

# International Rectifier

## SERIES IRK.F200

FAST SCR / DIODE and SCR / SCR

MAGN-A-pak™ Power Modules

### Features

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

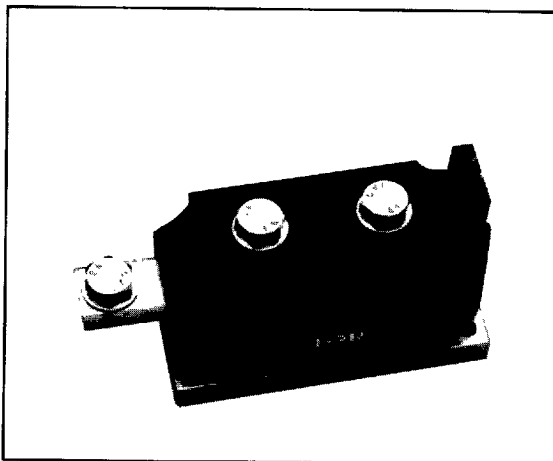
200A

### Description

These series of MAGN-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              |
|-------------------|-------------|--------------------|
| $I_{T(AV)}$       | 200         | A                  |
| @ $T_C$           | 85          | °C                 |
| $I_{T(RMS)}$      | 444         | A                  |
| $I_{TSM}$ @ 50Hz  | 7600        | A                  |
| @ 60Hz            | 8000        | A                  |
| $I^2_t$ @ 50Hz    | 290         | kA <sup>2</sup> s  |
| @ 60Hz            | 265         | kA <sup>2</sup> s  |
| $I^2\sqrt{t}$     | 2900        | kA <sup>2</sup> /s |
| $V_{TM}$          | 1.73        | V                  |
| $V_{RRM}/V_{DRM}$ | 200 to 1200 | V                  |
| $t_q$ range       | 18 to 25    | μs                 |
| $t_{\pi}$ (diode) | 2 max       | μs                 |
| $T_J$             | -40 to 125  | °C                 |
| $V_{INS}$         | 3000        | V                  |



## ELECTRICAL SPECIFICATIONS

## Voltage Ratings

| Part 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/NF200 | 02              | 200                                                              | 200                                                                | 50                                        |
|                      | 04              | 400                                                              | 400                                                                | 50                                        |
|                      | 06              | 600                                                              | 600                                                                | 50                                        |
|                      | 08              | 800                                                              | 800                                                                | 50                                        |
|                      | 10              | 1000                                                             | 1000                                                               | 50                                        |
|                      | 12              | 1200                                                             | 1200                                                               | 50                                        |

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

## Current Carrying Capacity

| Frequency f                      |                      |     |                      |      |                      |      | Units |
|----------------------------------|----------------------|-----|----------------------|------|----------------------|------|-------|
| 50Hz                             | 380                  | 560 | 630                  | 850  | 2460                 | 3180 | A     |
| 400Hz                            | 460                  | 690 | 710                  | 1060 | 1570                 | 2080 | A     |
| 2500Hz                           | 310                  | 450 | 530                  | 760  | 630                  | 860  | A     |
| 5000Hz                           | 250                  | 360 | 410                  | 560  | 410                  | 560  | A     |
| 10000Hz                          | 180                  | 280 | 300                  | 410  | -                    | -    | 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                 | 85                   | 60  | 85                   | 60   | 85                   | 60   | °C    |
| Equivalent values for RC circuit | 10Ω/0.47µF           |     | 10Ω/0.47µF           |      | 10Ω/0.47µF           |      |       |

