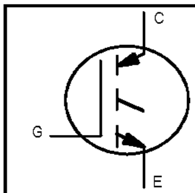
International
IOR Rectifier

INSULATED GATE BIPOLAR TRANSISTOR

PD- 95657

# IRG4P254SPbF

Standard Speed IGBT




$V_{CES} = 250V$

$V_{CE(on)\,typ.} = 1.32V$

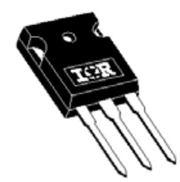
$@V_{GE} = 15V, I_C = 55A$

## Features

- Standard: Optimized for minimum saturation voltage and operating frequencies up to 10kHz
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency than Generation 3
- Industry standard TO-247AC package
- Lead-Free

## Benefits

- Generation 4 IGBT's offer highest efficiency available
- IGBT's optimized for specified application conditions
- High Power density
- Lower conduction losses than similarly rated MOSFET
- Lower Gate Charge than equivalent MOSFET
- Simple Gate Drive characteristics compared to Thyristors




## Absolute Maximum Ratings

[redacted]

| | Parameter | Max. | Units |
|---|---|---|---|
| $V_{CES}$ | Collector-to-Emitter Breakdown Voltage | 250 | V |
| $I_C$ @ $T_C$ = 25°C | Continuous Collector Current | 98* | A |
| $I_C$ @ $T_C$ = 100°C | Continuous Collector Current | 55 | |
| $I_{CM}$ | Pulsed Collector Current ① | 196 | |
| $I_{LM}$ | Clamped Inductive Load Current ② | 196 | |
| $V_{GE}$ | Gate-to-Emitter Voltage | ± 20 | V |
| $E_{ARV}$ | Reverse Voltage Avalanche Energy ③ | 160 | mJ |
| $P_D$ @ $T_C$ = 25°C | Maximum Power Dissipation | 200 | W |
| $P_D$ @ $T_C$ = 100°C | Maximum Power Dissipation | 78 | |
| $T_J$<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 | —– | 0.64 | °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 (0.21) | —– | g (oz) |

* Package limited to 70A



7/26/04

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

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)CES}$ | Collector-to-Emitter Breakdown Voltage | 250 | — | — | 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 | — | 0.33 | — | V/°C | $V_{GE}$ = 0V, $I_C$ = 1.0mA |
| $V_{CE(ON)}$ | Collector-to-Emitter Saturation Voltage | — | 1.32 | 1.5 | V | $I_C$ = 55A, $V_{GE}$ = 15V, See Fig.2, 5 |
| | | — | 1.69 | — | | $I_C$ =98A |
| | | — | 1.31 | — | | $I_C$ =55A , $T_J$ = 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 | — | -12 | — | mV/°C | $V_{CE}$ = $V_{GE}$, $I_C$ = 250µA |
| $g_{fe}$ | Forward Transconductance ⑤ | 43 | 63 | — | S | $V_{CE}$ = 100V, $I_C$ = 55A |
| $I_{CES}$ | Zero Gate Voltage Collector Current | — | — | 250 | µA | $V_{GE}$ = 0V, $V_{CE}$ = 250V |
| | | — | — | 2.0 | | $V_{GE}$ = 0V, $V_{CE}$ = 10V, $T_J$ = 25°C |
| | | — | — | 1000 | | $V_{GE}$ = 0V, $V_{CE}$ = 250V, $T_J$ = 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) | — | 200 | 300 | nC | $I_C$ =55A |
| $Q_{ge}$ | Gate - Emitter Charge (turn-on) | — | 29 | 44 | | $V_{CC}$ = 200V See Fig. 8 |
| $Q_{gc}$ | Gate - Collector Charge (turn-on) | — | 66 | 99 | | $V_{GE}$ = 15V |
| $t_{d(on)}$ | Turn-On Delay Time | — | 40 | — | ns | |
| $t_r$ | Rise Time | — | 44 | — | | $T_J$ = 25°C |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 270 | 400 | | $I_C$ = 55A, $V_{CC}$ = 200V |
| $t_f$ | Fall Time | — | 510 | 760 | | $V_{GE}$ = 15V, $R_G$ = 5.0Ω |
| $E_{on}$ | Turn-On Switching Loss | — | 0.38 | — | mJ | Energy losses include "tail" |
| $E_{off}$ | Turn-Off Switching Loss | — | 3.50 | — | | See Fig. 9, 10, 14 |
| $E_{ts}$ | Total Switching Loss | — | 3.88 | 5.3 | | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 38 | — | ns | $T_J$ = 150°C, |
| $t_r$ | Rise Time | — | 45 | — | | $I_C$ = 55A, $V_{CC}$ = 200V |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 400 | — | | $V_{GE}$ = 15V, $R_G$ = 5.0Ω |
| $t_f$ | Fall Time | — | 940 | — | | Energy losses include "tail" |
| $E_{ts}$ | Total Switching Loss | — | 6.52 | — | mJ | See Fig. 11, 14 |
| $L_E$ | Internal Emitter Inductance | — | 13 | — | nH | Measured 5mm from package |
| $C_{ies}$ | Input Capacitance | — | 4500 | — | pF | $V_{GE}$ = 0V |
| $C_{oes}$ | Output Capacitance | — | 510 | — | | $V_{CC}$ = 30V See Fig. 7 |
| $C_{res}$ | Reverse Transfer Capacitance | — | 100 | — | | $f$ = 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, $R_G$ = 5.0Ω, (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.

