March, 26th 2012

Automotive grade

International
IOR Rectifier

AUIPS7091(G)(S)PbF

INTELLIGENT POWER HIGH SIDE SWITCH

Features

- Over temperature shutdown (with auto-restart)
- Short circuit protection (current limit)
- Active clamp
- Open load detection
- Logic ground isolated from power ground
- ESD protection
- Ground loss protection
- Status feedback

Product Summary

Rds(on)	120mΩ max.
Vclamp	70V
I Limit	5A (typ.)
Open load	3V

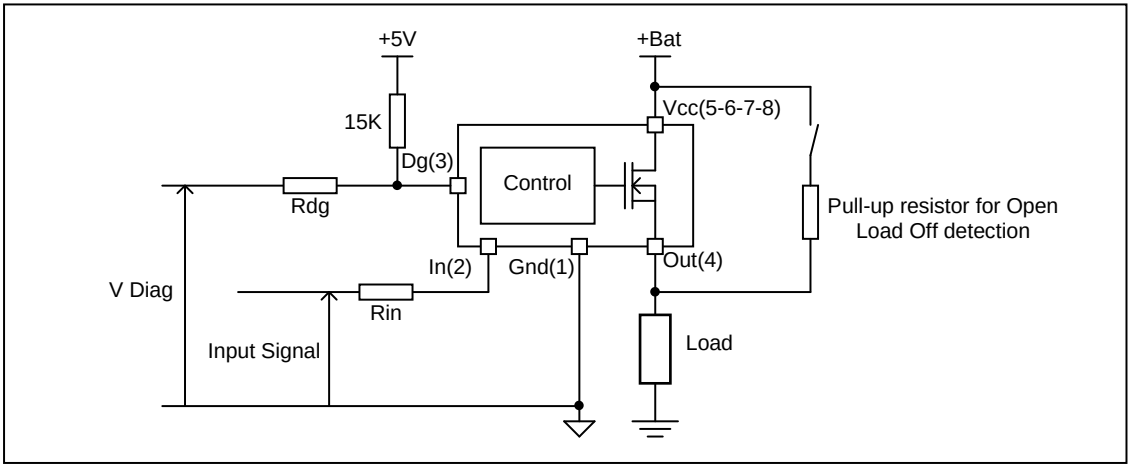
Description

The AUIPS7091(G)(S)PbF is a five terminal Intelligent Power Switch (IPS) with built in short circuit, over-temperature, ESD protection, inductive load capability and diagnostic feedback. The output current is limited at Ilim value. Current limitation is activated until the thermal protection acts. The over-temperature protection turns off the device if the junction temperature exceeds Tshutdown. It will automatically restart after the junction has cooled 7°C below Tshutdown. A diagnostic pin is provided for status feedback of short circuit, over-temperature and open load detection. The double level shifter circuitry allows large offsets between the logic ground and the load.

Package

TO220	D2-Pak	SO-8
AUIPS7091PbF	AUIPS7091SPbF	AUIPS7091GPbF

Typical Connection



Qualification Information†

Qualification Level		Automotive (per AEC-Q100)	
		Comments: This family of ICs has passed an Automotive qualification. IR's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.	
Moisture Sensitivity Level		D2PAK-5L	MSL1, 260°C (per IPC/JEDEC J-STD-020)
		TO-220	Not applicable (non-surface mount package style)
		SOIC-8	MSL2, 260°C (per IPC/JEDEC J-STD-020)
ESD	Machine Model	Class M2 (+/-200V) (per AEC-Q100-003)	
	Human Body Model	Class H2 (+/-4000V) (per AEC-Q100-002)	
	Charged Device Model	Class C4 (+/-1000V) (per AEC-Q100-011)	
IC Latch-Up Test		Class II, Level A (per AEC-Q100-004)	
RoHS Compliant		Yes	

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

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-63	Vcc+0.3	V
Voffset	Maximum logic ground to load ground offset	Vcc-63	Vcc+0.3	
Vin	Maximum input voltage	-0.3	5.5	
Vcc max.	Maximum Vcc voltage	—	60	
Vcc cont.	Maximum continuous Vcc voltage	—	35	
Vcc sc.	Maximum Vcc voltage with short circuit protection with Tj < -10°C	—	28	
Iin max.	Maximum IN current	-1	10	mA
Idg max.	Maximum diagnostic output current	-1	10	
Vdg	Maximum diagnostic output voltage	-0.3	5.5	V
Pd	Maximum power dissipation (internally limited by thermal protection) Rth=100°C/W	—	1.25	W
Isd cont.	Maximum continuous diode current (Rth=100°C/W)	—	1.8	A
ESD1	Electrostatic discharge voltage (Human body) 100pF, 1500Ω	—	4	kV
ESD2	Electrostatic discharge voltage (Machine Model) C=200pF,R=0Ω,L=10µH	—	0.5	
Tj op max.	Max. operating temperature junction temperature	-40	+150	°C
Tj Sto max.	Max. storage temperature junction temperature	-55	+150	°C

