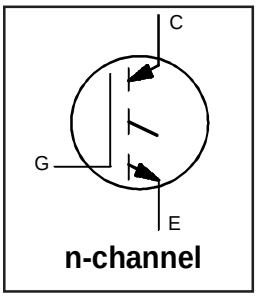
PD - 95569

International
IOR Rectifier

IRG4PC60U-PPbF

INSULATED GATE BIPOLAR TRANSISTOR

UltraFast Speed IGBT



n-channel

$V_{CES} = 600V$

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

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

TO-247AC

Features

- UltraFast: Optimized for high operating frequencies up to 50 kHz in hard switching and >200 kHz in resonant mode.
- Application in UPS, Welding and High Current power supply.
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency.
- Solder plated version of industry standard TO-247AC package.
- Lead-Free

Benefits

- Generation 4 IGBT's offer highest efficiency available.
- Solder plated version of the TO-247 allows the reflow soldering of the package heatsink to a substrate material.
- Designed for best performance when used with IR HEXFRED & IR FRED companion diodes.

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)	
	Maximum Reflow Temperature⑦	230 (Time above 183°C should not exceed 100s)	°C

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	
$R_{\theta JA}$	Junction-to-Ambient (PCB Mount, Steady State)⑥	----	20	
Wt	Weight	6 (0.21)	----	g (oz)

07/15/04

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} ≥ 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_J = 25°C
t_r	Rise Time	----	42	----		I_C = 40A, V_{CC} = 480V
$t_{d(off)}$	Turn-Off Delay Time	----	200			V_{GE} = 15V, R_G = 5.0Ω
t_f	Fall Time	----	100			Energy losses include "tail"
E_{on}	Turn-On Switching Loss	----	0.28	----	mJ	See Fig. 10, 11, 13, 14
E_{off}	Turn-Off Switching Loss	----	1.1	----		
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, Rg = 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.

⑥ When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994.

⑦ Refer to application note # 1023, "Surface Mounting of Larger Devices."

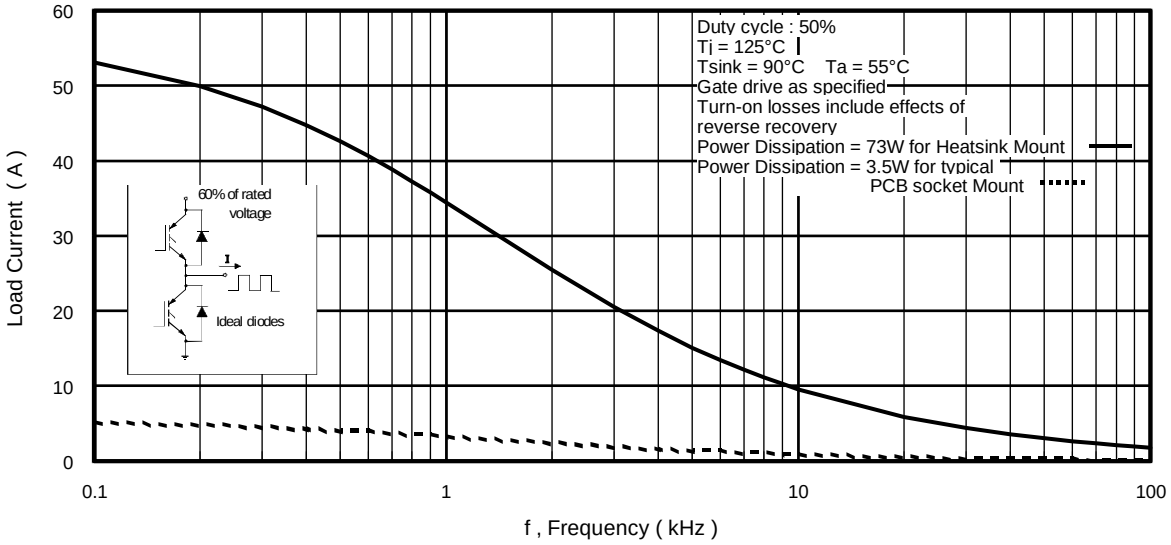


Fig. 1 - Typical Load Current vs. Frequency
(For square wave, $I=I_{RMS}$ of fundamental; for triangular wave, $I=I_{PK}$)

