International
IOR Rectifier

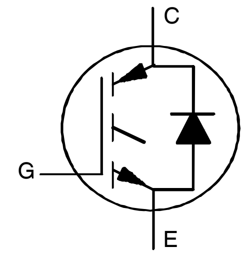
IRG7RC10FDPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

Features
- Low $V_{CE(on)}$
- Zero $V_{CE(on)}$ temperature coefficient
- 3µs Short Circuit Capability
- Ultra Fast Soft Recovery Co-pak Diode
- Square RBSOA

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

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



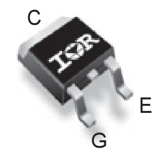
n-channel

V_{CES} = 600V

I_C = 9.0A, T_C = 100°C

t_{sc} > 3µs, T_{jmax} = 150°C

$V_{CE(on)\ typ.}$ = 1.6V
@ I_C = 5A



D-Pak
IRG7RC10FDPbF

G	C	E
Gate	Collector	Emitter

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Breakdown Voltage	600	V
I_C @ T_C = 25°C	Continuous Collector Current	16.5	A
I_C @ T_C = 100°C	Continuous Collector Current	9.0	
I_{CM}	Pulsed Collector Current, V_{GE} = 15V	20	
I_{LM}	Clamped Inductive Load Current, V_{GE} = 20V ①	20	
I_F@T_C=25°C	Diode Continuous Forward Current	16.5	
I_F@T_C=100°C	Diode Continuous Forward Current	9.0	
I_{FM}	Diode Maximum Forward Current ②	20	
V_{GE}	Gate-to-Emitter Voltage	± 30	V
P_D @ T_C =25°C	Maximum Power Dissipation	61	W
P_D @ T_C =100°C	Maximum Power Dissipation	24	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 150	°C
	Soldering Temperature, for 10 seconds	300 (0.063 in. (1.6mm) from case)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT ③	—	—	2.1	°C/W
$R_{\theta JC}$	Junction-to-Case - Diode ③	—	—	6.1	
$R_{\theta JA}$	Junction-to-Ambient (PCB Mount Steady State) ④	—	—	50	

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 =250 µA
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.55	—	V/°C	V_{GE} = 0V, I_c = 250µA (25 -150°C)
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.60	1.85	V	I_C = 5.0A, V_{GE} = 15V, T_J = 25°C
		—	1.60	—		I_C = 5.0A, V_{GE} = 15V, T_J = 150°C
$V_{GE(th)}$	Gate Threshold Voltage	4.5	—	7.0	V	V_{CE} = V_{GE}, I_C = 200µA
$\Delta V_{GE(th)}/\Delta TJ$	Threshold Voltage temp. coefficient	—	-14	—	mV/°C	V_{CE} = V_{GE}, I_C = 200µA (25 -150°C)
gfe	Forward Transconductance	—	3.9	—	S	V_{CE} = 50V, I_C = 5.0A
I_{CES}	Collector-to-Emitter Leakage Current	—	—	20	µA	V_{GE} = 0V,V_{CE} = 600V
		—	—	100		V_{GE} = 0V, V_{CE} = 600V, T_J =150°C
V_{FM}	Diode Forward Voltage Drop	—	1.5	1.9	V	I_F = 5.0A
		—	1.3	—		I_F = 5.0A, T_J = 150°C
I_{GES}	Gate-to-Emitter Leakage Current	—	—	±100	nA	V_{GE} = ± 30 V

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
Q_g	Total Gate Charge (turn-on)	—	24	36	nC	I_C = 5.0A
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	4.4	6.6		V_{CC} = 400V
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	11	17		V_{GE} = 15V ⑤
E_{on}	Turn-On Switching Loss	—	170	380	µJ	I_C = 5.0A, V_{CC} = 400V, V_{GE} = 15V
E_{off}	Turn-Off Switching Loss	—	150	365		R_G = 100Ω, L=1.6mH, T_J = 25°C ⑤
E_{total}	Total Switching Loss	—	320	745		Energy losses include tail and diode reverse recovery
$t_{d(on)}$	Turn-On delay time	—	38	55	ns	I_C = 5.0A, V_{CC} = 400V
t_r	Rise time	—	32	49		R_G = 100Ω, L=1.6mH
$t_{d(off)}$	Turn-Off delay time	—	240	325		T_J = 25°C ⑤
t_f	Fall time	—	10	26		
E_{on}	Turn-On Switching Loss	—	250	—	µJ	I_C = 5.0A, V_{CC} = 400V, V_{GE} = 15V
E_{off}	Turn-Off Switching Loss	—	310	—		R_G = 100Ω, L=1.6mH, T_J = 150°C
E_{total}	Total Switching Loss	—	560	—		Energy losses include tail and diode reverse recovery
$t_{d(on)}$	Turn-On delay time	—	32	—	ns	I_C = 5.0A, V_{CC} = 400V
t_r	Rise time	—	31	—		R_G = 100Ω, L=1.6mH
$t_{d(off)}$	Turn-Off delay time	—	275	—		T_J = 150°C
t_f	Fall time	—	305	—		
C_{ies}	Input Capacitance	—	580	—	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	—	24	—		V_{CC} = 30V
C_{res}	Reverse Transfer Capacitance	—	14	—		f = 1Mhz
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T_J = 150°C, I_C = 20A V_{CC} = 480V, Vp ≤ 600V R_G = 100Ω, V_{GE} = +20V to 0V
SCSOA	Short Circuit Safe Operating Area	3	—	—	µs	V_{GE} = 15V, V_{CC} = 400V, Vp ≤ 600V Rg = 100Ω, R_{shunt} = 50mΩ, T_C = 100°C
Erec	Reverse recovery energy of the diode	—	44	—	µJ	T_J = 150°C
trr	Diode Reverse recovery time	—	80	—	ns	V_{CC} = 400V, I_F = 5.0A
Irr	Peak Reverse Recovery Current	—	6.4	—	A	V_{GE} = 15V, Rg = 100Ω, L=1.0mH

Notes:

① V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 1.6mH, R_G = 100Ω.
② Pulse width limited by max. junction temperature.
③ R_θ is measured at T_J approximately 90°C.
④ When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994.
⑤ Max limit based on statistical sample size characterization.

