



# Thyristor \ Diode Module

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

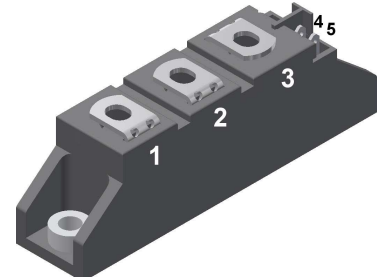
$I_{TAV} = 60 \text{ A}$

$V_T = 1.24 \text{ V}$

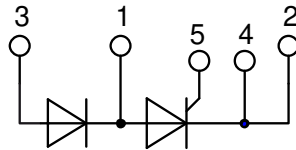
Phase leg

Part number

**MCD56-18io1B**



Backside: isolated



**Features / Advantages:**

- Thyristor for line frequency
- Planar passivated chip
- Long-term stability
- Direct Copper Bonded Al<sub>2</sub>O<sub>3</sub>-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

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| Rectifier      |  |  | Ratings                          |      |      |                   |
|----------------|--|--|----------------------------------|------|------|-------------------|
| Symbol         | Definition   | Conditions   | min.                             | typ. | max. | Unit              |
| $V_{RSM/DSM}$  | max. non-repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}C$   |                                  |      | 1900 | V                 |
| $V_{RRM/DRM}$  | max. repetitive reverse/forward blocking voltage     | $T_{VJ} = 25^{\circ}C$   |                                  |      | 1800 | V                 |
| $I_{RD}$       | reverse current, drain current                       | $V_{R/D} = 1800\text{ V}$  | $T_{VJ} = 25^{\circ}C$           |      | 200  | $\mu A$           |
|                |  | $V_{R/D} = 1800\text{ V}$  | $T_{VJ} = 125^{\circ}C$          |      | 5    | mA                |
| $V_T$          | forward voltage drop                                 | $I_T = 100\text{ A}$   | $T_{VJ} = 25^{\circ}C$           |      | 1.26 | V                 |
|                |  | $I_T = 200\text{ A}$   |                                  |      | 1.57 | V                 |
|                |  | $I_T = 100\text{ A}$   | $T_{VJ} = 125^{\circ}C$          |      | 1.24 | V                 |
|                |  | $I_T = 200\text{ A}$   |                                  |      | 1.62 | V                 |
| $I_{TAV}$      | average forward current                              | $T_C = 85^{\circ}C$  | $T_{VJ} = 125^{\circ}C$          |      | 60   | A                 |
| $I_{T(RMS)}$   | RMS forward current                                  | 180° sine  |                                  |      | 94   | A                 |
| $V_{T0}$       | threshold voltage                                    | } for power loss calculation only  | $T_{VJ} = 125^{\circ}C$          |      | 0.85 | V                 |
| $r_T$          | slope resistance                                     |  |                                  |      | 3.7  | m $\Omega$        |
| $R_{thJC}$     | thermal resistance junction to case                  |  |                                  |      | 0.45 | K/W               |
| $R_{thCH}$     | thermal resistance case to heatsink                  |  |                                  | 0.2  |      | K/W               |
| $P_{tot}$      | total power dissipation                              |  | $T_C = 25^{\circ}C$              |      | 222  | W                 |
| $I_{TSM}$      | max. forward surge current                           | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$   | $T_{VJ} = 45^{\circ}C$           |      | 1.50 | kA                |
|                |  | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$  | $V_R = 0\text{ V}$               |      | 1.62 | kA                |
|                |  | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$   | $T_{VJ} = 125^{\circ}C$          |      | 1.28 | kA                |
|                |  | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$  | $V_R = 0\text{ V}$               |      | 1.38 | kA                |
| $I^2t$         | value for fusing                                     | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$   | $T_{VJ} = 45^{\circ}C$           |      | 11.3 | kA <sup>2</sup> s |
