

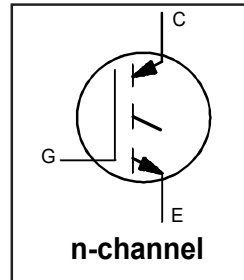
IRG4BC40UPbF

INSULATED GATE BIPOLAR TRANSISTOR

UltraFast Speed IGBT

Features

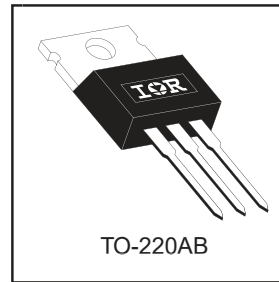
- UltraFast: optimized for high operating frequencies 8-40 kHz in hard switching, >200 kHz in resonant mode
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency than Generation 3
- Industry standard TO-220AB package
- Lead-Free



$V_{CES} = 600V$
$V_{CE(on) typ.} = 1.72V$
@ $V_{GE} = 15V, I_C = 20A$

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



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	40	A
$I_C @ T_C = 100^\circ C$	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
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	160	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	65	
T_J	Operating Junction and	-55 to +150	°C
T_{STG}	Storage Temperature Range		
	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)

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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
ΔV _{(BR)CES/ΔT_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
ΔV _{GE(th)/ΔT_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	mJ	Energy losses include "tail"
E _{on}	Turn-On Switching Loss	----	0.32	----		See Fig. 10, 11, 13, 14
E _{off}	Turn-Off Switching Loss	----	0.35	----		
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.

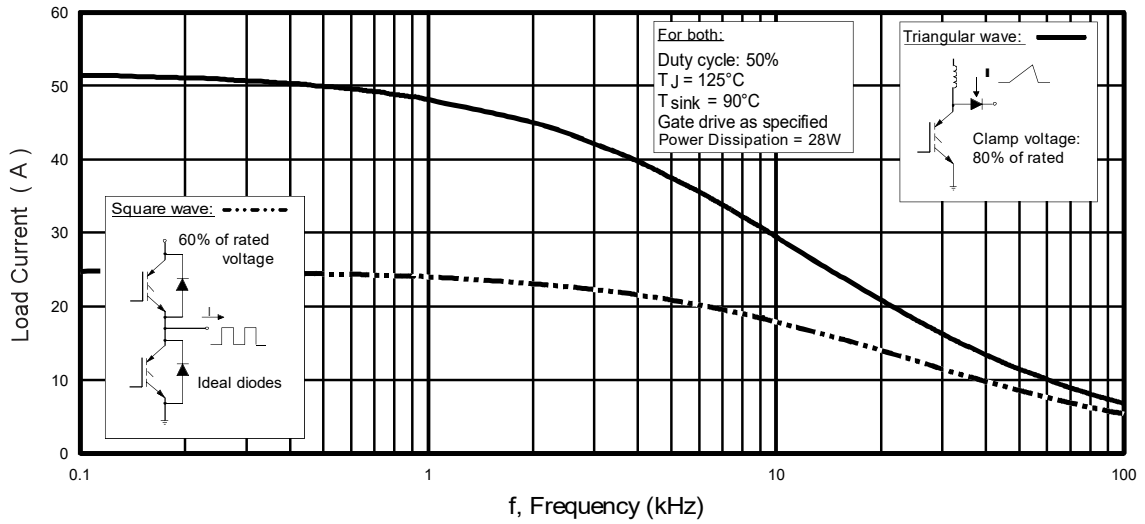


Fig. 1 - Typical Load Current vs. Frequency
(For square wave, $I = I_{RMS}$ of fundamental; for triangular wave, $I = I_{PK}$)

