

# Thyristor Module

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

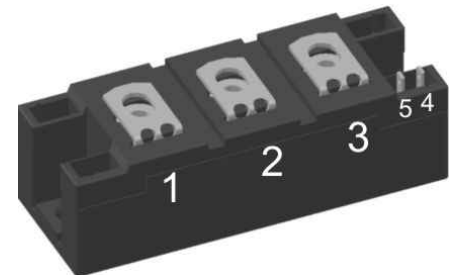
$$I_{TAV} = 260 \text{ A}$$

$$V_T = 1.06 \text{ V}$$

Phase leg

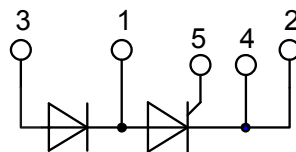
Part number

**MCMA260PD1600YB**



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:

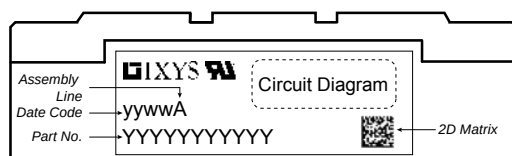
- Line rectifying 50/60 Hz
- Softstart AC motor control
- DC Motor control
- Power converter
- AC power control
- Lighting and temperature control

## Package: Y4

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

| Rectifier      |                                                      |                                                                                                                                                                         |                                | Ratings |      |       |                   |
|----------------|------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------|------|-------|-------------------|
| Symbol         | Definition                                           | Conditions                                                                                                                                                              |                                | min.    | typ. | max.  | Unit              |
| $V_{RSM/DSM}$  | max. non-repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}\text{C}$                                                                                                                                           |                                |         |      | 1700  | V                 |
| $V_{RRM/DRM}$  | max. repetitive reverse/forward blocking voltage     | $T_{VJ} = 25^{\circ}\text{C}$                                                                                                                                           |                                |         |      | 1600  | V                 |
| $I_{RD}$       | reverse current, drain current                       | $V_{R/D} = 1600\text{ V}$                                                                                                                                               | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 300   | $\mu\text{A}$     |
|                |                                                      | $V_{R/D} = 1600\text{ V}$                                                                                                                                               | $T_{VJ} = 140^{\circ}\text{C}$ |         |      | 20    | mA                |
| $V_T$          | forward voltage drop                                 | $I_T = 200\text{ A}$                                                                                                                                                    | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 1.12  | V                 |
|                |                                                      | $I_T = 400\text{ A}$                                                                                                                                                    |                                |         |      | 1.33  | V                 |
|                |                                                      | $I_T = 200\text{ A}$                                                                                                                                                    | $T_{VJ} = 125^{\circ}\text{C}$ |         |      | 1.06  | V                 |
|                |                                                      | $I_T = 400\text{ A}$                                                                                                                                                    |                                |         |      | 1.31  | V                 |
| $I_{TAV}$      | average forward current                              | $T_C = 85^{\circ}\text{C}$                                                                                                                                              | $T_{VJ} = 140^{\circ}\text{C}$ |         |      | 260   | A                 |
| $I_{T(RMS)}$   | RMS forward current                                  | 180° sine                                                                                                                                                               |                                |         |      | 408   | A                 |
| $V_{T0}$       | threshold voltage                                    | } for power loss calculation only                                                                                                                                       | $T_{VJ} = 140^{\circ}\text{C}$ |         |      | 0.81  | V                 |
| $r_T$          | slope resistance                                     |                                                                                                                                                                         |                                |         |      | 1.23  | m $\Omega$        |
| $R_{thJC}$     | thermal resistance junction to case                  |                                                                                                                                                                         |                                |         |      | 0.13  | K/W               |
| $R_{thCH}$     | thermal resistance case to heatsink                  |                                                                                                                                                                         |                                |         | 0.08 |       | K/W               |
| $P_{tot}$      | total power dissipation                              |                                                                                                                                                                         | $T_C = 25^{\circ}\text{C}$     |         |      | 880   | W                 |
| $I_{TSM}$      | max. forward surge current                           | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$                                                                                                                        | $T_{VJ} = 45^{\circ}\text{C}$  |         |      | 8.30  | kA                |
