

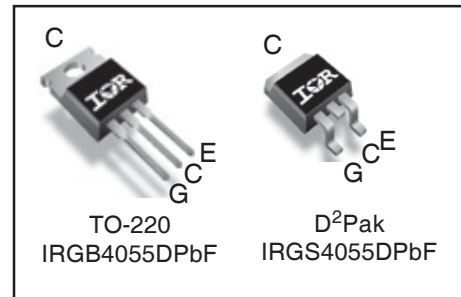
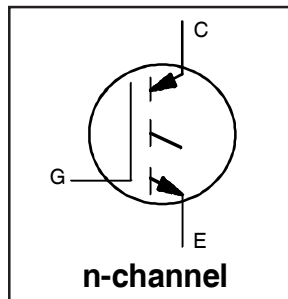
PDP TRENCH IGBT

**IRGB4055PbF**  
**IRGS4055PbF**

**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		
$V_{CE\ min}$	300	V
$V_{CE(ON)}\ typ.\ @\ 110A$	1.70	V
$I_{RP}\ max\ @\ T_C = 25^\circ C\ ①$	270	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, $V_{GE} @ 15V$	110④	A
$I_C @ T_C = 100^\circ C$	Continuous Collector, $V_{GE} @ 15V$	60	
$I_{RP} @ T_C = 25^\circ C$	Repetitive Peak Current ①	270	
$P_D @ T_C = 25^\circ C$	Power Dissipation	255	W
$P_D @ T_C = 100^\circ C$	Power Dissipation	102	
	Linear Derating Factor	2.04	W/ $^\circ C$
$T_J$ $T_{STG}$	Operating Junction and Storage Temperature Range	-40 to + 150	$^\circ C$
	Soldering Temperature for 10 seconds	300	
	Mounting Torque, 6-32 or M3 Screw	10lb·in (1.1N·m)	

**Thermal Resistance**

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ②	—	0.50	$^\circ C/W$
$R_{\theta CS}$	Case-to-Sink, Flat Greased Surface , TO-220	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient, TO-220 ②	—	62	
$R_{\theta JA}$	Junction-to-Ambient (PCB Mount) , D²Pak ②	—	40	

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$BV_{CES}$	Collector-to-Emitter Breakdown Voltage	300	—	—	V	$V_{GE} = 0V, I_{CE} = 1\text{ mA}$
$\Delta BV_{CES}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.23	—	V/°C	Reference to $25^\circ\text{C}, I_{CE} = 1\text{ mA}$
$V_{CE(on)}$	Static Collector-to-Emitter Voltage	—	1.10	1.30	V	$V_{GE} = 15V, I_{CE} = 35A$ ③
		—	1.70	2.10	V	$V_{GE} = 15V, I_{CE} = 110A$ ③
		—	2.35	—	V	$V_{GE} = 15V, I_{CE} = 200A$ ③
		—	1.95	—	V	$V_{GE} = 15V, I_{CE} = 110A, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	2.6	—	5.0	V	$V_{CE} = V_{GE}, I_{CE} = 1\text{ mA}$
$\Delta V_{GE(th)}/\Delta T_J$	Gate Threshold Voltage Coefficient	—	-11	—	mV/°C	
$I_{CES}$	Collector-to-Emitter Leakage Current	—	2.0	25	$\mu\text{A}$	$V_{CE} = 300V, V_{GE} = 0V$
		—	100	—		$V_{CE} = 300V, V_{GE} = 0V, T_J = 150^\circ\text{C}$
$I_{GES}$	Gate-to-Emitter Forward Leakage	—	—	100	nA	$V_{GE} = 30V$
	Gate-to-Emitter Reverse Leakage	—	—	-100		$V_{GE} = -30V$
$g_{fe}$	Forward Transconductance	—	38	—	S	$V_{CE} = 25V, I_{CE} = 35A$
$Q_g$	Total Gate Charge	—	132	—	nC	$V_{CE} = 200V, I_C = 35A, V_{GE} = 15V$ ③
$Q_{gc}$	Gate-to-Collector Charge	—	42	—		
$t_{d(on)}$	Turn-On delay time	—	44	57	ns	$I_C = 35A, V_{CC} = 180V$ $R_G = 10\Omega, L = 250\mu\text{H}, L_S = 150\text{ nH}$ $T_J = 25^\circ\text{C}$
$t_r$	Rise time	—	39	55		
$t_{d(off)}$	Turn-Off delay time	—	245	308		
$t_f$	Fall time	—	152	198		
$t_{d(on)}$	Turn-On delay time	—	42	—	ns	$I_C = 35A, V_{CC} = 180V$ $R_G = 10\Omega, L = 250\mu\text{H}, L_S = 150\text{ nH}$ $T_J = 150^\circ\text{C}$
$t_r$	Rise time	—	40	—		
$t_{d(off)}$	Turn-Off delay time	—	362	—		
$t_f$	Fall time	—	309	—		
$t_{st}$	Shoot Through Blocking Time	100	—	—	ns	$V_{CC} = 240V, V_{GE} = 15V, R_G = 5.1\Omega$
$E_{PULSE}$	Energy per Pulse	—	705	—	$\mu\text{J}$	$L = 220\text{ nH}, C = 0.40\mu\text{F}, V_{GE} = 15V$ $V_{CC} = 240V, R_G = 5.1\Omega, T_J = 25^\circ\text{C}$
		—	915	—		$L = 220\text{ nH}, C = 0.40\mu\text{F}, V_{GE} = 15V$ $V_{CC} = 240V, R_G = 5.1\Omega, T_J = 100^\circ\text{C}$
$C_{iss}$	Input Capacitance	—	4280	—	pF	$V_{GE} = 0V$
$C_{oss}$	Output Capacitance	—	200	—		$V_{CE} = 30V$
$C_{rfs}$	Reverse Transfer Capacitance	—	125	—		$f = 1.0\text{ MHz}$ , See Fig.13
$L_C$	Internal Collector Inductance	—	5.0	—	nH	Between lead, 6mm (0.25in.)
$L_E$	Internal Emitter Inductance	—	13	—		from package and center of die contact

