

### THYRISTOR/ DIODE and THYRISTOR/ THYRISTOR

### NEWADD-A-pak™ Power Modules

#### Features

- Electrically isolated: DBC base plate
- 3500 V<sub>RMS</sub> isolating voltage
- Standard JEDEC package
- Simplified mechanical designs, rapid assembly
- Auxiliary cathode terminals for wiring convenience
- High surge capability
- Wide choice of circuit configurations
- Large creepage distances
- UL E78996 approved 

45 A  
60 A

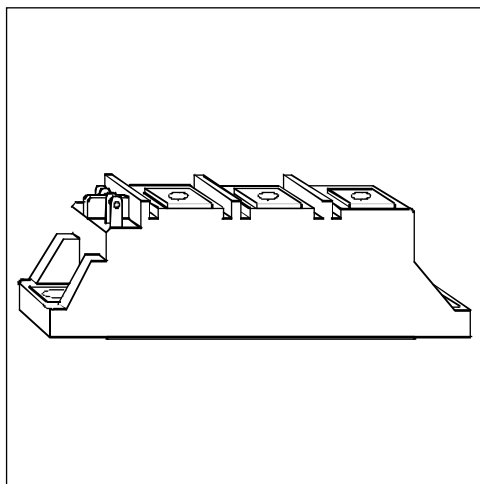
#### Description

These IRK series of NEW ADD-A-paks use power diodes and thyristors in a variety of circuit configurations. The semiconductor chips are electrically isolated from the base plate, allowing common heatsinks and compact assemblies to be built. They can be interconnected to form single phase or three phase bridges or AC controllers. These modules are intended for general purpose high voltage applications such as high voltage regulated power supplies, lighting circuits, and temperature and motor speed control circuits.

#### Major Ratings and Characteristics

| Parameters                          | IRK.41    | IRK.56 | Units              |
|-------------------------------------|-----------|--------|--------------------|
| $I_{T(AV)}$ or $I_{F(AV)}$<br>@85°C | 45        | 60     | A                  |
| $I_{O(RMS)}$ (*)                    | 100       | 135    | A                  |
| $I_{TSM}$ @50Hz                     | 850       | 1310   | A                  |
| $I_{FSM}$ @60Hz                     | 890       | 1370   | A                  |
| $I^2t$ @50Hz                        | 3.61      | 8.50   | KA <sup>2</sup> s  |
| @60Hz                               | 3.30      | 7.82   | KA <sup>2</sup> s  |
| $I^2\sqrt{t}$                       | 36.1      | 85.0   | KA <sup>2</sup> √s |
| $V_{RRM}$ range                     | 400to1600 |        | V                  |
| $T_{STG}$                           | -40to125  |        | °C                 |
| $T_J$                               | -40to125  |        | °C                 |

(\*) As AC switch.



## IRK.41, .56 Series

Bulletin I27131 rev. C 09/97

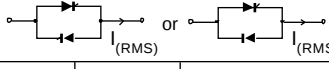
International  
**IR** Rectifier

### ELECTRICAL SPECIFICATIONS

#### Voltage Ratings

| Type number | Voltage Code | $V_{RRM}$ , maximum repetitive peak reverse voltage<br>V | $V_{RSM}$ , maximum non-repetitive peak reverse voltage<br>V | $V_{DRM}$ , max. repetitive peak off-state voltage, gate open circuit<br>V | $I_{RRM}$ , $I_{DRM}$ 125°C<br>mA |
|-------------|--------------|----------------------------------------------------------|--------------------------------------------------------------|----------------------------------------------------------------------------|-----------------------------------|
| IRK.41/.56  | 04           | 400                                                      | 500                                                          | 400                                                                        | 15                                |
|             | 06           | 600                                                      | 700                                                          | 600                                                                        |                                   |
|             | 08           | 800                                                      | 900                                                          | 800                                                                        |                                   |
|             | 10           | 1000                                                     | 1100                                                         | 1000                                                                       |                                   |
|             | 12           | 1200                                                     | 1300                                                         | 1200                                                                       |                                   |
|             | 14           | 1400                                                     | 1500                                                         | 1400                                                                       |                                   |
|             | 16           | 1600                                                     | 1700                                                         | 1600                                                                       |                                   |