|                |                                                      | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$                                                                                                                       | $V_R = 0\text{ V}$             |         |      | 8.97  | kA                |
|                |                                                      | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$                                                                                                                        | $T_{VJ} = 140^{\circ}\text{C}$ |         |      | 7.06  | kA                |
|                |                                                      | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$                                                                                                                       | $V_R = 0\text{ V}$             |         |      | 7.62  | kA                |
| $I^2t$         | value for fusing                                     | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$                                                                                                                        | $T_{VJ} = 45^{\circ}\text{C}$  |         |      | 344.5 | kA <sup>2</sup> s |
|                |                                                      | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$                                                                                                                       | $V_R = 0\text{ V}$             |         |      | 334.3 | kA <sup>2</sup> s |
|                |                                                      | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$                                                                                                                        | $T_{VJ} = 140^{\circ}\text{C}$ |         |      | 248.9 | kA <sup>2</sup> s |
|                |                                                      | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$                                                                                                                       | $V_R = 0\text{ V}$             |         |      | 241.6 | 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, $I_T = 780\text{ A}$                                                                                       |                                |         |      | 100   | A/ $\mu\text{s}$  |
|                |                                                      | $t_P = 200\text{ }\mu\text{s}; di_G/dt = 0.5\text{ A}/\mu\text{s};$<br>$I_G = 0.5\text{ A}; V_D = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 500\text{ A}$                 |                                |         |      | 260   | A/ $\mu\text{s}$  |
| $(dv/dt)_{cr}$ | critical rate of rise of voltage                     | $V_D = \frac{2}{3} V_{DRM}$<br>$R_{GK} = \infty$ ; method 1 (linear voltage rise)                                                                                       | $T_{VJ} = 140^{\circ}\text{C}$ |         |      | 1000  | V/ $\mu\text{s}$  |
| $V_{GT}$       | 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                |
|                |                                                      | $I_G = 0.5\text{ A}; di_G/dt = 0.5\text{ A}/\mu\text{s}$                                                                                                                |                                |         |      |       |                   |
| $I_H$          | 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     | $\mu\text{s}$     |
|                |                                                      | $I_G = 0.5\text{ A}; di_G/dt = 0.5\text{ A}/\mu\text{s}$                                                                                                                |                                |         |      |       |                   |
| $t_q$          | turn-off time                                        | $V_R = 100\text{ V}; I_T = 260\text{ A}; V_D = \frac{2}{3} V_{DRM}$<br>$di/dt = 10\text{ A}/\mu\text{s}; dv/dt = 50\text{ V}/\mu\text{s}; t_P = 200\text{ }\mu\text{s}$ | $T_{VJ} = 140^{\circ}\text{C}$ |         | 200  |       | $\mu\text{s}$     |

| Package Y4    |                                                              |                      |                                     | Ratings |      |      |      |
|---------------|--------------------------------------------------------------|----------------------|-------------------------------------|---------|------|------|------|
| Symbol        | Definition                                                   | Conditions           |                                     | min.    | typ. | max. | Unit |
| $I_{RMS}$     | RMS current                                                  | per terminal         |                                     |         |      | 300  | A    |
| $T_{VJ}$      | virtual junction temperature                                 |                      |                                     | -40     |      | 140  | °C   |
| $T_{op}$      | operation temperature                                        |                      |                                     | -40     |      | 125  | °C   |
| $T_{stg}$     | storage temperature                                          |                      |                                     | -40     |      | 125  | °C   |
| Weight        |                                                              |                      |                                     |         | 150  |      | g    |
| $M_D$         | mounting torque                                              |                      |                                     | 2.25    |      | 2.75 | Nm   |
| $M_T$         | terminal torque                                              |                      |                                     | 4.5     |      | 5.5  | Nm   |
| $d_{Spp/App}$ | creepage distance on surface   striking distance through air | terminal to terminal | 14.0                                | 10.0    |      |      | mm   |
| $d_{Spb/Apb}$ |                                                              | terminal to backside | 16.0                                | 16.0    |      |      | mm   |
| $V_{ISOL}$    | isolation voltage                                            | t = 1 second         | 50/60 Hz, RMS; $I_{ISOL} \leq 1$ mA | 4800    |      |      | V    |
|               |                                                              | t = 1 minute         |                                     | 4000    |      |      | V    |



