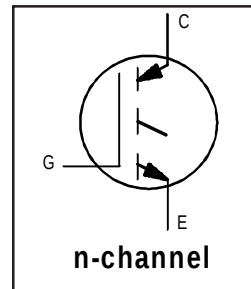


IRG4PF50W

INSULATED GATE BIPOLAR TRANSISTOR

Features

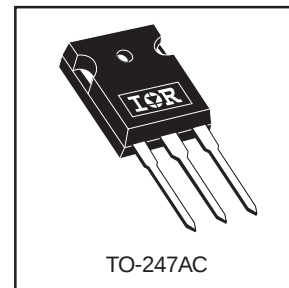
- Optimized for use in Welding and Switch-Mode Power Supply applications
- Industry benchmark switching losses improve efficiency of all power supply topologies
- 50% reduction of E_{off} parameter
- Low IGBT conduction losses
- Latest technology IGBT design offers tighter parameter distribution coupled with exceptional reliability



$V_{CES} = 900V$
$V_{CE(on)} \text{ typ.} = 2.25V$
@ $V_{GE} = 15V, I_C = 28A$

Benefits

- Lower switching losses allow more cost-effective operation and hence efficient replacement of larger-die MOSFETs up to 100kHz
- Of particular benefit in single-ended converters and Power Supplies 150W and higher
- Reduction in critical E_{off} parameter due to minimal minority-carrier recombination coupled with low on-state losses allow maximum flexibility in device application



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Breakdown Voltage	900	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	51	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	28	
I_{CM}	Pulsed Collector Current ①	204	
I_{LM}	Clamped Inductive Load Current ②	204	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
E_{ARV}	Reverse Voltage Avalanche Energy ③	186	mJ
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	200	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	78	
T_J	Operating Junction and	-55 to + 150	$^\circ C$
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds	300 (0.063 in. (1.6mm from case)	

Thermal Resistance

	Parameter	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 (0.21)	—	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	900	—	—	V	$V_{GE} = 0V, I_C = 250\mu A$
$V_{(BR)ECS}$	Emitter-to-Collector Breakdown Voltage ④	18	—	—	V	$V_{GE} = 0V, I_C = 1.0A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.295	—	V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 3.5mA$
$V_{CE(ON)}$	Collector-to-Emitter Saturation Voltage	—	2.25	2.7	V	$I_C = 28A, V_{GE} = 15V$
		—	2.74	—		$I_C = 60A, V_{GE} = 15V$
		—	2.12	—		$I_C = 28A, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	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	—	-13	—	mV/ $^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 1.0mA$
g_{fe}	Forward Transconductance ⑤	26	39	—	S	$V_{CE} \geq 15V, I_C = 28A$
I_{CES}	Zero Gate Voltage Collector Current	—	—	500	μA	$V_{GE} = 0V, V_{CE} = 900V$
		—	—	2.0		$V_{GE} = 0V, V_{CE} = 10V, T_J = 25^\circ\text{C}$
		—	—	5.0	mA	$V_{GE} = 0V, V_{CE} = 900V, T_J = 150^\circ\text{C}$
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)	—	160	240	nC	$I_C = 28A$
Q_{ge}	Gate - Emitter Charge (turn-on)	—	19	29		$V_{CC} = 400V$
Q_{gc}	Gate - Collector Charge (turn-on)	—	53	80		$V_{GE} = 15V$
$t_{d(on)}$	Turn-On Delay Time	—	29	—	ns	$T_J = 25^\circ\text{C}$ $I_C = 28A, V_{CC} = 720V$ $V_{GE} = 15V, R_G = 5.0\Omega$ Energy losses include "tail" See Fig. 10, 11, 13, 14
t_r	Rise Time	—	26	—		
$t_{d(off)}$	Turn-Off Delay Time	—	110	170		
t_f	Fall Time	—	150	220		
E_{on}	Turn-On Switching Loss	—	0.19	—	mJ	$T_J = 150^\circ\text{C},$ $I_C = 28A, V_{CC} = 720V$ $V_{GE} = 15V, R_G = 5.0\Omega$ Energy losses include "tail" See Fig. 13, 14
E_{off}	Turn-Off Switching Loss	—	1.06	—		
E_{ts}	Total Switching Loss	—	1.25	1.7		
$t_{d(on)}$	Turn-On Delay Time	—	28	—	ns	$T_J = 150^\circ\text{C},$ $I_C = 28A, V_{CC} = 720V$ $V_{GE} = 15V, R_G = 5.0\Omega$ Energy losses include "tail" See Fig. 13, 14
t_r	Rise Time	—	26	—		
$t_{d(off)}$	Turn-Off Delay Time	—	280	—		
t_f	Fall Time	—	90	—		
E_{ts}	Total Switching Loss	—	3.45	—	mJ	
L_E	Internal Emitter Inductance	—	13	—	nH	Measured 5mm from package
C_{ies}	Input Capacitance	—	3300	—	pF	$V_{GE} = 0V$
C_{oes}	Output Capacitance	—	200	—		$V_{CC} = 30V$
C_{res}	Reverse Transfer Capacitance	—	45	—		$f = 1.0MHz$

