PD- 95235

International
IOR Rectifier

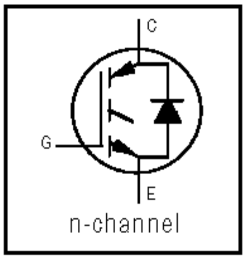
IRG4PC50KDPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

Short Circuit Rated UltraFast IGBT

Features

- Short Circuit Rated UltraFast: Optimized for high operating frequencies >5.0 kHz, and Short Circuit Rated to 10µs @125°C, V_{GE} = 15V
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency than Generation 3
- IGBT co-packaged with HEXFRED™ ultrafast, ultra-soft recovery anti-parallel diodes for use in bridge configurations
- Industry standard TO-247AC package
- Lead-Free



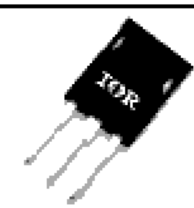
V_{CES} = 600V

$V_{CE(on)\ typ.}$ = 1.84V

@V_{GE} = 15V, I_C = 30A

Benefits

- Generation 4 IGBTs offer highest efficiencies availabl
- HEXFRED diodes optimized for performance with IGB Minimized recovery characteristics require less/no snul
- Designed to be a "drop-in" replacement for equivalent industry-standard Generation 3 IR IGBTs



TO-247AC

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
I_C @ T_C = 25°C	Continuous Collector Current	52	A
I_C @ T_C = 100°C	Continuous Collector Current	30	
I_{CM}	Pulsed Collector Current ①	104	
I_{LM}	Clamped Inductive Load Current ②	104	
I_F @ T_C = 100°C	Diode Continuous Forward Current	25	
I_{FM}	Diode Maximum Forward Current	280	
t_{sc}	Short Circuit Withstand Time	10	µs
V_{GE}	Gate-to-Emitter Voltage	± 20	V
P_D @ T_C = 25°C	Maximum Power Dissipation	200	W
P_D @ T_C = 100°C	Maximum Power Dissipation	78	
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 (1.1 N•m)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT	—	—	0.64	°C/W
$R_{\theta JC}$	Junction-to-Case - Diode	—	—	0.83	
$R_{\theta CS}$	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)

05/04/04

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage [3]	600	—	—	V	V_{GE} = 0V, I_C = 250µA
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.47	—	V/°C	V_{GE} = 0V, I_C = 1.0mA
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.84	2.2	V	I_C = 30A, V_{GE} = 15V
		—	2.19	—		I_C = 52A, see figures 2, 5
		—	1.79	—		I_C = 25A, 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	—	-12	—	mV/°C	V_{CE} = V_{GE}, I_C = 250µA
g_{fe}	Forward Transconductance [4]	17	24	—	S	V_{CE} = 100V, I_C = 30A
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	µA	V_{GE} = 0V, V_{CE} = 600V
		—	—	6500		V_{GE} = 0V, V_{CE} = 600V, T_J = 150°C
V_{FM}	Diode Forward Voltage Drop	—	1.3	1.7	V	I_C = 25A, see figure 13
		—	1.2	1.5		I_C = 25A, 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)	—	200	300		I_C = 30A	
Q_{ge}	Gate - Emitter Charge (turn-on)	—	25	38	nC	V_{CC} = 400V see figure 8	
Q_{gc}	Gate - Collector Charge (turn-on)	—	85	127		V_{GE} = 15V	
$t_{d(on)}$	Turn-On Delay Time	—	63	—			
t_r	Rise Time	—	49	—	ns	T_J = 25°C	
$t_{d(off)}$	Turn-Off Delay Time	—	150	220		I_C = 30A, V_{CC} = 480V	
t_f	Fall Time	—	95	140		V_{GE} = 15V, R_G = 5.0Ω	
E_{on}	Turn-On Switching Loss	—	1.61	—		Energy losses include "tail"	
E_{off}	Turn-Off Switching Loss	—	0.84	—	mJ	and diode reverse recovery	
E_{ts}	Total Switching Loss	—	2.45	3.0		see figures 9,10,18	
t_{sc}	Short Circuit Withstand Time	10	—	—	µs	V_{CC} = 360V, T_J = 125°C	
						V_{GE} = 15V, R_G = 10Ω, V_{CPK} < 500V	
$t_{d(on)}$	Turn-On Delay Time	—	61	—		T_J = 150°C, see figures 11,18	
t_r	Rise Time	—	46	—	ns	I_C = 30A, V_{CC} = 480V	
$t_{d(off)}$	Turn-Off Delay Time	—	310	—		V_{GE} = 15V, R_G = 5.0Ω	
t_f	Fall Time	—	170	—		Energy losses include "tail"	
E_{ts}	Total Switching Loss	—	3.53	—	mJ	and diode reverse recovery	
L_E	Internal Emitter Inductance	—	13	—	nH	Measured 5mm from package	
C_{ies}	Input Capacitance	—	3200	—		V_{GE} = 0V	
C_{oes}	Output Capacitance	—	370	—	pF	V_{CC} = 30V see figure 7	
C_{res}	Reverse Transfer Capacitance	—	95	—		ƒ = 1.0MHz	
t_{rr}	Diode Reverse Recovery Time	—	50	75	ns	T_J = 25°C see figure	
		—	105	160		T_J = 125°C 14	I_F = 25A
I_{rr}	Diode Peak Reverse Recovery Current	—	4.5	10	A	T_J = 25°C see figure	
		—	8.0	15		T_J = 125°C 15	V_R = 200V
Q_{rr}	Diode Reverse Recovery Charge	—	112	375	nC	T_J = 25°C see figure	
		—	420	1200		T_J = 125°C 16	di/dt 200A/µs
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery	—	250	—	A/µs	T_J = 25°C see figure	
	During t_b	—	160	—		T_J = 125°C 17	

