International
IOR Rectifier

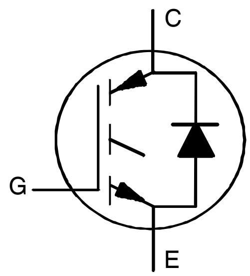
IRG7IC30FDPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

Features
- Low $V_{CE(on)}$
- Zero $V_{CE(on)}$ temperature coefficient
- 3µs Short Circuit Capability
- Square RBSOA

Benefits
- Benchmark Efficiency for Motor Control Applications
- Rugged Transient Performance
- Low EMI

Applications
- Air Conditioner Compressor
- Refrigerator
- Vacuum Cleaner
- Low Frequency Inverter



n-channel

V_{CES} = 600V

I_{NOM} = 24A

$V_{CE(on)}$ typ. = 1.60V

$t_{SC} \geq 3\mu s$, $T_{J(max)}$ = 150°C

TO-220AB
Full-Pak

G	C	E
Gate	Collector	Emitter

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
I_C @ T_C = 25°C	Continuous Collector Current	24	A
I_C @ T_C = 100°C	Continuous Collector Current	12	
I_{CM}	Pulse Collector Current, V_{GE} = 15V	72	
I_{LM}	Clamped Inductive Load Current, V_{GE} = 20V ①	96	
I_F @ T_C = 25°C	Diode Continous Forward Current	24	
I_F @ T_C = 100°C	Diode Continous Forward Current	12	
I_{FM}	Diode Maximum Forward Current ②	96	
V_{GE}	Gate-to-Emitter Voltage	±30	
P_D @ T_C = 25°C	Maximum Power Dissipation	42	W
P_D @ T_C = 100°C	Maximum Power Dissipation	17	
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
$R_{\theta JC}$ (IGBT)	Thermal Resistance Junction-to-Case-(each IGBT) ③	—	—	3.0	°C/W
$R_{\theta JC}$ (Diode)	Thermal Resistance Junction-to-Case-(each Diode) ③	—	—	3.7	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (typical socket mount)	—	65	—	

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	—	—	V	V_{GE} = 0V, I_C = 1.0mA
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.51	—	V/°C	V_{GE} = 0V, I_C = 2.0mA (25°C-150°C)
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.60	1.85		I_C = 24A, V_{GE} = 15V, T_J = 25°C ②
		—	1.60	—	V	I_C = 24A, V_{GE} = 15V, T_J = 150°C ②
$V_{GE(th)}$	Gate Threshold Voltage	4.5	—	7.0	V	$V_{CE} = V_{GE}$, I_C = 1.0mA
$\Delta V_{GE(th)}/\Delta TJ$	Threshold Voltage temp. coefficient	—	-14	—	mV/°C	$V_{CE} = V_{GE}$, I_C = 1.0mA (25°C - 150°C)
gfe	Forward Transconductance	—	26	—	S	V_{CE} = 50V, I_C = 24A, PW = 30µs
I_{CES}	Collector-to-Emitter Leakage Current	—	1.0	30	µA	V_{GE} = 0V, V_{CE} = 600V
		—	1.3	—	mA	V_{GE} = 0V, V_{CE} = 600V, T_J = 150°C
V_{FM}	Diode Forward Voltage Drop	—	1.50	1.80	V	I_F = 24A
		—	1.40	—		I_F = 24A, T_J = 150°C
I_{GES}	Gate-to-Emitter Leakage Current	—	—	±100	nA	V_{GE} = ±30V

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

	Parameter	Min.	Typ.	Max.④	Units	Conditions
Q_g	Total Gate Charge (turn-on)	—	88	130		I_C = 24A
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	17	26	nC	V_{GE} = 15V
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	43	65		V_{CC} = 400V
E_{on}	Turn-On Switching Loss	—	785	1015		I_C = 24A, V_{CC} = 400V, V_{GE} = 15V
E_{off}	Turn-Off Switching Loss	—	780	1010	µJ	R_G = 22Ω, L = 400µH, T_J = 25°C
E_{total}	Total Switching Loss	—	1570	2020		Energy losses include tail & diode reverse recovery
$t_{d(on)}$	Turn-On delay time	—	58	76		I_C = 24A, V_{CC} = 400V, V_{GE} = 15V
t_r	Rise time	—	36	54	ns	R_G = 22Ω, L = 400µH, T_J = 25°C
$t_{d(off)}$	Turn-Off delay time	—	249	283		
t_f	Fall time	—	114	133		
E_{on}	Turn-On Switching Loss	—	1090	—		I_C = 24A, V_{CC} = 400V, V_{GE}=15V
E_{off}	Turn-Off Switching Loss	—	1530	—	µJ	R_G=22Ω, L=400µH, T_J = 150°C
E_{total}	Total Switching Loss	—	2620	—		Energy losses include tail & diode reverse recovery
$t_{d(on)}$	Turn-On delay time	—	54	—		I_C = 24A, V_{CC} = 400V, V_{GE} = 15V
t_r	Rise time	—	35	—	ns	R_G = 22Ω, L = 400µH
$t_{d(off)}$	Turn-Off delay time	—	295	—		T_J = 150°C
t_f	Fall time	—	277	—		
C_{ies}	Input Capacitance	—	2400	—	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	—	130	—		V_{CC} = 30V
C_{res}	Reverse Transfer Capacitance	—	57	—		f = 1.0Mhz
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T_J = 150°C, I_C = 96A V_{CC} = 480V, Vp ≤ 600V Rg = 22Ω, V_{GE} = +20V to 0V
SCSOA	Short Circuit Safe Operating Area	3	—	—	µs	V_{GE} = 15V, V_{CC} = 400V, Vp ≤ 600V Rg = 22Ω, R_{shunt} = 11mΩ, T_C = 100°C
Erec	Reverse Recovery Energy of the Diode	—	147	—	µJ	T_J = 150°C
t_{rr}	Diode Reverse Recovery Time	—	105	—	ns	V_{CC} = 400V, I_F = 24A
I_{rr}	Peak Reverse Recovery Current	—	22	—	A	V_{GE} = 15V, Rg = 22Ω, L =400µH

Notes:

① V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 400µH, R_G = 22Ω.
② Pulse width limited by max. junction temperature.
③ R_θ is measured at T_J of approximately 90°C.
④ Maximum limits are based on statistical sample size characterization.

