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Evaluating the ADP5304 Ultralow Step-Down Regulator

FEATURES

Ultralow quiescent current
Input voltage monitoring
Few external components and compact solution size
AC and dc input source available

EQUIPMENT NEEDED

ADP5304 evaluation board
Power supply
Function generator
Electronic load
Multimeter

DOCUMENTS NEEDED

ADP5304 data sheet
ADP5304-EVALZ user guide

GENERAL DESCRIPTION

The ADP5304 is an ultralow power, synchronous step-down dc-to-dc regulator in a 10-lead LFCSP package. The ADP5304 runs from input voltages of 2.15 V to 6.50 V and requires minimal external components to provide a high efficiency solution with an integrated power switch, synchronous rectifier, and internal compensation.

The ADP5304 evaluation board with full bridge rectifier can support both an ac and dc voltage power source and regulate the input voltage as a maximum power point as the preset VINOK threshold.

The ADP5304 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 ADP5304 is available in the ADP5304 data sheet, which should be consulted in conjunction with this user guide when using the evaluation board.

ADP5304 EVALUATION BOARD

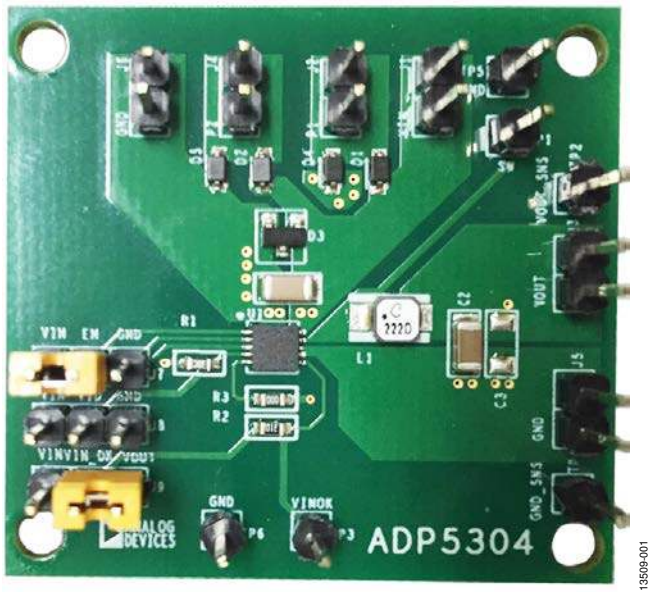

Figure 1.

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REVISION HISTORY

12/15—Revision 0: Initial Version

SETTING UP THE EVALUATION BOARD

POWERING UP THE EVALUATION BOARD

The ADP5304 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, ensure the enable input, EN, is high.

Table 1. Jumper Settings

Jumper	State or Connection	Function
J7 (EN)	High	Enable VOUT
	Low	Disable VOUT
J8 (VID)	VIN	2.5 V
	GND	3 V
	Floating	Program VOUT by external resistor
J9 (VIN_OK)	VIN	Pull VINOK to VIN
	VOUT	Pull VINOK to VOUT

High Impedance DC Voltage Power Source Connection

Before connecting a power source to the ADP5304 evaluation board, ensure 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 (J1) on the evaluation board.
2. Connect the negative terminal of the power source to the GND terminal (J5) on the 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 (J5) on the evaluation board.
3. Connect the negative terminal of the current meter to the VIN terminal (J1) on the evaluation board.

Output Load Connection

Before connecting the load to the ADP5304 evaluation board, ensure 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 load connection to the VOUT terminal (J3).
2. Connect the negative load connection to the GND terminal (J6).

If a 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 (J3) terminal 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 (J6) on the evaluation board.

Input and Output Voltmeter Connections

Measure the input and output voltages with voltmeters. Ensure the voltmeters connect to the appropriate test points on the evaluation board. If the voltmeters are not connected to the correct test point, 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 voltmeter measuring the input voltage to the TP2 test point on the board.
2. Connect the negative terminal of the voltmeter measuring the input voltage to the TP4 test point on the board.

High impedance AC Voltage Power Source Connection

The ac voltage power source can connect to the J2 and J4 input terminals of the ADP5304 evaluation board. Ensure the voltage at the J1 terminal does not exceed 6.5 V even though the Zener diode (D3) clamps the voltage to 6.5 V.

