

# Thyristor \ Diode Module

$$V_{RRM} = 2 \times 800 \text{ V}$$

$$I_{TAV} = 181 \text{ A}$$

$$V_T = 1.03 \text{ V}$$


Phase leg

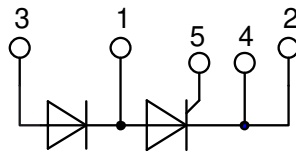
Part number

**MCD162-08io1**



Backside: isolated

 E72873



### Features / Advantages:

- Thyristor for line frequency
- Planar passivated chip
- Long-term stability
- Direct Copper Bonded Al<sub>2</sub>O<sub>3</sub>-ceramic

### Applications:

- Line rectifying 50/60 Hz
- Softstart AC motor control
- DC Motor control
- Power converter
- AC power control
- Lighting and temperature control

### Package: Y4

- Isolation Voltage: 3600 V~
- Industry standard outline
- RoHS compliant
- Soldering pins for PCB mounting
- Base plate: DCB ceramic
- Reduced weight
- Advanced power cycling

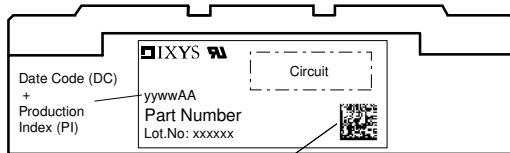
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| Rectifier      |                                                      |                                                                                                                            | Ratings                   |      |       |                   |
|----------------|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|---------------------------|------|-------|-------------------|
| Symbol         | Definition                                           | Conditions                                                                                                                 | min.                      | typ. | max.  | Unit              |
| $V_{RSM/DSM}$  | max. non-repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}C$                                                                                                     |                           |      | 900   | V                 |
| $V_{RRM/DRM}$  | max. repetitive reverse/forward blocking voltage     | $T_{VJ} = 25^{\circ}C$                                                                                                     |                           |      | 800   | V                 |
| $I_{RD}$       | reverse current, drain current                       | $V_{R/D} = 800 V$                                                                                                          | $T_{VJ} = 25^{\circ}C$    |      | 300   | $\mu A$           |
|                |                                                      | $V_{R/D} = 800 V$                                                                                                          | $T_{VJ} = 125^{\circ}C$   |      | 10    | mA                |
| $V_T$          | forward voltage drop                                 | $I_T = 150 A$                                                                                                              | $T_{VJ} = 25^{\circ}C$    |      | 1.09  | V                 |
|                |                                                      | $I_T = 300 A$                                                                                                              |                           |      | 1.25  | V                 |
|                |                                                      | $I_T = 150 A$                                                                                                              | $T_{VJ} = 125^{\circ}C$   |      | 1.03  | V                 |
|                |                                                      | $I_T = 300 A$                                                                                                              |                           |      | 1.25  | V                 |
| $I_{TAV}$      | average forward current                              | $T_C = 85^{\circ}C$                                                                                                        | $T_{VJ} = 125^{\circ}C$   |      | 181   | A                 |
| $I_{T(RMS)}$   | RMS forward current                                  | 180° sine                                                                                                                  |                           |      | 300   | A                 |
| $V_{T0}$       | threshold voltage                                    | } for power loss calculation only                                                                                          | $T_{VJ} = 125^{\circ}C$   |      | 0.88  | V                 |
| $r_T$          | slope resistance                                     |                                                                                                                            |                           |      | 1.15  | m $\Omega$        |
| $R_{thJC}$     | thermal resistance junction to case                  |                                                                                                                            |                           |      | 0.155 | K/W               |
| $R_{thCH}$     | thermal resistance case to heatsink                  |                                                                                                                            |                           | 0.07 |       | K/W               |
| $P_{tot}$      | total power dissipation                              |                                                                                                                            | $T_C = 25^{\circ}C$       |      | 645   | W                 |
| $I_{TSM}$      | max. forward surge current                           | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$                                                                         | $T_{VJ} = 45^{\circ}C$    |      | 6.00  | kA                |
|                |                                                      | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$                                                                        | $V_R = 0 V$               |      | 6.48  | kA                |
|                |                                                      | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$                                                                         | $T_{VJ} = 125^{\circ}C$   |      | 5.10  | kA                |
