


## MEDIUM POWER PHASE CONTROL THYRISTORS

## Power Modules

### Features

- Electrically isolated base plate
- Types up to 1200 V<sub>RRM</sub>
- 3500 V<sub>RMS</sub> isolating voltage
- Simplified mechanical designs, rapid assembly
- High surge capability
- Large creepage distances
- UL E78996 approved 

50 A  
 70 A  
 90 A

### Description

These series of T-modules are intended for general purpose applications such as battery chargers, welders and plating equipment, regulated power supplies and temperature and speed control circuits. The semiconductors are electrically isolated from the metal base, allowing common heatsinks and compact assemblies to be built.

### Major Ratings and Characteristics

| Parameters                         | T50RIA      | T70RIA | T90RIA | Units             |
|------------------------------------|-------------|--------|--------|-------------------|
| $I_{T(AV)}$                        | 50          | 70     | 90     | A                 |
| @ T <sub>C</sub>                   | 70          | 70     | 70     | °C                |
| $I_{T(RMS)}$                       | 80          | 110    | 141    | A                 |
| $I_{TSM}$ @50Hz                    | 1310        | 1660   | 1780   | A                 |
| @60Hz                              | 1370        | 1740   | 1870   | A                 |
| $I^2t$ @50Hz                       | 8550        | 13860  | 15900  | A <sup>2</sup> s  |
| @60Hz                              | 7800        | 12650  | 14500  | A <sup>2</sup> s  |
| $i^2vt$                            | 85500       | 138500 | 159100 | A <sup>2</sup> √s |
| V <sub>DRM</sub> /V <sub>RRM</sub> | 100 to 1200 |        |        | V                 |
| T <sub>J</sub>                     | -40 to 125  |        |        | °C                |

## T.RIA Series

Bulletin I27105 rev. B 02/02

International  
IR Rectifier

### ELECTRICAL SPECIFICATIONS

#### Voltage Ratings

| Type number                | Voltage Code | $V_{DRM}/V_{RRM}$ , maximum repetitive peak reverse voltage<br>V | $V_{RSM}$ , maximum non-repetitive peak reverse voltage<br>V | $I_{DRM}/I_{RRM}$ max.<br>@ 25°C<br>μA |
|----------------------------|--------------|--|--|--|
| T50RIA<br>T70RIA<br>T90RIA | 10           | 100  | 150  | 100                                    |
|                            | 20           | 200  | 300  |  |
|                            | 40           | 400  | 500  |  |
|                            | 60           | 600  | 700  |  |
|                            | 80           | 800  | 900  |  |
|                            | 100          | 1000   | 1100   |  |
|                            | 120          | 1200   | 1300   |  |

