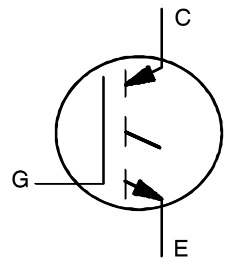
INSULATED GATE BIPOLAR TRANSISTOR



n-channel

V_{CES} = 1200V

I_C = 81A @ T_C = 100°C

$V_{CE(on)}$ typ. = 1.47V @ 33A

Features

- Standard: Optimized for minimum saturation voltage and low operating frequencies (< 1kHz)
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency
- Industry standard TO-247AC package
- Lead-Free
- Automotive Qualified *

Benefits

- Generation 4 IGBT's offer highest efficiency available
- IGBT's optimized for specified application conditions

TO-247AC

G	C	E
Gate	Collector	Emitter

Base part number	Package Type	Standard Pack		Complete Part Number
		Form	Quantity	
AUIRG4PH50S	TO-247AC	Tube	25	AUIRG4PH50S

Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only; and functional operation of the device at these or any other condition beyond those indicated in the specifications is not implied.Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability. The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions. Ambient temperature (T_A) is 25°C, unless otherwise specified.

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
I_C @ T_C = 25°C	Continuous Collector Current	141⑤	A
I_C @ T_C = 100°C	Continuous Collector Current	81	
I_{CM}	Pulse Collector Current, V_{GE} = 15V ②	99	
I_{LM}	Clamped Inductive Load Current, V_{GE} = 20V ①	99	
V_{GE}	Continuous Gate-to-Emitter Voltage	±20	V
	Transient Gate-to-Emitter Voltage	±30	
P_D @ T_C = 25°C	Maximum Power Dissipation	543	W
P_D @ T_C = 100°C	Maximum Power Dissipation	217	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	°C
	Soldering Temperature, for 10 sec. (1.6mm from case)	300	
	Mounting Torque, 6-32 or M3 Screw	10 lbf·in (1.1N·m)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$ (IGBT)	Thermal Resistance Junction-to-Case (IGBT) ④	—	—	0.23	°C/W
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink (flat, greased surface)	—	0.24	—	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	—	40	—	

*Qualification standards can be found at http://www.irf.com/

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)③
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.47	1.7	V	I_C = 33A, V_{GE} = 15V, T_J = 25°C
		—	1.55	—		I_C = 33A, V_{GE} = 15V, T_J = 150°C
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0	V	V_{CE} = V_{GE}, I_C = 250µA
$\Delta V_{GE(th)}/\Delta TJ$	Threshold Voltage temp. coefficient	—	-11	—	mV/°C	V_{CE} = V_{GE}, I_C = 250µA (25°C - 150°C)
gfe	Forward Transconductance	—	30	—	S	V_{CE} = 50V, I_C = 33A, PW = 20µs
I_{CES}	Collector-to-Emitter Leakage Current	—	—	250	µA	V_{GE} = 0V, V_{CE} = 1200V, T_J = 25°C
		—	—	1000		V_{GE} = 0V, V_{CE} = 1200V, T_J = 150°C
I_{GES}	Gate-to-Emitter Leakage Current	—	—	±100	nA	V_{GE} = ±20V

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
Q_g	Total Gate Charge (turn-on)	—	151	227	nC	I_C = 33A
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	26	39		V_{GE} = 15V
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	62	93		V_{CC} = 600V
E_{off}	Turn-Off Switching Loss	—	15	16	mJ	I_C = 33A, V_{CC} = 600V, V_{GE} = 15V R_G = 5Ω, L = 400µH, T_J = 25°C Energy losses include tail
$t_{d(off)}$	Turn-Off delay time	—	485	616	ns	I_C = 33A, V_{CC} = 600V, V_{GE} = 15V
t_f	Fall time	—	1193	1371		R_G = 5Ω, L = 400µH, T_J = 25°C
E_{off}	Turn-Off Switching Loss	—	29	—	mJ	I_C = 33A, V_{CC} = 600V, V_{GE} = 15V R_G = 5Ω, L = 400µH, T_J = 150°C Energy losses include tail
$t_{d(off)}$	Turn-Off delay time	—	689	—	ns	I_C = 33A, V_{CC} = 600V, V_{GE} = 15V
t_f	Fall time	—	2462	—		R_G = 5Ω, L = 400µH, T_J = 150°C
C_{ies}	Input Capacitance	—	3804	—	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	—	161	—		V_{CC} = 30V
C_{res}	Reverse Transfer Capacitance	—	31	—		f = 1.0Mhz
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T_J = 150°C, I_C = 99A V_{CC} = 960V, Vp ≤ 1200V Rg = 5Ω, V_{GE} = +20V to 0V

Notes:

① V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 400µH, 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.
⑤ Calculated continuous current based on maximum allowable junction temperature. Bond wire current limit is 78A. Note that current limitations arising from heating of the device leads may occur with some lead mounting arrangements.

