Automotive grade

AUIPS6021(S)(R)

INTELLIGENT POWER HIGH SIDE SWITCH

Features

- Over temperature shutdown (with auto-restart)
- Short circuit protection (current limit)
- Reverse battery protection (turns On the MOSFET)
- Full diagnostic capability (short circuit to battery)
- Active clamp
- Open load detection in On and Off state
- Ground loss protection

International

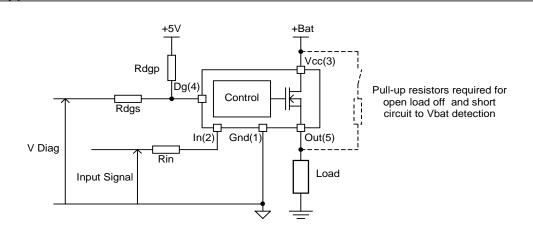
ICR Rectifier

- Logic ground isolated from power ground
- ESD protection
- Lead Free and RoHS compliant

Description

The AUIPS6021(S)(R) is a five terminal Intelligent Power Switch (IPS) for use in a high side configuration. It features short circuit, over-temperature, ESD protection, inductive load capability and diagnostic feedback. The output current is limited to the llim value. The current limitation is activated until the thermal protection acts. The over-temperature protection turns off the device if the junction temperature exceeds the Tshutdown value. It will automatically restart after the junction has cooled 7°C below the Tshutdown value. The reverse battery protection turns On the MOSFET. A diagnostic pin provides different voltage levels for each fault condition. The double level shifter circuitry will allow large offsets between the logic and load ground.

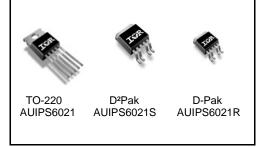
Typical Connection



Product Summary

Rds(on)	$30 \text{m}\Omega$ max.
Vclamp	39V
I Limit	32A
Open load	3V / 1.1A

Packages





Qualification Information[†]

Qualification Level			Automotive (per AEC-Q100 ^{††})				
		Comments: This family of ICs has pas	Comments: This family of ICs has passed an Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher				
		D2PAK-5L	MSL1, 260°C (per IPC/JEDEC J-STD-020)				
Moisture	Sensitivity Level	TO-220	Not applicable (non-surface mount package style)				
		DPAK-5L	MSL1, 260°C (per IPC/JEDEC J-STD-020)				
	Machine Model		Class M2 (+/-150V) ¹¹¹ (per AEC-Q100-003)				
ESD	Human Body Model	Class H1C (+ (per AEC-0					
E9D	Charged Device Model (DPAK,D2PAK)	Class C4 (+ (per AEC-0	,				
Charged Device Model (TO220)			Class C3B (+/-750V) ¹¹¹ (per AEC-Q100-011)				
IC Latch-Up Test		· · · · · · · · · · · · · · · · · · ·	Class II, Level A (per AEC-Q100-004)				
RoHS Co	ompliant	Ye	Yes				

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

the Exceptions to AEC-Q100 requirements are noted in the qualification report.

††† Passing voltage level



Absolute Maximum Ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are referenced to Ground lead. Tj= -40°C..150°C, Vcc=6..35V (unless otherwise specified).

Symbol	Parameter	Min.	Max.	Units
Vout	Maximum output voltage	Vcc-35	Vcc+0.3	
Voffset	Maximum logic ground to load ground offset	Vcc-35	Vcc+0.3	
Vin	Maximum input voltage	-0.3	5.5	V
Vcc max.	Maximum Vcc voltage	_	36	v
Vcc cont.	Maximum continuous Vcc voltage	_	28	
Vcc sc.	Maximum Vcc voltage with short circuit protection	_	28	
lin max.	Maximum IN current	-3	10	~^^
ldg max.	Maximum diagnostic output current	-3	10	mA
Vdg	Maximum diagnostic output voltage	-0.3	5.5	V
	Maximum power dissipation (internally limited by thermal protection)			
Pd	Rth=5°C/W AUIPS6021		25	W
Pu	Rth=40°C/W AUIPS6021S 1"sqrt. footprint		3.1	vv
	Rth=50°C/W AUIPS6021R 1"sqrt. footprint		2.5	
Tj max.	Max. storage & operating temperature junction temperature		150	°C
Tsoldering	Soldering temperature (10 seconds)	_	300	°C

