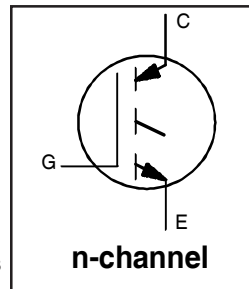


# IRG4BC30W-SPbF

## INSULATED GATE BIPOLAR TRANSISTOR

### Features

- Designed expressly for Switch-Mode Power Supply and PFC (power factor correction) applications
- Industry-benchmark switching losses improve efficiency of all power supply topologies
- 50% reduction of Eoff parameter
- Low IGBT conduction losses
- Latest-generation IGBT design and construction offers tighter parameters distribution, exceptional reliability



$V_{CES} = 600V$   
 $V_{CE(on)} \text{ typ.} = 2.10V$   
 @  $V_{GE} = 15V, I_C = 12A$

### Benefits

- Lower switching losses allow more cost-effective operation than power MOSFETs up to 150 kHz ("hard switched" mode)
- Of particular benefit to single-ended converters and boost PFC topologies 150W and higher
- Low conduction losses and minimal minority-carrier recombination make these an excellent option for resonant mode switching as well (up to >>300 kHz)
- Lead-Free



D²Pak

### Absolute Maximum Ratings

|                           | Parameter                              | Max.                              | Units      |
|---------------------------|----------------------------------------|-----------------------------------|------------|
| $V_{CES}$                 | Collector-to-Emitter Breakdown Voltage | 600                               | V          |
| $I_C @ T_C = 25^\circ C$  | Continuous Collector Current           | 23                                | A          |
| $I_C @ T_C = 100^\circ C$ | Continuous Collector Current           | 12                                |            |
| $I_{CM}$                  | Pulsed Collector Current ①             | 92                                |            |
| $I_{LM}$                  | Clamped Inductive Load Current ②       | 92                                |            |
| $V_{GE}$                  | Gate-to-Emitter Voltage                | $\pm 20$                          | V          |
| $E_{ARV}$                 | Reverse Voltage Avalanche Energy ③     | 180                               | mJ         |
| $P_D @ T_C = 25^\circ C$  | 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              |                                   |            |
|                           | Soldering Temperature, for 10 seconds  |                                   |            |
|                           |                                        | 300 (0.063 in. (1.6mm from case ) |            |

### Thermal Resistance

|                 | Parameter                                         | Typ. | Max. | Units        |
|-----------------|---------------------------------------------------|------|------|--------------|
| $R_{\theta JC}$ | Junction-to-Case                                  | —    | 1.2  | $^\circ C/W$ |
| $R_{\theta JA}$ | Junction-to-Ambient, ( PCB Mounted,steady-state)* | —    | 40   |              |

\* When mounted on 1" square PCB (FR-4 or G-10 Material ). For recommended footprint and soldering techniques refer to application note #AN-994.

## 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   | 600  | —    | —         | V                    | $V_{GE} = 0V, I_C = 250\mu A$                         |
| $V_{(BR)ECS}$                   | Emitter-to-Collector Breakdown Voltage ④ | 18   | —    | —         | V                    | $V_{GE} = 0V, I_C = 1.0A$                             |
| $\Delta V_{(BR)CES}/\Delta T_J$ | Temperature Coeff. of Breakdown Voltage  | —    | 0.34 | —         | V/ $^\circ\text{C}$  | $V_{GE} = 0V, I_C = 1.0mA$                            |
| $V_{CE(ON)}$                    | Collector-to-Emitter Saturation Voltage  | —    | 2.1  | 2.7       | V                    | $I_C = 12A, V_{GE} = 15V$                             |
|                                 |                                          | —    | 2.45 | —         |                      | $I_C = 23A, V_{GE} = 15V$                             |
|                                 |                                          | —    | 1.95 | —         |                      | $I_C = 12A, T_J = 150^\circ\text{C}$                  |
| $V_{GE(th)}$                    | Gate Threshold Voltage                   | 3.0  | —    | 6.0       |                      | $V_{CE} = V_{GE}, I_C = 250\mu A$                     |
| $\Delta V_{GE(th)}/\Delta T_J$  | Temperature Coeff. of Threshold Voltage  | —    | -11  | —         | mV/ $^\circ\text{C}$ | $V_{CE} = V_{GE}, I_C = 250\mu A$                     |
| $g_{fe}$                        | Forward Transconductance ⑤               | 11   | 16   | —         | S                    | $V_{CE} = 100V, I_C = 12A$                            |
| $I_{CES}$                       | Zero Gate Voltage Collector Current      | —    | —    | 250       | $\mu A$              | $V_{GE} = 0V, V_{CE} = 600V$                          |
|                                 |                                          | —    | —    | 2.0       |                      | $V_{GE} = 0V, V_{CE} = 10V, T_J = 25^\circ\text{C}$   |
|                                 |                                          | —    | —    | 1000      |                      | $V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$ |
| $I_{GES}$                       | Gate-to-Emitter Leakage Current          | —    | —    | $\pm 100$ | nA                   | $V_{GE} = \pm 20V$                                    |

