

International Rectifier **IPS1041(L)(R)PbF / IPS1042GPbF**

SINGLE/DUAL CHANNEL 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

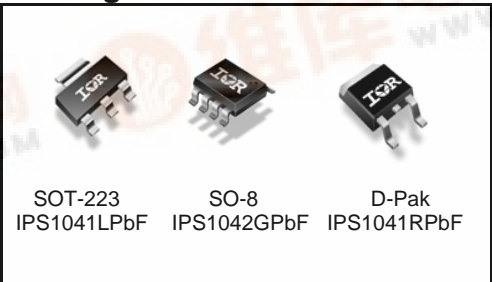
Product Summary

Rds(on)	100mΩ (max.)
Vclamp	39V
Ishutdown	4.5A (typ.)

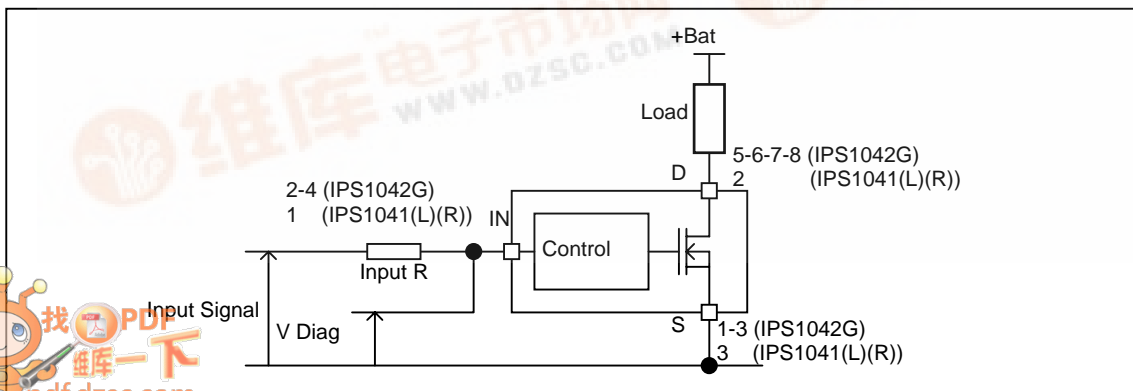
Description

The IPS1041(L)(R)PbF and IPS1042GPbF are three terminal Intelligent Power Switches (IPS) featuring low side MOSFETs with over-current, over-temperature, ESD protection and drain to source active clamp. The IPS1042G is a dual channel device while the IPS1041 is a single channel. These devices offer protections and the high reliability required in harsh environments. Each switch provides efficient protection by turning OFF the power MOSFET when the temperature exceeds 165°C or when the drain current reaches 4.5A. 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



Typical Connection



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. (Tambient=25°C 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
I _{sd} cont.	Max diode continuous current (limited by thermal dissipation)	—	1.5	A
Pd	Maximum power dissipation (internally limited by thermal protection)			
	R _{th} =60°C/W IPS1041L 1" sqr. footprint R _{th} =100°C/W IPS1042G std. footprint		2 1.25	W
ESD	Electrostatic discharge voltage (Human body) C=100pF, R=1500Ω			
	Between drain and source	—	4	kV
	Other combinations	—	3	
	Electrostatic discharge voltage (Machine Model) C=200pF, R=0Ω			
Between drain and source	—	0.5		
	Other combinations	—	0.3	
T _j max.	Max. storage & operating temperature junction temperature	-40	150	°C
T _{soldering}	Lead soldering temperature (10 seconds)	—	300	°C

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
R _{th1}	Thermal resistance junction to ambient IPS1041L SOT-223 std. footprint	100	—	°C/W
R _{th2}	Thermal resistance junction to ambient IPS1041L SOT-223 1" sqr. footprint	60	—	
R _{th1}	Thermal resistance junction to ambient IPS1041R D-Pak std. footprint	70	—	
R _{th2}	Thermal resistance junction to case IPS1041R D-Pak	6	—	
R _{th1}	Thermal resistance junction to ambient IPS1042G SO-8 std. Footprint 1 die active	100	—	
R _{th1}	Thermal resistance junction to ambient IPS1042G SO-8 std. footprint 2 die active	130	—	