## On-state Conduction

| Parameters                                                         | Values | Units              | Conditions                                                                |                |
|--------------------------------------------------------------------|--------|--------------------|---------------------------------------------------------------------------|----------------|
| $I_{T(AV)}$ Max. average on-state current                          | 200    | A                  | 180° sinusoidal conduction Max. case temperature $T_c = 85^\circ\text{C}$ |                |
| $I_{T(RMS)}$ Maximum RMS current                                   | 444    | A                  | as AC switch                                                              |                |
| $I_{TSM}$ Maximum peak one half cycle non repetitive surge current | 7600   | A                  | 10ms                                                                      | No voltage     |
|                                                                    | 8000   | A                  | 8.3ms                                                                     | reapplied      |
|                                                                    | 6400   | A                  | 10ms                                                                      | 100% $V_{RRM}$ |
|                                                                    | 6700   | A                  | 8.3ms                                                                     | reapplied      |
| $I^2t$ Maximum $I^2t$ for fusing                                   | 290    | kA <sup>2</sup> s  | 10ms                                                                      | No voltage     |
|                                                                    | 265    | kA <sup>2</sup> s  | 8.3ms                                                                     | reapplied      |
|                                                                    | 205    | kA <sup>2</sup> s  | 10ms                                                                      | 100% $V_{RRM}$ |
|                                                                    | 187    | kA <sup>2</sup> s  | 8.3ms                                                                     | reapplied      |
| $I^2t$ Maximum $I^2t$ for fusing                                   | 2900   | kA <sup>2</sup> /s | t=0 to 10ms, no voltage reapplied Initial $T_j = 125^\circ\text{C}$       |                |

## On-state Conduction

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| Parameters                                             | Values | Units      | Conditions                                                                              |
|--------------------------------------------------------|--------|------------|-----------------------------------------------------------------------------------------|
| $V_{TM}$ Max. peak on-state voltage                    | 1.73   | V          | $I_T = 600A$ (peak) half sine wave, $T_J = T_{Jmax}$ , $t_p = 10ms$                     |
| $V_{T(TO)1}$ Low level value of threshold voltage      | 1.18   | 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     | 1.25   | V          | $T_J = 125^\circ C$ ( $\pi \times I_{T(AV)} < I < 20 \times \pi \times I_{T(AV)}$ )     |
| $r_{i1}$ Low level value of on-state slope resistance  | 0.74   | m $\Omega$ | $T_J = 125^\circ C$ ( $16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)}$ ) |
| $r_{i2}$ High level value of on-state slope resistance | 0.70   | 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 $80\% V_{DRM}$ (*)        |
| $I_{RRM}$ 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  | $\mu s$    | $I_T = 750A$ , $T_J = 125^\circ C$<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 $\Omega$ , $t_r \leq 1\mu s$ , $V_D = 80\% V_{DRM}$<br>$T_J = 125^\circ C$                            |

## Thermal and Mechanical Specifications

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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 | 0.125      | K/W     | DC operation per junction                                                                                                                                                                                                                                                              |
| $R_{thCS}$ | Thermal resistance case to sink               | 0.025      | 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. |
|            | MAGN-A-pak to heatsink                        | 35 to 53   | lb * in |                                                                                                                                                                                                                                                                                        |
|            | Busbar to MAGN-A-pak                          | 8 to 10    | Nm      |                                                                                                                                                                                                                                                                                        |
|            |                                               | 70 to 90   | lb * in |                                                                                                                                                                                                                                                                                        |
| wt         | Approximate weight                            | 850/30     | g/oz    |                                                                                                                                                                                                                                                                                        |
|            | Case style                                    | MAGN-A-pak |         | See Outline Table                                                                                                                                                                                                                                                                      |

 $\Delta R$  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°             | 0.009                 | 0.006                  | K/W   | $T_J = T_J \text{ max.}$ |
| 120°             | 0.010                 | 0.011                  | K/W   |                          |
| 90°              | 0.014                 | 0.015                  | K/W   |                          |
| 60°              | 0.020                 | 0.020                  | K/W   |                          |
| 30°              | 0.032                 | 0.033                  | K/W   |                          |