Qualification Information†

Qualification Level		Automotive (per AEC-Q101) ††	
		This part number(s) passed Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.	
Moisture Sensitivity Level		TO-247AC	N/A
ESD	Machine Model	Class M3 AEC-Q101-002	
	Human Body Model	Class H2 AEC-Q101-001	
	Charged Device Model	Class C4 AEC-Q101-005	
RoHS Compliant		Yes	

† Qualification standards can be found at International Rectifier's web site: http//www.irf.com/

†† Highest passing voltage.

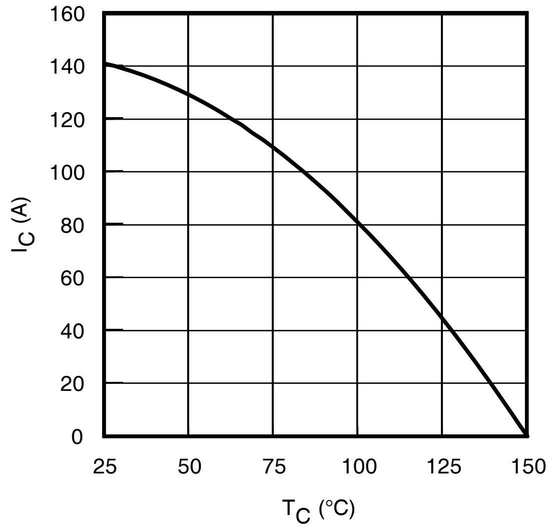


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

