PD - 95781

International
IOR Rectifier

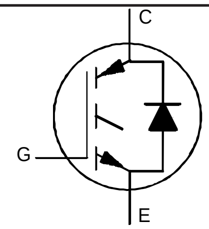
IRG4BC15UD-SPbF
IRG4BC15UD-LPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

UltraFast CoPack IGBT

Features

- UltraFast: Optimized for high frequencies from10 to 30 kHz in hard switching
- IGBT Co-packaged with ultra-soft-recovery antiparallel diode
- Industry standard D^2Pak & TO-262 packages
- Lead-Free



n-channel

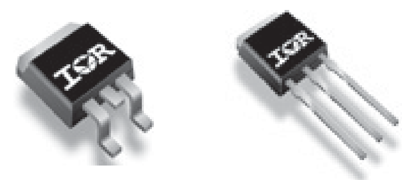
V_{CES} = 600V

$V_{CE(on)\ typ.}$ = 2.02V

@V_{GE} = 15V, I_C = 7.8A

Benefits

- Best Value for Appliance and Industrial Applications
- High noise immune "Positive Only" gate drive- Negative bias gate drive not necessary
- For Low EMI designs- requires little or no snubbing
- Single Package switch for bridge circuit applications
- Compatible with high voltage Gate Driver IC's
- Allows simpler gate drive



D^2Pak
IRG4BC15UD-S

TO-262
IRG4BC15UD-L

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
I_C @ T_C = 25°C	Continuous Collector Current	14	
I_C @ T_C = 100°C	Continuous Collector Current	7.8	
I_{CM}	Pulsed Collector Current ①	42	A
I_{LM}	Clamped Inductive Load Current ②	42	
I_F @ T_C = 100°C	Diode Continuous Forward Current	4.0	
I_{FM}	Diode Maximum Forward Current	16	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
P_D @ T_C = 25°C	Maximum Power Dissipation	49	
P_D @ T_C = 100°C	Maximum Power Dissipation	19	W
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)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT	——	——	2.7	
$R_{\theta JC}$	Junction-to-Case - Diode	——	——	7.0	°C/W
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	——	0.50	——	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount ⑤	——	——	80	
$R_{\theta JA}$	Junction-to-Ambient (PCB Mount, steady state)⑥	——	——	40	
Wt	Weight	——	2 (0.07)	——	g (oz)

08/27/04

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage③	600	——	——	V	V_{GE} = 0V, I_C = 250µA	
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	——	0.63	——	V/°C	V_{GE} = 0V, I_C = 1.0mA	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	——	2.02	2.4	V	I_C = 7.8A	V_{GE} = 15V
		——	2.56	——		I_C = 14A	
		——	2.21	——		I_C = 7.8A, 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	——	-10	——	mV/°C	$V_{CE} = V_{GE}$, I_C = 250µA	
g_{fe}	Forward Transconductance ④	4.1	6.2	——	S	V_{CE} = 100V, I_C = 7.8A	
I_{CES}	Zero Gate Voltage Collector Current	——	——	250	µA	V_{GE} = 0V, V_{CE} = 600V	
		——	——	1400		V_{GE} = 0V, V_{CE} = 600V, T_J = 150°C	
V_{FM}	Diode Forward Voltage Drop	——	1.5	1.8	V	I_C = 4.0A	
		——	1.4	1.7		I_C = 4.0A, 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)	——	23	35	nC	I_C = 7.8A	
Qge	Gate - Emitter Charge (turn-on)	——	4.0	6.0		V_{CC} = 400V	
Q_{gc}	Gate - Collector Charge (turn-on)	——	9.6	14		V_{GE} = 15V	
$t_{d(on)}$	Turn-On Delay Time	——	17	——	ns	T_J = 25°C	
t_r	Rise Time	——	20	——		I_C = 7.8A, V_{CC} = 480V	
$t_{d(off)}$	Turn-Off Delay Time	——	160	240		V_{GE} = 15V, R_G = 75Ω	
t_f	Fall Time	——	83	120		Energy losses include "tail" and	
E_{on}	Turn-On Switching Loss	——	0.24	——	mJ	diode reverse recovery.	
E_{off}	Turn-Off Switching Loss	——	0.26	——			
E_{ts}	Total Switching Loss	——	0.50	0.63			
$t_{d(on)}$	Turn-On Delay Time	——	16	——	ns	T_J = 150°C,	
t_r	Rise Time	——	21	——		I_C = 7.8A, V_{CC} = 480V	
$t_{d(off)}$	Turn-Off Delay Time	——	180	——		V_{GE} = 15V, R_G = 75Ω	
t_f	Fall Time	——	220	——		Energy losses include "tail" and	
E_{ts}	Total Switching Loss	——	0.76	——	mJ	diode reverse recovery.	
L_E	Internal Emitter Inductance	——	7.5	——	nH	Measured 5mm from package	
C_{ies}	Input Capacitance	——	410	——	pF	V_{GE} = 0V	
C_{oes}	Output Capacitance	——	37	——		V_{CC} = 30V	
C_{res}	Reverse Transfer Capacitance	——	5.3	——		f = 1.0MHz	
t_{rr}	Diode Reverse Recovery Time	——	28	42	ns	T_J = 25°C	
		——	38	57		T_J = 125°C	I_F = 4.0A
I_{rr}	Diode Peak Reverse Recovery Current	——	2.9	5.2	A	T_J = 25°C	
		——	3.7	6.7		T_J = 125°C	V_R = 200V
Q_{rr}	Diode Reverse Recovery Charge	——	40	60	nC	T_J = 25°C	
		——	70	110		T_J = 125°C	di/dt 200A/µs
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery	——	280	——	A/µs	T_J = 25°C	
	During t_b	——	240	——		T_J = 125°C	

