# 60V , 1.2A ,480KHz,DC-DC Step-Down Converter

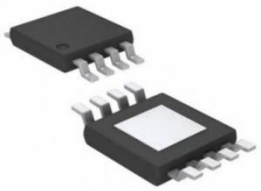
# SSP9461

## General Description

The SSP9461 is a monolithic, step-down, switch-mode converter with a built-in power MOSFET. Current-mode operation provides a fast transient response and eases loop stabilization.

The wide input range(4.5V to 60V) provides high efficiency output of 1.2A current. Low shutdown mode quiescent current of 0.1μA is suitable for battery-powered applications.

Fault state protection includes Cycle by Cycle OCP and thermal shutdown protection.



ESOP-8

## Features

- Output 1.2A peak current
- Operation from 4.5V to 60V Input
- 1Ω internal power MOSFET
- 480KHz fixed switching frequency
- Stable with ceramic output capacitors
- Cycle by Cycle OCP
- Thermal shutdown protection
- >90% efficiency
- Output voltage: adjustable from +0.81V to 0.95VIN
- Low shutdown mode current：<1μA
- ESOP-8 package with good heat dissipation

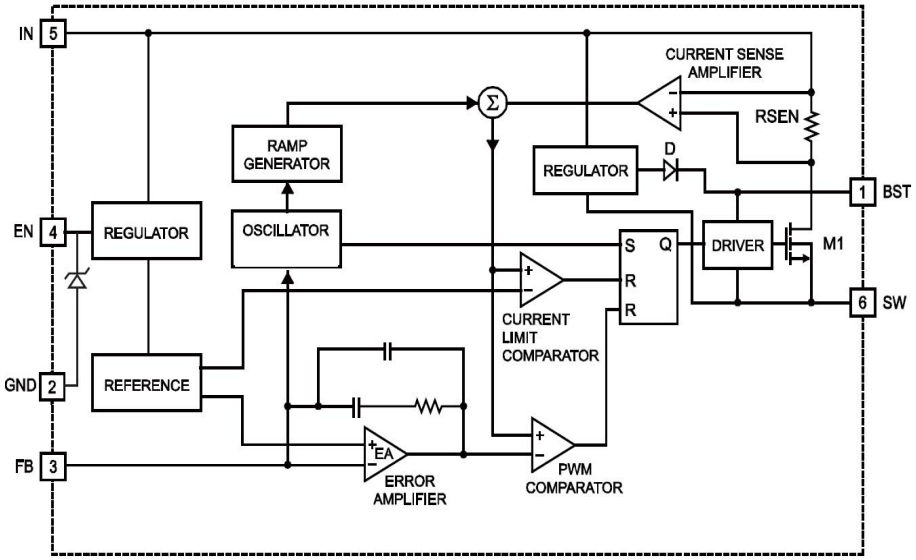
## Applications

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

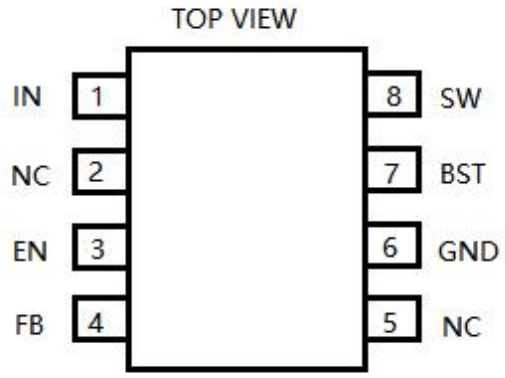
## Order specification

| Part No | Package | Manner of Packing | Devices per bag/reel |
|---|---|---|---|
| SSP9461 | ESOP-8 | Reel | 4000 |