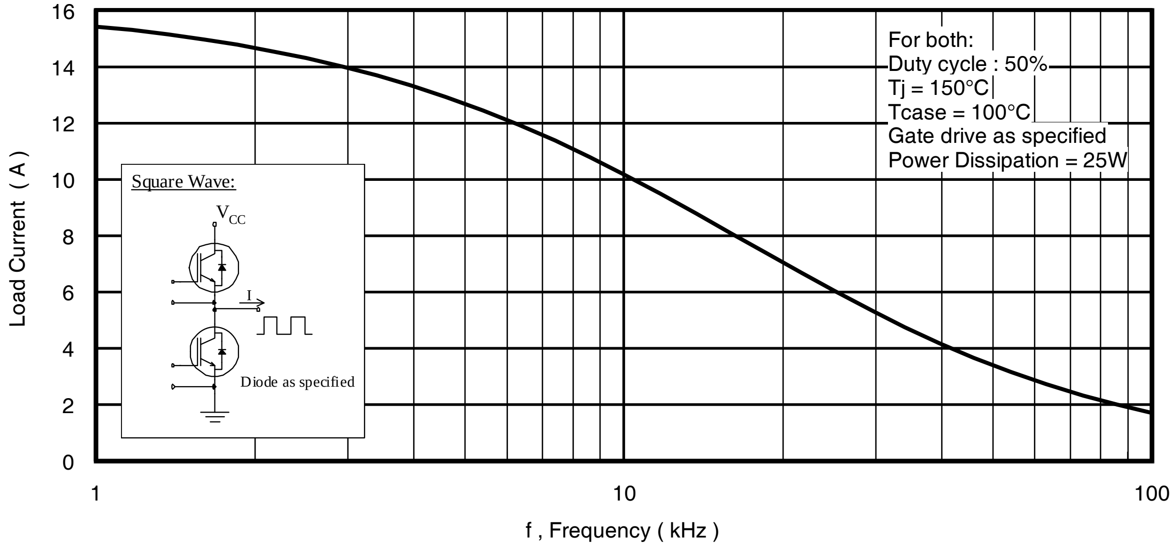


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

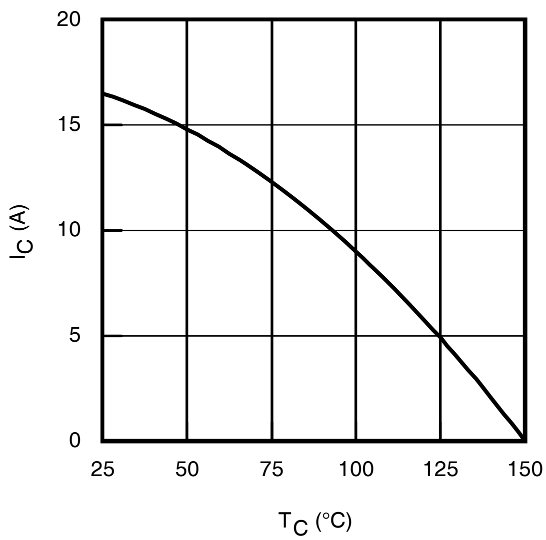


Fig. 2 - Maximum DC Collector Current vs. Case Temperature

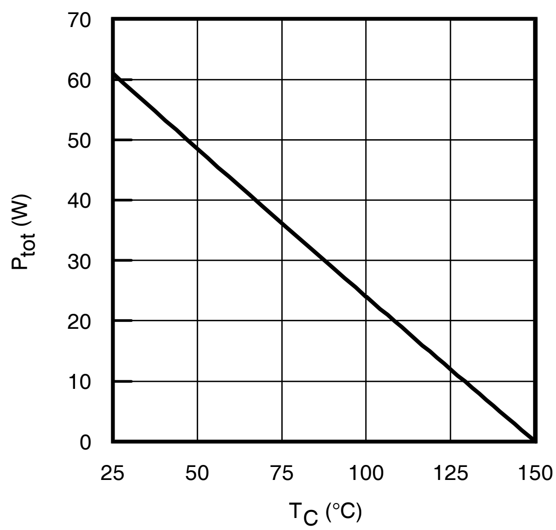


Fig. 3 - Power Dissipation vs. Case Temperature

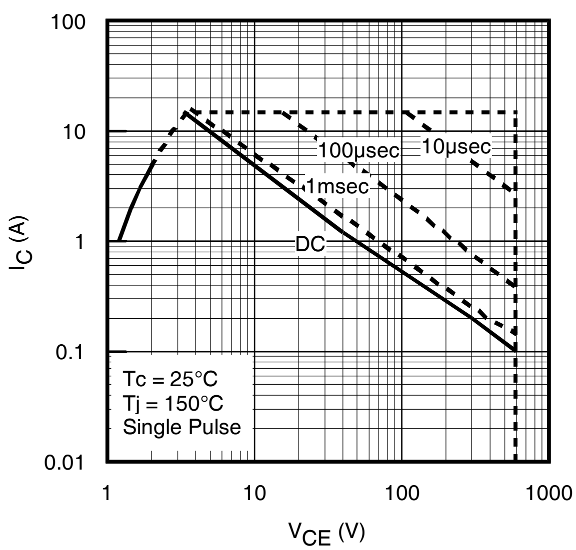


Fig. 4 - Forward SOA,
$T_C = 25°C$, $T_J \le 150°C$, $V_{GE} = 15V$

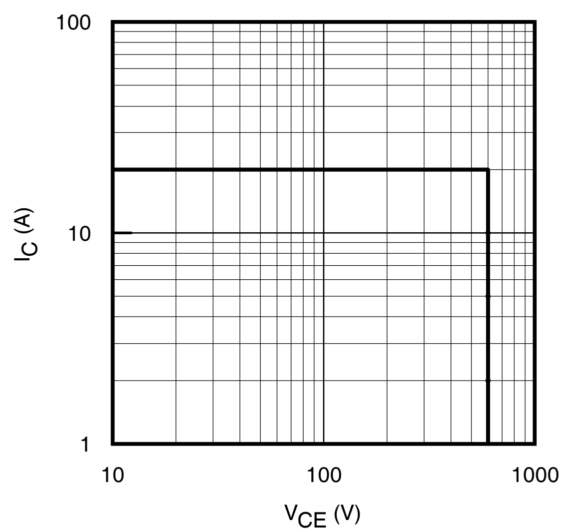


Fig. 5 - Reverse Bias SOA
$T_J = 150°C$, $V_{GE} = 20V$

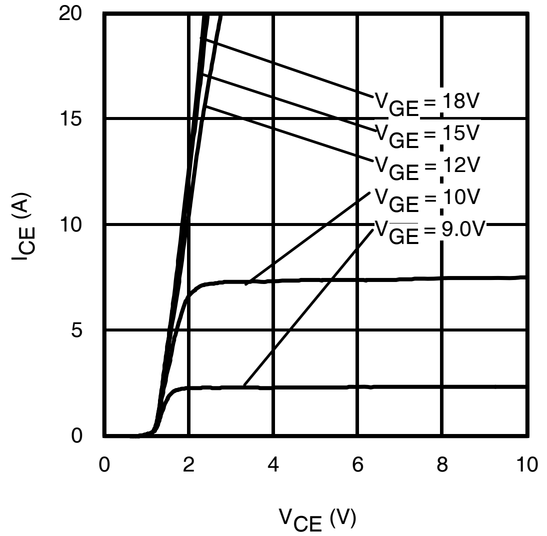


Fig. 6 - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 20µs

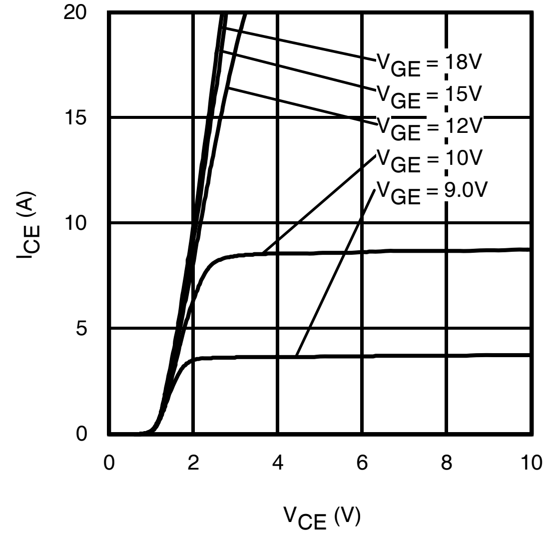


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 20µs