|                |                                                      | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$                                                                        | $V_R = 0 V$               |      | 5.51  | kA                |
| $I^2t$         | value for fusing                                     | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$                                                                         | $T_{VJ} = 45^{\circ}C$    |      | 180.0 | kA <sup>2</sup> s |
|                |                                                      | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$                                                                        | $V_R = 0 V$               |      | 174.7 | kA <sup>2</sup> s |
|                |                                                      | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$                                                                         | $T_{VJ} = 125^{\circ}C$   |      | 130.1 | kA <sup>2</sup> s |
|                |                                                      | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$                                                                        | $V_R = 0 V$               |      | 126.3 | kA <sup>2</sup> s |
| $C_J$          | junction capacitance                                 | $V_R = 400 V \quad f = 1 \text{ MHz}$                                                                                      | $T_{VJ} = 25^{\circ}C$    |      | 273   | pF                |
| $P_{GM}$       | max. gate power dissipation                          | $t_p = 30 \mu s$                                                                                                           | $T_C = 125^{\circ}C$      |      | 120   | W                 |
|                |                                                      | $t_p = 500 \mu s$                                                                                                          |                           |      | 60    | W                 |
| $P_{GAV}$      | average gate power dissipation                       |                                                                                                                            |                           |      | 8     | W                 |
| $(di/dt)_{cr}$ | critical rate of rise of current                     | $T_{VJ} = 125^{\circ}C; f = 50 \text{ Hz}$                                                                                 | repetitive, $I_T = 540 A$ |      | 150   | A/ $\mu s$        |
|                |                                                      | $t_p = 200 \mu s; di_G/dt = 0.5 A/\mu s;$<br>$I_G = 0.5 A; V = \frac{2}{3} V_{DRM}$                                        | non-repet., $I_T = 180 A$ |      | 500   | A/ $\mu s$        |
| $(dv/dt)_{cr}$ | critical rate of rise of voltage                     | $V = \frac{2}{3} V_{DRM}$<br>$R_{GK} = \infty; \text{ method 1 (linear voltage rise)}$                                     | $T_{VJ} = 125^{\circ}C$   |      | 1000  | V/ $\mu s$        |
| $V_{GT}$       | gate trigger voltage                                 | $V_D = 6 V$                                                                                                                | $T_{VJ} = 25^{\circ}C$    |      | 2.5   | V                 |
|                |                                                      |                                                                                                                            | $T_{VJ} = -40^{\circ}C$   |      | 2.6   | V                 |
| $I_{GT}$       | gate trigger current                                 | $V_D = 6 V$                                                                                                                | $T_{VJ} = 25^{\circ}C$    |      | 150   | mA                |
|                |                                                      |                                                                                                                            | $T_{VJ} = -40^{\circ}C$   |      | 200   | mA                |
| $V_{GD}$       | gate non-trigger voltage                             | $V_D = \frac{2}{3} V_{DRM}$                                                                                                | $T_{VJ} = 125^{\circ}C$   |      | 0.2   | V                 |
| $I_{GD}$       | gate non-trigger current                             |                                                                                                                            |                           |      | 10    | mA                |
| $I_L$          | latching current                                     | $t_p = 30 \mu s$                                                                                                           | $T_{VJ} = 25^{\circ}C$    |      | 300   | mA                |
|                |                                                      | $I_G = 0.5 A; di_G/dt = 0.5 A/\mu s$                                                                                       |                           |      |       |                   |
| $I_H$          | holding current                                      | $V_D = 6 V \quad R_{GK} = \infty$                                                                                          | $T_{VJ} = 25^{\circ}C$    |      | 200   | mA                |
| $t_{gd}$       | gate controlled delay time                           | $V_D = \frac{1}{2} V_{DRM}$                                                                                                | $T_{VJ} = 25^{\circ}C$    |      | 2     | $\mu s$           |
|                |                                                      | $I_G = 0.5 A; di_G/dt = 0.5 A/\mu s$                                                                                       |                           |      |       |                   |
| $t_q$          | turn-off time                                        | $V_R = 100 V; I_T = 300 A; V = \frac{2}{3} V_{DRM}$<br>$di/dt = 10 A/\mu s \quad dv/dt = 20 V/\mu s \quad t_p = 200 \mu s$ | $T_{VJ} = 100^{\circ}C$   |      | 150   | $\mu s$           |



