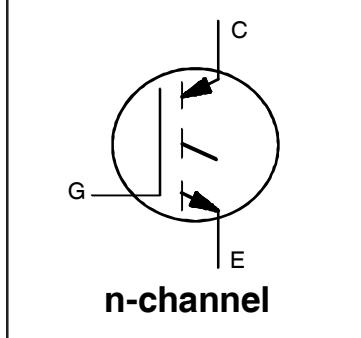


INSULATED GATE BIPOLAR TRANSISTOR

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	$^\circ C$
	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	$^\circ C/W$
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
$t_{\text{d}(\text{off})}$	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
$t_{\text{d}(\text{off})}$	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.

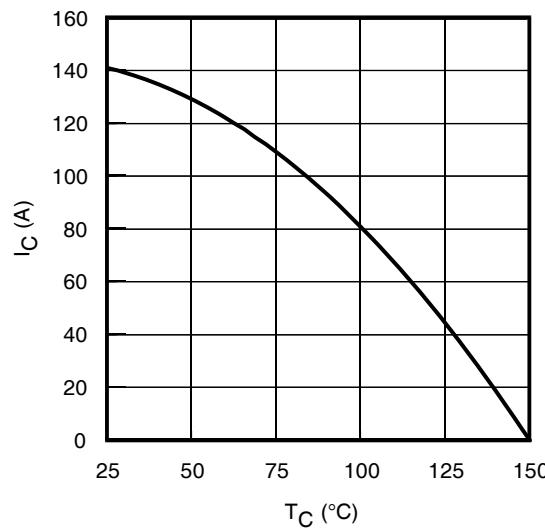


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

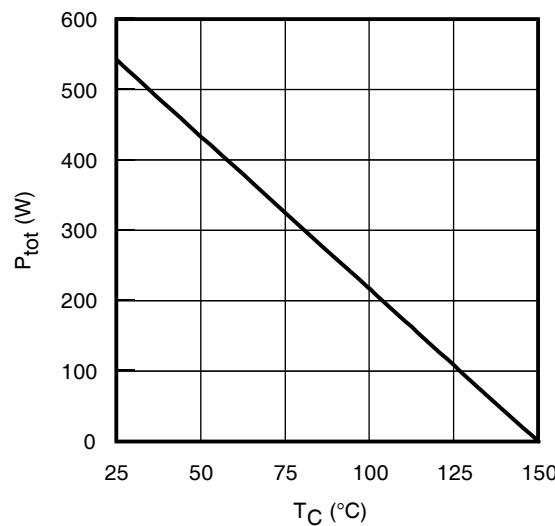


Fig. 2 - Power Dissipation vs. Case Temperature

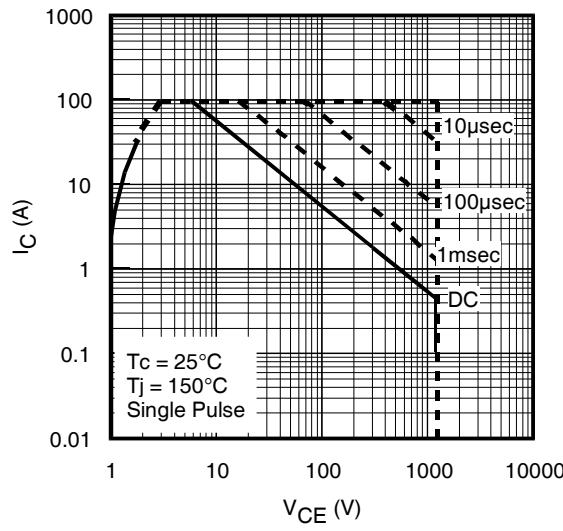


