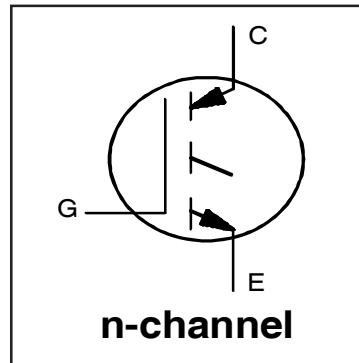


INSULATED GATE BIPOLAR TRANSISTOR

IRGP4063PbF
IRGP4063-EPbF

Features

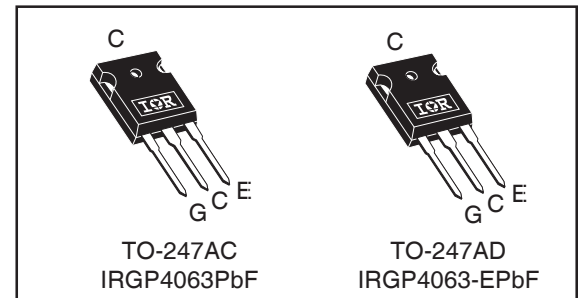
- Low $V_{CE(ON)}$ Trench IGBT Technology
- Low switching losses
- Maximum Junction temperature 175 °C
- 5 μ S short circuit SOA
- Square RBSOA
- 100% of the parts tested for I_{LM} ①
- Positive $V_{CE(ON)}$ Temperature co-efficient
- Tight parameter distribution
- Lead Free Package



$V_{CES} = 600V$
$I_C = 48A, T_C = 100^\circ C$
$t_{SC} \geq 5\mu s, T_{J(max)} = 175^\circ C$
$V_{CE(on)} \text{ typ.} = 1.65V$

Benefits

- High Efficiency in a wide range of applications
- Suitable for a wide range of switching frequencies due to Low $V_{CE(ON)}$ and Low Switching losses
- Rugged transient Performance for increased reliability
- Excellent Current sharing in parallel operation
- Low EMI



G	C	E
Gate	Collector	Emitter

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	96 ②	
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	48	
I_{CM}	Pulse Collector Current, $V_{GE} = 15V$	144	A
I_{LM}	Clamped Inductive Load Current, $V_{GE} = 20V$ ①	192	A
V_{GE}	Continuous Gate-to-Emitter Voltage	± 20	V
	Transient Gate-to-Emitter Voltage	± 30	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	330	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	170	
T_J	Operating Junction and	-55 to +175	°C
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 sec.		
	Mounting Torque, 6-32 or M3 Screw	10 lbf-in (1.1 N·m)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$ (IGBT)	Thermal Resistance Junction-to-Case-(each IGBT)	—	—	0.45	°C/W
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink (flat, greased surface)	—	0.24	—	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (typical socket mount)	—	—	40	

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 = 150μA ④	CT6
ΔV _{(BR)CES} /ΔT _J	Temperature Coeff. of Breakdown Voltage	—	0.30	—	V/°C	V _{GE} = 0V, I _C = 1mA (25°C-175°C)	CT6
V _{CE(on)}	Collector-to-Emitter Saturation Voltage	—	1.65	2.14	V	I _C = 48A, V _{GE} = 15V, T _J = 25°C	5,6,7
		—	2.0	—		I _C = 48A, V _{GE} = 15V, T _J = 150°C	8,9,10
		—	2.05	—		I _C = 48A, V _{GE} = 15V, T _J = 175°C	
V _{GE(th)}	Gate Threshold Voltage	4.0	—	6.5	V	V _{CE} = V _{GE} , I _C = 1.4mA	8,9
ΔV _{GE(th)} /ΔT _J	Threshold Voltage temp. coefficient	—	-21	—	mV/°C	V _{CE} = V _{GE} , I _C = 1.0mA (25°C - 175°C)	10,11
g _{fe}	Forward Transconductance	—	32	—	S	V _{CE} = 50V, I _C = 48A, PW = 80μs	
I _{CES}	Collector-to-Emitter Leakage Current	—	1.0	150	μA	V _{GE} = 0V, V _{CE} = 600V	
		—	450	1000		V _{GE} = 0V, V _{CE} = 600V, T _J = 175°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
Q _g	Total Gate Charge (turn-on)	—	95	140	nC	I _C = 48A	18
Q _{ge}	Gate-to-Emitter Charge (turn-on)	—	28	42		V _{GE} = 15V	CT1
Q _{gc}	Gate-to-Collector Charge (turn-on)	—	35	53		V _{CC} = 400V	
E _{on}	Turn-On Switching Loss ⑤	—	625	1141	μJ	I _C = 48A, V _{CC} = 400V, V _{GE} = 15V	CT4
E _{off}	Turn-Off Switching Loss	—	1275	1481		R _G = 10Ω, L = 200μH, L _S = 150nH, T _J = 25°C	
E _{total}	Total Switching Loss	—	1900	2622		Energy losses include tail & diode reverse recovery	
t _{d(on)}	Turn-On delay time	—	60	78	ns	I _C = 48A, V _{CC} = 400V, V _{GE} = 15V	CT4
t _r	Rise time	—	40	56		R _G = 10Ω, L = 200μH, L _S = 150nH, T _J = 25°C	
t _{d(off)}	Turn-Off delay time	—	145	176			
t _f	Fall time	—	35	46			
E _{on}	Turn-On Switching Loss ⑤	—	1625	—		μJ	I _C = 48A, V _{CC} = 400V, V _{GE} = 15V
E _{off}	Turn-Off Switching Loss	—	1585	—	R _G = 10Ω, L = 200μH, L _S = 150nH, T _J = 175°C ④		CT4
E _{total}	Total Switching Loss	—	3210	—	Energy losses include tail & diode reverse recovery		WF1, WF2
t _{d(on)}	Turn-On delay time	—	55	—	ns	I _C = 48A, V _{CC} = 400V, V _{GE} = 15V	13, 15
t _r	Rise time	—	45	—		R _G = 10Ω, L = 200μH, L _S = 150nH	CT4
t _{d(off)}	Turn-Off delay time	—	165	—		T _J = 175°C	WF1
t _f	Fall time	—	45	—			WF2
C _{ies}	Input Capacitance	—	3025	—		pF	V _{GE} = 0V
C _{oes}	Output Capacitance	—	245	—	V _{CC} = 30V		
C _{res}	Reverse Transfer Capacitance	—	90	—	f = 1.0Mhz		
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T _J = 175°C, I _C = 192A V _{CC} = 480V, V _p = 600V R _G = 10Ω, V _{GE} = +15V to 0V	4 CT2
SCSOA	Short Circuit Safe Operating Area	5	—	—	μs	V _{CC} = 400V, V _p = 600V R _G = 10Ω, V _{GE} = +15V to 0V	16, CT3 WF3

