

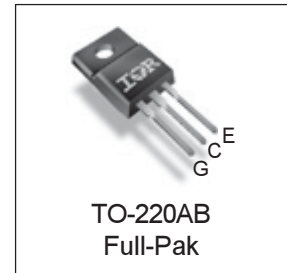
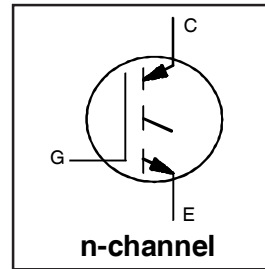
**PDP TRENCH IGBT**

**IRG6I320UPbF**

**Features**

- Advanced Trench IGBT Technology
- Optimized for Sustain and Energy Recovery circuits in PDP applications
- Low  $V_{CE(on)}$  and Energy per Pulse ( $E_{PULSE}^{TM}$ ) for improved panel efficiency
- High repetitive peak current capability
- Lead Free package

Key Parameters		
$V_{CE\ min}$	330	V
$V_{CE(on)}\ typ.\ @\ I_C = 24A$	1.45	V
$I_{RP}\ max\ @\ T_C = 25^\circ C$	160	A
$T_J\ max$	150	$^\circ C$



G	C	E
Gate	Collector	Emitter

**Description**

This IGBT is specifically designed for applications in Plasma Display Panels. This device utilizes advanced trench IGBT technology to achieve low  $V_{CE(on)}$  and low  $E_{PULSE}^{TM}$  rating per silicon area which improve panel efficiency. Additional features are  $150^\circ C$  operating junction temperature and high repetitive peak current capability. These features combine to make this IGBT a highly efficient, robust and reliable device for PDP applications.

**Absolute Maximum Ratings**

	Parameter	Max.	Units
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 30$	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current, $V_{GE} @ 15V$	24	A
$I_C @ T_C = 100^\circ C$	Continuous Collector, $V_{GE} @ 15V$	12	
$I_{RP} @ T_C = 25^\circ C$	Repetitive Peak Current ①	160	
$P_D @ T_C = 25^\circ C$	Power Dissipation	39	W
$P_D @ T_C = 100^\circ C$	Power Dissipation	16	
	Linear Derating Factor	0.31	$W/^\circ C$
$T_J$	Operating Junction and	-40 to + 150	$^\circ C$
$T_{STG}$	Storage Temperature Range		
	Soldering Temperature for 10 seconds		
	Mounting Torque, 6-32 or M3 Screw	10lb·in (1.1N·m)	N