Fig. 3 - Forward SOA
T_C = 25°C, T_J ≤ 150°C; V_{GE} = 15V

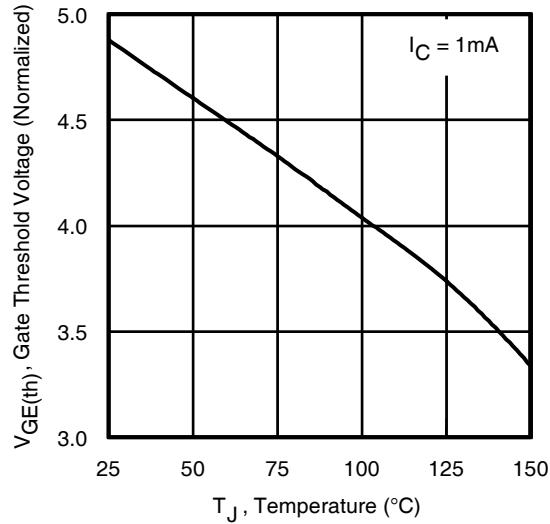


Fig. 4 - Typical Gate Threshold Voltage (Normalized) vs. Junction Temperature

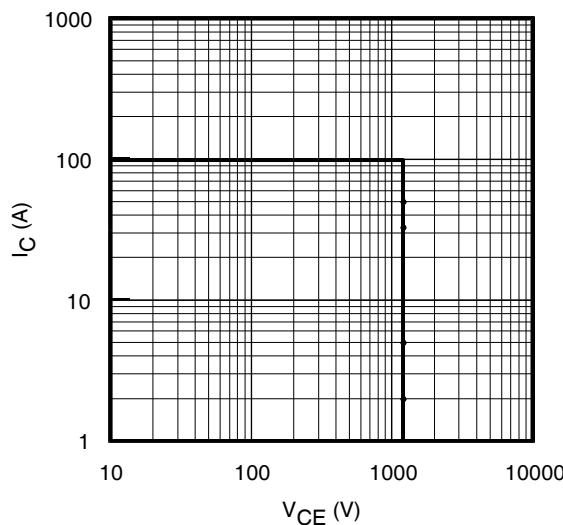


Fig. 5 - Reverse Bias SOA
T_J = 150°C; V_{GE} = 20V

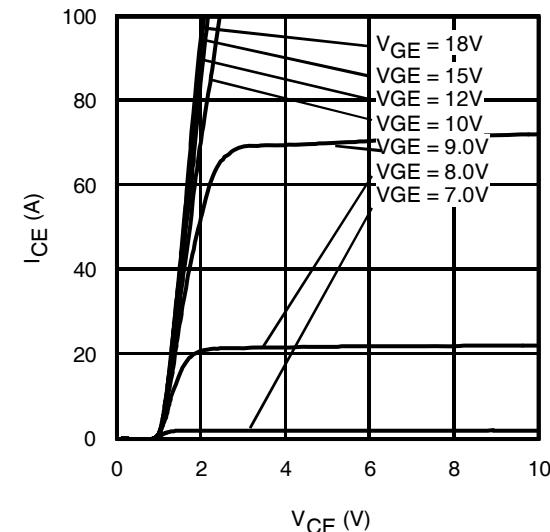


Fig. 6 - Typ. IGBT Output Characteristics
T_J = -40°C; t_p = 20μs

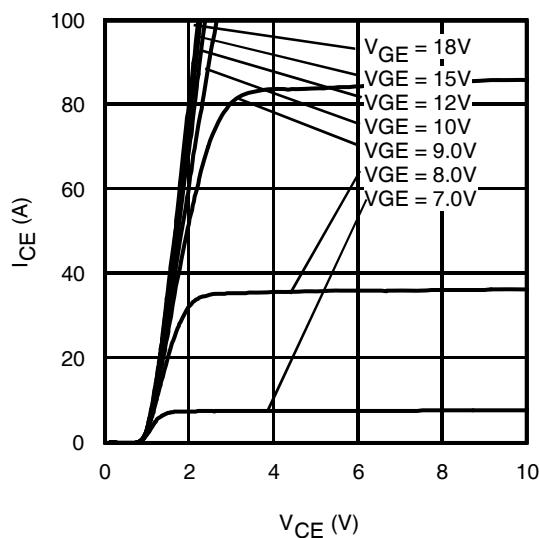


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $tp = 20\mu\text{s}$

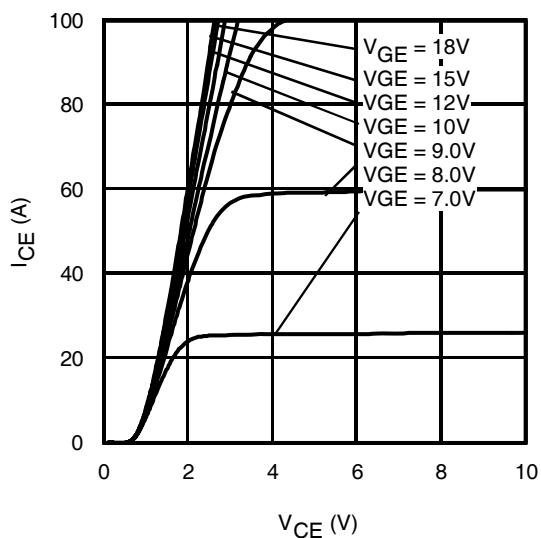


Fig. 8 - Typ. IGBT Output Characteristics
 $T_J = 150^\circ\text{C}$; $tp = 20\mu\text{s}$

