International Rectifier

PD- 95765A

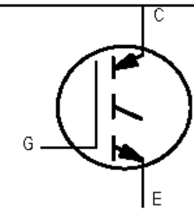
# IRG4BH20K-LPbF

INSULATED GATE BIPOLAR TRANSISTOR

Short Circuit Rated
UltraFast IGBT

## Features

- High short circuit rating optimized for motor control, $t_{sc}$ =10µs, $V_{CC}$ = 720V , $T_J$ = 125°C, $V_{GE}$ = 15V
- Combines low conduction losses with high switching speed
- Latest generation design provides tighter parameter distribution and higher efficiency than previous generations
- Industry standard TO-262 package
- Lead-Free




**n-channel**

$V_{CES}$ = 1200V

$V_{CE(on)\ typ.}$ = 3.17V

**@$V_{GE}$ = 15V, $I_C$ = 5.0A**

## Benefits

- As a Freewheeling Diode we recommend our HEXFRED™ ultrafast, ultrasoft recovery diodes for minimum EMI / Noise and switching losses in the Diode and IGBT
- Latest generation 4 IGBT's offer highest power density motor controls possible

TO-262

## Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $V_{CES}$ | Collector-to-Emitter Voltage | 1200 | V |
| $I_C$ @ $T_C$ = 25°C | Continuous Collector Current | 11 | A |
| $I_C$ @ $T_C$ = 100°C | Continuous Collector Current | 5.0 | |
| $I_{CM}$ | Pulsed Collector Current ① | 22 | |
| $I_{LM}$ | Clamped Inductive Load Current ② | 22 | |
| $t_{sc}$ | Short Circuit Withstand Time | 10 | µs |
| $V_{GE}$ | Gate-to-Emitter Voltage | ±20 | V |
| $E_{ARV}$ | Reverse Voltage Avalanche Energy ③ | 130 | 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 |

## 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 | 0.24 | ––– | |
| $R_{\theta JA}$ | Junction-to-Ambient, typical socket mount | ––– | 40 | |
| Wt | Weight | 6 (0.21) | ––– | g (oz) |



01/21/2010

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

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)CES}$ | Collector-to-Emitter Breakdown Voltage | 1200 | — | — | 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 | — | 1.13 | — | V/°C | $V_{GE}$ = 0V, $I_C$ = 2.5mA |
| $V_{CE(ON)}$ | Collector-to-Emitter Saturation Voltage | — | 3.17 | 4.3 | V | $I_C$ = 5.0A $V_{GE}$ = 15V |
| | | — | 4.04 | — | | $I_C$ = 11A See Fig.2, 5 |
| | | — | 2.84 | — | | $I_C$ = 5.0A , $T_J$ = 150°C |
| $V_{GE(th)}$ | Gate Threshold Voltage | 3.5 | — | 6.5 | | $V_{CE}$ = $V_{GE}$, $I_C$ = 250µA |
| $\Delta V_{GE(th)}/\Delta T_J$ | Temperature Coeff. of Threshold Voltage | — | -10 | — | mV/°C | $V_{CE}$ = $V_{GE}$, $I_C$ = 1mA |
| $g_{fe}$ | Forward Transconductance ⑤ | 2.3 | 3.5 | — | S | $V_{CE}$ = 100 V, $I_C$ = 5.0A |
| $I_{CES}$ | Zero Gate Voltage Collector Current | — | — | 250 | µA | $V_{GE}$ = 0V, $V_{CE}$ = 1200V |
| | | — | — | 2.0 | | $V_{GE}$ = 0V, $V_{CE}$ = 10V, $T_J$ = 25°C |
| | | — | — | 1000 | | $V_{GE}$ = 0V, $V_{CE}$ = 1200V, $T_J$ = 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) | — | 28 | 43 | nC | $I_C$ = 5.0A |
| $Q_{ge}$ | Gate - Emitter Charge (turn-on) | — | 4.4 | 6.6 | | $V_{CC}$ = 400V See Fig.8 |
| $Q_{gc}$ | Gate - Collector Charge (turn-on) | — | 12 | 18 | | $V_{GE}$ = 15V |
| $t_{d(on)}$ | Turn-On Delay Time | — | 23 | — | ns | |
| $t_r$ | Rise Time | — | 26 | — | | $T_J$ = 25°C |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 93 | 140 | | $I_C$ =5.0A, $V_{CC}$ = 960V |
| $t_f$ | Fall Time | — | 270 | 400 | | $V_{GE}$ = 15V, $R_G$ = 50Ω |
| $E_{on}$ | Turn-On Switching Loss | — | 0.45 | — | mJ | Energy losses include "tail" |
| $E_{off}$ | Turn-Off Switching Loss | — | 0.44 | — | | See Fig. 9,10,14 |
| $E_{ts}$ | Total Switching Loss | — | 0.89 | 1.2 | | |
| $t_{sc}$ | Short Circuit Withstand Time | 10 | — | — | µs | $V_{CC}$ = 720V, $T_J$ = 125°C<br>$V_{GE}$ = 15V, $R_G$ = 50Ω |
| $t_{d(on)}$ | Turn-On Delay Time | — | 23 | — | ns | $T_J$ = 150°C, |
| $t_r$ | Rise Time | — | 28 | — | | $I_C$ = 5.0A, $V_{CC}$ = 960V |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 100 | — | | $V_{GE}$ = 15V, $R_G$ = 50Ω |
| $t_f$ | Fall Time | — | 620 | — | | Energy losses include "tail" |
| $E_{ts}$ | Total Switching Loss | — | 1.7 | — | mJ | See Fig. 10,11,14 |
| $L_E$ | Internal Emitter Inductance | — | 7.5 | — | nH | Measured 5mm from package |
| $C_{ies}$ | Input Capacitance | — | 435 | — | pF | $V_{GE}$ = 0V |
| $C_{oes}$ | Output Capacitance | — | 44 | — | | $V_{CC}$ = 30V See Fig. 7 |
| $C_{res}$ | Reverse Transfer Capacitance | — | 8.3 | — | | ƒ = 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.

