IRG7PK35UD1PbF
IRG7PK35UD1-EPbF

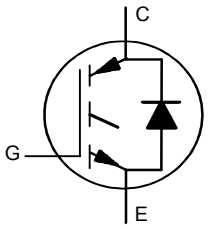
Insulated Gate Bipolar Transistor with Ultrafast Soft Recovery Diode

V_{CES} = 1400V

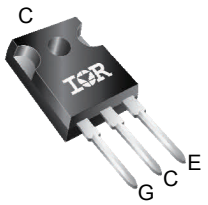
I_C = 20A, T_C =100°C

$T_{J(max)}$ = 150°C

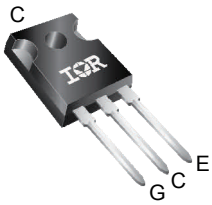
$V_{CE(ON)}$ typ. = 2.0V @ I_C = 20A



n-channel



IRG7PK35UD1PbF
TO-247AC



IRG7PK35UD1-EPbF
TO-247AD

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°C	Continuous Collector Current	40	A
I_C @ T_C = 100°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°C	Diode Continuous Forward Current	40	
I_F @ T_C = 100°C	Diode Continuous Forward Current	20	
V_{GE}	Continuous Gate-to-Emitter Voltage	±30	V
P_D @ T_C = 25°C	Maximum Power Dissipation	167	W
P_D @ T_C = 100°C	Maximum Power Dissipation	67	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-40 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
$R_{\theta JC}$ (IGBT)	Thermal Resistance Junction-to-Case (IGBT) ④	—	—	0.75	°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°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 = 20A, V_{GE} = 15V, T_J = 25°C
		—	2.4	—		I_C = 20A, V_{GE} = 15V, T_J = 150°C
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0	V	V_{CE} = V_{GE}, I_C = 600µA
gfe	Forward Transconductance	—	21	—	S	V_{CE} = 50V, I_C = 20A, PW = 20µs
I_{CES}	Collector-to-Emitter Leakage Current	—	1.0	100	µA	V_{GE} = 0V, V_{CE} = 1400V
		—	150	—		V_{GE} = 0V, V_{CE} = 1400V, T_J = 150°C
I_{GES}	Gate-to-Emitter Leakage Current	—	—	±100	nA	V_{GE} = ±30V
V_F	Diode Forward Voltage Drop	—	1.30	1.43	V	I_F = 20A
		—	1.25	—		I_F = 20A, T_J = 150°C

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

	Parameter	Min.	Typ.	Max⑥	Units	Conditions
Q_g	Total Gate Charge (turn-on)	—	65	98	nC	I_C = 20A
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	15	23		V_{GE} = 15V
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	25	38		V_{CC} = 600V
E_{off}	Turn-Off Switching Loss	—	0.65	0.90	mJ	I_C = 20A, V_{CC} = 600V, V_{GE} = 15V R_G = 10Ω, T_J = 25°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 = 20A, V_{CC} = 600V, V_{GE} = 15V R_G = 10Ω, T_J = 150°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} = 0V
C_{oes}	Output Capacitance	—	70	—		V_{CC} = 30V
C_{res}	Reverse Transfer Capacitance	—	35	—		f = 1.0MHz
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T_J = 150°C, I_C = 80A V_{CC} = 1120V, Vp ≤ 1400V R_G = 10Ω, V_{GE} = +20V to 0V

Notes:

① FBSOA operating conditions only.

② Pulse width limited by max. junction temperature.

③ V_{CC} = 80% (V_{CES}), V_{GE} = 20V, R_G = 10Ω.

④ R_θ is measured at T_J of approximately 90°C.

⑤ Refer to AN-1086 for guidelines for measuring $V_{(BR)CES}$ safely.

⑥ Maximum limits are based on statistical sample size characterization.

