

# High Voltage Standard Rectifier Module

$$V_{RRM} = 2 \times 2000 \text{ V}$$

$$I_{FAV} = 310 \text{ A}$$

$$V_F = 1,03 \text{ V}$$

Phase leg

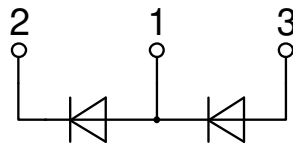
Part number

**MDD312-20N1**



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: Y1

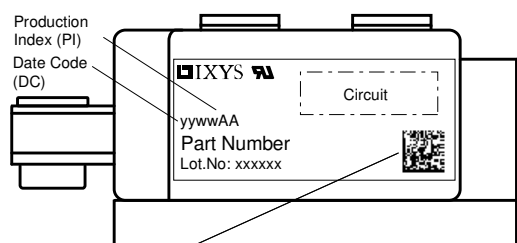
- Isolation Voltage: 4800 V~
- Industry standard outline
- RoHS compliant
- Base plate: Copper internally DCB isolated
- Advanced power cycling

## Disclaimer Notice

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| Rectifier    |                                              |                                        |                                | Ratings                        |      |       |                   |
|--------------|----------------------------------------------|----------------------------------------|--------------------------------|--------------------------------|------|-------|-------------------|
| Symbol       | Definition                                   | Conditions                             |                                | min.                           | typ. | max.  | Unit              |
| $V_{RSM}$    | max. non-repetitive reverse blocking voltage | $T_{VJ} = 25^{\circ}\text{C}$          |                                |                                |      | 2100  | V                 |
| $V_{RRM}$    | max. repetitive reverse blocking voltage     | $T_{VJ} = 25^{\circ}\text{C}$          |                                |                                |      | 2000  | V                 |
| $I_R$        | reverse current                              | $V_R = 2000\text{ V}$                  | $T_{VJ} = 25^{\circ}\text{C}$  |                                |      | 500   | $\mu\text{A}$     |
|              |                                              | $V_R = 2000\text{ V}$                  | $T_{VJ} = 150^{\circ}\text{C}$ |                                |      | 30    | mA                |
| $V_F$        | forward voltage drop                         | $I_F = 300\text{ A}$                   | $T_{VJ} = 25^{\circ}\text{C}$  |                                |      | 1,13  | V                 |
|              |                                              | $I_F = 600\text{ A}$                   |                                |                                |      | 1,33  | V                 |
|              |                                              | $I_F = 300\text{ A}$                   | $T_{VJ} = 125^{\circ}\text{C}$ |                                |      | 1,03  | V                 |
|              |                                              | $I_F = 600\text{ A}$                   |                                |                                |      | 1,29  | V                 |
| $I_{FAV}$    | average forward current                      | $T_C = 100^{\circ}\text{C}$            | $T_{VJ} = 150^{\circ}\text{C}$ |                                |      | 310   | A                 |
| $I_{F(RMS)}$ | RMS forward current                          | 180° sine      d = 0.5                 |                                |                                |      | 520   | A                 |
| $V_{F0}$     | threshold voltage                            | } for power loss calculation only      |                                | $T_{VJ} = 150^{\circ}\text{C}$ |      | 0,80  | V                 |
| $r_F$        | slope resistance                             |                                        |                                |                                |      | 0,6   | m $\Omega$        |
| $R_{thJC}$   | thermal resistance junction to case          |                                        |                                |                                |      | 0,12  | K/W               |
| $R_{thCH}$   | thermal resistance case to heatsink          |                                        |                                |                                | 0,04 |       | K/W               |
| $P_{tot}$    | total power dissipation                      | $T_C = 25^{\circ}\text{C}$             |                                |                                |      | 1040  | W                 |
| $I_{FSM}$    | max. forward surge current                   | t = 10 ms; (50 Hz), sine               | $T_{VJ} = 45^{\circ}\text{C}$  |                                |      | 10,8  | kA                |
|              |                                              | t = 8,3 ms; (60 Hz), sine              | $V_R = 0\text{ V}$             |                                |      | 11,7  | kA                |
|              |                                              | t = 10 ms; (50 Hz), sine               | $T_{VJ} = 150^{\circ}\text{C}$ |                                |      | 9,18  | kA                |
|              |                                              | t = 8,3 ms; (60 Hz), sine              | $V_R = 0\text{ V}$             |                                |      | 9,92  | kA                |
| $I^2t$       | value for fusing                             | t = 10 ms; (50 Hz), sine               | $T_{VJ} = 45^{\circ}\text{C}$  |                                |      | 583,2 | kA <sup>2</sup> s |
|              |                                              | t = 8,3 ms; (60 Hz), sine              | $V_R = 0\text{ V}$             |                                |      | 566,1 | kA <sup>2</sup> s |
|              |                                              | t = 10 ms; (50 Hz), sine               | $T_{VJ} = 150^{\circ}\text{C}$ |                                |      | 421,4 | kA <sup>2</sup> s |
|              |                                              | t = 8,3 ms; (60 Hz), sine              | $V_R = 0\text{ V}$             |                                |      | 409,0 | kA <sup>2</sup> s |
| $C_J$        | junction capacitance                         | $V_R = 700\text{ V}; f = 1\text{ MHz}$ |                                | $T_{VJ} = 25^{\circ}\text{C}$  | 288  |       | pF                |