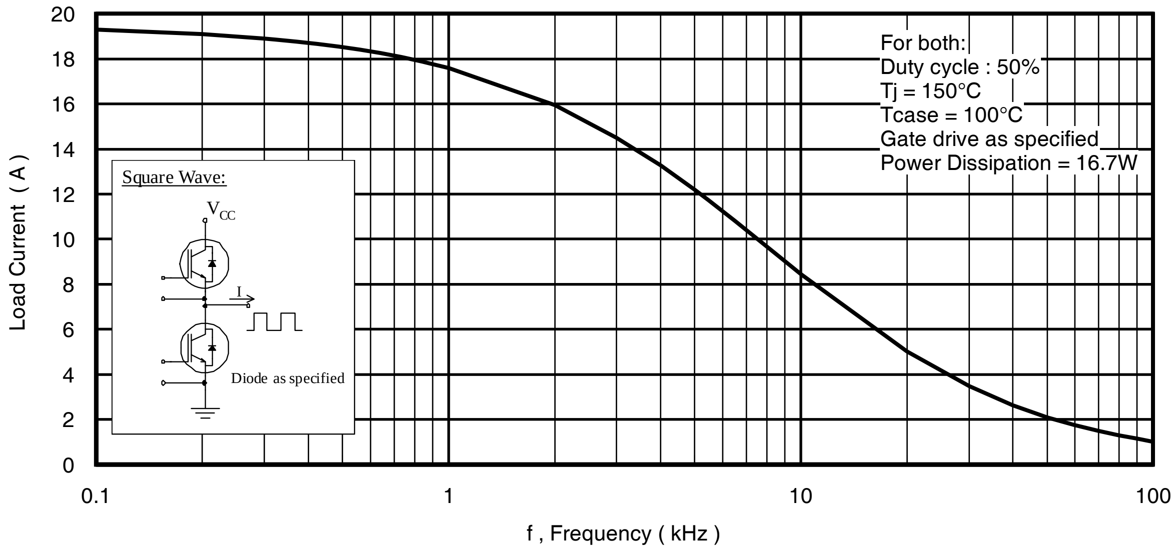


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

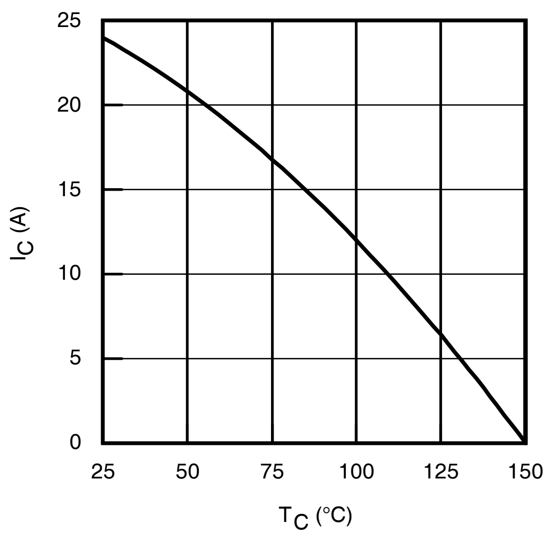


Fig. 2 - Maximum DC Collector Current vs. Case Temperature

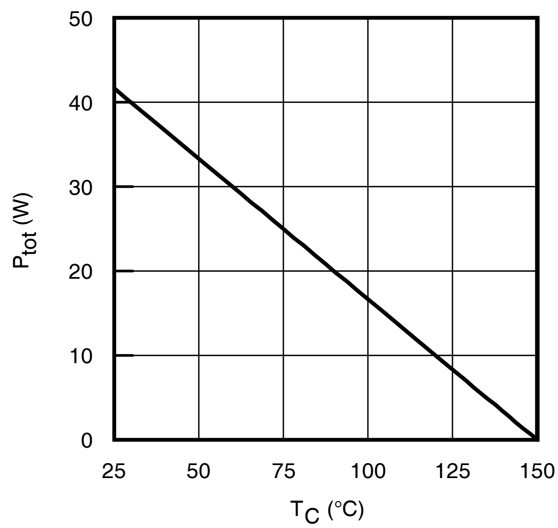


Fig. 3 - Power Dissipation vs. Case Temperature

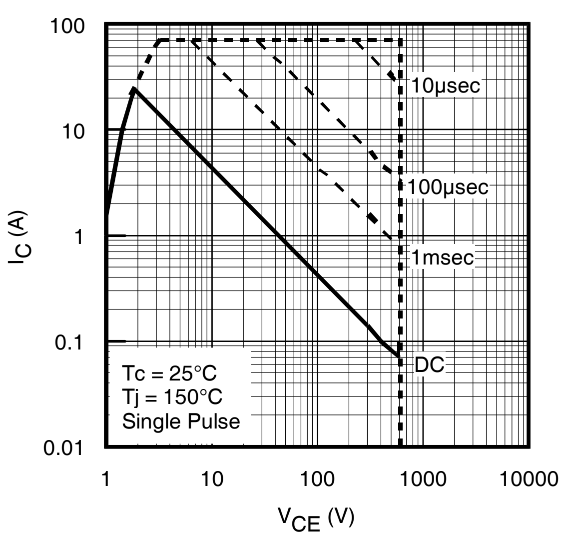


Fig. 4 - Forward SOA
T_C = 25°C, $T_J \leq$ 150°C, V_{GE} =15V

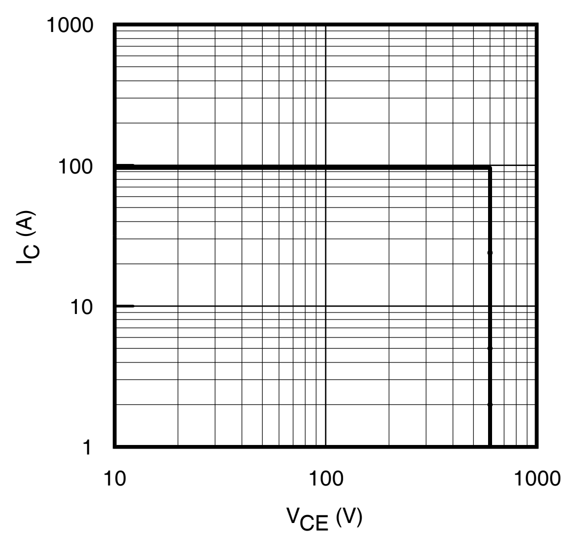


Fig. 5 - Reverse Bias SOA
T_J = 150°C, V_{GE} =20V

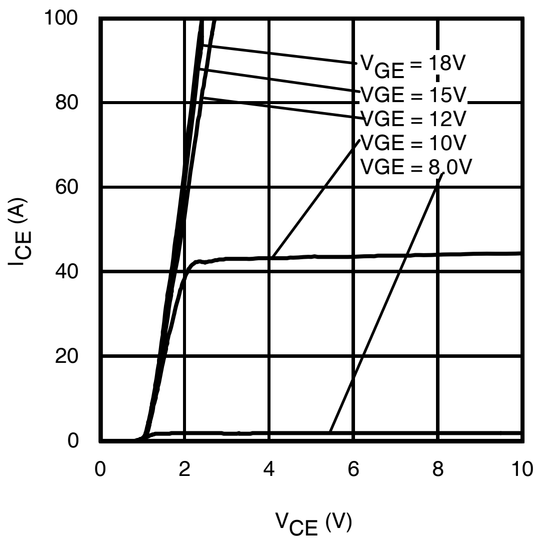


Fig. 6 - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 30µs

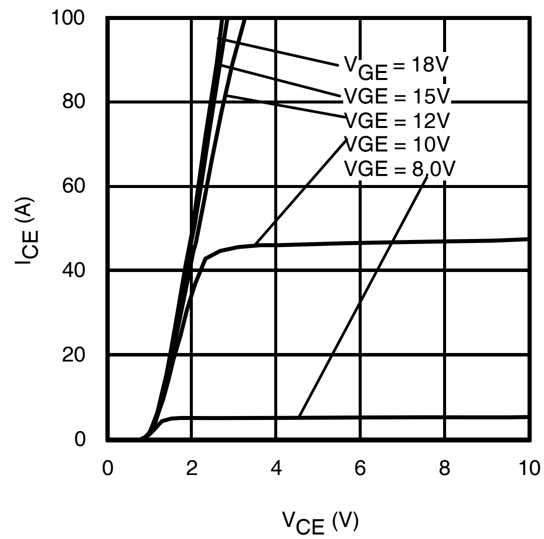


