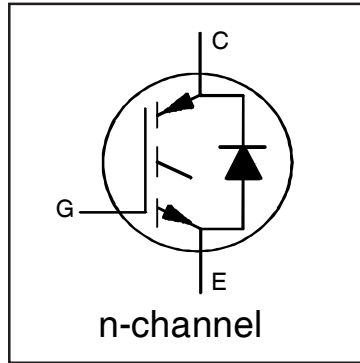


**INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRA-LOW VF DIODE  
FOR INDUCTION HEATING AND SOFT SWITCHING APPLICATIONS**

**IRG7PH42UD1PbF  
IRG7PH42UD1-EP**

**Features**

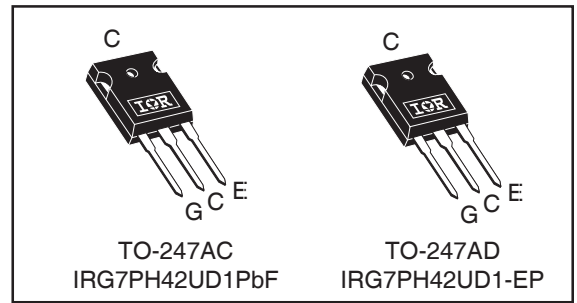
- Low  $V_{CE(ON)}$  trench IGBT technology
- Low switching losses
- Square RBSOA
- Ultra-low  $V_F$  Diode
- 1300Vpk repetitive transient capacity
- 100% of the parts tested for  $I_{LM}$  ①
- Positive  $V_{CE(ON)}$  temperature co-efficient
- Tight parameter distribution
- Lead free package



$V_{CES} = 1200V$
$I_{NOMINAL} = 30A$
$T_{J(max)} = 150^{\circ}C$
$V_{CE(on)} \text{ typ.} = 1.7V$

**Benefits**

- Device optimized for induction heating and soft switching applications
- High Efficiency due to Low  $V_{CE(on)}$ , low switching losses and Ultra-low  $V_F$
- Rugged transient performance for increased reliability
- Excellent current sharing in parallel operation
- Low EMI



<b>G</b>	<b>C</b>	<b>E</b>
Gate	Collector	Emitter

**Absolute Maximum Ratings**

	Parameter	Max.	Units
$V_{CES}$	Collector-to-Emitter Voltage	1200	V
$I_C @ T_C = 25^{\circ}C$	Continuous Collector Current	85 <sup>②</sup>	A
$I_C @ T_C = 100^{\circ}C$	Continuous Collector Current	45	
$I_{NOMINAL}$	Nominal Current	30	
$I_{CM}$	Pulse Collector Current, $V_{GE}=15V$ ⑥	90	
$I_{LM}$	Clamped Inductive Load Current, $V_{GE}=20V$ ①	120	
$I_F @ T_C = 25^{\circ}C$	Diode Continuous Forward Current	70	
$I_F @ T_C = 100^{\circ}C$	Diode Continuous Forward Current	35	
$I_{FRM}$	Diode Repetitive Peak Forward Current ②	120	
$V_{GE}$	Continuous Gate-to-Emitter Voltage	$\pm 30$	V
$P_D @ T_C = 25^{\circ}C$	Maximum Power Dissipation	313	W
$P_D @ T_C = 100^{\circ}C$	Maximum Power Dissipation	125	
$T_J$ $T_{STG}$	Operating Junction and Storage Temperature Range	-55 to +150	$^{\circ}C$
	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 Resistance**

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$ (IGBT)	Thermal Resistance Junction-to-Case-(each IGBT) ④	—	—	0.4	$^{\circ}C/W$
$R_{\theta JC}$ (Diode)	Thermal Resistance Junction-to-Case-(each Diode) ④	—	—	1.05	
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink (flat, greased surface)	—	0.24	—	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (typical socket mount)	—	40	—	

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

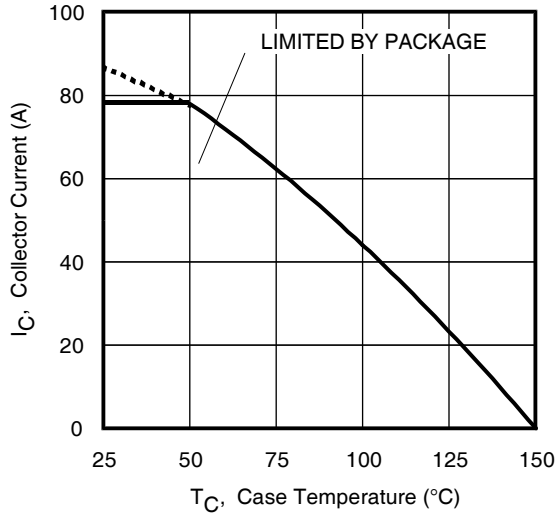
	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	1200	—	—	V	$V_{GE} = 0V, I_C = 100\mu\text{A}$ ③
$V_{CES(Transient)}$	Repetitive Transient Collector-to-Emitter Voltage	—	—	1300	V	$V_{GE} = 0V, T_J = 75^\circ\text{C}, PW \leq 10\mu\text{s}$ ③
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	1.2	—	V/°C	$V_{GE} = 0V, I_C = 2.0\text{mA}$ (25°C-150°C)
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.7	2.0	V	$I_C = 30A, V_{GE} = 15V, T_J = 25^\circ\text{C}$
		—	2.0	—		$I_C = 30A, V_{GE} = 15V, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0	V	$V_{CE} = V_{GE}, I_C = 1.0\text{mA}$
$g_{fe}$	Forward Transconductance	—	32	—	S	$V_{CE} = 50V, I_C = 30A, PW = 80\mu\text{s}$
$I_{CES}$	Collector-to-Emitter Leakage Current	—	1.0	100	$\mu\text{A}$	$V_{GE} = 0V, V_{CE} = 1200V$
		—	230	—		$V_{GE} = 0V, V_{CE} = 1200V, T_J = 150^\circ\text{C}$
$V_{FM}$	Diode Forward Voltage Drop	—	1.15	1.30	V	$I_F = 30A$
		—	1.10	—		$I_F = 30A, T_J = 150^\circ\text{C}$
$I_{GES}$	Gate-to-Emitter Leakage Current	—	—	$\pm 100$	nA	$V_{GE} = \pm 30V$

