



5STR 03T2040

Old part no. TP 907FC-320-20

Reverse Conducting Thyristor

Properties

- Integrated freewheeling diode
- Optimized for low dynamic losses

Applications

- Traction

Key Parameters

| | | |
|------------|---------|----|
| V_{DRM} | = 2 000 | V |
| I_{TAVm} | = 360 | A |
| I_{TSM} | = 5 000 | A |
| V_{TO} | = 1.550 | V |
| r_T | = 1.010 | mΩ |
| t_q | = 40 | μs |

Types

| | |
|--|----------------|
| | V_{DRM} |
| 5STR 03T2040 | 2 000 V |
| Conditions: $T_j = -40 \div 125$ °C, half sine waveform, $f = 50$ Hz | |

Mechanical Data

| | | |
|-------|---------------------------|-----------|
| F_m | Mounting force | 10 ± 2 kN |
| m | Weight | 0.20 kg |
| D_s | Surface creepage distance | 13 mm |
| D_a | Air strike distance | 8 mm |

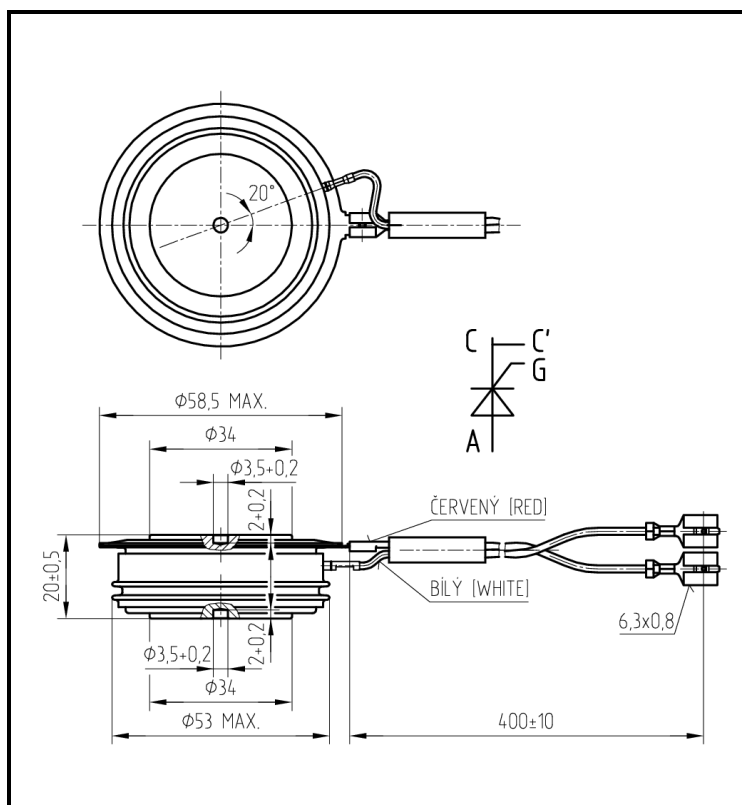


Fig. 1 Case



ABB s.r.o.

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

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

| Maximum Ratings - Thyristor | | | Maximum Limits | Unit |
|------------------------------------|--|------------------------|----------------------------------|------------------------------------|
| V_{DRM} | Repetitive peak off-state voltage $T_j = -40 \div 125 \text{ }^\circ\text{C}$ | | 2 000 | V |
| I_{TRMS} | RMS on-state current $T_c = 70 \text{ }^\circ\text{C}$, half sine waveform, $f = 50 \text{ Hz}$ | | 566 | A |
| I_{TAVm} | Average on-state current $T_c = 70 \text{ }^\circ\text{C}$, half sine waveform, $f = 50 \text{ Hz}$ | | 360 | A |
| I_{TSM} | Peak non-repetitive surge half sine pulse, $V_R = 0 \text{ V}$ | $t_p = 10 \text{ ms}$ | 5 000 | A |
| | | $t_p = 8.3 \text{ ms}$ | 5 300 | |
| I^2t | Limiting load integral half sine pulse, $V_R = 0 \text{ V}$ | $t_p = 10 \text{ ms}$ | 125 000 | A²s |
| | | $t_p = 8.3 \text{ ms}$ | 118 000 | |
| $(di_T/dt)_{cr}$ | Critical rate of rise of on-state current $I_T = 1\,000 \text{ A}$, $V_D = 0.67 V_{DRM}$, half sine waveform, $f = 50 \text{ Hz}$ | | 400 | A/μs |
| $(dv_D/dt)_{cr}$ | Critical rate of rise of off-state voltage $V_D = 0.67 V_{DRM}$ | | 1 000 | V/μs |
| P_{AV} | Maximum average gate power losses | | 5 | W |
| I_{GTM} | Peak gate current | | 25 | A |
| V_{GTM} | Peak gate voltage | | 15 | V |
| V_{RGTM} | Reverse peak gate voltage | | 2 | V |
| $T_{jmin} - T_{jmax}$ | Operating temperature range | | -40 \div 125 | $^\circ\text{C}$ |
| $T_{stgmin} - T_{stgmax}$ | Storage temperature range | | -40 \div 125 | $^\circ\text{C}$ |

