

IRG7RC10FDPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

Features

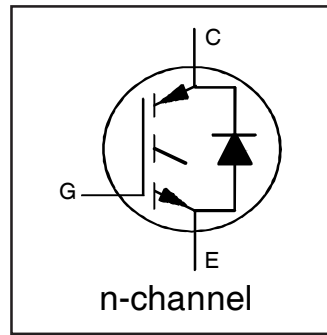
- Low $V_{CE(on)}$
- Zero $V_{CE(on)}$ temperature coefficient
- 3 μ s Short Circuit Capability
- Ultra Fast Soft Recovery Co-pak Diode
- Square RBSOA

Benefits

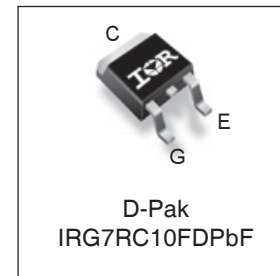
- Benchmark Efficiency for Motor Control Applications
- Rugged Transient Performance
- Low EMI

Applications

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



$V_{CES} = 600V$
$I_C = 9.0A, T_C = 100^\circ C$
$t_{sc} > 3\mu s, T_{jmax} = 150^\circ C$
$V_{CE(on) typ.} = 1.6V$ @ $I_C = 5A$



G	C	E
Gate	Collector	Emitter

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Breakdown Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	16.5	A
$I_C @ T_C = 100^\circ C$	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	
$I_F @ T_C = 25^\circ C$	Diode Continuous Forward Current	16.5	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	9.0	
I_{FM}	Diode Maximum Forward Current ②	20	
V_{GE}	Gate-to-Emitter Voltage	± 30	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	61	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	24	
T_J	Operating Junction and	-55 to + 150	$^\circ C$
T_{STG}	Storage Temperature Range		
	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	$^\circ C/W$
$R_{\theta JC}$	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
ΔV _{(BR)CES} /ΔT _J	Temperature Coeff. of Breakdown Voltage	—	0.55	—	V/°C	V _{GE} = 0V, I _C = 250 μA (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 = 200 μA
ΔV _{GE(th)} /ΔT _J	Threshold Voltage temp. coefficient	—	-14	—	mV/°C	V _{CE} = V _{GE} , I _C = 200 μA (25 - 150°C)
g _{fe}	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 ①
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 ②
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 ③
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, V _p ≤ 600V R _G = 100Ω, V _{GE} = +20V to 0V
SCSOA	Short Circuit Safe Operating Area	3	—	—	μs	V _{GE} = 15V, V _{CC} = 400V, V _p ≤ 600V R _G = 100Ω, R _{shunt} = 50mΩ, T _C = 100°C
E _{rec}	Reverse recovery energy of the diode	—	44	—	μJ	T _J = 150°C
t _{rr}	Diode Reverse recovery time	—	80	—	ns	V _{CC} = 400V, I _F = 5.0A
I _{rr}	Peak Reverse Recovery Current	—	6.4	—	A	V _{GE} = 15V, R _G = 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.

