



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

## Phase Control Thyristor Type T143-800-18

|                                   |            |      |      |           |                                      |      |      |      |
|-----------------------------------|------------|------|------|-----------|--------------------------------------|------|------|------|
| Mean on-state current             |            |      |      | $I_{TAV}$ | 800 A                                |      |      |      |
| Repetitive peak off-state voltage |            |      |      | $V_{DRM}$ | 1000...1800 V                        |      |      |      |
| Repetitive peak reverse voltage   |            |      |      | $V_{RRM}$ |                                      |      |      |      |
| Turn-off time                     |            |      |      | $t_q$     | 160, 200, 250, 320, 400, 500 $\mu$ s |      |      |      |
| $V_{DRM}, V_{RRM}, V$             | 1000       | 1100 | 1200 | 1300      | 1400                                 | 1500 | 1600 | 1800 |
| Voltage code                      | 10         | 11   | 12   | 13        | 14                                   | 15   | 16   | 18   |
| $T_j, ^\circ C$                   | -60...+125 |      |      |           |                                      |      |      |      |

### MAXIMUM ALLOWABLE RATINGS

| Symbols and parameters |                                                                           | Units            | Values                                   | Test conditions                                                                                                                              |                                                                                                                                                                                                  |
|------------------------|---------------------------------------------------------------------------|------------------|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ON-STATE               |                                                                           |                  |                                          |                                                                                                                                              |                                                                                                                                                                                                  |
| $I_{TAV}$              | Maximum allowable mean on-state current                                   | A                | 800<br>796                               | $T_c=84\text{ }^{\circ}\text{C}$ , Double side cooled<br>$T_c=85\text{ }^{\circ}\text{C}$ , Double side cooled<br>180° half-sine wave; 50 Hz |                                                                                                                                                                                                  |
| $I_{TRMS}$             | RMS on-state current                                                      | A                | 1256                                     | $T_c=84\text{ }^{\circ}\text{C}$ , Double side cooled<br>180° half-sine wave; 50 Hz                                                          |                                                                                                                                                                                                  |
| $I_{TSM}$              | Surge on-state current                                                    | kA               | 14.0<br>16.0                             | $T_j=T_{j\text{ max}}$<br>$T_j=25\text{ }^{\circ}\text{C}$                                                                                   | 180° half-sine wave;<br>$t_p=10\text{ ms}$ ; single pulse;<br>$V_D=V_R=0\text{ V}$ ;<br>Gate pulse: $I_G=2\text{ A}$ ;<br>$t_{GP}=50\text{ }\mu\text{s}$ ; $di_G/dt\geq 1\text{ A}/\mu\text{s}$  |
|                        |                                                                           |                  | 15.0<br>17.0                             | $T_j=T_{j\text{ max}}$<br>$T_j=25\text{ }^{\circ}\text{C}$                                                                                   | 180° half-sine wave;<br>$t_p=8.3\text{ ms}$ ; single pulse;<br>$V_D=V_R=0\text{ V}$ ;<br>Gate pulse: $I_G=2\text{ A}$ ;<br>$t_{GP}=50\text{ }\mu\text{s}$ ; $di_G/dt\geq 1\text{ A}/\mu\text{s}$ |
| $I^2t$                 | Safety factor                                                             | $A^2s\cdot 10^3$ | 980<br>1280                              | $T_j=T_{j\text{ max}}$<br>$T_j=25\text{ }^{\circ}\text{C}$                                                                                   | 180° half-sine wave;<br>$t_p=10\text{ ms}$ ; single pulse;<br>$V_D=V_R=0\text{ V}$ ;<br>Gate pulse: $I_G=2\text{ A}$ ;<br>$t_{GP}=50\text{ }\mu\text{s}$ ; $di_G/dt\geq 1\text{ A}/\mu\text{s}$  |
|                        |                                                                           |                  | 930<br>1190                              | $T_j=T_{j\text{ max}}$<br>$T_j=25\text{ }^{\circ}\text{C}$                                                                                   | 180° half-sine wave;<br>$t_p=8.3\text{ ms}$ ; single pulse;<br>$V_D=V_R=0\text{ V}$ ;<br>Gate pulse: $I_G=2\text{ A}$ ;<br>$t_{GP}=50\text{ }\mu\text{s}$ ; $di_G/dt\geq 1\text{ A}/\mu\text{s}$ |
| BLOCKING               |                                                                           |                  |                                          |                                                                                                                                              |                                                                                                                                                                                                  |
| $V_{DRM}, V_{RRM}$     | Repetitive peak off-state and<br>Repetitive peak reverse voltages         | V                | 1000...1800                              | $T_{j\text{ min}} < T_j < T_{j\text{ max}}$ ;<br>180° half-sine wave; 50 Hz;<br>Gate open                                                    |                                                                                                                                                                                                  |
| $V_{DSM}, V_{RSM}$     | Non-repetitive peak off-state and<br>Non-repetitive peak reverse voltages | V                | 1100...1900                              | $T_{j\text{ min}} < T_j < T_{j\text{ max}}$ ;<br>180° half-sine wave; single pulse; Gate<br>open                                             |                                                                                                                                                                                                  |
| $V_D, V_R$             | Direct off-state and<br>Direct reverse voltages                           | V                | $0.6\cdot V_{DRM}$<br>$0.6\cdot V_{RRM}$ | $T_j=T_{j\text{ max}}$ ;<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/ $\mu$ s       | 1250        | $T_j = T_{j\max}$ ; $V_D = 0.67 \cdot V_{DRM}$ ; $I_{TM} = 2000$ A;<br>Gate pulse: $I_G = 2$ A;<br>$t_{GP} = 50$ $\mu$ s; $di_G/dt \geq 2$ A/ $\mu$ s |
| THERMAL            |                                                                      |                  |             |                                                                                                                                                       |
| $T_{stg}$          | Storage temperature                                                  | $^{\circ}$ C     | -60...+50   |                                                                                                                                                       |
| $T_j$              | Operating junction temperature                                       | $^{\circ}$ C     | -60...+125  |                                                                                                                                                       |
| MECHANICAL         |                                                                      |                  |             |                                                                                                                                                       |
| F                  | Mounting force                                                       | kN               | 14.0...16.0 |                                                                                                                                                       |
| a                  | Acceleration                                                         | m/s <sup>2</sup> | 50          | Device clamped                                                                                                                                        |

