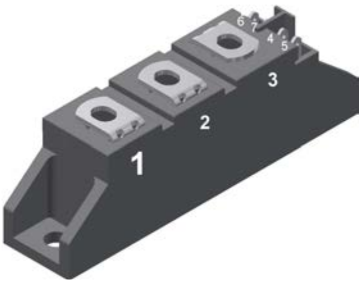
# Thyristor Module

$V_{RRM}$ = 2x 1600 V
$I_{TAV}$ = 116 A
$V_T$ = 1,28 V

Phase leg

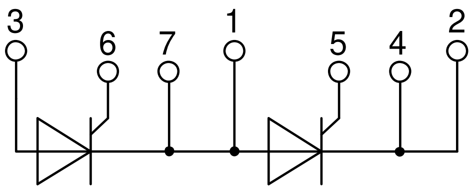
**Part number**

**MCC95-16io1**




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

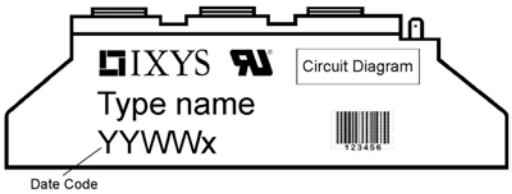
**Package:** TO-240AA

- Isolation Voltage: 4800 V~
- Industry standard outline
- RoHS compliant
- Soldering pins for PCB mounting
- Base plate: DCB ceramic
- Reduced weight
- Advanced power cycling