## Part number

M = Module  
 C = Thyristor (SCR)  
 M = Thyristor  
 A = (up to 1800V)  
 260 = Current Rating [A]  
 PD = Phase leg  
 1600 = Reverse Voltage [V]  
 YB = Y4-M6

| Ordering | Part Number     | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|---------------|----------|----------|
| Standard | MCMA260PD1600YB | MCMA260PD1600YB    | Box           | 6        | 509778   |

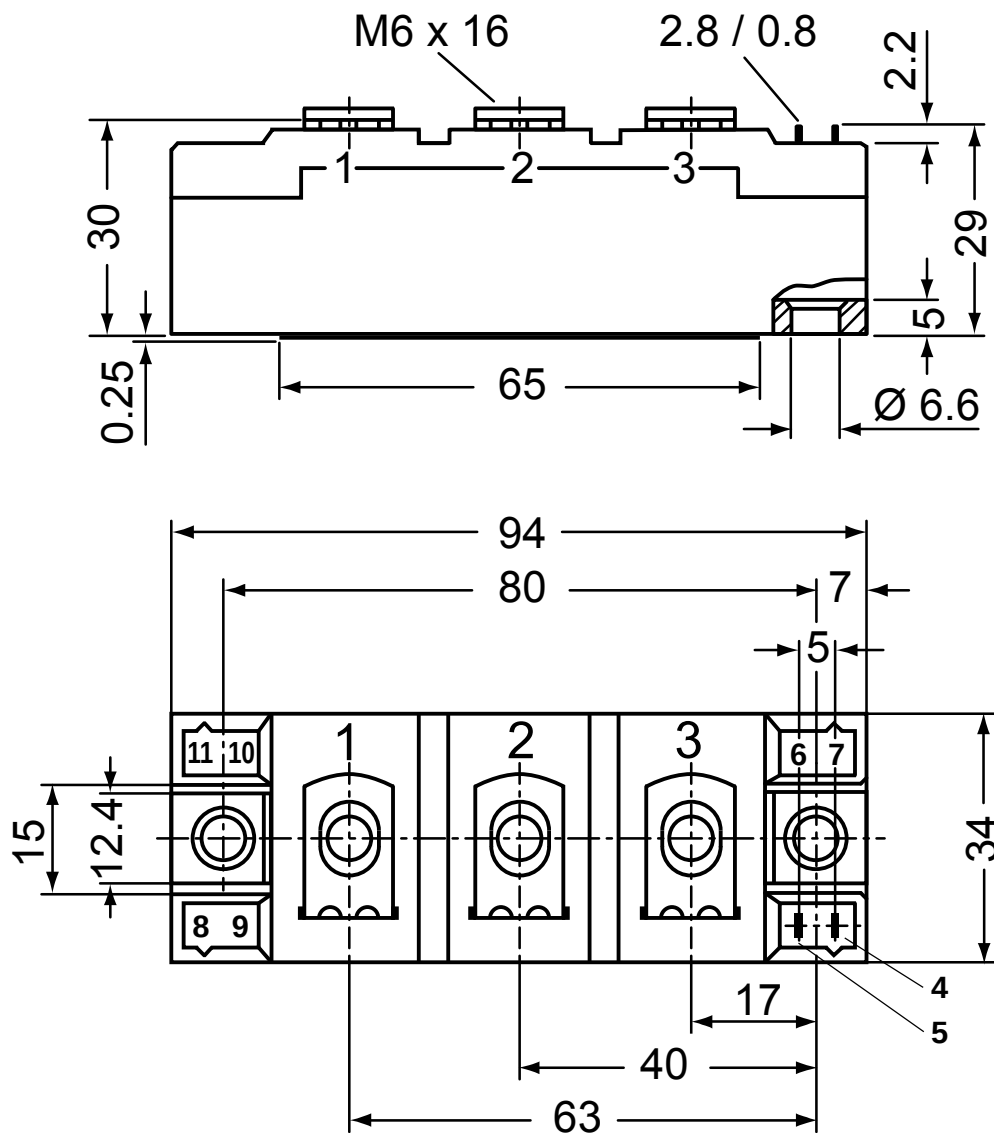
## Equivalent Circuits for Simulation

\* on die level

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

|             |                    |           |    |
|-------------|--------------------|-----------|----|
|             |                    | Thyristor |    |
| $V_{0\max}$ | threshold voltage  | 0.81      | V  |
| $R_{0\max}$ | slope resistance * | 0.59      | mΩ |

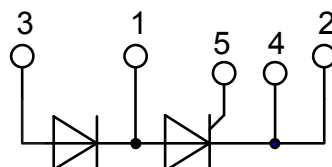
## Outlines Y4



### 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) } UL 758, style 3751  
 Type ZY 180R (R = Right for pin pair 6/7)



