

### FEATURES

- 1 A buck boost regulator**
- Input voltage range: 2.3 V to 5.5 V**
- Fixed output voltage range: 2.8 V to 5.0 V**
- Switching frequency: 2.5 MHz**
- 1.5  $\mu$ H inductor compatible**
- Maximum output current: 1 A**
- Typical quiescent current: 38  $\mu$ A**
- Automatic pulse skip mode**
- Synchronization pin**

### GENERAL DESCRIPTION

The ADP2504 evaluation board is a complete buck boost converter solution that tests the ADP2504, a high efficiency, low quiescent current step-up/step-down, dc-to-dc converter. It provides accurate ( $\pm 3\%$ ) regulation for load currents of up to 1 A. The ADP2504 evaluation board is available with a fixed 3.3 V option. Additional voltage options are available upon request from Sales at Analog Devices, Inc.

At high load currents, the ADP2504 uses a current-mode, fixed frequency PWM control scheme for excellent stability and transient response. To ensure the longest battery life in portable applications, the ADP2504 features an optional power-saving pulse skip mode that reduces the switching frequency under light load conditions to save power.

### APPLICATIONS EVALUATION BOARD DIAGRAM

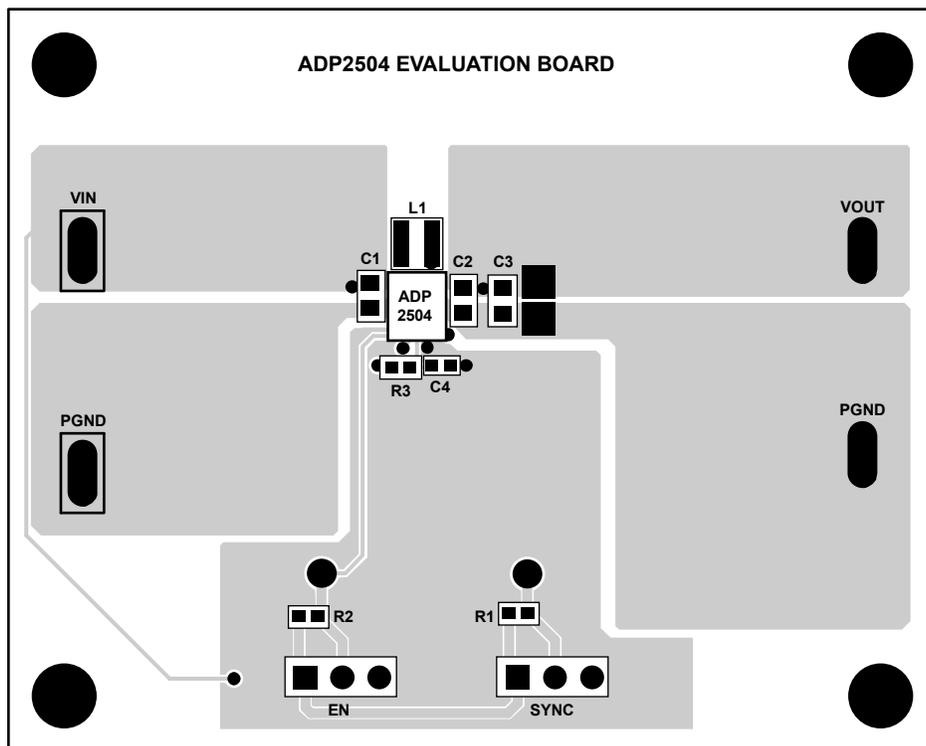


Figure 1.

#### Rev. 0

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## REVISION HISTORY

6/08—Revision 0: Initial Version

## USING THE EVALUATION BOARD

The ADP2504 evaluation boards are supplied fully assembled and tested. Before applying power to the evaluation board, follow the procedures in this section and refer to Figure 8.