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

| Maximum Ratings - Diode | | | Maximum Limits | Unit |
|--------------------------------|---|------------------------|-----------------------|-----------------------|
| V_{RRM} | Repetitive peak reverse voltage $T_j = -40 \div 125 \text{ }^\circ\text{C}$ | | 2 000 | V |
| I_{FRMS} | RMS forward current $T_c = 70 \text{ }^\circ\text{C}$, half sine waveform, $f = 50 \text{ Hz}$ | | 351 | A |
| I_{FAVm} | Average forward current $T_c = 70 \text{ }^\circ\text{C}$, half sine waveform, $f = 50 \text{ Hz}$ | | 223 | A |
| I_{FSM} | Peak non-repetitive surge half sine pulse, $V_R = 0 \text{ V}$ | $t_p = 10 \text{ ms}$ | 3 500 | A |
| | | $t_p = 8.3 \text{ ms}$ | 3 800 | |
| I^2t | Limiting load integral half sine pulse, $V_R = 0 \text{ V}$ | $t_p = 10 \text{ ms}$ | 61 000 | A²s |
| | | $t_p = 8.3 \text{ ms}$ | 58 000 | |

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

| Characteristics – Thyristor | | Value | | | Unit |
|------------------------------------|---|--|-------------|---|-------------|
| | | <i>min.</i> | <i>typ.</i> | <i>max.</i> | |
| V_{TM} | Maximum peak on-state voltage $I_{TM} = 1\ 000\ A$ | | | 2.610 | V |
| V_{T0} | Threshold voltage | | | 1.550 | V |
| r_T | Slope resistance $I_{T1} = 500\ A, I_{T2} = 1\ 500\ A$ | | | 1.010 | mΩ |
| I_{DM} | Peak off-state current $V_D = V_{DRM}$ | | | 70 | mA |
| t_{gd} | Delay time $T_j = 25\ ^\circ C, V_D = 100\ V, I_{TM} = 320\ A, t_r = 0.5\ \mu s, I_{GT} = 2\ A$ | | | 1 | μs |
| t_{gt} | Switch-on time <i>the same conditions as at t_{gd}</i> | | | 4 | μs |
| t_q | Turn-off time $I_T = 320\ A, di_T/dt = -50\ A/\mu s,$ $V_D = 0.67\ V_{DRM}, dv_D/dt = 50\ V/\mu s$ | | | 40 | μs |
| I_H | Holding current | $T_j = 25\ ^\circ C$ $T_j = 125\ ^\circ C$ | | 100 | mA |
| I_L | Latching current | $T_j = 25\ ^\circ C$ $T_j = 125\ ^\circ C$ | | 500 | mA |
| V_{GT} | Gate trigger voltage $V_D = 12\ V, I_T = 4\ A$ | $T_j = -40\ ^\circ C$ $T_j = 25\ ^\circ C$ $T_j = 125\ ^\circ C$ | 0.25 | 4.5 2.5 2.0 | V |
| I_{GT} | Gate trigger current $V_D = 12\ V, I_T = 4\ A$ | $T_j = -40\ ^\circ C$ $T_j = 25\ ^\circ C$ $T_j = 125\ ^\circ C$ | 10 | 1000 400 250 | mA |

