International
IOR Rectifier

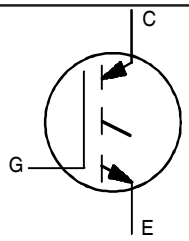
PD - 95782A

# 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




**N-channel**

$V_{CES}$ = 600V

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



D$^2$Pak

## Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $V_{CES}$ | Collector-to-Emitter Breakdown Voltage | 600 | V |
| $I_C$ @ $T_C$ = 25°C | Continuous Collector Current | 13 | A |
| $I_C$ @ $T_C$ = 100°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 | ± 20 | V |
| $E_{ARV}$ | Reverse Voltage Avalanche Energy ③ | 200 | mJ |
| $P_D$ @ $T_C$ = 25°C | Maximum Power Dissipation | 60 | W |
| $P_D$ @ $T_C$ = 100°C | Maximum Power Dissipation | 24 | |
| $T_J$<br>$T_{STG}$ | Operating Junction and<br>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 | |
| Wt | Weight | 1.44 | — | g (oz) |

## Electrical Characteristics @ $T_J$ = 25°C (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)CES}$ | Collector-to-Emitter Breakdown Voltage | 600 | — | — | V | $V_{GE}$ = 0V, $I_C$ = 250µA |
| $V_{(BR)ECS}$ | 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 $V_{GE}$ = 15V |
| | | — | 2.55 | — | | $I_C$ = 13A See Fig.2, 5 |
| | | — | 2.05 | — | | $I_C$ = 6.5A , $T_J$ = 150°C |
| $V_{GE(th)}$ | Gate Threshold Voltage | 3.0 | — | 6.0 | | $V_{CE}$ = $V_{GE}$, $I_C$ = 250µA |
| $\Delta V_{GE(th)}/\Delta T_J$ | Temperature Coeff. of Threshold Voltage | — | -8.8 | — | mV/°C | $V_{CE}$ = $V_{GE}$, $I_C$ = 250µA |
| $g_{fe}$ | Forward Transconductance ⑤ | 5.5 | 8.3 | — | S | $V_{CE}$ = 100 V, $I_C$ = 6.5A |
| $I_{CES}$ | Zero Gate Voltage Collector Current | — | — | 250 | µA | $V_{GE}$ = 0V, $V_{CE}$ = 600V |
| | | — | — | 2.0 | | $V_{GE}$ = 0V, $V_{CE}$ = 10V, $T_J$ = 25°C |
| | | — | — | 1000 | | $V_{GE}$ = 0V, $V_{CE}$ = 600V, $T_J$ = 150°C |
| $I_{GES}$ | Gate-to-Emitter Leakage Current | — | — | ±100 | nA | $V_{GE}$ = ±20V |

## Switching Characteristics @ $T_J$ = 25°C (unless otherwise specified)

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $Q_g$ | Total Gate Charge (turn-on) | — | 26 | 38 | nC | $I_C$ = 6.5A |
| $Q_{ge}$ | Gate - Emitter Charge (turn-on) | — | 3.7 | 5.5 | | $V_{CC}$ = 400V See Fig.8 |
| $Q_{gc}$ | Gate - Collector Charge (turn-on) | — | 10 | 15 | | $V_{GE}$ = 15V |
| $t_{d(on)}$ | Turn-On Delay Time | — | 22 | — | ns | |
| $t_r$ | Rise Time | — | 14 | — | | $T_J$ = 25°C |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 110 | 160 | | $I_C$ = 6.5A, $V_{CC}$ = 480V |
| $t_f$ | Fall Time | — | 64 | 96 | | $V_{GE}$ = 15V, $R_G$ = 50Ω |
| $E_{on}$ | Turn-On Switching Loss | — | 0.06 | — | mJ | Energy losses include "tail" |
| $E_{off}$ | Turn-Off Switching Loss | — | 0.08 | — | | See Fig. 9, 10, 14 |
| $E_{ts}$ | Total Switching Loss | — | 0.14 | 0.2 | | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 21 | — | ns | $T_J$ = 150°C, |
| $t_r$ | Rise Time | — | 15 | — | | $I_C$ = 6.5A, $V_{CC}$ = 480V |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 150 | — | | $V_{GE}$ = 15V, $R_G$ = 50Ω |
| $t_f$ | Fall Time | — | 150 | — | | Energy losses include "tail" |
| $E_{ts}$ | Total Switching Loss | — | 0.34 | — | mJ | See Fig. 10, 11, 14 |
| $L_E$ | Internal Emitter Inductance | — | 7.5 | — | nH | Measured 5mm from package |
| $C_{ies}$ | Input Capacitance | — | 490 | — | pF | $V_{GE}$ = 0V |
| $C_{oes}$ | Output Capacitance | — | 38 | — | | $V_{CC}$ = 30V See Fig. 7 |
| $C_{res}$ | Reverse Transfer Capacitance | — | 8.8 | — | | $f$ = 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 = 10µH, $R_G$ = 50Ω, (See Fig. 13a)

