International
IOR Rectifier

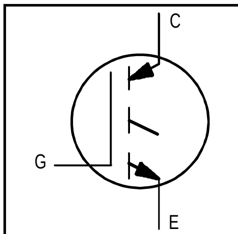
PRELIMINARY

# IRG4IBC30W

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




n-channel

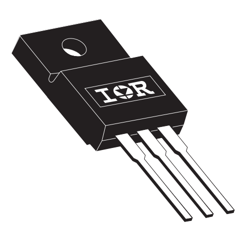
$V_{CES} = 600V$

$V_{CE(on)\ typ.} = 2.1V$

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

## 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 | 17 | A |
| $I_C$ @ $T_C$ = 100°C | Continuous Collector Current | 8.4 | |
| $I_{CM}$ | 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 | 180 | mJ |
| $P_D$ @ $T_C$ = 25°C | Maximum Power Dissipation | 45 | W |
| $P_D$ @ $T_C$ = 100°C | Maximum Power Dissipation | 18 | |
| $T_J$<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 | ––– | 2.8 | °C/W |
| $R_{\theta JA}$ | Junction-to-Ambient, typical socket mount | ––– | 65 | |
| Wt | Weight | 2.0 (0.07) | ––– | g (oz) |



8/13/98

## 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 | — | 0.34 | — | V/°C | $V_{GE}$ = 0V, $I_C$ = 1.0mA |
| $V_{CE(ON)}$ | Collector-to-Emitter Saturation Voltage | — | 2.1 | 2.7 | V | $I_C$ = 12A, $V_{GE}$ = 15V |
| | | — | 2.45 | — | | $I_C$ = 23A, See Fig.2, 5 |
| | | — | 1.95 | — | | $I_C$ = 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 | — | -11 | — | mV/°C | $V_{CE}$ = $V_{GE}$, $I_C$ = 250µA |
| $g_{fe}$ | Forward Transconductance ⑤ | 11 | 16 | — | 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) | — | 51 | 76 | nC | $I_C$ = 12A |
| $Q_{ge}$ | Gate - Emitter Charge (turn-on) | — | 7.6 | 11 | | $V_{CC}$ = 400V See Fig.8 |
| $Q_{gc}$ | Gate - Collector Charge (turn-on) | — | 18 | 27 | | $V_{GE}$ = 15V |
| $t_{d(on)}$ | Turn-On Delay Time | — | 25 | — | ns | |
| $t_r$ | Rise Time | — | 16 | — | | $T_J$ = 25°C |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 99 | 150 | | $I_C$ = 12A, $V_{CC}$ = 480V |
| $t_f$ | Fall Time | — | 67 | 100 | | $V_{GE}$ = 15V, $R_G$ = 23Ω |
| $E_{on}$ | Turn-On Switching Loss | — | 0.13 | — | mJ | Energy losses include "tail" |
| $E_{off}$ | Turn-Off Switching Loss | — | 0.13 | — | | See Fig. 9, 10, 13, 14 |
| $E_{ts}$ | Total Switching Loss | — | 0.26 | 0.35 | | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 24 | — | ns | $T_J$ = 150°C, |
| $t_r$ | Rise Time | — | 17 | — | | $I_C$ = 12A, $V_{CC}$ = 480V |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 150 | — | | $V_{GE}$ = 15V, $R_G$ = 23Ω |
| $t_f$ | Fall Time | — | 150 | — | | Energy losses include "tail" |
| $E_{ts}$ | Total Switching Loss | — | 0.55 | — | mJ | See Fig. 11,13, 14 |
| $L_E$ | Internal Emitter Inductance | — | 7.5 | — | nH | Measured 5mm from package |
| $C_{ies}$ | Input Capacitance | — | 980 | — | pF | $V_{GE}$ = 0V |
| $C_{oes}$ | Output Capacitance | — | 71 | — | | $V_{CC}$ = 30V See Fig. 7 |
| $C_{res}$ | Reverse Transfer Capacitance | — | 18 | — | | 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, $R_G$ = 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.

