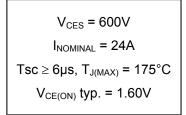


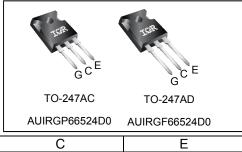
AUTOMOTIVE GRADE

COOLiR*IGBT*™

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE



n-channel



G C E Gate Collector Emitter

Applications

- Air Conditioning Compressor
- · Auxiliary Motor Drive

Features	→ Benefits
Low V _{CE(on)} Trench IGBT Technology	High Efficiency in a Wide Range of Applications
Low Switching Losses	Suitable for a Wide Range of Switching Frequencies
6μs SCSOA Guaranteed	Enables Short Circuit Protection Scheme
Square RBSOA and 100% Clamp IL Tested	Rugged Hard Switching Operation
Positive V _{CE(on)} Temperature Coefficient	Enables Easy Paralleling of Devices
Ultra Fast Soft Recovery Co-pak Diode	Better Efficiency and Improved EMI Performance
Lead-Free, RoHS Compliant, Automotive Qualified *	Environmentally Friendly

Base Part Number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
AUIRGP66524D0	TO-247AC	Tube	25	AUIRGP66524D0
AUIRGF66524D0	TO-247AD	Tube	25	AUIRGF66524D0

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	600	V
I _{Nominal}	Nominal Collector Current	24	
I _C @ T _C = 25°C	Continuous Collector Current	60	
I _C @ T _C = 100°C	Continuous Collector Current	40	
I _{CM}	Pulse Collector Current, V _{GE} = 15V	72	Α
I _{LM}	Clamped Inductive Load Current, V _{GE} = 20V ①	96	
I _F @ T _C = 25°C	Diode Continous Forward Current	55	
I _F @ T _C = 100°C	Diode Continous Forward Current	35	
I _{FM}	Diode Maximum Forward Current ②	72	
V_{GE}	Continuous Gate-to-Emitter Voltage	±20	V
	Transient Gate-to-Emitter Voltage	±30	
dV/dt	Maximum Voltage Transient	15	V/ns
P _D @ T _C = 25°C	Maximum Power Dissipation	214	W
P _D @ T _C = 100°C	Maximum Power Dissipation	107	
T _J	Operating Junction and	-55 to +175	
T _{STG}	Storage Temperature Range		°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)	

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



Thermal Resistance

	Parameter	Тур.	Max.	Units
$R_{\theta JC}$ (IGBT)	Thermal Resistance Junction-to-Case (each IGBT) @		0.7	
R _{θJC} (Diode)	Thermal Resistance Junction-to-Case (each Diode) ④		1.1	°C/W
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink (flat, greased surface)	0.24		C/VV
$R_{ hetaJA}$	Thermal Resistance, Junction-to-Ambient (typical socket mount)		40	

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

	Parameter	Min.	Тур.	Max.	Units	Conditions
V _{(BR)CES}	Collector-to-Emitter Breakdown Voltage	600	_	_	V	$V_{GE} = 0V, I_{C} = 100\mu A$ 3
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage		0.21	_	V/°C	V _{GE} =0V, I _C =20mA (25°C-175°C)
		_	1.60	1.90		$I_C = 24A$, $V_{GE} = 15V$, $T_J = 25$ °C
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage		1.95	_	V	$I_C = 24A$, $V_{GE} = 15V$, $T_J = 150$ °C
			2.0	_		$I_C = 24A$, $V_{GE} = 15V$, $T_J = 175$ °C
$V_{GE(th)}$	Gate Threshold Voltage	5.5	6.5	7.5	V	$V_{CE} = V_{GE}$, $I_C = 250\mu A$
$\Delta V_{GE(th)}/\Delta TJ$	Threshold Voltage temp. coefficient	_	-28	_	mV/°C	$V_{CE} = V_{GE}, I_{C} = 1 \text{mA} (25^{\circ}\text{C} - 175^{\circ}\text{C})$
gfe	Forward Transconductance		21	_	S	$V_{CE} = 50V, I_{C} = 24A, PW = 20\mu s$
I _{CES}	Collector-to-Emitter Leakage Current		1.1	50	μΑ	$V_{GE} = 0V, V_{CE} = 600V$
.,	Diado Farward Voltago Drop	_	1.50	1.90	V	I _F = 24A
V_{FM}	Diode Forward Voltage Drop		1.40		V	$I_F = 24A, T_J = 175^{\circ}C$
I _{GES}	Gate-to-Emitter Leakage Current	_	_	±100	nA	$V_{GE} = \pm 20V$

