

High Voltage Thyristor Module

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

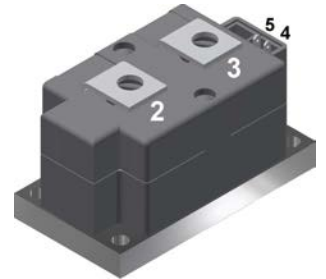
$$I_{TAV} = 464 \text{ A}$$

$$V_T = 1,01 \text{ V}$$

Single Thyristor

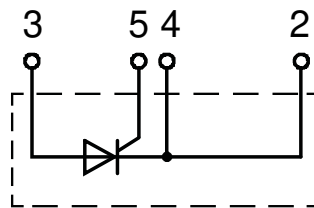
Part number

MCO450-20io1



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: Y1

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

Disclaimer Notice

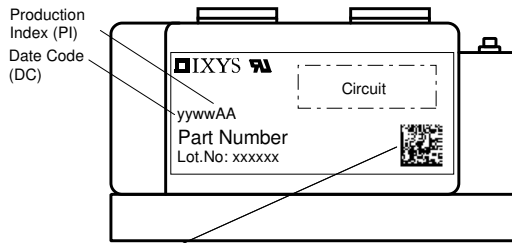
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| Thyristor | | | Ratings | | | |
|----------------|--|---|-------------------------|-------|-------|-------------------|
| Symbol | Definition | Conditions | min. | typ. | max. | Unit |
| $V_{RSM/DSM}$ | max. non-repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}C$ | | | 2100 | V |
| $V_{RRM/DRM}$ | max. repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}C$ | | | 2000 | V |
| I_{RD} | reverse current, drain current | $V_{R/D} = 2000\text{ V}$ | $T_{VJ} = 25^{\circ}C$ | | 2 | mA |
| | | $V_{R/D} = 2000\text{ V}$ | $T_{VJ} = 125^{\circ}C$ | | 40 | mA |
| V_T | forward voltage drop | $I_T = 450\text{ A}$ | $T_{VJ} = 25^{\circ}C$ | | 1,07 | V |
| | | $I_T = 900\text{ A}$ | | | 1,32 | V |
| | | $I_T = 450\text{ A}$ | $T_{VJ} = 125^{\circ}C$ | | 1,01 | V |
| | | $I_T = 900\text{ A}$ | | | 1,33 | V |
| I_{TAV} | average forward current | $T_C = 85^{\circ}C$ | $T_{VJ} = 140^{\circ}C$ | | 464 | A |
| $I_{T(RMS)}$ | RMS forward current | 180° sine | | | 750 | A |
| V_{T0} | threshold voltage | } for power loss calculation only | $T_{VJ} = 140^{\circ}C$ | | 0,77 | V |
| r_T | slope resistance | | | | 0,42 | mΩ |
| R_{thJC} | thermal resistance junction to case | | | | 0,072 | K/W |
| R_{thCH} | thermal resistance case to heatsink | | | 0,024 | | K/W |
| P_{tot} | total power dissipation | | $T_C = 25^{\circ}C$ | | 1600 | W |
| I_{TSM} | max. forward surge current | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$ | $T_{VJ} = 45^{\circ}C$ | | 15,0 | kA |
| | | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$ | $V_R = 0\text{ V}$ | | 16,2 | kA |
| | | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$ | $T_{VJ} = 140^{\circ}C$ | | 12,8 | kA |
| | | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$ | $V_R = 0\text{ V}$ | | 13,8 | kA |
| I^2t | value for fusing | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$ | $T_{VJ} = 45^{\circ}C$ | | 1,13 | MA ² s |
| | | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$ | $V_R = 0\text{ V}$ | | 1,09 | MA ² s |
| | | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$ | $T_{VJ} = 140^{\circ}C$ | | 812,8 | kA ² s |
| | | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$ | $V_R = 0\text{ V}$ | | 788,8 | kA ² s |
| C_J | junction capacitance | $V_R = 700\text{ V}$ $f = 1\text{ MHz}$ | $T_{VJ} = 25^{\circ}C$ | | 469 | pF |
| P_{GM} | max. gate power dissipation | $t_p = 30\text{ }\mu\text{s}$ | $T_C = 140^{\circ}C$ | | 120 | W |
| | | $t_p = 300\text{ }\mu\text{s}$ | | | 60 | W |
| P_{GAV} | average gate power dissipation | | | | 20 | W |
| $(di/dt)_{cr}$ | critical rate of rise of current | $T_{VJ} = 140^{\circ}C; f = 50\text{ Hz}$ repetitive, $I_T = 1350\text{ A}$ | | | 100 | A/ μs |
| | | $t_p = 200\text{ }\mu\text{s}; di_G/dt = 1\text{ A}/\mu\text{s};$ $I_G = 1\text{ A}; V_D = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 450\text{ A}$ | | | 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 | $V_D = 6\text{ V}$ | $T_{VJ} = 25^{\circ}C$ | | 2 | V |
| | | | $T_{VJ} = -40^{\circ}C$ | | 3 | V |
| I_{GT} | gate trigger current | $V_D = 6\text{ V}$ | $T_{VJ} = 25^{\circ}C$ | | 300 | mA |
| | | | $T_{VJ} = -40^{\circ}C$ | | 400 | 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 | $t_p = 30\text{ }\mu\text{s}$ | $T_{VJ} = 25^{\circ}C$ | | 400 | mA |
| | | $I_G = 1\text{ A}; di_G/dt = 1\text{ A}/\mu\text{s}$ | | | | |
| I_H | holding current | $V_D = 6\text{ V}$ $R_{GK} = \infty$ | $T_{VJ} = 25^{\circ}C$ | | 300 | mA |
| t_{gd} | gate controlled delay time | $V_D = \frac{1}{2} V_{DRM}$ | $T_{VJ} = 25^{\circ}C$ | | 2 | μs |
| | | $I_G = 1\text{ A}; di_G/dt = 1\text{ A}/\mu\text{s}$ | | | | |
| t_q | turn-off time | $V_R = 100\text{ V}; I_T = 450\text{ A}; V_D = \frac{2}{3} V_{DRM}$ $di/dt = 10\text{ A}/\mu\text{s}; dv/dt = 50\text{ V}/\mu\text{s}; t_p = 200\text{ }\mu\text{s}$ | $T_{VJ} = 125^{\circ}C$ | | 350 | 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 | | | | | 650 | 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 | 25,0 | | | mm | |
| V_{ISOL} | isolation voltage | t = 1 second | 4800 | | | V | |
| | | t = 1 minute | 4000 | | | V | |