| Package Y4    |                                                              |                      |                                     | Ratings |      |      |  |
|---------------|--------------------------------------------------------------|----------------------|-------------------------------------|---------|------|------|--|
| Symbol        | Definition                                                   | Conditions           | min.                                | typ.    | max. | Unit |  |
| $I_{RMS}$     | RMS current                                                  | per terminal         |                                     |         | 300  | A    |  |
| $T_{VJ}$      | virtual junction temperature                                 |                      | -40                                 |         | 125  | °C   |  |
| $T_{op}$      | operation temperature                                        |                      | -40                                 |         | 100  | °C   |  |
| $T_{stg}$     | storage temperature                                          |                      | -40                                 |         | 125  | °C   |  |
| <b>Weight</b> |                                                              |                      |                                     |         | 150  | g    |  |
| $M_D$         | mounting torque                                              |                      | 2.25                                |         | 2.75 | Nm   |  |
| $M_T$         | terminal torque                                              |                      | 4.5                                 |         | 5.5  | Nm   |  |
| $d_{Spp/App}$ | creepage distance on surface   striking distance through air | terminal to terminal | 14.0                                | 10.0    |      | mm   |  |
| $d_{Spb/Apb}$ |                                                              | terminal to backside | 16.0                                | 16.0    |      | mm   |  |
| $V_{ISOL}$    | isolation voltage                                            | t = 1 second         |                                     |         | 3600 | V    |  |
|               |                                                              | t = 1 minute         | 50/60 Hz, RMS; $I_{ISOL} \leq 1$ mA |         | 3000 | V    |  |



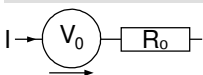
Data Matrix: part no. (1-19), DC + PI (20-25), lot.no.# (26-31), blank (32), serial no.# (33-36)

| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|---------------|----------|----------|
| Standard | MCD162-08io1    | MCD162-08io1       | Box           | 6        | 429635   |

**Equivalent Circuits for Simulation**

\* on die level

$T_{VJ} = 125^{\circ}\text{C}$

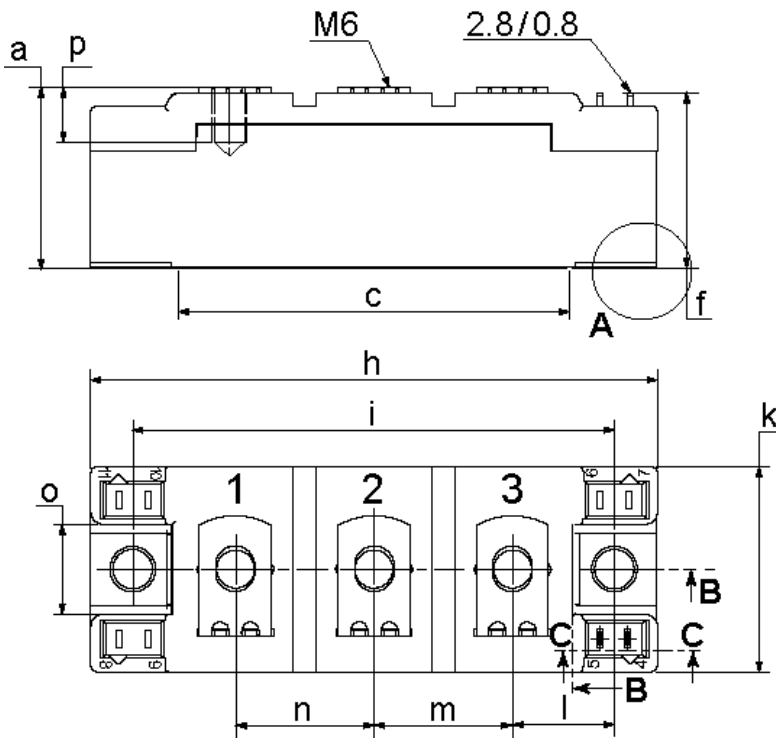


**Thyristor**

|              |                    |      |    |
|--------------|--------------------|------|----|
| $V_{0\ max}$ | threshold voltage  | 0.88 | V  |
| $R_{0\ max}$ | slope resistance * | 0.8  | mΩ |

