


### THYRISTOR / DIODE and THYRISTOR / THYRISTOR

### SUPER MAGN-A-pak™ Power Modules

#### Features

- High current capability
- 3000 V<sub>RMS</sub> isolating voltage with non-toxic substrate
- High surge capability
- Industrial standard package
- UL E78996 approved 

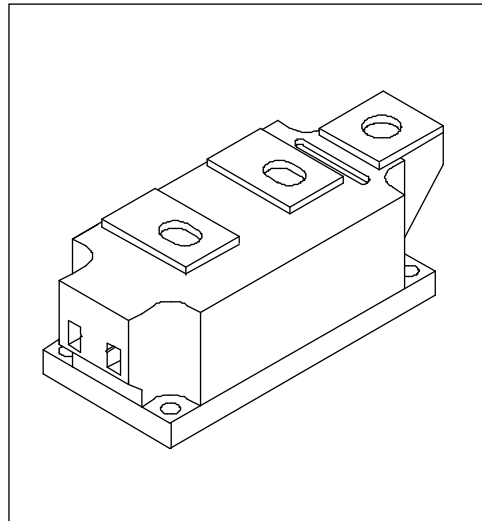
500 A

#### Typical Applications

- Motor starters
- DC motor controls - AC motor controls
- Uninterruptable power supplies

#### Major Ratings and Characteristics

| Parameters                    | IRK.500..   | Units              |
|-------------------------------|-------------|--------------------|
| $I_{T(AV)}$ or $I_{F(AV)}$    | 500         | A                  |
| @ $T_C$                       | 82          | °C                 |
| $I_{T(RMS)}$                  | 785         | A                  |
| @ $T_C$                       | 82          | °C                 |
| $I_{TSM}$ or $I_{FSM}$ @ 50Hz | 17.8        | KA                 |
| @ 60Hz                        | 18.7        | KA                 |
| $I^2t$ @ 50Hz                 | 1591        | KA <sup>2</sup> s  |
| @ 60Hz                        | 1452        | KA <sup>2</sup> s  |
| $I^2\sqrt{t}$                 | 15910       | KA <sup>2</sup> √s |
| $V_{DRM}/V_{RRM}$ range       | 800 to 1600 | V                  |
| $T_{STG}$ range               | -40 to 150  | °C                 |
| $T_J$ range                   | -40 to 130  | °C                 |



**ELECTRICAL SPECIFICATIONS**

**Voltage Ratings**

| Type number | Voltage Code | $V_{RRM}/V_{DRM}$ maximum repetitive peak reverse voltage V | $V_{RSM}$ , maximum non-repetitive peak rev. voltage V | $I_{RRM}/I_{DRM}$ max. @ $T_J = T_J$ max. mA |
|-------------|--------------|---|--|--|
| IRK.500..   | 08           | 800   | 900  | 100  |
|             | 12           | 1200  | 1300   |  |
|             | 14           | 1400  | 1500   |  |
|             | 16           | 1600  | 1700   |  |

**On-state Conduction**

| Parameter  | IRK.500.. | Units              | Conditions   |
|--|-----------|--------------------|--|
| $I_{T(AV)}$ Maximum average on-state current @ Case temperature              | 500       | A                  | 180° conduction, half sine wave  |
| $I_{F(AV)}$  | 82        | °C                 |  |
| $I_{T(RMS)}$ Maximum RMS on-state current                                    | 785       | A                  | 180° conduction, half sine wave @ $T_C = 82^\circ\text{C}$                           |
| $I_{TSM}$ Maximum peak, one-cycle, non-repetitive surge current<br>$I_{FSM}$ | 17.8      | KA                 | t = 10ms No voltage  |
|  | 18.7      |                    | t = 8.3ms reappplied   |
|  | 15.0      |                    | t = 10ms 100% $V_{RRM}$  |
|  | 15.7      |                    | t = 8.3ms reappplied   |
| $I^2t$ Maximum $I^2t$ for fusing   | 1591      | KA <sup>2</sup> s  | t = 10ms No voltage  |
|  | 1452      |                    | t = 8.3ms reappplied   |
|  | 1125      |                    | t = 10ms 100% $V_{RRM}$  |
|  | 1027      |                    | t = 8.3ms reappplied   |
| $I^2/t$ Maximum $I^2/t$ for fusing   | 15910     | KA <sup>2</sup> /s | t = 0.1 to 10ms, no voltage reappplied   |
| $V_{T(TO)1}$ Low level value of threshold voltage                            | 0.85      | 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 voltage                           | 0.93      |                    | $(I > \pi \times I_{T(AV)})$ , $T_J = T_J$ max.                                      |
| $r_{t1}$ Low level value of on-state slope resistance                        | 0.36      | 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 slope resistance                       | 0.32      |                    | $(I > \pi \times I_{T(AV)})$ , $T_J = T_J$ max.                                      |
| $V_{TM}$ Maximum on-state or forward voltage drop<br>$V_{FM}$                | 1.50      | V                  | $I_{pk} = 1500\text{A}$ , $T_J = 25^\circ\text{C}$ , $t_p = 10\text{ms}$ sine pulse  |
| $I_H$ Maximum holding current  | 500       | mA                 | $T_J = 25^\circ\text{C}$ , anode supply 12V resistive load                           |
| $I_L$ Typical latching current   | 1000      |                    |  |