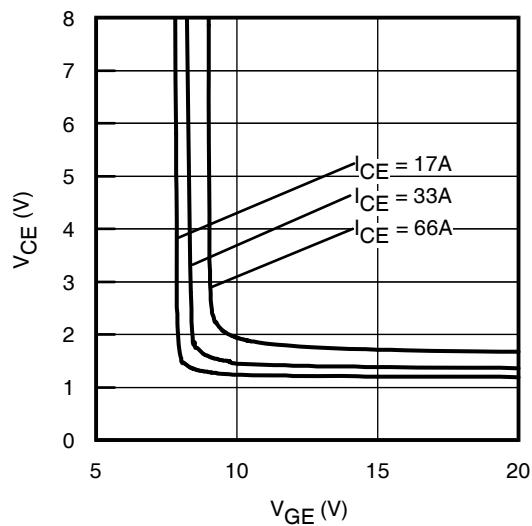


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

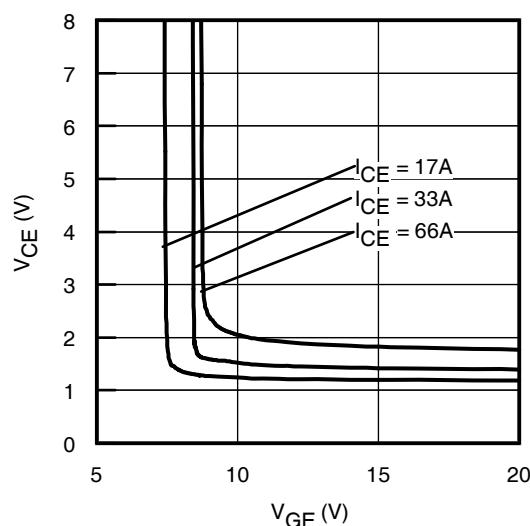


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

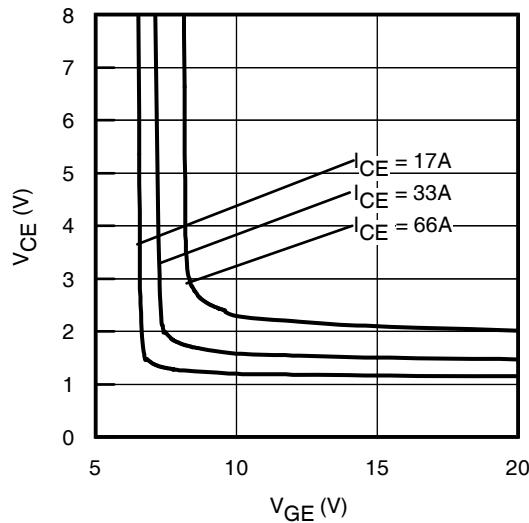


Fig. 11 - Typical V_{CE} vs. V_{GE}
 $T_J = 150^\circ\text{C}$

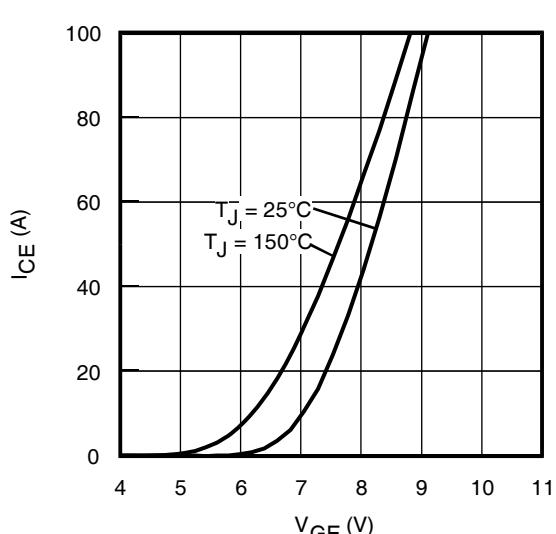


Fig. 12- Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $tp = 20\mu\text{s}$

