

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

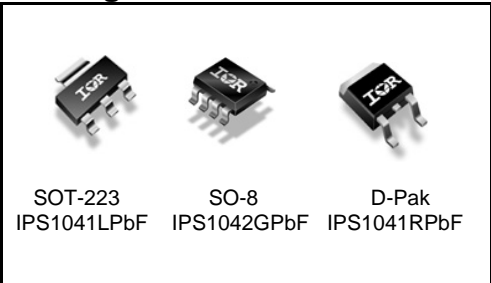
Description

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.

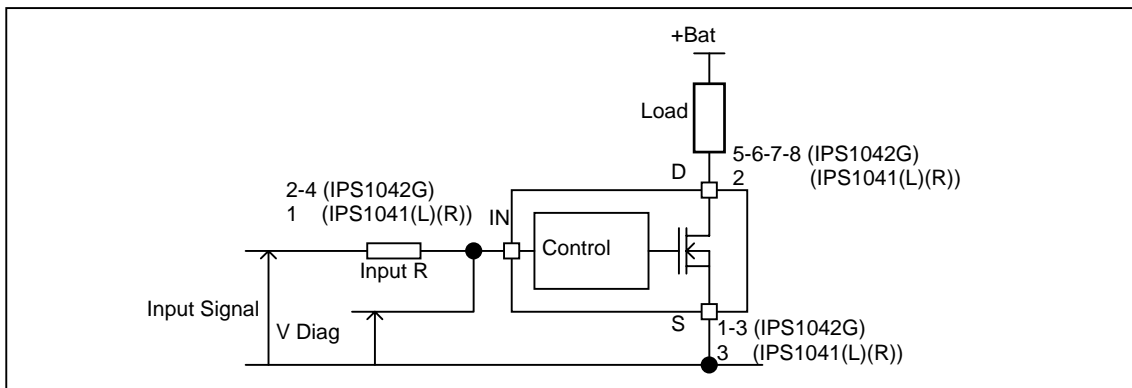
Product Summary

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

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
Isd cont.	Max diode continuous current (limited by thermal dissipation)	—	1.5	A
Pd	Maximum power dissipation (internally limited by thermal protection)			
	Rth=60°C/W IPS1041L 1" sqr. footprint Rth=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 Other combinations	— —	0.5 0.3		
Tj max.	Max. storage & operating temperature junction temperature	-40	150	°C
Tsoldering	Lead soldering temperature (10 seconds)	—	300	°C

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
Rth1	Thermal resistance junction to ambient IPS1041L SOT-223 std. footprint	100	—	°C/W
Rth2	Thermal resistance junction to ambient IPS1041L SOT-223 1" sqr. footprint	60	—	
Rth1	Thermal resistance junction to ambient IPS1041R D-Pak std. footprint	70	—	
Rth2	Thermal resistance junction to case IPS1041R D-Pak	6	—	
Rth1	Thermal resistance junction to ambient IPS1042G SO-8 std. Footprint 1 die active	100	—	
Rth1	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
VIH	High level input voltage	4.5	5.5	V
VIL	Low level input voltage	0	0.5	
Ids	Continuous drain current, Tambient=85°C, Tj=125°C, Vin=5V Rth=60°C/W IPS1041L 1" sqr. Footprint	—	1.95	A
	Continuous drain current, Tambient=85°C, Tj=125°C, Vin=5V Rth=50°C/W IPS1041R 1" sqr. Footprint	—	2.2	
	Continuous drain current, Tambient=85°C, Tj=125°C, Vin=5V Rth=100°C/W IPS1042G 1" sqr. Footprint - 1 die active	—	1.5	
	Continuous drain current, Tambient=85°C, Tj=125°C, Vin=5V Rth=130°C/W IPS1042G 1" sqr. Footprint - 2 die active		0.7	
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)	—	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

$T_j=25^{\circ}\text{C}$, $V_{cc}=14\text{V}$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Rds(on)	ON state resistance $T_j=25^{\circ}\text{C}$	—	80	100	m Ω	$V_{in}=5\text{V}$, $I_{ds}=3\text{A}$
	ON state resistance $T_j=150^{\circ}\text{C}$	—	135	175		
Idss1	Drain to source leakage current	—	0.1	5	μA	$V_{cc}=14\text{V}$, $T_j=25^{\circ}\text{C}$
Idss2	Drain to source leakage current	—	0.2	10		$V_{cc}=28\text{V}$, $T_j=25^{\circ}\text{C}$
V clamp1	Drain to source clamp voltage 1	36	38	—	V	$I_d=10\text{mA}$
V clamp2	Drain to source clamp voltage 2	—	39	42		$I_d=1\text{A}$
Vin clamp	IN to source pin clamp voltage	5.5	6.5	7.5		$I_{in}=1\text{mA}$
Vth	Input threshold voltage	—	1.7	—		$I_d=10\text{mA}$

