

# International IR Rectifier

## SERIES IRK.136, .142, .162

**THYRISTOR/DIODE and  
THYRISTOR/THYRISTOR**

**NEW INT-A-pak Power Modules**

### Features

- High Voltage
- Electrically Isolated by DBC Ceramic ( $Al_2O_3$ )
- 3500  $V_{RMS}$  Isolating Voltage
- Industrial Standard Package
- High Surge Capability
- Glass Passivated Chips
- Modules uses High Voltage Power thyristor/diodes in three Basic Configurations
- Simple Mounting
- UL E78996 approved 

135 A  
140 A  
160 A

### Applications

- DC Motor Control and Drives
- Battery Charges
- Welders
- Power Converters
- Lighting Control
- Heat and Temperature Control

### Major Ratings and Characteristics

| Parameters    | IRK.136..   | IRK.142.. | IRK.162.. | Units              |                   |
|---------------|-------------|-----------|-----------|--------------------|-------------------|
| $I_{T(AV)}$   | 135         | 140       | 160       | A                  |                   |
| @ $T_C$       | 85          | 85        | 85        | °C                 |                   |
| $I_{T(RMS)}$  | 300         | 310       | 355       | A                  |                   |
| $I_{TSM}$     | @ 50Hz      | 3200      | 4500      | 4870               | A                 |
|               | @ 60Hz      | 3360      | 4712      | 5100               | A                 |
| $I^2t$        | @ 50Hz      | 51.5      | 102       | 119                | KA <sup>2</sup> s |
|               | @ 60Hz      | 47        | 92.5      | 108                | KA <sup>2</sup> s |
| $I^2\sqrt{t}$ | 515.5       | 1013      | 1190      | KA <sup>2</sup> √s |                   |
| $V_{RRM}$     | 400 to 1600 |           |           | V                  |                   |
| $T_J$ range   | -40 to 125  |           |           | °C                 |                   |

CASE STYLE NEW INT-A-PAK



## Electrical Specifications

### Voltage Ratings

| Type number | Voltage Code | $V_{RRM}/V_{DRM}$ , Maximum repetitive peak reverse voltage<br>V | $V_{RSM}/V_{DSM}$ , Maximum non-repetitive peak reverse voltage<br>V | $I_{RRM}/I_{DRM}$<br>@ 125°C<br>mA |
|-------------|--------------|--|--|------------------------------------|
| IRK.136     | 04           | 400  | 500  | 50                                 |
| IRK.142     | 08           | 800  | 900  |                                    |
| IRK.162     | 12           | 1200   | 1300   |                                    |
|             | 14           | 1400   | 1500   |                                    |
|             | 16           | 1600   | 1700   |                                    |

### Forward Conduction

| Parameter  | IRK.136 | IRK.142 | IRK.162 | Units              | Conditions   |   |
|--|---------|---------|---------|--------------------|--|---|
| $I_{T(AV)}$ Max. average on-state current<br>@ Case temperature          | 135     | 140     | 160     | A                  | 180° conduction, half sine wave  |   |
|  | 85      | 85      | 85      | °C                 |  |   |
| $I_{T(RMS)}$ Max. RMS on-state current                                   | 300     | 310     | 355     | A                  | as AC switch   |   |
| $I_{TSM}$ Maximum peak, one-cycle on-state, non-repetitive surge current | 3200    | 4500    | 4870    | A                  | t = 10ms No voltage  | Sine half wave,<br>Initial $T_J = T_{J \text{ max.}}$ |
|  | 3360    | 4712    | 5100    |                    | t = 8.3ms reappplied   |   |
|  | 2700    | 3785    | 4100    |                    | t = 10ms 100% $V_{RRM}$  |   |
|  | 2800    | 3963    | 4300    |                    | t = 8.3ms reappplied   |   |
| $I^2t$ Maximum $I^2t$ for fusing   | 51.5    | 102     | 119     | KA <sup>2</sup> s  | t = 10ms No voltage  |   |
|  | 47      | 92.5    | 108     |                    | t = 8.3ms reappplied   |   |
|  | 36.5    | 71.6    | 84      |                    | t = 10ms 100% $V_{RRM}$  |   |
|  | 33.3    | 65.4    | 76.7    |                    | t = 8.3ms reappplied   |   |
| $I^2\sqrt{t}$ Maximum $I^2\sqrt{t}$ for fusing                           | 515.5   | 1013    | 1190    | KA <sup>2</sup> √s | t = 0.1 to 10ms, no voltage reappplied   |   |
| $V_{T(TO)1}$ Low level value of threshold voltage                        | 0.86    | 0.83    | 0.8     | V                  | $(16.7\% \times \pi \times I_{T(AV)}) < I < \pi \times I_{T(AV)}$ , @ $T_{J \text{ max.}}$ |   |
| $V_{T(TO)2}$ High level value of threshold voltage                       | 1.05    | 1       | 0.98    |                    | $(I > \pi \times I_{T(AV)})$ , @ $T_{J \text{ max.}}$                                      |   |
| $r_{\theta 1}$ Low level value on-state slope resistance                 | 2.02    | 1.78    | 1.67    | mΩ                 | $(16.7\% \times \pi \times I_{T(AV)}) < I < \pi \times I_{T(AV)}$ , @ $T_{J \text{ max.}}$ |   |
| $r_{\theta 2}$ High level value on-state slope resistance                | 1.65    | 1.43    | 1.38    |                    | $(I > \pi \times I_{T(AV)})$ , @ $T_{J \text{ max.}}$                                      |   |
| $V_{TM}$ Maximum forward voltage drop                                    | 1.57    | 1.55    | 1.54    | V                  | $I_{TM} = \pi \times I_{T(AV)}$ , $T_J = 25^\circ\text{C}$ , 180° conduction               |   |
| $I_H$ Maximum holding current  | 200     |         |         | mA                 | Anode supply = 6V initial $I_r = 30A$ , $T_J = 25^\circ\text{C}$                           |   |
| $I_L$ Maximum latching current   | 400     |         |         | mA                 | Anode supply = 6V resistive load = 1Ω<br>Gate pulse: 10V, 100μs, $T_J = 25^\circ\text{C}$  |   |

