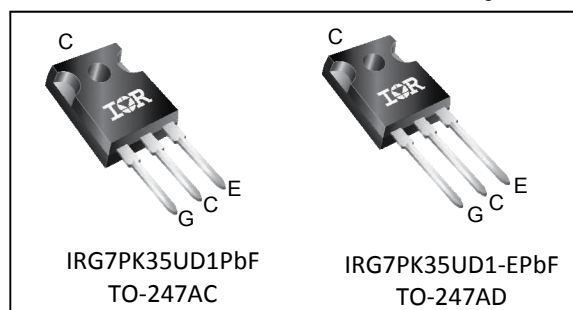
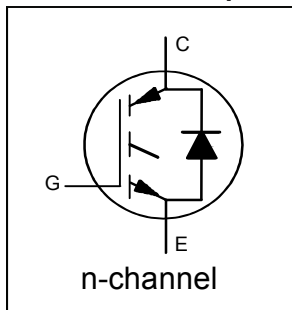


$V_{CES} = 1400V$
$I_C = 20A, T_C = 100^\circ C$
$T_{J(max)} = 150^\circ C$
$V_{CE(ON)} \text{ typ.} = 2.0V @ I_C = 20A$

**Insulated Gate Bipolar Transistor with Ultrafast Soft Recovery Diode**



G	C	E
Gate	Collector	Emitter

**Applications**

- Induction heating
- Microwave ovens
- Soft switching applications

Features	Benefits
Low $V_{CE(ON)}$ , ultra-low $V_F$ , and turn-off soft switching losses	High efficiency in a wide range of soft switching applications and switching frequencies
Positive $V_{CE(ON)}$ temperature coefficient and tight distribution of parameters	Excellent current sharing in parallel operation
Lead-free, RoHS compliant	Environmentally friendly

Base part number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRG7PK35UD1PbF	TO-247AC	Tube	25	IRG7PK35UD1PbF
IRG7PK35UD1-EPbF	TO-247AD	Tube	25	IRG7PK35UD1-EPbF

**Absolute Maximum Ratings**

	Parameter	Max.	Units
$V_{CES}$	Collector-to-Emitter Voltage	1400	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	40	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	20	
$I_{CM}$	Pulse Collector Current, $V_{GE} = 15V$ ①②	200	
$I_{LM}$	Clamped Inductive Load Current, $V_{GE} = 20V$ ③	80	
$I_F @ T_C = 25^\circ C$	Diode Continuous Forward Current	40	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	20	W
$V_{GE}$	Continuous Gate-to-Emitter Voltage	$\pm 30$	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	167	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	67	
$T_J$	Operating Junction and Storage Temperature Range	-40 to +150	C
$T_{STG}$	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 (IGBT) ④	—	—	0.75	$^\circ C/W$
$R_{\theta JC}$ (Diode)	Thermal Resistance Junction-to-Case (Diode) ④	—	—	1.4	
$R_{\theta CS}$	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)**

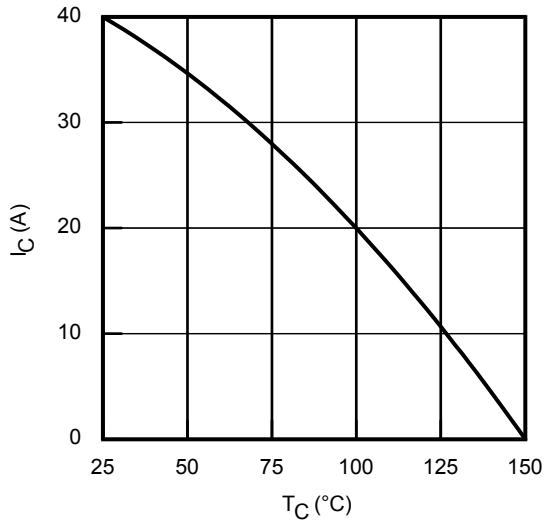
	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	2.0	2.35	V	$I_C = 20\text{A}$ , $V_{GE} = 15\text{V}$ , $T_J = 25^\circ\text{C}$
		—	2.4	—		$I_C = 20\text{A}$ , $V_{GE} = 15\text{V}$ , $T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0	V	$V_{CE} = V_{GE}$ , $I_C = 600\mu\text{A}$
$g_{fe}$	Forward Transconductance	—	21	—	S	$V_{CE} = 50\text{V}$ , $I_C = 20\text{A}$ , $PW = 20\mu\text{s}$
$I_{CES}$	Collector-to-Emitter Leakage Current	—	1.0	100	$\mu\text{A}$	$V_{GE} = 0\text{V}$ , $V_{CE} = 1400\text{V}$
		—	150	—		$V_{GE} = 0\text{V}$ , $V_{CE} = 1400\text{V}$ , $T_J = 150^\circ\text{C}$
$I_{GES}$	Gate-to-Emitter Leakage Current	—	—	$\pm 100$	nA	$V_{GE} = \pm 30\text{V}$
$V_F$	Diode Forward Voltage Drop	—	1.30	1.43	V	$I_F = 20\text{A}$
		—	1.25	—		$I_F = 20\text{A}$ , $T_J = 150^\circ\text{C}$