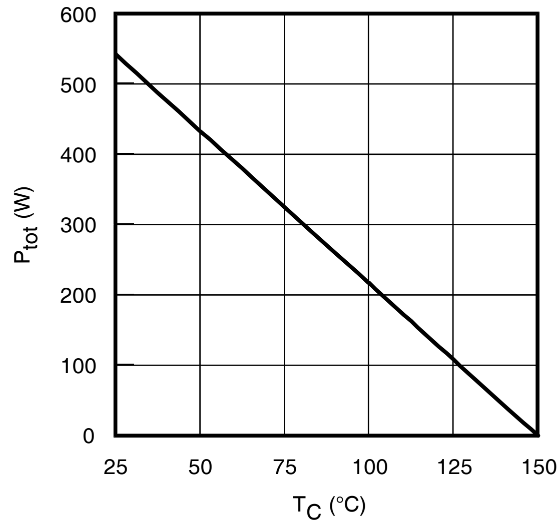


Fig. 2 - Power Dissipation vs. Case Temperature

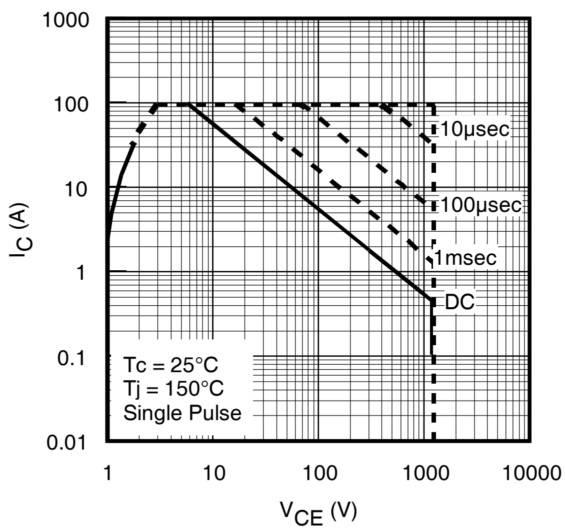


Fig. 3 - Forward SOA
$T_C = 25°C$, $T_J \leq 150°C$; $V_{GE} = 15V$

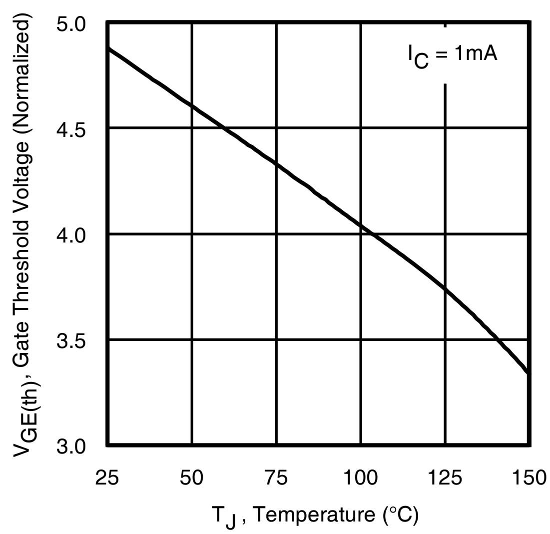


Fig. 4 - Typical Gate Threshold Voltage (Normalized) vs. Junction Temperature

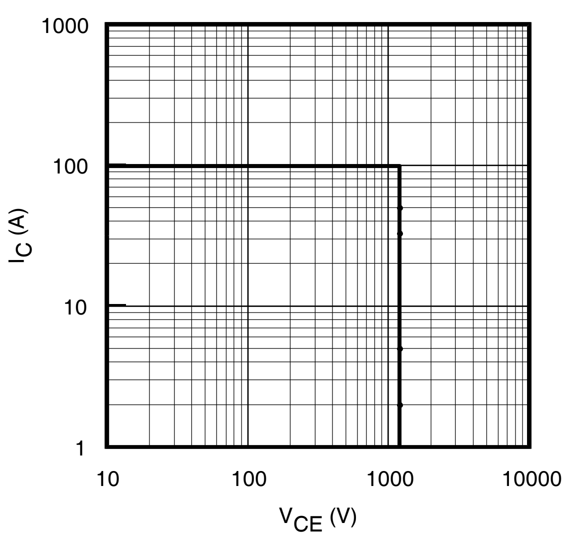


Fig. 5- Reverse Bias SOA
$T_J = 150°C$; $V_{GE} = 20V$

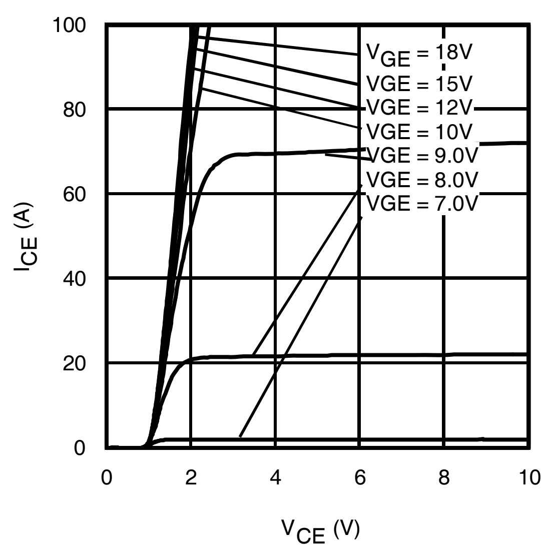


Fig. 6 - Typ. IGBT Output Characteristics
$T_J = -40°C$; $tp = 20μs$

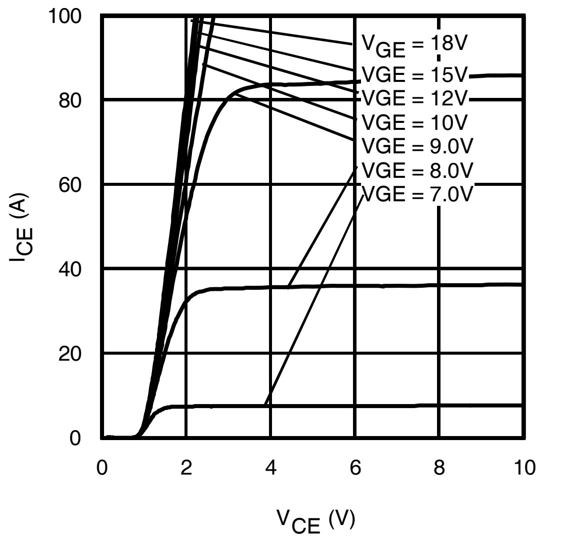