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

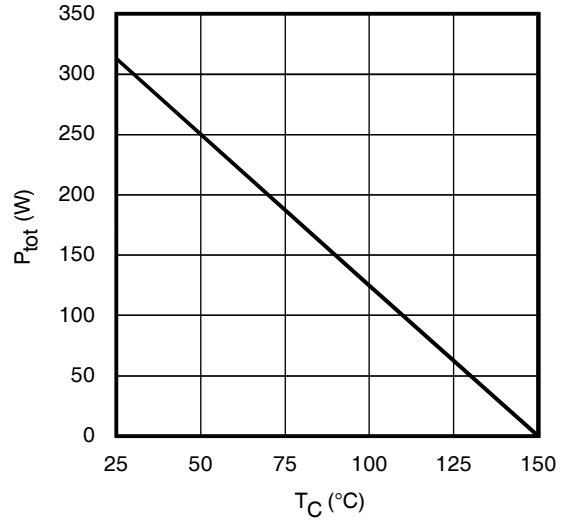
	Parameter	Min.	Typ.	Max.	Units	Conditions
$Q_g$	Total Gate Charge (turn-on)	—	180	270	nC	$I_C = 30A$ $V_{GE} = 15V$ $V_{CC} = 600V$
$Q_{ge}$	Gate-to-Emitter Charge (turn-on)	—	24	36		
$Q_{gc}$	Gate-to-Collector Charge (turn-on)	—	70	110		
$E_{off}$	Turn-Off Switching Loss	—	1210	1450	$\mu\text{J}$	$I_C = 30A, V_{CC} = 600V, V_{GE} = 15V$ $R_G = 10\Omega, L = 200\mu\text{H}, T_J = 25^\circ\text{C}$ Energy losses include tail
$t_{d(off)}$	Turn-Off delay time	—	270	290	ns	$I_C = 30A, V_{CC} = 600V, V_{GE} = 15V$ $R_G = 10\Omega, L = 200\mu\text{H}, T_J = 25^\circ\text{C}$
$t_f$	Fall time	—	35	43		
$E_{off}$	Turn-Off Switching Loss	—	1936	—	$\mu\text{J}$	$I_C = 30A, V_{CC} = 600V, V_{GE} = 15V$ $R_G = 10\Omega, L = 200\mu\text{H}, T_J = 150^\circ\text{C}$ Energy losses include tail
$t_{d(off)}$	Turn-Off delay time	—	300	—	ns	$I_C = 30A, V_{CC} = 600V, V_{GE} = 15V$ $R_G = 10\Omega, L = 200\mu\text{H}, T_J = 150^\circ\text{C}$
$t_f$	Fall time	—	160	—		
$C_{ies}$	Input Capacitance	—	3390	—	pF	$V_{GE} = 0V$ $V_{CC} = 30V$ $f = 1.0\text{Mhz}$
$C_{oes}$	Output Capacitance	—	130	—		
$C_{res}$	Reverse Transfer Capacitance	—	83	—		
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				$T_J = 150^\circ\text{C}, I_C = 120A$ $V_{CC} = 960V, V_p = 1200V$ $R_g = 10\Omega, V_{GE} = +20V \text{ to } 0V$

### Notes:

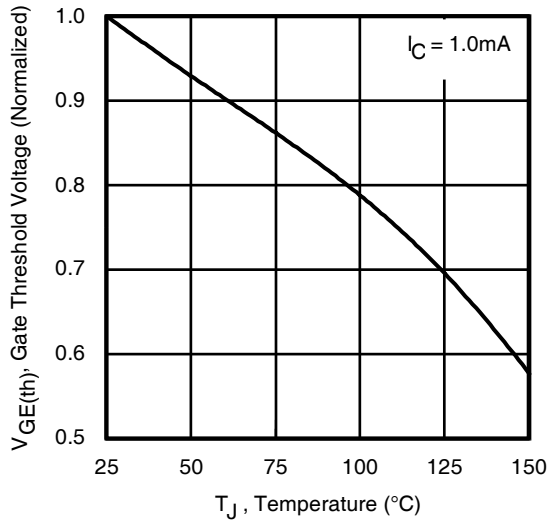
- ①  $V_{CC} = 80\% (V_{CES}), V_{GE} = 20V, L = 22\mu\text{H}, R_G = 10\Omega$ .
- ② Pulse width limited by max. junction temperature.
- ③ Refer to AN-1086 for guidelines for measuring  $V_{(BR)CES}$  safely.
- ④  $R_\theta$  is measured at  $T_J$  of approximately  $90^\circ\text{C}$ .
- ⑤ Calculated continuous current based on maximum allowable junction temperature. Bond wire current limit is 78A. Note that current limitations arising from heating of the device leads may occur with some lead mounting arrangements.
- ⑥ Rating for Hard Switching conditions. Rating is higher in Soft Switching conditions.



