

# High Voltage Thyristor Module

$$V_{RRM} = 2 \times 2200 \text{ V}$$

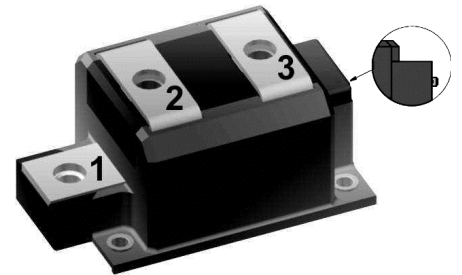
$$I_{TAV} = 650 \text{ A}$$

$$V_T = 1.16 \text{ V}$$

Phase leg

Part number

**MCNA650P2200CA**



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: ComPack

- Isolation Voltage: 4800 V~
- Industry standard outline
- RoHS compliant
- Soldering pins for PCB mounting
- Base plate: Copper internally DCB isolated
- Advanced power cycling
- Phase Change Material available

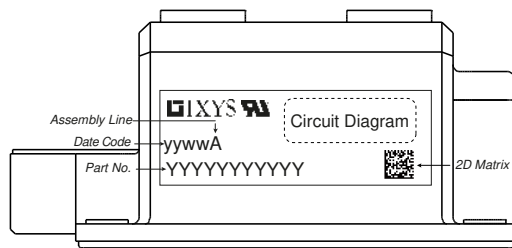
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| Rectifier      |  |  | Ratings                    |      |       |                   |
|----------------|--|--|----------------------------|------|-------|-------------------|
| Symbol         | Definition   | Conditions   | min.                       | typ. | max.  | Unit              |
| $V_{RSM/DSM}$  | max. non-repetitive reverse/forward blocking voltage | $T_{VJ} = 25^{\circ}C$   |                            |      | 2300  | V                 |
| $V_{RRM/DRM}$  | max. repetitive reverse/forward blocking voltage     | $T_{VJ} = 25^{\circ}C$   |                            |      | 2200  | V                 |
| $I_{RD}$       | reverse current, drain current                       | $V_{R/D} = 2200 V$   | $T_{VJ} = 25^{\circ}C$     |      | 2     | mA                |
|                |  | $V_{R/D} = 2200 V$   | $T_{VJ} = 125^{\circ}C$    |      | 40    | mA                |
| $V_T$          | forward voltage drop                                 | $I_T = 650 A$  | $T_{VJ} = 25^{\circ}C$     |      | 1.19  | V                 |
|                |  | $I_T = 1300 A$   |                            |      | 1.53  | V                 |
|                |  | $I_T = 650 A$  | $T_{VJ} = 125^{\circ}C$    |      | 1.16  | V                 |
|                |  | $I_T = 1300 A$   |                            |      | 1.59  | V                 |
| $I_{TAV}$      | average forward current                              | $T_C = 85^{\circ}C$  | $T_{VJ} = 140^{\circ}C$    |      | 650   | A                 |
| $I_{T(RMS)}$   | RMS forward current                                  | 180° sine  |                            |      | 1020  | A                 |
| $V_{T0}$       | threshold voltage                                    | } for power loss calculation only  | $T_{VJ} = 140^{\circ}C$    |      | 0.75  | V                 |
| $r_T$          | slope resistance                                     |  |                            |      | 0.63  | mΩ                |
| $R_{thJC}$     | thermal resistance junction to case                  |  |                            |      | 0.045 | K/W               |
| $R_{thCH}$     | thermal resistance case to heatsink                  |  |                            | 0.02 |       | K/W               |
| $P_{tot}$      | total power dissipation                              |  | $T_C = 25^{\circ}C$        |      | 2555  | W                 |
| $I_{TSM}$      | max. forward surge current                           | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$   | $T_{VJ} = 45^{\circ}C$     |      | 16.0  | kA                |