### SETTING UP THE EVALUATION BOARD

#### **Jumper J6**

Jumper J6 enables the part. Connect a jumper between Position 1 and Position 2 to enable the ADP2504. Connect a jumper between Position 2 to Position 3 to disable the ADP2504 and bring the current to  $< 1 \mu\text{A}$ .

#### **Jumper J5**

The ADP2504 can be configured to operate in low noise pulse width mode (PWM) or in pulse skip mode (PSM), depending on the SYNC pin polarity. If the SYNC pin is pulled high (Position 1 and Position 2 connected together), the ADP2504 operates in forced PWM mode. If the SYNC pin is pulled low, pulse skip mode is turned on when the load current drops below approximately 75 mA.

#### **Input Power Source**

If the input power source includes a current meter, use that meter to monitor the input current. Connect the positive terminal of the power source to the  $V_{\text{IN}}$  terminal on the evaluation board, and connect the negative terminal of the power source to the GND terminal of the evaluation board.

If the power source does not include a current meter, connect a current meter in series with the input source voltage. Then, connect the positive lead (+) of the power source to the ammeter positive (+) connection, the negative lead (-) of the power source to the GND terminal on the evaluation board, and the negative lead (-) of the ammeter to the  $V_{\text{IN}}$  terminal on the board.

#### **Output Load**

Connect an electronic load or resistor to set the load current. If the load includes an ammeter, or if the current is not measured, connect the load directly to the evaluation board, with the positive (+) load connection to the  $V_{\text{OUT}}$  terminal and negative (-) load connection to the GND terminal.

If an ammeter is used, connect it in series with the load. Connect the positive (+) ammeter terminal to the evaluation board  $V_{\text{OUT}}$  terminal, the negative (-) ammeter terminal to the positive (+) load terminal, and the negative (-) load terminal to the evaluation board GND terminal.

#### **Input and Output Voltmeters**

Measure the input and output voltages with voltmeters. Make sure that the voltmeters are connected to the appropriate evaluation board terminals and not to the loads or power sources. If the voltmeters are not connected directly to the evaluation board, the measured voltages incorrect due to the voltage drop across the leads and/or connections will be between the evaluation board, the power source, and/or the load.

Connect the input voltage measuring voltmeter positive (+) terminal to the evaluation board  $V_{\text{IN}}$  terminal, and the negative (-) terminal to the evaluation board GND terminal. Connect the output voltage measuring voltmeter positive (+) terminal to the evaluation board  $V_{\text{OUT}}$  terminal and the negative (-) terminal to the evaluation board GND terminal.

### POWERING UP THE EVALUATION BOARD

Once the power source and load are connected to the ADP2504 evaluation board, the board can be powered for operation. Ensure that the power source voltage is  $>2.5 \text{ V}$  and  $<5.5 \text{ V}$ . If using an amp meter, increase the range value to 1 A or 3 A for the initial startup.

Bring the EN pin high using J6, and monitor the output voltage. If the load is not already enabled, enable the load and verify that it is drawing the proper current, and that the output voltage maintains voltage regulation.

### MEASURING EVALUATION BOARD PERFORMANCE

#### **Measuring Output Voltage Ripple**

To observe the output voltage ripple, place an oscilloscope probe across the output capacitors (C2 and C3) with the probe ground lead at the negative (-) capacitor terminal and the probe tip at the positive (+) capacitor terminal. Set the oscilloscope to ac, 20 mV/division, and 2  $\mu\text{s}$ /division time base.

#### **Measuring the Switching Waveform**

To observe the switching waveform with an oscilloscope, place the oscilloscope probe tip at the end of the inductor connected to the SW1pin/SW2 pin with the probe ground at GND. Set the oscilloscope to dc, 2 V/division, and 2  $\mu\text{s}$ /division time base.

#### **Measuring Load Regulation**

The load regulation must be tested by increasing the load at the output and looking at the change in output voltage. To minimize voltage drop, use short low resistance wires, especially for heavy loads.

#### **Measuring Line Regulation**

Vary the input voltage and examine the change in the output voltage.

