

# International IR Rectifier

INSULATED GATE BIPOLAR TRANSISTOR WITH  
HYPERFAST DIODE

## Features

- Fast: optimized for medium operating frequencies (1-5 kHz in hard switching, >20kHz in resonant mode).
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency than Generation 3.
- IGBT co-packaged with HEXFRED™ ultrafast, ultra-soft recovery anti-parallel diodes for use in bridge configurations.

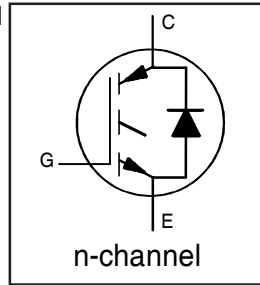
## Benefits

- Generation 4 IGBT's offer highest efficiency available.
- IGBT's optimized for specific application conditions.
- HEXFRED diodes optimized for performance with IGBT's. Minimized recovery characteristics require less/no snubbing.
- Designed to be a "drop-in" replacement for equivalent industry-standard Generation 3 IR IGBT's.

# IRG4BC30FD-S

Fast CoPack IGBT

PD - 96929



$$V_{CES} = 600V$$

$$V_{CE(on)} \text{ typ.} = 1.59V$$

$$@V_{GE} = 15V, I_C = 17A$$



## Absolute Maximum Ratings

|                           | Parameter                                 | Max.        | Units      |
|---------------------------|-------------------------------------------|-------------|------------|
| $V_{CES}$                 | Collector-to-Emitter Voltage              | 600         | V          |
| $I_C @ T_C = 25^\circ C$  | Continuous Collector Current              | 31          | A          |
| $I_C @ T_C = 100^\circ C$ | Continuous Collector Current              | 17          |            |
| $I_{CM}$                  | Pulse Collector Current (Ref.Fig.C.T.5) ① | 120         |            |
| $I_{LM}$                  | Clamped Inductive Load current ②          | 120         |            |
| $I_F @ T_C = 100^\circ C$ | Diode Continuous Forward Current          | 12          |            |
| $I_{FM}$                  | Diode Maximum Forward Current             | 120         |            |
| $V_{GE}$                  | Gate-to-Emitter Voltage                   | $\pm 20$    | V          |
| $P_D @ T_C = 25^\circ C$  | Maximum Power Dissipation                 | 100         | W          |
| $P_D @ T_C = 100^\circ C$ | Maximum Power Dissipation                 | 42          |            |
| $T_J$                     | Operating Junction and                    | -55 to +150 | $^\circ C$ |
| $T_{STG}$                 | Storage Temperature Range                 |             |            |

## Thermal / Mechanical Characteristics

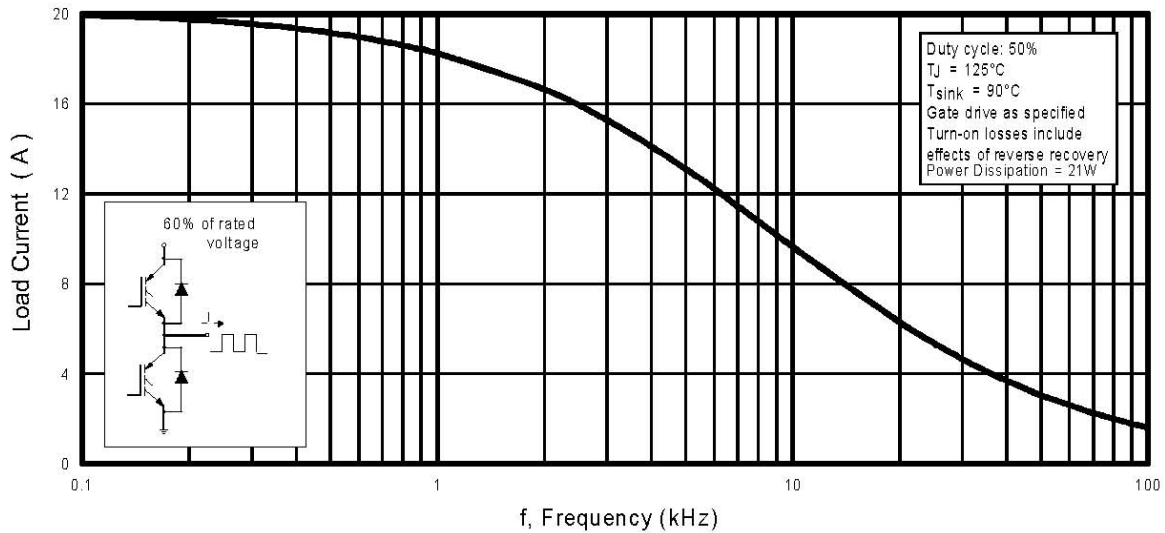
|                 | Parameter                                         | Min. | Typ.       | Max. | Units        |
|-----------------|---------------------------------------------------|------|------------|------|--------------|
| $R_{\theta JC}$ | Junction-to-Case- IGBT                            | —    | —          | 1.2  | $^\circ C/W$ |
| $R_{\theta CS}$ | Case-to-Sink, flat, greased surface               | —    | 0.50       | —    |              |
| $R_{\theta JA}$ | Junction-to-Ambient (PCB Mounted, steady state) ⑤ | —    | —          | 40   |              |
| Wt              | Weight                                            | —    | 2.0 (0.07) | —    | g (oz.)      |

## Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

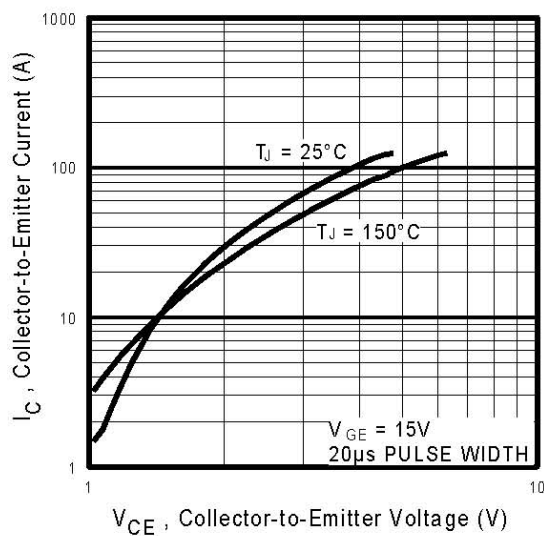
|                                 | Parameter                                | Min. | Typ. | Max.      | Units                | Conditions                                            |
|---------------------------------|------------------------------------------|------|------|-----------|----------------------|-------------------------------------------------------|
| $V_{(BR)CES}$                   | Collector-to-Emitter Breakdown Voltage ③ | 600  | —    | —         | V                    | $V_{GE} = 0V, I_C = 250\mu A$                         |
| $\Delta V_{(BR)CES}/\Delta T_J$ | Temperature Coeff. of Breakdown Voltage  | —    | 0.69 | —         | V/ $^\circ\text{C}$  | $V_{GE} = 0V, I_C = 1mA$                              |
| $V_{CE(on)}$                    | Collector-to-Emitter Voltage             | —    | 1.59 | 1.8       | V                    | $I_C = 17A, V_{GE} = 15V$                             |
|                                 |                                          | —    | 1.99 | —         |                      | $I_C = 31A$ See Fig. 2, 5                             |
|                                 |                                          | —    | 1.7  | —         |                      | $I_C = 17A, T_J = 150^\circ\text{C}$                  |
| $V_{GE(th)}$                    | Gate Threshold Voltage                   | 3.0  | —    | 6.0       | V                    | $V_{CE} = V_{GE}, I_C = 250\mu A$                     |
| $\Delta V_{GE(th)}/\Delta T_J$  | Threshold Voltage temp. coefficient      | —    | -11  | —         | mV/ $^\circ\text{C}$ | $V_{CE} = V_{GE}, I_C = 250\mu A$                     |
| $g_{fe}$                        | Forward Transconductance ④               | 6.1  | 10   | —         | S                    | $V_{CE} = 100V, I_C = 17A$                            |
| $I_{CES}$                       | Zero Gate Voltage Collector Current      | —    | —    | 250       | $\mu A$              | $V_{GE} = 0V, V_{CE} = 600V$                          |
|                                 |                                          | —    | —    | 2500      |                      | $V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$ |
| $V_{FM}$                        | Diode Forward Voltage Drop               | —    | 1.4  | 1.7       | V                    | $I_F = 12A$ See Fig. 13                               |
|                                 |                                          | —    | 1.3  | 1.6       |                      | $I_F = 12A, T_J = 150^\circ\text{C}$                  |
| $I_{GES}$                       | Gate-to-Emitter Leakage Current          | —    | —    | $\pm 100$ | nA                   | $V_{GE} = \pm 20V$                                    |