Notes:

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

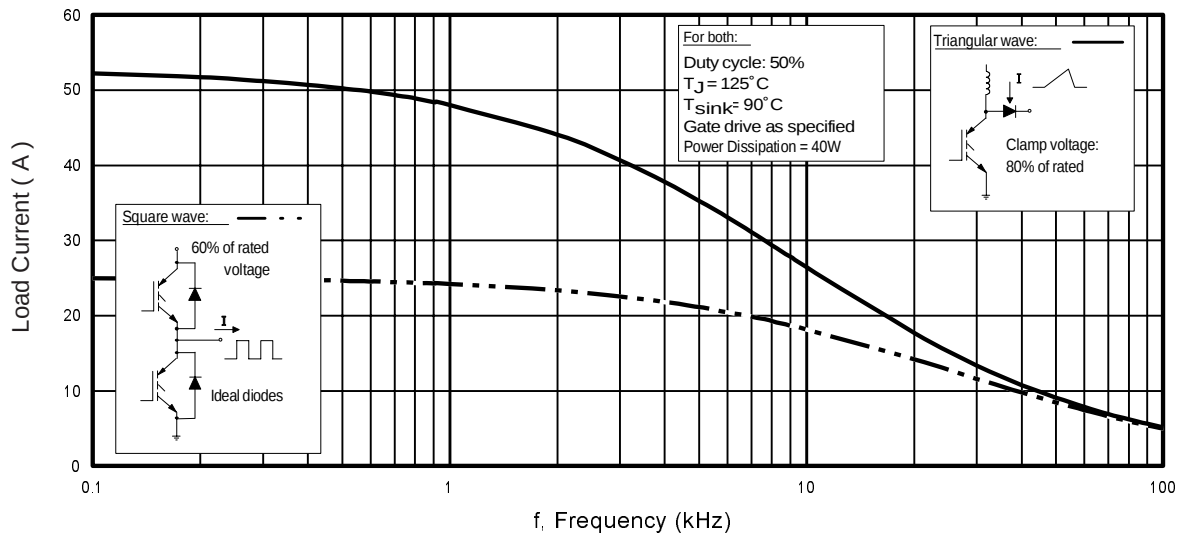


Fig. 1 - Typical Load Current vs. Frequency
(For square wave, $I = I_{\text{RMS}}$ of fundamental; for triangular wave, $I = I_{\text{PK}}$)