|                |  | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$  | $V_R = 0 V$                |      | 17.3  | kA                |
|                |  | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$   | $T_{VJ} = 140^{\circ}C$    |      | 13.6  | kA                |
|                |  | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$  | $V_R = 0 V$                |      | 14.7  | kA                |
| $I^2t$         | value for fusing                                     | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$   | $T_{VJ} = 45^{\circ}C$     |      | 1.28  | MA <sup>2</sup> s |
|                |  | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$  | $V_R = 0 V$                |      | 1.24  | MA <sup>2</sup> s |
|                |  | $t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$   | $T_{VJ} = 140^{\circ}C$    |      | 924.8 | kA <sup>2</sup> s |
|                |  | $t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$  | $V_R = 0 V$                |      | 897.7 | kA <sup>2</sup> s |
| $C_J$          | junction capacitance                                 | $V_R = 700 V \quad f = 1 \text{ MHz}$  | $T_{VJ} = 25^{\circ}C$     |      | 469   | pF                |
| $P_{GM}$       | max. gate power dissipation                          | $t_p = 30 \mu s$   | $T_C = 140^{\circ}C$       |      | 120   | W                 |
|                |  | $t_p = 300 \mu s$  |                            |      | 60    | W                 |
| $P_{GAV}$      | average gate power dissipation                       |  |                            |      | 30    | W                 |
| $(di/dt)_{cr}$ | critical rate of rise of current                     | $T_{VJ} = 140^{\circ}C; f = 50 \text{ Hz}$   | repetitive, $I_T = 1950 A$ |      | 100   | A/μs              |
|                |  | $t_p = 200 \mu s; di_G/dt = 1 A/\mu s;$<br>$I_G = 1 A; V = \frac{2}{3} V_{DRM}$  | non-repet., $I_T = 650 A$  |      | 500   | A/μs              |
| $(dv/dt)_{cr}$ | critical rate of rise of voltage                     | $V = \frac{2}{3} V_{DRM}$  | $T_{VJ} = 140^{\circ}C$    |      | 1000  | V/μs              |
|                |  | $R_{GK} = \infty; \text{method 1 (linear voltage rise)}$   |                            |      |       |                   |
| $V_{GT}$       | 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                                 | $V_D = 6 V$  | $T_{VJ} = 25^{\circ}C$     |      | 300   | mA                |
|                |  |  | $T_{VJ} = -40^{\circ}C$    |      | 400   | 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                                     | $t_p = 30 \mu s$   | $T_{VJ} = 25^{\circ}C$     |      | 400   | mA                |
|                |  | $I_G = 1 A; di_G/dt = 1 A/\mu s$   |                            |      |       |                   |
| $I_H$          | holding current                                      | $V_D = 6 V \quad R_{GK} = \infty$  | $T_{VJ} = 25^{\circ}C$     |      | 300   | 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  | $V_R = 100 V; I_T = 650 A; V = \frac{2}{3} V_{DRM}$<br>$di/dt = 10 A/\mu s \quad dv/dt = 50 V/\mu s \quad t_p = 200 \mu s$ | $T_{VJ} = 125^{\circ}C$    |      | 350   | μs                |