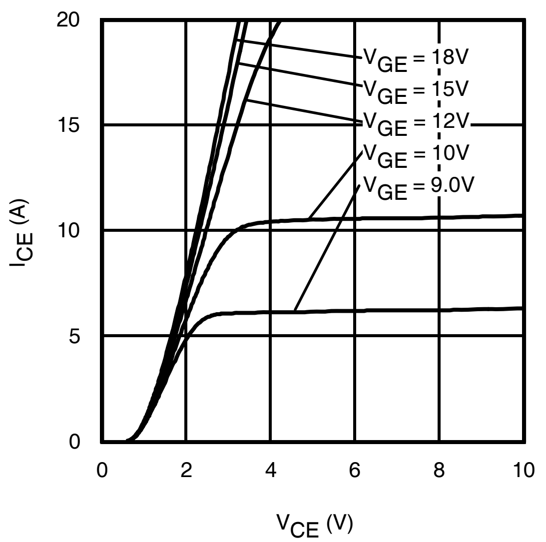


Fig. 8 - Typ. IGBT Output Characteristics
T_J = 150°C; tp = 20µs

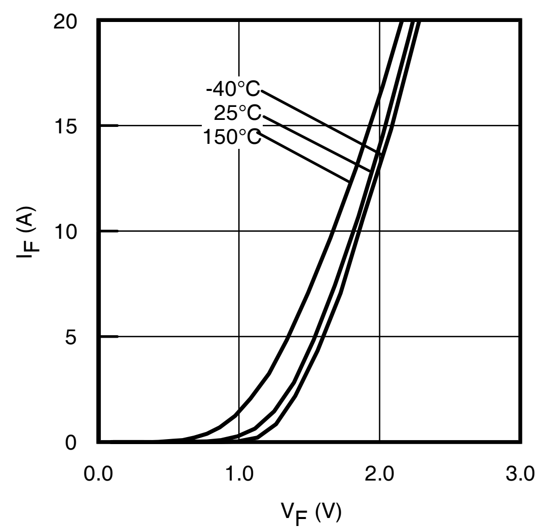


Fig. 9 - Typ. Diode Forward Characteristics
tp = 20µs

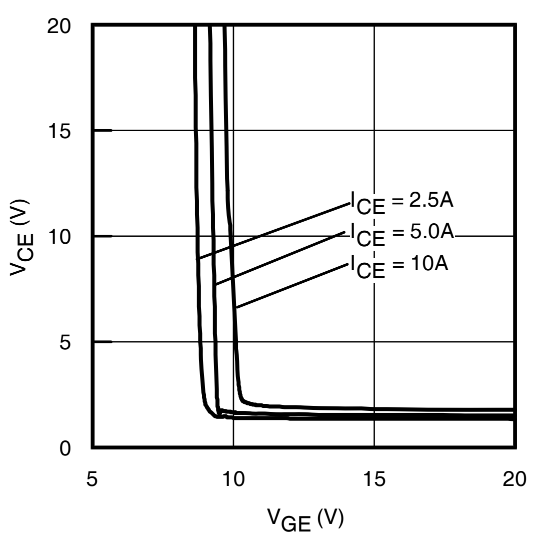


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

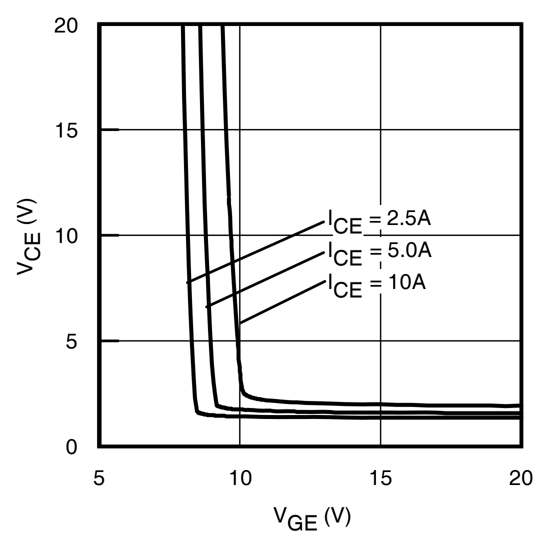


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

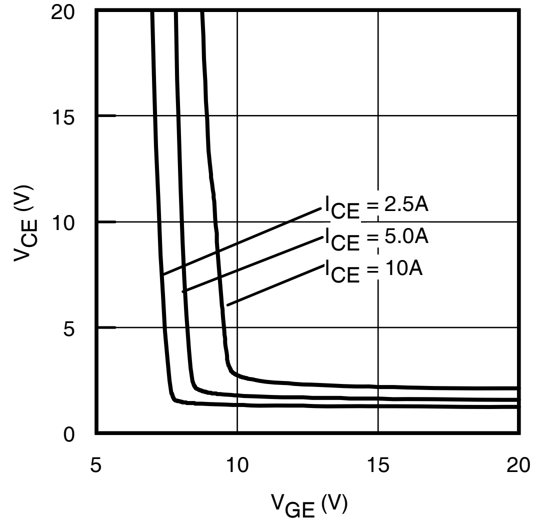


Fig. 12 - Typical V_{CE} vs. V_{GE}
$T_J = 150°C$

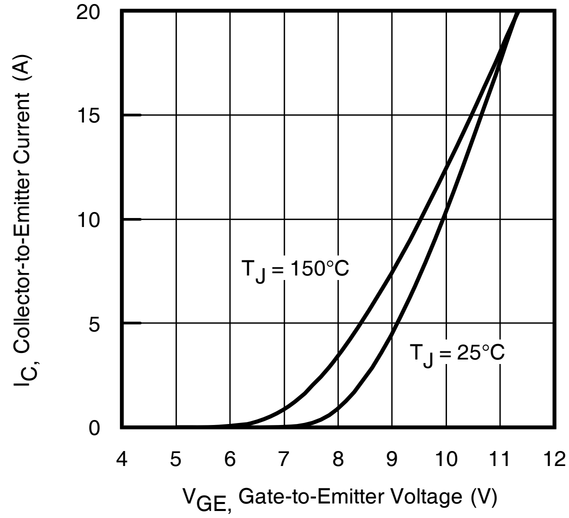


Fig. 13 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 20µs

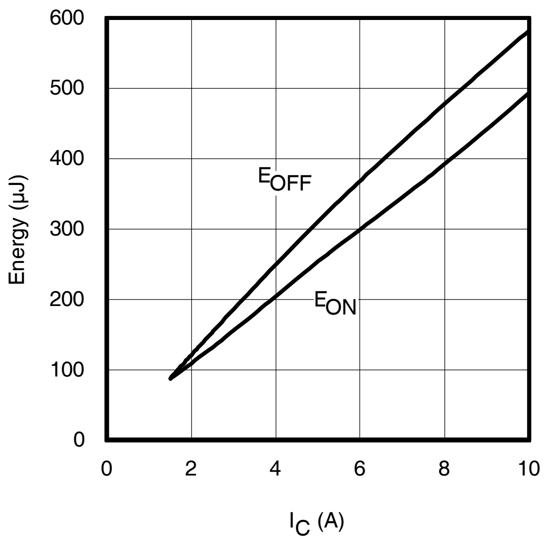


Fig. 14 - Typ. Energy Loss vs. I_C
T_J = 150°C; L = 1.6mH; V_{CE} = 400V, R_G = 100Ω; V_{GE} = 15V.