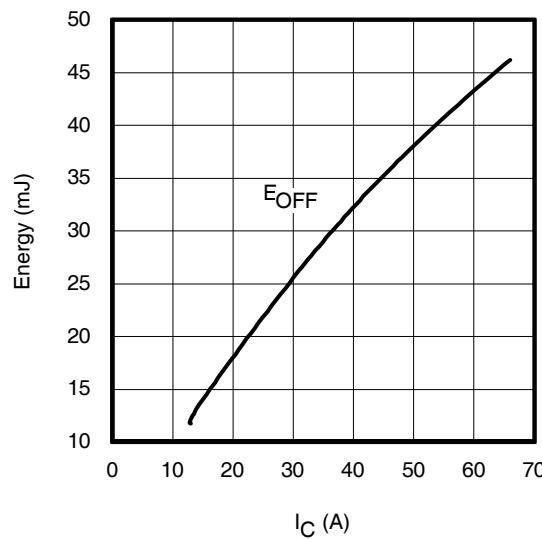


Fig. 13 - Typ. Energy Loss vs. I_C
 $T_J = 150^\circ\text{C}$; $L = 400\mu\text{H}$; $V_{CE} = 600\text{V}$, $R_G = 5\Omega$; $V_{GE} = 15\text{V}$

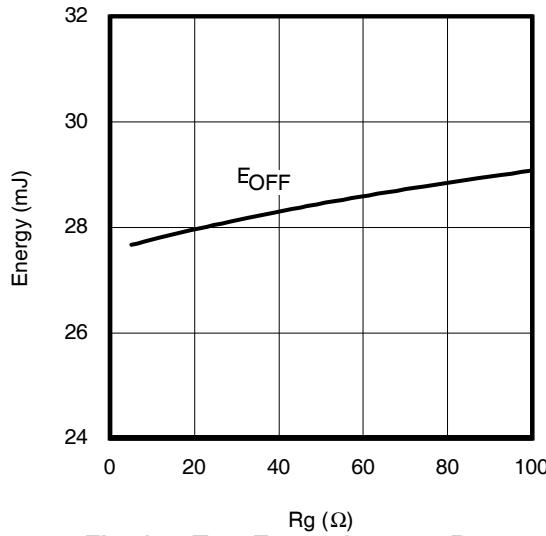


Fig. 15 - Typ. Energy Loss vs. R_G
 $T_J = 150^\circ\text{C}$; $L = 400\mu\text{H}$; $V_{CE} = 600\text{V}$, $I_{CE} = 33\text{A}$; $V_{GE} = 15\text{V}$

