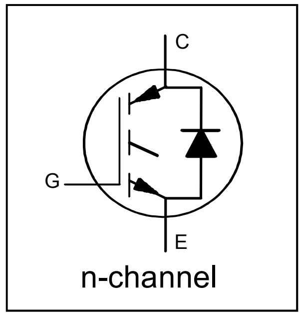
Insulated Gate Bipolar Transistor with Ultrafast Soft Recovery Diode

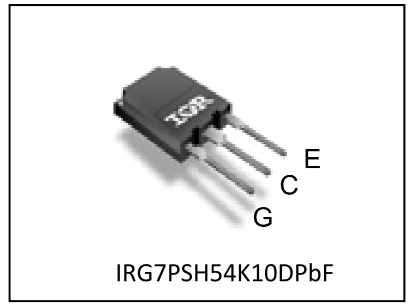
V_{CES} = 1200V

I_C = 65A, T_C =100°C

$t_{SC} \geq$ 10µs, $T_{J(max)}$ = 150°C

$V_{CE(ON)}$ typ. = 1.9V @ Ic = 50A





G	C	E
Gate	Collector	Emitter

Applications
- Industrial Motor Drive
- UPS
- Solar Inverters
- Welding

Features →	Benefits
Low $V_{CE(ON)}$ and switching losses	High efficiency in a Wide Range of Applications
10µs Short Circuit SOA	Rugged Transient Performance
Square RBSOA	
Maximum Junction Temperature 150°C	Increased Reliability
Positive $V_{CE\ (ON)}$ Temperature Coefficient	Excellent Current Sharing in Parallel Operation

Base part number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRG7PSH54K10DPbF	Super-247	Tube	25	IRG7PSH54K10DPbF

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
I_C @ T_C = 25°C	Continuous Collector Current	120	A
I_C @ T_C = 100°C	Continuous Collector Current	65	
I_{CM}	Pulse Collector Current, V_{GE}=20V	200	
I_{LM}	Clamped Inductive Load Current, V_{GE}=20V ①	200	
I_F @ T_C = 25°C	Diode Continuous Forward Current	50	
I_F @ T_C = 100°C	Diode Continuous Forward Current	25	
V_{GE}	Continuous Gate-to-Emitter Voltage	±30	V
P_D @ T_C = 25°C	Maximum Power Dissipation	520	W
P_D @ T_C = 100°C	Maximum Power Dissipation	210	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-40 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) ②	——	——	0.24	°C/W
$R_{\theta JC}$ (Diode)	Thermal Resistance Junction-to-Case-(each Diode) ②	——	——	0.70	
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink (flat, greased surface)	——	0.24	——	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (typical socket mount)	——	——	40	

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	1200	—	—	V	V_{GE} = 0V, I_C = 250μA ③
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	1.3	—	V/°C	V_{GE} = 0V, I_C = 5mA (25°C-150°C)
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.9	2.4	V	I_C = 50A, V_{GE} = 15V, T_J = 25°C
		—	2.4	—		I_C = 50A, V_{GE} = 15V, T_J = 150°C
$V_{GE(th)}$	Gate Threshold Voltage	5.0	—	7.5	V	V_{CE} = V_{GE}, I_C = 2.4mA
$\Delta V_{GE(th)}/\Delta T_J$	Threshold Voltage Temperature Coeff.	—	-15	—	mV/°C	V_{CE} = V_{GE}, I_C = 2.4mA (25°C-150°C)
gfe	Forward Transconductance	—	36	—	S	V_{CE} = 50V, I_C = 50A, PW = 20μs
I_{CES}	Collector-to-Emitter Leakage Current	—	1.0	45	μA	V_{GE} = 0V, V_{CE} = 1200V
		—	1800	—		V_{GE} = 0V, V_{CE} = 1200V, T_J = 150°C
I_{GES}	Gate-to-Emitter Leakage Current	—	—	±200	nA	V_{GE} = ±30V
V_F	Diode Forward Voltage Drop	—	2.5	3.5	V	I_F = 16A
		—	2.1	—		I_F = 16A, T_J = 150°C

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

	Parameter	Min.	Typ.	Max④	Units	Conditions
Q_g	Total Gate Charge (turn-on)	—	290	435	nC	I_C = 50A
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	60	90		V_{GE} = 15V
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	130	195		V_{CC} = 600V
E_{on}	Turn-On Switching Loss	—	4.8	5.7	mJ	I_C = 50A, V_{CC} = 600V, V_{GE}=15V
E_{off}	Turn-Off Switching Loss		2.8	3.7		R_G = 5Ω, T_J = 25°C
E_{total}	Total Switching Loss		7.6	9.4		Energy losses include tail & diode reverse recovery ⑤⑥
$t_{d(on)}$	Turn-On delay time	—	110	130	ns	
t_r	Rise time	—	80	105		
$t_{d(off)}$	Turn-Off delay time	—	490	520		
t_f	Fall time	—	70	90		
E_{on}	Turn-On Switching Loss	—	6.8	—	mJ	I_C = 50A, V_{CC} = 600V, V_{GE}=15V
E_{off}	Turn-Off Switching Loss	—	4.7	—		R_G = 5Ω, T_J = 150°C
E_{total}	Total Switching Loss		11.5			Energy losses include tail & diode reverse recovery ⑤⑥
$t_{d(on)}$	Turn-On delay time	—	85	—	ns	
t_r	Rise time	—	90	—		
$t_{d(off)}$	Turn-Off delay time	—	490	—		
t_f	Fall time	—	290	—		
C_{ies}	Input Capacitance	—	5700	—	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	—	290	—		V_{CC} = 30V
C_{res}	Reverse Transfer Capacitance	—	150	—		f = 1.0Mhz
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T_J = 150°C, I_C = 200A V_{CC} = 960V, Vp ≤ 1200V V_{GE} = +20V to 0V
SCSOA	Short Circuit Safe Operating Area	10	—	—	μs	T_J = 150°C,V_{CC} = 600V, Vp ≤ 1200V V_{GE} = +15V to 0V
Erec	Reverse Recovery Energy of the Diode	—	640	—	μJ	T_J = 150°C
t_{rr}	Diode Reverse Recovery Time	—	170	—	ns	V_{CC} = 600V, I_F = 16A
I_{rr}	Peak Reverse Recovery Current	—	25	—	A	V_{GE} = 15V, Rg = 5Ω

Notes:
① V_{CC} = 80% (V_{CES}), V_{GE} = 20V
② R_θ is measured at T_J of approximately 90°C.
③ Refer to AN-1086 for guidelines for measuring $V_{(BR)CES}$ safely.
④ Maximum limits are based on statistical sample size characterization.
⑤ Pulse width limited by max. junction temperature.
⑥ Values influenced by parasitic L and C in measurement.

