

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

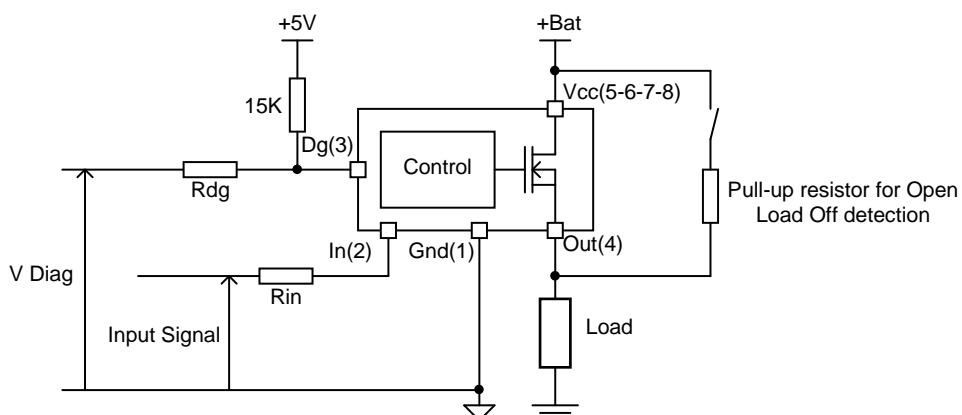
Description

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 I_{lim} value. Current limitation is activated until the thermal protection acts. The over-temperature protection turns off the device if the junction temperature exceeds $T_{shutdown}$. It will automatically restart after the junction has cooled 7°C below $T_{shutdown}$. 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. $T_j = -40^\circ\text{C}..150^\circ\text{C}$, $V_{cc}=6..35\text{V}$ (unless otherwise specified).

Symbol	Parameter	Min.	Max.	Units
V_{out}	Maximum output voltage	$V_{cc}-63$	$V_{cc}+0.3$	V
V_{offset}	Maximum logic ground to load ground offset	$V_{cc}-63$	$V_{cc}+0.3$	
V_{in}	Maximum input voltage	-0.3	5.5	
$V_{cc\ max.}$	Maximum V_{cc} voltage	—	60	
$V_{cc\ cont.}$	Maximum continuous V_{cc} voltage	—	35	
$V_{cc\ sc.}$	Maximum V_{cc} voltage with short circuit protection with $T_j < -10^\circ\text{C}$	—	28	
$I_{in\ max.}$	Maximum IN current	-1	10	
$I_{dg\ max.}$	Maximum diagnostic output current	-1	10	
V_{dg}	Maximum diagnostic output voltage	-0.3	5.5	
P_d	Maximum power dissipation (internally limited by thermal protection) $R_{th}=100^\circ\text{C}/\text{W}$	—	1.25	W
$I_{sd\ cont.}$	Maximum continuous diode current ($R_{th}=100^\circ\text{C}/\text{W}$)	—	1.8	A
ESD1	Electrostatic discharge voltage (Human body) 100pF, 1500Ω	—	4	kV
ESD2	Electrostatic discharge voltage (Machine Model) $C=200\text{pF}, R=0\Omega, L=10\mu\text{H}$	—	0.5	
$T_{j\ op\ max.}$	Max. operating temperature junction temperature	-40	+150	°C
$T_{j\ Sto\ max.}$	Max. storage temperature junction temperature	-55	+150	°C

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
R_{th1}	Thermal resistance junction to ambient SO8 std. footprint	100	—	°C/W
R_{th1}	Thermal resistance junction to ambient TO220 free air	60	—	
R_{th1}	Thermal resistance junction to ambient D2Pak std. footprint	60	—	
R_{th2}	Thermal resistance junction to ambient D2Pak 1" sqrt. footprint	40	—	
R_{th3}	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, $T_{amb}=85^\circ\text{C}$, $T_j=125^\circ\text{C}$, $V_{in}=5\text{V}$, $R_{th}=100^\circ\text{C}/\text{W}$	—	1.5	A
R_{in}	Recommended resistor in series with IN pin	10	20	$\text{k}\Omega$
R_{dgs}	Recommended resistor in series with DG pin	10	20	
R_{ol}	Recommended pull-up resistor for open load detection	5	100	