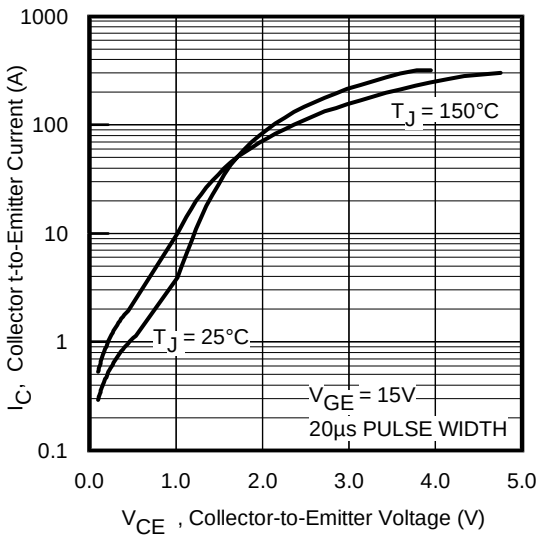


Fig. 2 - Typical Output Characteristics

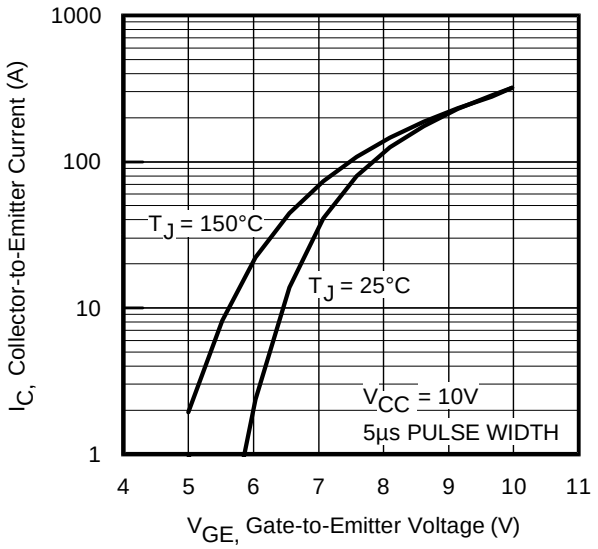


Fig. 3 - Typical Transfer Characteristics

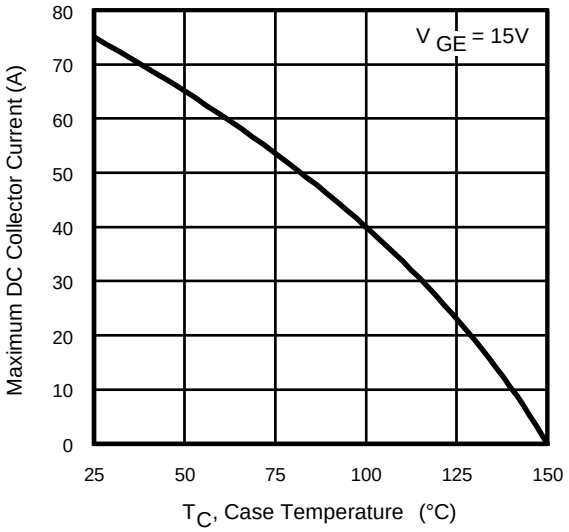


Fig. 4 - Maximum Collector Current vs. Case Temperature

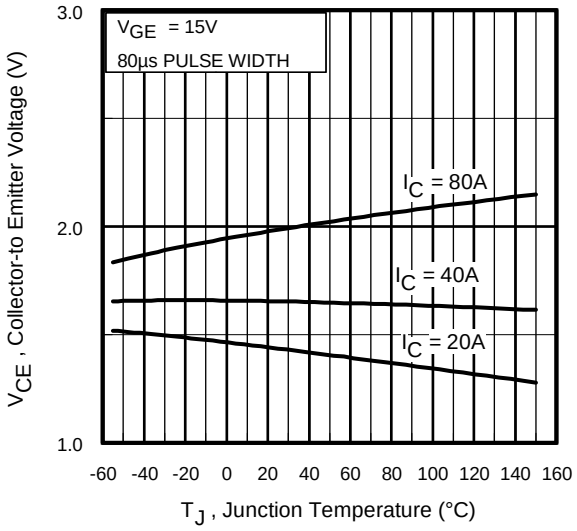


Fig. 5 - Collector-to-Emitter Voltage vs. Junction Temperature

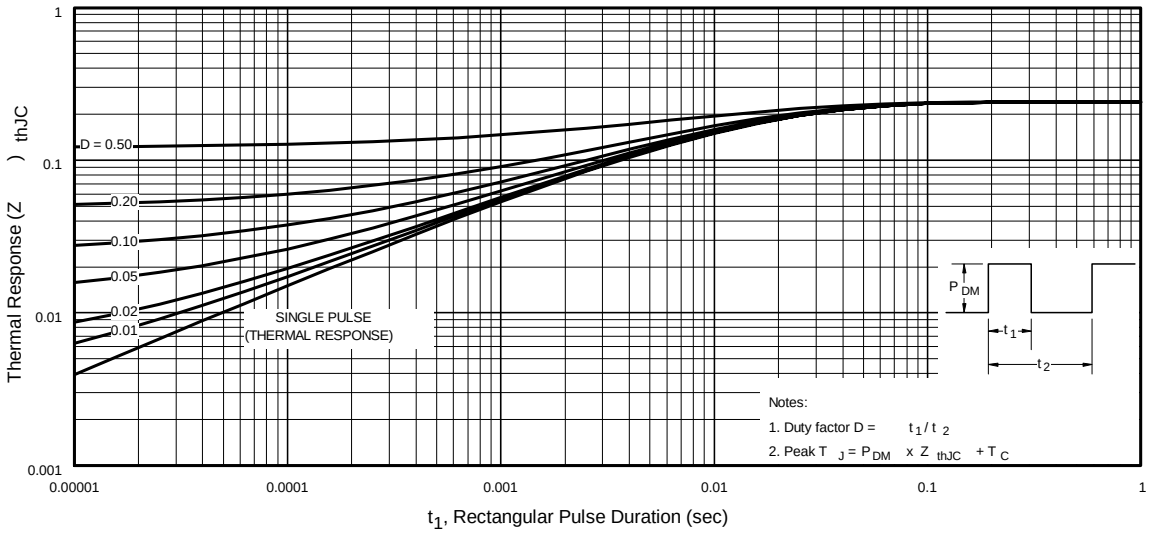