## Thyristor

| Symbol | Definition | Conditions | | Ratings min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|---|
| $V_{RSM/DSM}$ | *max. non-repetitive reverse/forward blocking voltage* | | $T_{VJ}$ = 25°C | | | 1700 | V |
| $V_{RRM/DRM}$ | *max. repetitive reverse/forward blocking voltage* | | $T_{VJ}$ = 25°C | | | 1600 | V |
| $I_{R/D}$ | *reverse current, drain current* | $V_{R/D}$ = 1600 V | $T_{VJ}$ = 25°C | | | 200 | µA |
| | | $V_{R/D}$ = 1600 V | $T_{VJ}$ = 125°C | | | 5 | mA |
| $V_T$ | *forward voltage drop* | $I_T$ = 150 A | $T_{VJ}$ = 25°C | | | 1,29 | V |
| | | $I_T$ = 300 A | | | | 1,50 | V |
| | | $I_T$ = 150 A | $T_{VJ}$ = 125°C | | | 1,28 | V |
| | | $I_T$ = 300 A | | | | 1,70 | V |
| $I_{TAV}$ | *average forward current* | $T_C$ = 85°C | $T_{VJ}$ = 125°C | | | 116 | A |
| $I_{T(RMS)}$ | *RMS forward current* | 180° sine | | | | 182 | A |
| $V_{T0}$ | *threshold voltage* | *for power loss calculation only* | $T_{VJ}$ = 125°C | | | 0,85 | V |
| $r_T$ | *slope resistance* | | | | | 2,4 | mΩ |
| $R_{thJC}$ | *thermal resistance junction to case* | | | | | 0,22 | K/W |
| $R_{thCH}$ | *thermal resistance case to heatsink* | | | | 0,2 | | K/W |
| $P_{tot}$ | *total power dissipation* | | $T_C$ = 25°C | | | 455 | W |
| $I_{TSM}$ | *max. forward surge current* | t = 10 ms; (50 Hz), sine | $T_{VJ}$ = 45°C | | | 2,25 | kA |
| | | t = 8,3 ms; (60 Hz), sine | $V_R$ = 0 V | | | 2,43 | kA |
| | | t = 10 ms; (50 Hz), sine | $T_{VJ}$ = 125°C | | | 1,92 | kA |
| | | t = 8,3 ms; (60 Hz), sine | $V_R$ = 0 V | | | 2,07 | kA |
| $I^2t$ | *value for fusing* | t = 10 ms; (50 Hz), sine | $T_{VJ}$ = 45°C | | | 25,3 | kA²s |
| | | t = 8,3 ms; (60 Hz), sine | $V_R$ = 0 V | | | 24,6 | kA²s |
| | | t = 10 ms; (50 Hz), sine | $T_{VJ}$ = 125°C | | | 18,3 | kA²s |
| | | t = 8,3 ms; (60 Hz), sine | $V_R$ = 0 V | | | 17,7 | kA²s |
| $C_J$ | *junction capacitance* | $V_R$ = 400V f = 1 MHz | $T_{VJ}$ = 25°C | | 119 | | pF |
| $P_{GM}$ | *max. gate power dissipation* | $t_P$ = 30 µs | $T_C$ = 125°C | | | 10 | W |
| | | $t_P$ = 300 µs | | | | 5 | W |
| $P_{GAV}$ | *average gate power dissipation* | | | | | 0,5 | W |
| $(di/dt)_{cr}$ | *critical rate of rise of current* | $T_{VJ}$ = 125°C; f = 50 Hz | repetitive, $I_T$ = 250 A | | | 150 | A/µs |
| | | $t_P$ = 200 µs; $di_G/dt$ = 0,45 A/µs; | | | | | |
| | | $I_G$ = 0,45 A; $V_D$ = ⅔ $V_{DRM}$ | non-repet., $I_T$ = 116 A | | | 500 | A/µs |
| $(dv/dt)_{cr}$ | *critical rate of rise of voltage* | $V_D$ = ⅔ $V_{DRM}$ | $T_{VJ}$ = 125°C | | | 1000 | V/µs |
| | | $R_{GK}$ = ∞; method 1 (linear voltage rise) | | | | | |
| $V_{GT}$ | *gate trigger voltage* | $V_D$ = 6 V | $T_{VJ}$ = 25°C | | | 2,5 | V |
| | | | $T_{VJ}$ = -40°C | | | 2,6 | V |
| $I_{GT}$ | *gate trigger current* | $V_D$ = 6 V | $T_{VJ}$ = 25°C | | | 150 | mA |
| | | | $T_{VJ}$ = -40°C | | | 200 | mA |
| $V_{GD}$ | *gate non-trigger voltage* | $V_D$ = ⅔ $V_{DRM}$ | $T_{VJ}$ = 125°C | | | 0,2 | V |
| $I_{GD}$ | *gate non-trigger current* | | | | | 10 | mA |
| $I_L$ | *latching current* | $t_p$ = 10 µs | $T_{VJ}$ = 25°C | | | 450 | mA |
| | | $I_G$ = 0,45 A; $di_G/dt$ = 0,45 A/µs | | | | | |
| $I_H$ | *holding current* | $V_D$ = 6 V $R_{GK}$ = ∞ | $T_{VJ}$ = 25°C | | | 200 | mA |
| $t_{gd}$ | *gate controlled delay time* | $V_D$ = ½ $V_{DRM}$ | $T_{VJ}$ = 25°C | | | 2 | µs |
| | | $I_G$ = 0,45 A; $di_G/dt$ = 0,45 A/µs | | | | | |
| $t_q$ | *turn-off time* | $V_R$ = 100 V; $I_T$ = 150A; $V_D$ = ⅔ $V_{DRM}$ | $T_{VJ}$ = 100 °C | | 185 | | µs |
| | | di/dt = 10 A/µs; dv/dt = 20 V/µs; $t_p$ = 200 µs | | | | | |

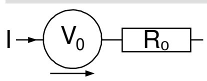
| Package TO-240AA | | | | Ratings | | | |
|---|---|---|---|---|---|---|---|
| Symbol | Definition | Conditions | | min. | typ. | max. | Unit |
| $I_{RMS}$ | *RMS current* | per terminal | | | | 200 | A |
| $T_{VJ}$ | *virtual junction temperature* | | | -40 | | 125 | °C |
| $T_{op}$ | *operation temperature* | | | -40 | | 100 | °C |
| $T_{stg}$ | *storage temperature* | | | -40 | | 125 | °C |
| **Weight** | | | | | 81 | | g |
| $M_D$ | *mounting torque* | | | 2,5 | | 4 | Nm |
| $M_T$ | *terminal torque* | | | 2,5 | | 4 | Nm |
| $d_{Spp/App}$ | *creepage distance on surface \| striking distance through air* | *terminal to terminal* | 13,0 | 9,7 | | | mm |
| $d_{Spb/Apb}$ | | *terminal to backside* | 16,0 | 16,0 | | | mm |
| $V_{ISOL}$ | *isolation voltage* | t = 1 second; 50/60 Hz, RMS; $I_{ISOL} \le 1$ mA | | 4800 | | | V |
| | | t = 1 minute | | 4000 | | | V |




| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|---|---|---|---|---|---|
| Standard | MCC95-16IO1 | MCC95-16IO1 | Box | 36 | 442577 |