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

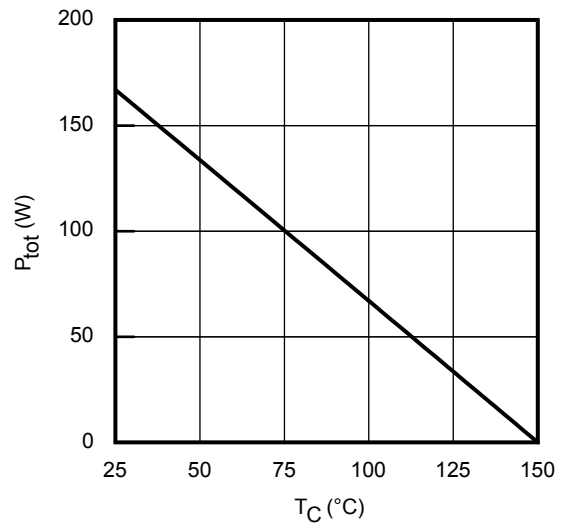
	Parameter	Min.	Typ.	Max <sup>⑥</sup>	Units	Conditions
$Q_g$	Total Gate Charge (turn-on)	—	65	98	nC	$I_C = 20\text{A}$ $V_{GE} = 15\text{V}$ $V_{CC} = 600\text{V}$
$Q_{ge}$	Gate-to-Emitter Charge (turn-on)	—	15	23		
$Q_{gc}$	Gate-to-Collector Charge (turn-on)	—	25	38		
$E_{off}$	Turn-Off Switching Loss	—	0.65	0.90	mJ	$I_C = 20\text{A}$ , $V_{CC} = 600\text{V}$ , $V_{GE} = 15\text{V}$ $R_G = 10\Omega$ , $T_J = 25^\circ\text{C}$
$t_{d(off)}$	Turn-Off delay time	—	150	170	ns	Energy losses include tail
$t_f$	Fall time	—	75	95		
$E_{off}$	Turn-Off Switching Loss	—	1.3	—	mJ	$I_C = 20\text{A}$ , $V_{CC} = 600\text{V}$ , $V_{GE} = 15\text{V}$ $R_G = 10\Omega$ , $T_J = 150^\circ\text{C}$
$t_{d(off)}$	Turn-Off delay time	—	180	—	ns	Energy losses include tail
$t_f$	Fall time	—	180	—		
$C_{ies}$	Input Capacitance	—	2200	—	pF	$V_{GE} = 0\text{V}$ $V_{CC} = 30\text{V}$ $f = 1.0\text{MHz}$
$C_{oes}$	Output Capacitance	—	70	—		
$C_{res}$	Reverse Transfer Capacitance	—	35	—		
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				$T_J = 150^\circ\text{C}$ , $I_C = 80\text{A}$ $V_{CC} = 1120\text{V}$ , $V_p \leq 1400\text{V}$ $R_G = 10\Omega$ , $V_{GE} = +20\text{V to } 0\text{V}$

**Notes:**

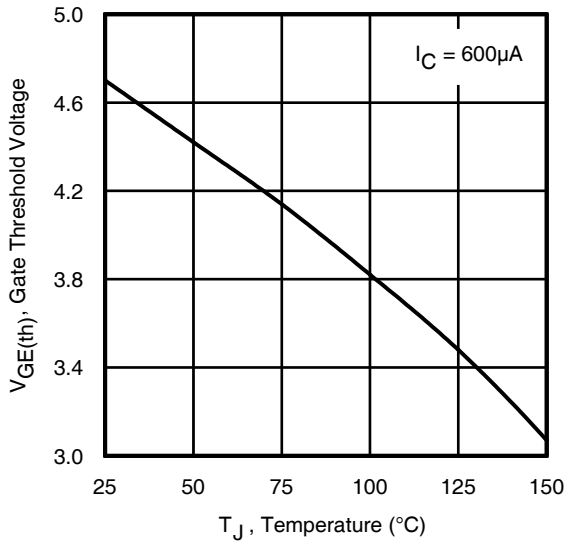
- ① FBSOA operating conditions only.
- ② Pulse width limited by max. junction temperature.
- ③  $V_{CC} = 80\% (V_{CES})$ ,  $V_{GE} = 20\text{V}$ ,  $R_G = 10\Omega$ .
- ④  $R_\theta$  is measured at  $T_J$  of approximately  $90^\circ\text{C}$ .
- ⑤ Refer to AN-1086 for guidelines for measuring  $V_{(BR)CES}$  safely.
- ⑥ Maximum limits are based on statistical sample size characterization.



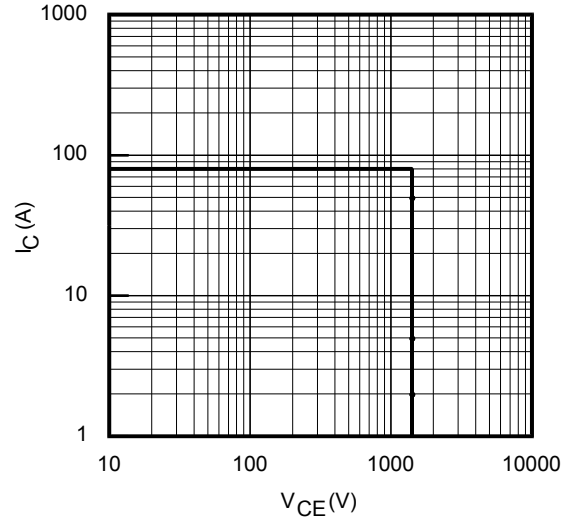
**Fig. 1 - Maximum DC Collector Current vs. Case Temperature**



