

Medium Power Phase Control Thyristors (Stud Version), 16 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



RoHS
COMPLIANT

| PRIMARY CHARACTERISTICS | |
|-------------------------|---|
| $I_{T(AV)}$ | 16 A |
| V_{DRM}/V_{RRM} | 100 V, 200 V, 400 V, 600 V, 800 V, 1000 V, 1200 V |
| V_{TM} | 1.75 V |
| I_{GT} | 60 mA |
| T_J | -65 °C to +125 °C |
| Package | TO-48 (TO-208AA) |
| Circuit configuration | Single SCR |

TYPICAL APPLICATIONS

- Medium power switching
- Phase control applications

| MAJOR RATINGS AND CHARACTERISTICS | | | |
|-----------------------------------|-----------------|-------------|------------------|
| PARAMETER | TEST CONDITIONS | VALUES | UNITS |
| $I_{T(AV)}$ | | 16 | A |
| | T_C | 85 | °C |
| $I_{T(RMS)}$ | | 35 | A |
| I_{TSM} | 50 Hz | 340 | A |
| | 60 Hz | 360 | |
| I^2t | 50 Hz | 574 | A ² s |
| | 60 Hz | 524 | |
| 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 ⁽¹⁾ V | V_{RSM} , MAXIMUM NON-REPETITIVE PEAK VOLTAGE ⁽²⁾ V | I_{DRM}/I_{RRM} MAXIMUM AT $T_J = T_J$ MAXIMUM mA |
| VS-16RIA | 10 | 100 | 150 | 20 |
| | 20 | 200 | 300 | 10 |
| | 40 | 400 | 500 | |
| | 60 | 600 | 700 | |
| | 80 | 800 | 900 | |
| | 100 | 1000 | 1100 | |
| | 120 | 1200 | 1300 | |

Notes

- ⁽¹⁾ Units may be broken over non-repetitively in the off-state direction without damage, if di/dt does not exceed 20 A/μs
⁽²⁾ 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 | | 16 | A |
| | | | | 85 | °C |
| Maximum RMS on-state current | $I_{T(RMS)}$ | | | 35 | A |
| Maximum peak, one-cycle non-repetitive surge current | I_{TSM} | t = 10 ms | No voltage reapplied | Sinusoidal half wave, initial $T_J = T_J$ maximum | A |
| | | t = 8.3 ms | | | |
| | | t = 10 ms | 100 % V_{RRM} reapplied | | |
| | | t = 8.3 ms | | | |
| Maximum I^2t for fusing | I^2t | t = 10 ms | No voltage reapplied | | A ² s |
| | | t = 8.3 ms | | | |
| | | t = 10 ms | 100 % V_{RRM} reapplied | | |
| | | t = 8.3 ms | | | |
| 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 | | 5740 | A ² √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) | | 0.97 | V |
| High level value of threshold voltage | $V_{T(TO)2}$ | (I $> \pi \times I_{T(AV)}$, $T_J = T_J$ maximum) | | 1.24 | |
| 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) | | 17.9 | mΩ |
| High level value of on-state slope resistance | r_{t2} | (I $> \pi \times I_{T(AV)}$, $T_J = T_J$ maximum) | | 13.6 | |
| Maximum on-state voltage | V_{TM} | $I_{pk} = 50$ A, $T_J = 25$ °C | | 1.75 | 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, $V_{DM} = \text{Rated } V_{DRM}$ Gate pulse = 20 V, 15 Ω, $t_p = 6$ μs, $t_r = 0.1$ μs maximum $I_{TM} = (2 \times \text{rated } di/dt)$ A | | 200 | A/μs |
| | | | | $V_{DRM} \leq 600$ V | |
| | | | | $V_{DRM} \leq 800$ V | |
| | | | | $V_{DRM} \leq 1000$ V | |
| 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 W | | 110 | |

Note

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

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

Note

- ⁽¹⁾ Available with: dV/dt = 1000 V/μs, to complete code add S90 i.e. 16RIA120S90



