

# High Voltage Standard Rectifier Module

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

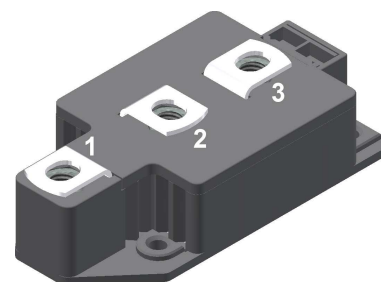
$$I_{FAV} = 300 \text{ A}$$

$$V_F = 1 \text{ V}$$

Phase leg

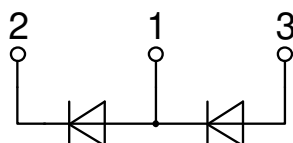
Part number

**MDD310-22N1**



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: Y2

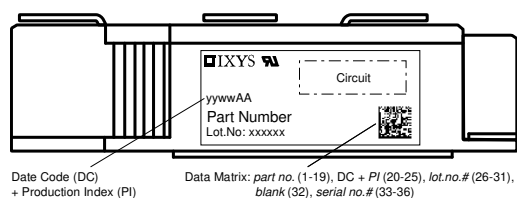
- Isolation Voltage: 3600 V~
- Industry standard outline
- RoHS compliant
- Height: 30 mm
- Base plate: DCB ceramic
- Reduced weight
- Advanced power cycling

## 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                              | $V_R = 2200\text{ V}$                   | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 1     | mA   |
|              |                                              | $V_R = 2200\text{ V}$                   | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 20    | mA   |
| $V_F$        | forward voltage drop                         | $I_F = 300\text{ A}$                    | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 1.13  | V    |
|              |                                              | $I_F = 600\text{ A}$                    |                                |         |      | 1.33  | V    |
|              |                                              | $I_F = 300\text{ A}$                    | $T_{VJ} = 125^{\circ}\text{C}$ |         |      | 1.00  | V    |
|              |                                              | $I_F = 600\text{ A}$                    |                                |         |      | 1.29  | V    |
| $I_{FAV}$    | average forward current                      | $T_C = 100^{\circ}\text{C}$             | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 300   | A    |
| $I_{F(RMS)}$ | RMS forward current                          | 180° sine                               |                                |         |      | 480   | A    |
| $V_{F0}$     | threshold voltage                            | } for power loss calculation only       | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 0.75  | V    |
| $r_F$        | slope resistance                             |                                         |                                |         |      | 0.63  | mΩ   |
| $R_{thJC}$   | thermal resistance junction to case          |                                         |                                |         |      | 0.13  | K/W  |
| $R_{thCH}$   | thermal resistance case to heatsink          |                                         |                                |         | 0.04 |       | K/W  |
| $P_{tot}$    | total power dissipation                      |                                         | $T_C = 25^{\circ}\text{C}$     |         |      | 960   | W    |
| $I_{FSM}$    | max. forward surge current                   | $t = 10\text{ ms; (50 Hz), sine}$       | $T_{VJ} = 45^{\circ}\text{C}$  |         |      | 11.5  | kA   |
|              |                                              | $t = 8,3\text{ ms; (60 Hz), sine}$      | $V_R = 0\text{ V}$             |         |      | 12.4  | kA   |
|              |                                              | $t = 10\text{ ms; (50 Hz), sine}$       | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 9.78  | kA   |
|              |                                              | $t = 8,3\text{ ms; (60 Hz), sine}$      | $V_R = 0\text{ V}$             |         |      | 10.6  | kA   |
| $I^2t$       | value for fusing                             | $t = 10\text{ ms; (50 Hz), sine}$       | $T_{VJ} = 45^{\circ}\text{C}$  |         |      | 661.3 | kA²s |
|              |                                              | $t = 8,3\text{ ms; (60 Hz), sine}$      | $V_R = 0\text{ V}$             |         |      | 641.7 | kA²s |
|              |                                              | $t = 10\text{ ms; (50 Hz), sine}$       | $T_{VJ} = 150^{\circ}\text{C}$ |         |      | 477.8 | kA²s |
|              |                                              | $t = 8,3\text{ ms; (60 Hz), sine}$      | $V_R = 0\text{ V}$             |         |      | 463.5 | kA²s |
| $C_J$        | junction capacitance                         | $V_R = 700\text{ V; } f = 1\text{ MHz}$ | $T_{VJ} = 25^{\circ}\text{C}$  |         | 288  |       | pF   |

