International
IOR Rectifier

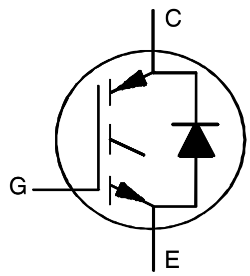
PD - 97548

IRG7PSH50UDPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

Features

- Low $V_{CE\ (ON)}$ trench IGBT technology
- Low switching losses
- Square RBSOA
- 100% of the parts tested for I_{LM} ①
- Positive $V_{CE\ (ON)}$ temperature co-efficient
- Ultra fast soft recovery co-pak diode
- Tight parameter distribution
- Lead-Free



n-channel

V_{CES} = 1200V

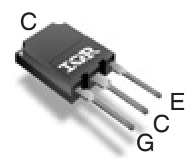
$I_{NOMINAL}$ = 50A

$T_{J(max)}$ = 150°C

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

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



Super-247

Applications

- U.P.S.
- Welding
- Solar Inverter
- Induction Heating

G	C	E
Gate	Collector	Emitter

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
I_C @ T_C = 25°C	Continuous Collector Current (Silicon Limited)	116	A
I_C @ T_C = 100°C	Continuous Collector Current (Silicon Limited)	70	
$I_{NOMINAL}$	Nominal Current	50	
I_{CM}	Pulse Collector Current, V_{GE} = 15V	150	
I_{LM}	Clamped Inductive Load Current, V_{GE} = 20V ①	200	
I_F @ T_C = 25°C	Diode Continous Forward Current	116	
I_F @ T_C = 100°C	Diode Continous Forward Current	70	
I_{FM}	Diode Maximum Forward Current ②	200	
V_{GE}	Continuous Gate-to-Emitter Voltage	±30	V
P_D @ T_C = 25°C	Maximum Power Dissipation	462	W
P_D @ T_C = 100°C	Maximum Power Dissipation	185	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 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) ④	–––	–––	0.27	°C/W
$R_{\theta JC}$ (Diode)	Thermal Resistance Junction-to-Case-(each Diode) ④	–––	–––	0.37	
$R_{\theta CS}$	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 = 100µA ③
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	1.0	—	V/°C	V_{GE} = 0V, I_C = 1.0mA (25°C-150°C)
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.7	2.0	V	I_C = 50A, V_{GE} = 15V, T_J = 25°C
		—	2.0	—		I_C = 50A, V_{GE} = 15V, T_J = 150°C
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0	V	V_{CE} = V_{GE}, I_C = 2.0mA
$\Delta V_{GE(th)}/\Delta TJ$	Threshold Voltage temp. coefficient	—	-17	—	mV/°C	V_{CE} = V_{GE}, I_C = 1.0mA (25°C - 150°C)
gfe	Forward Transconductance	—	55	—	S	V_{CE} = 50V, I_C = 50A, PW = 30µs
I_{CES}	Collector-to-Emitter Leakage Current	—	2.0	100	µA	V_{GE} = 0V, V_{CE} = 1200V
		—	3700	—		V_{GE} = 0V, V_{CE} = 1200V, T_J = 150°C
V_{FM}	Diode Forward Voltage Drop	—	3.0	3.9	V	I_F = 50A
		—	2.7	—		I_F = 50A, T_J = 150°C
I_{GES}	Gate-to-Emitter Leakage Current	—	—	±200	nA	V_{GE} = ±30V

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
Q_g	Total Gate Charge (turn-on)	—	290	440	nC	I_C = 50A
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	40	60		V_{GE} = 15V
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	110	170		V_{CC} = 600V
E_{on}	Turn-On Switching Loss	—	3600	4600	µJ	I_C = 50A, V_{CC} = 600V, V_{GE} = 15V
E_{off}	Turn-Off Switching Loss	—	2200	3200		R_G = 5.0Ω, L = 200µH, T_J = 25°C
E_{total}	Total Switching Loss	—	5800	7800		Energy losses include tail & diode reverse recovery
$t_{d(on)}$	Turn-On delay time	—	35	55	ns	
t_r	Rise time	—	40	60		
$t_{d(off)}$	Turn-Off delay time	—	430	500		
t_f	Fall time	—	45	65		
E_{on}	Turn-On Switching Loss	—	5080	—	µJ	I_C = 50A, V_{CC} = 600V, V_{GE}=15V
E_{off}	Turn-Off Switching Loss	—	3370	—		R_G=5.0Ω, L=200µH, T_J = 150°C ③
E_{total}	Total Switching Loss	—	8450	—		Energy losses include tail & diode reverse recovery
$t_{d(on)}$	Turn-On delay time	—	30	—	ns	
t_r	Rise time	—	40	—		
$t_{d(off)}$	Turn-Off delay time	—	480	—		
t_f	Fall time	—	170	—		
C_{ies}	Input Capacitance	—	6000	—	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	—	300	—		V_{CC} = 30V
C_{res}	Reverse Transfer Capacitance	—	130	—		f = 1.0Mhz
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T_J = 150°C, I_C = 200A V_{CC} = 960V, Vp =1200V Rg = 5.0Ω, V_{GE} = +20V to 0V
Erec	Reverse Recovery Energy of the Diode	—	1510	—	µJ	T_J = 150°C
t_{rr}	Diode Reverse Recovery Time	—	190	—	ns	V_{CC} = 600V, I_F = 5.0A
I_{rr}	Peak Reverse Recovery Current	—	5760	—	A	Rg = 5.0Ω, L =1.0mH

Notes:

① V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 200µH, R_G = 5.0Ω.
② Pulse width limited by max. junction temperature.
③ Refer to AN-1086 for guidelines for measuring $V_{(BR)CES}$ safely.
④ R_θ is measured at T_J of approximately 90°C.