Thermal Characteristics

Symbol	Parameter	Тур.	Max.	Units
Rth1	Thermal resistance junction to ambient AUIPS6021 TO220 free air	50	_	
Rth2	Thermal resistance junction to case AUIPS6021 TO220	2.6	_	
Rth1	Thermal resistance junction to ambient AUIPS6021S D ² Pak std. footprint	60	_	
Rth2	Thermal resistance junction to ambient AUIPS6021S D ² Pak 1" sqrt. Footprint	40	_	°C/W
Rth3	Thermal resistance junction to case AUIPS6021S D ² Pak	2.6	_	C/vv
Rth1	Thermal resistance junction to ambient AUIPS6021R D-Pak std. footprint	70	_	
Rth2	Thermal resistance junction to ambient AUIPS6021R D-Pak 1" sqrt. Footprint	50	_	
Rth3	Thermal resistance junction to case AUIPS6021R D-Pak	2.6	_	

Recommended Operating Conditions

These values are given for a quick design. For operation outside these conditions, please consult the application notes.

Symbol	Parameter	Min.	Max.	Units
VIH	High level input voltage	4	5.5	
VIL	Low level input voltage	0	0.9	
lout	Continuous drain current, Tambient=85°C, Tj=125°C, Vin=5V			
	Rth=5°C/W AUIPS6021	—	12	A
	Rth=40°C/W AUIPS6021S 1" sqrt. footprint	_	4.3	
	Rth=50°C/W AUIPS6021R 1" sqrt. footprint		3.9	
Rin	Recommended resistor in series with IN pin	4	10	
Rdgs	Recommended resistor in series with DG pin for reverse battery protection	4	20	kΩ
Rdgp	Recommended pull-up resistor for DG		20	K52
Rol	Recommended pull-up resistor for open load detection	5 100		
F max.	Max. switching frequency		1.5	kHz



Static Electrical Characteristics

Tj=-40°C..150°C, Vcc=6..28V (unless otherwise specified), typical values are given for Vcc=14V and Tj=25°C

Symbol	Parameter	Min.	Тур.	Max.	Units	Test Conditions
Rds(on)	ON state resistance Tj=25°C	_	24	30		Vin=5V, lout=10A
	ON state resistance Tj=150°C		42	52		Vin=5V, lout=10A
	ON state resistance Tj=25°C, Vcc=6V	_	29	36	mΩ	Vin=5V, lout=5A
	ON state resistance during reverse battery Tj=25°C	_	31	39		Vcc-Gnd=-14V
Vcc op.	Operating voltage range with short circuit protection	6	_	28	v	
V clamp 1	Vcc to Out clamp voltage 1	37	39	43	v	lout=40mA
V clamp 2	Vcc to Out clamp voltage 2	—	40	—		lout=8A (see Fig. 1)
Icc Off	Supply current when Off and Vout connected to ground with $R<4\Omega$	—	4	9	μA	Vin=0V, Vout=0V, Tj=25°C, Vcc=14V
Icc On	Supply current when On	_	2.2	5	mA	Vin=5V, Vcc=14V
Vih	Input high threshold voltage	_	2.5	3		
Vil	Input low threshold voltage	1.5	2	—	V	
In hyst.	Input hysteresis	0.2	0.5	1		
lin On	Input current when device is On	_	40	100		Vin=5V
ldg	Dg leakage current	_	0.1	10	μA	Vdg=5V
Vdg	Low level DG voltage	_	0.25	0.4	V	ldg=1.6mA

Switching Electrical Characteristics

Vcc=14V, Resistive load=6Ω, Vin=5V, Tj=-40°C..150°C, typical values are given for Tj=25°C

Symbol	Parameter	Min.	Тур.	Max.	Units	Test Conditions
Tdon	Turn-on delay time	_	14	40		
Tr1	Rise time to Vout=Vcc-5V	_	10	35	μs	
Tr2	Rise time to Vout=0.9 x Vcc	_	18	65		
dV/dt (On)	Turn On dV/dt	_	0.8	_	V/µs	
EOn	Turn On energy		250		μJ	see Fig. 3
Tdoff	Turn-off delay time		40	80		
Tf	Fall time to Vout=0.1 x Vcc	_	15	35	μs	
dV/dt (Off)	Turn Off dV/dt		1.5		V/µs	
EOff	Turn Off energy		100		μJ	



Protection Characteristics

Tj=-40°C..150°C, Vcc=6..28V (unless otherwise specified), typical values are given for Vcc=14V and Tj=25°C

Symbol	Parameter	Min.	Тур.	Max.	Units	Test Conditions	
llim	Internal current limit	19	32	50	Α	Vout=0V, Tj=25°C	
Tsd+	Over temperature high threshold	150(1)	165	_	•	°C	See fig. 2
Tsd-	Over temperature low threshold	—	158		C	See lig. 2	
Vsc	Short-circuit detection voltage(2)	2	3	4			
UV+	Under voltage protection Vcc going up	—	5	6.2			
UV-	Under voltage protection Vcc going down	—	4.5	5.8	V		
VOL Off	Open load detection threshold	2	3	4			
	Open load detection threshold	0.3	0.8	1.25	^	Tj=-4025°C	
I OL On		0.3	0.7	1.1	A	Tj=25150°C	