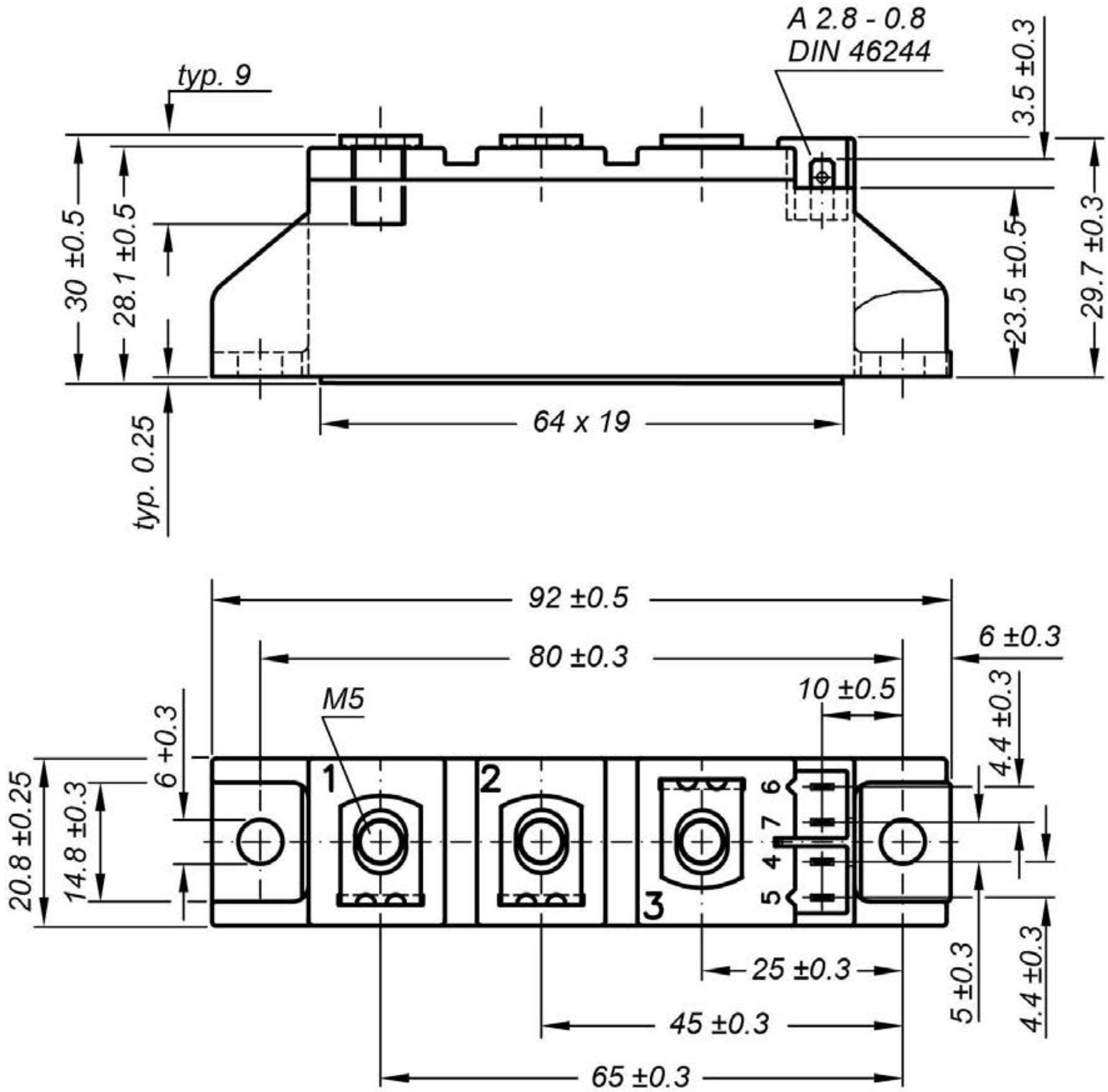
## Equivalent Circuits for Simulation

** on die level* $T_{VJ} = 125°C$

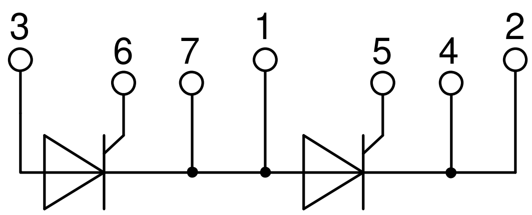



| | | Thyristor | |
|---|---|---|---|
| $V_{0\ max}$ | *threshold voltage* | 0,85 | V |
| $R_{0\ max}$ | *slope resistance ** | 1,2 | mΩ |

## Outlines TO-240AA




Optional accessories for modules
Keyed gate/cathode twin plugs with wire length = 350 mm, gate = white, cathode = red
Type ZY 200L (L = Left for pin pair 4/5) } UL 758, style 3751
