



# Thyristor Module

$V_{RRM} = 2x 1200 V$

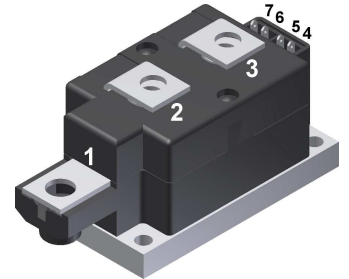
$I_{TAV} = 220 A$

$V_T = 0,97 V$

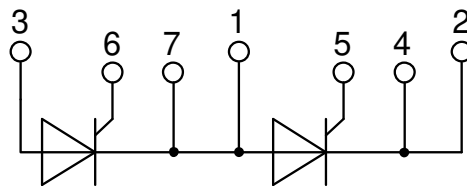
Phase leg

Part number

**MCC225-12io1**



Backside: isolated



### Features / Advantages:

- International standard package
- Direct copper bonded Al<sub>2</sub>O<sub>3</sub>-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

### Disclaimer Notice

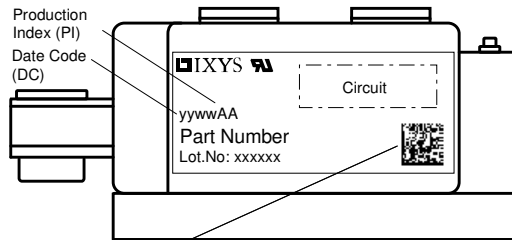
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| Rectifier      |  |  | Ratings                 |      |       |                   |
|----------------|--|--|-------------------------|------|-------|-------------------|
| Symbol         | Definition   | Conditions   | min.                    | typ. | max.  | Unit              |
| $V_{RSM/DSM}$  | max. non-repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}C$   |                         |      | 1300  | V                 |
| $V_{RRM/DRM}$  | max. repetitive reverse/forward blocking voltage     | $T_{VJ} = 25^{\circ}C$   |                         |      | 1200  | V                 |
| $I_{RD}$       | reverse current, drain current                       | $V_{R/D} = 1200 V$   | $T_{VJ} = 25^{\circ}C$  |      | 1     | mA                |
|                |  | $V_{R/D} = 1200 V$   | $T_{VJ} = 125^{\circ}C$ |      | 40    | mA                |
| $V_T$          | forward voltage drop                                 | $I_T = 200 A$  | $T_{VJ} = 25^{\circ}C$  |      | 1,04  | V                 |
|                |  | $I_T = 400 A$  |                         |      | 1,18  | V                 |
|                |  | $I_T = 200 A$  | $T_{VJ} = 125^{\circ}C$ |      | 0,97  | V                 |
|                |  | $I_T = 400 A$  |                         |      | 1,14  | V                 |
| $I_{TAV}$      | average forward current                              | $T_C = 85^{\circ}C$  | $T_{VJ} = 140^{\circ}C$ |      | 220   | A                 |
| $I_{T(RMS)}$   | RMS forward current                                  | 180° sine  |                         |      | 400   | A                 |
| $V_{T0}$       | threshold voltage                                    | } for power loss calculation only  | $T_{VJ} = 140^{\circ}C$ |      | 0,79  | V                 |
| $r_T$          | slope resistance                                     |  |                         |      | 0,83  | mΩ                |
| $R_{thJC}$     | thermal resistance junction to case                  |  |                         |      | 0,157 | K/W               |
| $R_{thCH}$     | thermal resistance case to heatsink                  |  |                         | 0,04 |       | K/W               |
| $P_{tot}$      | total power dissipation                              |  | $T_C = 25^{\circ}C$     |      | 730   | W                 |
| $I_{TSM}$      | max. forward surge current                           | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$   | $T_{VJ} = 45^{\circ}C$  |      | 8,00  | kA                |
|                |  | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$  | $V_R = 0 V$             |      | 8,64  | kA                |
|                |  | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$   | $T_{VJ} = 140^{\circ}C$ |      | 6,80  | kA                |
|                |  | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$  | $V_R = 0 V$             |      | 7,35  | kA                |
| $I^2t$         | value for fusing                                     | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$   | $T_{VJ} = 45^{\circ}C$  |      | 320,0 | kA <sup>2</sup> s |
|                |  | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$  | $V_R = 0 V$             |      | 310,5 | kA <sup>2</sup> s |
|                |  | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$   | $T_{VJ} = 140^{\circ}C$ |      | 231,2 | kA <sup>2</sup> s |
|                |  | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$  | $V_R = 0 V$             |      | 224,4 | kA <sup>2</sup> s |
| $C_J$          | junction capacitance                                 | $V_R = 400V \quad f = 1 \text{ MHz}$   | $T_{VJ} = 25^{\circ}C$  |      | 366   | 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, $I_T = 660 A$   |                         |      | 100   | A/μs              |
|                |  | $t_p = 200 \mu s; di_G/dt = 1 A/\mu s;$<br>$I_G = 1 A; V_D = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 220 A$        |                         |      | 500   | A/μs              |
| $(dv/dt)_{cr}$ | critical rate of rise of voltage                     | $V_D = \frac{2}{3} V_{DRM}$<br>$R_{GK} = \infty; \text{ method 1 (linear voltage rise)}$                           | $T_{VJ} = 140^{\circ}C$ |      | 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  | $V_R = 100 V; I_T = 220 A; V_D = \frac{2}{3} V_{DRM}$<br>$di/dt = 10 A/\mu s; dv/dt = 50 V/\mu s; t_p = 200 \mu s$ | $T_{VJ} = 125^{\circ}C$ |      | 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   |
| <b>Weight</b> |  |                      |         | 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    |



