

IRG4IBC20UDPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH
ULTRAFAST SOFT RECOVERY DIODE

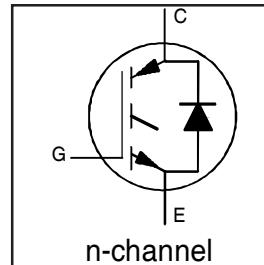
UltraFast CoPack IGBT

Features

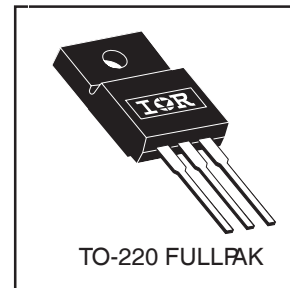
- 2.5kV, 60s insulation voltage ⑤
- 4.8 mm creepage distance to heatsink
- UltraFast: Optimized for high operating frequencies 8-40 kHz in hard switching, >200 kHz in resonant mode
- IGBT co-packaged with HEXFRED™ ultrafast, ultrasoft recovery antiparallel diodes
- Tighter parameter distribution
- Industry standard Isolated TO-220 Fullpak™ outline
- Lead-Free

Benefits

- Simplified assembly
- Highest efficiency and power density
- HEXFRED™ antiparallel Diode minimizes switching losses and EMI



$V_{CES} = 600V$
$V_{CE(on)} \text{ typ.} = 1.85V$
@ $V_{GE} = 15V, I_C = 6.5A$



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	11.4	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	6.0	
I_{CM}	Pulsed Collector Current ①	52	
I_{LM}	Clamped Inductive Load Current ②	52	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	6.5	
I_{FM}	Diode Maximum Forward Current	52	
V_{isol}	RMS Isolation Voltage, Terminal to Case⑤	2500	V
V_{GE}	Gate-to-Emitter Voltage	± 20	W
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	34	
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	14	$^\circ C$
T_J	Operating Junction and	-55 to +150	
T_{STG}	Storage Temperature Range		
	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	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT	—	3.7	$^\circ C/W$
$R_{\theta JC}$	Junction-to-Case - Diode	—	5.1	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	65	
Wt	Weight	2.0 (0.07)	—	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 ^③	600	—	—	V	$V_{GE} = 0V, I_C = 250\mu A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.69	—	V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 1.0mA$
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.85	2.1	V	$I_C = 6.5A, V_{GE} = 15V$
		—	2.27	—		$I_C = 13A$
		—	1.87	—		$I_C = 6.5A, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	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	—	-11	—	mV/ $^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 250\mu A$
g_{fe}	Forward Transconductance ^④	1.4	4.3	—	S	$V_{CE} = 100V, I_C = 6.5A$
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	μA	$V_{GE} = 0V, V_{CE} = 600V$
		—	—	1700		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$
V_{FM}	Diode Forward Voltage Drop	—	1.4	1.7	V	$I_C = 8.0A$
		—	1.3	1.6		$I_C = 8.0A, T_J = 150^\circ\text{C}$
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)	—	27	41	nC	$I_C = 6.5A$
Q_{ge}	Gate - Emitter Charge (turn-on)	—	4.5	6.8		$V_{CC} = 400V$
Q_{gc}	Gate - Collector Charge (turn-on)	—	10	16		$V_{GE} = 15V$
$t_{d(on)}$	Turn-On Delay Time	—	39	—	ns	$T_J = 25^\circ\text{C}$
t_r	Rise Time	—	15	—		$I_C = 6.5A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off Delay Time	—	93	140		$V_{GE} = 15V, R_G = 50\Omega$
t_f	Fall Time	—	110	170		Energy losses include "tail" and diode reverse recovery.
E_{on}	Turn-On Switching Loss	—	0.16	—	mJ	See Fig. 9, 10, 11, 18
E_{off}	Turn-Off Switching Loss	—	0.13	—		
E_{ts}	Total Switching Loss	—	0.29	0.3		
$t_{d(on)}$	Turn-On Delay Time	—	38	—	ns	$T_J = 150^\circ\text{C}$, See Fig. 9, 10, 11, 18
t_r	Rise Time	—	17	—		$I_C = 6.5A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off Delay Time	—	100	—		$V_{GE} = 15V, R_G = 50\Omega$
t_f	Fall Time	—	220	—		Energy losses include "tail" and diode reverse recovery.
E_{ts}	Total Switching Loss	—	0.49	—	mJ	
L_E	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package
C_{ies}	Input Capacitance	—	530	—	pF	$V_{GE} = 0V$
C_{oes}	Output Capacitance	—	39	—		$V_{CC} = 30V$
C_{res}	Reverse Transfer Capacitance	—	7.4	—		$f = 1.0MHz$
t_{rr}	Diode Reverse Recovery Time	—	37	55	ns	$T_J = 25^\circ\text{C}$ See Fig. 14
		—	55	90		$T_J = 125^\circ\text{C}$
I_{rr}	Diode Peak Reverse Recovery Current	—	3.5	5.0	A	$T_J = 25^\circ\text{C}$ See Fig. 15
		—	4.5	8.0		$T_J = 125^\circ\text{C}$
Q_{rr}	Diode Reverse Recovery Charge	—	65	138	nC	$T_J = 25^\circ\text{C}$ See Fig. 16
		—	124	360		$T_J = 125^\circ\text{C}$
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery During t_b	—	240	—	A/ μs	$T_J = 25^\circ\text{C}$ See Fig. 17
		—	210	—		$T_J = 125^\circ\text{C}$

