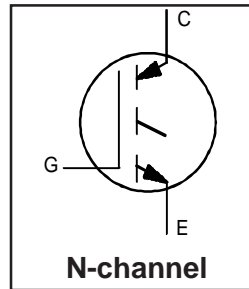


# IRG4BC20W-SPbF

INSULATED GATE BIPOLAR TRANSISTOR

## Features

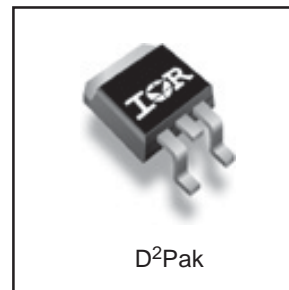
- Designed expressly for Switch-Mode Power Supply and PFC (power factor correction) applications
- Industry-benchmark switching losses improve efficiency of all power supply topologies
- 50% reduction of Eoff parameter
- Low IGBT conduction losses
- Latest-generation IGBT design and construction offers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



|                                   |
|-----------------------------------|
| $V_{CES} = 600V$                  |
| $V_{CE(on)} \text{ typ.} = 2.16V$ |
| @ $V_{GE} = 15V, I_C = 6.5A$      |

## Benefits

- Lower switching losses allow more cost-effective operation than power MOSFETs up to 150kHz ("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 >>300kHz)



## 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                     | 13                                 | A     |
| $I_C @ T_C = 100^\circ C$ | Continuous Collector Current                     | 6.5                                |       |
| $I_{CM}$                  | Pulsed Collector Current ①                       | 52                                 |       |
| $I_{LM}$                  | Clamped Inductive Load Current ②                 | 52                                 |       |
| $V_{GE}$                  | Gate-to-Emitter Voltage                          | $\pm 20$                           | V     |
| $E_{ARV}$                 | Reverse Voltage Avalanche Energy ③               | 200                                | mJ    |
| $P_D @ T_C = 25^\circ C$  | Maximum Power Dissipation                        | 60                                 | W     |
| $P_D @ T_C = 100^\circ C$ | Maximum Power Dissipation                        | 24                                 |       |
| $T_J$<br>$T_{STG}$        | Operating Junction and Storage Temperature Range | -55 to + 150                       | °C    |
|                           | 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                          | —    | 2.1  | °C/W   |
| $R_{\theta CS}$ | Case-to-Sink, Flat, Greased Surface       | 0.5  | —    |        |
| $R_{\theta JA}$ | Junction-to-Ambient, typical socket mount | —    | 40   |        |
| $W_t$           | Weight                                    | 1.44 | —    | g (oz) |

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

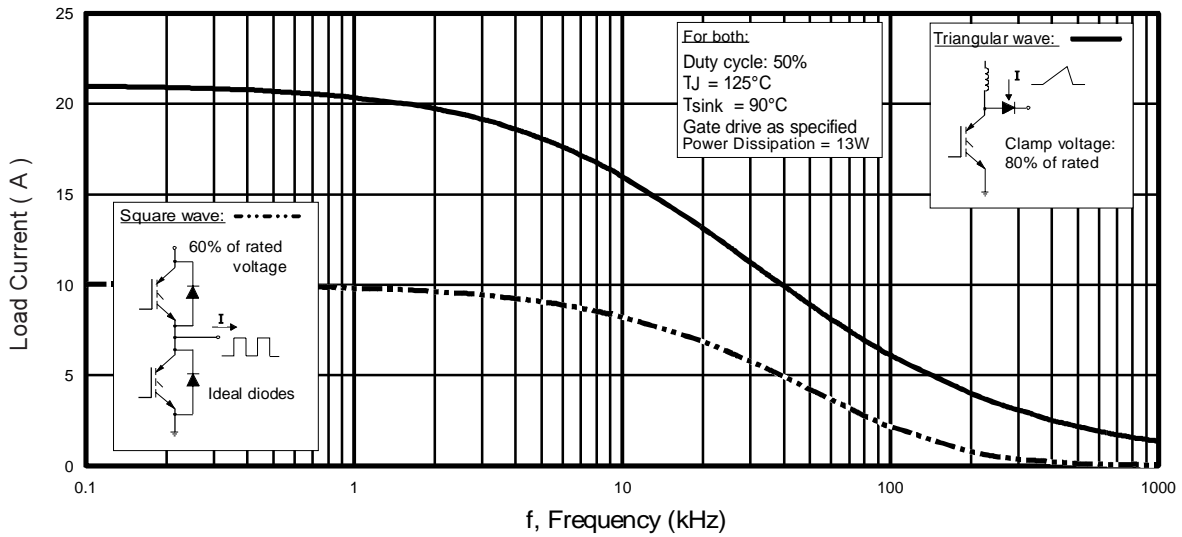
|                                 | Parameter                                | Min. | Typ. | Max.      | Units   | Conditions   |
|---------------------------------|--|------|------|-----------|---------|--|
| $V_{(BR)CES}$                   | Collector-to-Emitter Breakdown Voltage   | 600  | —    | —         | 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  | —    | 0.48 | —         | V/°C    | $V_{GE} = 0V, I_C = 1.0mA$   |
| $V_{CE(ON)}$                    | Collector-to-Emitter Saturation Voltage  | —    | 2.16 | 2.6       | V       | $I_C = 6.5A$<br>$I_C = 13A$<br>$I_C = 6.5A, T_J = 150^\circ\text{C}$<br>$V_{GE} = 15V$<br>See Fig.2, 5 |
|                                 |  | —    | 2.55 | —         |         |  |
|                                 |  | —    | 2.05 | —         |         |  |
| $V_{GE(th)}$                    | 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  | —    | -8.8 | —         | mV/°C   | $V_{CE} = V_{GE}, I_C = 250\mu A$  |
| $g_{fe}$                        | Forward Transconductance ⑤               | 5.5  | 8.3  | —         | S       | $V_{CE} = 100V, I_C = 6.5A$  |
| $I_{CES}$                       | 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)

