

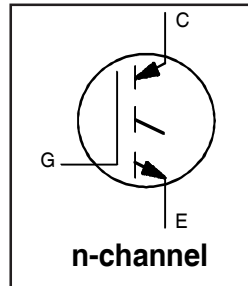
IRG4PH50S-EPbF

INSULATED GATE BIPOLAR TRANSISTOR

Standard Speed IGBT

Features

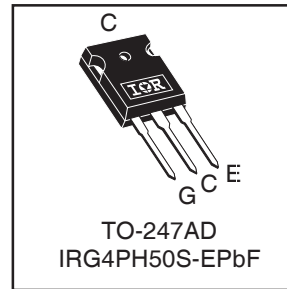
- Standard: Optimized for minimum saturation voltage and low operating frequencies (< 1kHz)
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency than Generation 3
- Industry standard TO-247AC package
- Lead-Free



$V_{CES} = 1200V$
$V_{CE(on)} \text{ typ.} = 1.47V$
@ $V_{GE} = 15V, I_C = 33A$

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



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	57	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	33	
I_{CM}	Pulsed Collector Current ^①	114	
I_{LM}	Clamped Inductive Load Current ^②	114	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
	Transient Gate-to-Emitter Voltage	± 30	
E_{ARV}	Reverse Voltage Avalanche Energy ^③	270	mJ
$P_D @ T_C = 25^\circ$	Maximum Power Dissipation	200	W
$P_D @ T_C = 100^\circ$	Maximum Power Dissipation	80	
T_J	Operating Junction and Storage Temperature Range	-55 to + 150	$^\circ C$
T_{STG}			
	Soldering Temperature, for 10 sec.	300 (0.063 in. (1.6mm) from case)	
	Mounting Torque, 6-32 or M3 Screw.	10 lbf·in (1.1 N·m)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	—	0.64	$^\circ C/W$
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	—	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	—	40	
Wt	Weight	—	6.0(0.21)	—	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	1200	—	—	V	$V_{GE} = 0V, I_C = 250\mu A$
$V_{(BR)ECS}$	Emitter-to-Collector Breakdown Voltage ④	18	—	—	V	$V_{GE} = 0V, I_C = 1.0 A$
$\Delta V_{(BR)CES}/\Delta T_J$	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	$I_C = 33A, V_{GE} = 15V$ $I_C = 57A$ $I_C = 33A, T_J = 150^\circ C$ See Fig.2, 5
		—	1.75	—		
		—	1.55	—		
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0		$V_{CE} = V_{GE}, I_C = 250\mu A$
$DV_{GE(th)}/DT_J$	Temperature Coeff. of Threshold Voltage	—	-11	—	mV/°C	$V_{CE} = V_{GE}, I_C = 250\mu A$
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		$V_{GE} = 0V, V_{CE} = 10V, T_J = 25^\circ C$
		—	—	1000		$V_{GE} = 0V, V_{CE} = 1200V, T_J = 150^\circ C$
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)	—	167	251	nC	$I_C = 33A$ $V_{CC} = 400V$ $V_{GE} = 15V$ See Fig. 8
Q_{ge}	Gate - Emitter Charge (turn-on)	—	25	38		
Q_{gc}	Gate - Collector Charge (turn-on)	—	55	83		
$t_{d(on)}$	Turn-On Delay Time	—	32	—	ns	$T_J = 25^\circ C$ $I_C = 33A, V_{CC} = 960V$ $V_{GE} = 15V, R_G = 5.0\Omega$ Energy losses include "tail" See Fig. 9, 10, 14
t_r	Rise Time	—	29	—		
$t_{d(off)}$	Turn-Off Delay Time	—	845	1268		
t_f	Fall Time	—	425	638		
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	$T_J = 150^\circ C,$ $I_C = 33A, V_{CC} = 960V$ $V_{GE} = 15V, R_G = 5.0\Omega$ Energy losses include "tail" See Fig. 10,11,14
t_r	Rise Time	—	30	—		
$t_{d(off)}$	Turn-Off Delay Time	—	1170	—		
t_f	Fall Time	—	1000	—		
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	$V_{GE} = 0V$ $V_{CC} = 30V$ $f = 1.0MHz$ See Fig. 7
C_{oes}	Output Capacitance	—	160	—		
C_{res}	Reverse Transfer Capacitance	—	30	—		

Notes:

- ① Repetitive rating; $V_{GE} = 20V$, pulse width limited by max. junction temperature. (See fig. 13b)
- ② $V_{CC} = 80\%(V_{CES}), V_{GE} = 20V, L = 10\mu H, R_G = 5.0\Omega,$ (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.