Static Electrical Characteristics

$T_j=-40..150^\circ\text{C}$, $V_{cc}=6..35\text{V}$ (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
Rds(on)	ON state resistance $T_j=25^\circ\text{C}$	—	80	120	mΩ	Vin=5V, Iout=2A
	ON state resistance $T_j=150^\circ\text{C}$	—	150	230		Vin=5V, Iout=2A
	ON state resistance $T_j=25^\circ\text{C}$, $V_{cc}=6.5\text{V}$	—	90	130		Vin=5V, Iout=2A
Vcc op.	Operating voltage range	6	—	35	V	Iout=30mA (see Fig. 1)
V clamp	Vcc to Out clamp voltage	63	70	—		
Vf	Body diode forward voltage	—	1	1.4		Iout= 2.5A
Icc Off	Supply current when Off	—	2.5	10	μA	Vin=Vout=0V, $T_j=25^\circ\text{C}$
Icc On	Supply current when On	—	2.5	4	mA	Vin=5V, $V_{cc}=14\text{V}$
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		V
Vil	Input low threshold voltage	1	2	—		
In hys	Input hysteresis	0.05	0.4	1	V	V
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	μA	Vin=5V
Iin On	Input current when device is On	—	40	80		

Switching Electrical Characteristics

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Tdon	Turn-on delay time	—	12	35	μs	See Fig. 3
Tr1	Rise time to $V_{out}=V_{cc}-5\text{V}$	—	7	40		
Tr2	Rise time to $V_{out}=0.9 \times V_{cc}$	—	14	50		
dV/dt (On)	Turn On dV/dt	—	0.95	5		
EOn	Turn On energy	—	250	—		
Tdoff	Turn-off delay time	—	20	45		
Tf	Fall time to $V_{out}=0.1 \times V_{cc}$	—	6	25		
dV/dt (Off)	Turn Off dV/dt	—	1.8	5		
EOff	Turn Off energy	—	20	—		
Tdiag	V_{out} to V_{diag} propagation delay	—	15	—	μs	See Fig. 4 and Fig. 12

Protection 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
I _{lim}	Internal current limit	2	5	8	A	V _{out} =0V, T _j =25°C
T _{sd+}	Over temperature high threshold	150 ⁽¹⁾	165	—	°C	See Fig. 2
T _{sd-}	Over temperature low threshold	—	158	—		
V _{sc}	Short-circuit detection voltage ⁽²⁾	2	3	4	V	
V _{open} load	Open load detection threshold	2	3	4		