## Notes:

- ① Half sine wave with duty cycle = 0.25,  $t_{on} = 1\mu\text{sec}$ .
- ②  $R_\theta$  is measured at  $T_J$  of approximately  $90^\circ\text{C}$ .
- ③ Pulse width  $\leq 400\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ④ Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 70A.

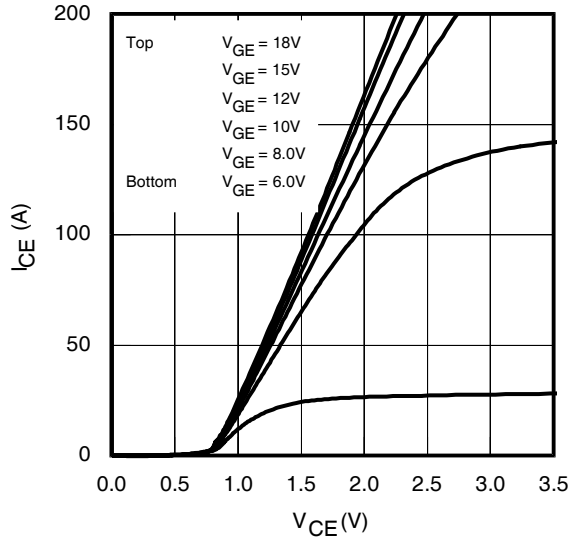


Fig 1. Typical Output Characteristics @ 25°C

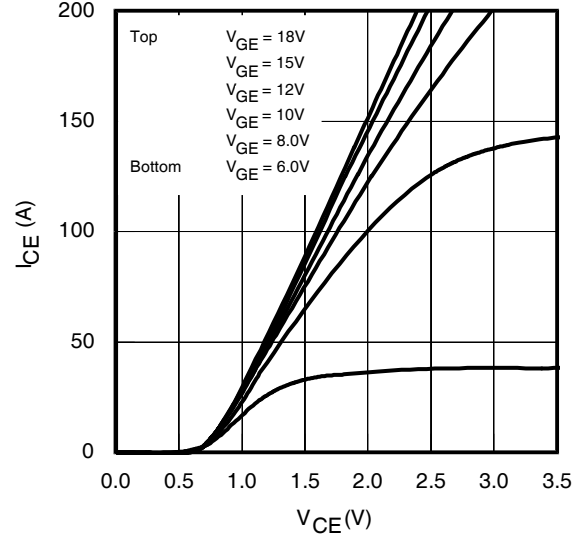