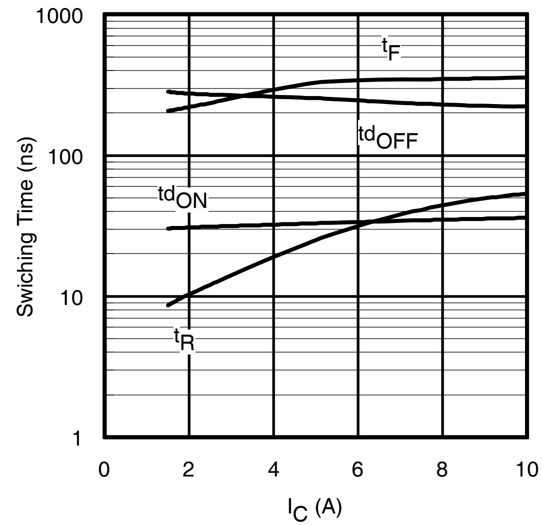


Fig. 15 - Typ. Switching Time vs. I_C
T_J = 150°C; L=1.6mH; V_{CE}= 400V
R_G= 100Ω; V_{GE}= 15V

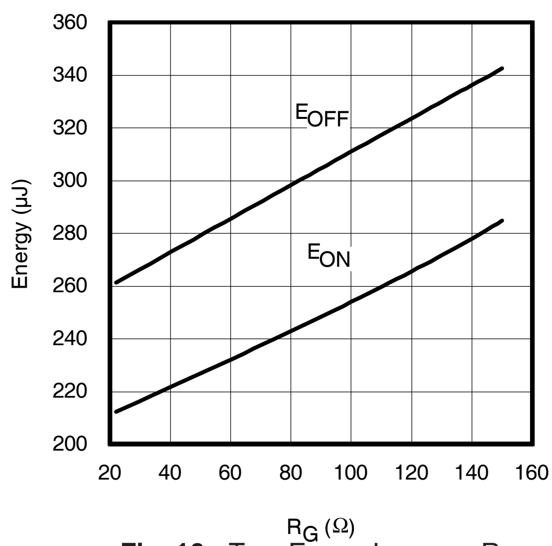


Fig. 16 - Typ. Energy Loss vs. R_G
T_J = 150°C; L = 1.6mH; V_{CE} = 400V, I_{CE} = 5.0A; V_{GE} = 15V

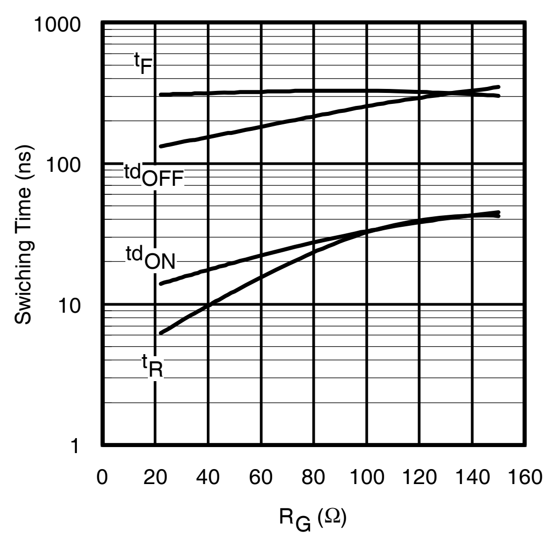


Fig. 17- Typ. Switching Time vs. R_G
T_J = 150°C; L=1.6mH; V_{CE}= 400V
I_{CE}= 5.0A; V_{GE}= 15V

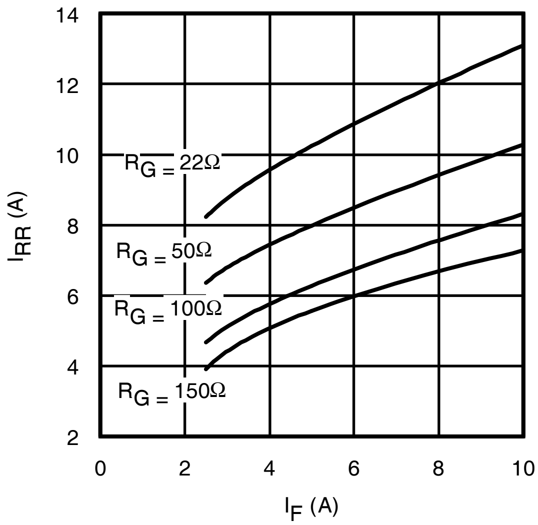


Fig. 18 - Typical Diode I_{RR} vs. I_F
T_J = 150°C

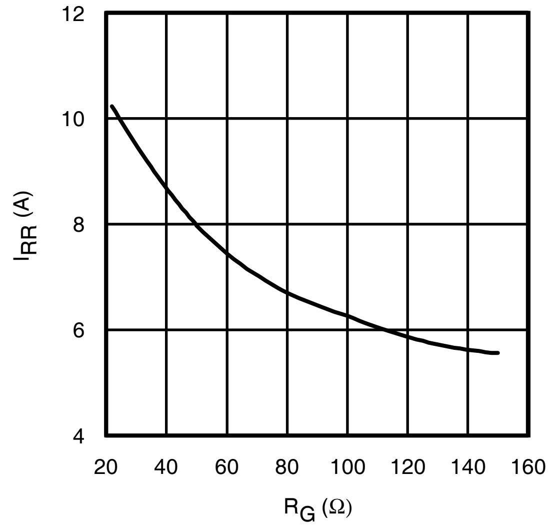


Fig. 19 - Typical Diode I_{RR} vs. R_G
T_J = 150°C; I_F = 5.0A

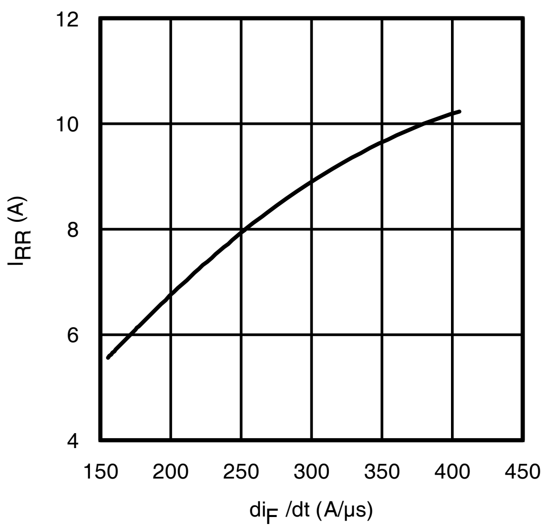


Fig. 20 - Typical Diode I_{RR} vs. di_F/dt
V_{CC}= 400V; V_{GE}= 15V;
I_{CE}= 5.0A; T_J = 150°C