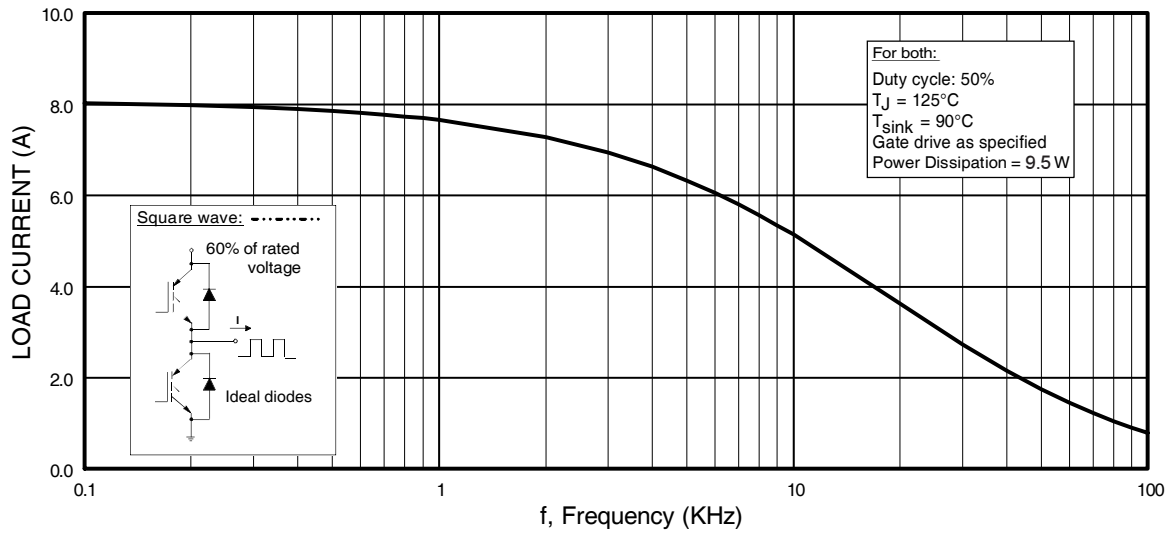


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

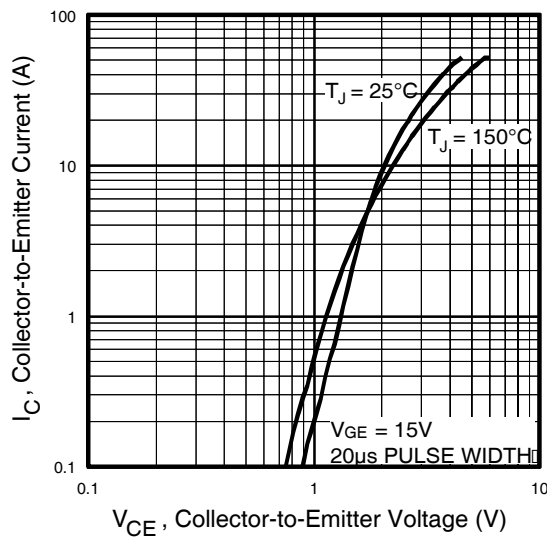


Fig. 2 - Typical Output Characteristics
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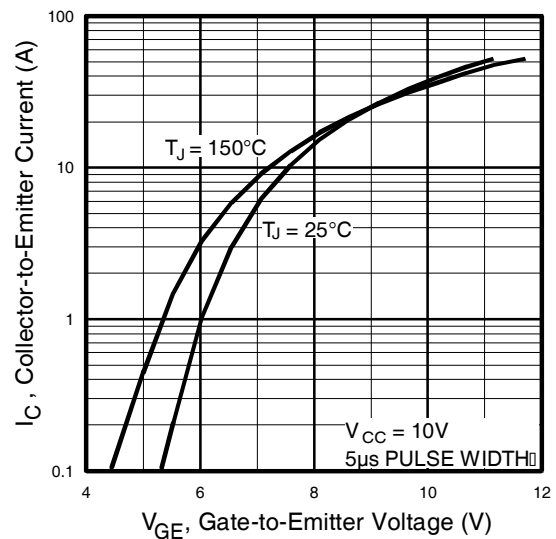