| Package Y1    |                                                              |                      | Ratings |      |      |      |
|---------------|--------------------------------------------------------------|----------------------|---------|------|------|------|
| Symbol        | Definition                                                   | Conditions           | min.    | typ. | max. | Unit |
| $I_{RMS}$     | RMS current                                                  | per terminal         |         |      | 600  | A    |
| $T_{VJ}$      | virtual junction temperature                                 |                      | -40     |      | 150  | °C   |
| $T_{op}$      | operation temperature                                        |                      | -40     |      | 125  | °C   |
| $T_{stg}$     | storage temperature                                          |                      | -40     |      | 125  | °C   |
| Weight        |                                                              |                      |         | 680  |      | g    |
| $M_D$         | mounting torque                                              |                      | 4,5     |      | 7    | Nm   |
| $M_T$         | terminal torque                                              |                      | 11      |      | 13   | Nm   |
| $d_{Spp/App}$ | creepage distance on surface   striking distance through air | terminal to terminal | 16,0    |      |      | mm   |
| $d_{Spb/Apb}$ |                                                              | terminal to backside | 16,0    |      |      | mm   |
| $V_{ISOL}$    | isolation voltage                                            | t = 1 second         | 4800    |      |      | V    |
|               |                                                              | t = 1 minute         | 4000    |      |      | V    |



Data Matrix: part no. (1-19), DC + PI (20-25), lot.no.# (26-31), blank (32), serial no.# (33-36)