## Switching Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

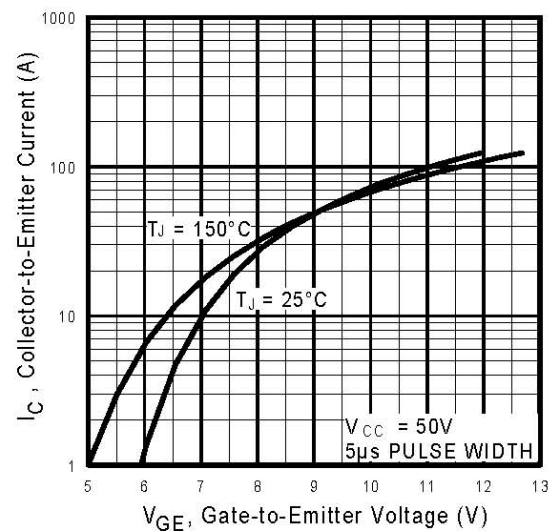
|                  | Parameter                                        | Min. | Typ. | Max. | Units      | Conditions                                               |
|------------------|--------------------------------------------------|------|------|------|------------|----------------------------------------------------------|
| $Q_g$            | Total Gate Charge (turn-on)                      | —    | 51   | 77   | nC         | $I_C = 17A$                                              |
| $Q_{ge}$         | Gate-to-Emitter Charge (turn-on)                 | —    | 7.9  | 12   |            | $V_{CC} = 400V$ See Fig. 8                               |
| $Q_{gc}$         | Gate-to-Collector Charge (turn-on)               | —    | 19   | 28   |            | $V_{GE} = 15V$                                           |
| $t_{d(on)}$      | Turn-On delay time                               | —    | 42   | —    | ns         | $T_J = 25^\circ\text{C}$                                 |
| $t_r$            | Rise time                                        | —    | 26   | —    |            | $I_C = 17A, V_{CC} = 480V$                               |
| $t_{d(off)}$     | Turn-Off delay time                              | —    | 230  | 350  |            | $V_{GE} = 15V, R_G = 23\Omega$                           |
| $t_f$            | Fall time                                        | —    | 160  | 230  |            | Energy losses include "tail" and diode reverse recovery. |
| $E_{on}$         | Turn-On Switching Loss                           | —    | 0.63 | —    | mJ         | See Fig. 9, 10, 11, 18                                   |
| $E_{off}$        | Turn-Off Switching Loss                          | —    | 1.39 | —    |            |                                                          |
| $E_{ts}$         | Total Switching Loss                             | —    | 2.02 | 3.9  |            |                                                          |
| $t_{d(on)}$      | Turn-On delay time                               | —    | 42   | —    | ns         | $T_J = 150^\circ\text{C}$ See Fig. 9,10,11,18            |
| $t_r$            | Rise time                                        | —    | 27   | —    |            | $I_C = 17A, V_{CC} = 480V$                               |
| $t_{d(off)}$     | Turn-Off delay time                              | —    | 310  | —    |            | $V_{GE} = 15V, R_G = 23\Omega$                           |
| $t_f$            | Fall time                                        | —    | 310  | —    |            | Energy losses include "tail" and diode reverse recovery. |
| $E_{ts}$         | Total Switching Loss                             | —    | 3.2  | —    | mJ         |                                                          |
| $L_E$            | Internal Emitter Inductance                      | —    | 7.5  | —    | nH         | Measured 5mm from package                                |
| $C_{ies}$        | Input Capacitance                                | —    | 1100 | —    | pF         | $V_{GE} = 0V$                                            |
| $C_{oes}$        | Output Capacitance                               | —    | 74   | —    |            | $V_{CC} = 30V$ See Fig. 7                                |
| $C_{res}$        | Reverse Transfer Capacitance                     | —    | 14   | —    |            | $f = 1.0MHz$                                             |
| $t_{rr}$         | Diode Reverse Recovery Time                      | —    | 42   | 60   | ns         | $T_J = 25^\circ\text{C}$ See Fig. 14                     |
|                  |                                                  | —    | 80   | 120  |            | $T_J = 125^\circ\text{C}$                                |
| $I_{rr}$         | Diode Peak Reverse Recovery Current              | —    | 3.5  | 6.0  | A          | $T_J = 25^\circ\text{C}$ See Fig. 15                     |
|                  |                                                  | —    | 5.6  | 10   |            | $T_J = 125^\circ\text{C}$                                |
| $Q_{rr}$         | Diode Reverse Recovery Charge                    | —    | 80   | 180  | nC         | $T_J = 25^\circ\text{C}$ See Fig. 16                     |
|                  |                                                  | —    | 220  | 600  |            | $T_J = 125^\circ\text{C}$                                |
| $di_{(rec)M}/dt$ | Diode Peak Rate of Fall of Recovery During $t_b$ | —    | 180  | —    | A/ $\mu s$ | $T_J = 25^\circ\text{C}$ See Fig. 17                     |
|                  |                                                  | —    | 120  | —    |            | $T_J = 125^\circ\text{C}$                                |



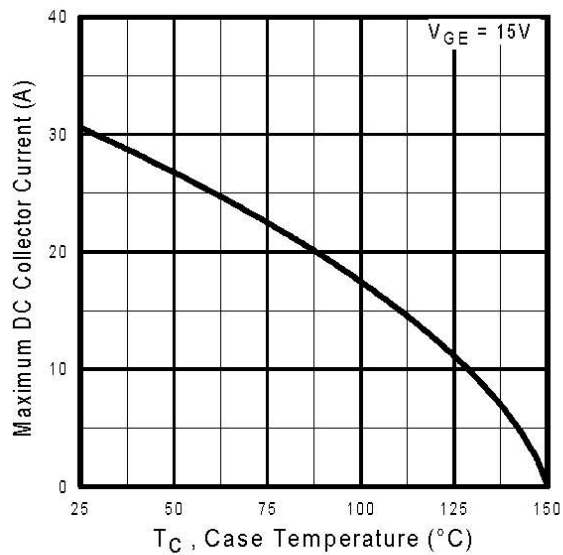
**Fig. 1** - Typical Load Current vs. Frequency  
 (Load Current =  $I_{\text{RMS}}$  of fundamental)



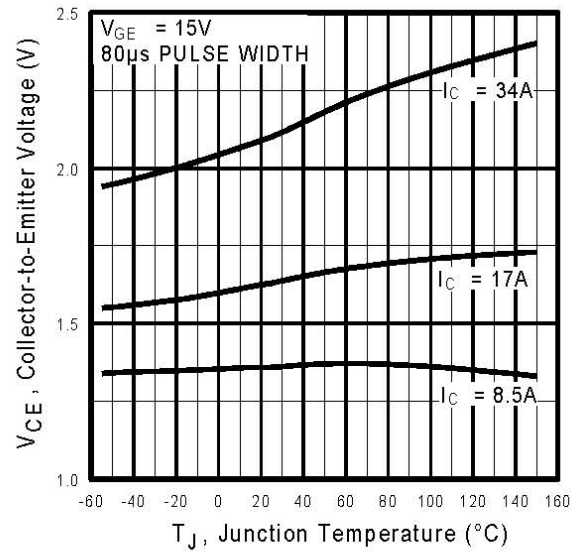
**Fig. 2** - Typical Output Characteristics