| Package Y2    |                                                              |                      | Ratings |      |      |      |
|---------------|--------------------------------------------------------------|----------------------|---------|------|------|------|
| Symbol        | Definition                                                   | Conditions           | min.    | typ. | max. | Unit |
| $I_{RMS}$     | RMS current                                                  | per terminal         |         |      | 600  | 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> |                                                              |                      |         | 254  |      | g    |
| $M_D$         | mounting torque                                              |                      | 2.5     |      | 5    | Nm   |
| $M_T$         | terminal torque                                              |                      | 12      |      | 15   | Nm   |
| $d_{Spp/App}$ | creepage distance on surface   striking distance through air | terminal to terminal | 13.0    |      |      | mm   |
| $d_{Spb/Apb}$ |                                                              | terminal to backside | 13.0    |      |      | mm   |
| $V_{ISOL}$    | isolation voltage                                            | t = 1 second         | 3600    |      |      | V    |
|               |                                                              | t = 1 minute         | 3000    |      |      | V    |

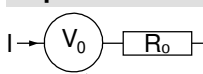


| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|---------------|----------|----------|
| Standard | MDD310-22N1     | MDD310-22N1        | Box           | 2        | 470082   |

### Equivalent Circuits for Simulation

\* on die level

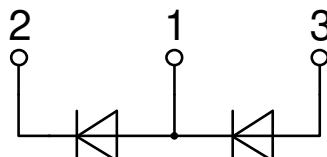
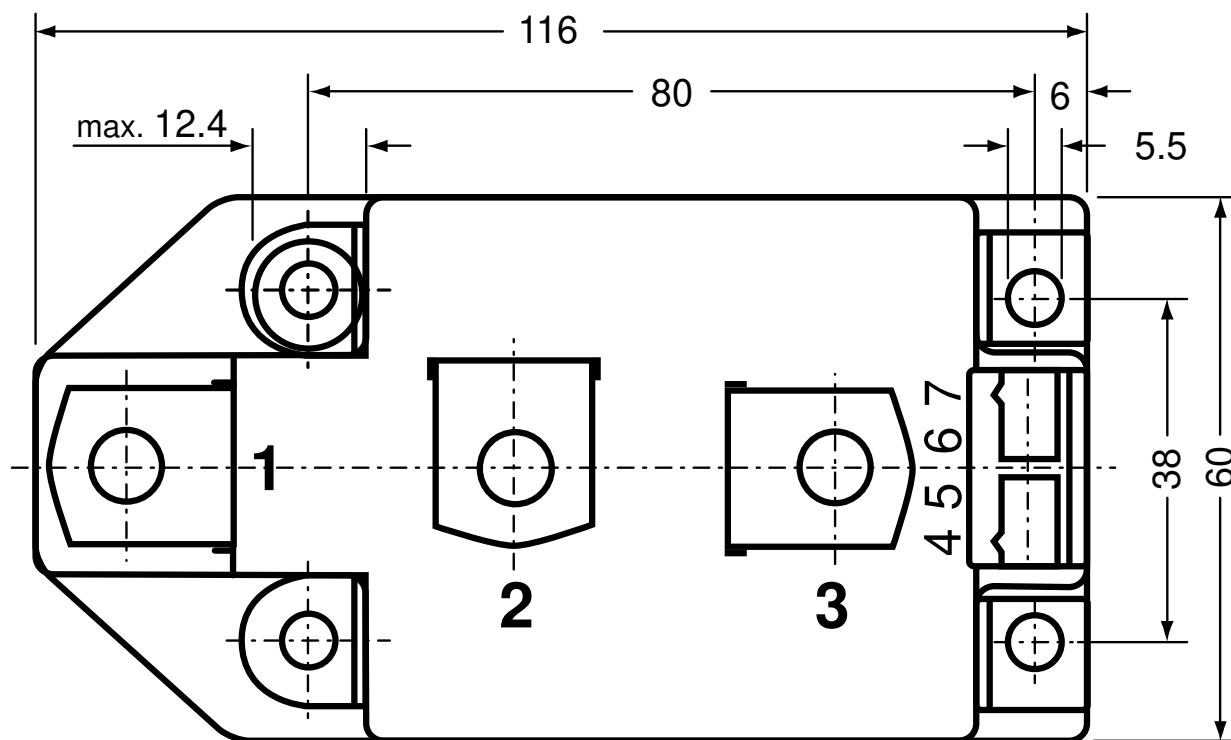
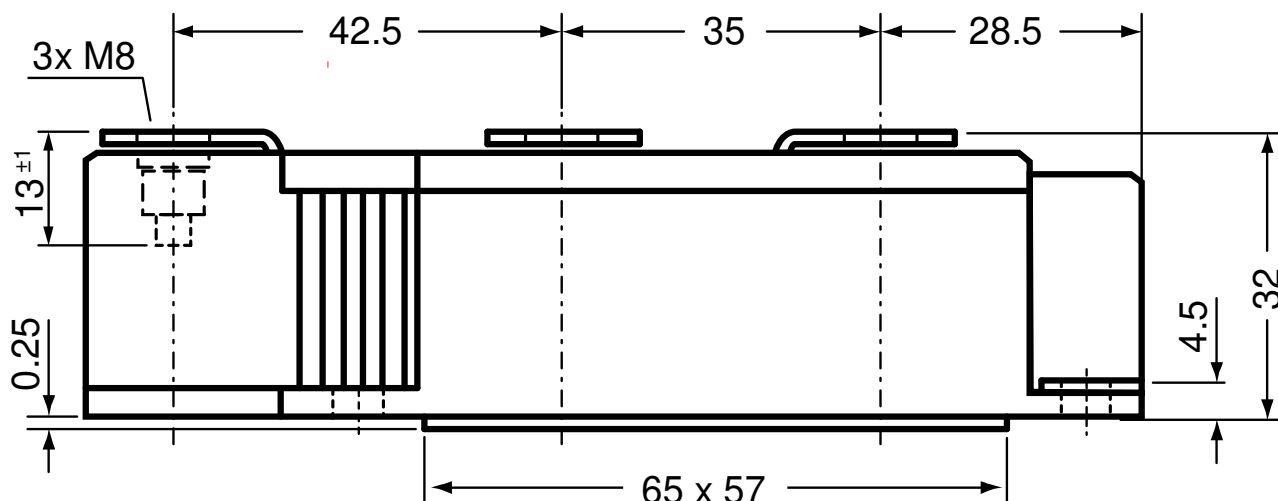
$T_{VJ} = 150^{\circ}\text{C}$