**Thermal Resistance**

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ②	—	3.2	$^\circ C/W$

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{CES}$	Collector-to-Emitter Breakdown Voltage	330	—	—	V	$V_{GE} = 0V, I_{CE} = 500\mu A$
$V_{(BR)ECS}$	Emitter-to-Collector Breakdown Voltage <sup>③</sup>	30	—	—	V	$V_{GE} = 0V, I_{CE} = 1 A$
$\Delta V_{CES}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.30	—	V/ $^\circ\text{C}$	Reference to $25^\circ\text{C}$ , $I_{CE} = 1\text{mA}$
$V_{CE(on)}$	Static Collector-to-Emitter Voltage	—	1.20	—	V	$V_{GE} = 15V, I_{CE} = 12A$ ③
		—	1.45	1.65		$V_{GE} = 15V, I_{CE} = 24A$ ③
		—	1.95	—		$V_{GE} = 15V, I_{CE} = 48A$ ③
		—	2.20	—		$V_{GE} = 15V, I_{CE} = 60A$ ③
		—	2.26	—		$V_{GE} = 15V, I_{CE} = 48A, T_J = 150^\circ\text{C}$ ③
$V_{GE(th)}$	Gate Threshold Voltage	2.6	—	5.0	V	$V_{CE} = V_{GE}, I_{CE} = 250\mu A$
$\Delta V_{GE(th)}/\Delta T_J$	Gate Threshold Voltage Coefficient	—	-10	—	mV/ $^\circ\text{C}$	
$I_{CES}$	Collector-to-Emitter Leakage Current	—	1.0	10	$\mu A$	$V_{CE} = 330V, V_{GE} = 0V$
		—	5.0	—		$V_{CE} = 330V, V_{GE} = 0V, T_J = 100^\circ\text{C}$
		—	20	100		$V_{CE} = 330V, V_{GE} = 0V, T_J = 125^\circ\text{C}$
		—	75	—		$V_{CE} = 330V, V_{GE} = 0V, T_J = 150^\circ\text{C}$
$I_{GES}$	Gate-to-Emitter Forward Leakage	—	—	100	nA	$V_{GE} = 30V$
	Gate-to-Emitter Reverse Leakage	—	—	-100	nA	$V_{GE} = -30V$
$g_{fe}$	Forward Transconductance	—	28	—	S	$V_{CE} = 25V, I_{CE} = 12A$
$Q_g$	Total Gate Charge	—	46	—	nC	$V_{CE} = 200V, I_C = 12A, V_{GE} = 15V$ ③
$Q_{gc}$	Gate-to-Collector Charge	—	7.7	—	nC	
$t_{d(on)}$	Turn-On delay time	—	24	—	ns	$I_C = 12A, V_{CC} = 196V$ $R_G = 10\Omega, L = 210\mu H, L_S = 150nH$ $T_J = 25^\circ\text{C}$
$t_r$	Rise time	—	20	—		
$t_{d(off)}$	Turn-Off delay time	—	89	—		
$t_f$	Fall time	—	70	—		
$t_{d(on)}$	Turn-On delay time	—	23	—	ns	$I_C = 12A, V_{CC} = 196V$ $R_G = 10\Omega, L = 200\mu H, L_S = 150nH$ $T_J = 150^\circ\text{C}$
$t_r$	Rise time	—	52	—		
$t_{d(off)}$	Turn-Off delay time	—	130	—		
$t_f$	Fall time	—	140	—		
$t_{st}$	Shoot Through Blocking Time	100	—	—	ns	$V_{CC} = 240V, V_{GE} = 15V, R_G = 5.1\Omega$
$E_{PULSE}$	Energy per Pulse	—	240	—	$\mu J$	$L = 220nH, C = 0.10\mu F, V_{GE} = 15V$ $V_{CC} = 240V, R_G = 5.1\Omega, T_J = 25^\circ\text{C}$
		—	280	—		$L = 220nH, C = 0.10\mu F, V_{GE} = 15V$ $V_{CC} = 240V, R_G = 5.1\Omega, T_J = 100^\circ\text{C}$
ESD	Human Body Model	Class 2 (Per JEDEC standard JESD22-A114)				
	Machine Model	Class B (Per EIA/JEDEC standard EIA/JESD22-A115)				
$C_{ies}$	Input Capacitance	—	1160	—	pF	$V_{GE} = 0V$
$C_{oes}$	Output Capacitance	—	61	—		$V_{CE} = 30V$
$C_{res}$	Reverse Transfer Capacitance	—	38	—		$f = 1.0\text{MHz}$ , See Fig.13
$L_C$	Internal Collector Inductance	—	4.5	—	nH	Between lead, 6mm (0.25in.)
$L_E$	Internal Emitter Inductance	—	7.5	—		from package and center of die contact

### Notes:

- ① Half sine wave with duty cycle  $\leq 0.05$ ,  $t_{on} = 2\mu\text{sec}$ .
- ②  $R_\theta$  is measured at  $T_J$  of approximately  $90^\circ\text{C}$ .
- ③ Pulse width  $\leq 400\mu\text{s}$ ; duty cycle  $\leq 2\%$ .

