

International  
**IOR** Rectifier

Bulletin I2404 rev. A 07/00

**16RIA SERIES**

**MEDIUM POWER THYRISTORS**

**Stud Version**

**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  $V_{DRM}/V_{RRM}$

16A

**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 <sup>2</sup> s |
| @ 60Hz            | 524         | 235          | A <sup>2</sup> s |
| $V_{DRM}/V_{RRM}$ | 100 to 1200 | 1400 to 1600 | V                |
| $t_q$ typical     | 110         |              | μs               |
| $T_J$             | - 65 to 125 |              | °C               |



Case Style  
TO-208AA (TO-48)



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### ELECTRICAL SPECIFICATIONS

#### Voltage Ratings

| Type number | Voltage Code | $V_{DRM}/V_{RRM}$ , max. repetitive peak and off-state voltage (1)<br>V | $V_{RSM}$ , maximum non-repetitive peak voltage (2)<br>V | $I_{DRM}/I_{RRM}$ max.<br>@ $T_J = T_J$ max.<br>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  $20A/\mu s$

(2) For voltage pulses with  $t_p \leq 5ms$

#### On-state Conduction

| Parameter     |                                                      | 16RIA     |            | Units         | Conditions                                                                        |                |                                                   |  |
|---------------|------------------------------------------------------|-----------|------------|---------------|-----------------------------------------------------------------------------------|----------------|---------------------------------------------------|--|
|               |                                                      | 10 to 120 | 140 to 160 |               |                                                                                   |                |                                                   |  |
| $I_{T(AV)}$   | Max. average on-state current<br>@ Case temperature  | 16        | 16         | A             | 180° sinusoidal conduction                                                        |                |                                                   |  |
|               |                                                      | 85        | 85         | °C            |                                                                                   |                |                                                   |  |
| $I_{T(RMS)}$  | Max. RMS on-state current                            | 35        | 35         | A             |                                                                                   |                |                                                   |  |
| $I_{TSM}$     | Max. peak, one-cycle<br>non-repetitive surge current | 340       | 225        | A             | t = 10ms                                                                          | No voltage     | Sinusoidal half wave,<br>Initial $T_J = T_J$ max. |  |
|               |                                                      |           |            |               | t = 8.3ms                                                                         | reapplied      |                                                   |  |
|               |                                                      |           |            |               | t = 10ms                                                                          | 100% $V_{RRM}$ |                                                   |  |
|               |                                                      |           |            |               | t = 8.3ms                                                                         | reapplied      |                                                   |  |
| $I^2t$        | Maximum $I^2t$ for fusing                            | 574       | 255        | $A^2s$        | t = 10ms                                                                          | No voltage     |                                                   |  |
|               |                                                      |           |            |               | t = 8.3ms                                                                         | reapplied      |                                                   |  |
|               |                                                      |           |            |               | t = 10ms                                                                          | 100% $V_{RRM}$ |                                                   |  |
|               |                                                      |           |            |               | t = 8.3ms                                                                         | reapplied      |                                                   |  |
|               |                                                      | 524       | 235        |               |                                                                                   |                |                                                   |  |
|               |                                                      | 405       | 180        |               |                                                                                   |                |                                                   |  |
|               |                                                      | 375       | 165        |               |                                                                                   |                |                                                   |  |
| $I^2\sqrt{t}$ | 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<br>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<br>voltage             | 1.24      | 1.31       |               | $(I > \pi \times I_{T(AV)}), T_J = T_J$ max.                                      |                |                                                   |  |
| $r_{t1}$      | Low level value of on-state<br>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<br>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             | $I_{pk} = 50 A, T_J = 25^\circ C$                                                 |                |                                                   |  |
|               |                                                      | —         | 1.80       |               |                                                                                   |                |                                                   |  |
| $I_H$         | Maximum holding current                              | 130       |            | mA            | $T_J = 25^\circ C$ . 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<br>$V_{DRM} \leq 800V$ 180<br>$V_{DRM} \leq 1000V$ 160<br>$V_{DRM} \leq 1600V$ 150 | A/ $\mu s$ | $T_J = T_J \text{ max.}$ , $V_{DM} = \text{rated } V_{DRM}$<br>Gate pulse = 20V, 15 $\Omega$ , $t_p = 6\mu s$ , $t_r = 0.1\mu s \text{ max.}$<br>$I_{TM} = (2 \times \text{rated di/dt}) A$ |
| $t_{gt}$ Typical turn-on time                | 0.9                                                                                                        | $\mu s$    | $T_J = 25^\circ C$ ,<br>at = rated $V_{DRM}/V_{RRM}$ , $T_J = 125^\circ C$                                                                                                                  |
| $t_r$ Typical reverse recovery time          | 4                                                                                                          |            | $T_J = T_J \text{ max.}$ ,<br>$I_{TM} = I_{T(AV)}$ , $t_p > 200\mu s$ , di/dt = -10A/ $\mu s$                                                                                               |
| $t_q$ Typical turn-off time                  | 110                                                                                                        |            | $T_J = T_J \text{ max.}$ , $I_{TM} = I_{T(AV)}$ , $t_p > 200\mu s$ , $V_R = 100V$ ,<br>di/dt = -10A/ $\mu s$ , dv/dt = 20V/ $\mu s$ linear to<br>67% $V_{DRM}$ , gate bias 0V-100V          |

