



Low switching losses  
Low reverse recovery charge  
High power cycling capability

## Fast Recovery Diode Type DF253-1000-24

|                                 |            |                  |                           |
|---------------------------------|------------|------------------|---------------------------|
| Average forward current         |            | I <sub>FAV</sub> | 1000 A                    |
| Repetitive peak reverse voltage |            | V <sub>RRM</sub> | 2000...2400 V             |
| Reverse recovery time           |            | t <sub>rr</sub>  | 4.00, 5.00, 6.30, 8.00 μs |
| V <sub>RRM</sub> , V            | 2000       | 2200             | 2400                      |
| Voltage code                    | 20         | 22               | 24                        |
| T <sub>j</sub> , °C             | -60...+125 |                  |                           |

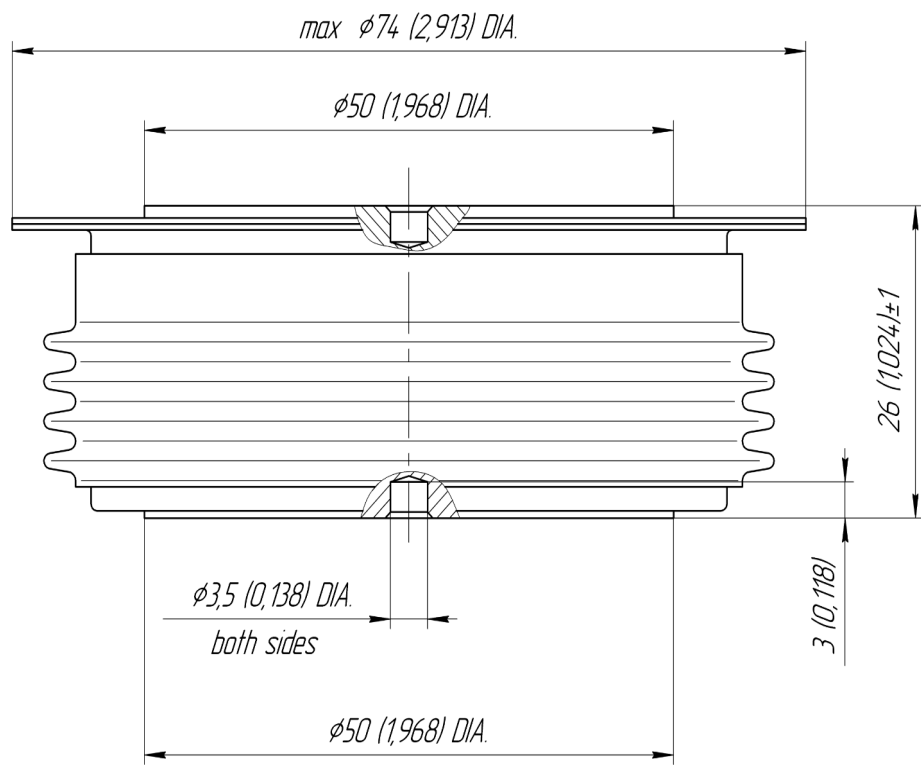
### MAXIMUM ALLOWABLE RATINGS

| Symbols and parameters |                                           | Units                            | Values               | Test conditions                                                                                                        |                                                                                       |
|------------------------|-------------------------------------------|----------------------------------|----------------------|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| ON-STATE               |                                           |                                  |                      |                                                                                                                        |                                                                                       |
| I <sub>FAV</sub>       | Maximum allowable average forward current | A                                | 1000<br>1559         | T <sub>c</sub> =87 °C; Double side cooled;<br>T <sub>c</sub> =55 °C; Double side cooled;<br>180° half-sine wave; 50 Hz |                                                                                       |
| I <sub>FRMS</sub>      | RMS forward current                       | A                                | 1570                 | T <sub>c</sub> =87 °C; Double side cooled;<br>180° half-sine wave; 50 Hz                                               |                                                                                       |
| I <sub>FSM</sub>       | Surge forward current                     | kA                               | 29.0<br>33.0         | T <sub>j</sub> =T <sub>j max</sub><br>T <sub>j</sub> =25 °C                                                            | 180° half-sine wave;<br>t <sub>p</sub> =10 ms; single pulse;<br>V <sub>R</sub> =0 V;  |
|                        |                                           |                                  | 30.0<br>35.0         | T <sub>j</sub> =T <sub>j max</sub><br>T <sub>j</sub> =25 °C                                                            | 180° half-sine wave;<br>t <sub>p</sub> =8.3 ms; single pulse;<br>V <sub>R</sub> =0 V; |
| I <sup>2</sup> t       | Safety factor                             | A <sup>2</sup> s·10 <sup>3</sup> | 4200<br>5400         | T <sub>j</sub> =T <sub>j max</sub><br>T <sub>j</sub> =25 °C                                                            | 180° half-sine wave;<br>t <sub>p</sub> =10 ms; single pulse;<br>V <sub>R</sub> =0 V;  |
|                        |                                           |                                  | 3700<br>5000         | T <sub>j</sub> =T <sub>j max</sub><br>T <sub>j</sub> =25 °C                                                            | 180° half-sine wave;<br>t <sub>p</sub> =8.3 ms; single pulse;<br>V <sub>R</sub> =0 V; |
| BLOCKING               |                                           |                                  |                      |                                                                                                                        |                                                                                       |
| V <sub>RRM</sub>       | Repetitive peak reverse voltages          | V                                | 2000...2400          | T <sub>j min</sub> < T <sub>j</sub> < T <sub>j max</sub> ;<br>180° half-sine wave; 50 Hz;                              |                                                                                       |
| V <sub>RSM</sub>       | Non-repetitive peak reverse voltages      | V                                | 2100...2500          | T <sub>j min</sub> < T <sub>j</sub> < T <sub>j max</sub> ;<br>180° half-sine wave; single pulse;                       |                                                                                       |
| V <sub>R</sub>         | Reverse continuous voltages               | V                                | 0.6·V <sub>RRM</sub> | T <sub>j</sub> =T <sub>j max</sub> ;                                                                                   |                                                                                       |
| THERMAL                |                                           |                                  |                      |                                                                                                                        |                                                                                       |
| T <sub>stg</sub>       | Storage temperature                       | °C                               | −60...+55            |                                                                                                                        |                                                                                       |
| T <sub>j</sub>         | Operating junction temperature            | °C                               | −60...+125           |                                                                                                                        |                                                                                       |
| MECHANICAL             |                                           |                                  |                      |                                                                                                                        |                                                                                       |
| F                      | Mounting force                            | kN                               | 24.0...28.0          |                                                                                                                        |                                                                                       |
| a                      | Acceleration                              | m/s <sup>2</sup>                 | 50                   | Device clamped                                                                                                         |                                                                                       |