Notes:

- ① V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 200μH, R_G = 10Ω.
- ② This is only applied to TO-247AC package.
- ③ Pulse width limited by max. junction temperature.
- ④ Refer to AN-1086 for guidelines for measuring V_{(BR)CES} safely.
- ⑤ Turn-on energy is measured using the same co-pak diode as IRGP4063DPbF.
- ⑥ Calculated continuous current based on maximum allowable junction temperature.
Bond wire current limit is 80A. Note that current limitations arising from heating of the device leads may occur with some lead mounting arrangements.

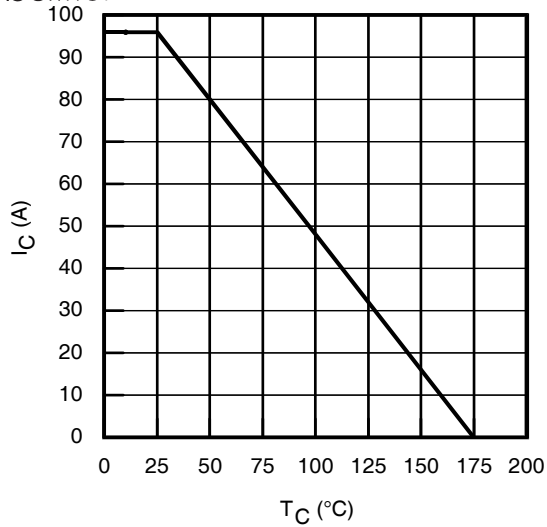


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

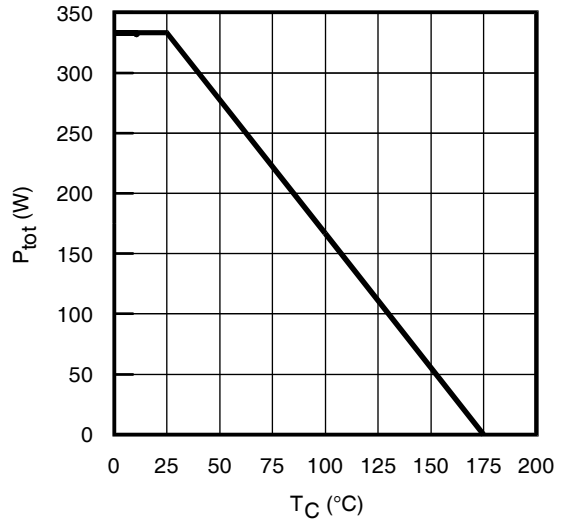


Fig. 2 - Power Dissipation vs. Case Temperature

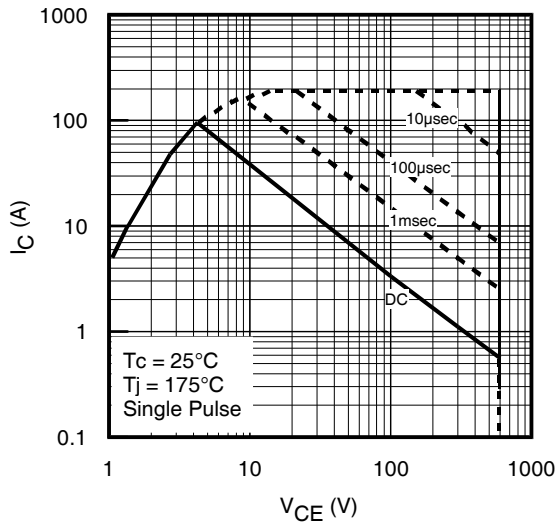


Fig. 3 - Forward SOA
 $T_C = 25^\circ\text{C}$, $T_J \leq 175^\circ\text{C}$; $V_{GE} = 15\text{V}$

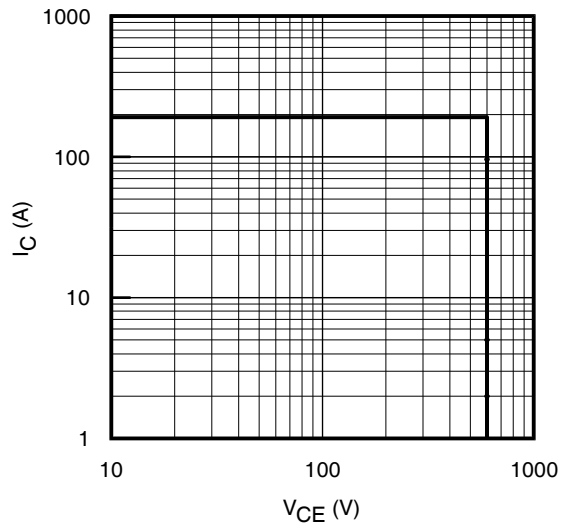


Fig. 4 - Reverse Bias SOA
 $T_J = 175^\circ\text{C}$; $V_{GE} = 15\text{V}$

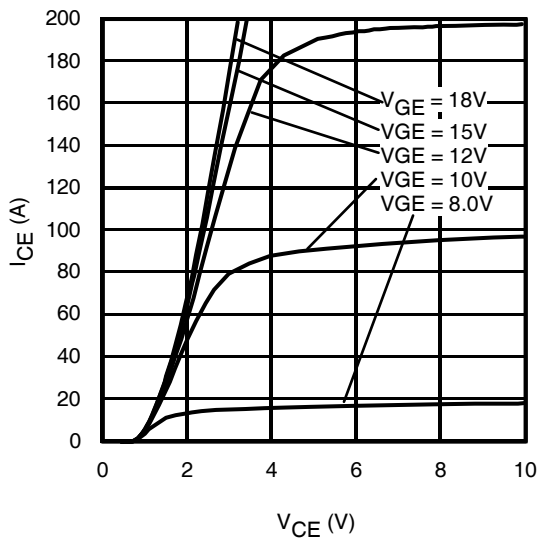


Fig. 5 - Typ. IGBT Output Characteristics
 $T_J = -40^\circ\text{C}$; $t_p = 80\mu\text{s}$