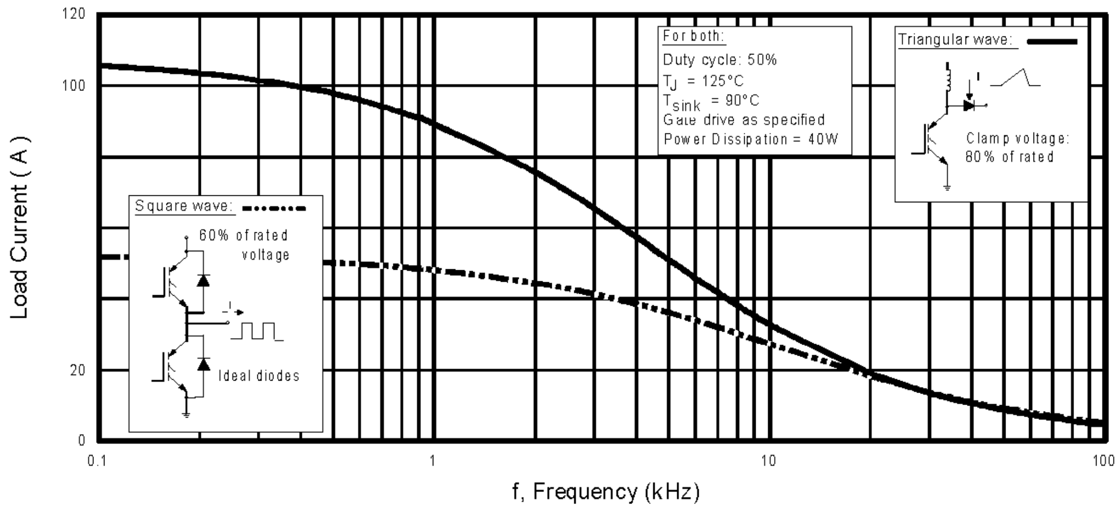



**Fig. 1** - Typical Load Current vs. Frequency
(Load Current = $I_{RMS}$ of fundamental)

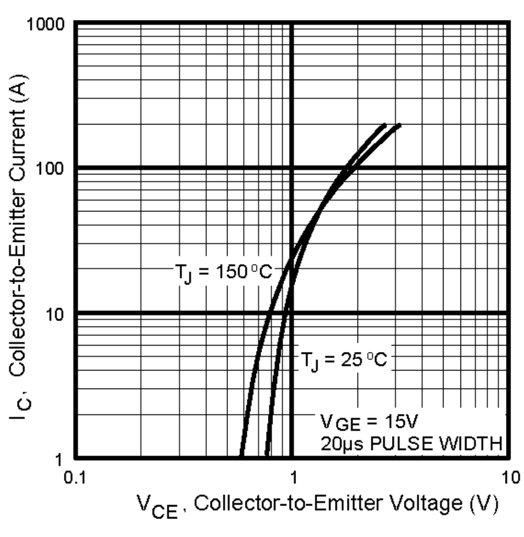



**Fig. 2** - Typical Output Characteristics

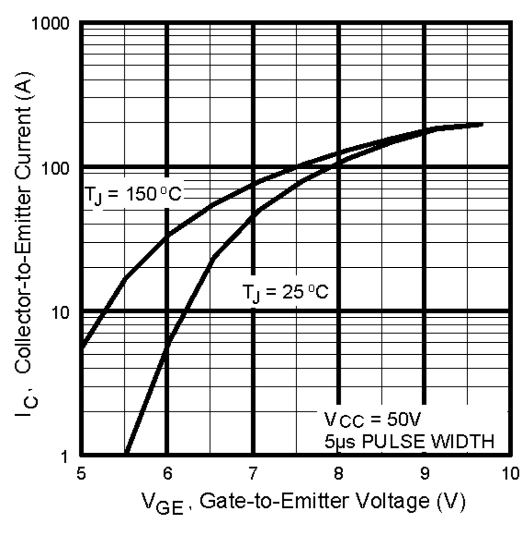



**Fig. 3** - Typical Transfer Characteristics

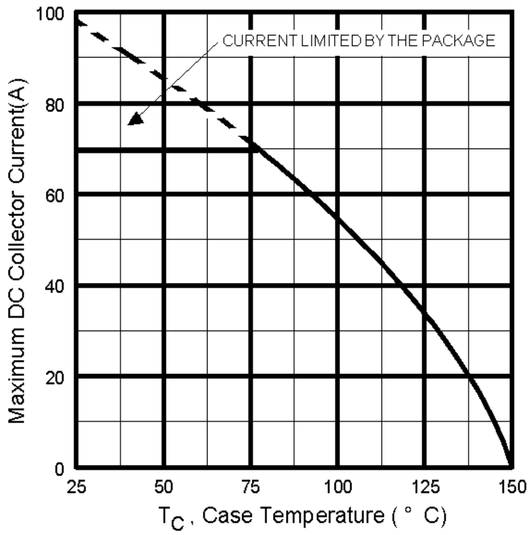