#### On-state Conduction

| Parameter  | T50RIA                       | T70RIA                                      | T90RIA                         | Units                            | Conditions  |   |            |   |            |                          |           |                |           |                |           |           |
|--|------------------------------|---|--------------------------------|----------------------------------|---|---|------------|---|------------|--------------------------|-----------|----------------|-----------|----------------|-----------|-----------|
| $I_{T(AV)}$ Max. average on-state current<br>@ Case temperature          | 50<br>70                     | 70<br>70                                    | 90<br>70                       | A<br>°C                          | 180° conduction, half sine wave   |   |            |   |            |                          |           |                |           |                |           |           |
| $I_{T(RMS)}$ Max. RMS on-state current                                   | 80                           | 110   | 141                            | A                                |   |   |            |   |            |                          |           |                |           |                |           |           |
| $I_{TSM}$ Maximum peak, one-cycle on-state, non-repetitive surge current | 1310<br>1370<br>1100<br>1150 | 1660<br>1740<br>1400<br>1460                | 1780<br>1870<br>1500<br>1570   | A                                | <table border="1"> <tr> <td>t = 10ms</td> <td>No voltage</td> <td rowspan="8">Sine half wave,<br/>Initial <math>T_J = T_J</math> max.</td> </tr> <tr> <td>t = 8.3ms</td> <td>reapplied</td> </tr> <tr> <td>t = 10ms</td> <td>100% <math>V_{RRM}</math></td> </tr> <tr> <td>t = 8.3ms</td> <td>reapplied</td> </tr> </table> | t = 10ms  | No voltage | Sine half wave,<br>Initial $T_J = T_J$ max. | t = 8.3ms  | reapplied                | t = 10ms  | 100% $V_{RRM}$ | t = 8.3ms | reapplied      |           |           |
| t = 10ms   | No voltage                   | Sine 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   | 8550<br>7800<br>6050<br>5520 |   | 13860<br>12650<br>9800<br>8950 | 15900<br>14500<br>11250<br>10270 | A <sup>2</sup> s  | <table border="1"> <tr> <td>t = 10ms</td> <td>No voltage</td> <td rowspan="4">Initial <math>T_J = T_J</math> max.</td> </tr> <tr> <td>t = 8.3ms</td> <td>reapplied</td> </tr> <tr> <td>t = 10ms</td> <td>100% <math>V_{RRM}</math></td> </tr> <tr> <td>t = 8.3ms</td> <td>reapplied</td> </tr> </table> | t = 10ms   |   | No voltage | Initial $T_J = T_J$ max. | t = 8.3ms | reapplied      | t = 10ms  | 100% $V_{RRM}$ | t = 8.3ms | reapplied |
| t = 10ms   | No voltage                   |   | Initial $T_J = T_J$ max.       |                                  |   |   |            |   |            |                          |           |                |           |                |           |           |
| t = 8.3ms  | reapplied                    |   |                                |                                  |   |   |            |   |            |                          |           |                |           |                |           |           |
| t = 10ms   | 100% $V_{RRM}$               |   |                                |                                  |   |   |            |   |            |                          |           |                |           |                |           |           |
| t = 8.3ms  | reapplied                    |   |                                |                                  |   |   |            |   |            |                          |           |                |           |                |           |           |
| $I^2/t$ Maximum $I^2/t$ for fusing                                       | 85500                        | 138500                                      | 159100                         | A <sup>2</sup> √s                | t = 0.1 to 10ms, no voltage reapplied   |   |            |   |            |                          |           |                |           |                |           |           |
| $V_{T(TO)1}$ Low level value of threshold voltage                        | 0.97                         | 0.77  | 0.78                           | V                                | $(16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$ , @ $T_J$ max.  |   |            |   |            |                          |           |                |           |                |           |           |
| $V_{T(TO)2}$ High level value of threshold voltage                       | 1.13                         | 0.88  | 0.88                           | V                                | $(I > \pi \times I_{T(AV)})$ , @ $T_J$ max.   |   |            |   |            |                          |           |                |           |                |           |           |
| $r_{t1}$ Low level value on-state slope resistance                       | 4.1                          | 3.6   | 2.9                            | mΩ                               | $(16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$ , @ $T_J$ max.  |   |            |   |            |                          |           |                |           |                |           |           |
| $r_{t2}$ High level value on-state slope resistance                      | 3.3                          | 3.2   | 2.6                            | mΩ                               | $(I > \pi \times I_{T(AV)})$ , @ $T_J$ max.   |   |            |   |            |                          |           |                |           |                |           |           |
| $V_{TM}$ Maximum on-state voltage drop                                   | 1.60                         | 1.55  | 1.55                           | V                                | $I_{TM} = \pi \times I_{T(AV)}$ , $T_J = 25^\circ\text{C}$ , $t_p = 400\mu\text{s}$ square<br>Av. power = $V_{T(TO)} \times I_{T(AV)} + r_f \times (I_{T(RMS)})^2$  |   |            |   |            |                          |           |                |           |                |           |           |
| $I_H$ Maximum holding current  |                              | 200   |                                | mA                               | Anode supply = 6V initial $I_T = 30A$ , $T_J = 25^\circ\text{C}$  |   |            |   |            |                          |           |                |           |                |           |           |
| $I_L$ Maximum latching current   |                              | 400   |                                | mA                               | Anode supply = 6V resistive load = 10Ω<br>gate pulse: 10V, 100μs, $T_J = 25^\circ\text{C}$  |   |            |   |            |                          |           |                |           |                |           |           |

#### Switching

| Parameter                              | T50RIA | T70RIA | T90RIA | Units | Conditions   |
|--|--------|--------|--------|-------|--|
| $t_{gd}$ Typical turn-on time          |        | 0.9    |        | μs    | $T_J = 25^\circ\text{C}$ $V_d = 50\% V_{DRM}$ , $I_{TM} = 50A$<br>$I_g = 500mA$ , $t_r \leq 0.5$ , $t_p \geq 6\mu\text{s}$         |
| $t_{rr}$ Typical reverse recovery time |        | 3.0    |        | μs    | $T_J = 125^\circ\text{C}$ , $I_{TM} = 50A$ $t_p = 300\mu\text{s}$ $di/dt = 10A/\mu\text{s}$  |
| $t_q$ Typical turn-off time            |        | 110    |        | μs    | $T_J = T_J$ max., $I_{TM} = 50A$ , $t_p = 300\mu\text{s}$ ,<br>$-di/dt = 15A/\mu\text{s}$ , $V_r = 100V$ ; linear to 80% $V_{DRM}$ |

Blocking

| Parameter   | T50RIA | T70RIA | T90RIA | Units            | Conditions   |
|---|--------|--------|--------|------------------|--|
| $I_{RRM}$<br>$I_{DRM}$ Maximum peak reverse and off-state leakage current | 15     |        |        | mA               | $T_J = T_J = T_J \text{ max.}$   |
| $V_{INS}$ RMS isolation voltage   | 3500   |        |        | V                | 50Hz, circuit to base, all terminals shorted, $T_J = 25^\circ\text{C}$ , $t = 1\text{s}$ |
| $dv/dt$ Critical rate of rise of off-state voltage                        | 500    |        |        | V/ $\mu\text{s}$ | $T_J = T_J \text{ max.}$ , linear to 80% rated $V_{DRM}$ (1)                             |