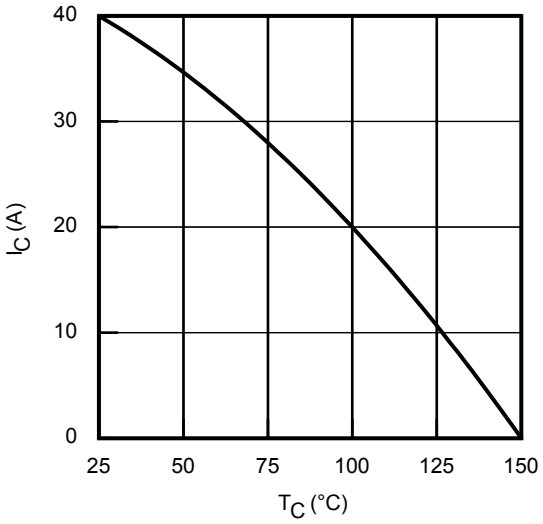


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

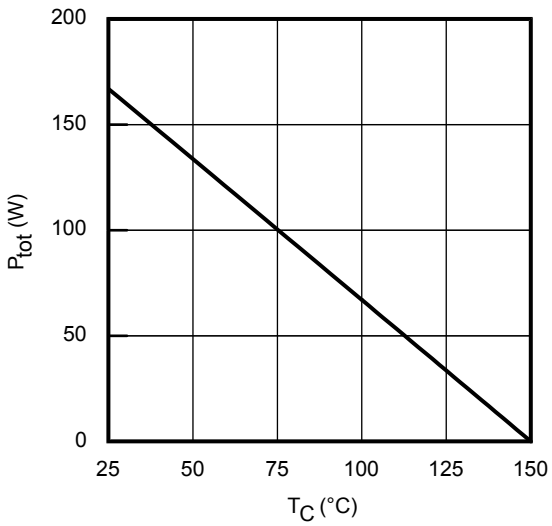


Fig. 2 - Power Dissipation vs. Case Temperature

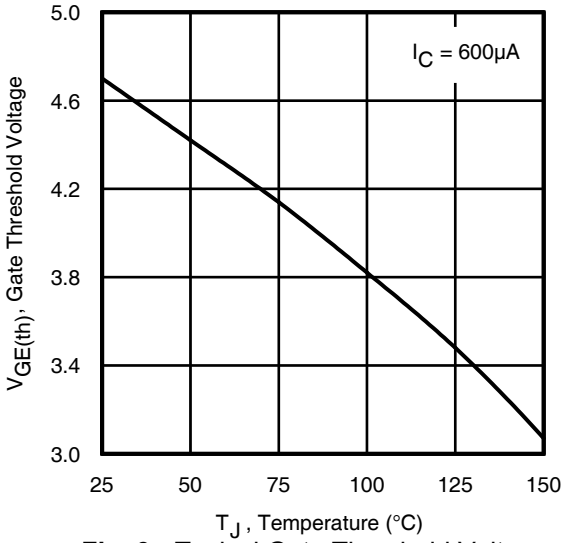


Fig. 3 - Typical Gate Threshold Voltage vs. Junction Temperature

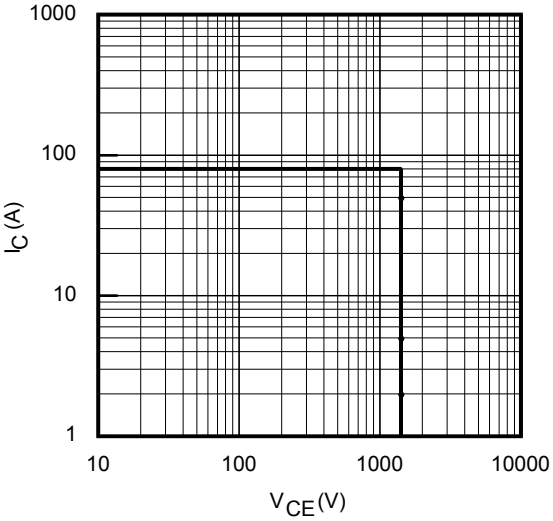


Fig. 4 - Reverse Bias SOA
T_J = 150°C; V_{GE} = 20V

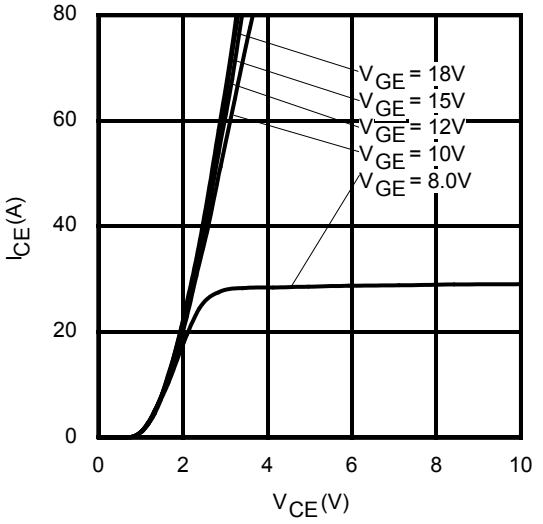


Fig. 5 - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 20µs

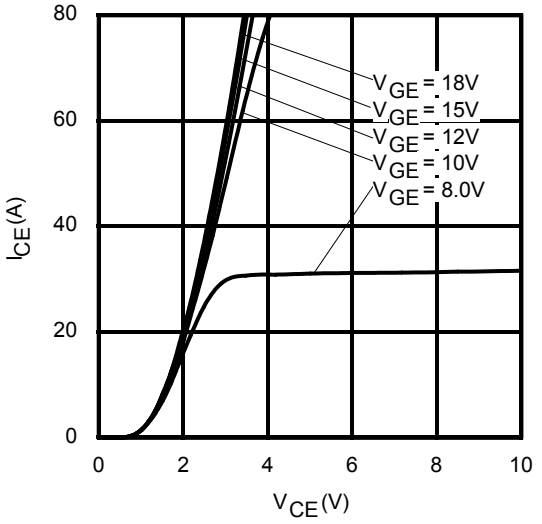


