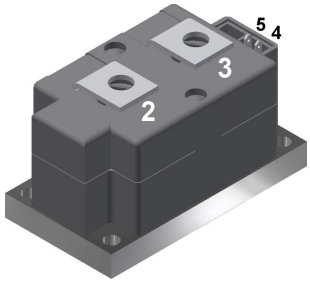
# Thyristor Module

$V_{RRM}$ = 1200 V
$I_{TAV}$ = 560 A
$V_T$ = 1.01 V

## Single Thyristor

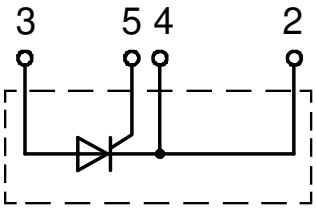
**Part number**

**MCO500-12io1**




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:** Y1

- Isolation Voltage: 3600 V~
- Industry standard outline
- RoHS compliant
- Soldering pins for PCB mounting
- Base plate: Copper internally DCB isolated
- Advanced power cycling

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## Thyristor

| Symbol | Definition | Conditions | | Ratings min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|---|
| $V_{RSM/DSM}$ | *max. non-repetitive reverse/forward blocking voltage* | | $T_{VJ}$ = 25°C | | | 1300 | V |
| $V_{RRM/DRM}$ | *max. repetitive reverse/forward blocking voltage* | | $T_{VJ}$ = 25°C | | | 1200 | V |
| $I_{R/D}$ | *reverse current, drain current* | $V_{R/D}$ = 1200 V | $T_{VJ}$ = 25°C | | | 2 | mA |
| | | $V_{R/D}$ = 1200 V | $T_{VJ}$ = 125°C | | | 40 | mA |
| $V_T$ | *forward voltage drop* | $I_T$ = 500 A | $T_{VJ}$ = 25°C | | | 1.08 | V |
| | | $I_T$ = 1000 A | | | | 1.27 | V |
| | | $I_T$ = 500 A | $T_{VJ}$ = 125°C | | | 1.01 | V |
| | | $I_T$ = 1000 A | | | | 1.24 | V |
| $I_{TAV}$ | *average forward current* | $T_C$ = 85°C | $T_{VJ}$ = 140°C | | | 560 | A |
| $I_{T(RMS)}$ | *RMS forward current* | 180° sine | | | | 880 | A |
| $V_{T0}$ | *threshold voltage* } *for power loss calculation only* | | $T_{VJ}$ = 140°C | | | 0.80 | V |
| $r_T$ | *slope resistance* } | | | | | 0.38 | 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°C | | | 1600 | W |
| $I_{TSM}$ | *max. forward surge current* | t = 10 ms; (50 Hz), sine | $T_{VJ}$ = 45°C | | | 17.0 | kA |
| | | t = 8,3 ms; (60 Hz), sine | $V_R$ = 0 V | | | 18.4 | kA |
| | | t = 10 ms; (50 Hz), sine | $T_{VJ}$ = 140°C | | | 14.5 | kA |
| | | t = 8,3 ms; (60 Hz), sine | $V_R$ = 0 V | | | 15.6 | kA |
