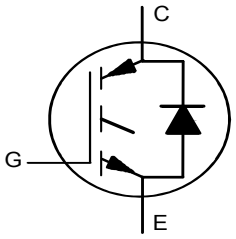
IRG7PH28UD1PbF
IRG7PH28UD1MPbF

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



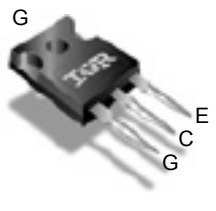
n-channel

V_{CES} = 1200V

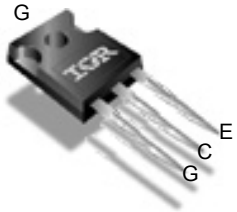
I_C = 15A, T_C = 100°C

$T_{J(MAX)}$ = 150°C

$V_{CE(ON)}$ typ. = 1.95V



IRG7PH28UD1PbF
TO-247AC



IRG7PH28UD1MPbF
TO-247AD

G	C	E
Gate	Collector	Emitter

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

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

Base part number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRG7PH28UD1PbF	TO-247AC	Tube	25	IRG7PH28UD1PbF
IRG7PH28UD1MPbF	TO-247AD	Tube	25	IRG7PH28UD1MPbF

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
$V_{(BR)\ Transient}$	Repetitive Transient Collector-to-Emitter Voltage ⑥	1300	
I_C @ T_C = 25°C	Continuous Collector Current	30	A
I_C @ T_C = 100°C	Continuous Collector Current	15	
I_{CM}	Pulse Collector Current, V_{GE} = 15V ②⑤	100	
I_{LM}	Clamped Inductive Load Current, V_{GE} = 20V ①	60	
I_F @ T_C = 25°C	Diode Continuous Forward Current	30	
I_F @ T_C = 100°C	Diode Continuous Forward Current	15	
I_{FM}	Diode Maximum Forward Current ②	60	
V_{GE}	Continuous Gate-to-Emitter Voltage	±30	V
P_D @ T_C = 25°C	Maximum Power Dissipation	115	W
P_D @ T_C = 100°C	Maximum Power Dissipation	46	
T_J T_{STG}	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)	

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Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$ (IGBT)	Junction-to-Case (IGBT) ④	—	—	1.09	°C/W
$R_{\theta JC}$ (Diode)	Junction-to-Case (Diode) ④	—	—	1.35	
$R_{\theta CS}$	Case-to-Sink (flat, greased surface)	—	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient (typical socket mount)	—	—	40	

Electrical Characteristics @ T_J = 25°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 = 100µA ③
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	1.4	—	V/°C	V_{GE} = 0V, I_C = 1mA (25°C-150°C)
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.95	2.30	V	I_C = 15A, V_{GE} = 15V, T_J = 25°C
		—	2.4	—		I_C = 15A, V_{GE} = 15V, T_J = 150°C
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0	V	V_{CE} = V_{GE}, I_C = 350µA
gfe	Forward Transconductance	—	13	—	S	V_{CE} = 50V, I_C = 15A, PW = 20µs
I_{CES}	Collector-to-Emitter Leakage Current	—	1.0	100	µA	V_{GE} = 0V, V_{CE} = 1200V
		—	100	—		V_{GE} = 0V, V_{CE} = 1200V, T_J = 150°C
V_{FM}	Diode Forward Voltage Drop	—	1.1	1.2	V	I_F = 15A
		—	1.0	—		I_F = 15A, T_J = 150°C
I_{GES}	Gate-to-Emitter Leakage Current	—	—	±100	nA	V_{GE} = ±30V

Switching Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
Q_g	Total Gate Charge (turn-on)	—	60	90	nC	I_C = 15A
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	10	15		V_{GE} = 15V
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	27	40		V_{CC} = 600V
E_{off}	Turn-Off Switching Loss	—	543	766	µJ	I_C = 15A, V_{CC} = 600V, V_{GE} = 15V
						R_G = 22Ω, L = 1.0mH, T_J = 25°C
$t_{d(off)}$	Turn-Off delay time	—	229	—	ns	Energy losses include tail & diode
t_f	Fall time	—	62	—		reverse recovery
E_{off}	Turn-Off Switching Loss	—	939	—	µJ	I_C = 15A, V_{CC} = 600V, V_{GE}=15V
						R_G = 22Ω, L = 1.0mH, T_J = 150°C
$t_{d(off)}$	Turn-Off delay time	—	272	—	ns	Energy losses include tail & diode
t_f	Fall time	—	167	—		reverse recovery
C_{ies}	Input Capacitance	—	1160	—	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	—	55	—		V_{CC} = 30V
C_{res}	Reverse Transfer Capacitance	—	30	—		f = 1.0Mhz
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T_J = 150°C, I_C = 60A
						V_{CC} = 960V, Vp ≤ 1200V
						Rg = 22Ω, V_{GE} = +20V to 0V

Notes:

① V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 25µH, R_G = 22Ω.
② Pulse width limited by max. junction temperature.
③ Refer to AN-1086 for guidelines for measuring $V_{(BR)CES}$ safely.
④ R_θ is measured at T_J of approximately 90°C.
⑤ FBSOA operating conditions only.
⑥ V_{GE} = 0V, T_J = 75°C, PW ≤ 10µs.

