PD - 95568

International
IOR Rectifier

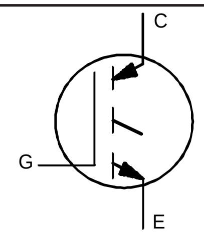
IRG4PC60UPbF

INSULATED GATE BIPOLAR TRANSISTOR

UltraFast Speed IGBT

Features

- UltraFast: Optimized for high operating frequencies up to 50 kHz in hard switching, >200 kHz in resonant mode.
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency.
- Industry standard TO-247AC package.
- Lead-Free



n-channel

$V_{CES} = 600V$

$V_{CE(on)\ typ.} = 1.6V$

$@V_{GE} = 15V, I_C = 40A$

Benefits

- Generation 4 IGBT's offer highest efficiency available.
- IGBT's optimized for specified application conditions.
- Designed for best performance when used with IR Hexfred & IR Fred companion diodes.

TO-247AC

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Breakdown Voltage	600	V
I_C @ T_C = 25°C	Continuous Collector Current	75	A
I_C @ T_C = 100°C	Continuous Collector Current	40	
I_{CM}	Pulsed Collector Current ①	300	
I_{LM}	Clamped Inductive Load Current ②	300	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
E_{ARV}	Reverse Voltage Avalanche Energy ③	200	mJ
P_D @ T_C = 25°C	Maximum Power Dissipation	520	W
P_D @ T_C = 100°C	Maximum Power Dissipation	210	
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	----	0.24	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.24	----	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	----	40	
Wt	Weight	6 (0.21)	----	g (oz)

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	17	----	----	V	V_{GE} = 0V, I_C = 1.0A	
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	----	0.28	----	V/°C	V_{GE} = 0V, I_C = 1.0mA	
$V_{CE(ON)}$	Collector-to-Emitter Saturation Voltage	----	1.7	2.0	V	I_C = 40A	V_{GE} = 15V
		----	1.9	----		I_C = 75A	See Fig.2, 5
		----	1.6	----		I_C = 40A , 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	----	-12	----	mV/°C	V_{CE} = V_{GE}, I_C = 250µA	
g_{fe}	Forward Transconductance ⑤	44	59	----	S	$V_{CE} \geq$ 100V, I_C = 40A	
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	
		----	----	5000		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)	----	310	320	nC	I_C = 40A
Q_{ge}	Gate - Emitter Charge (turn-on)	----	41	46		V_{CC} = 480V See Fig. 8
Q_{gc}	Gate - Collector Charge (turn-on)	----	110	120		V_{GE} = 15V
$t_{d(on)}$	Turn-On Delay Time	----	39	----	ns	
t_r	Rise Time	----	42	----		T_J = 25°C
$t_{d(off)}$	Turn-Off Delay Time	----	200			I_C = 40A, V_{CC} = 480V
t_f	Fall Time	----	100			V_{GE} = 15V, R_G = 5.0Ω
E_{on}	Turn-On Switching Loss	----	0.28	----	mJ	Energy losses include "tail"
E_{off}	Turn-Off Switching Loss	----	1.1	----		See Fig. 10, 11, 13, 14
E_{ts}	Total Switching Loss	----	1.3	1.8		
$t_{d(on)}$	Turn-On Delay Time	----	36	----	ns	T_J = 150°C,
t_r	Rise Time	----	42	----		I_C = 40A, V_{CC} = 480V
$t_{d(off)}$	Turn-Off Delay Time	----	300	----		V_{GE} = 15V, R_G = 5.0Ω
t_f	Fall Time	----	160	----		Energy losses include "tail"
E_{ts}	Total Switching Loss	----	2.6	----	mJ	See Fig. 13, 14
L_E	Internal Emitter Inductance	----	13	----	nH	Measured 5mm from package
C_{ies}	Input Capacitance	----	5860	----	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	----	370	----		V_{CC} = 30V See Fig. 7
C_{res}	Reverse Transfer Capacitance	----	75	----		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 = TBD µH, R_G = 5.0W. (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.

