

## Phase Control Thyristors (Stud Version), 180 A



TO-209AB (TO-93)

### FEATURES

- Hermetic glass-metal seal
- International standard case TO-209AB (TO-93)
- 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)


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### TYPICAL APPLICATIONS

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

### PRODUCT SUMMARY

|                   |                      |
|-------------------|----------------------|
| $I_{T(AV)}$       | 180 A                |
| $V_{DRM}/V_{RRM}$ | 400 V, 800 V, 1000 V |
| $V_{TM}$          | 1.35 V               |
| $I_{GT}$          | 65 mA                |
| $T_J$             | -40 °C to 125 °C     |
| Package           | TO-209AB (TO-93)     |
| Diode variation   | Single SCR           |

### MAJOR RATINGS AND CHARACTERISTICS

| PARAMETER         | TEST CONDITIONS | VALUES      | UNITS             |
|-------------------|-----------------|-------------|-------------------|
| $I_{T(AV)}$       |                 | 180         | A                 |
|                   | $T_C$           | 80          | °C                |
| $I_{T(RMS)}$      |                 | 285         | A                 |
| $I_{TSM}$         | 50 Hz           | 3800        |                   |
|                   | 60 Hz           | 4000        |                   |
| $I^2t$            | 50 Hz           | 72          | kA <sup>2</sup> s |
|                   | 60 Hz           | 66          |                   |
| $V_{DRM}/V_{RRM}$ |                 | 400 to 1000 | V                 |
| $t_q$             | Typical         | 100         | μs                |
| $T_J$             |                 | -40 to 125  | °C                |

### ELECTRICAL SPECIFICATIONS

#### VOLTAGE RATINGS

| PART 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 $T_J = T_J$ MAXIMUM<br>mA |
|------------------------|--------------|------------------------------------------------------------------------|------------------------------------------------------|--------------------------------------------------------|
| VS-180RKI<br>VS-181RKI | 40           | 400                                                                    | 500                                                  | 30                                                     |
|                        | 80           | 800                                                                    | 900                                                  |                                                        |
|                        | 100          | 1000                                                                   | 1100                                                 |                                                        |



| 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                                                                           |                                  |                                                                       | 180    | A                  |
|                                                      |                     |                                                                                                           |                                  |                                                                       | 80     | °C                 |
| Maximum RMS on-state current                         | I <sub>RMS</sub>    | DC at 79 °C case temperature                                                                              |                                  |                                                                       | 285    | 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 | 3800   |                    |
|                                                      |                     | t = 8.3 ms                                                                                                |                                  |                                                                       | 4000   |                    |
|                                                      |                     | t = 10 ms                                                                                                 | 100 % V <sub>RRM</sub> reapplied |                                                                       | 3500   |                    |
|                                                      |                     | t = 8.3 ms                                                                                                |                                  |                                                                       | 3660   |                    |
| Maximum I <sup>2</sup> t for fusing                  | I <sup>2</sup> t    | t = 10 ms                                                                                                 | No voltage reapplied             |                                                                       | 72     | kA <sup>2</sup> s  |
|                                                      |                     | t = 8.3 ms                                                                                                |                                  |                                                                       | 66     |                    |
|                                                      |                     | t = 10 ms                                                                                                 | 100 % V <sub>RRM</sub> reapplied |                                                                       | 61     |                    |
|                                                      |                     | t = 8.3 ms                                                                                                |                                  |                                                                       | 56     |                    |
| Maximum I <sup>2</sup> √t for fusing                 | I <sup>2</sup> √t   | t = 0.1 ms to 10 ms, no voltage reapplied                                                                 |                                  |                                                                       | 720    | kA <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 |                                  |                                                                       | 0.83   | 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                                    |                                  |                                                                       | 0.89   |                    |
| 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 |                                  |                                                                       | 0.92   | 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                                    |                                  |                                                                       | 0.81   |                    |
| Maximum on-state voltage                             | V <sub>TM</sub>     | I <sub>pk</sub> = 570 A, T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> = 10 ms sine pulse       |                                  |                                                                       | 1.35   | V                  |
| Maximum holding current                              | I <sub>H</sub>      | T <sub>J</sub> = 25 °C, anode supply 12 V resistive load                                                  |                                  |                                                                       | 600    | mA                 |
| Typical latching current                             | I <sub>L</sub>      |                                                                                                           |                                  |                                                                       | 1000   |                    |