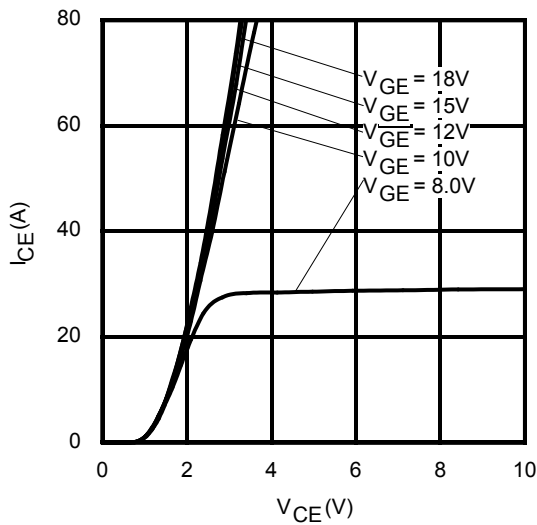
**Fig. 2 - Power Dissipation vs. Case Temperature**



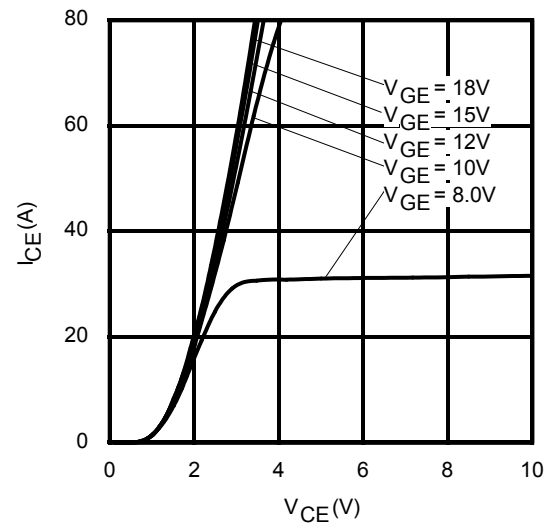
**Fig. 3 - Typical Gate Threshold Voltage vs. Junction Temperature**  
 $I_C = 600\mu A$



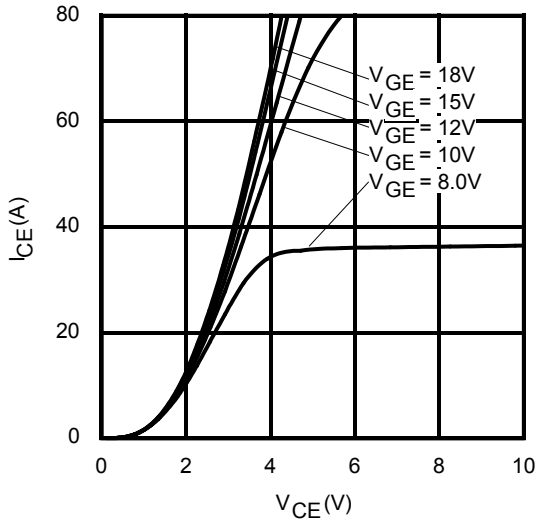
**Fig. 4 - Reverse Bias SOA**  
 $T_J = 150^\circ C; V_{GE} = 20V$



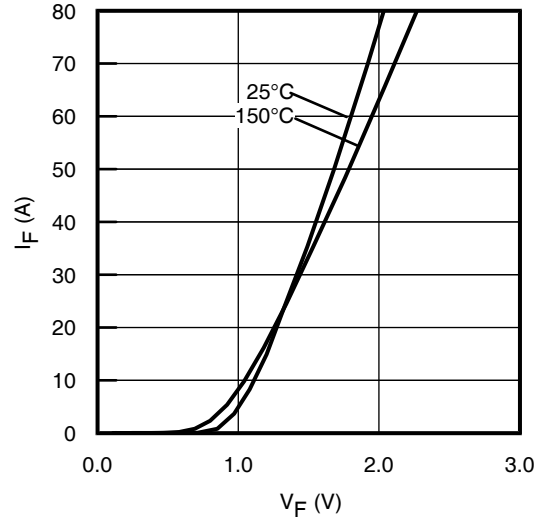
**Fig. 5 - Typ. IGBT Output Characteristics**  
 $T_J = -40^\circ C; t_p = 20\mu s$



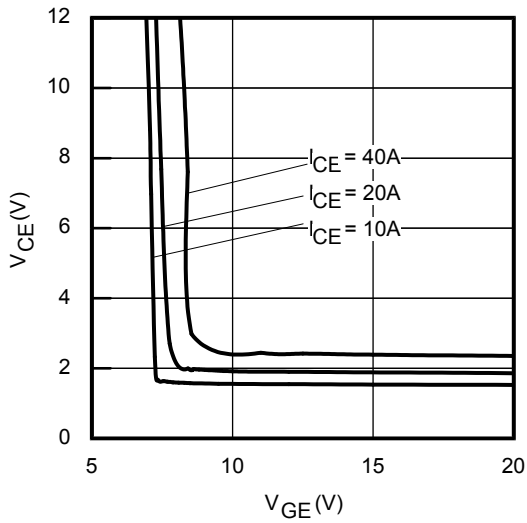
**Fig. 6 - Typ. IGBT Output Characteristics**  
 $T_J = 25^\circ C; t_p = 20\mu s$



