Bulletin I2404 rev. A 07/00

International
IOR Rectifier

# 16RIA SERIES

**MEDIUM POWER THYRISTORS** **Stud Version**

16A

## 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 1600V $V_{DRM}$/ $V_{RRM}$

## Typical Applications

- Medium power switching
- Phase control applications
- Can be supplied to meet stringent military, aerospace and other high-reliability requirements

## Major Ratings and Characteristics

| Parameters | | 16RIA | | Units |
|---|---|---|---|---|
| | | 10 to 120 | 140 to 160 | |
| $I_{T(AV)}$ | | 16 | 16 | A |
| | @ $T_C$ | 85 | 85 | °C |
| $I_{T(RMS)}$ | | 35 | 35 | A |
| $I_{TSM}$ | @50Hz | 340 | 225 | A |
| | @60Hz | 360 | 235 | A |
| $I^2t$ | @50Hz | 574 | 255 | $A^2s$ |
| | @60Hz | 524 | 235 | $A^2s$ |
| $V_{DRM}/V_{RRM}$ | | 100 to 1200 | 1400 to 1600 | V |
| $t_q$ | typical | 110 | | µs |
| $T_J$ | | - 65 to 125 | | °C |



Case Style
TO-208AA (TO-48)

## ELECTRICAL SPECIFICATIONS

### Voltage Ratings

| Type number | Voltage Code | $V_{DRM}/V_{RRM}$, max. repetitive peak and off-state voltage (1) V | $V_{RSM}$, maximum non-repetitive peak voltage (2) V | $I_{DRM}/I_{RRM}$ max. @ $T_J = T_J$ max. mA |
|---|---|---|---|---|
| 16RIA | 10 | 100 | 150 | 20 |
| | 20 | 200 | 300 | 10 |
| | 40 | 400 | 500 | |
| | 60 | 600 | 700 | |
| | 80 | 800 | 900 | |
| | 100 | 1000 | 1100 | |
| | 120 | 1200 | 1300 | |
| | 140 | 1400 | 1500 | |
| | 160 | 1600 | 1700 | |

(1) Units may be broken over non-repetitively in the off-state direction without damage, if dI/dt does not exceed 20A/µs
(2) For voltage pulses with $t_p \leq 5$ms

### On-state Conduction

| Parameter | | 16RIA 10 to 120 | 16RIA 140 to 160 | Units | Conditions | | |
|---|---|---|---|---|---|---|---|
| $I_{T(AV)}$ | Max. average on-state current | 16 | 16 | A | 180° sinusoidal conduction | | |
| | @ Case temperature | 85 | 85 | °C | | | |
| $I_{T(RMS)}$ | Max. RMS on-state current | 35 | 35 | A | | | |
| $I_{TSM}$ | Max. peak, one-cycle non-repetitive surge current | 340 | 225 | A | t = 10ms | No voltage reapplied | Sinusoidal half wave, Initial $T_J = T_J$ max. |
| | | 360 | 235 | | t = 8.3ms | | |
| | | 285 | 190 | | t = 10ms | 100% $V_{RRM}$ reapplied | |
| | | 300 | 200 | | t = 8.3ms | | |
| $I^2t$ | Maximum $I^2t$ for fusing | 574 | 255 | $A^2s$ | t = 10ms | No voltage reapplied | |
| | | 524 | 235 | | t = 8.3ms | | |
| | | 405 | 180 | | t = 10ms | 100% $V_{RRM}$ reapplied | |
| | | 375 | 165 | | t = 8.3ms | | |
| $I^2\sqrt{t}$ | Maximum $I^2\sqrt{t}$ for fusing | 5740 | 2550 | $A^2\sqrt{s}$ | t = 0.1 to 10ms, no voltage reapplied, $T_J = T_J$ max. | | |
| $V_{T(TO)1}$ | Low level value of threshold voltage | 0.97 | 1.14 | V | $(16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$, $T_J = T_J$ max. | | |
| $V_{T(TO)2}$ | High level value of threshold voltage | 1.24 | 1.31 | | $(I > \pi \times I_{T(AV)})$, $T_J = T_J$ max. | | |
| $r_{t1}$ | Low level value of on-state slope resistance | 17.9 | 14.83 | mΩ | $(16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$, $T_J = T_J$ max. | | |
| $r_{t2}$ | High level value of on-state slope resistance | 13.6 | 12.03 | | $(I > \pi \times I_{T(AV)})$, $T_J = T_J$ max. | | |
| $V_{TM}$ | Max. on-state voltage | 1.75 | --- | V | $I_{pk}$= 50 A, $T_J$ = 25°C | | |
| | | --- | 1.80 | | | | |
| $I_H$ | Maximum holding current | 130 | | mA | $T_J$ = 25°C. Anode supply 6V, resistive load, | | |
| $I_L$ | Latching current | 200 | | | | | |