#### On-state Conduction

| Parameters                                                                   | IRK.41 | IRK.56 | Units              | Conditions                                                                                                                              |
|------------------------------------------------------------------------------|--------|--------|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| $I_{T(AV)}$ Max. average on-state current (Thyristors)                       | 45     | 60     | A                  | 180° conduction, half sine wave, $T_c = 85^\circ\text{C}$                                                                               |
| $I_{F(AV)}$ Maximum average forward current (Diodes)                         | 45     | 60     |                    |                                                                                                                                         |
| $I_{O(RMS)}$ Max. continuous RMS on-state current. As AC switch              | 100    | 135    |                    |                                                      |
| $I_{TSM}$ Max. peak, one cycle or non-repetitive on-state or forward current | 850    | 1310   |                    |                                                                                                                                         |
|                                                                              | 890    | 1370   |                    |                                                                                                                                         |
|                                                                              | 715    | 1100   |                    |                                                                                                                                         |
|                                                                              | 750    | 1150   |                    |                                                                                                                                         |
|                                                                              | 940    | 1450   |                    |                                                                                                                                         |
|                                                                              | 985    | 1520   |                    |                                                                                                                                         |
| $I^2t$ Max. $I^2t$ for fusing                                                | 3.61   | 8.56   | KA <sup>2</sup> s  | t=10ms No voltage reappplied<br>t=8.3ms 100% $V_{RRM}$ reappplied<br>T <sub>J</sub> = 25°C,<br>no voltage reappplied                    |
|                                                                              | 3.30   | 7.82   |                    |                                                                                                                                         |
|                                                                              | 2.56   | 6.05   |                    |                                                                                                                                         |
|                                                                              | 2.33   | 5.53   |                    |                                                                                                                                         |
|                                                                              | 4.42   | 10.05  |                    |                                                                                                                                         |
| $I^2\sqrt{t}$ Max. $I^2\sqrt{t}$ for fusing (1)                              | 36.1   | 85.6   | KA <sup>2</sup> √s | t=10ms No voltage reappplied<br>t=8.3ms 100% $V_{RRM}$ reappplied<br>T <sub>J</sub> = 25°C,<br>no voltage reappplied                    |
|                                                                              | 0.88   | 0.85   |                    |                                                                                                                                         |
|                                                                              | 0.91   | 0.88   |                    |                                                                                                                                         |
|                                                                              | 5.90   | 3.53   |                    |                                                                                                                                         |
|                                                                              | 5.74   | 3.41   |                    |                                                                                                                                         |
| $V_{T(TO)}$ Max. value of threshold voltage (2)                              | 0.88   | 0.85   | V                  | Low level (3)<br>High level (4)                                                                                                         |
| $r_t$ Max. value of on-state slope resistance (2)                            | 5.90   | 3.53   |                    |                                                                                                                                         |
| $V_{TM}$ Max. peak on-state or forward voltage                               | 1.81   | 1.54   | V                  | $I_{TM} = \pi \times I_{T(AV)}$<br>$I_{FM} = \pi \times I_{F(AV)}$                                                                      |
| $V_{FM}$ Max. non-repetitive rate of rise of turned on current               | 150    | 150    |                    |                                                                                                                                         |
| $I_H$ Max. holding current                                                   | 200    | 200    | mA                 | T <sub>J</sub> = 25°C, anode supply = 6V, resistive load, gate open circuit<br>T <sub>J</sub> = 25°C, anode supply = 6V, resistive load |
| $I_L$ Max. latching current                                                  | 400    | 400    |                    |                                                                                                                                         |

(1)  $I^2t$  for time  $t_x = I^2\sqrt{t} \times \sqrt{t_x}$

(2) Average power =  $V_{T(TO)} \times I_{T(AV)} + r_t \times (I_{T(RMS)})^2$

(3)  $16.7\% \times \pi \times I_{AV} < I < \pi \times I_{AV}$

(4)  $I > \pi \times I_{AV}$

### Triggering

| Parameters         |                                         | IRK.41 | IRK.56 | Units | Conditions                                                |  |
|--------------------|-----------------------------------------|--------|--------|-------|-----------------------------------------------------------|--|
| P <sub>GM</sub>    | Max. peak gate power                    | 10     | 10     | W     |                                                           |  |
| P <sub>G(AV)</sub> | Max. average gate power                 | 2.5    | 2.5    |       |                                                           |  |
| I <sub>GM</sub>    | Max. peak gate current                  | 2.5    | 2.5    | A     |                                                           |  |
| -V <sub>GM</sub>   | Max. peak negative gate voltage         | 10     |        | V     | Anode supply = 6V<br>resistive load                       |  |
| V <sub>GT</sub>    | Max. gate voltage required to trigger   | 4.0    |        |       |                                                           |  |
|                    |                                         | 2.5    |        |       |                                                           |  |
|                    |                                         | 1.7    |        |       |                                                           |  |
| I <sub>GT</sub>    | Max. gate current required to trigger   | 270    |        | mA    | Anode supply = 6V<br>resistive load                       |  |
|                    |                                         | 150    |        |       |                                                           |  |
|                    |                                         | 80     |        |       |                                                           |  |
| V <sub>GD</sub>    | Max. gate voltage that will not trigger | 0.25   |        | V     | T <sub>J</sub> = 125°C,<br>rated V <sub>DRM</sub> applied |  |
| I <sub>GD</sub>    | Max. gate current that will not trigger | 6      |        | mA    | T <sub>J</sub> = 125°C,<br>rated V <sub>DRM</sub> applied |  |

### Blocking

| Parameters                                                                         | IRK.41                       | IRK.56 | Units            | Conditions                                                               |
|------------------------------------------------------------------------------------|------------------------------|--------|------------------|--------------------------------------------------------------------------|
| $I_{RRM}$ Max. peak reverse and off-state leakage current at $V_{RRM}$ , $V_{DRM}$ | 15                           |        | mA               | $T_J = 125^\circ\text{C}$ , gate open circuit                            |
| $V_{INS}$ RMS isolation voltage                                                    | 2500 (1 min)<br>3500 (1 sec) |        | V                | 50 Hz, circuit to base, all terminals shorted                            |
| $dv/dt$ Max. critical rate of rise of off-state voltage (5)                        | 500                          |        | V/ $\mu\text{s}$ | $T_J = 125^\circ\text{C}$ , linear to $0.67 V_{DRM}$ , gate open circuit |

(5) Available with  $dv/dt = 1000\text{V}/\mu\text{s}$ , to complete code add S90 i.e. IRKT41/16 S90.

