60V,480KHz,0.5A Low Dropout Linear Regulator

Description

- SL9459 is a step-down switch regulator with an integrated power MOSFET. It achieves fast loop response andimproves loop stability through current mode control.
- It offers high-efficiency output of 0.5A current with a wide input voltage range from 4.5V to 60V, suitable for various step-down power conversion applications in mobile environments.
- Its shutdown static current of 0.1uA makes it suitable for battery-powered applications.
- Fault protection features include cycle-by-cycle current limiting protection and thermal shutdown protection.
- The circuit has a simple peripheral design and comes in an SOT23-6L package.

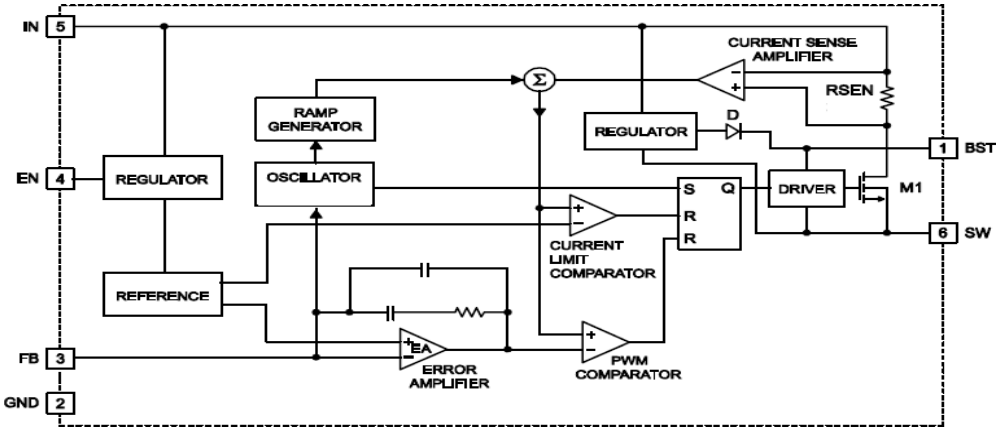
Features

- 0.5A peak output current
- Wide operating voltage range from 4.5V to 60V
- Internal power MOSFET with 1Ω on resistance
- Fixed switching frequency of 480kHz
- Ceramic output capacitor for stability
- Cycle-by-cycle overcurrent protection
- Thermal shutdown protection
- Efficiency greater than 90%
- Adjustable output from +0.81V to 0.95Vin
- Low shutdown mode current: <1uA
- 6-pin SOT23 package

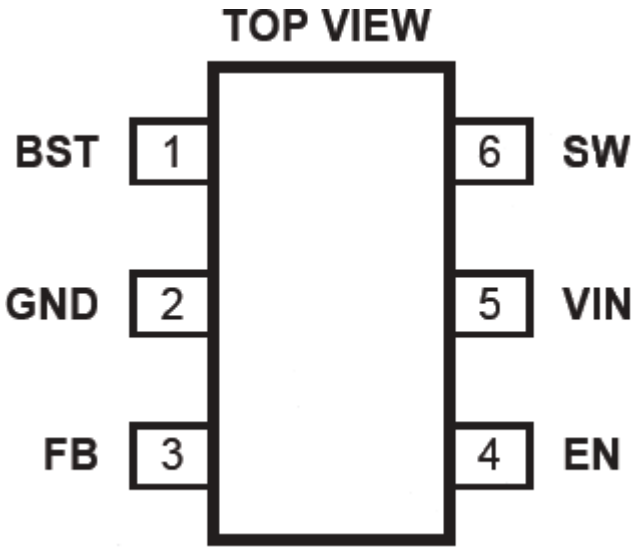
Application

- High voltage power conversion
- Automotive systems
- Industrial power systems
- Distributed power systems
- Battery-powered systems

Block diagram



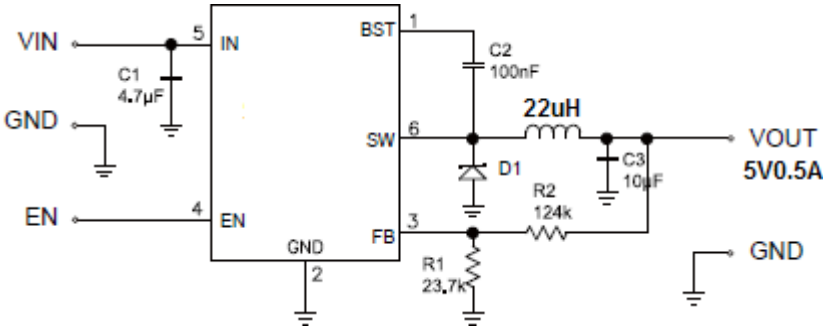
Outline diagram



Pin function

Pin Number	Pin Name	Function
1	BST	bootstrap pin. internally connected to the positive supply terminal of the high-side mosfet driver. connects to a boost capacitor between this pin and sw.
2	GND	ground pin. its connection should be made as close as possible to the output capacitor, avoiding high-current switching paths.
3	FB	feedback. input to the error amplifier. sets the output voltage. when the load is shorted, if the fb voltage drops below 250mv, the foldback circuit reduces the oscillation frequency to ensure reliable current limiting protection.
4	EN	enable input. pulling this pin voltage below the specified threshold will disable the chip. pulling it above the specified threshold enables the chip tooperate. connecting a 100k resistor to in automatically activates it.
5	IN	power supply input. supplies power to all internal control circuits. a decoupling capacitor should be connected to ground to reduce switching noise spikes.
6	SW	switching output pin. it is recommended to connect a low vf schottky diode to ground nearby to reduce switching noise spikes.

