POLOVODIČE
akciová společnost

TR 918F-1590-14

Medium Frequency Thyristor

Properties

- Amplifying gate
- High operational capability
- Optimized turn-on and turn-off parameters
- High operating frequency

Applications

- Power switching applications

Key Parameters

V_{DRM}, V_{RRM}	=	1 400	V
I_{TAV}	=	1 526	A
I_{TSM}	=	21.0	kA
V_{TO}	=	1.628	V
r_T	=	0.121	mΩ
t_q	=	12.5	µs

Types

	V_{RRM}, V_{DRM}
TR 918F-1590-14	**1 400 V**
TR 918F-1590-12	**1 200 V**
TR 918F-1590-10	**1 000 V**
Conditions:	*T_j = -40 ÷ 125 °C, half sine waveform, f = 50 Hz, note 1*

Mechanical Data

F_m	**Mounting force**	22 ± 2	kN
m	**Weight**	0.48	kg
D_S	**Surface creepage distance**	25	mm
D_a	**Air strike distance**	13	mm

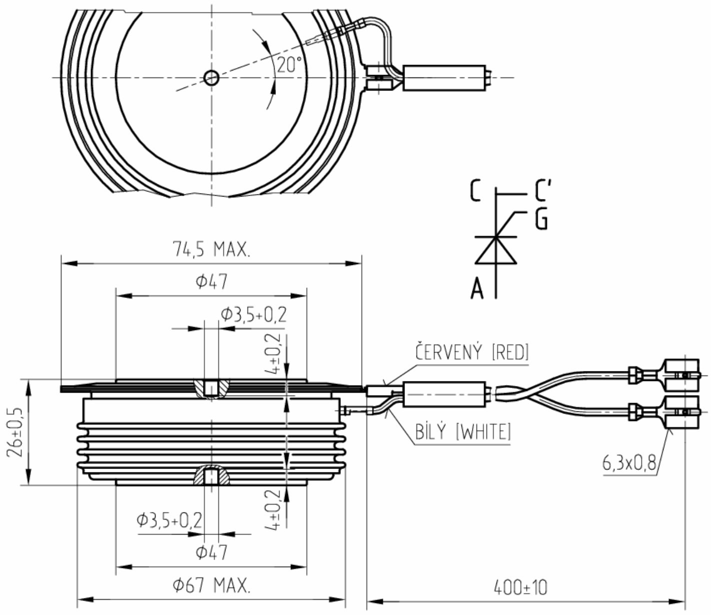

Fig. 1 Case

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Maximum Ratings			***Maximum Limits***	***Unit***
V_{RRM} V_{DRM}	**Repetitive peak reverse and off-state voltage** T_j = -40 ÷ 125 °C, note 1	**TR 918F-1590-14** **TR 918F-1590-12** **TR 918F-1590-10**	**1 400** **1 200** **1 000**	**V**
I_{TRMS}	**RMS on-state current** T_c = 70 °C, half sine waveform, f = 50 Hz		**2 397**	**A**
I_{TAVm}	**Average on-state current** T_c = 70 °C, half sine waveform, f = 50 Hz		**1 526**	**A**
I_{TSM}	**Peak non-repetitive surge** half sine pulse, V_R = 0 V	t_p = 10 ms t_p = 8.3 ms	**21 000** **22 400**	**A**
I^2t	**Limiting load integral** half sine pulse, V_R = 0 V	t_p = 10 ms t_p = 8.3 ms	**2 205 000** **2 088 000**	**A^2s**
$(di_T/dt)_{cr}$	**Critical rate of rise of on-state current** $I_T = I_{TAVm}$, half sine waveform, f = 50 Hz, $V_D = 2/3\ V_{DRM}$, t_r = 0.3 µs, I_{GT} = 2 A		**800**	**A/µs**
$(dv_D/dt)_{cr}$	**Critical rate of rise of off-state voltage** $V_D = 2/3\ V_{DRM}$		**1 000**	**V/µs**
P_{GAVm}	**Maximum average gate power losses**		**3**	**W**
I_{FGM}	**Peak gate current**		**10**	**A**
V_{FGM}	**Peak gate voltage**		**12**	**V**
V_{RGM}	**Reverse peak gate voltage**		**10**	**V**
T_{jmin} - T_{jmax}	**Operating temperature range**		**-40 ÷ 125**	**°C**
T_{stgmin} - T_{stgmax}	**Storage temperature range**		**-40 ÷ 125**	**°C**

Unless otherwise specified T_j = 125 °C

Note 1: De-rating factor of 0.13% V_{RRM} or V_{DRM} per °C is applicable for T_j below 25 °C

Characteristics			***Value***			***Unit***
			min.	***typ.***	***max.***	
V_{TM}	**Maximum peak on-state voltage** *I_{TM} = 2 000 A*				**1.870**	**V**
V_{T0} r_T	**Threshold voltage** **Slope resistance** *I_{T1} = 2 498 A, I_{T2} = 7 493 A*				**1.628** **0.121**	**V** **mΩ**
I_{DM}	**Peak off-state current** *$V_D = V_{DRM}$*				**100**	**mA**
I_{RM}	**Peak reverse current** *$V_R = V_{RRM}$*				**100**	**mA**
t_{gd}	**Delay time** *T_j = 25 °C, V_D = 0.4 V_{DRM}, $I_{TM} = I_{TAVm}$,* *t_r = 0.3 µs, I_{GT} = 2 A*				**2.0**	**µs**
t_{q1}	**Turn-off time** *I_T = 1 000 A, di_T/dt = -50 A/µs,* *V_R = 100 V, V_D = 2/3 V_{DRM},* *dv_D/dt = 50 V/µs*	**group of t_q** **D** **E** **F**			 **12.5** **16.0** **20.0**	**µs**
Q_{rr}	**Recovery charge** *the same conditions as at t_{q1}*				**300**	**µC**
I_{rrM}	**Reverse recovery current** *the same conditions as at t_{q1}*				**120**	**A**
I_H	**Holding current**	*T_j = 25 °C* *T_j = 125 °C*		**250** **150**		**mA**
I_L	**Latching current**	*T_j = 25 °C* *T_j = 125 °C*		**1 500** **1 000**		**mA**
V_{GT}	**Gate trigger voltage** *V_D = 12V, I_T = 4 A*	*T_j = - 40 °C* *T_j = 25 °C* *T_j = 125 °C*	 **0.25**		**4** **3** **2**	**V**
I_{GT}	**Gate trigger current** *V_D = 12V, I_T = 4 A*	*T_j = - 40 °C* *T_j = 25 °C* *T_j = 125 °C*	 **10**		**1000** **500** **300**	**mA**

Unless otherwise specified T_j = 125 °C

Thermal Parameters		***Value***	***Unit***
R_{thjc}	**Thermal resistance junction to case** *double side cooling*	**16.0**	**K/kW**
	anode side cooling	**25.0**	
	cathode side cooling	**45.0**	
R_{thch}	**Thermal resistance case to heatsink** *double side cooling*	**4.0**	**K/kW**
	single side cooling	**8.0**	

Transient Thermal Impedance

Analytical function for transient thermal impedance

$$Z_{thjc} = \sum_{i=1}^{4} R_i \left(1 - \exp(-t/\tau_i)\right)$$

Conditions:

F_m = 22 ± 2 kN, Double side cooled

Correction for periodic waveforms

180°	**sine:**	**add**	**1.3 K/kW**
180°	**rectangular:**	**add**	**1.8 K/kW**
120°	**rectangular:**	**add**	**3.0 K/kW**
60°	**rectangular:**	**add**	**5.1 K/kW**

i	**1**	**2**	**3**	**4**
τ_i **(s)**	**0.4653**	**0.1533**	**0.0375**	**0.0034**
R_i **(K/kW)**	**5.50**	**7.24**	**2.00**	**1.30**

