j$=$T_{j\,max}$<br>$T_j$=25 °C | 180° half-sine wave; 60 Hz ($t_p$=8.3 ms); single pulse;<br>$V_D$=$V_R$=0 V;<br>Gate pulse:$I_G$=$I_{FGM}$; $V_G$=20 V;<br>$t_{GP}$=50 μs; $di_G/dt$=1 A/μs |
| $I^2t$ | Safety factor | $A^2s{\cdot}10^3$ | 1280<br>1620 | $T_j$=$T_{j\,max}$<br>$T_j$=25 °C | 180° half-sine wave; 50 Hz ($t_p$=10 ms); single pulse;<br>$V_D$=$V_R$=0 V;<br>Gate pulse:$I_G$=$I_{FGM}$; $V_G$=20 V;<br>$t_{GP}$=50 μs; $di_G/dt$=1 A/μs |
| | | | 1195<br>1660 | $T_j$=$T_{j\,max}$<br>$T_j$=25 °C | 180° half-sine wave; 60 Hz ($t_p$=8.3 ms); single pulse;<br>$V_D$=$V_R$=0 V;<br>Gate pulse:$I_G$=$I_{FGM}$; $V_G$=20 V;<br>$t_{GP}$=50 μs; $di_G/dt$=1 A/μs |
| **BLOCKING** | | | | | |
| $V_{DRM}$, $V_{RRM}$ | Repetitive peak off-state and Repetitive peak reverse voltages | V | 3000–3400 | $T_{j\,min}$< $T_j$ <$T_{j\,max}$;<br>180° half-sine wave; 50 Hz;<br>Gate open | |
| $V_{DSM}$, $V_{RSM}$ | Non-repetitive peak off-state and Non-repetitive peak reverse voltages | V | 3100–3500 | $T_{j\,min}$< $T_j$ <$T_{j\,max}$;<br>180° half-sine wave; 50 Hz;single pulse;<br>Gate open | |
| $V_D$, $V_R$ | Direct off-state and Direct reverse voltages | V | $0.75{\cdot}V_{DRM}$<br>$0.75{\cdot}V_{RRM}$ | $T_j$=$T_{j\,max}$;<br>Gate open | |

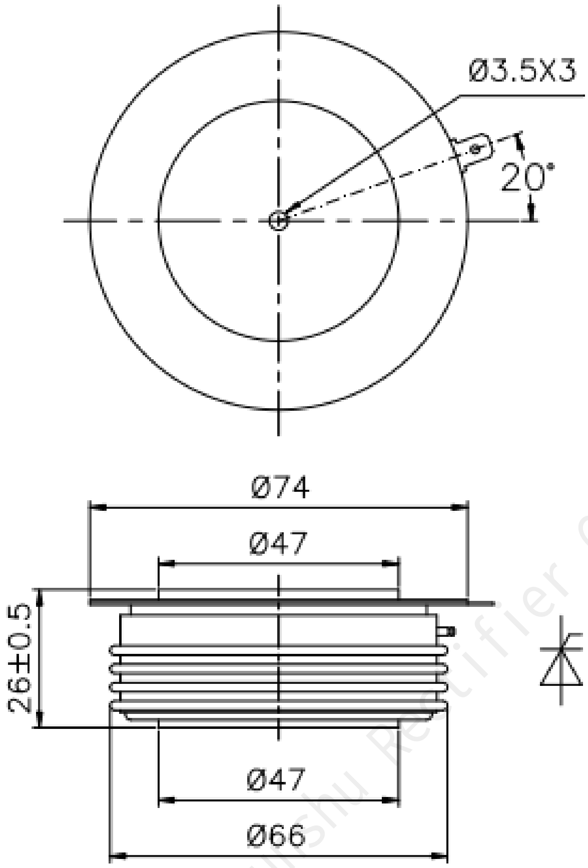
| | | | | |
|---|---|---|---|---|
| **TRIGGERING** | | | | |
| $I_{FGM}$ | Peak forward gate current | A | 8 | $T_j=T_{j\ max}$ |
| $V_{RGM}$ | Peak reverse gate voltage | V | 5 | |
| $P_G$ | Gate power dissipation | W | 8 | $T_j=T_{j\ max}$ for DC gate current |
| **SWITCHING** | | | | |
| $(di_T/dt)_{crit}$ | Critical rate of rise of on-state current non-repetitive (f=1 Hz) | A/µs | 2000 | $T_j=T_{j\ max}$; $V_D=0.67 \cdot V_{DRM}$; $I_{TM}=2\ I_{TAV}$; Gate pulse: $I_G=I_{FGM}$; $V_G=20$ V; $t_{GP}=50$ µs; $di_G/dt=1$ A/µs |
| **THERMAL** | | | | |
| $T_{stg}$ | Storage temperature | °C | -60 – 125 | |
| $T_j$ | Operating junction temperature | °C | -60 – 125 | |
| **MECHANICAL** | | | | |
| F | Mounting force | kN | 24.0 – 28.0 | |
| a | Acceleration | $m/s^2$ | 50<br>100 | Device unclamped<br>Device clamped |

## CHARACTERISTICS

| Symbols and parameters | | Units | Values | Conditions | |
|---|---|---|---|---|---|
| **ON-STATE** | | | | | |
| $V_{TM}$ | Peak on-state voltage, max | V | 2.60 | $T_j=25$ °C; $I_{TM}=2512$ A | |
| $V_{T(TO)}$ | On-state threshold voltage, max | V | 1.30 | $T_j=T_{j\ max}$; $0.5\ \pi\ I_{TAV} < I_T < 1.5\ \pi\ I_{TAV}$ | |
| $r_T$ | On-state slope resistance, max | mΩ | 0.70 | | |
| $I_H$ | 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 | 1000 | $T_j=T_{j\ max}$; $V_D=0.67 \cdot V_{DRM}$; Gate open | |
| **TRIGGERING** | | | | | |
| $V_{GT}$ | Gate trigger direct voltage, max | V | 4.00<br>2.50<br>2.00 | $T_j=T_{j\ min}$<br>$T_j=25$ °C<br>$T_j=T_{j\ max}$ | $V_D=12$ V; $I_D=3$ A; Direct gate current |
| $I_{GT}$ | Gate trigger direct current, max | mA | 500<br>300<br>200 | $T_j=T_{j\ min}$<br>$T_j=25$ °C<br>$T_j=T_{j\ max}$ | |
| $V_{GD}$ | Gate non-trigger direct voltage, min | V | 0.25 | $T_j=T_{j\ max}$; $V_D=0.67 \cdot V_{DRM}$; Direct gate current | |
| $I_{GD}$ | Gate non-trigger direct current, min | mA | 10.00 | | |
| **SWITCHING** | | | | | |
| $t_{gd}$ | Delay time | µs | 3.00 | $T_j=25$ °C; $V_D=0.4 \cdot V_{DRM}$; $I_{TM}=I_{TAV}$; Gate pulse: $I_G=I_{FGM}$; $V_G=20$ V; $t_{GP}=50$ µs; $di_G/dt=1$ A/µs | |
| $t_q$ | Turn-off time[2], max | µs | 63.0; 80.0; 100.0 | $dv_D/dt=50$ V/µs; | $T_j=T_{j\ max}$; $I_{TM}=I_{TAV}$; $di_R/dt=-10$ A/µs; $V_R=100$V; $V_D=0.67\ V_{DRM}$ |
| | | | 80.0; 100; 125 | $dv_D/dt=200$ V/µs; | |
| $Q_{rr}$ | Total recovered charge, max | µC | 1000 | $T_j=T_{j\ max}$; $I_{TM}=I_{TAV}$; $di_R/dt=-50$ A/µs; $V_R=100$ V | |
| $t_{rr}$ | Reverse recovery time, typ | µs | 8.0 | | |
| $I_{rrM}$ | Peak reverse recovery current, max | A | 260 | | |

| | | | | | |
|---|---|---|---|---|---|
| **THERMAL** | | | | | |
| $R_{thjc}$ | Thermal resistance, junction to case, max | °C/W | 0.0210 | Direct current | Double side cooled |
| $R_{thjc-A}$ | | | 0.0462 | | Anode side cooled |
| $R_{thjc-K}$ | | | 0.0378 | | Cathode side cooled |
| $R_{thck}$ | Thermal resistance, case to heatsink, max | °C/W | 0.0040 | Direct current | |
| **MECHANICAL** | | | | | |
| w | Weight, typ | g | 510 | | |
| $D_s$ | Surface creepage distance | mm (inch) | 31.60 (1.244) | | |
| $D_a$ | Air strike distance | mm (inch) | 16.50 (0.649) | | |