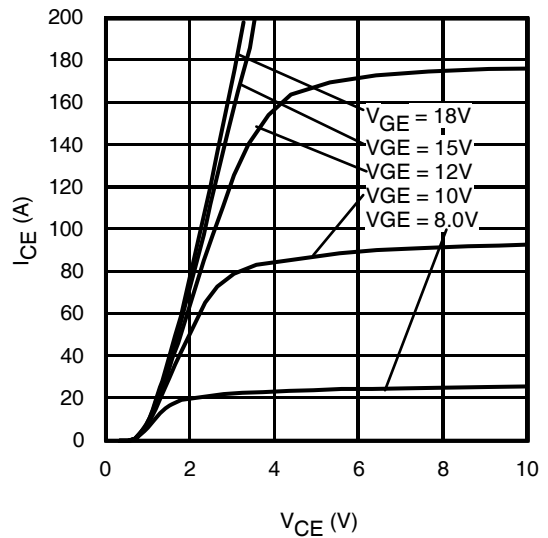


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 80\mu\text{s}$

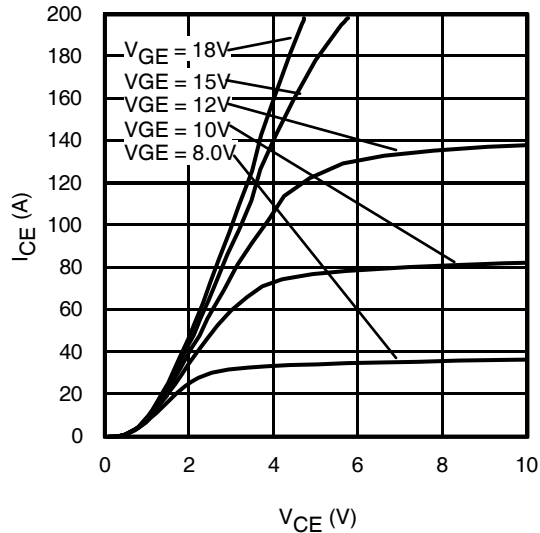


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 175^\circ\text{C}$; $t_p = 80\mu\text{s}$

