

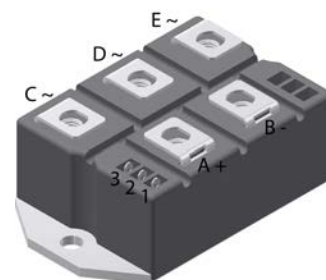
# Thyristor Module

| 3~<br>Rectifier           |
|---------------------------|
| $V_{RRM} = 1600\text{ V}$ |
| $I_{DAV} = 170\text{ A}$  |
| $I_{FSM} = 1500\text{ A}$ |

3~ Rectifier Bridge, half-controlled (high-side)

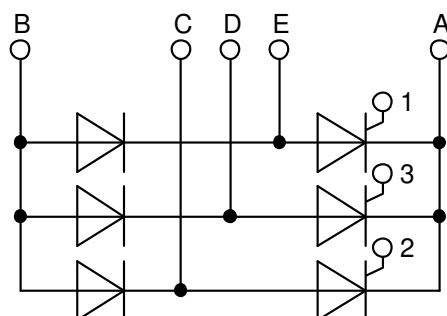
Part number

**VVZ175-16io7**



Backside: isolated

 E72873



## Features / Advantages:

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

## Applications:

- Line rectifying 50/60 Hz
- Drives
- SMPS
- UPS

## Package: PWS-E

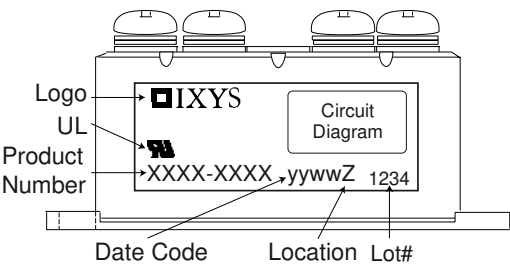
- Isolation Voltage: 3000 V~
- Industry standard outline
- RoHS compliant
- Easy to mount with two screws
- Base plate: Copper internally DCB isolated
- Advanced power cycling