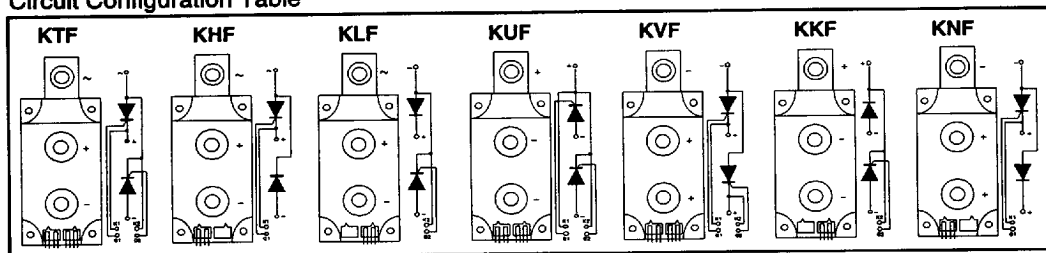
## Ordering Information Table

| Device Code |   |                                                         |     |   |    |     |
|-------------|---|---------------------------------------------------------|-----|---|----|-----|
| IRK         | T | F                                                       | 200 | - | 12 | H J |
| 1           | 2 | 3                                                       | 4   | 5 | 6  | 7   |
| 1           | - | Module type                                             |     |   |    |     |
| 2           | - | Circuit configuration (See Circuit Configuration Table) |     |   |    |     |
| 3           | - | Fast SCR                                                |     |   |    |     |
| 4           | - | Current rating                                          |     |   |    |     |
| 5           | - | Voltage code: Code x 100 = $V_{RRM}$                    |     |   |    |     |
| 6           | - | dv/dt code (See table)                                  |     |   |    |     |
| 7           | - | tq code (See table)                                     |     |   |    |     |

**tq**  
 P  $\leq 18\mu s$   
 K  $\leq 20\mu s$   
 J  $\leq 25\mu s$

**dv/dt**  
 C = 20V/ $\mu s$   
 D = 50V/ $\mu s$   
 For the following selections  
 contact factory  
 E = 100V/ $\mu s$   
 F = 200V/ $\mu s$   
 G = 300V/ $\mu s$   
 H = 400V/ $\mu s$

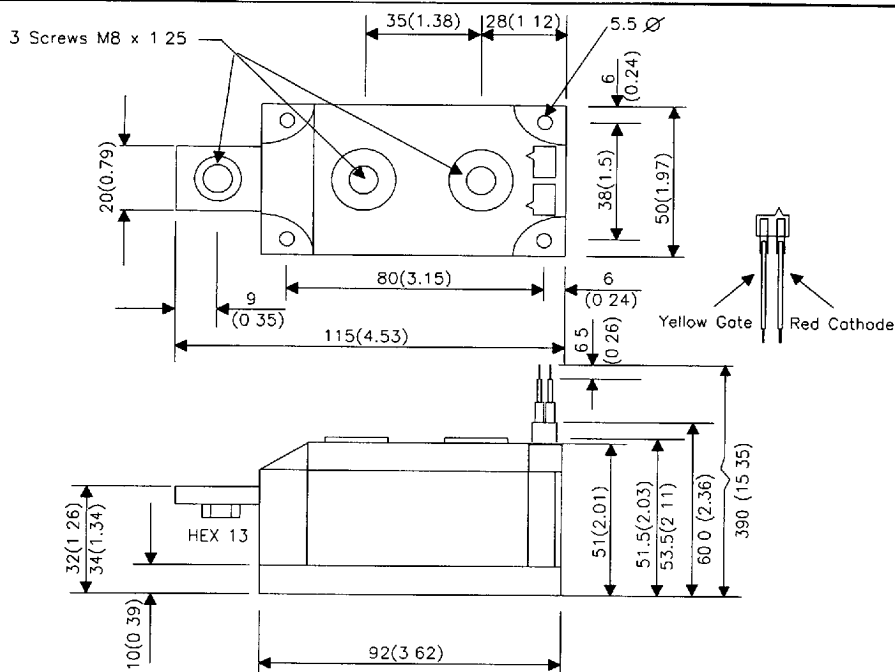
## Circuit Configuration Table



## Outline Table

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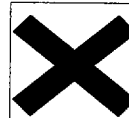
## 65E D



