

IRG7RC10FDPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

Features

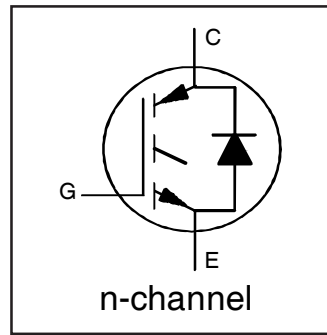
- Low $V_{CE(on)}$
- Zero $V_{CE(on)}$ temperature coefficient
- 3 μ s Short Circuit Capability
- Ultra Fast Soft Recovery Co-pak Diode
- Square RBSOA

Benefits

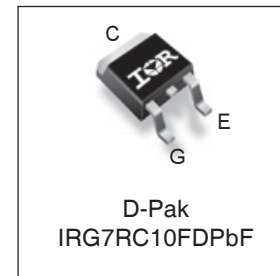
- Benchmark Efficiency for Motor Control Applications
- Rugged Transient Performance
- Low EMI

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	
$P_D @ T_C = 25^\circ C$	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 @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	—	—	V	$V_{GE} = 0V, I_C = 250\mu A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.55	—	V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 250\mu A$ (25 -150 $^\circ\text{C}$)
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.60	1.85	V	$I_C = 5.0A, V_{GE} = 15V, T_J = 25^\circ\text{C}$
		—	1.60	—		$I_C = 5.0A, V_{GE} = 15V, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	4.5	—	7.0	V	$V_{CE} = V_{GE}, I_C = 200\mu A$
$\Delta V_{GE(th)}/\Delta T_J$	Threshold Voltage temp. coefficient	—	-14	—	mV/ $^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 200\mu A$ (25 -150 $^\circ\text{C}$)
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		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$
V_{FM}	Diode Forward Voltage Drop	—	1.5	1.9	V	$I_F = 5.0A$
		—	1.3	—		$I_F = 5.0A, T_J = 150^\circ\text{C}$
I_{GES}	Gate-to-Emitter Leakage Current	—	—	± 100	nA	$V_{GE} = \pm 30V$

Switching Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

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

Notes:

- ① $V_{CC} = 80\% (V_{CES}), V_{GE} = 20V, L = 1.6mH, R_G = 100\Omega.$
- ② Pulse width limited by max. junction temperature.
- ③ R_θ is measured at T_J approximately $90^\circ\text{C}.$
- 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.