⑥ t = 60s, f = 60Hz

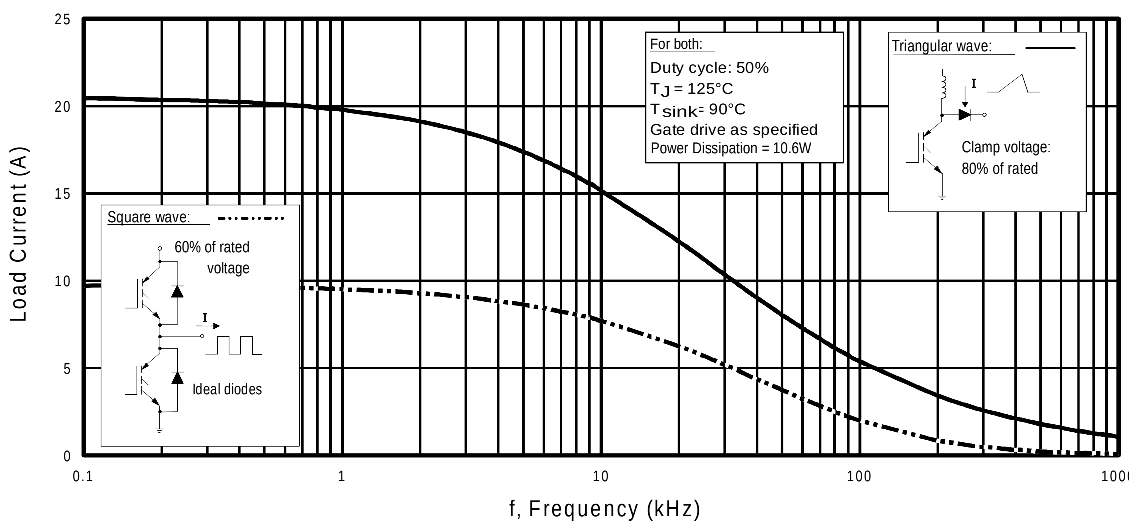



**Fig. 1** - Typical Load Current vs. Frequency
(For square wave, $I=I_{RMS}$ of fundamental; for triangular wave, $I=I_{PK}$)