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
Rth1	Thermal resistance junction to ambient SO8 std. footprint	100	—	°C/W
Rth1	Thermal resistance junction to ambient TO220 free air	60	—	
Rth1	Thermal resistance junction to ambient D2Pak std. footprint	60	—	
Rth2	Thermal resistance junction to ambient D2Pak 1" sqrt. footprint	40	—	
Rth3	Thermal resistance junction to case D2pak/TO220	4	—	

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	V
VIL	Low level input voltage	-0.3	0.9	
Iout	Continuous drain current, Tamb=85°C, Tj=125°C, Vin=5V, Rth=100°C/W	—	1.5	A
Rin	Recommended resistor in series with IN pin	10	20	kΩ
Rdgs	Recommended resistor in series with DG pin	10	20	
Rol	Recommended pull-up resistor for open load detection	5	100	

Static Electrical Characteristics

Tj=-40..150°C, Vcc=6..35V (unless otherwise specified), typical values are given for Vcc=14V and Tj=25°C

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Rds(on)	ON state resistance Tj=25°C	—	80	120	mΩ	Vin=5V, Iout=2A
	ON state resistance Tj=150°C	—	150	230		Vin=5V, Iout=2A
	ON state resistance Tj=25°C, Vcc=6.5V	—	90	130		Vin=5V, Iout=2A
Vcc op.	Operating voltage range	6	—	35	V	
V clamp	Vcc to Out clamp voltage	63	70	—		Iout=30mA (see Fig. 1)
Vf	Body diode forward voltage	—	1	1.4		Iout= 2.5A
Icc Off	Supply current when Off	—	2.5	10	µA	Vin=Vout=0V, Tj=25°C
Icc On	Supply current when On	—	2.5	4	mA	Vin=5V, Vcc=14V
Iout@0V	Output leakage current	—	—	10	µA	Vout=0V
Iout@6V	Output leakage current	—	20	—		Vout=6V
Idg leakage	Diagnostic output leakage current	—	—	10		Vdg=5.5V
Vdgl	Low level diagnostic output voltage	—	0.1	0.3	V	Idg=1.6mA
Vih	Input high threshold voltage	—	2.5	3.5		
Vil	Input low threshold voltage	1	2	—		
In hys	Input hysteresis	0.05	0.4	1		
UV high	Under voltage high threshold voltage	—	5	6.2		
UV low	Under voltage low threshold voltage	3	4.5	5.9		
UV hys	Under voltage hysteresis	0.1	0.8	1.5		
Iin On	Input current when device is On	—	40	80	µA	Vin=5V

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.	Typ.	Max.	Units	Test Conditions
Tdon	Turn-on delay time	—	12	35	µs	See Fig. 3
Tr1	Rise time to Vout=Vcc-5V	—	7	40		
Tr2	Rise time to Vout=0.9 x Vcc	—	14	50		
dV/dt (On)	Turn On dV/dt	—	0.95	5	V/µs	
EOn	Turn On energy	—	250	—	µJ	
Tdoff	Turn-off delay time	—	20	45	µs	
Tf	Fall time to Vout=0.1 x Vcc	—	6	25		
dV/dt (Off)	Turn Off dV/dt	—	1.8	5	V/µs	
EOff	Turn Off energy	—	20	—	µJ	
Tdiag	Vout to Vdiag propagation delay	—	15	—	µs	See Fig. 4 and Fig. 12

Protection Characteristics

Tj=-40..150°C, Vcc=6..35V (unless otherwise specified), typical values are given for Vcc=14V and Tj=25°C

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Ilim	Internal current limit	2	5	8	A	Vout=0V, Tj=25°C
Tsd+	Over temperature high threshold	150[1]	165	—	°C	See Fig. 2
Tsd-	Over temperature low threshold	—	158	—		
Vsc	Short-circuit detection voltage [2]	2	3	4	V	
Vopen load	Open load detection threshold	2	3	4		

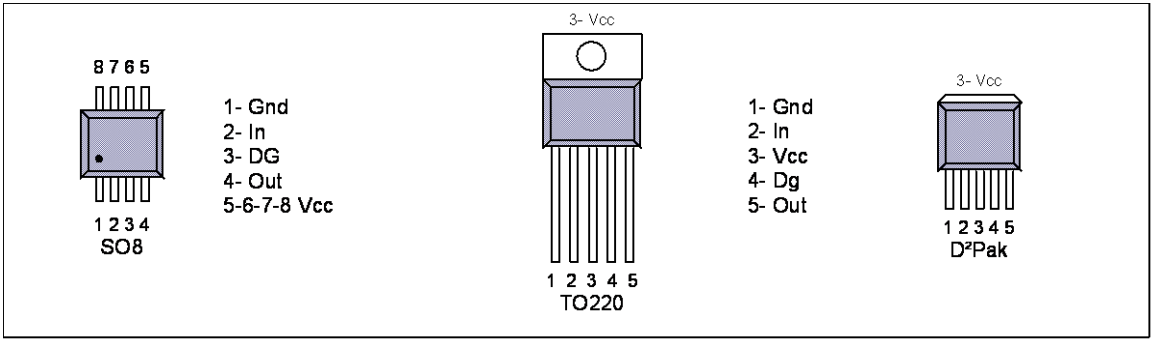
[1] Guaranteed by design
[2] Reference to Vcc