### Switching

|                             |          |    |   |                                    |
|-----------------------------|----------|----|---|------------------------------------|
| $t_{gd}$ Typical delay time | 1        | μs | $T_J = 25^\circ\text{C}$  | Gate Current=1A $dI_g/dt=1A/\mu s$ |
| $t_{gr}$ Typical rise time  | 2        |    | $T_J = 25^\circ\text{C}$  | $V_d=0,67\% V_{DRM}$               |
| $t_q$ Typical turn-off time | 50 - 200 |    | $I_{TM} = 300A$ ; $-dI/dt = 15A/\mu s$ ; $T_J = T_{J \text{ max}}$<br>$V_r = 50V$ ; $dV/dt = 20V/\mu s$ ; Gate 0V, 100Ω |                                    |

**Blocking**

|           |  |      |                  |   |
|-----------|--|------|------------------|---|
| $I_{RRM}$ | Maximum peak reverse and off-state leakage current | 50   | mA               | $T_J = 125^\circ\text{C}$                                     |
| $I_{DRM}$ | Maximum peak reverse and off-state leakage current |      |                  |   |
| $V_{INS}$ | RMS isolation voltage                              | 3500 | V                | 50Hz, circuit to base, all terminals shorted, $t = 1\text{s}$ |
| $dV/dt$   | critical rate of rise of off-state voltage         | 1000 | V/ $\mu\text{s}$ | $T_J = T_{J\text{max.}}$ , exponential to 67% rated $V_{DRM}$ |

**Triggering**

| Parameter   | IRK.136                                  | IRK.142 | IRK.162 | Units            | Conditions  |
|-------------|--|---------|---------|------------------|---|
| $P_{GM}$    | 12                                       |         |         | W                | $t_p \leq 5\text{ms}$ , $T_J = T_{J\text{max.}}$                            |
| $P_{G(AV)}$ | 3  |         |         | W                | $f = 50\text{Hz}$ , $T_J = T_{J\text{max.}}$                                |
| $I_{GM}$    | 3  |         |         | A                | $t_p \leq 5\text{ms}$ , $T_J = T_{J\text{max.}}$                            |
| $-V_{GT}$   | 10                                       |         |         | V                |   |
| $V_{GT}$    | Max. required DC gate voltage to trigger | 4       |         | V                | $T_J = -40^\circ\text{C}$   |
|             |  | 2.5     |         |                  | $T_J = 25^\circ\text{C}$  |
|             |  | 1.7     |         |                  | $T_J = T_{J\text{max.}}$  |
| $I_{GT}$    | Max. required DC gate current to trigger | 270     |         | mA               | $T_J = -40^\circ\text{C}$   |
|             |  | 150     |         |                  | $T_J = 25^\circ\text{C}$  |
|             |  | 80      |         |                  | $T_J = T_{J\text{max.}}$  |
| $V_{GD}$    | Max. gate voltage that will not trigger  | 0.3     |         | V                | @ $T_J = T_{J\text{max.}}$ , rated $V_{DRM}$ applied                        |
| $I_{GD}$    | Max. gate current that will not trigger  | 10      |         | mA               |   |
| $di/dt$     | Max. rate of rise of turned-on current   | 300     |         | A/ $\mu\text{s}$ | @ $T_J = T_{J\text{max.}}$ , $I_{TM} = 400\text{A}$ rated $V_{DRM}$ applied |