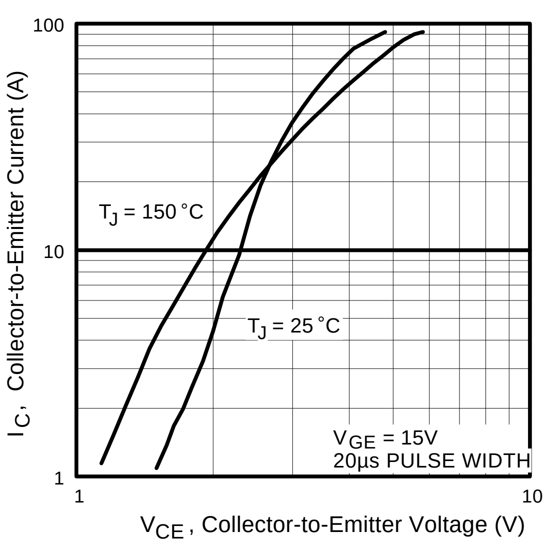



**Fig. 2** - Typical Output Characteristics

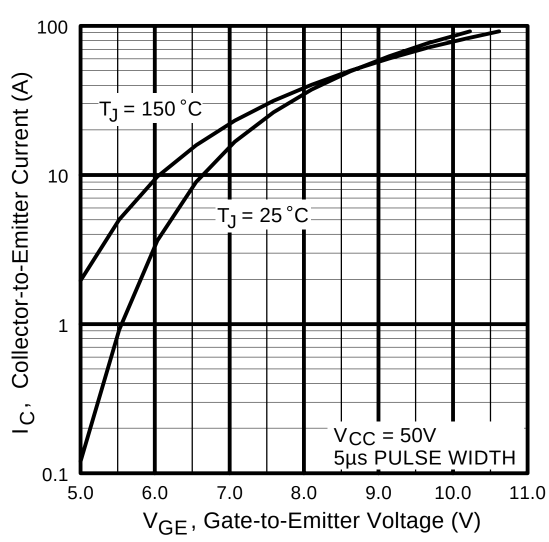



**Fig. 3** - Typical Transfer Characteristics

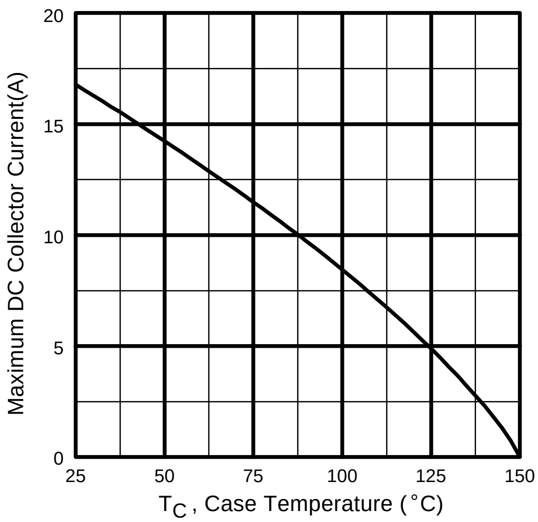



**Fig. 4** - Maximum Collector Current vs. Case Temperature

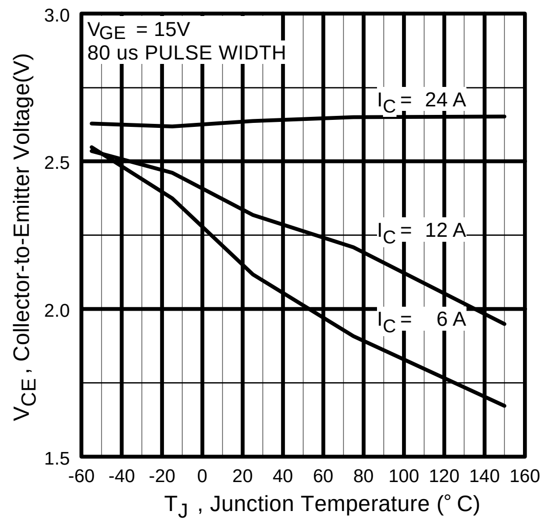



**Fig. 5** - Collector-to-Emitter Voltage vs. Junction Temperature

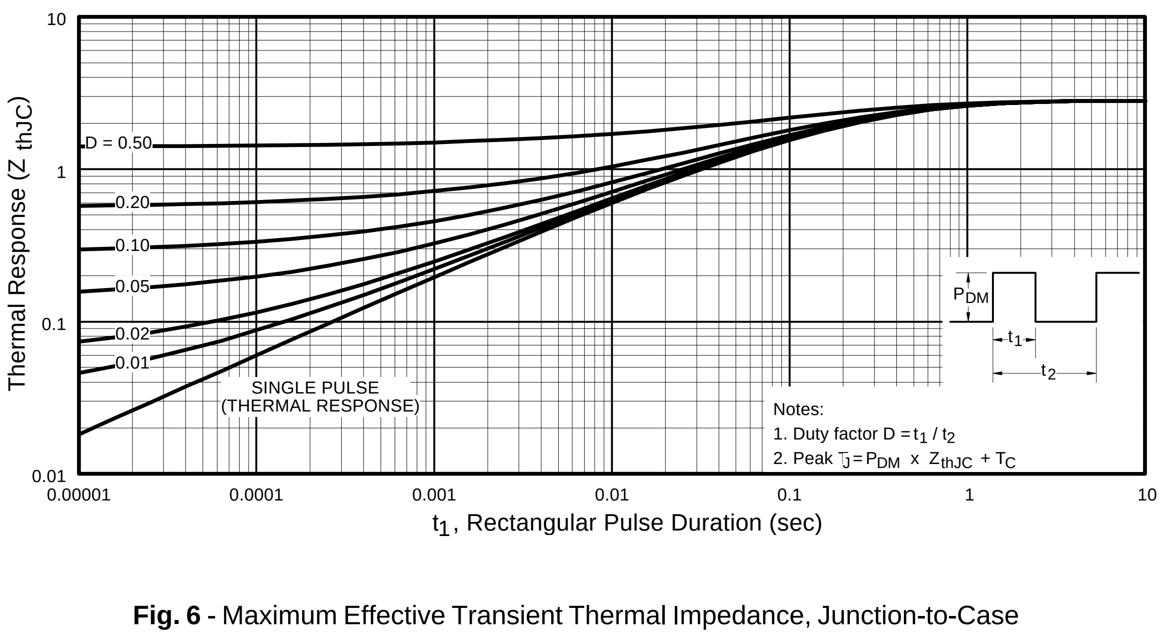



