

# Standard Rectifier Module

$$V_{RRM} = 2 \times 1600 \text{ V}$$

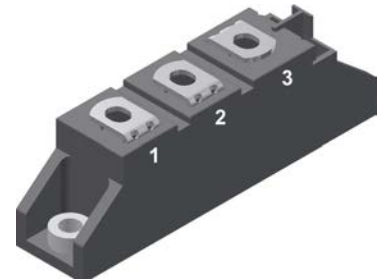
$$I_{FAV} = 71 \text{ A}$$

$$V_F = 1,14 \text{ V}$$

Phase leg

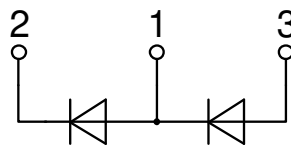
Part number

**MDD56-16N1B**



Backside: isolated

 E72873



## Features / Advantages:

- Package with DCB ceramic
- Improved temperature and power cycling
- Planar passivated chips
- Very low forward voltage drop
- Very low leakage current

## Applications:

- Diode for main rectification
- For single and three phase bridge configurations
- Supplies for DC power equipment
- Input rectifiers for PWM inverter
- Battery DC power supplies
- Field supply for DC motors

## Package: TO-240AA

- Isolation Voltage: 4800 V~
- Industry standard outline
- RoHS compliant
- Height: 30 mm
- Base plate: DCB ceramic
- Reduced weight
- Advanced power cycling

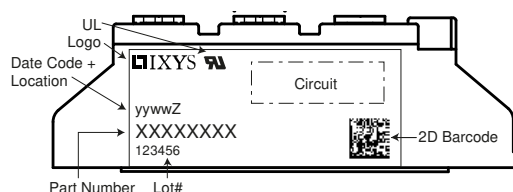
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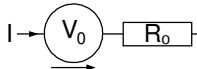
| Rectifier    |                                                     |                                          |                                | Ratings |      |      |                   |
|--------------|-----------------------------------------------------|------------------------------------------|--------------------------------|---------|------|------|-------------------|
| Symbol       | Definition                                          | Conditions                               |                                | min.    | typ. | max. | Unit              |
| $V_{RSM}$    | <i>max. non-repetitive reverse blocking voltage</i> | $T_{VJ} = 25^{\circ}\text{C}$            |                                |         |      | 1700 | V                 |
| $V_{RRM}$    | <i>max. repetitive reverse blocking voltage</i>     | $T_{VJ} = 25^{\circ}\text{C}$            |                                |         |      | 1600 | V                 |
| $I_R$        | <i>reverse current</i>                              | $V_R = 1600\text{ V}$                    | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 200  | $\mu\text{A}$     |
|              |                                                     | $V_R = 1600\text{ V}$                    | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 10   | mA                |
| $V_F$        | <i>forward voltage drop</i>                         | $I_F = 100\text{ A}$                     | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 1,21 | V                 |
|              |                                                     | $I_F = 200\text{ A}$                     |                                |         |      | 1,48 | V                 |
|              |                                                     | $I_F = 100\text{ A}$                     | $T_{VJ} = 125^{\circ}\text{C}$ |         |      | 1,14 | V                 |
|              |                                                     | $I_F = 200\text{ A}$                     |                                |         |      | 1,45 | V                 |
| $I_{FAV}$    | <i>average forward current</i>                      | $T_C = 100^{\circ}\text{C}$              | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 71   | A                 |
| $I_{F(RMS)}$ | <i>RMS forward current</i>                          | 180° sine                                |                                |         |      | 150  | A                 |
| $V_{F0}$     | <i>threshold voltage</i>                            | } <i>for power loss calculation only</i> | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 0,80 | V                 |
| $r_F$        | <i>slope resistance</i>                             |                                          |                                |         |      | 3    | m $\Omega$        |
| $R_{thJC}$   | <i>thermal resistance junction to case</i>          |                                          |                                |         |      | 0,51 | K/W               |
| $R_{thCH}$   | <i>thermal resistance case to heatsink</i>          |                                          |                                |         | 0,2  |      | K/W               |
| $P_{tot}$    | <i>total power dissipation</i>                      |                                          | $T_C = 25^{\circ}\text{C}$     |         |      | 245  | W                 |
| $I_{FSM}$    | <i>max. forward surge current</i>                   | t = 10 ms; (50 Hz), sine                 | $T_{VJ} = 45^{\circ}\text{C}$  |         |      | 1,40 | kA                |
|              |                                                     | t = 8,3 ms; (60 Hz), sine                | $V_R = 0\text{ V}$             |         |      | 1,51 | kA                |
|              |                                                     | t = 10 ms; (50 Hz), sine                 | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 1,19 | kA                |
|              |                                                     | t = 8,3 ms; (60 Hz), sine                | $V_R = 0\text{ V}$             |         |      | 1,29 | kA                |
| $I^2t$       | <i>value for fusing</i>                             | t = 10 ms; (50 Hz), sine                 | $T_{VJ} = 45^{\circ}\text{C}$  |         |      | 9,80 | kA <sup>2</sup> s |
|              |                                                     | t = 8,3 ms; (60 Hz), sine                | $V_R = 0\text{ V}$             |         |      | 9,49 | kA <sup>2</sup> s |
|              |                                                     | t = 10 ms; (50 Hz), sine                 | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 7,08 | kA <sup>2</sup> s |
|              |                                                     | t = 8,3 ms; (60 Hz), sine                | $V_R = 0\text{ V}$             |         |      | 6,87 | kA <sup>2</sup> s |
| $C_J$        | <i>junction capacitance</i>                         | $V_R = 400\text{ V}; f = 1\text{ MHz}$   | $T_{VJ} = 25^{\circ}\text{C}$  |         | 27   |      | pF                |

