

IRG4IBC30UDPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH
ULTRAFAST SOFT RECOVERY DIODE

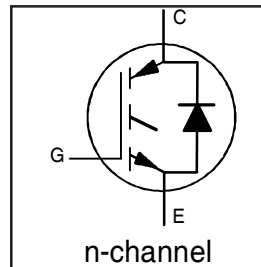
UltraFast CoPack IGBT

Features

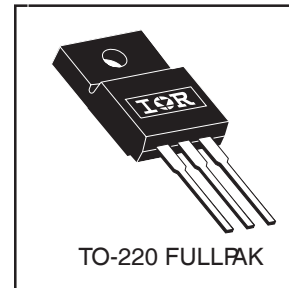
- 2.5kV, 60s insulation voltage ⑤
- 4.8 mm creepage distance to heatsink
- UltraFast: Optimized for high operating frequencies 8-40 kHz in hard switching, >200 kHz in resonant mode
- IGBT co-packaged with HEXFRED™ ultrafast, ultrasoft recovery antiparallel diodes
- Tighter parameter distribution
- Industry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

Benefits

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



$V_{CES} = 600V$
$V_{CE(on)} \text{ typ.} = 1.95V$
@ $V_{GE} = 15V, I_C = 12A$



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	17	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	8.9	
I_{CM}	Pulsed Collector Current ①	68	
I_{LM}	Clamped Inductive Load Current ②	68	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	8.5	
I_{FM}	Diode Maximum Forward Current	92	
V_{isol}	RMS Isolation Voltage, Terminal to Case⑤	2500	V
V_{GE}	Gate-to-Emitter Voltage	± 20	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	45	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	18	
T_J	Operating Junction and	-55 to +150	$^\circ C$
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	—	2.8	$^\circ C/W$
$R_{\theta JC}$	Junction-to-Case - Diode	—	4.1	
$R_{\theta JA}$	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 ^f	600	—	—	V	$V_{GE} = 0V, I_C = 250\mu A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.63	—	V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 1.0mA$
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.95	2.1	V	$I_C = 12A, V_{GE} = 15V$ $I_C = 23A$ $I_C = 12A, T_J = 150^\circ\text{C}$ See Fig. 2, 5
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0	V	$V_{CE} = V_{GE}, I_C = 250\mu A$
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	—	-11	—	mV/ $^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 250\mu A$
g_{fe}	Forward Transconductance [Ⓢ]	3.1	8.6	—	S	$V_{CE} = 100V, I_C = 12A$
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	μA	$V_{GE} = 0V, V_{CE} = 600V$ $V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$
V_{FM}	Diode Forward Voltage Drop	—	1.4	1.7	V	$I_C = 12A$ $I_C = 12A, T_J = 150^\circ\text{C}$ See Fig. 13
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)	—	50	75	nC	$I_C = 12A$ $V_{CC} = 400V$ $V_{GE} = 15V$ See Fig. 8
Q_{ge}	Gate - Emitter Charge (turn-on)	—	8.1	12	nC	
Q_{gc}	Gate - Collector Charge (turn-on)	—	18	27	nC	
$t_{d(on)}$	Turn-On Delay Time	—	40	—	ns	$T_J = 25^\circ\text{C}$ $I_C = 12A, V_{CC} = 480V$ $V_{GE} = 15V, R_G = 23\Omega$ Energy losses include "tail" and diode reverse recovery. See Fig. 9, 10, 11, 18
t_r	Rise Time	—	21	—	ns	
$t_{d(off)}$	Turn-Off Delay Time	—	91	140	ns	
t_f	Fall Time	—	80	130	ns	
E_{on}	Turn-On Switching Loss	—	0.38	—	mJ	
E_{off}	Turn-Off Switching Loss	—	0.16	—	mJ	
E_{ts}	Total Switching Loss	—	0.54	0.9	mJ	
$t_{d(on)}$	Turn-On Delay Time	—	40	—	ns	$T_J = 150^\circ\text{C}$, See Fig. 9, 10, 11, 18 $I_C = 12A, V_{CC} = 480V$ $V_{GE} = 15V, R_G = 23\Omega$ Energy losses include "tail" and diode reverse recovery.
t_r	Rise Time	—	22	—	ns	
$t_{d(off)}$	Turn-Off Delay Time	—	120	—	ns	
t_f	Fall Time	—	180	—	ns	
E_{ts}	Total Switching Loss	—	0.89	—	mJ	
L_E	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package
C_{ies}	Input Capacitance	—	1100	—	pF	$V_{GE} = 0V$ $V_{CC} = 30V$ $f = 1.0MHz$ See Fig. 7
C_{oes}	Output Capacitance	—	73	—	pF	
C_{res}	Reverse Transfer Capacitance	—	14	—	pF	
t_{rr}	Diode Reverse Recovery Time	—	42	60	ns	$T_J = 25^\circ\text{C}$ See Fig. 14 $T_J = 125^\circ\text{C}$ 15
I_{rr}	Diode Peak Reverse Recovery Current	—	3.5	6.0	A	$T_J = 25^\circ\text{C}$ See Fig. 15 $T_J = 125^\circ\text{C}$ 16
Q_{rr}	Diode Reverse Recovery Charge	—	80	180	nC	$T_J = 25^\circ\text{C}$ See Fig. 16 $T_J = 125^\circ\text{C}$ 17
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery During t_b	—	180	—	A/ μs	$T_J = 25^\circ\text{C}$ See Fig. 17 $T_J = 125^\circ\text{C}$