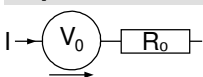
Data Matrix: part no. (1-19), DC + PI (20-25), lot.no.# (26-31), blank (32), serial no.# (33-36)

| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|---------------|----------|----------|
| Standard | MCO450-20io1 | MCO450-20io1 | Box | 2 | 467170 |

Equivalent Circuits for Simulation

* on die level

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

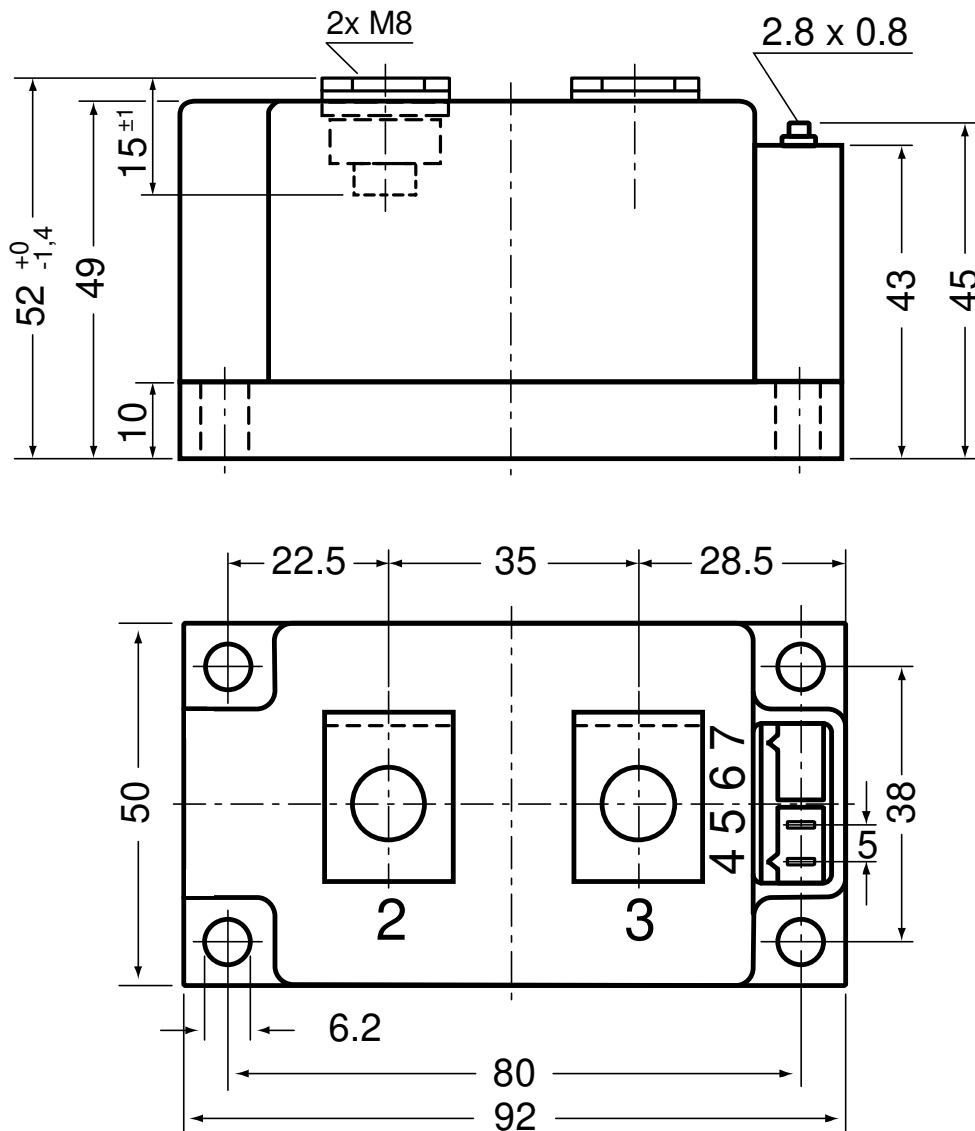


Thyristor

| | | | |
|--------------|--------------------|------|----|
| $V_{0\ max}$ | threshold voltage | 0,77 | V |
| $R_{0\ max}$ | slope resistance * | 0,22 | mΩ |