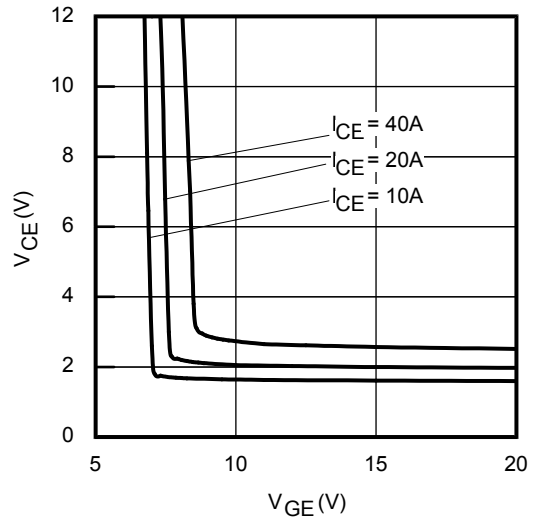
**Fig. 7 - Typ. IGBT Output Characteristics**  
 $T_J = 150^\circ\text{C}$ ;  $t_p = 20\mu\text{s}$



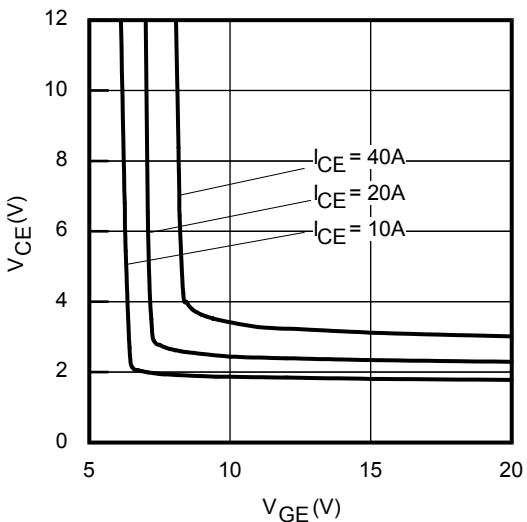
**Fig. 8 - Typ. Diode Forward Voltage Drop Characteristics**



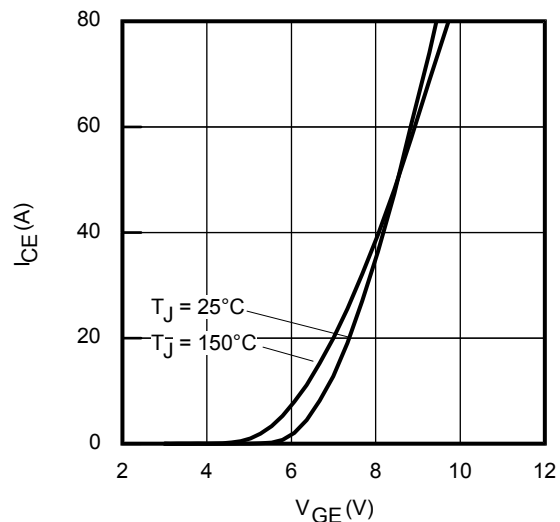
**Fig. 9 - Typical  $V_{CE}$  vs.  $V_{GE}$**   
 $T_J = -40^\circ\text{C}$