Truth Table

Operating Conditions	IN	OUT	DG pin
Normal	H	H	H
Normal	L	L	L
Open Load	H	H	H
Open Load [3]	L	H	H
Short circuit to Gnd	H	L (limiting)	L
Short circuit to Gnd	L	L	L
Over-temperature	H	L (cycling)	L
Over-temperature	L	L	L

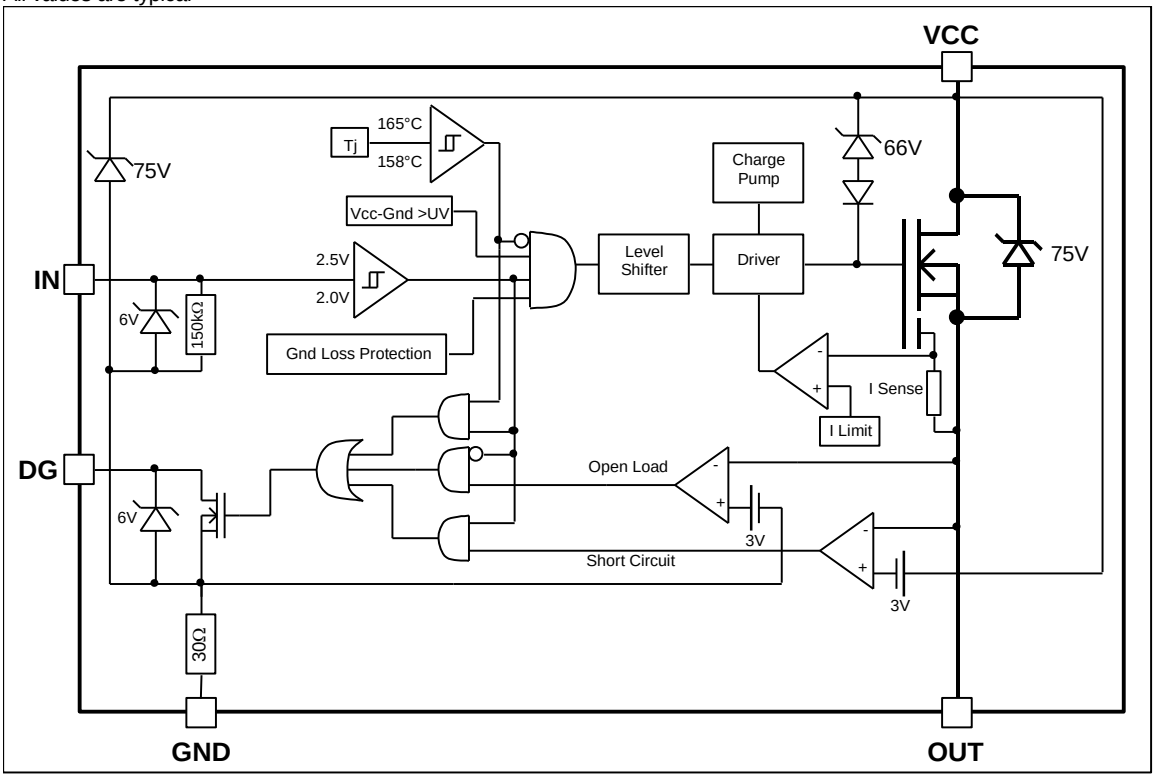
[3] With a pull-up resistor connected between the output and Vcc.