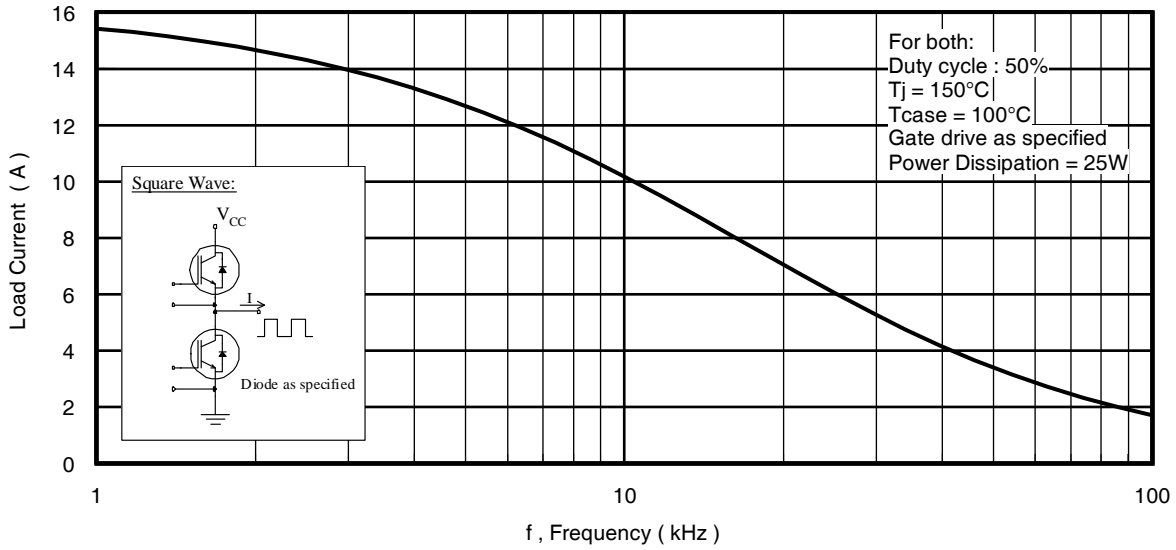


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

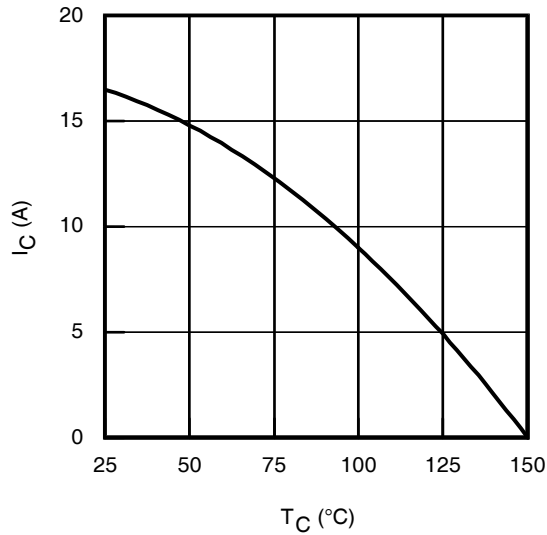


Fig. 2 - Maximum DC Collector Current vs. Case Temperature

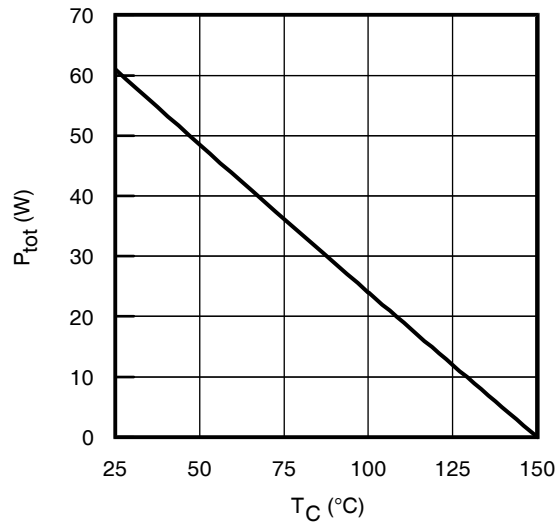


Fig. 3 - Power Dissipation vs. Case Temperature

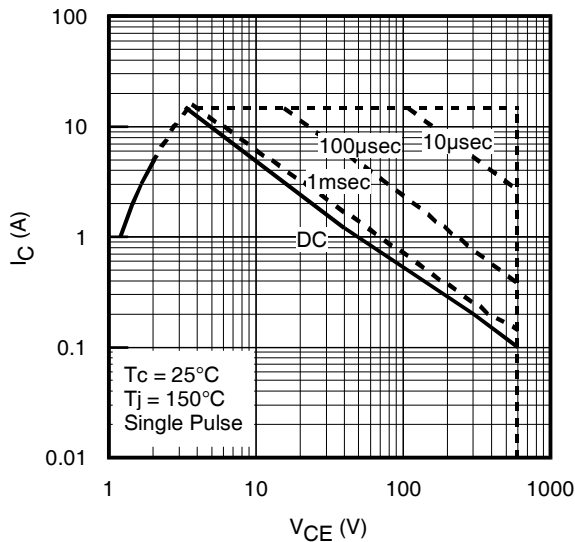


Fig. 4 - Forward SOA,
 $T_C = 25^\circ\text{C}$, $T_J \leq 150^\circ\text{C}$, $V_{\text{GE}} = 15\text{V}$

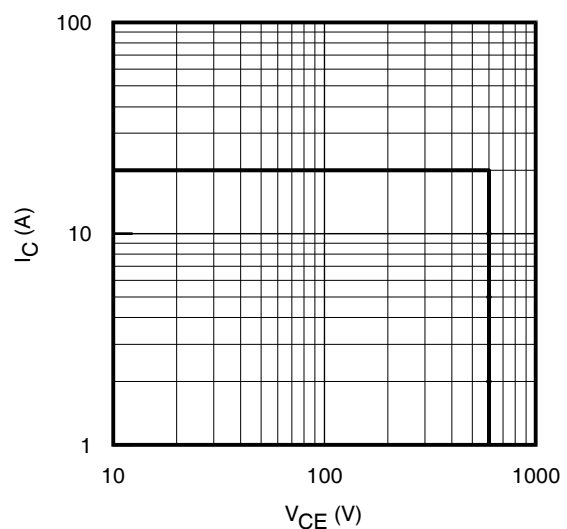


Fig. 5 - Reverse Bias SOA
 $T_J = 150^\circ\text{C}$, $V_{\text{GE}} = 20\text{V}$

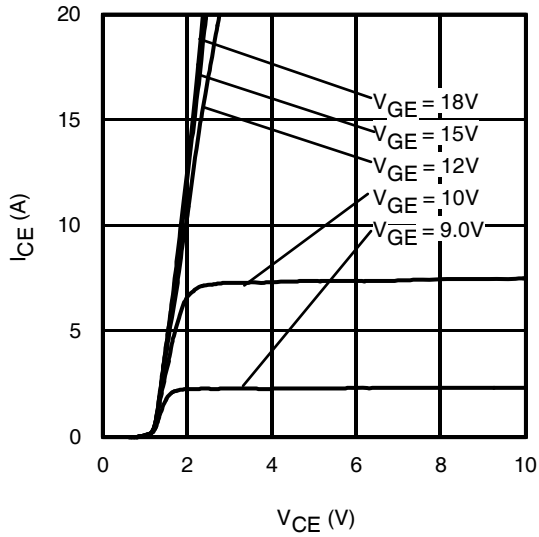


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = -40^\circ\text{C}$; $t_p = 20\mu\text{s}$

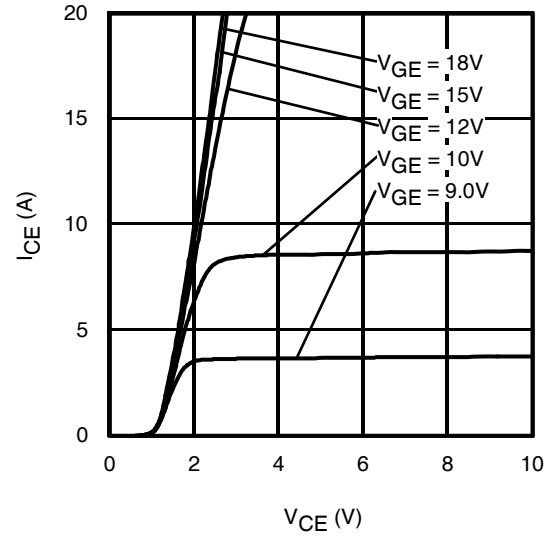


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 20\mu\text{s}$

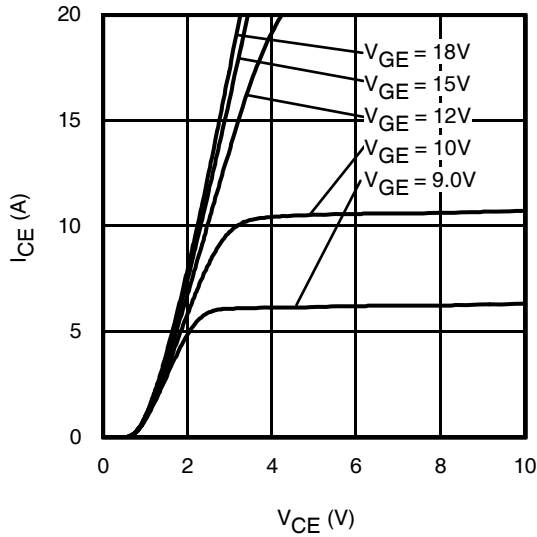


Fig. 8 - Typ. IGBT Output Characteristics
 $T_J = 150^\circ\text{C}$; $t_p = 20\mu\text{s}$

