

## Evaluating the **ADP5303** Ultralow Step-Down Regulator

### FEATURES

Ultralow quiescent current  
 Input voltage monitoring  
 Few external components and compact solution size

### EQUIPMENT NEEDED

**ADP5303** evaluation board  
 Power supply  
 Electronic load  
 Multimeter

### DOCUMENTS NEEDED

**ADP5303** data sheet  
**ADP5303-EVALZ** user guide

### GENERAL DESCRIPTION

The **ADP5303** is an ultralow power, synchronous step-down dc-to-dc regulator in a 9-lead WLCSP package. The **ADP5303** runs from input voltages of 2.06 V to 6.5 V and requires minimal external components to provide a high efficiency solution with an integrated power switch, synchronous rectifier, and internal compensation.

The **ADP5303** 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 **ADP5303** is available in the **ADP5303** data sheet, which should be consulted in conjunction with this user guide when using the evaluation board.

### THE **ADP5303** EVALUATION BOARD

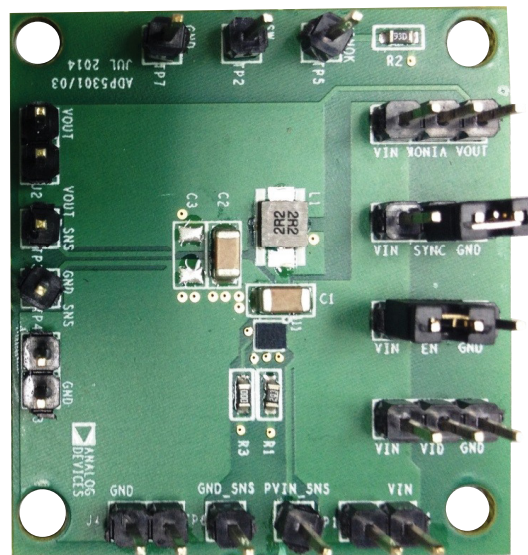


Figure 1.

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**REVISION HISTORY**

11/15—Revision 0: Initial Version

## SETTING UP THE EVALUATION BOARD

### POWERING UP THE EVALUATION BOARD

The [ADP5303](#) evaluation board arrives 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
J5 (EN)	High Low	Enable $V_{OUT}$ Disable $V_{OUT}$
J8 (VID)	VIN GND Floating	2.5 V 3 V Program $V_{OUT}$ by external resistor
J6 (SYNC/MODE)	VIN GND External frequency	FPWM mode Hysteresis mode Set frequency from 1.2 MHz to 2.5 MHz
J7 (VINOK)	VIN VOUT	Pull VINOK to VIN Pull VINOK to VOUT

#### Input Power Source Connection

Before connecting a power source to the [ADP5303](#) 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 (J3) 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 (J3) 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 [ADP5303](#) 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 (J2) on the evaluation board.
2. Connect the negative load connection to the GND terminal (J4) on the evaluation board.

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 terminal (J2) 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 (J4) 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 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 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 TP1 test point on the evaluation board.
2. Connect the negative terminal of the voltmeter measuring the input voltage to the TP4 test point on the evaluation board.
3. Connect the positive terminal of the voltmeter measuring the input voltage to the TP3 test point on the evaluation board.
4. Connect the negative terminal of the voltmeter measuring the input voltage to the TP6 test point on the evaluation board.

#### Power On the Evaluation Board

When the power source and load connect to the [ADP5303](#) evaluation board, the board can power on. If the input power source exceeds 2.06 V (typical), the output voltage rises to 1.8 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 the TP2 and TP4 test points with the probe ground connected to GND. Set the oscilloscope to a dc coupling, 2 V/division, 1  $\mu$ s/division time base. The switching waveform must alternate 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 TP4 and TP7 test points.

### Measuring Line Regulation

Vary the input voltage and measure the output voltage at a fixed output current. Measure the input voltage between the TP1 and TP4 test points. Measure the output voltage between the TP3 and TP6 test points.

### Measuring Efficiency

The efficiency,  $\eta$ , 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 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  $\mu$ s/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 lengths of the oscilloscope probe as short as possible, true ripple is measurable.

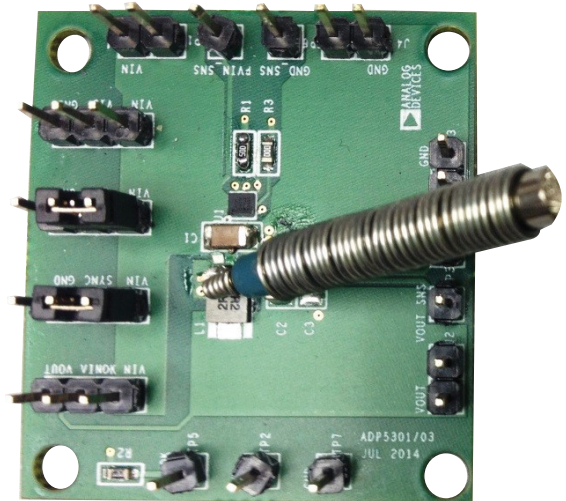


Figure 2. Output Ripple Measurement

### Output Voltage Change

The output voltage of the evaluation board is preset to 1.8 V. However, the output voltage can be adjusted with an external  $R_{VID}$  resistor through the VID pin to GND (see Table 5 in the [ADP5303](#) data sheet).