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

| Characteristics – Diode | | Value | | | Unit |
|--------------------------------|---|--------------|-------------|--------------|-------------|
| | | <i>min.</i> | <i>typ.</i> | <i>max.</i> | |
| V_{FM} | Maximum forward voltage <i>$I_{FM} = 1\ 000\ A$</i> | | | 3.420 | V |
| V_{T0} | Threshold voltage <i>$I_{F1} = 310\ A, I_{F2} = 940\ A$</i> | | | 1.340 | V |
| r_T | Forward slope resistance | | | 2.100 | mΩ |
| Q_{rr} | Reverse recovery charge <i>$I_{FM} = 200\ A, di_F/dt = -50\ A/\mu s, V_D = 100\ V$</i> | | 250 | | μC |
| I_{rrM} | Maximum reverse recovery current <i>the same conditions as at Q_{rr}</i> | | 150 | | A |
| t_{rr} | Reverse recovery time <i>the same conditions as at Q_{rr}</i> | | 4 | | μs |

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

| Thermal Parameters - Thyristor | | Value | Unit |
|---------------------------------------|--|--------------|-------------|
| R_{thjc} | Thermal resistance junction to case <i>double side cooling</i> | 55 | K/kW |
| | <i>anode side cooling</i> | 91 | |
| | <i>cathode side cooling</i> | 140 | |
| R_{thch} | Thermal resistance case to heatsink <i>double side cooling</i> | 10 | K/kW |
| | <i>single side cooling</i> | 20 | |

| Thermal Parameters - Diode | | Value | Unit |
|-----------------------------------|--|--------------|-------------|
| R_{thjc} | Thermal resistance junction to case <i>double side cooling</i> | 88 | K/kW |
| | <i>anode side cooling</i> | 190 | |
| | <i>cathode side cooling</i> | 165 | |

Transient Thermal Impedance - Thyristor**Correction for periodic waveforms - Thyristor**

| | |
|-------------------|---------------|
| 180° sine: | add 7.4 K/kW |
| 180° rectangular: | add 8.4 K/kW |
| 120° rectangular: | add 13.8 K/kW |
| 60° rectangular: | add 23.8 K/kW |

Analytical function for transient thermal impedance

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

Conditions:

 $F_m = 10 \pm 2$ kN, Double side cooled

| i | 1 | 2 | 3 | 4 | 5 |
|--------------|------|-------|--------|---------|----------|
| τ_i (s) | 1.62 | 0.111 | 0.0236 | 0.00322 | 0.307e-3 |
| R_i (K/kW) | 3.77 | 36.70 | 9.64 | 3.54 | 1.38 |

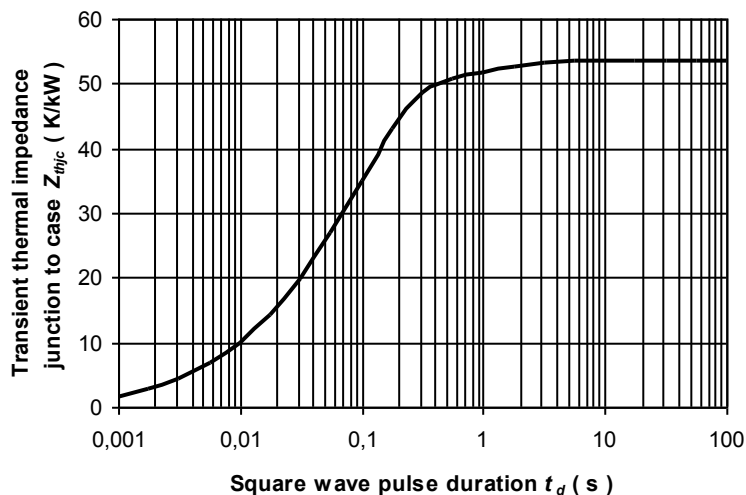


Fig. 2 Dependence transient thermal impedance junction to case on square pulse - Thyristor

Diode**Correction for periodic waveforms - Diode**

| | |
|-------------------|---------------|
| 180° sine: | add 10.7 K/kW |
| 180° rectangular: | add 11.1 K/kW |
| 120° rectangular: | add 18.2 K/kW |
| 60° rectangular: | add 31.9 K/kW |

| i | 1 | 2 | 3 | 4 | 5 |
|--------------|-------|-------|--------|--------|----------|
| τ_i (s) | 0.401 | 0.108 | 0.0267 | 0.0034 | 0.584e-3 |
| R_i (K/kW) | 23.00 | 41.00 | 17.20 | 3.47 | 2.50 |

