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International
IOR Rectifier

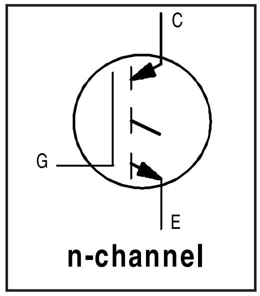
IRG4BC40U

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-220AB package



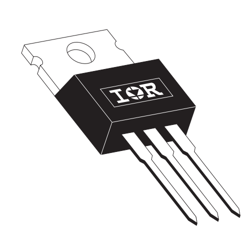
$V_{CES} = 600V$

$V_{CE(on)}$ typ. $= 1.72V$

$@V_{GE} = 15V, I_C = 20A$

Benefits

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



TO-220AB

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
I_C @ $T_C = 25°C$	Continuous Collector Current	40	A
I_C @ $T_C = 100°C$	Continuous Collector Current	20	
I_{CM}	Pulsed Collector Current ①	160	
I_{LM}	Clamped Inductive Load Current ②	160	
V_{GE}	Gate-to-Emitter Voltage	±20	V
E_{ARV}	Reverse Voltage Avalanche Energy ③	15	mJ
P_D @ $T_C = 25°C$	Maximum Power Dissipation	160	W
P_D @ $T_C = 100°C$	Maximum Power Dissipation	65	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	°C
	Soldering Temperature, for 10 sec.	300 (0.063 in. (1.6mm) from case)	
	Mounting torque, 6-32 or M3 screw.	10 lbf•in (1.1N•m)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	------	------	0.77	°C/W
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	------	0.50	------	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	------	------	80	
Wt	Weight	------	2 (0.07)	------	g (oz)

4/17/2000

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 See Fig. 2, 5
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	----	0.63	----	V/°C	V_{GE} = 0V, I_C = 1.0mA
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	----	1.72	2.1	V	I_C = 20A, V_{GE} = 15V
		----	2.15	----		I_C = 40A
		----	1.7	----		I_C = 20A, 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	11	18	----	S	V_{CE} = 100V, I_C = 20A
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
		----	----	2500		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)	----	100	150	nC	I_C = 20A
Q_{ge}	Gate - Emitter Charge (turn-on)	----	16	25		V_{CC} = 400V See Fig. 8
Q_{gc}	Gate - Collector Charge (turn-on)	----	40	60		V_{GE} = 15V
$t_{d(on)}$	Turn-On Delay Time	----	34	----	ns	T_J = 25°C
t_r	Rise Time	----	19	----		I_C = 20A, V_{CC} = 480V
$t_{d(off)}$	Turn-Off Delay Time	----	110	175		V_{GE} = 15V, R_G = 10Ω
t_f	Fall Time	----	120	180		Energy losses include "tail"
E_{on}	Turn-On Switching Loss	----	0.32	----	mJ	
E_{off}	Turn-Off Switching Loss	----	0.35	----		See Fig. 10, 11, 13, 14
E_{ts}	Total Switching Loss	----	0.67	1.0		
$t_{d(on)}$	Turn-On Delay Time	----	30	----	ns	T_J = 150°C,
t_r	Rise Time	----	19	----		I_C = 20A, V_{CC} = 480V
$t_{d(off)}$	Turn-Off Delay Time	----	220	----		V_{GE} = 15V, R_G = 10Ω
t_f	Fall Time	----	160	----		Energy losses include "tail"
E_{ts}	Total Switching Loss	----	1.4	----	mJ	See Fig. 13, 14
L_E	Internal Emitter Inductance	----	7.5	----	nH	Measured 5mm from package
C_{ies}	Input Capacitance	----	2100	----	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	----	140	----		V_{CC} = 30V See Fig. 7
C_{res}	Reverse Transfer Capacitance	----	34	----		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 = 10Ω, (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.

