LP5309

32V Tolerance Over-Voltage Protection Switch with Programmable Over-Current Protection
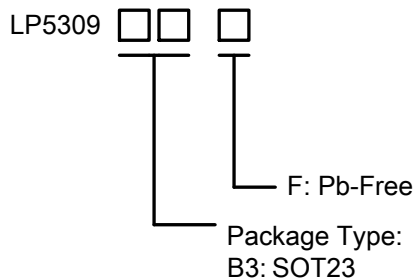
Features

- Input voltage tolerance up to 32V
- Low on-state resistance to 145mΩ
- 90μA low current consumption
- Integrated OCP at 2.5A (Typical)
- Under-voltage lockout: 2.7V
- Over-voltage protection: 6V
- Output discharge integrated
- Thermal shutdown protection
- ESD Protection:
  - Human Body Model: 4kV
  - Charged Device Model: 0.5kV
- Package: SOT23

Applications

- Notebook and PC
- Cell phone and PDAs
- USB or other peripheral ports
- Camera

General Description

The LP5309 is a power switch device provides full protection to systems and loads which may encounter large current and input over-voltage conditions.

The device contains a 145mΩ MOSFET which can operate over an input voltage range from 3.0V to 32V. The OVP will disconnect VIN and VOUT when the voltage on VIN is higher than over voltage threshold. The over-current protection could be settable using an external resistor. When the current reaches the threshold, the device will turn off the power FET to prohibit excessive currents from causing damage. Switch is controlled by an active-low logic pin. Thermal shutdown protection is integrated which shuts off the switch to prevent damage to the part when the temperature is higher than threshold.

These parts are available in space-saving SOT23 package.

SOT23

Marking Information

LP5309 ☐☐ ☐

F: Pb-Free

Package Type:
B3: SOT23

Ordering and Package Information

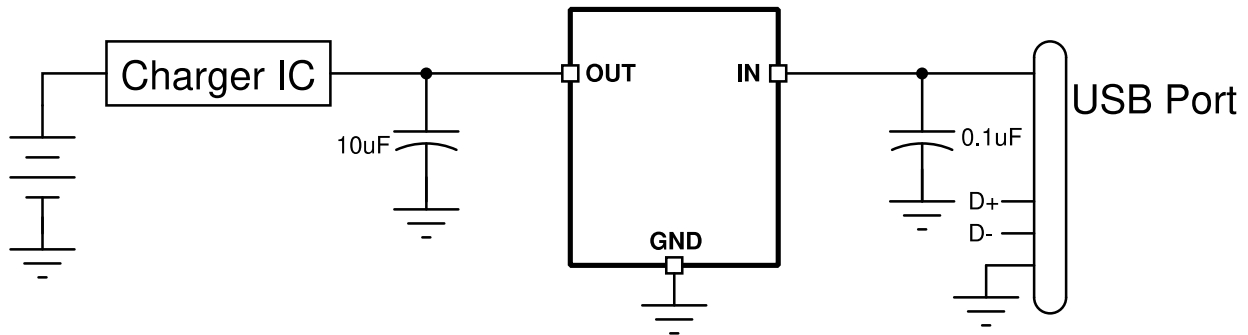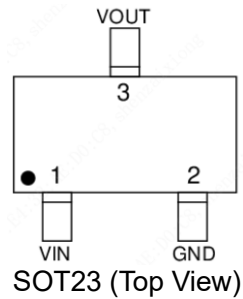| Part Number	Top Mark	Package	Tape & Reel
LP5309B3F	LPS 8AYWX	SOT23	3K/REEL
Marking indication: Y: Production Year, W: Production week, X: Series Number			

Typical Application Circuitry

Figure 1. Typical Application Circuitry

Pin Configuration

SOT23 (Top View)

Pin Description

Pin	Description
GND	Ground
VIN	Power supply and input of power switch
VOUT	Output of power switch

Functional Block Diagram

Figure 2. Internal Block Diagram

Absolute Maximum Ratings [(Note 1)]

- VIN to GND --- -0.3V to 32V
- VOUT to GND --- -0.3V to 7V
- Maximum Junction Temperature (T_A) -- 150°C
- Maximum Soldering Temperature (at leads, 10 seconds) ------------------------------ 260°C

Note 1: Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, instead of functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Thermal Information

- Maximum Power Dissipation (P_D, $T_A <= 25°C$) --------------------------------------- 0.6W
- Thermal Resistance (θJ_A) [(Note 2)] --- 203°C/W

Note 2: It is based on 2S2P JEDEC standard PCB.