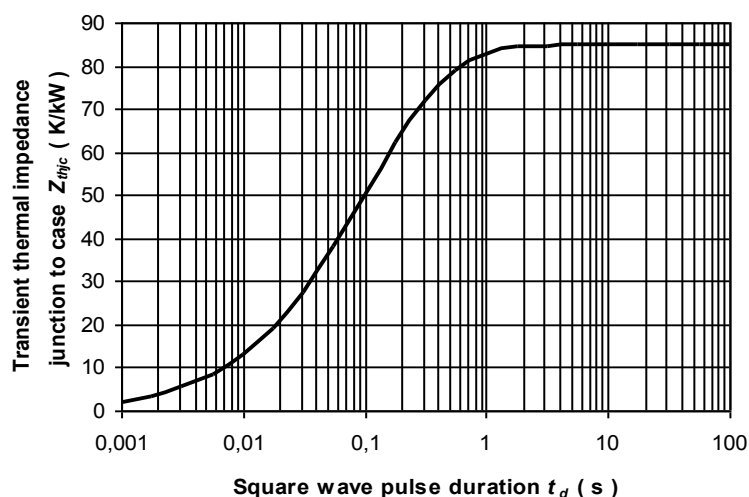


Fig. 3 Dependence transient thermal impedance junction to case on square pulse - Diode

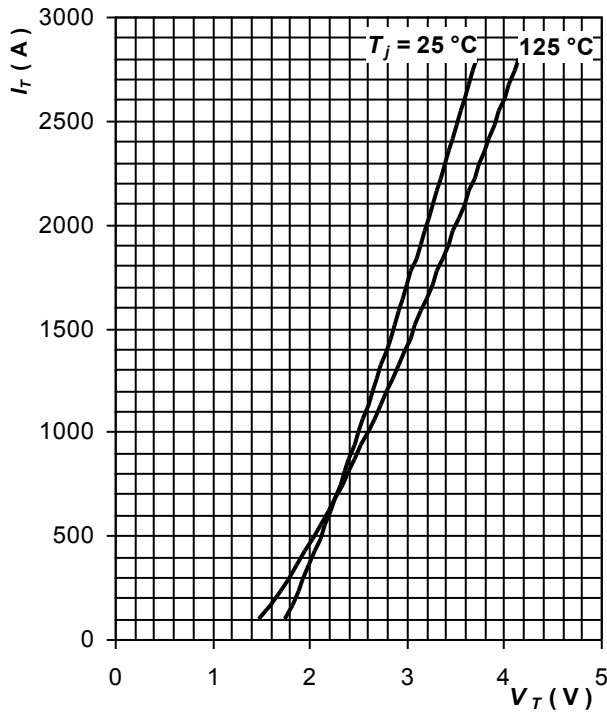


Fig. 4 Maximum on-state characteristics

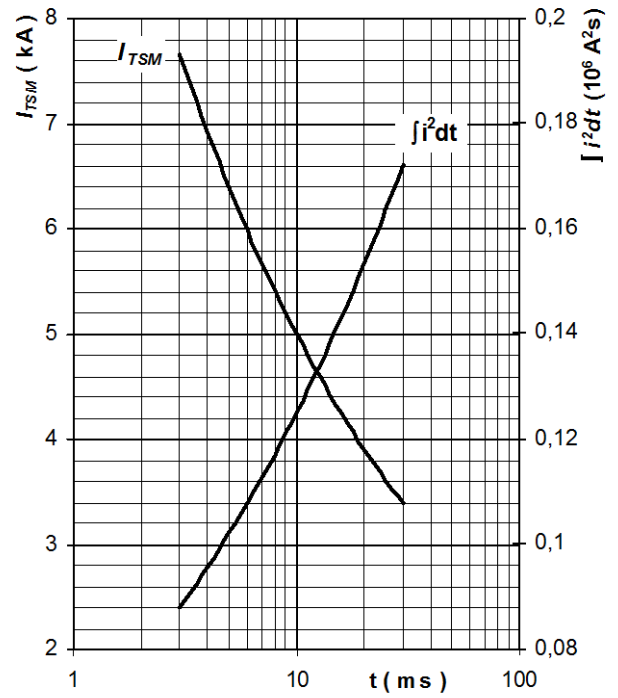


Fig. 5 Surge on-state current vs. pulse length, half sine wave, single pulse, $V_R = 0\text{ V}$, $T_j = T_{jmax}$