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

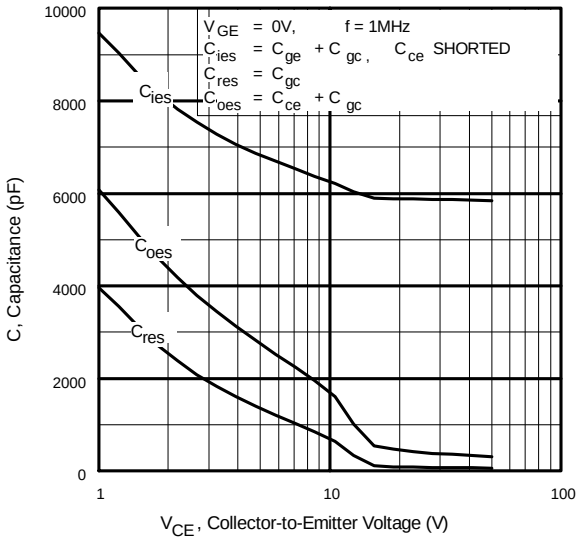


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

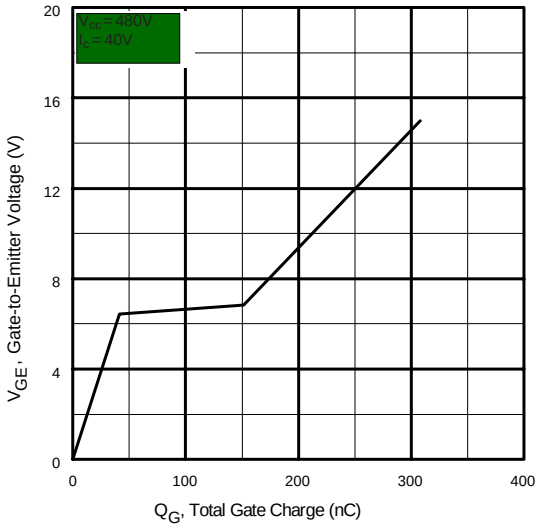


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

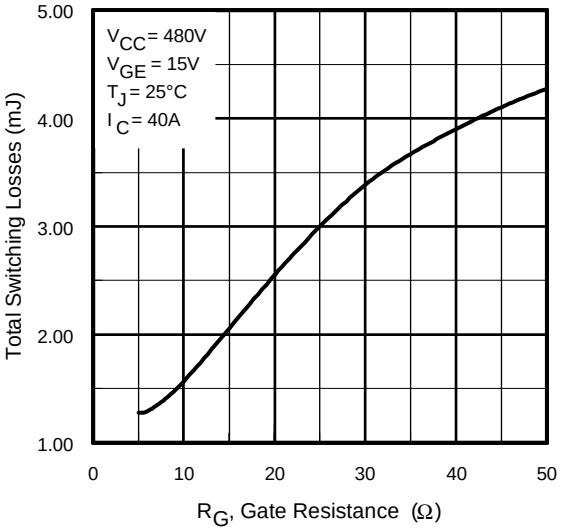


Fig. 9 - Typical Switching Losses vs. Gate Resistance

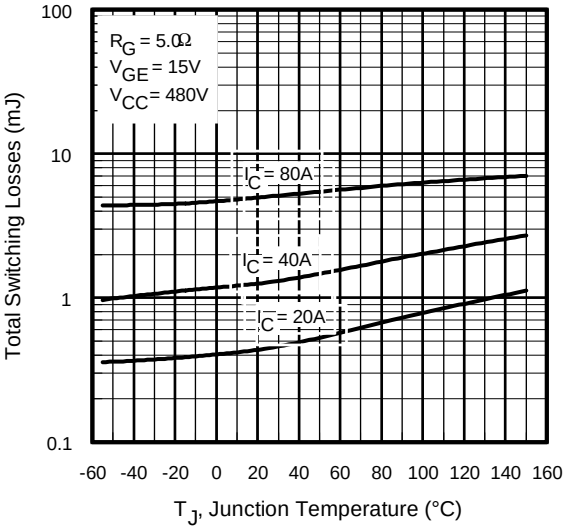


Fig. 10 - Typical Switching Losses vs. Junction Temperature