**Fig. 4** - Maximum Collector Current vs. Case Temperature

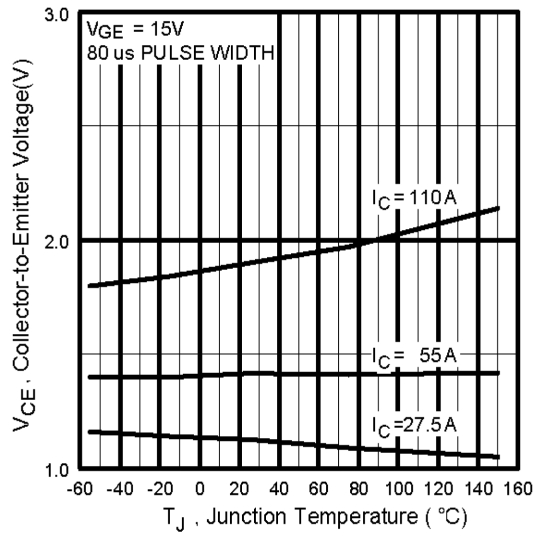



**Fig. 5** - Typical Collector-to-Emitter Voltage vs. Junction Temperature

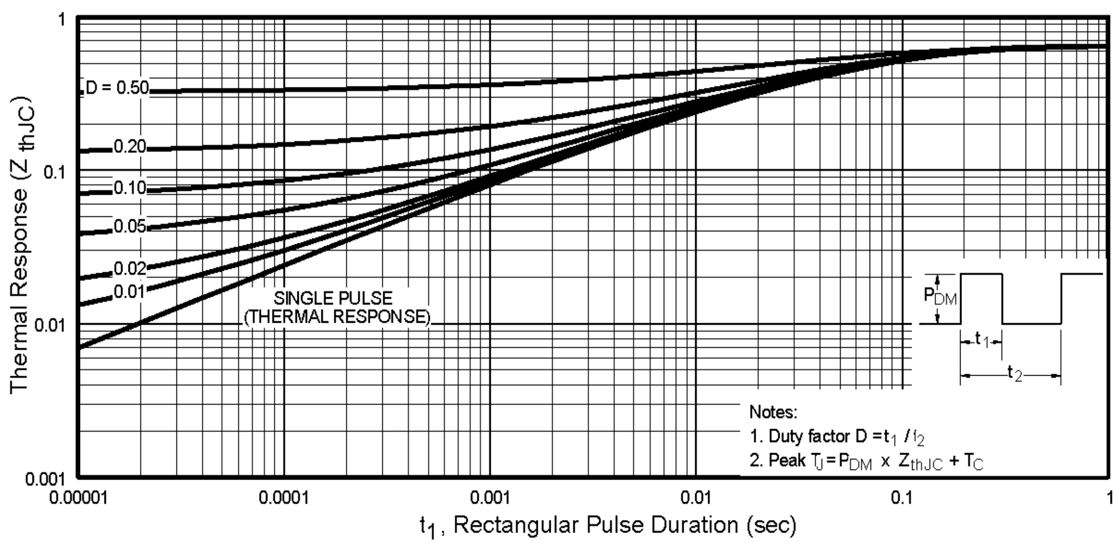



**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case

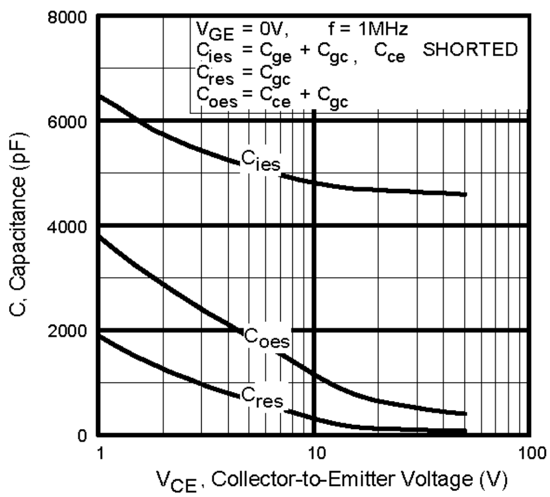