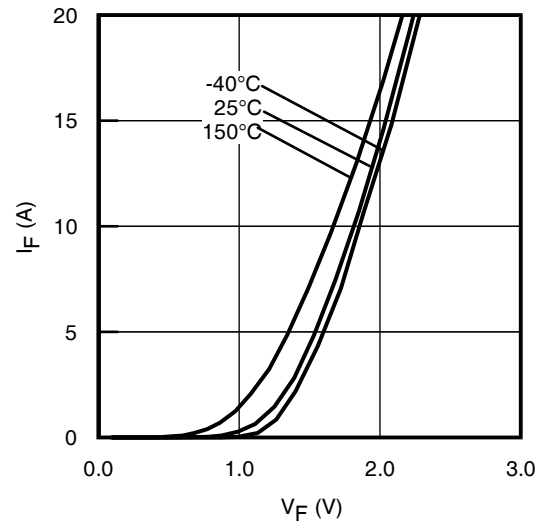


Fig. 9 - Typ. Diode Forward Characteristics
 $t_p = 20\mu\text{s}$

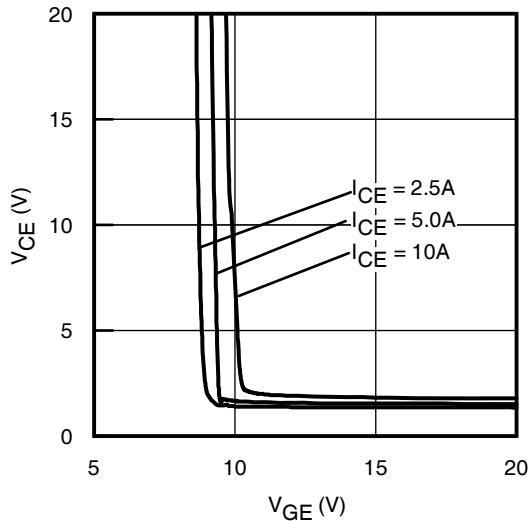


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

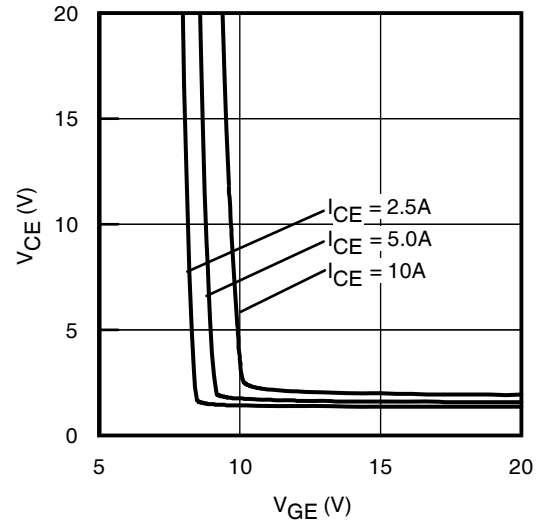


Fig. 11 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

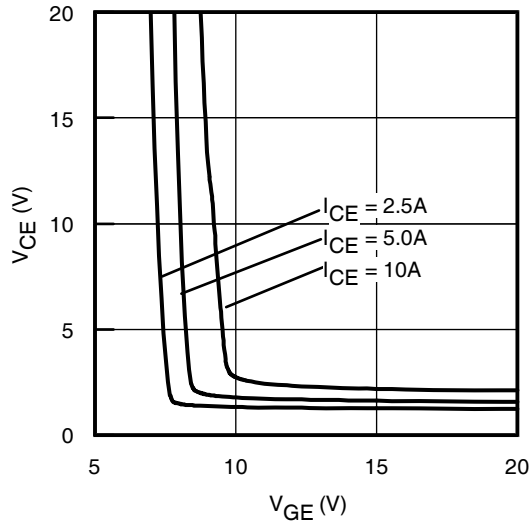


Fig. 12 - Typical V_{CE} vs. V_{GE}
 $T_J = 150^\circ\text{C}$

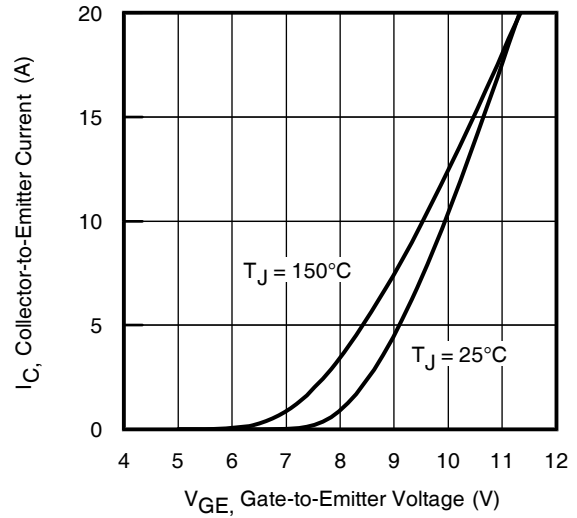


Fig. 13 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 20\mu\text{s}$

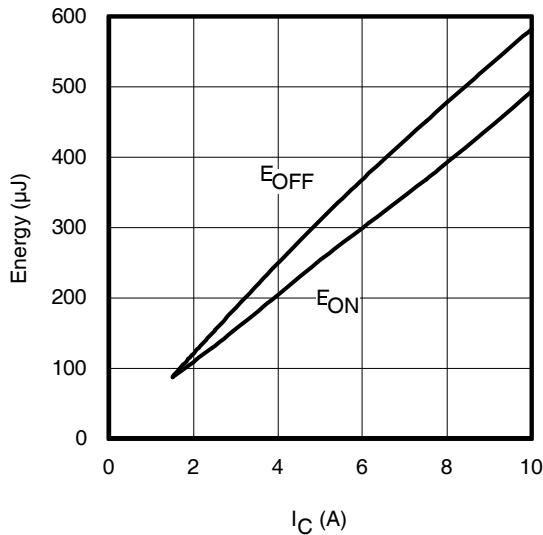


Fig. 14 - Typ. Energy Loss vs. I_C
 $T_J = 150^\circ\text{C}$; $L = 1.6\text{mH}$; $V_{CE} = 400\text{V}$, $R_G = 100\Omega$; $V_{GE} = 15\text{V}$.

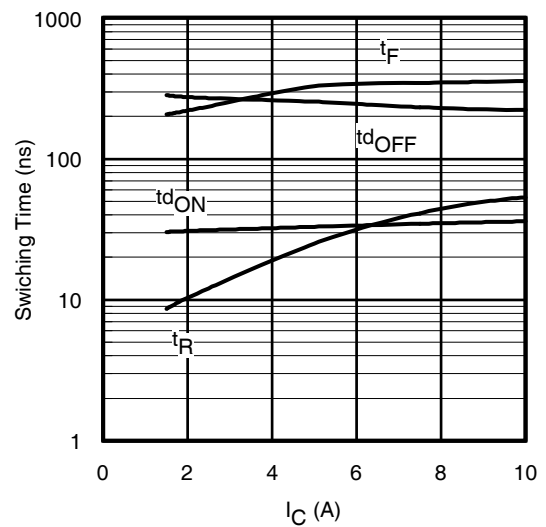


Fig. 15 - Typ. Switching Time vs. I_C
 $T_J = 150^\circ\text{C}$; $L = 1.6\text{mH}$; $V_{CE} = 400\text{V}$
 $R_G = 100\Omega$; $V_{GE} = 15\text{V}$

