International
IOR Rectifier

PD - 91455B

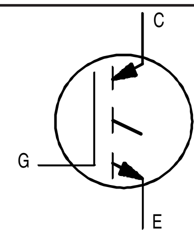
IRG4BC40S

INSULATED GATE BIPOLAR TRANSISTOR

Standard Speed IGBT

Features

- Standard: optimized for minimum saturation voltage and low operating frequencies (< 1kHz)
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency than Generation 3
- Industry standard TO-220AB package



n-channel

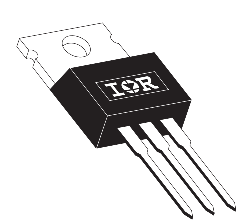
$V_{CES} = 600V$

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

@V_{GE} = 15V, I_C = 31A

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 Breakdown Voltage	600	V
I_C @ T_C = 25°C	Continuous Collector Current	60	A
I_C @ T_C = 100°C	Continuous Collector Current	31	
I_{CM}	Pulsed Collector Current ①	120	
I_{LM}	Clamped Inductive Load Current ②	120	
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 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	----	0.77	°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 (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	
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.75	—	V/°C	V_{GE} = 0V, I_C = 1.0mA	
$V_{CE(ON)}$	Collector-to-Emitter Saturation Voltage	—	1.32	1.5	V	I_C = 31A	V_{GE} = 15V
		—	1.68	—		I_C = 60A	See Fig.2, 5
		—	1.32	—		I_C = 31A , 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	—	-9.3	—	mV/°C	V_{CE} = V_{GE}, I_C = 250µA	
g_{fe}	Forward Transconductance ⑤	12	21	—	S	V_{CE} = 100V, I_C = 31A	
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)	—	100	150	nC	I_C = 31A
Q_{ge}	Gate - Emitter Charge (turn-on)	—	14	21		V_{CC} = 400V See Fig. 8
Q_{gc}	Gate - Collector Charge (turn-on)	—	34	51		V_{GE} = 15V
$t_{d(on)}$	Turn-On Delay Time	—	22	—	ns	
t_r	Rise Time	—	18	—		T_J = 25°C
$t_{d(off)}$	Turn-Off Delay Time	—	650	980		I_C = 31A, V_{CC} = 480V
t_f	Fall Time	—	380	570		V_{GE} = 15V, R_G = 10Ω
E_{on}	Turn-On Switching Loss	—	0.45	—	mJ	Energy losses include "tail"
E_{off}	Turn-Off Switching Loss	—	6.5	—		See Fig. 10, 11, 13, 14
E_{ts}	Total Switching Loss	—	6.95	9.9		
$t_{d(on)}$	Turn-On Delay Time	—	23	—	ns	T_J = 150°C,
t_r	Rise Time	—	21	—		I_C = 31A, V_{CC} = 480V
$t_{d(off)}$	Turn-Off Delay Time	—	1000	—		V_{GE} = 15V, R_G = 10Ω
t_f	Fall Time	—	940	—		Energy losses include "tail"
E_{ts}	Total Switching Loss	—	12	—	mJ	See Fig. 13, 14
L_E	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package
C_{ies}	Input Capacitance	—	2200	—	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	—	140	—		V_{CC} = 30V See Fig. 7
C_{res}	Reverse Transfer Capacitance	—	26	—		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.

