High power cycling capability
Low on-state and switching losses
Designed for traction and industrial applications

# Phase Control Thyristor
# Type T143-1250-8

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Mean on-state current | | | | $I_{TAV}$ | | 1250 A | | |
| Repetitive peak off-state voltage | | | | $V_{DRM}$ | | 100 ÷ 800 V | | |
| Repetitive peak reverse voltage | | | | $V_{RRM}$ | | | | |
| Turn-off time | | | | $t_q$ | | 160, 200, 250, 320, 400, 500 µs | | |
| $V_{DRM}$, $V_{RRM}$, V | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 |
| Voltage code | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| $T_j$, °C | -60 ÷ 150 | | | | | | | |

## MAXIMUM ALLOWABLE RATINGS

| Symbols and parameters | | Units | Values | Test conditions | |
|---|---|---|---|---|---|
| **ON-STATE** | | | | | |
| $I_{TAV}$ | Mean on-state current | A | 1250<br>1446 | $T_c$=97 °C, Double side cooled<br>$T_c$=85 °C, Double side cooled<br>180° half-sine wave; 50 Hz | |
| $I_{TRMS}$ | RMS on-state current | A | 1962 | $T_c$=97 °C, Double side cooled<br>180° half-sine wave; 50 Hz | |
| $I_{TSM}$ | Surge on-state current | kA | 22.0<br>25.0 | $T_j$=$T_{j\,max}$<br>$T_j$=25 °C | 180° half-sine wave;<br>$t_p$=10 ms; single pulse;<br>$V_D$=$V_R$=0 V;<br>Gate pulse: $I_G$=2 A;<br>$t_{GP}$=50 µs; $di_G/dt$≥1 A/µs |
| | | | 23.0<br>26.0 | $T_j$=$T_{j\,max}$<br>$T_j$=25 °C | 180° half-sine wave;<br>$t_p$=8.3 ms; single pulse;<br>$V_D$=$V_R$=0 V;<br>Gate pulse: $I_G$=2 A;<br>$t_{GP}$=50 µs; $di_G/dt$≥1 A/µs |
| $I^2t$ | Safety factor | $A^2s{\cdot}10^3$ | 2400<br>3100 | $T_j$=$T_{j\,max}$<br>$T_j$=25 °C | 180° half-sine wave;<br>$t_p$=10 ms; single pulse;<br>$V_D$=$V_R$=0 V;<br>Gate pulse: $I_G$=2 A;<br>$t_{GP}$=50 µs; $di_G/dt$≥1 A/µs |
| | | | 2100<br>2800 | $T_j$=$T_{j\,max}$<br>$T_j$=25 °C | 180° half-sine wave;<br>$t_p$=8.3 ms; single pulse;<br>$V_D$=$V_R$=0 V;<br>Gate pulse: $I_G$=2 A;<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 | 100÷800 | $T_{j\,min}$< $T_j$ <$T_{j\,max}$;<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 | 200÷900 | $T_{j\,min}$< $T_j$ <$T_{j\,max}$;<br>180° half-sine wave; single pulse; Gate open | |
| $V_D$, $V_R$ | Direct off-state and Direct reverse voltages | V | 0.6·$V_{DRM}$<br>0.6·$V_{RRM}$ | $T_j$=$T_{j\,max}$;<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 | 4 | $T_j=T_{j\,max}$ for DC gate current |
| **SWITCHING** | | | | |
| $(di_T/dt)_{crit}$ | Critical rate of rise of on-state current non-repetitive (f=1 Hz) | A/µs | 800 | $T_j=T_{j\,max}$; $V_D=0.67\cdot V_{DRM}$; $I_{TM}$=3500 A; Gate pulse: $I_G$=2 A; $t_{GP}$=50 µs; $di_G/dt\geq$2 A/µs |
| **THERMAL** | | | | |
| $T_{stg}$ | Storage temperature | °C | -60÷50 | |
| $T_j$ | Operating junction temperature | °C | -60÷150 | |
| **MECHANICAL** | | | | |
| F | Mounting force | kN | 14.0÷16.0 | |
| 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 | 1.55 | $T_j$=25 °C; $I_{TM}$=3925 A | |
| $V_{T(TO)}$ | On-state threshold voltage, max | V | 0.870 | $T_j=T_{j\,max}$; 0.5 π $I_{TAV}$ < $I_T$ < 1.5 π $I_{TAV}$ | |
| $r_T$ | On-state slope resistance, max | mΩ | 0.177 | | |
| $I_L$ | Latching current, max | mA | 1000 | $T_j$=25 °C; $V_D$=12 V; Gate pulse: $I_G$=2 A; $t_{GP}$=50 µs; $di_G/dt\geq$1 A/µs | |
| $I_H$ | Holding current, max | mA | 300 | $T_j$=25 °C; $V_D$=12 V; Gate open | |
| **BLOCKING** | | | | | |
| $I_{DRM}$, $I_{RRM}$ | Repetitive peak off-state and Repetitive peak reverse currents, max | mA | 100 | $T_j=T_{j\,max}$; $V_D=V_{DRM}$; $V_R=V_{RRM}$ | |
| $(dv_D/dt)_{crit}$ | Critical rate of rise of off-state voltage[1)], min | V/µs | 200, 320, 500, 1000, 1600, 2000, 2500 | $T_j=T_{j\,max}$; $V_D=0.67\cdot V_{DRM}$; Gate open | |
| **TRIGGERING** | | | | | |
| $V_{GT}$ | Gate trigger direct voltage, max | V | 3.00<br>2.50<br>1.50 | $T_j$= $T_{j\,min}$<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 | 400<br>250<br>150 | $T_j$= $T_{j\,min}$<br>$T_j$= 25 °C<br>$T_j$= $T_{j\,max}$ | |
| $V_{GD}$ | Gate non-trigger direct voltage, min | V | 0.55 | $T_j=T_{j\,max}$; $V_D=0.67\cdot V_{DRM}$; Direct gate current | |
| $I_{GD}$ | Gate non-trigger direct current, min | mA | 70.00 | | |
| **SWITCHING** | | | | | |
| $t_{gd}$ | Delay time, max | µs | 0.85 | $T_j$=25 °C; $V_D$=600 V; $I_{TM}=I_{TAV}$; di/dt=200 A/µs; Gate pulse: $I_G$=2 A; $V_G$=20 V; $t_{GP}$=50 µs; $di_G/dt$=2 A/µs | |
| $t_{gt}$ | Turn-on time, max | µs | 4.00 | | |
| $t_q$ | Turn-off time[2)], max | µs | 160, 200, 250, 320, 400, 500 | $dv_D/dt$=50 V/µs; $T_j=T_{j\,max}$; $I_{TM}=I_{TAV}$; $di_R/dt$=-10 A/µs; $V_R$=100V; $V_D=0.67\cdot V_{DRM}$ | |
| $Q_{rr}$ | Total recovered charge, max | µC | 1100 | $T_j=T_{j\,max}$; $I_{TM}$=1250 A; $di_R/dt$=-10 A/µs; $V_R$=100 V | |
| $t_{rr}$ | Reverse recovery time, max | µs | 18 | | |
| $I_{rrM}$ | Peak reverse recovery current, max | A | 122 | | |

| THERMAL | | | | | |
|---|---|---|---|---|---|
| $R_{thjc}$ | Thermal resistance, junction to case, max | °C/W | 0.030 | Direct current | Double side cooled |
| $R_{thjc-A}$ | | | 0.066 | | Anode side cooled |
| $R_{thjc-K}$ | | | 0.054 | | Cathode side cooled |
| $R_{thck}$ | Thermal resistance, case to heatsink, max | °C/W | 0.006 | Direct current | |
| **MECHANICAL** | | | | | |
| w | Weight, max | g | 210 | | |
| $D_s$ | Surface creepage distance | mm (inch) | 7.86 (0.309) | | |
| $D_a$ | Air strike distance | mm (inch) | 6.10 (0.240) | | |