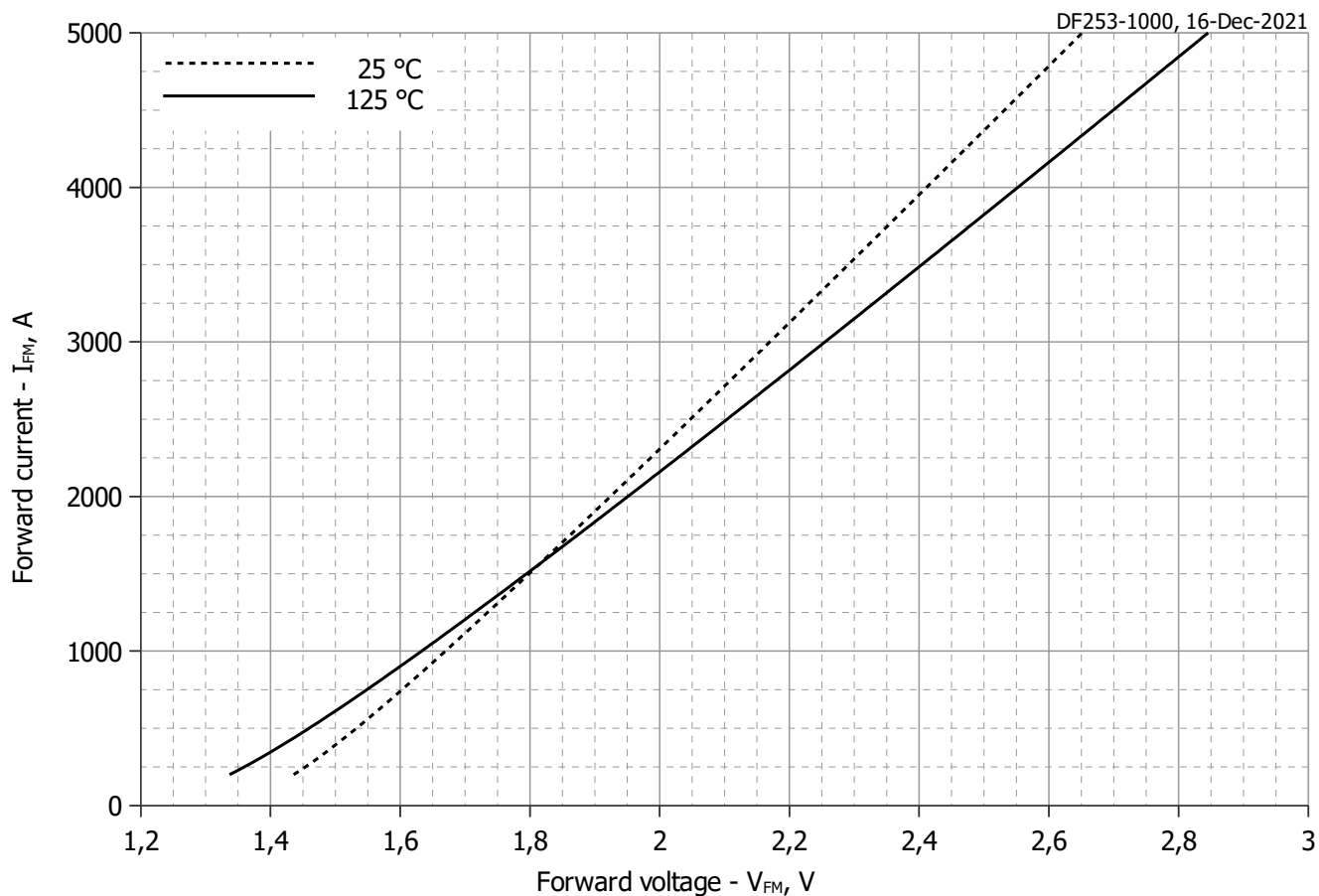
## CHARACTERISTICS

| Symbols and parameters |                                           | Units        | Values                    | Conditions                                                               |                     |
|------------------------|-------------------------------------------|--------------|---------------------------|--------------------------------------------------------------------------|---------------------|
| ON-STATE               |                                           |              |                           |                                                                          |                     |
| V <sub>FM</sub>        | Peak forward voltage, max                 | V            | 2.20                      | T <sub>j</sub> =25 °C; I <sub>FM</sub> =3140 A                           |                     |
| V <sub>F(TO)</sub>     | Forward threshold voltage, max            | V            | 1.344                     | T <sub>j</sub> =T <sub>j max</sub> ;                                     |                     |
| r <sub>T</sub>         | Forward slope resistance, max             | mΩ           | 0.301                     | 0.5 π I <sub>FAV</sub> < I <sub>T</sub> < 1.5 π I <sub>FAV</sub>         |                     |
| BLOCKING               |                                           |              |                           |                                                                          |                     |
| I <sub>RRM</sub>       | Repetitive peak reverse current, max      | mA           | 120                       | T <sub>j</sub> =T <sub>j max</sub> ;<br>V <sub>R</sub> =V <sub>RRM</sub> |                     |
| SWITCHING              |                                           |              |                           |                                                                          |                     |
| Q <sub>r</sub>         | Recovered charge, max                     | μC           | 500                       | T <sub>j</sub> =T <sub>j max</sub> ; I <sub>FM</sub> =I <sub>FAV</sub> ; |                     |
| t <sub>rr</sub>        | Reverse recovery time <sup>1)</sup> , max | μs           | 4.00, 5.00,<br>6.30, 8.00 | di <sub>R</sub> /dt=-100 A/μs;                                           |                     |
| I <sub>rr</sub>        | Reverse recovery current, max             | A            | 250                       | V <sub>R</sub> =100 V;                                                   |                     |
| THERMAL                |                                           |              |                           |                                                                          |                     |
| R <sub>thjc</sub>      | Thermal resistance, junction to case, max | °C/W         | 0.0180                    | Direct current                                                           | Double side cooled  |
| R <sub>thjc-A</sub>    |                                           |              | 0.0396                    |                                                                          | Anode side cooled   |
| R <sub>thjc-K</sub>    |                                           |              | 0.0324                    |                                                                          | Cathode side cooled |
| R <sub>thck</sub>      | Thermal resistance, case to heatsink, max | °C/W         | 0.0040                    | Direct current                                                           |                     |
| MECHANICAL             |                                           |              |                           |                                                                          |                     |
| m                      | Weight, max                               | g            | 550                       |                                                                          |                     |
| D <sub>s</sub>         | Surface creepage distance                 | mm<br>(inch) | 38.84<br>(1.529)          |                                                                          |                     |
| D <sub>a</sub>         | Air strike distance                       | mm<br>(inch) | 22.50<br>(0.886)          |                                                                          |                     |

| PART NUMBERING GUIDE                            |     |      |    |    |   | NOTES                    |  |  |  |  |
|-------------------------------------------------|-----|------|----|----|---|--------------------------|--|--|--|--|
| DF                                              | 253 | 1000 | 24 | H4 | N | 1) Reverse recovery time |  |  |  |  |
| 1                                               | 2   | 3    | 4  | 5  | 6 |                          |  |  |  |  |
| 1. Fast recovery diode                          |     |      |    |    |   |                          |  |  |  |  |
| 2. Design version                               |     |      |    |    |   |                          |  |  |  |  |
| 3. Average forward current, A                   |     |      |    |    |   |                          |  |  |  |  |
| 4. Voltage code                                 |     |      |    |    |   |                          |  |  |  |  |
| 5. Group of reverse recovery time               |     |      |    |    |   |                          |  |  |  |  |
| 6. Ambient conditions: N – normal; T – tropical |     |      |    |    |   |                          |  |  |  |  |
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All dimensions in millimeters (inches)



