International
IOR Rectifier

February, 28th 2011
Automotive grade

AUIPS1031(S)(R)

INTELLIGENT POWER LOW SIDE SWITCH

Features

- Over temperature shutdown
- Over current shutdown
- Active clamp
- Low current & logic level input
- ESD protection
- Optimized Turn On/Off for EMI
- Diagnostic on the input current

Product Summary

Rds(on)	50mΩ (max.)
Vclamp	39V
Ishutdown	18A (typ.)

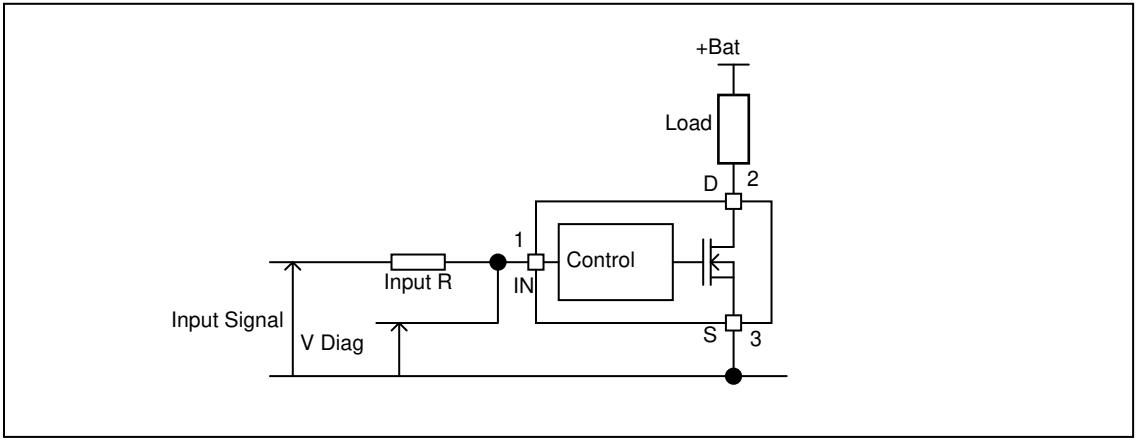
Description

The AUIPS1031(S)(R)PbF is a three terminal Intelligent Power Switch (IPS) that features a low side MOSFET with over-current, over-temperature, ESD protection and drain to source active clamp. This device offers protections and the high reliability required in harsh environments. The switch provides efficient protection by turning OFF the power MOSFET when the temperature exceeds 165°C or when the drain current reaches 18A. The device restarts once the input is cycled. A serial resistance connected to the input provides the diagnostic. The avalanche capability is significantly enhanced by the active clamp and covers most inductive load demagnetizations.

Packages

TO-220	D²Pak	D-Pak
AUIPS1031	AUIPS1031S	AUIPS1031R

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		DPAK-3L	MSL1, 260°C (per IPC/JEDEC J-STD-020)
		D2PAK-3L	MSL1, 260°C (per IPC/JEDEC J-STD-020)
		TO220-5L	Not applicable
ESD	Machine Model	Class M4 (+/-450V) (per AEC-Q100-003)	
	Human Body Model	Class H2 (+/-2500V) (per AEC-Q100-002)	
	Charged Device Model	Class C3B (+/-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/
†† Exceptions to AEC-Q100 requirements are noted in the qualification report.

Absolute Maximum Ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur. (Tj= -40°C..150°C, Vcc=6..36V unless otherwise specified).

Symbol	Parameter	Min.	Max.	Units
Vds	Maximum drain to source voltage	-0.3	36	V
Vds cont.	Maximum continuous drain to source voltage	-	28	V
Vin	Maximum input voltage	-0.3	6	V
Isd cont.	Max. diode continuous current (limited by thermal dissipation)	—	4	A
Pd	Maximum power dissipation (internally limited by thermal protection) Rth=5°C/W AUIPS1031	—	25	W
	Rth=40°C/W AUIPS1031S 1" sqr. Footprint	—	3.1	
	Rth=50C/W AUIPS1031R 1" sqr. footprint	—	2.5	
Tj max.	Max. storage & operating temperature junction temperature	-40	150	°C

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
Rth1	Thermal resistance junction to ambient AUIPS1031 TO-220 free air	50	—	°C/W
Rth2	Thermal resistance junction to case AUIPS1031 TO-220	3.9	—	
Rth1	Thermal resistance junction to ambient AUIPS1031S D²Pak std. footprint	60	—	
Rth2	Thermal resistance junction to ambient AUIPS1031S D²Pak 1" sqr. footprint	40	—	
Rth3	Thermal resistance junction to case AUIPS1031S D²Pak	3.9	—	
Rth1	Thermal resistance junction to ambient AUIPS1031R D-Pak std. footprint	70	—	
Rth2	Thermal resistance junction to ambient AUIPS1031R D-Pak 1" sqr. Footprint	50	—	
Rth3	Thermal resistance junction to case AUIPS1031R D-Pak	3.9	—	