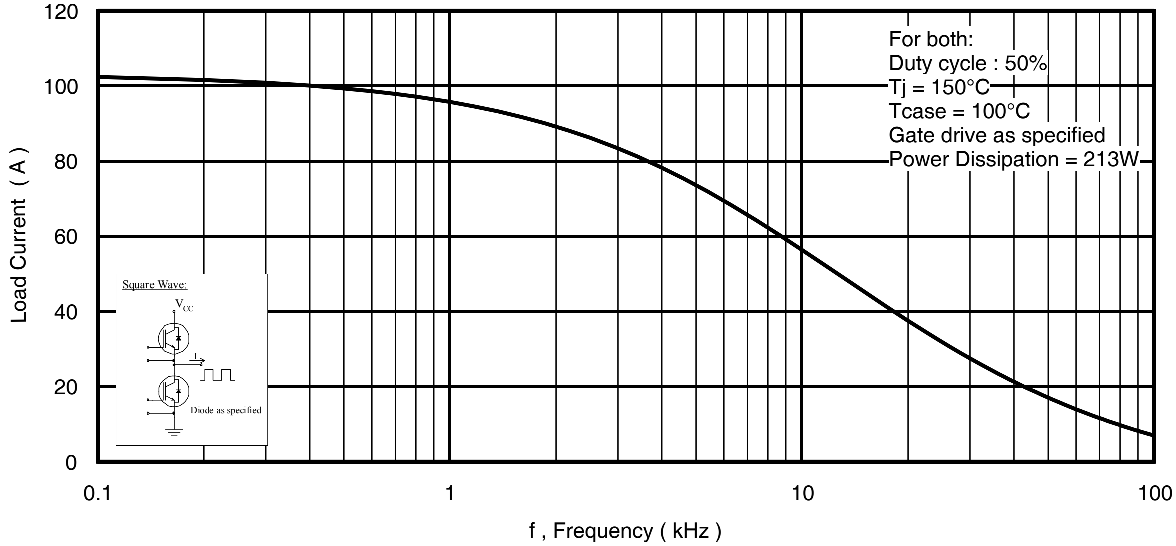


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = IRMS of fundamental)