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## **Measuring Efficiency**

Measure the efficiency,  $\eta$ , by comparing the input power with the output power.

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

Measure the input and output voltages as close as possible to the input and output capacitors to reduce the effect of IR drops.

## **Measuring Inductor Current**

Measure the inductor current by removing one end of the inductor from its pad and connecting a current loop in series. Then, use a current probe to measure the current flowing through the current loop.

## TYPICAL PERFORMANCE CHARACTERISTICS

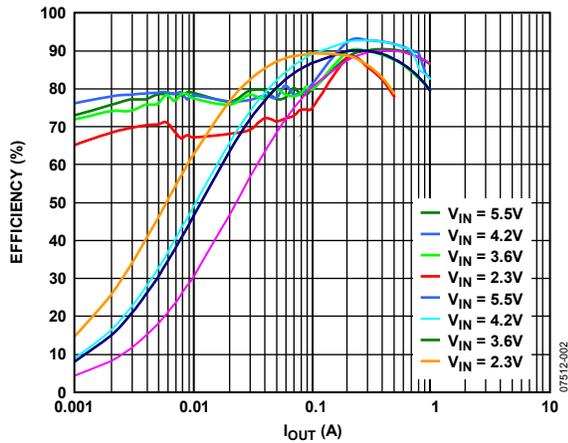


Figure 2. Efficiency vs. Load,  $V_{OUT} = 3.3\text{ V}$ , PWM and PSM

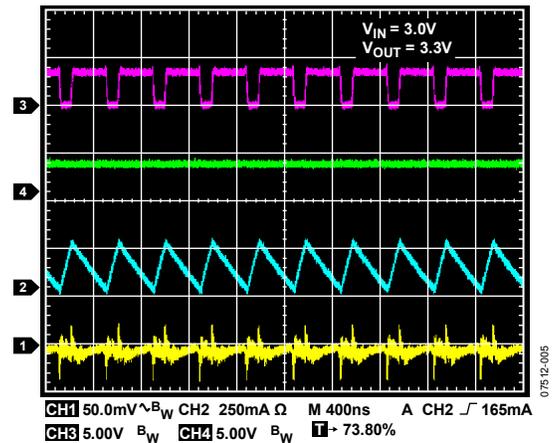


Figure 5. Boost Operation,  $V_{IN} = 3.0\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $I_{LOAD} = 500\text{ mA}$ , PWM

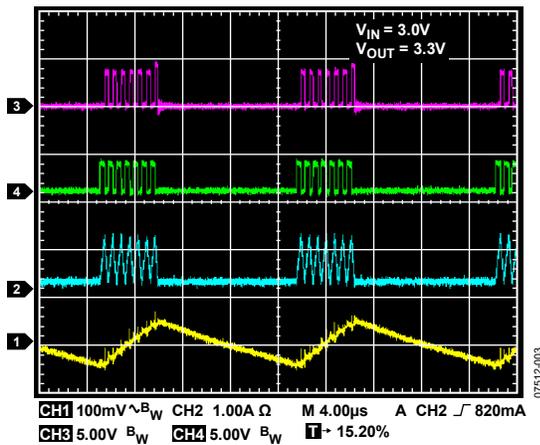


Figure 3. Buck Boost,  $V_{IN} = 3.0\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $I_{LOAD} = 50\text{ mA}$ , PSM

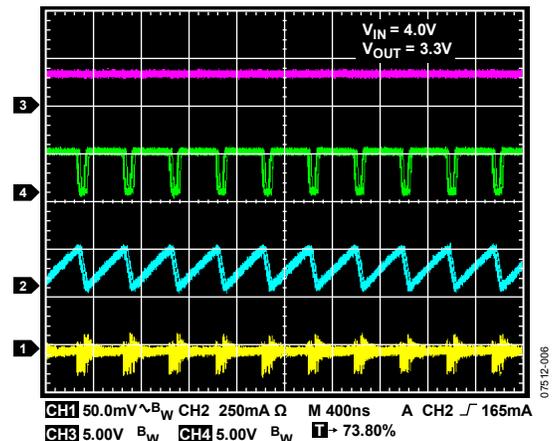


Figure 6. Buck Operation,  $V_{IN} = 4.0\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $I_{LOAD} = 500\text{ mA}$ , PWM