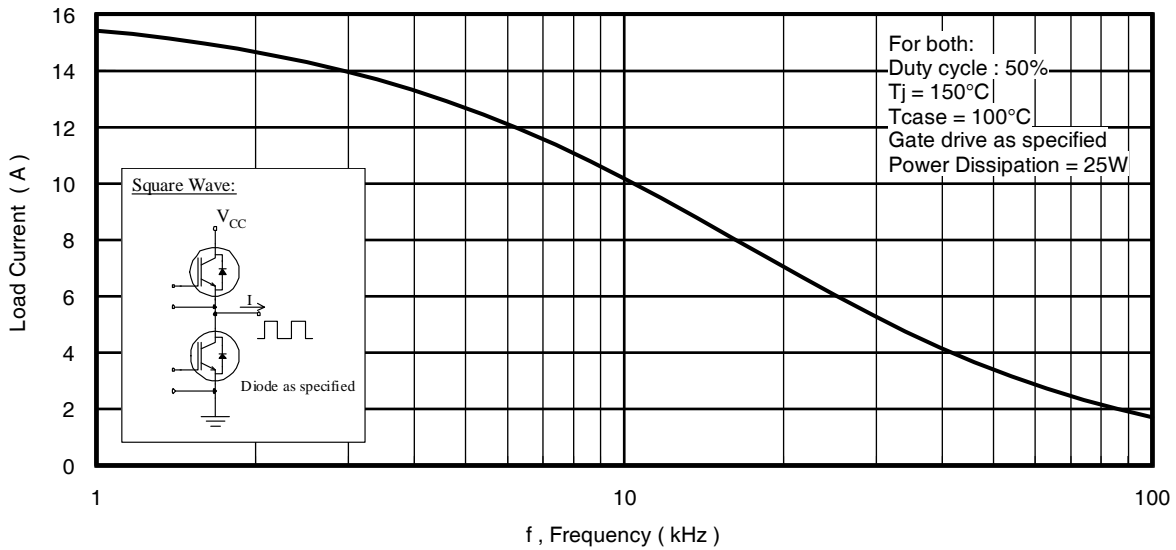


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

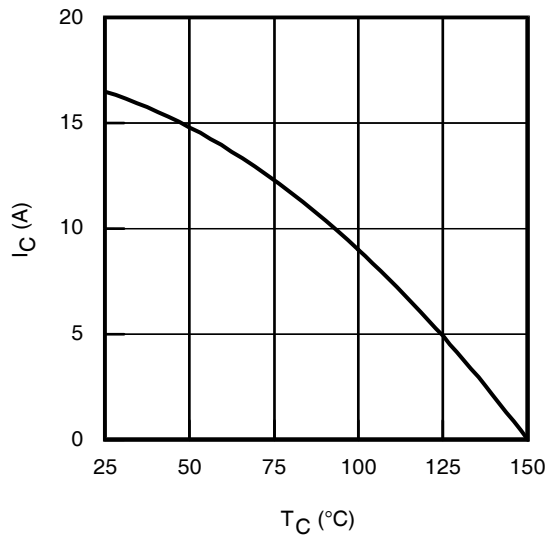


Fig. 2 - Maximum DC Collector Current vs. Case Temperature

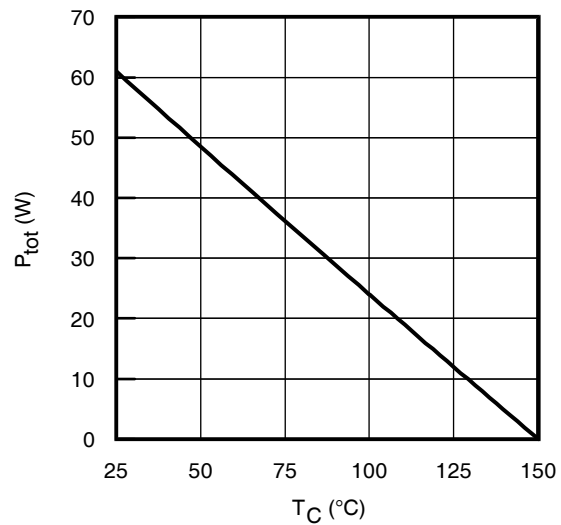


Fig. 3 - Power Dissipation vs. Case Temperature

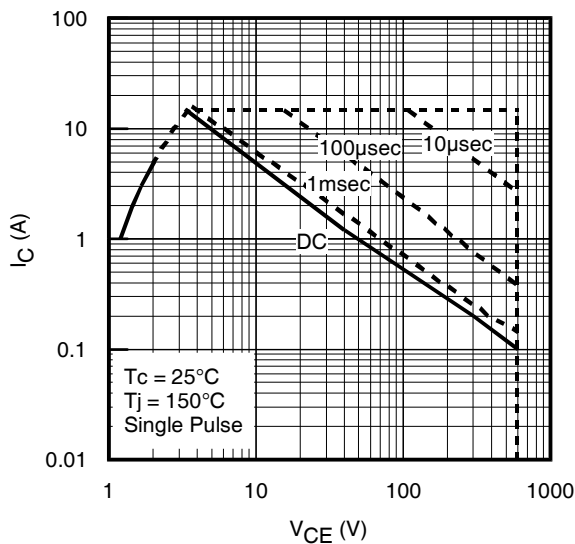


Fig. 4 - Forward SOA,
 $T_C = 25^\circ\text{C}$, $T_J \leq 150^\circ\text{C}$, $V_{GE} = 15\text{V}$

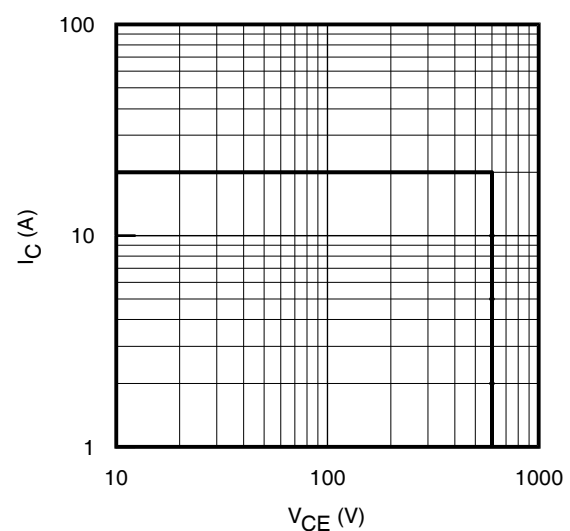


Fig. 5 - Reverse Bias SOA
 $T_J = 150^\circ\text{C}$, $V_{GE} = 20\text{V}$

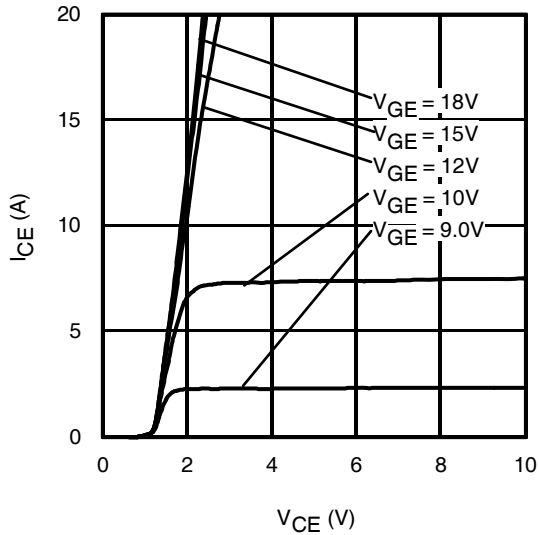


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = -40^\circ\text{C}$; $t_p = 20\mu\text{s}$

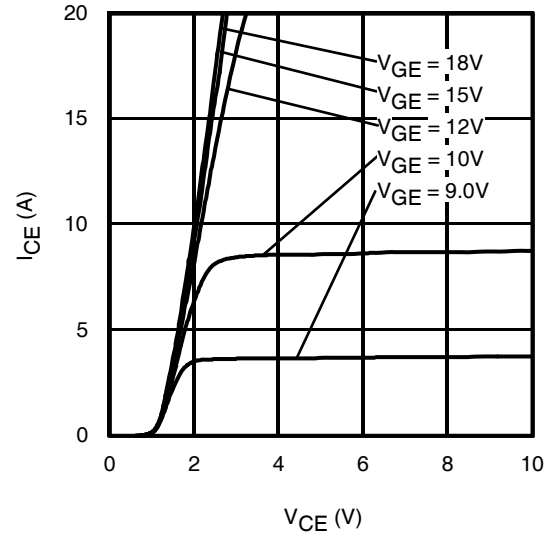


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 20\mu\text{s}$

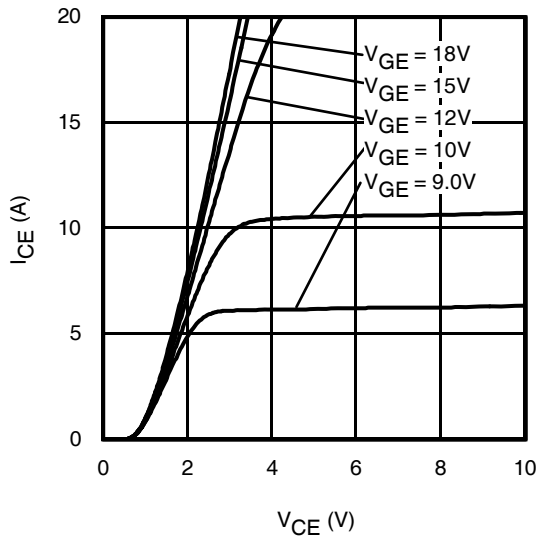


Fig. 8 - Typ. IGBT Output Characteristics
 $T_J = 150^\circ\text{C}$; $t_p = 20\mu\text{s}$

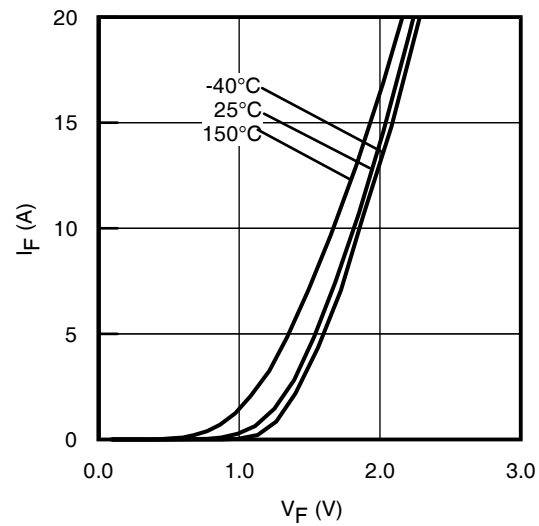


Fig. 9 - Typ. Diode Forward Characteristics
 $t_p = 20\mu\text{s}$

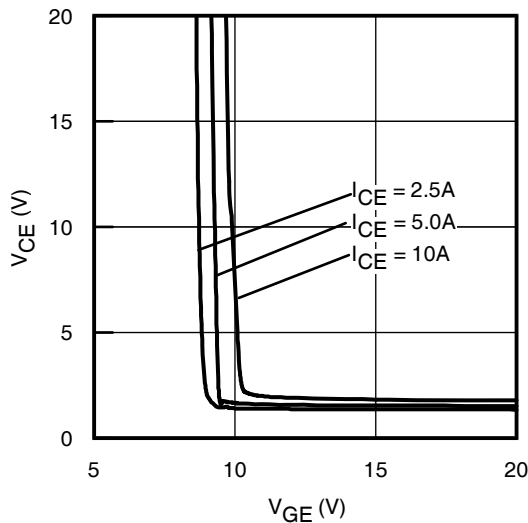


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

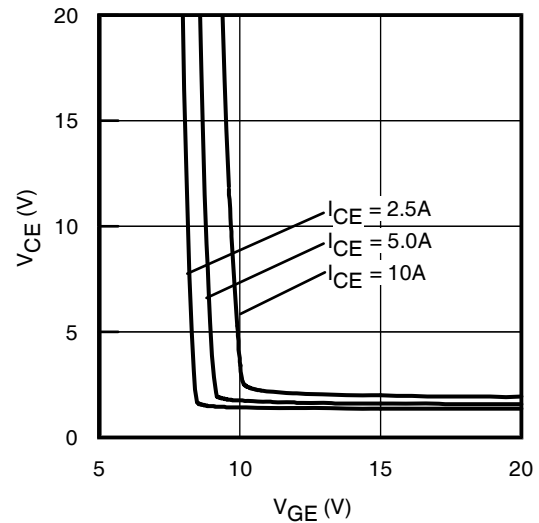


Fig. 11 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

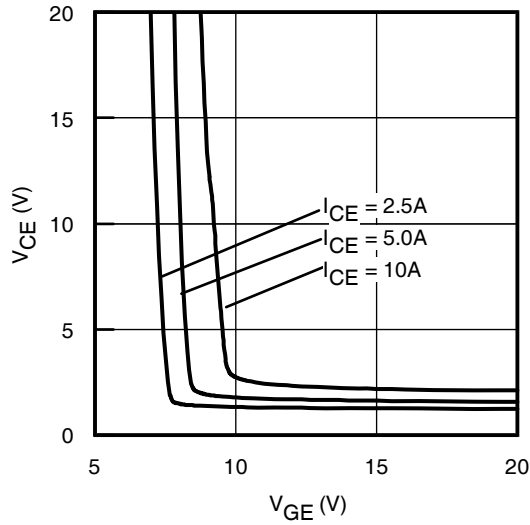


Fig. 12 - Typical V_{CE} vs. V_{GE}
 $T_J = 150^\circ\text{C}$

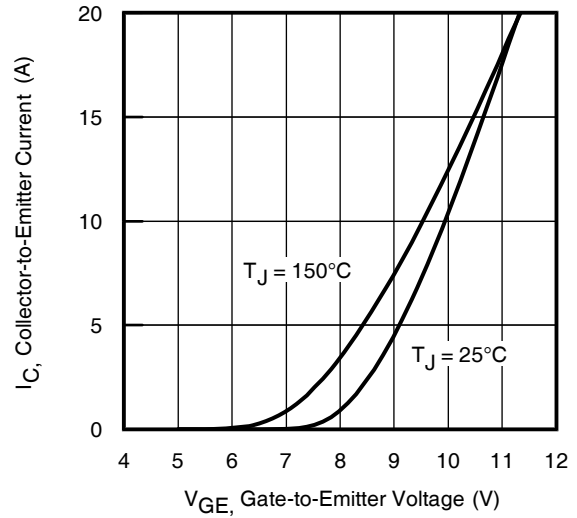


Fig. 13 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 20\mu\text{s}$

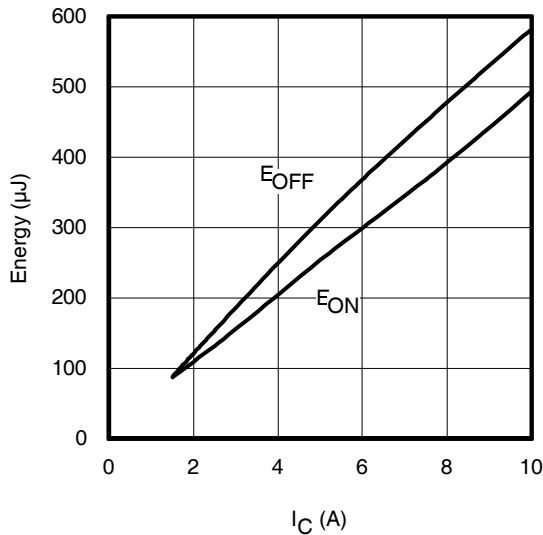


Fig. 14 - Typ. Energy Loss vs. I_C
 $T_J = 150^\circ\text{C}$; $L = 1.6\text{mH}$; $V_{CE} = 400\text{V}$, $R_G = 100\Omega$; $V_{GE} = 15\text{V}$.

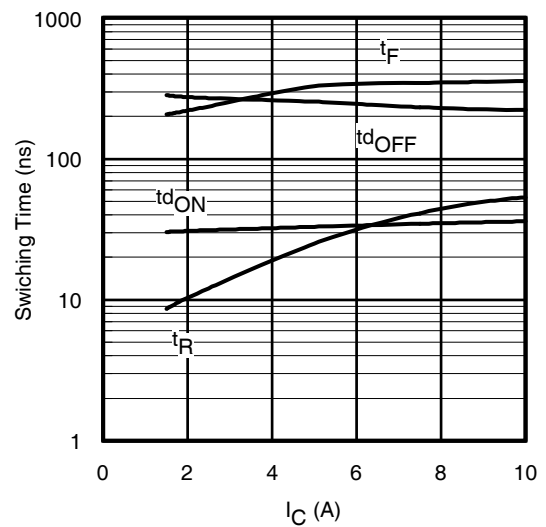


Fig. 15 - Typ. Switching Time vs. I_C
 $T_J = 150^\circ\text{C}$; $L = 1.6\text{mH}$; $V_{CE} = 400\text{V}$
 $R_G = 100\Omega$; $V_{GE} = 15\text{V}$

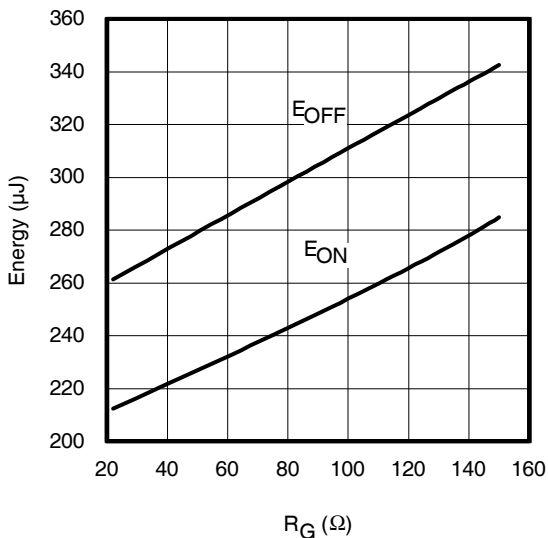


Fig. 16 - Typ. Energy Loss vs. R_G
 $T_J = 150^\circ\text{C}$; $L = 1.6\text{mH}$; $V_{CE} = 400\text{V}$, $I_{CE} = 5.0\text{A}$; $V_{GE} = 15\text{V}$

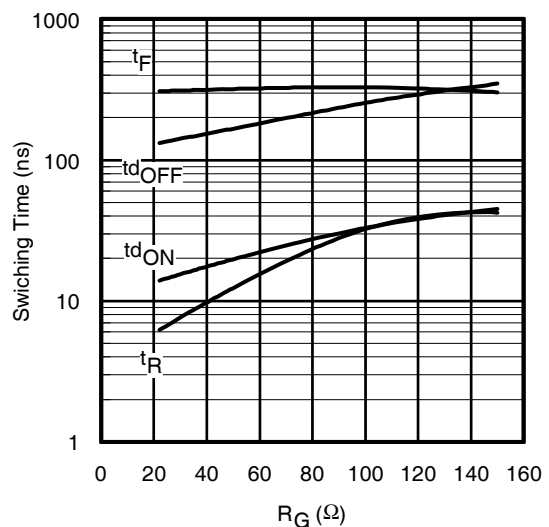


Fig. 17 - Typ. Switching Time vs. R_G
 $T_J = 150^\circ\text{C}$; $L = 1.6\text{mH}$; $V_{CE} = 400\text{V}$
 $I_{CE} = 5.0\text{A}$; $V_{GE} = 15\text{V}$

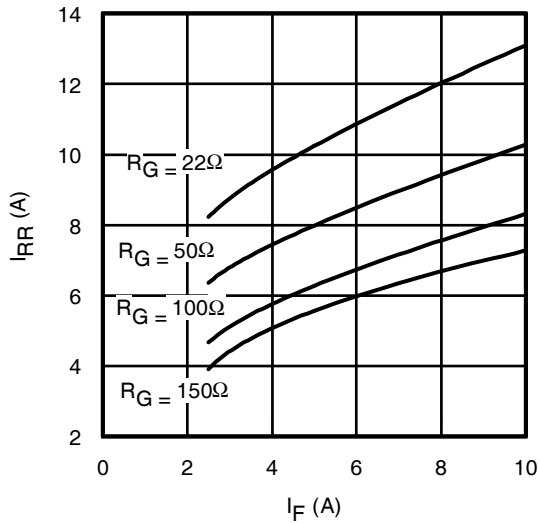


Fig. 18 - Typical Diode I_{RR} vs. I_F
 $T_J = 150^\circ\text{C}$

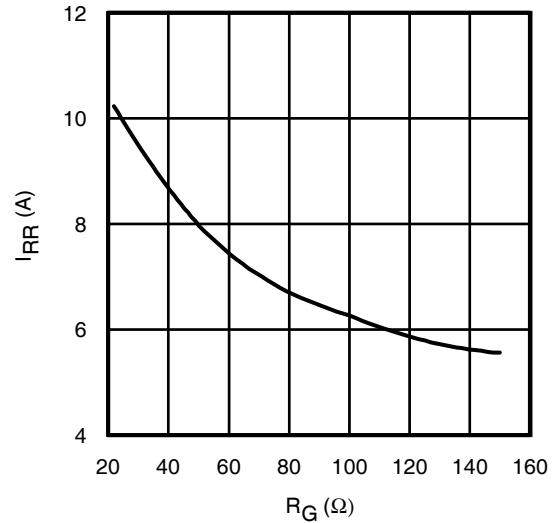


Fig. 19 - Typical Diode I_{RR} vs. R_G
 $T_J = 150^\circ\text{C}; I_F = 5.0\text{A}$

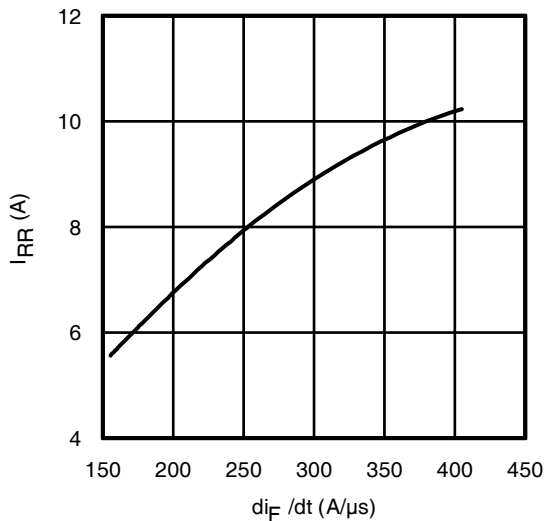


Fig. 20 - Typical Diode I_{RR} vs. di_F/dt
 $V_{CC} = 400\text{V}; V_{GE} = 15\text{V};$
 $I_{CE} = 5.0\text{A}; T_J = 150^\circ\text{C}$

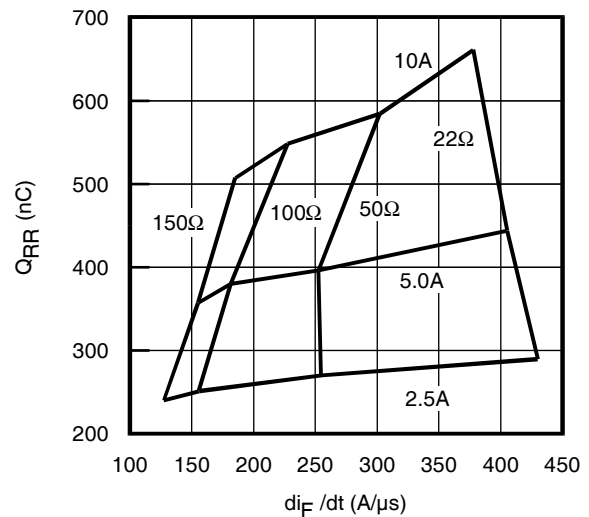


Fig. 21 - Typical Diode Q_{RR}
 $V_{CC} = 400\text{V}; V_{GE} = 15\text{V}; T_J = 150^\circ\text{C}$

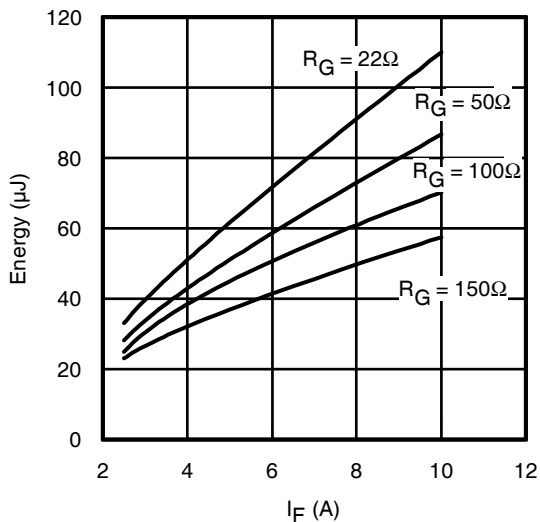


Fig. 22 - Typical Diode E_{RR} vs. I_F
 $T_J = 150^\circ\text{C}$

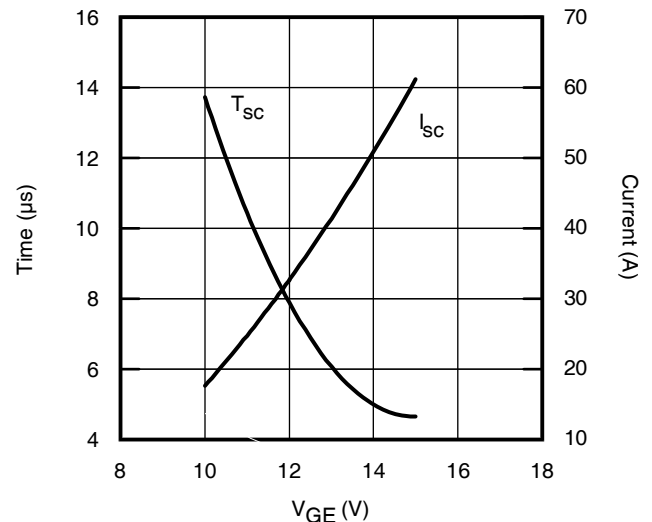


Fig. 23- Typ. V_{GE} vs. Short Circuit Time
 $V_{CC} = 400\text{V}, T_C = 25^\circ\text{C}$

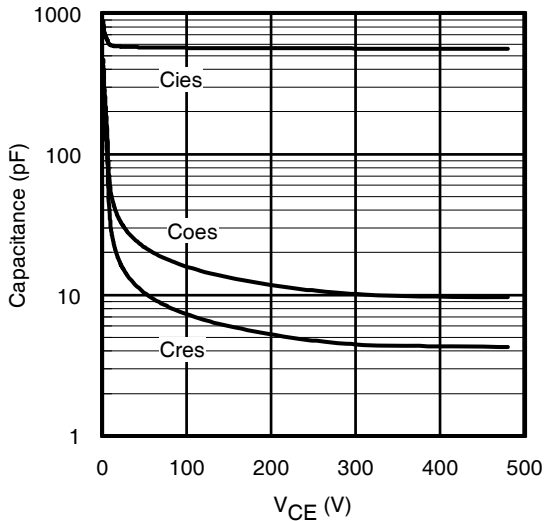


Fig. 24 - Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0V$; $f = 1MHz$

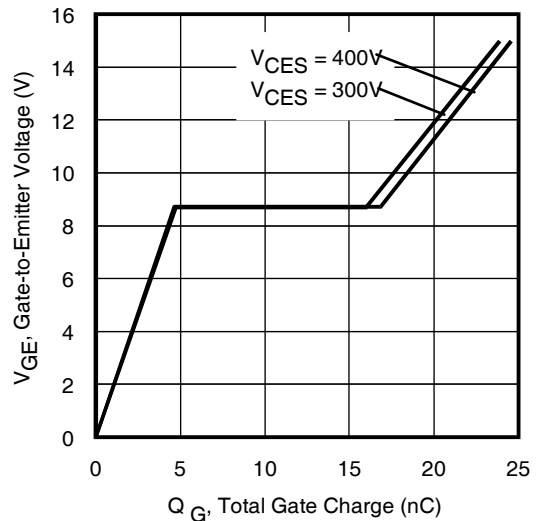


Fig. 25 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 5.0A$, $L = 2.2mH$

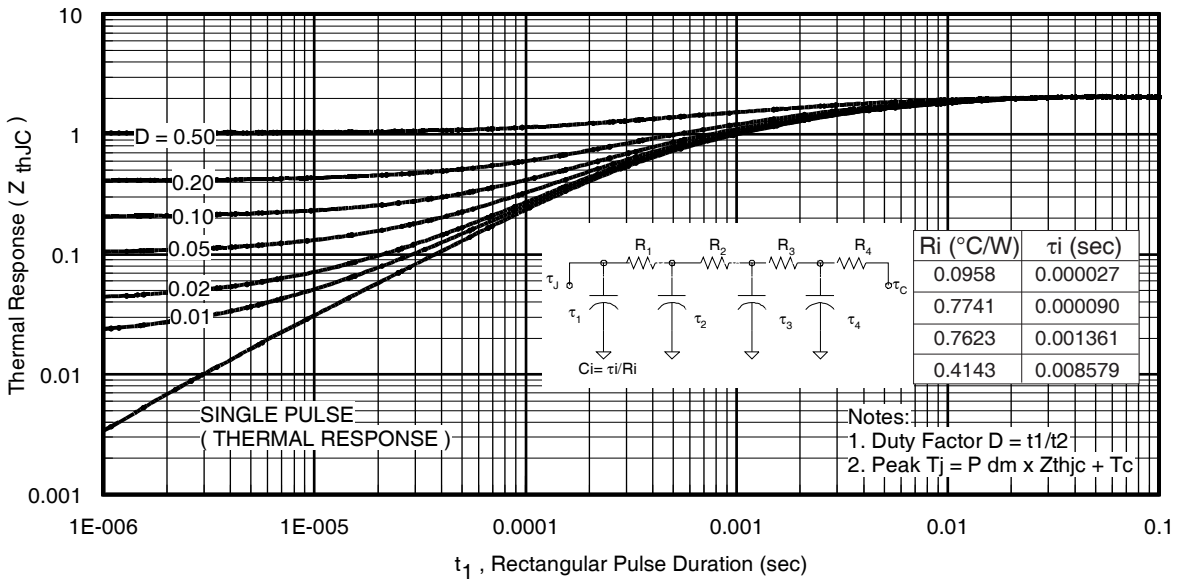


Fig. 26 - Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

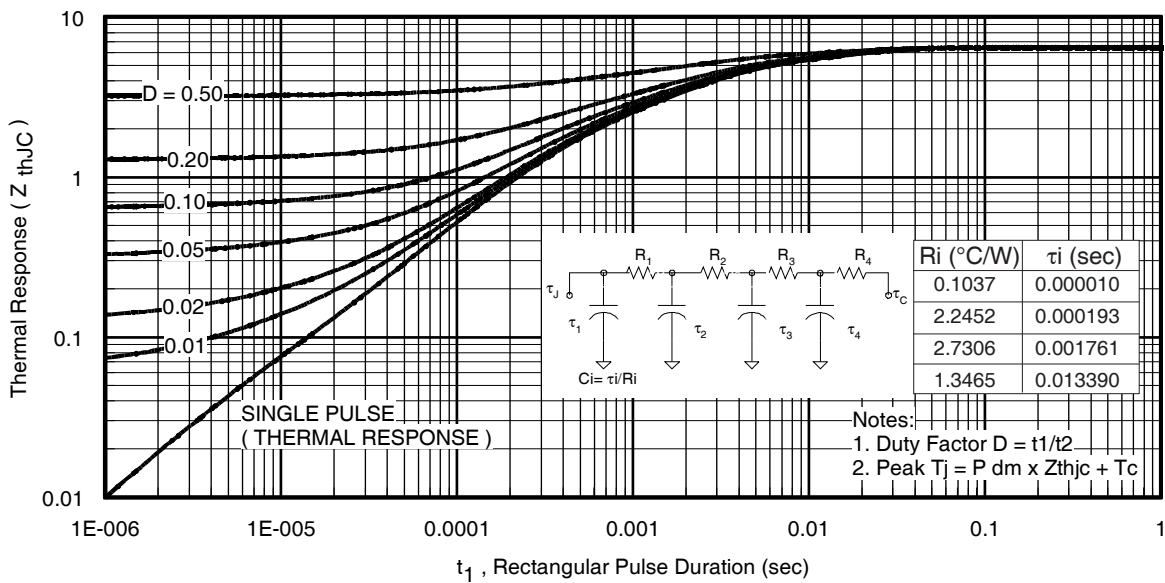


Fig. 27 - Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

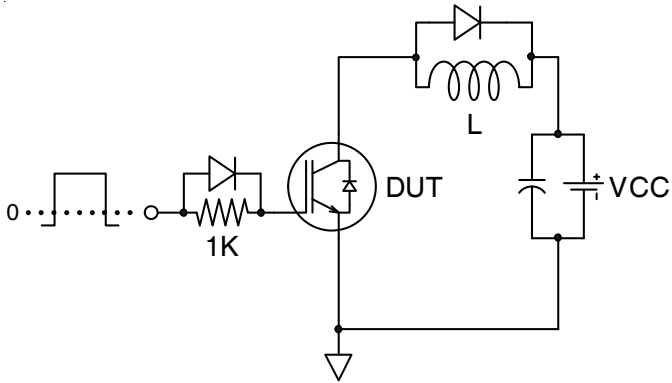


Fig.C.T.1 - Gate Charge Circuit (turn-off)