## Block Diagram and Pin Arrangement Diagram




## Pin Assignment




| Pin No. | Pin Name | Description |
|---|---|---|
| 1 | VIN | Input Supply. All internal control circuits are powered. A decoupling capacitor to ground is required close to this pin to reduce switching spikes. |

| | | |
|---|---|---|
| 2 | NC | No connected. |
| 3 | EN | Enable input. Pull this pin below the specified threshold to disable. Pull it above the specified threshold to enable. Connect 100K resistor to IN, it can be turned on automatically. |
| 4 | FB | Feedback. This is the input to the error amplifier. Set the output voltage. When the load is short-circuited and the FB voltage is lower than 250mV, the reentry circuit will reduce the oscillation frequency to ensure reliable current limiting protection. |
| 5 | NC | No connected. |
| 6 | GND | Ground. It should be connected as close as possible to the output capacitor,avoid high current switching paths. |
| 7 | BST | Bootstrap. This is the positive power supply for the internal floating high side MOSFET driver.Connect a bypass capacitor between this pin and SW pin. |
| 8 | SW | Switch node. A low VF Schottky diode to ground is required close to this pin to reduce switching spikes. |

## Absolute Maximum Ratings

| Parameter | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|
| Supply Voltage | $V_{IN}$ | -0.3 | 62 | V |
| Switch Voltage | $V_{SW}$ | -0.3 | $V_{IN}$(MAX)+0.3 | V |
| BST to SW | | -0.3 | 6.0 | V |
| All Other Pins | | -0.3 | 6.0 | V |
| Continuous Power Dissipation(TA=+25℃) | $P_D$ | | 0.568 | W |
| Junction Temperature | T | | 150 | ℃ |
| Lead Temperature | T | | 260 | ℃ |
| Storage Temperature | $T_{STG}$ | -65 | 150 | ℃ |
| Operating Junction Temp | $T_J$ | -40 | 125 | ℃ |
| Junction-to-Ambient THermal Resistance | $\theta_{JA}$ | | 50 | ℃/W |
| Junction-to-Case THermal Resistance | $\theta_{JC}$ | | 10 | ℃/W |

## Recommended Operating Conditions

| Parameter | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|
| Supply Voltage | $V_{IN}$ | 4.5 | 60 | V |
| Output Voltage | $V_{OUT}$ | 0.81 | 0.95*$V_{IN}$ | V |

## Electrical Characteristics

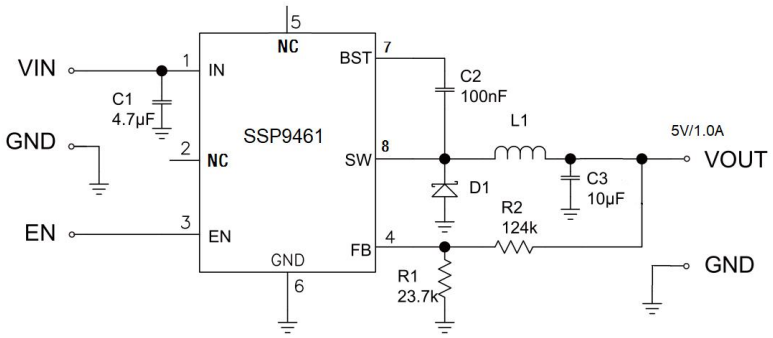
Vin=12V,Ven=2V,Tamb= 25℃,unless specified otherwise.

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Feedback Voltage | Vfb | 4.5<Vin<60V | 0.792 | 0.812 | 0.832 | V |
| Upper Switch ON Resistance | Rsw | Vbst-Vsw=5V | | 1 | | Ω |
| Upper Switch Leakage | Iswleak | Ven=0V, Vsw=0V | | | 1 | μA |
| Limiting Current | Ilim | | | 1.5 | | A |
| Oscillator Frequency | Fosc | | 380 | 480 | 580 | KHz |
| Turn-back frequency | Fsw-f | Vfb=0V | | 150 | | KHz |
| Under-voltage on voltage | Vuvlo-r | | 2.9 | 3.3 | 3.73 | V |
| Under-voltage lockout | Vuvlo-f | | 2.65 | 3.05 | 3.45 | V |
| Minimum Switch ON Time | Ton min | | | 100 | | ns |
| Enable on voltage | Venr | | | 1.35 | | V |
| Enable off voltage | Venf | | | 1.0 | | V |
| EN input current | Ien | Ven=2V | | 3.1 | | μA |
| | | Ven=0V | | 0.1 | | μA |
| Quiescent Current | Iq | Ven=2V, Vfb=1V | | 0.73 | 0.86 | mA |
| Shutdown Current | Is | Ven=0V | | 0.1 | 1.0 | μA |
| Thermal Shutdown | Tsd | | | 165 | | ℃ |