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

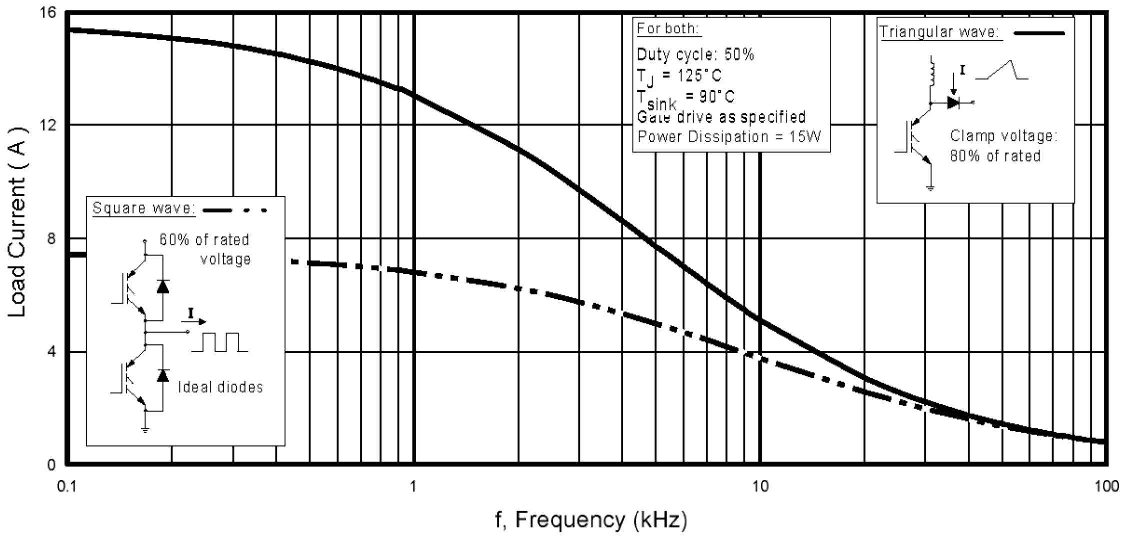



**Fig. 1** - Typical Load Current vs. Frequency
(Load Current = $I_{RMS}$ of fundamental)

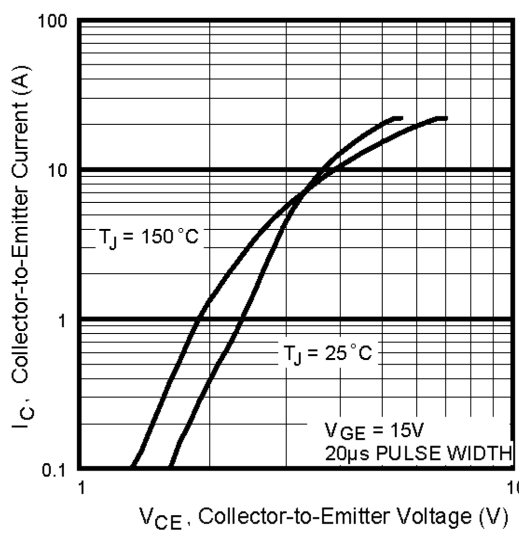



**Fig. 2** - Typical Output Characteristics

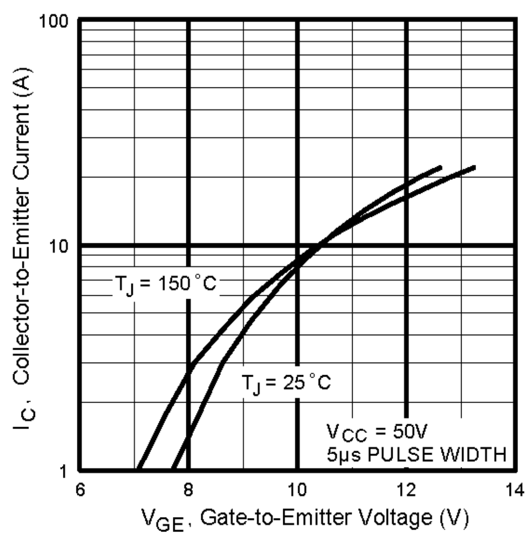



**Fig. 3** - Typical Transfer Characteristics

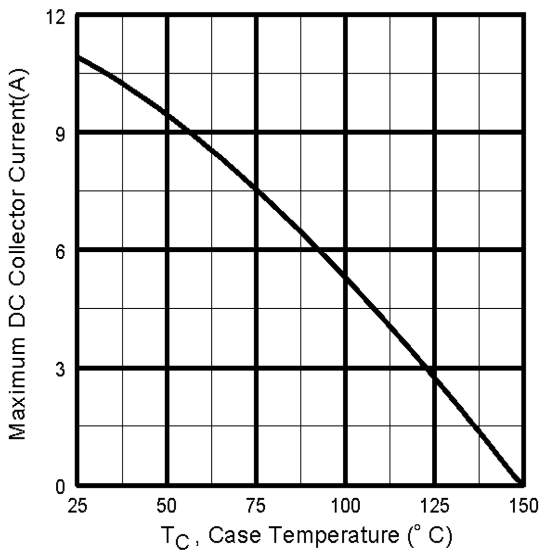



