International
IOR Rectifier

PD - 94923

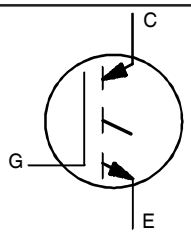
# IRG4PC30UPbF

INSULATED GATE BIPOLAR TRANSISTOR

UltraFast Speed IGBT

## Features

- UltraFast: Optimized for high operating frequencies 8-40 kHz in hard switching, >200 kHz in resonant mode
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency than Generation 3
- Industry standard TO-247AC package
- Lead-Free




**n-channel**

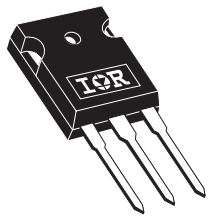
$V_{CES}$ = 600V

$V_{CE(on)\ typ.}$ = 1.95V

@$V_{GE}$ = 15V, $I_C$ = 12A

## Benefits

- Generation 4 IGBT's offer highest efficiency available
- IGBT's optimized for specified application conditions
- Designed to be a "drop-in" replacement for equivalent industry-standard Generation 3 IR IGBT's



TO-247AC

## Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $V_{CES}$ | Collector-to-Emitter Breakdown Voltage | 600 | V |
| $I_C$ @ $T_C$ = 25°C | Continuous Collector Current | 23 | A |
| $I_C$ @ $T_C$ = 100°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 | ± 20 | V |
| $E_{ARV}$ | Reverse Voltage Avalanche Energy ③ | 10 | mJ |
| $P_D$ @ $T_C$ = 25°C | Maximum Power Dissipation | 100 | W |
| $P_D$ @ $T_C$ = 100°C | Maximum Power Dissipation | 42 | |
| $T_J$<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 ) | |
| | Mounting torque, 6-32 or M3 screw. | 10 lbf•in (1.1N•m) | |

## Thermal Resistance

| | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case | ––– | 1.2 | °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) |




12/30/03

## 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 | — | 0.63 | — | V/°C | $V_{GE}$ = 0V, $I_C$ = 1.0mA | |
| $V_{CE(ON)}$ | Collector-to-Emitter Saturation Voltage | — | 1.95 | 2.1 | V | $I_C$ = 12A | $V_{GE}$ = 15V |
| | | — | 2.52 | — | | $I_C$ = 23A | See Fig.2, 5 |
| | | — | 2.09 | — | | $I_C$ = 12A , $T_J$ = 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 | — | -13 | — | mV/°C | $V_{CE}$ = $V_{GE}$, $I_C$ = 250µA | |
| $g_{fe}$ | Forward Transconductance ⑤ | 3.1 | 8.6 | — | S | $V_{CE}$ = 100 V, $I_C$ = 12A | |
| $I_{CES}$ | 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) | — | 50 | 75 | nC | $I_C$ = 12A | |
| $Q_{ge}$ | Gate - Emitter Charge (turn-on) | — | 8.1 | 12 | | $V_{CC}$ = 400V | See Fig.8 |
| $Q_{gc}$ | Gate - Collector Charge (turn-on) | — | 18 | 27 | | $V_{GE}$ = 15V | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 17 | — | ns | | |
| $t_r$ | Rise Time | — | 9.6 | — | | $T_J$ = 25°C | |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 78 | 120 | | $I_C$ = 12A, $V_{CC}$ = 480V | |
| $t_f$ | Fall Time | — | 97 | 150 | | $V_{GE}$ = 15V, $R_G$ = 23Ω | |
| $E_{on}$ | Turn-On Switching Loss | — | 0.16 | — | mJ | Energy losses include "tail" | |
| $E_{off}$ | Turn-Off Switching Loss | — | 0.20 | — | | See Fig. 10, 11, 13, 14 | |
| $E_{ts}$ | Total Switching Loss | — | 0.36 | 0.50 | | | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 20 | — | ns | $T_J$ = 150°C, | |
| $t_r$ | Rise Time | — | 13 | — | | $I_C$ = 12A, $V_{CC}$ = 480V | |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 180 | — | | $V_{GE}$ = 15V, $R_G$ = 23Ω | |
| $t_f$ | Fall Time | — | 140 | — | | Energy losses include "tail" | |
| $E_{ts}$ | Total Switching Loss | — | 0.73 | — | mJ | See Fig. 13, 14 | |
| $L_E$ | Internal Emitter Inductance | — | 13 | — | nH | Measured 5mm from package | |
| $C_{ies}$ | Input Capacitance | — | 1100 | — | pF | $V_{GE}$ = 0V | |
| $C_{oes}$ | Output Capacitance | — | 73 | — | | $V_{CC}$ = 30V | See Fig. 7 |
| $C_{res}$ | Reverse Transfer Capacitance | — | 14 | — | | $f$ = 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, $R_G$ = 23Ω, (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.

