

# Thyristor \ Diode Module

$$V_{RRM} = 2 \times 1800 \text{ V}$$

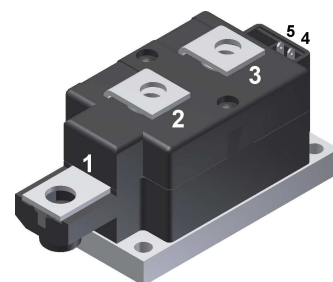
$$I_{TAV} = 220 \text{ A}$$

$$V_T = 1.18 \text{ V}$$

Phase leg

Part number

**MCD225-18io1**



Backside: isolated

 E72873



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

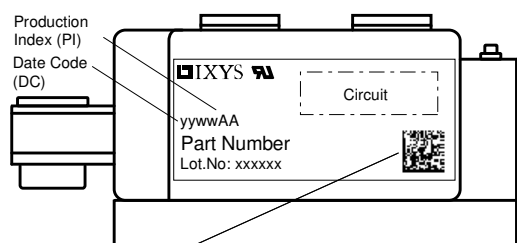
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| Rectifier      |                                                      |                                                                                                                                                                                                        |                                | Ratings |      |       |                   |
|----------------|------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------|------|-------|-------------------|
| Symbol         | Definition                                           | Conditions                                                                                                                                                                                             |                                | min.    | typ. | max.  | Unit              |
| $V_{RSM/DSM}$  | max. non-repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}\text{C}$                                                                                                                                                                          |                                |         |      | 1900  | V                 |
| $V_{RRM/DRM}$  | max. repetitive reverse/forward blocking voltage     | $T_{VJ} = 25^{\circ}\text{C}$                                                                                                                                                                          |                                |         |      | 1800  | V                 |
| $I_{R/D}$      | reverse current, drain current                       | $V_{R/D} = 1800\text{ V}$                                                                                                                                                                              | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 1     | mA                |
|                |                                                      | $V_{R/D} = 1800\text{ V}$                                                                                                                                                                              | $T_{VJ} = 125^{\circ}\text{C}$ |         |      | 40    | mA                |
| $V_T$          | forward voltage drop                                 | $I_T = 200\text{ A}$                                                                                                                                                                                   | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 1.04  | V                 |
|                |                                                      | $I_T = 400\text{ A}$                                                                                                                                                                                   |                                |         |      | 0.97  | V                 |
|                |                                                      | $I_T = 200\text{ A}$                                                                                                                                                                                   | $T_{VJ} = 125^{\circ}\text{C}$ |         |      | 1.18  | V                 |
|                |                                                      | $I_T = 400\text{ A}$                                                                                                                                                                                   |                                |         |      | 1.14  | V                 |
| $I_{TAV}$      | average forward current                              | $T_C = 85^{\circ}\text{C}$                                                                                                                                                                             | $T_{VJ} = 140^{\circ}\text{C}$ |         |      | 220   | A                 |
| $I_{T(RMS)}$   | RMS forward current                                  | 180° sine                                                                                                                                                                                              |                                |         |      | 400   | A                 |
| $V_{T0}$       | threshold voltage                                    | } for power loss calculation only                                                                                                                                                                      | $T_{VJ} = 140^{\circ}\text{C}$ |         |      | 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                              |                                                                                                                                                                                                        | $T_C = 25^{\circ}\text{C}$     |         |      | 730   | W                 |
| $I_{TSM}$      | max. forward surge current                           | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$                                                                                                                                                       | $T_{VJ} = 45^{\circ}\text{C}$  |         |      | 8.00  | kA                |
|                |                                                      | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$                                                                                                                                                      | $V_R = 0\text{ V}$             |         |      | 8.64  | kA                |
|                |                                                      | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$                                                                                                                                                       | $T_{VJ} = 140^{\circ}\text{C}$ |         |      | 6.80  | kA                |
|                |                                                      | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$                                                                                                                                                      | $V_R = 0\text{ V}$             |         |      | 7.35  | kA                |
| $I^2t$         | value for fusing                                     | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$                                                                                                                                                       | $T_{VJ} = 45^{\circ}\text{C}$  |         |      | 320.0 | kA <sup>2</sup> s |
|                |                                                      | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$                                                                                                                                                      | $V_R = 0\text{ V}$             |         |      | 310.5 | kA <sup>2</sup> s |
|                |                                                      | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$                                                                                                                                                       | $T_{VJ} = 140^{\circ}\text{C}$ |         |      | 231.2 | kA <sup>2</sup> s |
|                |                                                      | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$                                                                                                                                                      | $V_R = 0\text{ V}$             |         |      | 224.4 | kA <sup>2</sup> s |
| $C_J$          | junction capacitance                                 | $V_R = 400\text{ V}$ $f = 1\text{ MHz}$                                                                                                                                                                | $T_{VJ} = 25^{\circ}\text{C}$  |         | 366  |       | 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, $I_T = 660\text{ A}$                                                                                                                      |                                |         |      | 100   | A/ $\mu\text{s}$  |
|                |                                                      | $t_p = 200\text{ }\mu\text{s}; di_G/dt = 1\text{ A}/\mu\text{s};$<br>$I_G = 1\text{ A}; V = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 220\text{ A}$                                                      |                                |         |      | 500   | A/ $\mu\text{s}$  |
| $(dv/dt)_{cr}$ | critical rate of rise of voltage                     | $V = \frac{2}{3} V_{DRM}$                                                                                                                                                                              | $T_{VJ} = 140^{\circ}\text{C}$ |         |      | 1000  | V/ $\mu\text{s}$  |
|                |                                                      | $R_{GK} = \infty$ ; 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                |
|                |                                                      |                                                                                                                                                                                                        | $T_{VJ} = -40^{\circ}\text{C}$ |         |      | 220   | 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     | $\mu\text{s}$     |
|                |                                                      | $I_G = 1\text{ A}; di_G/dt = 1\text{ A}/\mu\text{s}$                                                                                                                                                   |                                |         |      |       |                   |
| $t_q$          | turn-off time                                        | $V_R = 100\text{ V}; I_T = 220\text{ A}; V = \frac{2}{3} V_{DRM}$ $T_{VJ} = 125^{\circ}\text{C}$<br>$di/dt = 10\text{ A}/\mu\text{s}$ $dv/dt = 50\text{ V}/\mu\text{s}$ $t_p = 200\text{ }\mu\text{s}$ |                                |         | 200  |       | $\mu\text{s}$     |

