

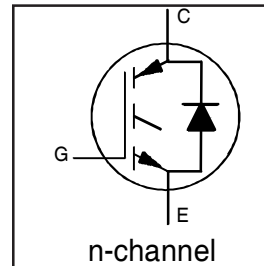
IRG4BC30UDPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH
ULTRAFAST SOFT RECOVERY DIODE

UltraFast CoPack IGBT

Features

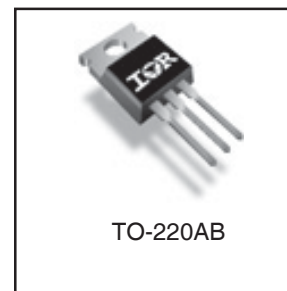
- UltraFast: Optimized for high operating frequencies 8-40 kHz in hard switching, >200 kHz in resonant mode
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency than Generation 3
- IGBT co-packaged with HEXFRED™ ultrafast, ultra-soft-recovery anti-parallel diodes for use in bridge configurations
- Industry standard TO-220AB package
- Lead-Free



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

Benefits

- Generation -4 IGBT's offer highest efficiencies available
- IGBTs optimized for specific application conditions
- HEXFRED diodes optimized for performance with IGBTs . Minimized recovery characteristics require less/no snubbing
- Designed to be a "drop-in" replacement for equivalent industry-standard Generation 3 IR IGBTs



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	23	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	12	
I_{CM}	Pulsed Collector Current ①	92	
I_{LM}	Clamped Inductive Load Current ②	92	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	12	
I_{FM}	Diode Maximum Forward Current	92	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	100	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	42	
T_J	Operating Junction and	-55 to +150	$^\circ C$
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 sec.		
	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	-----	-----	1.2	$^\circ C/W$
$R_{\theta JC}$	Junction-to-Case - Diode	-----	-----	2.5	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	-----	0.50	-----	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	-----	-----	80	
Wt	Weight	-----	2 (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	----	0.63	----	V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 1.0mA$
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	----	1.95	2.1	V	$I_C = 12A$
		----	2.52	----		$I_C = 23A$
		----	2.09	----		$I_C = 12A, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	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	3.1	8.6	----	S	$V_{CE} = 100V, I_C = 12A$
I_{CES}	Zero Gate Voltage Collector Current	----	----	250	μA	$V_{GE} = 0V, V_{CE} = 600V$
		----	----	2500		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$
V_{FM}	Diode Forward Voltage Drop	----	1.4	1.7	V	$I_C = 12A$
		----	1.3	1.6		$I_C = 12A, T_J = 150^\circ\text{C}$
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)	----	50	75		$I_C = 12A$
Q_{ge}	Gate - Emitter Charge (turn-on)	----	8.1	12	nC	$V_{CC} = 400V$ See Fig. 8
Q_{gc}	Gate - Collector Charge (turn-on)	----	18	27		$V_{GE} = 15V$
$t_{d(on)}$	Turn-On Delay Time	----	40	----		$T_J = 25^\circ\text{C}$
t_r	Rise Time	----	21	----	ns	$I_C = 12A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off Delay Time	----	91	140		$V_{GE} = 15V, R_G = 23\Omega$
t_f	Fall Time	----	80	130		Energy losses include "tail" and diode reverse recovery.
E_{on}	Turn-On Switching Loss	----	0.38	----	mJ	See Fig. 9, 10, 11, 18
E_{off}	Turn-Off Switching Loss	----	0.16	----		
E_{ts}	Total Switching Loss	----	0.54	0.9		
$t_{d(on)}$	Turn-On Delay Time	----	40	----	ns	$T_J = 150^\circ\text{C}$, See Fig. 9, 10, 11, 18
t_r	Rise Time	----	22	----		$I_C = 12A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off Delay Time	----	120	----		$V_{GE} = 15V, R_G = 23\Omega$
t_f	Fall Time	----	180	----	mJ	Energy losses include "tail" and diode reverse recovery.
E_{ts}	Total Switching Loss	----	0.89	----		
L_E	Internal Emitter Inductance	----	7.5	----	nH	Measured 5mm from package
C_{ies}	Input Capacitance	----	1100	----	pF	$V_{GE} = 0V$
C_{oes}	Output Capacitance	----	73	----		$V_{CC} = 30V$ See Fig. 7
C_{res}	Reverse Transfer Capacitance	----	14	----		$f = 1.0MHz$
t_{rr}	Diode Reverse Recovery Time	----	42	60	ns	$T_J = 25^\circ\text{C}$ See Fig.
I_{rr}	Diode Peak Reverse Recovery Current	----	80	120		$T_J = 125^\circ\text{C}$ 14
		----	3.5	6.0		$T_J = 25^\circ\text{C}$ See Fig.
Q_{rr}	Diode Reverse Recovery Charge	----	5.6	10	nC	$T_J = 125^\circ\text{C}$ 15
		----	80	180		$T_J = 25^\circ\text{C}$ See Fig.
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery During t_b	----	220	600	A/ μs	$T_J = 125^\circ\text{C}$ 16
		----	180	----		$T_J = 25^\circ\text{C}$ See Fig.
		----	120	----		$T_J = 125^\circ\text{C}$ 17