### Thermal and Mechanical Specifications

| Parameters                                                           | IRK.41      | IRK.56 | Units  | Conditions                                                                                                                              |
|----------------------------------------------------------------------|-------------|--------|--------|-----------------------------------------------------------------------------------------------------------------------------------------|
| T <sub>J</sub> Junction operating temperature range                  | - 40 to 125 |        | °C     |                                                                                                                                         |
| T <sub>stg</sub> Storage temp. range                                 | - 40 to 125 |        |        |                                                                                                                                         |
| R <sub>thJC</sub> Max. internal thermal resistance, junction to case | 0.23        | 0.20   | K/W    | Per module, DC operation                                                                                                                |
| R <sub>thCS</sub> Typical thermal resistance case to heatsink        | 0.1         |        |        | Mountingsurfaceflat, smoothandgreased. Flatness <0.03 mm; roughness< 0.02 mm                                                            |
| T Mounting torque ± 10%<br>to heatsink<br>busbar                     | 5           |        | Nm     | 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 |
|                                                                      | 3           |        |        |                                                                                                                                         |
| wt Approximate weight                                                | 83 (3)      |        | g (oz) |                                                                                                                                         |
| Case style                                                           | TO-240AA    |        | JEDEC  |                                                                                                                                         |

## IRK.41, .56 Series

Bulletin I27131 rev. C 09/97

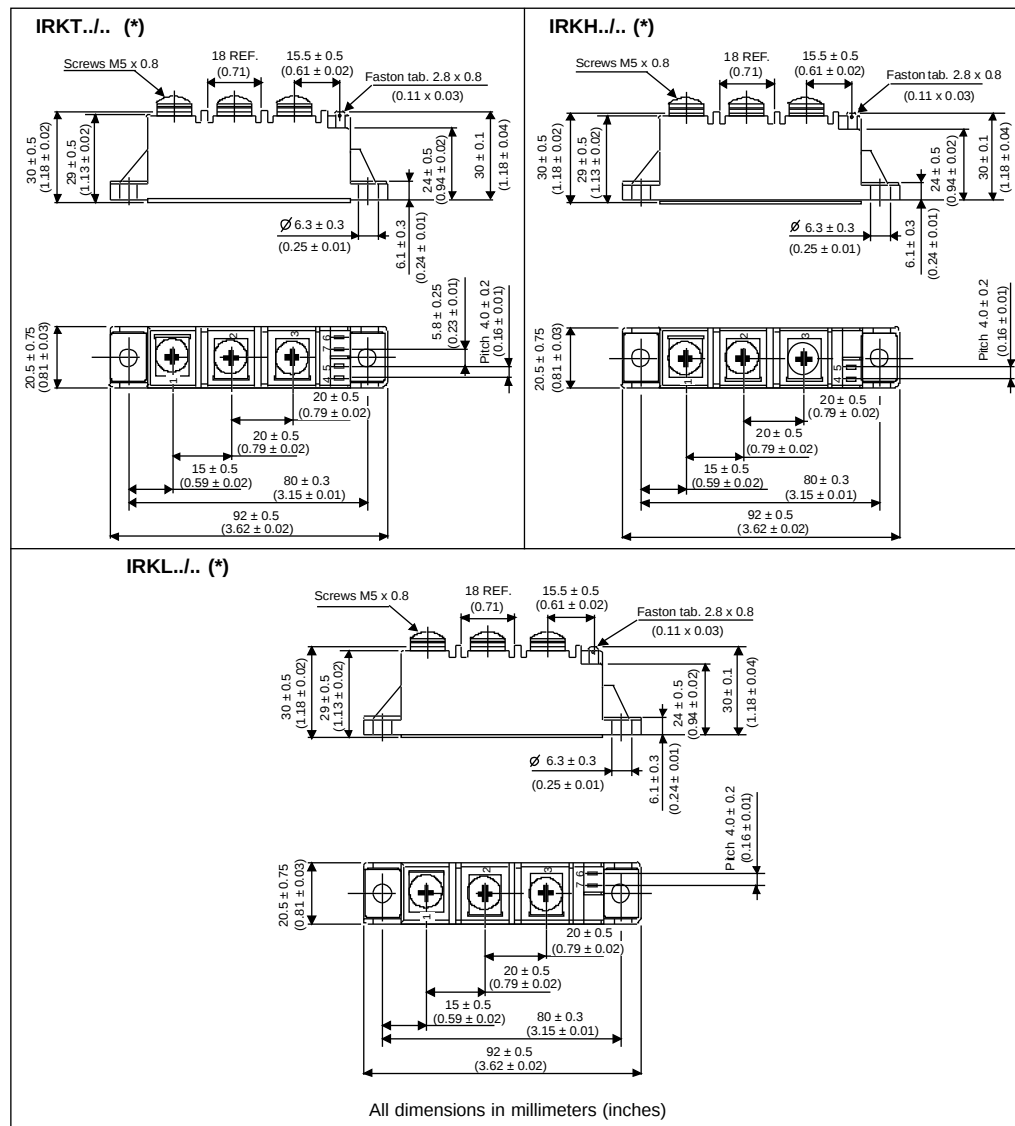
International  
**IR** Rectifier

### 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 | Sine half wave conduction |      |      |      |      | Rect. wave conduction |      |      |      |      | Units |
|---------|---------------------------|------|------|------|------|-----------------------|------|------|------|------|-------|
|         | 180°                      | 120° | 90°  | 60°  | 30°  | 180°                  | 120° | 90°  | 60°  | 30°  |       |
| IRK.41  | 0.11                      | 0.13 | 0.17 | 0.23 | 0.34 | 0.09                  | 0.14 | 0.18 | 0.23 | 0.34 | °C/W  |
| IRK.56  | 0.09                      | 0.11 | 0.13 | 0.18 | 0.27 | 0.07                  | 0.11 | 0.14 | 0.19 | 0.28 |       |

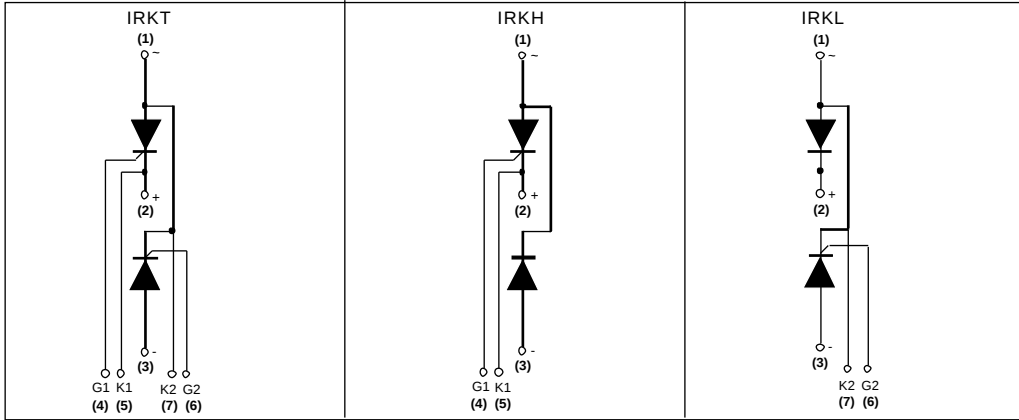
### Outlines Table



(\*) For terminals connections, see Circuit configurations Table

**NOTE: To order the Optional Hardware see Bulletin I27900**

Circuit Configurations Table



Ordering Information Table

**Device Code**

|     |   |    |   |    |     |
|-----|---|----|---|----|-----|
| IRK | T | 56 | / | 16 | S90 |
|-----|---|----|---|----|-----|

1 2 3 4 5

**IRK.57 types**  
With no auxiliary cathode

**1** - Module type  
**2** - Circuit configuration (See Circuit Configuration table)  
**3** - Current code\*\*  
**4** - Voltage code (See Voltage Ratings table)  
**5** - dv/dt code: S90 = dv/dt 1000 V/μs  
No letter = dv/dt 500 V/μs

\*\* Available with no auxiliary cathode.  
To specify change: 41 to 42  
56 to 57  
e.g. : IRKT57/16 etc.