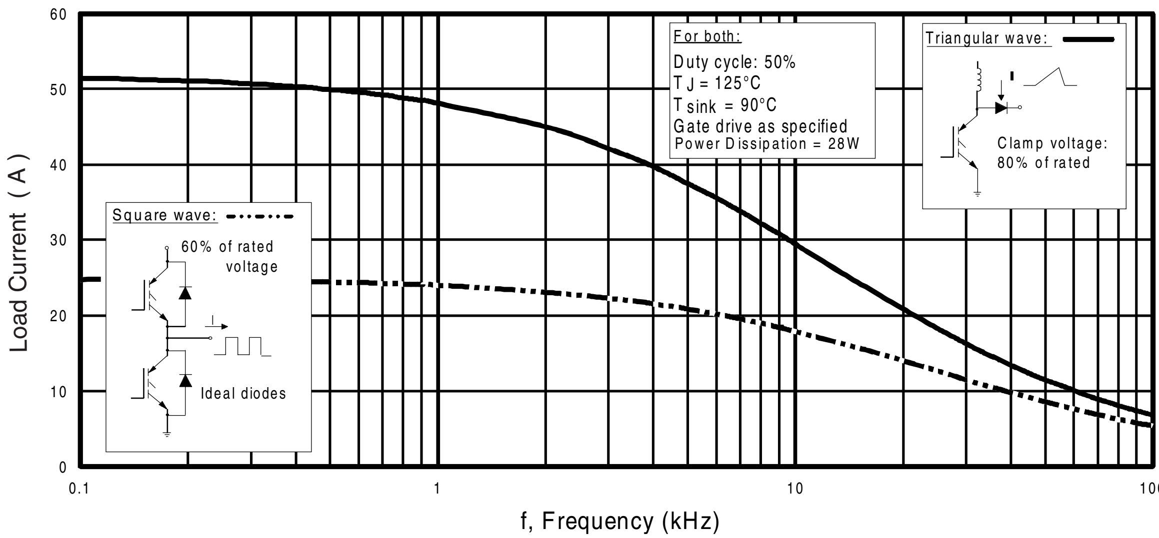


Fig. 1 - Typical Load Current vs. Frequency
(For square wave, $I=I_{RMS}$ of fundamental; for triangular wave, $I=I_{PK}$)