**Fig. 6** - Maximum Effective Transient Thermal Impedance, Junction-to-Case

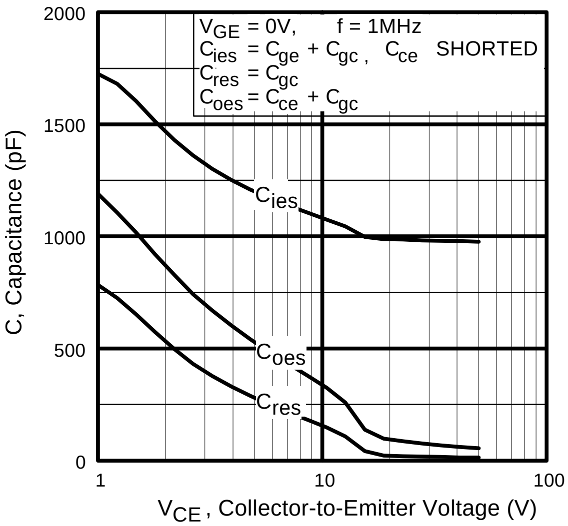



**Fig. 7 -** Typical Capacitance vs. Collector-to-Emitter Voltage

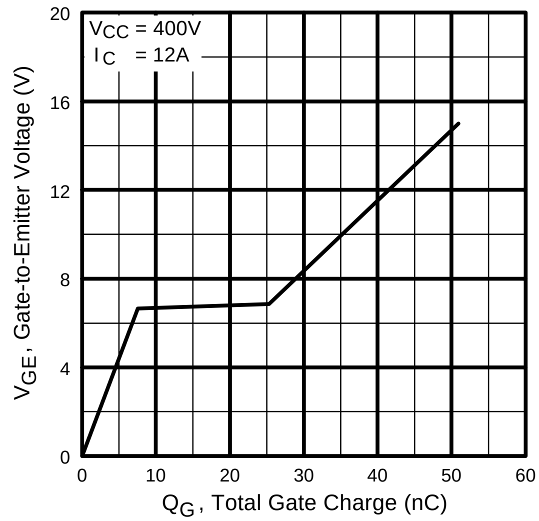



**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage

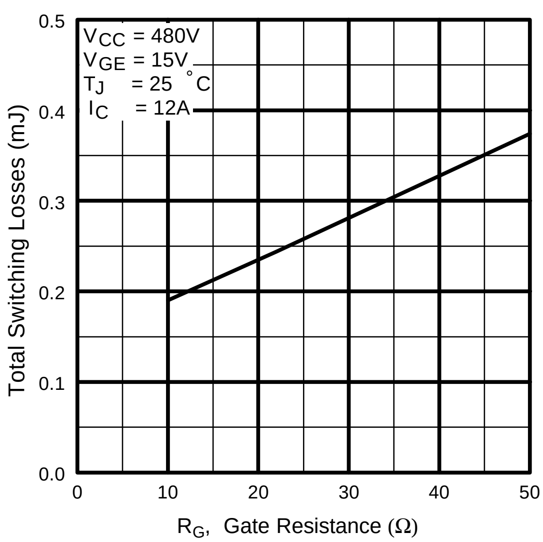




**Fig. 9** - Typical Switching Losses vs. Gate Resistance

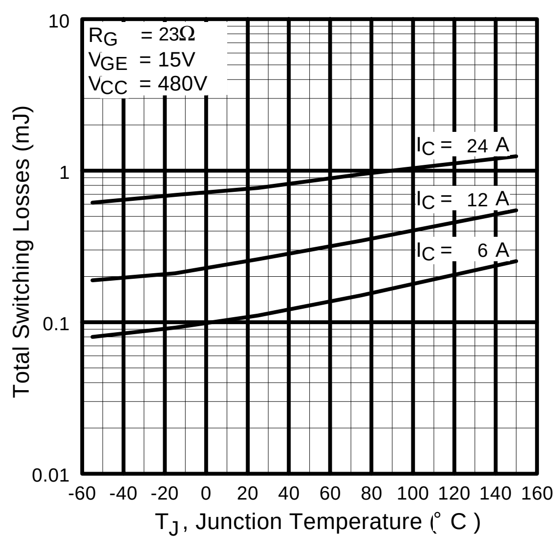



