Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

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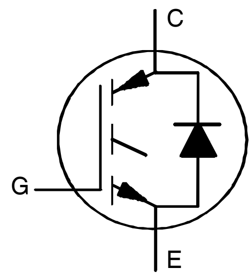
International Rectifier

PD-96288

IRG7PH35UDPbF
IRG7PH35UD-EP

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

Features
- Low $V_{CE\,(ON)}$ trench IGBT technology
- Low switching losses
- Square RBSOA
- 100% of the parts tested for I_{LM} ①
- Positive $V_{CE\,(ON)}$ temperature co-efficient
- Ultra fast soft recovery co-pak diode
- Tight parameter distribution
- Lead-Free



n-channel

V_{CES} = 1200V

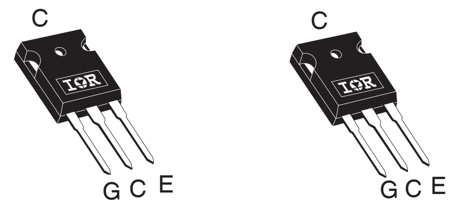
$I_{NOMINAL}$ = 20A

$T_{J(max)}$ = 150°C

$V_{CE(on)}$ typ. = 1.9V

Benefits
- High efficiency in a wide range of applications
- Suitable for a wide range of switching frequencies due to low $V_{CE\,(ON)}$ and low switching losses
- Rugged transient performance for increased reliability
- Excellent current sharing in parallel operation

Applications
- U.P.S.
- Welding
- Solar Inverter
- Induction Heating



TO-247AC IRG7PH35UDPbF   TO-247AD IRG7PH35UD-EP

G	C	E
Gate	Collector	Emitter

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
I_C @ T_C = 25°C	Continuous Collector Current	50	A
I_C @ T_C = 100°C	Continuous Collector Current	25	
$I_{NOMINAL}$	Nominal Current	20	
I_{CM}	Pulse Collector Current, V_{GE}=15V	60	
I_{LM}	Clamped Inductive Load Current, V_{GE}=20V ①	80	
I_F @ T_C = 25°C	Diode Continous Forward Current	50	
I_F @ T_C = 100°C	Diode Continous Forward Current	25	
I_{FM}	Diode Maximum Forward Current ②	80	
V_{GE}	Continuous Gate-to-Emitter Voltage	±30	V
P_D @ T_C = 25°C	Maximum Power Dissipation	180	W
P_D @ T_C = 100°C	Maximum Power Dissipation	70	
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)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$ (IGBT)	Thermal Resistance Junction-to-Case-(each IGBT) ④	—	—	0.70	°C/W
$R_{\theta JC}$ (Diode)	Thermal Resistance Junction-to-Case-(each Diode)	—	—	0.65	
$R_{\theta CS}$	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
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	1200	—	—	V	V_{GE} = 0V, I_C = 250μA ③
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	1.2	—	V/°C	V_{GE} = 0V, I_C = 1mA (25°C-150°C)
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.9	2.2	V	I_C = 20A, V_{GE} = 15V, T_J = 25°C
		—	2.3	—		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
$\Delta V_{GE(th)}/\Delta TJ$	Threshold Voltage temp. coefficient	—	-16	—	mV/°C	V_{CE} = V_{GE}, I_C = 600μA (25°C - 150°C)
gfe	Forward Transconductance	—	22	—	S	V_{CE} = 50V, I_C = 20A, PW = 30μs
I_{CES}	Collector-to-Emitter Leakage Current	—	2.0	100	μA	V_{GE} = 0V, V_{CE} = 1200V
		—	2000	—		V_{GE} = 0V, V_{CE} = 1200V, T_J = 150°C
V_{FM}	Diode Forward Voltage Drop	—	2.8	3.6	V	I_F = 20A
		—	2.5	—		I_F = 20A, 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)	—	85	130	nC	I_C = 20A
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	15	20		V_{GE} = 15V
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	35	50		V_{CC} = 600V
E_{on}	Turn-On Switching Loss	—	1060	1300	μJ	I_C = 20A, V_{CC} = 600V, V_{GE} = 15V
E_{off}	Turn-Off Switching Loss	—	620	850		R_G = 10Ω, L = 200uH, L_S = 150nH, T_J = 25°C
E_{total}	Total Switching Loss	—	1680	2150		Energy losses include tail & diode reverse recovery
$t_{d(on)}$	Turn-On delay time	—	30	50	ns	I_C = 20A, V_{CC} = 600V, V_{GE} = 15V
t_r	Rise time	—	15	30		R_G = 10Ω, L = 200uH, L_S = 150nH, T_J = 25°C
$t_{d(off)}$	Turn-Off delay time	—	160	180		
t_f	Fall time	—	80	105		
E_{on}	Turn-On Switching Loss	—	1750	—	μJ	I_C = 20A, V_{CC} = 600V, V_{GE}=15V
E_{off}	Turn-Off Switching Loss	—	1120	—		R_G=10Ω, L=200uH, L_S=150nH, T_J = 150°C ③
E_{total}	Total Switching Loss	—	2870	—		Energy losses include tail & diode reverse recovery
$t_{d(on)}$	Turn-On delay time	—	30	—	ns	I_C = 20A, V_{CC} = 600V, V_{GE} = 15V
t_r	Rise time	—	15	—		R_G = 10Ω, L = 200uH, L_S = 150nH
$t_{d(off)}$	Turn-Off delay time	—	190	—		T_J = 150°C
t_f	Fall time	—	210	—		
C_{ies}	Input Capacitance	—	1940	—	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	—	120	—		V_{CC} = 30V
C_{res}	Reverse Transfer Capacitance	—	40	—		f = 1.0Mhz
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T_J = 150°C, I_C = 80A V_{CC} = 960V, Vp =1200V Rg = 10Ω, V_{GE} = +20V to 0V
Erec	Reverse Recovery Energy of the Diode	—	790	—	μJ	T_J = 150°C
t_{rr}	Diode Reverse Recovery Time	—	105	—	ns	V_{CC} = 600V, I_F = 20A
I_{rr}	Peak Reverse Recovery Current	—	40	—	A	V_{GE} = 15V, Rg = 10Ω, L =1.0mH, L_s = 150nH

Notes:

① V_{CC} = 80% (V_{CES}), V_{GE} = 20V, R_G = 50Ω.
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.

