International
IOR Rectifier

PD - 91578B

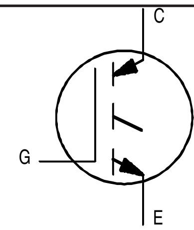
IRG4PH40K

INSULATED GATE BIPOLAR TRANSISTOR

Short Circuit Rated
UltraFast IGBT

Features

- High short circuit rating optimized for motor control, t_{sc} =10µs, V_{CC} = 720V , T_J = 125°C, V_{GE} = 15V
- Combines low conduction losses with high switching speed
- Latest generation design provides tighter parameter distribution and higher efficiency than previous generations



n-channel

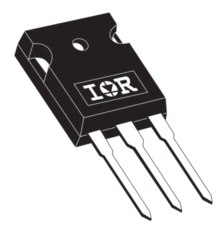
V_{CES} = 1200V

$V_{CE(on)\ typ.}$ = 2.74V

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

Benefits

- As a Freewheeling Diode we recommend our HEXFRED[TM] ultrafast, ultrasoft recovery diodes for minimum EMI / Noise and switching losses in the Diode and IGBT
- Latest generation 4 IGBT's offer highest power density motor controls possible
- This part replaces the IRGPH40K and IRGPH40M devices



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	30	A
I_C @ T_C = 100°C	Continuous Collector Current	15	
I_{CM}	Pulsed Collector Current ①	60	
I_{LM}	Clamped Inductive Load Current ②	60	
t_{sc}	Short Circuit Withstand Time	10	µs
V_{GE}	Gate-to-Emitter Voltage	±20	V
E_{ARV}	Reverse Voltage Avalanche Energy ③	180	mJ
P_D @ T_C = 25°C	Maximum Power Dissipation	160	W
P_D @ T_C = 100°C	Maximum Power Dissipation	65	
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	-----	0.77	°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)

2/7/2000

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 = 1.0A
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.37	—	V/°C	V_{GE} = 0V, I_C = 1.0mA
$V_{CE(ON)}$	Collector-to-Emitter Saturation Voltage	—	2.54	—	V	I_C = 10A; V_{GE} = 15V, See Fig.2, 5
		—	2.74	3.4		I_C = 15A
		—	3.29	—		I_C = 30A
		—	2.53	—		I_C = 15A , 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	—	-3.3	—	mV/°C	V_{CE} = V_{GE}, I_C = 250µA
g_{fe}	Forward Transconductance ⑤	8.0	12	—	S	V_{CE} = 100 V, I_C = 15A
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
		—	—	3000		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)	—	94	140	nC	I_C = 15A
Q_{ge}	Gate - Emitter Charge (turn-on)	—	14	22		V_{CC} = 400V See Fig.8
Q_{gc}	Gate - Collector Charge (turn-on)	—	37	55		V_{GE} = 15V
$t_{d(on)}$	Turn-On Delay Time	—	30	—	ns	
t_r	Rise Time	—	22	—		T_J = 25°C
$t_{d(off)}$	Turn-Off Delay Time	—	200	300		I_C = 15A, V_{CC} = 960V
t_f	Fall Time	—	150	230		V_{GE} = 15V, R_G = 10Ω
E_{on}	Turn-On Switching Loss	—	0.73	—	mJ	Energy losses include "tail"
E_{off}	Turn-Off Switching Loss	—	1.66	—		See Fig. 9,10,14
E_{ts}	Total Switching Loss	—	2.39	2.9		
t_{sc}	Short Circuit Withstand Time	10	—	—	µs	V_{CC} = 720V, T_J = 125°C V_{GE} = 15V, R_G = 10Ω
$t_{d(on)}$	Turn-On Delay Time	—	29	—	ns	T_J = 150°C,
t_r	Rise Time	—	24	—		I_C = 15A, V_{CC} = 960V
$t_{d(off)}$	Turn-Off Delay Time	—	870	—		V_{GE} = 15V, R_G = 10Ω
t_f	Fall Time	—	330	—		Energy losses include "tail"
E_{ts}	Total Switching Loss	—	4.93	—	mJ	See Fig. 10,11,14
E_{on}	Turn-On Switching Loss	—	0.37	—	mJ	T_J = 25°C, V_{GE} = 15V, R_G = 10Ω
E_{off}	Turn-Off Switching Loss	—	0.89	—		I_C = 10A, V_{CC} = 960V
E_{ts}	Total Switching Loss	—	1.26	—		Energy losses include "tail"
L_E	Internal Emitter Inductance	—	13	—	nH	Measured 5mm from package
C_{ies}	Input Capacitance	—	1600	—	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	—	77	—		V_{CC} = 30V See Fig. 7
C_{res}	Reverse Transfer Capacitance	—	26	—		f = 1.0MHz