| 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         | 3600    |      |      | V    |
|                |                                                              | t = 1 minute         | 3000    |      |      | V    |



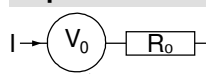
Data Matrix: part no. (1-19), DC + PI (20-25), lot.no.# (26-31), blank (32), serial no.# (33-36)

| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|---------------|----------|----------|
| Standard | MCD225-18io1    | MCD225-18io1       | Box           | 3        | 473596   |

### Equivalent Circuits for Simulation

\* on die level

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



Thyristor

|              |                    |      |    |
|--------------|--------------------|------|----|
| $V_{0 \max}$ | threshold voltage  | 0.79 | V  |
| $R_{0 \max}$ | slope resistance * | 0.64 | mΩ |

Technical drawing of a mechanical part, showing front and side views with dimensions.

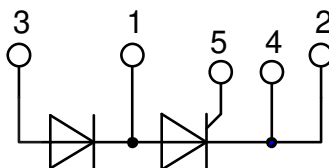
**Front View (Top):**

- Overall width: 115
- Overall height: 50
- Left flange width: 18
- Distance from left flange to first hole center: 20
- Distance between first and second hole centers: 22.5
- Distance between second and third hole centers: 35
- Distance from third hole center to right edge: 28.5
- Top flange width: 45
- Bottom flange width: 67
- Distance from bottom flange to first hole center: 6.2
- Distance from bottom flange to second hole center: 80
- Distance from bottom flange to third hole center: 92
- Distance from bottom flange to right edge: 38
- Right edge thickness: 5
- Three circular holes are shown, with the middle one labeled "2" and the right one labeled "3".

