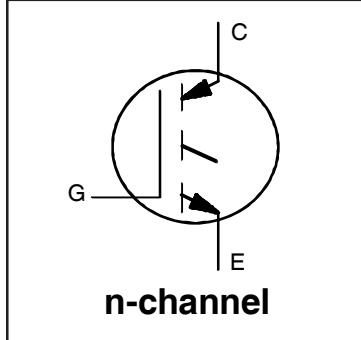


INSULATED GATE BIPOLAR TRANSISTOR

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 *



$V_{CES} = 1200V$
 $I_C = 81A @ T_C = 100^\circ C$
 $V_{CE(on)} \text{ typ.} = 1.47V @ 33A$



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 $25^\circ C$, unless otherwise specified.

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	141 ^①	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	81	
I_{CM}	Pulse Collector Current, $V_{GE} = 15V$ ^②	99	
I_{ILM}	Clamped Inductive Load Current, $V_{GE} = 20V$ ^①	99	
V_{GE}	Continuous Gate-to-Emitter Voltage	± 20	V
	Transient Gate-to-Emitter Voltage	± 30	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	543	W
$P_D @ T_C = 100^\circ C$	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_{JC} (IGBT)	Thermal Resistance Junction-to-Case (IGBT) ^④	—	—	0.23	°C/W
R_{CS}	Thermal Resistance, Case-to-Sink (flat, greased surface)	—	0.24	—	
R_{JA}	Thermal Resistance, Junction-to-Ambient	—	40	—	

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

Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(\text{BR})\text{CES}}$	Collector-to-Emitter Breakdown Voltage	1200	—	—	V	$V_{\text{GE}} = 0\text{V}$, $I_C = 250\mu\text{A}$ ③
$\Delta V_{(\text{BR})\text{CES}}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	1.2	—	$\text{V}/^\circ\text{C}$	$V_{\text{GE}} = 0\text{V}$, $I_C = 1\text{mA}$ (25°C - 150°C) ③
$V_{\text{CE}(\text{on})}$	Collector-to-Emitter Saturation Voltage	—	1.47	1.7	V	$I_C = 33\text{A}$, $V_{\text{GE}} = 15\text{V}$, $T_J = 25^\circ\text{C}$
		—	1.55	—		$I_C = 33\text{A}$, $V_{\text{GE}} = 15\text{V}$, $T_J = 150^\circ\text{C}$
$V_{\text{GE}(\text{th})}$	Gate Threshold Voltage	3.0	—	6.0	V	$V_{\text{CE}} = V_{\text{GE}}$, $I_C = 250\mu\text{A}$
$\Delta V_{\text{GE}(\text{th})}/\Delta T_J$	Threshold Voltage temp. coefficient	—	-11	—	$\text{mV}/^\circ\text{C}$	$V_{\text{CE}} = V_{\text{GE}}$, $I_C = 250\mu\text{A}$ (25°C - 150°C)
g_f	Forward Transconductance	—	30	—	S	$V_{\text{CE}} = 50\text{V}$, $I_C = 33\text{A}$, $P_W = 20\mu\text{s}$
I_{CES}	Collector-to-Emitter Leakage Current	—	—	250	μA	$V_{\text{GE}} = 0\text{V}$, $V_{\text{CE}} = 1200\text{V}$, $T_J = 25^\circ\text{C}$
		—	—	1000		$V_{\text{GE}} = 0\text{V}$, $V_{\text{CE}} = 1200\text{V}$, $T_J = 150^\circ\text{C}$
I_{GES}	Gate-to-Emitter Leakage Current	—	—	± 100	nA	$V_{\text{GE}} = \pm 20\text{V}$

Switching Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

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

Notes:

- ① $V_{\text{CC}} = 80\%$ (V_{CES}), $V_{\text{GE}} = 20\text{V}$, $L = 400\mu\text{H}$, $R_G = 50\Omega$.
- ② Pulse width limited by max. junction temperature.
- ③ Refer to AN-1086 for guidelines for measuring $V_{(\text{BR})\text{CES}}$ 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.

