PD - 94385E

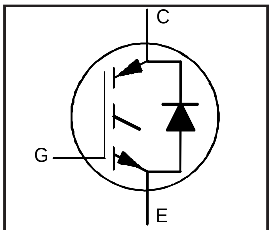
International
IOR Rectifier

IRGB5B120KD

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

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-220 Package.



n-channel

V_{CES} = 1200V

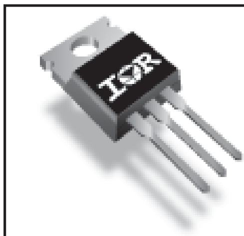
I_C = 6.0A, T_C=100°C

t_{sc} > 10µs, T_J=150°C

$V_{CE(on)}$ typ. = 2.75V

Benefits

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


TO-220AB

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
I_C @ T_C = 25°C	Continuous Collector Current	12	A
I_C @ T_C = 100°C	Continuous Collector Current	6.0	
I_{CM}	Pulsed Collector Current	24	
I_{LM}	Clamped Inductive Load Current ①	24	
I_F @ T_C = 25°C	Diode Continuous Forward Current	12	
I_F @ T_C = 100°C	Diode Continuous Forward Current	6.0	
I_{FM}	Diode Maximum Forward Current	24	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
P_D @ T_C = 25°C	Maximum Power Dissipation	89	W
P_D @ T_C = 100°C	Maximum Power Dissipation	36	
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
$R_{\theta JC}$	Junction-to-Case - IGBT	——	——	1.4	°C/W
$R_{\theta JC}$	Junction-to-Case - Diode	——	——	2.8	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	——	0.50	——	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	——	——	62	
Wt	Weight	——	2 (0.07)	——	g (oz)

8/18/04

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	—	1.15	—	V/°C	V_{GE} = 0V, I_C = 1.0mA, (25°C-125°C)	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	2.75	3.0		I_C = 6.0A V_{GE} = 15V	5, 6,7
		—	3.36	3.7	V	I_C = 6.0A 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
g_{fe}	Forward Transconductance	—	2.6	—	S	V_{CE} = 50V, I_C = 6.0A, PW=80µs	
I_{CES}	Zero Gate Voltage Collector Current	—	—	100	µA	V_{GE} = 0V, V_{CE} = 1200V	
		—	66	200		V_{GE} = 0V, V_{CE} = 1200V, T_J = 125°C	
V_{FM}	Diode Forward Voltage Drop	—	2.13	2.45		I_F = 6.0A	8
		—	2.38	2.75	V	I_F = 6.0A 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)	—	25	38		I_C = 6.0A	23
Qge	Gate - Emitter Charge (turn-on)	—	3.7	5.6	nC	V_{CC} = 800V	CT1
Qgc	Gate - Collector Charge (turn-on)	—	13	20		V_{GE} = 15V	
E_{on}	Turn-On Switching Loss	—	390	440	µJ	I_C = 6.0A, V_{CC} = 600V	CT4
E_{off}	Turn-Off Switching Loss	—	330	440		V_{GE} = 15V, R_G = 50Ω, L = 3.7mH	
E_{tot}	Total Switching Loss	—	720	880		Ls = 150nH T_J = 25°C ②	
$t_{d(on)}$	Turn-On Delay Time	—	22	29		I_C = 6.0A, V_{CC} = 600V	CT4
t_r	Rise Time	—	19	27		V_{GE} = 15V, R_G = 50Ω L = 3.7mH	
$t_{d(off)}$	Turn-Off Delay Time	—	100	120	ns	Ls = 150nH, T_J = 25°C	
t_f	Fall Time	—	19	25			
E_{on}	Turn-On Switching Loss	—	440	660		I_C = 6.0A, V_{CC} = 600V	CT4
E_{off}	Turn-Off Switching Loss	—	370	560	µJ	V_{GE} = 15V, R_G = 50Ω, L = 3.7mH	13,15
E_{tot}	Total Switching Loss	—	810	1220		Ls = 150nH T_J = 125°C ②	WF1WF2
$t_{d(on)}$	Turn-On Delay Time	—	21	27		I_C = 6.0A, V_{CC} = 600V	14, 16
t_r	Rise Time	—	18	25		V_{GE} = 15V, R_G = 50Ω L = 3.7mH	CT4
$t_{d(off)}$	Turn-Off Delay Time	—	110	150	ns	Ls = 150nH, T_J = 125°C	WF1
t_f	Fall Time	—	22	29			WF2
C_{ies}	Input Capacitance	—	370	—		V_{GE} = 0V	
C_{oes}	Output Capacitance	—	33	—	pF	V_{CC} = 30V	22
C_{res}	Reverse Transfer Capacitance	—	11	—		f = 1.0MHz	
RBSOA	Reverse Bias Safe Operting Area	FULL SQUARE				T_J = 150°C, I_C = 24A, Vp = 1200V V_{CC} = 1000V, V_{GE} = +15V to 0V, R_G=50Ω	4 CT2
SCSOA	Short Circuit Safe Operting Area	10	—	—	µs	T_J = 150°C, Vp = 1200V, R_G = 50Ω V_{CC} = 900V, V_{GE} = +15V to 0V	CT3 WF4
Erec	Reverse Recovery energy of the diode	—	360	—	µJ	T_J = 125°C	17,18,19
t_{rr}	Diode Reverse Recovery time	—	160	—	ns	V_{CC} = 600V, I_F = 6.0A, L = 2.0mH	20, 21
I_{rr}	Diode Peak Reverse Recovery Current	—	9.0	—	A	V_{GE} = 15V, R_G = 50Ω, Ls = 150nH	CT4,WF3

Note:

① V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 100µH, R_G = 50Ω.

