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# Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China









# **Thyristor Module**

= 2x 1200 V

220 A

 $V_{T}$ 1.18 V

## Phase leg

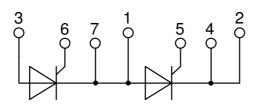
#### Part number

#### MCC225-12io1



Backside: isolated





#### Features / Advantages:

- International standard package
- Direct copper bonded Al2O3-ceramic with copper base plate
- Planar passivated chip
- Isolation voltage 3600 V~
- 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

#### Terms \_Conditions of usage:

The data contained in this product data sheet is exclusively intended for technically trained staff. The user will have to evaluate the suitability of the product for the intended application and the completeness of the product data with respect to his application. The specifications of our components may not be considered as an assurance of component characteristics. The information in the valid application- and assembly notes must be considered. Should you require product information in excess of the data given in this product data sheet or which concerns the specific application of your product, please contact your local sales office.

Due to technical requirements our product may contain dangerous substances. For information on the types in question please contact your local sales office.

Should you intend to use the product in aviation, in health or life endangering or life support applications, please notify. For any such application we urgently recommend

to perform joint risk and quality assessments;
the conclusion of quality agreements;

- to establish joint measures of an ongoing product survey, and that we may make delivery dependent on the realization of any such measures.

IXYS reserves the right to change limits, conditions and dimensions.