## Detailed Description

The SSP9461 is a 480KHz, step-down(buck) regulator with integrated internal high side MOSFET. The output of the circuit's internal error amplifier is proportional to the peak inductance current, and the feedback signal is compared with the internal 0.812V reference voltage to stabilize the output voltage. It has a wide input voltage range, precise current limits, low operational quiescent current feature is suit for battery powered applications.

## Application Circuits



### PCB Layout Guidelines:

PCB layout is very important for the circuit to achieve stable operation. The following suggestions are for your reference:

1.Switching current path as short as possible, input capacitance, high-side MOSFET and external high-speed switching Schottky diode formed loop area as small as possible.

2. Bypass ceramic capacitor is placed near the VIN end.SW output related cables should be as short and thick as possible.

3. All feedback circuit connections should be short and direct, with feedback resistance and compensation elements as close to the chip as possible.

4. SW route should be far away from sensitive simulated areas, such as FB.

5. SW, IN, and especially ground should be connected to a large copper-clad area to cool the chip, improve thermal performance, and enhance long-term reliability.

## Application recommendation: Select components

### Setting the Output Voltage

The output voltage is set using a resistive voltage divider from the output voltage to FB pin. VFB=VOUT*R1/(R1+R2)

Reference resistance 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

The inductor is required to supply constant current to the output load. A larger value inductor will result in lower output ripple voltage.However, the volume will be larger, large series resistance and low saturation current.

Generally, a good rule for determining the inductance to use is to allow the peak-to-peak ripple current in the inductor to be approximately 30% of the maximum load current. Also, make sure that the peak inductor current is below the maximum switch current limit.， it will not saturate at the maximum inductance peak. L1 can be calculated according to the following formula:

$$L1 = \frac{V_{OUT}}{f_S \times \Delta I_L} \times \left(1 - \frac{V_{OUT}}{V_{IN}}\right)$$