|                |  | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$  | $V_R = 0\text{ V}$               |      | 10.9 | kA <sup>2</sup> s |
|                |  | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$   | $T_{VJ} = 125^{\circ}C$          |      | 8.13 | kA <sup>2</sup> s |
|                |  | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$  | $V_R = 0\text{ V}$               |      | 7.87 | kA <sup>2</sup> s |
| $C_J$          | junction capacitance                                 | $V_R = 400\text{ V } f = 1\text{ MHz}$   | $T_{VJ} = 25^{\circ}C$           |      | 74   | pF                |
| $P_{GM}$       | max. gate power dissipation                          | $t_p = 30\text{ }\mu s$  | $T_C = 125^{\circ}C$             |      | 10   | W                 |
|                |  | $t_p = 300\text{ }\mu s$   |                                  |      | 5    | W                 |
| $P_{GAV}$      | average gate power dissipation                       |  |                                  |      | 0.5  | W                 |
| $(di/dt)_{cr}$ | critical rate of rise of current                     | $T_{VJ} = 125^{\circ}C; f = 50\text{ Hz}$  | repetitive, $I_T = 150\text{ A}$ |      | 150  | A/ $\mu s$        |
|                |  | $t_p = 200\text{ }\mu s; di_G/dt = 0.45\text{ A}/\mu s;$                                 | non-repet., $I_T = 60\text{ A}$  |      | 500  | A/ $\mu s$        |
| $(dv/dt)_{cr}$ | critical rate of rise of voltage                     | $V = \frac{2}{3} V_{DRM}$  | $T_{VJ} = 125^{\circ}C$          |      | 1000 | V/ $\mu s$        |
|                |  | $R_{GK} = \infty; \text{ method 1 (linear voltage rise)}$                                |                                  |      |      |                   |
| $V_{GT}$       | gate trigger voltage                                 | $V_D = 6\text{ V}$   | $T_{VJ} = 25^{\circ}C$           |      | 1.5  | V                 |
|                |  |  | $T_{VJ} = -40^{\circ}C$          |      | 1.6  | V                 |
| $I_{GT}$       | gate trigger current                                 | $V_D = 6\text{ V}$   | $T_{VJ} = 25^{\circ}C$           |      | 100  | mA                |
|                |  |  | $T_{VJ} = -40^{\circ}C$          |      | 200  | mA                |
| $V_{GD}$       | gate non-trigger voltage                             | $V_D = \frac{2}{3} V_{DRM}$  | $T_{VJ} = 125^{\circ}C$          |      | 0.2  | V                 |
| $I_{GD}$       | gate non-trigger current                             |  |                                  |      | 10   | mA                |
| $I_L$          | latching current                                     | $t_p = 10\text{ }\mu s$  | $T_{VJ} = 25^{\circ}C$           |      | 450  | mA                |
|                |  | $I_G = 0.45\text{ A}; di_G/dt = 0.45\text{ A}/\mu s$                                     |                                  |      |      |                   |
| $I_H$          | holding current                                      | $V_D = 6\text{ V } R_{GK} = \infty$  | $T_{VJ} = 25^{\circ}C$           |      | 200  | mA                |
| $t_{gd}$       | gate controlled delay time                           | $V_D = \frac{1}{2} V_{DRM}$  | $T_{VJ} = 25^{\circ}C$           |      | 2    | $\mu s$           |
|                |  | $I_G = 0.45\text{ A}; di_G/dt = 0.45\text{ A}/\mu s$                                     |                                  |      |      |                   |
| $t_q$          | turn-off time  | $V_R = 100\text{ V}; I_T = 150\text{ A}; V = \frac{2}{3} V_{DRM}$                        | $T_{VJ} = 100^{\circ}C$          |      | 150  | $\mu s$           |
|                |  | $di/dt = 10\text{ A}/\mu s \quad dv/dt = 20\text{ V}/\mu s \quad t_p = 200\text{ }\mu s$ |                                  |      |      |                   |