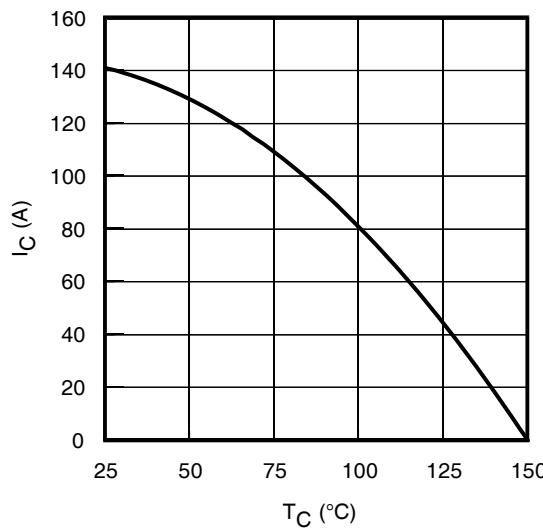


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

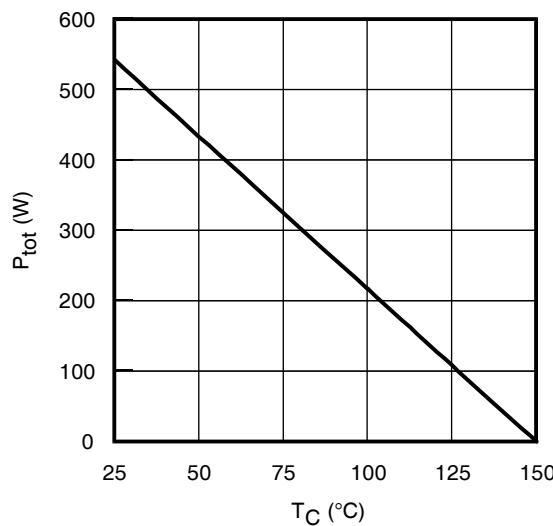


Fig. 2 - Power Dissipation vs. Case Temperature

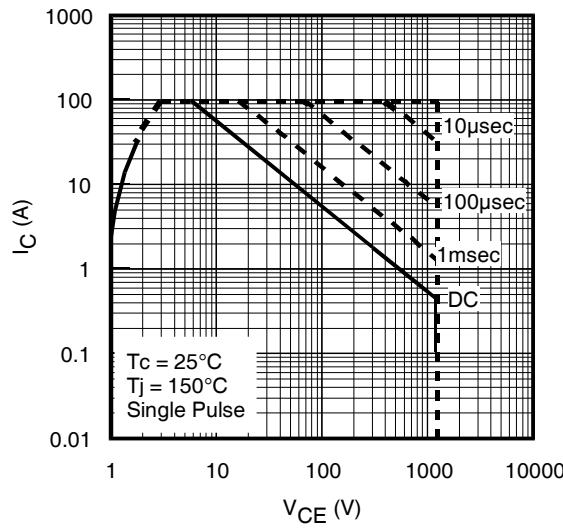


Fig. 3 - Forward SOA
T_C = 25°C, T_J ≤ 150°C; V_{GE} = 15V

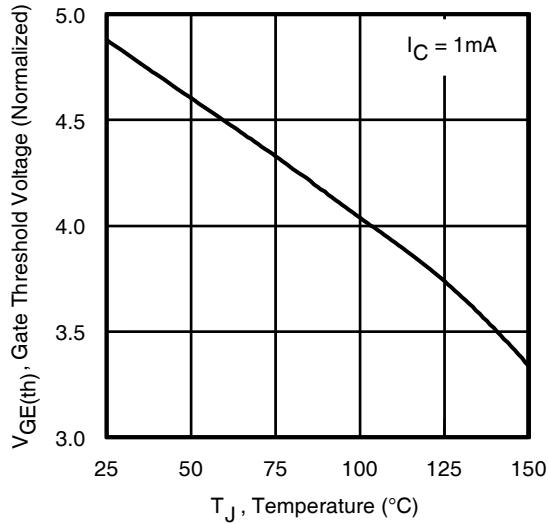


Fig. 4 - Typical Gate Threshold Voltage (Normalized) vs. Junction Temperature