| Package TO-240AA |                                                                     |                             |                                     | Ratings |      |      |      |
|------------------|---------------------------------------------------------------------|-----------------------------|-------------------------------------|---------|------|------|------|
| Symbol           | Definition                                                          | Conditions                  |                                     | min.    | typ. | max. | Unit |
| $I_{RMS}$        | <b>RMS current</b>                                                  | per terminal                |                                     |         |      | 200  | A    |
| $T_{VJ}$         | <b>virtual junction temperature</b>                                 |                             |                                     | -40     |      | 150  | °C   |
| $T_{op}$         | <b>operation temperature</b>                                        |                             |                                     | -40     |      | 125  | °C   |
| $T_{stg}$        | <b>storage temperature</b>                                          |                             |                                     | -40     |      | 125  | °C   |
| <b>Weight</b>    |                                                                     |                             |                                     |         | 76   |      | g    |
| $M_D$            | <b>mounting torque</b>                                              |                             |                                     | 2,5     |      | 4    | Nm   |
| $M_T$            | <b>terminal torque</b>                                              |                             |                                     | 2,5     |      | 4    | Nm   |
| $d_{Spp/App}$    | <b>creepage distance on surface   striking distance through air</b> | <b>terminal to terminal</b> | 13,0                                | 9,7     |      |      | mm   |
| $d_{Spb/Apb}$    |                                                                     | <b>terminal to backside</b> | 16,0                                | 16,0    |      |      | mm   |
| $V_{ISOL}$       | <b>isolation voltage</b>                                            | t = 1 second                | 50/60 Hz, RMS; $I_{ISOL} \leq 1$ mA | 4800    |      |      | V    |
|                  |                                                                     | t = 1 minute                |                                     | 4000    |      |      | V    |