**Fig. 7 -** Typical Capacitance vs. Collector-to-Emitter Voltage

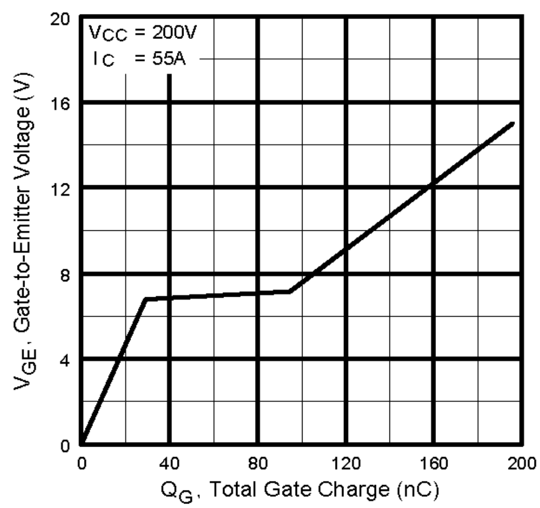



**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage

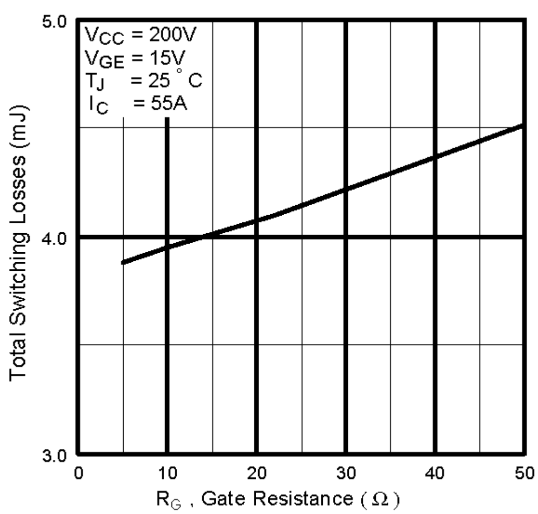



**Fig. 9** - Typical Switching Losses vs. Gate Resistance

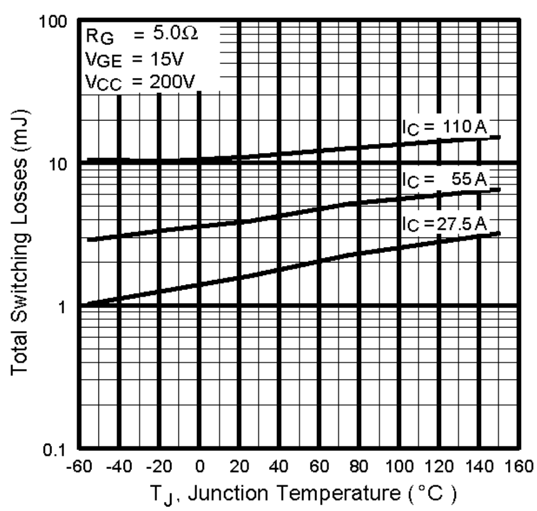