## Thyristor

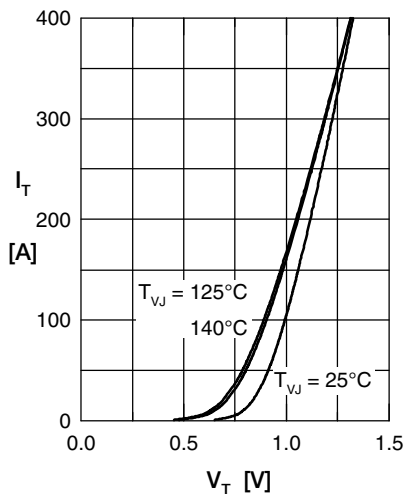


Fig. 1 Forward current vs. voltage drop per thyristor

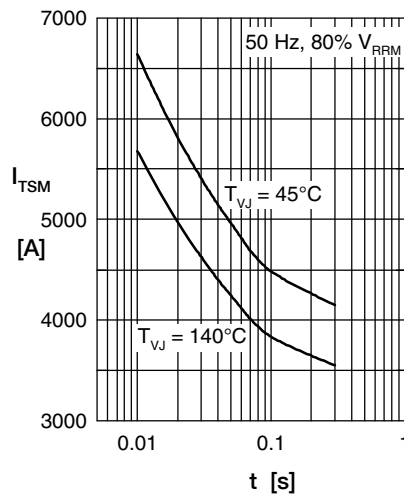


Fig. 2 Surge overload current vs. time per thyristor

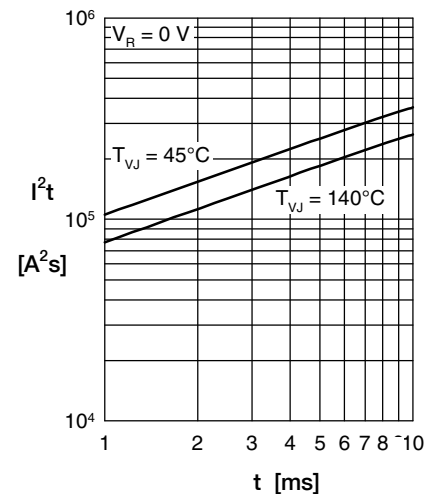


Fig. 3  $I^2t$  vs. time per thyristor

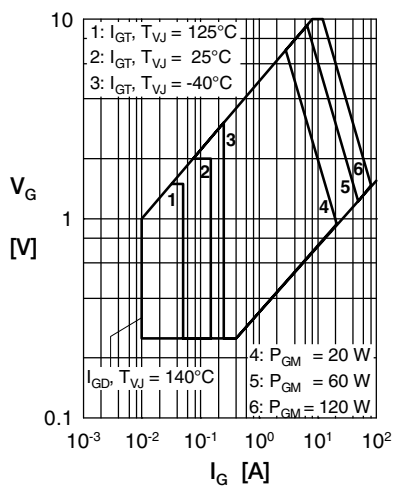


Fig. 4 Gate voltage & gate current

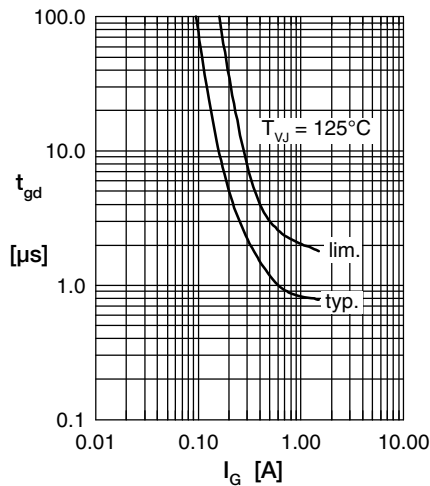