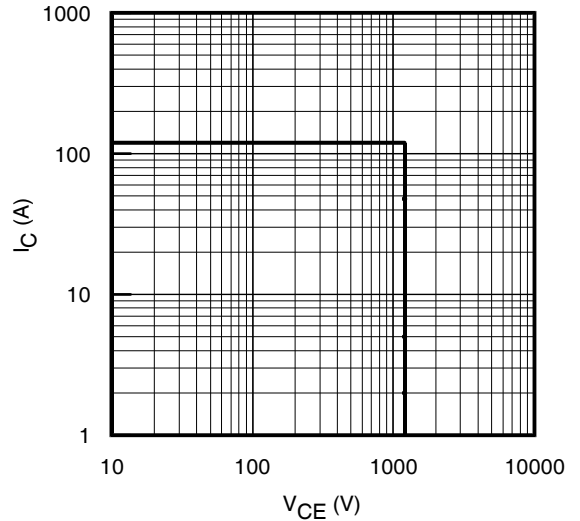
**Fig. 1** - Maximum DC Collector Current vs. Case Temperature



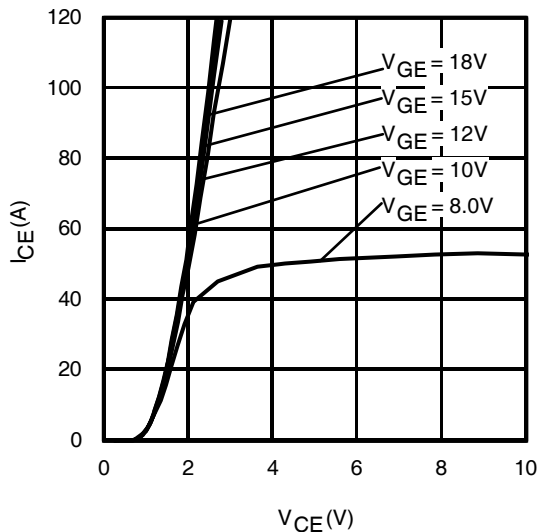
**Fig. 2** - Power Dissipation vs. Case Temperature



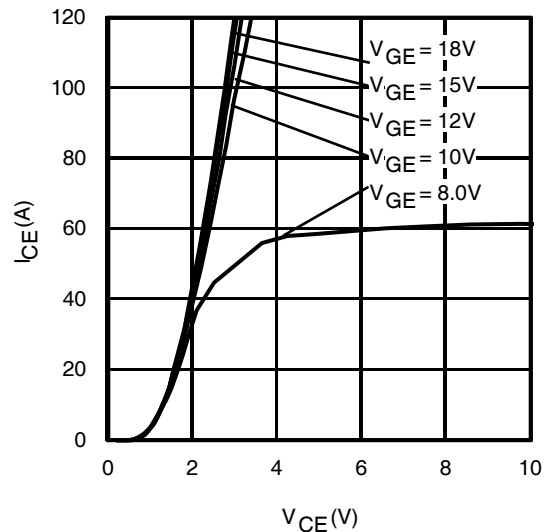
**Fig. 3** - Typical Gate Threshold Voltage (Normalized) vs. Junction Temperature



