

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

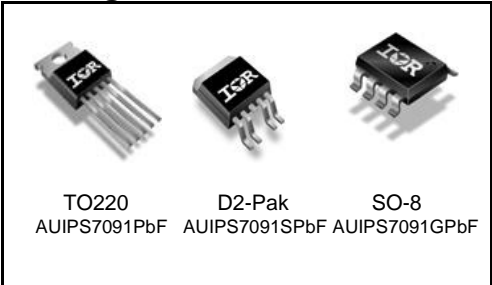
Product Summary

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

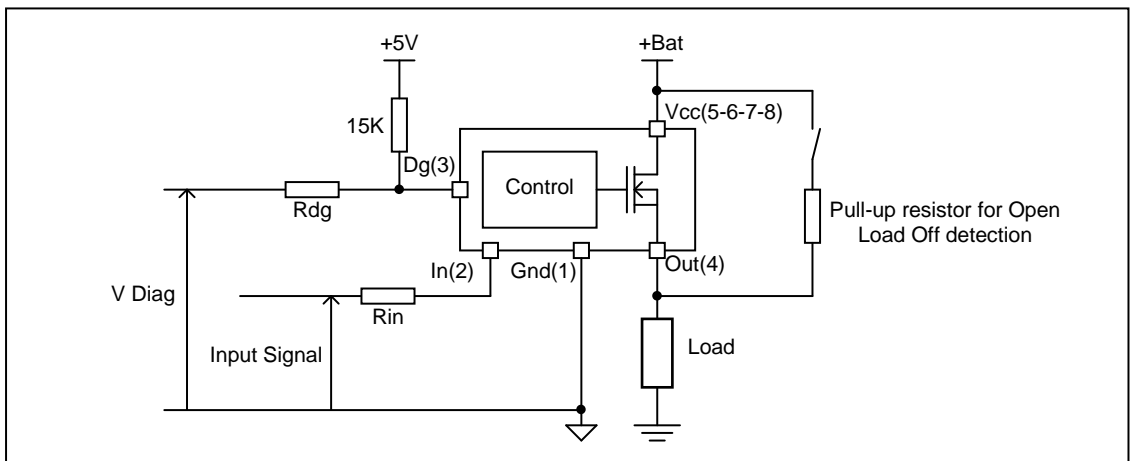
Description

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



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
I _{dg} max.	Maximum diagnostic output current	-1	10	
V _{dg}	Maximum diagnostic output voltage	-0.3	5.5	V
P _d	Maximum power dissipation (internally limited by thermal protection) R _{th} =100°C/W	—	1.25	W
I _{sd} cont.	Maximum continuous diode current (R _{th} =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
V _{IH}	High level input voltage	4	5.5	V
V _{IL}	Low level input voltage	-0.3	0.9	
I _{out}	Continuous drain current, T _{amb} =85°C, T _j =125°C, V _{in} =5V, R _{th} =100°C/W	—	1.5	A
R _{in}	Recommended resistor in series with IN pin	10	20	kΩ
R _{dg}	Recommended resistor in series with DG pin	10	20	
R _{ol}	Recommended pull-up resistor for open load detection	5	100	

Static Electrical Characteristics

T_j=-40..150°C, V_{cc}=6..35V (unless otherwise specified), typical values are given for V_{cc}=14V and T_j=25°C

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Rds(on)	ON state resistance T _j =25°C	—	80	120	mΩ	V _{in} =5V, I _{out} =2A
	ON state resistance T _j =150°C	—	150	230		V _{in} =5V, I _{out} =2A
	ON state resistance T _j =25°C, V _{cc} =6.5V	—	90	130		V _{in} =5V, I _{out} =2A
V _{cc op.}	Operating voltage range	6	—	35	V	
V _{clamp}	V _{cc} to Out clamp voltage	63	70	—		I _{out} =30mA (see Fig. 1)
V _f	Body diode forward voltage	—	1	1.4	μA	I _{out} = 2.5A
I _{cc Off}	Supply current when Off	—	2.5	10		V _{in} =V _{out} =0V, T _j =25°C
I _{cc On}	Supply current when On	—	2.5	4	mA	V _{in} =5V, V _{cc} =14V
I _{out@0V}	Output leakage current	—	—	10	μA	V _{out} =0V
I _{out@6V}	Output leakage current	—	20	—		V _{out} =6V
I _{dg leakage}	Diagnostic output leakage current	—	—	10		V _{dg} =5.5V
V _{dgl}	Low level diagnostic output voltage	—	0.1	0.3	V	I _{dg} =1.6mA
V _{ih}	Input high threshold voltage	—	2.5	3.5		
V _{il}	Input low threshold voltage	1	2	—		
I _{n 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		
I _{in On}	Input current when device is On	—	40	80		μA