| Package ComPack |  | Ratings              |      |      |      |      |
|-----------------|--|----------------------|------|------|------|------|
| Symbol          | Definition   | Conditions           | min. | typ. | max. | Unit |
| $I_{RMS}$       | RMS current  | per terminal         |      |      | 1200 | 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>   |  |                      |      | 500  |      | g    |
| $M_D$           | mounting torque  |                      | 3    |      | 5    | Nm   |
| $M_T$           | terminal torque  |                      | 12   |      | 14   | Nm   |
| $d_{Spp/Apb}$   | creepage distance on surface   striking distance through air | terminal to terminal | 21.0 |      |      | mm   |
| $d_{Spb/Apb}$   |  | terminal to backside | 18.0 |      |      | mm   |
| $V_{ISOL}$      | isolation voltage  | t = 1 second         | 4800 |      |      | V    |
|                 |  | t = 1 minute         | 4000 |      |      | V    |



**Part description**

- M = Module
- C = Thyristor (SCR)
- N = High Voltage Thyristor
- A = (>= 2000V)
- 650 = Current Rating [A]
- P = Phase leg
- 2200 = Reverse Voltage [V]
- CA = ComPack

| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|---------------|----------|----------|
| Standard | MCNA650P2200CA  | MCNA650P2200CA     | Box           | 3        | 523321   |

**Equivalent Circuits for Simulation**

\* on die level

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

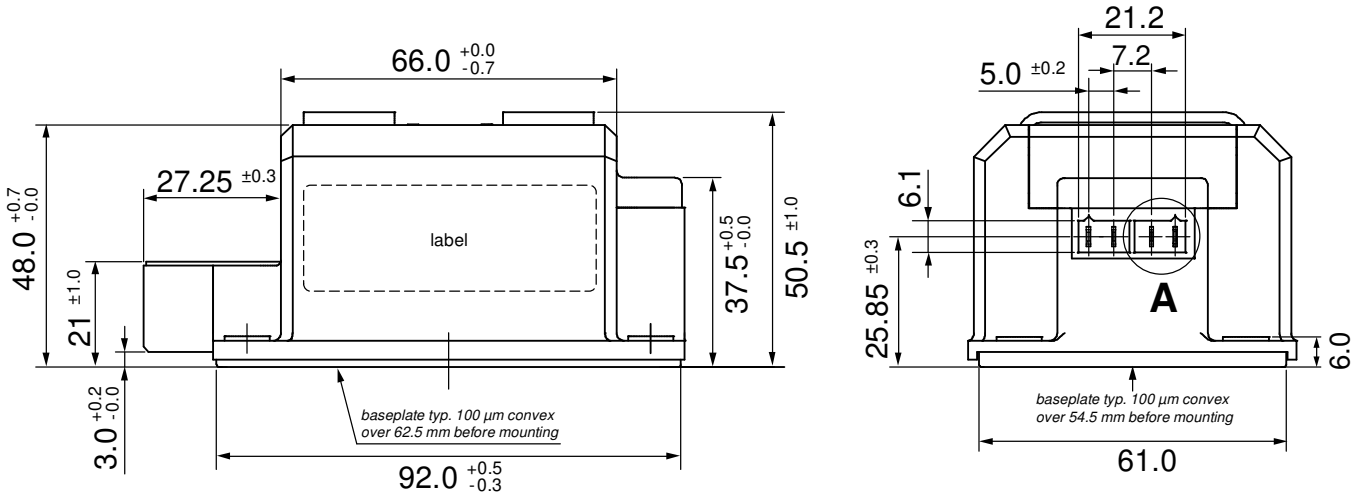


**Thyristor**

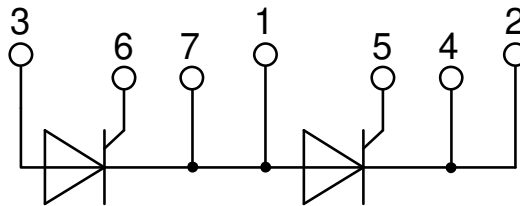
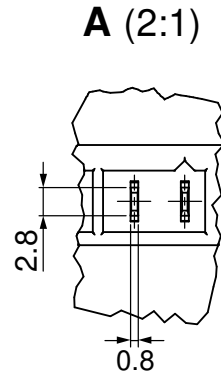
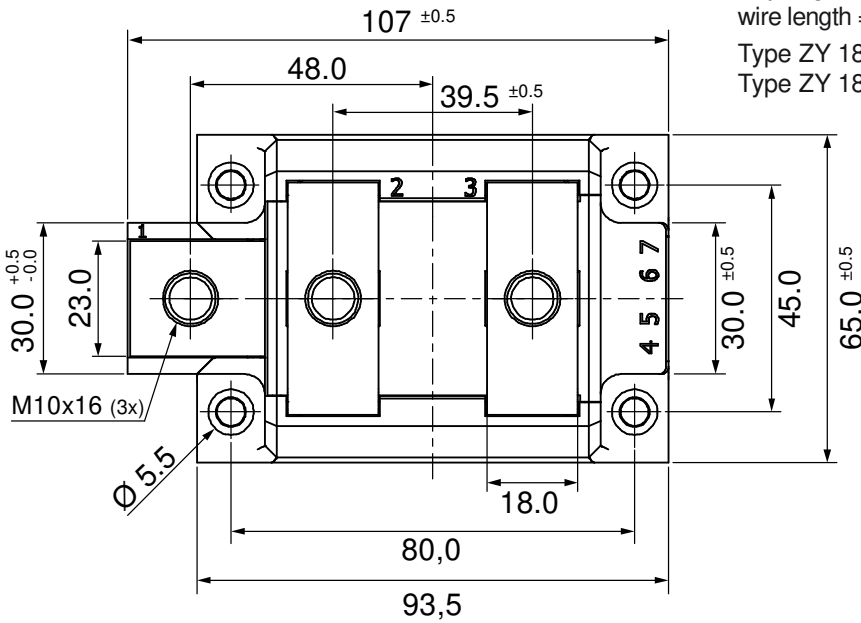
|              |                    |      |    |
|--------------|--------------------|------|----|
| $V_{0\ max}$ | threshold voltage  | 0.75 | V  |
| $R_{0\ max}$ | slope resistance * | 0.44 | mΩ |