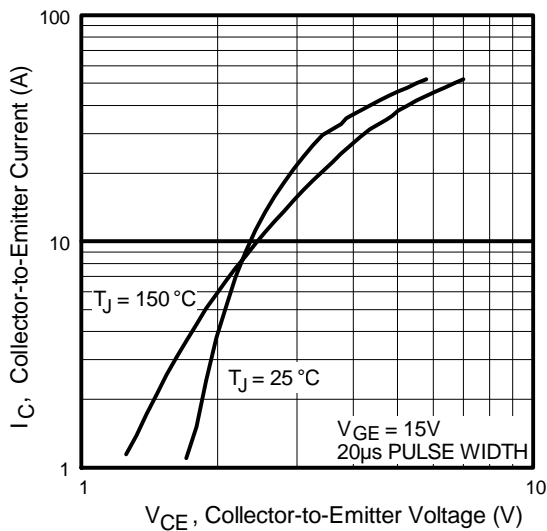
|              | Parameter                         | Min. | Typ. | Max. | Units | Conditions  |
|--------------|-----------------------------------|------|------|------|-------|---|
| $Q_g$        | Total Gate Charge (turn-on)       | —    | 26   | 38   | nC    | $I_C = 6.5A$<br>$V_{CC} = 400V$<br>$V_{GE} = 15V$<br>See Fig.8  |
| $Q_{ge}$     | Gate - Emitter Charge (turn-on)   | —    | 3.7  | 5.5  |       |   |
| $Q_{gc}$     | Gate - Collector Charge (turn-on) | —    | 10   | 15   |       |   |
| $t_{d(on)}$  | Turn-On Delay Time                | —    | 22   | —    | ns    | $T_J = 25^\circ\text{C}$<br>$I_C = 6.5A, V_{CC} = 480V$<br>$V_{GE} = 15V, R_G = 50\Omega$<br>Energy losses include "tail"<br>See Fig. 9, 10, 14     |
| $t_r$        | Rise Time                         | —    | 14   | —    |       |   |
| $t_{d(off)}$ | Turn-Off Delay Time               | —    | 110  | 160  |       |   |
| $t_f$        | Fall Time                         | —    | 64   | 96   |       |   |
| $E_{on}$     | Turn-On Switching Loss            | —    | 0.06 | —    | mJ    | See Fig. 9, 10, 14  |
| $E_{off}$    | Turn-Off Switching Loss           | —    | 0.08 | —    |       |   |
| $E_{ts}$     | Total Switching Loss              | —    | 0.14 | 0.2  |       |   |
| $t_{d(on)}$  | Turn-On Delay Time                | —    | 21   | —    | ns    | $T_J = 150^\circ\text{C}$ ,<br>$I_C = 6.5A, V_{CC} = 480V$<br>$V_{GE} = 15V, R_G = 50\Omega$<br>Energy losses include "tail"<br>See Fig. 10, 11, 14 |
| $t_r$        | Rise Time                         | —    | 15   | —    |       |   |
| $t_{d(off)}$ | Turn-Off Delay Time               | —    | 150  | —    |       |   |
| $t_f$        | Fall Time                         | —    | 150  | —    |       |   |
| $E_{ts}$     | Total Switching Loss              | —    | 0.34 | —    | mJ    |   |
| $L_E$        | Internal Emitter Inductance       | —    | 7.5  | —    | nH    | Measured 5mm from package   |
| $C_{ies}$    | Input Capacitance                 | —    | 490  | —    | pF    | $V_{GE} = 0V$<br>$V_{CC} = 30V$<br>$f = 1.0MHz$<br>See Fig. 7   |
| $C_{oes}$    | Output Capacitance                | —    | 38   | —    |       |   |
| $C_{res}$    | Reverse Transfer Capacitance      | —    | 8.8  | —    |       |   |