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	5.5	V
V _{IL}	Low level input voltage	0	0.5	
I _{ds}	Continuous drain current, Tambient=85°C, Tj=125°C, Vin=5V R _{th} =60°C/W IPS1041L 1" sqr. Footprint	—	1.95	A
	Continuous drain current, Tambient=85°C, Tj=125°C, Vin=5V R _{th} =50°C/W IPS1041R 1" sqr. Footprint	—	2.2	
	Continuous drain current, Tambient=85°C, Tj=125°C, Vin=5V R _{th} =100°C/W IPS1042G 1" sqr. Footprint - 1 die active	—	1.5	
	Continuous drain current, Tambient=85°C, Tj=125°C, Vin=5V R _{th} =130°C/W IPS1042G 1" sqr. Footprint - 2 die active		0.7	
R _{in}	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)	—	20	μH
Max. F	Max. frequency	—	2000	Hz
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

T_j=25°C, V_{cc}=14V (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Rds(on)	ON state resistance T _j =25°C	—	80	100	mΩ	Vin=5V, Ids=3A
	ON state resistance T _j =150°C	—	135	175		
Idss1	Drain to source leakage current	—	0.1	5	μA	V _{cc} =14V, T _j =25°C
Idss2	Drain to source leakage current	—	0.2	10		V _{cc} =28V, T _j =25°C
V clamp1	Drain to source clamp voltage 1	36	38	—	V	Id=10mA
V clamp2	Drain to source clamp voltage 2	—	39	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

V_{cc}=14V, Resistive load=5Ω, Rin_{put}=0Ω, Vin=5V, T_j=25°C

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Tdon	Turn-on delay time to 20%	3	10	23	μs	See figure 2
Tr	Rise time 20% to 80%	2	7	20		
Tdoff	Turn-off delay time to 80%	15	40	150		
Tf	Fall time 80% to 20%	4	10	20		
Eon + Eoff	Turn on and off energy	—	0.2	—	mJ	

Protection Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Tsd	Over temperature threshold	150(2)	165	—	°C	See figure 1
Isd	Over current threshold	3	4.5	6	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, T _j =25°C

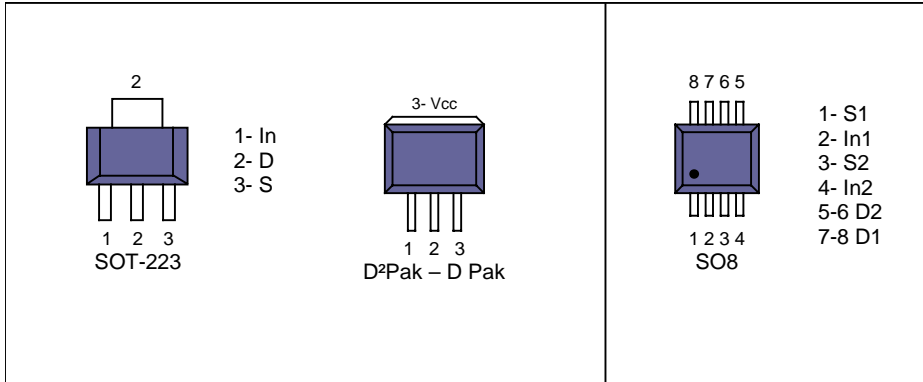
(2) Guaranteed by design

Diagnostic

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Iin, on	ON state IN positive current	15	32	70	μA	Vin=5V
Iin, off	OFF state IN positive current (after protection latched)	150	230	350		Vin=5V

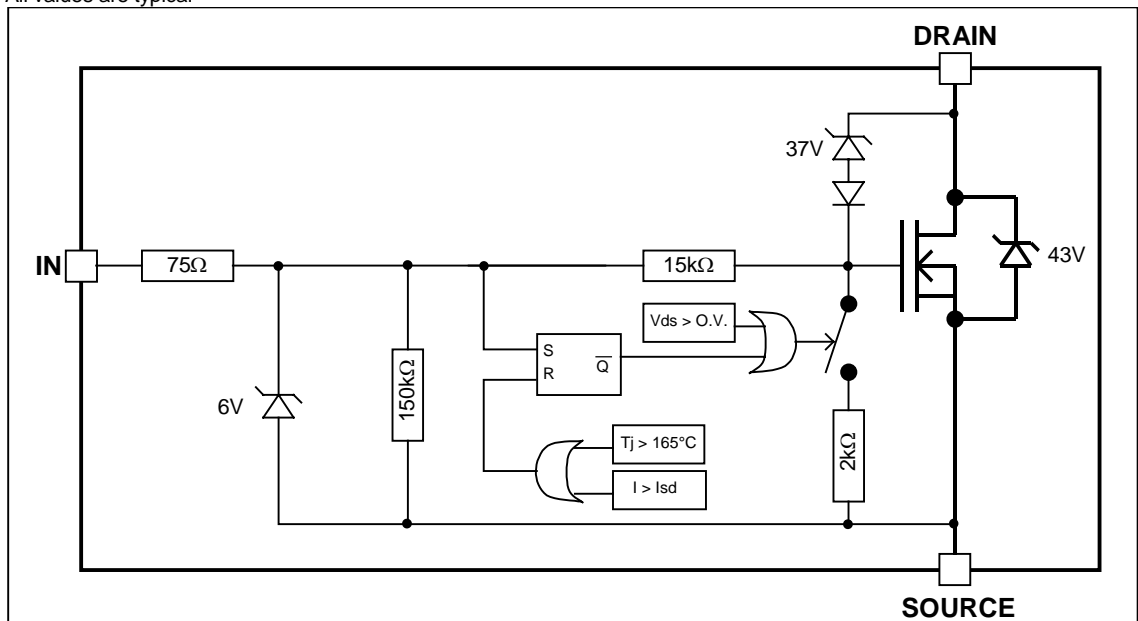
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Lead Assignments