## OVERALL DIMENSIONS




KT55

All dimensions in millimeters

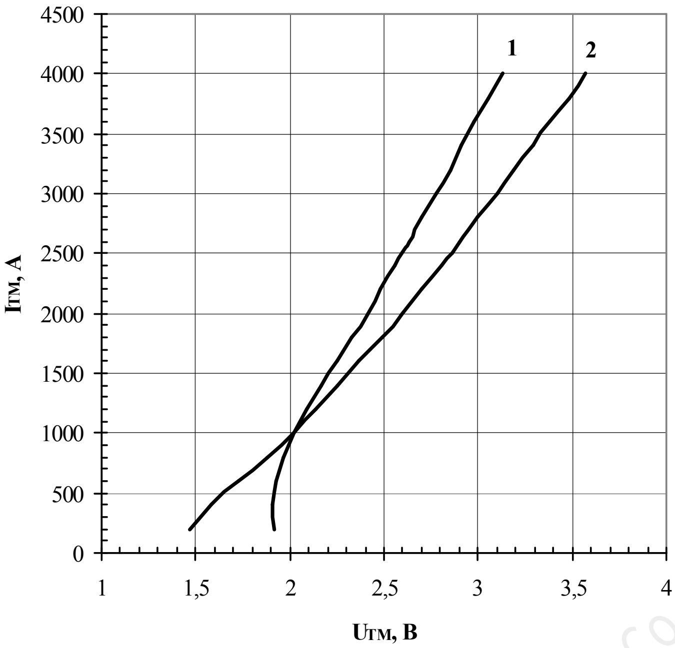
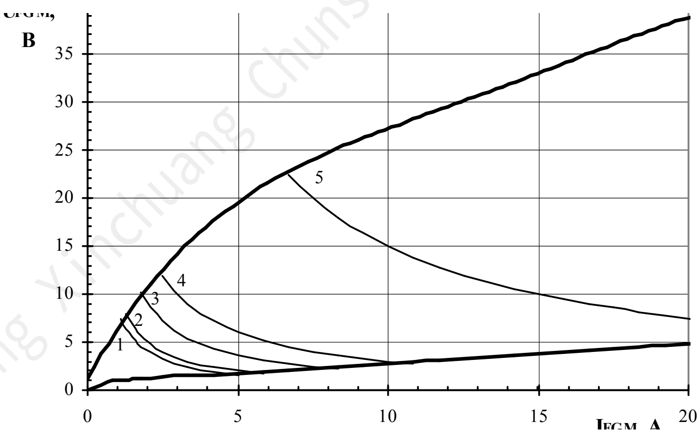



**Fig. 1** On-state characteristics of Limit device
1 – $T_j$=25 °C
2 – $T_j$=125 °C






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

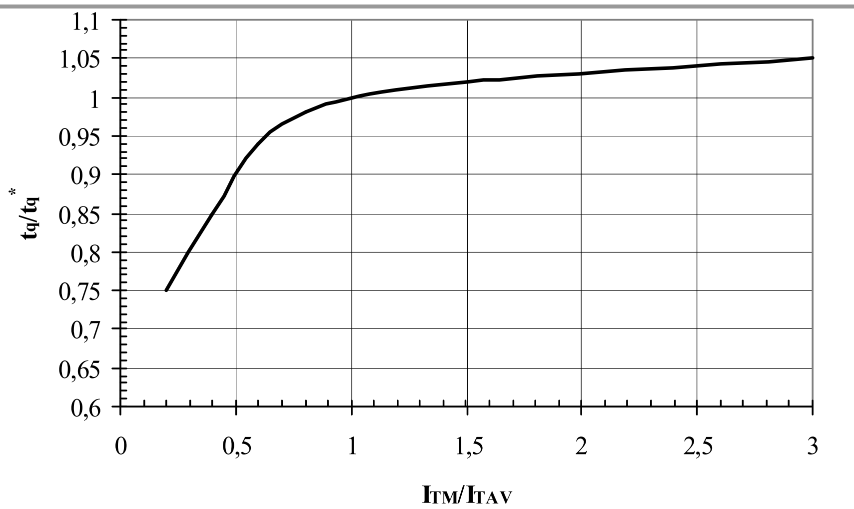



**Fig. 3** Turn-off time $t_q$ vs. On-state peak current $I_{TM}$

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)

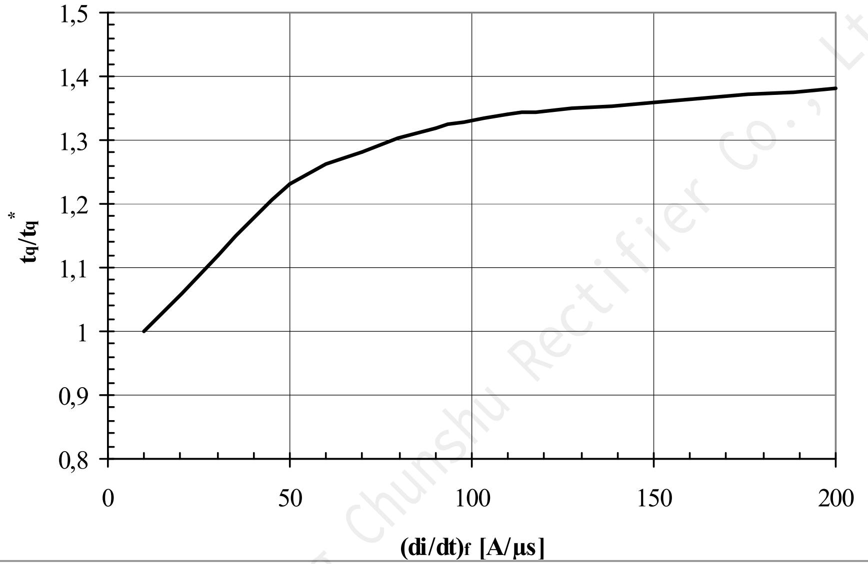



**Fig. 4** Turn-off time $t_q$ vs. Rate of fall of on-state current $di_R/dt$

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)

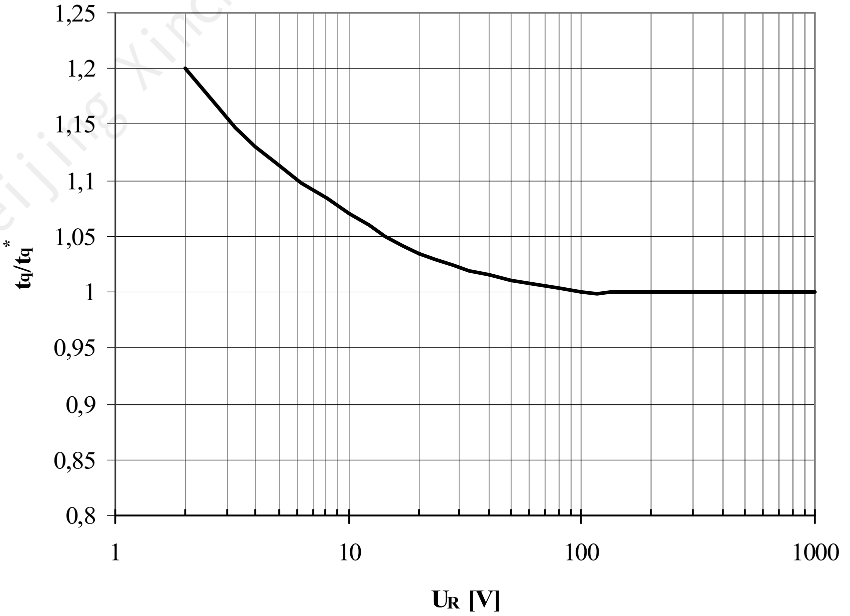



**Fig. 5** Turn-off time $t_q$ vs. Reverse voltage $V_R$

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)