⁽¹⁾ Guaranteed by design

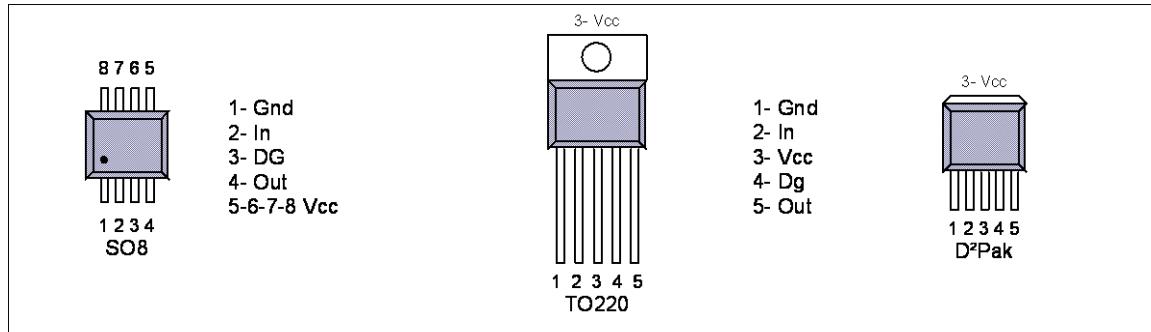
⁽²⁾ Reference to V_{cc}

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

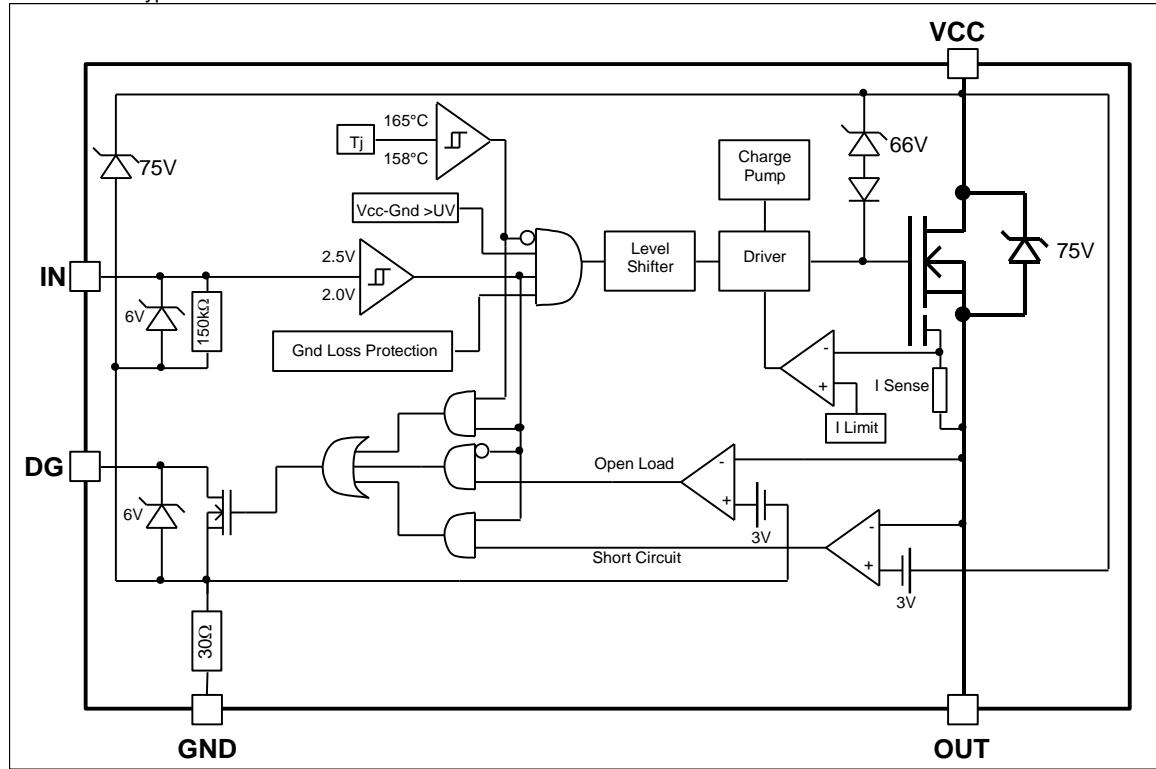
⁽³⁾ With a pull-up resistor connected between the output and V_{cc}.

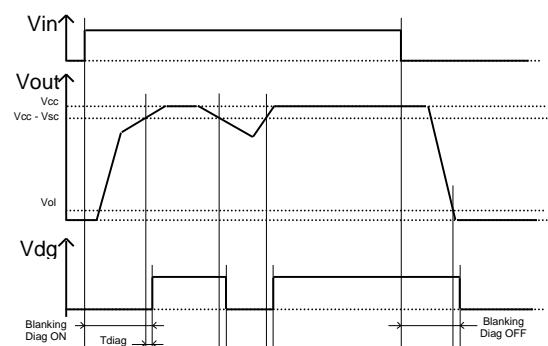
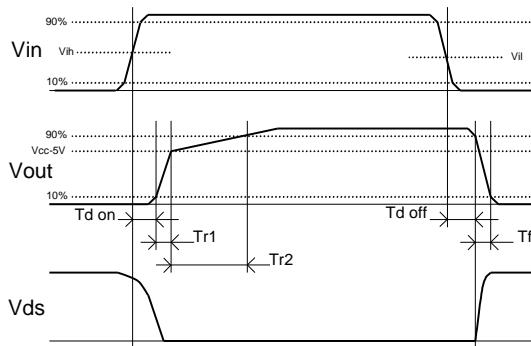
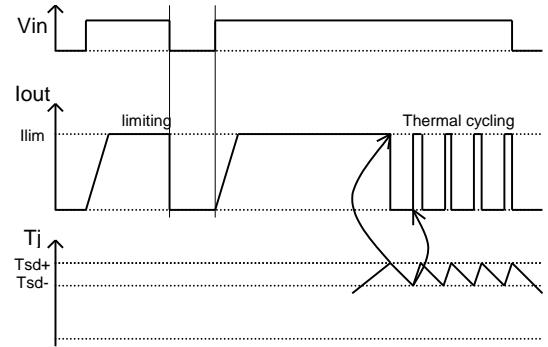
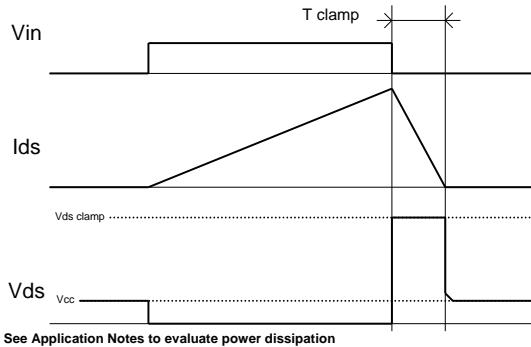
Lead Assignments