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 20µs

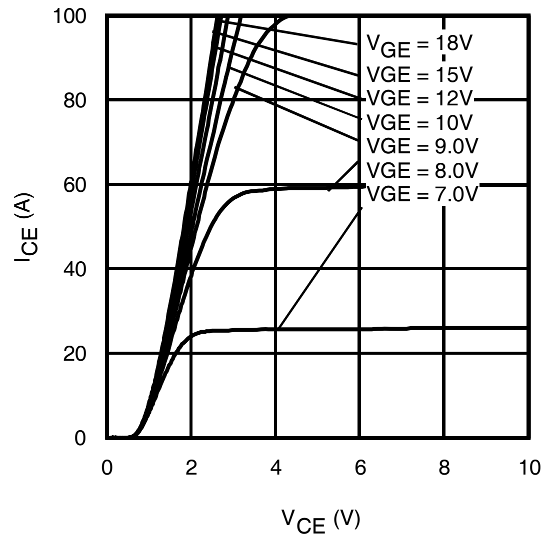


Fig. 8 - Typ. IGBT Output Characteristics
T_J = 150°C; tp = 20µs

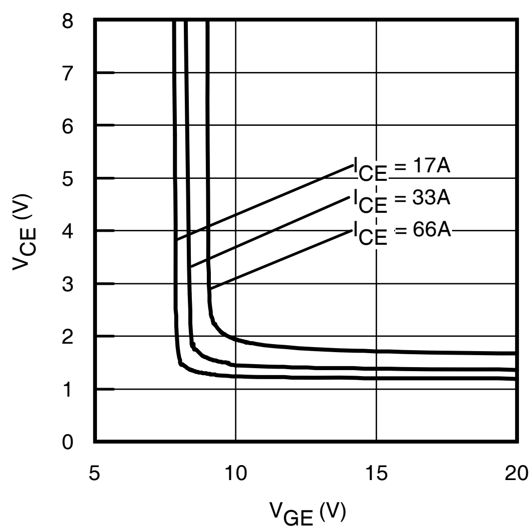


Fig. 9 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

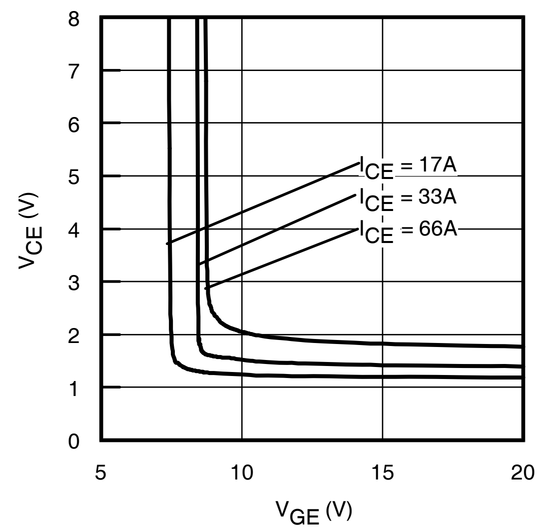


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

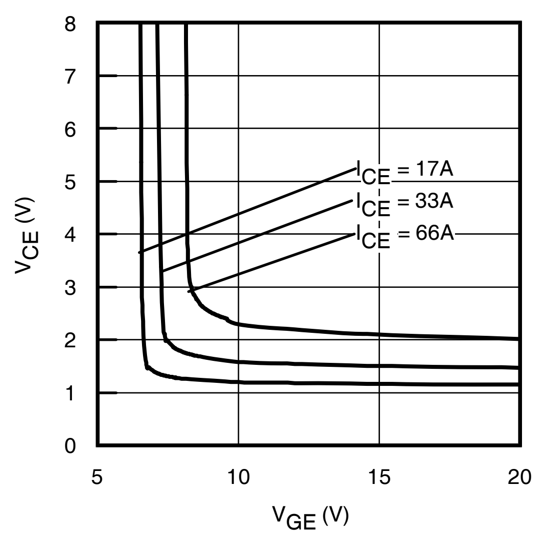


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 150°C

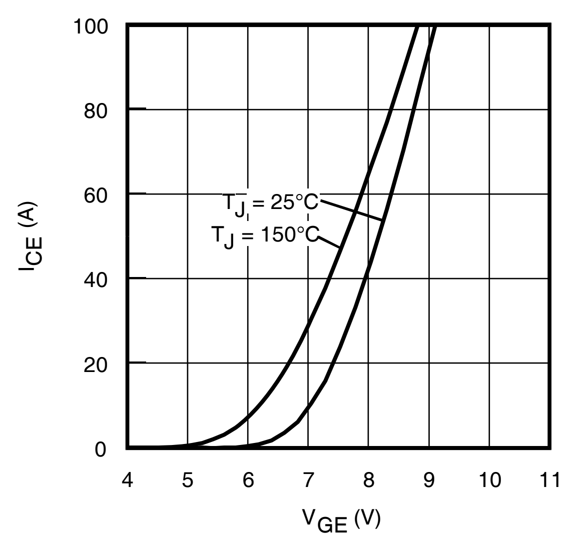


Fig. 12- Typ. Transfer Characteristics
V_{CE} = 50V; tp = 20µs