Fig. 6 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 20µs

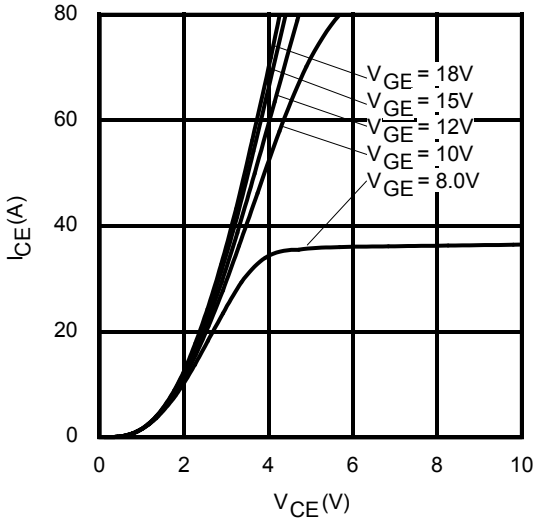


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 150°C; tp = 20µs

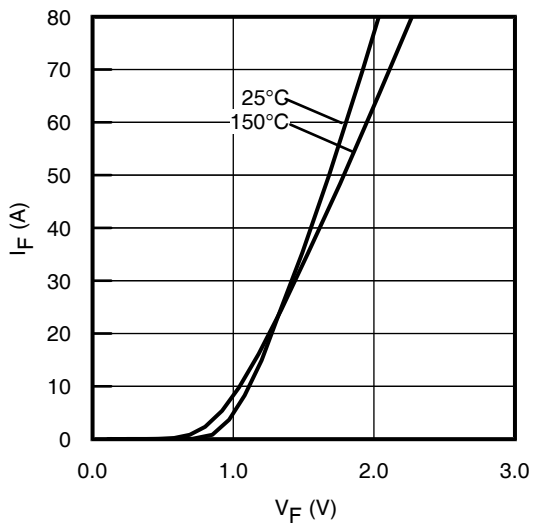


Fig. 8 - Typ. Diode Forward Voltage Drop Characteristics

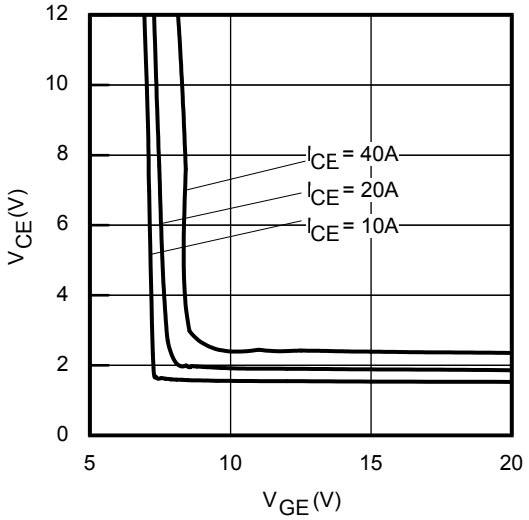


Fig. 9 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

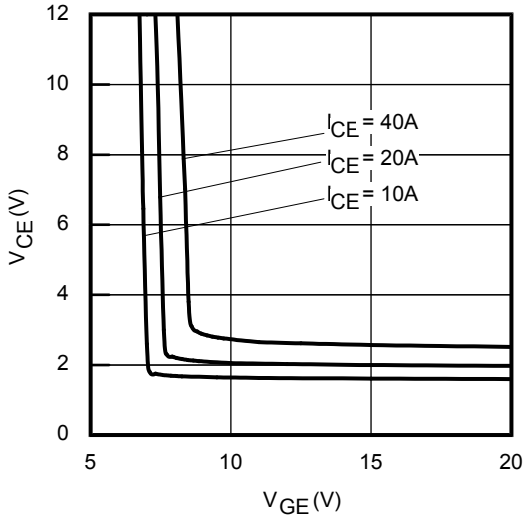


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

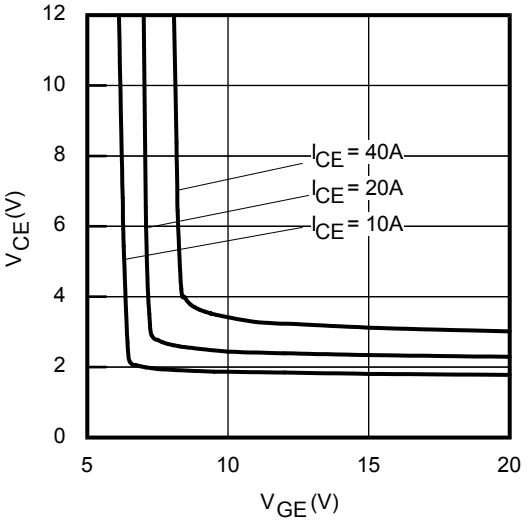