Functional Block Diagram

All values are typical



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

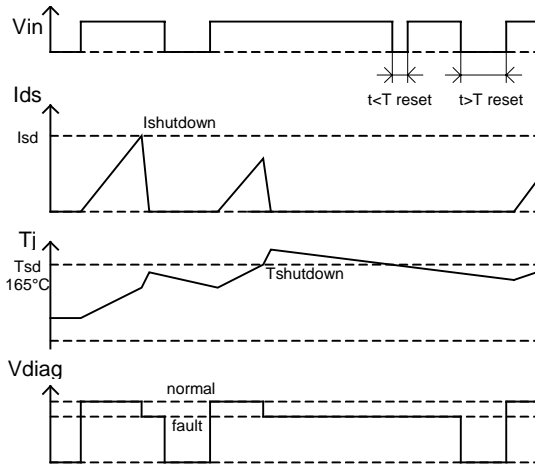


Figure 1 – Timing diagram

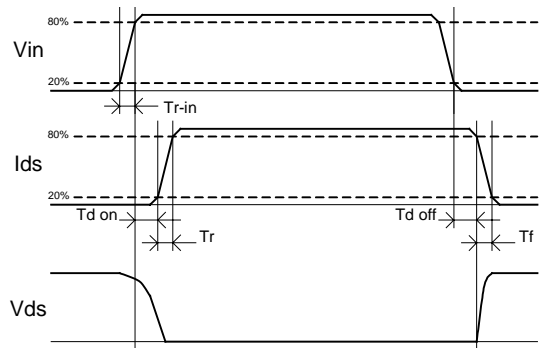
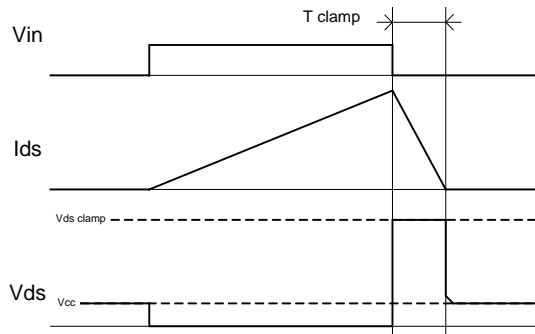


Figure 2 – IN rise time & switching definitions



See Application Notes to evaluate power dissipation

Figure 3 – Active clamp waveforms

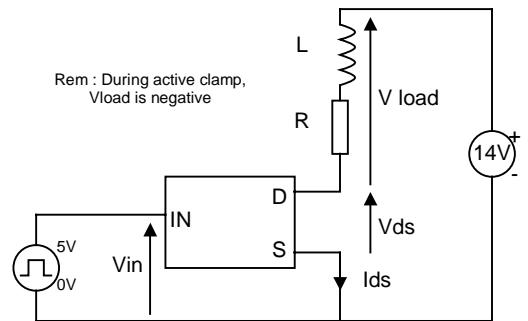


Figure 4 – Active clamp test circuit

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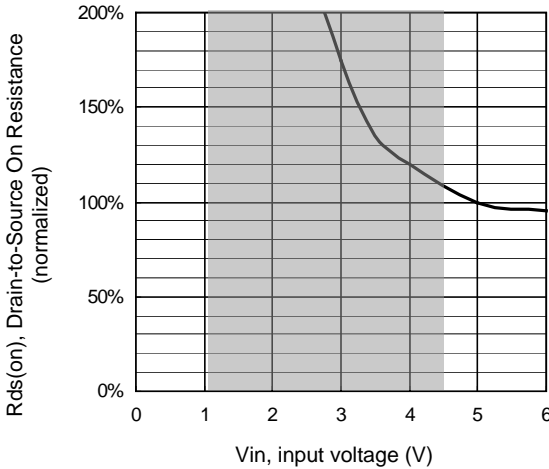