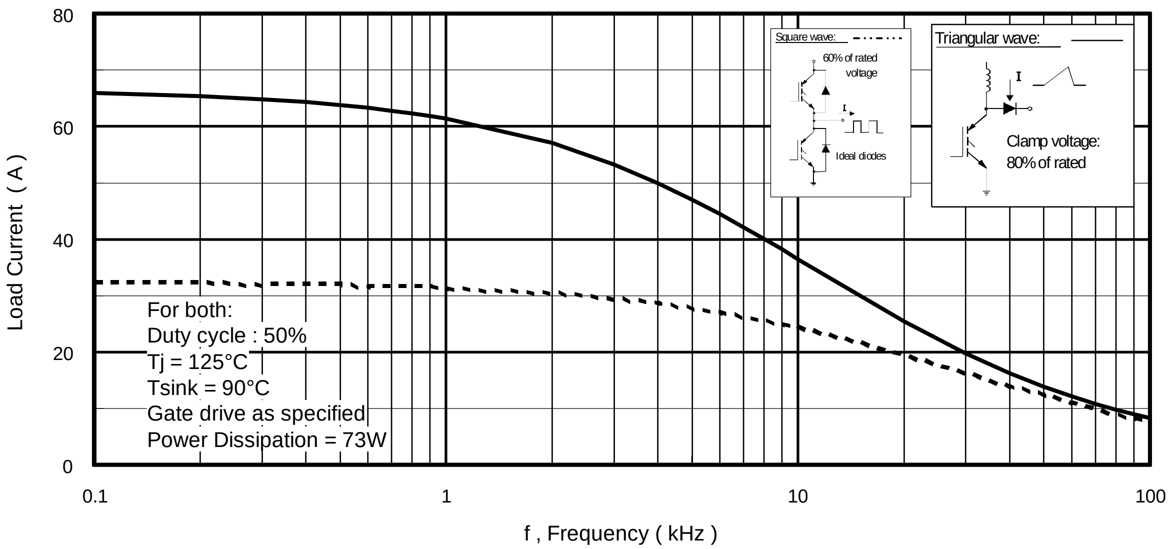


Fig. 1 - Typical Load Current vs. Frequency
(For square wave, $I=I_{RMS}$ of fundamental; for triangular wave, $I=I_{PK}$)