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 150°C

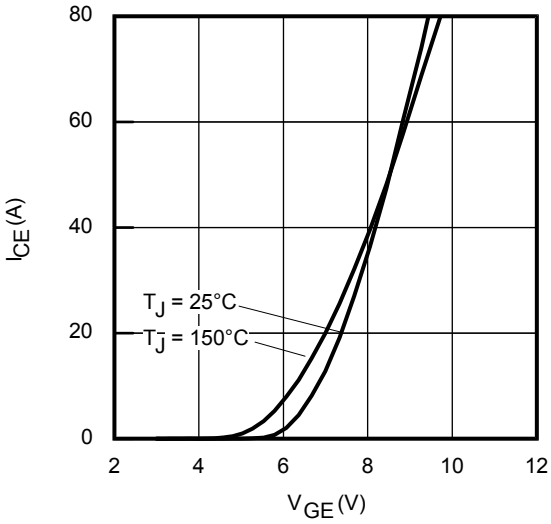


Fig. 12 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 20µs

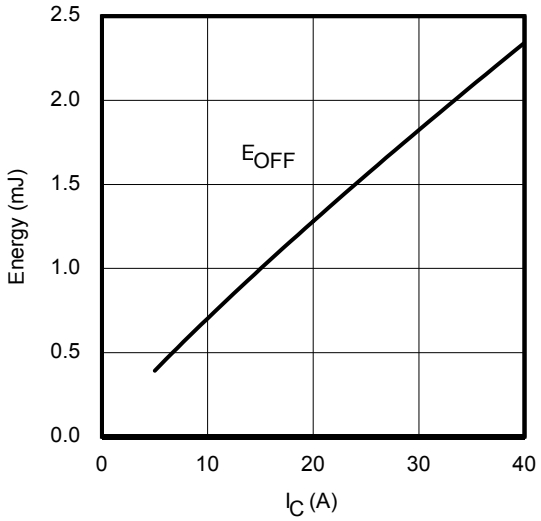


Fig. 13 - Typ. Energy Loss vs. I_C
T_J = 150°C; V_{CE} = 600V, R_G = 10Ω; V_{GE} = 15V

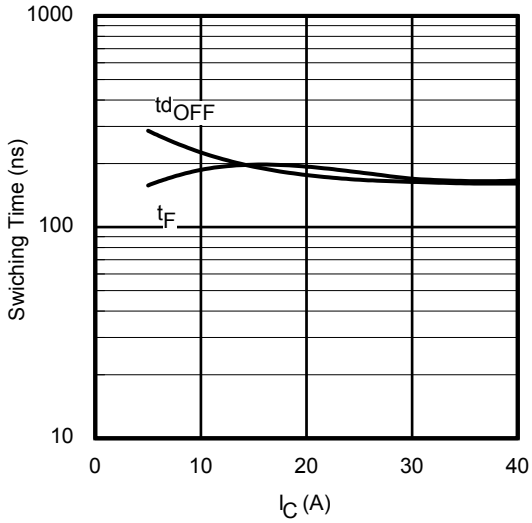


Fig. 14 - Typ. Switching Time vs. I_C
T_J = 150°C; V_{CE} = 600V, R_G = 10Ω; V_{GE} = 15V

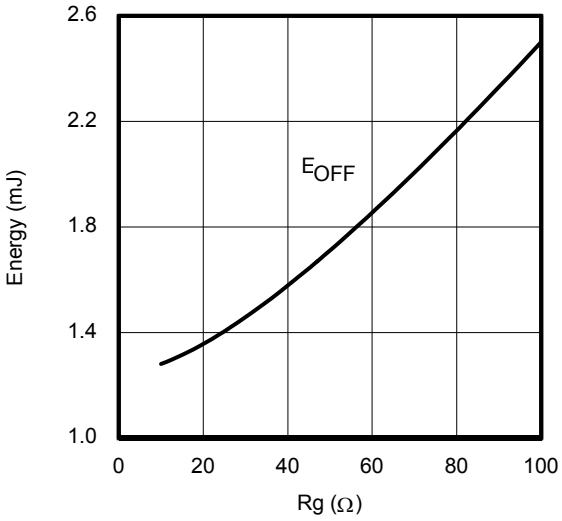


Fig. 15 - Typ. Energy Loss vs. R_G
T_J = 150°C; V_{CE} = 600V, I_{CE} = 20A; V_{GE} = 15V