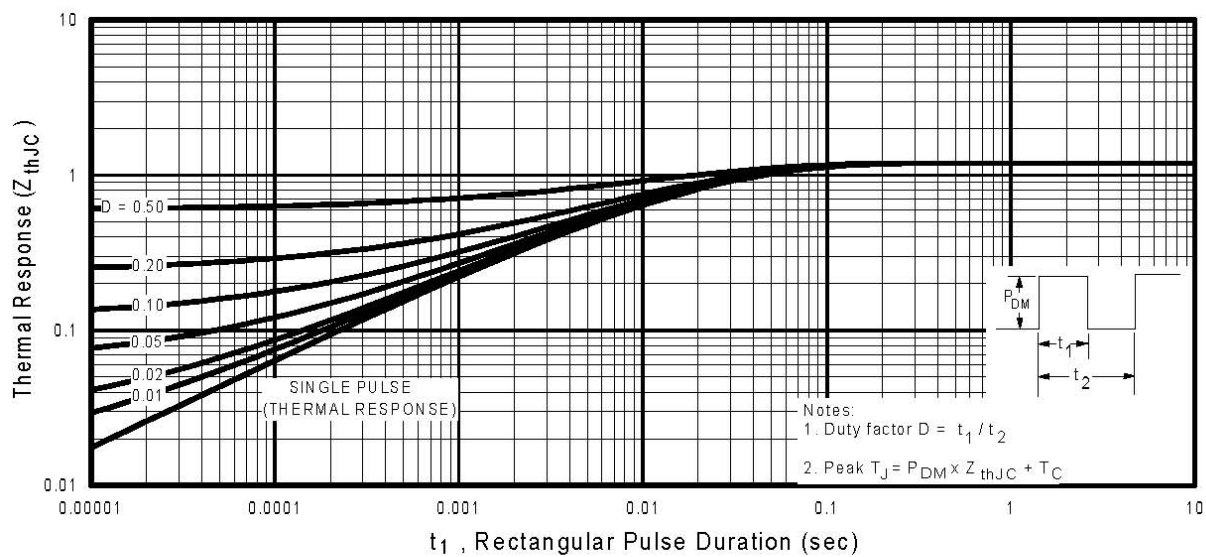
**Fig. 3** - Typical Transfer Characteristics



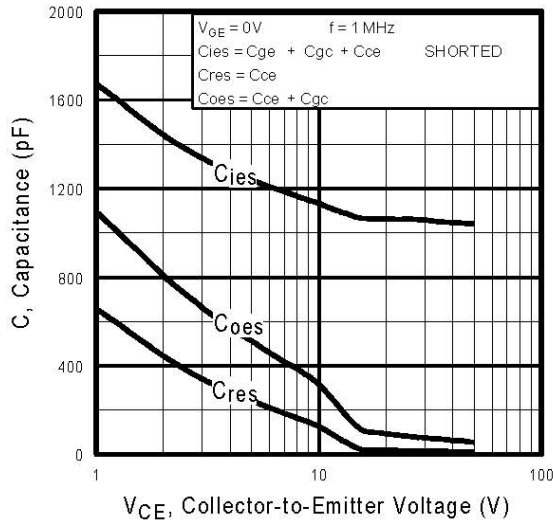
**Fig. 4** - Maximum Collector Current vs. Case Temperature



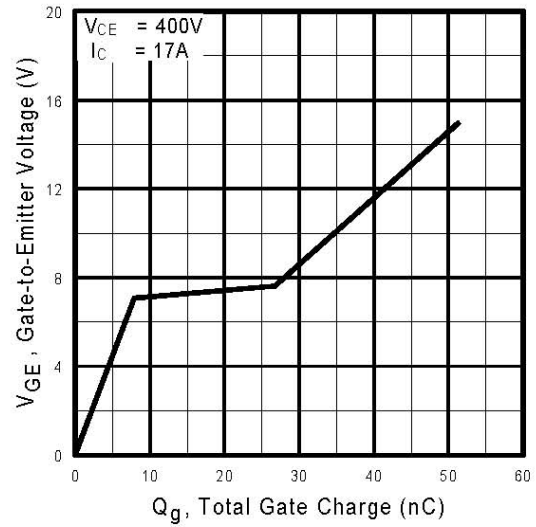
**Fig. 5** - Typical Collector-to-Emitter Voltage vs. Junction Temperature



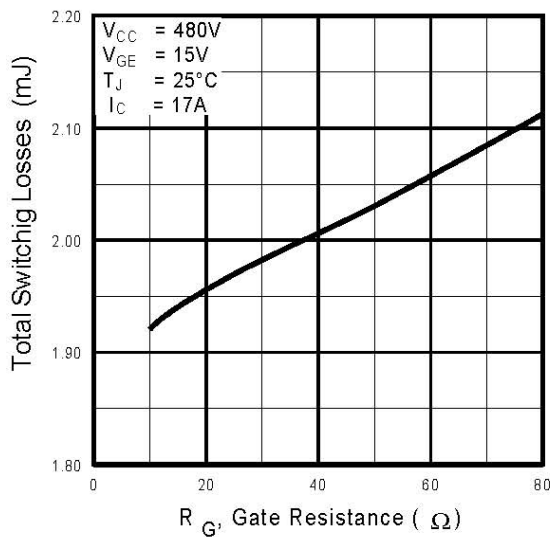
**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case



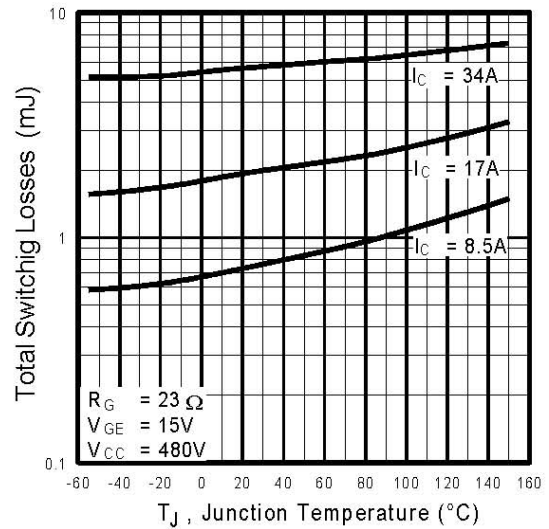
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