Figure 5 – Normalized R_{ds(on)} (%) Vs Input voltage (V)

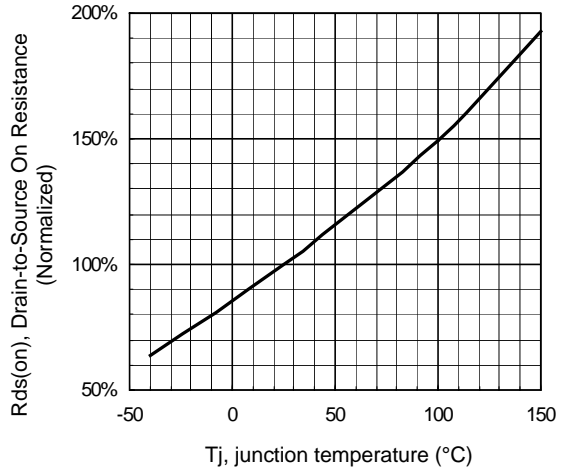


Figure 6 - Normalized R_{ds(on)} (%) Vs T_j (°C)

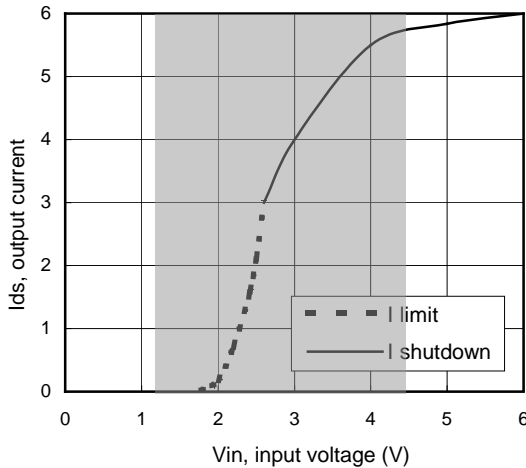


Figure 7 – Current limitation and current shutdown Vs Input voltage (V)

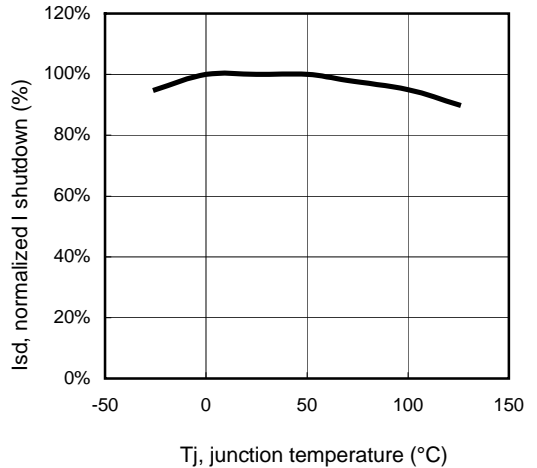


Figure 8 – Normalized I shutdown (%) Vs junction temperature (°C)

IPS1041(L)(R)PbF / IPS1042GPbF

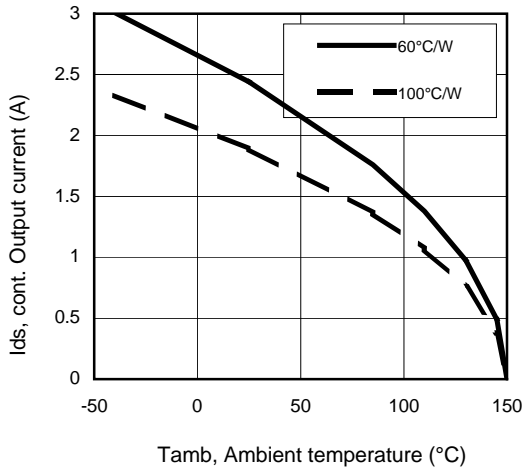


Figure 9 – Max. continuous output current (A) Vs Ambient temperature (°C)

