

## Medium Power Phase Control Thyristors (Stud Version), 50 A



TO-208AC (TO-65)

### FEATURES

- High current rating
- Excellent dynamic characteristics
- $dV/dt = 1000 \text{ V}/\mu\text{s}$  option
- Superior surge capabilities
- Standard package
- Metric threads version available
- Types up to 1200 V  $V_{\text{DRM}}/V_{\text{RRM}}$
- 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-208AC (TO-65) |
| Diode variation                 | Single SCR       |
| $I_{\text{T(AV)}}$              | 50 A             |
| $V_{\text{DRM}}/V_{\text{RRM}}$ | 100 V to 1200 V  |
| $V_{\text{TM}}$                 | 1.60 V           |
| $I_{\text{GT}}$                 | 100 mA           |
| $T_{\text{J}}$                  | -40 °C to 125 °C |

### TYPICAL APPLICATIONS

- Phase control applications in converters
- Lighting circuits
- Battery charges
- Regulated power supplies and temperature and speed control circuit
- Can be supplied to meet stringent military, aerospace and other high reliability requirements

### MAJOR RATINGS AND CHARACTERISTICS

| PARAMETER                       | TEST CONDITIONS | VALUES      | UNITS                 |
|---------------------------------|-----------------|-------------|-----------------------|
| $I_{\text{T(AV)}}$              |                 | 50          | A                     |
|                                 | $T_{\text{C}}$  | 94          | °C                    |
| $I_{\text{T(RMS)}}$             |                 | 80          | A                     |
| $I_{\text{TSM}}$                | 50 Hz           | 1430        | A                     |
|                                 | 60 Hz           | 1490        |                       |
| $I^2t$                          | 50 Hz           | 10.18       | $\text{kA}^2\text{s}$ |
|                                 | 60 Hz           | 9.30        |                       |
| $V_{\text{DRM}}/V_{\text{RRM}}$ |                 | 100 to 1200 | V                     |
| $t_{\text{q}}$                  | Typical         | 110         | $\mu\text{s}$         |
| $T_{\text{J}}$                  |                 | -40 to 125  | °C                    |

### ELECTRICAL SPECIFICATIONS

#### VOLTAGE RATINGS

| TYPE NUMBER | VOLTAGE CODE | $V_{\text{DRM}}/V_{\text{RRM}}$ , MAXIMUM REPETITIVE PEAK AND OFF-STATE VOLTAGE <sup>(1)</sup><br>V | $V_{\text{RSM}}$ , MAXIMUM NON-REPETITIVE PEAK VOLTAGE <sup>(2)</sup><br>V | $I_{\text{DRM}}/I_{\text{RRM}}$ MAXIMUM AT $T_{\text{J}} = T_{\text{J}}$ MAXIMUM<br>mA |
|-------------|--------------|-----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| VS-50RIA    | 10           | 100                                                                                                 | 150                                                                        | 15                                                                                     |
|             | 20           | 200                                                                                                 | 300                                                                        |                                                                                        |
|             | 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/ $\mu\text{s}$

