

## Medium Power Thyristors (Stud Version), 10 A



TO-208AA (TO-48)

### FEATURES

- Improved glass passivation for high reliability and exceptional stability at high temperature
- High  $di/dt$  and  $dV/dt$  capabilities
- Standard package
- Low thermal resistance
- Metric threads version available
- Types up to 1200 V  $V_{DRM}/V_{RRM}$
- RoHS compliant
- Designed and qualified for industrial and consumer level



### PRODUCT SUMMARY

|             |      |
|-------------|------|
| $I_{T(AV)}$ | 10 A |
|-------------|------|

### TYPICAL APPLICATIONS

- Medium power switching
- Phase control applications
- Can be supplied to meet stringent military, aerospace and other high reliability requirements

### MAJOR RATINGS AND CHARACTERISTICS

| PARAMETER         | TEST CONDITIONS | VALUES      | UNITS            |
|-------------------|-----------------|-------------|------------------|
| $I_{T(AV)}$       |                 | 10          | A                |
|                   | $T_C$           | 85          | °C               |
| $I_{T(RMS)}$      |                 | 25          | A                |
| $I_{TSM}$         | 50 Hz           | 225         | A                |
|                   | 60 Hz           | 240         |                  |
| $I^2t$            | 50 Hz           | 255         | A <sup>2</sup> s |
|                   | 60 Hz           | 233         |                  |
| $V_{DRM}/V_{RRM}$ |                 | 100 to 1200 | V                |
| $t_q$             | Typical         | 110         | μs               |
| $T_J$             |                 | - 65 to 125 | °C               |

## ELECTRICAL SPECIFICATIONS

| VOLTAGE RATINGS |              |                                                                                       |                                                                     |                                                        |
|-----------------|--------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------|--------------------------------------------------------|
| TYPE NUMBER     | VOLTAGE CODE | $V_{DRM}/V_{RRM}$ , MAXIMUM REPETITIVE PEAK AND OFF-STATE VOLTAGE <sup>(1)</sup><br>V | $V_{RSM}$ , MAXIMUM NON-REPETITIVE PEAK VOLTAGE <sup>(2)</sup><br>V | $I_{DRM}/I_{RRM}$ MAXIMUM AT $T_J = T_J$ MAXIMUM<br>mA |
| 10RIA           | 10           | 100                                                                                   | 150                                                                 | 20                                                     |
|                 | 20           | 200                                                                                   | 300                                                                 | 10                                                     |
|                 | 40           | 400                                                                                   | 500                                                                 |                                                        |
|                 | 60           | 600                                                                                   | 700                                                                 |                                                        |
|                 | 80           | 800                                                                                   | 900                                                                 |                                                        |
|                 | 100          | 1000                                                                                  | 1100                                                                |                                                        |
|                 | 120          | 1200                                                                                  | 1300                                                                |                                                        |

### Notes

<sup>(1)</sup> Units may be broken over non-repetitively in the off-state direction without damage, if  $di/dt$  does not exceed 20 A/ $\mu$ s