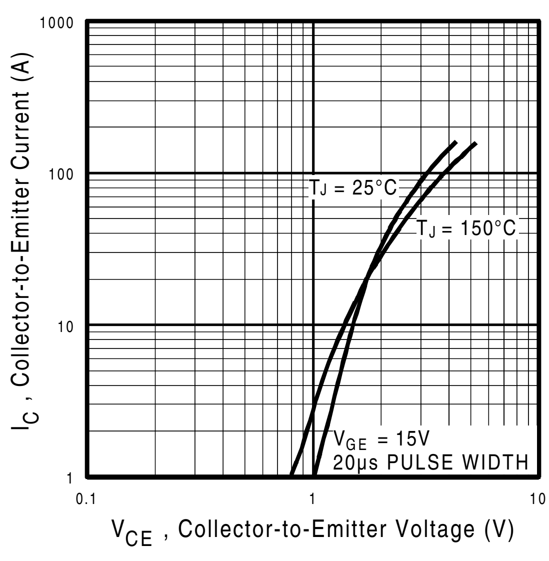


Fig. 2 - Typical Output Characteristics
$T_C = 25°C$

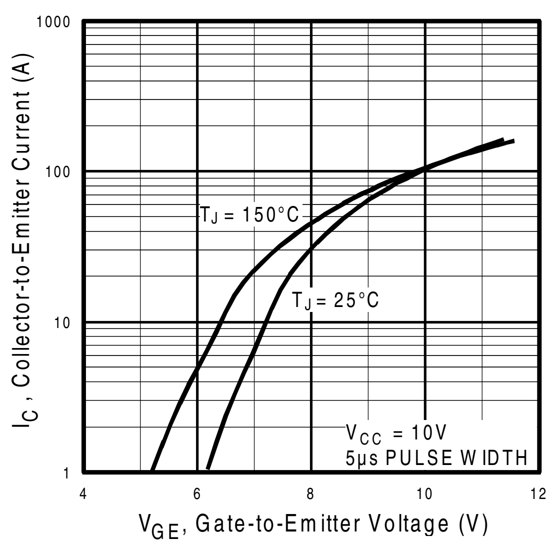


Fig. 3 - Typical Transfer Characteristics

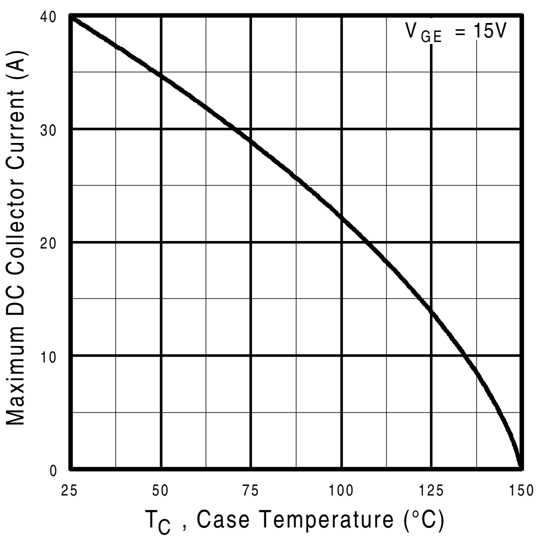


Fig. 4 - Maximum Collector Current vs. Case Temperature

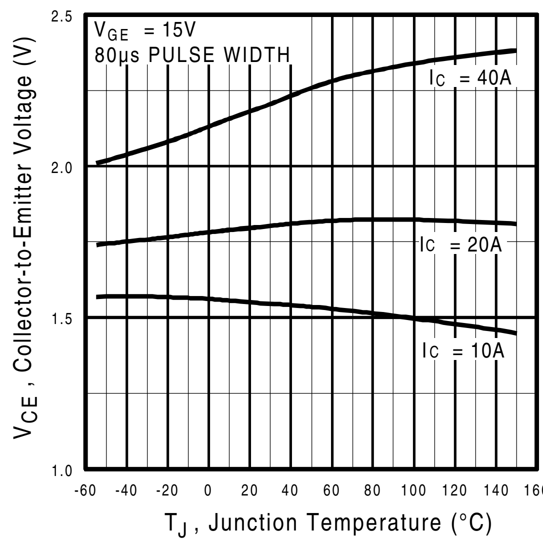


