



### DESCRIPTION

The A7120H is a monolithic integrated circuit designed for step-down (buck) DC/DC converter applications. It features a low EMI signature, making it ideal for noise-sensitive environments. The device supports up to 2A continuous output current with excellent load and line regulation, ensuring stable performance across varying conditions.

Key performance features include the ability to operate at up to 97% duty cycle, allowing for low dropout operation, which is critical for maximizing output voltage in low-input voltage scenarios. An internal soft start minimizes inrush current during startup, helping to extend battery life in portable applications.

Protection Features are Cycle-by-cycle peak current limit, Short-circuit protection, Thermal shutdown, and Under-voltage lockout (UVLO)

The A7120H is offered in a PSOP-8 package, providing a compact, thermally efficient solution for a variety of power management.

### ORDERING INFORMATION

| Package Type                   | Part Number                               |             |
|--------------------------------|---|-------------|
| PSOP8<br>SPQ:4,000pcs/Reel     | MP8                                       | A7120HMP8VR |
| Note                           | V: Halogen free Package<br>R: Tape & Reel |             |
| AiT provides all RoHS products |   |             |

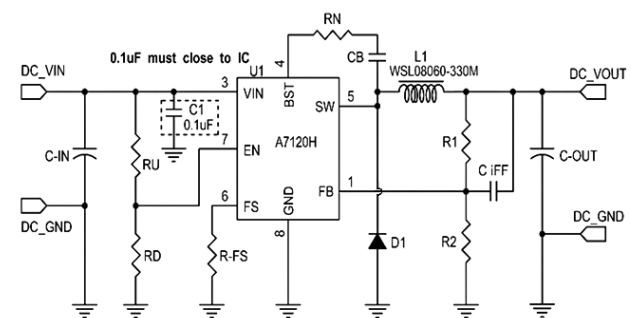
### FEATURES

- Wide input voltage Range: 4.5V~100V
- Adjustable Output Voltage: 0.78V to  $V_{IN}$
- 2A Continuous Output Current
- Low  $R_{DS(ON)}$  Internal Switches: 900mΩ
- Adjustable Switching Frequency: 150K/ 270K/ and 450K
- High Duty Cycle Operation: up to 97%
- Short Circuit Protection
- Over Current Protection
- Internal Soft Startup
- Thermal Shutdown Protection

### APPLICATION

- LCD Monitor and LCD TVs
- Battery-powered Equipment
- Entertainment Devices
- Digital Home Appliances (e.g., Digital TVs)
- ADSL Modem and Portable Instruments

### TYPICAL APPLICATION



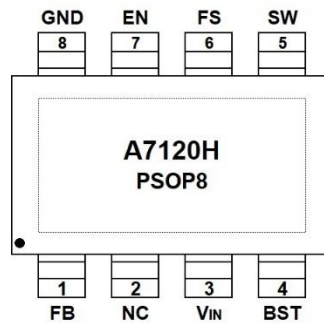
L1: WSL08060-330M

WSL10040-470M

D1:SS310A



**PIN DESCRIPTION**



PSOP8, MP8

Top View

| PIN# | Symbol          | Function   |
|------|-----------------|--|
| 1    | FB              | Feedback: Provides input to the internal control loop. Connect this pin to an external resistor divider from the output to set the regulated output voltage. |
| 2    | NC              | Do not connect   |
| 3    | V <sub>IN</sub> | Power supply voltage input   |
| 4    | BST             | Bootstrap: A capacitor must be connected between the BST and SW pins to create a floating voltage supply that drives the high-side MOSFET gate.              |
| 5    | SW              | Switch pin connected to the internal FET switches and inductor terminal. Connect the inductor of the output filter to this pin.                              |
| 6    | FS              | Switching Frequency Set  |
| 7    | EN              | Enable: Logic input for device enable control. A logic high enables the device, while a logic low disables it and places it into shutdown mode.              |
| 8    | GND             | Ground pin.  |

