International
IOR Rectifier

PD -95525

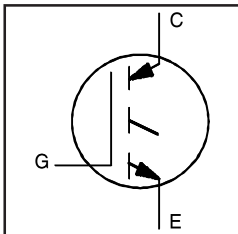
IRG4PH50SPbF

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-247AC package
- Lead-Free



n-channel

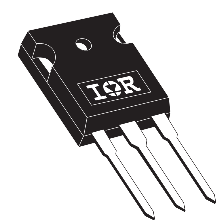
V_{CES} =1200V

$V_{CE(on)}$ typ. = 1.47V

@V_{GE} = 15V, I_C = 33A

Benefits

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



TO-247AC

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
I_C @ T_C = 25°C	Continuous Collector Current	57	
I_C @ T_C = 100°C	Continuous Collector Current	33	A
I_{CM}	Pulsed Collector Current①	114	
I_{LM}	Clamped Inductive Load Current ②	114	
V_{GE}	Gate-to-Emitter Voltage	±20	V
E_{ARV}	Reverse Voltage Avalanche Energy③	270	mJ
P_D @ T_C = 25°C	Maximum Power Dissipation	200	W
P_D @ T_C = 100°C	Maximum Power Dissipation	80	
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	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	–––	0.64	
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.24	–––	°C/W
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	–––	40	
Wt	Weight	6.0 (0.21)	–––	g (oz)

7/16/04

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	1200	—	—	V	V_{GE} = 0V, I_C = 250µA
$V_{(BR)ECS}$	Emitter-to-Collector Breakdown Voltage ④	18	—	—	V	V_{GE} = 0V, I_C = 1.0 A
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	1.22	—	V/°C	V_{GE} = 0V, I_C = 2.0 mA
$V_{CE(ON)}$	Collector-to-Emitter Saturation Voltage	—	1.47	1.7	V	I_C = 33A; V_{GE} = 15V
		—	1.75	—		I_C = 57A; See Fig.2, 5
		—	1.55	—		I_C = 33A , T_J = 150°C
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0		V_{CE} = V_{GE}, I_C = 250µA
$DV_{GE(th)}/DT_J$	Temperature Coeff. of Threshold Voltage	—	-11	—	mV/°C	V_{CE} = V_{GE}, I_C = 250µA
g_{fe}	Forward Transconductance ⑤	27	40	—	S	V_{CE} = 100V, I_C = 33A
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	µA	V_{GE} = 0V, V_{CE} = 1200V
		—	—	2.0		V_{GE} = 0V, V_{CE} = 10V, T_J = 25°C
		—	—	1000		V_{GE} = 0V, V_{CE} = 1200V, 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)	—	167	251	nC	I_C = 33A
Q_{ge}	Gate - Emitter Charge (turn-on)	—	25	38		V_{CC} = 400V See Fig. 8
Q_{gc}	Gate - Collector Charge (turn-on)	—	55	83		V_{GE} = 15V
$t_{d(on)}$	Turn-On Delay Time	—	32	—	ns	T_J = 25°C
t_r	Rise Time	—	29	—		I_C = 33A, V_{CC} = 960V
$t_{d(off)}$	Turn-Off Delay Time	—	845	1268		V_{GE} = 15V, R_G = 5.0Ω
t_f	Fall Time	—	425	638		Energy losses include "tail"
E_{on}	Turn-On Switching Loss	—	1.80	—	mJ	See Fig. 9, 10, 14
E_{off}	Turn-Off Switching Loss	—	19.6	—		
E_{ts}	Total Switching Loss	—	21.4	44		
$t_{d(on)}$	Turn-On Delay Time	—	32	—	ns	T_J = 150°C,
t_r	Rise Time	—	30	—		I_C = 33A, V_{CC} = 960V
$t_{d(off)}$	Turn-Off Delay Time	—	1170	—		V_{GE} = 15V, R_G = 5.0Ω
t_f	Fall Time	—	1000	—		Energy losses include "tail"
E_{ts}	Total Switching Loss	—	37	—	mJ	See Fig. 10,11,14
L_E	Internal Emitter Inductance	—	13	—	nH	Measured 5mm from package
C_{ies}	Input Capacitance	—	3600	—	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	—	160	—		V_{CC} = 30V See Fig. 7
C_{res}	Reverse Transfer Capacitance	—	30	—		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 = 5.0Ω, (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.