Power On the Evaluation Board

When the power source and load are connected to the ADP5304 evaluation board, the board can power on. If the voltage at VIN is above the VINOK rising threshold, the output voltage rises to 1.8 V by default. The ADP5304 stops switching when the voltage at VIN is below the VINOK falling threshold. If the input energy is weak, the input voltage regulates at the typical value 3.0 V.

MEASURING PERFORMANCE OF THE EVALUATION BOARD

Measuring the Switching Waveform

To observe the switching waveform with an oscilloscope, place the oscilloscope probe tip at the TP1 and TP5 test points 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 alternates between 0 V and the approximate input voltage.

Measuring Load Regulation

Test load regulation by increasing the load at the output and measuring the output voltage between the TP2 and TP4 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 J1 and J5 terminals. The output voltage is measured between the TP2 and TP4 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

Measure the inductor current can by removing one end of the inductor from the pad on the board and using a wire connected between the pad and the inductor. Use a current probe to measure the inductor current through the wire.

Measuring Output Voltage Ripple

To observe the output voltage ripple, place an oscilloscope probe across the C2 and C3 output capacitors 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.

Output Voltage Change

The output voltage of the ADP5304 evaluation board is preset to 1.8 V. However, the output voltage can be adjusted using a different resistor at the VID pin and restarting the power-on sequence.