| 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   |  |
| <b>Weight</b>    |  |                      |                                     |         | 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         |                                     | 4800    |      | V    |  |
|                  |  | t = 1 minute         | 50/60 Hz, RMS; $I_{ISOL} \leq 1$ mA | 4000    |      | V    |  |



| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|---------------|----------|----------|
| Standard | MCD56-18io1B    | MCD56-18io1B       | Box           | 36       | 494216   |

**Equivalent Circuits for Simulation**

\* on die level

$T_{VJ} = 125^{\circ}\text{C}$

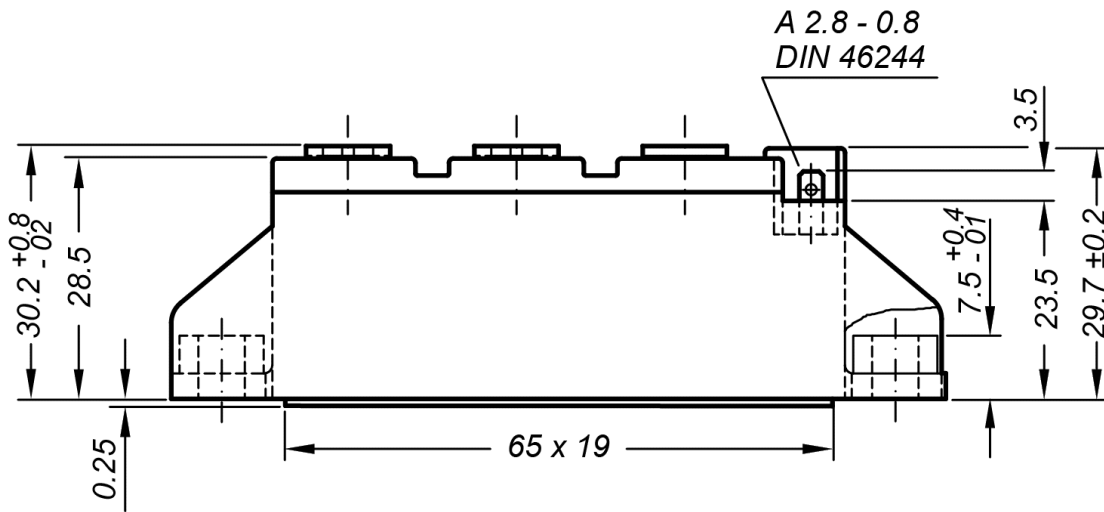


**Thyristor**

|              |                    |      |    |
|--------------|--------------------|------|----|
| $V_{0\ max}$ | threshold voltage  | 0.85 | V  |
| $R_{0\ max}$ | slope resistance * | 2.5  | mΩ |



**Outlines TO-240AA**



General tolerance: DIN ISO 2768 class „c“



**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





**Thyristor**

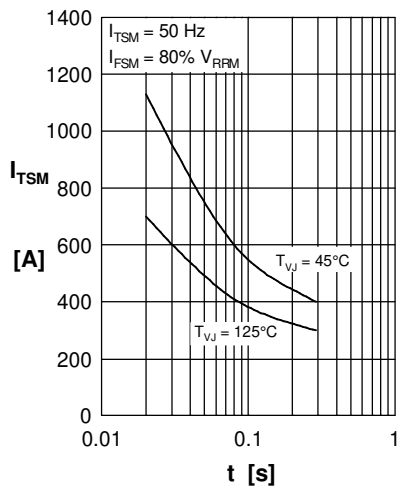


Fig. 1 Surge overload current  $I_{TSM}$ ,  $I_{FSM}$ : Crest value,  $t$ : duration

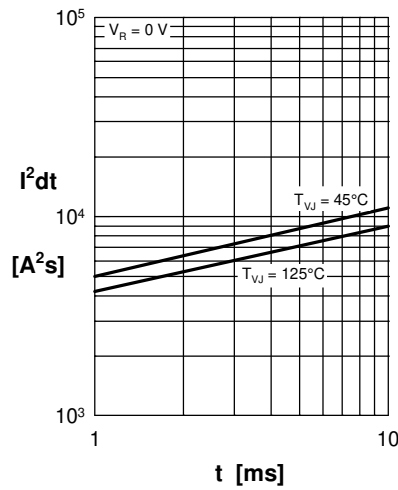


Fig. 2  $I^2dt$  versus time (1-10 ms)

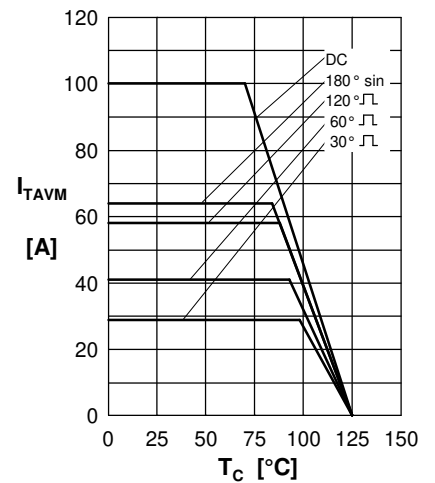


Fig. 3 Max. forward current at case temperature

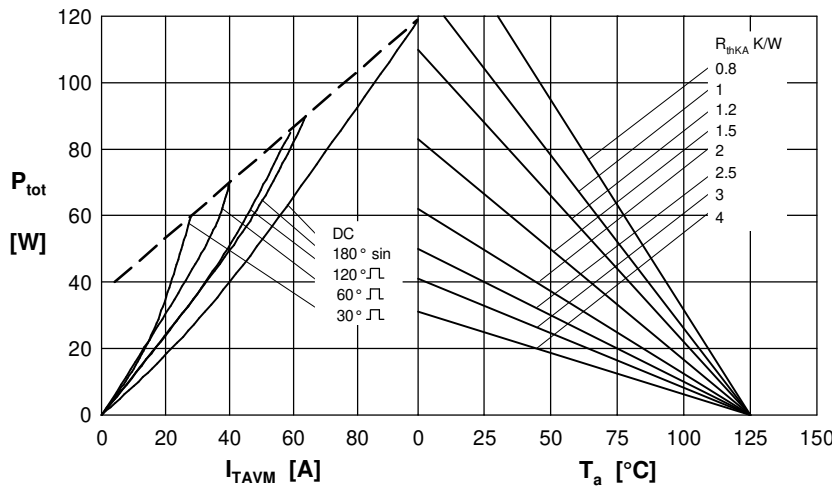


Fig. 4 Power dissipation vs. on-state current & ambient temperature (per thyristor or diode)