Fig. 5 - Collector-to-Emitter Voltage vs. Junction Temperature

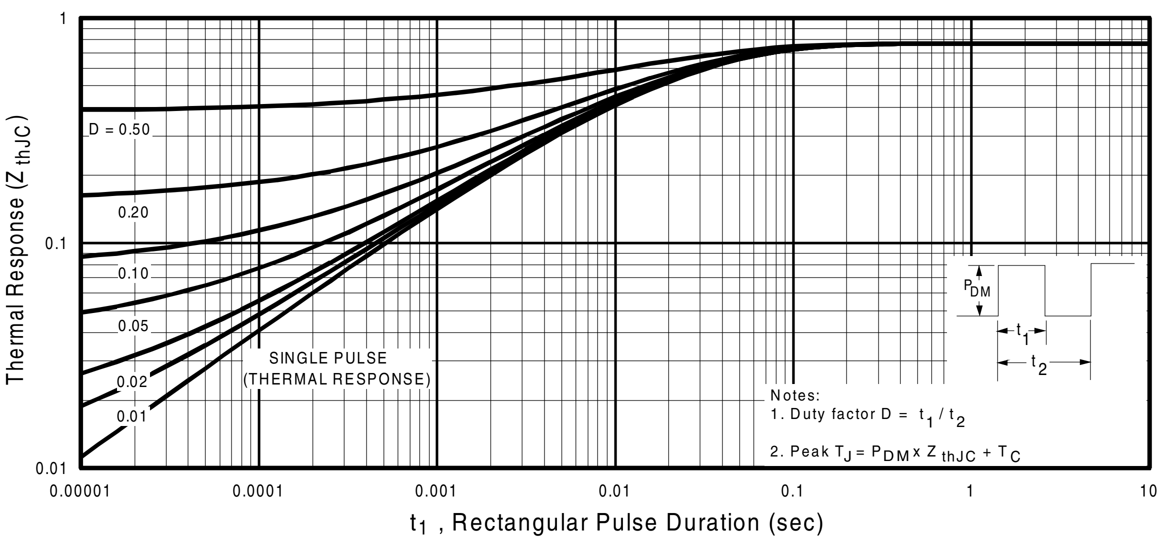


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

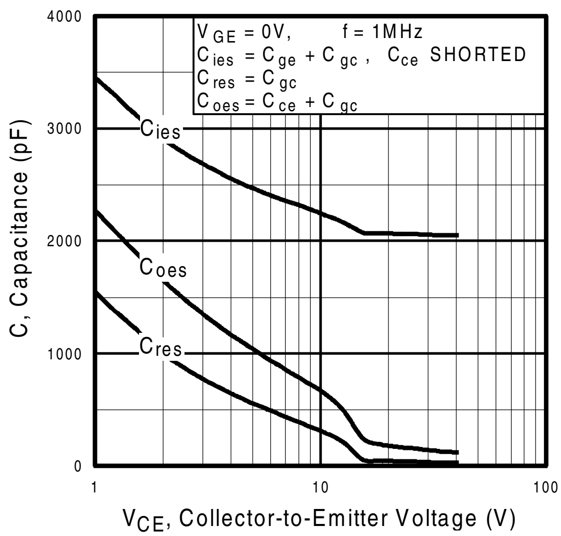


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

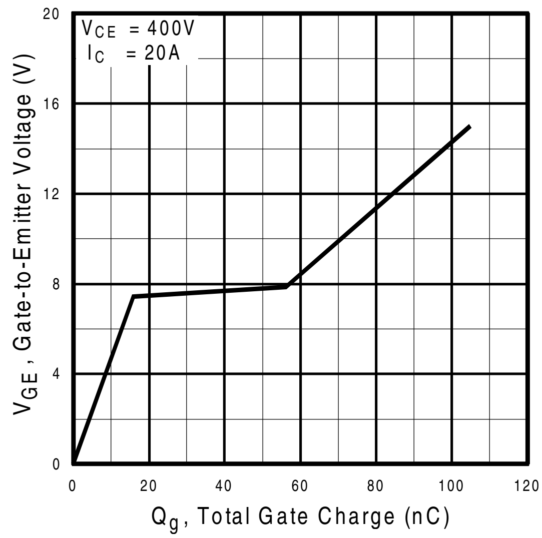


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

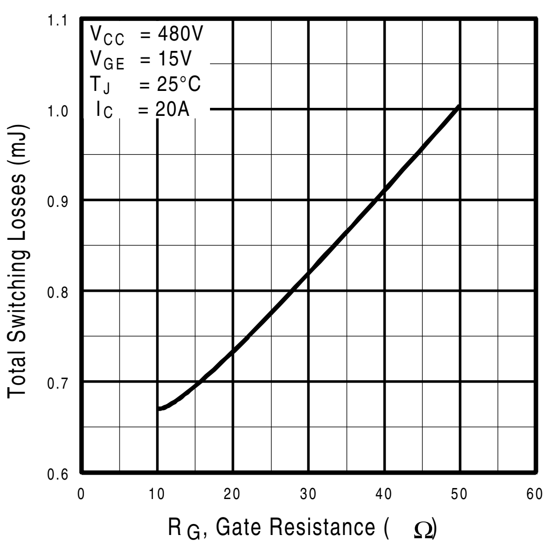


