



# 5STR 10T2520

Old part no. TP 919FC-1000-25

## Reverse Conducting Thyristor

### Properties

- Amplifying gate
- Integrated freewheeling diode
- Optimized for low dynamic losses

### Applications

- Traction

### Key Parameters

$V_{DRM}$	= 2 500	V
$I_{TAVm}$	= 857	A
$I_{TSM}$	= 14 000	A
$V_{TO}$	= 2.039	V
$r_T$	= 0.321	mΩ
$t_q$	= 20	μs

### Types

	$V_{DRM}$
<b>5STR 10T2520</b>	<b>2 500 V</b>
Conditions: $T_j = -40 \div 125 \text{ }^\circ\text{C}$ , half sine waveform, $f = 50 \text{ Hz}$ , note 1	

### Mechanical Data

$F_m$	Mounting force	30 ± 3 kN
$m$	Weight	0.700 kg
$D_s$	Surface creepage distance	30.4 mm
$D_a$	Air strike distance	13.2 mm

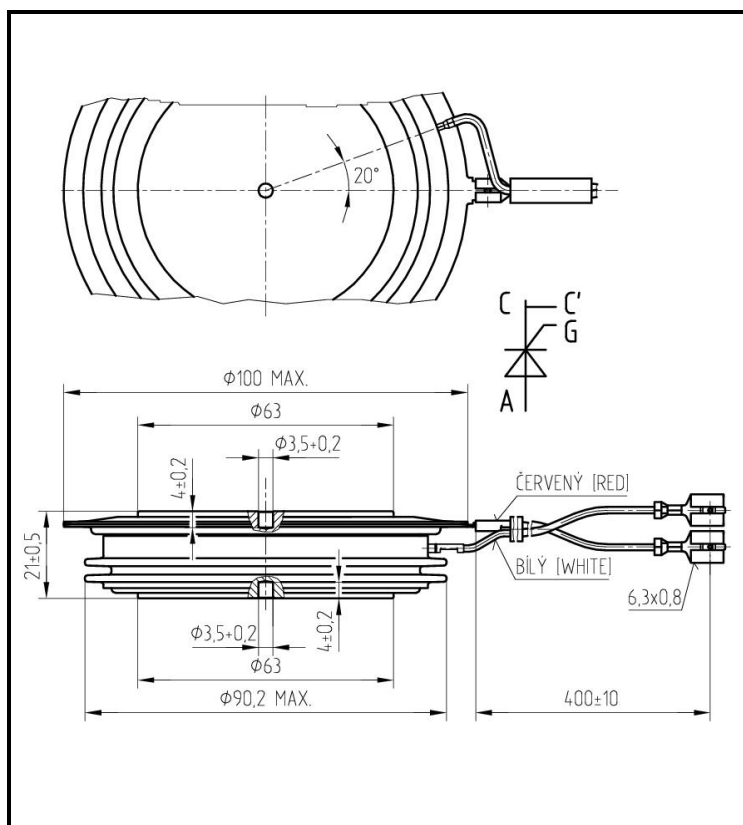


Fig. 1 Case



ABB s.r.o.

Novodvorska 1768/138a, 142 21 Praha 4, Czech Republic

tel.: +420 261 306 250, <http://www.abb.com/semiconductors>

<b>Maximum Ratings - Thyristor</b>		<b>Maximum Limits</b>	<b>Unit</b>
$V_{DRM}$	<b>Repetitive peak off-state voltage</b> $T_j = -40 \div 125 \text{ }^\circ\text{C}$ , note 1	<b>2 500</b>	<b>V</b>
$I_{TRMS}$	<b>RMS on-state current</b> $T_c = 70 \text{ }^\circ\text{C}$ , half sine waveform, $f = 50 \text{ Hz}$	<b>1 347</b>	<b>A</b>
$I_{TAVm}$	<b>Average on-state current</b> $T_c = 70 \text{ }^\circ\text{C}$ , half sine waveform, $f = 50 \text{ Hz}$	<b>857</b>	<b>A</b>
$I_{TSM}$	<b>Peak non-repetitive surge</b> half sine pulse, $V_R = 0 \text{ V}$	$t_p = 10 \text{ ms}$	<b>14 000</b>
		$t_p = 8.3 \text{ ms}$	<b>15 000</b>
$I^2t$	<b>Limiting load integral</b> half sine pulse, $V_R = 0 \text{ V}$	$t_p = 10 \text{ ms}$	<b>980 000</b>
		$t_p = 8.3 \text{ ms}$	<b>928 000</b>
$(di_T/dt)_{cr}$	<b>Critical rate of rise of on-state current</b> $I_T = 2000 \text{ A}$ , $V_D = 0.67 V_{DRM}$ , half sine wave, $f = 50 \text{ Hz}$	<b>400</b>	<b>A/<math>\mu\text{s}</math></b>
$(dv_D/dt)_{cr}$	<b>Critical rate of rise of off-state voltage</b> $V_D = 0.67 V_{DRM}$	<b>1 000</b>	<b>V/<math>\mu\text{s}</math></b>
$P_{AV}$	<b>Maximum average gate power losses</b>	<b>5</b>	<b>W</b>
$I_{GTM}$	<b>Peak gate current</b>	<b>25</b>	<b>A</b>
$V_{GTM}$	<b>Peak gate voltage</b>	<b>15</b>	<b>V</b>
$V_{RGTM}$	<b>Reverse peak gate voltage</b>	<b>2</b>	<b>V</b>
$T_{jmin} - T_{jmax}$	<b>Operating temperature range</b>	<b>-40 <math>\div</math> 125</b>	<b><math>^\circ\text{C}</math></b>
$T_{stgmin} - T_{stgmax}$	<b>Storage temperature range</b>	<b>-40 <math>\div</math> 125</b>	<b><math>^\circ\text{C}</math></b>