**Fig. 4** - Reverse Bias SOA  
 $T_J = 150^{\circ}\text{C}$ ;  $V_{GE} = 20\text{V}$

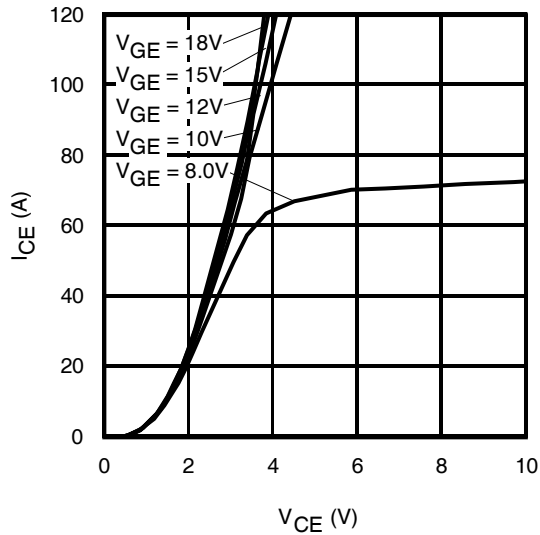


**Fig. 5** - Typ. IGBT Output Characteristics  
 $T_J = -40^{\circ}\text{C}$ ;  $t_p = 80\mu\text{s}$

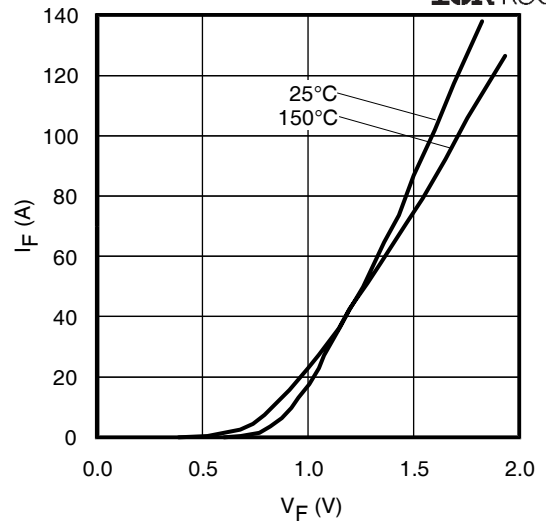


**Fig. 6** - Typ. IGBT Output Characteristics  
 $T_J = 25^{\circ}\text{C}$ ;  $t_p = 80\mu\text{s}$

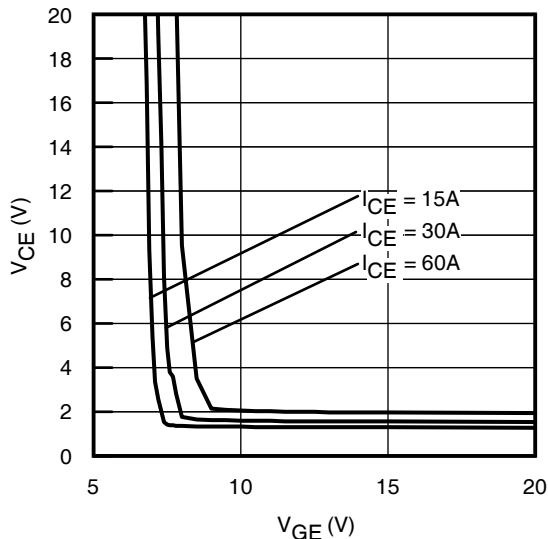
# IRG7PH42UD1PbF/IRG7PH42UD1-EP



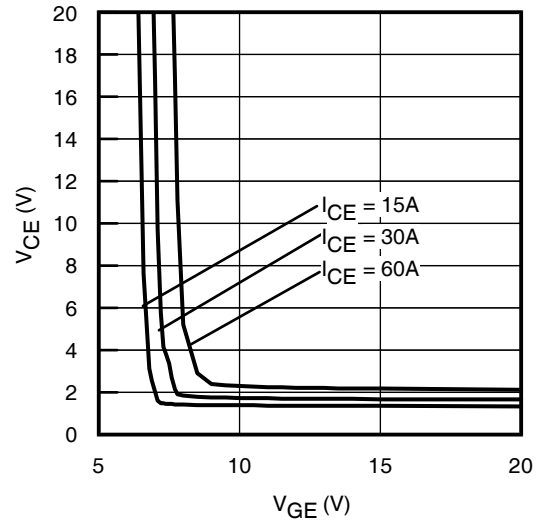
**Fig. 7** - Typ. IGBT Output Characteristics  
 $T_J = 150^\circ\text{C}$ ;  $t_p = 80\mu\text{s}$



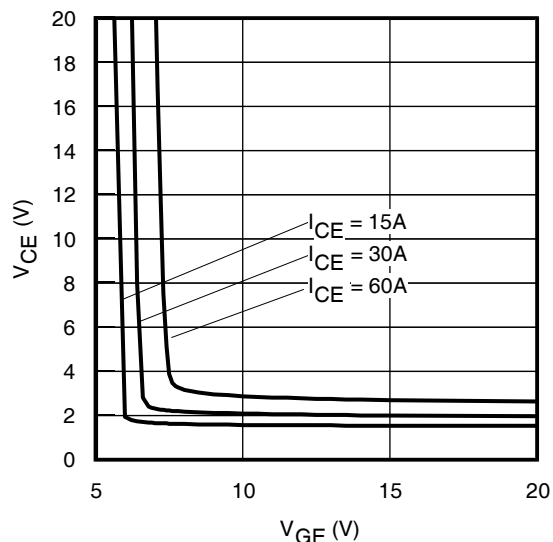
**Fig. 8** - Typ. Diode Forward Voltage Drop Characteristics



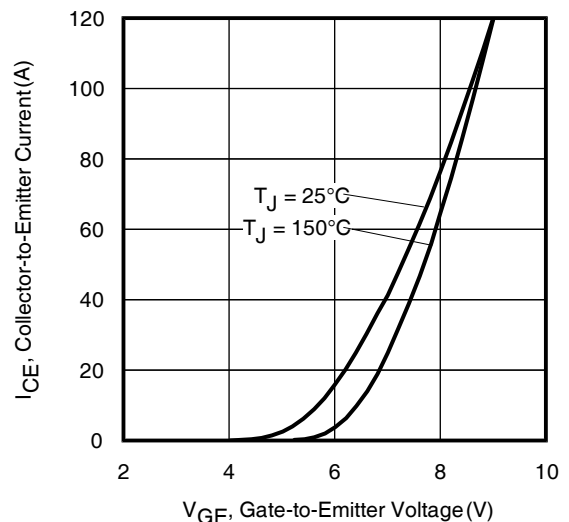
**Fig. 9** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = -40^\circ\text{C}$



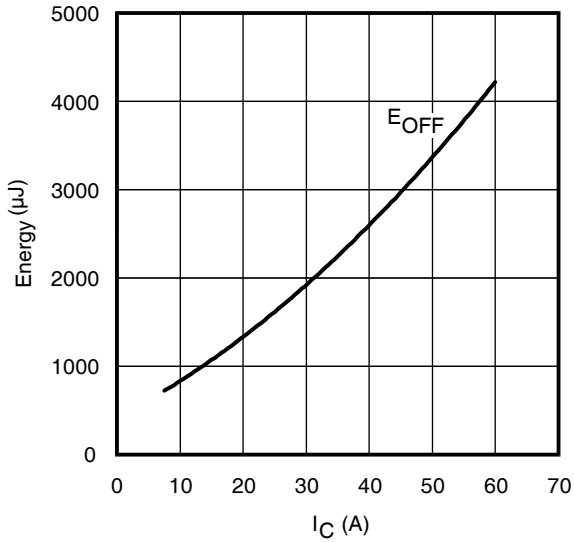
**Fig. 10** - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 25^\circ\text{C}$