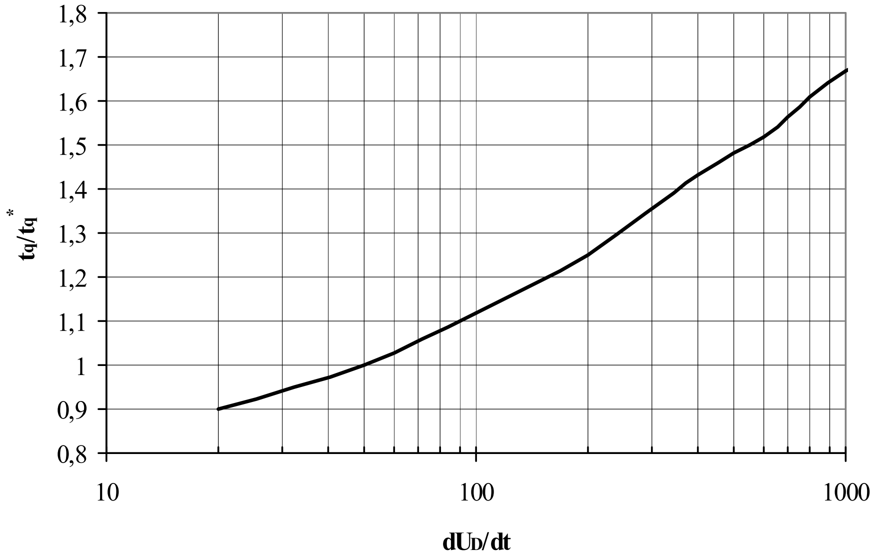



**Fig. 6** Turn-off time $t_q$ vs. Rate of rise of commutating voltage $dv_D/dt$

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

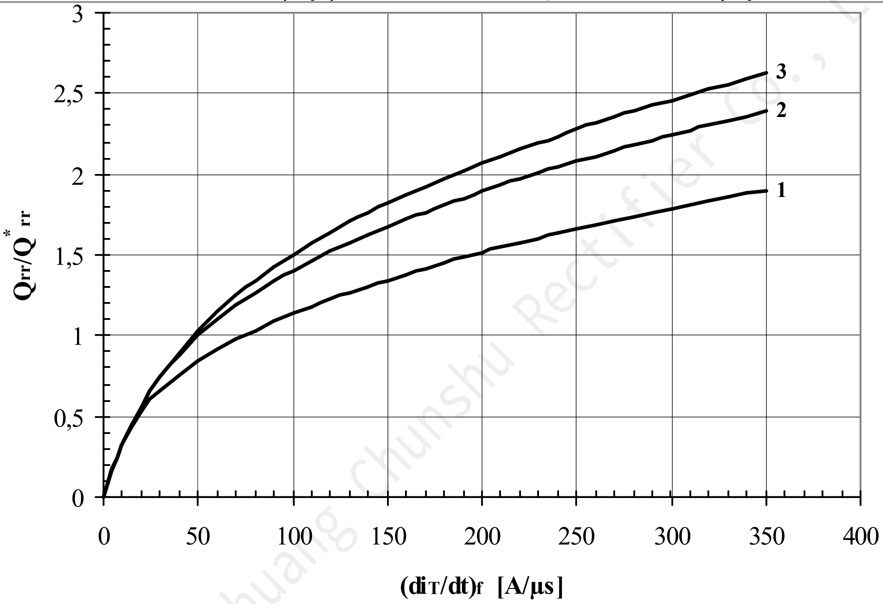



**Fig. 7** Reverse recovery charge $Q_{rr}$, vs. Rate of fall of on-state current $di_R/dt$

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)



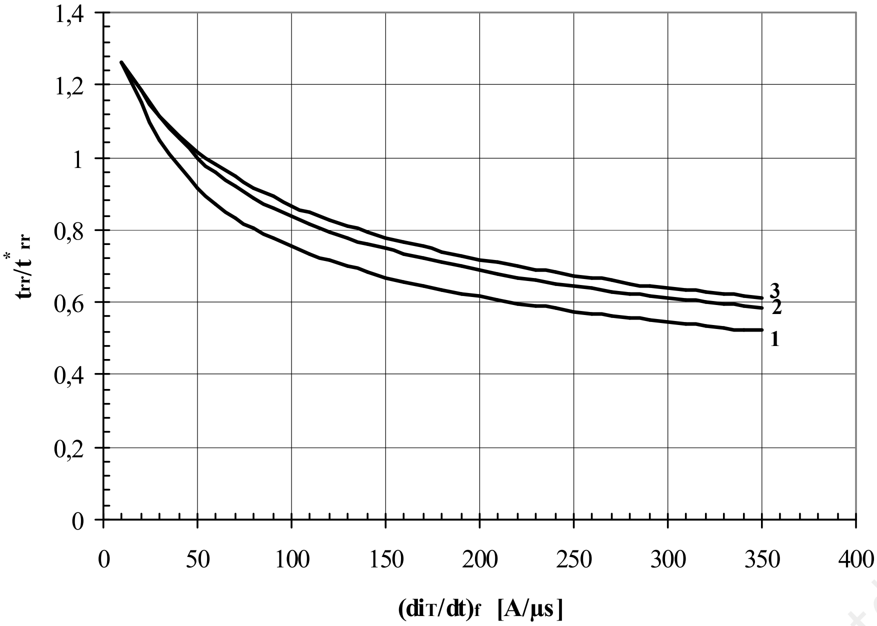



**Fig. 8** Reverse recovery time $t_{rr}$ vs. Rate of fall of on-state current $di_R/dt$
1 – $I_{TM} = 0.5 \cdot I_{TAV}$
2 – $I_{TM} = I_{TAV}$,
3 – $I_{TM} = 1.5 \cdot I_{TAV}$

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)

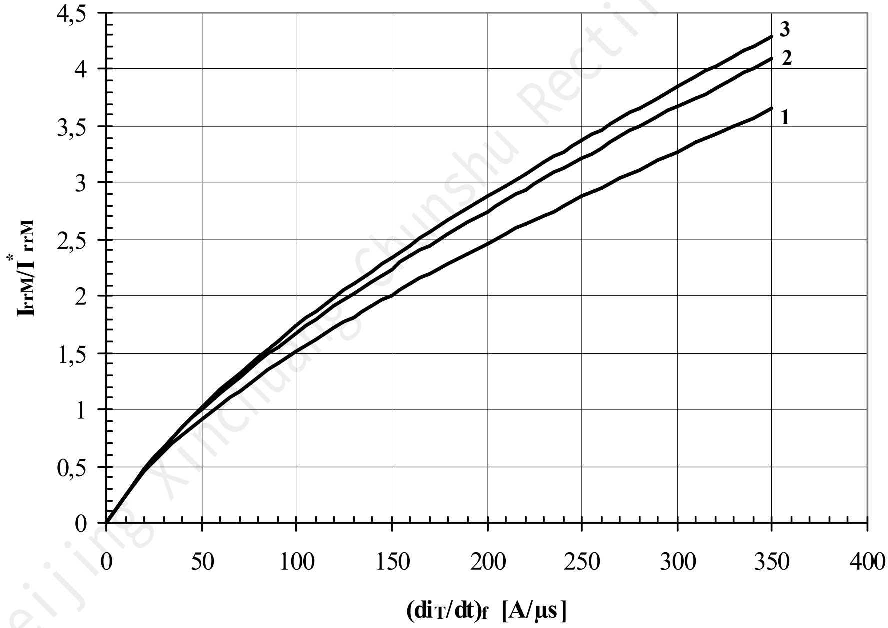



**Fig. 9** Peak reverse recovery current $I_{rrM}$ vs. Rate of fall of on-state current $di_R/dt$
1 – $I_{TM} = 0.5 \cdot I_{TAV}$
2 – $I_{TM} = I_{TAV}$,
3 – $I_{TM} = 1.5 \cdot I_{TAV}$

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)