## Switching

| | Parameter | | 16RIA | Units | Conditions |
|---|---|---|---|---|---|
| di/dt | Max. rate of rise of turned-on current | $V_{DRM} \leq 600V$ | 200 | A/µs | $T_J = T_J$ max., $V_{DM}$ = rated $V_{DRM}$<br>Gate pulse = 20V, 15Ω, $t_p$ = 6µs, $t_r$ = 0.1µs max.<br>$I_{TM}$ = (2x rated di/dt) A |
| | | $V_{DRM} \leq 800V$ | 180 | | |
| | | $V_{DRM} \leq 1000V$ | 160 | | |
| | | $V_{DRM} \leq 1600V$ | 150 | | |
| $t_{gt}$ | Typical turn-on time | | 0.9 | µs | $T_J$ = 25°C,<br>at = rated $V_{DRM}/V_{RRM}$, $T_J$ = 125°C |
| $t_{rr}$ | Typical reverse recovery time | | 4 | | $T_J = T_J$ max.,<br>$I_{TM} = I_{T(AV)}$, $t_p$ > 200µs, di/dt = -10A/µs |
| $t_q$ | Typical turn-off time | | 110 | | $T_J = T_J$ max., $I_{TM} = I_{T(AV)}$, $t_p$ > 200µs, $V_R$ = 100V,<br>di/dt = -10A/µs, dv/dt = 20V/µs linear to<br>67% $V_{DRM}$, gate bias 0V-100W |

(*) $t_q$ = 10µsup to 600V, $t_q$ = 30µs up to 1600V available on special request.

## Blocking

| | Parameter | 16RIA | Units | Conditions |
|---|---|---|---|---|
| dv/dt | Max. critical rate of rise of off-state voltage | 100 | V/µs | $T_J = T_J$ max. linear to 100% rated $V_{DRM}$ |
| | | 300 (*) | | $T_J = T_J$ max. linear to 67% rated $V_{DRM}$ |

(**) Available with: dv/dt = 1000V/µs, to complete code add S90 i.e. 16RIA160S90.

## Triggering

| | Parameter | 16RIA | Units | Conditions | |
|---|---|---|---|---|---|
| $P_{GM}$ | Maximum peak gate power | 8.0 | W | $T_J = T_J$ max. | |
| $P_{G(AV)}$ | Maximum average gate power | 2.0 | | | |
| $I_{GM}$ | Max. peak positive gate current | 1.5 | A | $T_J = T_J$ max. | |
| $-V_{GM}$ | Maximum peak negative gate voltage | 10 | V | $T_J = T_J$ max. | |
| $I_{GT}$ | DC gate current required to trigger | 90 | mA | $T_J$ = - 65°C | Max. required gate trigger current/ voltage are the lowest value which will trigger all units 6V anode-to-cathode applied |
| | | 60 | | $T_J$ = 25°C | |
| | | 35 | | $T_J$ = 125°C | |
| $V_{GT}$ | DC gate voltage required to trigger | 3.0 | V | $T_J$ = - 65°C | |
| | | 2.0 | | $T_J$ = 25°C | |
| | | 1.0 | V | $T_J$ = 125°C | |
| $I_{GD}$ | DC gate current not to trigger | 2.0 | mA | $T_J = T_J$ max., $V_{DRM}$ = rated value | |
| $V_{GD}$ | DC gate voltage not to trigger | 0.2 | V | $T_J = T_J$ max.<br>$V_{DRM}$ = rated value | Max. gate current/ voltage not to trigger is the max. value which will not trigger any unit with rated $V_{DRM}$ anode-to-cathode applied |