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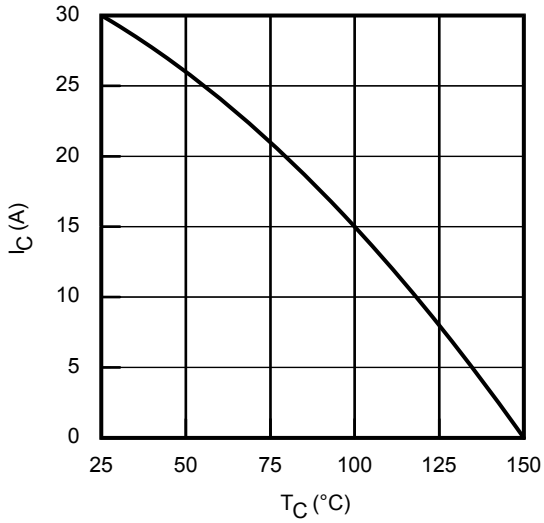


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

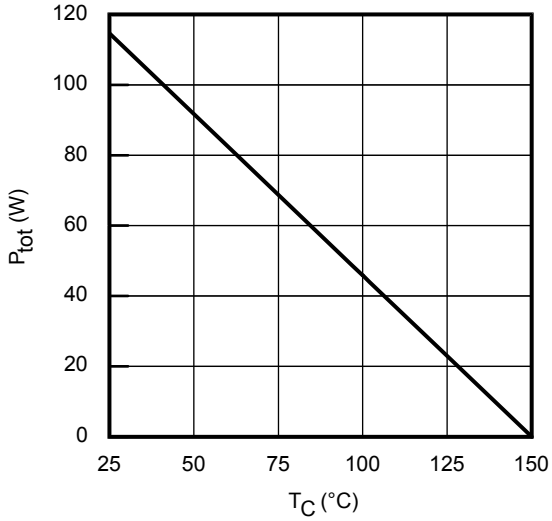


Fig. 2 - Power Dissipation vs. Case Temperature

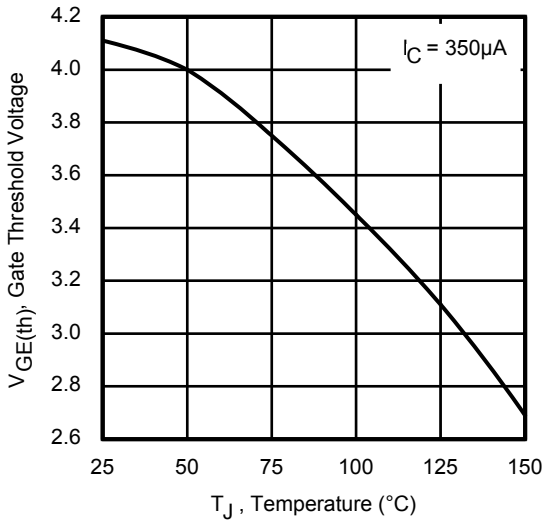


Fig. 3 - Typical Gate Threshold Voltage vs. Junction Temperature

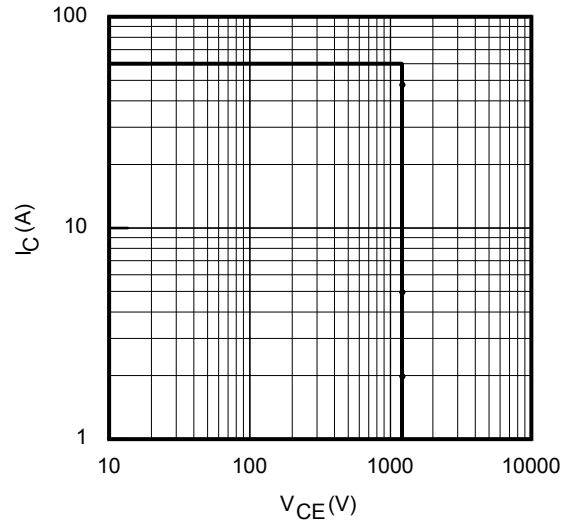


Fig. 4 - Reverse Bias SOA
T_J = 150°C; V_{GE} = 20V

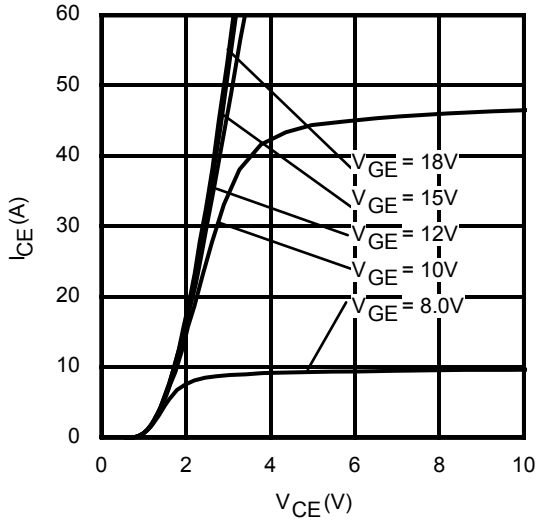


Fig. 5 - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 20µs

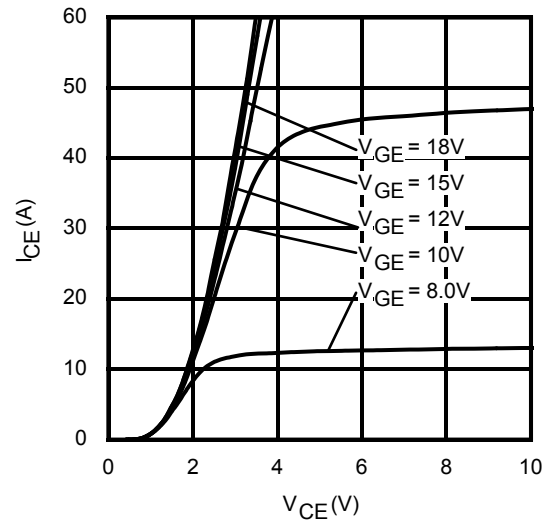


Fig. 6 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 20µs

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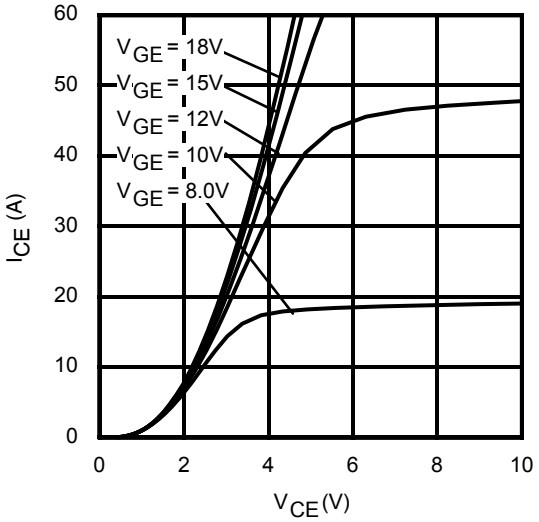