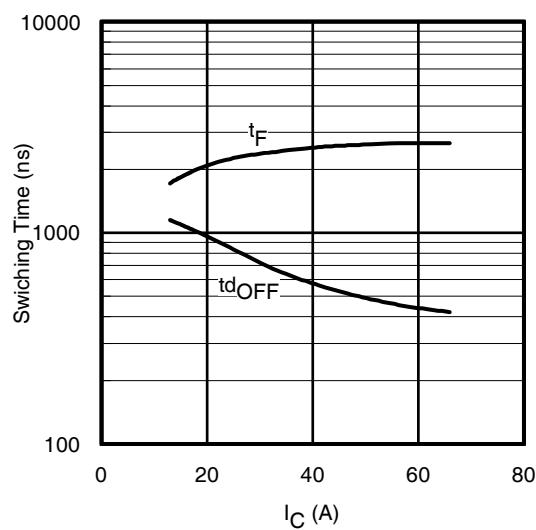


Fig. 14 - Typ. Switching Time vs. I_C
 $T_J = 150^\circ\text{C}$; $L = 400\mu\text{H}$; $V_{CE} = 600\text{V}$, $R_G = 5\Omega$; $V_{GE} = 15\text{V}$

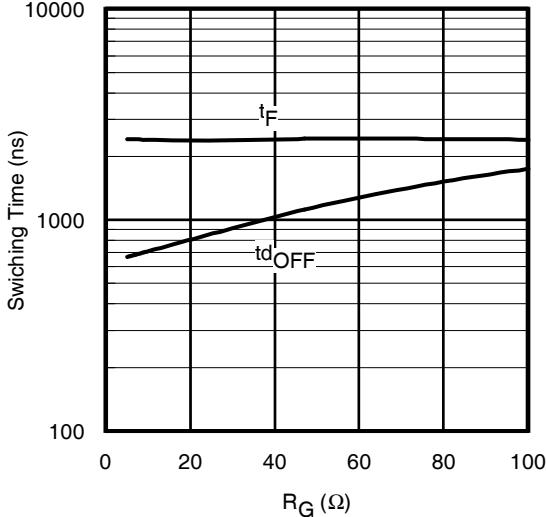


Fig. 16- Typ. Switching Time vs. R_G
 $T_J = 150^\circ\text{C}$; $L = 400\mu\text{H}$; $V_{CE} = 600\text{V}$, $I_{CE} = 33\text{A}$; $V_{GE} = 15\text{V}$

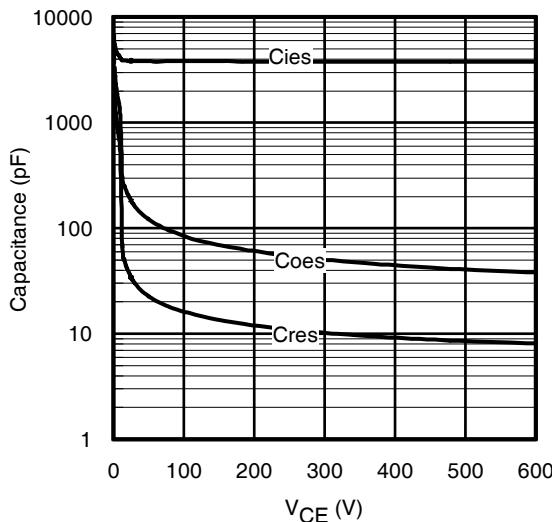


Fig. 17 - Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0\text{V}$; $f = 1\text{MHz}$

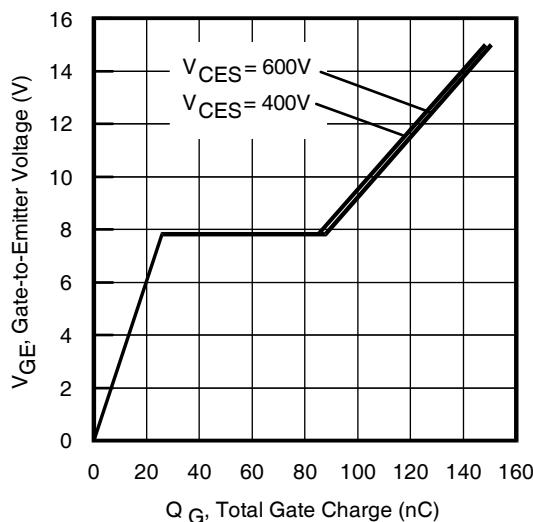


Fig. 18 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 33\text{A}$; $L = 2.0\text{mH}$

