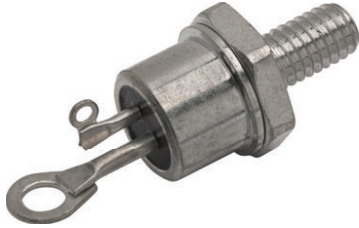


## Medium Power Phase Control Thyristors (Stud Version), 22 A



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  $V_{DRM}/V_{RRM}$
- Designed and qualified for industrial and consumer level
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



RoHS  
COMPLIANT

| PRODUCT SUMMARY   |                  |
|-------------------|------------------|
| Package           | TO-208AA (TO-48) |
| Diode variation   | Single SCR       |
| $I_{T(AV)}$       | 22 A             |
| $V_{DRM}/V_{RRM}$ | 100 V to 1200 V  |
| $V_{TM}$          | 1.70 V           |
| $I_{GT}$          | 60 mA            |
| $T_J$             | -65 °C to 125 °C |

### 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            |
| $I_{T(AV)}$                       |                 | 22          | A                |
|                                   | $T_C$           | 85          | °C               |
| $I_{T(RMS)}$                      |                 | 35          | A                |
| $I_{TSM}$                         | 50 Hz           | 400         | A                |
|                                   | 60 Hz           | 420         |                  |
| $I^2t$                            | 50 Hz           | 793         | A <sup>2</sup> s |
|                                   | 60 Hz           | 724         |                  |
| $V_{DRM}/V_{RRM}$                 |                 | 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 |
| VS-22RIA        | 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/μs  
<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 | $I_{T(AV)}$   | 180° sinusoidal conduction   |                           | 22     | A                 |
|  |               |  |                           | 85     | °C                |
| Maximum RMS on-state current                         | $I_{T(RMS)}$  |  |                           | 35     | A                 |
| Maximum peak, one-cycle non-repetitive surge current | $I_{TSM}$     | t = 10 ms  | No voltage reapplied      | 400    | A                 |
|  |               | t = 8.3 ms   |                           | 420    |                   |
|  |               | t = 10 ms  | 100 % $V_{RRM}$ reapplied | 335    |                   |
|  |               | t = 8.3 ms   |                           | 355    |                   |
| Maximum $I^2t$ for fusing                            | $I^2t$        | t = 10 ms  | No voltage reapplied      | 793    | A <sup>2</sup> s  |
|  |               | t = 8.3 ms   |                           | 724    |                   |
|  |               | t = 10 ms  | 100 % $V_{RRM}$ reapplied | 560    |                   |
|  |               | t = 8.3 ms   |                           | 515    |                   |
| Maximum $I^2\sqrt{t}$ for fusing                     | $I^2\sqrt{t}$ | t = 0.1 to 10 ms, no voltage reapplied, $T_J = T_J$ maximum                              |                           | 7930   | A <sup>2</sup> √s |
| Low level value of threshold voltage                 | $V_{T(TO)1}$  | $(16.7 \% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$ , $T_J = T_J$ maximum |                           | 0.83   | V                 |
| High level value of threshold voltage                | $V_{T(TO)2}$  | $(I > \pi \times I_{T(AV)})$ , $T_J = T_J$ maximum                                       |                           | 0.95   |                   |
| Low level value of on-state slope resistance         | $r_{t1}$      | $(16.7 \% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$ , $T_J = T_J$ maximum |                           | 14.9   | mΩ                |
| High level value of on-state slope resistance        | $r_{t2}$      | $(I > \pi \times I_{T(AV)})$ , $T_J = T_J$ maximum                                       |                           | 13.4   |                   |
| Maximum on-state voltage                             | $V_{TM}$      | $I_{pk} = 70$ A, $T_J = 25$ °C   |                           | 1.70   | V                 |
| Maximum holding current                              | $I_H$         | $T_J = 25$ °C, anode supply 6 V, resistive load  |                           | 130    | mA                |
| Latching current                                     | $I_L$         |  |                           | 200    |                   |