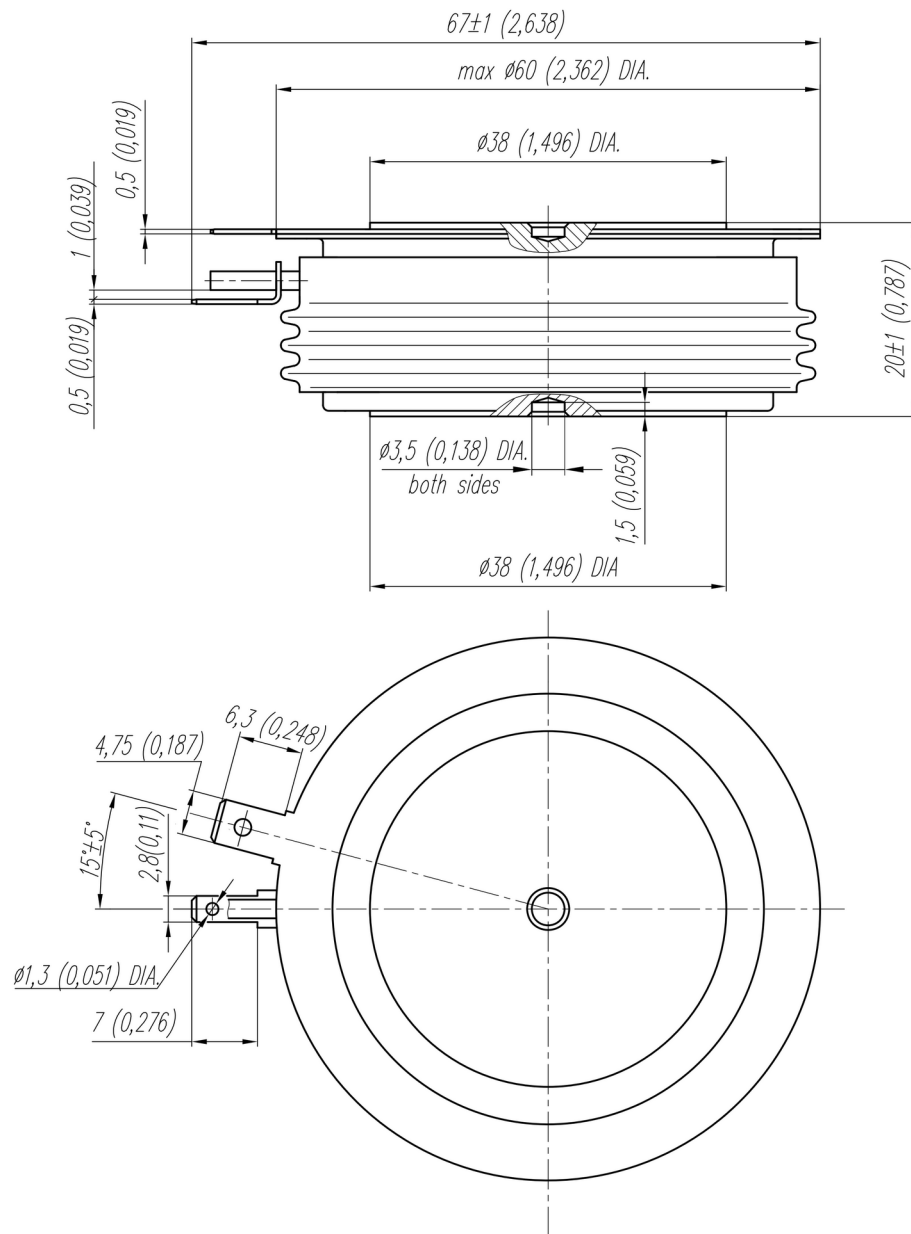
## CHARACTERISTICS

| Symbols and parameters                |                                                                        | Units | Values                                         | Conditions                                                                                                                                                                                             |                                                                   |
|---------------------------------------|------------------------------------------------------------------------|-------|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| ON-STATE                              |                                                                        |       |                                                |                                                                                                                                                                                                        |                                                                   |
| V <sub>TM</sub>                       | Peak on-state voltage, max                                             | V     | 1.70                                           | T <sub>j</sub> =25 °C; I <sub>TM</sub> =2512 A                                                                                                                                                         |                                                                   |
| V <sub>T(TO)</sub>                    | On-state threshold voltage, max                                        | V     | 0.938                                          | T <sub>j</sub> =T <sub>j max</sub> ;                                                                                                                                                                   |                                                                   |
| r <sub>T</sub>                        | On-state slope resistance, max                                         | mΩ    | 0.323                                          | 0.5 π I <sub>TAV</sub> < I <sub>T</sub> < 1.5 π I <sub>TAV</sub>                                                                                                                                       |                                                                   |
| I <sub>L</sub>                        | Latching current, max                                                  | mA    | 1000                                           | T <sub>j</sub> =25 °C; V <sub>D</sub> =12 V;<br>Gate pulse: I <sub>G</sub> =2 A;<br>t <sub>GP</sub> =50 μs; di <sub>G</sub> /dt≥1 A/μs                                                                 |                                                                   |
| I <sub>H</sub>                        | Holding current, max                                                   | mA    | 300                                            | T <sub>j</sub> =25 °C;<br>V <sub>D</sub> =12 V; Gate open                                                                                                                                              |                                                                   |
| BLOCKING                              |                                                                        |       |                                                |                                                                                                                                                                                                        |                                                                   |
| I <sub>DRM</sub> , I <sub>RRM</sub>   | Repetitive peak off-state and<br>Repetitive peak reverse currents, max | mA    | 100                                            | T <sub>j</sub> =T <sub>j max</sub> ;<br>V <sub>D</sub> =V <sub>DRM</sub> ; V <sub>R</sub> =V <sub>RRM</sub>                                                                                            |                                                                   |
| (dv <sub>D</sub> /dt) <sub>crit</sub> | Critical rate of rise of<br>off-state voltage <sup>1)</sup> , min      | V/μs  | 200, 320,<br>500, 1000,<br>1600, 2000,<br>2500 | T <sub>j</sub> =T <sub>j max</sub> ;<br>V <sub>D</sub> =0.67·V <sub>DRM</sub> ; Gate open                                                                                                              |                                                                   |
| TRIGGERING                            |                                                                        |       |                                                |                                                                                                                                                                                                        |                                                                   |
| V <sub>GT</sub>                       | Gate trigger direct voltage, max                                       | V     | 3.00<br>2.50<br>1.50                           | T <sub>j</sub> = T <sub>j min</sub><br>T <sub>j</sub> =25 °C<br>T <sub>j</sub> = T <sub>j max</sub>                                                                                                    | V <sub>D</sub> =12 V; I <sub>D</sub> =3 A;<br>Direct gate current |
| I <sub>GT</sub>                       | Gate trigger direct current, max                                       | mA    | 400<br>250<br>150                              | T <sub>j</sub> = T <sub>j min</sub><br>T <sub>j</sub> = 25 °C<br>T <sub>j</sub> = T <sub>j max</sub>                                                                                                   |                                                                   |
| V <sub>GD</sub>                       | Gate non-trigger direct voltage, min                                   | V     | 0.30                                           | T <sub>j</sub> =T <sub>j max</sub> ;<br>V <sub>D</sub> =0.67·V <sub>DRM</sub> ;                                                                                                                        |                                                                   |
| I <sub>GD</sub>                       | Gate non-trigger direct current, min                                   | mA    | 35.00                                          | Direct gate current                                                                                                                                                                                    |                                                                   |
| SWITCHING                             |                                                                        |       |                                                |                                                                                                                                                                                                        |                                                                   |
| t <sub>gd</sub>                       | Delay time, max                                                        | μs    | 0.80                                           | T <sub>j</sub> =25 °C; V <sub>D</sub> =1000 V; I <sub>TM</sub> =I <sub>TAV</sub> ;<br>di/dt=200 A/μs;                                                                                                  |                                                                   |
| t <sub>gt</sub>                       | Turn-on time, max                                                      | μs    | 3.00                                           | Gate pulse: I <sub>G</sub> =2 A; V <sub>G</sub> =20 V;<br>t <sub>GP</sub> =50 μs; di <sub>G</sub> /dt=2 A/μs                                                                                           |                                                                   |
| t <sub>q</sub>                        | Turn-off time <sup>2)</sup> , max                                      | μs    | 160, 200,<br>250, 320,<br>400, 500             | dv <sub>D</sub> /dt=50 V/μs; T <sub>j</sub> =T <sub>j max</sub> ; I <sub>TM</sub> = I <sub>TAV</sub> ;<br>di <sub>R</sub> /dt=-10 A/μs; V <sub>R</sub> =100V;<br>V <sub>D</sub> =0.67·V <sub>DRM</sub> |                                                                   |
| Q <sub>rr</sub>                       | Recovered charge, max                                                  | μC    | 1890                                           | T <sub>j</sub> =T <sub>j max</sub> ; I <sub>TM</sub> =800 A;                                                                                                                                           |                                                                   |
| t <sub>rr</sub>                       | Reverse recovery time, max                                             | μs    | 25                                             | di <sub>R</sub> /dt=-10 A/μs;                                                                                                                                                                          |                                                                   |
| I <sub>rr</sub>                       | Reverse recovery current, max                                          | A     | 151                                            | V <sub>R</sub> =100 V                                                                                                                                                                                  |                                                                   |