## PART NUMBERING GUIDE

| T | 143 | 1250 | 8 | A2 | E2 | N |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

1. Phase Control Thyristor
2. Design version
3. Mean on-state current, A
4. Voltage code
5. Critical rate of rise of off-state voltage, V/μs
6. Turn-off time ($dv_D/dt$=50 V/μs)
7. Ambient conditions: N – normal; T – tropical

## NOTES

[1] Critical rate of rise of off-state voltage

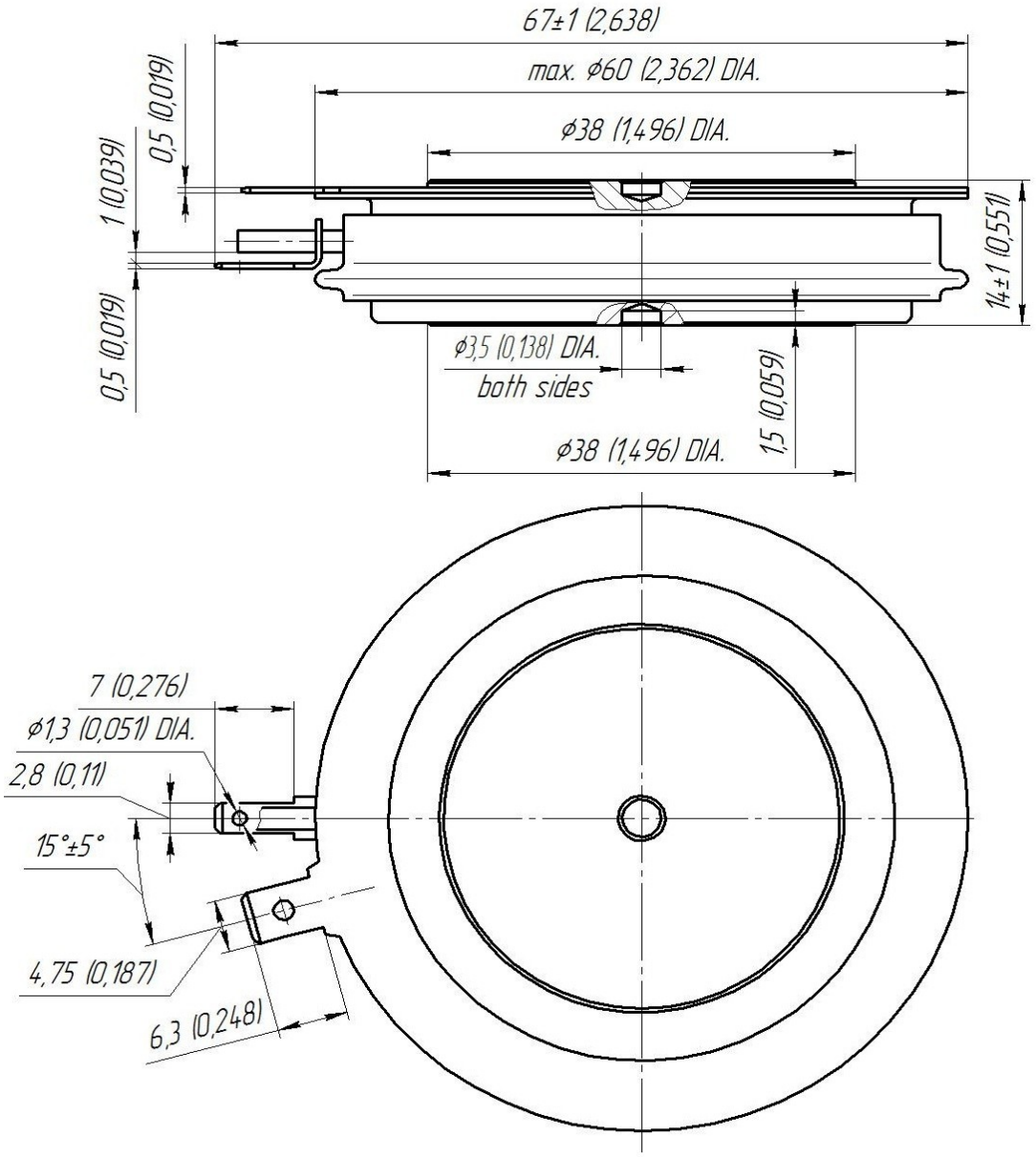
| Symbol of Group | P2 | K2 | E2 | A2 | T1 | P1 | M1 |
|---|---|---|---|---|---|---|---|
| $(dv_D/dt)_{crit}$, V/μs | 200 | 320 | 500 | 1000 | 1600 | 2000 | 2500 |

[2] Turn-off time ($dv_D/dt$=50 V/μs)

| Symbol of Group | T2 | P2 | M2 | K2 | H2 | E2 |
|---|---|---|---|---|---|---|
| $t_q$, μs | 160 | 200 | 250 | 320 | 400 | 500 |

## OVERALL DIMENSIONS

**Package type: T.C1**




All dimensions in millimeters (inches)