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 150°C; tp = 20µs

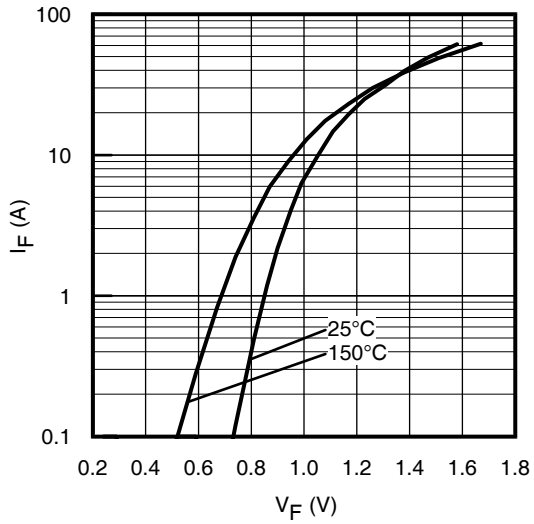


Fig. 8 - Typ. Diode Forward Voltage Drop Characteristics

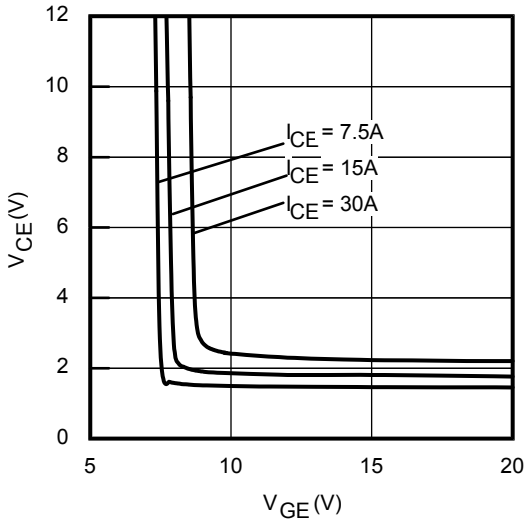


Fig. 9 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

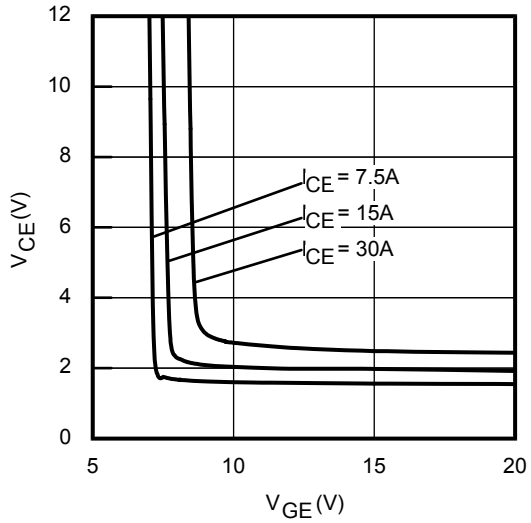


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

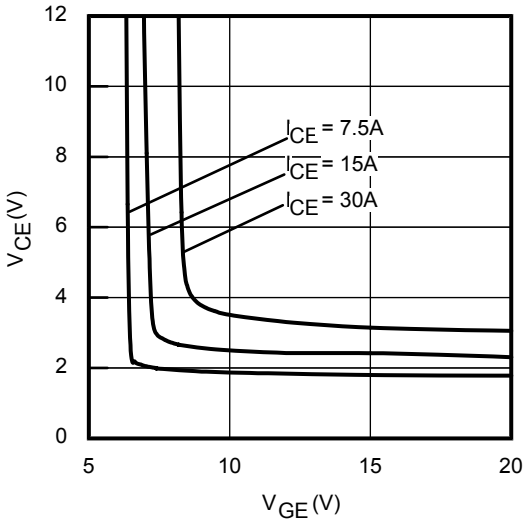


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 150°C

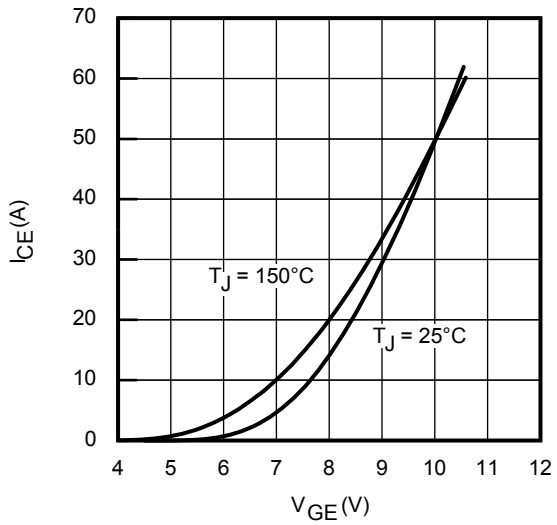


Fig. 12 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 20µs

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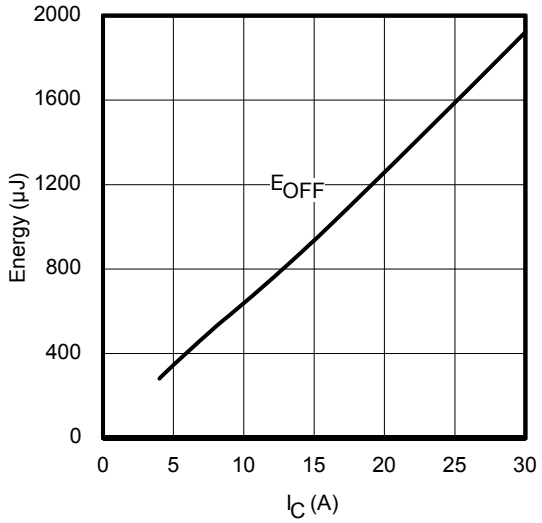


Fig. 13 - Typ. Energy Loss vs. I_C
T_J = 150°C; L = 1.0mH; V_{CE} = 600V, R_G = 22Ω; V_{GE} = 15V

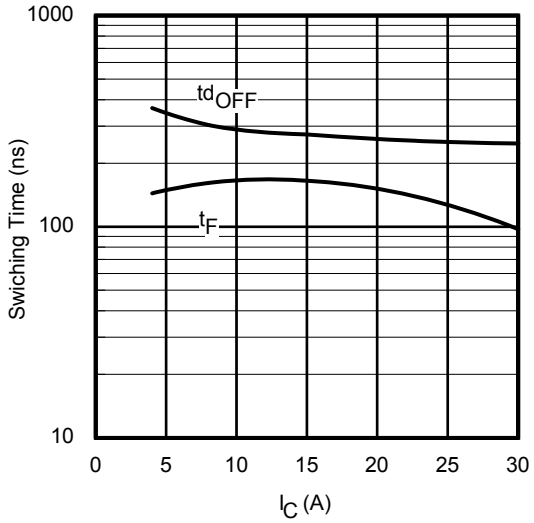


Fig. 14 - Typ. Switching Time vs. I_C
T_J = 150°C; L = 1.0mH; V_{CE} = 600V, R_G = 22Ω; V_{GE} = 15V