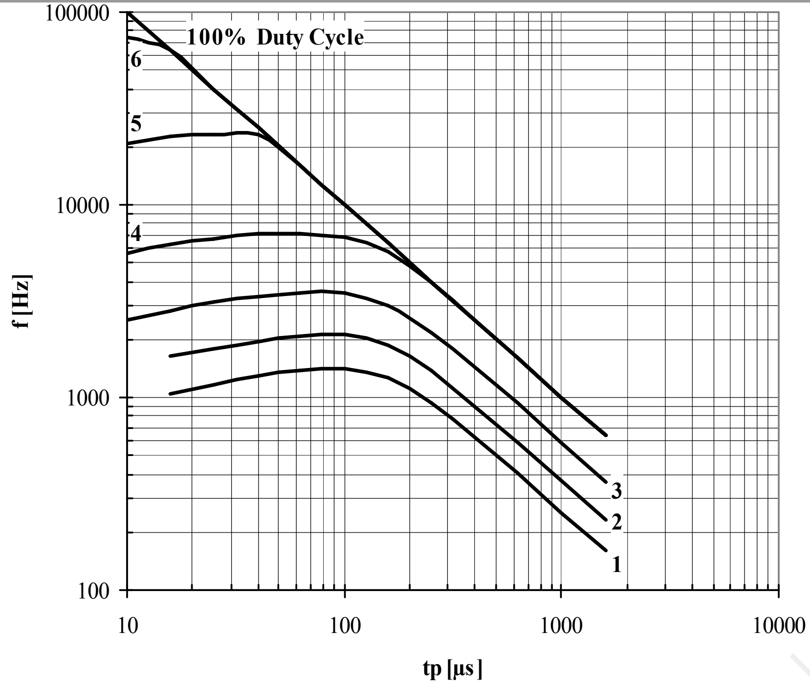



**Fig. 10** Sine wave frequency ratings

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; $T_C = 55\ ^oC$

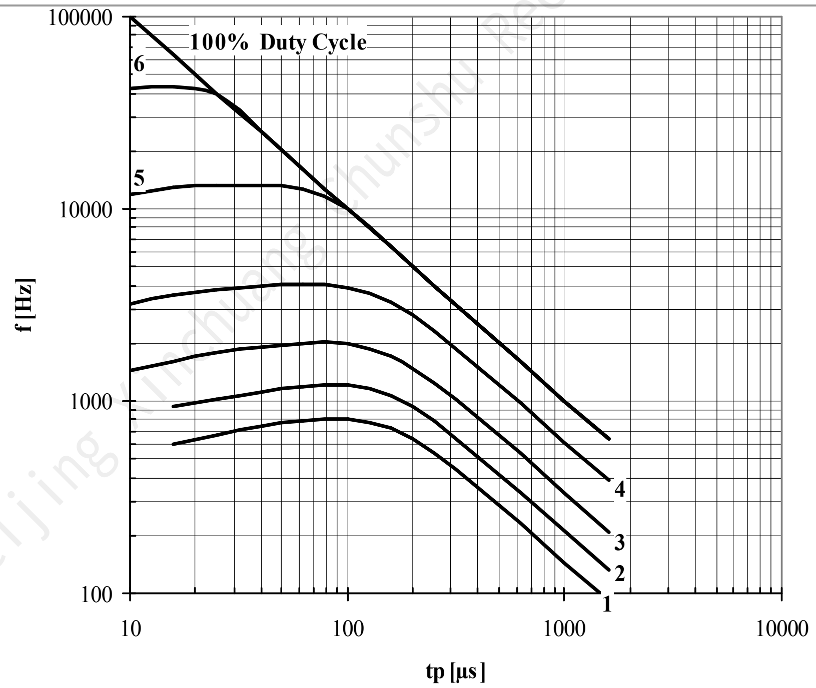



**Fig. 11** Sine wave frequency ratings

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

Conditions: $V_R \leq 3$ V; $T_C = 80\ ^oC$

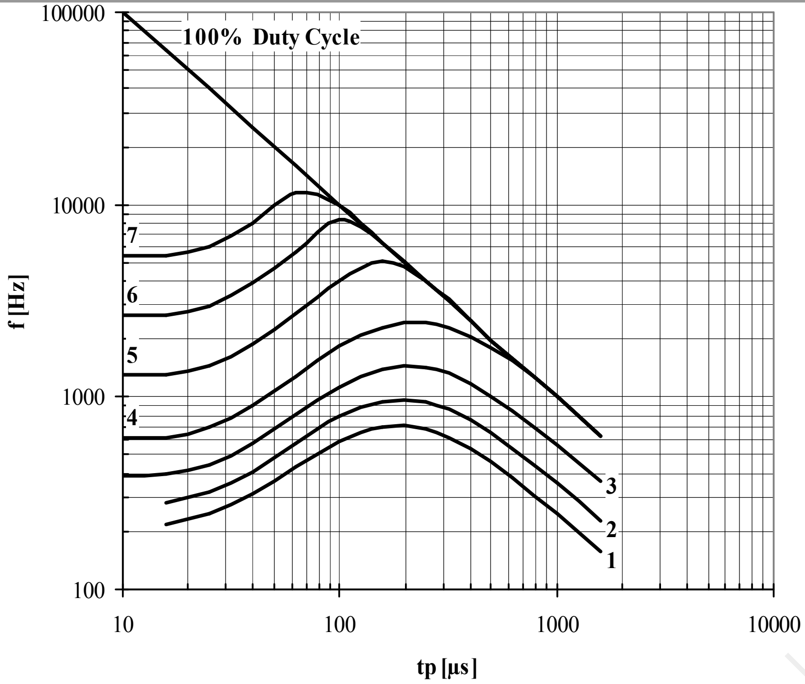



**Fig. 12** Sine wave frequency ratings
1 – $I_{TM}$ = 5000 A
2 – $I_{TM}$ = 4000 A
3 – $I_{TM}$ = 3000 A
4 – $I_{TM}$ = 2000 A
5 – $I_{TM}$ = 1000 A
6 – $I_{TM}$ = 500 A
7 – $I_{TM}$ = 250 A

Conditions: $V_R$=0.67·$V_{RRM}$; $T_C$=55 °C

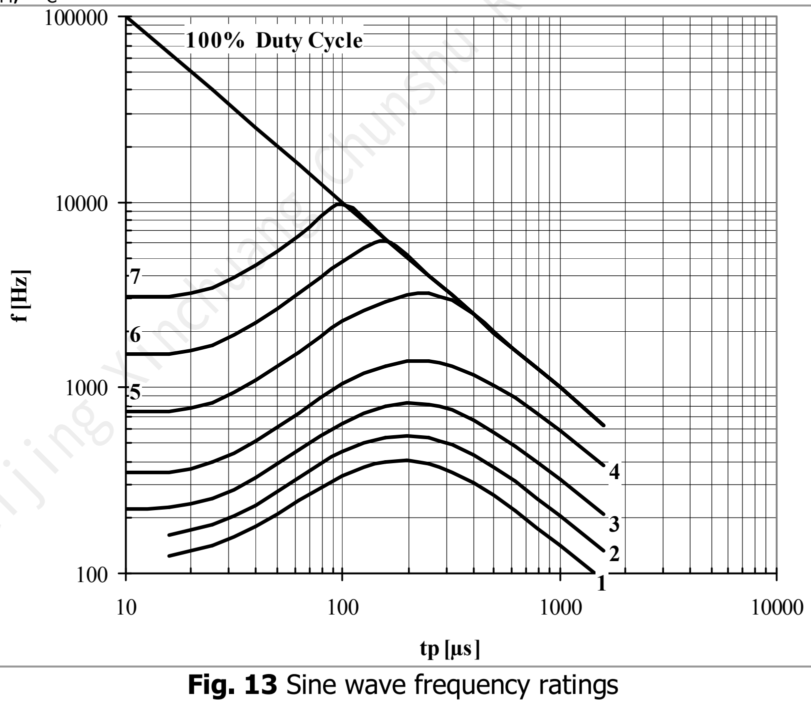



**Fig. 13** Sine wave frequency ratings
1 – $I_{TM}$ = 5000 A
2 – $I_{TM}$ = 4000 A
3 – $I_{TM}$ = 3000 A
4 – $I_{TM}$ = 2000 A
5 – $I_{TM}$ = 1000 A
6 – $I_{TM}$ = 500 A
7 – $I_{TM}$ = 250 A

Conditions: $V_R$=0.67·$V_{RRM}$; $T_C$=80 °C



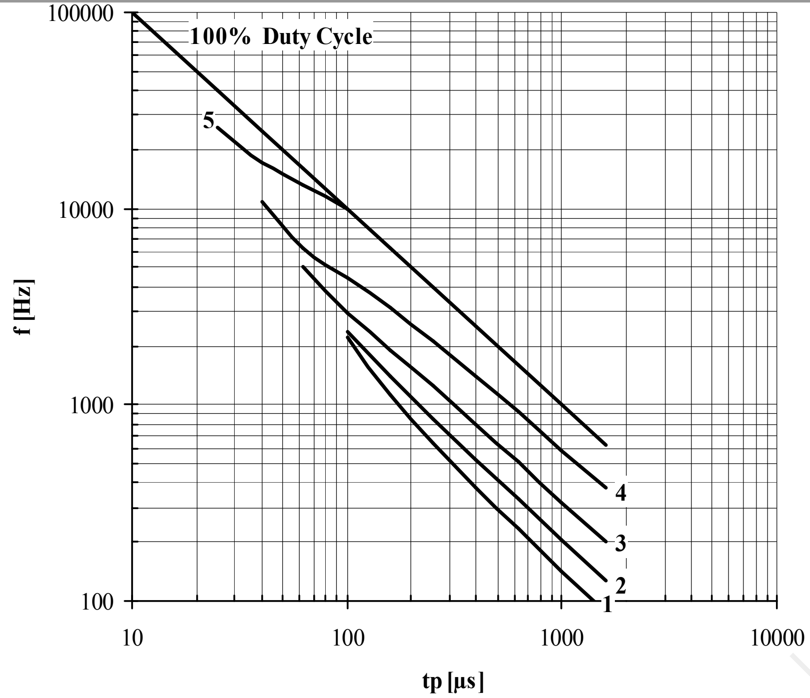



**Fig. 14** Square wave frequency ratings
1 – $I_{TM}$ = 5000 A
2 – $I_{TM}$ = 4000 A
3 – $I_{TM}$ = 3000 A
4 – $I_{TM}$ = 2000 A
5 – $I_{TM}$ = 1000 A