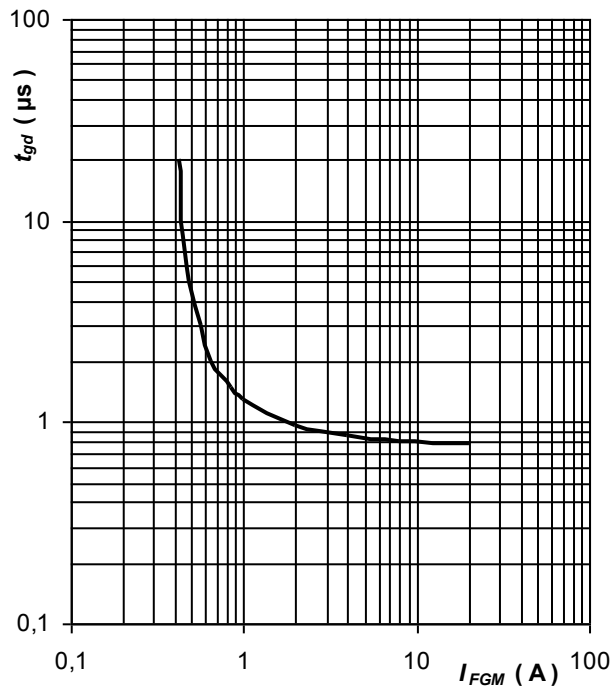


Fig. 6 Delay time vs. forward gate current, $T_j = 25\text{ °C}$, $V_D = 100\text{ V}$, $I_{TM} = I_{TAVm}$, $t_r \leq 0,5\text{ }\mu\text{s}$, $t_p = 1\text{ ms}$