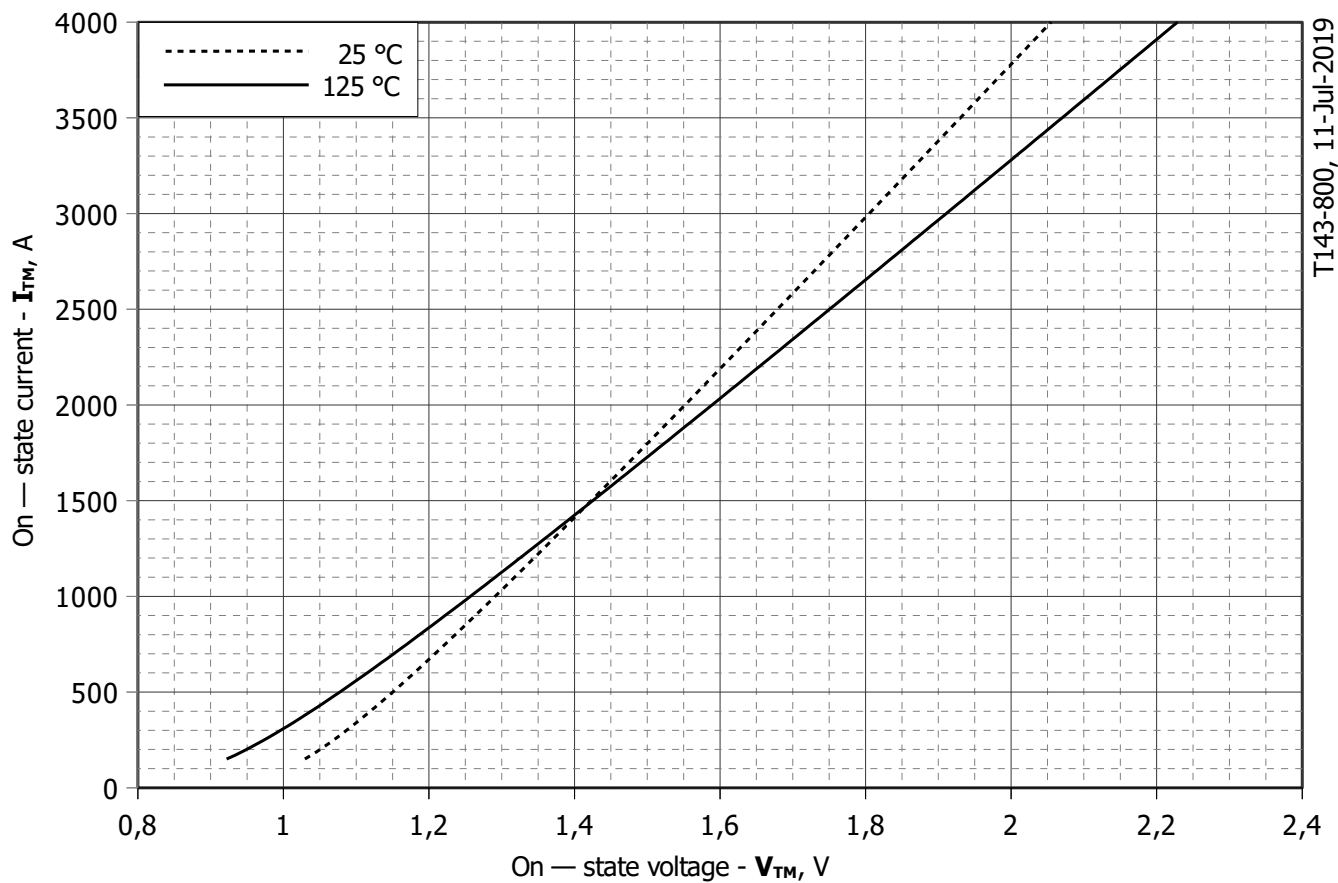
| THERMAL             |                                           |              |                  |                |                     |
|---------------------|-------------------------------------------|--------------|------------------|----------------|---------------------|
| R <sub>thjc</sub>   | Thermal resistance, junction to case, max | °C/W         | 0.0320           | Direct current | Double side cooled  |
| R <sub>thjc-A</sub> |                                           |              | 0.0704           |                | Anode side cooled   |
| R <sub>thjc-K</sub> |                                           |              | 0.0576           |                | Cathode side cooled |
| R <sub>thck</sub>   | Thermal resistance, case to heatsink, max | °C/W         | 0.0060           | Direct current |                     |
| MECHANICAL          |                                           |              |                  |                |                     |
| m                   | Weight, max                               | g            | 235              |                |                     |
| D <sub>s</sub>      | Surface creepage distance                 | mm<br>(inch) | 19.44<br>(0.765) |                |                     |
| D <sub>a</sub>      | Air strike distance                       | mm<br>(inch) | 12.10<br>(0.476) |                |                     |

| PART NUMBERING GUIDE                                |     |     |     |      |      |      | NOTES                                                                                                                                                                                                                                                                                                                               |  |                 |    |    |    |    |    |    |    |                           |     |     |     |      |      |      |      |
|-----------------------------------------------------|-----|-----|-----|------|------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----------------|----|----|----|----|----|----|----|---------------------------|-----|-----|-----|------|------|------|------|
| T                                                   | 143 | 800 | 18  | A2   | E2   | N    | <div>1) Critical rate of rise of off-state voltage</div> <table><tr><td>Symbol of Group</td><td>P2</td><td>K2</td><td>E2</td><td>A2</td><td>T1</td><td>P1</td><td>M1</td></tr><tr><td><math>(dv_D/dt)_{crit}</math>, V/μs</td><td>200</td><td>320</td><td>500</td><td>1000</td><td>1600</td><td>2000</td><td>2500</td></tr></table> |  | Symbol of Group | P2 | K2 | E2 | A2 | T1 | P1 | M1 | $(dv_D/dt)_{crit}$ , V/μs | 200 | 320 | 500 | 1000 | 1600 | 2000 | 2500 |
| Symbol of Group                                     | P2  | K2  | E2  | A2   | T1   | P1   |                                                                                                                                                                                                                                                                                                                                     |  | M1              |    |    |    |    |    |    |    |                           |     |     |     |      |      |      |      |
| $(dv_D/dt)_{crit}$ , V/μs                           | 200 | 320 | 500 | 1000 | 1600 | 2000 | 2500                                                                                                                                                                                                                                                                                                                                |  |                 |    |    |    |    |    |    |    |                           |     |     |     |      |      |      |      |
| 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     |     |     |     |      |      |      |                                                                                                                                                                                                                                                                                                                                     |  |                 |    |    |    |    |    |    |    |                           |     |     |     |      |      |      |      |

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



All dimensions in millimeters (inches)



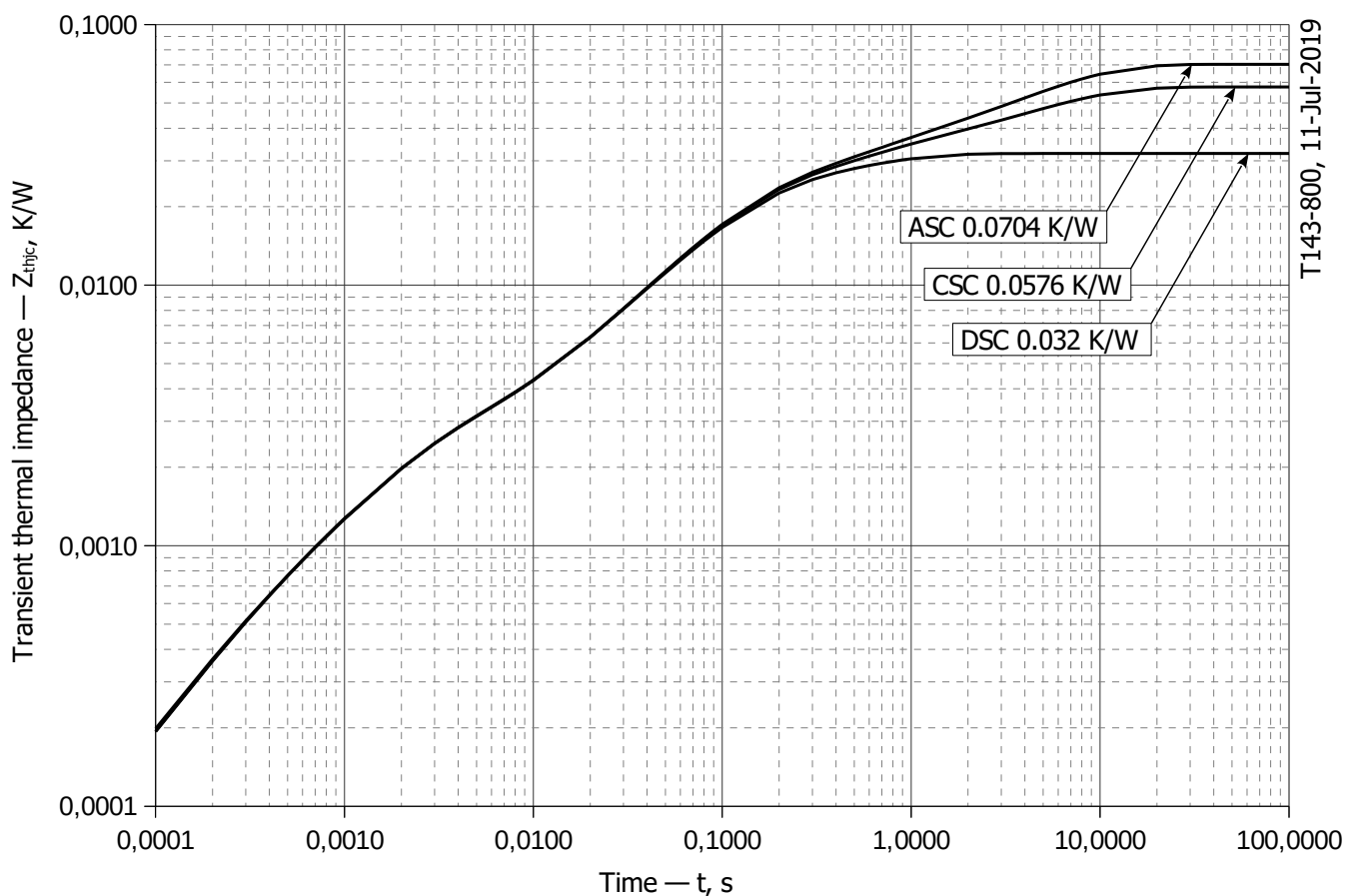
**Fig 1 – On-state characteristics of Limit device**