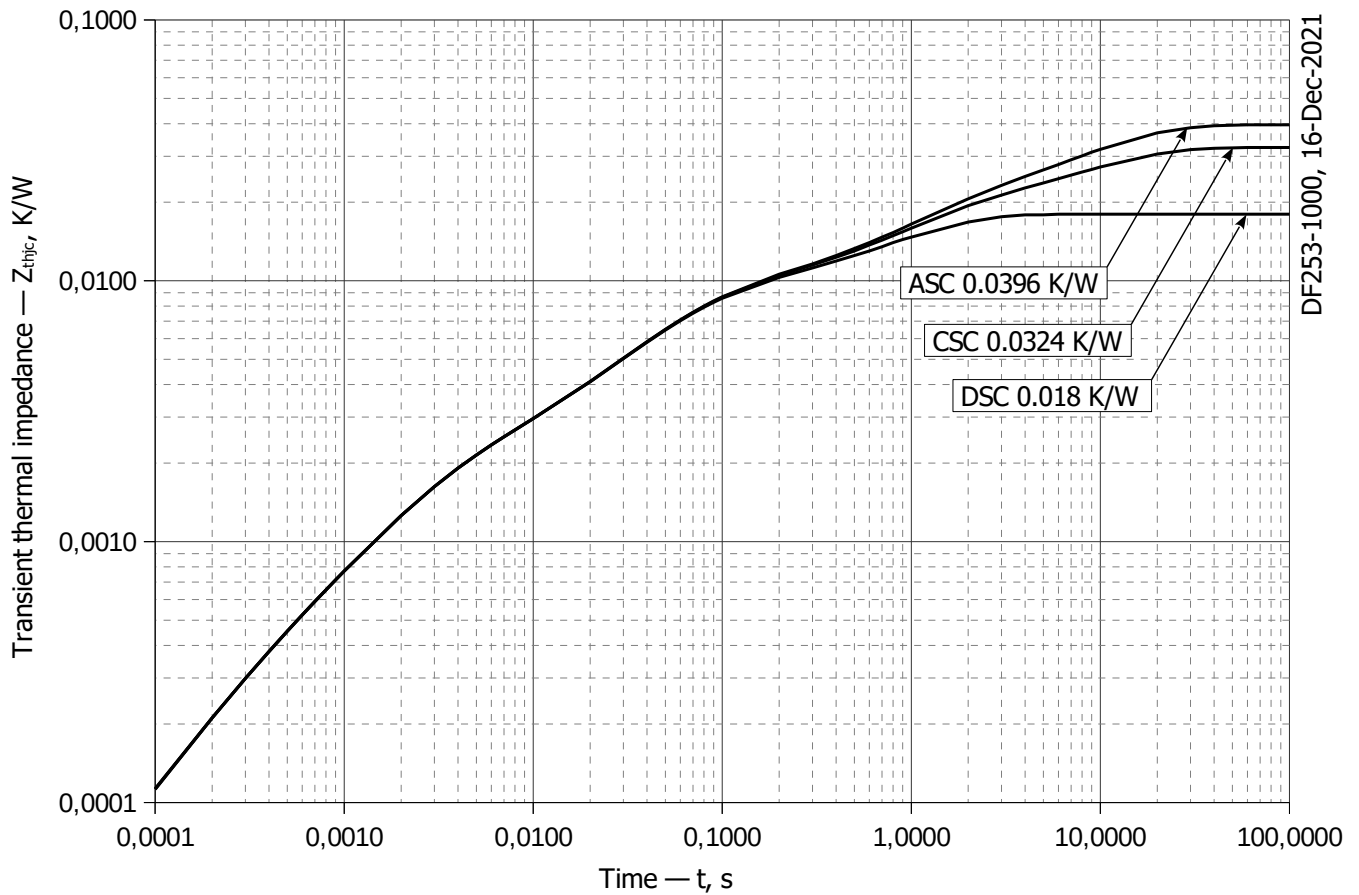
**Fig 1 – Forward characteristics of Limit device**

Analytical function for Forward characteristic:

$$V_F = A + B \cdot i_F + C \cdot \ln(i_F + 1) + D \cdot \sqrt{i_F}$$

|          | Coefficients for max curves |                          |
|----------|-----------------------------|--------------------------|
|          | $T_j = 25^\circ\text{C}$    | $T_j = T_{j\text{ max}}$ |
| <b>A</b> | 1.24304390                  | 1.12025142               |
| <b>B</b> | 0.00023116                  | 0.00027060               |
| <b>C</b> | 0.02663995                  | 0.02441665               |
| <b>D</b> | 0.00036122                  | 0.00232376               |

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

DC Double side cooled

| $i$          | 1        | 2        | 3        | 4        | 5         | 6          |
|--------------|----------|----------|----------|----------|-----------|------------|
| $R_i$ , K/W  | 0.009241 | 0.006037 | 0.001231 | 0.001054 | 0.0003396 | 0.00009575 |
| $\tau_i$ , s | 0.9673   | 0.04967  | 0.002733 | 0.07734  | 0.001638  | 0.0002248  |

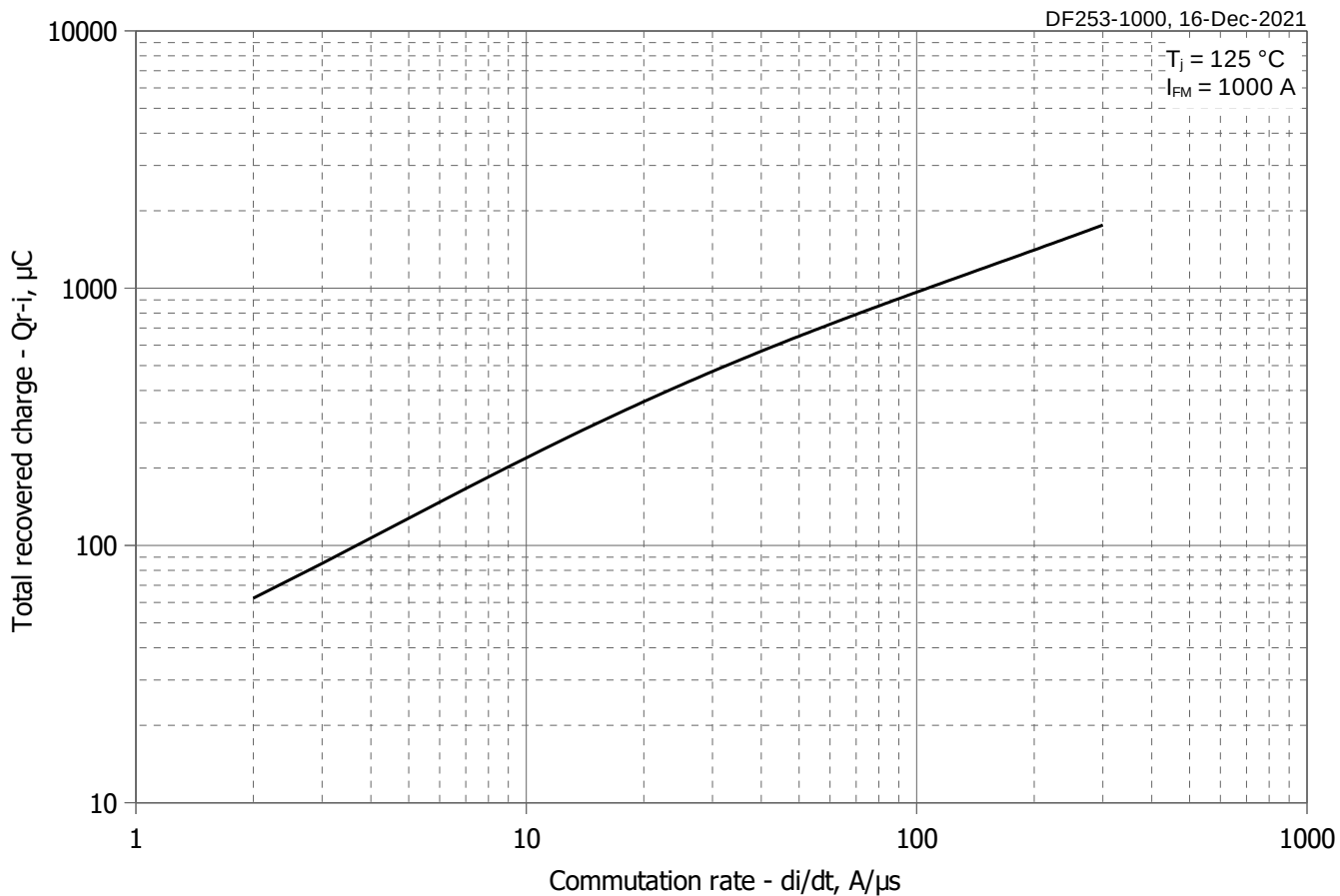
DC Cathode side cooled

| $i$          | 1      | 2        | 3        | 4        | 5        | 6         |
|--------------|--------|----------|----------|----------|----------|-----------|
| $R_i$ , K/W  | 0.0144 | 0.009281 | 0.006055 | 0.001018 | 0.001535 | 0.0001182 |
| $\tau_i$ , s | 9.745  | 1.028    | 0.05591  | 0.03732  | 0.002468 | 0.0002687 |