- All dimensions in millimeters (inches)
- Dimensions are nominal
- Full engineering drawings are available on request
- UL identification number for gate and cathode wire: UL 1385
- UL identification number for package: UL 94V0

## CONTAINS BERYLLIUM OXIDE CERAMIC

- May contain Beryllium Oxide Ceramic, and under normal circumstances is non hazardous
- Do not open, cut or grind
- Unserviceable parts must be disposed of as harmful waste.



HARMFUL

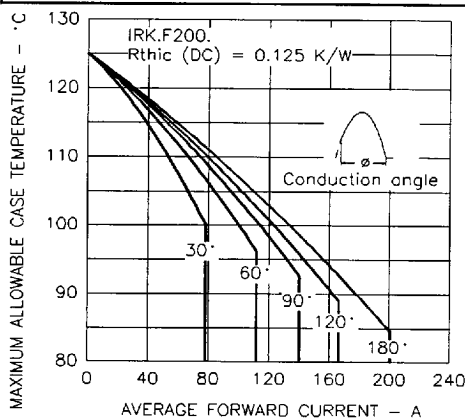


Fig. 1 - Current Ratings Characteristics

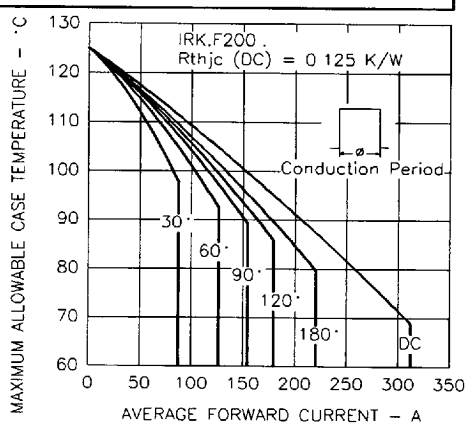


Fig. 2 - Current Ratings Characteristics

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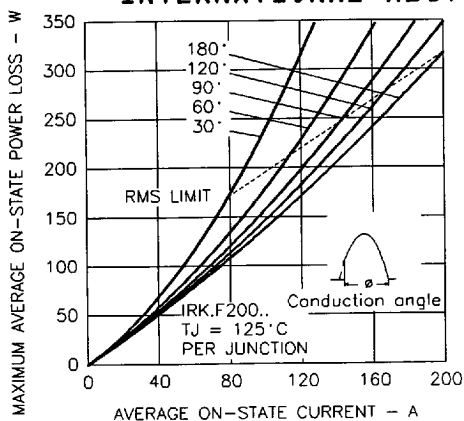


Fig. 3 - On-state Power Loss Characteristics

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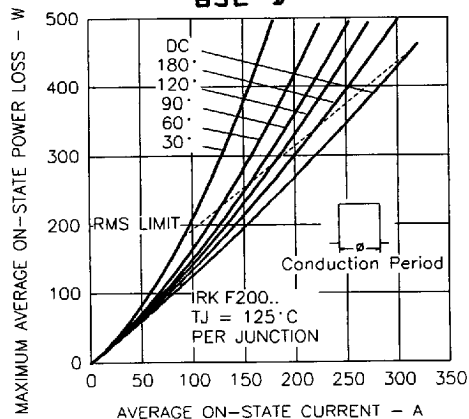