③ Repetitive rating; pulse width limited by maximum junction temperature.

④ Pulse width ≤ 80µs; duty factor ≤ 0.1%.

⑤ Pulse width 5.0µs, single shot.

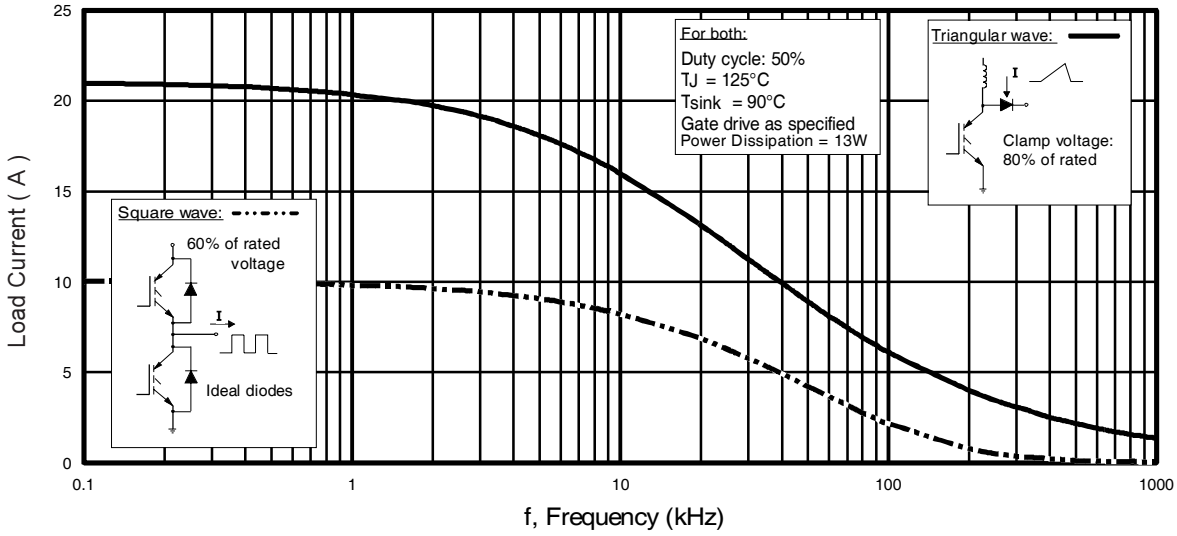



**Fig. 1** - Typical Load Current vs. Frequency
(Load Current = $I_{RMS}$ of fundamental)

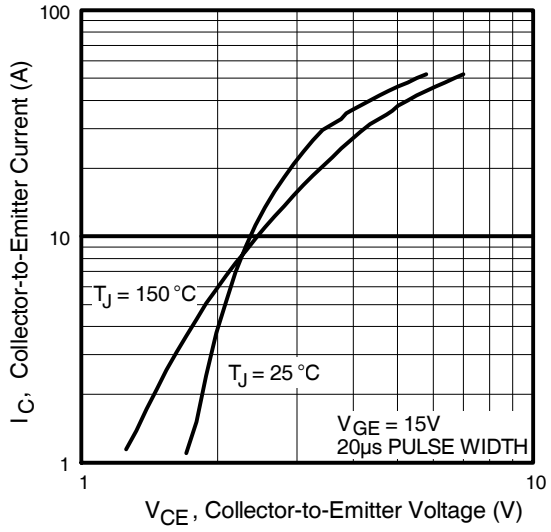