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 30µs

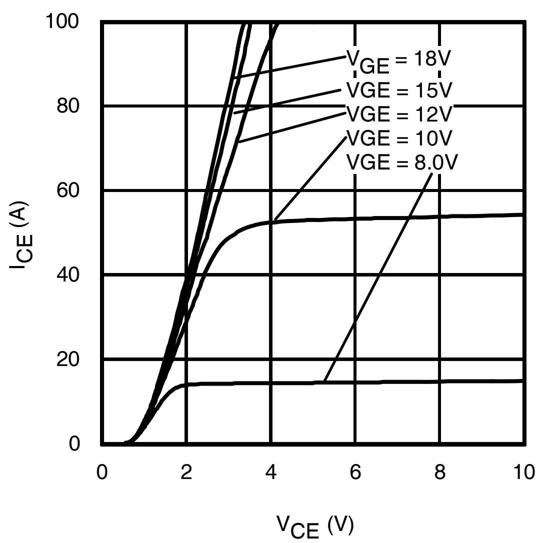


Fig. 8 - Typ. IGBT Output Characteristics
T_J = 150°C; tp = 30µs

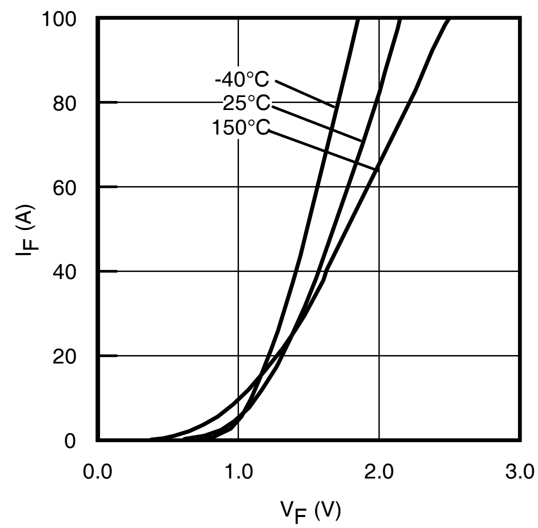


Fig. 9 - Typ. Diode Forward Characteristics
tp = 30µs

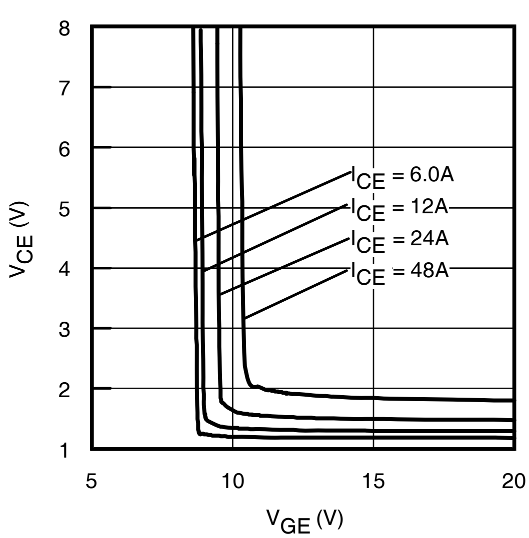


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

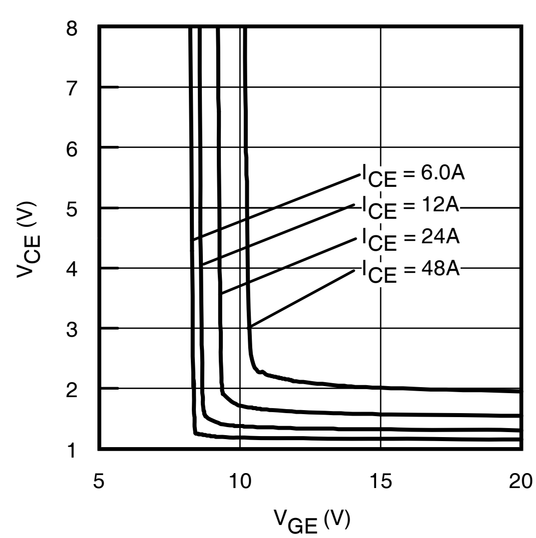


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

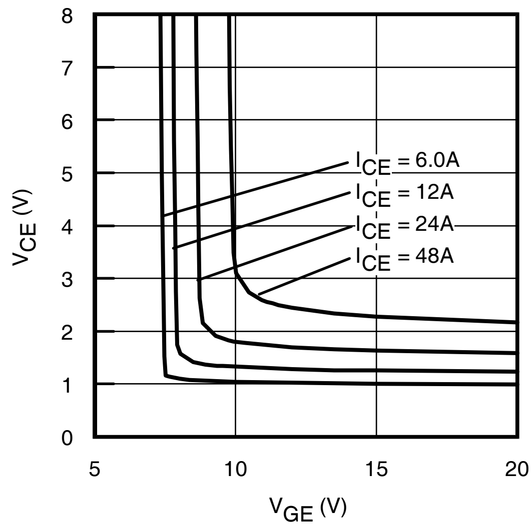


Fig. 12 - Typical V_{CE} vs. V_{GE}
$T_J = 150°C$

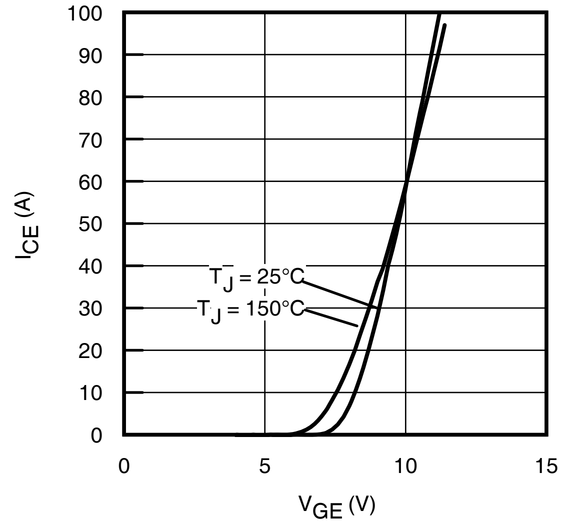


Fig. 13 - Typ. Transfer Characteristics