Fig. 4 - On-state Power Loss Characteristics

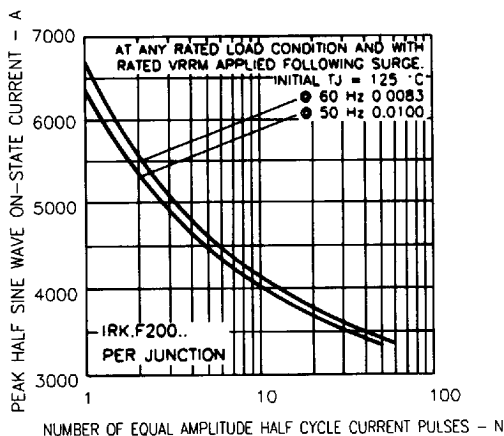


Fig. 5 - Maximum Non-Repetitive Surge Current

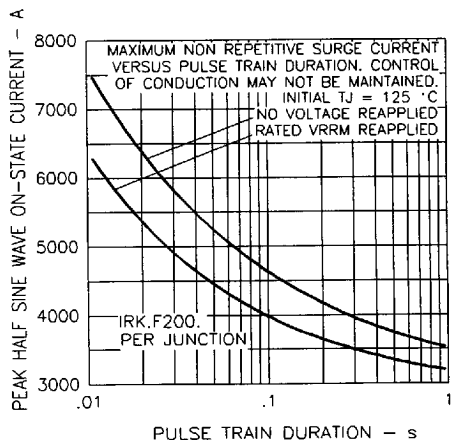


Fig. 6 - Maximum Non-Repetitive Surge Current

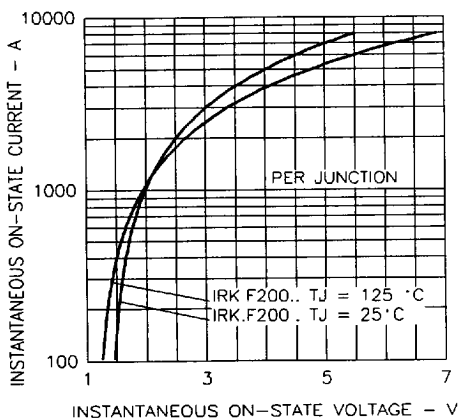
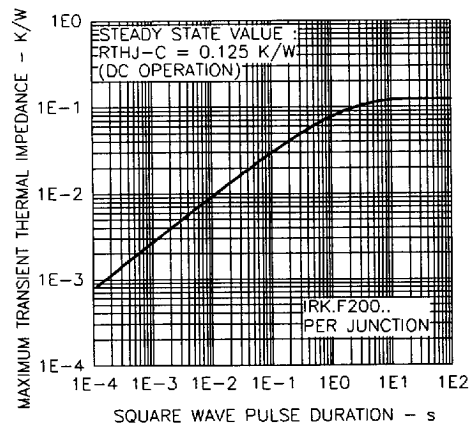


Fig. 7 - On-state Voltage Drop Characteristics

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

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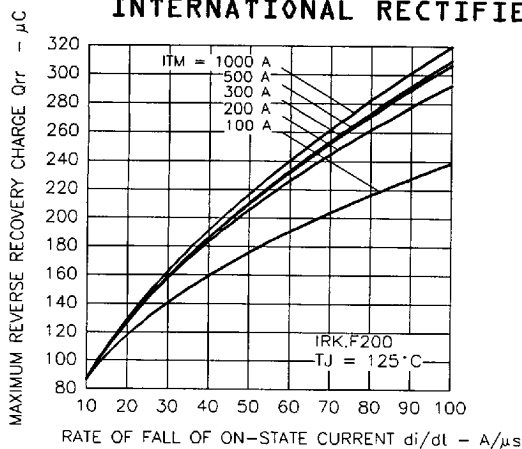


Fig. 9 - Reverse Recovery Charge Characteristics (Thyristor)

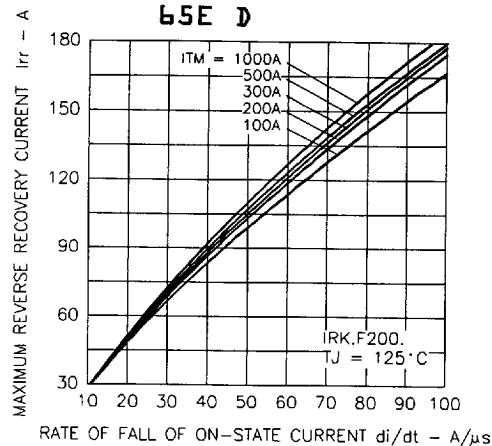


Fig. 10 - Reverse Recovery Current Characteristics (Thyristor)

