International
IOR Rectifier

PD -9.1712

PRELIMINARY

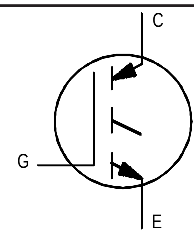
IRG4PH50S

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



n-channel

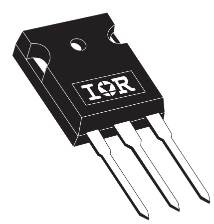
V_{CES} =1200V

$V_{CE(on)\ typ.}$ = 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	A
I_C @ T_C = 100°C	Continuous Collector Current	33	
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	°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)

12/17/97

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_r	Rise Time	—	29	—		T_J = 25°C
$t_{d(off)}$	Turn-Off Delay Time	—	845	1268		I_C = 33A, V_{CC} = 960V
t_f	Fall Time	—	425	638		V_{GE} = 15V, R_G = 5.0Ω
E_{on}	Turn-On Switching Loss	—	1.80	—	mJ	Energy losses include "tail"
E_{off}	Turn-Off Switching Loss	—	19.6	—		See Fig. 9, 10, 14
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.

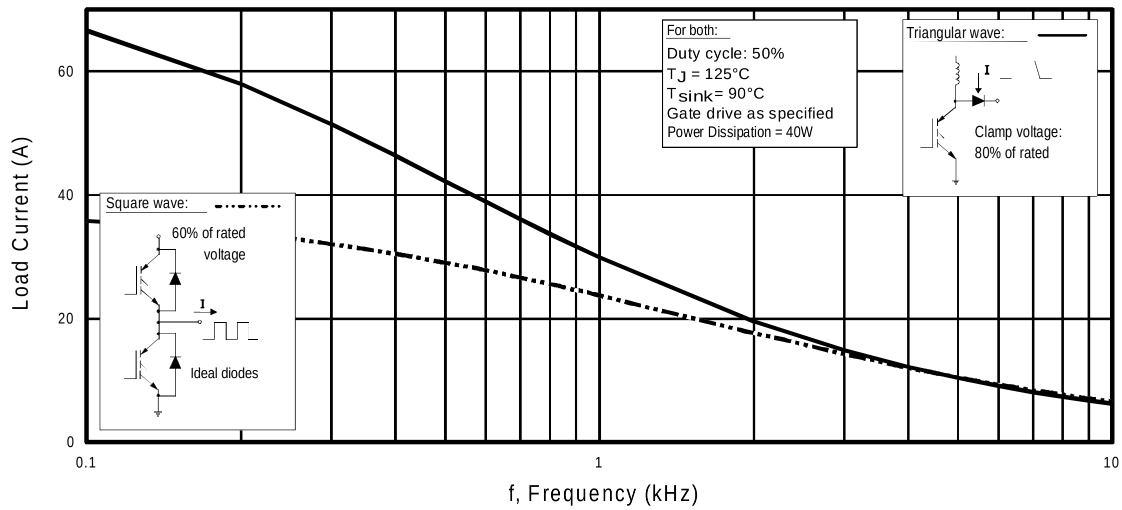


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

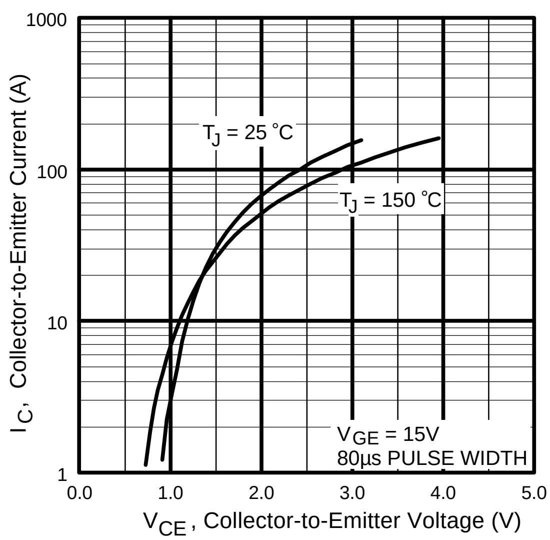


Fig. 2 - Typical Output Characteristics

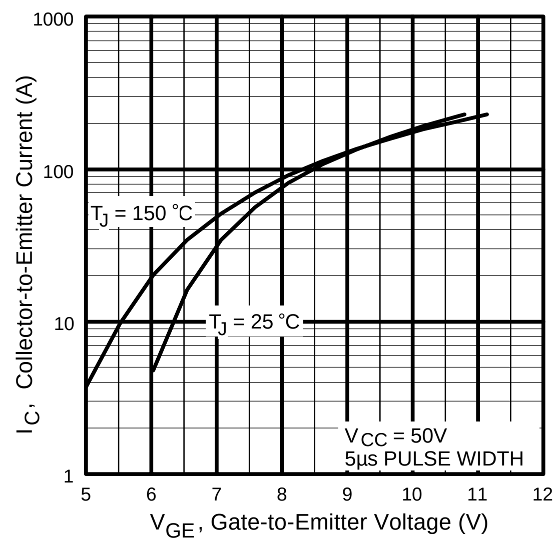


Fig. 3 - Typical Transfer Characteristics

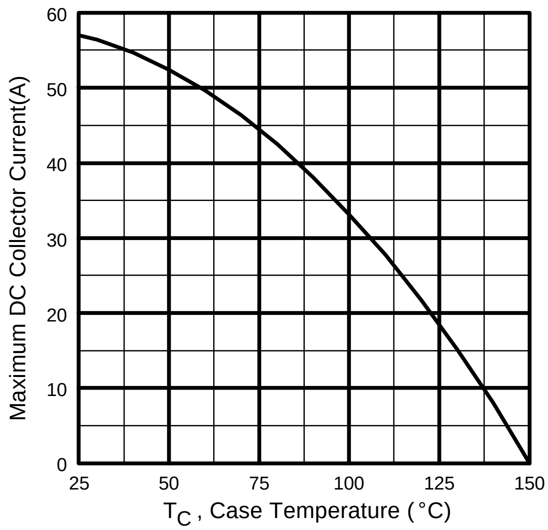


Fig. 4 - Maximum Collector Current vs. Case Temperature