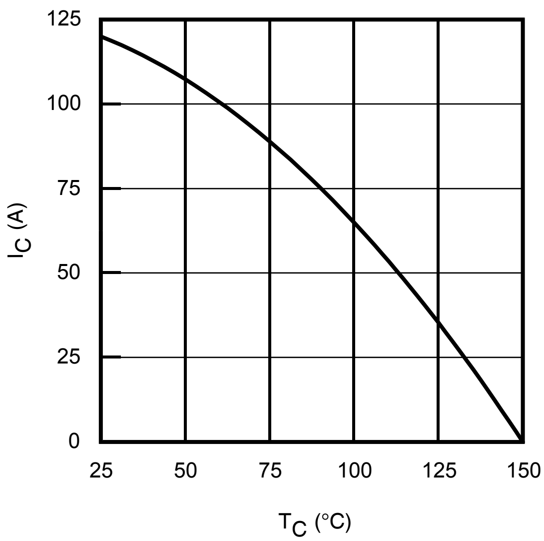


Fig. 2 - Maximum DC Collector Current vs. Case Temperature

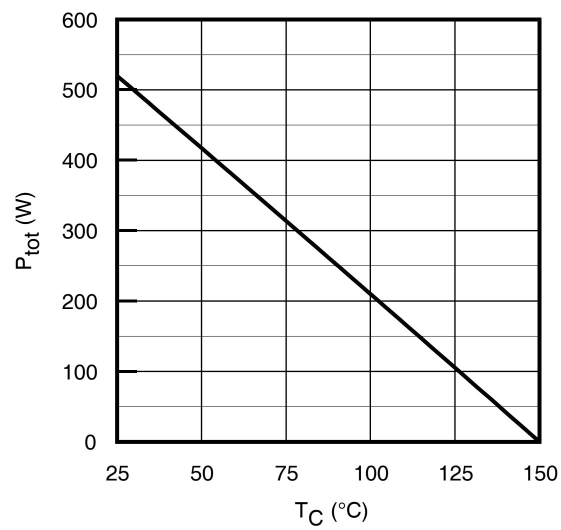


Fig. 3 - Power Dissipation vs. Case Temperature

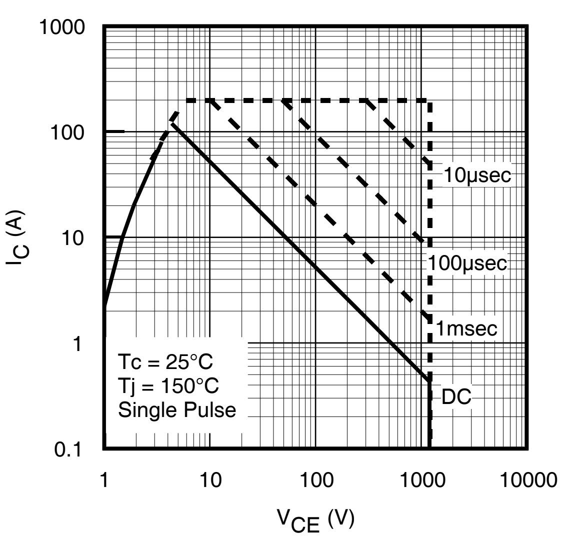


Fig. 4 - Forward SOA
T_C = 25°C, $T_J \leq$ 150°C, V_{GE} =15V

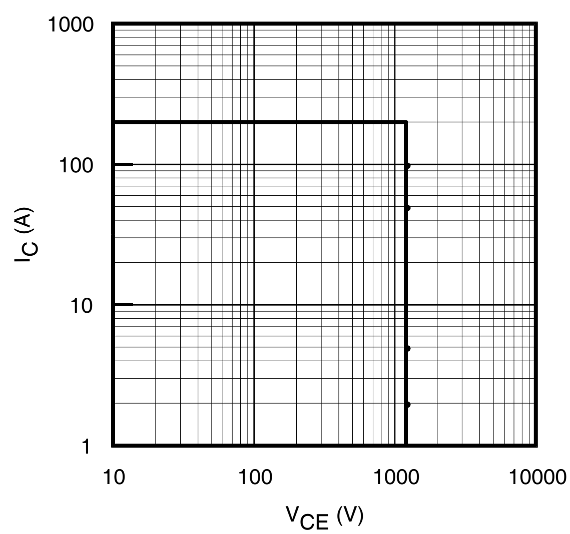


Fig. 5- Reverse Bias SOA
T_J = 150°C; V_{GE} = 20V

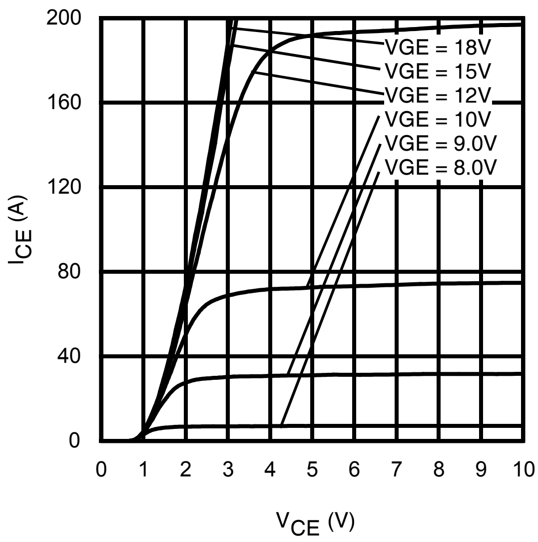


Fig. 6 - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 20µs

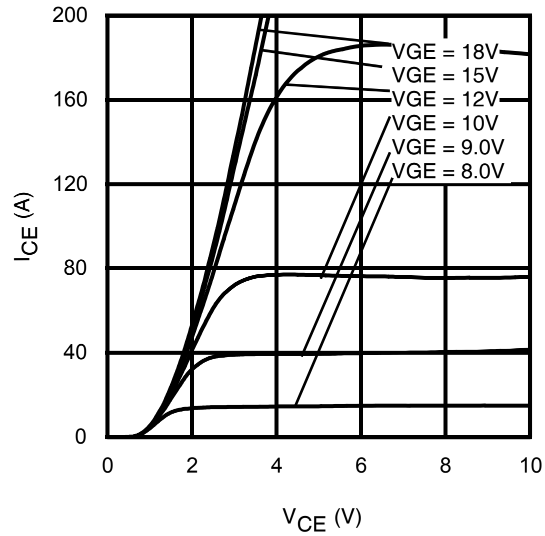


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 20µs

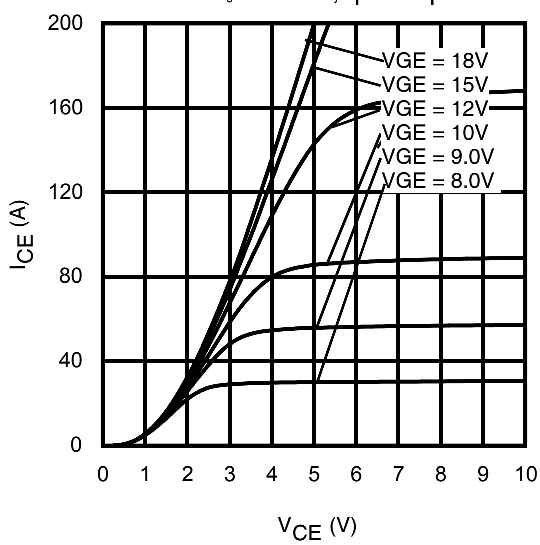


Fig. 8 - Typ. IGBT Output Characteristics
T_J = 150°C; tp = 20µs

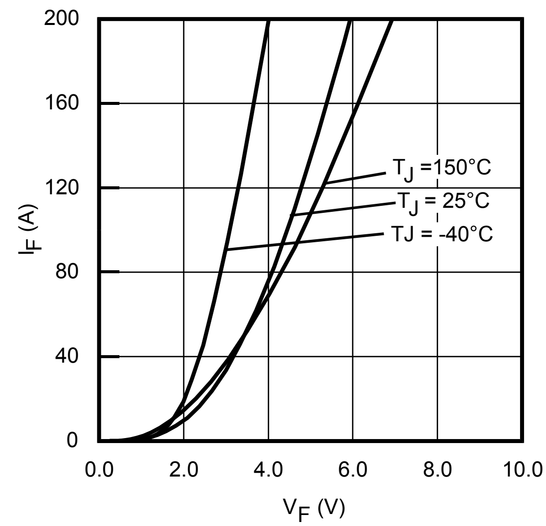


Fig. 9 - Typ. Diode Forward Characteristics
tp = 20µs

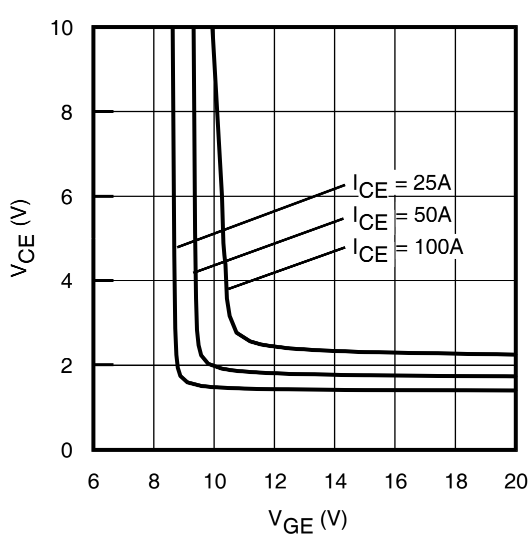