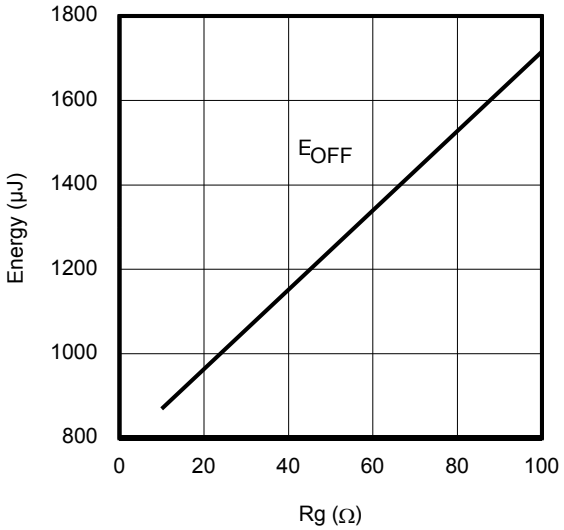


Fig. 15 - Typ. Energy Loss vs. R_G

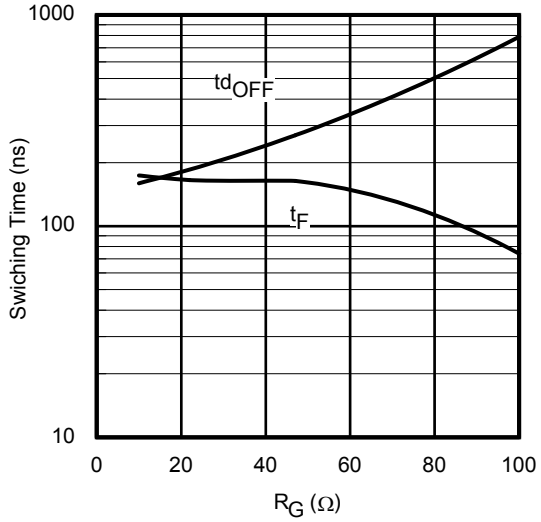


Fig. 16 - Typ. Switching Time vs. R_G
T_J = 150°C; L = 1.0mH; V_{CE} = 600V, I_{CE} = 15A; V_{GE} = 15V