<sup>(2)</sup> For voltage pulses with  $t_p \leq 5$  ms

| ABSOLUTE MAXIMUM RATINGS                             |                     |                                                                                                            |                                  |                                                                       |        |                   |
|------------------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------|----------------------------------|-----------------------------------------------------------------------|--------|-------------------|
| PARAMETER                                            | SYMBOL              | TEST CONDITIONS                                                                                            |                                  |                                                                       | VALUES | UNITS             |
| Maximum average on-state current at case temperature | I <sub>T(AV)</sub>  | 180° conduction, half sine wave                                                                            |                                  |                                                                       | 10     | A                 |
|                                                      |                     |                                                                                                            |                                  |                                                                       | 85     | °C                |
| Maximum RMS on-state current                         | I <sub>T(RMS)</sub> |                                                                                                            |                                  |                                                                       | 25     | A                 |
| Maximum peak, one-cycle non-repetitive surge current | I <sub>TSM</sub>    | t = 10 ms                                                                                                  | No voltage reapplied             | Sinusoidal half wave, initial T <sub>J</sub> = T <sub>J</sub> maximum | 225    | A                 |
|                                                      |                     | t = 8.3 ms                                                                                                 |                                  |                                                                       | 240    |                   |
|                                                      |                     | t = 10 ms                                                                                                  | 100 % V <sub>RRM</sub> reapplied |                                                                       | 190    |                   |
|                                                      |                     | t = 8.3 ms                                                                                                 |                                  |                                                                       | 200    |                   |
| Maximum I <sup>2</sup> t for fusing                  | I <sup>2</sup> t    | t = 10 ms                                                                                                  | No voltage reapplied             |                                                                       | 255    | A <sup>2</sup> s  |
|                                                      |                     | t = 8.3 ms                                                                                                 |                                  |                                                                       | 233    |                   |
|                                                      |                     | t = 10 ms                                                                                                  | 100 % V <sub>RRM</sub> reapplied |                                                                       | 180    |                   |
|                                                      |                     | t = 8.3 ms                                                                                                 |                                  |                                                                       | 165    |                   |
| Maximum I <sup>2</sup> √t for fusing                 | I <sup>2</sup> √t   | t = 0.1 to 10 ms, no voltage reapplied                                                                     |                                  |                                                                       | 2550   | A <sup>2</sup> √s |
| Low level value of threshold voltage                 | V <sub>T(TO)1</sub> | (16.7 % × π × I <sub>T(AV)</sub> ) < I < π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum |                                  |                                                                       | 1.10   | V                 |
| High level value of threshold voltage                | V <sub>T(TO)2</sub> | (I > π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum                                     |                                  |                                                                       | 1.39   |                   |
| Low level value of on-state slope resistance         | r <sub>t1</sub>     | (16.7 % × π × I <sub>T(AV)</sub> ) < I < π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum |                                  |                                                                       | 24.3   | mΩ                |
| High level value of on-state slope resistance        | r <sub>t2</sub>     | (I > π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum                                     |                                  |                                                                       | 16.7   |                   |
| Maximum on-state voltage                             | V <sub>TM</sub>     | I <sub>pk</sub> = 32 A, T <sub>J</sub> = 25 °C, t <sub>p</sub> = 10 ms sine pulse                          |                                  |                                                                       | 1.75   | V                 |
| Maximum holding current                              | I <sub>H</sub>      | T <sub>J</sub> = 25 °C, anode supply 12 V resistive load                                                   |                                  |                                                                       | 130    | mA                |
| Typical latching current                             | I <sub>L</sub>      |                                                                                                            |                                  |                                                                       | 200    |                   |

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| <b>SWITCHING</b>                          |                 |                                                                                                                                                                                                                                    |        |       |
|-------------------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------|
| PARAMETER                                 | SYMBOL          | TEST CONDITIONS                                                                                                                                                                                                                    | VALUES | UNITS |
| Maximum rate of rise of turned-on current | di/dt           | T <sub>J</sub> = T <sub>J</sub> maximum, V <sub>DM</sub> = Rated V <sub>DRM</sub><br>Gate pulse = 20 V, 15 Ω, t <sub>p</sub> = 6 μs, t <sub>r</sub> = 0.1 μs maximum<br>I <sub>TM</sub> = (2 x rated di/dt) A                      | 200    | A/μs  |
|                                           |                 |                                                                                                                                                                                                                                    | 180    |       |
|                                           |                 |                                                                                                                                                                                                                                    | 160    |       |
|                                           |                 |                                                                                                                                                                                                                                    | 150    |       |
| Typical turn-on time                      | t <sub>gt</sub> | T <sub>J</sub> = 25 °C,<br>at rated V <sub>DRM</sub> /V <sub>RRM</sub> , T <sub>J</sub> = 125 °C                                                                                                                                   | 0.9    | μs    |
| Typical reverse recovery time             | t <sub>rr</sub> | T <sub>J</sub> = T <sub>J</sub> maximum,<br>I <sub>TM</sub> = I <sub>T(AV)</sub> , t <sub>p</sub> > 200 μs, di/dt = - 10 A/μs                                                                                                      | 4      |       |
| Typical turn-off time                     | t <sub>q</sub>  | T <sub>J</sub> = T <sub>J</sub> maximum, I <sub>TM</sub> = I <sub>T(AV)</sub> , t <sub>p</sub> > 200 μs, V <sub>R</sub> = 100 V,<br>di/dt = - 10 A/μs, dV/dt = 20 V/μs linear to 67 % V <sub>DRM</sub> ,<br>gate bias 0 V to 100 W | 110    |       |