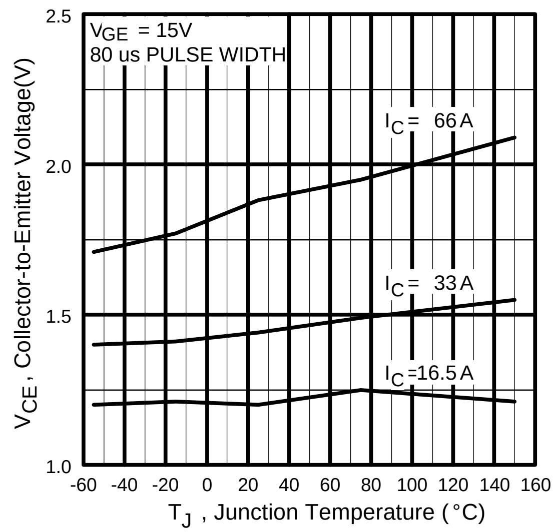


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

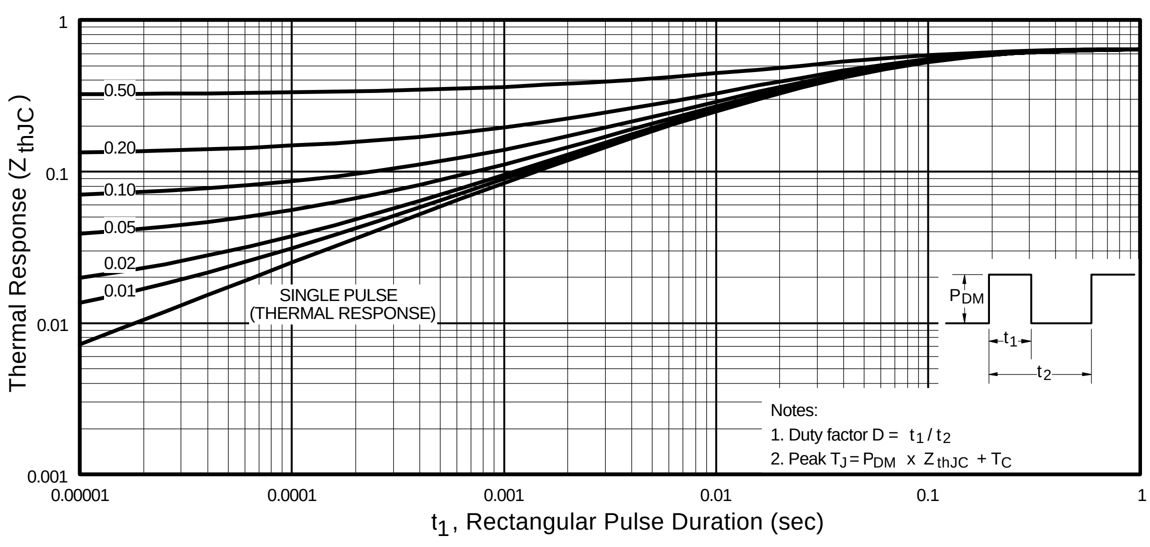


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

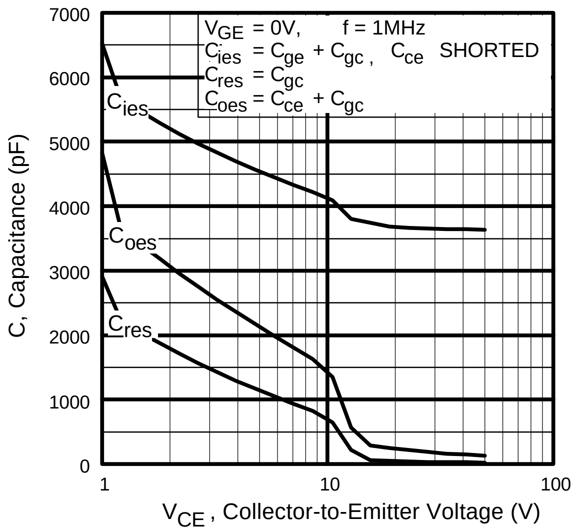


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

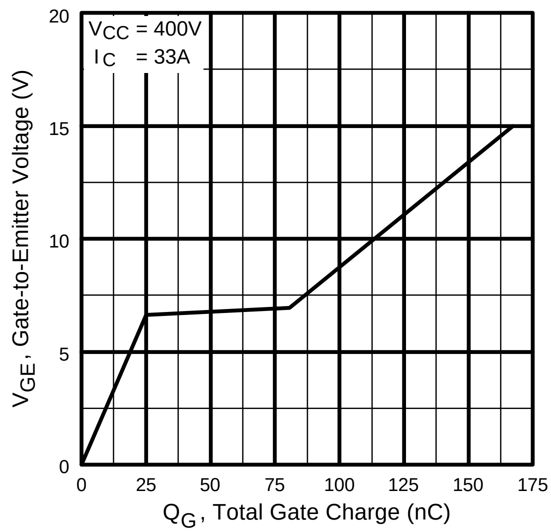


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

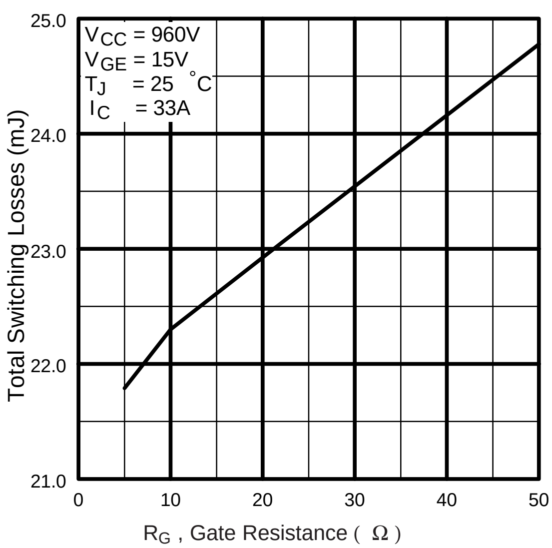


Fig. 9 - Typical Switching Losses vs. Gate Resistance

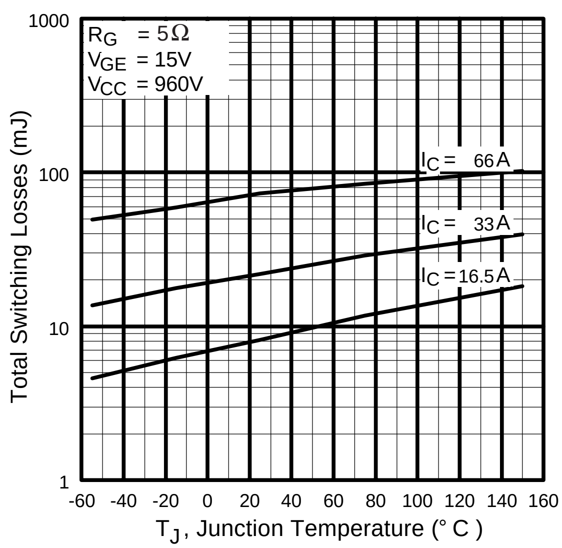


Fig. 10 - Typical Switching Losses vs. Junction Temperature

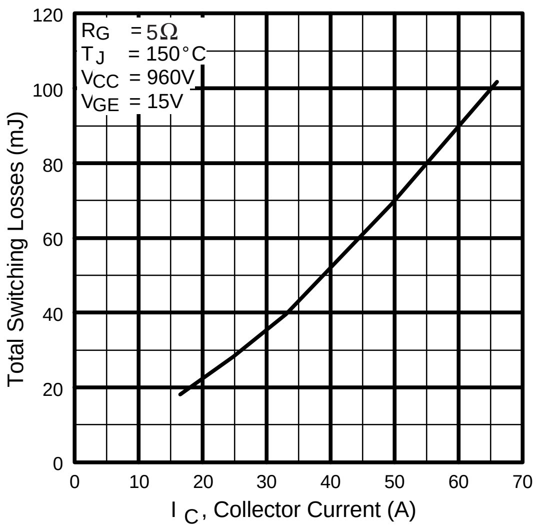


