

# Standard Rectifier Module

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

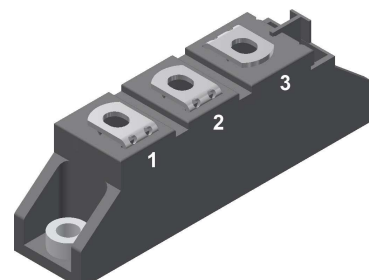
$$I_{FAV} = 120 \text{ A}$$

$$V_F = 1.13 \text{ V}$$

Phase leg

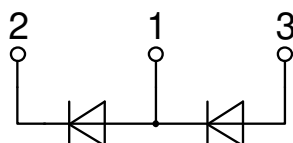
Part number

**MDD95-22N1B**



Backside: isolated

 E72873



## Features / Advantages:

- Package with DCB ceramic
- Improved temperature and power cycling
- Planar passivated chips
- Very low forward voltage drop
- Very low leakage current

## Applications:

- Diode for main rectification
- For single and three phase bridge configurations
- Supplies for DC power equipment
- Input rectifiers for PWM inverter
- Battery DC power supplies
- Field supply for DC motors

## Package: TO-240AA

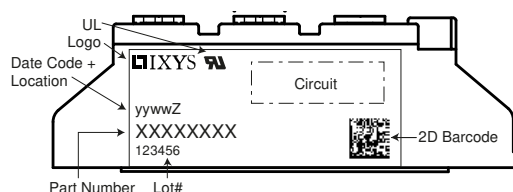
- Isolation Voltage: 4800 V~
- Industry standard outline
- RoHS compliant
- Height: 30 mm
- Base plate: DCB ceramic
- Reduced weight
- Advanced power cycling

## Disclaimer Notice

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| Rectifier    |                                              |                                                   |                                | Ratings |      |      |                   |
|--------------|----------------------------------------------|---------------------------------------------------|--------------------------------|---------|------|------|-------------------|
| Symbol       | Definition                                   | Conditions                                        |                                | min.    | typ. | max. | Unit              |
| $V_{RSM}$    | max. non-repetitive reverse blocking voltage | $T_{VJ} = 25^{\circ}\text{C}$                     |                                |         |      | 2300 | V                 |
| $V_{RRM}$    | max. repetitive reverse blocking voltage     | $T_{VJ} = 25^{\circ}\text{C}$                     |                                |         |      | 2200 | V                 |
| $I_R$        | reverse current                              | $V_R = 2200\text{ V}$                             | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 200  | $\mu\text{A}$     |
|              |                                              | $V_R = 2200\text{ V}$                             | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 15   | mA                |
| $V_F$        | forward voltage drop                         | $I_F = 150\text{ A}$                              | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 1.20 | V                 |
|              |                                              | $I_F = 300\text{ A}$                              |                                |         |      | 1.43 | V                 |
|              |                                              | $I_F = 150\text{ A}$                              | $T_{VJ} = 125^{\circ}\text{C}$ |         |      | 1.13 | V                 |
|              |                                              | $I_F = 300\text{ A}$                              |                                |         |      | 1.46 | V                 |
| $I_{FAV}$    | average forward current                      | $T_C = 100^{\circ}\text{C}$                       | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 120  | A                 |
| $I_{F(RMS)}$ | RMS forward current                          | 180° sine                                         |                                |         |      | 180  | A                 |
| $V_{F0}$     | threshold voltage                            | } for power loss calculation only                 | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 0.75 | V                 |
| $r_F$        | slope resistance                             |                                                   |                                |         |      | 1.95 | m $\Omega$        |
| $R_{thJC}$   | thermal resistance junction to case          |                                                   |                                |         |      | 0.26 | K/W               |
| $R_{thCH}$   | thermal resistance case to heatsink          |                                                   |                                |         | 0.2  |      | K/W               |
| $P_{tot}$    | total power dissipation                      |                                                   | $T_C = 25^{\circ}\text{C}$     |         |      | 481  | W                 |
| $I_{FSM}$    | max. forward surge current                   | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$  | $T_{VJ} = 45^{\circ}\text{C}$  |         |      | 2.80 | kA                |
|              |                                              | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$ | $V_R = 0\text{ V}$             |         |      | 3.03 | kA                |
|              |                                              | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$  | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 2.38 | kA                |
|              |                                              | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$ | $V_R = 0\text{ V}$             |         |      | 2.57 | kA                |
| $I^2t$       | value for fusing                             | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$  | $T_{VJ} = 45^{\circ}\text{C}$  |         |      | 39.2 | kA <sup>2</sup> s |
|              |                                              | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$ | $V_R = 0\text{ V}$             |         |      | 38.1 | kA <sup>2</sup> s |
|              |                                              | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$  | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 28.3 | kA <sup>2</sup> s |
|              |                                              | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$ | $V_R = 0\text{ V}$             |         |      | 27.5 | kA <sup>2</sup> s |
| $C_J$        | junction capacitance                         | $V_R = 400\text{ V}; f = 1\text{ MHz}$            | $T_{VJ} = 25^{\circ}\text{C}$  |         | 116  |      | pF                |

