International Rectifier

PD- 95967

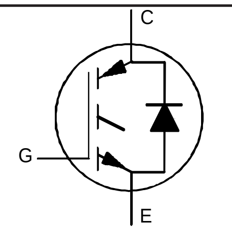
IRGPS40B120UDP

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

UltraFast Co-Pack IGBT

Features

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



N-channel

V_{CES} = 1200V

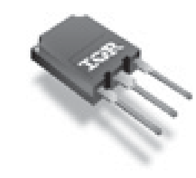
$V_{CE(on)}$ typ. = 3.12V

@ V_{GE} = 15V,

I_{CE} = 40A, Tj=25°C

Benefits

- Benchmark Efficiency for Motor Control.
- Rugged Transient Performance.
- Low EMI.
- Significantly Less Snubber Required
- Excellent Current Sharing in Parallel Operation.


Super-247™

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
I_C @ T_C = 25°C	Continuous Collector Current	80	A
I_C @ T_C = 100°C	Continuous Collector Current	40	
I_{CM}	Pulsed Collector Current	160	
I_{LM}	Clamped Inductive Load Current①	160	
I_F @ T_C = 25°C	Diode Continuous Forward Current	80	
I_F @ T_C = 100°C	Diode Continuous Forward Current	40	
I_{FM}	Diode Maximum Forward Current	160	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
P_D @ T_C = 25°C	Maximum Power Dissipation	595	W
P_D @ T_C = 100°C	Maximum Power Dissipation	238	
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)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT	—	—	0.20	°C/W
$R_{\theta JC}$	Junction-to-Case - Diode	—	—	0.83	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	—	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	—	40	
	Recommended Clip Force	20 (2)	—	—	N(kgf)
Wt	Weight	—	6.0 (0.21)	—	g (oz)
Le	Internal Emitter Inductance (5mm from package)	—	13	—	nH

Electrical Characteristics @ T_J = 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	——	0.40	——	V/°C	V_{GE} = 0V, I_C = 1.0mA, (25°C-125°C)	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	——	3.12	3.40	V	I_C = 40A V_{GE} = 15V	5, 6
		——	3.39	3.70		I_C = 50A	7, 9
		——	3.88	4.30		I_C = 40A, T_J = 125°C	10
		——	4.24	4.70		I_C = 50A, T_J = 125°C	11
$V_{GE(th)}$	Gate Threshold Voltage	4.0	5.0	6.0		V_{CE} = V_{GE}, I_C = 250µA	9,10
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	——	-12	——	mV/°C	V_{CE} = V_{GE}, I_C = 1.0mA, (25°C-125°C)	11 ,12
g_{fe}	Forward Transconductance	——	30.5	——	S	V_{CE} = 50V, I_C = 40A, PW=80µs	
I_{CES}	Zero Gate Voltage Collector Current	——	——	500	µA	V_{GE} = 0V, V_{CE} = 1200V	
		——	420	1200		V_{GE} = 0V, V_{CE} = 1200V, T_J = 125°C	
V_{FM}	Diode Forward Voltage Drop	——	2.03	2.40	V	I_C = 40A	8
		——	2.17	2.60		I_C = 50A	
		——	2.26	2.68		I_C = 40A, T_J = 125°C	
		——	2.46	2.95		I_C = 50A, T_J = 125°C	
I_{GES}	Gate-to-Emitter Leakage Current	——	——	±100	nA	V_{GE} = ±20V	

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

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig.
Qg	Total Gate Charge (turn-on)	——	340	510	nC	I_C = 40A	23
Qge	Gate - Emitter Charge (turn-on)	——	40	60		V_{CC} = 600V	CT1
Q_{gc}	Gate - Collector Charge (turn-on)	——	165	248		V_{GE} = 15V	
E_{on}	Turn-On Switching Loss	——	1400	1750	µJ	I_C = 40A, V_{CC} = 600V	CT4
E_{off}	Turn-Off Switching Loss	——	1650	2050		V_{GE} = 15V,R_G = 4.7Ω, L =200µH	WF1
E_{tot}	Total Switching Loss	——	3050	3800		Ls = 150nH T_J = 25°C	WF2
E_{on}	Turn-On Switching Loss	——	1950	2300	µJ	T_J = 125°C	13,15
E_{off}	Turn-Off Switching Loss	——	2200	2950		Energy losses include "tail" and	
E_{tot}	Total Switching Loss	——	4150	5250		diode reverse recovery.	
$t_{d(on)}$	Turn-On Delay Time	——	76	99	ns	I_C = 40A, V_{CC} = 600V	14, 16
t_r	Rise Time	——	39	55		V_{GE} = 15V, R_G = 4.7Ω L =200µH	CT4
$t_{d(off)}$	Turn-Off Delay Time	——	332	365		Ls = 150nH, T_J = 125°C	WF1
t_f	Fall Time	——	25	33			WF2
C_{ies}	Input Capacitance	——	4300	——	pF	V_{GE} = 0V	22
C_{oes}	Output Capacitance	——	330	——		V_{CC} = 30V	
C_{res}	Reverse Transfer Capacitance	——	160	——		f = 1.0MHz	
RBSOA	Reverse Bias Safe Operting Area	FULL SQUARE				T_J = 150°C, I_C = 160A, Vp =1200V V_{CC} = 1000V, V_{GE} = +15V to 0V R_G = 4.7Ω	4 CT2
SCSOA	Short Circuit Safe Operting Area	10	——	——	µs	T_J = 150°C, Vp =1200V V_{CC} = 900V, V_{GE} = +15V to 0V, R_G = 4.7Ω	CT3 WF4
Erec	Reverse Recovery energy of the diode	——	3346	——	µJ	T_J = 125°C	17,18,19
t_{rr}	Diode Reverse Recovery time	——	180	——	ns	V_{CC} = 600V, I_F = 60A, L =200µH	20, 21
I_{rr}	Diode Peak Reverse Recovery Current	——	50	——	A	V_{GE} = 15V,R_G = 4.7Ω, Ls = 150nH	CT4,WF3