Switching Electrical Characteristics

V_{cc}=14V, Resistive load=6Ω, V_{in}=5V, T_j=-40°C..150°C, typical values are given for T_j=25°C

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
T _{don}	Turn-on delay time	—	12	35	μs	See Fig. 3
Tr1	Rise time to V _{out} =V _{cc} -5V	—	7	40		
Tr2	Rise time to V _{out} =0.9 x V _{cc}	—	14	50		
dV/dt (On)	Turn On dV/dt	—	0.95	5	V/μs	
E _{On}	Turn On energy	—	250	—	μJ	
T _{doff}	Turn-off delay time	—	20	45	μs	
T _f	Fall time to V _{out} =0.1 x V _{cc}	—	6	25		
dV/dt (Off)	Turn Off dV/dt	—	1.8	5	V/μs	
E _{Off}	Turn Off energy	—	20	—	μJ	
T _{diag}	V _{out} to V _{diag} propagation delay	—	15	—	μs	See Fig. 4 and Fig. 12

Protection Characteristics

$T_j = -40..150^{\circ}\text{C}$, $V_{cc} = 6..35\text{V}$ (unless otherwise specified), typical values are given for $V_{cc} = 14\text{V}$ and $T_j = 25^{\circ}\text{C}$

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Ilim	Internal current limit	2	5	8	A	$V_{out} = 0\text{V}$, $T_j = 25^{\circ}\text{C}$
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

