

## EVAL-ADP1612/ADP1613

### FEATURES

#### Input voltage range

- 1.8 V to 5.5 V for the ADP1612-5-EVALZ
- 2.5 V to 5.5 V for the ADP1613-12-EVALZ

#### Output voltage

- 5 V for ADP1612-5-EVALZ
- 12 V for ADP1613-12-EVALZ

#### Shunt-selectable 1.3 MHz or 650 kHz switching frequency

#### Jumper for enable/shutdown control

#### Components optimized for the indicated output voltages

### GENERAL DESCRIPTION

The ADP1612/ADP1613 evaluation module is a complete step-up dc-to-dc switching converter application with components selected to allow operation over the full range of input and load conditions for the 5 V (ADP1612) and 12 V (ADP1613) output voltages. The evaluation boards can be adjusted for different output voltages by changing R1 and R2. In addition, L1, D1, C3, and R3 may need to be adjusted and should be recalculated to ensure stable operation.

The ADP1612/ADP1613 evaluation module operates in pulse-width modulation (PWM) current mode with up to 94% efficiency. The shunt-selectable switching frequency and PWM current-mode architecture allow for excellent transient response, easy noise filtering, and the use of small, cost-saving external inductors and capacitors. Other key features include a 33 nF soft start capacitor, undervoltage lockout (UVLO), thermal shutdown (TSD), and jumper selected enable. The evaluation module demonstrates the operation and performance of the ADP1612/ADP1613.

This data sheet includes I/O descriptions, setup instructions, the schematic, and the PCB layout drawings for the ADP1612/ADP1613 step-up converter evaluation module. Use this data sheet in conjunction with the ADP1612/ADP1613 data sheet available on [www.analog.com](http://www.analog.com).

### TYPICAL APPLICATION CIRCUIT

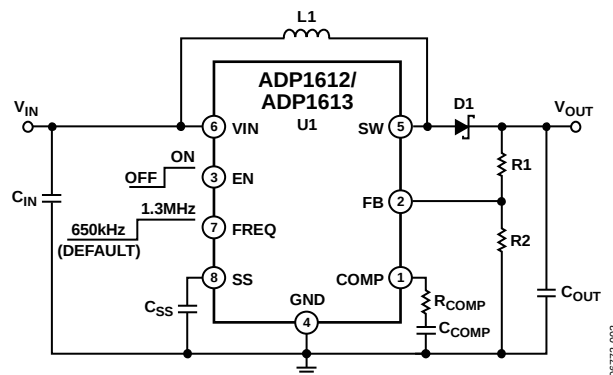


Figure 1. Step-Up Regulator Configuration

#### Rev. A

Evaluation boards are only intended for device evaluation and not for production purposes. Evaluation boards are supplied "as is" and without warranties of any kind, express, implied, or statutory including, but not limited to, any implied warranty of merchantability or fitness for a particular purpose. No license is granted by implication or otherwise under any patents or other intellectual property by application or use of evaluation boards. Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Analog Devices reserves the right to change devices or specifications at any time without notice. Trademarks and registered trademarks are the property of their respective owners. Evaluation boards are not authorized to be used in life support devices or systems.

TABLE OF CONTENTS

|                                   |   |                                             |   |
|-----------------------------------|---|---------------------------------------------|---|
| Features .....                    | 1 | Evaluation Board Schematic and Layout ..... | 5 |
| General Description .....         | 1 | Layout Guidelines.....                      | 5 |
| Typical Application Circuit ..... | 1 | Ordering Information.....                   | 6 |
| Revision History .....            | 2 | Bill of Materials.....                      | 6 |
| Evaluation Board Hardware.....    | 3 | Ordering Guide .....                        | 7 |
| Input/Output Connectors .....     | 3 | ESD Caution.....                            | 7 |
| Evaluation Setup .....            | 3 |                                             |   |
| Performance Evaluation .....      | 4 |                                             |   |

REVISION HISTORY

|                                      |   |
|--------------------------------------|---|
| 1/10—Rev. 0 to Rev. A                |   |
| Changes to Figure 4 to Figure 6..... | 3 |
| 12/09—Revision 0: Initial Version    |   |

## EVALUATION BOARD HARDWARE

The ADP1612/ADP1613 evaluation module is fully assembled and tested. The following sections describe the various connectors on the board, the proper evaluation setup, and the testing capabilities of the evaluation module.