| SWITCHING                                                |         |                                                                                                    |        |       |
|----------------------------------------------------------|---------|----------------------------------------------------------------------------------------------------|--------|-------|
| PARAMETER                                                | SYMBOL  | TEST CONDITIONS                                                                                    | VALUES | UNITS |
| Maximum non-repetitive rate of rise of turned-on current | $di/dt$ | Gate drive 20 V, 20 Ω, $t_r \leq 1$ μs<br>$T_J = T_J$ maximum, anode voltage $\leq 80$ % $V_{DRM}$ | 300    | A/μs  |
| Typical delay time                                       | $t_d$   | Gate current 1 A, $di_g/dt = 1$ A/μs<br>$V_d = 0.67$ % $V_{DRM}$ , $T_J = 25$ °C                   | 1.0    | μs    |
| Typical turn-off time                                    | $t_q$   | $I_{TM} = 50$ A, $T_J = T_J$ maximum, $di/dt = 10$ A/μs,<br>$V_R = 100$ V, $dV/dt = 20$ V/μs       | 100    |       |

| 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 80 % rated $V_{DRM}$  | 500    | V/μs  |
| Maximum peak reverse and off-state leakage current | $I_{RRM}$ ,<br>$I_{DRM}$ | $T_J = T_J$ maximum rated $V_{DRM}/V_{RRM}$ applied | 30     | mA    |



| TRIGGERING                          |                    |                                                                |                                                                                                                                                                   |        |      |       |
|-------------------------------------|--------------------|----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------|-------|
| PARAMETER                           | SYMBOL             | TEST CONDITIONS                                                |                                                                                                                                                                   | VALUES |      | UNITS |
|                                     |                    |                                                                |                                                                                                                                                                   | TYP.   | MAX. |       |
| Maximum peak gate power             | P <sub>GM</sub>    | T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> ≤ 5 ms |                                                                                                                                                                   | 10     |      | W     |
| Maximum average gate power          | P <sub>G(AV)</sub> | T <sub>J</sub> = T <sub>J</sub> maximum, f = 50 Hz, d% = 50    |                                                                                                                                                                   | 2.0    |      |       |
| Maximum peak positive gate current  | I <sub>GM</sub>    | T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> ≤ 5 ms |                                                                                                                                                                   | 3.0    |      | A     |
| Maximum peak positive gate voltage  | + V <sub>GM</sub>  |                                                                |                                                                                                                                                                   | 20     |      | V     |
| Maximum peak negative gate voltage  | - V <sub>GM</sub>  |                                                                |                                                                                                                                                                   | 5.0    |      |       |
| 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<br>value which will trigger all units<br>12 V anode to cathode applied                           | 130    | -    | mA    |
|                                     |                    | T <sub>J</sub> = 25 °C                                         |                                                                                                                                                                   | 65     | 150  |       |
|                                     |                    | T <sub>J</sub> = 125 °C                                        |                                                                                                                                                                   | 35     | -    |       |
| DC gate voltage required to trigger | V <sub>GT</sub>    | T <sub>J</sub> = - 40 °C                                       |                                                                                                                                                                   | 2.0    | -    | V     |
|                                     |                    | T <sub>J</sub> = 25 °C                                         |                                                                                                                                                                   | 1.2    | 2.5  |       |
|                                     |                    | T <sub>J</sub> = 125 °C                                        |                                                                                                                                                                   | 0.9    | -    |       |
| DC gate current not to trigger      | I <sub>GD</sub>    | T <sub>J</sub> = T <sub>J</sub> maximum                        | Maximum gate current/voltage not<br>to trigger is the maximum value<br>which will not trigger any unit with<br>rated V <sub>DRM</sub> anode to cathode<br>applied | 10     |      | 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    | $T_J$      |                                               |  | -40 to 125       | °C                  |
| Maximum storage temperature range               | $T_{Stg}$  |                                               |  | -40 to 150       |                     |
| Maximum thermal resistance, junction to case    | $R_{thJC}$ | DC operation                                  |  | 0.15             | K/W                 |
| Maximum thermal resistance, junction to ambient | $R_{thCS}$ | Mounting surface, smooth, flat and greased    |  | 0.04             |                     |
| Mounting force, $\pm 10$ %                      |            | Non-lubricated threads                        |  | 31<br>(275)      | N · m<br>(lbf · in) |
|                                                 |            | Lubricated threads                            |  | 24.5<br>(210)    |                     |
| Approximate weight                              |            |                                               |  | 280              | g                   |
| Case style                                      |            | See dimensions - link at the end of datasheet |  | TO-209AB (TO-93) |                     |