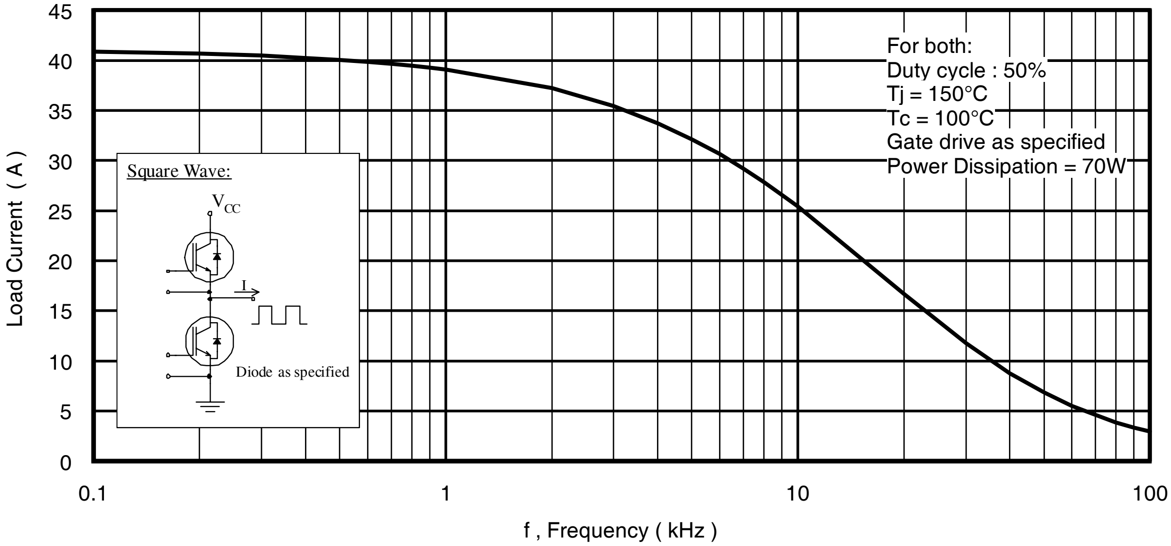


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

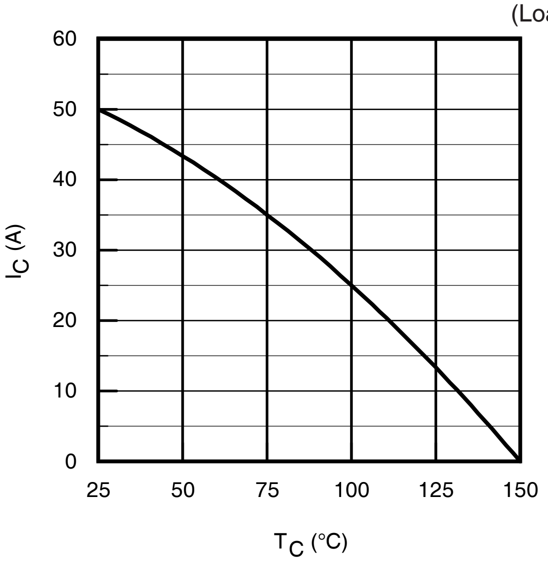


Fig. 2 - Maximum DC Collector Current vs. Case Temperature

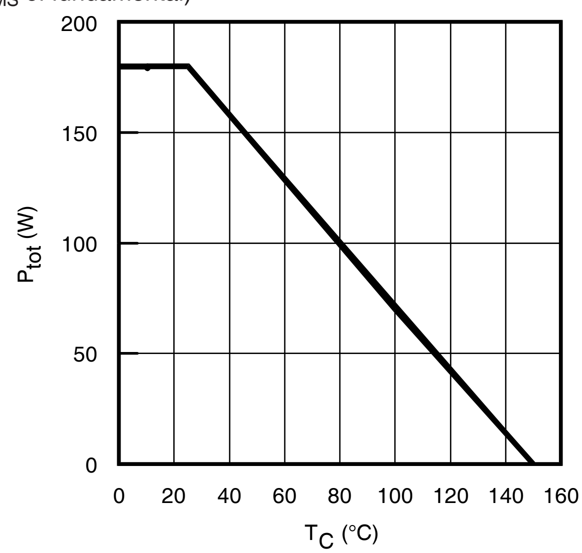


Fig. 3- Power Dissipation vs. Case Temperature

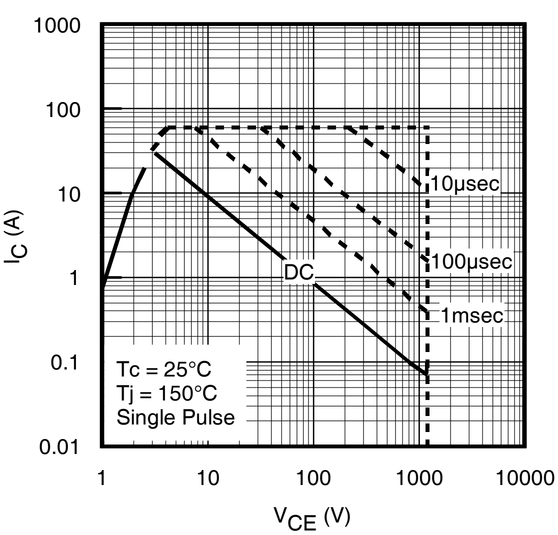


Fig. 4 - Forward SOA
T_C = 25°C, $T_J \leq$ 150°C; V_{GE} =15V

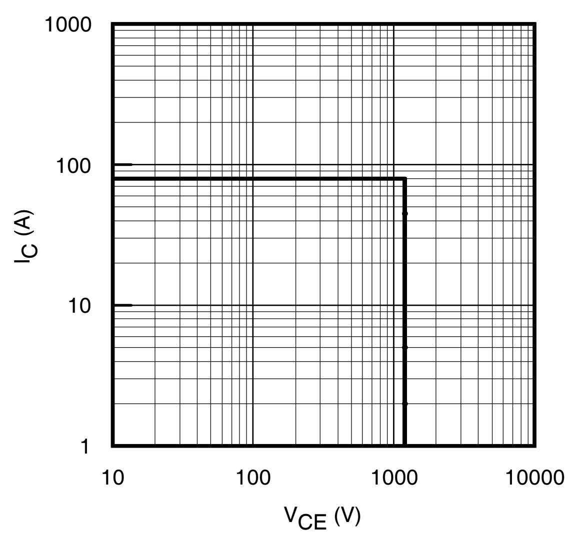


Fig. 5 - Reverse Bias SOA
T_J = 150°C; V_{GE} = 20V

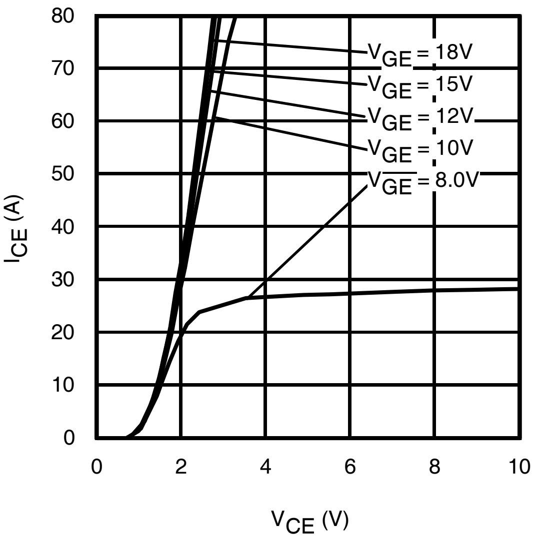


Fig. 6- Typ. IGBT Output Characteristics
T_J = -40°C; tp = 30µs

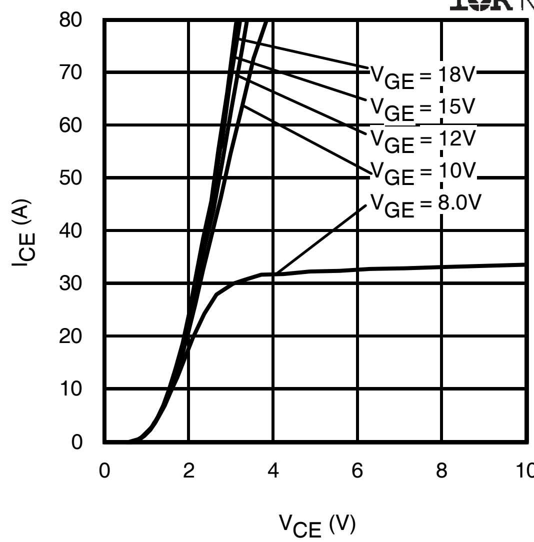