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 |                   |
|----------|-----------------------------|-------------------|
|          | $T_j = 25^\circ\text{C}$    | $T_j = T_{j\max}$ |
| <b>A</b> | 0.82614000                  | 0.65139000        |
| <b>B</b> | 0.00024594                  | 0.00031345        |
| <b>C</b> | 0.03486100                  | 0.04719700        |
| <b>D</b> | -0.00069745                 | -0.00107540       |

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



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**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 constant of  $r_{th}$  term.

DC Double side cooled

| $i$          | 1           | 2       | 3       | 4         | 5        | 6         |
|--------------|-------------|---------|---------|-----------|----------|-----------|
| $R_i$ , K/W  | 0.000005619 | 0.01031 | 0.01922 | 0.0004148 | 0.001895 | 0.0001521 |
| $\tau_i$ , s | 7.790       | 0.5094  | 0.09719 | 0.01725   | 0.0016   | 0.0002257 |

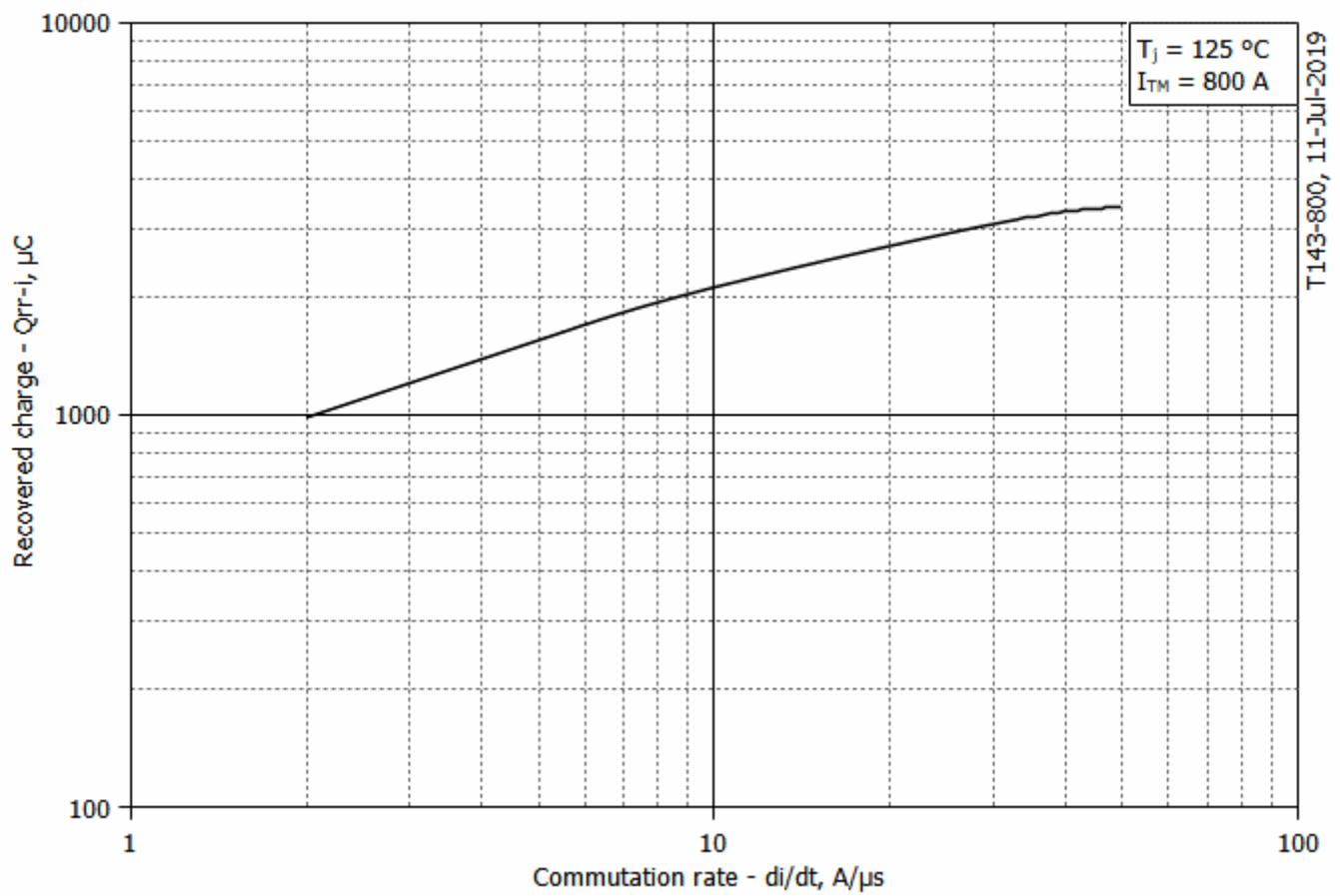
DC Anode side cooled

| $i$          | 1      | 2        | 3       | 4        | 5         | 6        |
|--------------|--------|----------|---------|----------|-----------|----------|
| $R_i$ , K/W  | 0.0381 | 0.008681 | 0.01867 | 0.001961 | 0.0001787 | 0.002771 |
| $\tau_i$ , s | 5.351  | 0.4584   | 0.09325 | 0.001734 | 0.0002174 | 0.9059   |