**Rectifier**

|             |                    |      |    |
|-------------|--------------------|------|----|
| $V_{0\max}$ | threshold voltage  | 0.75 | V  |
| $R_{0\max}$ | slope resistance * | 0.34 | mΩ |

**Outlines Y2**



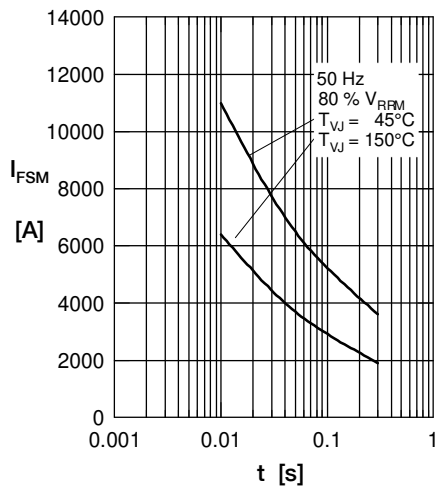
**Rectifier**


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

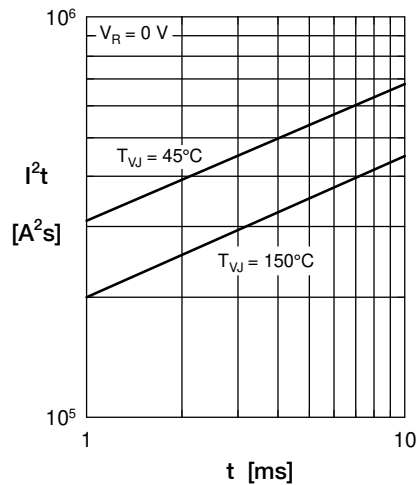


Fig. 2  $I^2t$  versus time (1-10 ms)