| 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     |      | 150  | °C   |
| $T_{op}$         | operation temperature                                        |                      |                                     | -40     |      | 125  | °C   |
| $T_{stg}$        | storage temperature                                          |                      |                                     | -40     |      | 125  | °C   |
| <b>Weight</b>    |                                                              |                      |                                     |         | 76   |      | 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         | 50/60 Hz, RMS; $I_{ISOL} \leq 1$ mA | 4800    |      |      | V    |
|                  |                                                              | t = 1 minute         |                                     | 4000    |      |      | V    |

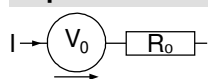


| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|---------------|----------|----------|
| Standard | MDD95-22N1B     | MDD95-22N1B        | Box           | 36       | 470236   |

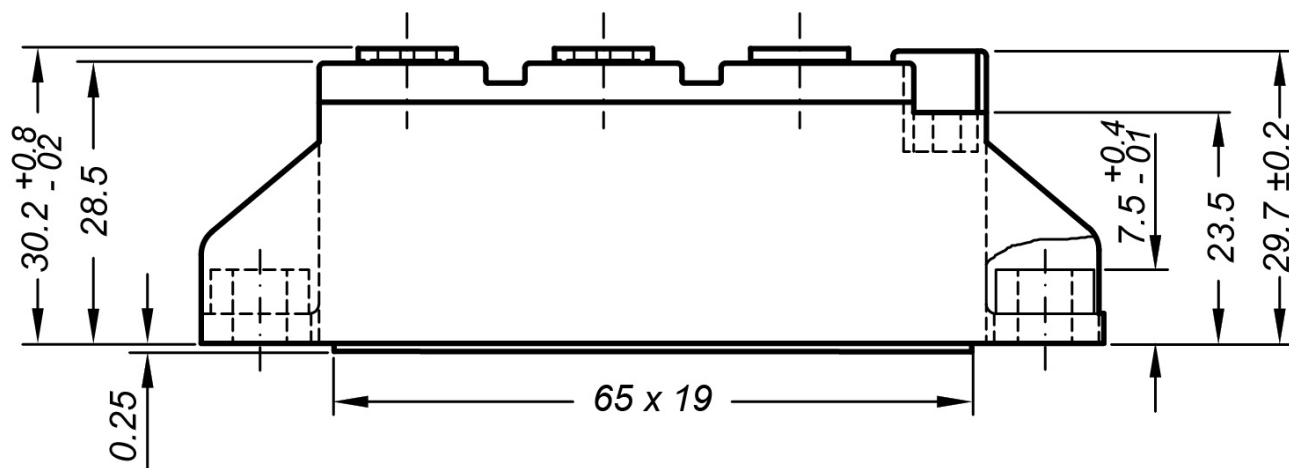
### Equivalent Circuits for Simulation

\* on die level

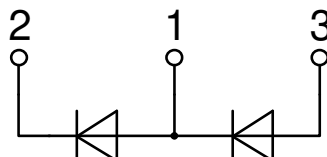
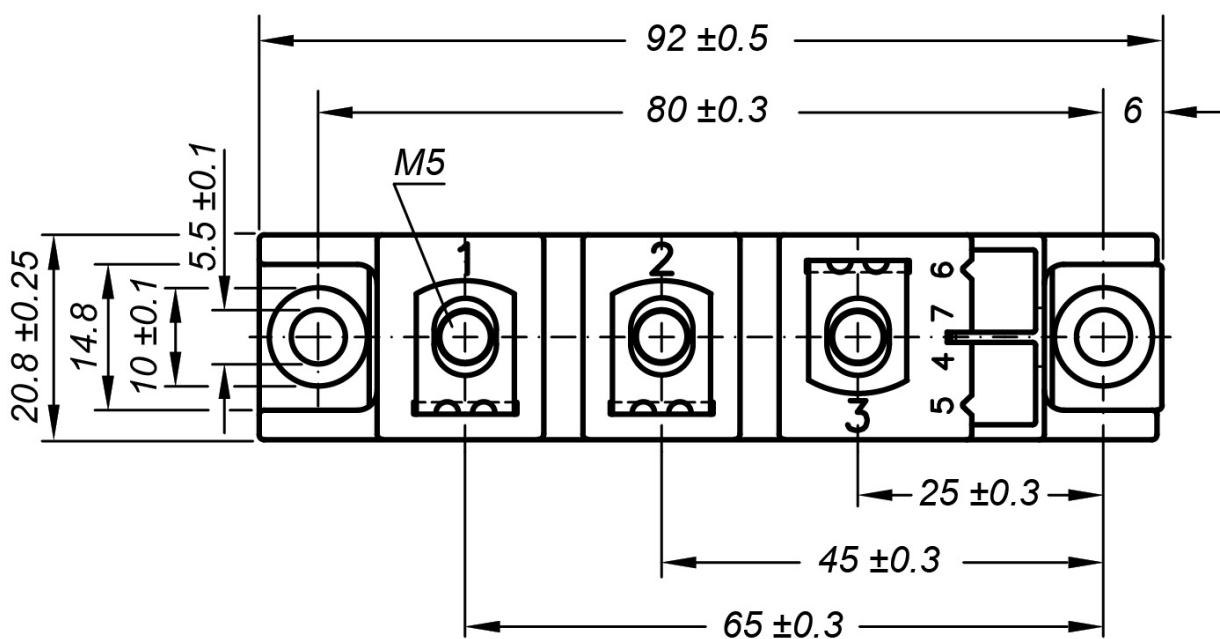
$T_{VJ} = 150^{\circ}\text{C}$

|                                                                                     |                    |                  |    |
|-------------------------------------------------------------------------------------|--------------------|------------------|----|
|  |                    | <b>Rectifier</b> |    |
| $V_{0\max}$                                                                         | threshold voltage  | 0.75             | V  |
| $R_{0\max}$                                                                         | slope resistance * | 0.76             | mΩ |

Outlines TO-240AA



General tolerance: DIN ISO 2768 class „c“



**Rectifier**

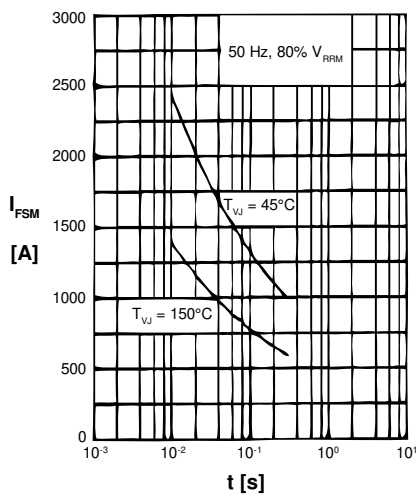


Fig. 1 Surge overload current  
 $I_{TSM}$ ,  $I_{FSM}$ : Crest value,  $t$ : duration

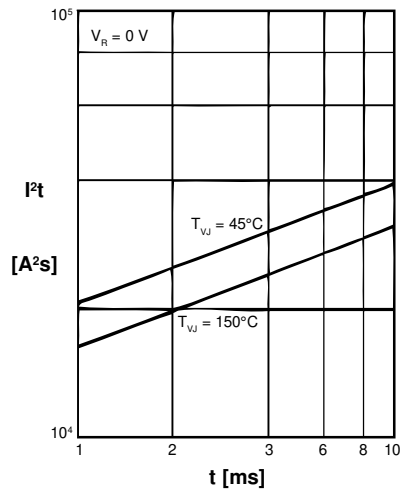


Fig. 2  $I^2t$  versus time (1-10 ms)