**Fig. 4** - Maximum Collector Current vs. Case Temperature

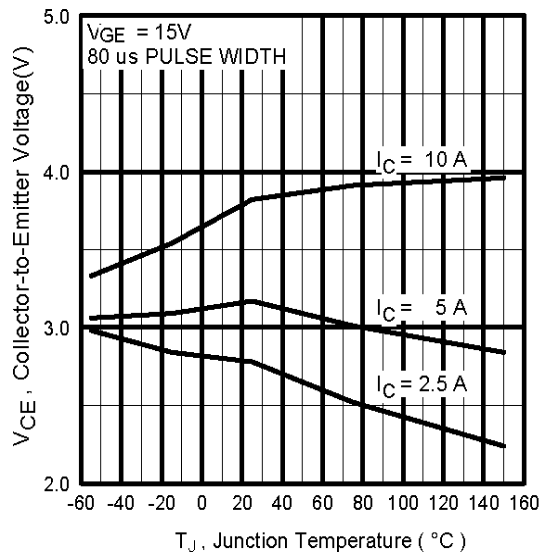



**Fig. 5** - Typical Collector-to-Emitter Voltage vs. Junction Temperature

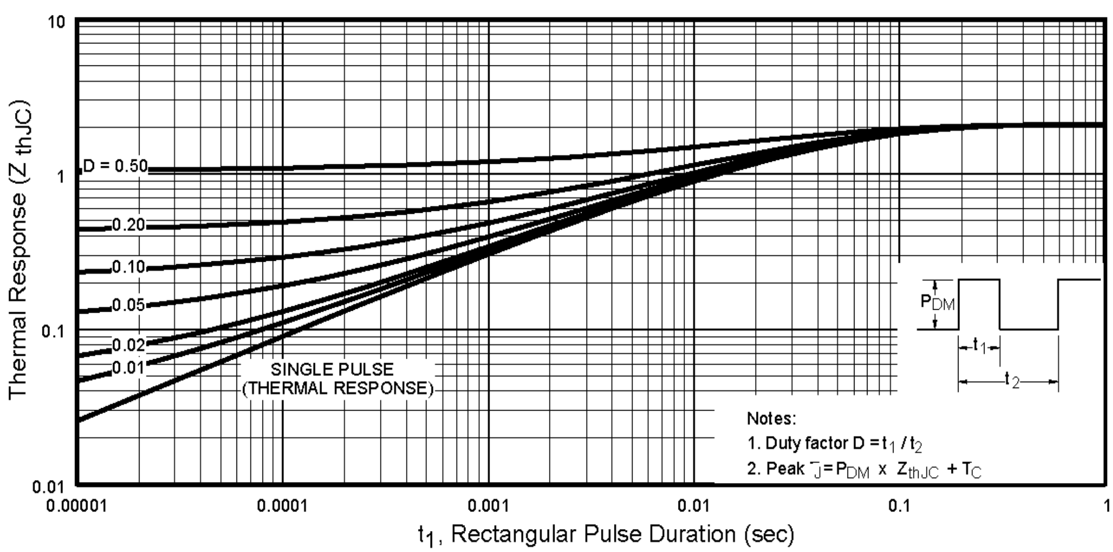



**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case

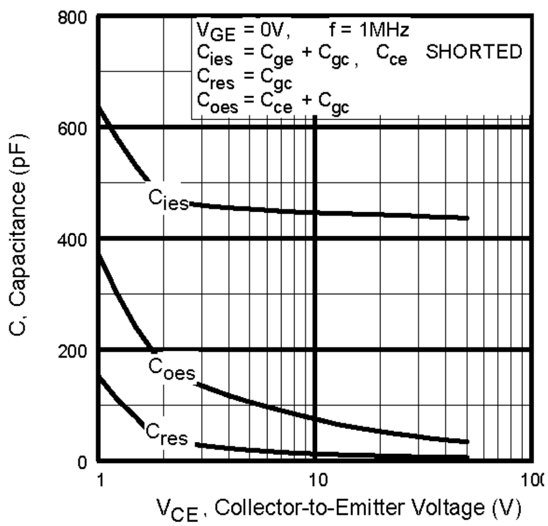