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



## ABSOLUTE MAXIMUM RATINGS

| PARAMETER                                            | SYMBOL              | TEST CONDITIONS                                                                                          |                                  |                                                                       | VALUES | UNITS              |  |
|------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------|----------------------------------|-----------------------------------------------------------------------|--------|--------------------|--|
| Maximum average on-state current at case temperature | I <sub>T(AV)</sub>  | 180° sinusoidal conduction                                                                               |                                  |                                                                       | 50     | A                  |  |
|                                                      |                     |                                                                                                          |                                  |                                                                       | 94     | °C                 |  |
| Maximum RMS on-state current                         | I <sub>T(RMS)</sub> |                                                                                                          |                                  |                                                                       | 80     | 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 | 1430   | A                  |  |
|                                                      |                     | t = 8.3 ms                                                                                               |                                  |                                                                       | 1490   |                    |  |
|                                                      |                     | t = 10 ms                                                                                                | 100 % V <sub>RRM</sub> reapplied |                                                                       | 1200   |                    |  |
|                                                      |                     | t = 8.3 ms                                                                                               |                                  |                                                                       | 1255   |                    |  |
| Maximum I <sup>2</sup> t for fusing                  | I <sup>2</sup> t    | t = 10 ms                                                                                                | No voltage reapplied             |                                                                       | 10.18  | kA <sup>2</sup> s  |  |
|                                                      |                     | t = 8.3 ms                                                                                               |                                  |                                                                       | 9.30   |                    |  |
|                                                      |                     | t = 10 ms                                                                                                | 100 % V <sub>RRM</sub> reapplied |                                                                       | 7.20   |                    |  |
|                                                      |                     | t = 8.3 ms                                                                                               |                                  |                                                                       | 6.56   |                    |  |
| Maximum I <sup>2</sup> √t for fusing                 | I <sup>2</sup> √t   | t = 0.1 to 10 ms, no voltage reapplied, T <sub>J</sub> = T <sub>J</sub> maximum                          |                                  |                                                                       | 101.8  | 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 |                                  |                                                                       | 0.94   | V                  |  |
| High level value of threshold voltage                | V <sub>T(TO)2</sub> | (π × I <sub>T(AV)</sub> < I < 20 × π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum     |                                  |                                                                       | 1.08   |                    |  |
| 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 |                                  |                                                                       | 4.08   | mΩ                 |  |
| High level value of on-state slope resistance        | r <sub>t2</sub>     | (π × I <sub>T(AV)</sub> < I < 20 × π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum     |                                  |                                                                       | 3.34   |                    |  |
| Maximum on-state voltage                             | V <sub>TM</sub>     | I <sub>pk</sub> = 157 A, T <sub>J</sub> = 25 °C                                                          |                                  |                                                                       | 1.60   | V                  |  |
| Maximum holding current                              | I <sub>H</sub>      | T <sub>J</sub> = 25 °C, anode supply 22 V, resistive load, initial I <sub>T</sub> = 2 A                  |                                  |                                                                       | 200    | mA                 |  |
| Latching current                                     | I <sub>L</sub>      | Anode supply 6 V, resistive load                                                                         |                                  |                                                                       | 400    |                    |  |

## SWITCHING

| PARAMETER                                 | SYMBOL | TEST CONDITIONS                                                                                                                                                | VALUES | UNITS |
|-------------------------------------------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------|
| Maximum rate of rise of turned-on current | dI/dt  | $T_C = 125$ °C, $V_{DM} = \text{Rated } V_{DRM}$ , 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  |
|                                           |        |                                                                                                                                                                | 100    |       |
| Typical delay time                        | $t_d$  | $T_C = 25$ °C, $V_{DM} = \text{Rated } V_{DRM}$ , $I_{TM} = 10$ A dc resistive circuit<br>Gate pulse = 10 V, 15 Ω source, $t_p = 20$ μs                        | 0.9    | μs    |
| Typical turn-off time                     | $t_q$  | $T_C = 125$ °C, $I_{TM} = 50$ A, reapplied dV/dt = 20 V/μs<br>dI/dt = - 10 A/μs, $V_R = 50$ 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 $V_{DRM}$ | 200                | V/μs  |
|                                                    |        | $T_J = T_J$ maximum linear to 67 % rated $V_{DRM}$  | 500 <sup>(1)</sup> |       |

### Note

<sup>(1)</sup> Available with dV/dt = 1000 V/μs, to complete code add S90 i.e. 50RIA120S90



| TRIGGERING                          |             |                                                |                                                                                                                                                |              |
|-------------------------------------|-------------|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| PARAMETER                           | SYMBOL      | TEST CONDITIONS                                |                                                                                                                                                | VALUES UNITS |
| Maximum peak gate power             | $P_{GM}$    | $T_J = T_J$ maximum, $t_p \leq 5$ ms           |                                                                                                                                                | 10 W         |
| Maximum average gate power          | $P_{G(AV)}$ |                                                |                                                                                                                                                | 2.5          |
| Maximum peak positive gate current  | $I_{GM}$    |                                                |                                                                                                                                                | 2.5 A        |
| Maximum peak positive gate voltage  | $+V_{GM}$   |                                                |                                                                                                                                                | 20 V         |
| Maximum peak negative gate voltage  | $-V_{GM}$   |                                                |                                                                                                                                                | 10           |
| DC gate current required to trigger | $I_{GT}$    | $T_J = -40$ °C                                 | Maximum required gate trigger current/voltage are the lowest value which will trigger all units 6 V anode to cathode applied                   | 250 mA       |
|                                     |             | $T_J = 25$ °C                                  |                                                                                                                                                | 100          |
|                                     |             | $T_J = 125$ °C                                 |                                                                                                                                                | 50           |
| DC gate voltage required to trigger | $V_{GT}$    | $T_J = -40$ °C                                 |                                                                                                                                                | 3.5 V        |
|                                     |             | $T_J = 25$ °C                                  |                                                                                                                                                | 2.5          |
| DC gate current not to trigger      | $I_{GD}$    | $T_J = T_J$ maximum, $V_{DRM} =$ Rated voltage | 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 | 5.0 mA       |
| DC gate voltage not to trigger      | $V_{GD}$    | $T_J = T_J$ maximum                            |                                                                                                                                                | 0.2 V        |

