

Thyristor \ Diode Module

$$V_{RRM} = 2 \times 1400 \text{ V}$$

$$I_{TAV} = 320 \text{ A}$$

$$V_T = 1,06 \text{ V}$$

Phase leg

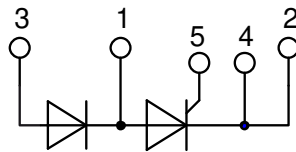
Part number

MCD312-14io1



Backside: isolated

 E72873



Features / Advantages:

- International standard package
- Direct copper bonded Al₂O₃-ceramic with copper base plate
- Planar passivated chip
- Keyed gate/cathode twin pins

Applications:

- Motor control, softstarter
- Power converter
- Heat and temperature control for industrial furnaces and chemical processes
- Lighting control
- Solid state switches

Package: Y1

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

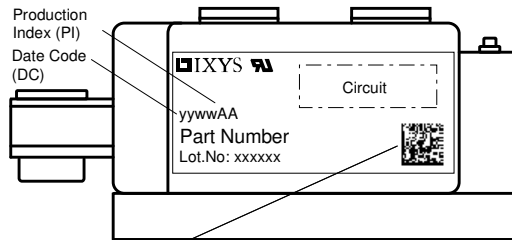
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| Rectifier | | | | Ratings | | | |
|----------------|--|--|-------------------------|---------|-------|-------------------|--|
| Symbol | Definition | Conditions | min. | typ. | max. | Unit | |
| $V_{RSM/DSM}$ | max. non-repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}C$ | | | 1500 | V | |
| $V_{RRM/DRM}$ | max. repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}C$ | | | 1400 | V | |
| I_{RD} | reverse current, drain current | $V_{R/D} = 1400 V$ | $T_{VJ} = 25^{\circ}C$ | | 1 | mA | |
| | | $V_{R/D} = 1400 V$ | $T_{VJ} = 140^{\circ}C$ | | 40 | mA | |
| V_T | forward voltage drop | $I_T = 300 A$ | $T_{VJ} = 25^{\circ}C$ | | 1,12 | V | |
| | | $I_T = 600 A$ | | | 1,32 | V | |
| | | $I_T = 300 A$ | $T_{VJ} = 125^{\circ}C$ | | 1,06 | V | |
| | | $I_T = 600 A$ | | | 1,29 | V | |
| I_{TAV} | average forward current | $T_C = 85^{\circ}C$ | $T_{VJ} = 140^{\circ}C$ | | 320 | A | |
| $I_{T(RMS)}$ | RMS forward current | 180° sine | | | 520 | A | |
| V_{T0} | threshold voltage | } for power loss calculation only | $T_{VJ} = 140^{\circ}C$ | | 0,80 | V | |
| r_T | slope resistance | | | | 0,68 | mΩ | |
| 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 | | $T_C = 25^{\circ}C$ | | 960 | W | |
| I_{TSM} | max. forward surge current | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$ | $T_{VJ} = 45^{\circ}C$ | | 9,60 | kA | |
| | | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$ | $V_R = 0 V$ | | 10,4 | kA | |
| | | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$ | $T_{VJ} = 140^{\circ}C$ | | 8,16 | kA | |
| | | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$ | $V_R = 0 V$ | | 8,82 | kA | |
| I^2t | value for fusing | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$ | $T_{VJ} = 45^{\circ}C$ | | 460,8 | kA ² s | |
| | | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$ | $V_R = 0 V$ | | 447,4 | kA ² s | |
| | | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$ | $T_{VJ} = 140^{\circ}C$ | | 332,9 | kA ² s | |
| | | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$ | $V_R = 0 V$ | | 323,3 | kA ² s | |
| C_J | junction capacitance | $V_R = 400V \quad f = 1 \text{ MHz}$ | $T_{VJ} = 25^{\circ}C$ | 438 | | pF | |
| P_{GM} | max. gate power dissipation | $t_p = 30 \mu s$ | $T_C = 140^{\circ}C$ | | 120 | W | |
| | | $t_p = 500 \mu s$ | | | 60 | W | |
| P_{GAV} | average gate power dissipation | | | | 20 | W | |
| $(di/dt)_{cr}$ | critical rate of rise of current | $T_{VJ} = 140^{\circ}C; f = 50 \text{ Hz}$ repetitive, $I_T = 960 A$ | | | 100 | A/μs | |
| | | $t_p = 200 \mu s; di_G/dt = 1 A/\mu s;$ $I_G = 1 A; V_D = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 320 A$ | | | 500 | A/μs | |
| $(dv/dt)_{cr}$ | critical rate of rise of voltage | $V_D = \frac{2}{3} V_{DRM}$ $R_{GK} = \infty$; method 1 (linear voltage rise) | $T_{VJ} = 140^{\circ}C$ | | 1000 | V/μs | |
| V_{GT} | gate trigger voltage | $V_D = 6 V$ | $T_{VJ} = 25^{\circ}C$ | | 2 | V | |
| | | | $T_{VJ} = -40^{\circ}C$ | | 3 | V | |
| I_{GT} | gate trigger current | $V_D = 6 V$ | $T_{VJ} = 25^{\circ}C$ | | 150 | mA | |
| | | | $T_{VJ} = -40^{\circ}C$ | | 220 | mA | |
| V_{GD} | gate non-trigger voltage | $V_D = \frac{2}{3} V_{DRM}$ | $T_{VJ} = 140^{\circ}C$ | | 0,25 | V | |
| I_{GD} | gate non-trigger current | | | | 10 | mA | |
| I_L | latching current | $t_p = 30 \mu s$ | $T_{VJ} = 25^{\circ}C$ | | 200 | mA | |
| | | $I_G = 0,45 A; di_G/dt = 0,45 A/\mu s$ | | | | | |
| I_H | holding current | $V_D = 6 V \quad R_{GK} = \infty$ | $T_{VJ} = 25^{\circ}C$ | | 150 | mA | |
| t_{gd} | gate controlled delay time | $V_D = \frac{1}{2} V_{DRM}$ | $T_{VJ} = 25^{\circ}C$ | | 2 | μs | |
| | | $I_G = 1 A; di_G/dt = 1 A/\mu s$ | | | | | |
| t_q | turn-off time | $V_R = 100 V; I_T = 300 A; V_D = \frac{2}{3} V_{DRM}$ $di/dt = 10 A/\mu s; dv/dt = 50 V/\mu s; t_p = 200 \mu s$ | $T_{VJ} = 125^{\circ}C$ | 200 | | μs | |



