

## FAST SCR / DIODE and SCR / SCR

## INT-A-PAK™ Power Modules

### Features

- Fast turn-off thyristor
- Fast recovery diode
- High surge capability
- Electrically isolated baseplate
- 3000 V<sub>RMS</sub> isolating voltage
- Industrial standard package

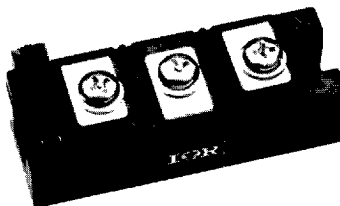
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### Description

These series of INT-A-pak modules are intended for applications such as self-commutated inverters, DC choppers, electronic welders, induction heating and others where fast switching characteristics are required.

### Major Ratings and Characteristics

| Parameters        | Value       | Units              |
|-------------------|-------------|--------------------|
| $I_{T(AV)}$       | 105         | A                  |
| @ $T_C$           | 90          | °C                 |
| $I_{T(RMS)}$      | 233         | A                  |
| $I_{TSM}$ @ 50Hz  | 2850        | A                  |
| @ 60Hz            | 3000        | A                  |
| $I^2t$ @ 50Hz     | 40.8        | kA <sup>2</sup> s  |
| @ 60Hz            | 37.2        | kA <sup>2</sup> s  |
| $I^2\sqrt{t}$     | 408         | kA <sup>2</sup> /s |
| $V_{TM}$          | 1.97        | V                  |
| $V_{RRM}/V_{DRM}$ | 600 to 1200 | V                  |
| $t_q$ range       | 18 to 25    | μs                 |
| $t_{rr}$ (diode)  | 2 max       | μs                 |
| $T_J$             | -40 to 125  | °C                 |
| $V_{INS}$         | 3000        | V                  |



## ELECTRICAL SPECIFICATIONS

## Voltage Ratings

| Type number<br>(*)   | Voltage<br>code | $V_{RRM}$ , maximum<br>repetitive peak<br>reverse voltage<br>V | $V_{DRM}$ , maximum<br>repetitive peak<br>off-state voltage<br>V | $I_{RRM}$ $I_{DRM}$ max<br>@125°C<br>mA |
|----------------------|-----------------|----------------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------|
| IRKT/H/L/U/V/K/NF102 | 06              | 600                                                            | 600                                                              | 30                                      |
| IRKT/H/L/U/V/K/NF102 | 08              | 800                                                            | 800                                                              | 30                                      |
| IRKT/H/L/U/V/K/NF102 | 10              | 1000                                                           | 1000                                                             | 30                                      |
| IRKT/H/L/U/V/K/NF102 | 12              | 1200                                                           | 1200                                                             | 30                                      |

(\*) Refer to Ordering Information Table to complete Part number

## Current Carrying Capacity

| Frequency f                      |                      |     |                      | Units |                      |      |      |
|----------------------------------|----------------------|-----|----------------------|-------|----------------------|------|------|
| 50Hz                             | 210                  | 340 | 320                  | 500   | 1590                 | 2210 | A    |
| 400Hz                            | 265                  | 415 | 395                  | 625   | 975                  | 1390 | A    |
| 2500Hz                           | 180                  | 280 | 320                  | 490   | 390                  | 570  | A    |
| 5000Hz                           | 145                  | 230 | 260                  | 380   | 260                  | 380  | A    |
| 10000Hz                          | 110                  | 175 | 190                  | 275   | -                    | -    | A    |
| Recovery voltage Vr              | 50                   | 50  | 50                   | 50    | 50                   | 50   | V    |
| Voltage before turn-on Vd        | 80% V <sub>DRM</sub> |     | 80% V <sub>DRM</sub> |       | 80% V <sub>DRM</sub> |      | V    |
| Rise of on-state current di/dt   | 50                   | 50  | -                    | -     | -                    | -    | A/µs |
| Case temperature                 | 90                   | 60  | 90                   | 60    | 90                   | 60   | °C   |
| Equivalent values for RC circuit | 47Ω/0.22 µF          |     | 47Ω/0.22 µF          |       | 47Ω/0.22 µF          |      |      |