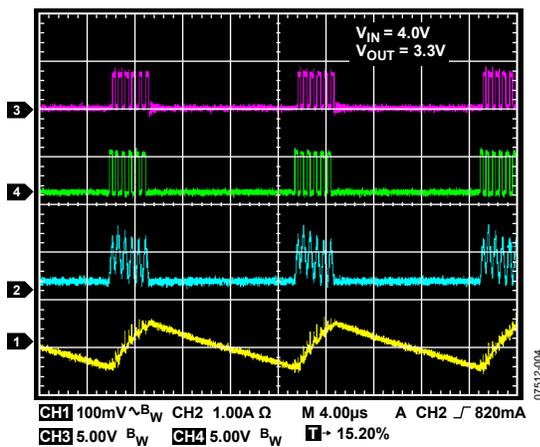


Figure 4. Buck Boost,  $V_{IN} = 4.0\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $I_{LOAD} = 50\text{ mA}$ , PSM

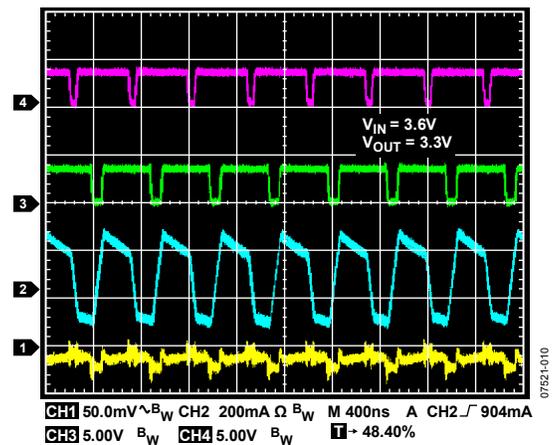


Figure 7. Buck Boost,  $V_{IN} = 3.6\text{ V}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $I_{LOAD} = 200\text{ mA}$ , PSM

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## EVALUATION BOARD SCHEMATIC AND ARTWORK

