

IRG7PSH50UDPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

Features

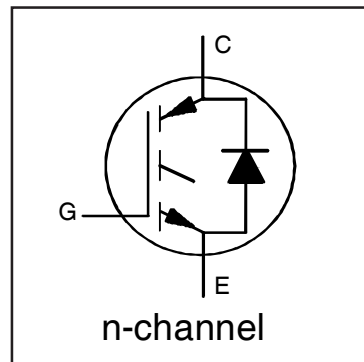
- Low $V_{CE(ON)}$ trench IGBT technology
- Low switching losses
- Square RBSOA
- 100% of the parts tested for I_{LM} ①
- Positive $V_{CE(ON)}$ temperature co-efficient
- Ultra fast soft recovery co-pak diode
- Tight parameter distribution
- Lead-Free

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

Applications

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

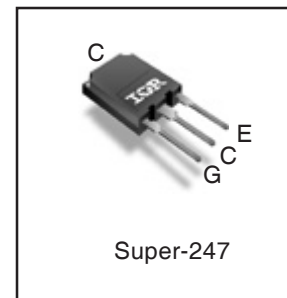


$$V_{CES} = 1200V$$

$$I_{NOMINAL} = 50A$$

$$T_{J(max)} = 150^{\circ}C$$

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



G	C	E
Gate	Collector	Emitter

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
$I_C @ T_C = 25^{\circ}C$	Continuous Collector Current (Silicon Limited)	116	A
$I_C @ T_C = 100^{\circ}C$	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	
$I_F @ T_C = 25^{\circ}C$	Diode Continuous Forward Current	116	
$I_F @ T_C = 100^{\circ}C$	Diode Continuous Forward Current	70	V
I_{FM}	Diode Maximum Forward Current ②	200	
V_{GE}	Continuous Gate-to-Emitter Voltage	± 30	V
$P_D @ T_C = 25^{\circ}C$	Maximum Power Dissipation	462	W
$P_D @ T_C = 100^{\circ}C$	Maximum Power Dissipation	185	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	$^{\circ}C$
	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	$^{\circ}C/W$
$R_{\theta JC}$ (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 @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	1200	—	—	V	$V_{GE} = 0V, I_C = 100\mu A$ 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	$I_C = 50A, V_{GE} = 15V, T_J = 25^\circ\text{C}$
		—	2.0	—		$I_C = 50A, V_{GE} = 15V, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0	V	$V_{CE} = V_{GE}, I_C = 2.0mA$
$\Delta V_{GE(th)}/\Delta T_J$	Threshold Voltage temp. coefficient	—	-17	—	mV/°C	$V_{CE} = V_{GE}, I_C = 1.0mA$ (25°C - 150°C)
g_{fe}	Forward Transconductance	—	55	—	S	$V_{CE} = 50V, I_C = 50A, PW = 30\mu s$
I_{CES}	Collector-to-Emitter Leakage Current	—	2.0	100	μA	$V_{GE} = 0V, V_{CE} = 1200V$
		—	3700	—		$V_{GE} = 0V, V_{CE} = 1200V, T_J = 150^\circ\text{C}$
V_{FM}	Diode Forward Voltage Drop	—	3.0	3.9	V	$I_F = 50A$
		—	2.7	—		$I_F = 50A, T_J = 150^\circ\text{C}$
I_{GES}	Gate-to-Emitter Leakage Current	—	—	±200	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)	—	290	440	nC	$I_C = 50A$ $V_{GE} = 15V$ $V_{CC} = 600V$
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	40	60		
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	110	170		
E_{on}	Turn-On Switching Loss	—	3600	4600	μJ	$I_C = 50A, V_{CC} = 600V, V_{GE} = 15V$ $R_G = 5.0\Omega, L = 200\mu H, T_J = 25^\circ\text{C}$ Energy losses include tail & diode reverse recovery
E_{off}	Turn-Off Switching Loss	—	2200	3200		
E_{total}	Total Switching Loss	—	5800	7800		
$t_{d(on)}$	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	$I_C = 50A, V_{CC} = 600V, V_{GE} = 15V$ $R_G = 5.0\Omega, L = 200\mu H, T_J = 150^\circ\text{C}$ ③ Energy losses include tail & diode reverse recovery
E_{off}	Turn-Off Switching Loss	—	3370	—		
E_{total}	Total Switching Loss	—	8450	—		
$t_{d(on)}$	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	$V_{GE} = 0V$ $V_{CC} = 30V$ $f = 1.0MHz$
C_{oes}	Output Capacitance	—	300	—		
C_{res}	Reverse Transfer Capacitance	—	130	—		
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				$T_J = 150^\circ\text{C}, I_C = 200A$ $V_{CC} = 960V, V_p = 1200V$ $R_g = 5.0\Omega, V_{GE} = +20V \text{ to } 0V$
E_{rec}	Reverse Recovery Energy of the Diode	—	1510	—	μJ	$T_J = 150^\circ\text{C}$
t_{rr}	Diode Reverse Recovery Time	—	190	—	ns	$V_{CC} = 600V, I_F = 5.0A$
I_{rr}	Peak Reverse Recovery Current	—	5760	—	A	$R_g = 5.0\Omega, L = 1.0mH$

Notes:

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

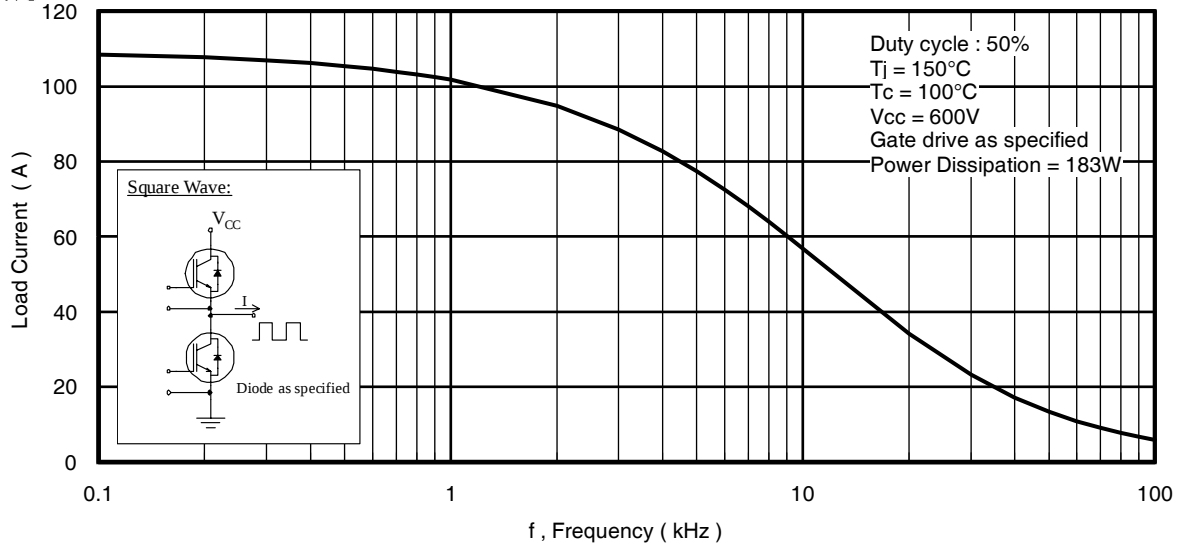


Fig. 1 - Typical Load Current vs. Frequency
 (Load Current = I_{RMS} of fundamental)

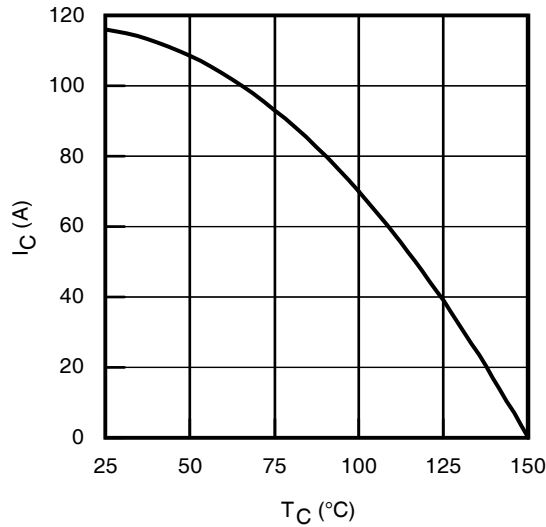


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

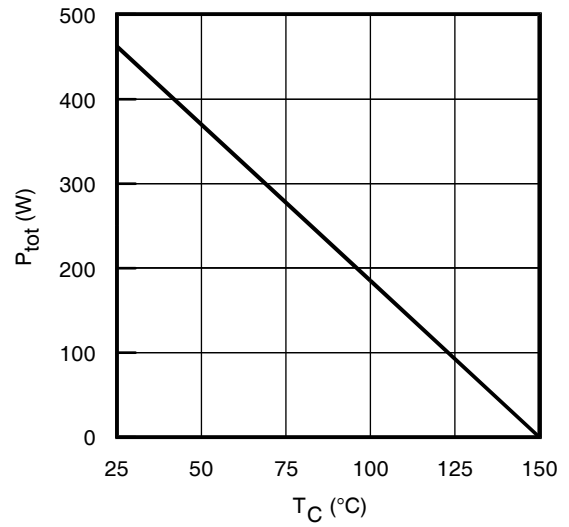


Fig. 2 - Power Dissipation vs. Case Temperature

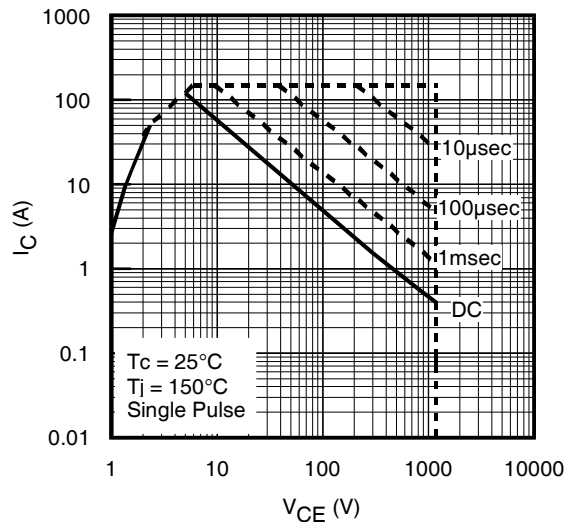


Fig. 3 - Forward SOA
 $T_C = 25^{\circ}\text{C}$, $T_J \leq 150^{\circ}\text{C}$; $V_{GE} = 15\text{V}$

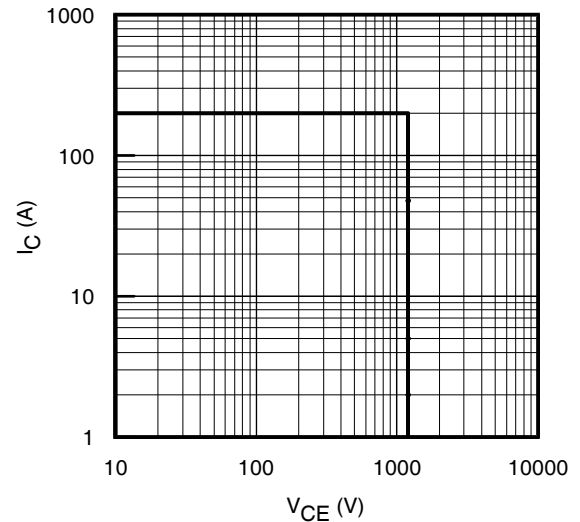


Fig. 4 - Reverse Bias SOA
 $T_J = 150^{\circ}\text{C}$; $V_{GE} = 20\text{V}$

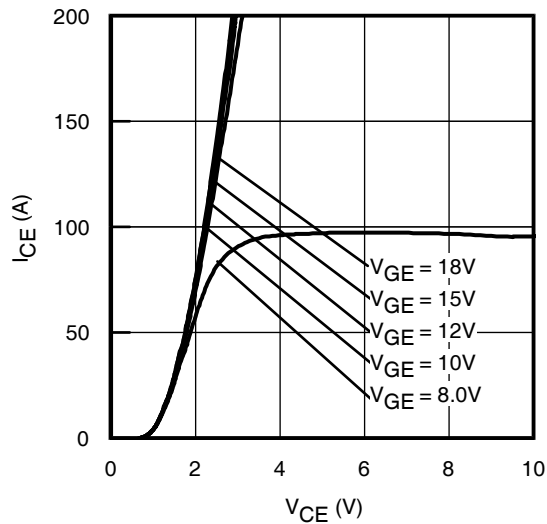


Fig. 5 - Typ. IGBT Output Characteristics
 $T_J = -40^{\circ}\text{C}$; $t_p = 30\mu\text{s}$