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	5.5	
VIL	Low level input voltage	0	0.5	
Ids	Continuous drain current, Tambient=85°C, Tj=125°C, Vin=5V Rth=5°C/W AUIPS1031	—	9.5	A
	Rth=40°C/W AUIPS1031S 1" sqr. footprint	—	3.3	
	Rth=50C/W AUIPS1031R 1" sqr. footprint	—	3	
Rin	Recommended resistor in series with IN pin to generate a diagnostic	0.5	10	kΩ
Max L	Max recommended load inductance (including line inductance) (1)	—	50	µH
Max F	Max. frequency (switching losses = conduction losses)	—	1.5	kHz
Max. t rise	Max. input rising time	—	1	µs

(1) Higher inductance is possible if maximum load current is limited - see figure 11

Static Electrical Characteristics

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Rds(on)	ON state resistance Tj=25°C	—	40	50	mΩ	Vin=5V, Ids=8A
	ON state resistance Tj=150°C (2)	—	76	95		
Idss1	Drain to source leakage current	—	0.1	2	µA	Vcc=14V, Tj=25°C
Idss2	Drain to source leakage current	—	0.2	4		Vcc=28V, Tj=25°C
V clamp1	Drain to source clamp voltage 1	36	39	—	V	Id=20mA
V clamp2	Drain to source clamp voltage 2	—	40	42		Id=1A
Vin clamp	IN to source pin clamp voltage	5.5	6.5	7.5		Iin=1mA
Vth	Input threshold voltage	—	1.7	—		Id=10mA

Switching Electrical Characteristics

Vcc=14V, Resistive load=1.5Ω, Rinput=0Ω, Vin=5V, Tj=25°C

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Tdon	Turn-on delay time to 20%	3	10	30	µs	See figure 2
Tr	Rise time 20% to 80%	6	20	40		
Tdoff	Turn-off delay time to 80%	20	70	200		
Tf	Fall time 80% to 20%	6	15	30		
Eon + Eoff	Turn on and off energy	—	0.7	—	mJ	

Protection Characteristics

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Tsd	Over temperature threshold	150(2)	165	—	°C	See figure 1
Isd	Over current threshold	9.5	18	27	A	See figure 1
OV	Over voltage protection (not active when the device is ON)	34	37	—	V	
Vreset	IN protection reset threshold	—	1.7	—	V	
Treset	Time to reset protection	15(2)	50	200	µs	Vin=0V

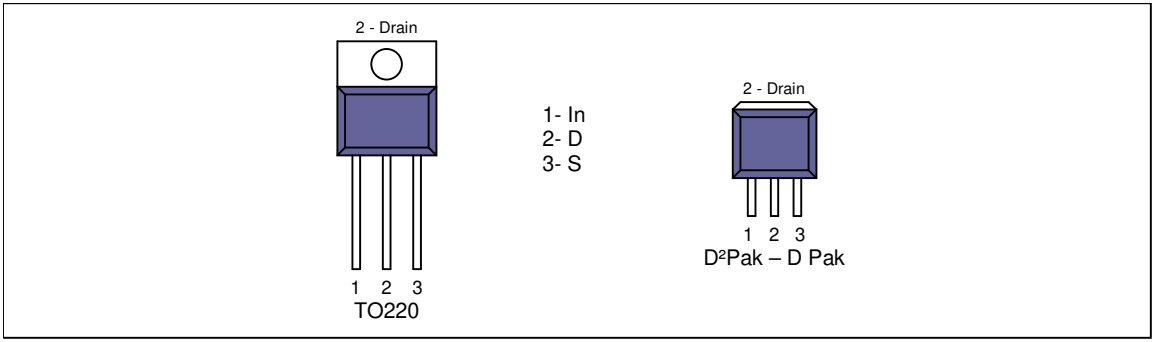
Diagnostic

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Iin, on	ON state IN positive current	10	32	80	µA	Vin=5V
Iin, off	OFF state IN positive current (after protection latched)	120	230	350		Vin=5V

