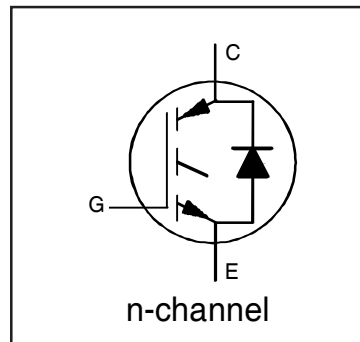


### INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRA-LOW V<sub>F</sub> DIODE FOR INDUCTION HEATING AND SOFT SWITCHING APPLICATIONS

#### Features

- Low V<sub>CE(ON)</sub> Trench IGBT Technology
- Low Switching Losses
- Square RBSOA
- 100% of the parts tested for 4X rated current (I<sub>LM</sub>)
- Positive V<sub>CE(ON)</sub> Temperature co-efficient
- Ultra-low V<sub>F</sub> Diode
- Tight parameter distribution
- Lead Free Package



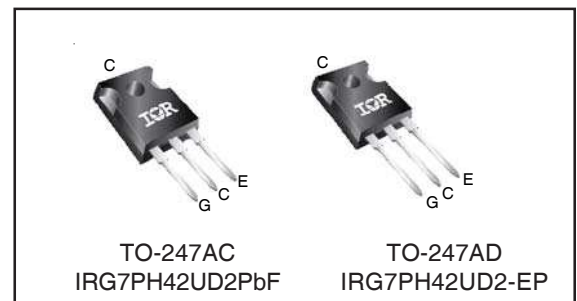
$$V_{CES} = 1200V$$

$$I_C = 30A, T_C = 100^\circ C$$

$$V_{CE(on)} \text{ typ.} = 1.69V$$

#### Benefits

- Device optimized for induction heating and soft switching applications
- High Efficiency due to Low V<sub>CE(on)</sub>, Low Switching Losses and Ultra-low V<sub>F</sub>
- 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

Base part number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRG7PH42UD2PbF	TO-247AC	Tube	25	IRG7PH42UD2PbF
IRG7PH42UD2-EP	TO-247AD	Tube	25	IRG7PH42UD2-EP

#### Absolute Maximum Ratings

	Parameter	Max.	Units
V <sub>CES</sub>	Collector-to-Emitter Voltage	1200	V
I <sub>C</sub> @ T <sub>C</sub> = 25°C	Continuous Collector Current	60	A
I <sub>C</sub> @ T <sub>C</sub> = 100°C	Continuous Collector Current	30	
I <sub>CM</sub>	Pulse Collector Current, V <sub>GE</sub> =15V	90	
I <sub>LM</sub>	Clamped Inductive Load Current, V <sub>GE</sub> =20V ①	120	
I <sub>F</sub> @ T <sub>C</sub> = 100°C	Diode Continuous Forward Current	10	
I <sub>FSM</sub>	Diode Non Repetitive Peak Surge Current @ T <sub>J</sub> = 25°C ②	170	
I <sub>FM</sub>	Diode Peak Repetitive Forward Current ②	90	
V <sub>GE</sub>	Continuous Gate-to-Emitter Voltage	±30	V
P <sub>D</sub> @ T <sub>C</sub> = 25°C	Maximum Power Dissipation	321	W
P <sub>D</sub> @ T <sub>C</sub> = 100°C	Maximum Power Dissipation	128	
T <sub>J</sub> T <sub>STG</sub>	Operating Junction and Storage Temperature Range	-55 to +150	°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 <sub>θJC</sub> (IGBT)	Thermal Resistance Junction-to-Case-(each IGBT)	—	—	0.39	°C/W
R <sub>θJC</sub> (Diode)	Thermal Resistance Junction-to-Case-(each Diode)	—	—	0.82	
R <sub>θCS</sub>	Thermal Resistance, Case-to-Sink (flat, greased surface)	—	0.24	—	
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient (typical socket mount)	—	40	—	

**Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

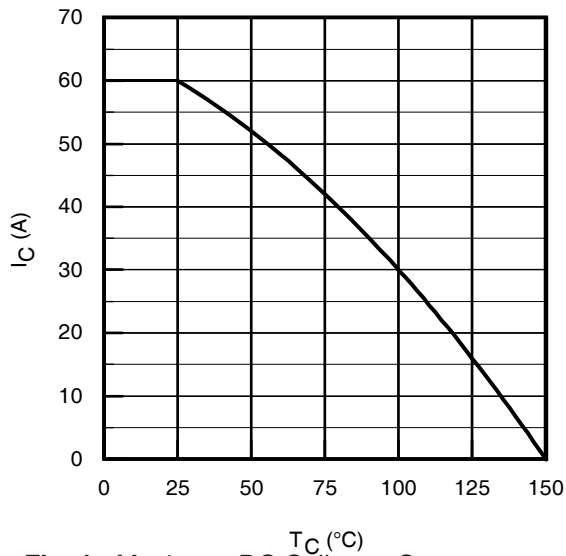
	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig
V <sub>(BR)CES</sub>	Collector-to-Emitter Breakdown Voltage	1200	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 100μA ③	CT4
V <sub>(BR)Transient</sub>	Repetitive Transient Collector-to-Emitter Voltage	—	—	1300	V	V <sub>GE</sub> = 0V, T <sub>J</sub> = 75°C, PW ≤ 10μs	
ΔV <sub>(BR)CES/ΔT<sub>J</sub></sub>	Temperature Coeff. of Breakdown Voltage	—	1.18	—	V/°C	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1mA (25°C-150°C)	CT4
V <sub>CE(on)</sub>	Collector-to-Emitter Saturation Voltage	—	1.69	2.02	V	I <sub>C</sub> = 30A, V <sub>GE</sub> = 15V, T <sub>J</sub> = 25°C	4,5,6
		—	2.07	—		I <sub>C</sub> = 30A, V <sub>GE</sub> = 15V, T <sub>J</sub> = 150°C	8,9,10
V <sub>GE(th)</sub>	Gate Threshold Voltage	3.0	—	6.0	V	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 1.0mA	8,9
ΔV <sub>GE(th)/ΔT<sub>J</sub></sub>	Threshold Voltage temp. coefficient	—	-15	—	mV/°C	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 1.0mA (25°C - 150°C)	10,11
g <sub>fe</sub>	Forward Transconductance	—	32	—	S	V <sub>CE</sub> = 50V, I <sub>C</sub> = 30A, PW = 60μs	
I <sub>CES</sub>	Collector-to-Emitter Leakage Current	—	1.0	150	μA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 1200V	
		—	450	1000		V <sub>GE</sub> = 0V, V <sub>CE</sub> = 1200V, T <sub>J</sub> = 150°C	
V <sub>FM</sub>	Diode Forward Voltage Drop	—	1.08	1.24	V	I <sub>F</sub> = 10A	7
		—	1.0	1.15		I <sub>F</sub> = 10A, T <sub>J</sub> = 150°C	
I <sub>GES</sub>	Gate-to-Emitter Leakage Current	—	—	±100	nA	V <sub>GE</sub> = ±30V	

**Switching Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

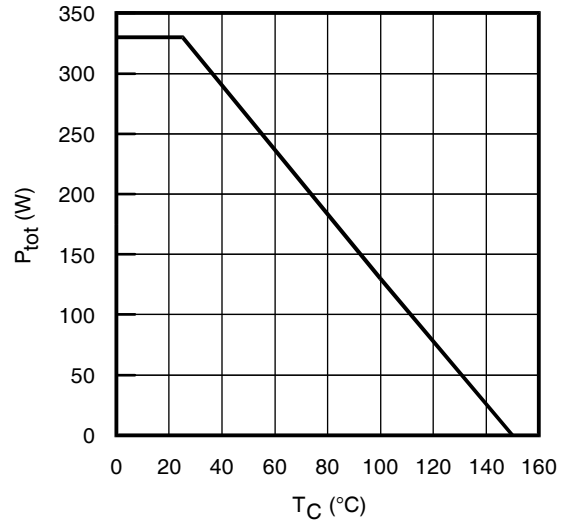
	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig
Q <sub>g</sub>	Total Gate Charge (turn-on)	—	156	234	nC	I <sub>C</sub> = 30A V <sub>GE</sub> = 15V V <sub>CC</sub> = 600V	17
Q <sub>ge</sub>	Gate-to-Emitter Charge (turn-on)	—	21	32			CT1
Q <sub>gc</sub>	Gate-to-Collector Charge (turn-on)	—	69	104			
E <sub>off</sub>	Turn-Off Switching Loss	—	1320	1460	μJ	I <sub>C</sub> = 30A, V <sub>CC</sub> = 600V, V <sub>GE</sub> = 15V R <sub>G</sub> = 10Ω, L = 200μH, T <sub>J</sub> = 25°C Energy losses include tail	CT3
t <sub>d(off)</sub>	Turn-Off delay time	—	233	292	ns	I <sub>C</sub> = 30A, V <sub>CC</sub> = 600V, V <sub>GE</sub> = 15V R <sub>G</sub> = 10Ω, L = 200μH, T <sub>J</sub> = 25°C	
t <sub>f</sub>	Fall time	—	64	85			
E <sub>off</sub>	Turn-Off Switching Loss	—	2080	—	μJ	I <sub>C</sub> = 30A, V <sub>CC</sub> = 600V, V <sub>GE</sub> = 15V R <sub>G</sub> = 10Ω, L = 200μH, T <sub>J</sub> = 150°C Energy losses include tail	CT3
t <sub>d(off)</sub>	Turn-Off delay time	—	297	—	ns	I <sub>C</sub> = 30A, V <sub>CC</sub> = 600V, V <sub>GE</sub> = 15V R <sub>G</sub> = 10Ω, L = 200μH, T <sub>J</sub> = 150°C	
t <sub>f</sub>	Fall time	—	173	—			WF1
C <sub>ies</sub>	Input Capacitance	—	3338	—	pF	V <sub>GE</sub> = 0V V <sub>CC</sub> = 30V f = 1.0Mhz	16
C <sub>oes</sub>	Output Capacitance	—	124	—			
C <sub>res</sub>	Reverse Transfer Capacitance	—	75	—			
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T <sub>J</sub> = 150°C, I <sub>C</sub> = 120A V <sub>CC</sub> = 960V, V <sub>p</sub> = 1200V R <sub>G</sub> = 10Ω, V <sub>GE</sub> = +15V to 0V	3 CT2

