

# IRG4PSH71UD

INSULATED GATE BIPOLAR TRANSISTOR WITH  
 ULTRAFAST SOFT RECOVERY DIODE

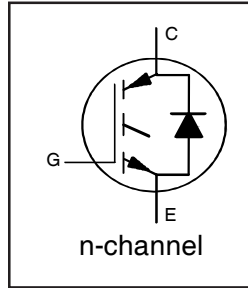
UltraFast Copack IGBT

### Features

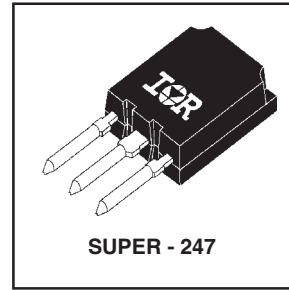
- UltraFast switching speed optimized for operating frequencies 8 to 40kHz in hard switching, 200kHz in resonant mode soft switching
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency (minimum switching and conduction losses) than prior generations
- Industry-benchmark Super-247 package with higher power handling capability compared to same footprint TO-247
- Creepage distance increased to 5.35mm

### Benefits

- Generation 4 IGBT's offer highest efficiencies available
- Maximum power density, twice the power handling of the TO-247, less space than TO-264
- IGBTs optimized for specific application conditions
- Cost and space saving in designs that require multiple, paralleled IGBTs
- HEXFRED™ antiparallel Diode minimizes switching losses and EMI



$V_{CES} = 1200V$
$V_{CE(on)} \text{ typ.} = 2.52V$
@ $V_{GE} = 15V, I_C = 50A$



### Absolute Maximum Ratings

	Parameter	Max.	Units
$V_{CES}$	Collector-to-Emitter Voltage	1200	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	99	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	50	
$I_{CM}$	Pulse Collector Current ①	200	
$I_{LM}$	Clamped Inductive Load current ②	200	
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 20$	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	70	W
$I_{FM}$	Diode Maximum Forward Current	200	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	350	
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	140	
$T_J$	Operating Junction and	-55 to +150	°C
$T_{STG}$	Storage Temperature Range		
	Storage Temperature Range, for 10 sec.	300 (0.063 in. (1.6mm) from case)	

### Thermal / Mechanical Characteristics

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case- IGBT	—	—	0.36	°C/W
$R_{\theta JC}$	Junction-to-Case- Diode	—	—	0.36	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	—	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	—	38	
	Recommended Clip Force	20 (2.0)			N (kgf)
Wt	Weight	—	6 (0.21)	—	g (oz.)

# IRG4PSH71UD

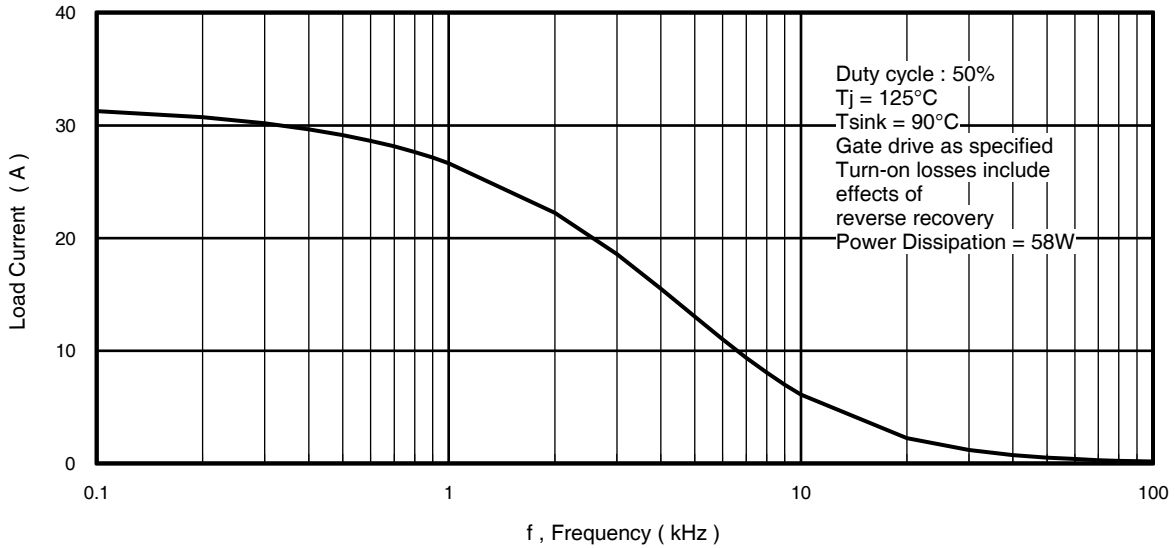
International  
IR Rectifier

## Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)

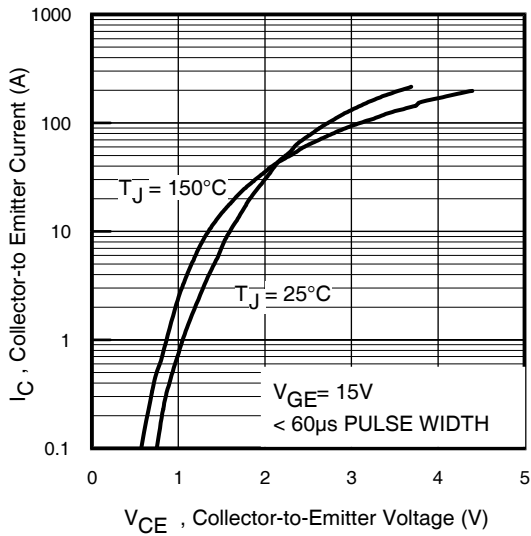
Parameter	Min.	Typ.	Max.	Units	Conditions	
V <sub>(BR)CES</sub>	1200	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 250μA	
V <sub>(BR)ECS</sub>	19	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1.0A	
ΔV <sub>(BR)CES</sub> /ΔT <sub>J</sub>	—	0.78	—	V/°C	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1mA	
V <sub>CE(on)</sub>	Collector-to-Emitter Saturation Voltage	—	2.52	2.70	V	I <sub>C</sub> = 70A, V <sub>GE</sub> = 15V I <sub>C</sub> = 140A I <sub>C</sub> = 70A, T <sub>J</sub> = 150°C See Fig.2, 5
		—	3.17	—		
		—	2.68	—		
V <sub>GE(th)</sub>	3.0	—	6.0		V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA	
ΔV <sub>GE(th)</sub> /ΔT <sub>J</sub>	—	-9.2	—	mV/°C	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 1.0mA	
g <sub>f</sub>	48	72	—	S	V <sub>CE</sub> = 100V, I <sub>C</sub> = 70A	
I <sub>CES</sub>	Zero Gate Voltage Collector Current	—	—	500	μA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 1200V V <sub>GE</sub> = 0V, V <sub>CE</sub> = 10V V <sub>GE</sub> = 0V, V <sub>CE</sub> = 1200V, T <sub>J</sub> = 150°C
		—	—	2.0		
		—	—	5000		
V <sub>FM</sub>	Diode Forward Voltage Drop	—	2.92	3.9	V	I <sub>F</sub> = 70A See Fig.13 I <sub>F</sub> = 70A, T <sub>J</sub> = 150°C
		—	2.88	3.7		
I <sub>GES</sub>	Gate-to-Emitter Leakage Current	—	—	±100	nA	V <sub>GE</sub> = ±20V

## Switching Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)

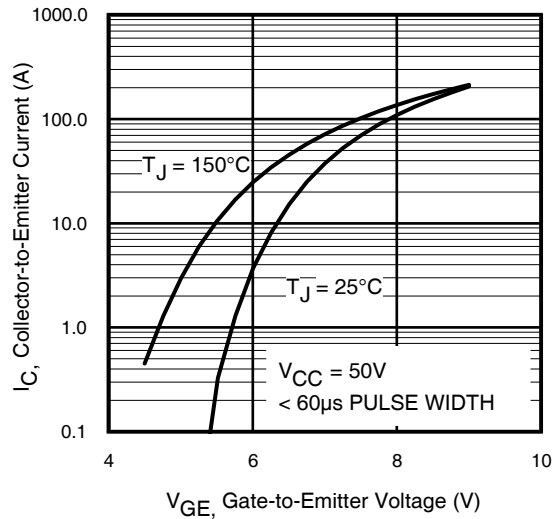
Parameter	Min.	Typ.	Max.	Units	Conditions	
Q <sub>g</sub>	—	380	570	nC	I <sub>C</sub> = 70A V <sub>CC</sub> = 400V See Fig.8 V <sub>GE</sub> = 15V	
Q <sub>ge</sub>	—	61	24			
Q <sub>gc</sub>	—	130	200			
t <sub>d(on)</sub>	—	46	—	ns	I <sub>C</sub> = 70A, V <sub>CC</sub> = 960V V <sub>GE</sub> = 15V, R <sub>G</sub> = 5.0Ω Energy losses include "tail" See Fig. 9, 10, 11, 14	
t <sub>r</sub>	—	77	—			
t <sub>d(off)</sub>	—	250	350			
t <sub>f</sub>	—	220	330			
E <sub>on</sub>	—	8.8	—	mJ	T <sub>J</sub> = 150°C, See Fig. 9, 10, 11, 14 I <sub>C</sub> = 70A, V <sub>CC</sub> = 960V V <sub>GE</sub> = 15V, R <sub>G</sub> = 5.0Ω Energy losses include "tail"	
E <sub>off</sub>	—	9.4	—			
E <sub>tot</sub>	—	18.2	19.7			
t <sub>d(on)</sub>	—	43	—	ns	T <sub>J</sub> = 150°C, See Fig. 9, 10, 11, 14 I <sub>C</sub> = 70A, V <sub>CC</sub> = 960V V <sub>GE</sub> = 15V, R <sub>G</sub> = 5.0Ω Energy losses include "tail"	
t <sub>r</sub>	—	78	—			
t <sub>d(off)</sub>	—	330	—			
t <sub>f</sub>	—	480	—			
E <sub>TS</sub>	—	26	—	mJ		
L <sub>E</sub>	—	13	—	nH	Measured 5mm from package	
C <sub>ies</sub>	—	6640	—	pF	V <sub>GE</sub> = 0V V <sub>CC</sub> = 30V, See Fig.7 f = 1.0MHz	
C <sub>oes</sub>	—	420	—			
C <sub>res</sub>	—	60	—			
t <sub>rr</sub>	Diode Reverse Recovery Time	—	110	170	ns	T <sub>J</sub> =25°C See Fig 14 T <sub>J</sub> =125°C
		—	180	270		
I <sub>rr</sub>	Diode Peak Reverse Recovery Current	—	6.0	9.0	A	T <sub>J</sub> =25°C See Fig 15 T <sub>J</sub> =125°C
		—	8.9	13		
Q <sub>rr</sub>	Diode Reverse Recovery Charge	—	350	530	nC	T <sub>J</sub> =25°C See Fig 16 T <sub>J</sub> =125°C
		—	870	1300		
di <sub>(rec)M</sub> /dt	Diode Peak Rate of Fall of Recovery During t <sub>b</sub>	—	150	230	A/μs	T <sub>J</sub> =25°C See Fig 17 T <sub>J</sub> =125°C
		—	130	200		



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



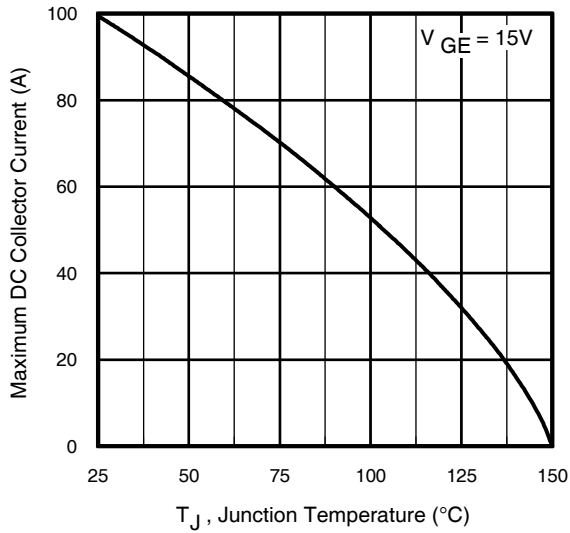
**Fig. 2 - Typical Output Characteristics**



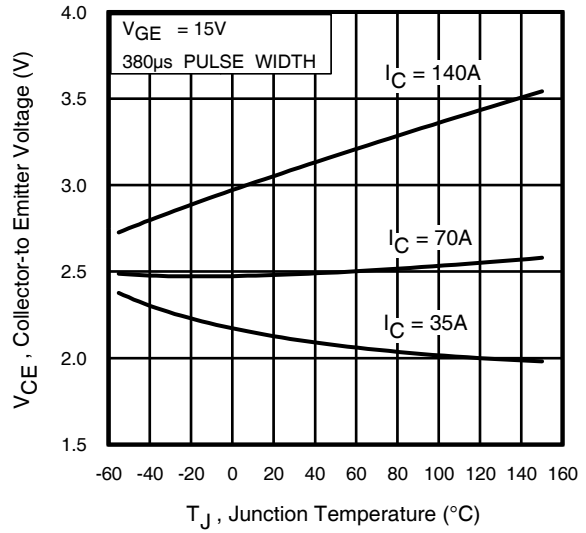
**Fig. 3 - Typical Transfer Characteristics**

# IRG4PSH71UD

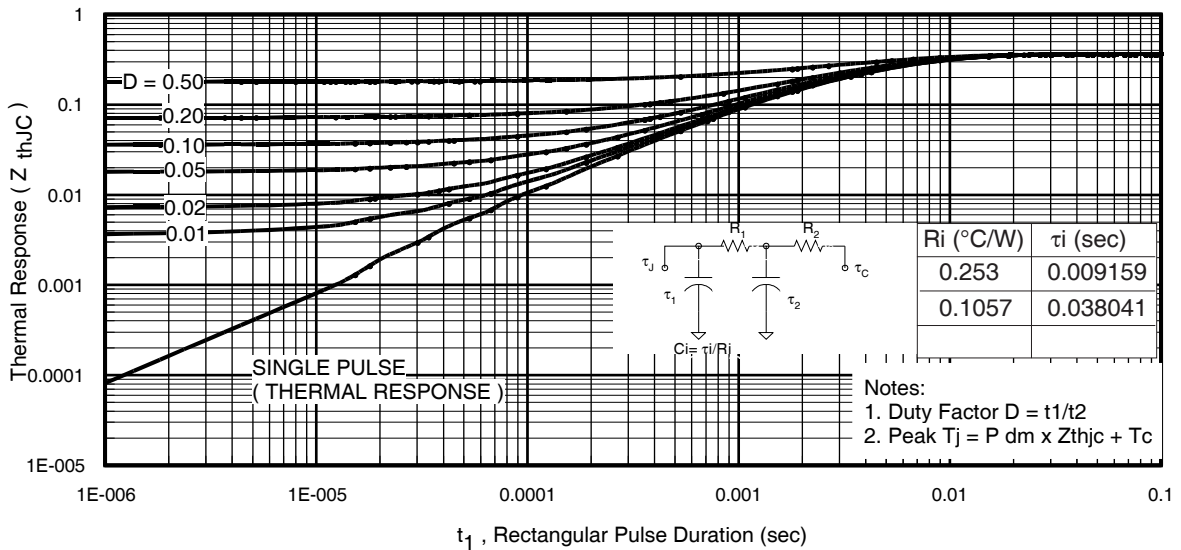
International  
**IR** Rectifier



**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

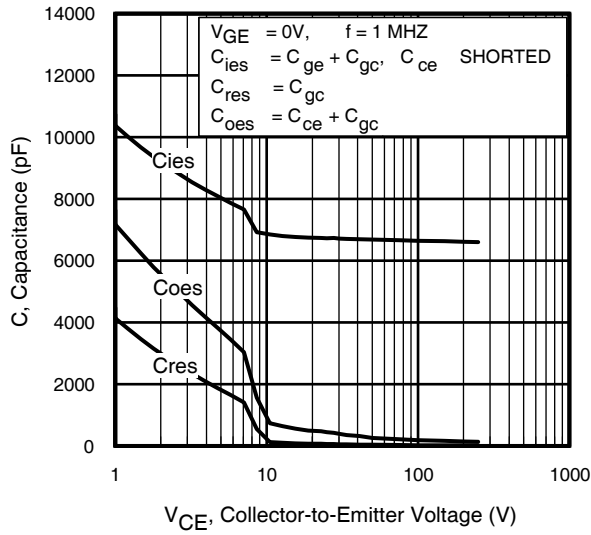


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

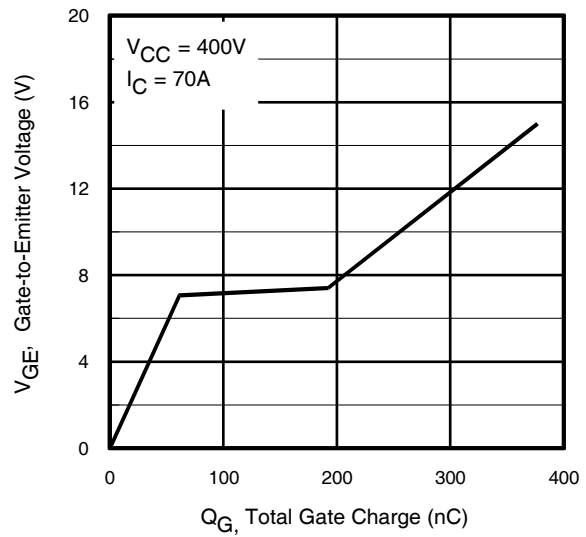


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

