Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

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International
IOR Rectifier

PD - 91574B

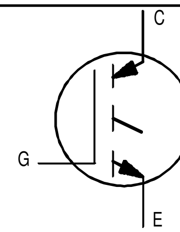
# IRG4PH50U

INSULATED GATE BIPOLAR TRANSISTOR

Ultra Fast Speed IGBT

## Features

- UltraFast: Optimized for high operating frequencies up to 40 kHz in hard switching, >200 kHz in resonant mode
- New IGBT design provides tighter parameter distribution and higher efficiency than previous generations
- Optimized for power conversion; SMPS, UPS and welding
- Industry standard TO-247AC package




n-channel

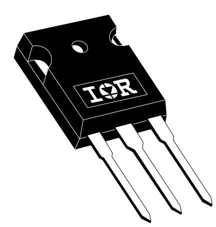
$V_{CES}$ = 1200V

$V_{CE(on)\ typ.}$ = 2.78V

@$V_{GE}$ = 15V, $I_C$ = 24A

## Benefits

- Higher switching frequency capability than competitive IGBTs
- Highest efficiency available
- Much lower conduction losses than MOSFETs
- More efficient than short circuit rated IGBTs



TO-247AC

## Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $V_{CES}$ | Collector-to-Emitter Breakdown Voltage | 1200 | V |
| $I_C$ @ $T_C$ = 25°C | Continuous Collector Current | 45 | |
| $I_C$ @ $T_C$ = 100°C | Continuous Collector Current | 24 | A |
| $I_{CM}$ | Pulsed Collector Current ① | 180 | |
| $I_{LM}$ | Clamped Inductive Load Current ② | 180 | |
| $V_{GE}$ | Gate-to-Emitter Voltage | ± 20 | V |
| $E_{ARV}$ | Reverse Voltage Avalanche Energy ③ | 170 | 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 | |
| $R_{\theta CS}$ | Case-to-Sink, Flat, Greased Surface | 0.24 | —— | °C/W |
| $R_{\theta JA}$ | Junction-to-Ambient, typical socket mount | —— | 40 | |
| Wt | Weight | 6 (0.21) | —— | g (oz) |



01/14/02

## 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 | — | 1.20 | — | V/°C | $V_{GE}$ = 0V, $I_C$ = 1.0mA |
| $V_{CE(ON)}$ | Collector-to-Emitter Saturation Voltage | — | 2.56 | 3.5 | V | $I_C$ = 20A |
| | | — | 2.78 | 3.7 | | $I_C$ = 24A   $V_{GE}$ = 15V |
| | | — | 3.20 | — | | $I_C$ = 45A   See Fig.2, 5 |
| | | — | 2.54 | — | | $I_C$ = 24A , $T_J$ = 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 | 23 | 35 | — | S | $V_{CE}$ = 100V, $I_C$ = 24A |
| $I_{CES}$ | Zero Gate Voltage Collector Current | — | — | 250 | µA | $V_{GE}$ = 0V, $V_{CE}$ = 1200V |
| | | — | — | 2.0 | | $V_{GE}$ = 0V, $V_{CE}$ = 24V, $T_J$ = 25°C |
| | | — | — | 5000 | | $V_{GE}$ = 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) | — | 160 | 250 | nC | $I_C$ = 24A |
| $Q_{ge}$ | Gate - Emitter Charge (turn-on) | — | 27 | 40 | | $V_{CC}$ = 400V   See Fig. 8 |
| $Q_{gc}$ | Gate - Collector Charge (turn-on) | — | 53 | 83 | | $V_{GE}$ = 15V |
| $t_{d(on)}$ | Turn-On Delay Time | — | 35 | — | ns | |
| $t_r$ | Rise Time | — | 15 | — | | $T_J$ = 25°C |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 200 | 350 | | $I_C$ = 24A, $V_{CC}$ = 960V |
| $t_f$ | Fall Time | — | 290 | 500 | | $V_{GE}$ = 15V, $R_G$ = 5.0Ω |
| $E_{on}$ | Turn-On Switching Loss | — | 0.53 | — | mJ | Energy losses include "tail" |
| $E_{off}$ | Turn-Off Switching Loss | — | 1.41 | — | | See Fig. 9, 10, 14 |
| $E_{ts}$ | Total Switching Loss | — | 1.94 | 2.6 | | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 31 | — | ns | $T_J$ = 150°C |
| $t_r$ | Rise Time | — | 18 | — | | $I_C$ = 24A, $V_{CC}$ = 960V |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 320 | — | | $V_{GE}$ = 15V, $R_G$ = 5.0Ω |
| $t_f$ | Fall Time | — | 280 | — | | Energy losses include "tail" |
| $E_{ts}$ | Total Switching Loss | — | 5.40 | — | mJ | See Fig. 11, 14 |
| $E_{on}$ | Turn-On Switching Loss | — | 0.35 | — | mJ | $T_J$ = 25°C, $V_{GE}$ = 15V, $R_G$ = 5.0Ω |
| $E_{off}$ | Turn-Off Switching Loss | — | 1.43 | — | | $I_C$ = 20A, $V_{CC}$ = 960V |
| $E_{ts}$ | Total Switching Loss | — | 1.78 | 2.9 | | Energy losses include "tail" |
| | | — | 4.56 | — | | See Fig. 9, 10, 11, 14,   $T_J$ = 150°C |
| $L_E$ | Internal Emitter Inductance | — | 13 | — | nH | Measured 5mm from package |
| $C_{ies}$ | Input Capacitance | — | 3600 | — | pF | $V_{GE}$ = 0V |
| $C_{oes}$ | Output Capacitance | — | 160 | — | | $V_{CC}$ = 30V   See Fig. 7 |
| $C_{res}$ | Reverse Transfer Capacitance | — | 31 | — | | $f$ = 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.

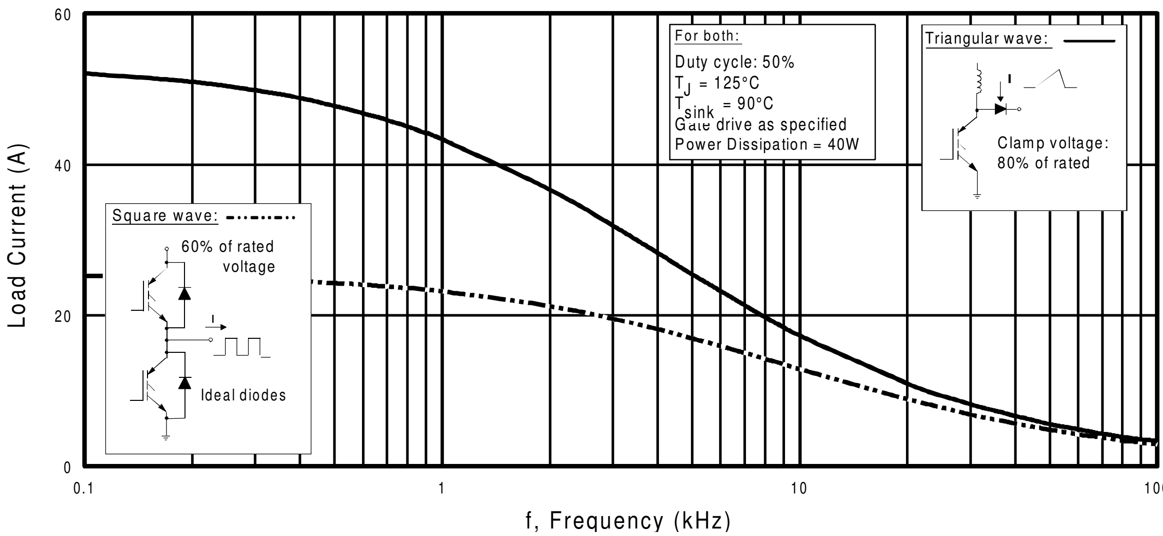



**Fig. 1** - Typical Load Current vs. Frequency
(Load Current = $I_{RMS}$ of fundamental)

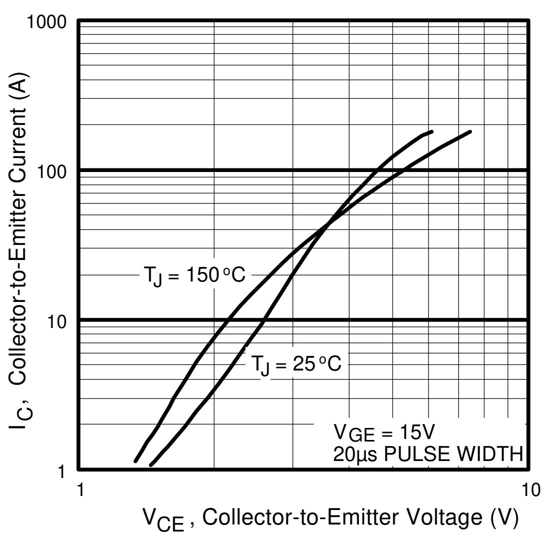



**Fig. 2** - Typical Output Characteristics

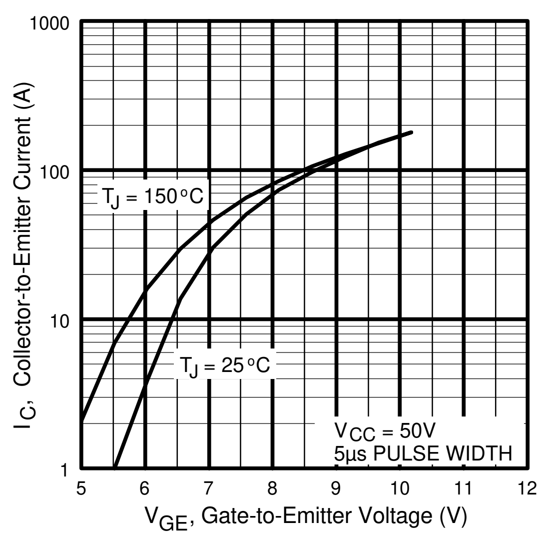



**Fig. 3** - Typical Transfer Characteristics

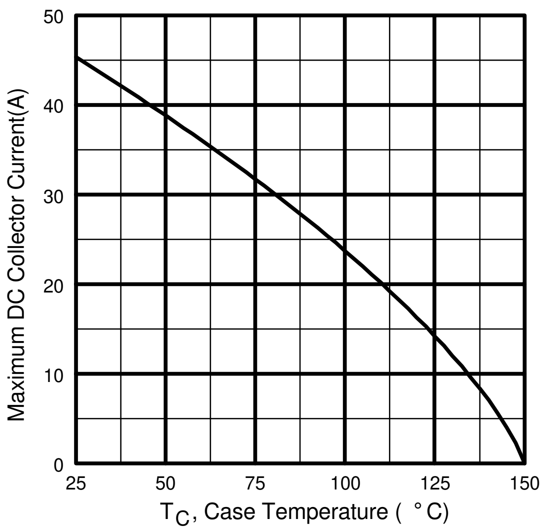



**Fig. 4** - Maximum Collector Current vs. Case Temperature

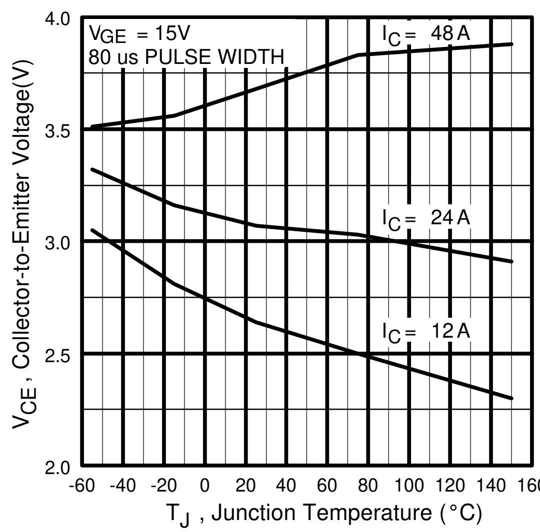



**Fig. 5** - Typical Collector-to-Emitter Voltage vs. Junction Temperature

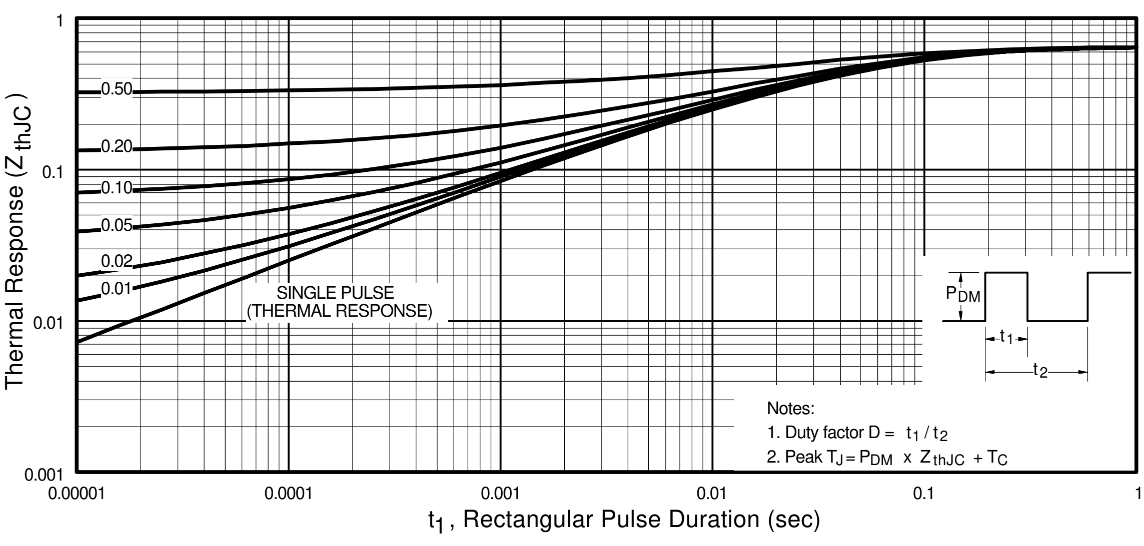



**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case

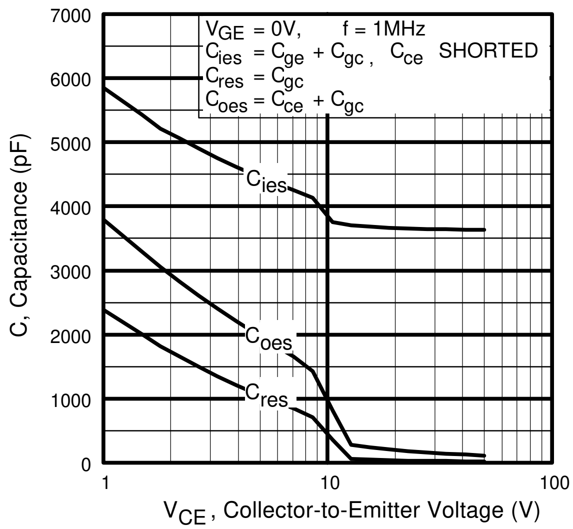



**Fig. 7 -** Typical Capacitance vs. Collector-to-Emitter Voltage

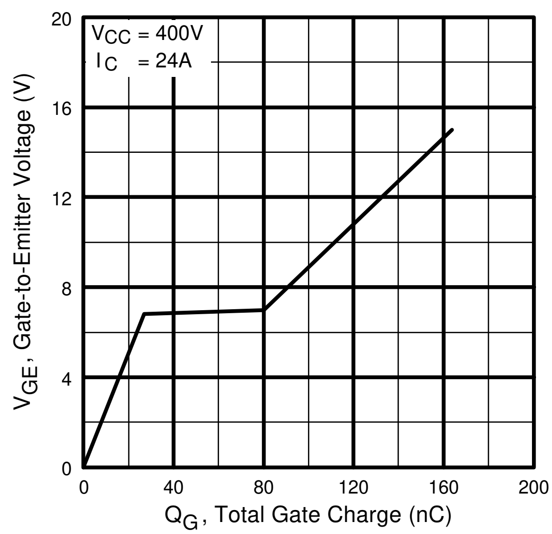



**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage

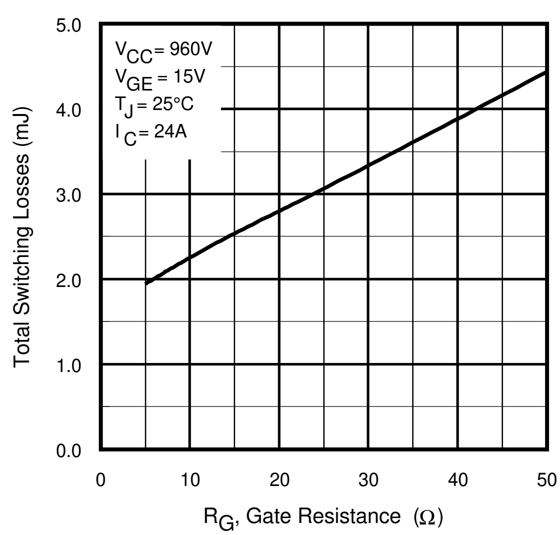



**Fig. 9** - Typical Switching Losses vs. Gate Resistance

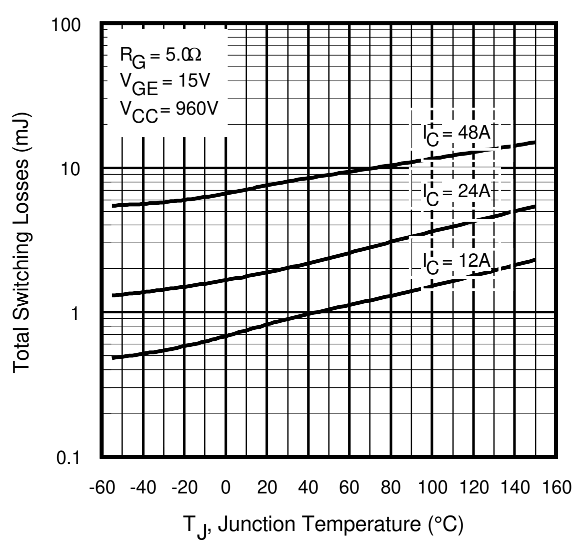



**Fig. 10** - Typical Switching Losses vs. Junction Temperature

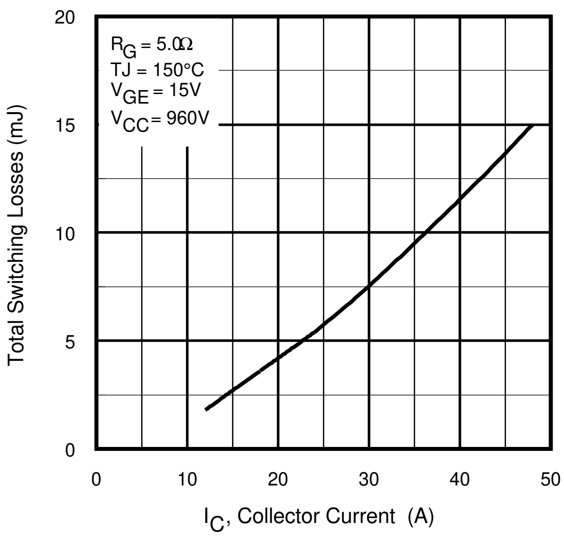



**Fig. 11 -** Typical Switching Losses vs. Collector-to-Emitter Current

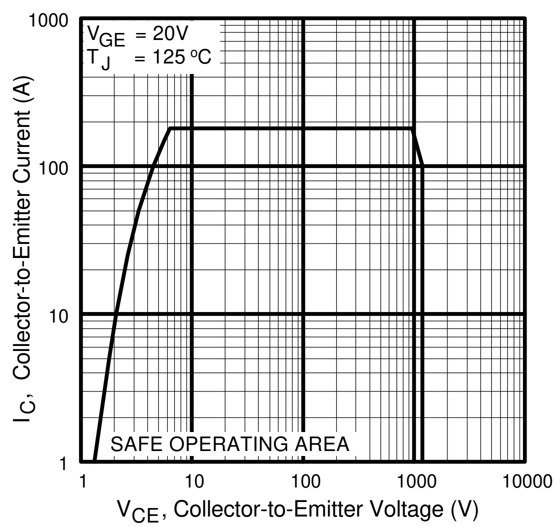
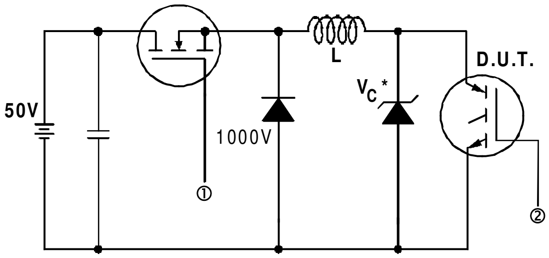



**Fig. 12** - Turn-Off SOA




* 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

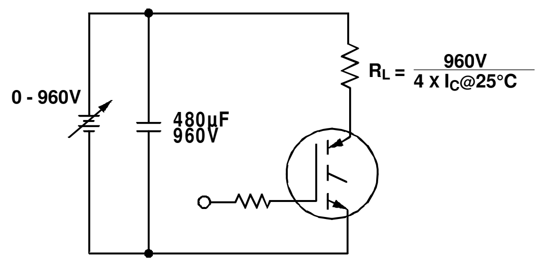



**Fig. 13b** - Pulsed Collector Current Test Circuit

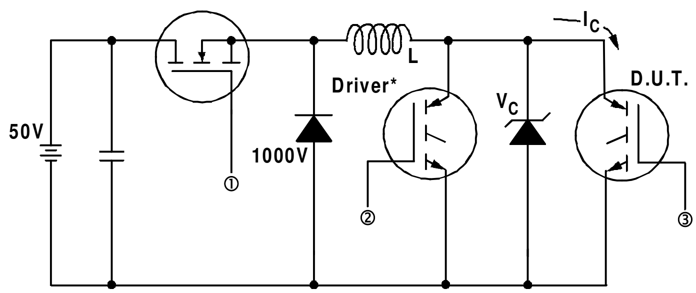



**Fig. 14a** - Switching Loss Test Circuit

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

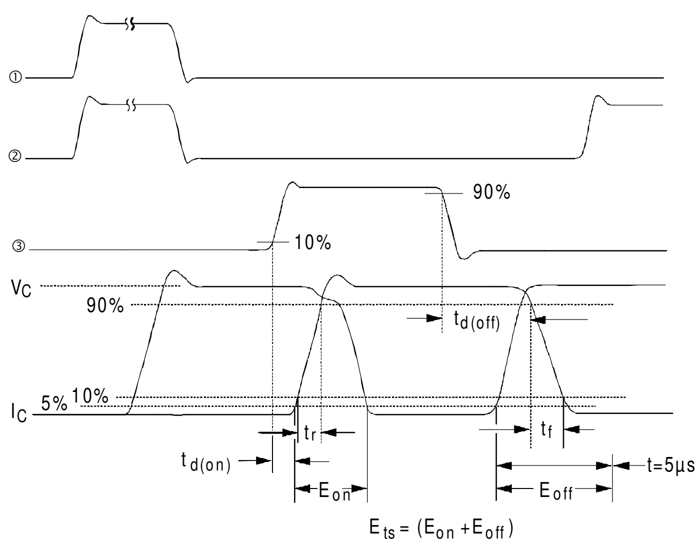
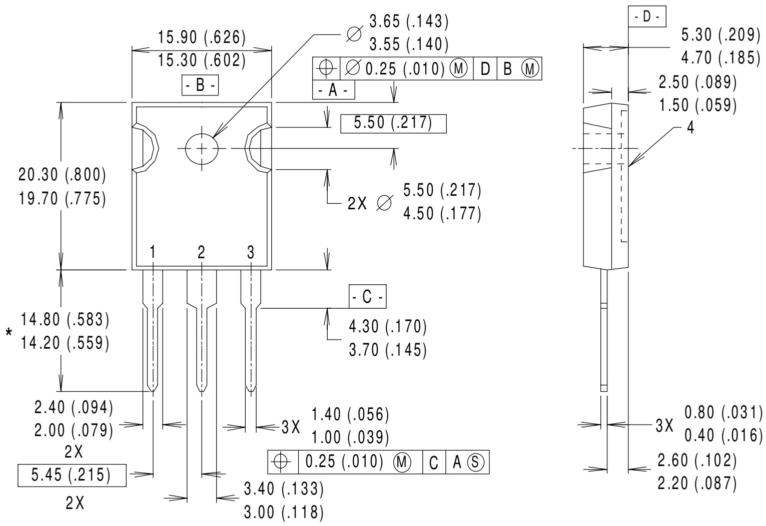



**Fig. 14b** - Switching Loss Waveforms

## Case Outline and Dimensions — TO-247AC




NOTES:
1 DIMENSIONS & TOLERANCING PER ANSI Y14.5M, 1982.
2 CONTROLLING DIMENSION : INCH.
3 DIMENSIONS ARE SHOWN MILLIMETERS (INCHES).
4 CONFORMS TO JEDEC OUTLINE TO-247AC.

LEAD ASSIGNMENTS
1 - GATE
2 - COLLECTOR
3 - EMITTER
4 - COLLECTOR

* LONGER LEADED (20mm) VERSION AVAILABLE (TO-247AD) TO ORDER ADD "-E" SUFFIX TO PART NUMBER

**CONFORMS TO JEDEC OUTLINE TO-247AC (TO-3P)**
Dimensions in Millimeters and (Inches)

International
IOR Rectifier

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**IR CANADA:** 15 Lincoln Court, Brampton, Ontario L6T3Z2, Tel: (905) 453 2200
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*http://www.irf.com/ Data and specifications subject to change without notice. 01/02*

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