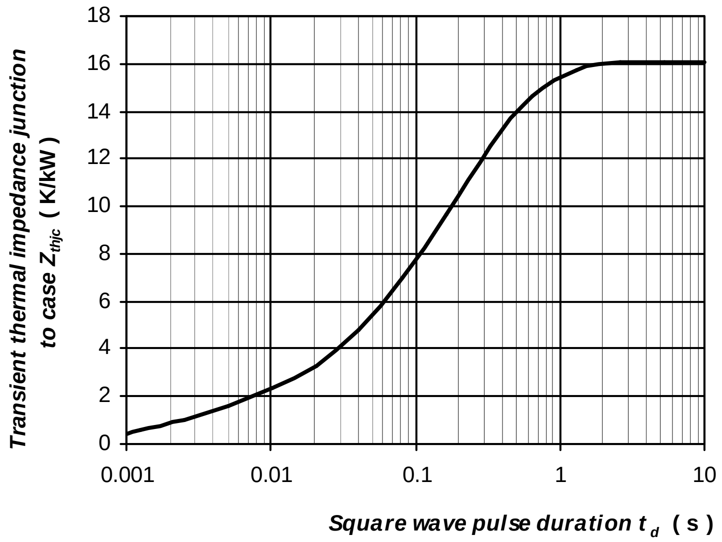

Fig. 2 Dependence transient thermal impedance junction to case on square pulse

On-State Characteristics

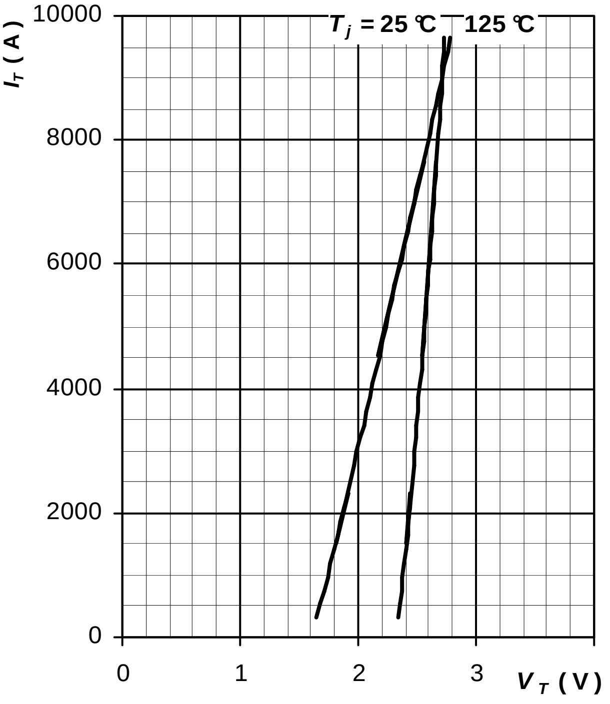

Fig. 3 Maximum on-state characteristics

Gate Trigger Characteristics

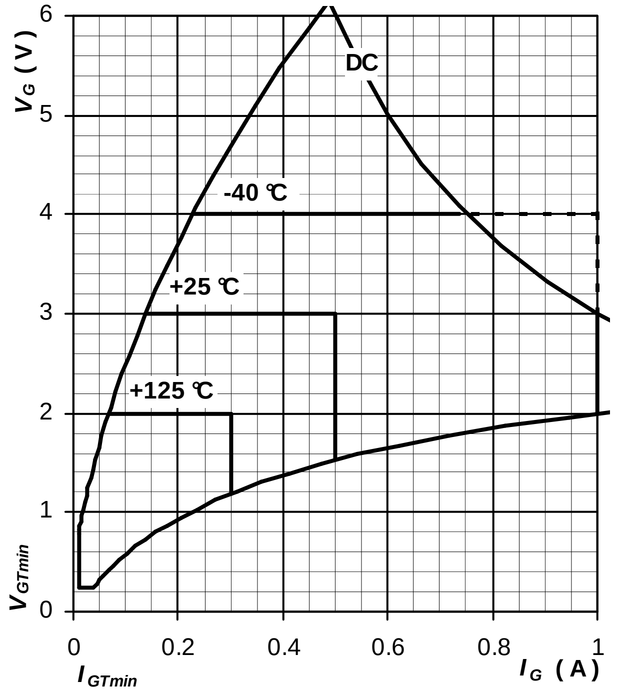

Fig. 4 Gate trigger characteristics

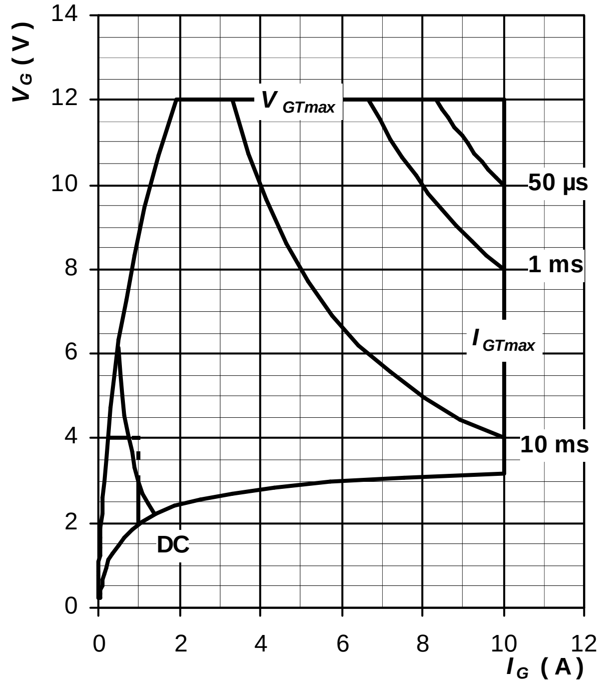

Fig. 5 Maximum peak gate power loss

Surge Characteristics

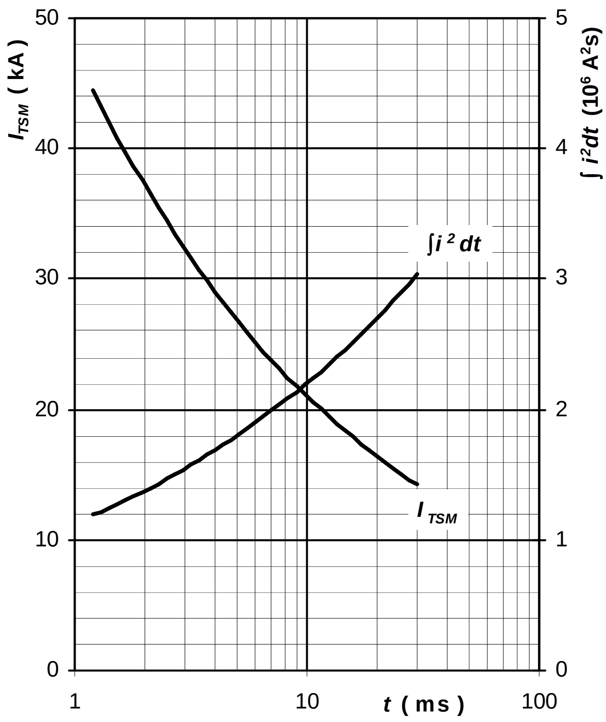

Fig. 6 Surge on-state current vs. pulse length, half sine wave, single pulse, $V_R = 0$ V, $T_j = T_{jmax}$