Fig 2. Typical Output Characteristics @ 75°C

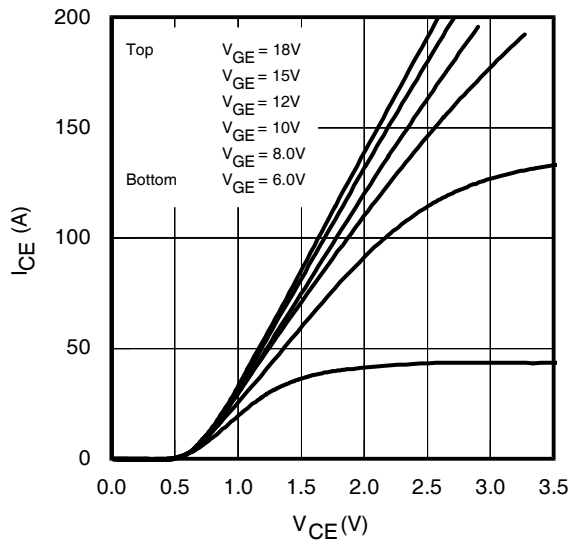


Fig 3. Typical Output Characteristics @ 125°C

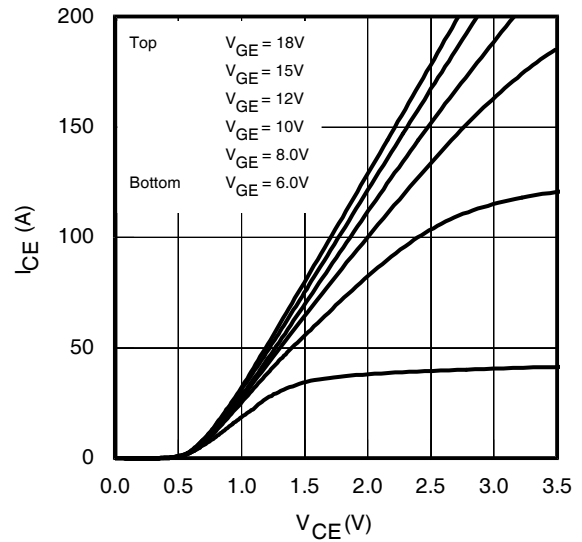


Fig 4. Typical Output Characteristics @ 150°C

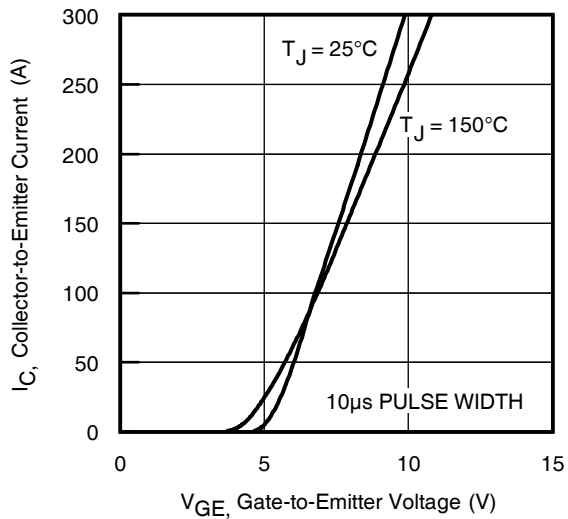


Fig 5. Typical Transfer Characteristics

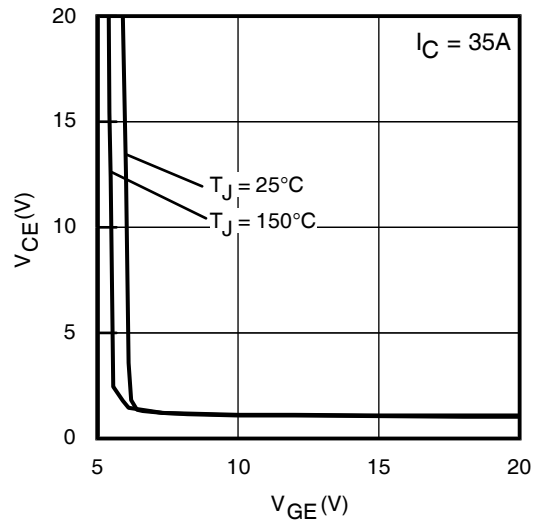


Fig 6.  $V_{CE(ON)}$  vs. Gate Voltage

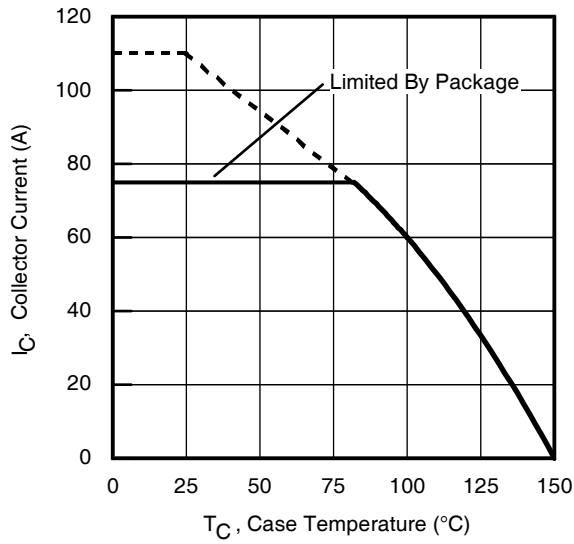


