

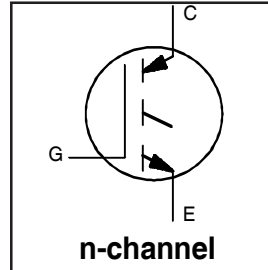
IRG4BC40KPbF

Short Circuit Rated
UltraFast IGBT

INSULATED GATE BIPOLAR TRANSISTOR

Features

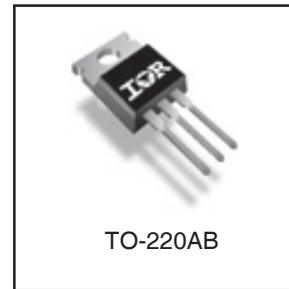
- Short Circuit Rated UltraFast: optimized for high operating frequencies >5.0KHz , and Short Circuit Rated to 10 μ s @ 125°C, $V_{GE} = 15V$
- Generation 4 IGBT design provides higher efficiency than Generation 3
- Industry standard TO-247AC package
- Lead-Free



$V_{CES} = 600V$
$V_{CE(on)} \text{ typ.} = 2.1V$
@ $V_{GE} = 15V, I_C = 25A$

Benefits

- Generation 4 IGBTs offer highest efficiency available
- IGBTs optimized for specified application conditions



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	42	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	25	
I_{CM}	Pulsed Collector Current ①	84	
I_{LM}	Clamped Inductive Load Current ②	84	
t_{sc}	Short Circuit Withstand Time	10	μs
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	$^\circ C$
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	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	0.77	$^\circ C/W$
$R_{\theta CS}$	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)

Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	—	—	V	$V_{GE} = 0V, I_C = 250\mu A$
$V_{(BR)ECS}$	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	—	0.46	—	V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 1.0mA$
$V_{CE(ON)}$	Collector-to-Emitter Saturation Voltage	—	2.10	2.6	V	$I_C = 25A, V_{GE} = 15V$
		—	2.70	—		$I_C = 42A, V_{GE} = 15V$
		—	2.14	—		$I_C = 25A, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0		$V_{CE} = V_{GE}, I_C = 250\mu A$
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	—	-13	—	mV/ $^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 250\mu A$
g_{fe}	Forward Transconductance ⑤	7.0	14	—	S	$V_{CE} = 100V, I_C = 25A$
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	μA	$V_{GE} = 0V, V_{CE} = 600V$
		—	—	2.0		$V_{GE} = 0V, V_{CE} = 10V, T_J = 25^\circ\text{C}$
		—	—	2000		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$
I_{GES}	Gate-to-Emitter Leakage Current	—	—	± 100	nA	$V_{GE} = \pm 20V$

Switching Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
Q_g	Total Gate Charge (turn-on)	—	120	180	nC	$I_C = 25A$
Q_{ge}	Gate - Emitter Charge (turn-on)	—	16	24		$V_{CC} = 400V$
Q_{gc}	Gate - Collector Charge (turn-on)	—	51	77		$V_{GE} = 15V$
$t_{d(on)}$	Turn-On Delay Time	—	30	—	ns	$T_J = 25^\circ\text{C}$
t_r	Rise Time	—	15	—		$I_C = 25A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off Delay Time	—	140	210		$V_{GE} = 15V, R_G = 10\Omega$
t_f	Fall Time	—	140	210		Energy losses include "tail"
E_{on}	Turn-On Switching Loss	—	0.62	—	mJ	See Fig. 9,10,14
E_{off}	Turn-Off Switching Loss	—	0.33	—		
E_{ts}	Total Switching Loss	—	0.95	1.4		
t_{sc}	Short Circuit Withstand Time	10	—	—	μs	$V_{CC} = 400V, T_J = 125^\circ\text{C}$ $V_{GE} = 15V, R_G = 10\Omega, V_{CPK} < 500V$
$t_{d(on)}$	Turn-On Delay Time	—	30	—	ns	$T_J = 150^\circ\text{C}$
t_r	Rise Time	—	18	—		$I_C = 25A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off Delay Time	—	190	—		$V_{GE} = 15V, R_G = 10\Omega$
t_f	Fall Time	—	150	—		Energy losses include "tail"
E_{ts}	Total Switching Loss	—	1.9	—	mJ	See Fig. 11,14
L_E	Internal Emitter Inductance	—	13	—	nH	Measured 5mm from package
C_{ies}	Input Capacitance	—	1600	—	pF	$V_{GE} = 0V$
C_{oes}	Output Capacitance	—	130	—		$V_{CC} = 30V$
C_{res}	Reverse Transfer Capacitance	—	55	—		$f = 1.0MHz$