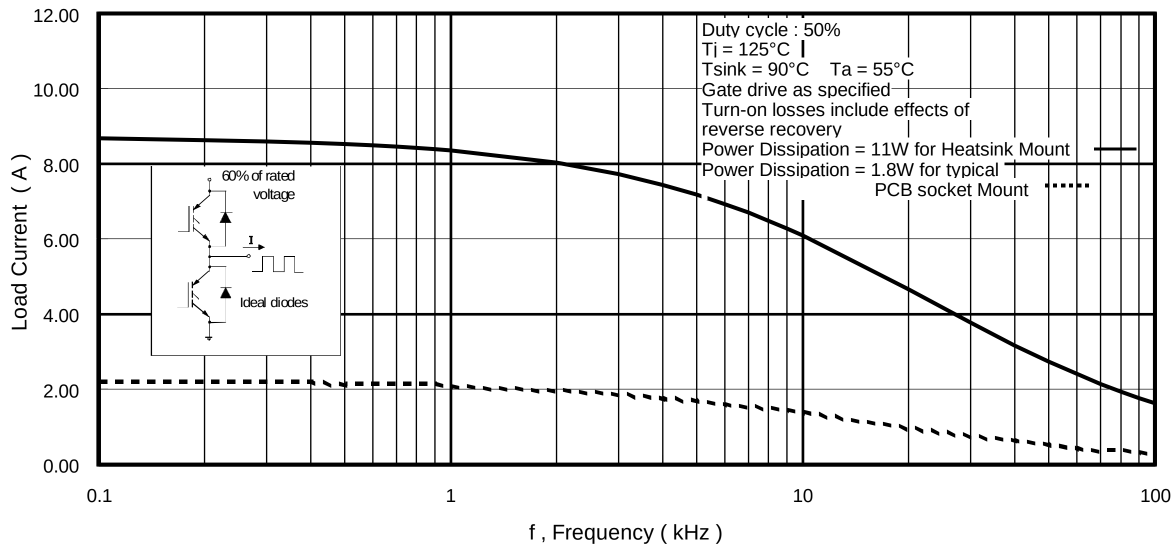


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

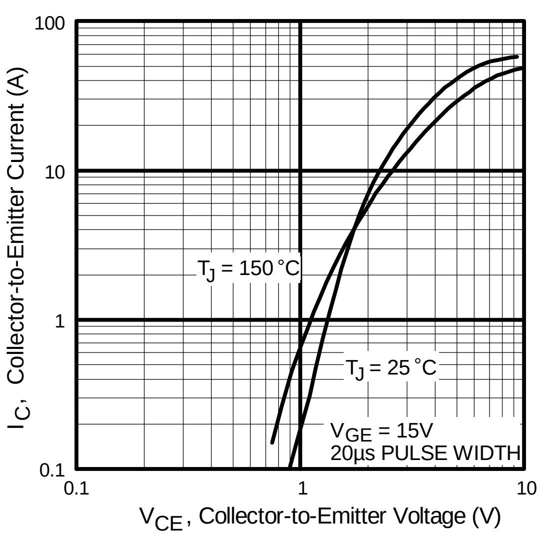


Fig. 2 - Typical Output Characteristics

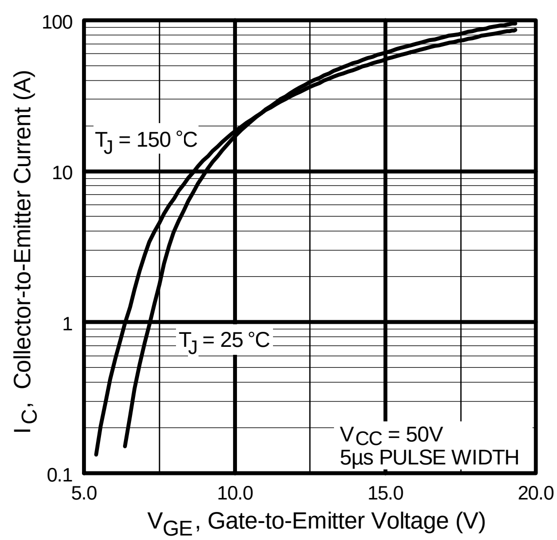


Fig. 3 - Typical Transfer Characteristics

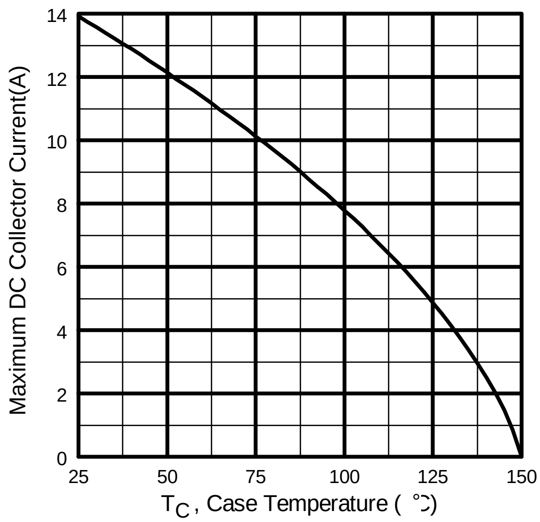


Fig. 4 - Maximum Collector Current vs. Case Temperature

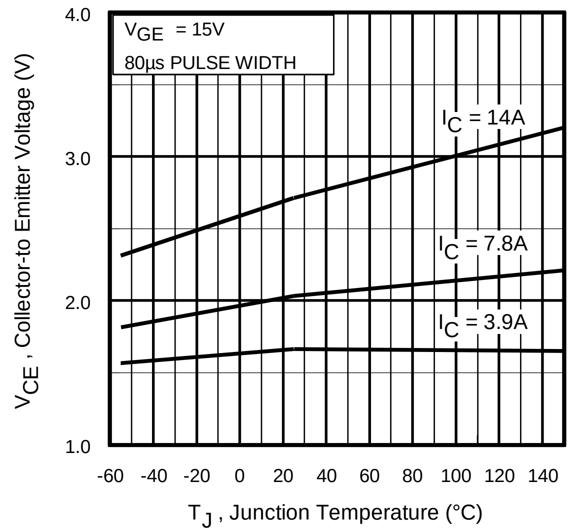