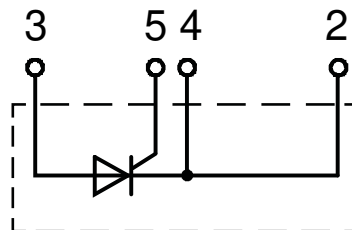


Outlines Y1



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

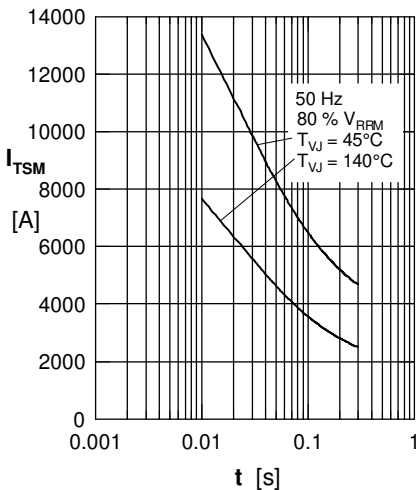


Fig. 1 Surge overload current
 I_{FSM} : Crest value, t : duration

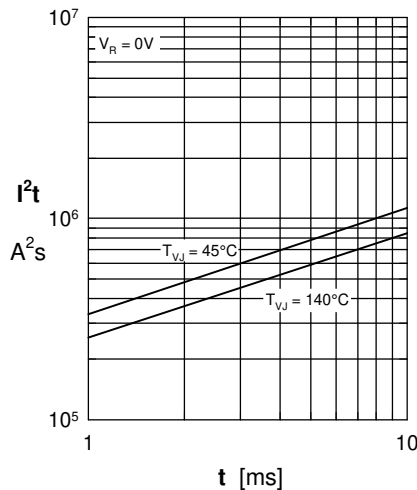


Fig. 2 I^2t versus time (1-10 ms)

