Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!

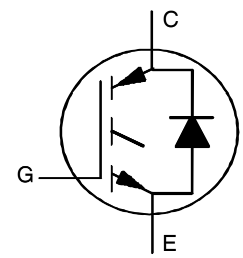
Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
Email & Skype: info@chipsmall.com Web: www.chipsmall.com
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

International
IOR Rectifier

IRGR4045DPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE



n-channel

V_{CES} = 600V

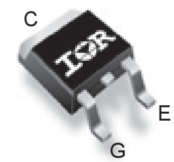
I_C = 6.0A, T_C = 100°C

T_{jmax} = 175°C

$V_{CE(on)\ typ.}$ = 1.7V

Features

- Low $V_{CE\ (on)}$ Trench IGBT Technology
- Low Switching Losses
- Maximum Junction temperature 175 °C
- 5µs SCSOA
- Square RBSOA
- 100% of the parts tested for I_{LM} ①
- Positive $V_{CE\ (on)}$ Temperature Coefficient.
- Ultra Fast Soft Recovery Co-pak Diode
- Tighter Distribution of Parameters
- Lead-Free, RoHS Compliant



D-Pak
IRGR4045DPbF

G	C	E
Gate	Colletor	Emitter

Benefits

- High Efficiency in a Wide Range of Applications
- Suitable for a Wide Range of Switching Frequencies due to Low $V_{CE\ (ON)}$ and Low Switching Losses
- Rugged Transient Performance for Increased Reliability
- Excellent Current Sharing in Parallel Operation
- Low EMI

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Breakdown Voltage	600	V
I_C @ T_C = 25°C	Continuous Collector Current	12	A
I_C @ T_C = 100°C	Continuous Collector Current	6.0	
I_{CM}	Pulsed Collector Current, V_{GE} = 15V	18	
I_{LM}	Clamped Inductive Load Current, V_{GE} = 20V ①	24	
I_F@T_C=25°C	Diode Continuous Forward Current	8.0	
I_F@T_C=100°C	Diode Continuous Forward Current	4.0	
I_{FM}	Diode Maximum Forward Current ②	24	
V_{GE}	Continuous Gate-to-Emitter Voltage	± 20	V
	Transient Gate-to-Emitter Voltage	± 30	
P_D @ T_C =25°	Maximum Power Dissipation	77	W
P_D @ T_C =100°	Maximum Power Dissipation	39	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 175	°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	–––	–––	1.9	°C/W
$R_{\theta JC}$	Junction-to-Case - Diode ③	–––	–––	6.8	
$R_{\theta JA}$	Junction-to-Ambient (PCB Mount) ⑤	–––	–––	50	
$R_{\theta JA}$	Junction-to-Ambient	–––	–––	110	

*Qualification standards can be found at http://www.irf.com/

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

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	—	—	V	V_{GE} = 0V, I_c =100 µA ④	CT 6
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.36	—	V/°C	V_{GE} = 0V, I_c = 250µA (25 -175 °C) ④	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.7	2.0	V	I_C = 6.0A, V_{GE} = 15V, T_J = 25°C	5,6,7,9, 10 ,11
		—	2.07	—		I_C = 6.0A, V_{GE} = 15V, T_J = 150°C	
		—	2.14	—		I_C = 6.0A, V_{GE} = 15V, T_J = 175°C	
$V_{GE(th)}$	Gate Threshold Voltage	3.5	—	6.5	V	V_{CE} = V_{GE}, I_C = 150µA	9,10,11,12
$\Delta V_{GE(th)}/\Delta TJ$	Threshold Voltage temp. coefficient	—	-13	—	mV/°C	V_{CE} = V_{GE}, I_C = 250µA (25 -175 °C)	
gfe	Forward Transconductance	—	5.8	—	S	V_{CE} = 25V, I_C = 6.0A, PW =80µs	
I_{CES}	Collector-to-Emitter Leakage Current	—	—	25	µA	V_{GE} = 0V,V_{CE} = 600V	8
		—	—	250		V_{GE} = 0V, V_{CE} = 600V, T_J =175°C	
V_{FM}	Diode Forward Voltage Drop	—	1.60	2.30	V	I_F = 6.0A	
		—	1.30	—		I_F = 6.0A, T_J = 175°C	
I_{GES}	Gate-to-Emitter Leakage Current	—	—	±100	nA	V_{GE} = ± 20 V	

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

	Parameter	Min.	Typ.	Max.⑥	Units	Conditions	Ref.Fig
Q_g	Total Gate Charge (turn-on)	—	13	19.5	nC	I_C = 6.0A	24
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	3.1	4.65		V_{CC} = 400V	CT 1
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	6.4	9.6		V_{GE} = 15V	
E_{on}	Turn-On Switching Loss	—	56	86	µJ	I_C = 6.0A, V_{CC} = 400V, V_{GE} = 15V	CT 4
E_{off}	Turn-Off Switching Loss	—	122	143		R_G = 47Ω, L=1mH, L_S= 150nH, T_J = 25°C	
E_{total}	Total Switching Loss	—	178	229		Energy losses include tail and diode reverse recovery	
$t_{d(on)}$	Turn-On delay time	—	27	35	ns	I_C = 6.0A, V_{CC} = 400V	CT 4
t_r	Rise time	—	11	15		R_G = 47Ω, L=1mH, L_S= 150nH	
$t_{d(off)}$	Turn-Off delay time	—	75	93		T_J = 25°C	
t_f	Fall time	—	17	22			
E_{on}	Turn-On Switching Loss	—	140	—	µJ	I_C = 6.0A, V_{CC} = 400V, V_{GE} = 15V	13, 15
E_{off}	Turn-Off Switching Loss	—	189	—		R_G = 47Ω, L=1mH, L_S= 150nH, T_J = 175°C	CT 4
E_{total}	Total Switching Loss	—	329	—		Energy losses include tail and diode reverse recovery	WF 1,WF 2
$t_{d(on)}$	Turn-On delay time	—	26	—	ns	I_C = 6.0A, V_{CC} = 400V	14, 16
t_r	Rise time	—	12	—		R_G = 47Ω, L=1mH, L_S= 150nH	CT 4
$t_{d(off)}$	Turn-Off delay time	—	95	—		T_J = 175°C	WF 1,WF 2
t_f	Fall time	—	32	—			
C_{ies}	Input Capacitance	—	350	—	pF	V_{GE} = 0V	23
C_{oes}	Output Capacitance	—	29	—		V_{CC} = 30V	
C_{res}	Reverse Transfer Capacitance	—	10	—		f = 1Mhz	
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T_J = 175°C, I_C = 24A V_{CC} = 500V, Vp =600V R_G = 100Ω, V_{GE} = +20V to 0V	4 CT 2
SCSOA	Short Circuit Safe Operating Area	—	5	—	µs	V_{CC} = 400V, Vp =600V R_G = 100Ω, V_{GE} = +15V to 0V	22 CT 3, WF 4
Erec	Reverse recovery energy of the diode	—	178	—	µJ	T_J = 175°C	17, 18, 19
trr	Diode Reverse recovery time	—	74	—	ns	V_{CC} = 400V, I_F = 6.0A	20,21
Irr	Peak Reverse Recovery Current	—	12	—	A	V_{GE} = 15V, Rg = 47Ω, L=1mH, L_S=150nH	WF 3

Notes:

① V_{CC} = 80% (V_{CES}), V_{GE} = 15V, L = 1.0mH, R_G = 47Ω.
② Pulse width limited by max. junction temperature.
③ R_θ is measured at T_J approximately 90°C.
④ Refer to AN-1086 for guidelines for measuring $V_{(BR)CES}$ safely.
⑤ When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994.
⑥ Maximum limits are based on statistical sample size characterization.

