ANALOG DEVICES

Evaluation Board User Guide
UG-329

One Technology Way • P.O. Box 9106 • Norwood, MA 02062-9106, U.S.A. • Tel: 781.329.4700 • Fax: 781.461.3113 • www.analog.com

Evaluation Board for the ADP2164 Step-Down Regulator

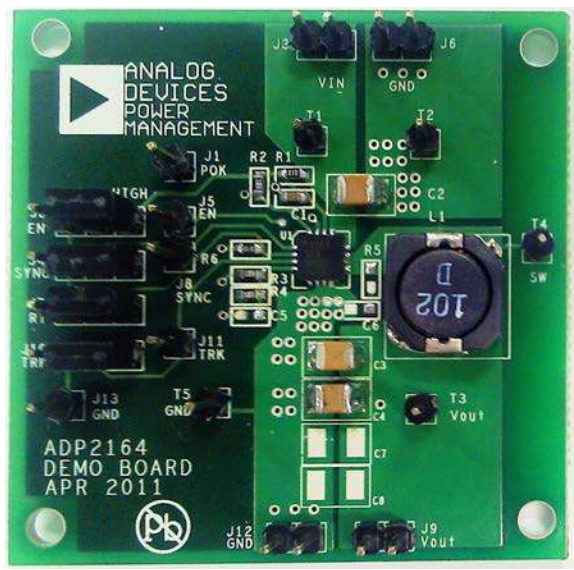
GENERAL DESCRIPTION

The ADP2164 is a synchronous, step-down dc-to-dc regulator in a compact, 4 mm × 4 mm LFCSP package. The ADP2164 requires minimal external components to provide a high efficiency solution with integrated power switch, synchronous rectifier, and internal compensation. The input voltage range of the ADP2164 is 2.7 V to 6.5 V.

The ADP2164 evaluation board provides an easy way to evaluate the device. This user guide describes how to quickly set up the board to collect performance data.

Complete information about the ADP2164 is available in the ADP2164 data sheet, which should be consulted in conjunction with this user guide when using the evaluation board.

DIGITAL PICTURE OF THE EVALUATION BOARD



10236-001

Figure 1.

TABLE OF CONTENTS

REVISION HISTORY

1/12—Revision 0: Initial Version

SETTING UP THE EVALUATION BOARD

POWERING UP THE EVALUATION BOARD

The ADP2164 evaluation board is fully assembled and tested. Before applying power to the evaluation board, follow the setup procedures in this section.

Jumper Settings

Table 1 describes the jumper settings. Before selecting the jumper settings, make sure that the enable input, EN, is high.

Table 1. Jumper Settings

Jumper	State or Connection	Function
J2 (EN)	High	Enable output voltage
	Low	Disable output voltage
J4 (SYNC)	High or low	Force PWM
	External clock	Synchronize to the external clock
J7 (RT)	High	Set frequency to 1.2 MHz
	Low	Set frequency to 600 kHz
	External resistor	Set frequency from 500 kHz to 1.4 MHz
J10 (TRK)	High	Tracking function not used
	External voltage	Tracking with the external voltage

Input Power Source Connection

Before connecting the power source to the ADP2164 evaluation board, make sure that the board is turned off. If the input power source includes a current meter, use the meter to monitor the input current as follows:

1. Connect the positive terminal of the power source to the VIN terminal (J3) on the evaluation board.
2. Connect the negative terminal of the power source to the GND terminal (J6) on the evaluation board.

If the power source does not include a current meter, connect a current meter in series with the input source voltage as follows:

1. Connect the positive terminal of the power source to the positive terminal (+) of the current meter.
2. Connect the negative terminal of the power source to the GND terminal (J6) on the evaluation board.
3. Connect the negative terminal (−) of the current meter to the VIN terminal (J3) on the evaluation board.

Output Load Connection

Before connecting the load to the ADP2164 evaluation board, make sure that the board is turned off. If the load includes a current meter or if the current is not measured, connect the load directly to the evaluation board as follows:

1. Connect the positive terminal (+) of the load to the VOUT terminal (J9) on the evaluation board.
2. Connect the negative terminal (−) of the load to the GND terminal (J12) on the evaluation board.