$V_{CE} = 25V$; tp = 30µs

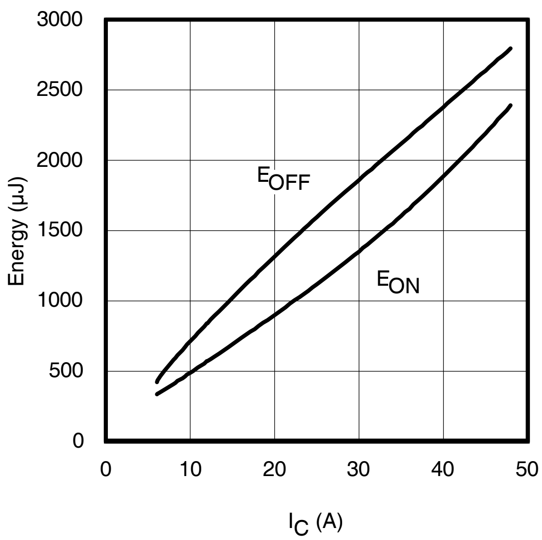


Fig. 14 - Typ. Energy Loss vs. I_C
$T_J = 150°C$; L = 400µH; $V_{CE} = 400V$, $R_G = 22\Omega$; $V_{GE} = 15V$

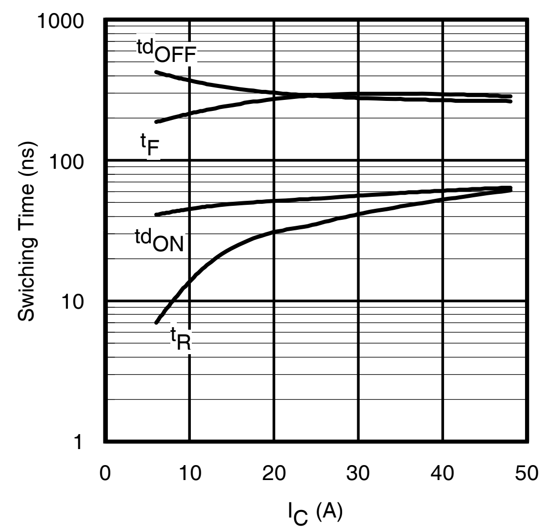


Fig. 15 - Typ. Switching Time vs. I_C
$T_J = 150°C$; L = 400µH; $V_{CE} = 400V$, $R_G = 22\Omega$; $V_{GE} = 15V$

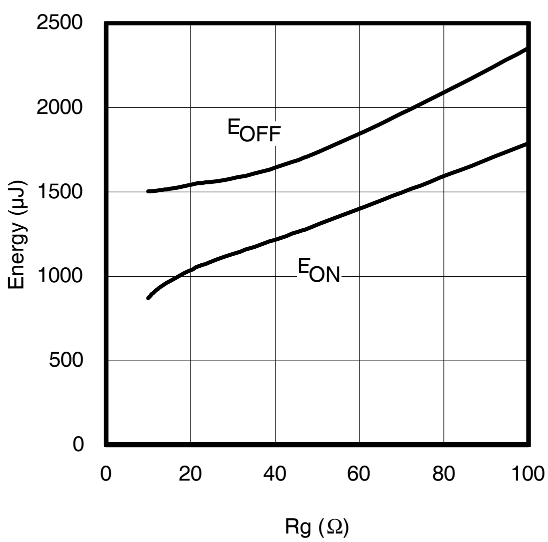


Fig. 16 - Typ. Energy Loss vs. R_G
$T_J = 150°C$; L = 400µH; $V_{CE} = 400V$, $I_{CE} = 24A$; $V_{GE} = 15V$

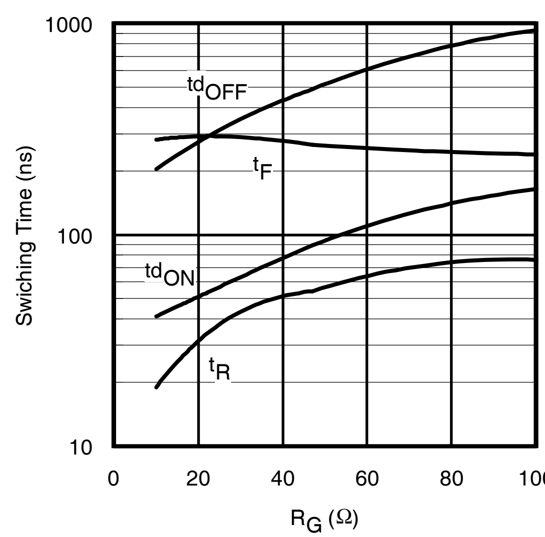


Fig. 17 - Typ. Switching Time vs. R_G
$T_J = 150°C$; L = 400µH; $V_{CE} = 400V$, $I_{CE} = 24A$; $V_{GE} = 15V$

