Bulletin I27133 rev. I 09/04

International
IOR Rectifier

# IRK.105 SERIES

**THYRISTOR/ DIODE and THYRISTOR/ THYRISTOR**

**ADD-A-pak™ GEN V Power Modules**

## Features

- High Voltage
- Industrial Standard Package
- Thick Al metal die and double stick bonding
- Thick copper baseplate
- UL E78996 approved
- 3500$V_{RMS}$ isolating voltage

## Benefits

- Up to 1600V
- Full compatible TO-240AA
- High Surge capability
- Easy Mounting on heatsink
- $Al_2O_3$ DBC insulator
- Heatsink grounded

105 A

## Mechanical Description

The Generation V of Add-A-pak module combine the excellent thermal performance obtained by the usage of Direct Bonded Copper substrate with superior mechanical ruggedness, thanks to the insertion of a solid Copper baseplate at the bottom side of the device. The Cu baseplate allow an easier mounting on the majority of heatsink with increased tolerance of surface roughness and improve thermal spread.
The Generation V of AAP module is manufactured without hard mold, eliminating in this way any possible direct stress on the leads.

The electrical terminals are secured against axial pull-out: they are fixed to the module housing via a click-stop feature already tested and proved as reliable on other IR modules.

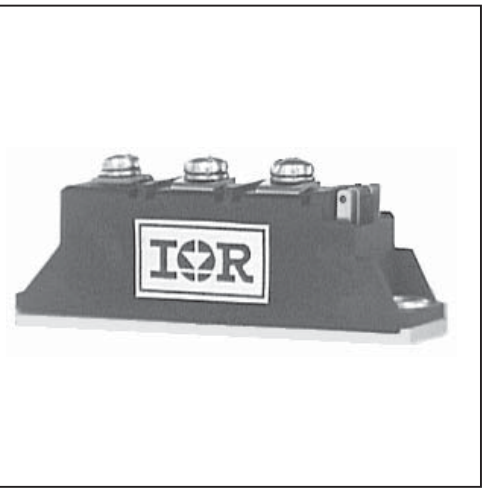
## Electrical Description

These modules are intended for general purpose high voltage applications such as high voltage regulated power supplies, lighting circuits, temperature and motor speed control circuits, UPS and battery charger.

## Major Ratings and Characteristics

| Parameters | IRK.105 | Units |
|---|---|---|
| $I_{T(AV)}$ or $I_{F(AV)}$ @85°C | 105 | A |
| $I_{O(RMS)}$ (*) | 235 | A |
| $I_{TSM}$ @50Hz | 1785 | A |
| $I_{FSM}$ @60Hz | 1870 | A |
| $I^2t$ @50Hz | 15.91 | $KA^2s$ |
| @60Hz | 14.52 | $KA^2s$ |
| $I^2\sqrt{t}$ | 159.1 | $KA^2\sqrt{s}$ |
| $V_{RRM}$ range | 400 to 1600 | V |
| $T_{STG}$ | -40 to 150 | °C |
| $T_J$ | -40 to130 | °C |

(*) As AC switch.