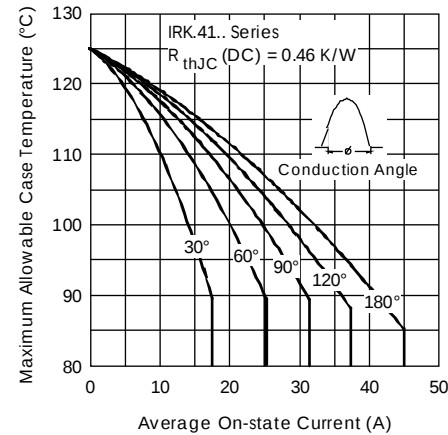


Fig. 1 - Current Ratings Characteristics

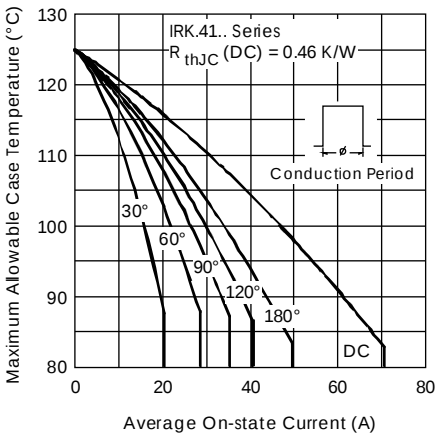


Fig. 2 - Current Ratings Characteristics

## IRK.41, .56 Series

Bulletin I27131 rev. C 09/97

International  
**IR** Rectifier

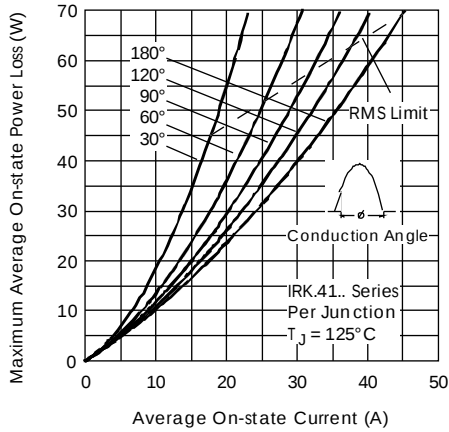


Fig. 3 - On-state Power Loss Characteristics

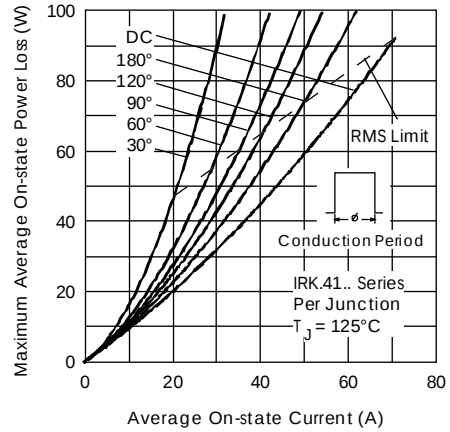


Fig. 4 - On-state Power Loss Characteristics

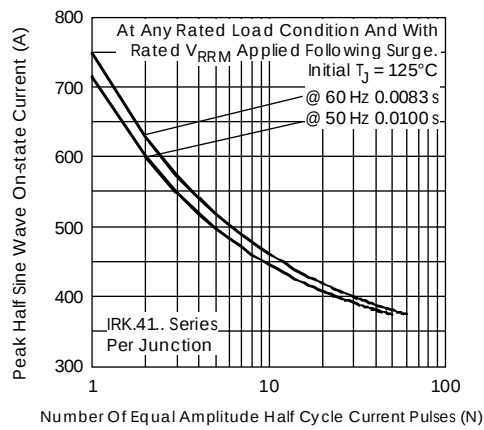


Fig. 5 - Maximum Non-Repetitive Surge Current

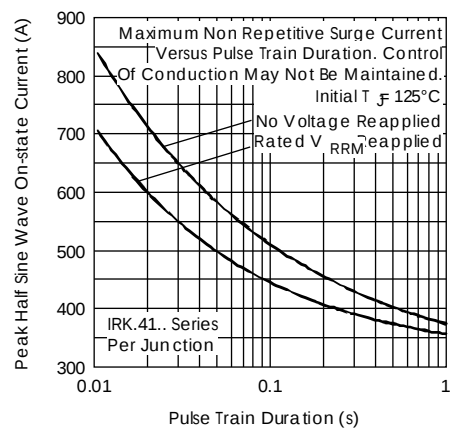