Data according to IEC 60747 and per semiconductor unless otherwise specified

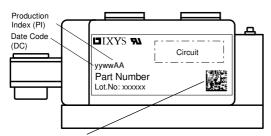
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| Rectifier             |                                    |   |                                       |      | Ratings | İ     | ! _              |
|-----------------------|------------------------------------|---|---------------------------------------|------|---------|-------|------------------|
| Symbol                | Definition                         | Conditions  |                                       | min. | typ.    | max.  | Uni              |
| V <sub>RSM/DSM</sub>  | max. non-repetitive reverse/forwa  | rd blocking voltage   | $T_{VJ} = 25^{\circ}C$                |      |         | 1300  | '                |
| V <sub>RRM/DRM</sub>  | max. repetitive reverse/forward bl |   | $T_{VJ} = 25^{\circ}C$                |      |         | 1200  | ١                |
| I <sub>R/D</sub>      | reverse current, drain current     | $V_{R/D} = 1200 \text{ V}$  | $T_{VJ} = 25^{\circ}C$                |      |         | 1     | m                |
|                       |                                    | $V_{R/D} = 1200 \text{ V}$  | $T_{VJ} = 125^{\circ}C$               |      |         | 40    | m                |
| V <sub>T</sub>        | forward voltage drop               | $I_T = 200 A$   | $T_{VJ} = 25^{\circ}C$                |      |         | 1.04  | ١                |
|                       |                                    | $I_T = 400 A$   |                                       |      |         | 0.97  | ١                |
|                       |                                    | I <sub>T</sub> = 200 A  | T <sub>VJ</sub> = 125°C               |      |         | 1.18  | ,                |
|                       |                                    | $I_T = 400 \text{ A}$   |                                       |      |         | 1.14  | ,                |
| I <sub>TAV</sub>      | average forward current            | T <sub>C</sub> = 85°C   | T <sub>vJ</sub> = 140°C               |      |         | 220   | ,                |
| I <sub>T(RMS)</sub>   | RMS forward current                | 180° sine   |                                       |      |         | 400   | ,                |
| V <sub>T0</sub>       | threshold voltage                  |   | T <sub>v.i</sub> = 140°C              |      |         | 0.79  | ,                |
| r <sub>T</sub>        | slope resistance                   | oss calculation only  | VO                                    |      |         | 0.83  | m۵               |
| R <sub>thJC</sub>     | thermal resistance junction to cas | e   |                                       |      |         | 0.157 | K/V              |
| R <sub>thCH</sub>     | thermal resistance case to heatsi  |   |                                       |      | 0.040   |       | K/V              |
| P <sub>tot</sub>      | total power dissipation            | **  | T <sub>C</sub> = 25°C                 |      | 0.0.0   | 730   | ٧                |
|                       | max. forward surge current         | t = 10 ms; (50 Hz), sine  | $T_{VJ} = 45^{\circ}C$                |      |         | 8.00  | k/               |
| I <sub>TSM</sub>      | max. forward surge current         | , (   | **                                    |      |         |       | ŀ                |
|                       |                                    | t = 8,3 ms; (60 Hz), sine   | V <sub>R</sub> = 0 V                  |      |         | 8.64  | k/               |
|                       |                                    | t = 10 ms; (50 Hz), sine  | $T_{VJ} = 140$ °C                     |      |         | 6.80  | k،               |
|                       |                                    | t = 8,3 ms; (60 Hz), sine   | $V_R = 0 V$                           |      |         | 7.35  | . k              |
| l²t                   | value for fusing                   | t = 10 ms; (50 Hz), sine  | $T_{VJ} = 45^{\circ}C$                |      |         | 320.0 | 1                |
|                       |                                    | t = 8,3 ms; (60 Hz), sine   | $V_R = 0 V$                           |      |         | 310.5 |                  |
|                       |                                    | t = 10 ms; (50 Hz), sine  | $T_{VJ} = 140$ °C                     |      |         | 231.2 | kA <sup>2</sup>  |
|                       |                                    | t = 8,3 ms; (60 Hz), sine   | $V_R = 0 V$                           |      |         | 224.4 | kA <sup>2</sup>  |
| <b>C</b> <sub>J</sub> | junction capacitance               | $V_R = 400 V$ $f = 1 MHz$   | $T_{VJ} = 25^{\circ}C$                |      | 366     |       | pl               |
| $P_{GM}$              | max. gate power dissipation        | t <sub>P</sub> = 30 μs  | T <sub>C</sub> = 140°C                |      |         | 120   | ٧                |
|                       |                                    | $t_{P} = 500  \mu s$  |                                       |      |         | 60    | ٧                |
| $P_{GAV}$             | average gate power dissipation     |   |                                       |      |         | 20    | ٧                |
| (di/dt) <sub>cr</sub> | critical rate of rise of current   | T <sub>v,i</sub> = 140 °C; f = 50 Hz re                                     | petitive, $I_{T} = 660 \text{ A}$     |      |         | 100   | A/u              |
| , , ,                 |                                    | $t_P = 200 \mu s; di_G/dt = 1 A/\mu s;$                                     | •                                     |      |         |       |                  |
|                       |                                    |   | on-repet., $I_{\tau} = 220 \text{ A}$ |      |         | 500   | Α/μ              |
| (dv/dt) <sub>cr</sub> | critical rate of rise of voltage   | $V = \frac{2}{3} V_{DRM}$   | $T_{VJ} = 140^{\circ}C$               |      |         | 1000  |                  |
| (av/at/ <sub>cr</sub> | childer rate of fise of voltage    | R <sub>GK</sub> = ∞; method 1 (linear volta                                 |                                       |      |         | 1000  | <b>ν</b> /μ      |
| W                     | gata trigger veltage               |   |                                       |      |         | 0     | ١                |
| $V_{GT}$              | gate trigger voltage               | $V_D = 6 V$   | $T_{VJ} = 25^{\circ}C$                |      |         | 2     | i                |
|                       |                                    |   | $T_{VJ} = -40$ °C                     |      |         | 3     | ١                |
| I <sub>GT</sub>       | gate trigger current               | $V_D = 6 V$   | $T_{VJ} = 25^{\circ}C$                |      |         | 150   | m/               |
|                       |                                    |   | $T_{VJ} = -40$ °C                     |      |         | 220   | m/               |
| $V_{GD}$              | gate non-trigger voltage           | $V_D = \frac{2}{3} V_{DRM}$   | $T_{VJ} = 140^{\circ}C$               |      |         | 0.25  | ١                |
| $I_{GD}$              | gate non-trigger current           |   |                                       |      |         | 10    | m/               |
| I <sub>L</sub>        | latching current                   | t <sub>p</sub> = 30 μs  | $T_{VJ} = 25^{\circ}C$                |      |         | 200   | m                |
|                       |                                    | $I_{G} = 0.45 A;  di_{G}/dt = 0.45 A/\mu s$                                 | 1                                     |      |         |       | !<br>!<br>!<br>! |
| I <sub>H</sub>        | holding current                    | V <sub>D</sub> = 6 V R <sub>GK</sub> = ∞                                    | $T_{VJ} = 25^{\circ}C$                |      |         | 150   | m                |
| t <sub>gd</sub>       | gate controlled delay time         | $V_D = \frac{1}{2} V_{DBM}$   | $T_{VJ} = 25$ °C                      |      |         | 2     | μ                |
| J-                    | -                                  | $I_G = 1 \text{ A}; \text{ di}_G/\text{dt} = 1 \text{ A/}\mu\text{s}$       |                                       |      |         |       | !<br>!           |
| tq                    | turn-off time                      | $V_{\rm R} = 100 \text{ V}; \ I_{\rm T} = 220 \text{ A}; \ V = \frac{2}{3}$ |                                       |      | 200     |       | μ                |
| •q                    |                                    | $di/dt = 10 \text{ A}/\mu \text{s} \text{ dv/dt} = 50 \text{ V/}$           |                                       |      | 200     |       | μ                |
|                       |                                    | $ai/ai = 10 A/\mu S av/ai = 30 V/$  | μο ι <sub>p</sub> = 200 μS            | 1    |         |       | !<br>!           |