EVALUATION BOARD SCHEMATIC AND ARTWORK

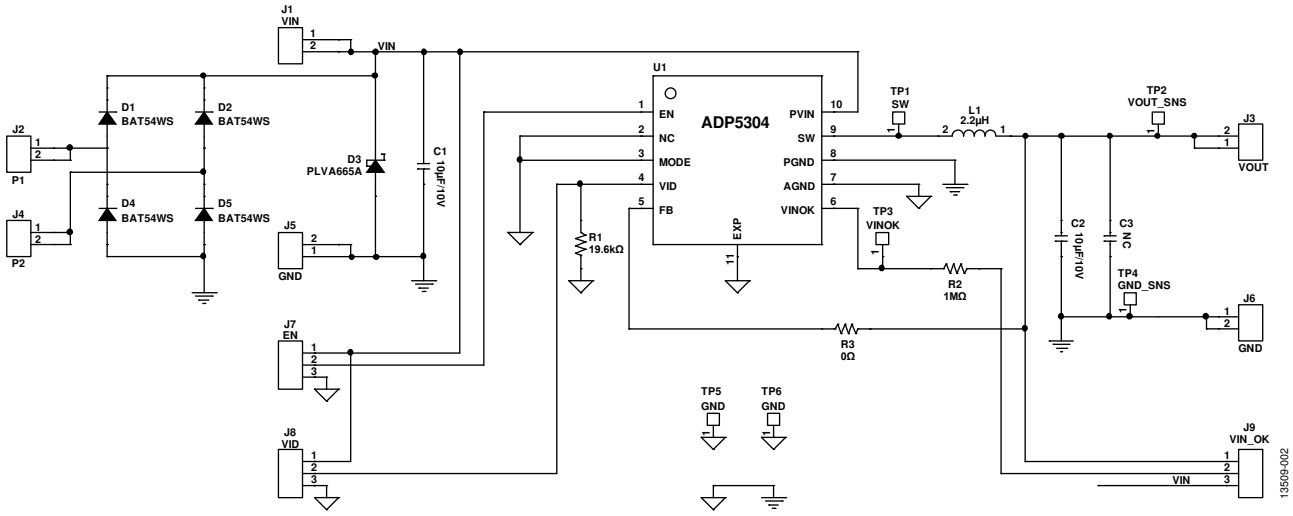

Figure 2. Schematic of the ADP5304 Evaluation Board

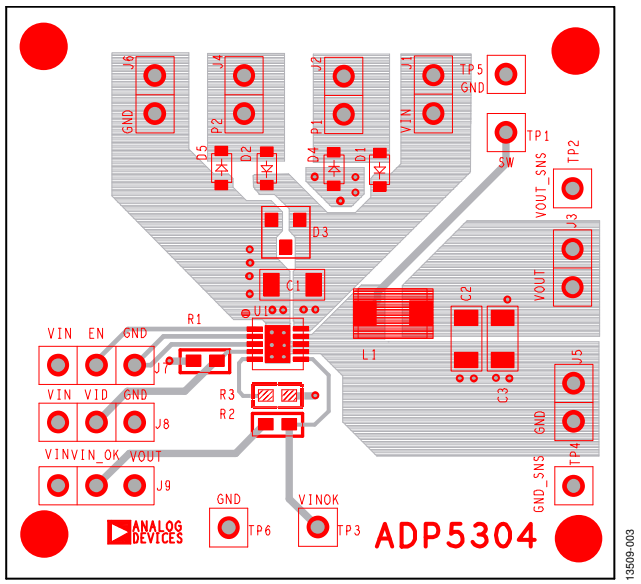

Figure 3. Top Layer

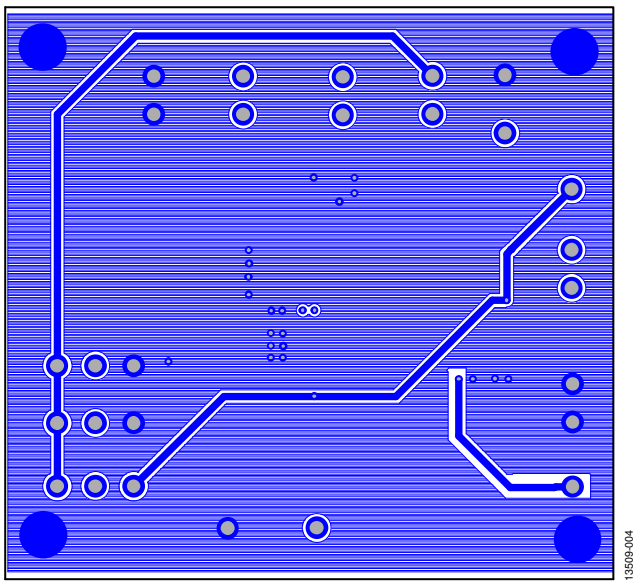

Figure 4. Bottom Layer

ORDERING INFORMATION

BILL OF MATERIALS

Table 2. ADP5304 Evaluation Board Bill of Materials

Qty	Reference Designator	Description	Part Number	Printed Circuit Board Footprint	Manufacturer
2	C1, C2	10 µF/10 V	GRM31CR71A106KA01	C1206	Murata
1	C3	Not connected	Not applicable	C1206	Not applicable
4	D1, D2, D4, D5	Schottky barrier diode	BAT54WS-7-F	SOD-323	Diodes
1	D3	Low voltage avalanche regulator diode	PLVA665A	SOT23	NXP
1	J1	VIN	M20-9990245	SIP2	Harwin
1	J2	P1	M20-9990245	SIP2	Harwin
1	J3	VOUT	M20-9990245	SIP2	Harwin
1	J4	P2	M20-9990245	SIP2	Harwin
2	J5, J6	GND	M20-9990245	SIP2	Harwin
1	J7	EN	M20-9990246	SIP3	Harwin
1	J8	VID	M20-9990246	SIP3	Harwin
1	J9	VIN_OK	M20-9990246	SIP3	Harwin
1	L1	2.2 µH	LPS3015-222MR	Inductor45x32	Coilcraft
		2.2 µH	74438334022	Inductor45x32	Wurth Elektronik
1	R1	19.6 kΩ	CRCW060319K6FKEA	R0603	Vishay Dale
1	R2	1 MΩ	CRCW06031M00FKEA	R0603	Vishay Dale
1	R3	0 Ω	CRCW06030000FKEA	R0603	Vishay Dale
1	TP1	SW	M20-9990245	SIP1	Harwin
1	TP2	VOUT_SNS	M20-9990245	SIP1	Harwin
1	TP3	VINOK	M20-9990245	SIP1	Harwin
1	TP4	GND_SNS	M20-9990245	SIP1	Harwin
2	TP5, TP6	GND	M20-9990245	SIP1	Harwin
1	U1	ADP5304	ADP5304ACPZ-1-R7	QFN10_3x3	Analog Devices, Inc.