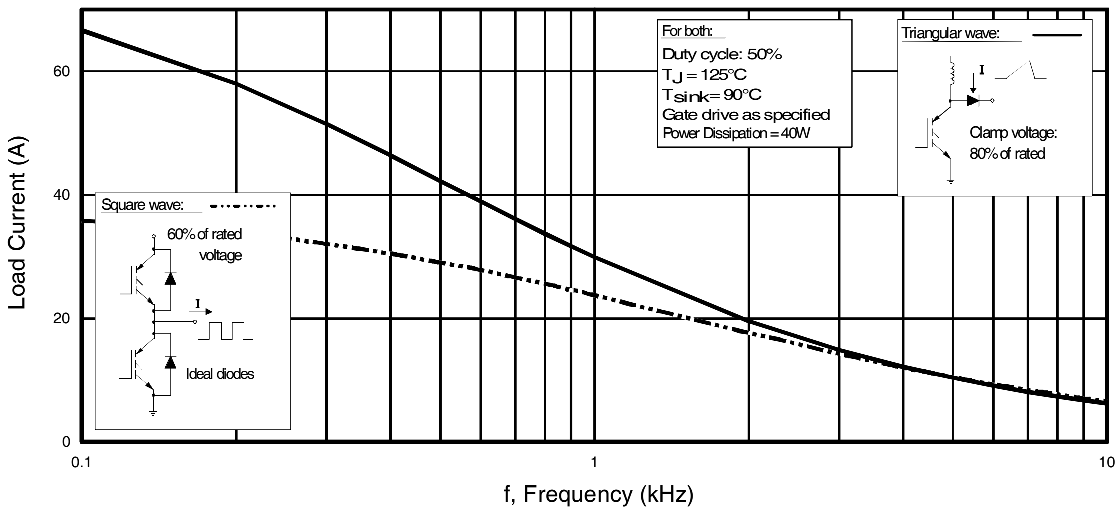


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

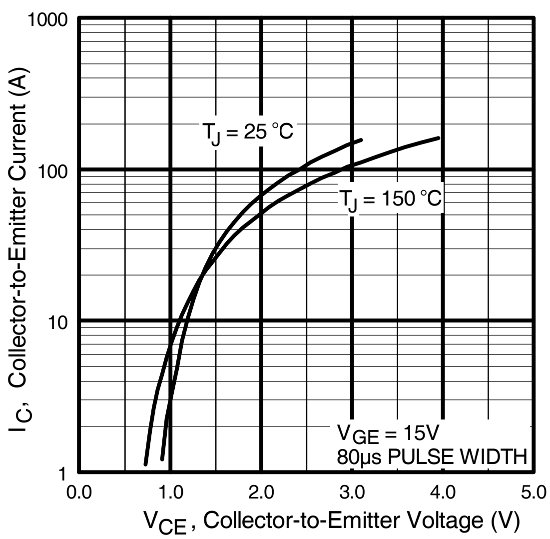


Fig. 2 - Typical Output Characteristics

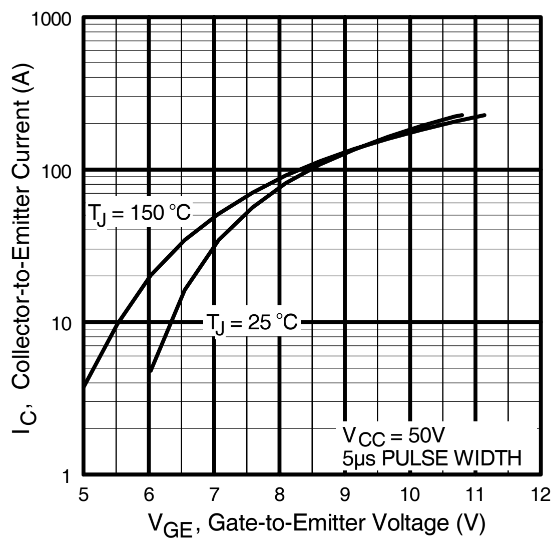


Fig. 3 - Typical Transfer Characteristics