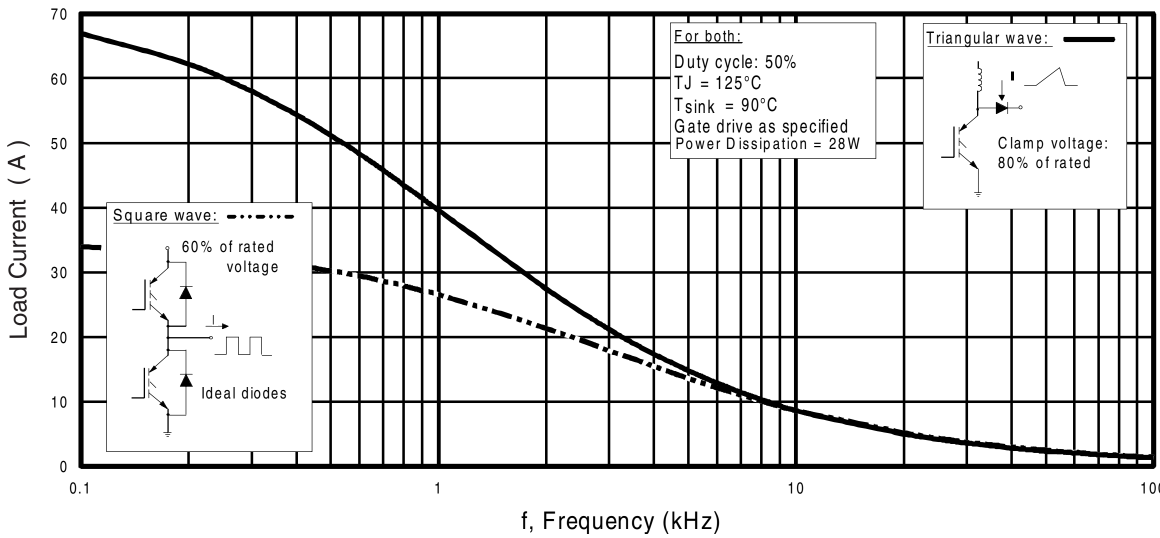


Fig. 1 - Typical Load Current vs. Frequency
(For square wave, $I=I_{RMS}$ of fundamental; for triangular wave, $I=I_{PK}$)