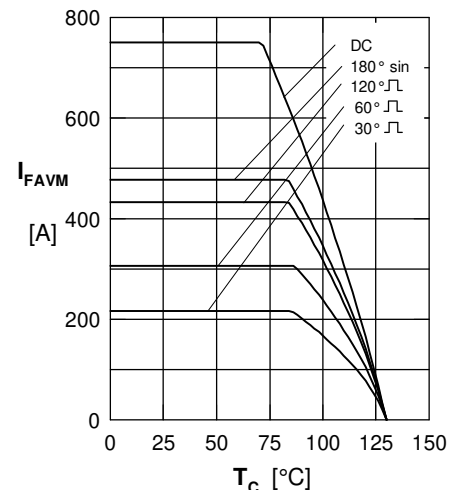


Fig. 3 Maximum forward current at case temperature

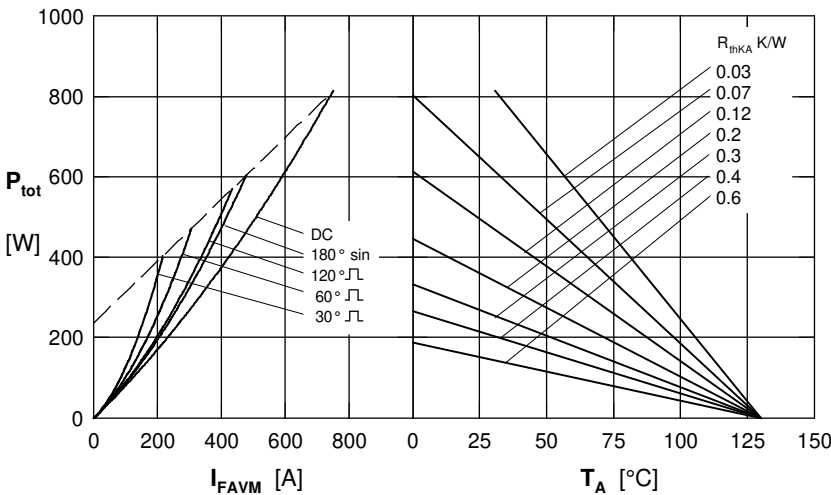


Fig. 4 Power dissipation vs. forward current and ambient temperature

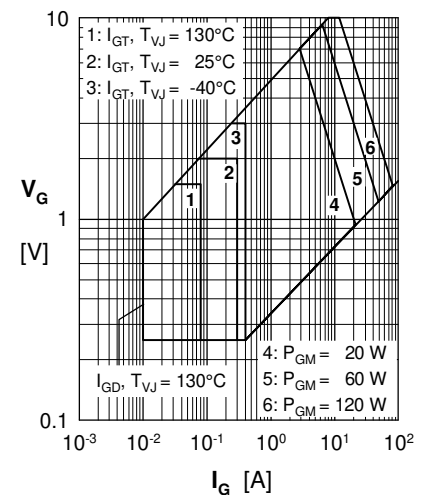


Fig. 5 Gate trigger characteristics

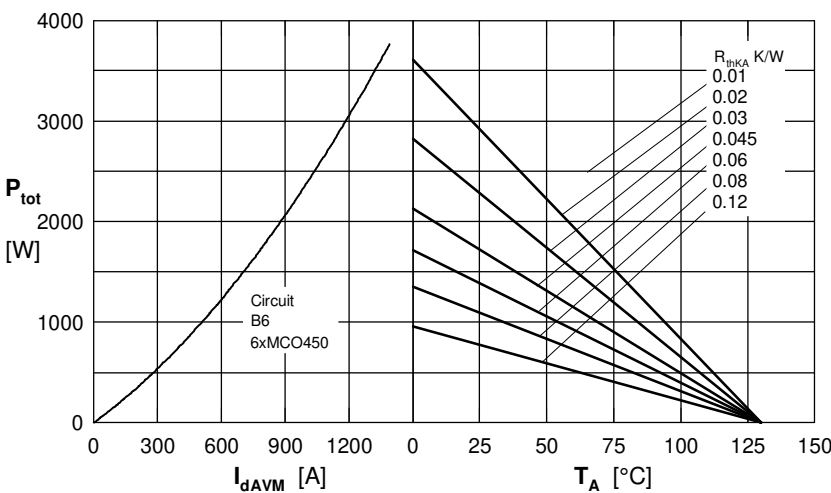