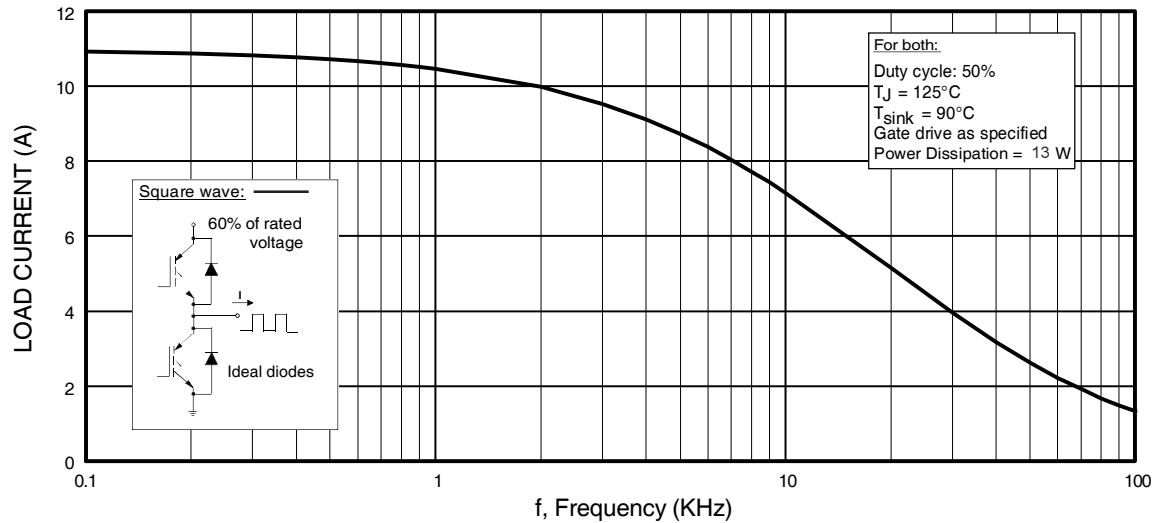


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

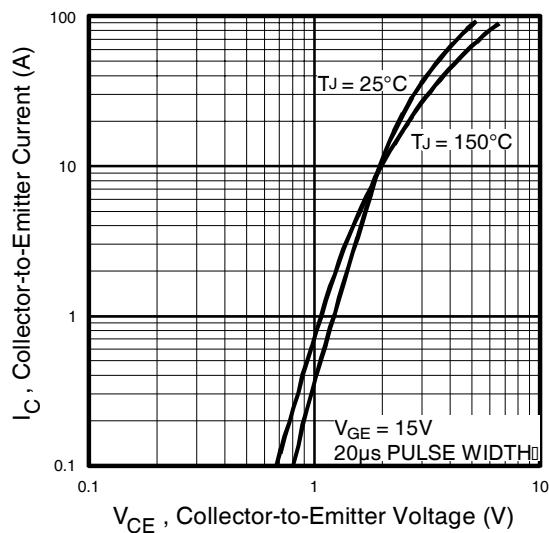


Fig. 2 - Typical Output Characteristics
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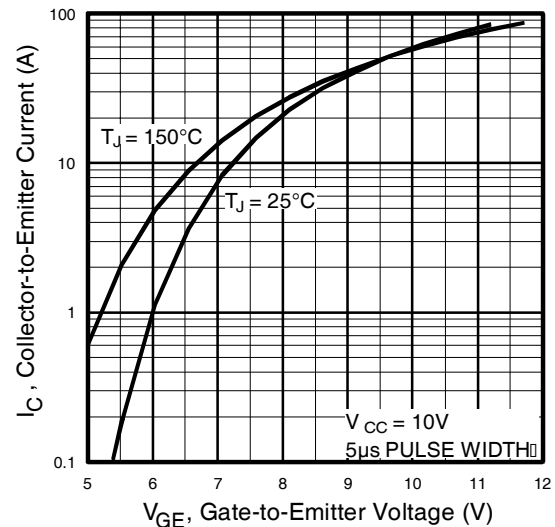