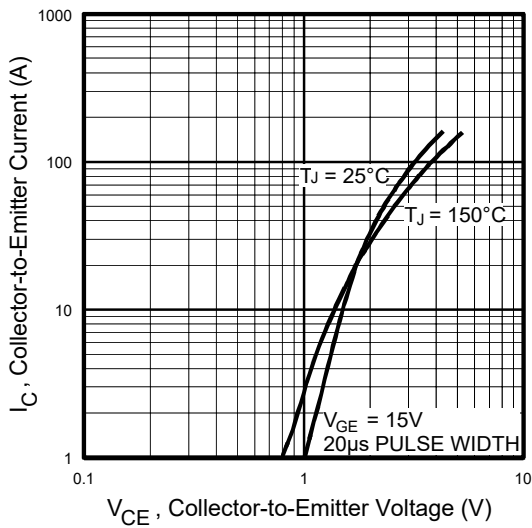


Fig. 2 - Typical Output Characteristics
 $T_C = 25^\circ\text{C}$

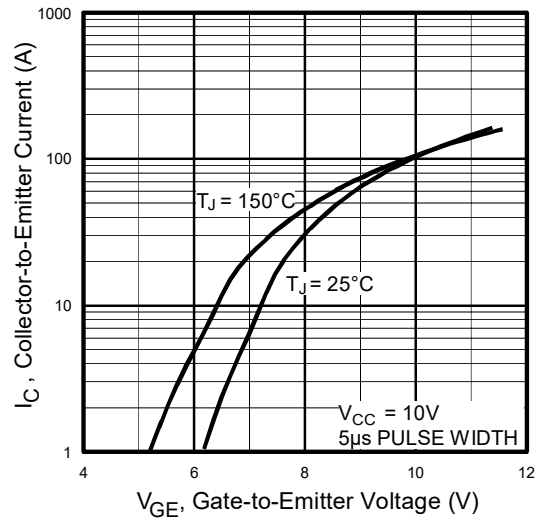


Fig. 3 - Typical Transfer Characteristics

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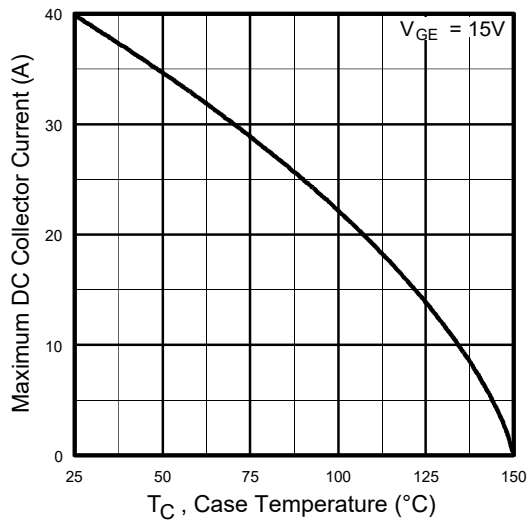