**Outlines ComPack**



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



## Thyristor

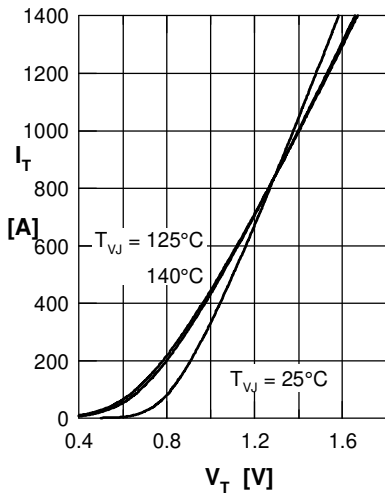


Fig. 1 Forward characteristics

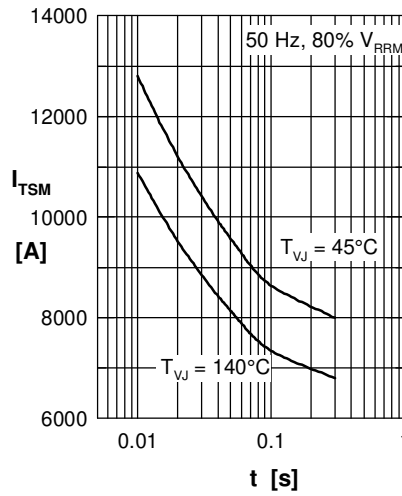


Fig. 2 Surge overload current  
 $I_{TSM}$ : crest value,  $t$ : duration

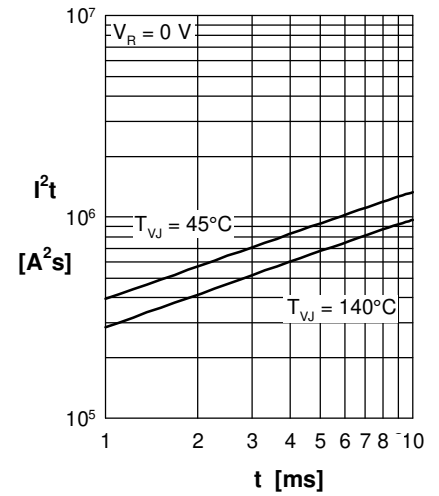


Fig. 3  $I^2t$  versus time (1-10 s)