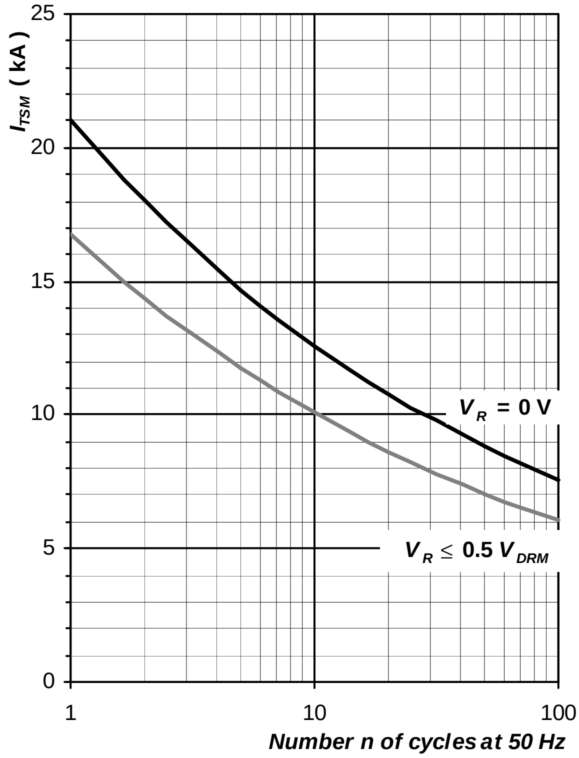

Fig. 7 Surge on-state current vs. number of pulses, half sine wave, $T_j = T_{jmax}$

Power Loss and Maximum Case Temperature Characteristics

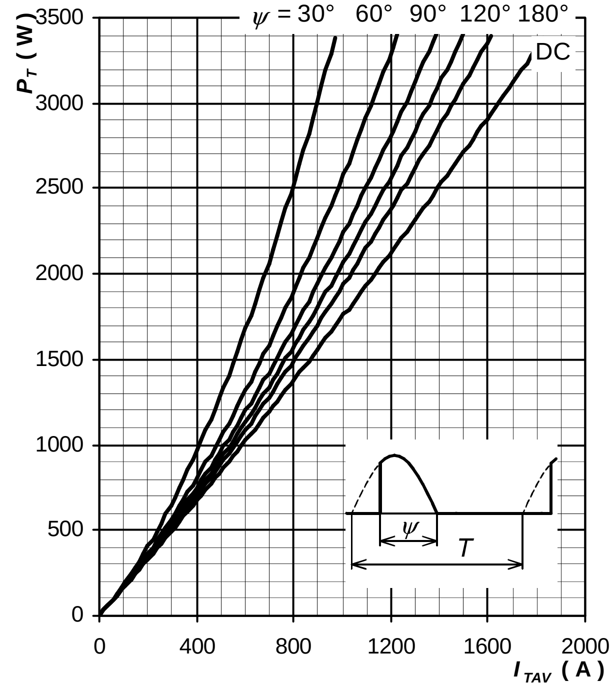

Fig. 8 On-state power loss vs. average on-state current, sine waveform, f = 50 Hz, T = 1/f

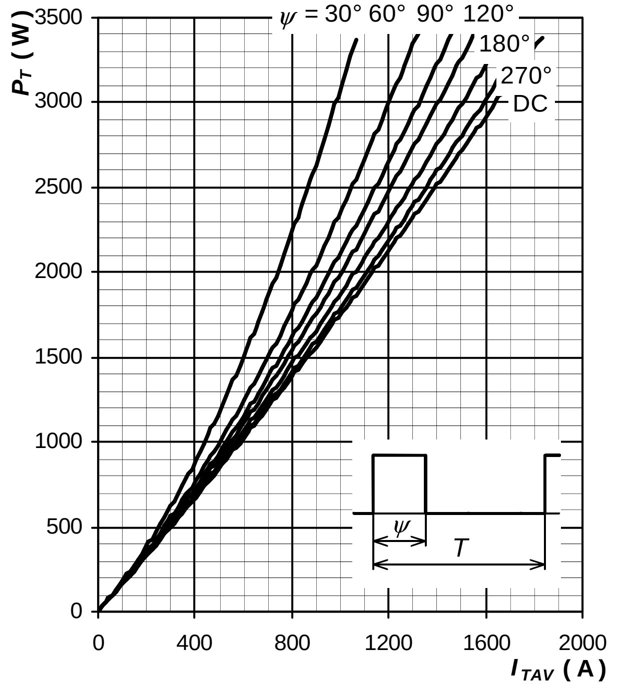

Fig. 9 On-state power loss vs. average on-state current, square waveform, f = 50 Hz, T = 1/f

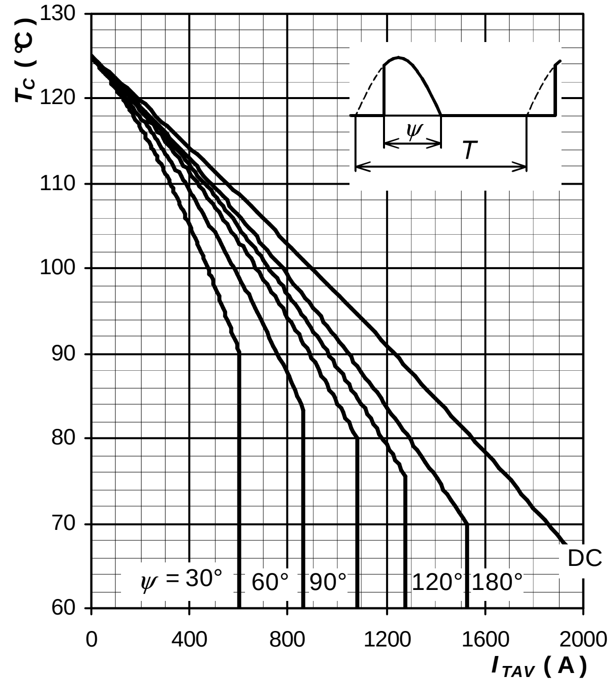

Fig. 10 Max. case temperature vs. aver. on-state current, sine waveform, f = 50 Hz, T = 1/f

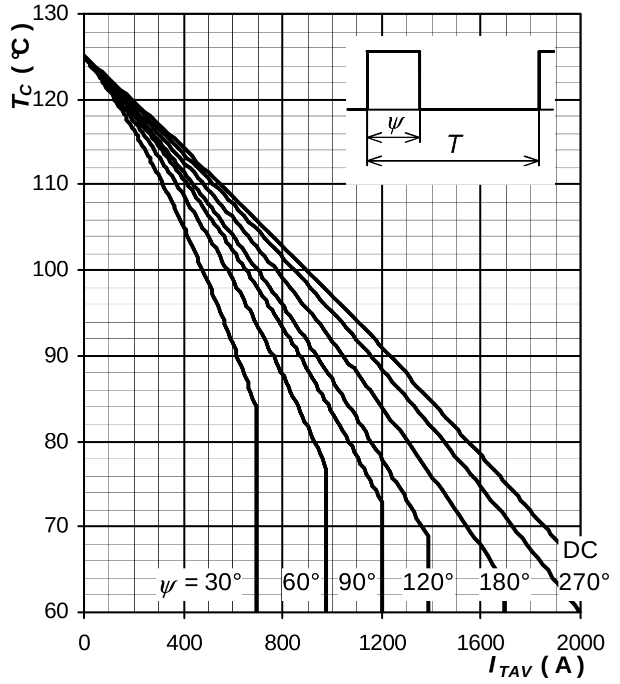

Fig. 11 Max. case temperature vs. aver. on-state current, square waveform, f = 50 Hz, T = 1/f

Note 2: Figures number 8 ÷ 11 have been calculated without considering any turn-on and turn-off losses. They are valid for f = 50 or 60 Hz operation.

