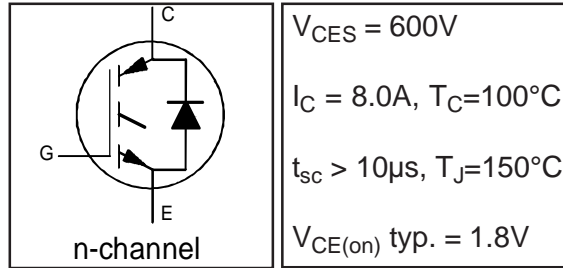


INSULATED GATE BIPOLAR TRANSISTOR WITH
ULTRAFAST SOFT RECOVERY DIODE

IRGIB7B60KD

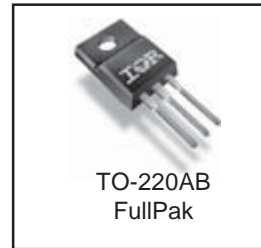
Features

- Low VCE (on) Non Punch Through IGBT Technology.
- 10µs Short Circuit Capability.
- Square RBSOA.
- Positive VCE (on) Temperature Coefficient.
- Maximum Junction Temperature rated at 175°C.



Benefits

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



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	12	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	8.0	
I_{CM}	Pulse Collector Current (Ref.Fig.C.T.5)	24	
I_{LM}	Clamped Inductive Load current ①	24	
$I_F @ T_C = 25^\circ C$	Diode Continuous Forward Current	9.0	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	6.0	
I_{FM}	Diode Maximum Forward Current	18	
V_{ISOL}	RMS Isolation Voltage, Terminal to Case, t=1 min.	2500	V
V_{GE}	Gate-to-Emitter Voltage	±20	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	39	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	20	
T_J	Operating Junction and	-55 to +175	°C
T_{STG}	Storage Temperature Range		
	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 / Mechanical Characteristics

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case- IGBT	—	—	3.8	°C/W
$R_{\theta JC}$	Junction-to-Case- Diode	—	—	6.0	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	—	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	—	62	
Wt	Weight	—	2.0	—	g

IRGIB7B60KD

International
IR Rectifier

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	600	—	—	V	V _{GE} = 0V, I _C = 500μA	
ΔV _{(BR)CES} /ΔT _J	Temperature Coeff. of Breakdown Voltage	—	0.57	—	V/°C	V _{GE} = 0V, I _C = 1mA (25°C-150°C)	
V _{CE(on)}	Collector-to-Emitter Voltage	—	1.8	2.2	V	I _C = 8.0A, V _{GE} = 15V, T _J = 25°C	5,6,7
		—	2.2	2.5		I _C = 8.0A, V _{GE} = 15V, T _J = 150°C	9,10,11
		—	2.3	2.5		I _C = 8.0A, V _{GE} = 15V, T _J = 175°C	
V _{GE(th)}	Gate Threshold Voltage	3.5	4.5	5.5	V	V _{CE} = V _{GE} , I _C = 250μA	9,10,11
ΔV _{GE(th)} /ΔT _J	Threshold Voltage temp. coefficient	—	-9.5	—	mV/°C	V _{CE} = V _{GE} , I _C = 1mA (25°C-150°C)	12
g _{fe}	Forward Transconductance	—	3.7	—	S	V _{CE} = 50V, I _C = 8.0A, PW = 80μs	
I _{CES}	Zero Gate Voltage Collector Current	—	1.0	150	μA	V _{GE} = 0V, V _{CE} = 600V	
		—	200	500		V _{GE} = 0V, V _{CE} = 600V, T _J = 150°C	
		—	720	1100		V _{GE} = 0V, V _{CE} = 600V, T _J = 175°C	
V _{FM}	Diode Forward Voltage Drop	—	1.25	1.45	V	I _F = 5.0A, V _{GE} = 0V	8
		—	1.20	1.40		I _F = 5.0A, T _J = 150°C, V _{GE} = 0V	
		—	1.20	1.30		I _F = 5.0A, T _J = 175°C, V _{GE} = 0V	
I _{GES}	Gate-to-Emitter Leakage Current	—	—	±100	nA	V _{GE} = ±20V, V _{CE} = 0V	

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

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig.	
Q _g	Total Gate Charge (turn-on)	—	29	44	nC	I _C = 8.0A	23	
Q _{ge}	Gate-to-Emitter Charge (turn-on)	—	3.7	5.6		V _{CC} = 400V	CT1	
Q _{gc}	Gate-to-Collector Charge (turn-on)	—	14	21		V _{GE} = 15V		
E _{on}	Turn-On Switching Loss	—	160	268	μJ	I _C = 8.0A, V _{CC} = 400V	CT4	
E _{off}	Turn-Off Switching Loss	—	160	268		V _{GE} = 15V, R _G = 50Ω, L = 1.1mH		
E _{tot}	Total Switching Loss	—	320	433		T _J = 25°C ②		
t _{d(on)}	Turn-On delay time	—	23	27	ns	I _C = 8.0A, V _{CC} = 400V	CT4	
t _r	Rise time	—	22	26		V _{GE} = 15V, R _G = 50Ω, L = 1.1mH		
t _{d(off)}	Turn-Off delay time	—	140	150		T _J = 25°C		
t _f	Fall time	—	32	42				
E _{on}	Turn-On Switching Loss	—	220	330		I _C = 8.0A, V _{CC} = 400V		CT4
E _{off}	Turn-Off Switching Loss	—	270	381		V _{GE} = 15V, R _G = 50Ω, L = 1.1mH		13,15
E _{tot}	Total Switching Loss	—	490	711	T _J = 150°C ②	WF1,WF2		
t _{d(on)}	Turn-On delay time	—	22	27	ns	I _C = 8.0A, V _{CC} = 400V	14,16	
t _r	Rise time	—	21	25		V _{GE} = 15V, R _G = 50Ω, L = 1.1mH	CT4	
t _{d(off)}	Turn-Off delay time	—	180	198		T _J = 150°C	WF1	
t _f	Fall time	—	40	56			WF2	
L _E	Internal Emitter Inductance	—	7.5	—		nH	Measured 5mm from package	
C _{ies}	Input Capacitance	—	440	660	pF	V _{GE} = 0V	22	
C _{oes}	Output Capacitance	—	38	57		V _{CC} = 30V		
C _{res}	Reverse Transfer Capacitance	—	16	24		f = 1.0MHz		
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T _J = 150°C, I _C = 54A, V _p = 600V V _{CC} =500V, V _{GE} = +15V to 0V, R _G = 50Ω	4 CT2	
SCSOA	Short Circuit Safe Operating Area	10	—	—	μs	T _J = 150°C, V _p = 600V, R _G = 100Ω V _{CC} =360V, V _{GE} = +15V to 0V	CT3 WF4	
I _{SC (Peak)}	Peak Short Circuit Collector Current	—	70	—	A		WF4	
E _{rec}	Reverse Recovery Energy of the Diode	—	100	133	μJ	T _J = 150°C	17,18,19	
t _{rr}	Diode Reverse Recovery Time	—	95	120	ns	V _{CC} = 400V, I _F = 8.0A, L = 1.07mH	20,21	
I _{rr}	Peak Reverse Recovery Current	—	13	17	A	V _{GE} = 15V, R _G = 50Ω	CT4,WF3	
Q _{rr}	Diode Reverse Recovery Charge	—	620	800	nC	di/dt = 500A/μS		

Note ① to ② are on page 12

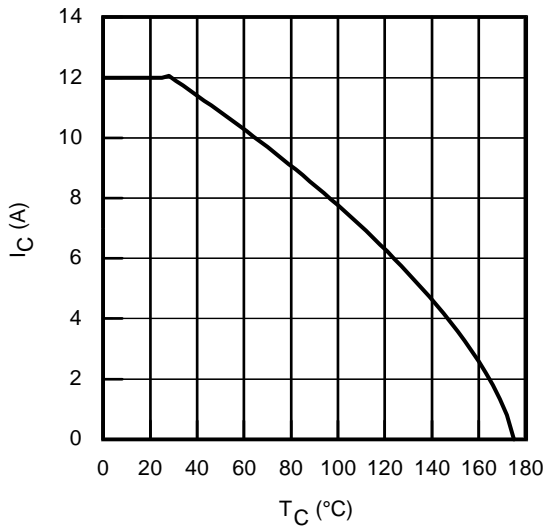


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

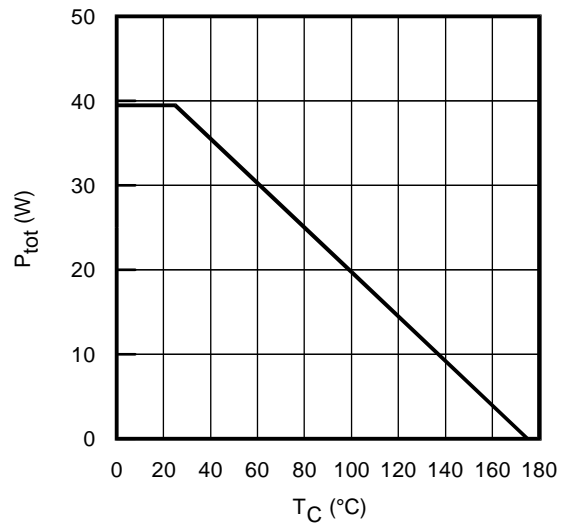


Fig. 2 - Power Dissipation vs. Case Temperature

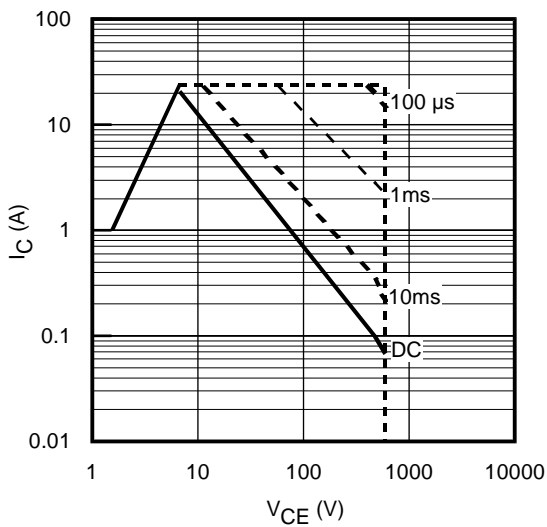


Fig. 3 - Forward SOA
 $T_C = 25^{\circ}C$; $T_J \leq 150^{\circ}C$

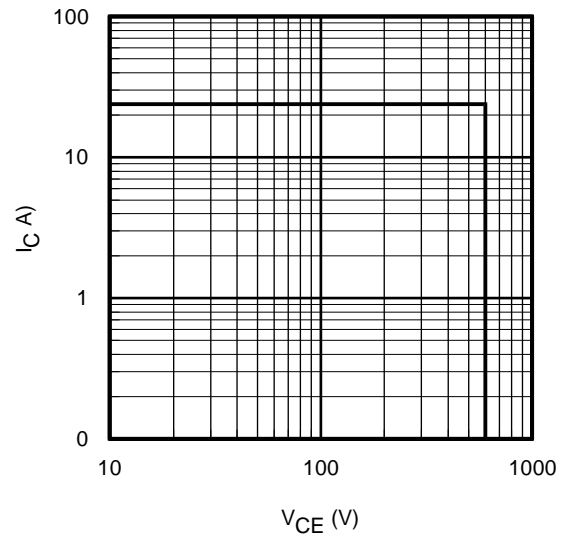


Fig. 4 - Reverse Bias SOA
 $T_J = 150^{\circ}C$; $V_{GE} = 15V$

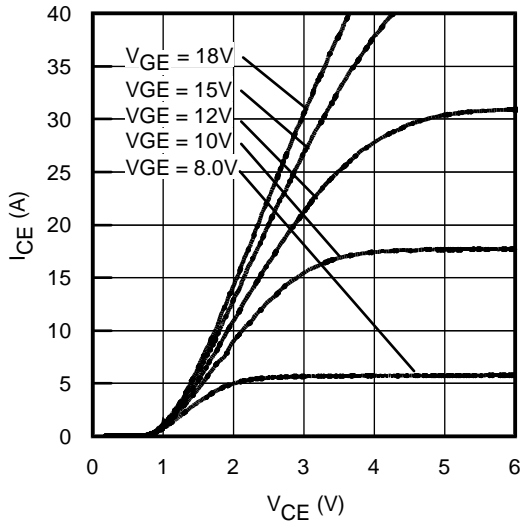


Fig. 5 - Typ. IGBT Output Characteristics
 $T_J = -40^\circ\text{C}$; $t_p = 80\mu\text{s}$

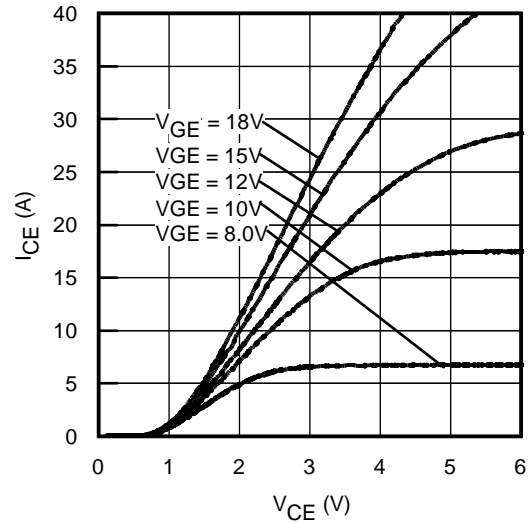


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 80\mu\text{s}$

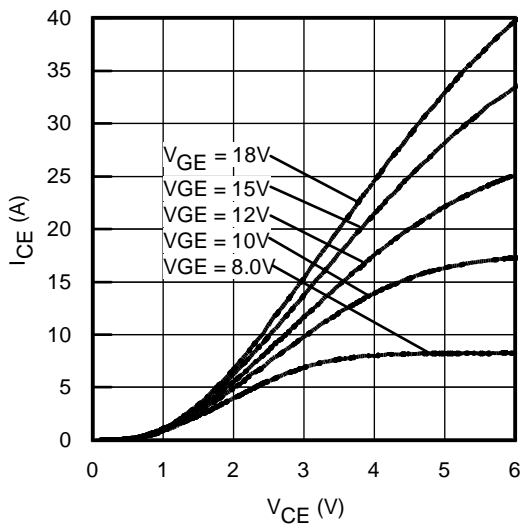


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 150^\circ\text{C}$; $t_p = 80\mu\text{s}$

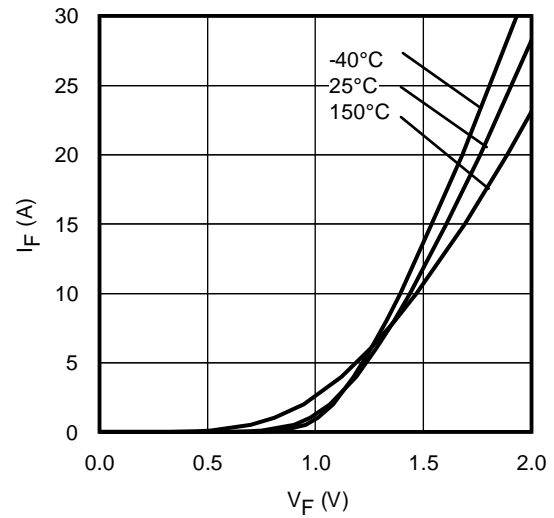


Fig. 8 - Typ. Diode Forward Characteristics
 $t_p = 80\mu\text{s}$

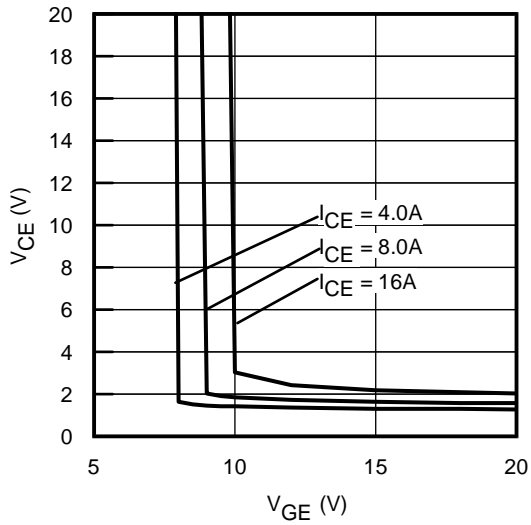


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

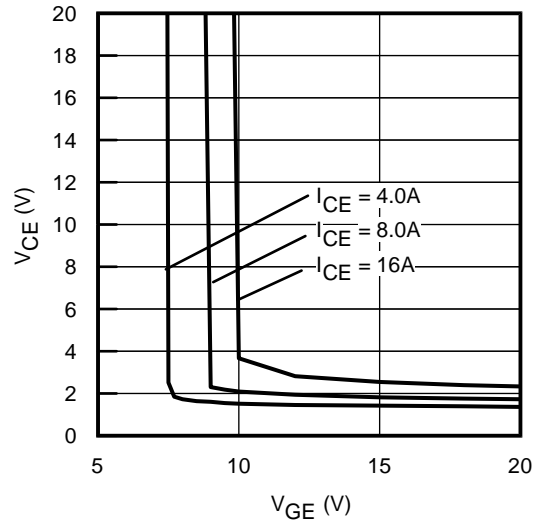


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

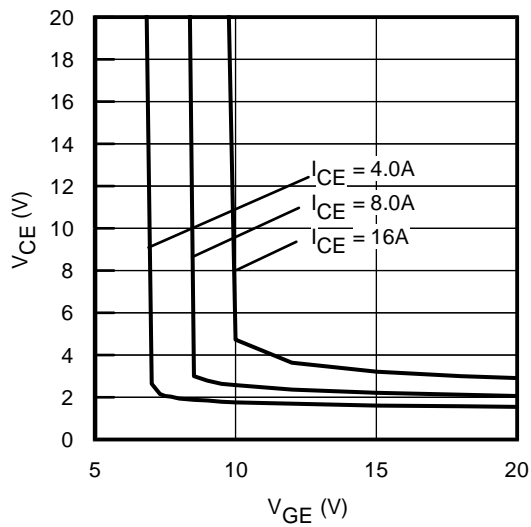


Fig. 11 - Typical V_{CE} vs. V_{GE}
 $T_J = 150^\circ\text{C}$

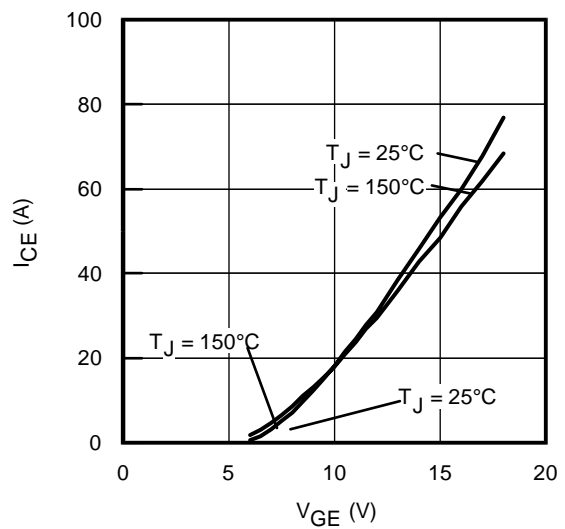


Fig. 12 - Typ. Transfer Characteristics
 $V_{CE} = 360\text{V}$; $t_p = 10\mu\text{s}$

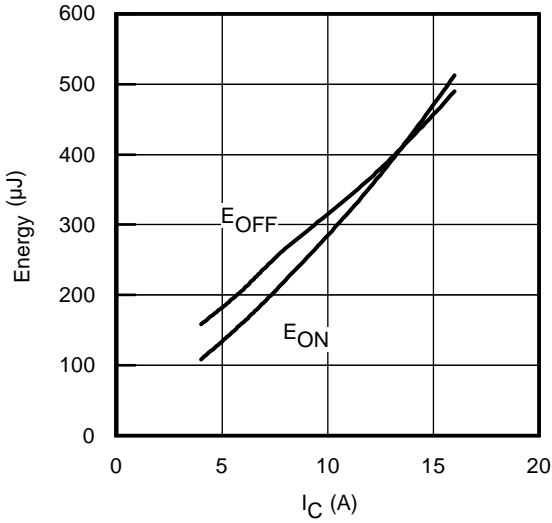


Fig. 13 - Typ. Energy Loss vs. I_C
 $T_J = 150^\circ\text{C}$; $L=1.1\text{mH}$; $V_{CE}= 400\text{V}$,
 $R_G= 50\Omega$; $V_{GE}= 15\text{V}$

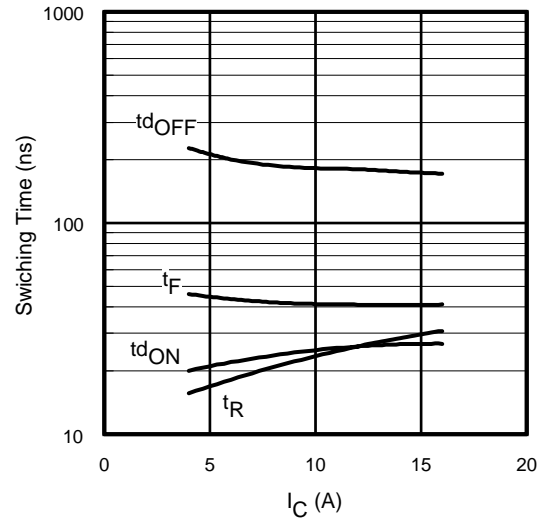


Fig. 14 - Typ. Switching Time vs. I_C
 $T_J = 150^\circ\text{C}$; $L=1.1\text{mH}$; $V_{CE}= 400\text{V}$
 $R_G= 50\Omega$; $V_{GE}= 15\text{V}$

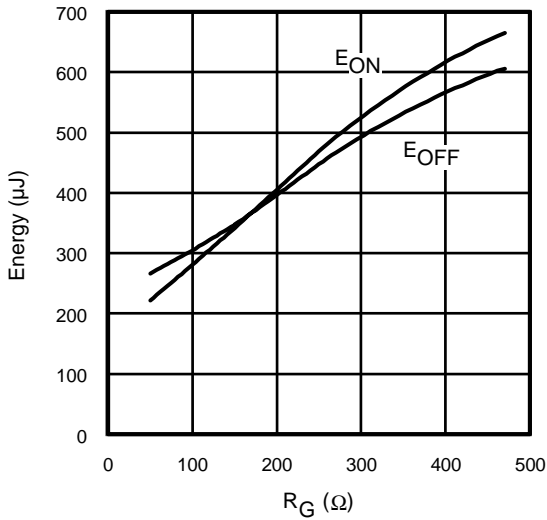


Fig. 15 - Typ. Energy Loss vs. R_G
 $T_J = 150^\circ\text{C}$; $L=1.1\text{mH}$; $V_{CE}= 400\text{V}$
 $I_{CE}= 8.0\text{A}$; $V_{GE}= 15\text{V}$

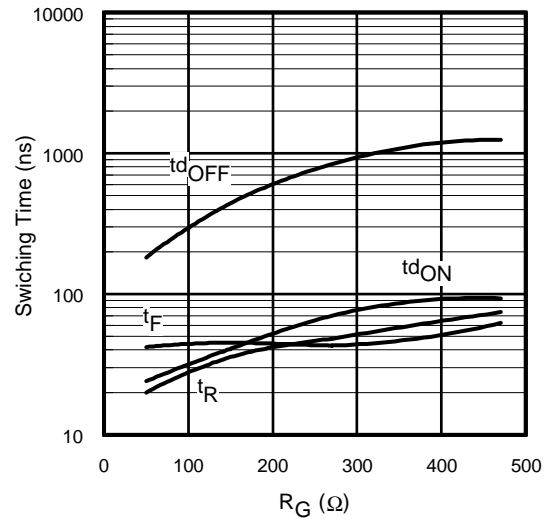


Fig. 16 - Typ. Switching Time vs. R_G
 $T_J = 150^\circ\text{C}$; $L=1.1\text{mH}$; $V_{CE}= 400\text{V}$
 $I_{CE}= 8.0\text{A}$; $V_{GE}= 15\text{V}$

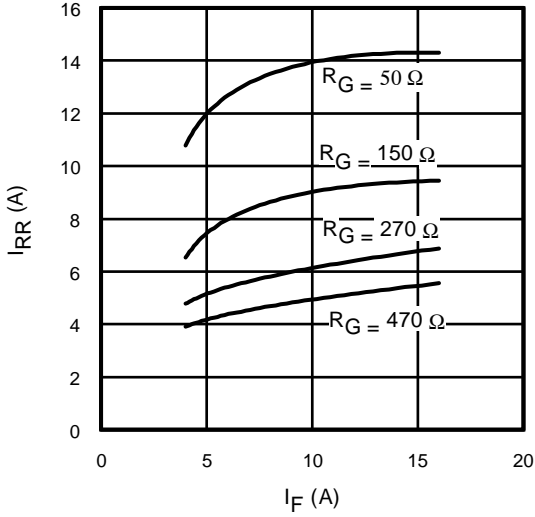


Fig. 17 - Typical Diode I_{RR} vs. I_F
 $T_J = 150^\circ\text{C}$

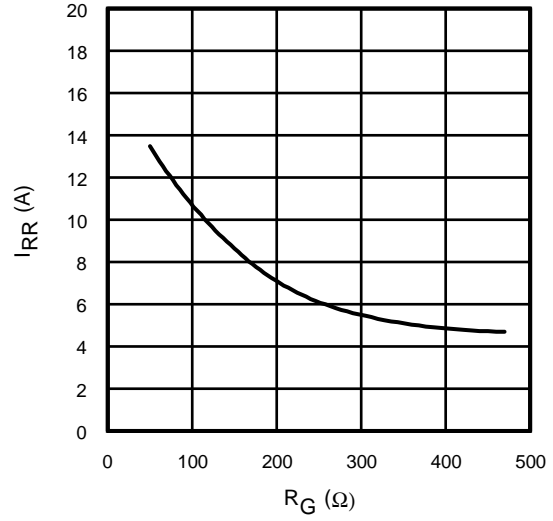


Fig. 18 - Typical Diode I_{RR} vs. R_G
 $T_J = 150^\circ\text{C}$; $I_F = 8.0\text{A}$

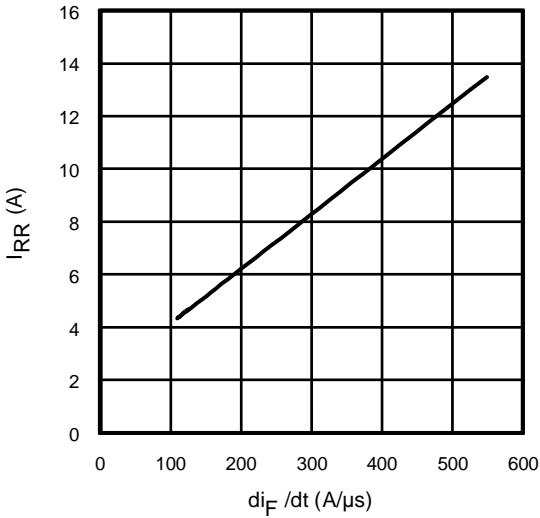


Fig. 19- Typical Diode I_{RR} vs. di_F/dt
 $V_{CC} = 400\text{V}$; $V_{GE} = 15\text{V}$;
 $I_F = 8.0\text{A}$; $T_J = 150^\circ\text{C}$

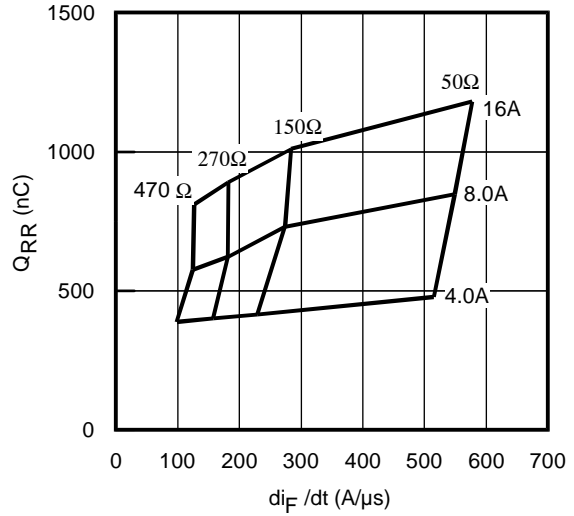


Fig. 20 - Typical Diode Q_{RR}
 $V_{CC} = 400\text{V}$; $V_{GE} = 15\text{V}$; $T_J = 150^\circ\text{C}$

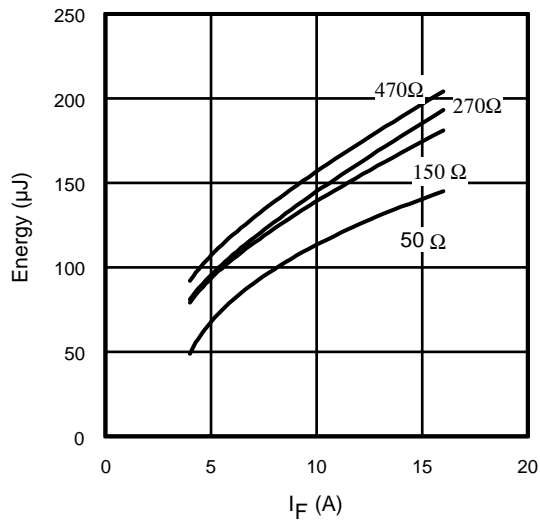


Fig. 21 - Typical Diode E_{RR} vs. I_F
 $T_J = 150^\circ\text{C}$

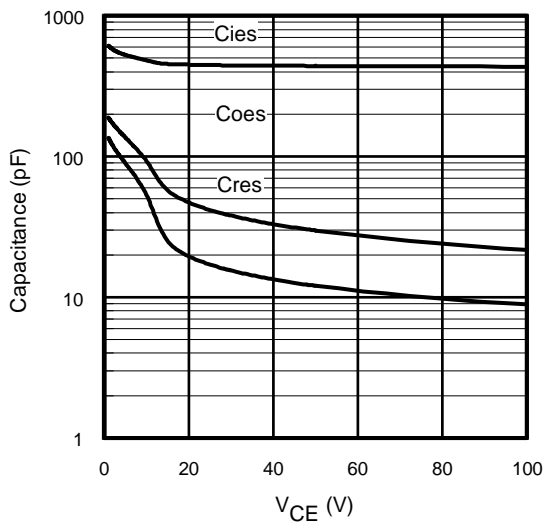


Fig. 22- Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0\text{V}$; $f = 1\text{MHz}$

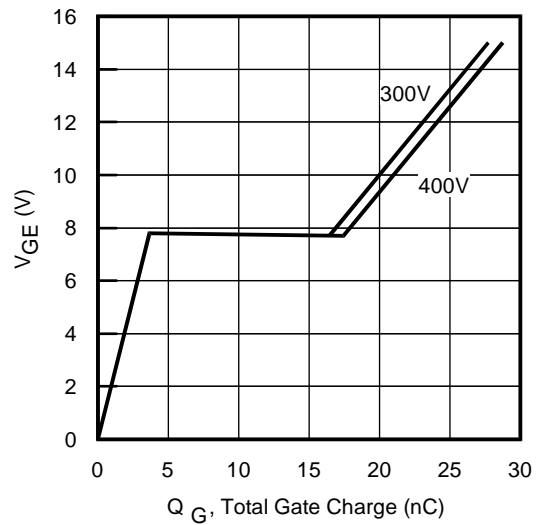


Fig. 23 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 8.0\text{A}$; $L = 600\mu\text{H}$

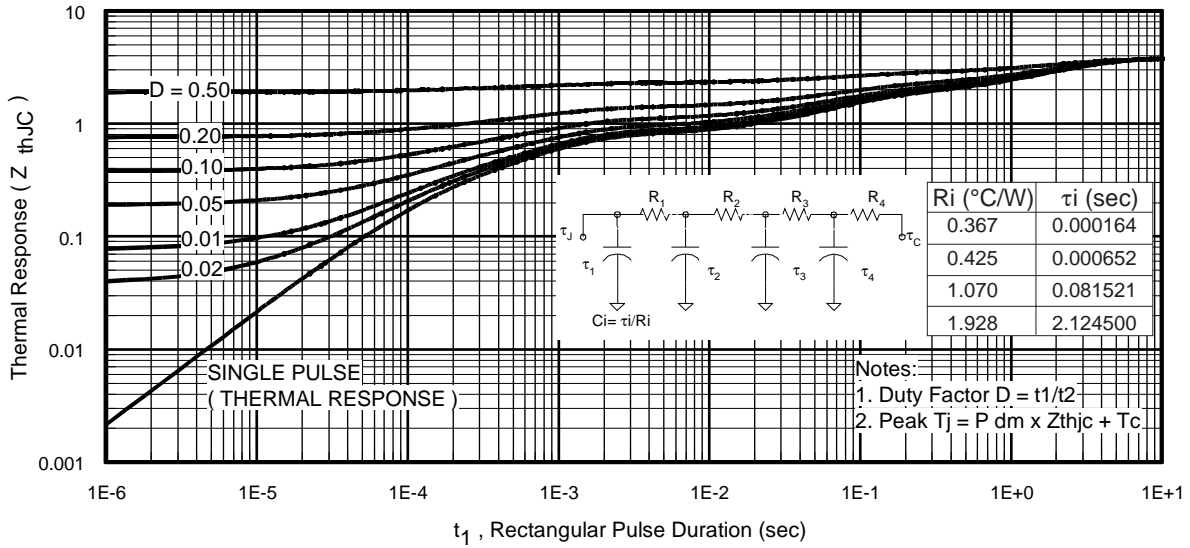


Fig 24. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

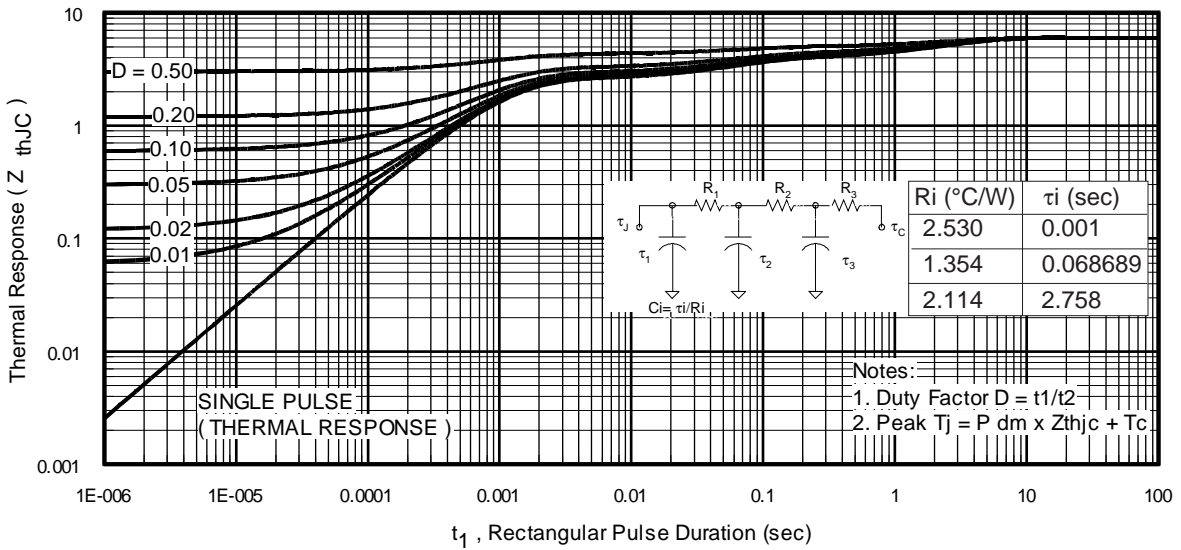


Fig 25. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

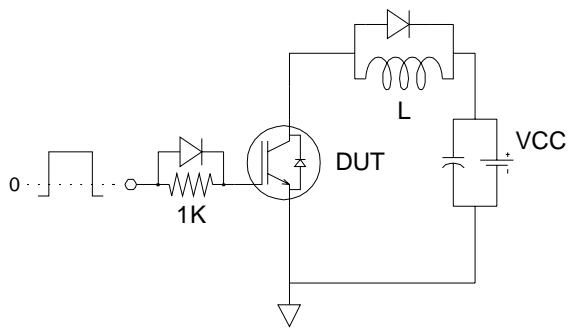


Fig.C.T.1 - Gate Charge Circuit (turn-off)

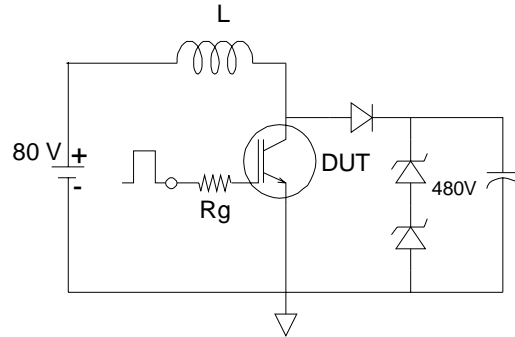


Fig.C.T.2 - RBSOA Circuit

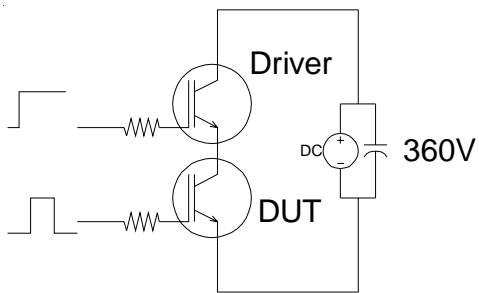


Fig.C.T.3 - S.C.SOA Circuit

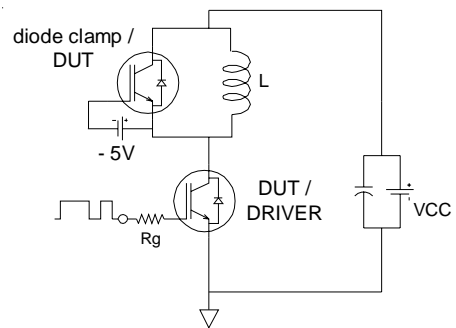


Fig.C.T.4 - Switching Loss Circuit

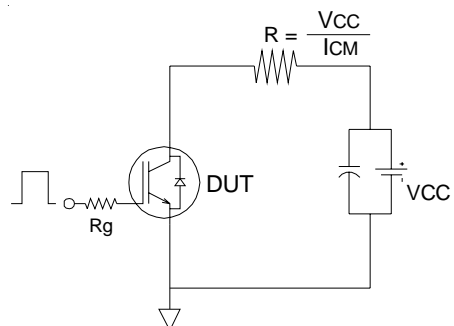


Fig.C.T.5 - Resistive Load Circuit

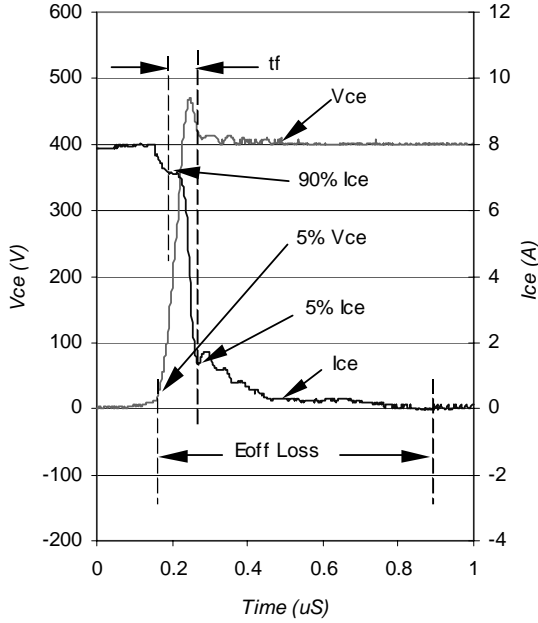


Fig. WF1- Typ. Turn-off Loss Waveform
 @ T_J = 150°C using Fig. CT.4

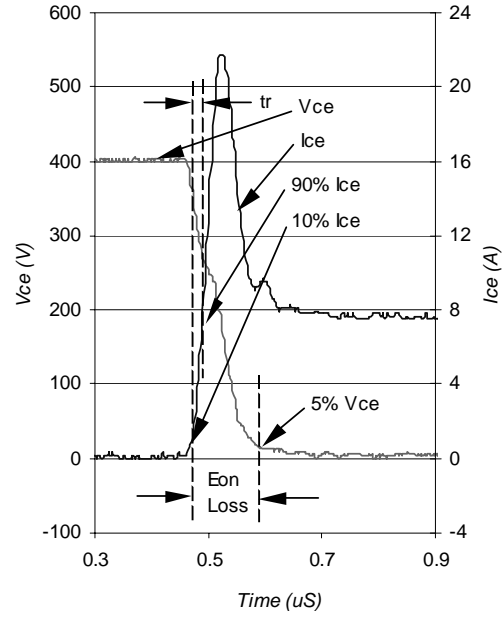


Fig. WF2- Typ. Turn-on Loss Waveform
 @ T_J = 150°C using Fig. CT.4

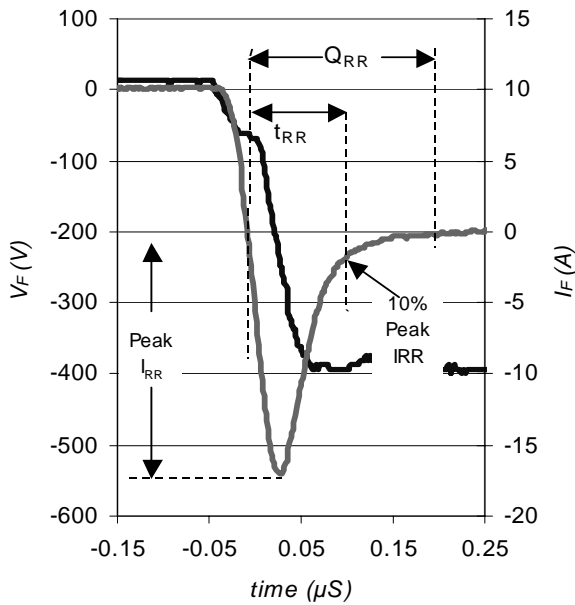


Fig. WF3- Typ. Diode Recovery Waveform
 @ T_J = 150°C using Fig. CT.4

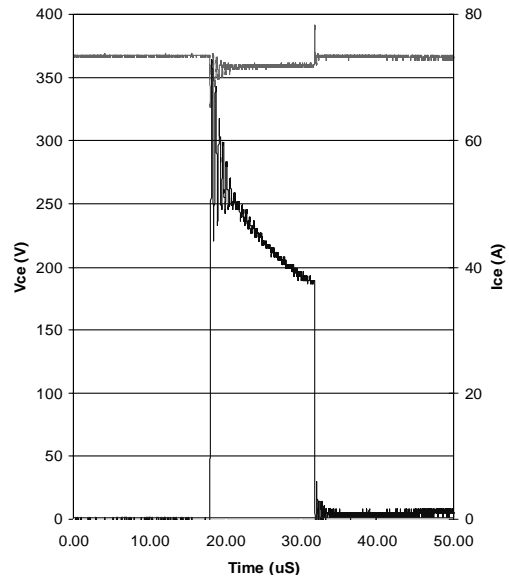
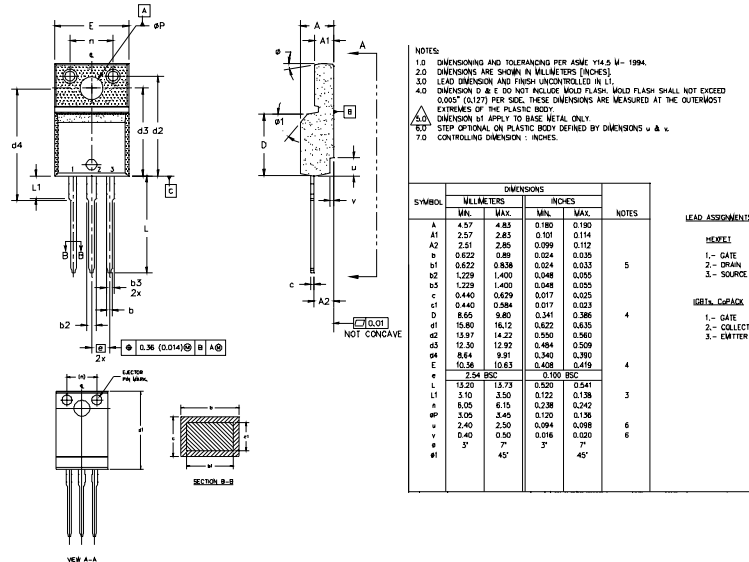


Fig. WF4- Typ. S.C Waveform
 @ T_C = 150°C using Fig. CT.3

IRGIB7B60KD

TO-220 Full-Pak Package Outline

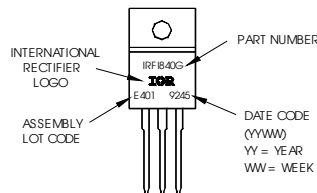
Dimensions are shown in millimeters (inches)



TO-220 Full-Pak Part Marking Information

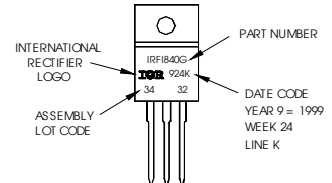
Notes: This part marking information applies to all devices produced before 02/26/2001 and currently for parts manufactured in GB.

EXAMPLE: THIS IS AN IRFB40G WITH ASSEMBLY LOT CODE E401



Notes: This part marking information applies to devices produced after 02/26/2001 in location other than GB.

EXAMPLE: THIS IS AN IRFB40G WITH ASSEMBLY LOT CODE 3432 ASSEMBLED ON WW 24 1999 IN THE ASSEMBLY LINE "K"



Notes:

- ① $V_{CC} = 80\% (V_{CES})$, $V_{GE} = 15V$, $L = 100\mu H$, $R_G = 50\Omega$.
- ② Energy losses include "tail" and diode reverse recovery.

TO-220AB FullPak 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.



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