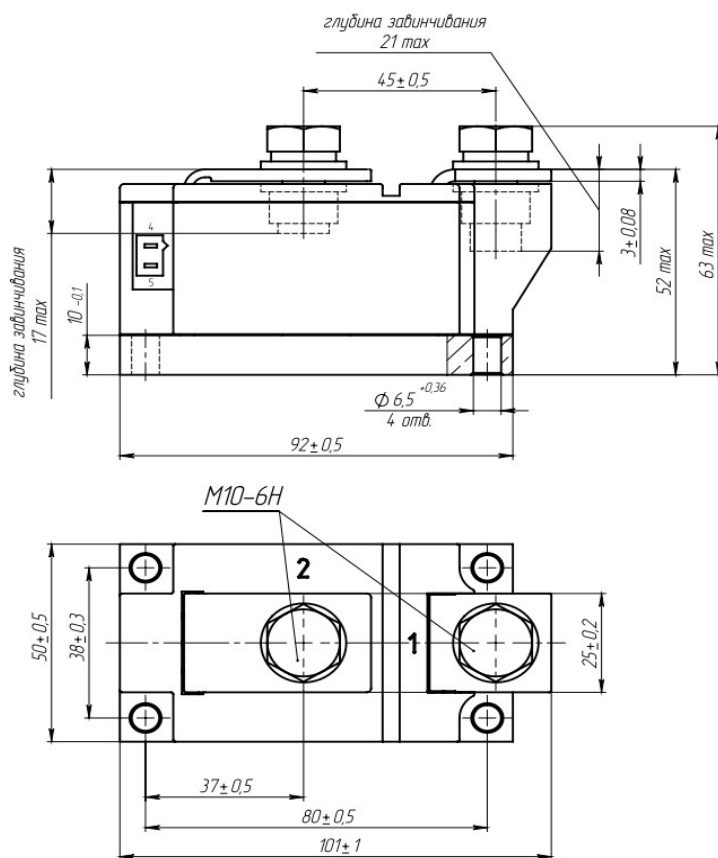




# Single Diode Module For Phase Control MD1-500-44-B0

|  |  |                                                                                   |  |  |  |
|--|--|-----------------------------------------------------------------------------------|--|--|--|
|  |  | <b>MD1</b>                                                                        |  |  |  |
|  |  |  |  |  |  |



All dimensions in millimeters (inches)