Fig. 6 Single phase rectifier bridge: Power dissipation vs. direct output current and ambient temperature. R = resistive load, L = inductive load

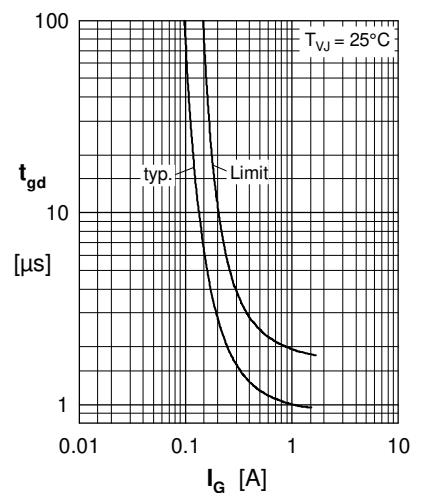


Fig. 7 Gate trigger delay time

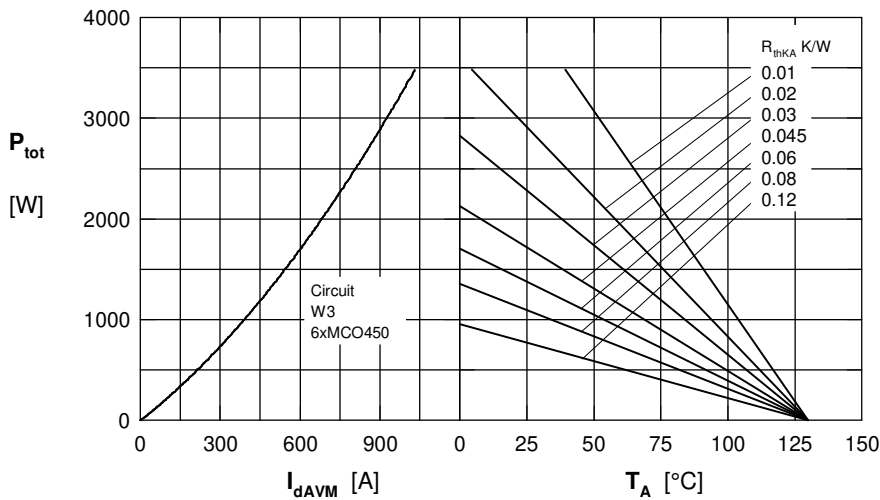
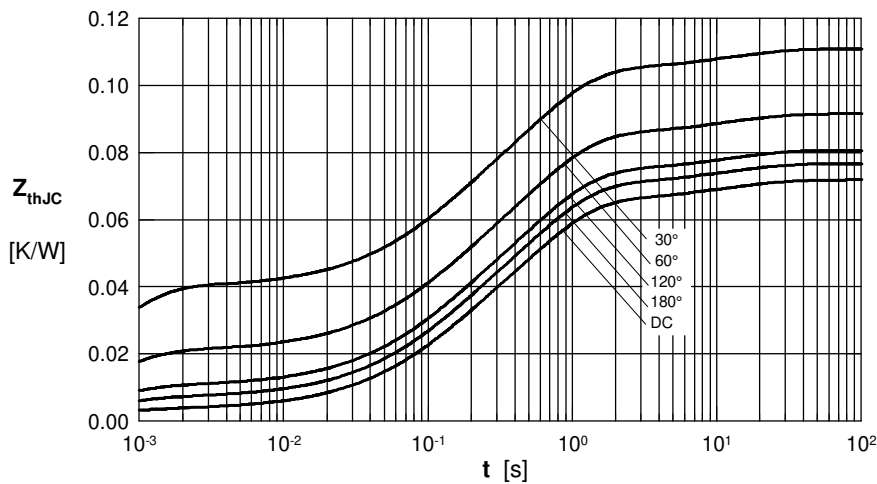
Thyristor