**Side View (Bottom):**

- Overall height: 52 (+0, -1.4)
- Distance from bottom to first step: 49
- Distance from bottom to second step: 32 (+0, -1.9)
- Second step thickness: 2
- Distance from second step to top flange: 15 ±1
- Top flange thickness: 10
- Top flange width: 43
- Overall width: 45
- Three M8 holes are shown, with the middle one labeled "3x M8".
- Right edge thickness: 2.8 x 0.8

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

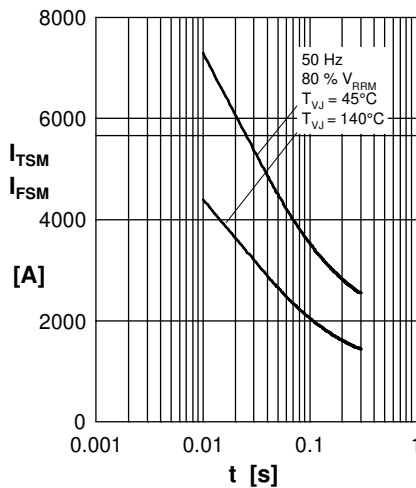


Fig. 1 Surge overload current  
 $I_{TSM/FSM}$ : Crest value,  $t$ : duration

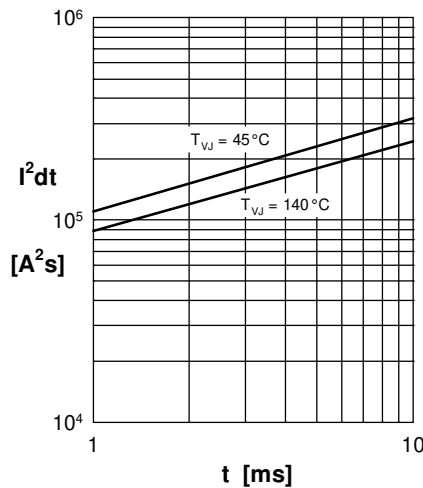


Fig. 2  $I^2dt$  versus time

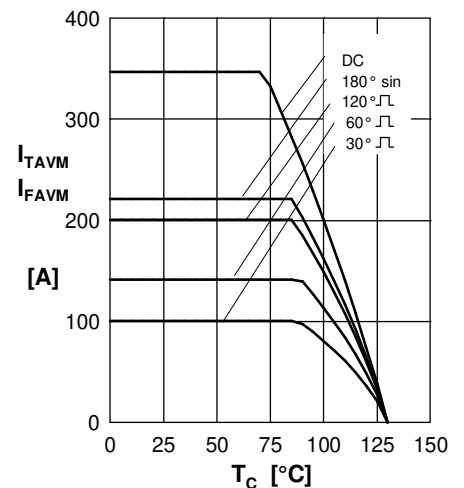


Fig. 3 Max. forward current at case temperature

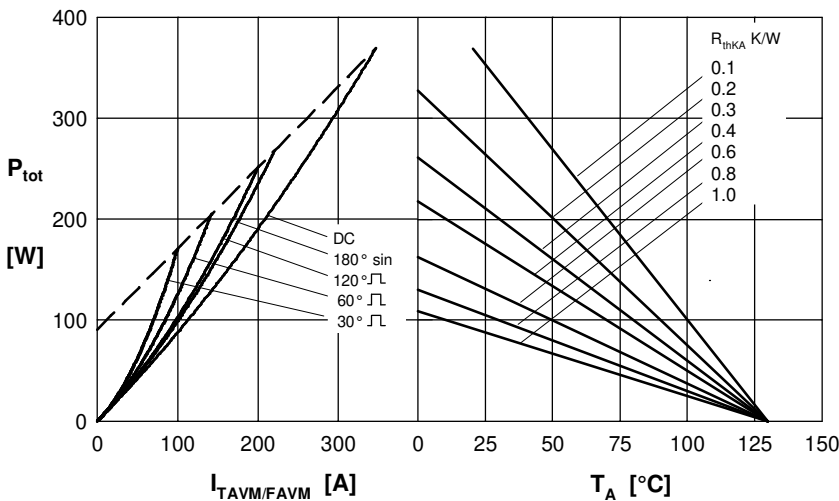


Fig. 4 Power dissipation versus on-state current and ambient temperature (per thyristor or diode)