Type ZY 200R (R = Right for pin pair 6/7)



## Thyristor

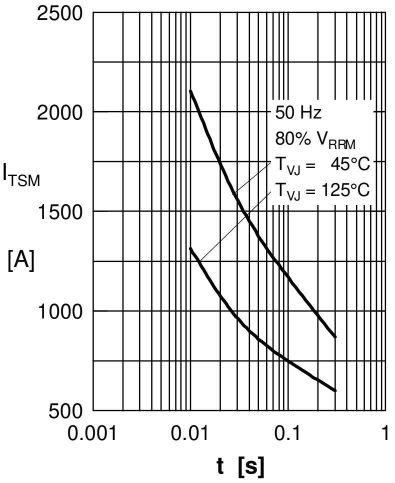



Fig. 1 Surge overload current $I_{TSM}$, $I_{FSM}$: Crest value, t: duration

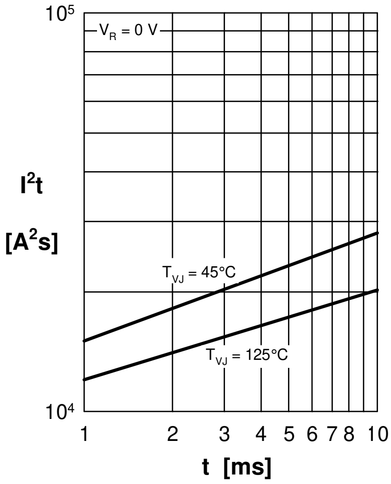



Fig. 2 $I^2t$ versus time (1-10 ms)

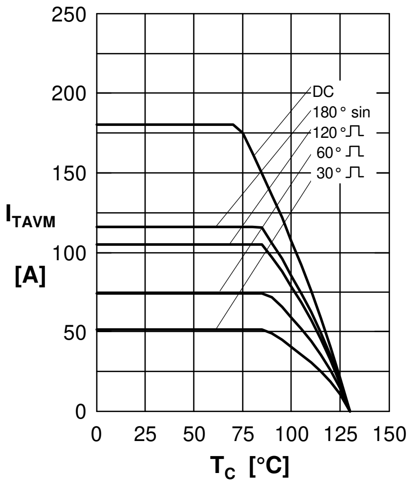



Fig. 3 Max. forward current at case temperature

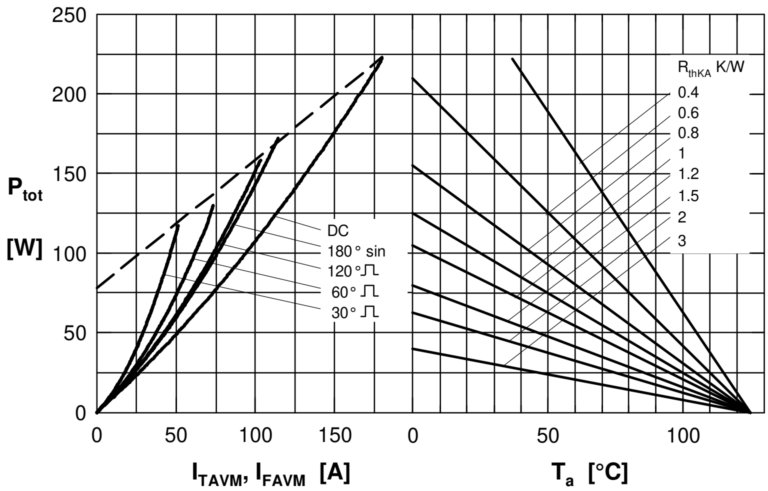



Fig. 4 Power dissipation vs. on-state current & ambient temperature (per thyristor or diode)