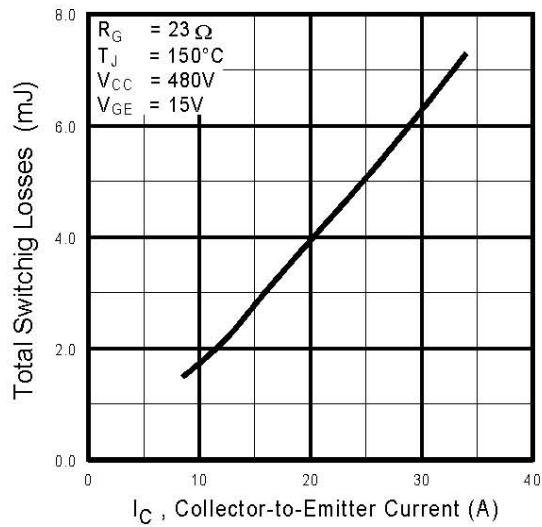
**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage



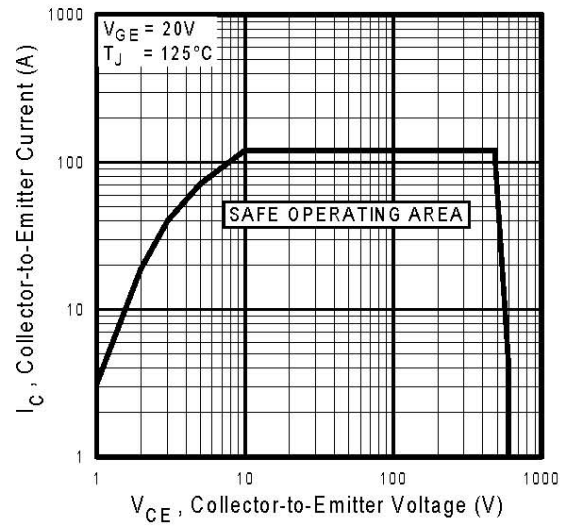
**Fig. 9** - Typical Switching Losses vs. Gate Resistance



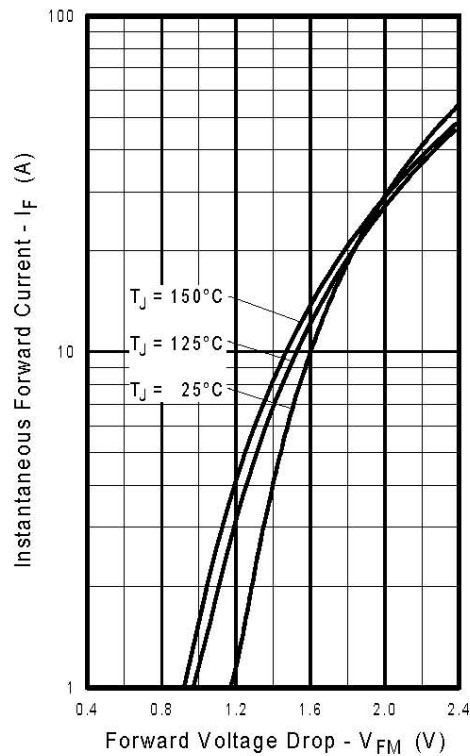
**Fig. 10** - Typical Switching Losses vs. Junction Temperature



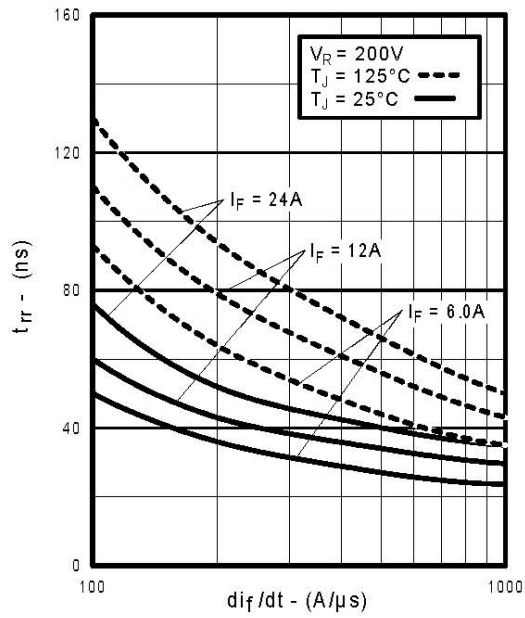
**Fig. 11** - Typical Switching Losses vs. Collector-to-Emitter Current