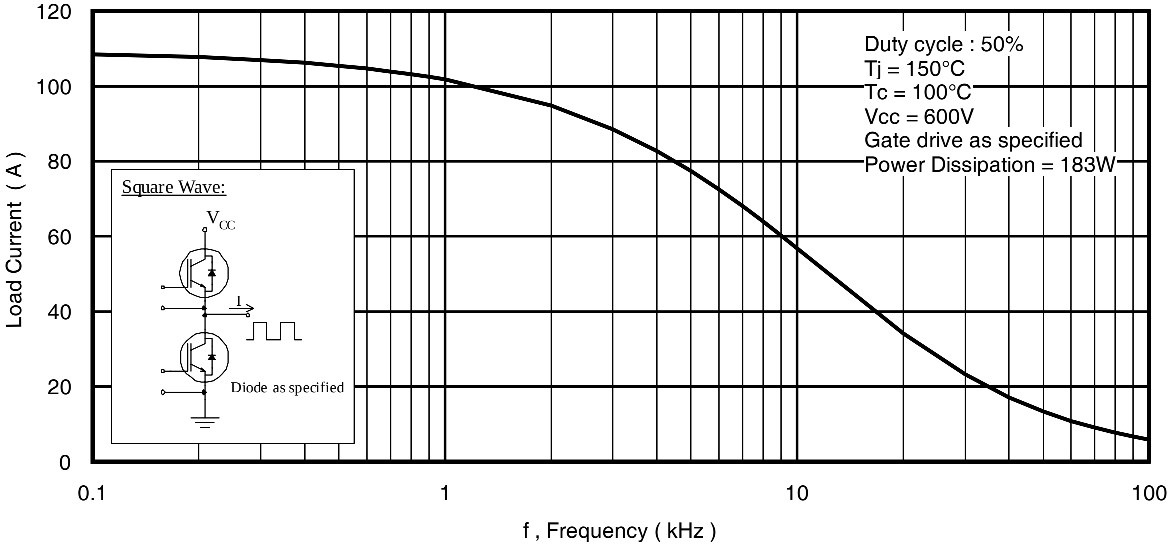


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

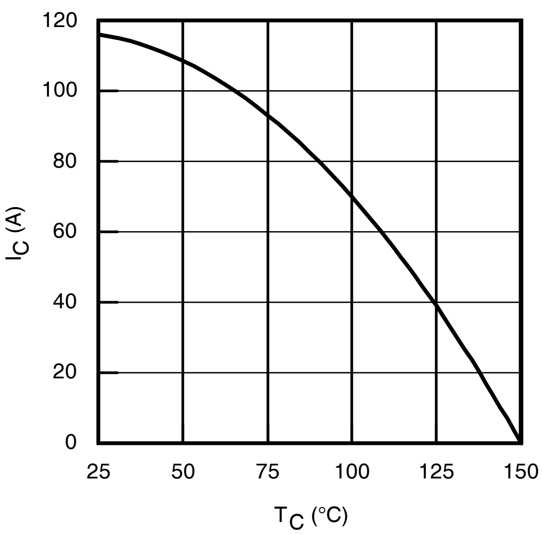


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

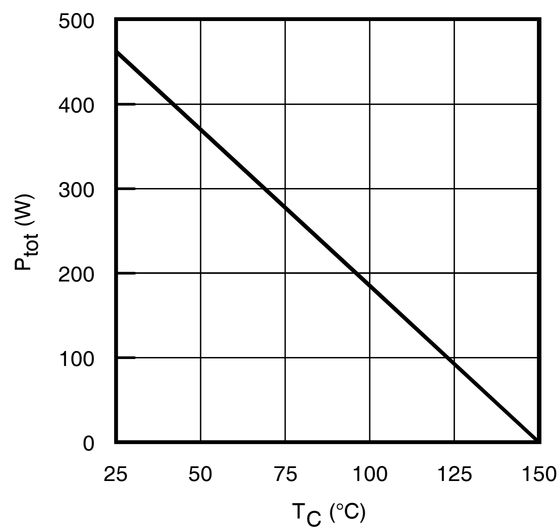


Fig. 2 - Power Dissipation vs. Case Temperature

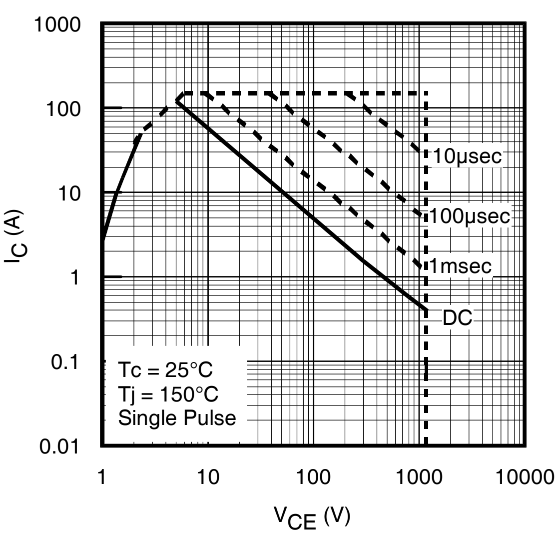


Fig. 3 - Forward SOA
T_C = 25°C, $T_J \leq$ 150°C; V_{GE} =15V

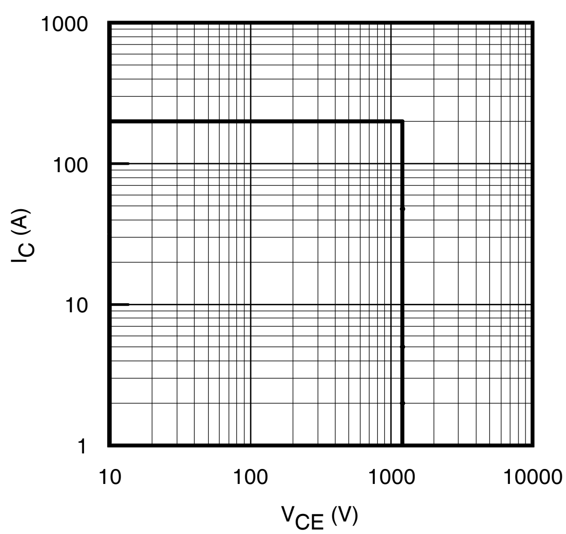


Fig. 4 - Reverse Bias SOA
T_J = 150°C; V_{GE} = 20V

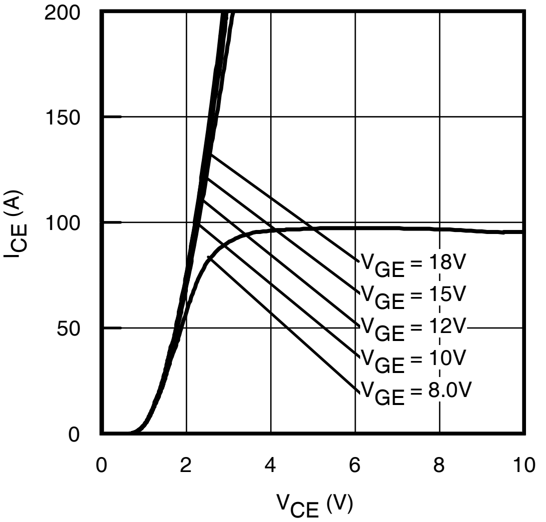


Fig. 5 - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 30µs

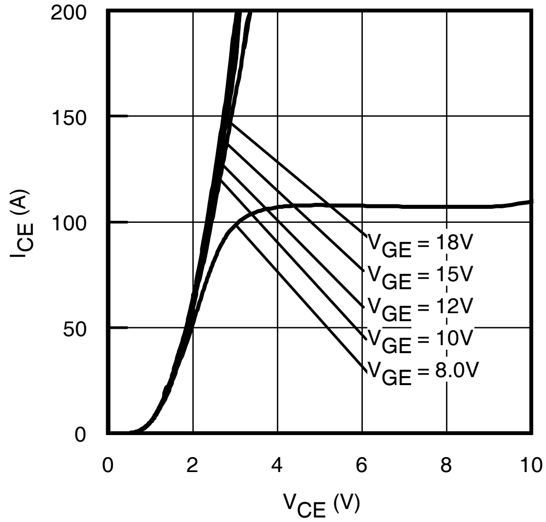