| $I^2t$ | *value for fusing* | t = 10 ms; (50 Hz), sine | $T_{VJ}$ = 45°C | | | 1.45 | $MA^2s$ |
| | | t = 8,3 ms; (60 Hz), sine | $V_R$ = 0 V | | | 1.40 | $MA^2s$ |
| | | t = 10 ms; (50 Hz), sine | $T_{VJ}$ = 140°C | | | 1.04 | $MA^2s$ |
| | | t = 8,3 ms; (60 Hz), sine | $V_R$ = 0 V | | | 1.01 | $MA^2s$ |
| $C_J$ | *junction capacitance* | $V_R$ = 400 V f = 1 MHz | $T_{VJ}$ = 25°C | | 876 | | pF |
| $P_{GM}$ | *max. gate power dissipation* | $t_P$ = 30 µs | $T_C$ = 140°C | | | 120 | W |
| | | $t_P$ = 300 µs | | | | 60 | W |
| $P_{GAV}$ | *average gate power dissipation* | | | | | 20 | W |
| $(di/dt)_{cr}$ | *critical rate of rise of current* | $T_{VJ}$ = 140°C; f = 50 Hz | repetitive, $I_T$ = 1500 A | | | 100 | A/µs |
| | | $t_P$ = 200 µs; $di_G/dt$ = 1 A/µs; | | | | | |
| | | $I_G$ = 1 A; V = ⅔ $V_{DRM}$ | non-repet., $I_T$ = 500 A | | | 500 | A/µs |
| $(dv/dt)_{cr}$ | *critical rate of rise of voltage* | V = ⅔ $V_{DRM}$ | $T_{VJ}$ = 140°C | | | 1000 | V/µs |
| | | $R_{GK}$ = ∞; method 1 (linear voltage rise) | | | | | |
| $V_{GT}$ | *gate trigger voltage* | $V_D$ = 6 V | $T_{VJ}$ = 25°C | | | 2 | V |
| | | | $T_{VJ}$ = -40°C | | | 3 | V |
| $I_{GT}$ | *gate trigger current* | $V_D$ = 6 V | $T_{VJ}$ = 25°C | | | 300 | mA |
| | | | $T_{VJ}$ = -40°C | | | 400 | mA |
| $V_{GD}$ | *gate non-trigger voltage* | $V_D$ = ⅔ $V_{DRM}$ | $T_{VJ}$ = 140°C | | | 0.25 | V |
| $I_{GD}$ | *gate non-trigger current* | | | | | 10 | mA |
| $I_L$ | *latching current* | $t_p$ = 30 µs | $T_{VJ}$ = 25°C | | | 400 | mA |
| | | $I_G$ = 1 A; $di_G/dt$ = 1 A/µs | | | | | |
| $I_H$ | *holding current* | $V_D$ = 6 V $R_{GK}$ = ∞ | $T_{VJ}$ = 25°C | | | 300 | mA |
| $t_{gd}$ | *gate controlled delay time* | $V_D$ = ½ $V_{DRM}$ | $T_{VJ}$ = 25°C | | | 2 | µs |
| | | $I_G$ = 1 A; $di_G/dt$ = 1 A/µs | | | | | |
| $t_q$ | *turn-off time* | $V_R$ = 100 V; $I_T$ = 500A; V = ⅔ $V_{DRM}$ | $T_{VJ}$ = 125 °C | | 350 | | µs |
| | | di/dt = 10 A/µs dv/dt = 50 V/µs $t_p$ = 200 µs | | | | | |