**Thermal and Mechanical Specifications**

| Parameter  | IRK.136                    | IRK.142                       | IRK.162 | Units            | Conditions   |
|------------|----------------------------|-------------------------------|---------|------------------|--|
| $T_J$      | -40 to 125                 |                               |         | $^\circ\text{C}$ |  |
| $T_{stg}$  | -40 to 150                 |                               |         | $^\circ\text{C}$ |  |
| $R_{thJC}$ | 0.18                       | 0.18                          | 0.16    | K/W              | DC operation, per junction   |
| $R_{thCS}$ | 0.05                       |                               |         | K/W              | Mounting surface smooth, flat and greased<br>Per module  |
| T          | Mounting torque $\pm 10\%$ | 4 to 6                        |         | 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. Lubricated threads. |
|            |                            | IAP to heatsink busbar to IAP |         |                  |  |
| wt         | 200 (7.1)                  |                               |         | g(oz)            |  |
| Case Style | New Int-A-Pak              |                               |         |                  |  |

**$\Delta R$  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 @ $T_J\text{max.}$ |        |        |        |        | Rectangular conduction @ $T_J\text{max.}$ |        |        |        |        | Units |
|---------|--|--------|--------|--------|--------|---|--------|--------|--------|--------|-------|
|         | 180°                                     | 120°   | 90°    | 60°    | 30°    | 180°                                      | 120°   | 90°    | 60°    | 30°    |       |
| IRK.136 | 0.007                                    | 0.01   | 0.013  | 0.0155 | 0.017  | 0.009                                     | 0.012  | 0.014  | 0.015  | 0.017  | K/W   |
| IRK.142 | 0.0019                                   | 0.0019 | 0.0020 | 0.0020 | 0.0021 | 0.0018                                    | 0.0022 | 0.0023 | 0.0023 | 0.0020 |       |
| IRK.162 | 0.0030                                   | 0.0031 | 0.0032 | 0.0033 | 0.0034 | 0.0029                                    | 0.0036 | 0.0039 | 0.0041 | 0.0040 |       |

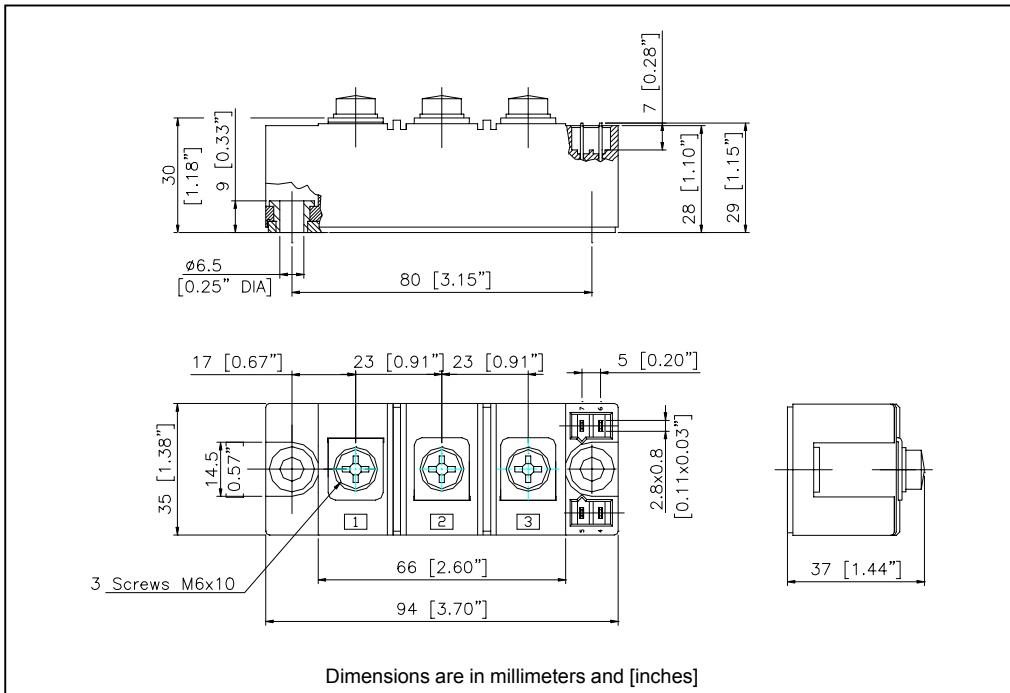
# IRK.136, .142, .162 Series

Bulletin I27117 rev. C 03/02

## Ordering Information Table

| Device Code |  |     |   |    |
|-------------|--|-----|---|----|
| 1           | 2                                      | 3   | 4 |    |
| IRK         | T                                      | 162 | / | 16 |
| 1           | -                                      |     |   |    |
| 2           | -                                      |     |   |    |
| 3           | -                                      |     |   |    |
| 4           | -                                      |     |   |    |
|             | - Module Type                          |     |   |    |
|             | - Circuit Configuration                |     |   |    |
|             | - Current Rating: $I_{T(AV)}$          |     |   |    |
|             | - Voltage Code: Code x 100 = $V_{RRM}$ |     |   |    |