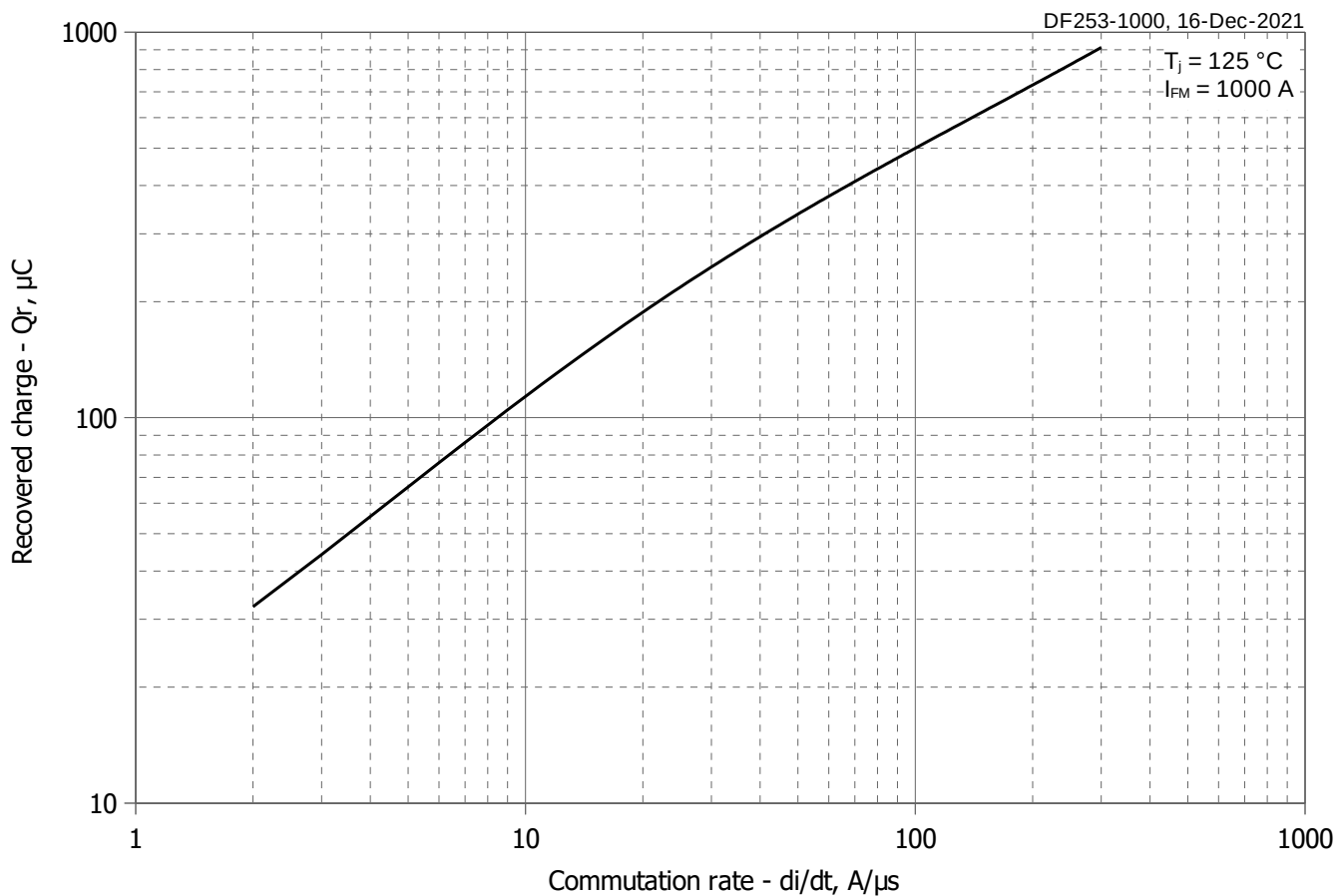
DC Anode side cooled

| $i$          | 1      | 2        | 3        | 4         | 5        | 6         |
|--------------|--------|----------|----------|-----------|----------|-----------|
| $R_i$ , K/W  | 0.0216 | 0.009325 | 0.006949 | 0.0001252 | 0.001516 | 0.0001119 |
| $\tau_i$ , s | 9.752  | 1.065    | 0.05344  | 0.01407   | 0.002421 | 0.0002554 |

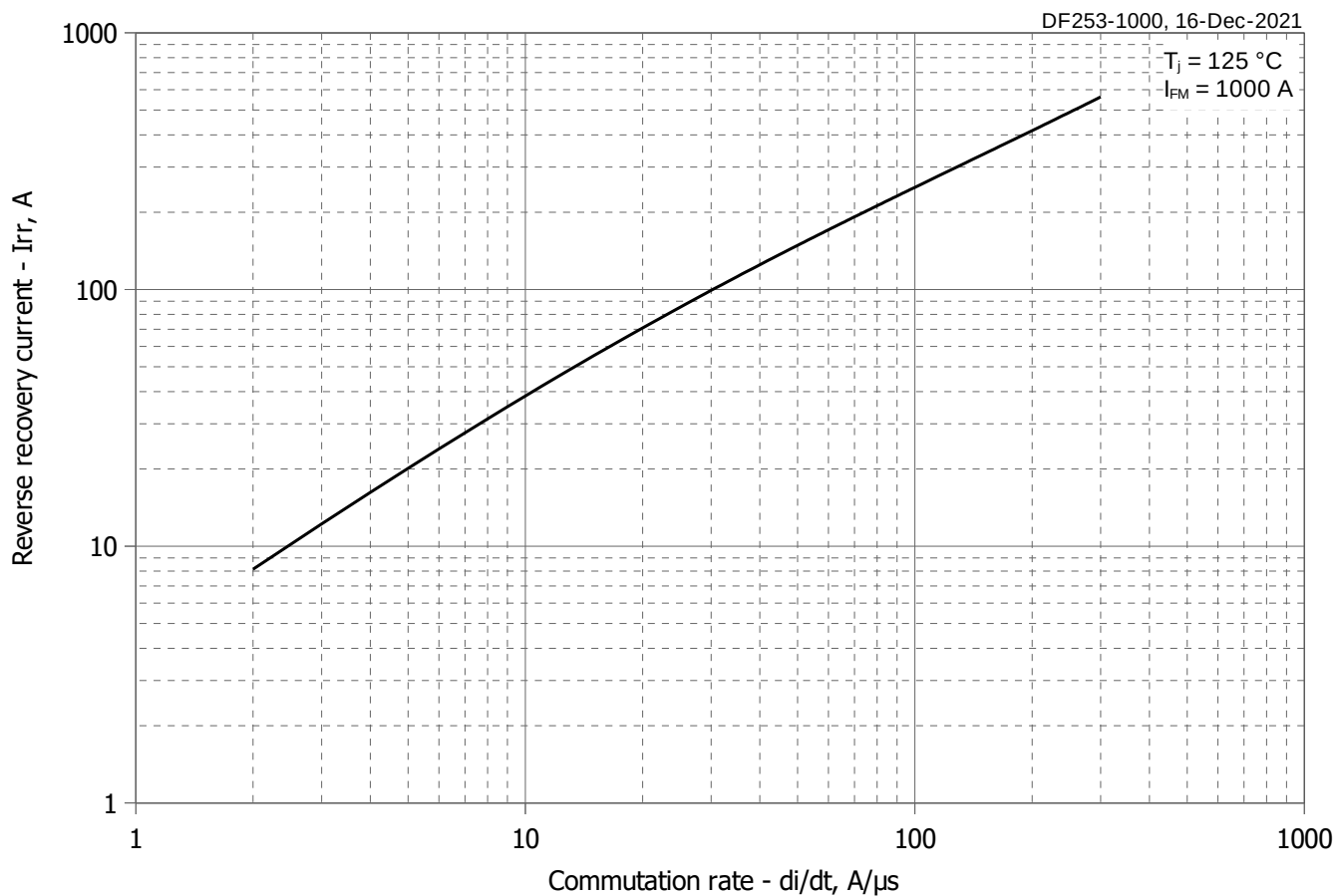
**Transient thermal impedance junction to case  $Z_{thjc}$  model (see Fig. 2)**