Fig. 4 - Maximum Collector Current vs. Case Temperature

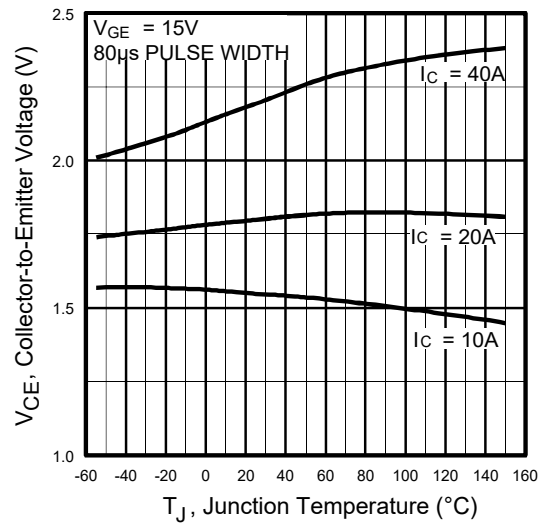


Fig. 5 - Collector-to-Emitter Voltage vs. Junction Temperature

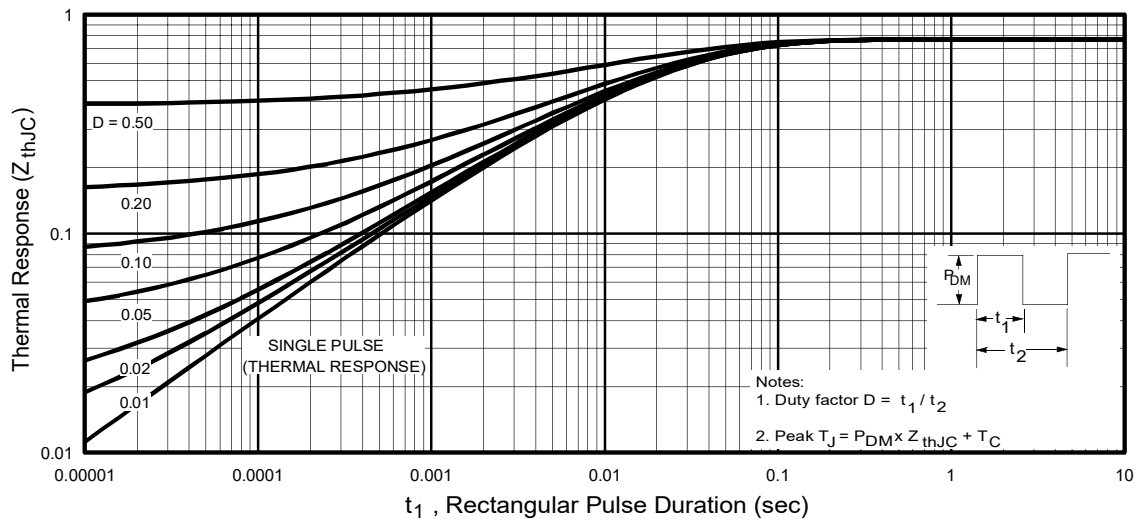


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

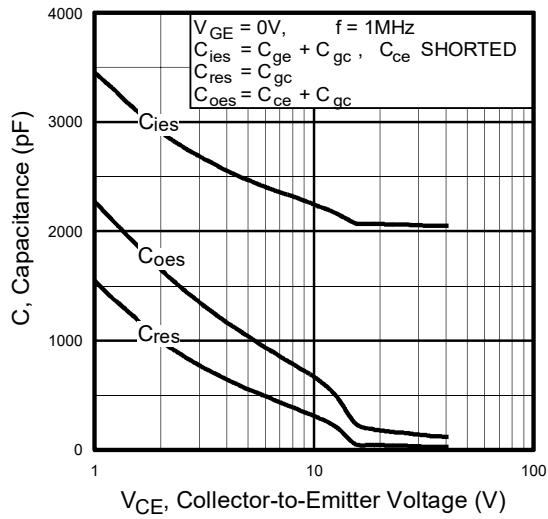


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

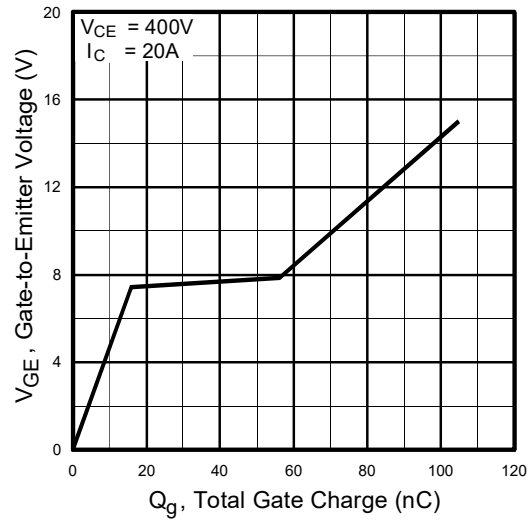


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

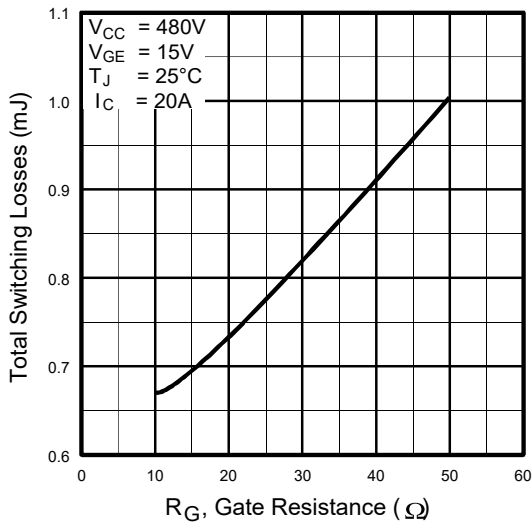


Fig. 9 - Typical Switching Losses vs. Gate Resistance