(\*)  $t_q = 10\mu s$  up to 600V,  $t_q = 30\mu s$  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/ $\mu s$ | $T_J = T_J \text{ max.}$ linear to 100% rated $V_{DRM}$ |
|                                                       | 300 (*) |            | $T_J = T_J \text{ max.}$ linear to 67% rated $V_{DRM}$  |

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

### Triggering

| Parameter                                    | 16RIA             | Units | Conditions                                                                                                                                                                                              |
|----------------------------------------------|-------------------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $P_{GM}$ Maximum peak gate power             | 8.0               | W     | $T_J = T_J \text{ max.}$                                                                                                                                                                                |
| $P_{G(AV)}$ Maximum average gate power       | 2.0               |       |                                                                                                                                                                                                         |
| $I_{GM}$ Max. peak positive gate current     | 1.5               | A     | $T_J = T_J \text{ max.}$                                                                                                                                                                                |
| $-V_{GM}$ Maximum peak negative gate voltage | 10                | V     | $T_J = T_J \text{ max.}$                                                                                                                                                                                |
| $I_{GT}$ DC gate current required to trigger | 90<br>60<br>35    | mA    | $T_J = -65^\circ C$<br>$T_J = 25^\circ C$<br>$T_J = 125^\circ C$                                                                                                                                        |
| $V_{GT}$ DC gate voltage required to trigger | 3.0<br>2.0<br>1.0 |       | $T_J = -65^\circ C$<br>$T_J = 25^\circ C$<br>$T_J = 125^\circ C$                                                                                                                                        |
| $I_{GD}$ DC gate current not to trigger      | 2.0               | mA    | $T_J = T_J \text{ max.}$ , $V_{DRM} = \text{rated value}$                                                                                                                                               |
| $V_{GD}$ DC gate voltage not to trigger      | 0.2               |       | $T_J = T_J \text{ max.}$<br>$V_{DRM} = \text{rated value}$<br>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 |

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### 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 | Lubricated threads<br>(Non-lubricated threads) |
|                                                      | 20(27.5)         | 25        |                                                |
|                                                      | 0.23(0.32)       | 0.29      |                                                |
|                                                      | 2.3(3.1)         | 2.8       |                                                |
| 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 resistance  $R_{thJC}$  when devices operate at different conduction angles than DC)

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

### Ordering Information Table

|                    |                                                                                            |            |          |            |
|--------------------|--------------------------------------------------------------------------------------------|------------|----------|------------|
| <b>Device Code</b> |                                                                                            |            |          |            |
| <b>16</b>          | <b>RIA</b>                                                                                 | <b>160</b> | <b>M</b> | <b>S90</b> |
| ①                  | ②                                                                                          | ③          | ④        | ⑤          |
| <b>1</b>           | - Current code                                                                             |            |          |            |
| <b>2</b>           | - Essential part number                                                                    |            |          |            |
| <b>3</b>           | - Voltage code: Code x 10 = $V_{RRM}$ (See Voltage Rating Table)                           |            |          |            |
| <b>4</b>           | - None = Stud base TO-208AA (TO-48) 1/4" 28UNF-2A<br>M = Stud base TO-208AA (TO-48) M6 X 1 |            |          |            |
| <b>5</b>           | - Critical dv/dt: None = 300V/μs (Standard value)<br>S90 = 1000V/μs (Special selection)    |            |          |            |