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 30µs

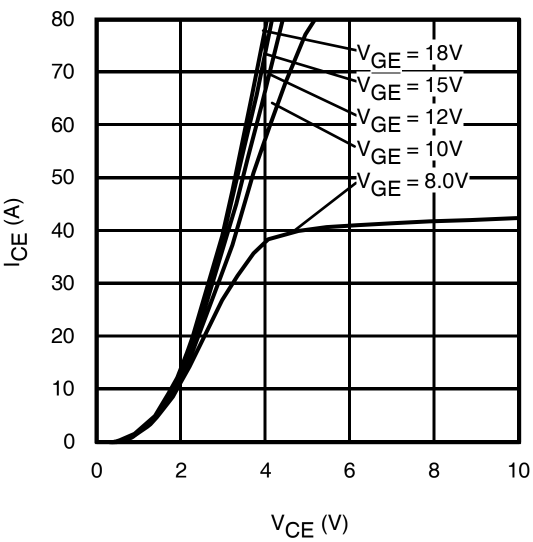


Fig. 8 - Typ. IGBT Output Characteristics
T_J = 150°C; tp = 30µs

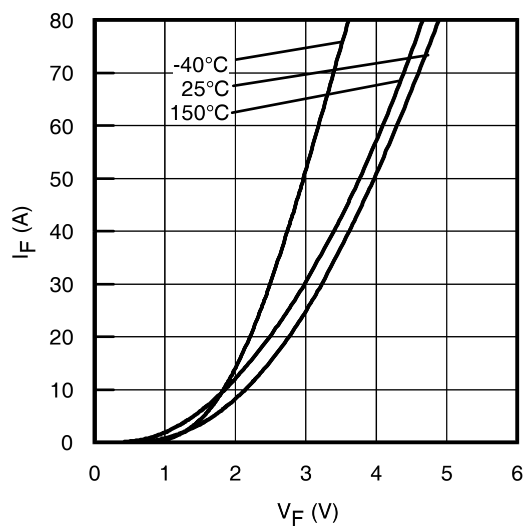


Fig. 9 - Typ. Diode Forward Characteristics
tp = 380µs

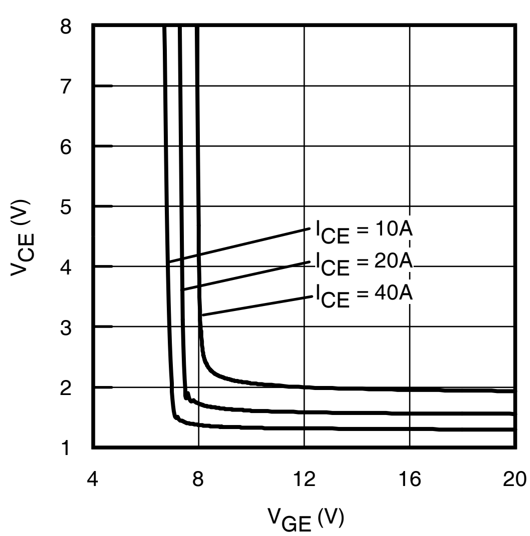


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

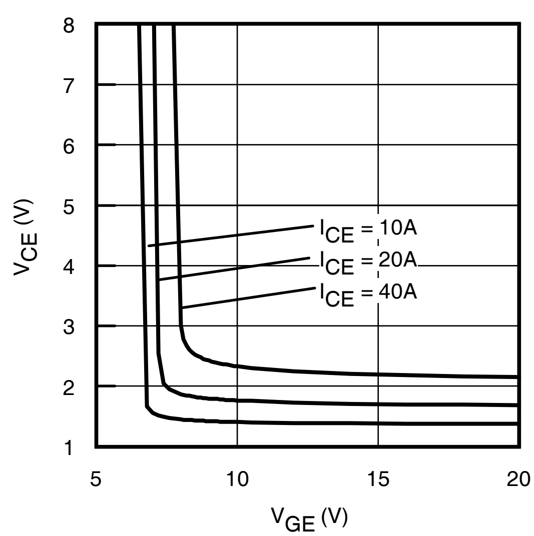


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

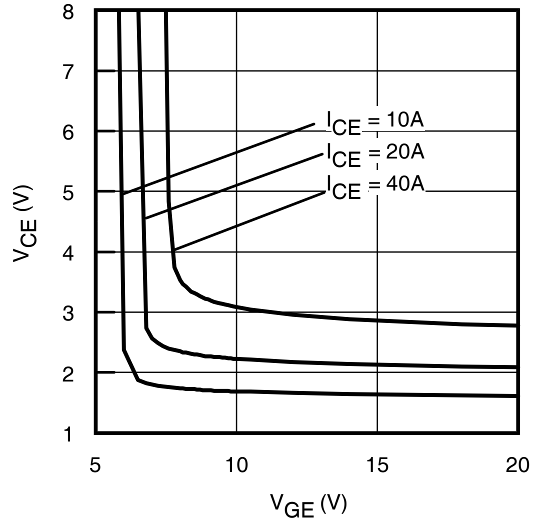


Fig. 12 - Typical V_{CE} vs. V_{GE}
$T_J = 150°C$

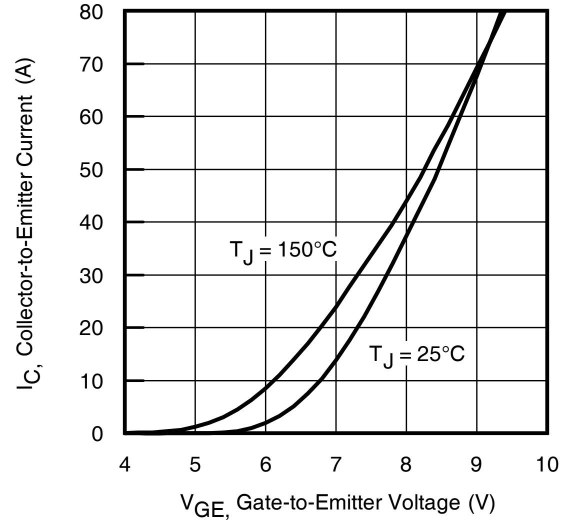


