

Thyristor \ Diode Module

$$V_{RRM} = 2 \times 1200 \text{ V}$$

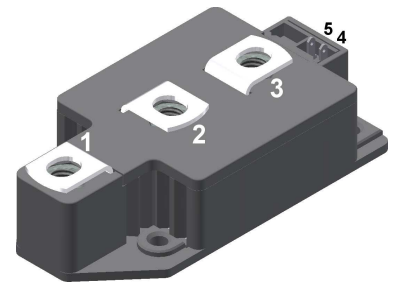
$$I_{TAV} = 320 \text{ A}$$

$$V_T = 1.08 \text{ V}$$

Phase leg

Part number

MCD310-12io1



Backside: isolated

 E72873



Features / Advantages:

- Thyristor for line frequency
- Planar passivated chip
- Long-term stability
- Direct Copper Bonded Al₂O₃-ceramic

Applications:

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

Package: Y2

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

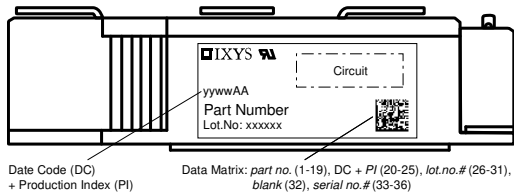
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| Rectifier | | | Ratings | | | |
|----------------|--|--|----------------------------------|------|-------|-------------------|
| Symbol | Definition | Conditions | min. | typ. | max. | Unit |
| $V_{RSM/DSM}$ | max. non-repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}\text{C}$ | | | 1300 | V |
| $V_{RRM/DRM}$ | max. repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}\text{C}$ | | | 1200 | V |
| I_{RD} | reverse current, drain current | $V_{R/D} = 1200\text{ V}$ | $T_{VJ} = 25^{\circ}\text{C}$ | | 1 | mA |
| | | $V_{R/D} = 1200\text{ V}$ | $T_{VJ} = 140^{\circ}\text{C}$ | | 40 | mA |
| V_T | forward voltage drop | $I_T = 300\text{ A}$ | $T_{VJ} = 25^{\circ}\text{C}$ | | 1.14 | V |
| | | $I_T = 600\text{ A}$ | | | 1.32 | V |
| | | $I_T = 300\text{ A}$ | $T_{VJ} = 125^{\circ}\text{C}$ | | 1.08 | V |
| | | $I_T = 600\text{ A}$ | | | 1.30 | V |
| I_{TAV} | average forward current | $T_C = 85^{\circ}\text{C}$ | $T_{VJ} = 140^{\circ}\text{C}$ | | 320 | A |
| $I_{T(RMS)}$ | RMS forward current | 180° sine | | | 500 | A |
| V_{T0} | threshold voltage | } for power loss calculation only | $T_{VJ} = 140^{\circ}\text{C}$ | | 0.80 | V |
| r_T | slope resistance | | | | 0.82 | mΩ |
| R_{thJC} | thermal resistance junction to case | | | | 0.11 | K/W |
| R_{thCH} | thermal resistance case to heatsink | | | 0.04 | | K/W |
| P_{tot} | total power dissipation | | $T_C = 25^{\circ}\text{C}$ | | 1030 | W |
| I_{TSM} | max. forward surge current | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$ | $T_{VJ} = 45^{\circ}\text{C}$ | | 9.20 | kA |
| | | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$ | $V_R = 0\text{ V}$ | | 9.94 | kA |
| | | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$ | $T_{VJ} = 140^{\circ}\text{C}$ | | 7.82 | kA |
| | | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$ | $V_R = 0\text{ V}$ | | 8.45 | kA |