Turn-off Time, Parameter Relationship

Maximum values of turn-off time at application specific conditions are given by using this formula:

$$t_q = t_{q1} \cdot \frac{t_q}{t_{q1}}(T_j) \cdot \frac{t_q}{t_{q1}}(dv_D/dt) \cdot \frac{t_q}{t_{q1}}(-di_T/dt)$$

where:

t_{q1} *is turn-off time at standard conditions, see section "Characteristics"*

$\frac{t_q}{t_{q1}}(T_j)$ *is factor to be taken from fig. 12*

$\frac{t_q}{t_{q1}}(dv_D/dt)$ *is factor to be taken from fig. 13*

$\frac{t_q}{t_{q1}}(-di_T/dt)$ *is factor to be taken from fig. 14*

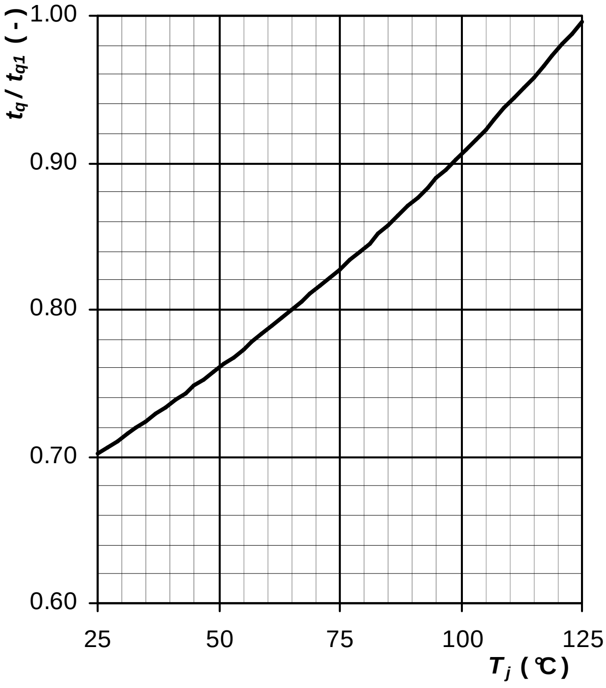

Fig. 12 Normalised maximum turn-off time vs. junction temperature

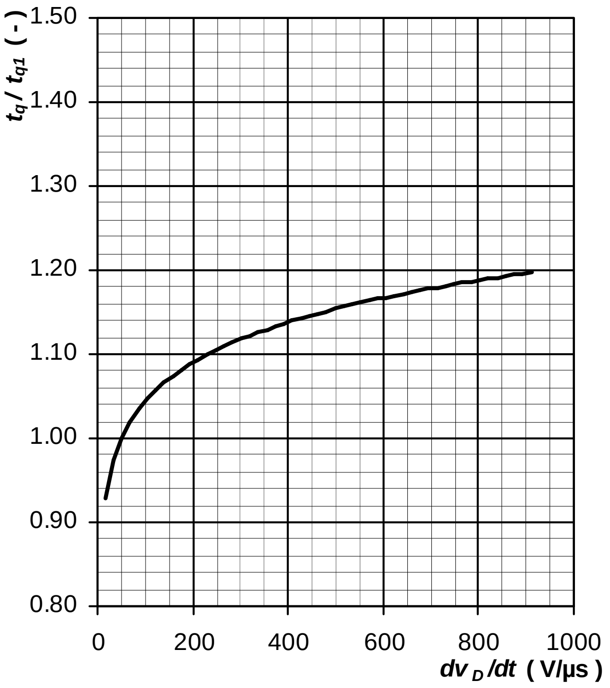

Fig. 13 Normalised maximum turn-off time vs. rate of rise of off-state voltage

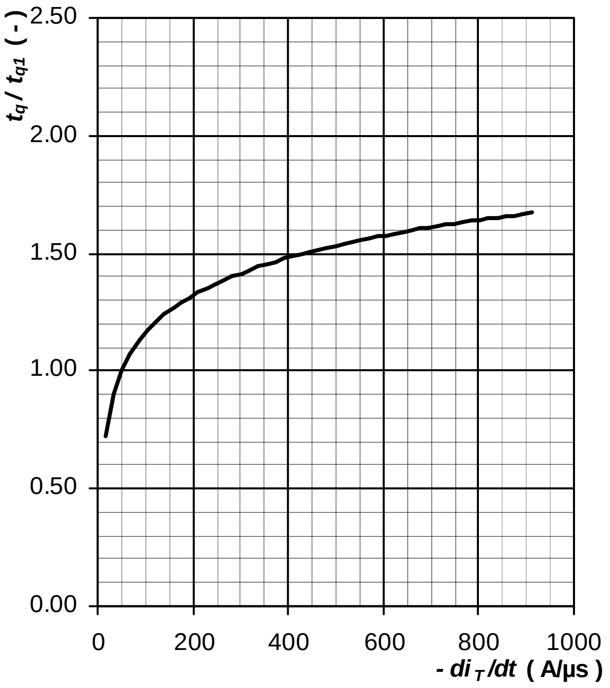

Fig. 14 Normalised maximum turn-off time vs. rate of fall of on-state current

Turn-on Characteristics

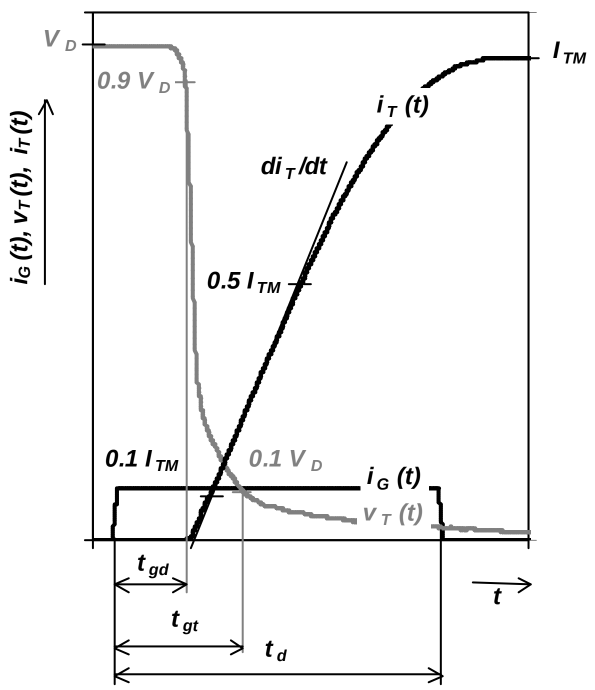

Fig. 15 Typical waveforms and definition of symbols at turn-on of a thyristor

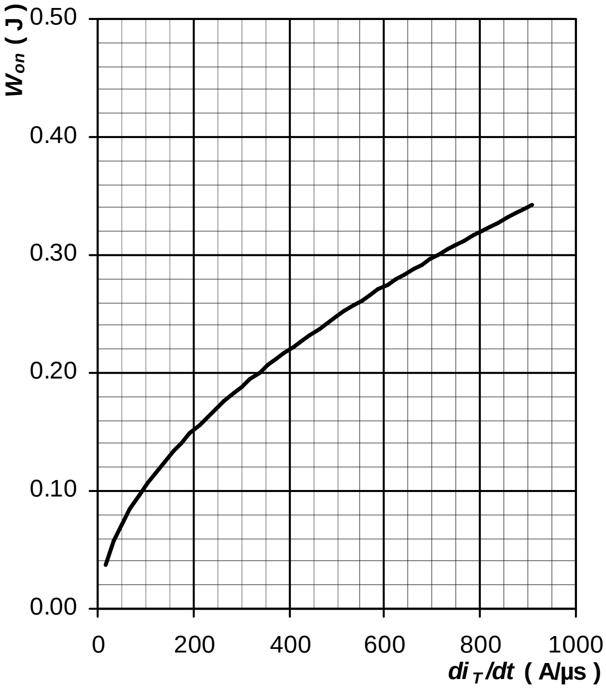

Fig. 16 Maximum turn-on energy per pulse vs. rate of rise on-state current, $T_j = T_{jmax}$