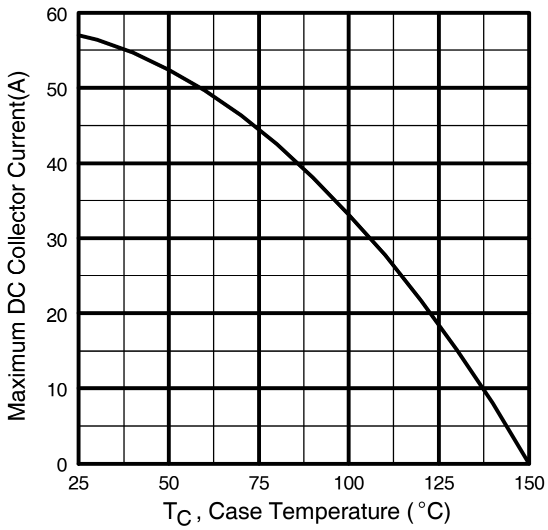


Fig. 4 - Maximum Collector Current vs. Case Temperature

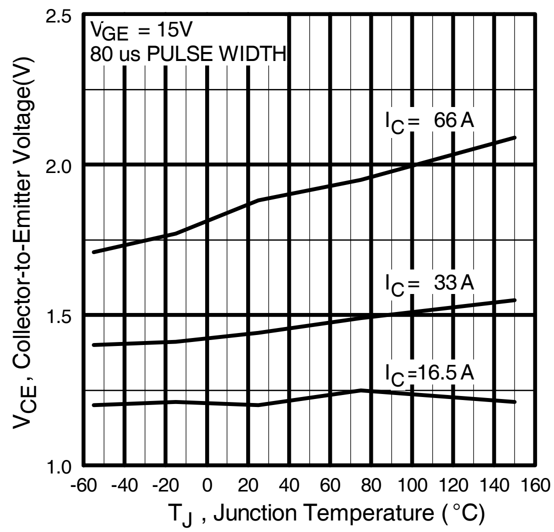


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

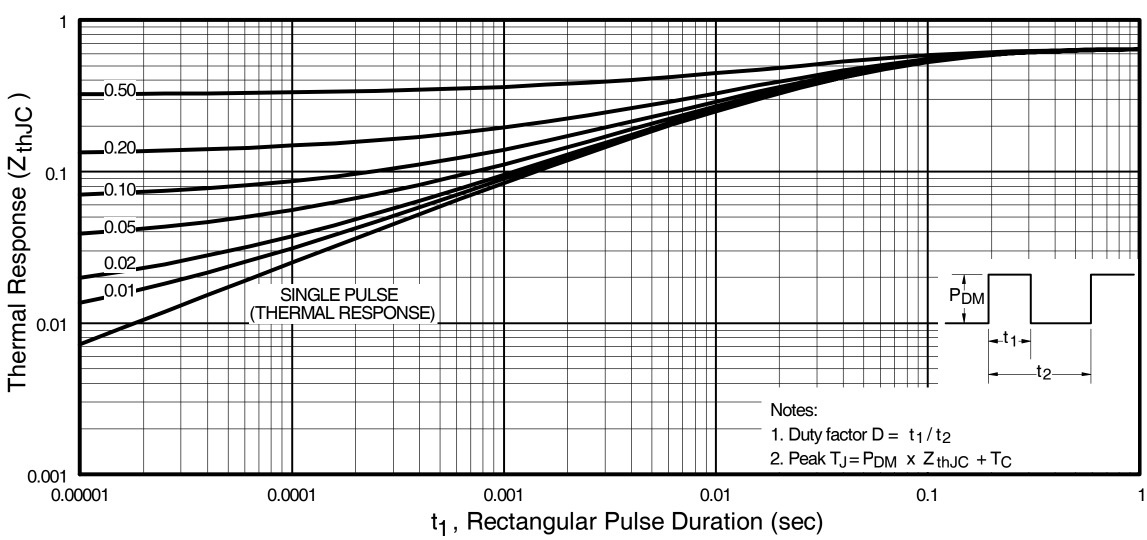


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