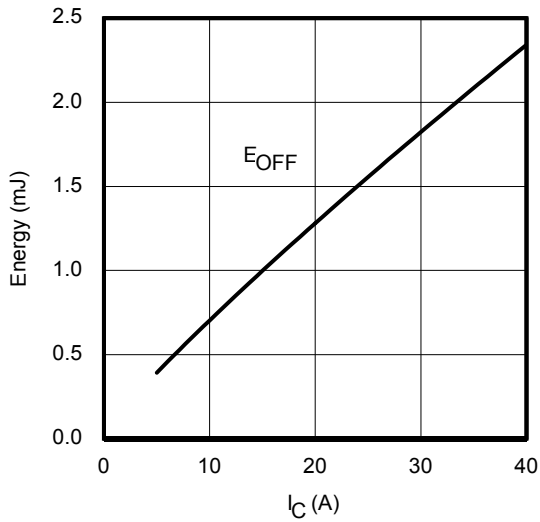
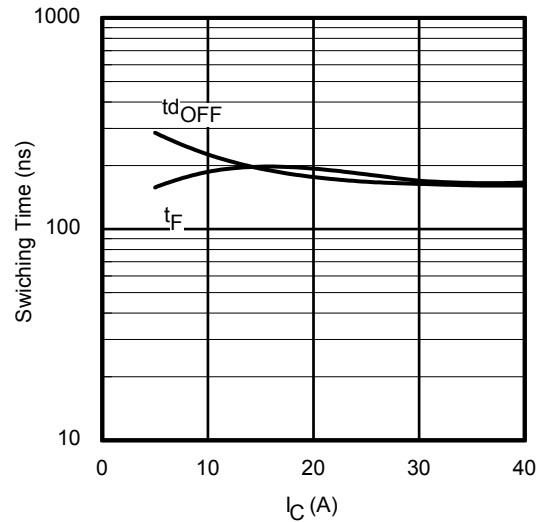
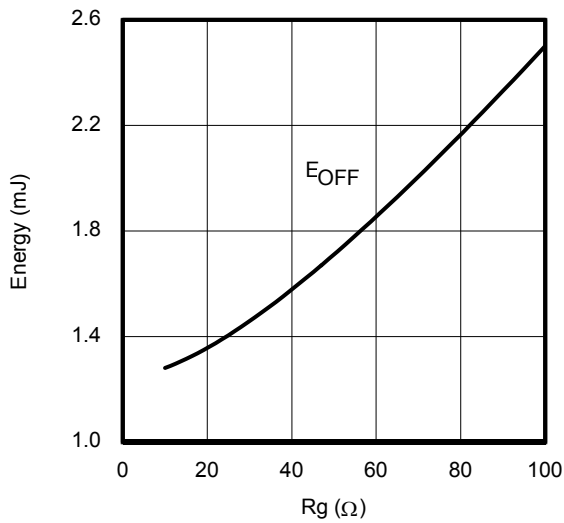
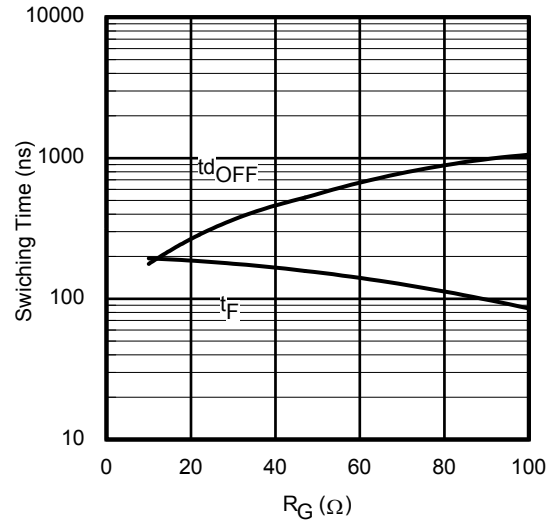
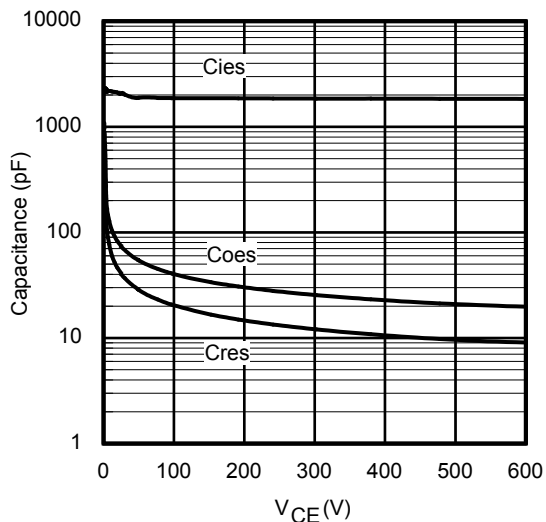
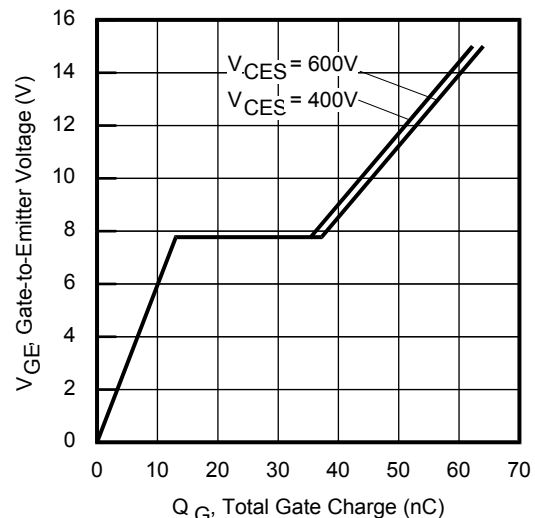
**Fig. 10 - Typical  $V_{CE}$  vs.  $V_{GE}$**   
 $T_J = 25^\circ\text{C}$