| SWITCHING                                 |          |   |  |                       |       |     |
|---|----------|---|--|-----------------------|-------|-----|
| PARAMETER                                 | SYMBOL   | TEST CONDITIONS   |  | VALUES                | UNITS |     |
| Maximum rate of rise of turned-on current | di/dt    | $T_J = T_J$ maximum, $V_{DM} = \text{Rated } V_{DRM}$<br>Gate pulse = 20 V, 15 Ω, $t_p = 6$ μs, $t_r = 0.1$ μs maximum<br>$I_{TM} = (2 \times \text{rated } di/dt)$ A |  | 200                   | A/μs  |     |
|   |          |   |  | $V_{DRM} \leq 600$ V  |       | 180 |
|   |          |   |  | $V_{DRM} \leq 800$ V  |       | 160 |
|   |          |   |  | $V_{DRM} \leq 1000$ V |       | 150 |
| Typical turn-on time                      | $t_{gt}$ | $T_J = 25$ °C, at rated $V_{DRM}/V_{RRM}$ , $T_J = 125$ °C  |  | 0.9                   | μs    |     |
| Typical reverse recovery time             | $t_{rr}$ | $T_J = T_J$ maximum, $I_{TM} = I_{T(AV)}$ , $t_p > 200$ μs, $di/dt = -10$ A/μs  |  | 4                     |       |     |
| Typical turn-off time                     | $t_q$    | $T_J = T_J$ maximum, $I_{TM} = I_{T(AV)}$ , $t_p > 200$ μs, $V_R = 100$ V, $di/dt = -10$ A/μs, $dV/dt = 20$ V/μs linear to 67 % $V_{DRM}$ , gate bias 0 V to 100 V    |  | 110                   |       |     |

**Note**

- $t_q = 10$  μs up to 600 V,  $t_q = 30$  μs up to 1600 V available on special request

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

**Note**

- <sup>(1)</sup> Available with:  $dV/dt = 1000$  V/μs, to complete code add S90 i.e. 22RIA120S90



| TRIGGERING                          |             |   |  |        |       |
|-------------------------------------|-------------|---|--|--------|-------|
| PARAMETER                           | SYMBOL      | TEST CONDITIONS                                 |  | VALUES | UNITS |
| Maximum peak gate power             | $P_{GM}$    | $T_J = T_J$ maximum                             |  | 8.0    | W     |
| Maximum average gate power          | $P_{G(AV)}$ |   |  | 2.0    |       |
| Maximum peak positive gate current  | $I_{GM}$    | $T_J = T_J$ maximum                             |  | 1.5    | A     |
| Maximum peak negative gate voltage  | $-V_{GM}$   | $T_J = T_J$ maximum                             |  | 10     | V     |
| DC gate current required to trigger | $I_{GT}$    | $T_J = -65\text{ }^\circ\text{C}$               | Maximum required gate trigger current/voltage are the lowest value which will trigger all units<br>6 V anode to cathode applied                | 90     | mA    |
|                                     |             | $T_J = 25\text{ }^\circ\text{C}$                |  | 60     |       |
|                                     |             | $T_J = 125\text{ }^\circ\text{C}$               |  | 35     |       |
| DC gate voltage required to trigger | $V_{GT}$    | $T_J = -65\text{ }^\circ\text{C}$               |  | 3.0    | V     |
|                                     |             | $T_J = 25\text{ }^\circ\text{C}$                |  | 2.0    |       |
|                                     |             | $T_J = 125\text{ }^\circ\text{C}$               |  | 1.0    |       |
| DC gate current not to trigger      | $I_{GD}$    | $T_J = T_J$ maximum, $V_{DRM} =$ Rated value    |  | 2.0    | mA    |
| DC gate voltage not to trigger      | $V_{GD}$    | $T_J = T_J$ maximum,<br>$V_{DRM} =$ Rated value | Maximum gate current/voltage not to trigger is the maximum value which will not trigger any unit with rated $V_{DRM}$ anode to cathode applied | 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       |                  | $^\circ\text{C}$ |
| Maximum thermal resistance, junction to case             | $R_{thJC}$     | DC operation                                   | 0.86             |                  | K/W              |
| Maximum thermal resistance, case to heatsink             | $R_{thCS}$     | Mounting surface, smooth, flat and greased     | 0.35             |                  |                  |
|  |                |  | <b>TO NUT</b>    | <b>TO DEVICE</b> |                  |
| Mounting torque  |                | Lubricated threads<br>(Non-lubricated threads) | 20 (27.5)        | 25               | lbf · in         |
|  |                |  | 0.23 (0.32)      | 0.29             | kgf · m          |
|  |                |  | 2.3 (3.1)        | 2.8              | N · m            |
| 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°                         | 0.21                  | 0.15                   | $T_J = T_J$ maximum | K/W   |
| 120°                         | 0.25                  | 0.25                   |                     |       |
| 90°                          | 0.31                  | 0.34                   |                     |       |
| 60°                          | 0.45                  | 0.47                   |                     |       |
| 30°                          | 0.76                  | 0.76                   |                     |       |