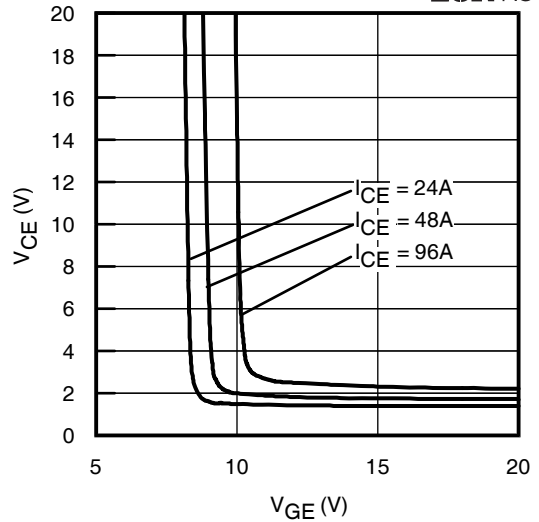


Fig. 8 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

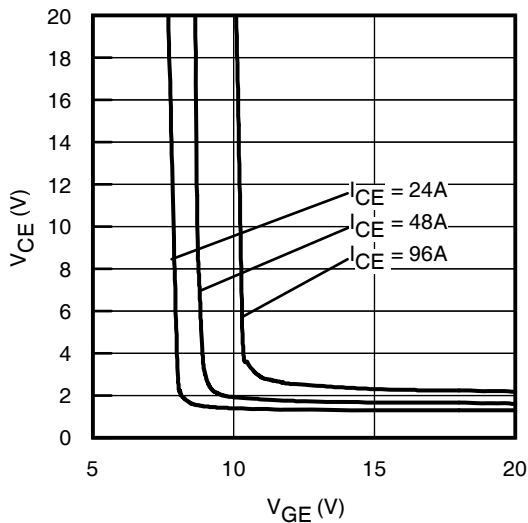


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

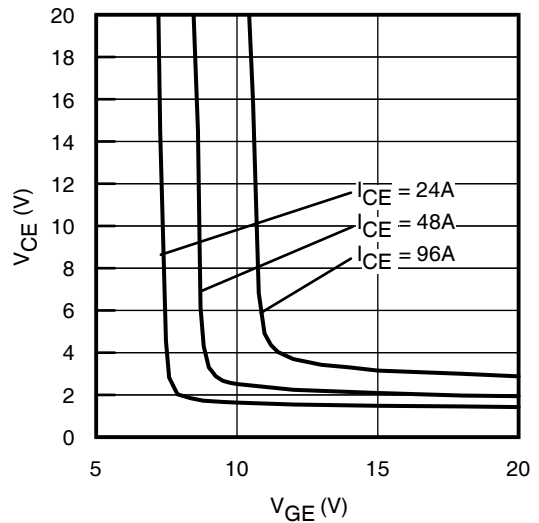


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 175^\circ\text{C}$

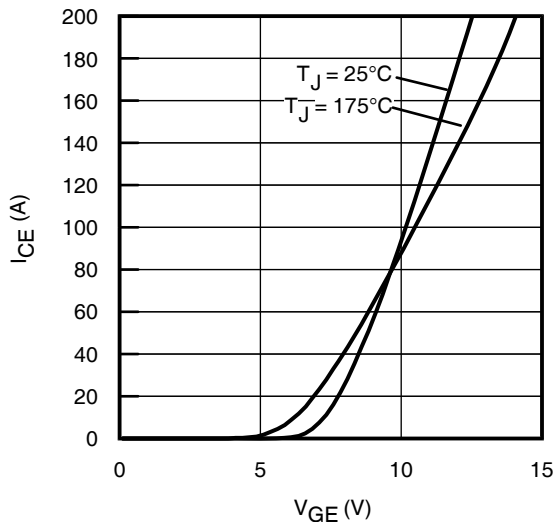


Fig. 11 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 10\mu\text{s}$

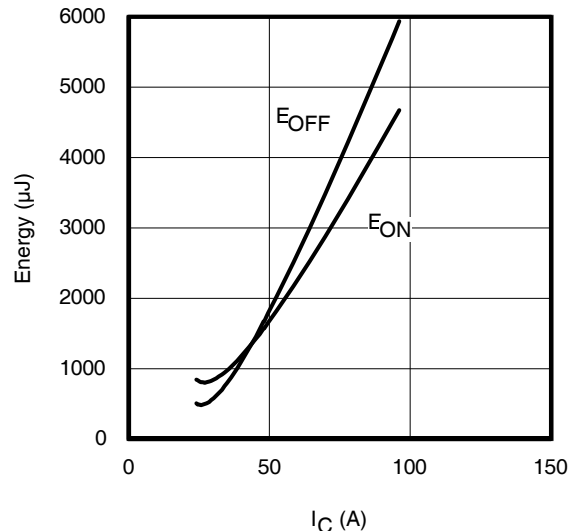


Fig. 12 - Typ. Energy Loss vs. I_C
 $T_J = 175^\circ\text{C}$; $L = 200\mu\text{H}$; $V_{CE} = 400\text{V}$; $R_G = 10\Omega$; $V_{GE} = 15\text{V}$

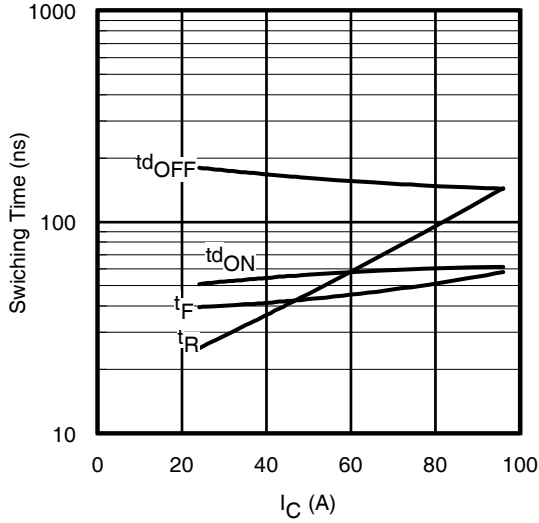


Fig. 13 - Typ. Switching Time vs. I_C
 $T_J = 175^\circ\text{C}$; $L = 200\mu\text{H}$; $V_{CE} = 400\text{V}$; $R_G = 10\Omega$; $V_{GE} = 15\text{V}$

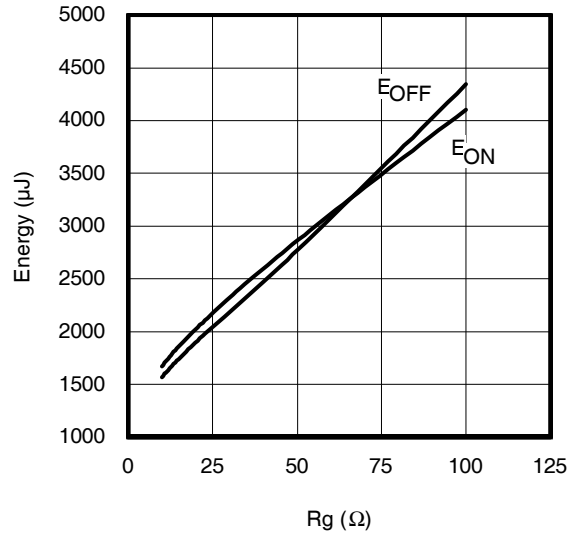


Fig. 14 - Typ. Energy Loss vs. R_G
 $T_J = 175^\circ\text{C}$; $L = 200\mu\text{H}$; $V_{CE} = 400\text{V}$; $I_{CE} = 48\text{A}$; $V_{GE} = 15\text{V}$

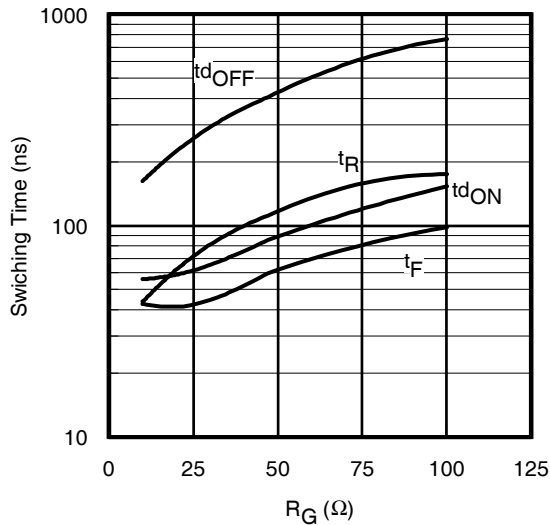


Fig. 15 - Typ. Switching Time vs. R_G
 $T_J = 175^\circ\text{C}$; $L = 200\mu\text{H}$; $V_{CE} = 400\text{V}$; $I_{CE} = 48\text{A}$; $V_{GE} = 15\text{V}$