Application diagram



Maximum ratings

Parameter	Value
supply voltage(V_{in})	-0.3V to 62V
switch voltage (V_{sw})	-0.3V to V_{IN} (Max)+0.3V
bst to sw	-0.3 to 6.0V
other pins	-0.3V to 6.0V
continuous power consumption(Ta=+25°c)	0.568W
node temperature	150°C
pin temperature	260°C
storage temperature	-65°C to 150°C

Recommended working conditions

Parameter	Value
supply voltage Vin	4.5V to 60V
sw terminal voltage Vout	+0.81V to 0.95*VIN
junction temperature (Tj)	-40°C to +125°C

Thermal resistance

	θ_{JA}	θ_{JC}	
SOT23-6L	220	110	°C/W

Electrical characteristics

V_{in}=12V, V_{en}=2V, T_a=25°C, except for special conditions.

Symbol	Parameter	Test condictions	Min	Typ	Max	Unit
V_{fb}	feedback voltage	4.5<V_{in}<60V	0.792	0.812	0.832	V
R_{sw}	switch-on resistance	V_{bst}-V_{sw}=5V		1		Ω
I_{swleak}	switch leakagecurrent	V_{en}=0V, V_{sw}=0V			1	uA
I_{lim}	extreme current		1.0	1.25	1.5	A
F_{osc}	oscillation frequency		380	480	580	KHZ
F_{sw-f}	foldback frequency	V_{fb}=0V		150		KHz
V_{uvlo-r}	undervoltage turn-on voltage		2.9	3.3	3.73	V
V_{uvlo-f}	undervoltage turn-off voltage		2.65	3.05	3.45	V
T_{on} min	minimum switch-on time			100		ns
V_{enr}	enable turn-on voltage			1.35		V
V_{enf}	enable turn-off voltage			1.17		V
I_{en}	en input current quiescent current	V_{en}=2V		3.1		uA
		V_{en}=0V		0.1		uA

Principle of operation

- The SL9459 is a current-mode buck switching regulator circuit with an internal high-voltage power MOSFET, operating at a 480kHz oscillation frequency.
- Its internal error amplifier outputs a signal proportional to peak inductor current, comparing the feedback signal with an internal 0.812V reference voltage to stabilize the output voltage.
- It features a wide input voltage range, precise current limiting, and very low quiescentcurrent, making it suitable for battery-powered applications.

Application

Component selection and output voltage setting

The output voltage is set by the voltage divider connected to the FB terminal, according to the feedbackdivider ratio:
$V_{FB} = V_{OUT}*R_2/(R_1 + R_2)$

The reference resistors for each output voltage.

Vout（V）	R1(KΩ)	R2(KΩ)
1.8	64.9（1%）	80.6（1%）
2.5	23.7（1%）	49.9（1%）
3.3	16.2（1%）	49.9（1%）
5	9.53（1%）	49.9（1%）

Inductor (l)

When switching input voltages, the inductor is used to provide continuous current to the output load, with larger inductors yielding lower output ripple. Typically, the choice of inductor involves selecting one rated for a current 30% higher than the maximum load current. Simultaneously, ensure that the peak current is less than the maximum switch current to avoid saturation at peak inductance.