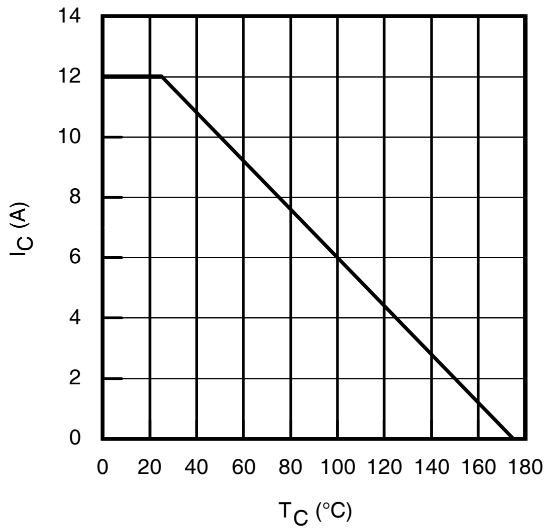


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

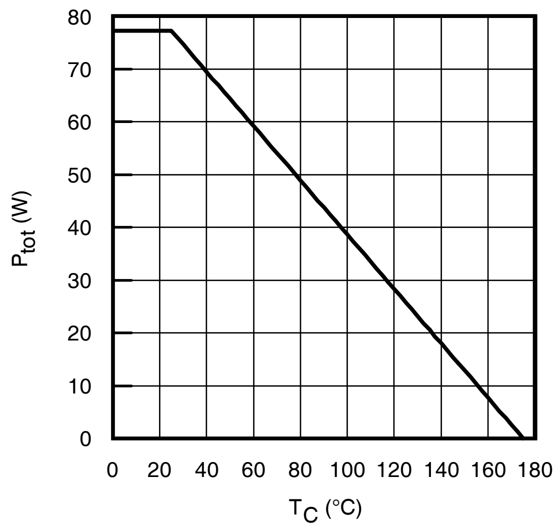


Fig. 2 - Power Dissipation vs. Case Temperature

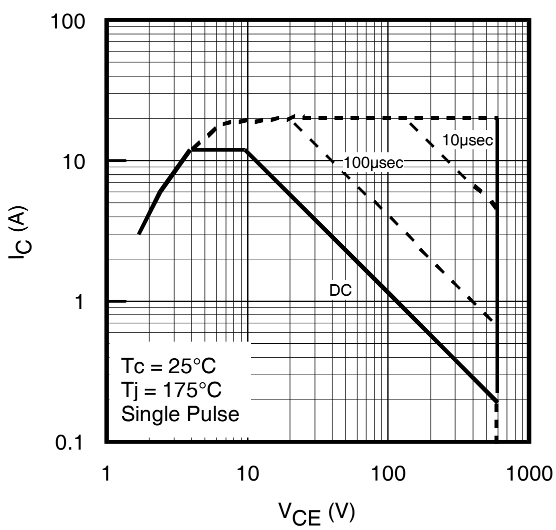


Fig. 3 - Forward SOA, $T_C = 25°C$, $T_J \leq 175°C$, $V_{GE} = 15V$

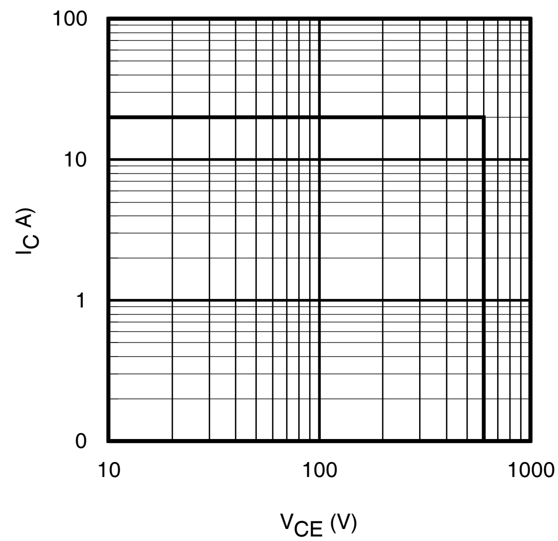


Fig. 4 - Reverse Bias SOA $T_J = 175°C$, $V_{GE} = 20V$

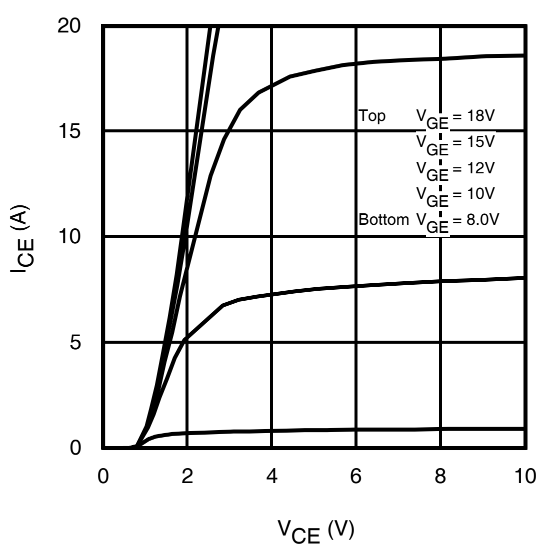


Fig. 5 - Typ. IGBT Output Characteristics $T_J = -40°C$; tp = 80µs

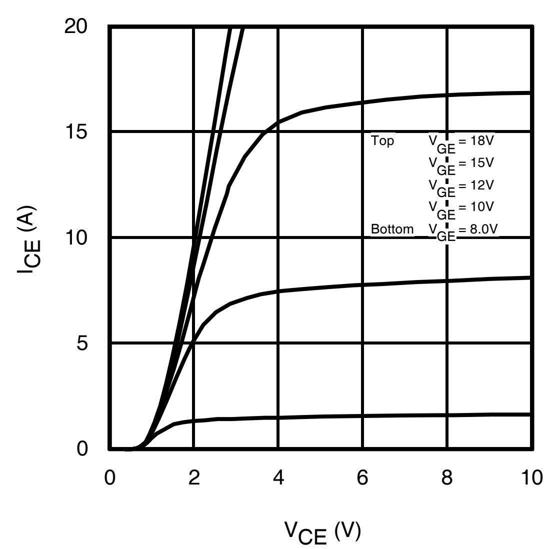


Fig. 6 - Typ. IGBT Output Characteristics $T_J = 25°C$; tp = 80µs

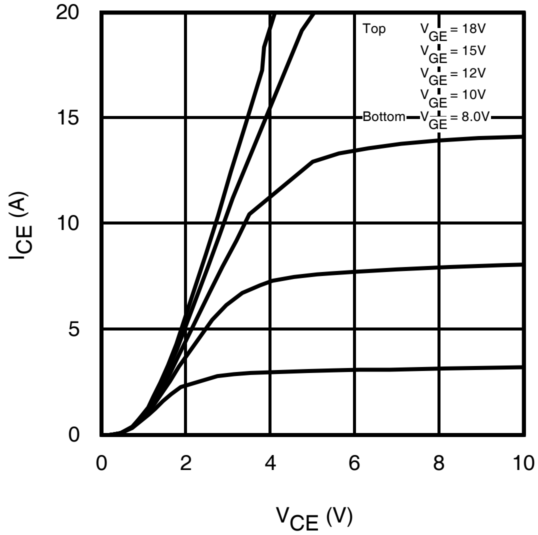