Unless otherwise specified  $T_j = 125 \text{ }^\circ\text{C}$

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

<b>Maximum Ratings - Diode</b>		<b>Maximum Limits</b>	<b>Unit</b>	
$V_{RRM}$	<b>Repetitive peak reverse voltage</b> <i><math>T_j = -40 \div 125 \text{ }^\circ\text{C}</math>, note 1</i>	<b>2 500</b>	<b>V</b>	
$I_{FRMS}$	<b>RMS forward current</b> <i><math>T_c = 70 \text{ }^\circ\text{C}</math>, half sine waveform, <math>f = 50 \text{ Hz}</math></i>	<b>610</b>	<b>A</b>	
$I_{FAVm}$	<b>Average forward current</b> <i><math>T_c = 70 \text{ }^\circ\text{C}</math>, half sine waveform, <math>f = 50 \text{ Hz}</math></i>	<b>388</b>	<b>A</b>	
$I_{FSM}$	<b>Peak non-repetitive surge</b> <i>half sine pulse, <math>V_R = 0 \text{ V}</math></i>	<i><math>t_p = 10 \text{ ms}</math></i>	<b>6 000</b>	<b>A</b>
		<i><math>t_p = 8.3 \text{ ms}</math></i>	<b>6 400</b>	
$I^2t$	<b>Limiting load integral</b> <i>half sine pulse, <math>V_R = 0 \text{ V}</math></i>	<i><math>t_p = 10 \text{ ms}</math></i>	<b>180 000</b>	<b>A<sup>2</sup>s</b>
		<i><math>t_p = 8.3 \text{ ms}</math></i>	<b>170 000</b>	

Unless otherwise specified  $T_j = 125 \text{ }^\circ\text{C}$

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

<b>Characteristics – Thyristor</b>		<b>Value</b>			<b>Unit</b>
		<i>min.</i>	<i>typ.</i>	<i>max.</i>	
$V_{TM}$	<b>Maximum peak on-state voltage</b> $I_{TM} = 2\ 000\ A$			<b>2.700</b>	<b>V</b>
$V_{T0}$	<b>Threshold voltage</b>			<b>2.039</b>	<b>V</b>
$r_T$	<b>Slope resistance</b> $I_{T1} = 1\ 570\ A, I_{T2} = 4\ 712\ A$			<b>0.321</b>	<b>mΩ</b>
$I_{DM}$	<b>Peak off-state current</b> $V_D = V_{DRM}$			<b>80</b>	<b>mA</b>
$t_{gd}$	<b>Delay time</b> $T_j = 25\ ^\circ C, V_D = 0.4\ V_{DRM}, I_{TM} = I_{TAVm},$ $t_r = 0.3\ \mu s, I_{GT} = 2\ A$			<b>2</b>	<b>μs</b>
$t_q$	<b>Turn-off time</b> $I_T = I_{TAVm}, di_T/dt = -50\ A/\mu s,$ $V_D = 0.67\ V_{DRM}, dv_D/dt = 50\ V/\mu s$			<b>20</b>	<b>μs</b>
$t_q$	<b>Turn-off time</b> $I_T = 2\ 000\ A, di_T/dt = -50\ A/\mu s,$ $V_D = 1\ 250\ V, dv_D/dt = 700\ V/\mu s$			<b>35</b>	<b>μs</b>
$I_H$	<b>Holding current</b>	$T_j = 25\ ^\circ C$ $T_j = 125\ ^\circ C$		<b>500</b>	<b>mA</b>
$I_L$	<b>Latching current</b>	$T_j = 25\ ^\circ C$ $T_j = 125\ ^\circ C$		<b>2000</b>	<b>mA</b>
$V_{GT}$	<b>Gate trigger voltage</b> $V_{AC} = 12\ V, I_T = 4\ A$	$T_j = -40\ ^\circ C$ $T_j = +25\ ^\circ C$ $T_j = +125\ ^\circ C$	<b>0.25</b>	<b>4</b> <b>3</b> <b>2</b>	<b>V</b>
$I_{GT}$	<b>Gate trigger current</b> $V_{AC} = 12\ V, I_T = 4\ A$	$T_j = -40\ ^\circ C$ $T_j = +25\ ^\circ C$ $T_j = +125\ ^\circ C$	<b>10</b>	<b>1000</b> <b>500</b> <b>300</b>	<b>mA</b>