## Thermal and Mechanical Specification

| | Parameter | 16RIA | | Units | Conditions |
|---|---|---|---|---|---|
| $T_J$ | Max. operating temperature range | - 65 to 125 | | °C | |
| $T_{stg}$ | Max. storage temperature range | - 65 to 125 | | °C | |
| $R_{thJC}$ | Max. thermal resistance, junction to case | 0.86 | | K/W | DC operation |
| $R_{thCS}$ | Max. thermal resistance, case to heatsink | 0.35 | | K/W | Mounting surface, smooth, flat and greased |
| T | Mounting torque | to nut | to device | | |
| | | 20(27.5) | 25 | lbf-in | Lubricated threads |
| | | 0.23(0.32) | 0.29 | kgf.m | (Non-lubricated threads) |
| | | 2.3(3.1) | 2.8 | Nm | |
| wt | Approximate weight | 14 (0.49) | | g (oz) | |
| | Case style | TO-208AA (TO-48) | | | See Outline Table |

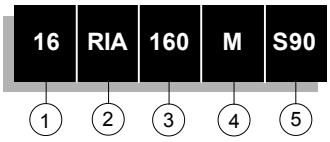
## $\Delta R_{thJC}$ Conduction

(The following table shows the increment of thermal resistence $R_{thJC}$ when devices operate at different conduction angles than DC)

| Conduction angle | Sinusoidal conduction | Rectangular conduction | Units | Conditions |
|---|---|---|---|---|
| 180° | 0.21 | 0.15 | K/W | $T_J = T_J$ max. |
| 120° | 0.25 | 0.25 | | |
| 90° | 0.31 | 0.34 | | |
| 60° | 0.45 | 0.47 | | |
| 30° | 0.76 | 0.76 | | |

## Ordering Information Table

**Device Code**




**1** - Current code

**2** - Essential part number

**3** - Voltage code: Code x 10 = $V_{RRM}$ (See Voltage Rating Table)

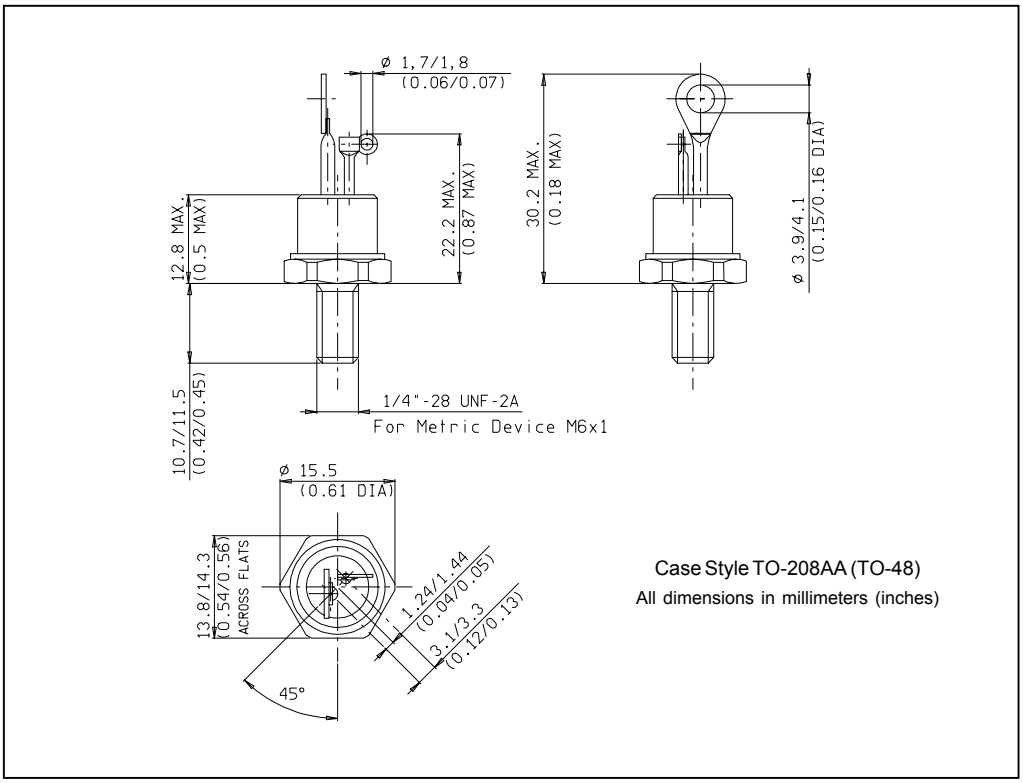
**4** - None = Stud base TO-208AA (TO-48) 1/4" 28UNF-2A