Functional Block Diagram

All values are typical





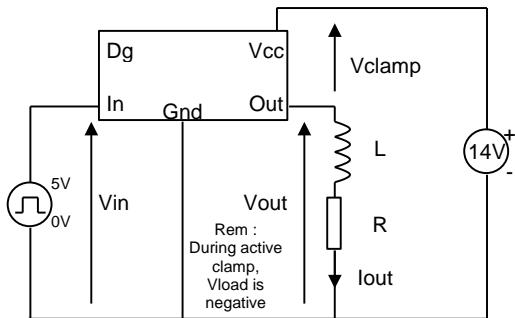


Figure 5 – Active clamp test circuit

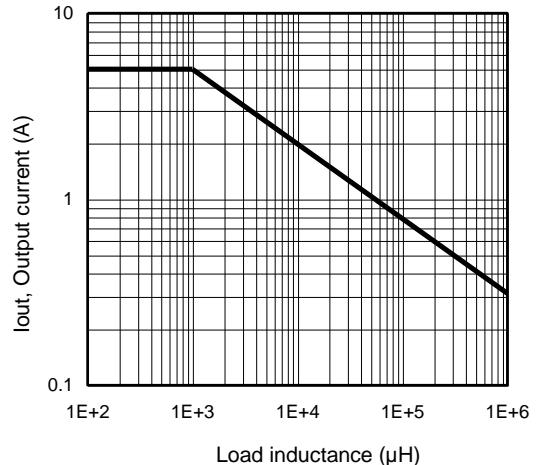


Figure 6 – Max. Output current (A) Vs Load inductance (μH)

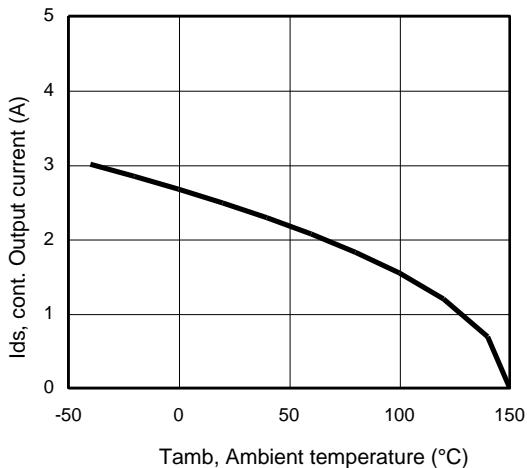


Figure 7 – Max. output current (A) Vs Ambient temperature (°C) $R_{th}=100\text{ }^{\circ}\text{C/W}$

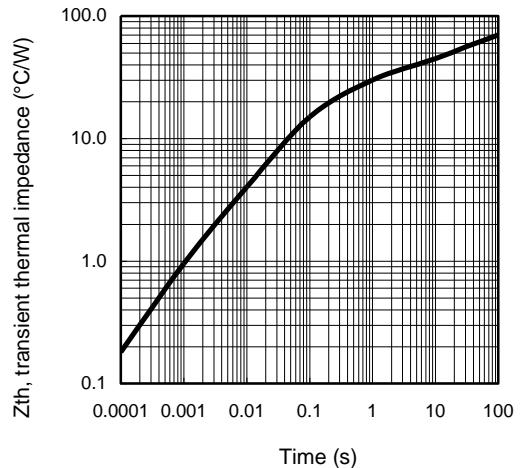
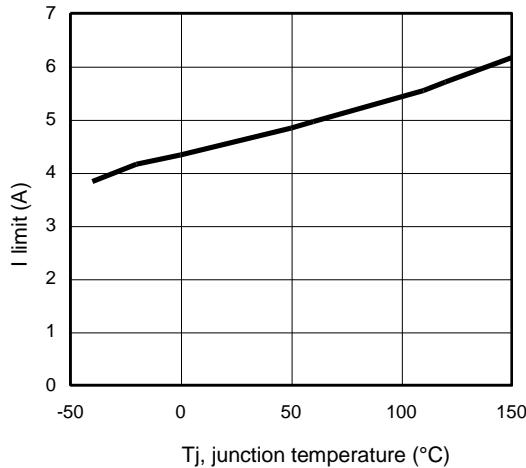
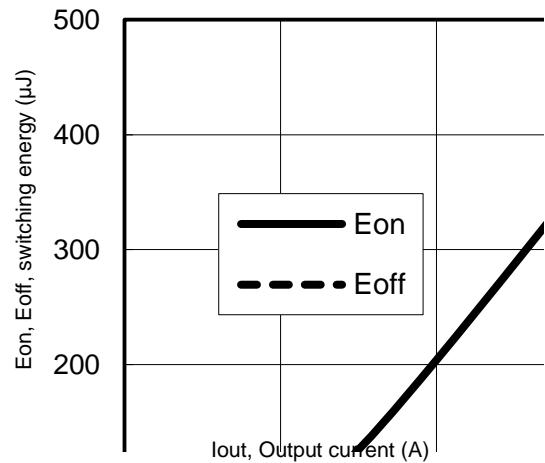