**Note**

- t<sub>q</sub> = 10 μs up to 600 V, t<sub>q</sub> = 30 μs up to 1600 V available on special request

| <b>BLOCKING</b>                                    |        |                                                                                |                    |       |
|----------------------------------------------------|--------|--------------------------------------------------------------------------------|--------------------|-------|
| PARAMETER                                          | SYMBOL | TEST CONDITIONS                                                                | VALUES             | UNITS |
| Maximum critical rate of rise of off-state voltage | dV/dt  | T <sub>J</sub> = T <sub>J</sub> maximum linear to 100 % rated V <sub>DRM</sub> | 100                | V/μs  |
|                                                    |        | T <sub>J</sub> = T <sub>J</sub> maximum linear to 67 % rated V <sub>DRM</sub>  | 300 <sup>(1)</sup> |       |

**Note**

- <sup>(1)</sup> Available with: dV/dt = 1000 V/μs, to complete code add S90 i.e. 10RIA120S90

| <b>TRIGGERING</b>                   |                    |                                                                            |        |       |
|-------------------------------------|--------------------|----------------------------------------------------------------------------|--------|-------|
| PARAMETER                           | SYMBOL             | TEST CONDITIONS                                                            | VALUES | UNITS |
| Maximum peak gate power             | P <sub>GM</sub>    | T <sub>J</sub> = T <sub>J</sub> maximum                                    | 8.0    | W     |
| Maximum average gate power          | P <sub>G(AV)</sub> |                                                                            | 2.0    |       |
| Maximum peak positive gate current  | I <sub>GM</sub>    | T <sub>J</sub> = T <sub>J</sub> maximum                                    | 1.5    | A     |
| Maximum peak negative gate voltage  | -V <sub>GM</sub>   | T <sub>J</sub> = T <sub>J</sub> maximum                                    | 10     | V     |
| DC gate current required to trigger | I <sub>GT</sub>    | T <sub>J</sub> = - 65 °C                                                   | 90     | mA    |
|                                     |                    | T <sub>J</sub> = 25 °C                                                     | 60     |       |
|                                     |                    | T <sub>J</sub> = 125 °C                                                    | 35     |       |
| DC gate voltage required to trigger | V <sub>GT</sub>    | T <sub>J</sub> = - 65 °C                                                   | 3.0    | V     |
|                                     |                    | T <sub>J</sub> = 25 °C                                                     | 2.0    |       |
|                                     |                    | T <sub>J</sub> = 125 °C                                                    | 1.0    |       |
| DC gate current not to trigger      | I <sub>GD</sub>    | T <sub>J</sub> = T <sub>J</sub> maximum, V <sub>DRM</sub> = Rated value    | 2.0    | mA    |
| DC gate voltage not to trigger      | V <sub>GD</sub>    | T <sub>J</sub> = T <sub>J</sub> maximum,<br>V <sub>DRM</sub> = Rated value | 0.2    | V     |