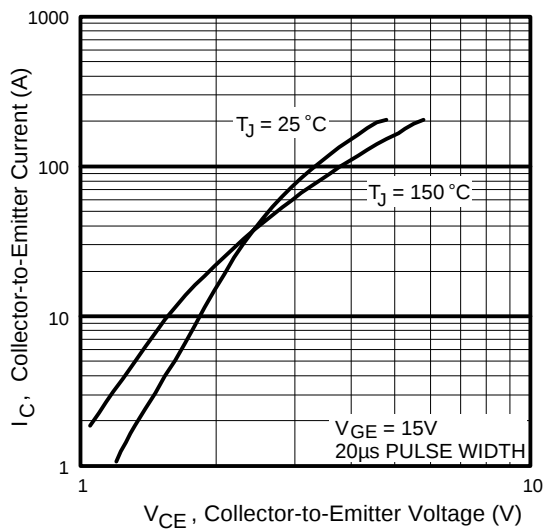


Fig. 2 - Typical Output Characteristics

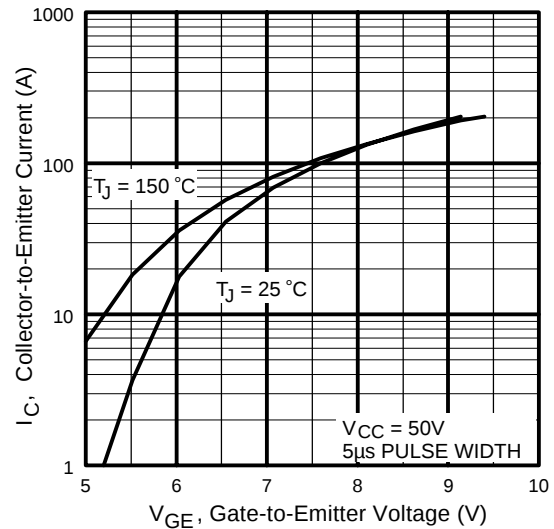


Fig. 3 - Typical Transfer Characteristics

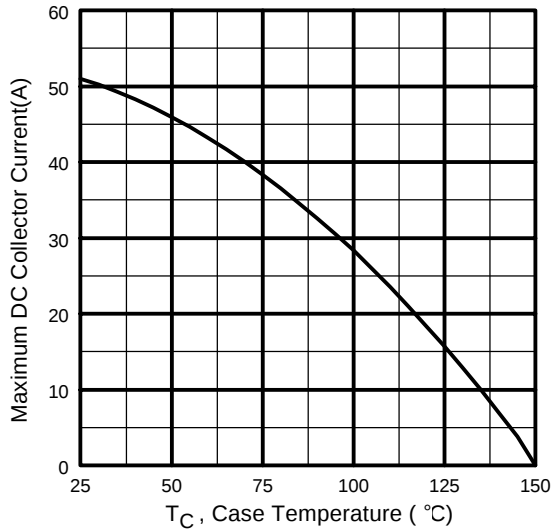


Fig. 4 - Maximum Collector Current vs. Case Temperature

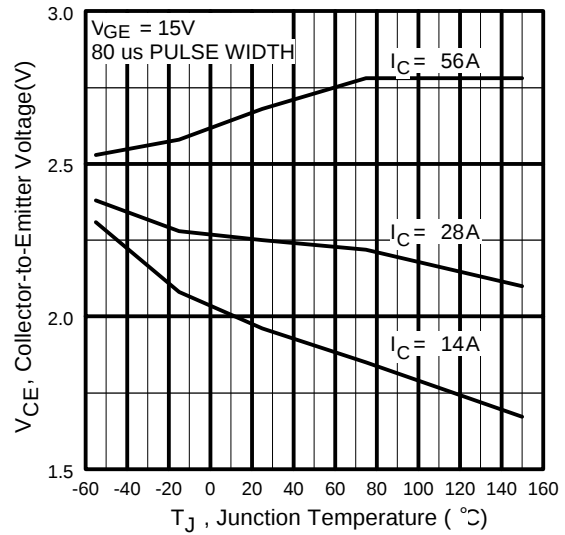


Fig. 5 - Collector-to-Emitter Voltage vs. Junction Temperature

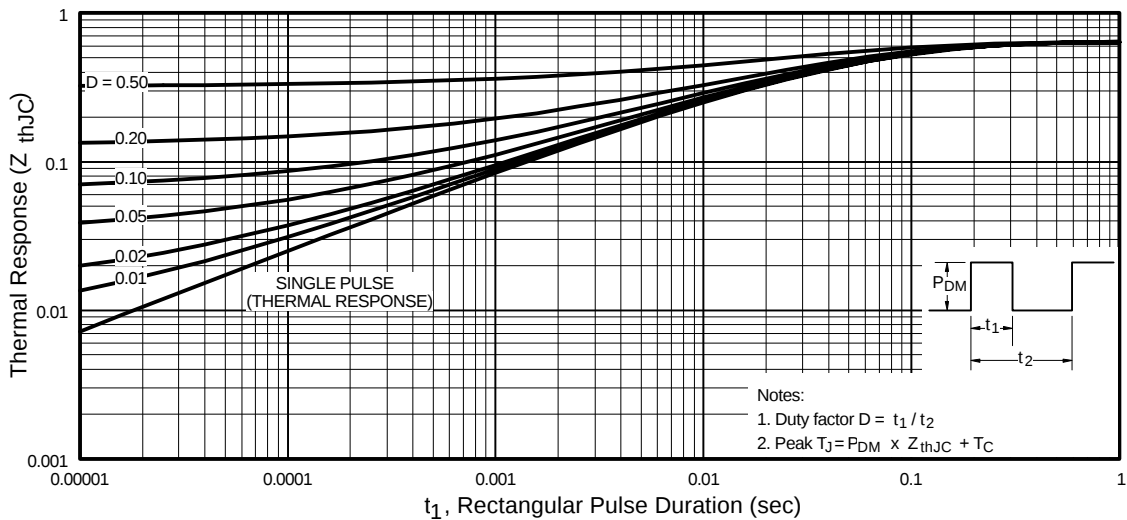


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

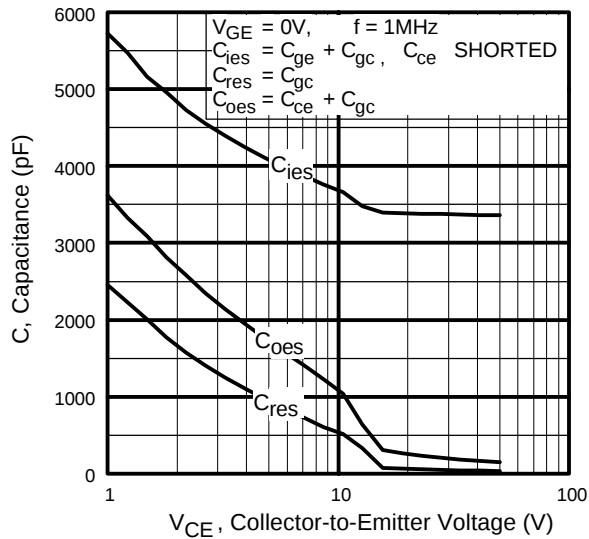