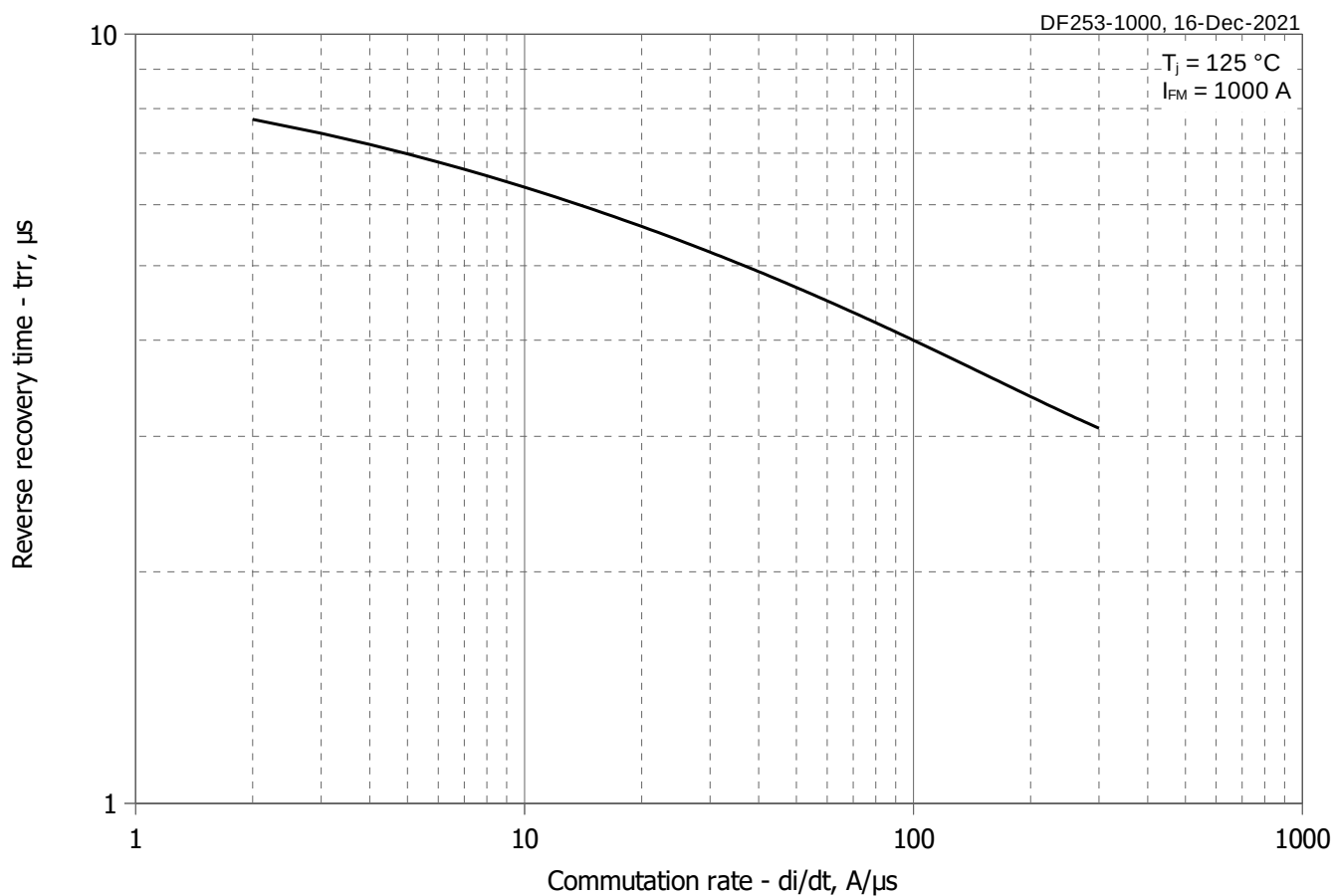
**Fig 3 - Total recovered charge  $Q_{r-i}$  (integral) vs. commutation rate  $di_R/dt$**