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

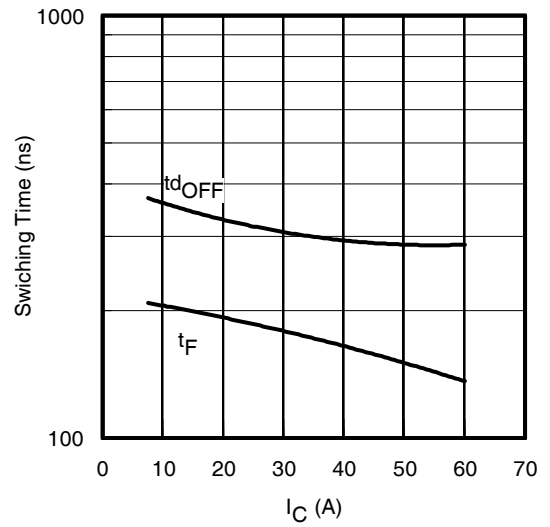


**Fig. 12** - Typ. Transfer Characteristics  
 $V_{CE} = 50\text{V}$ ;  $t_p = 10\mu\text{s}$



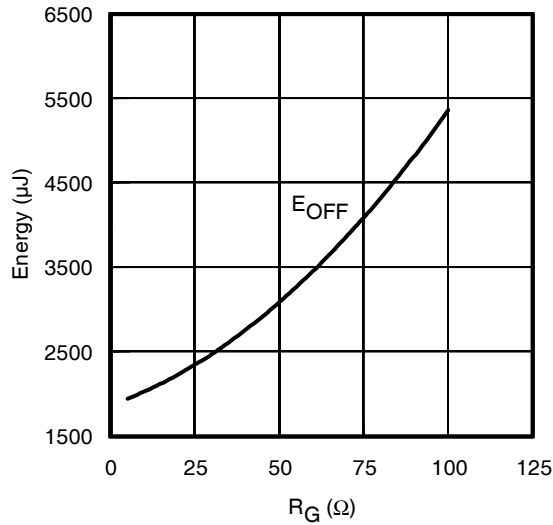
**Fig. 13** - Typ. Energy Loss vs. I<sub>C</sub>

T<sub>J</sub> = 150°C; L = 200μH; V<sub>CE</sub> = 600V, R<sub>G</sub> = 10Ω; V<sub>GE</sub> = 15V



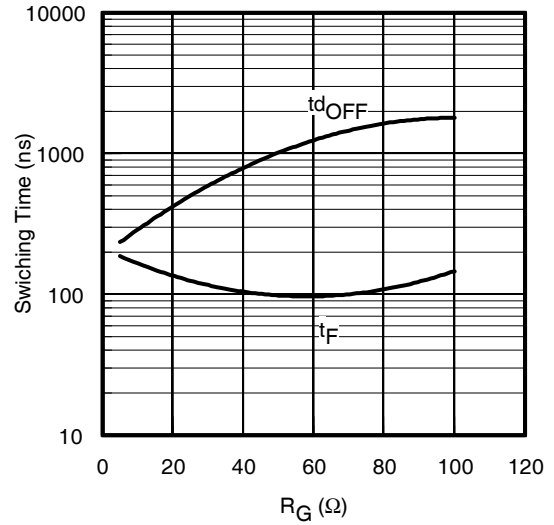
**Fig. 14** - Typ. Switching Time vs. I<sub>C</sub>

T<sub>J</sub> = 150°C; L = 200μH; V<sub>CE</sub> = 600V, R<sub>G</sub> = 10Ω; V<sub>GE</sub> = 15V



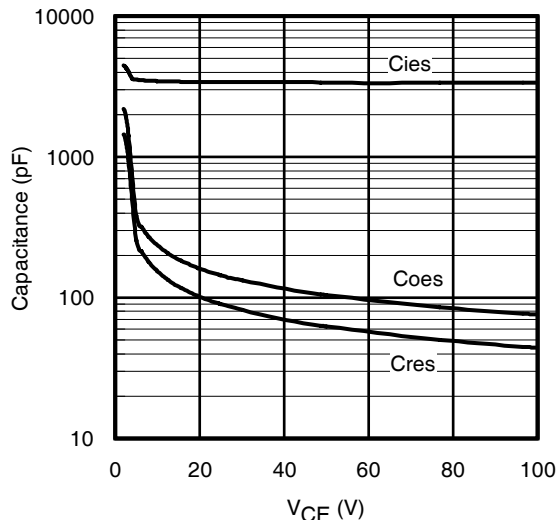
**Fig. 15** - Typ. Energy Loss vs. R<sub>G</sub>

T<sub>J</sub> = 150°C; L = 200μH; V<sub>CE</sub> = 600V, I<sub>CE</sub> = 30A; V<sub>GE</sub> = 15V