| Package Y1 | | | Ratings | | | |
|---------------|--|----------------------|---------|------|------|------|
| Symbol | Definition | Conditions | min. | typ. | max. | Unit |
| I_{RMS} | RMS current | per terminal | | | 600 | A |
| T_{VJ} | virtual junction temperature | | -40 | | 140 | °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 |



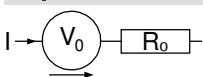
Data Matrix: part no. (1-19), DC + PI (20-25), lot.no.# (26-31), blank (32), serial no.# (33-36)

| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|---------------|----------|----------|
| Standard | MCD312-14io1 | MCD312-14io1 | Box | 3 | 466174 |

Equivalent Circuits for Simulation

* on die level

$T_{VJ} = 140^{\circ}C$

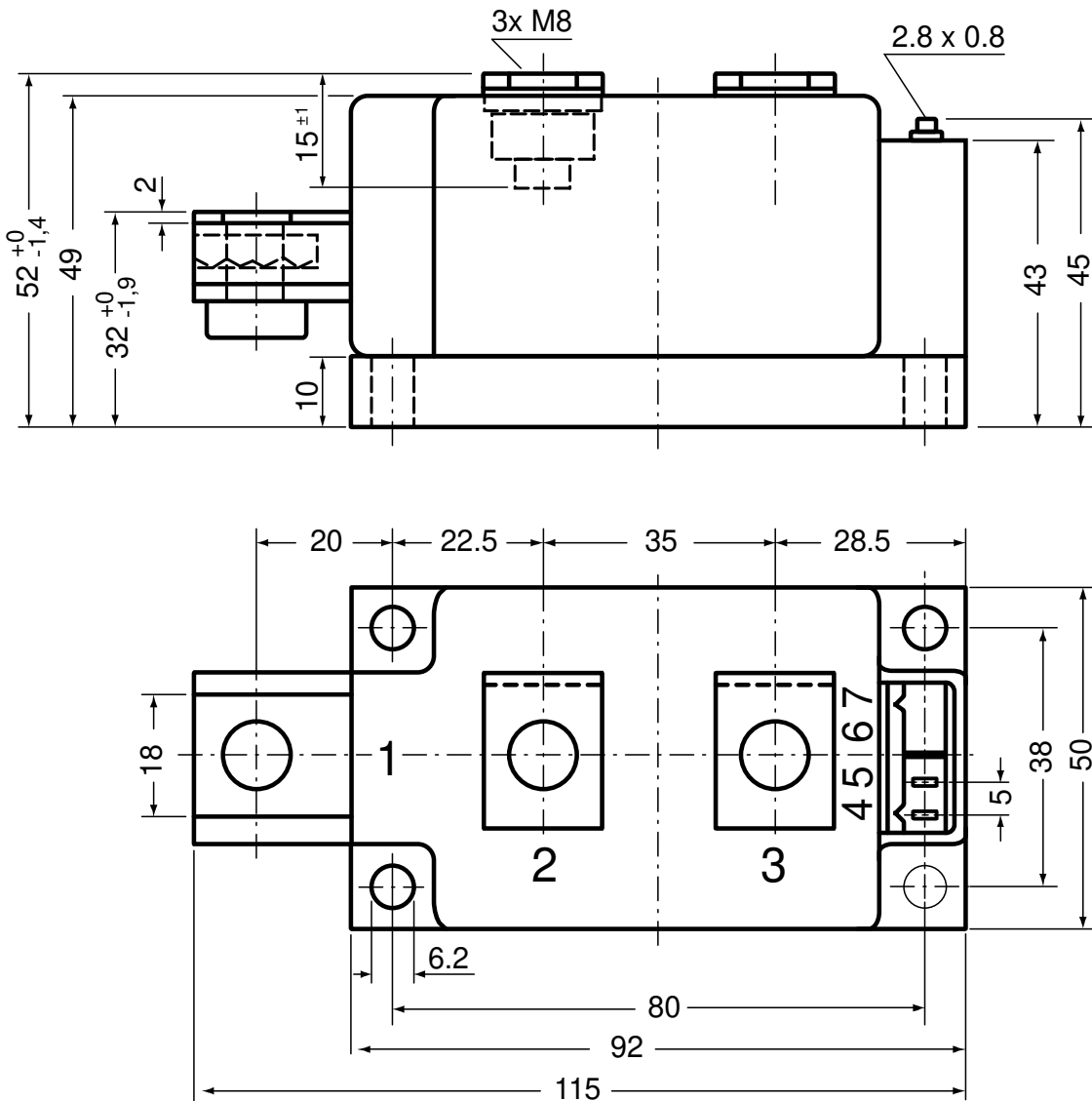


Thyristor

| | | | |
|--------------|--------------------|-----|----|
| $V_{0\ max}$ | threshold voltage | 0,8 | V |
| $R_{0\ max}$ | slope resistance * | 0,5 | mΩ |

