

# Thyristor Module

$$V_{RRM} = 2 \times 1600 \text{ V}$$

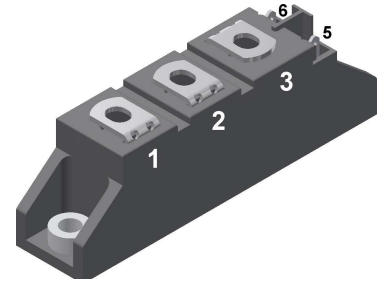
$$I_{TAV} = 18 \text{ A}$$

$$V_T = 1.57 \text{ V}$$

Phase leg

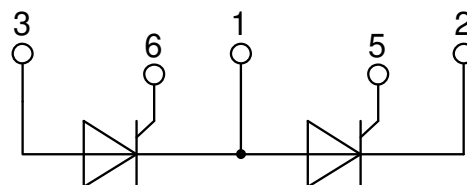
Part number

**MCC19-16io8B**



Backside: isolated

 E72873



### 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

### Disclaimer Notice

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| Thyristor      |  |   | Ratings                  |      |      |                  |
|----------------|--|---|--------------------------|------|------|------------------|
| Symbol         | Definition   | Conditions  | min.                     | typ. | max. | Unit             |
| $V_{RSM/DSM}$  | max. non-repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}C$  |                          |      | 1700 | V                |
| $V_{RRM/DRM}$  | max. repetitive reverse/forward blocking voltage     | $T_{VJ} = 25^{\circ}C$  |                          |      | 1600 | V                |
| $I_{RD}$       | reverse current, drain current                       | $V_{R/D} = 1600 V$  | $T_{VJ} = 25^{\circ}C$   |      | 100  | $\mu A$          |
|                |  | $V_{R/D} = 1600 V$  | $T_{VJ} = 125^{\circ}C$  |      | 3    | mA               |
| $V_T$          | forward voltage drop                                 | $I_T = 40 A$  | $T_{VJ} = 25^{\circ}C$   |      | 1.56 | V                |
|                |  | $I_T = 80 A$  |                          |      | 2.05 | V                |
|                |  | $I_T = 40 A$  | $T_{VJ} = 125^{\circ}C$  |      | 1.57 | V                |
|                |  | $I_T = 80 A$  |                          |      | 2.29 | V                |
| $I_{TAV}$      | average forward current                              | $T_C = 85^{\circ}C$   | $T_{VJ} = 125^{\circ}C$  |      | 18   | A                |
| $I_{T(RMS)}$   | RMS forward current                                  | 180° sine   |                          |      | 28   | A                |
| $V_{T0}$       | threshold voltage                                    | } for power loss calculation only   | $T_{VJ} = 125^{\circ}C$  |      | 0.85 | V                |
| $r_T$          | slope resistance                                     |   |                          |      | 18   | m $\Omega$       |
| $R_{thJC}$     | thermal resistance junction to case                  |   |                          |      | 1.3  | K/W              |
| $R_{thCH}$     | thermal resistance case to heatsink                  |   |                          | 0.2  |      | K/W              |
| $P_{tot}$      | total power dissipation                              |   | $T_C = 25^{\circ}C$      |      | 77   | W                |
| $I_{TSM}$      | max. forward surge current                           | $t = 10 ms; (50 Hz), sine$  | $T_{VJ} = 45^{\circ}C$   |      | 400  | A                |
|                |  | $t = 8,3 ms; (60 Hz), sine$   | $V_R = 0 V$              |      | 430  | A                |
|                |  | $t = 10 ms; (50 Hz), sine$  | $T_{VJ} = 125^{\circ}C$  |      | 340  | A                |
|                |  | $t = 8,3 ms; (60 Hz), sine$   | $V_R = 0 V$              |      | 365  | A                |
| $I^2t$         | value for fusing                                     | $t = 10 ms; (50 Hz), sine$  | $T_{VJ} = 45^{\circ}C$   |      | 800  | A <sup>2</sup> s |
|                |  | $t = 8,3 ms; (60 Hz), sine$   | $V_R = 0 V$              |      | 770  | A <sup>2</sup> s |