Lead Assignments



Functional Block Diagram

All values are typical



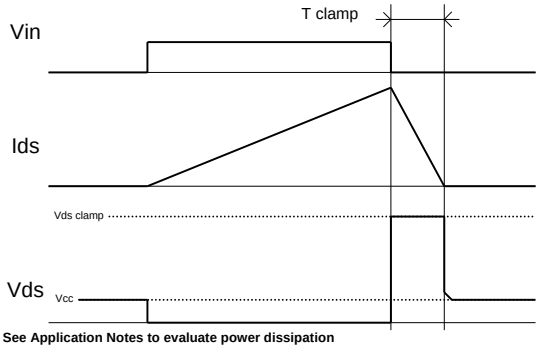


Figure 1 – Active clamp waveforms

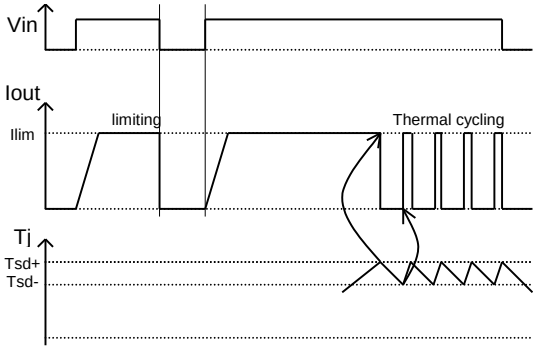


Figure 2 – Protection timing diagram

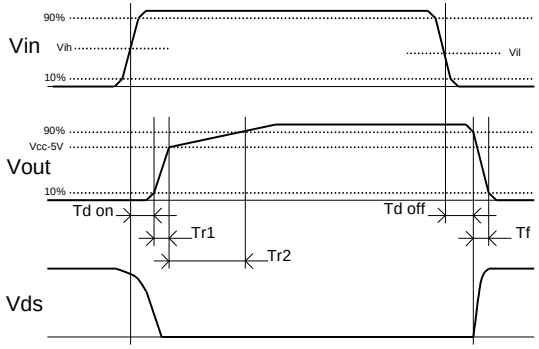


Figure 3 – Switching times definition

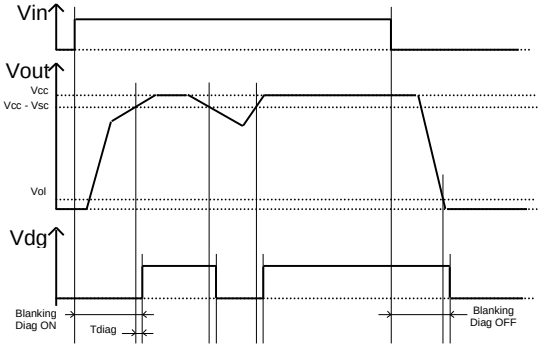


Figure 4 – Diagnostic delay definition

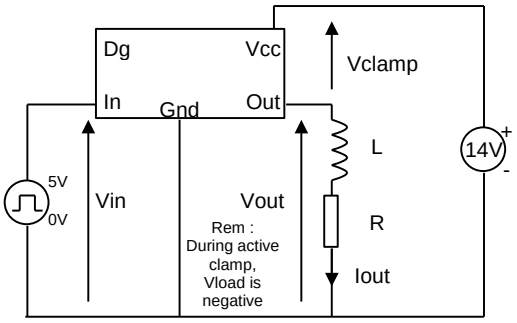


Figure 5 – Active clamp test circuit

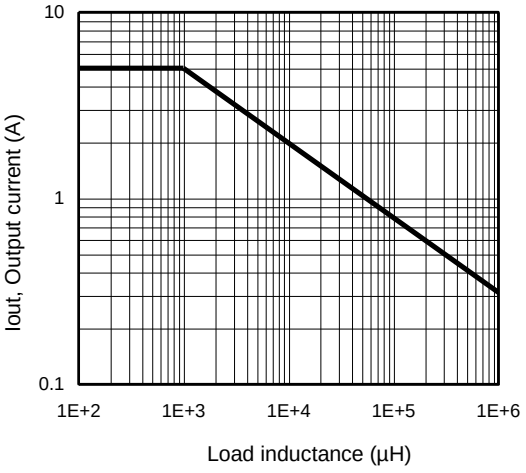


Figure 6 – Max. Output current (A) Vs Load inductance (µH)

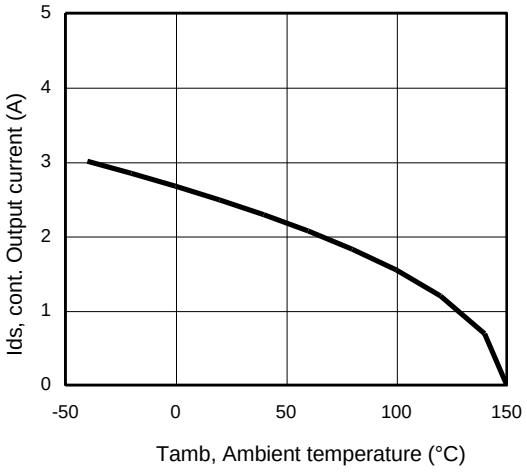


Figure 7 – Max. ouput current (A) Vs Ambient temperature (°C) Rth=100°C/W

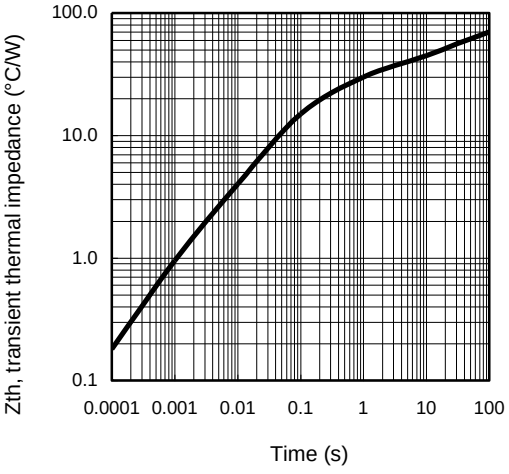


Figure 8 – Transient thermal impedance (°C/W) Vs time (s)