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

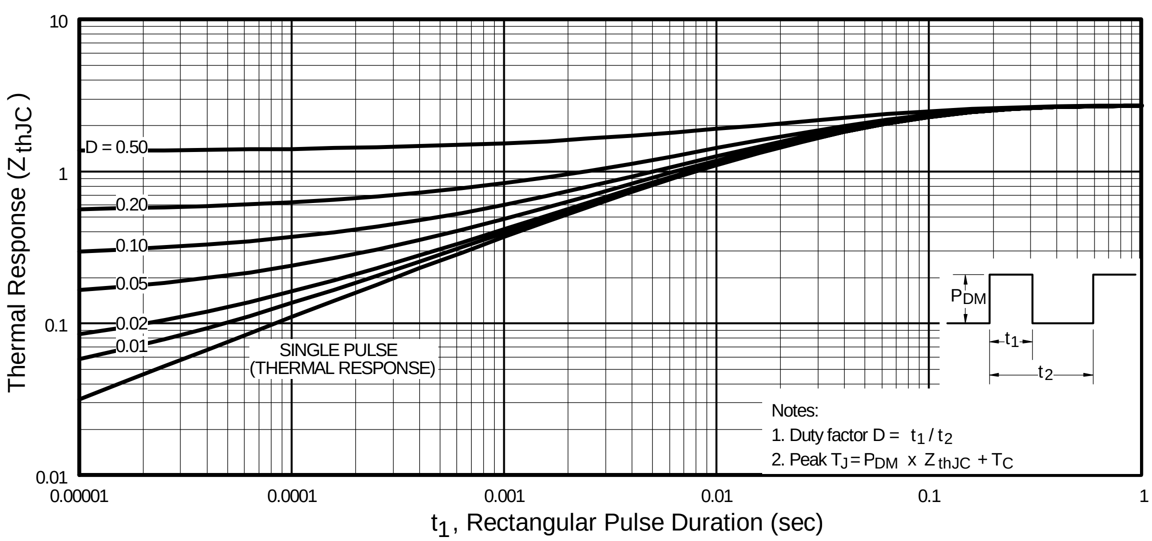


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

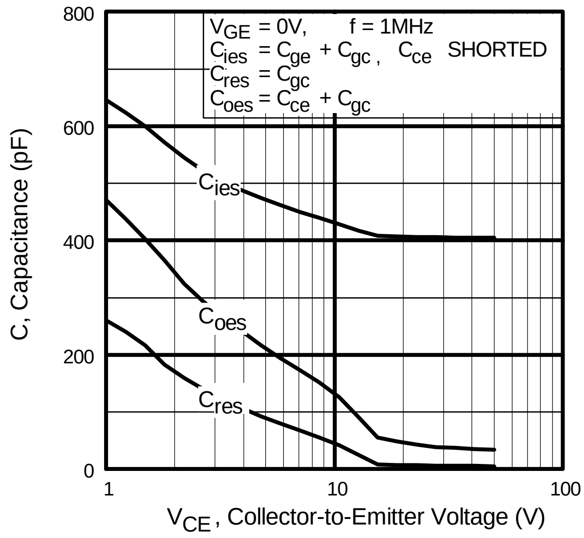


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

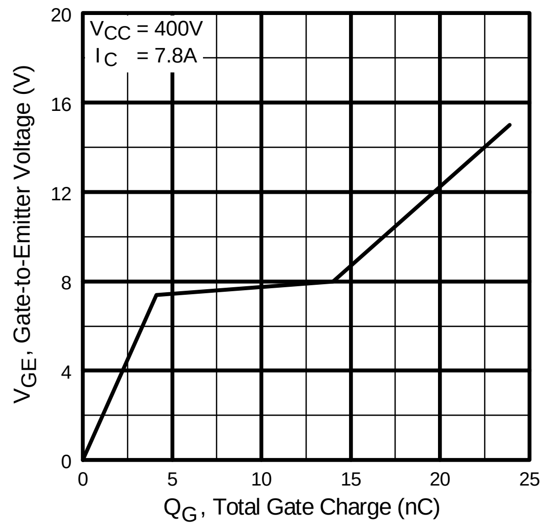


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

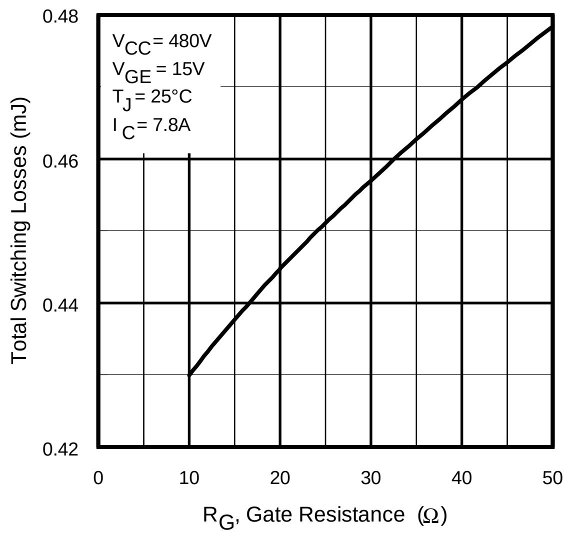


Fig. 9 - Typical Switching Losses vs. Gate Resistance