Outline Table

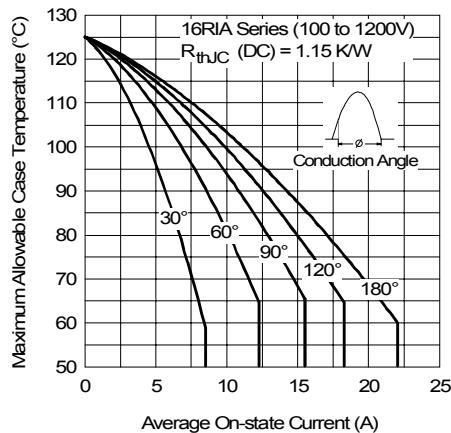
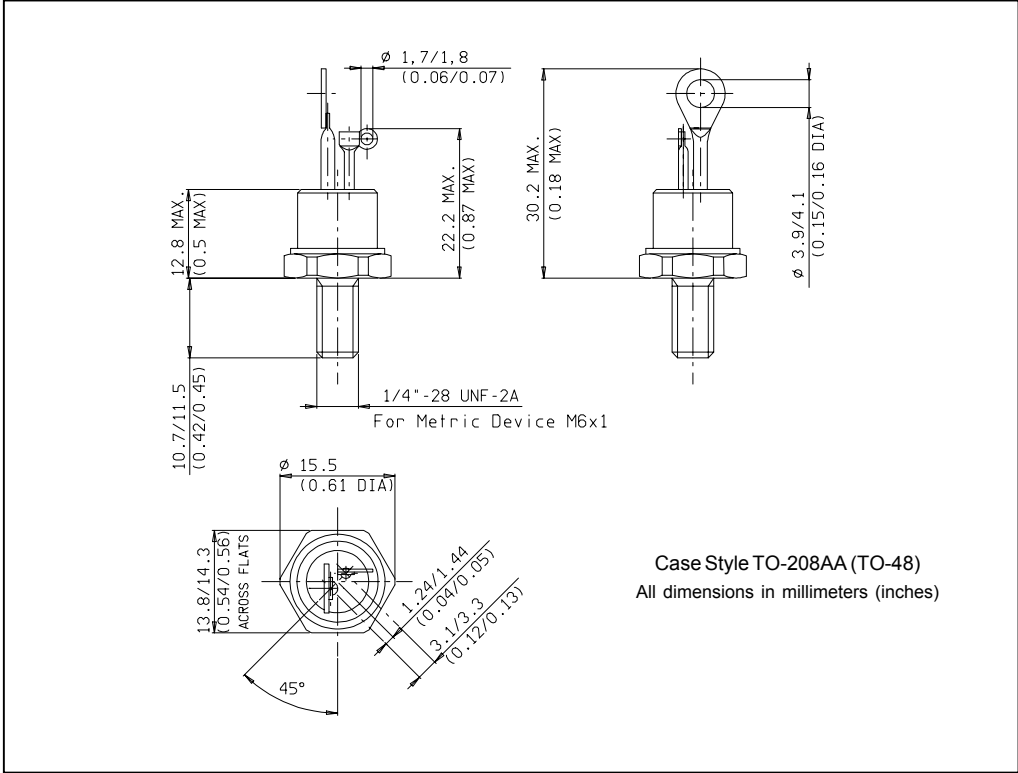