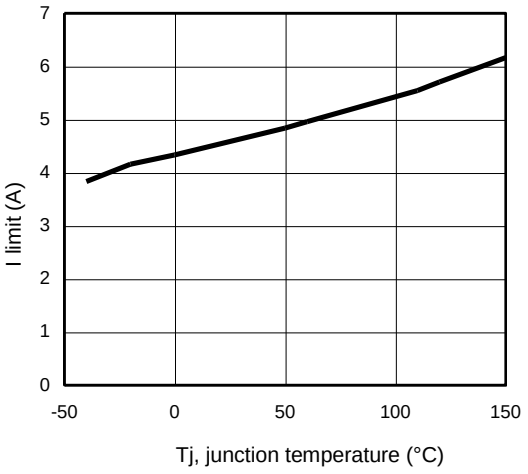


**Figure 9 –I limit (A)
Vs junction temperature (°C)**

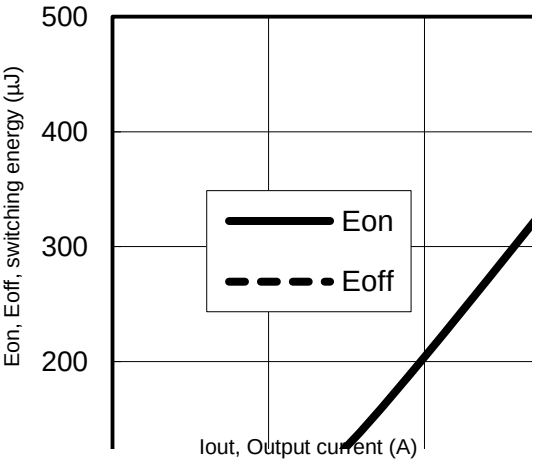


**Figure 10 – Switching energy (µJ)
Vs Output current (A)**

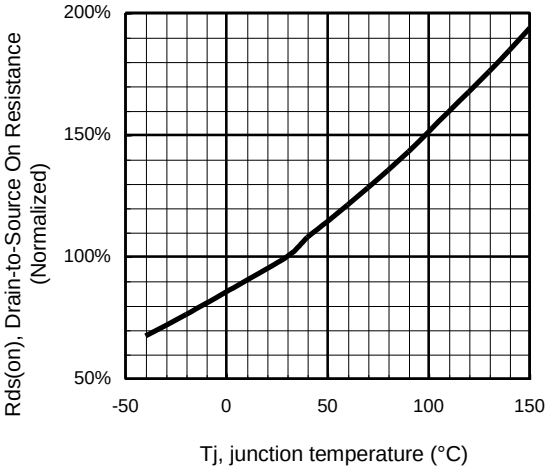


Figure 11 - Normalized Rds(on) (%) Vs Tj (°C)

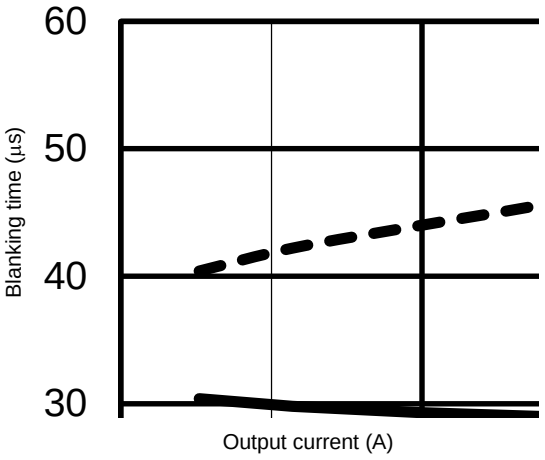


**Figure 12 – Diagnostic Blanking time (µs)
Vs Output current (A)**

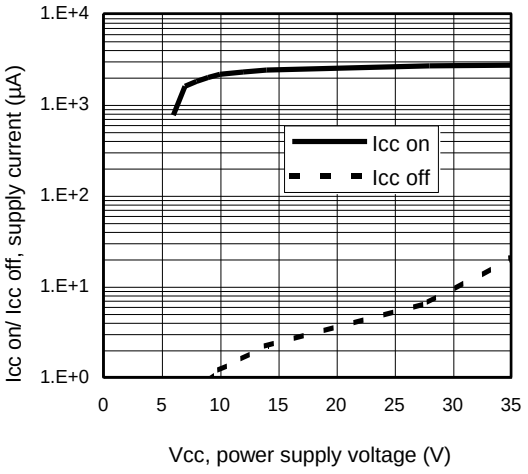


Figure 13 – Icc on/ Icc off (µA) Vs Vcc (V)