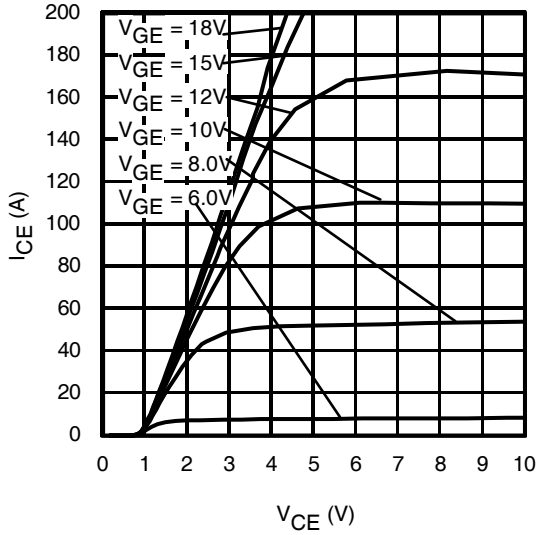


Fig 1. Typical Output Characteristics @ 25°C

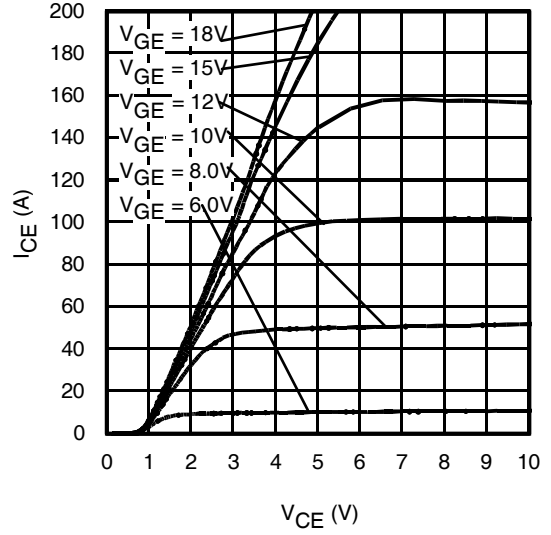


Fig 2. Typical Output Characteristics @ 75°C

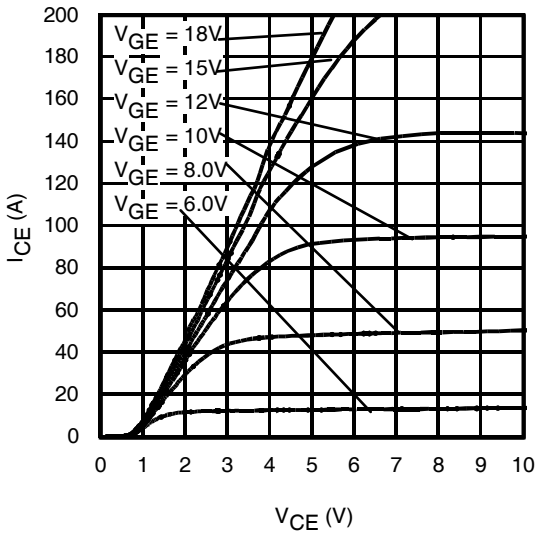


Fig 3. Typical Output Characteristics @ 125°C

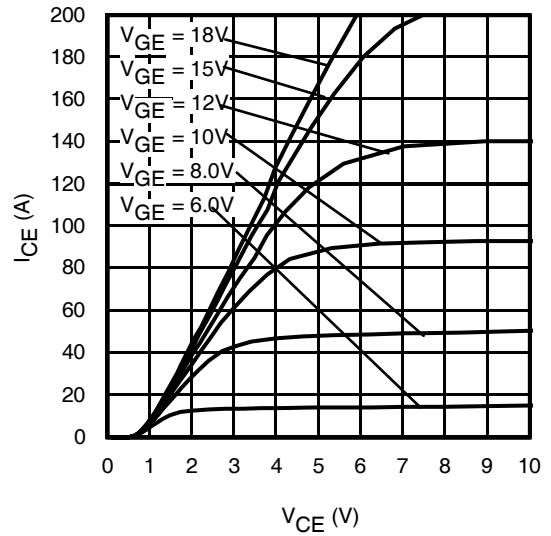