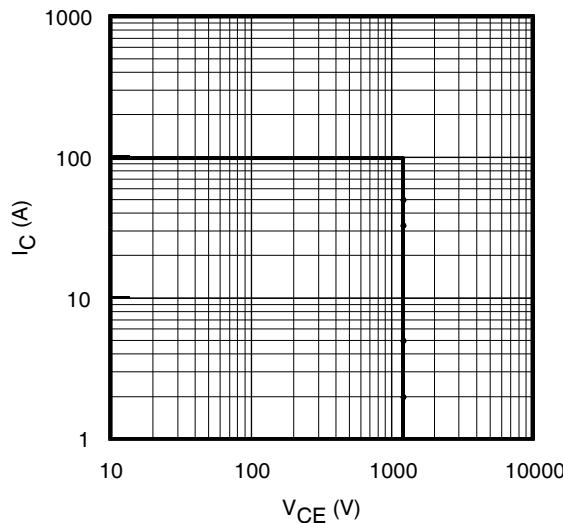


Fig. 5 - Reverse Bias SOA
T_J = 150°C; V_{GE} = 20V

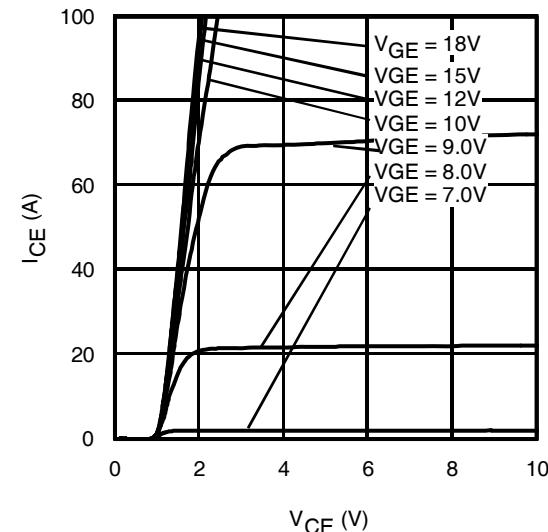


Fig. 6 - Typ. IGBT Output Characteristics
T_J = -40°C; t_p = 20μs

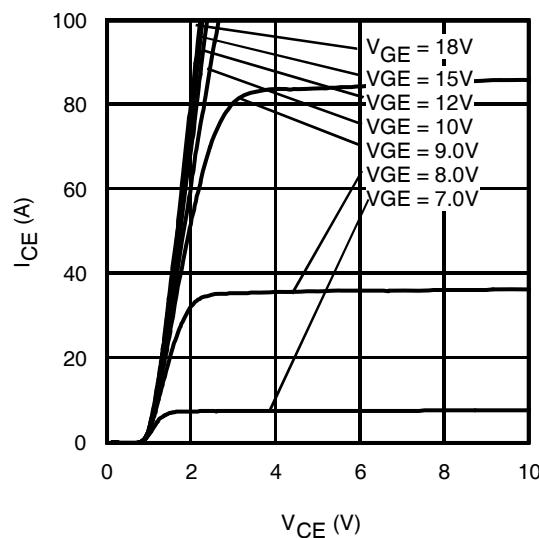


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 20\mu\text{s}$

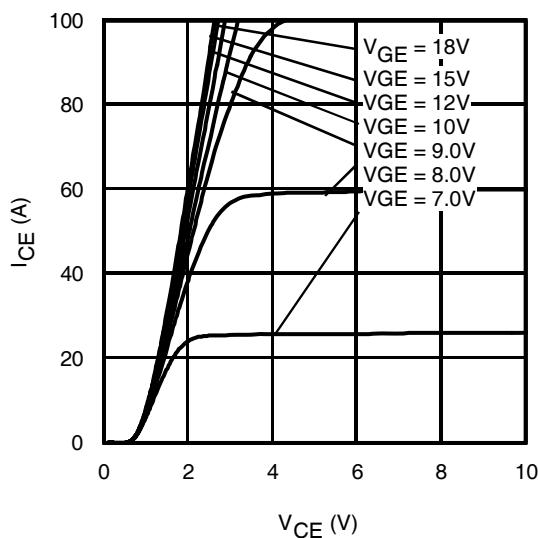


Fig. 8 - Typ. IGBT Output Characteristics
 $T_J = 150^\circ\text{C}$; $t_p = 20\mu\text{s}$