**Switching**

| Parameter                                       | IRK.500.. | Units | Conditions   |
|---|-----------|-------|--|
| di/dt Maximum rate of rise of turned-on current | 1000      | A/μs  | $T_J = T_J$ max., $I_{TM} = 400\text{A}$ , $V_{DRM}$ applied   |
| $t_d$ Typical delay time                        | 2.0       | μs    | Gate current 1A, $di_g/dt = 1\text{A}/\mu\text{s}$<br>$V_d = 0.67\% V_{DRM}$ , $T_J = 25^\circ\text{C}$  |
| $t_q$ Typical turn-off time                     | 200       | μs    | $I_{TM} = 750\text{A}$ , $T_J = T_J$ max, $di/dt = -60\text{A}/\mu\text{s}$ ,<br>$V_R = 50\text{V}$ , $dv/dt = 20\text{V}/\mu\text{s}$ , Gate 0 V 100Ω |

**Blocking**

| Parameter   | IRK.500.. | Units      | Conditions  |
|---|-----------|------------|---|
| dv/dt Maximum critical rate of rise of off-state voltage                  | 1000      | V/ $\mu$ s | $T_J = 130^\circ\text{C}$ ., linear to $V_D = 80\% V_{DRM}$ |
| $V_{INS}$ RMS isolation voltage   | 3000      | V          | $t = 1 \text{ s}$   |
| $I_{RRM}$ Maximum peak reverse and off-state leakage current<br>$I_{DRM}$ | 100       | mA         | $T_J = T_J \text{ max.}$ ., rated $V_{DRM}/V_{RRM}$ applied |

**Triggering**

| Parameter   | IRK.500.. | Units | Conditions   |
|---|-----------|-------|--|
| $P_{GM}$ Maximum peak gate power                  | 10        | W     | $T_J = T_J \text{ max.}$ ., $t_p \leq 5 \text{ ms}$          |
| $P_{G(AV)}$ Maximum peak average gate power       | 2.0       | W     | $T_J = T_J \text{ max.}$ ., $f = 50 \text{ Hz}$ , $d\% = 50$ |
| $+I_{GM}$ Maximum peak positive gate current      | 3.0       | A     | $T_J = T_J \text{ max.}$ ., $t_p \leq 5 \text{ ms}$          |
| $+V_{GM}$ Maximum peak positive gate voltage      | 20        | V     |  |
| $-V_{GM}$ Maximum peak negative gate voltage      | 5.0       | V     |  |
| $I_{GT}$ Max. DC gate current required to trigger | 200       | mA    | $T_J = 25^\circ\text{C}$ $V_{ak} 12 \text{ V}$               |
| $V_{GT}$ DC gate voltage required to trigger      | 3.0       | V     | $T_J = 25^\circ\text{C}$ $V_{ak} 12 \text{ V}$               |
| $I_{GD}$ DC gate current not to trigger           | 10        | mA    | $T_J = T_J \text{ max.}$                                     |
| $V_{GD}$ DC gate voltage not to trigger           | 0.25      | V     |  |