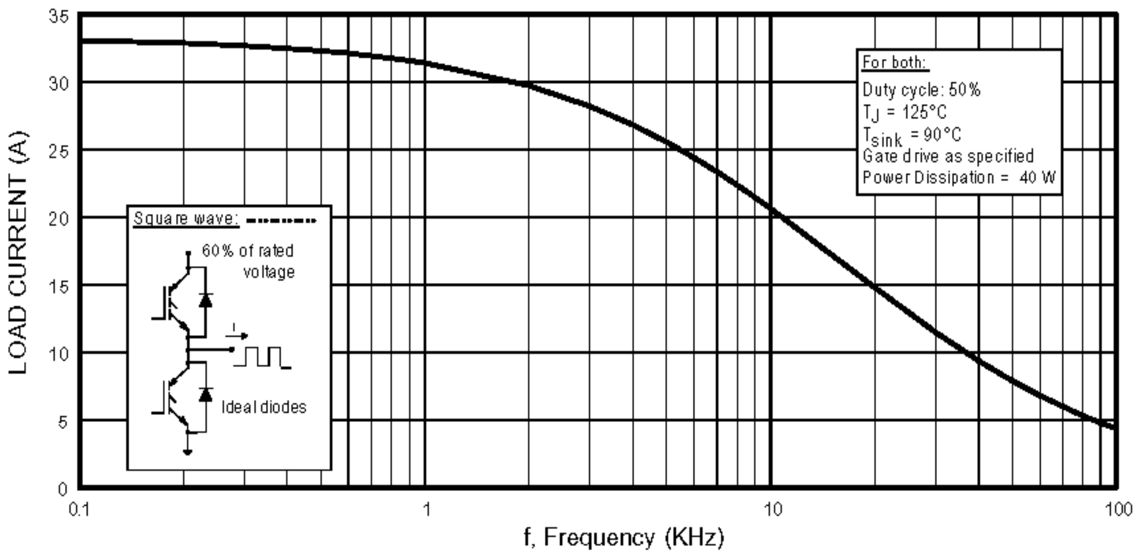


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

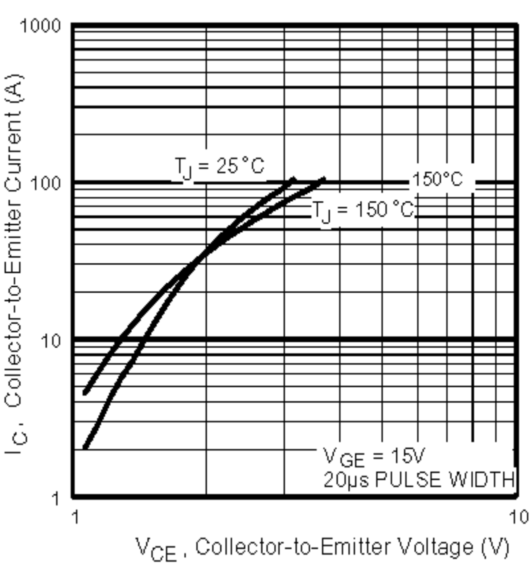


Fig. 2 - Typical Output Characteristics

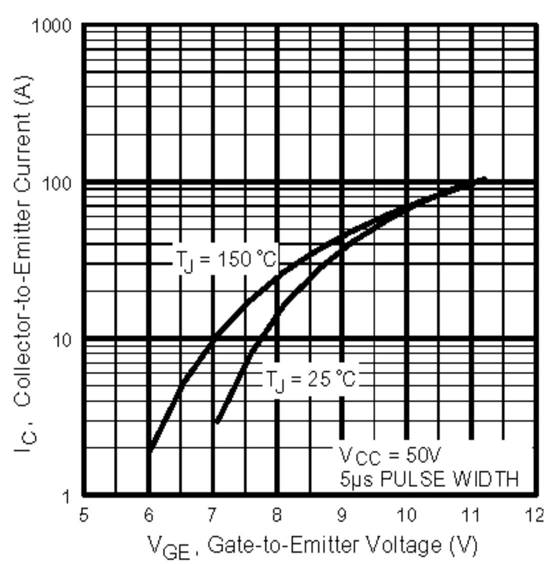


Fig. 3 - Typical Transfer Characteristics

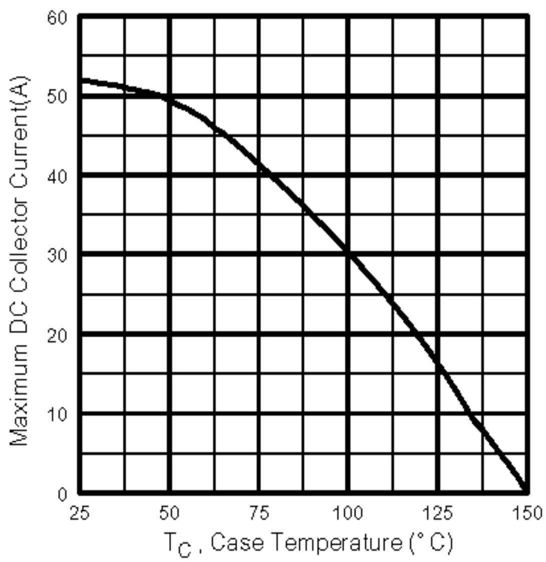