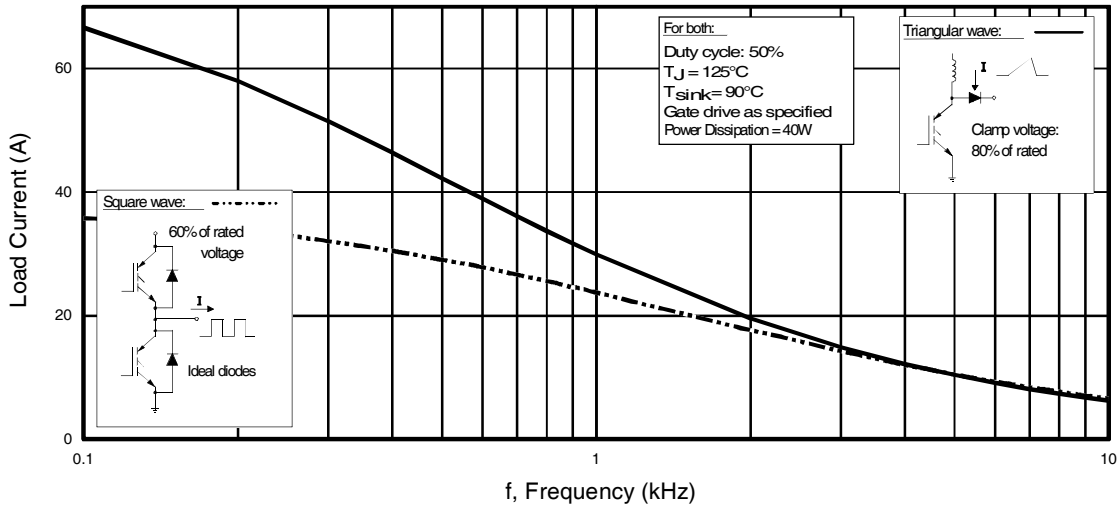


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

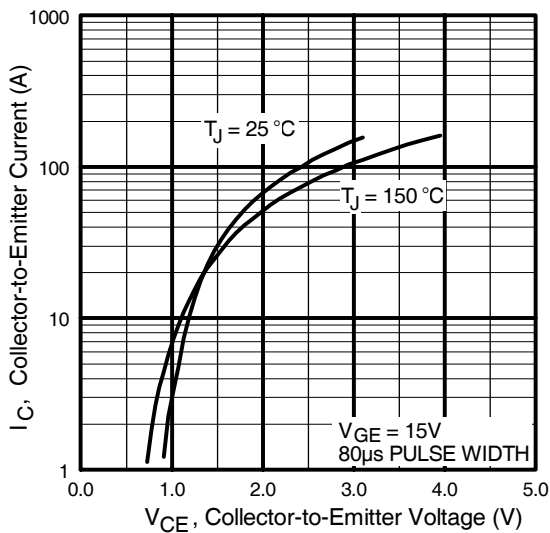


Fig. 2 - Typical Output Characteristics

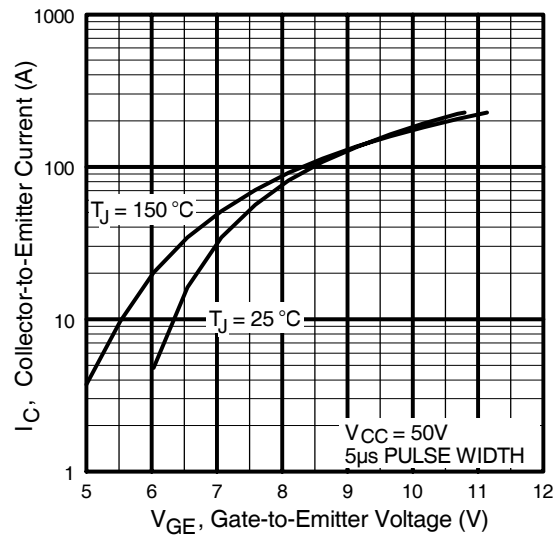


Fig. 3 - Typical Transfer Characteristics

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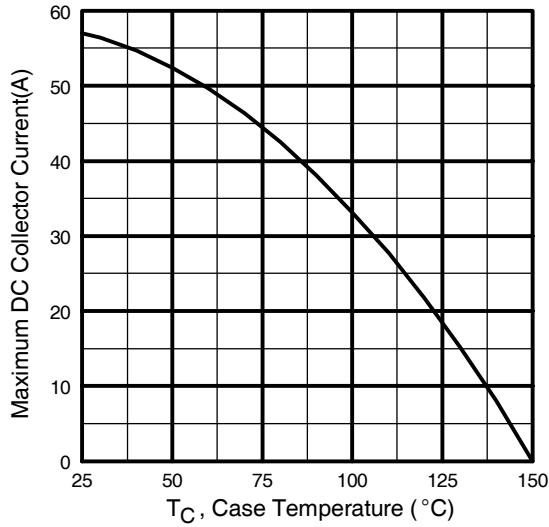