**ABSOLUTE MAXIMUM RATINGS**

Over operating temperature range(25°C) (unless otherwise noted)

|   |                                    |                                |
|---|------------------------------------|--------------------------------|
| Voltage <sup>(1)</sup>  | V <sub>IN</sub>                    | -0.3V ~ +110V                  |
|   | EN                                 | -0.3V ~ +6.5V                  |
|   | BST                                | V <sub>SW</sub> +5V            |
|   | SW (less than 10ns) <sup>(2)</sup> | -0.3V ~ +V <sub>IN</sub> +0.5V |
|   | FB                                 | -0.3V ~ +6.5V                  |
| T <sub>J</sub> , Operating Junction Temperature                   |                                    | -40°C ~ +150°C                 |
| T <sub>STG</sub> , Storage Temperature                            |                                    | -55°C ~ +150°C                 |
| R <sub>θJA</sub> , Junction-to-Ambient Thermal Resistance         |                                    | 48.8 °C/W                      |
| R <sub>θJC(top)</sub> , Junction-to-Case (top) Thermal Resistance |                                    | 52.5 °C/W                      |

Stresses above may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated in the Electrical Characteristics are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

(1) All voltage values are with respect to network ground terminal.

(2) While switching

**RECOMMENDED OPERATING CONDITIONS**

|   | MIN. | MAX. | Units |
|---|------|------|-------|
| Operating Junction Temperature <sup>(1)</sup> | -40  | 125  | °C/W  |
| Operating Temperature Range                   | -40  | 85   | °C/W  |
| V <sub>IN</sub> , Input Voltage               | 4.5  | 100  | V     |
| V <sub>OUT</sub> , Output Voltage             | 0.8  | 30   | V     |
| Output Current(12V)                           | 0    | 1.5  | A     |
| Output Current(5V)                            | 0    | 2.0  | A     |
| Output Current (5V Load Peak<100mS)           | 0    | 3.5  | A     |

(1) All limits specified at room temperature (T<sub>A</sub> = 25°C) unless otherwise specified. All room temperature limits are 100% production tested. All limits at temperature extremes are ensured through correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level (AOQL).

**ELECTRICAL CHARACTERISTICS** $V_{IN}=48V$ ,  $T_A=25^{\circ}C$ , unless otherwise specified.

| Parameter                                 | Symbol              | Conditions       | Min | Typ. | Max | Unit        |
|---|---------------------|------------------|-----|------|-----|-------------|
| Input Voltage Range                       | $V_{IN}$            |                  | 4.5 | -    | 100 | V           |
| Non Switching Quiescent Current           | $I_Q$               | EN=5V            | -   | 175  | 300 | $\mu A$     |
| Shut Down Current                         | $I_{OFF}$           | EN = GND         | -   | -    | 3   | $\mu A$     |
| Regulated Feedback Voltage                | $V_{FB}$            |                  | 764 | 780  | 795 | mV          |
| $V_{IN}$ Under Voltage Lockout            | $V_{IN(UVLO)}$      |                  | -   | 4.3  | -   | V           |
| $V_{IN}$ Under Voltage Lockout Hysteresis |                     |                  | -   | 200  | -   | mV          |
| <b>ENABLE (EN PIN)</b>                    |                     |                  |     |      |     |             |
| Enable Threshold                          | $V_{(EN\_RISING)}$  | Rising           | 1.5 | -    | -   | V           |
|   | $V_{(EN\_FALLING)}$ | Falling          | -   |      | 1   | V           |
| Threshold Hysteresis                      | $V_{(EN\_HYS)}$     |                  | -   | 200  | -   | mV          |
| EN Pull-Up Current                        | $I_{(ENPULL\_UP)}$  | $V_{EN}=HIGH$    | -   | 4    | -   | $\mu A$     |
|   |                     | $V_{EN}=LOW$     | --  | 1    | -   | $\mu A$     |
| <b>POWER STAGE</b>                        |                     |                  |     |      |     |             |
| High-Side FET on Resistance               | $R_{(HSD)}$         | $I_{SW}= 1000mA$ | -   | 900  | -   | m $\Omega$  |
| <b>CURRENT LIMIT</b>                      |                     |                  |     |      |     |             |
| High side FET Current Limit               | $I_{(LIM\_HS)}$     | FB=90%           | -   | -    | 3.5 | A           |
| <b>OSCILLATOR</b>                         |                     |                  |     |      |     |             |
| Centre Switching Frequency                | $F_{SW}$            | FS=Float         | -   | 450  | -   | kHz         |
|   |                     | FS=240K          | -   | 270  | -   | kHz         |
|   |                     | FS=75K           | -   | 150  | -   | kHz         |
| <b>OVER TEMPERATURE PROTECTION</b>        |                     |                  |     |      |     |             |
| Rising Temperature                        | Thermal Shutdown    |                  | -   | 160  | -   | $^{\circ}C$ |
| Hysteresis                                |                     |                  | -   | 20   | -   | $^{\circ}C$ |
| Soft Start                                |                     |                  | 1   | 1.8  | 3   | ms          |