Fig. 3 - Typical Transfer Characteristics

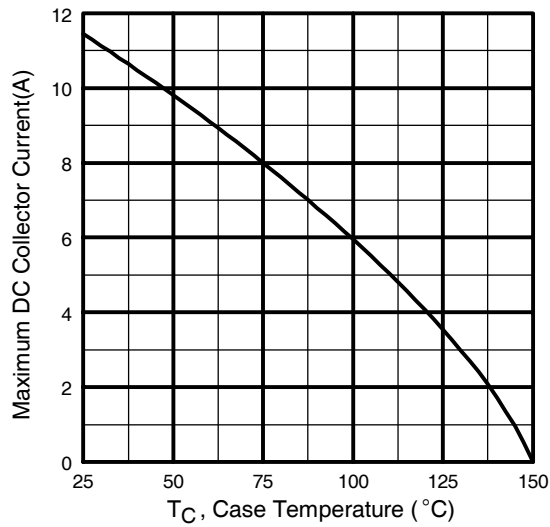


Fig. 4 - Maximum Collector Current vs. Case Temperature

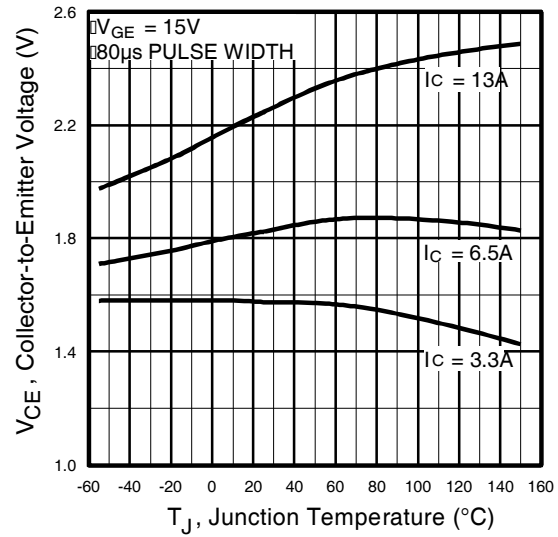


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

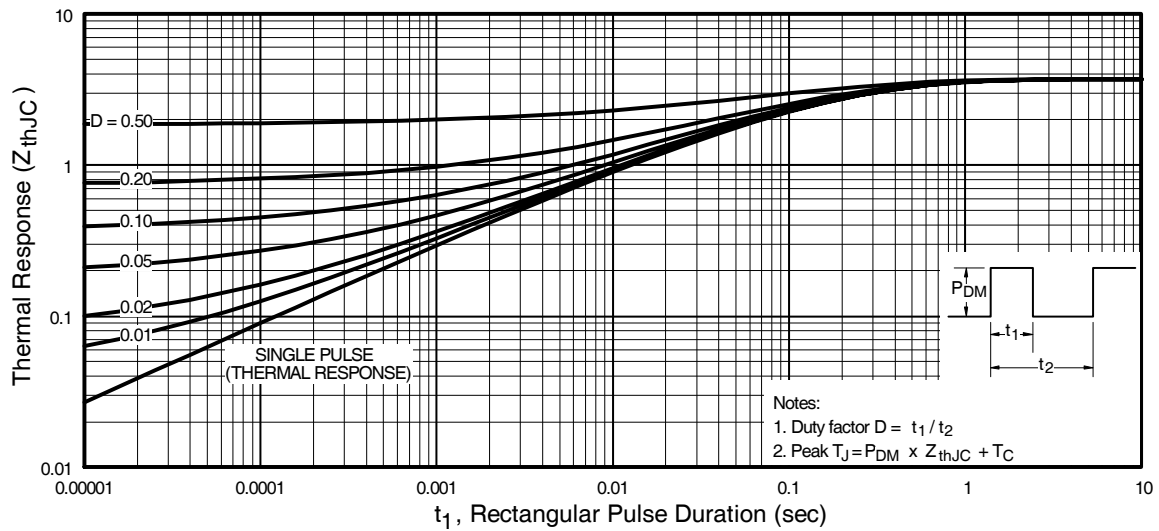