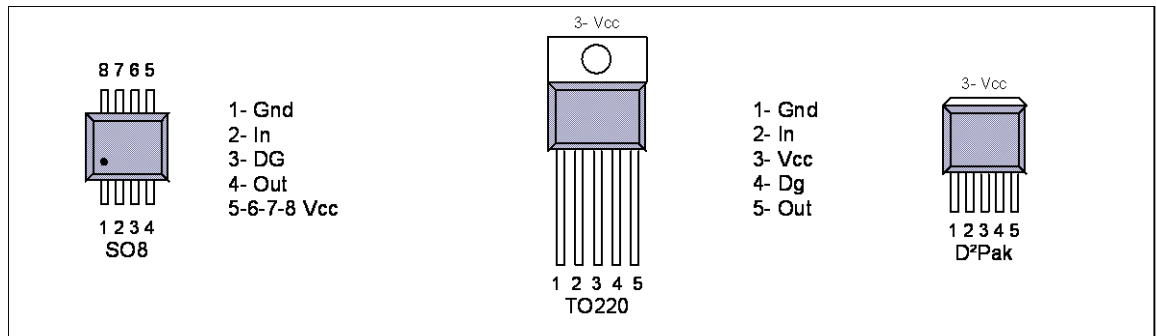
⁽²⁾ Reference to V_{cc}

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

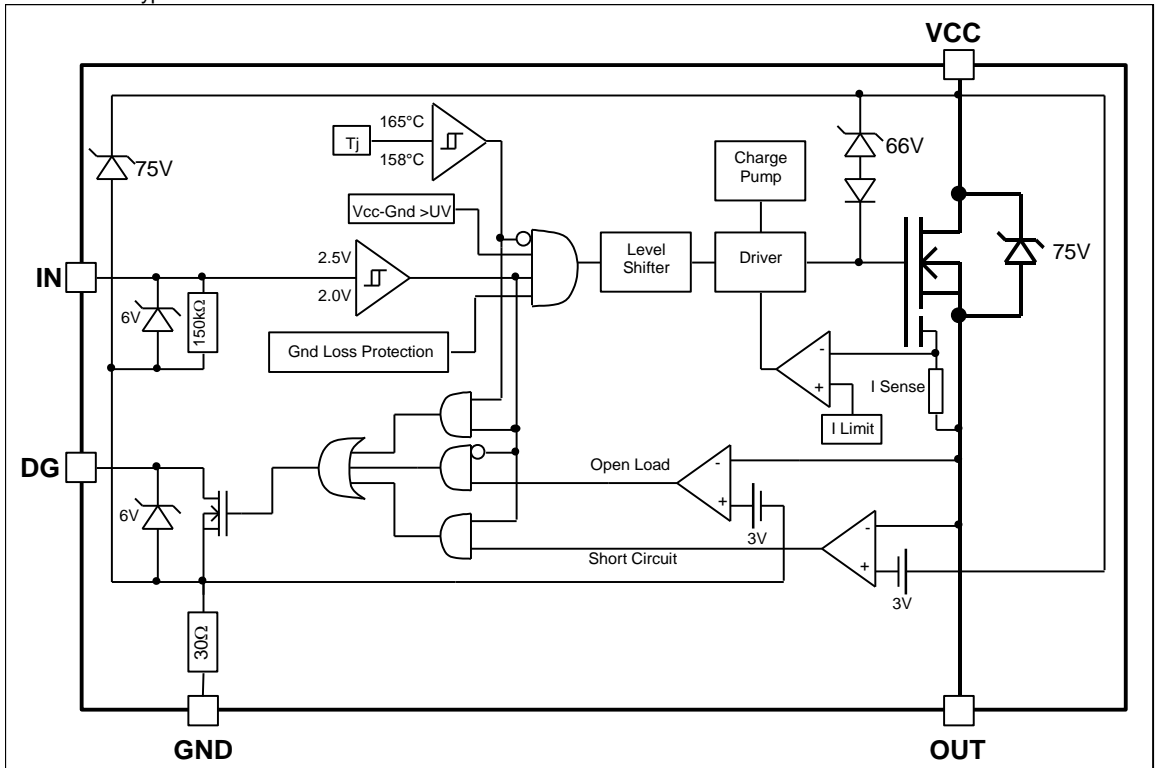
⁽³⁾ With a pull-up resistor connected between the output and V_{cc} .