## Disclaimer Notice

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| Rectifier      |                                                             |                                                                                                                                                                        |                                | Ratings |      |      |                   |
|----------------|-------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------|------|------|-------------------|
| Symbol         | Definition                                                  | Conditions                                                                                                                                                             |                                | min.    | typ. | max. | Unit              |
| $V_{RSM/DSM}$  | <b>max. non-repetitive reverse/forward blocking voltage</b> | $T_{VJ} = 25^{\circ}\text{C}$                                                                                                                                          |                                |         |      | 1700 | V                 |
| $V_{RRM/DRM}$  | <b>max. repetitive reverse/forward blocking voltage</b>     | $T_{VJ} = 25^{\circ}\text{C}$                                                                                                                                          |                                |         |      | 1600 | V                 |
| $I_{R/D}$      | <b>reverse current, drain current</b>                       | $V_{R/D} = 1600\text{ V}$                                                                                                                                              | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 300  | $\mu\text{A}$     |
|                |                                                             | $V_{R/D} = 1600\text{ V}$                                                                                                                                              | $T_{VJ} = 125^{\circ}\text{C}$ |         |      | 5    | mA                |
| $V_T$          | <b>forward voltage drop</b>                                 | $I_T = 60\text{ A}$                                                                                                                                                    | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 1,09 | V                 |
|                |                                                             | $I_T = 180\text{ A}$                                                                                                                                                   |                                |         |      | 1,42 | V                 |
|                |                                                             | $I_T = 60\text{ A}$                                                                                                                                                    | $T_{VJ} = 125^{\circ}\text{C}$ |         |      | 1,03 | V                 |
|                |                                                             | $I_T = 180\text{ A}$                                                                                                                                                   |                                |         |      | 1,44 | V                 |
| $I_{DAV}$      | <b>bridge output current</b>                                | $T_C = 85^{\circ}\text{C}$<br>rectangular $d = \frac{1}{3}$                                                                                                            | $T_{VJ} = 125^{\circ}\text{C}$ |         |      | 170  | A                 |
| $V_{T0}$       | <b>threshold voltage</b>                                    | } <b>for power loss calculation only</b>                                                                                                                               | $T_{VJ} = 125^{\circ}\text{C}$ |         |      | 0,82 | V                 |
| $r_T$          | <b>slope resistance</b>                                     |                                                                                                                                                                        |                                |         |      | 3,5  | m $\Omega$        |
| $R_{thJC}$     | <b>thermal resistance junction to case</b>                  |                                                                                                                                                                        |                                |         |      | 0,46 | K/W               |
| $R_{thCH}$     | <b>thermal resistance case to heatsink</b>                  |                                                                                                                                                                        |                                |         | 0,09 |      | K/W               |
| $P_{tot}$      | <b>total power dissipation</b>                              |                                                                                                                                                                        | $T_C = 25^{\circ}\text{C}$     |         |      | 220  | W                 |
| $I_{TSM}$      | <b>max. forward surge current</b>                           | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$                                                                                                                       | $T_{VJ} = 45^{\circ}\text{C}$  |         |      | 1,50 | kA                |
|                |                                                             | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$                                                                                                                      | $V_R = 0\text{ V}$             |         |      | 1,62 | kA                |
|                |                                                             | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$                                                                                                                       | $T_{VJ} = 125^{\circ}\text{C}$ |         |      | 1,28 | kA                |
|                |                                                             | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$                                                                                                                      | $V_R = 0\text{ V}$             |         |      | 1,38 | kA                |
| $I^2t$         | <b>value for fusing</b>                                     | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$                                                                                                                       | $T_{VJ} = 45^{\circ}\text{C}$  |         |      | 11,3 | kA <sup>2</sup> s |
|                |                                                             | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$                                                                                                                      | $V_R = 0\text{ V}$             |         |      | 10,9 | kA <sup>2</sup> s |
|                |                                                             | $t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$                                                                                                                       | $T_{VJ} = 125^{\circ}\text{C}$ |         |      | 8,13 | kA <sup>2</sup> s |
|                |                                                             | $t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$                                                                                                                      | $V_R = 0\text{ V}$             |         |      | 7,87 | kA <sup>2</sup> s |
| $C_J$          | <b>junction capacitance</b>                                 | $V_R = 400\text{ V}$ $f = 1\text{ MHz}$                                                                                                                                | $T_{VJ} = 25^{\circ}\text{C}$  |         | 95   |      | pF                |
| $P_{GM}$       | <b>max. gate power dissipation</b>                          | $t_p = 30\text{ }\mu\text{s}$                                                                                                                                          | $T_C = 125^{\circ}\text{C}$    |         |      | 10   | W                 |
|                |                                                             | $t_p = 300\text{ }\mu\text{s}$                                                                                                                                         |                                |         |      | 1    | W                 |
| $P_{GAV}$      | <b>average gate power dissipation</b>                       |                                                                                                                                                                        |                                |         |      | 0,5  | W                 |
| $(di/dt)_{cr}$ | <b>critical rate of rise of current</b>                     | $T_{VJ} = 125^{\circ}\text{C}; f = 50\text{ Hz}$ repetitive, $I_T = 180\text{ A}$                                                                                      |                                |         |      | 150  | A/ $\mu\text{s}$  |
|                |                                                             | $t_p = 200\text{ }\mu\text{s}; di_G/dt = 0,3\text{ A}/\mu\text{s};$<br>$I_G = 0,3\text{ A}; V_D = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 60\text{ A}$                 |                                |         |      | 500  | A/ $\mu\text{s}$  |
| $(dv/dt)_{cr}$ | <b>critical rate of rise of voltage</b>                     | $V_D = \frac{2}{3} V_{DRM}$<br>$R_{GK} = \infty$ ; method 1 (linear voltage rise)                                                                                      | $T_{VJ} = 125^{\circ}\text{C}$ |         |      | 1000 | V/ $\mu\text{s}$  |
| $V_{GT}$       | <b>gate trigger voltage</b>                                 | $V_D = 6\text{ V}$                                                                                                                                                     | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 1,5  | V                 |
|                |                                                             |                                                                                                                                                                        | $T_{VJ} = -40^{\circ}\text{C}$ |         |      | 1,6  | V                 |
| $I_{GT}$       | <b>gate trigger current</b>                                 | $V_D = 6\text{ V}$                                                                                                                                                     | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 100  | mA                |
|                |                                                             |                                                                                                                                                                        | $T_{VJ} = -40^{\circ}\text{C}$ |         |      | 200  | mA                |
| $V_{GD}$       | <b>gate non-trigger voltage</b>                             | $V_D = \frac{2}{3} V_{DRM}$                                                                                                                                            | $T_{VJ} = 125^{\circ}\text{C}$ |         |      | 0,2  | V                 |
| $I_{GD}$       | <b>gate non-trigger current</b>                             |                                                                                                                                                                        |                                |         |      | 5    | mA                |
| $I_L$          | <b>latching current</b>                                     | $t_p = 30\text{ }\mu\text{s}$                                                                                                                                          | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 450  | mA                |
|                |                                                             | $I_G = 0,3\text{ A}; di_G/dt = 0,3\text{ A}/\mu\text{s}$                                                                                                               |                                |         |      |      |                   |
| $I_H$          | <b>holding current</b>                                      | $V_D = 6\text{ V}$ $R_{GK} = \infty$                                                                                                                                   | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 200  | mA                |
| $t_{gd}$       | <b>gate controlled delay time</b>                           | $V_D = \frac{1}{2} V_{DRM}$                                                                                                                                            | $T_{VJ} = 25^{\circ}\text{C}$  |         |      | 2    | $\mu\text{s}$     |
|                |                                                             | $I_G = 0,3\text{ A}; di_G/dt = 0,3\text{ A}/\mu\text{s}$                                                                                                               |                                |         |      |      |                   |
| $t_q$          | <b>turn-off time</b>                                        | $V_R = 100\text{ V}; I_T = 60\text{ A}; V_D = \frac{2}{3} V_{DRM}$<br>$di/dt = 10\text{ A}/\mu\text{s}; dv/dt = 20\text{ V}/\mu\text{s}; t_p = 300\text{ }\mu\text{s}$ | $T_{VJ} = 100^{\circ}\text{C}$ |         | 200  |      | $\mu\text{s}$     |