Fig. 13 - Typ. Transfer Characteristics
V_{CE} = 50V, tp = 30µs

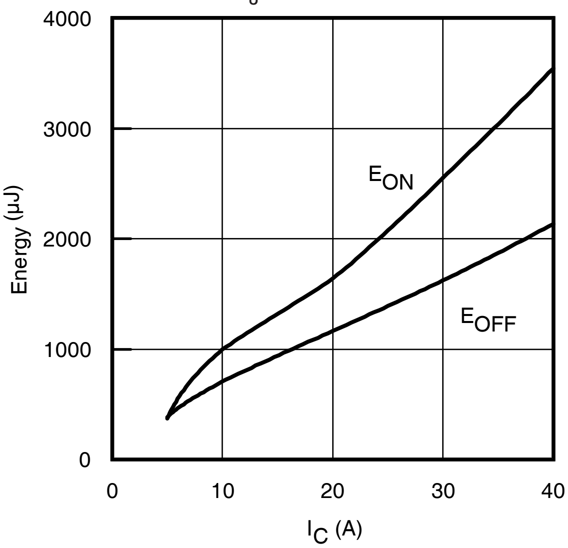


Fig. 14 - Typ. Energy Loss vs. I_C
$T_J = 150°C$; L = 680µH; V_{CE} = 600V, R_G = 10Ω; V_{GE} = 15V

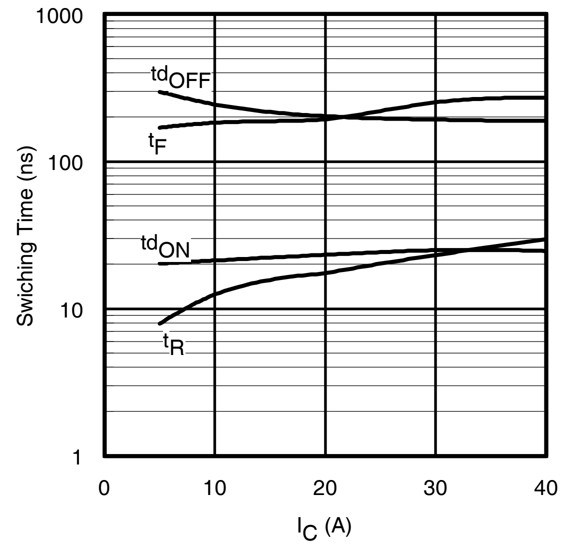


Fig. 15 - Typ. Switching Time vs. I_C
$T_J = 150°C$; L = 680µH; V_{CE} = 600V, R_G = 10Ω; V_{GE} = 15V

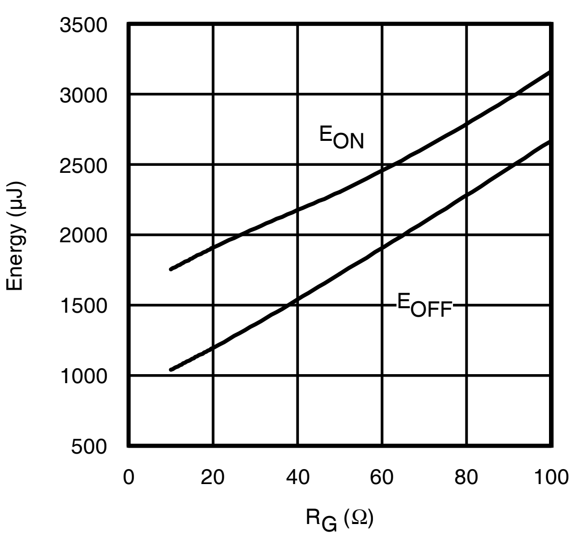


Fig. 16 - Typ. Energy Loss vs. R_G
$T_J = 150°C$; L = 680µH; V_{CE} = 600V, I_{CE} = 20A; V_{GE} = 15V

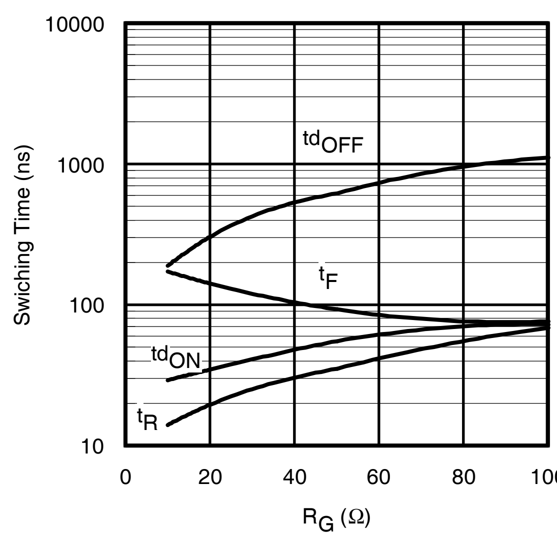


Fig. 17 - Typ. Switching Time vs. R_G
$T_J = 150°C$; L = 680µH; V_{CE} = 600V, I_{CE} = 20A; V_{GE} = 15V