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

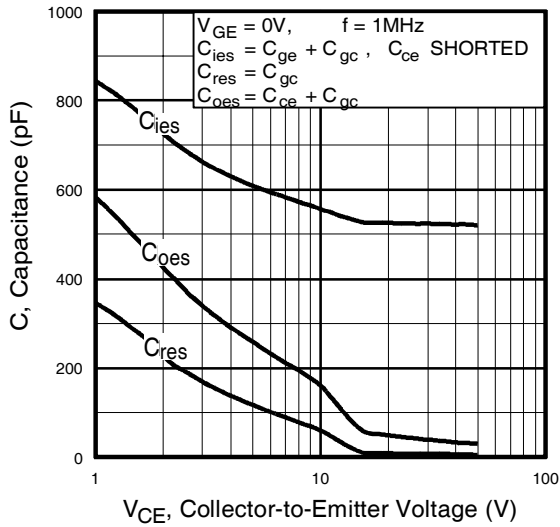


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

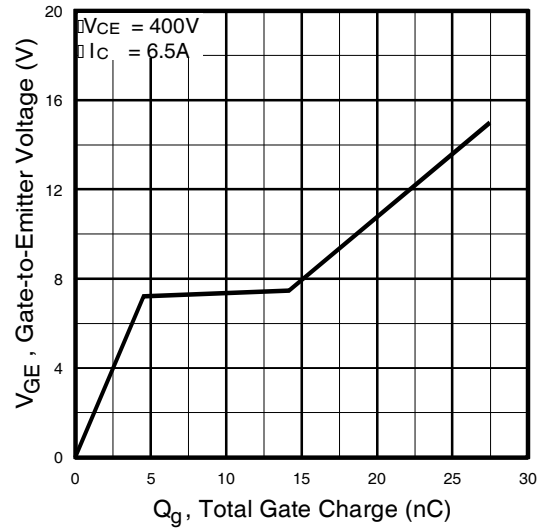


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