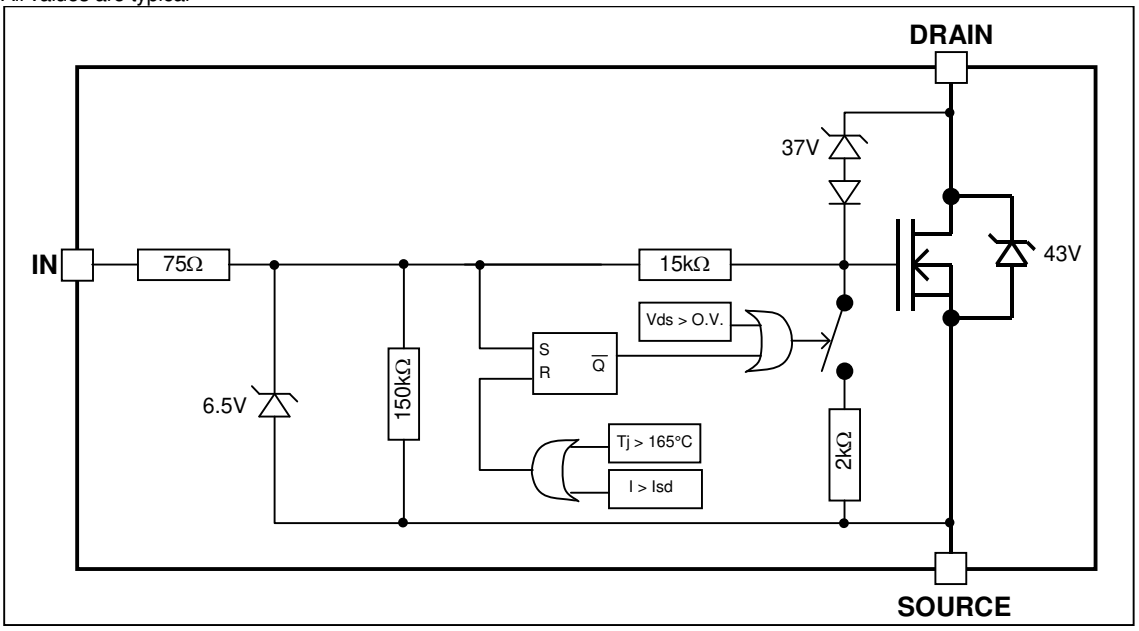
(2) Guaranteed by design

Lead Assignments



Functional Block Diagram

All values are typical



All curves are typical values. Operating in the shaded area is not recommended.

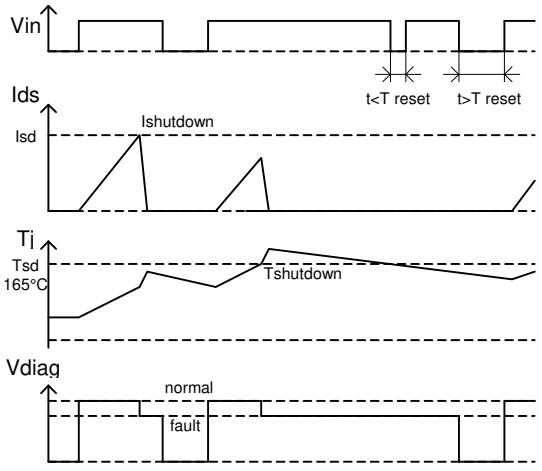


Figure 1 – Timing diagram

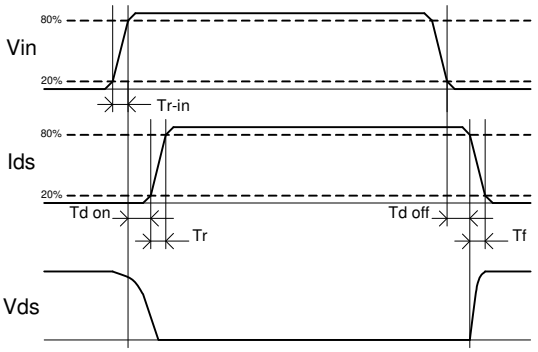
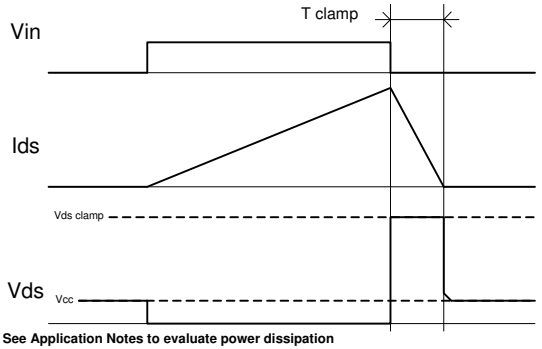


Figure 2 – IN rise time & switching definitions



See Application Notes to evaluate power dissipation

Figure 3 – Active clamp waveforms

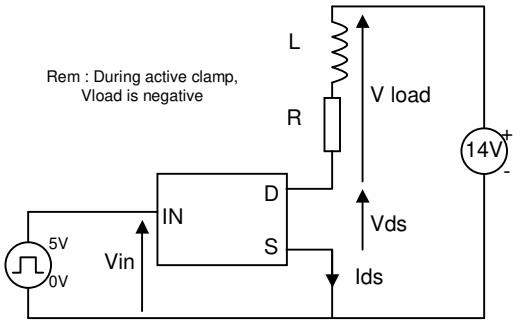


Figure 4 – Active clamp test circuit

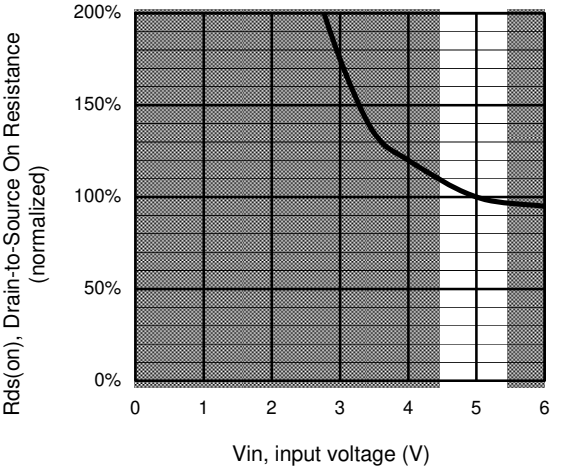


Figure 5 – Normalized Rds(on) (%) Vs Input voltage (V)