(1) Guaranteed by design

(2) Reference to Vcc

True Table

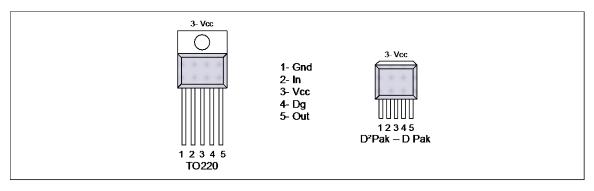
Operating Conditions	IN	OUT	DG
Normal	Н	Н	Н
Normal	L	L	Н
Open Load	Н	Н	L
Open Load (3)	L	Н	L
Short circuit to Gnd	Н	L	L
Short circuit to Gnd	L	L	Н
Short circuit to Vcc	Н	Н	L (4)
Short circuit to Vcc (5)	L	Н	L
Over-temperature	Н	L	L
Over-temperature	L	L	Н

(3) With a pull-up resistor connected between the output and Vcc.

(4) Vds lower than 10mV.

(5) Without a pull-up resistor connected between the output and Vcc.

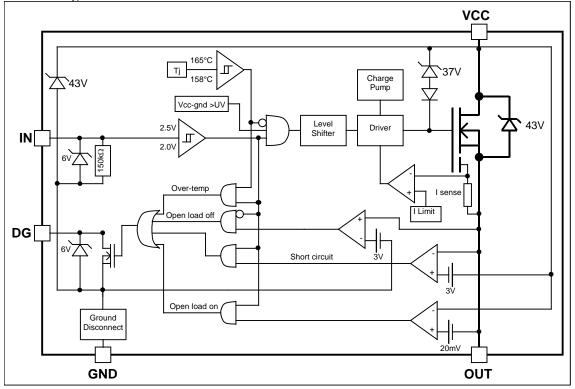
Lead Assignments





Functional Block Diagram

All values are typical





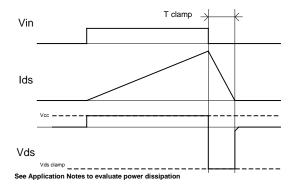


Figure 1 – Active clamp waveforms

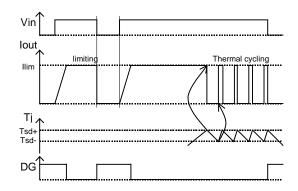


Figure 2 – Protection timing diagram

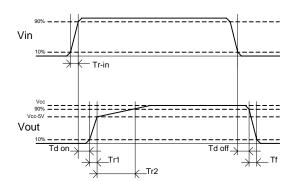
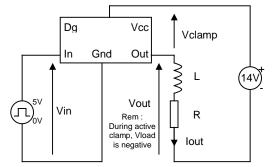
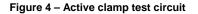


Figure 3 – Switching times definitions







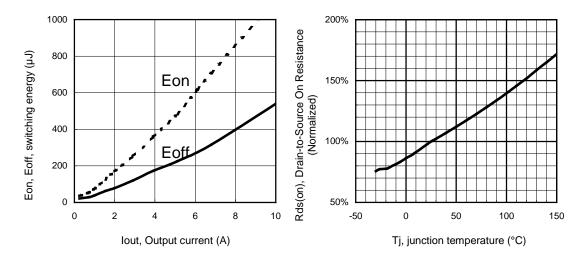
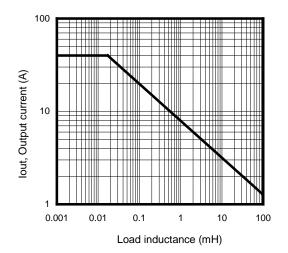


Figure 5 – Switching energy (µJ) Vs Output current (A)



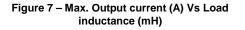


Figure 6 - Normalized Rds(on) (%) Vs Tj (°C)

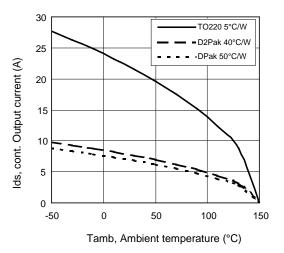
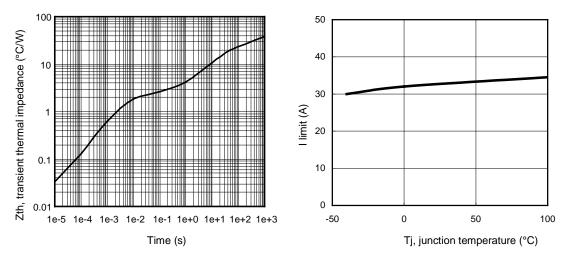
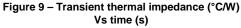
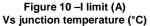