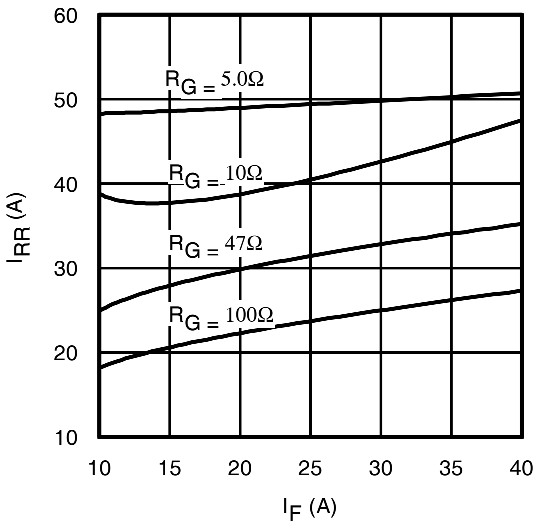


Fig. 18 - Typ. Diode I_{RR} vs. I_F
$T_J = 150°C$

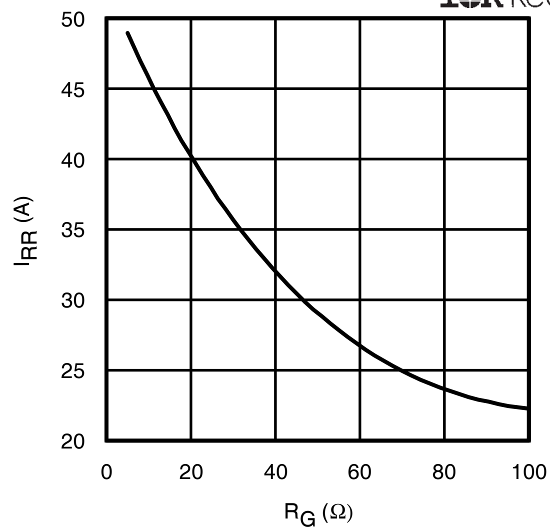


Fig. 19 - Typ. Diode I_{RR} vs. R_G
$T_J = 150°C$

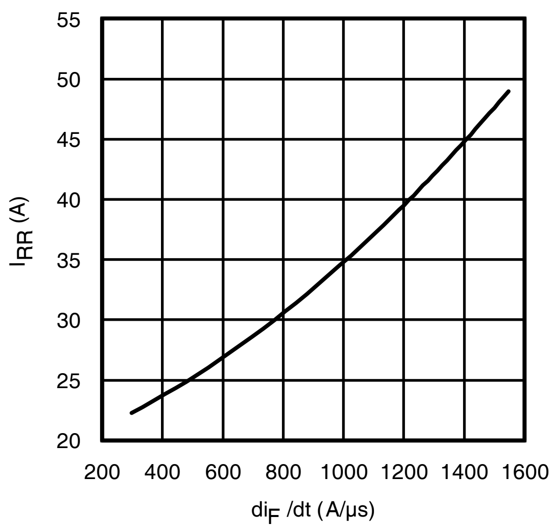


Fig. 20 - Typ. Diode I_{RR} vs. di_F/dt
$V_{CC} = 600V$; $V_{GE} = 15V$; $I_F = 20A$; $T_J = 150°C$

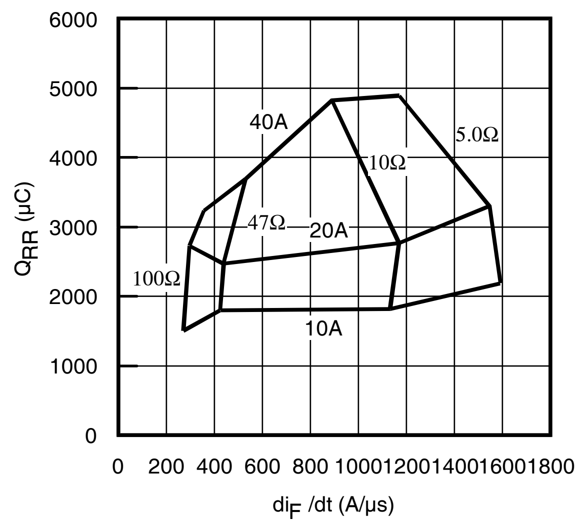


Fig. 21 - Typ. Diode Q_{RR} vs. di_F/dt
$V_{CC} = 600V$; $V_{GE} = 15V$; $T_J = 150°C$