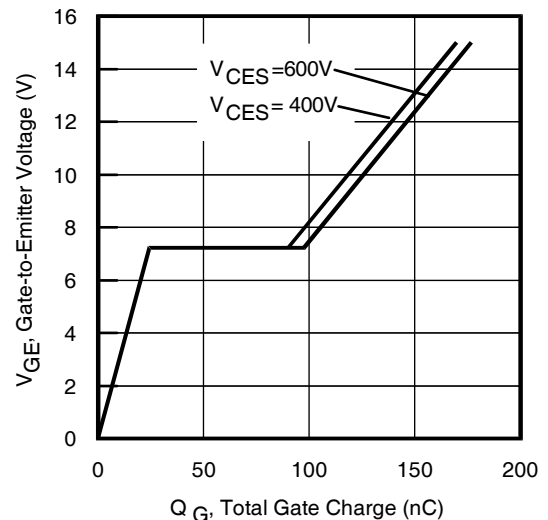


**Fig. 16** - Typ. Switching Time vs. R<sub>G</sub>

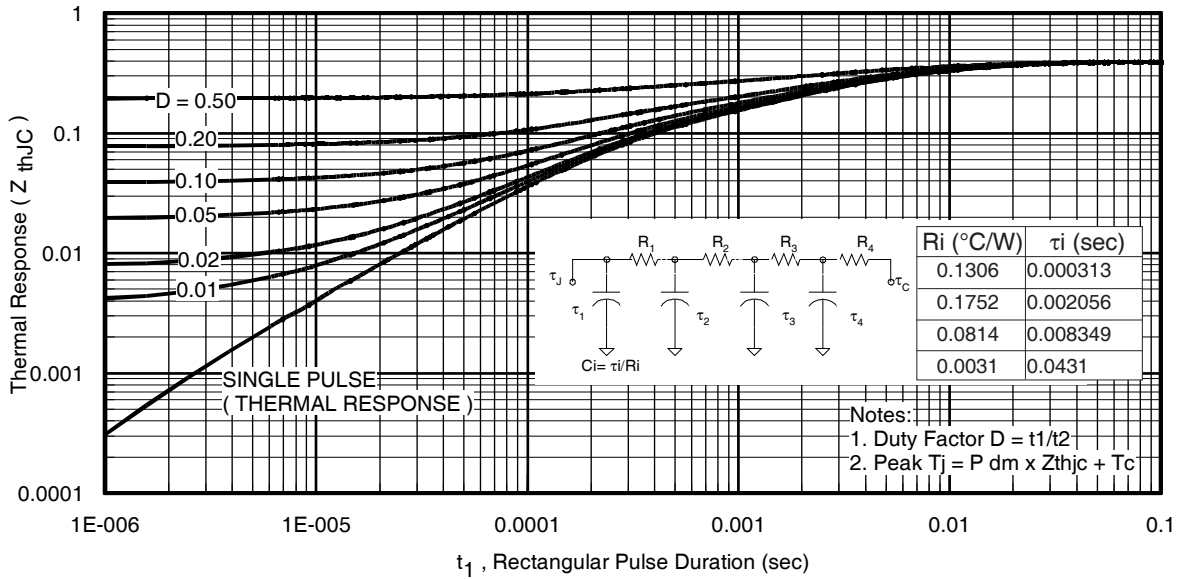
T<sub>J</sub> = 150°C; L = 200μH; V<sub>CE</sub> = 600V, I<sub>CE</sub> = 30A; V<sub>GE</sub> = 15V



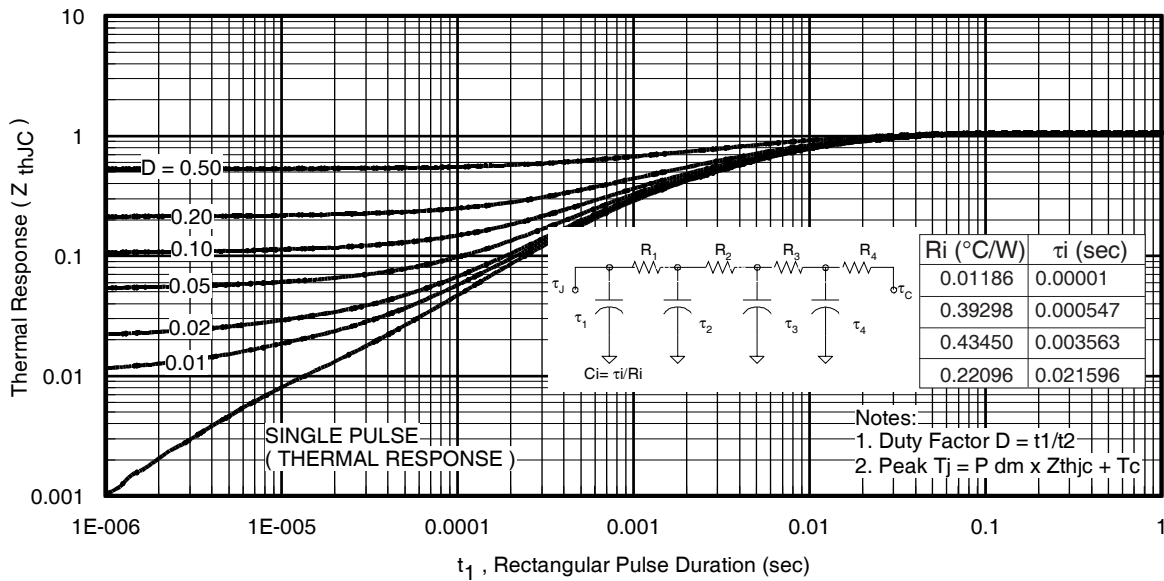
**Fig. 17** - Typ. Capacitance vs. V<sub>CE</sub>  
V<sub>GE</sub> = 0V; f = 1MHz