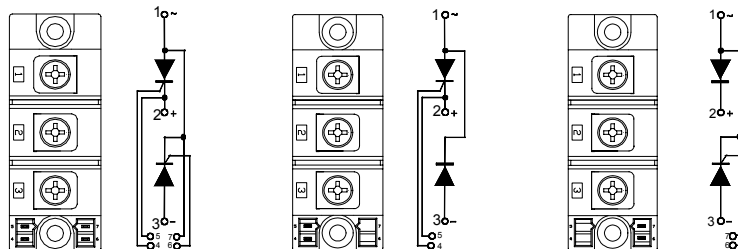
## Outline Table



**IRKT**

**IRKH**

**IRKL**



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



Fig. 1 - Current Ratings Characteristics

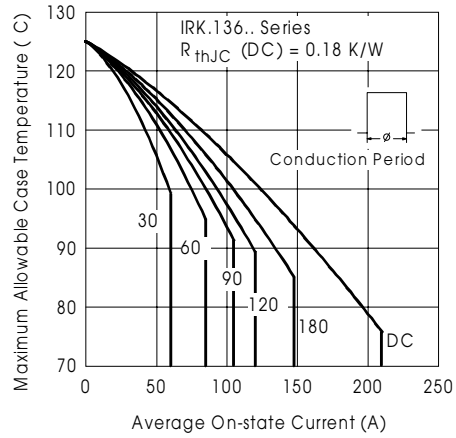


Fig. 2 - Current Ratings Characteristics



Fig. 3 - On-State Power Loss Characteristics

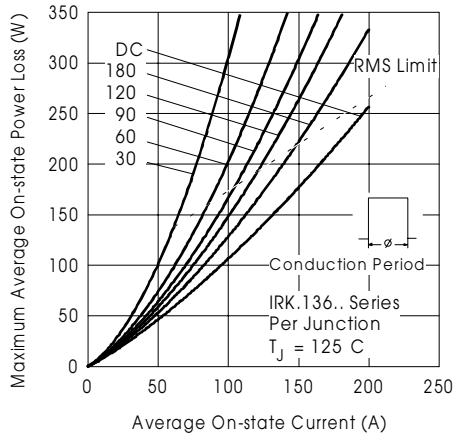


Fig. 4 - On-State Power Loss Characteristics



Fig. 5 - Maximum Non-Repetitive Surge Current

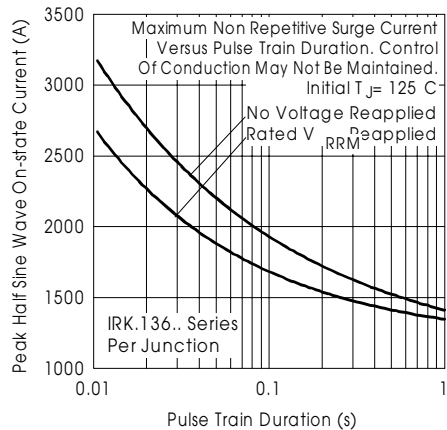


Fig. 6 - Maximum Non-Repetitive Surge Current

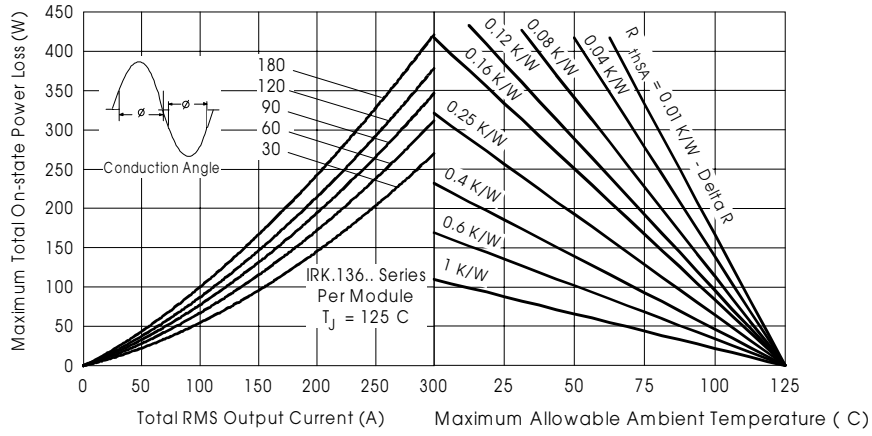