| THERMAL AND MECHANICAL SPECIFICATIONS                    |                |                                                |                  |           |
|----------------------------------------------------------|----------------|------------------------------------------------|------------------|-----------|
| PARAMETER                                                | SYMBOL         | TEST CONDITIONS                                | VALUES           | UNITS     |
| Maximum operating junction and storage temperature range | $T_J, T_{Stg}$ |                                                | - 65 to 125      | °C        |
| Maximum thermal resistance, junction to case             | $R_{thJC}$     | DC operation                                   | 1.85             | K/W       |
| Maximum thermal resistance, case to heatsink             | $R_{thCS}$     | Mounting surface, smooth, flat and greased     | 0.35             |           |
|                                                          |                |                                                | TO NUT           | TO DEVICE |
| Mounting torque                                          |                | Lubricated threads<br>(Non-lubricated threads) | 20 (27.5)        | 25        |
|                                                          |                |                                                | 0.23 (0.32)      | 0.29      |
|                                                          |                |                                                | 2.3 (3.1)        | 2.8       |
| Approximate weight                                       |                |                                                | 14               | g         |
|                                                          |                |                                                | 0.49             | oz.       |
| Case style                                               |                | See dimensions - link at the end of datasheet  | TO-208AA (TO-48) |           |

| $\Delta R_{thJC}$ CONDUCTION |                       |                        |                             |       |
|------------------------------|-----------------------|------------------------|-----------------------------|-------|
| CONDUCTION ANGLE             | SINUSOIDAL CONDUCTION | RECTANGULAR CONDUCTION | TEST CONDITIONS             | UNITS |
| 180°                         | 0.44                  | 0.32                   | $T_J = T_J \text{ maximum}$ | K/W   |
| 120°                         | 0.53                  | 0.56                   |                             |       |
| 90°                          | 0.68                  | 0.75                   |                             |       |
| 60°                          | 1.01                  | 1.05                   |                             |       |
| 30°                          | 1.71                  | 1.73                   |                             |       |

### Note

- The table above shows the increment of thermal resistance  $R_{thJC}$  when devices operate at different conduction angles than DC