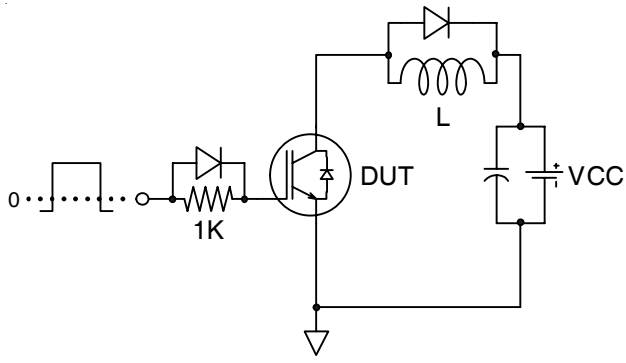
**Fig. 18** - Typical Gate Charge vs. V<sub>GE</sub>  
I<sub>CE</sub> = 30A; L = 680μH



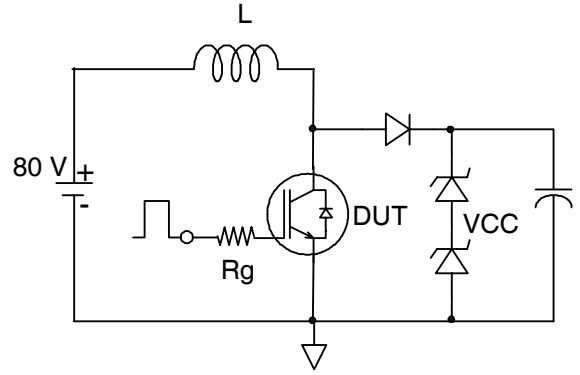
**Fig. 19.** Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)



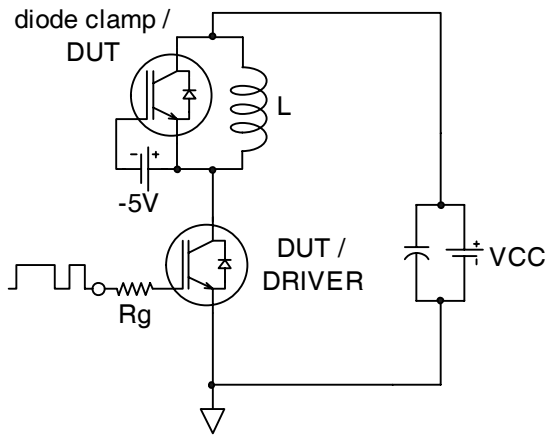
**Fig. 20.** Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)



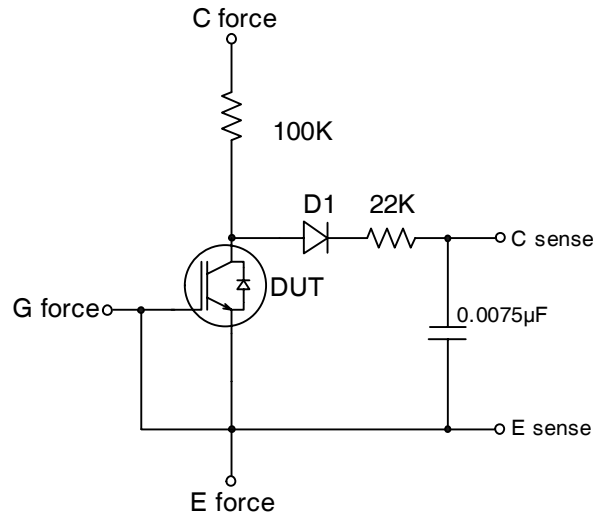
**Fig.C.T.1** - Gate Charge Circuit (turn-off)