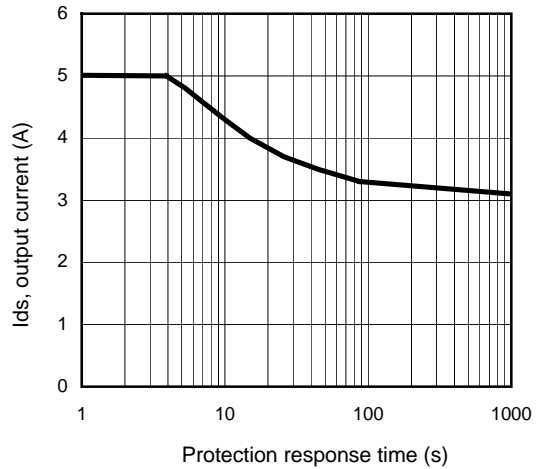


Figure 10 – Ids (A) Vs over temperature protection response time (s) / IPS1041L

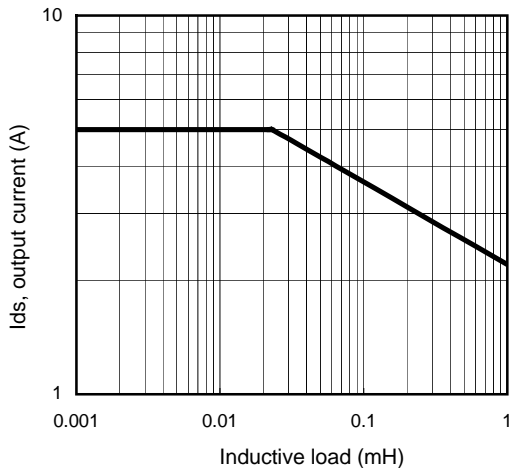


Figure 11 – Max. output current (A) Vs Inductive load (mH)

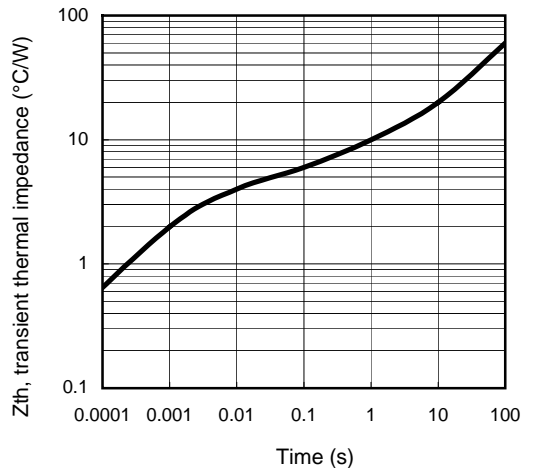


Figure 12 – Transient thermal impedance (°C/W) Vs time (s)

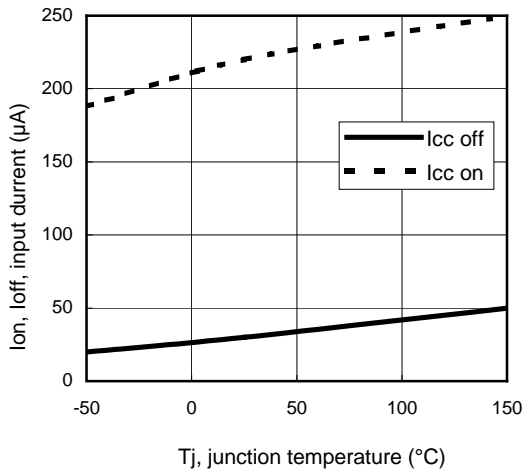


Figure 13 – Input current (µA) On and Off Vs junction temperature (°C)

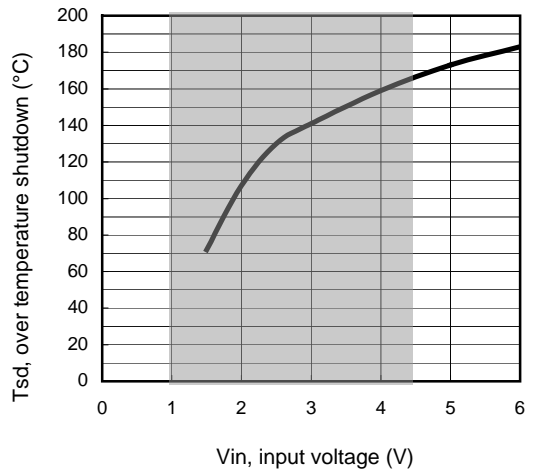
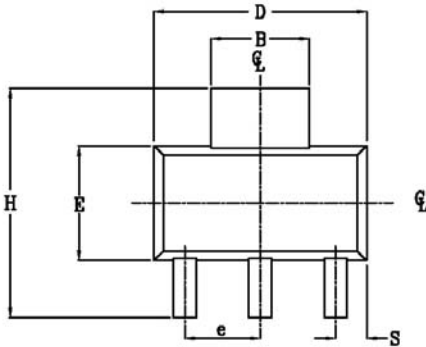