Fig.7 - On State Power Loss Characteristics

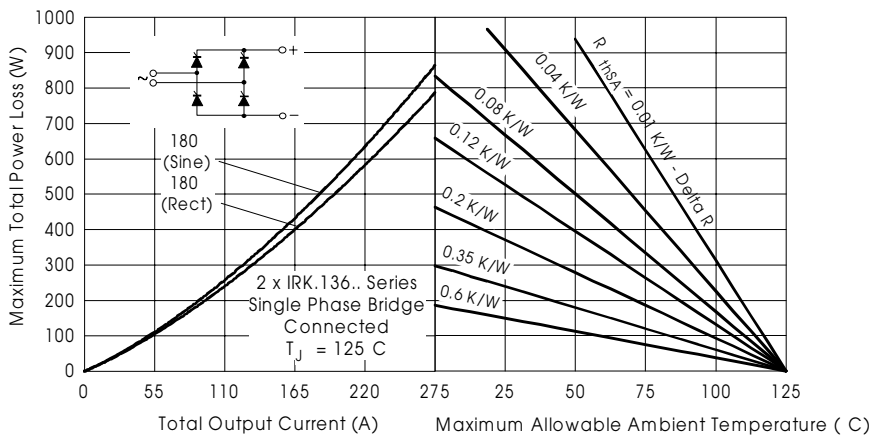


Fig.8 - On State Power Loss Characteristics

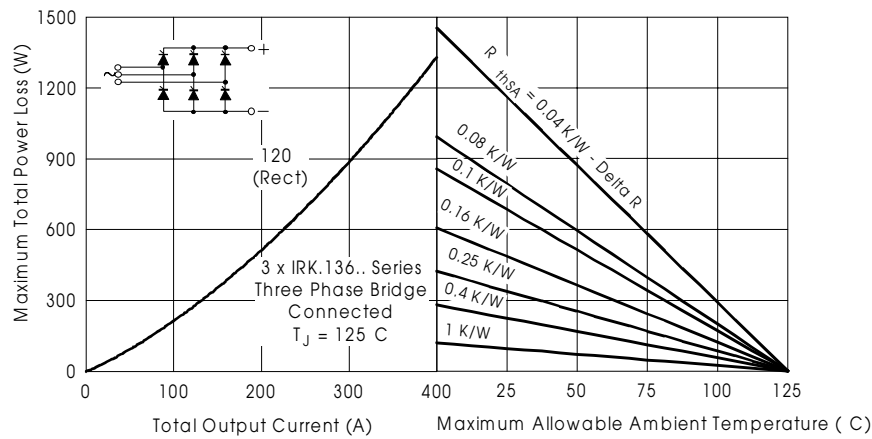


Fig.9 - On State Power Loss Characteristics

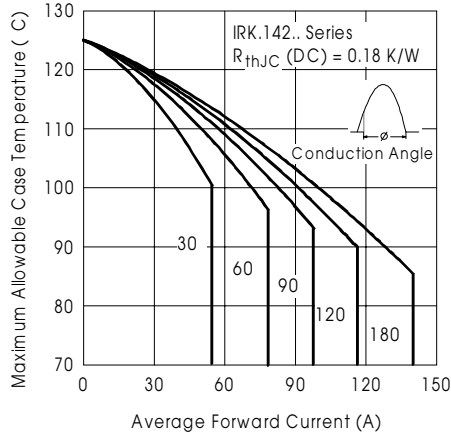


Fig. 10 - Current Ratings Characteristics

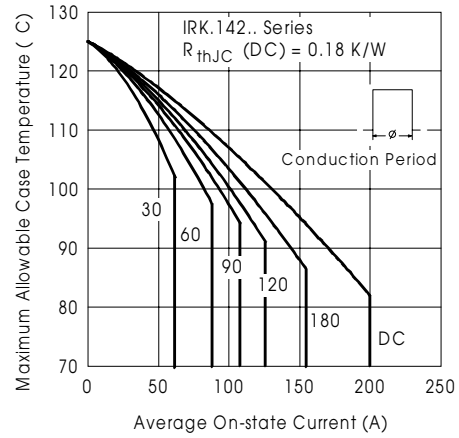


Fig. 11 - Current Ratings Characteristics

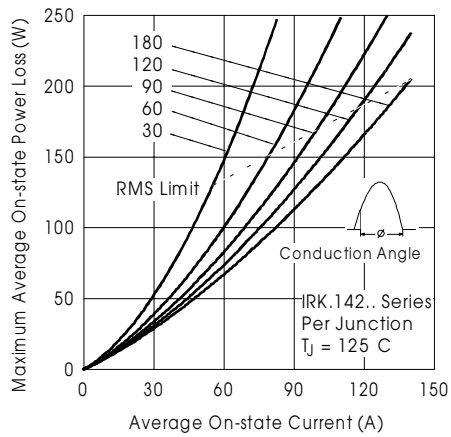


Fig. 12 - On-State Power Loss Characteristics

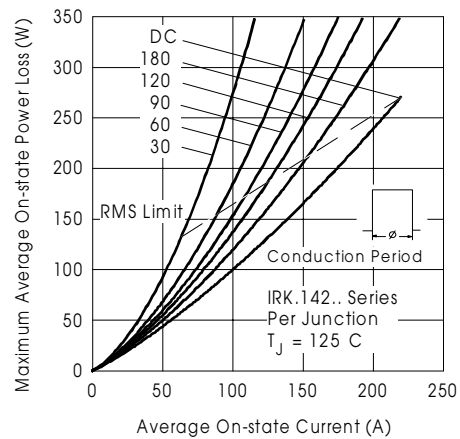


Fig. 13 - On-State Power Loss Characteristics