Fig. 9 - Typical Switching Losses vs. Gate Resistance

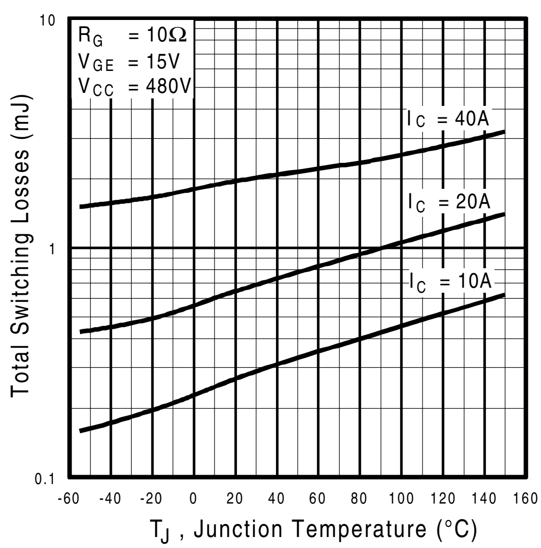


Fig. 10 - Typical Switching Losses vs. Junction Temperature

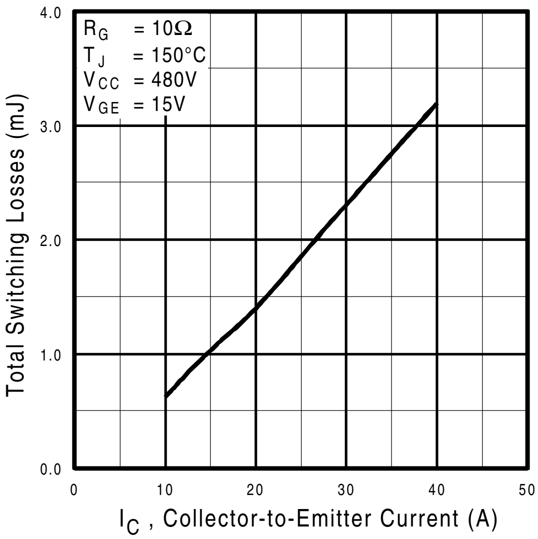


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

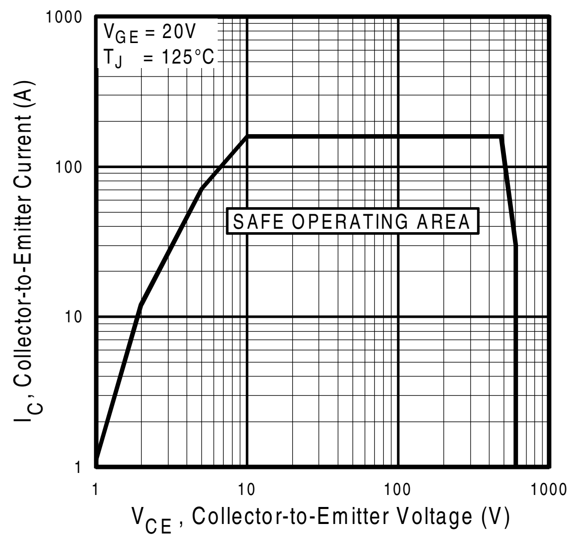
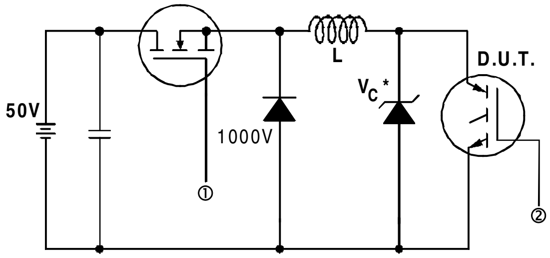