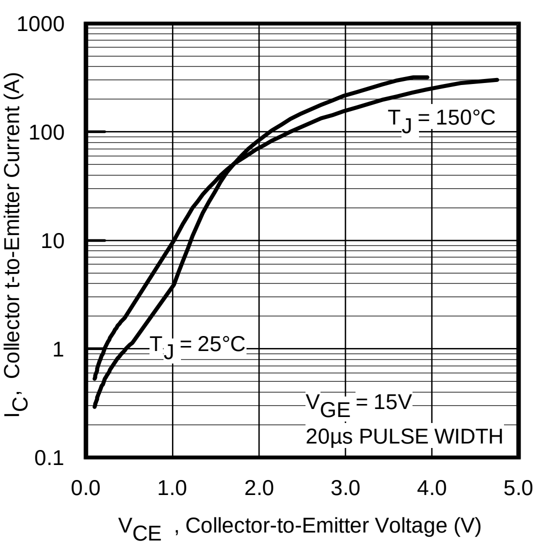


Fig. 2 - Typical Output Characteristics

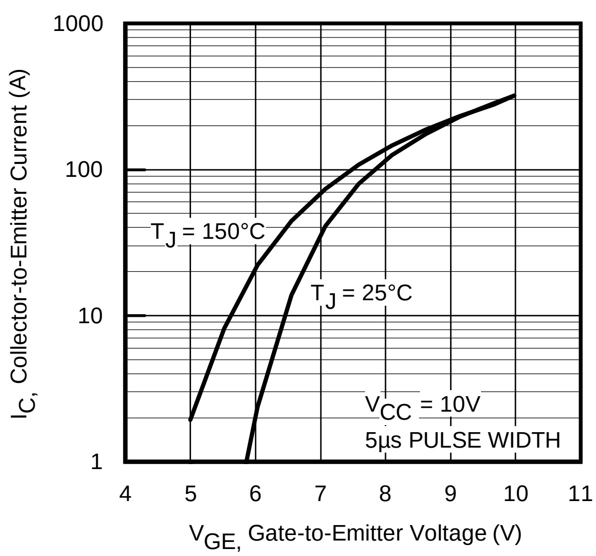


Fig. 3 - Typical Transfer Characteristics

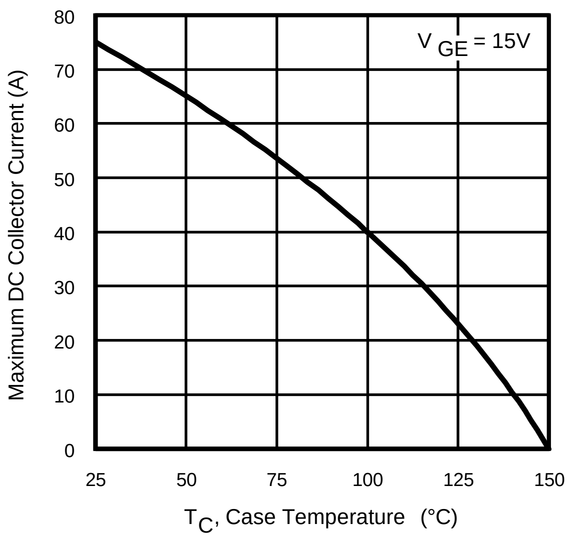


Fig. 4 - Maximum Collector Current vs. Case Temperature

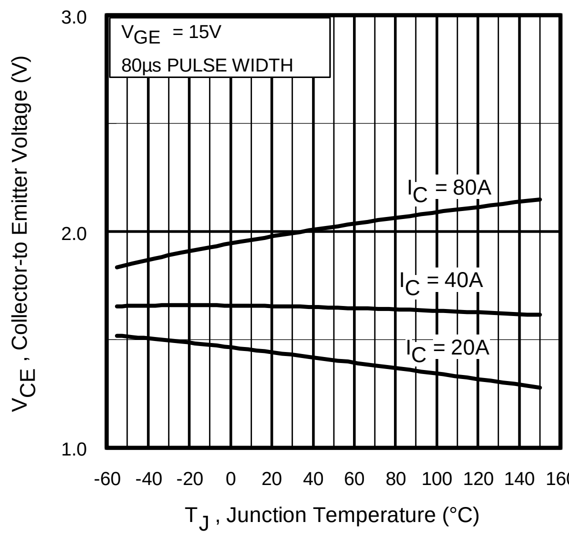


Fig. 5 - Collector-to-Emitter Voltage vs. Junction Temperature