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

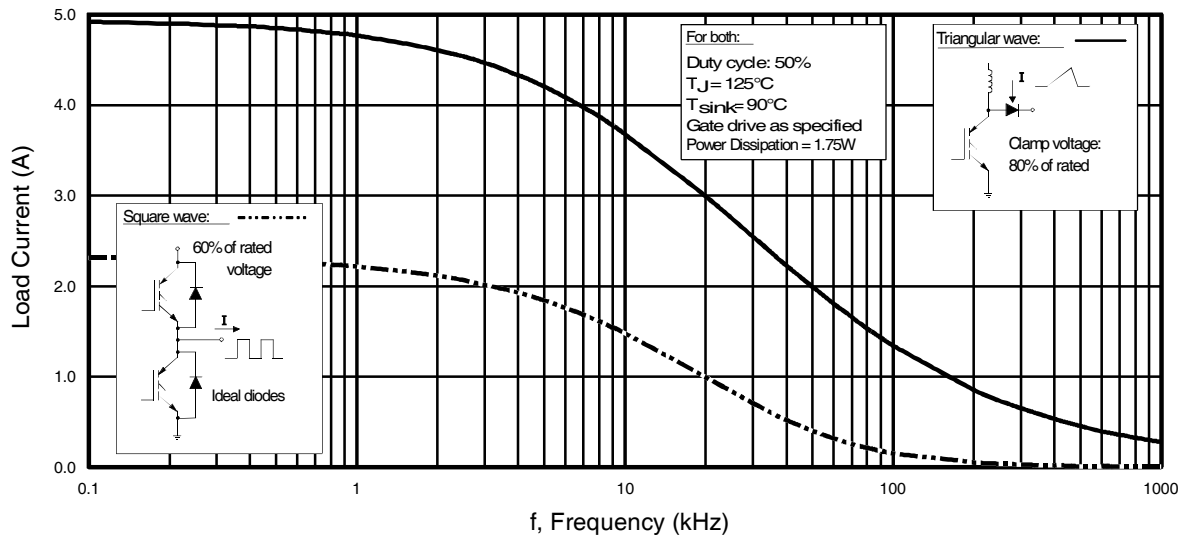
|              | Parameter                         | Min. | Typ. | Max. | Units | Conditions                     |
|--------------|-----------------------------------|------|------|------|-------|--------------------------------|
| $Q_g$        | Total Gate Charge (turn-on)       | —    | 51   | 76   | nC    | $I_C = 12A$                    |
| $Q_{ge}$     | Gate - Emitter Charge (turn-on)   | —    | 7.6  | 11   |       | $V_{CC} = 400V$                |
| $Q_{gc}$     | Gate - Collector Charge (turn-on) | —    | 18   | 27   |       | $V_{GE} = 15V$                 |
| $t_{d(on)}$  | Turn-On Delay Time                | —    | 25   | —    | ns    | $T_J = 25^\circ\text{C}$       |
| $t_r$        | Rise Time                         | —    | 16   | —    |       | $I_C = 12A, V_{CC} = 480V$     |
| $t_{d(off)}$ | Turn-Off Delay Time               | —    | 99   | 150  |       | $V_{GE} = 15V, R_G = 23\Omega$ |
| $t_f$        | Fall Time                         | —    | 67   | 100  |       | Energy losses include "tail"   |
| $E_{on}$     | Turn-On Switching Loss            | —    | 0.13 | —    | mJ    | See Fig. 9, 10, 13, 14         |
| $E_{off}$    | Turn-Off Switching Loss           | —    | 0.13 | —    |       |                                |
| $E_{ts}$     | Total Switching Loss              | —    | 0.26 | 0.35 |       |                                |
| $t_{d(on)}$  | Turn-On Delay Time                | —    | 24   | —    | ns    | $T_J = 150^\circ\text{C},$     |
| $t_r$        | Rise Time                         | —    | 17   | —    |       | $I_C = 12A, V_{CC} = 480V$     |
| $t_{d(off)}$ | Turn-Off Delay Time               | —    | 150  | —    |       | $V_{GE} = 15V, R_G = 23\Omega$ |
| $t_f$        | Fall Time                         | —    | 150  | —    |       | Energy losses include "tail"   |
| $E_{ts}$     | Total Switching Loss              | —    | 0.55 | —    | mJ    | See Fig. 11,13, 14             |
| $L_E$        | Internal Emitter Inductance       | —    | 7.5  | —    | nH    | Measured 5mm from package      |
| $C_{ies}$    | Input Capacitance                 | —    | 980  | —    | pF    | $V_{GE} = 0V$                  |
| $C_{oes}$    | Output Capacitance                | —    | 71   | —    |       | $V_{CC} = 30V$                 |
| $C_{res}$    | Reverse Transfer Capacitance      | —    | 18   | —    |       | $f = 1.0MHz$                   |