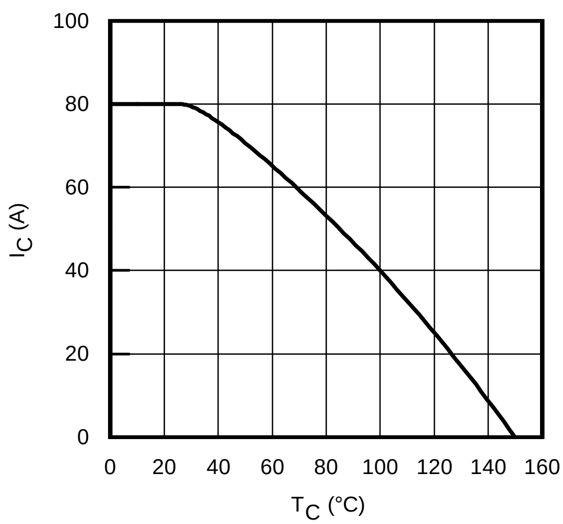


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

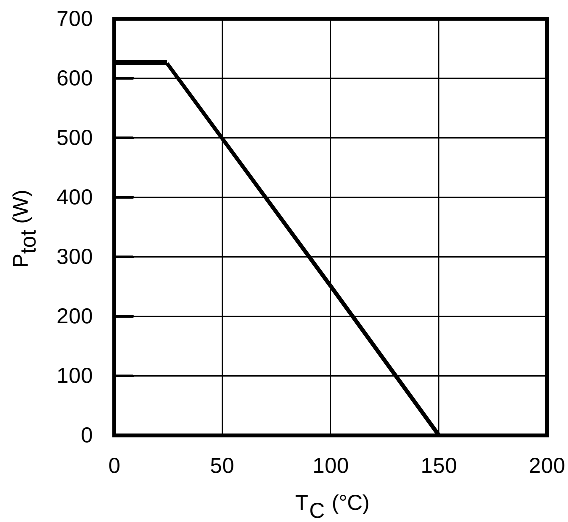


Fig. 2 - Power Dissipation vs. Case Temperature

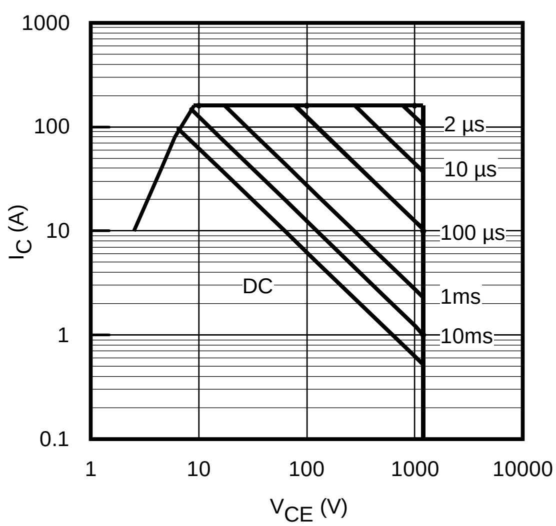


Fig. 3 - Forward SOA
T_C = 25°C; $T_{JS} \leq$ 150°C

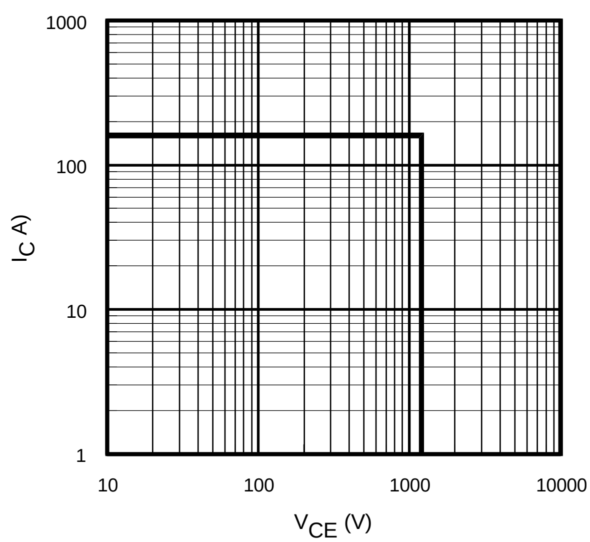


Fig. 4 - Reverse Bias SOA
T_J = 150°C; V_{GE} =15V

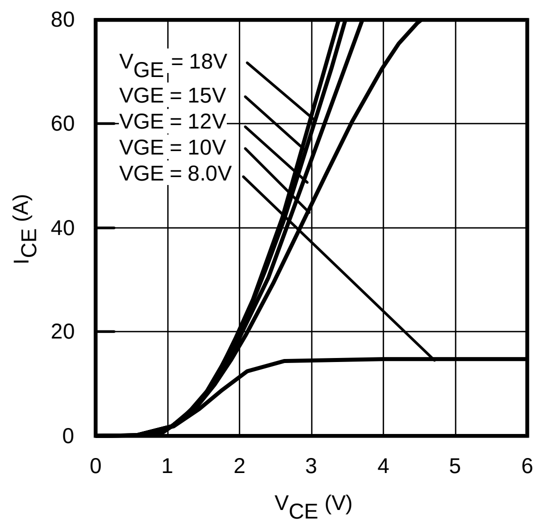


Fig. 5 - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 80µs

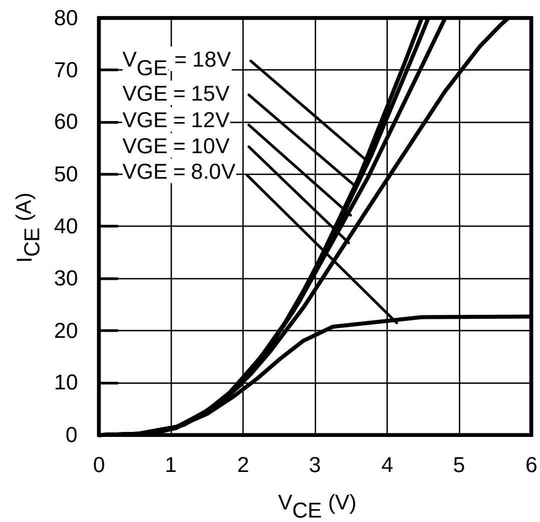


Fig. 6 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 80µs