Unless otherwise specified  $T_j = 125\ ^\circ C$

<b>Characteristics – Diode</b>		<b>Value</b>			<b>Unit</b>
		<i>min.</i>	<i>typ.</i>	<i>max.</i>	
$V_{FM}$	<b>Maximum forward voltage</b> <i>I<sub>FM</sub> = 1000 A</i>			<b>2.600</b>	<b>V</b>
$V_{T0}$	<b>Threshold voltage</b> <i>I<sub>F1</sub> = 628 A, I<sub>F2</sub> = 1 885 A</i>			<b>1.487</b>	<b>V</b>
$r_T$	<b>Forward slope resistance</b>			<b>1.066</b>	<b>mΩ</b>
$Q_{rr}$	<b>Reverse recovery charge</b> <i>I<sub>FM</sub> = 1 000 A, di/dt = -50 A/μs, V<sub>D</sub> = 100 V</i>			<b>250</b>	<b>μC</b>
$I_{rrM}$	<b>Maximum reverse recovery current</b> <i>the same conditions as at Q<sub>rr</sub></i>			<b>125</b>	<b>A</b>
$t_{rr}$	<b>Reverse recovery time</b> <i>the same conditions as at Q<sub>rr</sub></i>			<b>4</b>	<b>μs</b>

Unless otherwise specified  $T_j = 125\text{ °C}$

<b>Thermal Parameters - Thyristor</b>		<b>Value</b>	<b>Unit</b>
$R_{thjc}$	<b>Thermal resistance junction to case</b> <i>double side cooling</i>	<b>20</b>	<b>K/kW</b>
	<i>anode side cooling</i>	<b>30</b>	
	<i>cathode side cooling</i>	<b>60</b>	
$R_{thch}$	<b>Thermal resistance case to heatsink</b> <i>double side cooling</i>	<b>3</b>	<b>K/kW</b>
	<i>single side cooling</i>	<b>6</b>	

<b>Thermal Parameters - Diode</b>		<b>Value</b>	<b>Unit</b>
$R_{thjc}$	<b>Thermal resistance junction to case</b> <i>double side cooling</i>	<b>50</b>	<b>K/kW</b>
	<i>anode side cooling</i>	<b>75</b>	
	<i>cathode side cooling</i>	<b>150</b>	

**Transient Thermal Impedance - Thyristor**

**Correction for periodic waveforms - Thyristor**

- 180° sine: add 3.6 K/kW
- 180° rectangular: add 2.8 K/kW
- 120° rectangular: add 4.7 K/kW
- 60° rectangular: add 8.2 K/kW

**Analytical function for transient thermal impedance**

$$Z_{thjc} = \sum_{i=1}^5 R_i (1 - \exp(-t / \tau_i))$$

Conditions:  
 $F_m = 30 \pm 3$  kN, Double side cooled

$i$	1	2	3	4	5
$\tau_i$ (s)	0.3289	0.1376	0.0343	0.0037	0.0003
$R_i$ (K/kW)	6.17	8.56	3.08	1.80	0.39

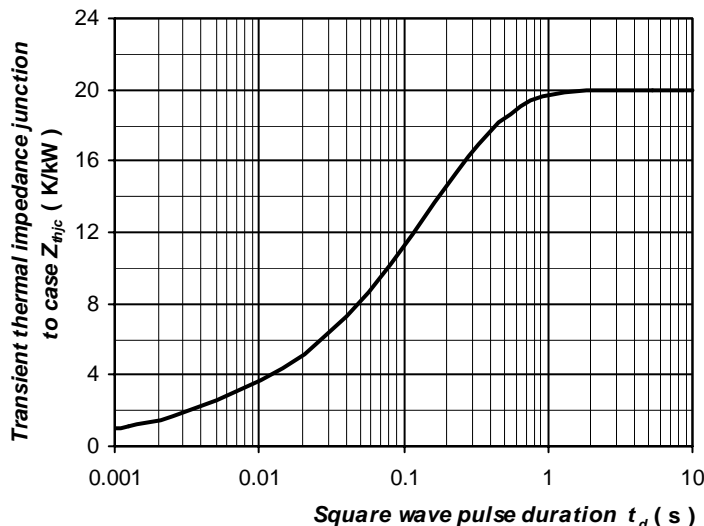


Fig. 2 Dependence transient thermal impedance junction to case on square pulse - Thyristor

**Diode**

**Correction for periodic waveforms - Diode**

- 180° sine: add 6.5 K/kW
- 180° rectangular: add 5.2 K/kW
- 120° rectangular: add 8.6 K/kW
- 60° rectangular: add 14.4 K/kW

$i$	1	2	3	4	5
$\tau_i$ (s)	0.3819	0.1733	0.0171	0.0046	0.0003
$R_i$ (K/kW)	31.39	11.99	2.05	3.85	0.73

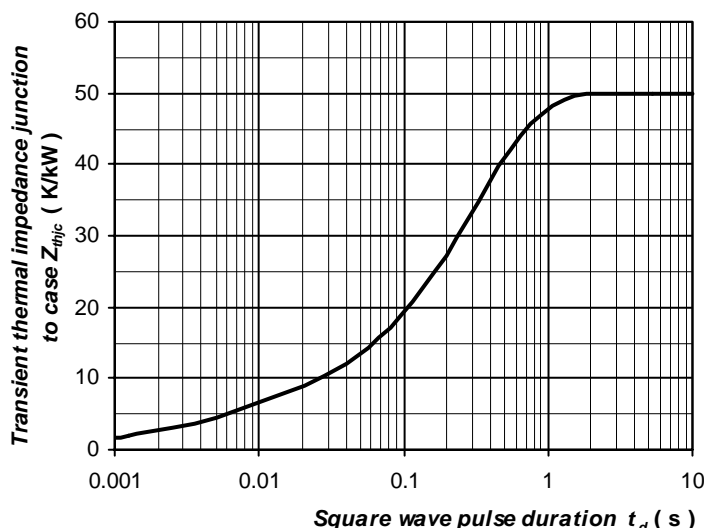


Fig. 3 Dependence transient thermal impedance junction to case on square pulse - Diode