**Fig. 10** - Typical Switching Losses vs. Junction Temperature

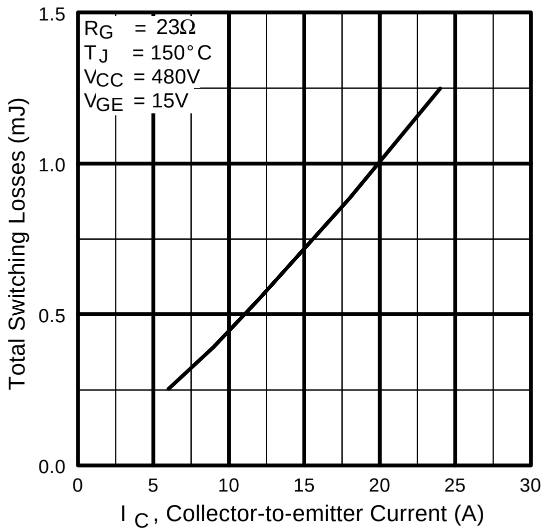



**Fig. 11 -** Typical Switching Losses vs. Collector-to-Emitter Current

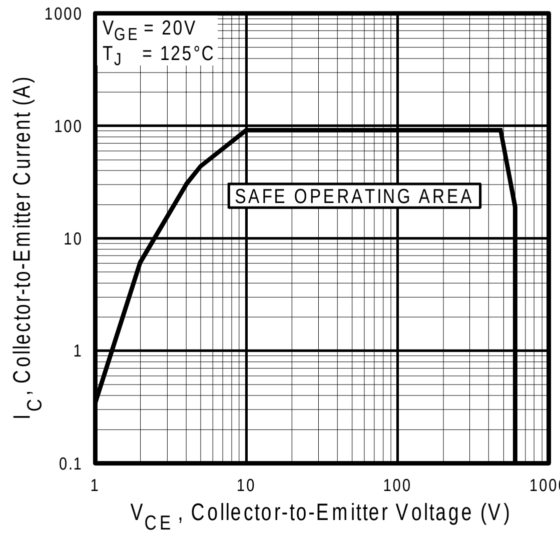



**Fig. 12** - Turn-Off SOA

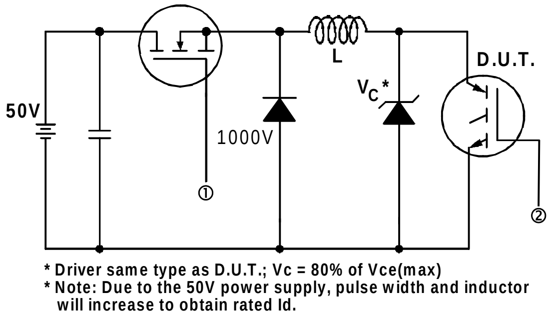



**Fig. 13a** - Clamped Inductive Load Test Circuit

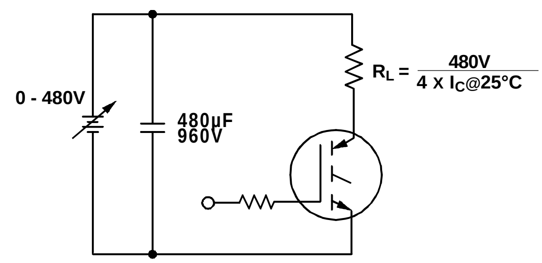