T_J =

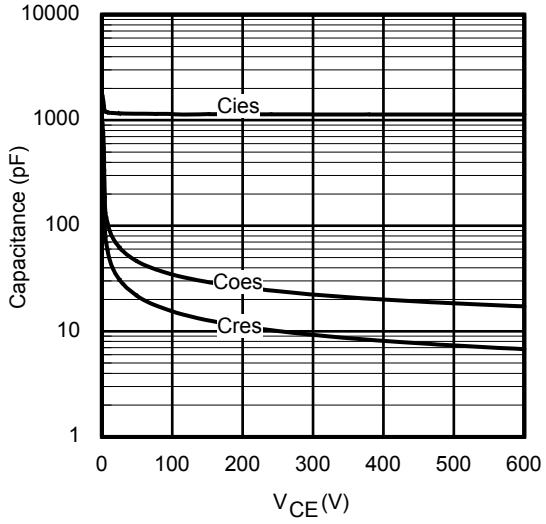


Fig. 17 - Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

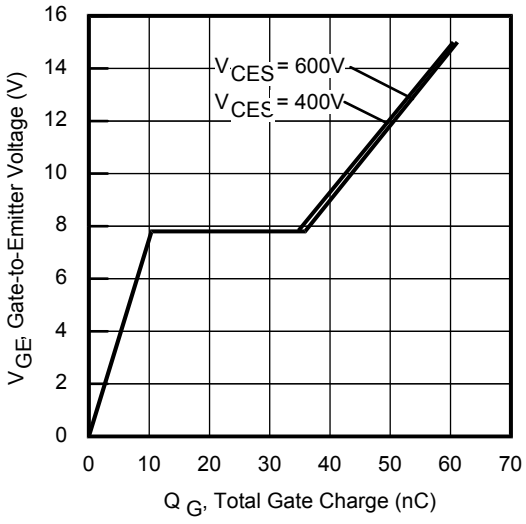


Fig. 18 - Typical Gate Charge vs. V_{GE}
I_{CE} = 15A

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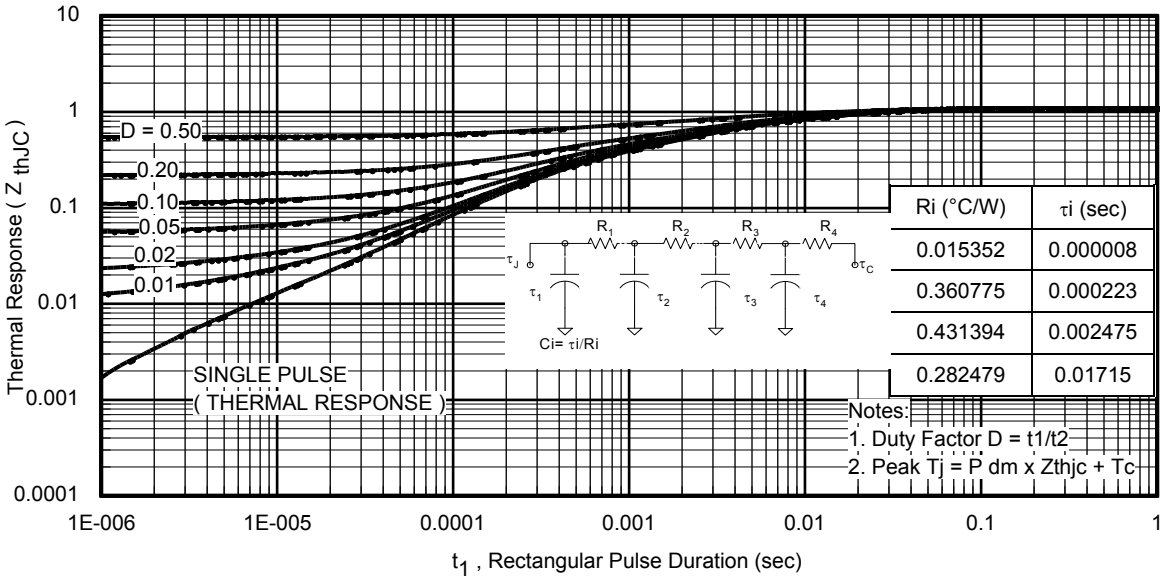