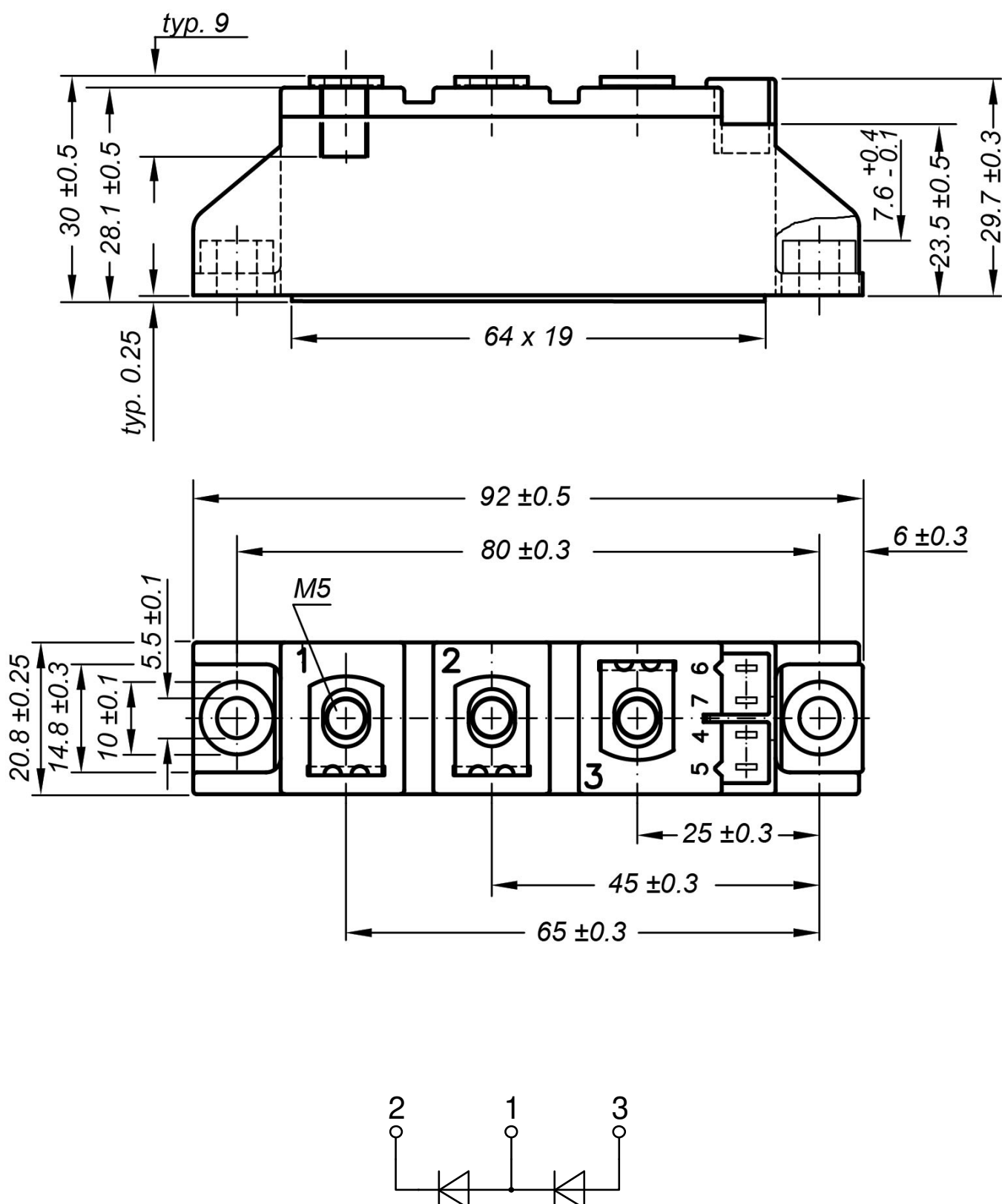


| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|---------------|----------|----------|
| Standard | MDD56-16N1B     | MDD56-16N1B        | Box           | 36       | 458082   |

| Similar Part | Package  | Voltage class |
|--------------|----------|---------------|
| MDD56-08N1B  | TO-240AA | 800           |
| MDD56-12N1B  | TO-240AA | 1200          |
| MDD56-14N1B  | TO-240AA | 1400          |
| MDD56-18N1B  | TO-240AA | 1800          |

| Equivalent Circuits for Simulation                                                  |                           |     | * on die level | $T_{VJ} = 150^{\circ}\text{C}$ |
|-------------------------------------------------------------------------------------|---------------------------|-----|----------------|--------------------------------|
|  | <b>Rectifier</b>          |     |                |                                |
| $V_{0\text{ max}}$                                                                  | <b>threshold voltage</b>  | 0,8 |                | V                              |
| $R_{0\text{ max}}$                                                                  | <b>slope resistance *</b> | 1,8 |                | mΩ                             |