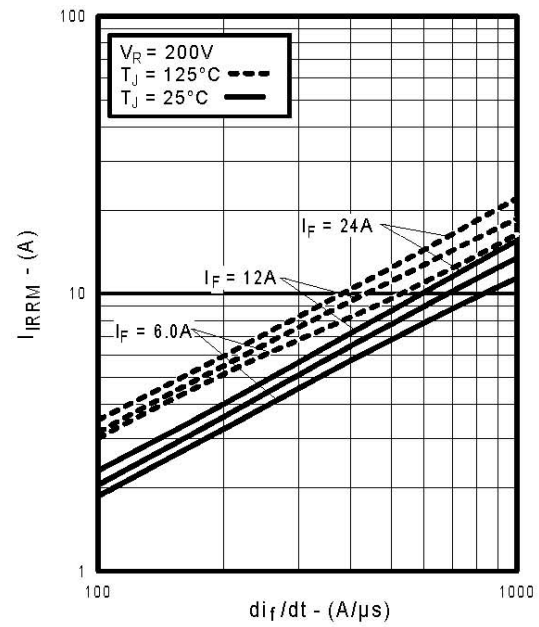
**Fig. 12** - Turn-Off SOA



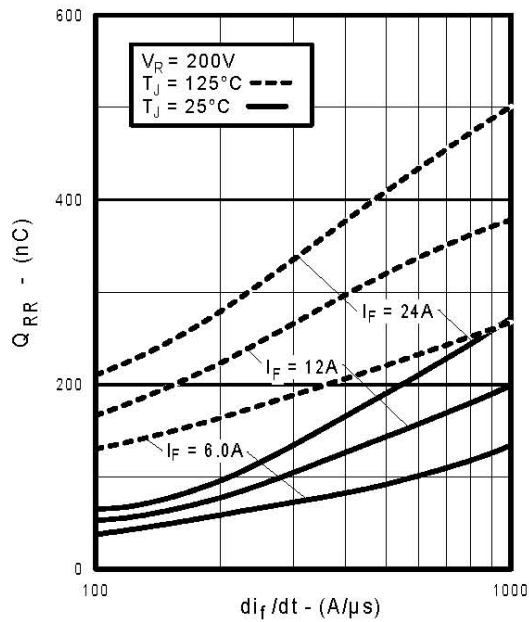
**Fig. 13** - Maximum Forward Voltage Drop vs. Instantaneous Forward Current



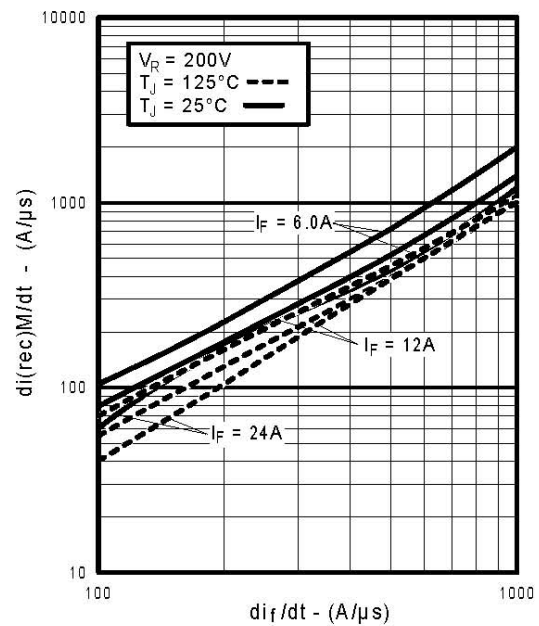
**Fig. 14** - Typical Reverse Recovery vs.  $di_f/dt$



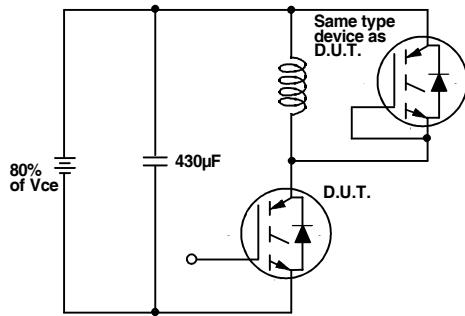
**Fig. 15** - Typical Recovery Current vs.  $di_f/dt$



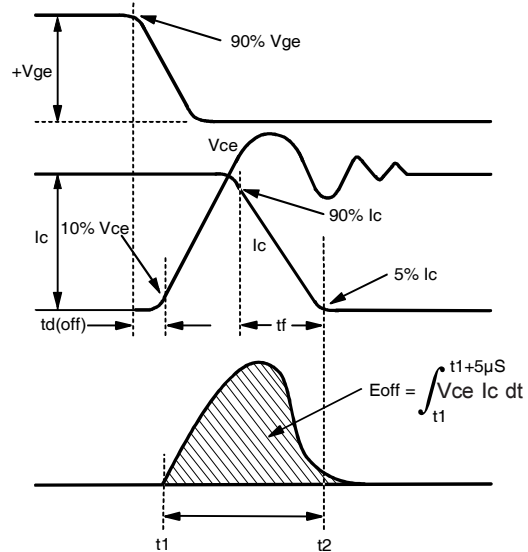
**Fig. 16** - Typical Stored Charge vs.  $di_f/dt$



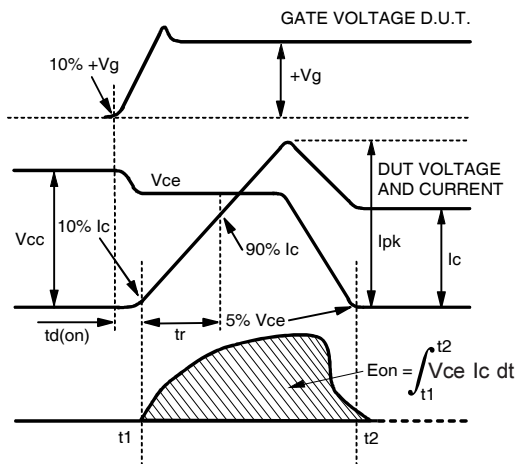
**Fig. 17** - Typical  $di_{(rec)M}/dt$  vs.  $di_f/dt$