**Notes:**

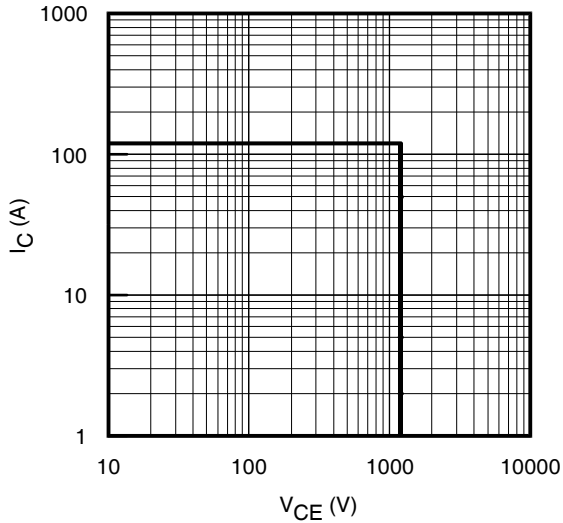
- ① V<sub>CC</sub> = 80% (V<sub>CES</sub>), V<sub>GE</sub> = 20V, L = 200μH, R<sub>G</sub> = 10Ω.
- ② Pulse width limited by max. junction temperature.
- ③ Refer to AN-1086 for guidelines for measuring V<sub>(BR)CES</sub> safely.



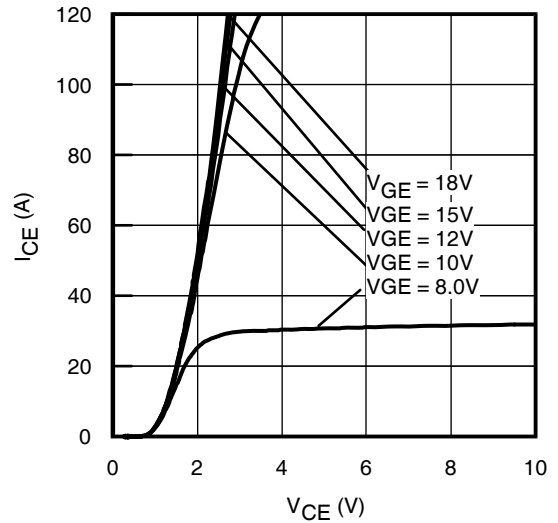
**Fig. 1** - Maximum DC Collector Current vs. Case Temperature



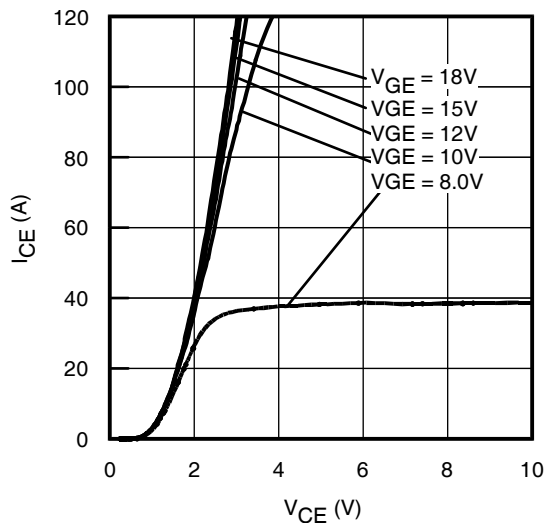
**Fig. 2** - Power Dissipation vs. Case Temperature



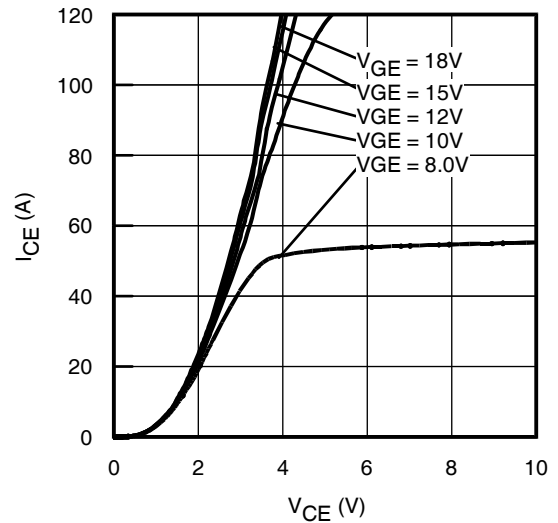
**Fig. 3** - Reverse Bias SOA  
 $T_J = 150^\circ\text{C}$ ;  $V_{GE} = 15\text{V}$