| $\Delta R_{thJC}$ CONDUCTION |                       |                        |                     |       |
|------------------------------|-----------------------|------------------------|---------------------|-------|
| CONDUCTION ANGLE             | SINUSOIDAL CONDUCTION | RECTANGULAR CONDUCTION | TEST CONDITIONS     | UNITS |
| 180°                         | 0.050                 | 0.032                  | $T_J = T_J$ maximum | K/W   |
| 120°                         | 0.063                 | 0.059                  |                     |       |
| 90°                          | 0.080                 | 0.082                  |                     |       |
| 60°                          | 0.118                 | 0.124                  |                     |       |
| 30°                          | 0.225                 | 0.228                  |                     |       |

**Note**

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

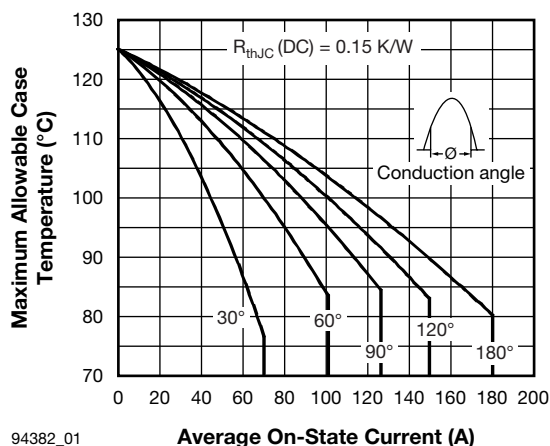


Fig. 1 - Current Ratings Characteristics

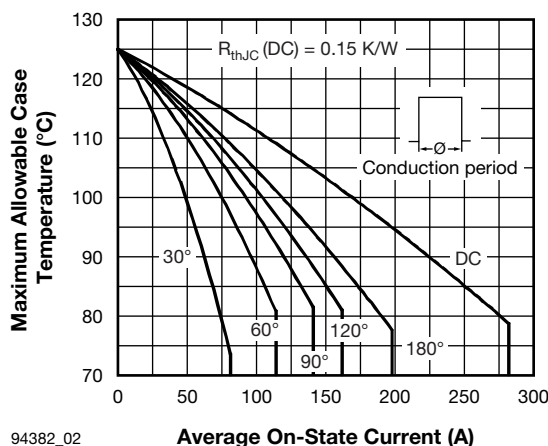


Fig. 2 - Current Ratings Characteristics

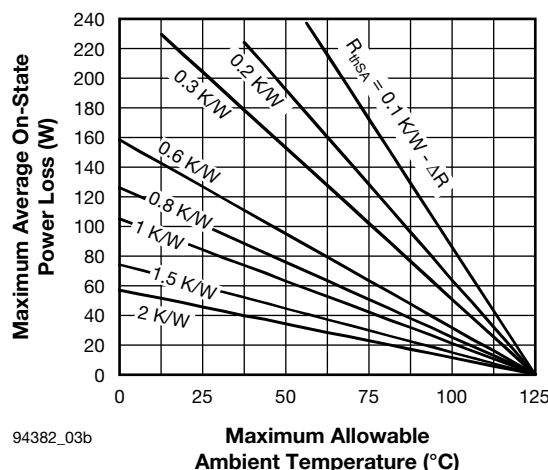
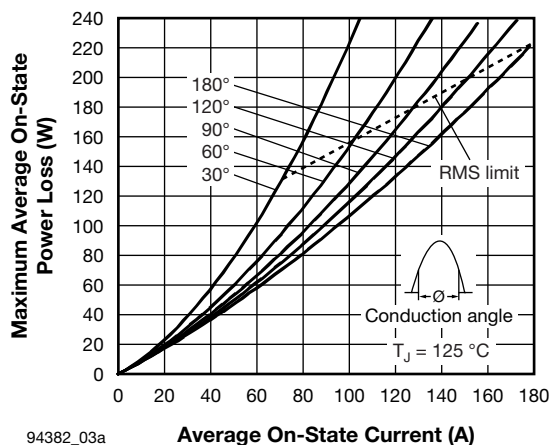