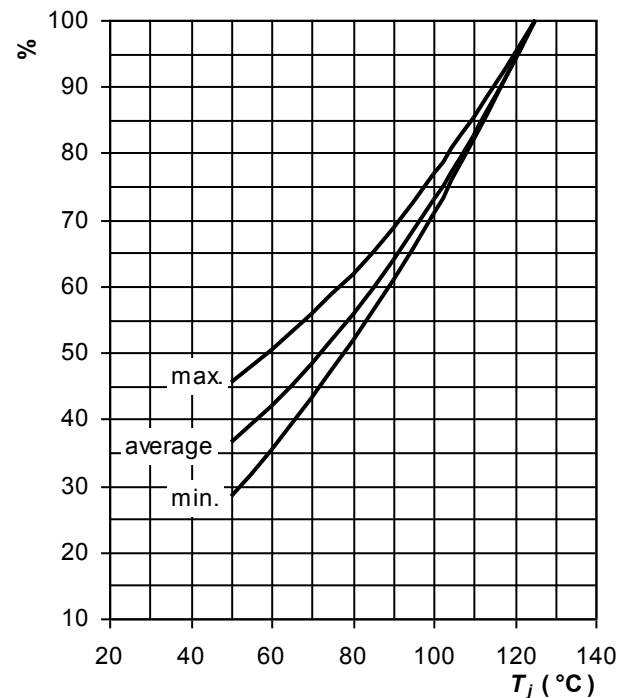


Fig. 7 Relative value of turn-off time vs. junction temperature

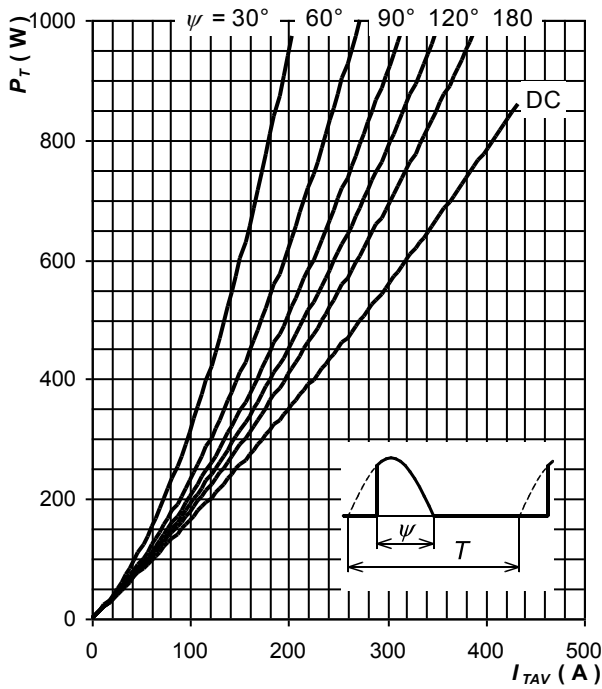


Fig. 8 On-state power loss vs. average on-state current, sine waveform, $f = 50 \text{ Hz}$, $T = 1/f$

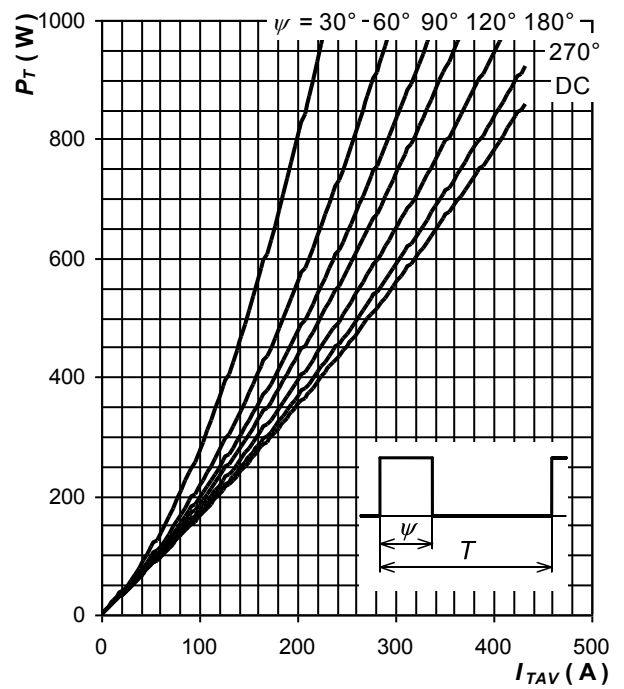


Fig. 9 On-state power loss vs. average on-state current, square waveform, $f = 50 \text{ Hz}$, $T = 1/f$

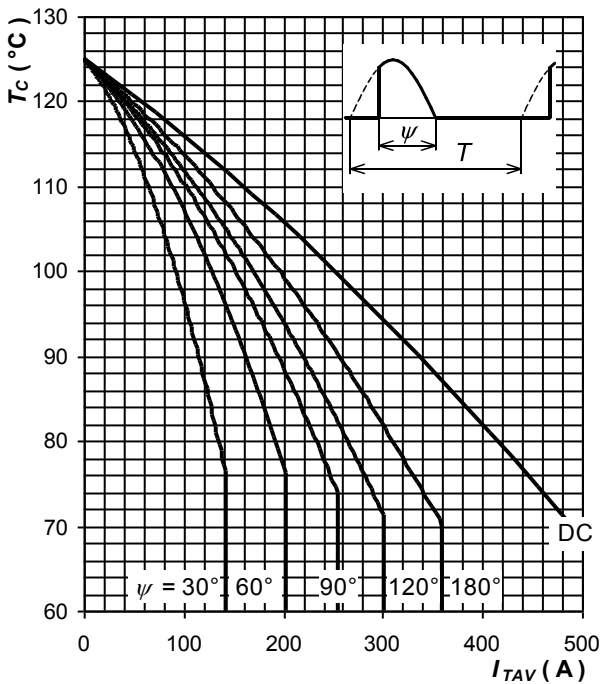


Fig. 10 Max. case temperature vs. aver. on-state current, sine waveform, $f = 50 \text{ Hz}$, $T = 1/f$