(1) Available with  $dv/dt = 1000\text{V}/\mu\text{s}$ , to complete code add S90 i.e. T90RIA80S90

Triggering

| Parameter   | T50RIA | T70RIA | T90RIA | Units            | Conditions  |
|---|--------|--------|--------|------------------|---|
| $P_{GM}$ Max. peak gate power                     | 10     | 12     | 12     | W                | $t_p \leq 5\text{ms}$ , $T_J = T_J \text{ max.}$  |
| $P_{G(AV)}$ Max. average gate power               | 2.5    | 3.0    | 3.0    | W                | $f = 50\text{Hz}$ , $T_J = T_J \text{ max.}$  |
| $I_{GM}$ Max. peak gate current                   | 2.5    | 3.0    | 3.0    | A                | $t_p \leq 5\text{ms}$ , $T_J = T_J \text{ max.}$  |
| $-V_{GT}$ Max. peak negative gate voltage         | 10     | 10     | 10     | V                |   |
| $V_{GT}$ Max. required DC gate voltage to trigger | 4.0    | 4.0    | 4.0    | V                | $T_J = -40^\circ\text{C}$<br>$T_J = 25^\circ\text{C}$<br>$T_J = T_J \text{ max.}$<br>Anode supply = 6V, resistive load; $R_a = 1\Omega$   |
|   | 2.5    | 2.5    | 2.5    |                  |   |
|   | 1.5    | 1.5    | 1.5    |                  |   |
| $I_{GT}$ Max. required DC gate current to trigger | 250    | 270    | 270    | mA               | $T_J = -40^\circ\text{C}$<br>$T_J = 25^\circ\text{C}$<br>$T_J = T_J \text{ max.}$<br>Anode supply = 6V, resistive load; $R_a = 1\Omega$   |
|   | 100    | 120    | 120    |                  |   |
|   | 50     | 60     | 60     |                  |   |
| $V_{GD}$ Max. gate voltage that will not trigger  | 0.2    | 0.2    | 0.2    | V                | @ $T_J = T_J \text{ max.}$ , rated $V_{DRM}$ applied  |
| $I_{GD}$ Max. gate current that will not trigger  | 5.0    | 6.0    | 6.0    | mA               |   |
| $di/dt$ Max. rate of rise of turned-on current    | 200    |        |        | A/ $\mu\text{s}$ | $V_G = 0.67 \text{ rated } V_{DRM}$ ; $I_{TM} = 2 \times \text{rated } di/dt$<br>$I_g = 400\text{mA}$ for T50RIA and $I_g = 500\text{mA}$ for T70RIA & T90RIA; $t_r < 0.5\mu\text{s}$ , $t_p \geq 6\mu\text{s}$<br>For repetitive value use 40% non-repetitive<br>Per JEDEC std. RS397, 5.2.2.6 |
|   | 180    |        |        |                  |   |
|   | 160    |        |        |                  |   |
|   | 150    |        |        |                  |   |

Thermal and Mechanical Specifications

| Parameter  | T50RIA                | T70RIA         | T90RIA | Units            | Conditions  |
|--|-----------------------|----------------|--------|------------------|---|
| $T_J$ Max. junction operating temperature range      | -40 to 125            |                |        | $^\circ\text{C}$ |   |
| $T_{stg}$ Max. storage temperature range             | -40 to 150            |                |        | $^\circ\text{C}$ |   |
| $R_{thJC}$ Max. thermal resistance, junction to case | 0.65                  | 0.50           | 0.38   | K/W              | DC operation, per junction  |
| $R_{thCS}$ Max. thermal resistance, case to heatsink | 0.2                   |                |        | K/W              | Mounting surface smooth, flat and greased                             |
| T Mounting torque $\pm 10\%$                         | to heatsink terminals | 1.3 $\pm 10\%$ |        | Nm               | M3.5 mounting screws (2) non lubricated<br>M5 screw terminals threads |
|  |                       | 3 $\pm 10\%$   |        |                  |   |
| wt Approximate weight                                | 54                    |                |        | g                | See outline table   |
| Case style   | D-56                  |                |        |                  | T type  |

(2) A mounting compound is recommended and the torque should be rechecked after a period of 3 hours to allow for the spread of the compound.

## T..RIA Series

Bulletin I27105 rev. B 02/02

International  
IRF Rectifier

### ΔR Conduction (per Junction)

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

| Devices | Sinusoidal conduction @ $T_j$ max. |      |      |      |      | Rectangular conduction @ $T_j$ max. |      |      |      |      | Units |
|---------|------------------------------------|------|------|------|------|-------------------------------------|------|------|------|------|-------|
|         | 180°                               | 120° | 90°  | 60°  | 30°  | 180°                                | 120° | 90°  | 60°  | 30°  |       |
| T50RIA  | 0.08                               | 0.10 | 0.13 | 0.19 | 0.31 | 0.06                                | 0.10 | 0.14 | 0.20 | 0.32 | K/W   |
| T70RIA  | 0.07                               | 0.08 | 0.10 | 0.14 | 0.24 | 0.05                                | 0.08 | 0.11 | 0.15 | 0.24 |       |
| T90RIA  | 0.05                               | 0.06 | 0.08 | 0.12 | 0.20 | 0.04                                | 0.06 | 0.09 | 0.12 | 0.20 |       |