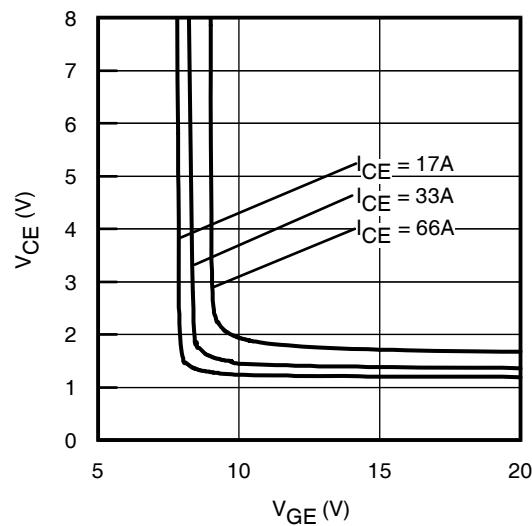


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

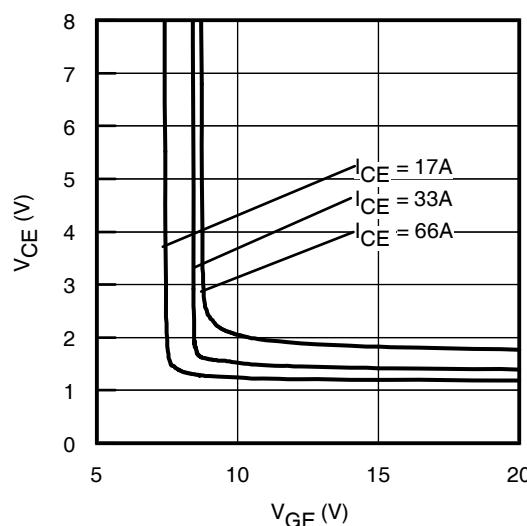


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

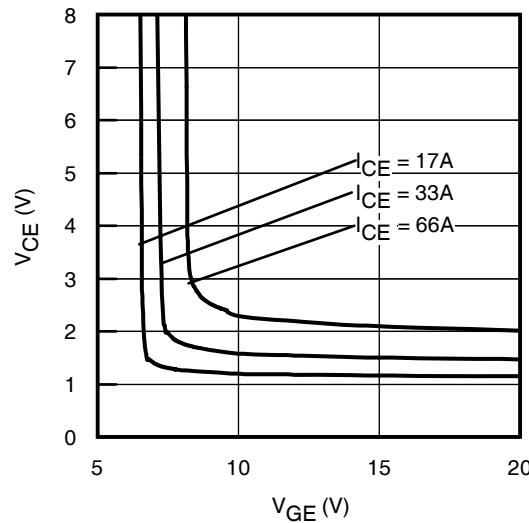


Fig. 11 - Typical V_{CE} vs. V_{GE}
 $T_J = 150^\circ\text{C}$

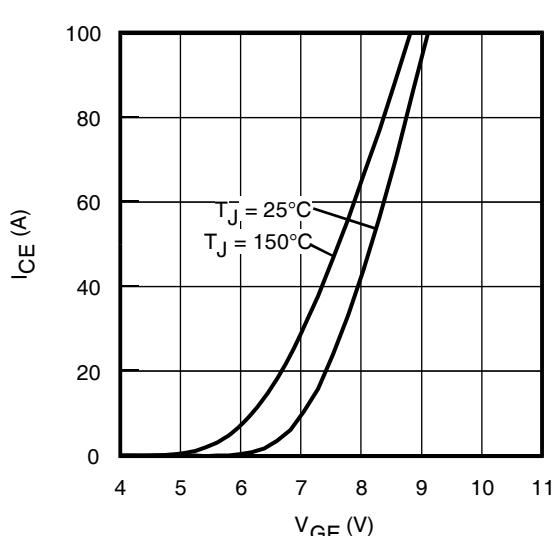


Fig. 12- Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 20\mu\text{s}$

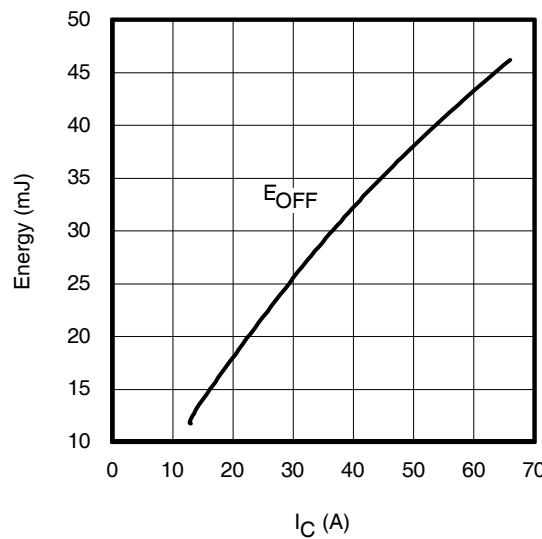


Fig. 13 - Typ. Energy Loss vs. I_C
 $T_J = 150^\circ\text{C}$; $L = 400\mu\text{H}$; $V_{CE} = 600\text{V}$, $R_G = 5\Omega$; $V_{GE} = 15\text{V}$