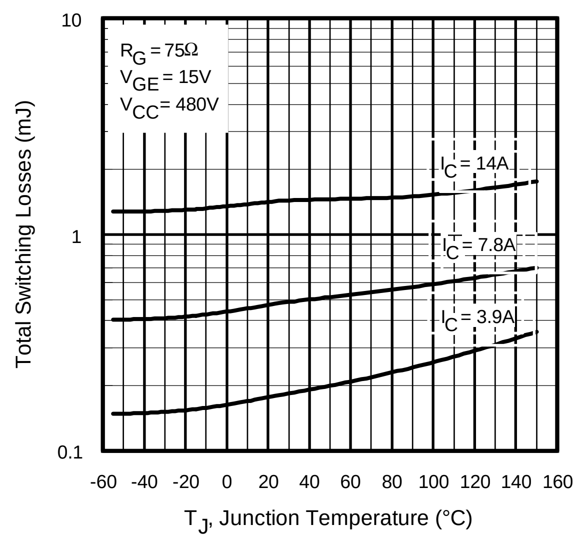


Fig. 10 - Typical Switching Losses vs. Junction Temperature

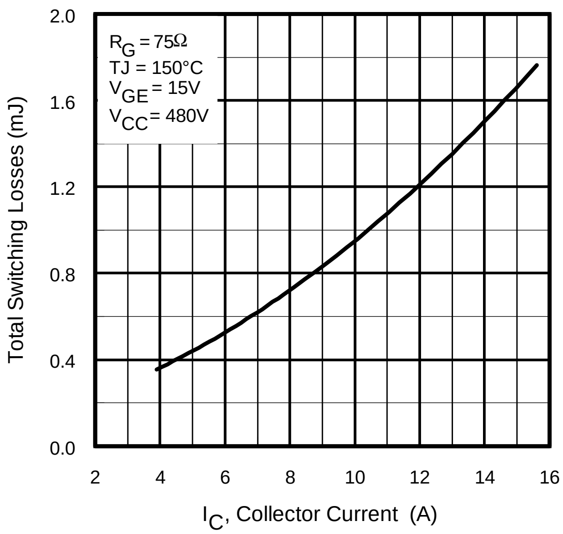


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

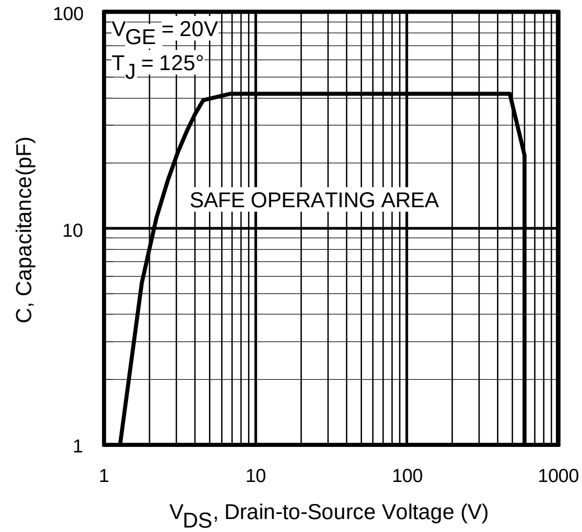


Fig. 12 - Turn-Off SOA

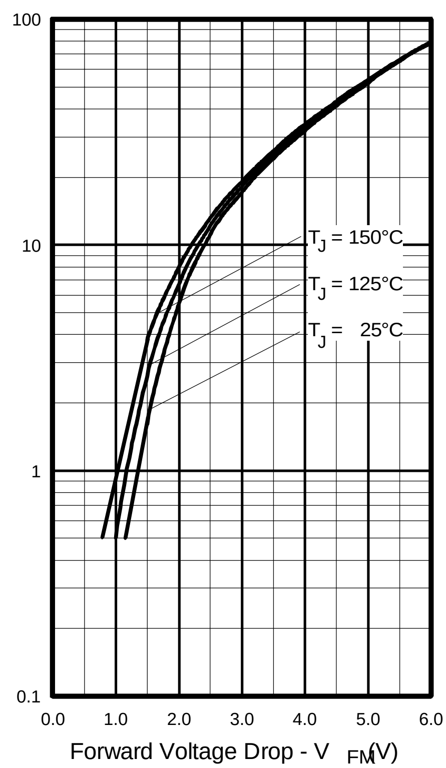


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

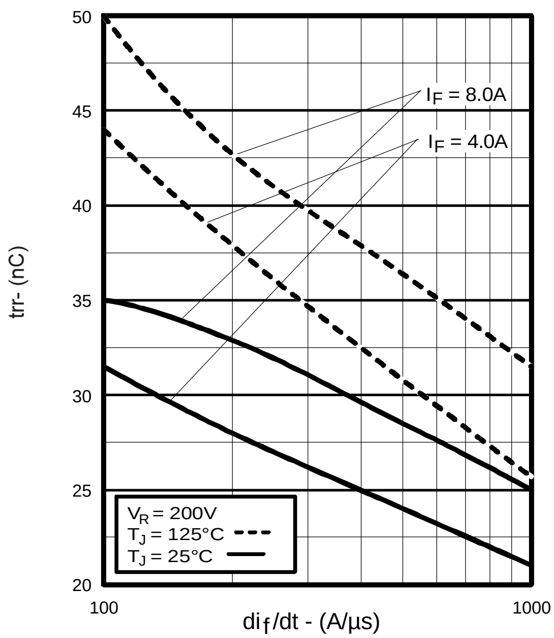


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

