



## Phase Control Thyristors (Stud Version), 80 A



TO-94 (TO-209AC)

### FEATURES

- Hermetic glass-metal seal
- International standard case TO-94 (TO-209AC)
- Designed and qualified for industrial level
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

### TYPICAL APPLICATIONS

- DC motor controls
- Controlled DC power supplies
- AC controllers

### PRIMARY CHARACTERISTICS

|                       |                      |
|-----------------------|----------------------|
| $I_{T(AV)}$           | 80 A                 |
| $V_{DRM}/V_{RRM}$     | 400 V, 800 V, 1200 V |
| $V_{TM}$              | 1.60 V               |
| $I_{GT}$              | 120 mA               |
| $T_J$                 | -40 °C to +125 °C    |
| Package               | TO-94 (TO-209AC)     |
| Circuit configuration | Single SCR           |

### MAJOR RATINGS AND CHARACTERISTICS

| PARAMETER         | TEST CONDITIONS | VALUES      | UNITS             |
|-------------------|-----------------|-------------|-------------------|
| $I_{T(AV)}$       |                 | 80          | A                 |
|                   | $T_C$           | 85          | °C                |
| $I_{T(RMS)}$      |                 | 125         | A                 |
| $I_{TSM}$         | 50 Hz           | 1900        |                   |
|                   | 60 Hz           | 1990        |                   |
| $I^2t$            | 50 Hz           | 18          | kA <sup>2</sup> s |
|                   | 60 Hz           | 16          |                   |
| $V_{DRM}/V_{RRM}$ |                 | 400 to 1200 | V                 |
| $t_q$             | Typical         | 110         | µs                |
| $T_J$             |                 | -40 to +125 | °C                |

### ELECTRICAL SPECIFICATIONS

#### VOLTAGE RATINGS

| TYPE NUMBER          | VOLTAGE CODE | $V_{DRM}/V_{RRM}$ , MAXIMUM REPETITIVE PEAK AND OFF-STATE VOLTAGE<br>V | $V_{RSM}$ , MAXIMUM NON-REPETITIVE PEAK VOLTAGE<br>V | $I_{DRM}/I_{RRM}$ MAXIMUM AT $T_J = 125\text{ °C}$<br>mA |
|----------------------|--------------|------------------------------------------------------------------------|------------------------------------------------------|----------------------------------------------------------|
| VS-80RIA<br>VS-81RIA | 40           | 400                                                                    | 500                                                  | 15                                                       |
|                      | 80           | 800                                                                    | 900                                                  |                                                          |
|                      | 120          | 1200                                                                   | 1300                                                 |                                                          |

**ABSOLUTE MAXIMUM RATINGS**

| PARAMETER                                            | SYMBOL        | TEST CONDITIONS                                                                                                                                                                                                                                   | VALUES                       | UNITS          |
|------------------------------------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|----------------|
| Maximum average on-state current at case temperature | $I_{T(AV)}$   | 180° conduction, half sine wave                                                                                                                                                                                                                   | 80                           | A              |
|                                                      |               |                                                                                                                                                                                                                                                   | 85                           | °C             |
| Maximum RMS on-state current                         | $I_{T(RMS)}$  | DC at 75 °C case temperature                                                                                                                                                                                                                      | 125                          |                |
| Maximum peak, one-cycle non-repetitive surge current | $I_{TSM}$     | <div> <div> <math>t = 10\text{ ms}</math><br/> <math>t = 8.3\text{ ms}</math> </div> <div> No voltage reappplied<br/> 100 % <math>V_{RRM}</math> reappplied </div> </div> <div>Sinusoidal half wave, initial <math>T_J = T_J</math> maximum</div> | 1900<br>1990<br>1600<br>1675 | A              |
| Maximum $I^2t$ for fusing                            | $I^2t$        | <div> <div> <math>t = 10\text{ ms}</math><br/> <math>t = 8.3\text{ ms}</math> </div> <div> No voltage<br/> 100 % <math>V_{RRM}</math> reappplied </div> </div>                                                                                    | 18<br>16<br>12.7<br>11.7     | $kA^2s$        |
| Maximum $I^2\sqrt{t}$ for fusing                     | $I^2\sqrt{t}$ | $t = 0.1\text{ ms to } 10\text{ ms}$ , no voltage reappplied                                                                                                                                                                                      | 180.5                        | $kA^2\sqrt{s}$ |
| 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                                                                                                                                                                                                | 1.13                         |                |
| 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                                                                                                                                                           | 2.29                         | $m\Omega$      |
| High level value of on-state slope resistance        | $r_{t2}$      | $(I > \pi \times I_{T(AV)})$ , $T_J = T_J$ maximum                                                                                                                                                                                                | 1.84                         |                |
| Maximum on-state voltage                             | $V_{TM}$      | $I_{pk} = 250\text{ A}$ , $T_J = 25\text{ °C}$ , $t_p = 10\text{ ms}$ sine pulse                                                                                                                                                                  | 1.60                         | V              |
| Maximum holding current                              | $I_H$         | $T_J = 25\text{ °C}$ , anode supply 12 V resistive load                                                                                                                                                                                           | 200                          | mA             |
| Typical latching current                             | $I_L$         |                                                                                                                                                                                                                                                   | 400                          |                |