Fig. 6 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 30µs

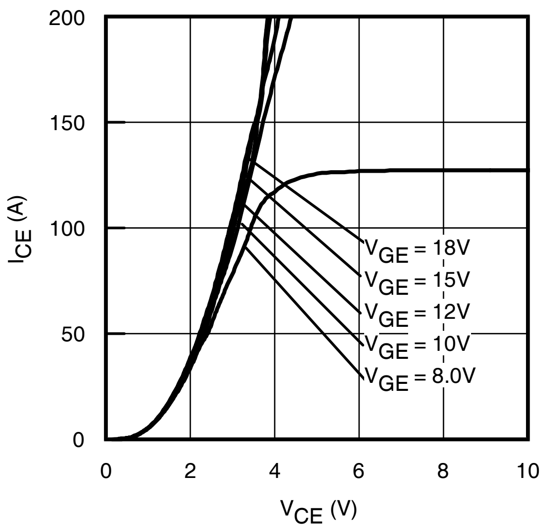


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 150°C; tp = 30µs

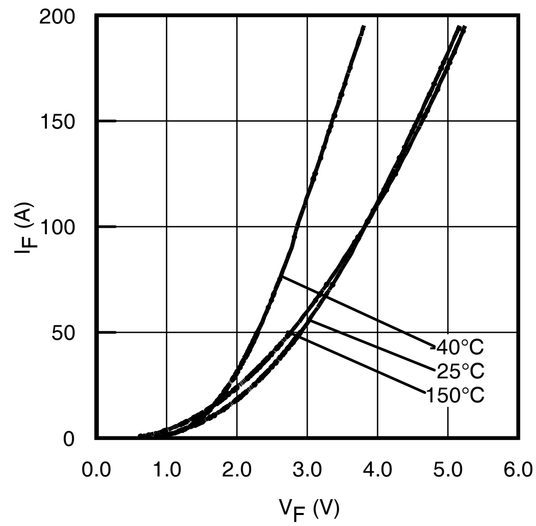


Fig. 8 - Typ. Diode Forward Characteristics
tp = 30µs

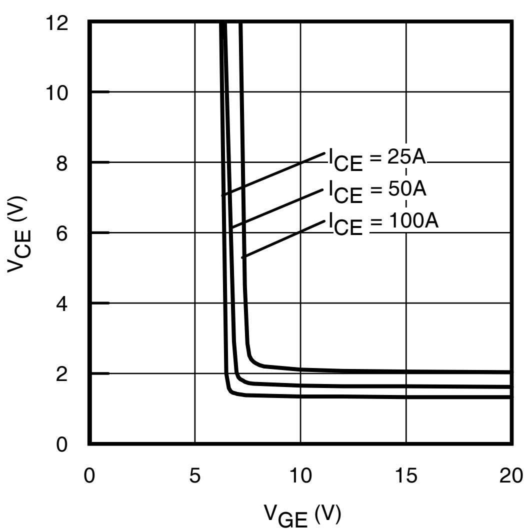


Fig. 9 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

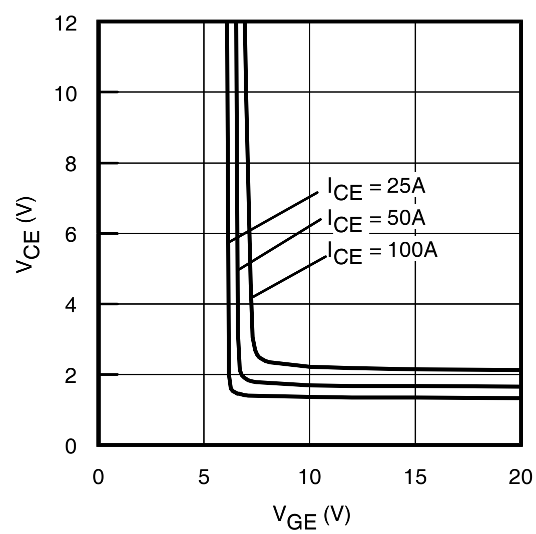


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

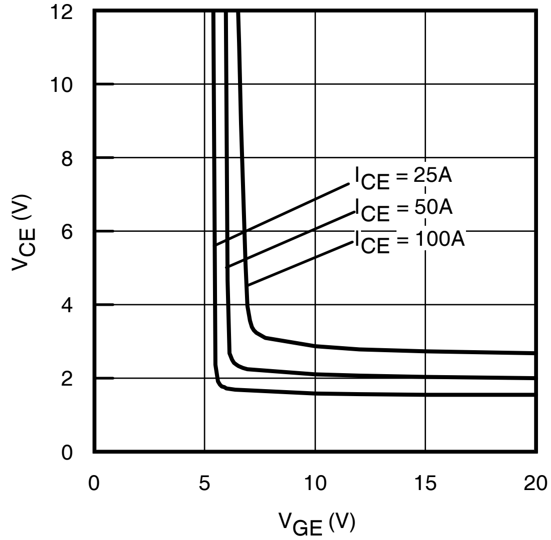


Fig. 11 - Typical V_{CE} vs. V_{GE}
$T_J = 150°C$

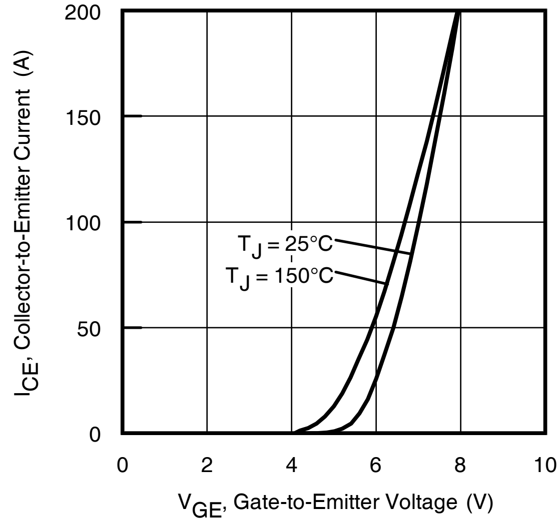