## On-state Conduction

| Parameters                                                         | Values | Units                  | Conditions                                                                  |                           |                                                          |
|--------------------------------------------------------------------|--------|------------------------|-----------------------------------------------------------------------------|---------------------------|----------------------------------------------------------|
| $I_{T(AV)}$ Max. average on-state current                          | 105    | A                      | 180° sinusoidal conduction Max. case temperature $T_C = 90^{\circ}\text{C}$ |                           |                                                          |
| $I_{T(RMS)}$ Maximum RMS current                                   | 233    | A                      | $T_C = 90^{\circ}\text{C}$ , as AC switch                                   |                           |                                                          |
| $I_{TSM}$ Maximum peak one half cycle non repetitive surge current | 2850   | A                      | 10ms                                                                        | No voltage reappplied     | Sinusoidal half Wave Initial $T_J = 125^{\circ}\text{C}$ |
|                                                                    | 3000   | A                      | 8.3ms                                                                       |                           |                                                          |
|                                                                    | 2400   | A                      | 10ms                                                                        | 100% $V_{RRM}$ reappplied | Sinusoidal half Wave Initial $T_J = 125^{\circ}\text{C}$ |
|                                                                    | 2500   | A                      | 8.3ms                                                                       |                           |                                                          |
| $I^2t$ Maximum $I^2t$ for fusing                                   | 40.8   | $\text{kA}^2\text{s}$  | 10ms                                                                        | No voltage reappplied     | Initial $T_J = 125^{\circ}\text{C}$                      |
|                                                                    | 37.2   | $\text{kA}^2\text{s}$  | 8.3ms                                                                       |                           |                                                          |
|                                                                    | 28.8   | $\text{kA}^2\text{s}$  | 10ms                                                                        | 100% $V_{RRM}$ reappplied | Initial $T_J = 125^{\circ}\text{C}$                      |
|                                                                    | 26.3   | $\text{kA}^2\text{s}$  | 8.3ms                                                                       |                           |                                                          |
| $I^2/t$ Maximum $I^2/t$ for fusing                                 | 408    | $\text{kA}^2/\text{s}$ | t=0 to 10ms, no voltage reappplied Initial $T_J = 125^{\circ}\text{C}$      |                           |                                                          |

On-state Conduction

INTERNATIONAL RECTIFIER

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| Parameters                                             | Values | Units      | Conditions                                                                              |
|--------------------------------------------------------|--------|------------|-----------------------------------------------------------------------------------------|
| $V_{TM}$ Max. peak on-state voltage                    | 1.97   | V          | $I_T = 350A$ (peak) half sine wave, $T_J = T_{J,max}$ , $t_p = 10ms$                    |
| $V_{T(TO)1}$ Low level value of threshold voltage      | 1.12   | V          | $T_J = 125^\circ C$ ( $16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)}$ ) |
| $V_{T(TO)2}$ High level value of threshold voltage     | 1.28   | V          | $T_J = 125^\circ C$ ( $\pi \times I_{T(AV)} < I < 20 \times \pi \times I_{T(AV)}$ )     |
| $r_{t1}$ Low level value of on-state slope resistance  | 2.43   | m $\Omega$ | $T_J = 125^\circ C$ ( $16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)}$ ) |
| $r_{t2}$ High level value of on-state slope resistance | 2.00   | m $\Omega$ | $T_J = 125^\circ C$ ( $\pi \times I_{T(AV)} < I < 20 \times \pi \times I_{T(AV)}$ )     |
| $I_H$ Maximum holding current                          | 600    | mA         | $T_J = 25^\circ C$ , $I_T > 30A$                                                        |
| $I_L$ Latching current                                 | 1000   | mA         | $T_J = 25^\circ C$ , $V_A = 12V$ , $R_a = 6\Omega$ , $I_g = 1A$                         |