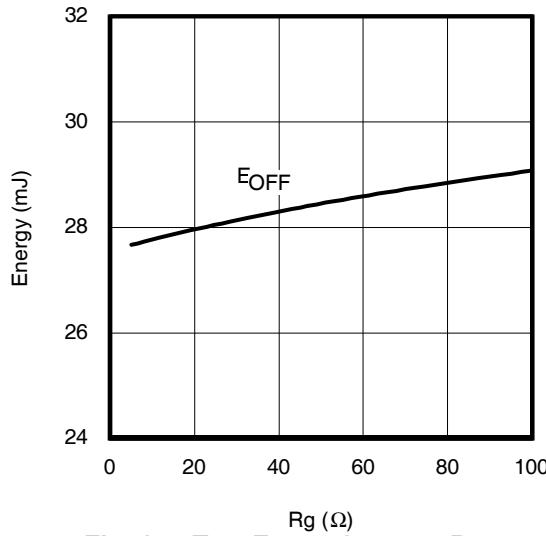


Fig. 15 - Typ. Energy Loss vs. R_G
 $T_J = 150^\circ\text{C}$; $L = 400\mu\text{H}$; $V_{CE} = 600\text{V}$, $I_{CE} = 33\text{A}$; $V_{GE} = 15\text{V}$

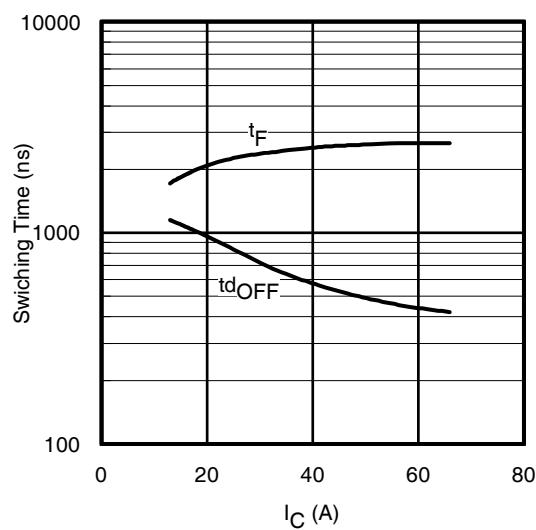


Fig. 14 - Typ. Switching Time vs. I_C
 $T_J = 150^\circ\text{C}$; $L = 400\mu\text{H}$; $V_{CE} = 600\text{V}$, $R_G = 5\Omega$; $V_{GE} = 15\text{V}$

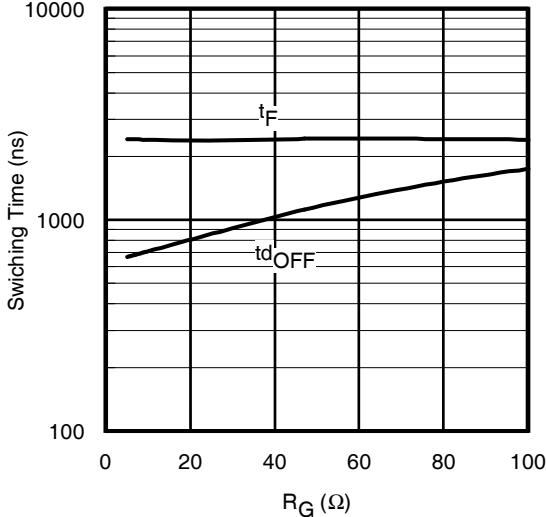


Fig. 16- Typ. Switching Time vs. R_G
 $T_J = 150^\circ\text{C}$; $L = 400\mu\text{H}$; $V_{CE} = 600\text{V}$, $I_{CE} = 33\text{A}$; $V_{GE} = 15\text{V}$