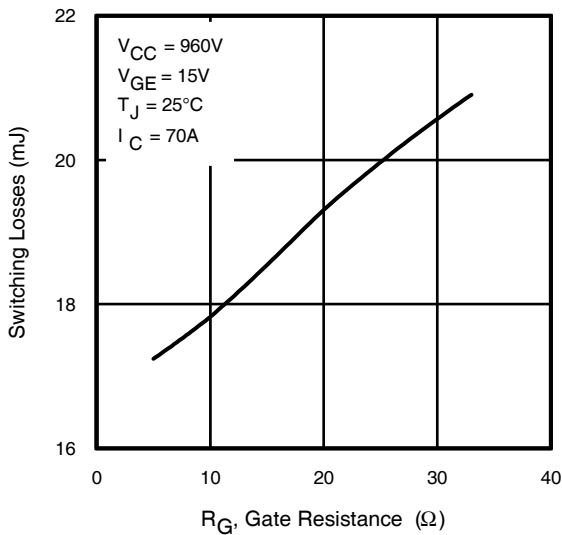


Fig. 9 - Typical Switching Losses vs. Gate Resistance

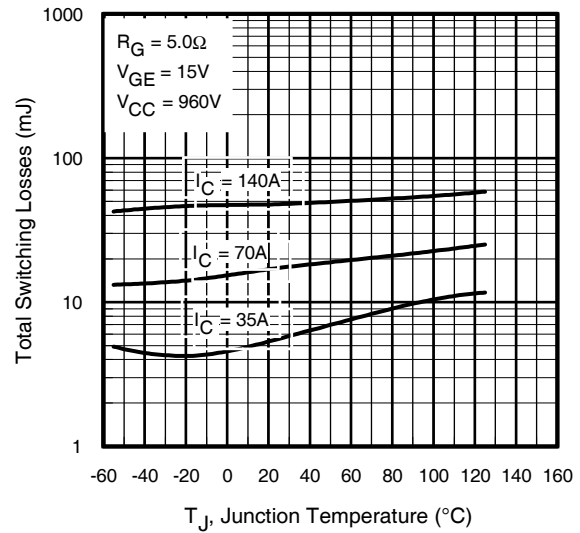
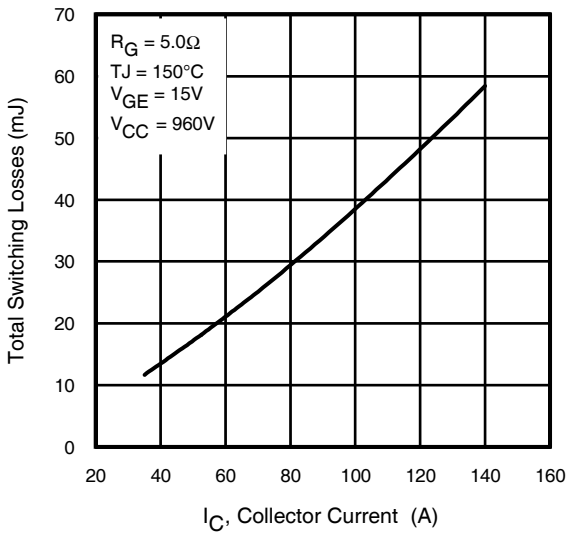
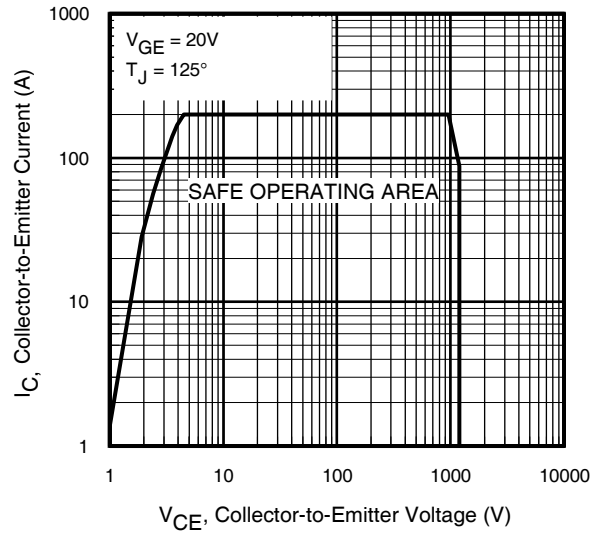


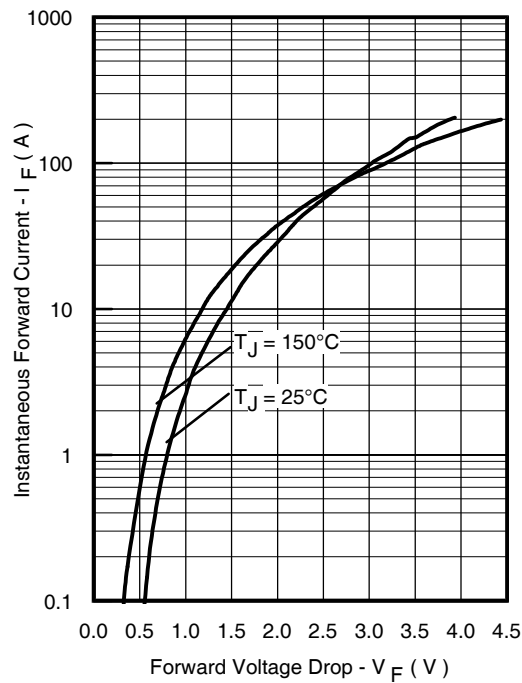
Fig. 10 - Typical Switching Losses vs. Junction Temperature