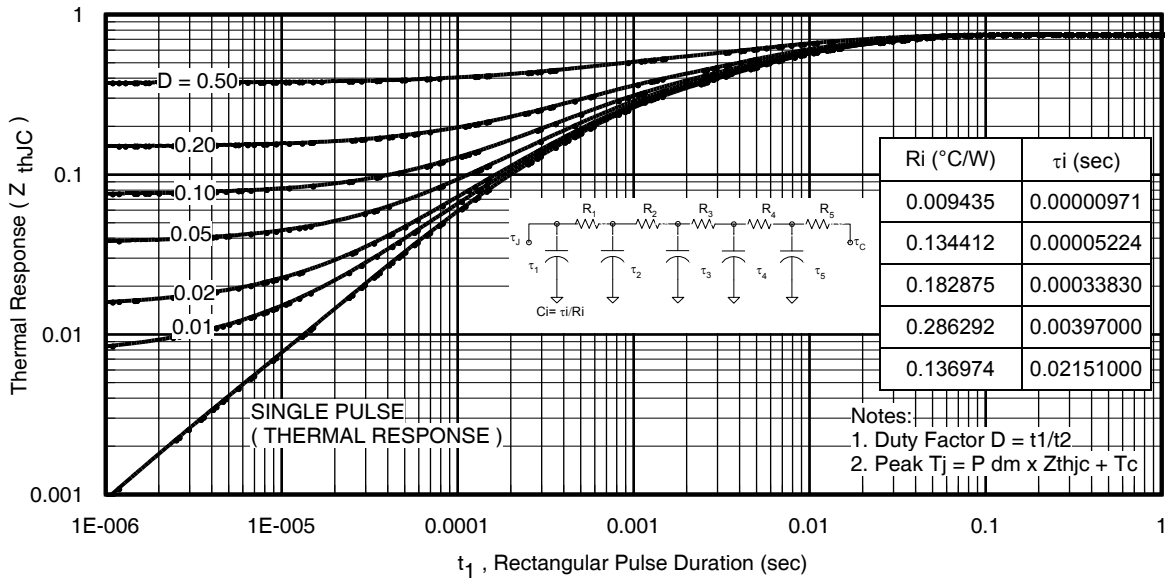
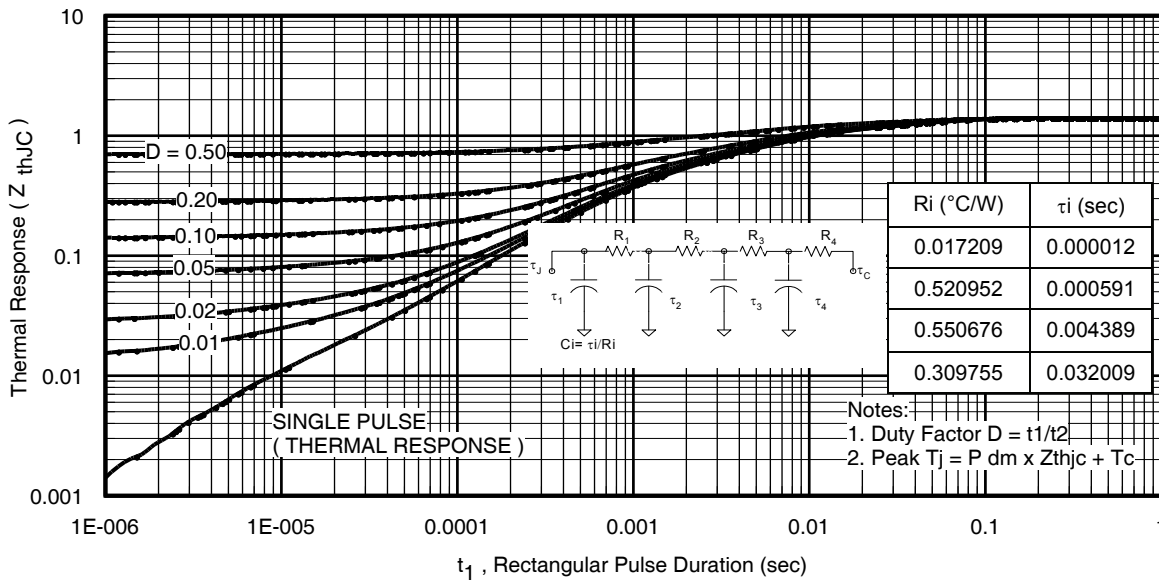