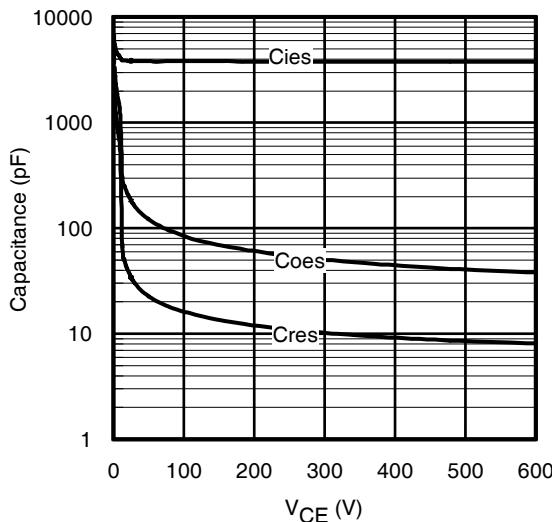


Fig. 17 - Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0\text{V}$; $f = 1\text{MHz}$

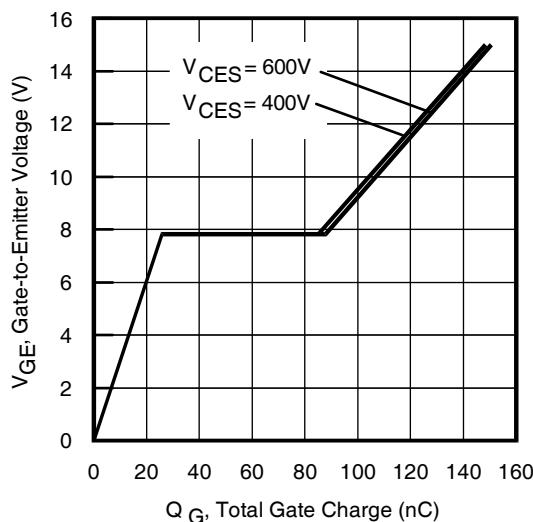


Fig. 18 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 33\text{A}$; $L = 2.0\text{mH}$