| TRIGGERING | | | | | |
|-------------------------------------|-------------|--|--|--------|-------|
| PARAMETER | SYMBOL | TEST CONDITIONS | | VALUES | UNITS |
| Maximum peak gate power | P_{GM} | $T_J = T_J$ maximum | | 8.0 | W |
| Maximum average gate power | $P_{G(AV)}$ | | | 2.0 | |
| Maximum peak positive gate current | I_{GM} | $T_J = T_J$ maximum | | 1.5 | A |
| Maximum peak negative gate voltage | $-V_{GM}$ | $T_J = T_J$ maximum | | 10 | V |
| DC gate current required to trigger | I_{GT} | $T_J = -65\text{ }^\circ\text{C}$ | Maximum required gate trigger current/voltage are the lowest value which will trigger all units 6 V anode to cathode applied | 90 | mA |
| | | $T_J = 25\text{ }^\circ\text{C}$ | | 60 | |
| | | $T_J = 125\text{ }^\circ\text{C}$ | | 35 | |
| DC gate voltage required to trigger | V_{GT} | $T_J = -65\text{ }^\circ\text{C}$ | | 3.0 | V |
| | | $T_J = 25\text{ }^\circ\text{C}$ | | 2.0 | |
| | | $T_J = 125\text{ }^\circ\text{C}$ | | 1.0 | |
| DC gate current not to trigger | I_{GD} | $T_J = T_J$ maximum, $V_{DRM} =$ Rated value | | 2.0 | mA |
| DC gate voltage not to trigger | V_{GD} | $T_J = T_J$ maximum, $V_{DRM} =$ Rated value | Maximum gate current/voltage not to trigger is the maximum value which will not trigger any unit with rated V_{DRM} anode to cathode applied | 0.2 | V |

| THERMAL AND MECHANICAL SPECIFICATIONS | | | | | |
|--|----------------|--|------------------|------------------|------------------|
| PARAMETER | SYMBOL | TEST CONDITIONS | VALUES | | UNITS |
| Maximum operating junction and storage temperature range | T_J, T_{Stg} | | -65 to +125 | | $^\circ\text{C}$ |
| Maximum thermal resistance, junction to case | R_{thJC} | DC operation | 0.86 | | K/W |
| Maximum thermal resistance, case to heat sink | R_{thCS} | Mounting surface, smooth, flat and greased | 0.35 | | |
| | | | TO NUT | TO DEVICE | |
| Mounting torque | | Lubricated threads (Non-lubricated threads) | 20 (27.5) | 25 | lbf · in |
| | | | 0.23 (0.32) | 0.29 | kgf · m |
| | | | 2.3 (3.1) | 2.8 | N · m |
| Approximate weight | | | 14 | | g |
| | | | 0.49 | | oz. |
| Case style | | See dimensions - link at the end of datasheet | TO-48 (TO-208AA) | | |

| ΔR_{thJC} CONDUCTION | | | | |
|--|-----------------------|------------------------|---------------------|-------|
| CONDUCTION ANGLE | SINUSOIDAL CONDUCTION | RECTANGULAR CONDUCTION | TEST CONDITIONS | UNITS |
| 180° | 0.21 | 0.15 | $T_J = T_J$ maximum | K/W |
| 120° | 0.25 | 0.25 | | |
| 90° | 0.31 | 0.34 | | |
| 60° | 0.45 | 0.47 | | |
| 30° | 0.76 | 0.76 | | |