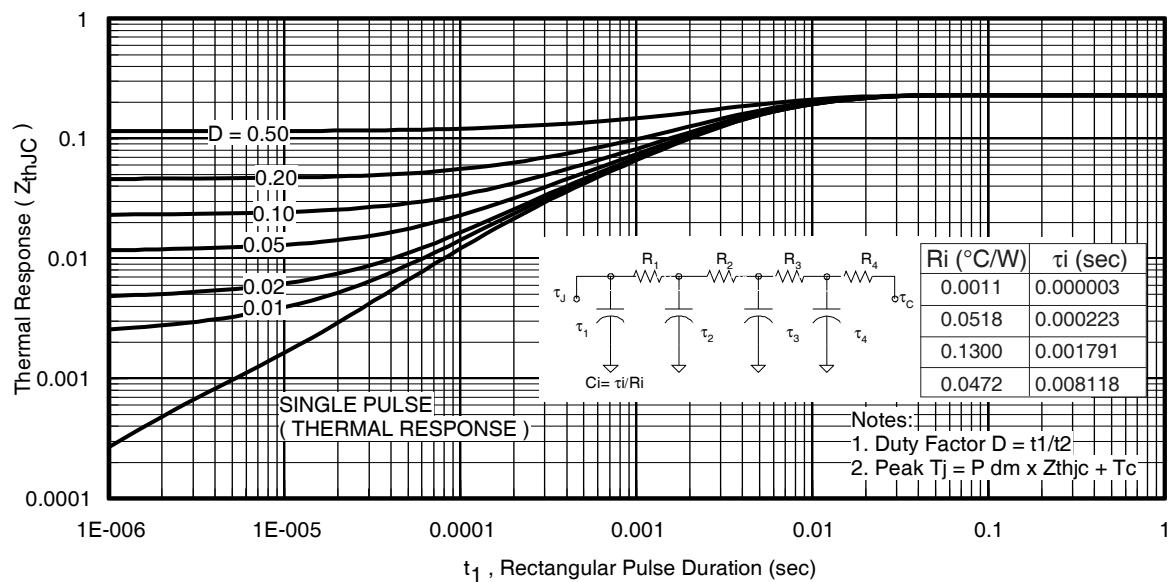


Fig 19. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

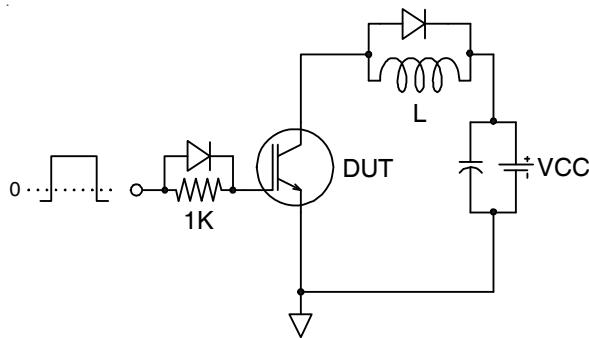


Fig.C.T.1 - Gate Charge Circuit (turn-off)