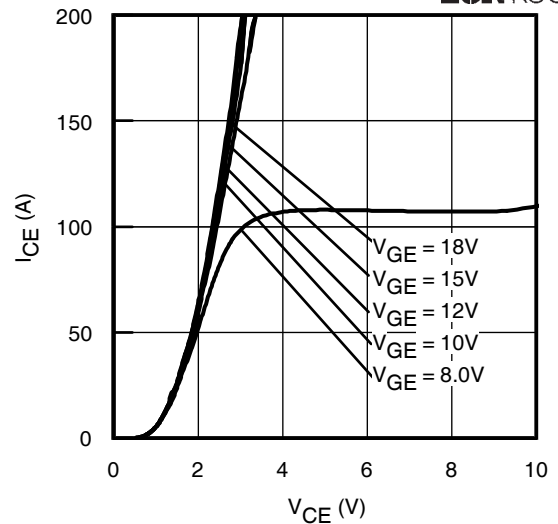


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = 25^{\circ}\text{C}$; $t_p = 30\mu\text{s}$

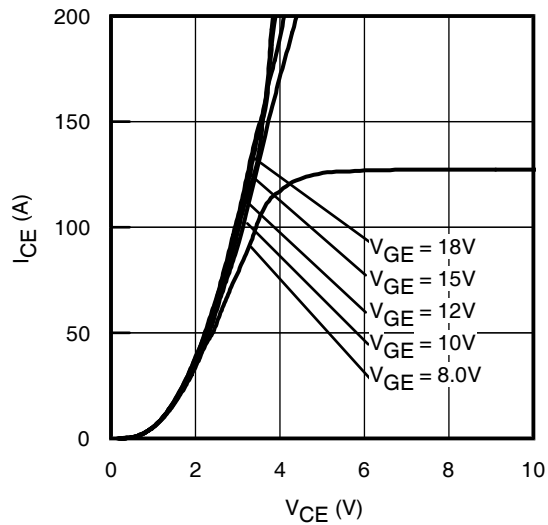


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 150^{\circ}\text{C}$; $t_p = 30\mu\text{s}$