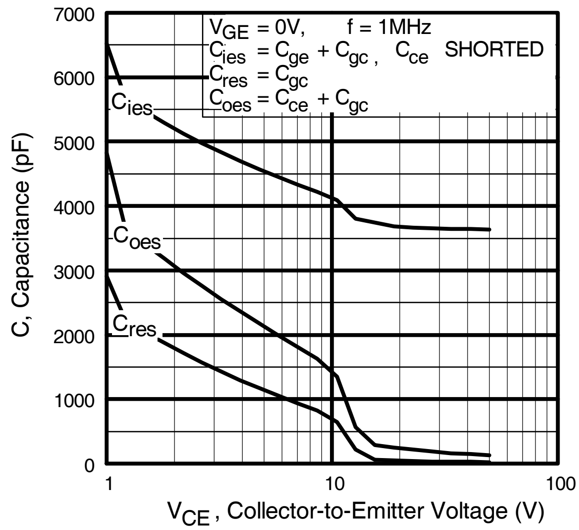


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

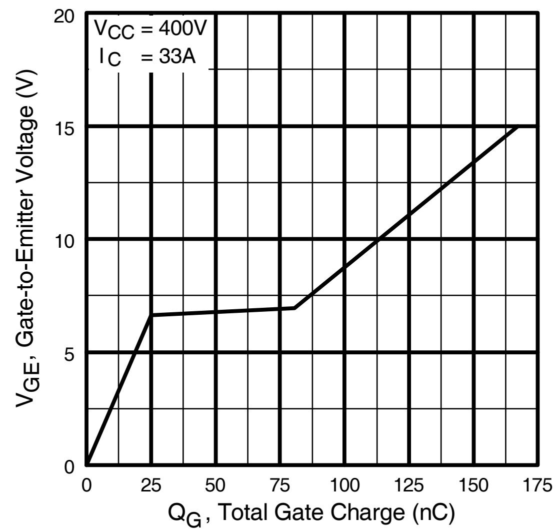


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

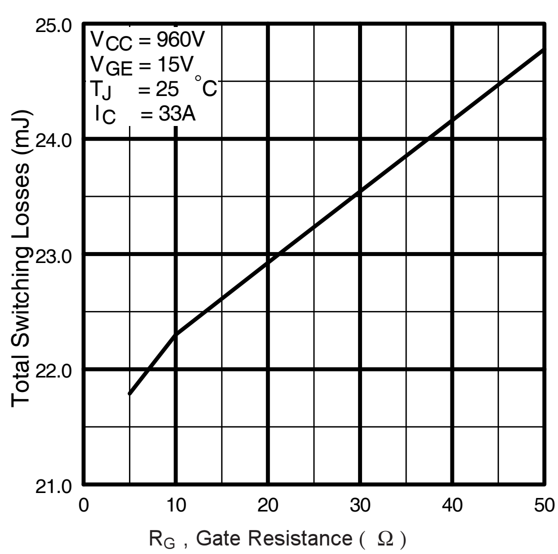


Fig. 9 - Typical Switching Losses vs. Gate Resistance