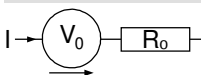
Data Matrix: part no. (1-19), DC + PI (20-25), lot.no.# (26-31), blank (32), serial no.# (33-36)

| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|---------------|----------|----------|
| Standard | MCC225-12io1    | MCC225-12io1       | Box           | 3        | 463280   |

**Equivalent Circuits for Simulation**

\* on die level

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

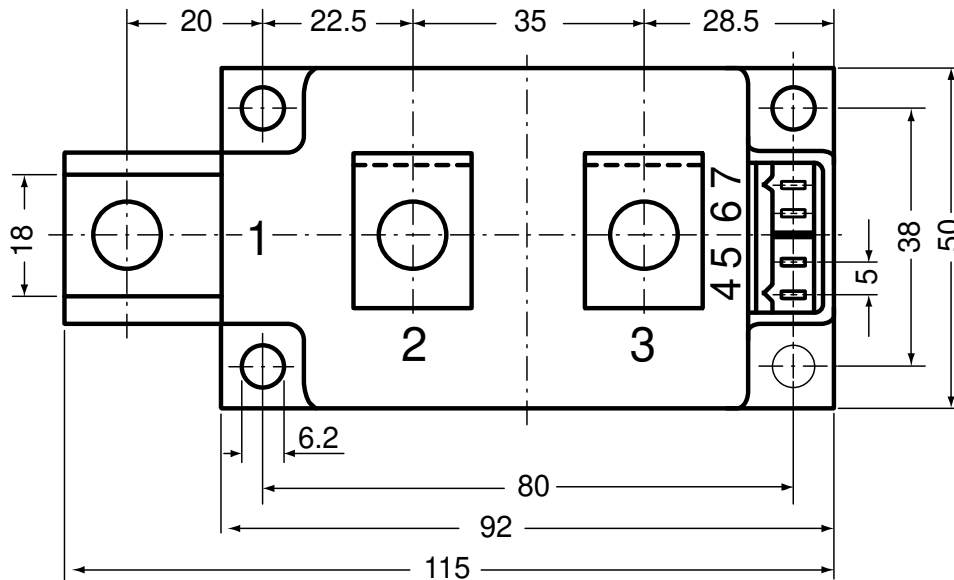
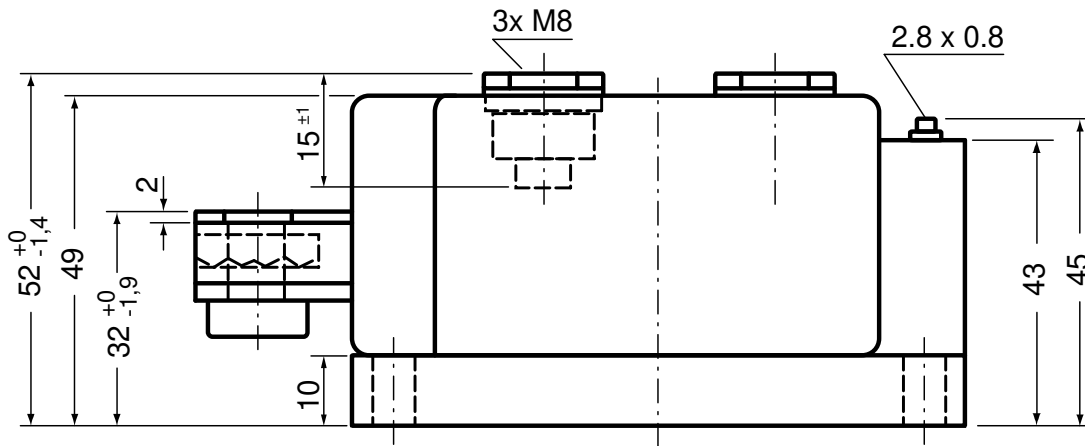