Figure 8 – Transient thermal impedance (°C/W) Vs time (s)



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



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

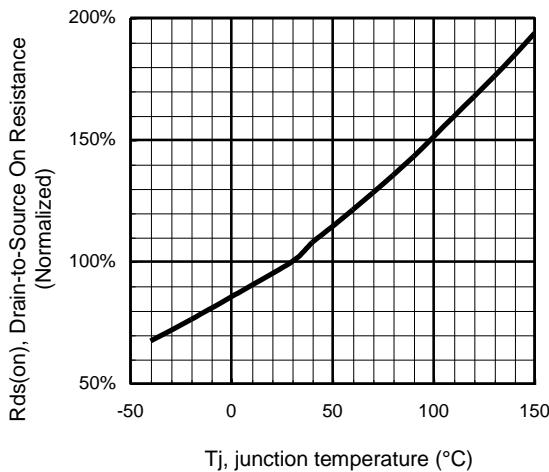
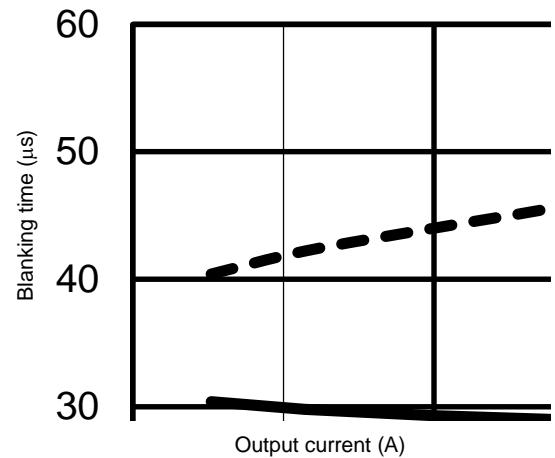


Figure 11 - Normalized Rds(on) (%) Vs Tj (°C)



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

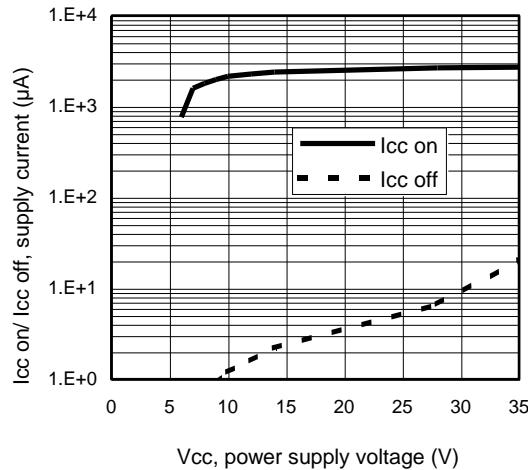


Figure 13 – $I_{cc\ on}/I_{cc\ off}$ (μA) Vs V_{cc} (V)