**On-State Characteristics - Thyristor**

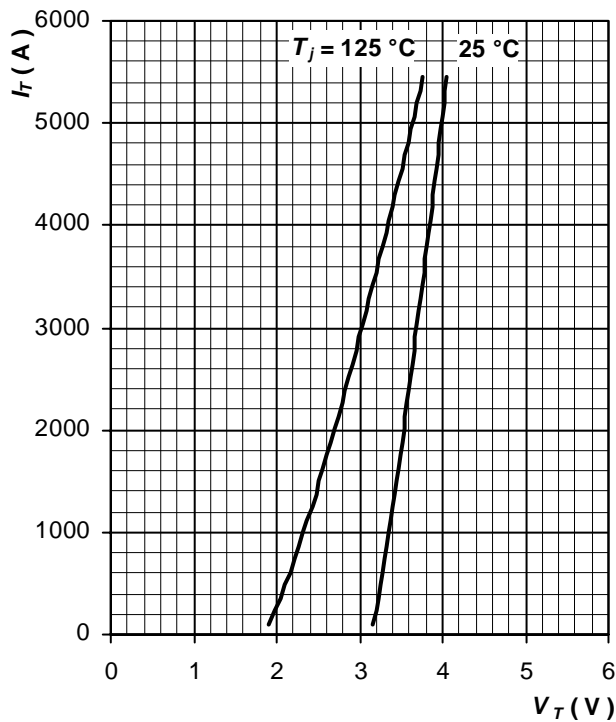


Fig. 4 Maximum on-state characteristics

**Gate Trigger Characteristics**

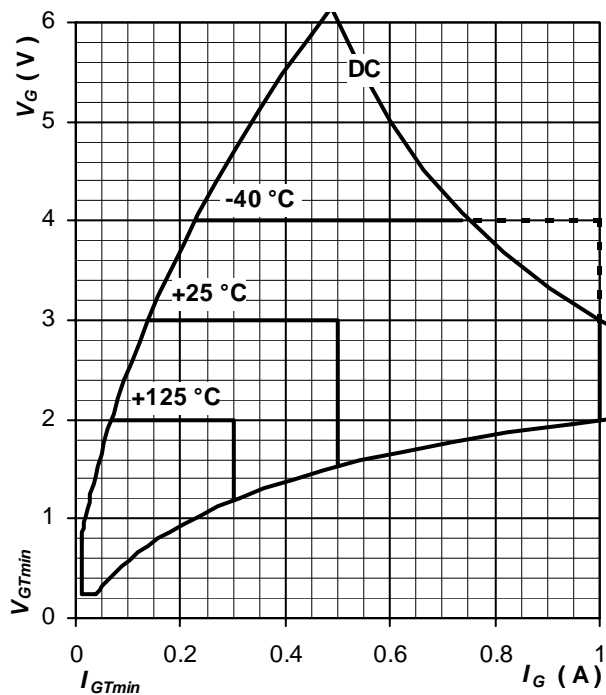


Fig. 5 Gate trigger characteristics

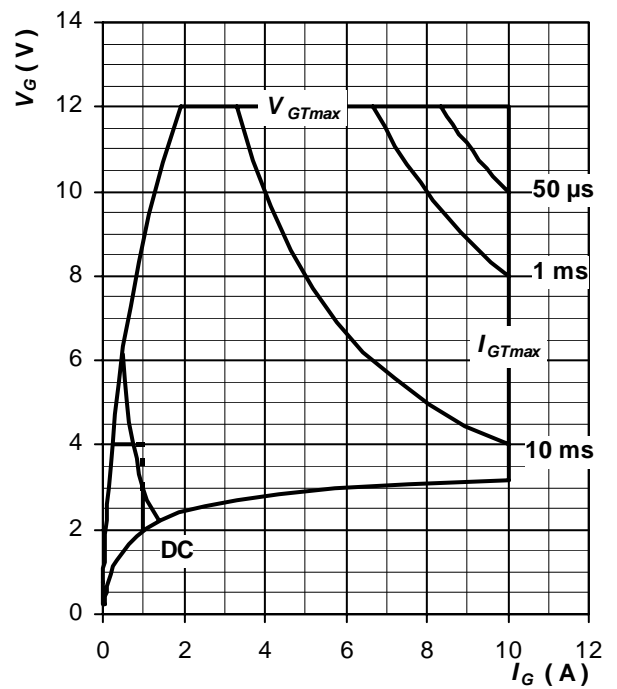


Fig. 6 Maximum peak gate power loss

### Surge Characteristics - Thyristor

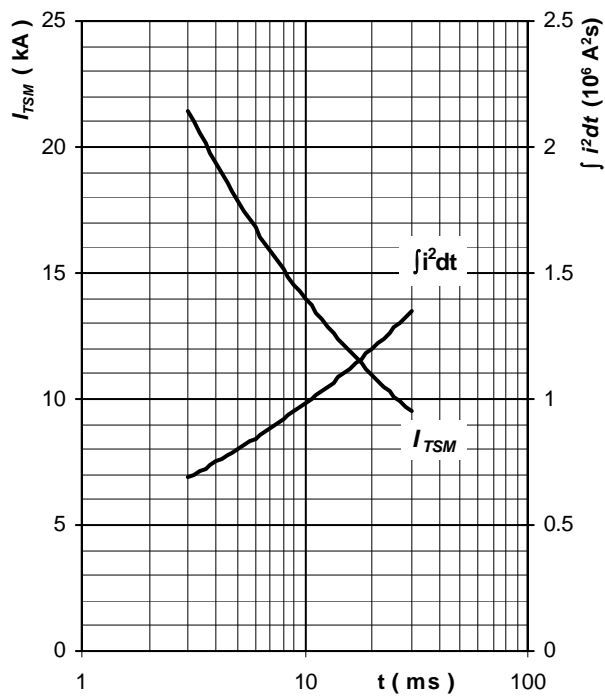