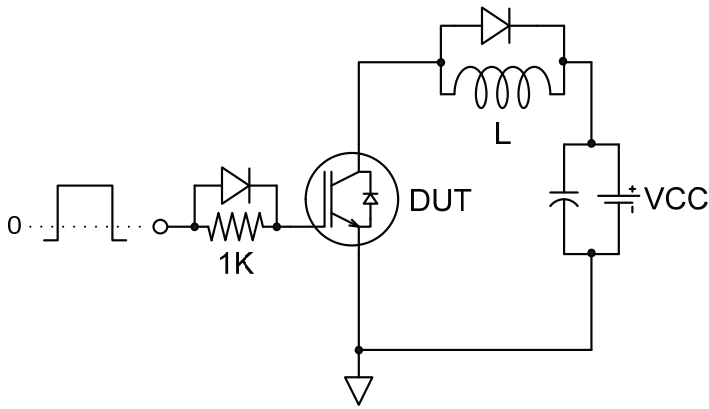
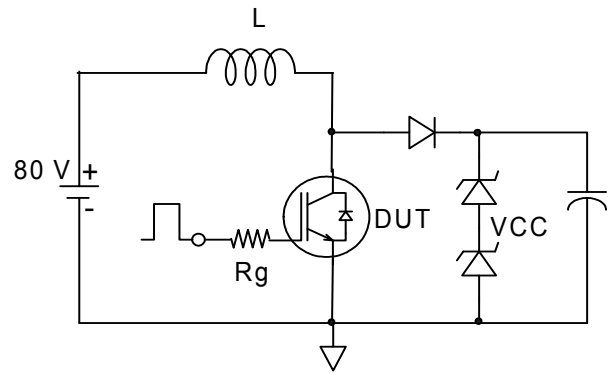
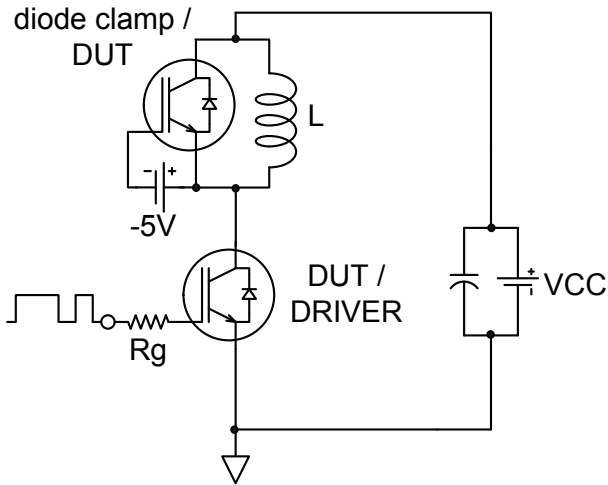
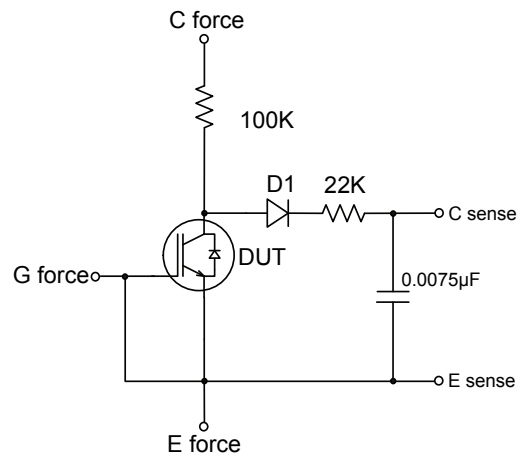
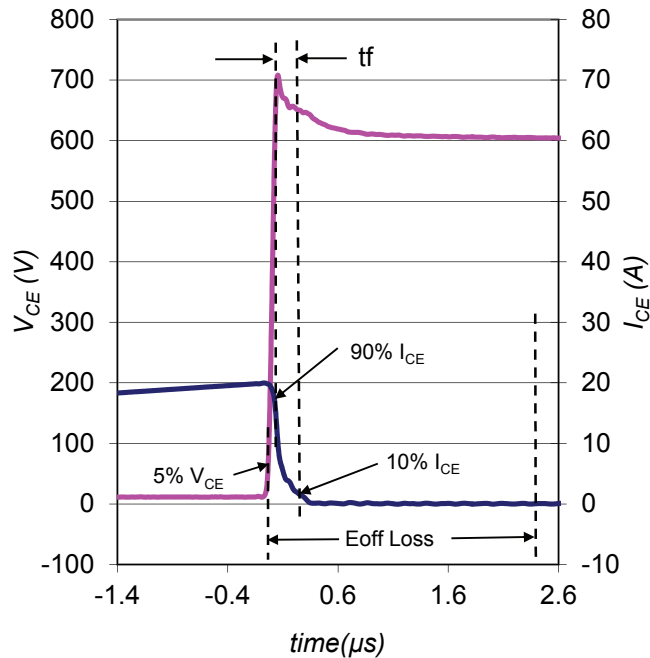
**Fig. 11 - Typical  $V_{CE}$  vs.  $V_{GE}$**   
 $T_J = 150^\circ\text{C}$



**Fig. 12 - Typ. Transfer Characteristics**  
 $V_{CE} = 50\text{V}$ ;  $t_p = 20\mu\text{s}$

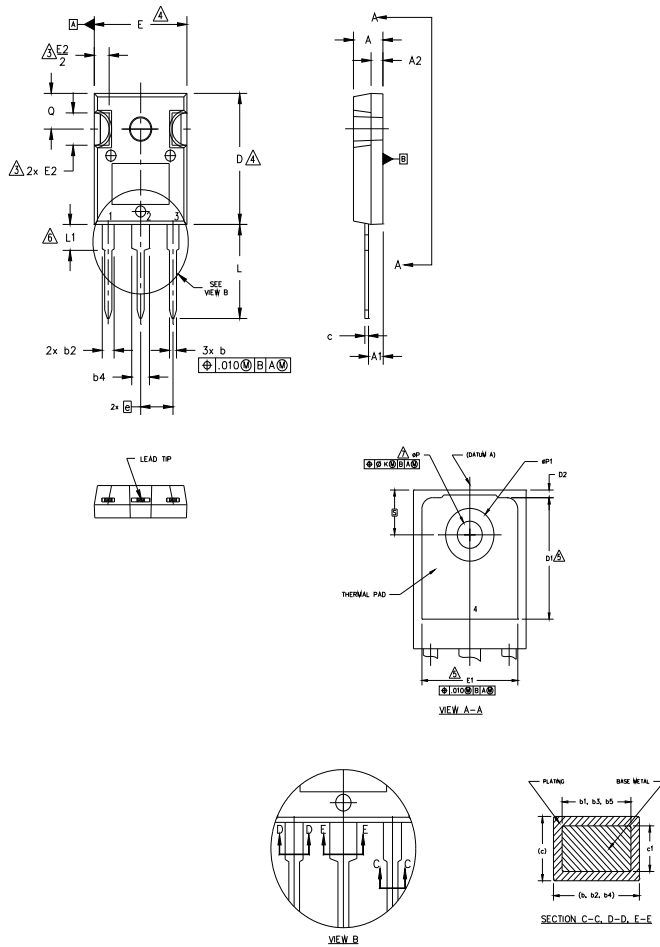

**Fig. 13 - Typ. Energy Loss vs.  $I_C$** 
 $T_J = 150^\circ\text{C}; V_{CE} = 600\text{V}, R_G = 10\Omega; V_{GE} = 15\text{V}$ 