**Fig. 10** - Typical Switching Losses vs. Junction Temperature

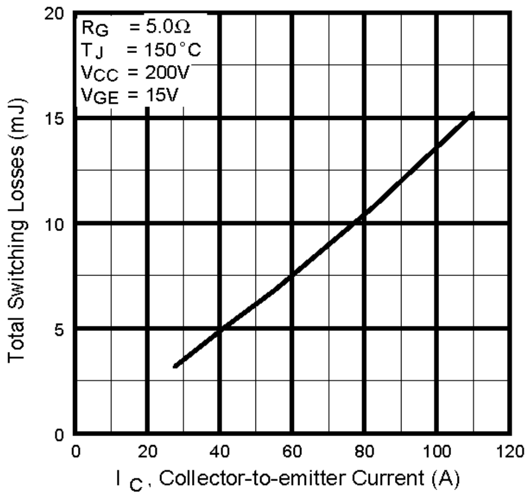



**Fig. 11 -** Typical Switching Losses vs. Collector-to-Emitter Current

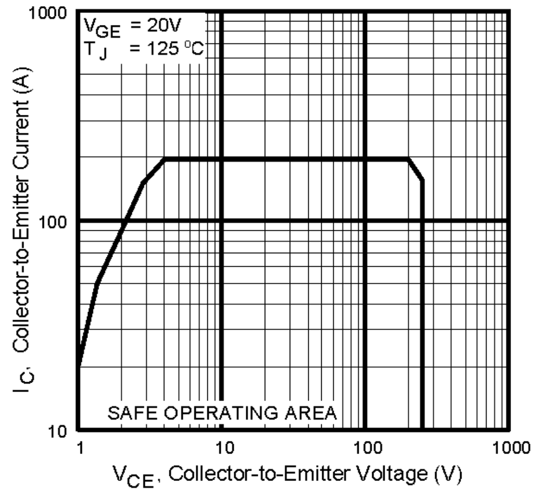



**Fig. 12** - Turn-Off SOA

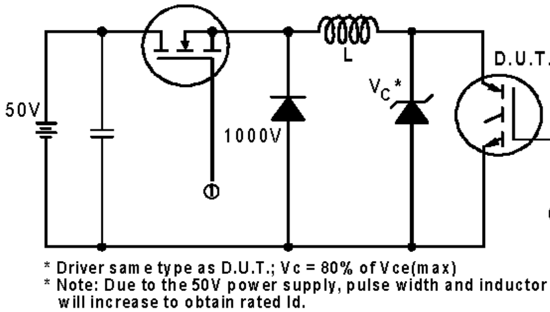