Fig 4. Typical Output Characteristics @ 150°C

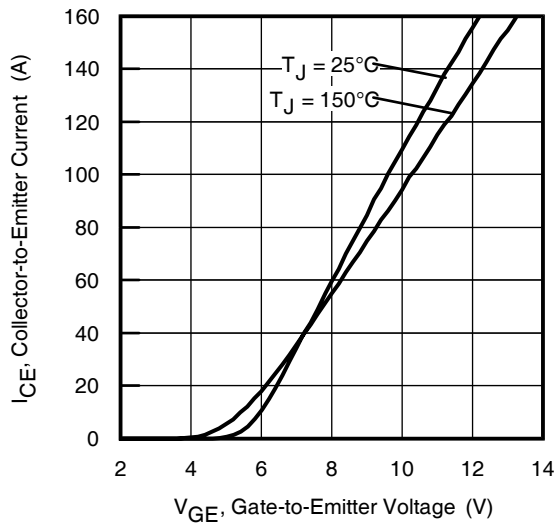


Fig 5. Typical Transfer Characteristics

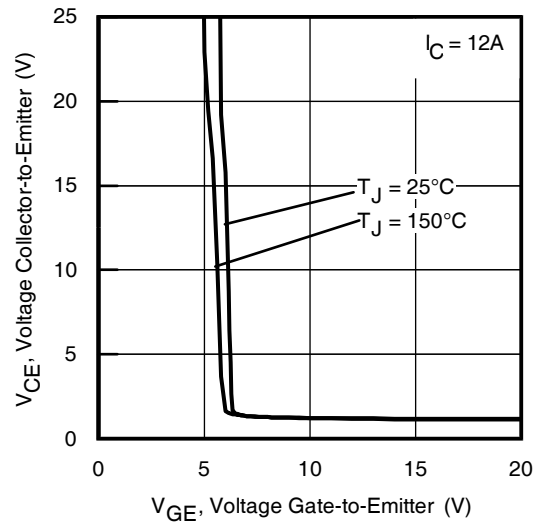


Fig 6.  $V_{CE(ON)}$  vs. Gate Voltage

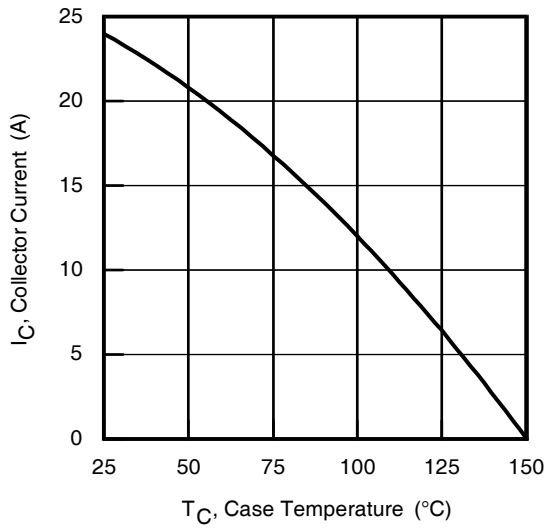