Switching Characteristics @ T₁ = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
Q _g	Total Gate Charge (turn-on)	_	50	80		I _C = 24A
Q _{qe}	Gate-to-Emitter Charge (turn-on)	_	16	24	nC	V _{GE} = 15V
Q_{gc}	Gate-to-Collector Charge (turn-on)	_	26	39		V _{CC} = 400V
E _{on}	Turn-On Switching Loss	_	915	1045		
E _{off}	Turn-Off Switching Loss	_	280	395	μJ	
E _{total}	Total Switching Loss	_	1195	1440		$I_C = 24A$, $V_{CC} = 400V$, $V_{GE} = 15V$
t _{d(on)}	Turn-On delay time	_	30	50		$R_G = 10\Omega$, L = 740µH, $T_J = 25$ °C
t _r	Rise time	_	25	45	ns	Energy losses include tail & diode
t _{d(off)}	Turn-Off delay time	_	75	95		reverse recovery
t _f	Fall time	_	25	45		
E _{on}	Turn-On Switching Loss	_	1280	_		
E _{off}	Turn-Off Switching Loss	_	550	_	μJ	
E _{total}	Total Switching Loss	_	1830	_		$I_C = 24A$, $V_{CC} = 400V$, $V_{GE} = 15V$
t _{d(on)}	Turn-On delay time	_	30	_		$R_G = 10\Omega$, L = 740µH, $T_J = 175$ °C
t _r	Rise time	_	25	_	ns	Energy losses include tail & diode
t _{d(off)}	Turn-Off delay time	_	100	_		reverse recovery
t _f	Fall time	_	95	_		
C _{ies}	Input Capacitance	_	1460	_		V _{GE} = 0V
C _{oes}	Output Capacitance	_	120	_	pF	$V_{CC} = 30V$
C _{res}	Reverse Transfer Capacitance	_	50	_		f = 1.0Mhz
RBSOA	Reverse Bias Safe Operating Area	FUL	L SQUA	\RE		$T_J = 175^{\circ}C$, $I_C = 96A$ $V_{CC} = 480V$, $Vp \le 600V$ $Rg = 10\Omega$, $V_{GE} = +20V$ to $0V$
SCSOA	Short Circuit Safe Operating Area	6	_	_	μs	$T_J = 150^{\circ}C$, $V_{CC} = 400V$, $Vp \le 600V$ Rg = 50Ω , $V_{GE} = +15V$ to $0V$
Erec	Reverse Recovery Energy of the Diode	_	570		μJ	T _J = 175°C
t _{rr}	Diode Reverse Recovery Time	_	176		ns	$V_{CC} = 400V, I_F = 24A$
I _{rr}	Peak Reverse Recovery Current	_	19	_	Α	$V_{GE} = 15V, Rg = 10\Omega, L = 740\mu H$

- $\oplus~V_{CC}$ = 80% (V_{CES}), V_{GE} = 20V, L = 740 $\mu H,~R_G$ = 10 $\Omega.$
- ② Pulse width limited by max. junction temperature.
- $\ \, \ \, \ \, \ \,$ Refer to AN-1086 for guidelines for measuring $V_{(BR)CES}$ safely.
- 4 R₀ is measured at T_J approximately 90°C.