Fig. 7 Surge on-state current vs. pulse length, half sine wave, single pulse,  $V_R = 0\text{ V}$ ,  $T_j = T_{jmax}$

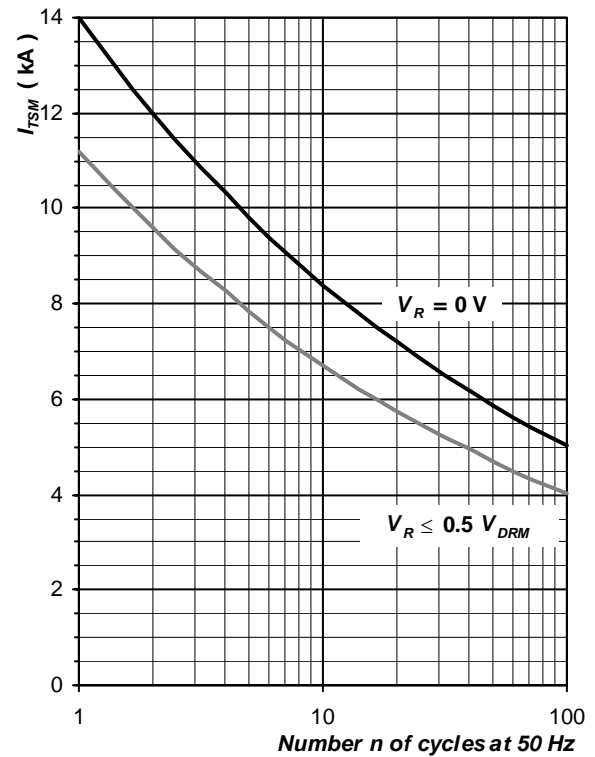


Fig. 8 Surge on-state current vs. number of pulses, half sine wave,  $T_j = T_{jmax}$



**Power Loss and Maximum Case Temperature Characteristics - Thyristor**

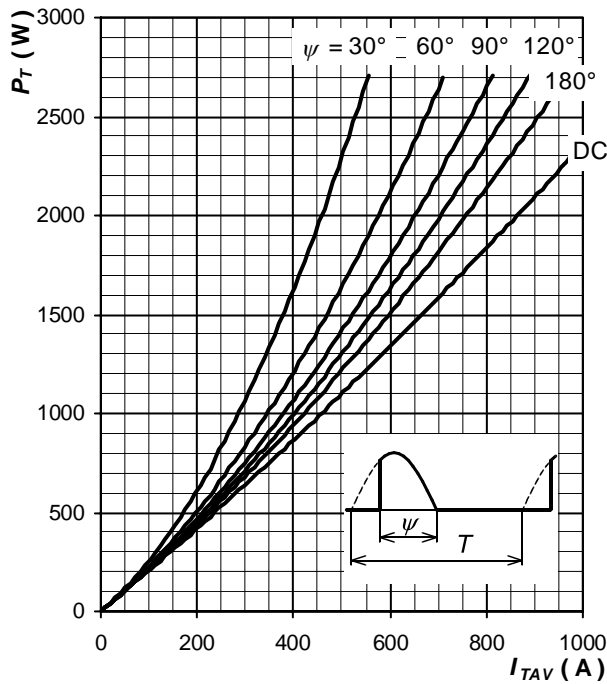


Fig. 9 On-state power loss vs. average on-state current, sine waveform,  $f = 50 \text{ Hz}$ ,  $T = 1/f$