Fig 7. Maximum Collector Current vs. Case Temperature

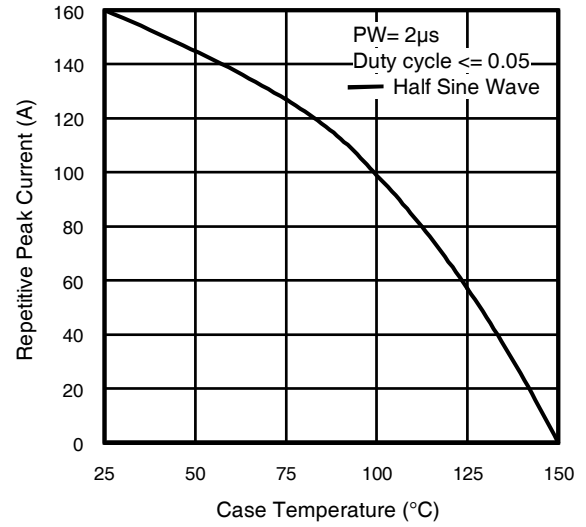


Fig 8. Typical Repetitive Peak Current vs. Case Temperature

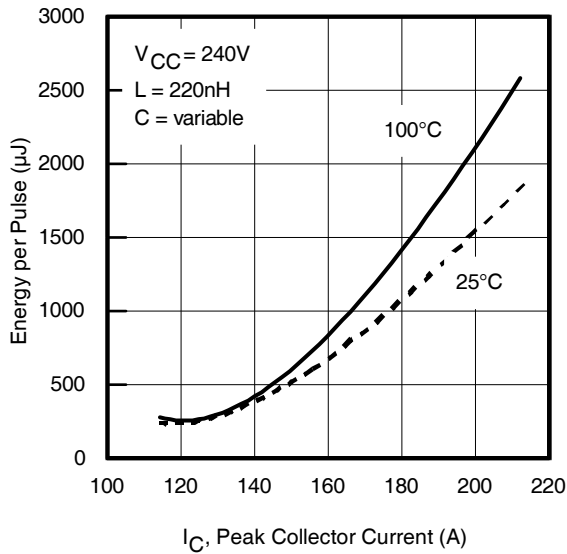


Fig 9. Typical  $E_{PULSE}$  vs. Collector Current

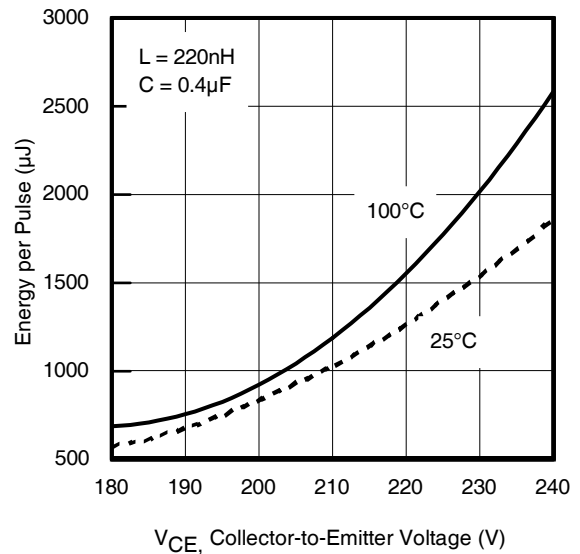