Notes:

- ① Repetitive rating; $V_{GE} = 20V$, pulse width limited by max. junction temperature. (See fig. 13b)
- ② $V_{CC} = 80\%(V_{CES})$, $V_{GE} = 20V$, $L = 10\mu H$, $R_G = 10\Omega$, (See fig. 13a)
- ③ Repetitive rating; pulse width limited by maximum junction temperature.
- ④ Pulse width $\leq 80\mu s$; duty factor $\leq 0.1\%$.
- ⑤ Pulse width $5.0\mu s$, single shot.

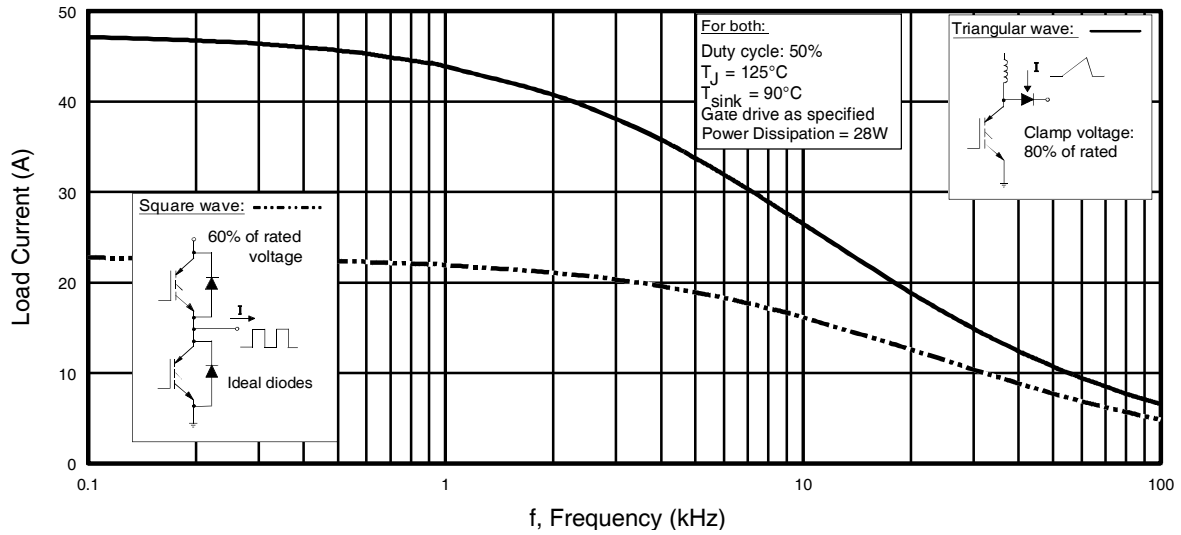


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

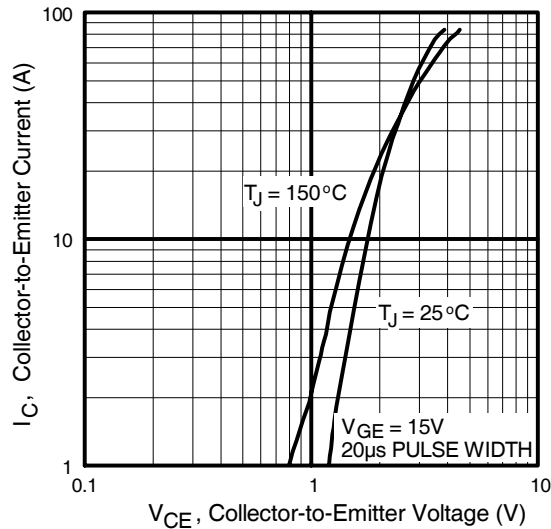


Fig. 2 - Typical Output Characteristics

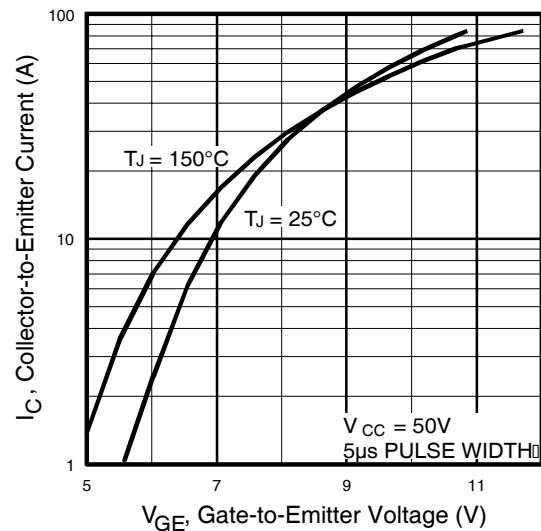


Fig. 3 - Typical Transfer Characteristics

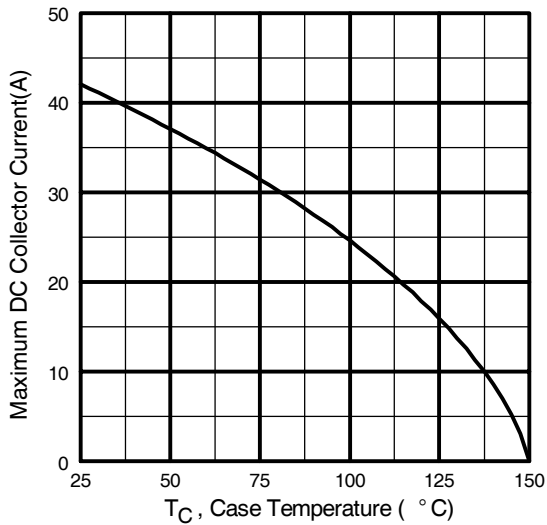