If a separate current meter is used, connect it in series with the load as follows:

1. Connect the positive terminal (+) of the current meter to the VOUT terminal (J9) on the evaluation board.
2. Connect the negative terminal (−) of the current meter to the positive terminal (+) of the load.
3. Connect the negative terminal (−) of the load to the GND terminal (J12) on the evaluation board.

Input and Output Voltmeter Connections

Measure the input and output voltages with voltmeters. Make sure that the voltmeters are connected to the appropriate test points on the board. If the voltmeters are not connected to the correct test points, the measured voltages may be incorrect due to the voltage drop across the leads or due to the connections between the board, the power source, and/or the load.

1. Connect the positive terminal (+) of the input voltage measuring voltmeter to Test Point T1 on the evaluation board.
2. Connect the negative terminal (−) of the input voltage measuring voltmeter to Test Point T2 on the board.
3. Connect the positive terminal (+) of the output voltage measuring voltmeter to Test Point T3 on the board.
4. Connect the negative terminal (−) of the output voltage measuring voltmeter to Test Point T5 on the board.

Power On the Evaluation Board

When the power source and load are connected to the ADP2164 evaluation board, the board can be powered on. If the input power source is above 2.7 V, the output voltage rises to 1.2 V by default.

MEASURING EVALUATION BOARD PERFORMANCE

Measuring the Switching Waveform

To observe the switching waveform with an oscilloscope, place the oscilloscope probe tip at Test Point T4 with the probe ground connected to GND. Set the oscilloscope to a dc coupling, 2 V/division, 1 μs/division time base. The switching waveform should alternate between 0 V and the approximate input voltage.

Measuring Load Regulation

Load regulation should be tested by increasing the load at the output and measuring the output voltage between the T3 and T5 test points.

Measuring Line Regulation

Vary the input voltage and measure the output voltage at a fixed output current. The input voltage can be measured between the T1 and T2 test points. The output voltage is measured between the T3 and T5 test points.

Measuring Efficiency

The efficiency, η, is measured by comparing the input power with the output power.

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

Measuring Inductor Current

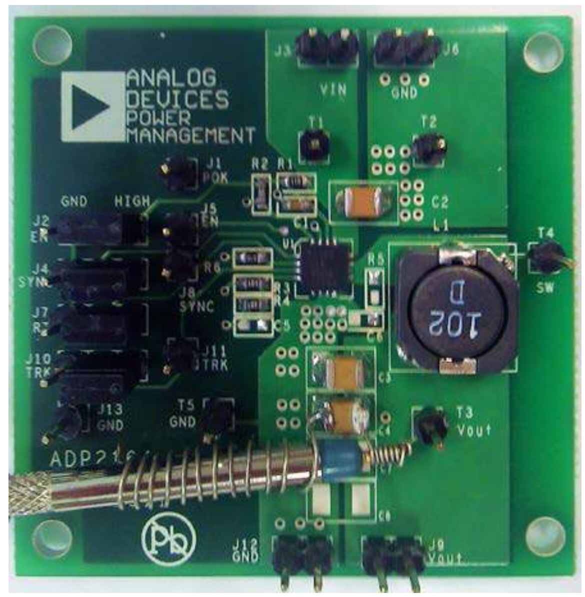
The inductor current can be measured by removing one end of the inductor from the pad on the board and connecting a wire between the pad and the inductor. A current probe can then be used to measure the inductor current.

Measuring Output Voltage Ripple

To observe the output voltage ripple, place an oscilloscope probe across Output Capacitor C4 with the probe ground lead placed at the negative capacitor terminal (−) and the probe tip placed at the positive capacitor terminal (+). Set the oscilloscope to an ac coupling, 10 mV/division, 2 μs/division time base and 20 MHz bandwidth.

A standard oscilloscope probe has a long wire ground clip. For high frequency measurements, this ground clip picks up high frequency noise and injects it into the measured output ripple.

Figure 2 shows a simple way to properly measure the output ripple. It requires removing the oscilloscope probe sheath and wrapping a nonshielded wire around the oscilloscope probe. By keeping the ground length of the oscilloscope probe as short as possible, true ripple can be measured.