**Thyristor**

|              |                    |      |    |
|--------------|--------------------|------|----|
| $V_{0\ max}$ | threshold voltage  | 0,79 | V  |
| $R_{0\ max}$ | slope resistance * | 0,64 | mΩ |



**Outlines Y1**



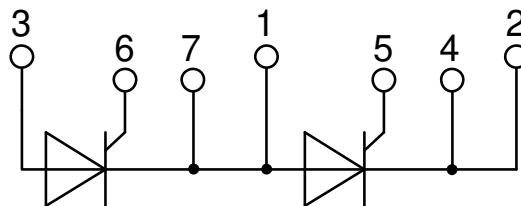
**Optional accessories for modules**

Keyed gate/cathode twin plugs with wire length = 350 mm, gate = white, cathode = red

Type ZY 180L (L = Left for pin pair 4/5)

Type ZY 180R (R = Right for pin pair 6/7)

UL 758, style 3751



**Thyristor**

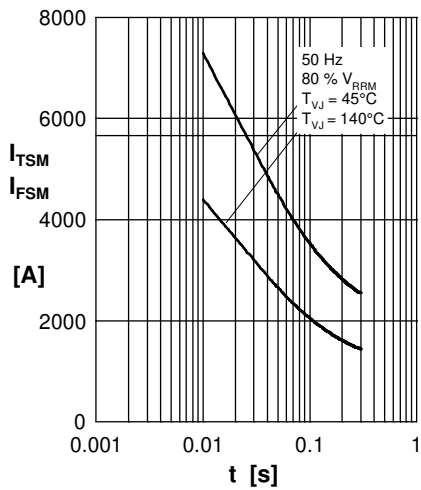


Fig. 1 Surge overload current  