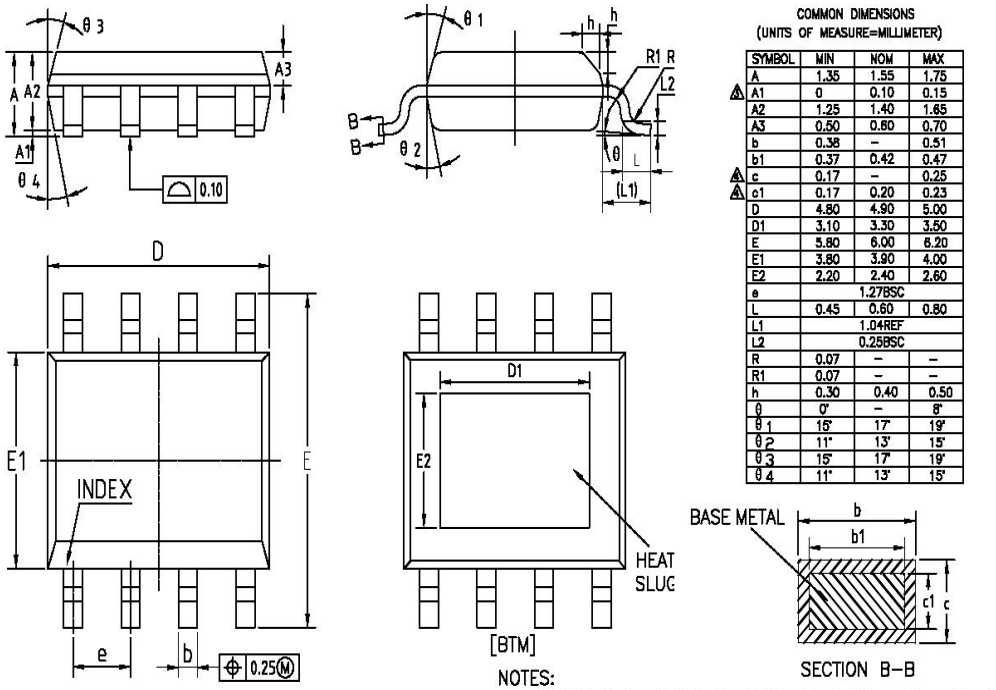
### Input Capacitor

The input capacitor can be electrolytic, tantalum or ceramic. When using electrolytic or tantalum capacitors, a small, high quality ceramic capacitor, i.e. 0.1μF, should be placed as close to the IC as possible. When using ceramic capacitors, make sure they have sufficient capacitance values to prevent input from excessive voltage ripple.

### Output Capacitor

The output capacitor is used to maintain the DC output voltage. Low ESR electrolytic capacitors are recommended to keep the output voltage ripple low. The characteristics of the output capacitor will affect the stability of the voltage stabilizer system.

## Package Information（ESOP8）




COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

| SYMBOL | MIN | NOM | MAX |
|---|---|---|---|
| A | 1.35 | 1.55 | 1.75 |
| A1 | 0 | 0.10 | 0.15 |
| A2 | 1.25 | 1.40 | 1.65 |
| A3 | 0.50 | 0.60 | 0.70 |
| b | 0.38 | – | 0.51 |
| b1 | 0.37 | 0.42 | 0.47 |
| c | 0.17 | – | 0.25 |
| c1 | 0.17 | 0.20 | 0.23 |
| D | 4.80 | 4.90 | 5.00 |
| D1 | 3.10 | 3.30 | 3.50 |
| E | 5.80 | 6.00 | 6.20 |
| E1 | 3.80 | 3.90 | 4.00 |
| E2 | 2.20 | 2.40 | 2.60 |
| e | | 1.27BSC | |
| L | 0.45 | 0.60 | 0.80 |
| L1 | | 1.04REF | |
| L2 | | 0.25BSC | |
| R | 0.07 | – | – |
| R1 | 0.07 | – | – |
| h | 0.30 | 0.40 | 0.50 |
| θ | 0° | – | 8° |
| θ1 | 15° | 17° | 19° |
| θ2 | 11° | 13° | 15° |
| θ3 | 15° | 17° | 19° |
| θ4 | 11° | 13° | 15° |

NOTES:
ALL DIMENSIONS REFER TO JEDEC STANDARD MS-012 AA
DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.

| Symbol | Dimensions In Millimeters | | | Symbol | Dimensions In Millimeters | | |
|---|---|---|---|---|---|---|---|
| | Min. | Typ | Max. | | Min. | Typ | Max. |
| **A** | - | - | 1.77 | **D** | 4.7 | 4.9 | 5.1 |
| **A1** | 0.08 | 0.18 | 0.28 | **E** | 5.8 | 6 | 6.2 |
| **A2** | 1.2 | 1.4 | 1.6 | **E1** | 3.7 | 3.9 | 4.1 |
| **A3** | 0.55 | 0.65 | 0.75 | **e** | 1.27BSC | | |
| **b** | 0.39 | - | 0.48 | **L** | 0.5 | 0.65 | 0.8 |
| **b1** | 0.38 | 0.41 | 0.43 | **L1** | 1.05BSC | | |
| **c** | 0.21 | - | 0.26 | θ | 0° | - | 8° |
| **D1** | 3.1 | 3.3 | 3.5 | **E2** | 2.2 | 2.4 | 2.6 |

## Special Instructions

The company reserves the right of final interpretation of this specification.

## Version Change Description

| | | |
|---|---|---|
| Version：V1.3 | Author：Siyuan Wu | Time：2021.10.14 |

Modify the record：

1. Re-typesetting the manual and checking some data

# Statement

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