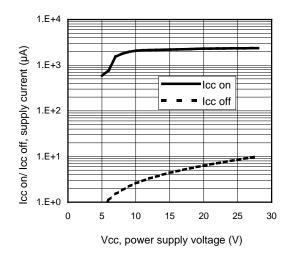
Figure 8 – Max. ouput current (A) Vs Ambient temperature (°C)

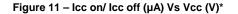












*Vout connected to ground with R<4Ω

1.E+4 1.E+3

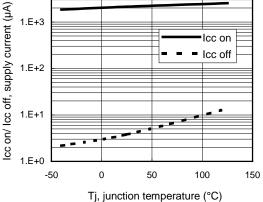
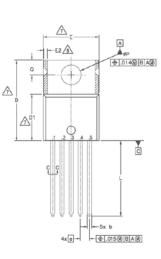
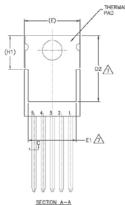


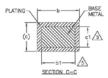
Figure 12 - Icc on/ Icc off (µA) Vs Tj (°C)*

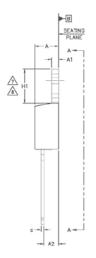


Case Outline - TO220 (5 leads)









SYMBOL	DIMENSIONS					
B	MILLIN	ETERS	INC	INCHES		
Ľ	MIN.	NAX.	MIN.	MAX.	NOTES	
Α	3.58	4.83	.140	.190		
A1	0.51	1.40	.020	.055	1 1	
A2	2.03	2.92	.080	.115	1 1	
b	0.64	0.89	.025	.035	1 1	
b1	0.64	0.84	.025	.033	5	
с	0.35	0.61	.014	.024	1 1	
c1	0.36	0.56	.014	.022	5	
D	14.22	16.51	.560	.650	4	
D1	8.38	9.02	.330	.355		
D2	11.68	12.88	.460	.507	7	
Ε	9.65	10.67	.380	.420	4,7	
E1	6.85	8.89	.270	.350	7	
E2	-	0.76	-	.030	8	
6	1.70	BSC	.067	BSC	1	
H1	5.84	6.86	.230	.270	7,8	
L	12.70	14.73	.500	.580		
¢٩	3.53	3.73	.139	.147		
Q	2.54	3.05	.100	.120		

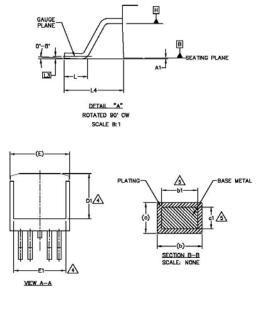
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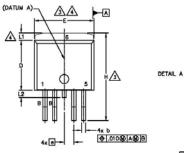
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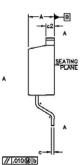
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- 4.-
- <u>/5.</u>]
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- 10.- LEADS AND DRAIN ARE PLATED WITH 100% Sn



Case Outline D2PAK - 5 Leads







M		N				
BO	мШи	ETERS	INC	HES	NOTES	
Ľ	MIN.	MAX.	MIN.	MAX.	Š	
A	4.06	4.83	.160	.190		
A1	-	0.254	-	.010		
b	0.51	0.99	.020	.039	4	
b1	D.51	0.89	.020	.035		
C	0.38	0.74	.015	.029		
e1	0.38	0.58	.015	.023	4	
c2	1.14	1.65	.045	.065		
D	8.38	9.65	.330	.380	3	
D1	6.86	-	.270	-		
Ε	9.65	10.67	.380	.420	3	
E1	6.22	-	.245	-		
e	1.70	1.70 BSC		BSC		
н	14.61	15.88	.575	.625		
L	1.78	2.79	.070	.110		
L1	-	1.68	-	.066		
L2	-	1.78	-	.070		
L3	0.25	0.25 BSC		.010 BSC		
L4	4.78	5.28	.188	.208		

NOTES:

S

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

- 2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
- DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 (.005") PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.