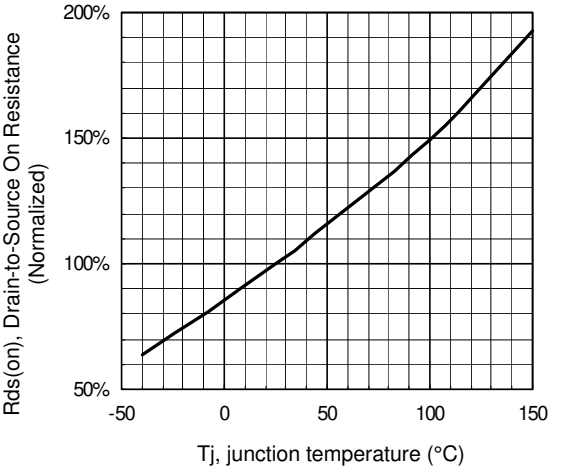


Figure 6 - Normalized Rds(on) (%) Vs Tj (°C)

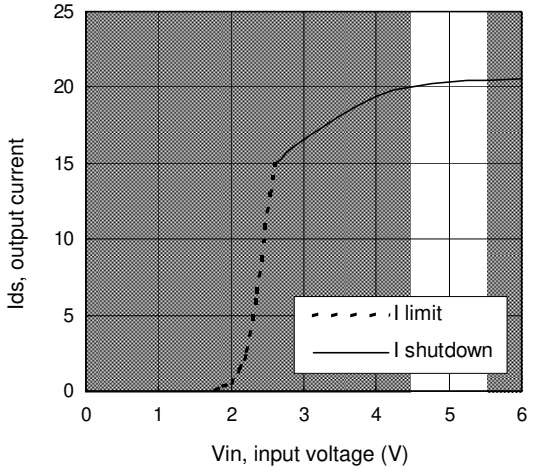


Figure 7 – Current limitation and current shutdown Vs Input voltage (V)

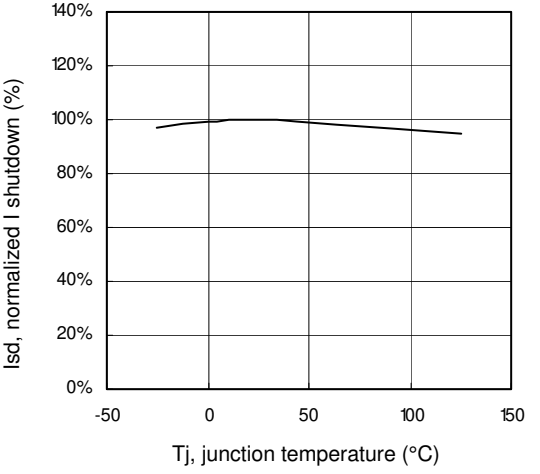


Figure 8 – Normalized I shutdown (%) Vs junction temperature (°C)

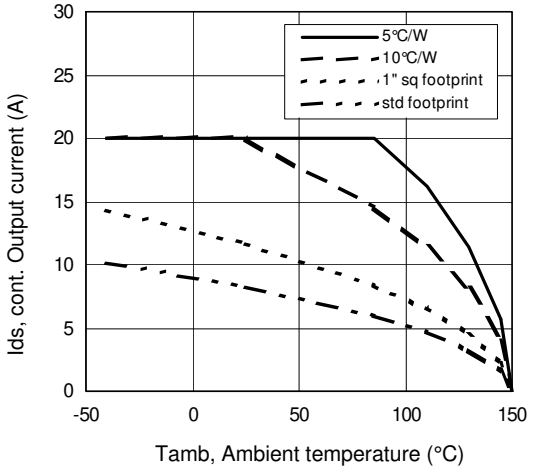


Figure 9 – Max. continuous output current (A) Vs Ambient temperature (°C)

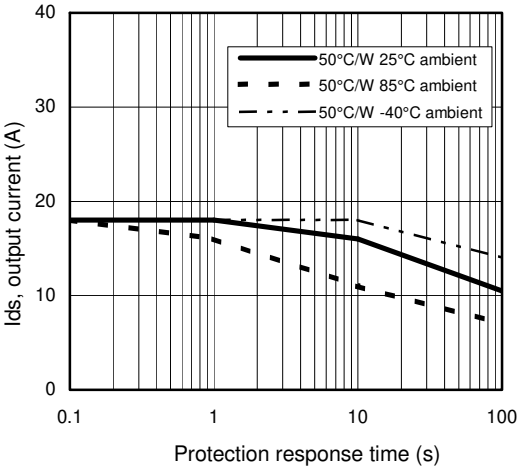


Figure 10 – Ids (A) Vs over temperature protection response time (s)