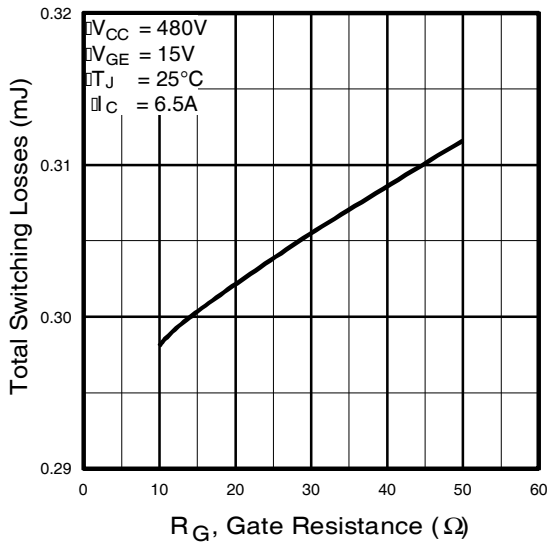


Fig. 9 - Typical Switching Losses vs. Gate Resistance

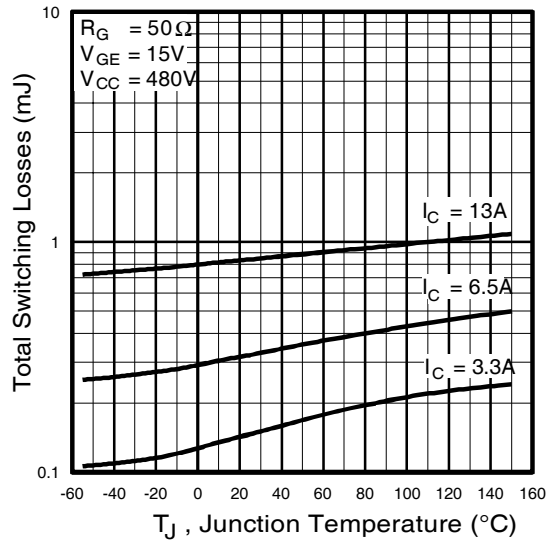
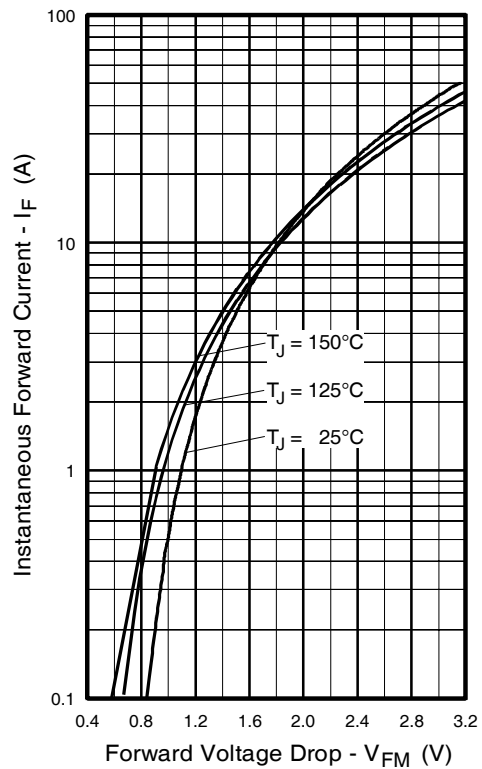
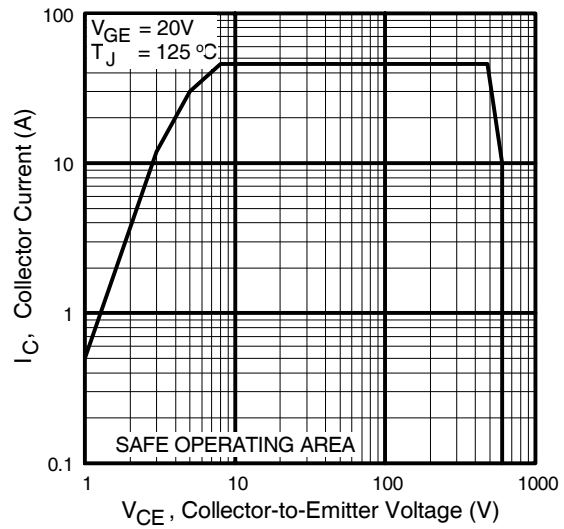
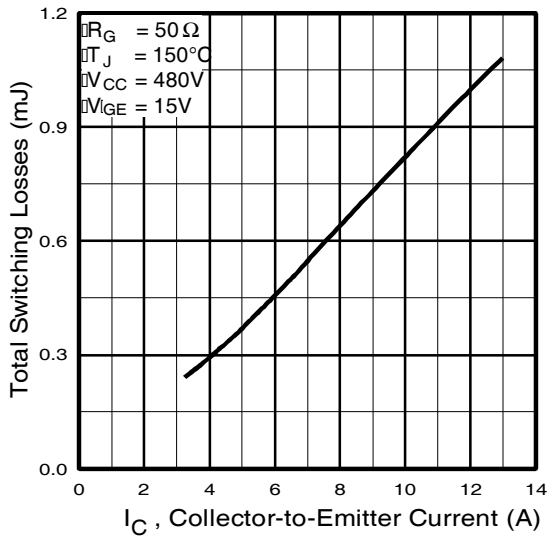