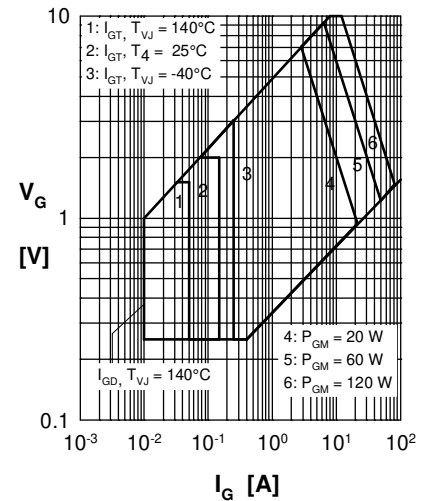


Fig. 5 Gate voltage and current

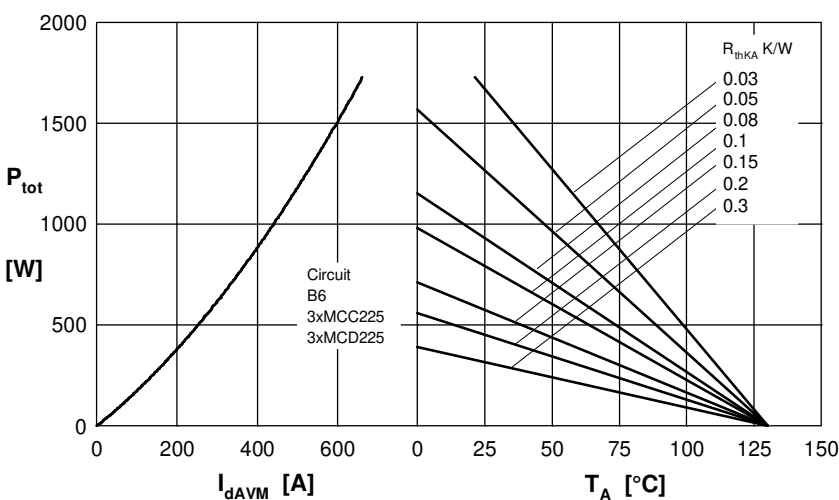


Fig. 6 Three phase rectifier bridge: Power dissipation versus direct output current and ambient temperature