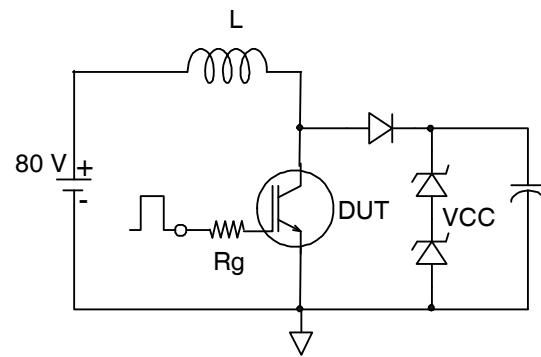


Fig.C.T.2 - RBSOA Circuit

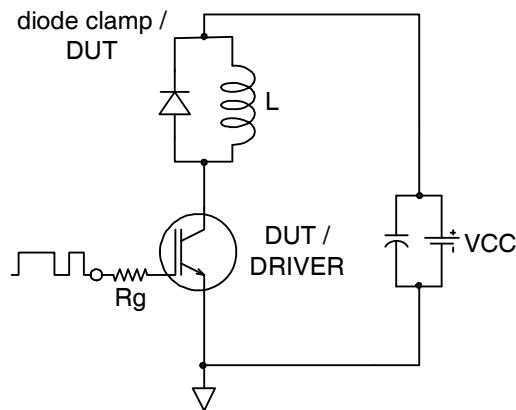


Fig.C.T.3 - Switching Loss Circuit

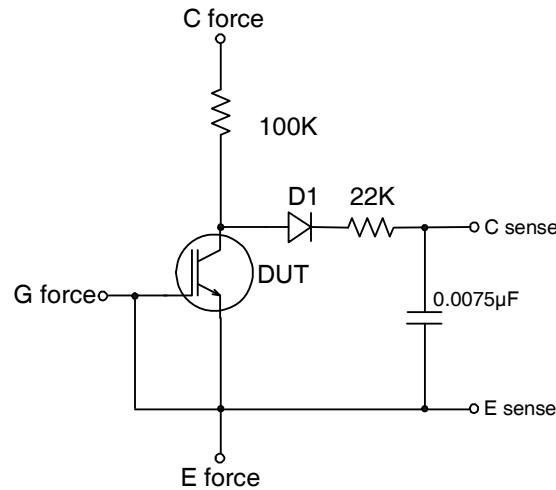
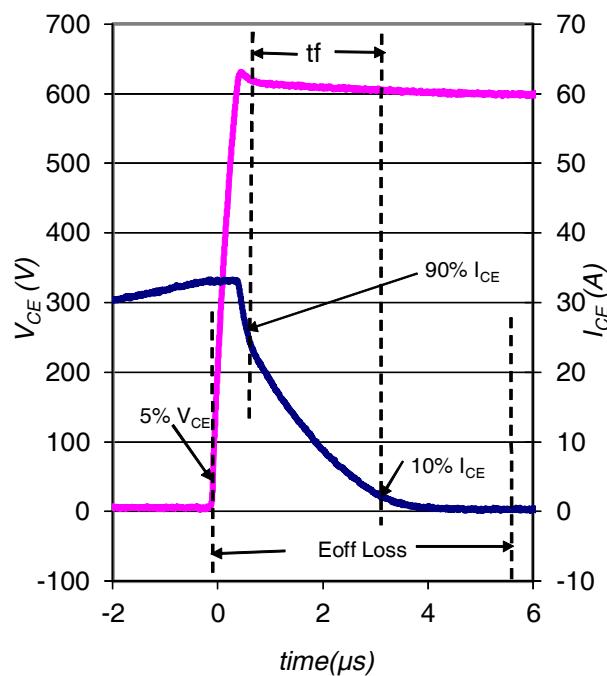
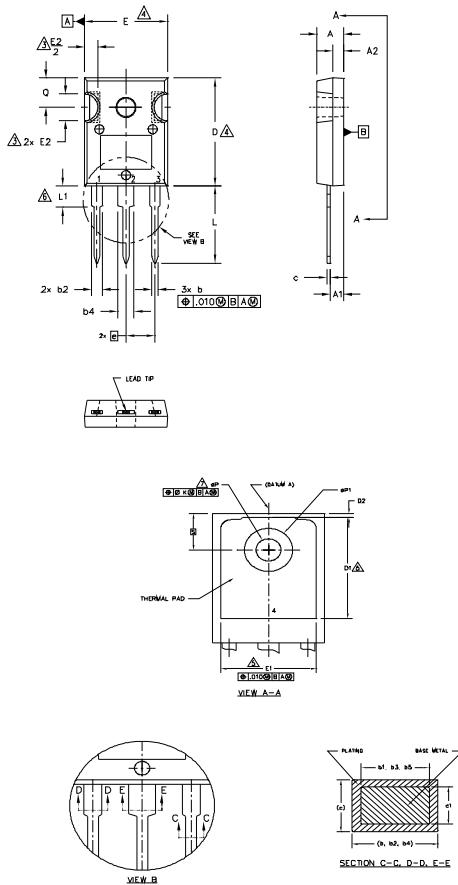