Fig. 5 Gate controlled delay time  $t_{gd}$

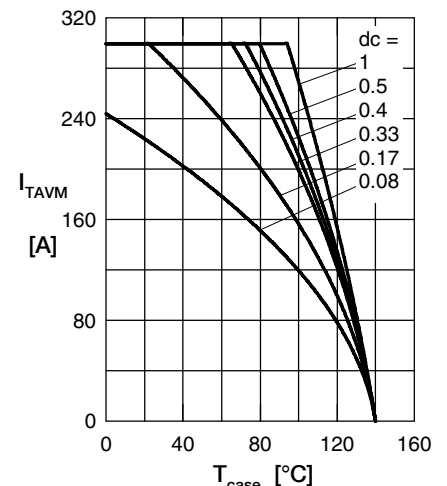


Fig. 6 Max. forward current vs. case temperature per thyrr.

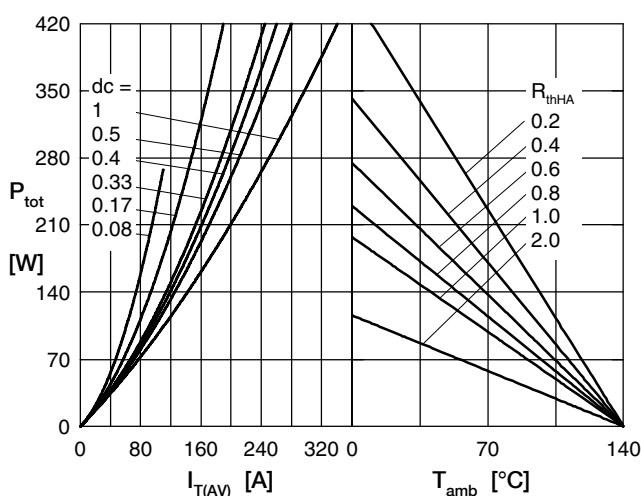


Fig. 7 Power dissipation vs. forward current and ambient temperature per thyristor

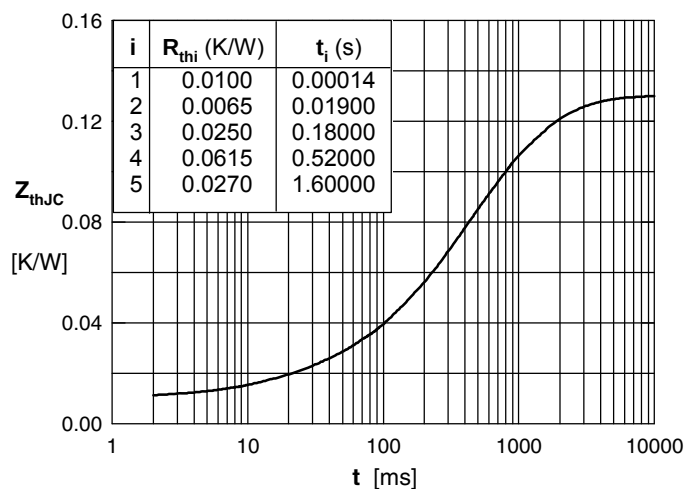


Fig. 8 Transient thermal impedance junction to case vs. time per thyristor