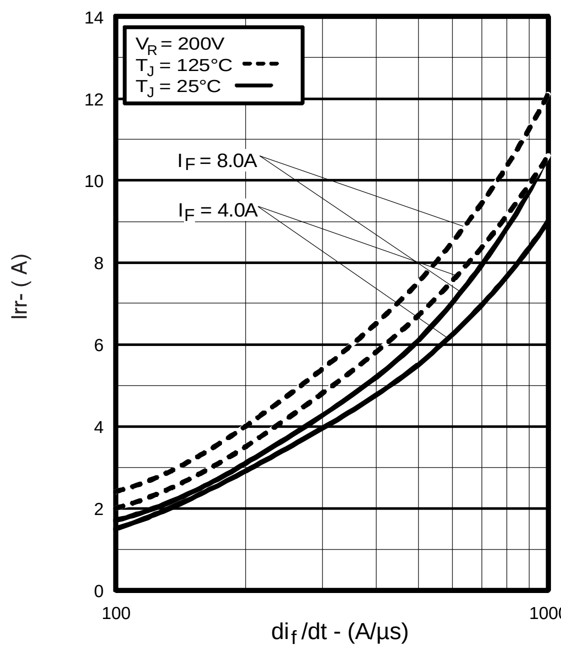


Fig. 15 - Typical Recovery Current vs. di_f/dt

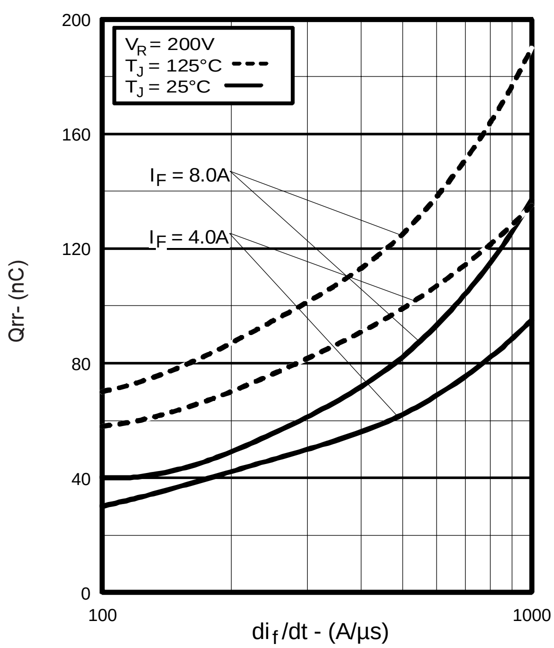


Fig. 16 - Typical Stored Charge vs. di_f/dt

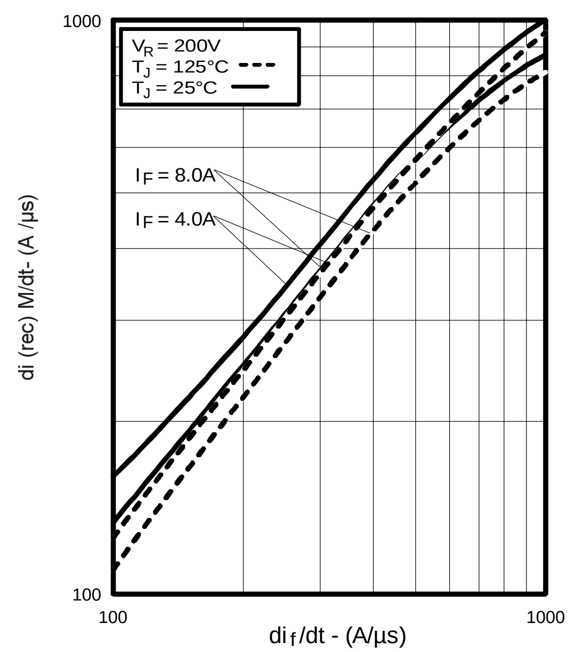


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt,

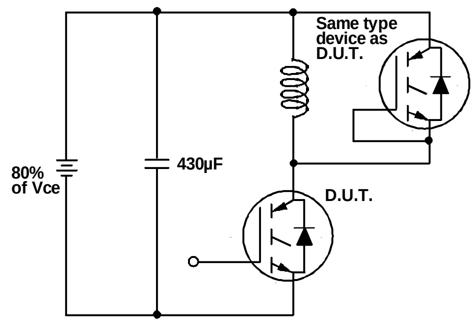


Fig. 18a - Test Circuit for Measurement of I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