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

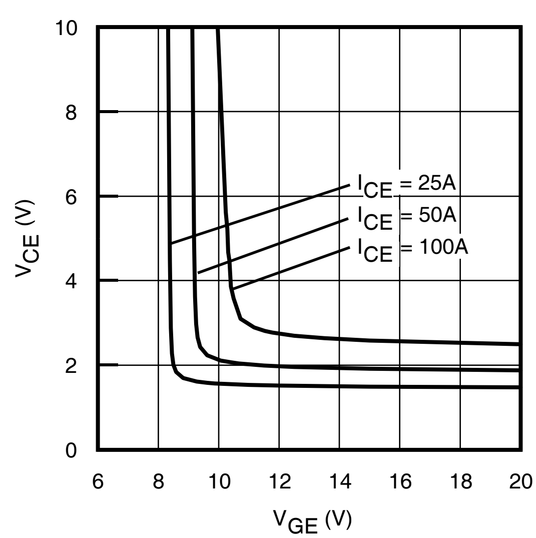


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

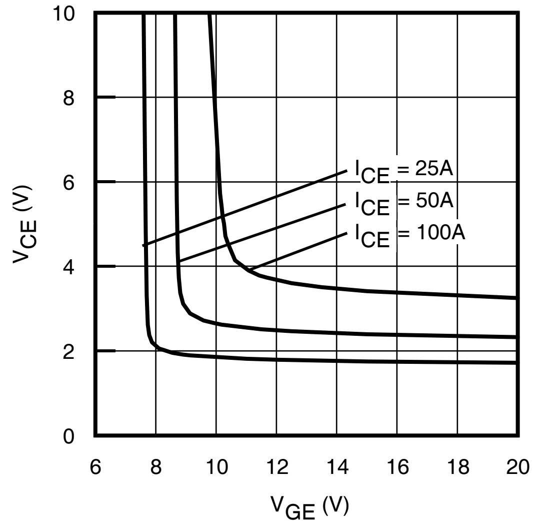


Fig. 12 - Typical V_{CE} vs. V_{GE}
T_J = 150°C

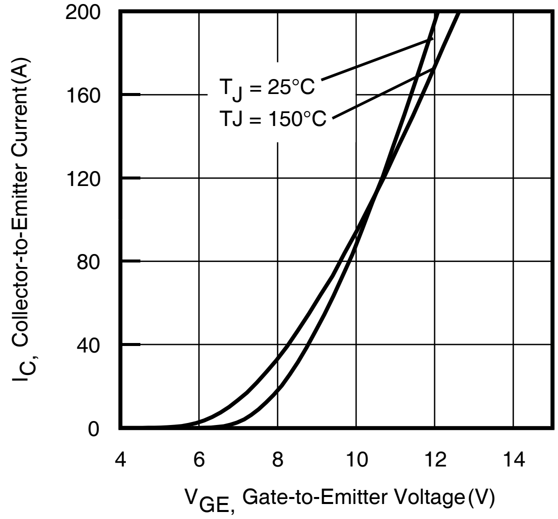


Fig. 13 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 20µs

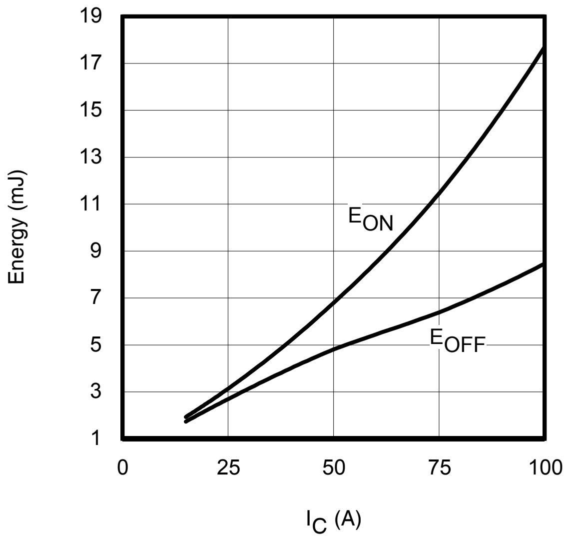


Fig. 14 - Typ. Energy Loss vs. I_C
T_J = 150°C; V_{CE} = 600V, R_G = 5Ω; V_{GE} = 15V

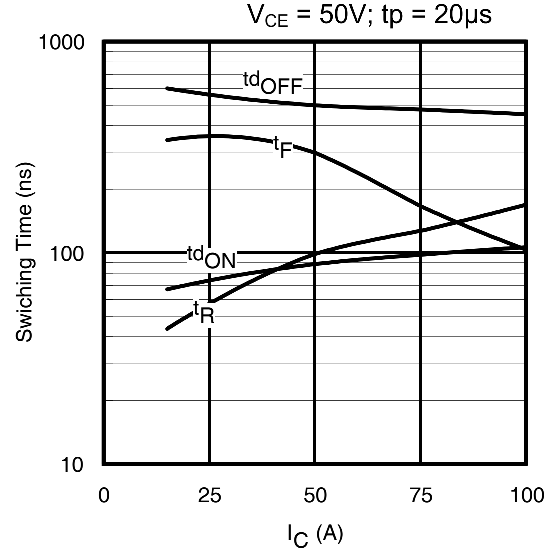


Fig. 15 - Typ. Switching Time vs. I_C
T_J = 150°C; V_{CE} = 600V, R_G = 5Ω; V_{GE} = 15V

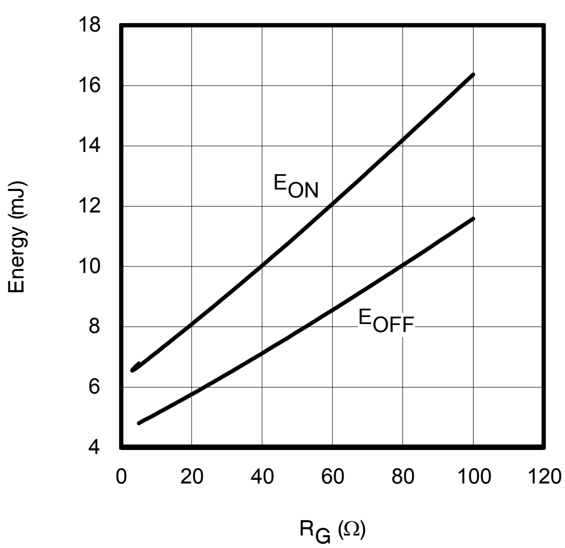


Fig. 16 - Typ. Energy Loss vs. RG
T_J = 150°C; V_{CE} = 600V, I_{CE} = 50A; VGE = 15V

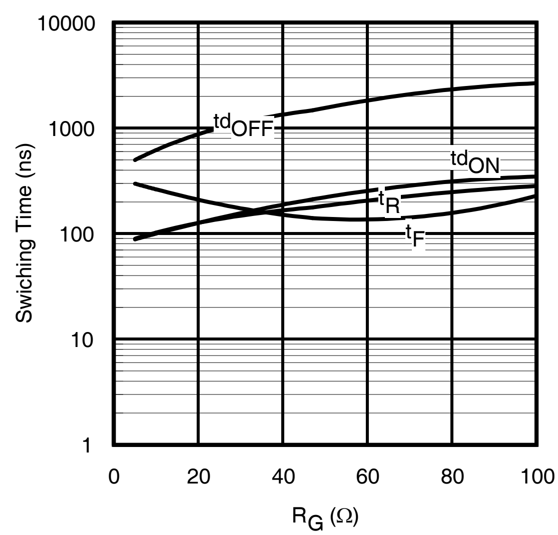


Fig. 17 - Typ. Switching Time vs. RG
T_J = 150°C; V_{CE} = 600V, I_{CE} = 50A; V_{GE} = 15V