Figure 14 – Over temperature shutdown (°C) Vs input voltage (V)

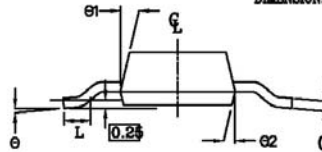
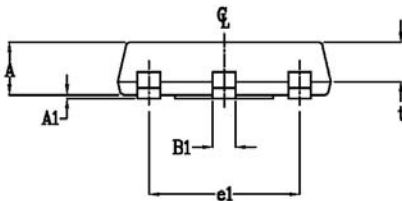
IPS1041(L)(R)PbF / IPS1042GPbF

Case Outline - SOT-223 - Automotive Q100 PbF MSL2 qualified



POS	MILLIMETERS		INCHES	
	MAX	MIN	MAX	MIN
I				
A	1.70	1.50	.067	.060
A1	0.10	0.02	.004	.0008
B	3.15	2.95	.124	.116
B1	0.85	0.65	.033	.026
C	0.35	0.25	.014	.010
D	6.70	6.30	.264	.248
e	2.30 NOM		.0905 NOM	
e1	4.80 NOM		.181 NOM	
E	3.70	3.30	.146	.130
H	7.30	6.70	.287	.264
S	1.05	0.85	.041	.033
t	1.30	1.10	.051	.043
θ	10° MAX		10° MAX	
$\theta 1$	16°	10°	16°	10°
$\theta 2$	16°	10°	16°	10°
L	0.75 MIN		0.0295 MIN	

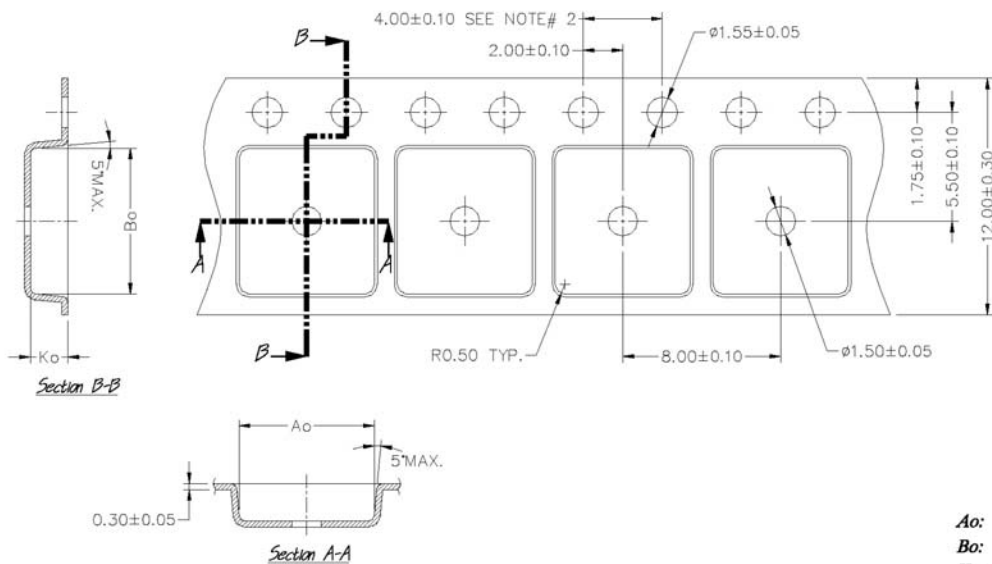
NOTE:
 1. PACKAGE OUTLINE EXCLUSIVE OF ANY MOLD FLASHES DIMENSION.
 2. PACKAGE OUTLINE EXCLUSIVE OF BURR DIMENSION.