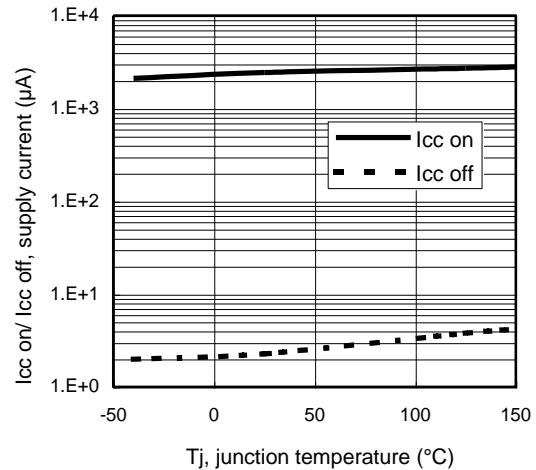
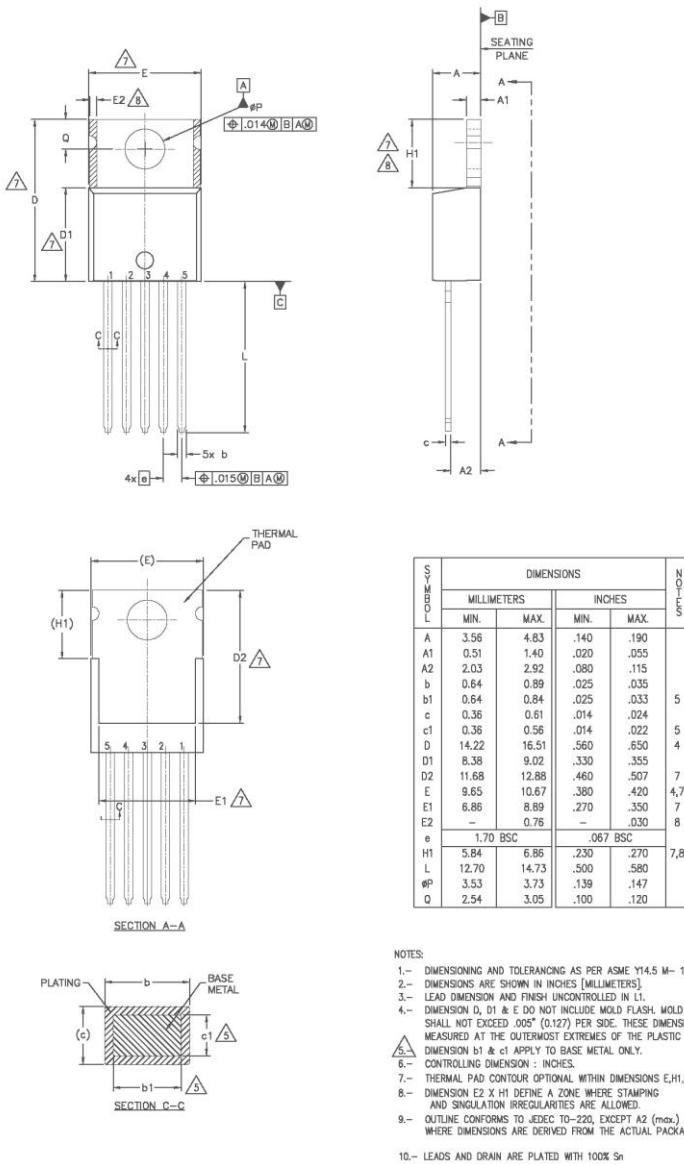
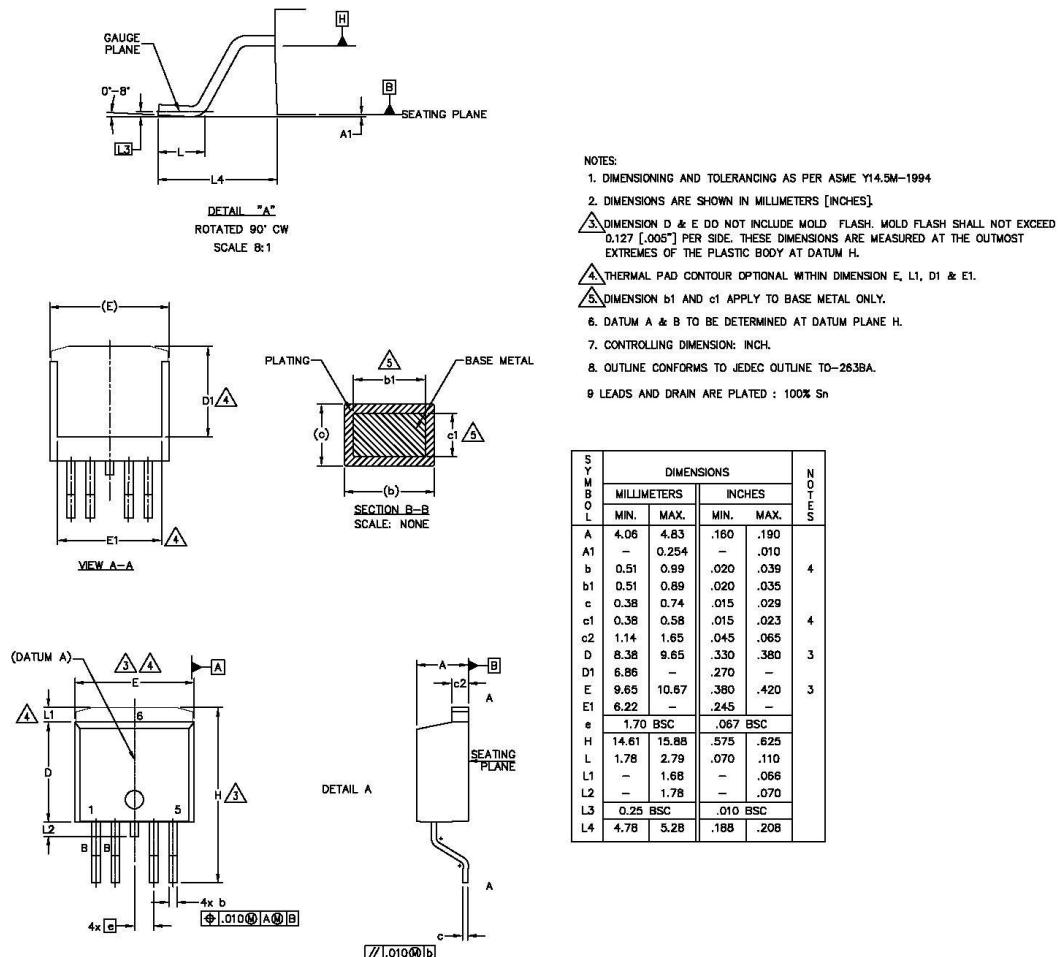