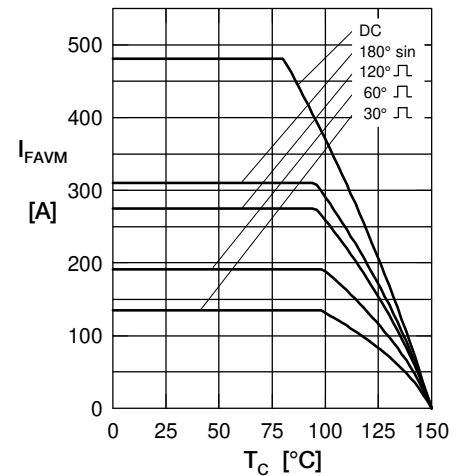


Fig. 3 Maximum forward current  
 at case temperature

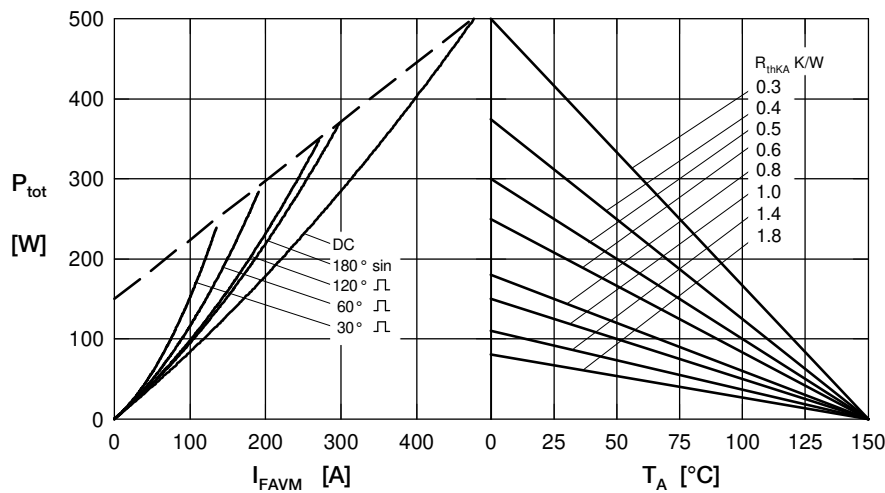


Fig. 4 Power dissipation versus forward current  
 and ambient temperature (per diode)

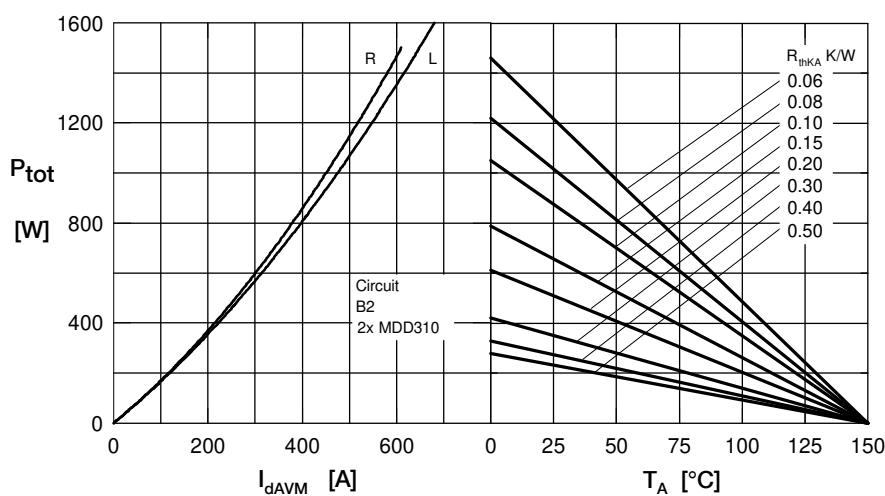


Fig. 5 Single phase rectifier bridge: Power dissipation vs. direct output current  
 and ambient temperature  $R$  = resistive load,  $L$  = inductive load