| Package Y1           |   |                    |                             | Ratings |      |      |      |
|----------------------|---|--------------------|-----------------------------|---------|------|------|------|
| Symbol               | Definition                                  | Conditions         |                             | min.    | typ. | max. | Unit |
| I <sub>RMS</sub>     | RMS current                                 | per terminal       |                             |         |      | 600  | Α    |
| T <sub>VJ</sub>      | virtual junction temperature                |                    |                             | -40     |      | 140  | °C   |
| T <sub>op</sub>      | operation temperature                       |                    |                             | -40     |      | 125  | °C   |
| T <sub>stg</sub>     | storage temperature                         |                    |                             | -40     |      | 125  | °C   |
| Weight               |   |                    |                             |         | 680  |      | g    |
| M <sub>D</sub>       | mounting torque                             |                    |                             | 4.5     |      | 7    | Nm   |
| $\mathbf{M}_{_{T}}$  | terminal torque                             |                    |                             | 11      |      | 13   | Nm   |
| d <sub>Spp/App</sub> | creepage distance on surface   striking dis | stance through air | terminal to terminal        | 16.0    |      |      | mm   |
| $d_{Spb/Apb}$        | creepage distance on surface / striking dis | stance through an  | terminal to backside        | 16.0    |      |      | mm   |
| V <sub>ISOL</sub>    | isolation voltage                           | t = 1 second       |                             | 3600    |      |      | V    |
| .002                 |   | t = 1 minute       | 50/60 Hz, RMS; lisoL ≤ 1 mA | 3000    |      |      | ٧    |



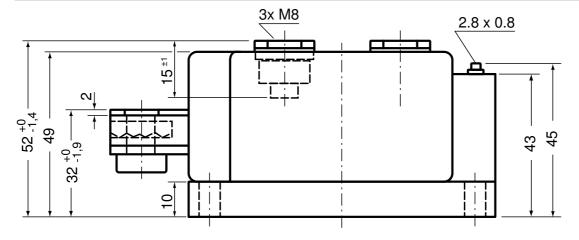
Data Matrix: part no. (1-19), DC + PI (20-25), lot.no.# (26-31), blank (32), serial no.# (33-36)

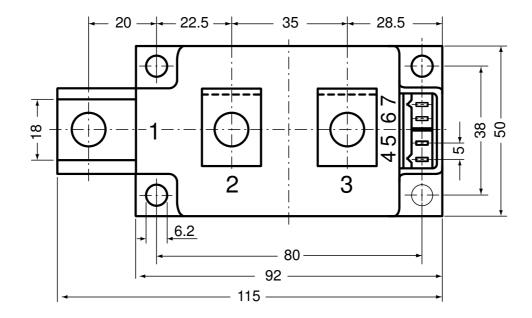
| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|---------------|----------|----------|
| Standard | MCC225-12io1    | MCC225-12io1       | Box           | 3        | 463280   |

| <b>Equivalent Circuits for Simulation</b> |                    | * on die level | T <sub>vJ</sub> = 140 °C |           |
|---|--------------------|----------------|--------------------------|-----------|
| $I \rightarrow V_0$                       | $R_0$              | Thyristor      |                          |           |
| V <sub>0 max</sub>                        | threshold voltage  | 0.79           |                          | V         |
| $R_{0 \; max}$                            | slope resistance * | 0.64           |                          | $m\Omega$ |



### Outlines Y1



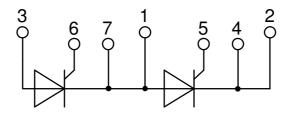


Optional accessories for modules

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

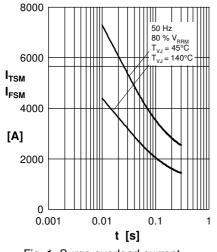
Type ZY 180L (L = Left for pin pair 4/5) Type ZY 180R (R = Right for pin pair 6/7)

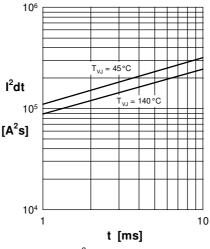
UL 758, style 3751





### **Thyristor**





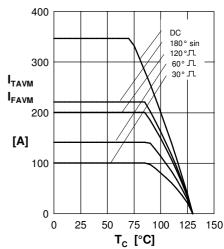
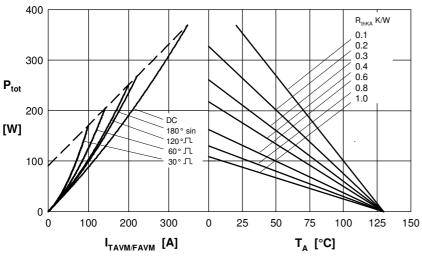