**SWITCHING**

| PARAMETER                                                | SYMBOL  | TEST CONDITIONS                                                                                                                                                                                                                             | VALUES | UNITS      |
|----------------------------------------------------------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------|
| Maximum non-repetitive rate of rise of turned-on current | $di/dt$ | $T_J = 125\text{ °C}$ , $V_d = \text{Rated } V_{DRM}$ , $I_{TM} = 2 \times di/dt$ snubber 0.2 $\mu F$ , 15 $\Omega$ , gate pulse: 20 V, 65 $\Omega$ , $t_p = 6\text{ }\mu s$ , $t_r = 0.5\text{ }\mu s$ Per JEDEC standard RS-397, 5.2.2.6. | 300    | A/ $\mu s$ |
| Typical delay time                                       | $t_d$   | Gate pulse: 10 V, 15 $\Omega$ source, $t_p = 6\text{ }\mu s$ , $t_r = 0.1\text{ }\mu s$ , $V_d = \text{Rated } V_{DRM}$ , $I_{TM} = 50\text{ Adc}$ , $T_J = 25\text{ °C}$                                                                   | 1      | $\mu s$    |
| Typical turn-off time                                    | $t_q$   | $I_{TM} = 50\text{ A}$ , $T_J = T_J$ maximum, $di/dt = -5\text{ A}/\mu s$ , $V_R = 50\text{ V}$ , $dV/dt = 20\text{ V}/\mu s$ , gate bias: 0 V 25 $\Omega$ , $t_p = 500\text{ }\mu s$                                                       | 110    |            |

**BLOCKING**

| PARAMETER                                          | SYMBOL                   | TEST CONDITIONS                                           | VALUES | UNITS      |
|----------------------------------------------------|--------------------------|-----------------------------------------------------------|--------|------------|
| Maximum critical rate of rise of off-state voltage | $dV/dt$                  | $T_J = 125\text{ °C}$ exponential to 67 % rated $V_{DRM}$ | 500    | V/ $\mu s$ |
| Maximum peak reverse and off-state leakage current | $I_{RRM}$ ,<br>$I_{DRM}$ | $T_J = 125\text{ °C}$ rated $V_{DRM}/V_{RRM}$ applied     | 15     | mA         |