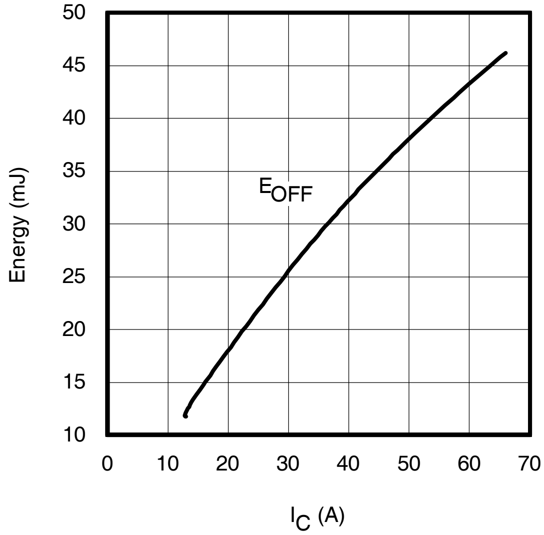


Fig. 13 - Typ. Energy Loss vs. I_C
T_J = 150°C; L = 400µH; V_{CE} = 600V, R_G = 5Ω; V_{GE} = 15V

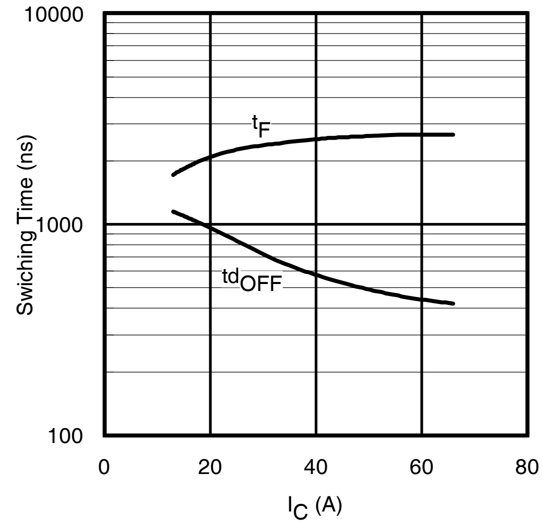


Fig. 14 - Typ. Switching Time vs. I_C
T_J = 150°C; L = 400µH; V_{CE} = 600V, R_G = 5Ω; V_{GE} = 15V

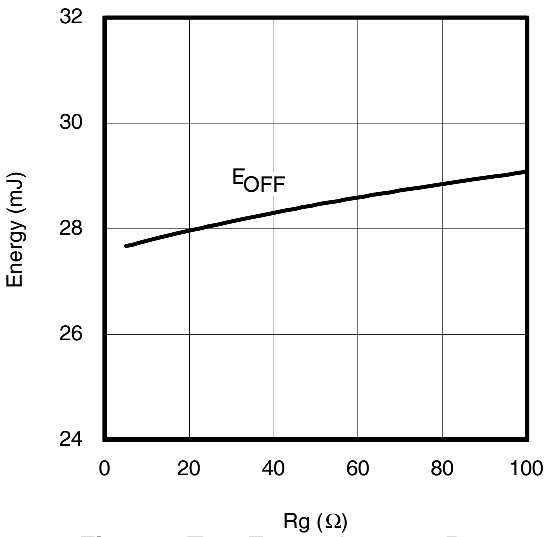


Fig. 15 - Typ. Energy Loss vs. R_G
T_J = 150°C; L = 400µH; V_{CE} = 600V, I_{CE} = 33A; V_{GE} = 15V

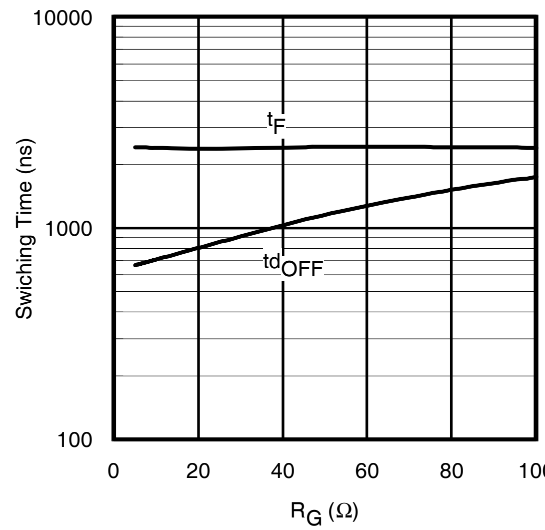


Fig. 16- Typ. Switching Time vs. R_G
T_J = 150°C; L = 400µH; V_{CE} = 600V, I_{CE} = 33A; V_{GE} = 15V