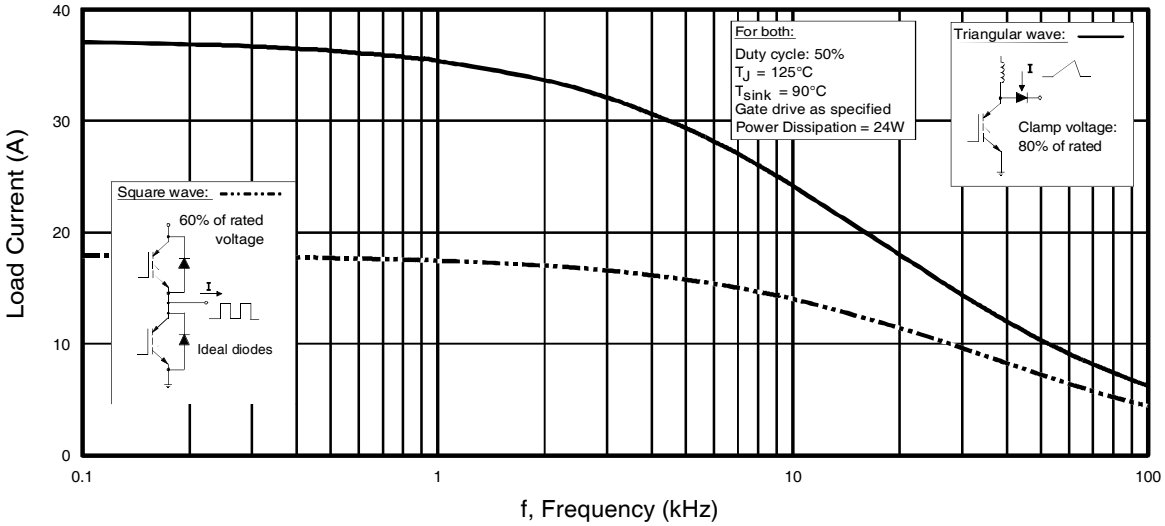



**Fig. 1** - Typical Load Current vs. Frequency
(For square wave, $I=I_{RMS}$ of fundamental; for triangular wave, $I=I_{PK}$)