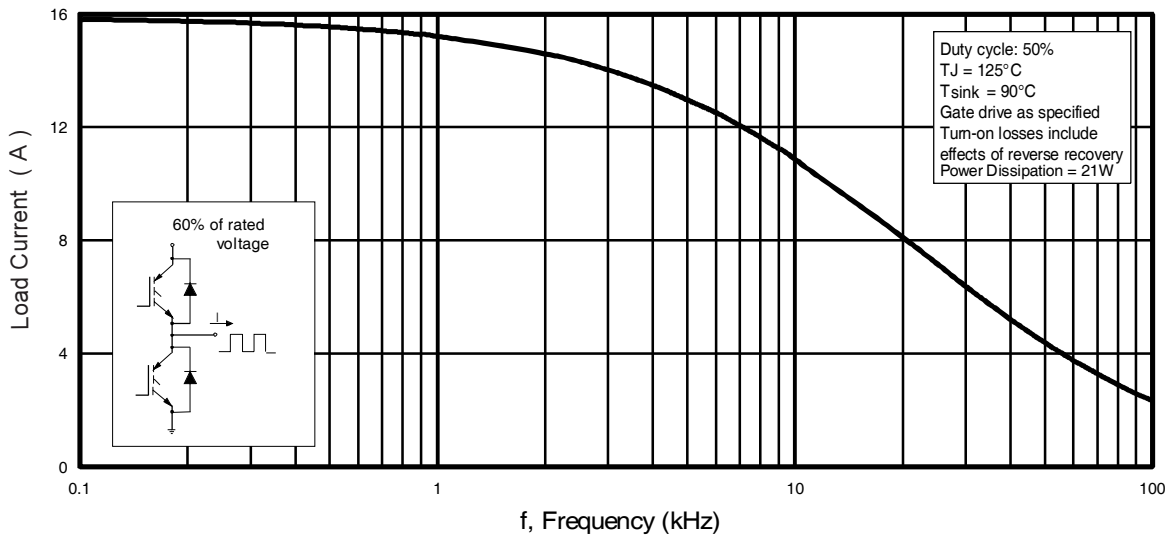


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

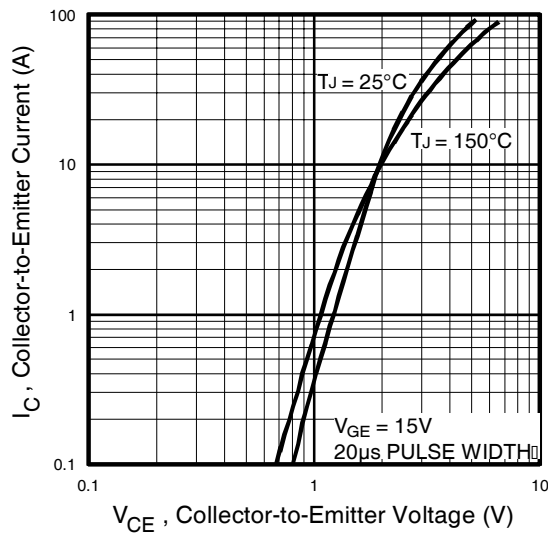


Fig. 2 - Typical Output Characteristics

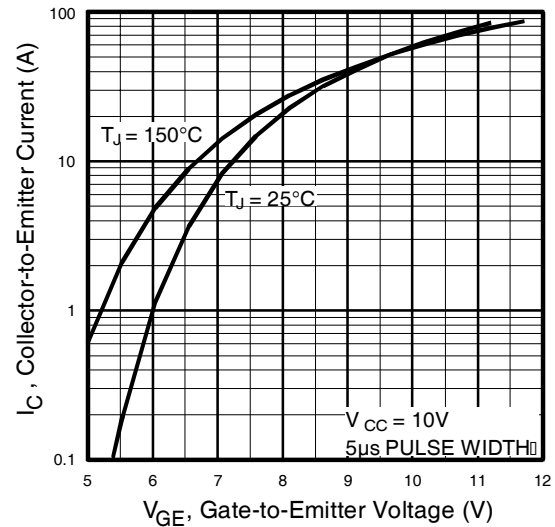


Fig. 3 - Typical Transfer Characteristics