Triggering

| Parameters                                                     | Values | Units | Conditions                                         |
|----------------------------------------------------------------|--------|-------|----------------------------------------------------|
| $P_{GM}$ Maximum peak gate power                               | 60     | W     | $f = 50$ Hz, $d\% = 50$                            |
| $P_{G(AV)}$ Maximum average gate power                         | 10     | W     | $T_J = 125^\circ C$ , $f = 50$ Hz, $d\% = 50$      |
| $I_{GM}$ Maximum peak gate current                             | 10     | A     | $T_J = 125^\circ C$ , $t_p \leq 5ms$               |
| $-V_{GM}$ Maximum peak negative gate voltage                   | 5      | V     | $T_J = 125^\circ C$ , $t_p \leq 5ms$               |
| $V_{GT}$ Maximum gate voltage required to fire all devices     | 3      | V     | $T_J = 25^\circ C$ , $V_A = 12V$ , $R_a = 6\Omega$ |
| $I_{GT}$ Maximum gate current required to fire all devices     | 200    | mA    | $T_J = 25^\circ C$ , $V_A = 12V$ , $R_a = 6\Omega$ |
| $V_{GD}$ Maximum gate voltage                                  | 0.25   | V     | $T_J = 125^\circ C$ , rated $V_{DRM}$ applied      |
| $I_{GD}$ Maximum gate current that will not trigger any device | 20     | mA    | $T_J = 125^\circ C$ , rated $V_{DRM}$ applied      |

Blocking

|                                                                        |      |            |                                                         |
|------------------------------------------------------------------------|------|------------|---------------------------------------------------------|
| $dv/dt$ Maximum critical rate of rise of off-state voltage             | 400  | V/ $\mu s$ | $T_J = 125^\circ C$ linear to $80\% V_{DRM}$ (*)        |
| $I_{RRM}$<br>$I_{DRM}$ Max. peak reverse and off-state leakage current | 30   | mA         | $T_J = 125^\circ C$ rated $V_{DRM}$ , $V_{RRM}$ applied |
| $V_{INS}$ RMS isolation voltage                                        | 3000 | V          | 50 Hz, circuit to base, $T_J = 25^\circ C$ , 1s         |

(\*) Contact factory for other selections

Switching

|                                          |     |    |    |            |                                                                                                                            |
|------------------------------------------|-----|----|----|------------|----------------------------------------------------------------------------------------------------------------------------|
| $t_q$ Maximum turn-off time              | P   | K  | J  | $\mu s$    | $I_T = 350A$ , $T_J = 125^\circ C$<br>$-di/dt = 25 A/\mu s$ , $V_R = 50V$<br>$dv/dt = 50 V/\mu s$ linear to $80\% V_{DRM}$ |
|                                          | 18  | 20 | 25 |            |                                                                                                                            |
| $t_{rr}$ Maximum recovery time           | 2   |    |    | $\mu s$    | $I_T = 350A$ , $-di/dt = 25 A/\mu s$ , $V_R = 50V$ , $T_J = 25^\circ C$                                                    |
| $di/dt$ Max. non-repetitive rate of rise | 800 |    |    | A/ $\mu s$ | Gate drive 20V, 20 $\Omega$ , $t_r \leq 1 \mu s$ , $V_D = 80\% V_{DRM}$ , $T_J = 125^\circ C$                              |