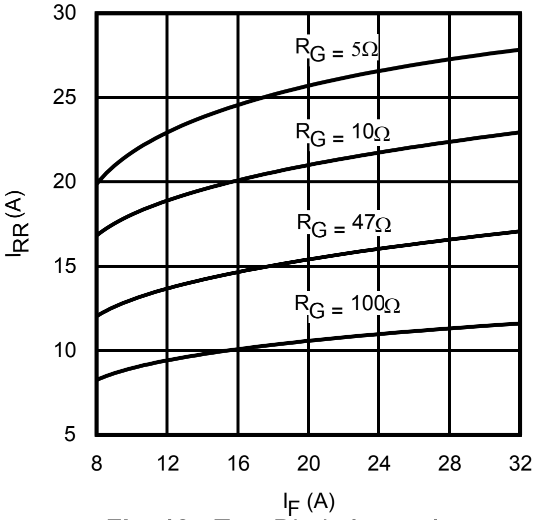


Fig. 18 - Typ. Diode I_{RR} vs. I_F
T_J = 150°C

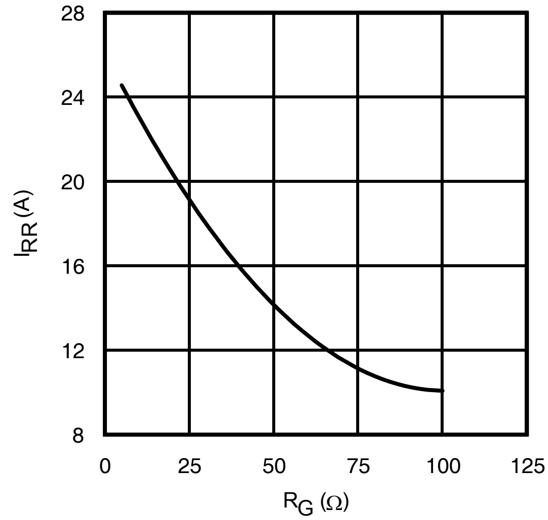


Fig. 19 - Typ. Diode I_{RR} vs. R_G
T_J = 150°C

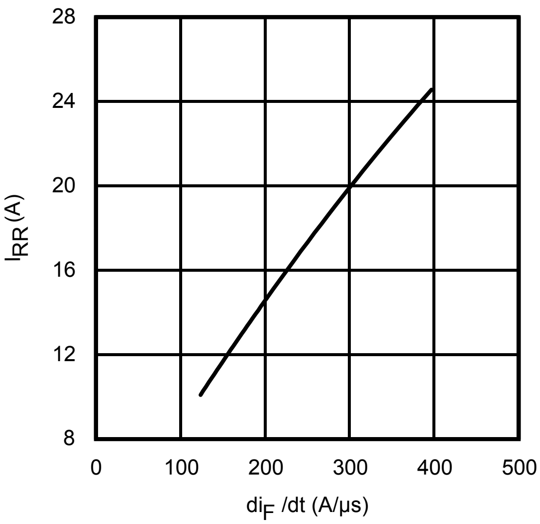


Fig. 20 - Typ. Diode I_{RR} vs. diF/dt
V_{CC} = 600V; V_{GE} = 15V; I_F = 16A; T_J = 150°C