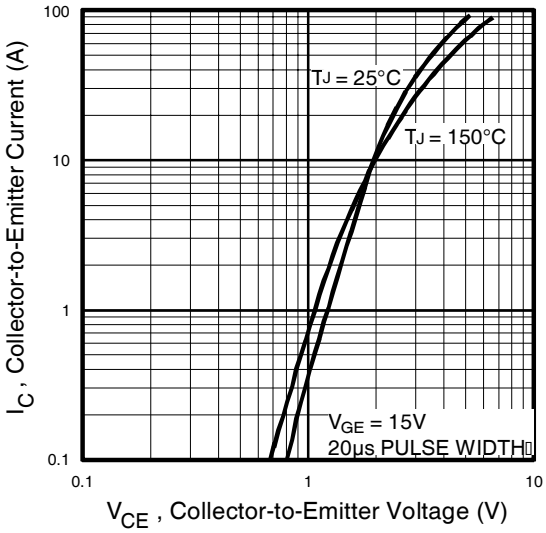



**Fig. 2** - Typical Output Characteristics

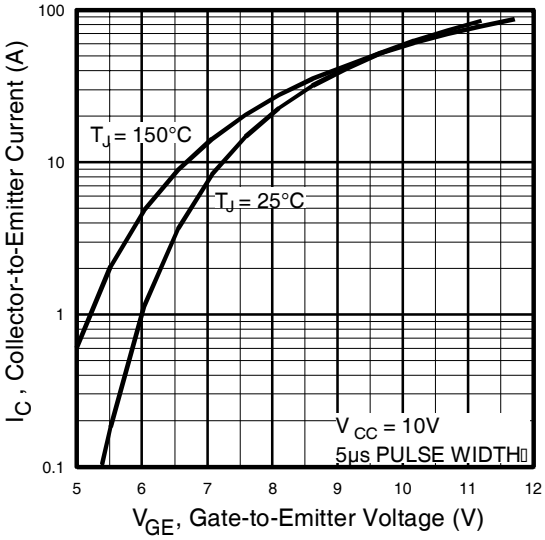



**Fig. 3** - Typical Transfer Characteristics

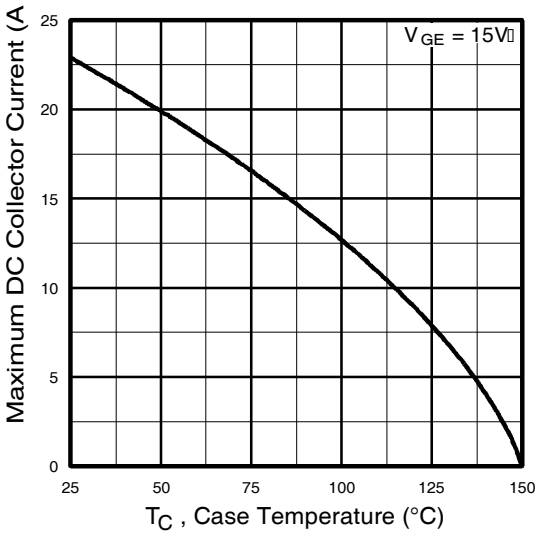



**Fig. 4** - Maximum Collector Current vs. Case Temperature

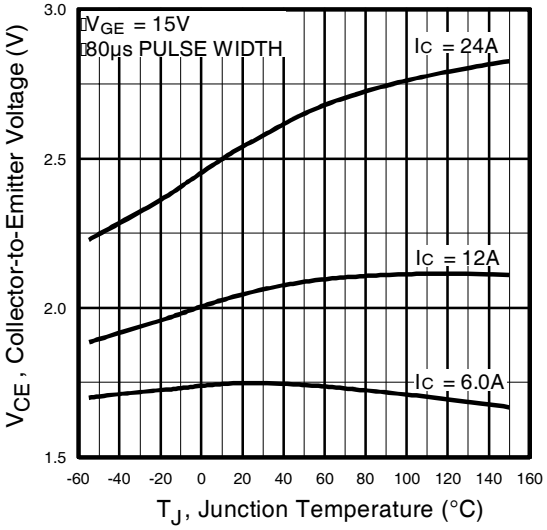