**Fig. 13a** - Clamped Inductive Load Test Circuit

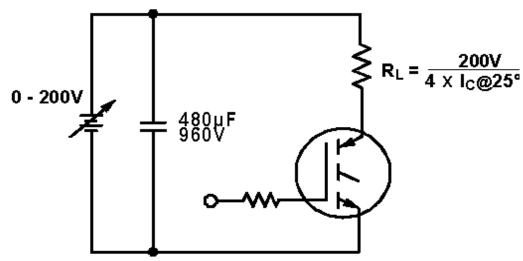



**Fig. 13b** - Pulsed Collector Current Test Circuit

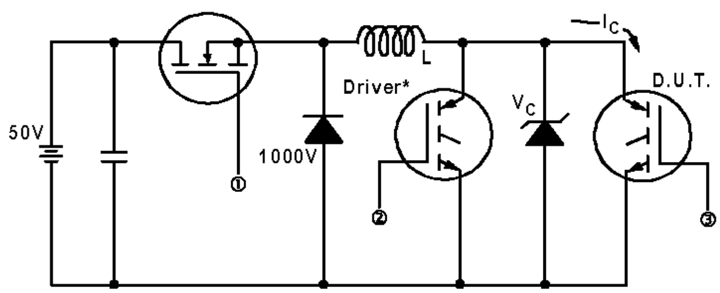



**Fig. 14a** - Switching Loss Test Circuit

*** Driver same type as D.U.T., VC = 200V**

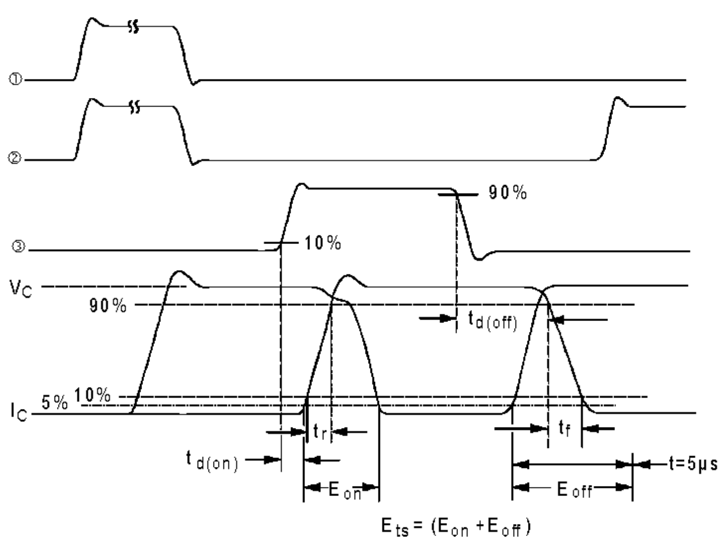
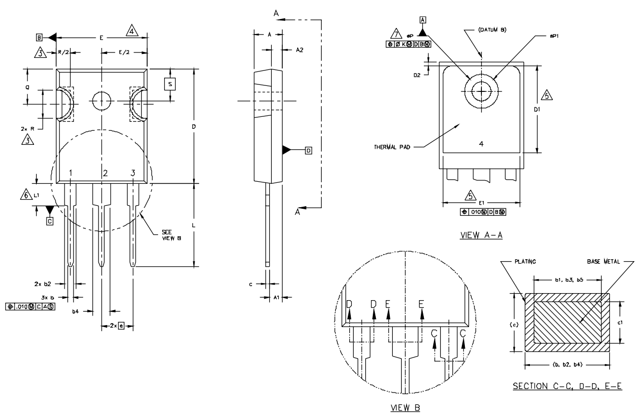