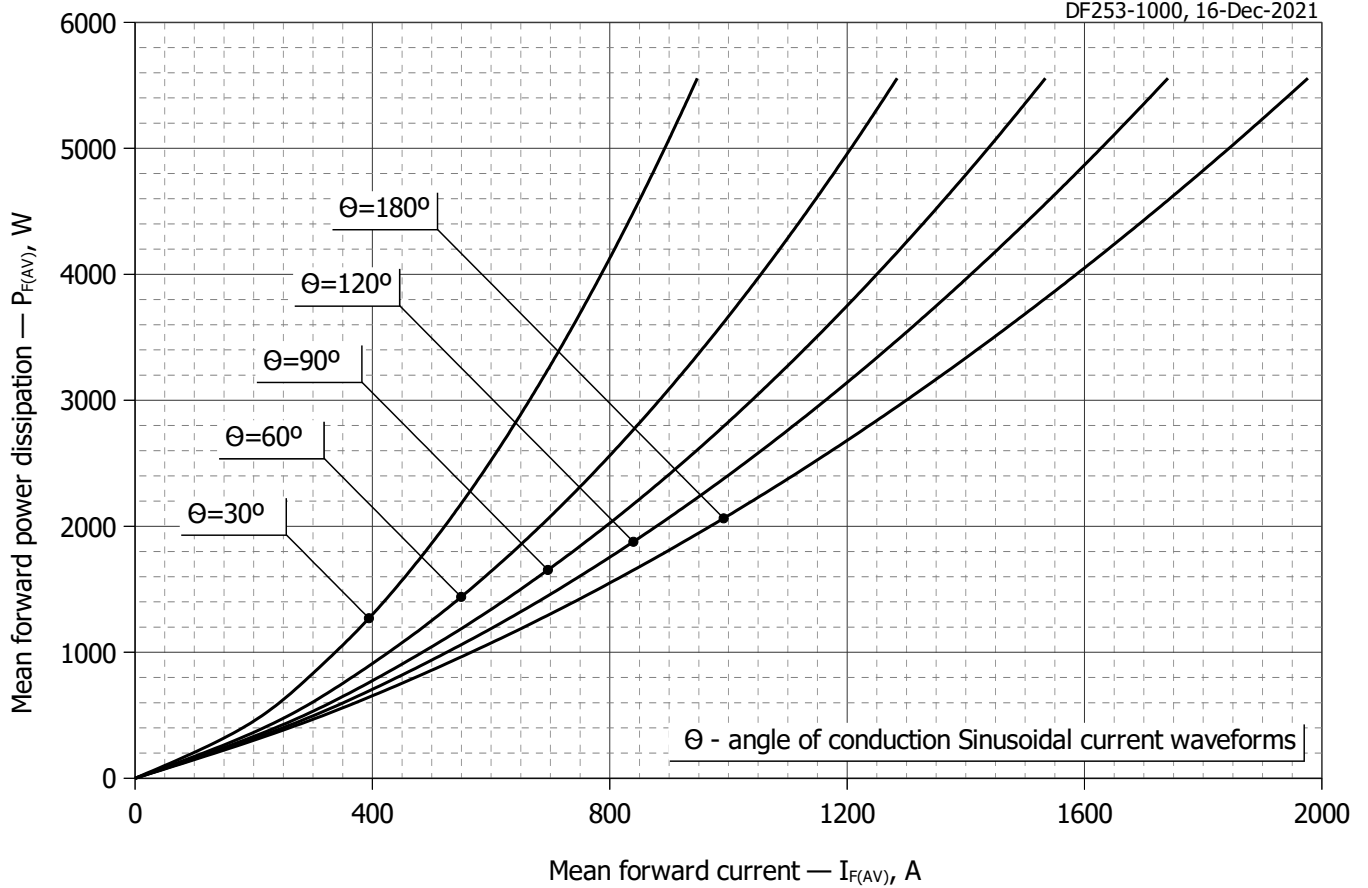
**Fig 4 - Maximum recovered charge  $Q_r$  vs. commutation rate  $di_R/dt$  (50% chord)**



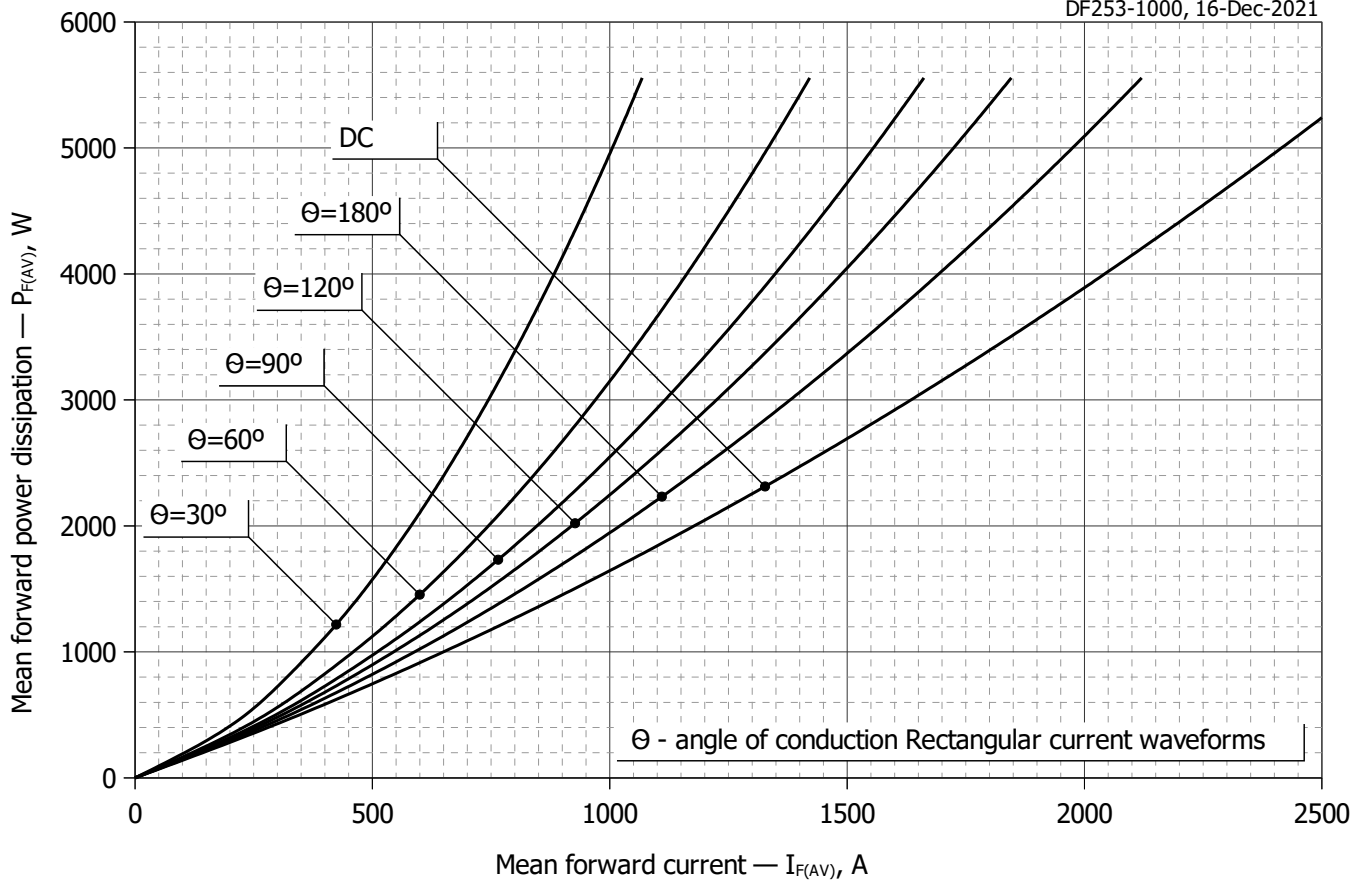
**Fig 5 - Maximum reverse recovery current  $I_{rr}$  vs. commutation rate  $di_R/dt$**