**Fig. 2** - Typical Output Characteristics

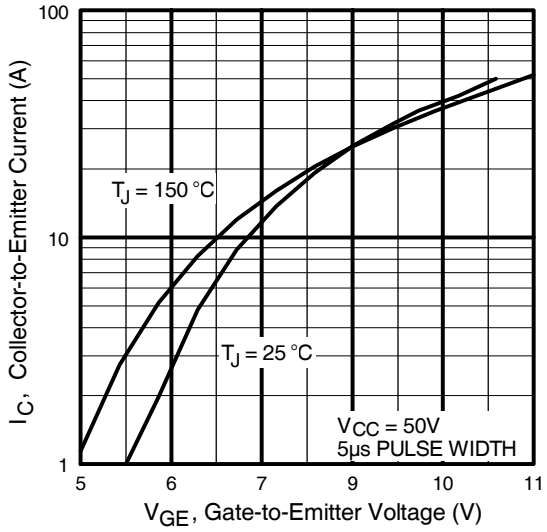



**Fig. 3** - Typical Transfer Characteristics

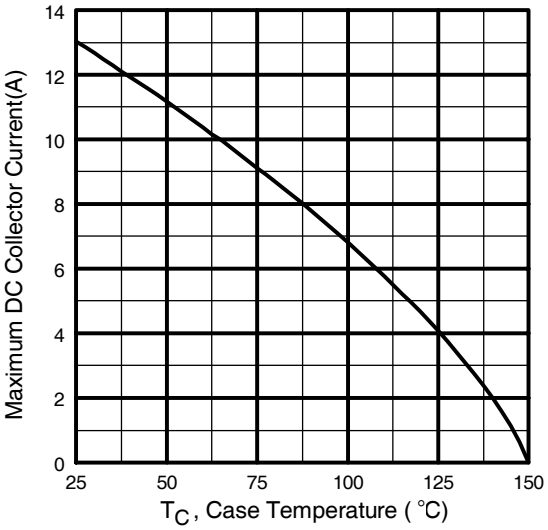



**Fig. 4** - Maximum Collector Current vs. Case Temperature

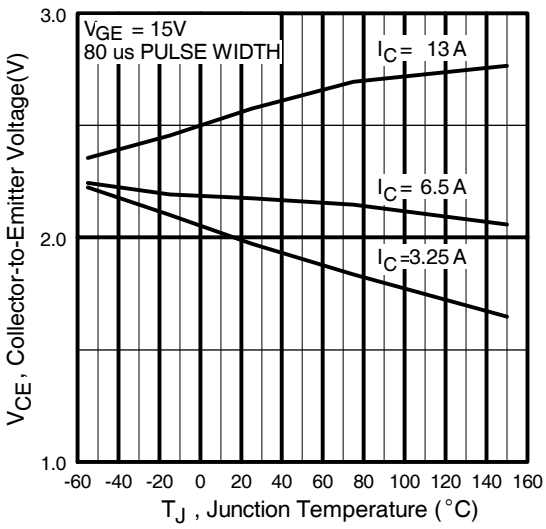



**Fig. 5** - Typical Collector-to-Emitter Voltage vs. Junction Temperature

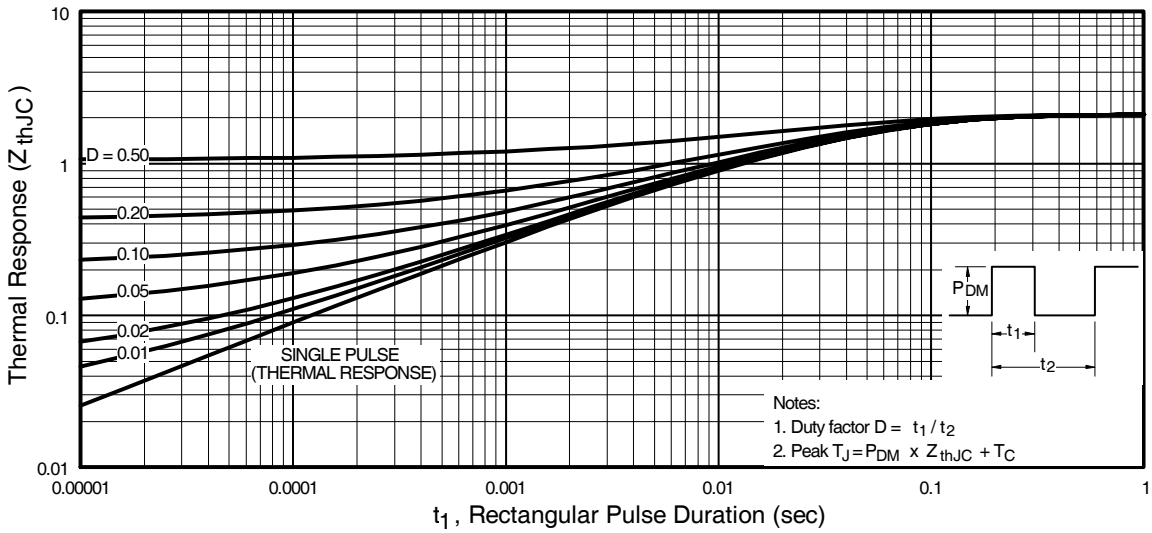