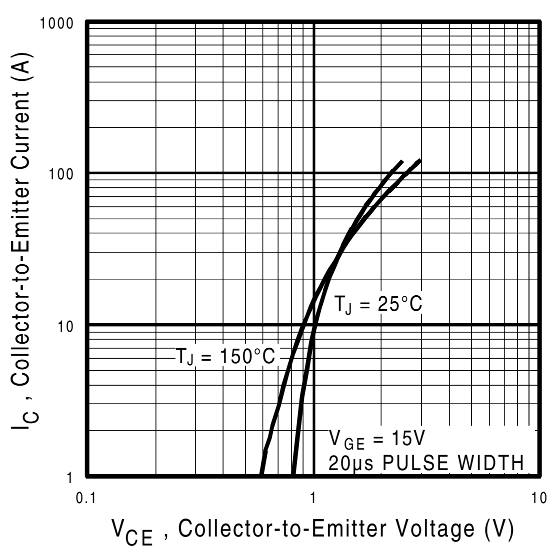


Fig. 2 - Typical Output Characteristics

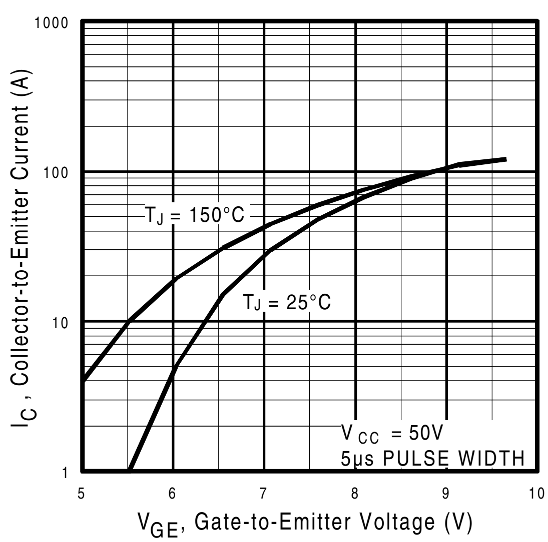


Fig. 3 - Typical Transfer Characteristics

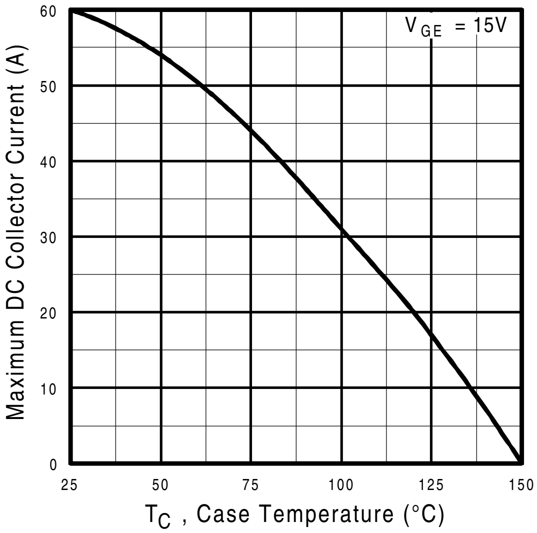


Fig. 4 - Maximum Collector Current vs. Case Temperature

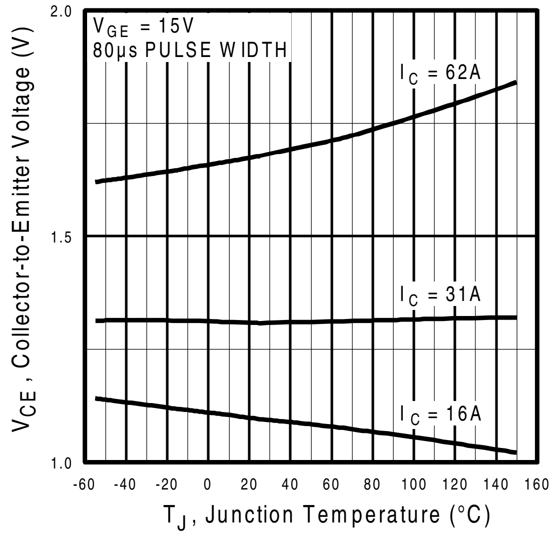


Fig. 5 - Collector-to-Emitter Voltage vs. Junction Temperature

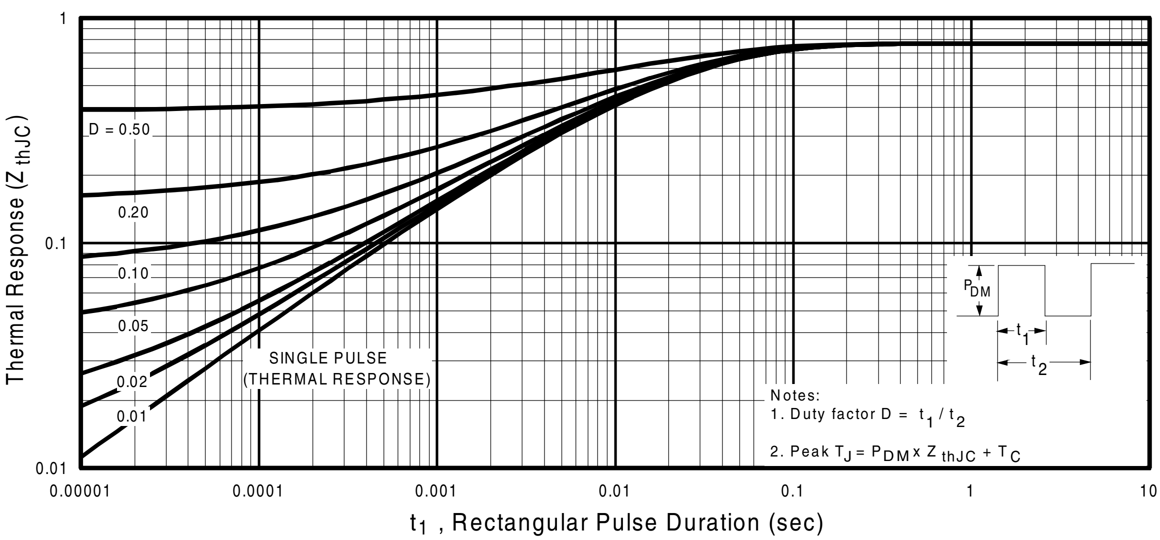


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

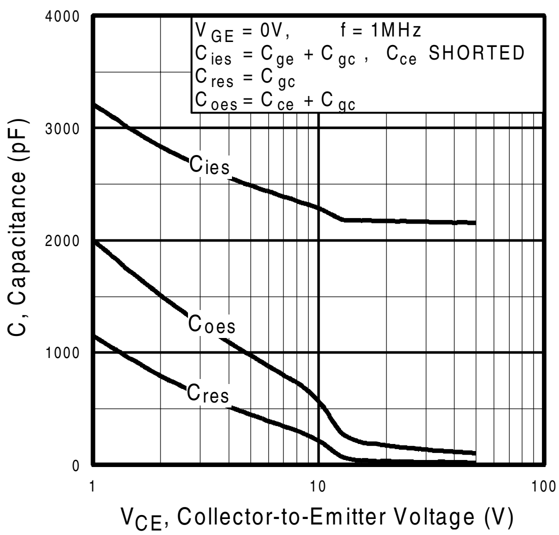