## Thermal and Mechanical Specifications

## INTERNATIONAL RECTIFIER

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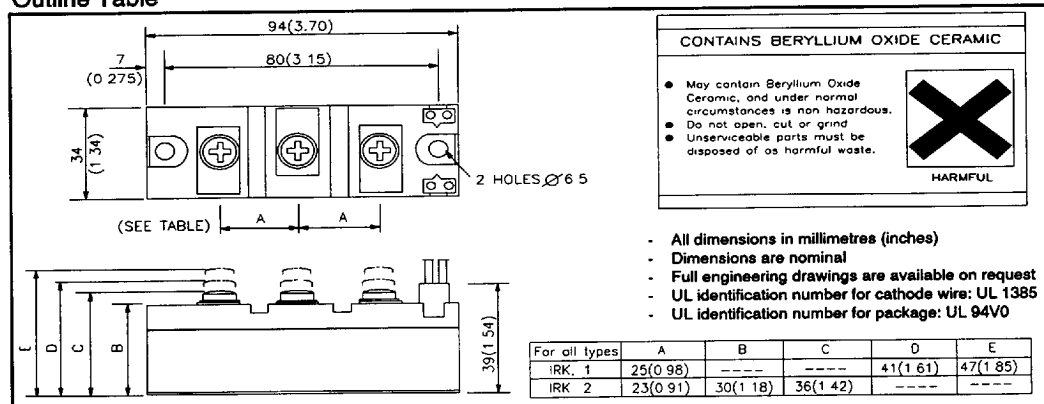
|            |                                               |            |         |                                                                                                                                                                                                                                                                                        |
|------------|-----------------------------------------------|------------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $T_J$      | Junction temperature range                    | -40 to 125 | °C      |                                                                                                                                                                                                                                                                                        |
| $T_{stg}$  | Storage temperature range                     | -40 to 150 | °C      |                                                                                                                                                                                                                                                                                        |
| $R_{thJC}$ | Internal thermal resistance, junction to case | 0.170      | K/W     | DC operation per junction                                                                                                                                                                                                                                                              |
| $R_{thCS}$ | Thermal resistance case to sink               | 0.035      | K/W     | Mounting surface flat and greased - Per module                                                                                                                                                                                                                                         |
| T          | Mounting torque, $\pm 10\%$                   | 4 to 6     | Nm      | A mounting compound is recommended. The torque should be rechecked after a period of about 3 hours to allow for the spread of the compound. Use of cable lugs is not recommended, busbars should be used and restrained during tightening. Threads must be lubricated with a compound. |
|            |                                               | 35 to 53   | lb * in |                                                                                                                                                                                                                                                                                        |
|            |                                               | 4 to 6     | Nm      |                                                                                                                                                                                                                                                                                        |
|            |                                               | 35 to 53   | lb * in |                                                                                                                                                                                                                                                                                        |
| wt         | Approximate weight                            | 500/17.8   | g/oz    |                                                                                                                                                                                                                                                                                        |
| Case style |                                               | INT-A-pak  |         |                                                                                                                                                                                                                                                                                        |

 $\Delta R$  Conduction (per Junction)

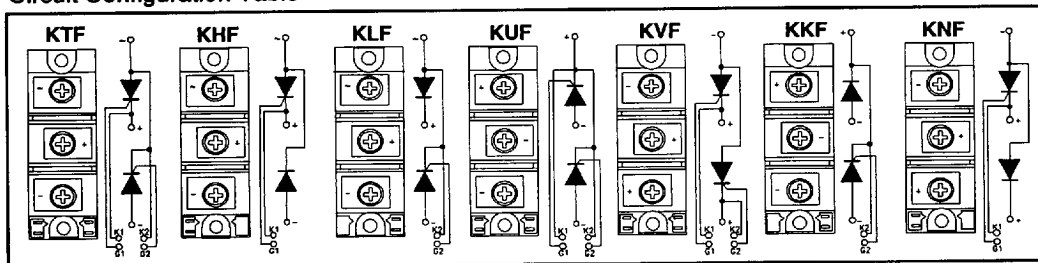
(The following table shows the increment of thermal resistance  $R_{thJC}$  when devices operate at different conduction angles than DC)

| Conduction angle | Sinusoidal conduction | Rectangular conduction | Units | Conditions                |
|------------------|-----------------------|------------------------|-------|---------------------------|
| 180°             | 0.016                 | 0.011                  | K/W   | $T_J = 125^\circ\text{C}$ |
| 120°             | 0.019                 | 0.020                  | K/W   |                           |
| 90°              | 0.024                 | 0.026                  | K/W   |                           |
| 60°              | 0.035                 | 0.037                  | K/W   |                           |
| 30°              | 0.060                 | 0.060                  | K/W   |                           |