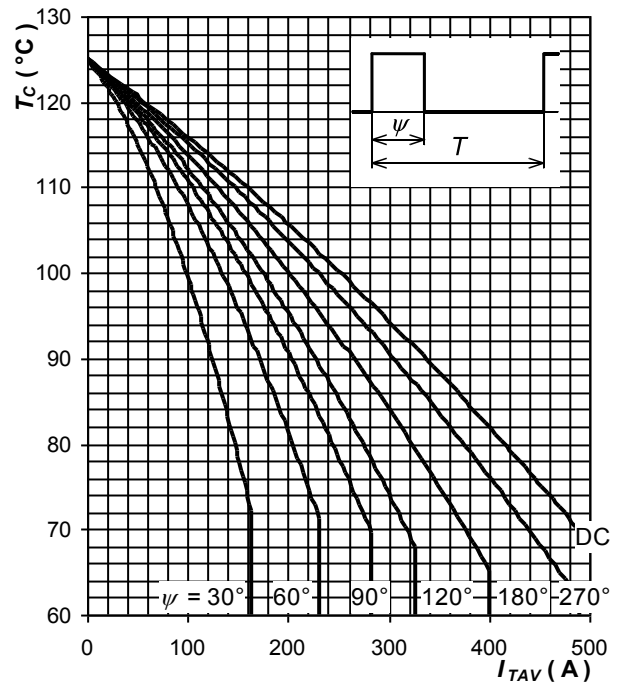


Fig. 11 Max. case temperature vs. aver. on-state current, square waveform, $f = 50 \text{ Hz}$, $T = 1/f$

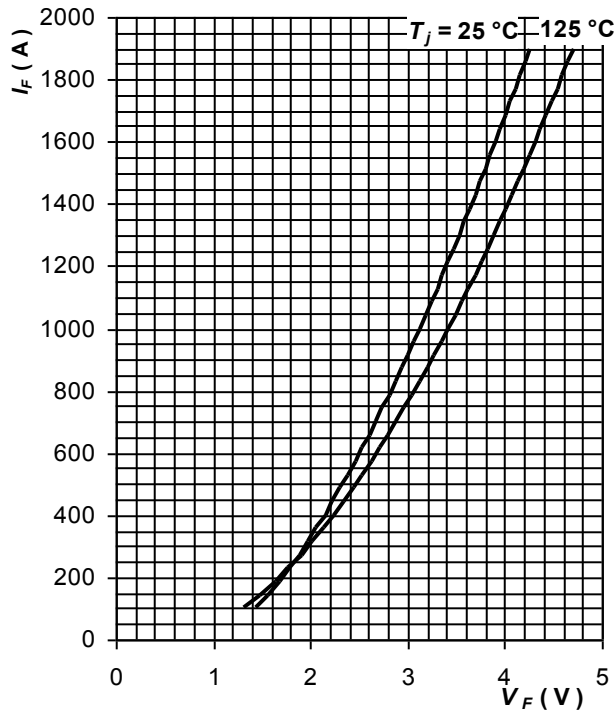


Fig. 12 Maximum forward voltage drop characteristics of the diode

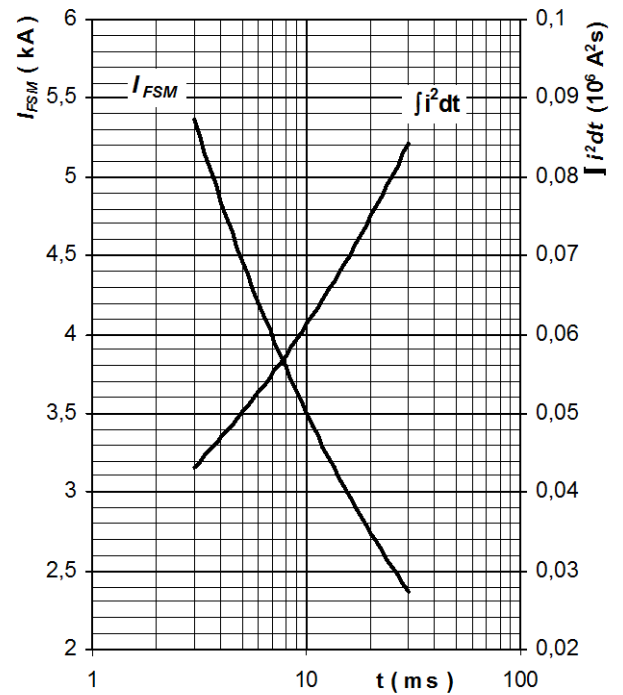


Fig. 13 Surge on-state current vs. pulse length of the diode. Half sine wave, single pulse, $V_R = 0$ V, $T_j = T_{jmax}$

Notes: