PD 91785A

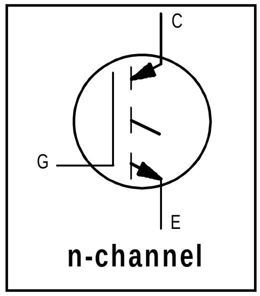
International
IOR Rectifier

# IRG4IBC20W

INSULATED GATE BIPOLAR TRANSISTOR

## Features

- Designed expressly for Switch-Mode Power Supply and PFC (power factor correction) applications
- 2.5kV, 60s insulation voltage ⑥
- 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
- Industry standard Isolated TO-220 Fullpak™ outline



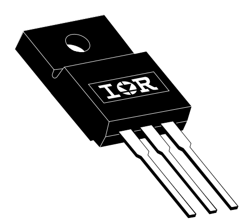

$V_{CES} = 600V$

$V_{CE(on)\ typ.} = 2.16V$

$@V_{GE} = 15V, I_C = 6.5A$

## Benefits

- Lower switching losses allow more cost-effective operation than power MOSFETs up to 150 kHz ("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 >>300 kHz)



TO-220 FULLPAK

## Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $V_{CES}$ | Collector-to-Emitter Breakdown Voltage | 600 | V |
| $I_C$ @ $T_C$ = 25°C | Continuous Collector Current | 11.8 | A |
| $I_C$ @ $T_C$ = 100°C | Continuous Collector Current | 6.2 | |
| $I_{CM}$ | 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 | 34 | W |
| $P_D$ @ $T_C$ = 100°C | Maximum Power Dissipation | 14 | |
| $T_J$<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 - IGBT | —— | 3.7 | °C/W |
| $R_{\theta JA}$ | Junction-to-Ambient, typical socket mount | —— | 65 | |
| Wt | Weight | 2.0 (0.07) | —— | g (oz) |



12/30/00

## 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.

⑥ t = 60s, f = 60Hz

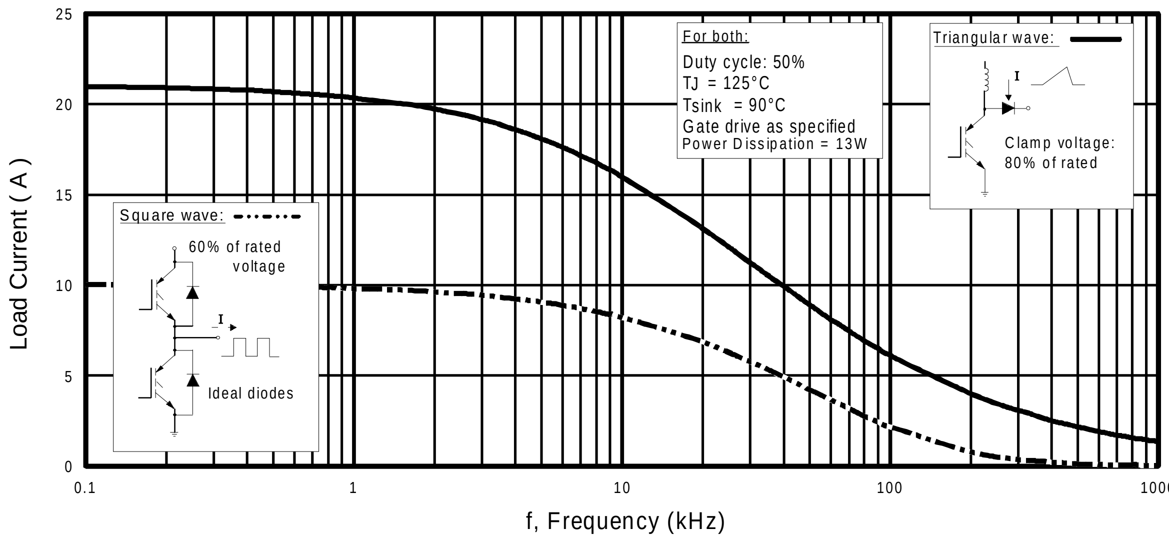



**Fig. 1** - Typical Load Current vs. Frequency
(Load Current = $I_{RMS}$ of fundamental)

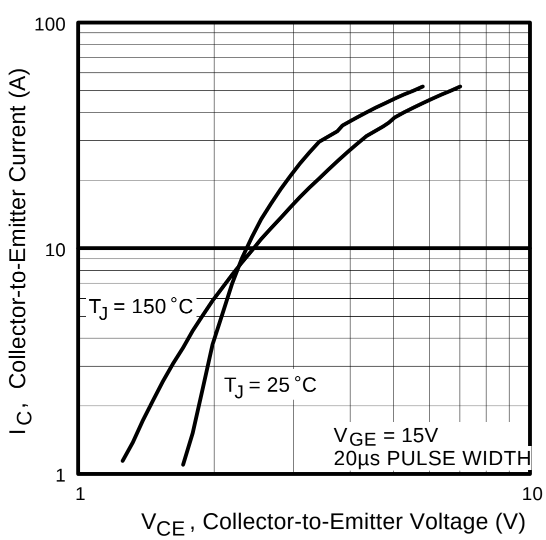



**Fig. 2** - Typical Output Characteristics

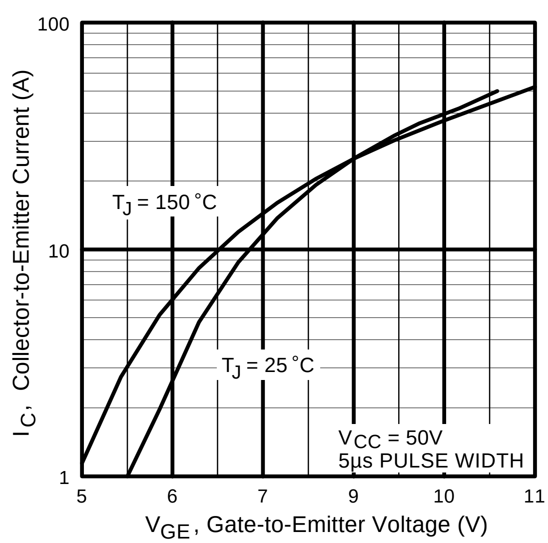



**Fig. 3** - Typical Transfer Characteristics

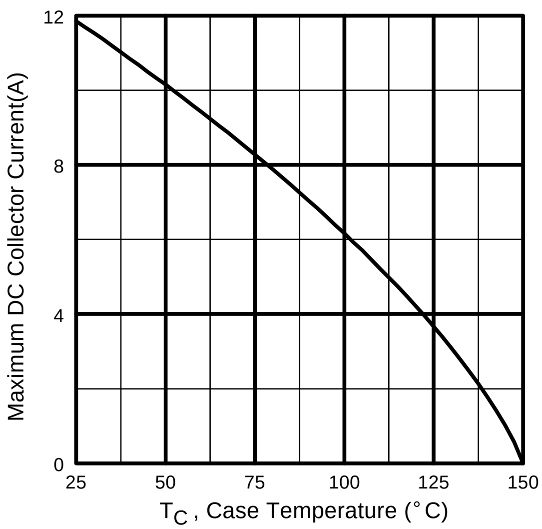



**Fig. 4** - Maximum Collector Current vs. Case Temperature

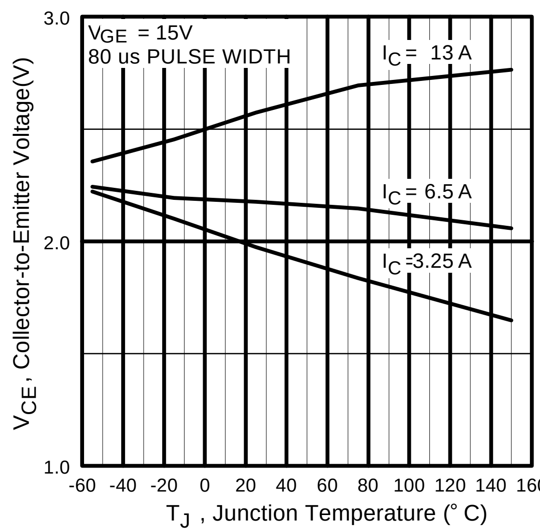



**Fig. 5** - Typical Collector-to-Emitter Voltage vs. Junction Temperature

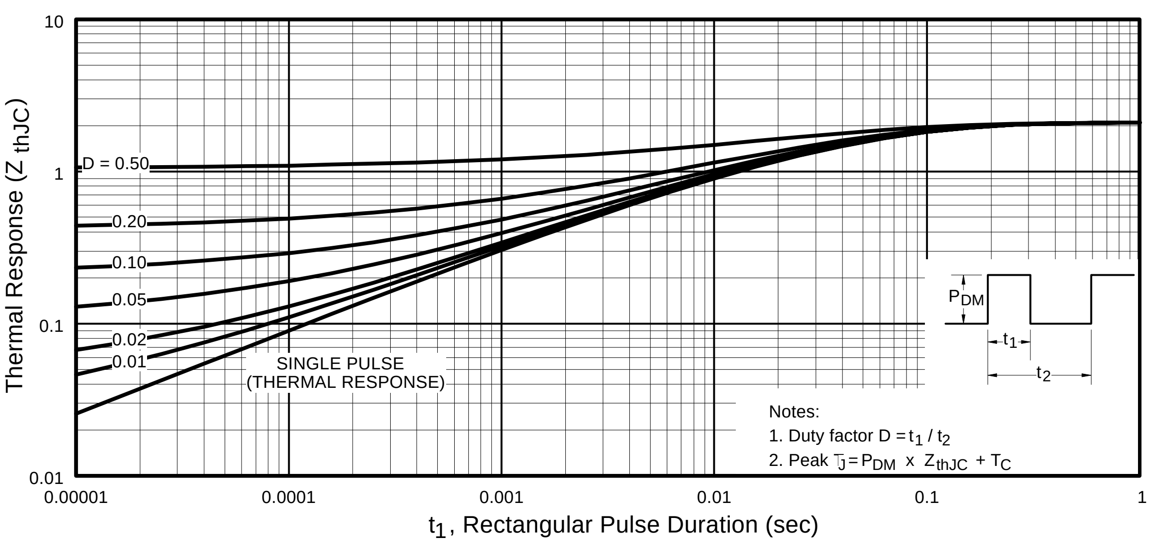



**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case

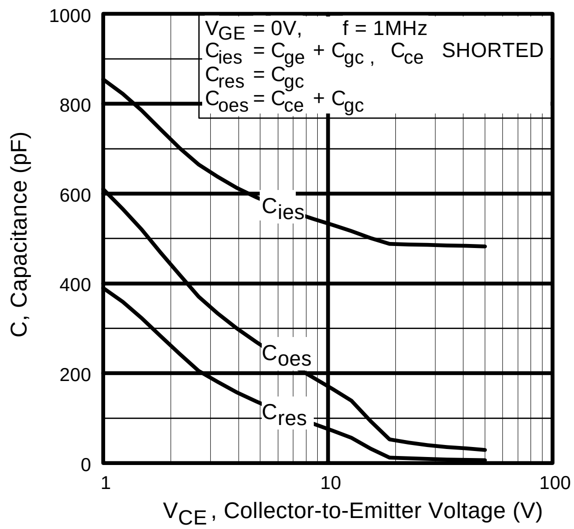



**Fig. 7 -** Typical Capacitance vs. Collector-to-Emitter Voltage

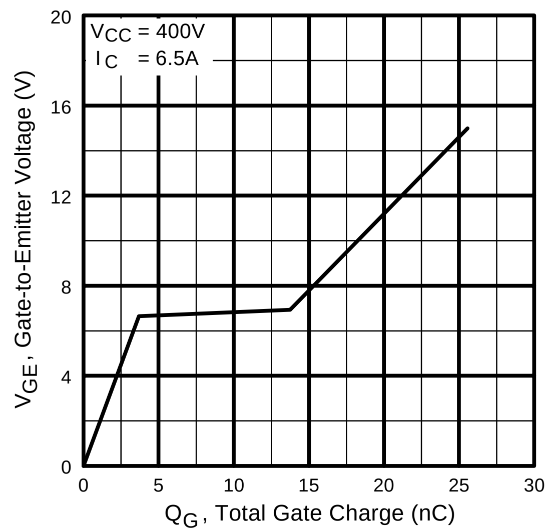



**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage

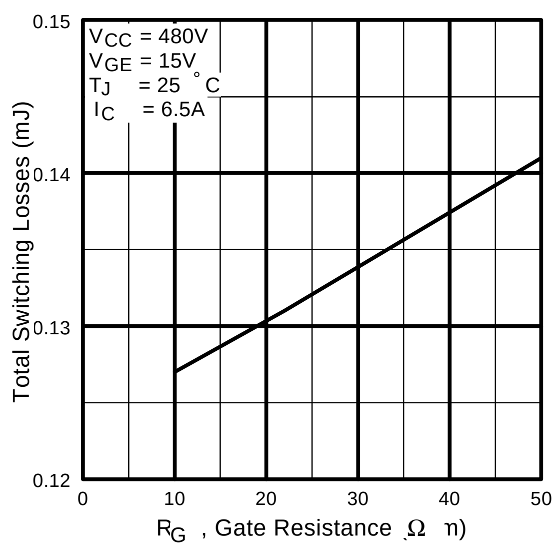



**Fig. 9** - Typical Switching Losses vs. Gate Resistance

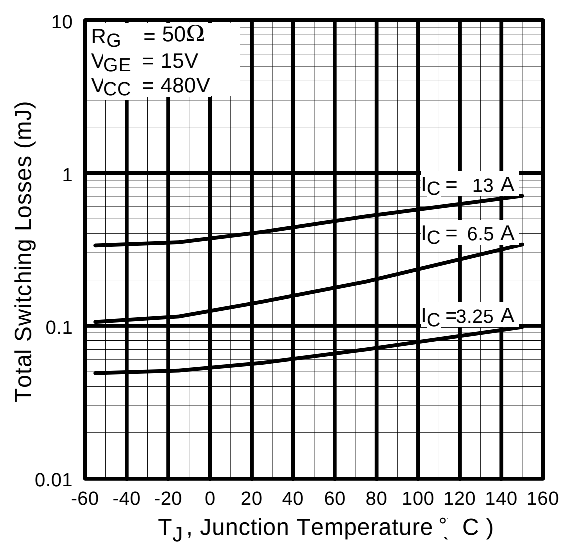



**Fig. 10** - Typical Switching Losses vs. Junction Temperature

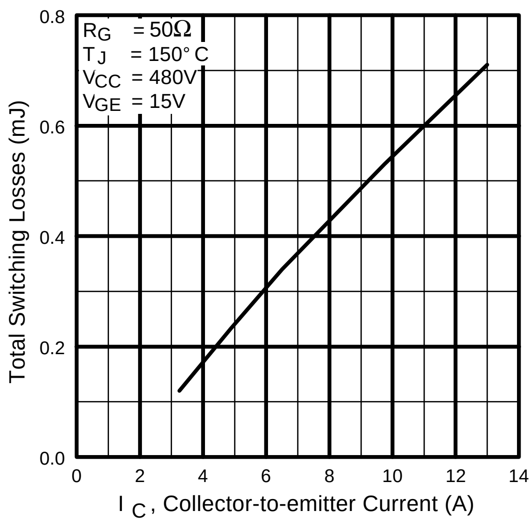



**Fig. 11 -** Typical Switching Losses vs. Collector-to-Emitter Current

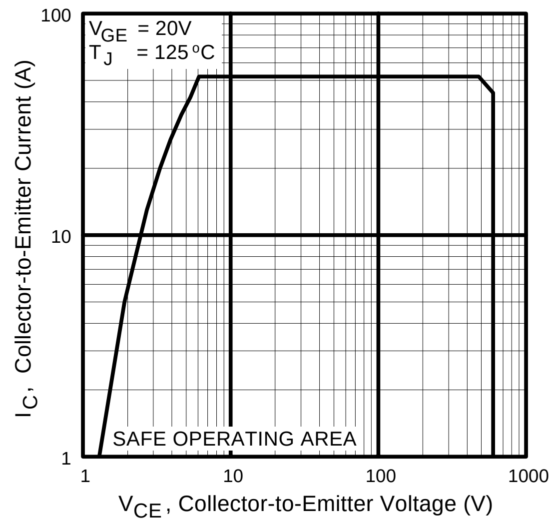



**Fig. 12 -** Turn-Off SOA

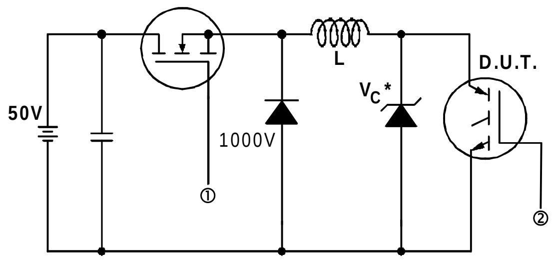



**Fig. 13a** - Clamped Inductive Load Test Circuit

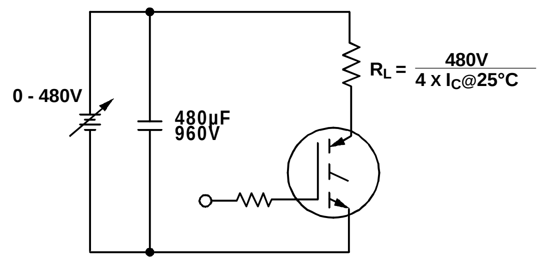



**Fig. 13b** - Pulsed Collector Current Test Circuit

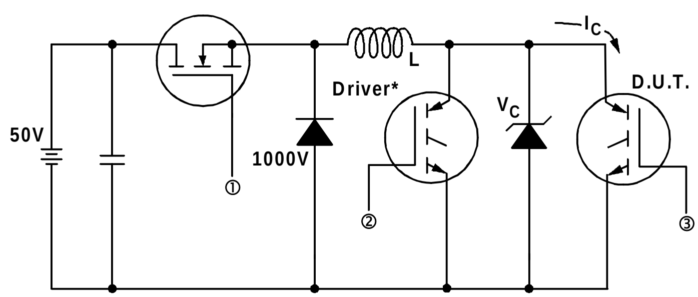



**Fig. 14a** - Switching Loss Test Circuit

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

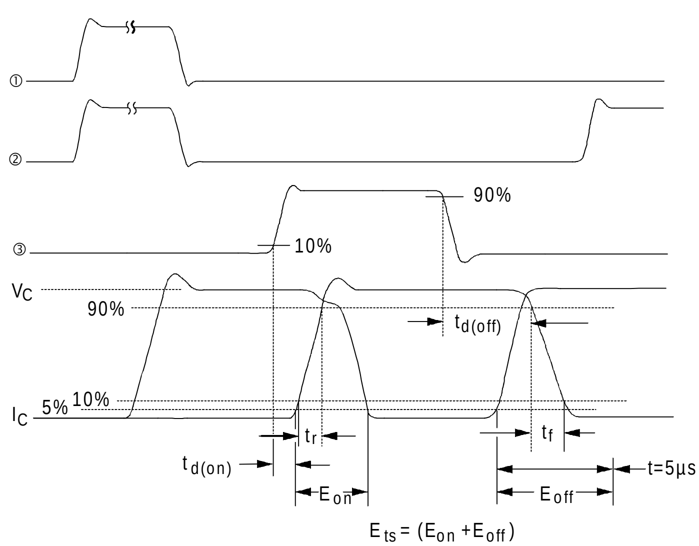
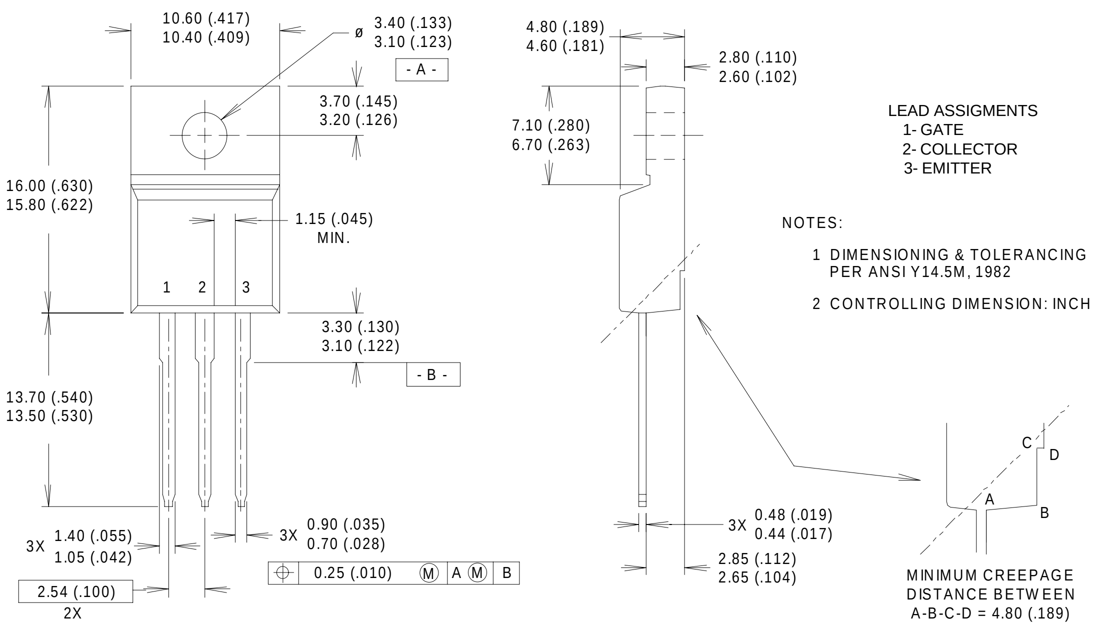



**Fig. 14b** - Switching Loss Waveforms

## Case Outline — TO-220 FULLPAK




LEAD ASSIGMENTS
1- GATE
2- COLLECTOR
3- EMITTER

NOTES:

1 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982

2 CONTROLLING DIMENSION: INCH.

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*Data and specifications subject to change without notice. 12/00*

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