 $I_{TSM/FSM}$ : Crest value,  $t$ : duration

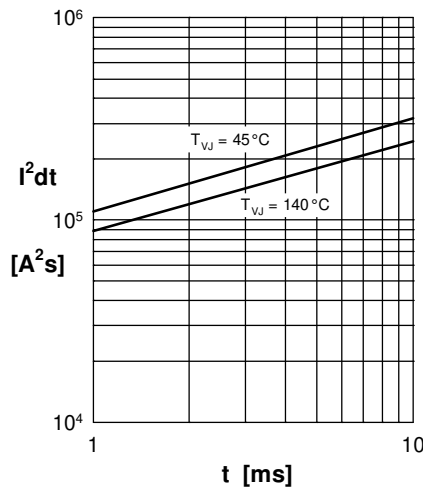


Fig. 2  $I^2dt$  versus time

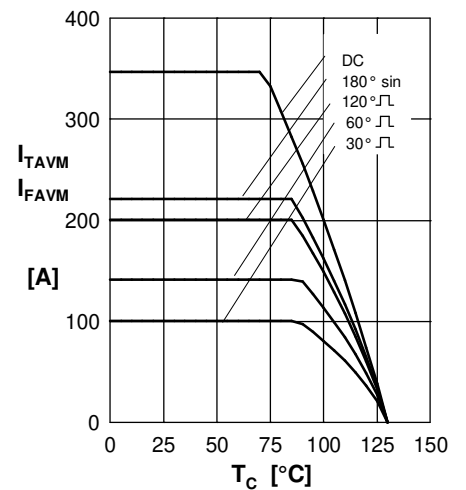


Fig. 3 Max. forward current at case temperature

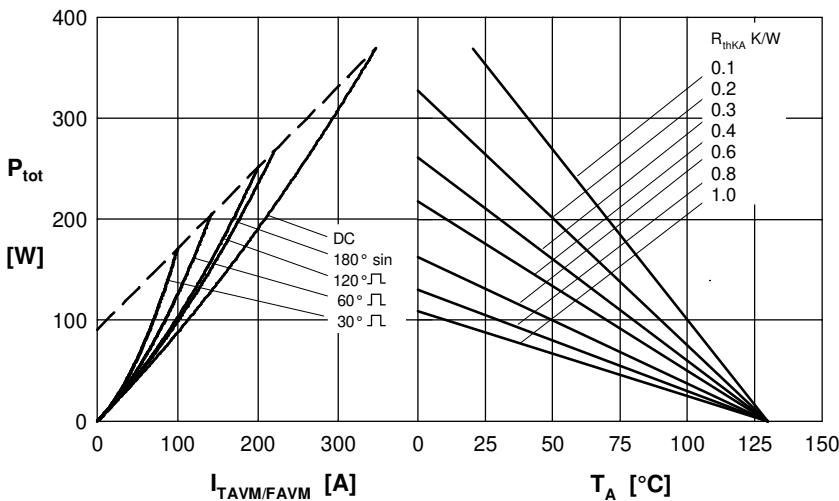


Fig. 4 Power dissipation versus on-state current and ambient temperature (per thyristor or diode)

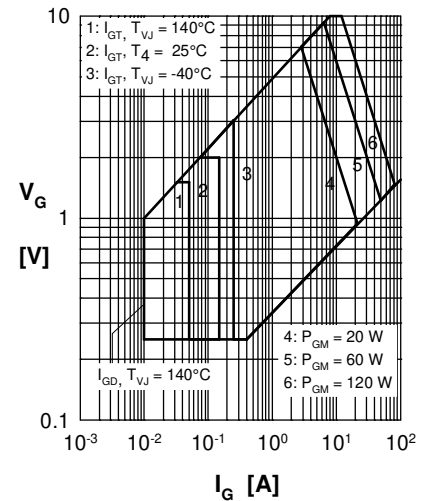


Fig. 5 Gate voltage and current

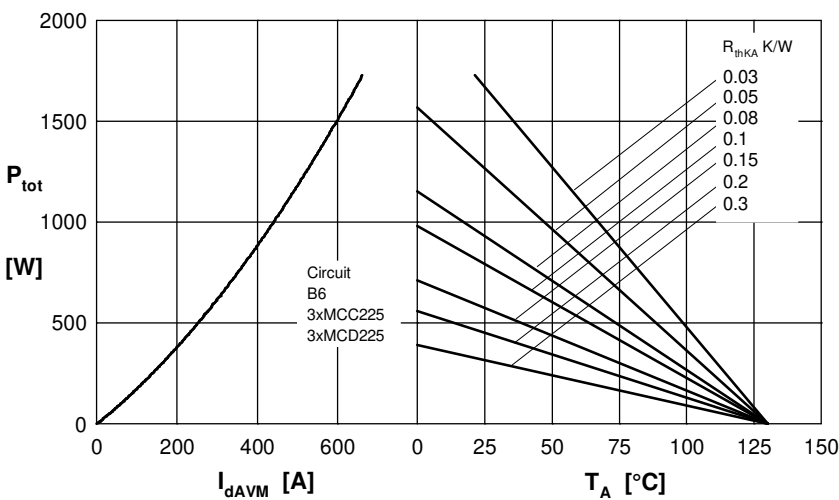


Fig. 6 Three phase rectifier bridge: Power dissipation versus direct output current and ambient temperature