Turn-off Characteristics

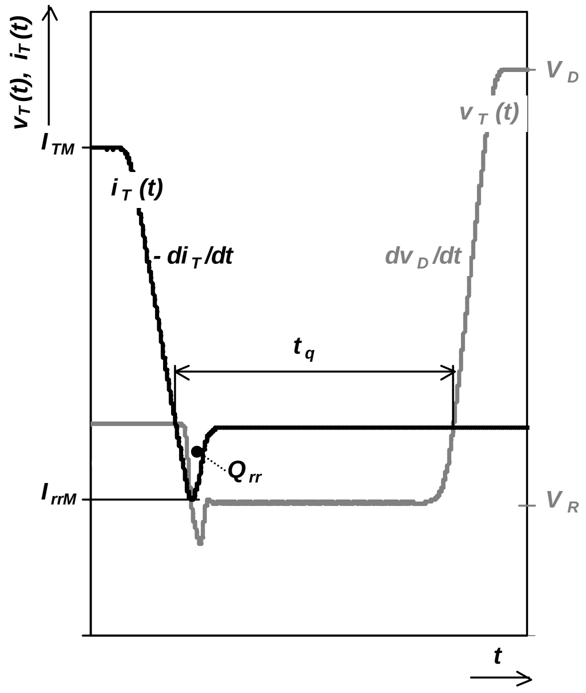

Fig. 17 Typical waveforms and definition of symbols at turn-off of a thyristor, inductive switching without RC snubber

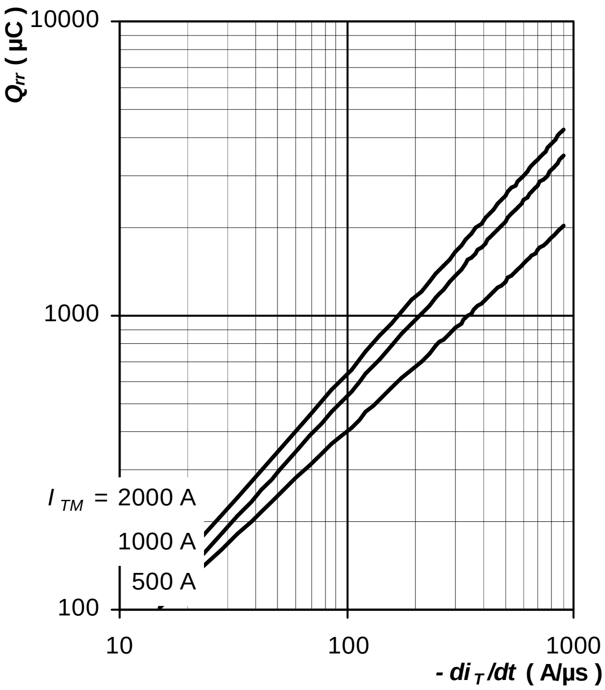

Fig. 18 Max. recovered charge vs. rate of fall on-state current, trapezoid pulse, V_R = 100 V, $T_j = T_{jmax}$

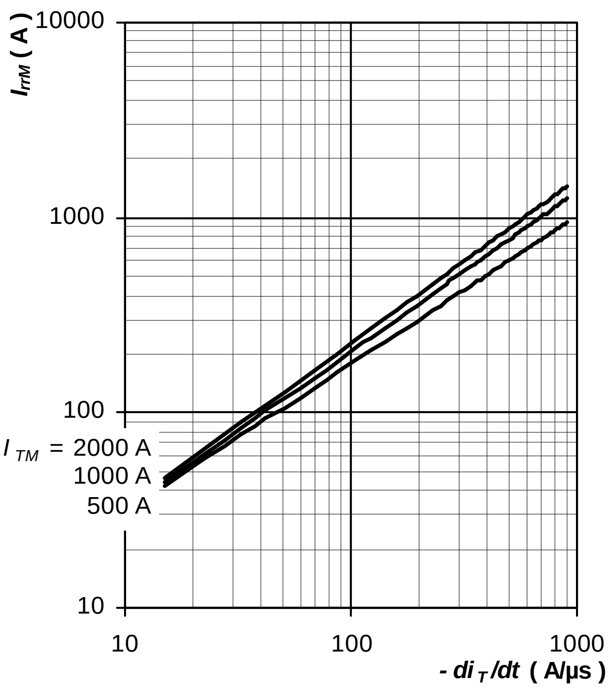

Fig. 19 Max. reverse recovery current vs. rate of fall on-state current, trapezoid pulse, V_R = 100 V, $T_j = T_{jmax}$

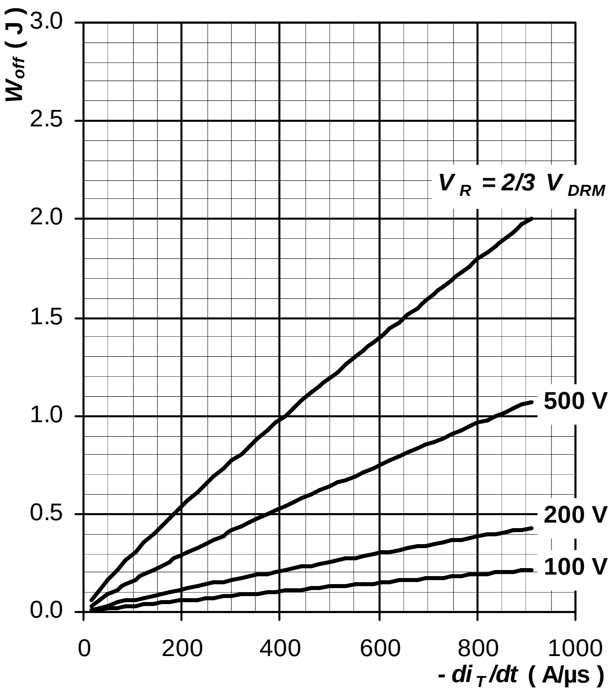

Fig. 20 Maximum turn-off energy per pulse vs. rate of fall on-state current, trapezoid pulse, inductive switching without RC snubber, I_{TM} = 2 000 A, $T_j = T_{jmax}$

Frequency Ratings

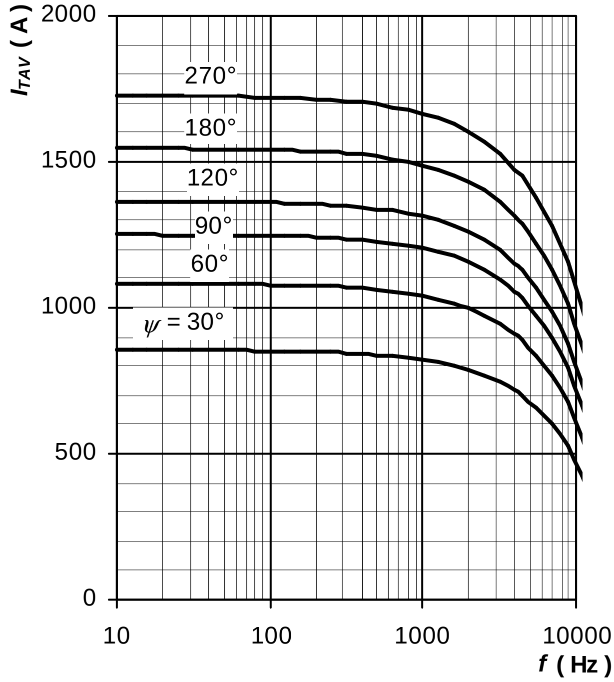

Fig. 21 Average on-state current vs. frequency, trapezoid waveform, T_C = 70 ℃, di_T/dt = ±100 A/µs, V_R = 100 V