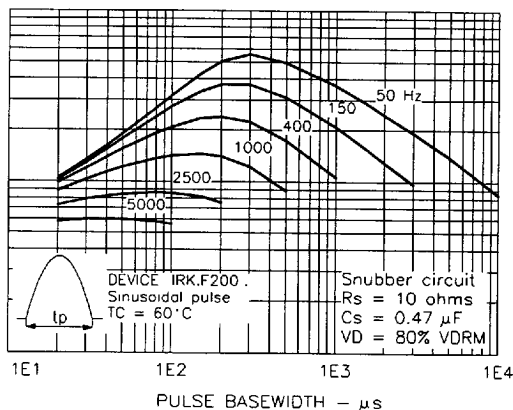
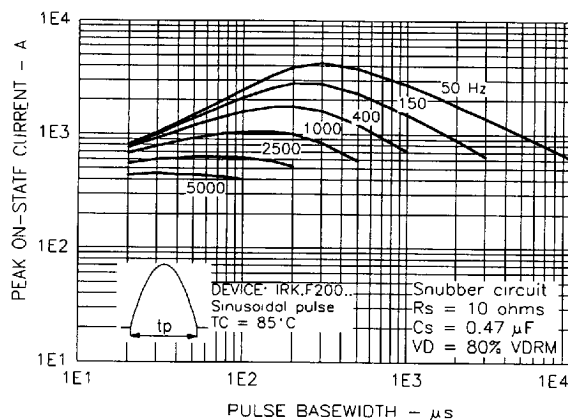


Fig. 11 - Frequency Characteristics

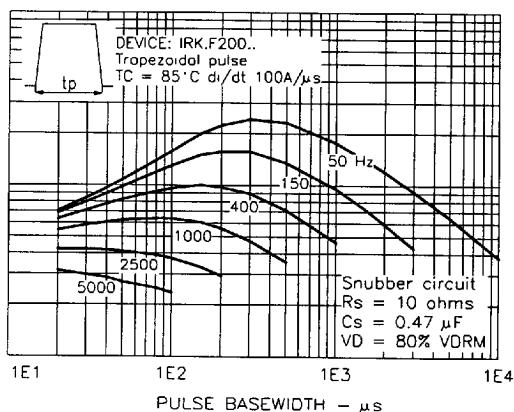
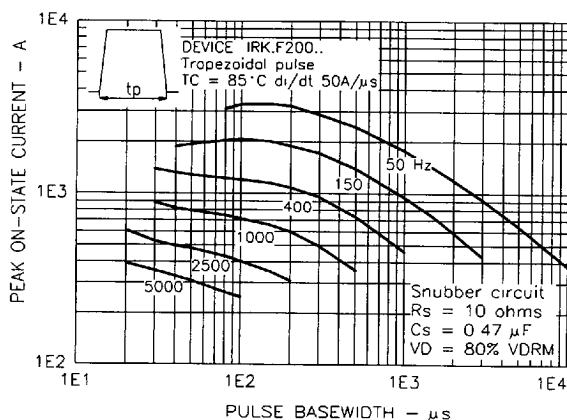