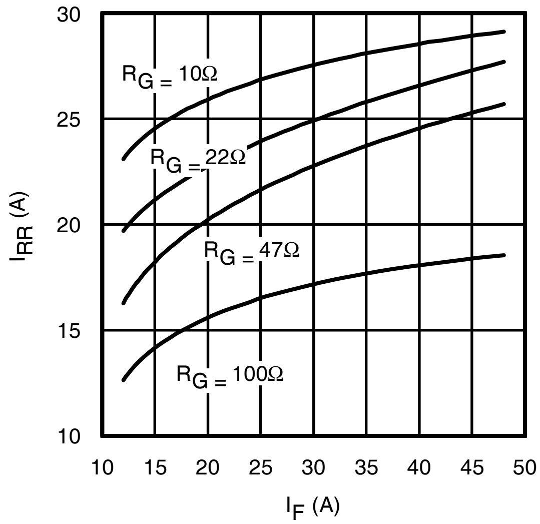


Fig. 18 - Typ. Diode I_{RR} vs. I_F
$T_J = 150°C$

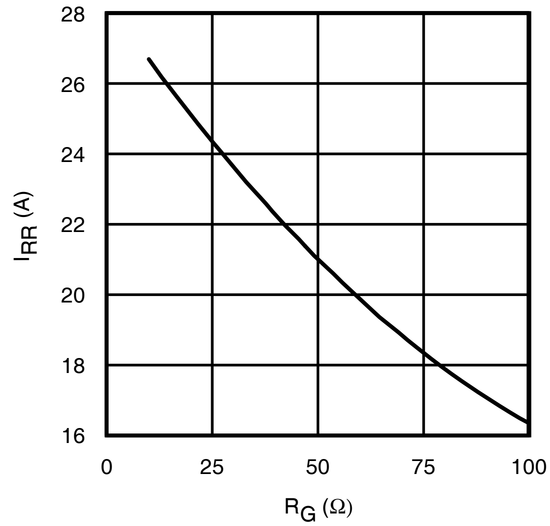


Fig. 19 - Typ. Diode I_{RR} vs. R_G
$T_J = 150°C$

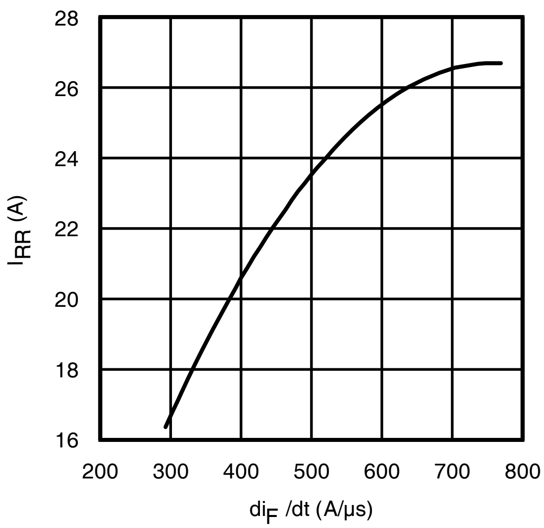


Fig. 20 - Typ. Diode I_{RR} vs. di_F/dt
$V_{CC} = 400V$; $V_{GE} = 15V$; $I_F = 24A$; $T_J = 150°C$

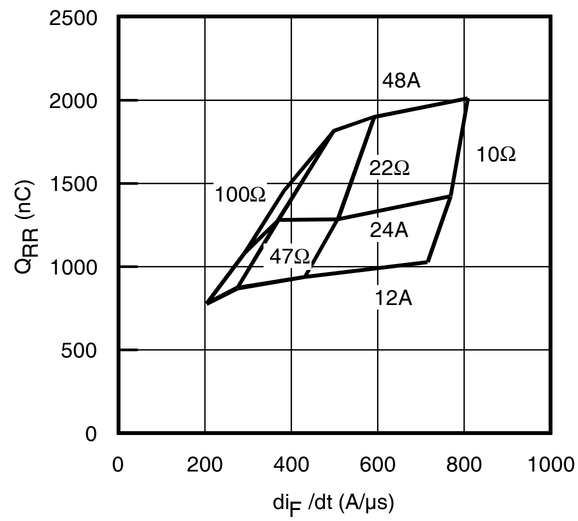


Fig. 21 - Typ. Diode Q_{RR} vs. di_F/dt
$V_{CC} = 400V$; $V_{GE} = 15V$; $T_J = 150°C$