### INPUT/OUTPUT CONNECTORS

#### EN Test Bus

The EN connector is used to enable/disable the converter via the EN pin. Use one of the following methods to enable the converter. Do not leave the EN pin floating.

- Use a jumper to connect the top two pins of the EN test bus. This connects EN to VIN and enables the converter (see Figure 2).

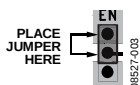


Figure 2. Enabled Jumper Position

- Use a jumper to connect the bottom two pins of the EN test bus. This connects EN to GND and disables the converter (see Figure 3).

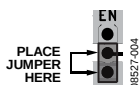


Figure 3. Disabled Jumper Position

- Alternatively, connect a voltage between VIN and GND to the center pin of the EN test bus for independent control of the EN pin voltage (see Figure 4).

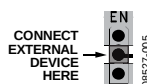


Figure 4. EN Pin Direct Connection

#### 0 $\Omega$ Shunt FREQ (R4)

This shunt selects the switching frequency via the FREQ pin. Several methods are available as follows.

- Shunt the top pads of FREQ (R4) for 1.3 MHz operation (see Figure 5).



Figure 5. 1.3 MHz Operation Shunt Position

- Shunt the bottom pads of FREQ (R4) for 650 kHz operation (see Figure 6).



Figure 6. 650 kHz Operation Shunt Position

- If this shunt is left open, the part defaults to 650 kHz.

#### VOUT Test Bus

The output voltage at the VOUT test bus is set by the resistive voltage divider network, R1 and R2. A load can be attached to the VOUT test bus.

#### VIN Test Bus

The VIN test bus connects the positive input supply voltage to the VIN pin. Connect the power supply to this bus and keep the wires as short as possible to minimize the EMI transmission.

#### GND Test Bus

The GND test bus is the power ground connection for the part via the GND pin as well as the bypass capacitors. Connect ground connections from external equipment to this bus.

#### SW Test Point

The SW test point is for measuring the switch node (SW pin) behavior and switching frequency.

### EVALUATION SETUP

Follow these setup instructions to ensure proper operation of the ADP1612/ADP1613 evaluation module:

- Select the passive components for the bypass capacitance, desired output voltage, compensation, and start-up time, using the applications information from the ADP1612/ADP1613 data sheet.
- Connect the input supply ground to GND.
- Connect the positive input supply to VIN.
- Connect the desired load between VOUT and GND. The maximum continuous output current of the ADP1612/ADP1613 is dependent upon the input and output conditions.
- Apply a voltage between 1.8 V and 5.5 V (ADP1612) or 2.5 V and 5.5 V (ADP1613) to the VIN test bus.
- Move the jumper on the EN test bus to the enabled position.

# EVAL-ADP1612/ADP1613

## PERFORMANCE EVALUATION

The following sections discuss tests and the resulting oscilloscope waveforms. Oscilloscope waveforms and typical performance characteristics are provided in the [ADP1612/ADP1613](#) data sheet.

### **Line Regulation**

The line regulation is observed and measured by monitoring the output voltage (VOUT) while varying the input voltage (VIN).

### **Load Regulation**

The load regulation is observed and measured by monitoring the output voltage (VOUT) while sweeping the applied load between VOUT and GND. To minimize voltage drop, use short low resistance wires, especially for heavy loads.

### **Efficiency**

The efficiency,  $\eta$ , is measured by comparing the input power to the output power

$$\eta = \frac{V_{OUT} \times I_{OUT}}{V_{IN} \times I_{IN}}$$

### **Line Transient**

The line transient performance is evaluated by generating a high speed voltage transient on the input (VIN) and observing the behavior of the evaluation module at the inductor (SW) and the output (VOUT.)