|                |  | $t = 10 ms; (50 Hz), sine$  | $T_{VJ} = 125^{\circ}C$  |      | 580  | A <sup>2</sup> s |
|                |  | $t = 8,3 ms; (60 Hz), sine$   | $V_R = 0 V$              |      | 555  | A <sup>2</sup> s |
| $C_J$          | junction capacitance                                 | $V_R = 400 V \quad f = 1 MHz$   | $T_{VJ} = 25^{\circ}C$   |      | 22   | pF               |
| $P_{GM}$       | max. gate power dissipation                          | $t_p = 30 \mu s$  | $T_C = 125^{\circ}C$     |      | 10   | W                |
|                |  | $t_p = 300 \mu s$   |                          |      | 5    | W                |
| $P_{GAV}$      | average gate power dissipation                       |   |                          |      | 0.5  | W                |
| $(di/dt)_{cr}$ | critical rate of rise of current                     | $T_{VJ} = 125^{\circ}C; f = 50 Hz$  | repetitive, $I_T = 75 A$ |      | 150  | A/ $\mu s$       |
|                |  | $t_p = 200 \mu s; di_G/dt = 0.45 A/\mu s;$<br>$I_G = 0.45 A; V = \frac{2}{3} V_{DRM}$                                     | non-repet., $I_T = 18 A$ |      | 500  | A/ $\mu s$       |
| $(dv/dt)_{cr}$ | critical rate of rise of voltage                     | $V = \frac{2}{3} V_{DRM}$<br>$R_{GK} = \infty; \text{method 1 (linear voltage rise)}$                                     | $T_{VJ} = 125^{\circ}C$  |      | 1000 | V/ $\mu s$       |
| $V_{GT}$       | gate trigger voltage                                 | $V_D = 6 V$   | $T_{VJ} = 25^{\circ}C$   |      | 1.5  | V                |
|                |  |   | $T_{VJ} = -40^{\circ}C$  |      | 1.6  | V                |
| $I_{GT}$       | gate trigger current                                 | $V_D = 6 V$   | $T_{VJ} = 25^{\circ}C$   |      | 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                             |   |                          |      | 5    | mA               |
| $I_L$          | latching current                                     | $t_p = 10 \mu s$  | $T_{VJ} = 25^{\circ}C$   |      | 450  | mA               |
|                |  | $I_G = 0.45 A; di_G/dt = 0.45 A/\mu s$  |                          |      |      |                  |
| $I_H$          | holding current                                      | $V_D = 6 V \quad R_{GK} = \infty$   | $T_{VJ} = 25^{\circ}C$   |      | 200  | mA               |
| $t_{gd}$       | gate controlled delay time                           | $V_D = \frac{1}{2} V_{DRM}$   | $T_{VJ} = 25^{\circ}C$   |      | 2    | $\mu s$          |
|                |  | $I_G = 0.45 A; di_G/dt = 0.45 A/\mu s$  |                          |      |      |                  |
| $t_q$          | turn-off time  | $V_R = 100 V; I_T = 20 A; V = \frac{2}{3} V_{DRM}$<br>$di/dt = 10 A/\mu s \quad dv/dt = 20 V/\mu s \quad t_p = 200 \mu s$ | $T_{VJ} = 100^{\circ}C$  |      | 150  | $\mu s$          |



| 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 | MCC19-16io8B    | MCC19-16io8B       | Box           | 36       | 457833   |

| Similar Part  | Package     | Voltage class |
|---------------|-------------|---------------|
| MCMA25P1600TA | TO-240AA-1B | 1600          |
| MCMA35P1600TA | TO-240AA-1B | 1600          |

**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 * | 16.8 | mΩ |



**Outlines TO-240AA**



General tolerance: DIN ISO 2768 class „c“

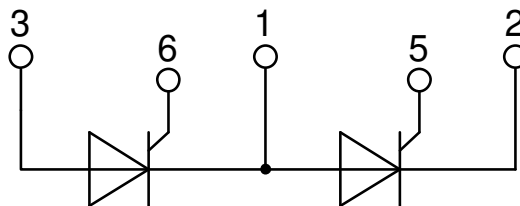


**Optional accessories for modules**

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

Type ZY 200L (L = Left for pin pair 4/5)