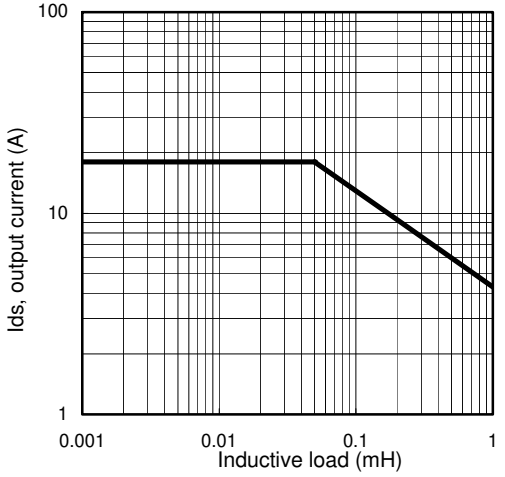


Figure 11 – Max. ouput current (A) Vs Inductive load (mH)

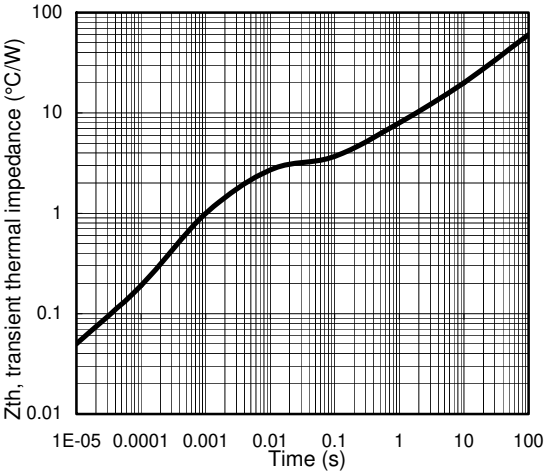


Figure 12 – Transient thermal impedance (°C/W) Vs time (s)

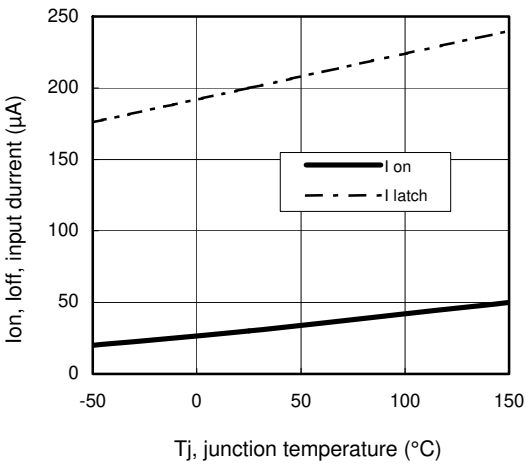


Figure 13 – Input current (µA) On and Off Vs junction temperature (°C)

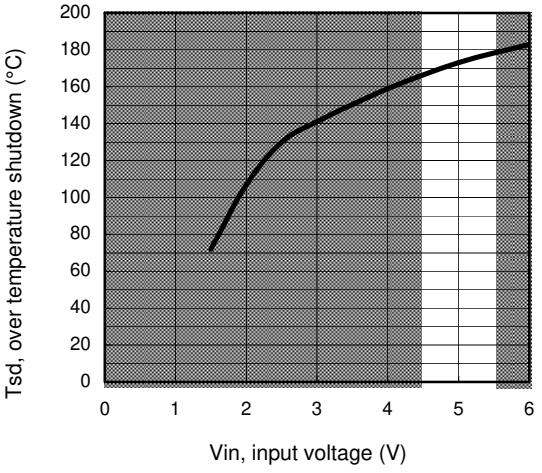
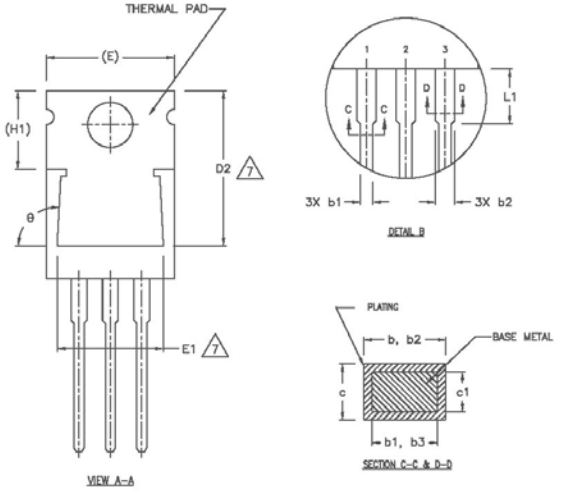
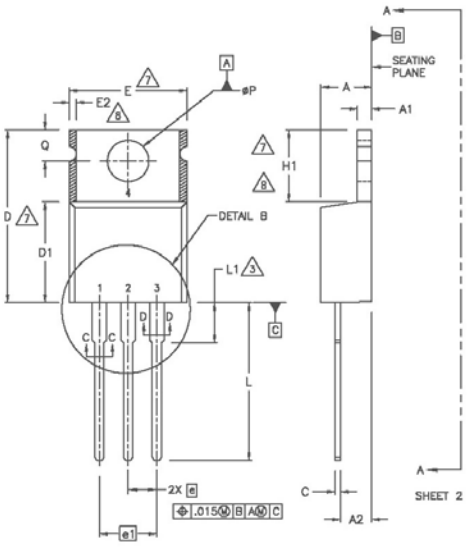


Figure 14 – Over temperature shutdown (°C) Vs input voltage (V)