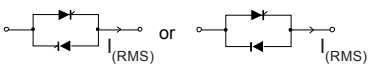


## ELECTRICAL SPECIFICATIONS

### Voltage Ratings

| Type number | Voltage Code - | $V_{RRM}$ , maximum repetitive peak reverse voltage V | $V_{RSM}$ , maximum non-repetitive peak reverse voltage V | $V_{DRM}$ , max. repetitive peak off-state voltage, gate open circuit V | $I_{RRM}$ $I_{DRM}$ 130°C mA |
|---|---|---|---|---|---|
| IRK.105 | 04 | 400 | 500 | 400 | 20 |
| | 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.105 | Units | Conditions | | |
|---|---|---|---|---|---|---|
| $I_{T(AV)}$ $I_{F(AV)}$ | Max. average on-state current (Thyristors) Max. average forward current (Diodes) | 105 | A | 180° conduction, half sine wave, $T_C$ = 85°C | | |
| $I_{O(RMS)}$ | Max. continuous RMS on-state current. As AC switch | 235 | |  $I_{(RMS)}$ or $I_{(RMS)}$ | | |
| $I_{TSM}$ or $I_{FSM}$ | Max. peak, one cycle non-repetitive on-state or forward current | 1785 | | t=10ms | No voltage reapplied | Sinusoidal half wave, Initial $T_J = T_J$ max. |
| | | 1870 | | t=8.3ms | | |
| | | 1500 | | t=10ms | 100% $V_{RRM}$ reapplied | |
| | | 1570 | | t=8.3ms | | |
| | | 2000 | | t=10ms | $T_J$ = 25°C, no voltage reapplied | |
| | | 2100 | | t=8.3ms | | |
| $I^2t$ | Max. $I^2t$ for fusing | 15.91 | $KA^2s$ | t=10ms | No voltage reapplied | Initial $T_J = T_J$ max. |
| | | 14.52 | | t=8.3ms | | |
| | | 11.25 | | t=10ms | 100% $V_{RRM}$ reapplied | |
| | | 10.27 | | t=8.3ms | | |
| | | 20.00 | | t=10ms | $T_J$ = 25°C, no voltage reapplied | |
| | | 18.30 | | t=8.3ms | | |
| $I^2\sqrt{t}$ | Max. $I^2\sqrt{t}$ for fusing (1) | 159.1 | $KA^2\sqrt{s}$ | t=0.1 to 10ms, no voltage reappl. $T_J = T_J$ max | | |
| $V_{T(TO)}$ | Max. value of threshold voltage (2) | 0.80 | V | Low level (3) | | $T_J = T_J$ max |
| | | 0.85 | | High level (4) | | |
| $r_t$ | Max. value of on-state slope resistance (2) | 2.37 | mΩ | Low level (3) | | $T_J = T_J$ max |
| | | 2.25 | | High level (4) | | |
| $V_{TM}$ $V_{FM}$ | Max. peak on-state or forward voltage | 1.64 | V | $I_{TM} = \pi \times I_{T(AV)}$ $I_{FM} = \pi \times I_{F(AV)}$ | | $T_J$ = 25°C |
| di/dt | Max. non-repetitive rate of rise of turned on current | 150 | A/µs | $T_J$ = 25°C, from 0.67 $V_{DRM}$, $I_{TM} = \pi \times I_{T(AV)}$, $I_g$ = 500mA, $t_r$ < 0.5 µs, $t_p$ > 6 µs | | |
| $I_H$ | Max. holding current | 250 | mA | $T_J$ = 25°C, anode supply = 6V, resistive load, gate open circuit | | |
| $I_L$ | Max. latching current | 400 | | $T_J$ = 25°C, anode supply = 6V, resistive load | | |

(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% x p x $I_{AV}$ < I < p x $I_{AV}$
(4) I > p x $I_{AV}$

## Triggering

| | Parameters | IRK. 105 | Units | Conditions | |
|---|---|---|---|---|---|
| $P_{GM}$ | Max. peak gate power | 12 | W | | |
| $P_{G(AV)}$ | Max. average gate power | 3 | | | |
| $I_{GM}$ | Max. peak gate current | 3 | A | | |
| $-V_{GM}$ | Max. peak negative gate voltage | 10 | V | | |
| $V_{GT}$ | Max. gate voltage required to trigger | 4.0 | | $T_J$ = -40°C | Anode supply = 6V resistive load |
| | | 2.5 | | $T_J$ = 25°C | |
| | | 1.7 | | $T_J$ = 125°C | |
| $I_{GT}$ | Max. gate current required to trigger | 270 | mA | $T_J$ = -40°C | Anode supply = 6V resistive load |
| | | 150 | | $T_J$ = 25°C | |
| | | 80 | | $T_J$ = 125°C | |
| $V_{GD}$ | Max. gate voltage that will not trigger | 0.25 | V | $T_J$ = 125°C, rated $V_{DRM}$ applied | |
| $I_{GD}$ | Max. gate current that will not trigger | 6 | mA | $T_J$ = 125°C, rated $V_{DRM}$ applied | |

## Blocking

| | Parameters | IRK.105 | Units | Conditions |
|---|---|---|---|---|
| $I_{RRM}$ $I_{DRM}$ | Max. peak reverse and off-state leakage current at $V_{RRM}$, $V_{DRM}$ | 20 | mA | $T_J$ = 130°C, gate open circuit |
| $V_{INS}$ | RMS isolation voltage | 2500 (1 min) 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/µs | $T_J$ = 130°C, linear to 0.67 $V_{DRM}$, gate open circuit |

(5) Available with dv/dt = 1000V/ms, to complete code add S90 i.e. IRKT105/16AS90.