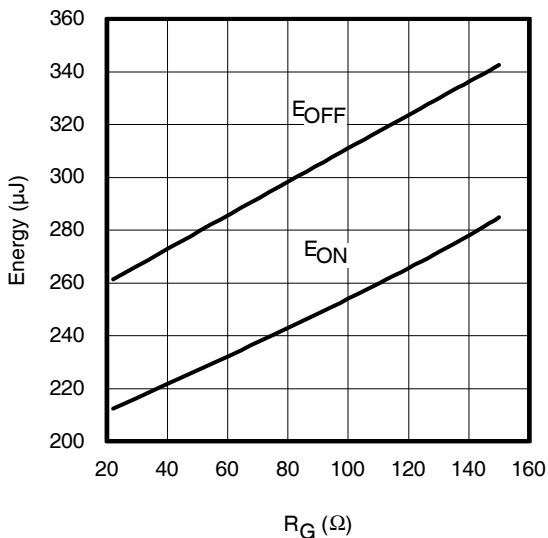


Fig. 16 - Typ. Energy Loss vs. R_G
 $T_J = 150^\circ\text{C}$; $L = 1.6\text{mH}$; $V_{CE} = 400\text{V}$, $I_{CE} = 5.0\text{A}$; $V_{GE} = 15\text{V}$

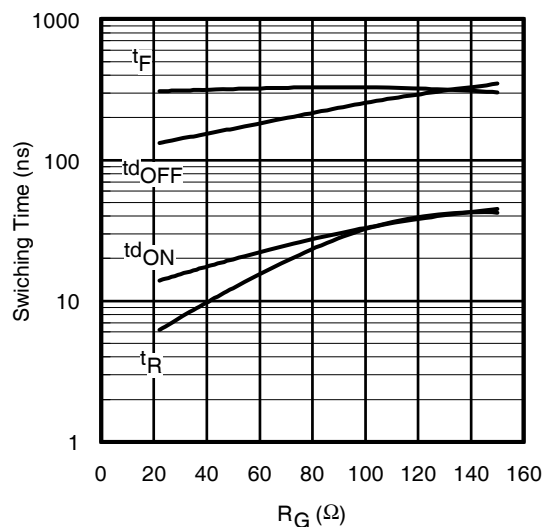


Fig. 17 - Typ. Switching Time vs. R_G
 $T_J = 150^\circ\text{C}$; $L = 1.6\text{mH}$; $V_{CE} = 400\text{V}$
 $I_{CE} = 5.0\text{A}$; $V_{GE} = 15\text{V}$

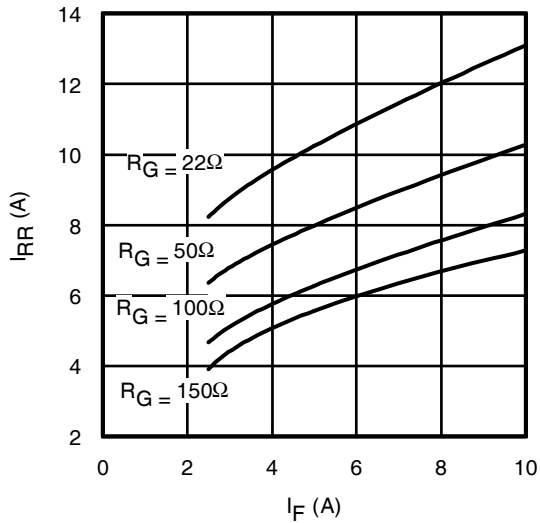


Fig. 18 - Typical Diode I_{RR} vs. I_F
 $T_J = 150^\circ\text{C}$

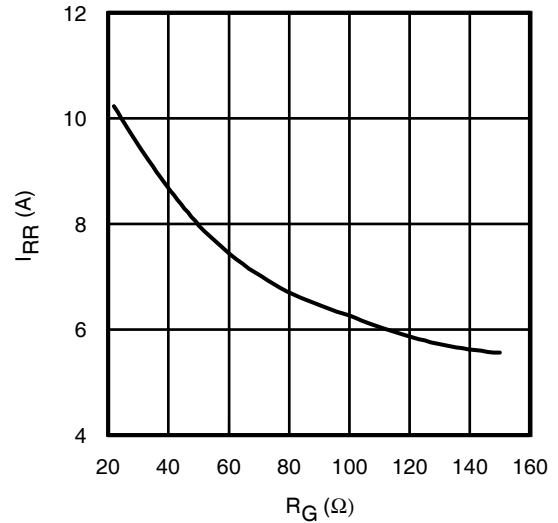


Fig. 19 - Typical Diode I_{RR} vs. R_G
 $T_J = 150^\circ\text{C}; I_F = 5.0\text{A}$

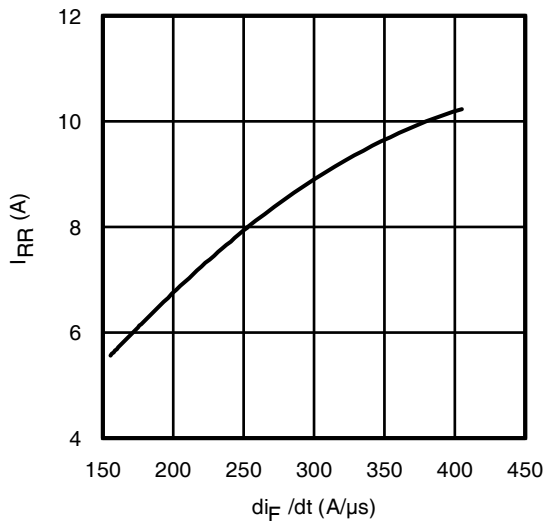


Fig. 20 - Typical Diode I_{RR} vs. di_F/dt
 $V_{CC} = 400\text{V}; V_{GE} = 15\text{V};$
 $I_{CE} = 5.0\text{A}; T_J = 150^\circ\text{C}$

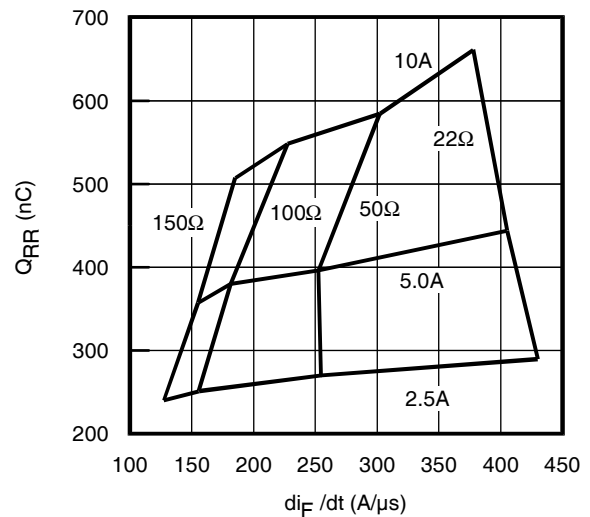


Fig. 21 - Typical Diode Q_{RR}
 $V_{CC} = 400\text{V}; V_{GE} = 15\text{V}; T_J = 150^\circ\text{C}$