## Outlines TO-240AA



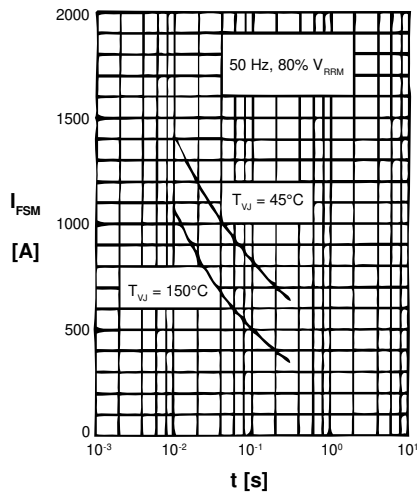
**Rectifier**


Fig. 1 Surge overload current  
 $I_{TSM}$ ,  $I_{FSM}$ : Crest value,  $t$ : duration

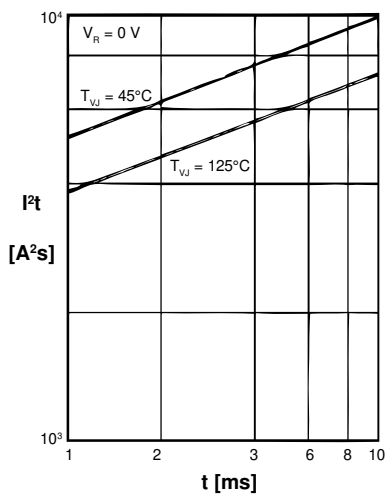


Fig. 2  $I^2t$  versus time (1-10 ms)

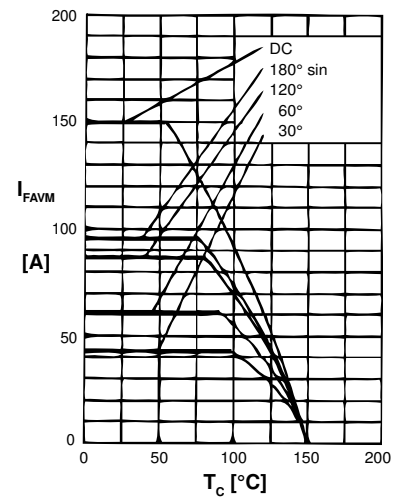


Fig. 3 Maximum forward current  
 at case temperature

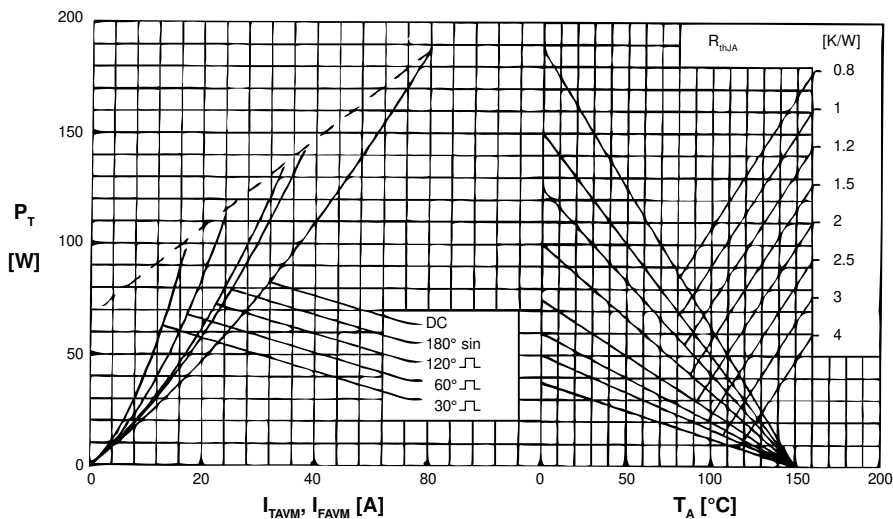


Fig. 4 Power dissipation vs. onstate current and ambient temperature (per diode)