Lead Assignments



Functional Block Diagram

All values are typical



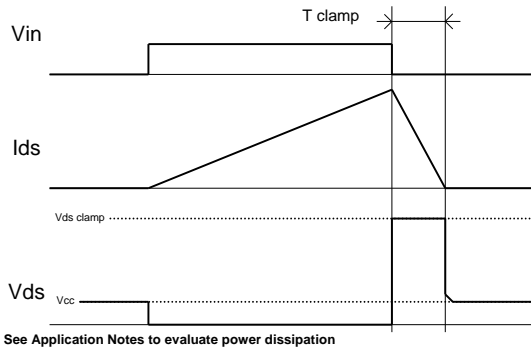


Figure 1 – Active clamp waveforms

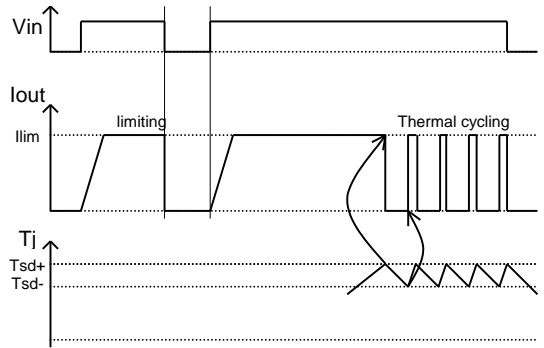


Figure 2 – Protection timing diagram

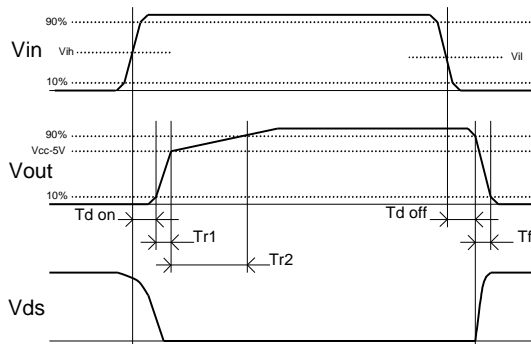


Figure 3 – Switching times definition

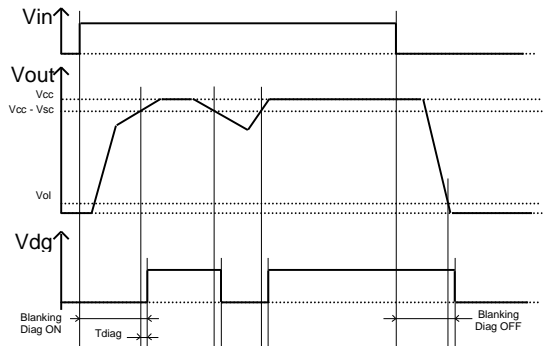


Figure 4 – Diagnostic delay definition

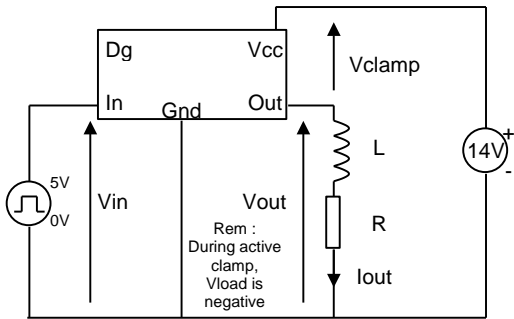


Figure 5 – Active clamp test circuit

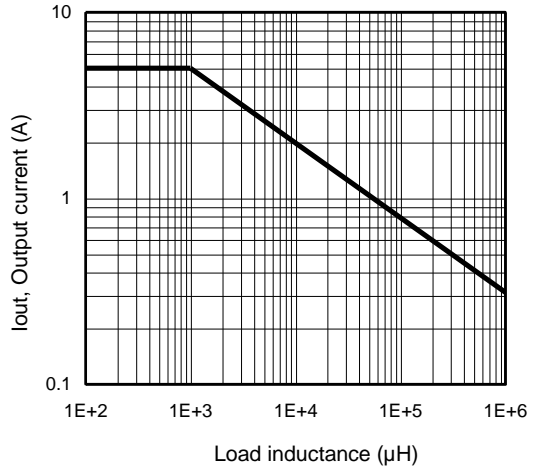


Figure 6 – Max. Output current (A) Vs Load inductance (µH)