Type ZY 200R (R = Right for pin pair 6/7) } UL 758, style 3751



**Thyristor**

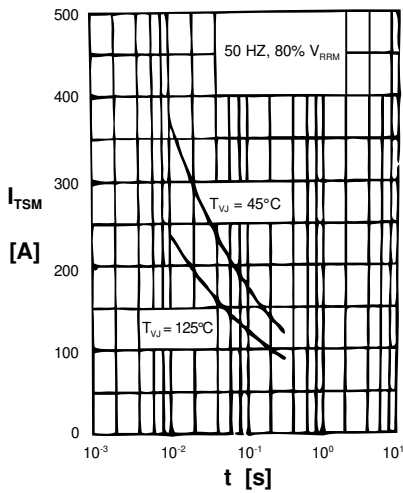


Fig. 1 Surge overload current  
 $I_{TSM}$ : Crest value,  $t$ : duration

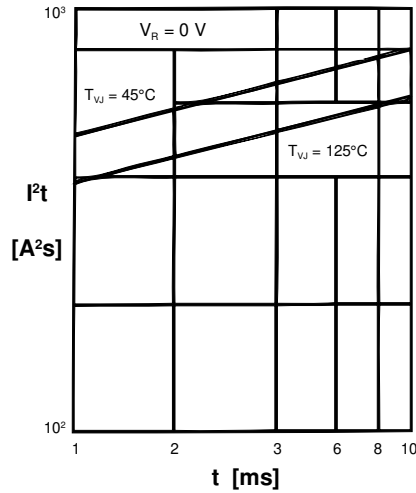


Fig. 2  $I^2t$  versus time (1-10 ms)

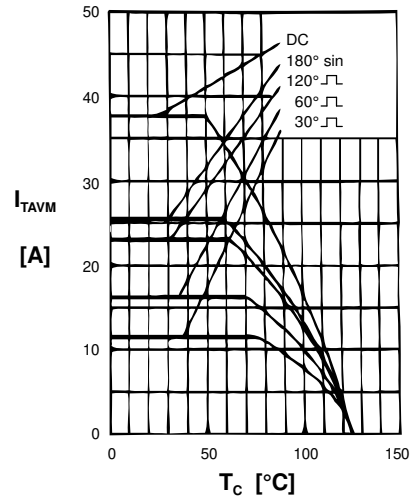


Fig. 3 Max. forward current at case temperature



Fig. 4 Power dissipation versus onstate current & ambient temp. (per thyristor)

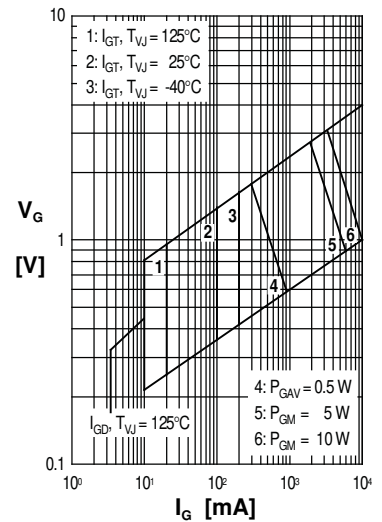


Fig. 5 Gate trigger charact.