| TRIGGERING                                  |                    |                                                                |                                                                                                                                                                |        |       |
|---------------------------------------------|--------------------|----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------|
| PARAMETER                                   | SYMBOL             | TEST CONDITIONS                                                |                                                                                                                                                                | VALUES | UNITS |
| Maximum peak gate power                     | P <sub>GM</sub>    | T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> ≤ 5 ms |                                                                                                                                                                | 12     | W     |
| Maximum average gate power                  | P <sub>G(AV)</sub> | T <sub>J</sub> = T <sub>J</sub> maximum, f = 50 Hz, d% = 50    |                                                                                                                                                                | 3      |       |
| Maximum peak positive gate current          | I <sub>GM</sub>    | T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> ≤ 5 ms |                                                                                                                                                                | 3      | A     |
| Maximum peak positive gate voltage          | + V <sub>GM</sub>  |                                                                |                                                                                                                                                                | 20     | V     |
| Maximum peak negative gate voltage          | - V <sub>GM</sub>  |                                                                |                                                                                                                                                                | 10     |       |
| Maximum DC gate current required to trigger | I <sub>GT</sub>    | T <sub>J</sub> = - 40 °C                                       | Maximum required gate trigger/<br>current/voltage are the lowest value<br>which will trigger all units 6 V anode<br>to cathode applied                         | 270    | mA    |
|                                             |                    | T <sub>J</sub> = 25 °C                                         |                                                                                                                                                                | 120    |       |
|                                             |                    | T <sub>J</sub> = 125 °C                                        |                                                                                                                                                                | 60     |       |
| Maximum DC gate voltage required to trigger | V <sub>GT</sub>    | T <sub>J</sub> = - 40 °C                                       |                                                                                                                                                                | 3.5    | V     |
|                                             |                    | T <sub>J</sub> = 25 °C                                         |                                                                                                                                                                | 2.5    |       |
|                                             |                    | T <sub>J</sub> = 125 °C                                        |                                                                                                                                                                | 1.5    |       |
| DC gate current not to trigger              | I <sub>GD</sub>    | T <sub>J</sub> = T <sub>J</sub> maximum                        | Maximum gate current/voltage not to<br>trigger is the maximum value which<br>will not trigger any unit with rated<br>V <sub>DRM</sub> anode to cathode applied | 6      | mA    |
| DC gate voltage not to trigger              | V <sub>GD</sub>    |                                                                |                                                                                                                                                                | 0.25   | V     |

| THERMAL AND MECHANICAL SPECIFICATIONS        |                   |                                               |                  |                     |
|----------------------------------------------|-------------------|-----------------------------------------------|------------------|---------------------|
| PARAMETER                                    | SYMBOL            | TEST CONDITIONS                               | VALUES           | UNITS               |
| Maximum operating junction temperature range | T <sub>J</sub>    |                                               | - 40 to 125      | °C                  |
| Maximum storage temperature range            | T <sub>Stg</sub>  |                                               | - 40 to 150      |                     |
| Maximum thermal resistance, junction to case | R <sub>thJC</sub> | DC operation                                  | 0.30             | K/W                 |
| Maximum thermal resistance, case to heatsink | R <sub>thCS</sub> | Mounting surface, smooth, flat and greased    | 0.1              |                     |
| Mounting torque, ± 10 %                      |                   | Non-lubricated threads                        | 15.5<br>(137)    | N · m<br>(lbf · in) |
|                                              |                   | Lubricated threads                            | 14<br>(120)      |                     |
| Approximate weight                           |                   |                                               | 130              | g                   |
| Case style                                   |                   | See dimensions - link at the end of datasheet | TO-94 (TO-209AC) |                     |

| $\Delta R_{thJC}$ CONDUCTION |                       |                        |                     |       |
|------------------------------|-----------------------|------------------------|---------------------|-------|
| CONDUCTION ANGLE             | SINUSOIDAL CONDUCTION | RECTANGULAR CONDUCTION | TEST CONDITIONS     | UNITS |
| 180°                         | 0.042                 | 0.030                  | $T_J = T_J$ maximum | K/W   |
| 120°                         | 0.050                 | 0.052                  |                     |       |
| 90°                          | 0.064                 | 0.070                  |                     |       |
| 60°                          | 0.095                 | 0.100                  |                     |       |
| 30°                          | 0.164                 | 0.165                  |                     |       |