**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case

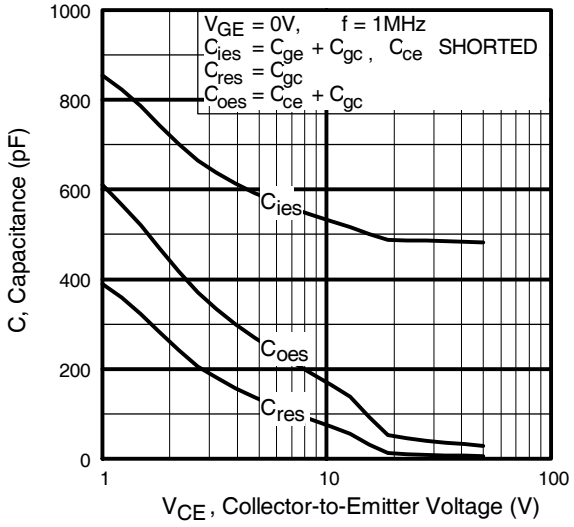



**Fig. 7 -** Typical Capacitance vs. Collector-to-Emitter Voltage

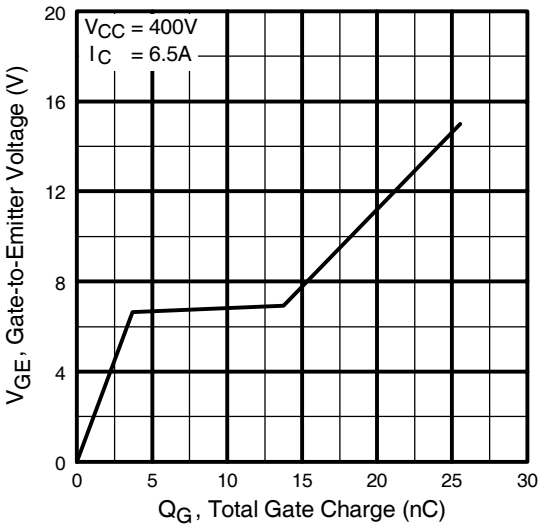



**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage

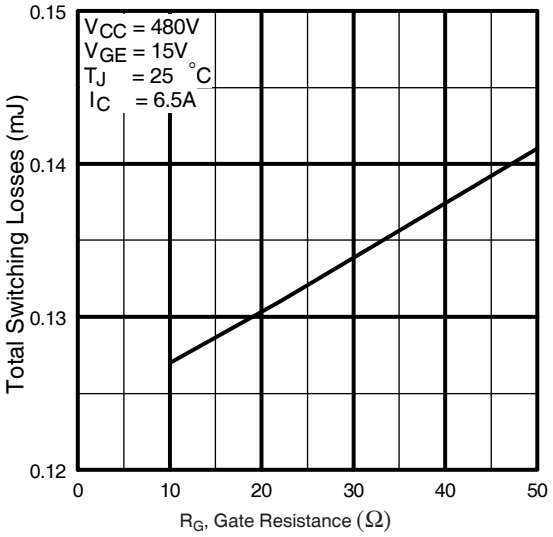



**Fig. 9** - Typical Switching Losses vs. Gate Resistance

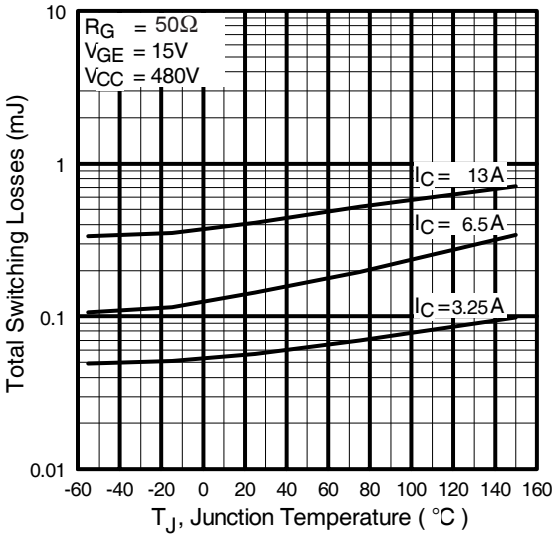