Fig. 19 - Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

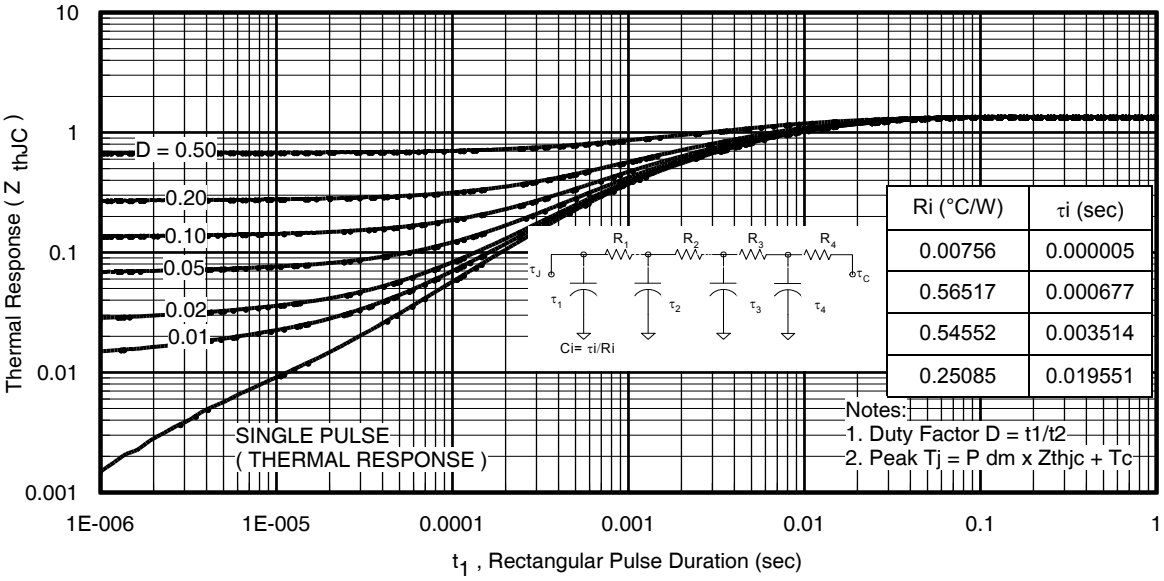


Fig. 20 - Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

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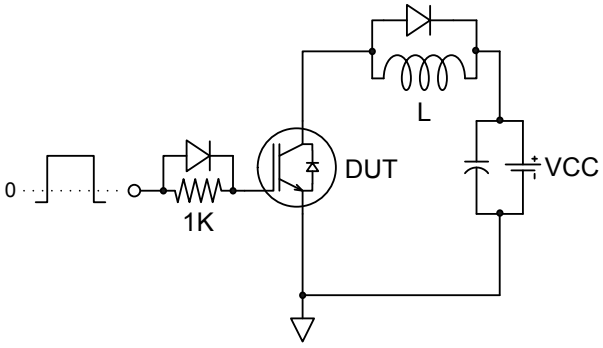


Fig.C.T.1 - Gate Charge Circuit (turn-off)