Case Outline – TO-220 AB – Automotive Q100 PbF qualified



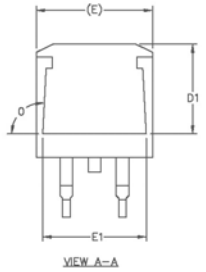


SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	3.56	4.82	.140	.190	
A1	0.51	1.40	.020	.055	
A2	2.04	2.92	.080	.115	
b	0.38	1.01	.015	.040	
b1	0.38	0.96	.015	.038	5
b2	1.15	1.77	.045	.070	
b3	1.15	1.73	.045	.068	
c	0.36	0.61	.014	.024	
c1	0.36	0.56	.014	.022	5
D	14.22	16.51	.560	.650	4
D1	8.38	9.02	.330	.355	
D2	12.19	12.88	.480	.507	7
E	9.66	10.66	.380	.420	4,7
E1	8.38	8.89	.330	.350	7
e	2.54 BSC		.100 BSC		
e1	5.08		.200 BSC		
H1	5.85	6.55	.230	.270	7,8
L	12.70	14.73	.500	.580	
L1	–	6.35	–	.250	3
øP	3.54	4.08	.139	.161	
Q	2.54	3.42	.100	.135	
ø	90°–93°		90°–93°		

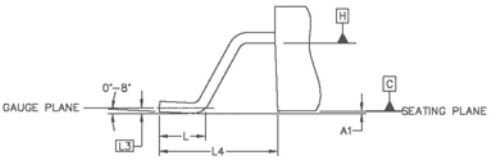
NOTES:

1 DIMENSIONING AND TOLERANCING PER ASME Y14.5 M– 1994.
2 DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].
3 LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
4 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 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 LEADS AND DRAIN ARE PLATED WITH 100% Sn

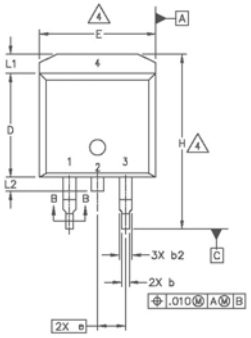
Case Outline - D²Pak (SMD-220) - Automotive Q100 PbF MSL1 qualified

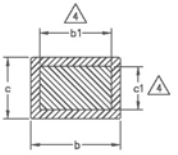


VIEW A–A



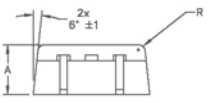
DETAIL "A"
ROTATED 90°
SCALE 8:1

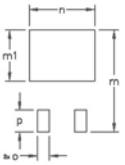




SECTION B–B
SCALE: NONE

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	0.00	0.254	.000	.010	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	4
b2	1.14	1.78	.045	.070	
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	4
c2	1.14	1.65	.045	.065	
D	8.51	9.65	.335	.380	3
D1	6.86		.270		
E	9.65	10.67	.380	.420	3
E1	6.22		.245		
e	2.54 BSC		.100 BSC		
H	14.61	15.88	.575	.625	
L	1.78	2.79	.070	.110	
L1		1.65		.065	
L2	1.27	1.78	.050	.070	
L3	0.25 BSC		.010 BSC		
L4	4.78	5.28	.188	.208	
m	17.78		.700		
m1	8.89		.350		
n	11.43		.450		
o	2.08		.082		
p	3.81		.150		
R	0.51	0.71	.020	.028	
θ	90°	93°	90°	93°	





FOOT PRINT
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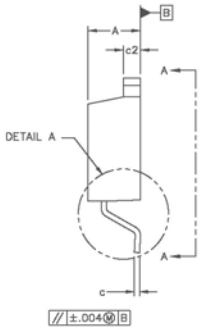
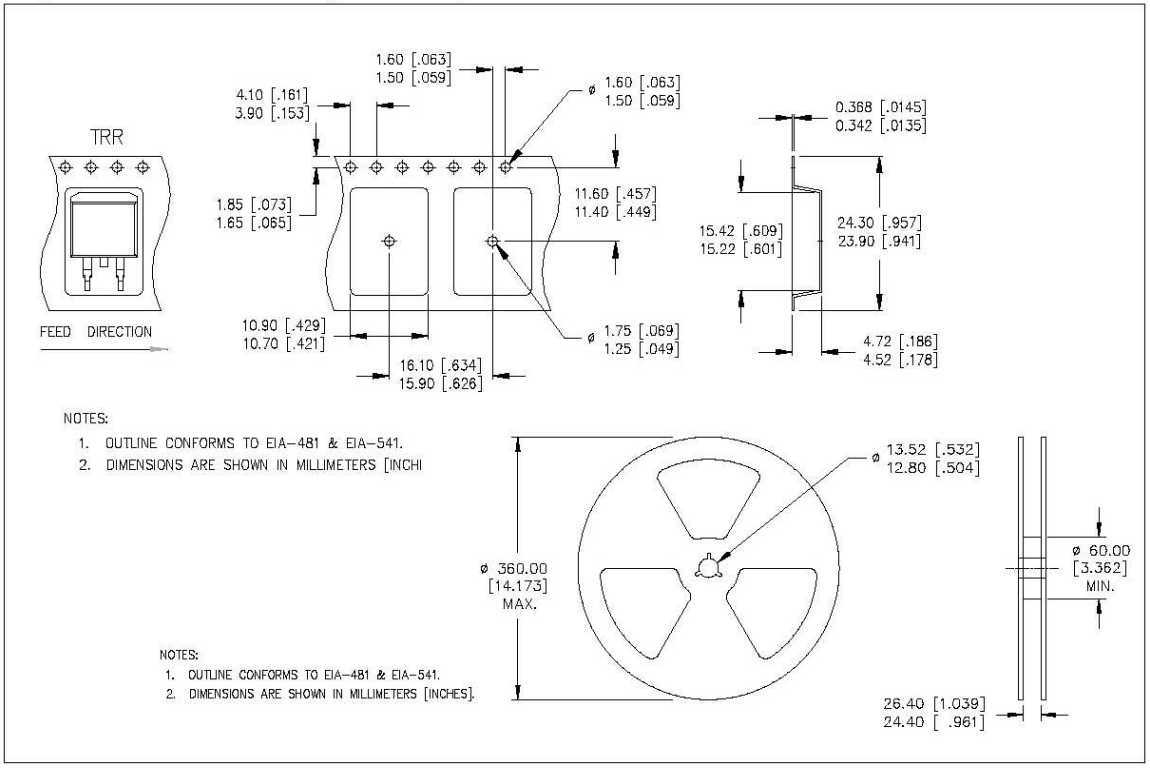


