

International IOR Rectifier

PD - 95567

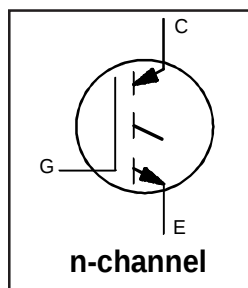
IRG4PC60F-PPbF

INSULATED GATE BIPOLAR TRANSISTOR

Fast Speed IGBT

Features

- Fast: Optimized for medium operating frequencies (1-5 kHz in hard switching, >20 kHz in resonant mode).
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency.
- Solder plated version of industry standard TO-247AC package.
- Lead-Free



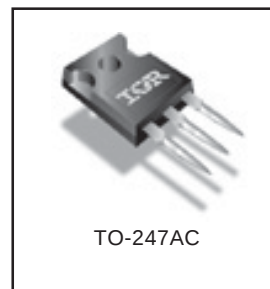
$$V_{CES} = 600V$$

$$V_{CE(on)} \text{ typ.} = 1.50V$$

$$@V_{GE} = 15V, I_C = 60A$$

Benefits

- Generation 4 IGBT's offer highest efficiency available.
- IGBT's optimized for specified application conditions.
- 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.



TO-247AC

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Breakdown Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	90	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	60	
I_{CM}	Pulsed Collector Current ①	120	
I_{LM}	Clamped Inductive Load Current ②	120	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
E_{ARV}	Reverse Voltage Avalanche Energy ③	200	mJ
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	520	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	210	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 150	$^\circ C$
	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 Temperature ④	230 (Time above 183°C should not exceed 100s)	$^\circ C$

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	0.24	$^\circ C/W$
$R_{\theta CS}$	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)

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	16	—	—	V	$V_{GE} = 0V, I_C = 1.0A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.13	—	V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 1.0mA$
$V_{CE(ON)}$	Collector-to-Emitter Saturation Voltage	—	1.5	1.8	V	$I_C = 60A, V_{GE} = 15V$
		—	1.7	—		$I_C = 90A, V_{GE} = 15V$
		—	1.5	—		$I_C = 60A, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	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	—	-11	—	mV/ $^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 250\mu A$
g_{fe}	Forward Transconductance ⑤	36	69	—	S	$V_{CE} = 100V, I_C = 60A$
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	μA	$V_{GE} = 0V, V_{CE} = 600V$
		—	—	2.0		$V_{GE} = 0V, V_{CE} = 10V, T_J = 25^\circ\text{C}$
		—	—	1000		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$
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)	—	290	340	nC	$I_C = 40A$
Q_{ge}	Gate - Emitter Charge (turn-on)	—	40	47		$V_{CC} = 400V$
Q_{gc}	Gate - Collector Charge (turn-on)	—	100	130		$V_{GE} = 15V$
$t_{d(on)}$	Turn-On Delay Time	—	42	—	ns	$T_J = 25^\circ\text{C}$
t_r	Rise Time	—	66	—		$I_C = 60A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off Delay Time	—	310	360		$V_{GE} = 15V, R_G = 5.0\Omega$
t_f	Fall Time	—	170	220		Energy losses include "tail"
E_{on}	Turn-On Switching Loss	—	0.30	—	mJ	See Fig. 10, 11, 13, 14
E_{off}	Turn-Off Switching Loss	—	4.6	—		
E_{ts}	Total Switching Loss	—	4.9	6.3		
$t_{d(on)}$	Turn-On Delay Time	—	39	—	ns	$T_J = 150^\circ\text{C}$
t_r	Rise Time	—	66	—		$I_C = 60A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off Delay Time	—	470	—		$V_{GE} = 15V, R_G = 5.0\Omega$
t_f	Fall Time	—	300	—		Energy losses include "tail"
E_{ts}	Total Switching Loss	—	8.8	—	mJ	See Fig. 13, 14
L_E	Internal Emitter Inductance	—	13	—	nH	Measured 5mm from package
C_{ies}	Input Capacitance	—	6050	—	pF	$V_{GE} = 0V$
C_{oes}	Output Capacitance	—	360	—		$V_{CC} = 30V$
C_{res}	Reverse Transfer Capacitance	—	66	—		$f = 1.0MHz$