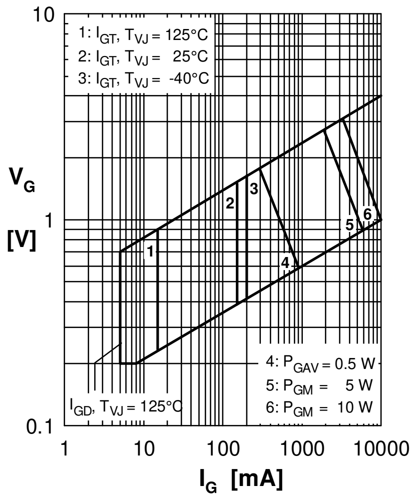



Fig. 5 Gate trigger characteristics

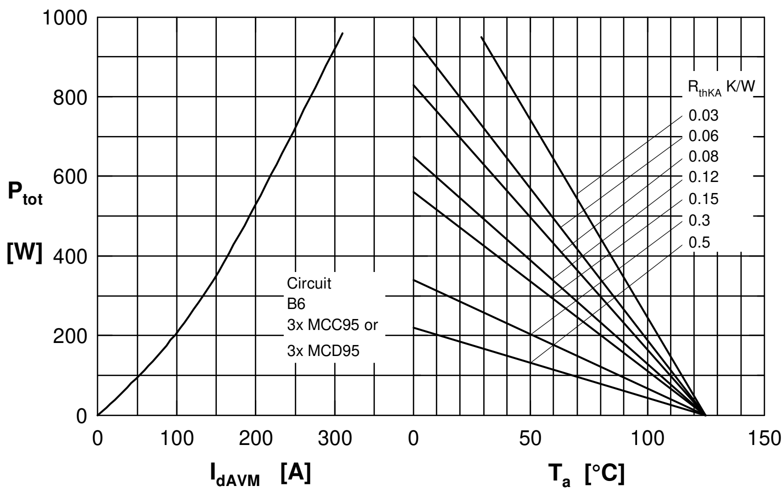



Fig. 6 Three phase rectifier bridge: Power dissipation vs. direct output current and ambient temperature

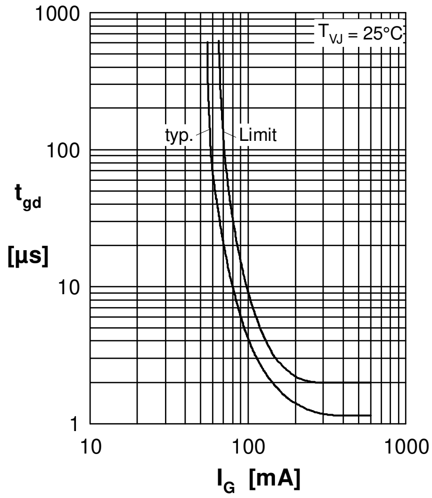



Fig. 7 Gate controlled delay time

## Thyristor

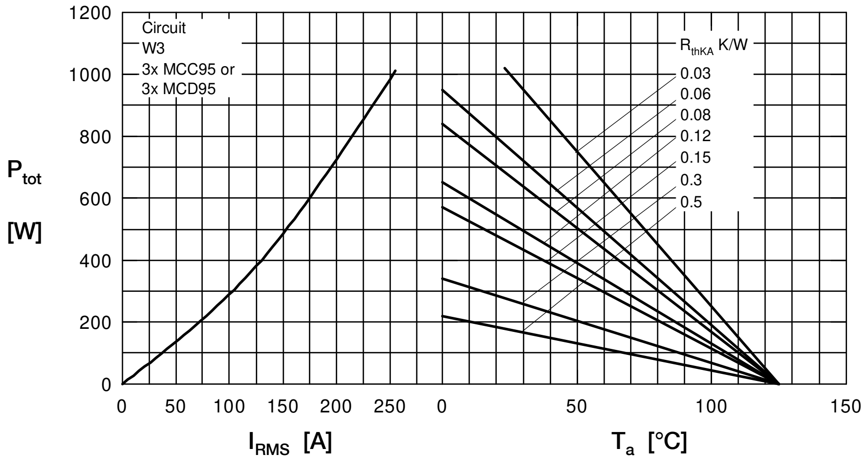



Fig. 8 Three phase AC-controller: Power dissipation versus RMS output current and ambient temperature