### **Load Transient**

The load transient performance is evaluated by generating a fast current transient on the output (VOUT) and observing the behavior of the evaluation module at the inductor (SW) and the output (VOUT.)

### **Oscillator Frequency**

The oscillator frequency can be measured by connecting an oscilloscope to the SW pin.

### **Inductor Current**

The inductor current is made accessible by removing one side of the inductor from its pad and connecting a current loop in series. Place an oscilloscope current probe on the loop to view the current waveform.

## EVALUATION BOARD SCHEMATIC AND LAYOUT

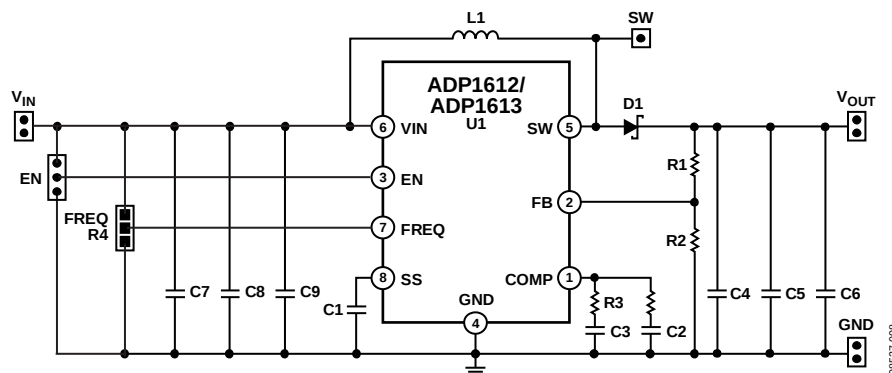


Figure 7. ADP1612/ADP1613 Boost Application Evaluation Board Schematic

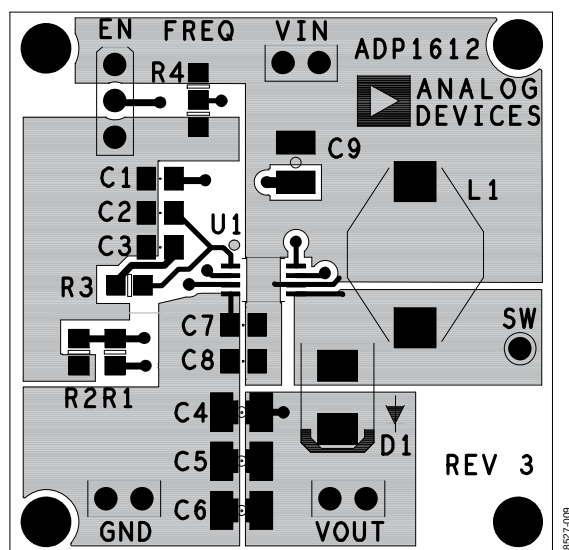


Figure 8. ADP1612/ADP1613 Boost Application PCB Top Layer

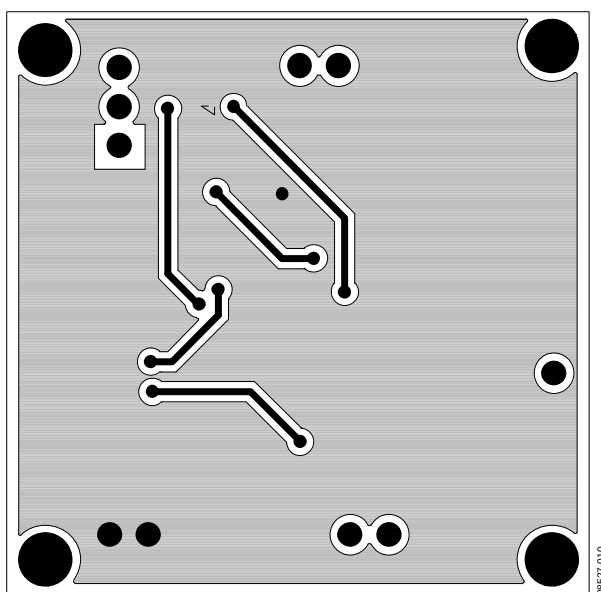


Figure 9. ADP1612/ADP1613 Boost Application PCB Bottom Layer

## LAYOUT GUIDELINES

For high efficiency, good regulation, and stability, a well-designed printed circuit board (PCB) layout is essential.