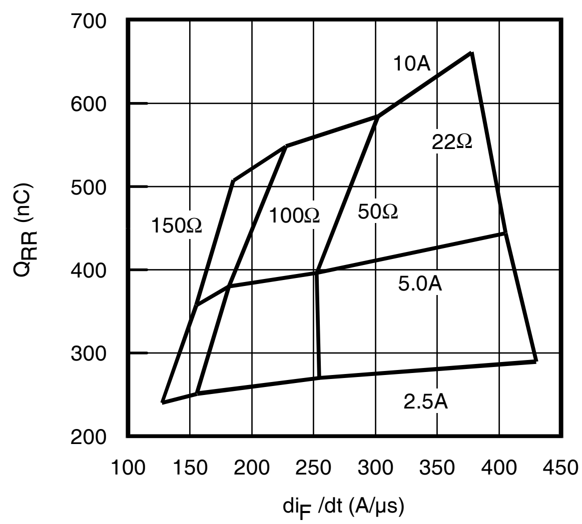


Fig. 21 - Typical Diode Q_{RR}
V_{CC}= 400V; V_{GE}= 15V; T_J = 150°C

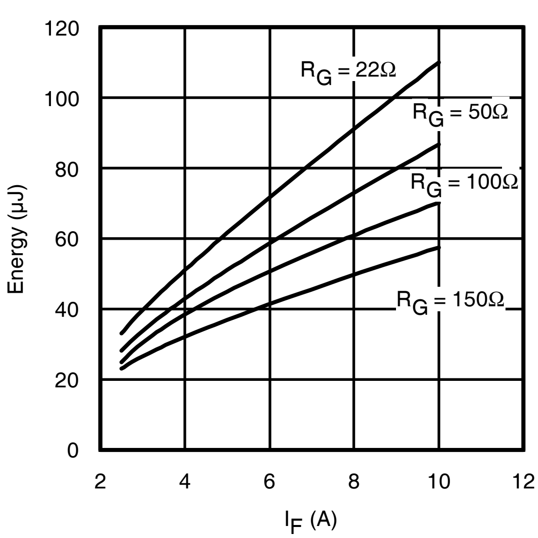


Fig. 22 - Typical Diode E_{RR} vs. I_F
T_J = 150°C

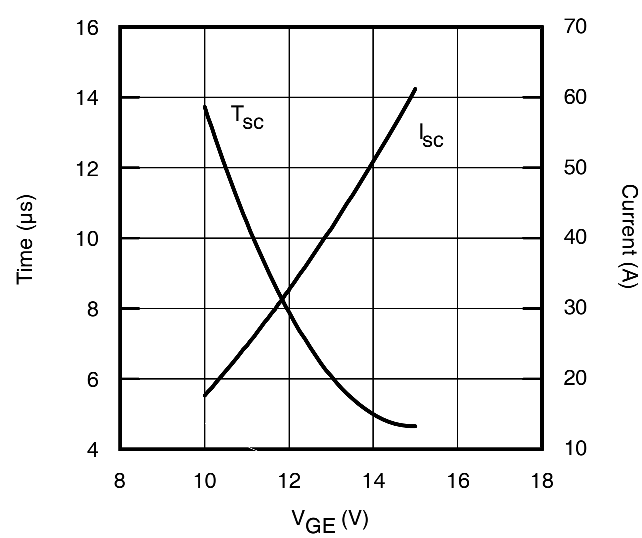


Fig. 23- Typ. V_{GE} vs. Short Circuit Time
V_{CC}=400V, T_C =25°C

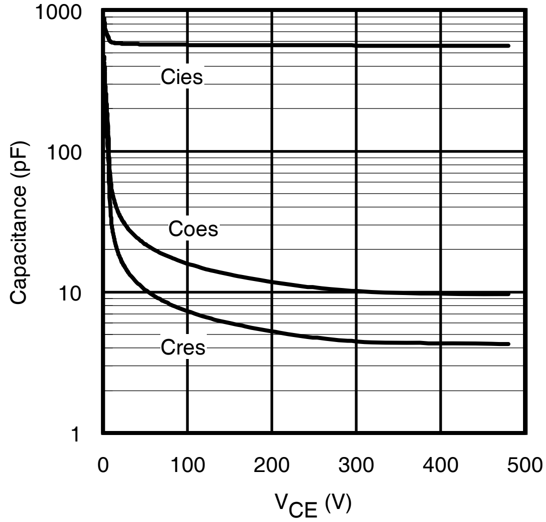


Fig. 24 - Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

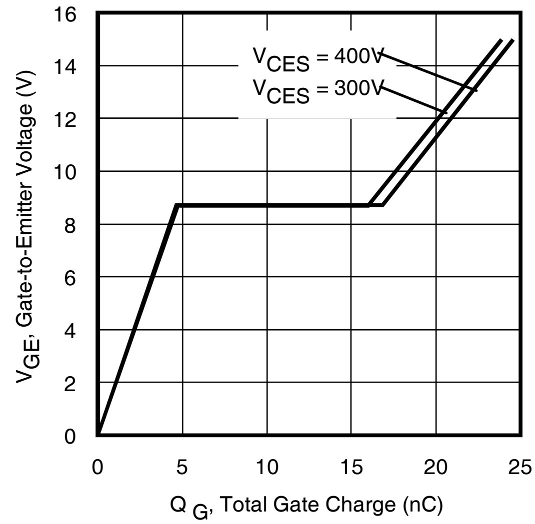