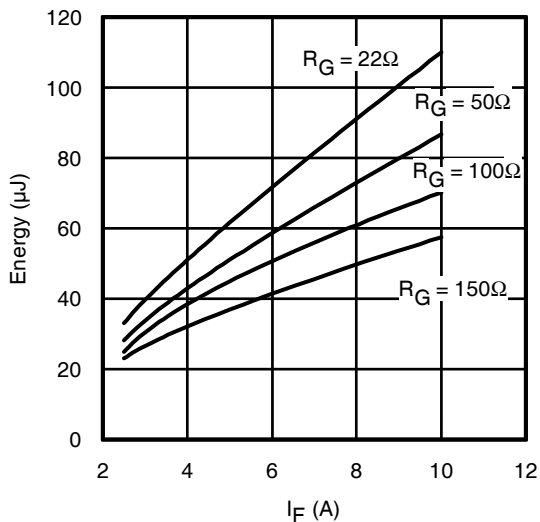


Fig. 22 - Typical Diode E_{RR} vs. I_F
 $T_J = 150^\circ\text{C}$

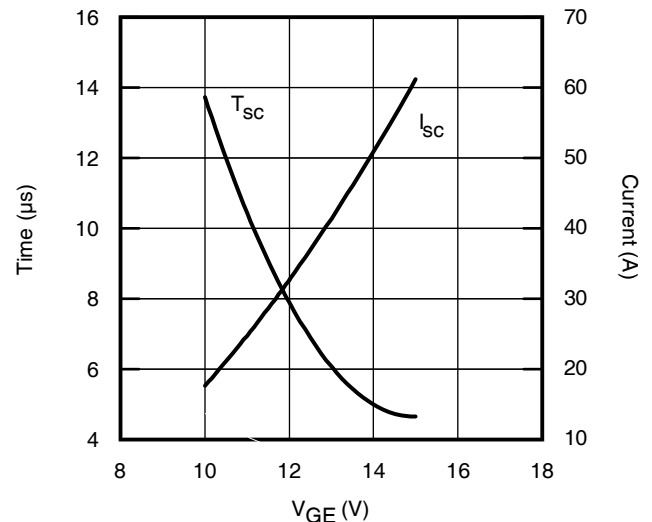


Fig. 23- Typ. V_{GE} vs. Short Circuit Time
 $V_{CC} = 400\text{V}, T_C = 25^\circ\text{C}$