Fig 10. Typical  $E_{PULSE}$  vs. Collector-to-Emitter Voltage

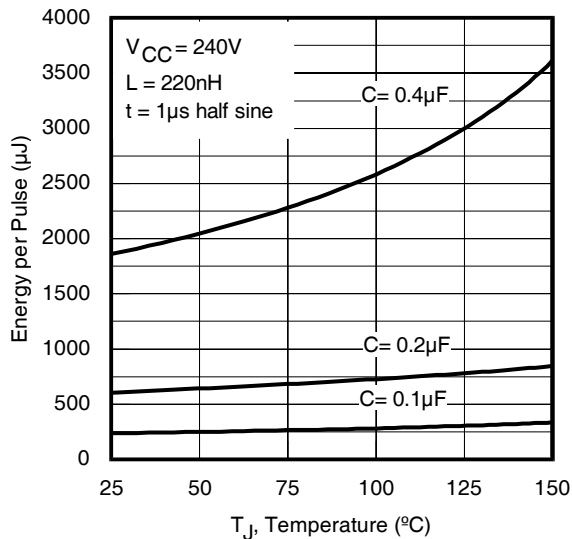


Fig 11.  $E_{PULSE}$  vs. Temperature

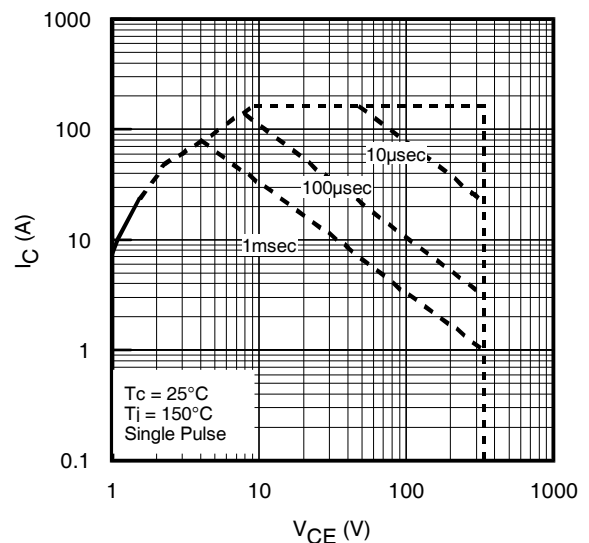


Fig 12. Forward Bias Safe Operating Area

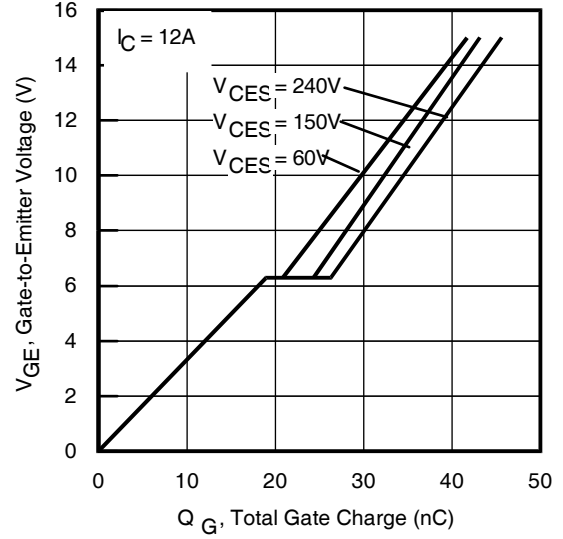
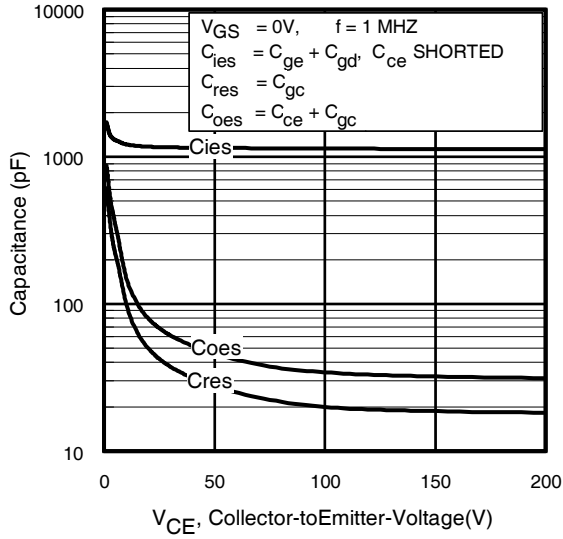