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 175°C; tp = 80µs

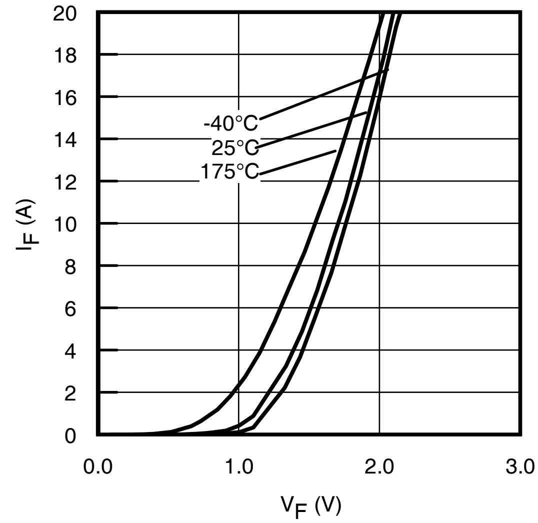


Fig. 8 - Typ. Diode Forward Characteristics
tp = 80µs

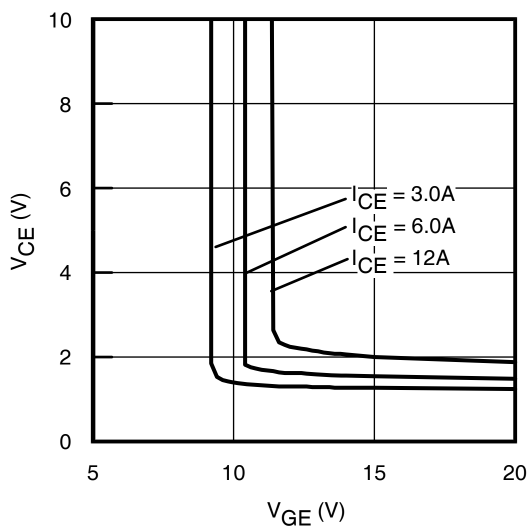


Fig. 9 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

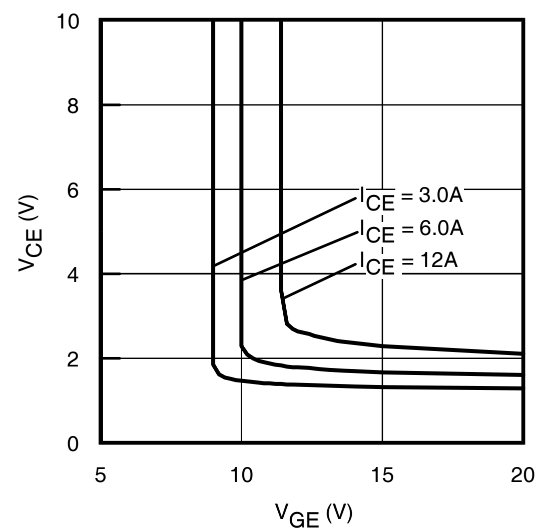


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

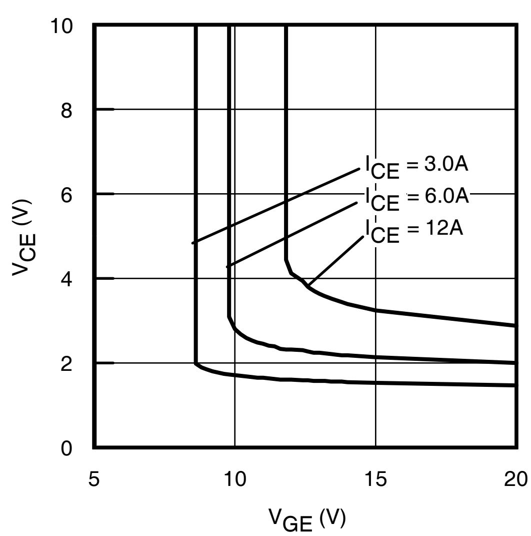


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 175°C

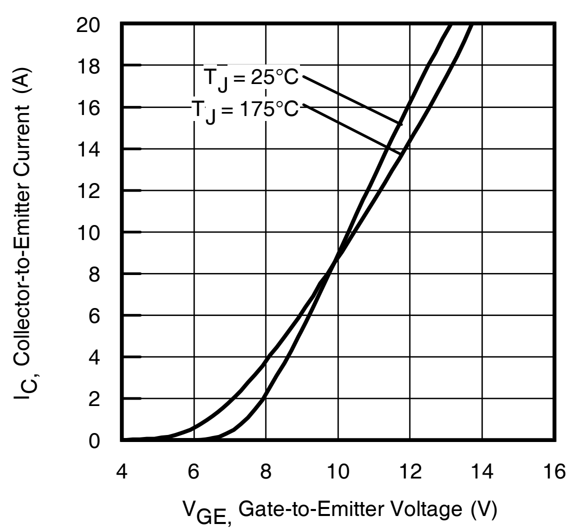


Fig. 12 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 10µs

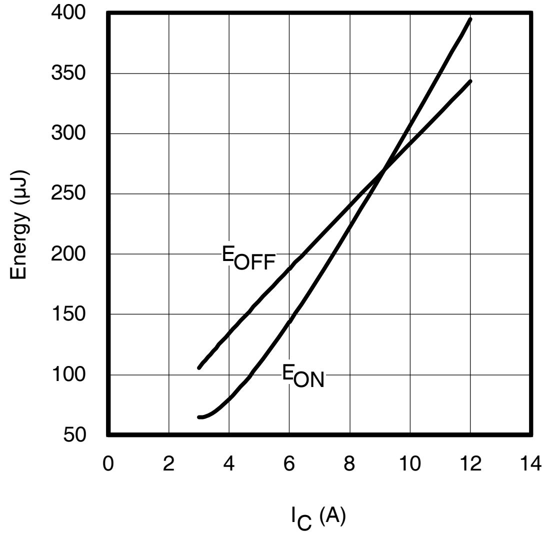


Fig. 13 - Typ. Energy Loss vs. I_C
T_J = 175°C; L = 1mH; V_{CE} = 400V, R_G = 47Ω; V_{GE} = 15V.