Fig. 4 - Maximum Collector Current vs. Case Temperature

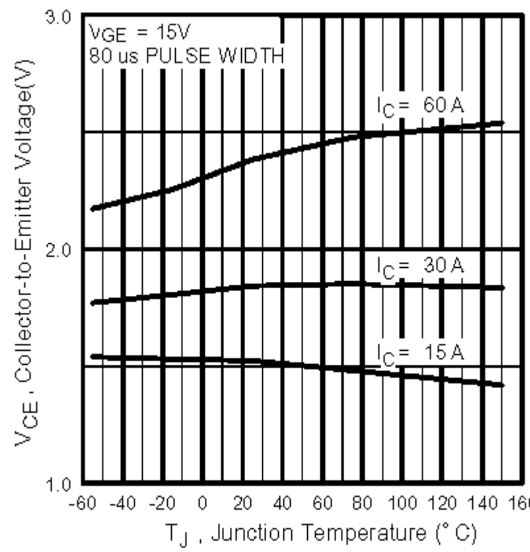


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

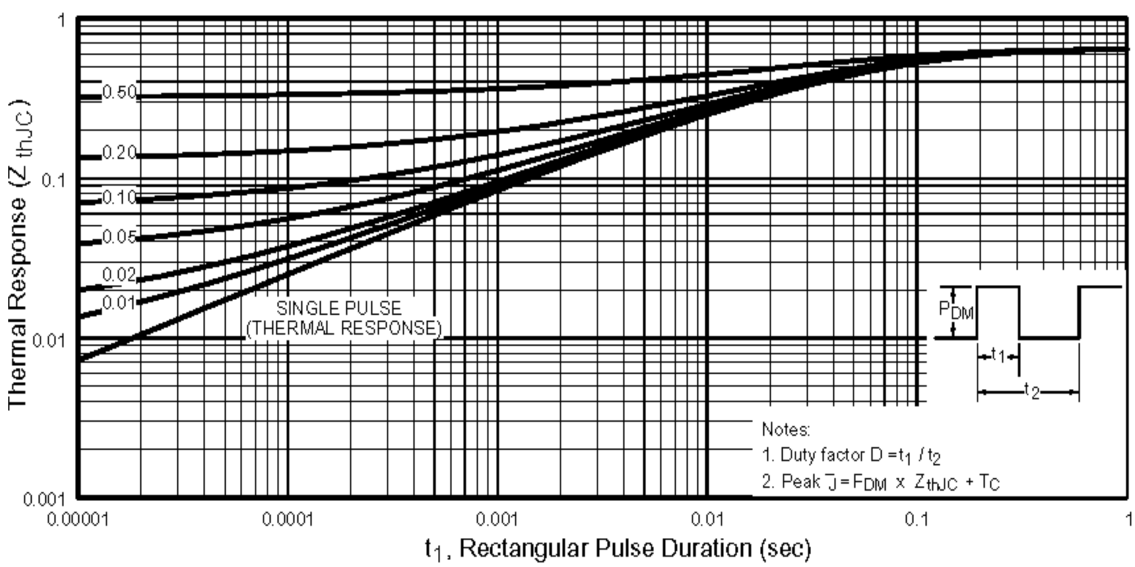


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

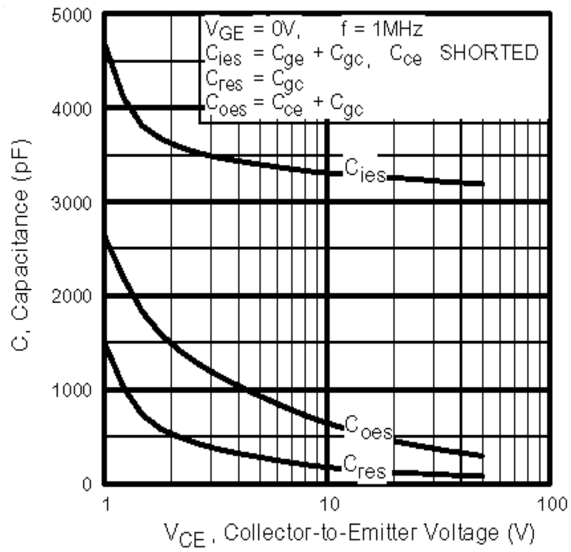


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