### Notes:

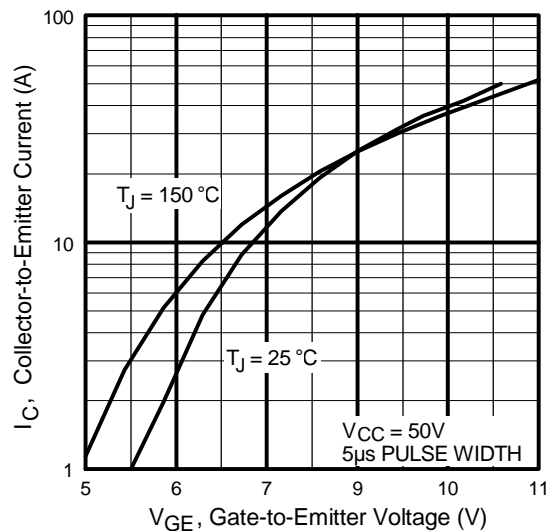
- ① Repetitive rating;  $V_{GE} = 20V$ , pulse width limited by max. junction temperature. (See Fig. 13b)
- ②  $V_{CC} = 80\%(V_{CES})$ ,  $V_{GE} = 20V$ ,  $L = 10\mu H$ ,  $R_G = 50\Omega$ , (See Fig. 13a)
- ③ Repetitive rating; pulse width limited by maximum junction temperature.
- ④ Pulse width  $\leq 80\mu s$ ; duty factor  $\leq 0.1\%$ .
- ⑤ Pulse width  $5.0\mu s$ , single shot.