Fig. 8 Three phase rectifier bridge: Power dissipation versus direct output current and ambient temperature



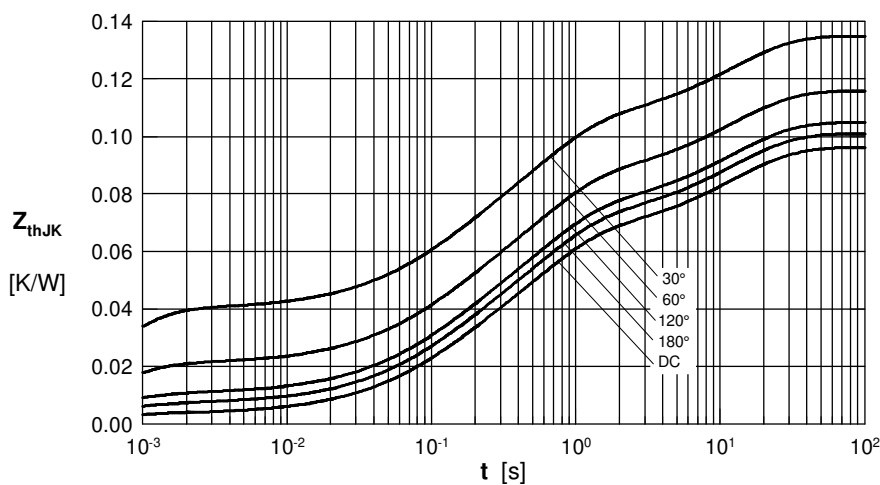
R_{thJC} for various conduction angles d:

| d | R_{thJC} (K/W) |
|------|------------------|
| DC | 0.072 |
| 180° | 0.0768 |
| 120° | 0.081 |
| 60° | 0.092 |
| 30° | 0.111 |

Constants for Z_{thJC} calculation:

| i | R_{thi} (K/W) | t_i (s) |
|---|-----------------|-----------|
| 1 | 0.0035 | 0.0054 |
| 2 | 0.0186 | 0.098 |
| 3 | 0.0432 | 0.54 |
| 4 | 0.0067 | 12 |

Fig. 9 Transient thermal impedance junction to case



R_{thJK} for various conduction angles d:

| d | R_{thJK} (K/W) |
|------|------------------|
| DC | 0.096 |
| 180° | 0.1 |
| 120° | 0.105 |
| 60° | 0.116 |
| 30° | 0.135 |

Constants for Z_{thJK} calculation:

| i | R_{thi} (K/W) | t_i (s) |
|---|-----------------|-----------|
| 1 | 0.0035 | 0.0054 |
| 2 | 0.0186 | 0.098 |
| 3 | 0.0432 | 0.54 |
| 4 | 0.0067 | 12 |
| 5 | 0.024 | 12 |

Fig. 10 Transient thermal impedance junction to heatsink