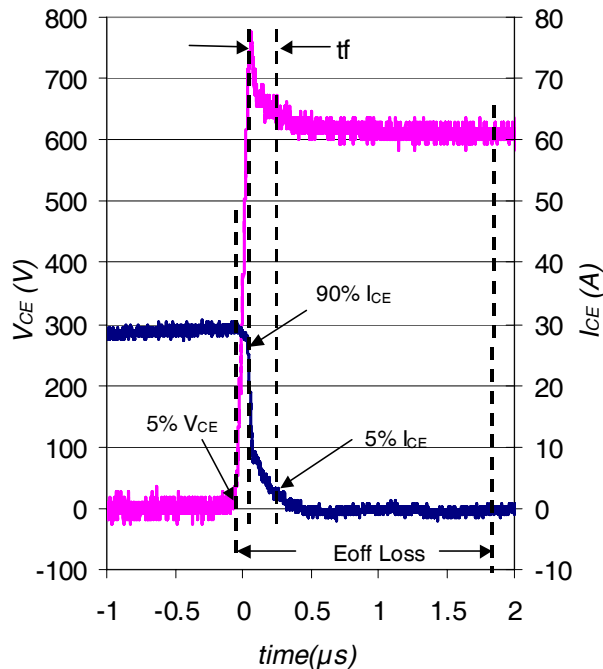
**Fig.C.T.2** - RBSOA Circuit



**Fig.C.T.3** - Switching Loss Circuit



**Fig.C.T.4** - BVCES Filter Circuit

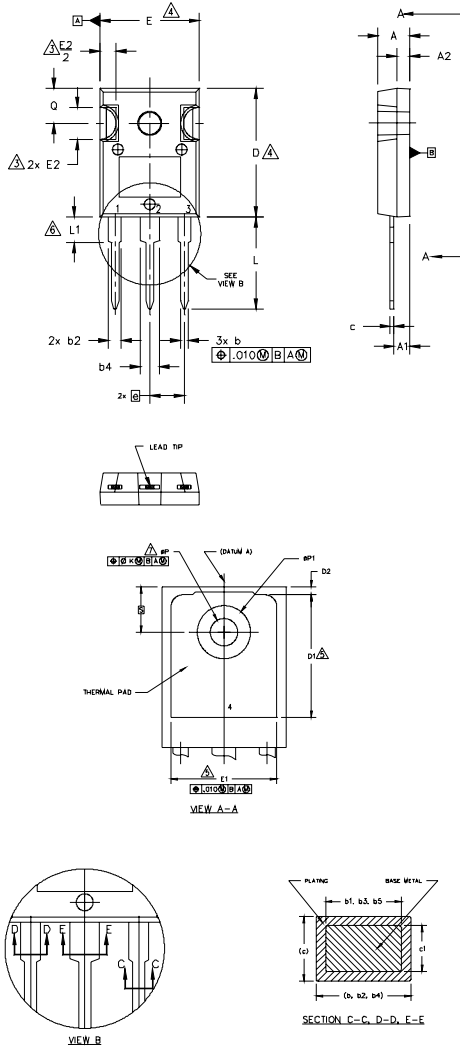


**Fig. WF1** - Typ. Turn-off Loss Waveform  
@  $T_J = 150^\circ\text{C}$  using Fig. CT.3

# IRG7PH42UD1PbF/IRG7PH42UD1-EP

## 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. ØP 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-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		
Øk	.010		0.25		
L	.559	.634	14.20	16.10	
L1	.146	.169	3.71	4.29	
ØP	.140	.144	3.56	3.66	
ØP1	-	.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

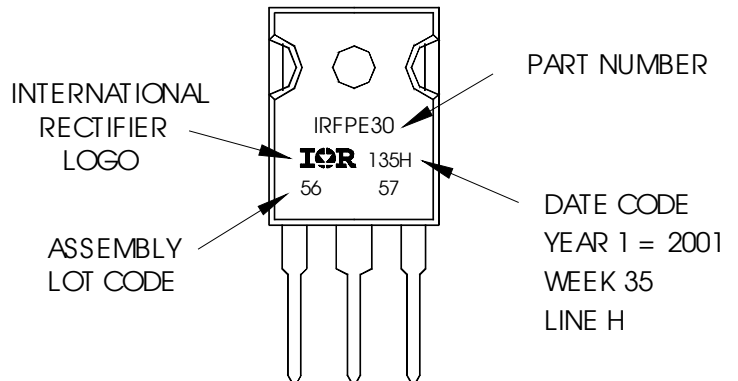
DIODES

- 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"



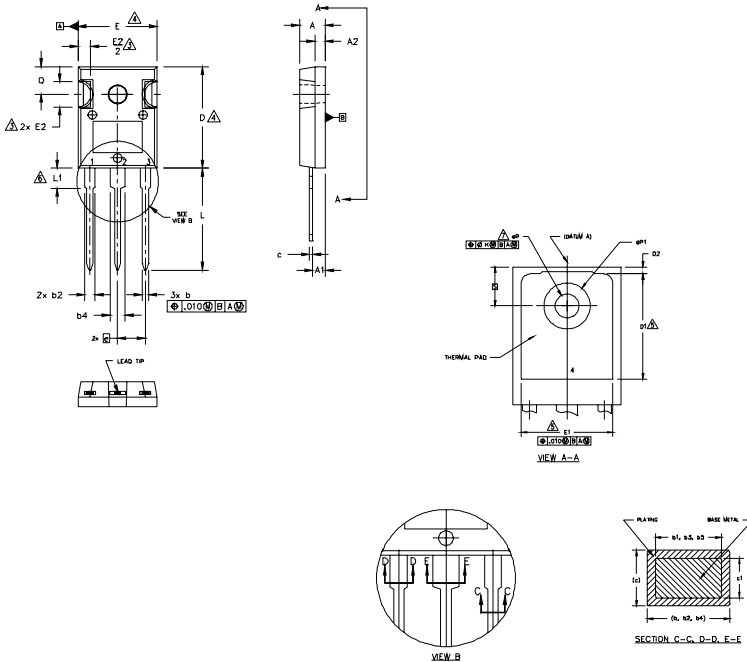
TO-247AC package is not recommended for Surface Mount Application.

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



## 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. ØP 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		
Øk	.010		0.25		
L	.780	.827	19.57	21.00	
L1	.146	.169	3.71	4.29	
ØP	.140	.144	3.56	3.66	
ØP1	-	.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

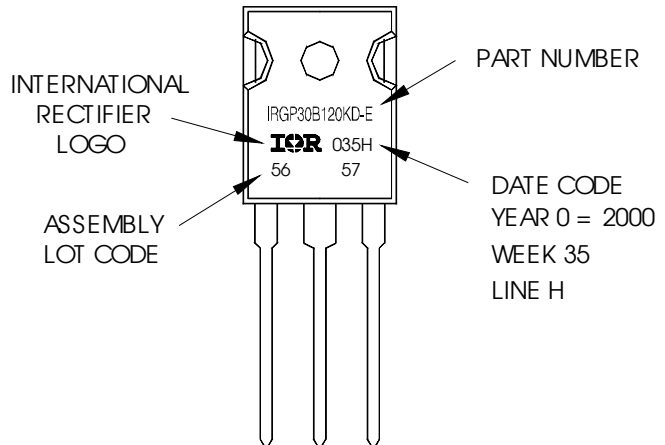
**DIODES**

- 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.