**Fig. 10** - Typical Switching Losses vs. Junction Temperature

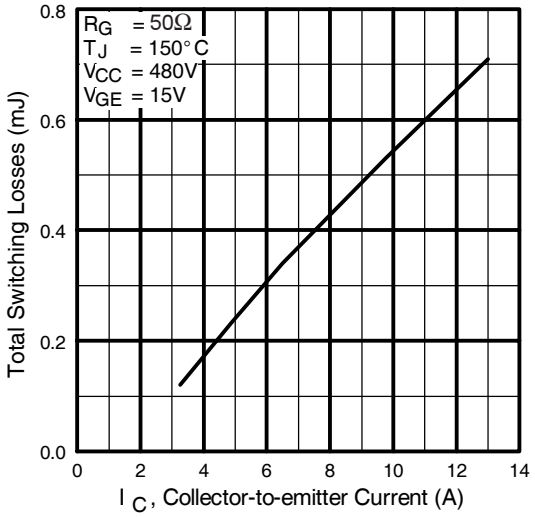



**Fig. 11 -** Typical Switching Losses vs. Collector-to-Emitter Current

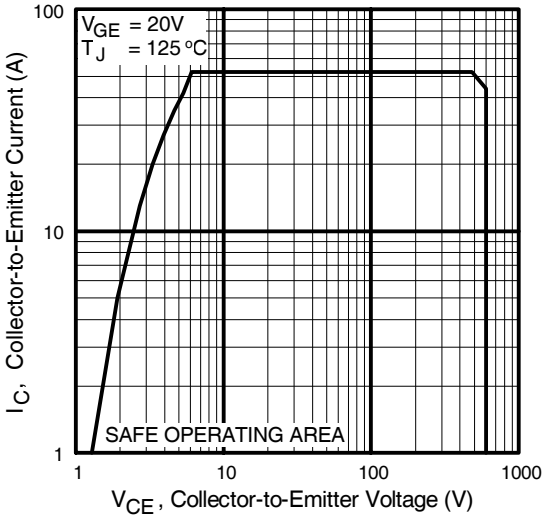



**Fig. 12** - Turn-Off SOA

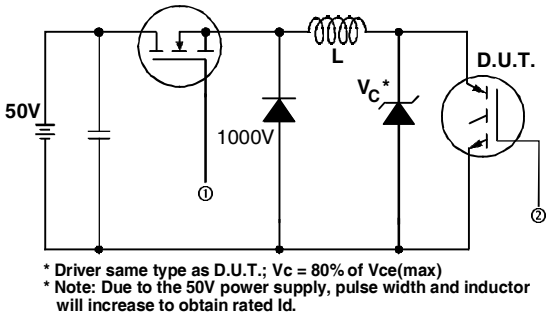
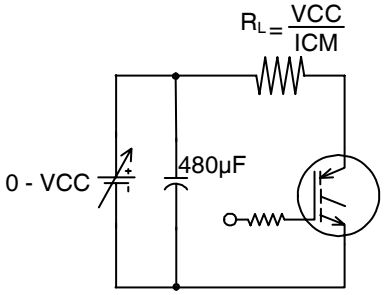