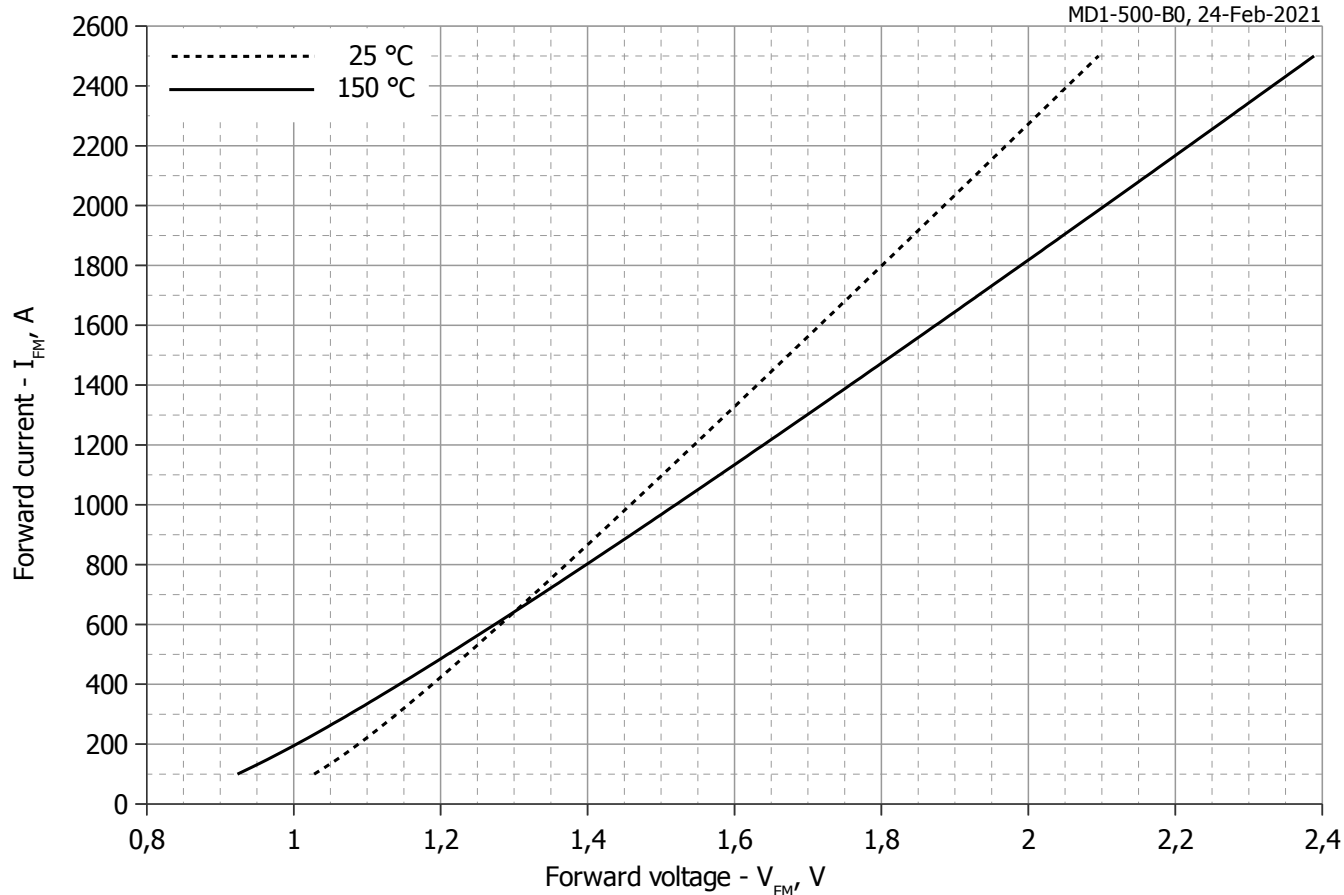
## MAXIMUM ALLOWABLE RATINGS

| Symbols and parameters |                                           | Units              | Values             | Test conditions                                                                                        |                                                                                  |
|------------------------|-------------------------------------------|--------------------|--------------------|--------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| ON-STATE               |                                           |                    |                    |                                                                                                        |                                                                                  |
| $I_{FAV}$              | Maximum allowable average forward current | A                  | 500<br>535         | $T_c=104\text{ }^{\circ}\text{C};$<br>$T_c=100\text{ }^{\circ}\text{C};$<br>180° half-sine wave; 50 Hz |                                                                                  |
| $I_{FRMS}$             | RMS forward current                       | A                  | 785                | $T_c=104\text{ }^{\circ}\text{C};$<br>180° half-sine wave; 50 Hz                                       |                                                                                  |
| $I_{FSM}$              | Surge forward current                     | kA                 | 13.0<br>15.0       | $T_j=T_{j\text{ max}}$<br>$T_j=25\text{ }^{\circ}\text{C}$                                             | 180° half-sine wave;<br>$t_p=10\text{ ms}$ ; single pulse;<br>$V_R=0\text{ V};$  |
|                        |                                           |                    | 14.0<br>16.0       | $T_j=T_{j\text{ max}}$<br>$T_j=25\text{ }^{\circ}\text{C}$                                             | 180° half-sine wave;<br>$t_p=8.3\text{ ms}$ ; single pulse;<br>$V_R=0\text{ V};$ |
| $I^2t$                 | Safety factor                             | $A^2s\cdot 10^3$   | 840<br>1120        | $T_j=T_{j\text{ max}}$<br>$T_j=25\text{ }^{\circ}\text{C}$                                             | 180° half-sine wave;<br>$t_p=10\text{ ms}$ ; single pulse;<br>$V_R=0\text{ V};$  |
|                        |                                           |                    | 810<br>1060        | $T_j=T_{j\text{ max}}$<br>$T_j=25\text{ }^{\circ}\text{C}$                                             | 180° half-sine wave;<br>$t_p=8.3\text{ ms}$ ; single pulse;<br>$V_R=0\text{ V};$ |
| BLOCKING               |                                           |                    |                    |                                                                                                        |                                                                                  |
| $V_{RRM}$              | Repetitive peak reverse voltages          | V                  | 3800...4400        | $T_{j\text{ min}} < T_j < T_{j\text{ max}};$<br>180° half-sine wave; 50 Hz;                            |                                                                                  |
| $V_{RSM}$              | Non-repetitive peak reverse voltages      | V                  | 3900...4500        | $T_{j\text{ min}} < T_j < T_{j\text{ max}};$<br>180° half-sine wave; single pulse;                     |                                                                                  |
| $V_R$                  | Reverse continuous voltages               | V                  | $0.6\cdot V_{RRM}$ | $T_j=T_{j\text{ max}};$                                                                                |                                                                                  |
| THERMAL                |                                           |                    |                    |                                                                                                        |                                                                                  |
| $T_{\text{stg}}$       | Storage temperature                       | $^{\circ}\text{C}$ | −40...+50          |                                                                                                        |                                                                                  |
| $T_j$                  | Operating junction temperature            | $^{\circ}\text{C}$ | −40...+150         |                                                                                                        |                                                                                  |
| $T_{c\text{ op}}$      | Operating temperature                     | $^{\circ}\text{C}$ | −40...+125         |                                                                                                        |                                                                                  |
| MECHANICAL             |                                           |                    |                    |                                                                                                        |                                                                                  |
| a                      | Acceleration under vibration              | $\text{m/s}^2$     | 50                 |                                                                                                        |                                                                                  |