| Package PWS-E        |                                                                     |                             |                                         | Ratings |      |      |      |
|----------------------|---------------------------------------------------------------------|-----------------------------|-----------------------------------------|---------|------|------|------|
| Symbol               | Definition                                                          | Conditions                  |                                         | min.    | typ. | max. | Unit |
| I <sub>RMS</sub>     | <i>RMS current</i>                                                  | per terminal                |                                         |         |      | 250  | A    |
| T <sub>VJ</sub>      | <i>virtual junction temperature</i>                                 |                             |                                         | -40     |      | 125  | °C   |
| T <sub>op</sub>      | <i>operation temperature</i>                                        |                             |                                         | -40     |      | 100  | °C   |
| T <sub>stg</sub>     | <i>storage temperature</i>                                          |                             |                                         | -40     |      | 125  | °C   |
| Weight               |                                                                     |                             |                                         |         | 284  |      | g    |
| M <sub>D</sub>       | <i>mounting torque</i>                                              |                             |                                         | 4,25    |      | 5,75 | Nm   |
| M <sub>T</sub>       | <i>terminal torque</i>                                              |                             |                                         | 4,25    |      | 5,75 | Nm   |
| d <sub>Spp/App</sub> | <i>creepage distance on surface   striking distance through air</i> | <i>terminal to terminal</i> |                                         | 12,0    |      |      | mm   |
| d <sub>Spb/Apb</sub> |                                                                     | <i>terminal to backside</i> |                                         | 26,0    |      |      | mm   |
| V <sub>ISOL</sub>    | <i>isolation voltage</i>                                            | t = 1 second                | 50/60 Hz, RMS; I <sub>ISOL</sub> ≤ 1 mA | 3000    |      |      | V    |
|                      |                                                                     | t = 1 minute                |                                         | 2500    |      |      | V    |

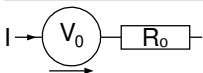


| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|----------|-----------------|--------------------|---------------|----------|----------|
| Standard | VVZ175-16io7    | VVZ175-16io7       | Box           | 5        | 464953   |