**Fig. 7 -** Typical Capacitance vs. Collector-to-Emitter Voltage

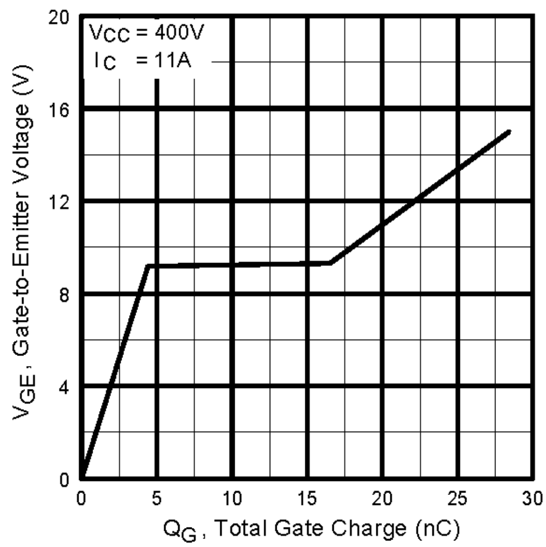



**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage

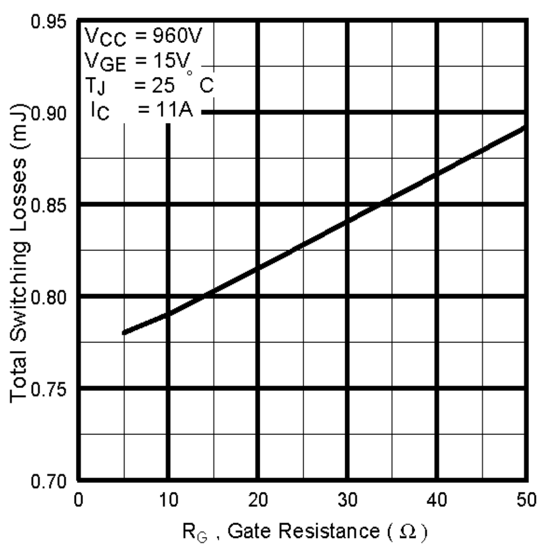



**Fig. 9** - Typical Switching Losses vs. Gate Resistance

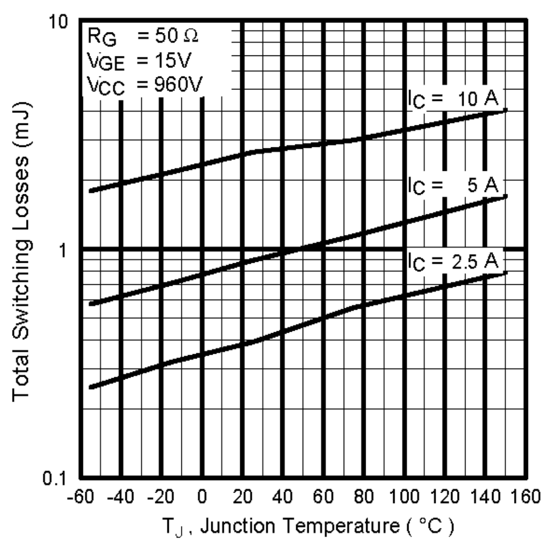



**Fig. 10** - Typical Switching Losses vs. Junction Temperature

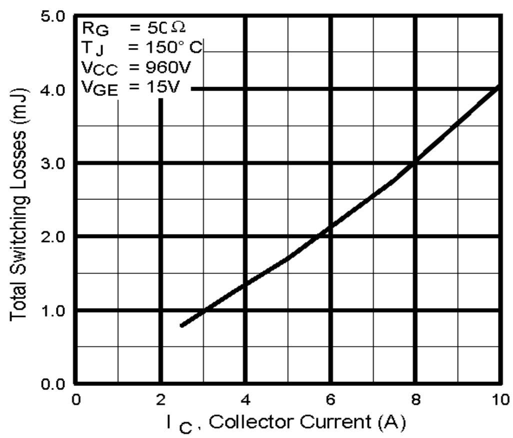