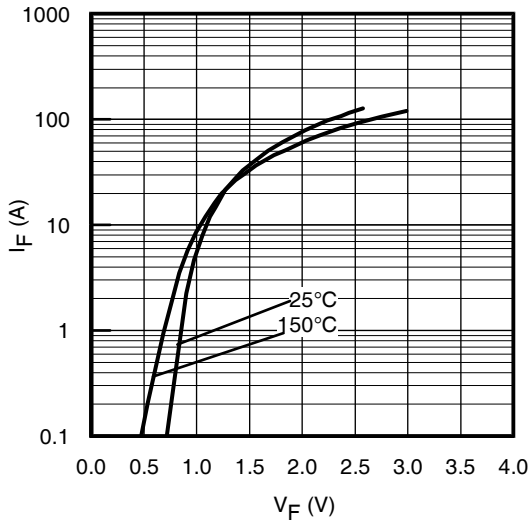
**Fig. 4** - Typ. IGBT Output Characteristics  
 $T_J = -40^\circ\text{C}$ ;  $t_p = 80\mu\text{s}$



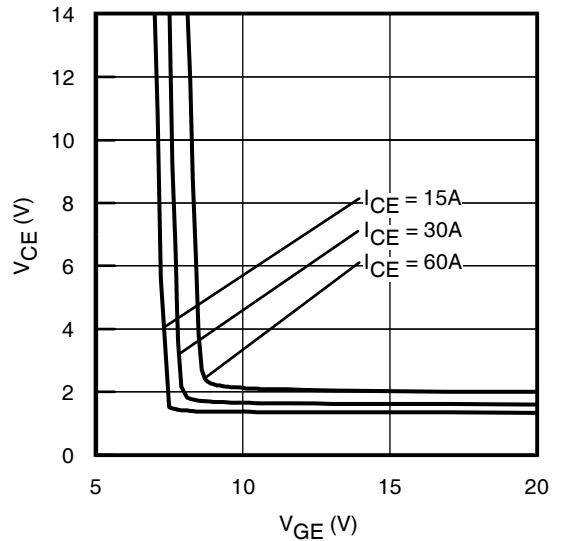
**Fig. 5** - Typ. IGBT Output Characteristics  
 $T_J = 25^\circ\text{C}$ ;  $t_p = 80\mu\text{s}$



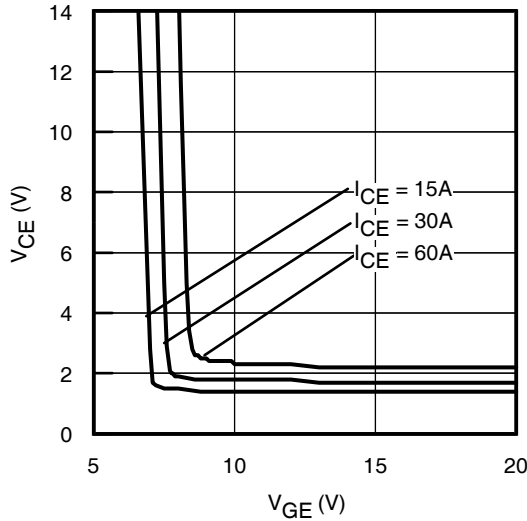
**Fig. 6** - Typ. IGBT Output Characteristics  
 $T_J = 150^\circ\text{C}$ ;  $t_p = 80\mu\text{s}$



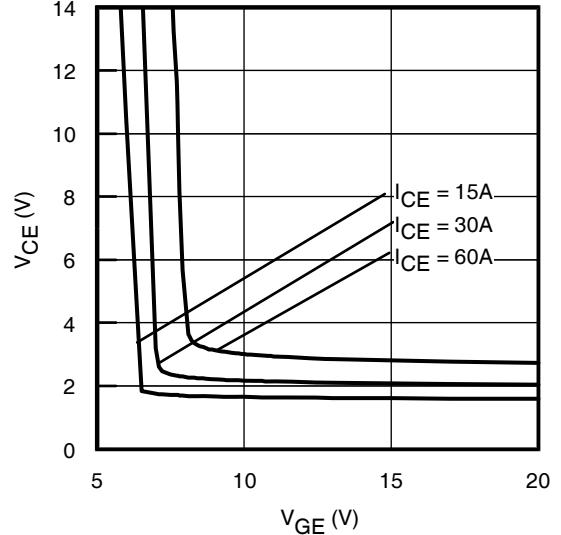
**Fig. 7 - Typ. Diode Forward Voltage Drop Characteristics**



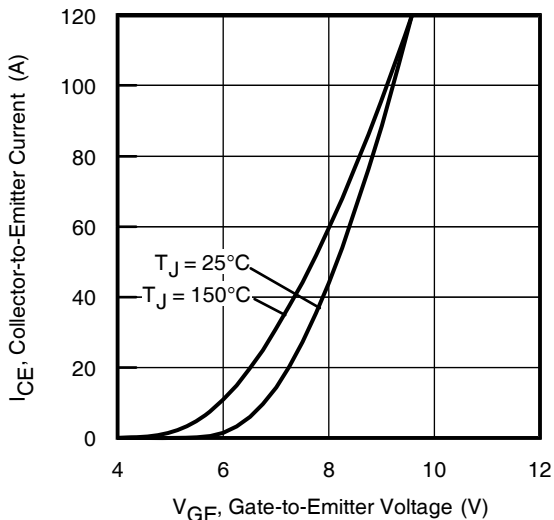
**Fig. 8 - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = -40^\circ\text{C}$**