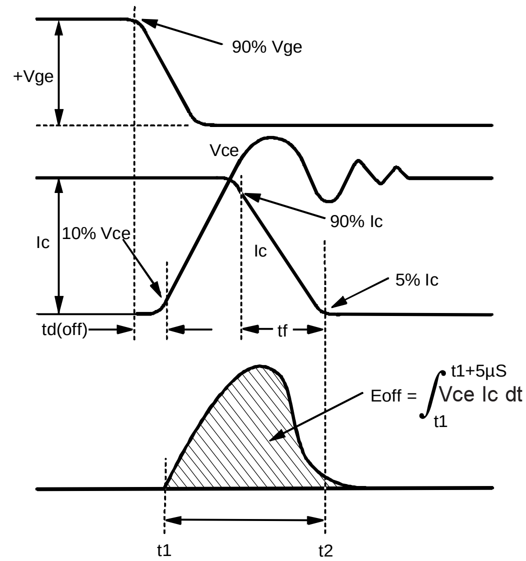


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off}, $t_{d(off)}$, t_f

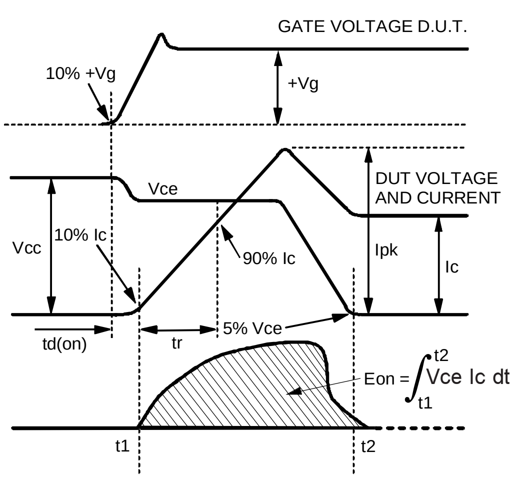


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on}, $t_{d(on)}$, t_r

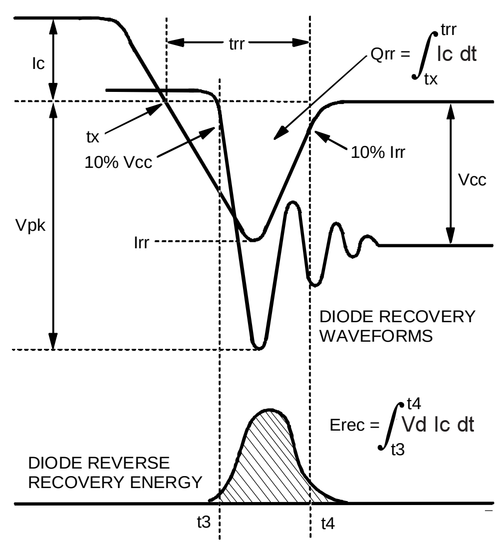


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

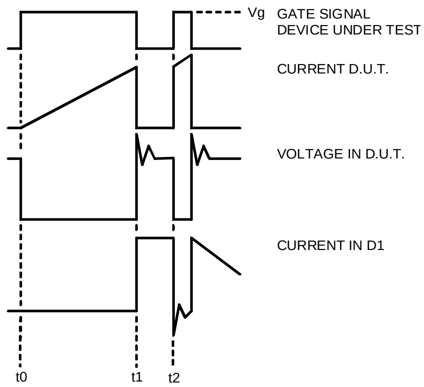


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

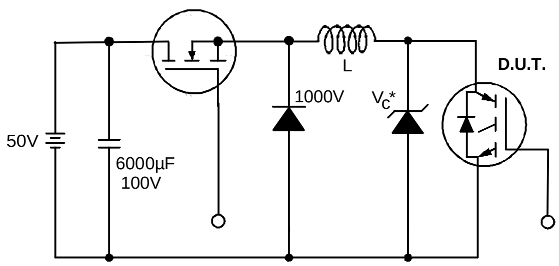


Figure 19. Clamped Inductive Load Test Circuit

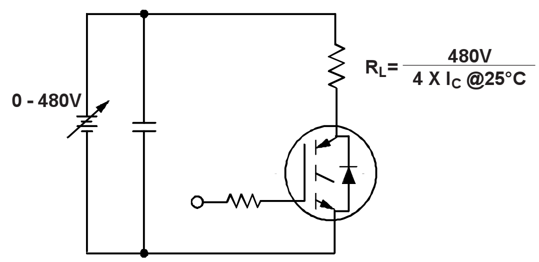
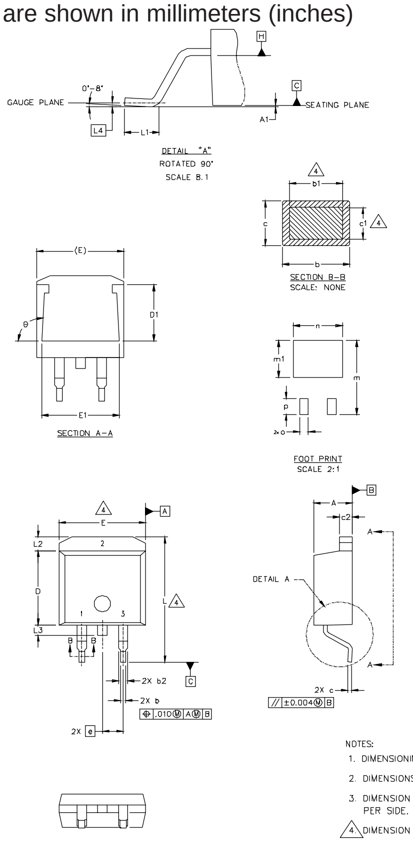


Figure 20. Pulsed Collector Current Test Circuit

D^2Pak Package Outline

Dimensions are shown in millimeters (inches)