Switching Electrical Characteristics

$V_{cc}=14\text{V}$, Resistive load= 5Ω , $R_{input}=0\Omega$, $V_{in}=5\text{V}$, $T_j=25^{\circ}\text{C}$

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

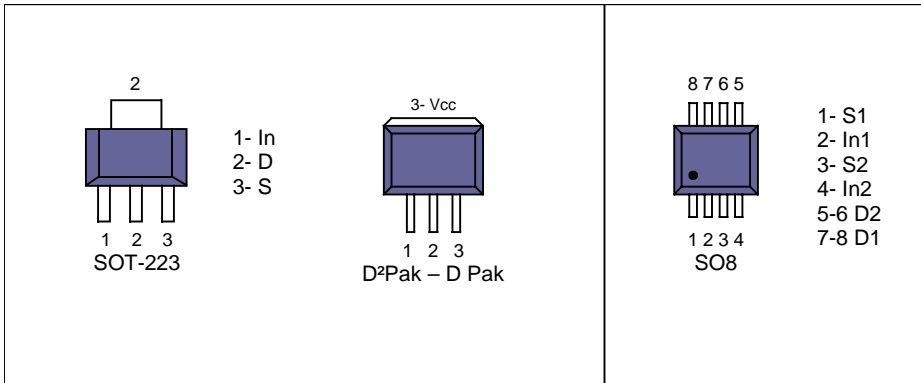
Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Tsd	Over temperature threshold	150(2)	165	—	$^{\circ}\text{C}$	See figure 1
Isd	Over current threshold	3	4.5	6	A	See figure 1
OV	Over voltage protection (not active when the device is ON)	34	37	—	V	
Vreset	IN protection reset threshold	—	1.7	—	V	
Treset	Time to reset protection	15(2)	50	200	μs	$V_{in}=0\text{V}$, $T_j=25^{\circ}\text{C}$

(2) Guaranteed by design

Diagnostic

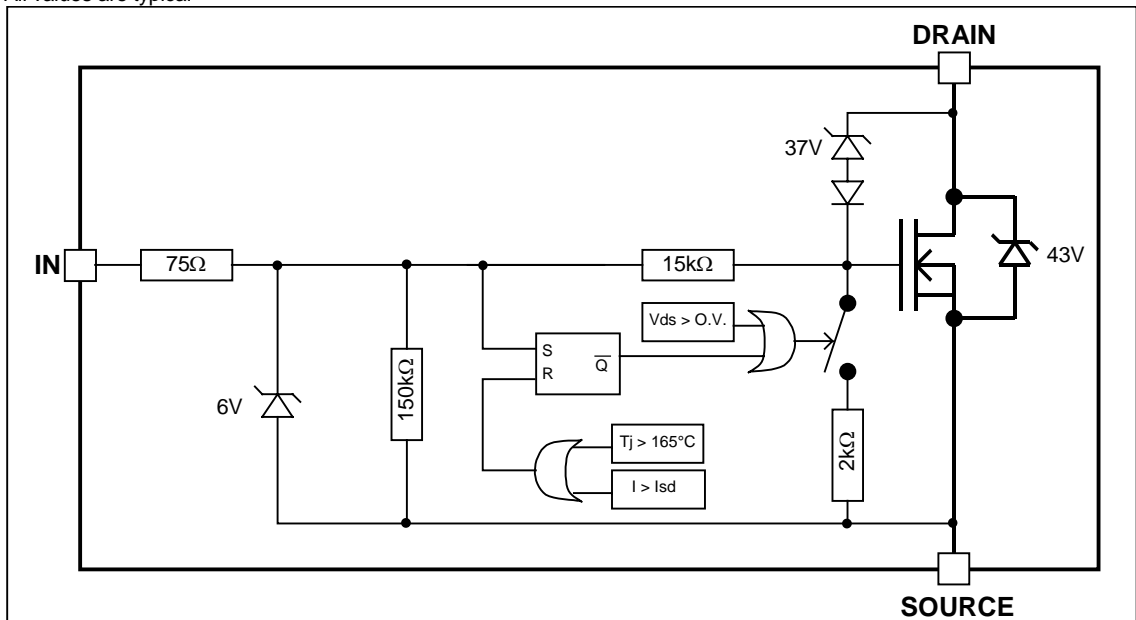
Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
Iin, on	ON state IN positive current	15	32	70	μA	$V_{in}=5\text{V}$
Iin, off	OFF state IN positive current (after protection latched)	150	230	350		$V_{in}=5\text{V}$