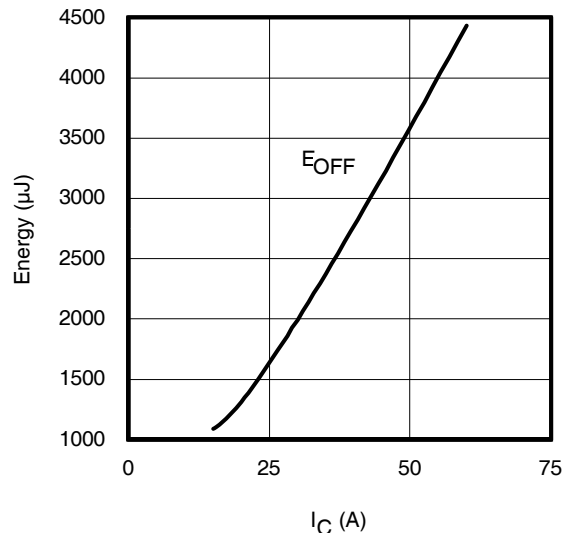
**Fig. 9 - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 25^\circ\text{C}$**



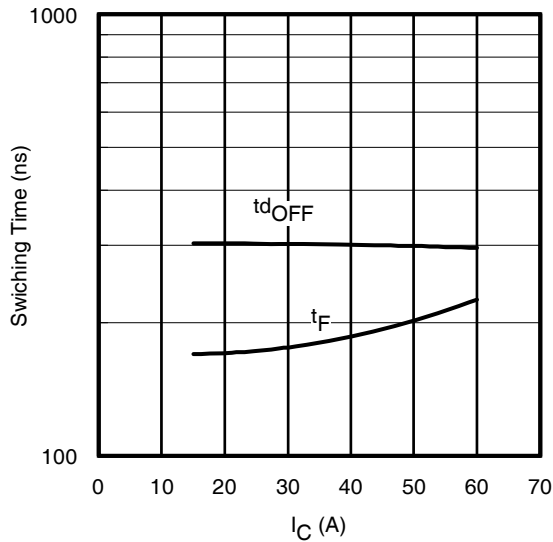
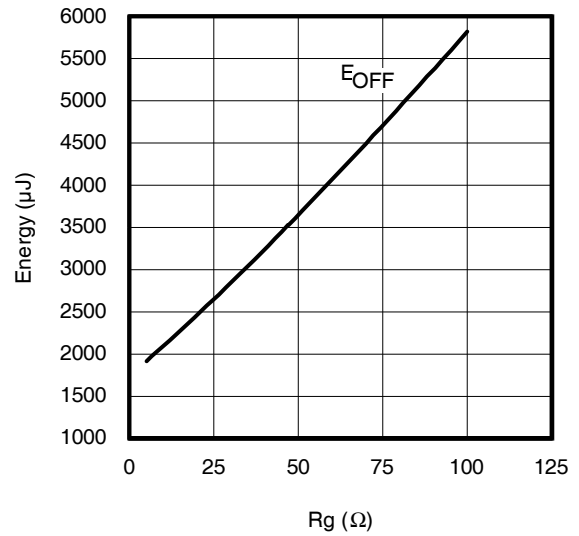
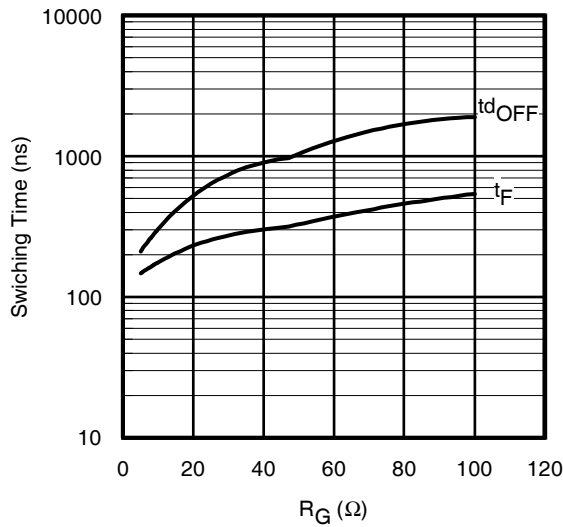
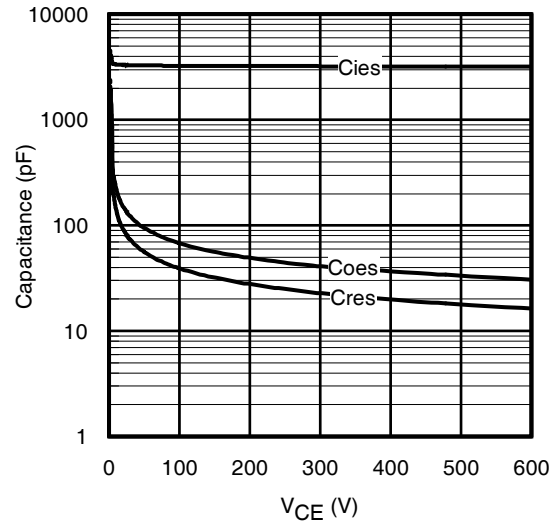
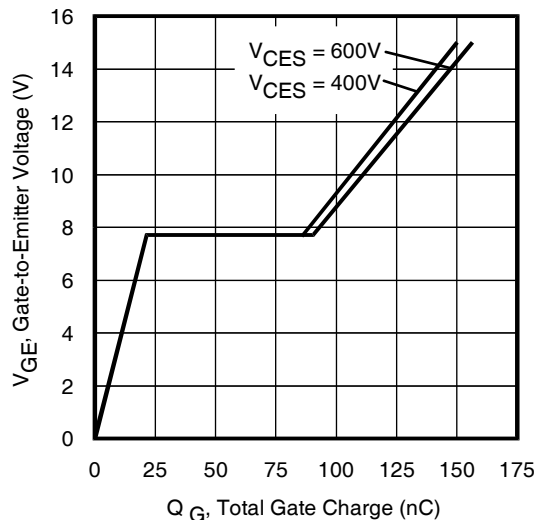
**Fig. 10 - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 150^\circ\text{C}$**