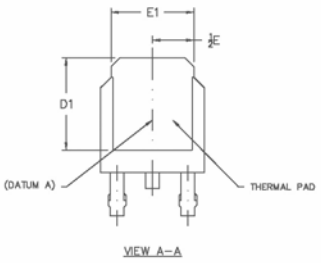
NOTES:

1. DIMENSIONING AND TOLERANCING 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.
4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: INCH.
6. LEADS & DRAIN CONTACT ARE PLATED : 100% Sn

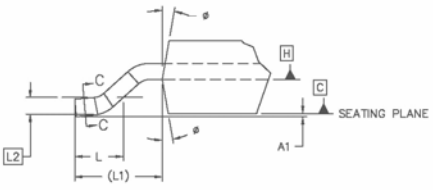
Tape & Reel - D²Pak (SMD220)



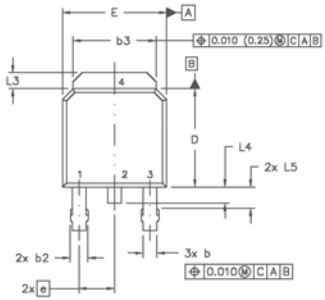
Case Outline – D-Pak - Automotive Q100 PbF MSL1 qualified



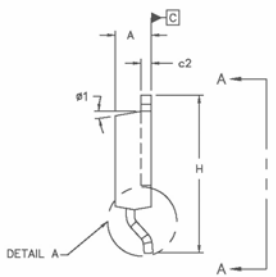
VIEW A–A

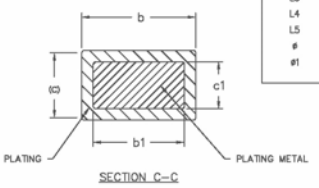


DETAIL "A"
ROTATED 90°



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	2.18	2.39	.086	.094	
A1		0.13		.005	
b	0.64	0.89	.025	.035	5
b1	0.64	0.79	.025	0.031	5
b2	0.76	1.14	.030	.045	
b3	4.95	5.46	.195	.215	
c	0.46	0.61	.018	.024	5
c1	0.41	0.56	.016	.022	5
c2	.046	0.89	.018	.035	5
D	5.97	6.22	.235	.245	6
D1	5.21	–	.205	–	4
E	6.35	6.73	.250	.265	6
E1	4.32	–	.170		4
e	2.29		.090 BSC		
H	9.40	10.41	.370	.410	
L	1.40	1.78	.055	.070	
L1	2.74 REF.		.108 REF.		
L2	0.051 BSC		.020 BSC		
L3	0.89	1.27	.035	.050	
L4		1.02		.040	
L5	1.14	1.52	.045	.060	3
ø	0°	10°	0°	10°	
ø1	0°	15°	0°	15°	





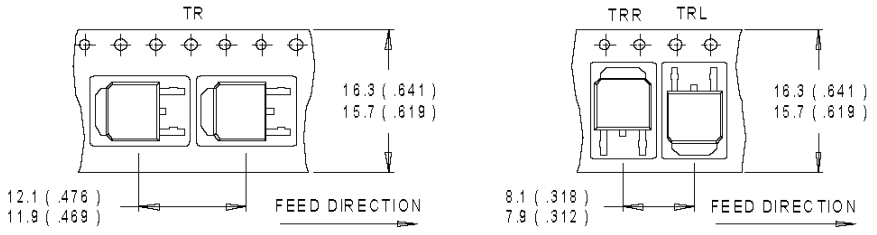
SECTION C–C

NOTES:

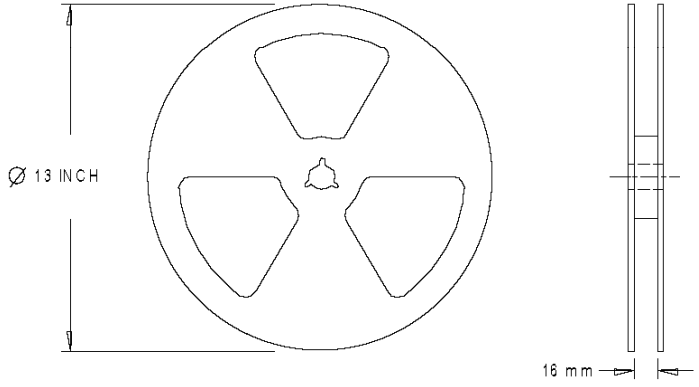
1.0 DIMENSIONING AND TOLERANCING PER ASME Y14.5 M– 1994.
2.0 DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].
3.0 LEAD DIMENSION UNCONTROLLED IN L5
4.0 DIMENSION D1 AND E1 ESTABLISH A MINIMUM MOUNTING SURFACE FOR THERMAL PAD.
5.0 SECTION C–C DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN .005 [0.127] AND .010 [0.2540 FROM THE LEAD TIP.
6.0 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.
7.0 OUTLINE CONFORMS TO JEDEC OUTLINE TO–252AA.

8.0 LEADS AND DRAIN ARE PLTED WITH 100% Sn

Tape & Reel - D-Pak



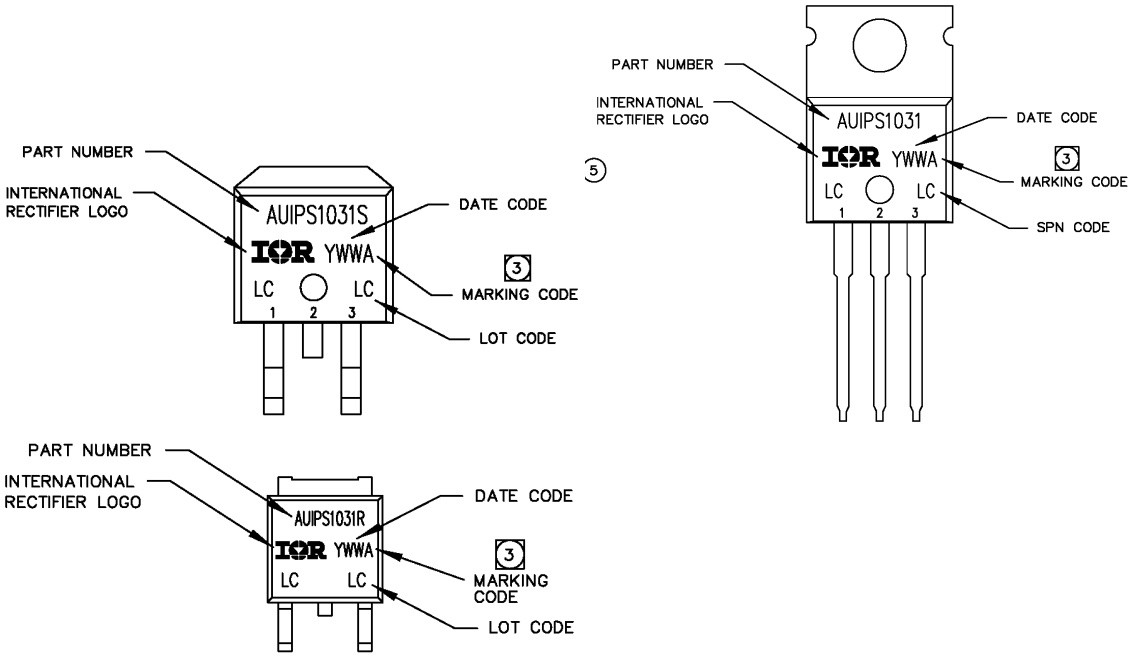
NOTES :
1. CONTROLLING DIMENSION : MILLIMETER.
2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
3. OUTLINE CONFORMS TO EIA-481 & EIA-541.



NOTES :
1. OUTLINE CONFORMS TO EIA-481.

Dimensions are shown in millimeters (inches)

Part Marking Information



Ordering Information

Base Part Number	Package Type	Standard Pack		Complete Part Number
		Form	Quantity	
AUIPS1031	TO220 – 5Leads	Tube	50	AUIPS1031
	D2-Pak-5-Leads	Tube	50	AUIPS1031S
		Tape and reel left	800	AUIPS1031STRL
		Tape and reel right	800	AUIPS1031STRR
	D-Pak-5-Lead	Tube	75	AUIPS1031R
		Tape and reel	2000	AUIPS1031RTR
		Tape and reel left	3000	AUIPS1031RTRL
		Tape and reel right	3000	AUIPS1031RTRR

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For technical support, please contact IR's Technical Assistance Center
http://www.irf.com/technical-info/

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Revision History

Revision	Date	Notes/Changes
D	November, 24th, 2010	AU release
D1	December, 7th, 2010	Remove ESD section page 3
D2	December, 9th 2010	Update qual page 2
E	February, 8th 2011	Update Vclamp page 1
F	February, 28th 2011	Update Max rating