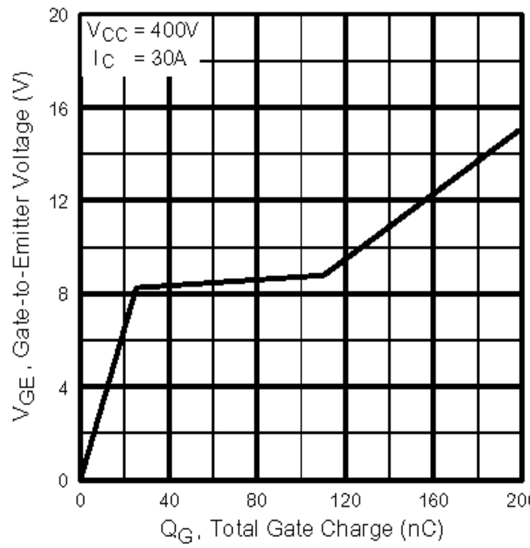


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

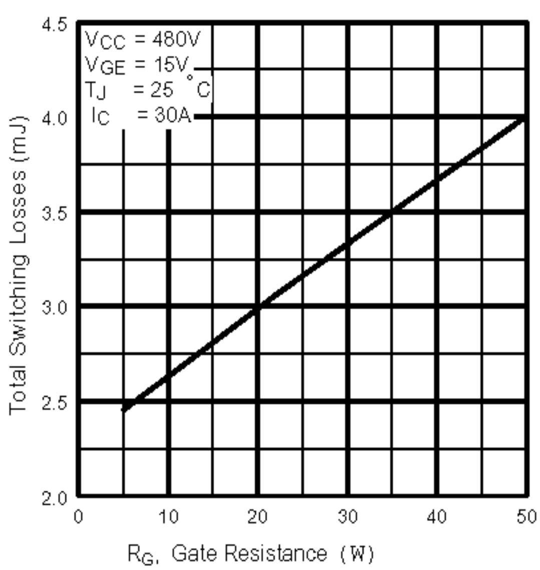


Fig. 9 - Typical Switching Losses vs. Gate Resistance

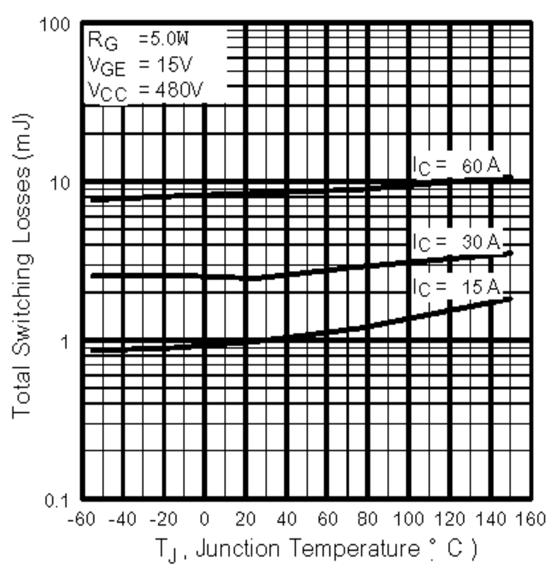


Fig. 10 - Typical Switching Losses vs. Junction Temperature

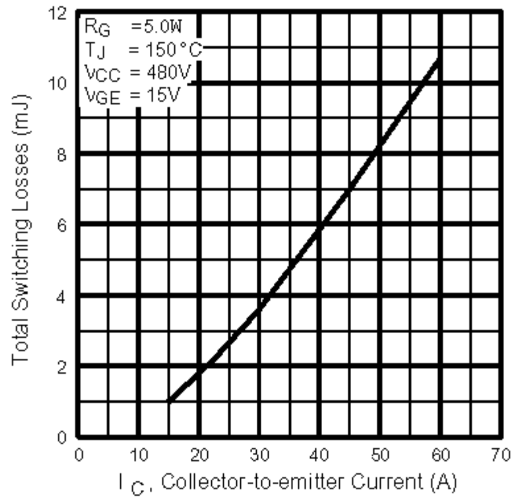


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

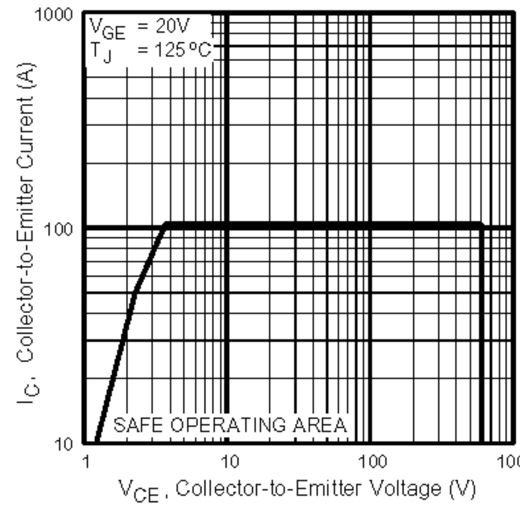


Fig. 12 - Turn-Off SOA

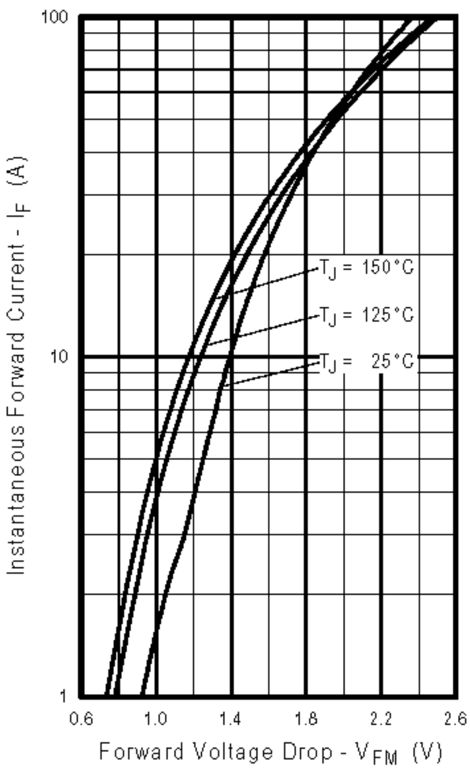


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

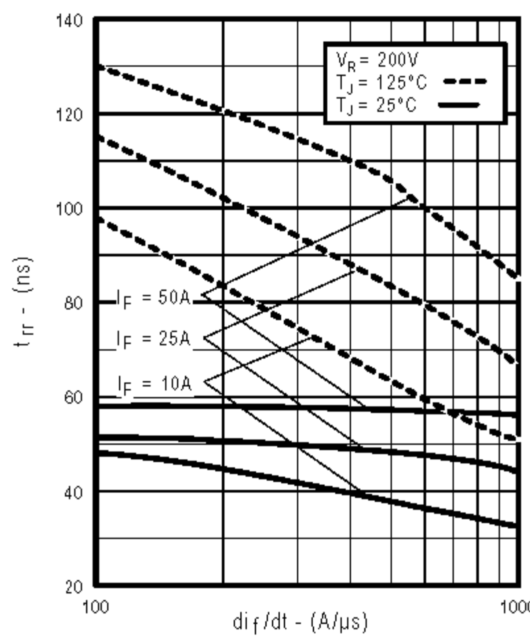


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

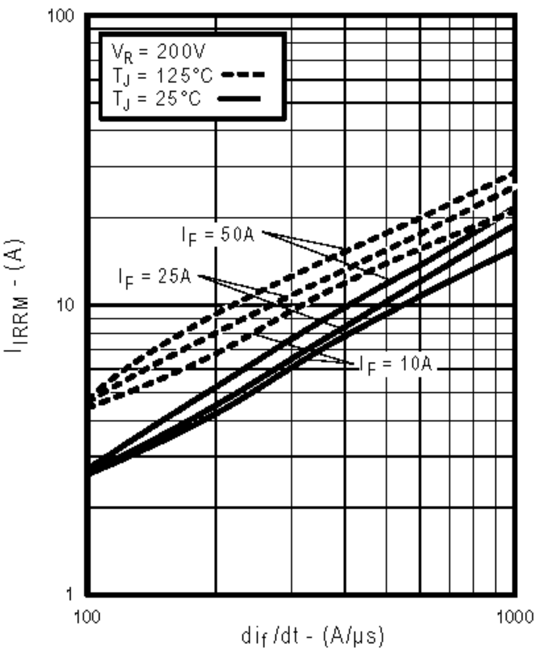