## Outline Table



## Circuit Configuration Table



## Ordering Information Table

## INTERNATIONAL RECTIFIER

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## Device Code

|     |   |   |    |   |   |    |   |   |
|-----|---|---|----|---|---|----|---|---|
| IRK | T | F | 10 | 2 | - | 12 | H | J |
| 1   | 2 | 3 | 4  | 5 | 6 | 7  | 8 |   |

- 1 - Module type
- 2 - Circuit configuration (See Circuit Configuration Table)
- 3 - Fast SCR
- 4 - Current rating: Code x 10 =  $I_{T(AV)}$
- 5 - 1 = option with spacers and longer terminal screws  
2 = option with standard terminal screws
- 6 - Voltage code: Code x 100 =  $V_{RRM}$
- 7 - dv/dt code (See table)
- 8 - tq code (See table)

|          |
|----------|
| tq       |
| P ≤ 18μs |
| K ≤ 20μs |
| J ≤ 25μs |

|             |
|-------------|
| dv/dt       |
| C = 20V/μs  |
| D = 50V/μs  |
| E = 100V/μs |
| F = 200V/μs |
| G = 300V/μs |
| H = 400V/μs |

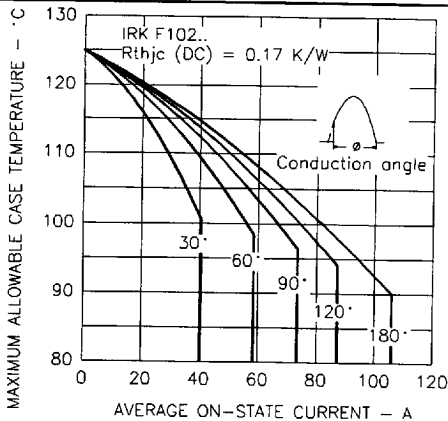


Fig. 1 - Current Ratings Characteristics

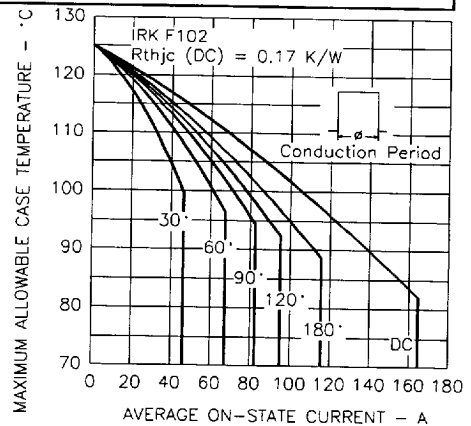


Fig. 2 - Current Ratings Characteristics

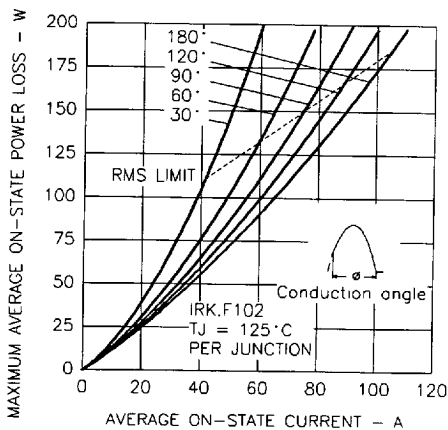


Fig. 3 - On-state Power Loss Characteristics

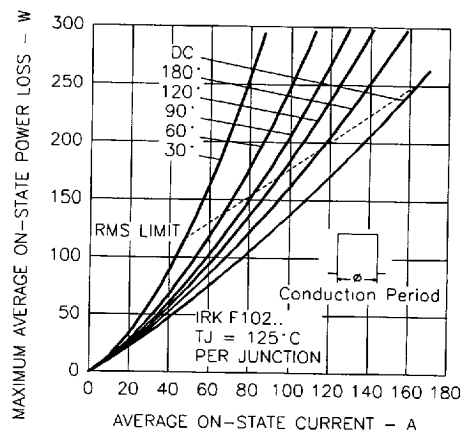


Fig. 4 - On-state Power Loss Characteristics

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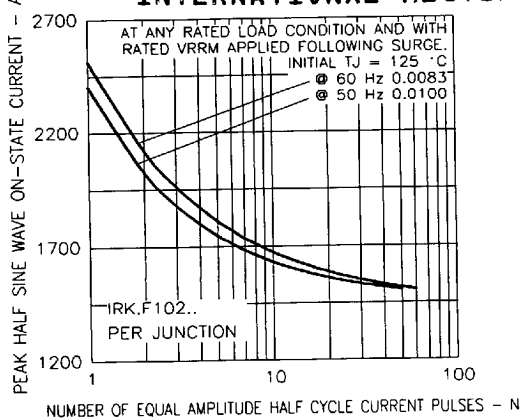


Fig. 5 - Maximum Non-Repetitive Surge Current

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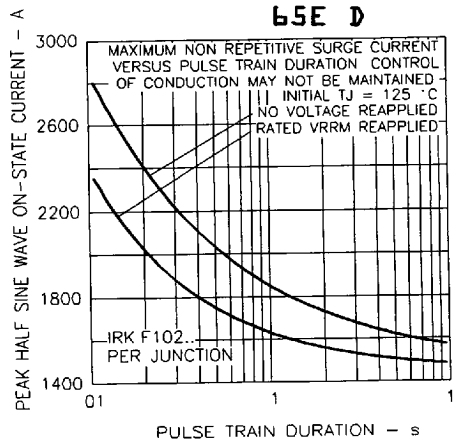


Fig. 6 - Maximum Non-Repetitive Surge Current

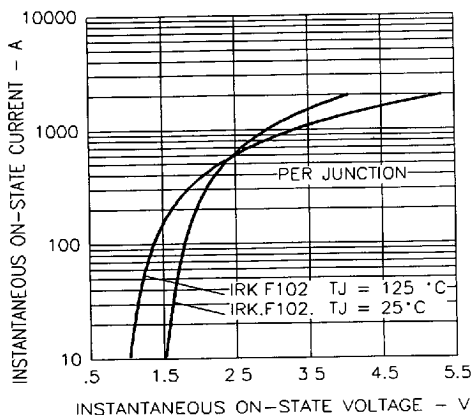


Fig. 7 - On-state Voltage Drop Characteristics

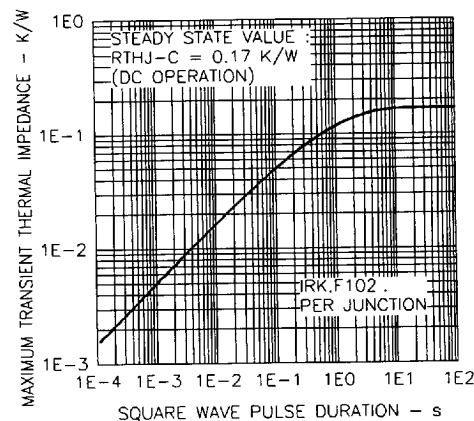
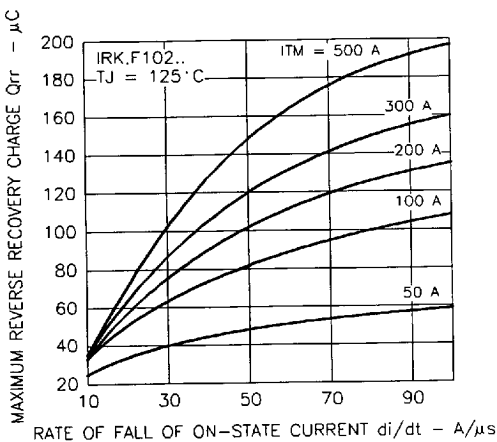
Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristics

Fig. 9 - Reverse Recovery Charge Characteristics (Thyristor)