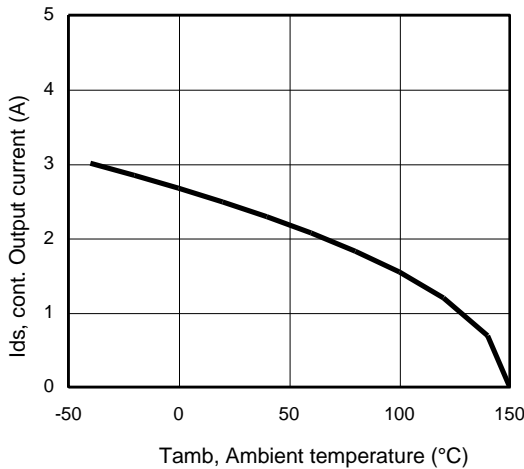


Figure 7 – Max. output current (A) Vs Ambient temperature (°C) Rth=100°C/W

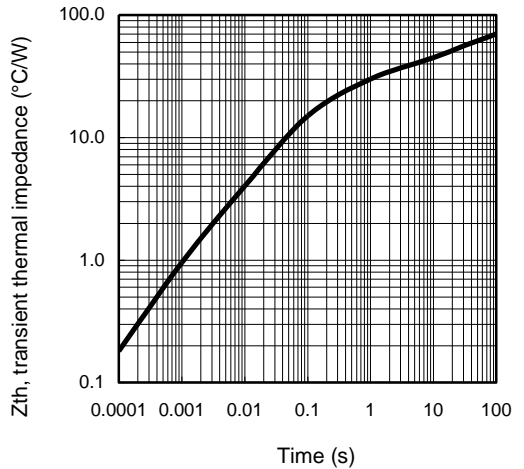
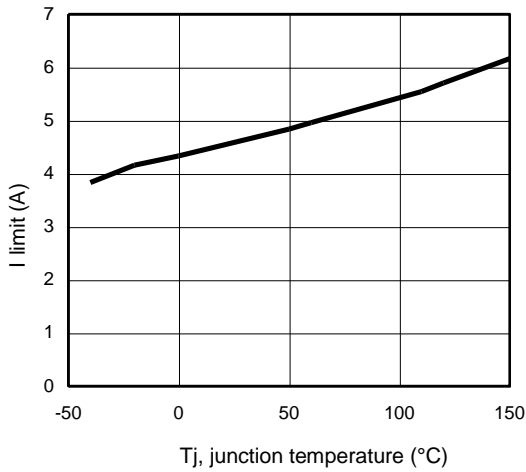
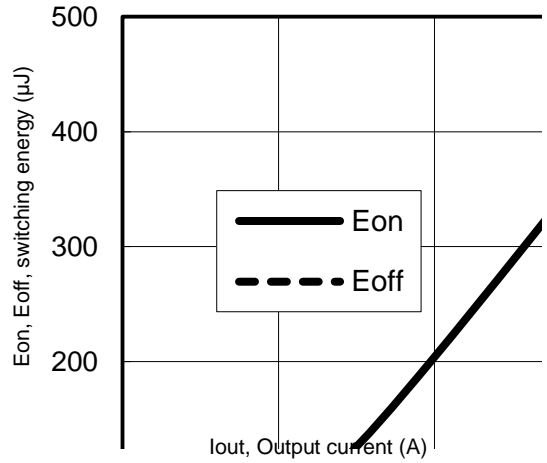


Figure 8 – Transient thermal impedance (°C/W) Vs time (s)



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



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

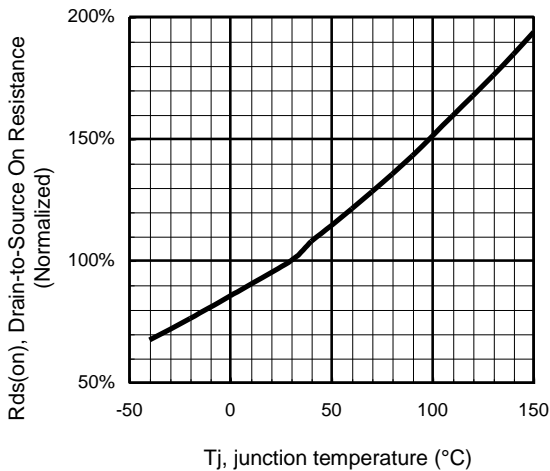
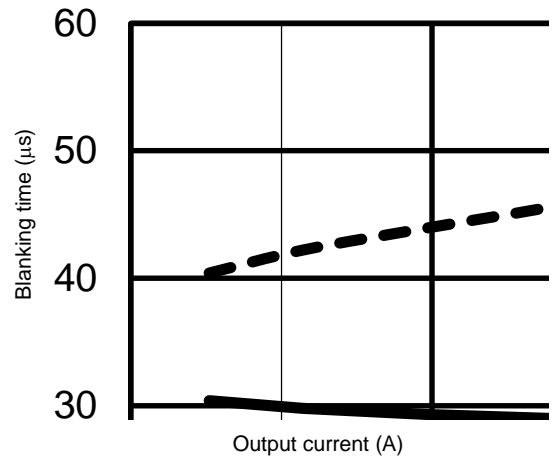


Figure 11 - Normalized R_{ds(on)} (%) Vs T_j (°C)



