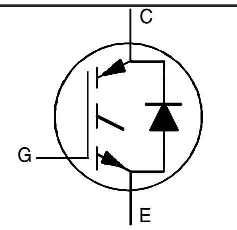
International
IOR Rectifier

IRGP8B120KD-E

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE



n-channel

V_{CES} = 1200V

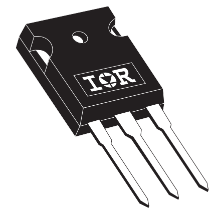
I_C = 10A, T_C=100°C

t_{sc} > 10µs, T_J=150°C

$V_{CE(on)}$ typ. = 2.25V

Features
- Low VCE (on) Non Punch Through IGBT Technology.
- Low Diode VF.
- 10µs Short Circuit Capability.
- Square RBSOA.
- Ultrasoft Diode Reverse Recovery Characteristics.
- Positive VCE (on) Temperature Coefficient.
- TO-247AD Package.

Benefits
- Benchmark Efficiency for Motor Control.
- Rugged Transient Performance.
- Low EMI.
- Excellent Current Sharing in Parallel Operation.


TO-247AD

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
I_C @ T_C = 25°C	Continuous Collector Current	20	A
I_C @ T_C = 100°C	Continuous Collector Current	10	
I_{CM}	Pulse Collector Current	40	
I_{LM}	Clamped Inductive Load current ①	40	
I_F @ T_C = 25°C	Diode Continuous Forward Current	20	
I_F @ T_C = 100°C	Diode Continuous Forward Current	10	
I_{FM}	Diode Maximum Forward Current	40	
V_{GE}	Gate-to-Emitter Voltage	±20	V
P_D @ T_C = 25°C	Maximum Power Dissipation	135	W
P_D @ T_C = 100°C	Maximum Power Dissipation	54	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	°C
	Storage Temperature Range, for 10 sec.	300 (0.063 in. (1.6mm) from case)	
	Mounting Torque, 6-32 or M3 Screw	10 lbf•in (1.1N•m)	

Thermal and Mechanical Characteristics

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case- IGBT	–––	–––	0.92	°C/W
$R_{\theta JC}$	Junction-to-Case- Diode	–––	–––	1.58	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	–––	0.24	–––	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	–––	–––	40	
Wt	Weight	–––	6 (0.21)	–––	g (oz.)

10/14/02

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

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref. Fig.
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	1200	—	—	V	V_{GE} = 0V, I_C = 500µA	
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	1.15	—	V/°C	V_{GE} = 0V, I_C = 1.0mA, (25°C-125°C)	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	2.25	2.45	V	I_C = 8.0A, V_{GE} = 15V	5,6,7
		—	2.65	2.85		I_C = 8.0A, V_{GE} = 15V, T_J = 125°C	9,10,11
$V_{GE(th)}$	Gate Threshold Voltage	4.0	5.0	6.0	V	V_{CE} = V_{GE}, I_C = 250µA	9,10,11
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	—	-11	—	mV/°C	V_{CE} = V_{GE}, I_C = 1.0mA, (25°C-125°C)	12
gfe	Forward Transconductance	—	5.2	—	S	V_{CE} = 50V, I_C = 8.0A, PW=80µs	
I_{CES}	Zero Gate Voltage Collector Current	—	5.0	100	µA	V_{GE} = 0V, V_{CE} = 1200V	
		—	125	300		V_{GE} = 0V, V_{CE} = 1200V, T_J = 125°C	
V_{FM}	Diode Forward Voltage Drop	—	1.85	2.10	V	I_F = 8.0A	8
		—	1.95	2.20		I_F = 8.0A T_J = 125°C	
I_{GES}	Gate-to-Emitter Leakage Current	—	—	±100	nA	V_{GE} = ±20V	

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

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig.
Qg	Total Gate Charge (turn-on)	—	50	75	nC	I_C = 8.0A	23
Qge	Gate - Emitter Charge (turn-on)	—	6.0	8.0		V_{CC} = 800V	CT 1
Qgc	Gate - Collector Charge (turn-on)	—	25	38		V_{GE} = 15V	
E_{on}	Turn-On Switching Loss	—	325	450	µJ	I_C = 8.0A, V_{CC} = 600V	CT 4
E_{off}	Turn-Off Switching Loss	—	525	700		V_{GE} = 15V, R_G = 22Ω, L = 1.0mH	
E_{tot}	Total Switching Loss	—	850	1150		Ls = 150nH T_J = 25°C ①	
$t_{d(on)}$	Turn-On Delay Time	—	30	39	ns	I_C = 8.0A, V_{CC} = 600V	CT 4
tr	Rise Time	—	15	21		V_{GE} = 15V, R_G = 22Ω L = 1.0mH	
$t_{d(off)}$	Turn-Off Delay Time	—	165	180		Ls = 150nH, T_J = 25°C	
t_f	Fall Time	—	33	43			
E_{on}	Turn-On Switching Loss	—	525	675	µJ	I_C = 8.0A, V_{CC} = 600V	CT 4
E_{off}	Turn-Off Switching Loss	—	725	975		V_{GE} = 15V, R_G = 22Ω, L = 1.0mH	13,15
E_{tot}	Total Switching Loss	—	1250	1650		Ls = 150nH T_J = 125°C ①	WF1WF2
$t_{d(on)}$	Turn-On Delay Time	—	30	39	ns	I_C = 8.0A, V_{CC} = 600V	14, 16
t_r	Rise Time	—	15	21		V_{GE} = 15V, R_G = 22Ω L = 1.0mH	CT 4
$t_{d(off)}$	Turn-Off Delay Time	—	195	210		Ls = 150nH, T_J = 125°C	WF 1
t_f	Fall Time	—	42	55			WF 2
C_{ies}	Input Capacitance	—	690	—	pF	V_{GE} = 0V	
C_{oes}	Output Capacitance	—	45	—		V_{CC} = 30V	22
C_{res}	Reverse Transfer Capacitance	—	22	—		f = 1.0MHz	
RBSOA	Reverse Bias Safe Operting Area	FULL SQUARE				T_J = 150°C, I_C = 40A, Vp = 1200V	4
						V_{CC} = 900V, V_{GE} = +15V to 0V, R_G = 22Ω	CT 2
SCSOA	Short Circuit Safe Operting Area	10	—	—	µs	T_J = 150°C, Vp = 1200V, R_G = 22Ω	CT 3
						V_{CC} = 900V, V_{GE} = +15V to 0V	WF 4
Erec	Reverse Recovery energy of the diode	—	650	875	µJ	T_J = 125°C	17,18,19
t_{rr}	Diode Reverse Recovery time	—	95	112	ns	V_{CC} = 600V, I_F = 8.0A, L = 1.0mH	20, 21
I_{rr}	Diode Peak Reverse Recovery Current	—	16	20	A	V_{GE} = 15V, R_G = 22Ω, Ls = 150nH	CT 4, WF 3