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1		0.127		.005	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	4
b2	1.14	1.40	.045	.055	
c	0.43	0.63	.017	.025	
c1	0.38	0.74	.015	.029	4
c2	1.14	1.40	.045	.055	
D	8.51	9.65	.335	.380	3
D1	5.33		.210		
E	9.65	10.67	.380	.420	3
E1	6.22		.245		
e	2.54 BSC		.100 BSC		
L	14.61	15.88	.575	.625	
L1	1.78	2.79	.070	.110	
L2		1.65		.065	
L3	1.27	1.78	.050	.070	
L4	0.25 BSC		.010 BSC		
m	17.78		.700		
m1	8.89		.350		
n	11.43		.450		
o	2.08		.082		
p	3.81		.150		
θ	90°	93°	90°	93°	

LEAD ASSIGNMENTS

HEXFET	IGBTs, CoPACK	DIODES
1.- GATE	1.- GATE	1.- ANODE *
2.- DRAIN	2.- COLLECTOR	2.- CATHODE
3.- SOURCE	3.- EMITTER	3.- ANODE

* PART DEPENDENT.

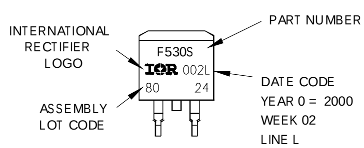
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: INCH.