Equivalent Circuits for Simulation

\* on die level

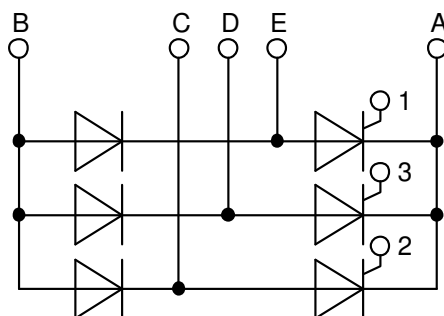
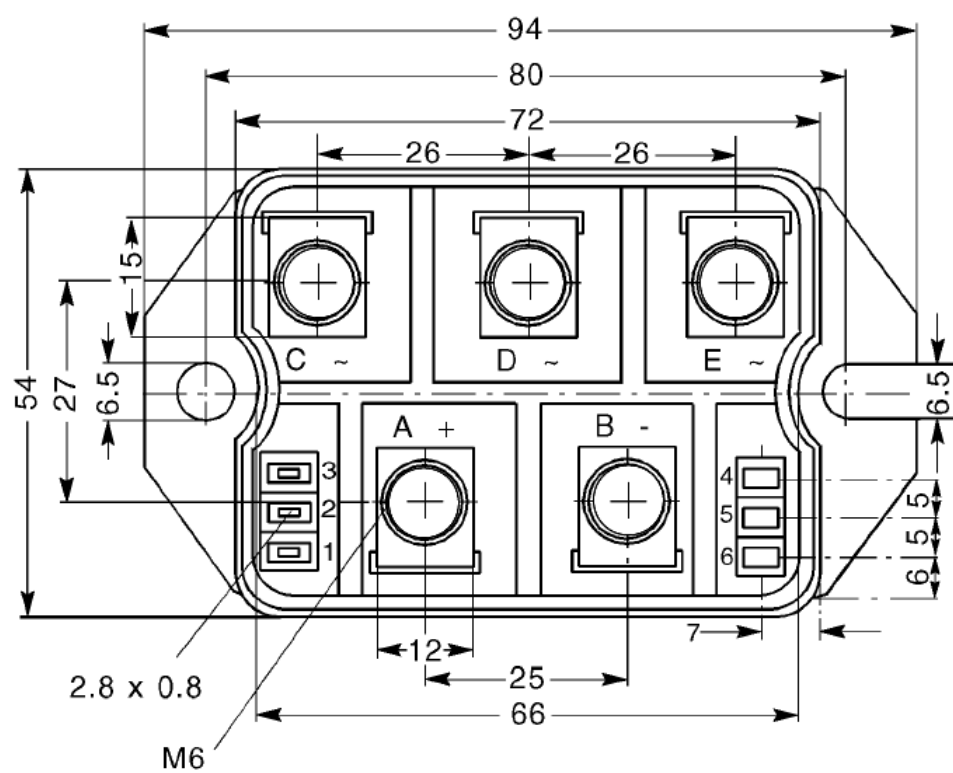
$T_{VJ} = 125^{\circ}\text{C}$



Thyristor

$V_{0\text{ max}}$ 
*threshold voltage*
0,82
V

$R_{0\text{ max}}$ 
*slope resistance \**
2,3
mΩ



## Thyristor

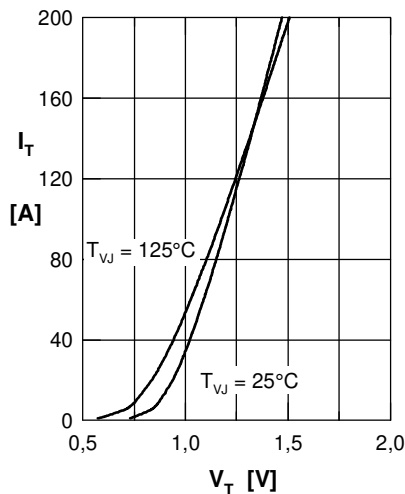


Fig. 1 Forward characteristics

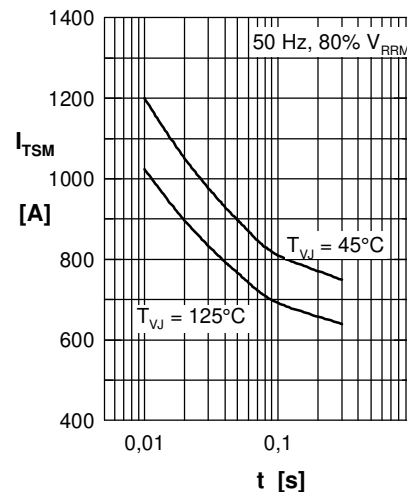


Fig. 2 Surge overload current  
 $I_{TSM}$ : crest value,  $t$ : duration

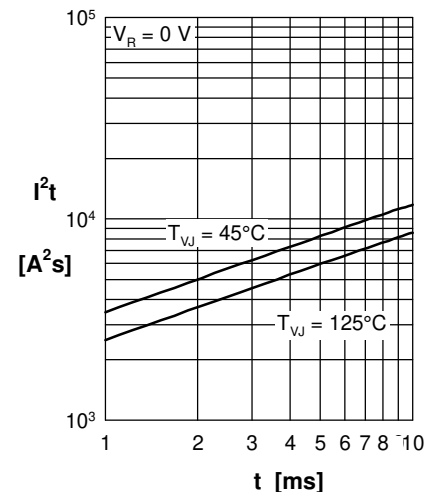


Fig. 3  $I^2t$  versus time (1-10 s)