Notes:

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

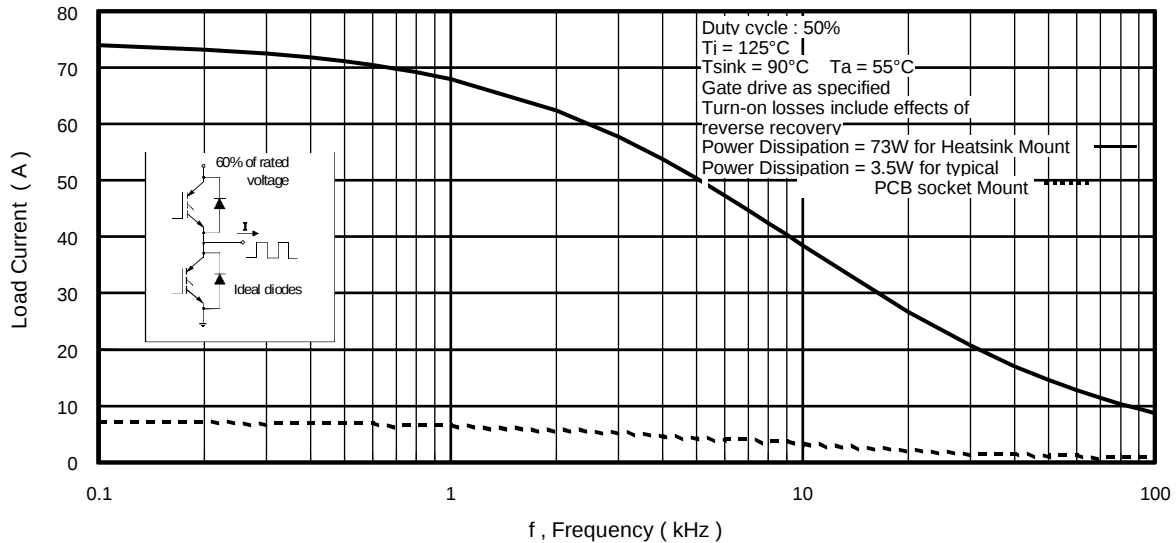


Fig. 1 - Typical Load Current vs. Frequency
 (For square wave, $I = I_{\text{RMS}}$ of fundamental; for triangular wave, $I = I_{\text{PK}}$)