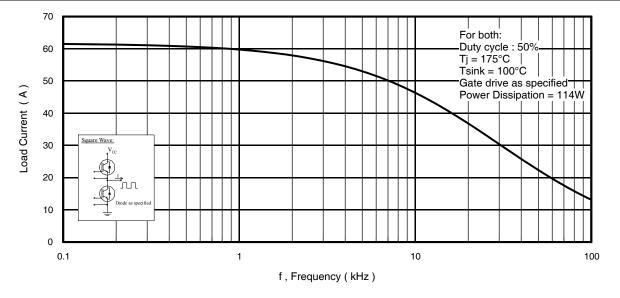


Fig. 1 - Typical Load Current vs. Frequency

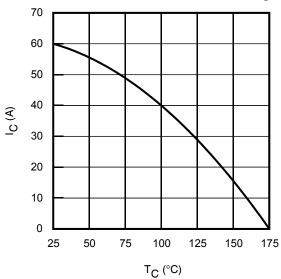


Fig. 2 - Maximum DC Collector Current vs. Case Temperature

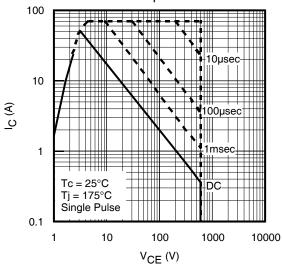


Fig. 4 - Forward SOA T_C = 25°C, T_J @ 175°C; V_{GE} =15V

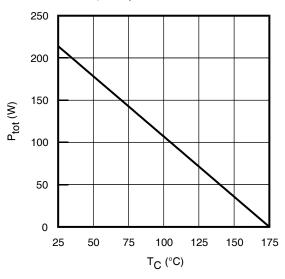


Fig. 3 - Power Dissipation vs. Case Temperature

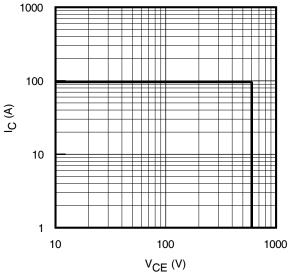


Fig. 5 - Reverse Bias SOA T_J = 175°C; VGE = 20V



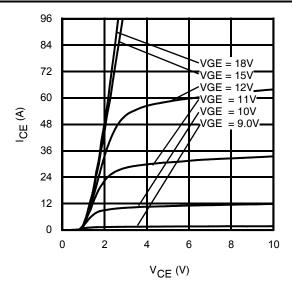


Fig. 6 - - Typ. IGBT Output Characteristics $T_J = -40^{\circ}C$; $tp = 20\mu s$

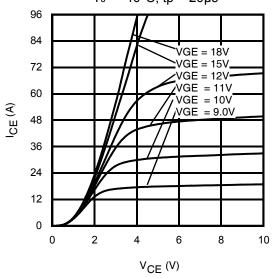


Fig. 8 - Typ. IGBT Output Characteristics

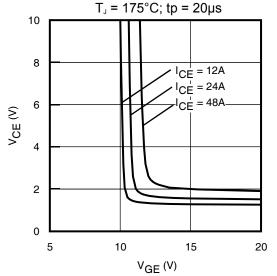


Fig. 10 - Typical V_{CE} vs. V_{GE} $T_J = -40$ °C

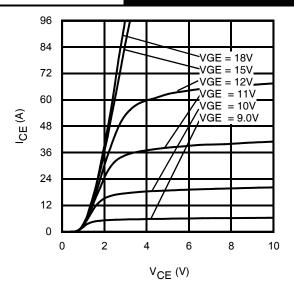


Fig. 7 - Typ. IGBT Output Characteristics TJ = 25°C; tp = 20µs

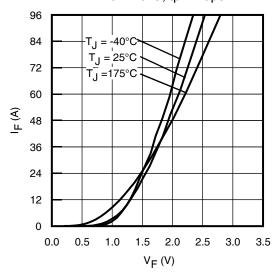


Fig. 9 - Typ. Diode Forward Characteristics

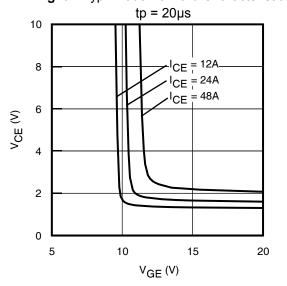
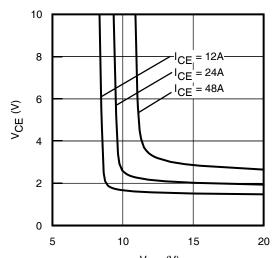
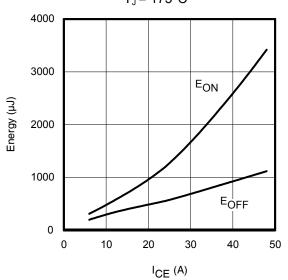