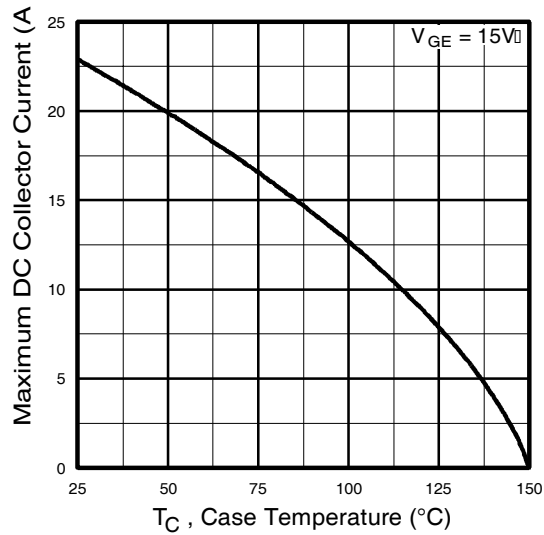


Fig. 4 - Maximum Collector Current vs. Case Temperature

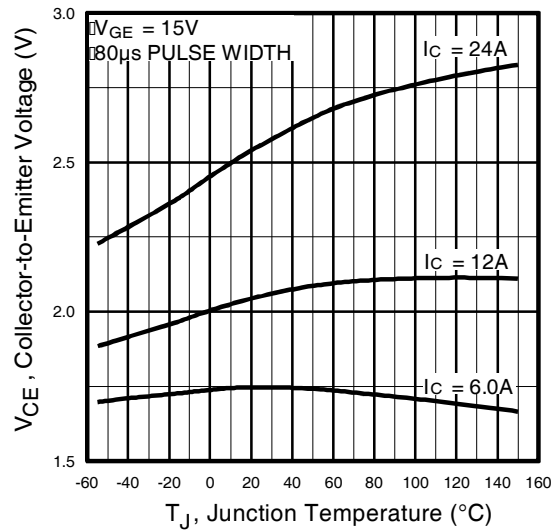


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

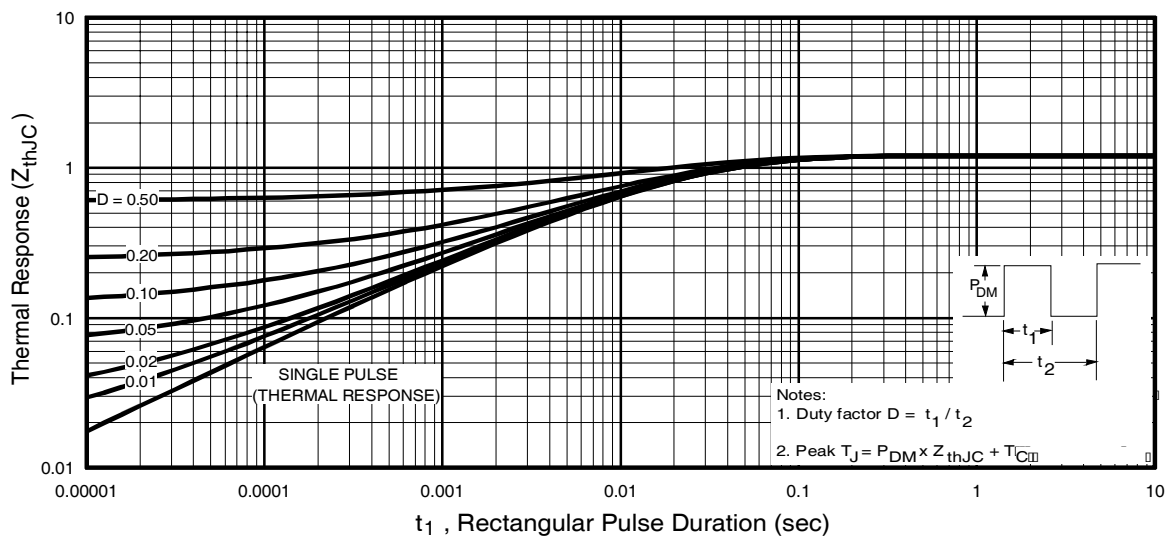


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