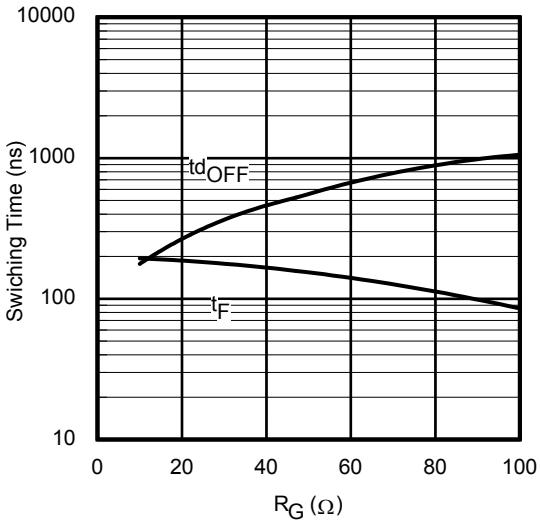


Fig. 16 - Typ. Switching Time vs. R_G
T_J = 150°C; V_{CE} = 600V, I_{CE} = 20A; V_{GE} = 15V

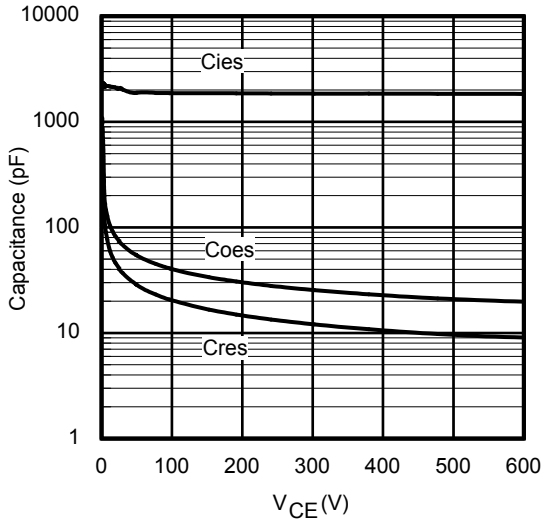


Fig. 17 - Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

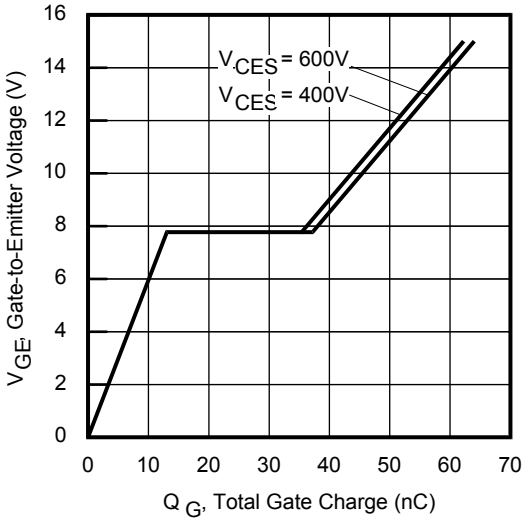
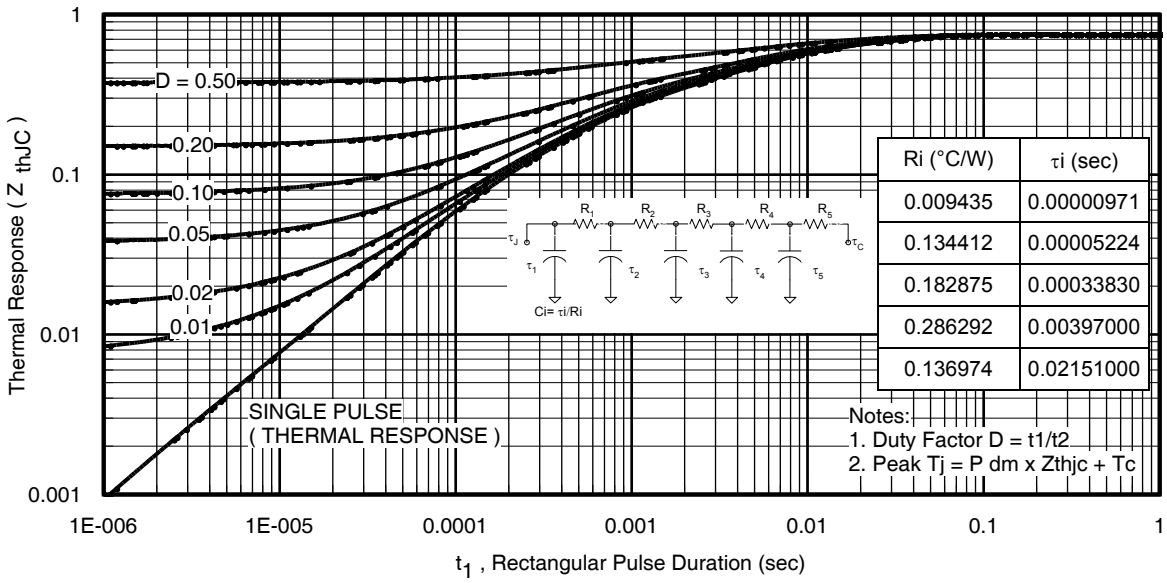
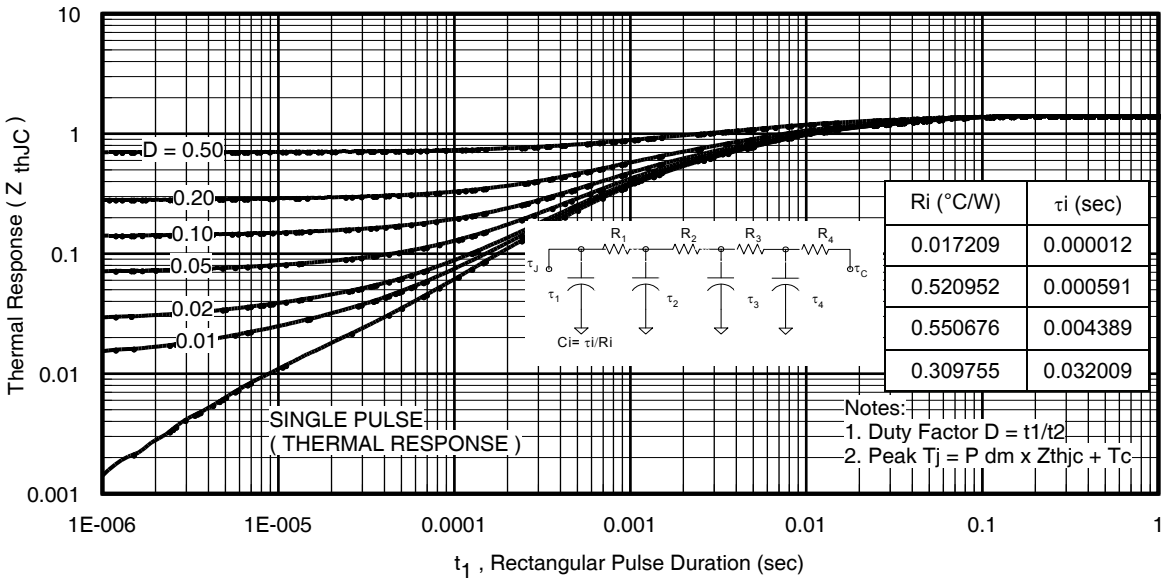


Fig. 18 - Typical Gate Charge vs. V_{GE}
I_{CE} = 20A