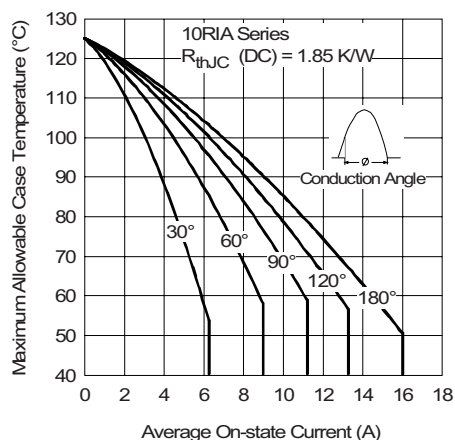


Fig. 1 - Current Ratings Characteristics

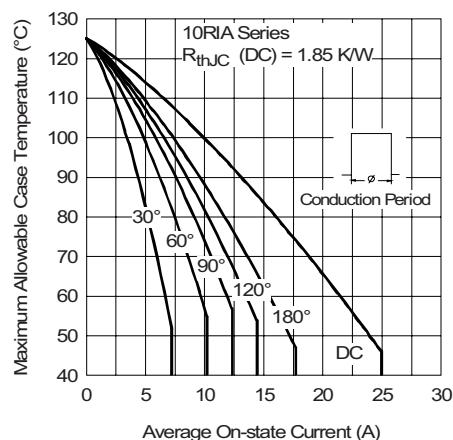


Fig. 2 - Current Ratings Characteristics

## Medium Power Thyristors Vishay High Power Products (Stud Version), 10 A

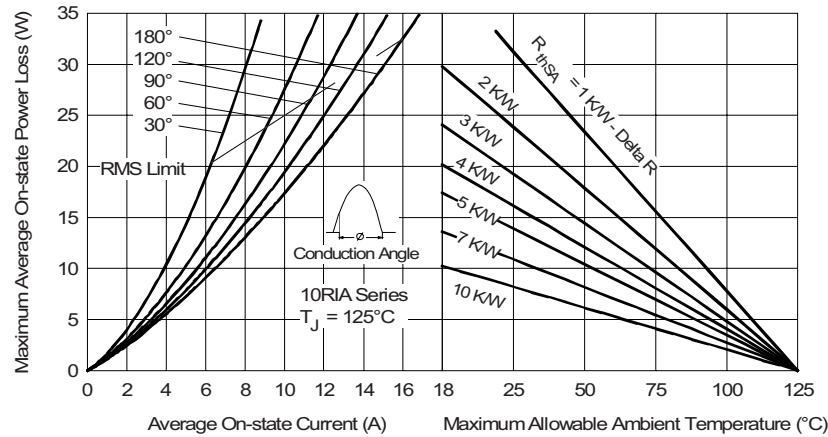


Fig. 3 - On-State Power Loss Characteristics

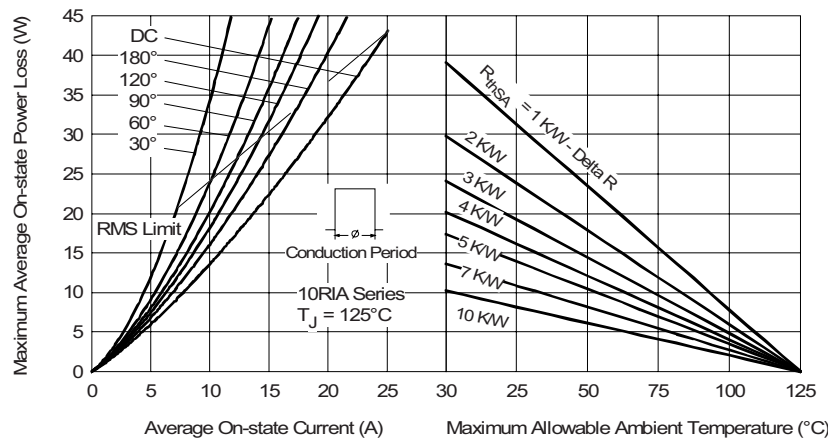


Fig. 4 - On-State Power Loss Characteristics

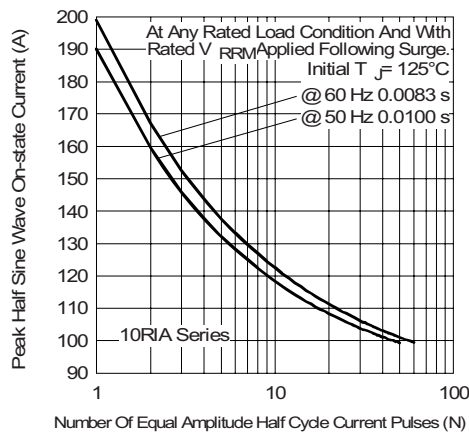


Fig. 5 - Maximum Non-Repetitive Surge Current

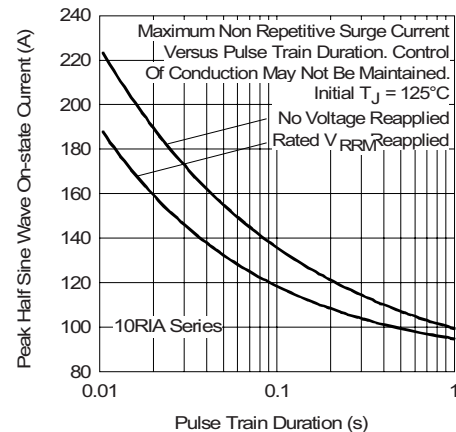


Fig. 6 - Maximum Non-Repetitive Surge Current

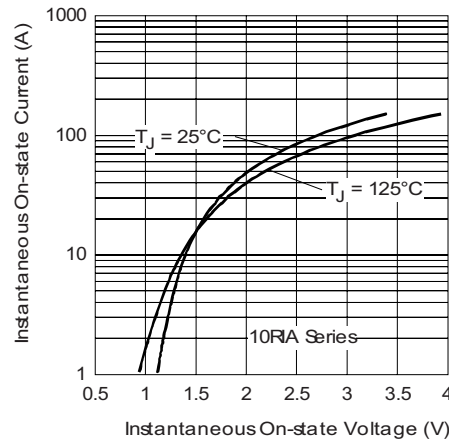


Fig. 7 - Forward Voltage Drop Characteristics

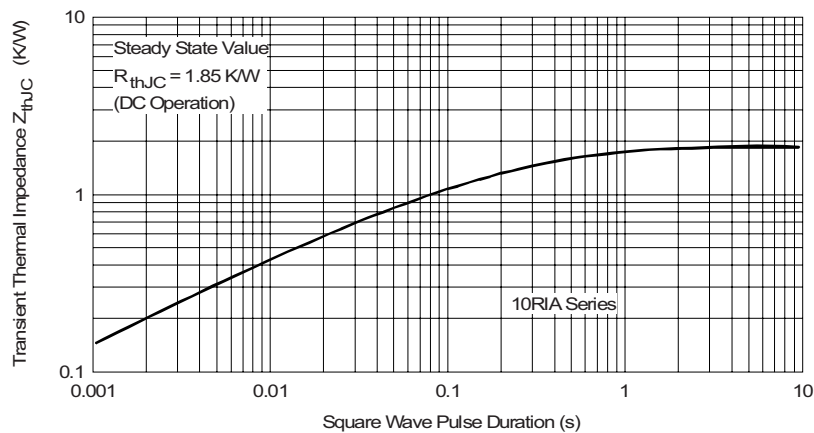


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristics

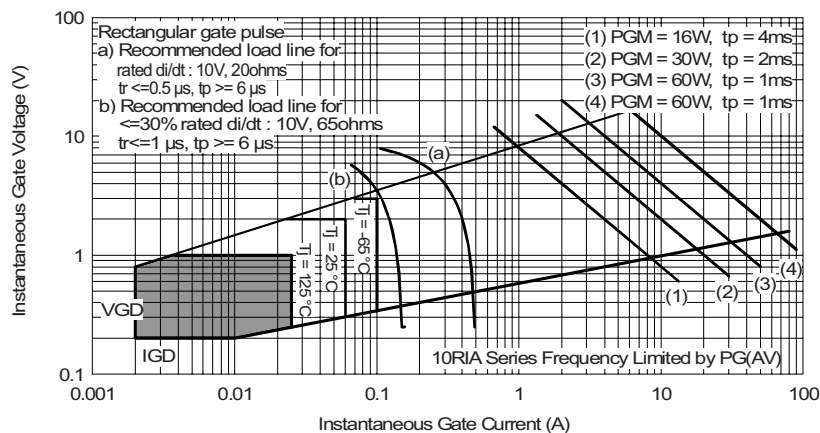


Fig. 9 - Gate Characteristics



### ORDERING INFORMATION TABLE

| Device code | 10                                                                                                       | RIA | 120 | M | S90 |
|-------------|----------------------------------------------------------------------------------------------------------|-----|-----|---|-----|
|             | 1                                                                                                        | 2   | 3   | 4 | 5   |
| 1           | - Current code                                                                                           |     |     |   |     |
| 2           | - Essential part number                                                                                  |     |     |   |     |
| 3           | - Voltage code x 10 = $V_{RRM}$ (see Voltage Ratings table)                                              |     |     |   |     |
| 4           | - None = Stud base TO-208AA (TO-48) 1/4" 28UNF-2A<br>M = Stud base TO-208AA (TO-48) M6 x 1               |     |     |   |     |
| 5           | - Critical dV/dt:<br>None = 300 V/ $\mu$ s (standard value)<br>S90 = 1000 V/ $\mu$ s (special selection) |     |     |   |     |

| LINKS TO RELATED DOCUMENTS |                                                                               |
|----------------------------|-------------------------------------------------------------------------------|
| Dimensions                 | <a href="http://www.vishay.com/doc?95333">http://www.vishay.com/doc?95333</a> |



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