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

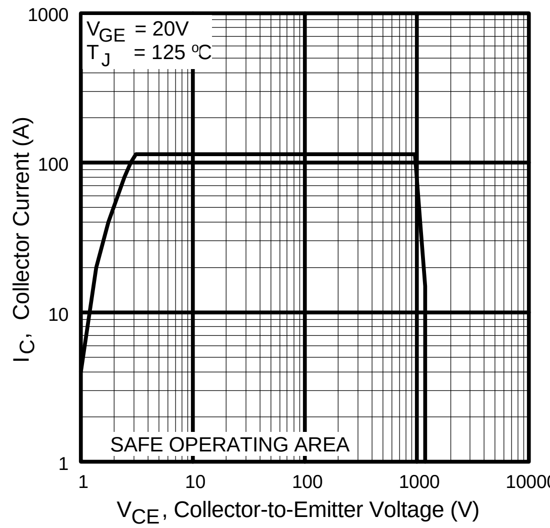


Fig. 12 - Reverse Bias SOA

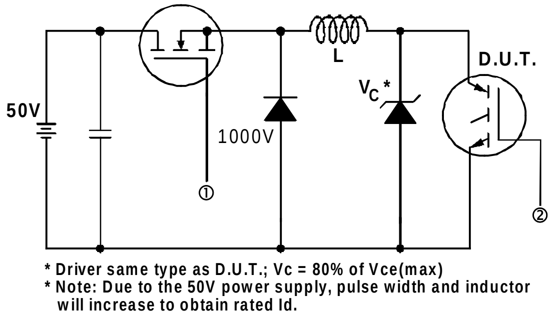


Fig. 13a - Clamped Inductive Load Test Circuit

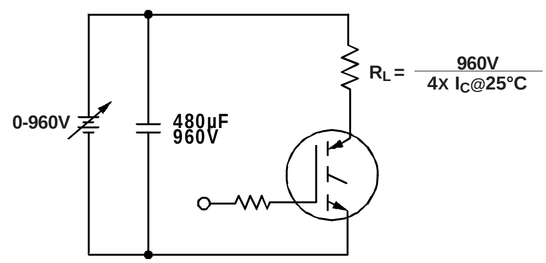


Fig. 13b - Pulsed Collector Current Test Circuit

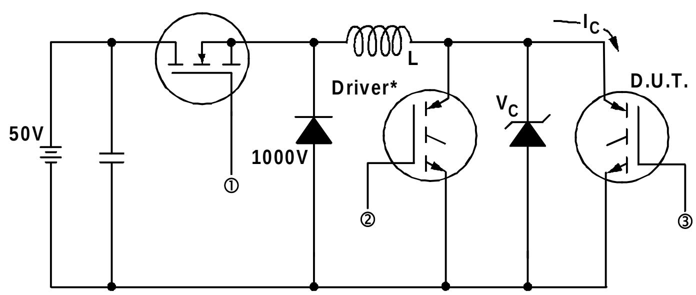


Fig. 14a - Switching Loss Test Circuit

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

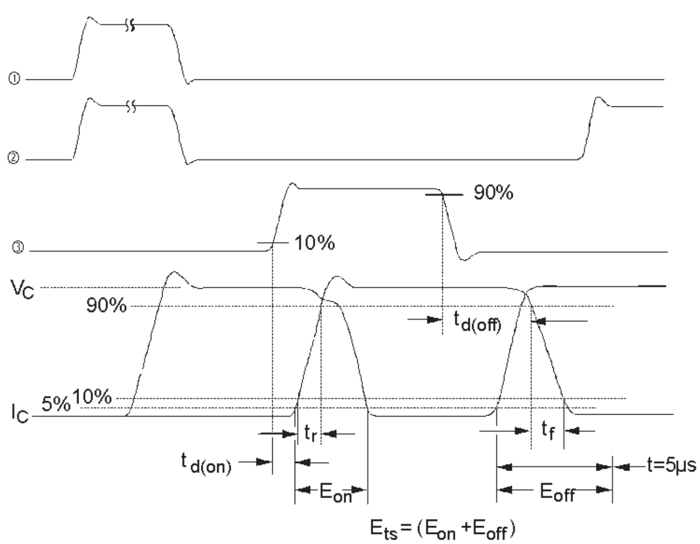
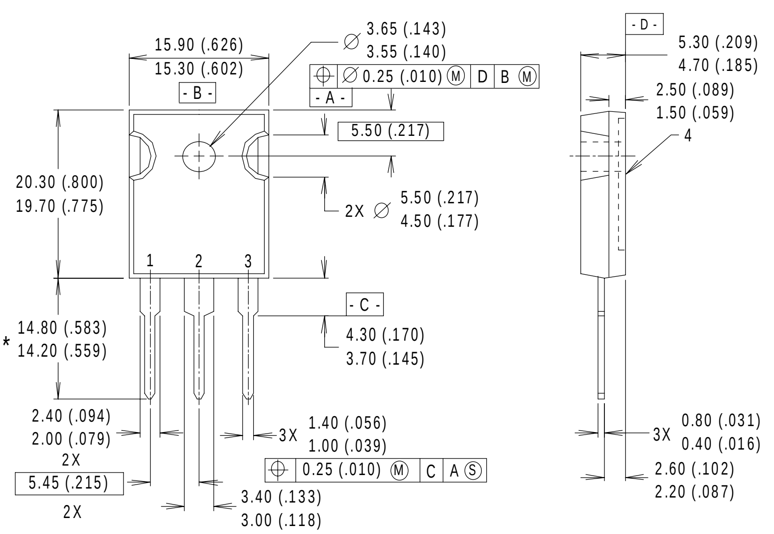


Fig. 14b - Switching Loss Waveforms

Case Outline and Dimensions — TO-247AC



NOTES:
1 DIMENSIONS & TOLERANCING PER ANSI Y14.5M, 1982.
2 CONTROLLING DIMENSION : INCH.
3 DIMENSIONS ARE SHOWN MILLIMETERS (INCHES).
4 CONFORMS TO JEDEC OUTLINE TO-247AC.

LEAD ASSIGNMENTS
1 - GATE
2 - COLLECTOR
3 - EMITTER
4 - COLLECTOR

* LONGER LEADED (20mm) VERSION AVAILABLE (TO-247AD) TO ORDER ADD "-E" SUFFIX TO PART NUMBER

CONFORMS TO JEDEC OUTLINE TO-247AC (TO-3P)
Dimensions in Millimeters and (Inches)

International
IOR Rectifier

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IR ITALY: Via Liguria 49, 10071 Borgaro, Torino Tel: ++ 39 11 451 0111
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