Fig. 25 - Typical Gate Charge vs. V_{GE}
I_{CE} = 5.0A, L= 2.2mH

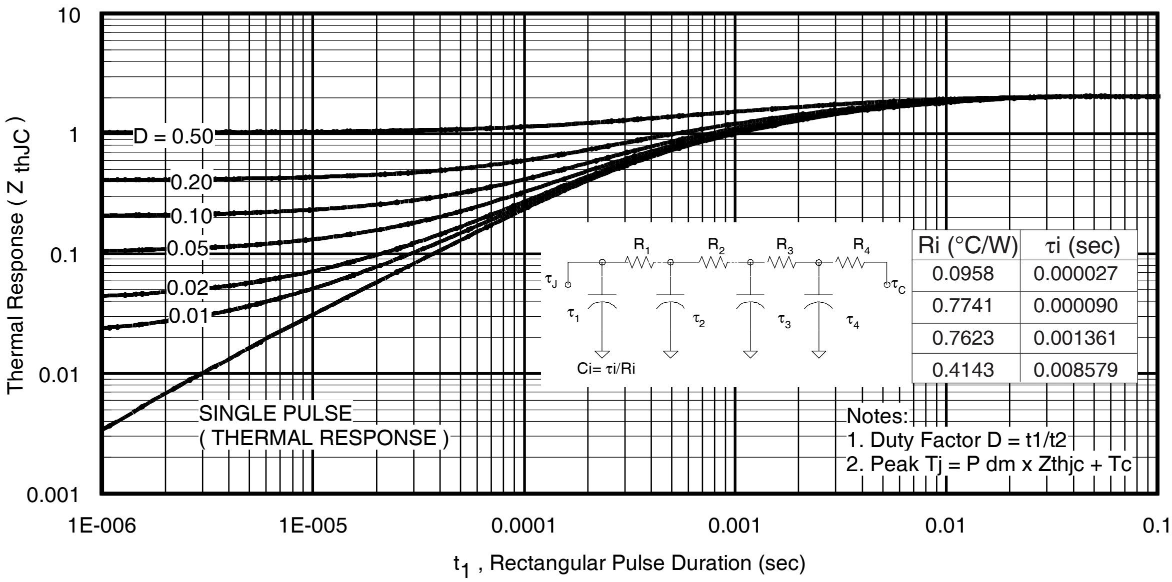


Fig 26 - Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

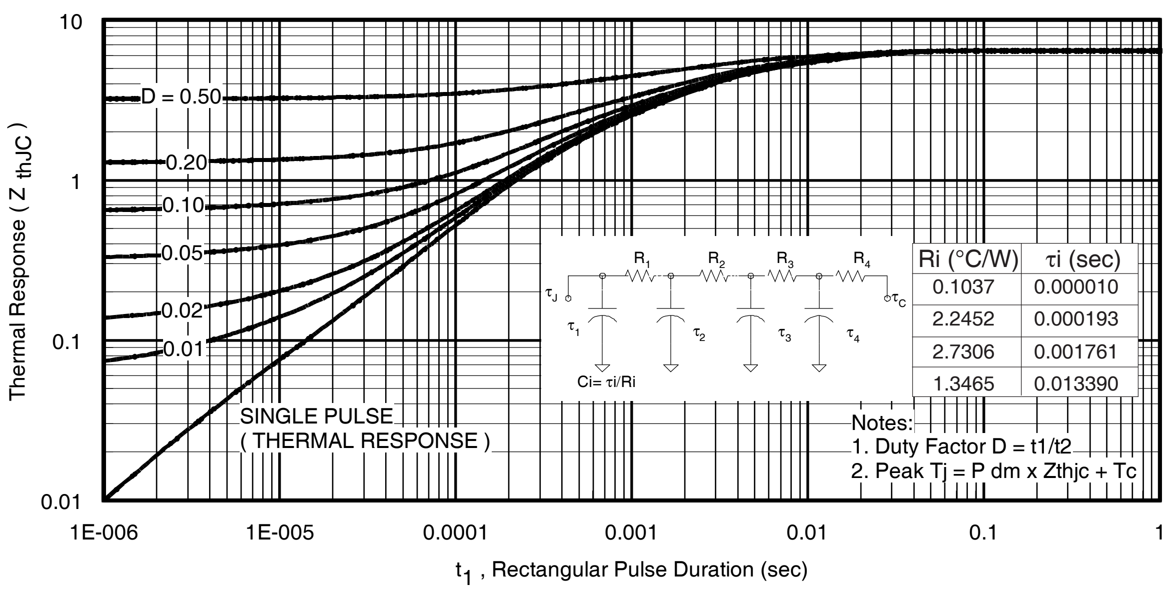


Fig. 27 - Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

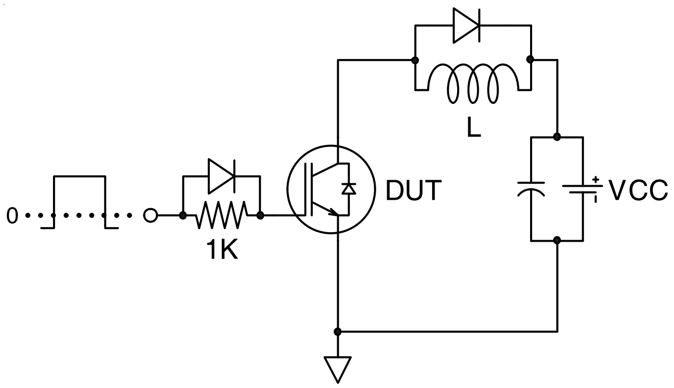


Fig.C.T.1 - Gate Charge Circuit (turn-off)

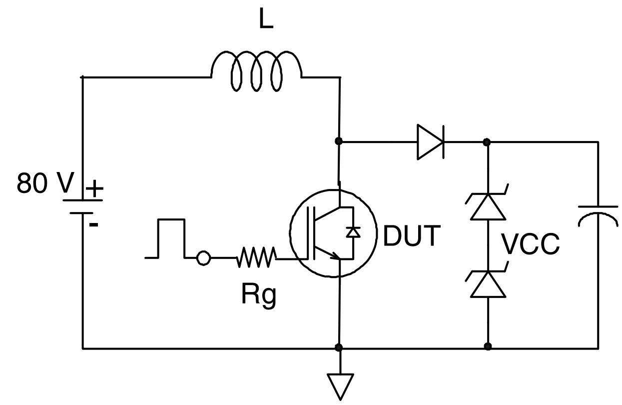
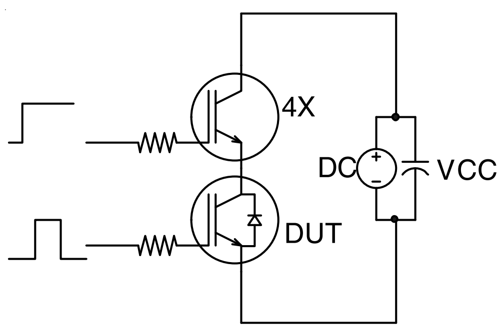