Note

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

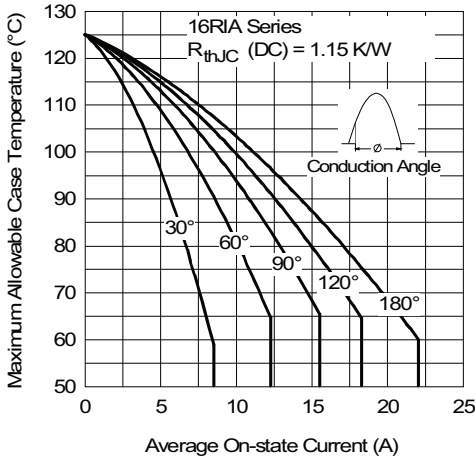


Fig. 1 - Current Ratings Characteristics

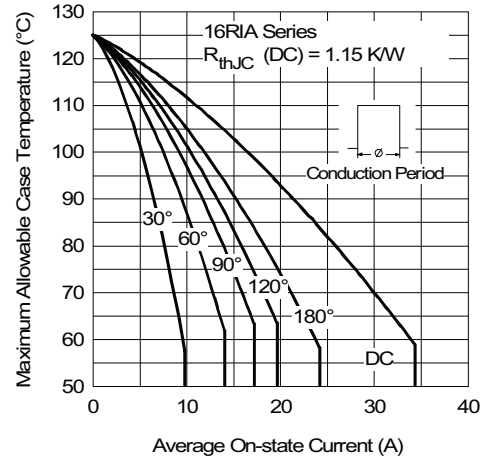


Fig. 2 - Current Ratings Characteristics

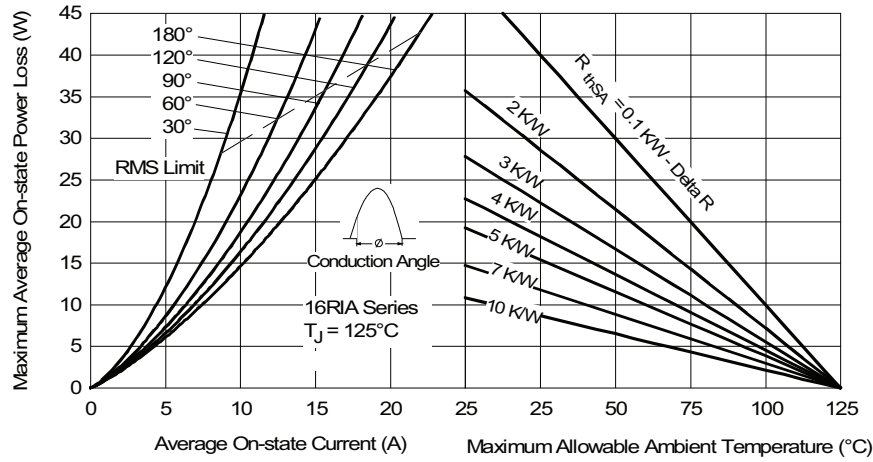


Fig. 3 - On-State Power Loss Characteristics

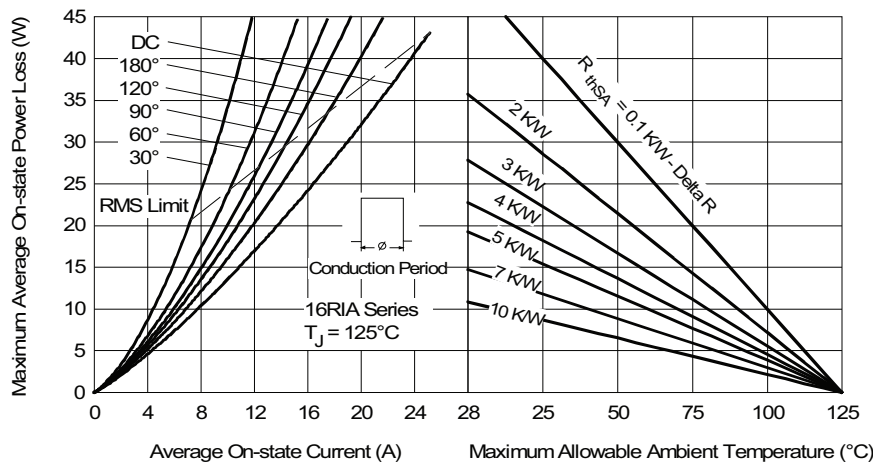


Fig. 4 - On-State Power Loss Characteristics



Fig. 5 - Maximum Non-Repetitive Surge Current



Fig. 6 - Maximum Non-Repetitive Surge Current



Fig. 7 - Forward Voltage Drop Characteristics

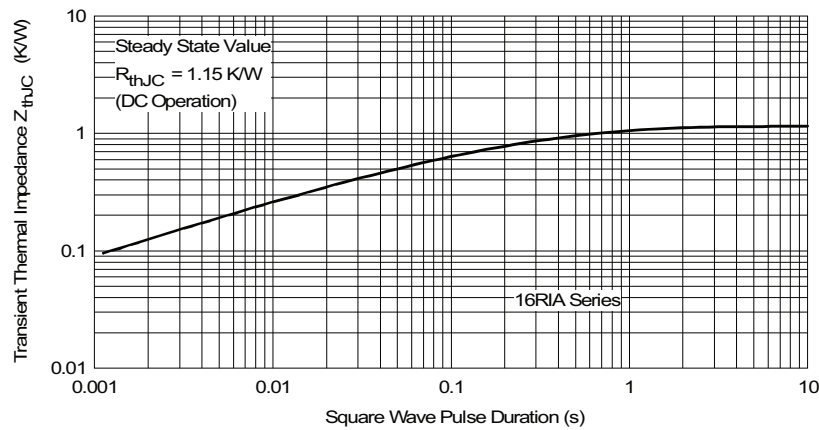


Fig. 8 - Thermal Impedance Z_{thJC} Characteristics

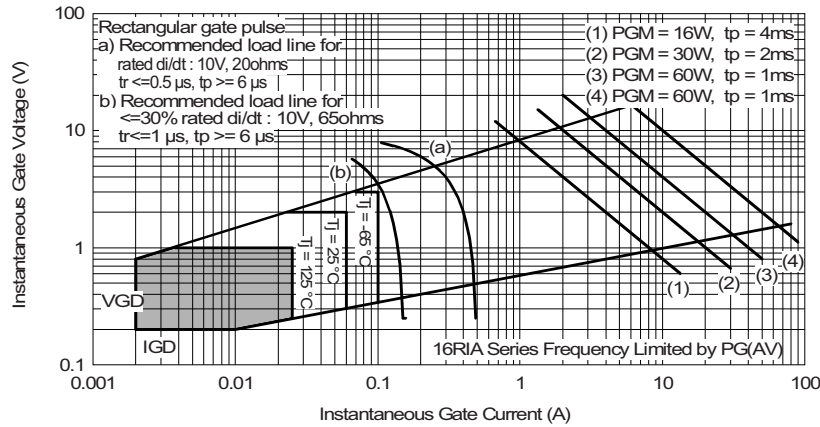


Fig. 9 - Gate Characteristics

ORDERING INFORMATION TABLE

| | | | | | | |
|-------------|------------|-----------|------------|------------|----------|------------|
| Device code | VS- | 16 | RIA | 120 | M | S90 |
| | ① | ② | ③ | ④ | ⑤ | ⑥ |