**TYPICAL PERFORMANCE CHARACTERISTICS**

Fig.1 Power-on sequence:  $\sim 3\text{mS}$   
 $C_{IN}=22\mu\text{Fx}2$ ,  $C_{OUT}=47\mu\text{Fx}2$ ,  $L=33\mu\text{H}$ ,  $T_A=+25^\circ\text{C}$   
 $V_{IN}=30\text{V}$ ,  $V_{OUT}=5\text{V}$ ,  $EN=5\text{V}$ .  $I_{OUT}=1\text{A}$

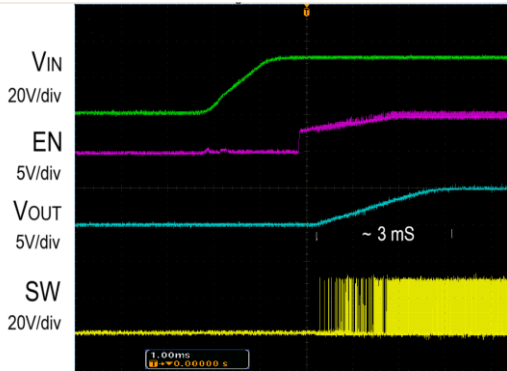


Fig.2 Power Off:  $\sim 16\text{mS}$   
 $C_{IN}=22\mu\text{Fx}2$ ,  $C_{OUT}=47\mu\text{Fx}2$ ,  $L=33\mu\text{H}$ ,  $T_A=+25^\circ\text{C}$   
 $V_{IN}=30\text{V}$ ,  $V_{OUT}=5\text{V}$ ,  $EN=5\text{V}$ .  $I_{OUT}=1\text{A}$

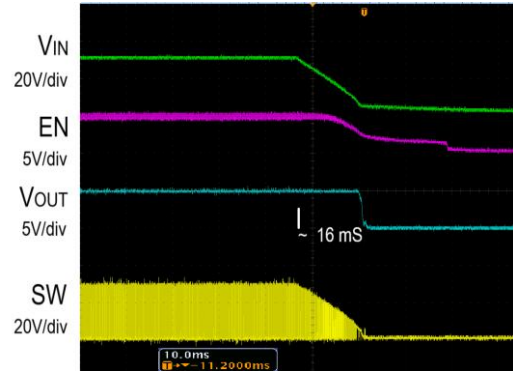


Fig.3 Power Disable by EN:  $\sim 500\mu\text{S}$   
 $C_{IN}=22\mu\text{Fx}2$ ,  $C_{OUT}=47\mu\text{Fx}2$ ,  $L=33\mu\text{H}$ ,  $T_A=+25^\circ\text{C}$   
 $V_{IN}=30\text{V}$ ,  $V_{OUT}=5\text{V}$ ,  $EN=5\text{V}$ .  $I_{OUT}=1\text{A}$

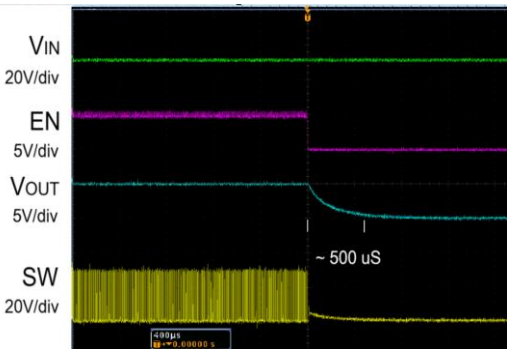


Fig.4 Steady State Test:  $\sim \pm 6\text{mV}$   
 $C_{IN}=22\mu\text{Fx}2$ ,  $C_{OUT}=47\mu\text{Fx}2$ ,  $L=33\mu\text{H}$ ,  $T_A=+25^\circ\text{C}$   
 $V_{IN}=30\text{V}$ ,  $V_{OUT}=5\text{V}$ ,  $EN=5\text{V}$ .  $I_{OUT}=1\text{A}$