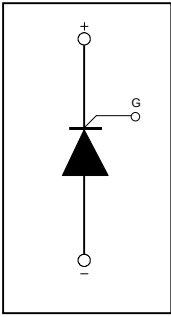
### Ordering Information Table

**Device Code**

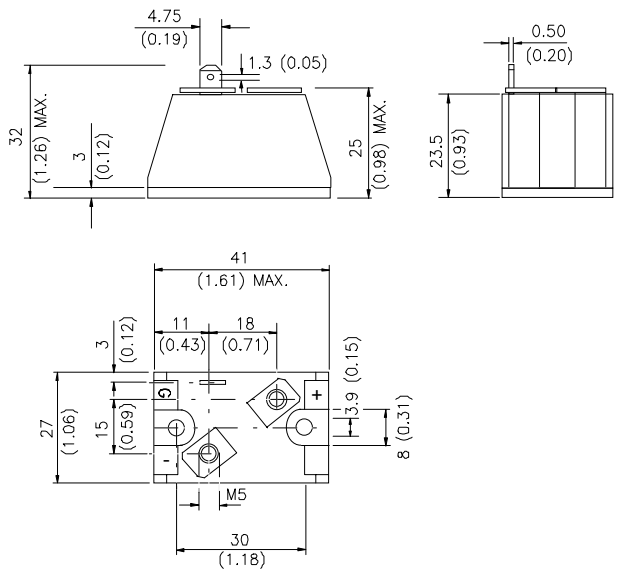
|   |    |     |     |
|---|----|-----|-----|
| T | 50 | RIA | 120 |
| ① | ②  | ③   | ④   |

- 1** - Module type
- 2** - Current rating
- 3** - Circuit configuration \*\*
- 4** - Voltage code : code x 10 =  $V_{RRM}$

**Circuit configuration \*\***



### Outline Table



All dimensions in millimeters (inches)