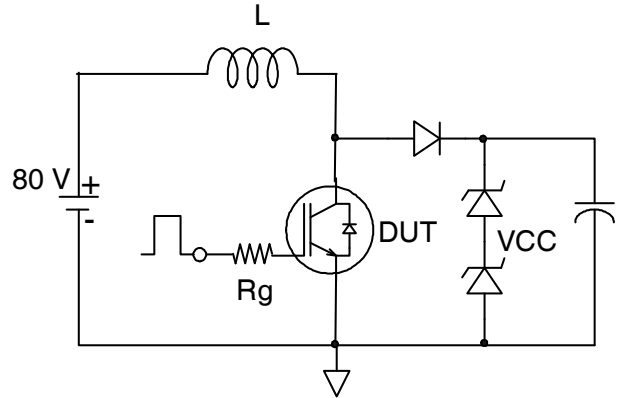


Fig.C.T.2 - RBSOA Circuit

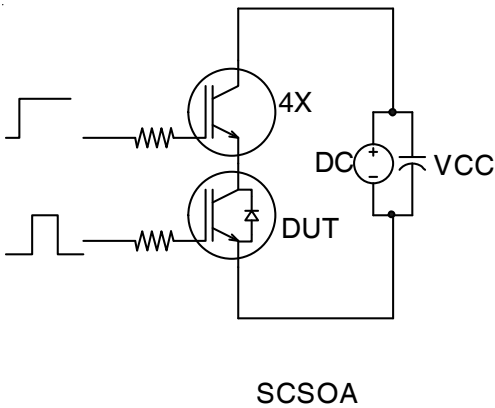


Fig.C.T.3 - S.C. SOA Circuit

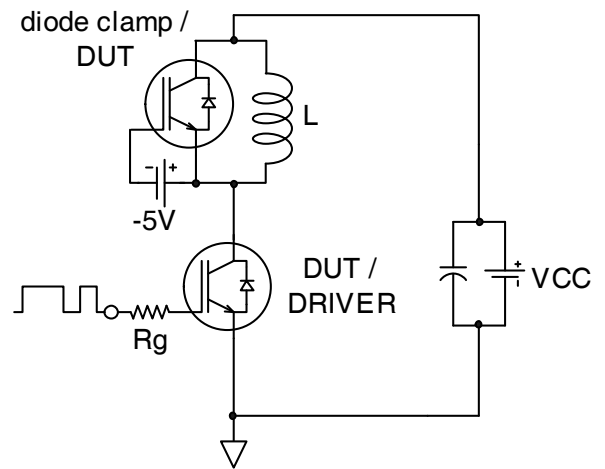


Fig.C.T.4 - Switching Loss Circuit

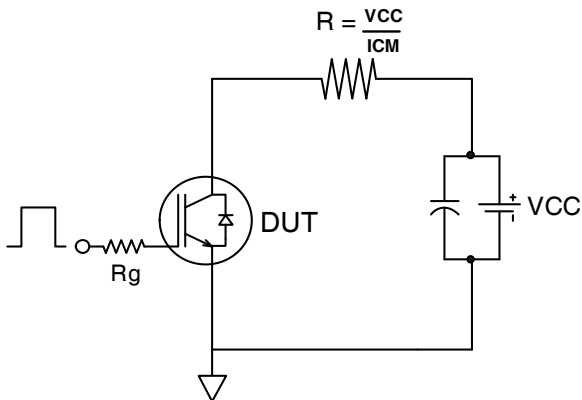


Fig.C.T.5 - Resistive Load Circuit

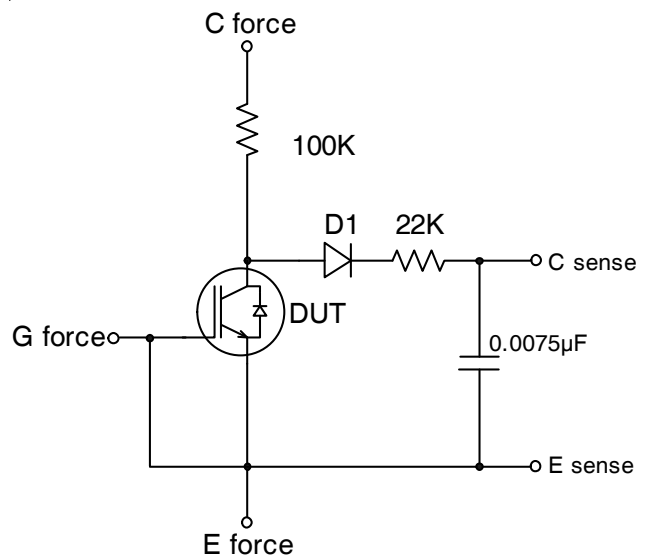


Fig.C.T.6 - BVCES Filter Circuit

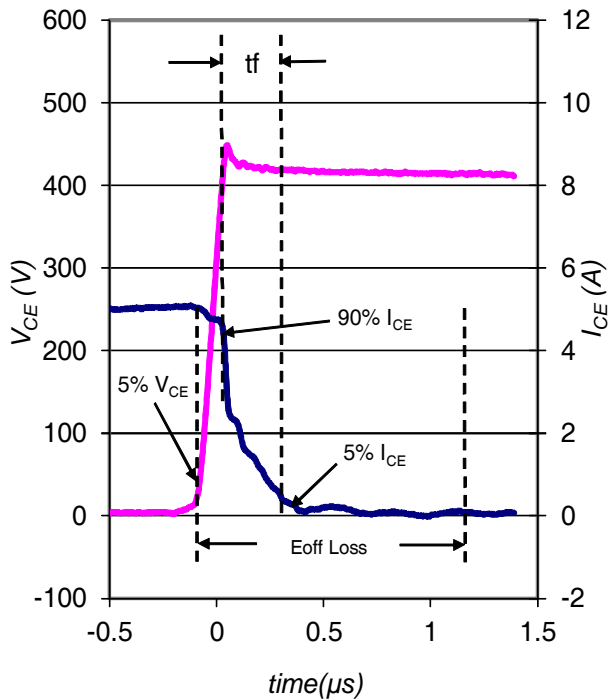


Fig. WF1 - Typ. Turn-off Loss Waveform
 @ $T_J = 150^\circ\text{C}$ using Fig. CT.4

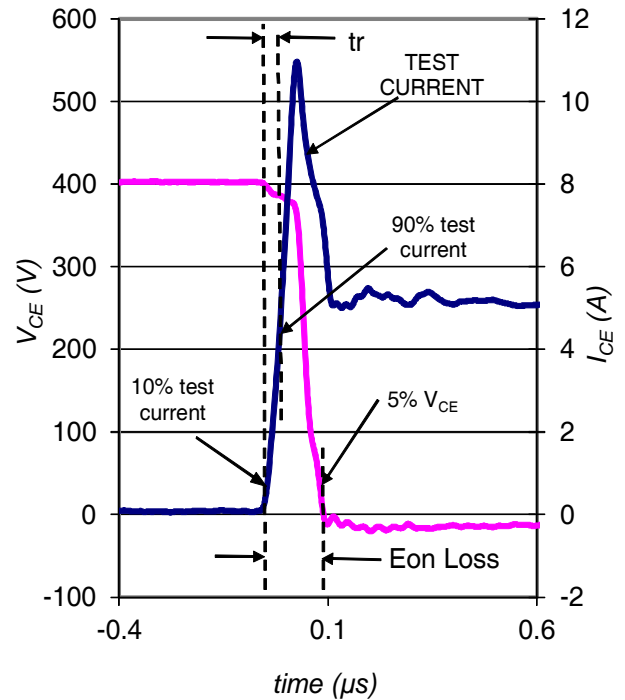
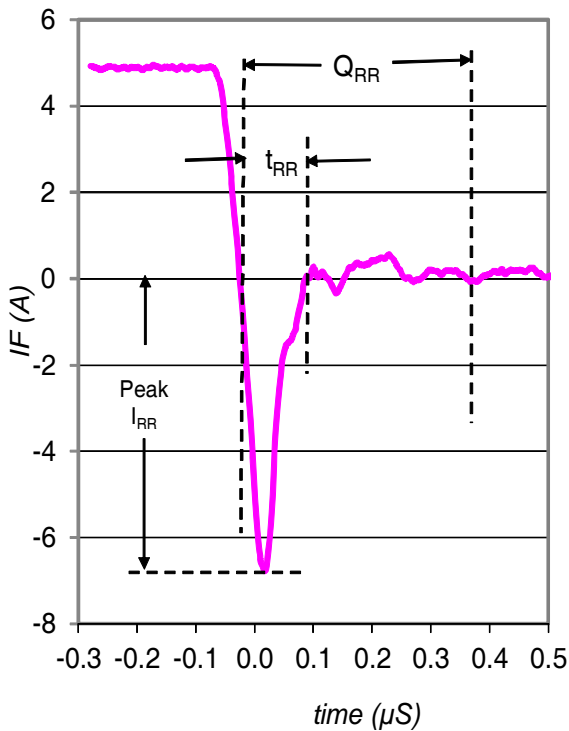
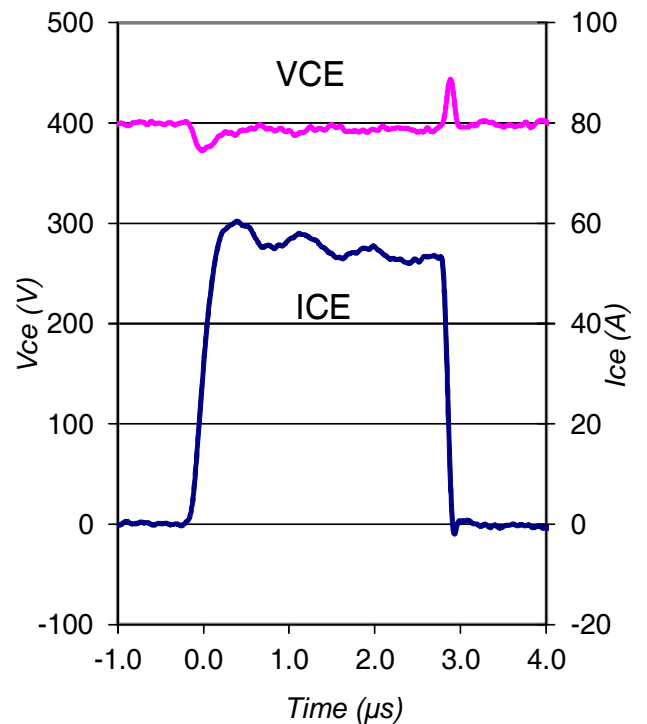