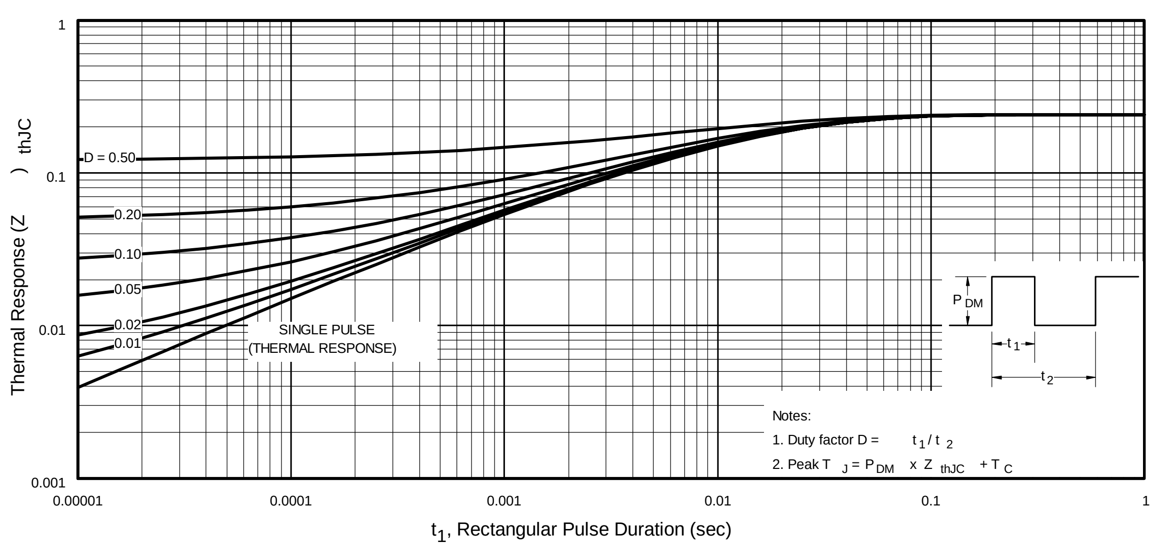


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

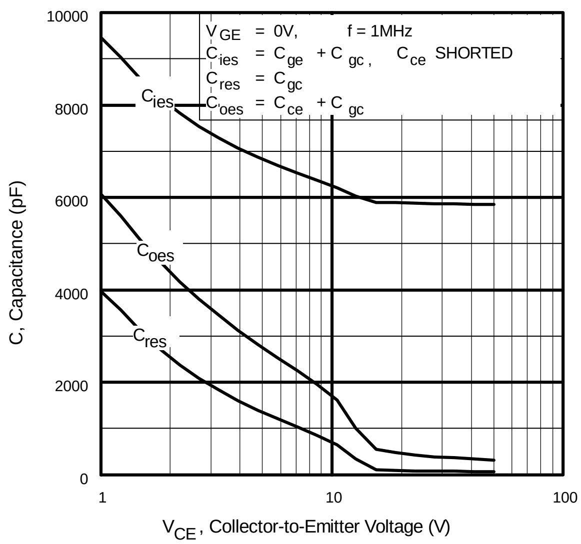


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

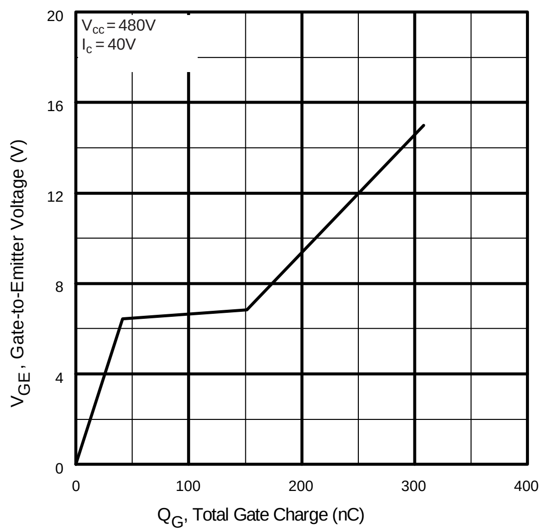


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

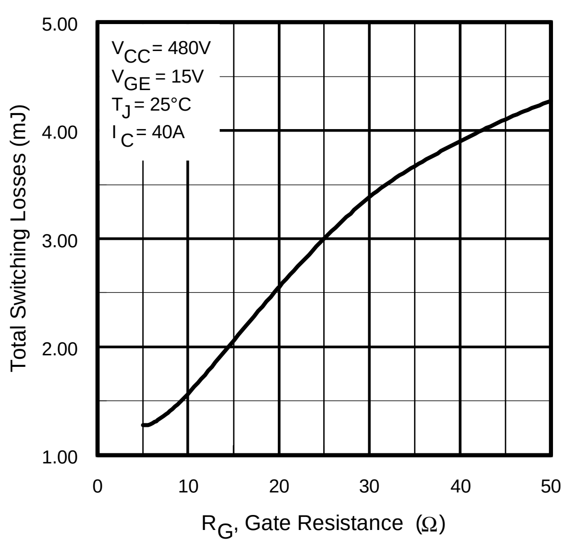