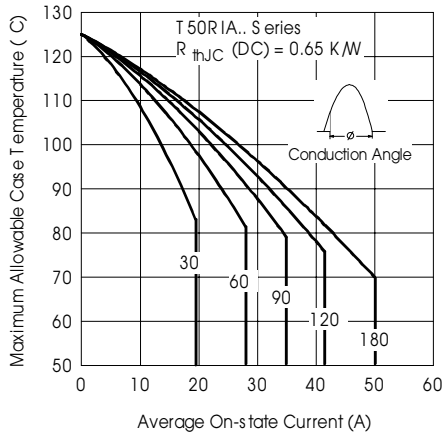


Fig. 1 - Current Ratings Characteristics

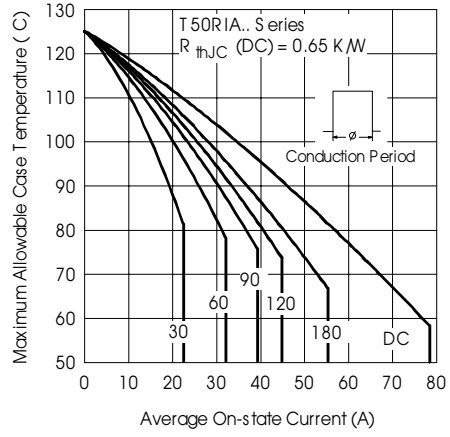


Fig. 2 - Current Ratings Characteristics

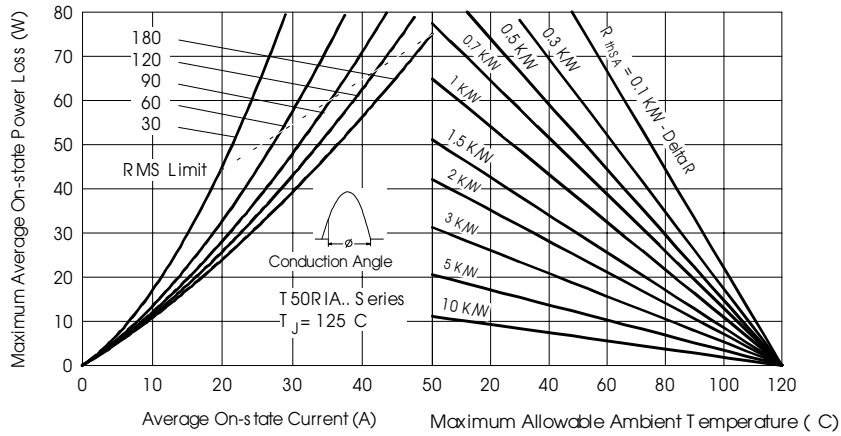


Fig. 3 - On-state Power Loss Characteristics

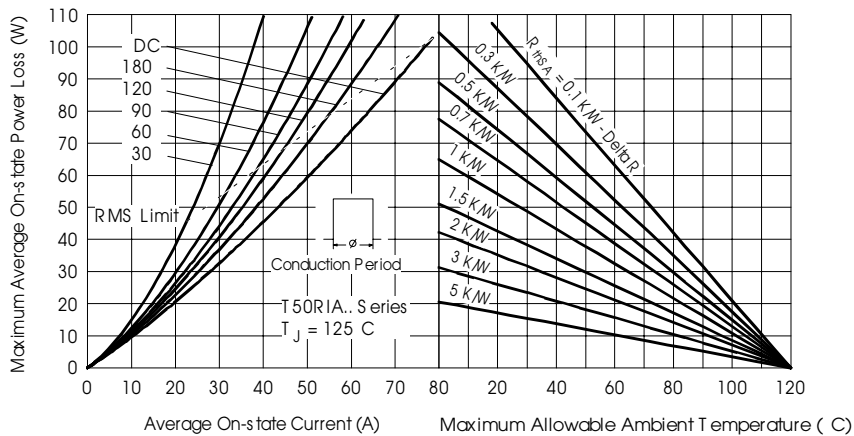


Fig. 4 - On-state Power Loss Characteristics

**T..RIA Series**

Bulletin I27105 rev. B 02/02

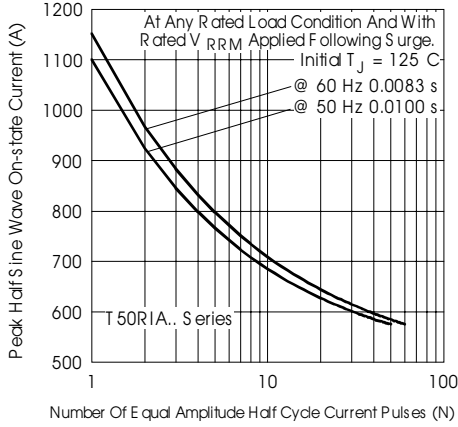


Fig. 5 - Maximum Non-Repetitive Surge Current

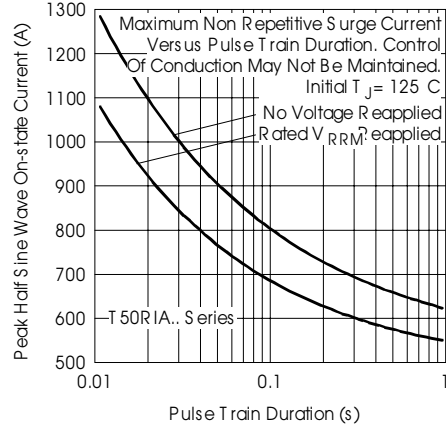


Fig. 6 - Maximum Non-Repetitive Surge Current

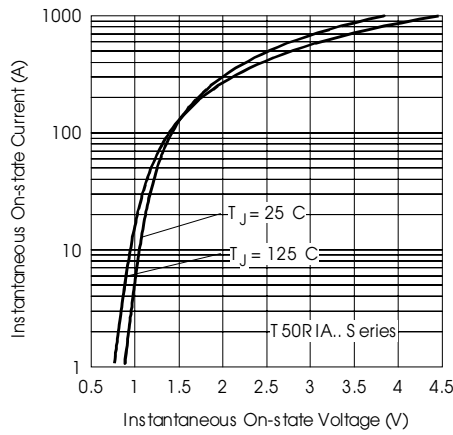


Fig. 10 - On-state Voltage Drop Characteristics