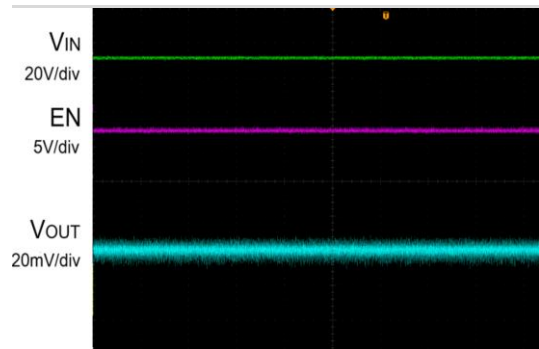


Fig.5 Light Load Transient Response: 230 KHz  
 $C_{IN}=22\mu\text{Fx}2$ ,  $C_{OUT}=47\mu\text{Fx}2$ ,  $L=33\mu\text{H}$ ,  $T_A=+25^\circ\text{C}$   
 $V_{IN}=30\text{V}$ ,  $V_{OUT}=5\text{V}$ ,  $EN=5\text{V}$ .  $I_{OUT}=0$ . 1A

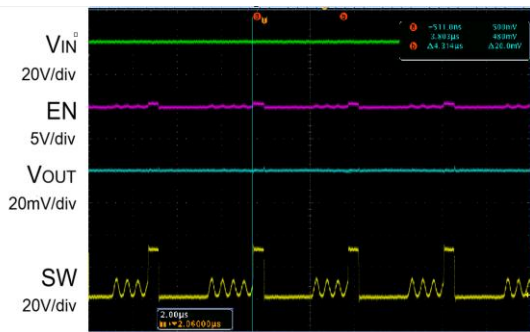


Fig.6 Load Transient Response: 480 KHz  
 $C_{IN}=22\mu\text{Fx}2$ ,  $C_{OUT}=47\mu\text{Fx}2$ ,  $L=33\mu\text{H}$ ,  $T_A=+25^\circ\text{C}$   
 $V_{IN}=30\text{V}$ ,  $V_{OUT}=5\text{V}$ ,  $EN=5\text{V}$ .  $I_{OUT}=1\text{A}$

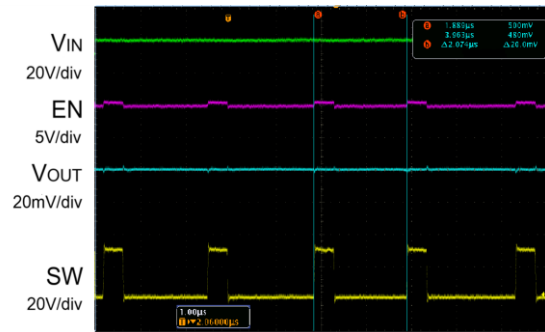




Fig.5 Short Circuit Entry:

$C_{IN}=22\mu F \times 2$ ,  $C_{OUT}=47\mu F \times 2$ ,  $L=33\mu H$ ,  $T_A=+25^\circ C$   
 $V_{IN}=30V$ ,  $V_{OUT}=5V$ ,  $EN=5V$ .  $I_{OUT}=0.1A$

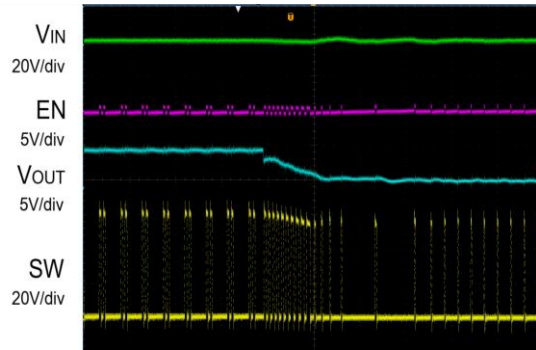
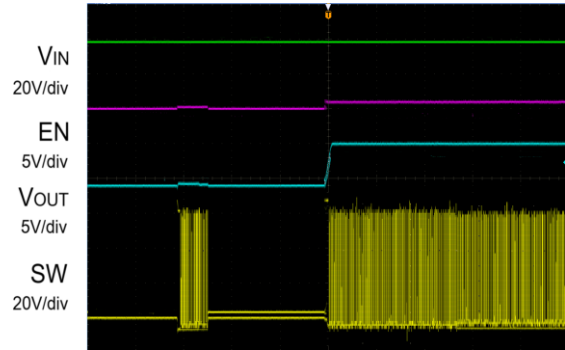