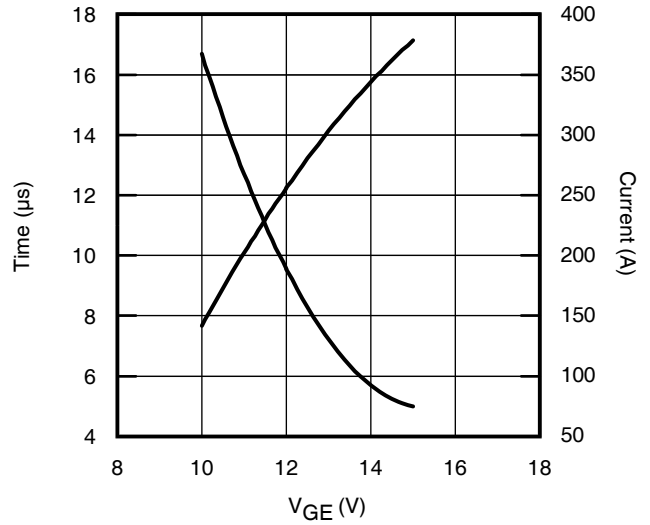


Fig. 16 - V_{GE} vs. Short Circuit Time
 $V_{CC} = 400\text{V}$; $T_C = 25^\circ\text{C}$

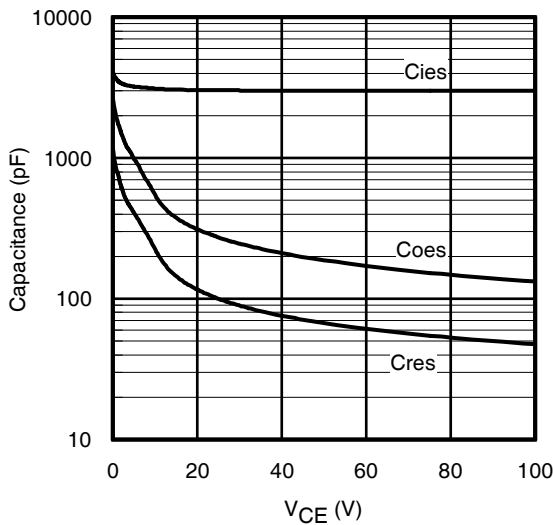


Fig. 17 - Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0\text{V}$; $f = 1\text{MHz}$

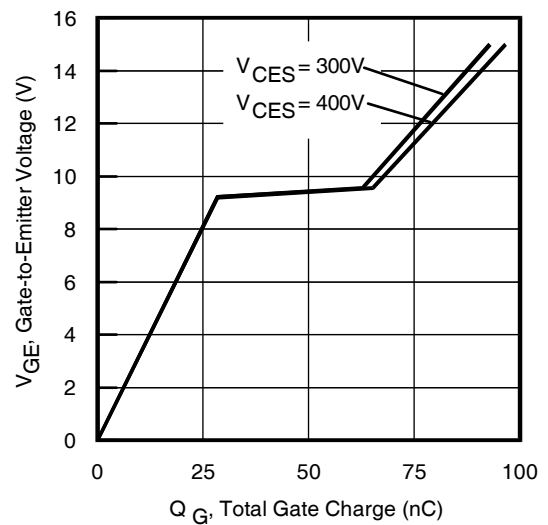


Fig. 18 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 48\text{A}$; $L = 600\mu\text{H}$

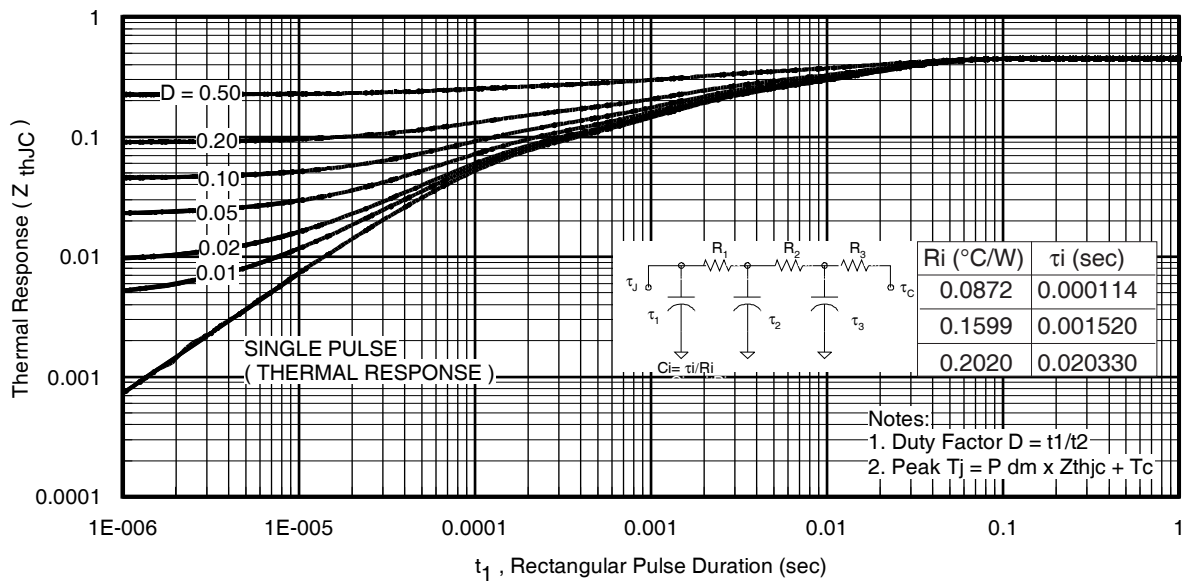


Fig 19. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

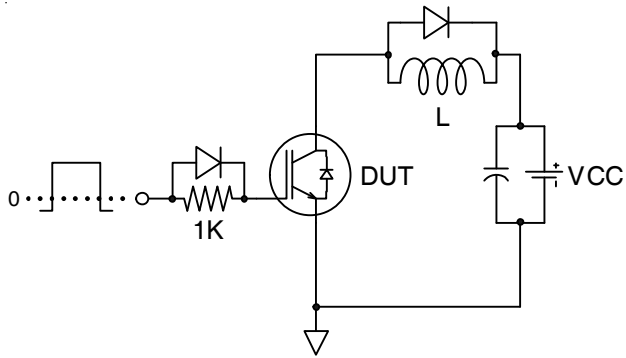


Fig.C.T.1 - Gate Charge Circuit (turn-off)

