

## Medium Power Phase Control Thyristors (Stud Version), 25 A



TO-48 (TO-208AA)

### 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

### TYPICAL APPLICATIONS

- Medium power switching
- Phase control applications

### PRIMARY CHARACTERISTICS

|                       |                                                  |
|-----------------------|--------------------------------------------------|
| $I_{T(AV)}$           | 25 A                                             |
| $V_{DRM}/V_{RRM}$     | 100 V, 200 V, 400 V, 600 V, 800 V, 1000 V 1200 V |
| $V_{TM}$              | 1.70 V                                           |
| $I_{GT}$              | 60 mA                                            |
| $T_J$                 | -65 °C to +125 °C                                |
| Package               | TO-48 (TO-208AA)                                 |
| Circuit configuration | Single SCR                                       |

### MAJOR RATINGS AND CHARACTERISTICS

| PARAMETER         | TEST CONDITIONS | VALUES      | UNITS            |
|-------------------|-----------------|-------------|------------------|
| $I_{T(AV)}$       |                 | 25          | A                |
|                   | $T_C$           | 85          | °C               |
| $I_{T(RMS)}$      |                 | 40          | A                |
| $I_{TSM}$         | 50 Hz           | 420         | A                |
|                   | 60 Hz           | 440         |                  |
| $I^2t$            | 50 Hz           | 867         | A <sup>2</sup> s |
|                   | 60 Hz           | 790         |                  |
| $V_{DRM}/V_{RRM}$ |                 | 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-25RIA    | 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                                                               |                           | 25     | A             |
|                                                      |               |                                                                                          |                           | 85     | °C            |
| Maximum RMS on-state current                         | $I_{T(RMS)}$  |                                                                                          |                           | 40     | A             |
| Maximum peak, one-cycle non-repetitive surge current | $I_{TSM}$     | t = 10 ms                                                                                | No voltage reapplied      | 420    | A             |
|                                                      |               | t = 8.3 ms                                                                               | No voltage reapplied      | 440    |               |
|                                                      |               | t = 10 ms                                                                                | 100 % $V_{RRM}$ reapplied | 350    |               |
|                                                      |               | t = 8.3 ms                                                                               | 100 % $V_{RRM}$ reapplied | 370    |               |
| Maximum $I^2t$ for fusing                            | $I^2t$        | t = 10 ms                                                                                | No voltage reapplied      | 867    | $A^2s$        |
|                                                      |               | t = 8.3 ms                                                                               | No voltage reapplied      | 790    |               |
|                                                      |               | t = 10 ms                                                                                | 100 % $V_{RRM}$ reapplied | 615    |               |
|                                                      |               | t = 8.3 ms                                                                               | 100 % $V_{RRM}$ reapplied | 560    |               |
| 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                              |                           | 8670   | $A^2\sqrt{s}$ |
| 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 |                           | 0.99   | V             |
| High level value of threshold voltage                | $V_{T(TO)2}$  | $(I > \pi \times I_{T(AV)})$ , $T_J = T_J$ maximum                                       |                           | 1.40   |               |
| 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 |                           | 10.1   | mΩ            |
| High level value of on-state slope resistance        | $r_{t2}$      | $(I > \pi \times I_{T(AV)})$ , $T_J = T_J$ maximum                                       |                           | 5.7    |               |
| Maximum on-state voltage                             | $V_{TM}$      | $I_{pk} = 79$ 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  |
|                                           |          |                                                                                                                                                                       | 180    |       |
|                                           |          |                                                                                                                                                                       | 160    |       |
|                                           |          |                                                                                                                                                                       | 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    |       |

**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. 25RIA120S90



| TRIGGERING                          |                    |                                                                         |                                                                                                                                                       |        |       |
|-------------------------------------|--------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------|
| 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                                                | Maximum required gate trigger current/voltage are the lowest value which will trigger all units 6 V anode to cathode applied                          | 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, V <sub>DRM</sub> = Rated value | Maximum gate current/voltage not to trigger is the maximum value which will not trigger any unit with rated V <sub>DRM</sub> 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                                  | 0.75                     | K/W                 |
| Maximum thermal resistance, case to heat sink            | $R_{thCS}$     | Mounting surface, smooth, flat and greased    | 0.35                     |                     |
| Allowable mounting torque                                |                | Non-lubricated threads                        | $3.4 + 0 - 10\%$<br>(30) | N · m<br>(lbf · in) |
|                                                          |                | Lubricated threads                            | $2.3 + 0 - 10\%$<br>(20) |                     |
| Approximate weight                                       |                |                                               | 14                       | g                   |
|                                                          |                |                                               | 0.49                     | oz.                 |
| Case style                                               |                | See dimensions - link at the end of datasheet | TO-48 (TO-208AA)         |                     |