## CHARACTERISTICS

| Symbols and parameters |                                                | Units | Values | Conditions                                                            |         |
|------------------------|------------------------------------------------|-------|--------|-----------------------------------------------------------------------|---------|
| ON-STATE               |                                                |       |        |                                                                       |         |
| V <sub>FM</sub>        | Peak forward voltage, max                      | V     | 1.70   | T <sub>j</sub> =25 °C; I <sub>FM</sub> =1570 A                        |         |
| V <sub>F(TO)</sub>     | Forward threshold voltage, max                 | V     | 0.930  | T <sub>j</sub> =T <sub>j max</sub> ;                                  |         |
| r <sub>T</sub>         | Forward slope resistance, max                  | mΩ    | 0.585  | 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    | 50     | T <sub>j</sub> =T <sub>j max</sub> ; V <sub>R</sub> =V <sub>RRM</sub> |         |
| THERMAL                |                                                |       |        |                                                                       |         |
| R <sub>thjc</sub>      | Thermal resistance, junction to case           |       |        | 180° half-sine wave, 50 Hz                                            |         |
|                        | per module                                     | °C/W  | 0.0550 |                                                                       |         |
| R <sub>thch</sub>      | Thermal resistance, case to heatsink           |       |        |                                                                       |         |
|                        | per module                                     | °C/W  | 0.0100 |                                                                       |         |
| INSULATION             |                                                |       |        |                                                                       |         |
| V <sub>ISOL</sub>      | Insulation test voltage                        | kV    | 7.00   | Sine wave, 50 Hz;<br>RMS                                              | t=1 min |
|                        |                                                |       | 8.40   |                                                                       | t=1 sec |
| MECHANICAL             |                                                |       |        |                                                                       |         |
| M <sub>1</sub>         | Mounting torque (M6) <sup>1)</sup>             | Nm    | 6.00   | Tolerance ± 15%                                                       |         |
| M <sub>2</sub>         | Terminal connection torque (M10) <sup>1)</sup> | Nm    | 12.00  | Tolerance ± 15%                                                       |         |
| m                      | Weight, max                                    | g     | 900    |                                                                       |         |

| PART NUMBERING GUIDE                                                                                                                                                  |   |   |     |   |    |   |    |   |   | NOTES                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|-----|---|----|---|----|---|---|----------------------------------|
| MD                                                                                                                                                                    | 1 | - | 500 | - | 44 | - | B0 | - | N | 1) The screws must be lubricated |
| 1                                                                                                                                                                     | 2 |   | 3   |   | 4  |   | 5  |   | 6 |                                  |
| 1. MD - Rectifier Diode<br>2. Circuit Schematic<br>3. Average Forward Current, A<br>4. Voltage Code<br>5. Package Type (M.B0)<br>6. Ambient Conditions:<br>N – Normal |   |   |     |   |    |   |    |   |   |                                  |



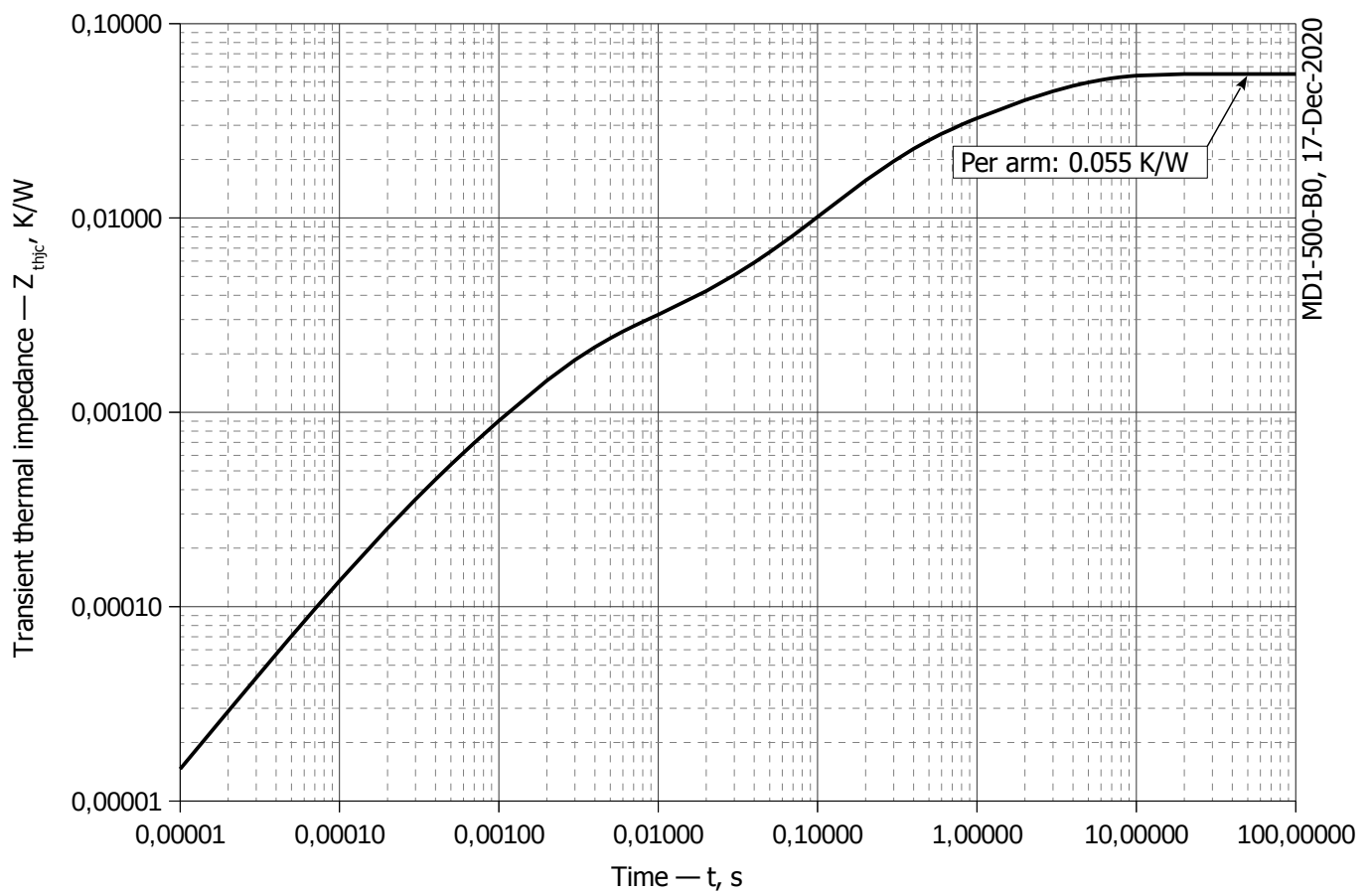
**Fig 1 – Forward characteristics of Limit device**