Fig. 10 - Typical Switching Losses vs. Junction Temperature

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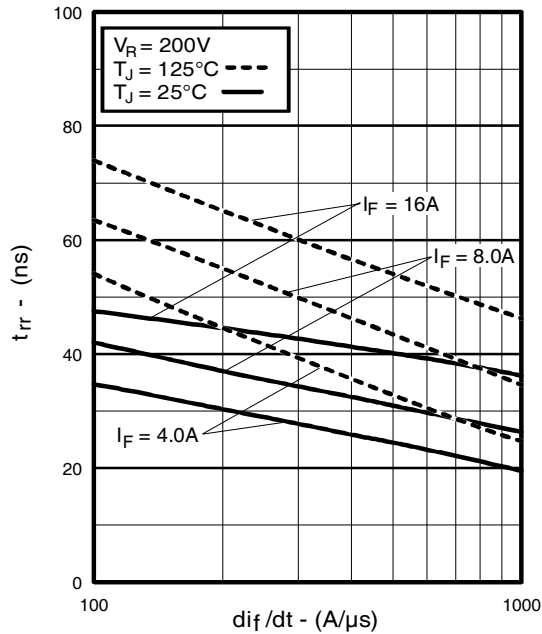


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

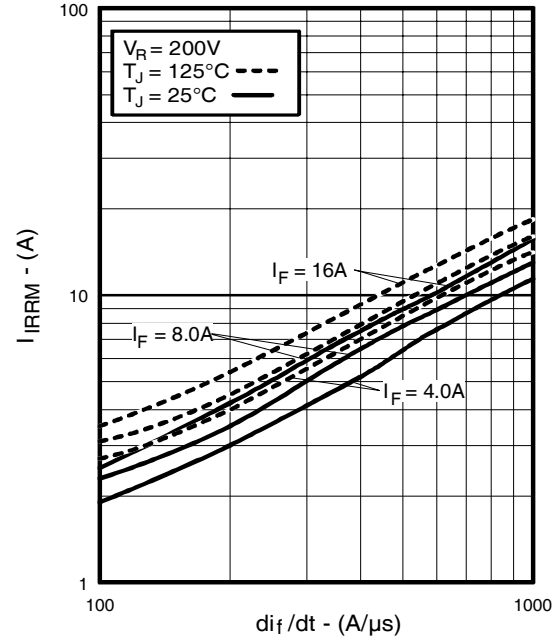


Fig. 15 - Typical Recovery Current vs. di_f/dt

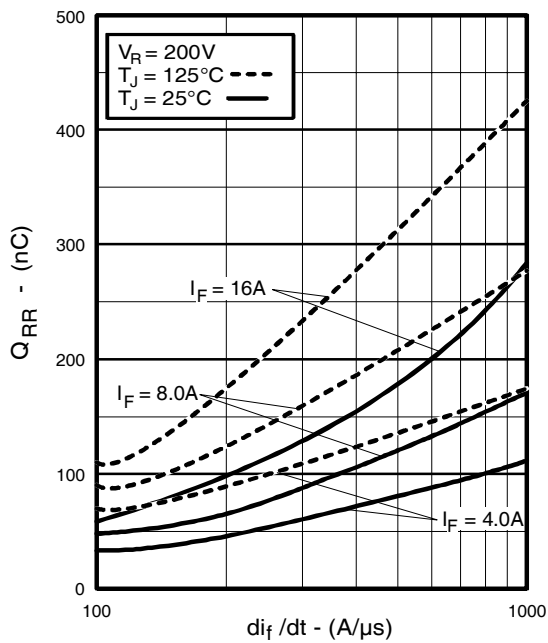


Fig. 16 - Typical Stored Charge vs. di_f/dt

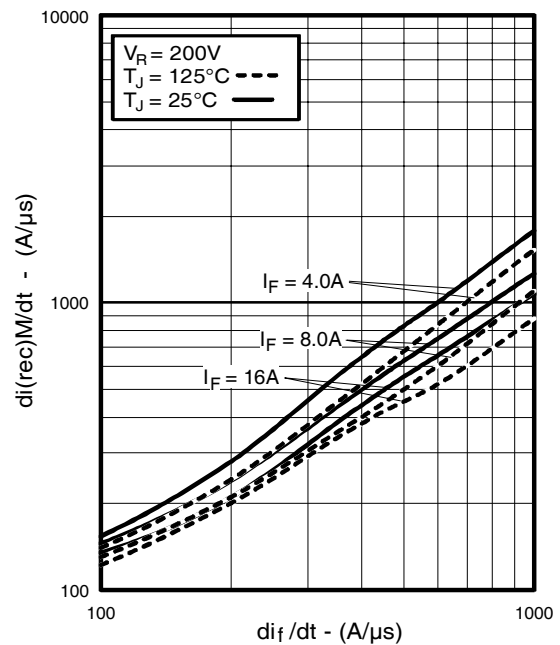


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

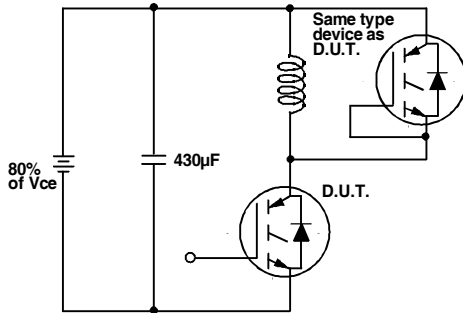


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

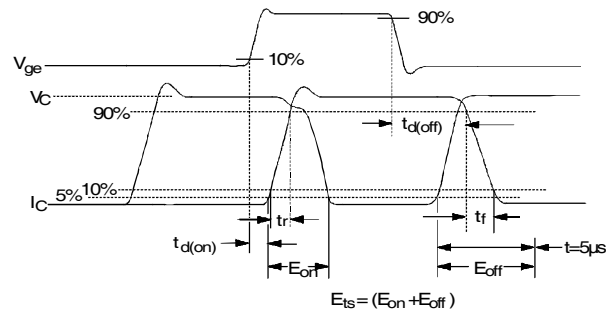


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_r

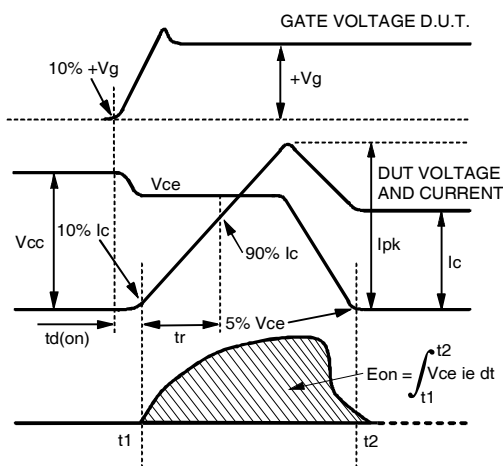


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

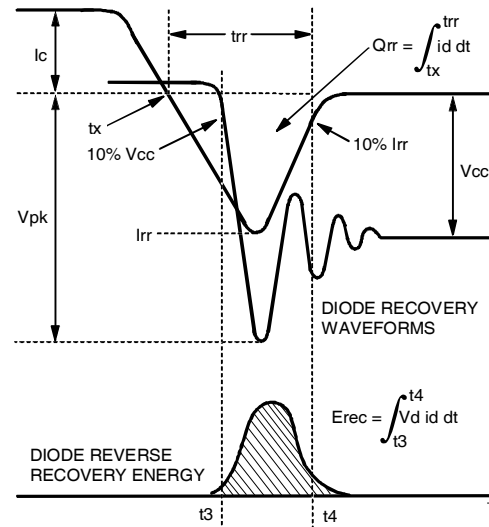


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

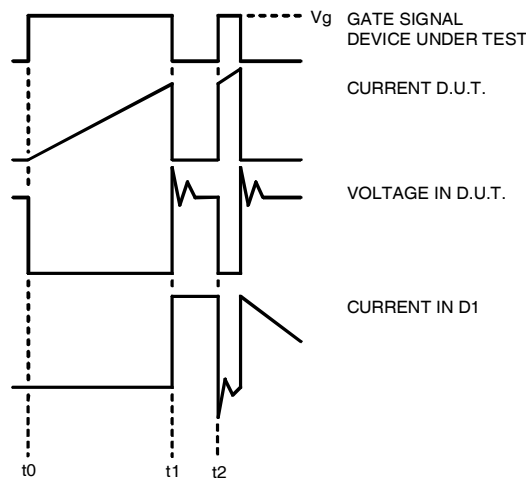


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

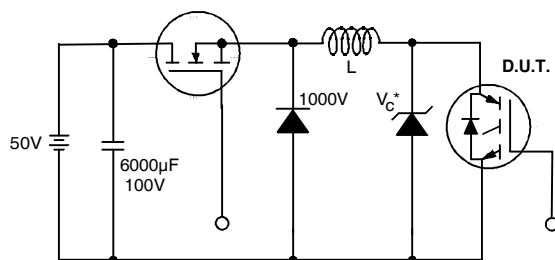


Figure 19. Clamped Inductive Load Test Circuit