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

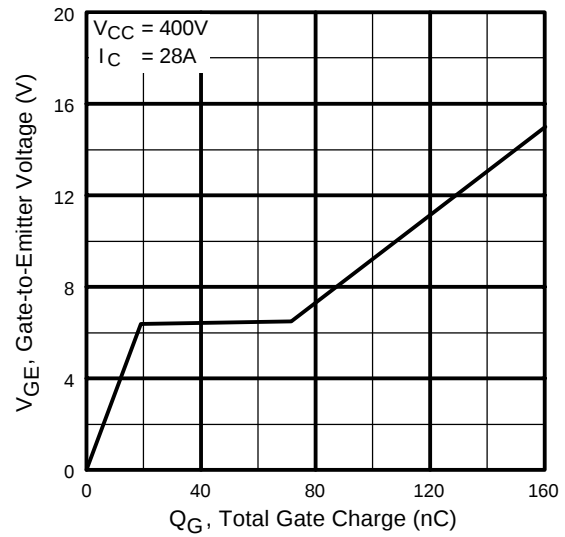


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

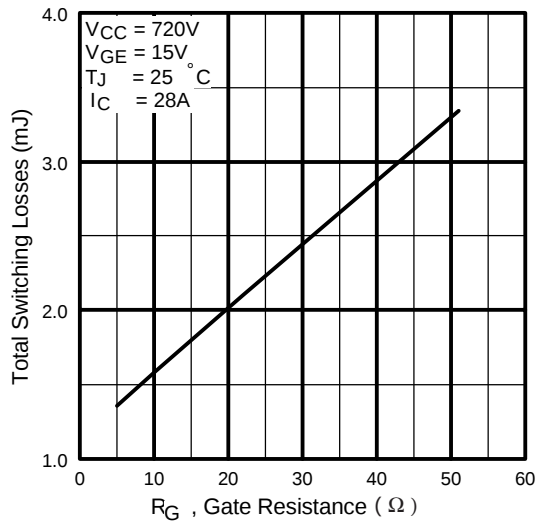


Fig. 9 - Typical Switching Losses vs. Gate Resistance

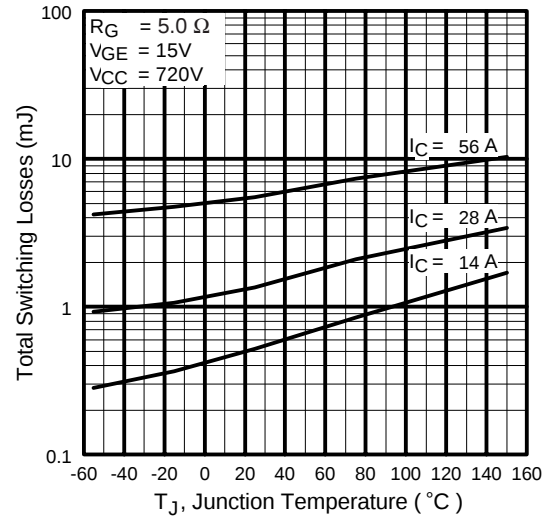


Fig. 10 - Typical Switching Losses vs. Junction Temperature

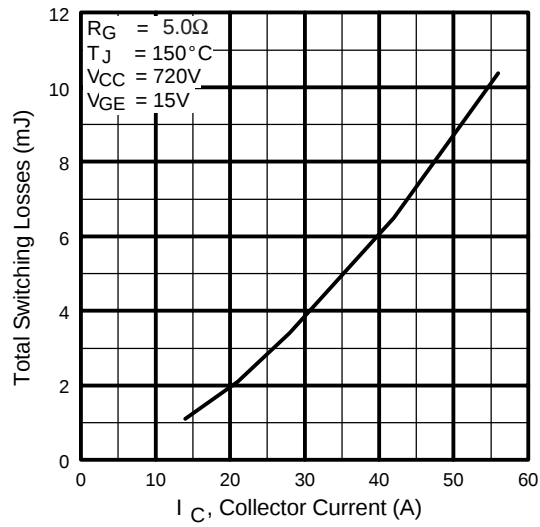


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

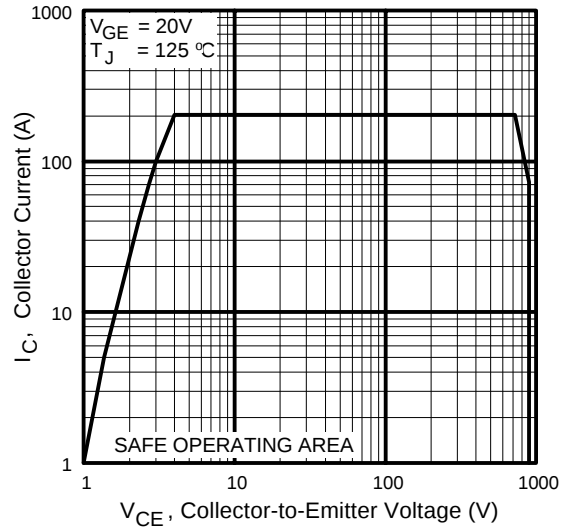


Fig. 12 - Turn-Off SOA

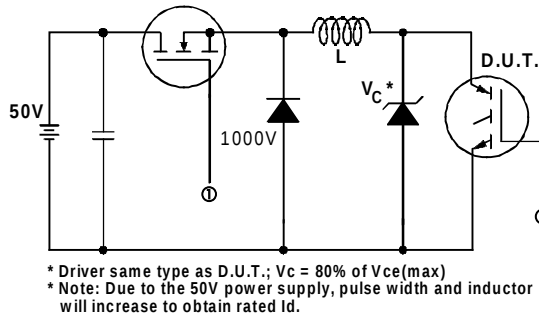