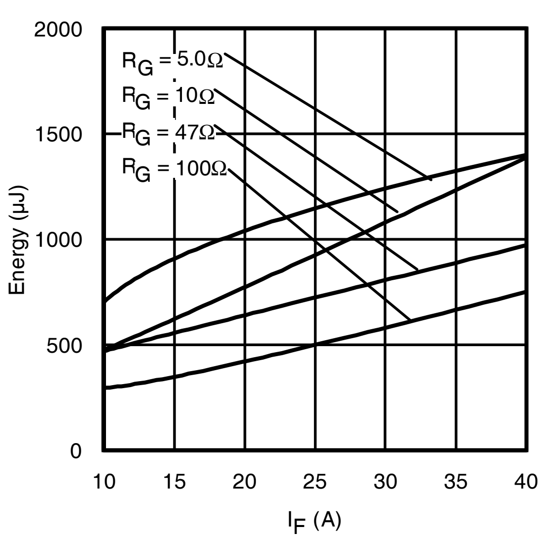


Fig. 22 - Typ. Diode E_{RR} vs. I_F
$T_J = 150°C$

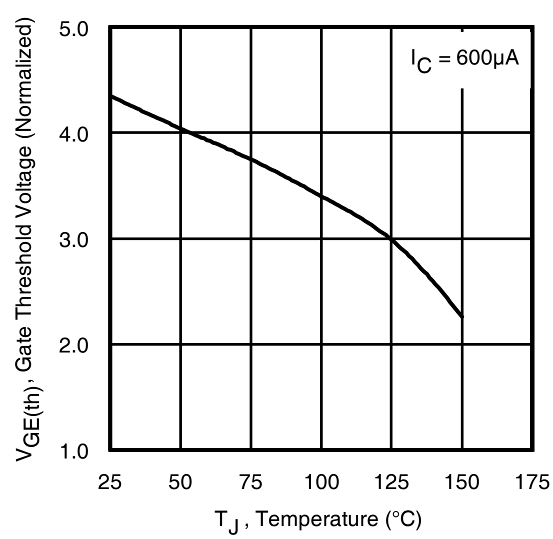


Fig. 23 - Typical Gate Threshold Voltage (Normalized) vs. Junction Temperature

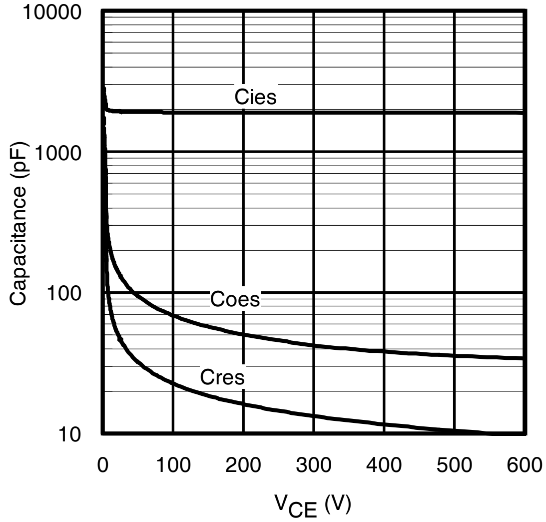


Fig. 23 - Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

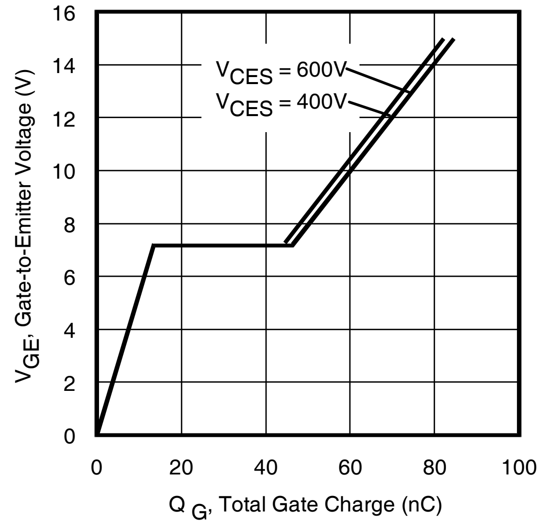
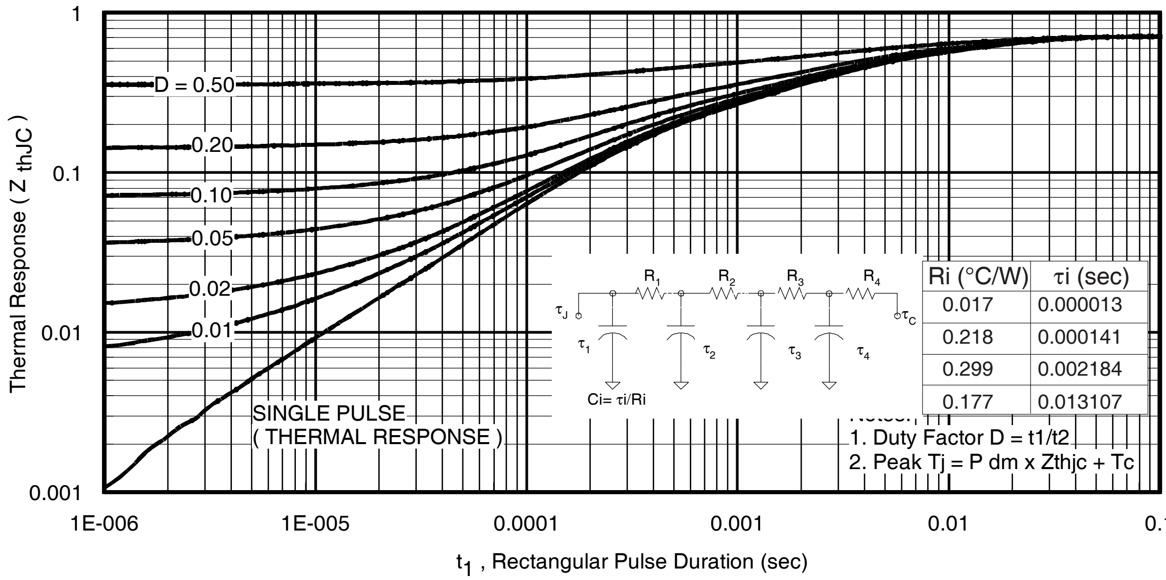
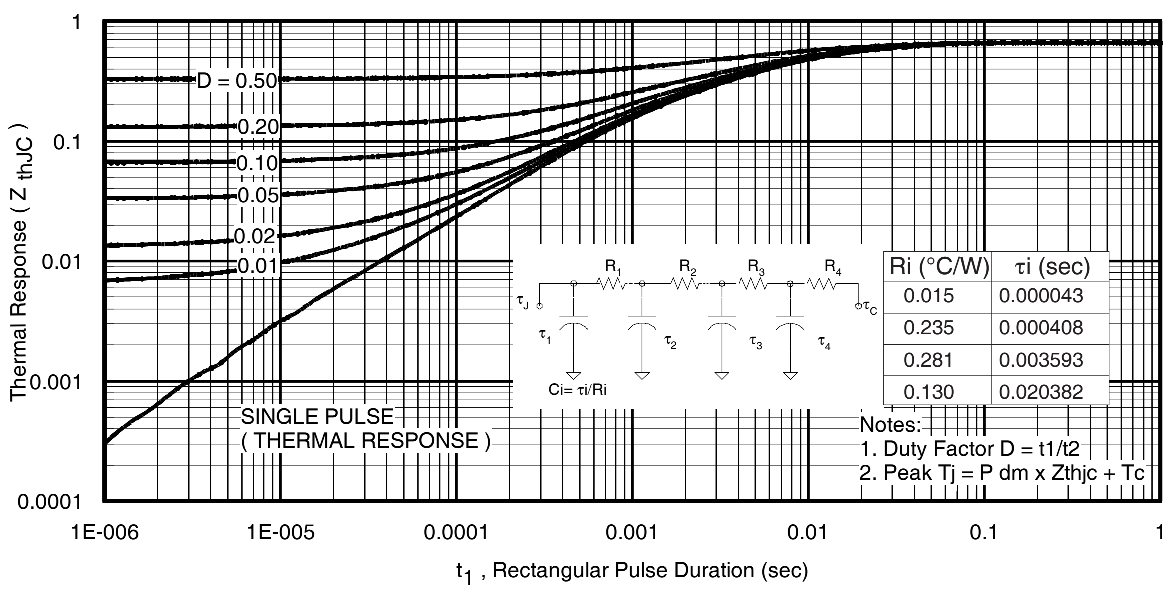


Fig. 24 - Typical Gate Charge vs. V_{GE}
I_{CE} = 20A; L = 2.4mH



Ri (°C/W)	τi (sec)
0.017	0.000013
0.218	0.000141
0.299	0.002184
0.177	0.013107

Fig 25. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)



Ri (°C/W)	τi (sec)
0.015	0.000043
0.235	0.000408
0.281	0.003593
0.130	0.020382

Fig. 26. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

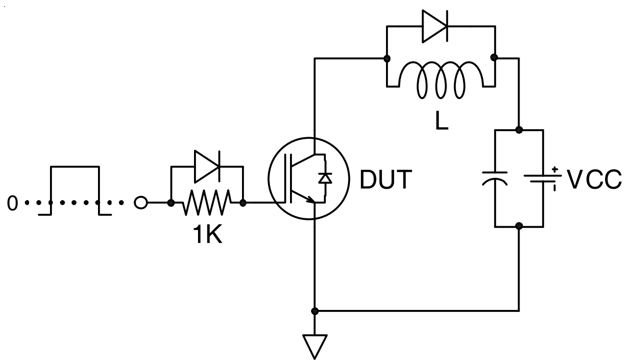


Fig.C.T.1 - Gate Charge Circuit (turn-off)