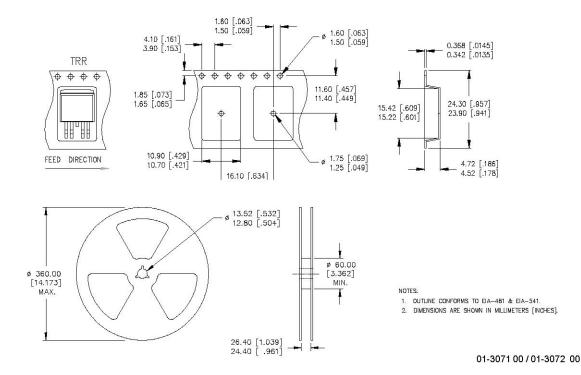
AUIPS6021(S)(R)

- A THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
- S DIMENSION 61 AND c1 APPLY TO BASE METAL ONLY.
- 6. DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
- 7. CONTROLLING DIMENSION: INCH.
- 8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-263BA.
- 9 LEADS AND DRAIN ARE PLATED : 100% Sn





Tape & Reel D2PAK - 5 Leads





NOT

ÈS

MAX.

.094

.005

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.024

.022 2

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.265 3

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070

.050

.040

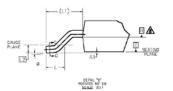
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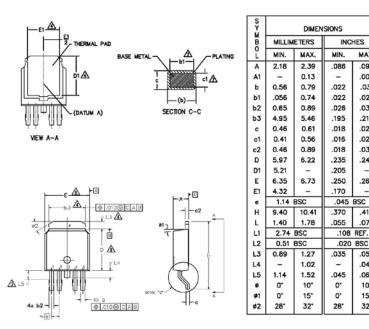
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15

32

Case Outline DPAK - 5 Leads



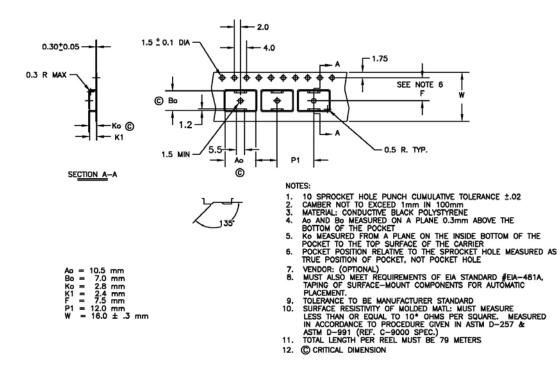


NOTES:

- 1.- DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M-1994
- 2.- DIMENSION ARE SHOWN IN INCHES [MILLIMETERS].
- A- LEAD DIMENSION UNCONTROLLED IN L5.
- A- DIMENSION D1, E1, L3 & b3 ESTABLISH A MINIMUM MOUNTING SURFACE FOR THERMAL PAD.
- 5.- SECTION C-C DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN .005 AND 0.10 [0.13 AND 0.25] FROM THE LEAD TIP.
- A- DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005 [0.13] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
- A- DIMENSION 61 & c1 APPLIED TO BASE METAL ONLY.
- 8.- DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
- 9 .- OUTLINE CONFORMS TO JEDEC OUTLINE TO-252.
- 10. LEADS AND DRAIN ARE PLATED WITH 100% Sn

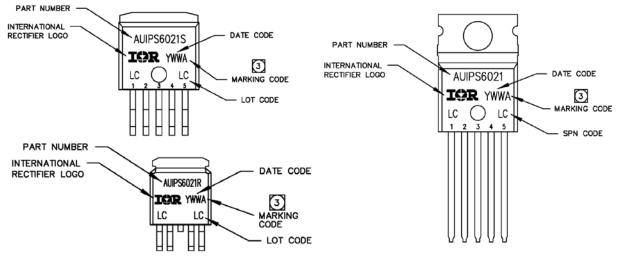


Tape & Reel DPAK - 5 Leads





Part Marking Information



Ordering Information

Base Part Number Packago Typo		Standard Pack		
Dase I alt Number	Package Type	Form	Quantity	Complete Part Number
AUIPS6021	TO220-5-Leads	Tube	50	AUIPS6021
		Tube	50	AUIPS6021S
AUIPS6021S	D2-Pak-5-Leads	Tape and reel left	800	AUIPS6021STRL
		Tape and reel right	800	AUIPS6011STRR
		Tube	75	AUIPS6021R
AUIPS6021R		Tape and reel	2000	AUIPS6021RTR
AUFSOUZIR	D-Pak-5-Leads	Tape and reel left	3000	AUIPS6021RTRL
		Tape and reel right	3000	AUIPS6021RTRR

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Revision History

Revision	Date	Notes/Changes
В	September, 12th 2011	AU release
С	May 15, 2012	Add the test condition for the ICC (off) parameters
D	Tuesday, October 16, 2012	Update the date in the front page

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