Fig. 15 - Typical Recovery Current vs. di_f/dt

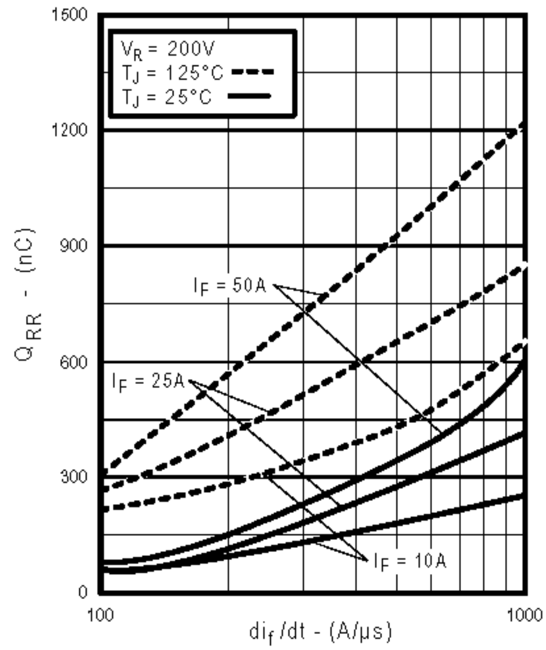


Fig. 16 - Typical Stored Charge vs. di_f/dt

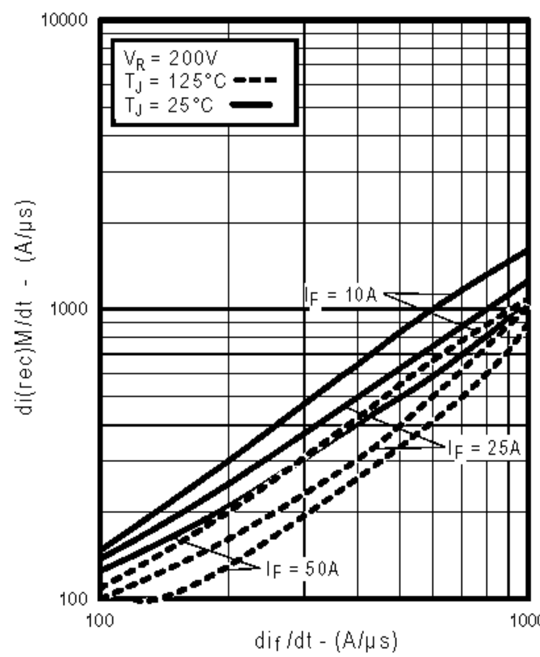


Fig. 17 - Typical $di_{(rec)M}$/dt vs. di_f/dt

Mechanical drawings, Appendix A
Test Circuit diagrams, Appendix B
Switching Loss Waveforms, Appendix C