Use the following guidelines when designing PCBs:

- Keep the low ESR input capacitor,  $C_{IN}$  (labeled as C7 in Figure 8), close to VIN and GND. This minimizes noise injected into the part from board parasitic inductance.
- Keep the high current path from  $C_{IN}$  (labeled as C7 in Figure 8) through the L1 inductor to SW and GND as short as possible.
- Keep the high current path from VIN through L1, the rectifier (D1), and the output capacitor,  $C_{OUT}$  (labeled as C4 in Figure 8), as short as possible.
- Keep high current traces as short and as wide as possible.
- Place the feedback resistors as close to FB as possible to prevent noise pickup. Connect the ground of the feedback network directly to an AGND plane to make a Kelvin connection to the GND pin.
- Place the compensation components as close as possible to COMP. Connect the ground of the compensation network directly to an AGND plane that makes a Kelvin connection to the GND pin.
- Connect the soft start capacitor,  $C_{SS}$  (labeled as C1 in Figure 8), as close to the device as possible. Connect the ground of the soft start capacitor to an AGND plane that makes a Kelvin connection to the GND pin.
- Avoid routing high impedance traces from the compensation and feedback resistors near any node connected to SW or near the inductor to prevent radiated noise injection.

# EVAL-ADP1612/ADP1613

## ORDERING INFORMATION

### BILL OF MATERIALS

Table 1. ADP1612 ( $V_{OUT} = 5\text{ V}$ )

| Qty | Reference Designator   | Description                                                              | Manufacturer <sup>1</sup> | Part Number      |
|-----|------------------------|--------------------------------------------------------------------------|---------------------------|------------------|
| 1   | U1                     | ADP1612 step-up converter                                                | Analog Devices, Inc.      | ADP1612          |
| 1   | L1                     | Inductor, 4.7 $\mu\text{H}$                                              | Coilcraft                 | DO3316P-472ML    |
| 1   | D1                     | Diode                                                                    | ON Semiconductor          | MBRS2040LT3      |
| 1   | C1                     | Soft start capacitor, MLCC, 33 nF, 50 V, 0805, $\pm 10\%$                | Panasonic-ECG             | ECJ-2VB1H333K    |
|     | C2                     | Compensation capacitor                                                   | Open                      |                  |
| 1   | C3                     | Compensation capacitor, 1200 pF, 50 V, 0805, $\pm 10\%$                  | Panasonic-ECG             | ECJ-2VB1H122K    |
| 1   | C4                     | Output capacitor, 10 $\mu\text{F}$ , 25 V, 1206, $\pm 10\%$              | Taiyo Yuden               | TMK316BJ106KL-T  |
|     | C5                     | Output capacitor                                                         | Open                      |                  |
|     | C6                     | Output capacitor                                                         | Open                      |                  |
| 1   | C7                     | Input capacitor, 10 $\mu\text{F}$ , 16 V, 0805, $\pm 10\%$               | Taiyo Yuden               | EMK212BJ106KG-T  |
|     | C8                     | Input capacitor                                                          | Open                      |                  |
|     | C9                     | Input capacitor                                                          | Open                      |                  |
| 1   | R1                     | Output voltage divider, 30.0 k $\Omega$ , 0805, $\pm 1\%$                | Yageo                     | RC0805FR-0730KL  |
| 1   | R2                     | Output voltage divider, 10.0 k $\Omega$ , 0805, $\pm 1\%$                | Vishay/Dale               | CRCW080510K0FKEA |
| 1   | R3                     | Compensation resistor, 12 k $\Omega$ , 0805, $\pm 5\%$                   | Yageo                     | RC0805JR-0712KL  |
| 1   | FREQ/R4                | Frequency select shunt resistor, 0 $\Omega$ , 0805, 1.3 MHz (top 2 pads) | Yageo                     | RC0805JR-070RL   |
| 10  | EN, VIN, SW, VOUT, GND | Header (0.10", single/double row, straight)                              | Sullins Electronics       | PBC36SAAN        |