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



**Fig. 12 - Typ. Energy Loss vs.  $I_C$   
 $T_J = 150^\circ\text{C}$ ;  $L = 200\mu\text{H}$ ;  $V_{CE} = 600\text{V}$ ;  $R_G = 10\Omega$ ;  $V_{GE} = 15\text{V}$**


**Fig. 13 - Typ. Switching Time vs.  $I_C$** 
 $T_J = 150^\circ\text{C}; L = 200\mu\text{H}; V_{CE} = 600\text{V}; R_G = 10\Omega; V_{GE} = 15\text{V}$ 

**Fig. 14 - Typ. Energy Loss vs.  $R_G$** 
 $T_J = 150^\circ\text{C}; L = 200\mu\text{H}; V_{CE} = 600\text{V}; I_{CE} = 30\text{A}; V_{GE} = 15\text{V}$ 

**Fig. 15 - Typ. Switching Time vs.  $R_G$** 
 $T_J = 150^\circ\text{C}; L = 200\mu\text{H}; V_{CE} = 600\text{V}; I_{CE} = 30\text{A}; V_{GE} = 15\text{V}$ 

**Fig. 16 - Typ. Capacitance vs.  $V_{CE}$** 
 $V_{GE} = 0\text{V}; f = 1\text{MHz}$ 

**Fig. 17 - Typical Gate Charge vs.  $V_{GE}$** 
 $I_{CE} = 30\text{A}; L = 600\mu\text{H}$

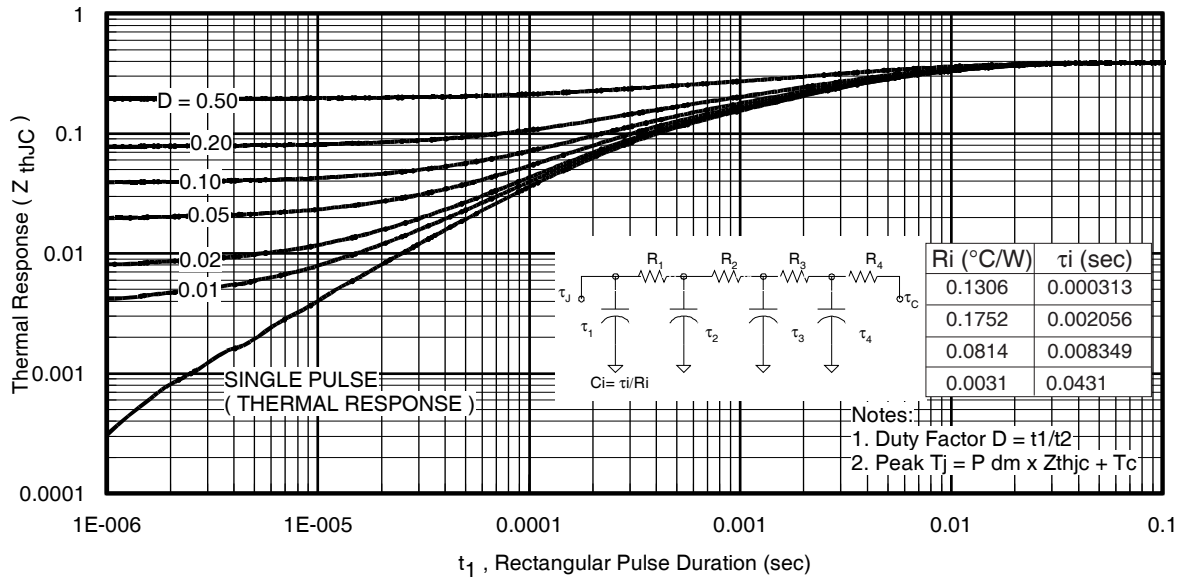


Fig 18. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

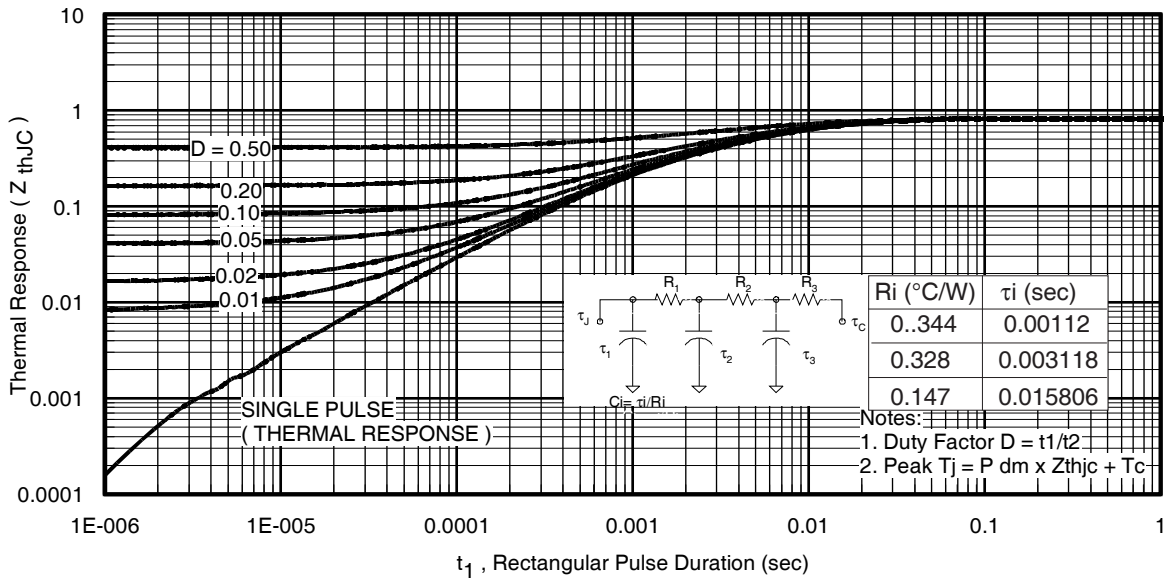
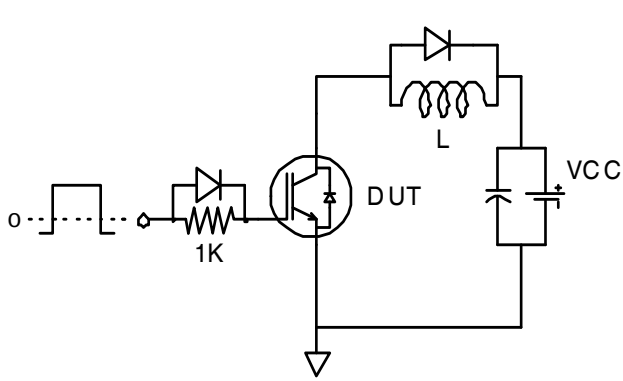
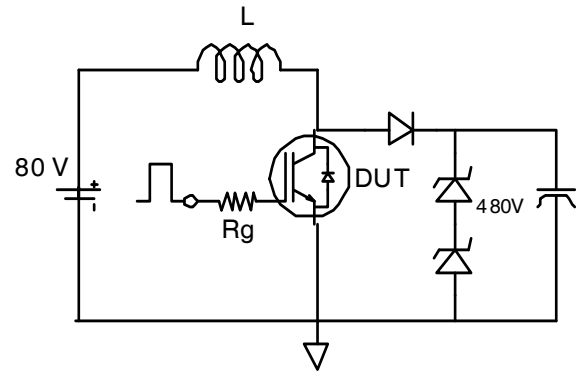
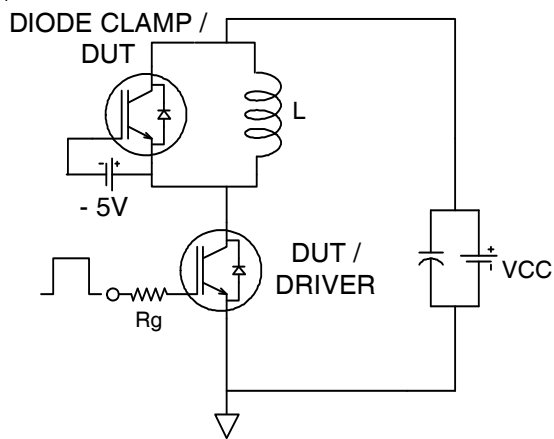
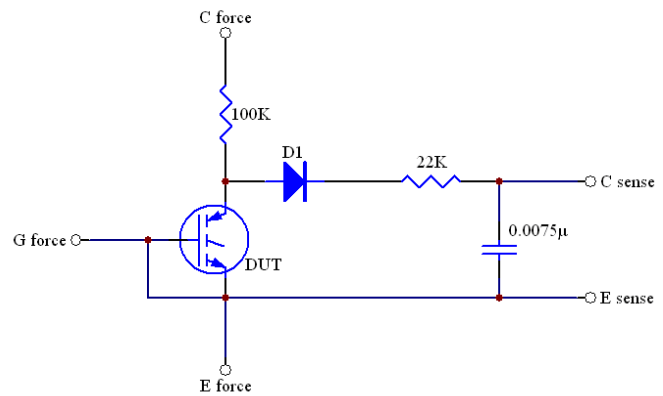
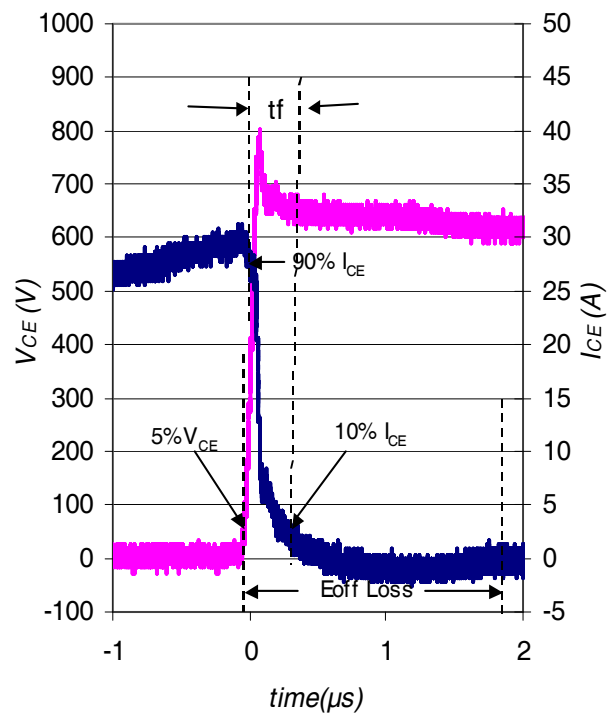