Fig.6 Short Circuit Exit :

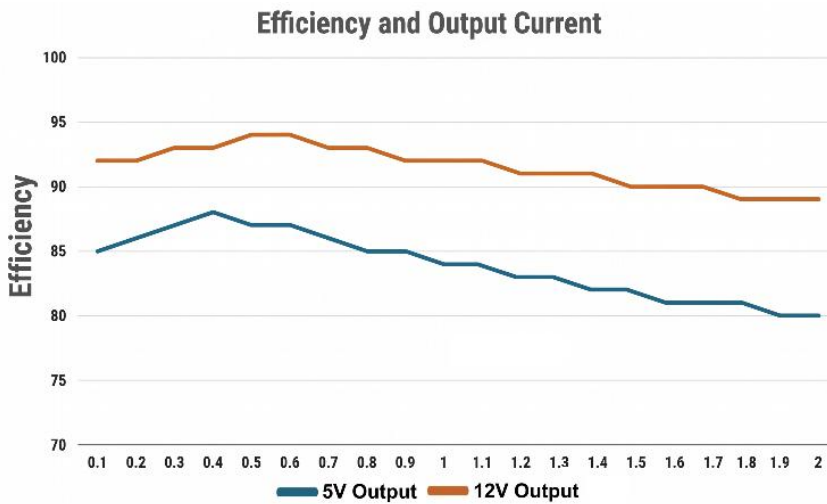
$C_{IN}=22\mu F \times 2$ ,  $C_{OUT}=47\mu F \times 2$ ,  $L=33\mu H$ ,  $T_A=+25^\circ C$   
 $V_{IN}=30V$ ,  $V_{OUT}=5V$ ,  $EN=5V$ .  $I_{OUT}=1A$



$C_{IN}=22\mu F \times 2$ ,  $C_{OUT}=47\mu F \times 2$ ,  $L=33\mu H$ ,  $T_A=+25^\circ C$