### Notes:

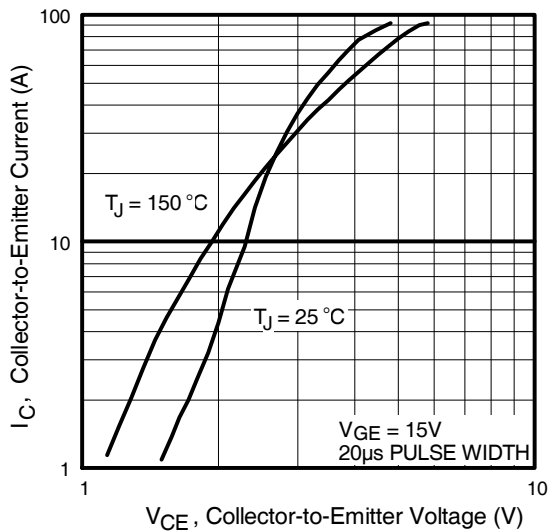
- ① Repetitive rating;  $V_{GE} = 20V$ , pulse width limited by max. junction temperature. ( See fig. 13b )
- ②  $V_{CC} = 80\%(V_{CES}), V_{GE} = 20V, L = 10\mu H, R_G = 23\Omega$ , (See fig. 13a)
- ③ Repetitive rating; pulse width limited by maximum junction temperature.

- ④ Pulse width  $\leq 80\mu s$ ; duty factor  $\leq 0.1\%$ .

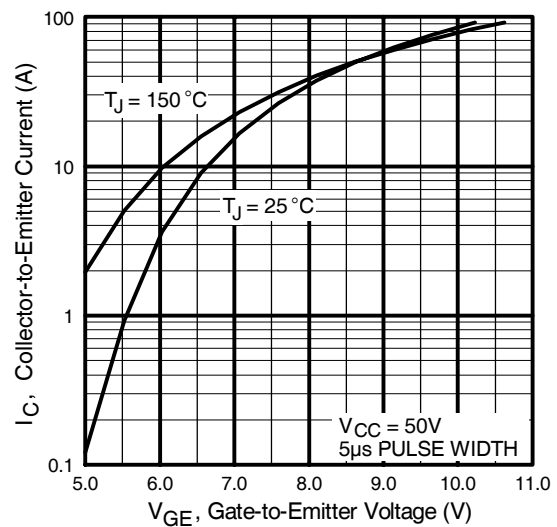
- ⑤ Pulse width  $5.0\mu s$ , single shot.



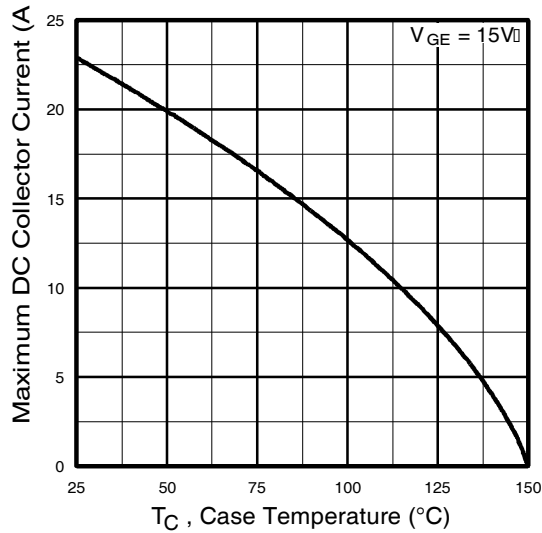
**Fig. 1 - Typical Load Current vs. Frequency**  
(For square wave,  $I = I_{\text{RMS}}$  of fundamental; for triangular wave,  $I = I_{\text{PK}}$ )