Ri (°C/W)	τi (sec)
0.009435	0.00000971
0.134412	0.00005224
0.182875	0.00033830
0.286292	0.00397000
0.136974	0.02151000

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



Ri (°C/W)	τi (sec)
0.017209	0.000012
0.520952	0.000591
0.550676	0.004389
0.309755	0.032009

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

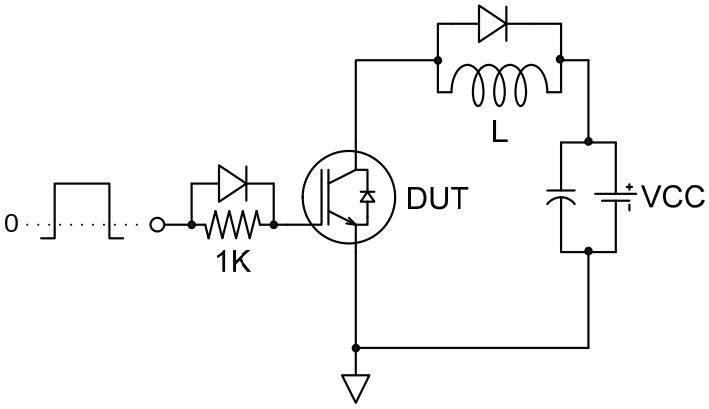


Fig.C.T.1 - Gate Charge Circuit (turn-off)