Fig. 1 - Current Ratings Characteristic

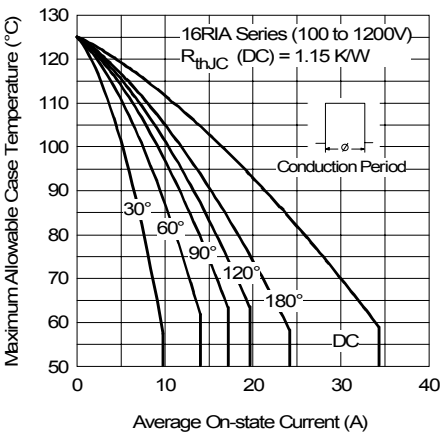


Fig. 2 - Current Ratings Characteristic

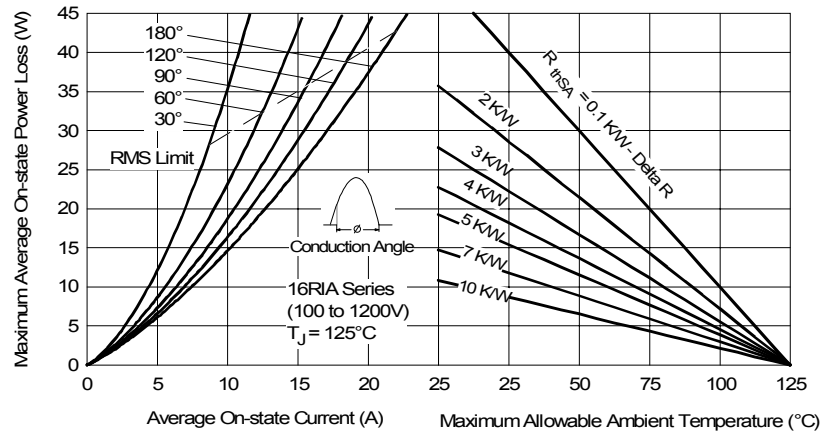


Fig. 3 - On-state Power Loss Characteristics

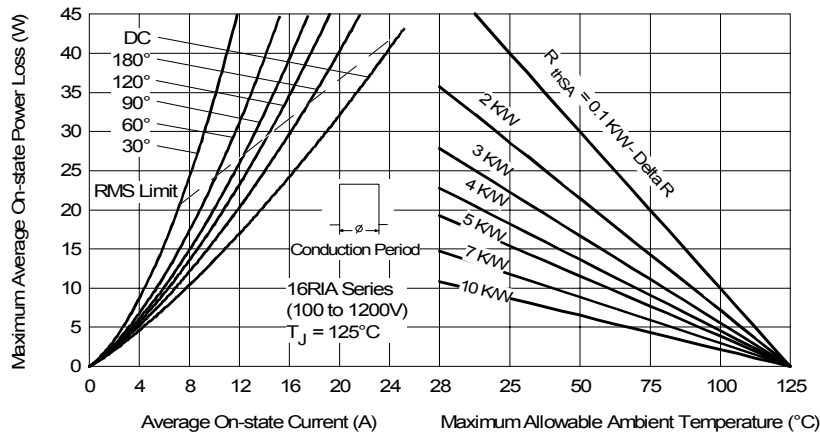


Fig. 4 - On-state Power Loss Characteristics

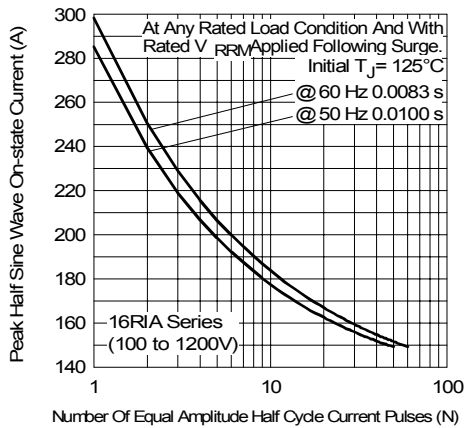


Fig. 5 - Maximum Non-Repetitive Surge Current

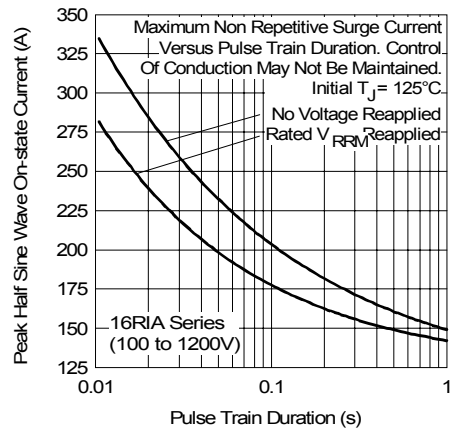


Fig. 6 - Maximum Non-Repetitive Surge Current