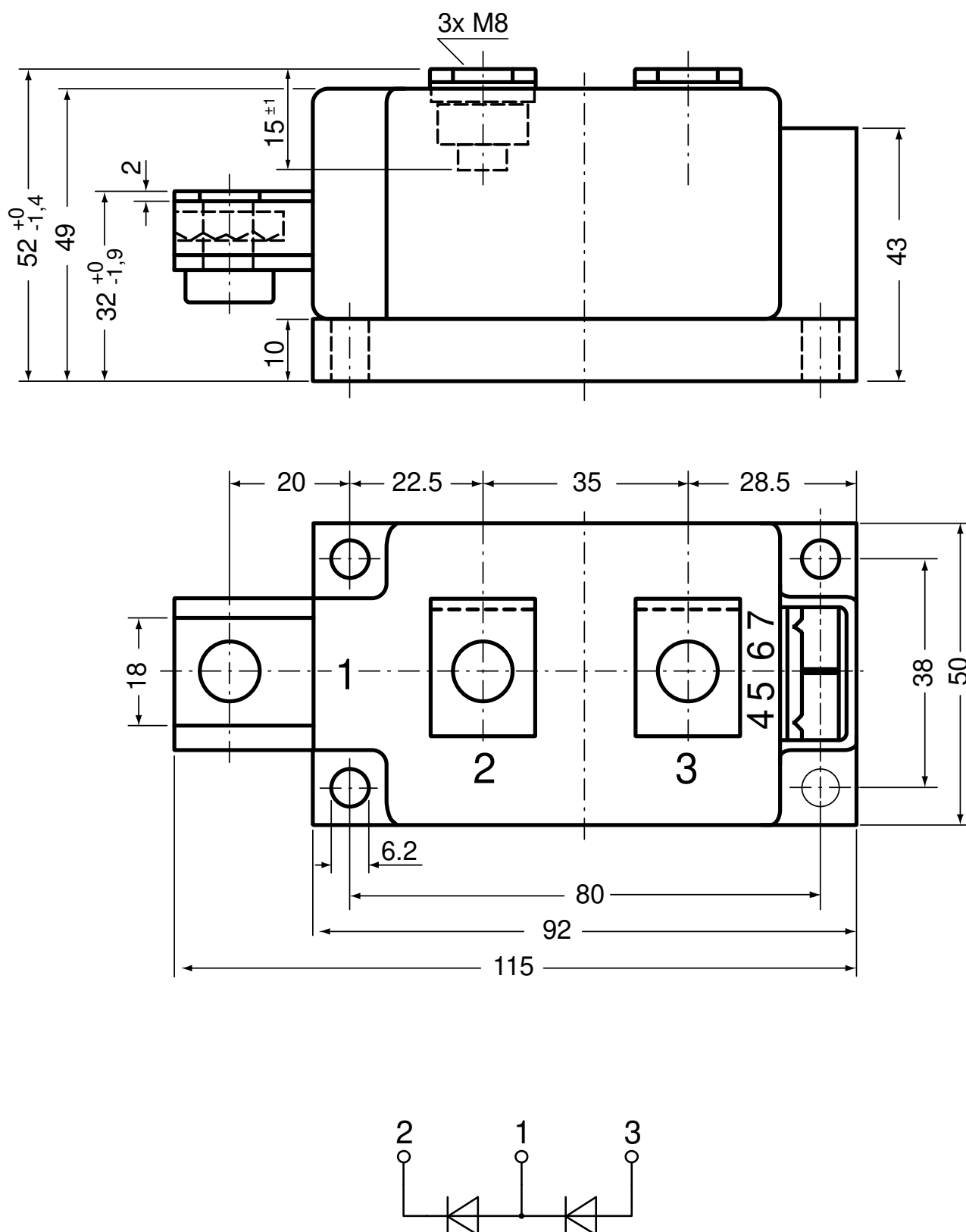
| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|---------------|----------|----------|
| Standard | MDD312-20N1     | MDD312-20N1        | Box           | 3        | 467251   |

| Similar Part | Package | Voltage class |
|--------------|---------|---------------|
| MDD312-12N1  | Y1-CU   | 1200          |
| MDD312-14N1  | Y1-CU   | 1400          |
| MDD312-16N1  | Y1-CU   | 1600          |
| MDD312-18N1  | Y1-CU   | 1800          |

|             |       |      |
|-------------|-------|------|
| MDD312-22N1 | Y1-CU | 2200 |
|-------------|-------|------|

| Equivalent Circuits for Simulation                                                  |                    | * on die level | $T_{VJ} = 150^{\circ}\text{C}$ |
|-------------------------------------------------------------------------------------|--------------------|----------------|--------------------------------|
|  |                    | Rectifier      |                                |
| $V_{0\ max}$                                                                        | threshold voltage  | 0,8            | V                              |
| $R_{0\ max}$                                                                        | slope resistance * | 0,4            | mΩ                             |