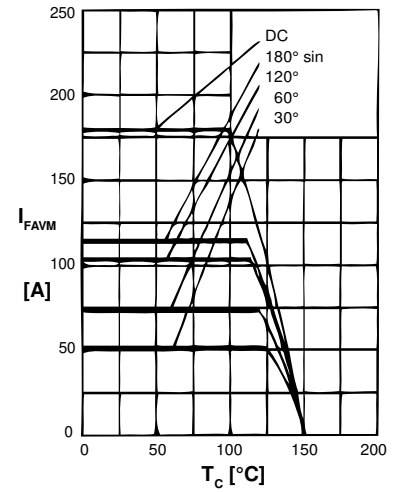


Fig. 3 Maximum forward current at case temperature

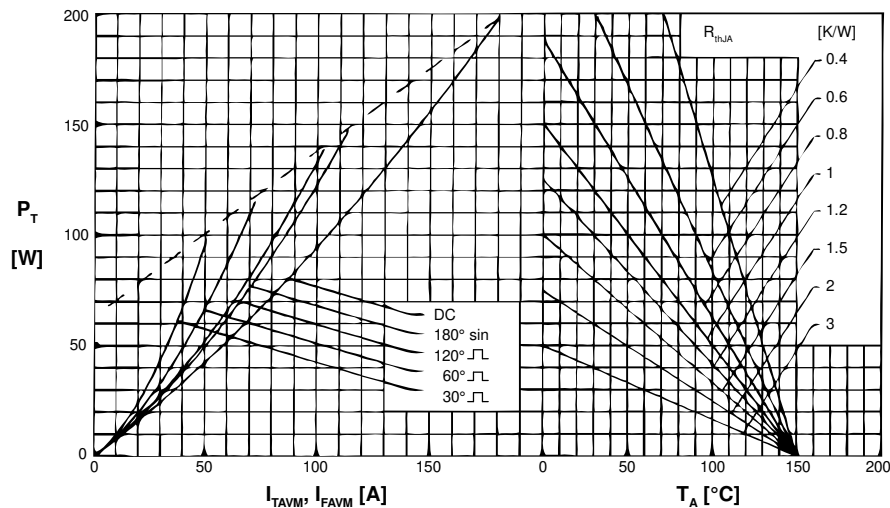


Fig. 4 Power dissipation vs. onstate current and ambient temperature (per diode)

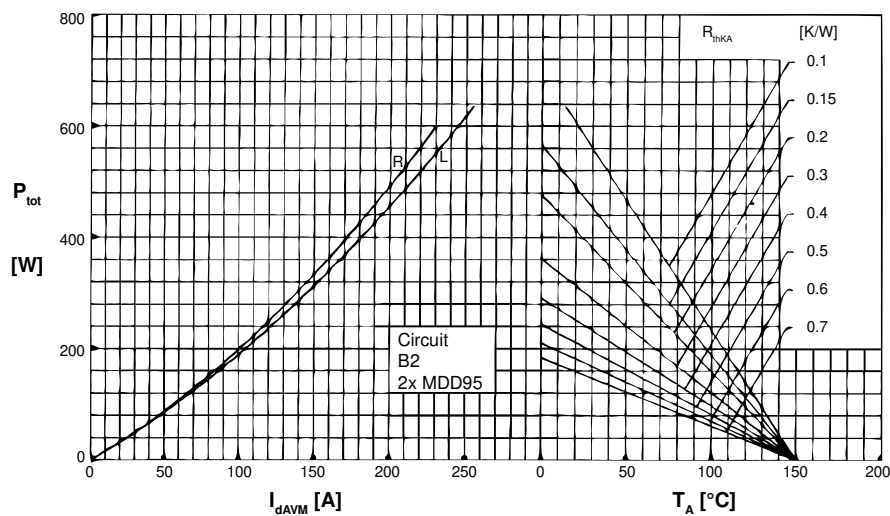


Fig. 6 Single phase rectifier bridge: Power dissipation versus direct output current and ambient temperature; R = resistive load, L = inductive load

## Rectifier

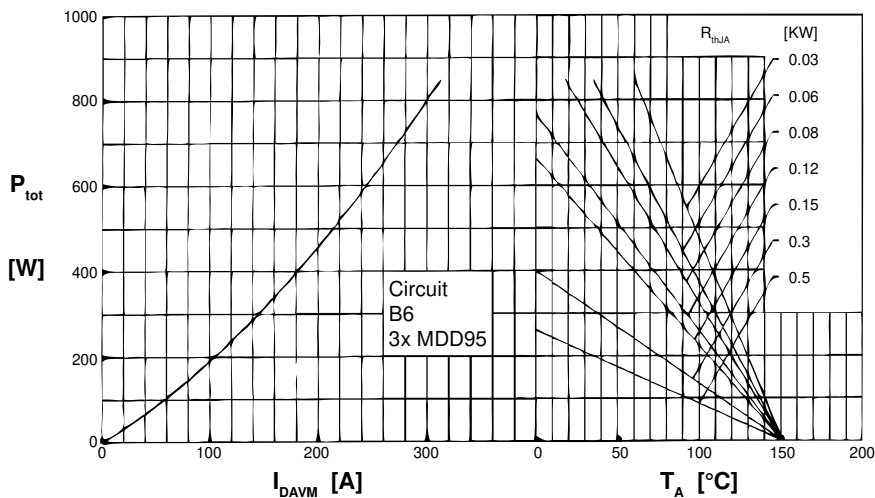


Fig. 6 Three phase rectifier bridge: Power dissipation versus direct output current and ambient temperature