Fig. 3 - Typical Transfer Characteristics

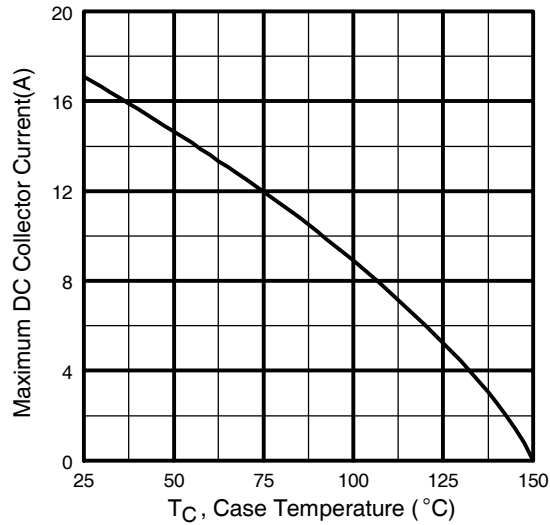


Fig. 4 - Maximum Collector Current vs. Case Temperature

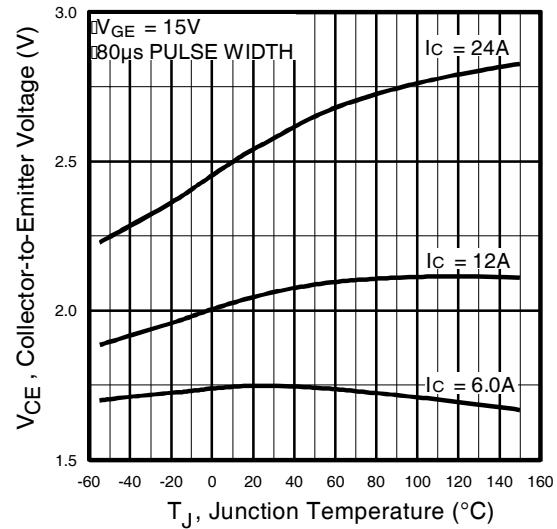


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

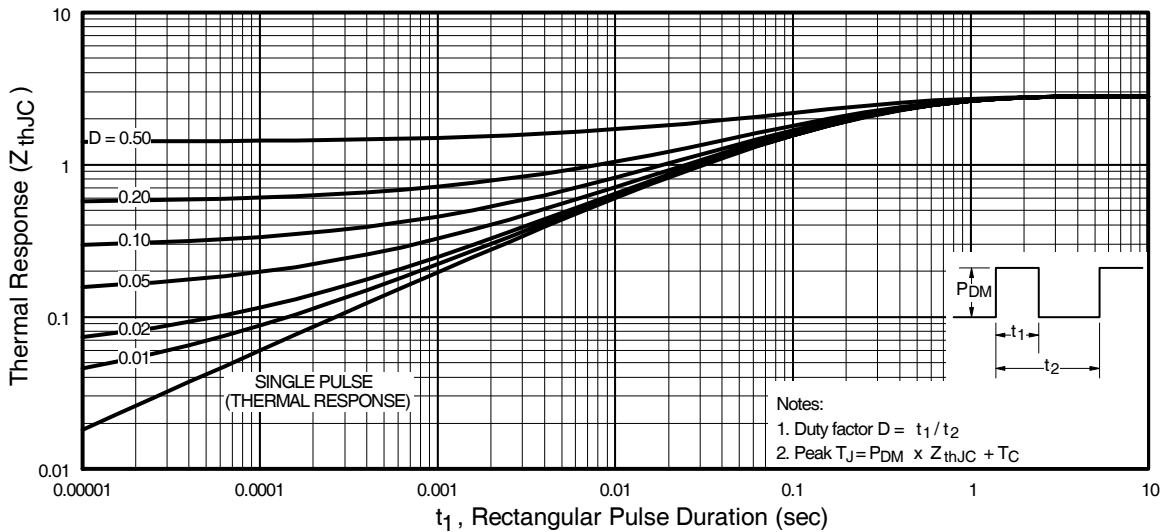


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