Fig 7. Maximum Collector Current vs. Case Temperature

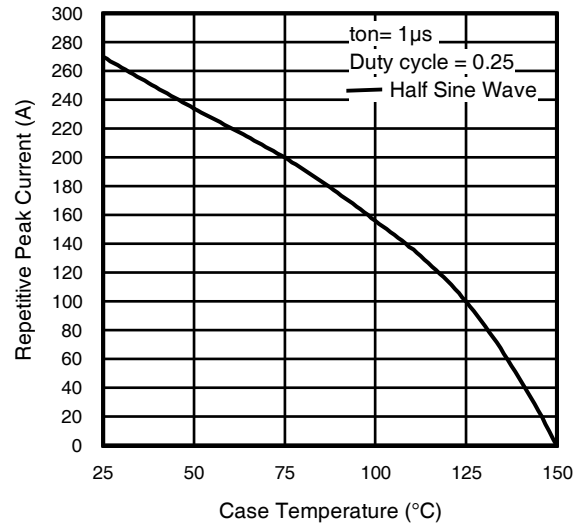


Fig 8. Typical Repetitive Peak Current vs. Case Temperature

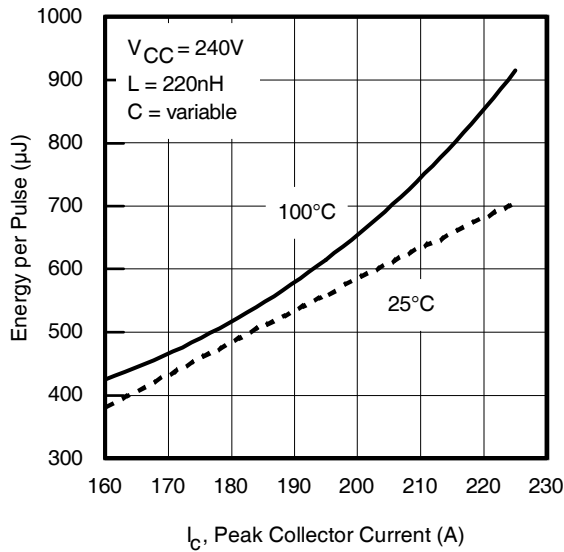


Fig 9. Typical  $E_{PULSE}$  vs. Collector Current

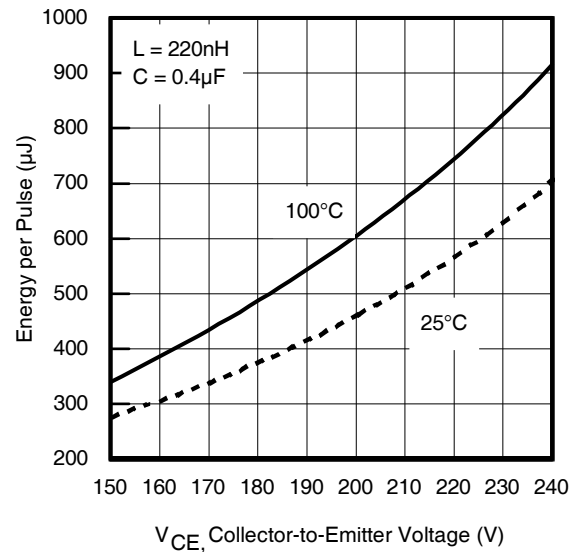


Fig 10. Typical  $E_{PULSE}$  vs. Collector-to-Emitter Voltage

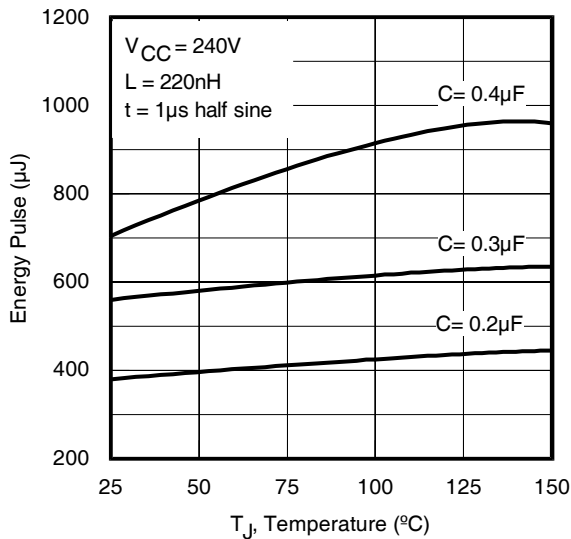


Fig 11.  $E_{PULSE}$  vs. Temperature