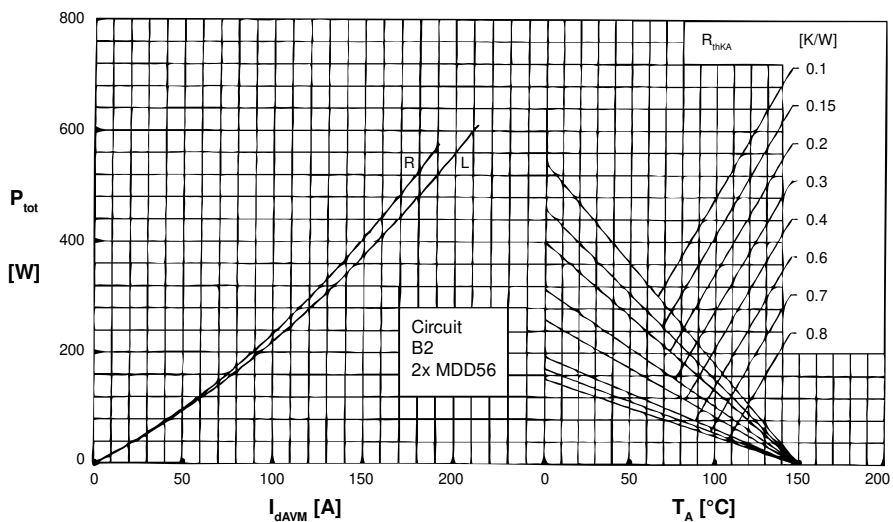


Fig. 6 Single phase rectifier bridge: Power dissipation versus direct output current  
 and ambient temperature; R = resistive load, L = inductive load

## Rectifier

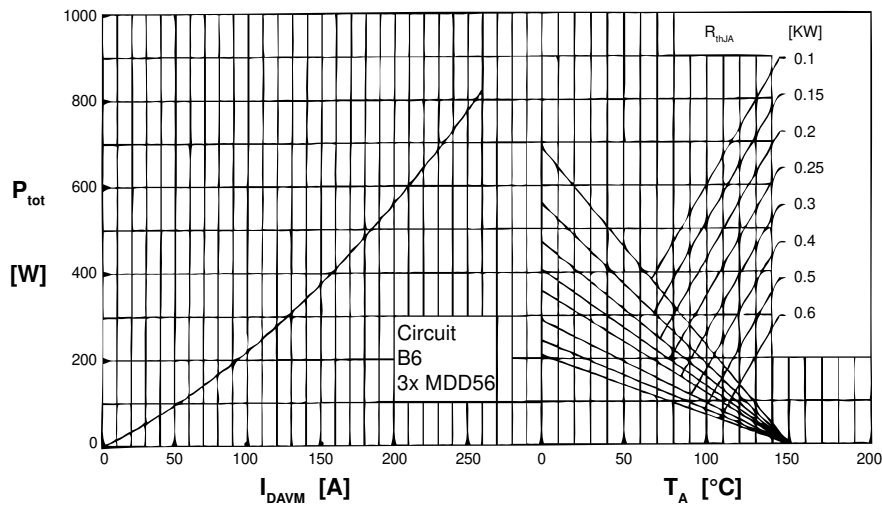


Fig. 6 Three phase rectifier bridge: Power dissipation versus direct output current and ambient temperature