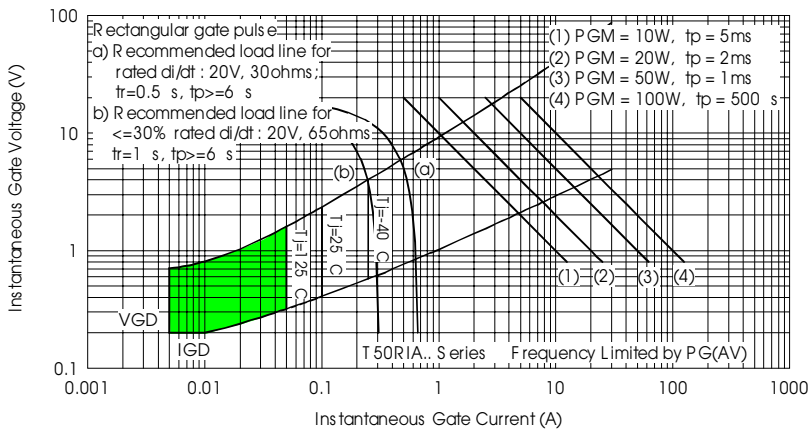


Fig. 9 - Gate Characteristics

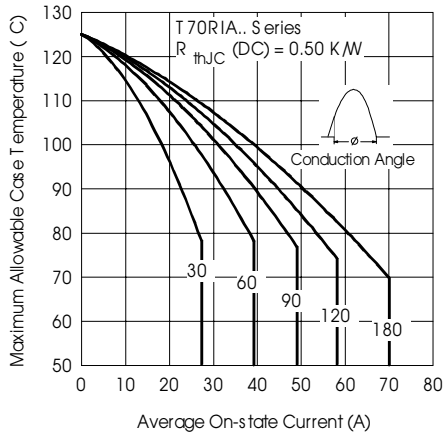


Fig. 12 - Current Ratings Characteristics

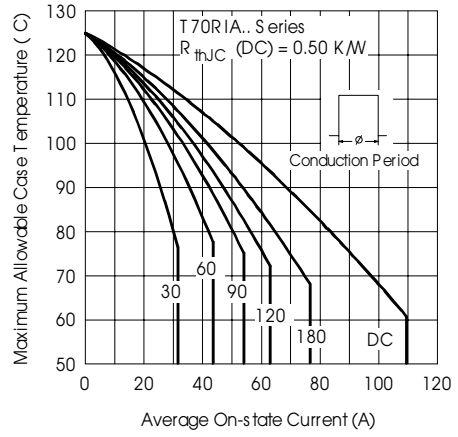


Fig. 13 - Current Ratings Characteristics

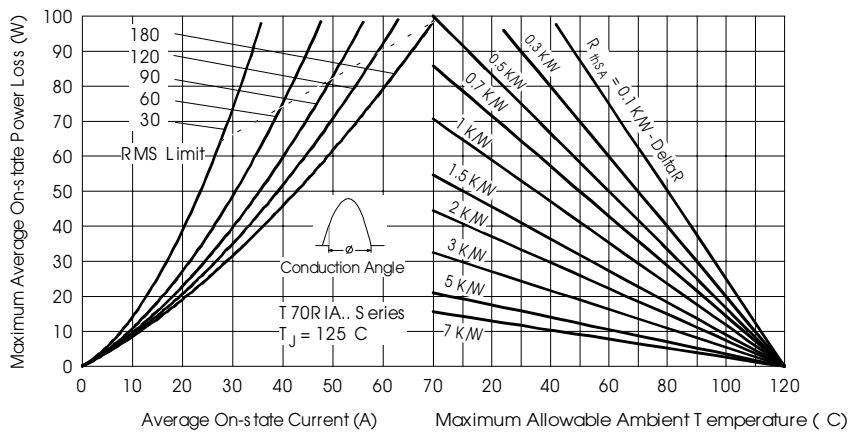


Fig. 18 - On-state Power Loss Characteristics

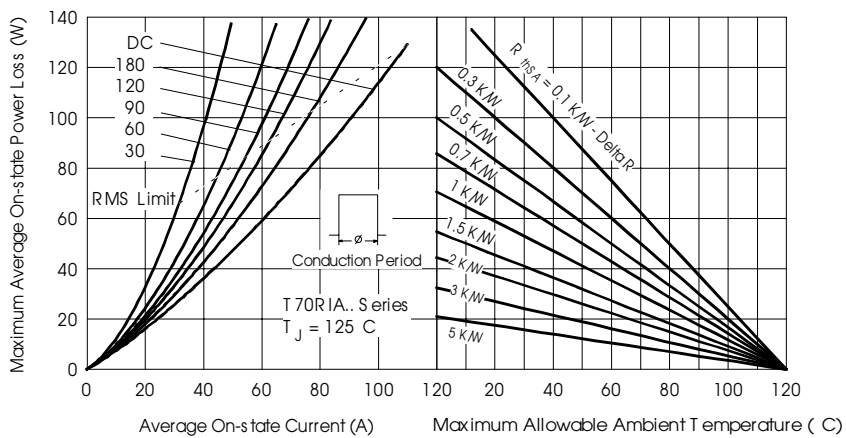


Fig. 15 - On-state Power Loss Characteristics

# T..RIA Series

Bulletin I27105 rev. B 02/02

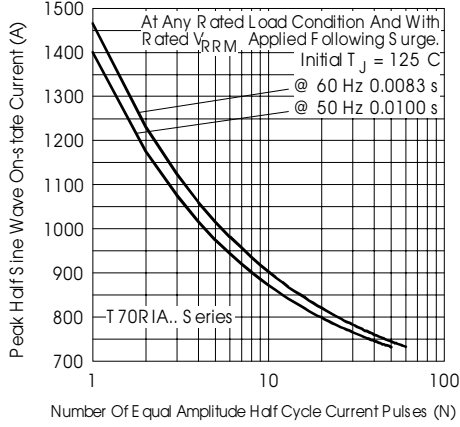


Fig. 16 - Maximum Non-Repetitive Surge Current

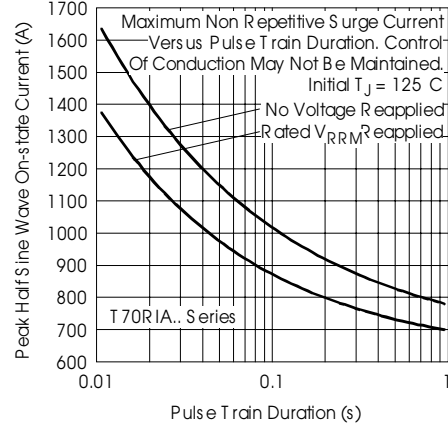


Fig. 17 - Maximum Non-Repetitive Surge Current