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



**Fig. 12** - Turn-Off SOA



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

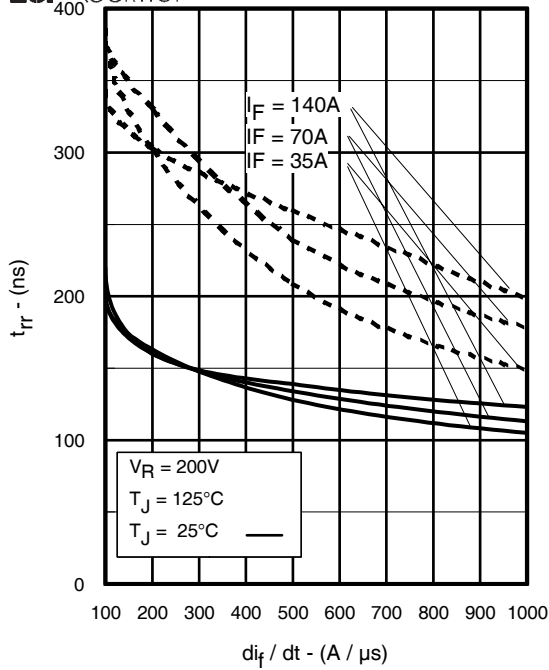


Fig. 14 - Typical Reverse Recovery vs.  $di_f/dt$

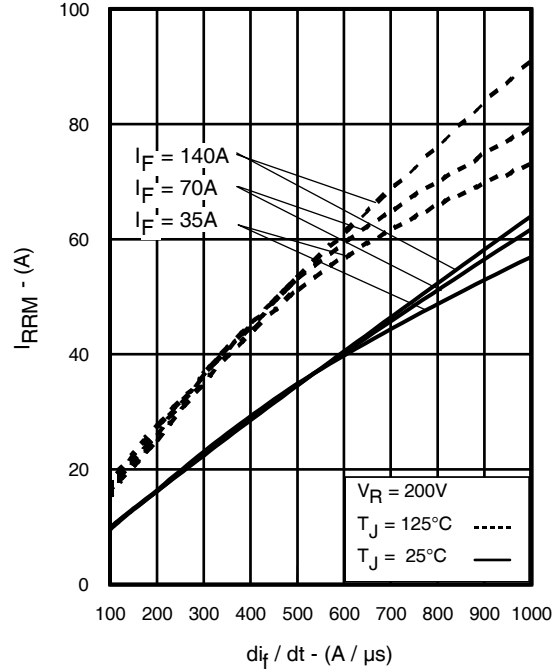


Fig. 15 - Typical Recovery Current vs.  $di_f/dt$

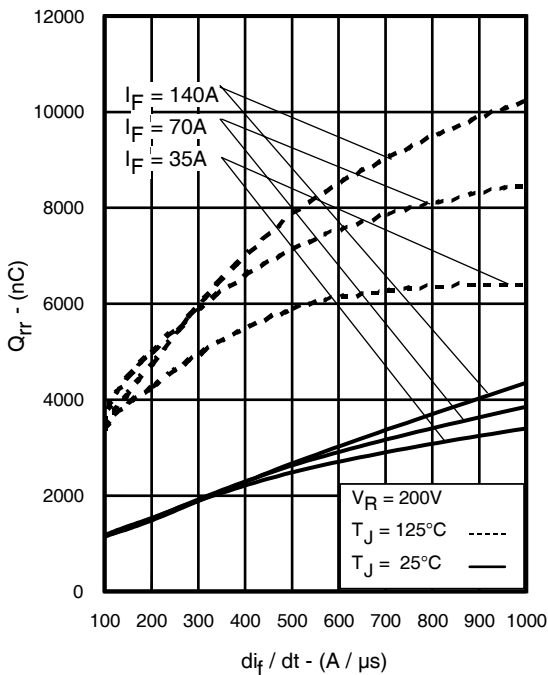


Fig. 16 - Typical Stored Charge vs.  $di_f/dt$