| I^2t | value for fusing | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$ | $T_{VJ} = 45^{\circ}\text{C}$ | | 423.2 | kA ² s |
| | | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$ | $V_R = 0\text{ V}$ | | 410.6 | kA ² s |
| | | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$ | $T_{VJ} = 140^{\circ}\text{C}$ | | 305.8 | kA ² s |
| | | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$ | $V_R = 0\text{ V}$ | | 296.7 | kA ² s |
| C_J | junction capacitance | $V_R = 400\text{ V } f = 1\text{ MHz}$ | $T_{VJ} = 25^{\circ}\text{C}$ | | 438 | pF |
| P_{GM} | max. gate power dissipation | $t_p = 30\text{ }\mu\text{s}$ | $T_C = 140^{\circ}\text{C}$ | | 120 | W |
| | | $t_p = 500\text{ }\mu\text{s}$ | | | 60 | W |
| P_{GAV} | average gate power dissipation | | | | 20 | W |
| $(di/dt)_{cr}$ | critical rate of rise of current | $T_{VJ} = 140^{\circ}\text{C}; f = 50\text{ Hz}$ | repetitive, $I_T = 960\text{ A}$ | | 100 | A/ μs |
| | | $t_p = 200\text{ }\mu\text{s}; di_G/dt = 1\text{ A}/\mu\text{s};$ | non-repet., $I_T = 320\text{ A}$ | | 500 | A/ μs |
| $(dv/dt)_{cr}$ | critical rate of rise of voltage | $V = \frac{2}{3} V_{DRM}$ | $T_{VJ} = 140^{\circ}\text{C}$ | | 1000 | V/ μs |
| | | $R_{GK} = \infty$; method 1 (linear voltage rise) | | | | |
| V_{GT} | gate trigger voltage | $V_D = 6\text{ V}$ | $T_{VJ} = 25^{\circ}\text{C}$ | | 2 | V |
| | | | $T_{VJ} = -40^{\circ}\text{C}$ | | 3 | V |
| I_{GT} | gate trigger current | $V_D = 6\text{ V}$ | $T_{VJ} = 25^{\circ}\text{C}$ | | 150 | mA |
| | | | $T_{VJ} = -40^{\circ}\text{C}$ | | 200 | mA |
| V_{GD} | gate non-trigger voltage | $V_D = \frac{2}{3} V_{DRM}$ | $T_{VJ} = 140^{\circ}\text{C}$ | | 0.25 | V |
| I_{GD} | gate non-trigger current | | | | 10 | mA |
| I_L | latching current | $t_p = 30\text{ }\mu\text{s}$ | $T_{VJ} = 25^{\circ}\text{C}$ | | 200 | mA |
| | | $I_G = 0.45\text{ A}; di_G/dt = 0.45\text{ A}/\mu\text{s}$ | | | | |
| I_H | holding current | $V_D = 6\text{ V } R_{GK} = \infty$ | $T_{VJ} = 25^{\circ}\text{C}$ | | 150 | mA |
| t_{gd} | gate controlled delay time | $V_D = \frac{1}{2} V_{DRM}$ | $T_{VJ} = 25^{\circ}\text{C}$ | | 2 | μs |
| | | $I_G = 1\text{ A}; di_G/dt = 1\text{ A}/\mu\text{s}$ | | | | |
| t_q | turn-off time | $V_R = 100\text{ V}; I_T = 320\text{ A}; V = \frac{2}{3} V_{DRM}$ | $T_{VJ} = 125^{\circ}\text{C}$ | | 200 | μs |
| | | $di/dt = 10\text{ A}/\mu\text{s } dv/dt = 50\text{ V}/\mu\text{s } t_p = 200\text{ }\mu\text{s}$ | | | | |