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

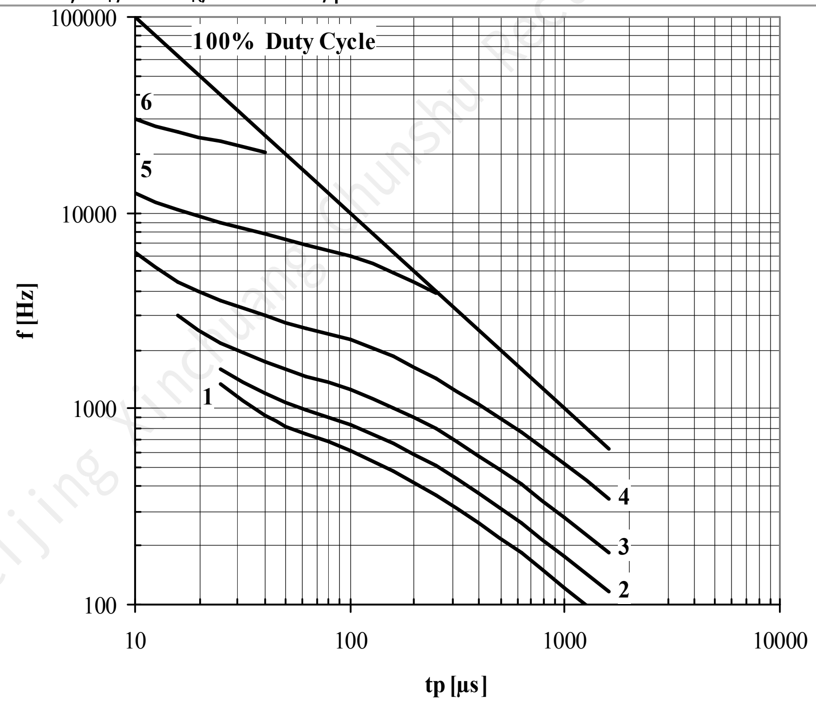
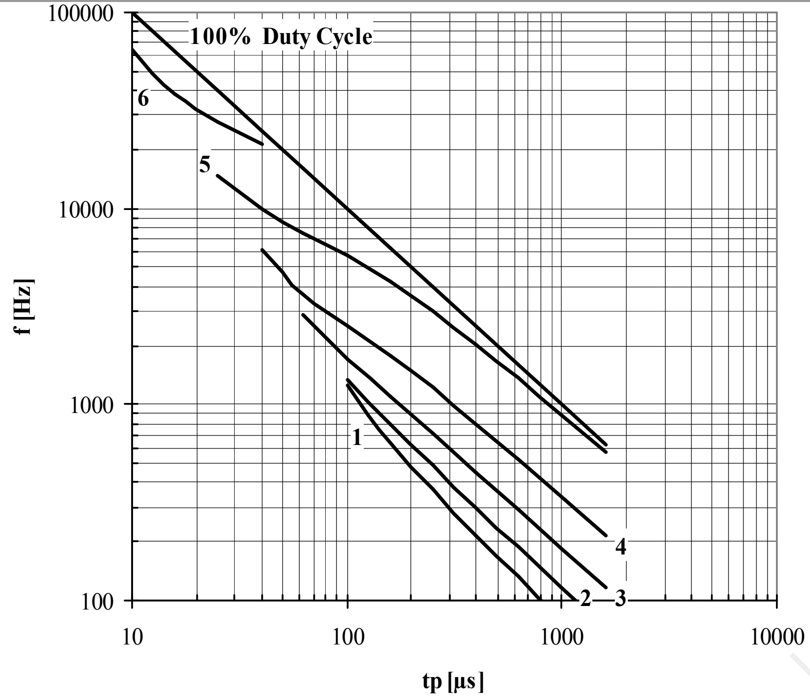
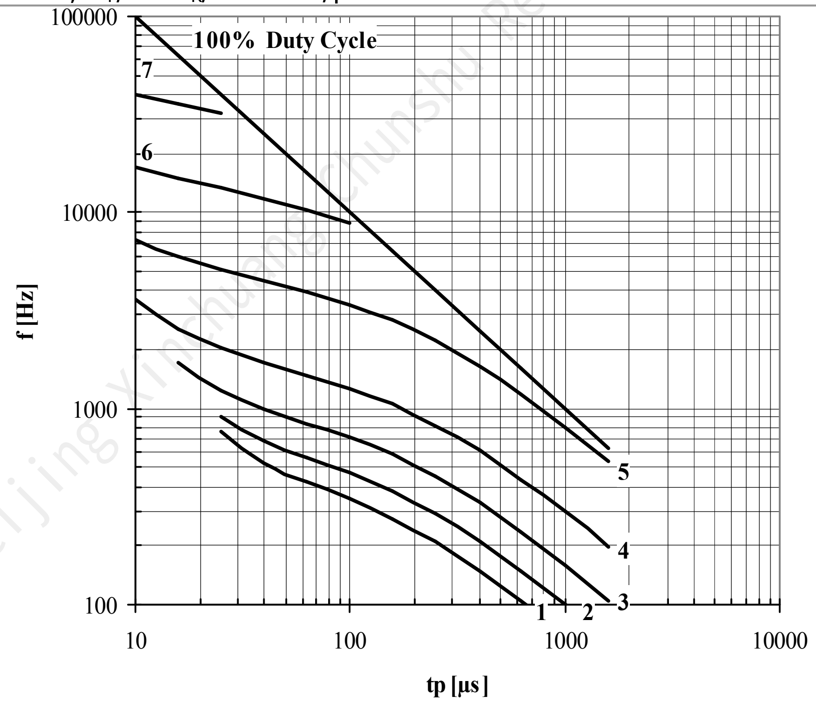



**Fig. 15** Square wave frequency ratings
1 – $I_{TM}$ = 5000 A
2 – $I_{TM}$ = 4000 A
3 – $I_{TM}$ = 3000 A
4 – $I_{TM}$ = 2000 A
5 – $I_{TM}$ = 1000 A
6 – $I_{TM}$ = 500 A

Conditions: $V_R \leq 3$ V; $T_C = 55\ ^oC$; $di_F/dt = di_R/dt = 500$ A/µs




| |
|---|
| **Fig. 16** Square wave frequency ratings<br>1 – $I_{TM}$ = 5000 A<br>2 – $I_{TM}$ = 4000 A<br>3 – $I_{TM}$ = 3000 A<br>4 – $I_{TM}$ = 2000 A<br>5 – $I_{TM}$ = 1000 A<br>6 – $I_{TM}$ = 500 A |
| Conditions: $V_R \leq 3$ V; $T_C$=80 °C; $di_F/dt=di_R/dt$=100 A/µs |




| |
|---|
| **Fig. 17** Square wave frequency ratings<br>1 – $I_{TM}$ = 5000 A<br>2 – $I_{TM}$ = 4000 A<br>3 – $I_{TM}$ = 3000 A<br>4 – $I_{TM}$ = 2000 A<br>5 – $I_{TM}$ = 1000 A<br>6 – $I_{TM}$ = 500 A<br>7 – $I_{TM}$ = 250 A |
| Conditions: $V_R \leq 3$ V; $T_C$=80 °C; $di_F/dt=di_R/dt$=500 A/µs |