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

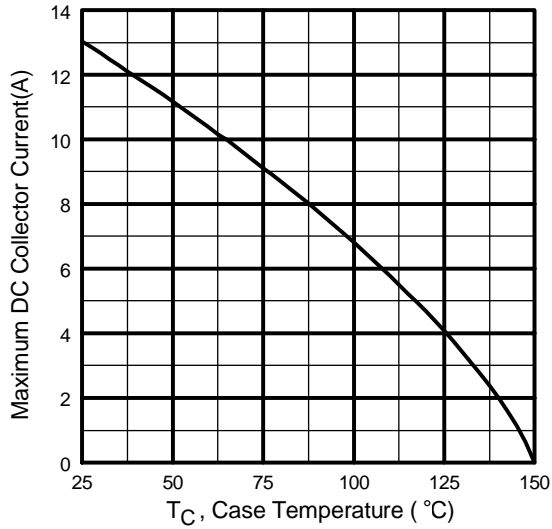


**Fig. 2** - Typical Output Characteristics

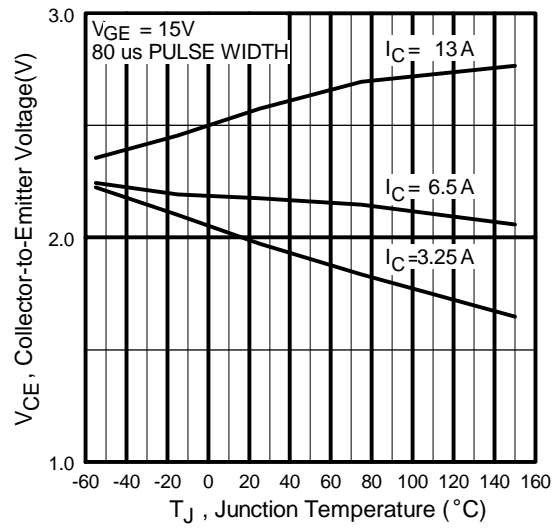


**Fig. 3** - Typical Transfer Characteristics

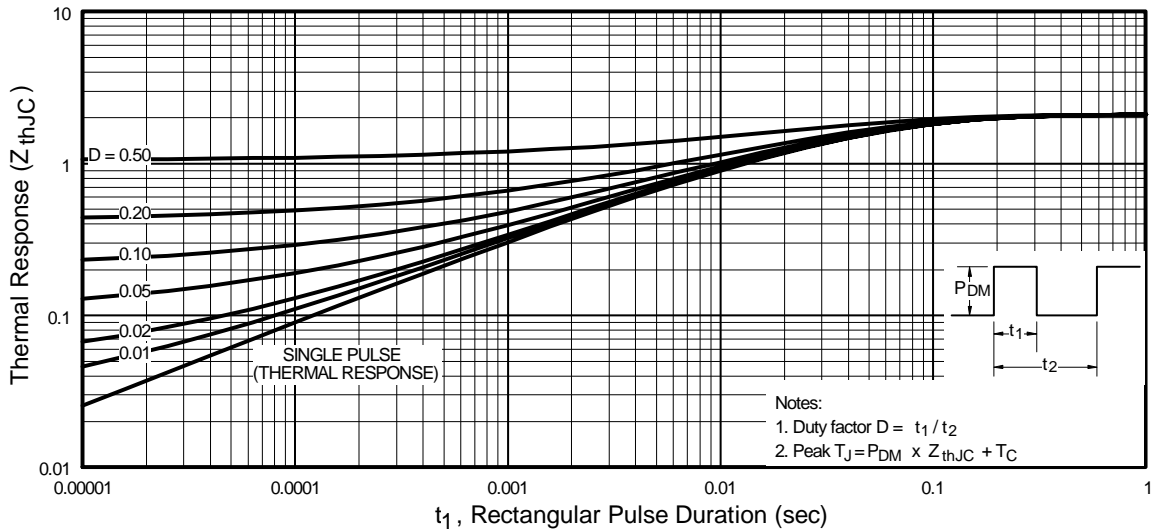
# IRG4BC20W-SPbF



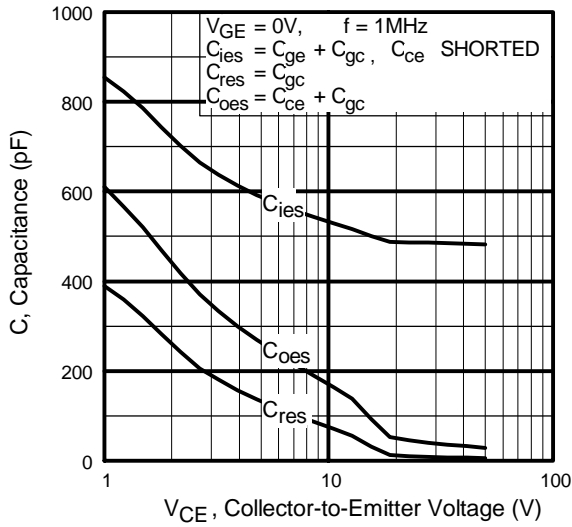
**Fig. 4** - Maximum Collector Current vs. Case Temperature



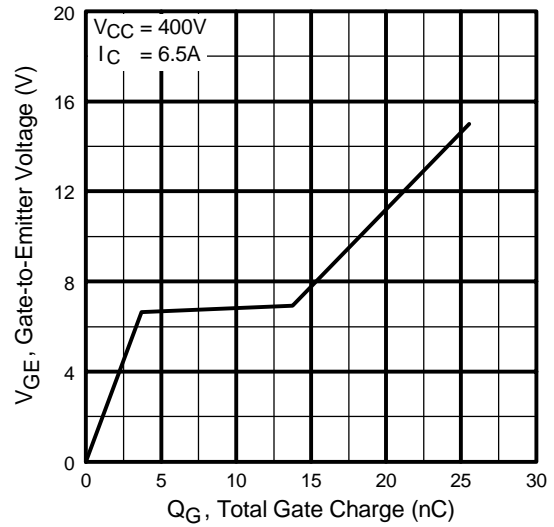
**Fig. 5** - Typical Collector-to-Emitter Voltage vs. Junction Temperature