| Package Y2 | | | 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 | | | | 255 | | g |
| M_D | mounting torque | | 2.5 | | 5 | Nm |
| M_T | terminal torque | | 12 | | 15 | Nm |
| $d_{Spp/App}$ | creepage distance on surface striking distance through air | terminal to terminal | 13.0 | | | mm |
| $d_{Spb/Apb}$ | | terminal to backside | 13.0 | | | mm |
| V_{ISOL} | isolation voltage | t = 1 second | 3600 | | | V |
| | | t = 1 minute | 3000 | | | V |



| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|---------------|----------|----------|
| Standard | MCD310-12io1 | MCD310-12io1 | Box | 2 | 428787 |

Equivalent Circuits for Simulation

* on die level

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

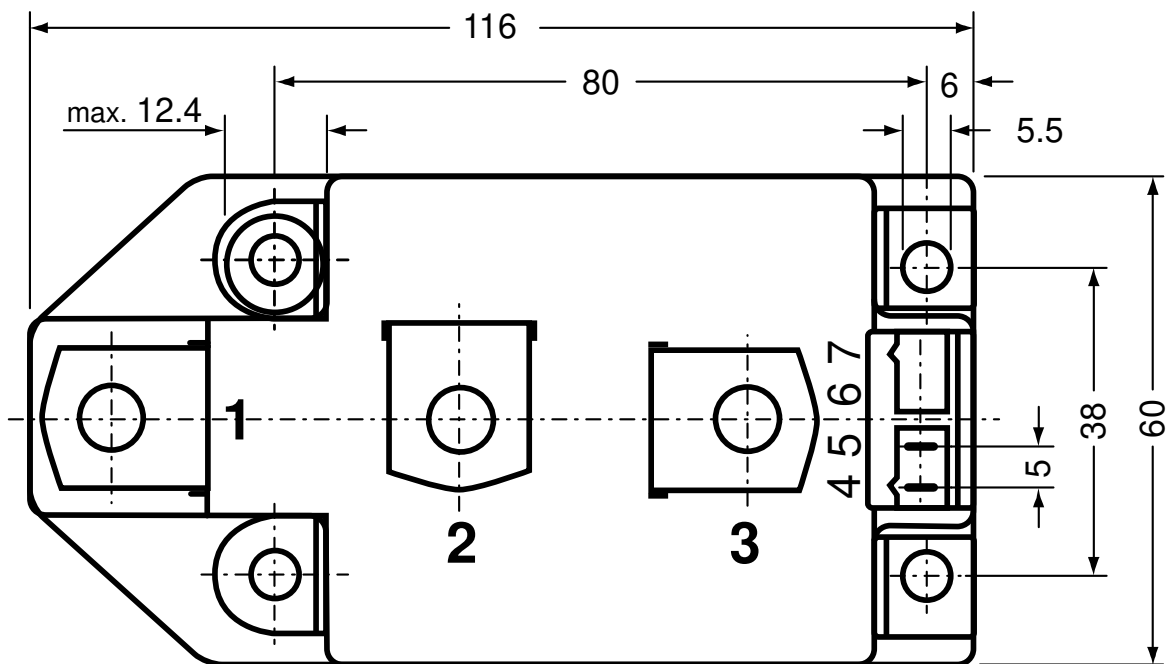
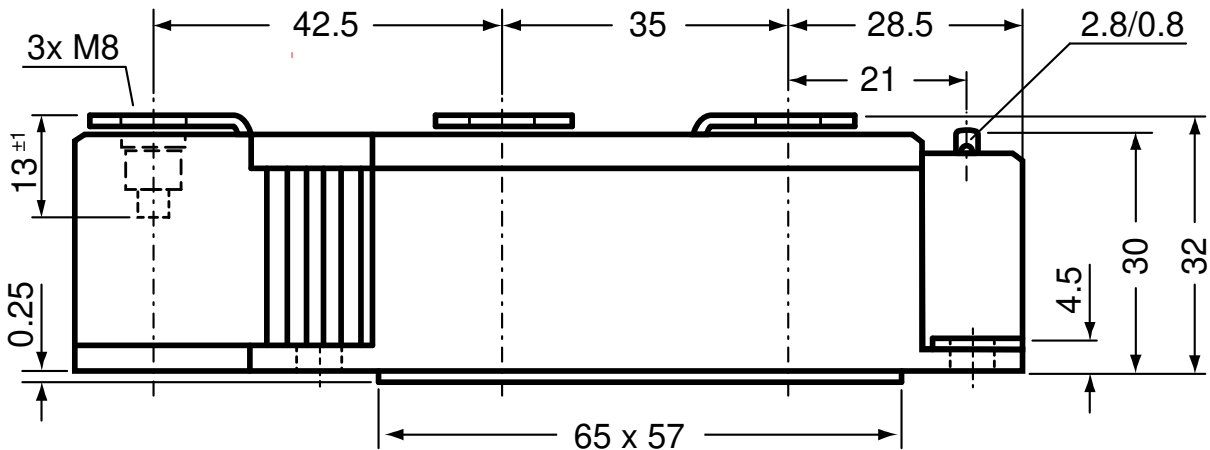


Thyristor

| | | | |
|--------------|--------------------|------|----|
| $V_{0\ max}$ | threshold voltage | 0.8 | V |
| $R_{0\ max}$ | slope resistance * | 0.32 | mΩ |