**Fig. 11 -** Typical Switching Losses vs. Collector-to-Emitter Current

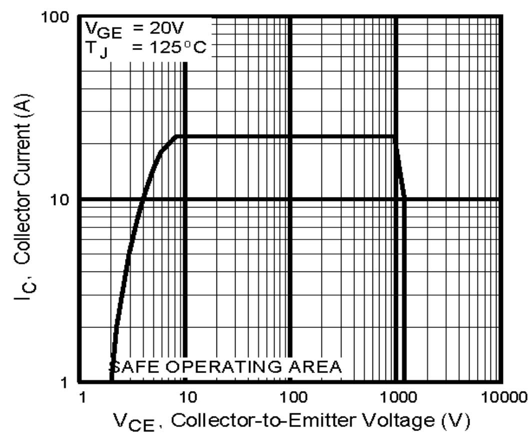
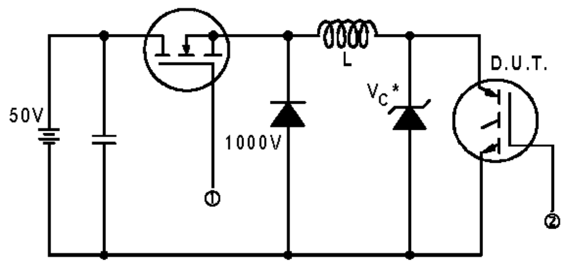



**Fig. 12** - Turn-Off SOA




* Driver same type as D.U.T.; Vc = 80% of Vce(max)
* Note: Due to the 50V power supply, pulse width and inductor will increase to obtain rated Id.