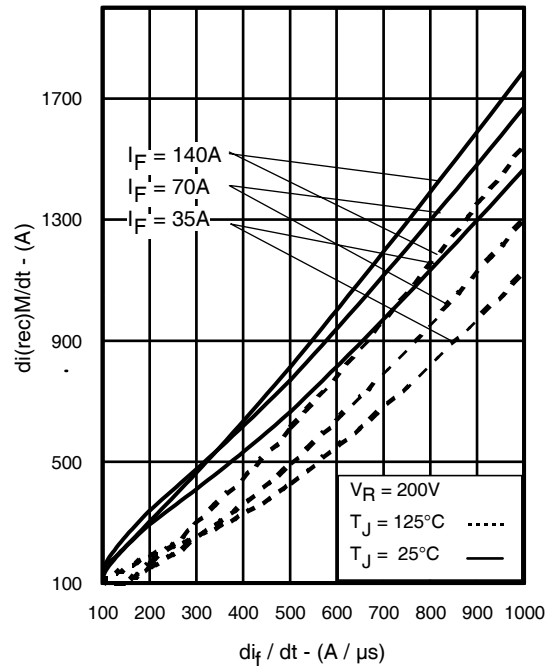
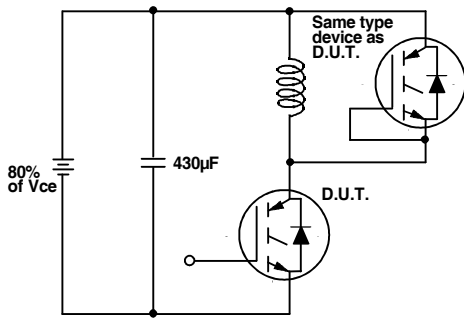
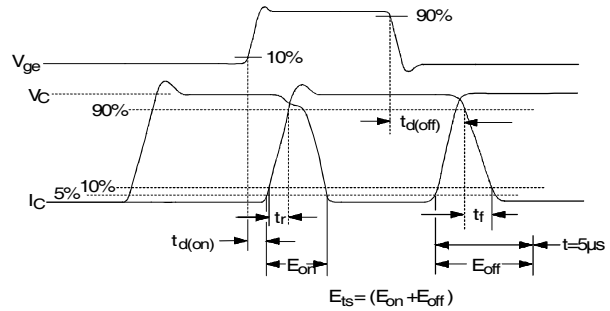


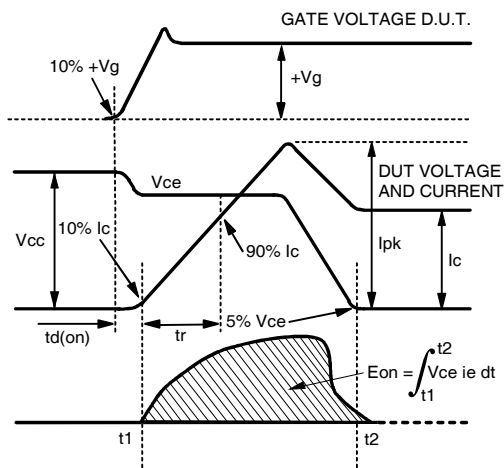
Fig. 17 - Typical  $di_{(rec)}M/dt$  vs.  $di_f/dt$



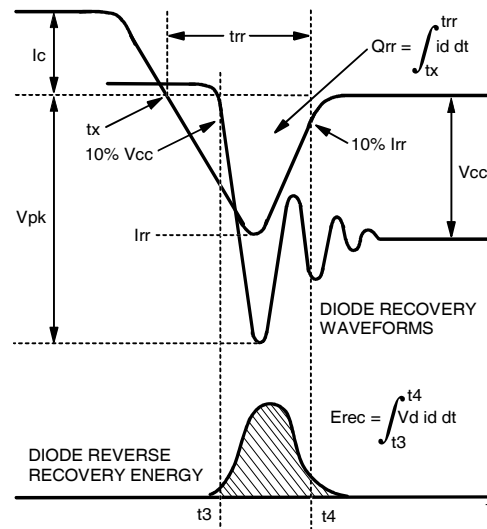
**Fig. 18a** - Test Circuit for Measurement of  $I_{LM}$ ,  $E_{on}$ ,  $E_{off}$ (diode),  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$ ,  $t_{d(on)}$ ,  $t_r$ ,  $t_{d(off)}$ ,  $t_f$