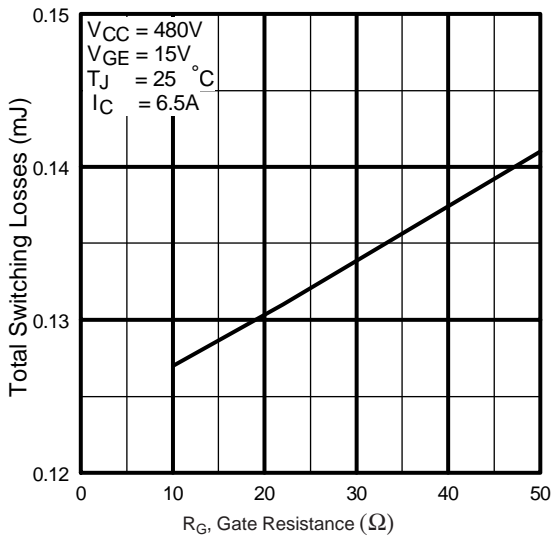
**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case



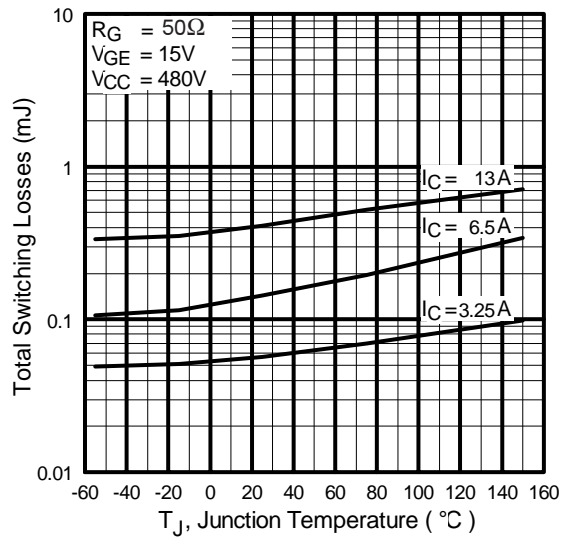
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