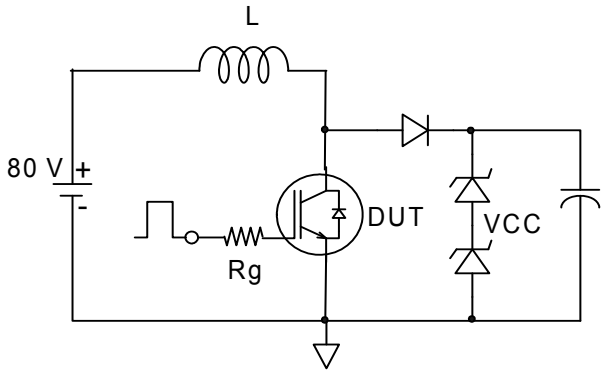


Fig.C.T.2 - RBSOA Circuit

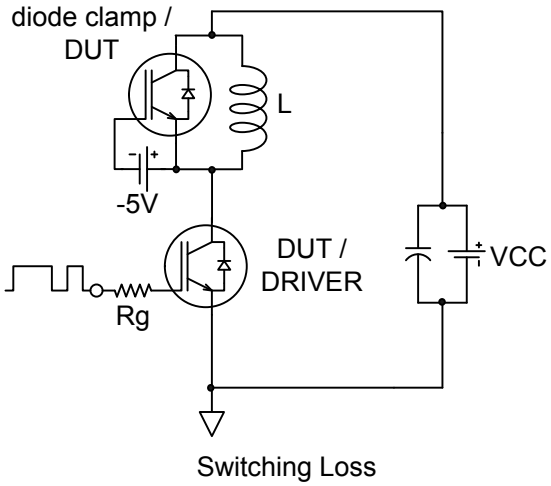


Fig.C.T.3 - Switching Loss Circuit

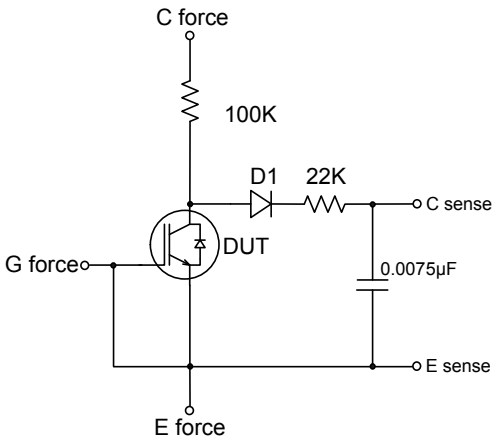


Fig.C.T.4 - BVCES Filter Circuit

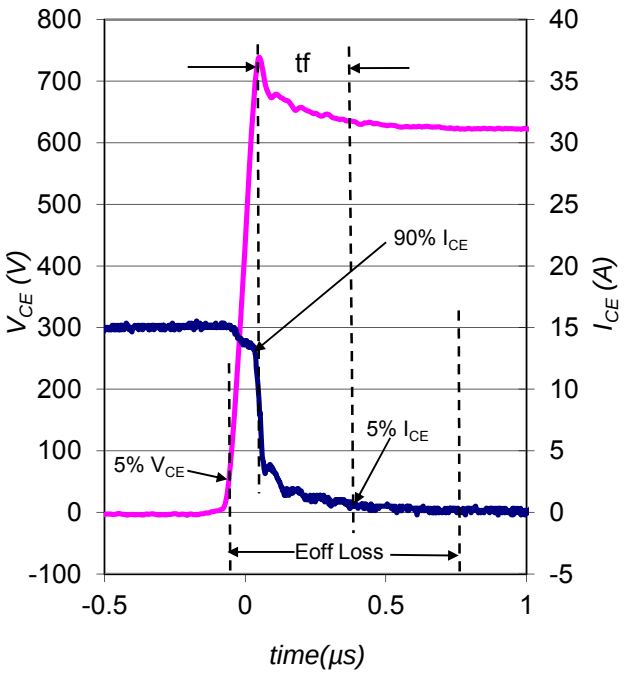
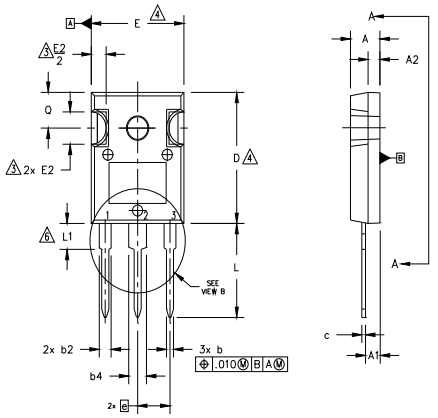


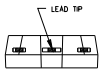
Fig. WF1 - Typ. Turn-off Loss Waveform
@ T_J = 150°C using Fig. CT.3

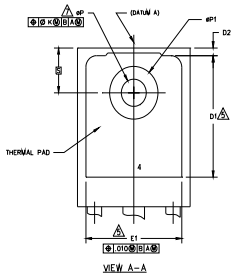
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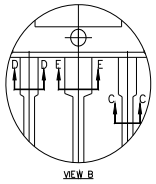
TO-247AC Package Outline

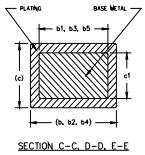
Dimensions are shown in millimeters (inches)