Fig.C.T.2 - RBSOA Circuit



SCSOA

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

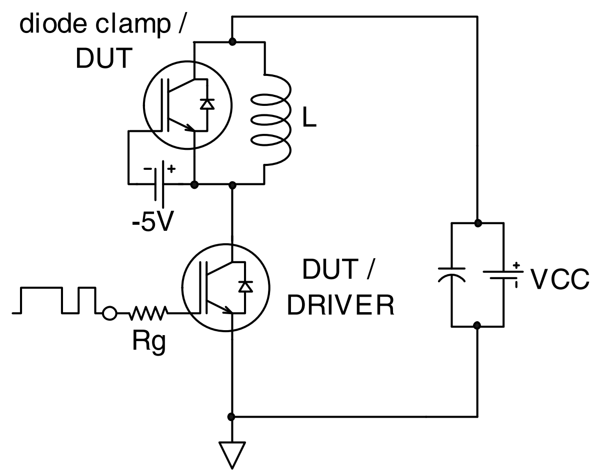


Fig.C.T.4 - Switching Loss Circuit

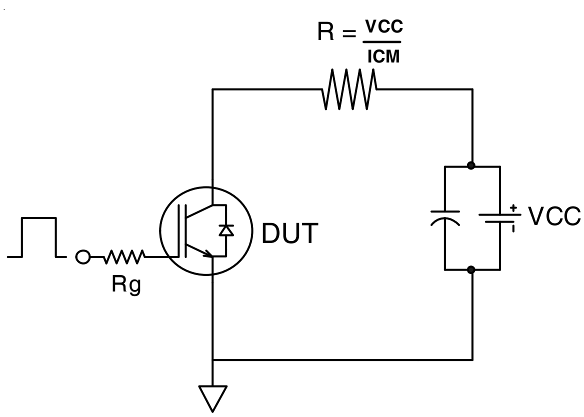


Fig.C.T.5 - Resistive Load Circuit

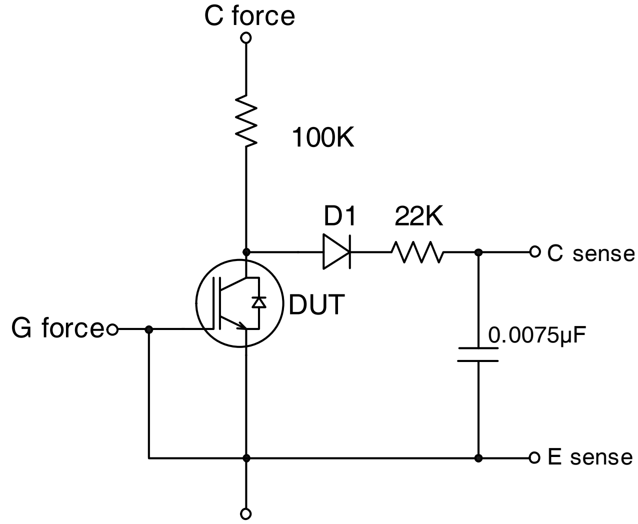


Fig.C.T.6 - BVCES Filter Circuit

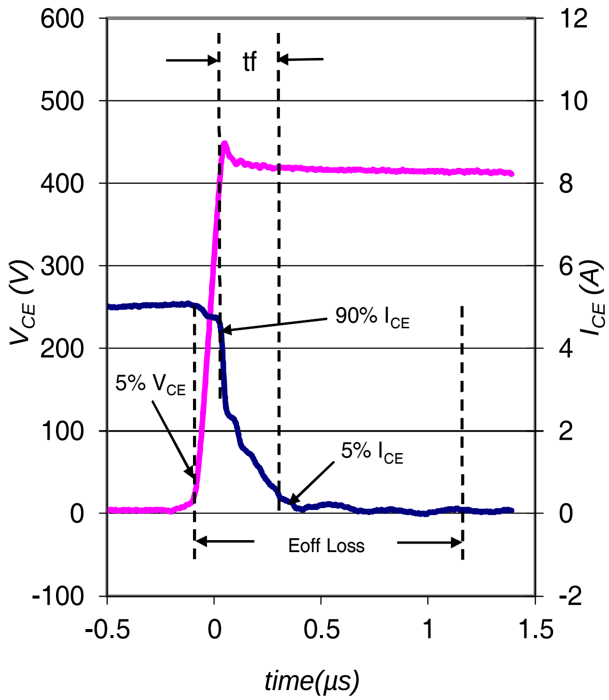


Fig. WF1 - Typ. Turn-off Loss Waveform
@ T_J = 150°C using Fig. CT.4

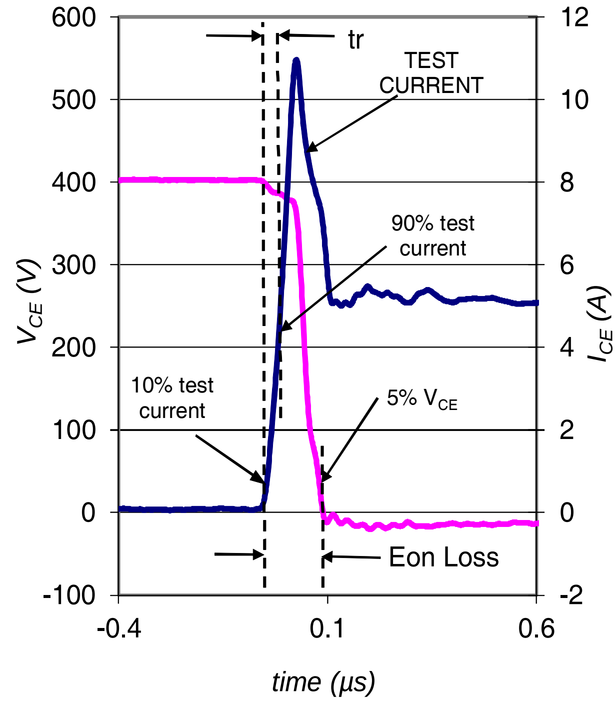
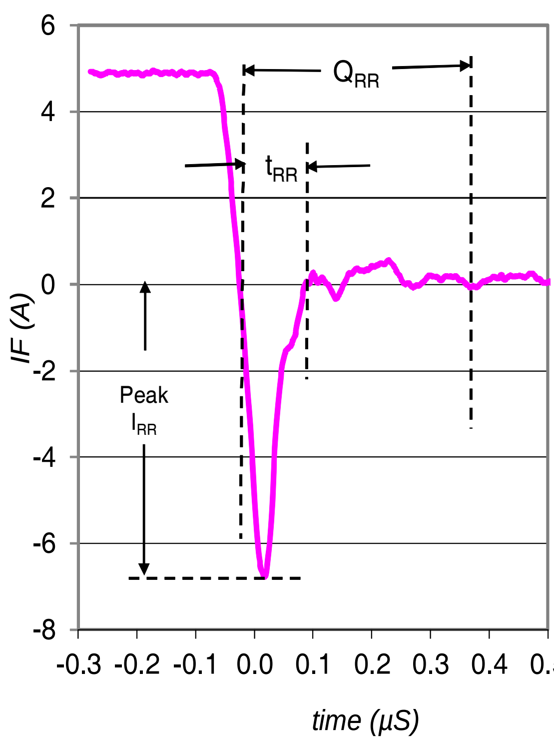
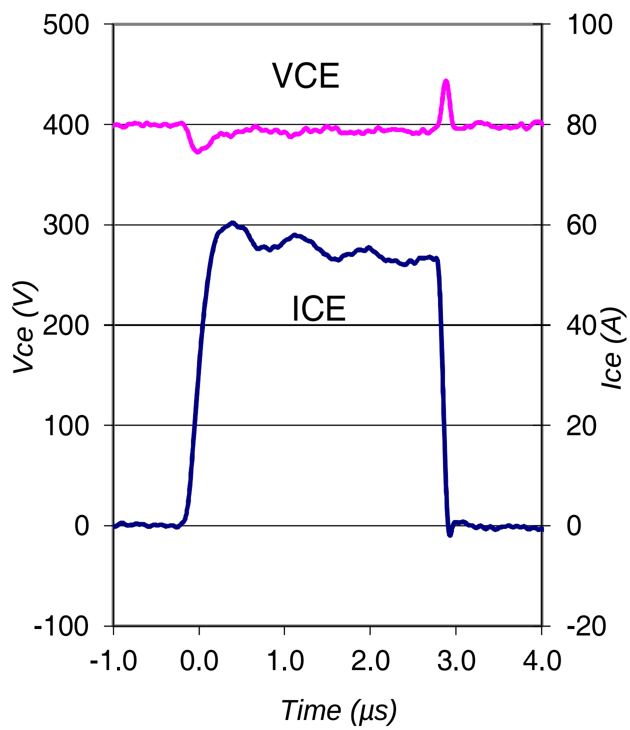


Fig. WF2 - Typ. Turn-on Loss Waveform
@ T_J = 150°C using Fig. CT.4



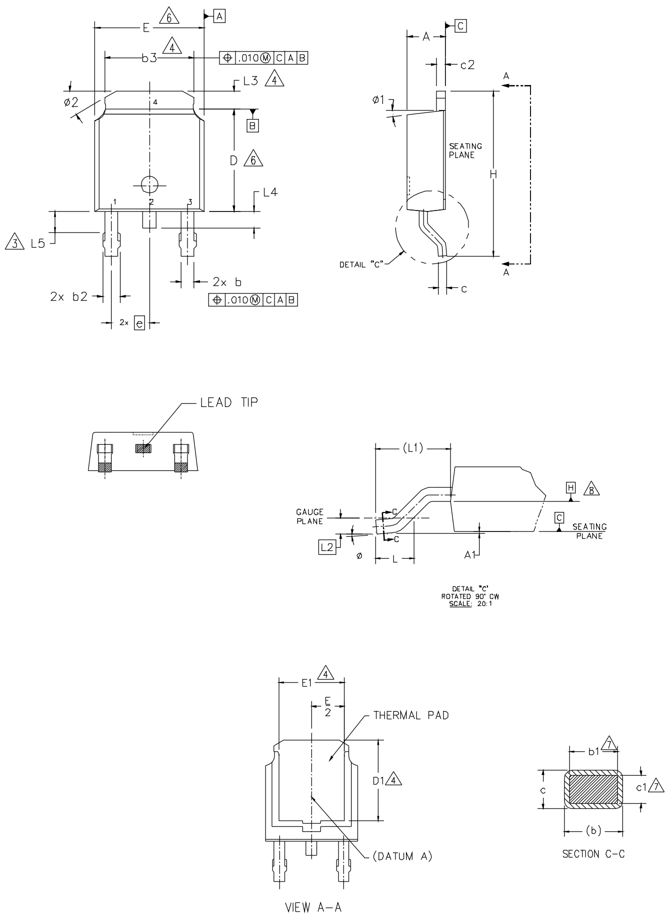
WF.3- Typ. Diode Recovery Waveform
@ T_J = 150°C using CT.4