## Thermal and Mechanical Specifications

| | Parameters | IRK.105 | Units | Conditions |
|---|---|---|---|---|
| $T_J$ | Junction operating temperature range | - 40 to 130 | °C | |
| $T_{stg}$ | Storage temp. range | - 40 to 150 | | |
| $R_{thJC}$ | Max. internal thermal resistance, junction to case | 0.135 | K/W | Per module, DC operation |
| $R_{thCS}$ | Typical thermal resistance case to heatsink | 0.1 | | Mounting surface flat, smooth and greased |
| T | Mounting torque ± 10% to heatsink | 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 |
| | busbar | 3 | | |
| wt | Approximate weight | 110 (4) | gr (oz) | |
| | Case style | TO-240AA | JEDEC | |

## 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.105 | 0.04 | 0.05 | 0.06 | 0.08 | 0.12 | 0.03 | 0.05 | 0.06 | 0.08 | 0.12 | °C/ W |

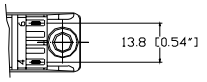
## Ordering Information Table

**Device Code**

| IRK | T | 105 | / | 16 | A | S90 |
|---|---|---|---|---|---|---|
| ① | ② | ③ | | ④ | ⑤ | ⑥ |

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

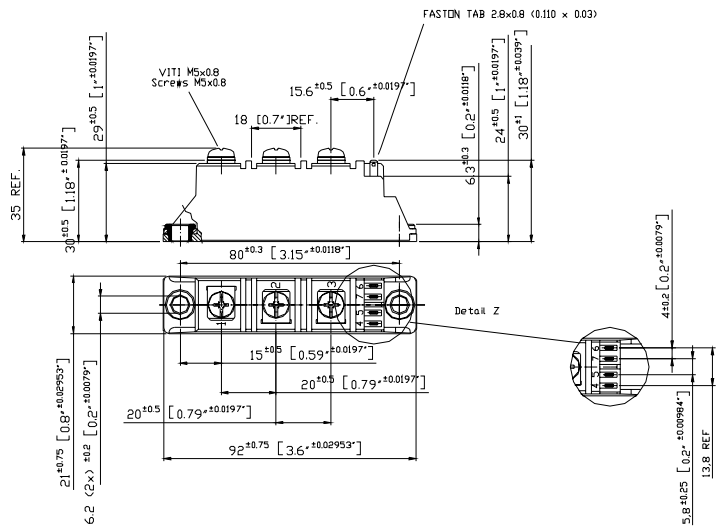
IRK.106 types
With no auxiliary cathode



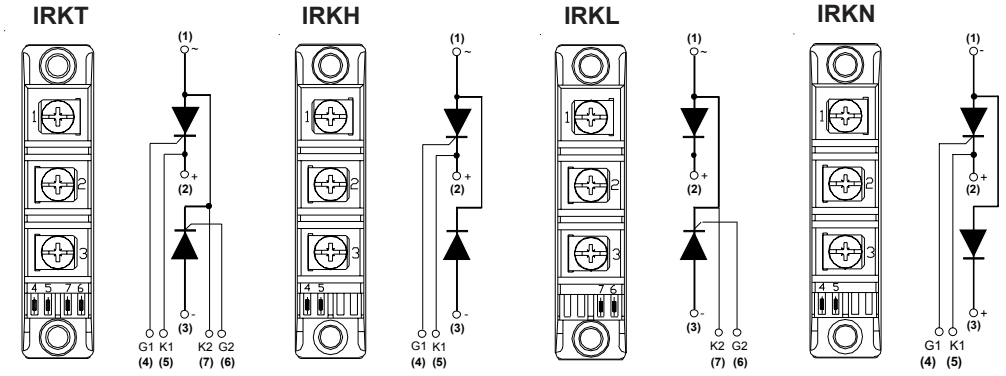

* * Available with no auxiliary cathode.
To specify change: 105 to 106

e.g. : IRKT106/16A etc.