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 |                   |
|----------|-----------------------------|-------------------|
|          | $T_j = 25^\circ\text{C}$    | $T_j = T_{j\max}$ |
| <b>A</b> | 0.85114414                  | 0.76364974        |
| <b>B</b> | 0.00041112                  | 0.00051069        |
| <b>C</b> | 0.03023093                  | 0.01279542        |
| <b>D</b> | -0.00040089                 | 0.00496810        |

**Forward 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  $t$ .

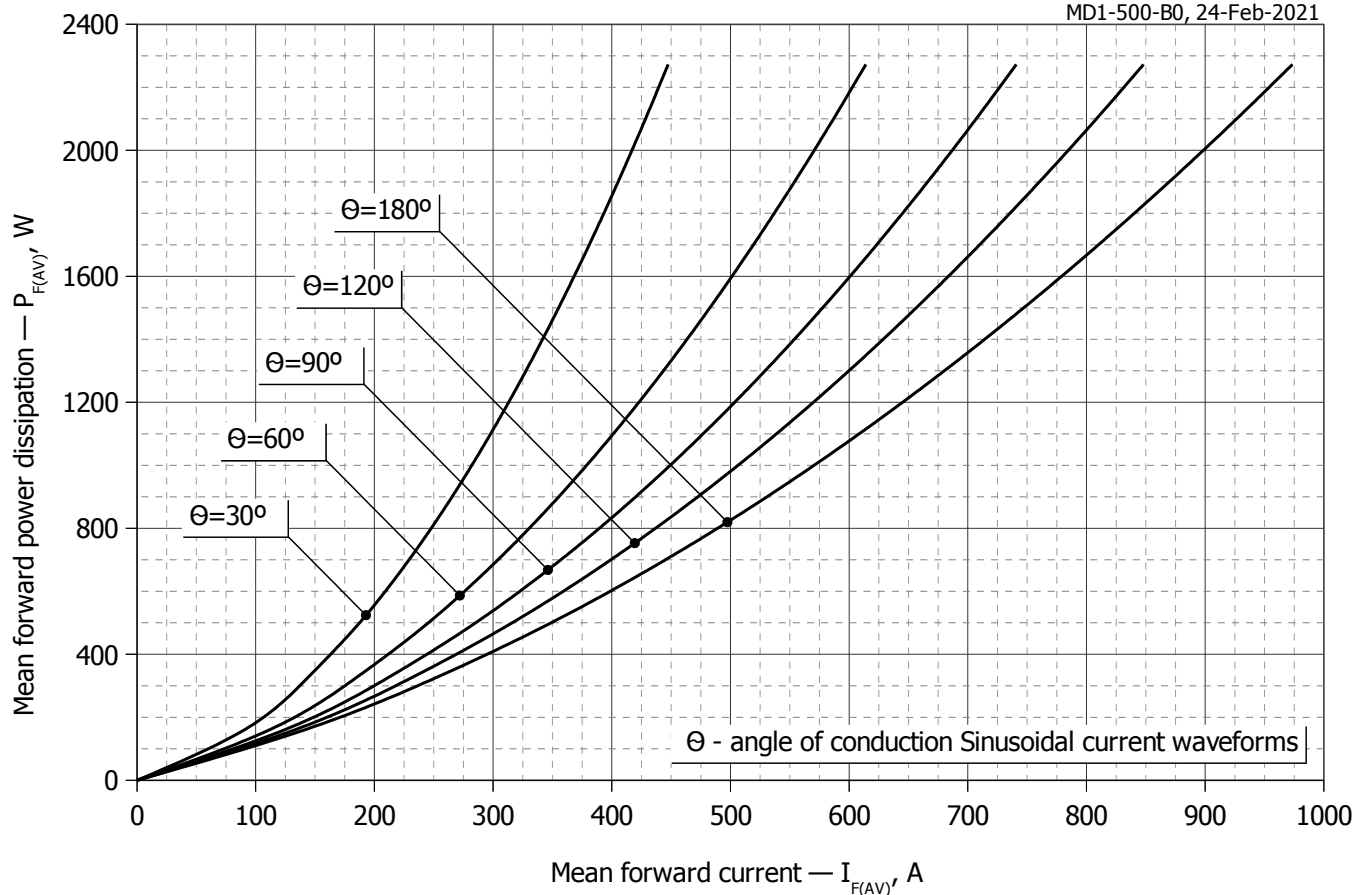
$R_i$  = Amplitude of  $p_{th}$  term.