**Outlines Y1**



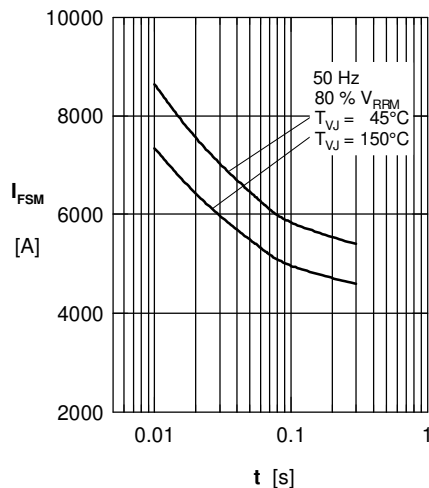
**Rectifier**


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



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

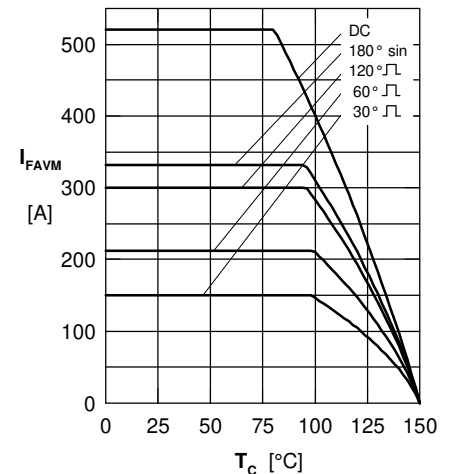


Fig. 3 Maximum forward current at case temperature

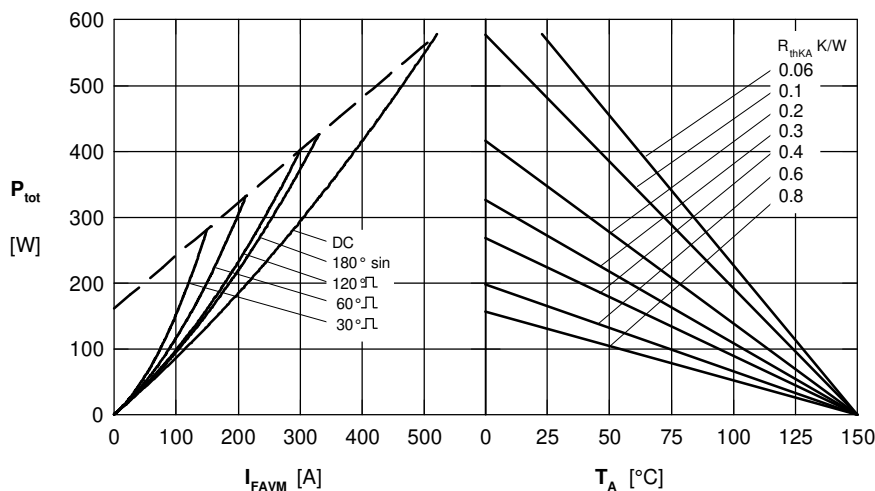


Fig. 4 Power dissipation vs. forward current & ambient temperature (per diode)