Fig. 12 - Frequency Characteristics

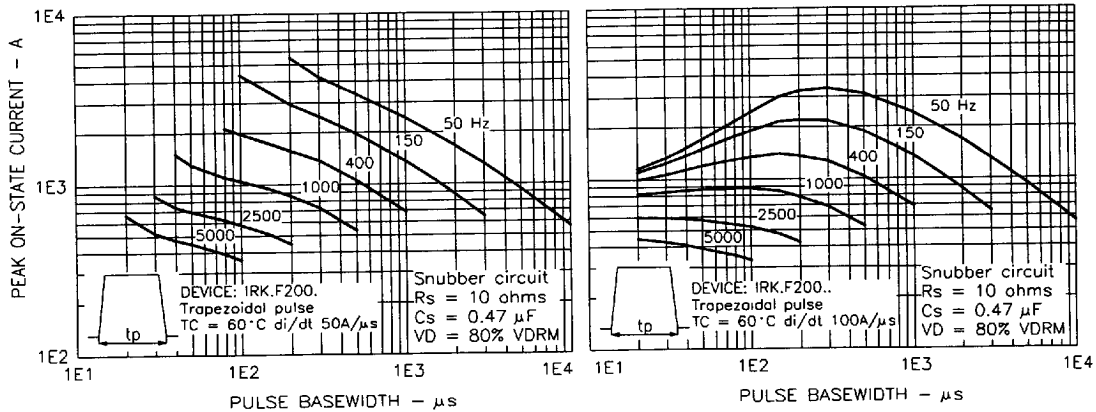


Fig. 13 - Frequency Characteristics

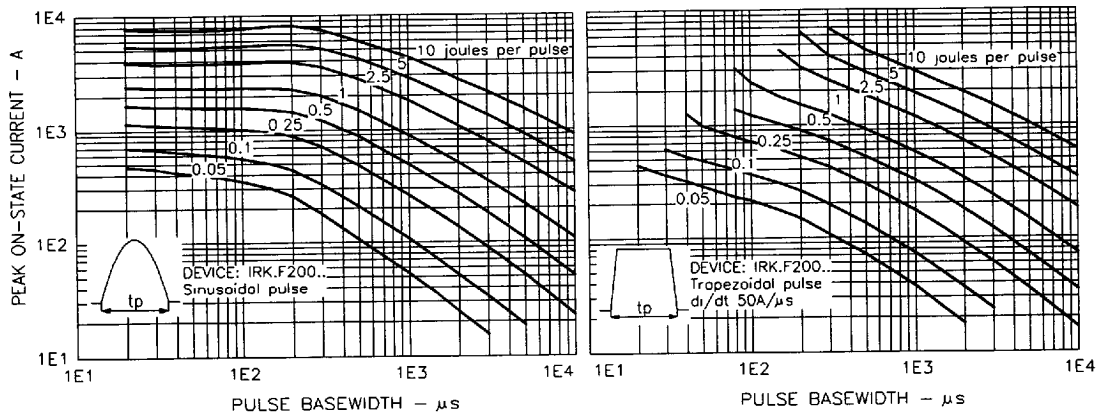


Fig. 14 - Maximum On-state Energy Power Loss Characteristics

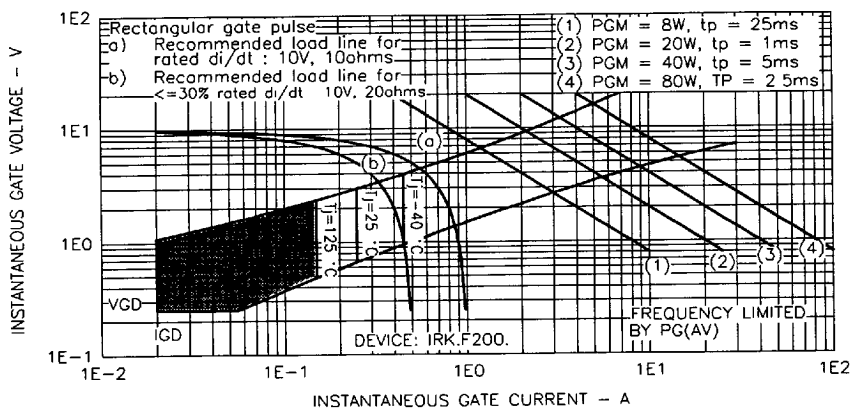


Fig. 15 - Gate Characteristics