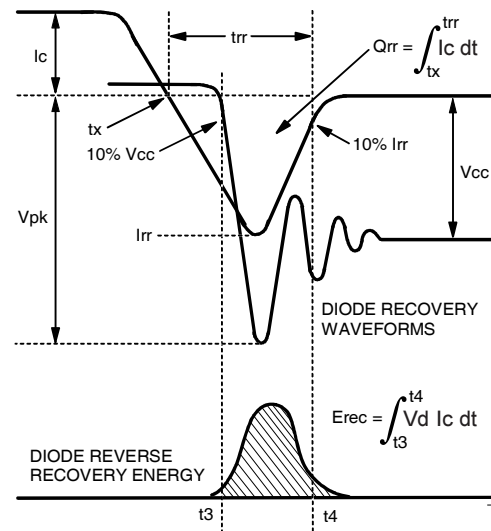
**Fig. 18a** - Test Circuit for Measurement of  $I_{LM}$ ,  $E_{on}$ ,  $E_{off}(\text{diode})$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$ ,  $t_{d(on)}$ ,  $t_r$ ,  $t_{d(off)}$ ,  $t_f$



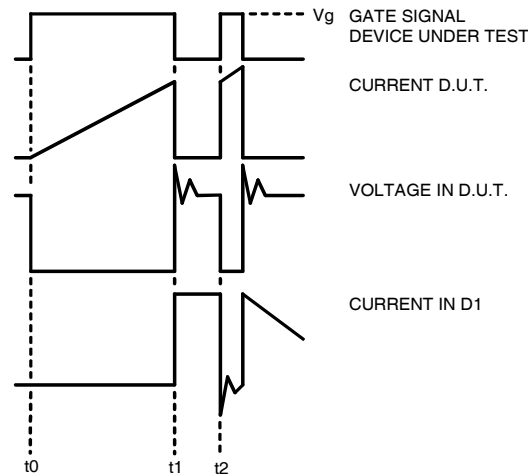
**Fig. 18b** - Test Waveforms for Circuit of Fig. 18a, Defining  $E_{off}$ ,  $t_{d(off)}$ ,  $t_f$



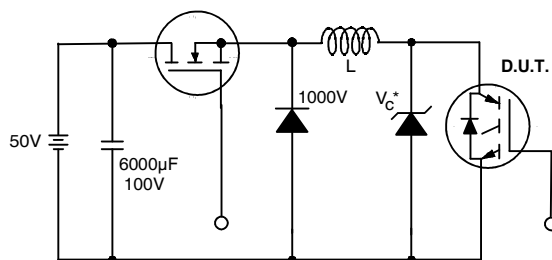
**Fig. 18c** - Test Waveforms for Circuit of Fig. 18a, Defining  $E_{on}$ ,  $t_{d(on)}$ ,  $t_r$



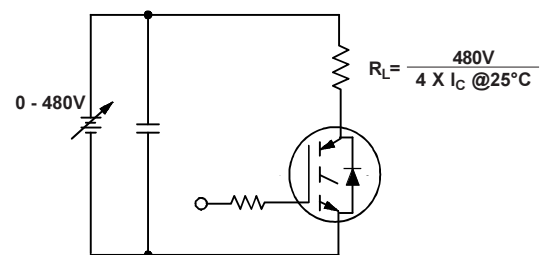
**Fig. 18d** - Test Waveforms for Circuit of Fig. 18a, Defining  $E_{rec}$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$



**Fig.18e** - Macro Waveforms for Figure 18a's Test Circuit



**Fig. 19** - Clamped Inductive Load Test Circuit



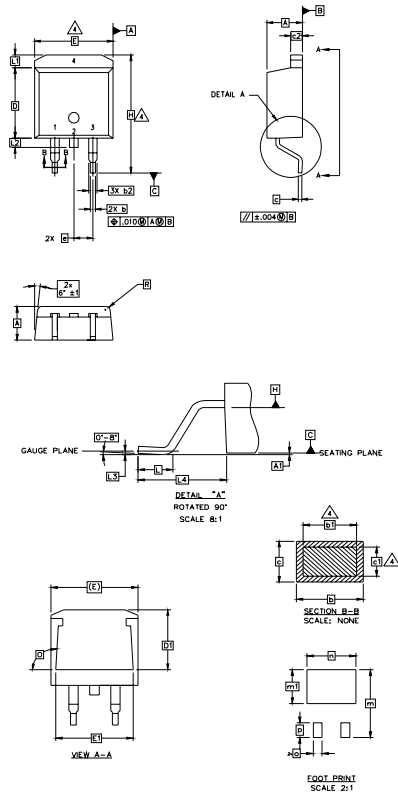
**Fig. 20** - Pulsed Collector Current Test Circuit

# IRG4BC30FD-S

## D<sup>2</sup>Pak Package Outline

Dimensions are shown in millimeters (inches)

International  
**IR** Rectifier



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
  2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES]
  3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
  4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
  5. CONTROLLING DIMENSION: INCH.