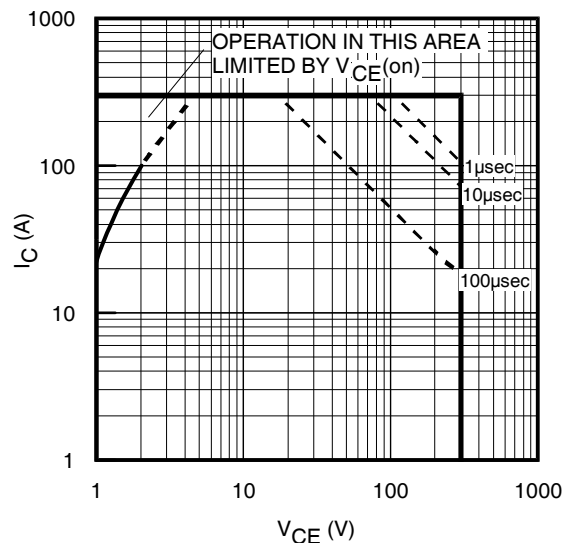


Fig 12. Forward Bias Safe Operating Area

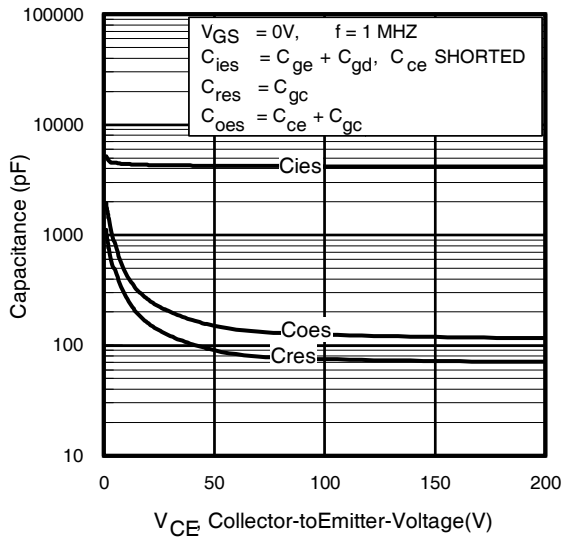


Fig 13. Typical Capacitance vs. Collector-to-Emitter Voltage

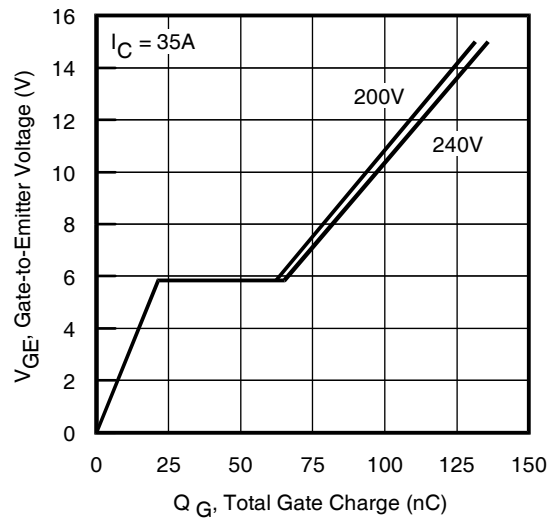


Fig 14. Typical Gate Charge vs. Gate-to-Emitter Voltage

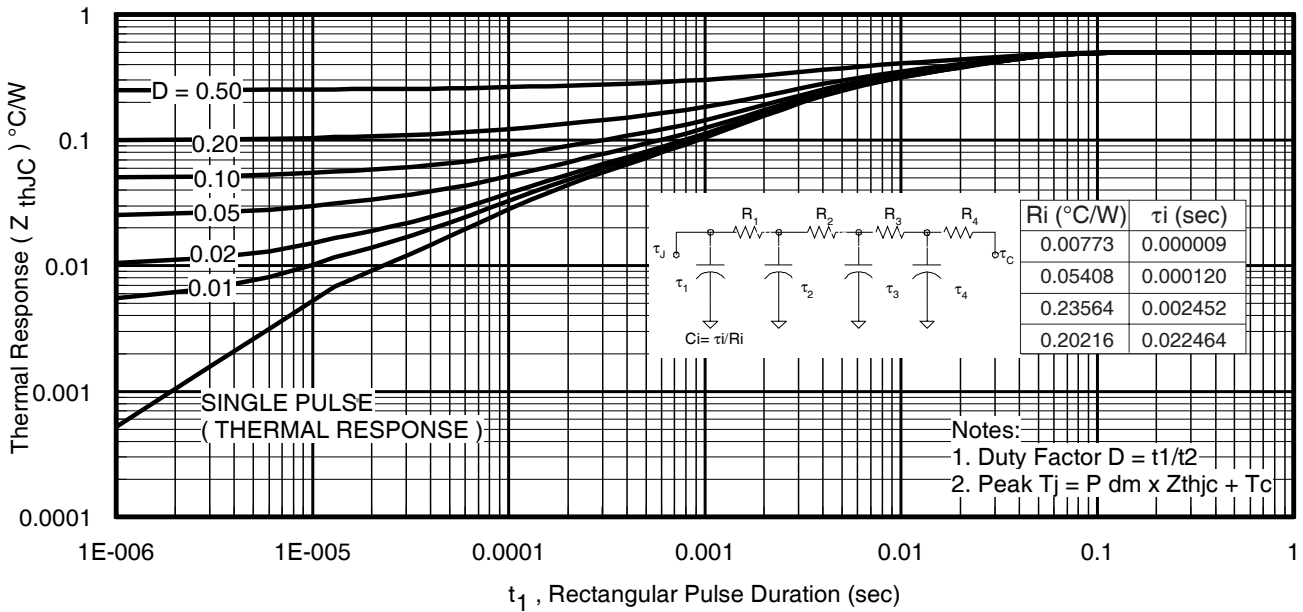
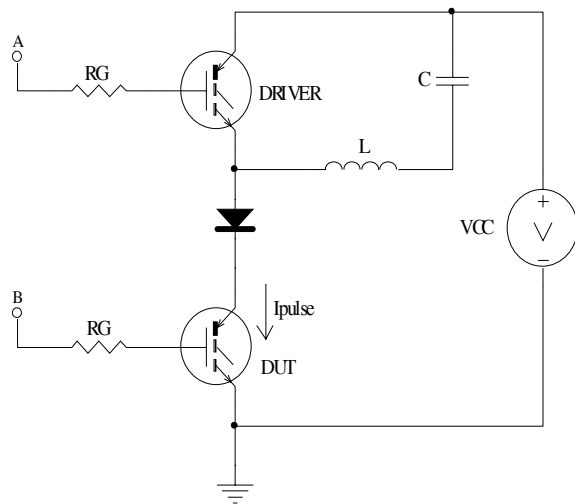
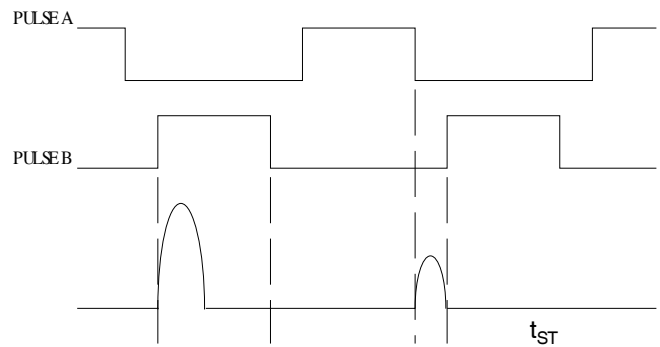