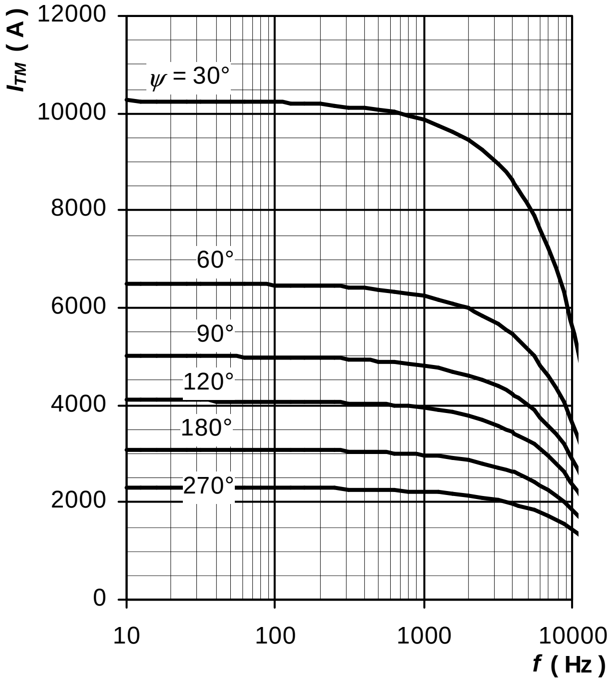

Fig. 22 Maximum on-state current vs. frequency, trapezoid waveform, T_C = 70 ℃, di_T/dt = ±100 A/µs, V_R = 100 V

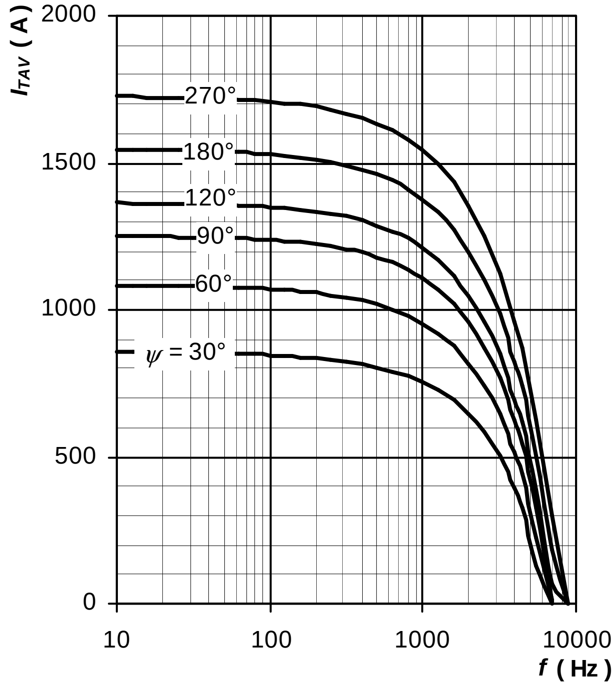

Fig. 23 Average on-state current vs. frequency, trapezoid waveform, T_C = 70 ℃, di_T/dt = ±100 A/µs, V_R = 2/3 V_{DRM}

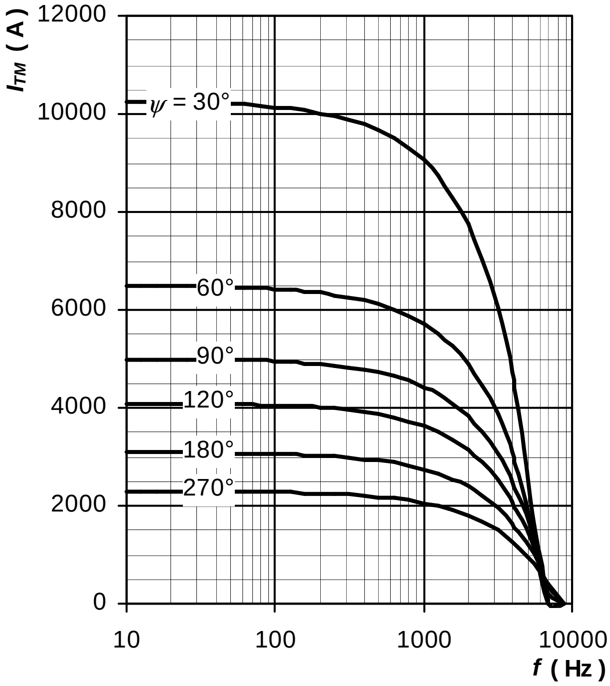

Fig. 24 Maximum on-state current vs. frequency, trapezoid waveform, T_C = 70 ℃, di_T/dt = ±100 A/µs, V_R = 2/3 V_{DRM}

Frequency Ratings

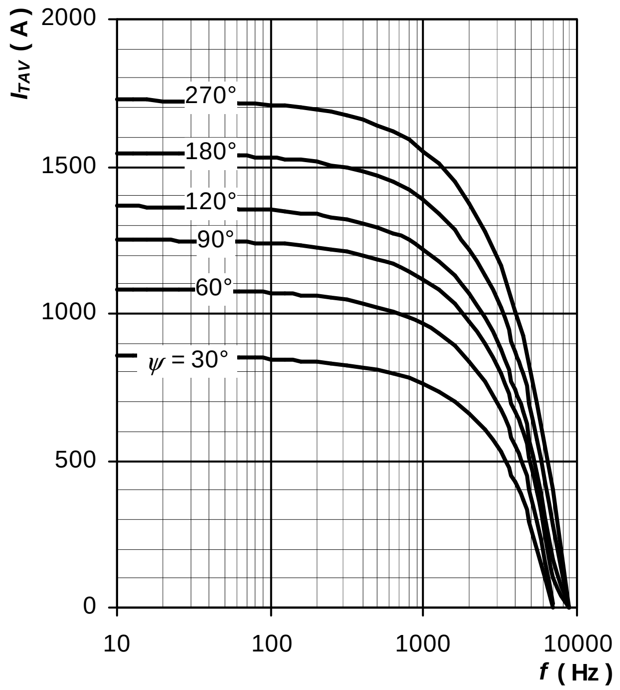

Fig. 25 Average on-state current vs. frequency, trapezoid waveform, T_C = 70 °C, $di_T/dt = \pm 500$ A/µs, V_R = 100 V

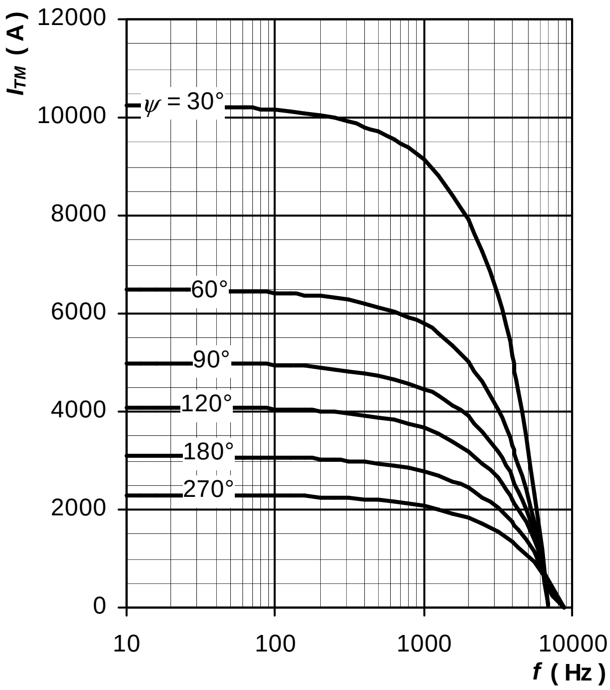

Fig. 26 Maximum on-state current vs. frequency, trapezoid waveform, T_C = 70 °C, $di_T/dt = \pm 500$ A/µs, V_R = 100 V