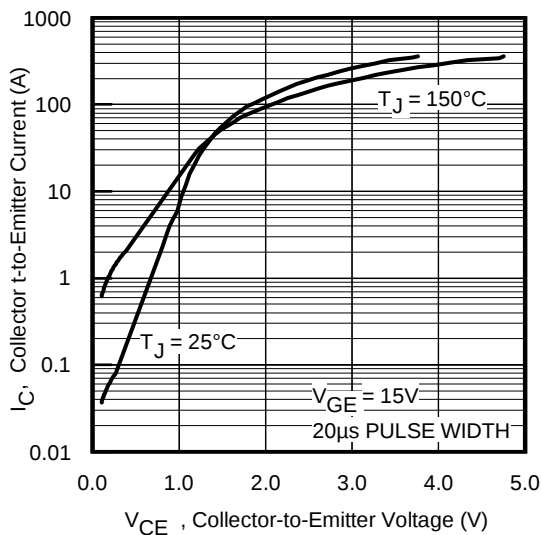


Fig. 2 - Typical Output Characteristics

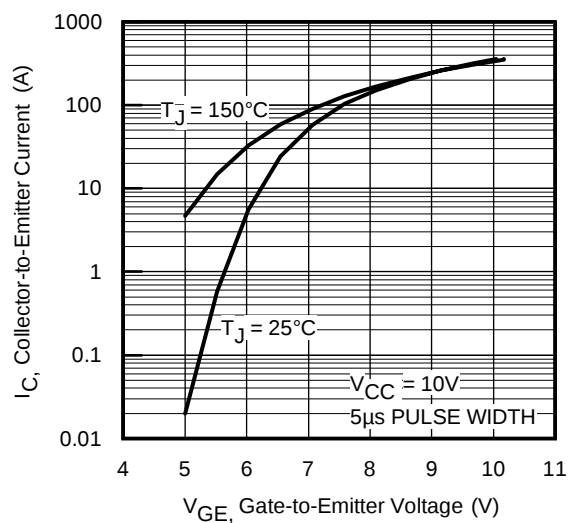


Fig. 3 - Typical Transfer Characteristics

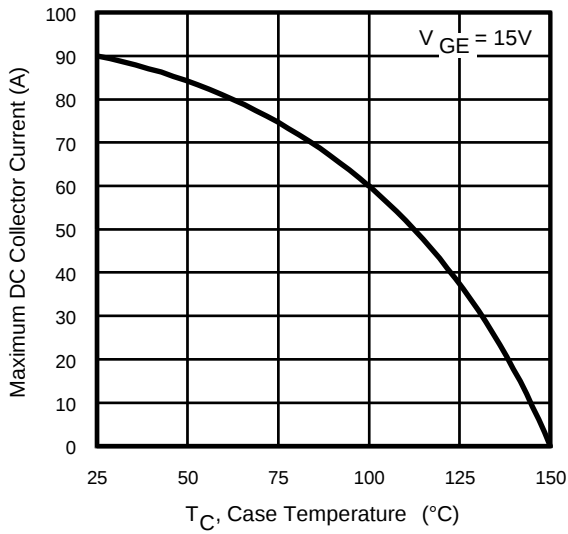


Fig. 4 - Maximum Collector Current vs. Case Temperature

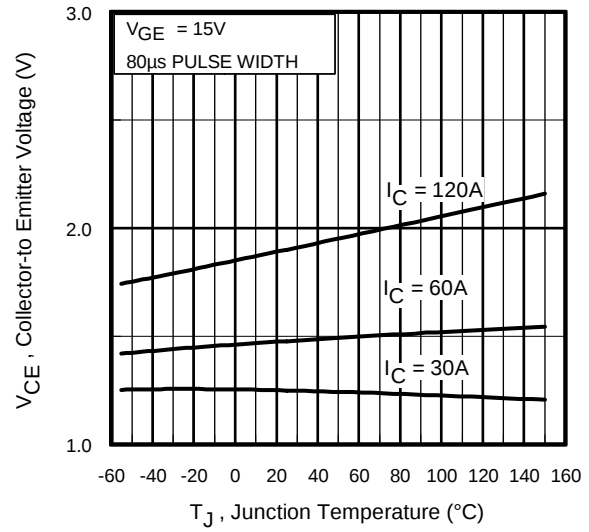


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

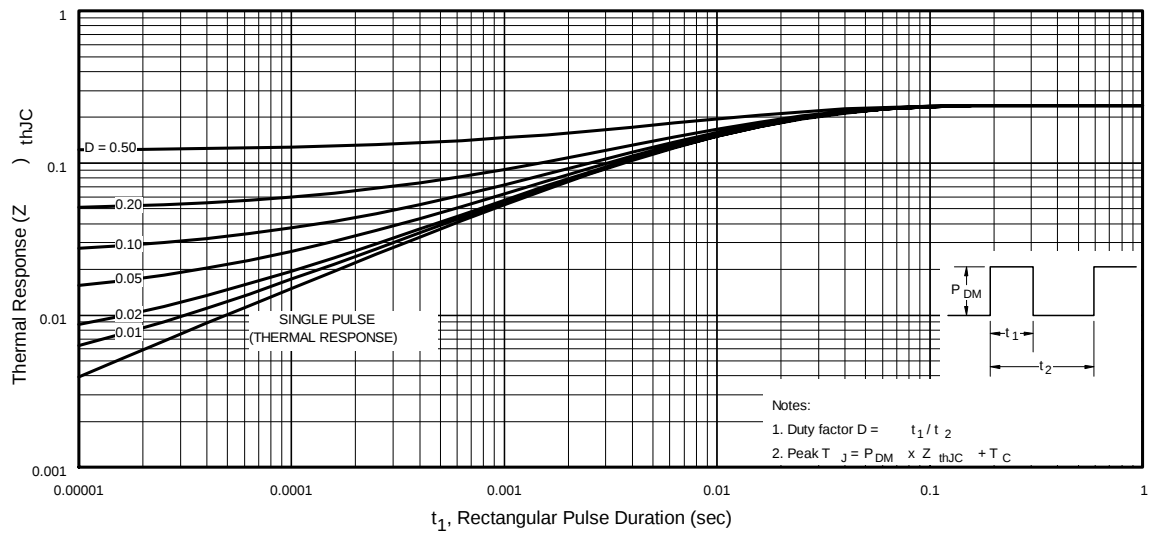


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