Figure 14 – $I_{cc\ on}/I_{cc\ off}$ (μA) Vs T_j (°C)

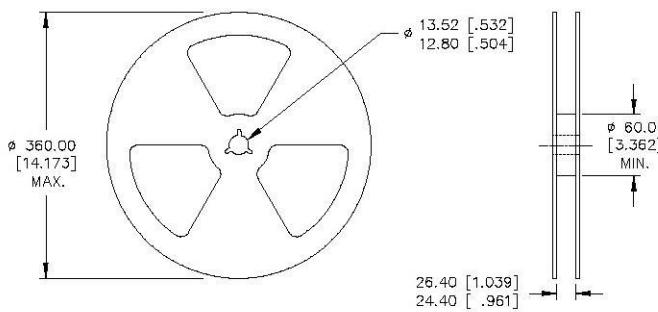
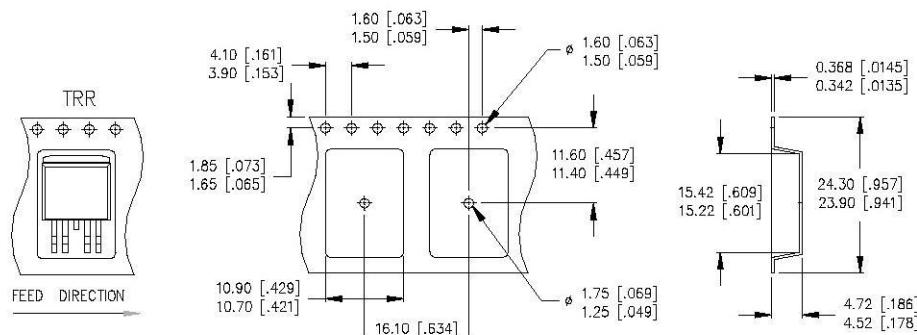
Case outline - TO220



Case outline – D²Pak



Tape and reel – D²Pak



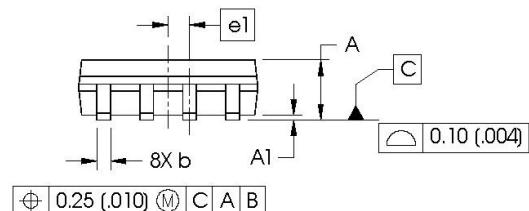
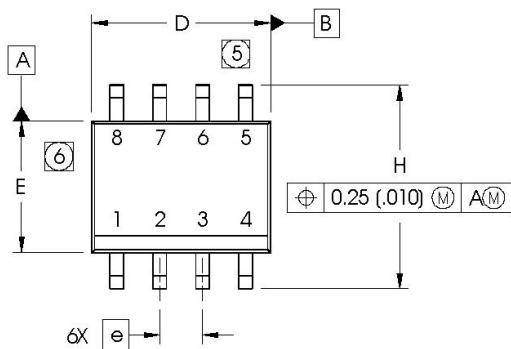
NOTES:

1. OUTLINE CONFORMS TO EIA-481 & EIA-541.
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].

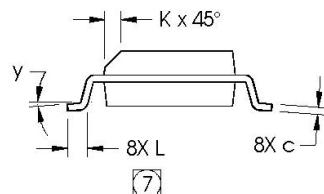
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Case Outline - SO-8

Dimensions are shown in millimeters (inches)