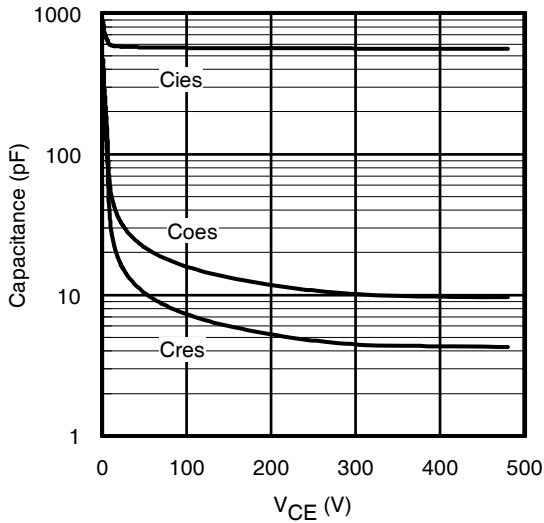


Fig. 24 - Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0V$; $f = 1MHz$

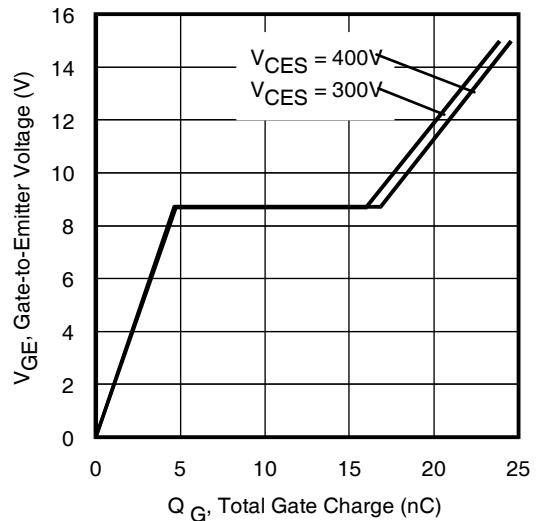


Fig. 25 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 5.0A$, $L = 2.2mH$

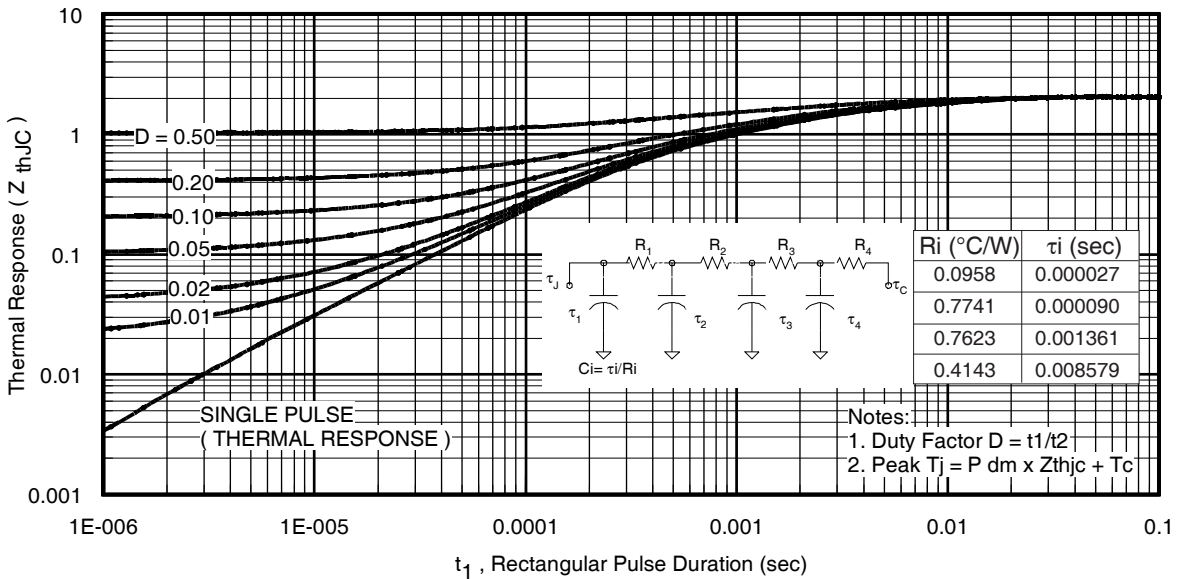


Fig. 26 - Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

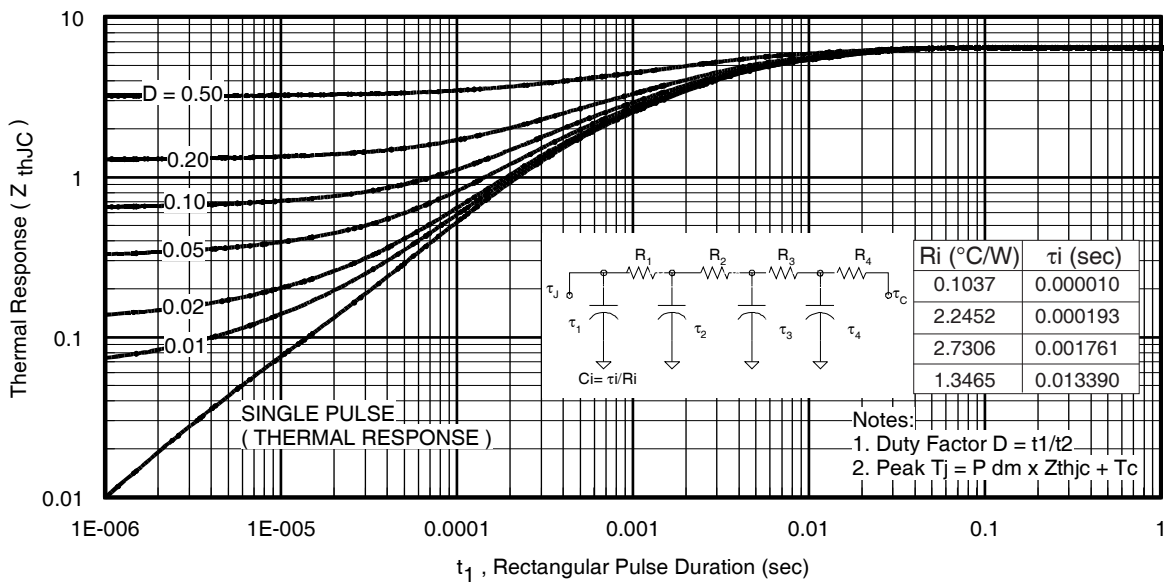


Fig. 27 - Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

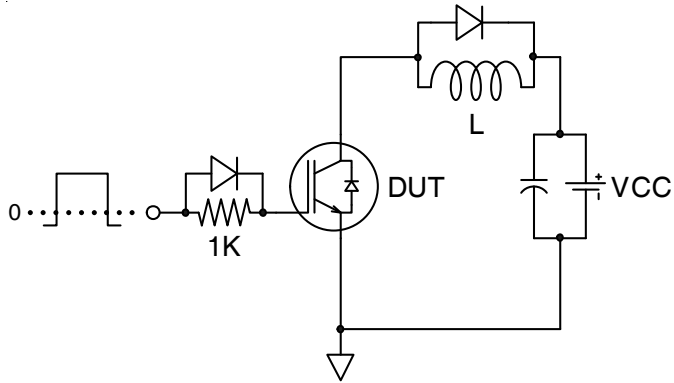


Fig.C.T.1 - Gate Charge Circuit (turn-off)