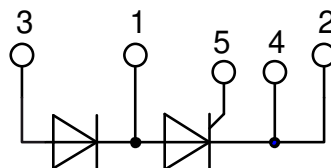


Outlines Y2



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

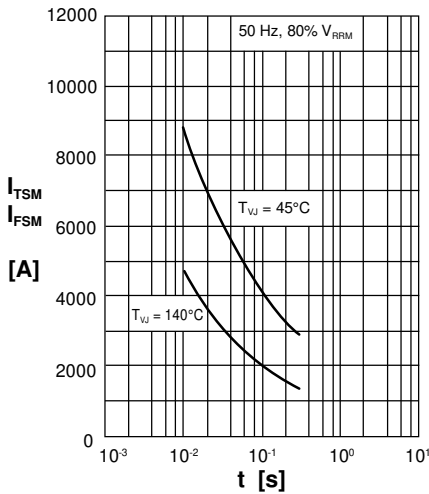


Fig. 1 Surge overload current
 $I_{T(F)SM}$: crest value, t: duration



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

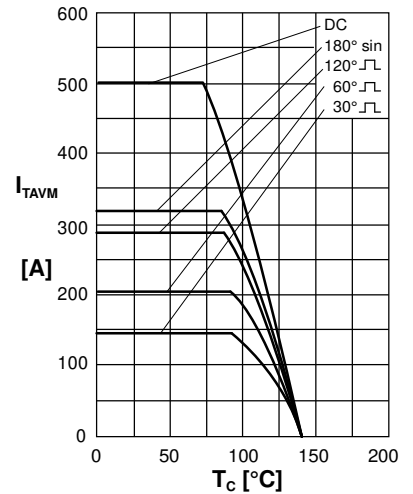


Fig. 3 Max. forward current at case temperature

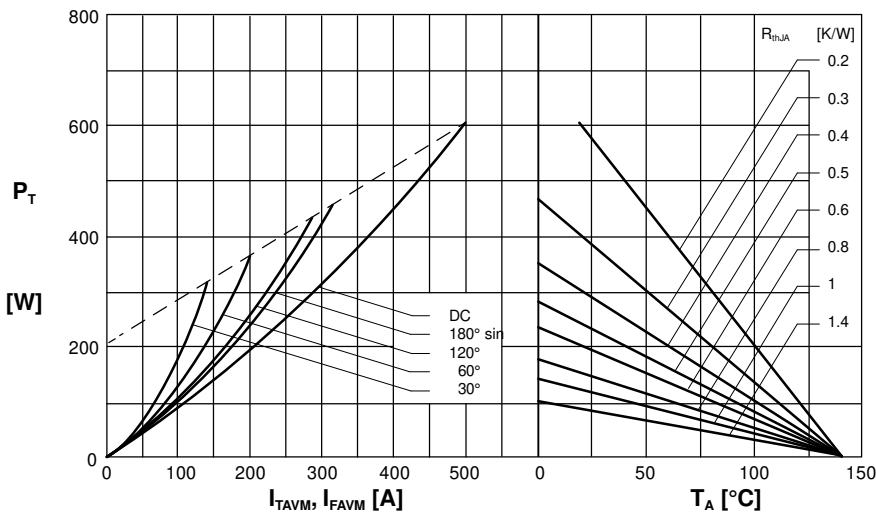


Fig. 4 Power dissipation versus onstate current and ambient temperature (per thyristor/diode)