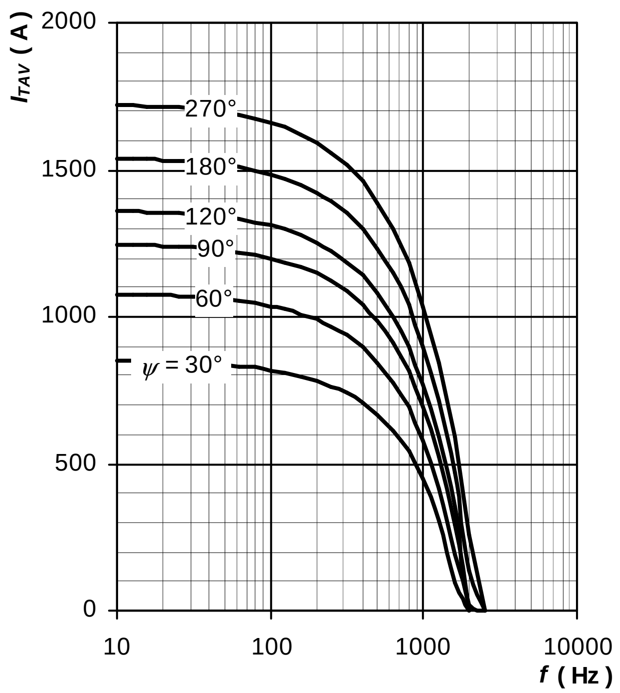

Fig. 27 Average on-state current vs. frequency, trapezoid waveform, T_C = 70 °C, $di_T/dt = \pm 500$ A/µs, V_R = 2/3 V_{DRM}

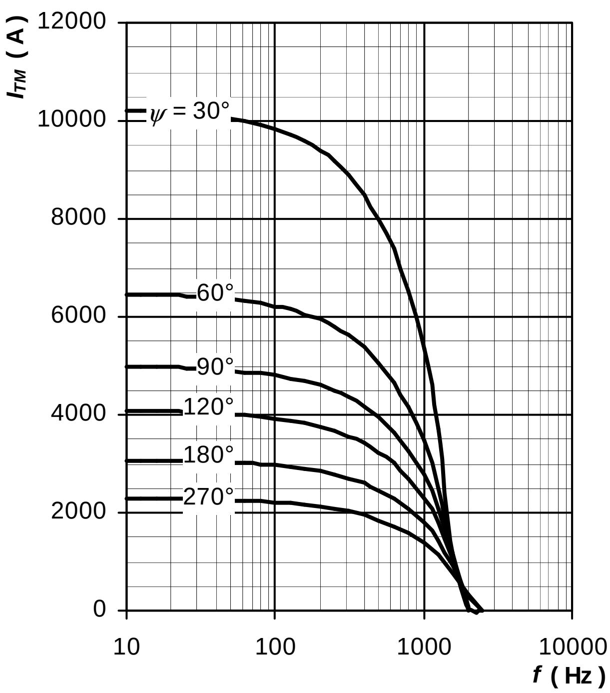

Fig. 28 Maximum on-state current vs. frequency, trapezoid waveform, T_C = 70 °C, $di_T/dt = \pm 500$ A/µs, V_R = 2/3 V_{DRM}

Frequency Ratings

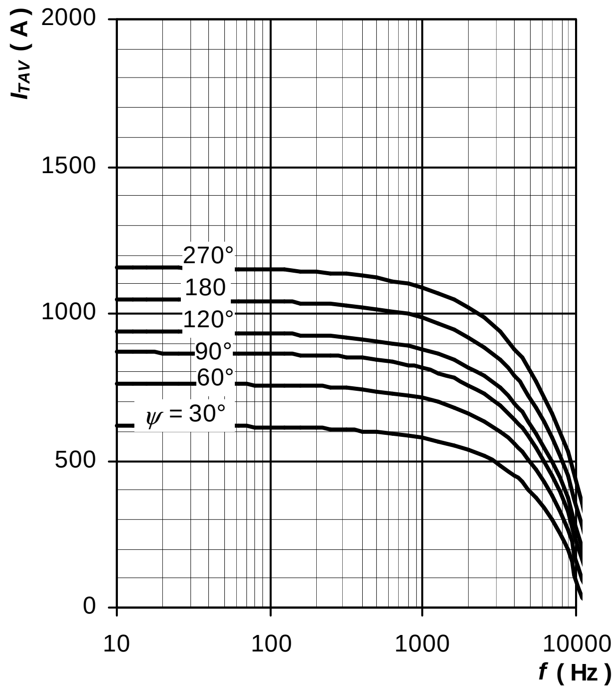

Fig. 29 Average on-state current vs. frequency, trapezoid waveform, T_C = 90 °C, $di_T/dt = \pm 100$ A/µs, V_R = 100 V

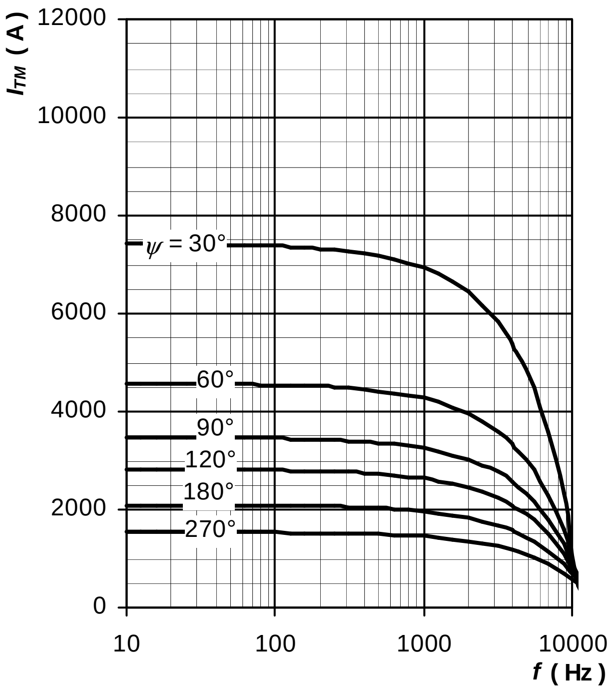

Fig. 30 Maximum on-state current vs. frequency, trapezoid waveform, T_C = 90 °C, $di_T/dt = \pm 100$ A/µs, V_R = 100 V

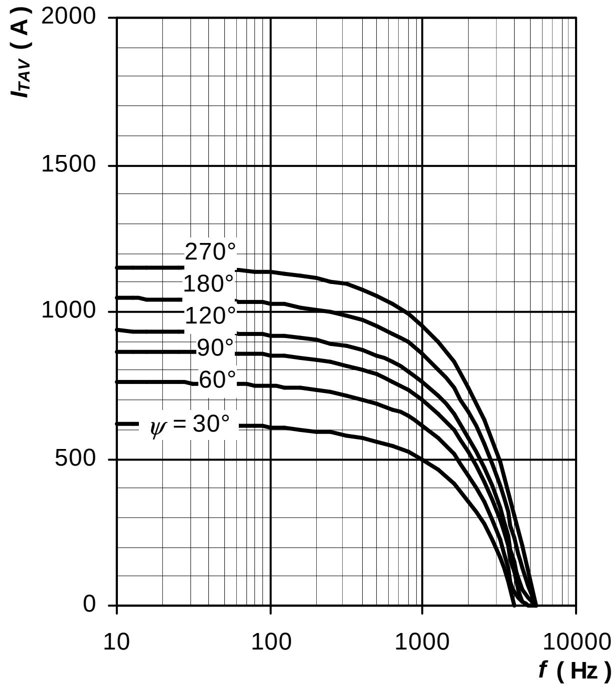

Fig. 31 Average on-state current vs. frequency, trapezoid waveform, T_C = 90 °C, $di_T/dt = \pm 100$ A/µs, V_R = 2/3 V_{DRM}