10236-002

Figure 2. Output Ripple Measurement

Output Voltage Change

The output voltage of the ADP2164 evaluation board is preset to 1.2 V. However, the output voltage can be adjusted using the following equation:

$$V_{OUT} = 0.6\text{ V} \times \left(\frac{R4 + R3}{R3}\right)$$

TYPICAL PERFORMANCE CHARACTERISTICS

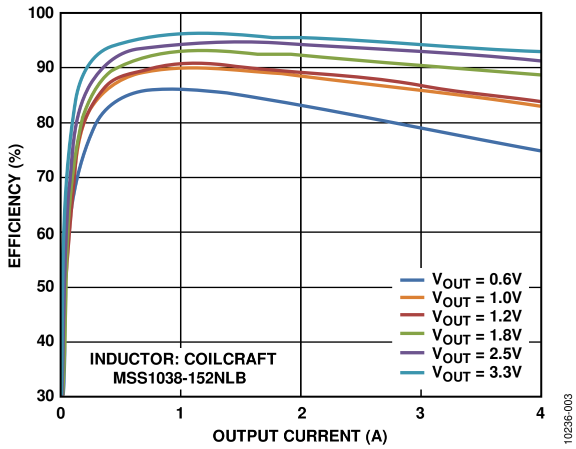


Figure 3. Efficiency vs. Output Current, $V_{IN} = 5$ V, $f_S = 600$ kHz

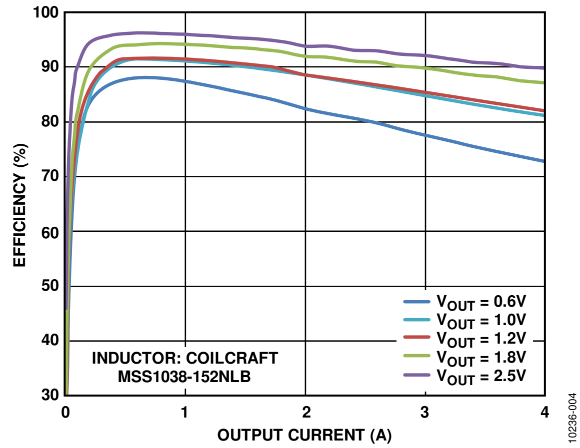


Figure 6. Efficiency vs. Output Current, $V_{IN} = 3.3$ V, $f_S = 600$ kHz