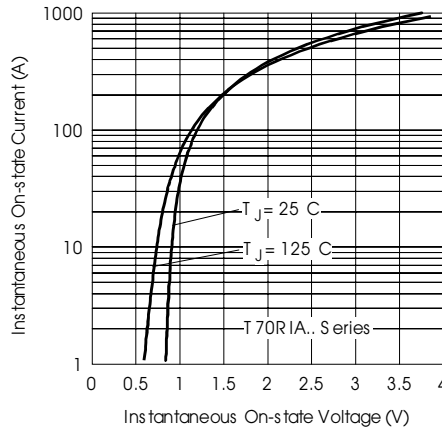


Fig. 10 - On-state Voltage Drop Characteristics

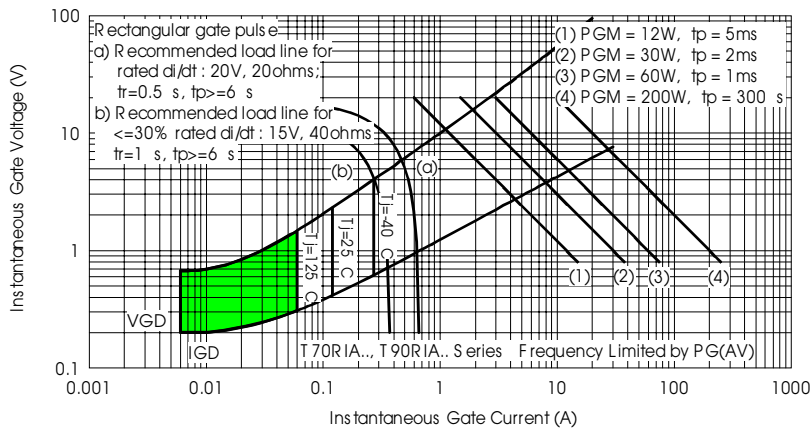


Fig. 19 - Gate Characteristics



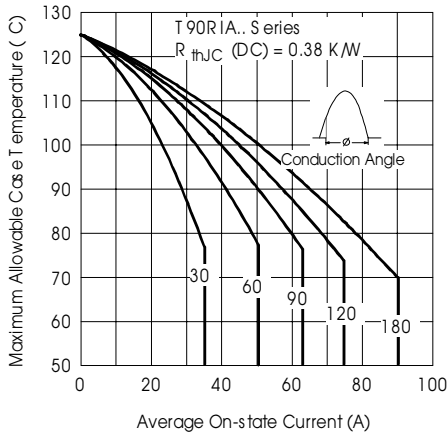


Fig. 23 - Current Ratings Characteristics

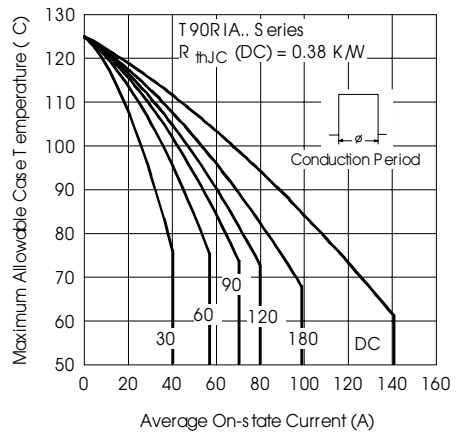


Fig. 24 - Current Ratings Characteristics

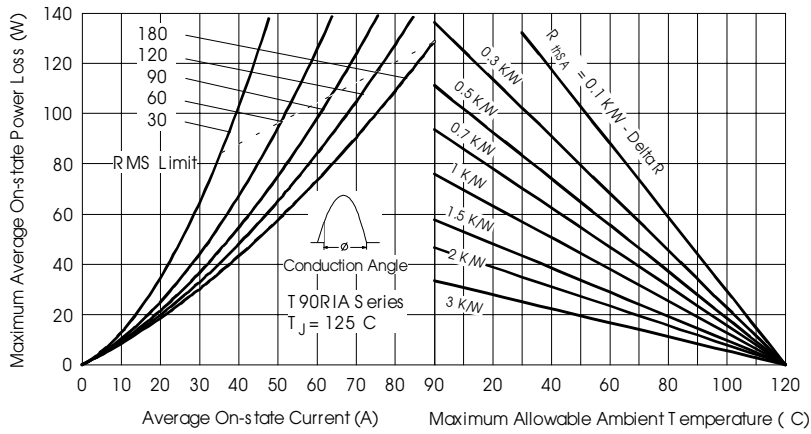


Fig. 29 - On-state Power Loss Characteristics

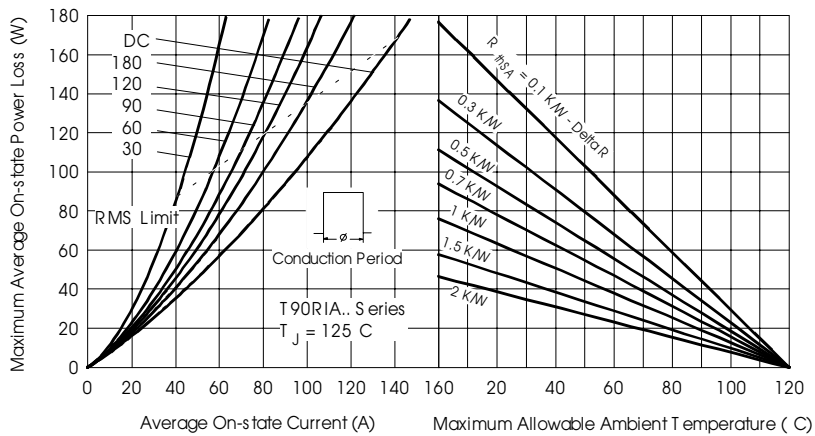


Fig. 29 - On-state Power Loss Characteristics

**T..RIA Series**

Bulletin I27105 rev. B 02/02

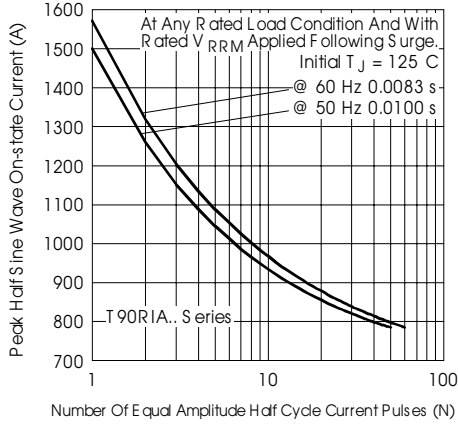


Fig. 27 - Maximum Non-Repetitive Surge Current