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

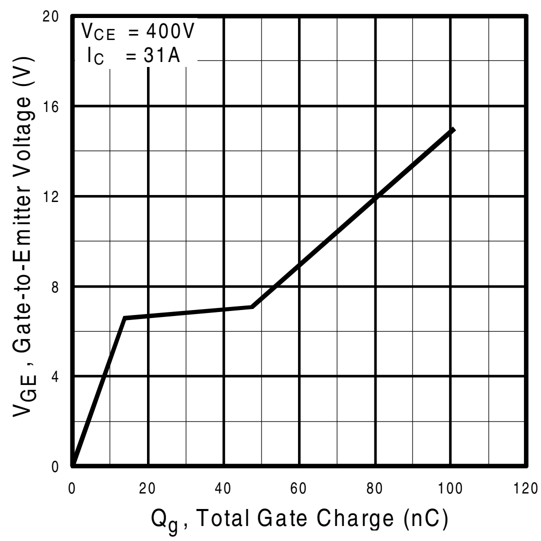


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

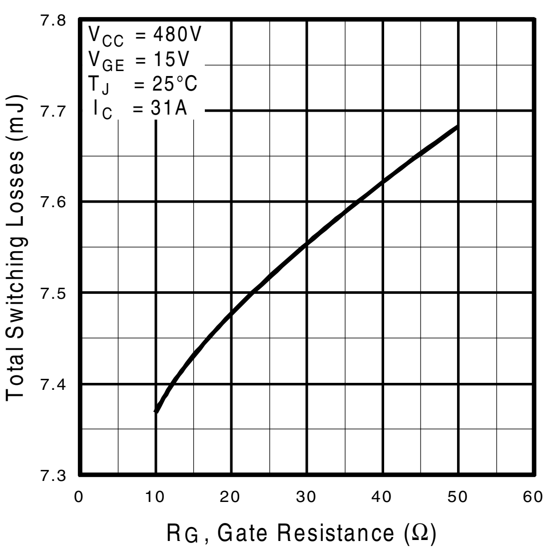


Fig. 9 - Typical Switching Losses vs. Gate Resistance

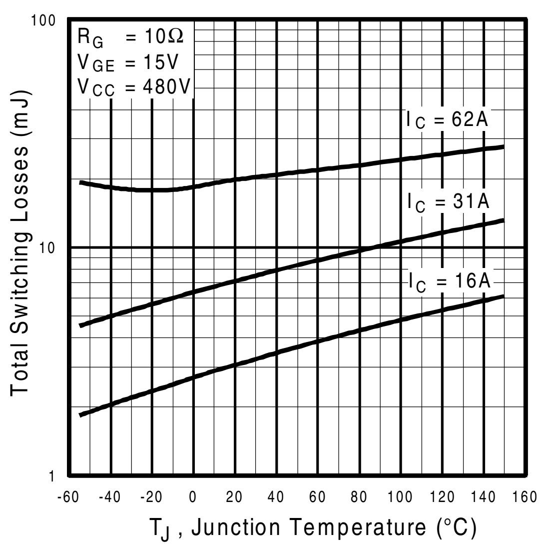


Fig. 10 - Typical Switching Losses vs. Junction Temperature

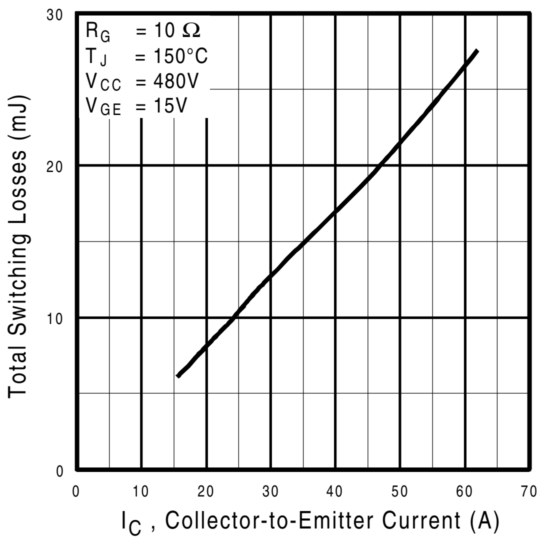


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

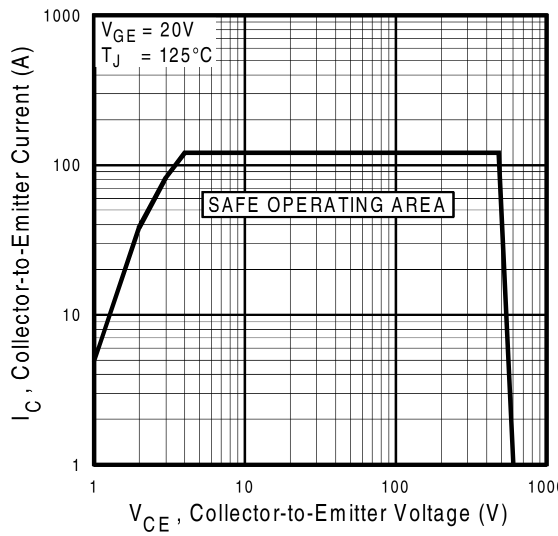
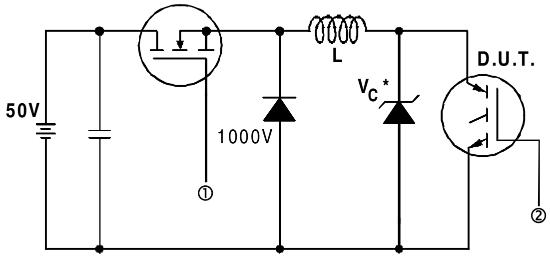