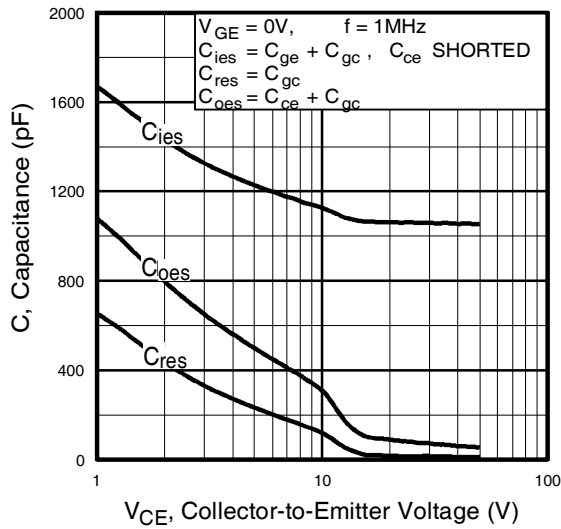


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

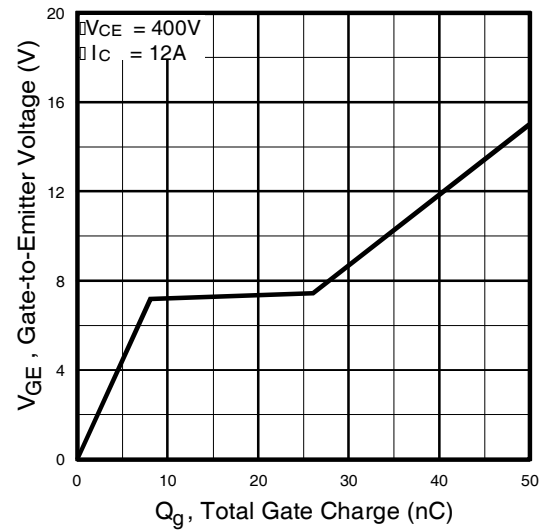


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

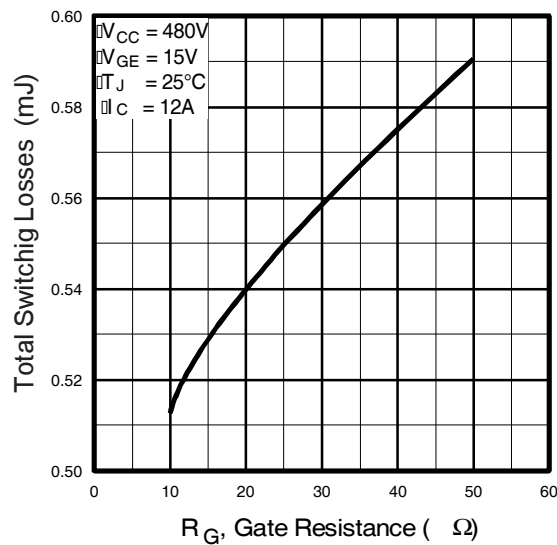


Fig. 9 - Typical Switching Losses vs. Gate Resistance