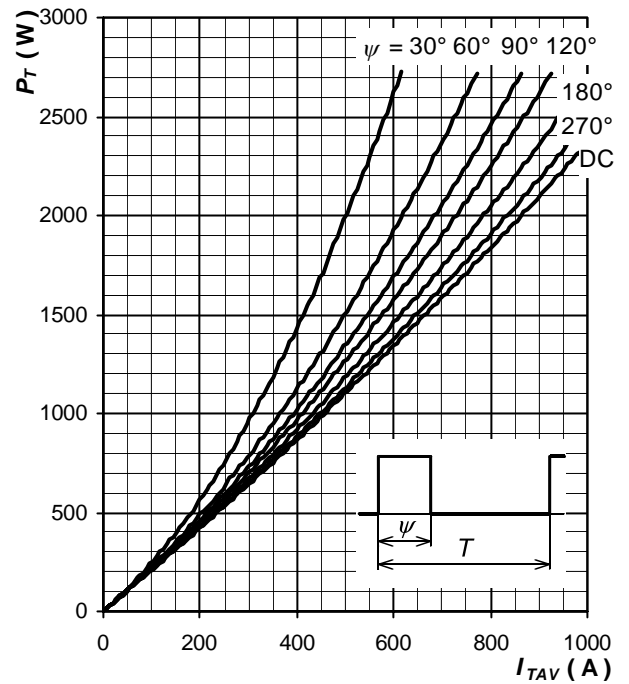


Fig. 10 On-state power loss vs. average on-state current, square waveform,  $f = 50 \text{ Hz}$ ,  $T = 1/f$

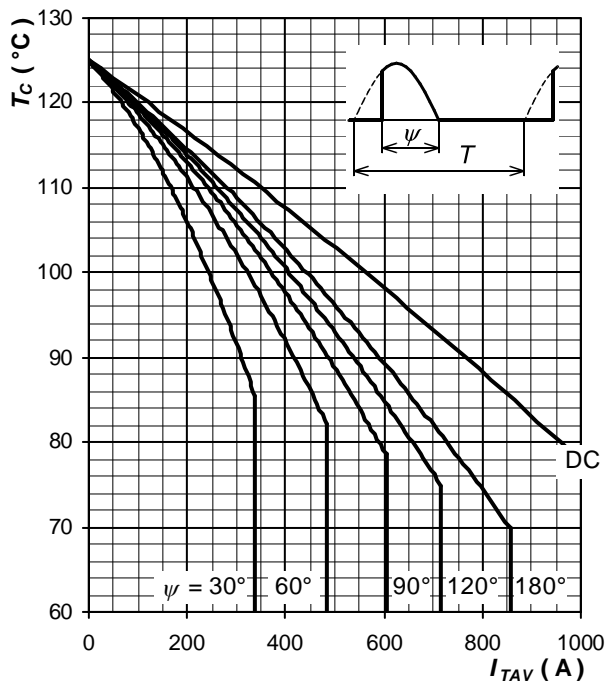


Fig. 11 Max. case temperature vs. aver. on-state current, sine waveform,  $f = 50 \text{ Hz}$ ,  $T = 1/f$

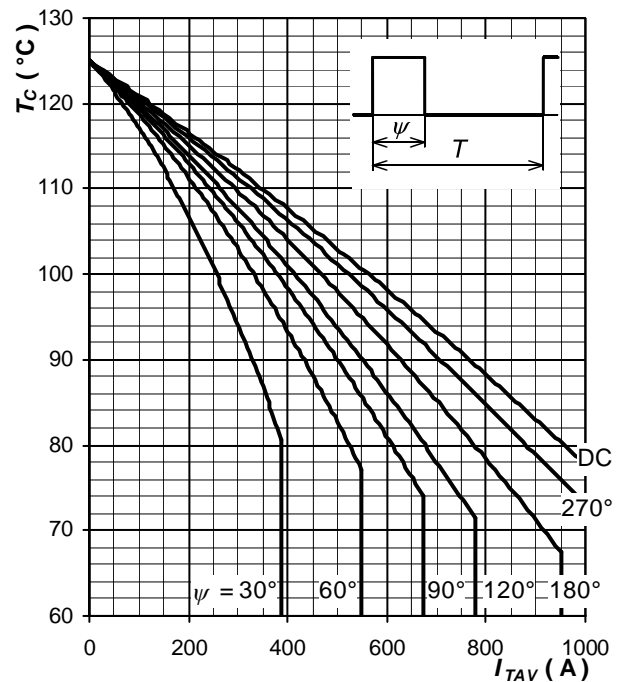


Fig. 12 Max. case temperature vs. aver. on-state current, square waveform,  $f = 50 \text{ Hz}$ ,  $T = 1/f$

Note 2: Figures number 9 ÷ 12 have been calculated without considering any forward and reverse recovery losses. They are valid for  $f = 50$  or  $60 \text{ Hz}$  operation.