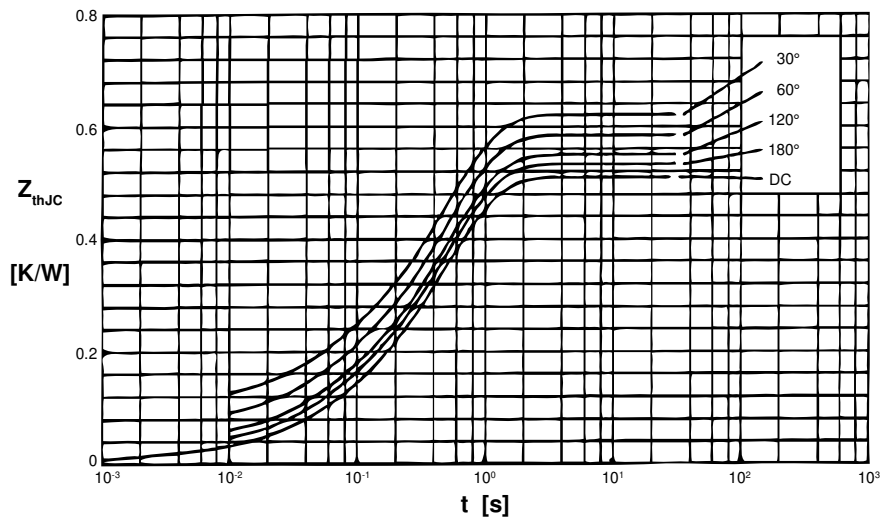


Fig. 7 Transient thermal impedance junction to case (per diode)

$R_{thJC}$  for various conduction angles d:

| d    | $R_{thJC}$ [K/W] |
|------|------------------|
| DC   | 0.51             |
| 180° | 0.53             |
| 120° | 0.55             |
| 60°  | 0.58             |
| 30°  | 0.62             |

Constants for  $Z_{thJC}$  calculation:

| i | $R_{thi}$ [K/W] | $t_i$ [s] |
|---|-----------------|-----------|
| 1 | 0.013           | 0.0015    |
| 2 | 0.055           | 0.0450    |
| 3 | 0.442           | 0.4850    |

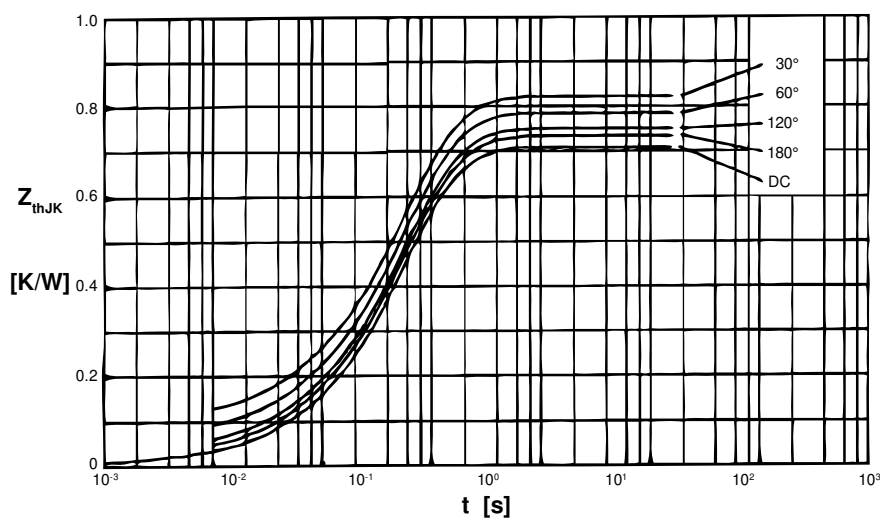


Fig. 8 Transient thermal impedance junction to heatsink (per thyristor)

$R_{thJK}$  for various conduction angles d:

| d    | $R_{thJK}$ [K/W] |
|------|------------------|
| DC   | 0.71             |
| 180° | 0.73             |
| 120° | 0.75             |
| 60°  | 0.78             |
| 30°  | 0.82             |

Constants for  $Z_{thJK}$  calculation:

| i | $R_{thi}$ [K/W] | $t_i$ [s] |
|---|-----------------|-----------|
| 1 | 0.013           | 0.0015    |
| 2 | 0.055           | 0.0450    |
| 3 | 0.442           | 0.4850    |
| 4 | 0.200           | 1.2500    |