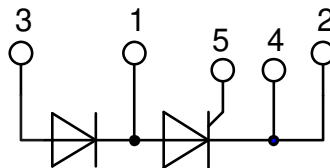


Outlines Y1



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

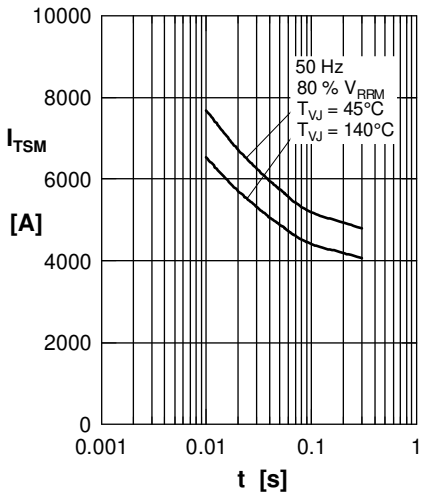


Fig. 1 Surge overload current
 I_{TSM} : Crest value, t : duration

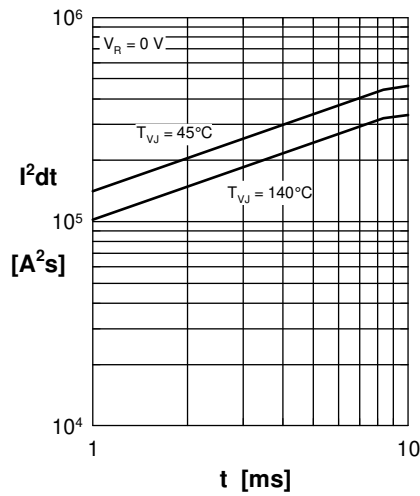


Fig. 2 I^2dt versus time

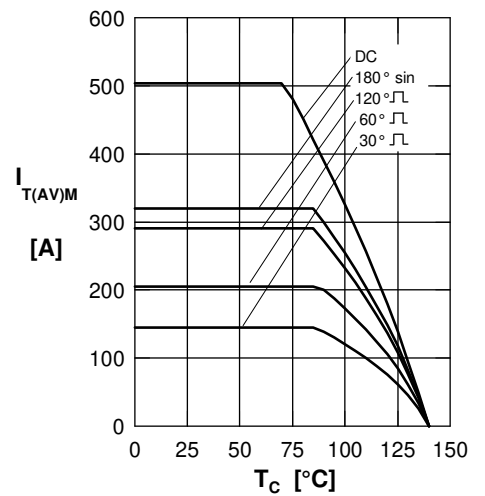


Fig. 3 Max. forward current at case temperature

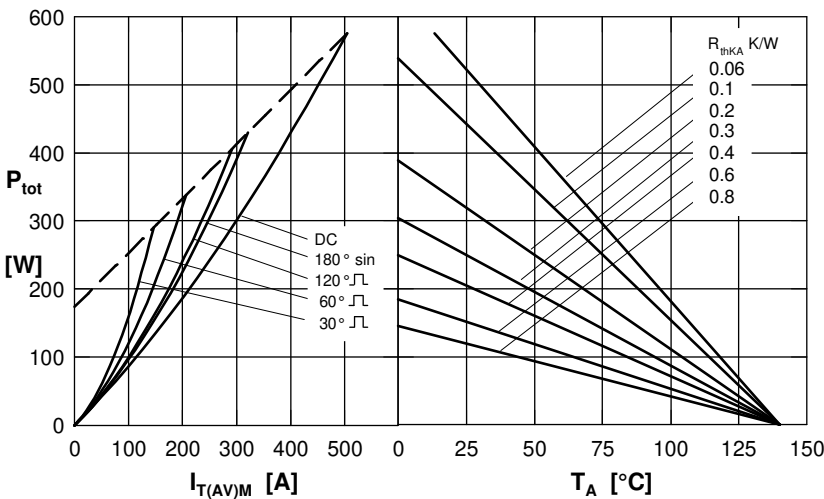


Fig. 4 Power dissipation versus on-state current and ambient temperature (per thyristor)