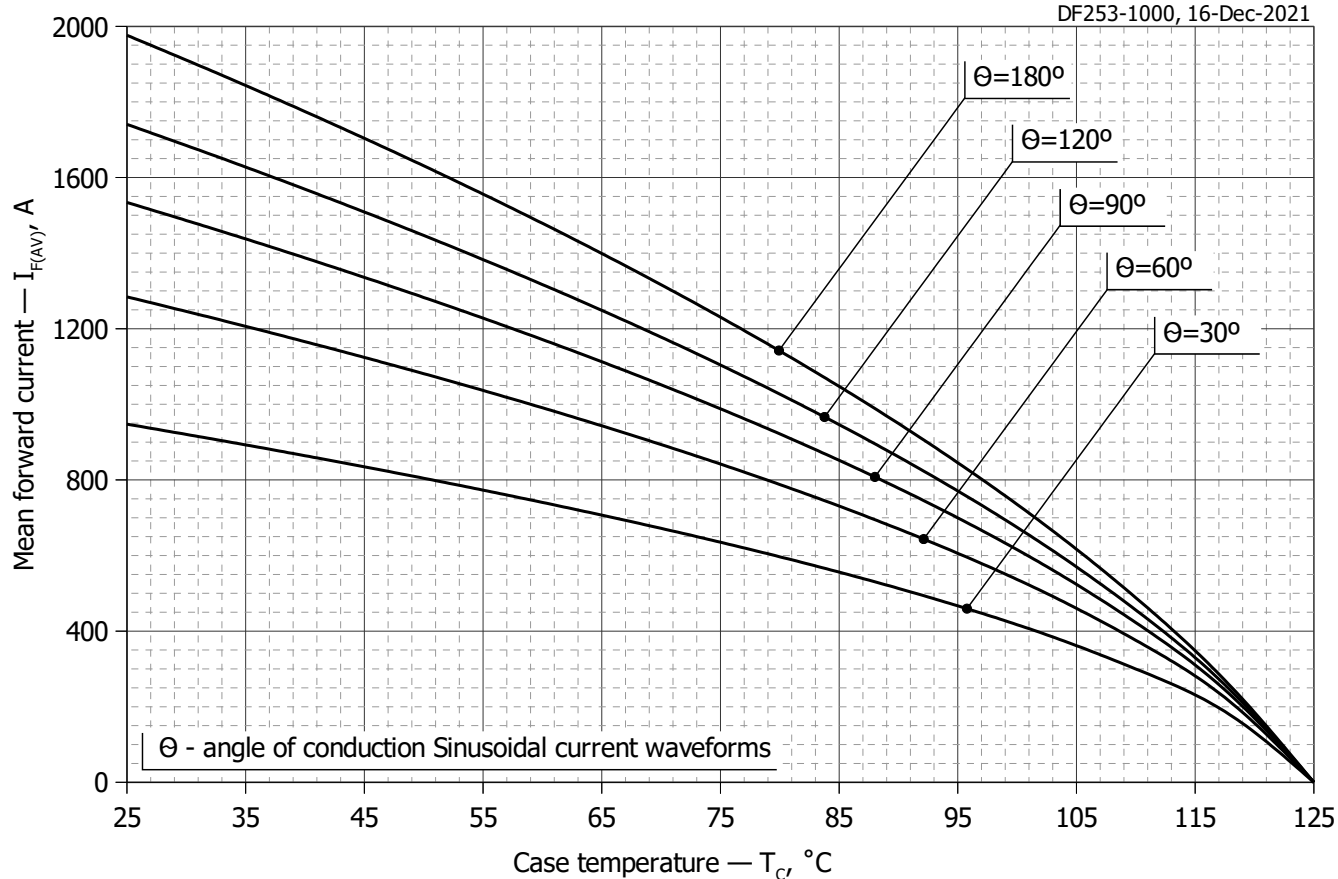
**Fig 6 - Maximum recovery time  $t_{rr}$  vs. commutation rate  $di_R/dt$  (50% chord)**



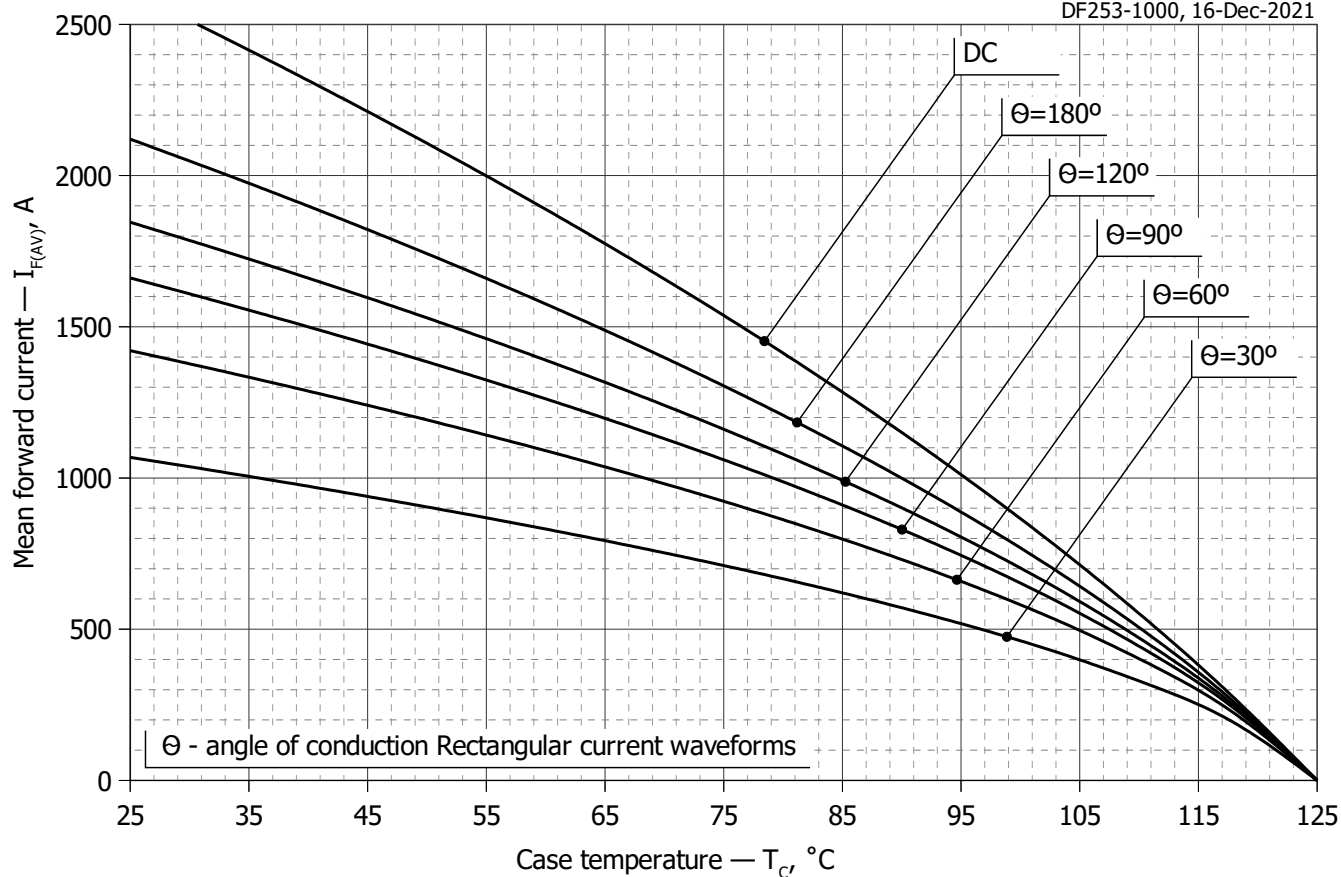
**Fig. 7 - Mean forward power dissipation  $P_{FAV}$  vs. mean forward current  $I_{FAV}$  for sinusoidal current waveforms at different conduction angles ( $f=50\text{Hz}$ , DSC)**