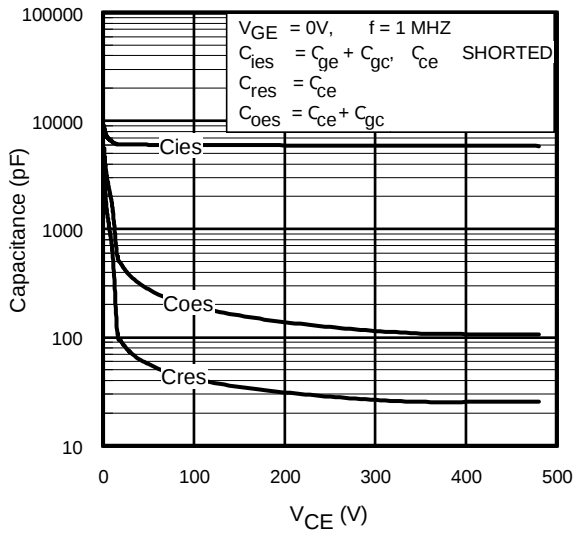


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

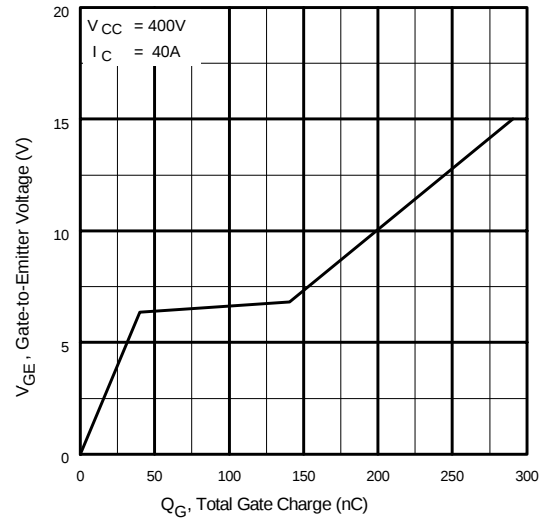


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

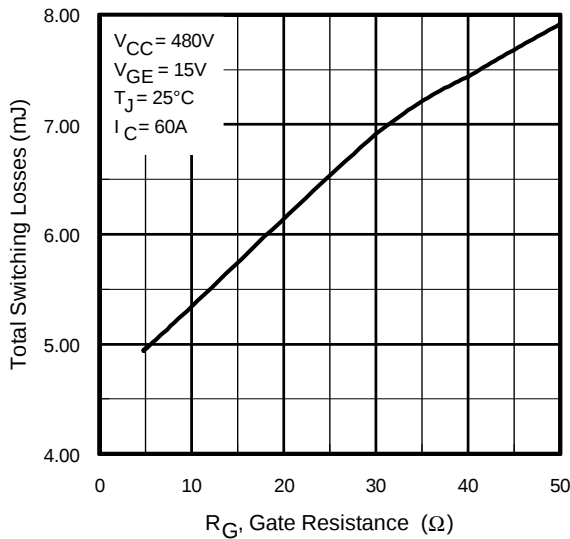


Fig. 9 - Typical Switching Losses vs. Gate Resistance

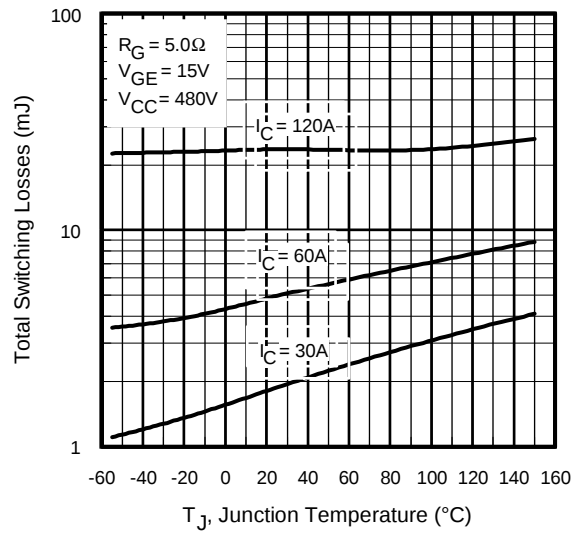


Fig. 10 - Typical Switching Losses vs. Junction Temperature

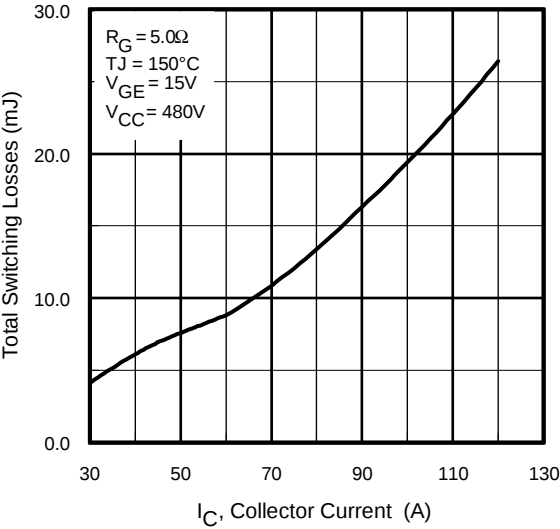