Fig. 12 - Turn-Off SOA



* 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

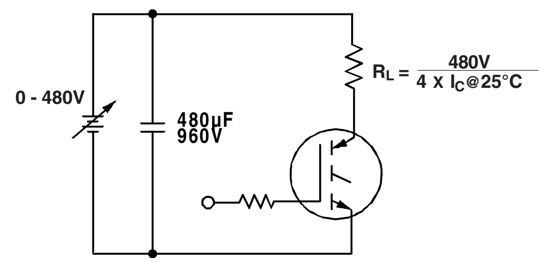


Fig. 13b - Pulsed Collector Current Test Circuit

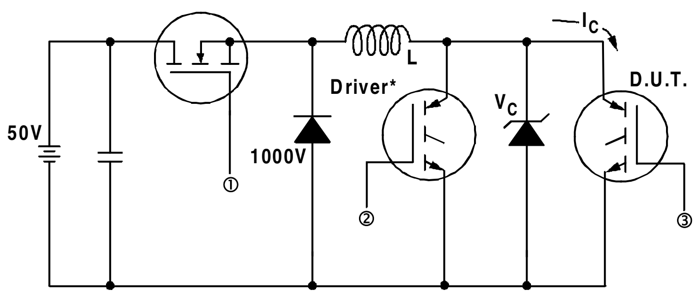


Fig. 14a - Switching Loss Test Circuit

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

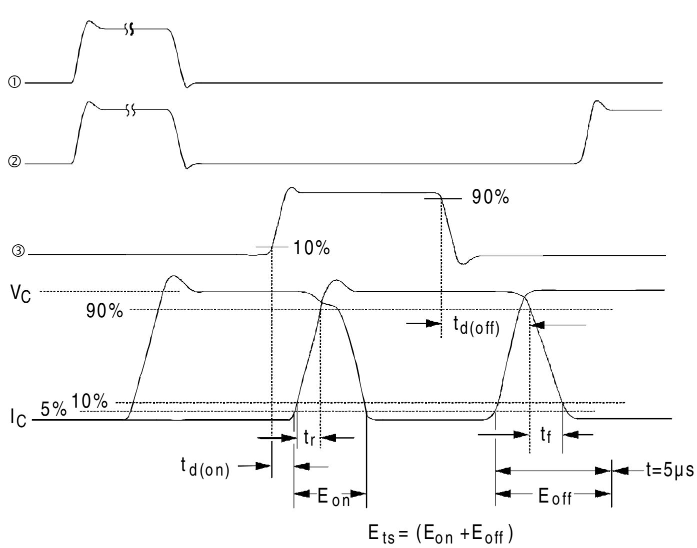
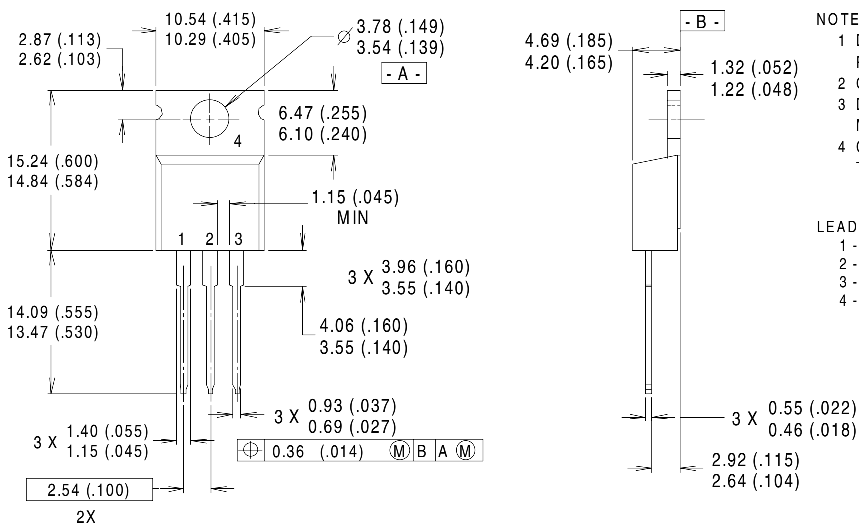


Fig. 14b - Switching Loss Waveforms

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
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