Fig. 11 - Typical V_{CE} vs. V_{GE} $T_J = 25^{\circ}C$





 V_{GE} (V) Fig. 12 - Typical V_{CE} vs. V_{GE} T_J = 175°C



 $\label{eq:fig.14-Typ.} \textbf{Fig. 14} - \text{Typ. Energy Loss vs. I}_C$ $T_J = 175^{\circ}\text{C}; \ L = 740 \mu\text{H}; \ V_{CE} = 400 \text{V}, \ R_G = 10 \Omega; \ V_{GE} = 15 \text{V}$

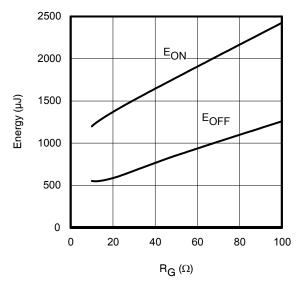


Fig. 16 - Typ. Energy Loss vs. R_G T_J = 175°C; L = 740 μ H; V_{CE} = 400V, I_{CE} = 24A; V_{GE} = 15V

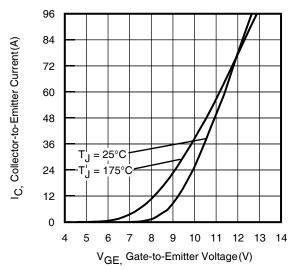


Fig. 13 - Typ. Transfer Characteristics V_{CE} = 50V; tp = 20 μ s

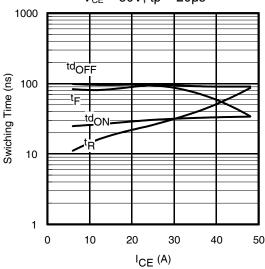


Fig. 15 - Typ. Switching Time vs. IC TJ = 175°C; L = 740 μ H; V_{CE} = 400V, R_G = 10 Ω ; V_{GE} = 15V

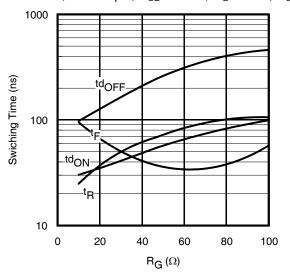


Fig. 17 - Typ. Switching Time vs. R_G T_J = 175°C; L = 740 μ H; V_{CE} = 400V, I_{CE} = 24A; V_{GE} = 15V



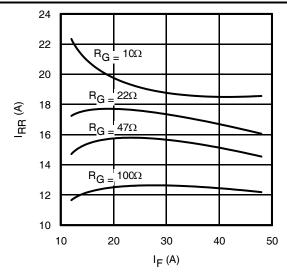


Fig. 18 - Typ. Diode I_{RR} vs. I_F $T_{J} = 175^{\circ}C$

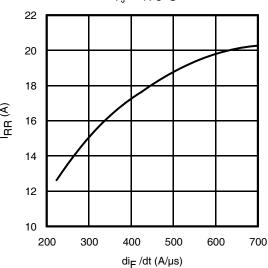


Fig. 20 - Typ. Diode I_{RR} vs. diF/dt V_{CC} = 400V; V_{GE} = 15V; I_F = 24A; T_J = 175°C

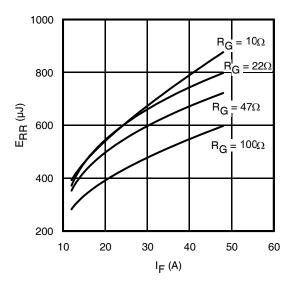


Fig. 22 - Typ. Diode E_{RR} vs. I_F $T_J = 175^{\circ}C$

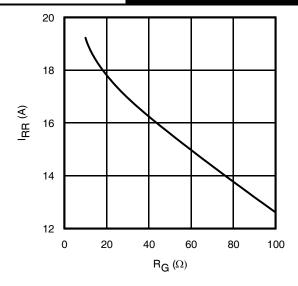


Fig. 19 - Typ. Diode I_{RR} vs. R_G $T_{\rm J} = 175^{\circ}{\rm C}$

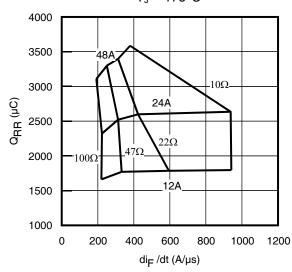


Fig. 21 - Typ. Diode Q_{RR} vs. diF/dt $V_{CC} = 400V$; $V_{GE} = 15V$; $T_{J} = 175$ °C