<sup>1</sup> Equivalent substitutions may be made for all resistors and capacitors.

Table 2. ADP1613 ( $V_{OUT} = 12\text{ V}$ )

| Qty | Reference Designator   | Description                                                              | Manufacturer <sup>1</sup> | Part Number      |
|-----|------------------------|--------------------------------------------------------------------------|---------------------------|------------------|
| 1   | U1                     | ADP1613 step-up converter                                                | Analog Devices, Inc.      | ADP1613          |
| 1   | L1                     | Inductor, 6.8 $\mu\text{H}$                                              | Coilcraft                 | DO3316P-682ML    |
| 1   | D1                     | Diode                                                                    | ON Semiconductor          | MBRA340T3G       |
| 1   | C1                     | Soft start capacitor, 33 nF, 50 V, 0805, $\pm 10\%$                      | Panasonic-ECG             | ECJ-2VB1H333K    |
|     | C2                     | Compensation capacitor                                                   | Open                      |                  |
| 1   | C3                     | Compensation capacitor, 1000 pF, 50 V, 0805, $\pm 10\%$                  | Panasonic-ECG             | ECJ-2VB1H102K    |
| 1   | C4                     | Output capacitor, 10 $\mu\text{F}$ , 25 V, 1206, $\pm 10\%$              | Taiyo Yuden               | TMK316BJ106KL-T  |
|     | C5                     | Output capacitor                                                         | Open                      |                  |
|     | C6                     | Output capacitor                                                         | Open                      |                  |
| 1   | C7                     | Input capacitor, 10 $\mu\text{F}$ , 16 V, 0805, $\pm 10\%$               | Taiyo Yuden               | EMK212BJ106KG-T  |
|     | C8                     | Input capacitor                                                          | Open                      |                  |
|     | C9                     | Input capacitor                                                          | Open                      |                  |
| 1   | R1                     | Output voltage divider, 86.6 k $\Omega$ , 0805, $\pm 1\%$                | Yageo                     | RC0805FR-0786K6L |
| 1   | R2                     | Output voltage divider, 10.0 k $\Omega$ , 0805, $\pm 1\%$                | Vishay/Dale               | CRCW080510K0FKEA |
| 1   | R3                     | Compensation resistor, 10 k $\Omega$ , 0805, $\pm 5\%$                   | Yageo                     | RC0805JR-0710KL  |
| 1   | FREQ/R4                | Frequency select shunt resistor, 0 $\Omega$ , 0805, 1.3 MHz (top 2 pads) | Yageo                     | RC0805JR-070RL   |
| 10  | EN, VIN, SW, VOUT, GND | Header (0.10", single/double row, straight)                              | Sullins Electronics       | PBC36SAAN        |

<sup>1</sup> Equivalent substitutions may be made for all resistors and capacitors.

**ORDERING GUIDE**

| Model <sup>1</sup> | Description                                                 |
|--------------------|-------------------------------------------------------------|
| ADP1612-5-EVALZ    | ADP1612 Evaluation Board, 5 V Output Voltage Configuration  |
| ADP1612-BL1-EVZ    | ADP1612 Blank Evaluation Board                              |
| ADP1613-12-EVALZ   | ADP1613 Evaluation Board, 12 V Output Voltage Configuration |
| ADP1613-BL1-EVZ    | ADP1613 Blank Evaluation Board                              |

<sup>1</sup> Z = RoHS Compliant Part.

**ESD CAUTION**

**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

## **NOTES**