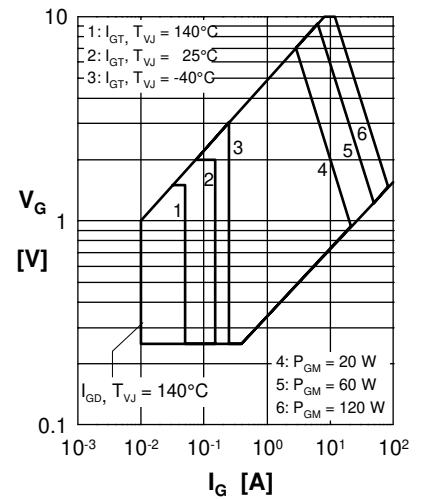


Fig. 5 Gate voltage & gate current

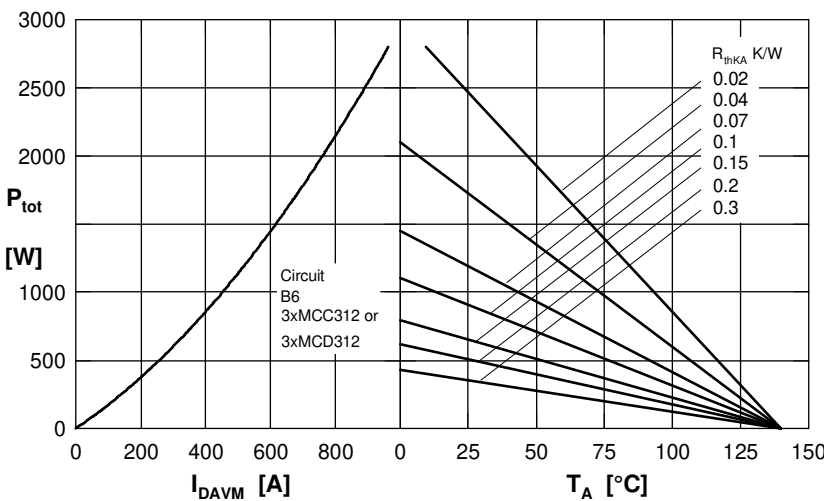


Fig. 6 Three phase rectifier bridge: Power dissipation versus direct output current and ambient temperature