**Fig. 5** - Collector-to-Emitter Voltage vs. Junction Temperature

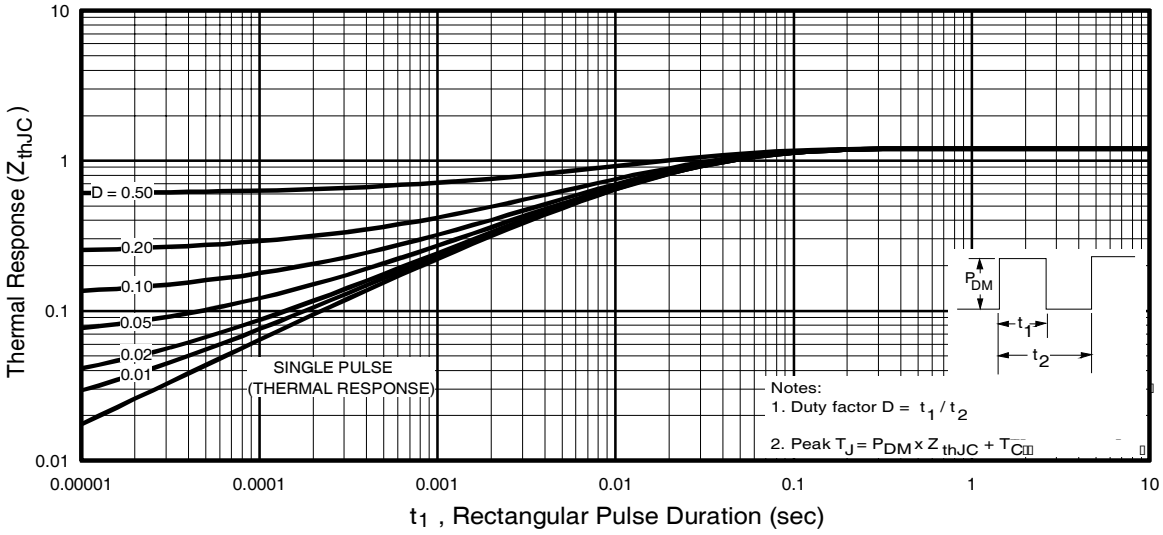



**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case

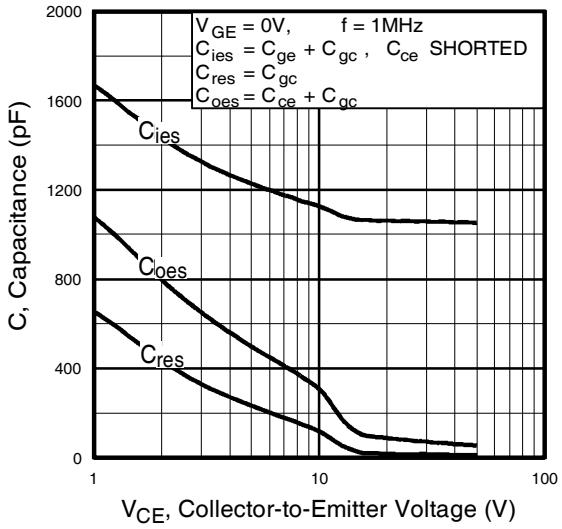



**Fig. 7 -** Typical Capacitance vs. Collector-to-Emitter Voltage

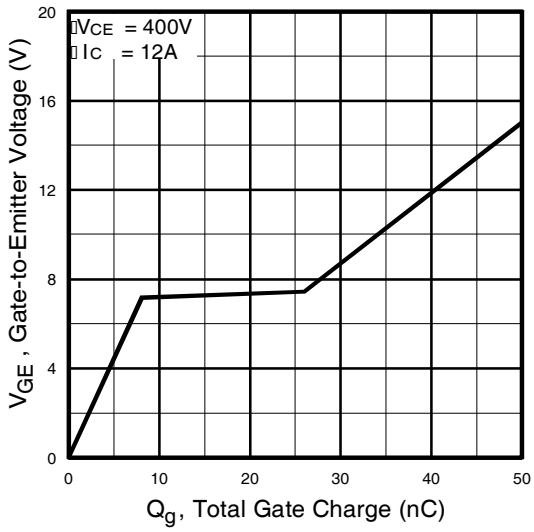



**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage

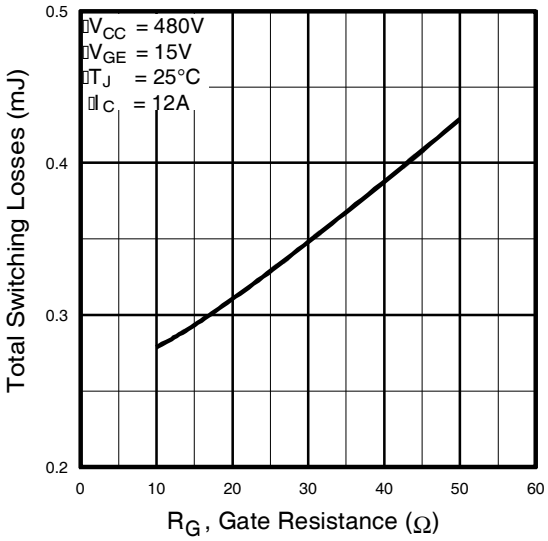