Fig. 6 - Maximum Non-Repetitive Surge Current

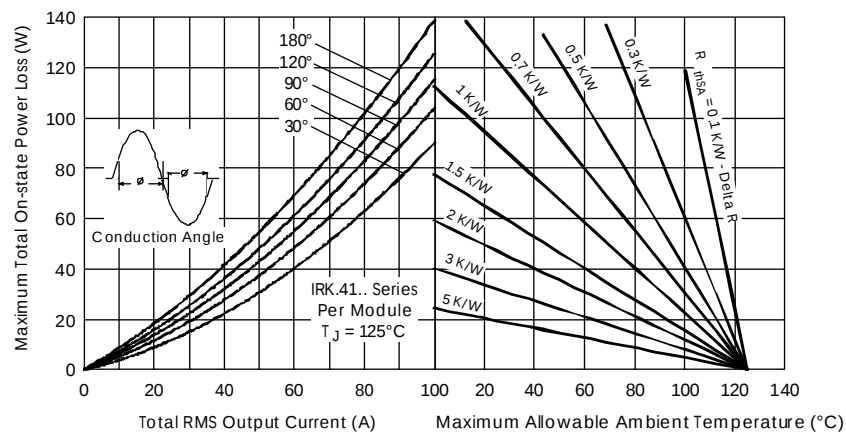


Fig. 7 - On-state Power Loss Characteristics

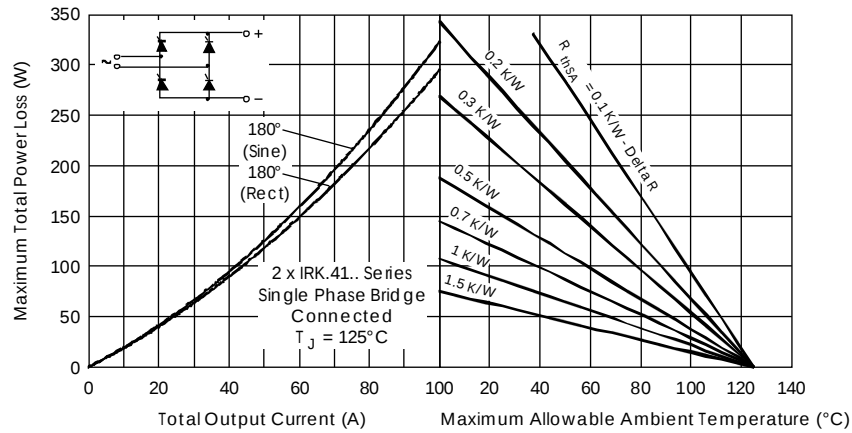


Fig. 8 - On-state Power Loss Characteristics

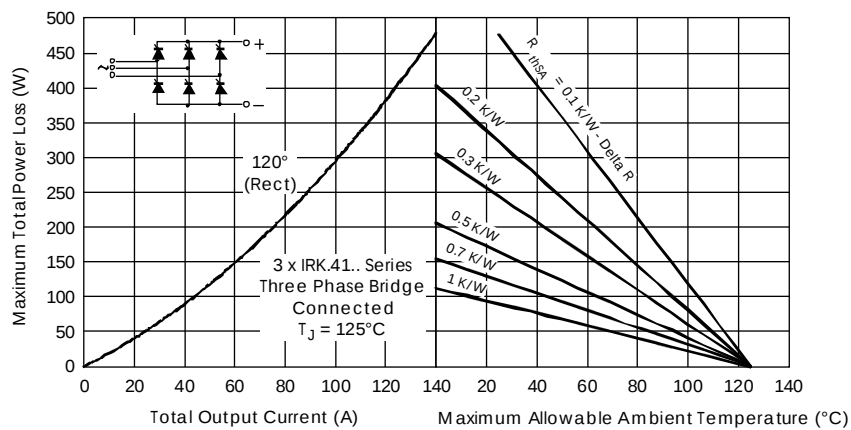


Fig. 9 - On-state Power Loss Characteristics

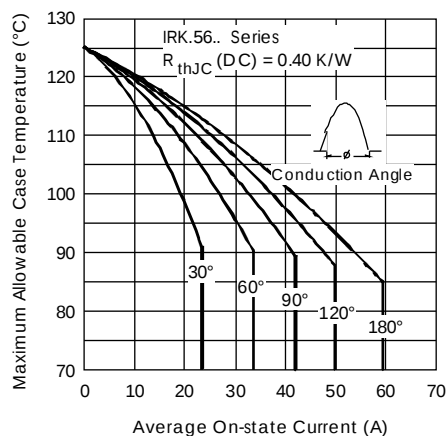


Fig. 10 - Current Ratings Characteristics

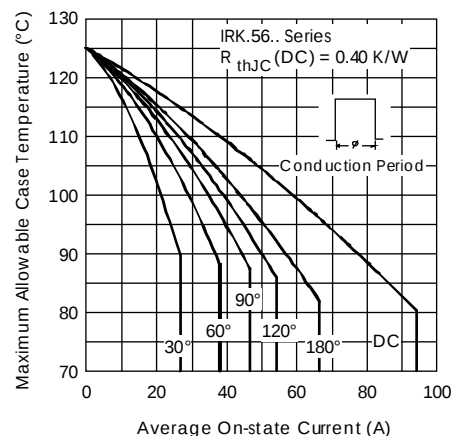


Fig. 11 - Current Ratings Characteristics

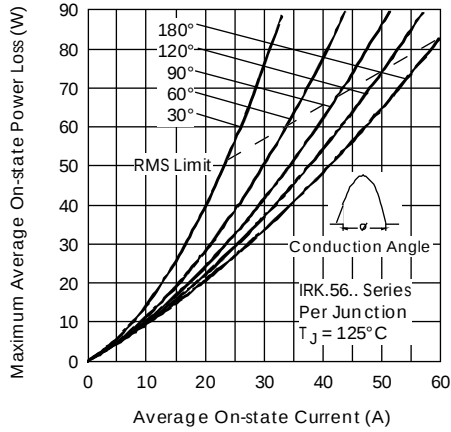


Fig. 12 - On-state Power Loss Characteristics