Fig. 4 - Maximum Collector Current vs. Case Temperature

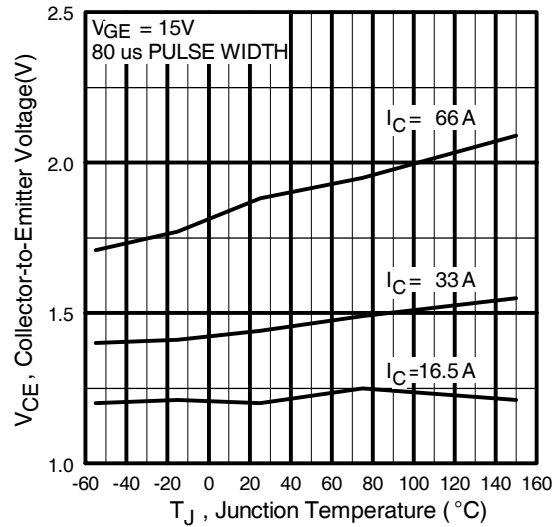


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

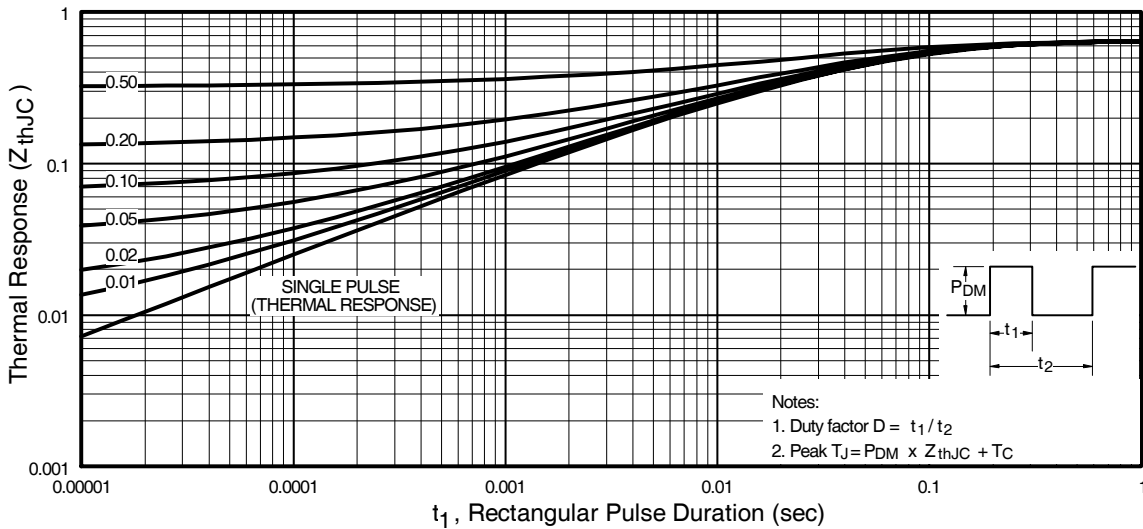


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

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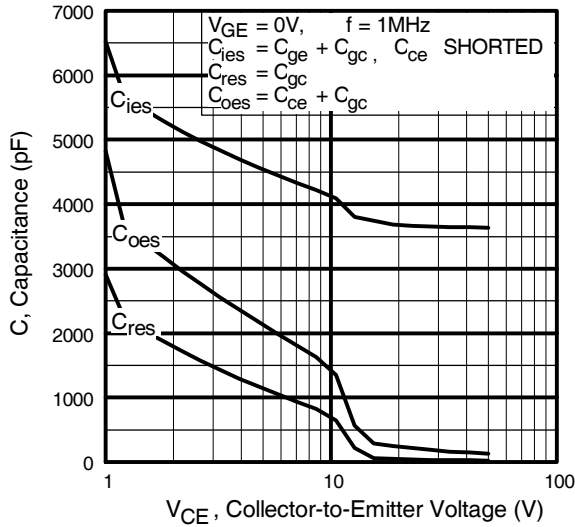