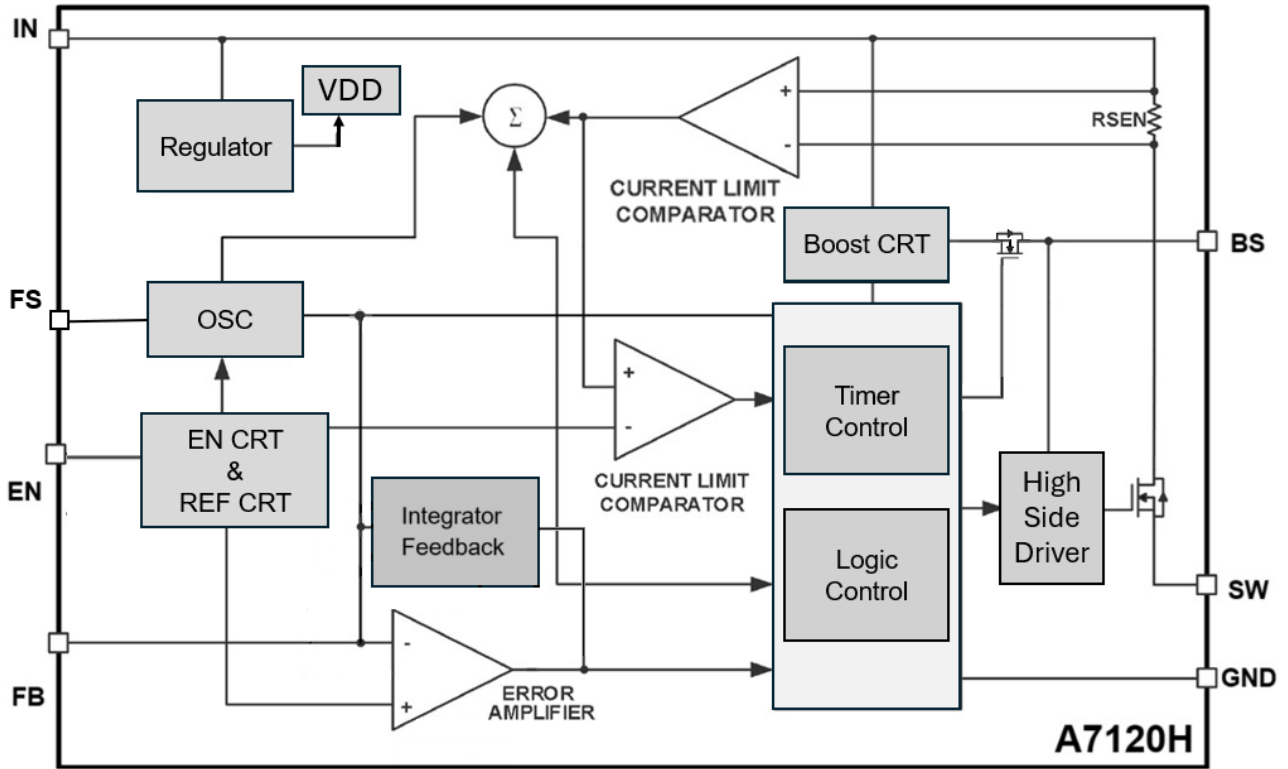
Fig.9 Efficiency & Output Current

$V_{out}=5V$  vs  $V_{out}=12V$





**BLOCK DIAGRAM**





## DETAILED INFORMATION

### Operation Overview

The A7120H is a high-performance monolithic switch-mode step-down (buck) DC-DC converter capable of delivering up to 2A continuous output current from a wide input voltage range of 4.5V to 100V.

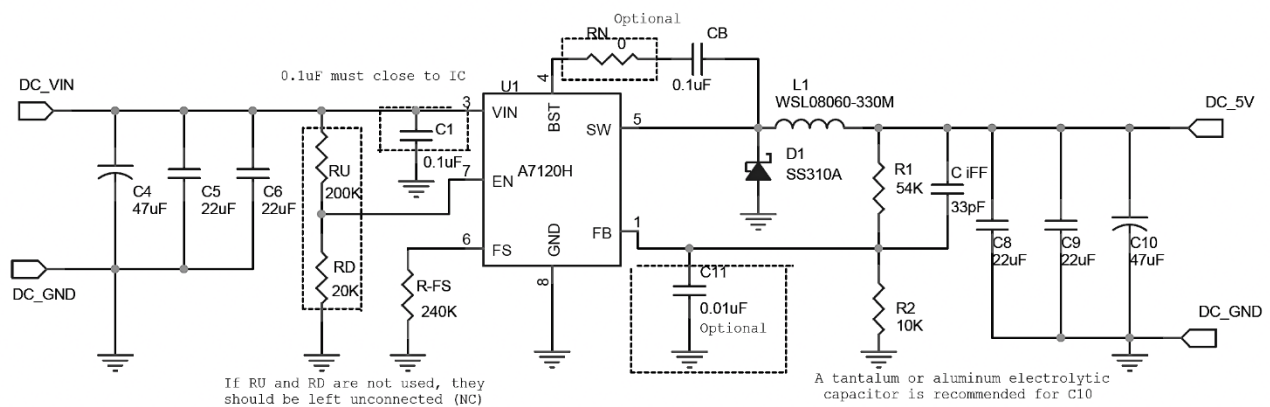
It features an adjustable high-frequency operation and is built on a slope-compensated current-mode control architecture, ensuring fast transient response and stable regulation. The internal feedback compensation provides excellent line and load regulation without the need for external components.

An external shutdown pin allows logic-level control for enabling or disabling the device, placing it into low-power standby mode when not in use.

Protection Features:

- Thermal shutdown prevents damage during high-temperature operation.
- Cycle-by-cycle current limiting protects the internal power switch during overcurrent conditions.
- If the feedback voltage  $V_{FB}$  drops below 0.78V due to a fault or overload, the switching frequency is automatically reduced, improving system stability and reducing thermal stress.