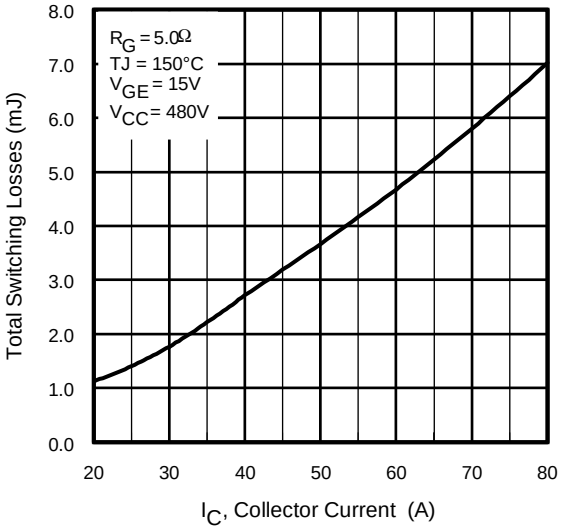


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

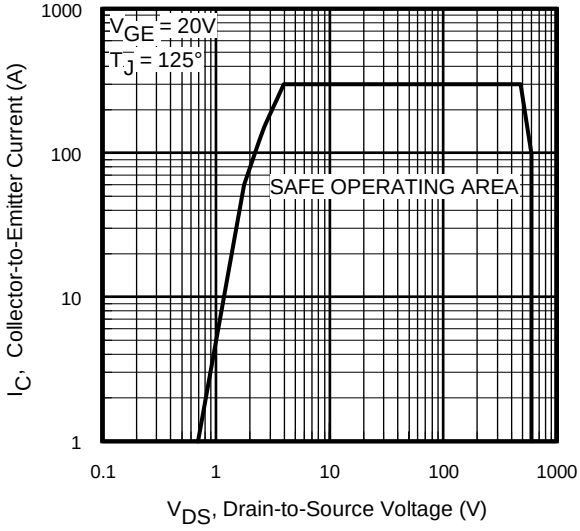


Fig. 12 - Turn-Off SOA

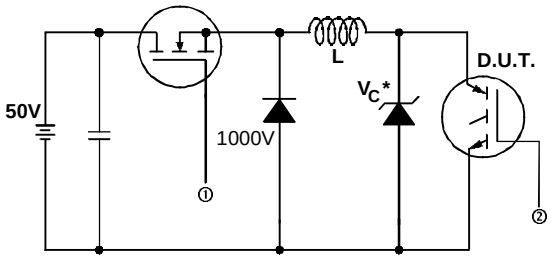


Fig. 13a - Clamped Inductive Load Test Circuit

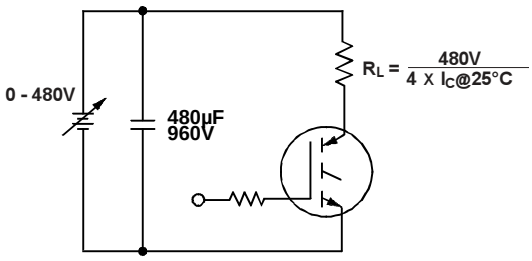


Fig. 13b - Pulsed Collector Current Test Circuit

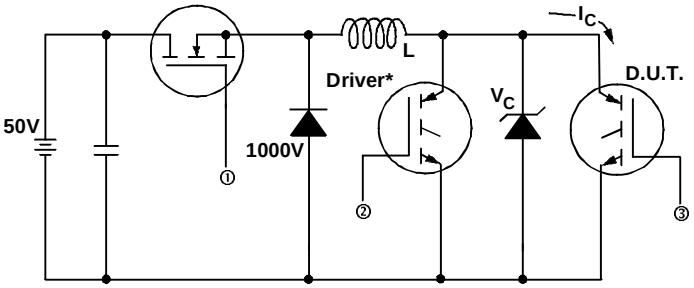