| SYMBOL | DIMENSIONS  |       |          |      | NOTES |
|--------|-------------|-------|----------|------|-------|
|        | MILLIMETERS |       | INCHES   |      |       |
|        | MIN.        | MAX.  | MIN.     | MAX. |       |
| A      | 4.06        | 4.83  | .160     | .190 | 4     |
| A1     | 0.00        | 0.254 | .000     | .010 |       |
| b      | 0.51        | 0.99  | .020     | .039 |       |
| b1     | 0.51        | 0.89  | .020     | .035 |       |
| b2     | 1.14        | 1.78  | .045     | .070 | 4     |
| c      | 0.38        | 0.74  | .015     | .029 |       |
| c1     | 0.38        | 0.58  | .015     | .023 |       |
| c2     | 1.14        | 1.65  | .045     | .065 |       |
| D      | 8.51        | 9.65  | .335     | .380 | 3     |
| D1     | 6.86        |       | .270     |      |       |
| E      | 9.65        | 10.67 | .380     | .420 |       |
| E1     | 6.22        |       | .245     |      |       |
| e      | 2.54 BSC    |       | .100 BSC |      | 3     |
| H      | 14.61       | 15.88 | .575     | .625 |       |
| L      | 1.78        | 2.79  | .070     | .110 |       |
| L1     |             | 1.65  |          | .065 |       |
| L2     | 1.27        | 1.78  | .050     | .070 | 3     |
| L3     | 0.25 BSC    |       | .010 BSC |      |       |
| L4     | 4.78        | 5.28  | .188     | .208 |       |
| m      | 17.78       |       | .700     |      | 3     |
| m1     | 8.89        |       | .350     |      |       |
| n      | 11.43       |       | .450     |      |       |
| o      | 2.08        |       | .082     |      |       |
| p      | 3.81        |       | .150     |      | 3     |
| R      | 0.51        | 0.71  | .020     | .028 |       |
| θ      | 90°         | 93°   | 90°      | 93°  |       |

### LEAD ASSIGNMENTS

#### HEXFET

- 1.- GATE
- 2, 4.- DRAIN
- 3.- SOURCE

#### IGBTs, CoPACK

- 1.- GATE
- 2, 4.- COLLECTOR
- 3.- EMITTER

#### DIODES

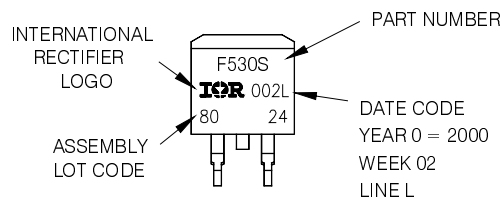
- 1.- ANODE \*
- 2, 4.- CATHODE
- 3.- ANODE

\* PART DEPENDENT.

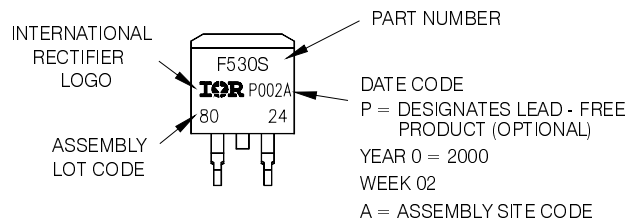
## D<sup>2</sup>Pak Part Marking Information

EXAMPLE: THIS IS AN IRF530S WITH  
LOT CODE 8024  
ASSEMBLED ON WW 02, 2000  
IN THE ASSEMBLY LINE "L"

Note: "P" in assembly line position  
indicates "Lead - Free"

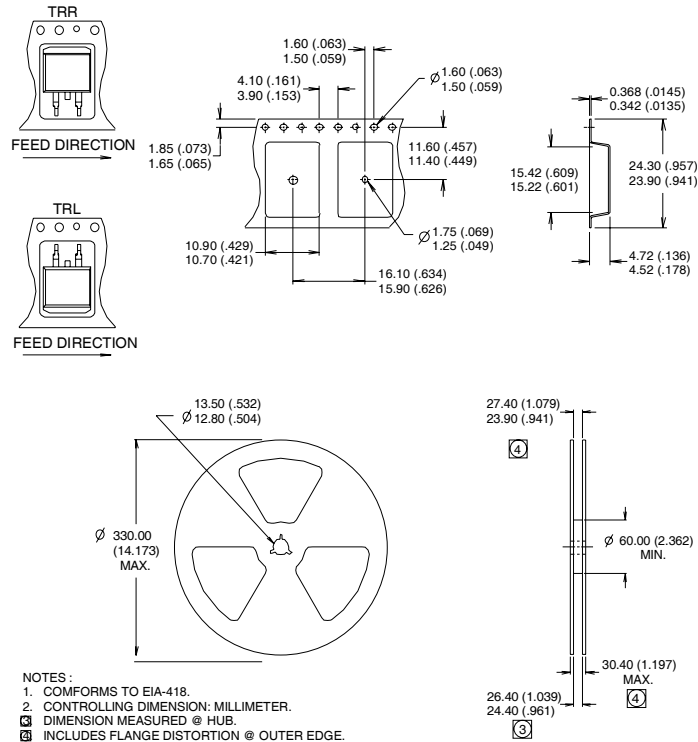


OR



## D<sup>2</sup>Pak Tape & Reel Information

Dimensions are shown in millimeters (inches)



### Notes:

- ① Repetitive rating:  $V_{GE}=20V$ ; pulse width limited by maximum junction temperature (figure 20).
- ②  $V_{CC}=80\%(V_{CES})$ ,  $V_{GE}=20V$ ,  $L=10\mu H$ ,  $R_G = 23\Omega$  (figure 19).
- ③ Pulse width  $\leq 80\mu s$ ; duty factor  $\leq 0.1\%$ .
- ④ Pulse width  $5.0\mu s$ , single shot.
- ⑤ When mounted on 1" square PCB (FR-4 or G-10 Material).

Data and specifications subject to change without notice.

International  
**IR** Rectifier

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TAC Fax: (310) 252-7903

Visit us at [www.irf.com](http://www.irf.com) for sales contact information. 12/04

Note: For the most current drawings please refer to the IR website at:  
<http://www.irf.com/package/>