Fig. 1 Surge overload current  $I_{TSM/FSM}$ : Crest value, t: duration

Fig. 2 I<sup>2</sup>dt versus time

Fig. 3 Max. forward current at case temperature



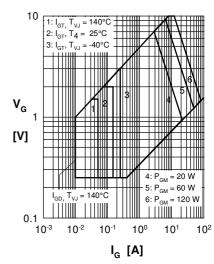
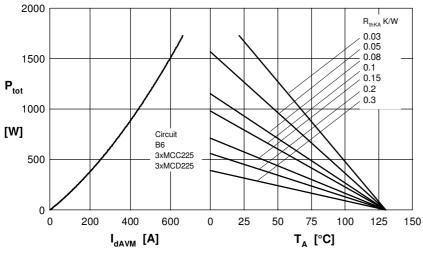


Fig. 4 Power dissipation versus on-state current and ambient temperature (per thyristor or diode)

Fig. 5 Gate voltage and current



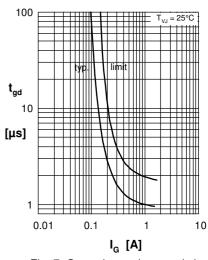
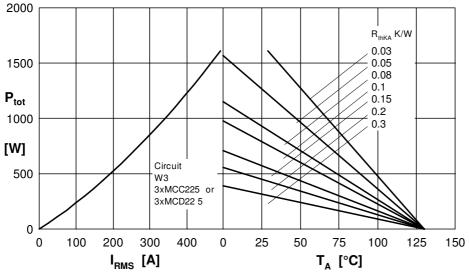


Fig. 6 Three phase rectifier bridge: Power dissipation versus direct output current and ambient temperature

Fig. 7 Gate trigger characteristics







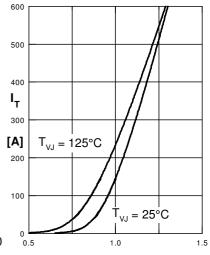
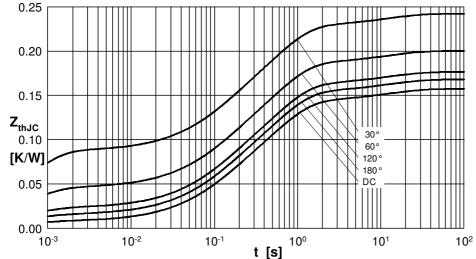


Fig. 8 Three phase AC-controller: Power dissipation versus  $R_{\rm MS}$  output current and ambient temperature

Fig. 9 Forward characteristics

 $V_T$  [V]



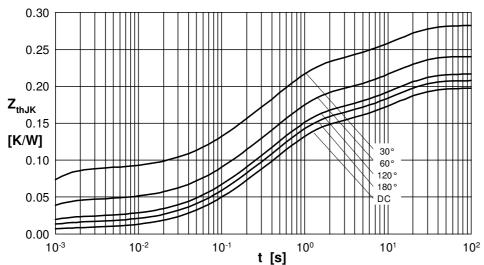
| R <sub>thJC</sub> for variou | is conduct. angles d: |
|------------------------------|-----------------------|
| d                            | $R_{th,IC}$ (K/W)     |
| 20                           | 0.457                 |

| d    | $R_{\text{\tiny th,IC}}$ (K/W) |
|------|--------------------------------|
| DC   | 0.157                          |
| 180° | 0.168                          |
| 120° | 0.177                          |
| 60°  | 0.200                          |
| 30°  | 0.243                          |

Constants for Z<sub>thJC</sub> calculation:

| i | $R_{thi}$ (K/W) | t <sub>,</sub> (s) |
|---|-----------------|--------------------|
| 1 | 0.0076          | 0.00054            |
| 2 | 0.0406          | 0.09800            |
| 3 | 0.0944          | 0.54000            |
| 4 | 0.0147          | 12.0000            |

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



 $R_{_{thJK}}$  for various conduct. angles d:

| d    | $R_{\text{\tiny th,lK}}$ (K/W) |
|------|--------------------------------|
| DC   | 0.197                          |
| 180° | 0.208                          |
| 120° | 0.217                          |
| 60°  | 0.240                          |
| 30°  | 0.283                          |

Constants for  $Z_{thJK}$  calculation:

| i | R <sub></sub> (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 |

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