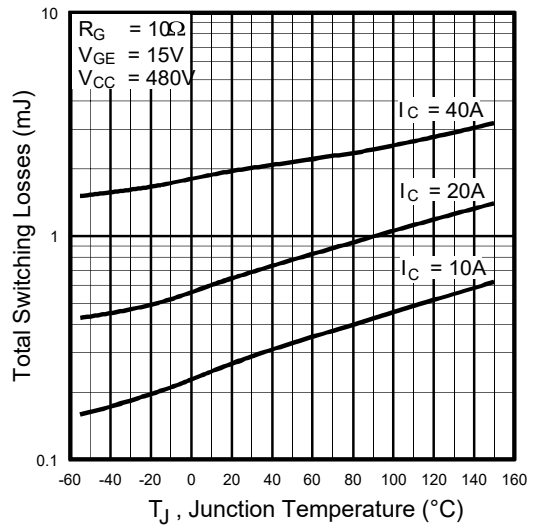


Fig. 10 - Typical Switching Losses vs. Junction Temperature

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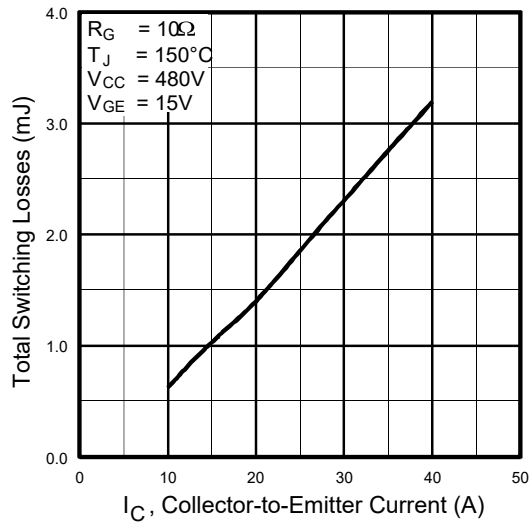


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

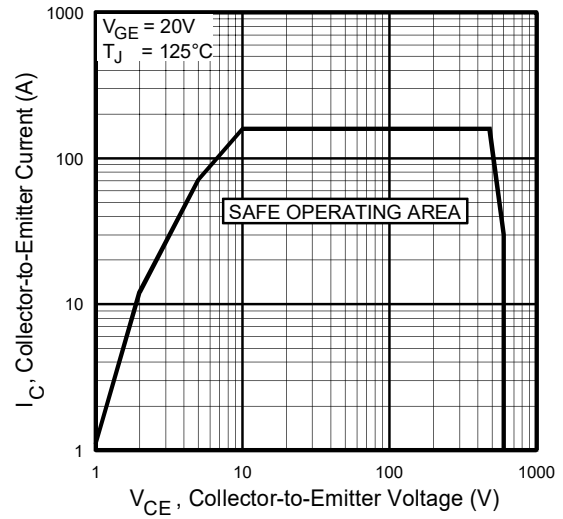
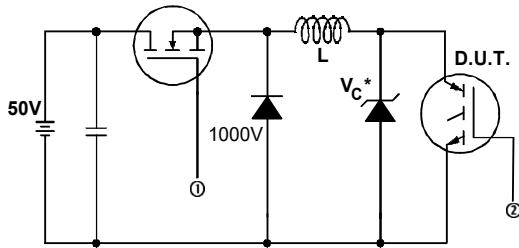


Fig. 12 - Turn-Off SOA



* Driver same type as D.U.T.; $V_c = 80\%$ of $V_{ce(max)}$
* Note: Due to the 50V power supply, pulse width and inductor will increase to obtain rated I_d .