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

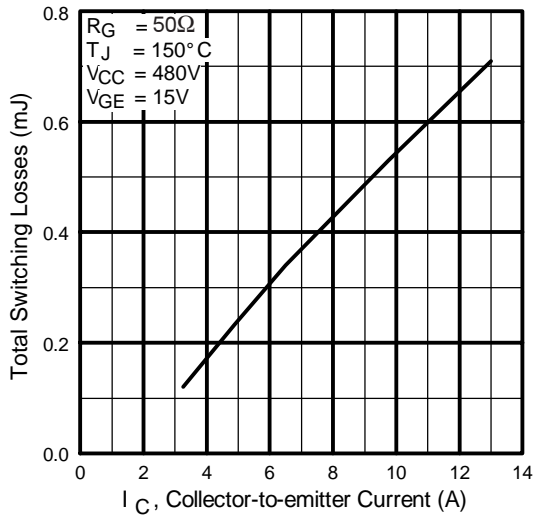


**Fig. 9** - Typical Switching Losses vs. Gate Resistance

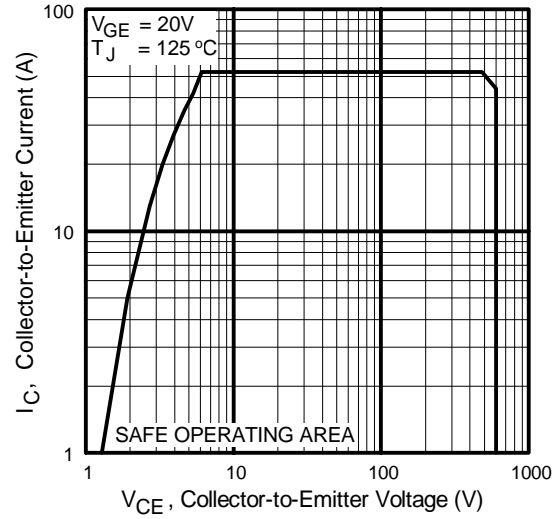


**Fig. 10** - Typical Switching Losses vs. Junction Temperature

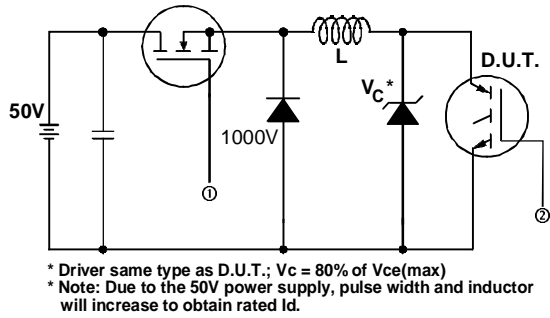
# IRG4BC20W-SPbF



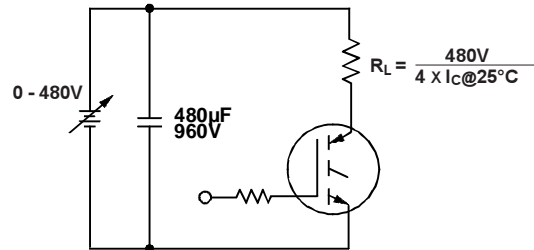
**Fig. 11** - Typical Switching Losses vs. Collector-to-Emitter Current



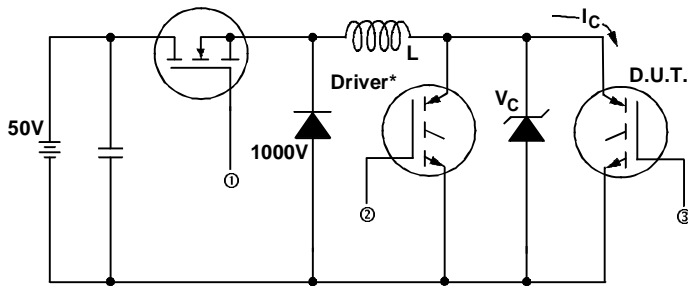
**Fig. 12** - Turn-Off SOA



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

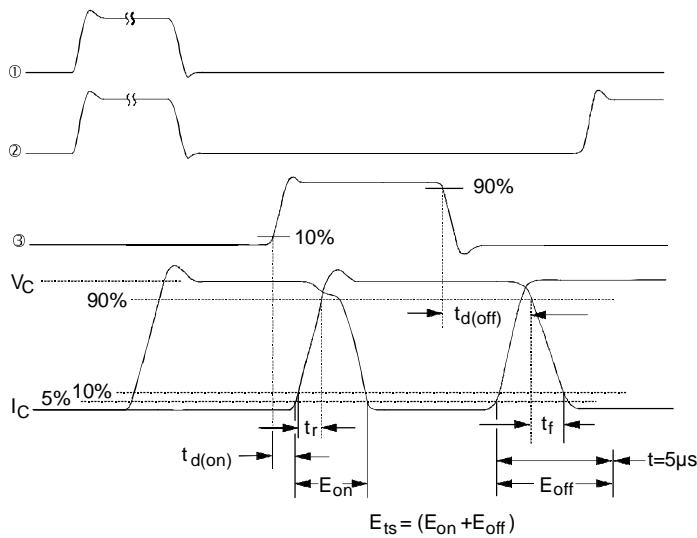


**Fig. 13b** - Pulsed Collector Current Test Circuit



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

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



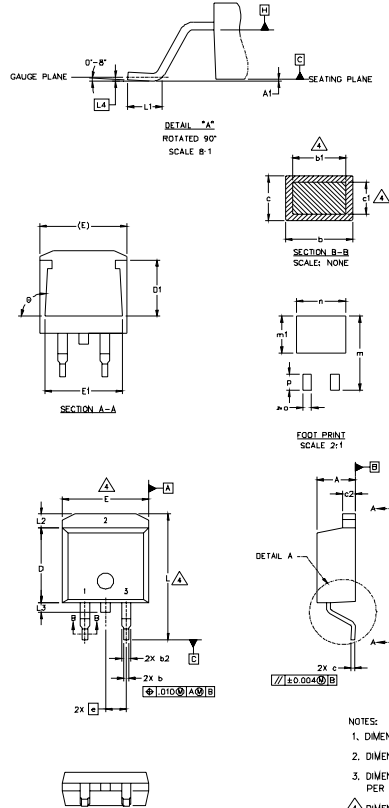
**Fig. 14b** - Switching Loss Waveforms

# IRG4BC20W-SPbF

International  
**IR** Rectifier

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

Dimensions are shown in millimeters (inches)