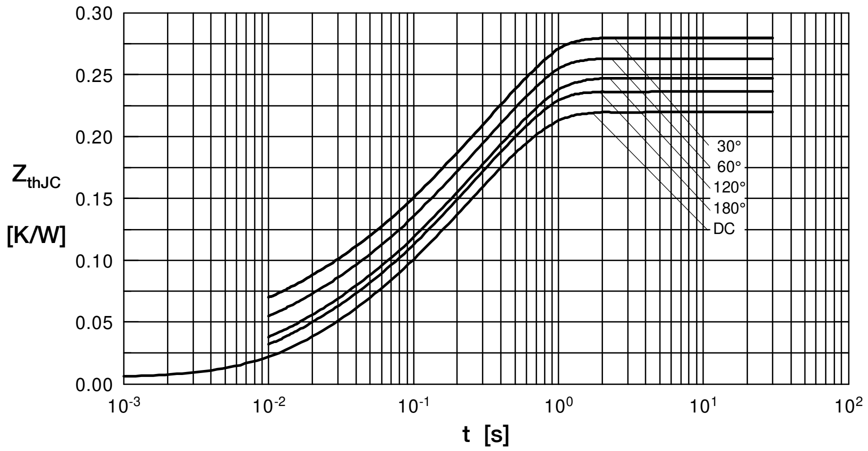



Fig. 9 Transient thermal impedance junction to case (per thyristor/diode)

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

| d | $R_{thJC}$ [K/W] |
|---|---|
| DC | 0.22 |
| 180° | 0.23 |
| 120° | 0.25 |
| 60° | 0.27 |
| 30° | 0.28 |

Constants for $Z_{thJC}$ calculation:

| i | $R_{thi}$ [K/W] | $t_i$ [s] |
|---|---|---|
| 1 | 0.0066 | 0.0019 |
| 2 | 0.0678 | 0.0477 |
| 3 | 0.1456 | 0.3440 |

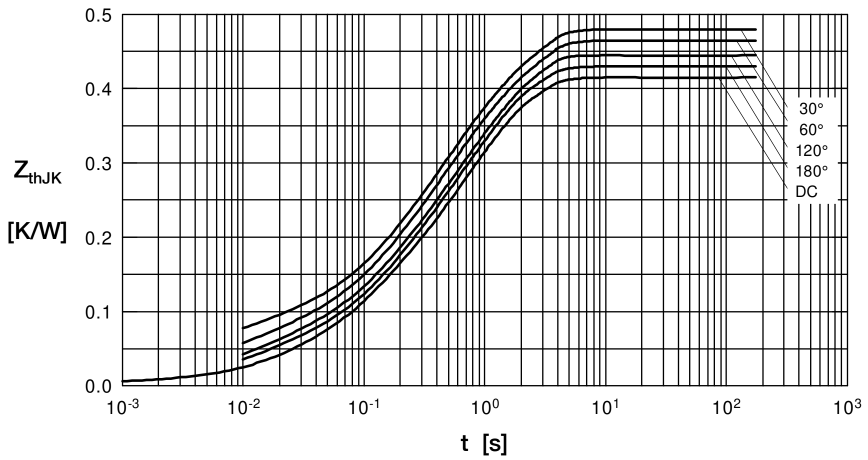



Fig. 10 Transient thermal impedance junction to heatsink (per thyristor/diode)

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

| d | $R_{thJK}$ [K/W] |
|---|---|
| DC | 0.42 |
| 180° | 0.43 |
| 120° | 0.45 |
| 60° | 0.47 |
| 30° | 0.48 |

Constants for $Z_{thJK}$ calculation:

| i | $R_{thi}$ [K/W] | $t_i$ [s] |
|---|---|---|
| 1 | 0.0066 | 0.0019 |
| 2 | 0.0678 | 0.0477 |
| 3 | 0.1456 | 0.3440 |
| 4 | 0.2000 | 1.3200 |