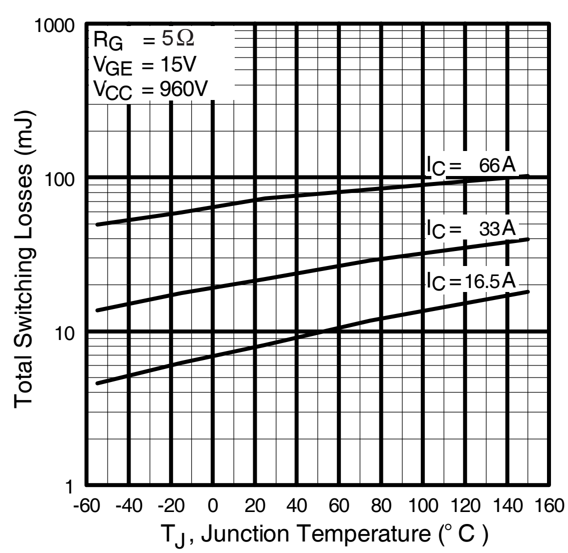


Fig. 10 - Typical Switching Losses vs. Junction Temperature

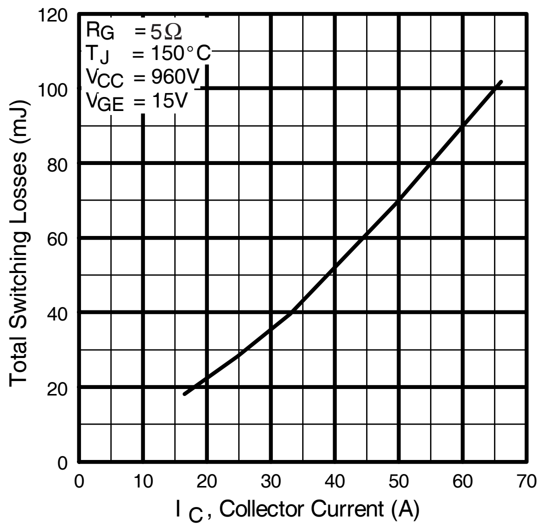


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

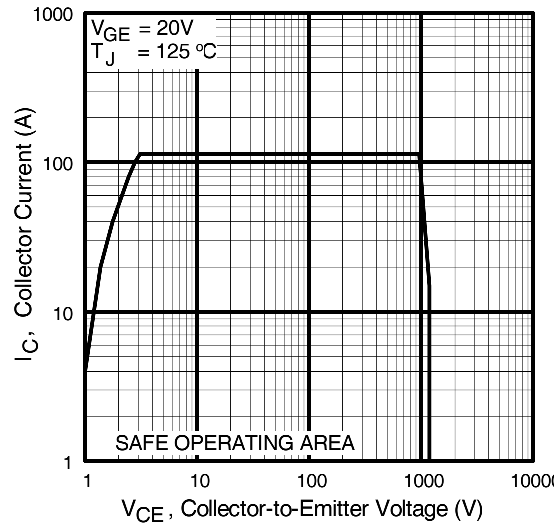
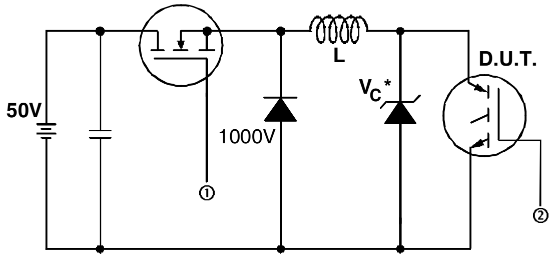