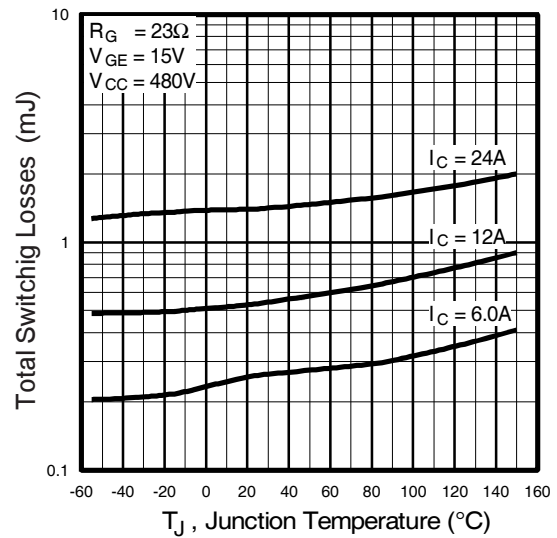
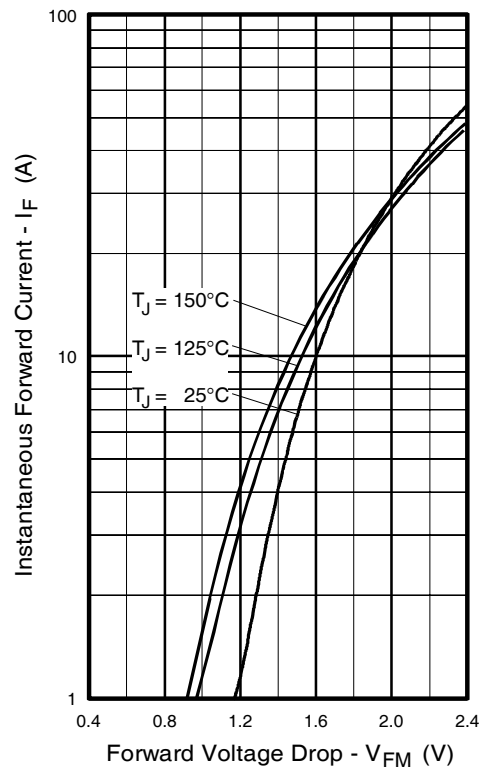
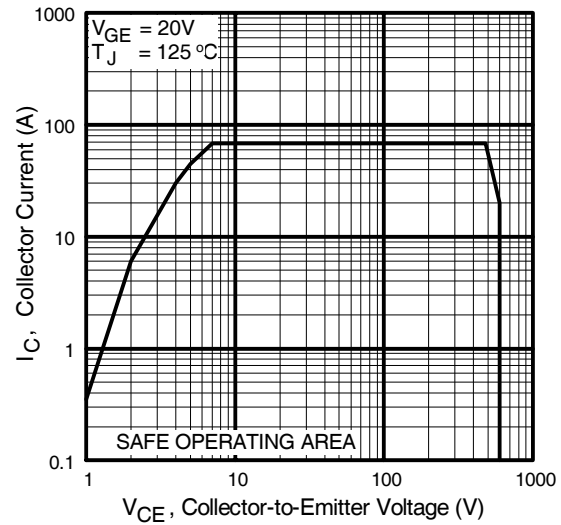
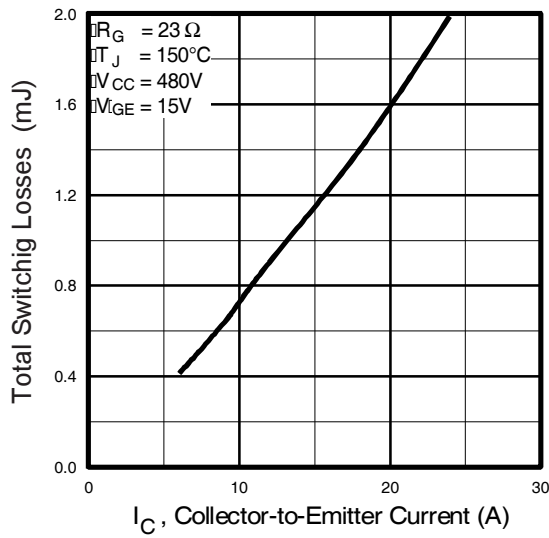


Fig. 10 - Typical Switching Losses vs. Junction Temperature

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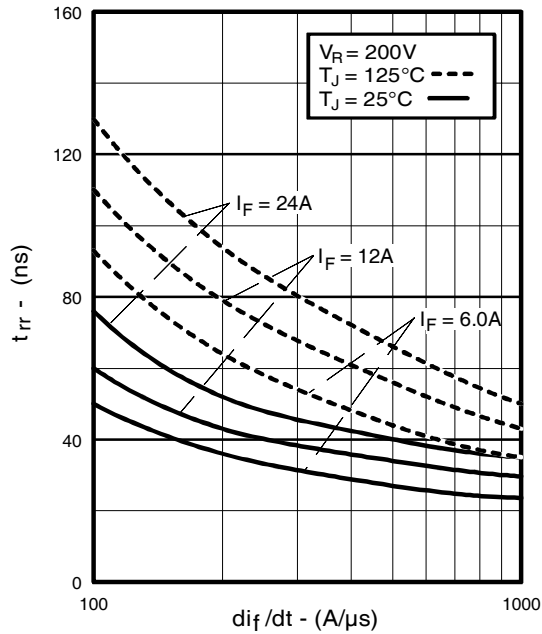