| $\Delta R_{thJC}$ CONDUCTION |                       |                        |                     |       |
|------------------------------|-----------------------|------------------------|---------------------|-------|
| CONDUCTION ANGLE             | SINUSOIDAL CONDUCTION | RECTANGULAR CONDUCTION | TEST CONDITIONS     | UNITS |
| 180°                         | 0.17                  | 0.13                   | $T_J = T_J$ maximum | K/W   |
| 120°                         | 0.21                  | 0.22                   |                     |       |
| 90°                          | 0.27                  | 0.30                   |                     |       |
| 60°                          | 0.40                  | 0.42                   |                     |       |
| 30°                          | 0.69                  | 0.70                   |                     |       |

**Note**

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

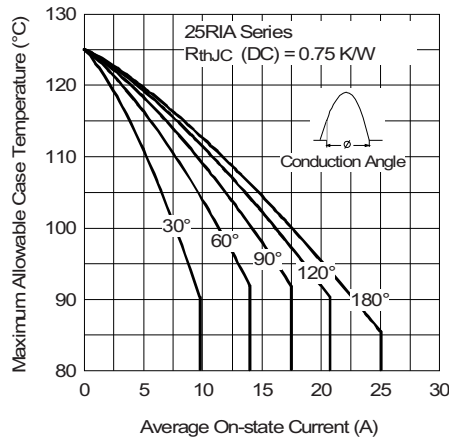


Fig. 1 - Current Ratings Characteristics

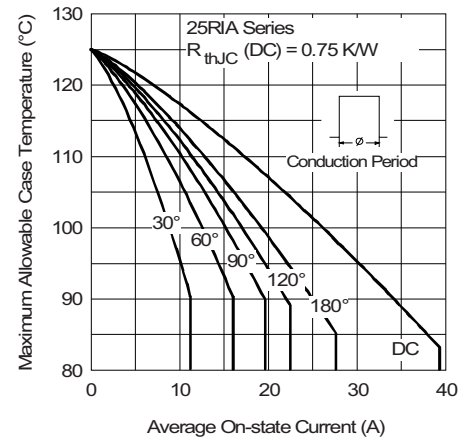


Fig. 1 - Current Ratings Characteristics

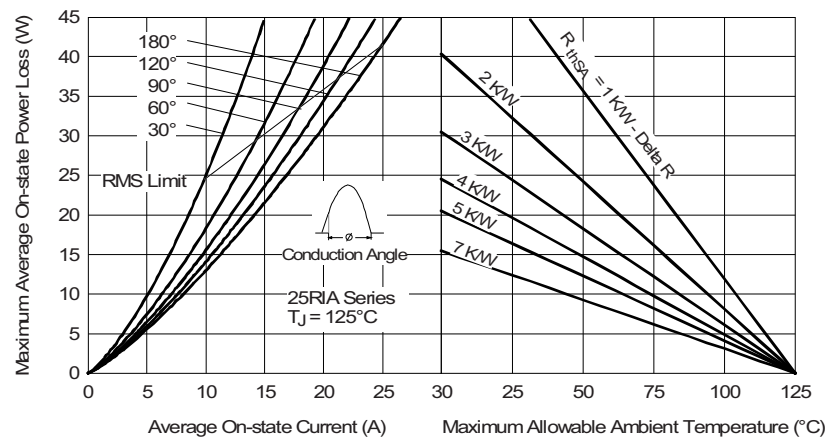


Fig. 2 - On-State Power Loss Characteristics

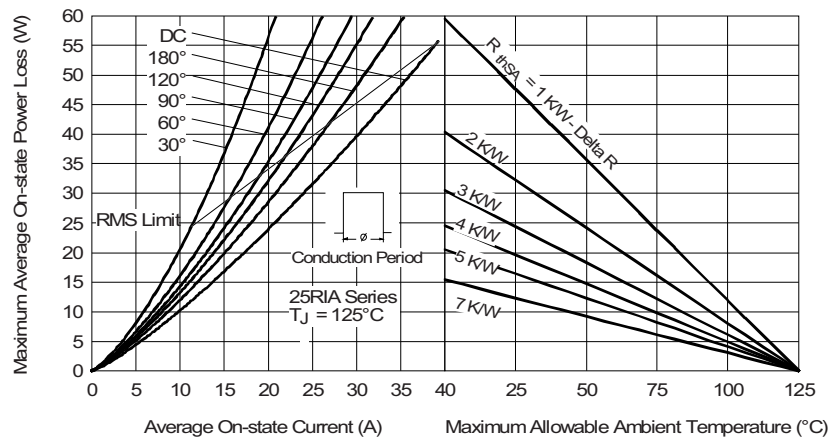


Fig. 3 - On-State Power Loss Characteristics

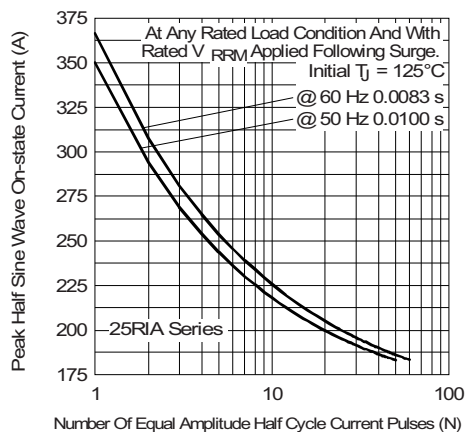


Fig. 4 - Maximum Non-Repetitive Surge Current

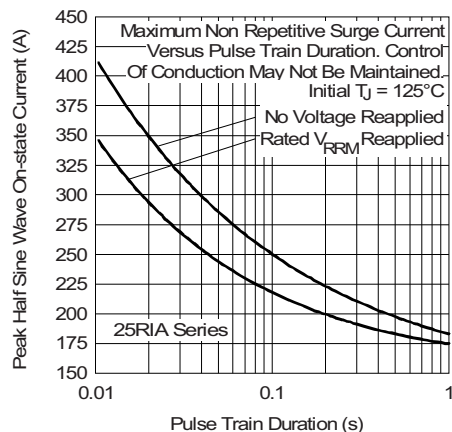


Fig. 5 - Maximum Non-Repetitive Surge Current

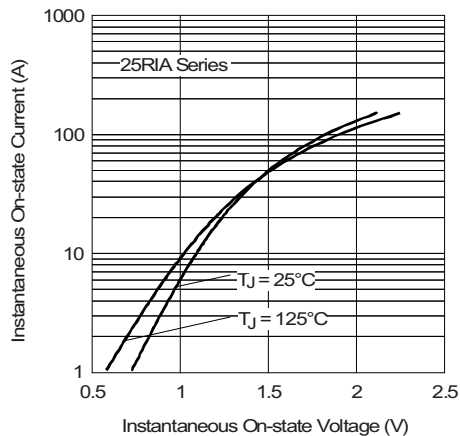


Fig. 6 - Forward Voltage Drop Characteristics

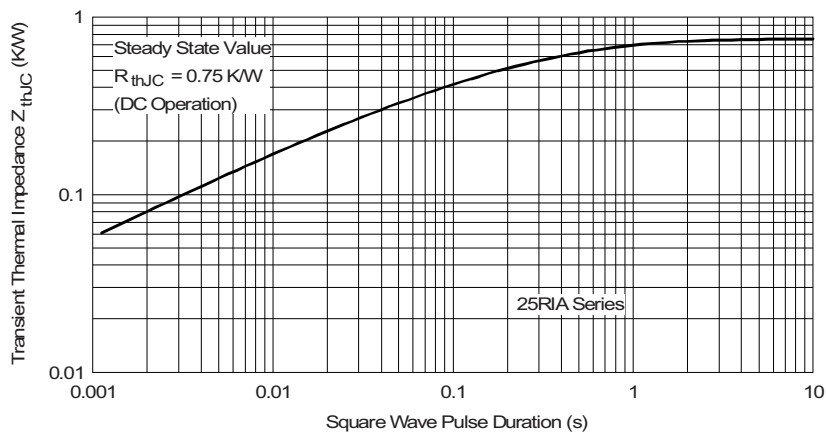


Fig. 7 - Thermal Impedance  $Z_{thJC}$  Characteristics

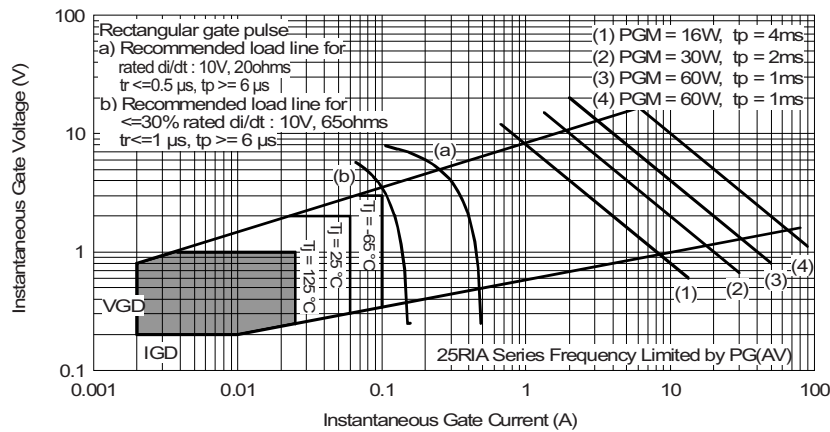


Fig. 8 - Gate Characteristics