WF.4- Typ. Short Circuit Waveform
@ T_J = 25°C using CT.3

D-Pak (TO-252AA) Package Outline

Dimensions are shown in millimeters (inches)



NOTES:

1. – DIMENSIONING AND TOLERANCING PER ASME Y14.5M–1994
2. – DIMENSION ARE SHOWN IN INCHES [MILLIMETERS].
3. – LEAD DIMENSION UNCONTROLLED IN L5.
4. – DIMENSION D1, E1, L3 & b3 ESTABLISH A MINIMUM MOUNTING SURFACE FOR THERMAL PAD.
5. – SECTION C–C DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN .005 AND 0.10 [0.13 AND 0.25] FROM THE LEAD TIP.
6. – DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005 [0.13] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
7. – DIMENSION b1 & c1 APPLIED TO BASE METAL ONLY.
8. – DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
9. – OUTLINE CONFORMS TO JEDEC OUTLINE TO–252AA.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	2.18	2.39	.086	.094	
A1	–	0.13	–	.005	
b	0.64	0.89	.025	.035	
b1	0.65	0.79	.025	.031	7
b2	0.76	1.14	.030	.045	
b3	4.95	5.46	.195	.215	4
c	0.46	0.61	.018	.024	
c1	0.41	0.56	.016	.022	7
c2	0.46	0.89	.018	.035	
D	5.97	6.22	.235	.245	6
D1	5.21	–	.205	–	4
E	6.35	6.73	.250	.265	6
E1	4.32	–	.170	–	4
e	2.29 BSC		.090 BSC		
H	9.40	10.41	.370	.410	
L	1.40	1.78	.055	.070	
L1	2.74 BSC		.108 REF.		
L2	0.51 BSC		.020 BSC		
L3	0.89	1.27	.035	.050	4
L4	–	1.02	–	.040	
L5	1.14	1.52	.045	.060	3
ø	0°	10°	0°	10°	
ø1	0°	15°	0°	15°	
ø2	25°	35°	25°	35°	

LEAD ASSIGNMENTS

HEXFET

1. – GATE
2. – DRAIN
3. – SOURCE
4. – DRAIN

IGBT & CoPAK

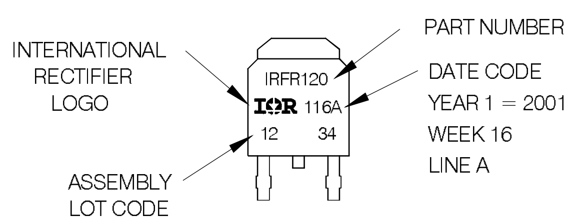
1. – GATE
2. – COLLECTOR
3. – EMITTER
4. – COLLECTOR

D-Pak (TO-252AA) Part Marking Information

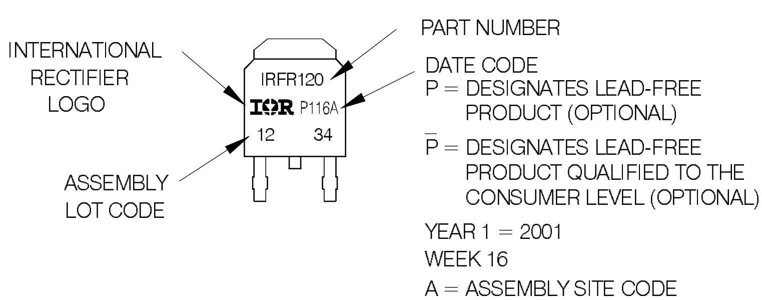
EXAMPLE: THIS IS AN IRFR120
WITH ASSEMBLY
LOT CODE 1234
ASSEMBLED ON WW 16, 2001
IN THE ASSEMBLY LINE "A"

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

"$\overline{P}$" in assembly line position indicates "Lead-Free" qualification to the consumer-level



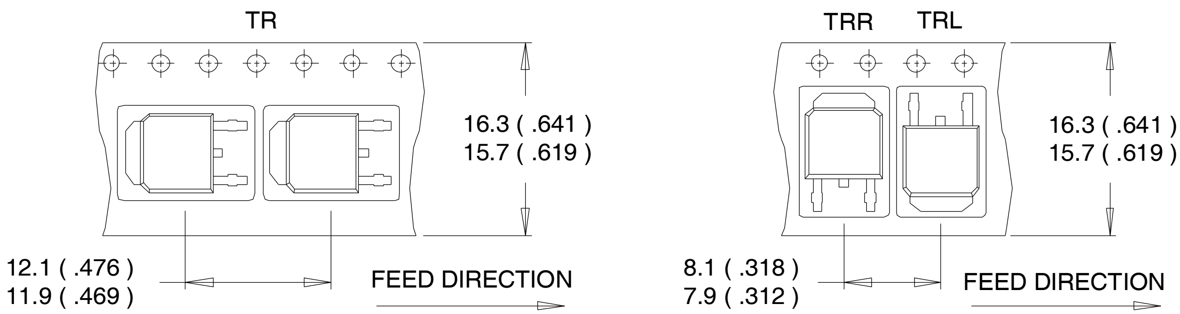
OR



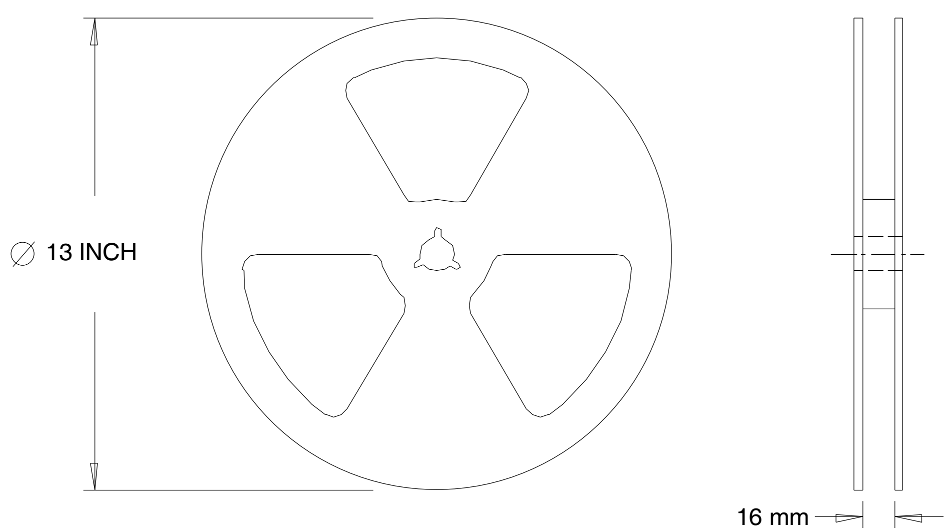
Note: For the most current drawing please refer to IR website at http://www.irf.com/package/

D-Pak (TO-252AA) Tape & Reel Information

Dimensions are shown in millimeters (inches)



NOTES :
1. CONTROLLING DIMENSION : MILLIMETER.
2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
3. OUTLINE CONFORMS TO EIA-481 & EIA-541.



NOTES :
1. OUTLINE CONFORMS TO EIA-481.

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.

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