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

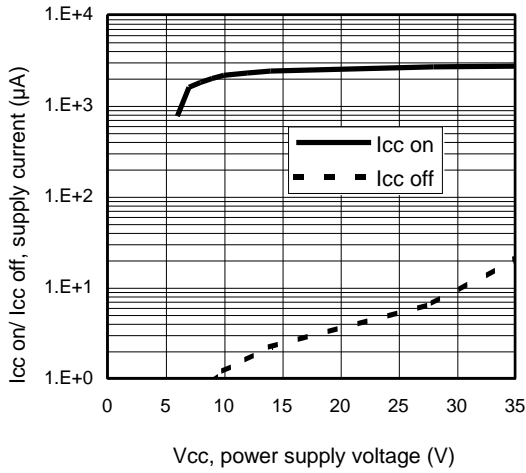


Figure 13 – I_{cc on}/ I_{cc off} (µA) Vs V_{cc} (V)

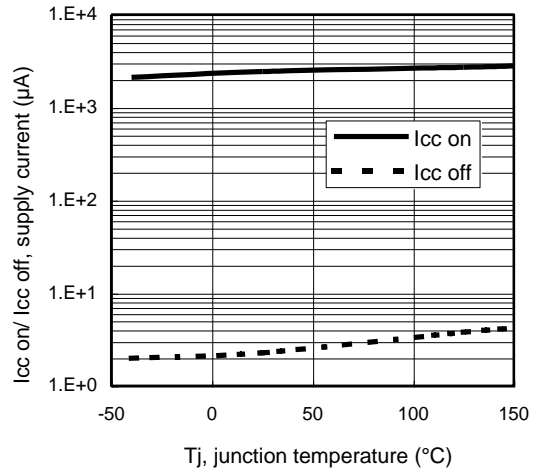
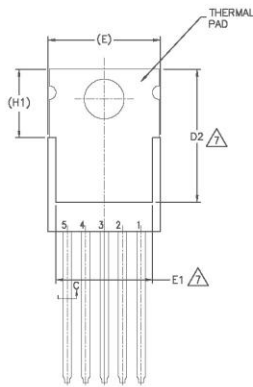
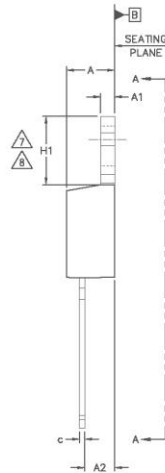
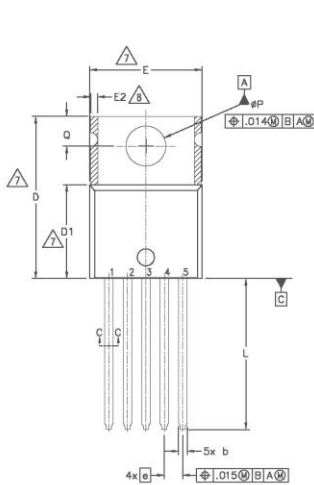
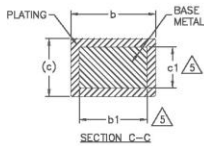


Figure 14 – I_{cc on}/ I_{cc off} (µA) Vs T_j (°C)

Case outline - TO220



SECTION A-A



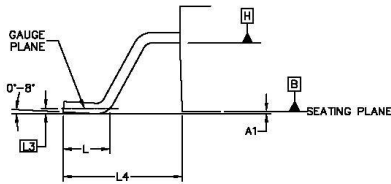
SECTION C-C

DIMENSION	DIMENSIONS				UNIT
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	3.56	4.83	.140	.190	5
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	
c	0.36	0.61	.014	.024	5
c1	0.36	0.56	.014	.022	
D	14.22	16.51	.560	.650	4
D1	8.39	9.02	.330	.355	
D2	11.68	12.88	.460	.507	7
E	9.65	10.67	.380	.420	
E1	6.86	8.89	.270	.350	7
E2	-	0.76	-	.030	
e	1.70 BSC		.067 BSC		7,8
H1	5.84	6.86	.230	.270	
L	12.70	14.73	.500	.580	7
ϕP	3.53	3.73	.139	.147	
Q	2.54	3.05	.100	.120	8