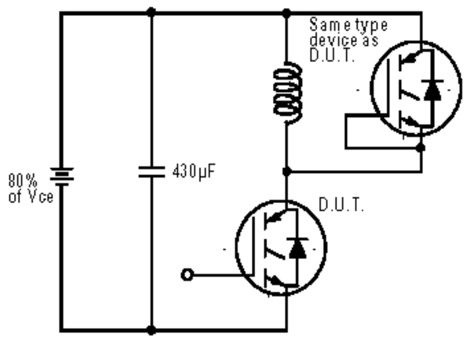


Fig. 18a - Test Circuit for Measurement of I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

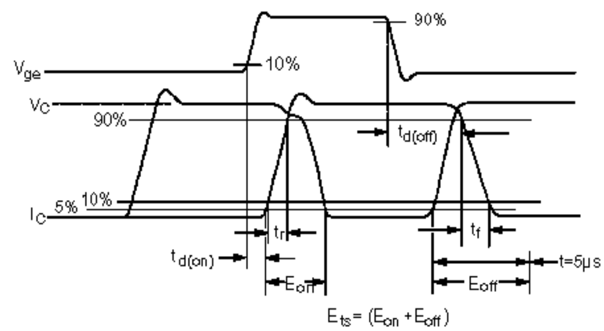


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off}, $t_{d(off)}$, t_f

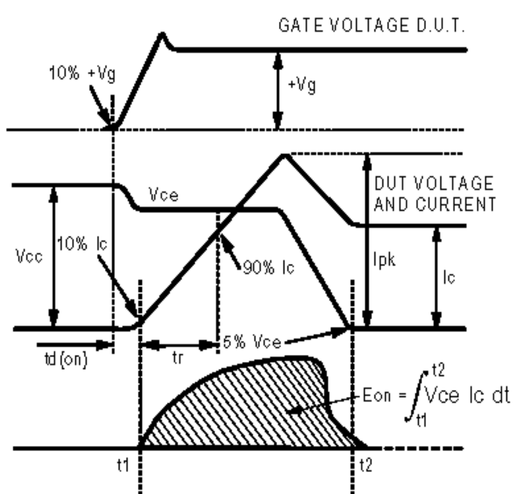


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on}, $t_{d(on)}$, t_r

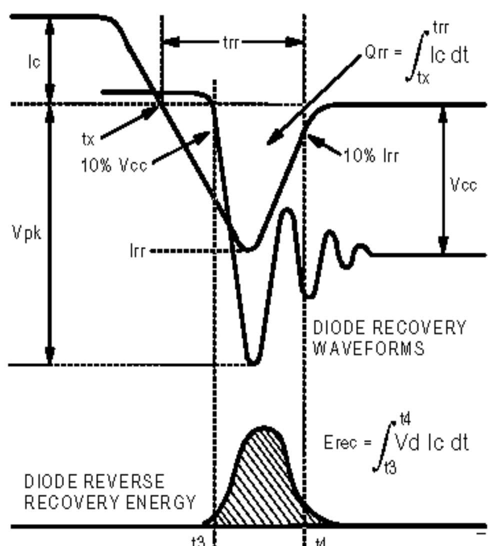


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

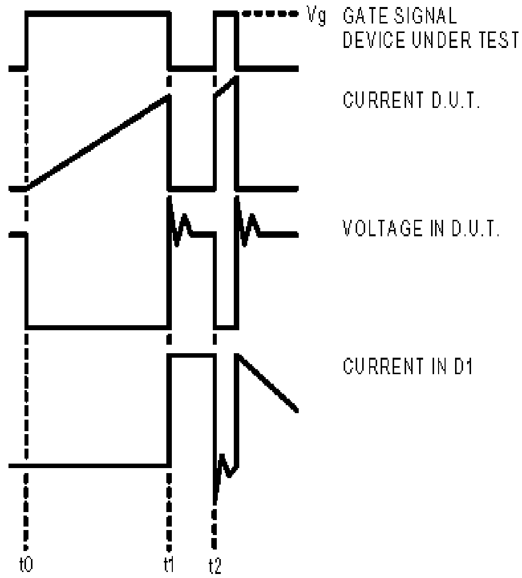


Figure 18e. *Macro Waveforms for Figure 18a's Test Circuit*

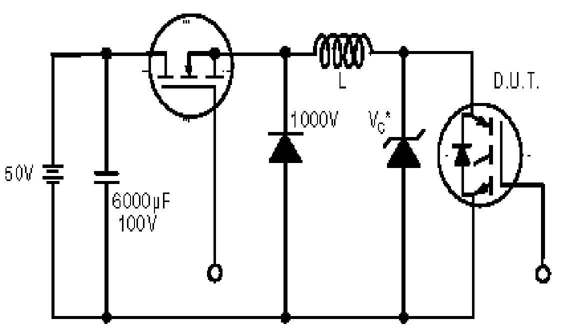


Figure 19. *Clamped Inductive Load Test Circuit*

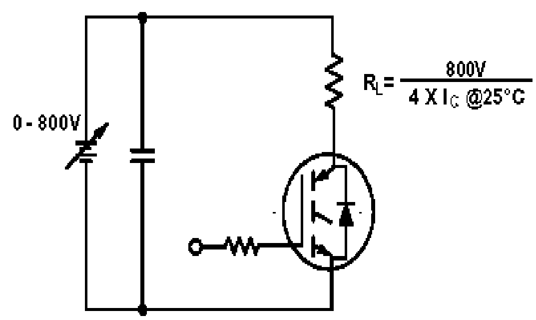
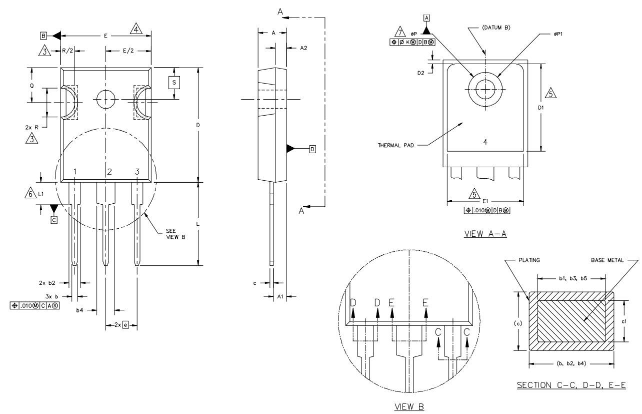


Figure 20. *Pulsed Collector Current Test Circuit*

TO-247AC Package Outline

Dimensions are shown in millimeters (inches)



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M 1994.
2. DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS]
3. CONTOUR OF SLOT OPTIONAL.
4. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
5. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENISONS D1 & E1.
6. LEAD FINISH UNCONTROLLED IN L1.
7. øP TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5 ° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154" [3.91].