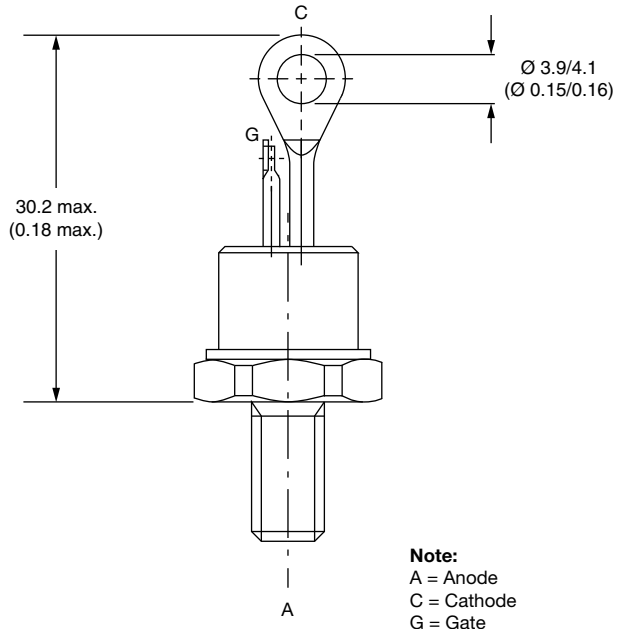
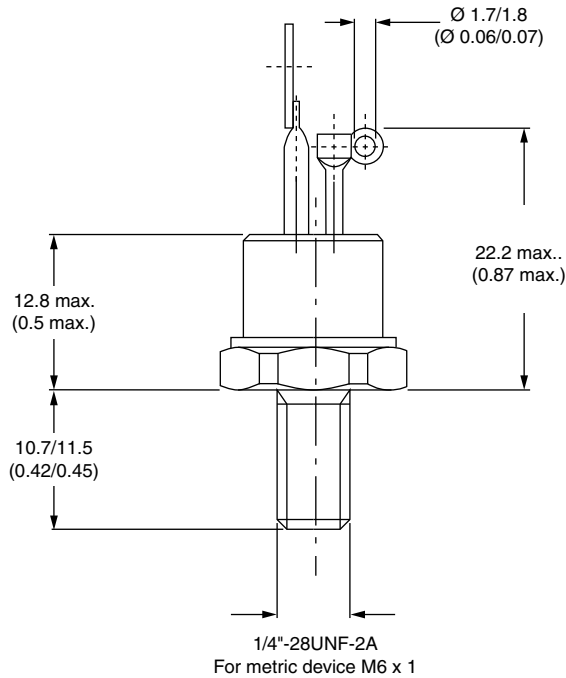
- 1** - Vishay Semiconductors product
- 2** - Current code
- 3** - Essential part number
- 4** - Voltage code x 10 = V_{RRM} (see Voltage Ratings table)
- 5** - None = stud base TO-48 (TO-208AA) 1/4" 28UNF-2A
M = stud base TO-48 (TO-208AA) M6 x 1
- 6** - Critical dV/dt:
None = 300 V/μs (standard value)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

| LINKS TO RELATED DOCUMENTS | |
|----------------------------|--|
| Dimensions | www.vishay.com/doc?95333 |

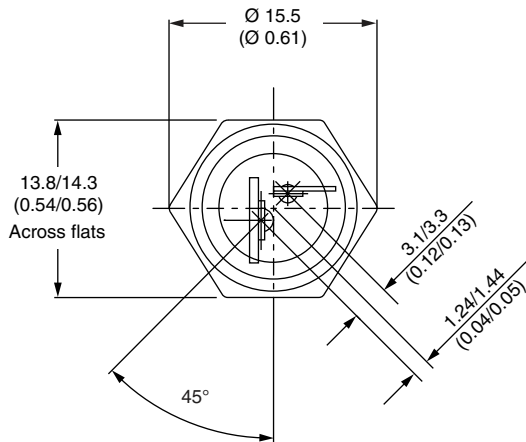


TO-208AA (TO-48)

DIMENSIONS in millimeters (inches)



Note:
A = Anode
C = Cathode
G = Gate





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