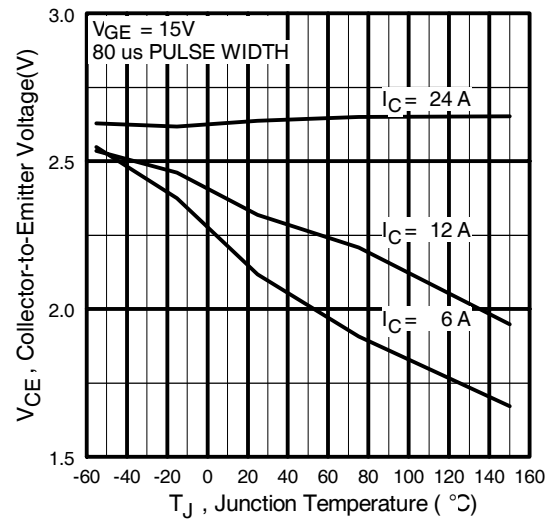
**Fig. 2 - Typical Output Characteristics**



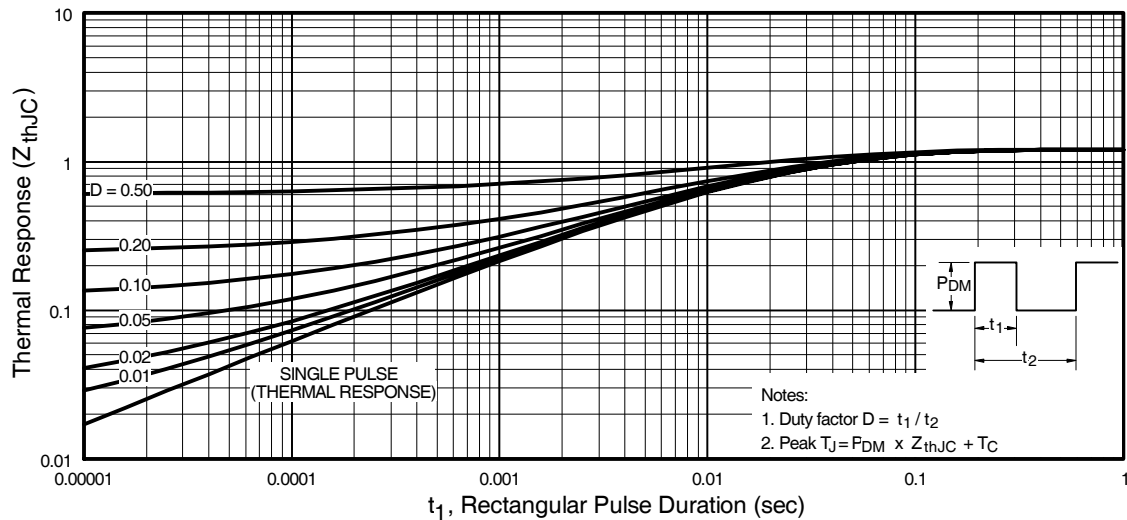
**Fig. 3 - Typical Transfer Characteristics**



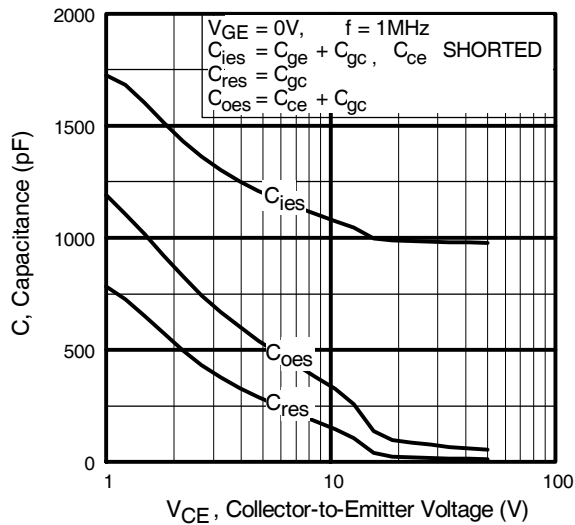
**Fig. 4** - Maximum Collector Current vs. Case Temperature