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

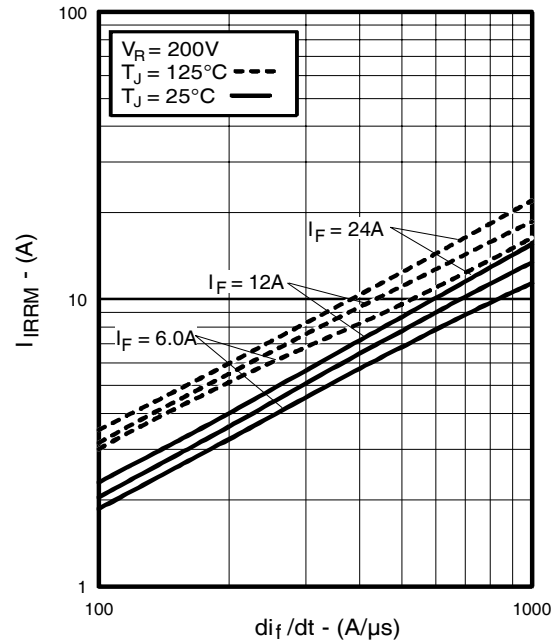


Fig. 15 - Typical Recovery Current vs. di_f/dt

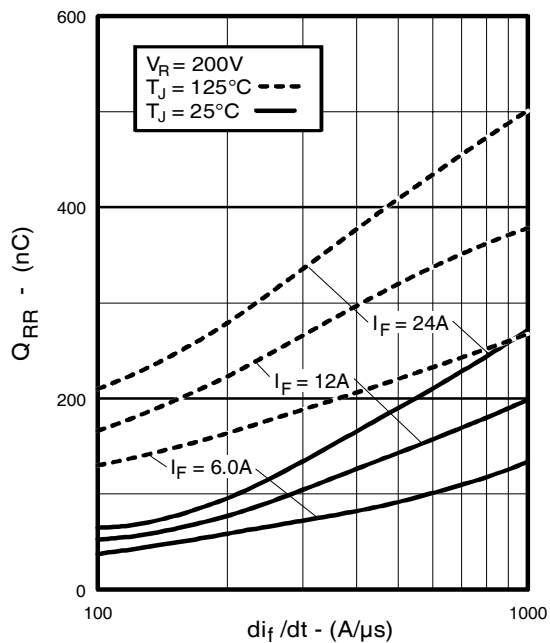


Fig. 16 - Typical Stored Charge vs. di_f/dt

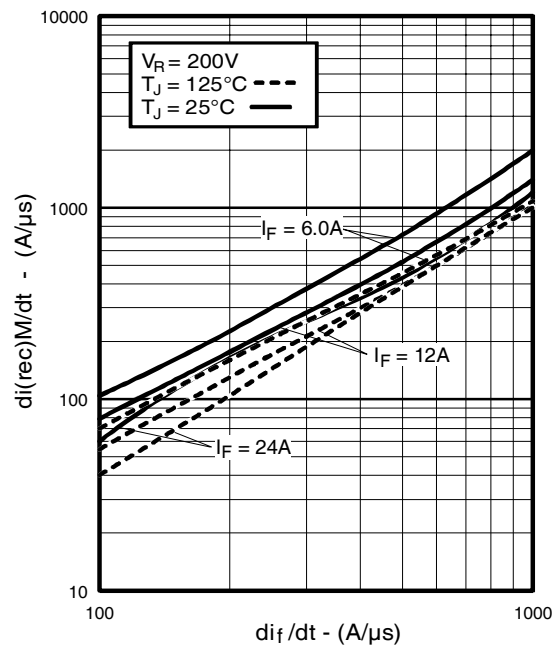


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

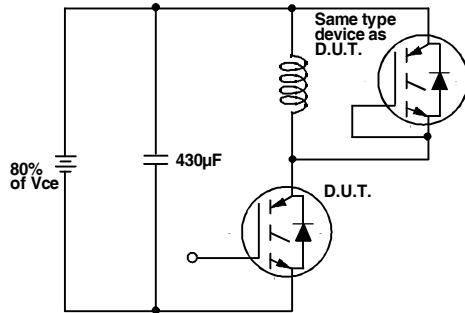


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

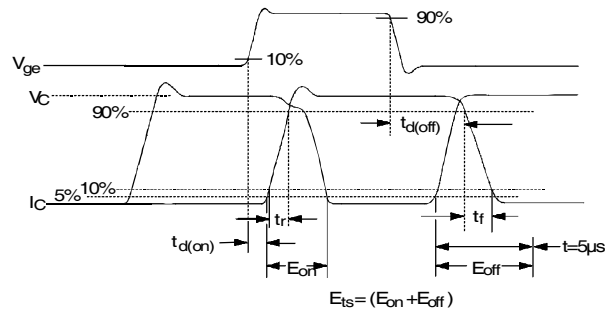


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

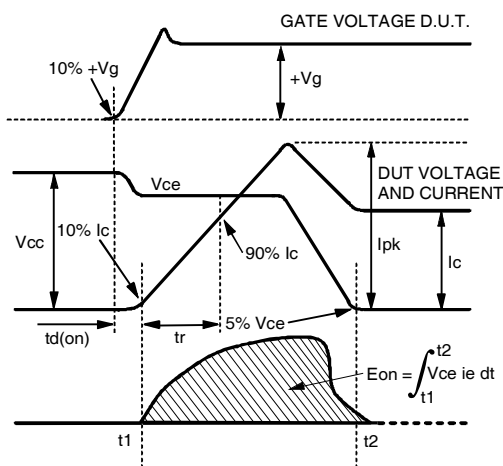


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

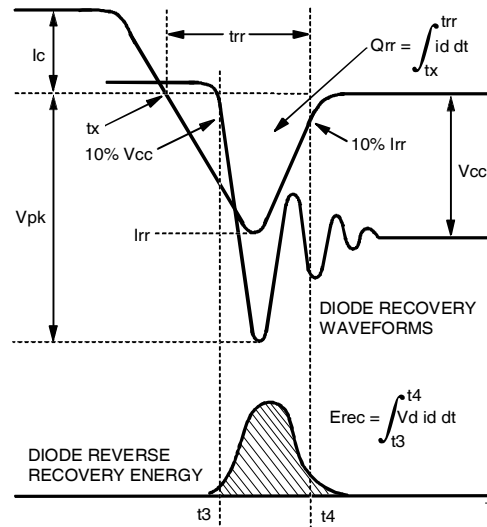


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

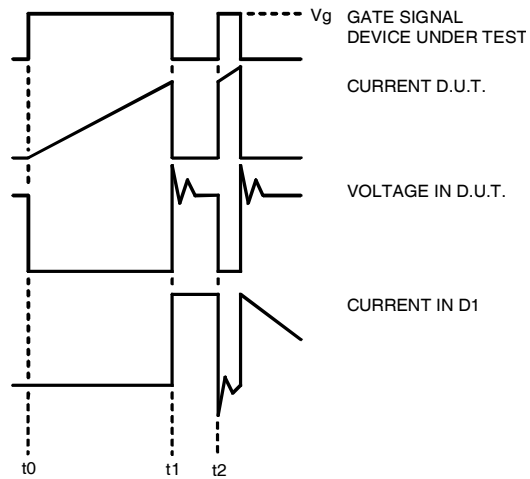


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

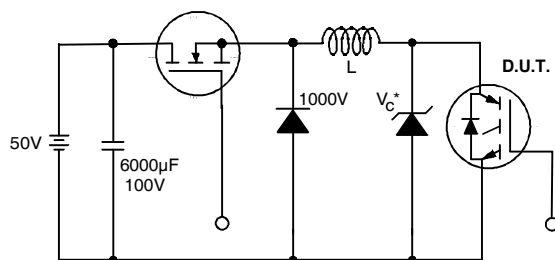


Figure 19. Clamped Inductive Load Test Circuit

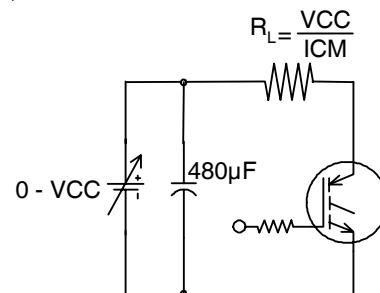


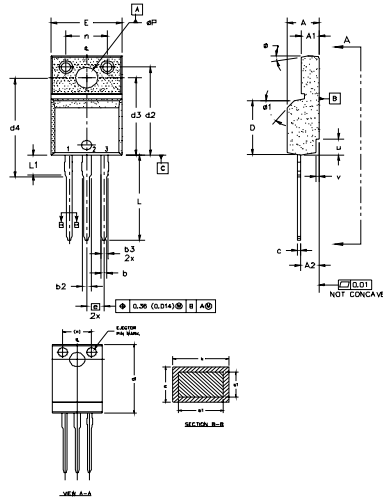
Figure 20. Pulsed Collector Current Test Circuit

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TO-220AB Full-Pak Package Outline