### Application information



The A7120H is a high-performance step-down DC/DC converter with a wide input voltage range of 4.5V to 100V, capable of delivering up to 2A continuous output current. It requires minimal external components—just input and output capacitors ( $C_{IN-4,5,6}$ ,  $C_{OUT-8,9,10}$ ) and an inductor ( $L_1$ )—making it ideal for space-constrained designs. The output voltage is adjustable via an external feedback network, allowing it to be set from 0.78V up to the input voltage, providing flexibility for a wide range of applications.

$$V_{out} = 0.78 \times \left( 1 + \frac{R1+R2}{R2} \right)$$



| V <sub>OUT</sub> (V) | L1 (μH) | C <sub>B</sub> (μF) | C <sub>4,5,6</sub> (μF) | C <sub>8,9,10</sub> (μF) | C <sub>IFF</sub> .(pF) | R1 (kΩ) | R2 (kΩ) | D1     |
|----------------------|---------|---------------------|-------------------------|--------------------------|------------------------|---------|---------|--------|
| 5                    | 33      | 0.1                 | 47+2.2/100Vx2           | 22+22+47                 | 47                     | 54      | 10      | SS310A |
| 12                   | 47      | 0.1                 | 47+2.2/100Vx2           | 22+22+47                 | 33                     | 144     | 10      | SS310A |

Table 1. Recommended Component Values

RU and RD are fixed by design at 200 kΩ and 20 kΩ, respectively. If the EN pin is not used for device enable/disable control, it may be left unconnected (NC). RN is an optional resistor, with an allowable value from 0 to 10 Ω. The R-FS pin is used to set the switching frequency. When left floating, the switching frequency is up to 450 kHz. The L1 inductor value must be recalculated accordingly to ensure proper operation.

### Output Capacitor

The output capacitor (C<sub>OUT</sub>) is critical for achieving a stable and low-ripple output voltage. Improper selection may result in abnormal system operation and excessive current ripple.

The equivalent series resistance (ESR) of the output capacitor must be within an appropriate range to ensure loop stability and proper feedback operation.

During the switching transition of the power MOSFET from ON to OFF, the feedback voltage (V<sub>FB</sub>) may exhibit a slight increase. To maintain a stable feedback voltage and ensure proper charge transfer, a certain ESR and inductor current are required. Therefore, a feedforward capacitor (C<sub>IFF</sub>) is necessary.

Taking V<sub>OUT</sub> = 5V as an example, when the feedforward capacitor is 0.1 μF, the recommended ESR range for the output capacitor is 100 mΩ to 250 mΩ.

It is recommended to use tantalum or aluminum electrolytic capacitors, optionally in parallel with a small ceramic capacitor (C<sub>IFF</sub>) to improve high-frequency performance.

If the output capacitor and its ESR cannot be adjusted, a feedforward capacitor can be connected in parallel with R1 to set the desired frequency response. The feedforward capacitor also helps reduce output voltage ripple.



## Power Supply Recommendations

The devices are designed to operate from an input voltage supply range of 4.5V to 100V. For optimal performance, the input supply must be well regulated. If the power source is located more than a few inches away from the device or converter, additional bulk capacitance is recommended to compensate for voltage drops and ensure stable operation. In such cases, an electrolytic capacitor with a typical value of 47  $\mu$ F can be used alongside ceramic bypass capacitors to maintain input stability.