**Note**

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

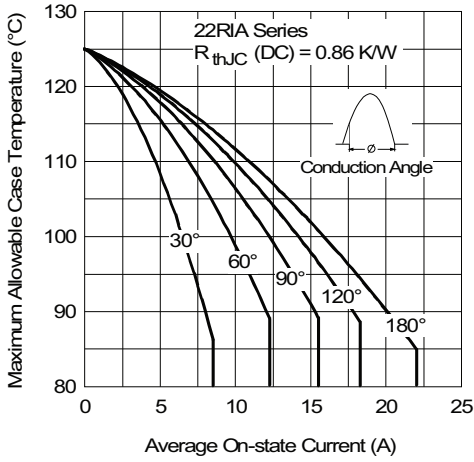


Fig. 1 - Current Ratings Characteristics

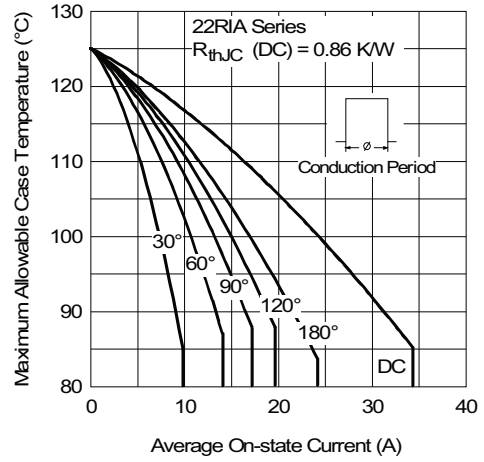


Fig. 1 - Current Ratings Characteristics

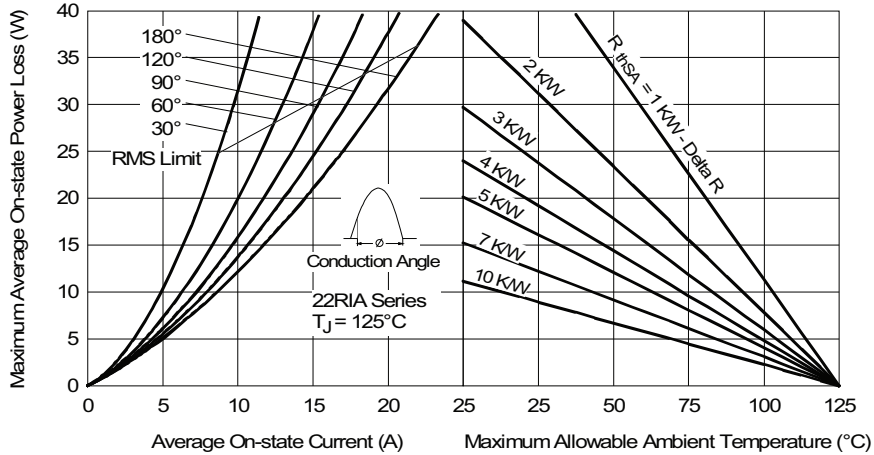


Fig. 2 - On-State Power Loss Characteristics

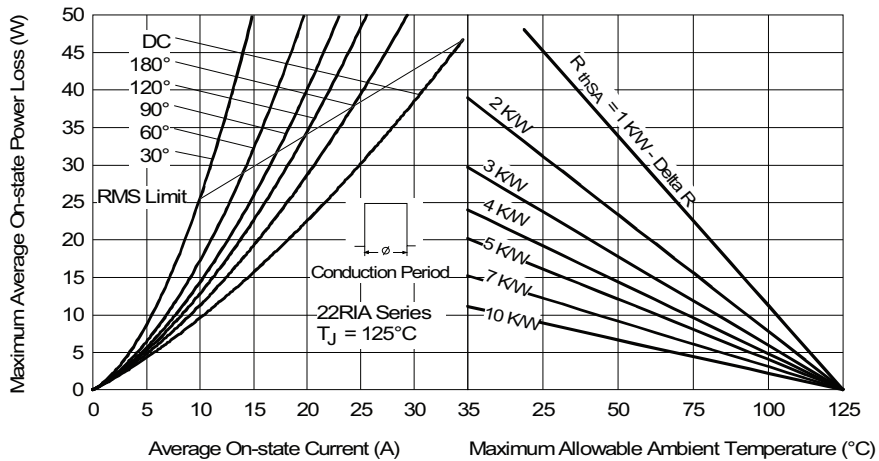


Fig. 3 - On-State Power Loss Characteristics

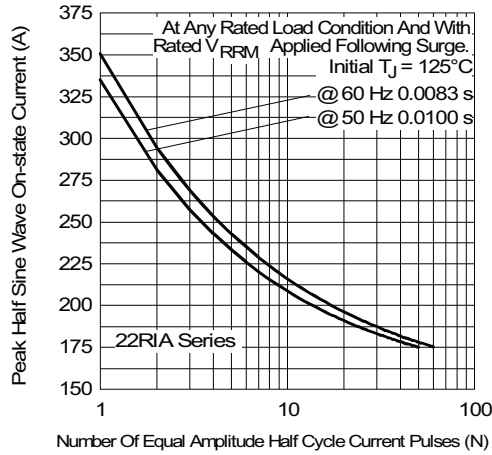


Fig. 4 - Maximum Non-Repetitive Surge Current

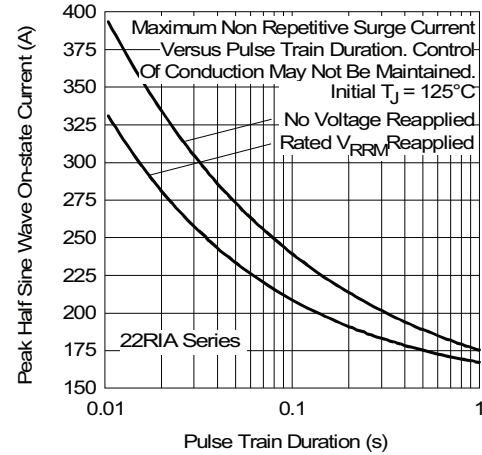


Fig. 5 - Maximum Non-Repetitive Surge Current

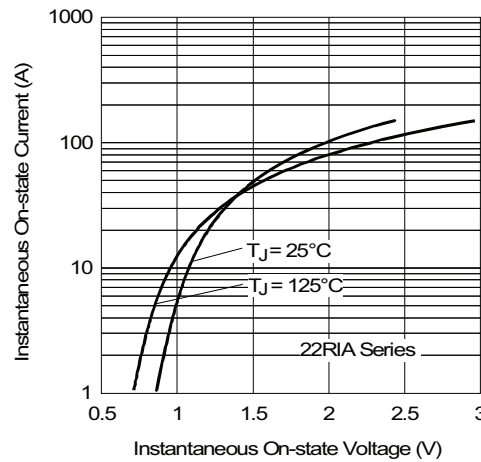


Fig. 6 - Forward Voltage Drop Characteristics

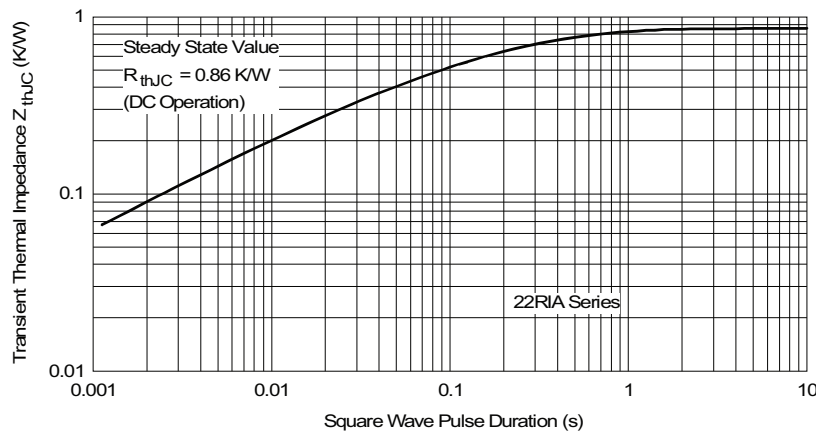