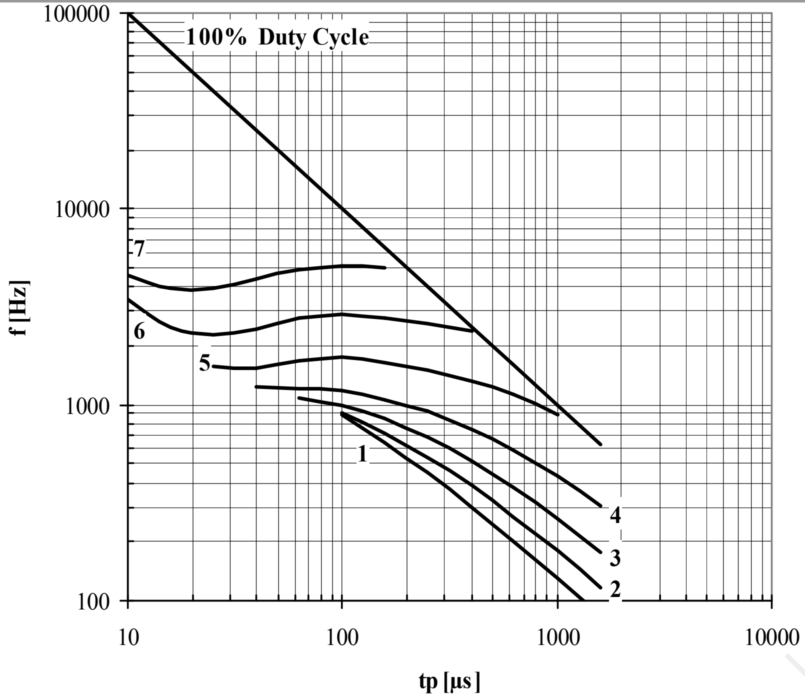



**Fig. 18** Square wave frequency ratings
1 – $I_{TM}$ = 5000 A
2 – $I_{TM}$ = 4000 A
3 – $I_{TM}$ = 3000 A
4 – $I_{TM}$ = 2000 A
5 – $I_{TM}$ = 1000 A
6 – $I_{TM}$ = 500 A
7 – $I_{TM}$ = 250 A

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

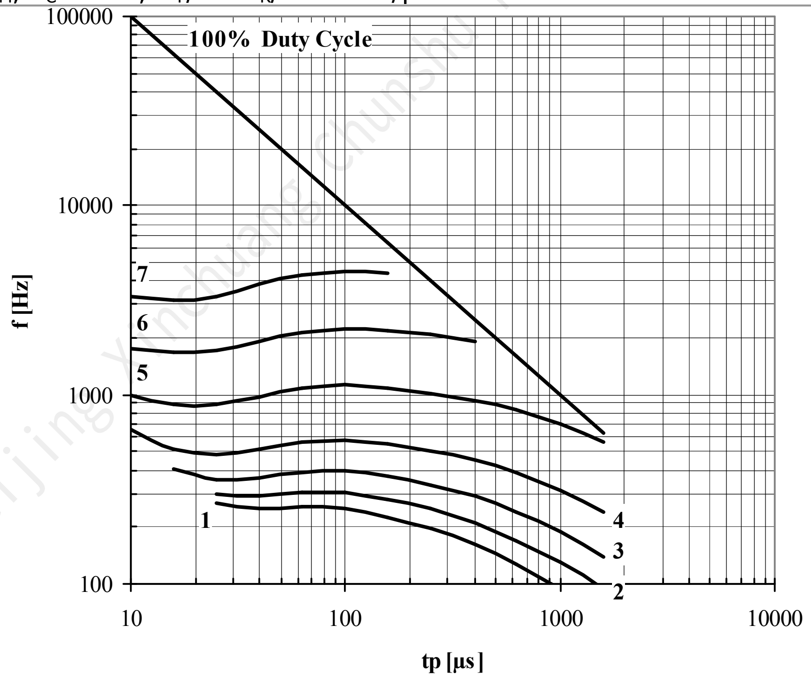



**Fig. 19** Square wave frequency ratings
1 – $I_{TM}$ = 5000 A
2 – $I_{TM}$ = 4000 A
3 – $I_{TM}$ = 3000 A
4 – $I_{TM}$ = 2000 A
5 – $I_{TM}$ = 1000 A
6 – $I_{TM}$ = 500 A
7 – $I_{TM}$ = 250 A

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

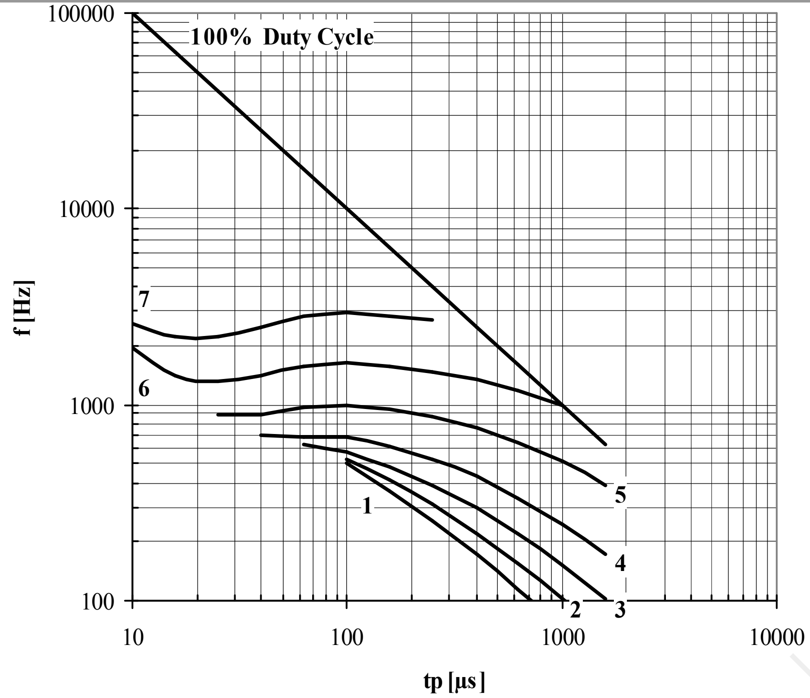



**Fig. 20** Square wave frequency ratings
1 – $I_{TM}$ = 5000 A
2 – $I_{TM}$ = 4000 A
3 – $I_{TM}$ = 3000 A
4 – $I_{TM}$ = 2000 A
5 – $I_{TM}$ = 1000 A
6 – $I_{TM}$ = 500 A
7 – $I_{TM}$ = 250 A

Conditions: $V_R = 0.67 \cdot V_{RRM}$; $T_C = 80\ ^oC$; $di_F/dt = di_R/dt = 100$ A/μs

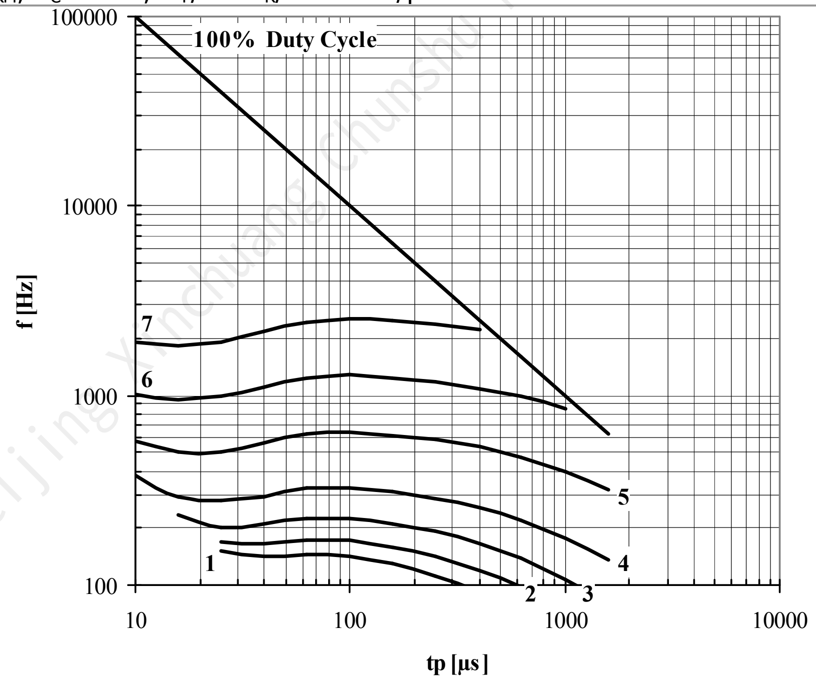



**Fig. 21** Square wave frequency ratings
1 – $I_{TM}$ = 5000 A
2 – $I_{TM}$ = 4000 A
3 – $I_{TM}$ = 3000 A
4 – $I_{TM}$ = 2000 A
5 – $I_{TM}$ = 1000 A
6 – $I_{TM}$ = 500 A
7 – $I_{TM}$ = 250 A