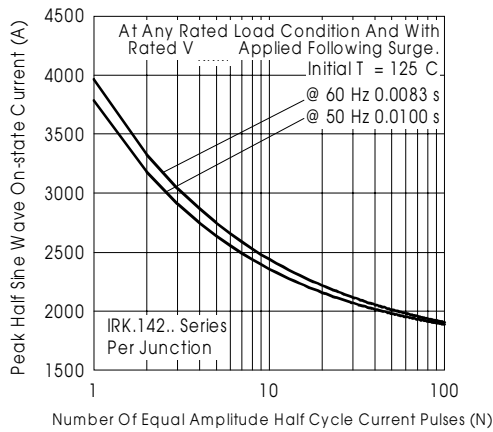


Fig. 14 - Maximum Non-Repetitive Surge Current

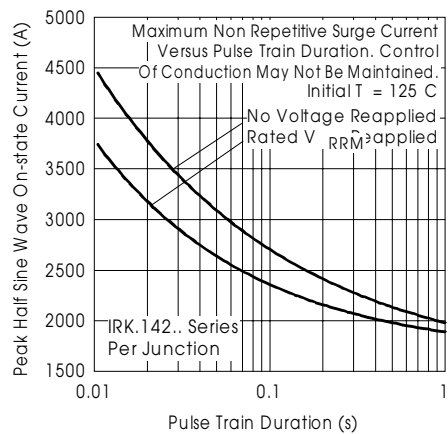


Fig. 15 - Maximum Non-Repetitive Surge Current

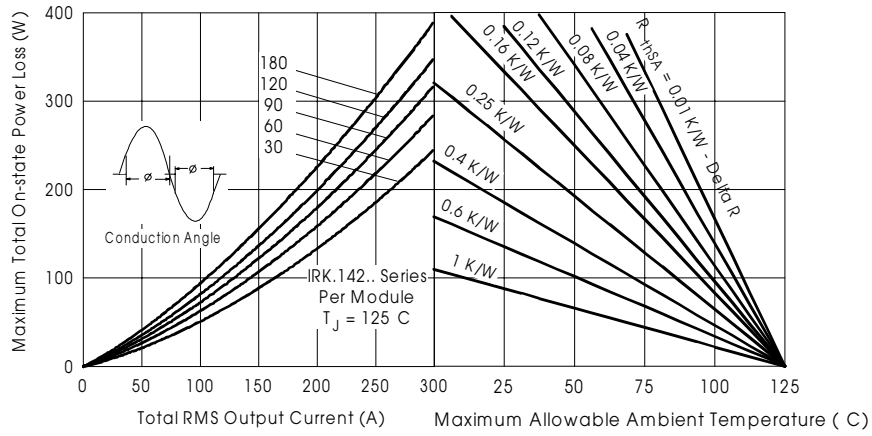


Fig.16 - On State Power Loss Characteristics

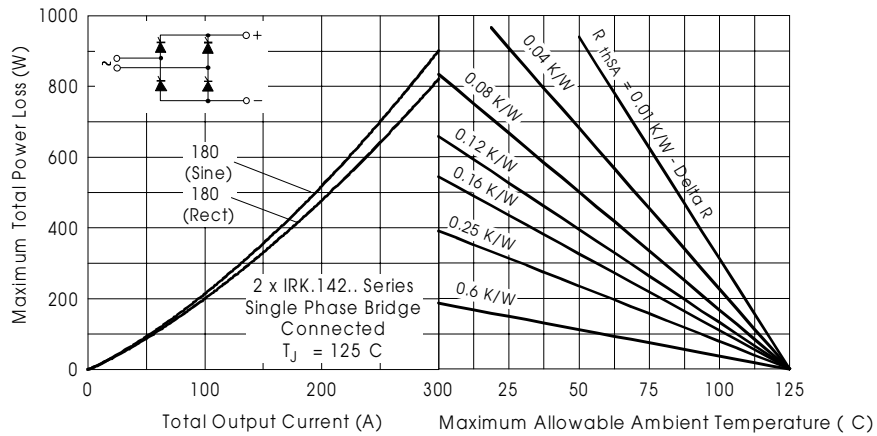


Fig.17 - On State Power Loss Characteristics

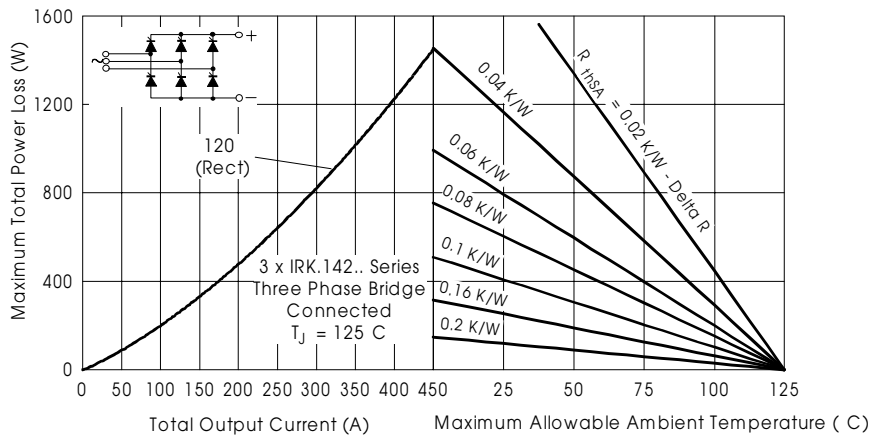


Fig.18 - On State Power Loss Characteristics





Fig. 19 - Current Ratings Characteristics



Fig. 20 - Current Ratings Characteristics



Fig. 21 - On-State Power Loss Characteristics



Fig. 22 - On-State Power Loss Characteristics