Fig. 7 - Thermal Impedance  $Z_{thJC}$  Characteristics



Fig. 8 - Gate Characteristics

**ORDERING INFORMATION TABLE**

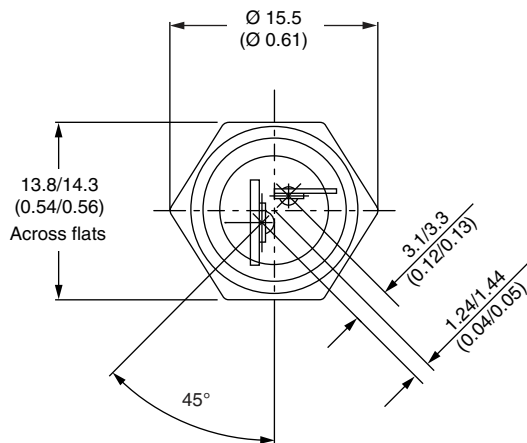
|             |            |           |            |            |          |            |
|-------------|------------|-----------|------------|------------|----------|------------|
| Device code | <b>VS-</b> | <b>22</b> | <b>RIA</b> | <b>120</b> | <b>M</b> | <b>S90</b> |
|             | ①          | ②         | ③          | ④          | ⑤        | ⑥          |

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

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

## TO-208AA (TO-48)

**DIMENSIONS** in millimeters (inches)





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