Fig. 3 - On-State Power Loss Characteristics

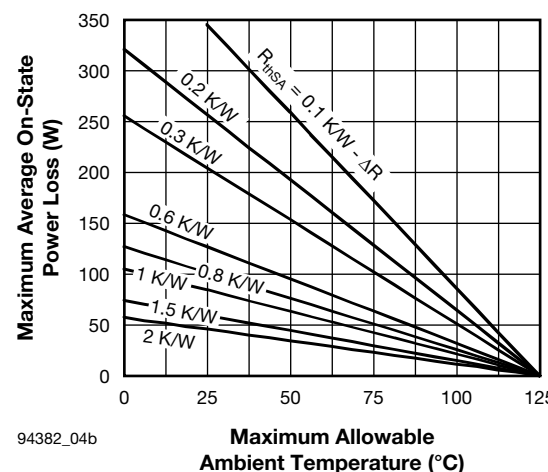
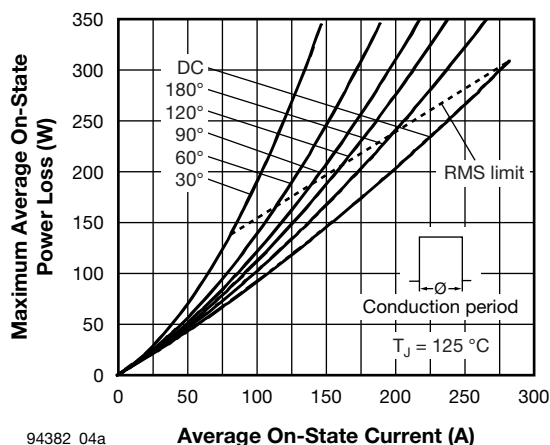