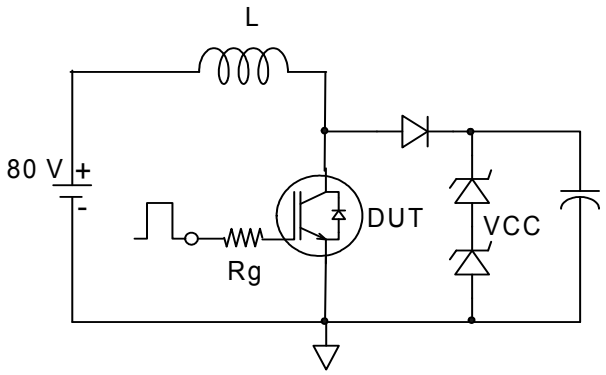


Fig.C.T.2 - RBSOA Circuit

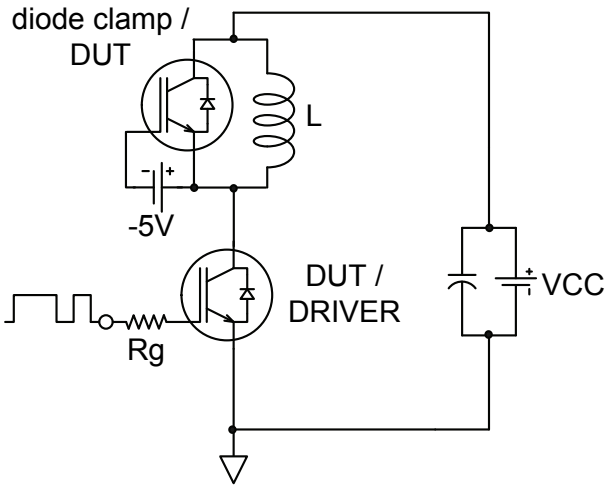


Fig.C.T.3 - Switching Loss Circuit

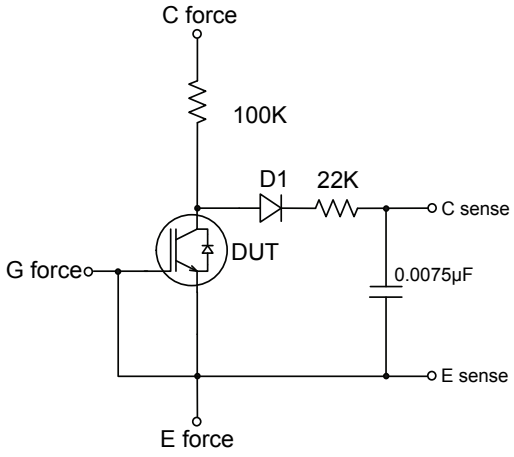


Fig.C.T.4 - BVCES Filter Circuit

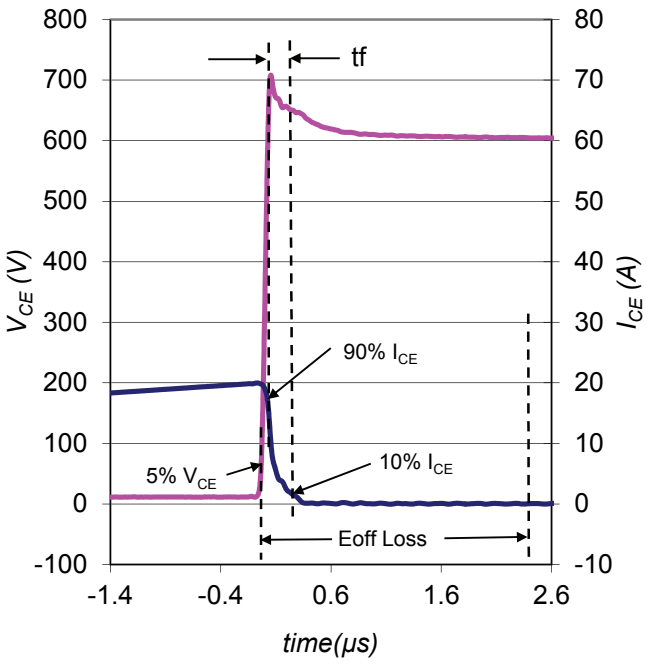
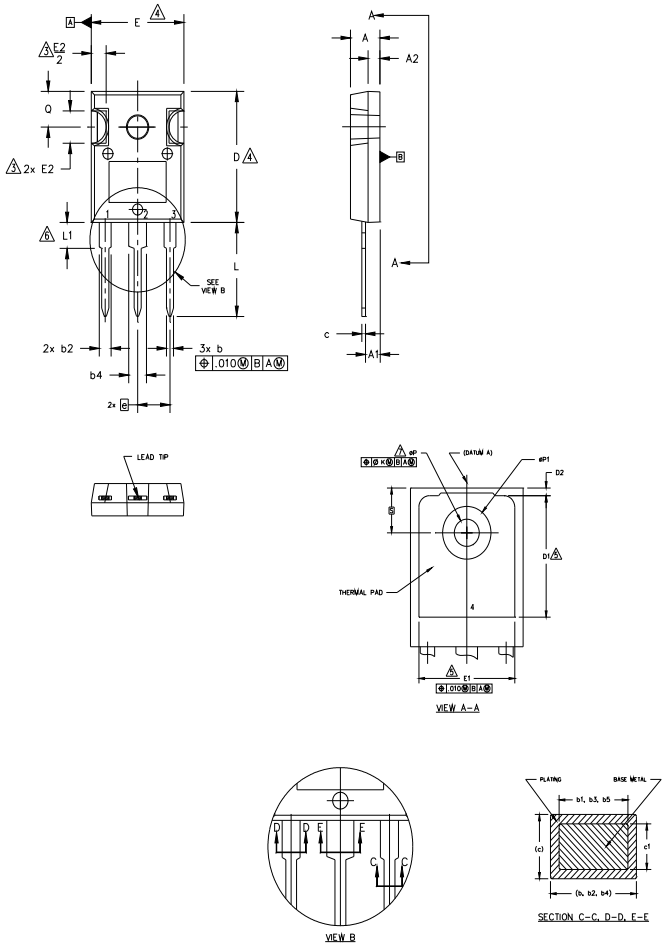