Fig. 9 - Typical Switching Losses vs. Gate Resistance

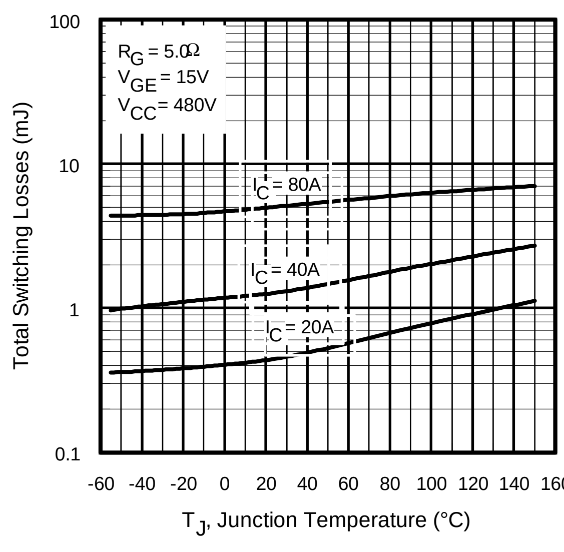


Fig. 10 - Typical Switching Losses vs. Junction Temperature

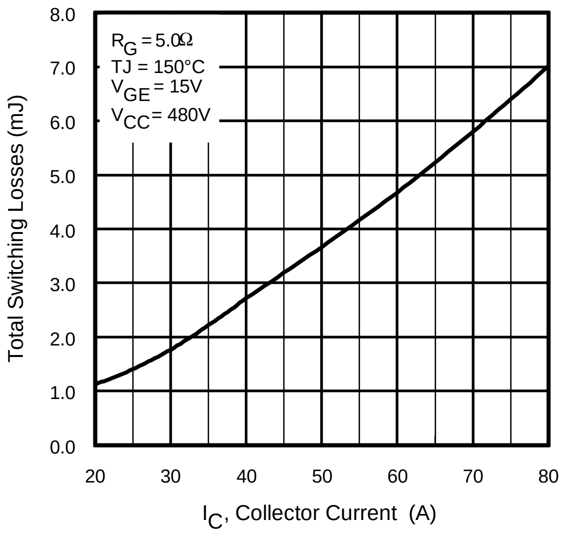


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

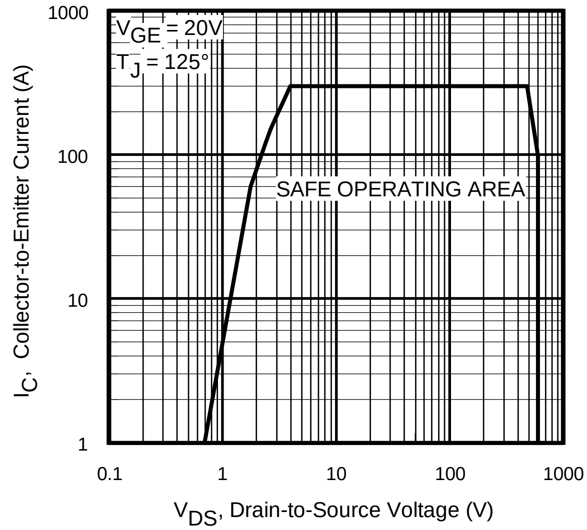
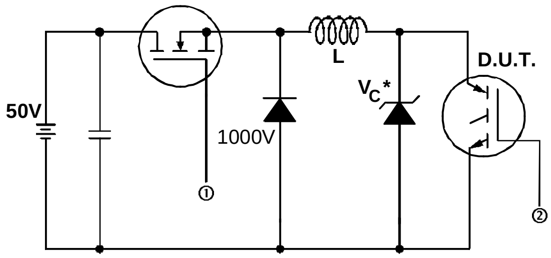