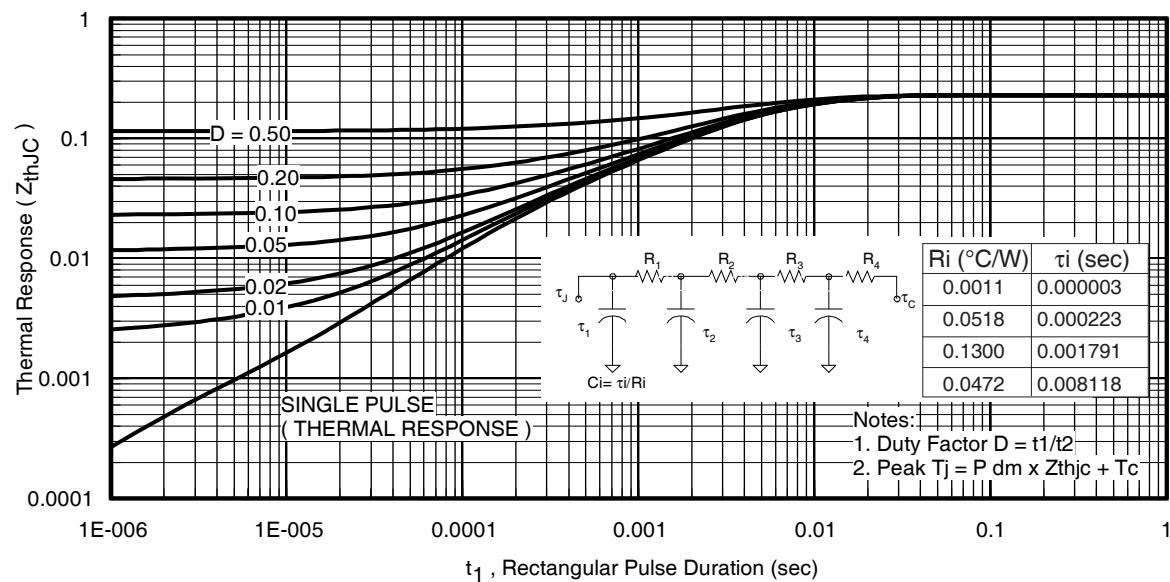


Fig 19. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

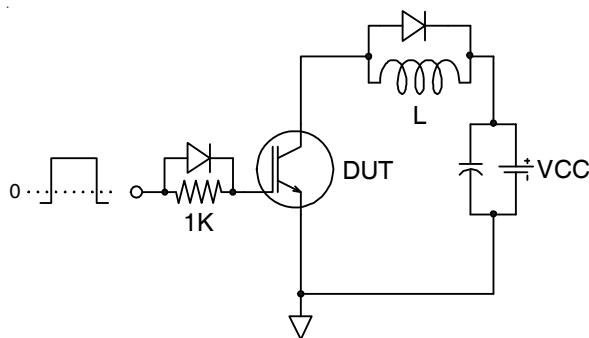


Fig.C.T.1 - Gate Charge Circuit (turn-off)

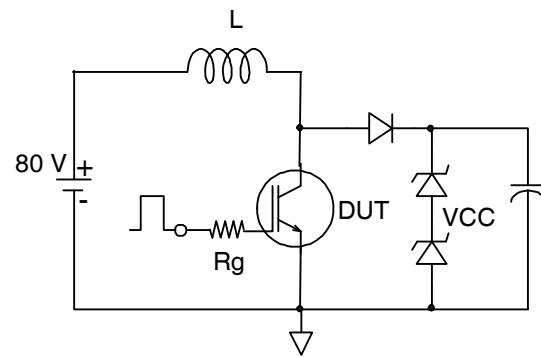


Fig.C.T.2 - RBSOA Circuit

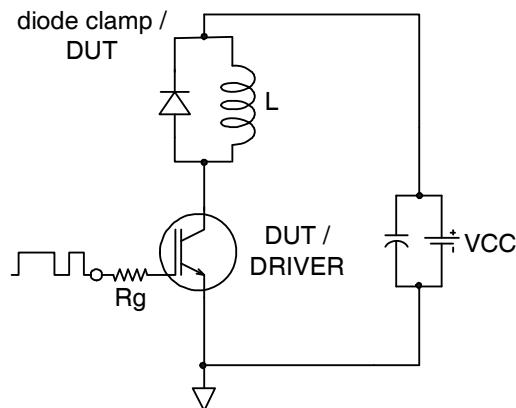


Fig.C.T.3 - Switching Loss Circuit

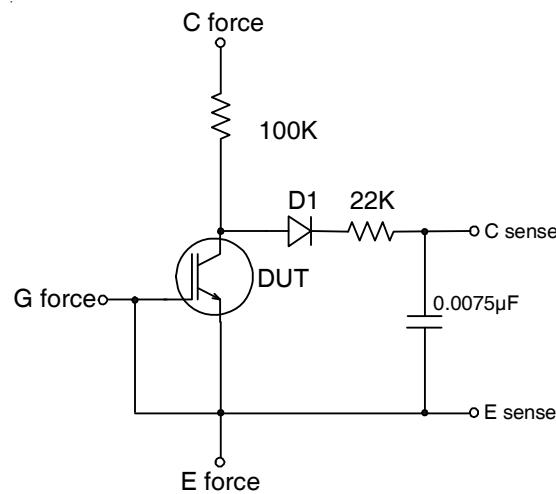
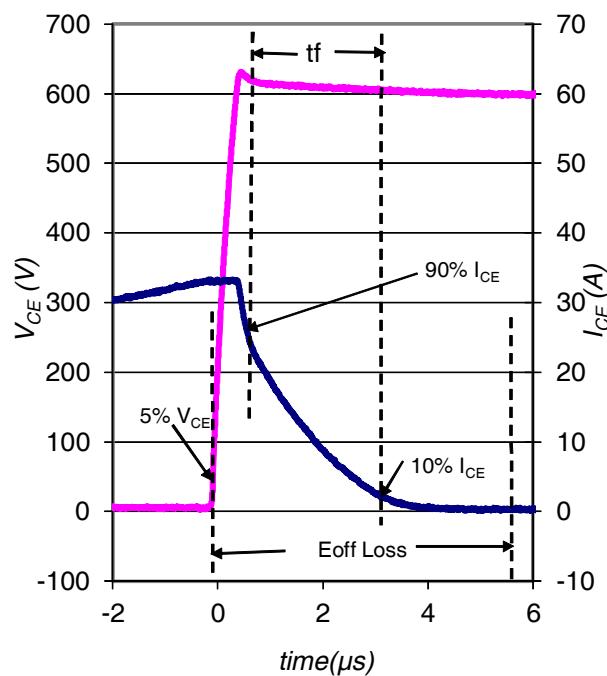
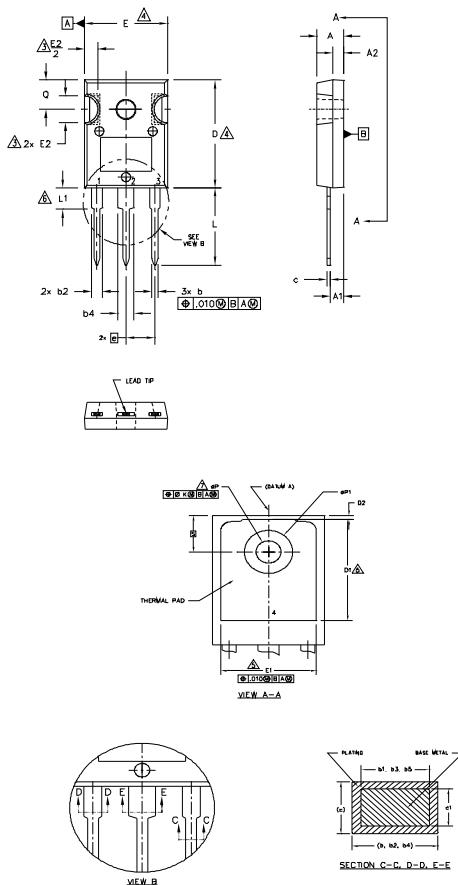