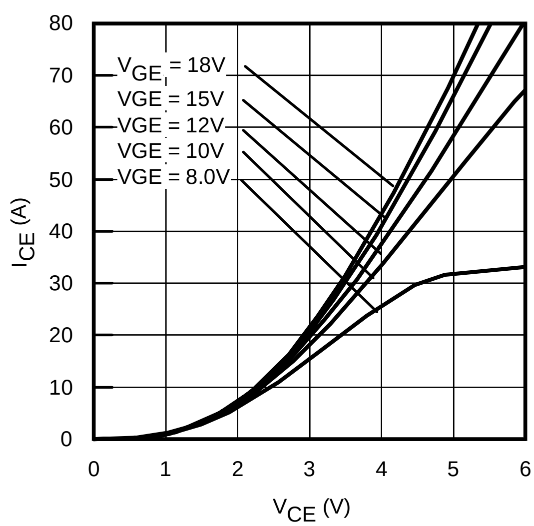


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 125°C; tp = 80µs

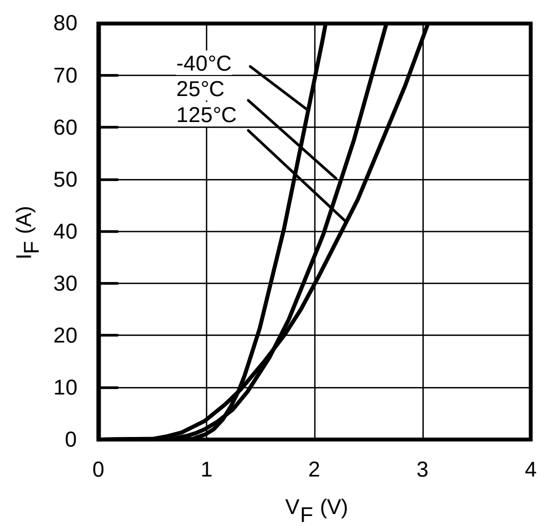


Fig. 8 - Typ. Diode Forward Characteristics
tp = 80µs

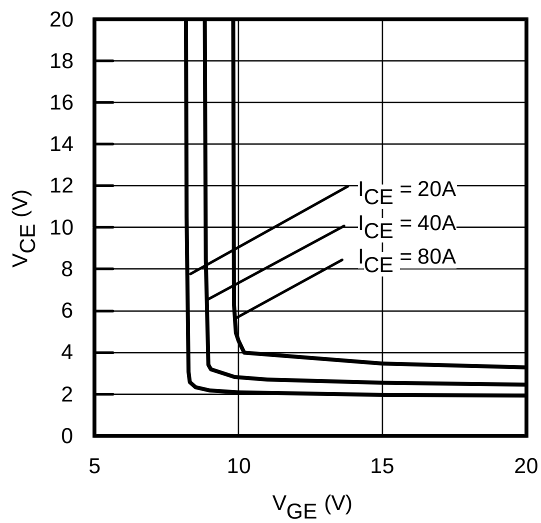


Fig. 9 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

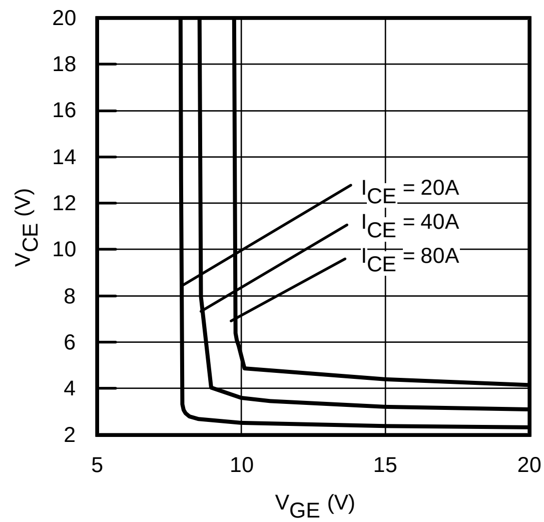


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

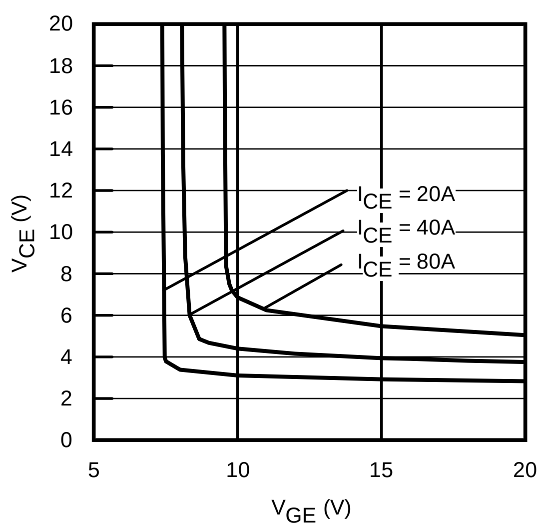


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 125°C

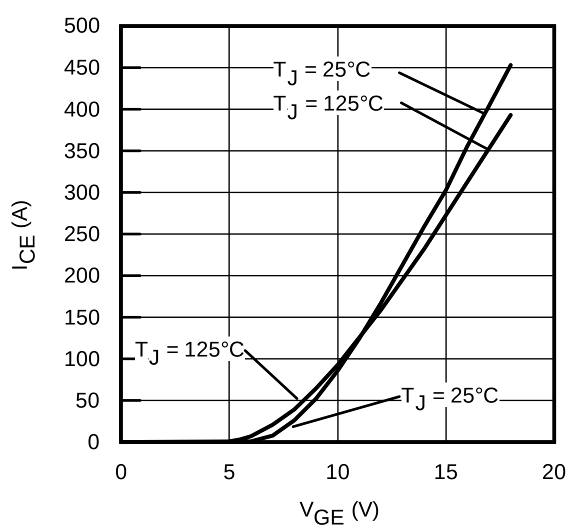


Fig. 12 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 10µs

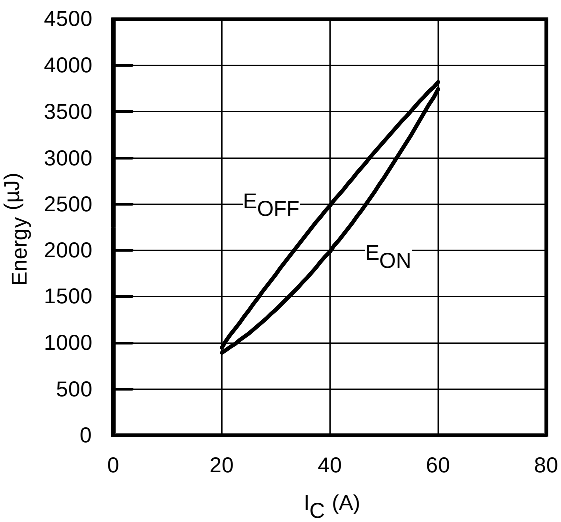


Fig. 13 - Typ. Energy Loss vs. I_C
T_J = 125°C; L=200µH; V_{CE}= 600V
R_G= 4.7Ω; V_{GE}= 15V

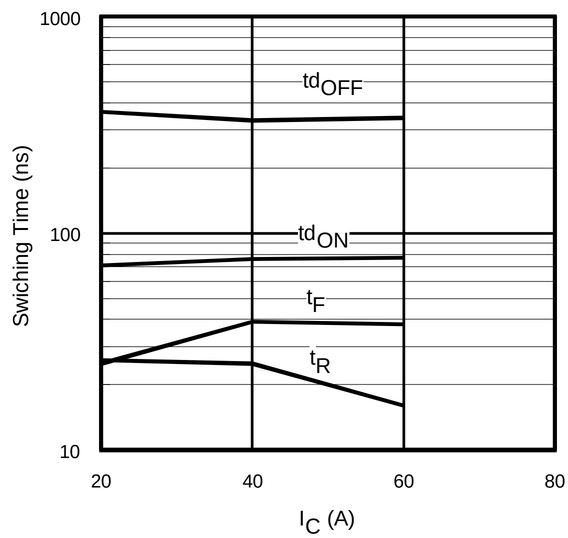


Fig. 14 - Typ. Switching Time vs. I_C
T_J = 125°C; L=200µH; V_{CE}= 600V
R_G= 4.7Ω; V_{GE}= 15V

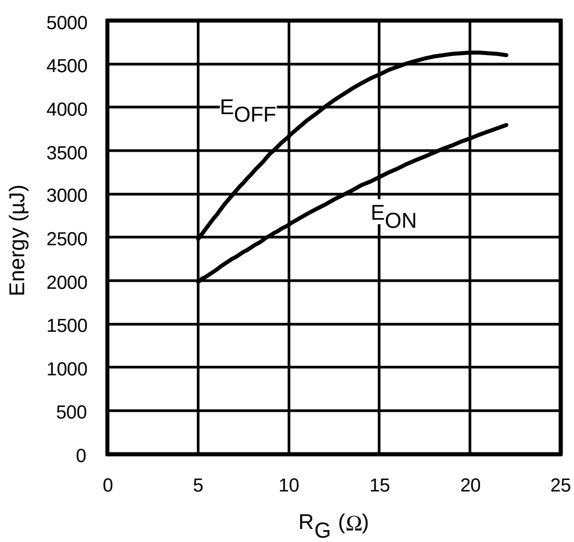


Fig. 15 - Typ. Energy Loss vs. R_G
T_J = 125°C; L=200µH; V_{CE}= 600V
I_{CE}= 40A; V_{GE}= 15V

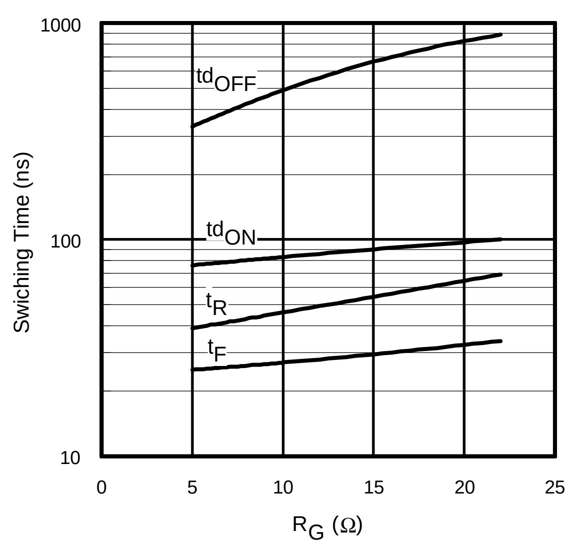


Fig. 16 - Typ. Switching Time vs. R_G
T_J = 125°C; L=200µH; V_{CE}= 600V
I_{CE}= 40A; V_{GE}= 15V

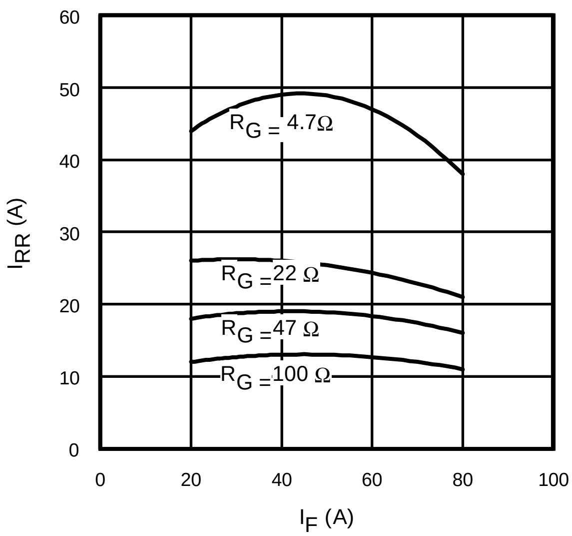


Fig. 17 - Typical Diode I_{RR} vs. I_F
T_J = 125°C

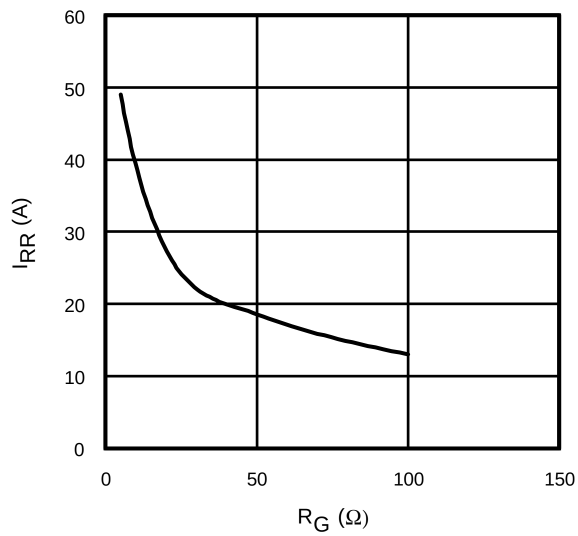


Fig. 18 - Typical Diode I_{RR} vs. R_G
T_J = 125°C; I_F = 40A

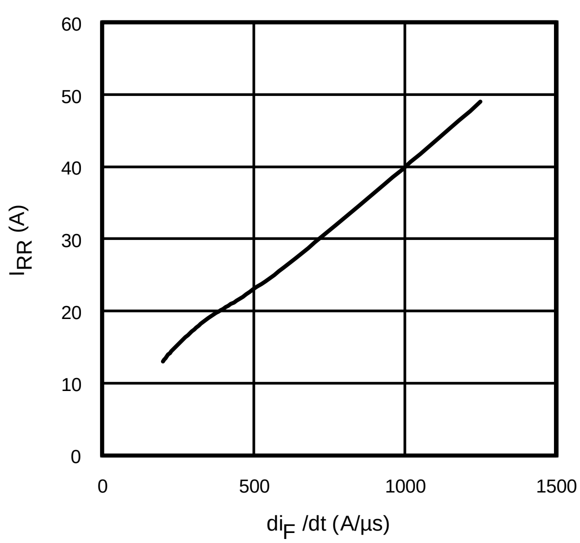


Fig. 19- Typical Diode I_{RR} vs. di_F/dt
V_{CC}= 600V; V_{GE}= 15V;
I_{CE}= 40A; T_J = 125°C

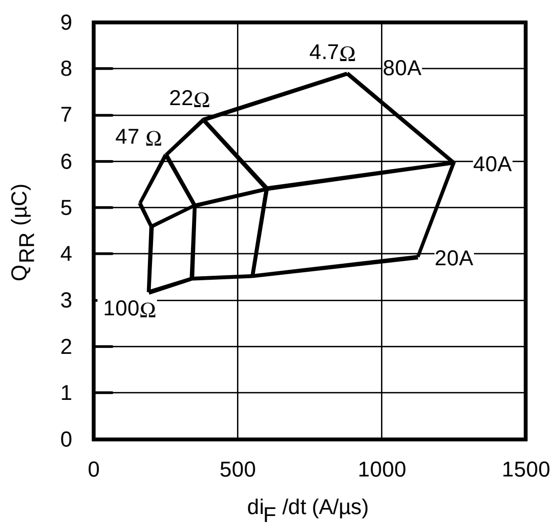


Fig. 20 - Typical Diode Q_{RR}
V_{CC}= 600V; V_{GE}= 15V;T_J = 125°C

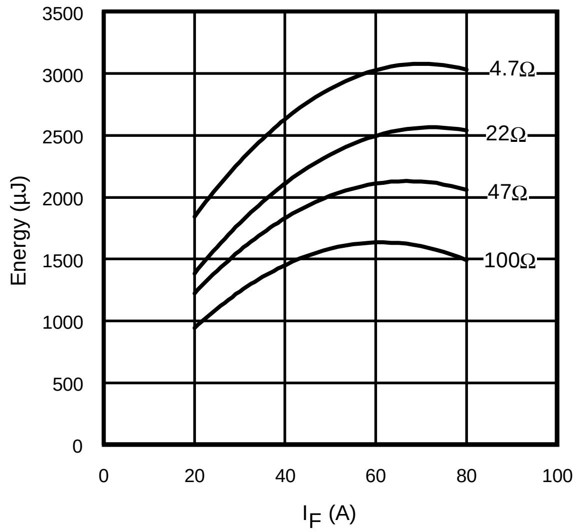


Fig. 21 - Typical Diode E_{RR} vs. I_F
T_J = 125°C

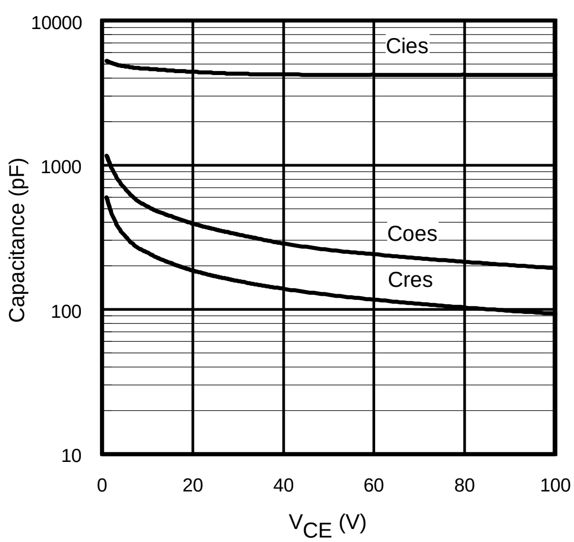


Fig. 22- Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

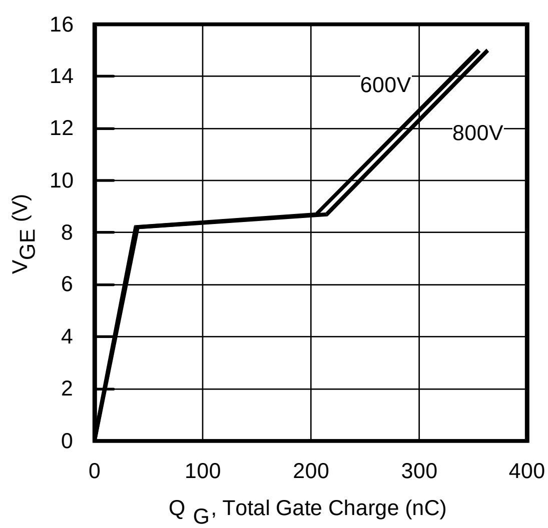


Fig. 23 - Typical Gate Charge vs. V_{GE}
I_{CE} = 40A; L = 600µH

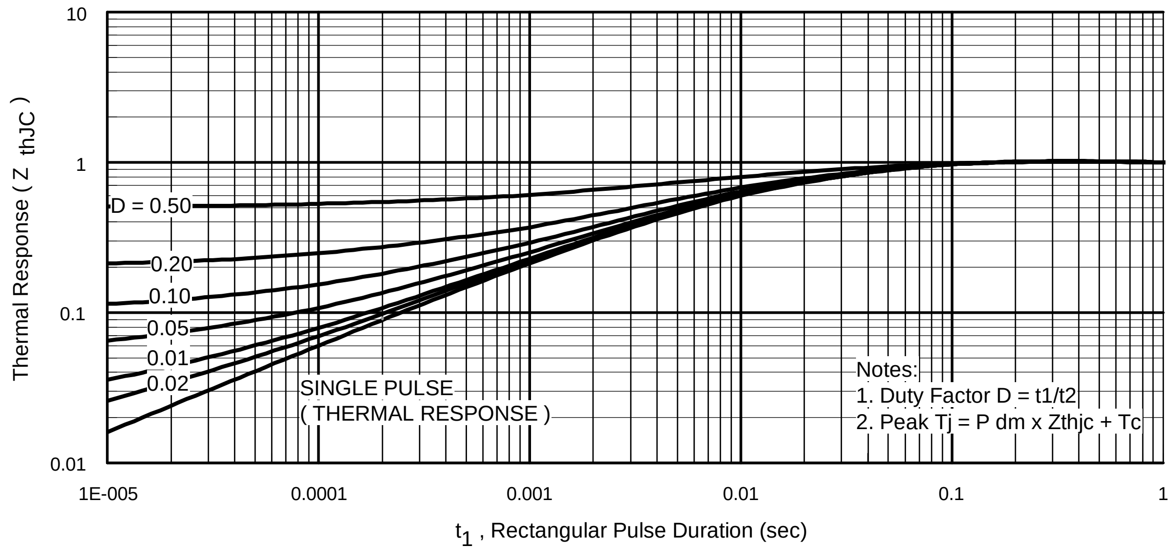


Fig 24. Normalized Transient Thermal Impedance, Junction-to-Case (IGBT)

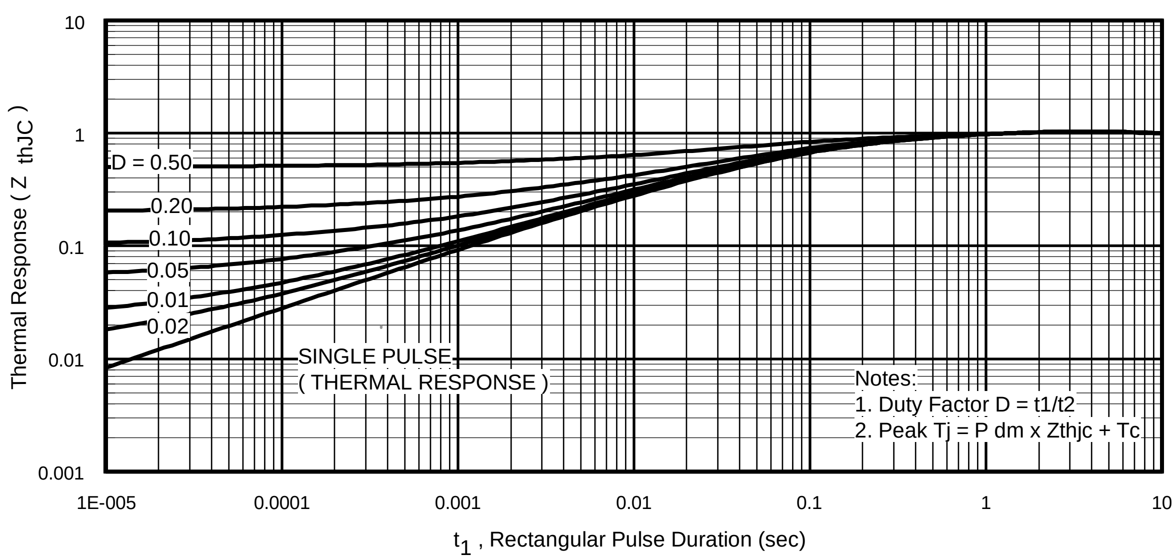


Fig 25. Normalized Transient Thermal Impedance, Junction-to-Case (DIODE)

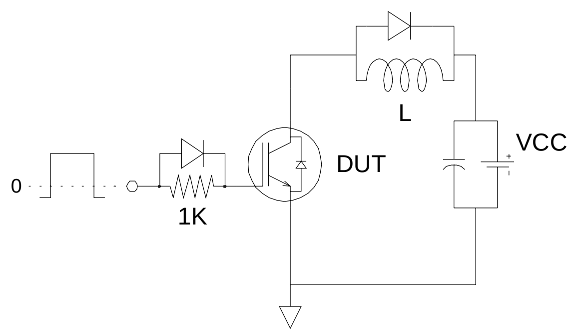


Fig.C.T.1 - Gate Charge Circuit (turn-on)

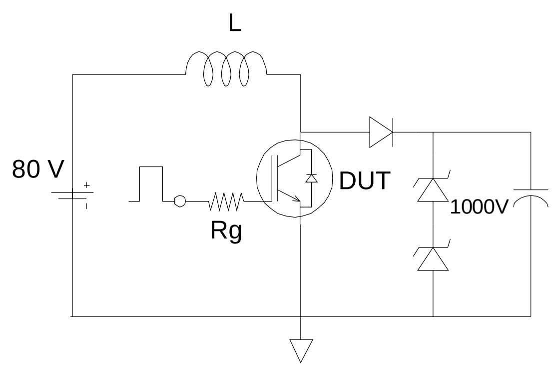


Fig.C.T.2 - RBSOA Circuit

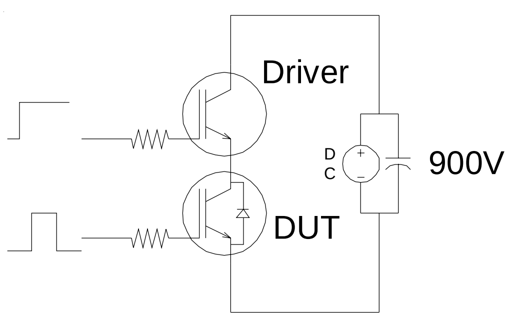


Fig.C.T.3 - RBSOA Circuit

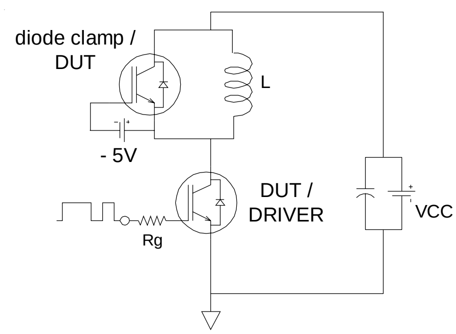


Fig.C.T.4 - RBSOA Circuit

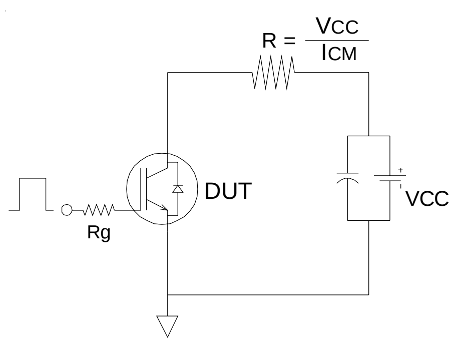


Fig.C.T.5 - RBSOA Circuit

Fig. WF.1 - Typ. Turn-off Loss Waveform @ Tj=125°C using Fig. CT.4

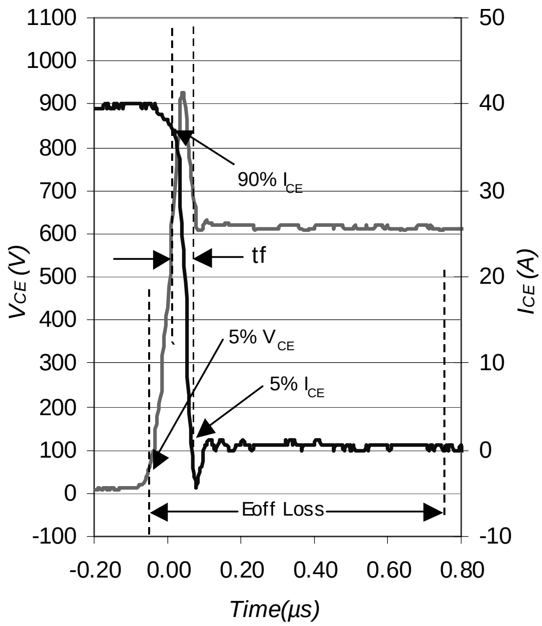


Fig. WF.2 - Typ. Turn-on Loss Waveform @ Tj=125C using Fig. CT.4

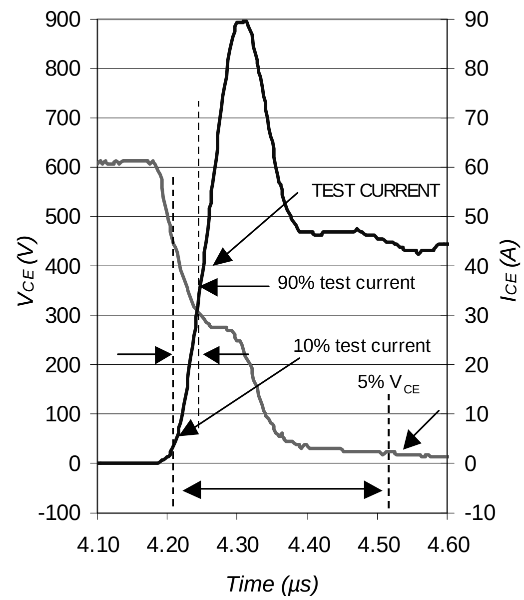


Fig. WF.3 - Typ. Diode Recovery Waveform @Tj=125°C using Fig. CT.4

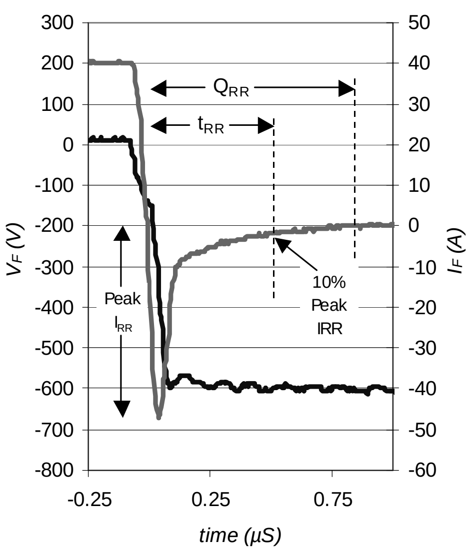
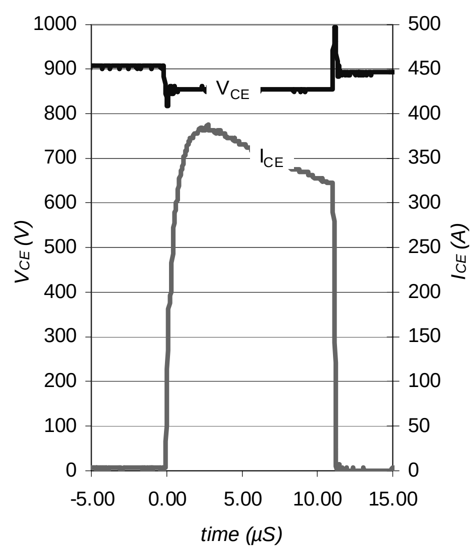
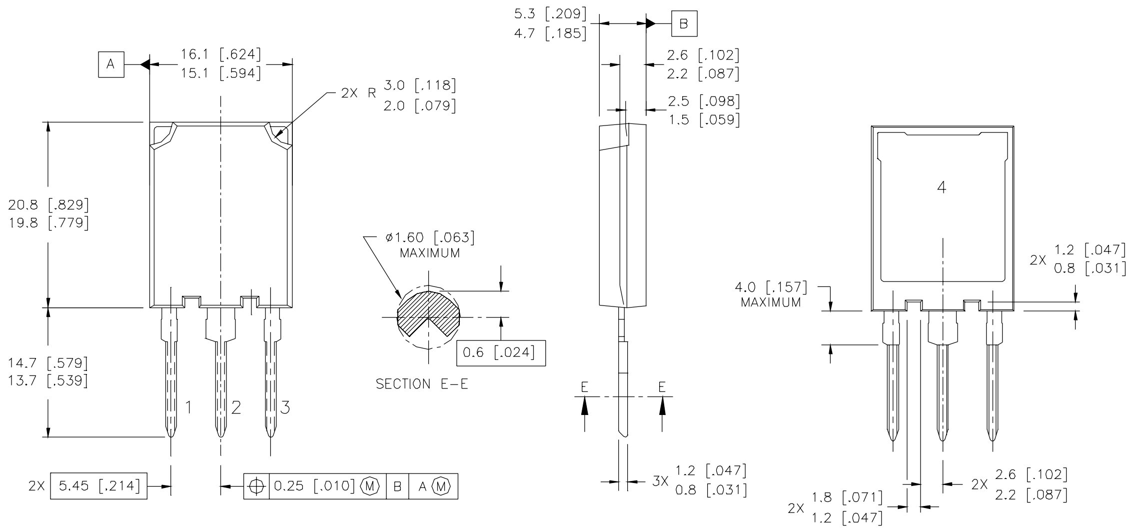


Fig. WF.4 - Typ. S.C. Waveform @ TC=150°C using Fig. CT.3



Case Outline and Dimensions — Super-247



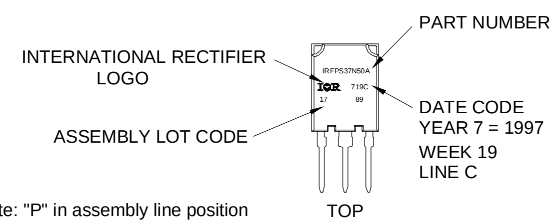
NOTES:
1. DIMENSIONS & TOLERANCING PER ASME Y14.5M-1994
2. CONTROLLING DIMENSION: MILLIMETER
3. DIMENSIONS ARE SHOWN IN MILLIMETRES [INCHES]

LEAD ASSIGNMENTS

MOSFET	IGBT
1 - GATE	1 - GATE
2 - DRAIN	2 - COLLECTOR
3 - SOURCE	3 - EMITTER
4 - DRAIN	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"

TOP

① V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 100 µH, R_G = 4.7Ω.

Data and specifications subject to change without notice.
This product has been designed and qualified for the industrial market.
Qualification Standards can be found on IR's Web site.

International
IOR Rectifier

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TAC Fax: (310) 252-7903
Visit us at www.irf.com for sales contact information.11/04