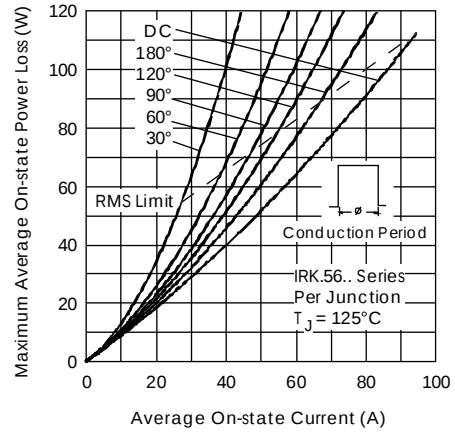


Fig. 13 - On-state Power Loss Characteristics

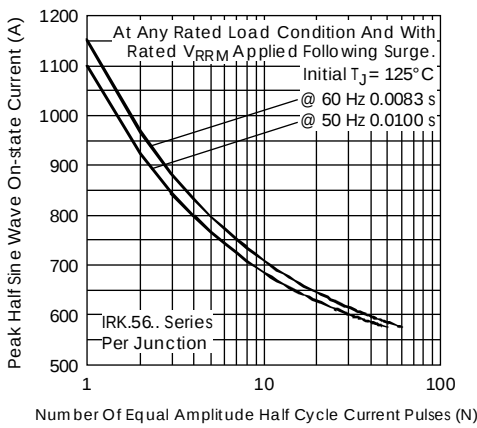


Fig. 14 - Maximum Non-Repetitive Surge Current

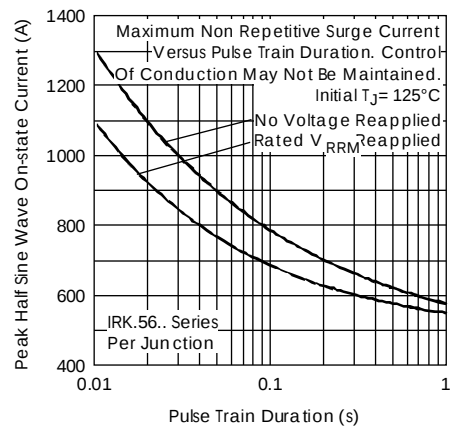


Fig. 15 - Maximum Non-Repetitive Surge Current

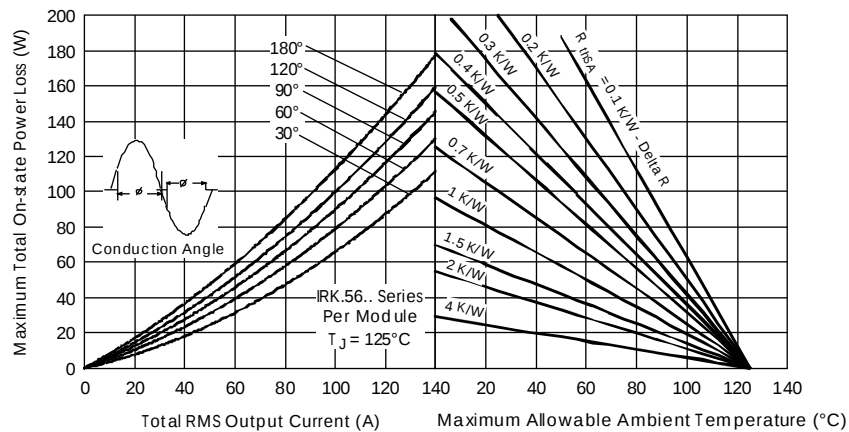


Fig. 16 - On-state Power Loss Characteristics

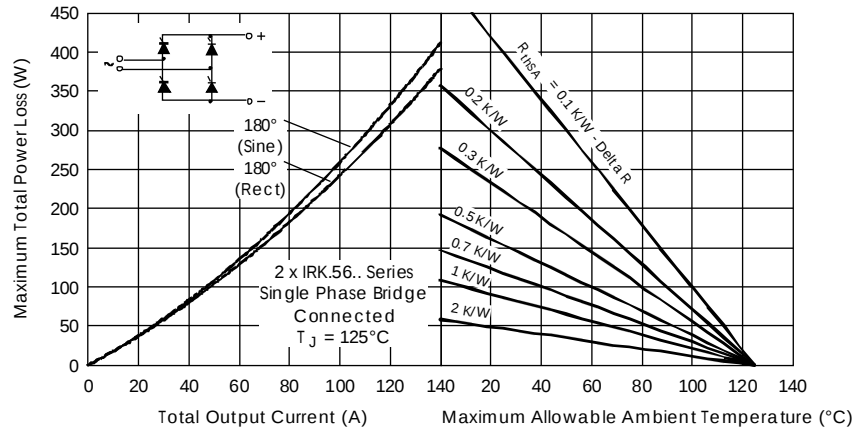


Fig. 17 - On-state Power Loss Characteristics

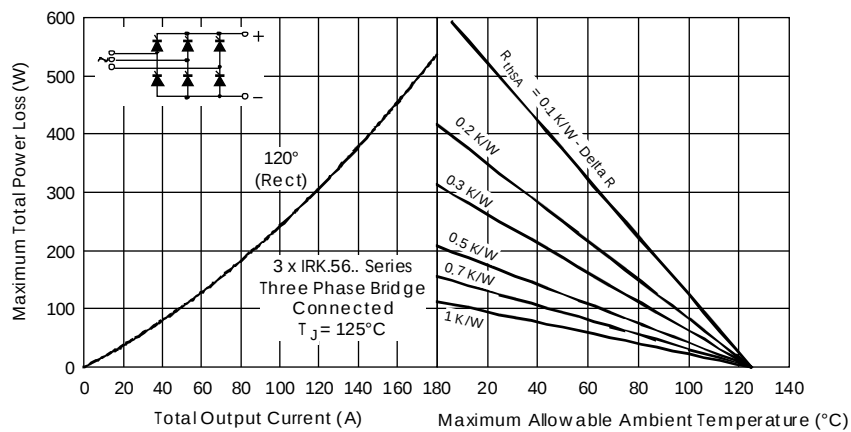


Fig. 18 - On-state Power Loss Characteristics

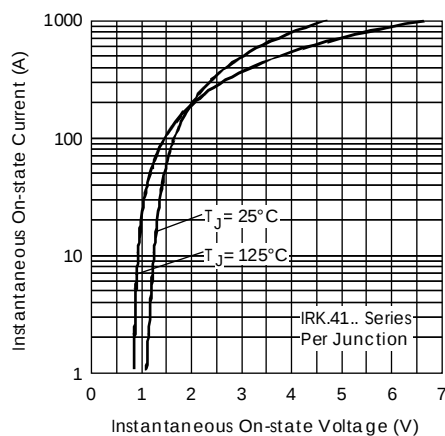