Leads and drain are plated with 100% Sn

IPS1041(L)(R)PbF / IPS1042GPbF

Tape & Reel - SOT-223



Ao:	6.85
Bo:	7.40
Ko:	1.90
Pitch:	8.00
Width:	12.00

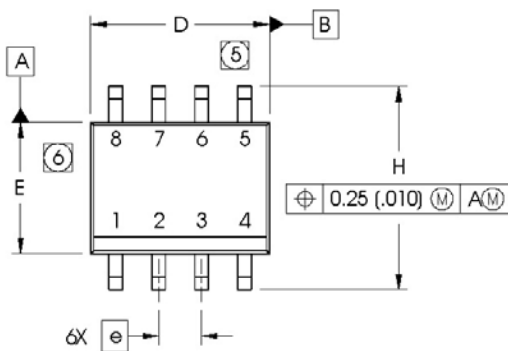
NOTES:

1. Ao & Bo are measured at 0.3mm above base of packet.
2. 10 pitches cumulative tol. ±0.2mm.

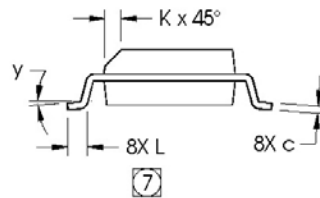
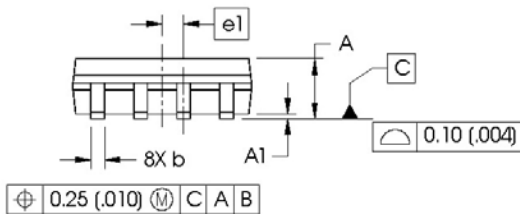
IPS1041(L)(R)PbF / IPS1042GPbF

Case Outline - SO-8 - Automotive Q100 PbF MSL2 qualified

Dimensions are shown in millimeters (inches)



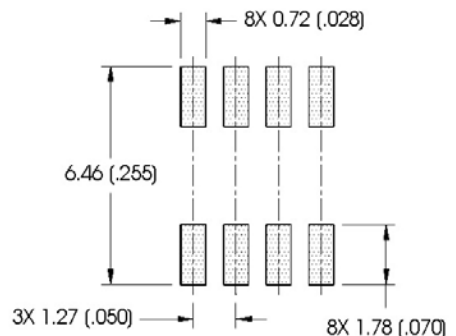
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.0532	.0688	1.35	1.75
A1	.0040	.0098	0.10	0.25
b	.013	.020	0.33	0.51
c	.0075	.0098	0.19	0.25
D	.189	.1968	4.80	5.00
E	.1497	.1574	3.80	4.00
e	.050 BASIC		1.27 BASIC	
e1	.025 BASIC		0.635 BASIC	
H	.2284	.2440	5.80	6.20
K	.0099	.0196	0.25	0.50
L	.016	.050	0.40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



NOTES:

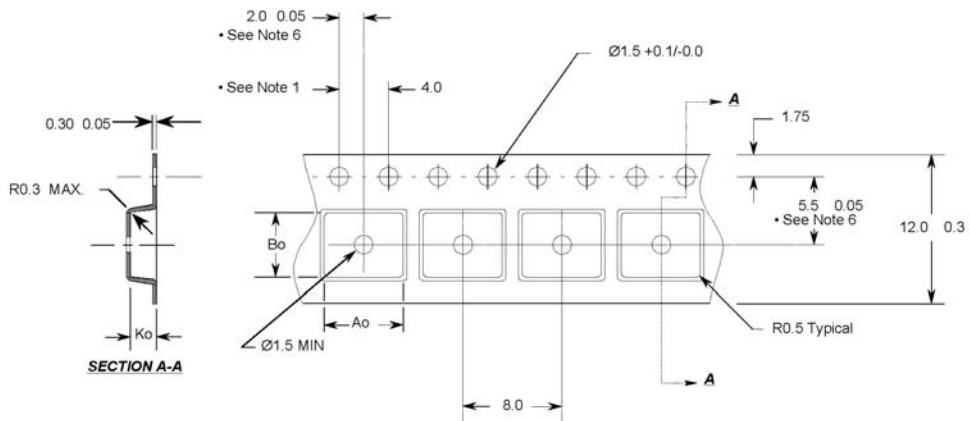
- DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994.
- CONTROLLING DIMENSION: MILLIMETER
- DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
- OUTLINE CONFORMS TO JEDEC OUTLINE MS-012AA.
- ⑤** DIMENSION DOES NOT INCLUDE MOLD PROTRUSIONS. MOLD PROTRUSIONS NOT TO EXCEED 0.15 (.006).
- ⑥** DIMENSION DOES NOT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

FOOTPRINT



Leads and drain are plated with 100% Sn

Tape & Reel - SO-8



Notes:

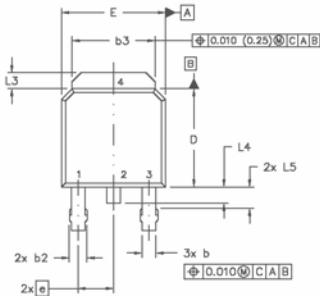
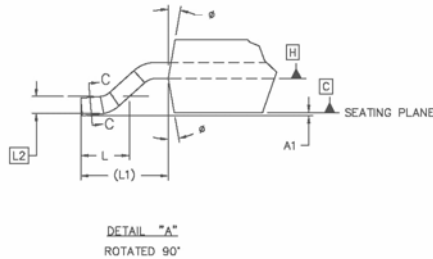
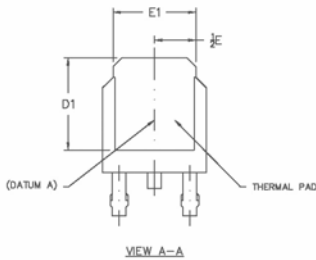
1. 10 sprocket hole pitch cumulative tolerance 0.2
2. Camber not to exceed 1mm in 100mm
3. Material: Black Conductive Advantek Polystyrene
4. Ao and Bo measured on a plane 0.3mm above the bottom of the pocket
5. Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier.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

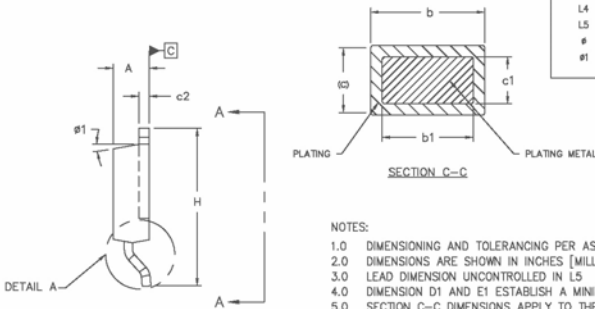
- All Dimensions in Millimeters -

IPS1041(L)(R)PbF / IPS1042GPbF

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



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	2.18	2.30	.086	.094	
A1		0.13		.005	
b	0.84	0.89	.025	.035	5
b1	0.84	0.79	.025	0.031	5
b2	0.78	1.14	.030	.045	
b3	4.95	5.46	.195	.215	
c	0.48	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	8.40	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	
ø	0"	10"	0"	10"	
ø1	0"	15"	0"	15"	3

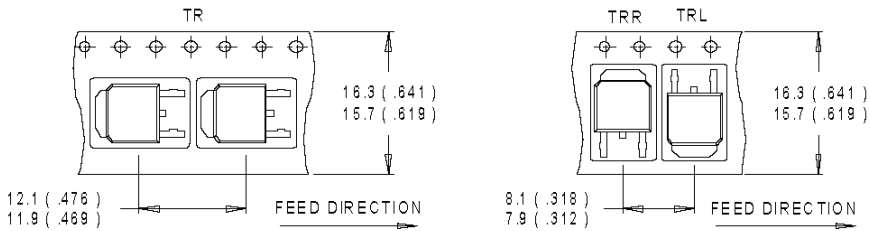


NOTES:

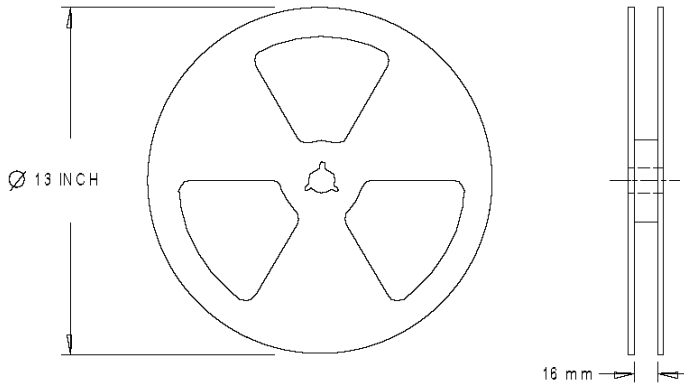
- 1.0 DIMENSIONING AND TOLERANCING PER ASME Y14.5 M- 1994.
- 2.0 DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].
- 3.0 LEAD DIMENSION UNCONTROLLED IN L5
- 4.0 DIMENSION D1 AND E1 ESTABLISH A MINIMUM MOUNTING SURFACE FOR THERMAL PAD.
- 5.0 SECTION C-C DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN .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 PLATED WITH 100% Sn

IPS1041(L)(R)PbF / IPS1042GPbF

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)