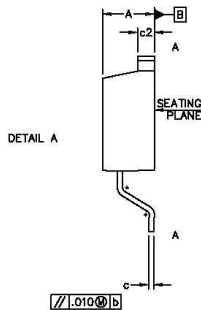
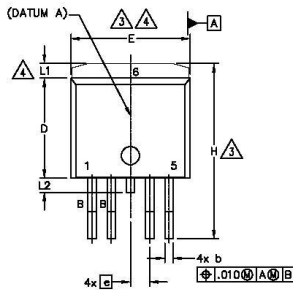
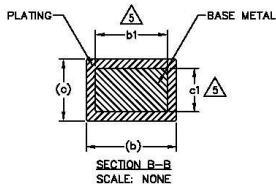
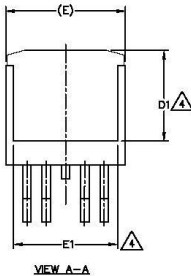
NOTES:

- 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 E1,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

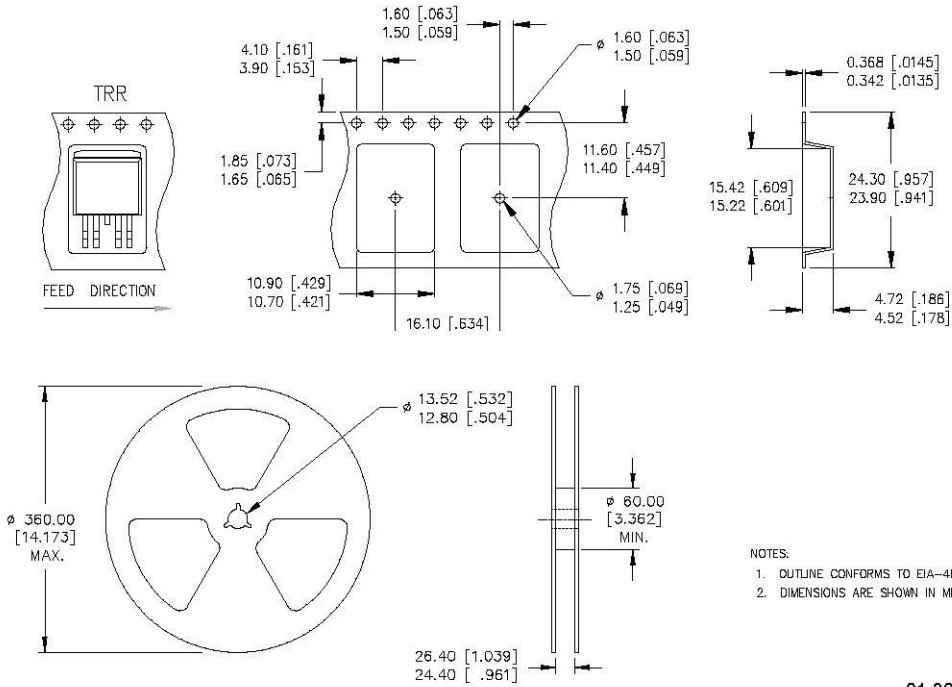


NOTES:

- DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M-1994
- 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.
- THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
- DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
- DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
- CONTROLLING DIMENSION: INCH.
- OUTLINE CONFORMS TO JEDEC OUTLINE TO-263BA.
- 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	10.87	.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	