| THERMAL AND MECHANICAL SPECIFICATIONS                    |                |                                               |                          |                     |
|----------------------------------------------------------|----------------|-----------------------------------------------|--------------------------|---------------------|
| PARAMETER                                                | SYMBOL         | TEST CONDITIONS                               | VALUES                   | UNITS               |
| Maximum operating junction and storage temperature range | $T_J, T_{Stg}$ |                                               | -40 to 125               | °C                  |
| Maximum thermal resistance, junction to case             | $R_{thJC}$     | DC operation                                  | 0.35                     | K/W                 |
| Maximum thermal resistance, case to heatsink             | $R_{thCS}$     | Mounting surface, smooth, flat and greased    | 0.25                     |                     |
| 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                                       |                |                                               | 28                       | g                   |
|                                                          |                |                                               | 1.0                      | oz.                 |
| Case style                                               |                | See dimensions - link at the end of datasheet | TO-208AC (TO-65)         |                     |

| $\Delta R_{thJC}$ CONDUCTION |                       |                        |                     |       |
|------------------------------|-----------------------|------------------------|---------------------|-------|
| CONDUCTION ANGLE             | SINUSOIDAL CONDUCTION | RECTANGULAR CONDUCTION | TEST CONDITIONS     | UNITS |
| 180°                         | 0.078                 | 0.057                  | $T_J = T_J$ maximum | K/W   |
| 120°                         | 0.094                 | 0.098                  |                     |       |
| 90°                          | 0.120                 | 0.130                  |                     |       |
| 60°                          | 0.176                 | 0.183                  |                     |       |
| 30°                          | 0.294                 | 0.296                  |                     |       |