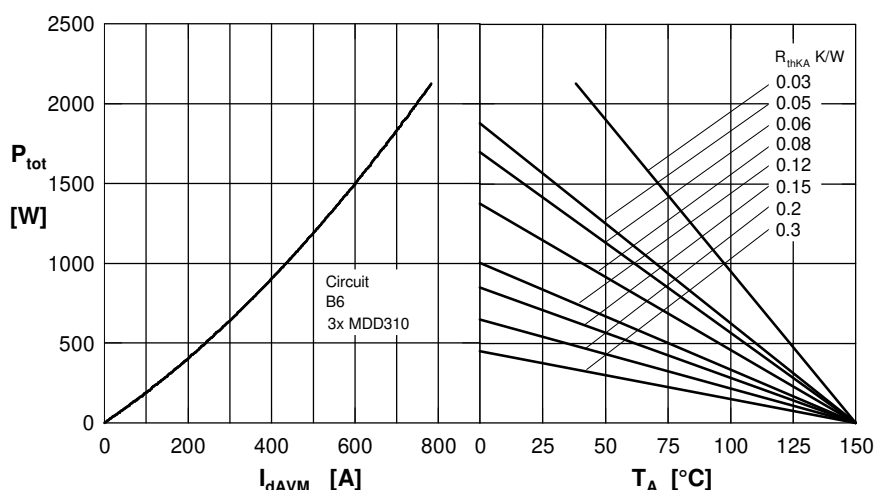
**Rectifier**


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

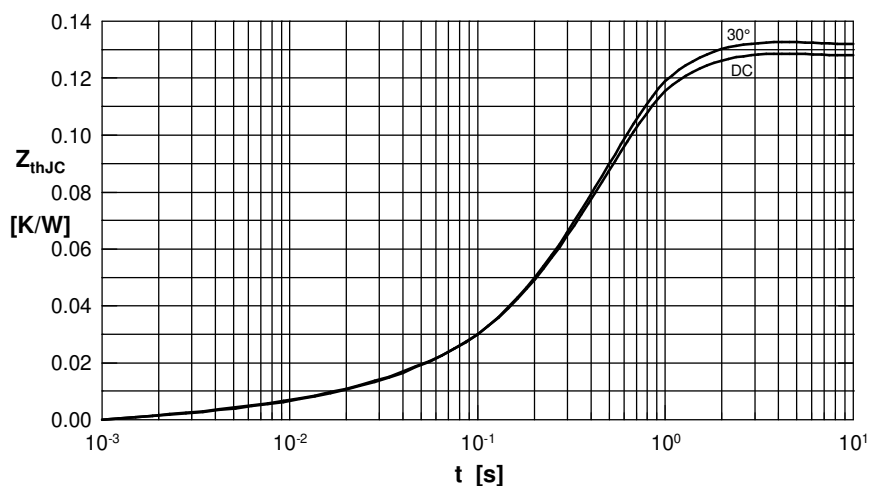


Fig. 7 Transient thermal impedance junction to case (per diode)

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

| $d$  | $R_{thJC}$ [K/W] |
|------|------------------|
| DC   | 0.129            |
| 180° | 0.131            |
| 120° | 0.132            |
| 60°  | 0.132            |
| 30°  | 0.133            |

Constants for  $Z_{thJC}$  calculation:

| $i$ | $R_{thi}$ [K/W] | $t_i$ [s] |
|-----|-----------------|-----------|
| 1   | 0.0035          | 0.0099    |
| 2   | 0.0165          | 0.1680    |
| 3   | 0.1091          | 0.4560    |

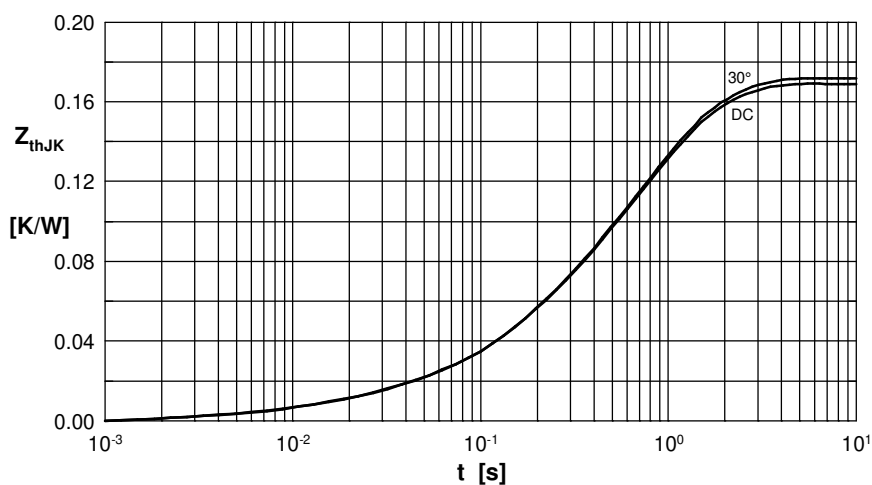


Fig. 8 Transient thermal impedance junction to heatsink (per diode)

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

| $d$  | $R_{thJK}$ [K/W] |
|------|------------------|
| DC   | 0.169            |
| 180° | 0.171            |
| 120° | 0.172            |
| 60°  | 0.172            |
| 30°  | 0.173            |

Constants for  $Z_{thJK}$  calculation:

| $i$ | $R_{thi}$ (K/W) | $t_i$ (s) |
|-----|-----------------|-----------|
| 1   | 0.0035          | 0.0099    |
| 2   | 0.0165          | 0.1680    |
| 3   | 0.1091          | 0.4560    |
| 4   | 0.0400          | 1.3600    |