Fig. 12 - Turn-Off SOA



* 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

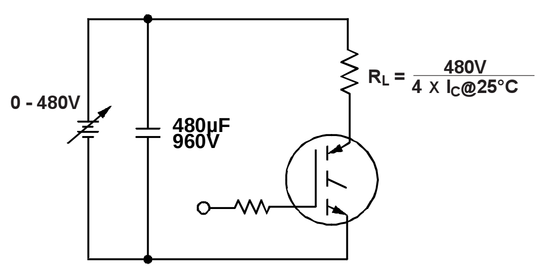


Fig. 13b - Pulsed Collector Current Test Circuit

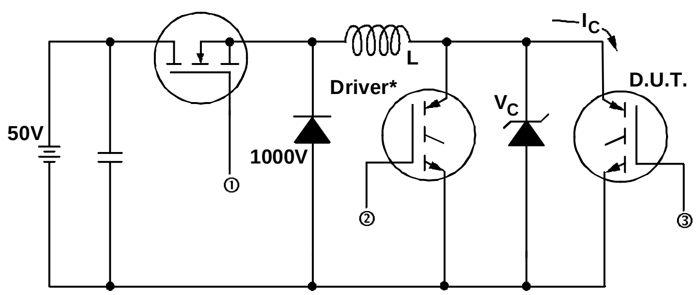


Fig. 14a - Switching Loss Test Circuit

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

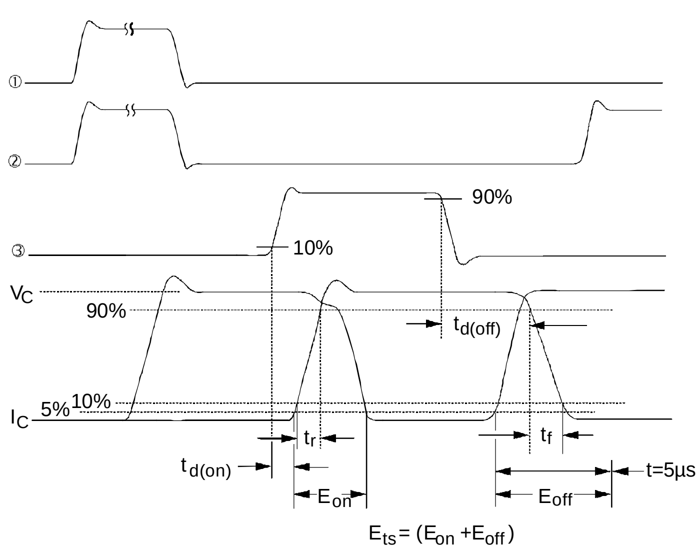
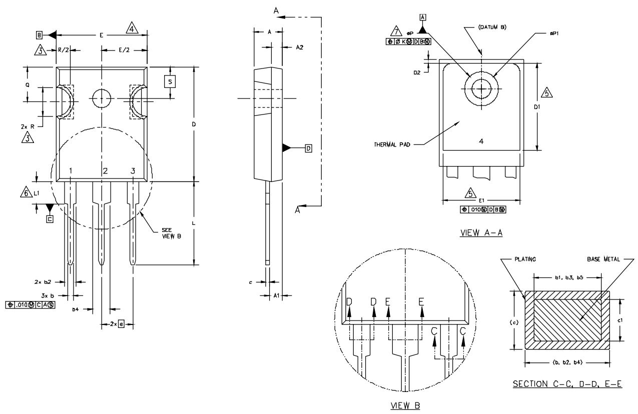


Fig. 14b - Switching Loss Waveforms

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

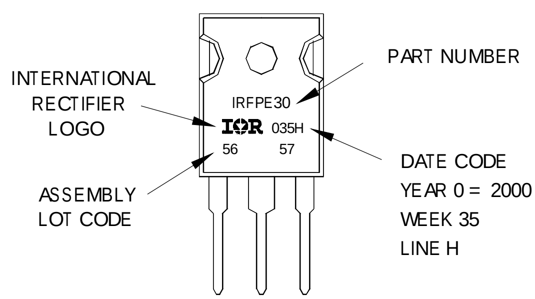
DIODES

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.
This product has been designed and qualified for the Industrial market.
Qualification Standards can be found on IR's Web site.

International
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IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
TAC Fax: (310) 252-7903
Visit us at www.irf.com for sales contact information.07/04

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