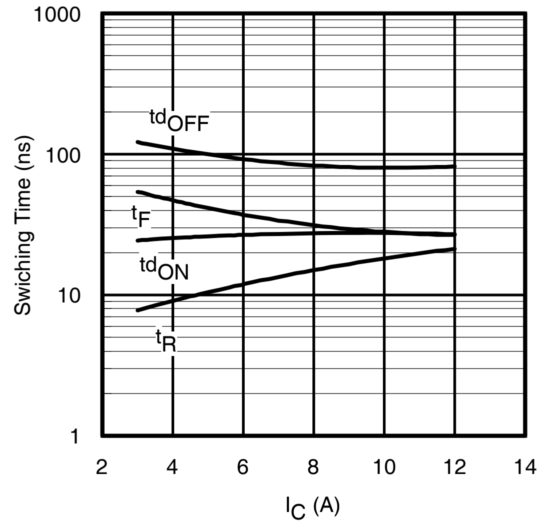


Fig. 14 - Typ. Switching Time vs. I_C
T_J = 175°C; L=1mH; V_{CE}= 400V
R_G= 47Ω; V_{GE}= 15V

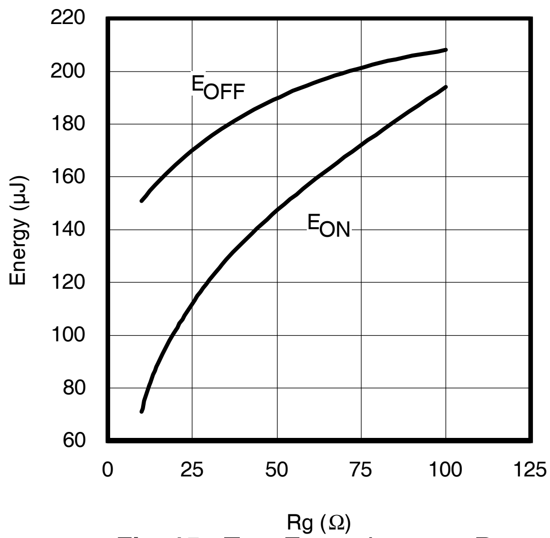


Fig. 15 - Typ. Energy Loss vs. R_G
T_J = 175°C; L = 1mH; V_{CE} = 400V, I_{CE} = 6.0A; V_{GE} = 15V

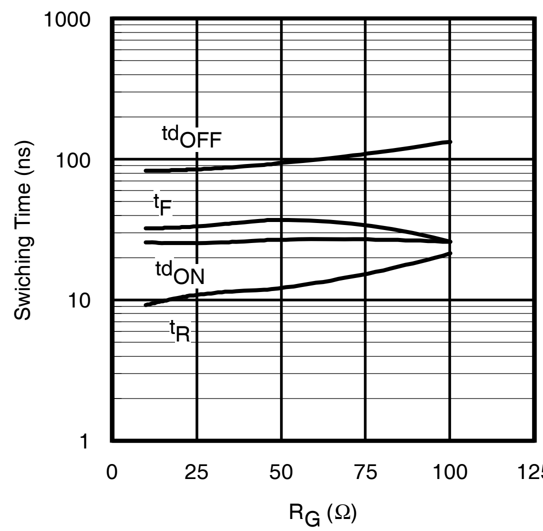


Fig. 16- Typ. Switching Time vs. R_G
T_J = 175°C; L=1mH; V_{CE}= 400V
I_{CE}= 6.0A; V_{GE}= 15V

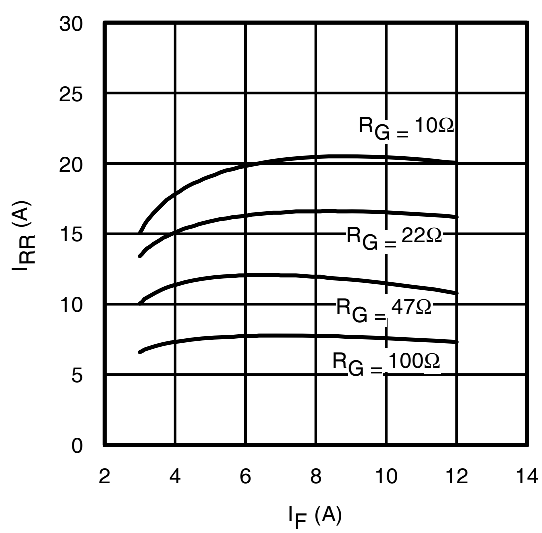


Fig. 17 - Typical Diode I_{RR} vs. I_F
T_J = 175°C

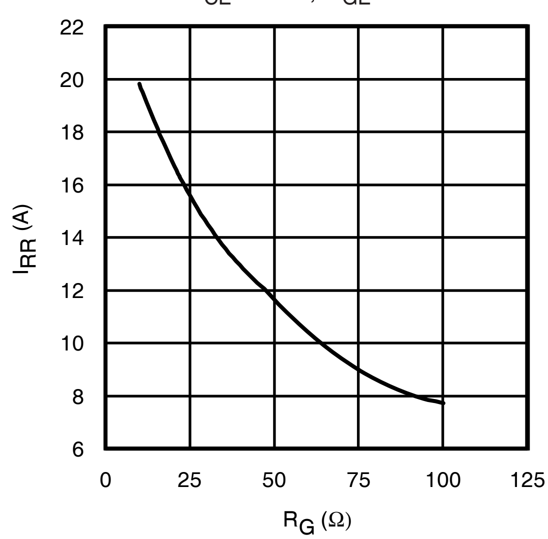


Fig. 18 - Typical Diode I_{RR} vs. R_G
T_J = 175°C; I_F = 6.0A

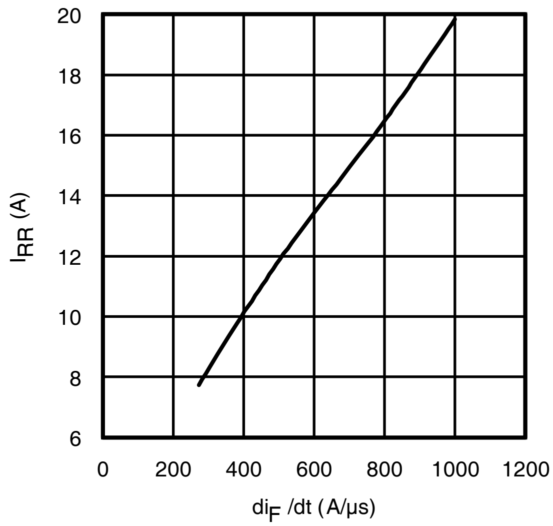


Fig. 19- Typical Diode I_{RR} vs. di_F/dt
V_{CC}= 400V; V_{GE}= 15V;
I_{CE}= 6.0A; T_J = 175°C

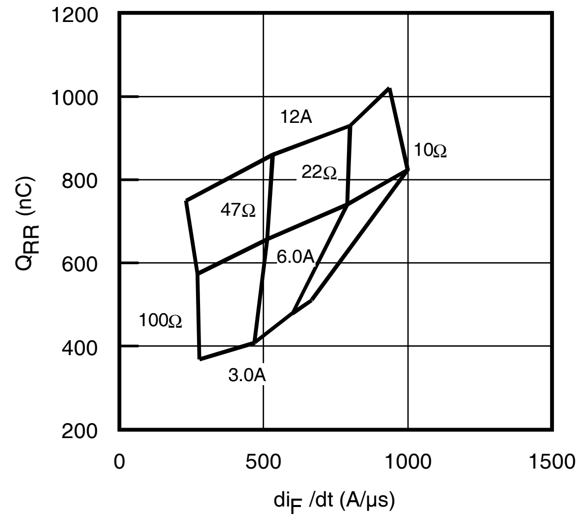


Fig. 20 - Typical Diode Q_{RR}
V_{CC}= 400V; V_{GE}= 15V; T_J = 175°C

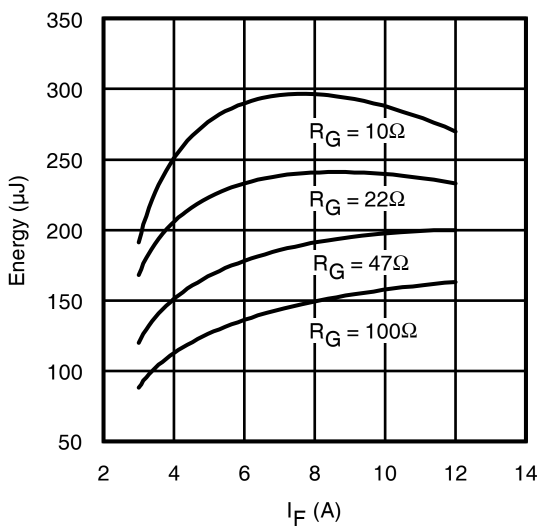


Fig. 21 - Typical Diode E_{RR} vs. I_F
T_J = 175°C

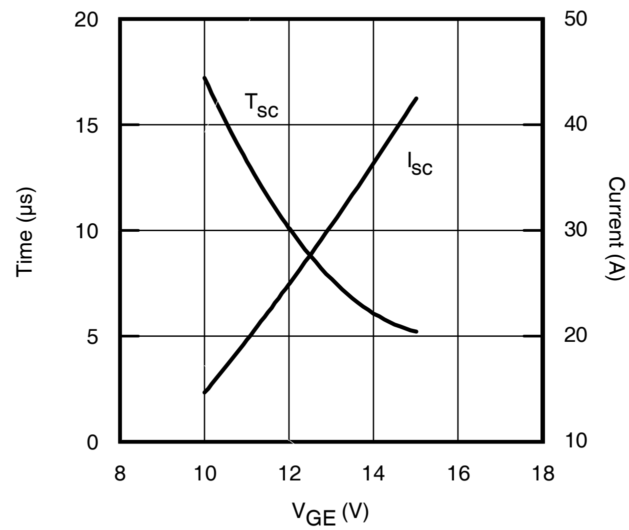


Fig. 22- Typ. V_{GE} vs. Short Circuit Time
V_{CC}=400V, T_C =25°C

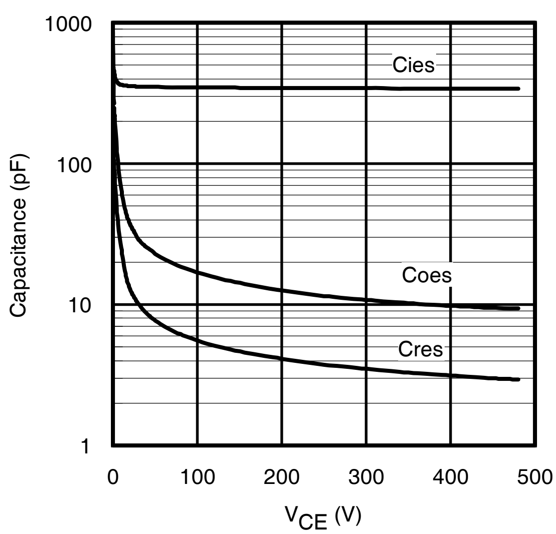


Fig. 23- Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

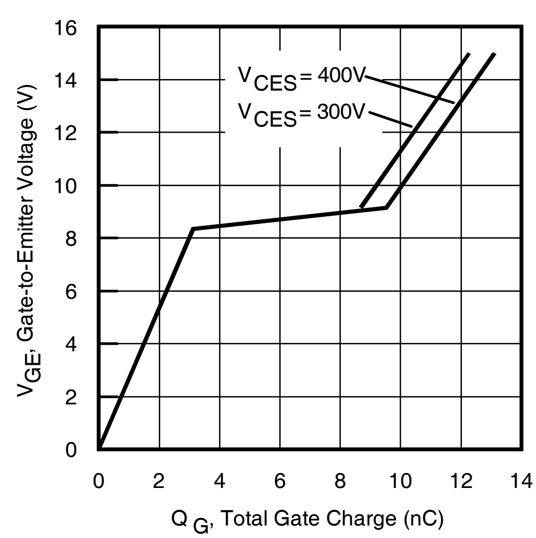
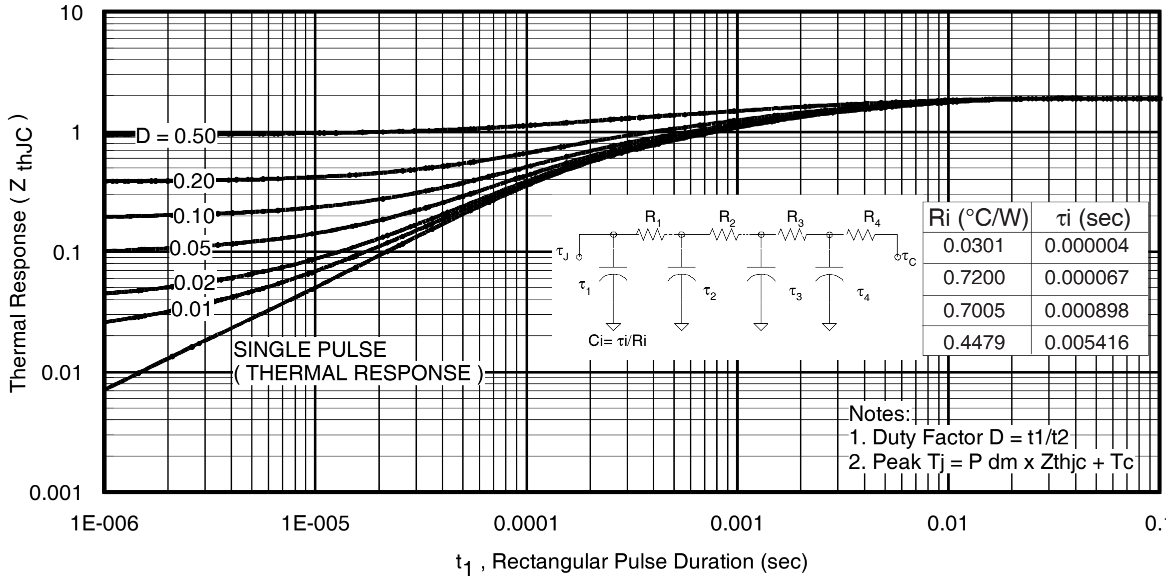