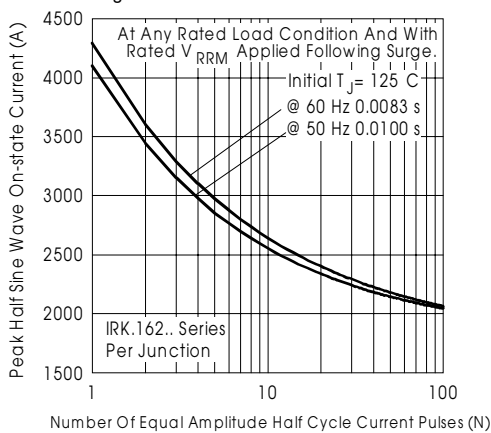


Fig. 23 - Maximum Non-Repetitive Surge Current

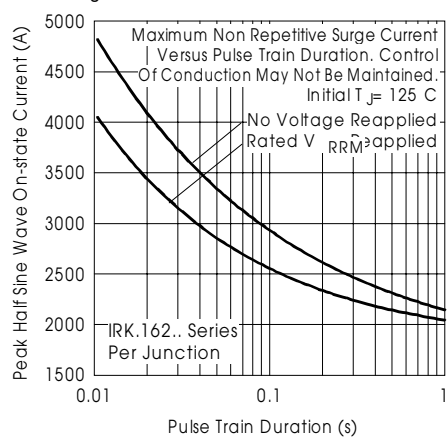


Fig. 24 - Maximum Non-Repetitive Surge Current

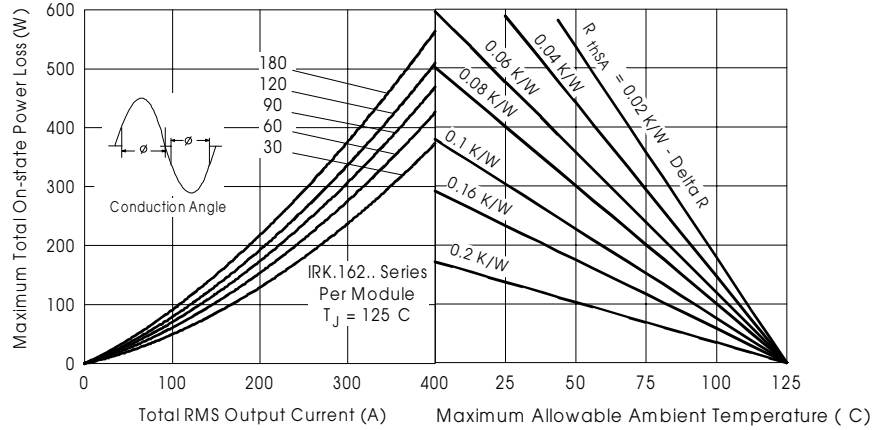


Fig.25 - On State Power Loss Characteristics

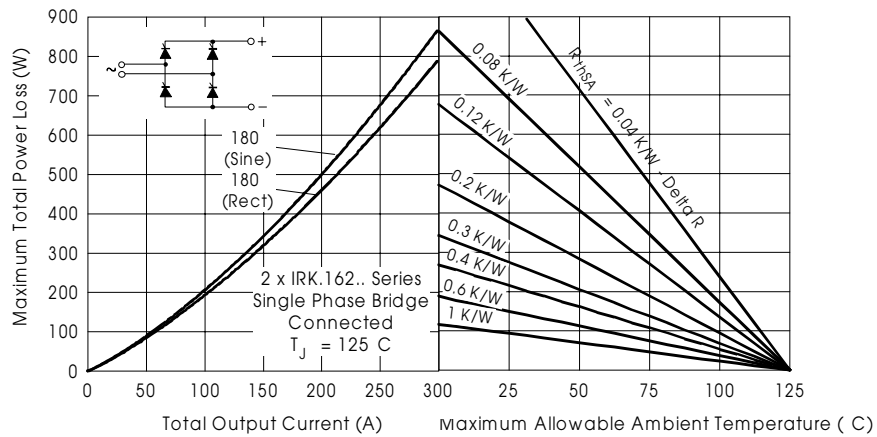


Fig.26 - On State Power Loss Characteristics

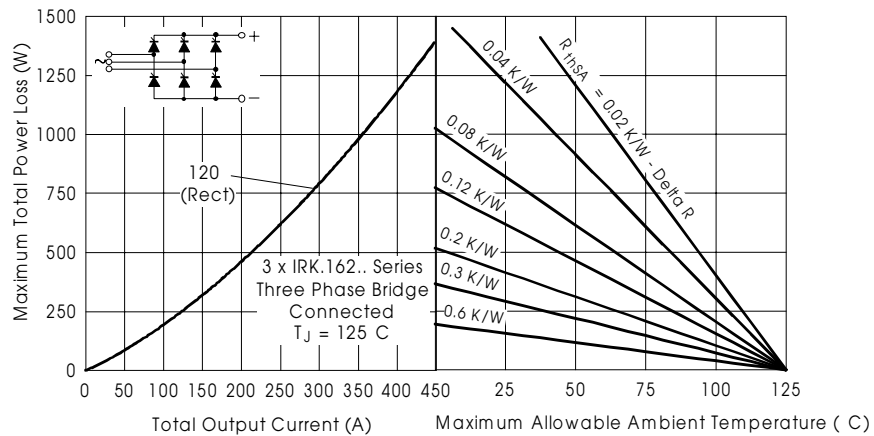


Fig.27 - On State Power Loss Characteristics



Fig.28 - On State Voltage Drop Characteristics



Fig.29 - On State Voltage Drop Characteristics

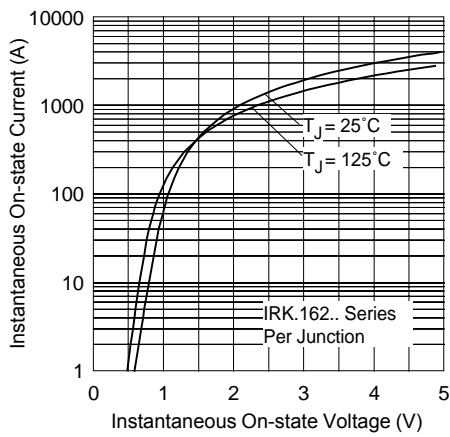