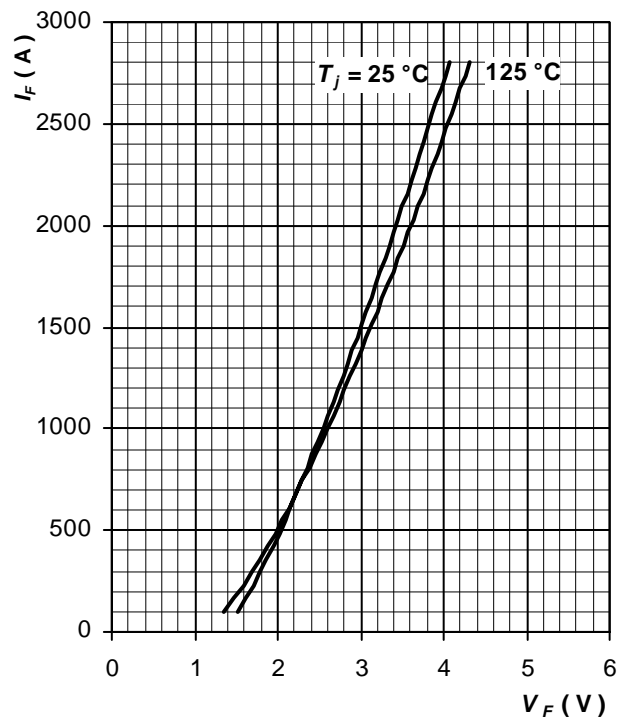
**Forward Characteristics - Diode**

Fig. 13 Maximum forward voltage drop characteristics

## Surge Characteristics - Diode

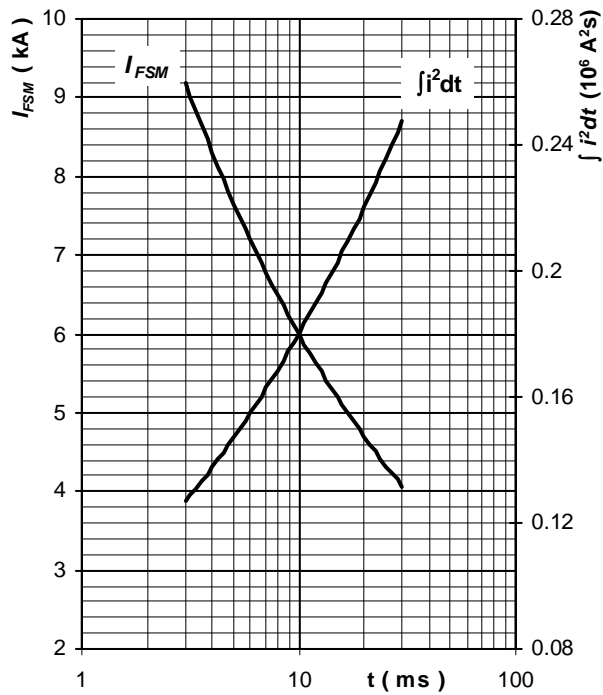


Fig. 14 Surge forward current vs. pulse length, half sine wave, single pulse,  $V_R = 0 V$ ,  $T_j = T_{jmax}$

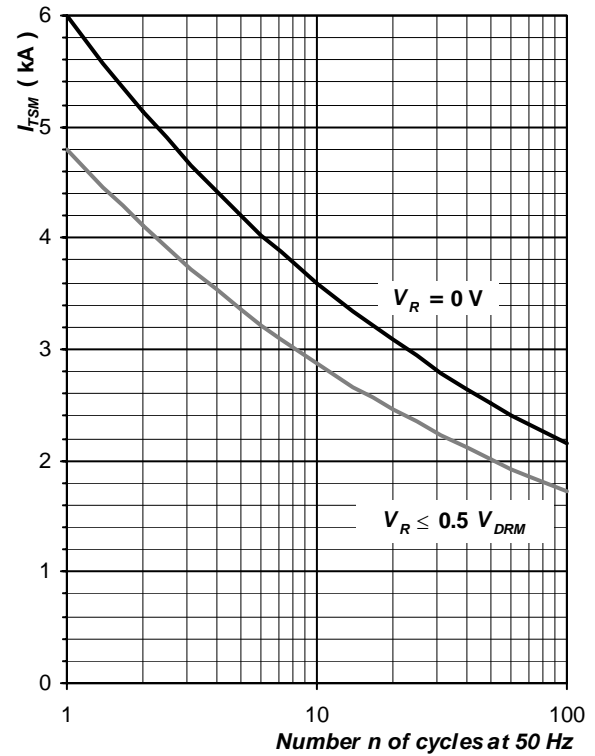


Fig. 15 Surge forward current vs. number of pulses, half sine wave,  $T_j = T_{jmax}$

**Power Loss and Maximum Case Temperature Characteristics - Diode**

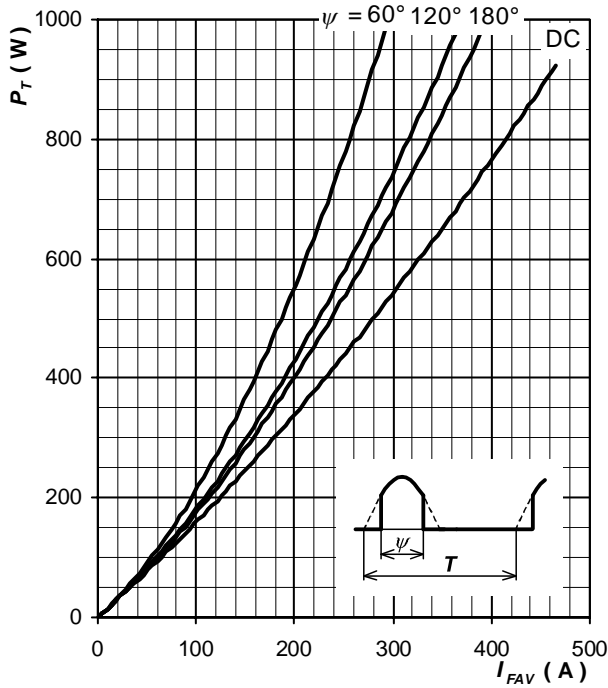


Fig. 16 Forward power loss vs. average forward current, sine waveform,  $f = 50 \text{ Hz}$ ,  $T = 1/f$