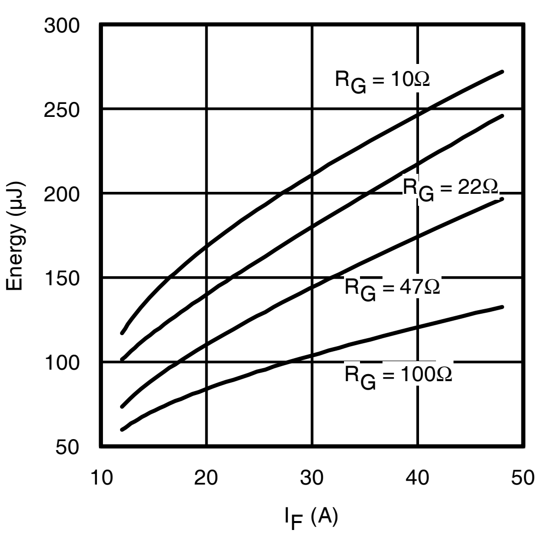


Fig. 22 - Typ. Diode E_{RR} vs. I_F
$T_J = 150°C$

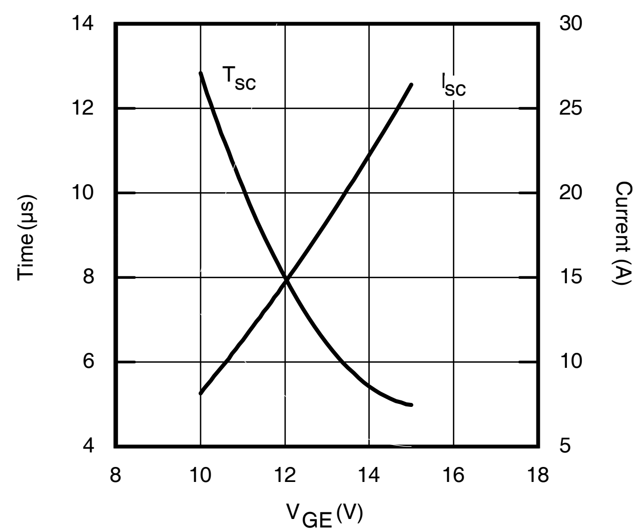


Fig. 23 - V_{GE} vs. Short Circuit Time
$V_{CC} = 400V$; $T_C = 25°C$

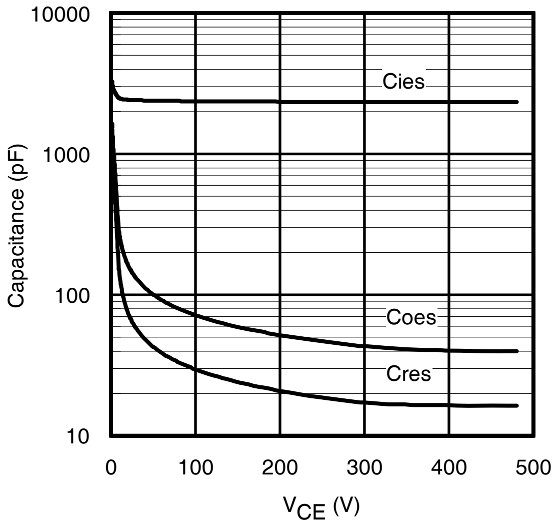


Fig. 24 - Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

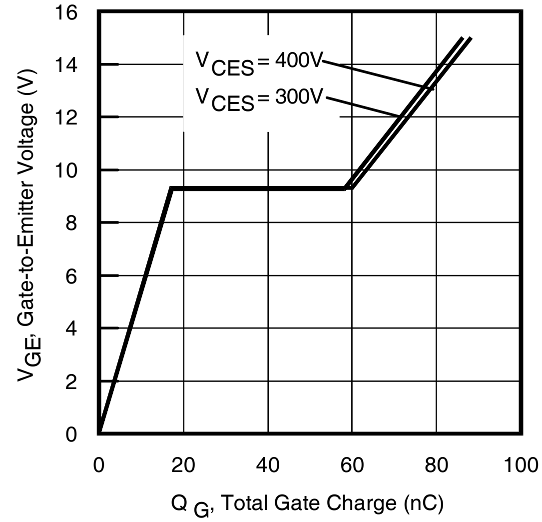


Fig. 25 - Typical Gate Charge vs. V_{GE}
I_{CE} = 24A; L = 600μH

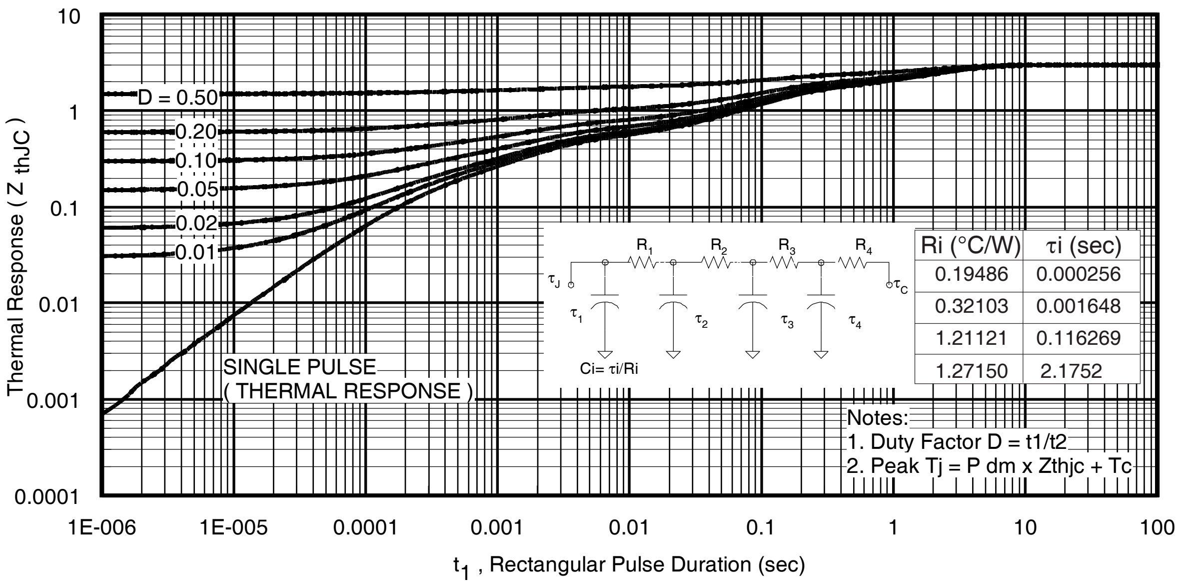


Fig 26. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

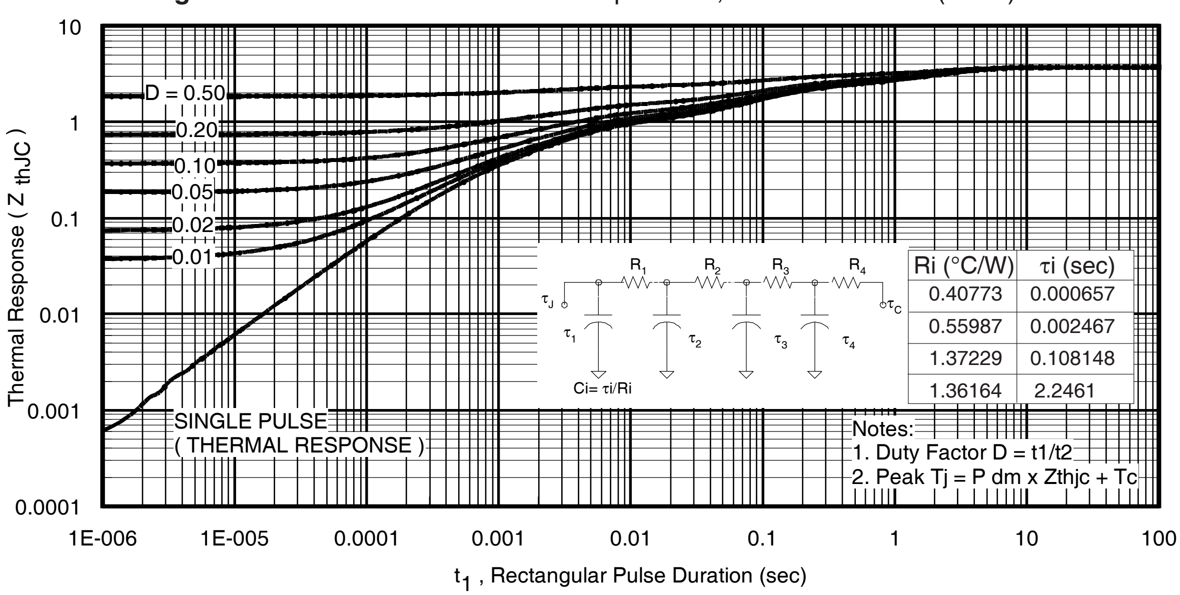


Fig. 27. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

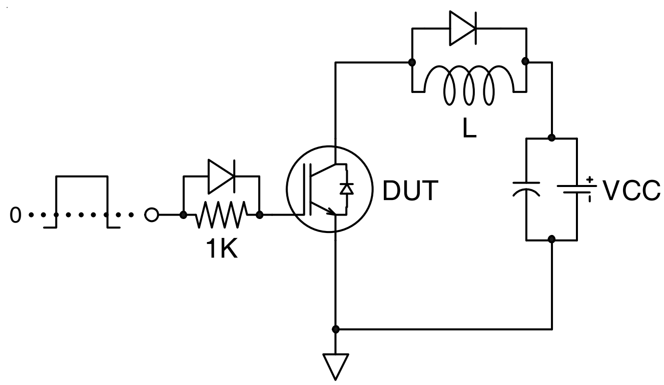


Fig.C.T.1 - Gate Charge Circuit (turn-off)