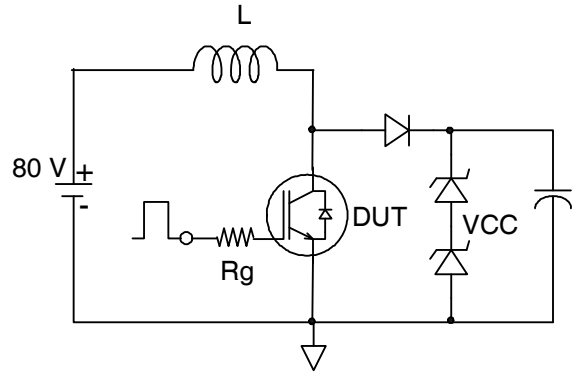


Fig.C.T.2 - RBSOA Circuit

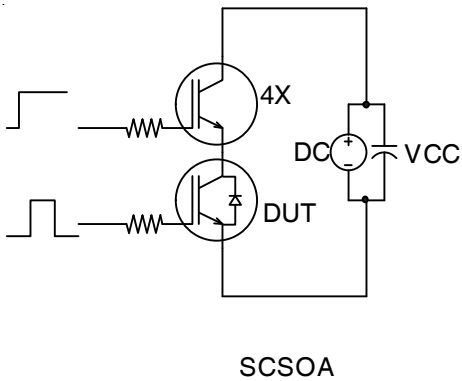


Fig.C.T.3 - S.C. SOA Circuit

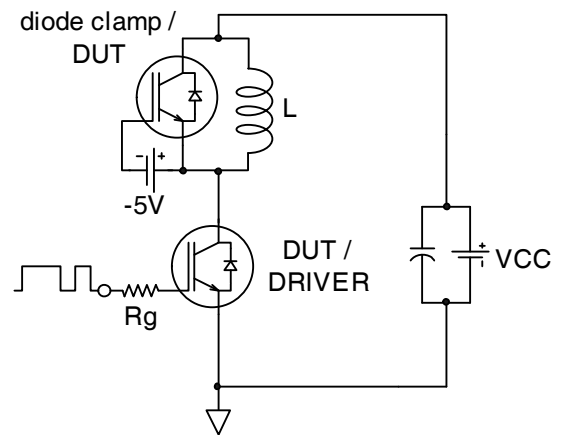


Fig.C.T.4 - Switching Loss Circuit

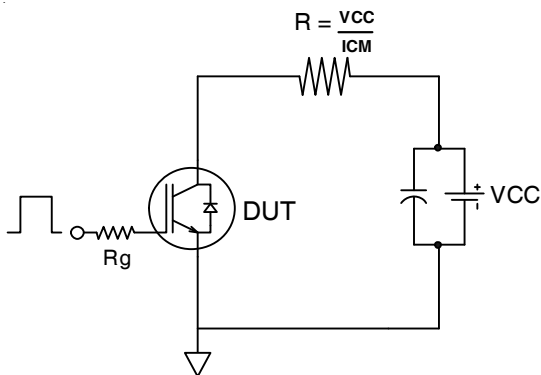


Fig.C.T.5 - Resistive Load Circuit

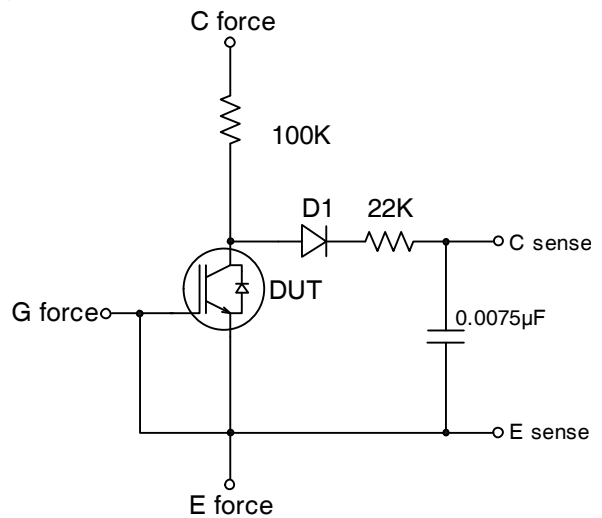


Fig.C.T.6 - BVCES Filter Circuit

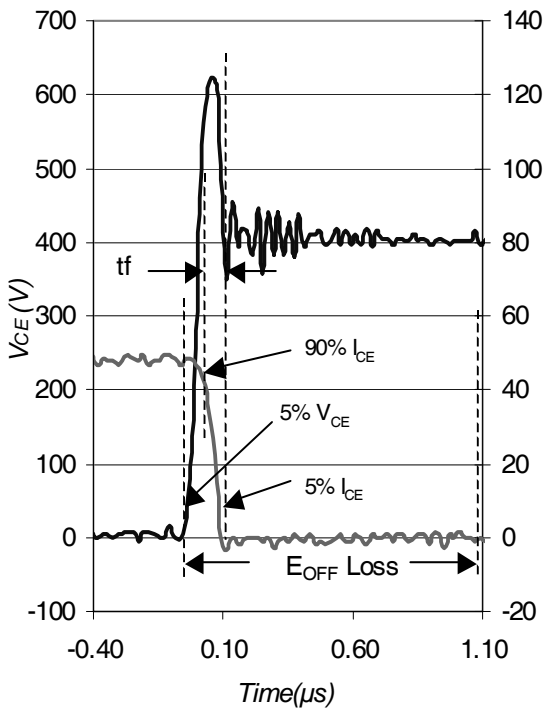


Fig. WF1 - Typ. Turn-off Loss Waveform
@ $T_J = 175^\circ\text{C}$ using Fig. CT.4