ESD Ratings

- HBM (Human Body Model, JEDEC JS-001) -- ±4000V
- CDM (Charged Device Model, JEDEC JS-002) -------------------------------------- ±500V

Recommended Operating Conditions

- Input Voltage --- 3.0V to 5.5V
- Output Current --- 0A to 1.5A
- Ambient Temperature -- -40°C to 85°C

Electrical Characteristics

The following parameters are guaranteed under condition V_{IN} =5V, T_A = -40°C to 85°C unless otherwise noted, T_A = 25°C for typical value.

Parameters	Symbol	Test conditions	Min	Typ	Max	Unit
On-resistance	$R_{DS(ON)}$	V_{IN} = 5V, I_{OUT}=200mA, T_A=25°C		145	175	mΩ
Input quiescent current	I_Q	V_{IN} = 5V, OUT floating, V_{ENB} = 0V		90	150	μA
Input shutdown current	I_{SD}	V_{IN} = 5V, OUT grounded, V_{ENB} = 5V		1		μA
Under-Voltage Lockout level	V_{UVLO_F}	VIN voltage falling	2.6	2.7	2.8	V
	V_{UVLO_R}	VIN voltage rising	2.7	2.8	2.9	V
Over-Voltage Protection level	V_{OVP_F}	VIN voltage falling		5.9		V
	V_{OVP_R}	VIN voltage rising		6.0		V
Over current protection level	I_{OCP}	V_{IN} = 5V, T_A=25°C		2.53		A
OCP accuracy	ACC_{OCP}	V_{IN} = 5V, T_A=25°C, I_{OCP} > 150mA		15		%
		V_{IN} = 5V, T_A=25°C, I_{OCP} < 150mA		25		
Over-Voltage Protection response time	t_{OVP}	V_{IN} rising from 5V with 30V/μs, R_{OUT} = 100Ω, C_{OUT} = 0, time from V_{IN} > V_{OVP_R} to OUT voltage stop rising		30	50	ns
Short circuit protection level	I_{SHORT}	V_{IN} = 5V, T_A=25°C		5		A
Output auto discharge	R_{DIS}	V_{IN} = 5V, V_{EN} = 0V		3		kΩ
Enable logic high voltage level	V_{IH}	V_{IN} = 2.4V to 6V	1.4			V
Enable logic high voltage level	V_{IL}	V_{IN} = 2.4V to 6V			0.4	V
OCP qualification time	t_{OCP_QUAL}	V_{IN} = 5V, T_A = 25°C, qualification time from I_{OUT} hits I_{OCP} to switch turned off		150		μs
Load switch turned on delay	t_{DON}	V_{IN} = 5V, R_{OUT} = 100Ω, C_{OUT} = 22μF, time from enabled to V_{OUT} = 0.5		10		ms
Output rising time	t_R	V_{IN} = 5V, R_{OUT} = 100Ω, C_{OUT} = 22μF, time from V_{OUT} = 0.1×V_{IN} to 0.9×V_{IN}		450		μs
Load switch turned off delay	t_{OFF}	V_{IN} = 5V, R_{OUT} = 500Ω, C_{OUT} = 0.1μF, time from disabled to V_{OUT} = 0.9×V_{IN}		10		μs
Thermal shutdown trigger	T_{SD}	Temperature rising		150		°C
Thermal shutdown release	T_{SD_REL}	Temperature falling		130		°C