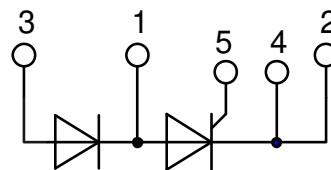


**Outlines Y4**



| Dim. | MIN [mm]  | MAX [mm] | MIN [inch] | MAX [inch] |
|------|-----------|----------|------------|------------|
| a    | 30.0      | 30.6     | 1.181      | 1.205      |
| b    | typ. 0.25 |          | typ. 0.010 |            |
| c    | 64.0      | 65.0     | 2.520      | 2.559      |
| d    | 6.5       | 7.0      | 0.256      | 0.275      |
| e    | 4.9       | 5.1      | 0.193      | 0.201      |
| f    | 28.6      | 29.2     | 1.126      | 1.150      |
| g    | 7.3       | 7.7      | 0.287      | 0.303      |
| h    | 93.5      | 94.5     | 3.681      | 3.720      |
| i    | 79.5      | 80.5     | 3.130      | 3.169      |
| j    | 4.8       | 5.2      | 0.189      | 0.205      |
| k    | 33.4      | 34.0     | 1.315      | 1.339      |
| l    | 16.7      | 17.3     | 0.657      | 0.681      |
| m    | 22.7      | 23.3     | 0.894      | 0.917      |
| n    | 22.7      | 23.3     | 0.894      | 0.917      |
| o    | 14.0      | 15.0     | 0.551      | 0.591      |
| p    | typ. 10.5 |          | typ. 0.413 |            |
| r    | 1.8       | 2.4      | 0.071      | 0.041      |

Optional accessories for modules  
Keyed gate/cathode twin plugs with wire length = 350 mm, gate = white, cathode = red  
Type ZY 180L (L = Left for pin pair 4/5) UL 758, style 3751



**Thyristor**

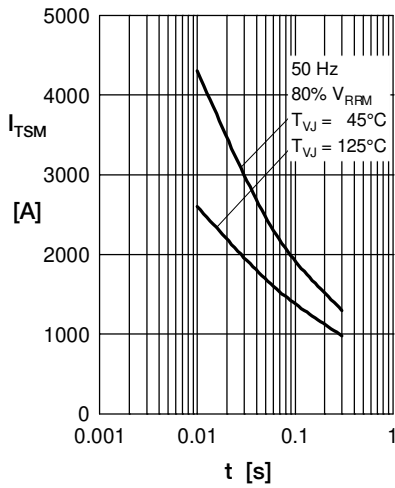


Fig. 1 Surge overload current  $I_{TSM}$ ,  $I_{FSM}$ : Crest value, t: duration

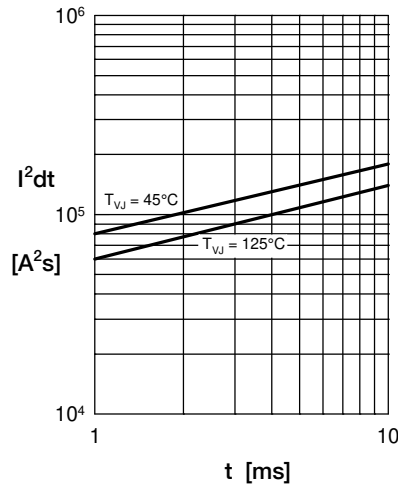


Fig. 2  $I^2dt$  versus time (1-10 ms)