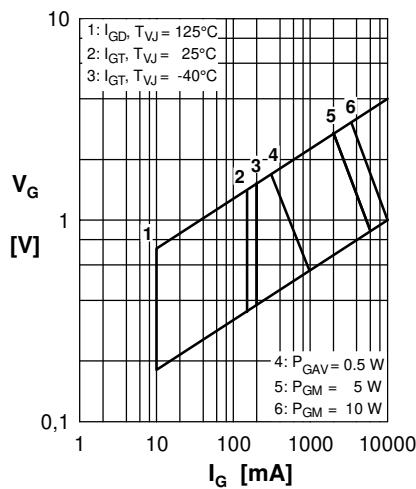


Fig. 4 Gate voltage & gate current

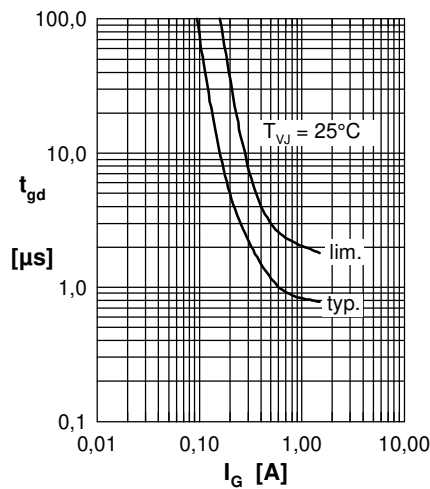


Fig. 5 Gate controlled delay time  $t_{gd}$

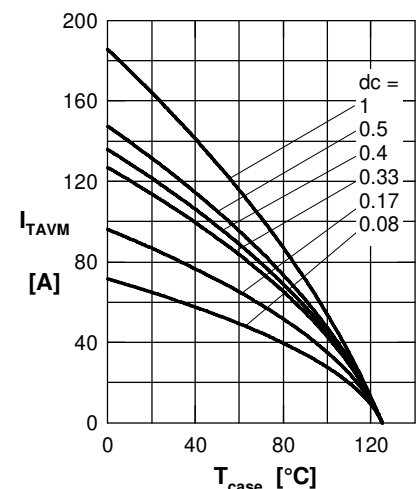


Fig. 6 Max. forward current at case temperature

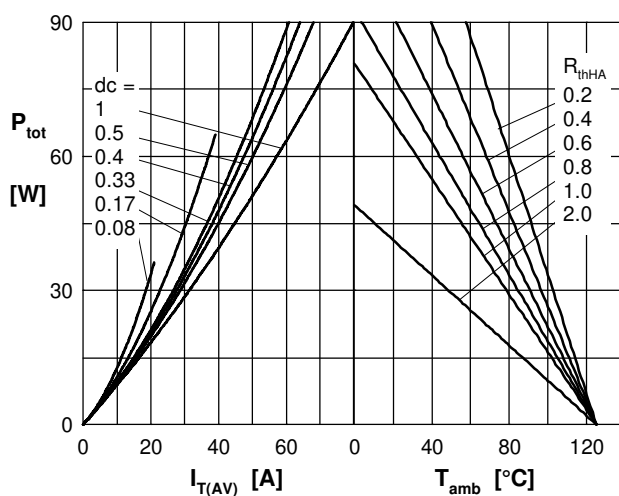


Fig. 7a Power dissipation versus direct output current  
 Fig. 7b and ambient temperature

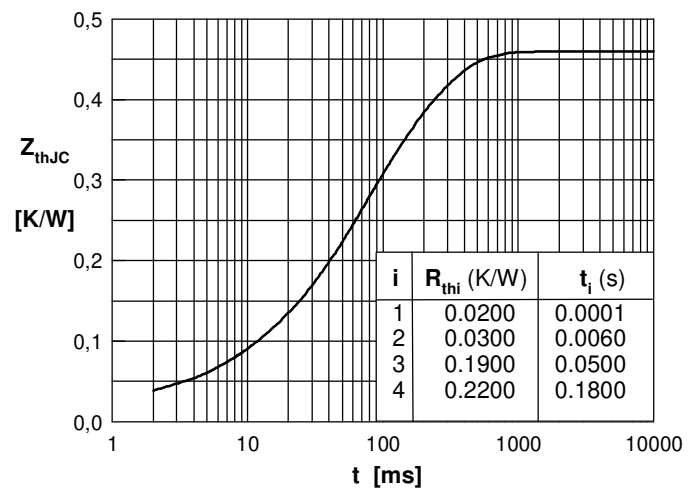


Fig. 8 Transient thermal impedance junction to case