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

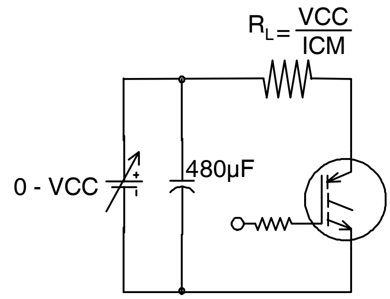



**Fig. 13b** - Pulsed Collector Current Test Circuit

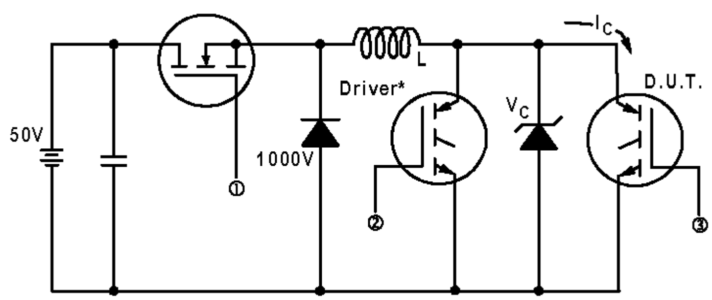



**Fig. 14a** - Switching Loss Test Circuit

*** Driver same type as D.U.T., VC = 960V**

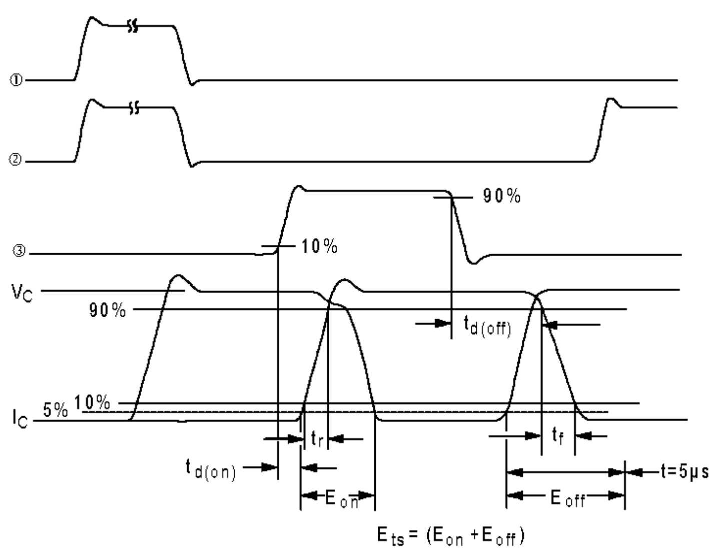
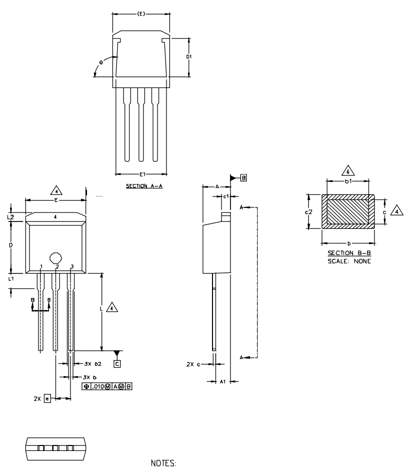



**Fig. 14b** - Switching Loss Waveforms

# TO-262 Package Outline

Dimensions are shown in millimeters (inches)



LEAD ASSIGNMENTS

HEXFET

1.– GATE
2.– DRAIN
3.– SOURCE
4.– DRAIN

IGBT

1 - GATE
2 - COLLECTOR
3 - EMITTER

NOTES:

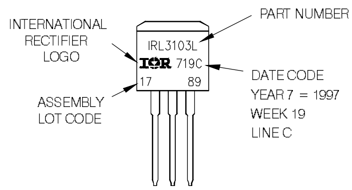
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: INCH.

| SYMBOL | DIMENSIONS | | | | NOTES |
|---|---|---|---|---|---|
| | MILLIMETERS | | INCHES | | |
| | MIN. | MAX. | MIN. | MAX. | |
| A | 4.06 | 4.83 | .160 | .190 | |
| A1 | 2.03 | 2.92 | .080 | .115 | |
| b | 0.51 | 0.99 | .020 | .039 | |
| b1 | 0.51 | 0.89 | .020 | .035 | 4 |
| b2 | 1.14 | 1.40 | .045 | .055 | |
| c | 0.38 | 0.63 | .015 | .025 | 4 |
| c1 | 1.14 | 1.40 | .045 | .055 | |
| c2 | 0.43 | .063 | .017 | .029 | |
| 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 | 13.46 | 14.09 | .530 | .555 | |
| L1 | 3.56 | 3.71 | .140 | .146 | |
| L2 | | 1.65 | | .065 | |

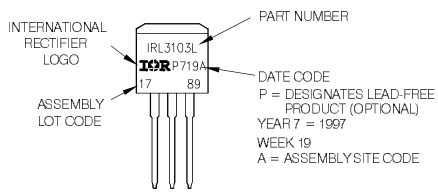
# TO-262 Part Marking Information

EXAMPLE: THIS IS AN IRL3103L
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"

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/

Data and specifications subject to change without notice.

International IOR Rectifier

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