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

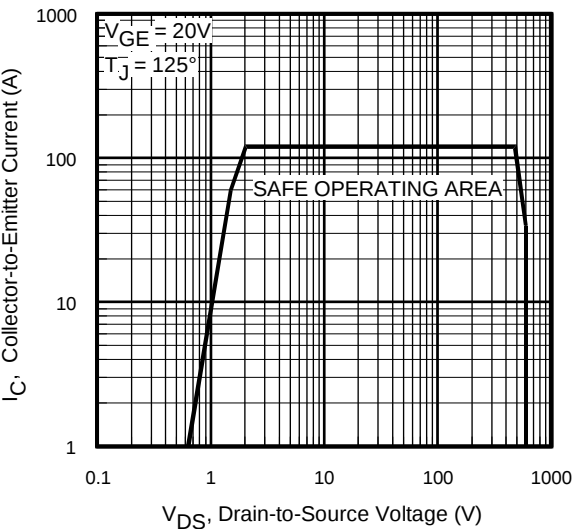


Fig. 12 - Turn-Off SOA

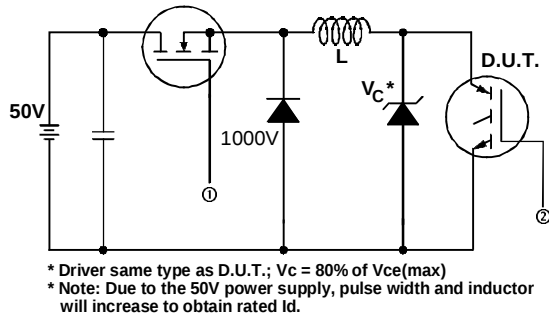


Fig. 13a - Clamped Inductive Load Test Circuit

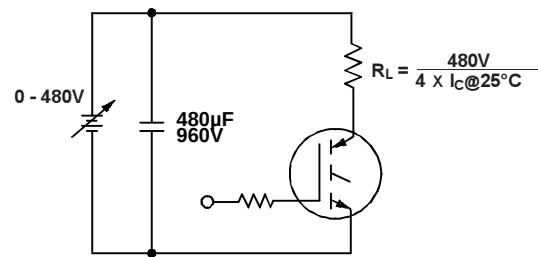


Fig. 13b - Pulsed Collector Current Test Circuit

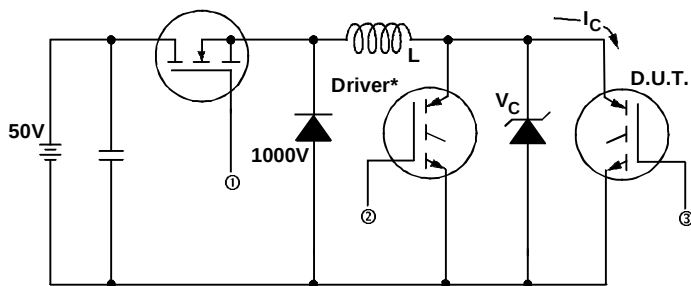


Fig. 14a - Switching Loss Test Circuit

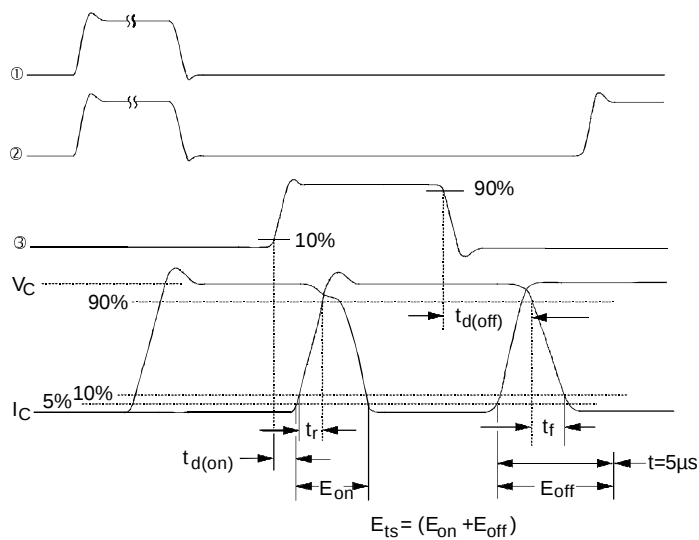