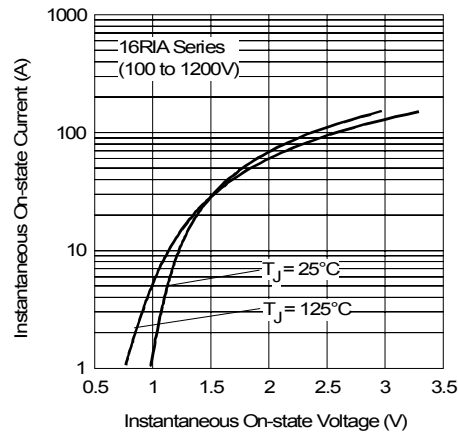


Fig. 7 - Forward Voltage Drop Characteristics

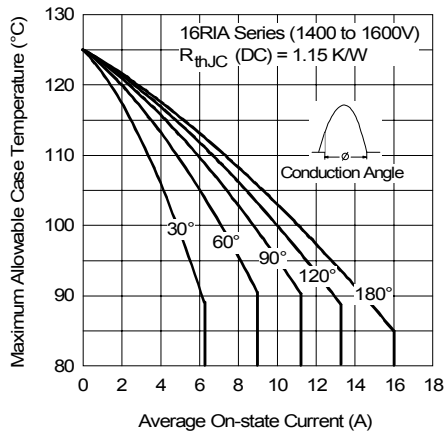


Fig. 8 - Current Ratings Characteristics

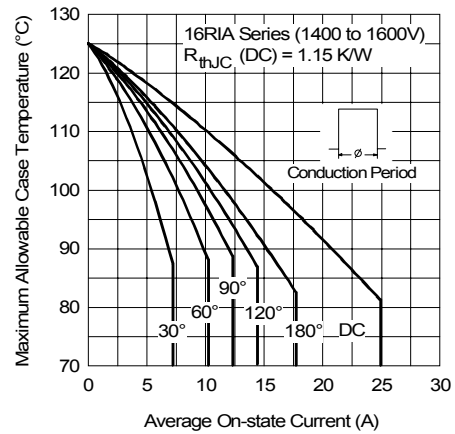


Fig. 9 - Current Ratings Characteristics

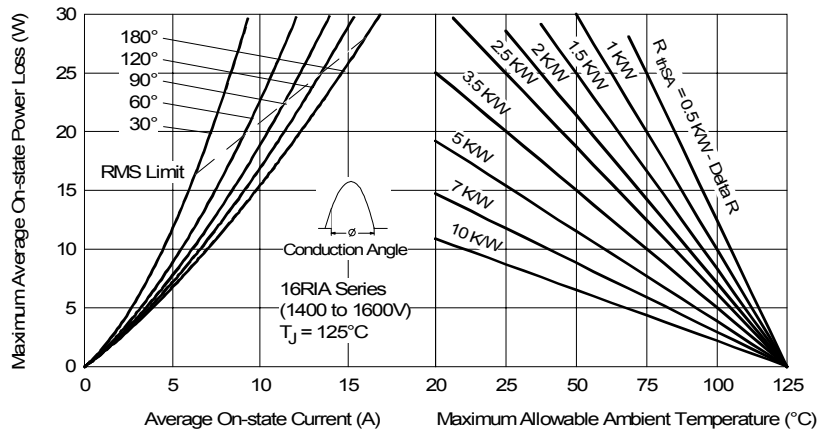


Fig. 10 - On-state Power Loss Characteristics

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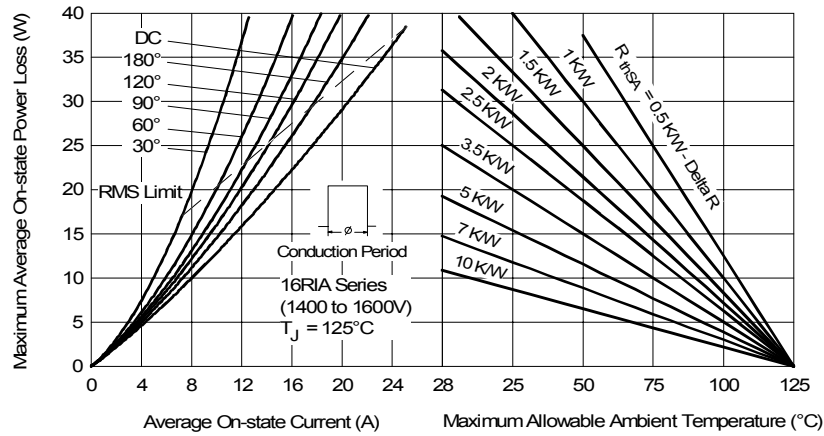