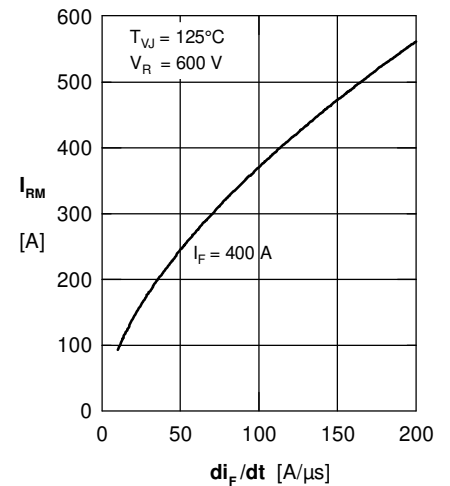


Fig. 5 Typ. peak reverse current

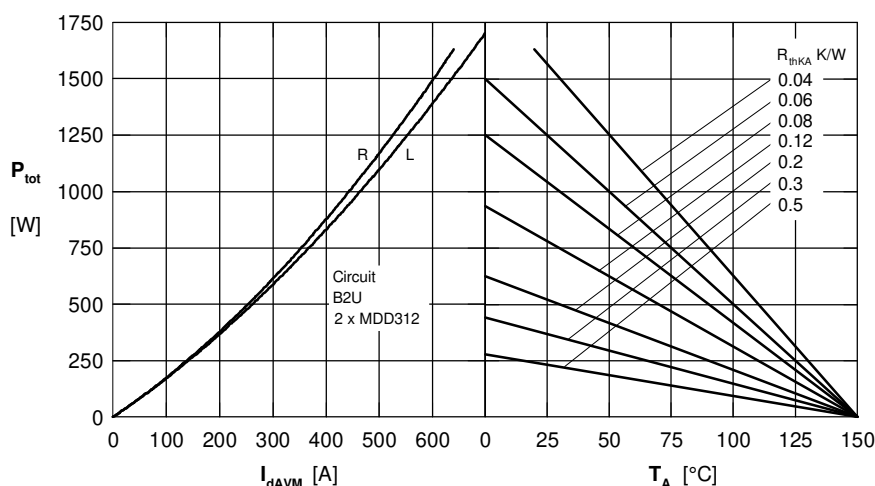


Fig. 6 Single phase rectifier bridge: Power dissipation vs. direct output current and ambient temperature  $R$  = resistive load,  $L$  = inductive load

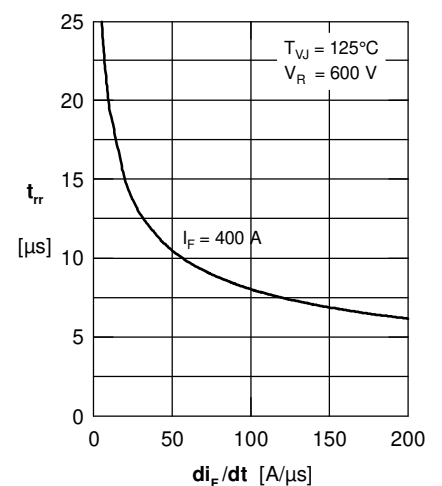


Fig. 7 Typ. recovery time  $t_{rr}$  versus  $-di_F/dt$

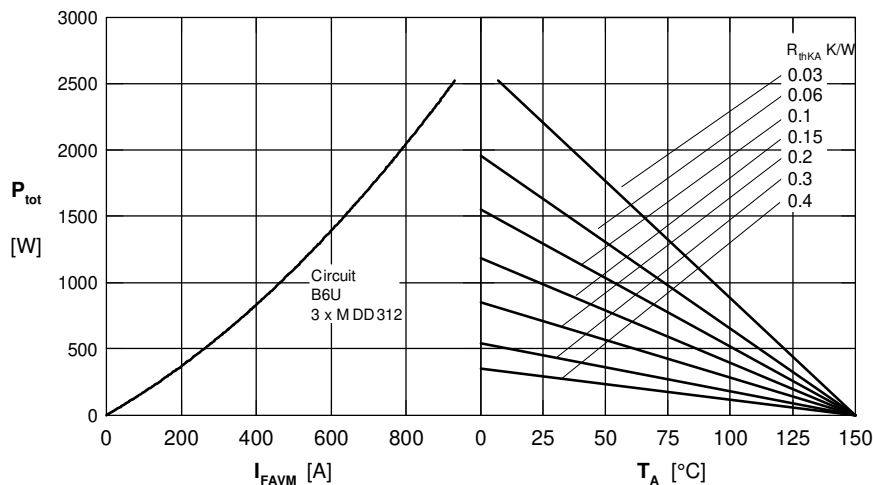
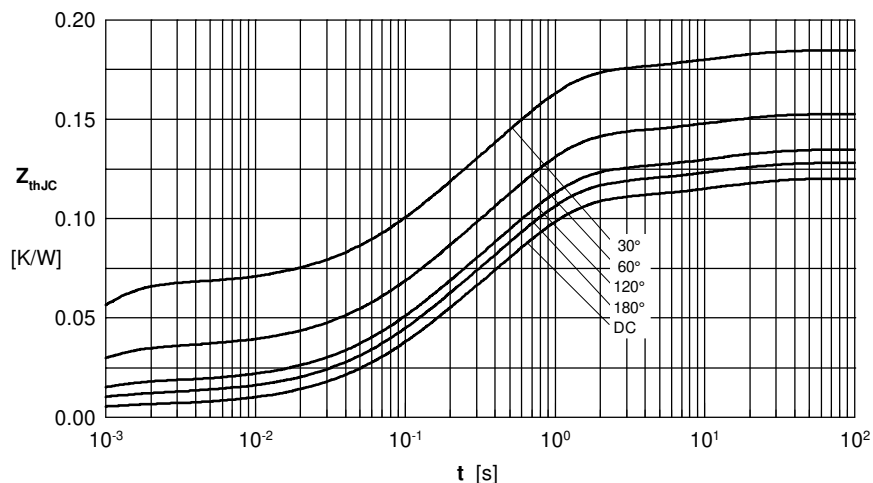
**Rectifier**