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

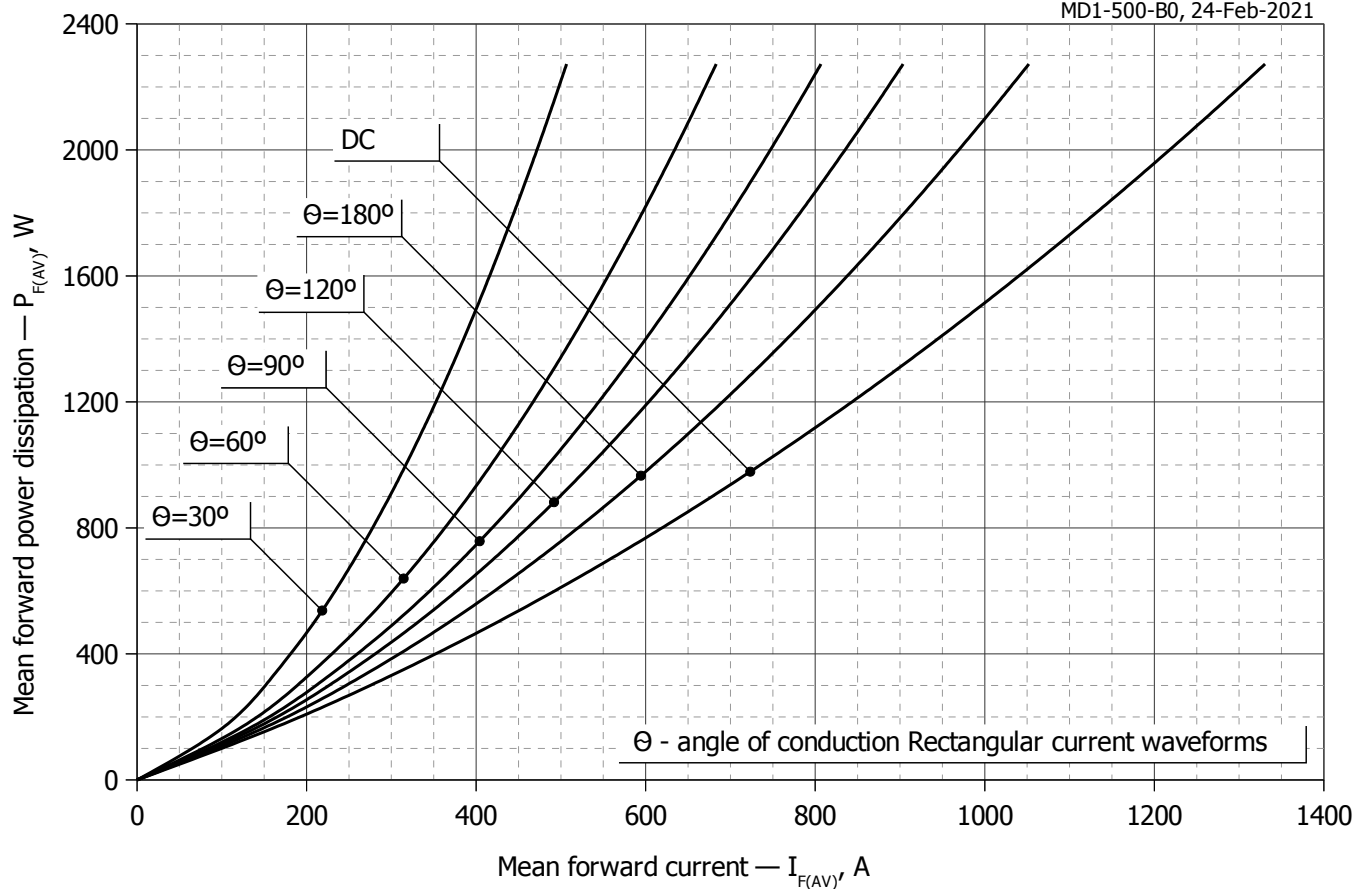
DC

| $i$          | 1      | 2      | 3       | 4         | 5        | 6         |
|--------------|--------|--------|---------|-----------|----------|-----------|
| $R_i$ , K/W  | 0.0249 | 0.0112 | 0.01635 | 0.0006528 | 0.001791 | 0.0001363 |
| $\tau_i$ , s | 3.132  | 1.000  | 0.2335  | 0.01038   | 0.002348 | 0.0002448 |