M = Stud base TO-208AA (TO-48) M6 X 1

**5** - Critical dv/dt: None = 300V/µs (Standard value)

S90 = 1000V/µs (Special selection)

Outline Table




Case Style TO-208AA (TO-48)
All dimensions in millimeters (inches)

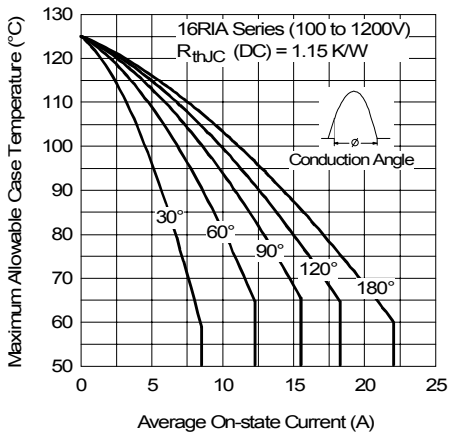



Fig. 1 - Current Ratings Characteristic

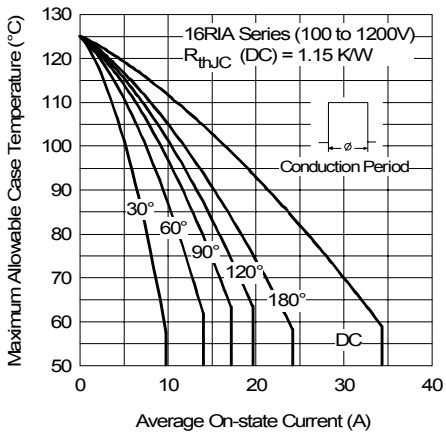



Fig. 2 - Current Ratings Characteristic

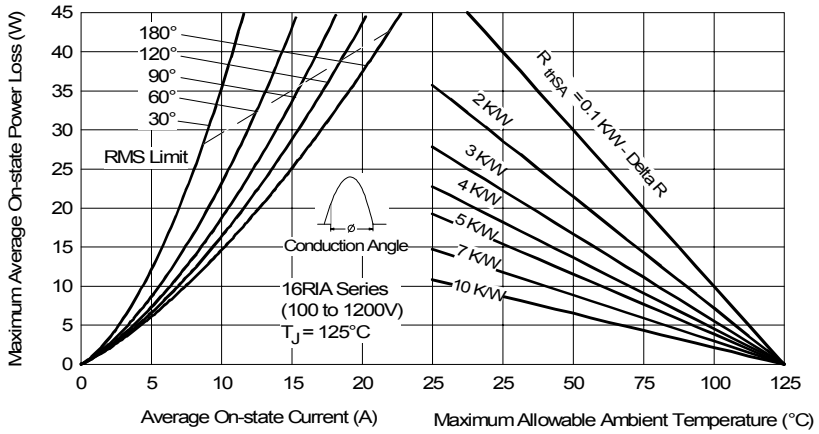



Fig. 3 - On-state Power Loss Characteristics

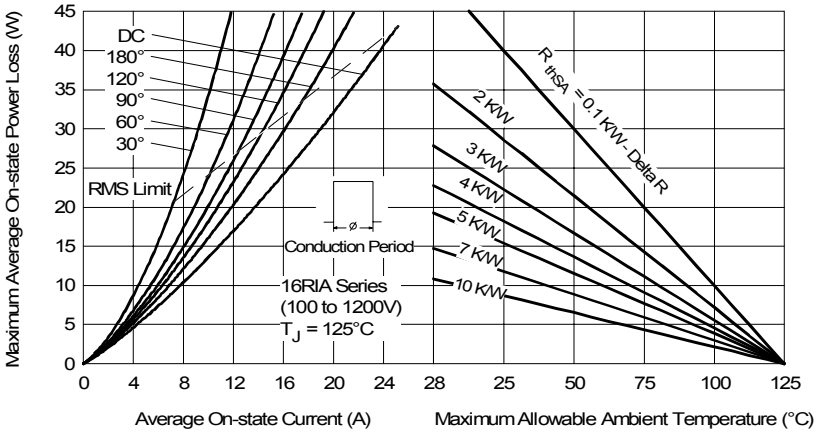



Fig. 4 - On-state Power Loss Characteristics

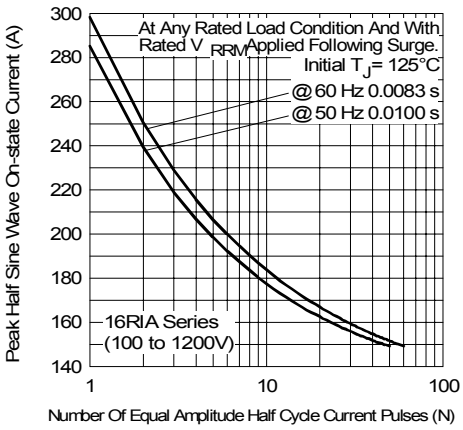



Fig. 5 - Maximum Non-Repetitive Surge Current