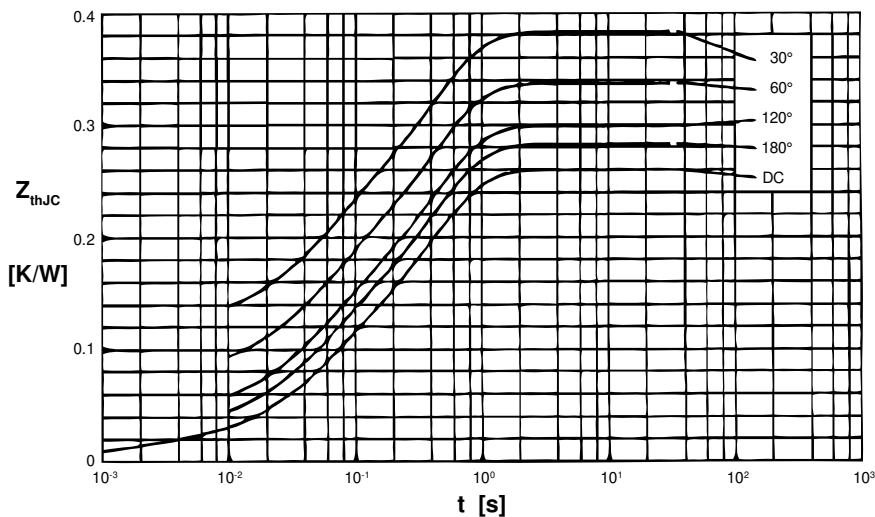


Fig. 7 Transient thermal impedance junction to case (per diode)

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

| d    | $R_{thJC}$ [K/W] |
|------|------------------|
| DC   | 0.26             |
| 180° | 0.28             |
| 120° | 0.30             |
| 60°  | 0.34             |
| 30°  | 0.38             |

Constants for  $Z_{thJC}$  calculation:

| i | $R_{thi}$ [K/W] | $t_i$ [s] |
|---|-----------------|-----------|
| 1 | 0.013           | 0.0012    |
| 2 | 0.072           | 0.0470    |
| 3 | 0.175           | 0.3940    |

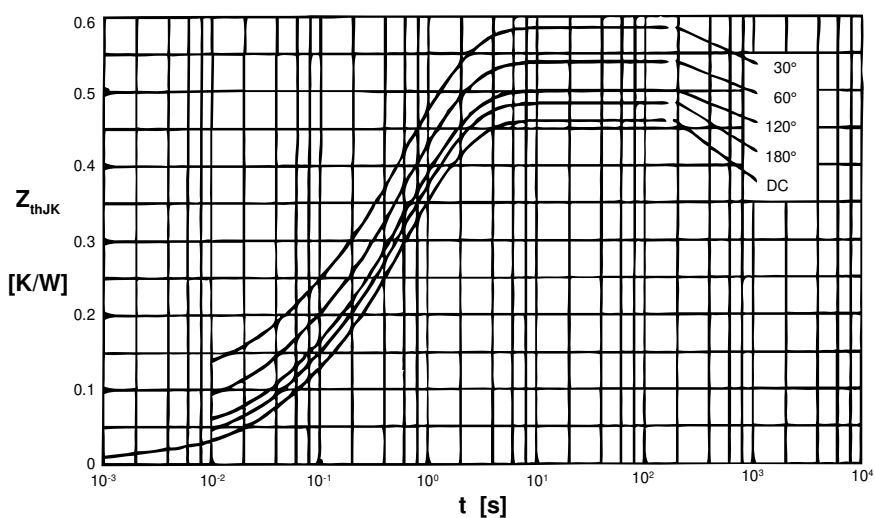


Fig. 8 Transient thermal impedance junction to heatsink (per thyristor)

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

| d    | $R_{thJK}$ [K/W] |
|------|------------------|
| DC   | 0.46             |
| 180° | 0.48             |
| 120° | 0.50             |
| 60°  | 0.54             |
| 30°  | 0.58             |

Constants for  $Z_{thJK}$  calculation:

| i | $R_{thi}$ [K/W] | $t_i$ [s] |
|---|-----------------|-----------|
| 1 | 0.013           | 0.0012    |
| 2 | 0.072           | 0.0470    |
| 3 | 0.175           | 0.3940    |
| 4 | 0.200           | 1.3200    |

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