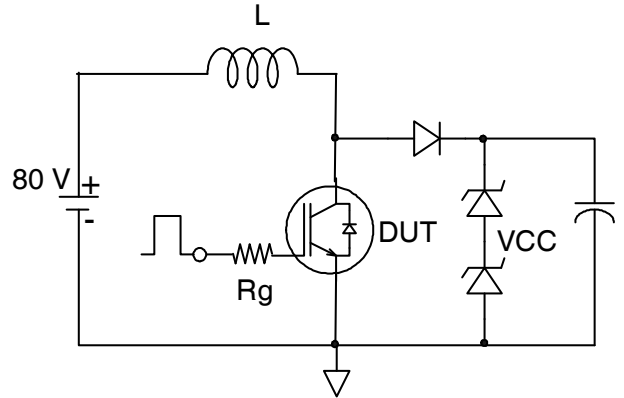


Fig.C.T.2 - RBSOA Circuit

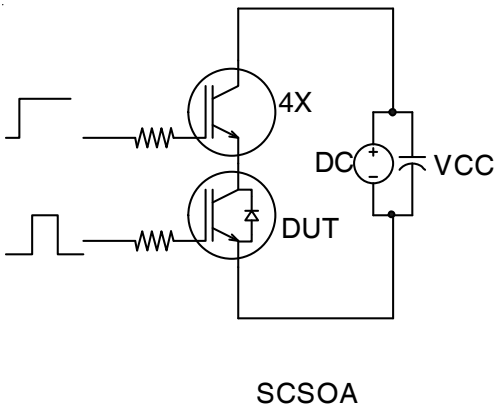


Fig.C.T.3 - S.C. SOA Circuit

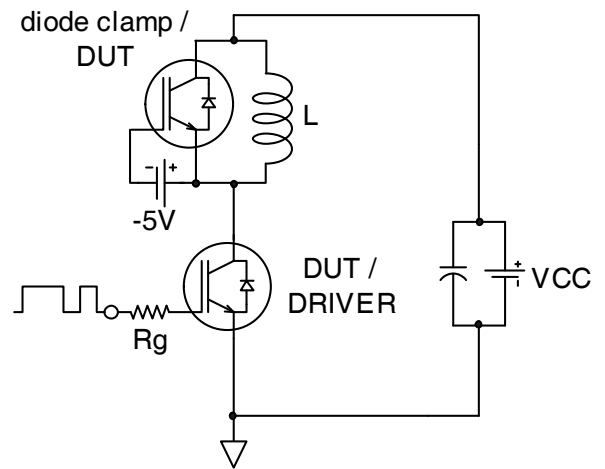


Fig.C.T.4 - Switching Loss Circuit

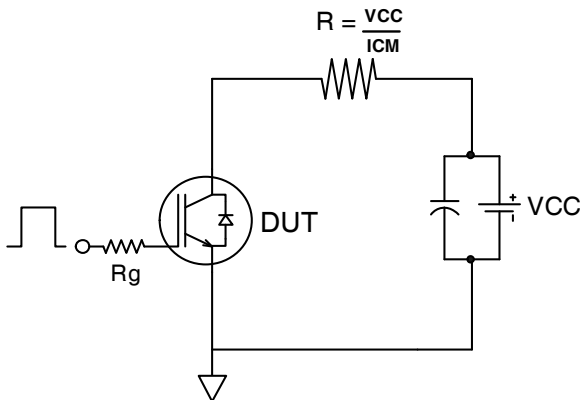


Fig.C.T.5 - Resistive Load Circuit

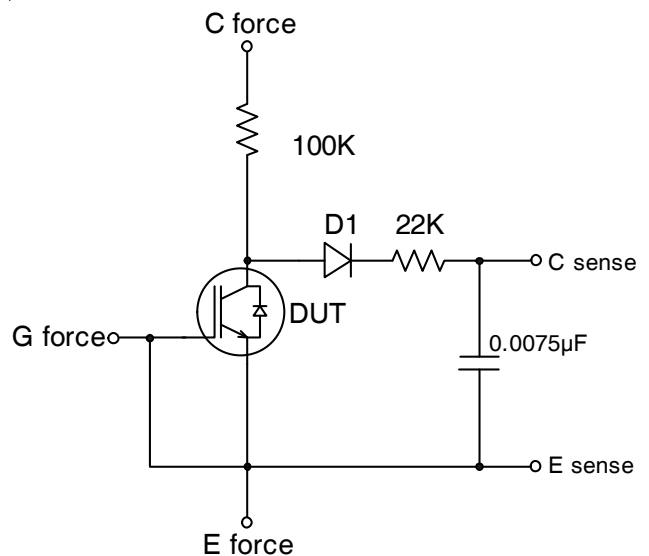


Fig.C.T.6 - BVCES Filter Circuit

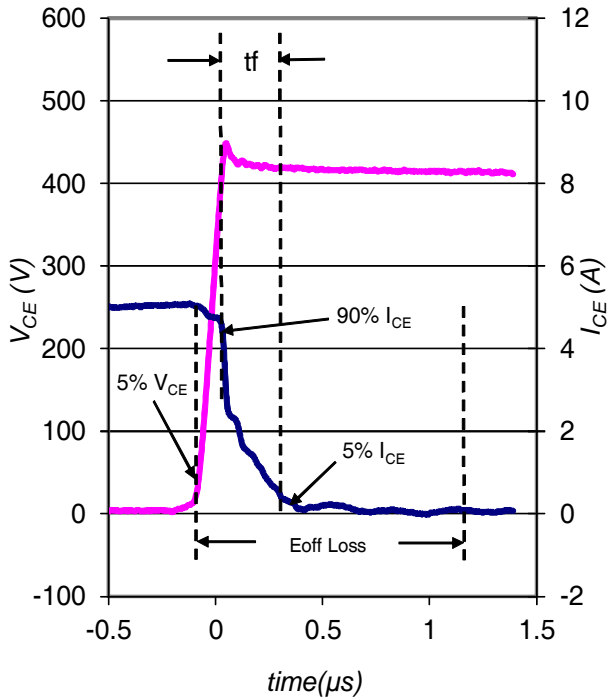


Fig. WF1 - Typ. Turn-off Loss Waveform
 @ $T_J = 150^\circ\text{C}$ using Fig. CT.4

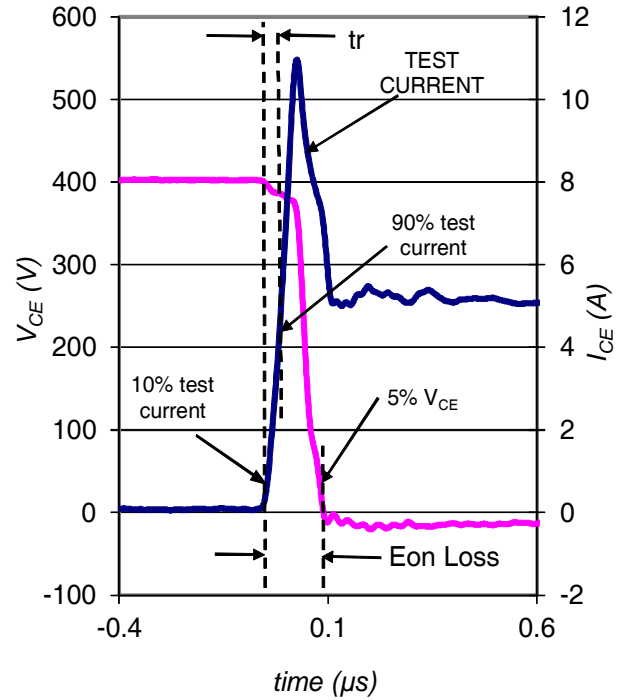
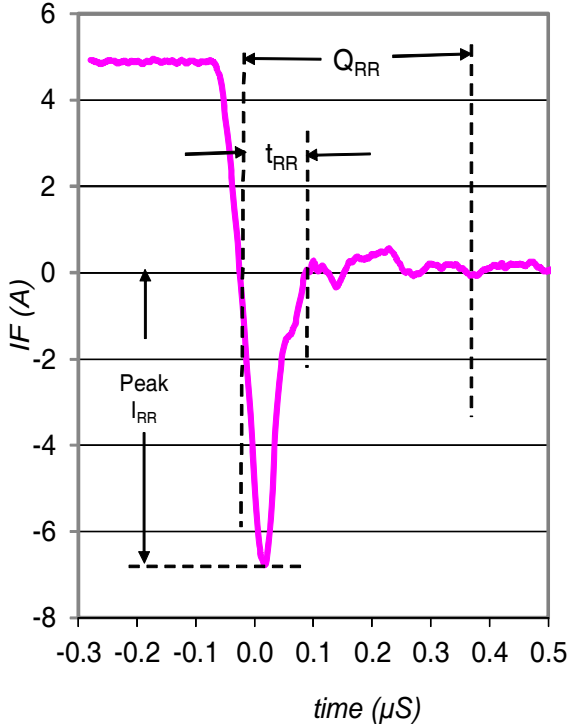
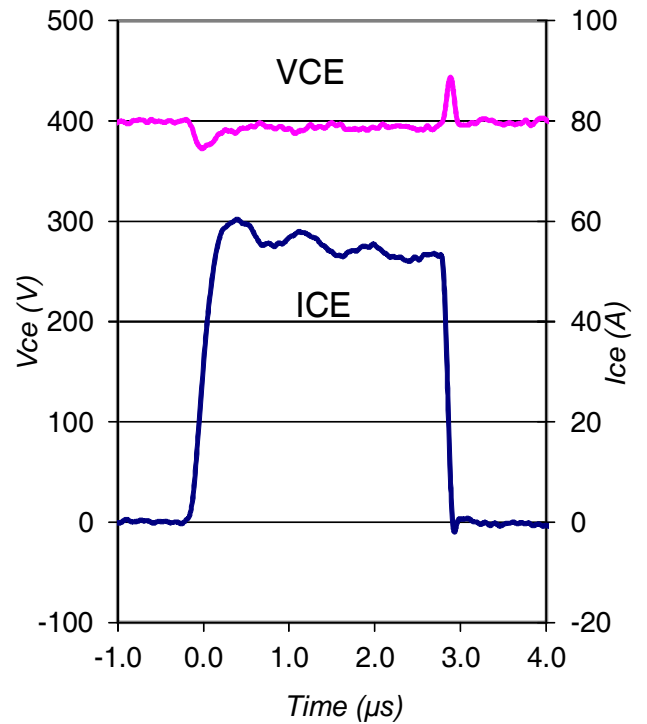