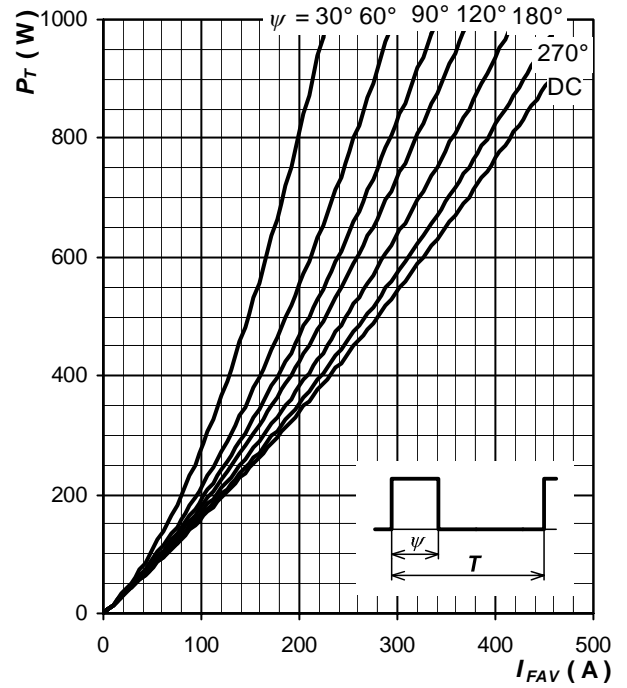


Fig. 17 Forward power loss vs. average forward current, square waveform,  $f = 50 \text{ Hz}$ ,  $T = 1/f$

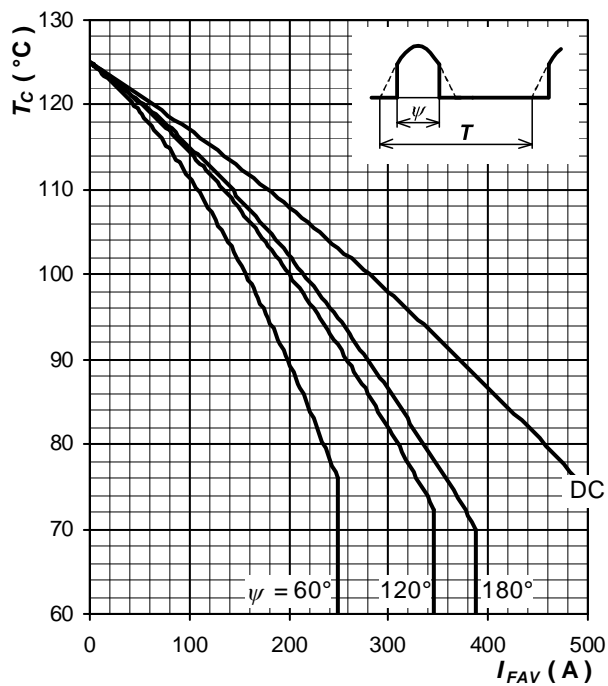


Fig. 18 Max. case temperature vs. aver. forward current, sine waveform,  $f = 50 \text{ Hz}$ ,  $T = 1/f$

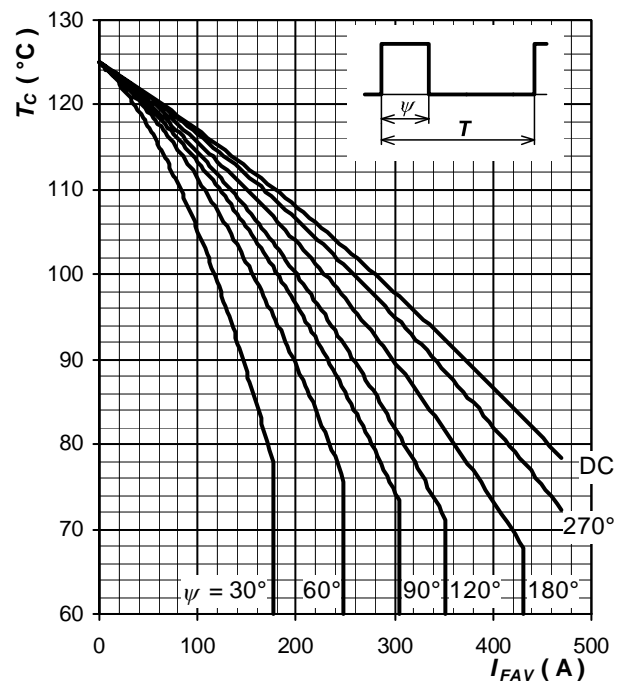


Fig. 19 Max. case temperature vs. aver. forward current, square waveform,  $f = 50 \text{ Hz}$ ,  $T = 1/f$

Note 2: Figures number 16 ÷ 19 have been calculated without considering any forward and reverse recovery losses. They are valid for  $f = 50$  or  $60 \text{ Hz}$  operation.

Notes:

ABB s.r.o., Novodvorska 1768/138a, 142 21 Praha 4, Czech Republic