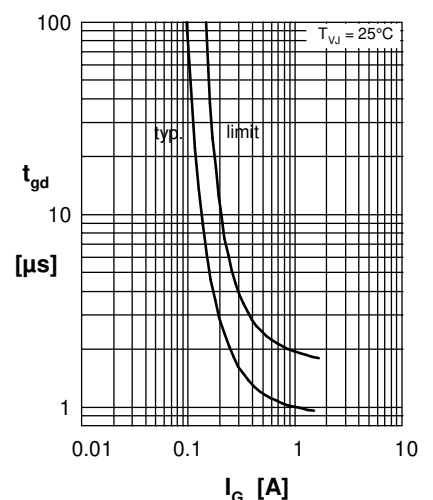


Fig. 7 Gate trigger characteristics

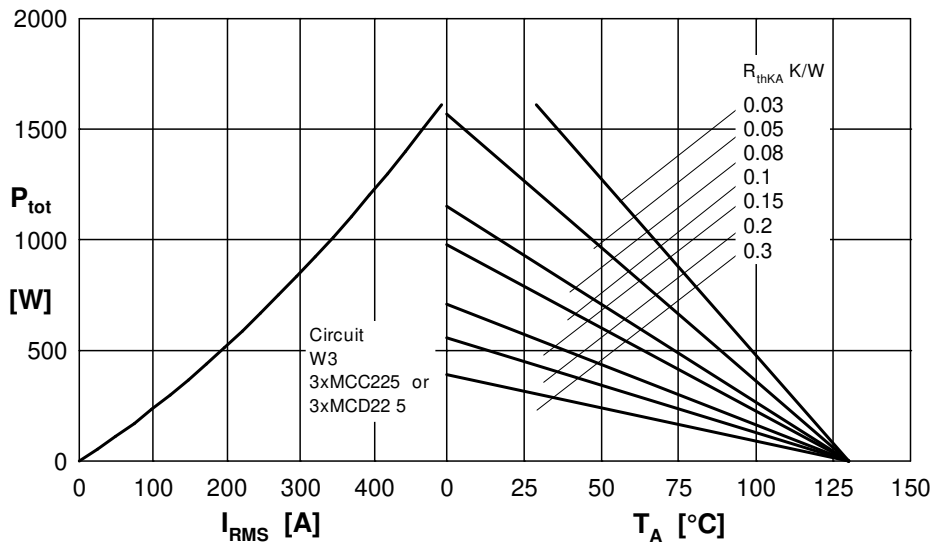
**Rectifier**


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

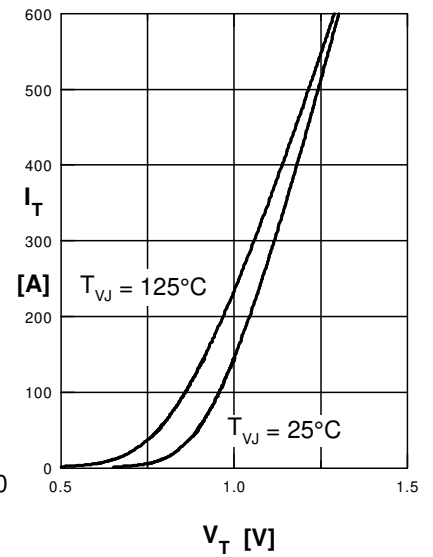


Fig. 9 Forward characteristics

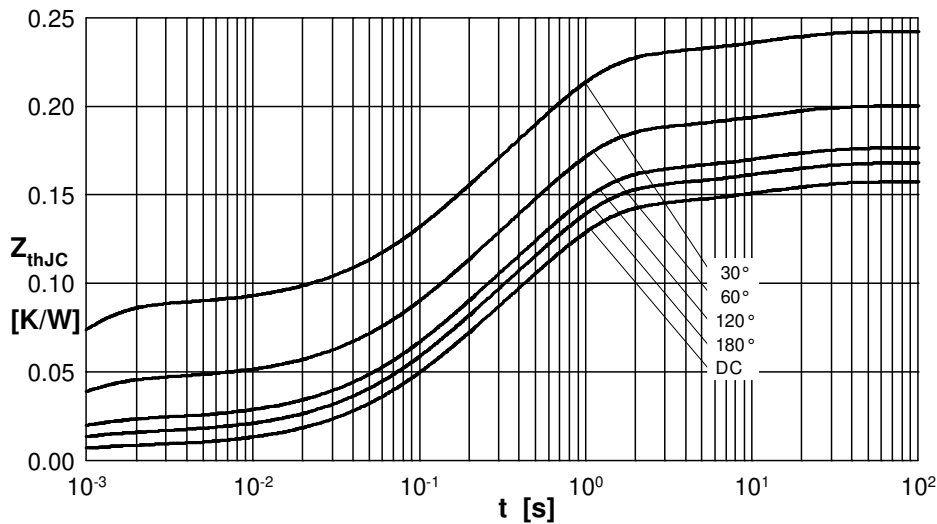


Fig. 10 Transient thermal impedance junction to case (per thyristor/diode)

$R_{thJC}$  for various conduct. angles d:

| d    | $R_{thJC}$ (K/W) |
|------|------------------|
| DC   | 0.157            |
| 180° | 0.168            |
| 120° | 0.177            |
| 60°  | 0.200            |
| 30°  | 0.243            |

Constants for  $Z_{thJC}$  calculation:

| i | $R_{thi}$ (K/W) | t (s)   |
|---|-----------------|---------|
| 1 | 0.0076          | 0.00054 |