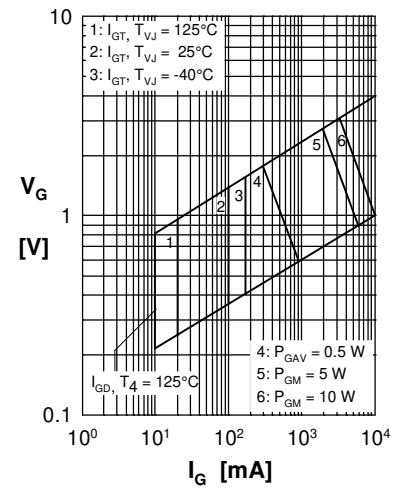


Fig. 5 Gate trigger characteristics

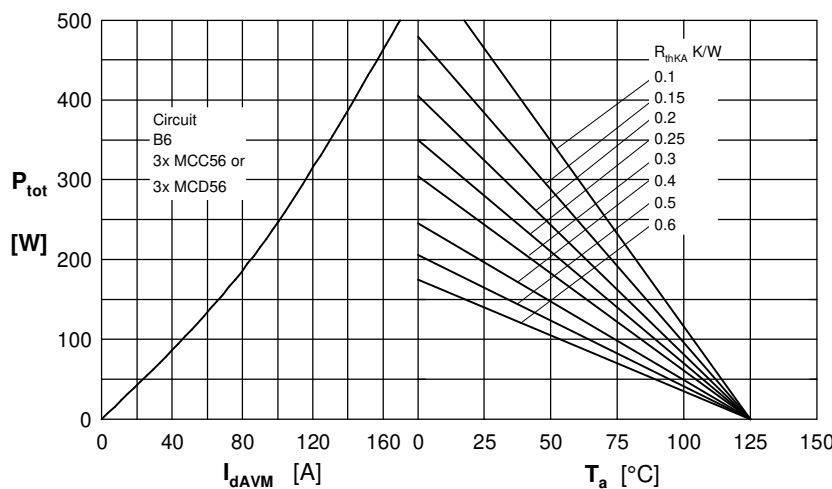


Fig. 6 Three phase rectifier bridge: Power dissipation versus direct output current and ambient temperature

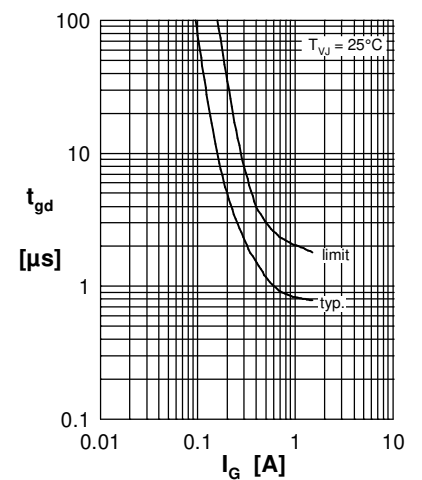


Fig. 7 Gate trigger delay time



**Rectifier**



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



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

| d    | $R_{thJC}$ [K/W] |
|------|------------------|
| DC   | 0.450            |
| 180° | 0.470            |
| 120° | 0.490            |
| 60°  | 0.505            |
| 30°  | 0.520            |

Constants for  $Z_{thJC}$  calculation:

| i | $R_{thi}$ [K/W] | $t_i$ [s] |
|---|-----------------|-----------|
| 1 | 0.014           | 0.0150    |
| 2 | 0.026           | 0.0095    |
| 3 | 0.410           | 0.1750    |

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



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

| d    | $R_{thJK}$ [K/W] |
|------|------------------|
| DC   | 0.650            |
| 180° | 0.670            |
| 120° | 0.690            |
| 60°  | 0.705            |
| 30°  | 0.720            |

Constants for  $Z_{thJK}$  calculation:

| i | $R_{thi}$ [K/W] | $t_i$ [s] |
|---|-----------------|-----------|
| 1 | 0.014           | 0.0150    |
| 2 | 0.026           | 0.0095    |
| 3 | 0.410           | 0.1750    |
| 4 | 0.200           | 0.6700    |

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