① V_{CC} = 80% (V_{CES}), V_{GE} = 15V, L = 100µH, R_G = 50Ω.

② Energy losses include "tail" and diode reverse recovery.

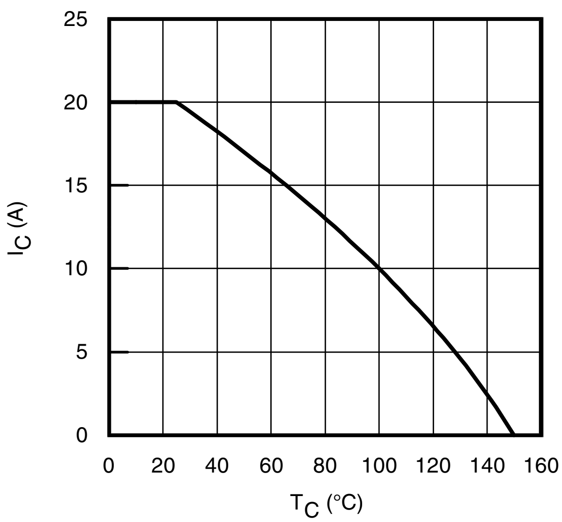


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

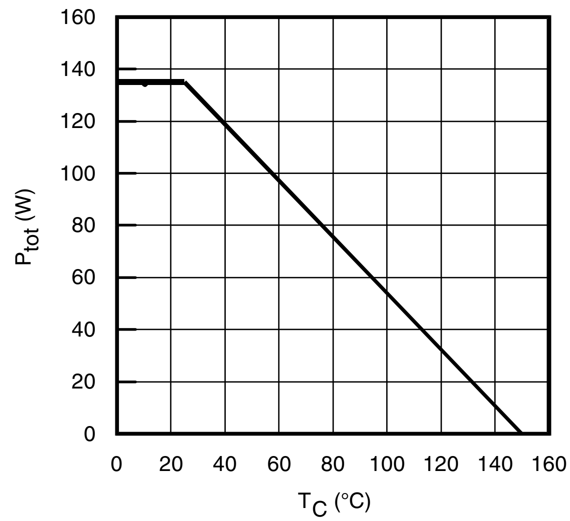


Fig. 2 - Power Dissipation vs. Case Temperature

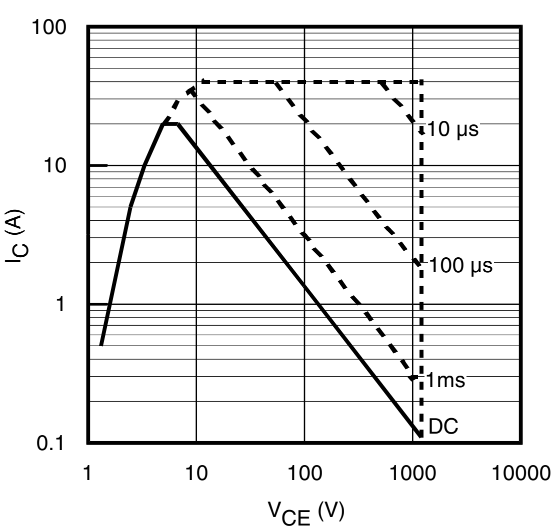


Fig. 3 - Forward SOA
T_C = 25°C; $T_J \leq$ 150°C

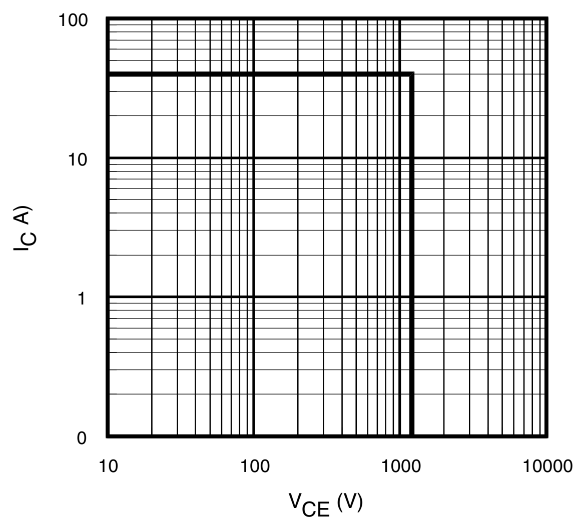


Fig. 4 - Reverse Bias SOA
T_J = 150°C; V_{GE} =15V

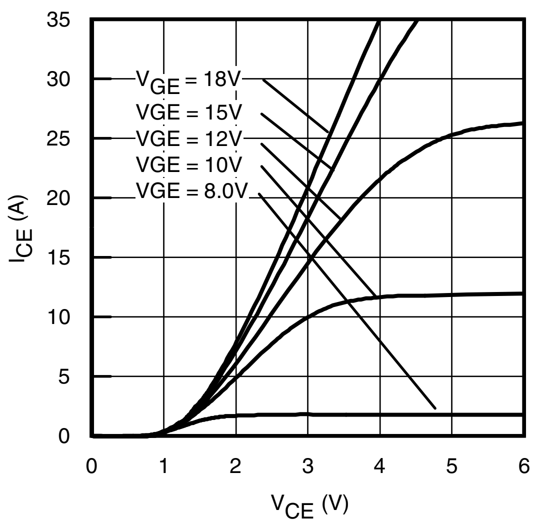


Fig. 5 - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 80µs

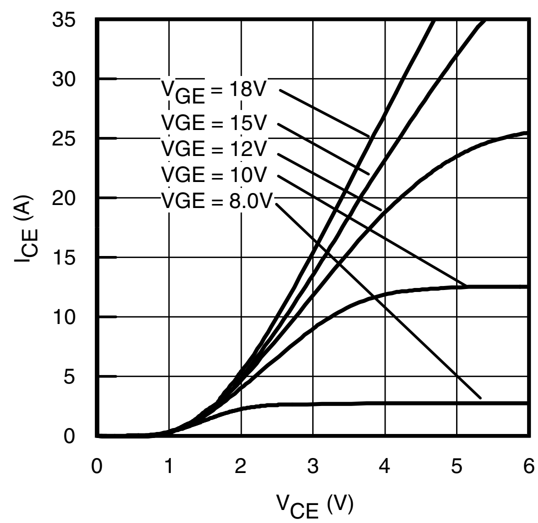


