

## Setting Up the Evaluation Board for the ADP151

### FEATURES

- Input voltage range: 2.2 V to 5.5 V**
- Output current range: 0 mA to 200 mA**
- Output voltage accuracy:  $\pm 1\%$**
- Operating temperature range:  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$**

### GENERAL DESCRIPTION

The ADP151 evaluation board is used to demonstrate the functionality of the ADP151 series of linear regulators.

Simple device measurements such as line and load regulation, dropout voltage, and ground current can be demonstrated with only a single voltage supply, a voltmeter, a current meter, and load resistors.

For more information about the ADP151 linear regulator, see the ADP151 data sheet.

### EVALUATION BOARDS

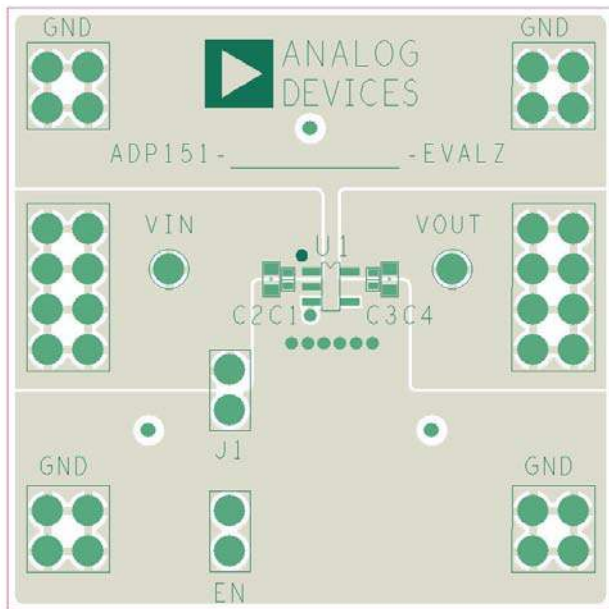


Figure 1. TSOT PCB Layout

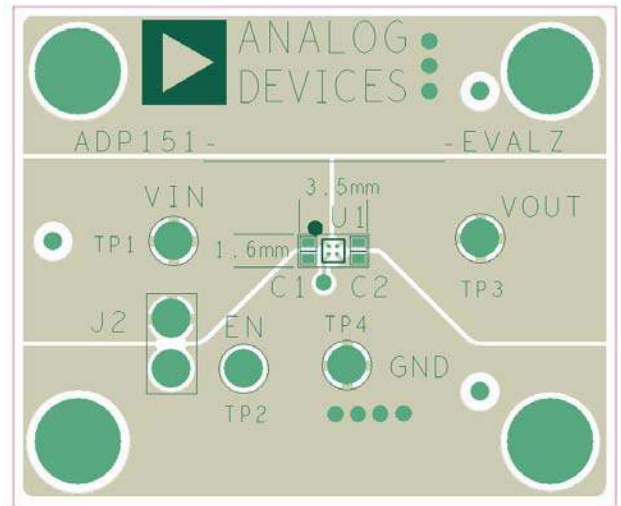


Figure 2. WLCSP PCB Layout

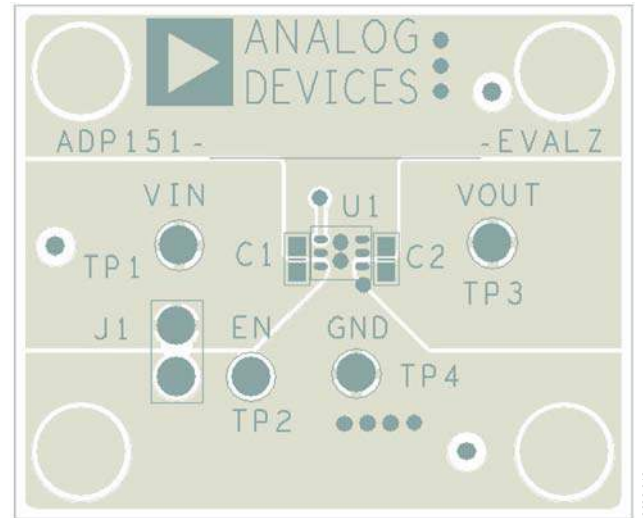


Figure 3. LFCSP PCB Layout

**TABLE OF CONTENTS**

Features .....	1	Measuring Output Voltage .....	4
General Description .....	1	Line Regulation Measurements.....	5
Evaluation Boards.....	1	Load Regulation Measurements.....	5
Revision History .....	2	Dropout Voltage Measurements.....	6
Revision History .....	2	Measuring Ground Current .....	7
Evaluation Board Hardware .....	3	Ground Current Consumption .....	8
Evaluation Board Configurations .....	3	Bill of Materials.....	9