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

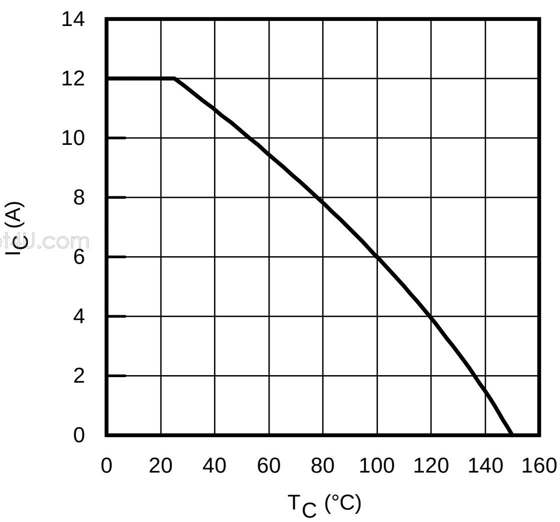


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

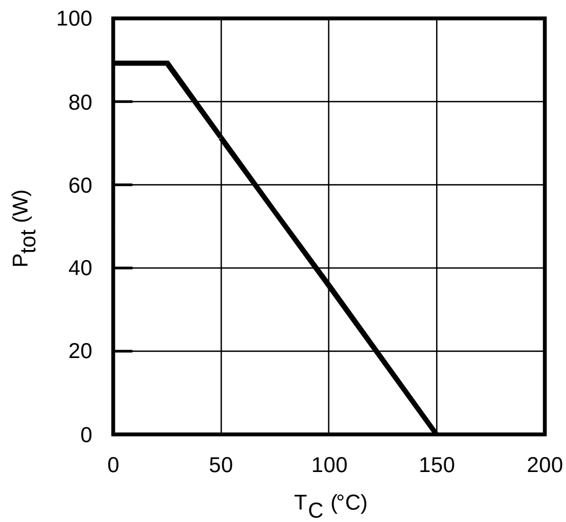


Fig. 2 - Power Dissipation vs. Case Temperature

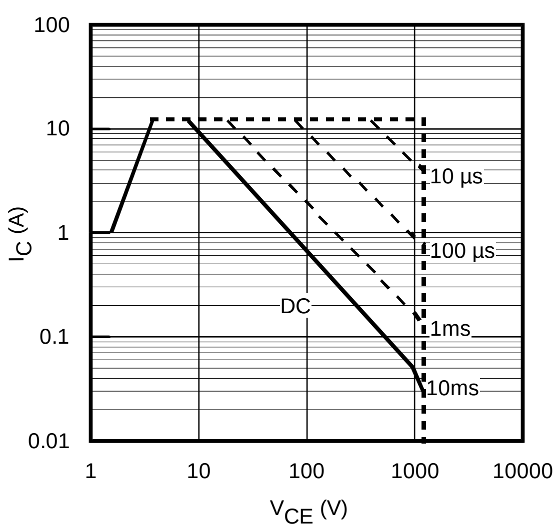


Fig. 3 - Forward SOA
T_C = 25°C; $T_J \leq$ 150°C

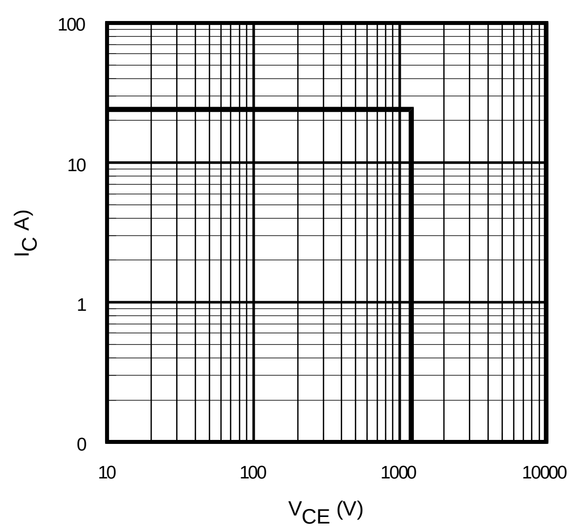


Fig. 4 - Reverse Bias SOA
T_J = 150°C; V_{GE} =15V

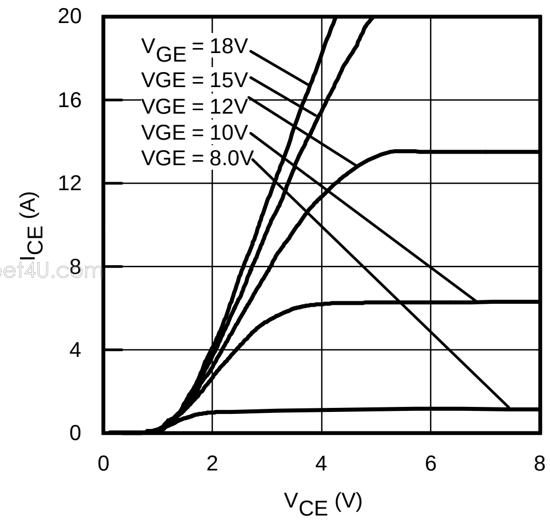


Fig. 5 - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 80µs

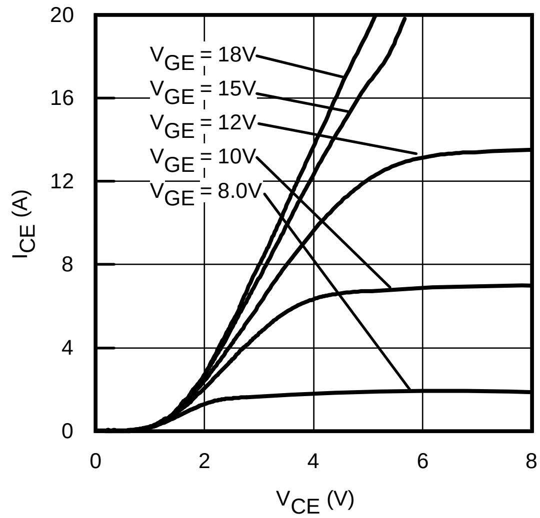


Fig. 6 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 80µs

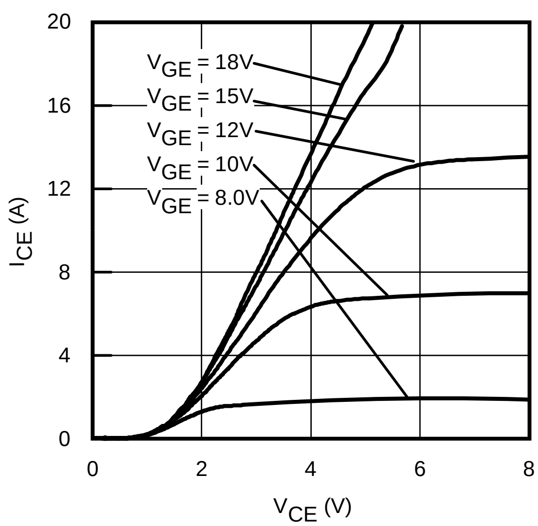


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 125°C; tp = 80µs

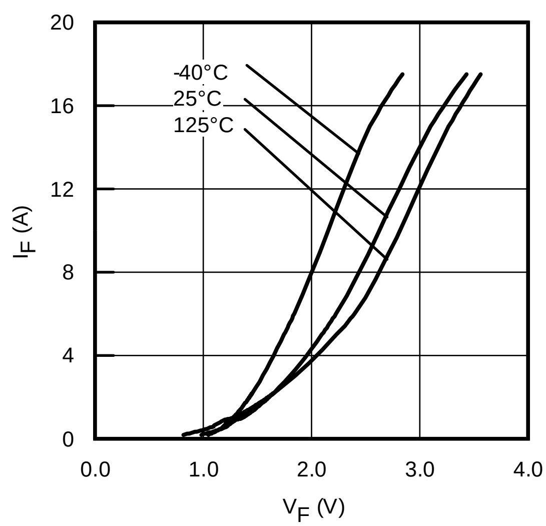


Fig. 8 - Typ. Diode Forward Characteristics
tp = 80µs

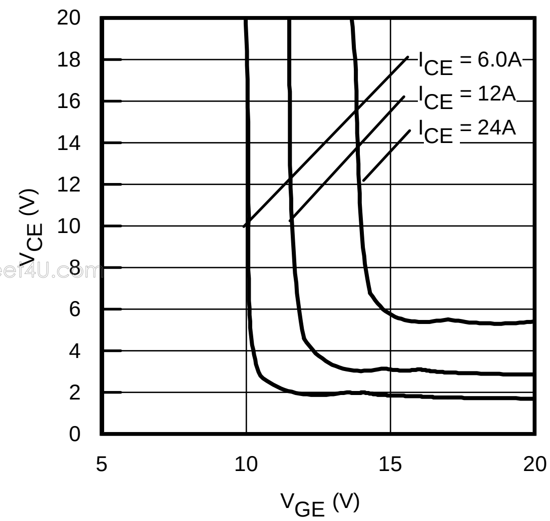


Fig. 9 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

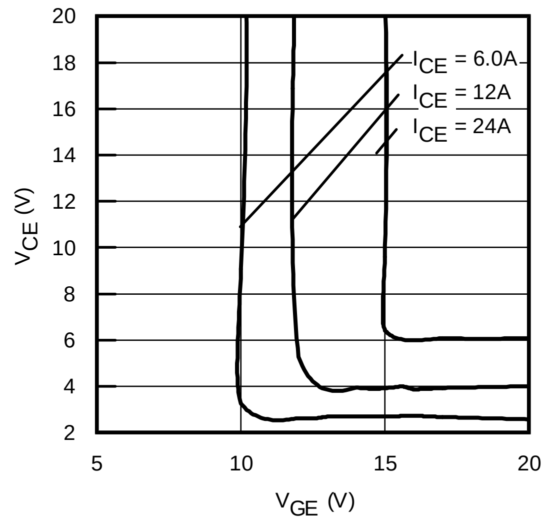


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

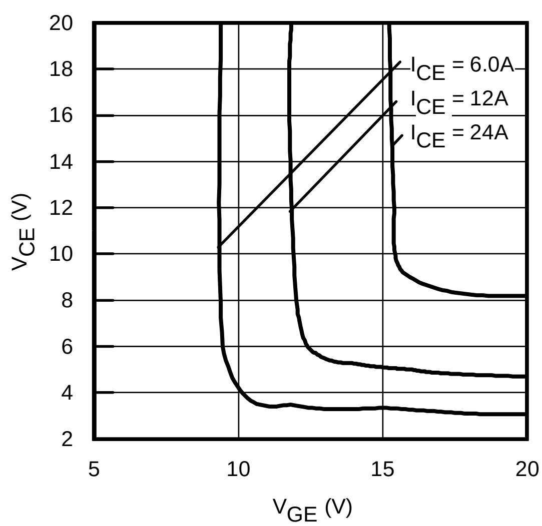


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 125°C

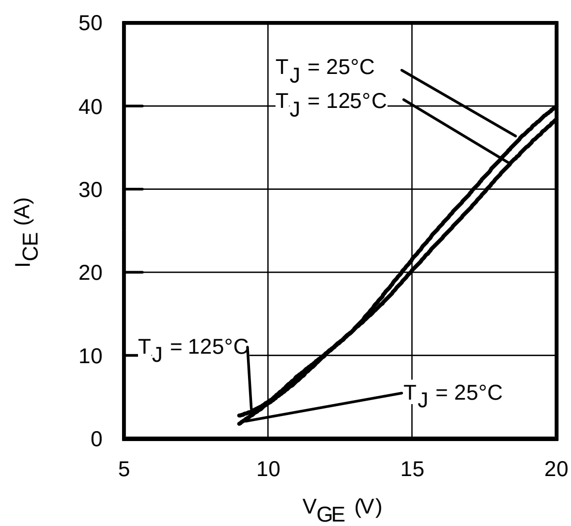


Fig. 12 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 10µs

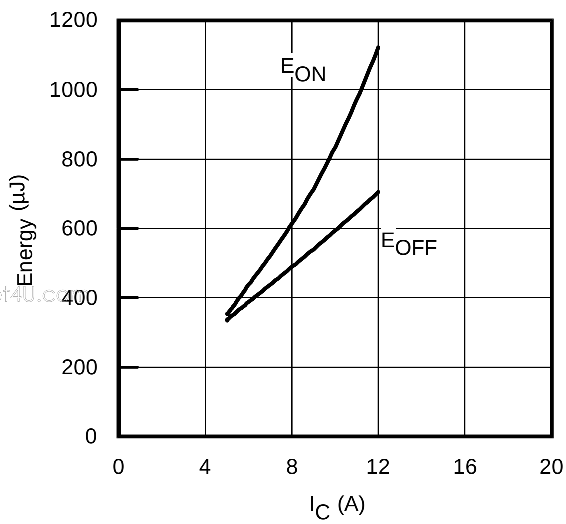


Fig. 13 - Typ. Energy Loss vs. I_C
T_J = 125°C; L=3.7mH; V_{CE}= 600V
R_G= 50Ω; V_{GE}= 15V

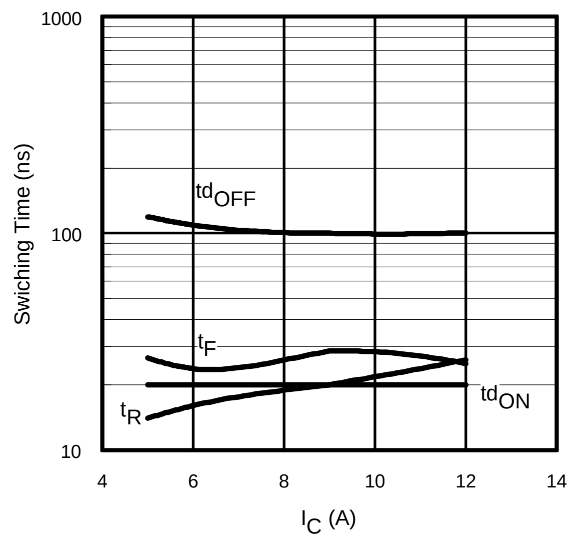


Fig. 14 - Typ. Switching Time vs. I_C
T_J = 125°C; L=3.7mH; V_{CE}= 600V
R_G= 50Ω; V_{GE}= 15V

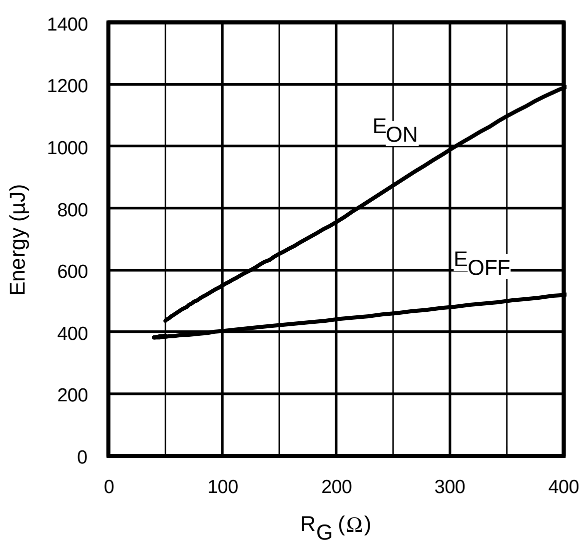


Fig. 15 - Typ. Energy Loss vs. R_G
T_J = 125°C; L=3.7mH; V_{CE}= 600V
I_{CE}= 6.0A; V_{GE}= 15V

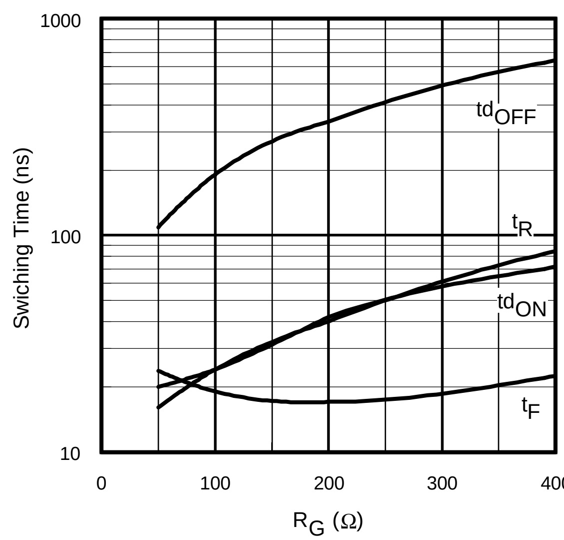


Fig. 16 - Typ. Switching Time vs. R_G
T_J = 125°C; L=3.7mH; V_{CE}= 600V
I_{CE}= 6.0A; V_{GE}= 15V

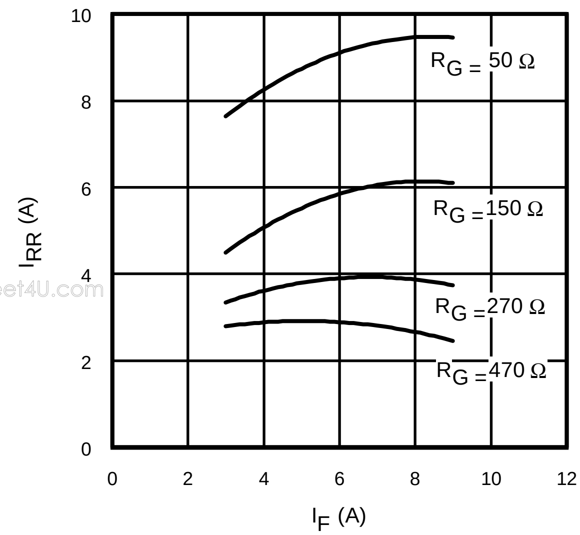


Fig. 17 - Typical Diode I_{RR} vs. I_F
T_J = 125°C

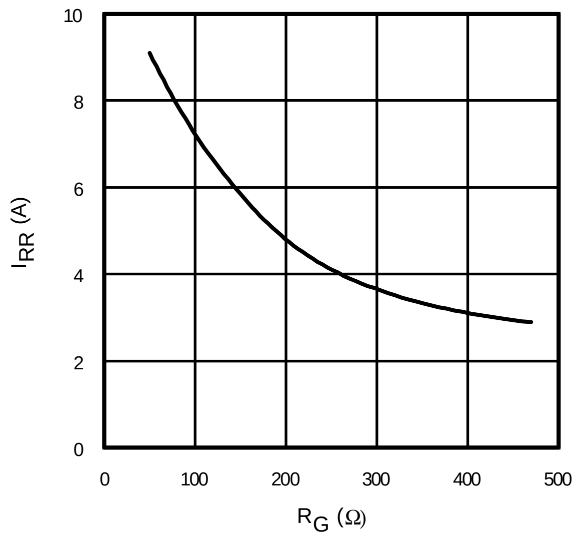


Fig. 18 - Typical Diode I_{RR} vs. R_G
T_J = 125°C; I_F = 6.0A

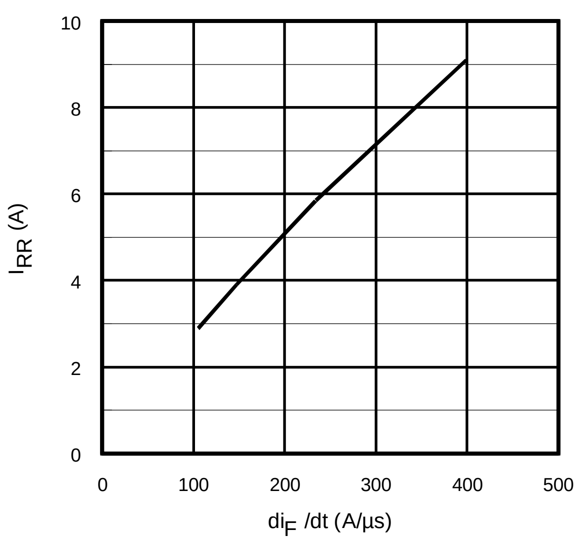


Fig. 19- Typical Diode I_{RR} vs. di_F/dt
V_{CC}= 600V; V_{GE}= 15V;
I_F = 6.0A; T_J = 125°C

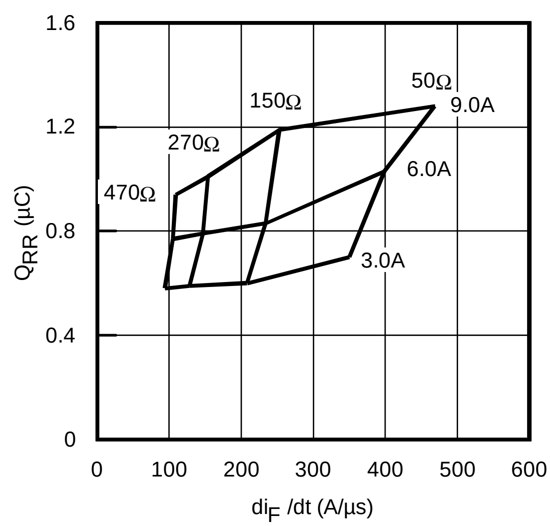


Fig. 20 - Typical Diode Q_{RR}
V_{CC}= 600V; V_{GE}= 15V;T_J = 125°C

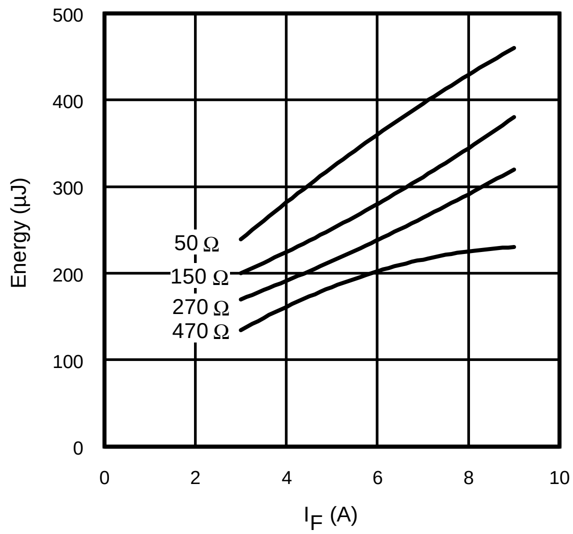


Fig. 21 - Typical Diode E_{RR} vs. I_F
T_J = 125°C

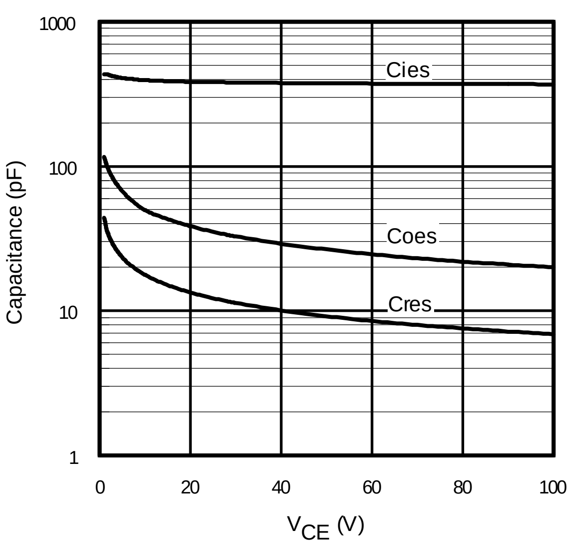


Fig. 22- Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

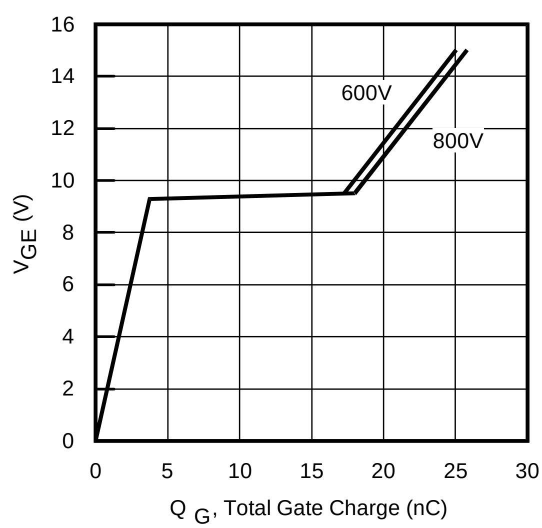
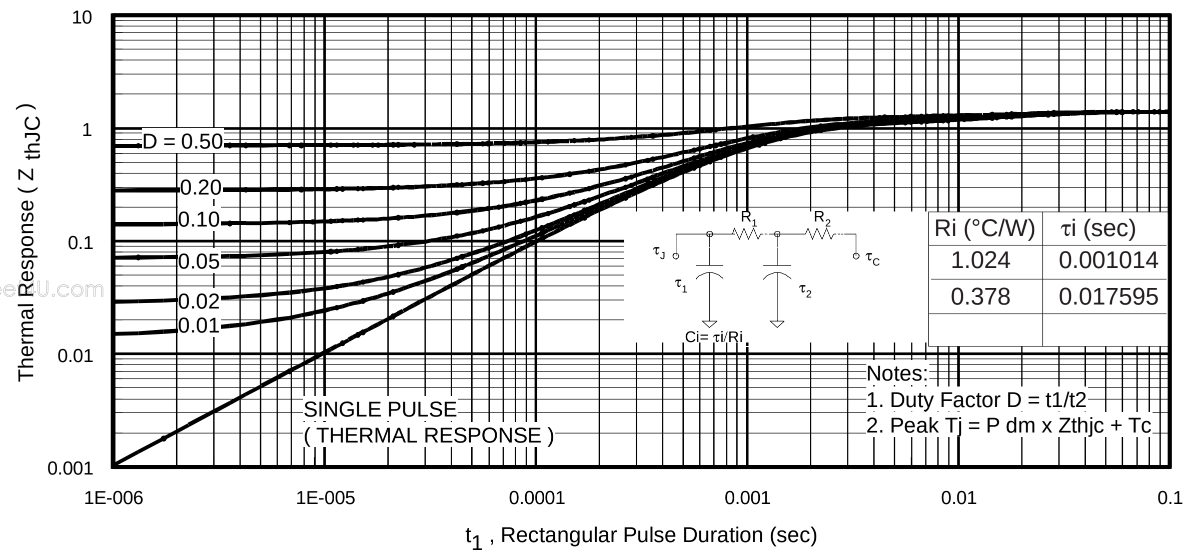
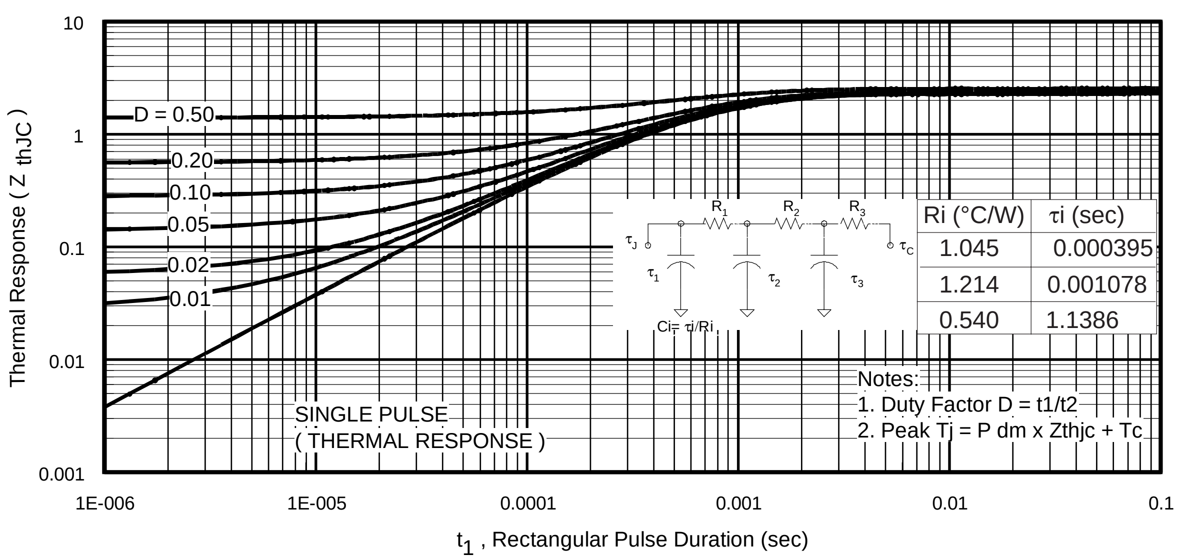


Fig. 23 - Typical Gate Charge vs. V_{GE}
I_{CE} = 6.0A; L = 600µH



Ri (°C/W)	τi (sec)
1.024	0.001014
0.378	0.017595

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



Ri (°C/W)	τi (sec)
1.045	0.000395
1.214	0.001078
0.540	1.1386

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

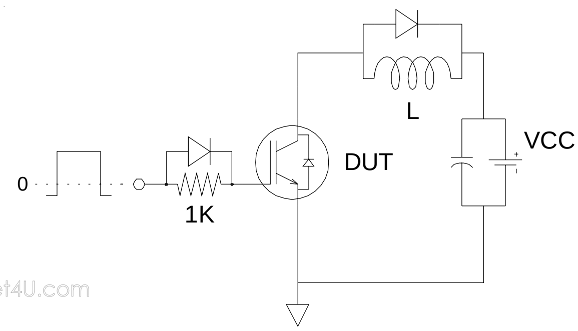


Fig.C.T.1 - Gate Charge Circuit (turn-off)

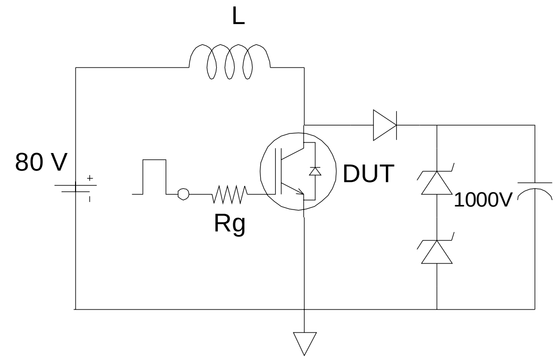


Fig.C.T.2 - RBSOA Circuit

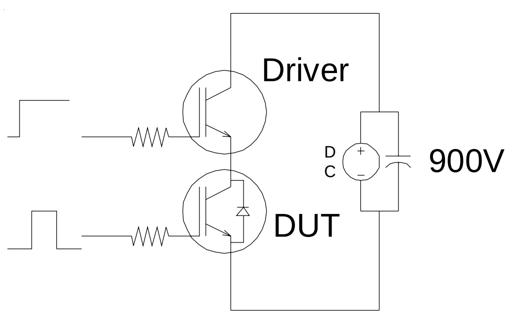


Fig.C.T.3 - S.C. SOA Circuit

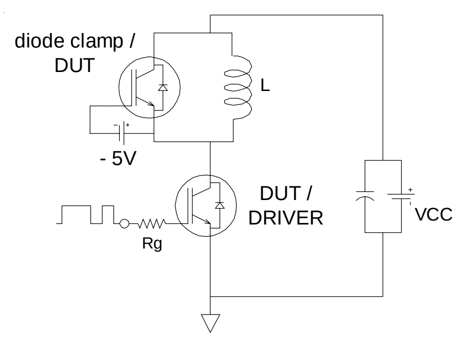


Fig.C.T.4 - Switching Loss Circuit

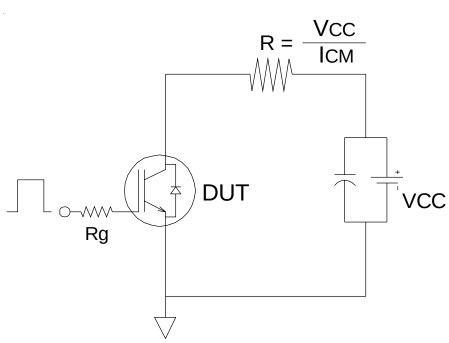


Fig.C.T.5 - Resistive Load Circuit

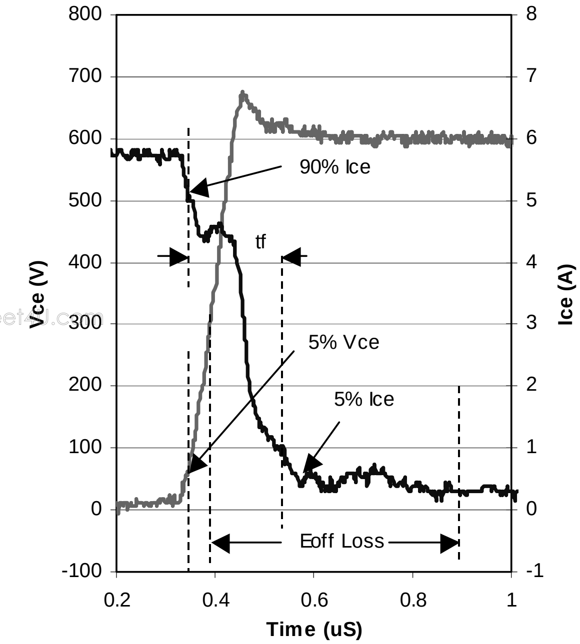


Fig.WF2-Typ. Turn-off Loss Waveform
@ T_J =125°C using Fig. CT4

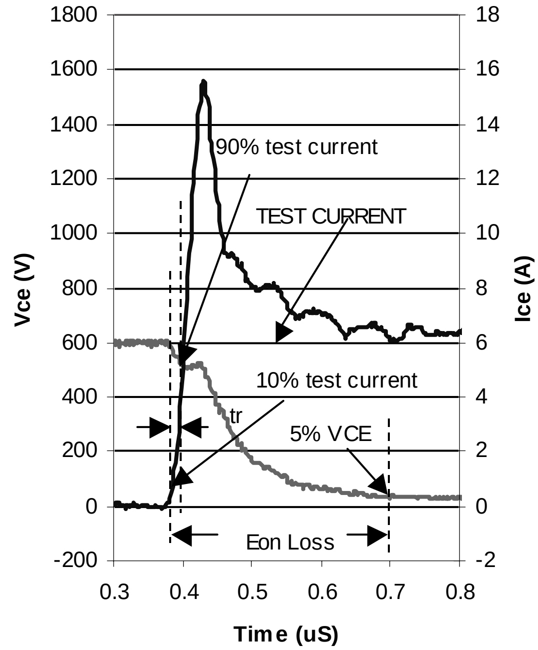


Fig.WF2-Typ. Turn-on Loss Waveform
@ T_J =125°C using Fig. CT4

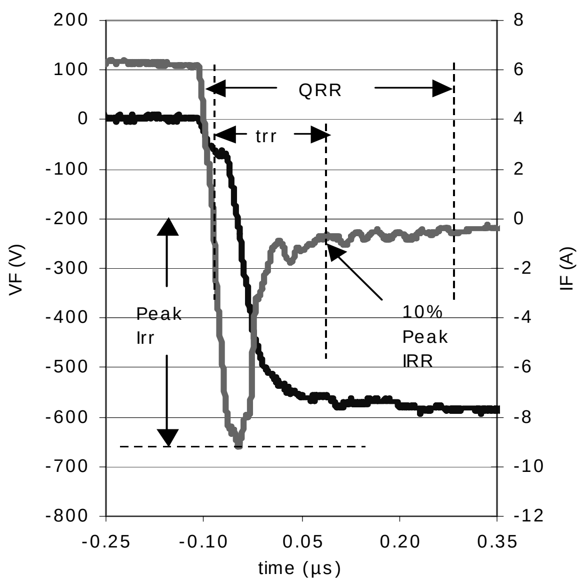


Fig.WF3-Typ. Diode Recovery Waveform
@ T_J =125°C using Fig. CT4

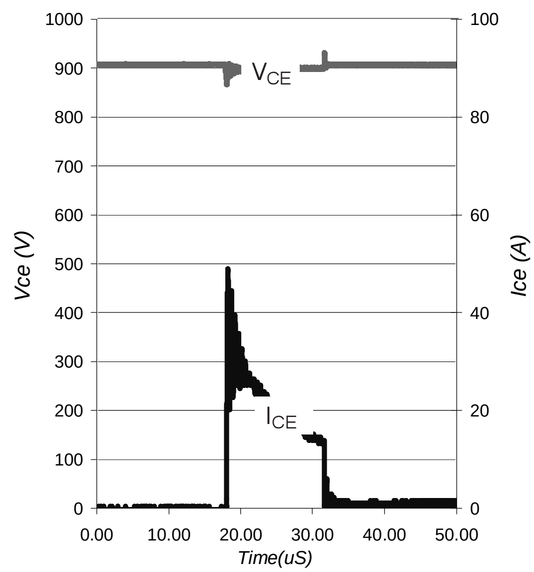
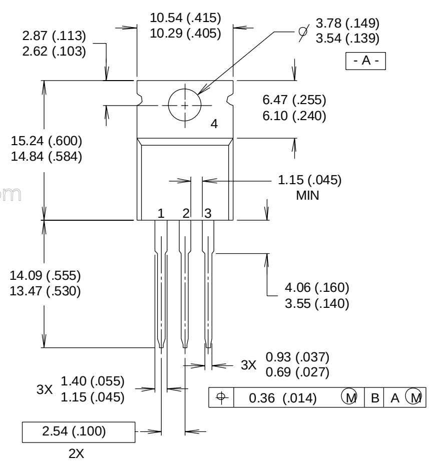
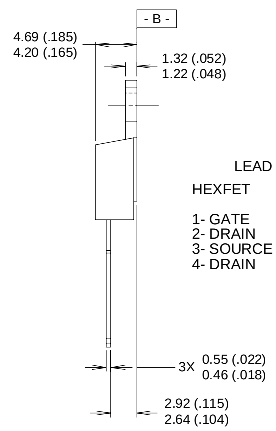


Fig.WF4-Typ. S.C. Waveform
@ T_C =150°C using Fig. CT3

TO-220AB Package Outline

Dimensions are shown in millimeters (inches)





LEAD ASSIGNMENTS

HEXFET	IGBTs, CoPACK
1- GATE	1- GATE
2- DRAIN	2- COLLECTOR
3- SOURCE	3- EMITTER
4- DRAIN	4- COLLECTOR

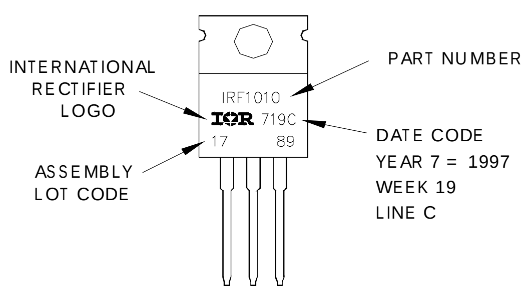
NOTES:

1 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
2 CONTROLLING DIMENSION : INCH
3 OUTLINE CONFORMS TO JEDEC OUTLINE TO-220AB.
4 HEATSINK & LEAD MEASUREMENTS DO NOT INCLUDE BURRS.

TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010
LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"

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



TO-220AB 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

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