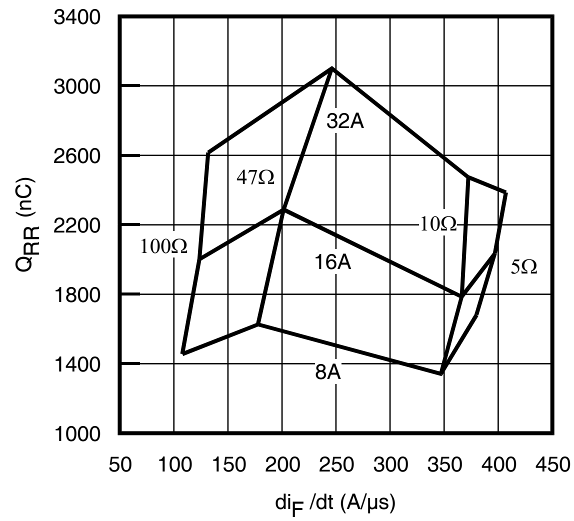


Fig. 21 - Typ. Diode Q_{RR} vs. diF/dt
V_{CC} = 600V; V_{GE} = 15V; T_J = 150°C

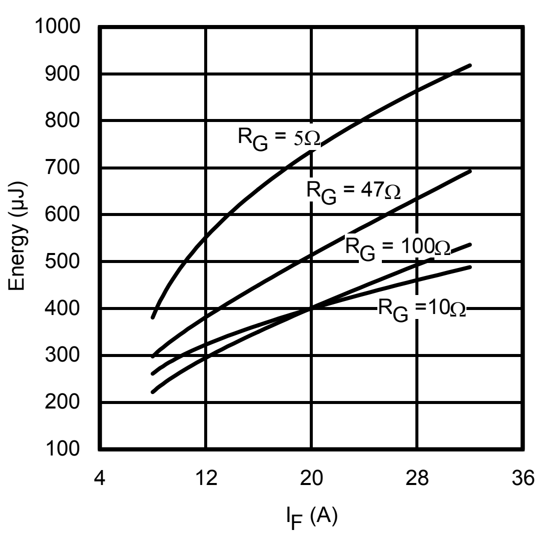


Fig. 22 - Typ. Diode E_{RR} vs. I_F
T_J = 150°C

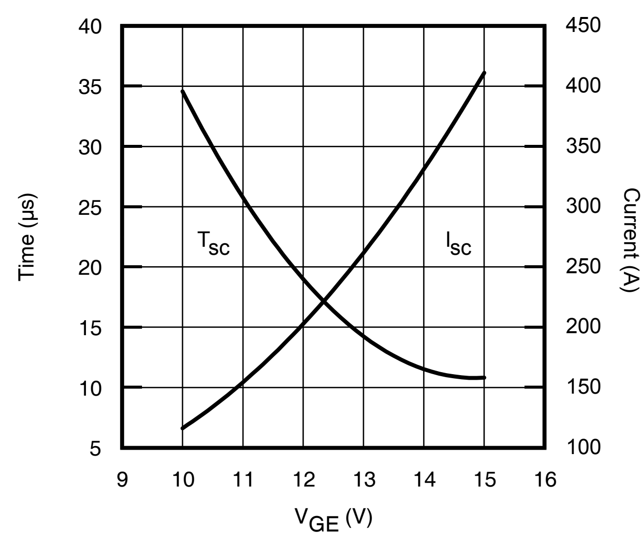


Fig. 23 - V_{CE} vs. Short Circuit Time
V_{cc}= 600V; T_C= 150°C

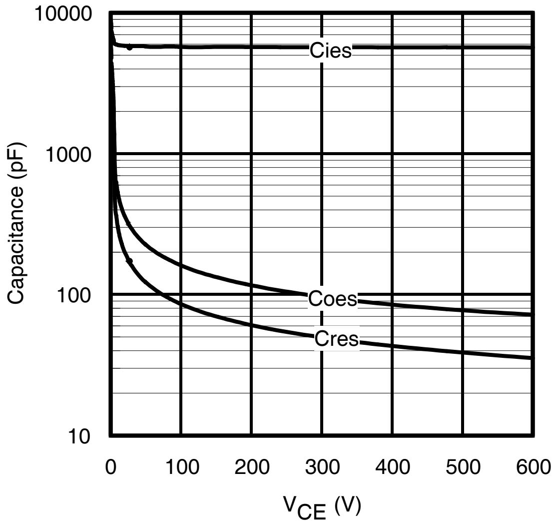


Fig. 24 - Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

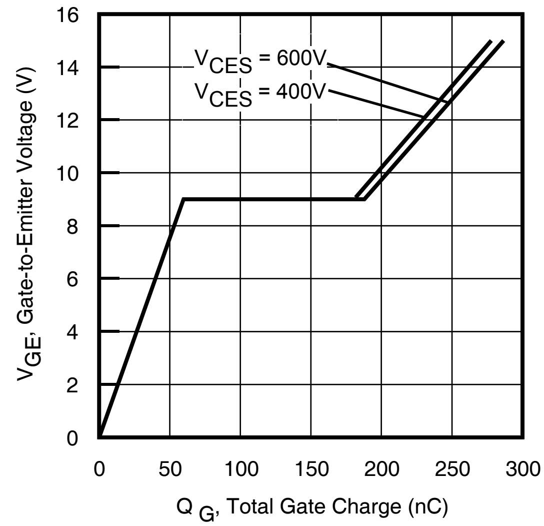
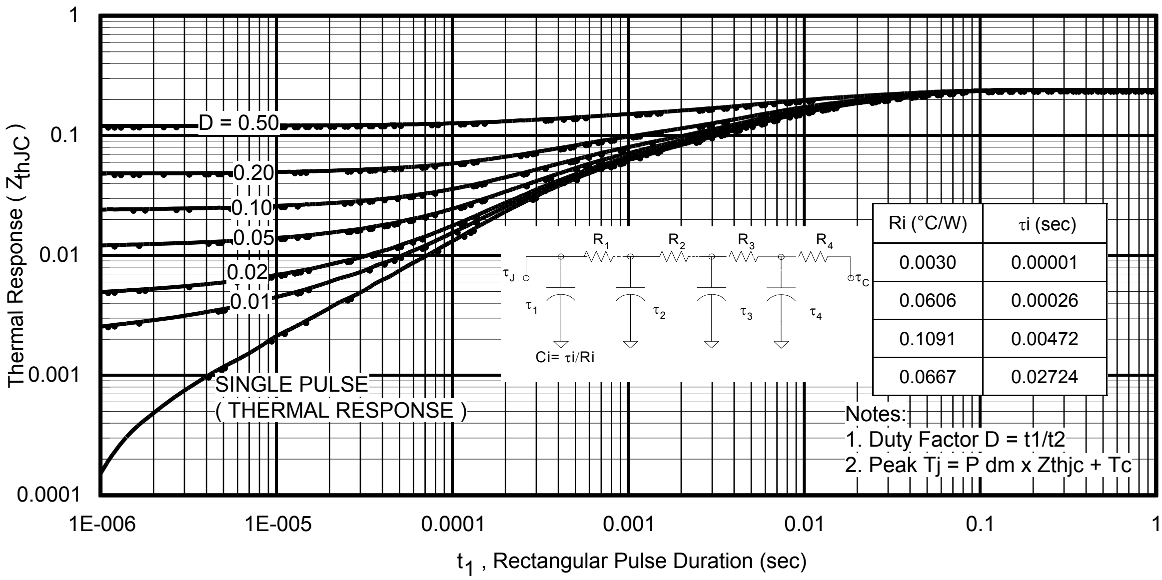
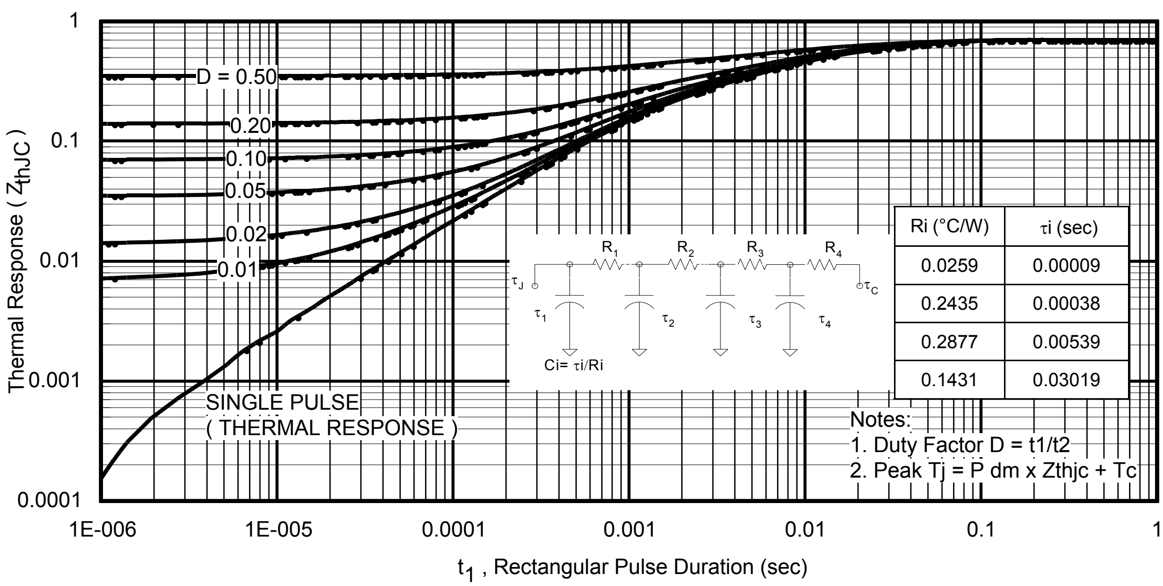


Fig. 25 - Typical Gate Charge vs. V_{GE}
I_{CE} = 50A



Ri (°C/W)	τi (sec)
0.0030	0.00001
0.0606	0.00026
0.1091	0.00472
0.0667	0.02724

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



Ri (°C/W)	τi (sec)
0.0259	0.00009
0.2435	0.00038
0.2877	0.00539
0.1431	0.03019

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

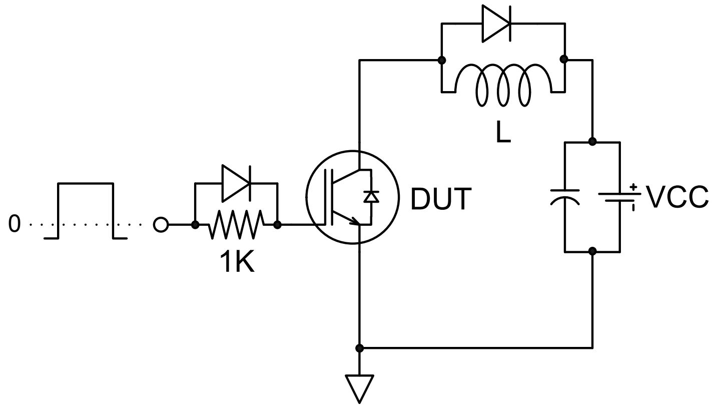


Fig.C.T.1 - Gate Charge Circuit (turn-off)