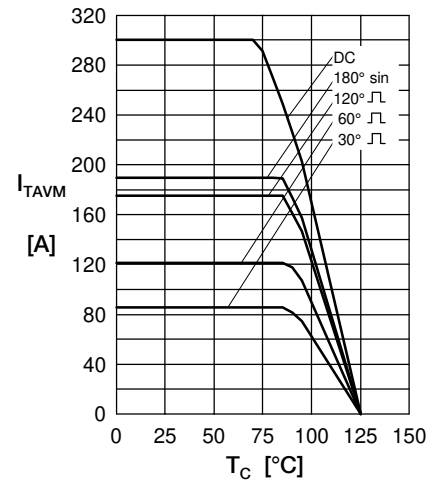


Fig. 3 Max. forward current at case temperature

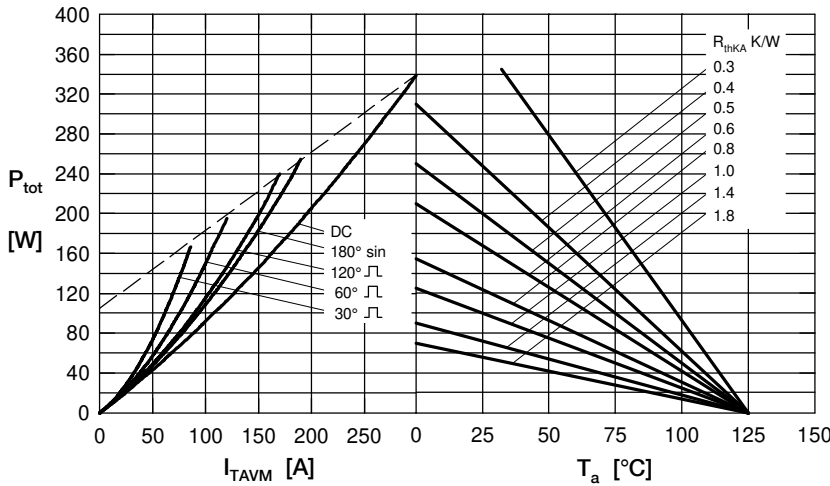


Fig. 4 Power dissipation vs. on-state current & ambient temperature (per thyristor or diode)

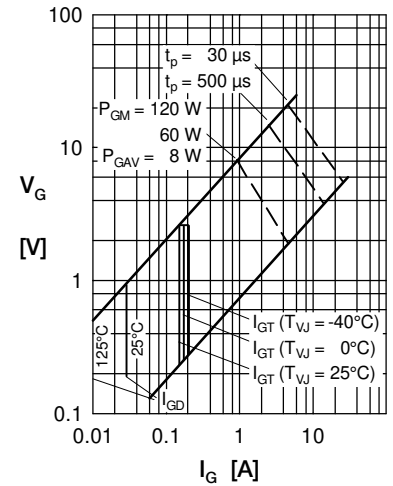


Fig. 5 Gate trigger characteristics

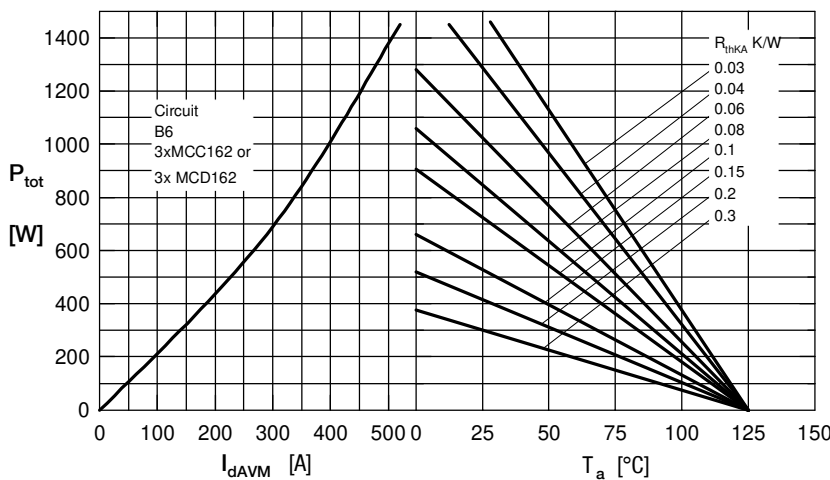


Fig. 6 Three phase rectifier bridge: Power dissipation versus direct output current and ambient temperature