Fig. 12 - Reverse Bias SOA



* 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

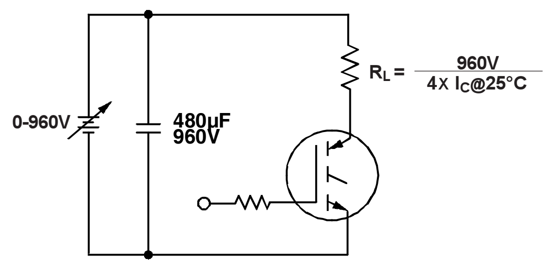


Fig. 13b - Pulsed Collector Current Test Circuit

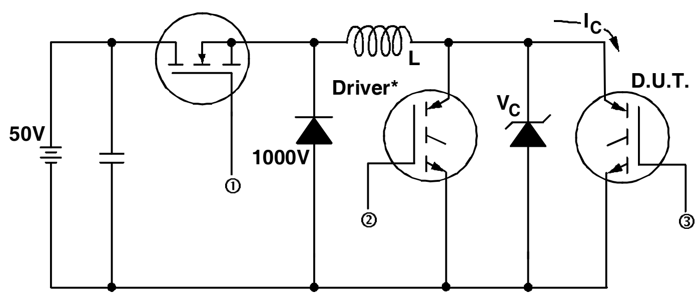


Fig. 14a - Switching Loss Test Circuit

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

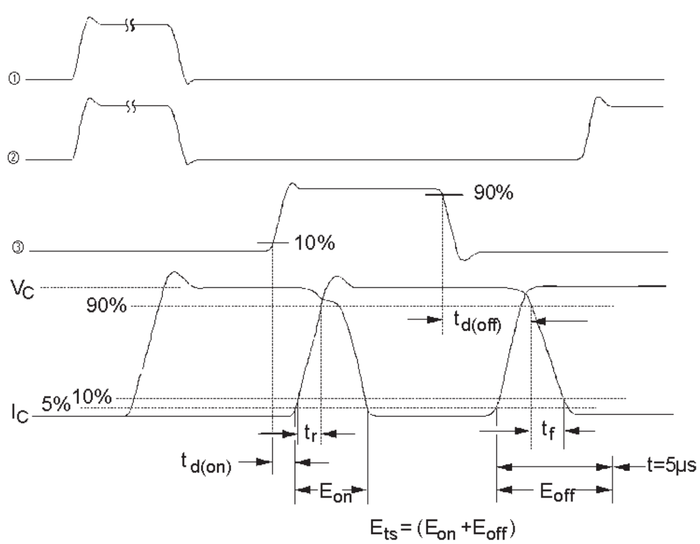
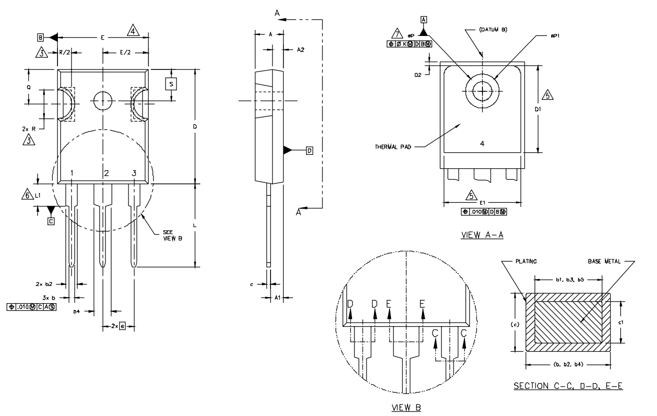


Fig. 14b - Switching Loss Waveforms

TO-247AC Package Outline

Dimensions are shown in millimeters (inches)



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M 1994.
2. DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS]
3. CONTOUR OF SLOT OPTIONAL.
4. DIMENSION D & 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. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENISONS D1 & E1.
6. LEAD FINISH UNCONTROLLED IN L1.
7. øP TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5 ° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154" [3.91].
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-247 WITH THE EXCEPTION OF DIMENSION c.

SYMBOL	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN.	MAX.	MIN.	MAX.	
A	.183	.209	4.65	5.31	
A1	.087	.102	2.21	2.59	
A2	.059	.098	1.50	2.49	
b	.039	.055	0.99	1.40	
b1	.039	.053	0.99	1.35	
b2	.065	.094	1.65	2.39	
b3	.065	.092	1.65	2.37	
b4	.102	.135	2.59	3.43	
b5	.102	.133	2.59	3.38	
c	.015	.034	0.38	0.86	
c1	.015	.030	0.38	0.76	
D	.776	.815	19.71	20.70	4
D1	.515	–	13.08	–	5
D2	.020	.030	0.51	0.76	
E	.602	.625	15.29	15.87	4
E1	.540	–	15.72	–	
e	.215 BSC		5.46 BSC		
Øk	.010		2.54		
L	.559	.634	14.20	16.10	
L1	.146	.169	3.71	4.29	
N	3		7.62 BSC		
øP	.140	.144	3.56	3.66	
øP1	–	.275	–	6.98	
Q	.209	.224	5.31	5.69	
R	.178	.216	4.52	5.49	
S	.217 BSC		5.51 BSC		

LEAD ASSIGNMENTS

HEXFET

1.- GATE
2.- DRAIN
3.- SOURCE
4.- DRAIN

IGBTs, CoPACK

1.- GATE
2.- COLLECTOR
3.- EMITTER
4.- COLLECTOR

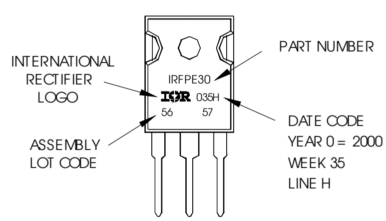
DIODES

1.- ANODE/OPEN
2.- CATHODE
3.- ANODE

TO-247AC Part Marking Information

EXAMPLE: THIS IS AN IRFPE30
WITH ASSEMBLY
LOT CODE 5657
ASSEMBLED ON WW 35, 2000
IN THE ASSEMBLY LINE "H"

Note: "P" in assembly line position indicates "Lead-Free"



Data and specifications subject to change without notice.

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