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

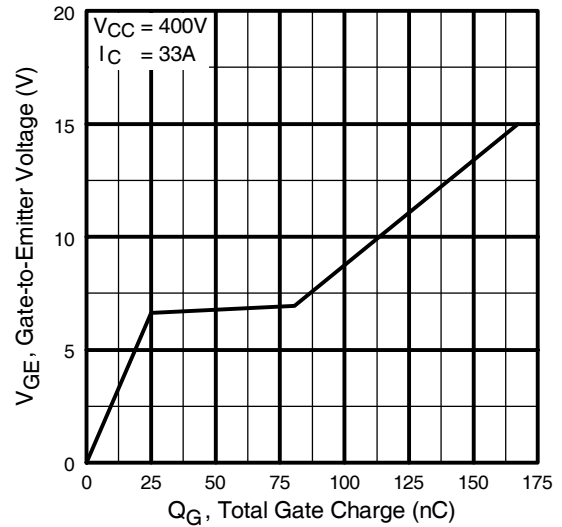


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

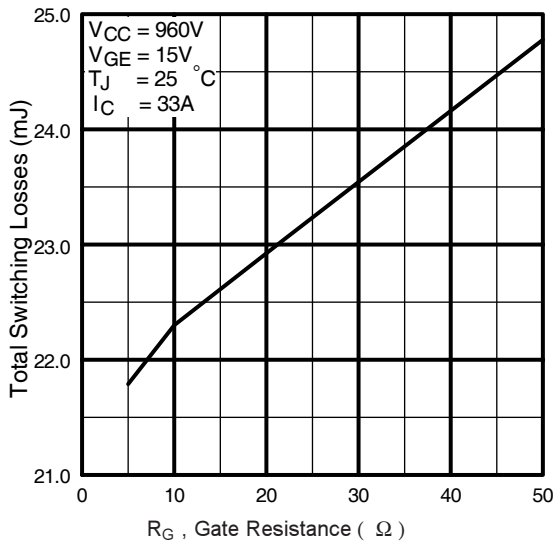


Fig. 9 - Typical Switching Losses vs. Gate Resistance

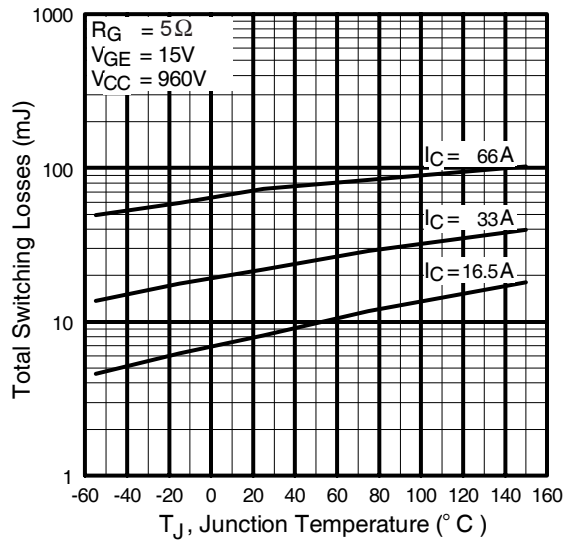


Fig. 10 - Typical Switching Losses vs. Junction Temperature

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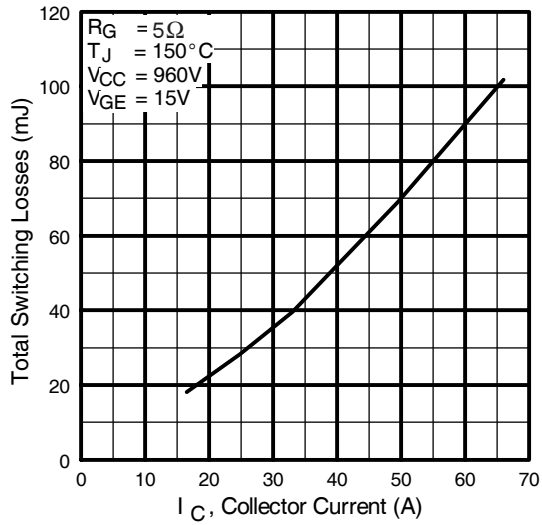


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

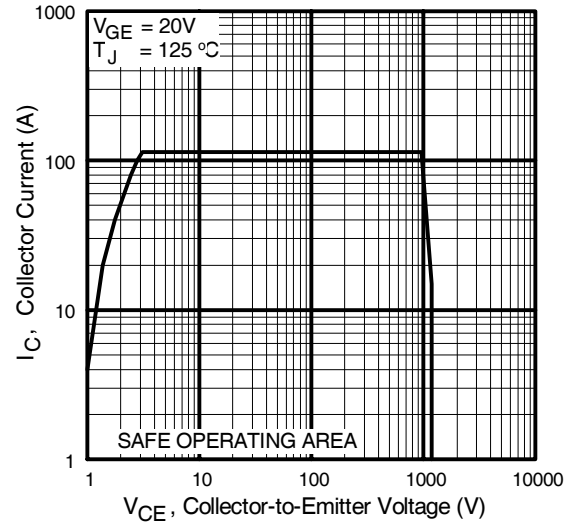
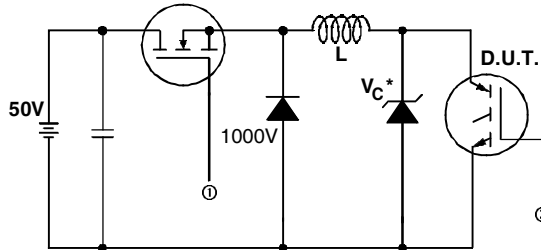