Details of note ① through ⑤ are on the last page

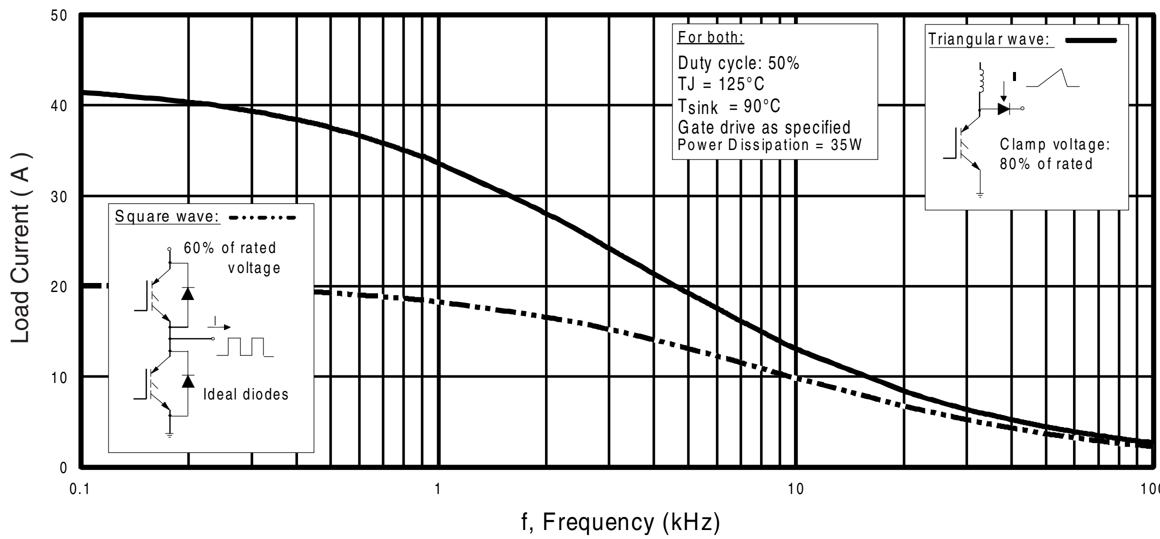


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

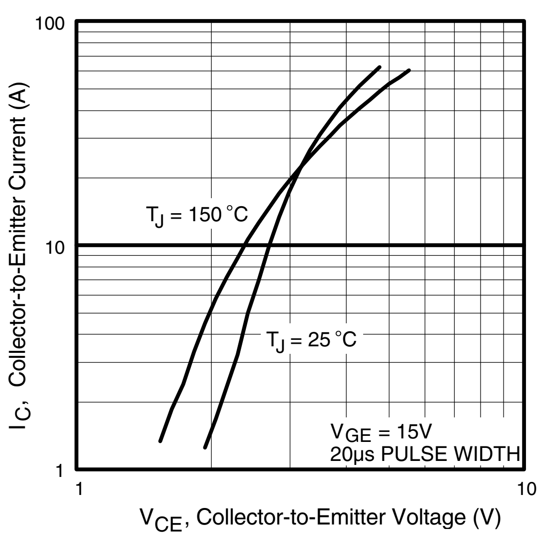


Fig. 2 - Typical Output Characteristics

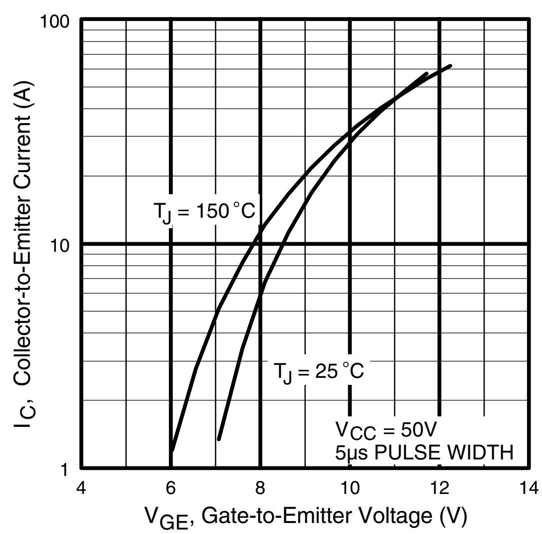


Fig. 3 - Typical Transfer Characteristics

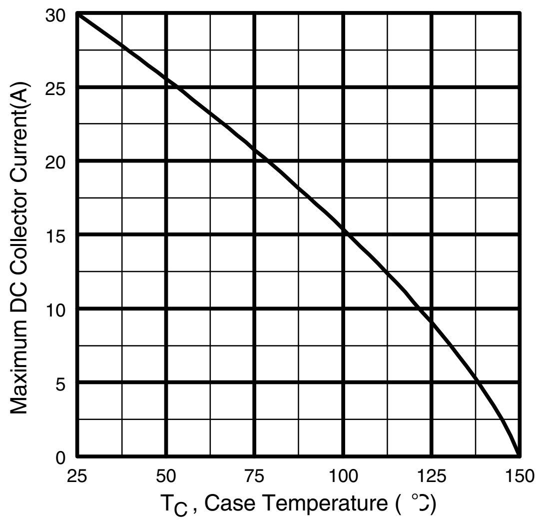


Fig. 4 - Maximum Collector Current vs. Case Temperature

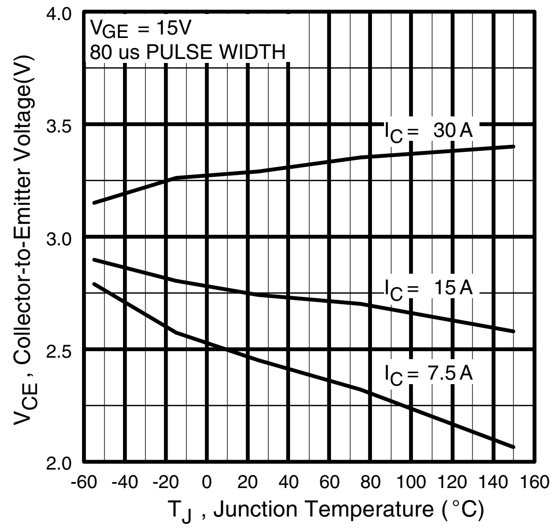