## Outline Table




Dimensions are in millimeters and [inches]




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

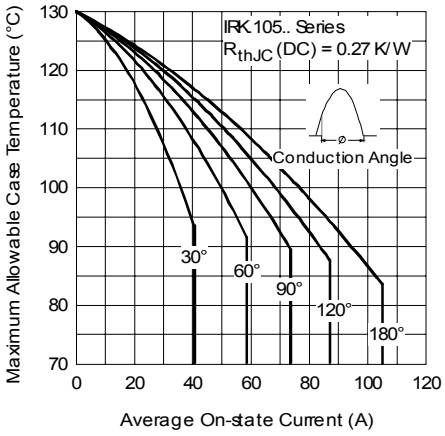



Fig. 1 - Current Ratings Characteristics

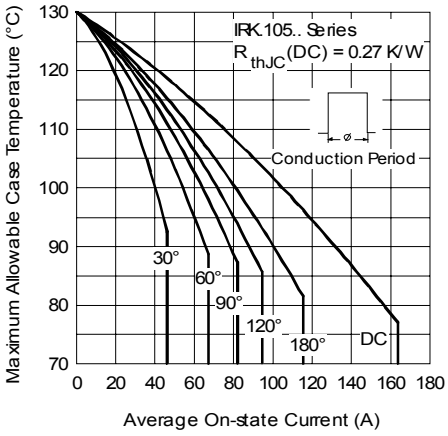



Fig. 2 - Current Ratings Characteristics

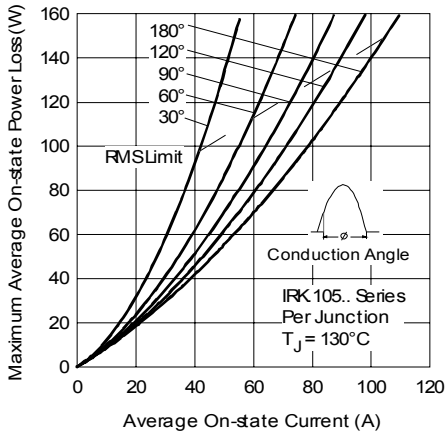



Fig. 3 - On-state Power Loss Characteristics

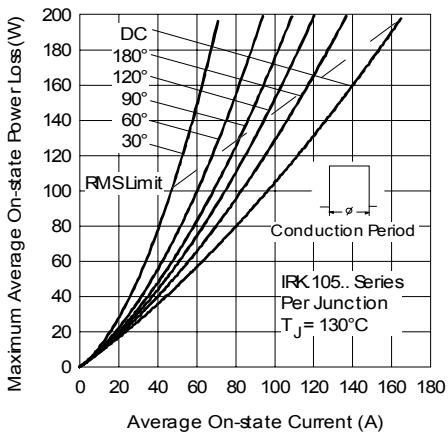



Fig. 4 - On-state Power Loss Characteristics