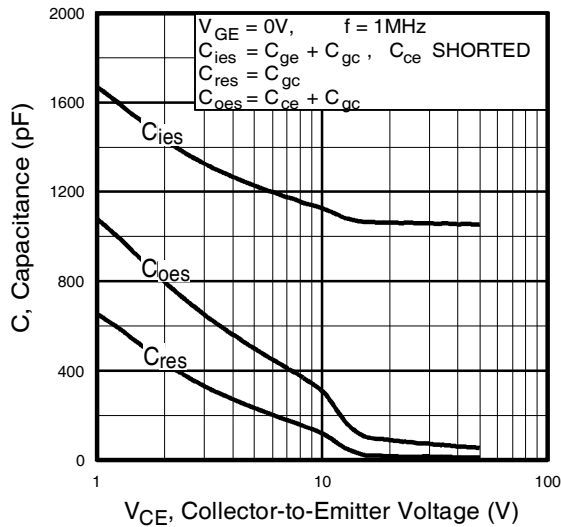


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

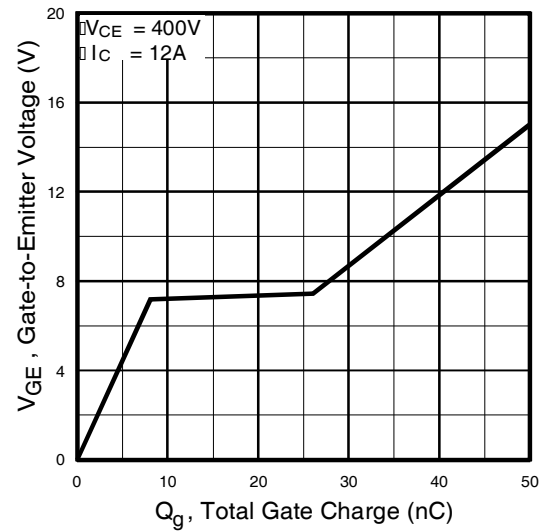


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

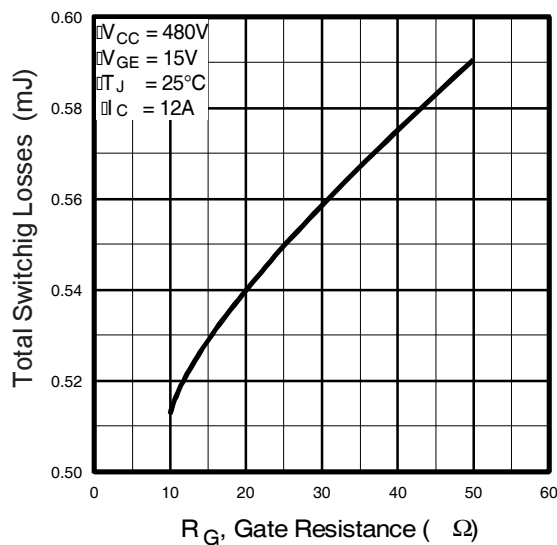