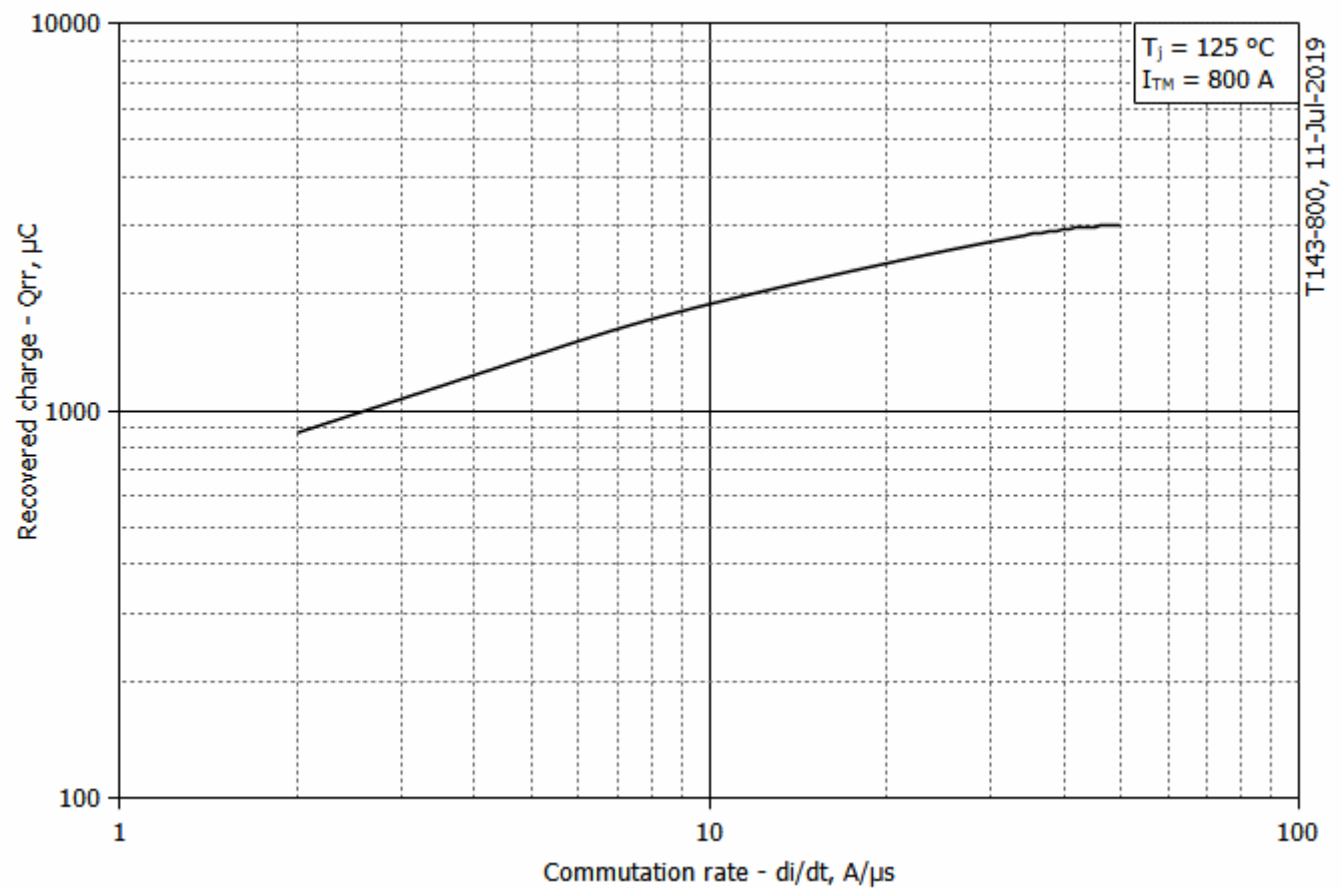
DC Cathode side cooled

| $i$          | 1       | 2        | 3       | 4        | 5         | 6       |
|--------------|---------|----------|---------|----------|-----------|---------|
| $R_i$ , K/W  | 0.02561 | 0.001472 | 0.01786 | 0.001926 | 0.0001928 | 0.01052 |
| $\tau_i$ , s | 5.328   | 0.1832   | 0.09031 | 0.001714 | 0.0002598 | 0.525   |

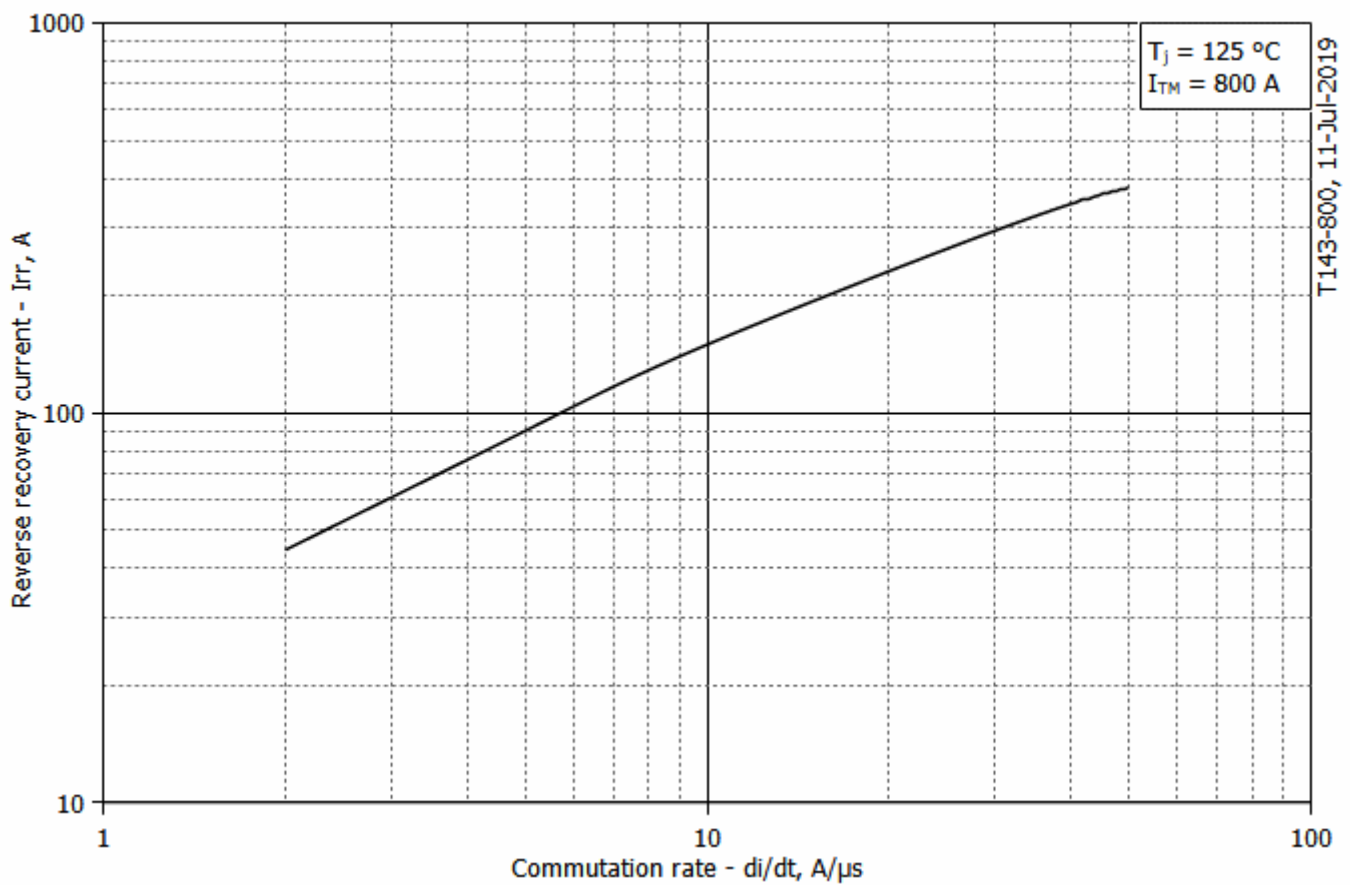
**Transient thermal impedance junction to case  $Z_{thjc}$  model (see Fig. 2)**



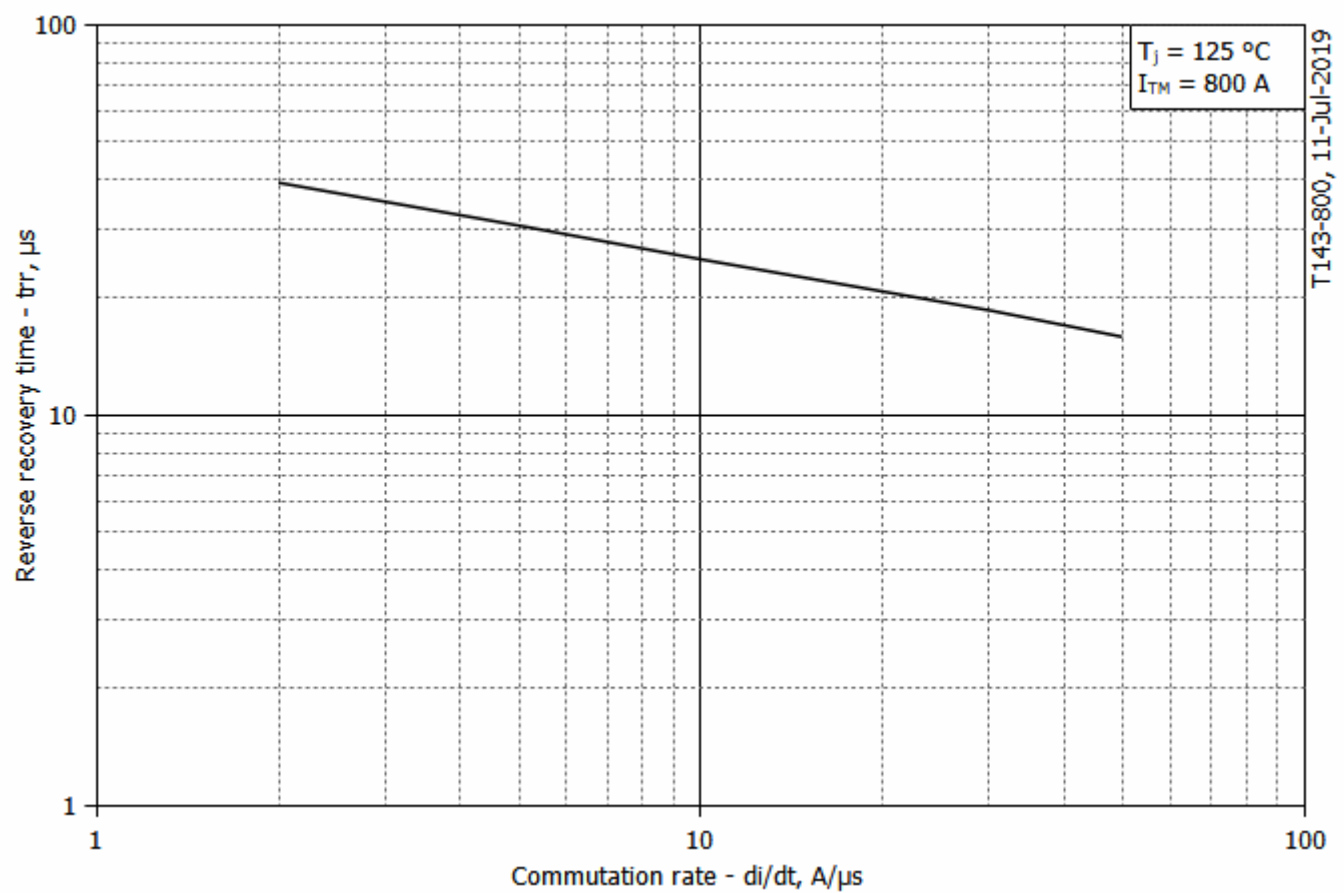
**Fig 3 – Maximum recovered charge  $Q_{rr-i}$  (integral) vs. commutation rate  $di_R/dt$**