Fig 13. Typical Capacitance vs. Collector-to-Emitter Voltage

Fig 14. Typical Gate Charge vs. Gate-to-Emitter Voltage

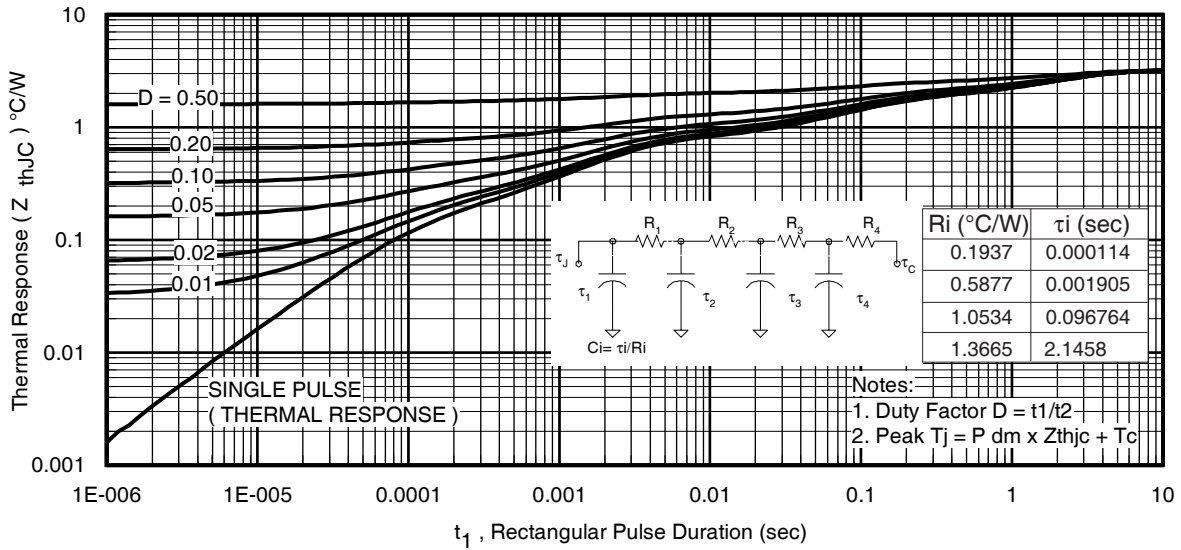
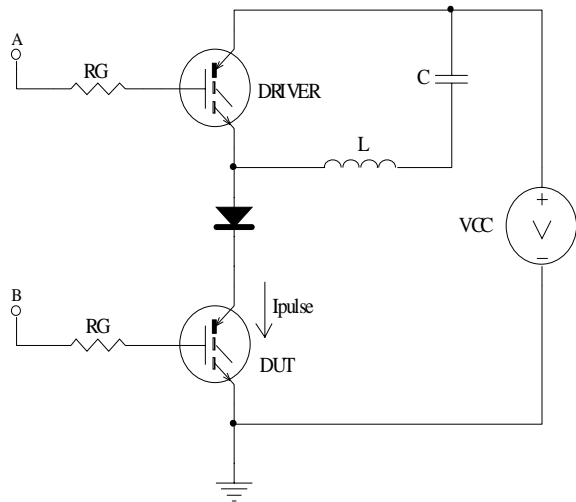
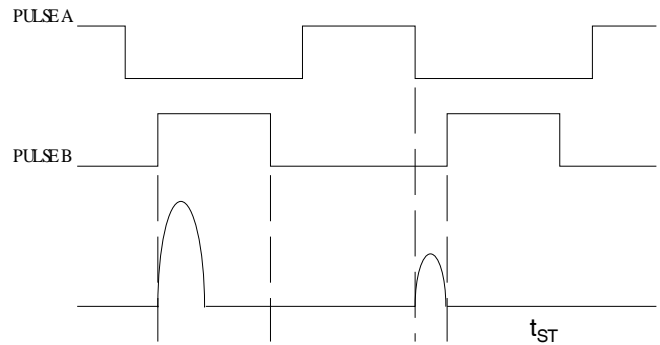


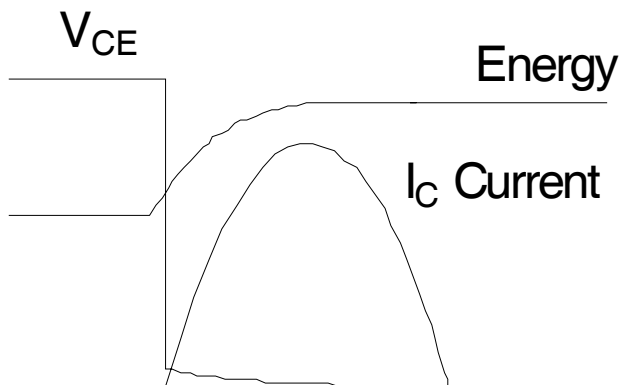
Fig 15. Maximum Effective Transient Thermal Impedance, Junction-to-Case



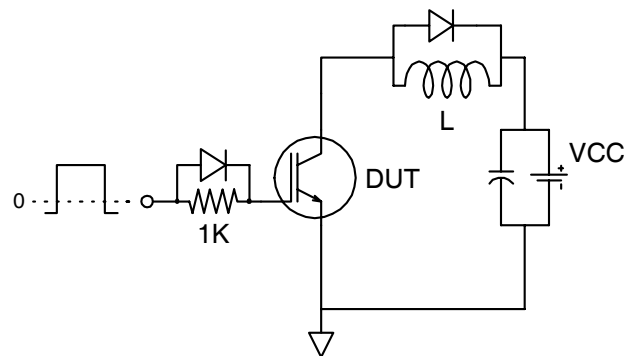
**Fig 16a.**  $t_{st}$  and  $E_{PULSE}$  Test Circuit