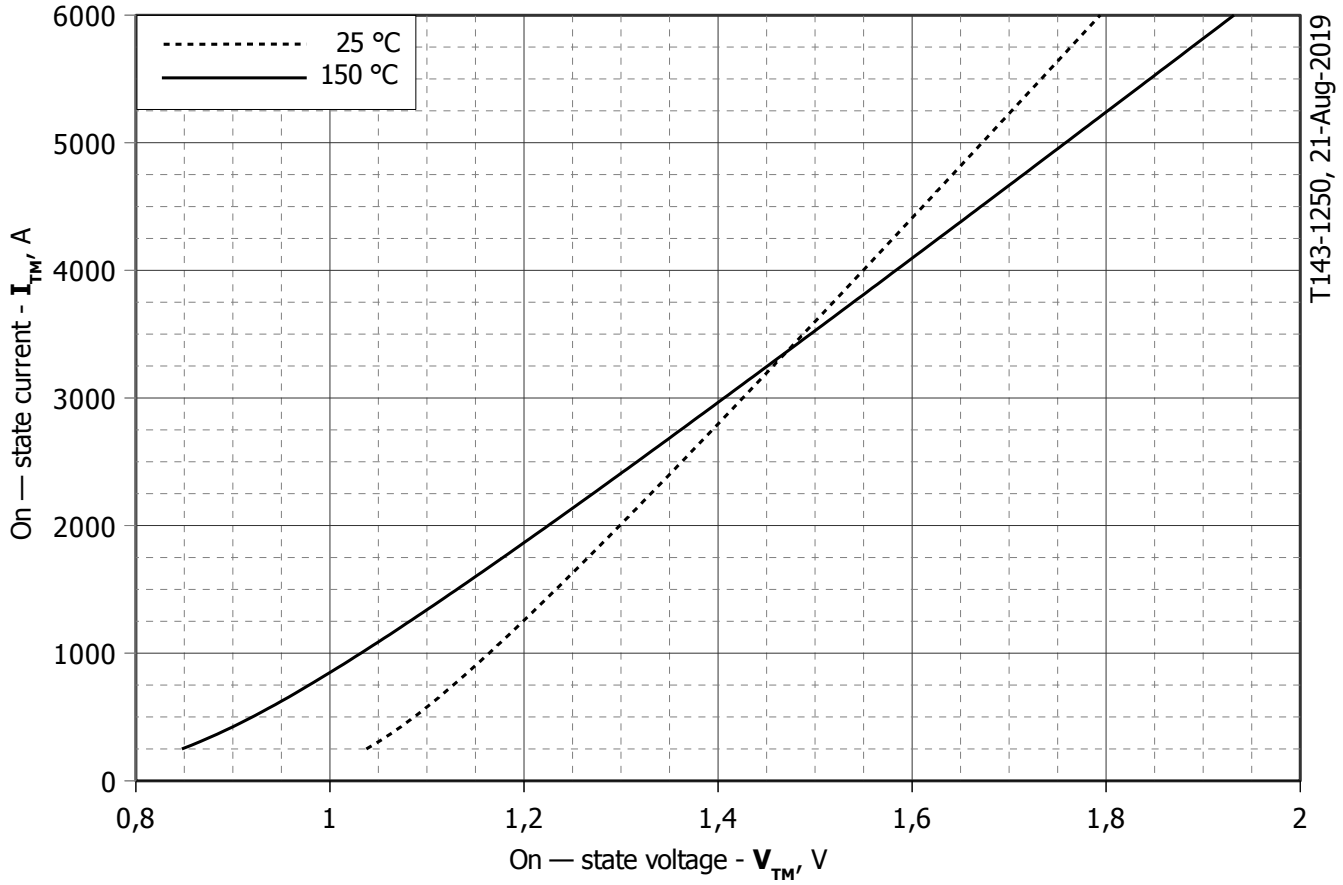



**Fig 1 – On-state characteristics of Limit device**

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 | |
|---|---|---|
| | $T_j = 25°C$ | $T_j = T_{j\,max}$ |
| **A** | 0.82795000 | 0.51947000 |
| **B** | 0.00012036 | 0.00017283 |
| **C** | 0.03462400 | 0.05552300 |
| **D** | -0.00074257 | -0.00139100 |

**On-state characteristic model (see Fig. 1)**

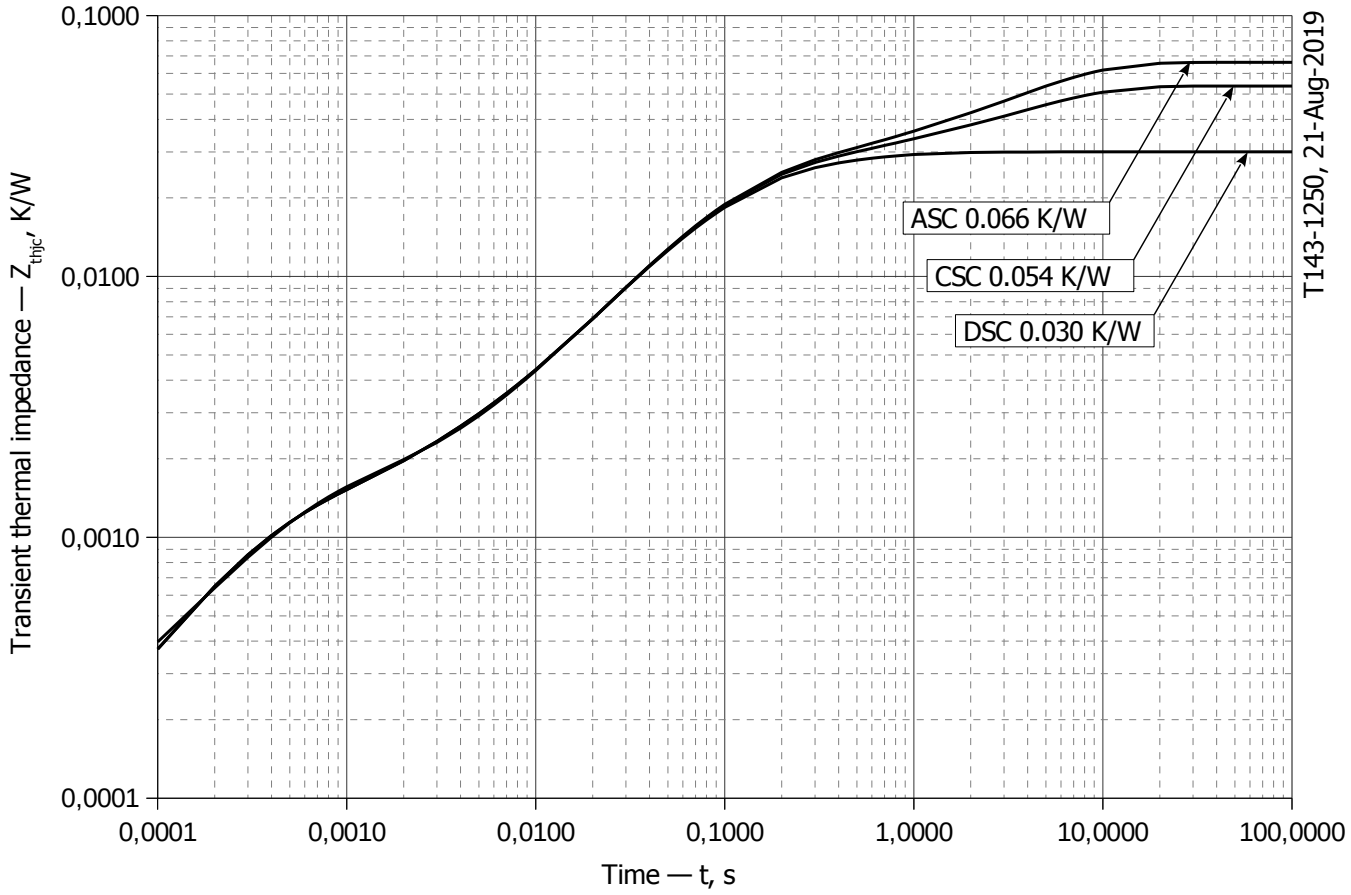



**Fig 2 – Transient thermal impedance $Z_{thjc}$ vs. time t**

Analytical function for Transient thermal impedance junction to case $Z_{thjc}$ for DC:

$$Z_{thjc} = \sum_{i=1}^{n} R_i \left(1 - e^{-\frac{t}{\tau_i}}\right)$$

Where ***i*** = 1 to ***n***, ***n*** is the number of terms in the series.

**t** = Duration of heating pulse in seconds.

**$Z_{thjc}$** = Thermal resistance at time t.

**$R_i$** = Amplitude of $p_{th}$ term.

**$\tau_i$** = Time constatnt of $r_{th}$ term.

DC Double side cooled

| i | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| **$R_i$, K/W** | 0.0007052 | 0.01986 | 0.001443 | 0.006652 | 0.001253 | 0.00009733 |
| **$\tau_i$, s** | 1.200 | 0.083 | 0.0205 | 0.350 | 0.0004173 | 0.000001 |

DC Anode side cooled

| i | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| **$R_i$, K/W** | 0.03615 | 0.006266 | 0.0178 | 0.004365 | 0.0004912 | 0.001067 |
| **$\tau_i$, s** | 4.713 | 0.5062 | 0.09497 | 0.04557 | 0.002123 | 0.0002807 |

DC Cathode side cooled

| i | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| **$R_i$, K/W** | 0.001065 | 0.0004934 | 0.004583 | 0.01764 | 0.006202 | 0.0237 |
| **$\tau_i$, s** | 0.0002798 | 0.002114 | 0.04598 | 0.09501 | 0.4891 | 4.712 |