**REVISION HISTORY**

**12/10—Rev. 0 to Rev. A**

Added LFCSP Throughout.....	Universal
Added Figure 3; Renumbered Sequentially .....	1
Added Figure 6.....	3
Added Figure 9.....	5
Added Figure 15.....	8

**4/10—Revision 0: Initial Version**

## EVALUATION BOARD HARDWARE

### EVALUATION BOARD CONFIGURATIONS

The ADP151 evaluation board is supplied with different components, depending on the version ordered. Components common to all versions are C1, C2, and J1. Figure 4 and Figure 5 show the schematics of these evaluation board configurations. Table 1 describes the components.

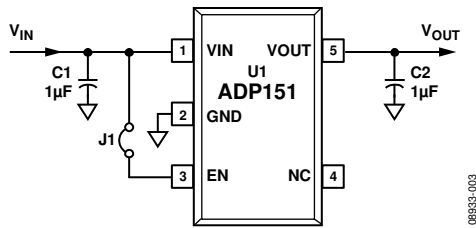


Figure 4. Evaluation Board Schematic, TSOT

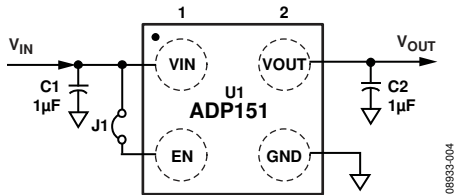


Figure 5. Evaluation Board Schematic, WLCSP

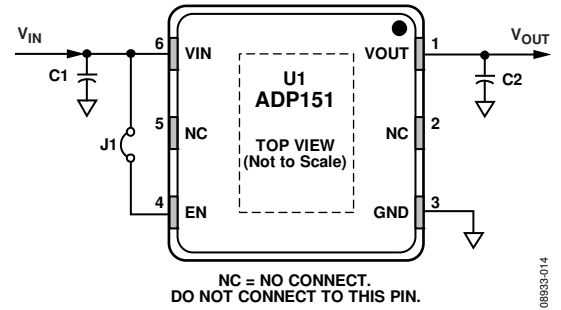


Figure 6. Evaluation Board Schematic, LFCSP

Table 1. Evaluation Board Hardware Components

Component	Description
U1 <sup>1</sup>	ADP151 ultralow noise, low dropout linear regulator
C1 <sup>2</sup>	Input bypass capacitor, 1 µF, 0402 size
C2 <sup>2</sup>	Output capacitor, 1 µF, 0402 size
J1	Jumper (connects EN to VIN for automatic startup)

<sup>1</sup> The evaluation board with the WLCSP package is the ADP151CB-xxx-EVALZ. The evaluation board with the TSOT package is the ADP151UJ-xxx-EVALZ.

<sup>2</sup> The ADP151 evaluation board requires only one input bypass capacitor and one output capacitor for stable operation.