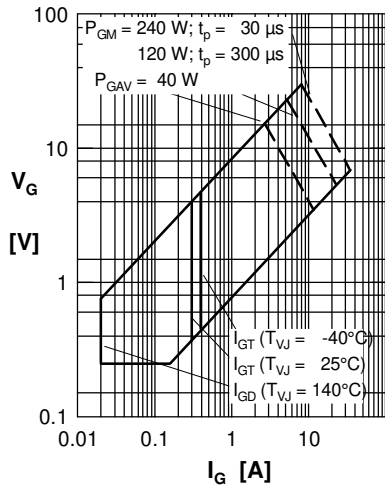


Fig. 4 Gate voltage & gate current

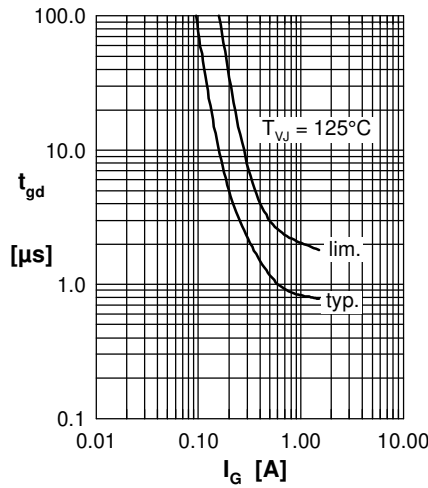


Fig. 5 Gate controlled delay time  $t_{gd}$

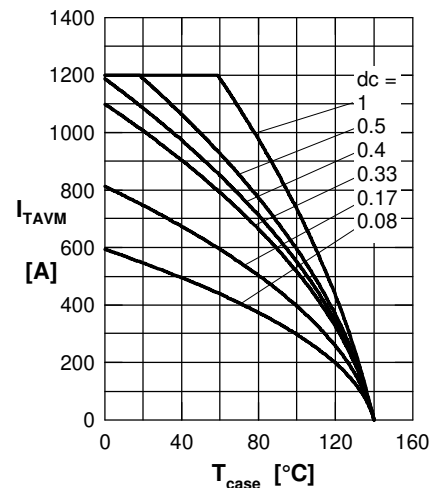


Fig. 6 Max. forward current at case temperature

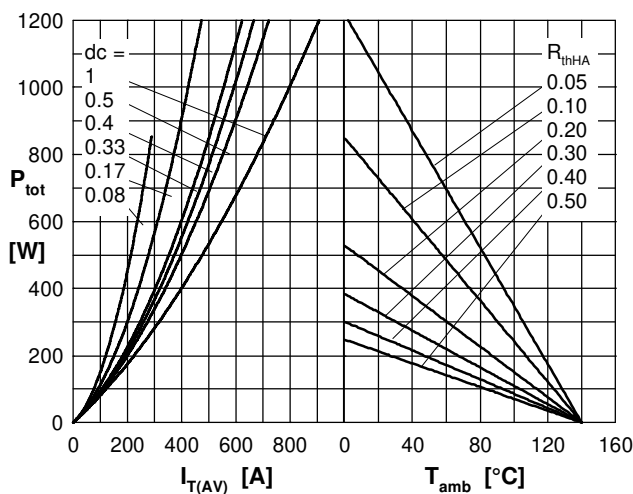


Fig. 7a Power dissipation versus direct output current  
 Fig. 7b and ambient temperature

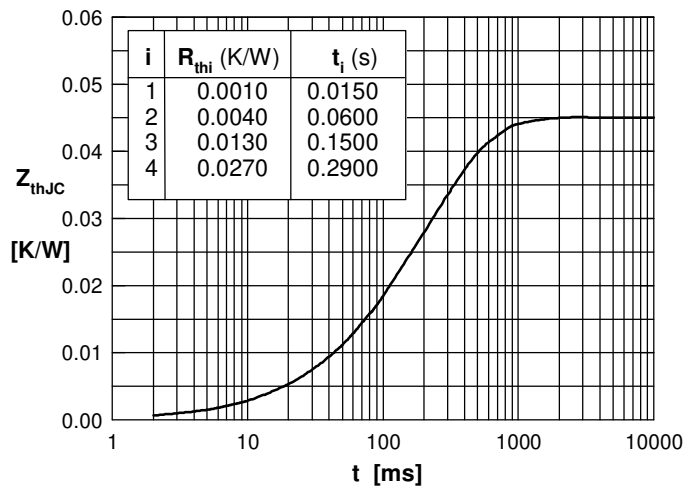


Fig. 8 Transient thermal impedance junction to case