**Transient thermal impedance junction to case $Z_{thjc}$ model (see Fig. 2)**

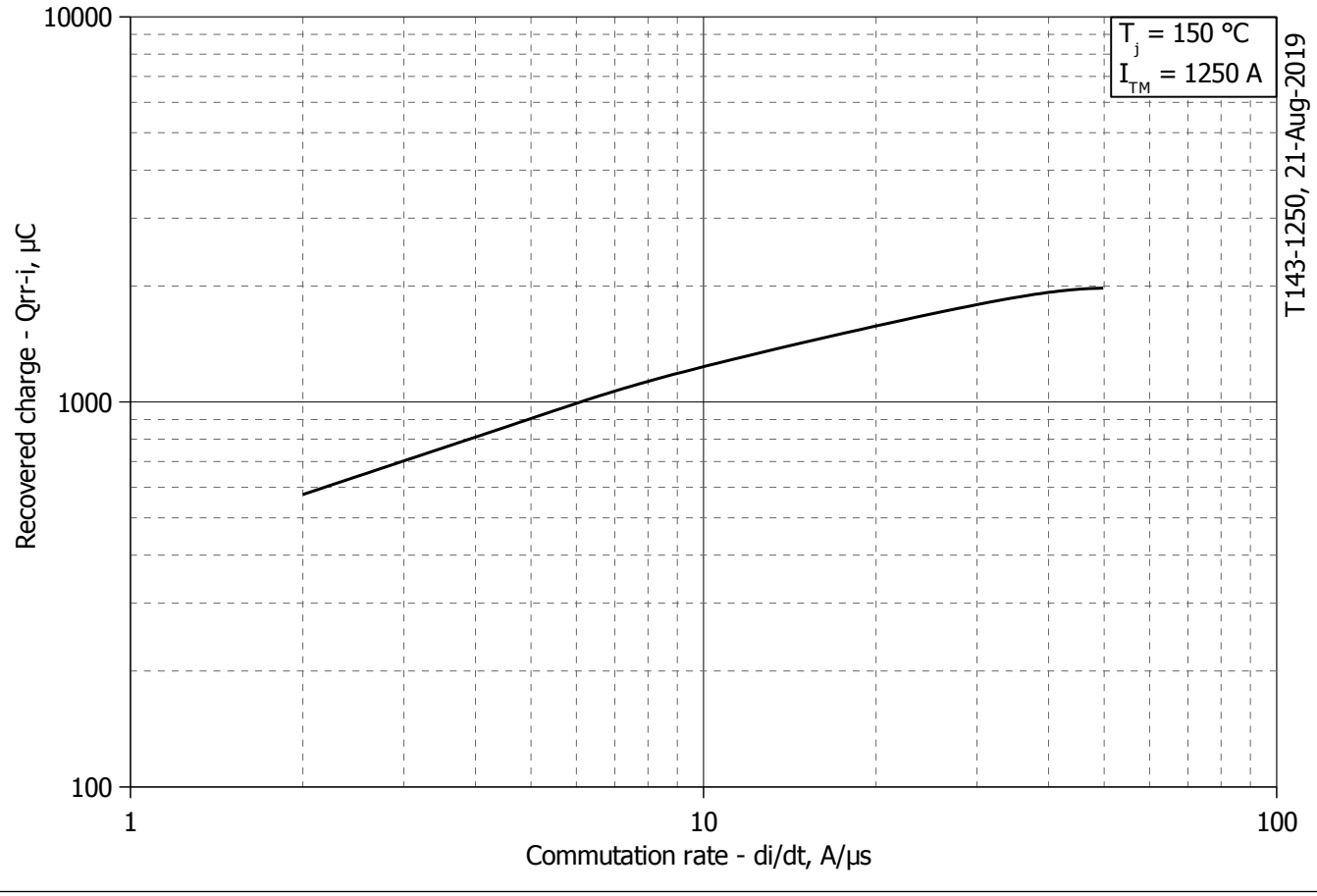



**Fig 3 – Maximum recovered charge $Q_{rr-i}$ (integral) vs. commutation rate $di_R/dt$**

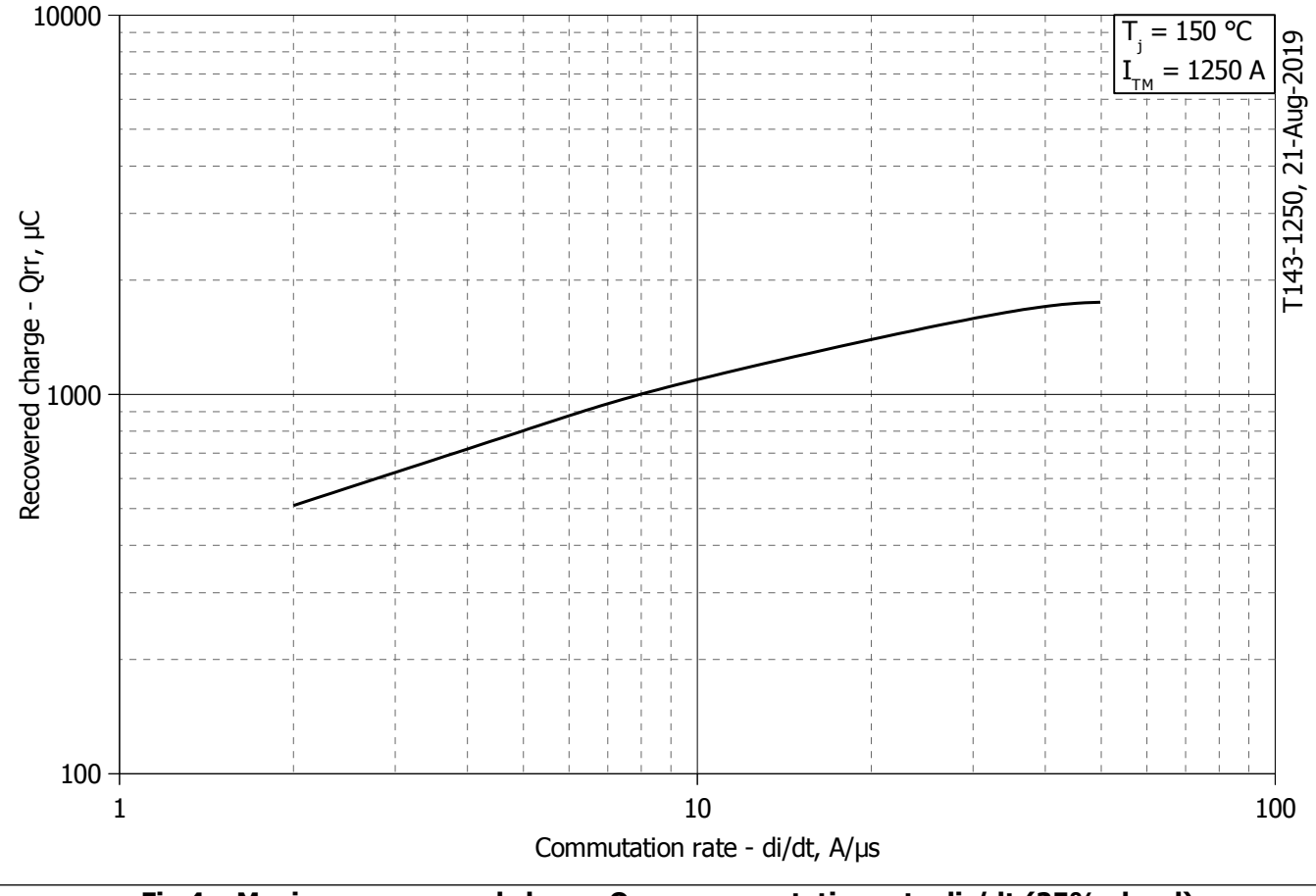



**Fig 4 – Maximum recovered charge $Q_{rr}$ vs. commutation rate $di_R/dt$ (25% chord)**

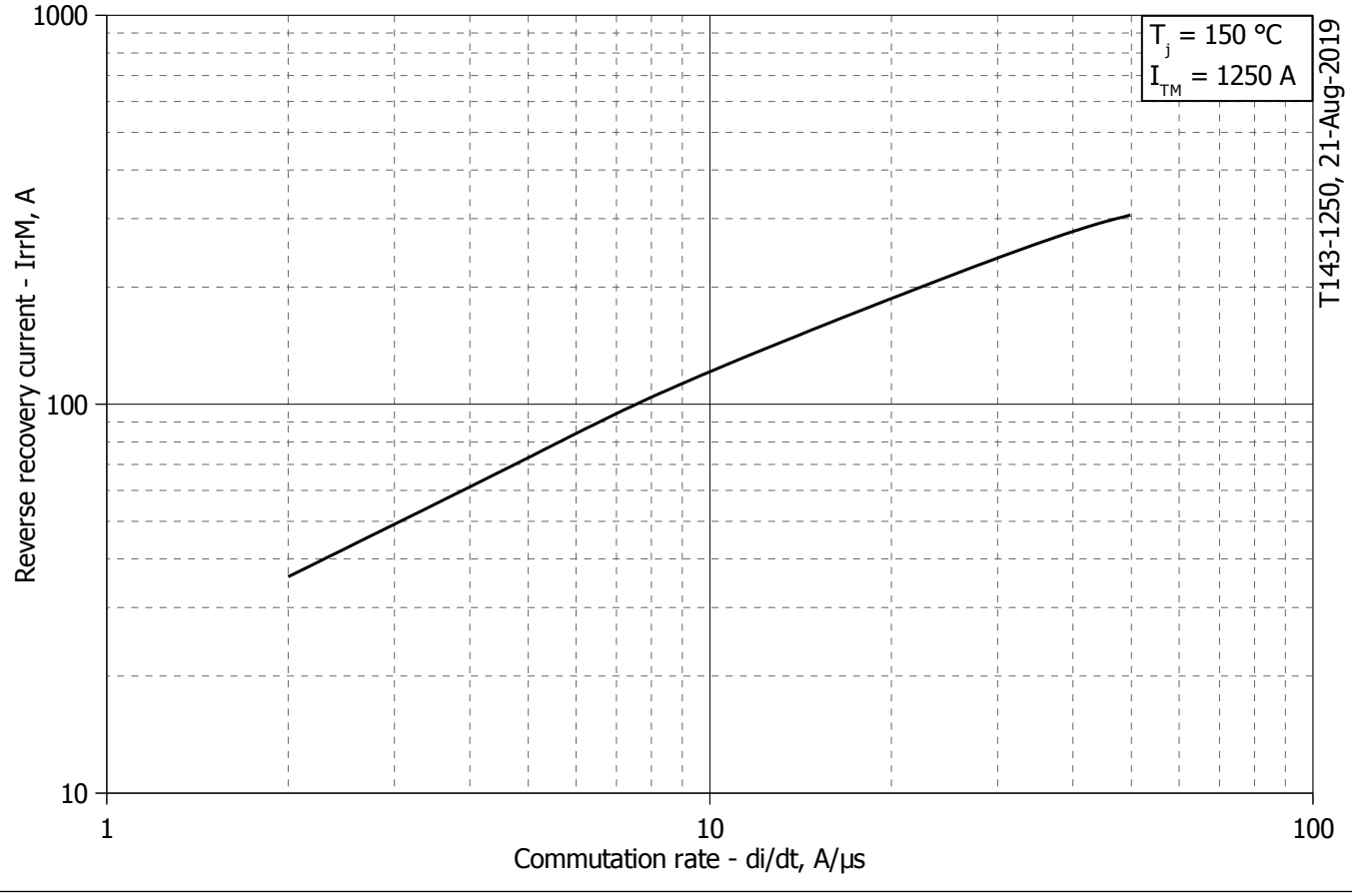



**Fig 5 – Maximum reverse recovery current $I_{rrM}$ vs. commutation rate $di_R/dt$**

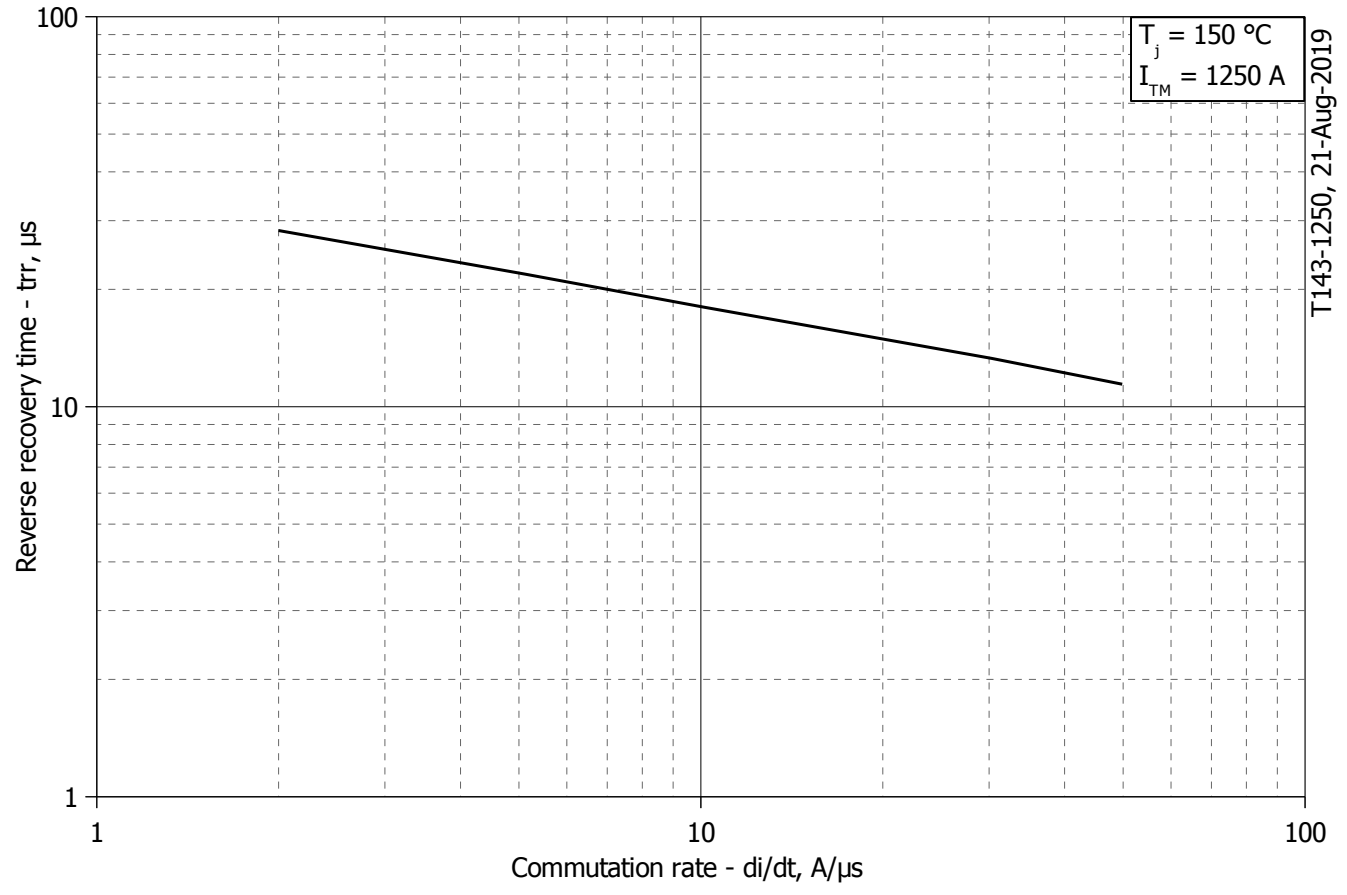



**Fig 6 – Maximum recovery time $t_{rr}$ vs. commutation rate $di_R/dt$ (25% chord)**

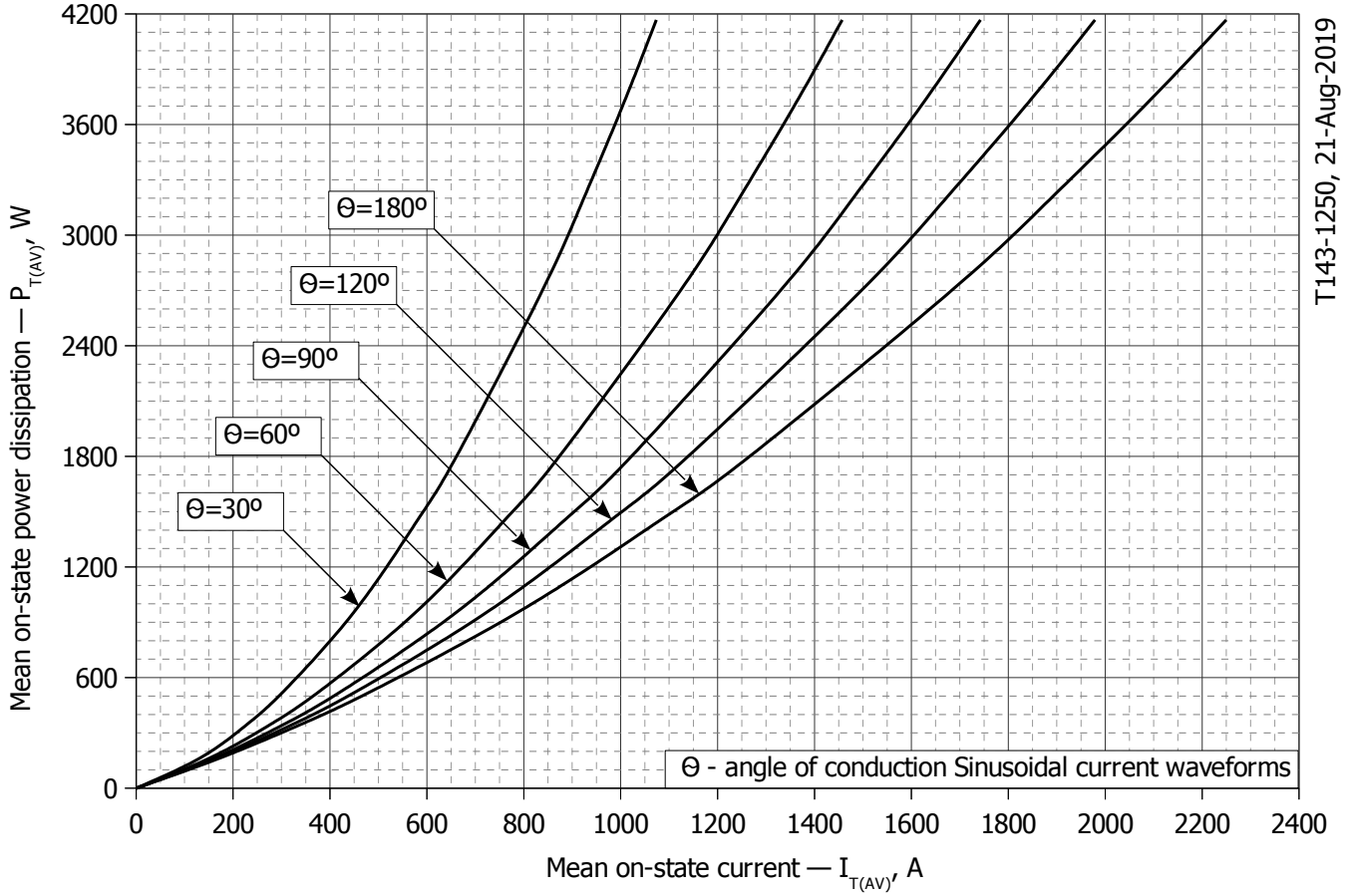