Fig. 19. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

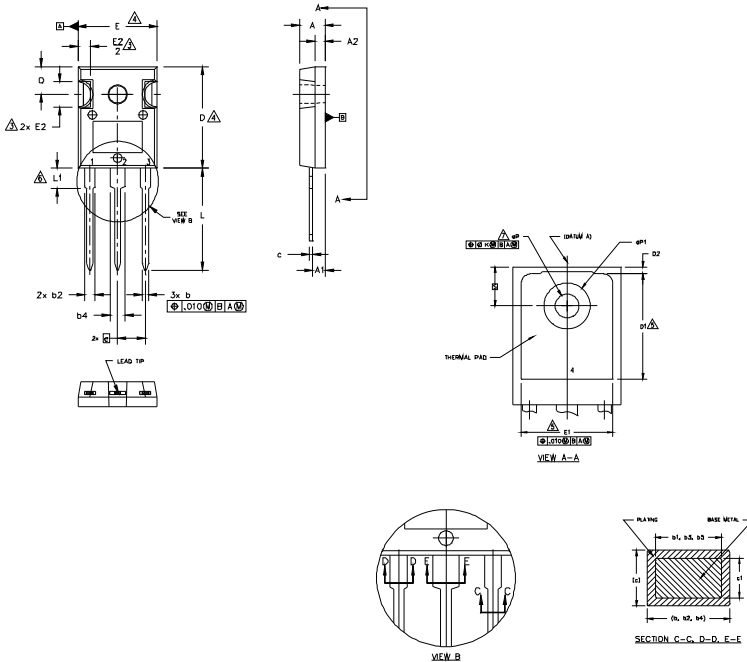

**Fig.C.T.1 - Gate Charge Circuit (turn-off)**

**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<sub>J</sub> = 150°C using Fig. CT.3





## 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

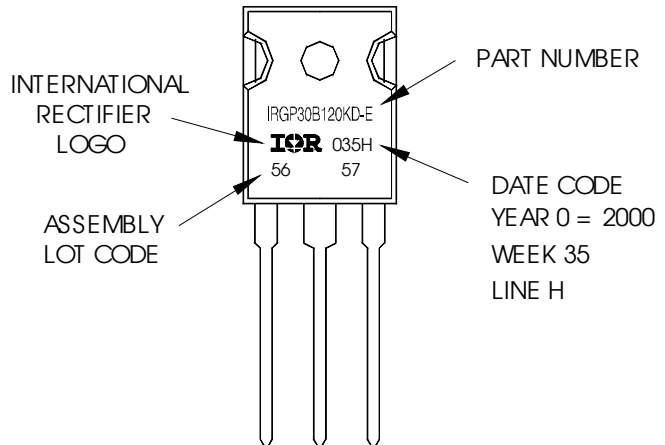
#### DIODES

- 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/>

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

<b>Qualification Level</b>	Industrial <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>

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

**Revision History**

<b>Date</b>	<b>Comments</b>
8/20/2014	<ul style="list-style-type: none"> <li>• Datasheet updated based on IR corporate template.</li> <li>• Removed "APPROVED (not released)" from top header on page 1.</li> </ul>