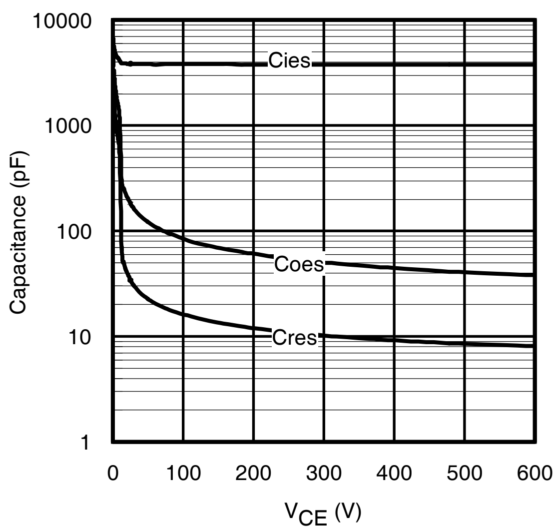


Fig. 17 - Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

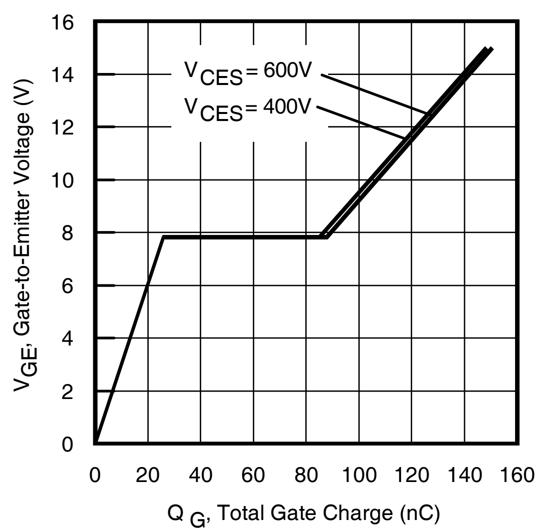


Fig. 18 - Typical Gate Charge vs. V_{GE}
I_{CE} = 33A; L = 2.0mH

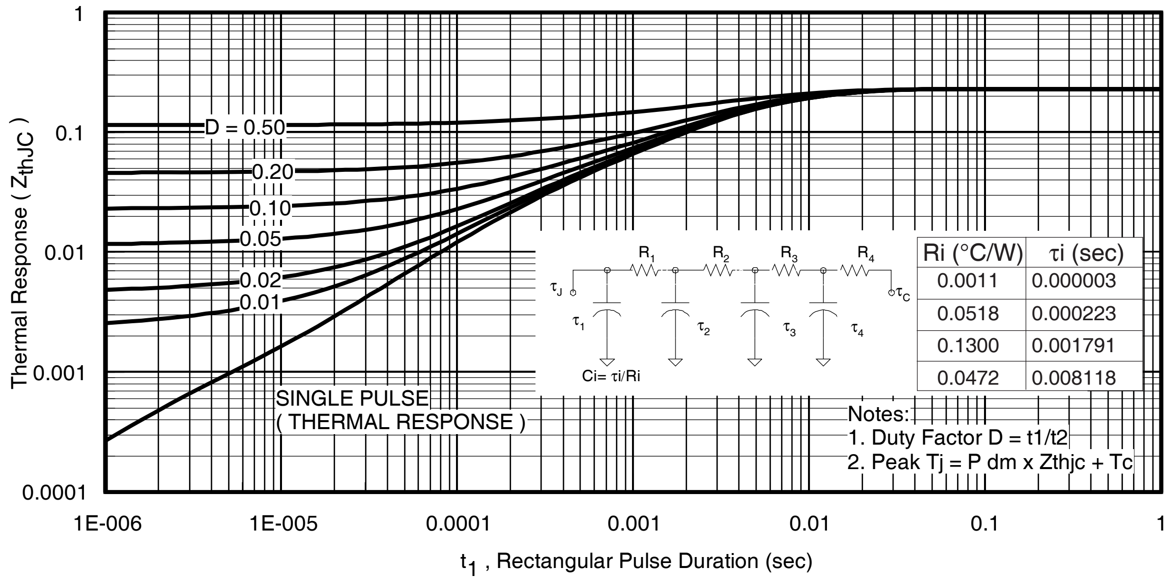


Fig 19. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

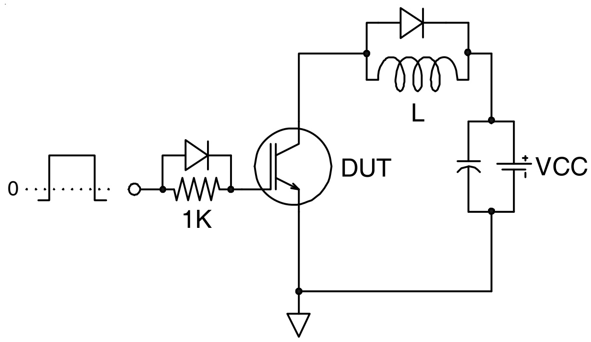


Fig.C.T.1 - Gate Charge Circuit (turn-off)