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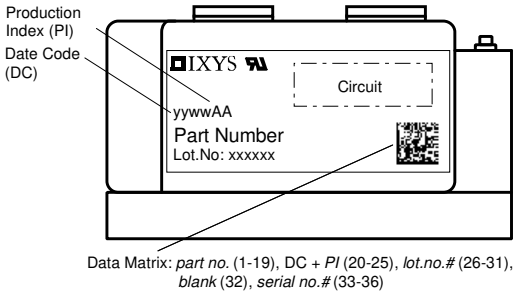
| Package Y1 | | | | Ratings | | | |
|---|---|---|---|---|---|---|---|
| **Symbol** | **Definition** | **Conditions** | | **min.** | **typ.** | **max.** | **Unit** |
| $I_{RMS}$ | *RMS current* | per terminal | | | | 600 | A |
| $T_{VJ}$ | *virtual junction temperature* | | | -40 | | 140 | °C |
| $T_{op}$ | *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 | 50/60 Hz, RMS; $I_{ISOL}$ ≤ 1 mA | 3600 | | | V |
| | | t = 1 minute | | 3000 | | | V |

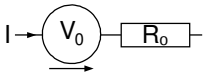



| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|---|---|---|---|---|---|
| Standard | MCO500-12io1 | MCO500-12io1 | Box | 2 | 463728 |

| Similar Part | Package | Voltage class |
|---|---|---|
| MCO500-14io1 | Y1-2-CU | 1400 |
| MCO500-16io1 | Y1-2-CU | 1600 |
| MCO500-18io1 | Y1-2-CU | 1800 |
| MCO600-20io1 | Y1-2-CU | 2000 |
| MCO600-22io1 | Y1-2-CU | 2200 |

## Equivalent Circuits for Simulation

** on die level* $T_{VJ}$ = 140°C




**Thyristor**

| | | | |
|---|---|---|---|
| $V_{0\ max}$ | *threshold voltage* | 0.8 | V |
| $R_{0\ max}$ | *slope resistance ** | 0.22 | mΩ |



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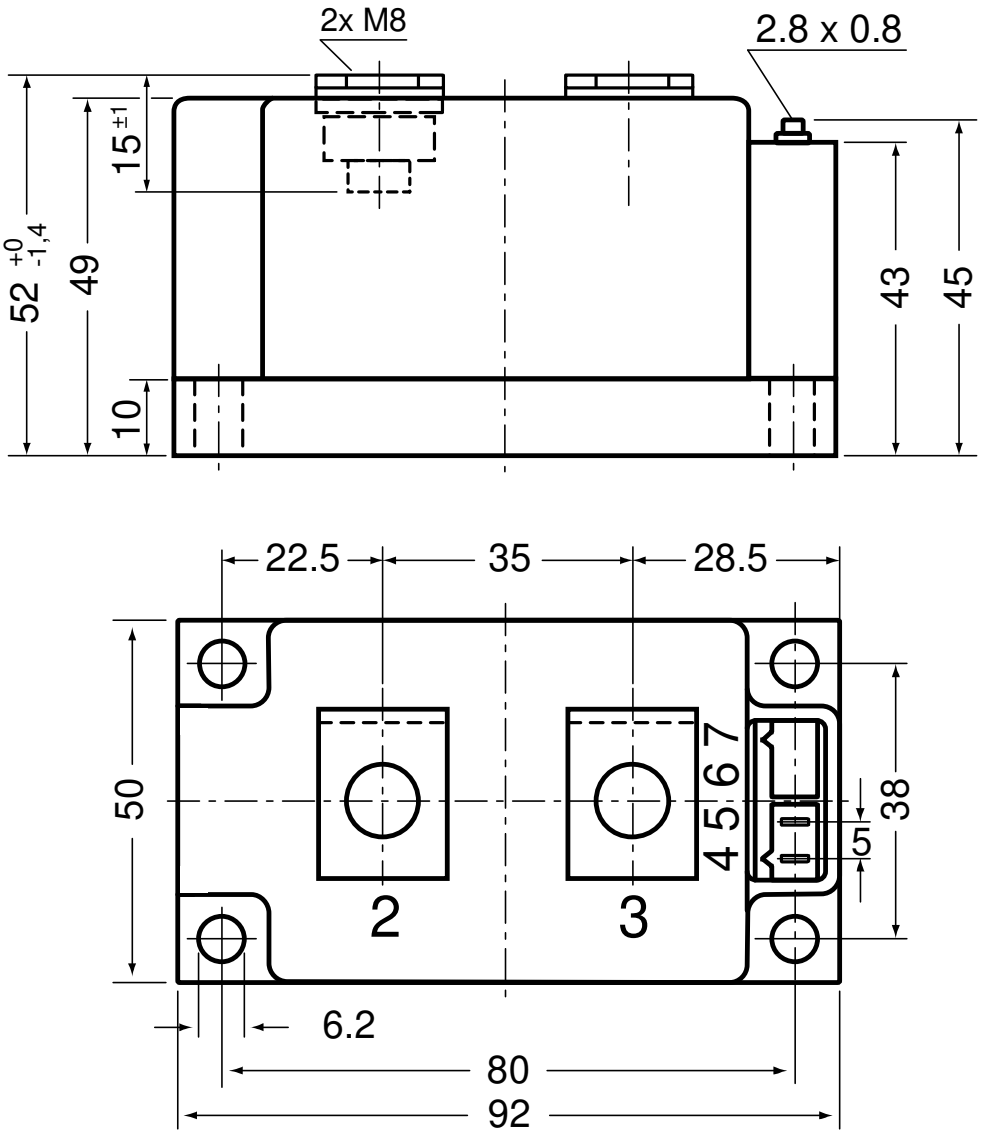
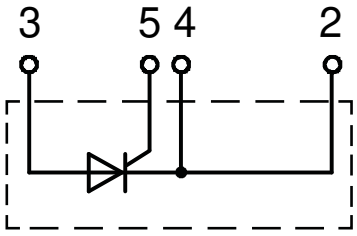
## Outlines Y1