Fig.C.T.4 - BVCES Filter Circuit

Fig. WF1 - Typ. Turn-off Loss Waveform
@ $T_J = 150^\circ\text{C}$ 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

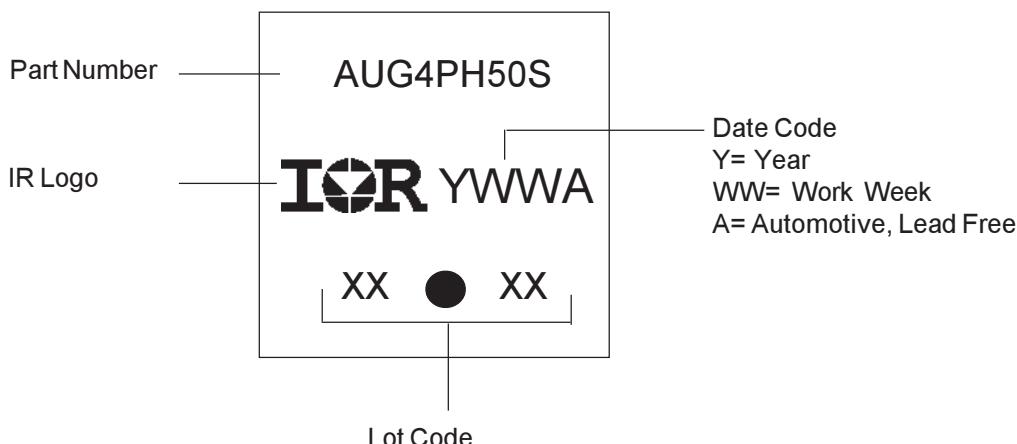
IGBTs, CoPACK

- 1. - GATE
- 2. - COLLECTOR
- 3. - Emitter
- 4. - COLLECTOR

DIODES

1. - ANODE/OPEN
2. - CATHODE
3. - ANODE

TO-247AC Part Marking Information



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:

101 N. Sepulveda Blvd., El Segundo, California 90245

Tel: (310) 252-7105

Revision History

Date	Comments
7/8/2014	<ul style="list-style-type: none">Updated datasheet based on new template and retest data.
7/11/2014	<ul style="list-style-type: none">Removed Ic Nominal current on page 1.Updated typo on switch time test condition from "25C" to "150C" on page 2.
1/9/2015	<ul style="list-style-type: none">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	<ul style="list-style-type: none">Removed $I_{CES} = 2\mu A$ @ $VCE = 10V$ on page 2.