Fig. 4 - Maximum Collector Current vs. Case Temperature

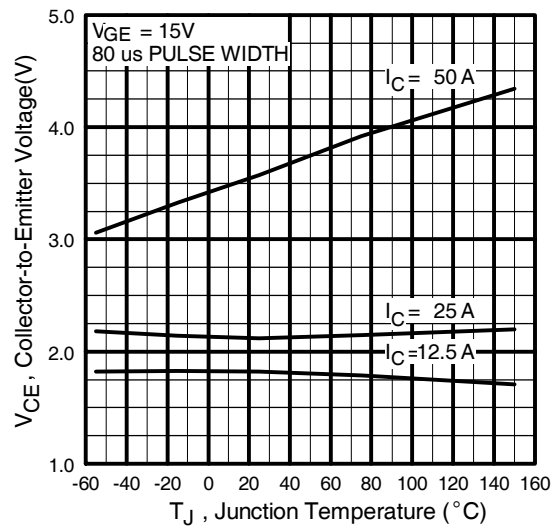


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

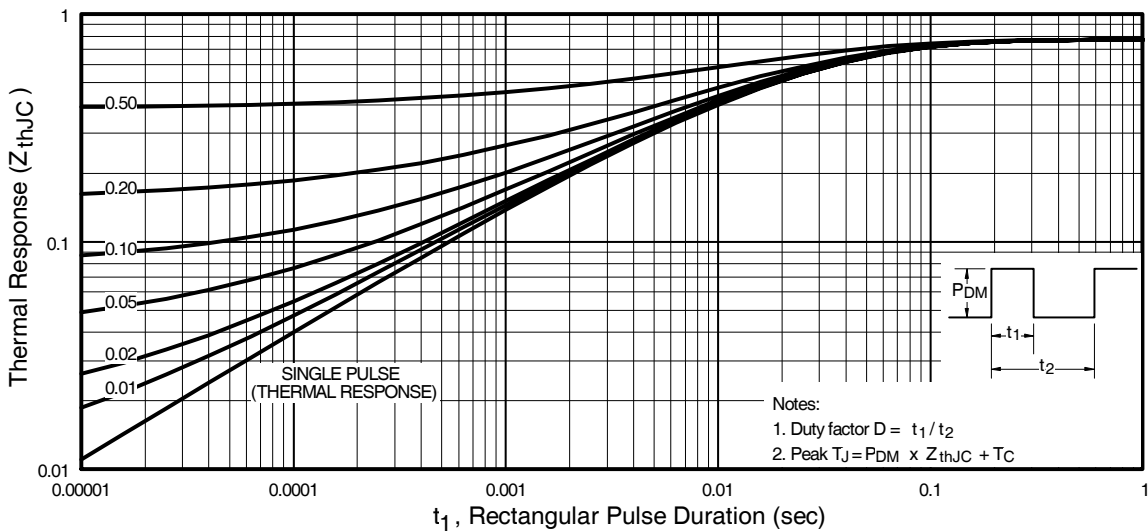
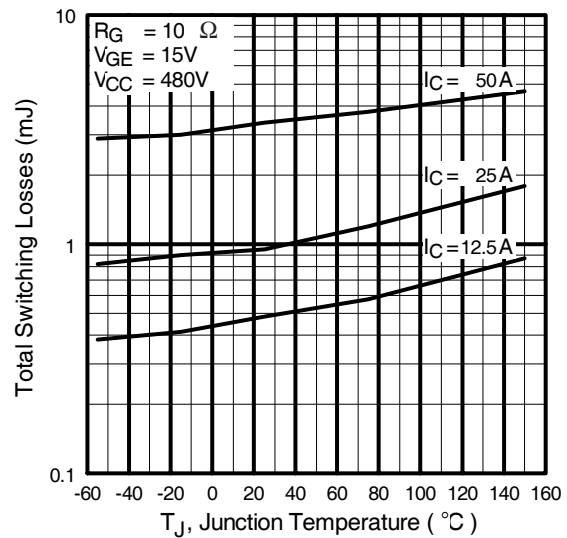
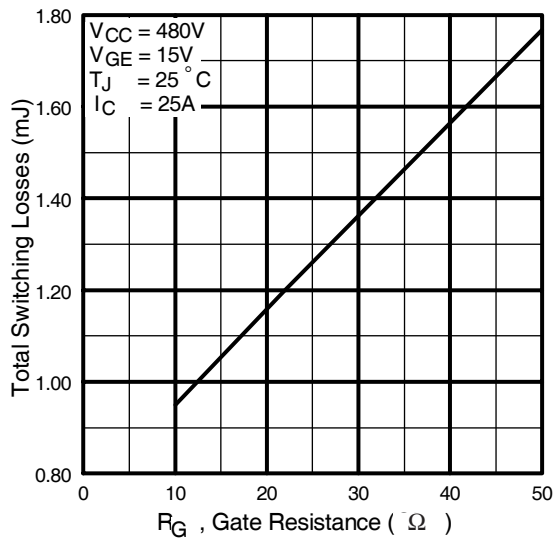
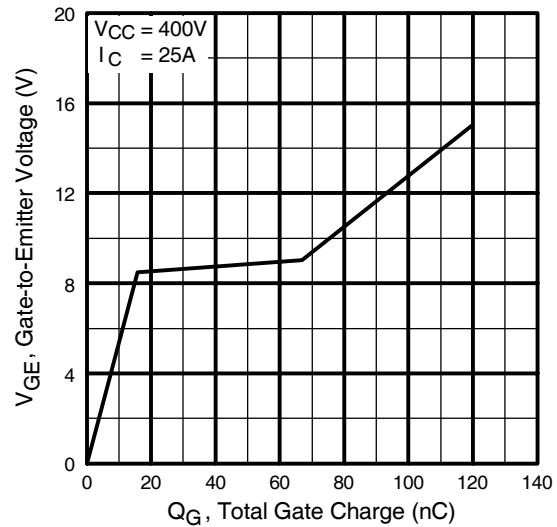
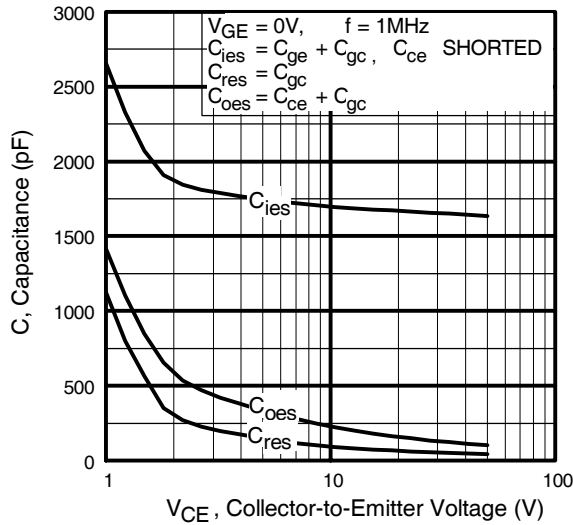