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

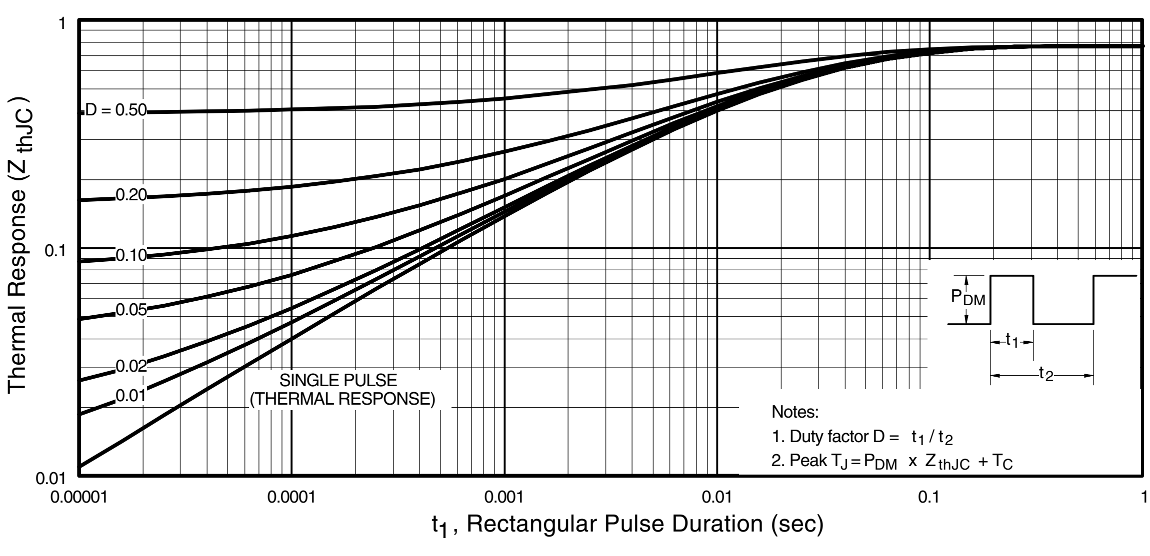


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

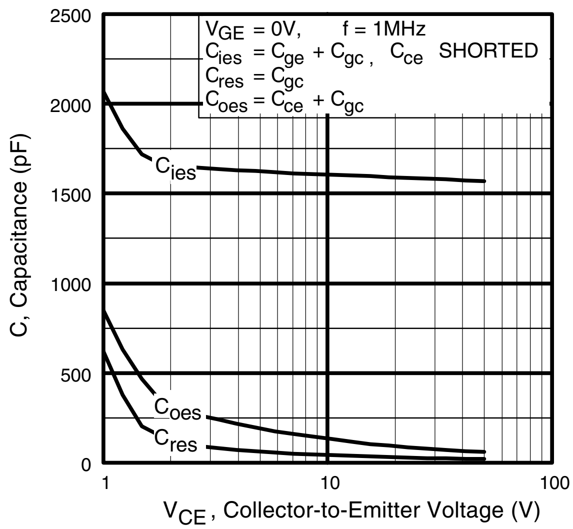


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

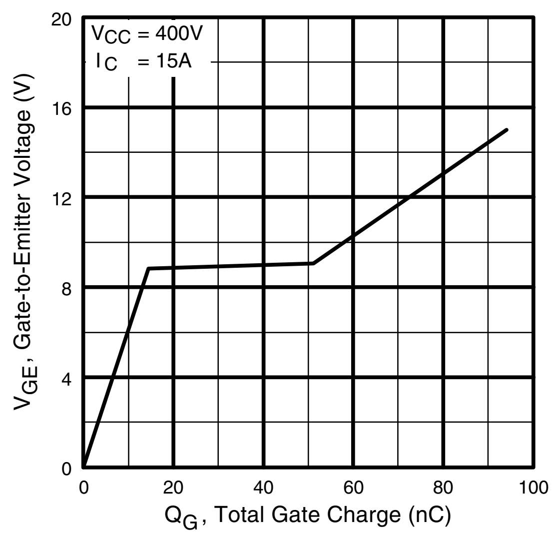


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

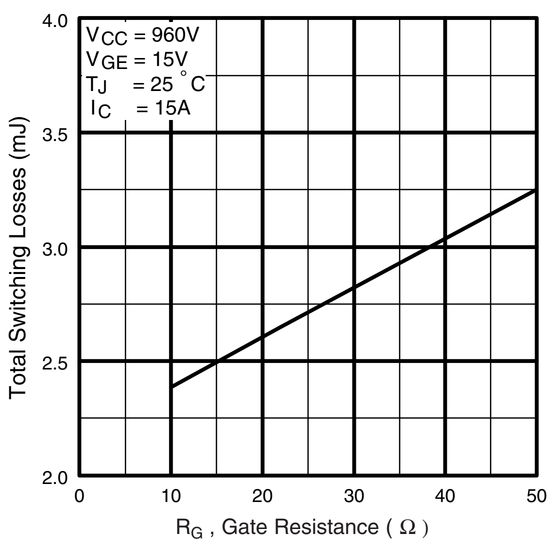


Fig. 9 - Typical Switching Losses vs. Gate Resistance

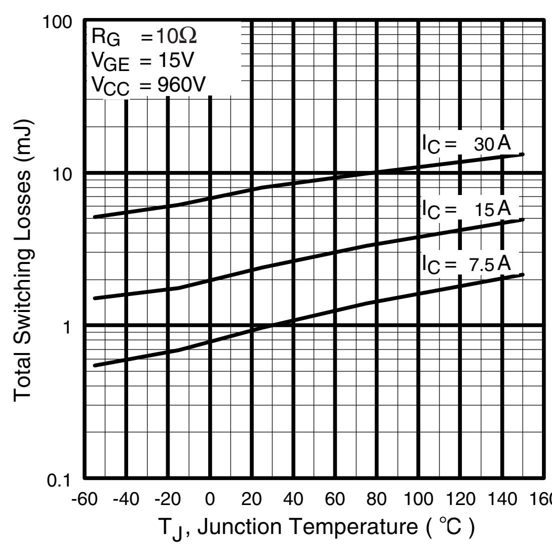