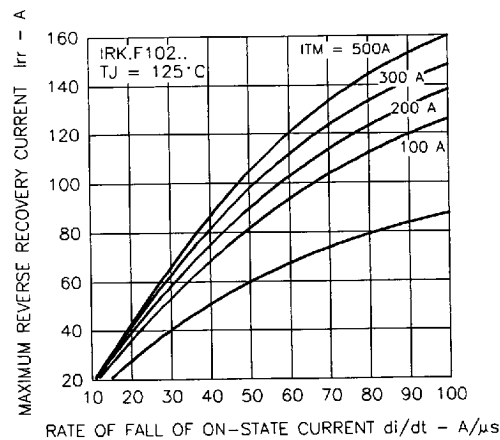
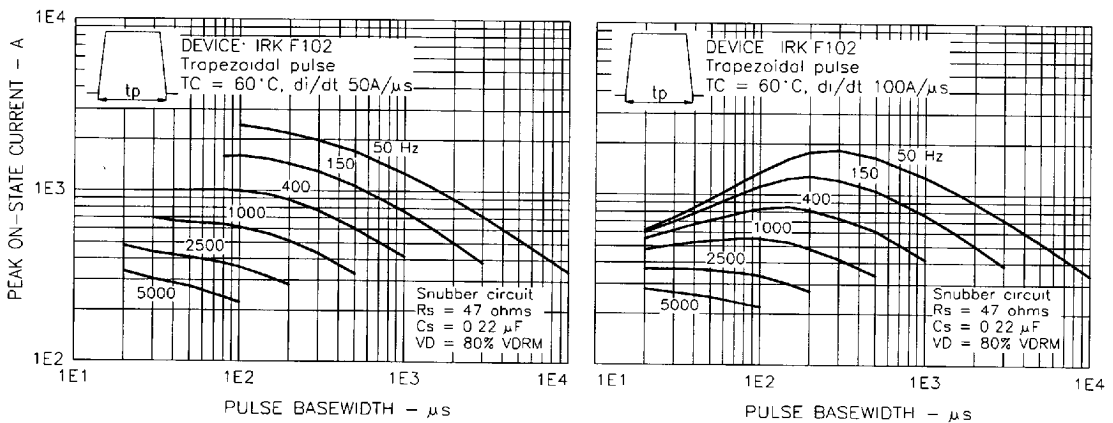
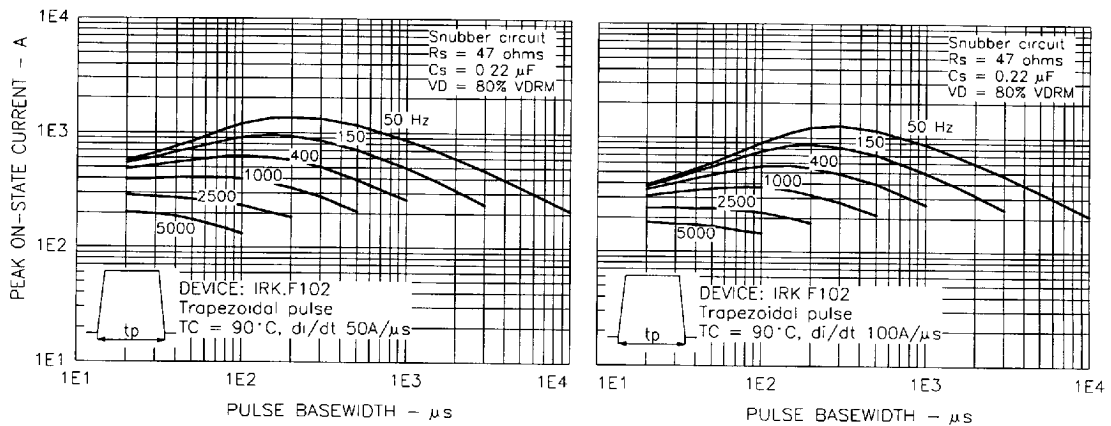
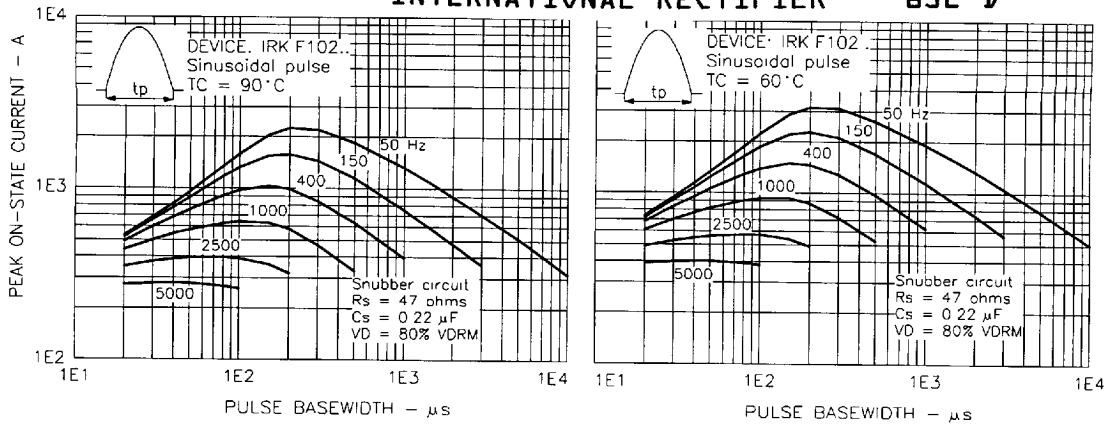