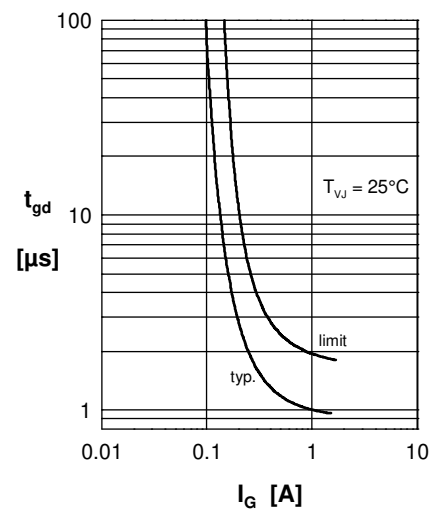


Fig. 7 Gate controlled delay time t_{gd}



Rectifier

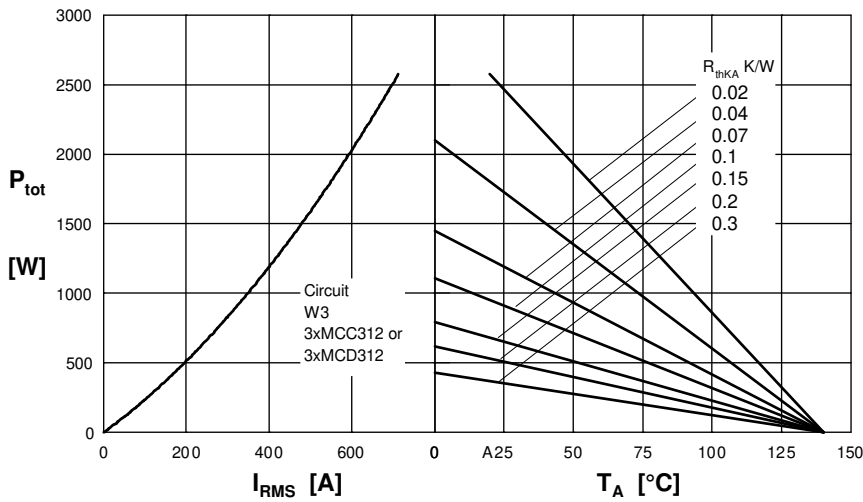


Fig. 8 Three phase AC-controller: Power dissipation versus R_{MS} output current and ambient temperature

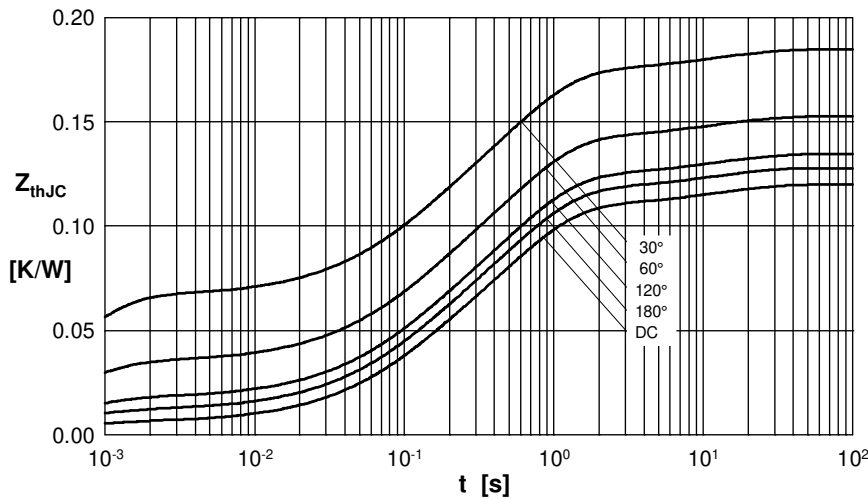


Fig. 9 Transient thermal impedance junction to case (per thyristor)

R_{thJC} for various conduct. 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 | 0.098 |
| 3 | 0.0720 | 0.54 |
| 4 | 0.0112 | 12 |

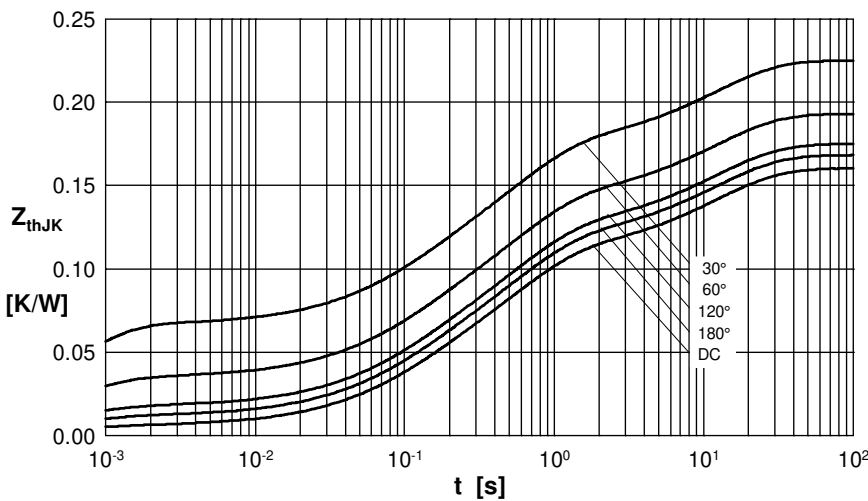


Fig. 10 Transient thermal impedance junction to heatsink (per thyristor)

R_{thJK} for various conduct. 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 | 0.098 |
| 3 | 0.0720 | 0.54 |
| 4 | 0.0114 | 12 |
| 5 | 0.0400 | 12 |