Fig. 4 - On-State Power Loss Characteristics

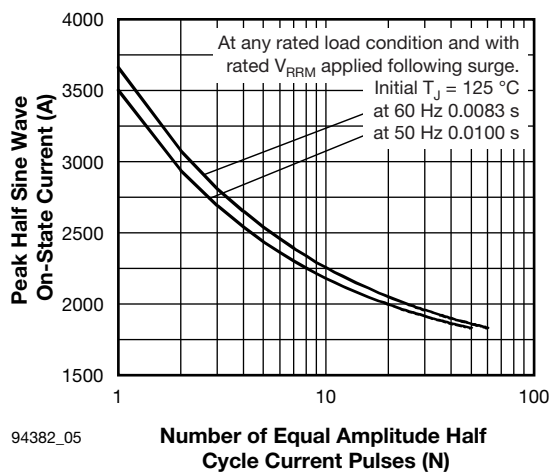


Fig. 5 - Maximum Non-Repetitive Surge Current

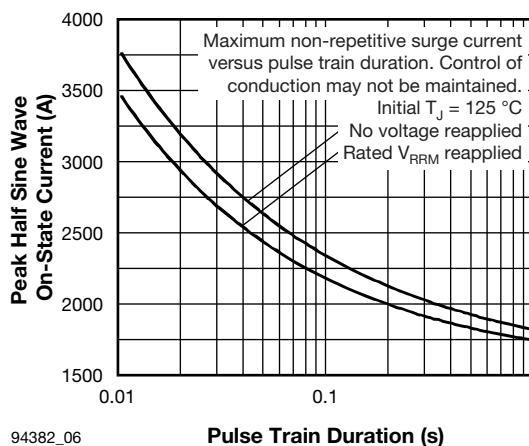


Fig. 6 - Maximum Non-Repetitive Surge Current

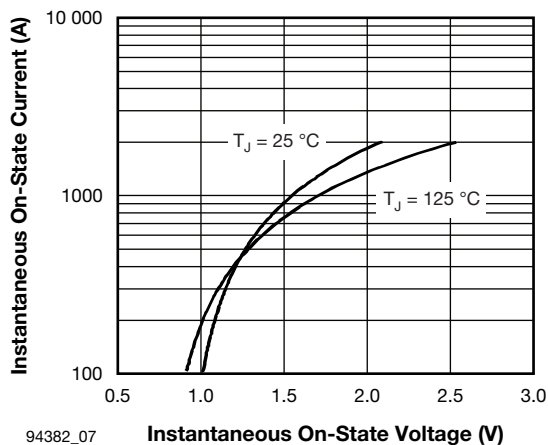


Fig. 7 - On-State Voltage Drop Characteristics

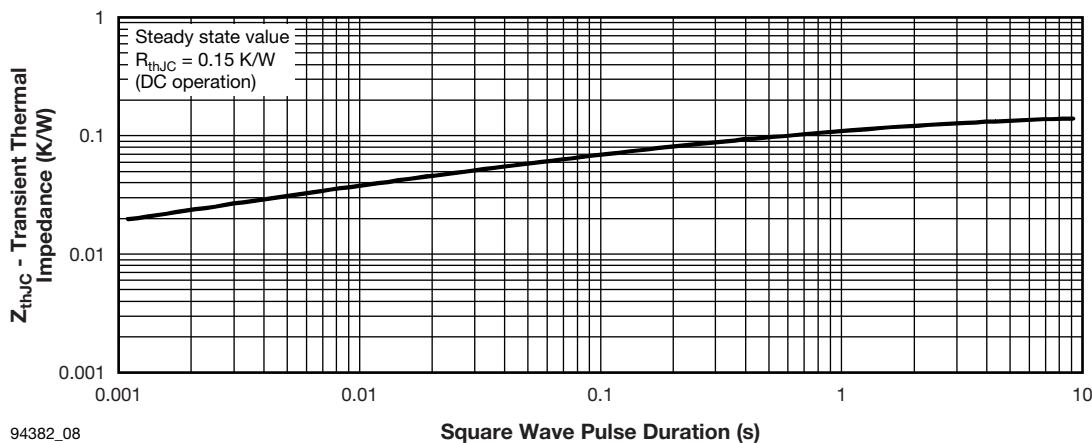


Fig. 8 - Thermal impedance  $Z_{thJC}$  Characteristics

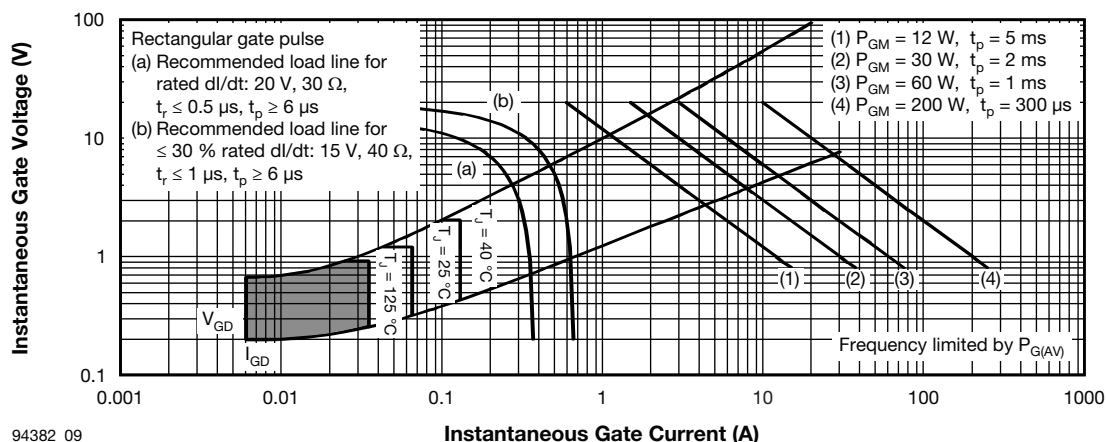


Fig. 9 - Gate Characteristics

## ORDERING INFORMATION TABLE

| Device code | VS-                                                                                                                                                                           | 18 | 1 | RKI | 100 | PbF |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|---|-----|-----|-----|
|             | 1                                                                                                                                                                             | 2  | 3 | 4   | 5   | 6   |
| 1           | - Vishay Semiconductors product                                                                                                                                               |    |   |     |     |     |
| 2           | - $I_{T(AV)}$ rated average output current (rounded/10)                                                                                                                       |    |   |     |     |     |
| 3           | - <ul style="list-style-type: none"> <li>0 = Eyelet terminals (gate and auxiliary cathode leads)</li> <li>1 = Fast-on terminals (gate and auxiliary cathode leads)</li> </ul> |    |   |     |     |     |
| 4           | - Thyristor                                                                                                                                                                   |    |   |     |     |     |
| 5           | - Voltage code x 10 = $V_{RRM}$ (see Voltage Ratings table)                                                                                                                   |    |   |     |     |     |
| 6           | - <ul style="list-style-type: none"> <li>None = Standard production</li> <li>PbF = Lead (Pb)-free</li> </ul>                                                                  |    |   |     |     |     |