Fig. WF1 - Typ. Turn-off Loss Waveform
@ T_J = 150°C using Fig. CT.3

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. 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

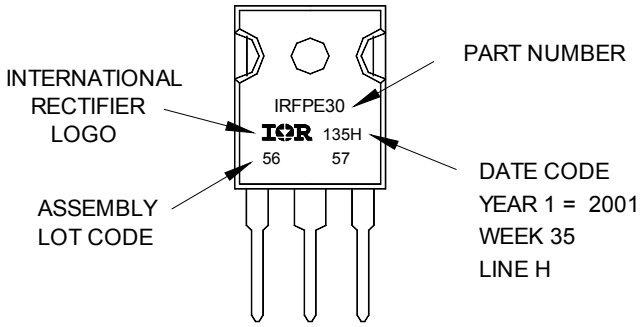
1.– ANODE/OPEN
2.– CATHODE
3.– ANODE

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"

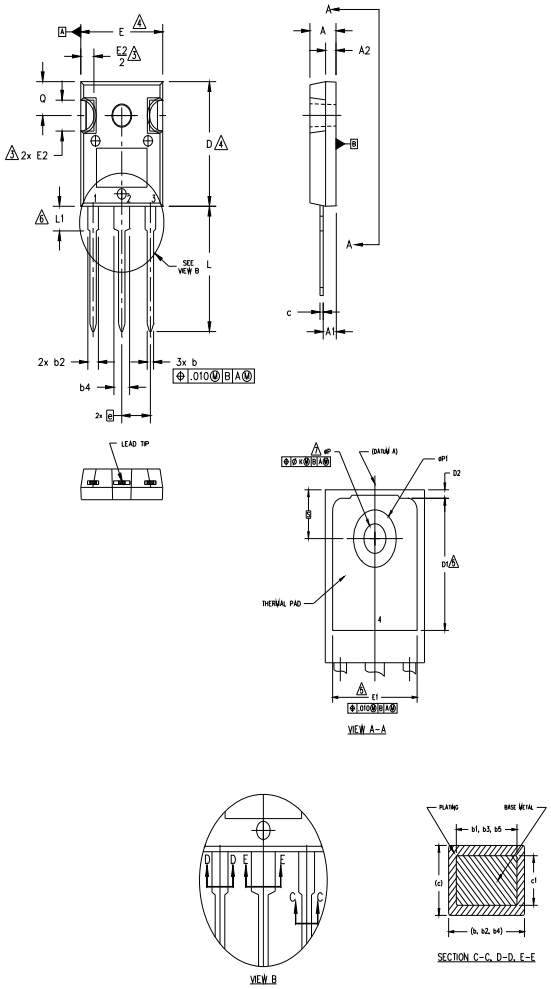


TO-247AC package is not recommended for Surface Mount Application.

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

TO-247AD Package Outline

Dimensions are shown in millimeters (inches)



NOTES:

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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

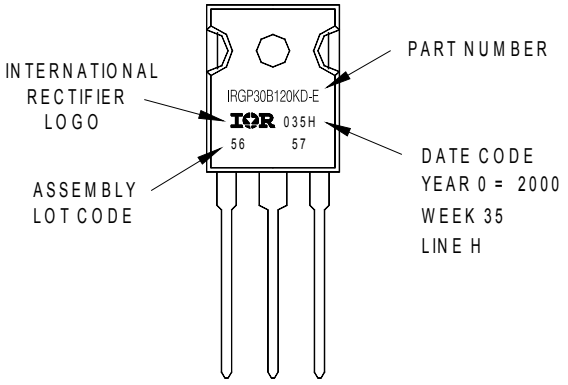
DIODES

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†

Qualification Level	Consumer†† (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

†† 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.

International IOR Rectifier

IR WORLD HEADQUARTERS: 101 N. Sepulveda Blvd., El Segundo, California 90245, USA

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