Fig. 6 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 80µs

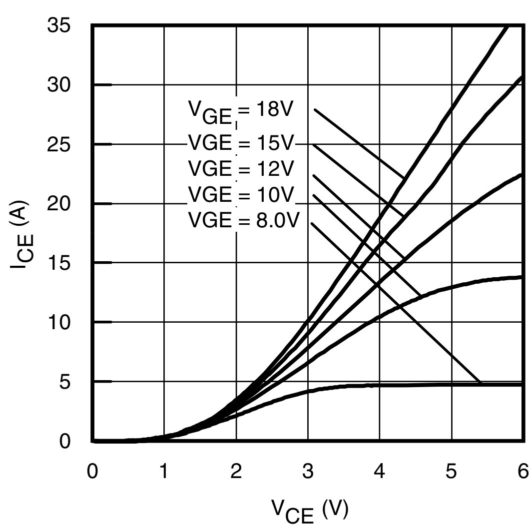


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 125°C; tp = 80µs

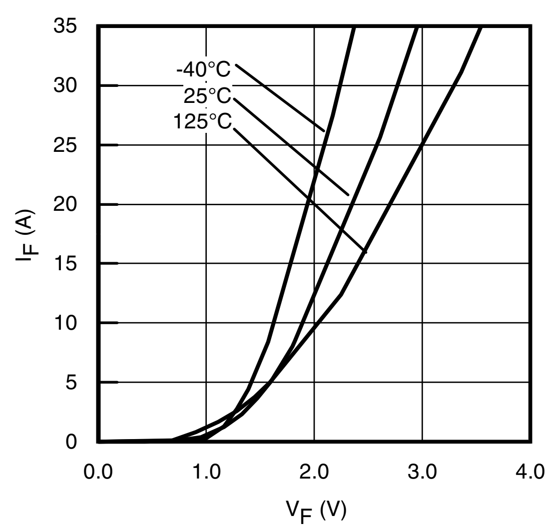


Fig. 8 - Typ. Diode Forward Characteristics
tp = 80µs

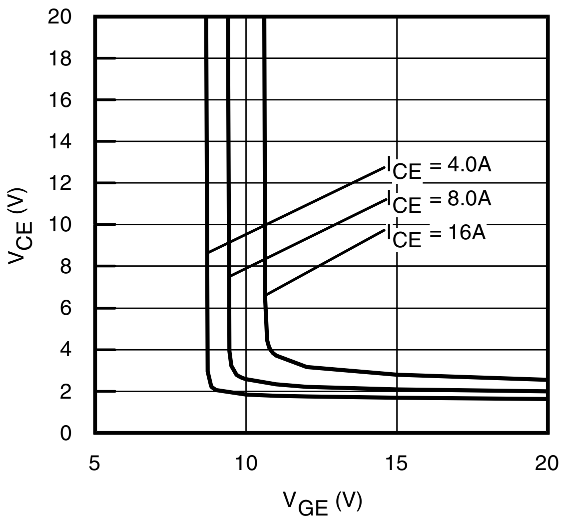


Fig. 9 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

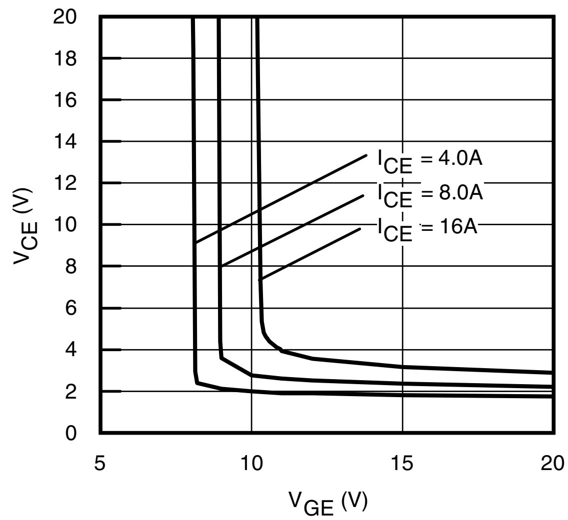


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

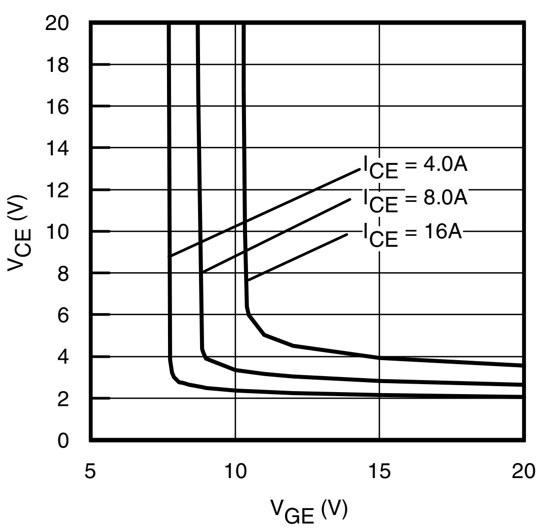


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 125°C

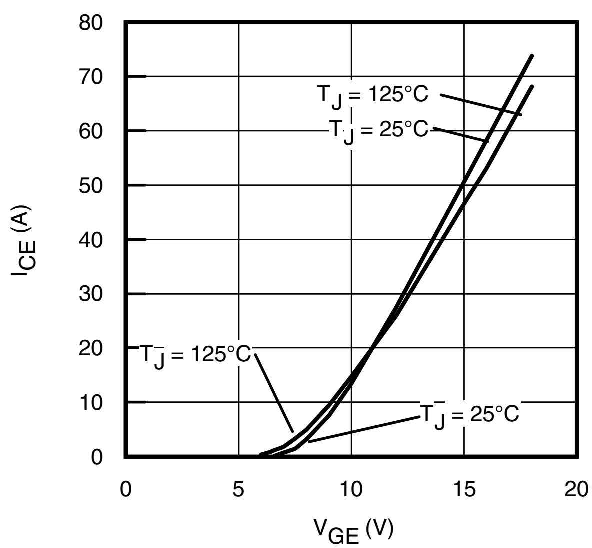