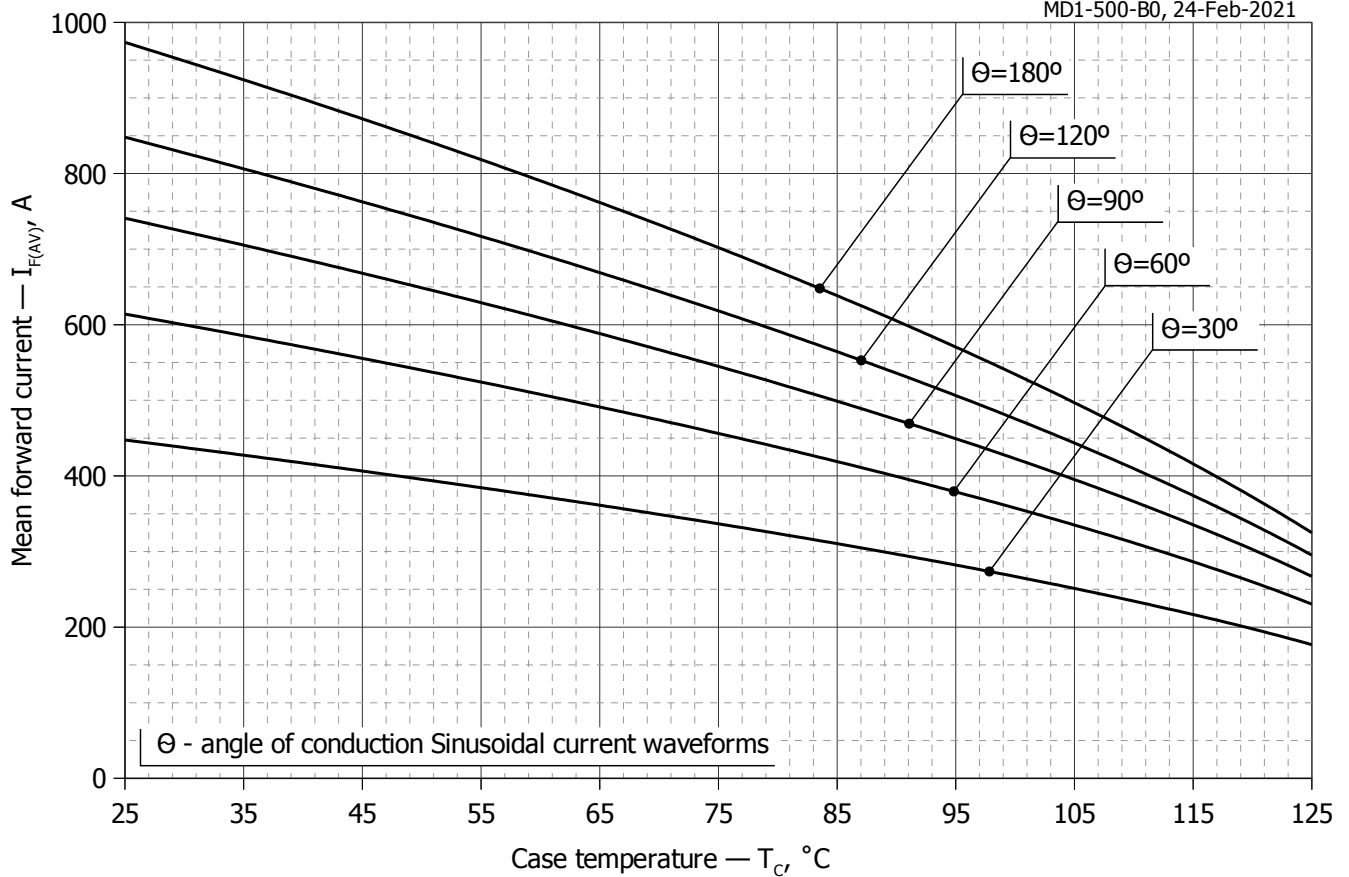
**Transient thermal impedance junction to case  $Z_{thjc}$  model (see Fig. 2)**



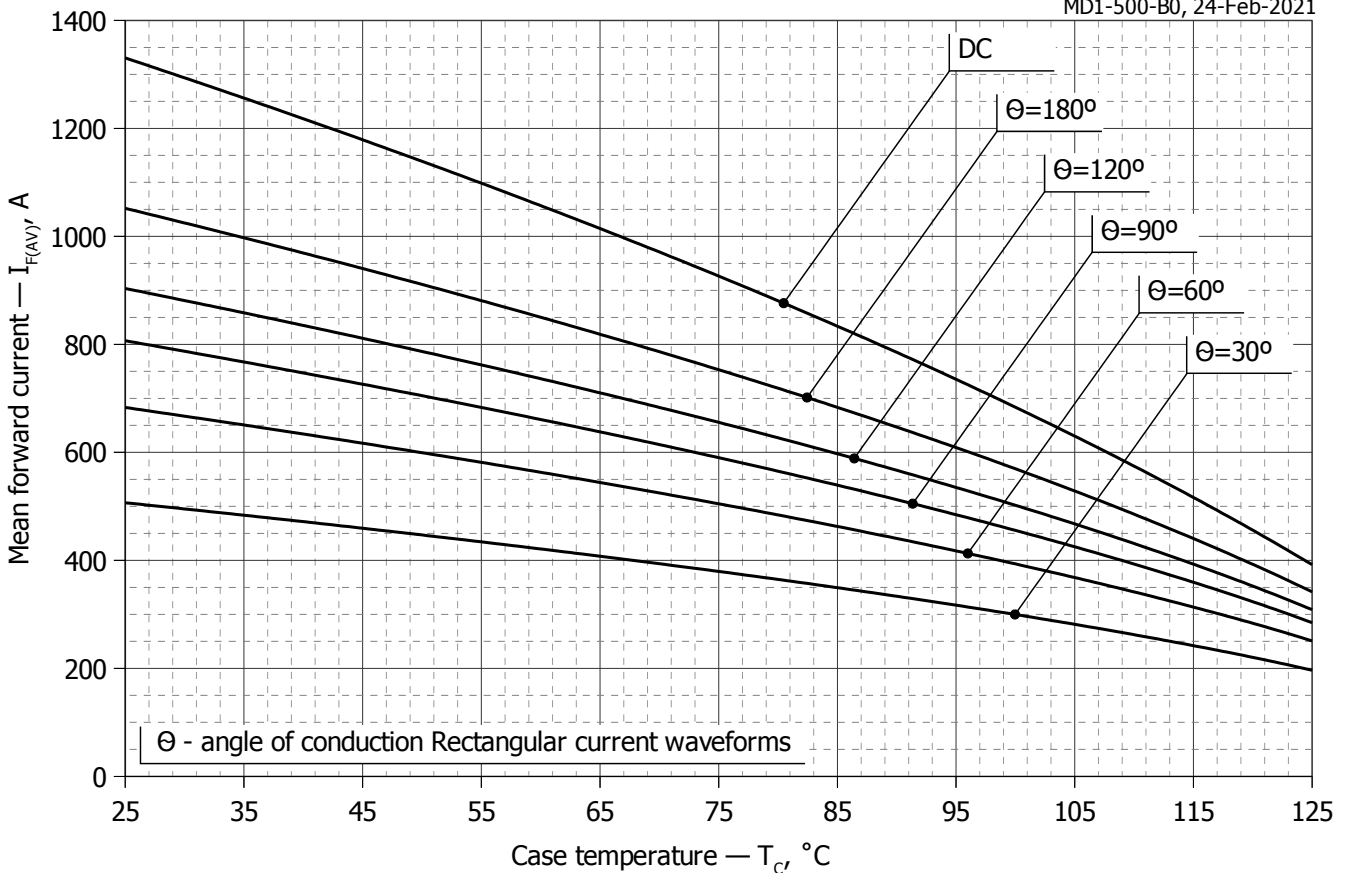
**Fig. 3 - Mean forward power dissipation  $P_{FAV}$  vs. mean forward current  $I_{FAV}$  for sinusoidal current waveforms at different conduction angles ( $f=50\text{Hz}$ , DSC)**