**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  $E_{rec}$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$



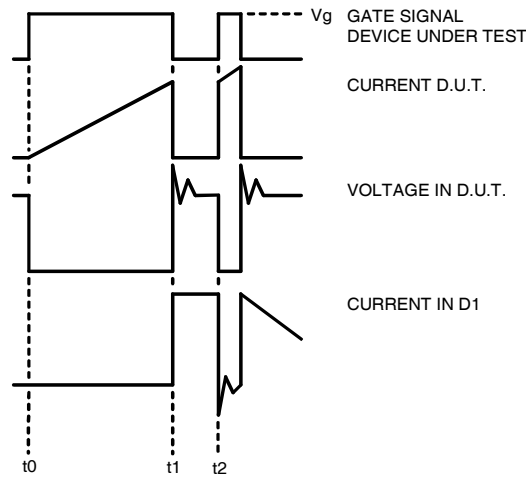


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

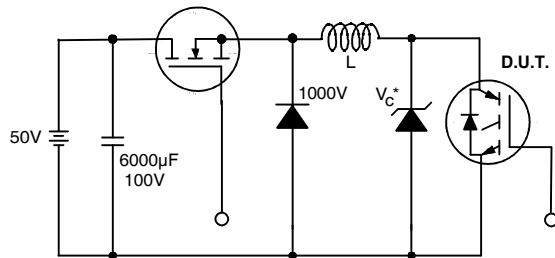


Figure 19. Clamped Inductive Load Test Circuit

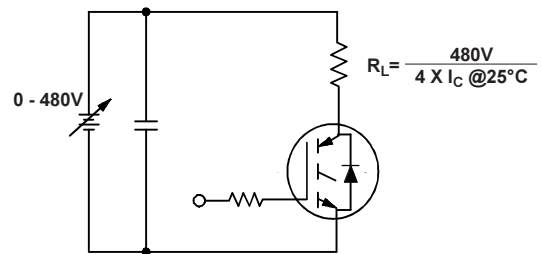
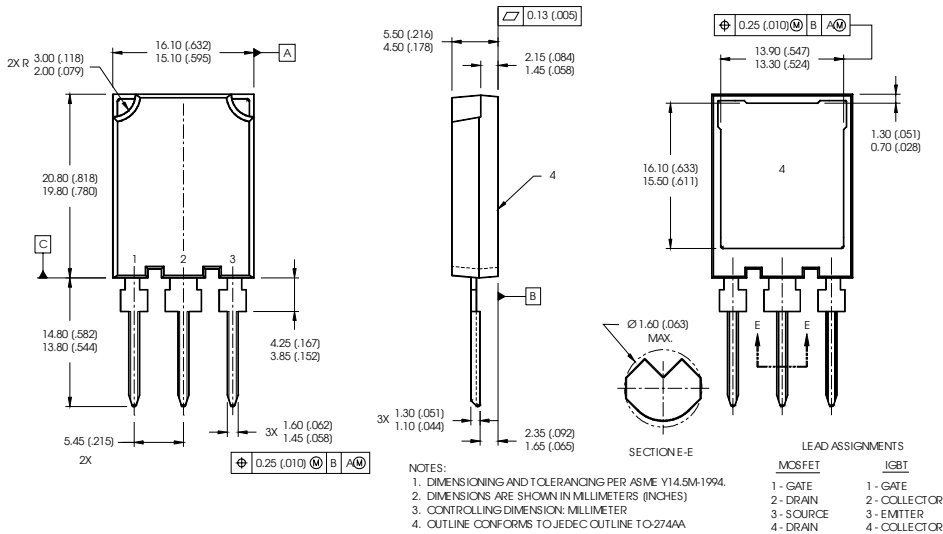


Figure 20. Pulsed Collector Current Test Circuit

# IRG4PSH71UD

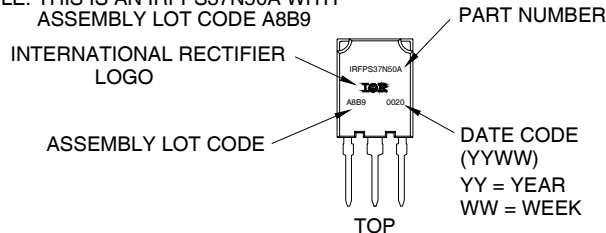
## Super-247™ (TO-274AA) Package Outline

International  
**IR** Rectifier



## Super-247™ (TO-274AA) Part Marking Information

EXAMPLE: THIS IS AN IRFPS37N50A WITH ASSEMBLY LOT CODE A8B9



**Super TO-247™ package is not recommended for Surface Mount Application.**

### Notes:

- ① Repetitive rating:  $V_{GE}=20V$ ; pulse width limited by maximum junction temperature (figure 20)
- ②  $V_{CC}=80\%(V_{CES})$ ,  $V_{GE}=20V$ ,  $L=10\mu H$ ,  $R_G=5.0\ \Omega$  (figure 13a)
- ③ Pulse width  $\leq 80\mu s$ ; duty factor  $\leq 0.1\%$ .
- ④ Pulse width  $5.0\mu s$ , single shot.
- ⑤ Repetitive rating; pulse width limited by maximum junction temperature.

Data and specifications subject to change without notice.  
 This product has been designed and qualified for the Consumer market.  
 Qualification Standards can be found on IR's Web site.

International  
**IR** 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](http://www.irf.com) for sales contact information.5/04

[www.irf.com](http://www.irf.com)