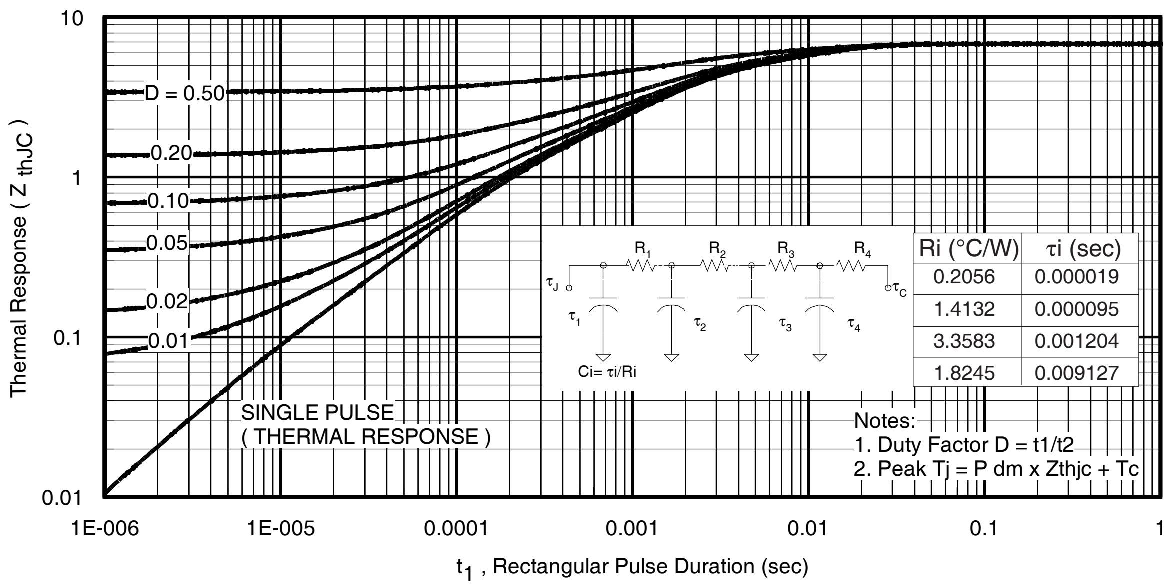


Fig. 24 - Typical Gate Charge vs. V_{GE}
I_{CE} = 6.0A, L=600µH



Ri (°C/W)	τi (sec)
0.0301	0.000004
0.7200	0.000067
0.7005	0.000898
0.4479	0.005416

Fig 25. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)



Ri (°C/W)	τi (sec)
0.2056	0.000019
1.4132	0.000095
3.3583	0.001204
1.8245	0.009127

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

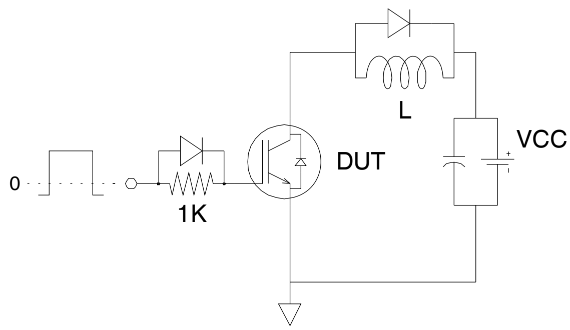


Fig.C.T.1 - Gate Charge Circuit (turn-off)