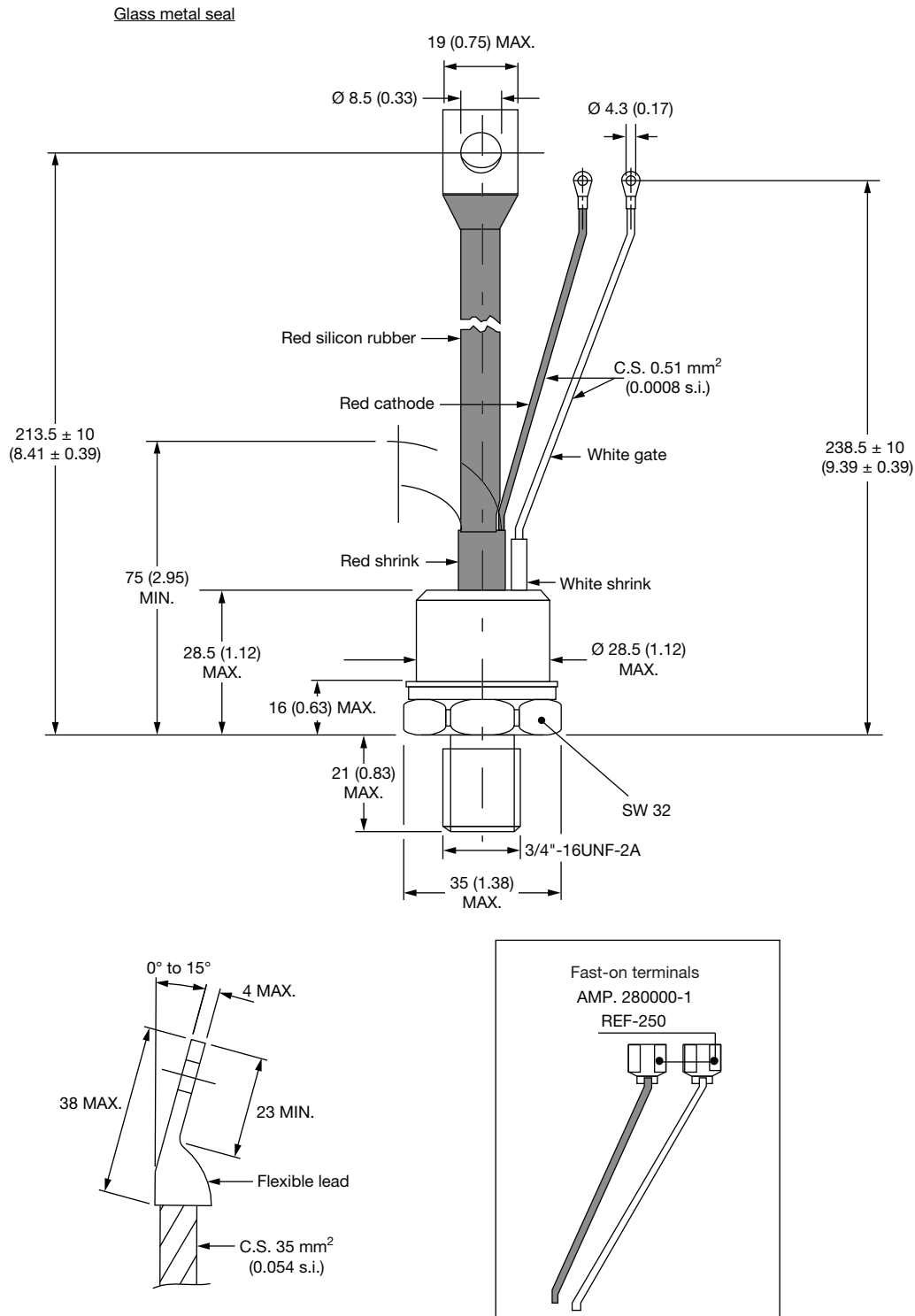
## LINKS TO RELATED DOCUMENTS

Dimensions

[www.vishay.com/doc?95077](http://www.vishay.com/doc?95077)

## TO-209AB (TO-93)

**DIMENSIONS** in millimeters (inches)





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Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

### Офис по работе с юридическими лицами:

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