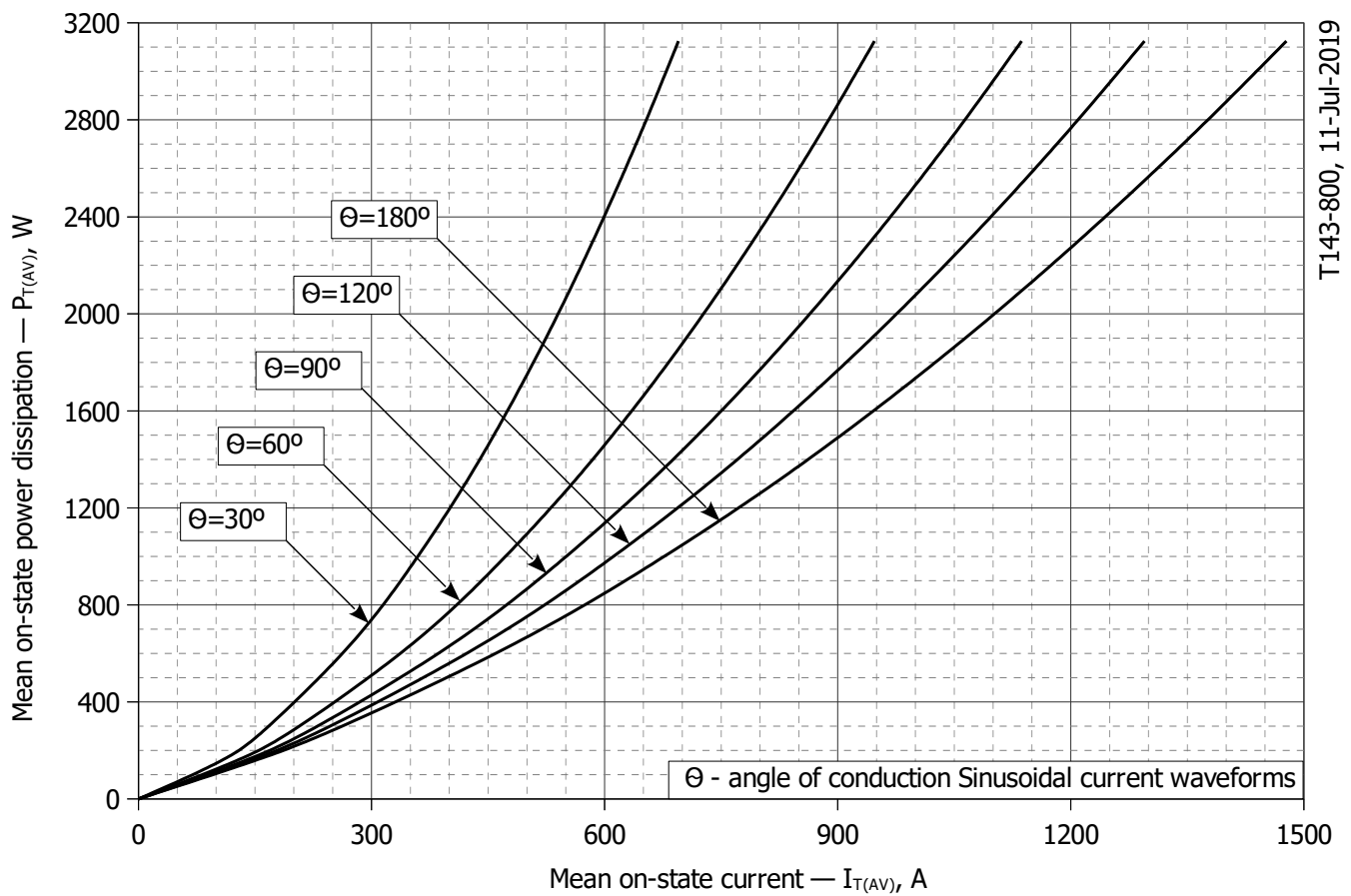
**Fig 4 – Maximum recovered charge  $Q_{rr}$  vs. commutation rate  $di_R/dt$  (25% chord)**