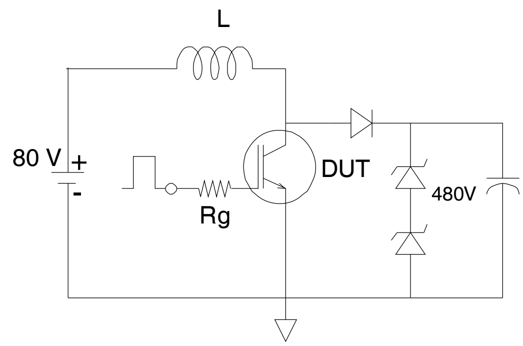


Fig.C.T.2 - RBSOA Circuit

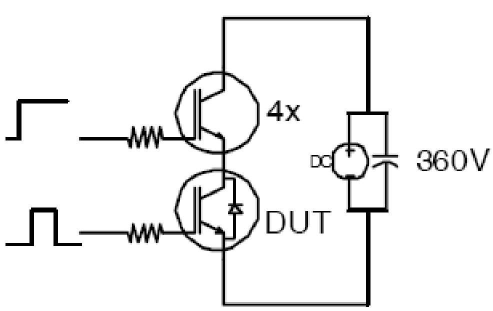


Fig.C.T.3 - S.C.SOA Circuit

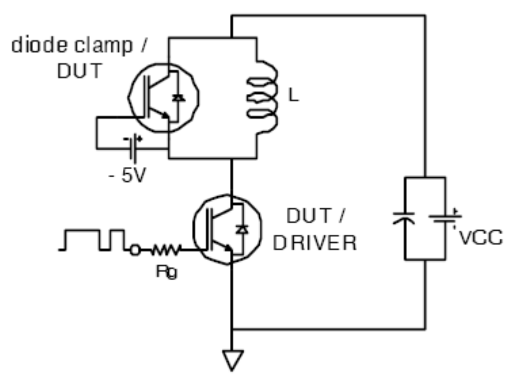


Fig.C.T.4 - Switching Loss Circuit

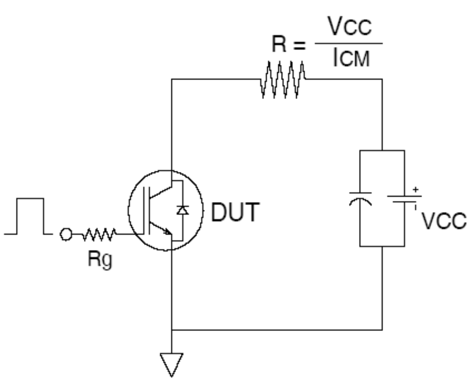


Fig.C.T.5 - Resistive Load Circuit

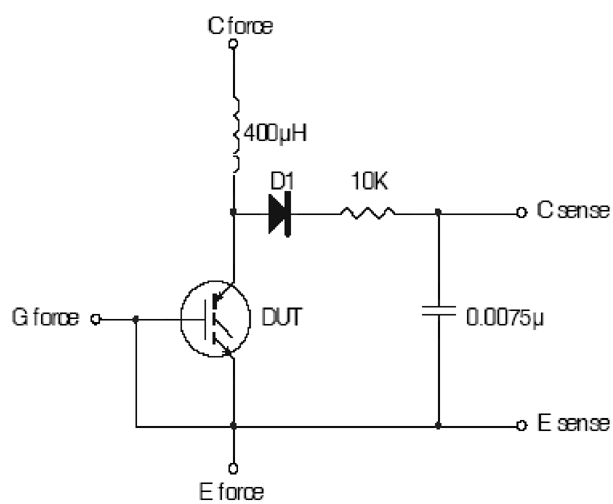


Fig.C.T.6 - Typical Filter Circuit for $V_{(BR)CES}$ Measurement

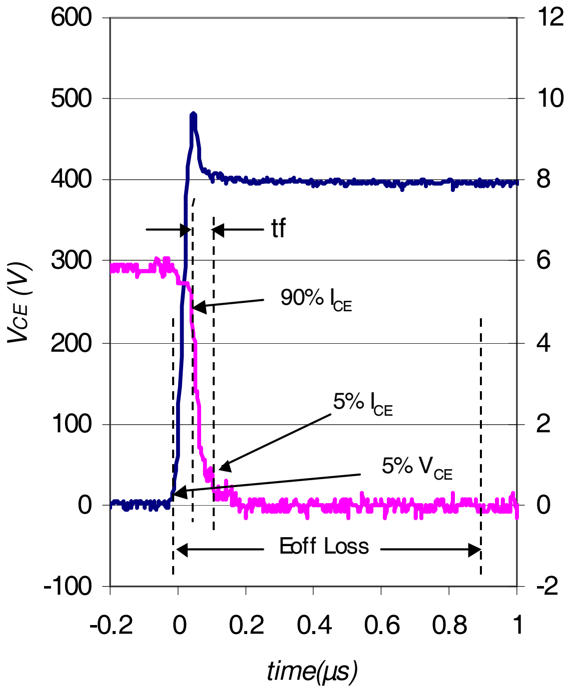


Fig. WF1 - Typ. Turn-off Loss Waveform
@ T_J = 175°C using Fig. CT.4

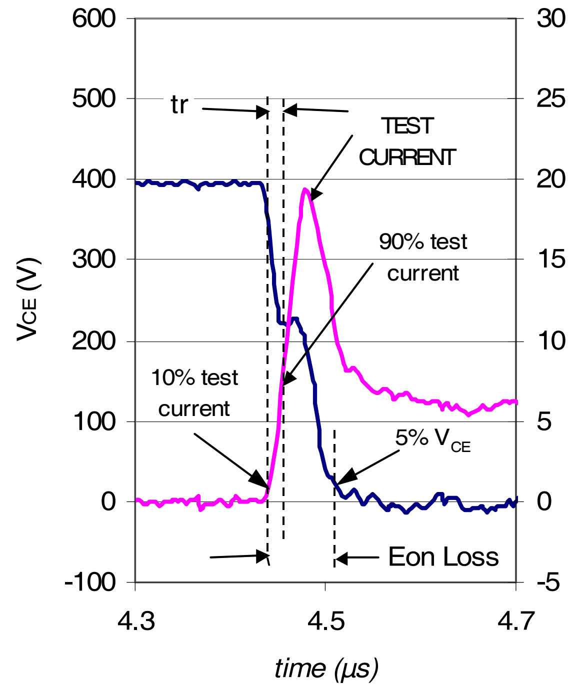
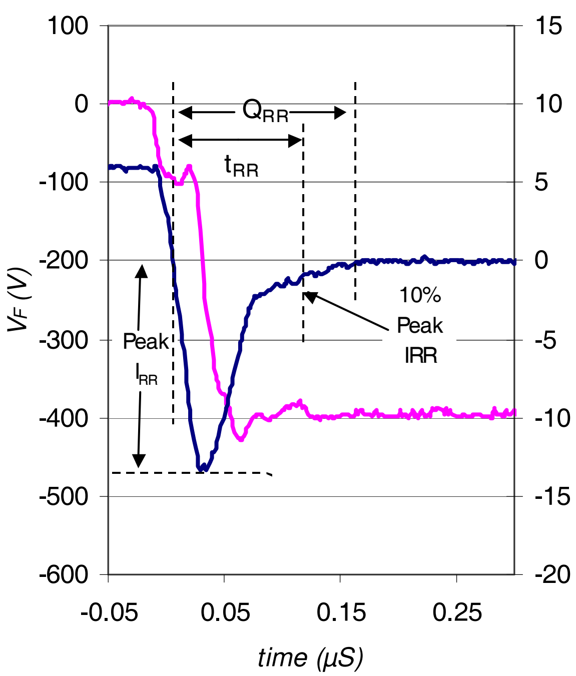
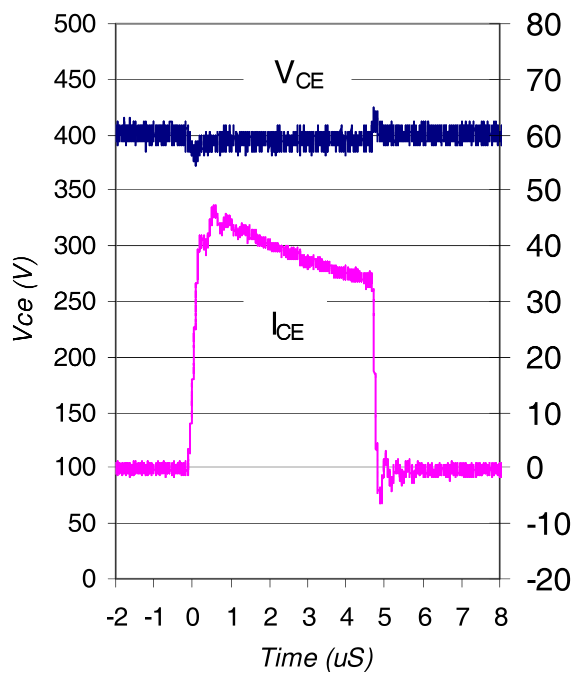