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case



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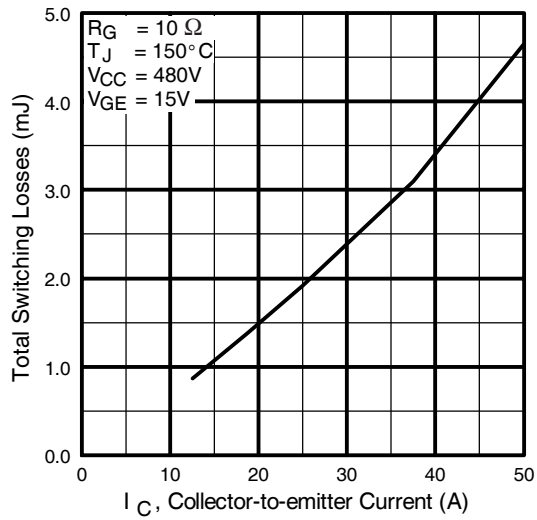


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

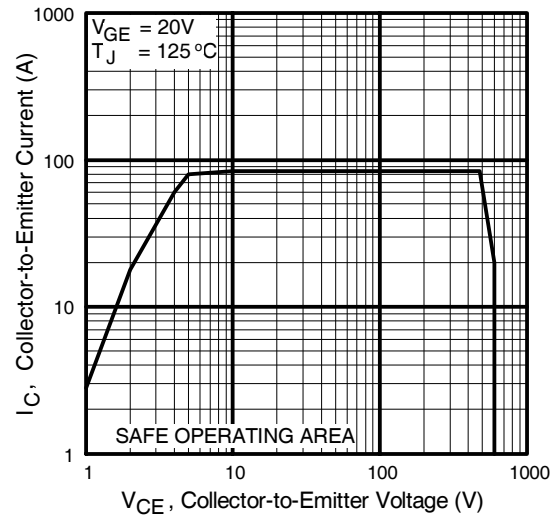


Fig. 12 - Turn-Off SOA

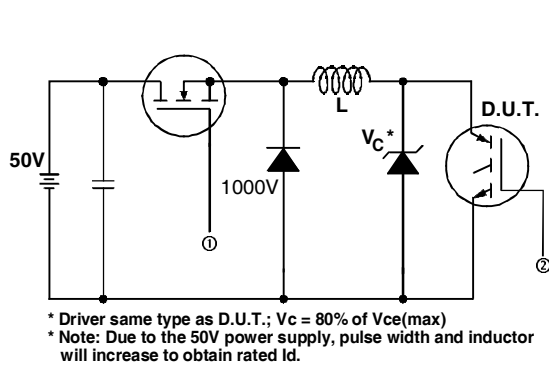


Fig. 13a - Clamped Inductive Load Test Circuit

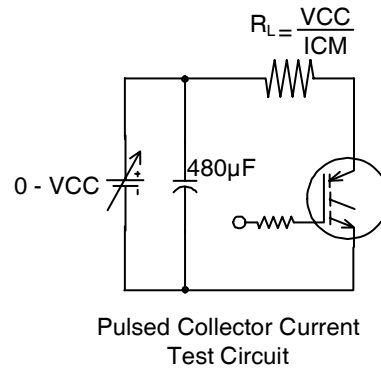


Fig. 13b - Pulsed Collector Current Test Circuit

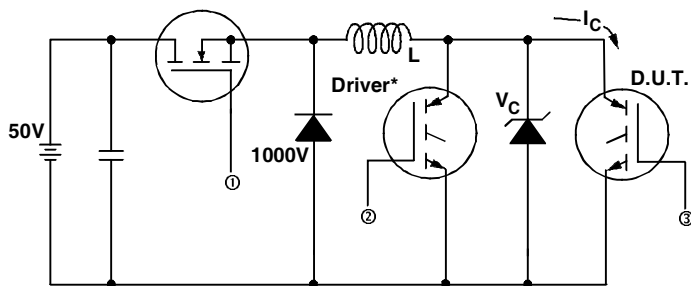


Fig. 14a - Switching Loss Test Circuit

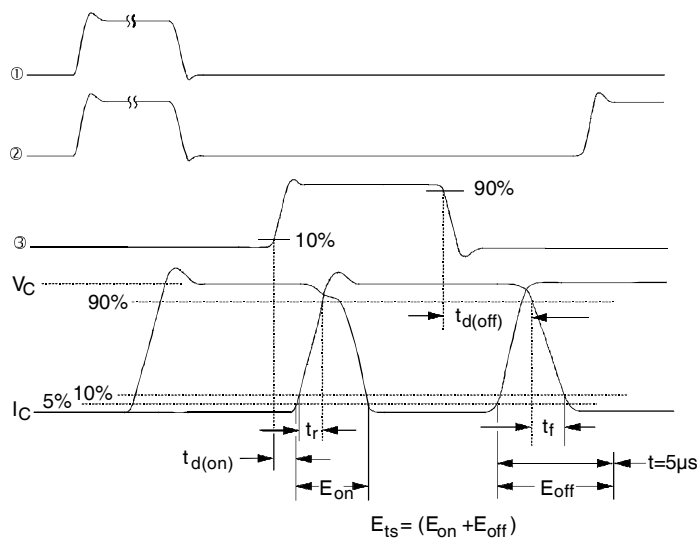
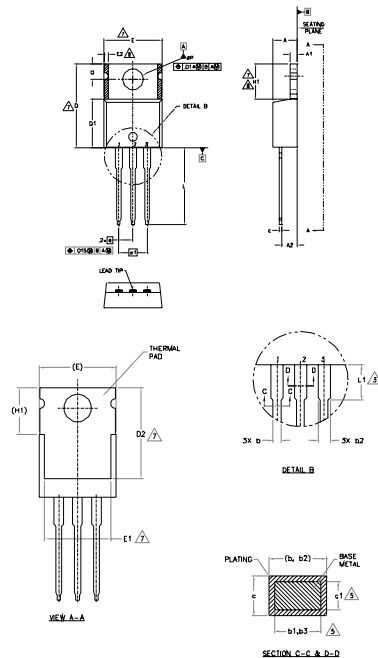


Fig. 14b - Switching Loss Waveforms

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TO-220AB Package Outline (Dimensions are shown in millimeters (inches))



- NOTES
- 1- DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M- 1994.
 - 2- DIMENSIONS ARE SHOWN IN INCHES (MILLIMETERS).
 - 3- LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
 - 4- DIMENSION D, D1 & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
 - 5- DIMENSION D1, D2 & E1 APPLY TO BASE METAL ONLY.
 - 6- CONTROLLING DIMENSION - INCHES.
 - 7- THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS E1/D2 & E1.