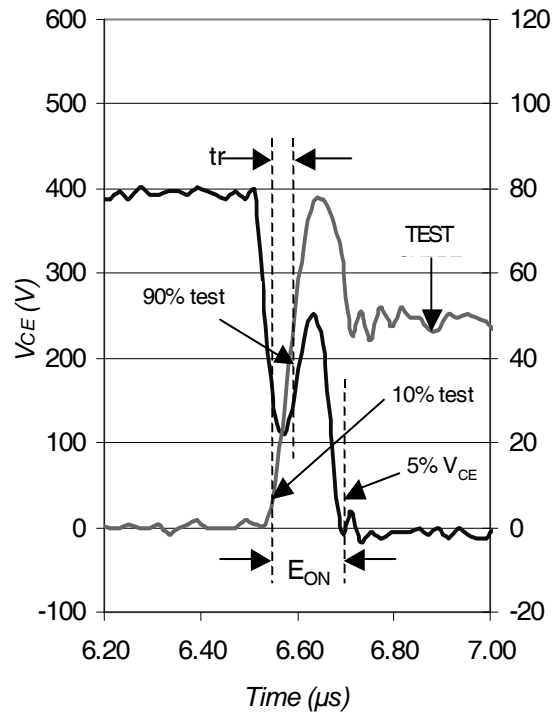


Fig. WF2 - Typ. Turn-on Loss Waveform
@ $T_J = 175^\circ\text{C}$ using Fig. CT.4

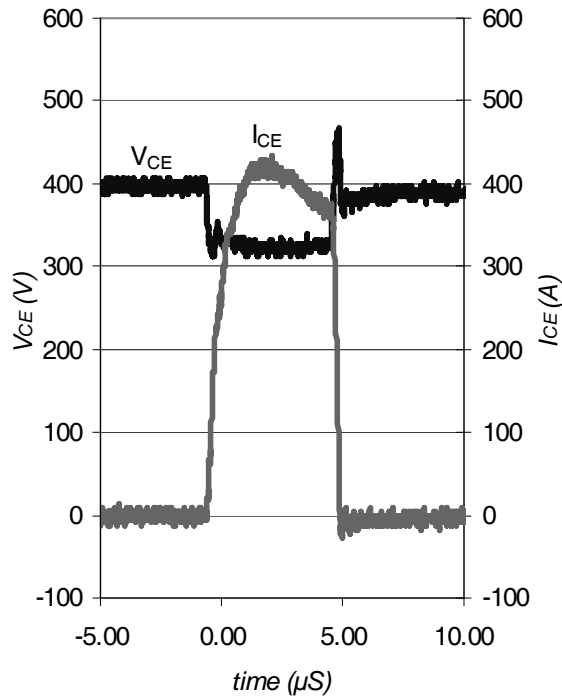
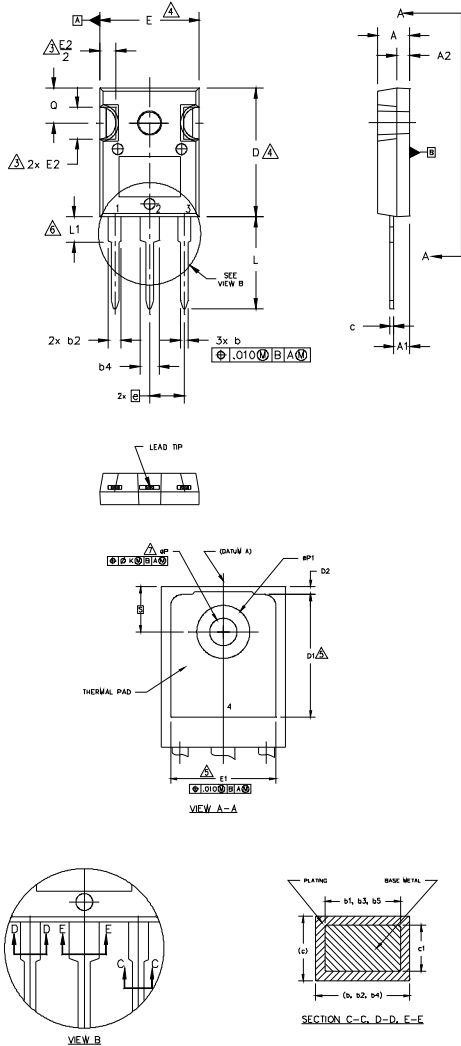


Fig. WF3 - Typ. S.C. Waveform
@ $T_J = 25^\circ\text{C}$ using Fig. CT.3

TO-247AC Package Outline

Dimensions are shown in millimeters (inches)



NOTES:

1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M 1994.
 2. DIMENSIONS ARE SHOWN IN INCHES.
 3. CONTOUR OF SLOT OPTIONAL.
 4. DIMENSION D & 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. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS D1 & E1.
 6. LEAD FINISH UNCONTROLLED IN L1.
 7. ϕP TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154 INCH.
- B. OUTLINE CONFORMS TO JEDEC OUTLINE TO-247AC .

SYMBOL	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN.	MAX.	MIN.	MAX.	
A	.183	.209	4.65	5.31	
A1	.087	.102	2.21	2.59	
A2	.059	.098	1.50	2.49	
b	.039	.055	0.99	1.40	
b1	.039	.053	0.99	1.35	
b2	.065	.094	1.65	2.39	
b3	.065	.092	1.65	2.34	
b4	.102	.135	2.59	3.43	
b5	.102	.133	2.59	3.38	
c	.015	.035	0.38	0.89	
c1	.015	.033	0.38	0.84	
D	.776	.815	19.71	20.70	4
D1	.515	-	13.08	-	5
D2	.020	.053	0.51	1.35	
E	.602	.625	15.29	15.87	4
E1	.530	-	13.46	-	
E2	.178	.216	4.52	5.49	
e	.215 BSC		5.46 BSC		
ϕk	.010		0.25		
L	.559	.634	14.20	16.10	
L1	.146	.169	3.71	4.29	
ϕP	.140	.144	3.56	3.66	
$\phi P1$	-	.291	-	7.39	
Q	.209	.224	5.31	5.69	
S	.217 BSC		5.51 BSC		