Fig. 11 - On-state Power Loss Characteristics

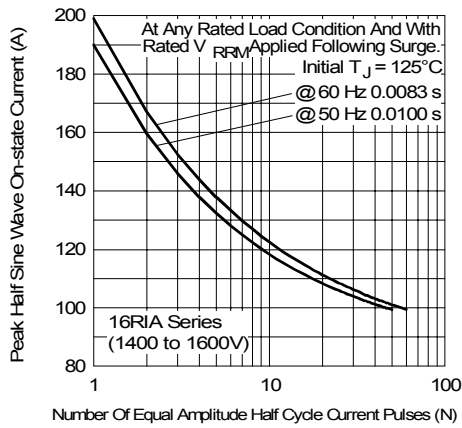


Fig. 12 - Maximum Non-Repetitive Surge Current

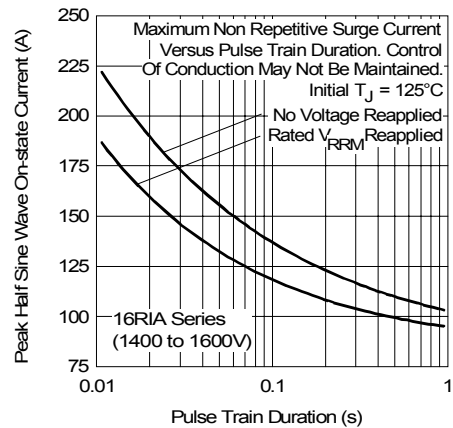


Fig. 13 - Maximum Non-Repetitive Surge Current

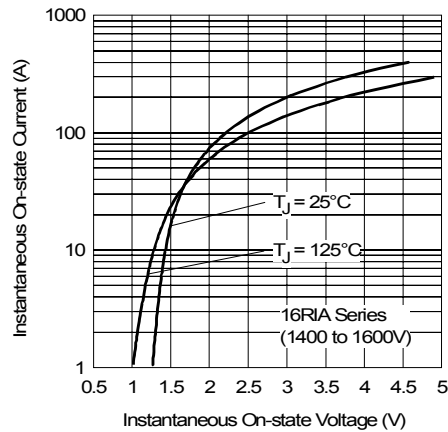


Fig. 14 - Forward Voltage Drop Characteristics



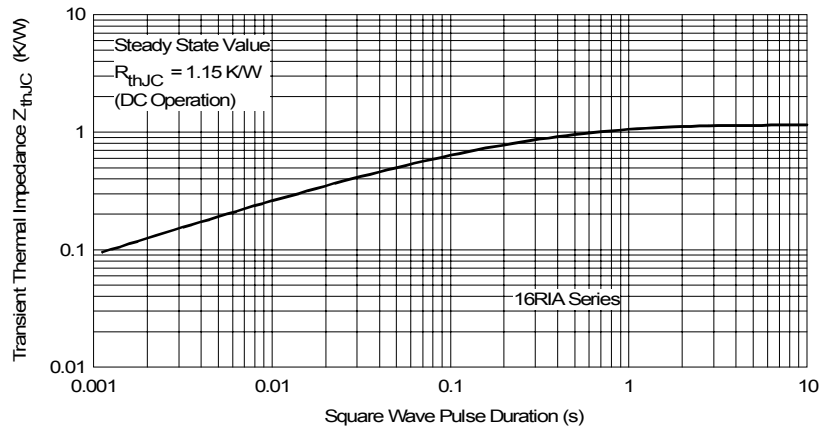


Fig. 15 - Thermal Impedance  $Z_{thJC}$  Characteristics

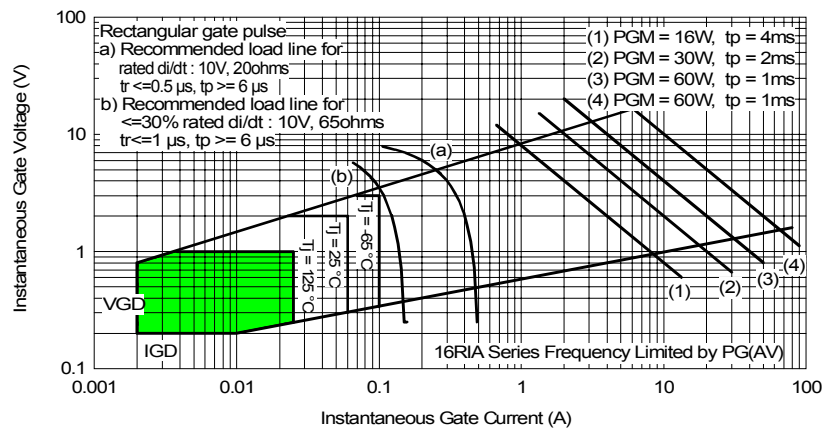


Fig. 16 - Gate Characteristics