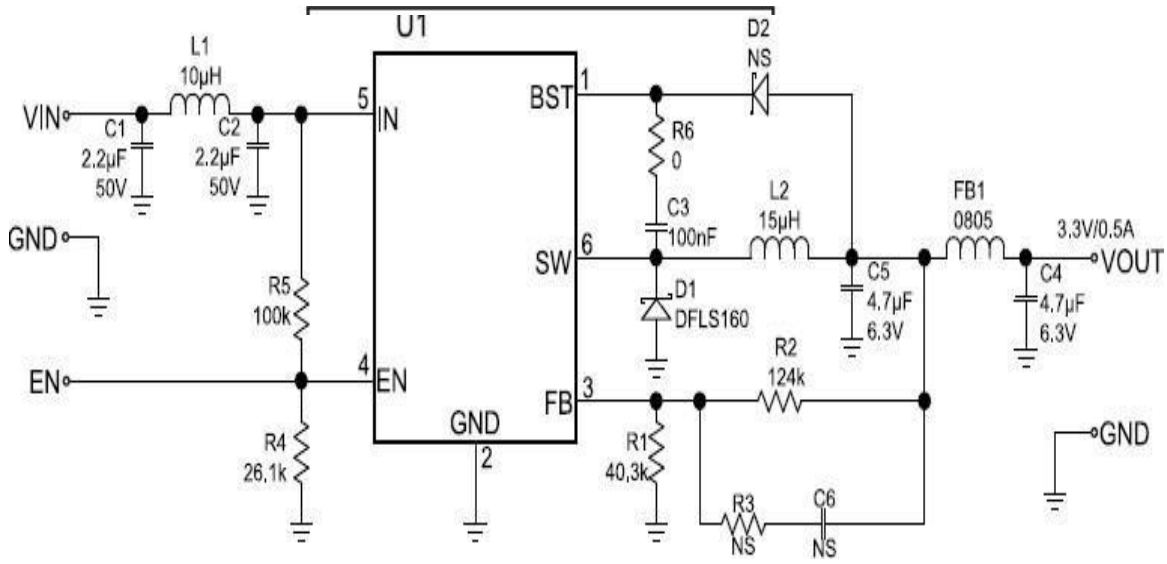
Input capacitance

Input capacitors can be electrolytic, tantalum, or ceramic capacitors. When using electrolytic or tantalum capacitors, include a small ceramic capacitor (e.g., 0.1uF) placed close to the circuit. When using ceramic capacitors, ensure they have sufficient capacitance to mitigate excessive input voltage ripple.

Output capacitance

Output capacitors maintain DC voltage stability at the output. It is recommended to use low ESR electrolytic capacitors to minimize output voltage ripple. The characteristics of output capacitors impact the stability of the voltage regulation system.

Typical Application Circuit



3.3V Output Application Circuit

Pcb layout

The PCB layout is crucial for ensuring stable operation of the circuit. Here are some recommendations:

1) Keep the switch current paths as short as possible. Minimize the loop area formed by the input capacitor, high-side MOSFET, and external switch diode.

2) Place bypass ceramic capacitors close to the VIN terminal.

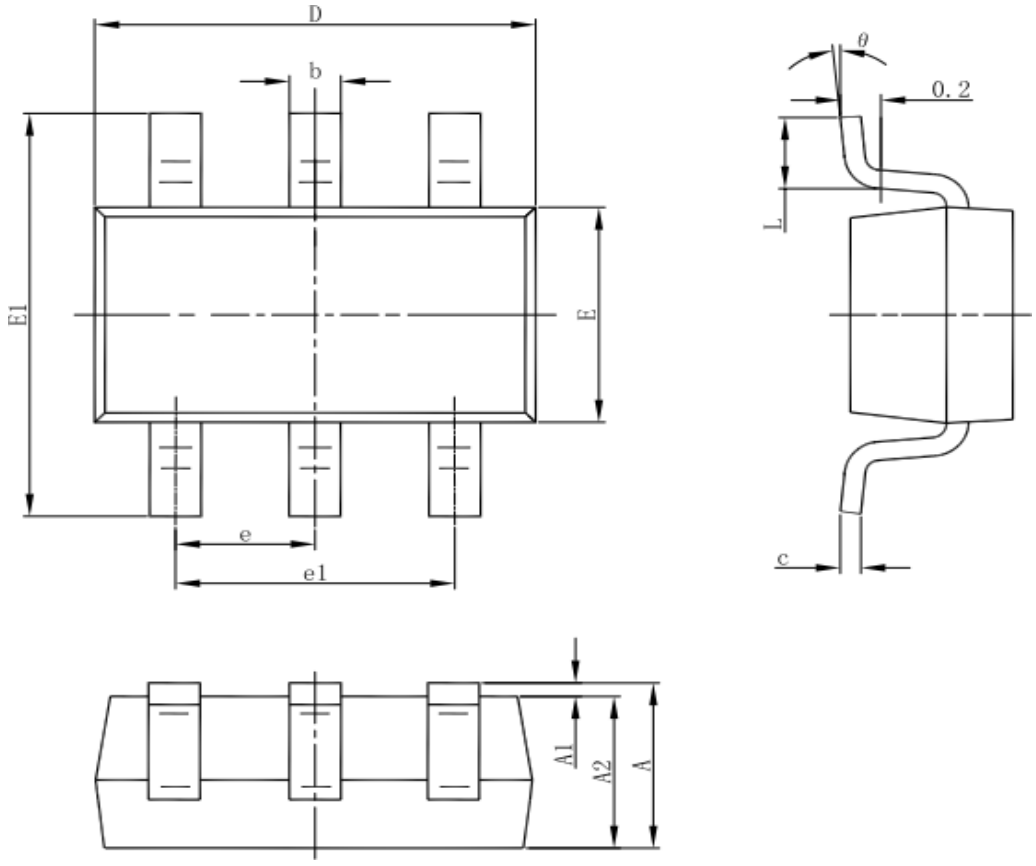
3) Ensure all connections for feedback circuits are short and direct. Position feedback resistors and compensation components as close to the chip as possible.

4) Route SW lines away from sensitive analog areas such as FB.

5) Connect SW, IN, and especially GND to large copper areas separately to enhance chip cooling, improve thermal performance, and ensure long-term reliability.

Package Dimensions Diagram:

SOT23-6L



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°