Conditions: $V_R = 0.67 \cdot V_{RRM}$; $T_C = 80\ ^oC$; $di_F/dt = di_R/dt = 500$ A/μs



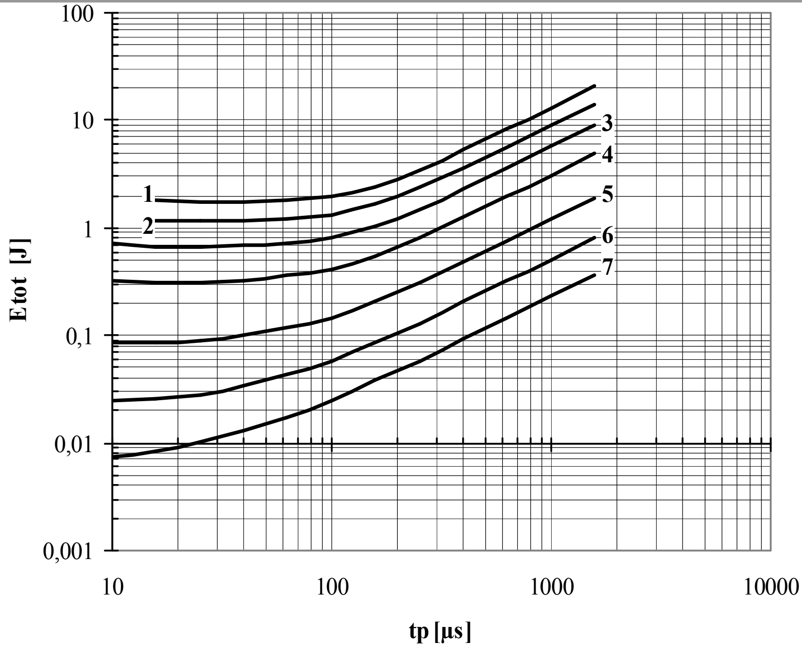



**Fig. 22** Sine wave loss energy per pulse
1 – $I_{TM}$ = 5000 A
2 – $I_{TM}$ = 4000 A
3 – $I_{TM}$ = 3000 A
4 – $I_{TM}$ = 2000 A
5 – $I_{TM}$ = 1000 A
6 – $I_{TM}$ = 500 A
7 – $I_{TM}$ = 250 A

Conditions: $V_R \leq 3$ V

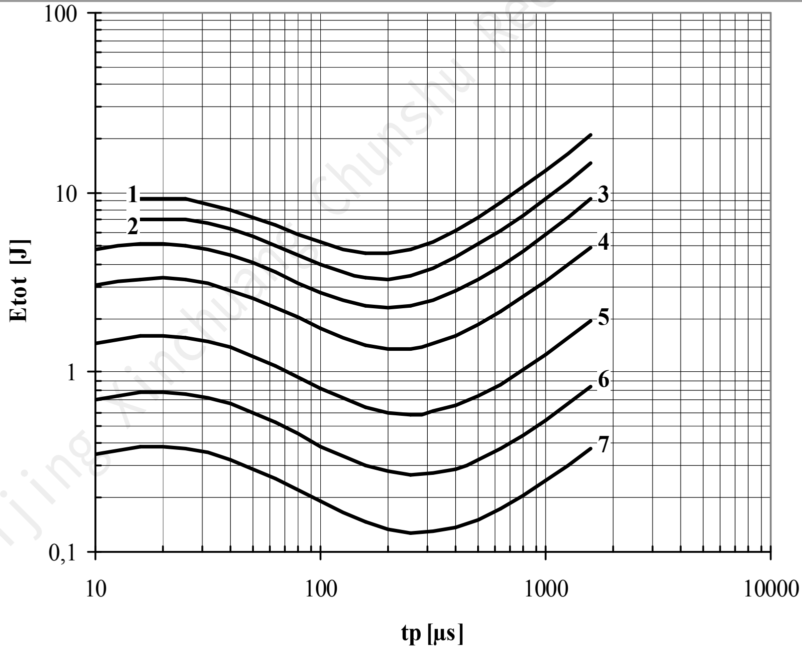



**Fig. 23** Sine wave loss energy per pulse
1 – $I_{TM}$ = 5000 A
2 – $I_{TM}$ = 4000 A
3 – $I_{TM}$ = 3000 A
4 – $I_{TM}$ = 2000 A
5 – $I_{TM}$ = 1000 A
6 – $I_{TM}$ = 500 A
7 – $I_{TM}$ = 250 A

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



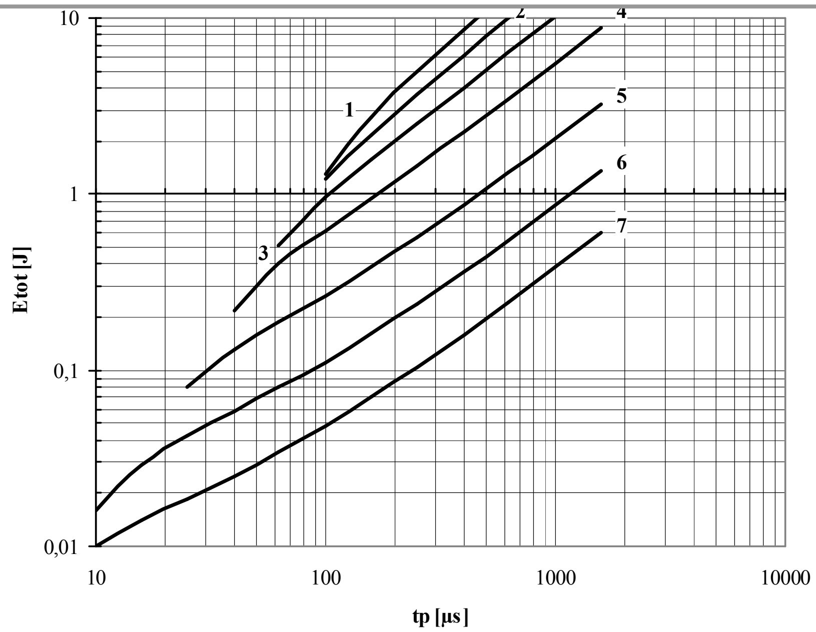



**Fig. 24** Square wave loss energy per pulse

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: $V_R \leq 3$ V; $di_F/dt = di_R/dt = 100$ A/µs