**Thermal and Mechanical Specifications**

| Parameter   | IRK.500..        | Units | Conditions  |
|---|------------------|-------|---|
| $T_J$ Max. junction operating temperature range                 | - 40 to 130      | °C    |   |
| $T_{stg}$ Max. storage temperature range                        | - 40 to 150      |       |   |
| $R_{thJC}$ Max. thermal resistance, junction to case            | 0.065            | K/W   | Per junction, DC operation  |
| $R_{thC-hs}$ Max. thermal resistance, case to heatsink          | 0.02             | K/W   |   |
| T Mounting torque $\pm 10\%$ SMAP to heatsink<br>busbar to SMAP | 6 - 8            | 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 |
|   | 12 - 15          |       |   |
| wt Approximate weight   | 1500             | g     |   |
| Case style  | SUPER MAGN-A-pak |       | See outline table   |

## IRK.500.. Series

Bulletin I27401 rev. A 09/97

International  
**IRF** Rectifier

### $\Delta R_{thJC}$ Conduction

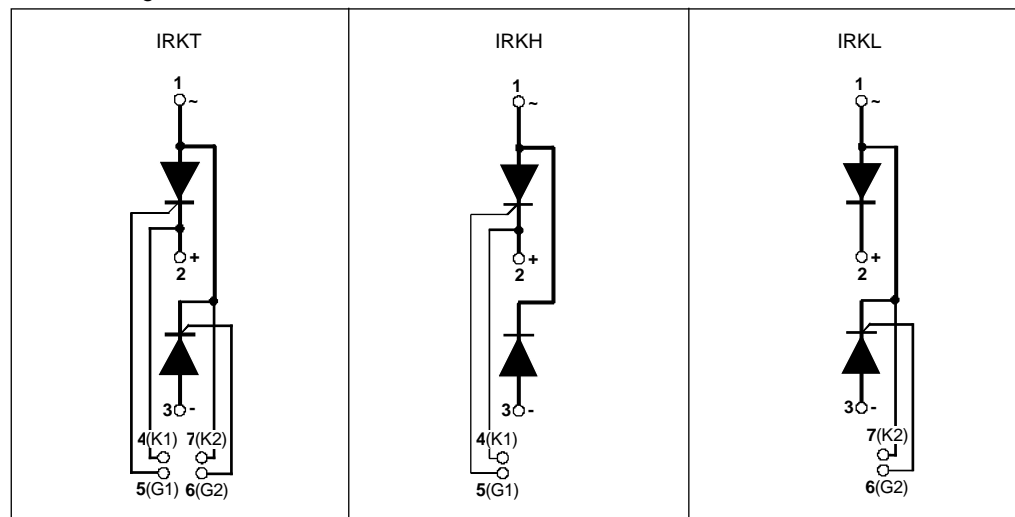
(The following table shows the increment of thermal resistance  $R_{thJC}$  when devices operate at different conduction angles than DC)

| Conduction angle | Sinusoidal conduction | Rectangular conduction | Units | Conditions                 |
|------------------|-----------------------|------------------------|-------|----------------------------|
| 180°             | 0.009                 | 0.006                  | K/W   | $T_J = T_{J \text{ max.}}$ |
| 120°             | 0.011                 | 0.011                  |       |                            |
| 90°              | 0.014                 | 0.015                  |       |                            |
| 60°              | 0.021                 | 0.022                  |       |                            |
| 30°              | 0.037                 | 0.038                  |       |                            |

### Ordering Information Table

| Device Code |  |     |   |    |
|-------------|--|-----|---|----|
| 1           | 2  | 3   | 4 |    |
| IRK         | T  | 500 | - | 16 |
| <b>1</b>    | - Module type  |     |   |    |
| <b>2</b>    | - Circuit configuration (See Circuit Configurations Table)         |     |   |    |
| <b>3</b>    | - Current rating   |     |   |    |
| <b>4</b>    | - Voltage code: Code x 100 = $V_{RRM}$ (See Voltage Ratings Table) |     |   |    |