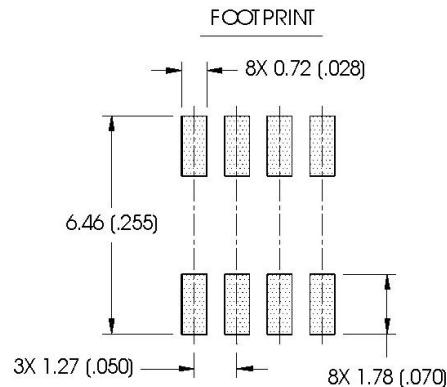


DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.0532	.0688	1.35	1.75
A1	.0040	.0098	0.10	0.25
b	.013	.020	0.33	0.51
c	.0075	.0098	0.19	0.25
D	.189	.1968	4.80	5.00
E	.1497	.1574	3.80	4.00
e	.050	BASIC	1.27	BASIC
e1	.025	BASIC	0.635	BASIC
H	.2284	.2440	5.80	6.20
K	.0099	.0196	0.25	0.50
L	.016	.050	0.40	1.27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

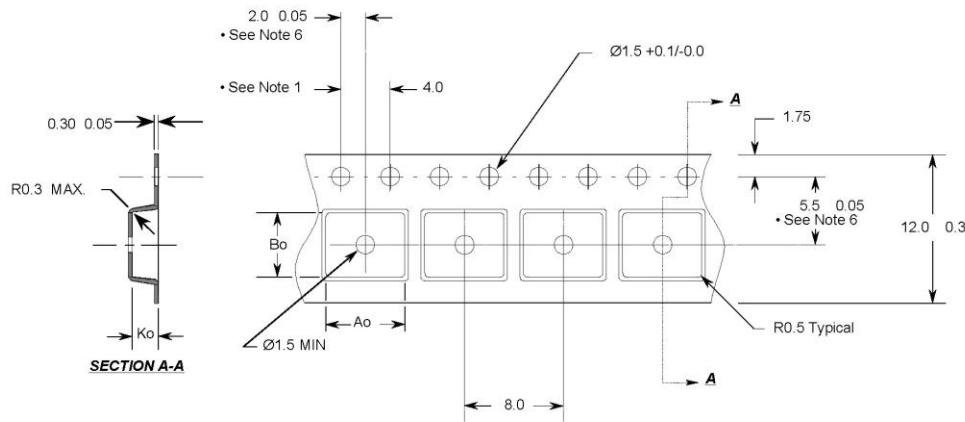


NOTES:

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

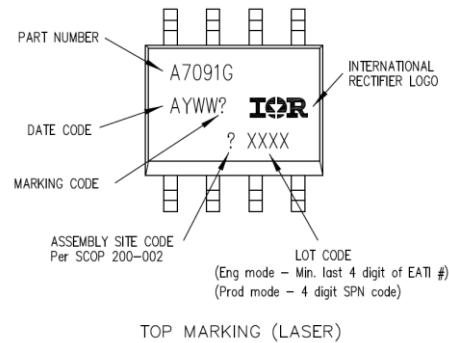
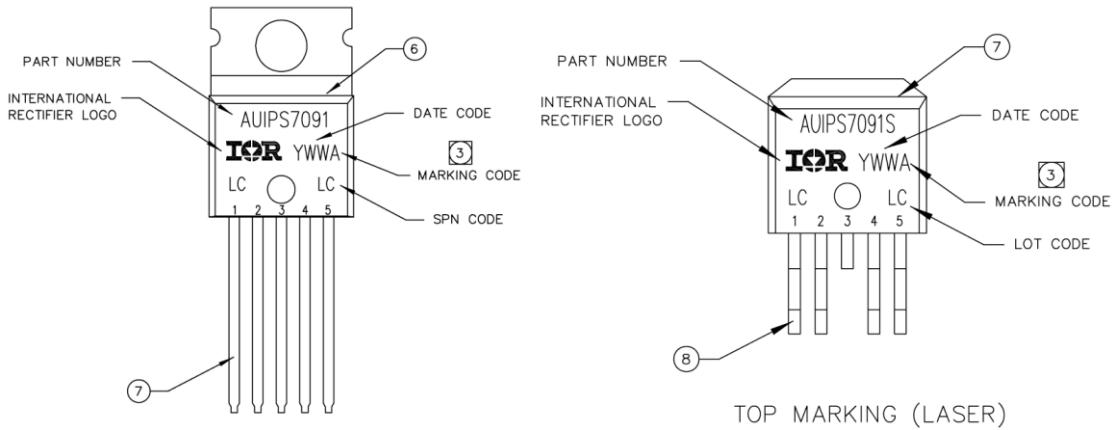


Notes:

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.

- All Dimensions in Millimeters -

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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Tel: (310) 252-7105

Revision History

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

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