Fig. 8 Three phase rectifier bridge: Power dissipation vs. direct output current &amp; ambient temperature

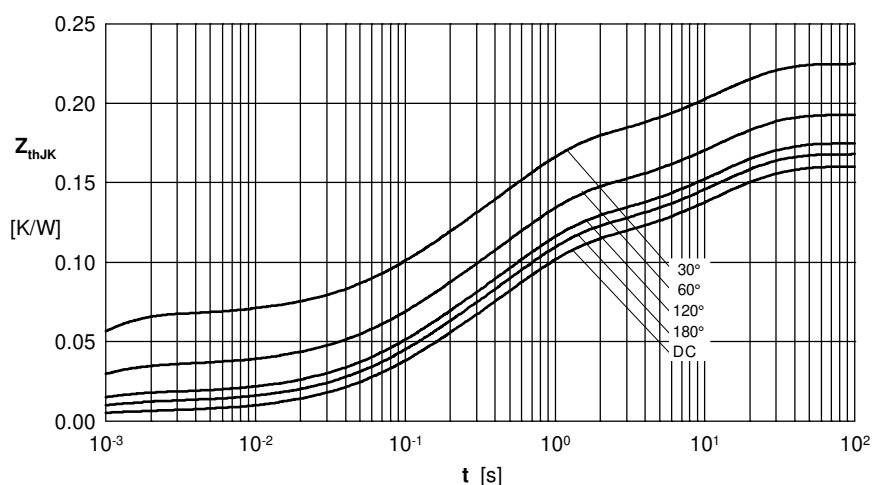

 $R_{thJC}$  for various conduction angles  $d$ :

| $d$  | $R_{thJC}$ [K/W] |
|------|------------------|
| DC   | 0.120            |
| 180° | 0.128            |
| 120° | 0.135            |
| 60°  | 0.153            |
| 30°  | 0.185            |

 Constants for  $Z_{thJC}$  calculation:

| $i$ | $R_{thi}$ (K/W) | $t_i$ (s) |
|-----|-----------------|-----------|
| 1   | 0.0058          | 0.00054   |
| 2   | 0.0310          | 0.09800   |
| 3   | 0.0720          | 0.54000   |
| 4   | 0.0112          | 12.0000   |

Fig. 9 Transient thermal impedance junction to case (per diode)


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

| $d$  | $R_{thJK}$ [K/W] |
|------|------------------|
| DC   | 0.160            |
| 180° | 0.168            |
| 120° | 0.175            |
| 60°  | 0.193            |
| 30°  | 0.225            |

 Constants for  $Z_{thJK}$  calculation:

| $i$ | $R_{thi}$ (K/W) | $t_i$ (s) |
|-----|-----------------|-----------|
| 1   | 0.0058          | 0.00054   |
| 2   | 0.0310          | 0.09800   |
| 3   | 0.0720          | 0.54000   |
| 4   | 0.0112          | 12.0000   |
| 5   | 0.0400          | 12.0000   |

Fig. 10 Transient thermal impedance junction to heatsink (per diode)