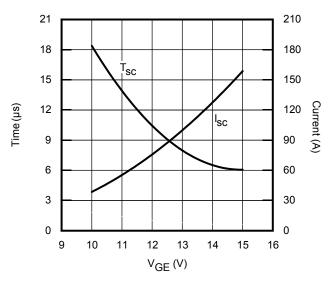
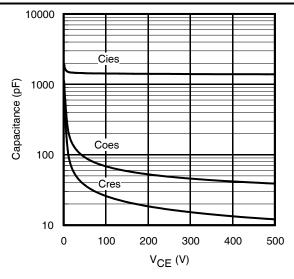


Fig. 23 - V_{GE} vs. Short Circuit Time $V_{CC} = 400V; T_C = 150^{\circ}C$





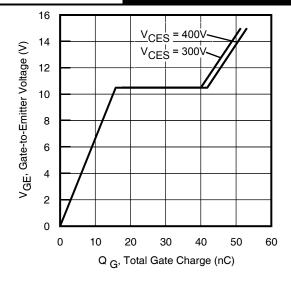


Fig. 24 - Typ. Capacitance vs. V_{CE} V_{GE} = 0V; f = 1MHz

Fig. 25 - Typical Gate Charge vs. V_{GE} I_{CE} = 24A; L= 485 μ H

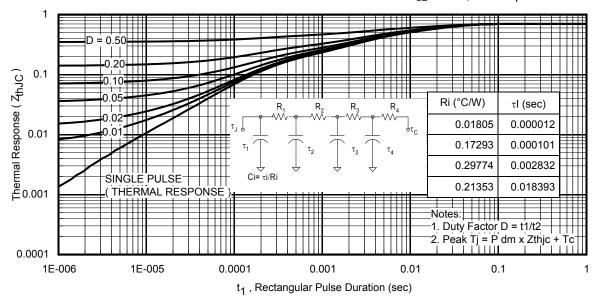


Fig 26. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

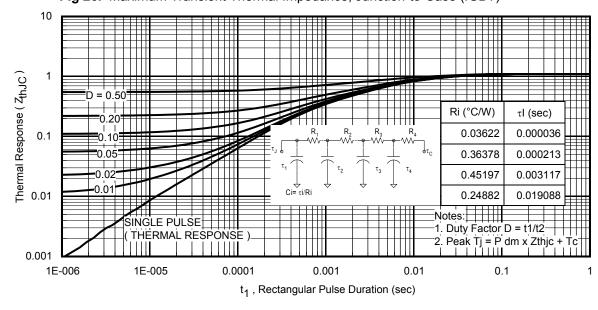
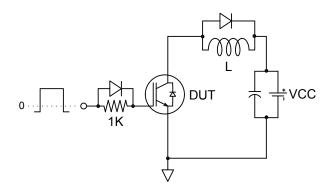


Fig 27. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)





Gate Charge Circuit

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

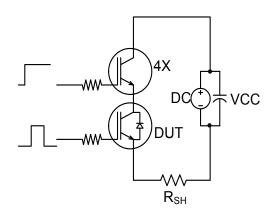


Fig.C.T.3 - S.C. SOA Circuit

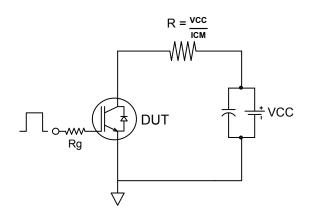
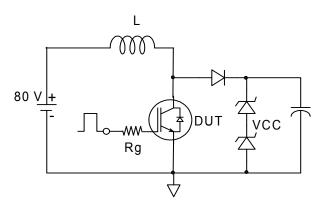