 - 8- DIMENSION E2 X H1 DEFINE A ZONE WHERE STAMPING AND SINGULATION IRREGULARITIES ARE ALLOWED.
 - 9- OUTLINE CONFORMS TO JEDEC TO-220, EXCEPT A2 (max) AND D2 (max) WHERE DIMENSIONS ARE DERIVED FROM THE ACTUAL PACKAGE OUTLINE.

DIMENSIONS					
SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	3.56	4.83	.140	.190	
A1	0.51	1.40	.020	.055	
A2	0.03	2.92	.000	.115	
b	0.38	1.01	.015	.040	
b1	0.38	0.97	.015	.038	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.36	0.61	.014	.024	
c1	0.36	0.56	.014	.022	5
D	14.22	16.51	.560	.650	4
D1	6.36	6.02	.330	.355	
D2	11.68	12.88	.460	.507	7
E	9.65	10.67	.380	.420	4,7
E1	6.86	8.89	.270	.350	7
E2	-	0.76	-	.030	8
e	2.54 BSC		100 BSC		
e1	2.06 BSC		200 BSC		
H1	5.94	6.86	.230	.270	7,8
L	12.70	14.73	.500	.580	
L1	3.56	4.06	.140	.160	3
øP	3.54	4.08	.139	.161	
Q	2.54	3.42	.100	.135	

LEAD ASSIGNMENTS

- MODEL
- 1- GATE
 - 2- SOURCE
 - 3- DRAIN

WELD SPACES

- 1- GATE
- 2- COLLECTION
- 3- WIPPER

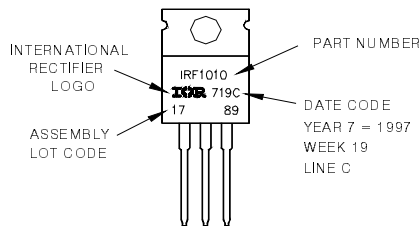
MARKS

- 1- MARK
- 2- CHISEL
- 3- MARK

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"



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

Data and specifications subject to change without notice.

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