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

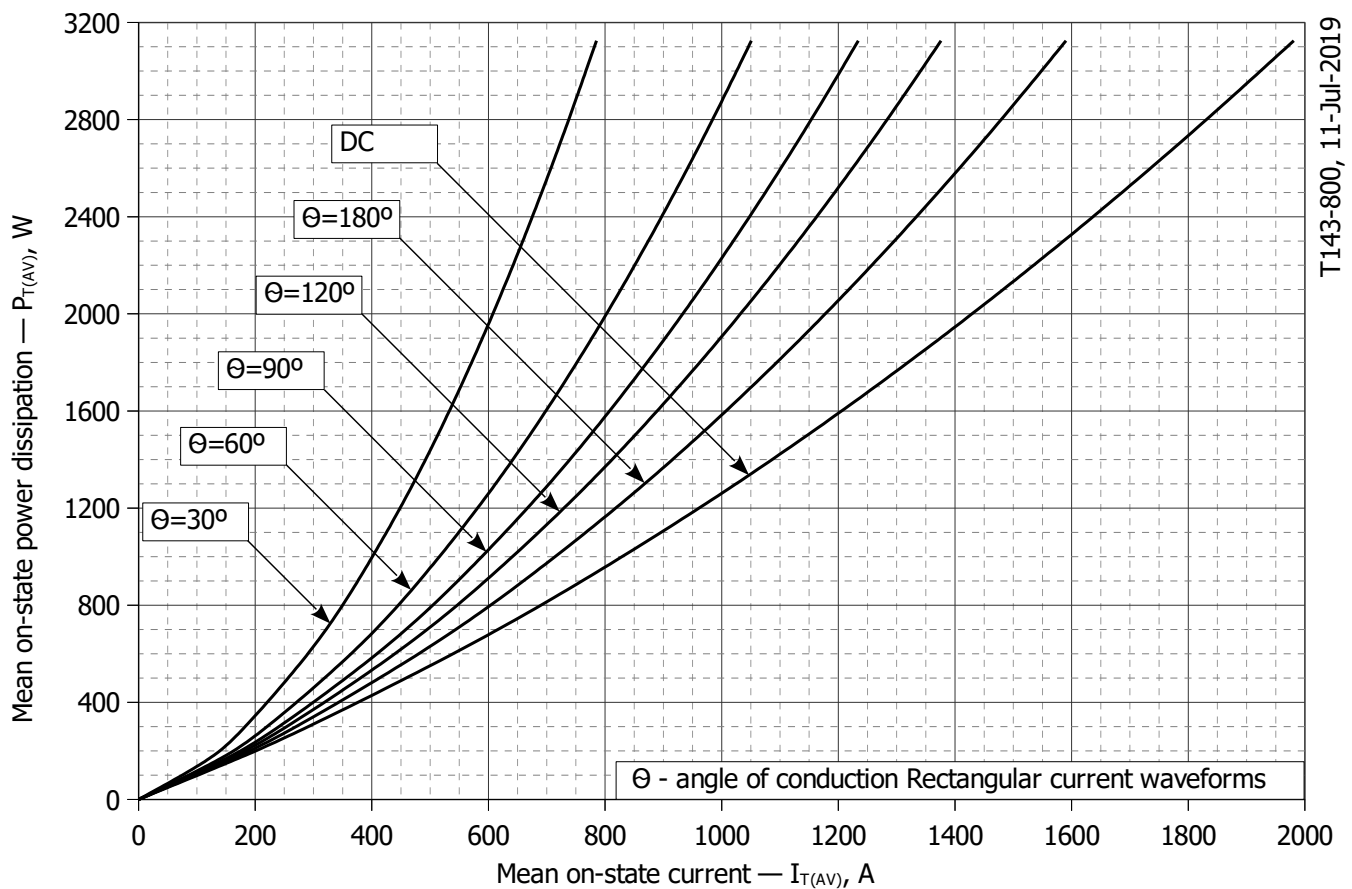


**Fig 6 – Maximum recovery time  $t_{rr}$  vs. commutation rate  $di_R/dt$  (25% chord)**



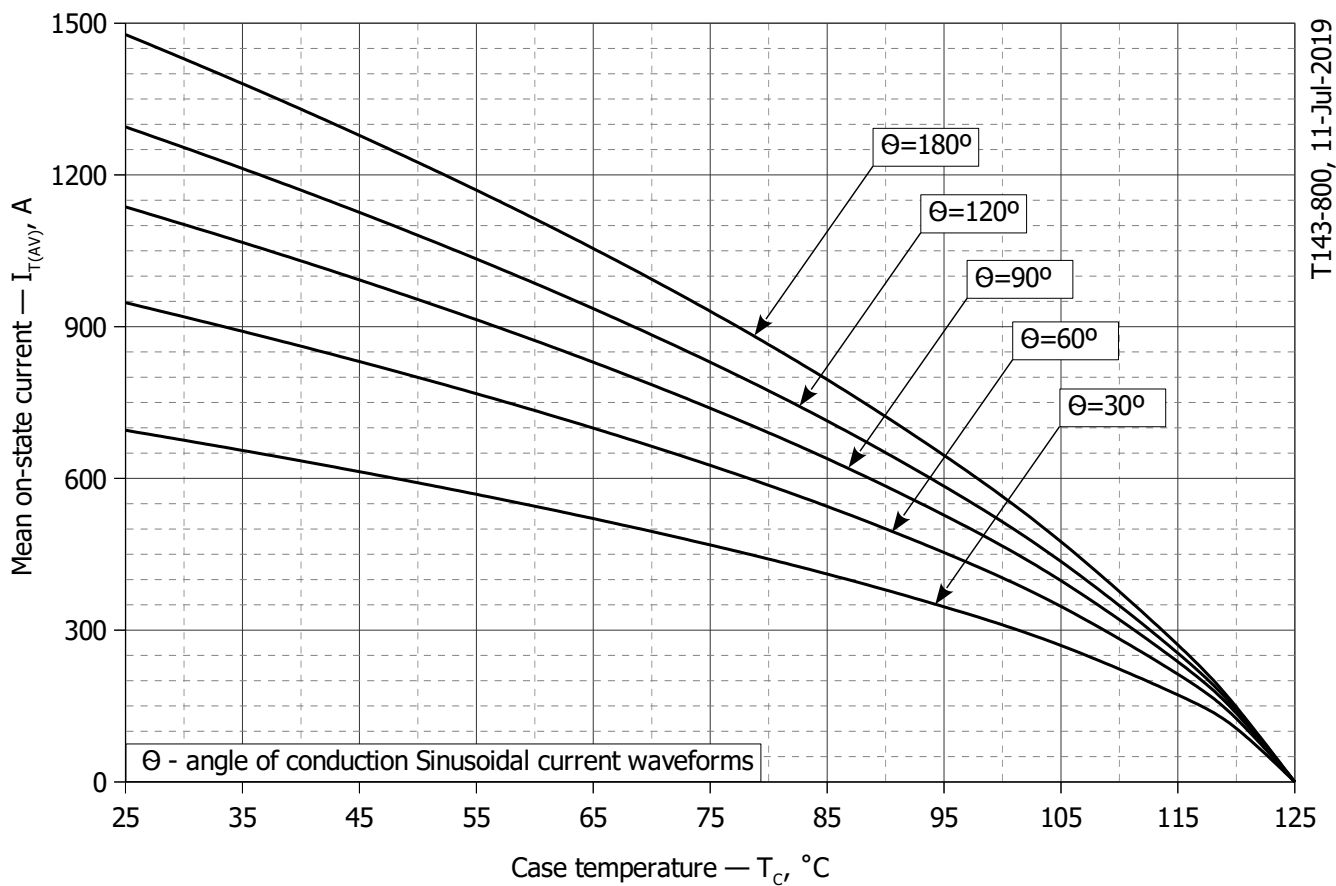
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**Fig. 7 - Mean on-state power dissipation  $P_{TAV}$  vs. mean on-state current  $I_{TAV}$  for sinusoidal current waveforms at different conduction angles ( $f=50\text{Hz}$ , DSC)**



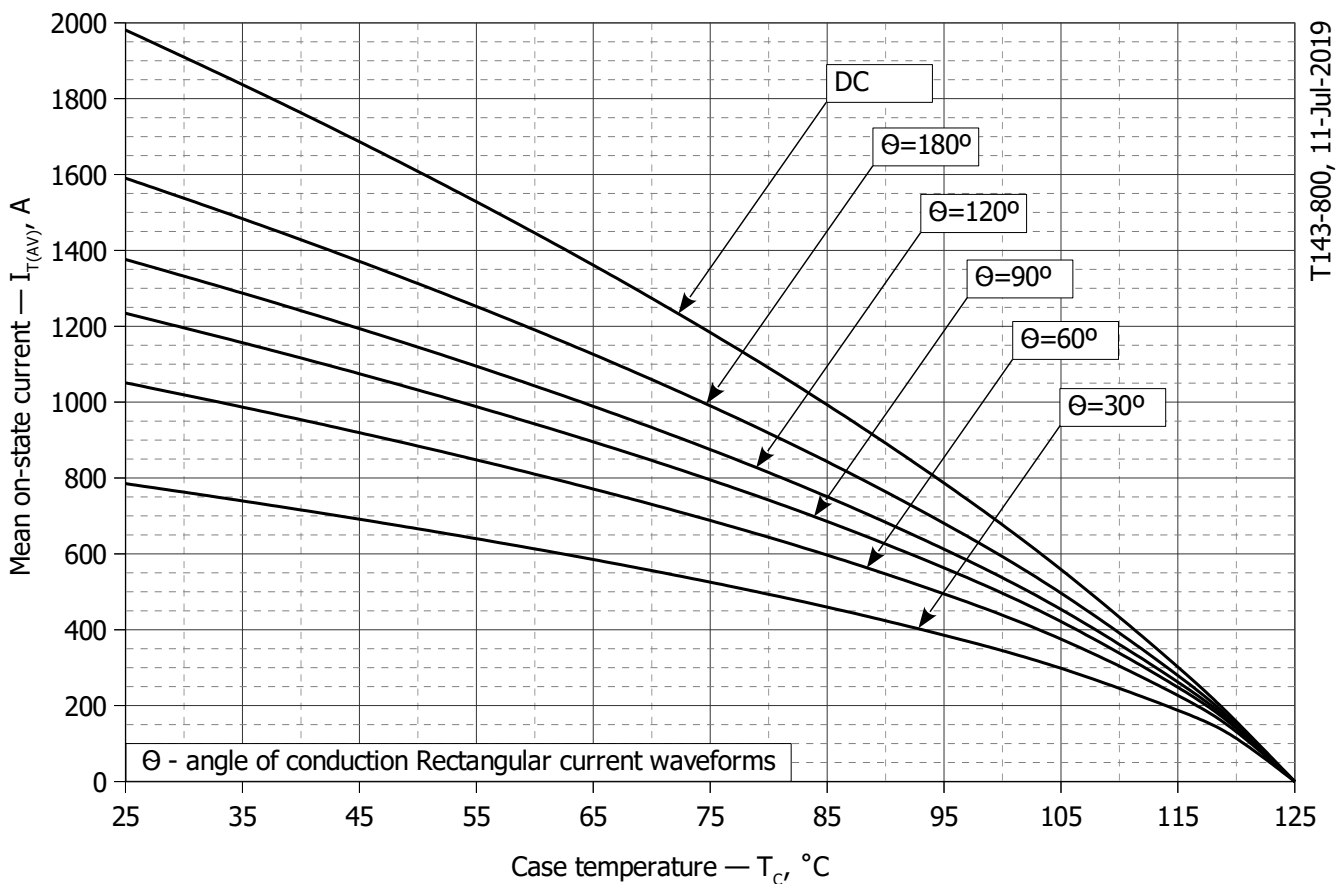
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**Fig. 8 – Mean on-state power dissipation  $P_{TAV}$  vs. mean on-state current  $I_{TAV}$  for rectangular current waveforms at different conduction angles and for DC ( $f=50\text{Hz}$ , DSC)**