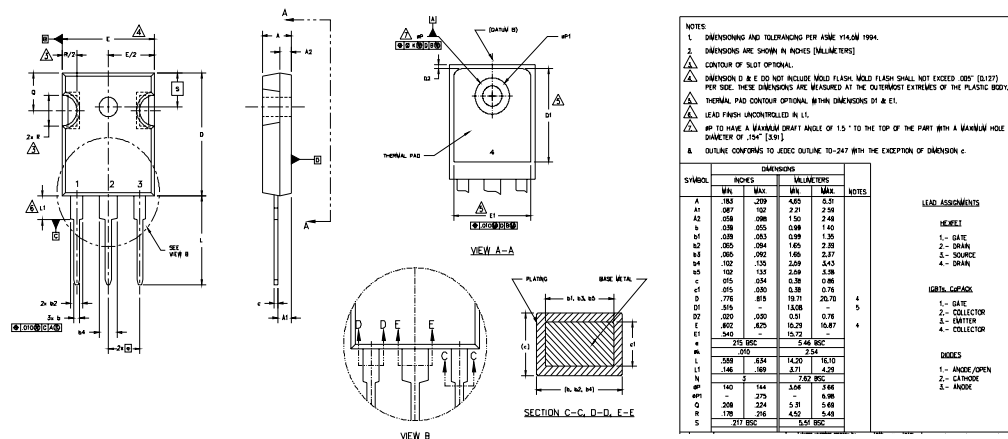


Fig. 14b - Switching Loss Waveforms

IRG4PC60F-PPbF

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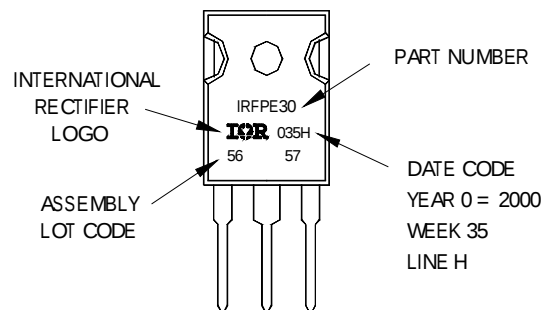
TO-247AC Package Outline



TO-247AC Part Marking Information

EXAMPLE: THIS IS AN IRFPE30
WITH ASSEMBLY
LOT CODE 5657
ASSEMBLED ON WW35, 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
IR Rectifier

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