### Circuit Configurations Table



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

Outline Table

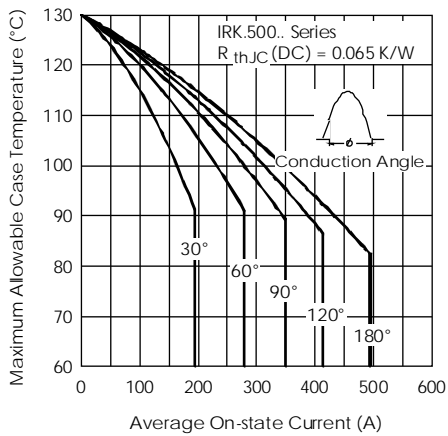
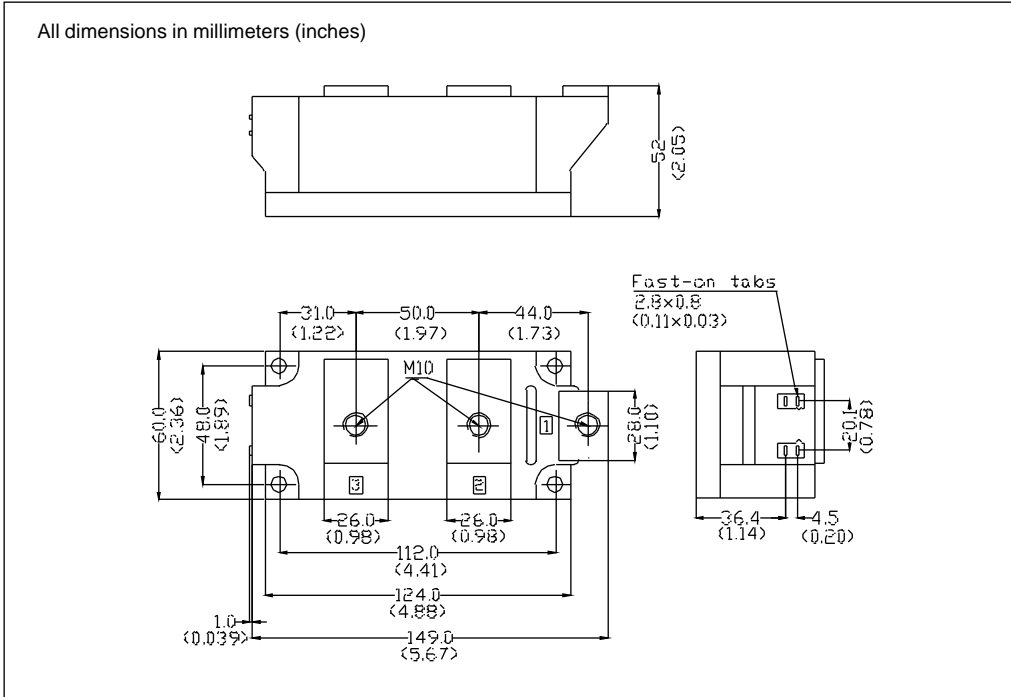