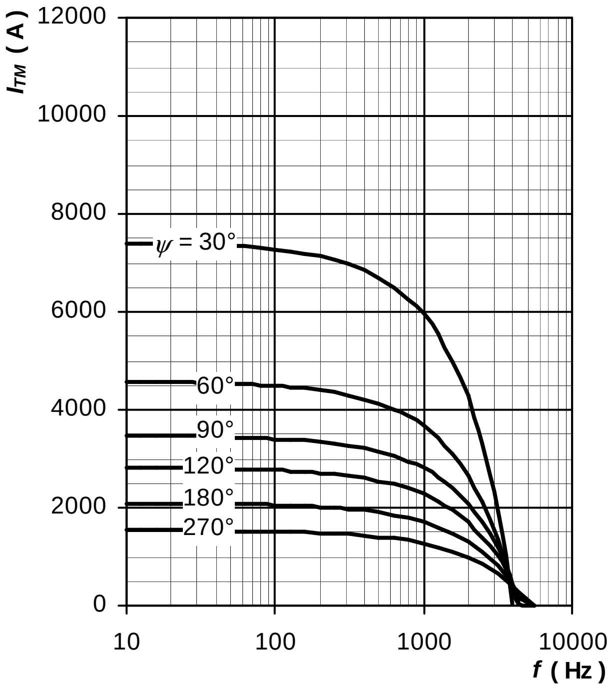

Fig. 32 Maximum on-state current vs. frequency, trapezoid waveform, T_C = 90 °C, $di_T/dt = \pm 100$ A/µs, V_R = 2/3 V_{DRM}

Frequency Ratings

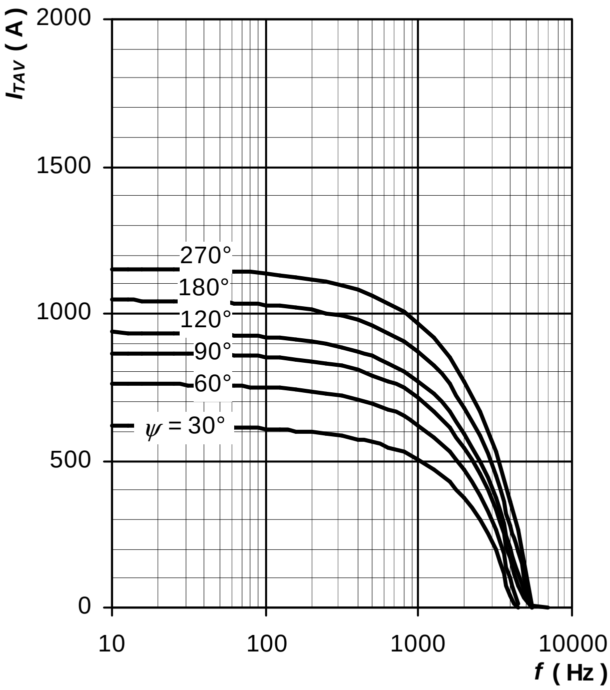

Fig. 33 Average on-state current vs. frequency, trapezoid waveform, T_C = 90 °C, di_T/dt = ±500 A/μs, V_R = 100 V

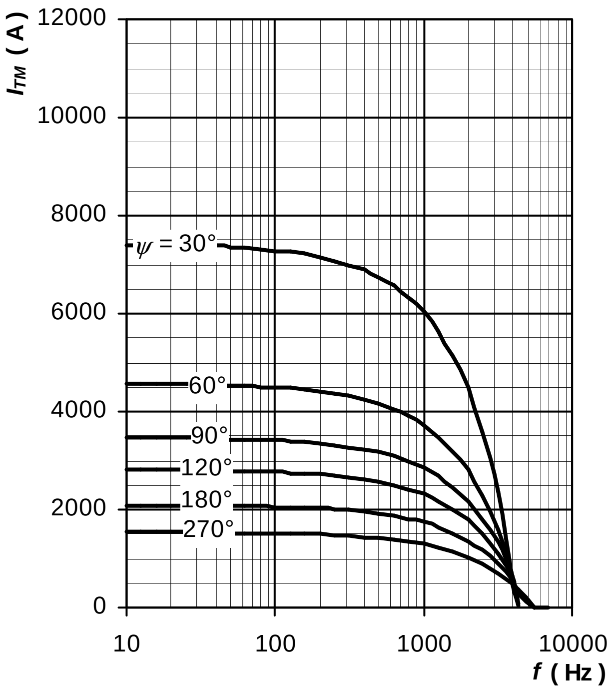

Fig. 34 Maximum on-state current vs. frequency, trapezoid waveform, T_C = 90 °C, di_T/dt = ±500 A/μs, V_R = 100 V

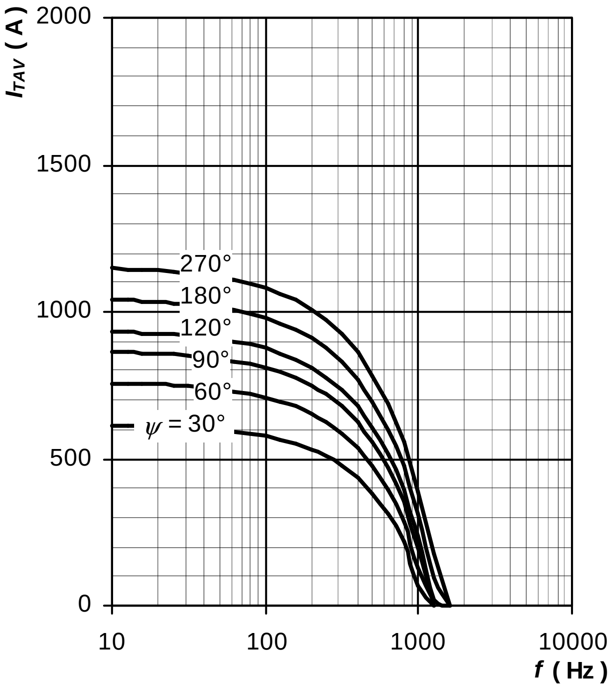

Fig. 35 Average on-state current vs. frequency, trapezoid waveform, T_C = 90 °C, di_T/dt = ±500 A/μs, V_R = 2/3 V_{DRM}

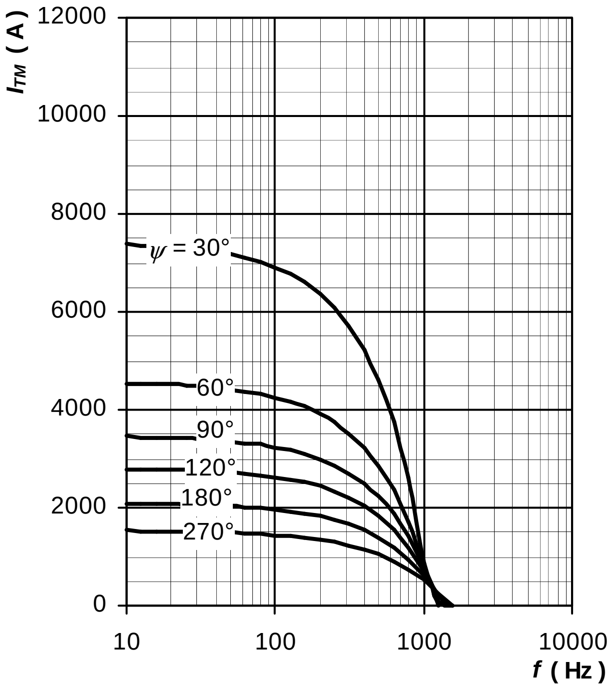

Fig. 36 Maximum on-state current vs. frequency, trapezoid waveform, T_C = 90 °C, di_T/dt = ±500 A/μs, V_R = 2/3 V_{DRM}

Notes: