

International
IR Rectifier

IRGIB7B60KDPbF

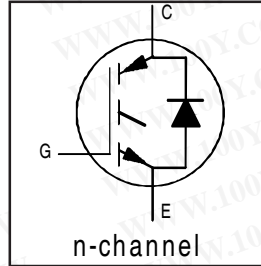
INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

Features

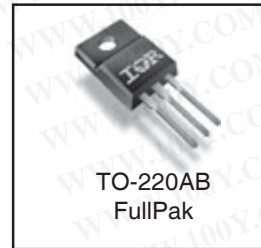
- Low VCE (on) Non Punch Through IGBT Technology.
- 10µs Short Circuit Capability.
- Square RBSOA.
- Positive VCE (on) Temperature Coefficient.
- Maximum Junction Temperature rated at 175°C.
- Lead-Free

Benefits

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



$V_{CES} = 600V$
 $I_C = 8.0A, T_C = 100^\circ C$
 $t_{sc} > 10\mu s, T_J = 150^\circ C$
 $V_{CE(on)} \text{ typ.} = 1.8V$



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

IRGIB7B60KDPbF

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Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig.
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	—	—	V	$V_{GE} = 0V, I_C = 500\mu A$	
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.57	—	$V/^\circ\text{C}$	$V_{GE} = 0V, I_C = 1mA (25^\circ\text{C}-150^\circ\text{C})$	
$V_{CE(on)}$	Collector-to-Emitter Voltage	—	1.8	2.2	V	$I_C = 8.0A, V_{GE} = 15V, T_J = 25^\circ\text{C}$	5,6,7
		—	2.2	2.5		$I_C = 8.0A, V_{GE} = 15V, T_J = 150^\circ\text{C}$	9,10,11
		—	2.3	2.5		$I_C = 8.0A, V_{GE} = 15V, T_J = 175^\circ\text{C}$	
$V_{GE(th)}$	Gate Threshold Voltage	3.5	4.5	5.5	V	$V_{CE} = V_{GE}, I_C = 250\mu A$	9,10,11
$\Delta V_{GE(th)}/\Delta T_J$	Threshold Voltage temp. coefficient	—	-9.5	—	$mV/^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 1mA (25^\circ\text{C}-150^\circ\text{C})$	12
g_{fe}	Forward Transconductance	—	3.7	—	S	$V_{CE} = 50V, I_C = 8.0A, PW = 80\mu s$	
I_{CES}	Zero Gate Voltage Collector Current	—	1.0	150	μA	$V_{GE} = 0V, V_{CE} = 600V$	
		—	200	500		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$	
		—	720	1100		$V_{GE} = 0V, V_{CE} = 600V, T_J = 175^\circ\text{C}$	
V_{FM}	Diode Forward Voltage Drop	—	1.25	1.45	V	$I_F = 5.0A, V_{GE} = 0V$	8
		—	1.20	1.40		$I_F = 5.0A, T_J = 150^\circ\text{C}, V_{GE} = 0V$	
		—	1.20	1.30		$I_F = 5.0A, T_J = 175^\circ\text{C}, V_{GE} = 0V$	
I_{GES}	Gate-to-Emitter Leakage Current	—	—	± 100	nA	$V_{GE} = \pm 20V, V_{CE} = 0V$	

Switching Characteristics @ $T_J = 25^\circ\text{C}$ (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		$V_{GE} = 15V, R_G = 50\Omega, L = 1.1mH$	
E_{tot}	Total Switching Loss	—	320	433		$T_J = 25^\circ\text{C} \text{ @}$	
$t_{d(on)}$	Turn-On delay time	—	23	27	ns	$I_C = 8.0A, V_{CC} = 400V$	CT4
t_r	Rise time	—	22	26		$V_{GE} = 15V, R_G = 50\Omega, L = 1.1mH$	
$t_{d(off)}$	Turn-Off delay time	—	140	150		$T_J = 25^\circ\text{C}$	
t_f	Fall time	—	32	42			
E_{on}	Turn-On Switching Loss	—	220	330		$I_C = 8.0A, V_{CC} = 400V$	
E_{off}	Turn-Off Switching Loss	—	270	381	μJ	$V_{GE} = 15V, R_G = 50\Omega, L = 1.1mH$	13,15
E_{tot}	Total Switching Loss	—	490	711		$T_J = 150^\circ\text{C} \text{ @}$	WF1,WF2
$t_{d(on)}$	Turn-On delay time	—	22	27		$I_C = 8.0A, V_{CC} = 400V$	14,16
t_r	Rise time	—	21	25	ns	$V_{GE} = 15V, R_G = 50\Omega, L = 1.1mH$	CT4
$t_{d(off)}$	Turn-Off delay time	—	180	198		$T_J = 150^\circ\text{C}$	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				$T_J = 150^\circ\text{C}, I_C = 54A, V_p = 600V$ $V_{CC}=500V, V_{GE} = +15V \text{ to } 0V, R_G = 50\Omega$	4 CT2
SCSOA	Short Circuit Safe Operating Area	10	—	—	μs	$T_J = 150^\circ\text{C}, V_p = 600V, R_G = 100\Omega$ $V_{CC}=360V, V_{GE} = +15V \text{ to } 0V$	CT3 WF4
$I_{SC}(\text{Peak})$	Peak Short Circuit Collector Current	—	70	—	A		WF4
E_{rec}	Reverse Recovery Energy of the Diode	—	100	133	μJ	$T_J = 150^\circ\text{C}$	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	$V_{GE} = 15V, R_G = 50\Omega$	CT4,WF3
Q_{rr}	Diode Reverse Recovery Charge	—	620	800	nC	$di/dt = 500A/\mu S$	

Note ① to ② are on page 12

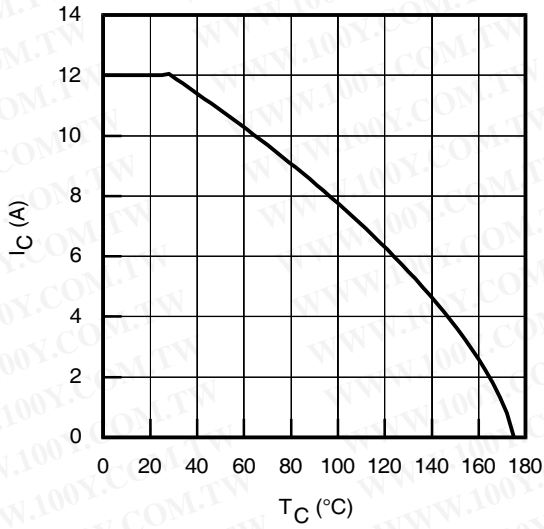


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

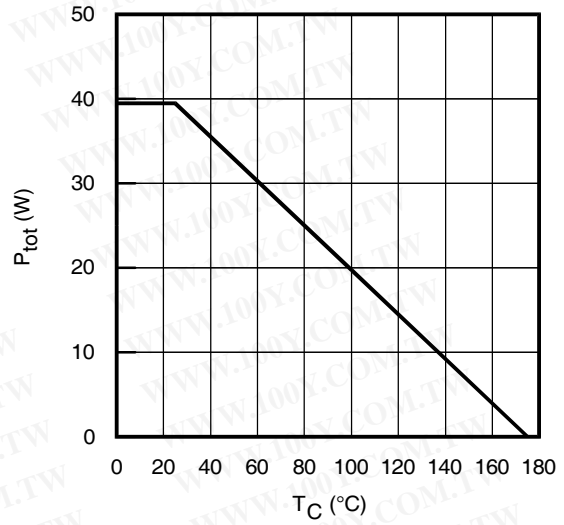


Fig. 2 - Power Dissipation vs. Case Temperature

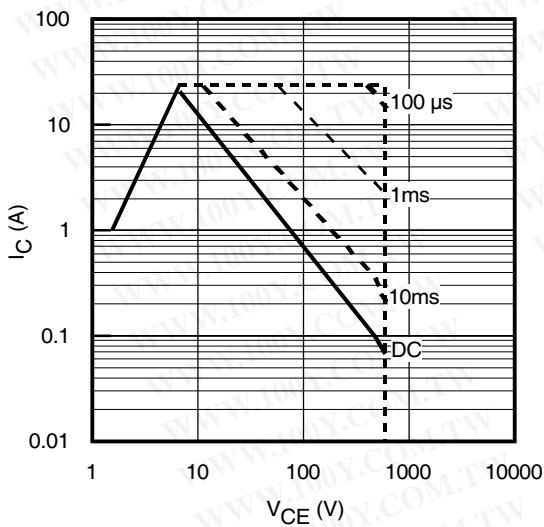


Fig. 3 - Forward SOA
 $T_C = 25^{\circ}C$; $T_J \leq 150^{\circ}C$

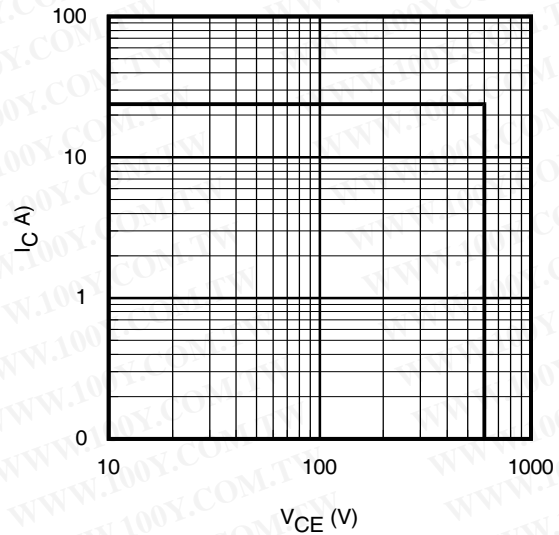


Fig. 4 - Reverse Bias SOA
 $T_J = 150^{\circ}C$; $V_{GE} = 15V$

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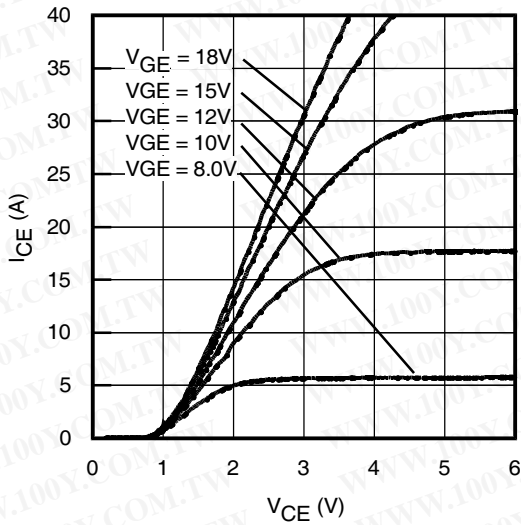


Fig. 5 - Typ. IGBT Output Characteristics
 $T_J = -40^\circ\text{C}$; $t_p = 80\mu\text{s}$

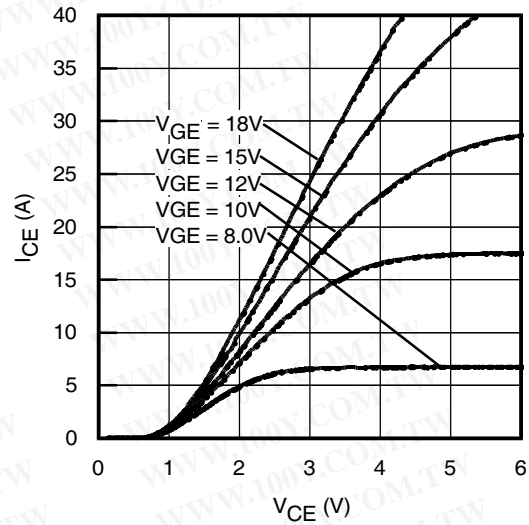


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 80\mu\text{s}$

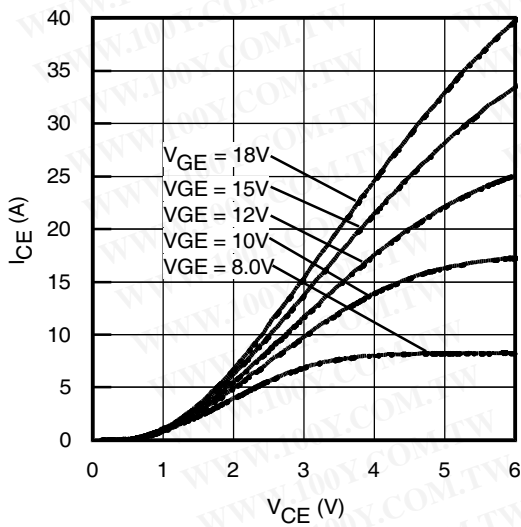


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 150^\circ\text{C}$; $t_p = 80\mu\text{s}$

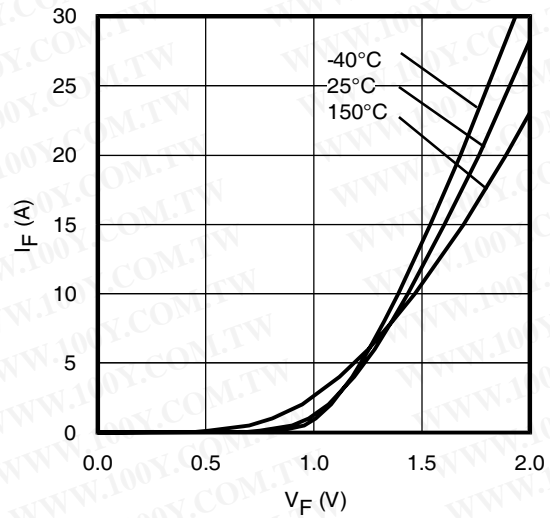


Fig. 8 - Typ. Diode Forward Characteristics
 $t_p = 80\mu\text{s}$

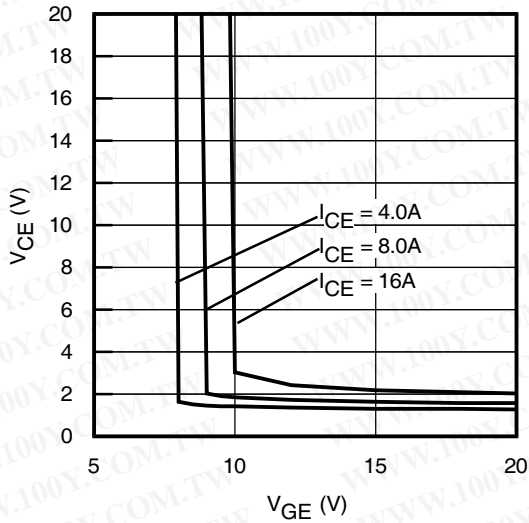


Fig. 9 - Typical V_{CE} vs. V_{GE}
 T_J = -40°C

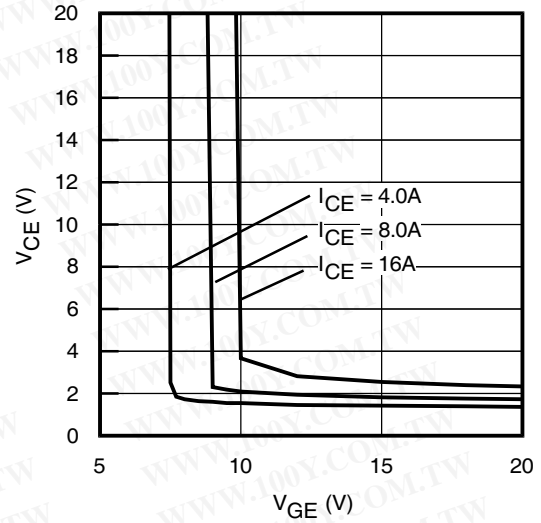


Fig. 10 - Typical V_{CE} vs. V_{GE}
 T_J = 25°C

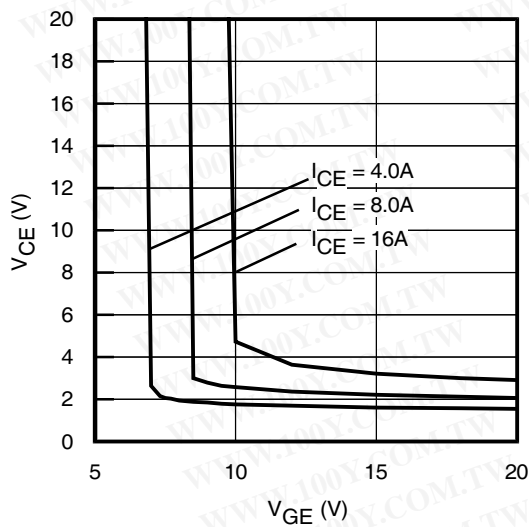


Fig. 11 - Typical V_{CE} vs. V_{GE}
 T_J = 150°C

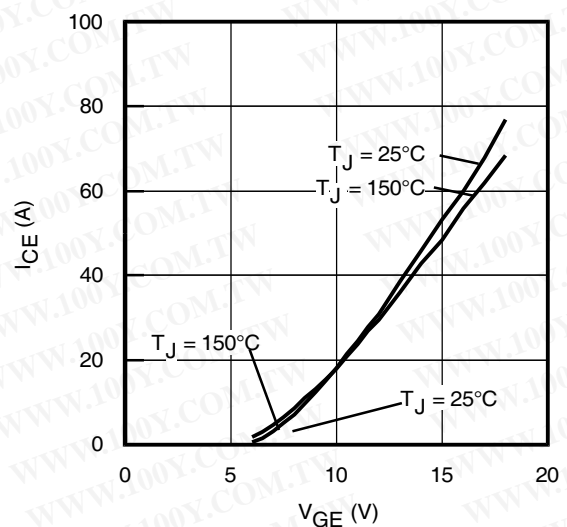


Fig. 12 - Typ. Transfer Characteristics
 V_{CE} = 360V; t_p = 10μs

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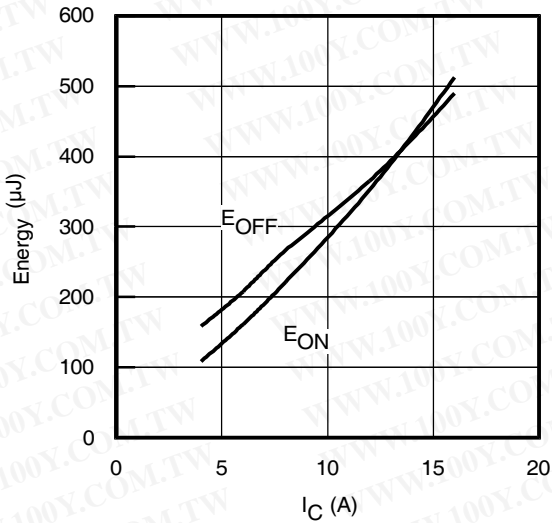


Fig. 13 - Typ. Energy Loss vs. I_C
 $T_J = 150^\circ\text{C}$; $L=1.1\text{mH}$; $V_{CE}= 400\text{V}$,
 $R_G= 50\Omega$; $V_{GE}= 15\text{V}$

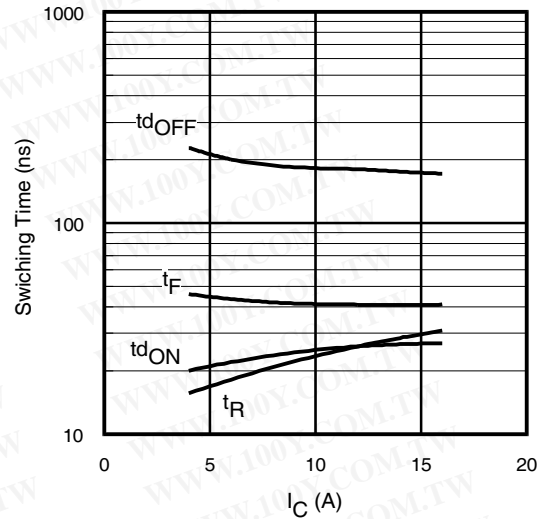


Fig. 14 - Typ. Switching Time vs. I_C
 $T_J = 150^\circ\text{C}$; $L=1.1\text{mH}$; $V_{CE}= 400\text{V}$
 $R_G= 50\Omega$; $V_{GE}= 15\text{V}$

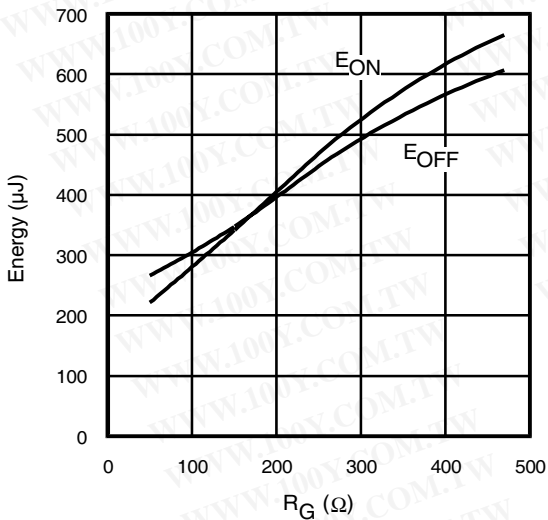


Fig. 15 - Typ. Energy Loss vs. R_G
 $T_J = 150^\circ\text{C}$; $L=1.1\text{mH}$; $V_{CE}= 400\text{V}$
 $I_{CE}= 8.0\text{A}$; $V_{GE}= 15\text{V}$

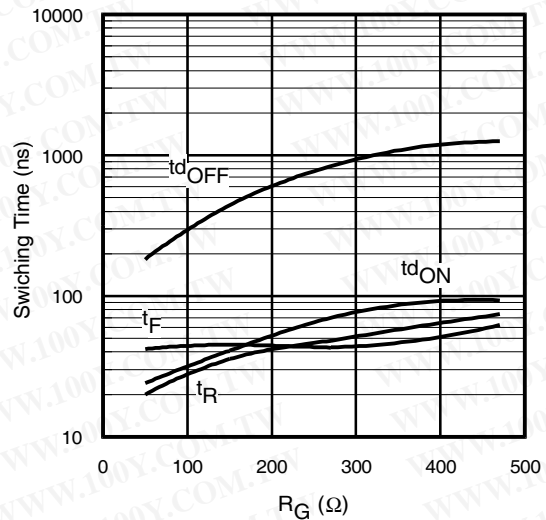


Fig. 16 - Typ. Switching Time vs. R_G
 $T_J = 150^\circ\text{C}$; $L=1.1\text{mH}$; $V_{CE}= 400\text{V}$
 $I_{CE}= 8.0\text{A}$; $V_{GE}= 15\text{V}$

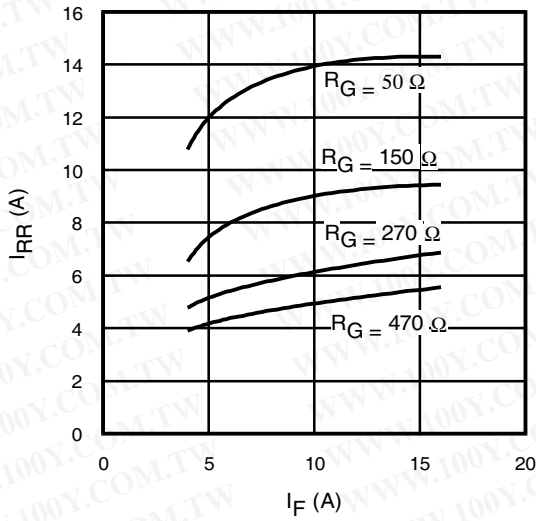


Fig. 17 - Typical Diode I_{RR} vs. I_F
 $T_J = 150^\circ\text{C}$

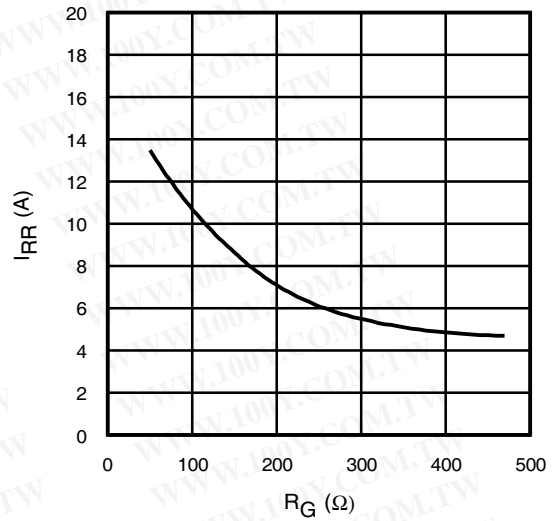


Fig. 18 - Typical Diode I_{RR} vs. R_G
 $T_J = 150^\circ\text{C}$; $I_F = 8.0\text{A}$

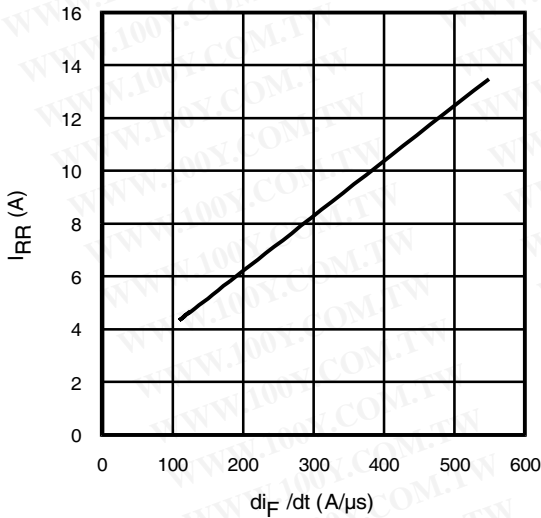


Fig. 19- Typical Diode I_{RR} vs. di_F/dt
 $V_{CC} = 400\text{V}$; $V_{GE} = 15\text{V}$;
 $I_F = 8.0\text{A}$; $T_J = 150^\circ\text{C}$

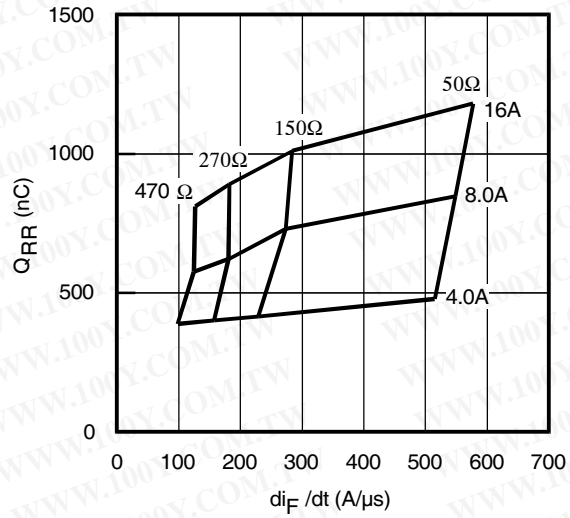


Fig. 20 - Typical Diode Q_{RR}
 $V_{CC} = 400\text{V}$; $V_{GE} = 15\text{V}$; $T_J = 150^\circ\text{C}$

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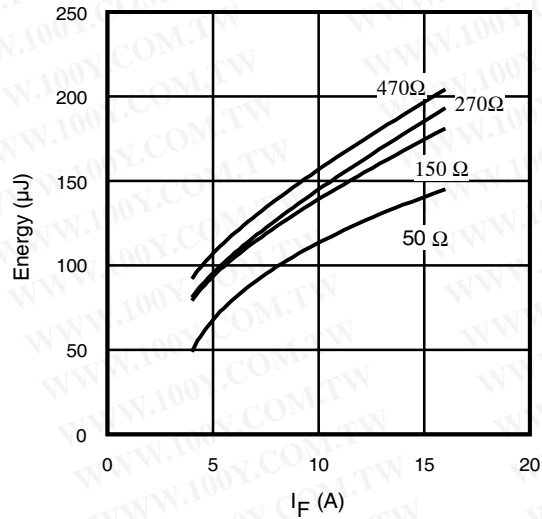


Fig. 21 - Typical Diode E_{RR} vs. I_F
 $T_J = 150^\circ\text{C}$

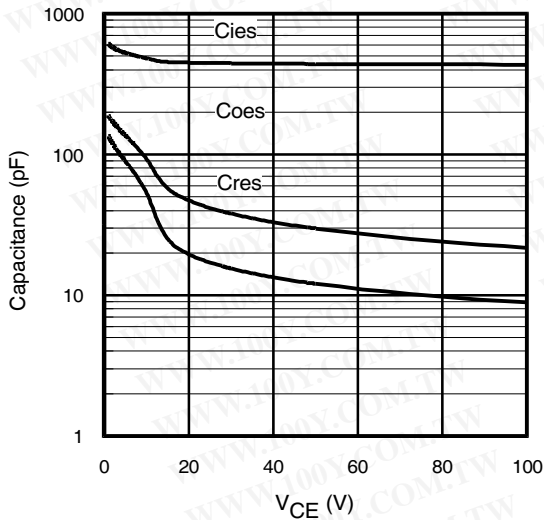


Fig. 22- Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0\text{V}$; $f = 1\text{MHz}$

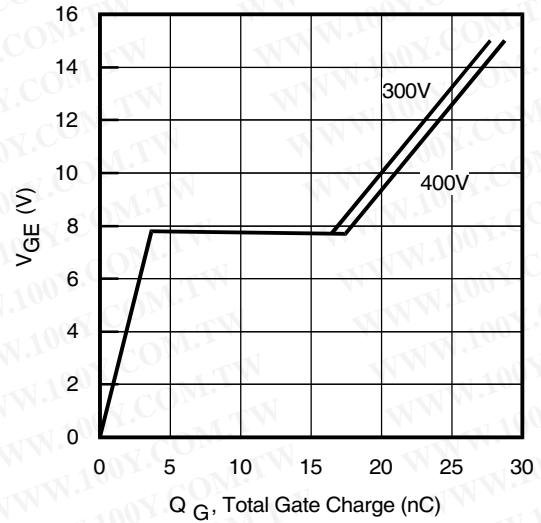


Fig. 23 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 8.0\text{A}$; $L = 600\mu\text{H}$

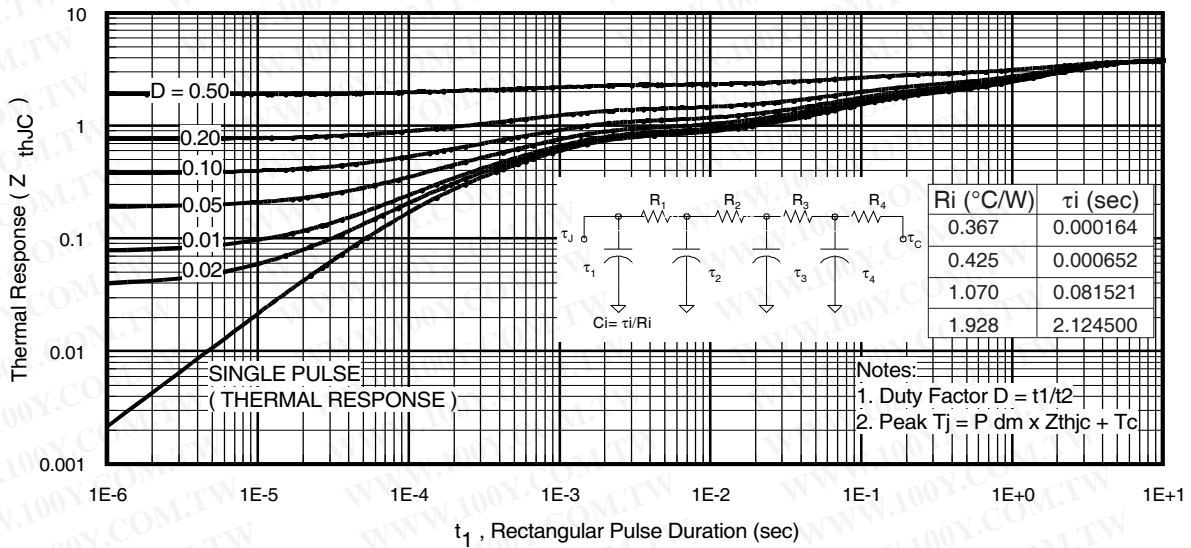


Fig 24. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

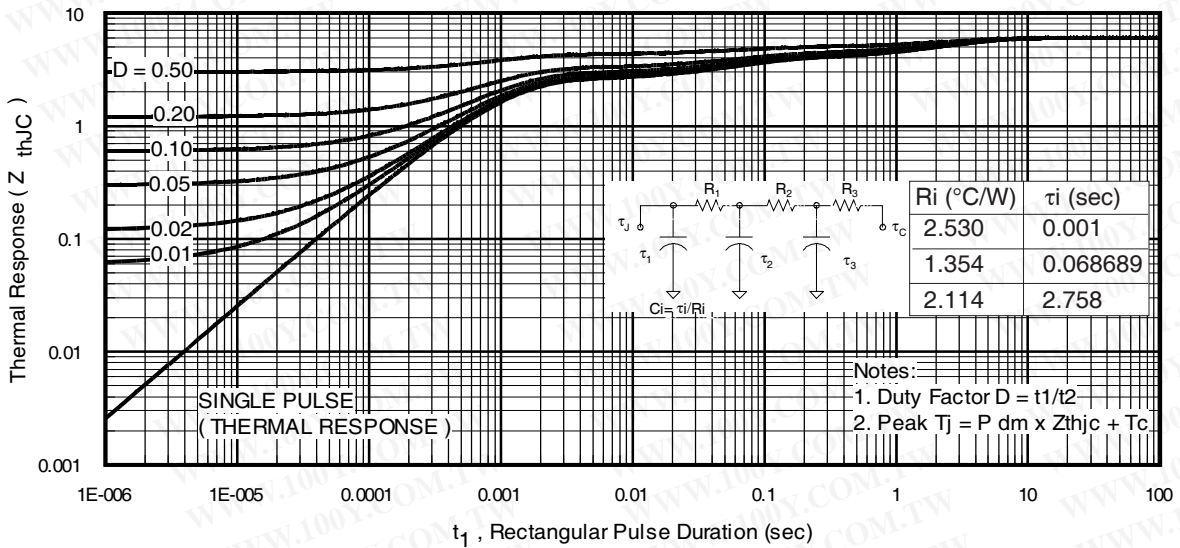


Fig 25. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

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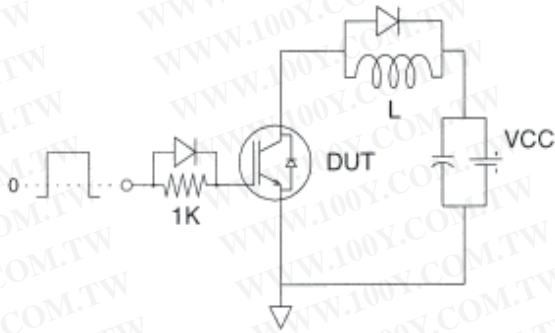


Fig.C.T.1 - Gate Charge Circuit (turn-off)

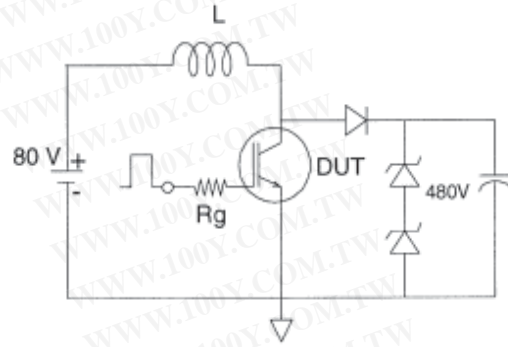


Fig.C.T.2 - RBSOA Circuit

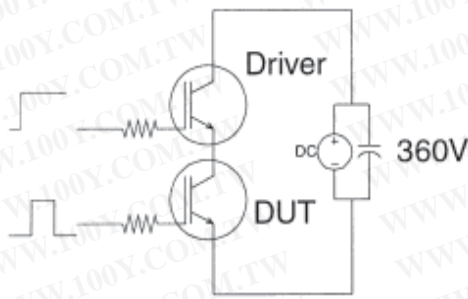


Fig.C.T.3 - S.C.SOA Circuit

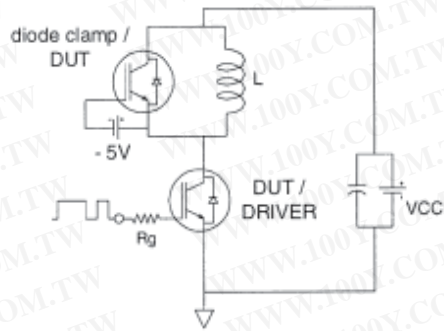


Fig.C.T.4 - Switching Loss Circuit

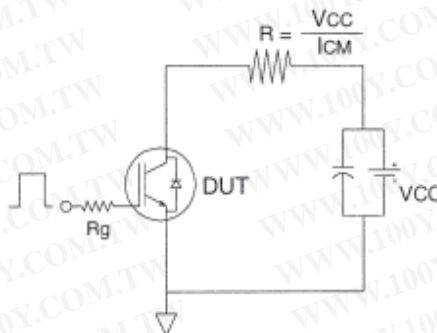


Fig.C.T.5 - Resistive Load Circuit

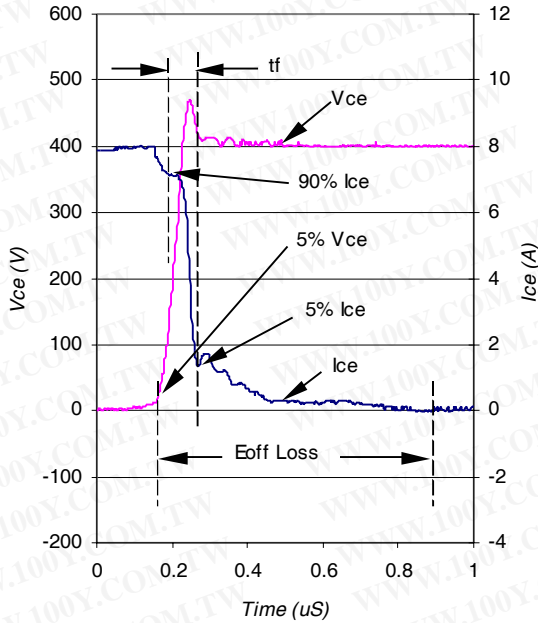


Fig. WF1- Typ. Turn-off Loss Waveform
@ T_J = 150°C using Fig. CT.4

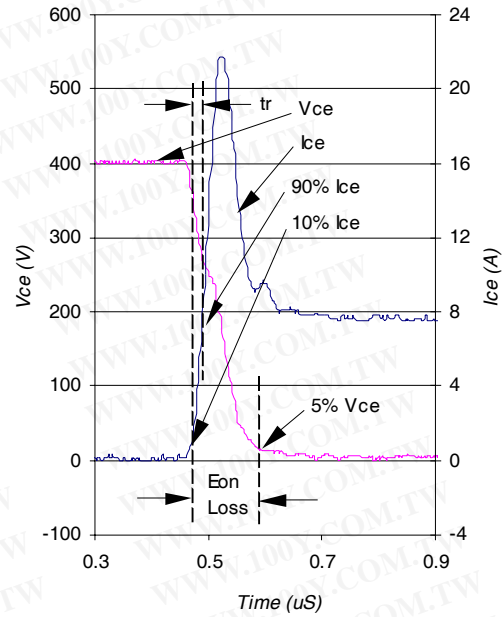


Fig. WF2- Typ. Turn-on Loss Waveform
@ T_J = 150°C using Fig. CT.4

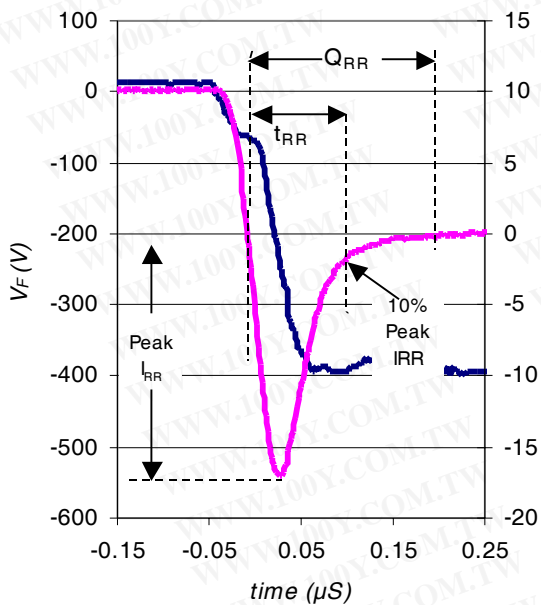


Fig. WF3- Typ. Diode Recovery Waveform
@ T_J = 150°C using Fig. CT.4

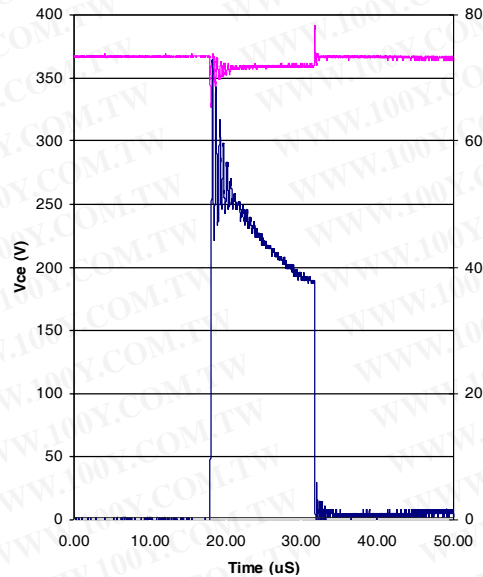


Fig. WF4- Typ. S.C. Waveform
@ T_C = 150°C using Fig. CT.3

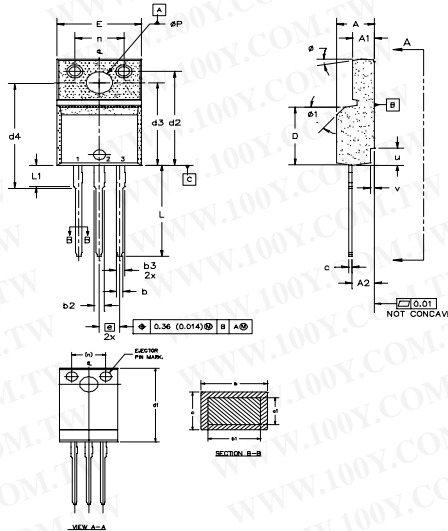
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TO-220 Full-Pak Package Outline

Dimensions are shown in millimeters (inches)

勝特力材料 886-3-5753170
 勝特力电子(上海) 86-21-34970699
 勝特力电子(深圳) 86-755-83298787
 Http://www.100y.com.tw

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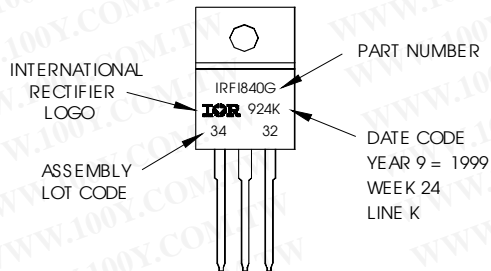
NOTES:
 1.0 DIMENSIONING AND TOLERANCING PER ASME Y14.5 M-1994.
 2.0 DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES)
 3.0 LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
 4.0 DIMENSION 9 & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
 DIMENSION #1 APPLY TO BASE METAL ONLY.
 #1 STEP OPTIONAL ON PLASTIC BODY DEFINED BY DIMENSIONS u & v.
 #1.0 CONTROLLING DIMENSION - INCHES.

SYMBOL	MILLIMETERS		INCHES		NOTES	LEAD ASSIGNMENTS
	MIN.	MAX.	MIN.	MAX.		
A	4.57	4.83	0.180	0.190		
A1	2.57	2.83	0.101	0.114		
A2	2.01	2.80	0.099	0.112		
b	0.622	0.80	0.024	0.033		
b1	0.822	0.838	0.024	0.033	5	1- GATE 2- DRAIN 3- SOURCE
b2	1.228	1.400	0.048	0.055		
b3	1.228	1.400	0.048	0.055		
v	0.440	0.626	0.017	0.025		
c1	0.440	0.584	0.017	0.023		
D	8.85	9.80	0.341	0.386	4	
d1	15.85	16.12	0.622	0.635		
d2	13.97	14.22	0.550	0.560		
d3	12.30	12.92	0.484	0.509		
d4	8.64	9.91	0.340	0.390		
E	10.36	10.63	0.408	0.419	4	
e	2.54 (0.100)		0.100 (0.039)			
L	13.20	13.73	0.520	0.541		
L1	3.10	3.50	0.122	0.138	3	
n	6.05	6.15	0.238	0.242		
#P	3.05	3.45	0.120	0.136		
u	2.40	2.90	0.094	0.099		
v	0.40	0.50	0.016	0.020		
#	7°	7°	7°	7°		
#1	3°	45°	3°	45°		

TO-220 Full-Pak Part Marking Information

EXAMPLE: THIS IS AN IRF1840G
 WITH ASSEMBLY
 LOT CODE 3432
 ASSEMBLED ON WW 24 1999
 IN THE ASSEMBLY LINE "K"

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



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.

International
IR Rectifier

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