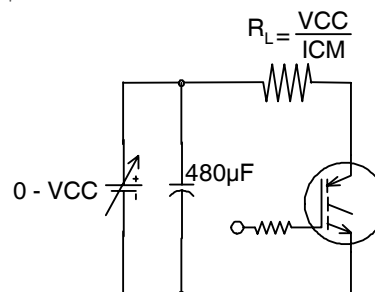


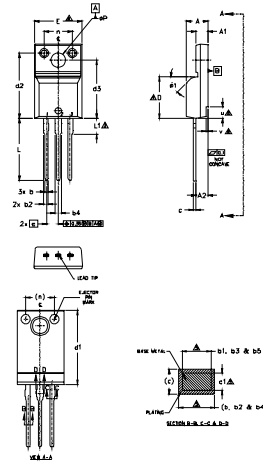
Figure 20. Pulsed Collector Current Test Circuit

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TO-220AB Full-Pak Package Outline

Dimensions are shown in millimeters (inches)

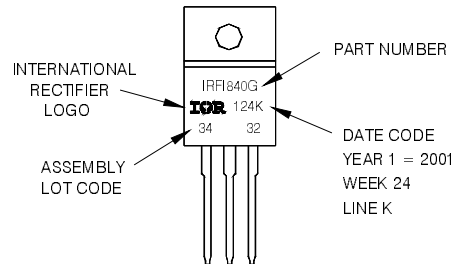


SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.57	4.83	.180	.190	NOTES: 1. DIMENSIONS AND TOLERANCES AS FOR JEDEC TRANSISTOR M-1894. 2. DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES). 3. LEAD DIMENSION AND PITCH UNCONTROLLED IN U.S. 4. DIMENSION D & E DO NOT INCLUDE WELD FLASH. WELD FLASH SHALL NOT EXCEED .200 (0.007) FOR SIZE. THESE DIMENSIONS ARE MEASURED AT THE OUTER MOST EXTREMES OF THE PLASTIC BODY. 5. DIMENSION D1, D2, D3 & D4 APPLY TO BRASS METAL ONLY. 6. STEP OPTIONAL ON PLASTIC BODY DEFINED BY DIMENSIONS 4 & 5. 7. CONTROLLING DIMENSION: INCHES.
A1	2.57	2.83	.101	.111	
A2	2.51	2.93	.099	.115	
b	0.61	0.94	.024	.037	
b1	0.61	0.89	.024	.035	
b2	0.76	1.27	.030	.050	
b3	0.76	1.22	.030	.048	
b4	1.02	1.52	.040	.060	
b5	1.02	1.47	.040	.058	
c	0.33	0.63	.013	.025	