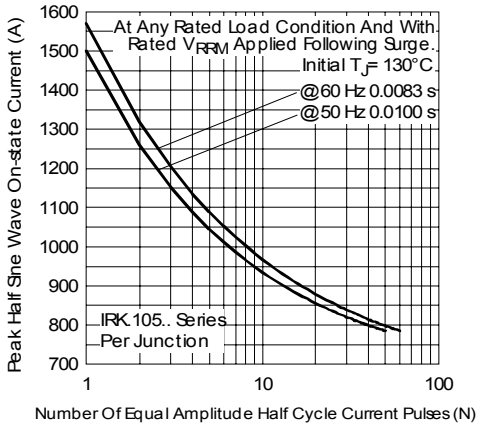



Fig. 5 - Maximum Non-Repetitive Surge Current

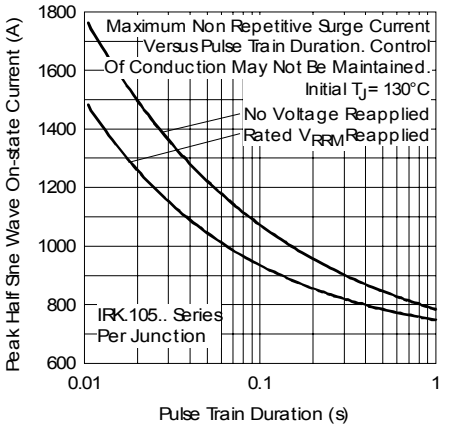



Fig. 6 - Maximum Non-Repetitive Surge Current

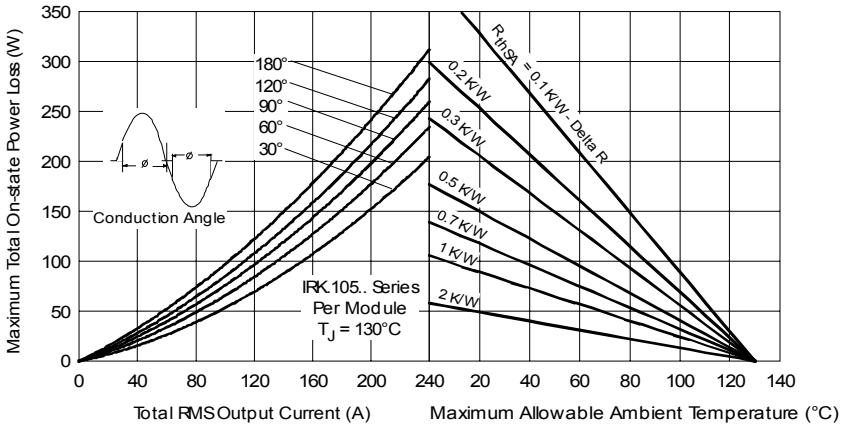



Fig. 7 - On-state Power Loss Characteristics

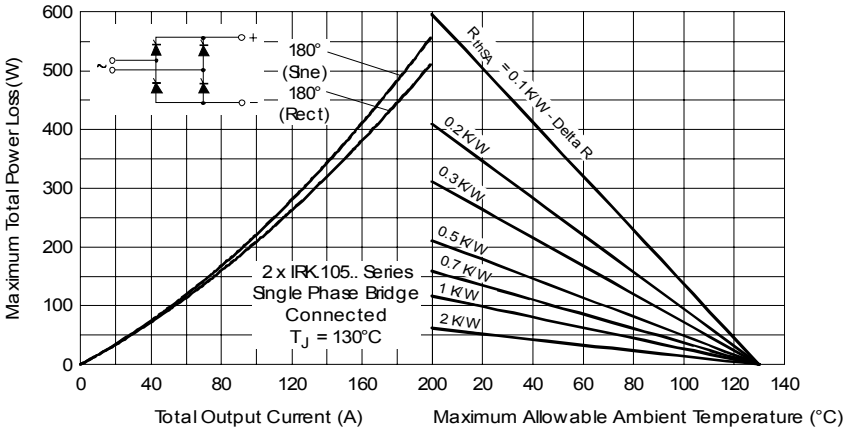



Fig. 8 - On-state Power Loss Characteristics

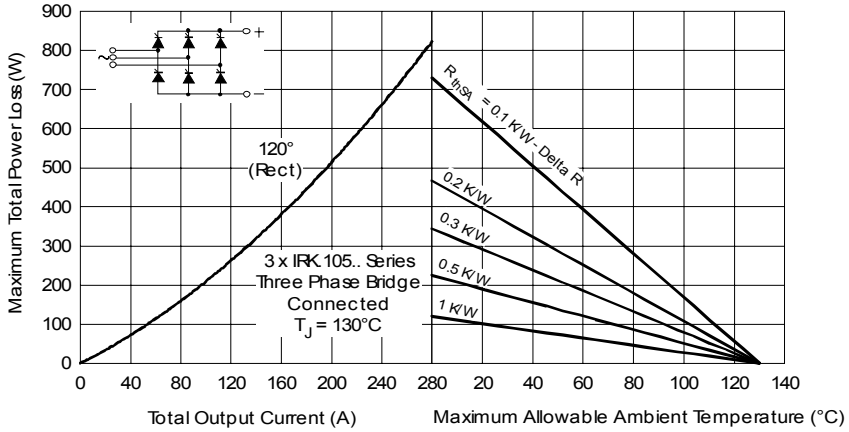



Fig. 9 - On-state Power Loss Characteristics

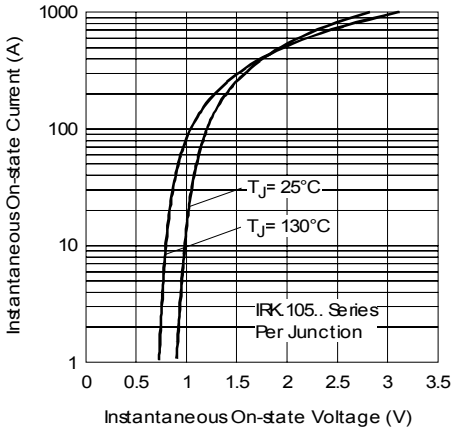