**Fig 16b.**  $t_{st}$  Test Waveforms



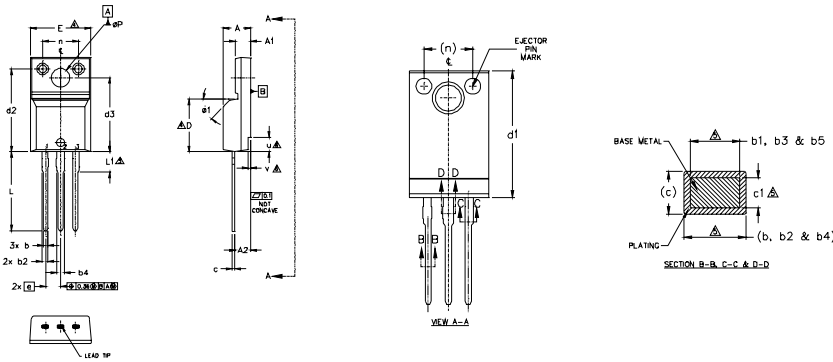
**Fig 16c.**  $E_{PULSE}$  Test Waveforms



**Fig 17 -** Gate Charge Circuit (turn-off)

## TO-220 Full-Pak Package Outline

Dimensions are shown in millimeters (inches)



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.57	4.83	.180	.190	1.0 DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M- 1994.
A1	2.57	2.83	.101	.111	
A2	2.51	2.93	.099	.115	2.0 DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
b	0.61	0.94	.024	.037	3.0 LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
b1	0.61	0.89	.024	.035	4.0 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTER MOST EXTREMES OF THE PLASTIC BODY.
b2	0.76	1.27	.030	.050	
b3	0.76	1.22	.030	.048	5.0 DIMENSION b1, b3, b5 & c1 APPLY TO BASE METAL ONLY.
b4	1.02	1.52	.040	.060	6.0 STEP OPTIONAL ON PLASTIC BODY DEFINED BY DIMENSIONS u & v.
b5	1.02	1.47	.040	.058	7.0 CONTROLLING DIMENSION : INCHES.
c	0.33	0.53	.013	.025	LEAD ASSIGNMENTS
c1	0.33	0.58	.013	.023	
D	8.66	9.80	.341	.386	HEXFET 1.- GATE 2.- DRAIN 3.- SOURCE
d1	15.80	16.13	.622	.635	
d2	13.97	14.22	.550	.560	IGBTs, CoPACK 1.- GATE 2.- COLLECTOR 3.- EMITTER
d3	12.30	12.93	.484	.509	
E	9.63	10.75	.379	.423	
e	2.54 BSC		.100 BSC		
L	13.20	13.72	.520	.540	
L1	3.37	3.67	.122	.145	
n	6.05	6.60	.238	.260	
phi P	3.05	3.45	.120	.136	
u	2.40	2.50	.094	.098	
v	0.40	0.50	.016	.020	
phi 1	-	45°	-	45°	

NOTES:  
 1.0 DIMENSIONING AND TOLERANCING AS 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 D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTER MOST EXTREMES OF THE PLASTIC BODY.  
 5.0 DIMENSION b1, b3, b5 & c1 APPLY TO BASE METAL ONLY.  
 6.0 STEP OPTIONAL ON PLASTIC BODY DEFINED BY DIMENSIONS u & v.  
 7.0 CONTROLLING DIMENSION : INCHES.

**LEAD ASSIGNMENTS**

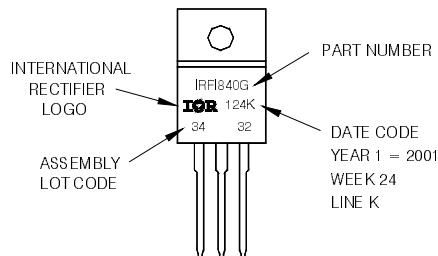
- HEXFET**  
 1.- GATE  
 2.- DRAIN  
 3.- SOURCE

- IGBTs, CoPACK**  
 1.- GATE  
 2.- COLLECTOR  
 3.- EMITTER

## TO-220 Full-Pak Part Marking Information

EXAMPLE: THIS IS AN IRF1840G  
 WITH ASSEMBLY  
 LOT CODE 3432  
 ASSEMBLED ON WW 24, 2001  
 IN THE ASSEMBLY LINE 'K'

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



**TO-220AB Full-Pak package is not recommended for Surface Mount Application.**

**Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>**

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