**Fig. 9** - Typical Switching Losses vs. Gate Resistance

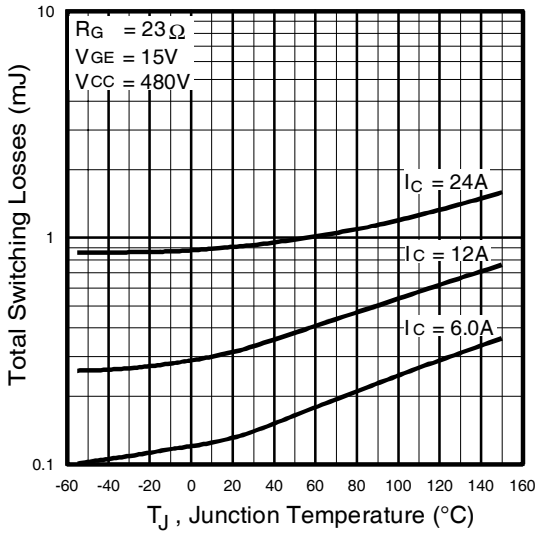



**Fig. 10** - Typical Switching Losses vs. Junction Temperature

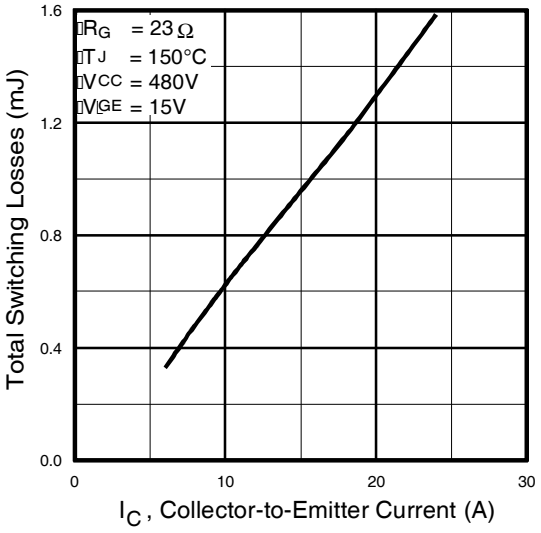



**Fig. 11 -** Typical Switching Losses vs. Collector-to-Emitter Current

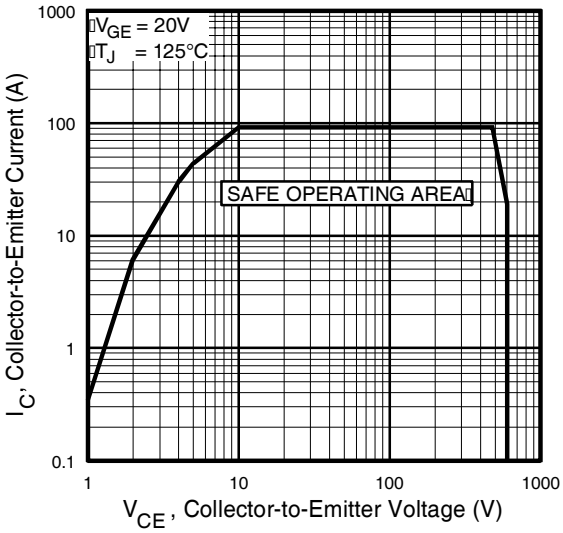
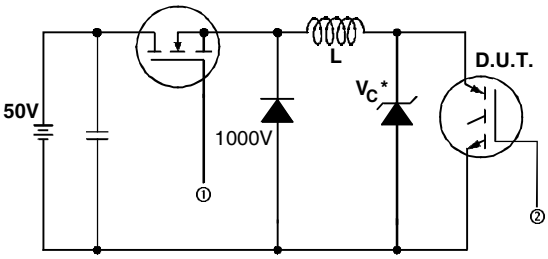