Fig. 9 - Typical Switching Losses vs. Gate Resistance

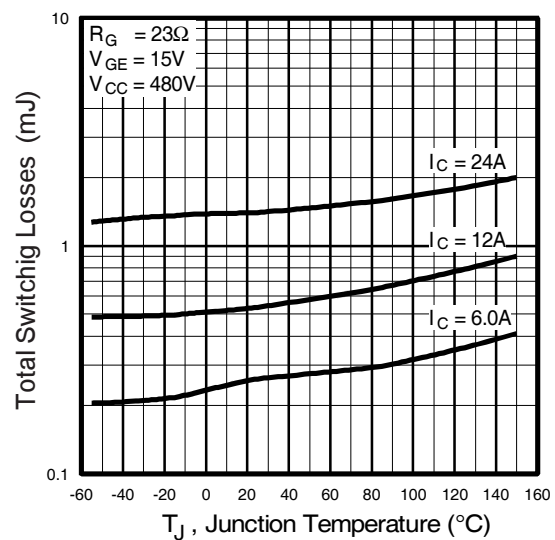


Fig. 10 - Typical Switching Losses vs. Junction Temperature

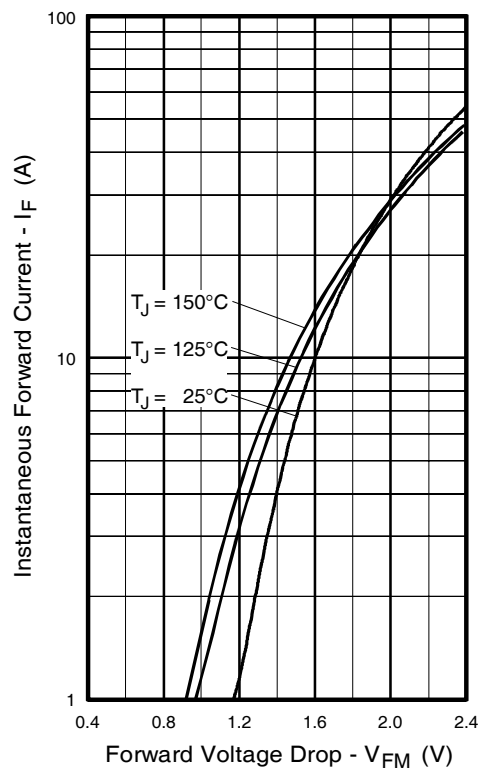
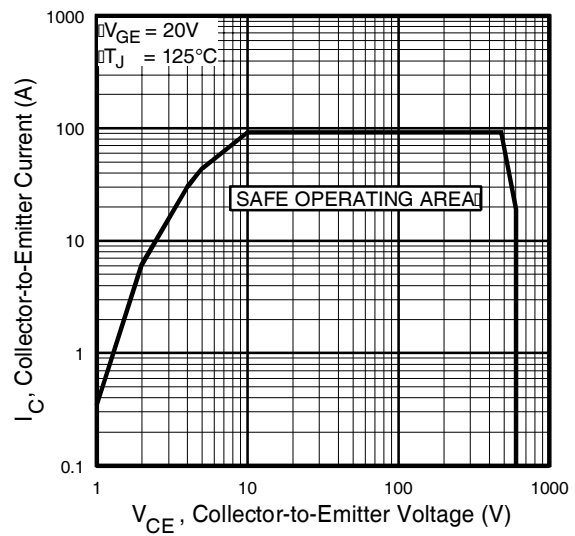
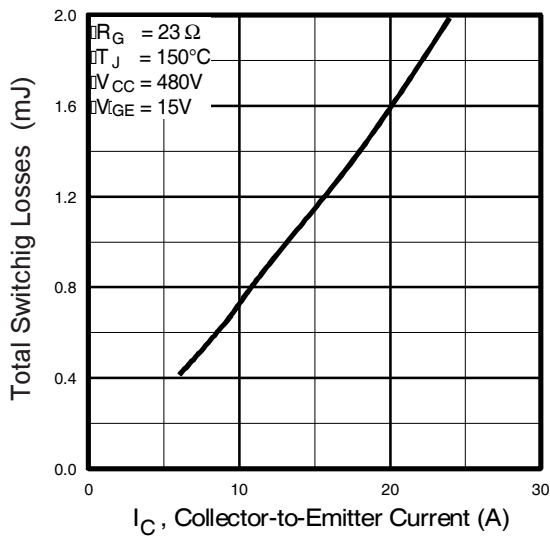