#### Note

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

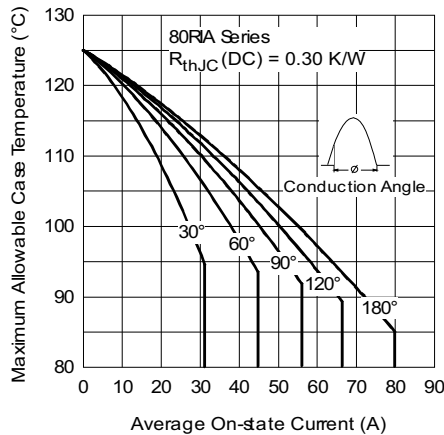


Fig. 1 - Current Ratings Characteristics

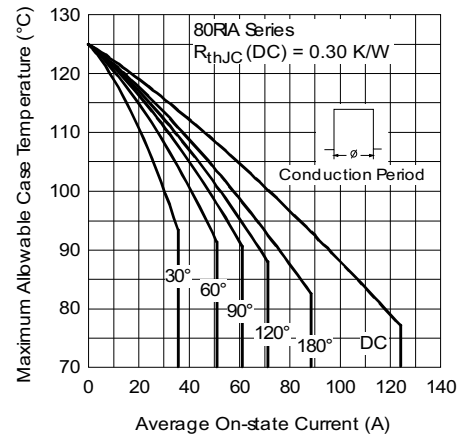


Fig. 2 - Current Ratings Characteristics

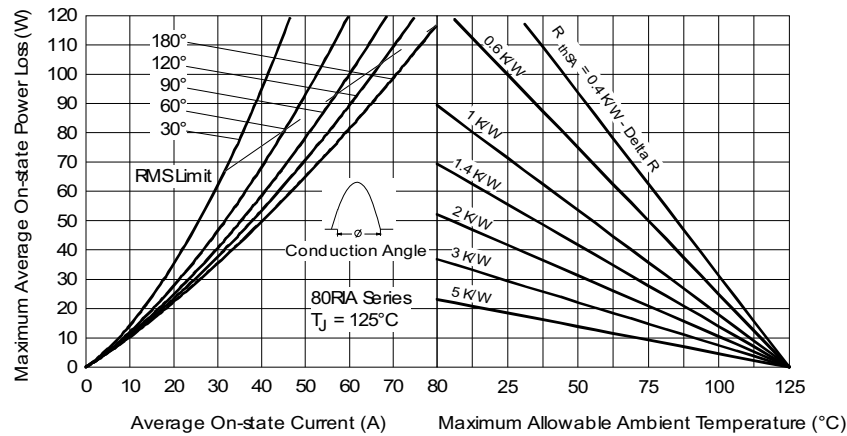


Fig. 3 - On-State Power Loss Characteristics

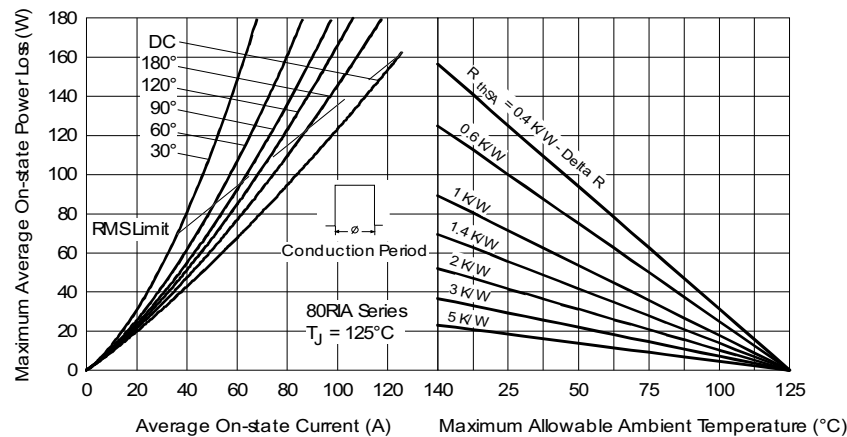


Fig. 4 - On-State Power Loss Characteristics

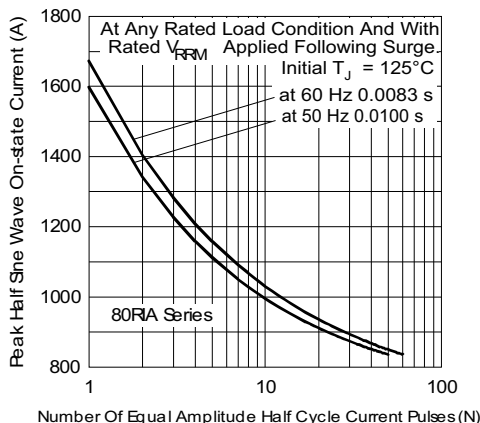


Fig. 5 - Maximum Non-Repetitive Surge Current

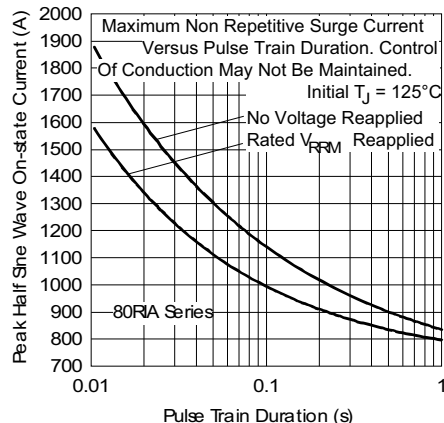


Fig. 6 - Maximum Non-Repetitive Surge Current

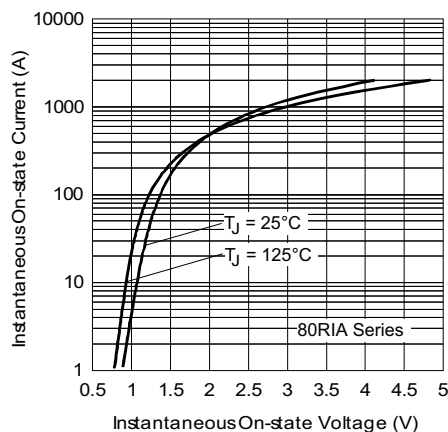


Fig. 7 - On-State Voltage Drop Characteristics

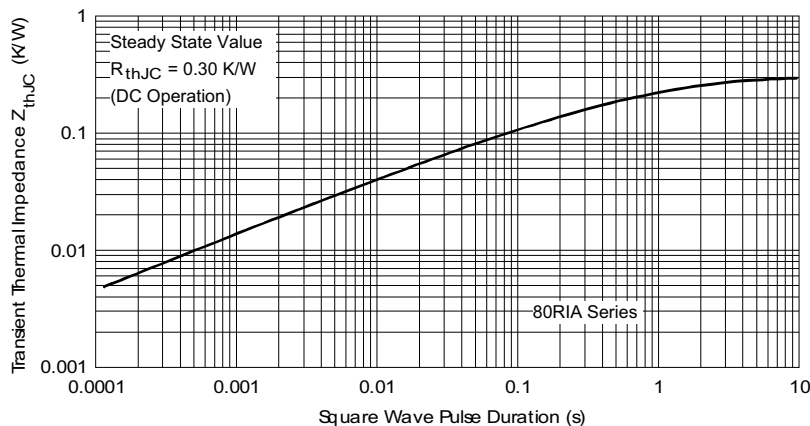


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristics

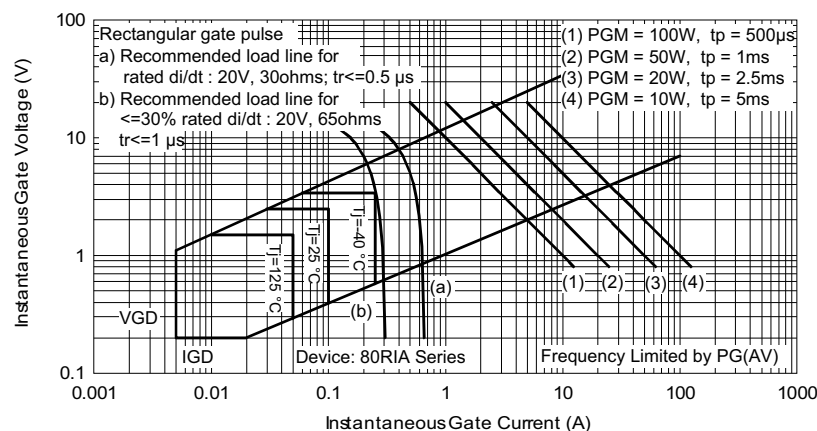


Fig. 9 - Gate Characteristics

## ORDERING INFORMATION TABLE

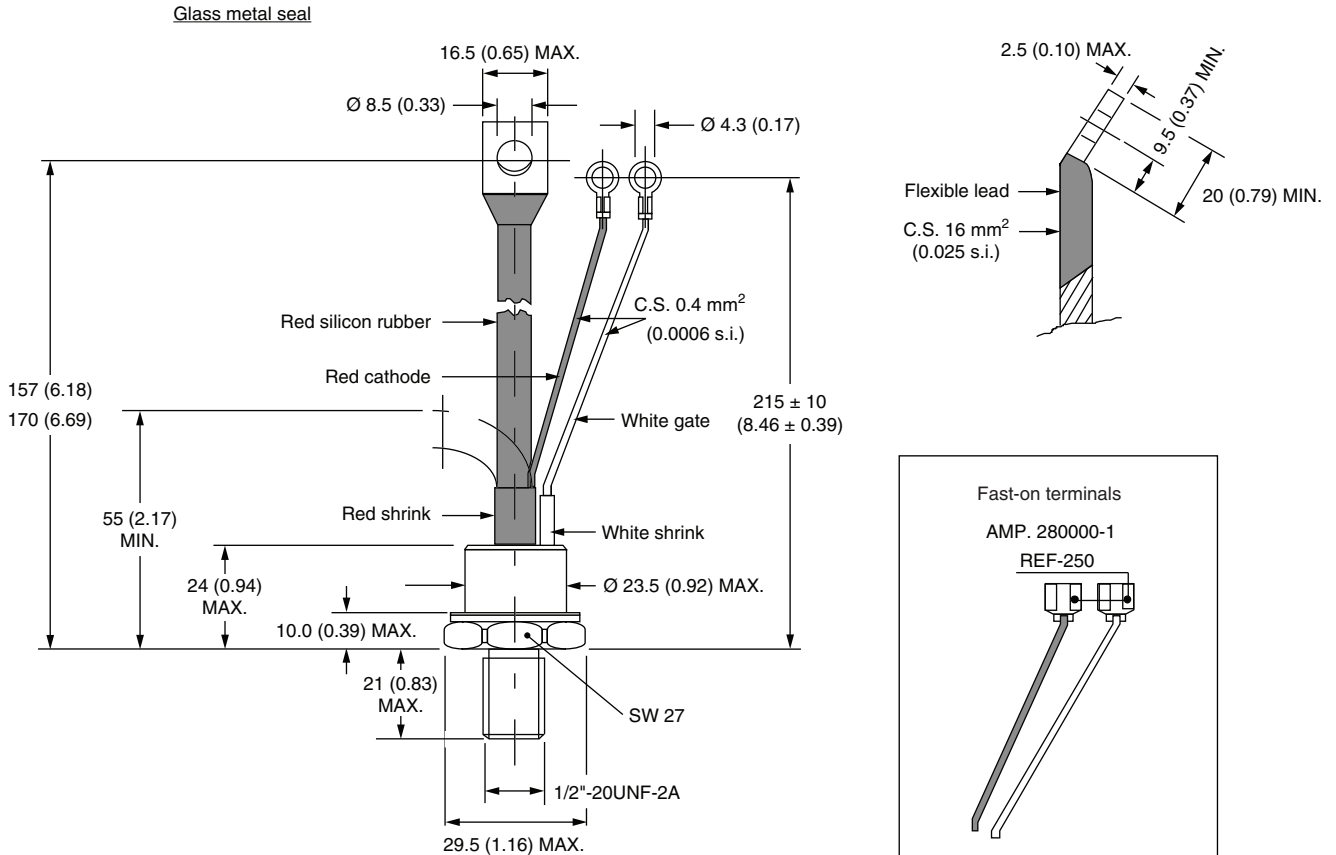
|             |            |          |          |            |            |          |            |
|-------------|------------|----------|----------|------------|------------|----------|------------|
| Device code | <b>VS-</b> | <b>8</b> | <b>0</b> | <b>RIA</b> | <b>120</b> | <b>M</b> | <b>PbF</b> |
|             | 1          | 2        | 3        | 4          | 5          | 6        | 7          |

- 1** - Vishay Semiconductors product
- 2** -  $I_{TAV} \times 10\text{ A}$
- 3** -
  - 0 = eyelet terminals (gate and auxiliary cathode leads)
  - 1 = fast-on terminals (gate and auxiliary cathode leads)
  - 2 = flag terminals (gate and auxiliary cathode terminals)
- 4** - RIA = essential part number
- 5** - Voltage code  $\times 100 = V_{RRM}$  (see Voltage Ratings table)
- 6** -
  - None = stud base 1/2"-20UNF- 2 A threads
  - M = stud base metric threads M12  $\times 1.75\text{ E }6$
- 7** -
  - None = standard production
  - PbF = lead (Pb)-free

| LINKS TO RELATED DOCUMENTS |                                                                        |
|----------------------------|------------------------------------------------------------------------|
| Dimensions                 | <a href="http://www.vishay.com/doc?95362">www.vishay.com/doc?95362</a> |

## TO-209AC (TO-94) for 80RIA Series

**DIMENSIONS** in millimeters (inches)





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