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-247 WITH THE EXCEPTION OF DIMENSION c.

SYMBOL	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN.	MAX.	MIN.	MAX.	
A	.183	.209	4.65	5.31	
A1	.087	.102	2.21	2.59	
A2	.059	.098	1.50	2.49	
b	.039	.055	0.99	1.40	
b1	.039	.053	0.99	1.35	
b2	.065	.094	1.65	2.39	
b3	.065	.092	1.65	2.37	
b4	.102	.135	2.59	3.43	
b5	.102	.133	2.59	3.38	
c	.015	.034	0.38	0.86	
c1	.015	.030	0.38	0.76	
D	.776	.815	19.71	20.70	4
D1	.515	-	13.08	-	5
D2	.020	.030	0.51	0.76	
E	.602	.625	15.29	15.87	4
E1	.540	-	15.72	-	
e	.215 BSC		5.46 BSC		
øk	.010		2.54		
L	.559	.634	14.20	16.10	
L1	.146	.169	3.71	4.29	
N	3		7.62 BSC		
øP	.140	.144	3.56	3.66	
øP1	-	.275	-	6.98	
Q	.209	.224	5.31	5.69	
R	.178	.216	4.52	5.49	
S	.217 BSC		5.51 BSC		

LEAD ASSIGNMENTS

HEXFET

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

IGBTs, CoPACK

1.- GATE
2.- COLLECTOR
3.- EMITTER
4.- COLLECTOR

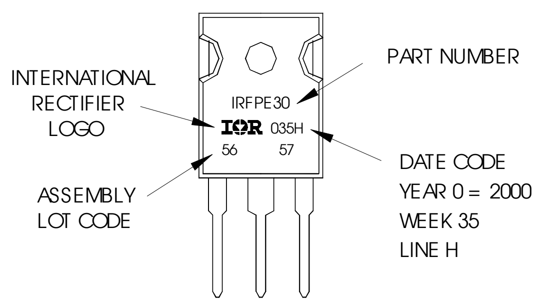
DIODES

1.- ANODE/OPEN
2.- CATHODE
3.- ANODE

TO-247AC Part Marking Information

EXAMPLE: THIS IS AN IRFPE30
WITH ASSEMBLY
LOT CODE 5657
ASSEMBLED ON WW 35, 2000
IN THE ASSEMBLY LINE "H"

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



Data and specifications subject to change without notice.

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