Dimensions are shown in millimeters (inches)

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NOTES:
1.0 DIMENSIONING AND TOLERANCING PER ASME Y14.5 M-1994.
2.0 DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
3.0 LEAD DIMENSION AND FINISH UNCONTROLLED ALL L.
4.0 DIMENSION D & E DO NOT INCLUDE MOLD FLASH; MOLD FLASH SHALL NOT EXCEED 0.025" (0.027) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
5.0 DIMENSION D1 APPLIES TO BASE METAL ONLY.
6.0 STEP OPTIONAL ON PLASTIC BODY DEFINED BY DIMENSIONS u & v.
7.0 CONTROLLING DIMENSION - INCHES.

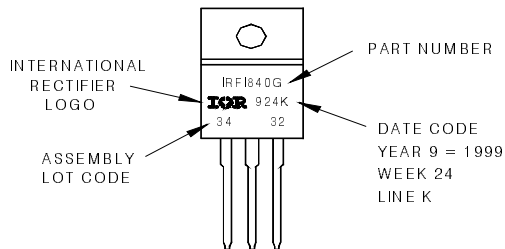
SYMBOL	DIMENSIONS				NOTES	LEAD ASSIGNMENT
	MILLIMETERS		INCHES			
	MIN.	MAX.	MIN.	MAX.		
A	4.37	4.83	0.180	0.190		
A1	2.57	2.85	0.102	0.114		
A2	2.51	2.85	0.099	0.112		HERE!
b	0.622	0.88	0.024	0.035		1 - DATE
b1	0.622	0.888	0.024	0.035	5	2 - DRAWN
b2	1.229	1.400	0.048	0.055		4 - SOURCE
b3	1.229	1.400	0.048	0.055		
c	0.640	0.629	0.025	0.025		DATE
c1	0.640	0.584	0.025	0.023		1 - DATE
D	8.65	9.80	0.341	0.386	4	2 - COLLECT
d1	13.80	14.12	0.543	0.555		