Fig. WF2 - Typ. Turn-on Loss Waveform
@ T_J = 175°C using Fig. CT.4



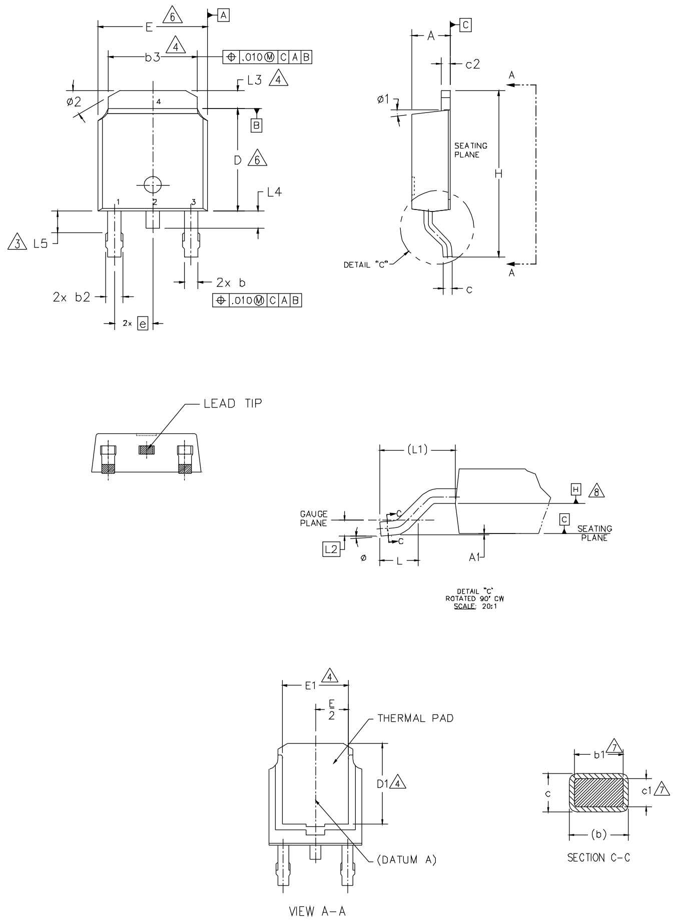
WF.3- Typ. Diode Recovery Waveform
@ T_J = 175°C using CT.4



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

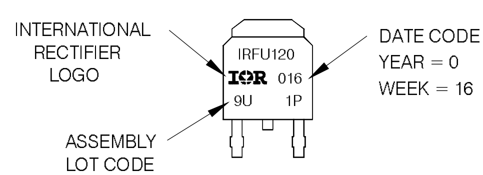
IGBT & CoPAK

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

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

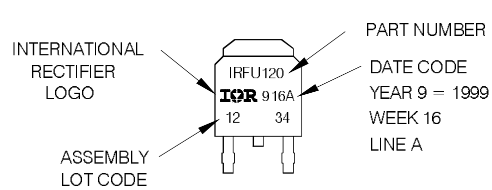
Notes: This part marking information applies to devices produced before 02/26/2001

EXAMPLE: THIS IS AN IRFR120
WITH ASSEMBLY
LOT CODE 9U1P



Notes: This part marking information applies to devices produced after 02/26/2001

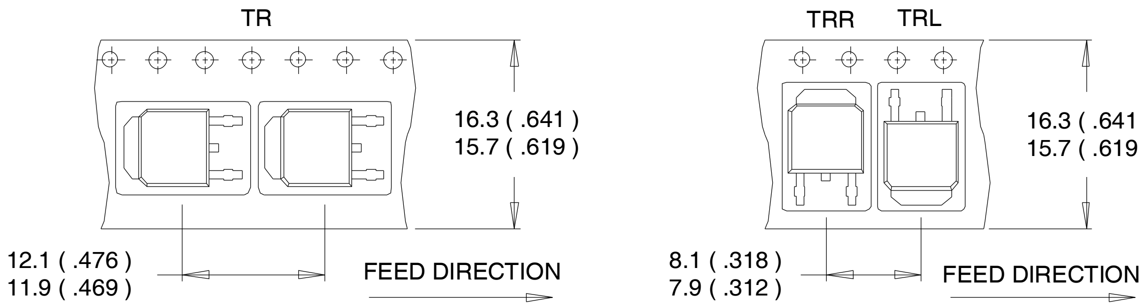
EXAMPLE: THIS IS AN IRFR120
WITH ASSEMBLY
LOT CODE 1234
ASSEMBLED ON WW 16, 1999
IN THE ASSEMBLY LINE "A"



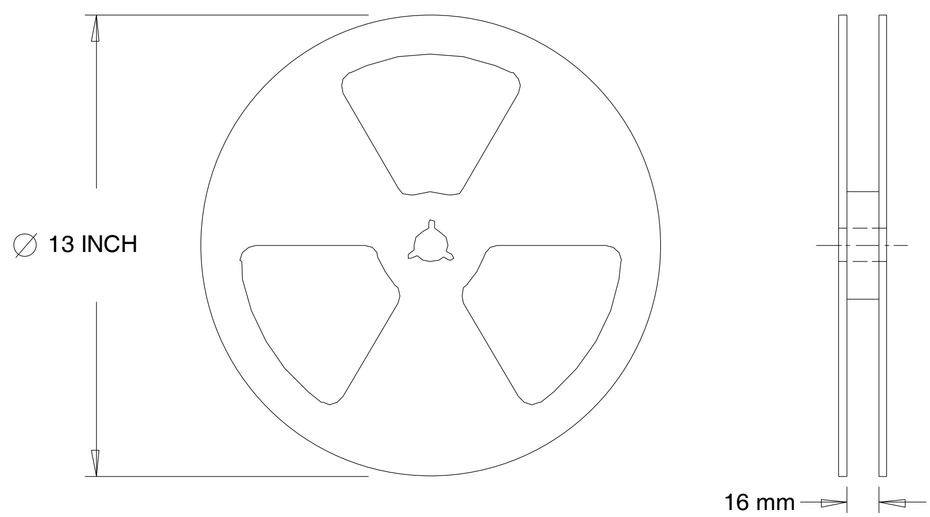
Note: For the most current drawing please refer to IR website at http://www.irf.com/package/

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.

Data and specifications subject to change without notice.
This product has been designed and qualified for the Industrial market.
Qualification Standards can be found on IR's Web site.

International
IOR Rectifier

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
TAC Fax: (310) 252-7903
Visit us at www.irf.com for sales contact information. 10/2012