Fig. 10 - Reverse Recovery Current Characteristics (Thyristor)

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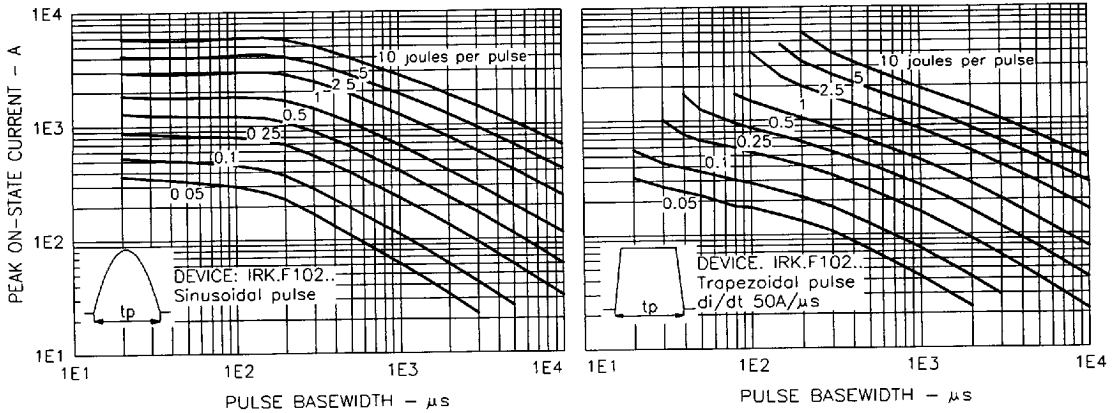


Fig. 14 - Maximum On-state Energy Power Loss Characteristics

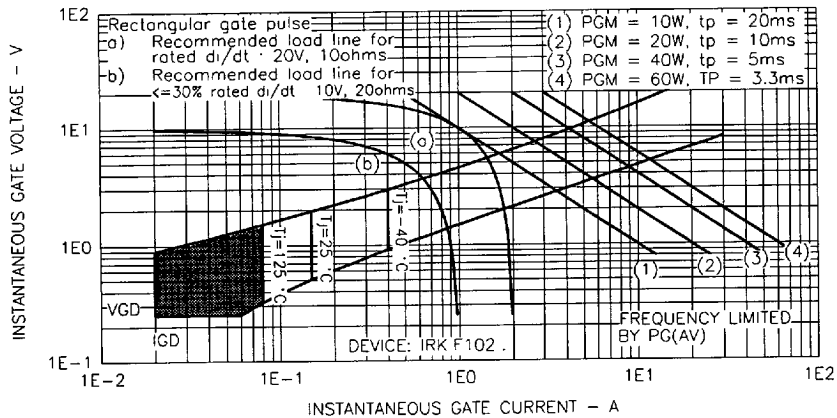


Fig. 15 - Gate Characteristics