**Fig. 13b** - Pulsed Collector Current Test Circuit

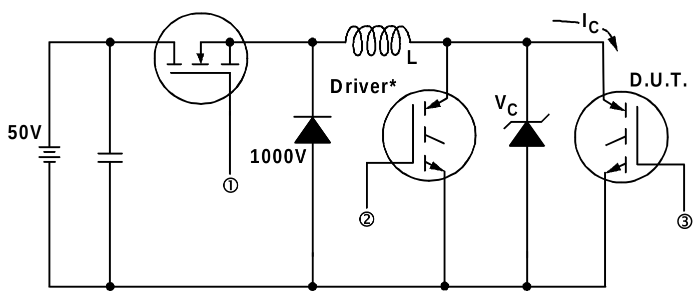



**Fig. 14a** - Switching Loss Test Circuit

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

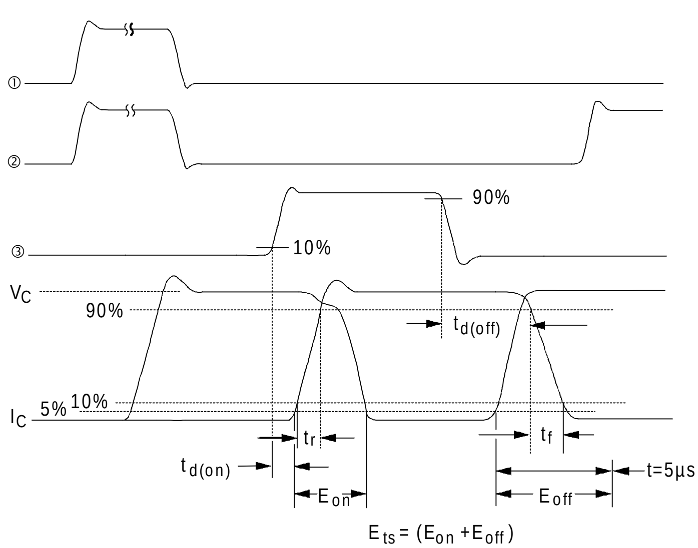
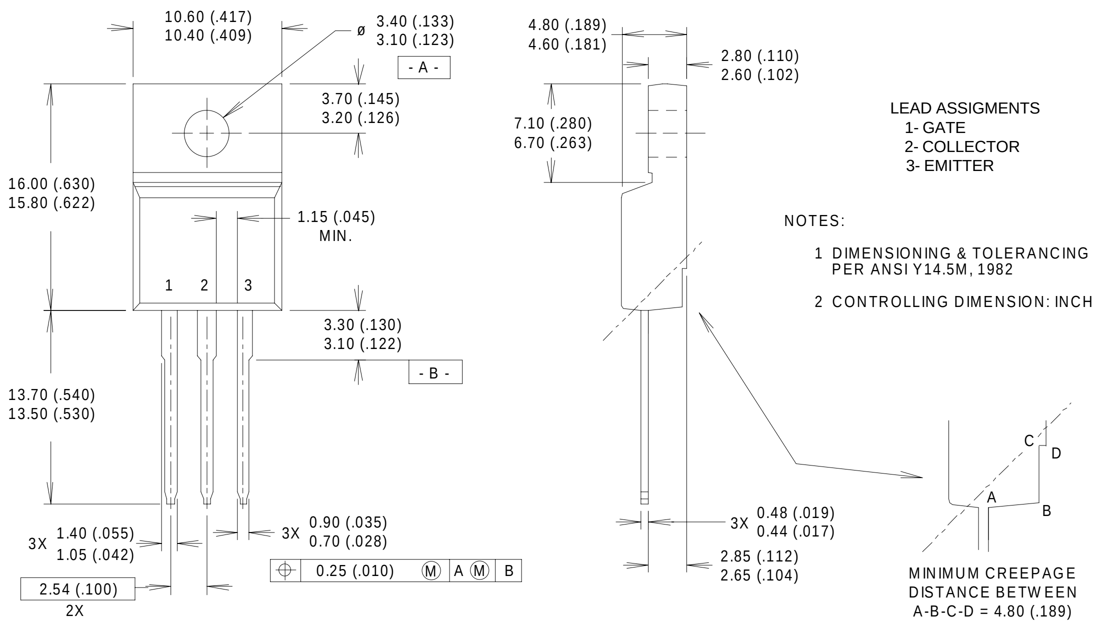



**Fig. 14b** - Switching Loss Waveforms

## Case Outline — TO-220 FULLPAK




International
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