Fig. 14a - Switching Loss Test Circuit

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

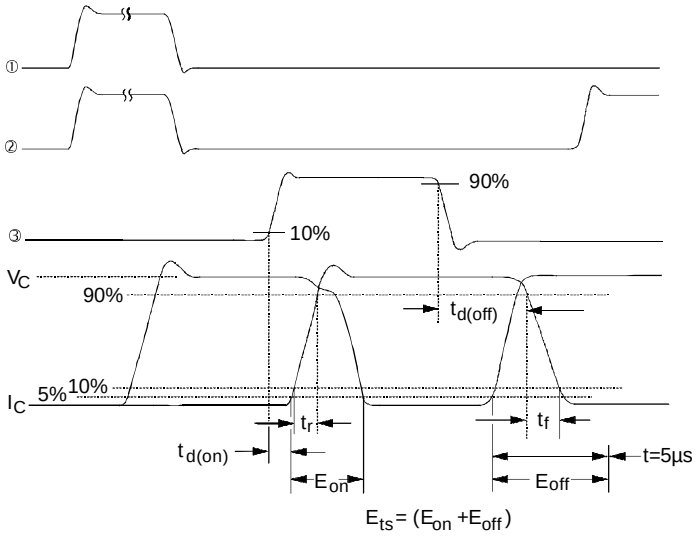
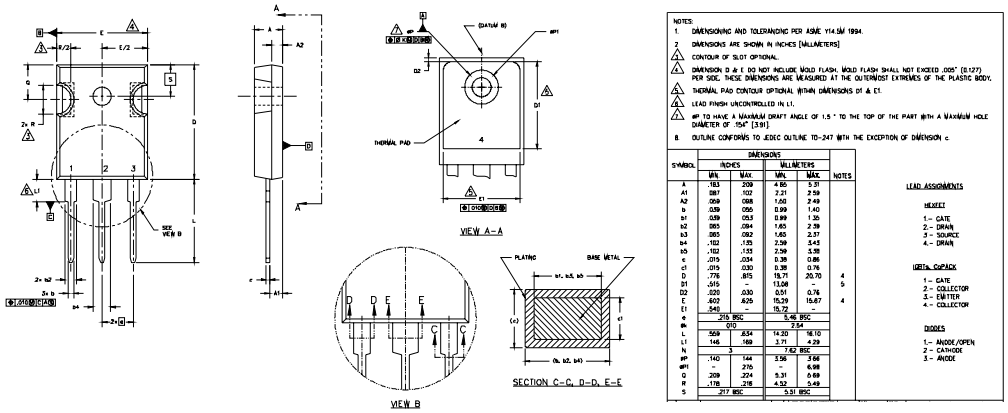


Fig. 14b - Switching Loss Waveforms

TO-247AC Package Outline

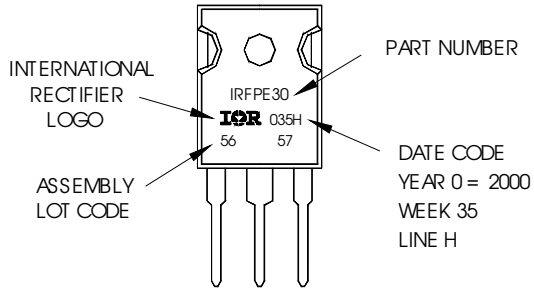
Dimensions are shown in millimeters (inches)



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"



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