Fig. 13a - Clamped Inductive Load Test Circuit

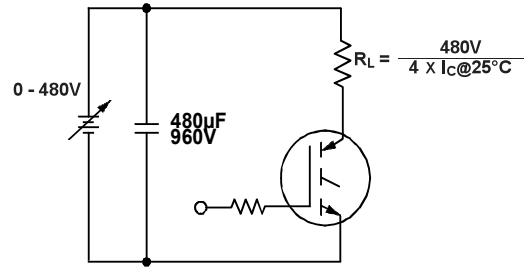


Fig. 13b - Pulsed Collector Current Test Circuit

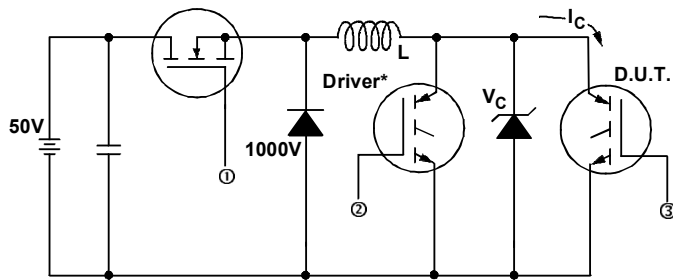


Fig. 14a - Switching Loss Test Circuit

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

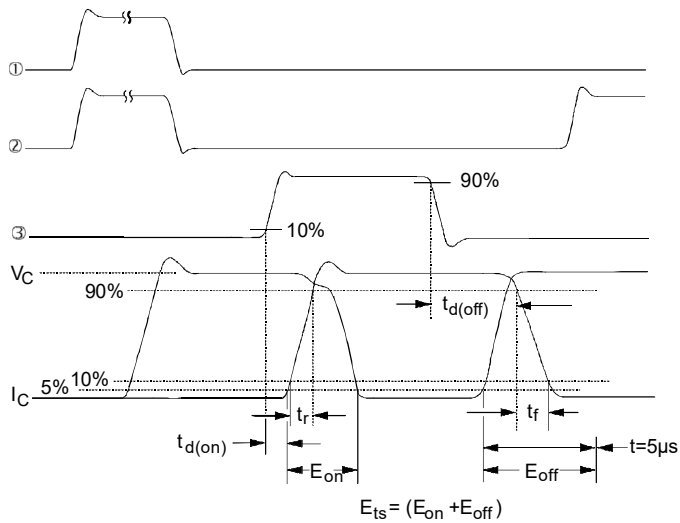


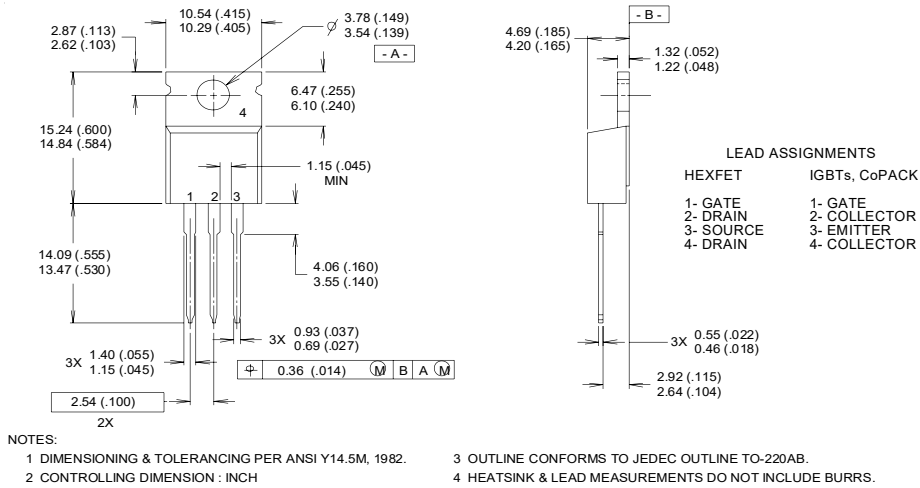
Fig. 14b - Switching Loss Waveforms

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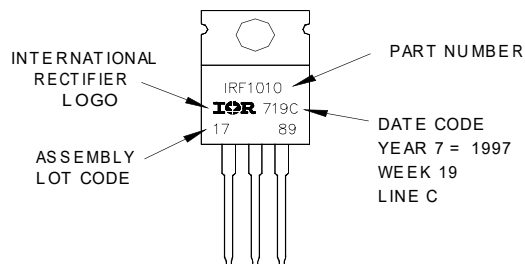
TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010
 LOT CODE 1789
 ASSEMBLED ON WW 19, 1997
 IN THE ASSEMBLY LINE "C"
Note: "P" in assembly line position indicates "Lead-Free"



Data and specifications subject to change without notice.

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Note: For the most current drawings please refer to the IR website at:
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