**Fig. 13a** - Clamped Inductive Load Test Circuit




Pulsed Collector Current Test Circuit

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

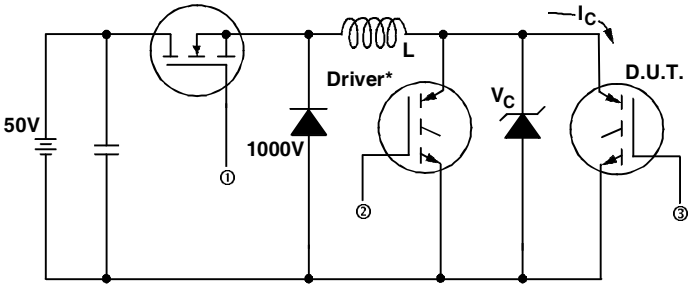



**Fig. 14a** - Switching Loss Test Circuit

*** Driver same type as D.U.T., VC = 480V**

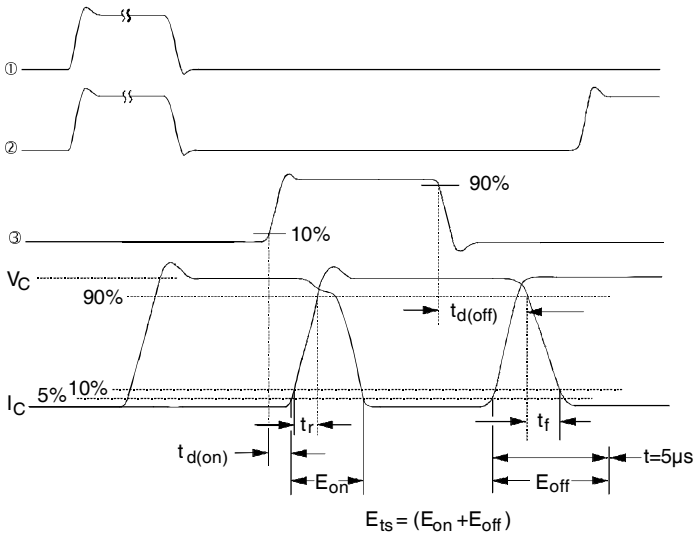
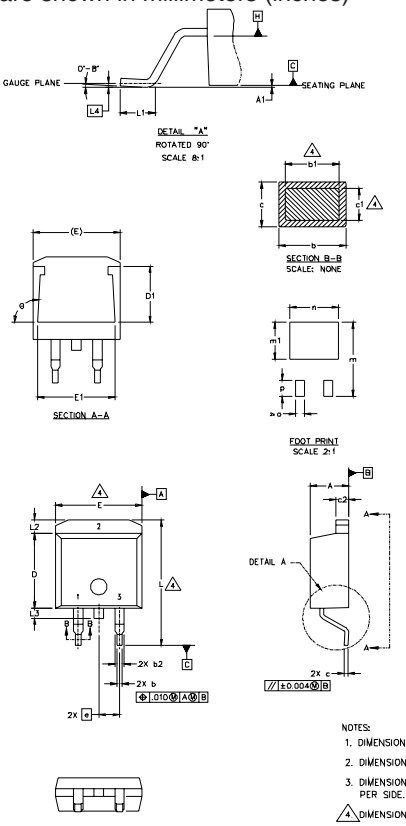