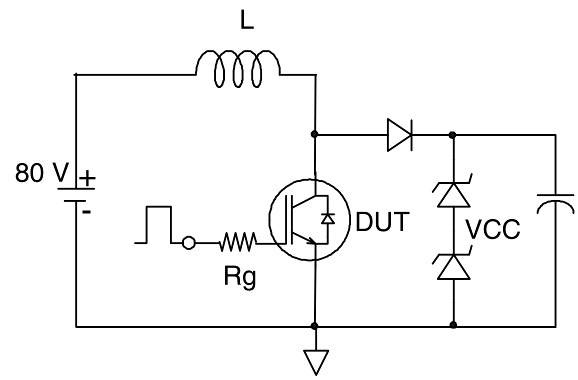


Fig.C.T.2 - RBSOA Circuit

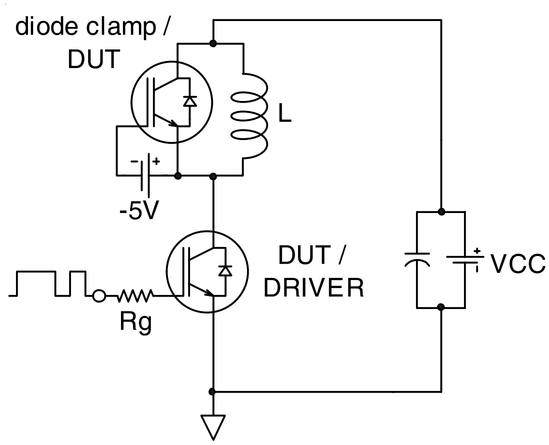


Fig.C.T.3 - Switching Loss Circuit

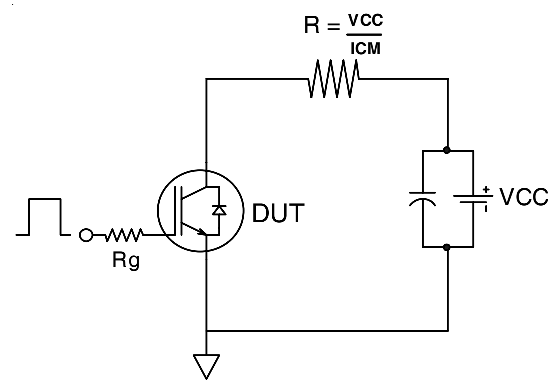


Fig.C.T.4 - Resistive Load Circuit

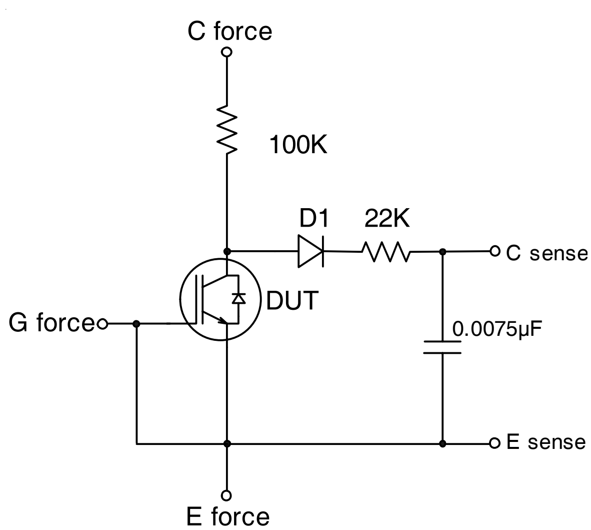


Fig.C.T.5 - BVCES Filter Circuit

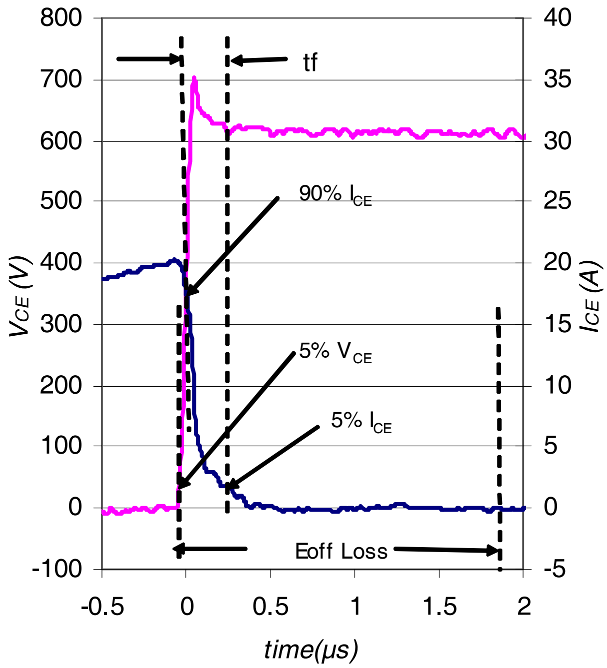


Fig. WF1 - Typ. Turn-off Loss Waveform
@ T_J = 150°C using Fig. CT.4

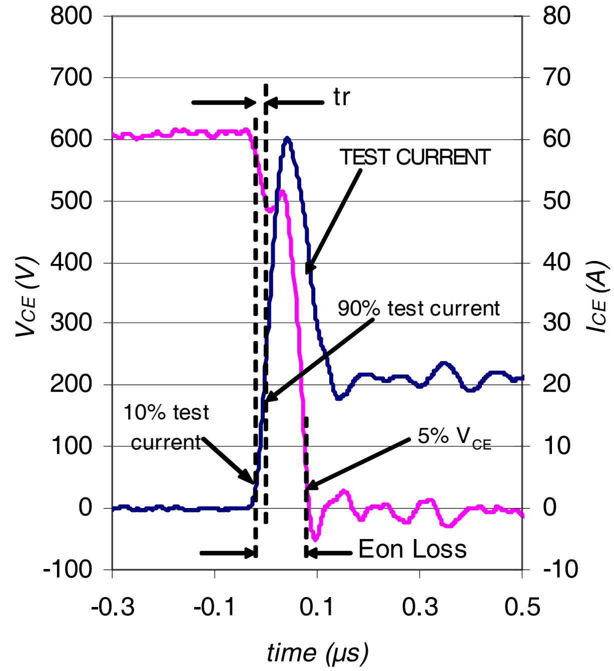


Fig. WF2 - Typ. Turn-on Loss Waveform
@ T_J = 150°C using Fig. CT.4

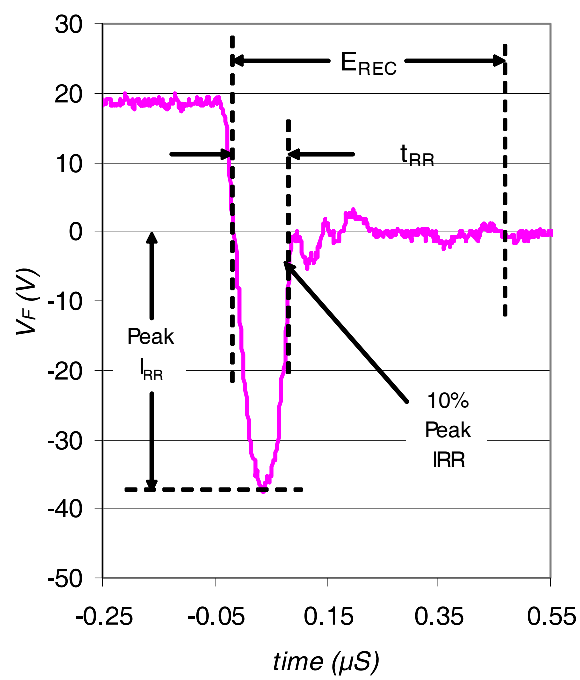