Fig.C.T.4 - BVCES Filter Circuit

Fig. WF1 - Typ. Turn-off Loss Waveform
@ T_J = 150°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

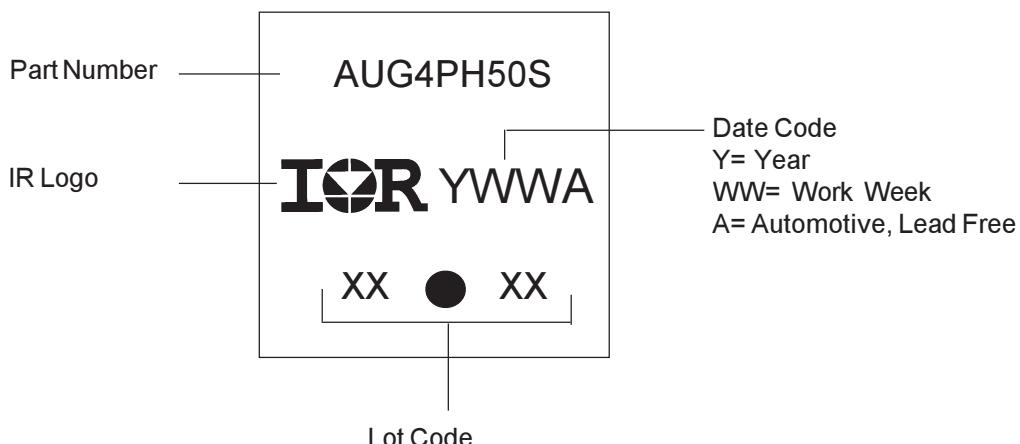
IGBTs, CoPACK

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/>

IMPORTANT NOTICE

Unless specifically designated for the automotive market, International Rectifier Corporation and its subsidiaries (IR) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or services without notice. Part numbers designated with the "AU" prefix follow automotive industry and / or customer specific requirements with regards to product discontinuance and process change notification. All products are sold subject to IR's terms and conditions of sale supplied at the time of order acknowledgment.

IR warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with IR's standard warranty. Testing and other quality control techniques are used to the extent IR deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

IR assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using IR components. To minimize the risks with customer products and applications, customers should provide adequate design and operating safeguards.

Reproduction of IR information in IR data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alterations is an unfair and deceptive business practice. IR is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of IR products or serviced with statements different from or beyond the parameters stated by IR for that product or service voids all express and any implied warranties for the associated IR product or service and is an unfair and deceptive business practice. IR is not responsible or liable for any such statements.

IR products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or in other applications intended to support or sustain life, or in any other application in which the failure of the IR product could create a situation where personal injury or death may occur. Should Buyer purchase or use IR products for any such unintended or unauthorized application, Buyer shall indemnify and hold International Rectifier and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that IR was negligent regarding the design or manufacture of the product.

Only products certified as military grade by the Defense Logistics Agency (DLA) of the US Department of Defense, are designed and manufactured to meet DLA military specifications required by certain military, aerospace or other applications. Buyers acknowledge and agree that any use of IR products not certified by DLA as military-grade, in applications requiring military grade products, is solely at the Buyer's own risk and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

IR products are neither designed nor intended for use in automotive applications or environments unless the specific IR products are designated by IR as compliant with ISO/TS 16949 requirements and bear a part number including the designation "AU". Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, IR will not be responsible for any failure to meet such requirements.

For technical support, please contact IR's Technical Assistance Center

<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.