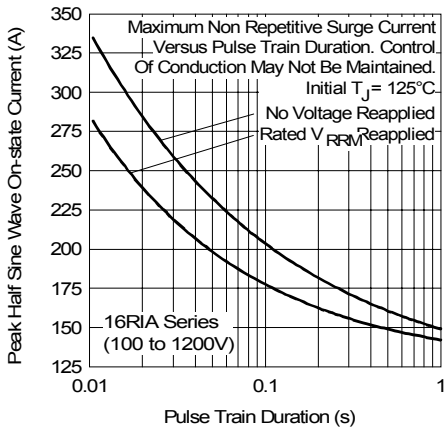



Fig. 6 - Maximum Non-Repetitive Surge Current

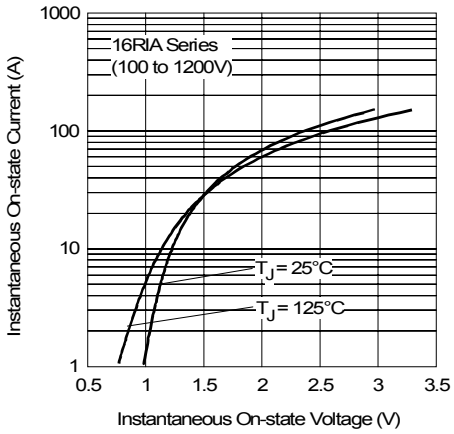



Fig. 7 - Forward Voltage Drop Characteristics

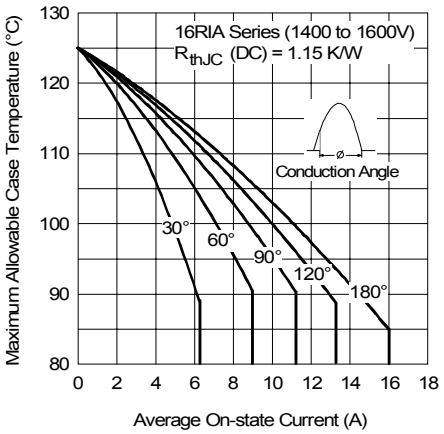



Fig. 8 - Current Ratings Characteristics

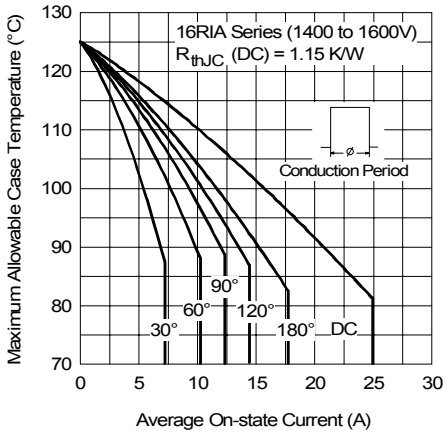



Fig. 9 - Current Ratings Characteristics

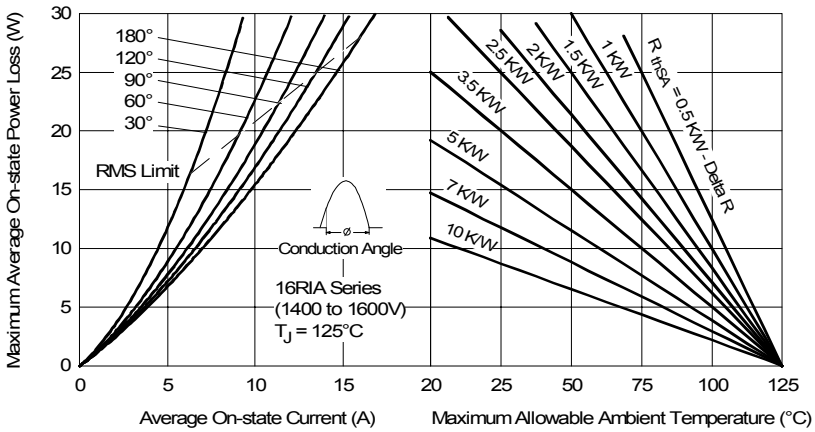



Fig. 10 - On-state Power Loss Characteristics

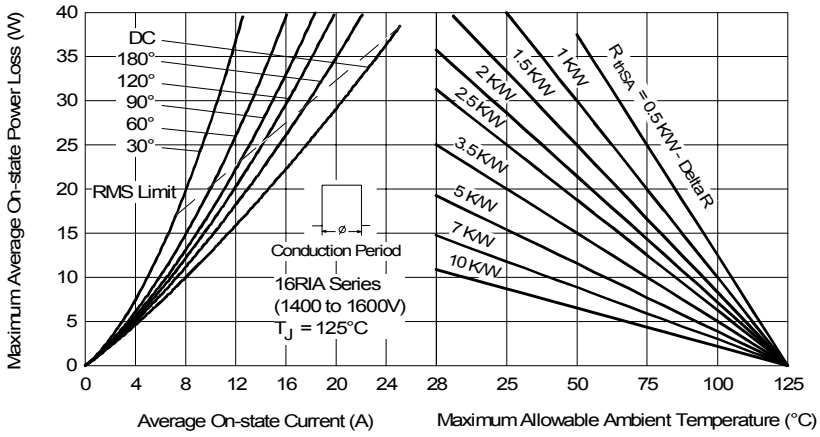



Fig. 11 - On-state Power Loss Characteristics

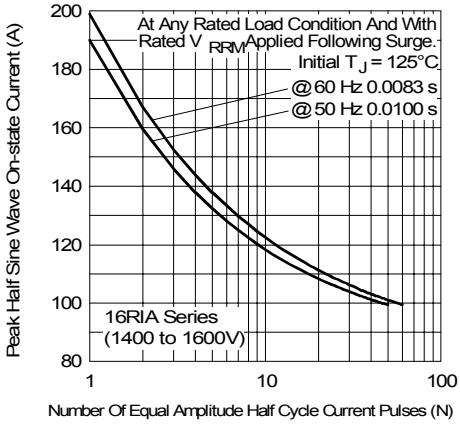



Fig. 12 - Maximum Non-Repetitive Surge Current

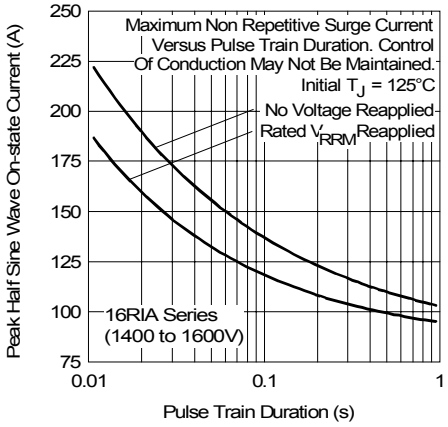