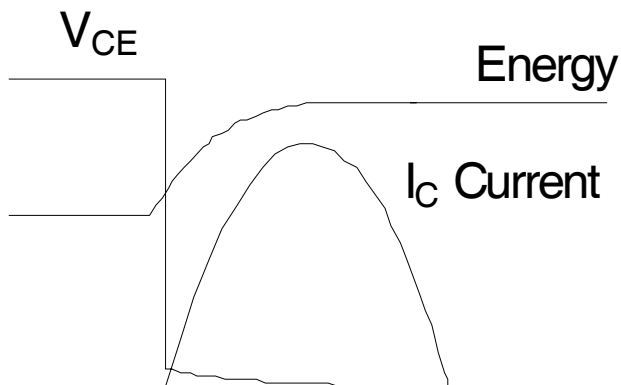
Fig 15. Maximum Effective Transient Thermal Impedance, Junction-to-Case



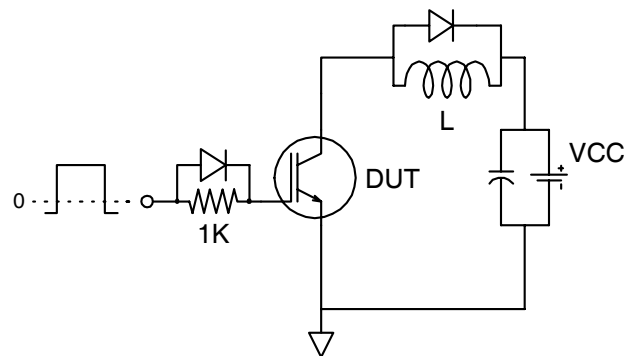
**Fig 16a.**  $t_{st}$  and  $E_{PULSE}$  Test Circuit



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



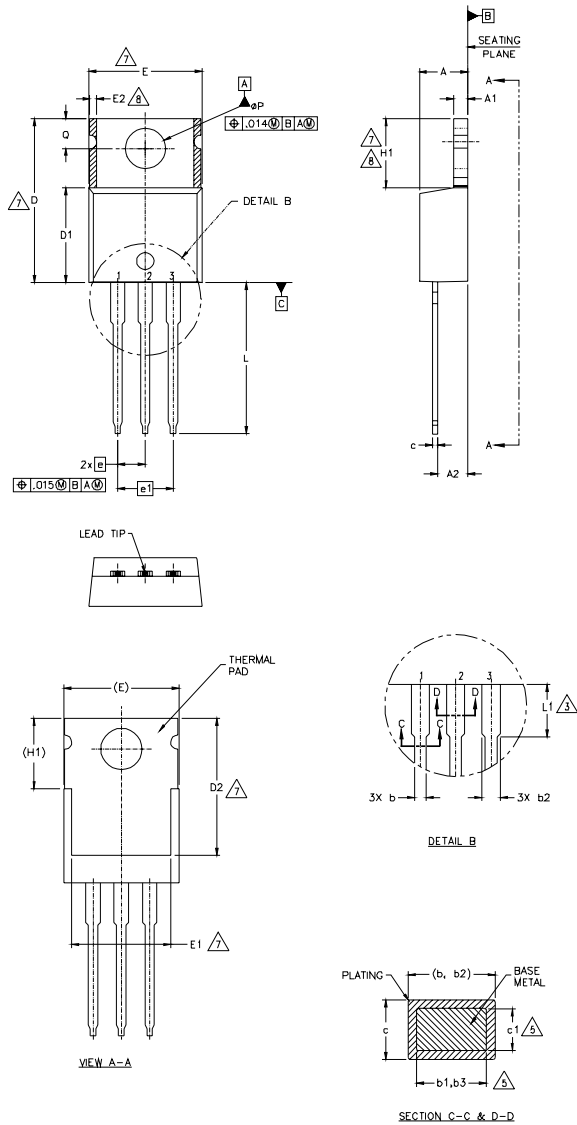
**Fig 16c.**  $E_{PULSE}$  Test Waveforms



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

**TO-220AB Package Outline**

Dimensions are shown in millimeters (inches)