Note 3. The parameter is guaranteed by design and characterization.
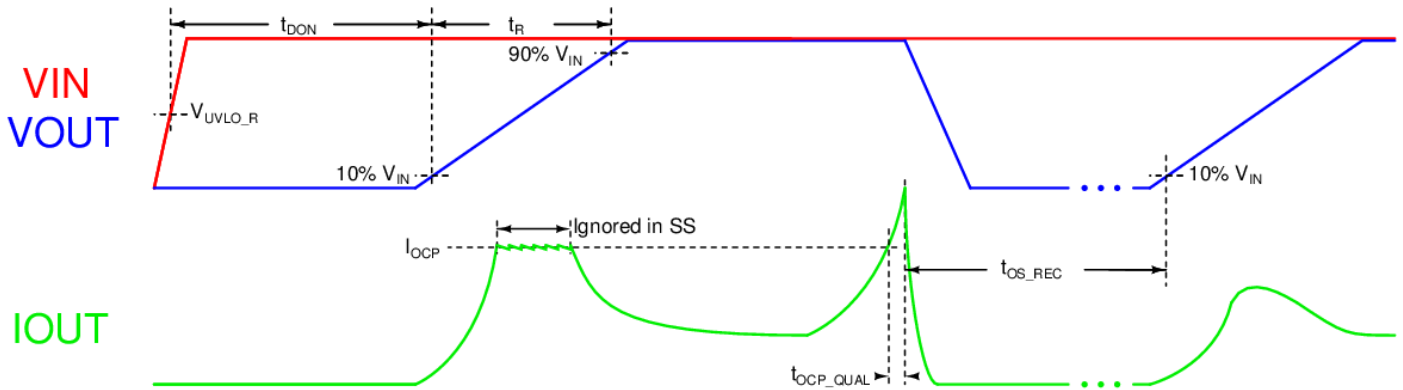
Typical Timing Diagram

Figure 3. Start-up and over current protection
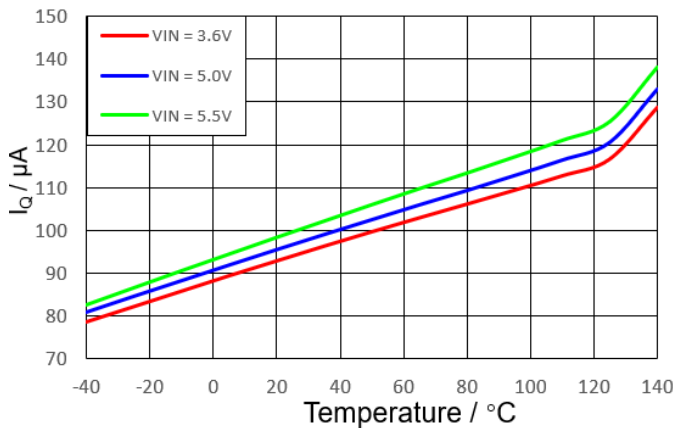
Typical Performance Characteristics

Figure 4. Quiescent Current vs Temperature and V$_{IN}$ (C$_{IN}$=C$_{OUT}$=1μF, no load)
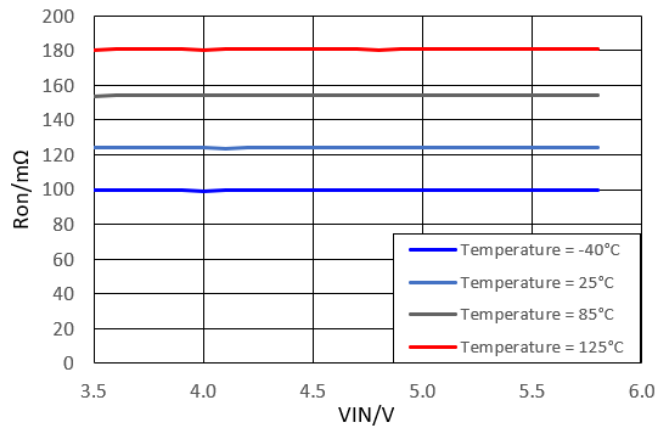