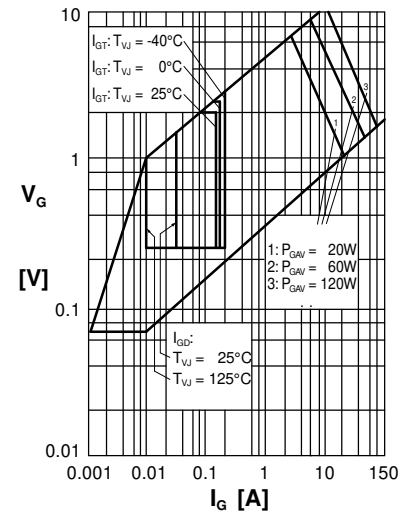


Fig. 5 Gate trigger characteristics

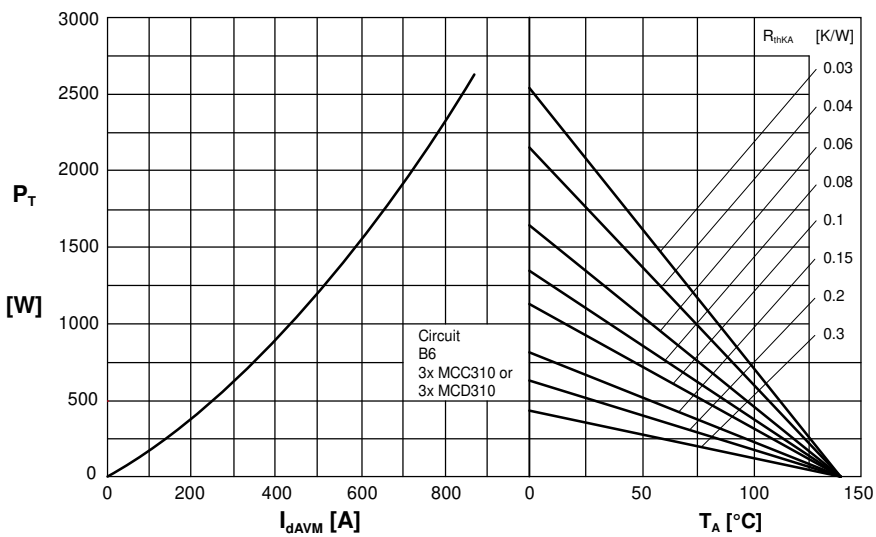


Fig. 6 Three phase rectifier bridge: Power dissipation versus direct output current and ambient temperature

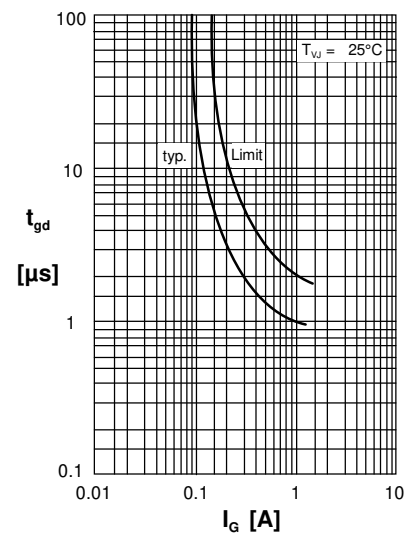


Fig. 7 Gate trigger delay time



Rectifier

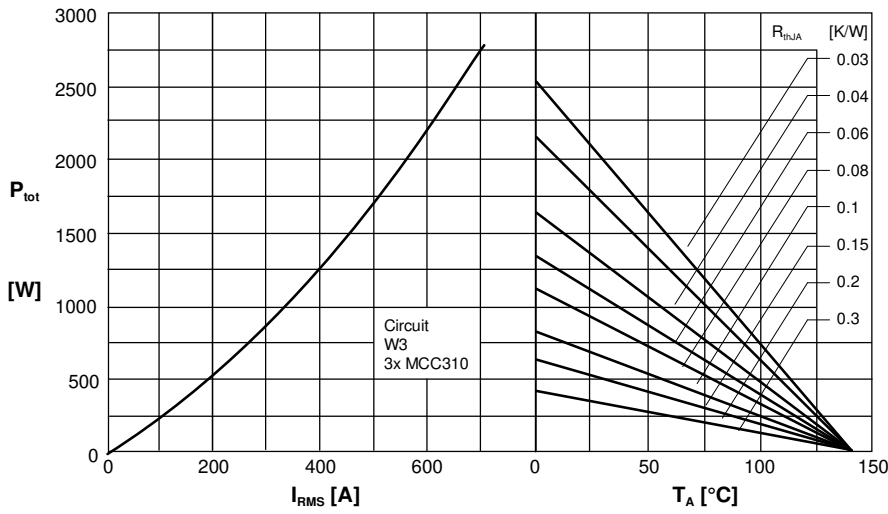


Fig. 7 Three phase AC-controller: •
Power dissipation versus RMS output current and ambient temperature