Fig. 19 - On-state Voltage Drop Characteristics

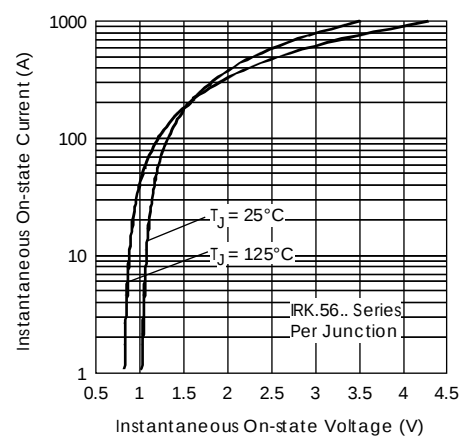


Fig. 20 - On-state Voltage Drop Characteristics

## IRK.41, .56 Series

Bulletin I27131 rev. C 09/97

International  
**IR** Rectifier

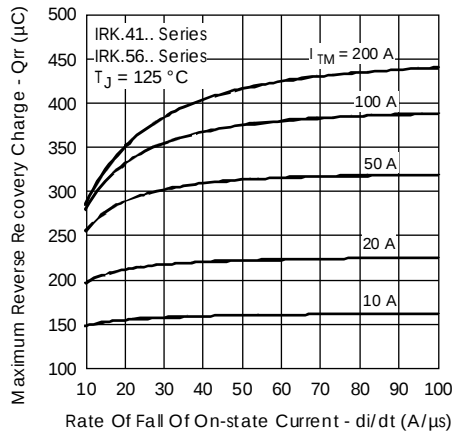


Fig. 21 - Recovery Charge Characteristics

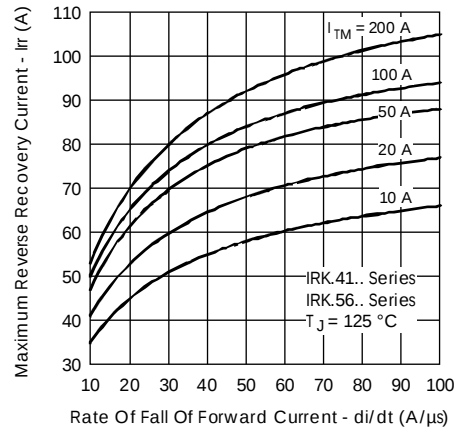


Fig. 22 - Recovery Current Characteristics

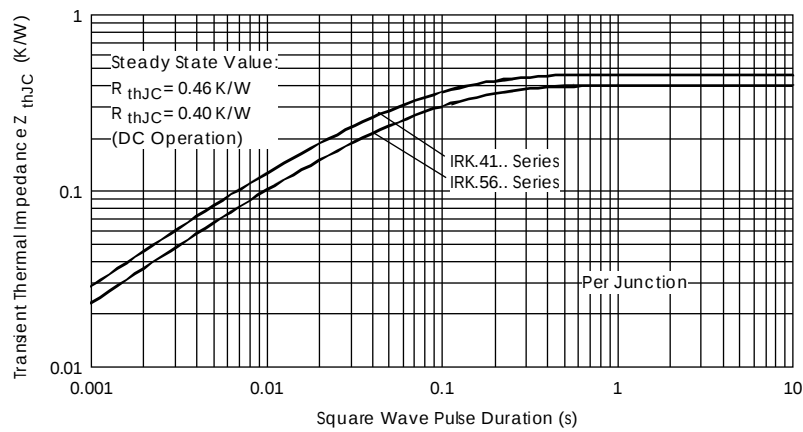


Fig. 23 - Thermal Impedance  $Z_{thJC}$  Characteristics

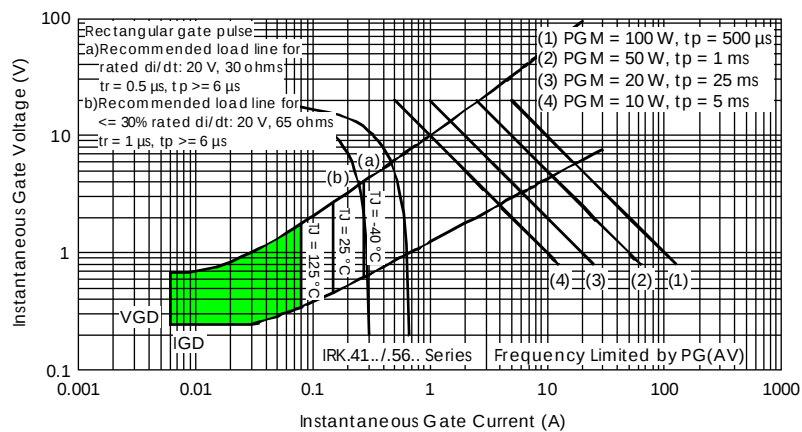


Fig. 24 - Gate Characteristics