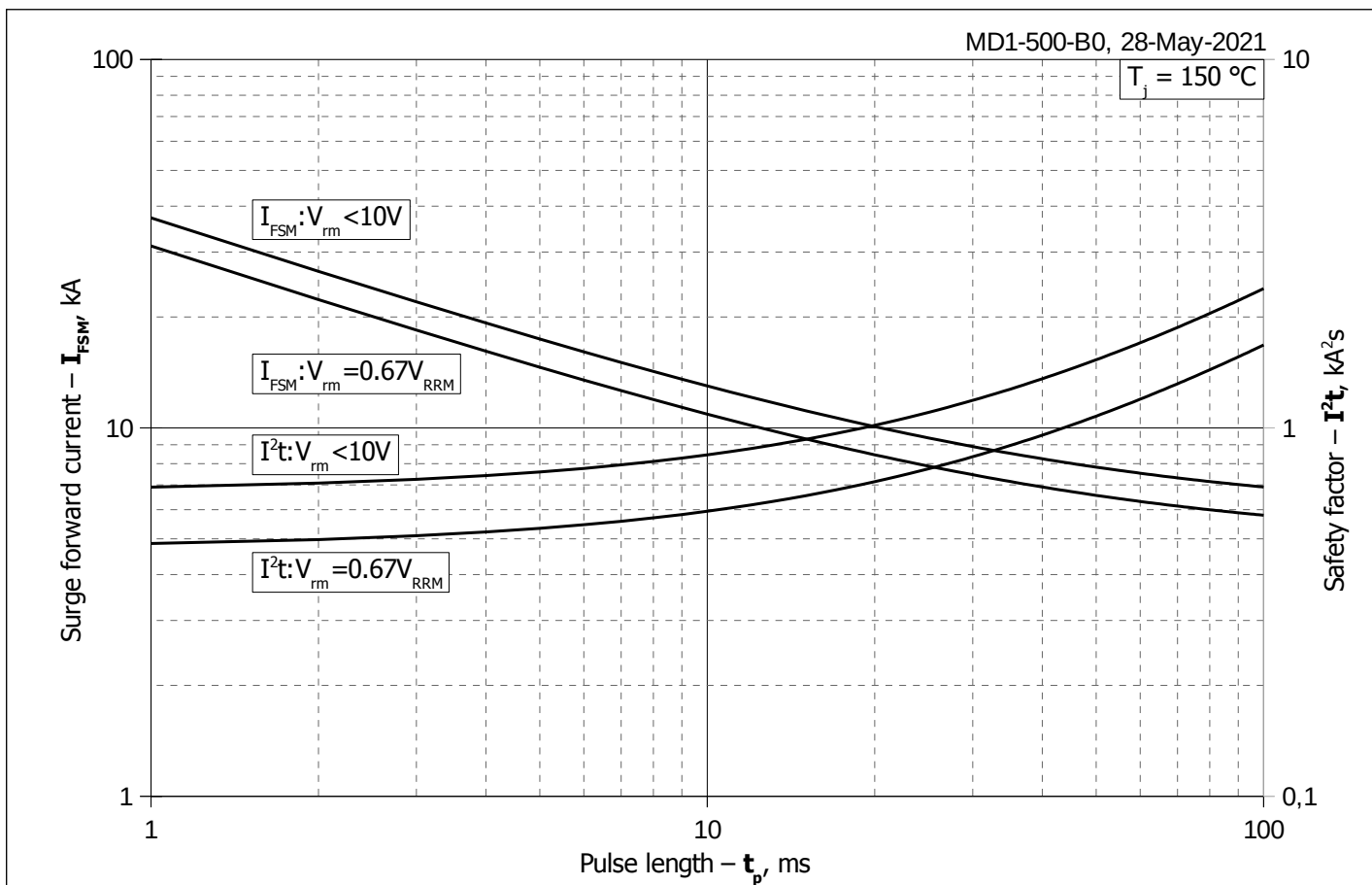
**Fig. 4 – Mean forward power dissipation  $P_{FAV}$  vs. mean forward current  $I_{FAV}$  for rectangular current waveforms at different conduction angles and for DC ( $f=50\text{Hz}$ , DSC)**