Fig. 1 - Current Ratings Characteristics

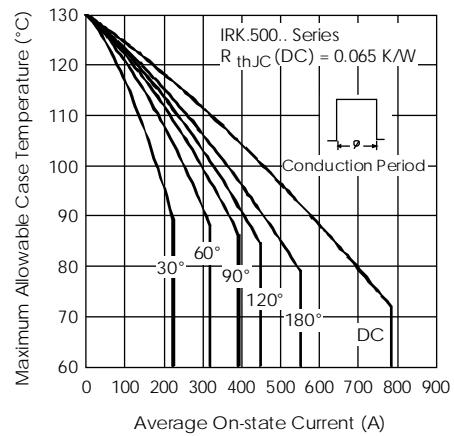


Fig. 2 - Current Ratings Characteristics

**IRK.500.. Series**

Bulletin I27401 rev. A 09/97

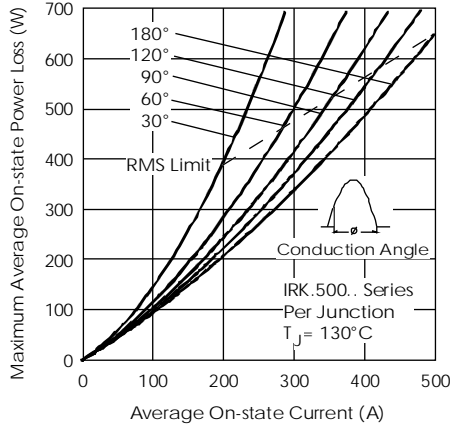


Fig. 3 - On-state Power Loss Characteristics

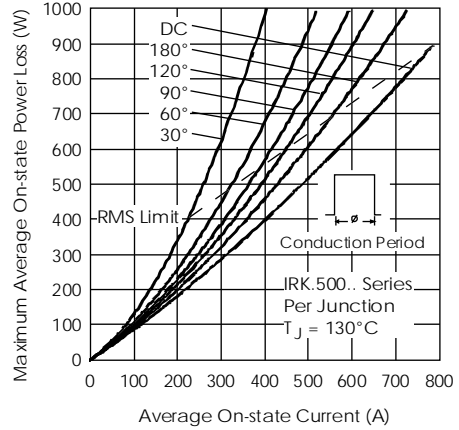


Fig. 4 - On-state Power Loss Characteristics

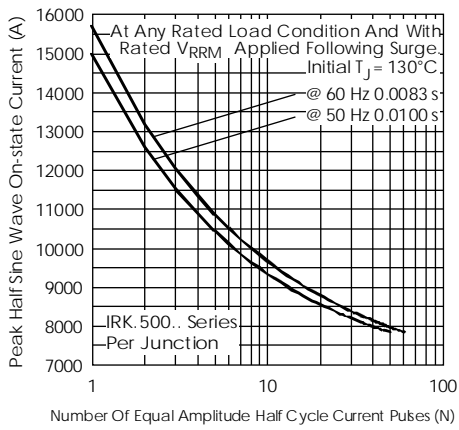


Fig. 5 - Maximum Non-Repetitive Surge Current

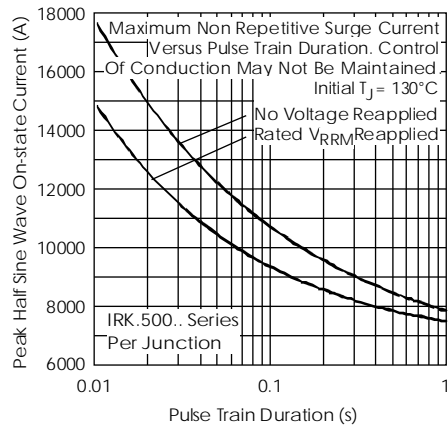


Fig. 6 - Maximum Non-Repetitive Surge Current

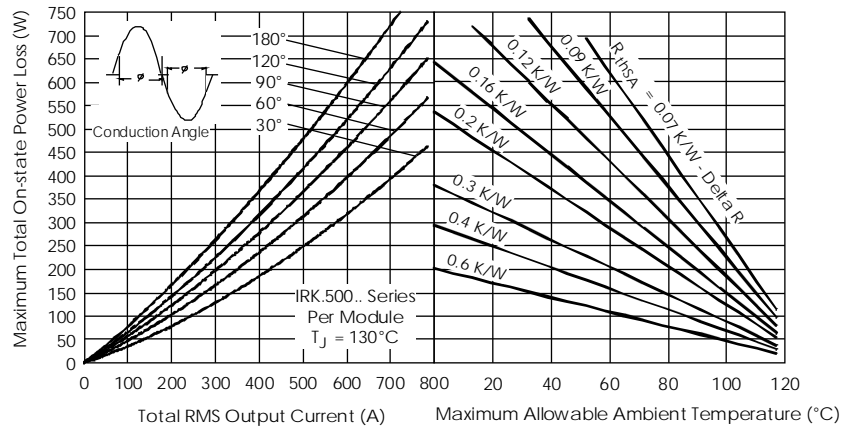