Fig.C.T.5 - Resistive Load Circuit



RBSOA Circuit

Fig.C.T.2 - RBSOA Circuit

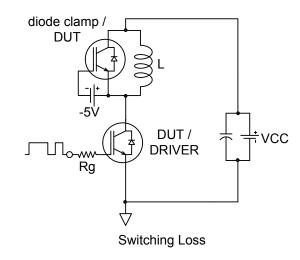


Fig.C.T.4 - Switching Loss Circuit

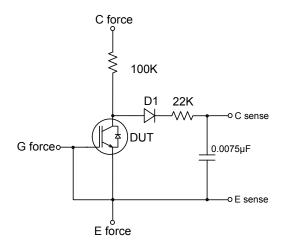


Fig.C.T.6 - BVCES Filter Circuit

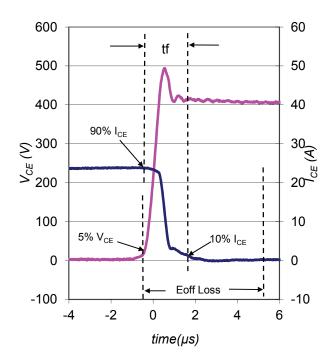


Fig. WF1 - Typ. Turn-off Loss Waveform $@T_J = 175^{\circ}C$ using Fig. CT.4

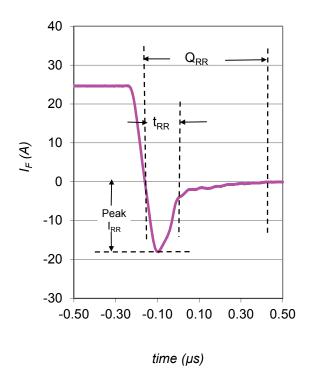


Fig. WF3 - Typ. Diode Recovery Waveform @ T_J = 175°C using Fig. CT.4

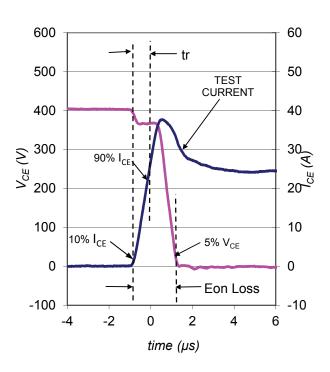


Fig. WF2 - Typ. Turn-on Loss Waveform @ T_J = 175°C using Fig. CT.4

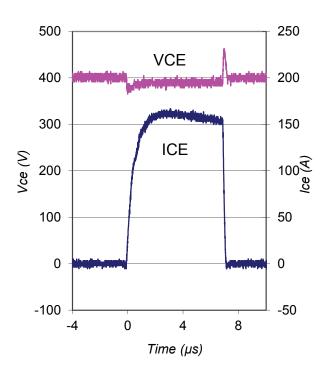
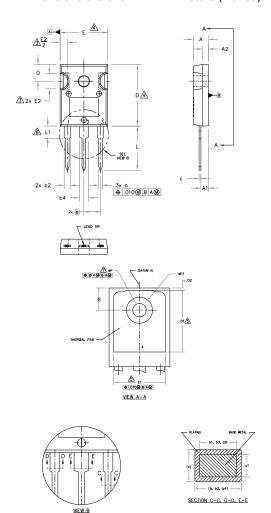


Fig. WF4 - Typ. S.C. Waveform @ T_J = 150°C using Fig. CT.3



TO-247AC Package Outline

Dimensions are shown in millimeters (inches)



DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M 1994.

DIMENSIONS ARE SHOWN IN INCHES.

CONTOUR OF SLOT OPTIONAL.

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.

THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS D1 & E1.

LEAD FINISH UNCONTROLLED IN L1.

ØP TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5 * TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154 INCH.

- OUTLINE CONFORMS TO JEDEC OUTLINE TO-247AC
- DIMENSION "A" HAS TIGHTER TOLERANCE WITH REFERENCE TO 115-0051 POD

		DIMEN	ISIONS		
SYMBOL	INC	HES	MILLIM	ETERS	
	MIN.	MAX.	MIN.	MAX.	NOTES
A	.190	.203	4.83	5.13	
A1	.087	.102	2.21	2.59	
A2	.059	.098	1.50	2.49	
b	.039	.055	0.99	1.40	
ь1	.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	
С	.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		BSC	5.46	BSC	
øk	.0	10	0.	25	
L	.559	.634	14.20	16.10	
L1	.146	.169	3.71	4.29	
øΡ	.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