Fig. 12 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 30µs

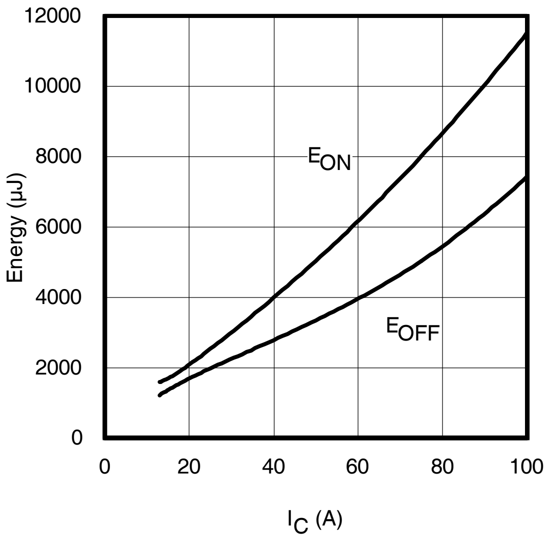


Fig. 13 - Typ. Energy Loss vs. I_C
T_J = 150°C; L = 200µH; V_{CE} = 600V, R_G = 5.0Ω; V_{GE} = 15V

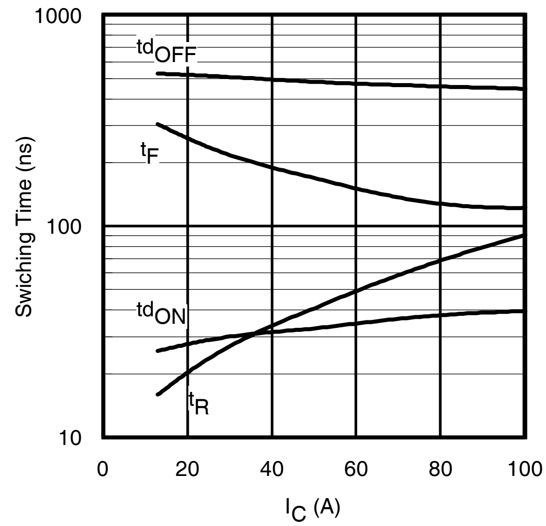


Fig. 14 - Typ. Switching Time vs. I_C
T_J = 150°C; L = 200µH; V_{CE} = 600V, R_G = 5.0Ω; V_{GE} = 15V

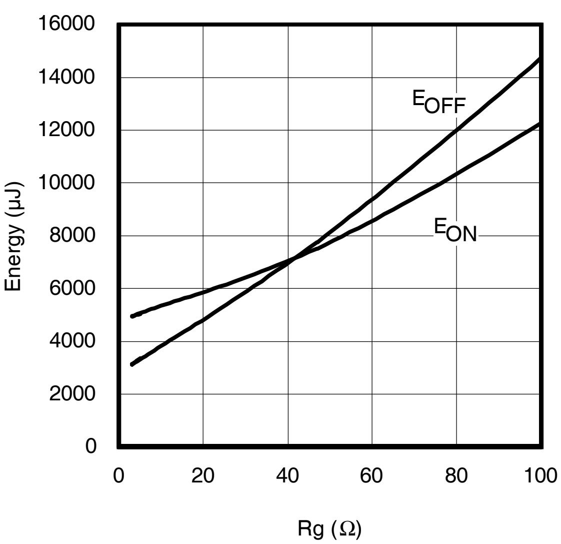


Fig. 15 - Typ. Energy Loss vs. R_G
T_J = 150°C; L = 200µH; V_{CE} = 600V, I_{CE} = 50A; V_{GE} = 15V

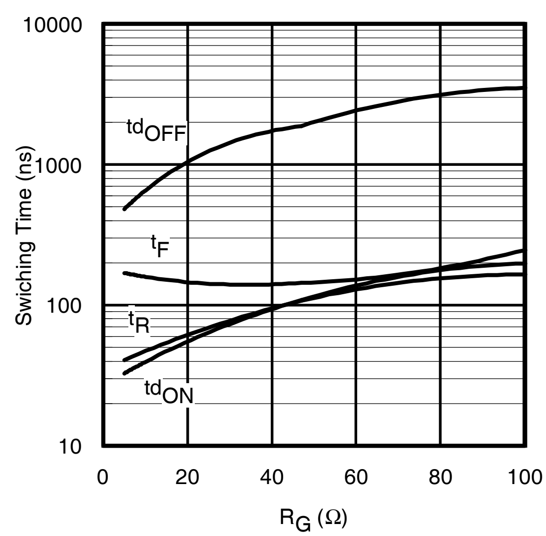


Fig. 16 - Typ. Switching Time vs. R_G
T_J = 150°C; L = 200µH; V_{CE} = 600V, I_{CE} = 50A; V_{GE} = 15V

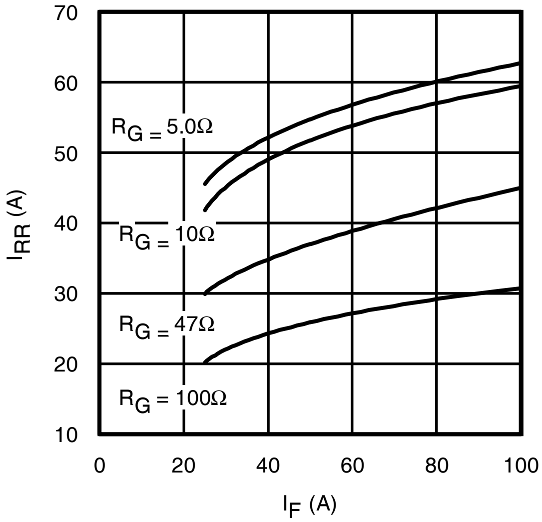


Fig. 17 - Typ. Diode I_{RR} vs. I_F
$T_J = 150°C$

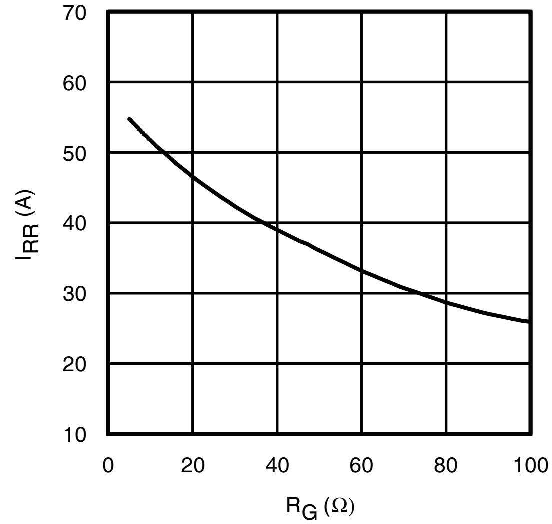


Fig. 18 - Typ. Diode I_{RR} vs. R_G
$T_J = 150°C$

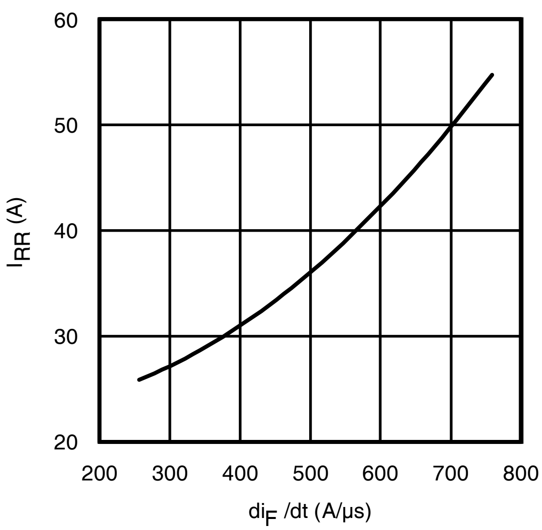


Fig. 19 - Typ. Diode I_{RR} vs. di_F/dt
$V_{CC} = 600V$; $V_{GE} = 15V$; $I_F = 50A$; $T_J = 150°C$

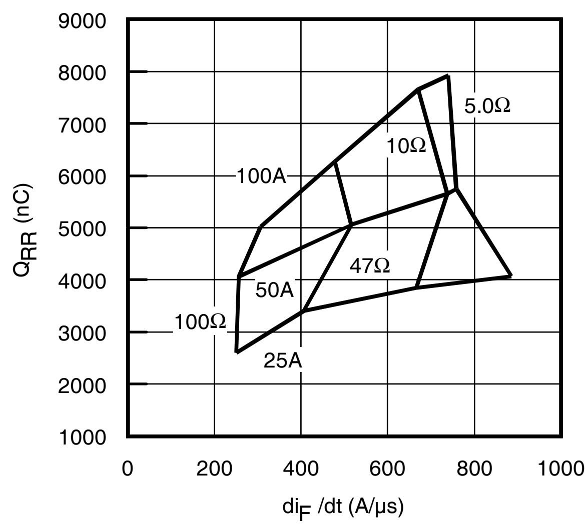


Fig. 20 - Typ. Diode Q_{RR} vs. di_F/dt
$V_{CC} = 600V$; $V_{GE} = 15V$; $T_J = 150°C$

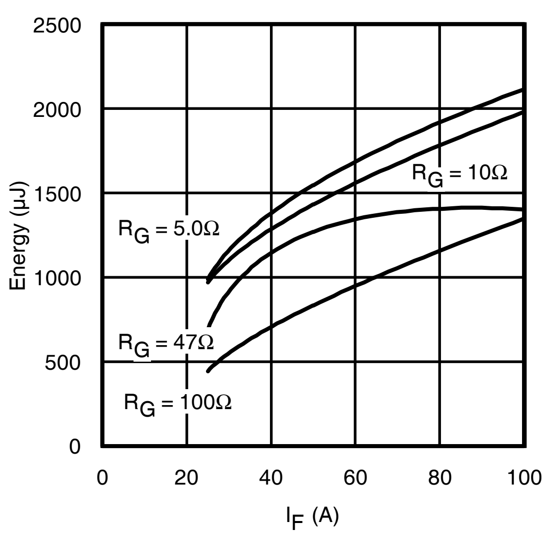


Fig. 21 - Typ. Diode E_{RR} vs. I_F
$T_J = 150°C$

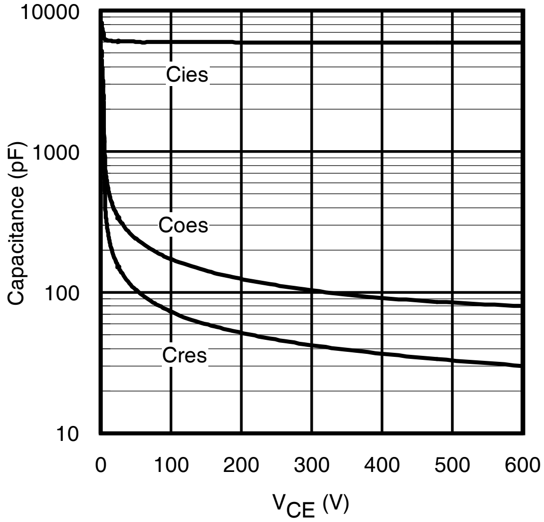


Fig. 22 - Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

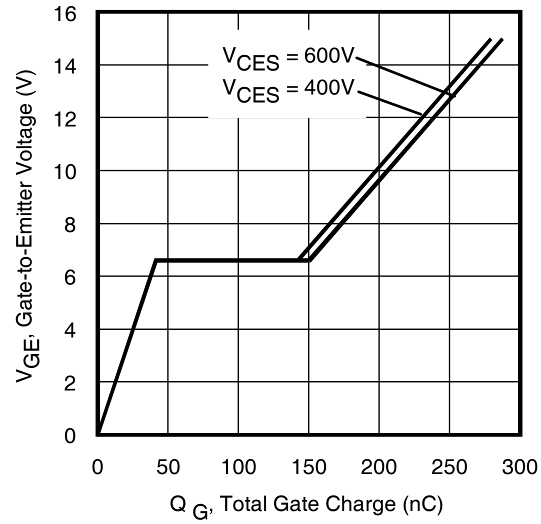
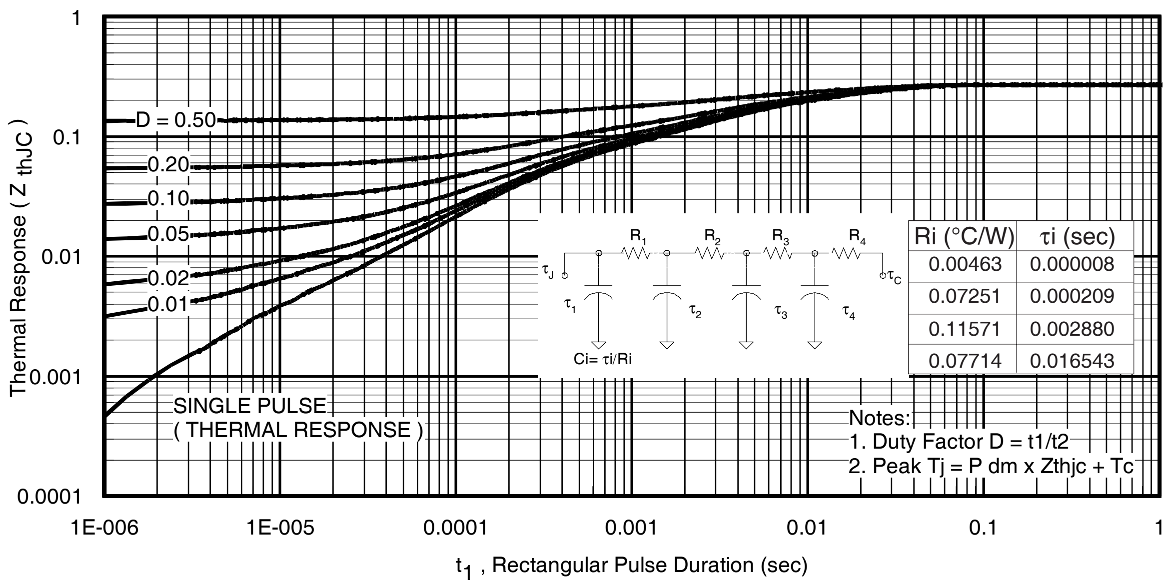
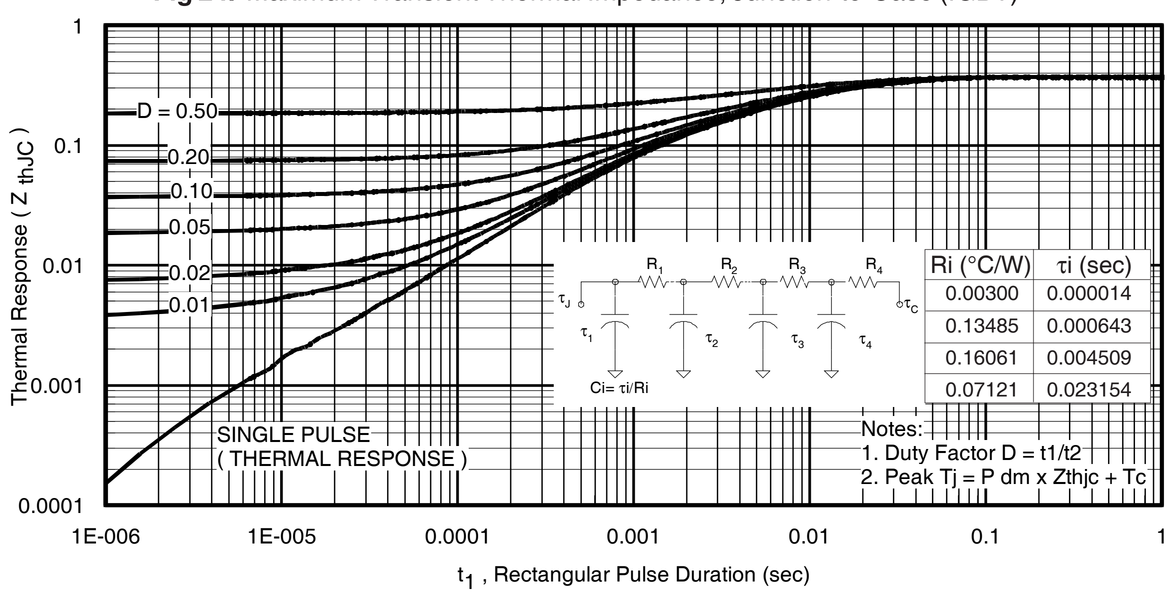


Fig. 23 - Typical Gate Charge vs. V_{GE}
I_{CE} = 50A



Ri (°C/W)	τi (sec)
0.00463	0.000008
0.07251	0.000209
0.11571	0.002880
0.07714	0.016543

Fig 24. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)



Ri (°C/W)	τi (sec)
0.00300	0.000014
0.13485	0.000643
0.16061	0.004509
0.07121	0.023154

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

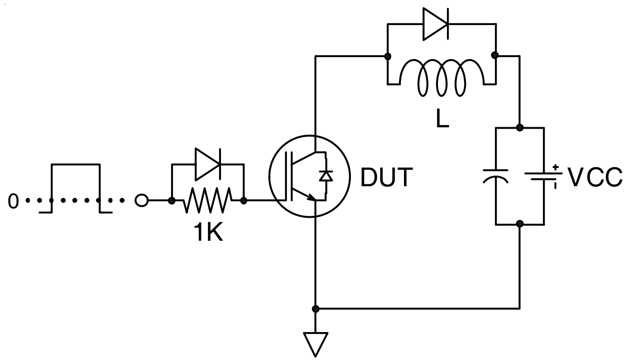


Fig.C.T.1 - Gate Charge Circuit (turn-off)

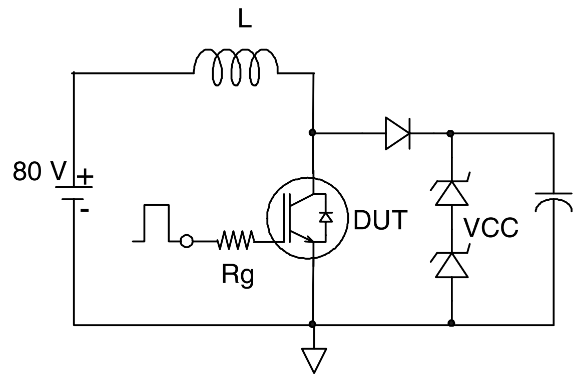


Fig.C.T.2 - RBSOA Circuit

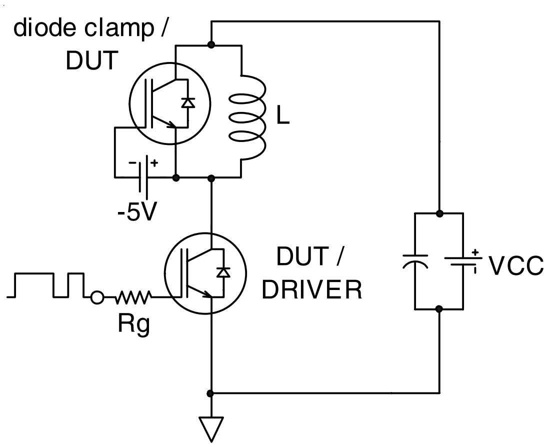


Fig.C.T.3 - Switching Loss Circuit

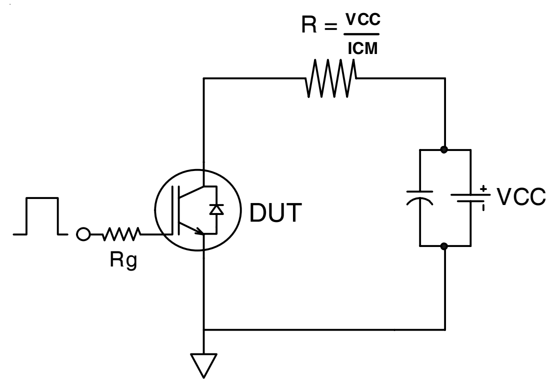


Fig.C.T.4 - Resistive Load Circuit

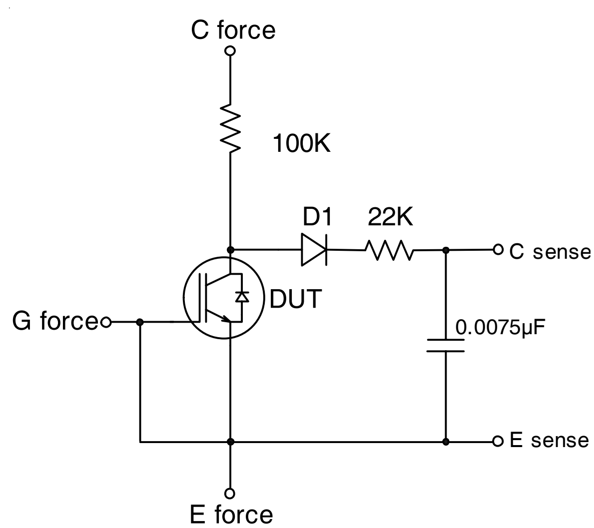


Fig.C.T.5 - BVCES Filter Circuit

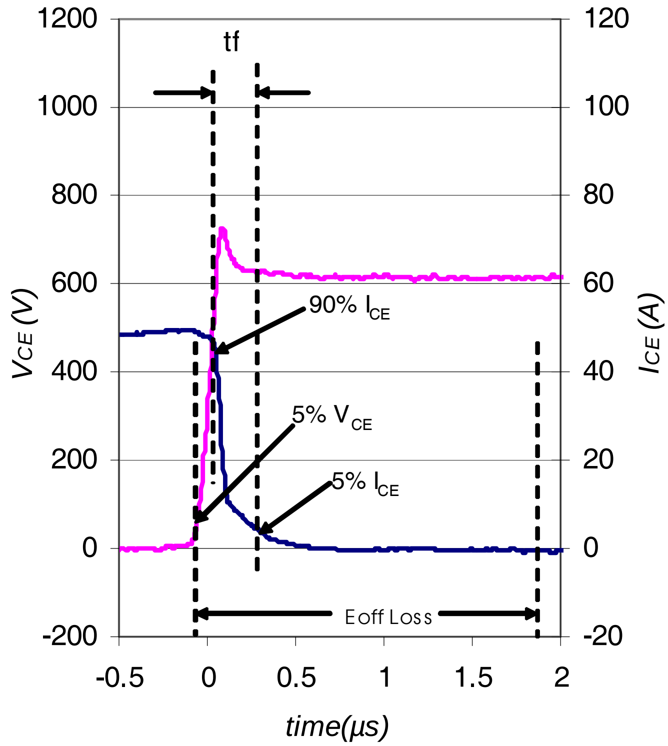


Fig. WF1 - Typ. Turn-off Loss Waveform
@ T_J = 150°C using Fig. CT.4

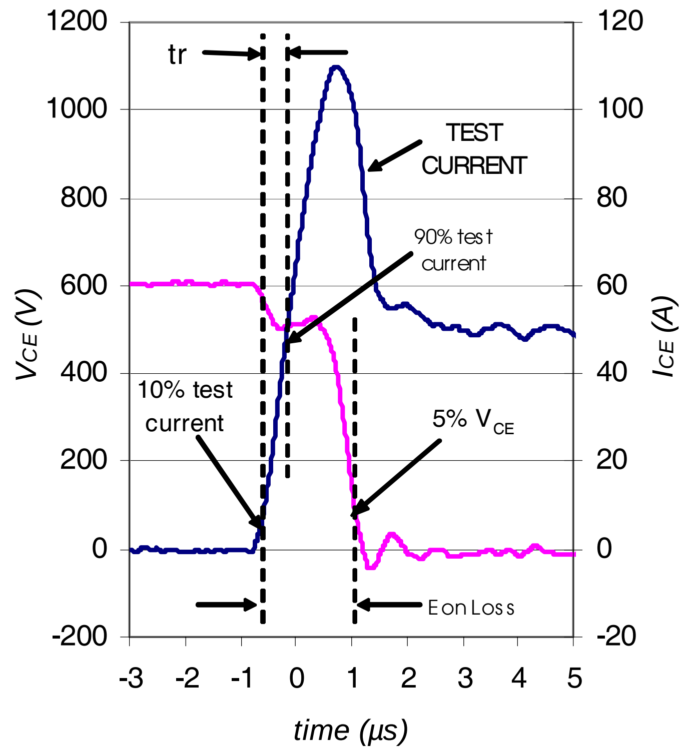


Fig. WF2 - Typ. Turn-on Loss Waveform
@ T_J = 150°C using Fig. CT.4

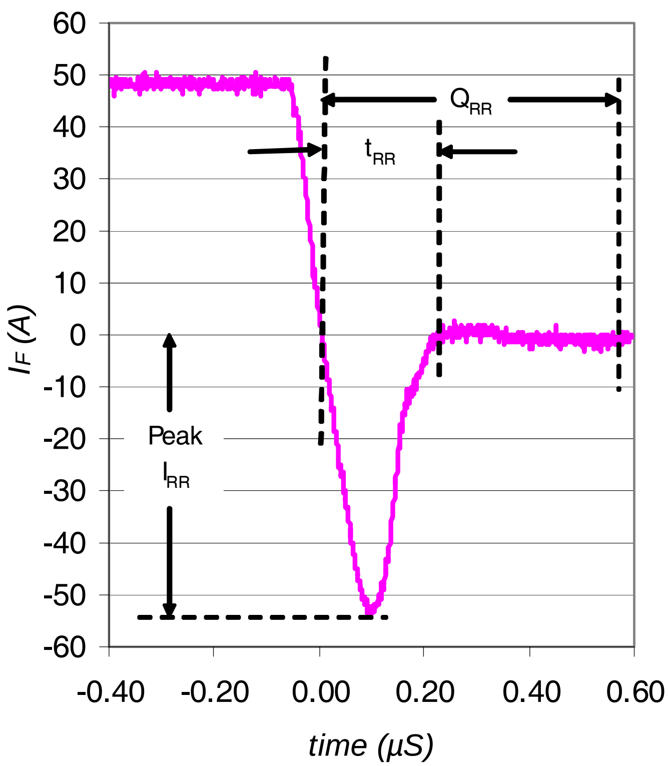
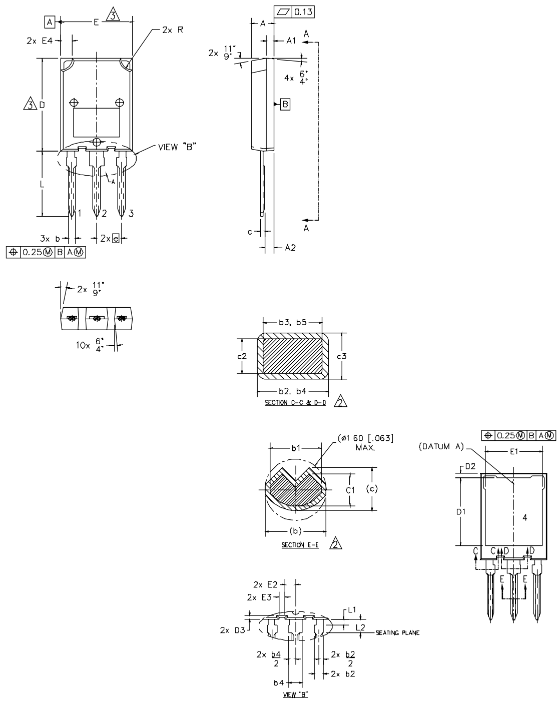


Fig. WF3 - Typ. Diode Recovery Waveform
@ T_J = 150°C using Fig. CT.4

Case Outline and Dimensions — Super-247



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

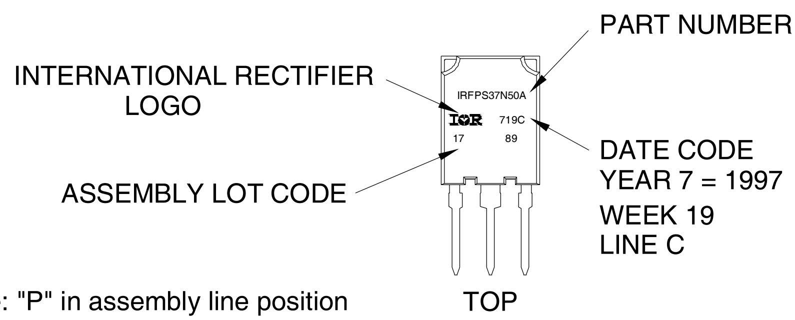
1.- GATE
2.- DRAIN
3.- SOURCE
4.- DRAIN

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/

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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