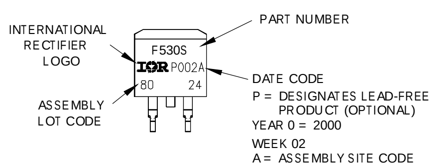
D^2Pak Part Marking Information

EXAMPLE: THIS IS AN IRF530S WITH LOT CODE 8024
ASSEMBLED ON WW 02, 2000
IN THE ASSEMBLY LINE "L"

Note: "P" in assembly line position indicates "Lead-Free"

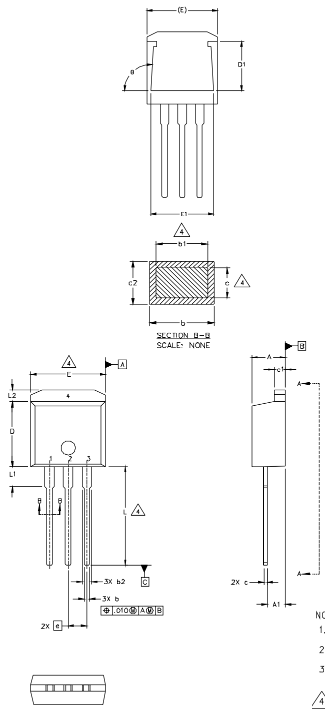


OR



TO-262 Package Outline

Dimensions are shown in millimeters (inches)



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	2.03	2.92	.080	.115	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	4
b2	1.14	1.40	.045	.055	
c	0.38	0.63	.015	.025	4
c1	1.14	1.40	.045	.055	
c2	0.43	.063	.017	.029	
D	8.51	9.65	.335	.380	3
D1	5.33		.210		
E	9.65	10.67	.380	.420	3
E1	6.22		.245		
e	2.54 BSC		.100 BSC		
L	13.46	14.09	.530	.555	
L1	3.56	3.71	.140	.146	
L2		1.65		.065	

LEAD ASSIGNMENTS

HEXFET

1.– GATE
2.– DRAIN
3.– SOURCE
4.– DRAIN

IGBT

1 - GATE
2 - COLLECTOR
3 - EMITTER

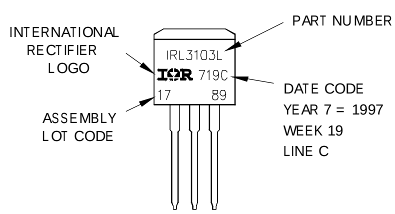
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: INCH.

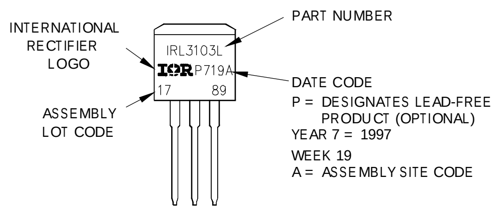
TO-262 Part Marking Information

EXAMPLE: THIS IS AN IRL3103L
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"

Note: "P" in assembly line position indicates "Lead-Free"

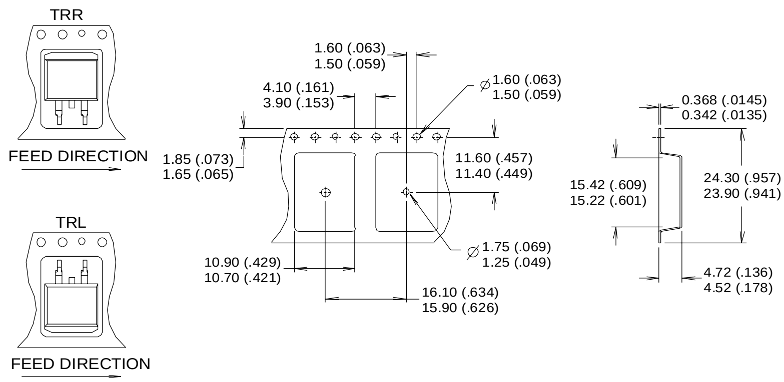


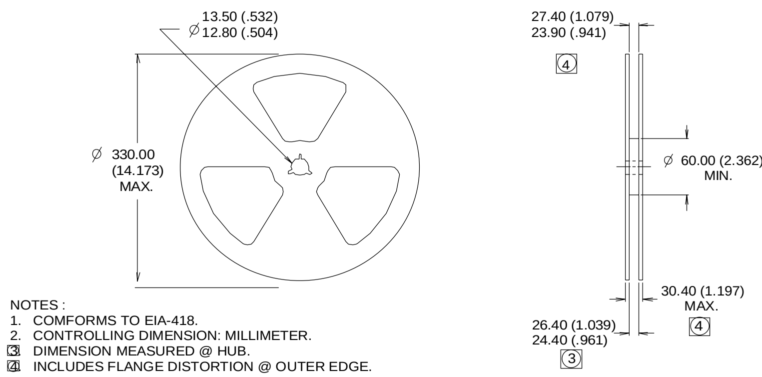
OR



D^2Pak Tape & Reel Information

Dimensions are shown in millimeters (inches)





Notes:

① Repetitive rating: V_{GE}=20V; pulse width limited by maximum junction temperature.

② V_{CC}=80%(V_{CES}), V_{GE}=20V, L=10µH, R_G = 75Ω

③ Pulse width ≤ 80µs; duty factor ≤ 0.1%.

④ Pulse width 5.0µs, single shot.

⑤ This only applies to TO-262 package.

⑥ This applies to D^2Pak, when mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994.

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 IOR Rectifier

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
TAC Fax: (310) 252-7903
Visit us at www.irf.com for sales contact information.08/04

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