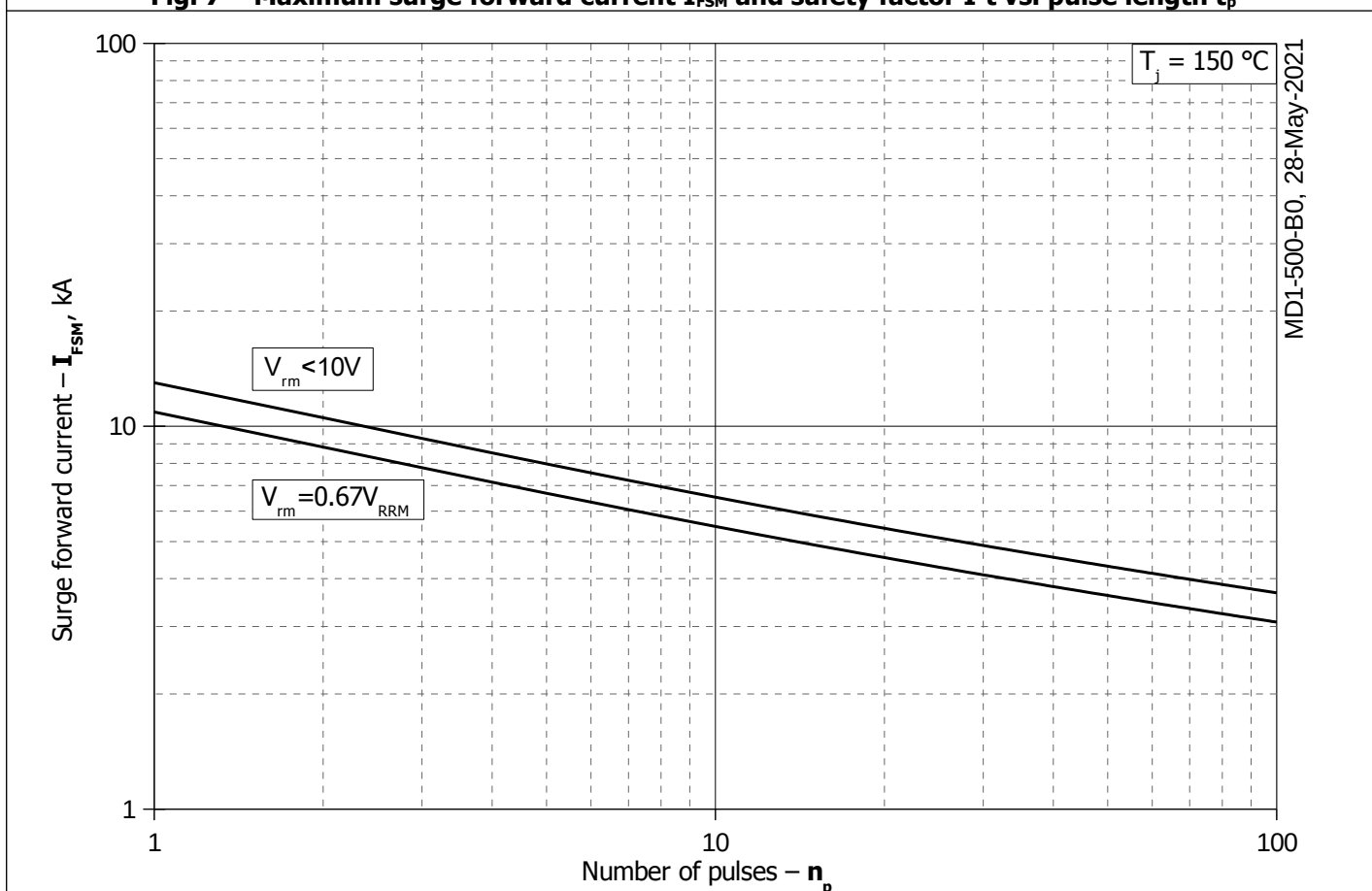
**Fig. 5 – Mean forward current  $I_{FAV}$  vs. case temperature  $T_C$  for sinusoidal current waveforms at different conduction angles ( $f=50\text{Hz}$ , DSC)**



**Fig. 6 - 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. 7 – Maximum surge forward current  $I_{FSM}$  and safety factor  $I^2t$  vs. pulse length  $t_p$**



**Fig. 8 – Maximum surge forward current  $I_{FSM}$  vs. number of pulses  $n_p$**