**Fig. 7 - Mean on-state power dissipation $P_{TAV}$ vs. mean on-state current $I_{TAV}$ for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)**

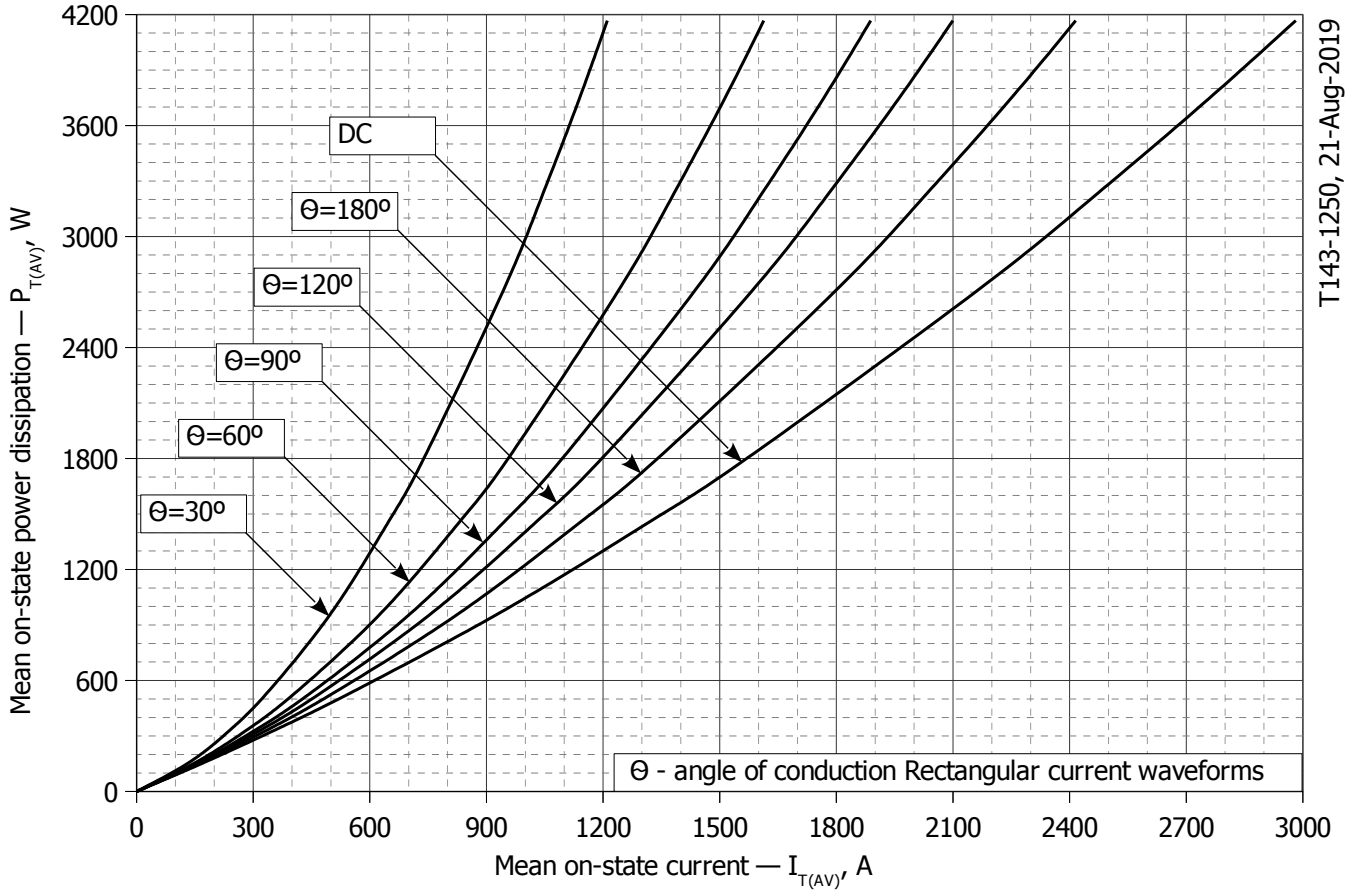



**Fig. 8 – Mean on-state power dissipation $P_{TAV}$ vs. mean on-state current $I_{TAV}$ for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)**