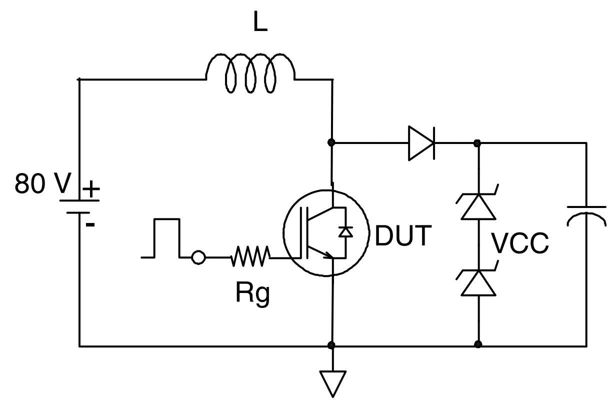


Fig.C.T.2 - RBSOA Circuit

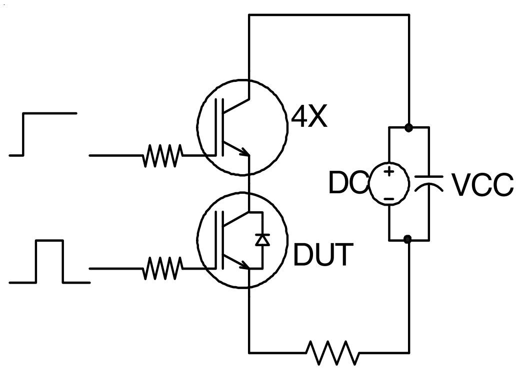


Fig.C.T.3 - S.C. SOA Circuit

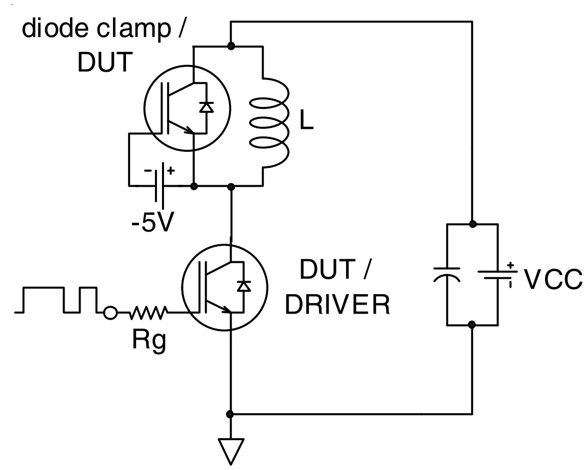


Fig.C.T.4 - Switching Loss Circuit

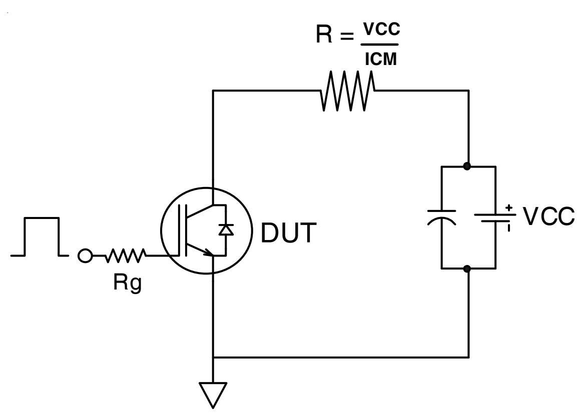


Fig.C.T.5 - Resistive Load Circuit

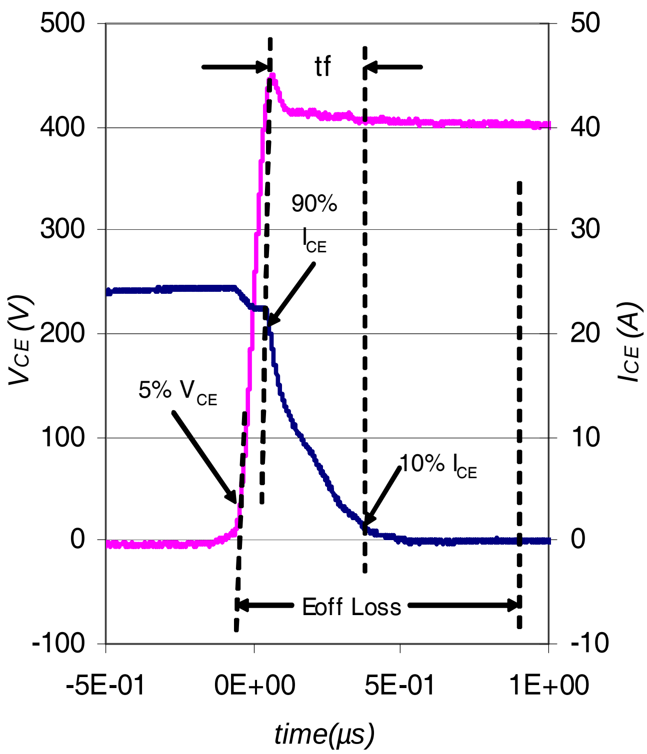


Fig. WF1 - Typ. Turn-off Loss Waveform @ T_J = 150°C using Fig. CT.4

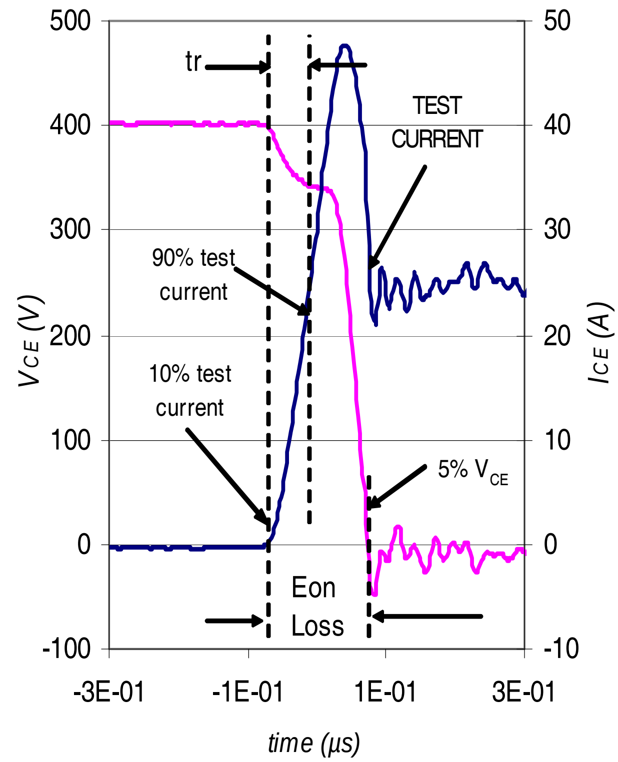


Fig. WF2 - Typ. Turn-on Loss Waveform @ T_J = 150°C using Fig. CT.4

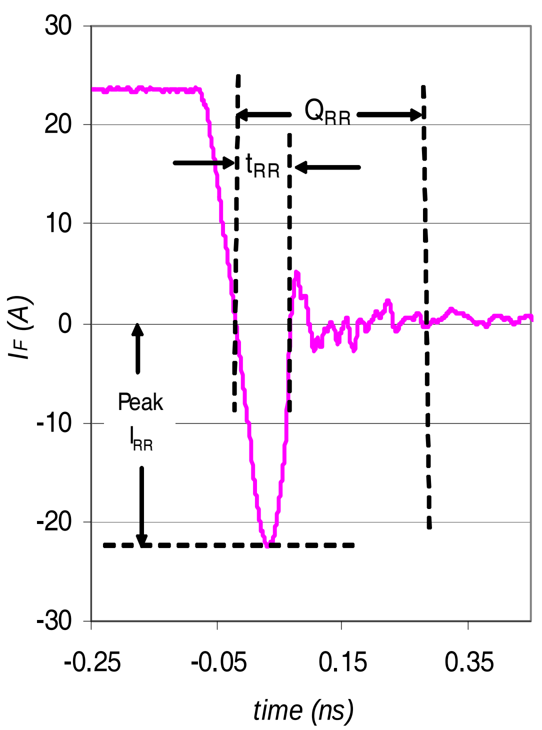


Fig. WF3 - Typ. Diode Recovery Waveform @ T_J = 150°C using Fig. CT.4

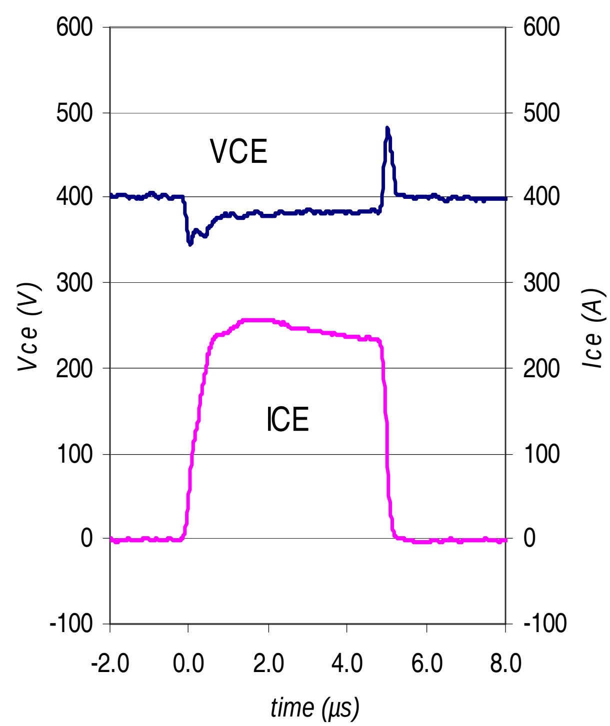
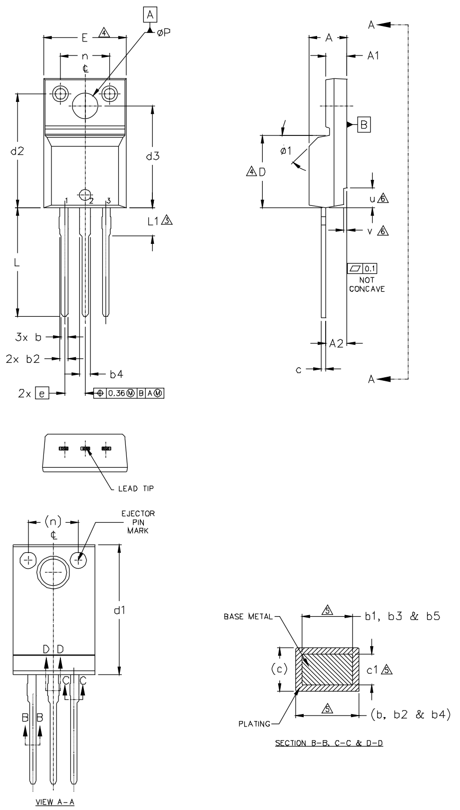


Fig. WF4 - Typ. S.C. Waveform @ T_J = 25°C using Fig. CT.3

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	
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	5
b2	0.76	1.27	.030	.050	
b3	0.76	1.22	.030	.048	5
b4	1.02	1.52	.040	.060	
b5	1.02	1.47	.040	.058	5
c	0.33	0.63	.013	.025	
c1	0.33	0.58	.013	.023	5
D	8.66	9.80	.341	.386	4
d1	15.80	16.13	.622	.635	
d2	13.97	14.22	.550	.560	
d3	12.30	12.93	.484	.509	
E	9.63	10.75	.379	.423	4
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	