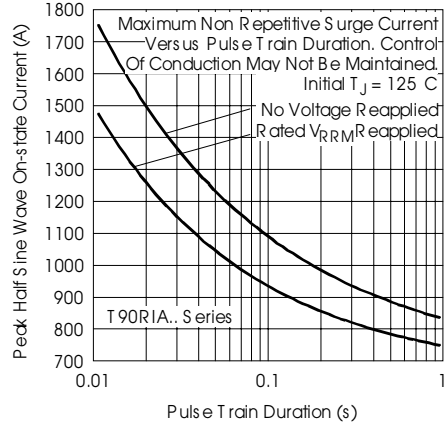


Fig. 28 - Maximum Non-Repetitive Surge Current

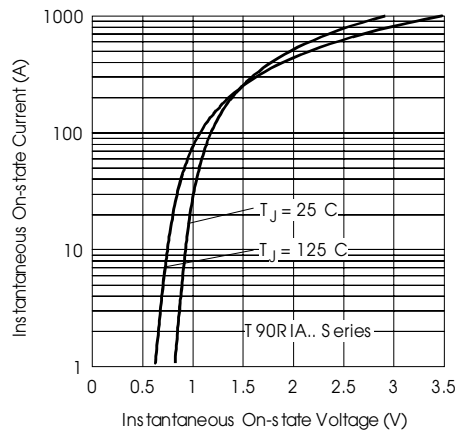


Fig. 21 - On-state Voltage Drop Characteristics

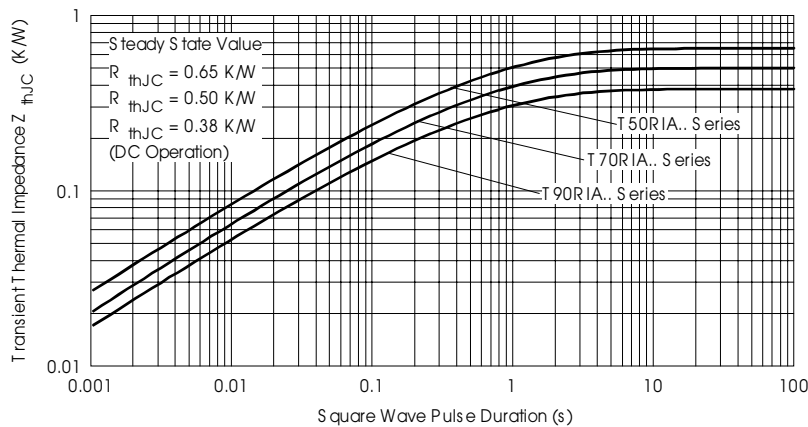


Fig. 34 - Thermal Impedance  $Z_{thJC}$  Characteristics

Data and specifications subject to change without notice.  
This product has been designed and qualified for Industrial Level.  
Qualification Standards can be found on IR's Web site.

International  
**IOR** Rectifier

**IR WORLD HEADQUARTERS:** 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105  
TAC Fax: (310) 252-7309  
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