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



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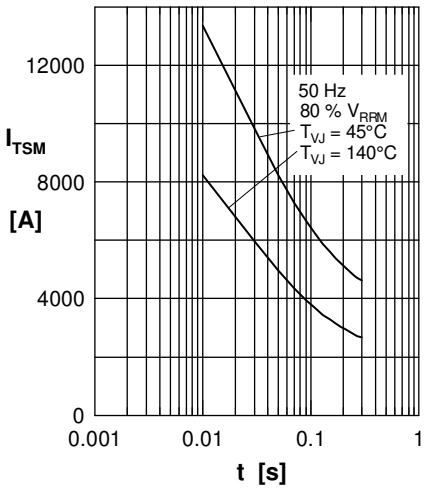


Fig. 1 Surge overload current
$I_{TSM}$ : Crest value, t: duration

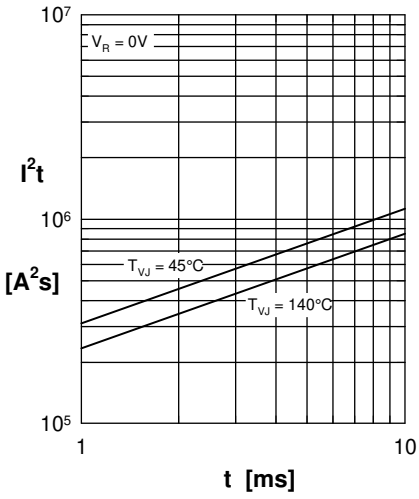


Fig. 2 $I^2t$ versus time (1-10 ms)