Fig. 12 - Turn-Off SOA



* 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

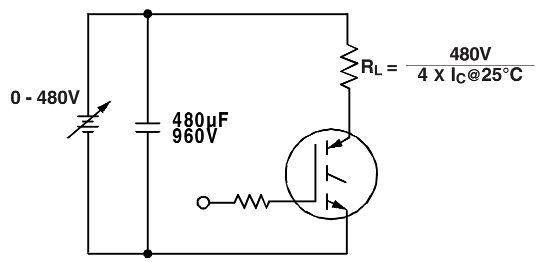


Fig. 13b - Pulsed Collector Current Test Circuit

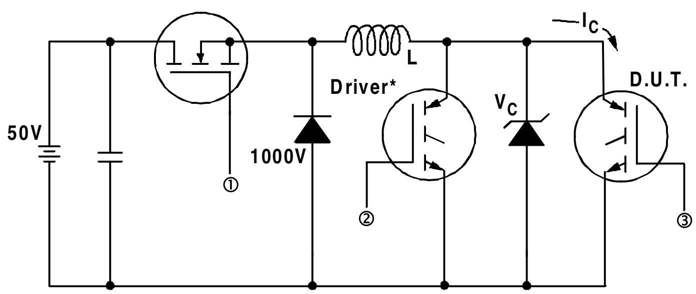


Fig. 14a - Switching Loss Test Circuit

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

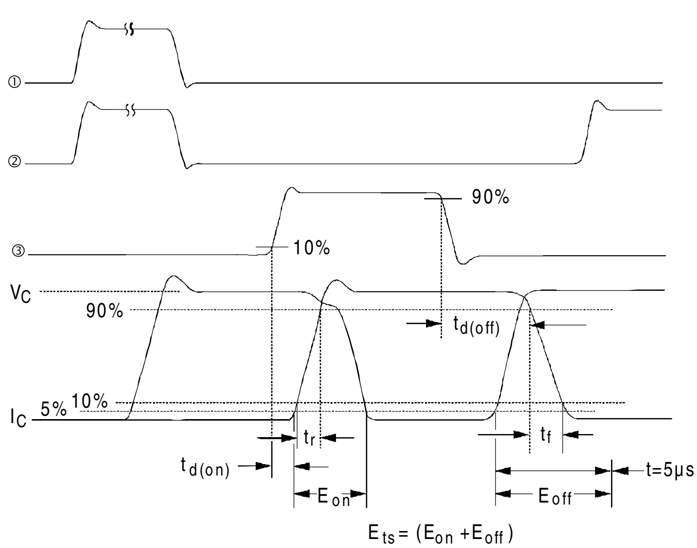
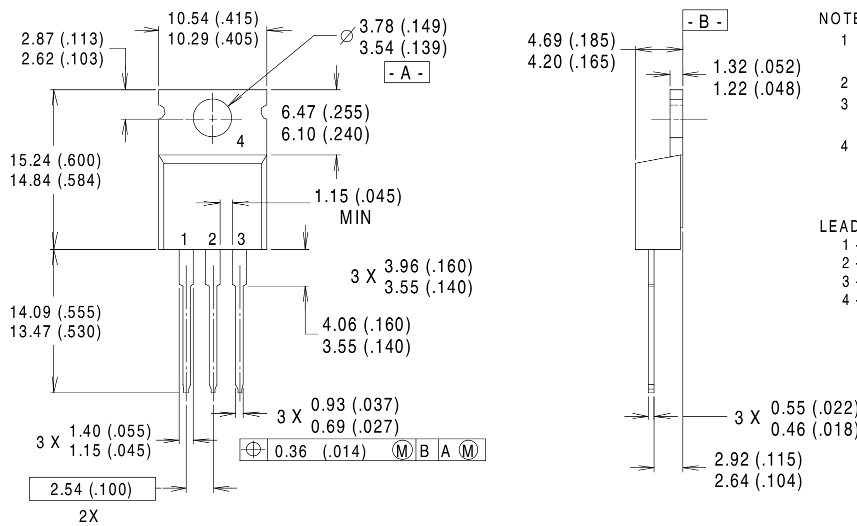


Fig. 14b - Switching Loss Waveforms

Case Outline and Dimensions — TO-220AB



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-220AB.

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

CONFORMS TO JEDEC OUTLINE TO-220AB
Dimensions in Millimeters and (Inches)

International
IOR Rectifier

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IR JAPAN: K&H Bldg., 2F, 30-4 Nishi-Ikebukuro 3-Chome, Toshima-Ku, Tokyo 171 Tel: 81 (0)3 3983 0086
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Data and specifications subject to change without notice. 4/00

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