øP	3.05	3.45	.120	.136	
u	2.40	2.50	.094	.098	6
v	0.40	0.50	.016	.020	6
ø1	–	45°	–	45°	

NOTES:

1.0 DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M- 1994.
2.0 DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3.0 LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
4.0 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTER MOST EXTREMES OF THE PLASTIC BODY.
5.0 DIMENSION b1, b3, b5 & c1 APPLY TO BASE METAL ONLY.
6.0 STEP OPTIONAL ON PLASTIC BODY DEFINED BY DIMENSIONS u & v.
7.0 CONTROLLING DIMENSION : INCHES.

LEAD ASSIGNMENTS

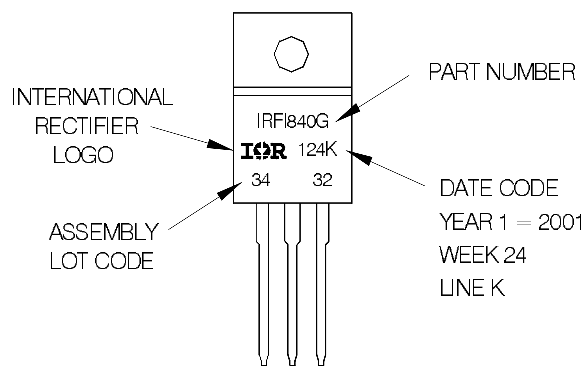
HEXFET
1.- GATE
2.- DRAIN
3.- SOURCE

IGBTs, CoPACK
1.- GATE
2.- COLLECTOR
3.- EMITTER

TO-220AB Full-Pak Part Marking Information

EXAMPLE: THIS IS AN IRFI840G
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.

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.
This product has been designed and qualified for Industrial market.
Qualification Standards can be found on IR's Web site.

International
IOR Rectifier
IR WORLD HEADQUARTERS: 101 N. Sepulveda Blvd., El Segundo, California 90245, USA Tel: (310) 252-7105
TAC Fax: (310) 252-7903
Visit us at www.irf.com for sales contact information.