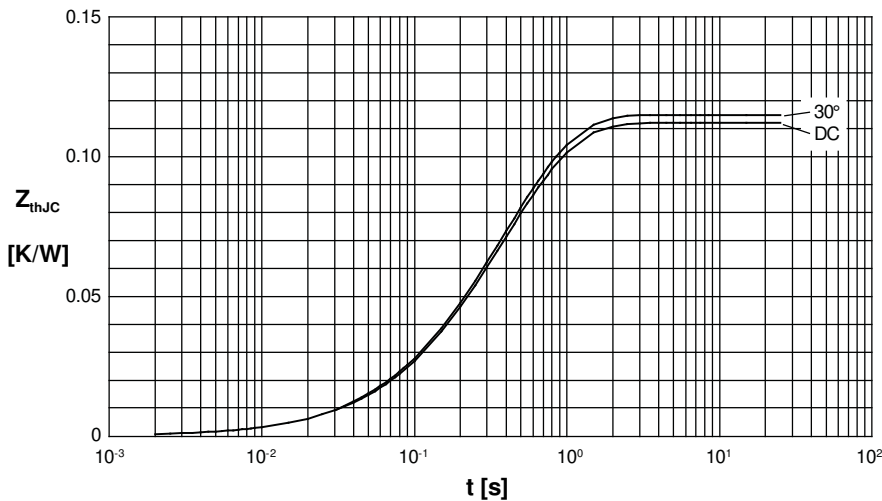


Fig. 8 Transient thermal impedance junction to case (per thyristor)

$R_{\theta JC}$ for various conduction angles d:

| d | $R_{\theta JC}$ (K/W) |
|-------|-----------------------|
| DC | 0.112 |
| 180°C | 0.113 |
| 120°C | 0.114 |
| 60°C | 0.115 |
| 30°C | 0.115 |

Constants for $Z_{\theta JC}$ calculation:

| i | $R_{\theta i}$ [K/W] | t_i [s] |
|---|----------------------|-----------|
| 1 | 0.003 | 0.099 |
| 2 | 0.0143 | 0.168 |
| 3 | 0.0947 | 0.456 |

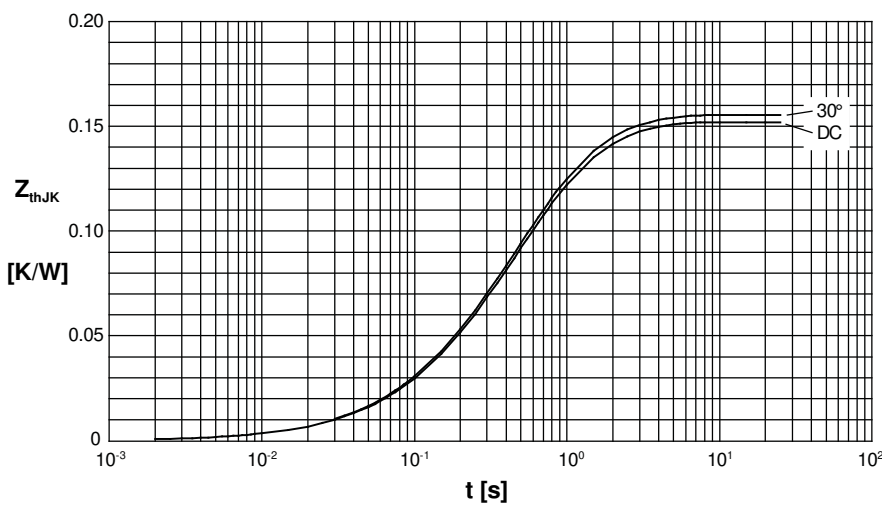


Fig. 9 Transient thermal impedance junction to heatsink (per thyristor)

$R_{\theta JK}$ for various conduction angles d:

| d | $R_{\theta JK}$ [K/W] |
|-------|-----------------------|
| DC | 0.152 |
| 180°C | 0.154 |
| 120°C | 0.154 |
| 60°C | 0.155 |
| 30°C | 0.155 |

Constants for $Z_{\theta JK}$ calculation:

| i | $R_{\theta i}$ (K/W) | t_i (s) |
|---|----------------------|-----------|
| 1 | 0.003 | 0.099 |
| 2 | 0.0143 | 0.168 |
| 3 | 0.0947 | 0.456 |
| 4 | 0.04 | 1.36 |