- NOTES:
- 1.- DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M- 1994.
  - 2.- DIMENSIONS ARE SHOWN IN INCHES (MILLIMETERS).
  - 3.- LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
  - 4.- DIMENSION D, D1 & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
  - 5.- DIMENSION b1, b3 & c1 APPLY TO BASE METAL ONLY.
  - 6.- CONTROLLING DIMENSION : INCHES.
  - 7.- THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS E,H1,D2 & E1
  - 8.- DIMENSION E2 X H1 DEFINE A ZONE WHERE STAMPING AND SINGULATION IRREGULARITIES ARE ALLOWED.
  - 9.- OUTLINE CONFORMS TO JEDEC TO-220, EXCEPT A2 (max.) AND D2 (min.) WHERE DIMENSIONS ARE DERIVED FROM THE ACTUAL PACKAGE OUTLINE.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	3.56	4.83	.140	.190	
A1	0.51	1.40	.020	.055	
A2	2.03	2.92	.080	.115	
b	0.38	1.01	.015	.040	
b1	0.38	0.97	.015	.038	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.36	0.61	.014	.024	
c1	0.36	0.56	.014	.022	5
D	14.22	16.51	.560	.650	4
D1	8.38	9.02	.330	.355	
D2	11.68	12.88	.460	.507	7
E	9.65	10.67	.380	.420	4,7
E1	6.86	8.89	.270	.350	7
E2	-	0.76	-	.030	8
e	2.54 BSC		.100 BSC		
e1	5.08 BSC		.200 BSC		
H1	5.84	6.86	.230	.270	7,8
L	12.70	14.73	.500	.580	
L1	-	6.35	-	.250	3
$\phi P$	3.54	4.08	.139	.161	
Q	2.54	3.42	.100	.135	

**LEAD ASSIGNMENTS**

**HEXKEET**

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

**IRGBs CoPACK**

- 1.- GATE
- 2.- COLLECTOR
- 3.- EMITTER

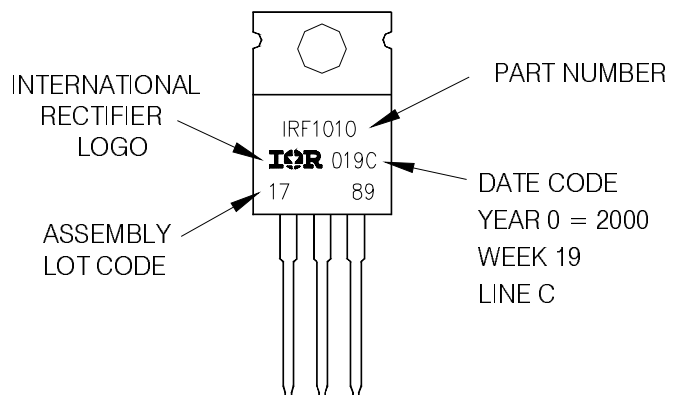
**DIODES**

- 1.- ANODE/OPEN
- 2.- CATHODE
- 3.- ANODE

**TO-220AB Part Marking Information**

EXAMPLE: THIS IS AN IRF1010  
 LOT CODE 1789  
 ASSEMBLED ON WW 19, 2000  
 IN THE ASSEMBLY LINE "C"

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

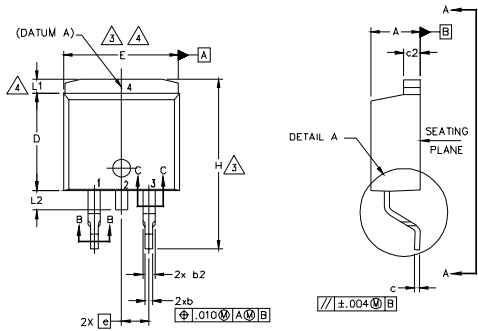


**TO-220AB package is not recommended for Surface Mount Application.**

# IRGB/S4055PbF

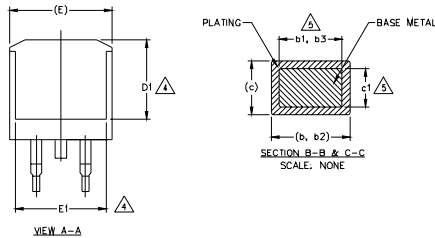
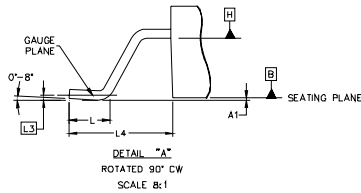
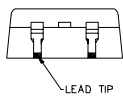
## D<sup>2</sup>Pak (TO-263AB) Package Outline

Dimensions are shown in millimeters (inches)



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
5. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
6. DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
7. CONTROLLING DIMENSION: INCH.
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-263AB.



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	0.00	0.254	.000	.010	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	5
c2	1.14	1.65	.045	.065	
D	8.38	9.65	.330	.380	3
D1	6.86	-	.270	-	4
E	9.65	10.67	.380	.420	3,4
E1	6.22	-	.245	-	4
e	2.54 BSC		.100 BSC		
H	14.61	15.88	.575	.625	
L	1.78	2.79	.070	.110	
L1	-	1.65	-	.066	4
L2	1.27	1.78	-	.070	
L3	0.25 BSC		.010 BSC		
L4	4.78	5.28	.188	.208	

**LEAD ASSIGNMENTS**

**HEXFET**

- 1.- GATE
- 2, 4.- DRAIN
- 3.- SOURCE

**IGBTs, CoPACK**

- 1.- GATE
- 2, 4.- COLLECTOR
- 3.- EMITTER

**DIODES**

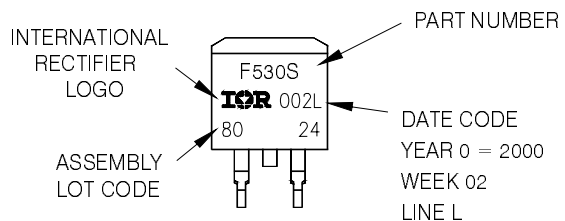
- 1.- ANODE \*
- 2, 4.- CATHODE
- 3.- ANODE

\* PART DEPENDENT.