Fig. 12 - Reverse Bias SOA



* 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

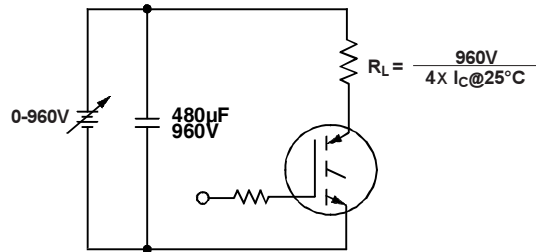


Fig. 13b - Pulsed Collector Current Test Circuit

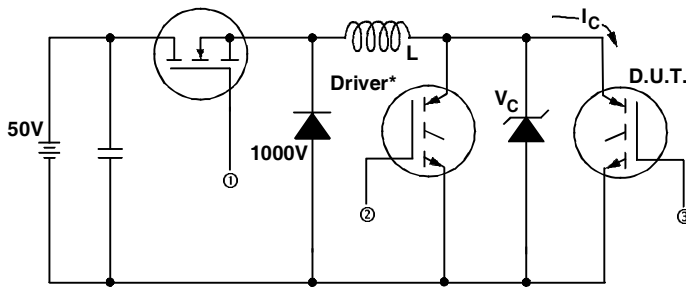


Fig. 14a - Switching Loss Test Circuit

* Driver same type as D.U.T., $V_C = \text{---}V$

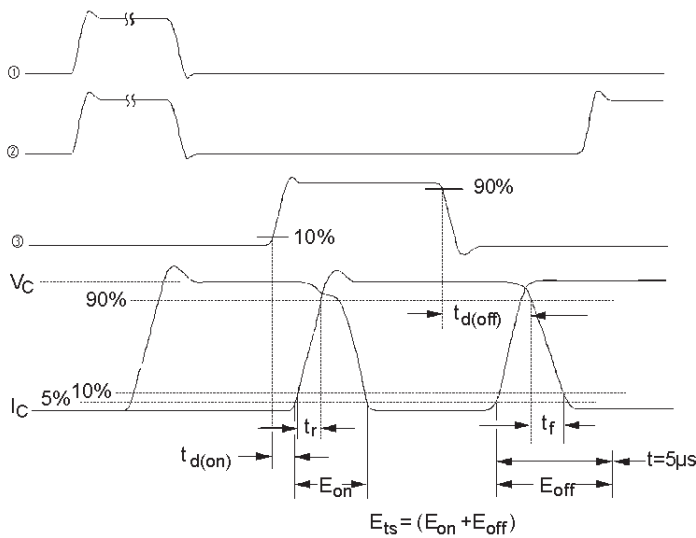
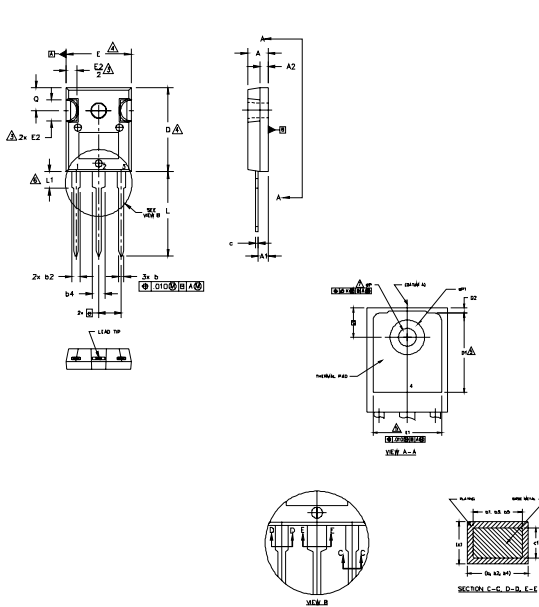


Fig. 14b - Switching Loss Waveforms

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TO-247AD Package Outline (Dimensions are shown in millimeters (inches))



NOTES:

- DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M 1994.
- DIMENSIONS ARE SHOWN IN INCHES.
- CONTOUR OF SLOT OPTIONAL.
- 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.
- THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS D1 & E1.
- LEAD FINISH UNCONTROLLED IN L1.
- ØP TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5 ° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154 INCH.
- OUTLINE CONFORMS TO JEDEC OUTLINE TO-247AD.

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	2.34	