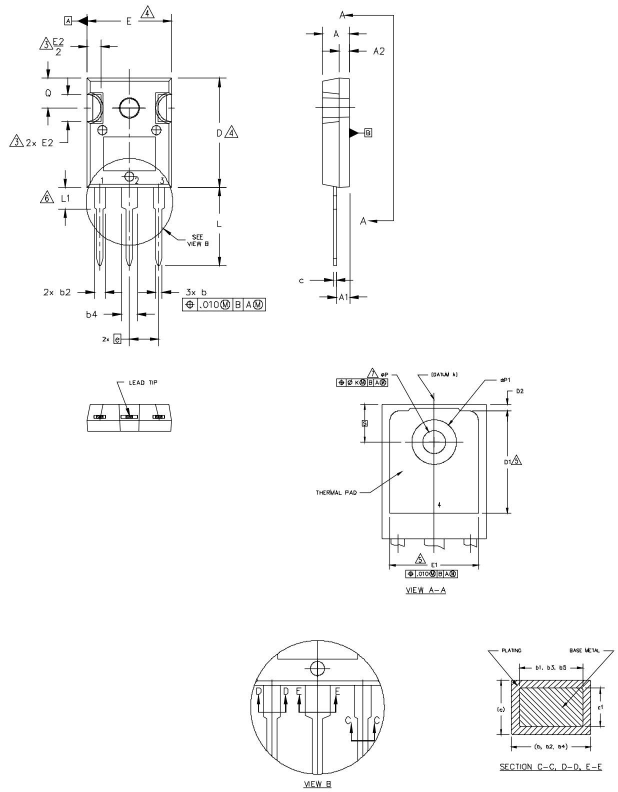


Fig. WF3 - Typ. Diode Recovery Waveform
@ T_J = 150°C using Fig. CT.4

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

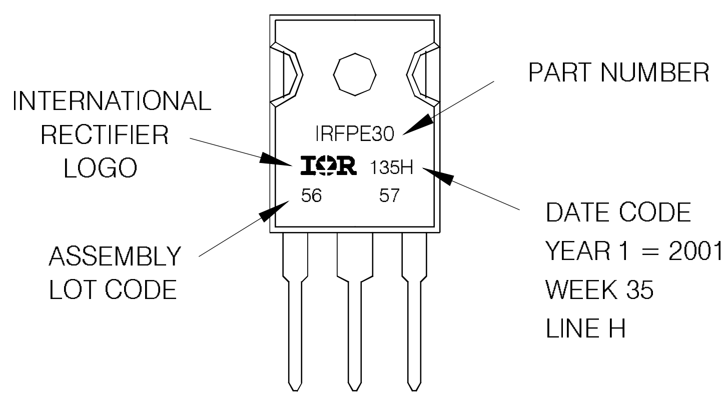
DIODES

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"

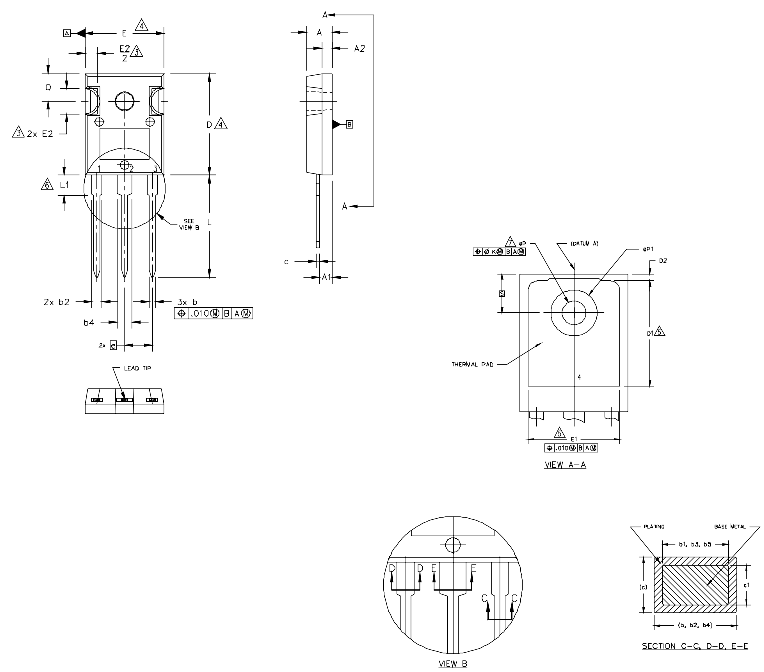


TO-247AC package is not recommended for Surface Mount Application.

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

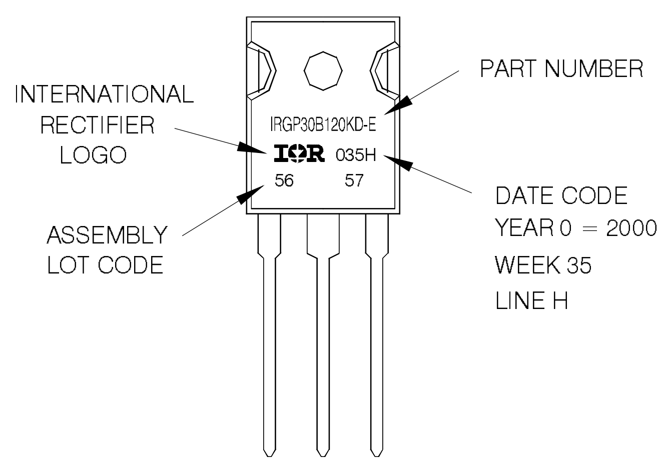
DIODES

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.

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