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

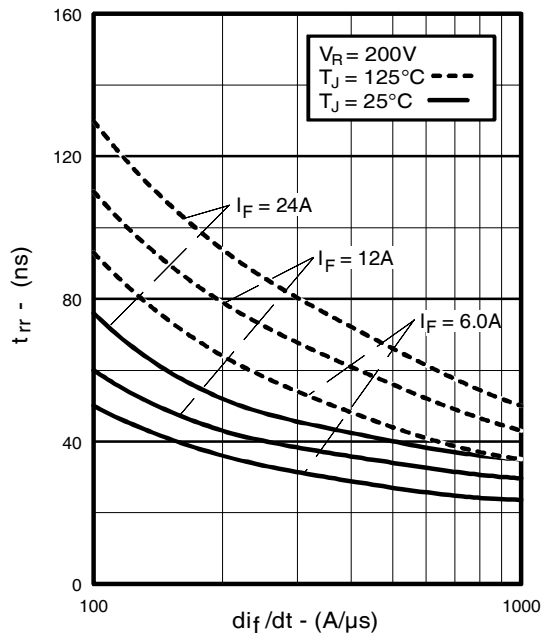


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

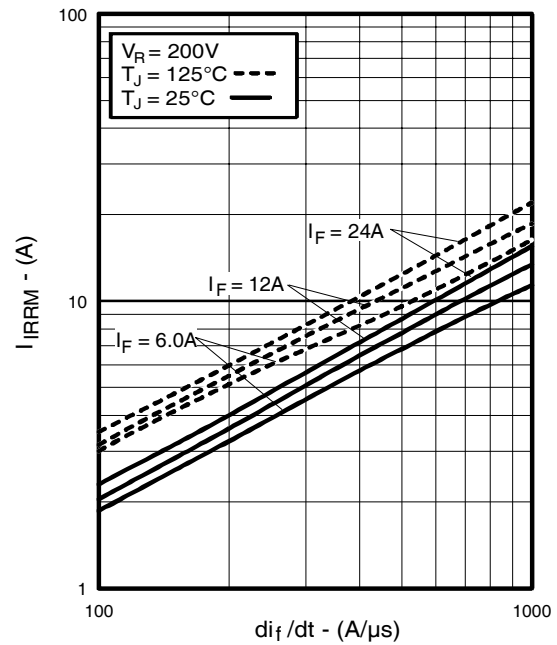


Fig. 15 - Typical Recovery Current vs. di_f/dt

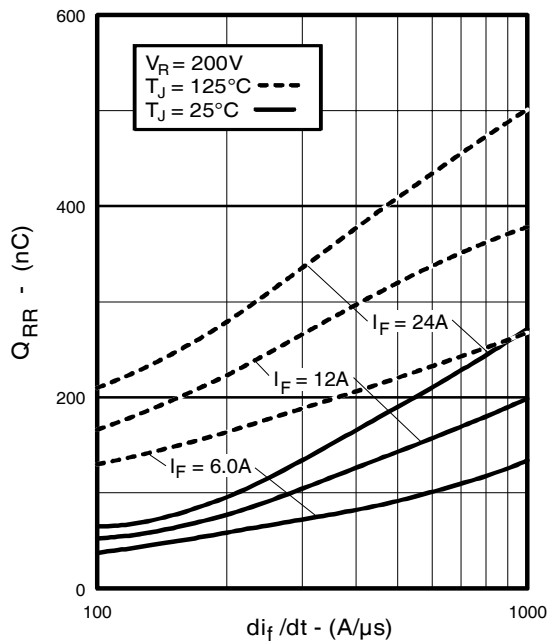


Fig. 16 - Typical Stored Charge vs. di_f/dt

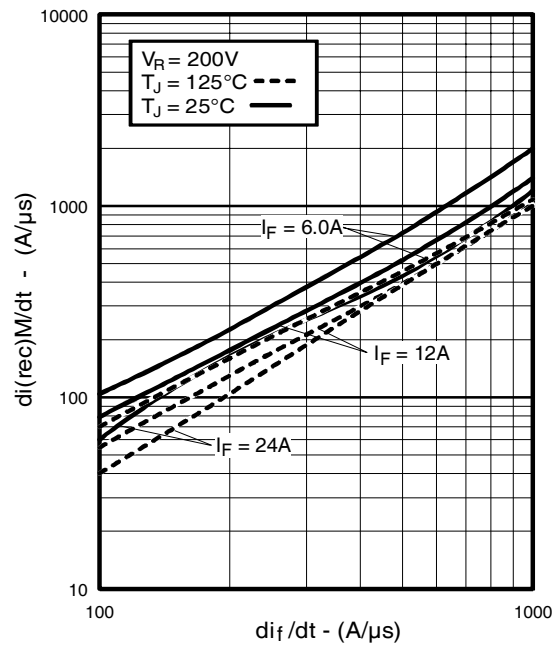


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

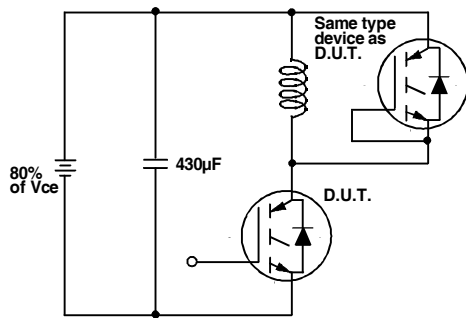


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