Lead Assignments



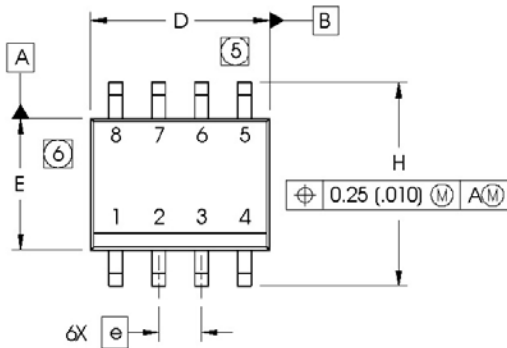
Functional Block Diagram

All values are typical

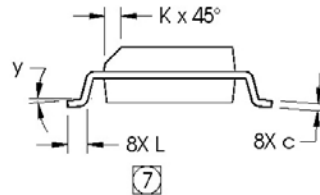
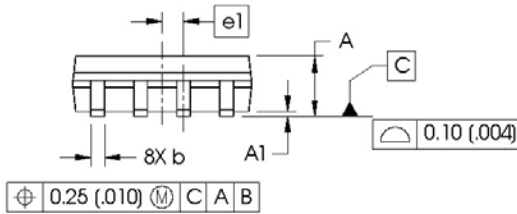


Case Outline - SO-8 - Automotive Q100 PbF MSL2 qualified

Dimensions are shown in millimeters (inches)

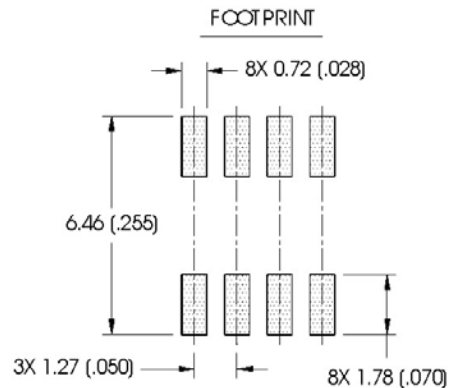


DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.0532	.0688	1.35	1.75
A1	.0040	.0098	0.10	0.25
b	.013	.020	0.33	0.51
c	.0075	.0098	0.19	0.25
D	.189	.1968	4.80	5.00
E	.1497	.1574	3.80	4.00
e	.050 BASIC		1.27 BASIC	
e1	.025 BASIC		0.635 BASIC	
H	.2284	.2440	5.80	6.20
K	.0099	.0196	0.25	0.50
L	.016	.050	0.40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



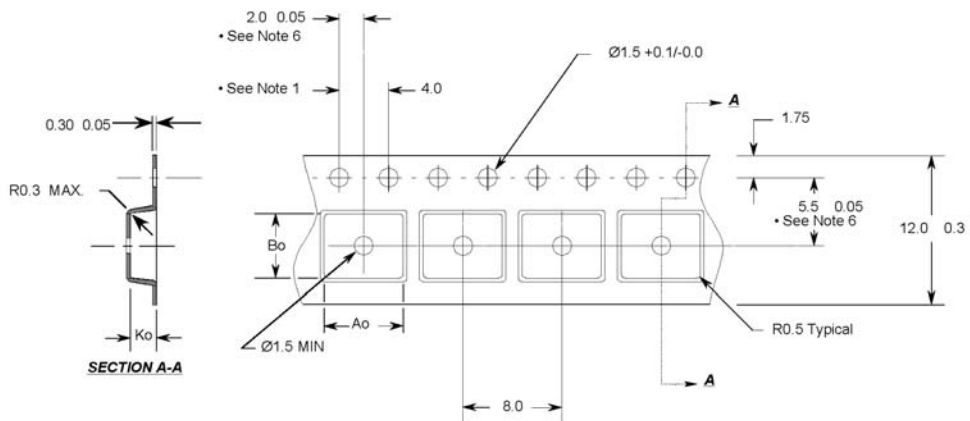
NOTES:

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.



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 -