| SYMBOL | DIMENSIONS  |          |        |          | NOTES |
|--------|-------------|----------|--------|----------|-------|
|        | MILLIMETERS |          | INCHES |          |       |
|        | MIN.        | MAX.     | MIN.   | MAX.     |       |
| A      | 4.06        | 4.83     | .160   | .190     |       |
| A1     |             | 0.127    |        | .005     |       |
| b      | 0.51        | 0.99     | .020   | .039     |       |
| b1     | 0.51        | 0.89     | .020   | .035     | 4     |
| b2     | 1.14        | 1.40     | .045   | .055     |       |
| c      | 0.43        | 0.63     | .017   | .025     | 4     |
| 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   |          |       |
| E      | 9.65        | 10.67    | .380   | .420     | 3     |
| 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   |          |       |
| theta  | 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.

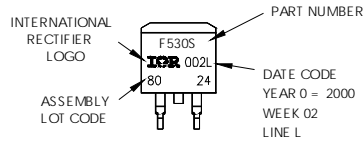
### NOTES:

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.

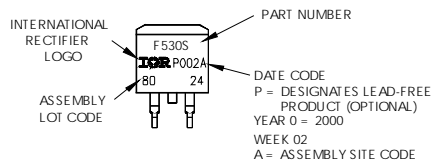
## D<sup>2</sup>Pak Part Marking Information

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"



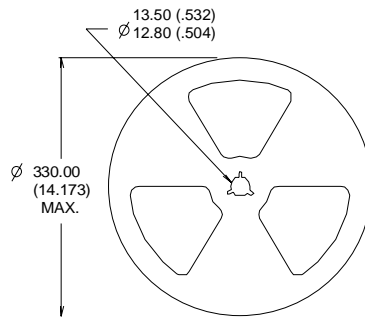
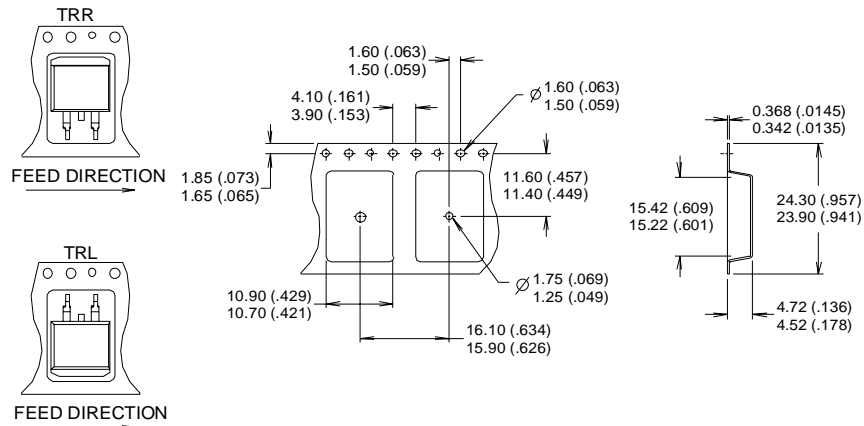
**OR**



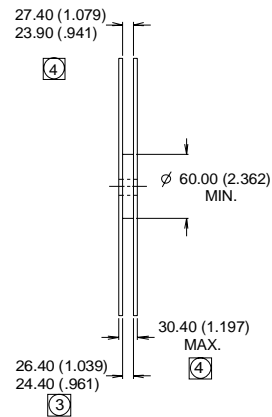


## D<sup>2</sup>Pak Tape & Reel Information

Dimensions are shown in millimeters (inches)



- NOTES:
1. CONFORMS TO EIA-418.
  2. CONTROLLING DIMENSION: MILLIMETER.
  - ③ DIMENSION MEASURED @ HUB.
  - ④ INCLUDES FLANGE DISTORTION @ OUTER EDGE.



Data and specifications subject to change without notice.  
 This product has been designed and qualified for the Industrial market.  
 Qualification Standards can be found on IR's Web site.

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