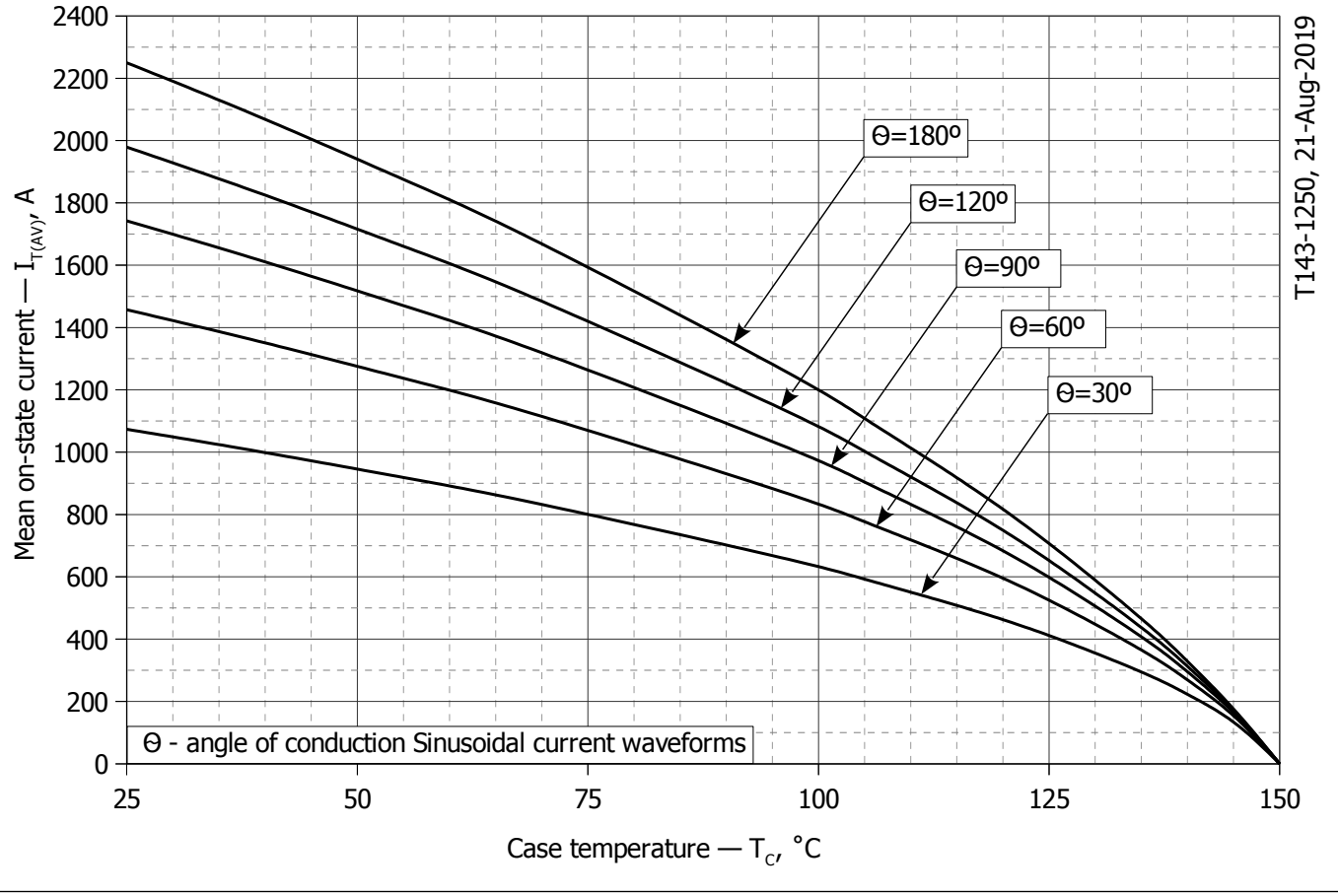



**Fig. 9 – Mean on-state current $I_{TAV}$ vs. case temperature $T_C$ for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)**

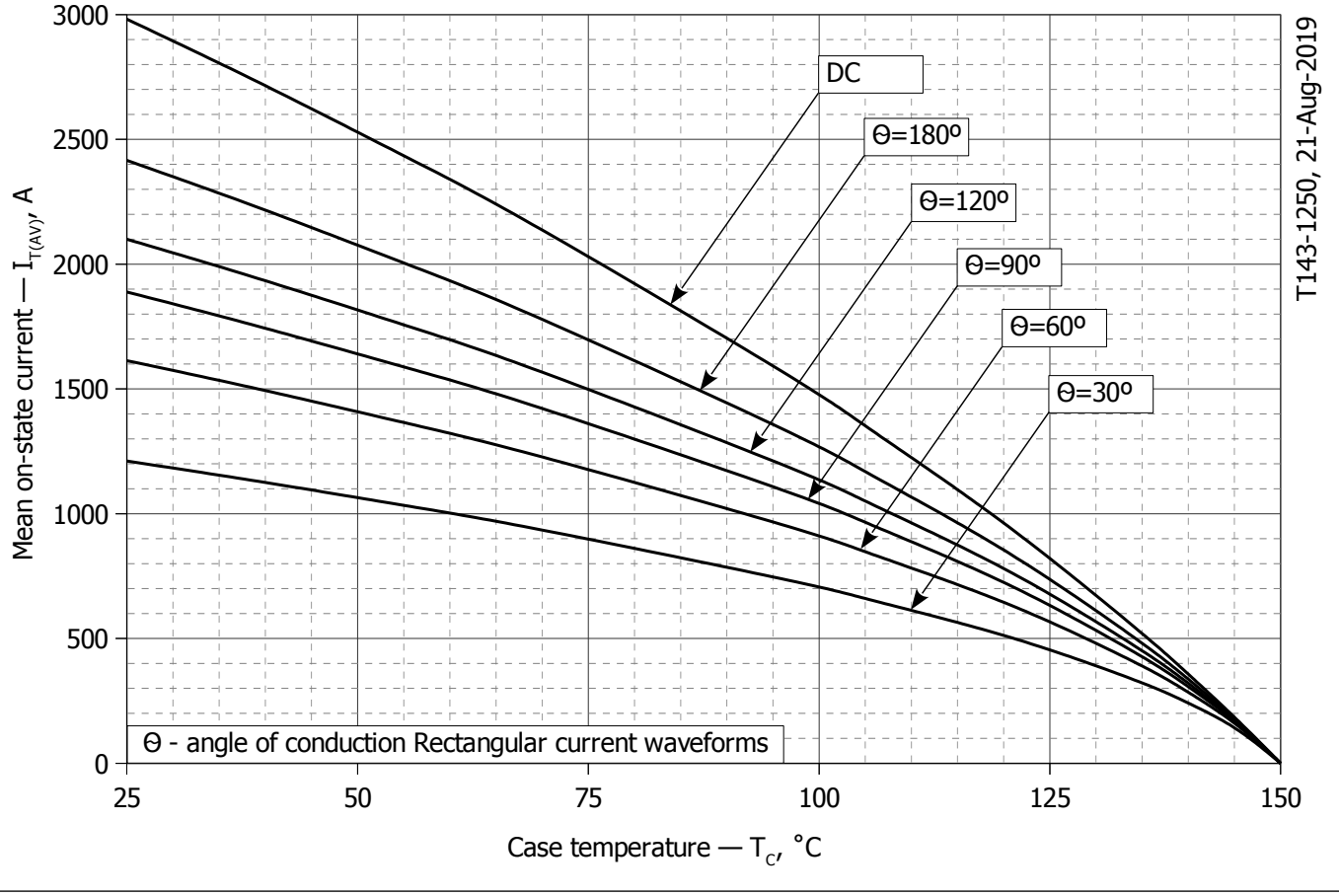



**Fig. 10 - Mean on-state current $I_{TAV}$ vs. case temperature $T_C$ for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)**