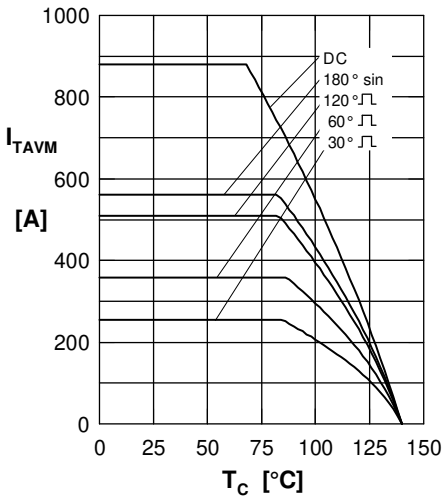


Fig. 3 Maximum forward current at case temperature

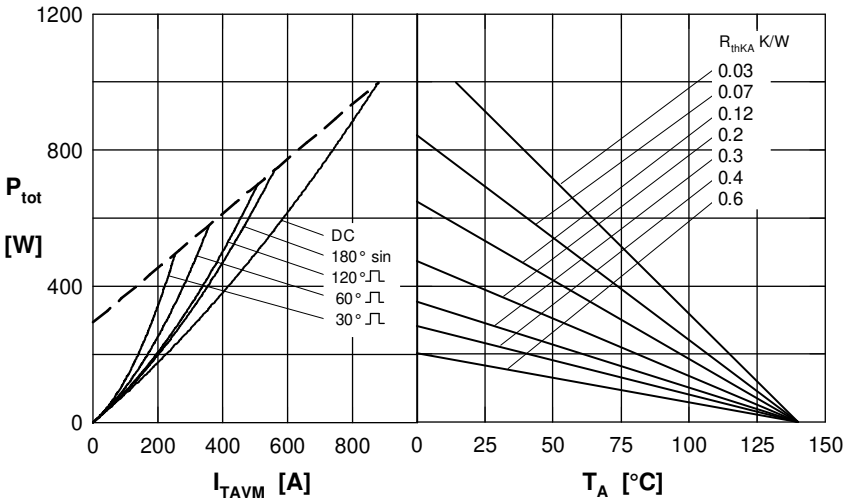


Fig. 4 Power dissipation versus on-state current & ambient temperature

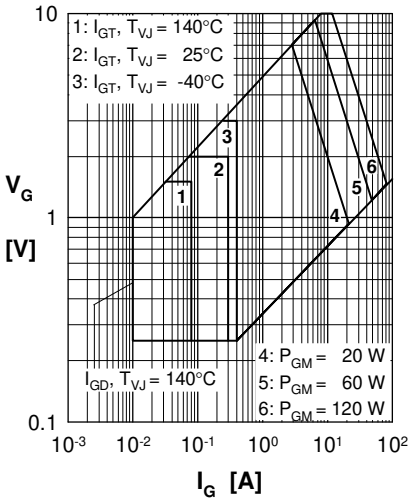


Fig. 5 Gate trigger characteristics

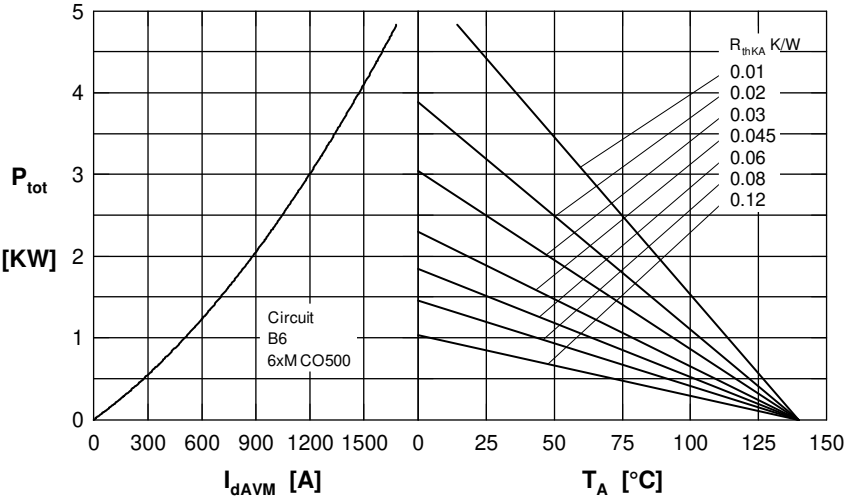


Fig. 6 Three phase rectifier bridge: Power dissipation versus direct output current and ambient temperature