LEAD ASSIGNMENTS

HEXFET

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

IGBTs, CoPACK

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

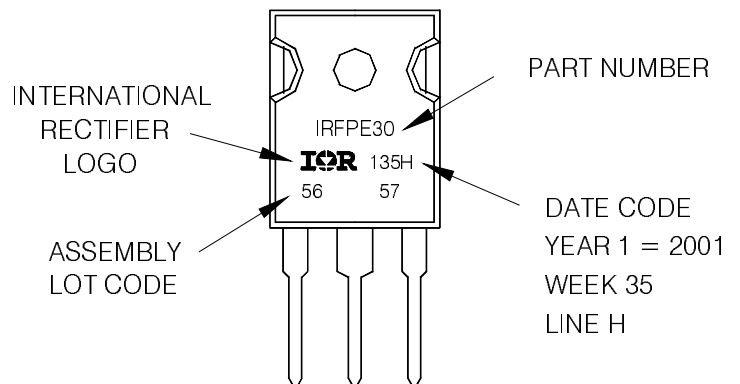
DIODES

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

TO-247AC Part Marking Information

EXAMPLE: THIS IS AN IRFPE30
WITH ASSEMBLY
LOT CODE 5657
ASSEMBLED ON WW 35, 2001
IN THE ASSEMBLY LINE "H"

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



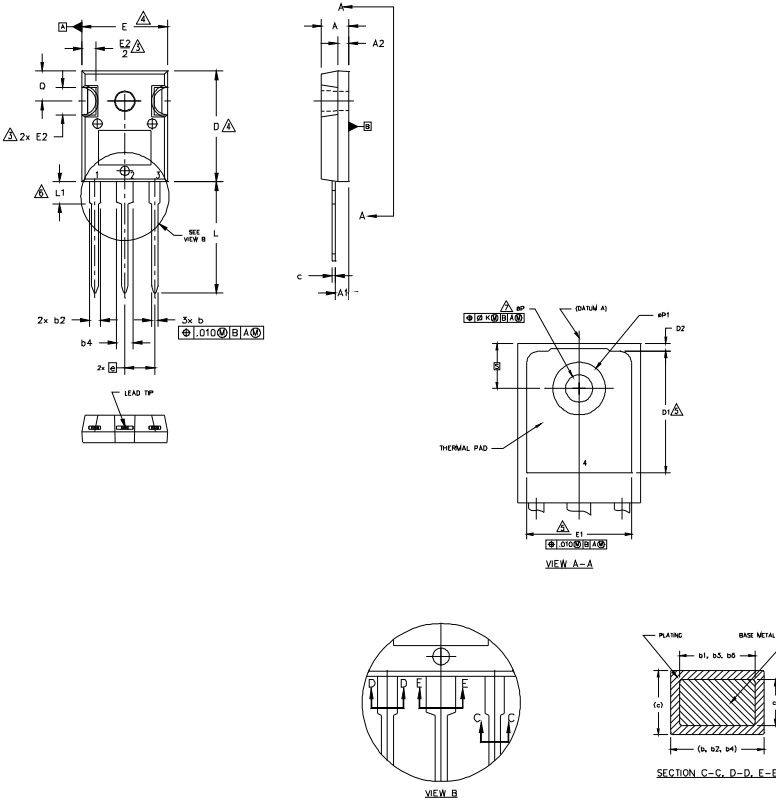
TO-247AC package is not recommended for Surface Mount Application.

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

IRGP4063PbF/IRGP4063-EPbF

TO-247AD Package Outline

Dimensions are shown in millimeters (inches)



NOTES:

1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M 1994.
2. DIMENSIONS ARE SHOWN IN INCHES.
3. CONTOUR OF SLOT OPTIONAL.
4. DIMENSION D & 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. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS D1 & E1.
6. LEAD FINISH UNCONTROLLED IN L1.
7. φP TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5 ° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154 INCH.
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-247AD.

SYMBOL	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN.	MAX.	MIN.	MAX.	
A	.183	.209	4.65	5.31	
A1	.087	.102	2.21	2.59	
A2	.059	.098	1.50	2.49	
b	.039	.055	0.99	1.40	
b1	.039	.053	0.99	1.35	
b2	.065	.094	1.65	2.39	
b3	.065	.092	1.65	2.34	
b4	.102	.135	2.59	3.43	
b5	.102	.133	2.59	3.38	
c	.015	.035	0.38	0.89	
c1	.015	.033	0.38	0.84	
D	.776	.815	19.71	20.70	4
D1	.515	-	13.08	-	5
D2	.020	.053	0.51	1.35	
E	.602	.625	15.29	15.87	4
E1	.530	-	13.46	-	
E2	.178	.216	4.52	5.49	
e	.215 BSC		5.46 BSC		
ek	.010		0.25		
L	.780	.827	19.57	21.00	
L1	.146	.169	3.71	4.29	
φP	.140	.144	3.56	3.66	
φP1	-	.291	-	7.39	
Q	.209	.224	5.31	5.69	
S	.217 BSC		5.51 BSC		

LEAD ASSIGNMENTS

HEXFET

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

IGBTs, CoPACK

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

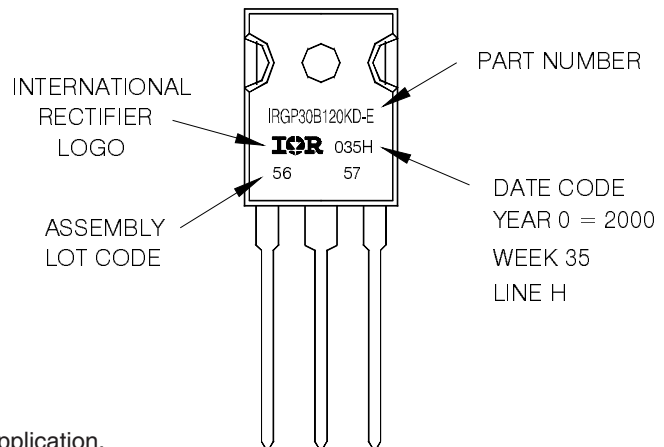
DIODES

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

TO-247AD Part Marking Information

EXAMPLE: THIS IS AN IRGP30B120KD-E
WITH ASSEMBLY
LOT CODE 5657
ASSEMBLED ON WW 35, 2000
IN THE ASSEMBLY LINE "H"

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



TO-247AD 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/>

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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