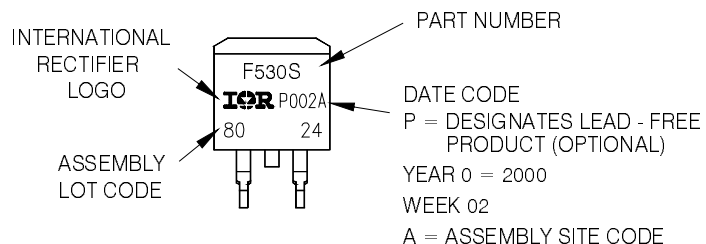
## D<sup>2</sup>Pak (TO-263AB) Part Marking Information

EXAMPLE: THIS IS AN IRF530S WITH  
LOT CODE 8024  
ASSEMBLED ON WW 02, 2000  
IN THE ASSEMBLY LINE "L"

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



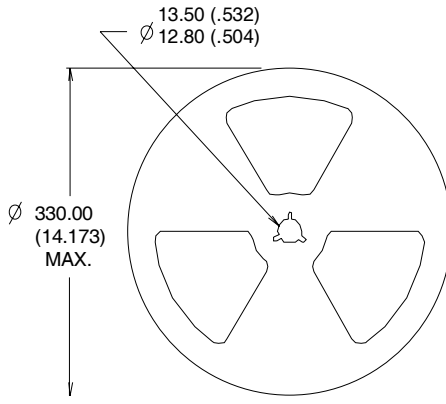
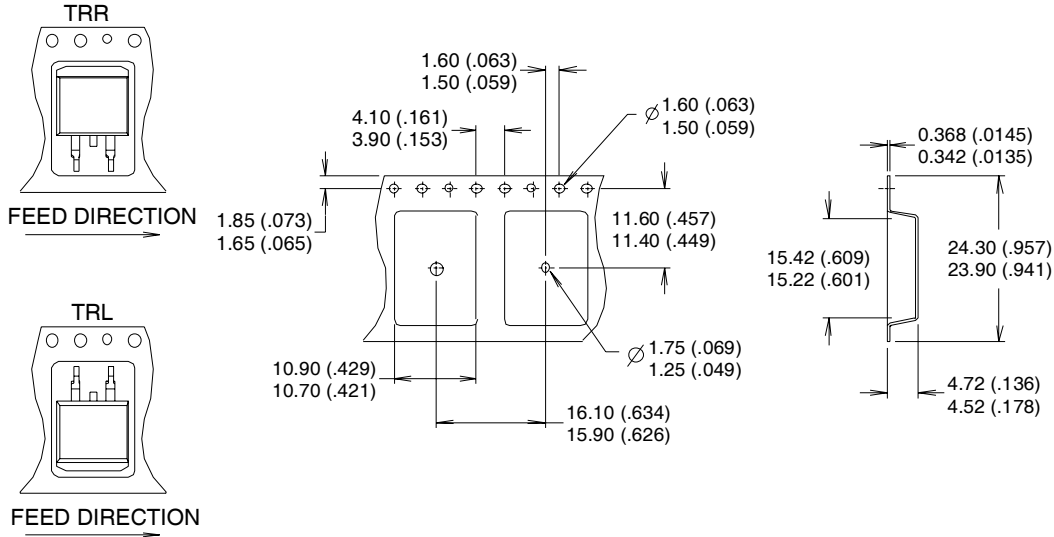
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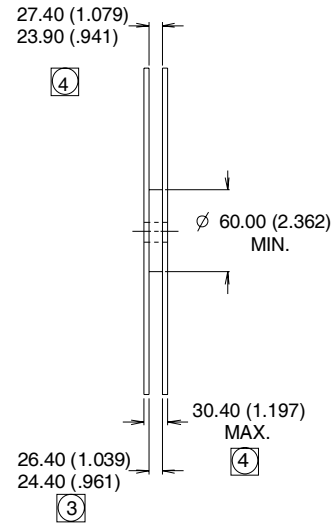
## D<sup>2</sup>Pak (TO-263AB) Tape & Reel Information

Dimensions are shown in millimeters (inches)



**NOTES :**

1. CONFORMS TO EIA-418.
2. CONTROLLING DIMENSION: MILLIMETER.
- ③ DIMENSION MEASURED @ HUB.
- ④ INCLUDES FLANGE DISTORTION @ OUTER EDGE.



The specifications set forth in this data sheet are the sole and exclusive specifications applicable to the identified product, and no specifications or features are implied whether by industry custom, sampling or otherwise. We qualify our products in accordance with our internal practices and procedures, which by their nature do not include qualification to all possible or even all widely used applications. Without limitation, we have not qualified our product for medical use or applications involving hi-reliability applications. Customers are encouraged to and responsible for qualifying product to their own use and their own application environments, especially where particular features are critical to operational performance or safety. Please contact your IR representative if you have specific design or use requirements or for further information.

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