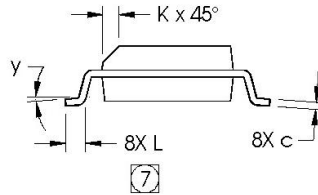
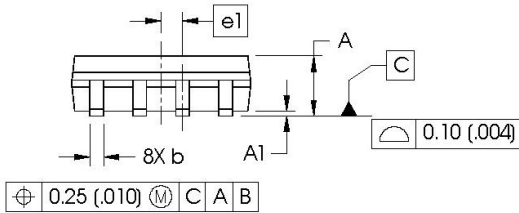
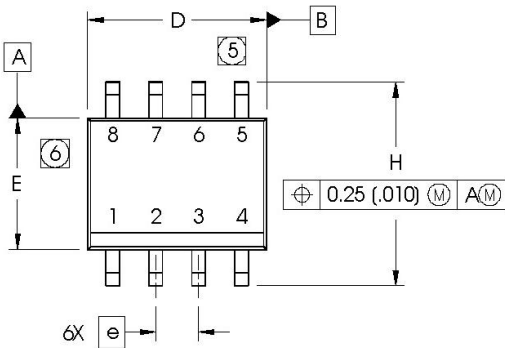
Tape and reel – D²Pak



01-3071 00 / 01-3072 00

Case Outline - SO-8

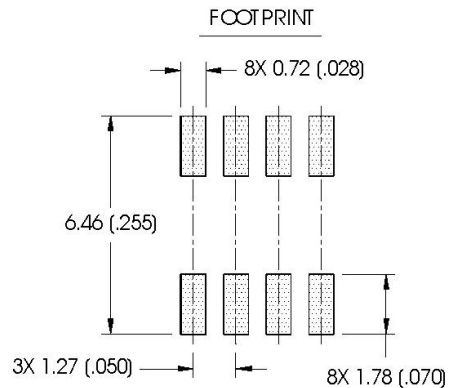
Dimensions are shown in millimeters (inches)



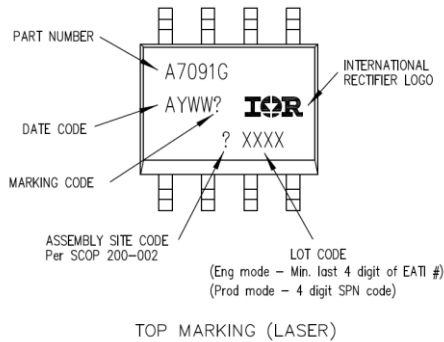
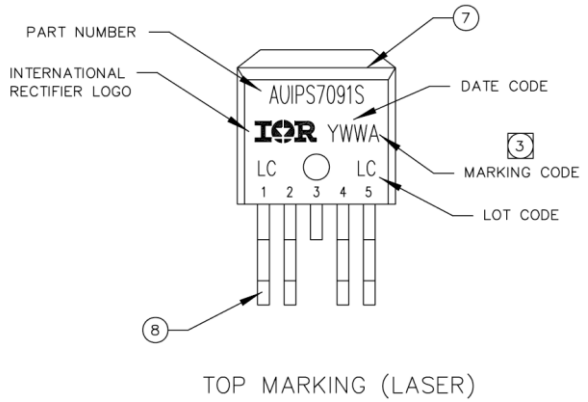
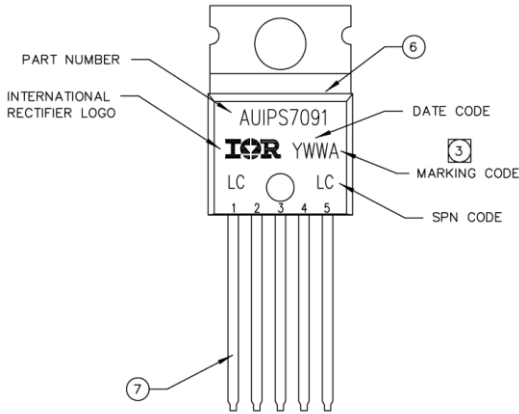
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.0532	.0688	1.35	1.75
A1	.0040	.0098	0.10	0.25
b	.013	.020	0.33	0.51
c	.0075	.0098	0.19	0.25
D	.189	.1968	4.80	5.00
E	.1497	.1574	3.80	4.00
e	.050 BASIC		1.27 BASIC	
e1	.025 BASIC		0.635 BASIC	
H	.2284	.2440	5.80	6.20
K	.0099	.0196	0.25	0.50
L	.016	.050	0.40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



Part Marking Information



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

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Revision History

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

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