Fig. WF2 - Typ. Turn-on Loss Waveform
 @ $T_J = 150^\circ\text{C}$ using Fig. CT.4



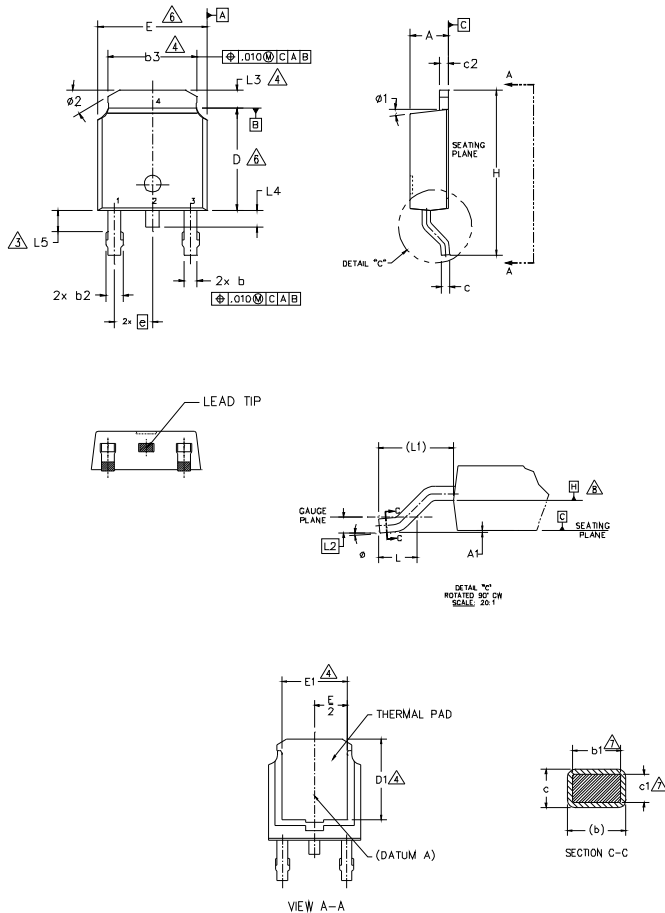
WF.3- Typ. Diode Recovery Waveform
 @ $T_J = 150^\circ\text{C}$ using CT.4



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

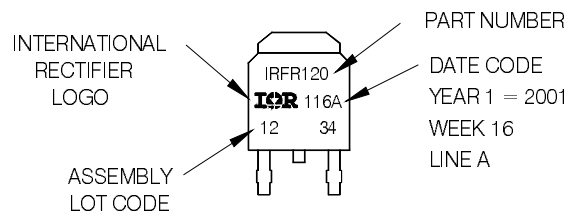
- 1.- GATE
- 2.- COLLECTOR
- 3.- EMITTER
- 4.- COLLECTOR

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

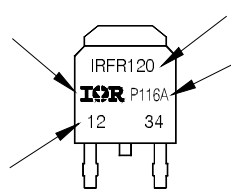
LINE A

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

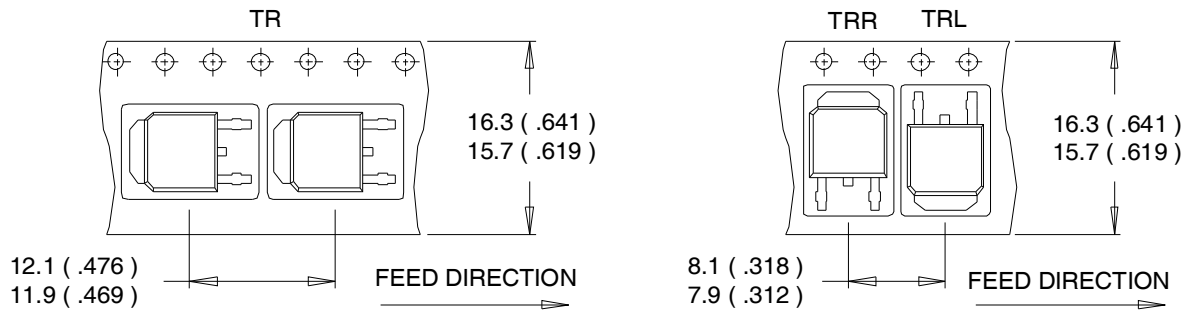
WEEK 16

A = ASSEMBLY SITE CODE

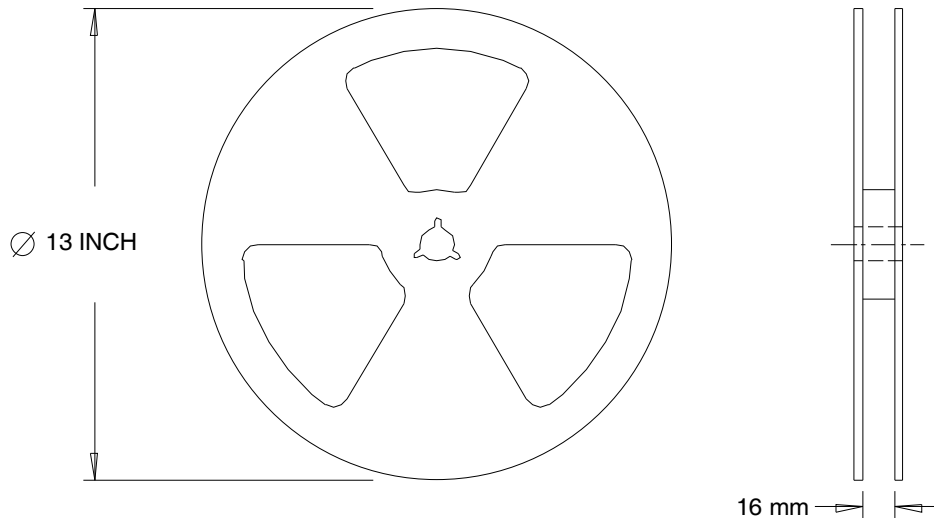
Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>

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

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