Fig. WF2 - Typ. Turn-on Loss Waveform
 @ $T_J = 150^\circ\text{C}$ using Fig. CT.4



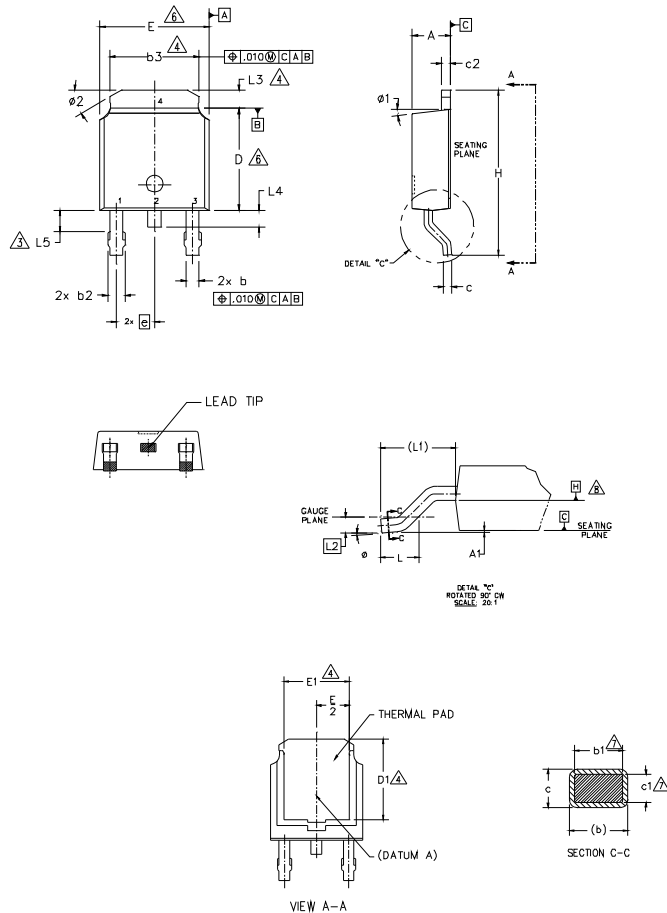
WF.3- Typ. Diode Recovery Waveform
 @ $T_J = 150^\circ\text{C}$ using CT.4



WF.4- Typ. Short Circuit Waveform
 @ $T_J = 25^\circ\text{C}$ 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.

SYM BO L	DIMENSIONS				NO TE S
	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

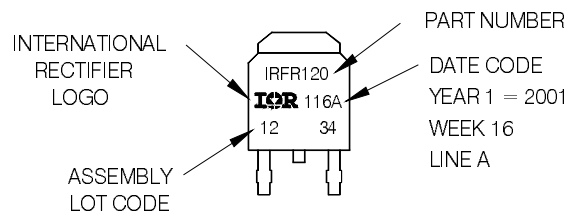
- 1.- GATE
- 2.- COLLECTOR
- 3.- EMITTER
- 4.- COLLECTOR

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"

"P̄" in assembly line position indicates
"Lead-Free" qualification to the consumer-level



PART NUMBER

DATE CODE

YEAR 1 = 2001

WEEK 16

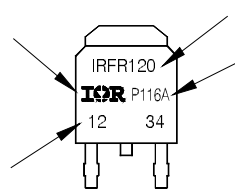
LINE A

ASSEMBLY
LOT CODE

OR

INTERNATIONAL
RECTIFIER
LOGO

ASSEMBLY
LOT CODE



PART NUMBER

DATE CODE

P = DESIGNATES LEAD-FREE
PRODUCT (OPTIONAL)

P̄ = DESIGNATES LEAD-FREE
PRODUCT QUALIFIED TO THE
CONSUMER LEVEL (OPTIONAL)

YEAR 1 = 2001

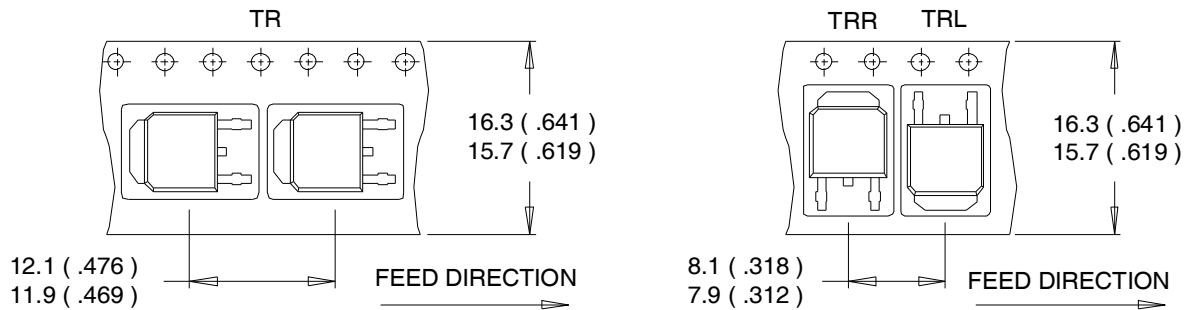
WEEK 16

A = ASSEMBLY SITE CODE

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

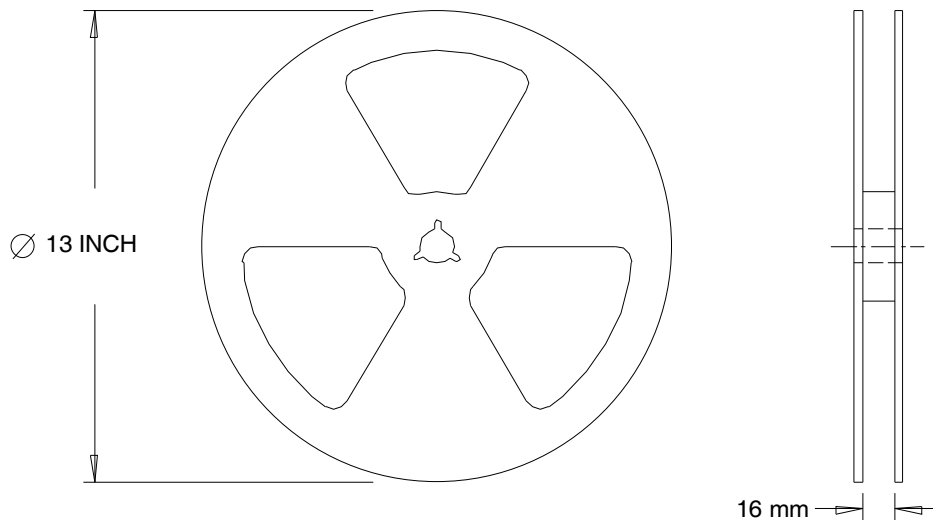
D-Pak (TO-252AA) Tape & Reel Information

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.

International
IR 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. 02/2012