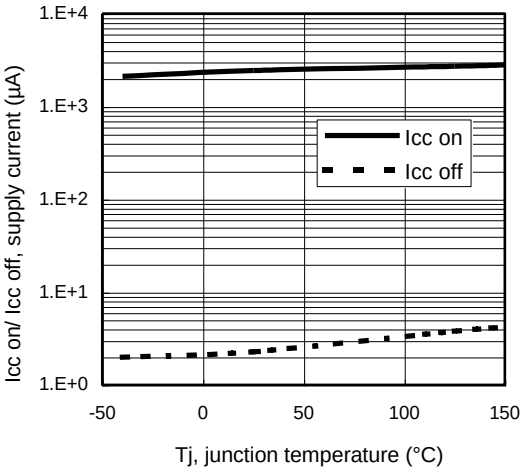
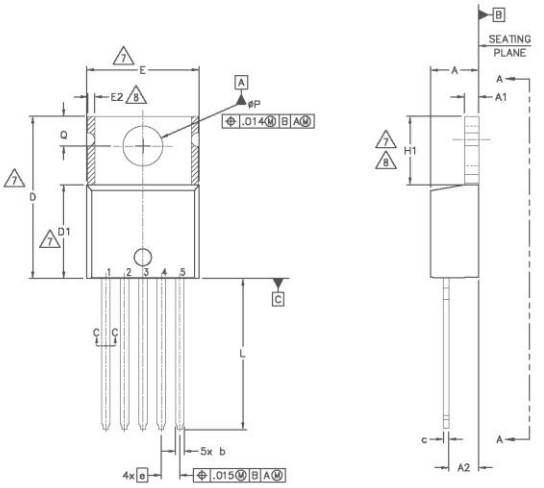
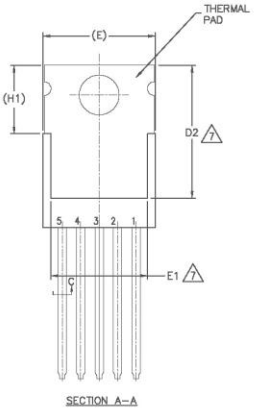


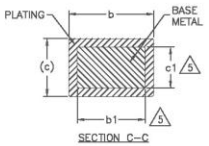
Figure 14 – Icc on/ Icc off (µA) Vs Tj (°C)

Case outline - TO220





SECTION A–A



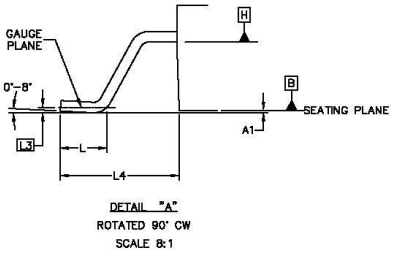
SECTION C–C

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	3.56	4.83	.140	.190	
A1	0.51	1.40	.020	.055	
A2	2.03	2.92	.080	.115	
b	0.64	0.89	.025	.035	
b1	0.64	0.84	.025	.033	5
c	0.36	0.61	.014	.024	
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
E	9.65	10.67	.380	.420	4,7
E1	6.86	8.89	.270	.350	7
E2	–	0.76	–	.030	8
e	1.70 BSC		.067 BSC		
H1	5.84	6.86	.230	.270	7,8
L	12.70	14.73	.500	.580	
øP	3.53	3.73	.139	.147	
Q	2.54	3.05	.100	.120	

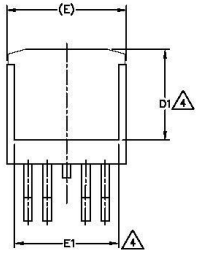
NOTES:

1.– DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M– 1994.
2.– DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].
3.– LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
4.– DIMENSION D, D1 & 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.– DIMENSION b1 & c1 APPLY TO BASE METAL ONLY.
6.– CONTROLLING DIMENSION : INCHES.
7.– THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS E,H1,D2 & E1
8.– DIMENSION E2 X H1 DEFINE A ZONE WHERE STAMPING AND SINGULATION IRREGULARITIES ARE ALLOWED.
9.– OUTLINE CONFORMS TO JEDEC TO–220, EXCEPT A2 (max.) AND D2 (min.) WHERE DIMENSIONS ARE DERIVED FROM THE ACTUAL PACKAGE OUTLINE.
10.– LEADS AND DRAIN ARE PLATED WITH 100% Sn