## ORDERING INFORMATION TABLE

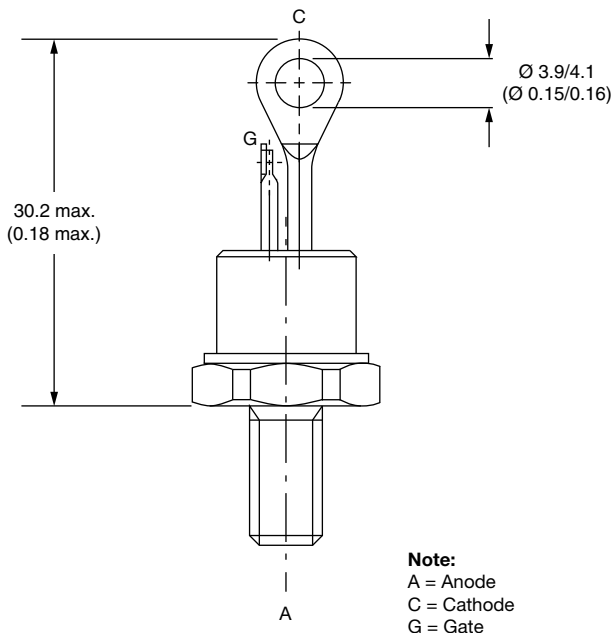
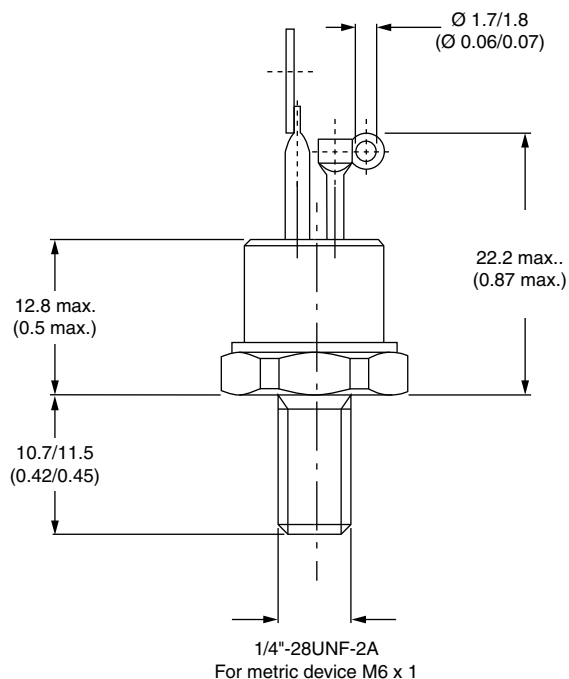
| Device code | VS-                                                                                                    | 25 | RIA | 120 | M | S90 |
|-------------|--------------------------------------------------------------------------------------------------------|----|-----|-----|---|-----|
|             | 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-48 (TO-208AA) 1/4" 28UNF-2A<br>M = stud base TO-48 (TO-208AA) M6 x 1               |    |     |     |   |     |
| 6           | 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">www.vishay.com/doc?95333</a> |

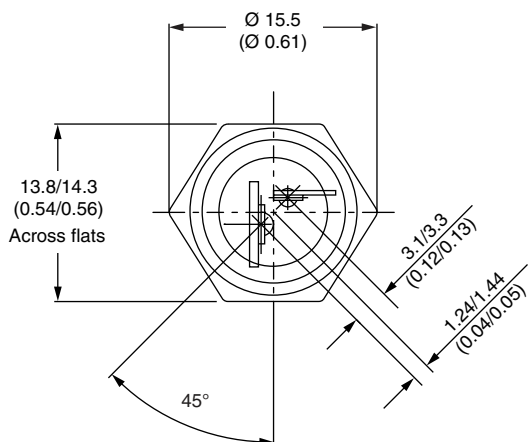


## TO-208AA (TO-48)

**DIMENSIONS** in millimeters (inches)



**Note:**  
A = Anode  
C = Cathode  
G = Gate





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