c1	0.33	0.58	.013	.023	LEAD ASSIGNMENTS 1- GATE 2- COLLECTOR 3- SOURCE
D	8.66	9.80	.341	.386	
d1	15.80	16.13	.622	.635	
d2	13.97	14.22	.550	.560	
d3	12.30	12.93	.484	.509	DETAIL CHECK 1- GATE 2- COLLECTOR 3- EMITTER
d4	9.63	10.75	.379	.423	
e	2.54	BSC	.100	BSC	
L	13.20	13.72	.520	.540	
L1	3.37	3.67	.122	.145	3
n	6.05	6.60	.238	.260	
gP	3.05	3.45	.120	.136	
u	2.40	2.50	.094	.098	
v	0.40	0.50	.016	.020	6
ø1	-	45°	-	45°	

TO-220AB Full-Pak Part Marking Information

EXAMPLE: THIS IS AN IRF840G
WITH ASSEMBLY
LOT CODE 3432
ASSEMBLED ON WW 24, 2001
IN THE ASSEMBLY LINE 'K'

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



TO-220AB Full-Pak 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 $V_{CC}=80\%(V_{CES})$, $V_{GE}=20V$, $L=10\mu H$, $R_G = 50\Omega$ (figure 19)
- ③ Pulse width $\leq 80\mu s$; duty factor $\leq 0.1\%$.
- ④ Pulse width $5.0\mu s$, single shot.
- ⑤ $t = 60s$, $f = 60Hz$

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

Data and specifications subject to change without notice.

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