Figure 7. On-resistance vs Input Voltage (I$_{LOAD}$ = 100mA)
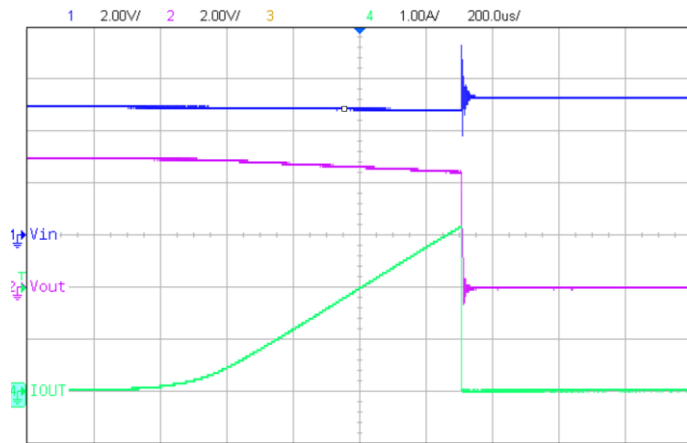
Typical Operating Waveforms

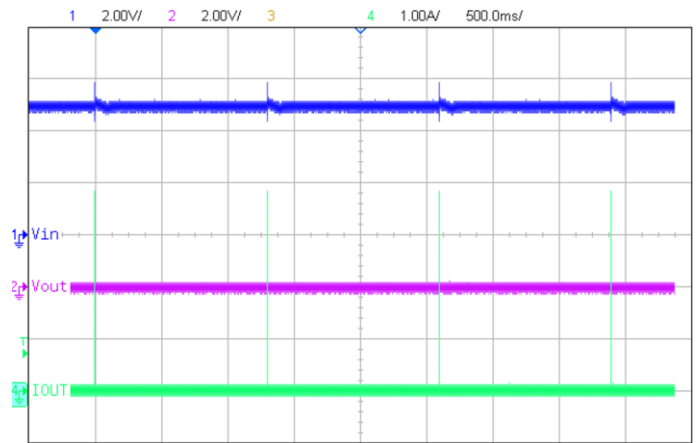**Figure 10. Over-Current Protection Response**

Figure 11. Short-Circuit Protection Response
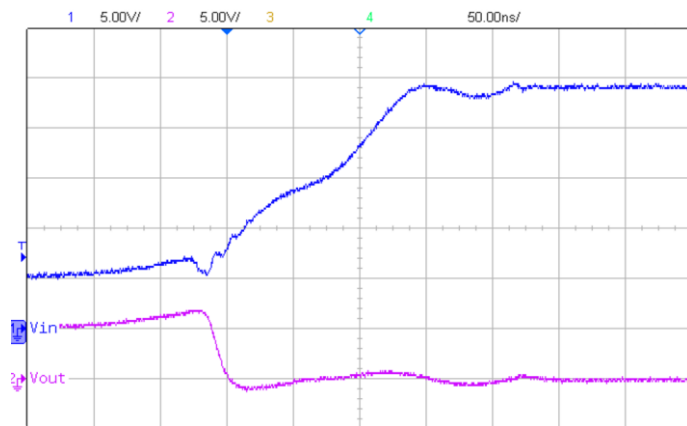

Figure 12. Over-Voltage Protection Response
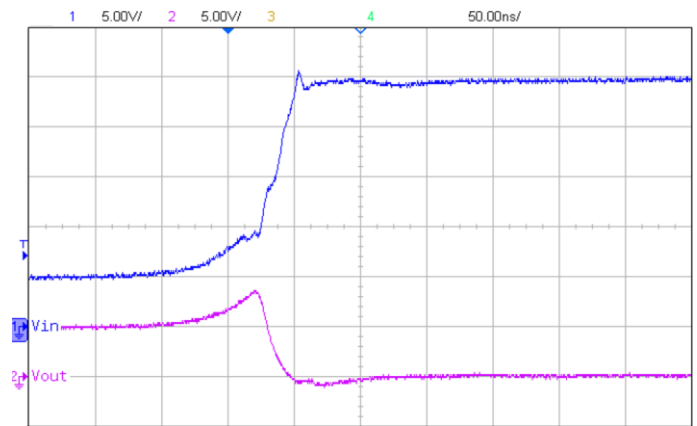**(V_{IN} normal ramp-up with 4V / 100ns, R_{LOAD} = 100Ω)**