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

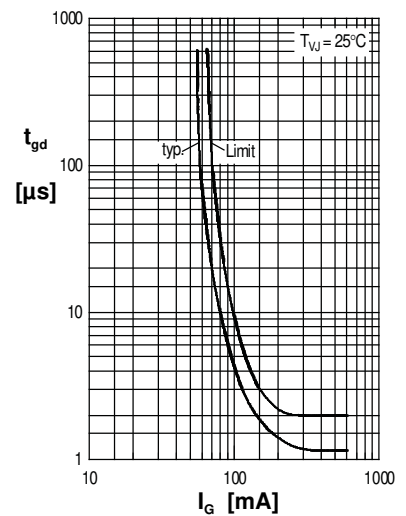
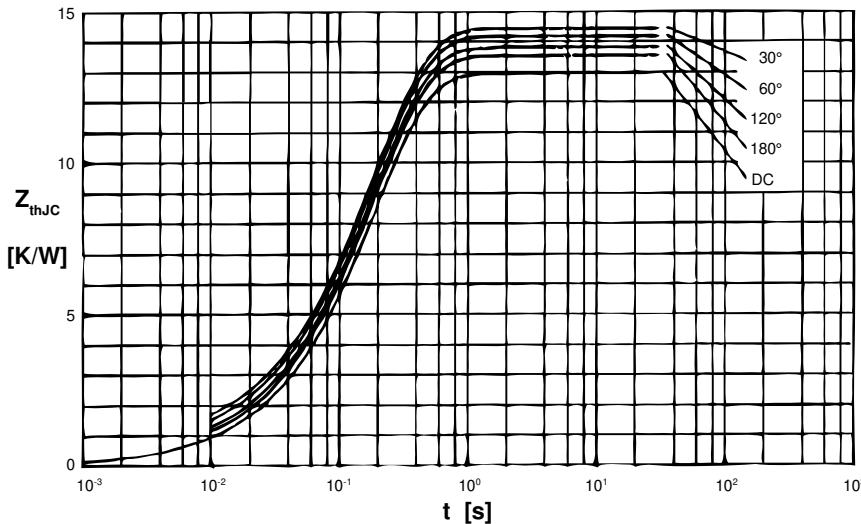


Fig. 7 Gate trigger delay time

**Thyristor**



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



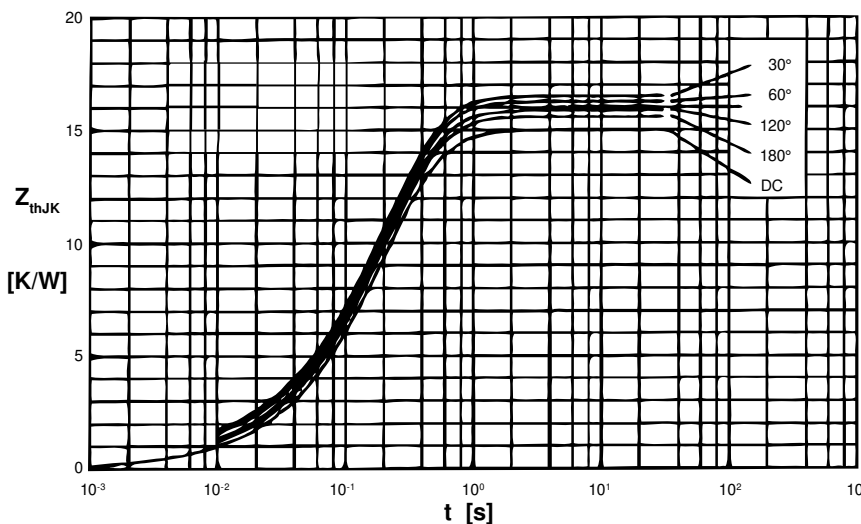
$R_{thJC}$  for various conduction angles d:

| d    | $R_{thJC}$ [K/W] |
|------|------------------|
| DC   | 1.30             |
| 180° | 1.35             |
| 120° | 1.39             |
| 60°  | 1.42             |
| 30°  | 1.45             |

Constants for  $Z_{thJC}$  calculation:

| i | $R_{thi}$ [K/W] | $t_i$ [s] |
|---|-----------------|-----------|
| 1 | 0.018           | 0.0033    |
| 2 | 0.041           | 0.0216    |
| 3 | 1.241           | 0.1910    |

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



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

| d    | $R_{thJK}$ [K/W] |
|------|------------------|
| DC   | 1.50             |
| 180° | 1.55             |
| 120° | 1.59             |
| 60°  | 1.62             |
| 30°  | 1.65             |

Constants for  $Z_{thJK}$  calculation:

| i | $R_{thi}$ [K/W] | $t_i$ [s] |
|---|-----------------|-----------|
| 1 | 0.018           | 0.0033    |
| 2 | 0.041           | 0.0216    |
| 3 | 1.241           | 0.1910    |
| 4 | 0.200           | 0.4600    |

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