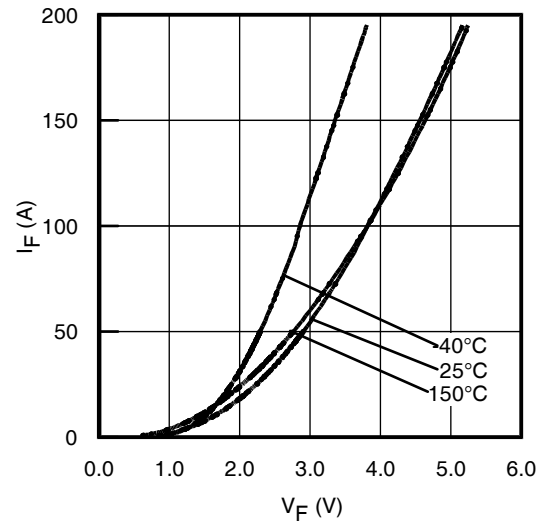


Fig. 8 - Typ. Diode Forward Characteristics
 $t_p = 30\mu\text{s}$

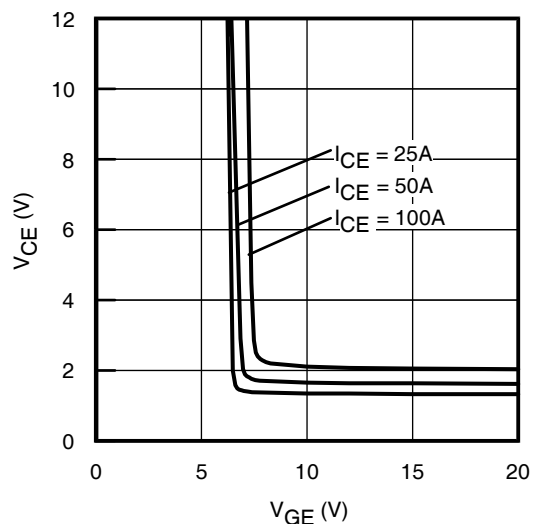


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^{\circ}\text{C}$

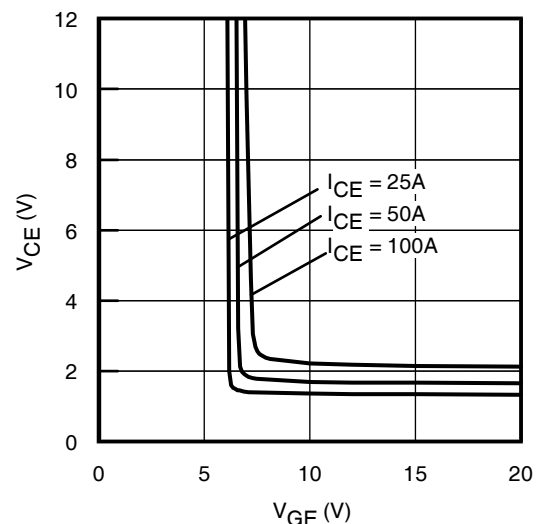


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^{\circ}\text{C}$

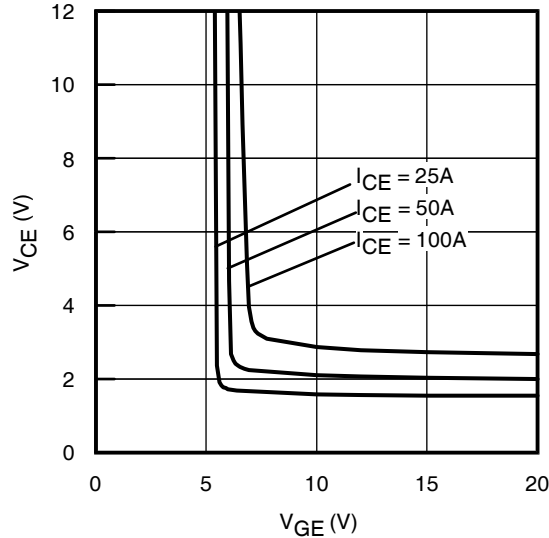


Fig. 11 - Typical V_{CE} vs. V_{GE}
 $T_J = 150^\circ\text{C}$

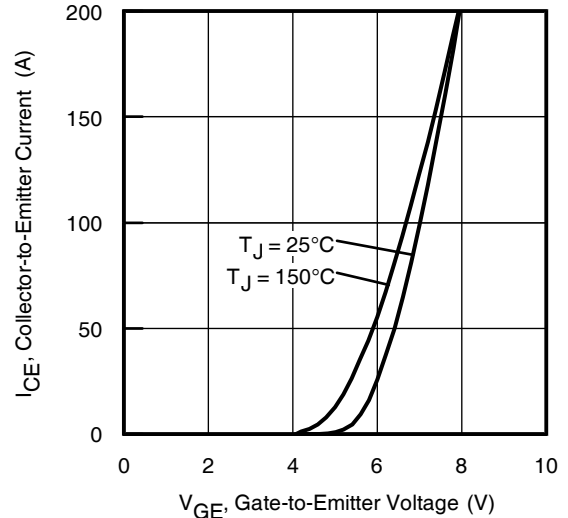


Fig. 12 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 30\mu\text{s}$

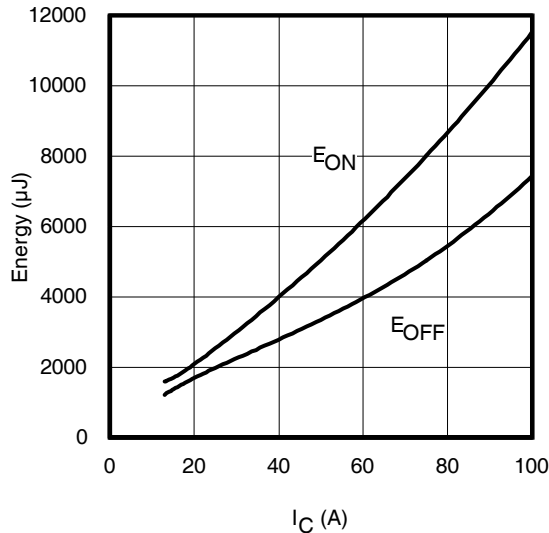


Fig. 13 - Typ. Energy Loss vs. I_C
 $T_J = 150^\circ\text{C}$; $L = 200\mu\text{H}$; $V_{CE} = 600\text{V}$; $R_G = 5.0\Omega$; $V_{GE} = 15\text{V}$

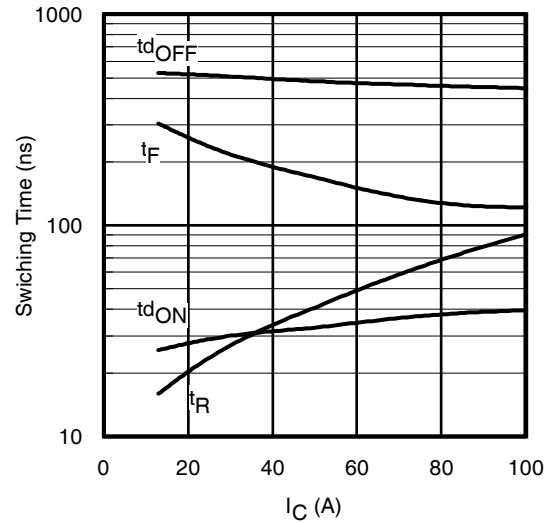


Fig. 14 - Typ. Switching Time vs. I_C
 $T_J = 150^\circ\text{C}$; $L = 200\mu\text{H}$; $V_{CE} = 600\text{V}$; $R_G = 5.0\Omega$; $V_{GE} = 15\text{V}$

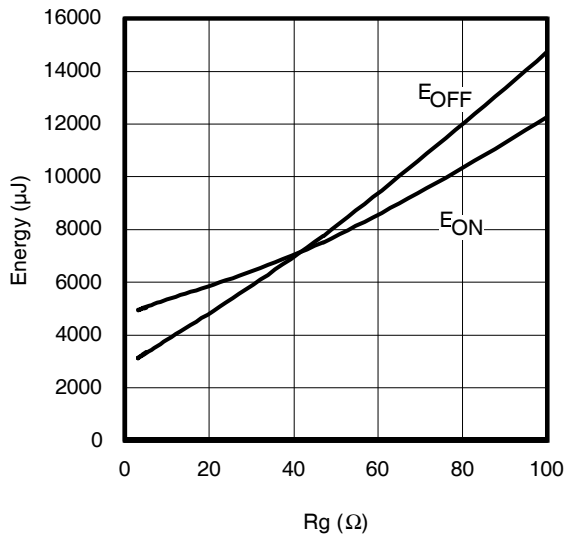


Fig. 15 - Typ. Energy Loss vs. R_G
 $T_J = 150^\circ\text{C}$; $L = 200\mu\text{H}$; $V_{CE} = 600\text{V}$; $I_{CE} = 50\text{A}$; $V_{GE} = 15\text{V}$

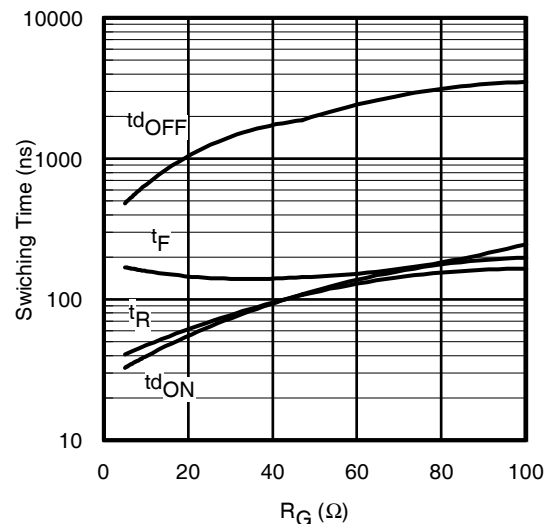


Fig. 16 - Typ. Switching Time vs. R_G
 $T_J = 150^\circ\text{C}$; $L = 200\mu\text{H}$; $V_{CE} = 600\text{V}$; $I_{CE} = 50\text{A}$; $V_{GE} = 15\text{V}$

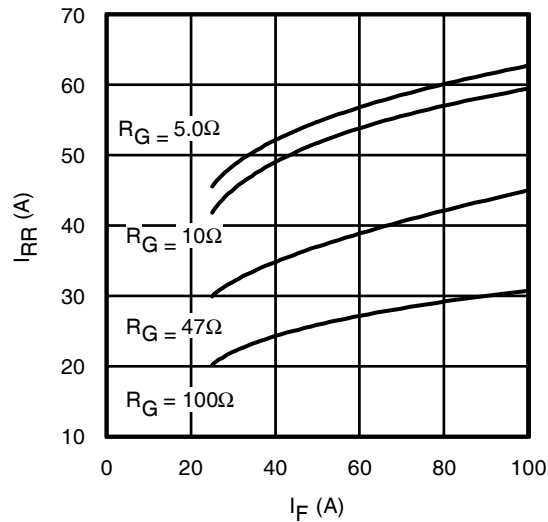


Fig. 17 - Typ. Diode I_{RR} vs. I_F
 $T_J = 150^\circ\text{C}$

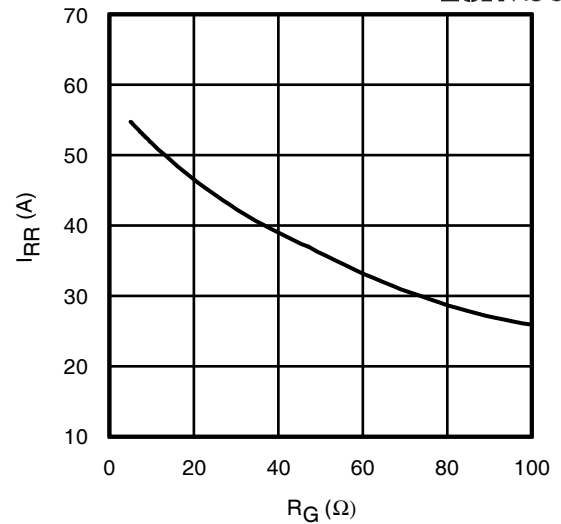


Fig. 18 - Typ. Diode I_{RR} vs. R_G
 $T_J = 150^\circ\text{C}$

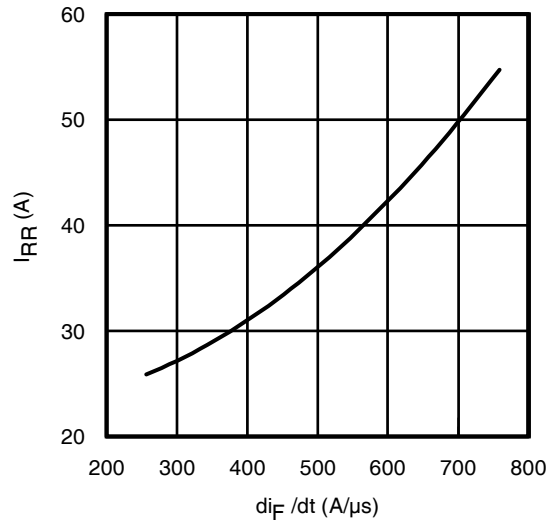


Fig. 19 - Typ. Diode I_{RR} vs. di_F/dt
 $V_{CC} = 600\text{V}$; $V_{GE} = 15\text{V}$; $I_F = 50\text{A}$; $T_J = 150^\circ\text{C}$

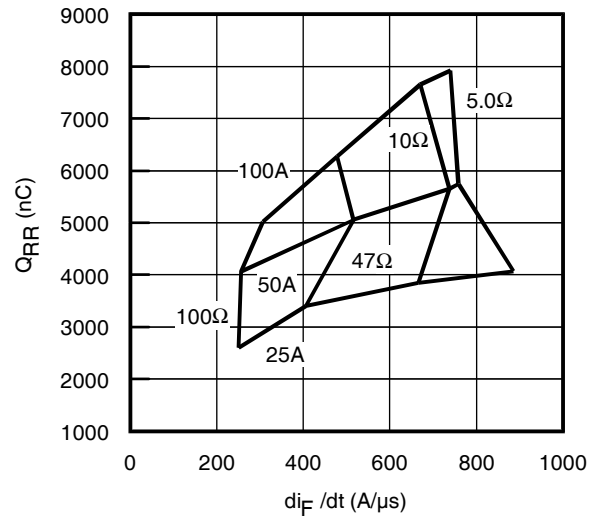


Fig. 20 - Typ. Diode Q_{RR} vs. di_F/dt
 $V_{CC} = 600\text{V}$; $V_{GE} = 15\text{V}$; $T_J = 150^\circ\text{C}$

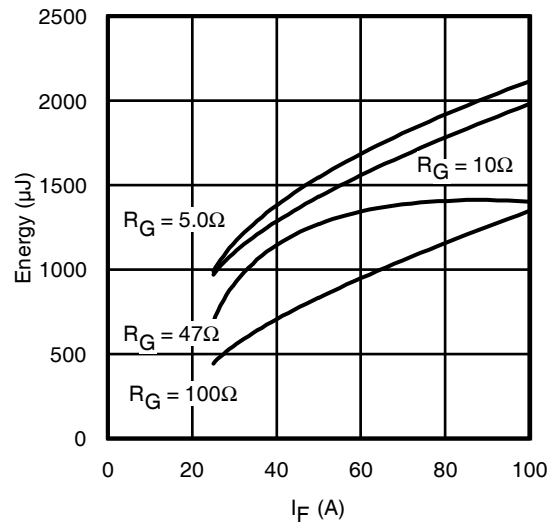


Fig. 21 - Typ. Diode E_{RR} vs. I_F
 $T_J = 150^\circ\text{C}$

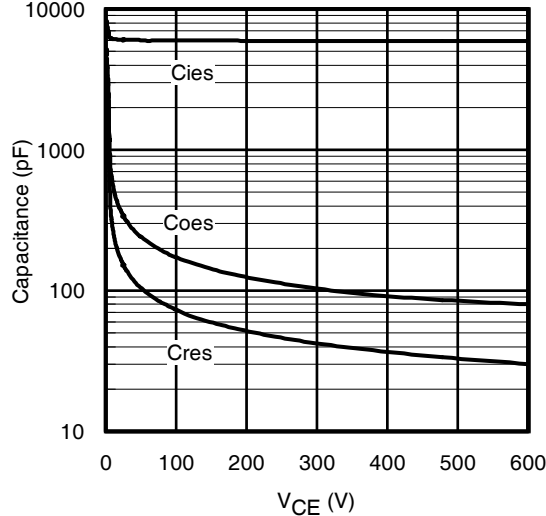


Fig. 22 - Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0V$; $f = 1MHz$

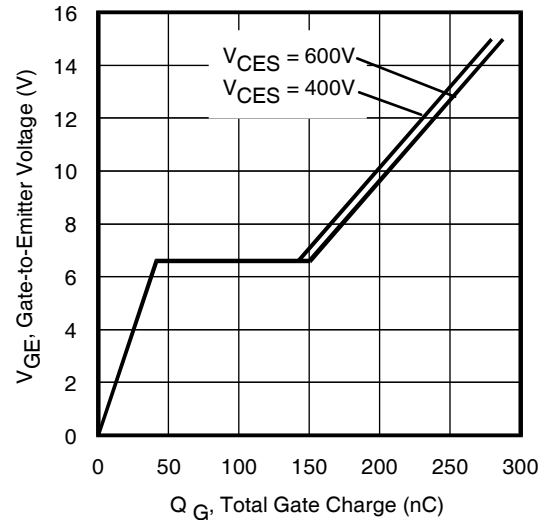


Fig. 23 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 50A$

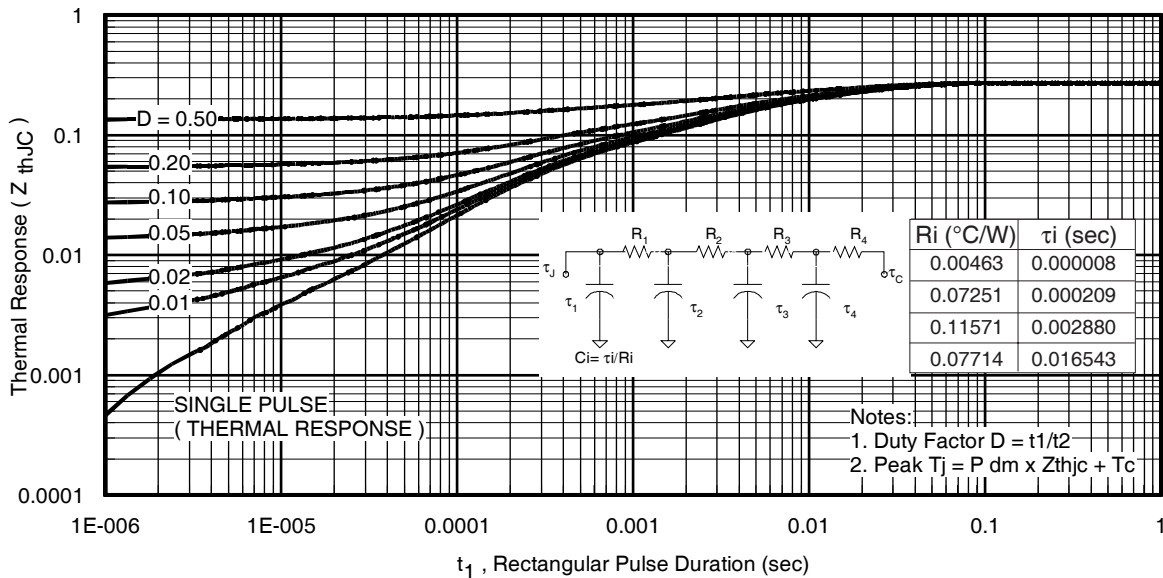


Fig. 24. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

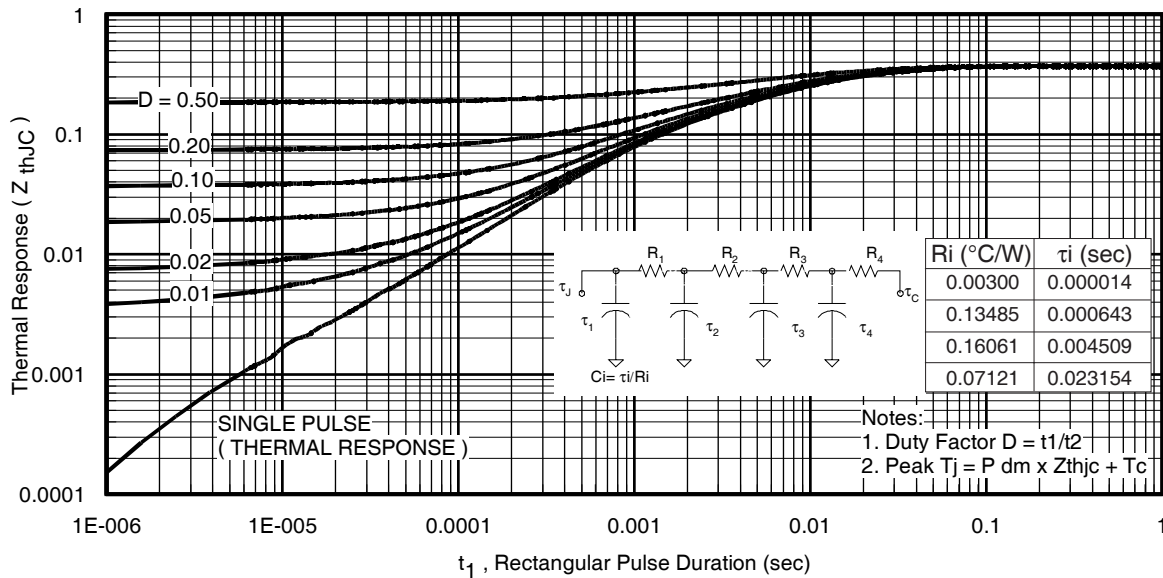


Fig. 25. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

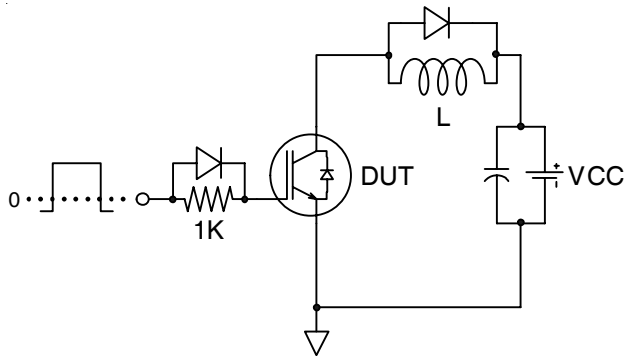


Fig.C.T.1 - Gate Charge Circuit (turn-off)

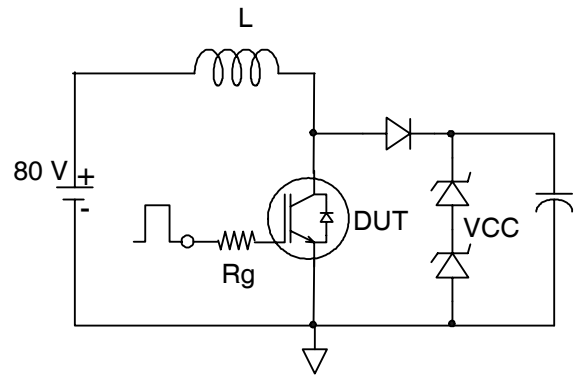


Fig.C.T.2 - RBSOA Circuit

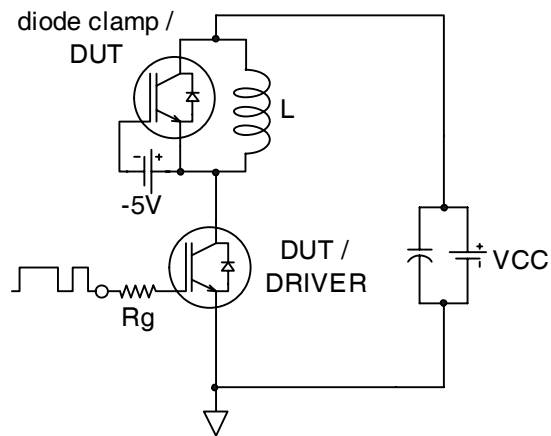


Fig.C.T.3 - Switching Loss Circuit

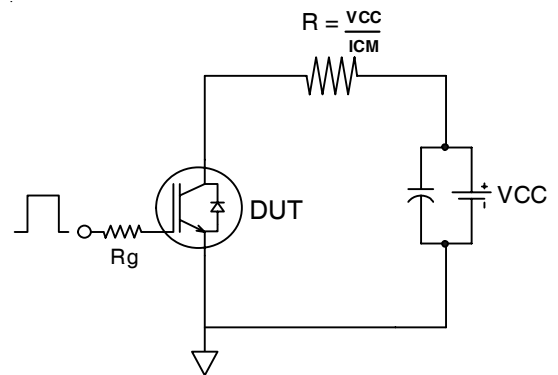


Fig.C.T.4 - Resistive Load Circuit

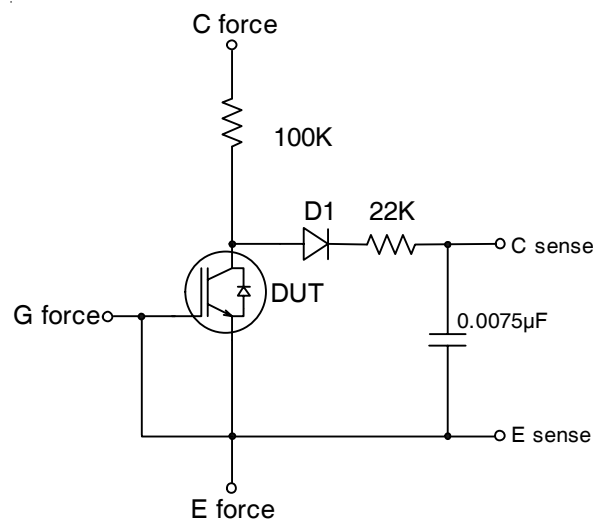


Fig.C.T.5 - BVCES Filter Circuit

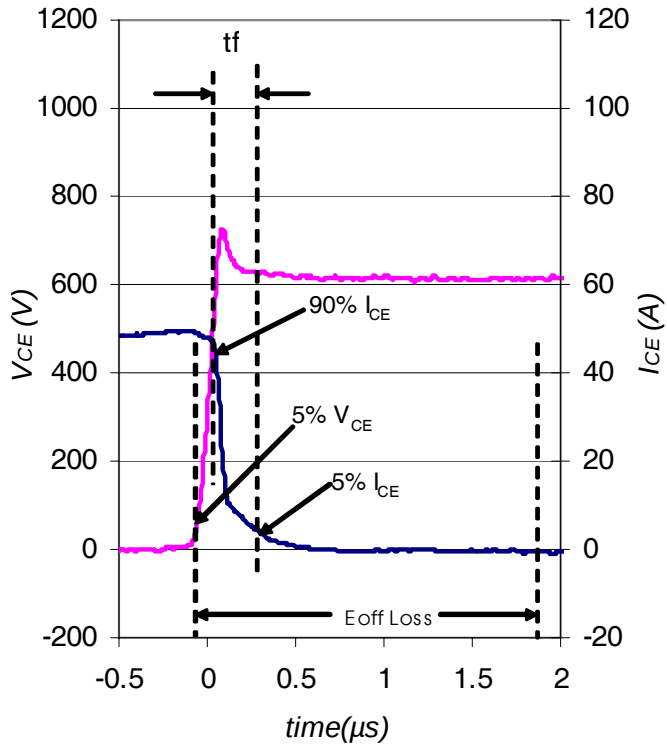


Fig. WF1 - Typ. Turn-off Loss Waveform
@ $T_J = 150^\circ\text{C}$ using Fig. CT.4

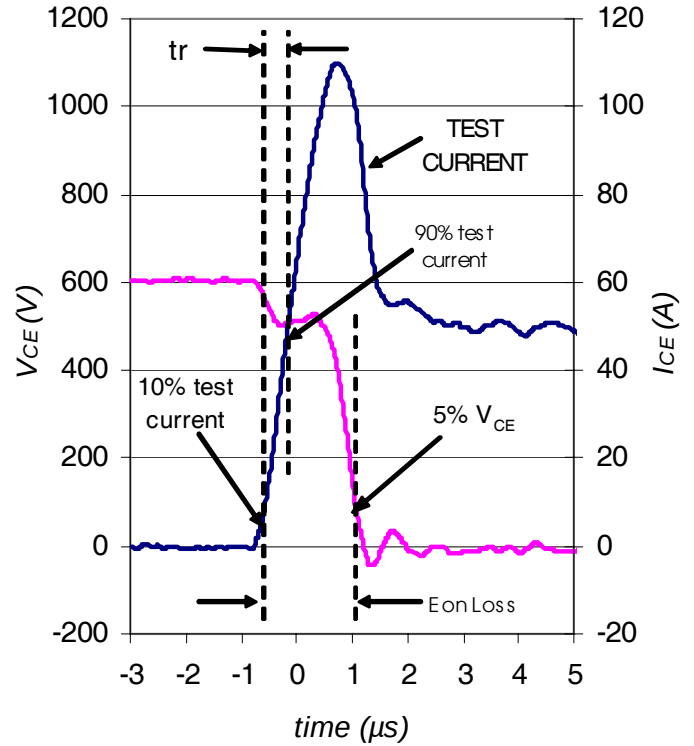


Fig. WF2 - Typ. Turn-on Loss Waveform
@ $T_J = 150^\circ\text{C}$ using Fig. CT.4

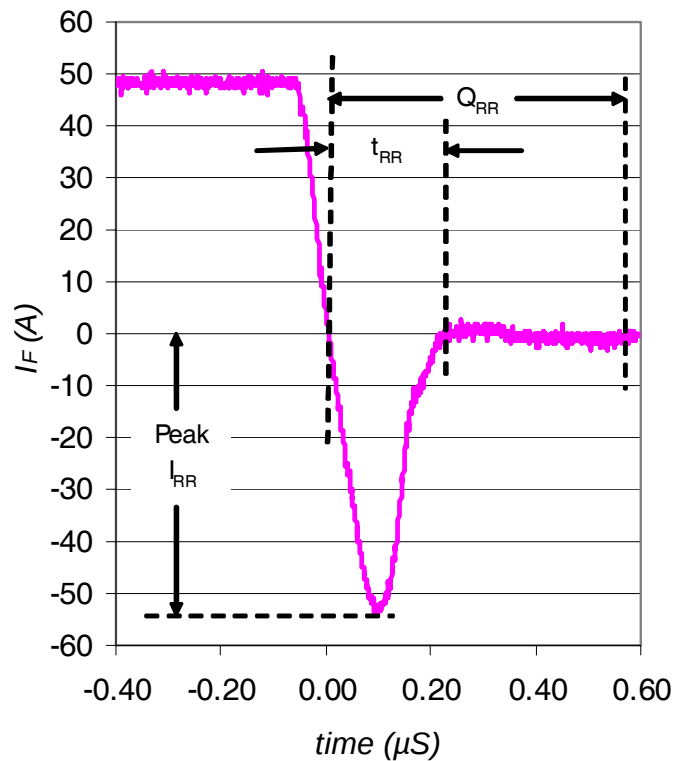
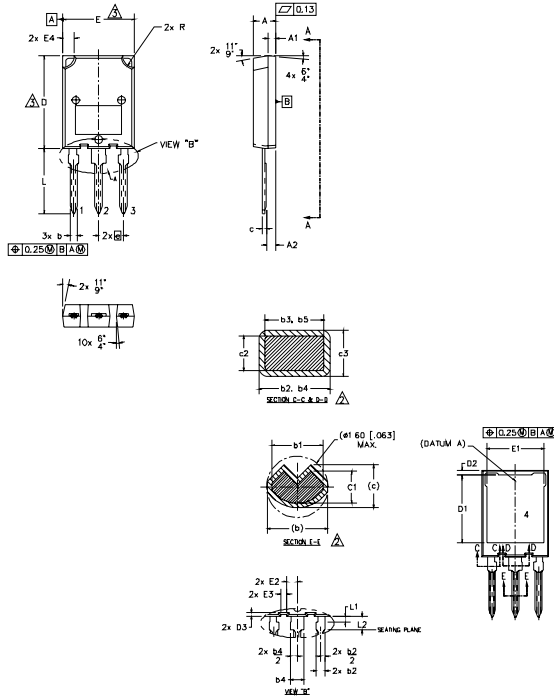


Fig. WF3 - Typ. Diode Recovery Waveform
@ $T_J = 150^\circ\text{C}$ using Fig. CT.4

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 [0.005"] 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

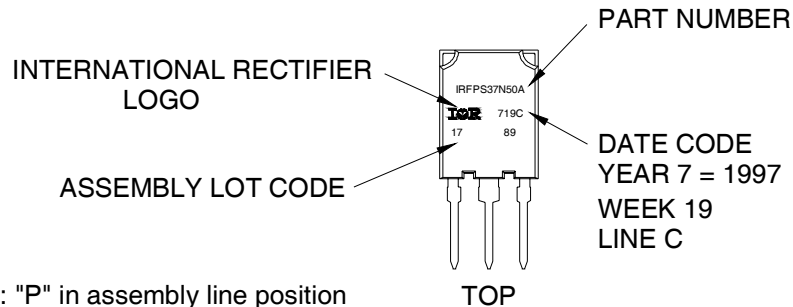
1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

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.

International
IR Rectifier

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105

TAC Fax: (310) 252-7903

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