**Fig. 12 -** Turn-Off SOA




* 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

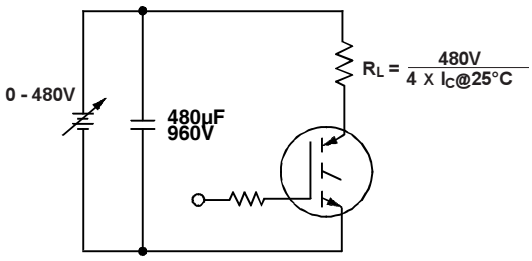



**Fig. 13b -** Pulsed Collector Current Test Circuit

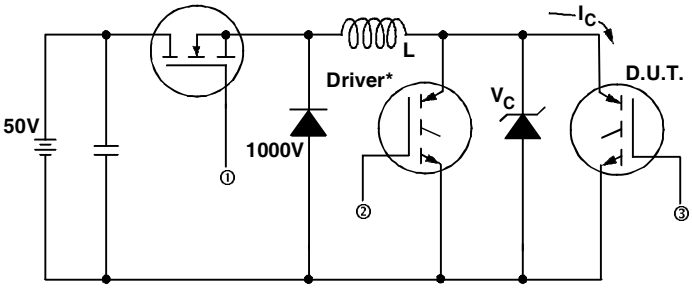



**Fig. 14a -** Switching Loss Test Circuit

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

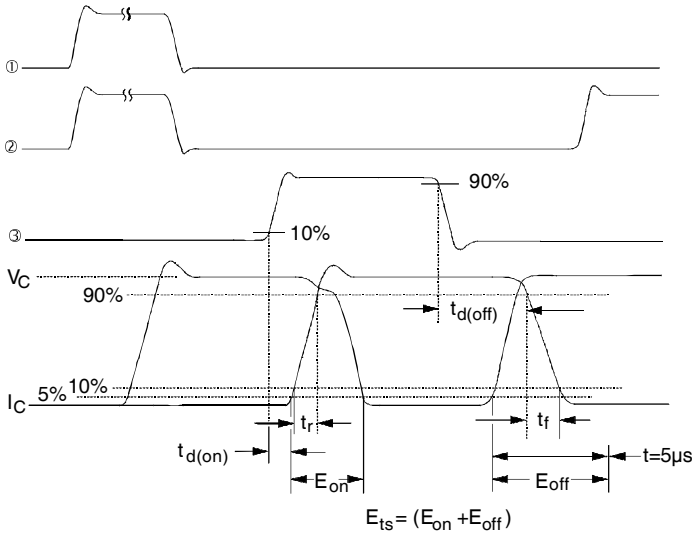
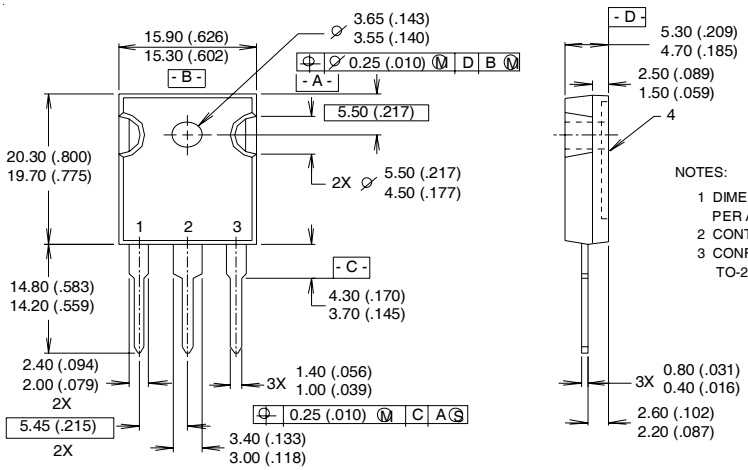



**Fig. 14b -** Switching Loss Waveforms

## TO-247AC Package Outline

Dimensions are shown in millimeters (inches)




NOTES:

1 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
2 CONTROLLING DIMENSION : INCH.
3 CONFORMS TO JEDEC OUTLINE TO-247-AC.

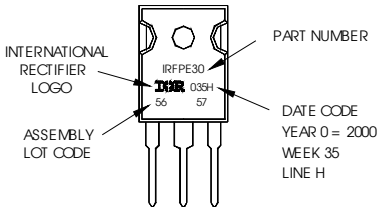
LEAD ASSIGNMENTS

| Hexfet | IGBT |
|---|---|
| 1 - Gate | 1 - Gate |
| 2 - Drain | 2 - Collector |
| 3 - Source | 3 - Emitter |
| 4 - Drain | 4 - Collector |

## TO-247AC Part Marking Information

EXAMPLE: THIS IS AN IRFPE30
WITH ASSEMBLY
LOT CODE 5657
ASSEMBLED ON WW 35, 2000
IN THE ASSEMBLY LINE "H"

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




Data and specifications subject to change without notice.

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

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