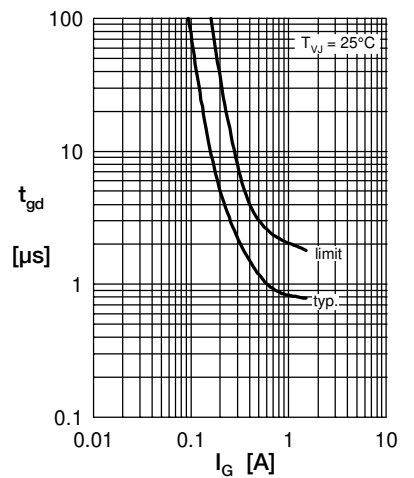


Fig. 7 Gate trigger delay time



**Rectifier**

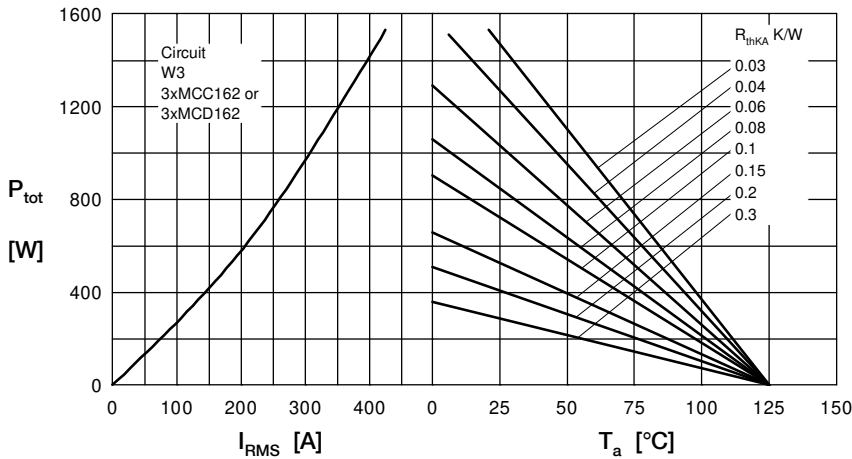
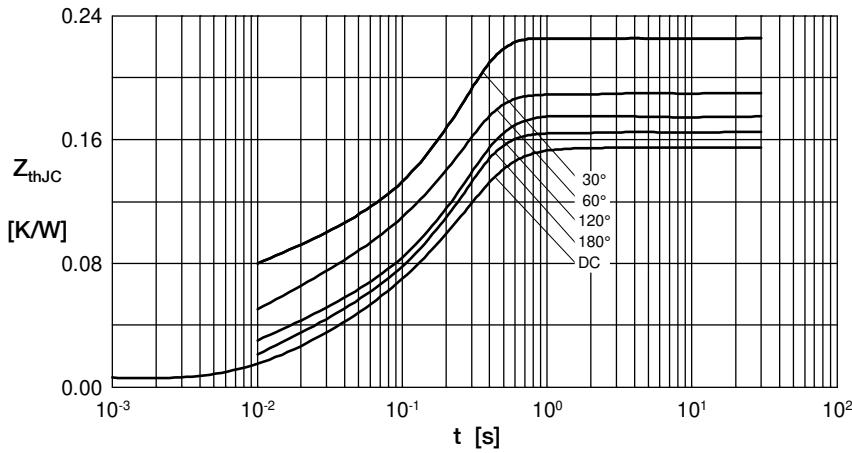


Fig. 8 Three phase AC-controller: Power dissipation versus RMS output current and ambient temperature



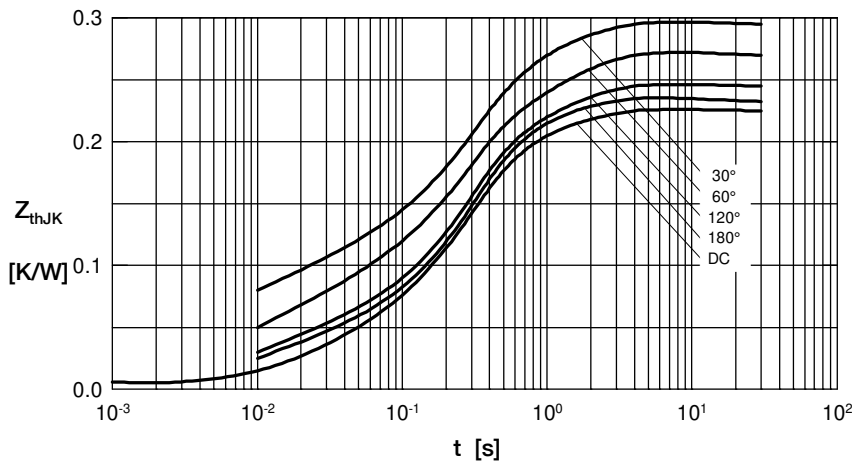
$R_{thJC}$  for various conduction angles d:

| d    | $R_{thJC}$ [K/W] |
|------|------------------|
| DC   | 0.155            |
| 180° | 0.167            |
| 120° | 0.176            |
| 60°  | 0.197            |
| 30°  | 0.227            |

Constants for  $Z_{thJC}$  calculation:

| i | $R_{thi}$ [K/W] | $t_i$ [s] |
|---|-----------------|-----------|
| 1 | 0.0072          | 0.001     |
| 2 | 0.0188          | 0.080     |
| 3 | 0.1290          | 0.200     |

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



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

| d    | $R_{thJK}$ [K/W] |
|------|------------------|
| DC   | 0.225            |
| 180° | 0.237            |
| 120° | 0.246            |
| 60°  | 0.267            |
| 30°  | 0.297            |

Constants for  $Z_{thJK}$  calculation:

| i | $R_{thi}$ [K/W] | $t_i$ [s] |
|---|-----------------|-----------|
| 1 | 0.0072          | 0.001     |
| 2 | 0.0188          | 0.080     |
| 3 | 0.1290          | 0.200     |
| 4 | 0.0700          | 1.000     |

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