Fig. 10 - Typical Switching Losses vs. Junction Temperature

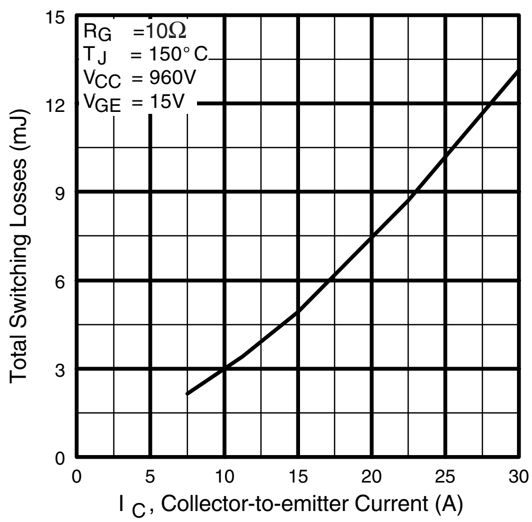


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

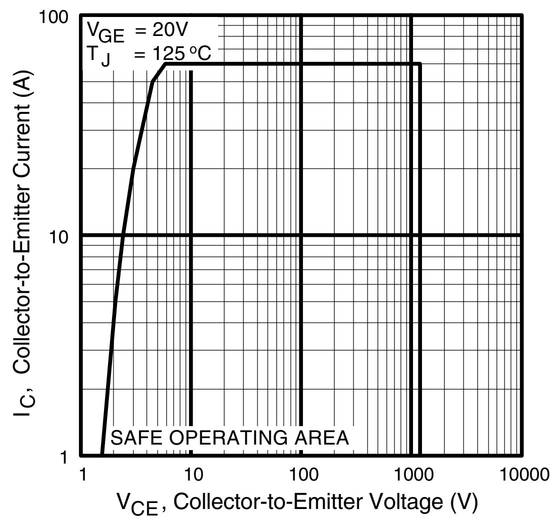


Fig. 12 - Turn-Off SOA

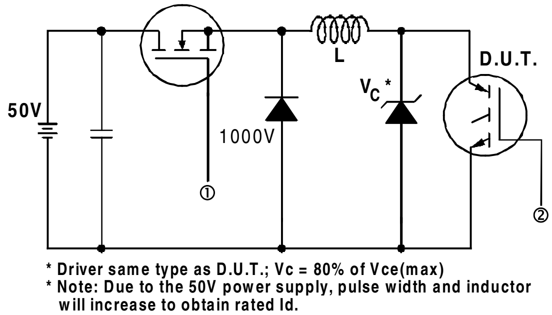


Fig. 13a - Clamped Inductive Load Test Circuit

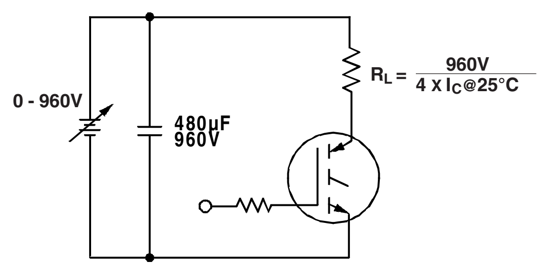


Fig. 13b - Pulsed Collector Current Test Circuit

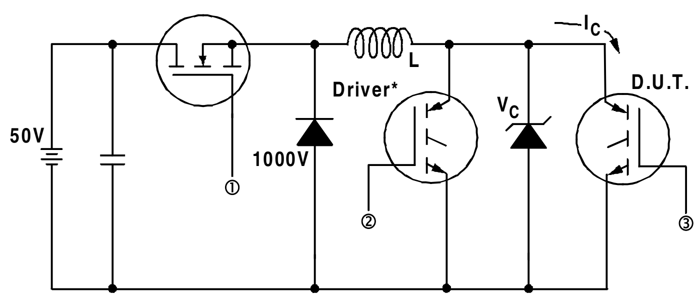


Fig. 14a - Switching Loss Test Circuit