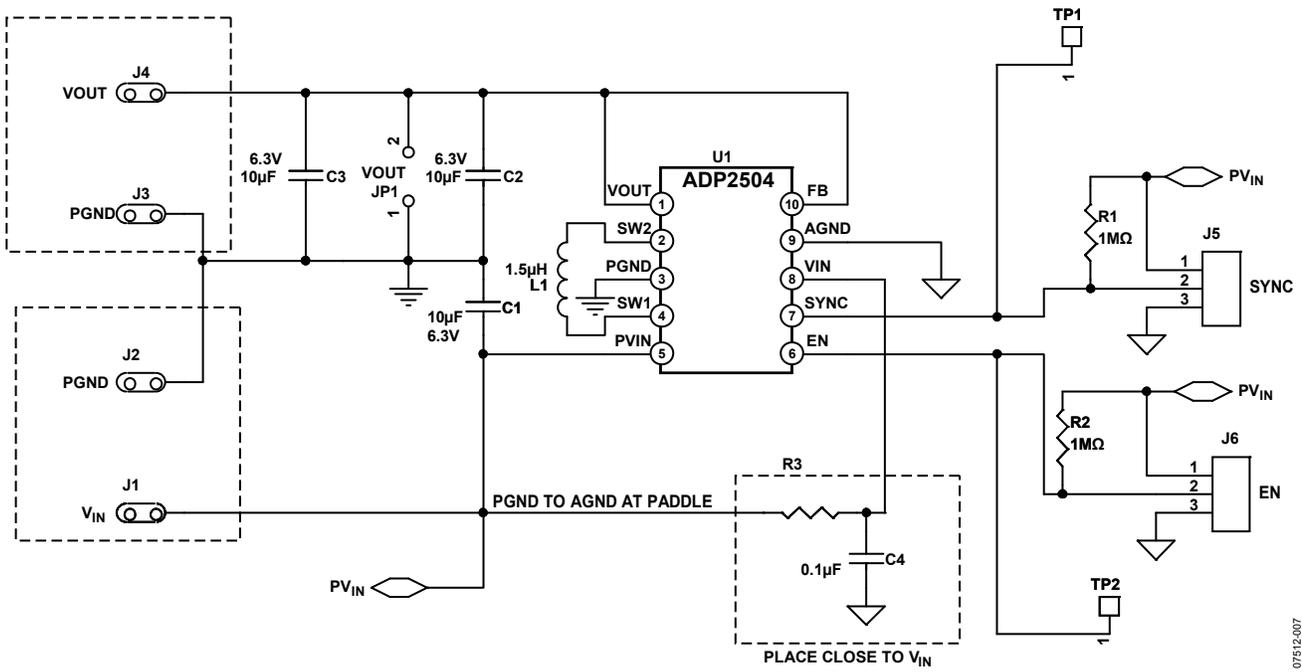


Figure 8. ADP2504 Evaluation Board Schematic

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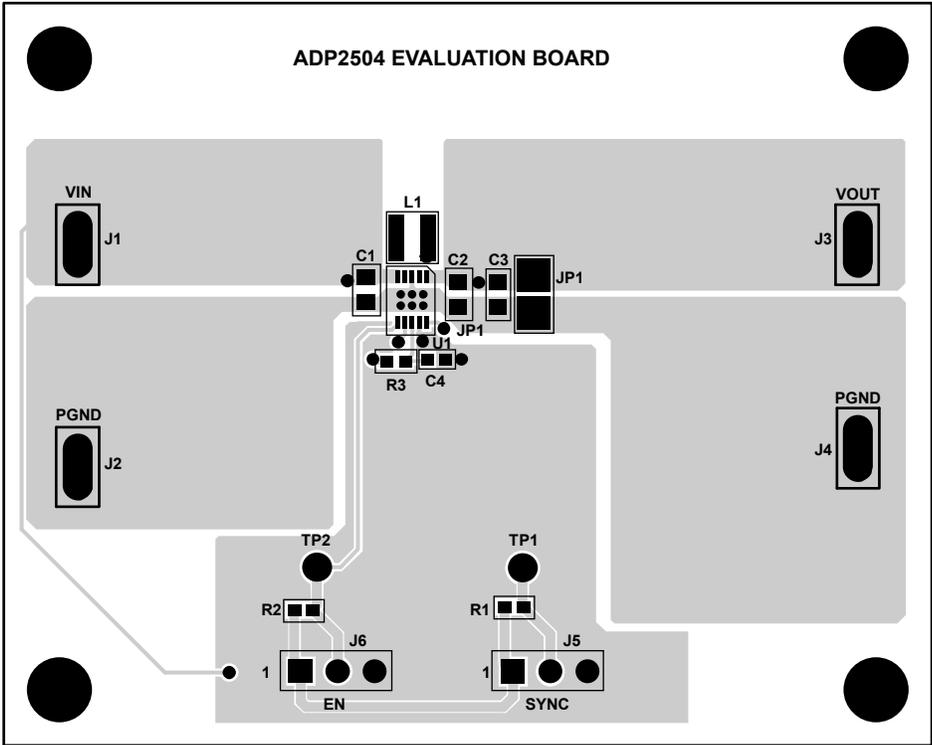