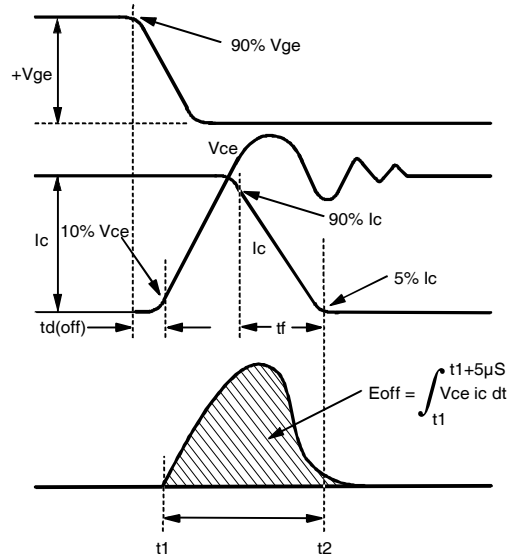


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

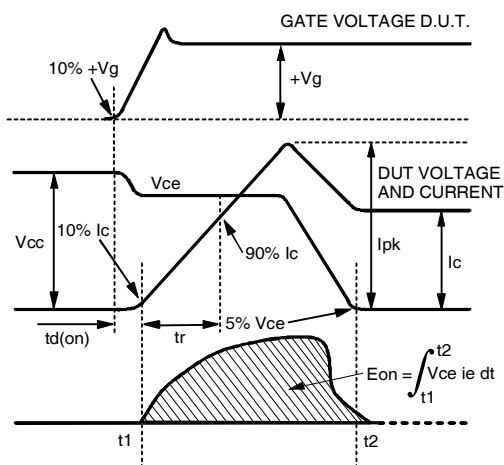


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

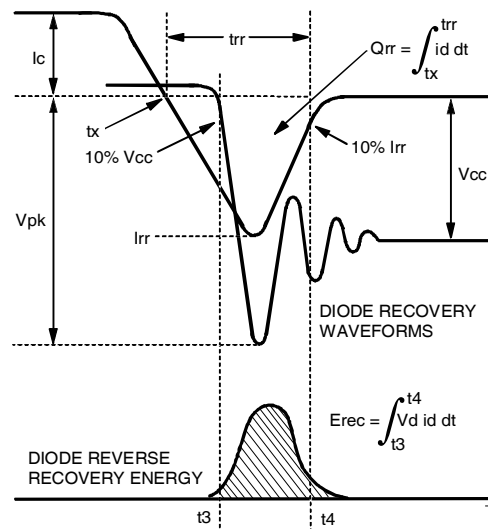


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

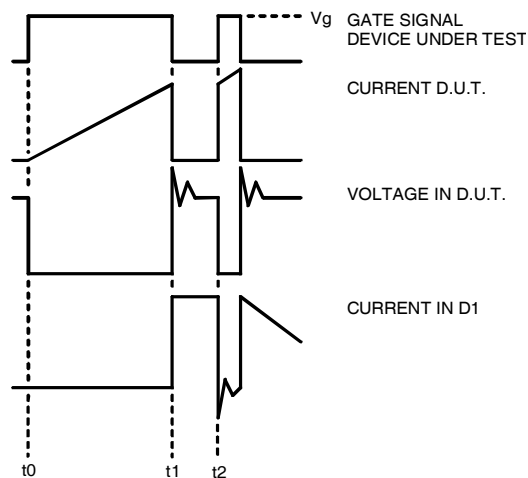


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

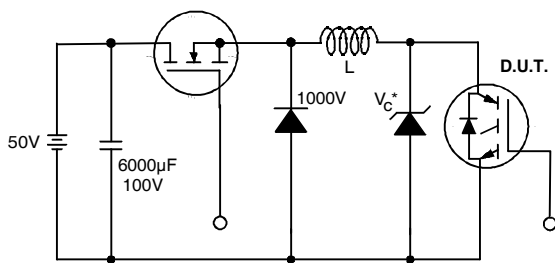
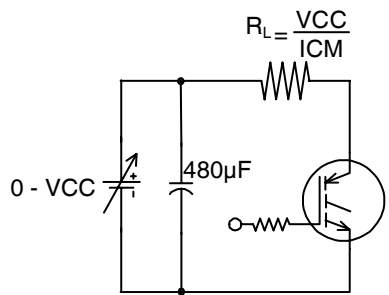