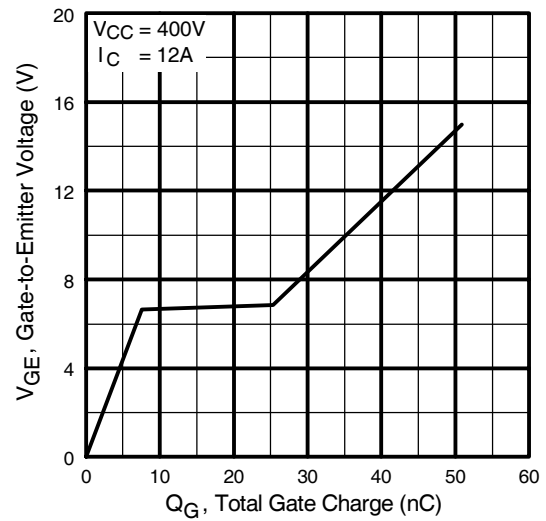
**Fig. 5** - Collector-to-Emitter Voltage vs. Junction Temperature



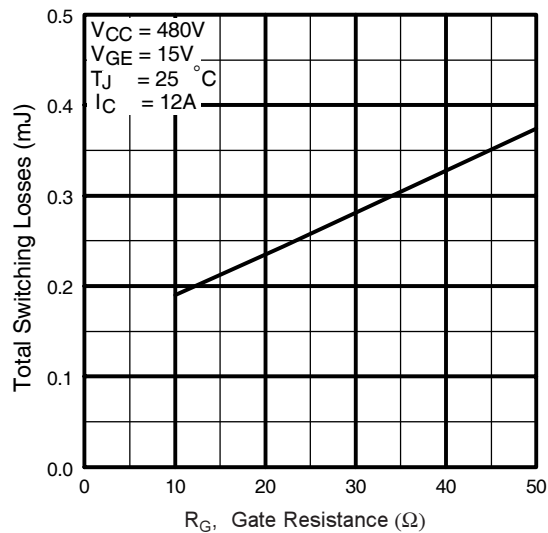
**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case



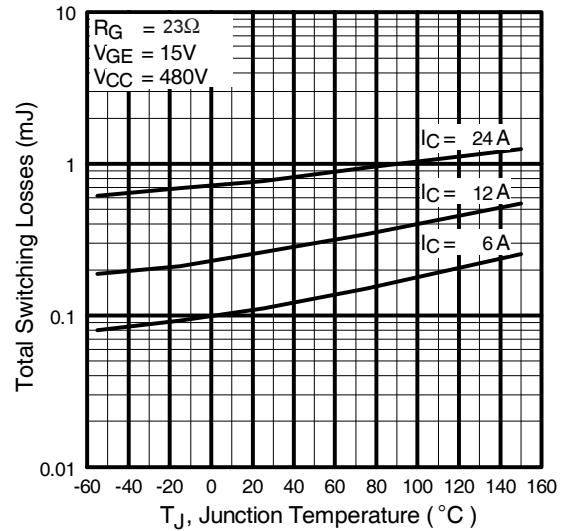
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



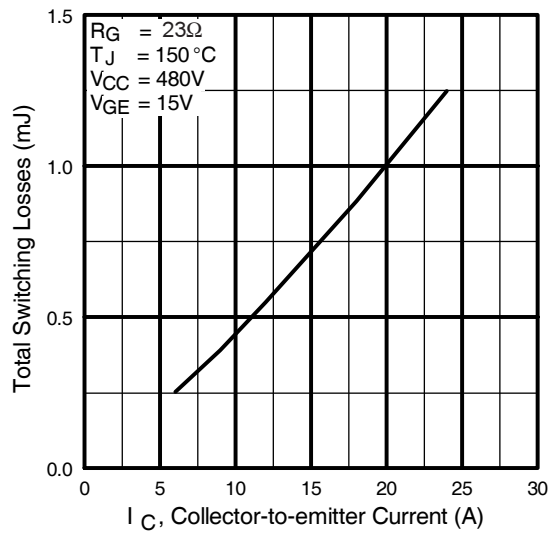
**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage



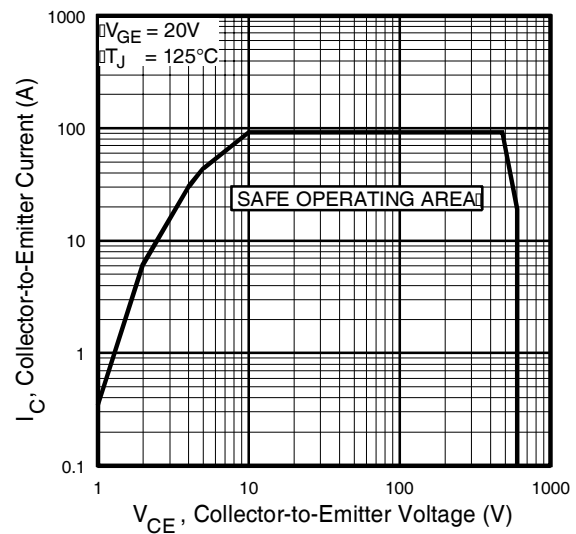
**Fig. 9** - Typical Switching Losses vs. Gate Resistance



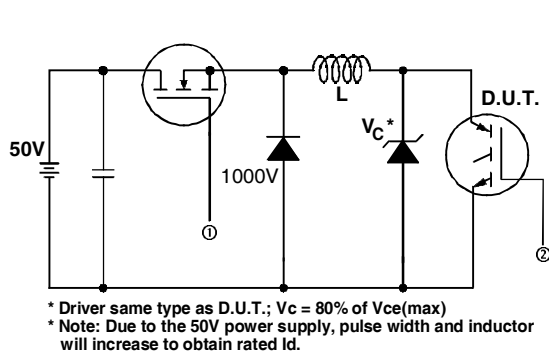
**Fig. 10** - Typical Switching Losses vs. Junction Temperature



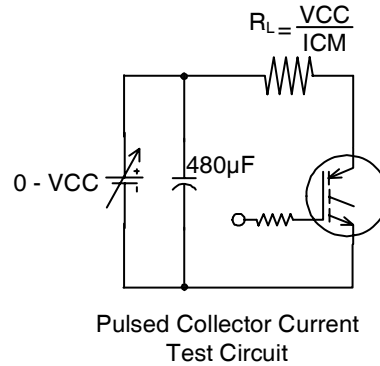
**Fig. 11** - Typical Switching Losses vs. Collector-to-Emitter Current