Figure 13. Over-Voltage Protection Response
(V_{IN} fast ramp-up with 25V / 100ns, R_{LOAD} = 100Ω)

Function Description

General Description

LP5309 is an OVP power switch integrated OCP feature to protect systems and loads which can be damaged or disrupted by the application of high currents. The devices all contain a 145mΩ N-channel MOSFET and a controller capable of working over a wide input operating range of 3V to 32V. The controller protects against system malfunctions through over-current protection, under-voltage lockout and thermal shutdown.

Over-Current Protection

The OCP feature ensures that the device will disconnect output from input when current through the switch exceed a setting value. The current at which the parts will limit is fixed to 2.53A (typical). Once the switch is turned off, unless by disabled through ENB pin, it will not conduct again until 1.3s later. The hiccup behavior will continue as long as the heavy loading condition exist.

Over-Voltage Protection

The LP5309 has Over-Voltage protection to prevent high voltage on VIN passing through to VOUT. Once the voltage on input exceeds the OVP threshold, the power FET will be turned off immediately. When VIN drop back below OVP release level, the switch will be turned on again after a 10ms de-bounce time.

Under-Voltage Lockout

The under-voltage lockout turns-off the switch if the input voltage drops below the under-voltage lockout threshold. With the input voltage rising above the under-voltage lockout threshold more than 10ms will cause a controlled turn-on of the switch which limits current over-shoots.
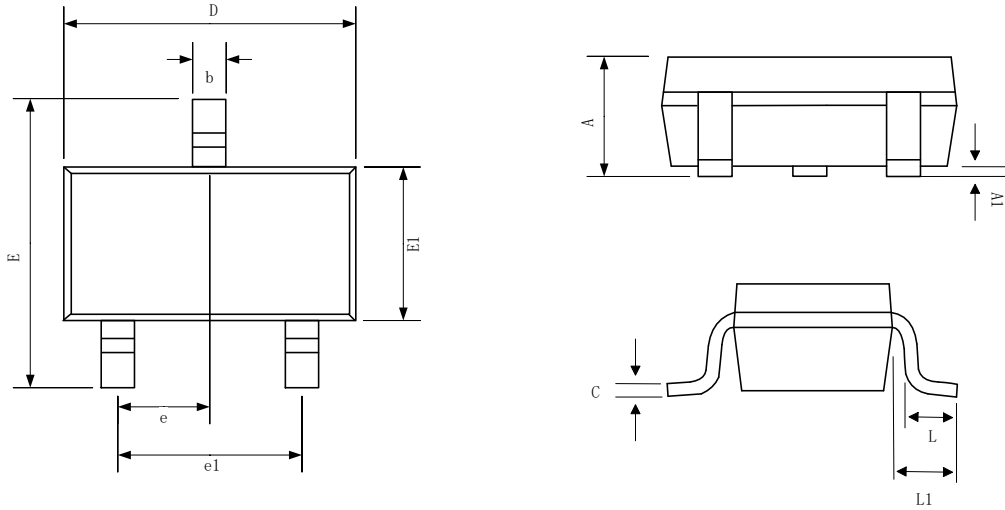
Thermal Shutdown

The thermal shutdown protects the device from internally or externally generated excessive temperatures. During an over temperature condition, the switch is turned off. The switch automatically turns on again if the temperature drops below the threshold temperature more than 1.3s.

Package Information

SOT23

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.900		1.200
A1	0.000	0.050	0.100
b	0.300	0.400	0.500
c	0.008	0.120	0.150
D	2.800	2.900	3.000
E	2.250	2.400	2.550
E1	1.200	1.300	1.400
e	0.950BSC		
e1	1.900BSC		
L	0.200	0.350	0.500
L1	0.550REF		