**Note**

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

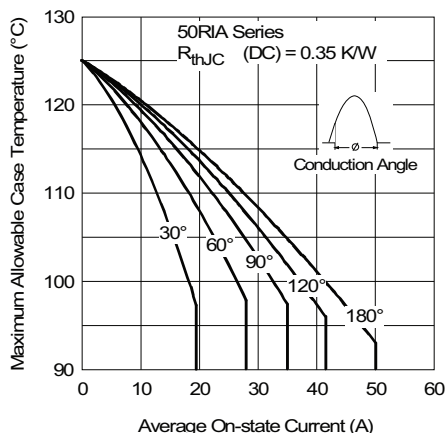


Fig. 1 - Current Ratings Characteristics

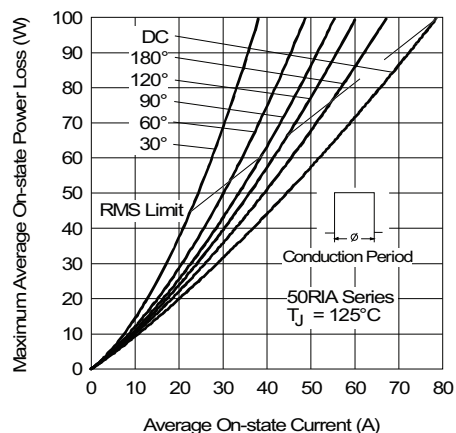


Fig. 4 - On-State Power Loss Characteristics

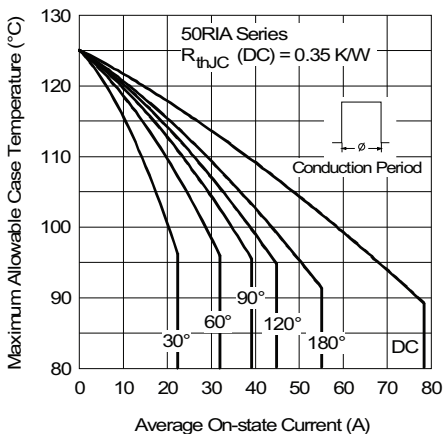


Fig. 2 - Current Ratings Characteristics

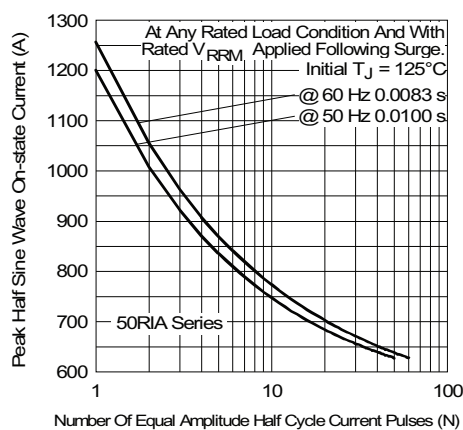


Fig. 5 - Maximum Non-Repetitive Surge Current

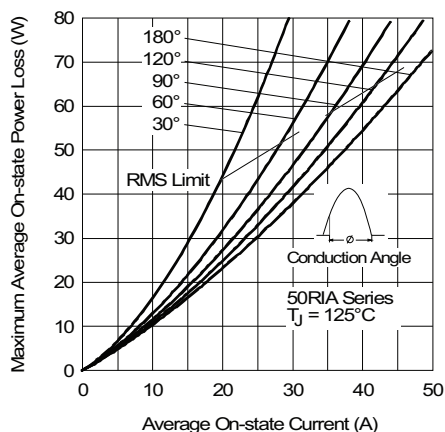


Fig. 3 - On-State Power Loss Characteristics

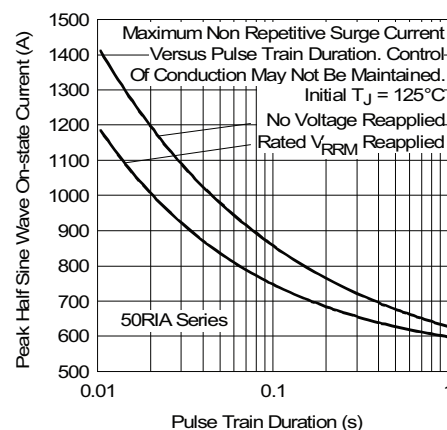


Fig. 6 - Maximum Non-Repetitive Surge Current

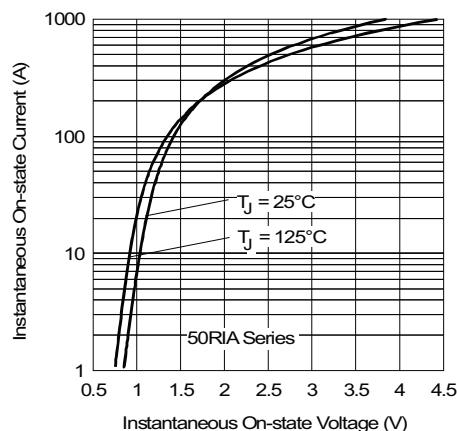


Fig. 7 - Forward Voltage Drop Characteristics

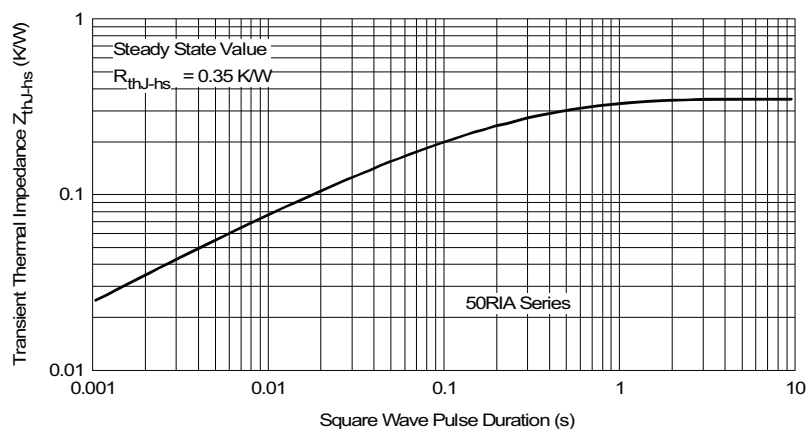


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristics

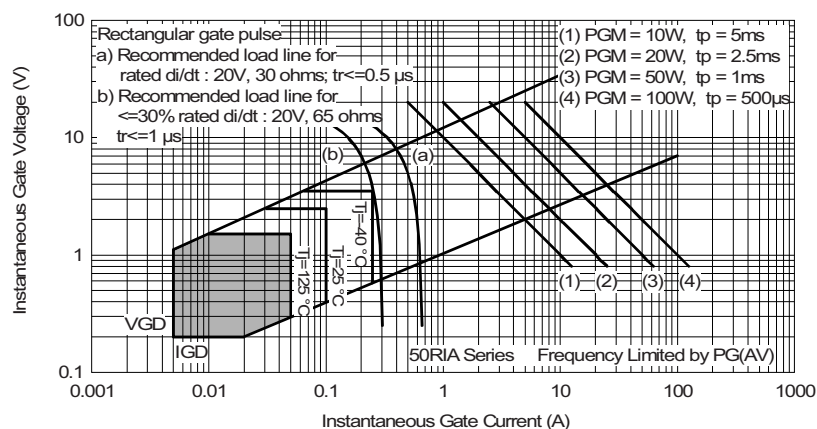


Fig. 9 - Gate Characteristics



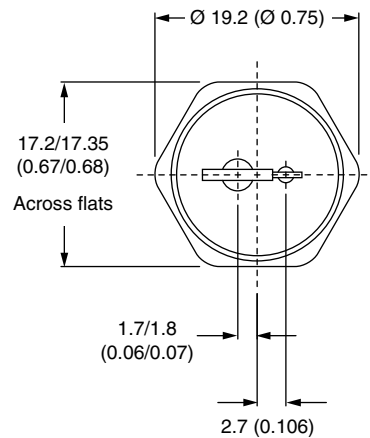
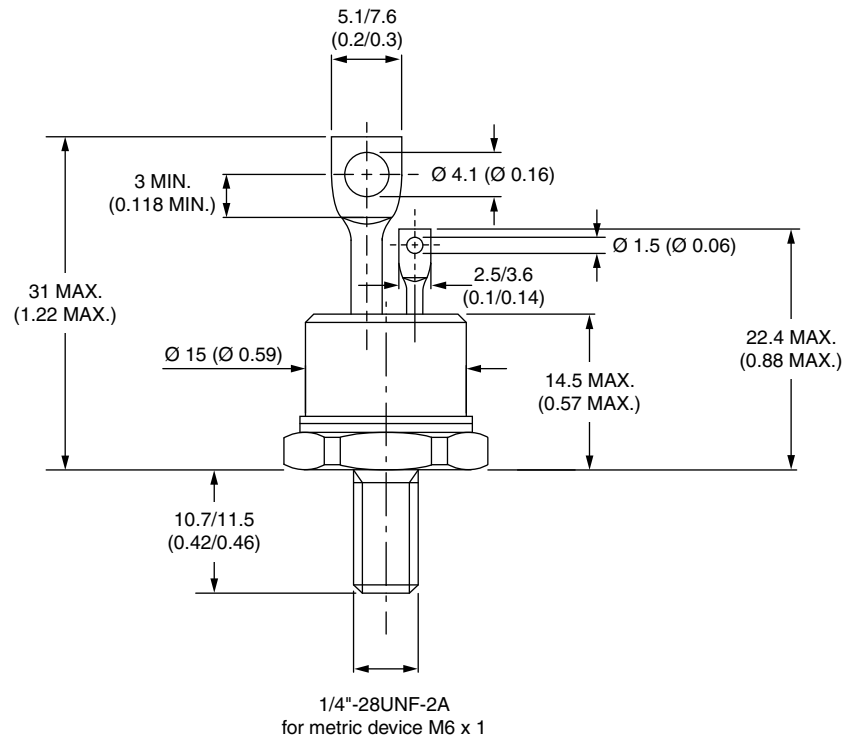
**ORDERING INFORMATION TABLE**

|             |                                                                                                                                                                                  |    |     |     |     |   |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|-----|-----|-----|---|
| Device code | VS-                                                                                                                                                                              | 50 | RIA | 120 | S90 | M |
|             | 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           | - Critical dV/dt: <ul style="list-style-type: none"><li>• None = 500 V/<math>\mu</math>s (standard value)</li><li>• S90 = 1000 V/<math>\mu</math>s (special selection)</li></ul> |    |     |     |     |   |
| 6           | - <ul style="list-style-type: none"><li>• None = Stud base TO-208AC (TO-65) 1/4" 28UNF-2A</li><li>• M = Stud base TO-208AC (TO-65) M6 x 1</li></ul>                              |    |     |     |     |   |

| LINKS TO RELATED DOCUMENTS |                                                                        |
|----------------------------|------------------------------------------------------------------------|
| Dimensions                 | <a href="http://www.vishay.com/doc?95334">www.vishay.com/doc?95334</a> |

## TO-208AC (TO-65)

**DIMENSIONS** in millimeters (inches)





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