Fig. 10 - On-state Voltage Drop Characteristics

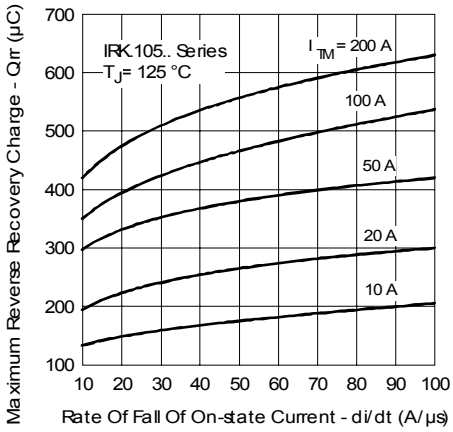



Fig. 11 - Recovery Charge Characteristics

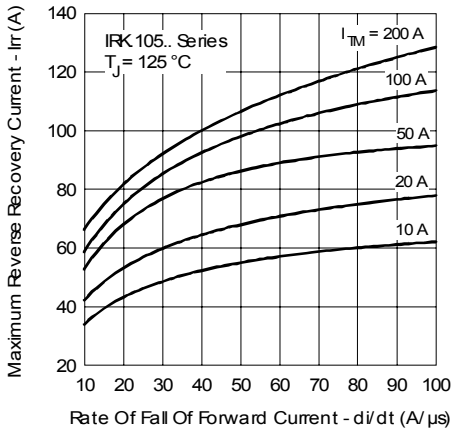



Fig. 12 - Recovery Current Characteristics

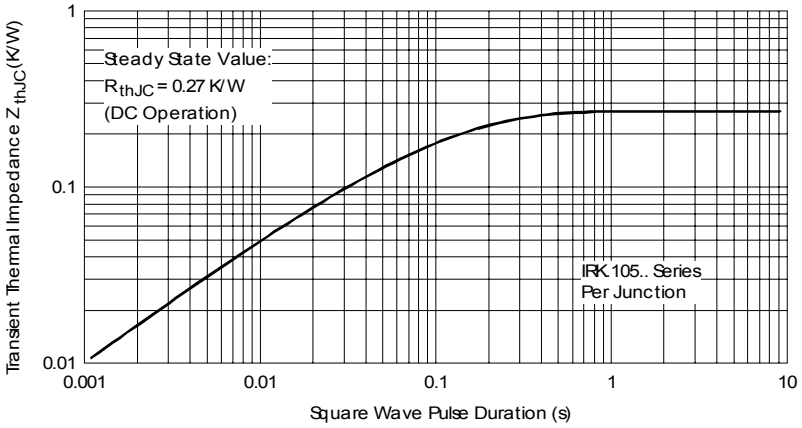



Fig. 13 - Thermal Impedance $Z_{thJC}$ Characteristics

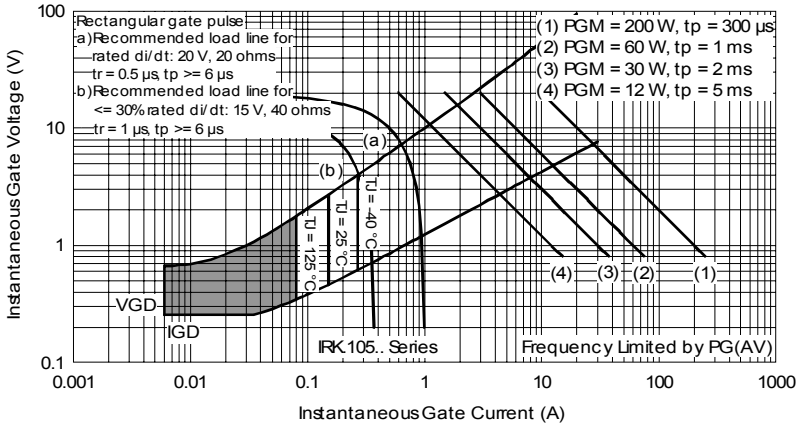



Fig. 14- Gate Characteristics



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09/04

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