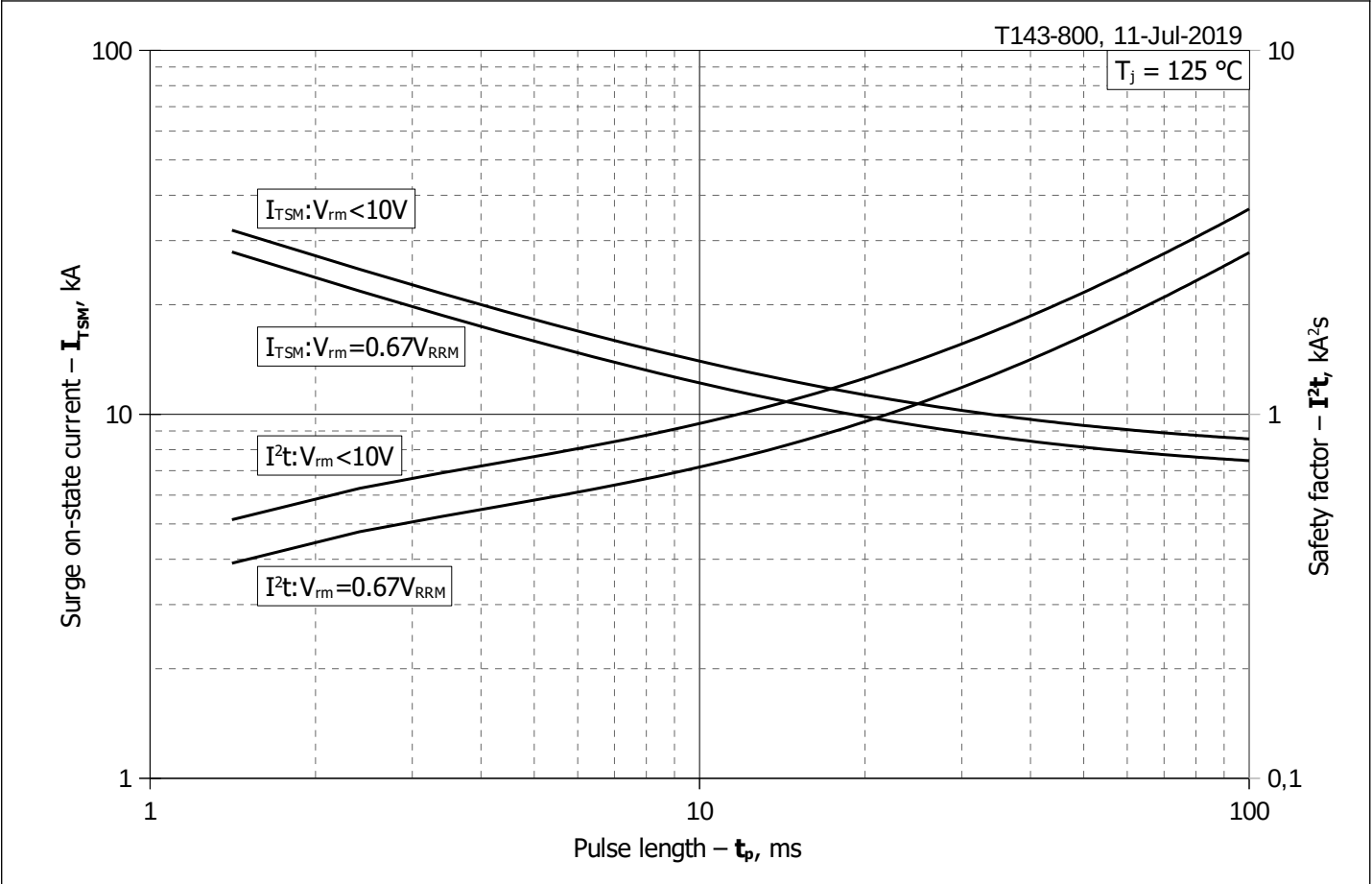
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**Fig. 9 – Mean on-state current  $I_{TAV}$  vs. case temperature  $T_c$  for sinusoidal current waveforms at different conduction angles ( $f=50\text{Hz}$ , DSC)**

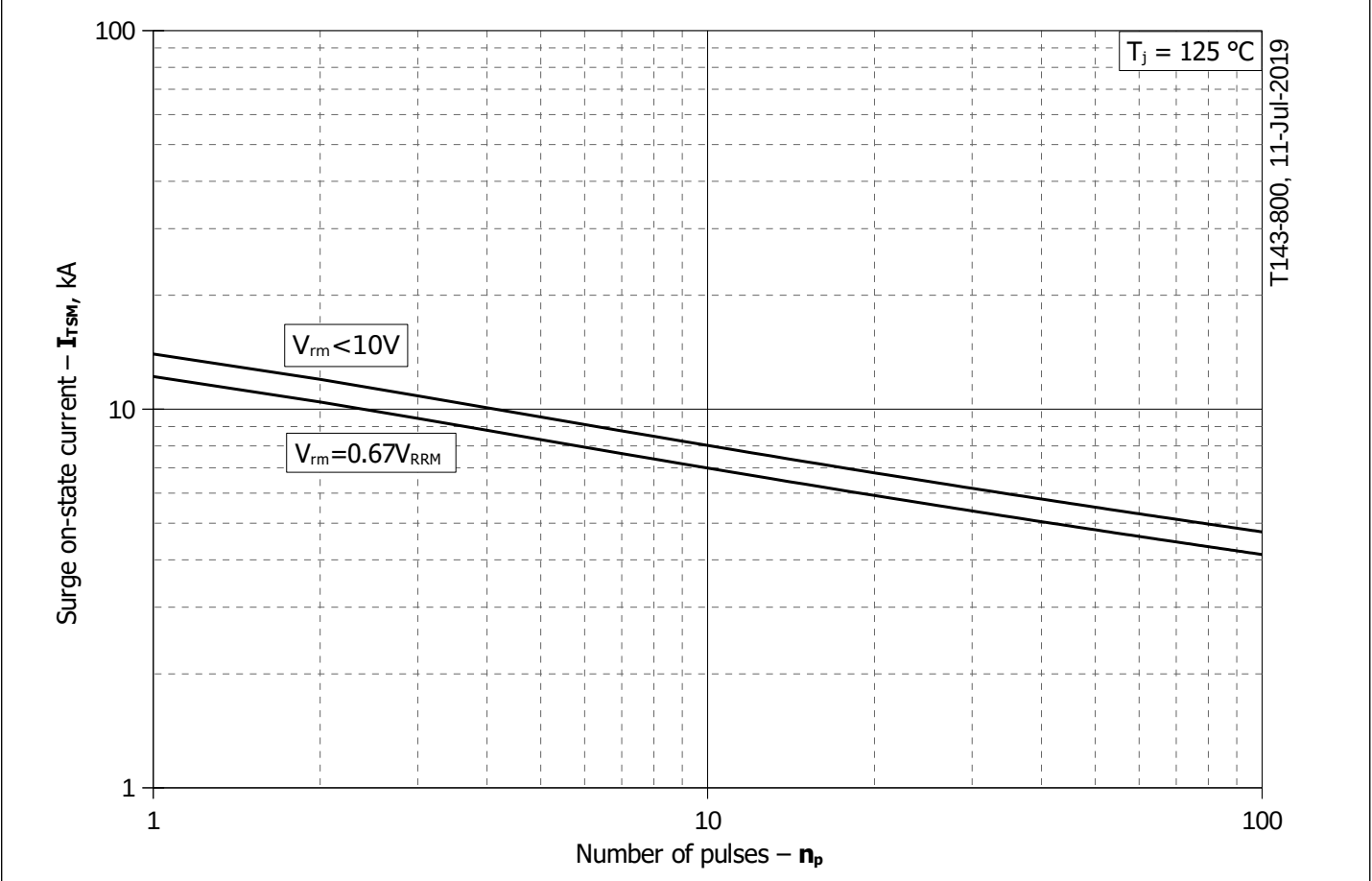


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**Fig. 10 - Mean on-state current  $I_{TAV}$  vs. case temperature  $T_c$  for rectangular current waveforms at different conduction angles and for DC ( $f=50\text{Hz}$ , DSC)**



**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  $n_p$**