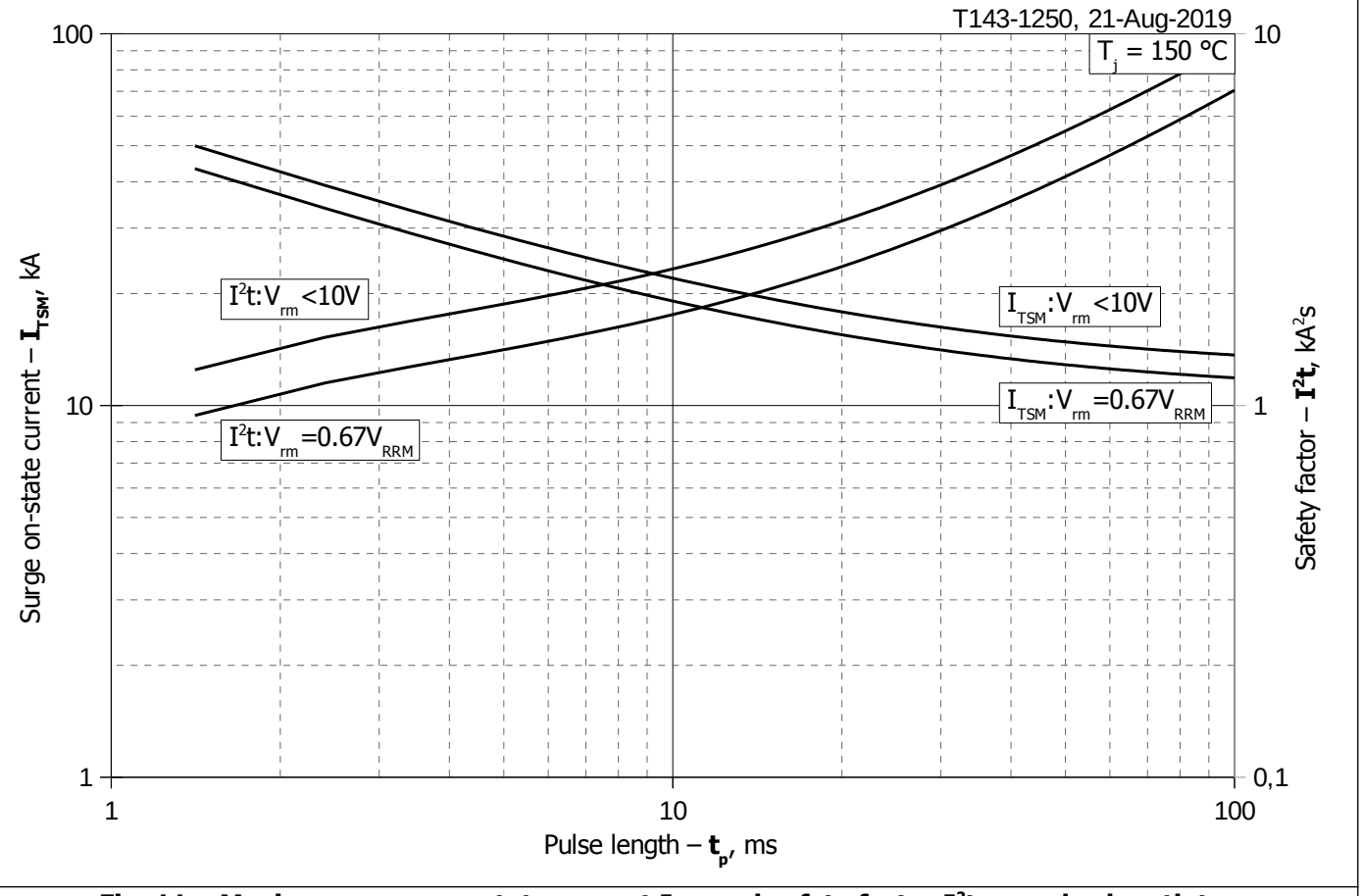



**Fig. 11 – Maximum surge on-state current $I_{TSM}$ and safety factor $I^2t$ vs. pulse length $t_p$**

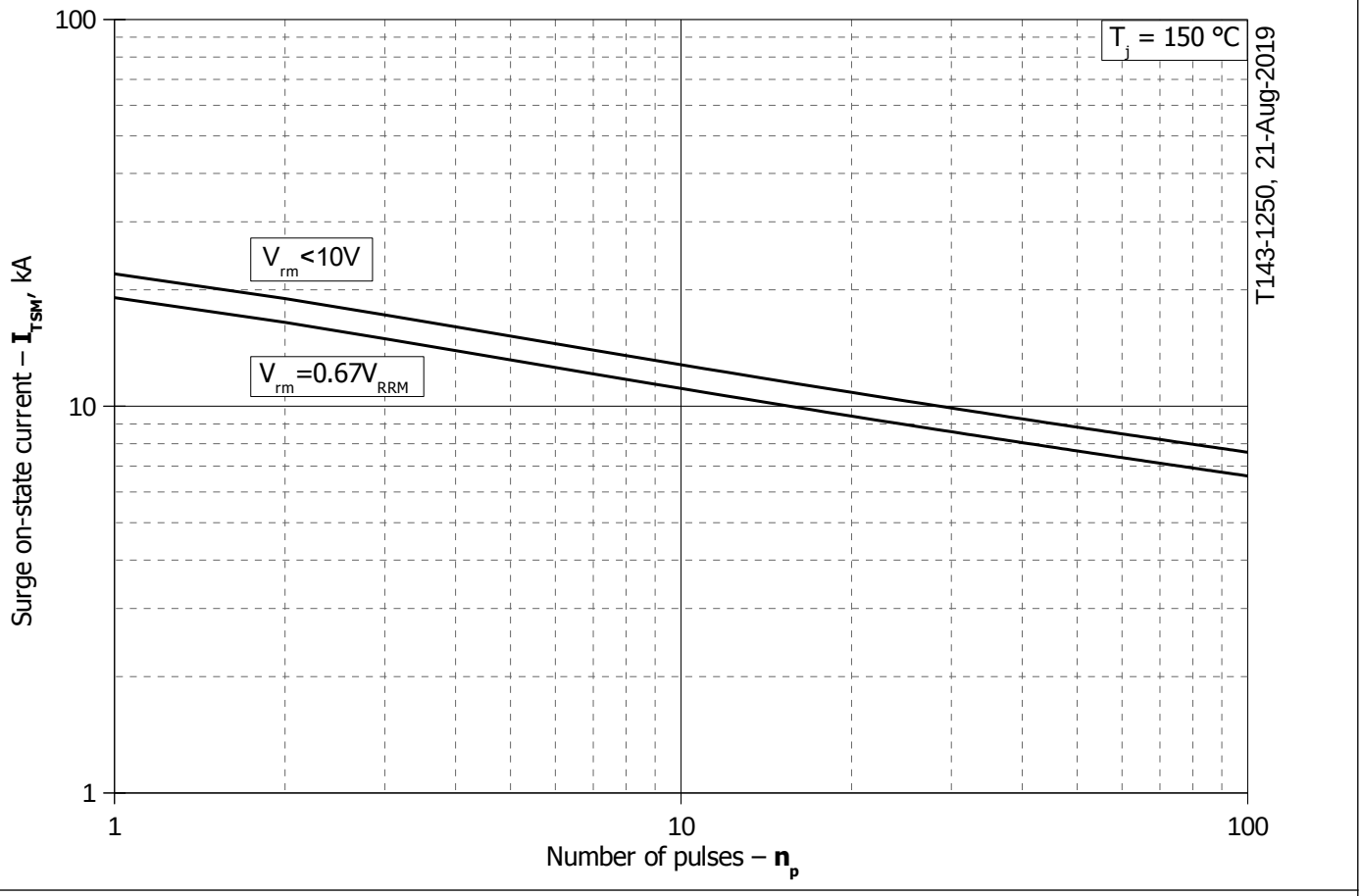



**Fig. 12 - Maximum surge on-state current $I_{TSM}$ vs. number of pulses $n_p$**