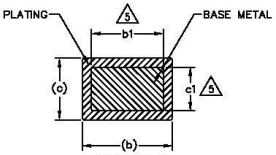
Case outline – D²Pak



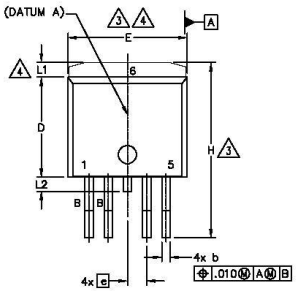
DETAIL "A"
ROTATED 90° CW
SCALE 8:1

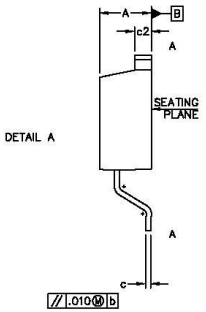


VIEW A–A



SECTION B–B
SCALE: NONE



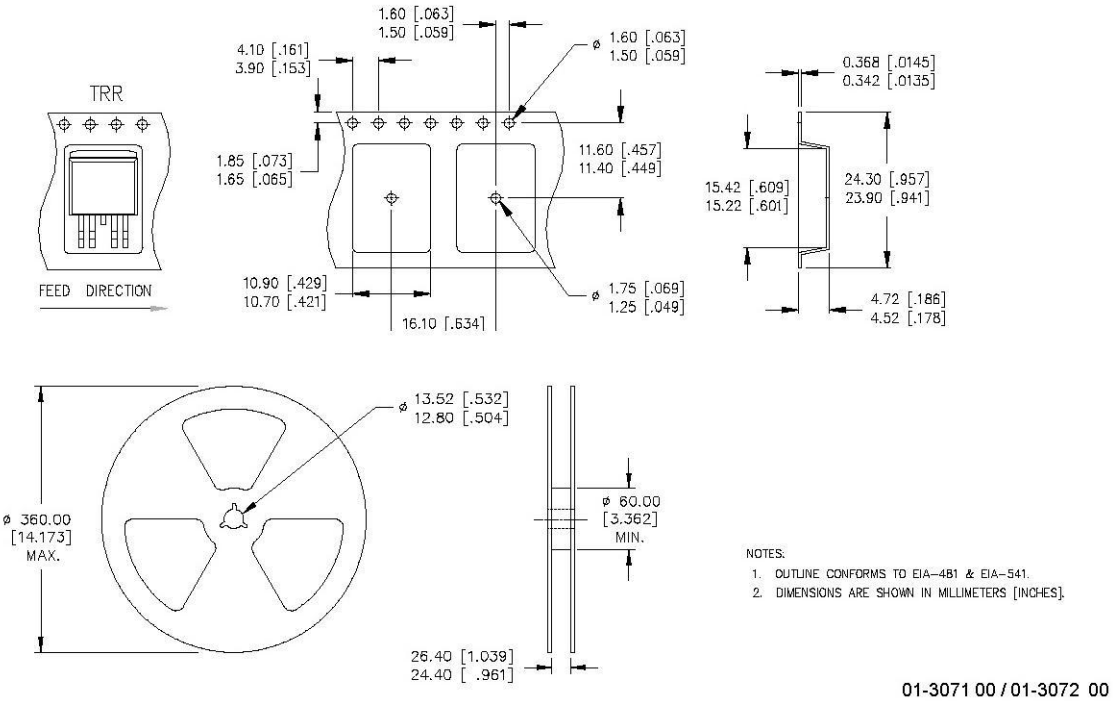


NOTES:

1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M–1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. 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.
4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
5. DIMENSION b1 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

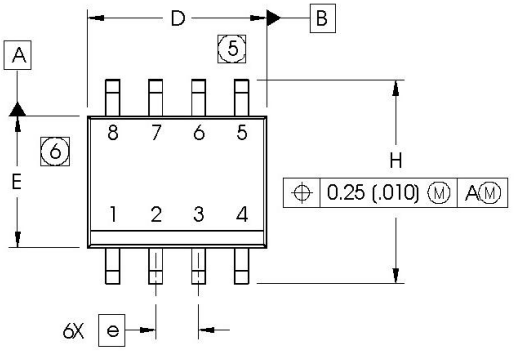
SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	–	0.254	–	.010	
b	0.51	0.99	.020	.039	4
b1	0.51	0.89	.020	.035	
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	4
c2	1.14	1.65	.045	.065	
D	8.38	9.65	.330	.380	3
D1	6.86	–	.270	–	
E	9.65	10.67	.380	.420	3
E1	6.22	–	.245	–	
e	1.70 BSC		.067 BSC		
H	14.61	15.88	.575	.625	
L	1.78	2.79	.070	.110	
L1	–	1.68	–	.066	
L2	–	1.78	–	.070	
L3	0.25 BSC		.010 BSC		
L4	4.78	5.28	.188	.208	

Tape and reel – D²Pak

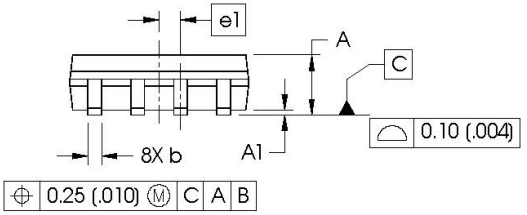


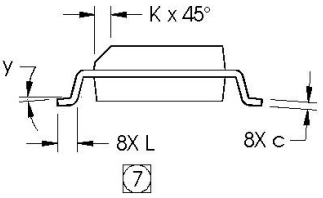
Case Outline - SO-8

Dimensions are shown in millimeters (inches)



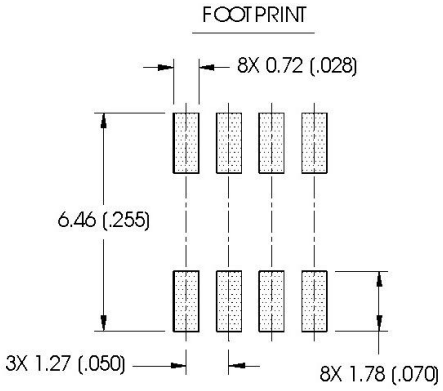
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.0532	.0688	1.35	1.75
A1	.0040	.0098	0.10	0.25
b	.013	.020	0.33	0.51
c	.0075	.0098	0.19	0.25
D	.189	.1968	4.80	5.00
E	.1497	.1574	3.80	4.00
e	.050 BASIC		1.27 BASIC	
e1	.025 BASIC		0.635 BASIC	
H	.2284	.2440	5.80	6.20
K	.0099	.0196	0.25	0.50
L	.016	.050	0.40	1.27
y	0°	8°	0°	8°