### MEASURING OUTPUT VOLTAGE

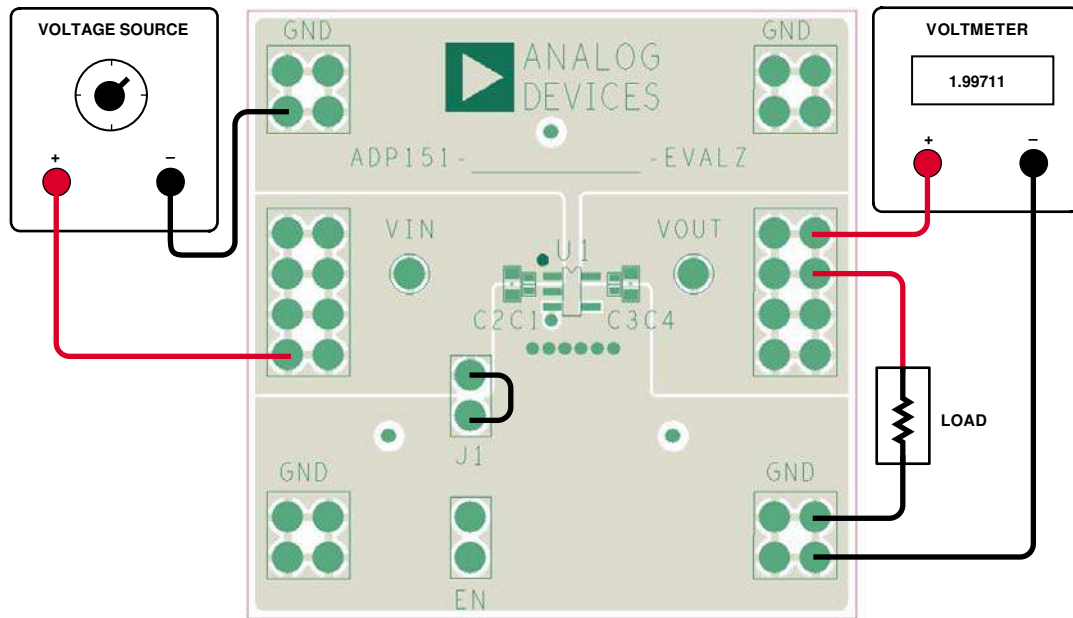


Figure 7. Output Voltage Measurement Setup, TSOT

08833-005

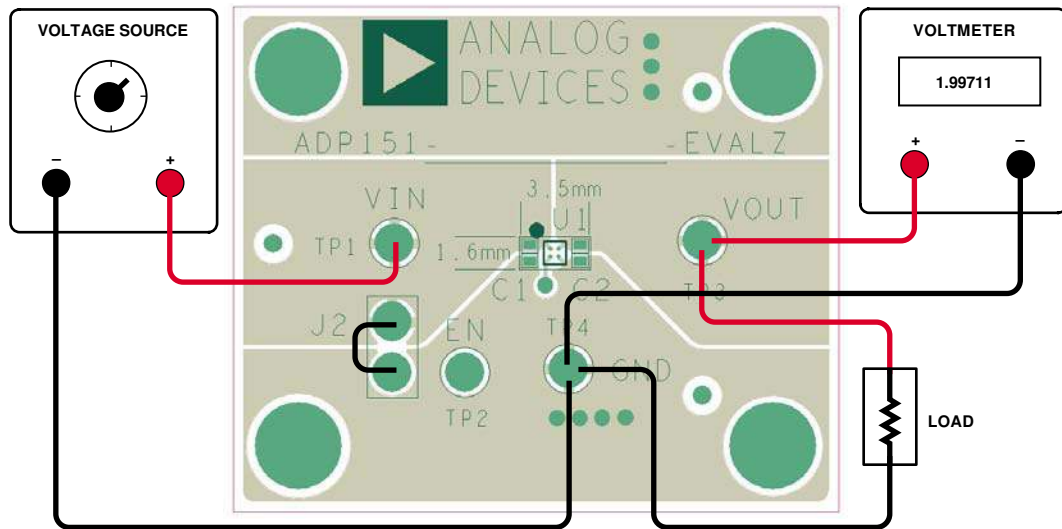


Figure 8. Output Voltage Measurement Setup, WLCSP

08833-006

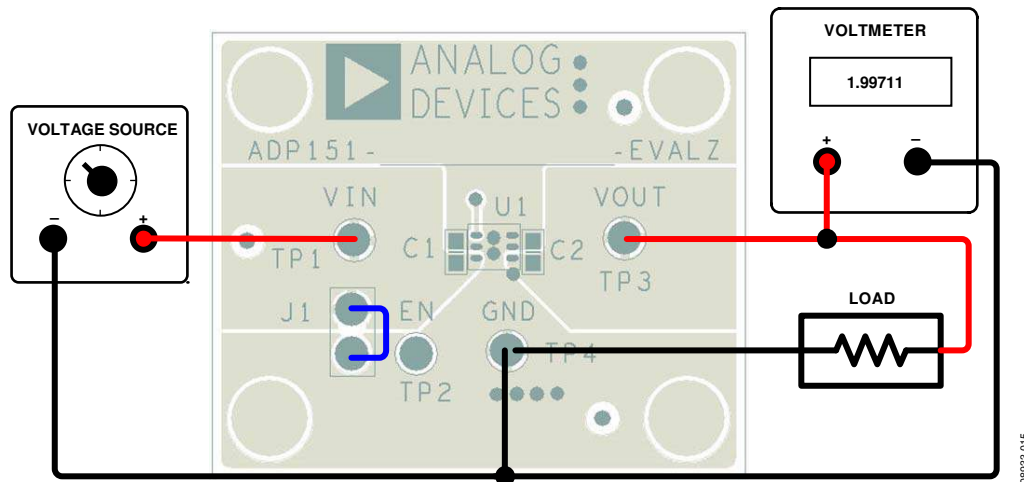


Figure 9. Output Voltage Measurement Setup, LFCSP

Figure 7 and Figure 8 show how the evaluation board can be connected to a voltage source and a voltmeter for basic output voltage accuracy measurements. A resistor can be used as the load for the regulator. Ensure that the resistor has a power rating that is adequate to handle the power that is expected to be dissipated across it. An electronic load can also be used as an alternative. Ensure that the voltage source can supply enough current for the expected load levels.

Use the following steps to connect to a voltage source and voltmeter:

1. Connect the negative terminal (-) of the voltage source to one of the GND pads on the evaluation board.
2. Connect the positive terminal (+) of the voltage source to the VIN pad of the evaluation board.
3. Connect a load between the VOUT pad and one of the GND pads.
4. Connect the negative terminal (-) of the voltmeter to one of the GND pads.
5. Connect the positive terminal (+) of the voltmeter to the VOUT pad.

When these steps are completed, the voltage source can be turned on. If J1 is inserted (connecting EN to VIN for automatic startup), the regulator powers up.

If the load current is large, the user must connect the voltmeter as close as possible to the output capacitor to reduce the effects of IR drops.

### LINE REGULATION MEASUREMENTS

For line regulation measurements, the output of the regulator is monitored while its input is varied. For good line regulation, the output must change as little as possible with varying input levels. To ensure that the device is not in dropout mode during this measurement,  $V_{IN}$  must be varied between  $V_{OUT}$  nominal + 0.4 V (or 2.2 V, whichever is greater) and  $V_{IN}$  maximum. For example, for an ADP151 with a 2.8 V output,  $V_{IN}$  needs to be varied between 3.2 V and 5.5 V.

This measurement can be repeated under different load conditions. Figure 10 shows the typical line regulation performance of an ADP151 with a 2.8 V output.