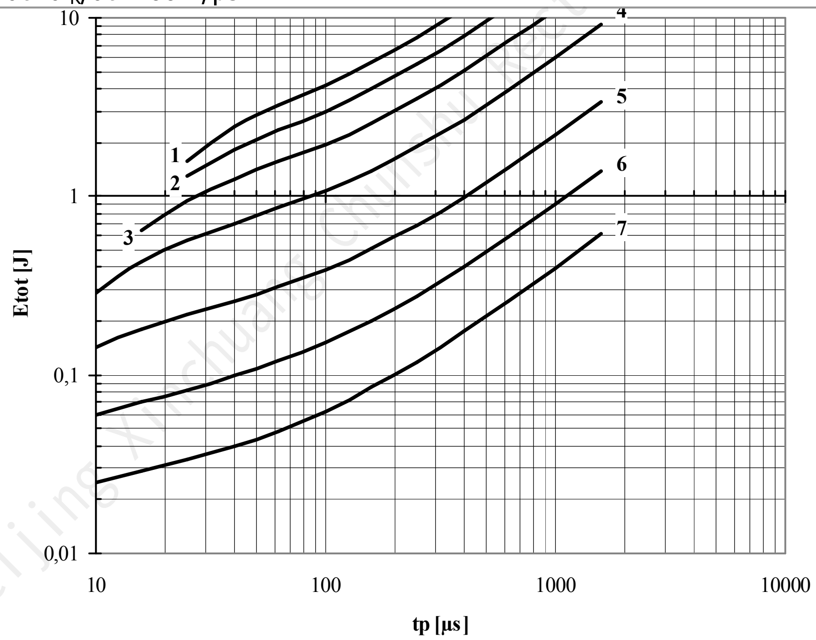



**Fig. 25** Square wave loss energy per pulse

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

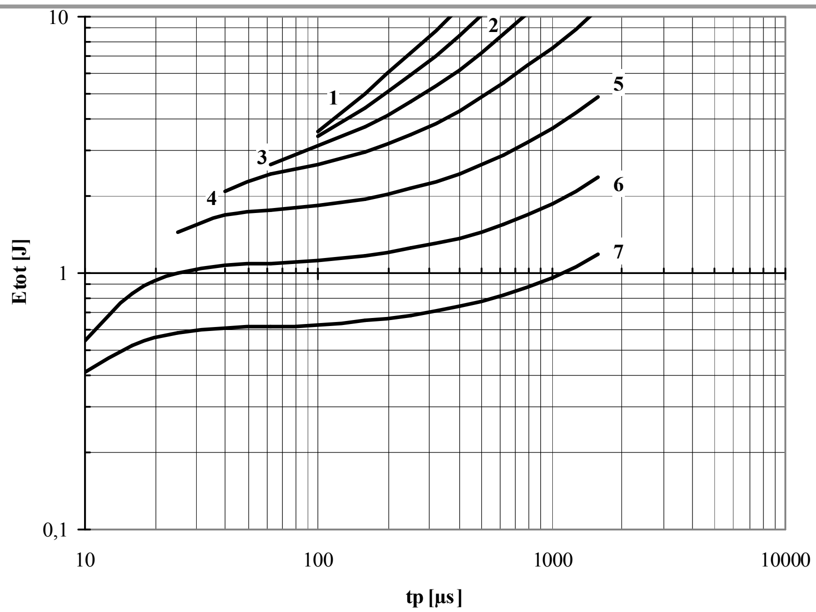



**Fig. 26** Square wave loss energy per pulse

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

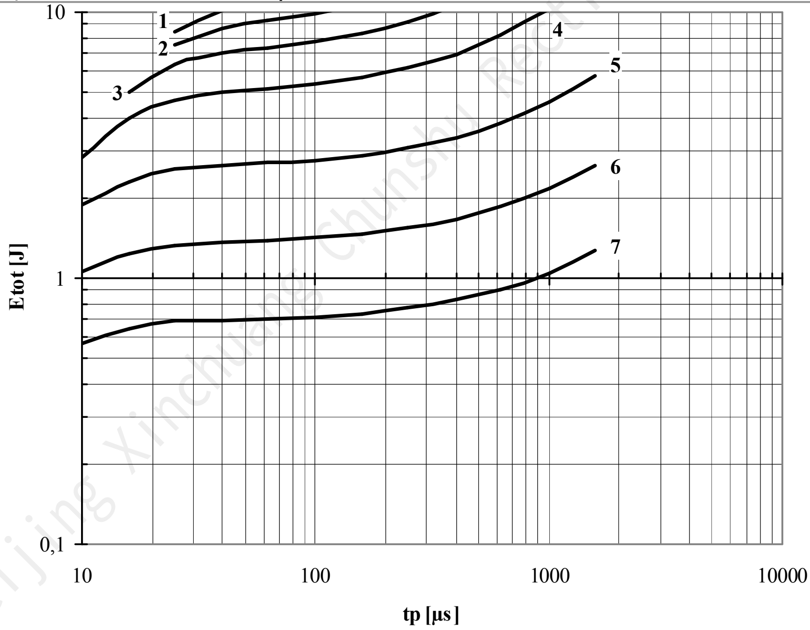



**Fig. 27** Square wave loss energy per pulse

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

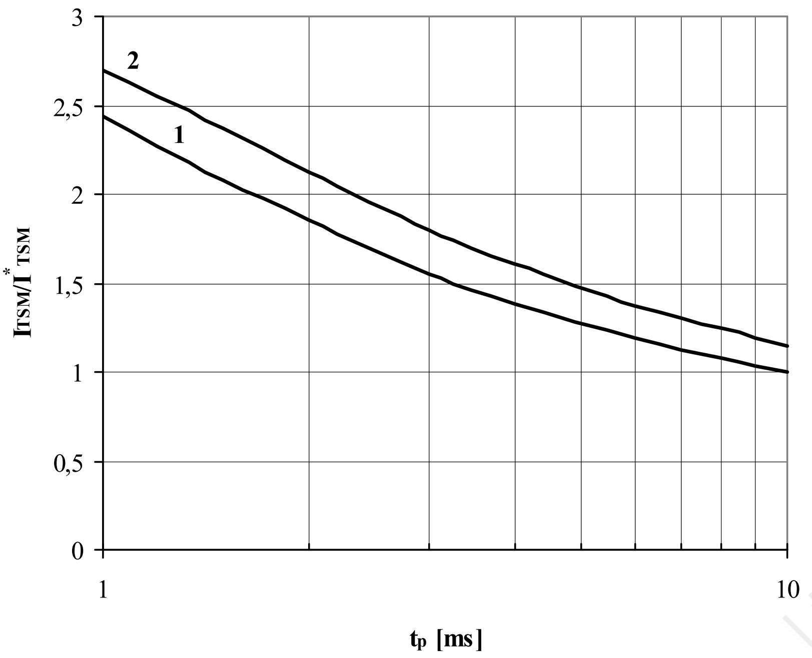



**Fig. 28** The surge current $I_{TSM}$ vs. Duration of surge $t_p$ for a half-sine wave
1 – $T_j$=125 °C
2 – $T_j$=25 °C

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



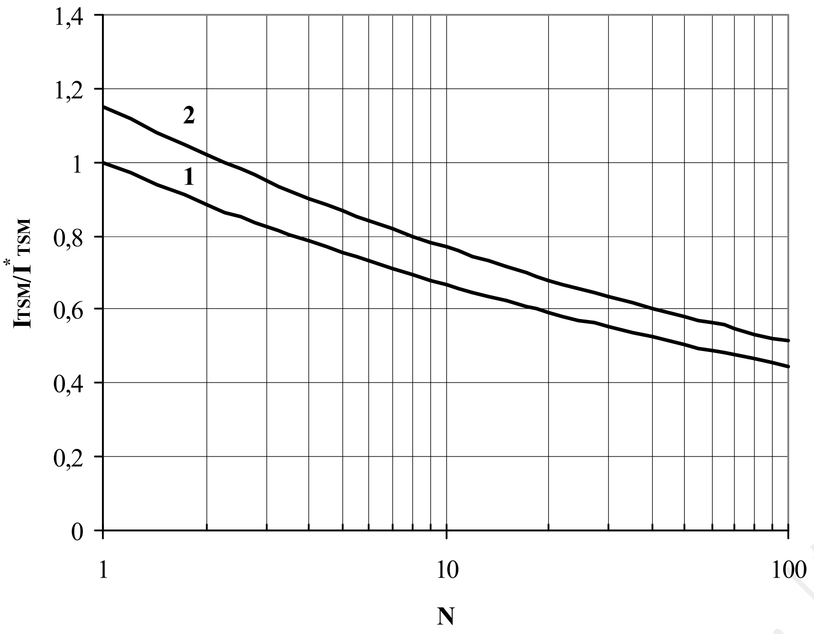



**Fig. 30** The surge current $I_{TSM}$ vs. Number of half-sine waves at 50 Hz

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

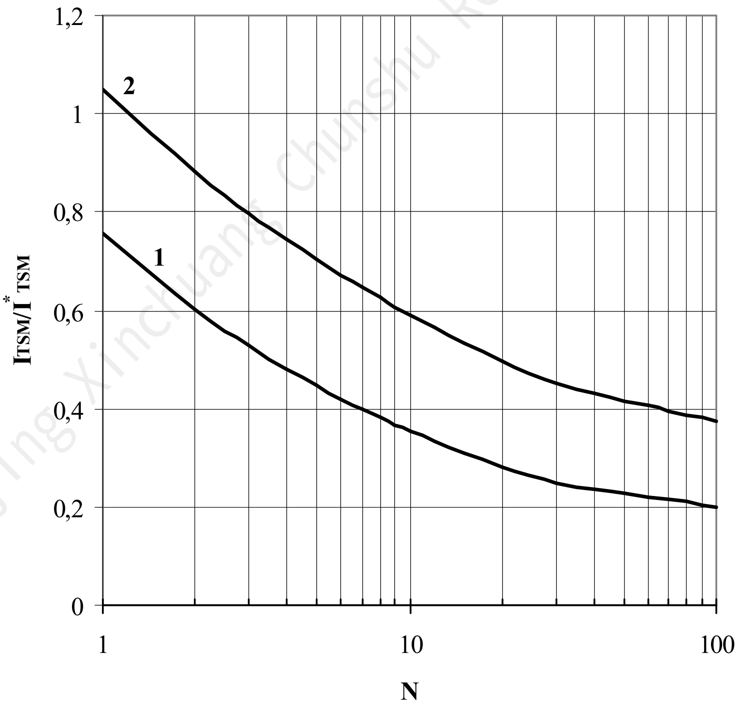



**Fig. 31** The surge current $I_{TSM}$ vs. Number of half-sine waves at 50 Hz

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