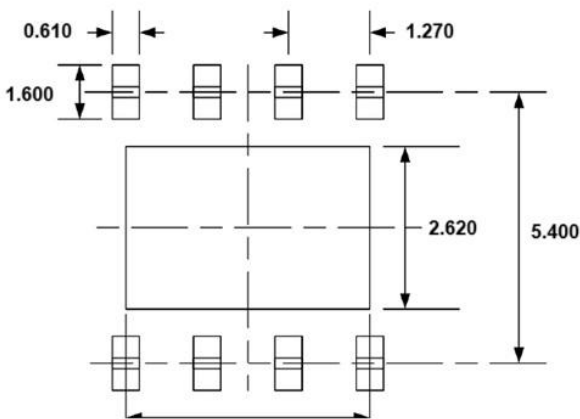
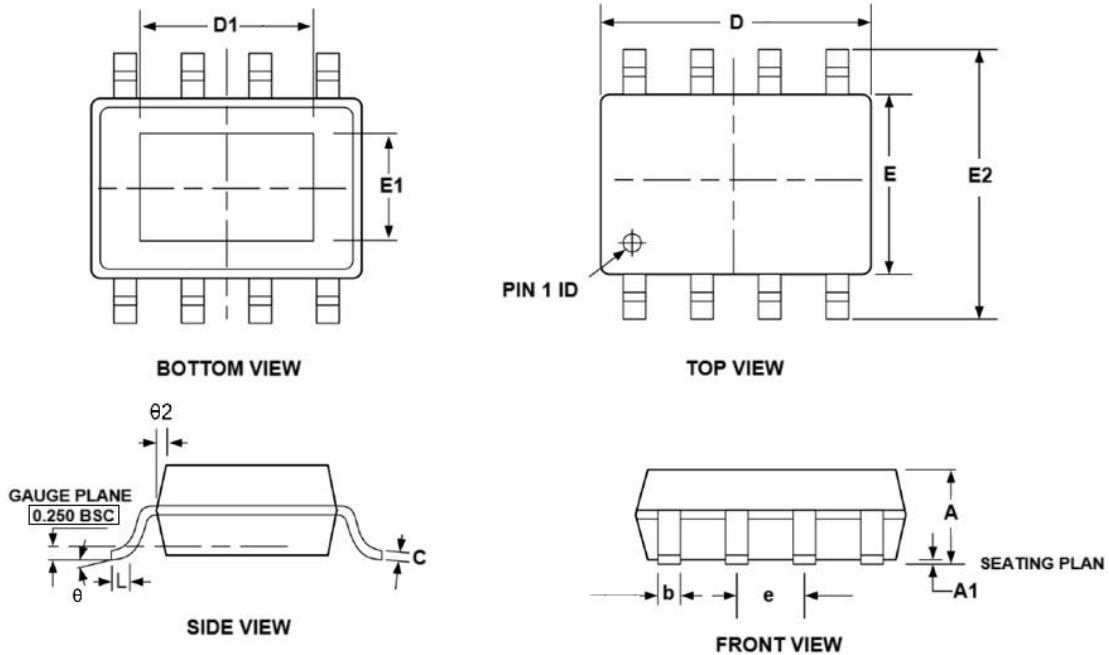
## PCB Layout Guidelines

- VIN and GND traces should be as wide as possible to reduce impedance and improve thermal dissipation.
- Input and output capacitors should be placed as close to the device as possible to minimize trace inductance and impedance.
- Provide adequate vias for both input and output capacitors to ensure solid grounding and current flow.
- Keep the SW (switching) trace as short and wide as possible to minimize radiated EMI.
- Avoid routing switching current beneath the IC to reduce potential noise and ground bounce.
- Use a dedicated VOUT trace to connect to the upper feedback resistor for accurate regulation.
- Implement a Kelvin connection from the feedback path to the GND pin for precise voltage sensing.
- Keep the voltage feedback loop away from high voltage switching traces, and shield it with a ground plane if possible.
- Minimize the trace area of the VFB node to reduce susceptibility to noise coupling.
- The GND trace between the output capacitor and the IC's GND pin should be as wide as possible to reduce voltage drop and ensure solid grounding.



**PACKAGE INFORMATION**

Dimension in PSOP8 (Unit: mm)



| Symbol | Millimeters |       |
|--------|-------------|-------|
|        | Min         | Max   |
| A      | 1.300       | 1.700 |
| A1     | 0.000       | 0.150 |
| b      | 0.330       | 0.510 |
| c      | 0.190       | 0.250 |
| D      | 4.800       | 5.000 |
| E      | 3.800       | 4.000 |
| E1     | 2.260       | 2.560 |
| D1     | 3.150       | 3.450 |
| E2     | 5.800       | 6.200 |
| e      | 1.270 BSC   |       |
| L      | 0.410       | 1.270 |
| theta  | 0°          | 8°    |
| theta2 | 11.25°      | 22.5° |



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