Fig. 7 - On-state Power Loss Characteristics

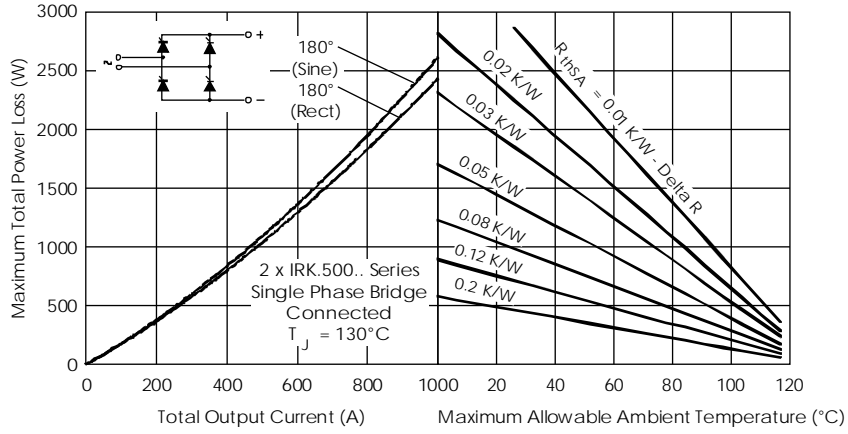


Fig. 8 - On-state Power Loss Characteristics

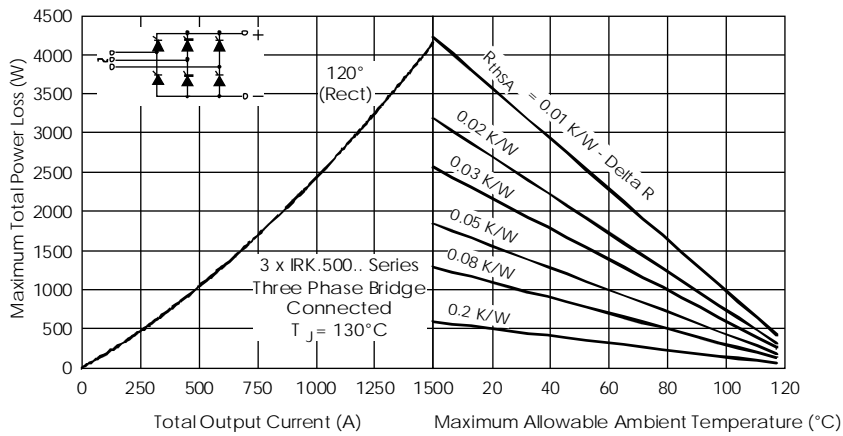


Fig. 9 - On-state Power Loss Characteristics

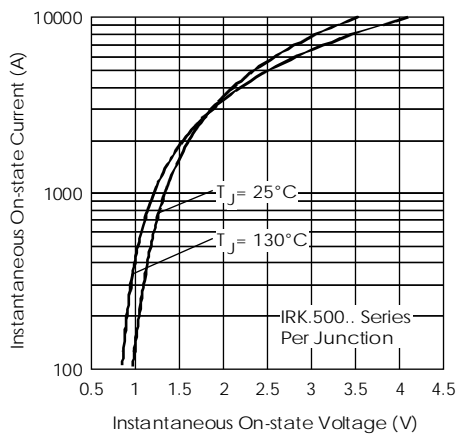


Fig. 10 - On-state Voltage Drop Characteristics

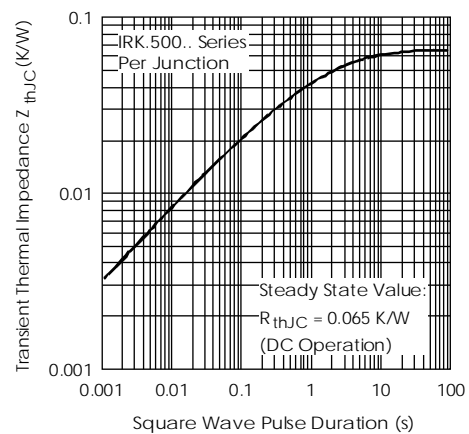


Fig. 11 - Thermal Impedance  $Z_{thJC}$  Characteristics

**IRK.500.. Series**

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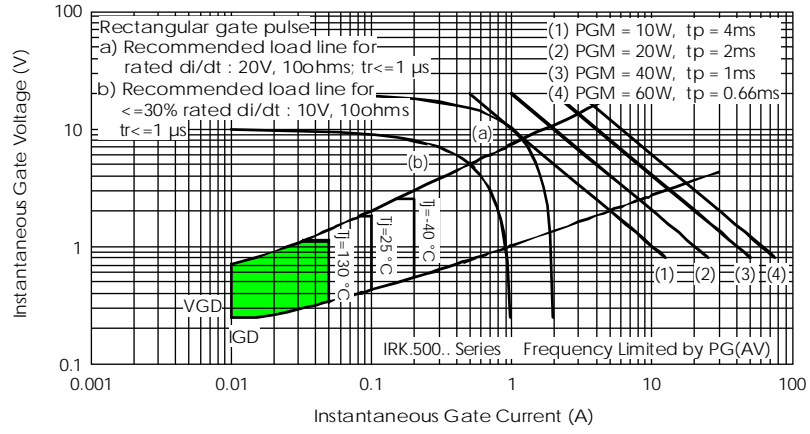


Fig. 12 - Gate Characteristics