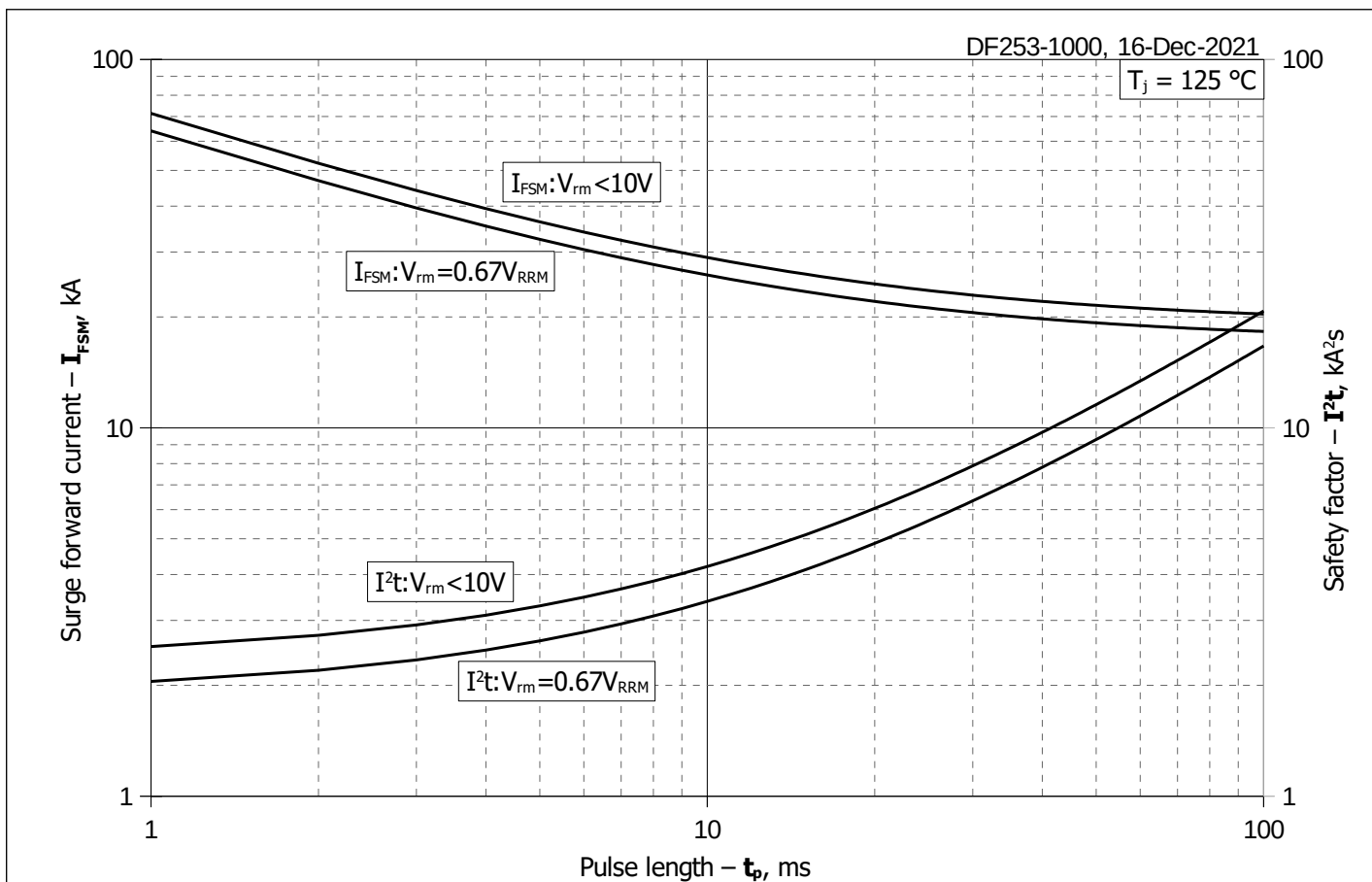
**Fig. 8 - Mean forward power dissipation  $P_{FAV}$  vs. mean forward current  $I_{FAV}$  for rectangular current waveforms at different conduction angles and for DC ( $f=50\text{Hz}$ , DSC)**



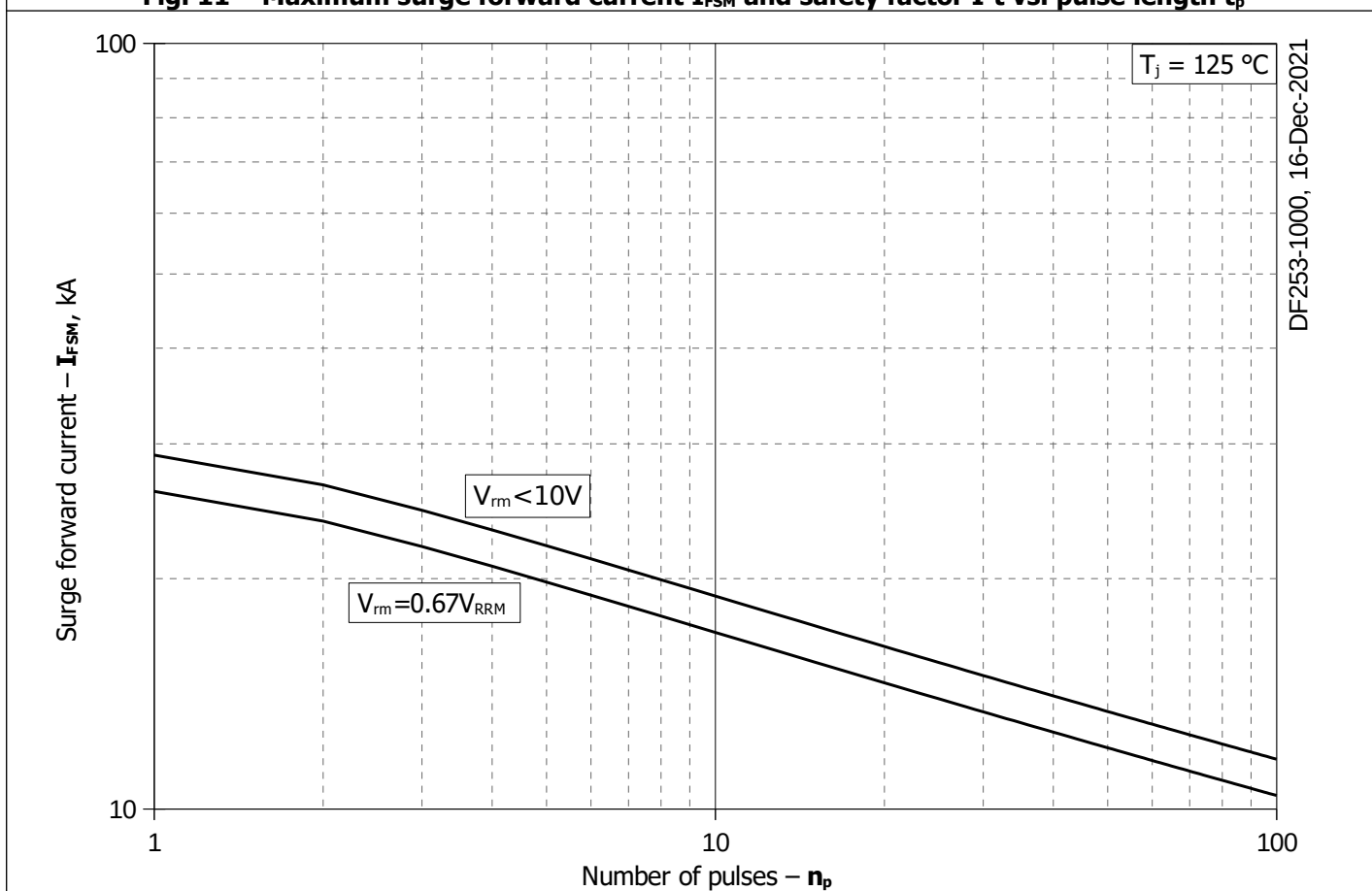
**Fig. 9 – Mean forward current  $I_{FAV}$  vs. case temperature  $T_C$  for sinusoidal current waveforms at different conduction angles ( $f=50\text{Hz}$ , DSC)**



**Fig. 10 - Mean forward current  $I_{FAV}$  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 forward current  $I_{FSM}$  and safety factor  $I^2t$  vs. pulse length  $t_p$**



**Fig. 12 - Maximum surge forward current  $I_{FSM}$  vs. number of pulses  $n_p$**