*** Driver same type as D.U.T., VC = 960V**

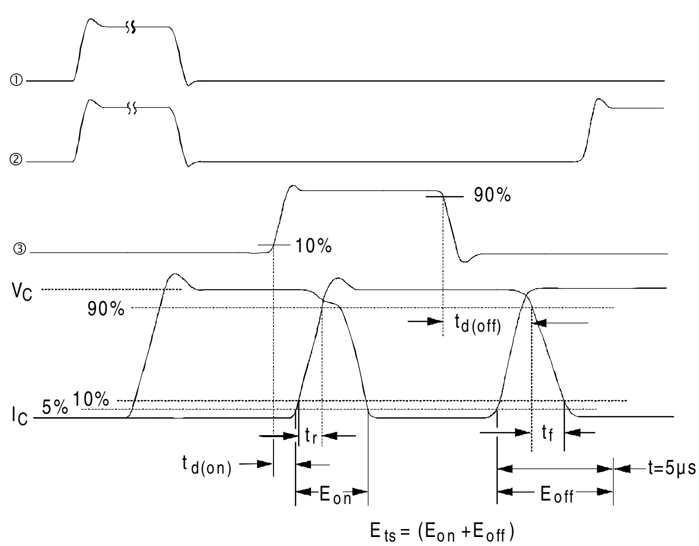


Fig. 14b - Switching Loss Waveforms

Notes:

① Repetitive rating; V_{GE} = 20V, pulse width limited by max. junction temperature. (See fig. 13b)

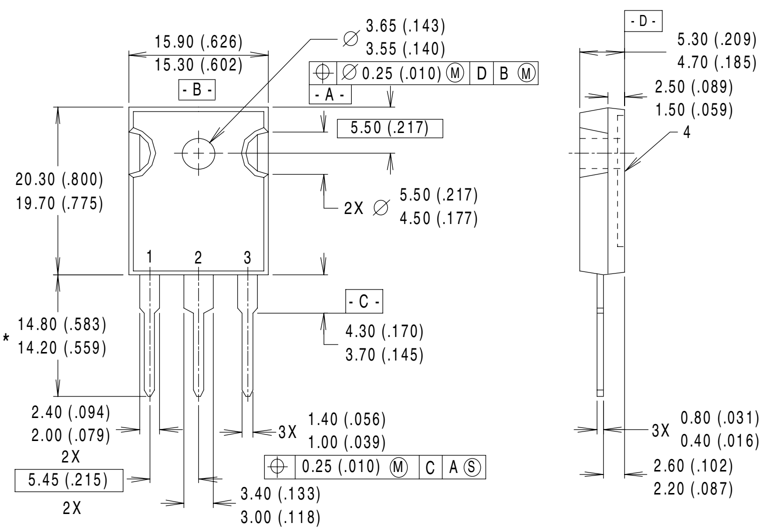
② V_{CC} = 80%(V_{CES}), V_{GE} = 20V, L = 10µH, R_G = 10Ω, (See fig. 13a)

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.

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)

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IR CANADA: 15 Lincoln Court, Brampton, Ontario L6T3Z2, Tel: (905) 453 2200
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IR ITALY: Via Liguria 49, 10071 Borgaro, Torino Tel: ++ 39 011 451 0111
IR JAPAN: K&H Bldg., 2F, 30-4 Nishi-Ikebukuro 3-Chome, Toshima-Ku, Tokyo 171 Tel: 81 (0)3 3983 0086
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Data and specifications subject to change without notice. 6/00