Figure 19. Clamped Inductive Load Test Circuit



Pulsed Collector Current
Test Circuit

Figure 20. Pulsed Collector Current
Test Circuit

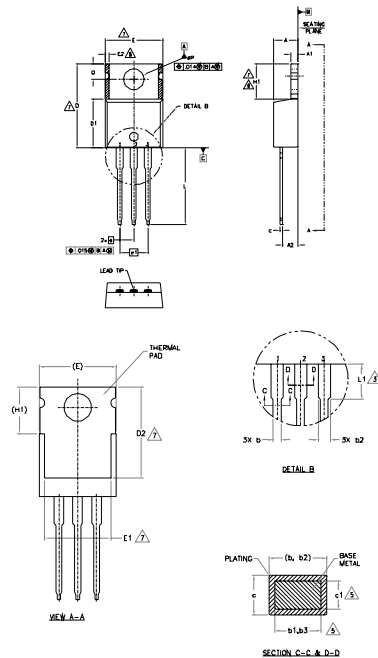
IRG4BC30UDPbF

International
IR Rectifier

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.

TO-220AB Package Outline (Dimensions are shown in millimeters (inches))



- NOTES:
- 1.- DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M-1994.
 - 2.- DIMENSIONS ARE SHOWN IN INCHES (MILLIMETERS).
 - 3.- LEAD DIMENSION AND FINISH UNCONTROLLED IN 1.
 - 4.- DIMENSION D, D1 & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMITY OF THE PLASTIC BODY.
 - 5.- DIMENSION b1, b2 & c1 APPLY TO BASE METAL ONLY.
 - 6.- CONTROLLING DIMENSION - INCHES.
 - 7.- THERMAL PAD CONTIGUOUS OPTIONAL WITHIN DIMENSIONS E, H, D2 & E1.
 - 8.- DIMENSION E2 X H1 DEFINE A ZONE WHERE STAMPING AND SINGULATION IRREGULARITIES ARE ALLOWED.
 - 9.- OUTLINE CONFORMS TO JEDEC TO-220, EXCEPT A2 (max.) AND D2 (min.) WHERE DIMENSIONS ARE DERIVED FROM THE ACTUAL PACKAGE OUTLINE.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	3.56	4.83	.140	.190	
A1	0.51	1.40	.020	.055	
A2	2.03	2.92	.080	.115	
b	0.38	1.01	.015	.040	5
b1	0.38	0.97	.015	.038	
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	
c	0.36	0.61	.014	.024	
c1	0.36	0.56	.014	.022	5
D	14.22	16.51	.560	.650	4
D1	8.38	9.02	.330	.355	
D2	11.68	12.88	.460	.507	7
E	9.65	10.67	.380	.420	4, 7
E1	6.86	8.89	.270	.350	7
E2	-	0.76	-	.030	8
e	2.54 BSC	-	.100 BSC	-	
e1	5.84	6.86	.230	.270	
H	12.70	14.73	.500	.580	7, 8
L	3.56	4.06	.140	.160	
L1	3.54	4.08	.139	.161	3
Q	2.54	3.42	.100	.135	

LEAD ASSIGNMENTS

- 1.- GATE
2.- GATE
3.- SOURCE

SYMBOLS

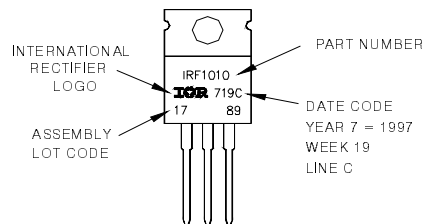
- 1.- GATE
2.- COLLECTOR
3.- GATE

BOXES

- 1.- ANODE
2.- CATHODE
3.- ANODE

TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE 'C'
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/>

Data and specifications subject to change without notice.

International
IR Rectifier

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