Fig. 12 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 10µs

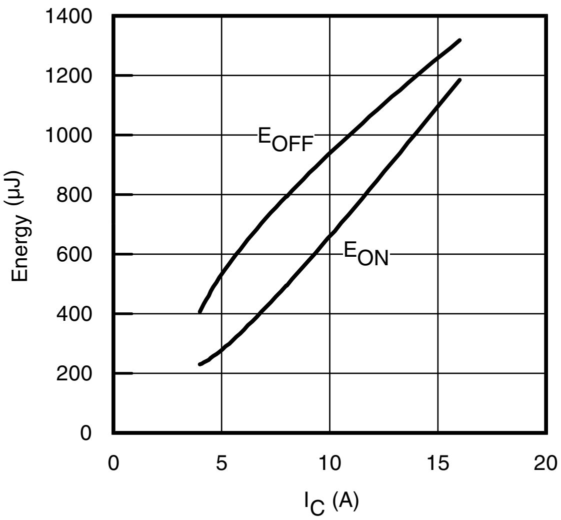


Fig. 13 - Typ. Energy Loss vs. I_C
T_J = 125°C; L=1.0mH; V_{CE}= 600V
R_G= 22Ω; V_{GE}= 15V

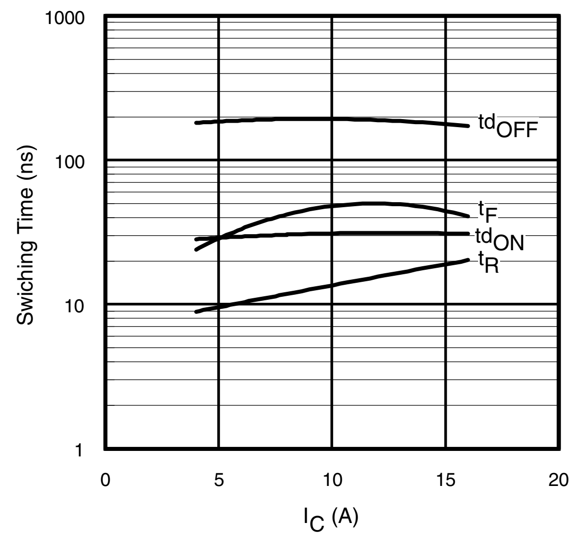


Fig. 14 - Typ. Switching Time vs. I_C
T_J = 125°C; L=1.0mH; V_{CE}= 600V
R_G= 22Ω; V_{GE}= 15V

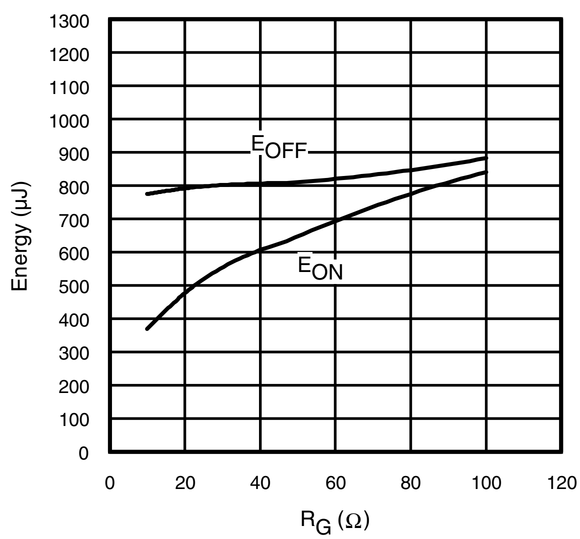


Fig. 15 - Typ. Energy Loss vs. R_G
T_J = 125°C; L=1.0mH; V_{CE}= 600V
I_{CE}= 8.0A; V_{GE}= 15V

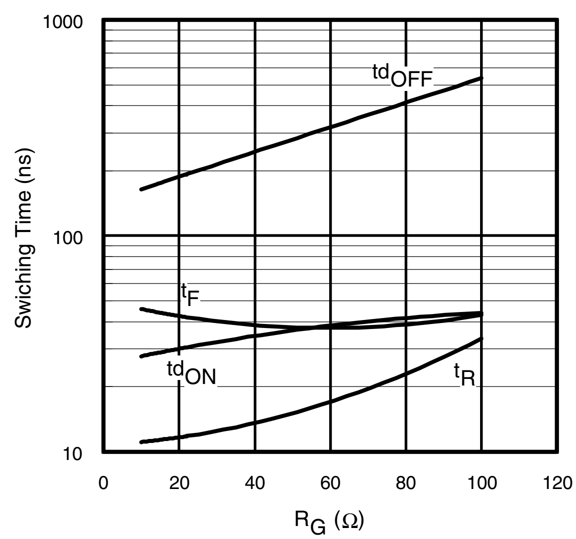


Fig. 16 - Typ. Switching Time vs. R_G
T_J = 125°C; L=1.0mH; V_{CE}= 600V
I_{CE}= 8.0A; V_{GE}= 15V

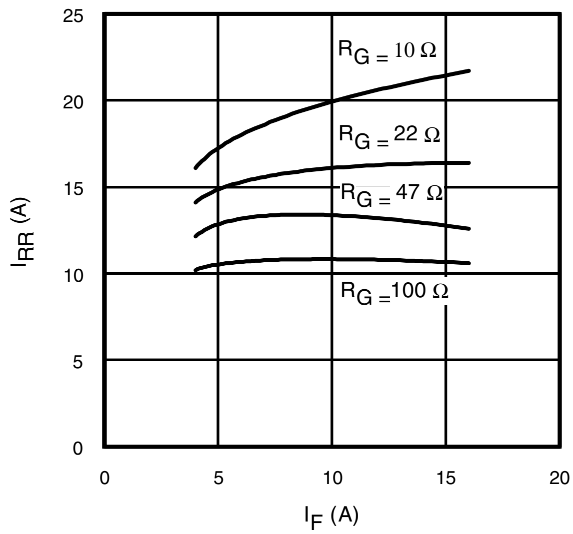


Fig. 17 - Typical Diode I_{RR} vs. I_F
$T_J = 125°C$

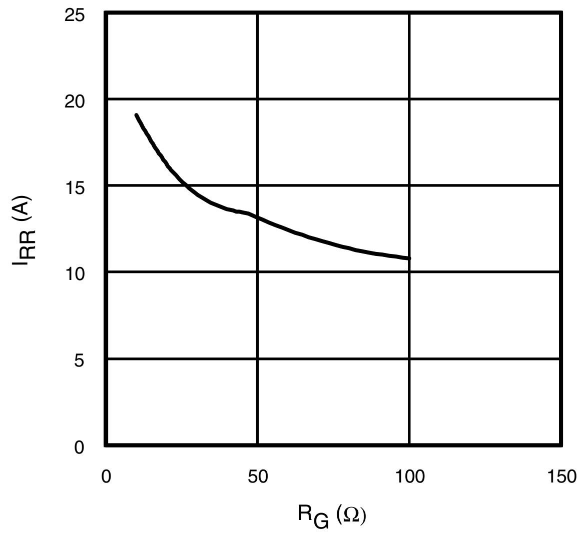


Fig. 18 - Typical Diode I_{RR} vs. R_G
$T_J = 125°C$; $I_F = 8.0A$

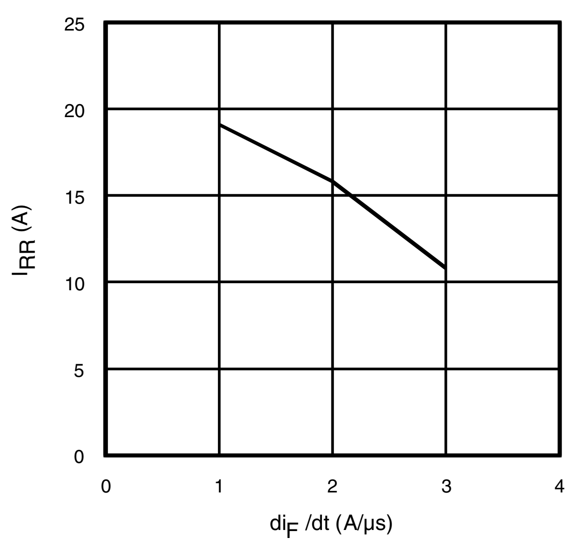


Fig. 19- Typical Diode I_{RR} vs. di_F/dt
V_{CC}= 600V; V_{GE}= 15V;
I_F= 8.0A; $T_J = 125°C$

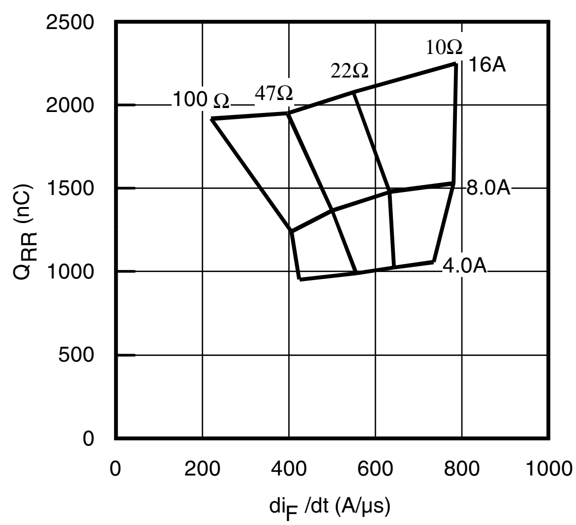


Fig. 20 - Typical Diode Q_{RR}
V_{CC}= 600V; V_{GE}= 15V;$T_J = 125°C$

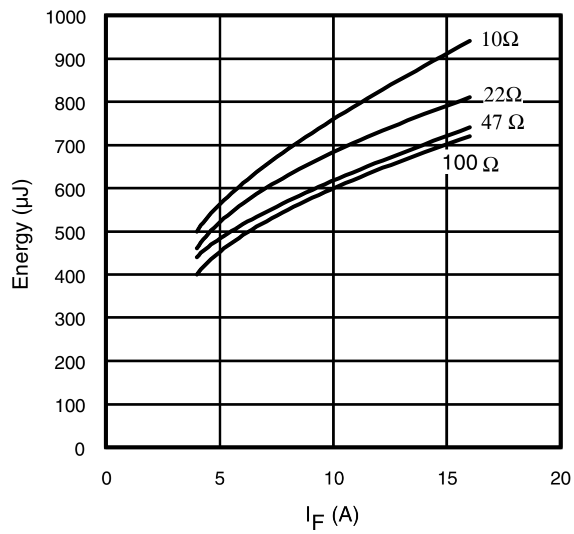


Fig. 21 - Typical Diode E_{RR} vs. I_F
$T_J = 125°C$

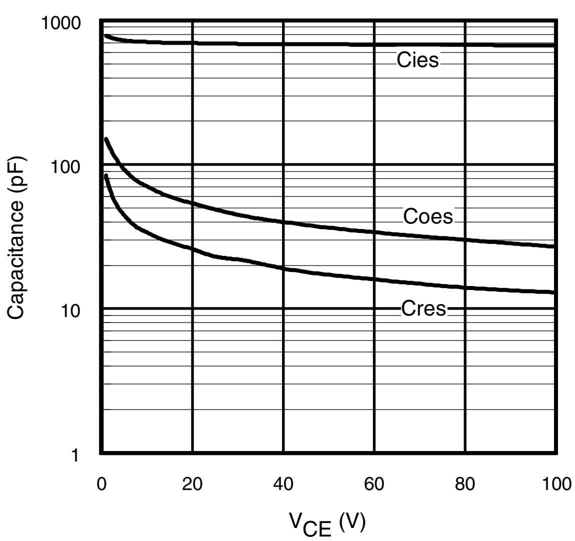


Fig. 22- Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

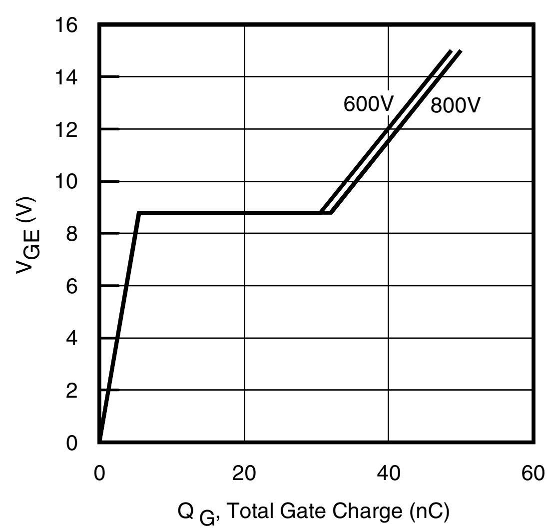
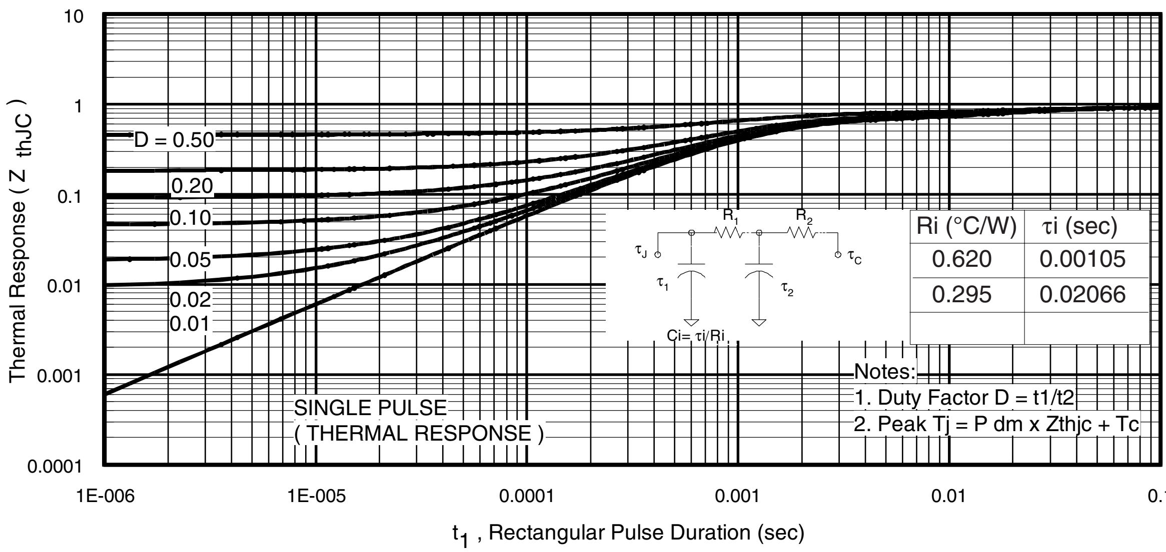
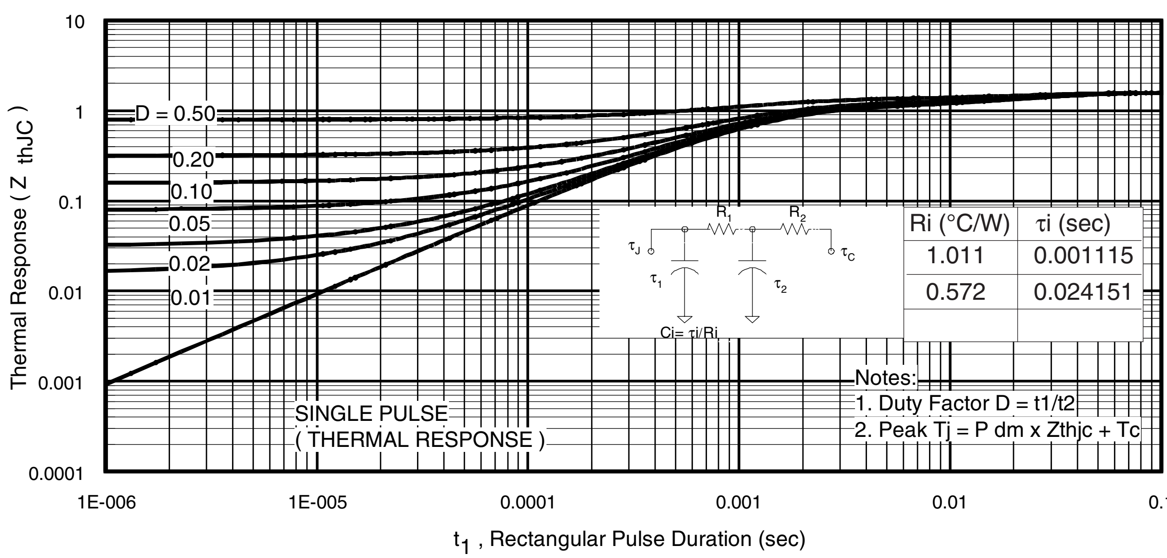


Fig. 23 - Typical Gate Charge vs. V_{GE}
I_{CE} = 8.0A; L = 600µH



Ri (°C/W)	τi (sec)
0.620	0.00105
0.295	0.02066

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



Ri (°C/W)	τi (sec)
1.011	0.001115
0.572	0.024151

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

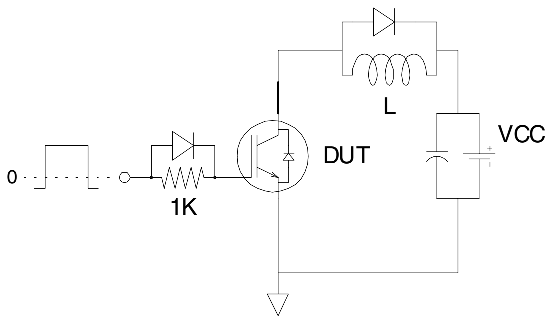


Fig.C.T.1 - Gate Charge Circuit (turn-off)

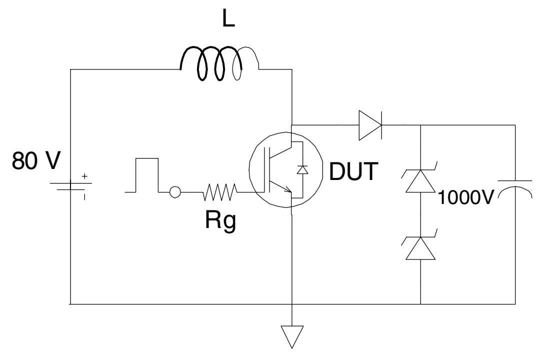


Fig.C.T.2 - RBSOA Circuit

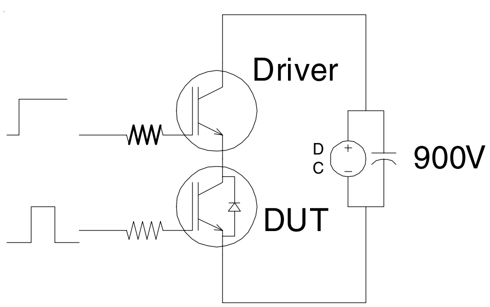


Fig.C.T.3 - S.C.SOA Circuit

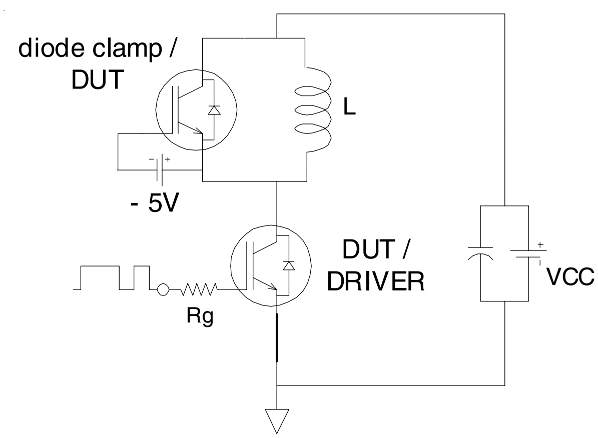


Fig.C.T.4 - Switching Loss Circuit

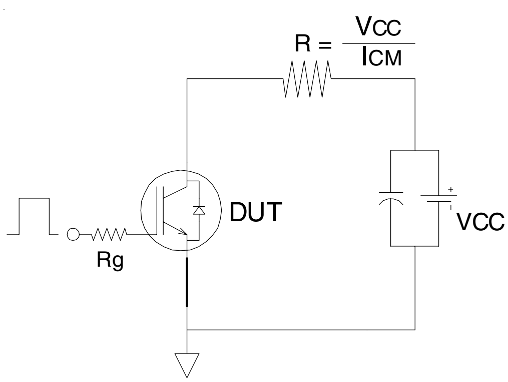


Fig.C.T.5 - Resistive Load Circuit

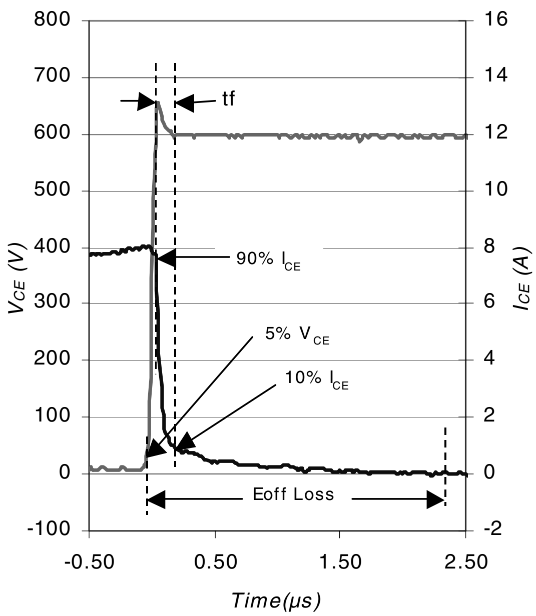


Fig. WF1- Typ. Turn-off Loss Waveform
@ T_J = 125°C using Fig. CT.4

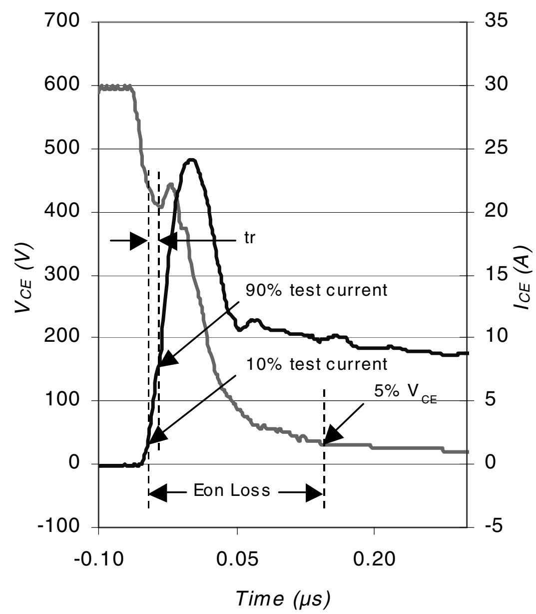


Fig. WF2- Typ. Turn-on Loss Waveform
@ T_J = 125°C using Fig. CT.4

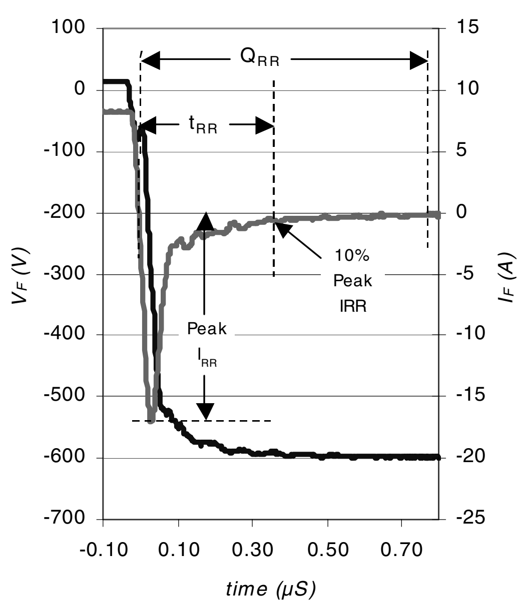


Fig. WF3- Typ. Diode Recovery Waveform
@ T_J = 125°C using Fig. CT.4

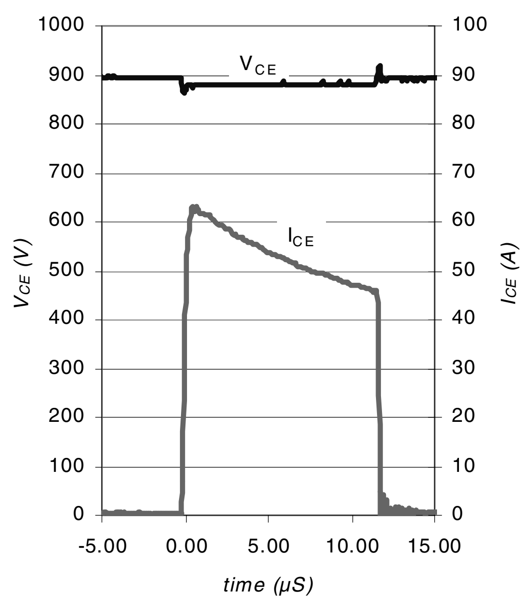
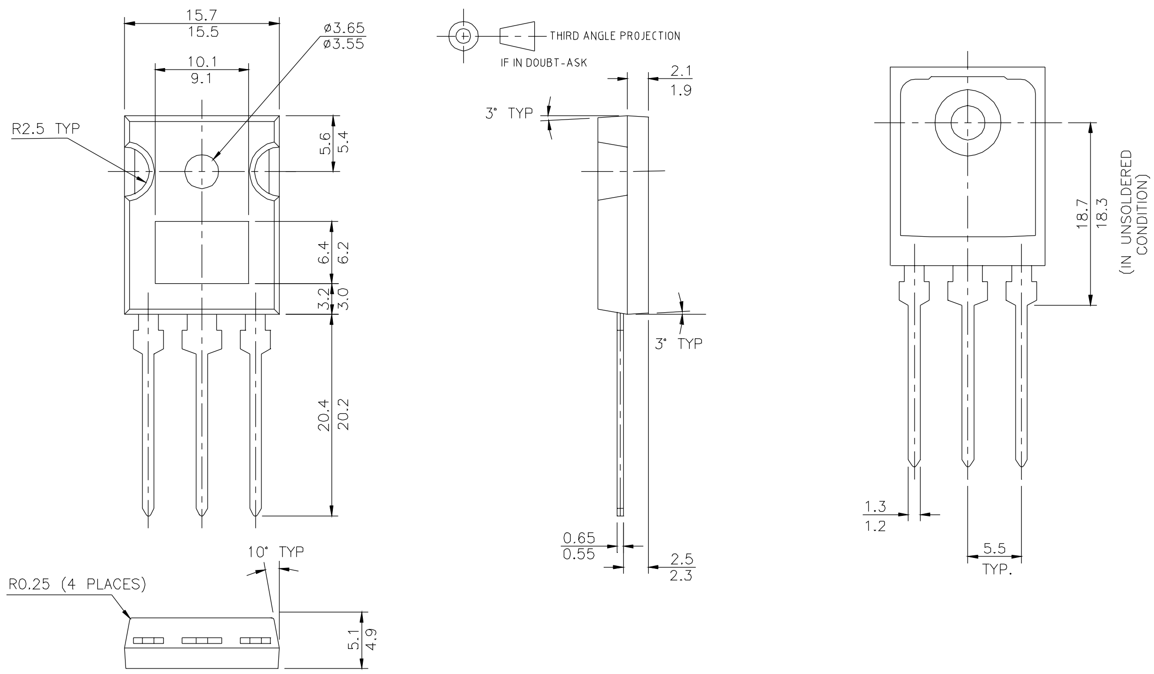


Fig. WF4- Typ. S.C Waveform
@ T_C = 150°C using Fig. CT.3

TO-247AD Case Outline and Dimensions



TO-247 package is not recommended for Surface Mount Application.

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
IOR Rectifier

IR WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
TAC Fax: (310) 252-7903
Visit us at www.irf.com for sales contact information. 10/02