Fig.30 - On State Voltage Drop Characteristics

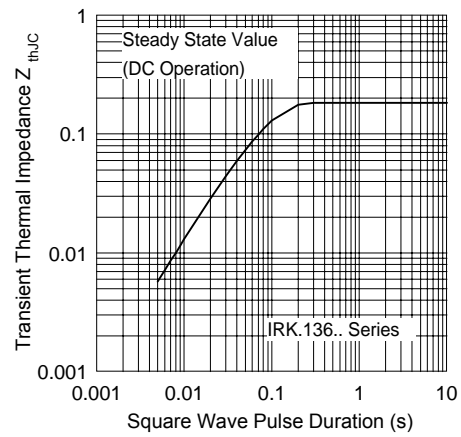


Fig.31 - Thermal Impedance ZthJC Characteristics



Fig.32 - Thermal Impedance ZthJC Characteristics

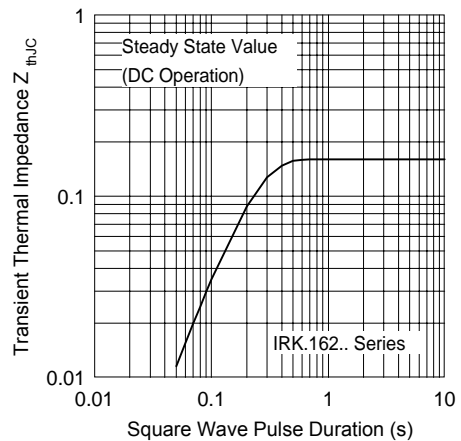


Fig.33 - Thermal Impedance ZthJC Characteristics

**IRK.136, .142, .162 Series**

Bulletin I27117 rev. C 03/02

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Fig. 34 - Gate Characteristics

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

International  
**IR** Rectifier

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