Figure 9. Top Layer, Recommended Layout

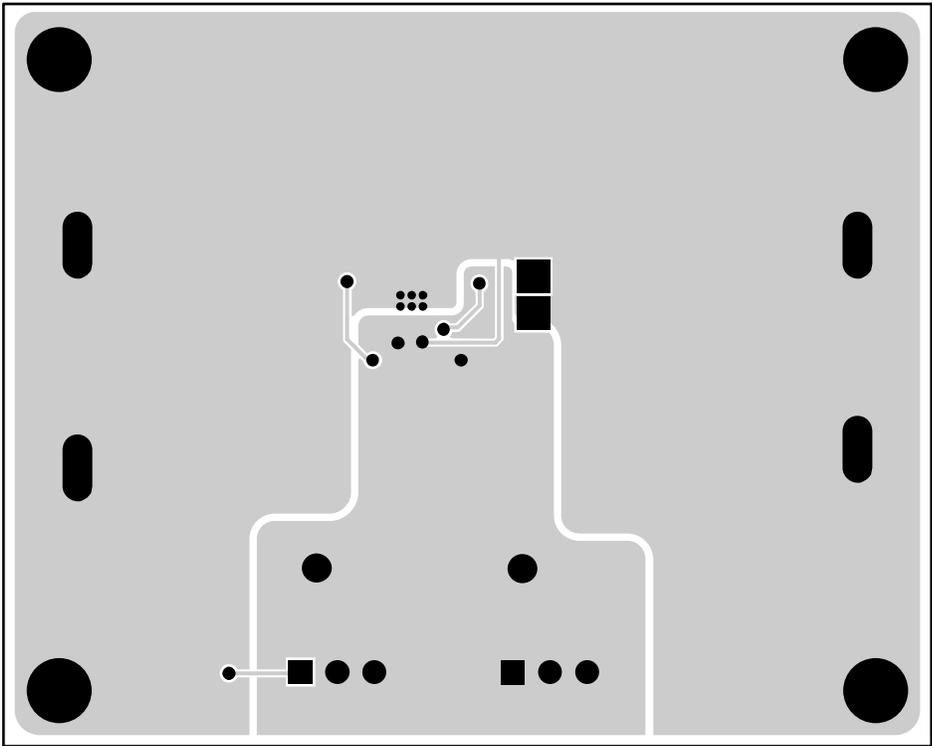


Figure 10. Bottom Layer, Recommended Layout

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## ORDERING INFORMATION

### BILL OF MATERIALS

Table 5.

Qty	Reference Designator	Description	Manufacturer	Part Number
1	C1	Capacitor, 10 $\mu$ F, 6.3 V, 0603, X5R	Murata Manufacturing Co., Ltd	GRM188R60J106M
2	C2, C3	Capacitor, 10 $\mu$ F, 6.3 V, 0603, X5R	Murata Manufacturing Co., Ltd	GRM188R60J106M
1	C4	Capacitor, 0.1 $\mu$ F, 6.3 V, 0402, X5R	Phycomp	223878615649
1	L1	Inductor, 1.5 $\mu$ H	Murata Manufacturing Co., Ltd	LQM2HPN1R5MG0L
2	R1, R2	Resistor, 1 M $\Omega$	Vishay Intertechnology, Inc.	CRCW04021004F
1	R3	Resistor, 0 $\Omega$	Vishay Intertechnology, Inc.	CRCW04020R00F
1	U1	ADP2504 Buck Boost Regulator	Analog Devices	ADP2504

### ORDERING GUIDE

Model	Description
ADP2504-2.8-EVALZ <sup>1</sup>	Evaluation Board for 2.8 V
ADP2504-3.3-EVALZ <sup>1</sup>	Evaluation Board for 3.3 V
ADP2504-3.5-EVALZ <sup>1</sup>	Evaluation Board for 3.5 V
ADP2504-4.2-EVALZ <sup>1</sup>	Evaluation Board for 4.2 V
ADP2504-4.5-EVALZ <sup>1</sup>	Evaluation Board for 4.5 V
ADP2504-5.0-EVALZ <sup>1</sup>	Evaluation Board for 5.0 V

<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.