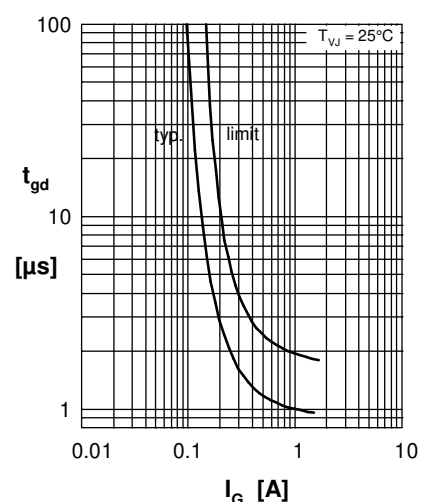


Fig. 7 Gate trigger characteristics

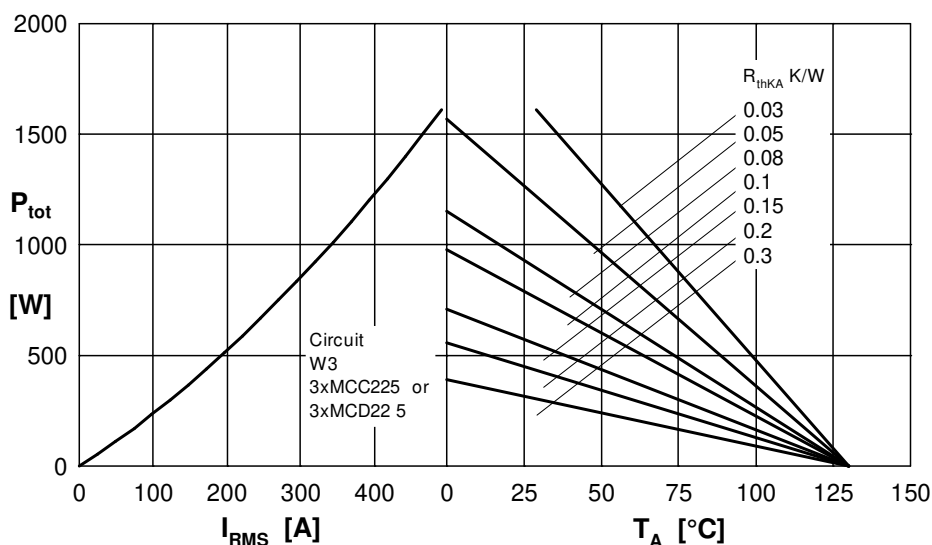
**Rectifier**


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

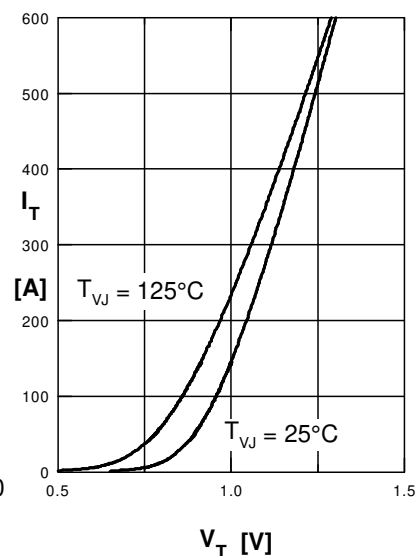


Fig. 9 Forward characteristics

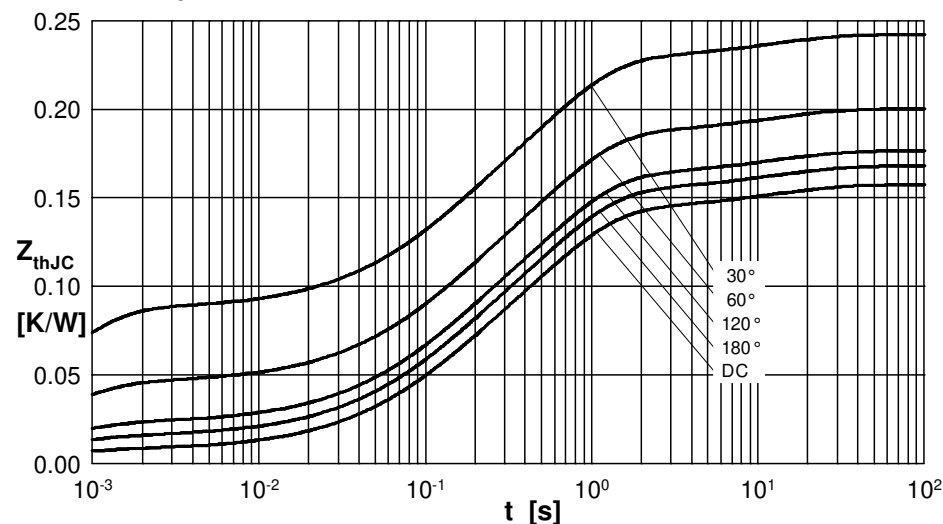


Fig. 10 Transient thermal impedance junction to case (per thyristor/diode)

$R_{thJC}$  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 |

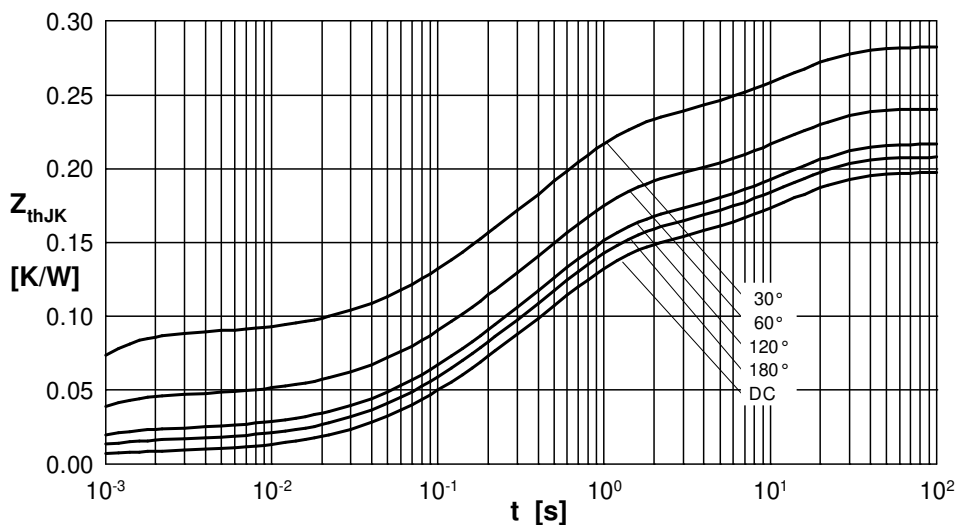


Fig. 11 Transient thermal impedance junction to heatsink (per thyristor/diode)

$R_{thJK}$  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 |