**Fig. 14 - Typ. Switching Time vs.  $I_C$** 
 $T_J = 150^\circ\text{C}; V_{CE} = 600\text{V}, R_G = 10\Omega; V_{GE} = 15\text{V}$ 

**Fig. 15 - Typ. Energy Loss vs.  $R_G$** 
 $T_J = 150^\circ\text{C}; V_{CE} = 600\text{V}, I_{CE} = 20\text{A}; V_{GE} = 15\text{V}$ 

**Fig. 16 - Typ. Switching Time vs.  $R_G$** 
 $T_J = 150^\circ\text{C}; V_{CE} = 600\text{V}, I_{CE} = 20\text{A}; V_{GE} = 15\text{V}$ 

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

**Fig. 18 - Typical Gate Charge vs.  $V_{GE}$** 
 $I_{CE} = 20\text{A}$


**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

## 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.  $\phi P$  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		
$\phi k$	.010		0.25		
L	.559	.634	14.20	16.10	
L1	.146	.169	3.71	4.29	
$\phi P$	.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**

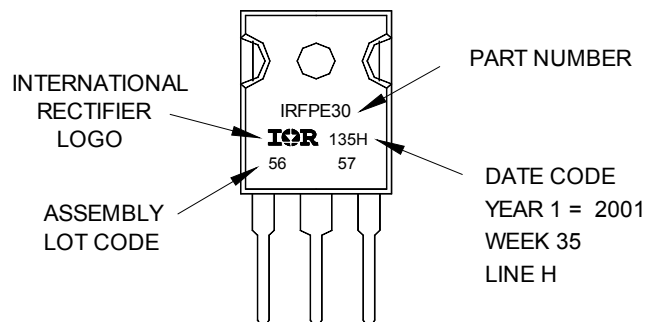
- 1.- ANODE/OPEN
- 2.- CATHODE
- 3.- ANODE

## TO-247AC Part Marking Information

Notes: This part marking information applies to devices produced after 02/26/2001

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"



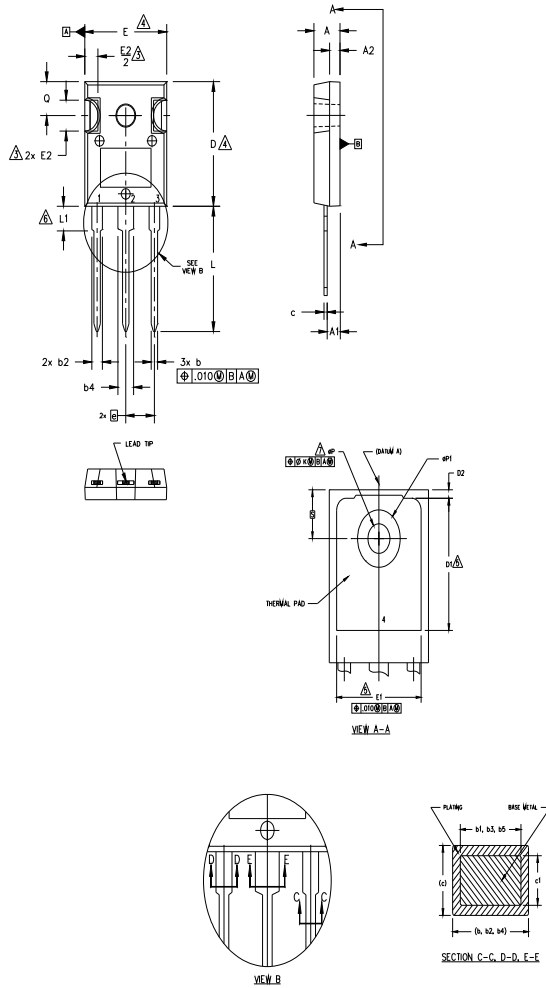
TO-247AC package is not recommended for Surface Mount Application.

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

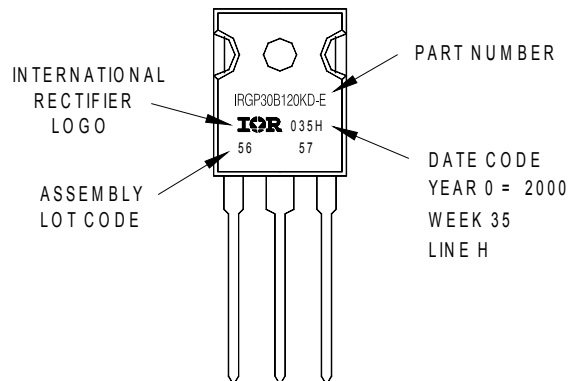
DIODES

- 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/>

**Qualification Information<sup>†</sup>**

<b>Qualification Level</b>	Consumer <sup>††</sup> (per JEDEC JESD47F) <sup>†††</sup>	
<b>Moisture Sensitivity Level</b>	TO-247AC	N/A
	TO-247AD	N/A
<b>RoHS Compliant</b>	Yes	

† Qualification standards can be found at International Rectifier's web site  
<http://www.irf.com/product-info/reliability>

†† Higher qualification ratings may be available should the user have such requirements.  
 Please contact your International Rectifier sales representative for further information:  
<http://www.irf.com/whoto-call/salesrep/>

††† Applicable version of JEDEC standard at the time of product release.