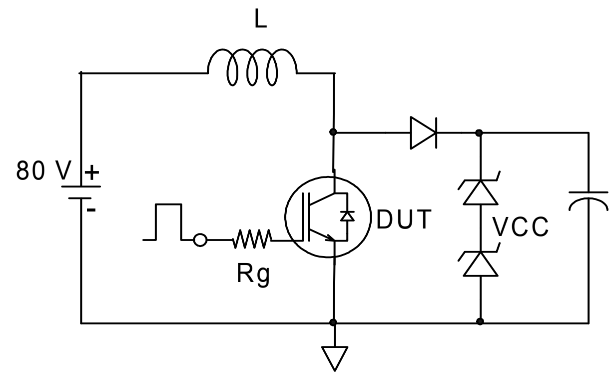


Fig.C.T.2 - RBSOA Circuit

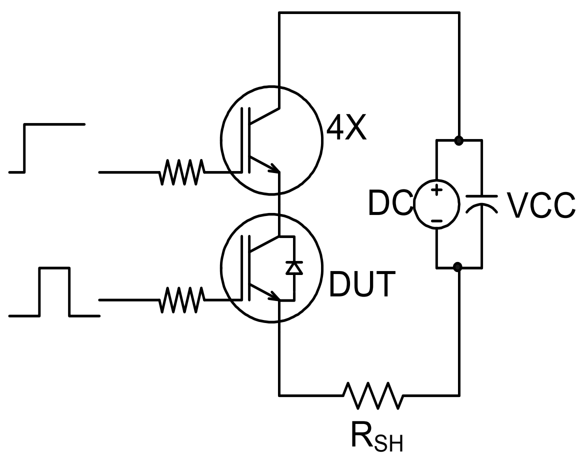


Fig.C.T.3 - S.C. SOA Circuit

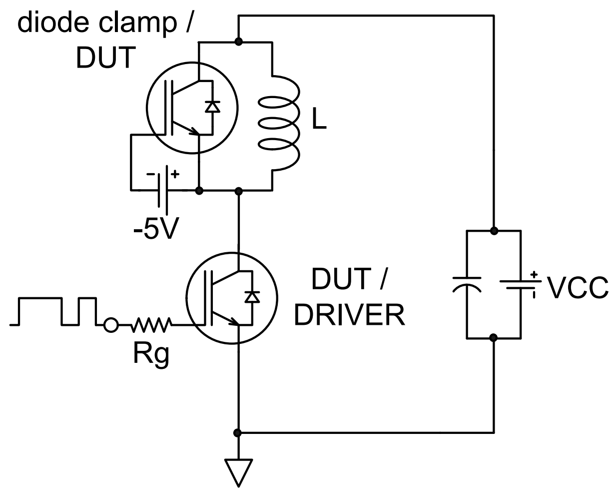


Fig.C.T.4 - Switching Loss Circuit

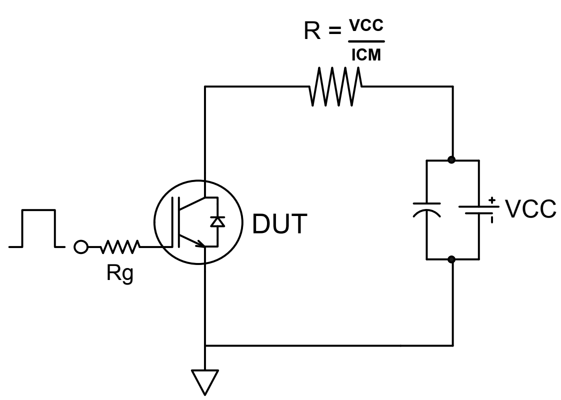


Fig.C.T.5 - Resistive Load Circuit

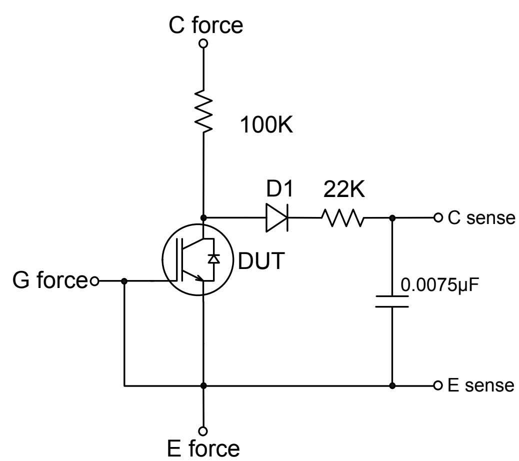


Fig.C.T.6 - BVCES Filter Circuit

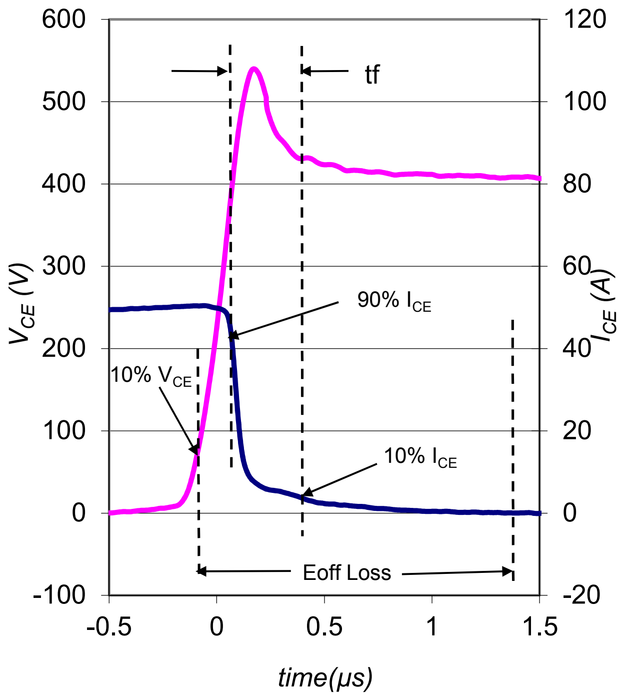


Fig. WF1 - Typ. Turn-off Loss Waveform
@ TJ = 150°C using Fig. CT.4

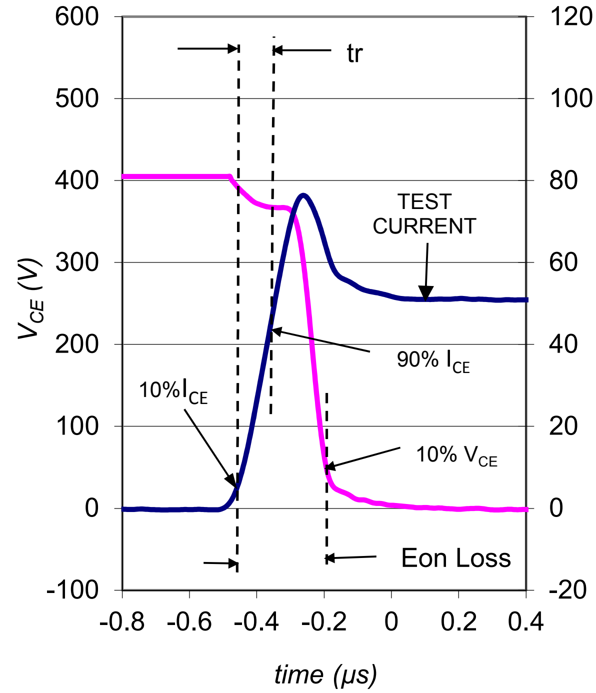


Fig. WF2 - Typ. Turn-on Loss Waveform
@ TJ = 150°C using Fig. CT.4

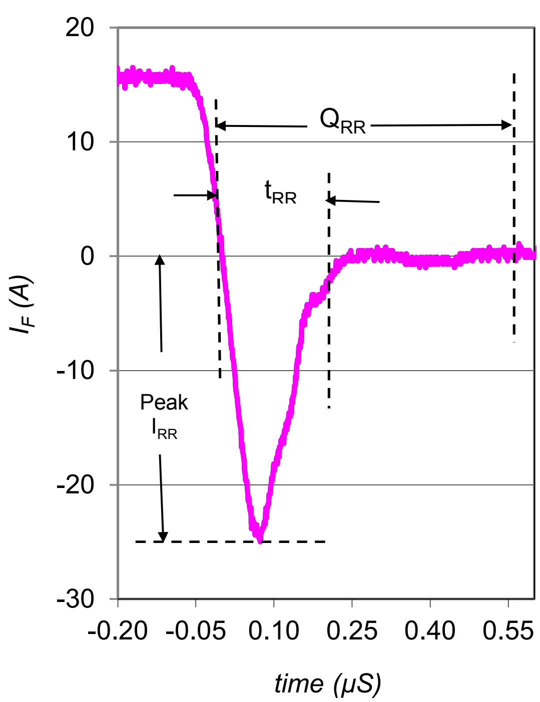


Fig. WF3 - Typ. Diode Recovery Waveform
@ T_J = 150°C using Fig. CT.4

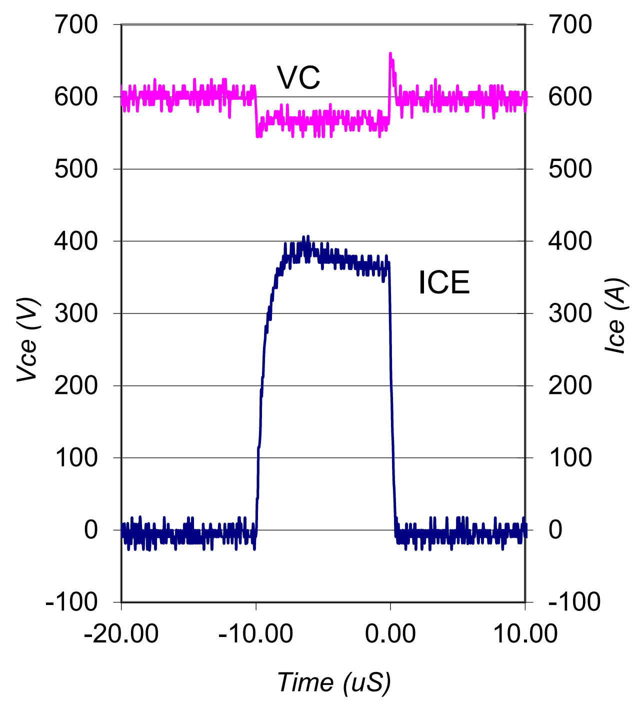
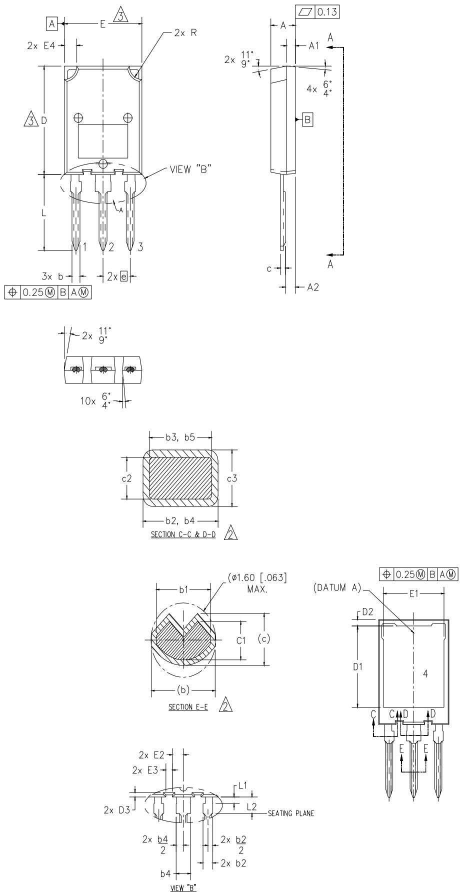


Fig. WF4 - Typ. S.C. Waveform
@ TJ = 150°C using Fig. CT.3

Super -247(TO-274AA) Package Outline

Dimensions are shown in millimeters (inches)



NOTES:
1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M−1994
2. DIMENSIONS b1, b3, b5, c1 & c3 APPLY TO BASE METAL ONLY.
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTER EXTREMES OF THE PLASTIC BODY.
4.− ALL DIMENSIONS SHOWN IN MILLIMETERS.
5.− CONTROLLING DIMENSION: MILLIMETER.
6.− OUTLINE CONFORMS TO JEDEC OUTLINE TO−274AA

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.50	5.50	.177	.217	
A1	1.45	2.15	.057	.085	
A2	1.65	2.35	.065	.093	
b	1.45	1.60	.054	.063	
b1	1.40	1.50	.055	.059	2
b2	2.00	2.40	.079	.094	
b3	1.95	2.35	.077	.093	2
b4	3.00	3.15	.118	.124	
b5	2.95	3.35	.116	.132	2
c	1.10	1.30	.043	.051	
c1	0.90	1.10	.035	.043	2
c2	0.65	0.85	.026	.033	
c3	0.50	0.70	.020	.028	2
D	19.80	20.80	.780	.819	3
D1	15.50	16.10	.610	.634	
D2	0.70	1.30	.028	.051	
D3	0.75	1.25	.030	.049	
E	15.10	16.10	.594	.634	3
E1	13.30	13.90	.524	.547	
E2	2.25	2.70	.089	.109	
E3	1.20	1.70	.047	.067	
E4	2.00	3.00	.079	.118	
e	5.45 BSC		.215 BSC		
L	13.80	14.80	.535	.583	
L1	1.00	1.60	.039	.063	
L2	3.85	4.25	.152	.167	
R	2.00	3.00	.079	.118	

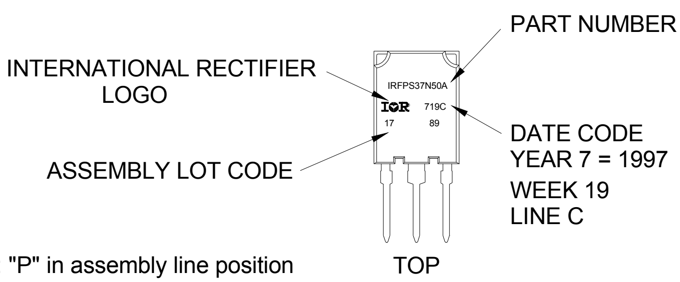
LEAD ASSIGNMENTS

MOSFET
1.− GATE
2.− DRAIN
3.− SOURCE
4.− DRAIN

IGBT
1.− GATE
2.− COLLECTOR
3.− EMITTER
4.− COLLECTOR

Super -247 (TO-274AA)Part Marking Information

EXAMPLE: THIS IS AN IRFPS37N50A WITH
ASSEMBLY LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"



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

Super -247 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/

Qualification Information†

Qualification Level	Industrial (per JEDEC JESD47F) ††	
Moisture Sensitivity Level	Super-247	N/A
RoHS Compliant	Yes	

† Qualification standards can be found at International Rectifier's web site: http://www.irf.com/product-info/reliability/

†† Applicable version of JEDEC standard at the time of product release.

Data and specifications subject to change without notice.

International Rectifier

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