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# EVALUATION BOARD SCHEMATIC AND ARTWORK

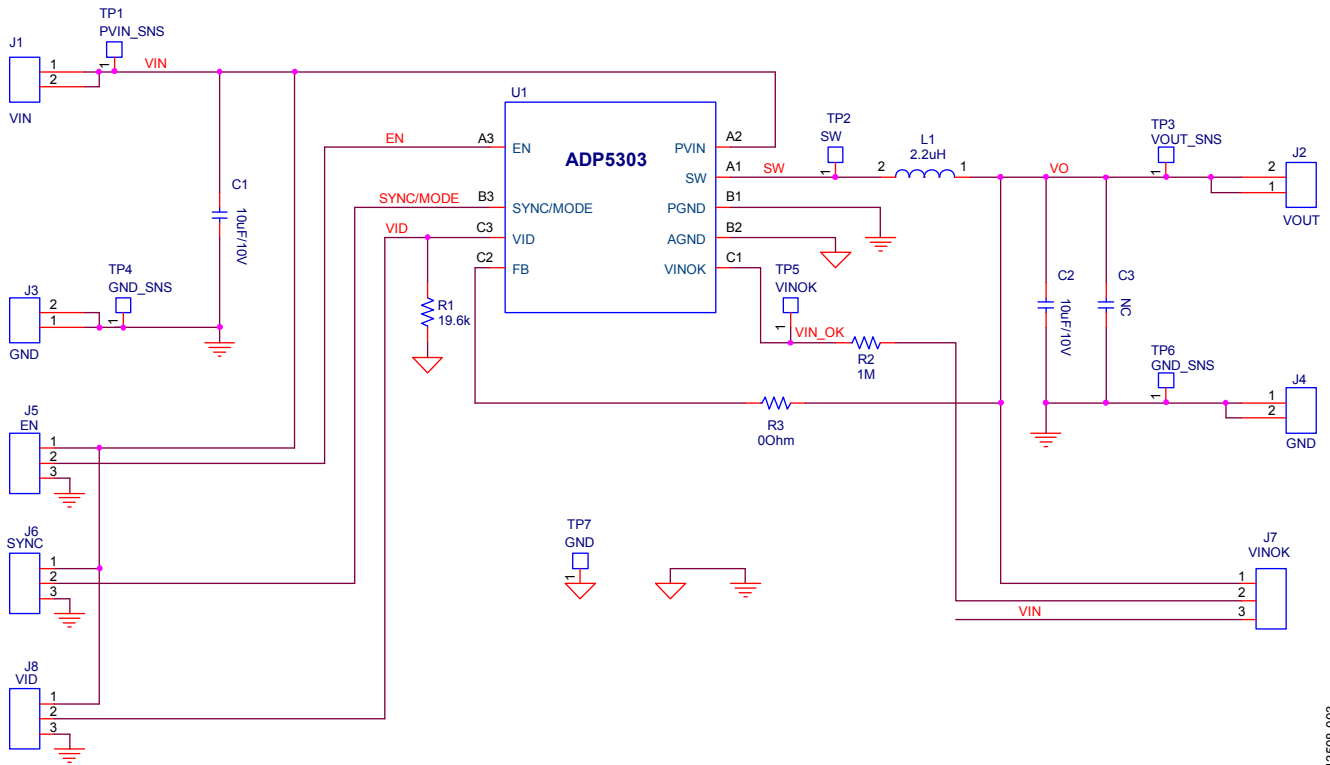


Figure 3. Schematic of the ADP5303 Evaluation Board

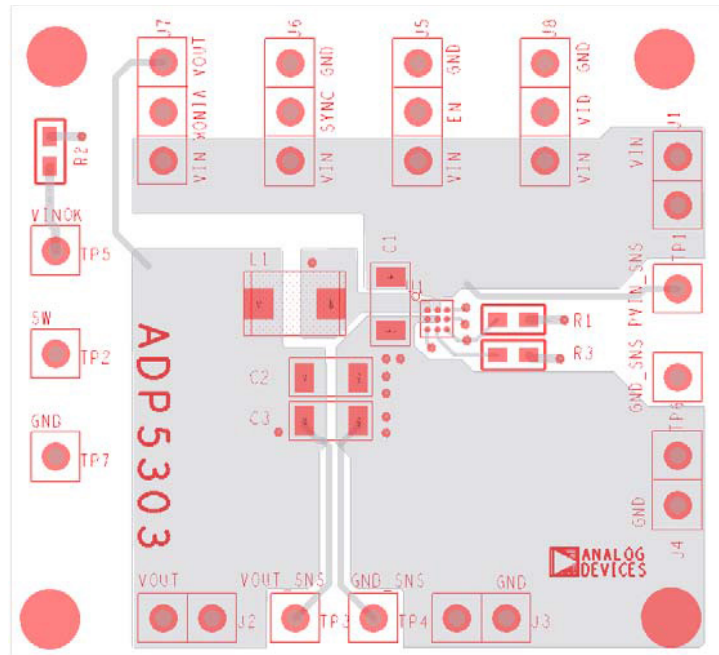


Figure 4. Top Layer of the ADP5303 Evaluation Board

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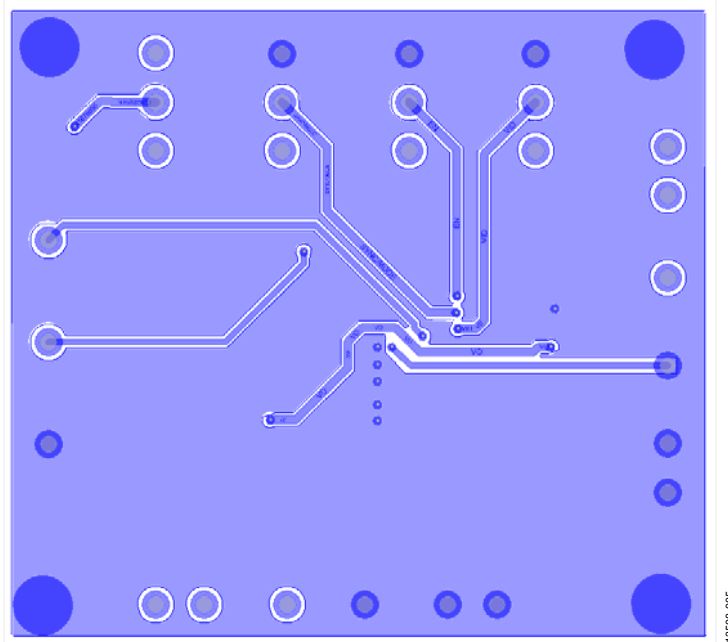


Figure 5. Second Layer of the ADP5303 Evaluation Board

## ORDERING INFORMATION

### BILL OF MATERIALS

Table 2. ADP5303 Evaluation Board Bill of Materials

Qty	Reference Designator	Description	Part Number	Printed Circuit Board Footprint	Manufacturer
2	C1, C2	10 $\mu$ F/10 V	GRM31CR71A106KA01	C1206	Murata
1	C3	Not connected	Not applicable	C1206	Not applicable
1	J1	VIN	M20-9990245	SIP2	Harwin
1	J2	VOUT	M20-9990245	SIP2	Harwin
2	J3, J4	GND	M20-9990245	SIP2	Harwin
1	J5	EN	M20-9990246	SIP3	Harwin
1	J6	SYNC	M20-9990246	SIP3	Harwin
1	J7	VINOK	M20-9990246	SIP3	Harwin
1	J8	VID, jumper	M20-9990246	SIP3	Harwin
1	L1	2.2 $\mu$ H	LPS3015-222MR	Inductor 45x32	Coilcraft
		2.2 $\mu$ H	74438334022	Inductor 45x32	Wurth Elektronik
1	R1	19.6 k $\Omega$	CRCW060319K6FKEA	R0603	Vishay Dale
1	R2	1 M $\Omega$	CRCW06031M00FKEA	R0603	Vishay Dale
1	R3	0 $\Omega$	CRCW0603100K0FKEA	R0603	Vishay Dale
1	TP1	PVIN_SNS	M20-9990245	SIP1	Harwin
1	TP2	SW	M20-9990245	SIP1	Harwin
1	TP3	VOUT_SNS	M20-9990245	SIP1	Harwin
2	TP4, TP6	GND_SNS	M20-9990245	SIP1	Harwin
1	TP5	VINOK	M20-9990245	SIP1	Harwin
1	TP7	GND	M20-9990245	SIP1	Harwin
1	U1	IC, ultralow power buck regulator	ADP5303ACBZ-2-R7	WLCSP9	Analog Devices, Inc.



#### 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.

#### Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. CONFIDENTIALITY. This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. ADDITIONAL RESTRICTIONS. Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. TERMINATION. ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. LIMITATION OF LIABILITY. THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS (\$100.00). EXPORT. Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. GOVERNING LAW. This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.