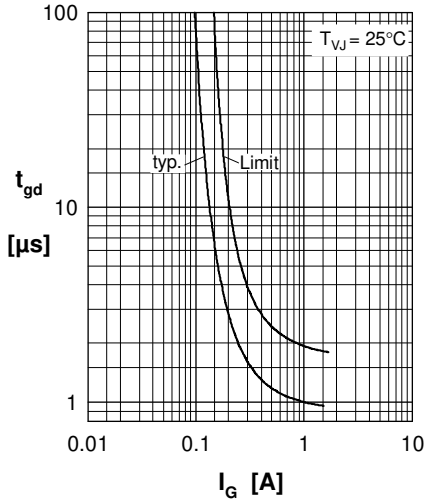


Fig. 7 Gate trigger delay time



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## Thyristor

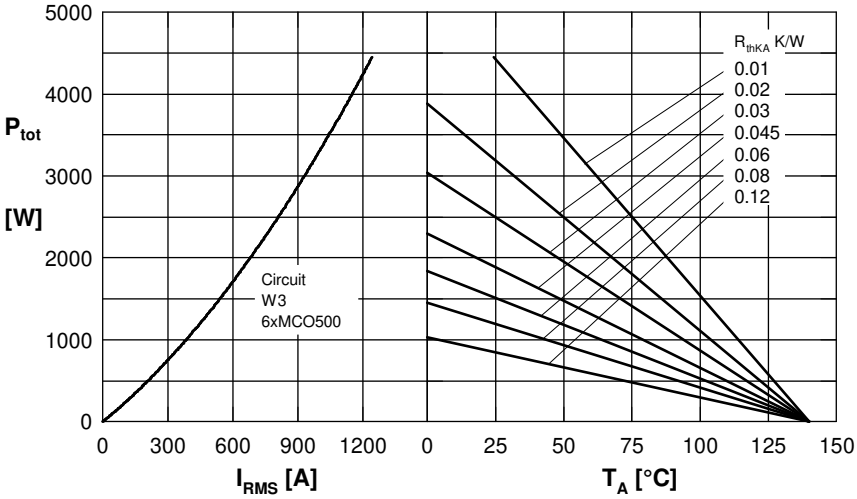


Fig. 8 Three phase AC-controller: Power dissipation versus RMS output current and ambient temperatur

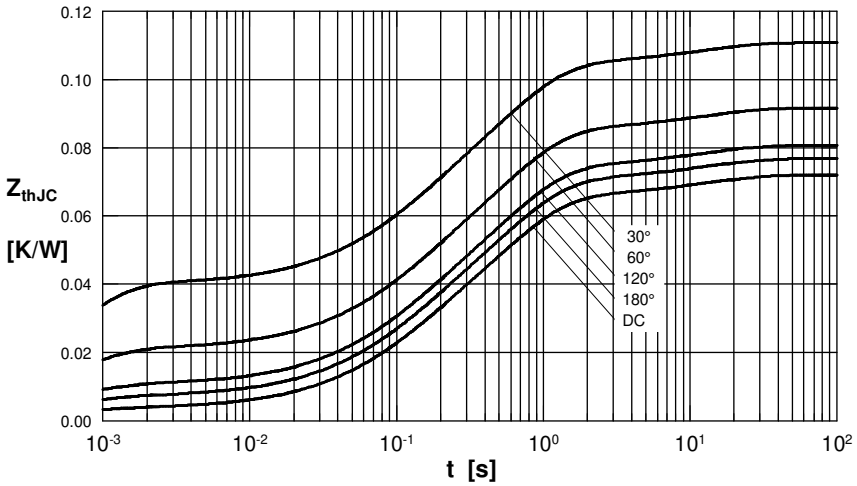


Fig. 9 Transient thermal impedance junction to case

$R_{thJC}$ 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 |

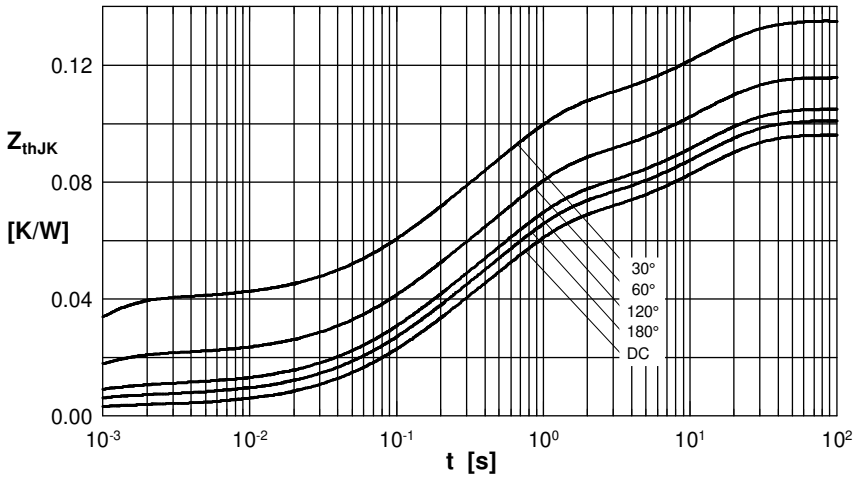


Fig.10 Transient thermal impedance junction to heatsink

$R_{thJK}$ 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 |



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