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

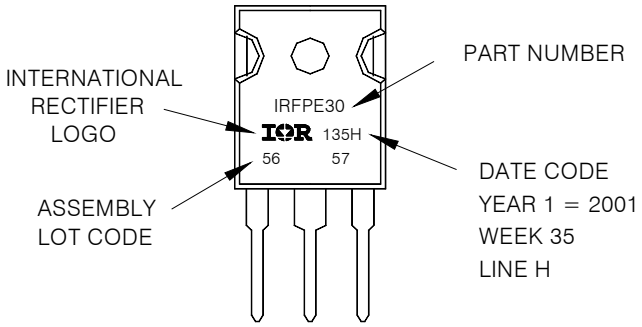
1.– ANODE/OPEN
2.– CATHODE
3.– ANODE

TO-247AC Part Marking Information

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"



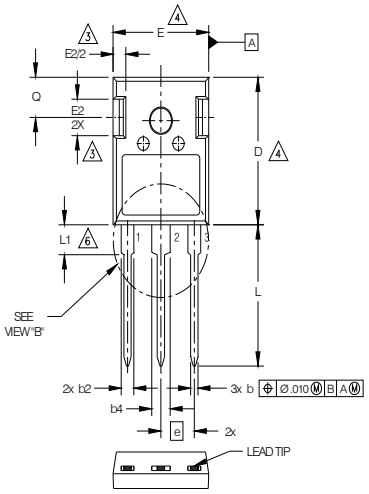
TO-247AC package is not recommended for Surface Mount Application.

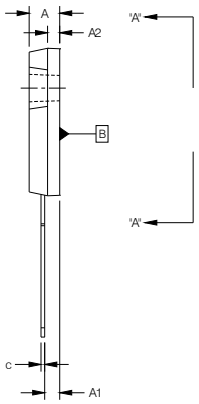
Note: For the most current drawing please refer to IR website at http://www.irf.com/package/

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TO-247AD Package Outline

Dimensions are shown in millimeters (inches)





SYMBOL	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN.	MAX.	MIN.	MAX.	
A	.190	.204	4.83	5.20	
A1	.090	.100	2.29	2.54	
A2	.075	.085	1.91	2.16	
b	.042	.052	1.07	1.33	
b2	.075	.094	1.91	2.41	
b4	.113	.133	2.87	3.38	
c	.022	.026	0.55	0.68	
D	.819	.830	20.80	21.10	4
D1	.640	694	16.25	17.65	5
E	.620	.635	15.75	16.13	4
E1	.512	.570	13.00	14.50	
E2	.145	.196	3.68	5.00	
e	.215 Typical		5.45 Typical		
L	.780	.800	19.80	20.32	
L1	.161	.173	4.10	4.40	
ø P	.138	.143	3.51	3.65	
Q	.216	.236	5.49	6.00	
S	.238	.248	6.04	6.30	

LEAD ASSIGNMENTS

HEXFET

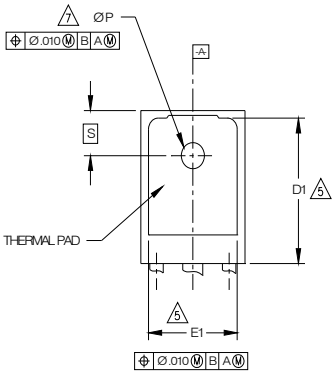
1.– GATE
2.– DRAIN
3.– SOURCE
4.– DRAIN

IGBTs, CoPACK

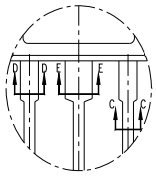
1.– GATE
2.– COLLECTOR
3.– EMITTER
4.– COLLECTOR

DIODES

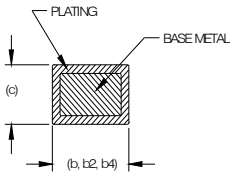
1.– ANODE/OPEN
2.– CATHODE
3.– ANODE



VIEW: "A" - "A"



VIEW: "B"



SECTION: C-C, D-D, E-E

NOTES:

1 DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M 1994.

2 DIMENSIONS ARE SHOWN IN INCHES AND MILLIMETERS.

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.

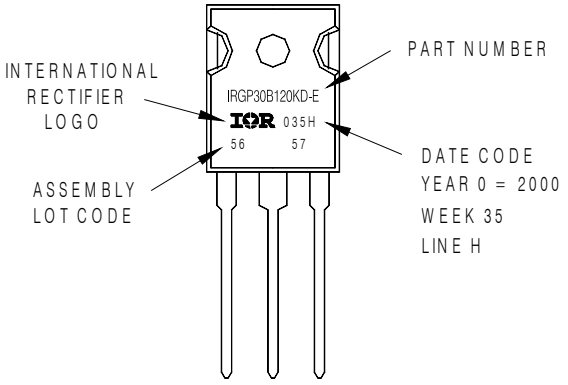
6 LEAD FINISH UNCONTROLLED IN L1.

7 ø P TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5 ° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154 INCH.

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/

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Qualification Information†

Qualification Level	Industrial† (per JEDEC JESD47F) ††	
Moisture Sensitivity Level	TO-247AC	N/A
	TO-247AD	N/A
RoHS Compliant	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.

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To contact International Rectifier, please visit http://www.irf.com/whoto-call/

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