d2	13.97	14.22	0.550	0.560		
d3	12.30	12.97	0.484	0.509		
d4	8.64	9.81	0.340	0.390		
E	10.36	10.63	0.408	0.419	4	
e	2.54 BSC		0.100 BSC			
L	13.20	13.13	0.520	0.541		
L1	3.10	3.50	0.122	0.138	3	
n	6.05	6.15	0.238	0.242		
n1	3.05	3.40	0.120	0.136		
u	2.40	2.50	0.094	0.098	6	
v	0.40	0.50	0.016	0.020	6	
u1	2"	4"	2"	4"		
u1	2"	4"	2"	4"		

LEAD ASSIGNMENTS
1- GATE
2- DRAIN
3- SOURCE
IRF1840G
1- GATE
2- COLLECTOR
3- EMITTER

TO-220 Full-Pak Part Marking Information

EXAMPLE: THIS IS AN IRF1840G
WITH ASSEMBLY
LOT CODE 3432
ASSEMBLED ON WW 24 1999
IN THE ASSEMBLY LINE 'K'

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



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

Notes:

- ① Repetitive rating: $V_{GE}=20V$; pulse width limited by maximum junction temperature (figure 20)
- ② $V_{CC}=80\%(V_{CES})$, $V_{GE}=20V$, $L=10\mu H$, $R_G=23\Omega$ (figure 19)
- ③ Pulse width $\leq 80\mu s$; duty factor $\leq 0.1\%$.
- ④ Pulse width $5.0\mu s$, single shot.
- ⑤ $t = 60s$, $f = 60Hz$

Data and specifications subject to change without notice.

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