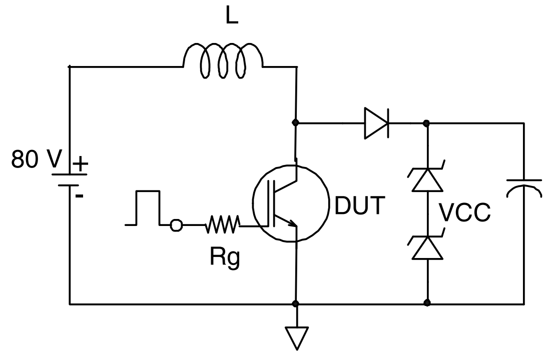


Fig.C.T.2 - RBSOA Circuit

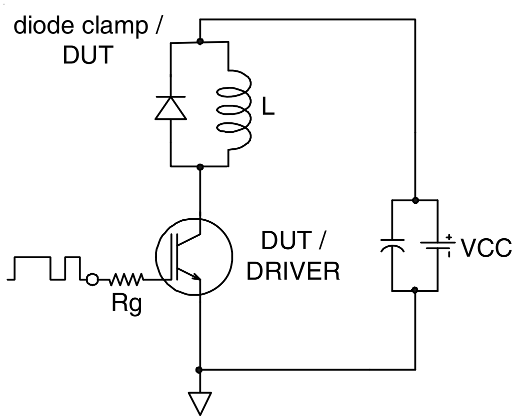


Fig.C.T.3 - Switching Loss Circuit

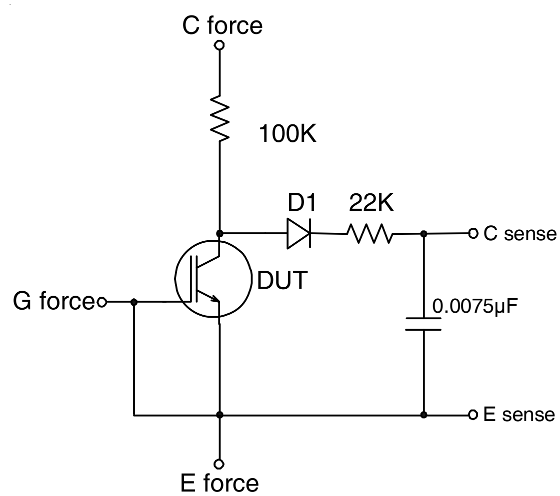


Fig.C.T.4 - BVCES Filter Circuit

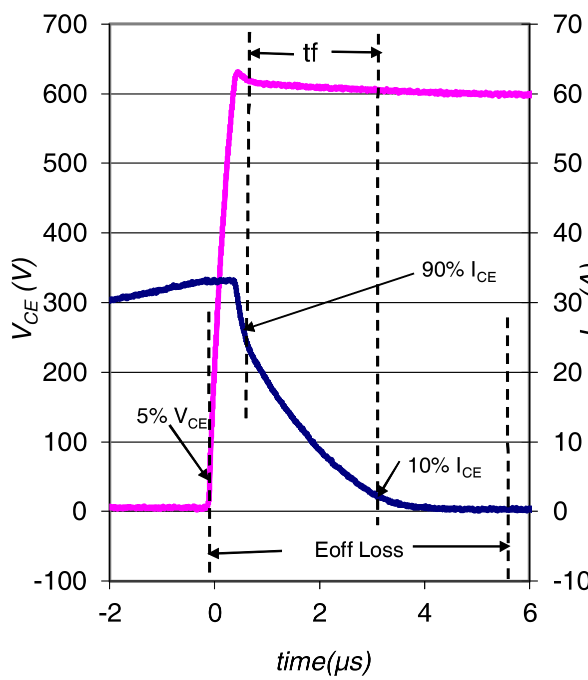
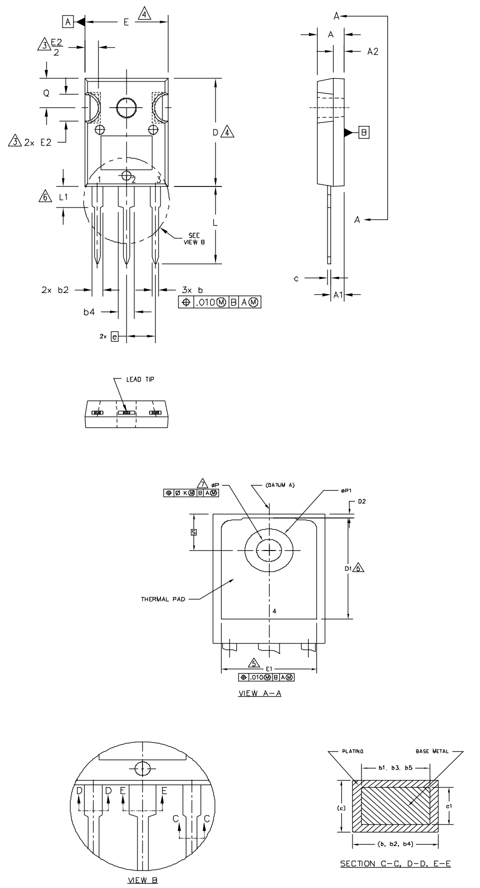


Fig. WF1 - Typ. Turn-off Loss Waveform
@ T_J = 150°C using Fig. CT.3

TO-247AC Package Outline

Dimensions are shown in milimeters (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

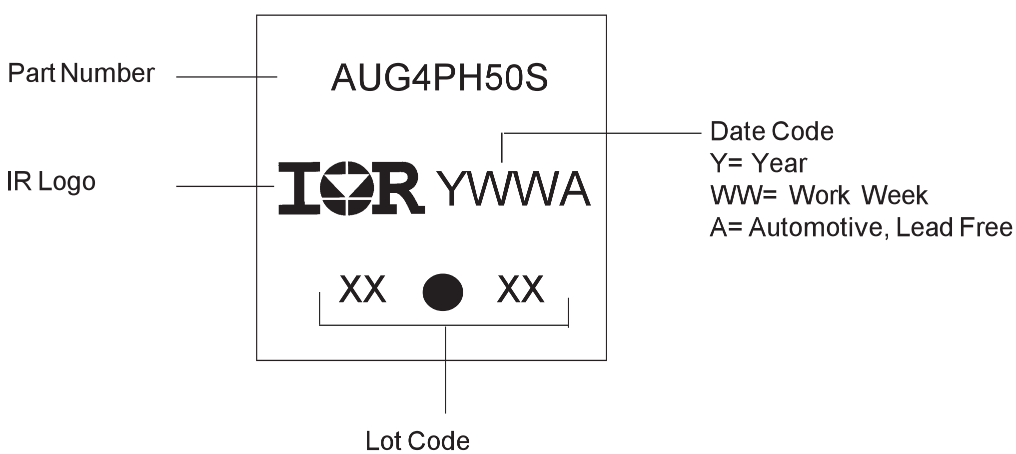
IGBTs, CoPACK

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

DIODES

1.– ANODE/OPEN
2.– CATHODE
3.– ANODE

TO-247AC Part Marking Information



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

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http://www.irf.com/technical-info/

WORLD HEADQUARTERS:

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Tel: (310) 252-7105

Revision History

Date	Comments
7/8/2014	• Updated datasheet based on new template and retest data.
7/11/2014	• Removed Ic Nominal current on page 1. • Updated typo on switch time test condition from "25C" to "150C" on page 2.
1/9/2015	• Corrected typo on $V_{(BR)CES}$ test condition from "100µA" to "250µA" on page 2. • Corrected typo on $V_{GE(TH)}$ test condition from "1mA" to "250µA" on page 2.
3/2/2015	• Removed I_{CES} = 2uA @ VCE = 10V on page 2.