| 2 | 0.0406          | 0.09800 |
| 3 | 0.0944          | 0.54000 |
| 4 | 0.0147          | 12.0000 |

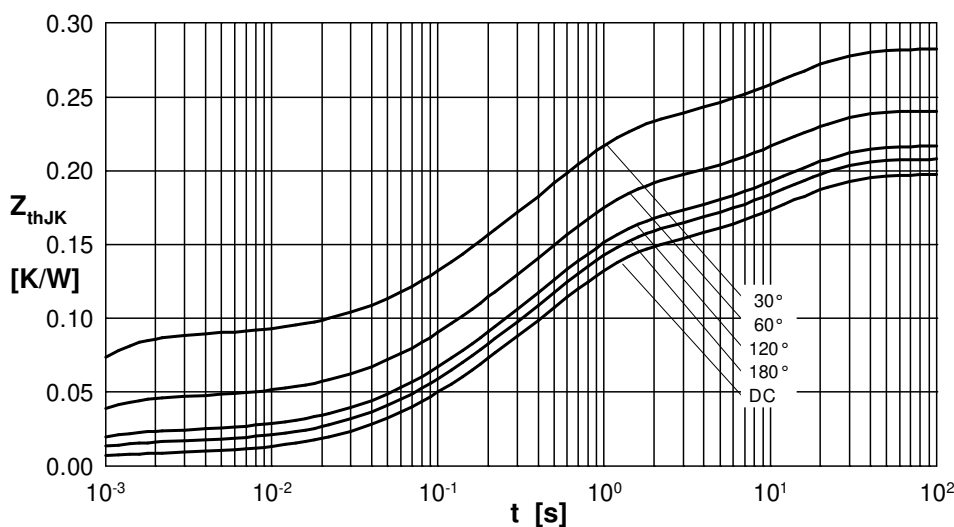


Fig. 11 Transient thermal impedance junction to heatsink (per thyristor/diode)

$R_{thJK}$  for various conduct. angles d:

| d    | $R_{thJK}$ (K/W) |
|------|------------------|
| DC   | 0.197            |
| 180° | 0.208            |
| 120° | 0.217            |
| 60°  | 0.240            |
| 30°  | 0.283            |

Constants for  $Z_{thJK}$  calculation:

| i | $R_{thi}$ (K/W) | t (s)   |
|---|-----------------|---------|
| 1 | 0.0076          | 0.00054 |
| 2 | 0.0406          | 0.09800 |
| 3 | 0.0944          | 0.54000 |
| 4 | 0.0147          | 12.0000 |
| 5 | 0.0400          | 12.0000 |