b4	.102	.135	2.59	3.43	
b5	.102	.133	2.59	3.38	
c	.015	.035	0.38	0.89	
c1	.015	.033	0.38	0.84	
D	.776	.815	19.71	20.70	4
D1	.515	-	13.08	-	5
D2	.020	.053	0.51	1.35	
E	.602	.625	15.29	15.87	4
E1	.530	-	13.46	-	
E2	.178	.216	4.52	5.49	
e	.215 BSC		5.46 BSC		
Øk	.010		0.25		
L	.780	.827	19.57	21.00	
L1	.146	.169	3.71	4.29	
ØP	.140	.144	3.56	3.66	
ØP1	-	.291	-	7.39	
Ø	.209	.224	5.31	5.69	
S	.217 BSC		5.51 BSC		

LEAD ASSIGNMENTS

HEXFLET

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

IGBTs, CoPACK

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

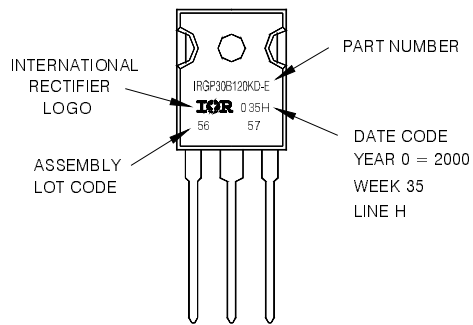
DIODES

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

TO-247AD Part Marking Information

EXAMPLE: THIS IS AN IRGP30B120KD-E
WITH ASSEMBLY
LOT CODE 5657
ASSEMBLED ON WW 35, 2000
IN THE ASSEMBLY LINE 'H'

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



TO-247AD package is not recommended for Surface Mount Application.

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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