**Fig. 14b** - Switching Loss Waveforms

## D²Pak 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 | |
| c1 | 0.38 | 0.74 | .015 | .029 | 4 |
| 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 | | |
| 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 |

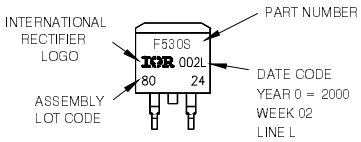
* PART DEPENDENT.

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 [.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.

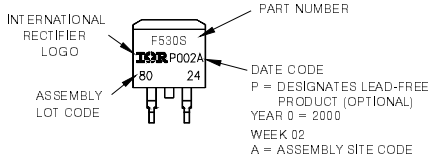
## D²Pak Part Marking Information

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"



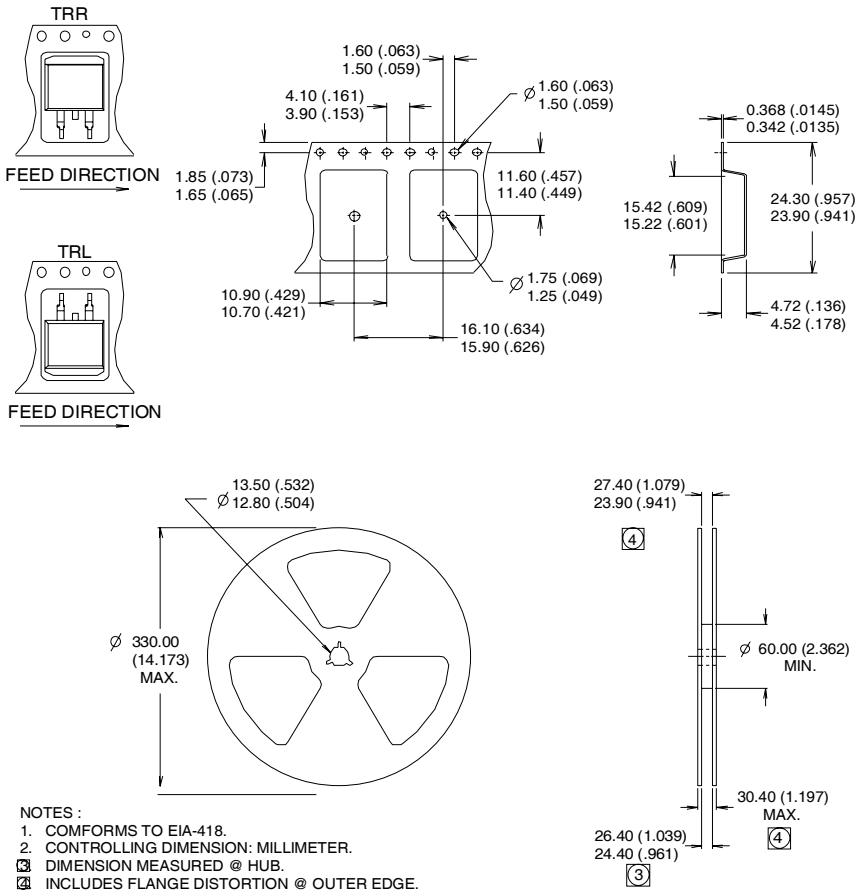

OR




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

## D²Pak Tape & Reel Information

Dimensions are shown in millimeters (inches)




NOTES :
1. COMFORMS 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.

International
IOR Rectifier

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