Fig. 13 - Maximum Non-Repetitive Surge Current

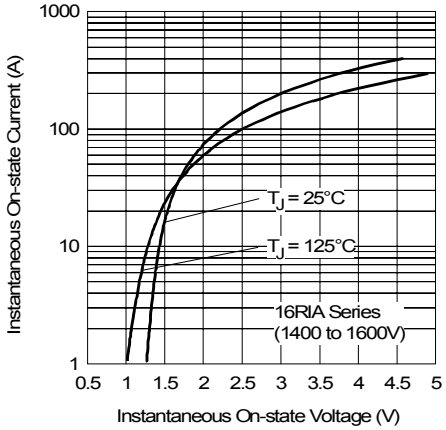



Fig. 14 - Forward Voltage Drop Characteristics

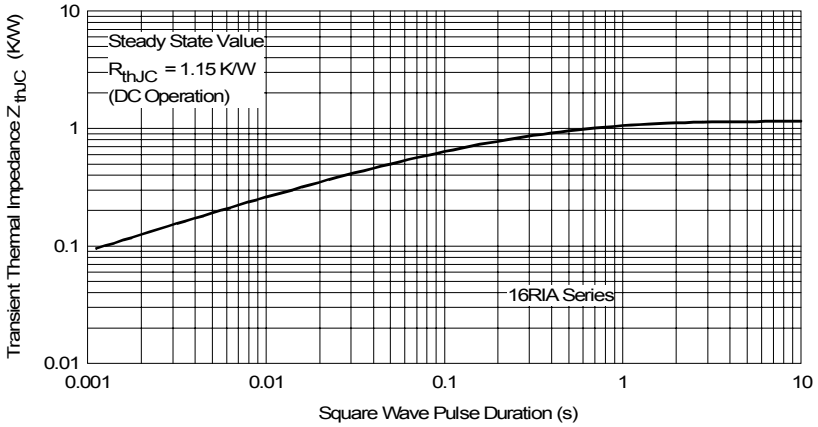



Fig. 15 - Thermal Impedance $Z_{thJC}$ Characteristics

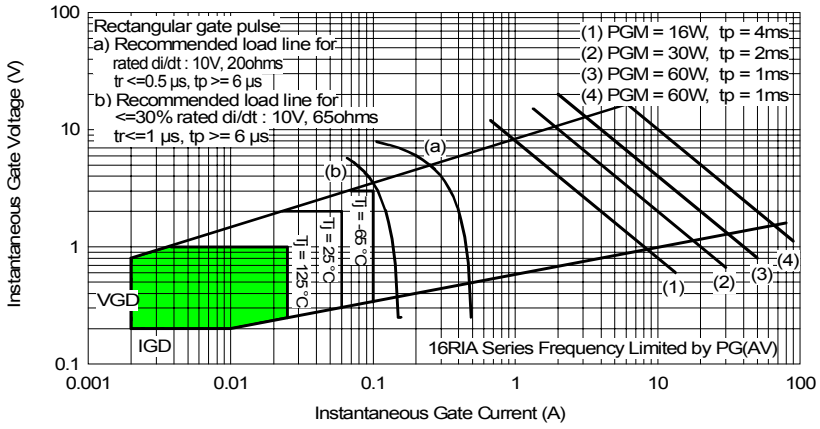



Fig. 16 - Gate Characteristics

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**WORLD HEADQUARTERS:** 233 Kansas St., El Segundo, California 90245 U.S.A. Tel: (310) 322 3331. Fax: (310) 322 3332.
**EUROPEAN HEADQUARTERS:** Hurst Green, Oxted, Surrey RH8 9BB, U.K. Tel: ++ 44 1883 732020. Fax: ++ 44 1883 733408.
**IR CANADA:** 15 Lincoln Court, Brampton, Markham, Ontario L6T3Z2. Tel: (905) 453 2200. Fax: (905) 475 8801.
**IR GERMANY:** Saalburgstrasse 157, 61350 Bad Homburg. Tel: ++ 49 6172 96590. Fax: ++ 49 6172 965933.
**IR ITALY:** Via Liguria 49, 10071 Borgaro, Torino. Tel: ++ 39 11 4510111. Fax: ++ 39 11 4510220.
**IR FAR EAST:** K&H Bldg., 2F, 30-4 Nishi-Ikebukuro 3-Chome, Toshima-Ku, Tokyo, Japan 171. Tel: 81 3 3983 0086.
**IR SOUTHEAST ASIA:** 1 Kim Seng Promenade, Great World City West Tower,13-11, Singapore 237994. Tel: ++ 65 838 4630.
**IR TAIWAN:** 16 Fl. Suite D.207, Sec. 2, Tun Haw South Road, Taipei, 10673, Taiwan. Tel: 886 2 2377 9936.

*http://www.irf.com* *Fax-On-Demand: +44 1883 733420* *Data and specifications subject to change without notice.*