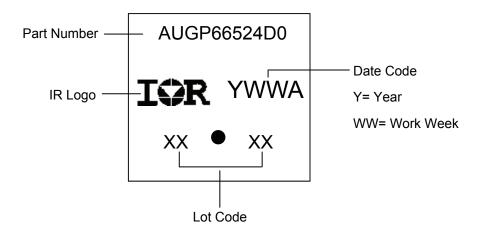
IGBTs, CoPACK

- 2.- COLLECTOR 3.- EMITTER 4.- COLLECTOR

DIODES

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

TO-247AC Part Marking Information



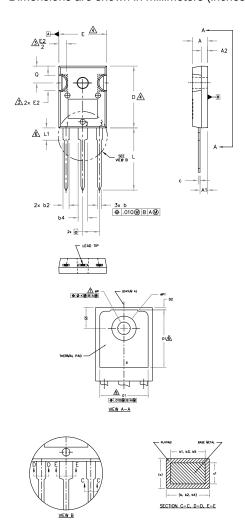
TO-247AC package is not recommended for Surface Mount Application.

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.

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.

DIMENSIONS

LEAD FINISH UNCONTROLLED IN L1.

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.
- TIGHTEN DIMENSIONS A, b, b2, b4, c, D, E, E1, L.

SYMBOL	INC	HES	MILLIN	ETERS	
	MIN.	MAX.	MIN.	MAX.	NOTES
Α	.190	.203	4.83	5.13	
A1	.087	.102	2.21	2.59	
A2	.059	.098	1.50	2.49	
b	.041	.051	1.04	1.30	
b1	.039	.053	0.99	1.35	
b2	.080	.094	2.02	2.38	
b3	.065	.092	1.65	2.34	
b4	.118	.134	3.00	3.40	
b5	.102	.133	2.59	3.38	
С	.017	.035	0.44	0.88	
c1	.015	.033	0.38	0.84	
D	.780	.795	19.80	20.20	4
D1	.515	-	13.08	-	5
D2	.020	.053	0.51	1.35	
Ε	.604	.624	15.35	15.85	4
E1	.530	.544	13.46	13.82	
E2	.178	.216	4.52	5.49	
е	.215	BSC	5.46	BSC	
Øk	010		0	25	

823

169

.144

291

.224

20.10

3.71

3.56

5.31

5.51 BSC

20.90

4.29

3.66

7.39

5.69

LEAD ASSIGNMENTS

HEXFET

- 1.- GATE
- 2.- DRAIN
- 3.- SOURCE 4.- DRAIN

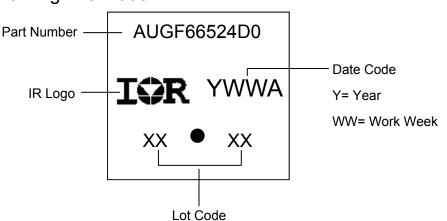
IGBTs, CoPACK

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

DIODES

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

TO-247AD Part Marking Information



1

1.1

øΡ

øP1

Q

791

146

.140

.209

.217 BSC

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 information							
		Automotive					
		(per AEC-Q101) [†]					
Qualification Level		This part number(s) passed Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.					
		TO-247AC	NI/A				
Moisture Sensitivit	ty Level	TO-247AD	N/A				
		Class H1C(+/- 2000) ^{††}					
	Human Body Model	AEC-Q101-001					
ESD		Class C5 (+/- 1000) ^{††}					
	Charged Device Model	AEC-Q101-005					
RoHS Compliant		Yes					

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

^{††} Highest passing voltage.



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 GT50JR22(STA1ES)
 TIG058E8-TL-H
 IGW40N120H3FKSA1
 VS-CPV364M4KPBF
 NGTB25N120FL2WAG
 NGTG40N120FL2WG

 RJH60F3DPQ-A0#T0
 APT40GR120B2SCD10
 APT15GT120BRG
 APT20GT60BRG
 NGTB75N65FL2WAG
 NGTG15N120FL2WG

 IXA30RG1200DHGLB
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 XP15PJS120CL1B1
 IGW30N60H3FKSA1
 STGWA8M120DF3
 IGW08T120FKSA1

 IGW75N60H3FKSA1
 FGH60N60SMD_F085
 FGH75T65UPD
 STGWA15H120F2
 IKA10N60TXKSA1
 IHW20N120R5XKSA1

 RJH60D2DPP-M0#T2
 IKP20N60TXKSA1
 IHW20N65R5XKSA1
 APT70GR120JD60
 AOD5B60D
 APT70GR120L
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