**Fig. 14b** - Switching Loss Waveforms

## TO-247AC Package Outline

Dimensions are shown in millimeters (inches)




NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M 1994.
2. DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS]
3. (△) CONTOUR OF SLOT OPTIONAL.
4. (△) DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
5. (△) THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENISONS D1 & E1
6. (△) LEAD FINISH UNCONTROLLED IN L1.
7. (△) ØP TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5 ° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154" [3.91]
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-247 WITH THE EXCEPTION OF DIMENSION c

| SYMBOL | DIMENSIONS | | | | NOTES |
|---|---|---|---|---|---|
| | INCHES | | MILLIMETERS | | |
| | MIN | MAX | MIN. | MAX. | |
| A | .183 | .209 | 4.65 | 5.31 | |
| A1 | .087 | .102 | 2.21 | 2.59 | |
| A2 | .059 | .098 | 1.50 | 2.49 | |
| b | .039 | .055 | 0.99 | 1.40 | |
| b1 | .039 | .053 | 0.99 | 1.35 | |
| b2 | .065 | .094 | 1.65 | 2.39 | |
| b3 | .065 | .092 | 1.65 | 2.37 | |
| b4 | .102 | .135 | 2.59 | 3.43 | |
| b5 | .102 | .133 | 2.59 | 3.38 | |
| c | .015 | .034 | 0.38 | 0.86 | |
| c1 | .015 | .030 | 0.38 | 0.76 | |
| D | .776 | .815 | 19.71 | 20.70 | 4 |
| D1 | .515 | – | 13.08 | – | 5 |
| D2 | .020 | .030 | 0.51 | 0.76 | |
| E | .602 | .625 | 15.29 | 15.87 | 4 |
| E1 | .540 | – | 15.72 | – | |
| e | .215 BSC | | 5.46 BSC | | |
| Øk | .010 | | 2.54 | | |
| L | .559 | .634 | 14.20 | 16.10 | |
| L1 | .146 | .169 | 3.71 | 4.29 | |
| N | 3 | | 7.62 BSC | | |
| ØP | .140 | .144 | 3.56 | 3.66 | |
| ØP1 | – | .275 | – | 6.98 | |
| Q | .209 | .224 | 5.31 | 5.69 | |
| R | .178 | .216 | 4.52 | 5.49 | |
| S | .217 BSC | | 5.51 BSC | | |

LEAD ASSIGNMENTS

HEXFET

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

IGBTs, CoPACK

1.– GATE
2.– COLLECTOR
3 – EMITTER
4.– COLLECTOR

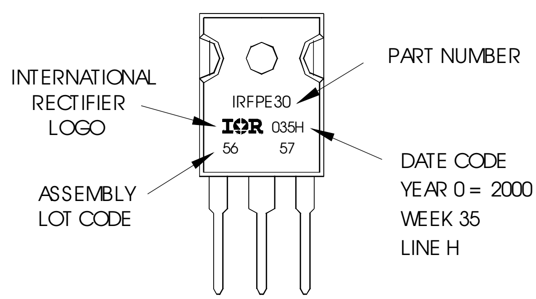
DIODES

1 – ANODE/OPEN
2.– CATHODE
3.– ANODE

## 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.

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