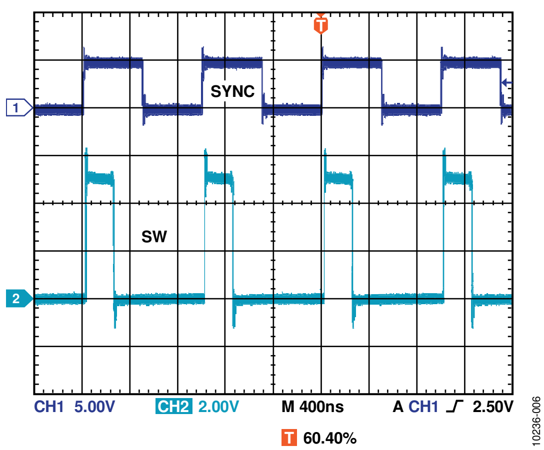


Figure 4. ADP2164 Synchronized to 1 MHz, in Phase

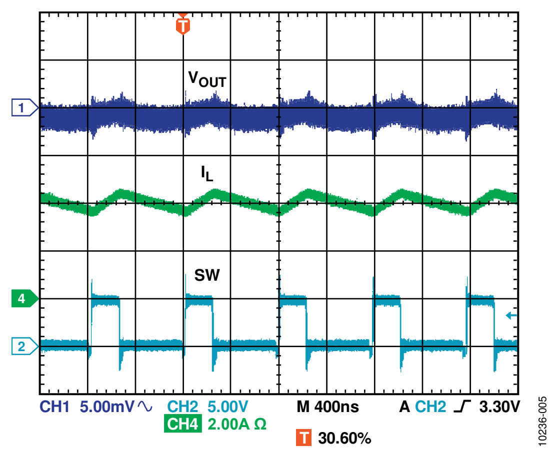


Figure 7. Steady Waveform, $V_{IN} = 5$ V, $V_{OUT} = 1.2$ V, $f_S = 1.2$ MHz

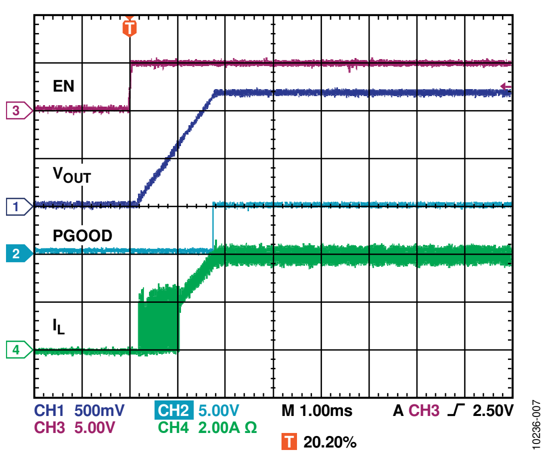


Figure 5. Soft Start with Full Load, $V_{IN} = 5$ V, $V_{OUT} = 1.2$ V, $f_S = 1.2$ MHz

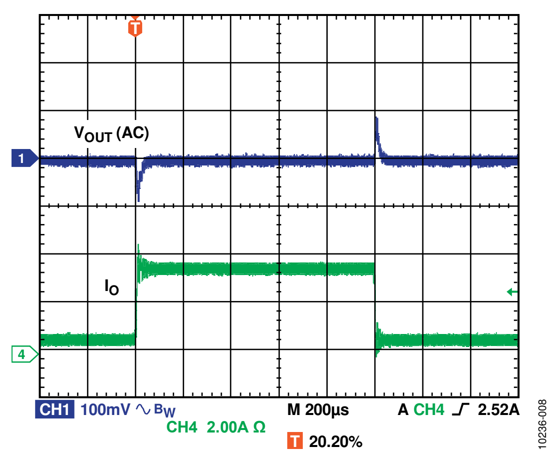


Figure 8. Load Transient, 0.5 A to 3.5 A Load Step, $V_{IN} = 5$ V, $V_{OUT} = 1.2$ V, $f_S = 1.2$ MHz