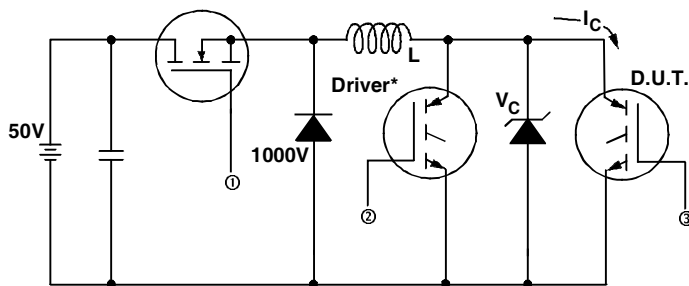
**Fig. 12** - Turn-Off SOA



**Fig. 13a** - Clamped Inductive Load Test Circuit

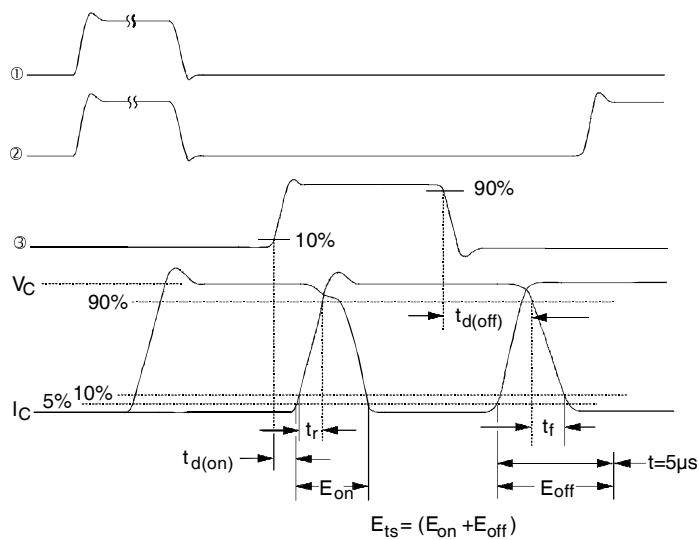


**Fig. 13b** - Pulsed Collector Current Test Circuit



**Fig. 14a** - Switching Loss Test Circuit

\* Driver same type as D.U.T.,  $V_C = 480V$



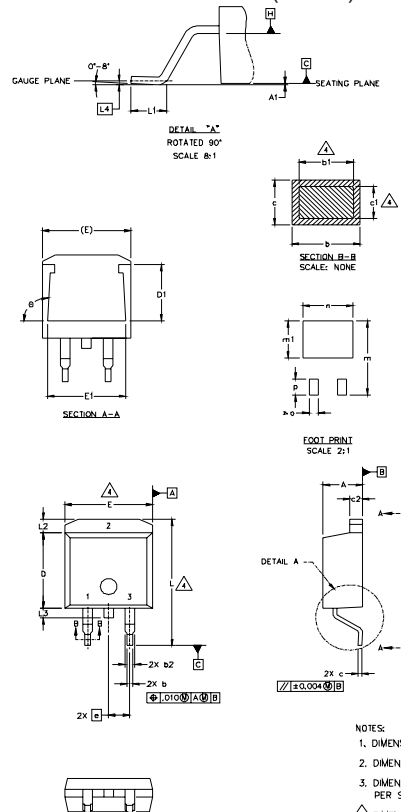
**Fig. 14b** - Switching Loss Waveforms

# IRG4BC30W-SPbF

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

Dimensions are shown in millimeters (inches)

International  
**IR** Rectifier



| SYMBOL | DIMENSIONS  |       |          |      | NOTES |
|--------|-------------|-------|----------|------|-------|
|        | MILLIMETERS |       | INCHES   |      |       |
|        | MIN.        | MAX.  | MIN.     | MAX. |       |
| A      | 4.06        | 4.83  | .160     | .190 | 4     |
| A1     |             | 0.127 |          | .005 |       |
| b      | 0.51        | 0.99  | .020     | .039 |       |
| b1     | 0.51        | 0.89  | .020     | .035 |       |
| b2     | 1.14        | 1.40  | .045     | .055 | 4     |
| c      | 0.43        | 0.63  | .017     | .025 |       |
| c1     | 0.38        | 0.74  | .015     | .029 |       |
| c2     | 1.14        | 1.40  | .045     | .055 |       |
| D      | 8.51        | 9.65  | .335     | .380 | 3     |
| D1     | 5.33        |       | .210     |      | 3     |
| E      | 9.65        | 10.67 | .380     | .420 |       |
| E1     | 6.22        |       | .245     |      |       |
| e      | 2.54 BSC    |       | .100 BSC |      |       |
| L      | 14.61       | 15.88 | .575     | .625 |       |
| L1     | 1.78        | 2.79  | .070     | .110 |       |
| L2     |             | 1.65  |          | .065 |       |
| L3     | 1.27        | 1.78  | .050     | .070 |       |
| L4     | 0.25 BSC    |       | .010 BSC |      |       |
| m      | 17.78       |       | .700     |      |       |
| m1     | 8.89        |       | .350     |      |       |
| n      | 11.43       |       | .450     |      |       |
| o      | 2.08        |       | .082     |      |       |
| p      | 3.81        |       | .150     |      |       |
| θ      | 90°         | 93°   | 90°      | 93°  |       |

### LEAD ASSIGNMENTS

| HEXFET     | IGBTs CoPACK  | DIODES      |
|------------|---------------|-------------|
| 1.- GATE   | 1.- GATE      | 1.- ANODE * |
| 2.- DRAIN  | 2.- COLLECTOR | 2.- CATHODE |
| 3.- SOURCE | 3.- EMITTER   | 3.- ANODE   |

\* PART DEPENDENT.

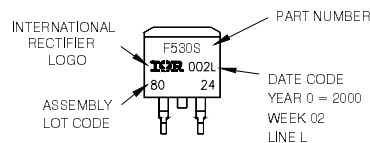
### NOTES:

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.

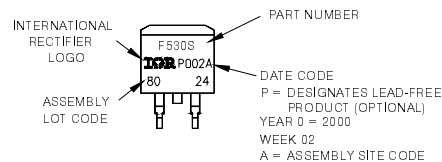
## D<sup>2</sup>Pak Part Marking Information

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**



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

Dimensions are shown in millimeters (inches)



International  
**IOR** Rectifier

Visit us at [www.irf.com](http://www.irf.com) for sales contact information. 02/2010