Fig. 13a - Clamped Inductive Load Test Circuit

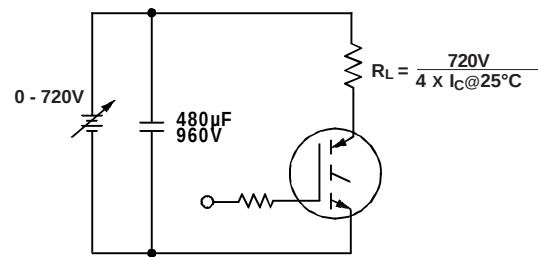


Fig. 13b - Pulsed Collector Current Test Circuit

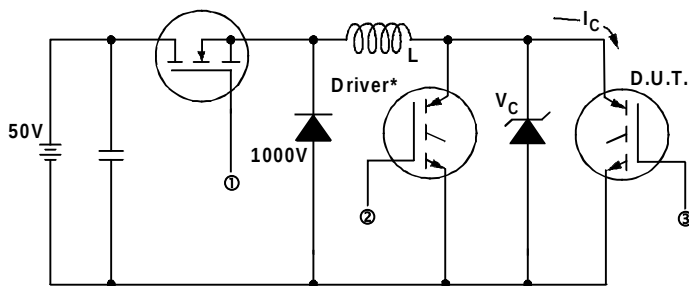


Fig. 14a - Switching Loss Test Circuit

* Driver same type as D.U.T., $V_C = 720V$

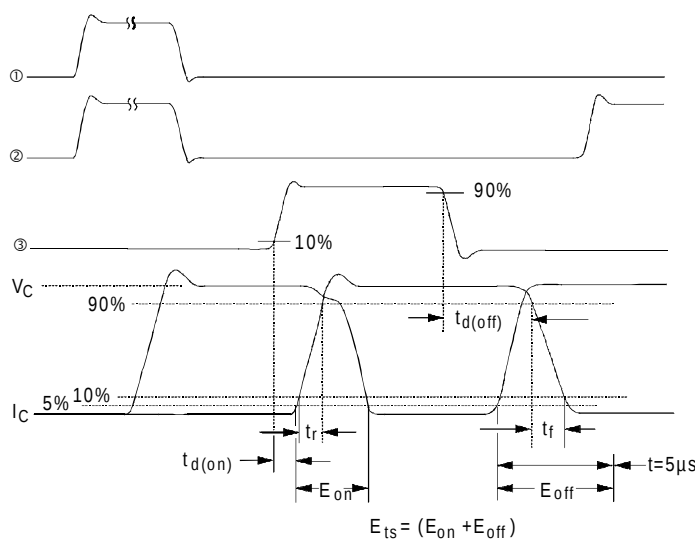
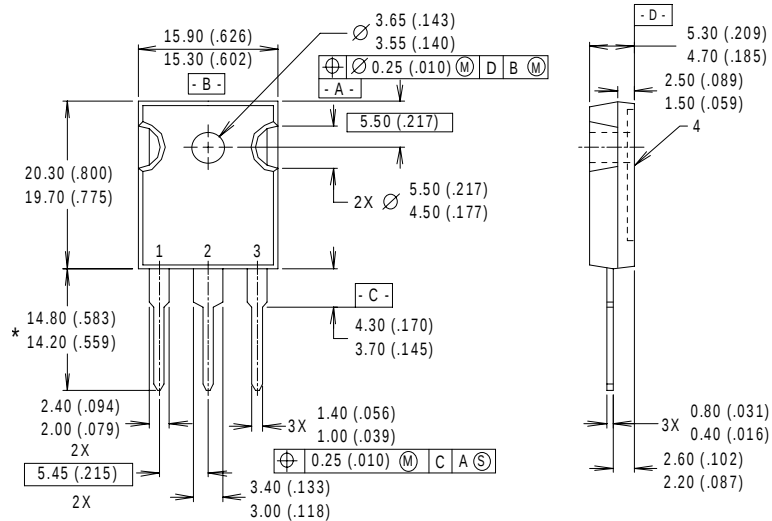


Fig. 14b - Switching Loss Waveforms

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

WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, Tel: (310) 322 3331

EUROPEAN HEADQUARTERS: Hurst Green, Oxted, Surrey RH8 9BB, UK Tel: ++ 44 1883 732020

IR CANADA: 15 Lincoln Court, Brampton, Ontario L6T 3Z2, Tel: (905) 453 2200

IR GERMANY: Saalburgstrasse 157, 61350 Bad Homburg Tel: ++ 49 6172 96590

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

IR FAR EAST: 171 (K&H Bldg.) 30-4 Nishi-ikebukuro 3-chome, Toshima-ku, Tokyo Japan Tel: 81 33 983 0086

IR SOUTHEAST ASIA: 315 Outram Road, #10-02 Tan Boon Liat Building, Singapore 16907 Tel: 65 221 8371

Data and specifications subject to change without notice.

4/98