EVALUATION BOARD SCHEMATICS

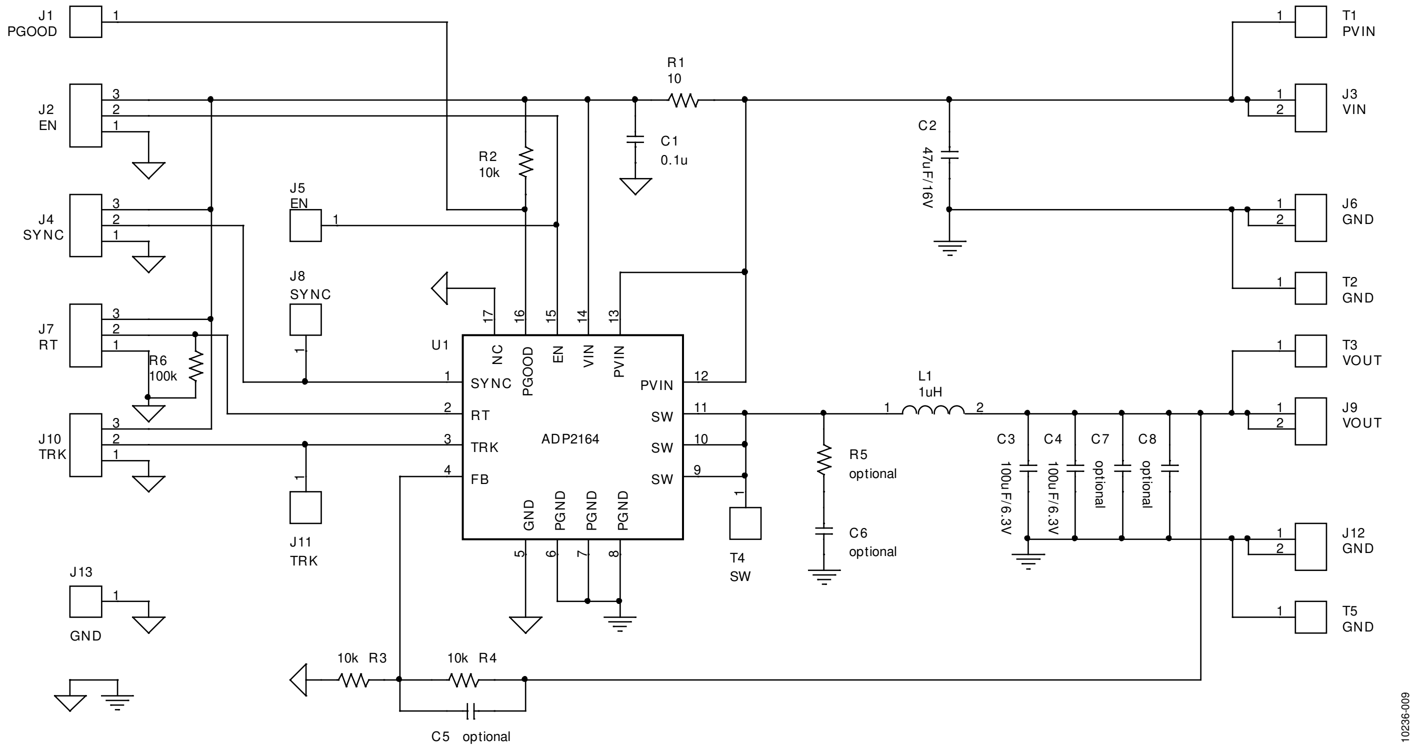


Figure 9. Schematic of the ADP2164 Evaluation Board

EVALUATION BOARD LAYOUT

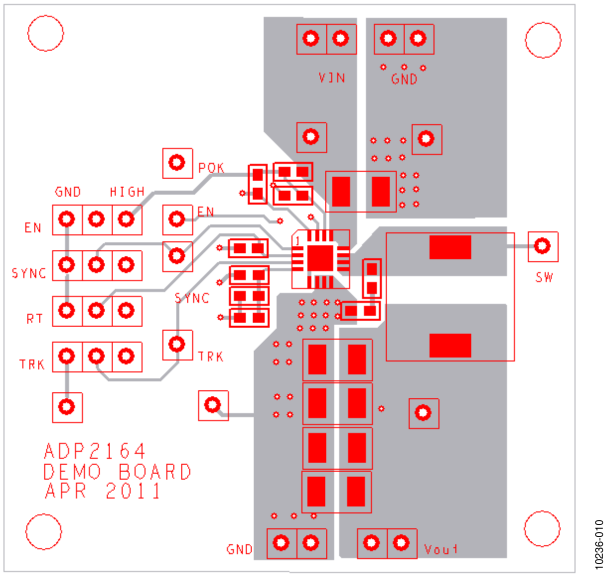


Figure 10. Top Layer

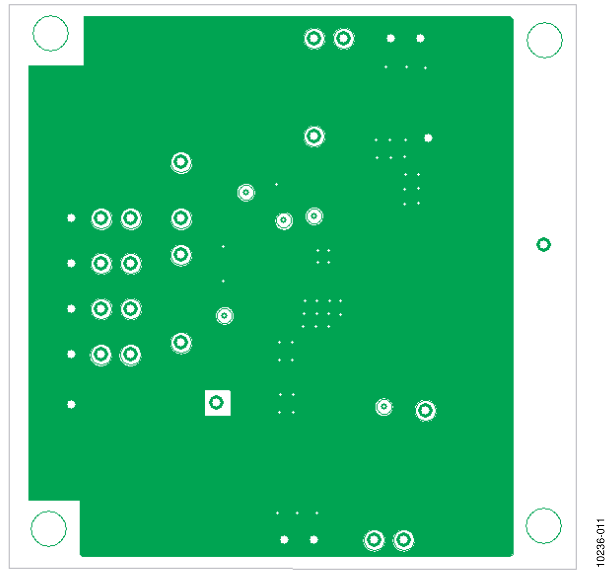


Figure 12. Second Layer

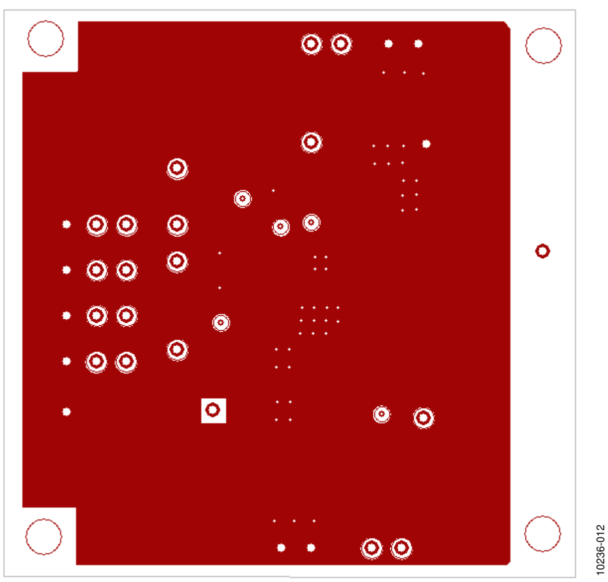


Figure 11. Third Layer

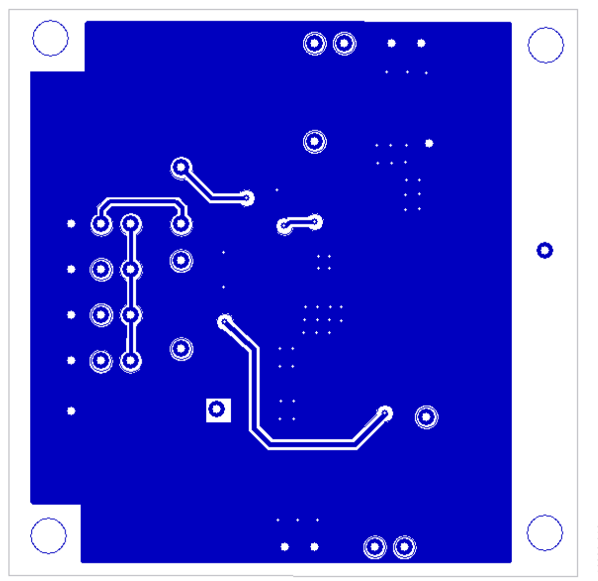


Figure 13. Bottom Layer

ORDERING INFORMATION

BILL OF MATERIALS

Table 2.

Qty	Reference Designator	Description	PCB Footprint	Vendor	Part No.
1	C1	Capacitor, 0.1 µF	C0603	Murata	GRM188R61E104KA01D
1	C2	Capacitor, 47 µF, 16 V	C1210	Murata	GRM32ER61C476ME15L
2	C3, C4	Capacitor, 100 µF, 6.3 V	C1210	Murata	GRM32ER60J107ME20L
2	C5, C6	Capacitor, optional	C0603		
2	C7, C8	Capacitor, optional	C1210		
1	L1	Inductor, 1 µH	Coilcraft_Mss1038	Coilcraft	MSS1038-102NL
1	R1	Resistor, 10 Ω	R0603	Vishay	CRCW0603-10R0F
3	R2, R3, R4	Resistor, 10 kΩ	R0603	Vishay	CRCW0603-1002F
1	R5	Resistor, optional	R0603		
1	R6	Resistor, 100 kΩ	R0603	Vishay	CRCW0603-1003F
1	U1	IC	16-lead LFCSP_WQ	Analog Devices, Inc.	ADP2164ACPZ-R7
10	J1, J5, J8, J11, J13, T1, T2, T3, T4, T5	Test point	SIP1	Harwin	M20-9990245
4	J3, J6, J9, J12	Connector	SIP2	Harwin	M20-9990245
4	J2, J4, J7, J10	Jumper	SIP3	Harwin	M20-9990346