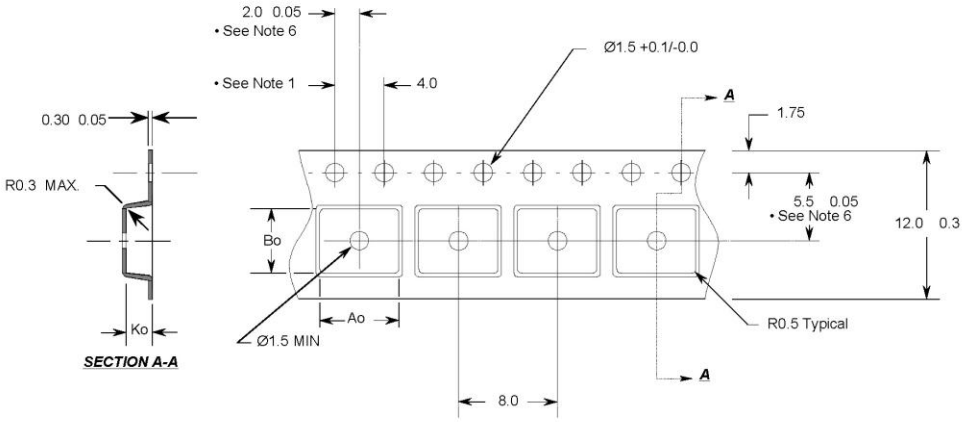


NOTES:

1. DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: MILLIMETER
3. DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
4. OUTLINE CONFORMS TO JEDEC OUTLINE MS-012AA.
5. DIMENSION DOES NOT INCLUDE MOLD PROTRUSIONS. MOLD PROTRUSIONS NOT TO EXCEED 0.15 (.006).
6. DIMENSION DOES NOT INCLUDE MOLD PROTRUSIONS. MOLD PROTRUSIONS NOT TO EXCEED 0.25 (.010).
7. DIMENSION IS THE LENGTH OF LEAD FOR SOLDERING TO A SUBSTRATE.



Tape & Reel - SO-8

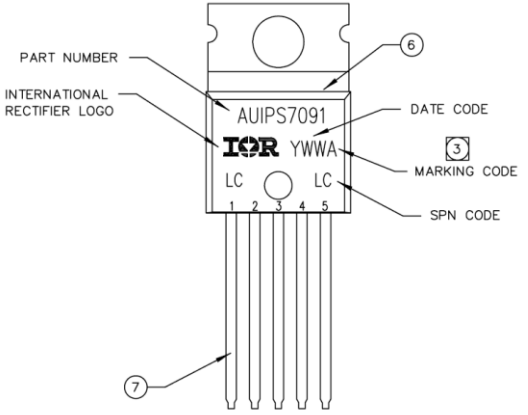


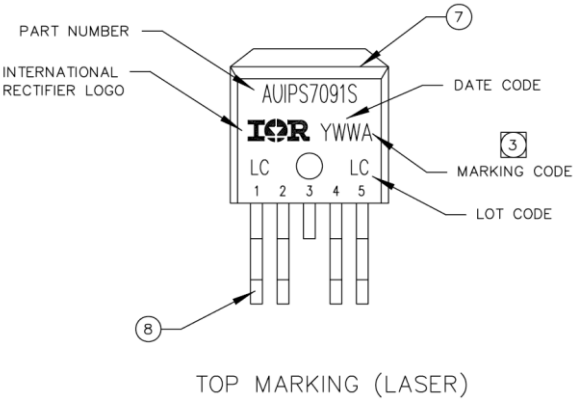
Notes:
1. 10 sprocket hole pitch cumulative tolerance 0.2
2. Camber not to exceed 1mm in 100mm
3. Material: Black Conductive Advantek Polystyrene
4. Ao and Bo measured on a plane 0.3mm above the bottom of the pocket
5. Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
6. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole.

Ao = 6.4 mm
Bo = 5.2 mm
Ko = 2.1 mm

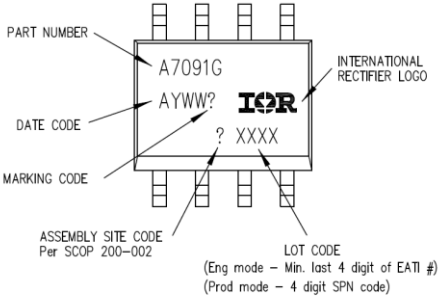
- All Dimensions in Millimeters -

Part Marking Information





TOP MARKING (LASER)



TOP MARKING (LASER)

Ordering Information

Base Part Number	Package Type	Standard Pack		Complete Part Number
		Form	Quantity	
AUIPS7091	TO220-5-Leads	Tube	50	AUIPS7091
AUIPS7091S	D2-Pak-5-Leads	Tube	50	AUIPS7091S
		Tape and reel left	800	AUIPS7091STRL
		Tape and reel right	800	AUIPS7091STRR
AUIPS7091G	SOIC-8	Tube	95	AUIPS7091G
		Tape and reel	2500	AUIPS7091GTR

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

Revision	Date	Notes/Changes
A1	October 2011	First release
B	March 2012	Remove the preliminary mention