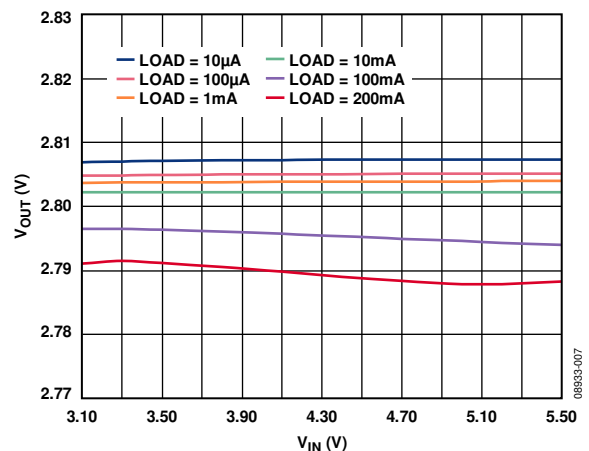


Figure 10. Output Voltage ( $V_{OUT}$ ) vs. Input Voltage ( $V_{IN}$ ) at  $T_A = 25^\circ\text{C}$

### LOAD REGULATION MEASUREMENTS

For load regulation measurements, the output of the regulator is monitored while the load is varied. For good load regulation, the output must change as little as possible with varying load. The input voltage must be held constant during this measurement. The load current can be varied from 0 mA to 200 mA. Figure 11 shows the typical load regulation performance of an ADP151 with a 2.8 V output for an input voltage of 3.2 V.

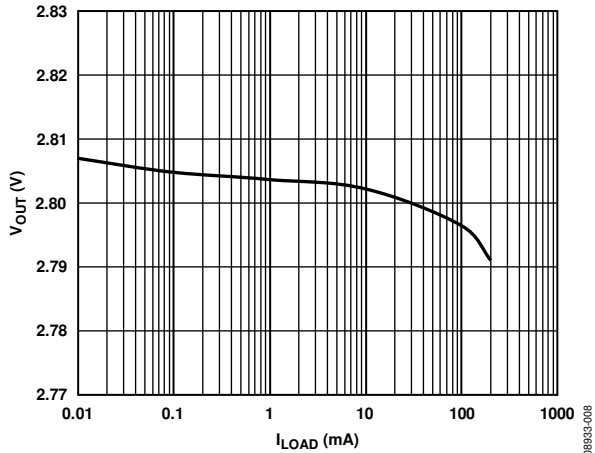


Figure 11. Output Voltage,  $V_{OUT}$  vs. Load Current,  $I_{OUT}$  at  $V_{IN} = 3.2 V$ ,  $V_{OUT} = 2.8 V$ ,  $T_A = 25^\circ C$

**DROPOUT VOLTAGE MEASUREMENTS**

Dropout voltage can be measured using the configurations shown in Figure 7 and Figure 8. Dropout voltage is defined as the input-to-output voltage differential when the input voltage is set to the nominal output voltage. This applies only to output voltages above 2.2 V. Dropout voltage increases with larger loads.

For more accurate measurements, a second voltmeter can be used to monitor the input voltage across the input capacitor.

The input supply voltage may need to be adjusted to account for IR drops, especially if large load currents are used. Figure 12 shows the typical curve of dropout voltage measurements with different load currents.

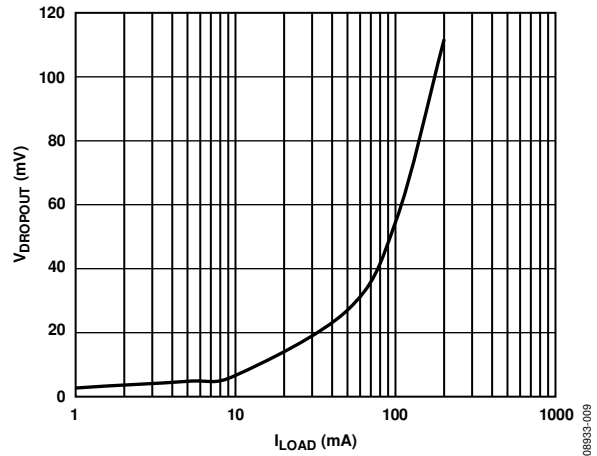


Figure 12. Dropout Voltage vs. Load Currents ( $I_{LOAD}$ )  $V_{OUT} = 2.8 V$ ,  $T_A = 25^\circ C$

### MEASURING GROUND CURRENT

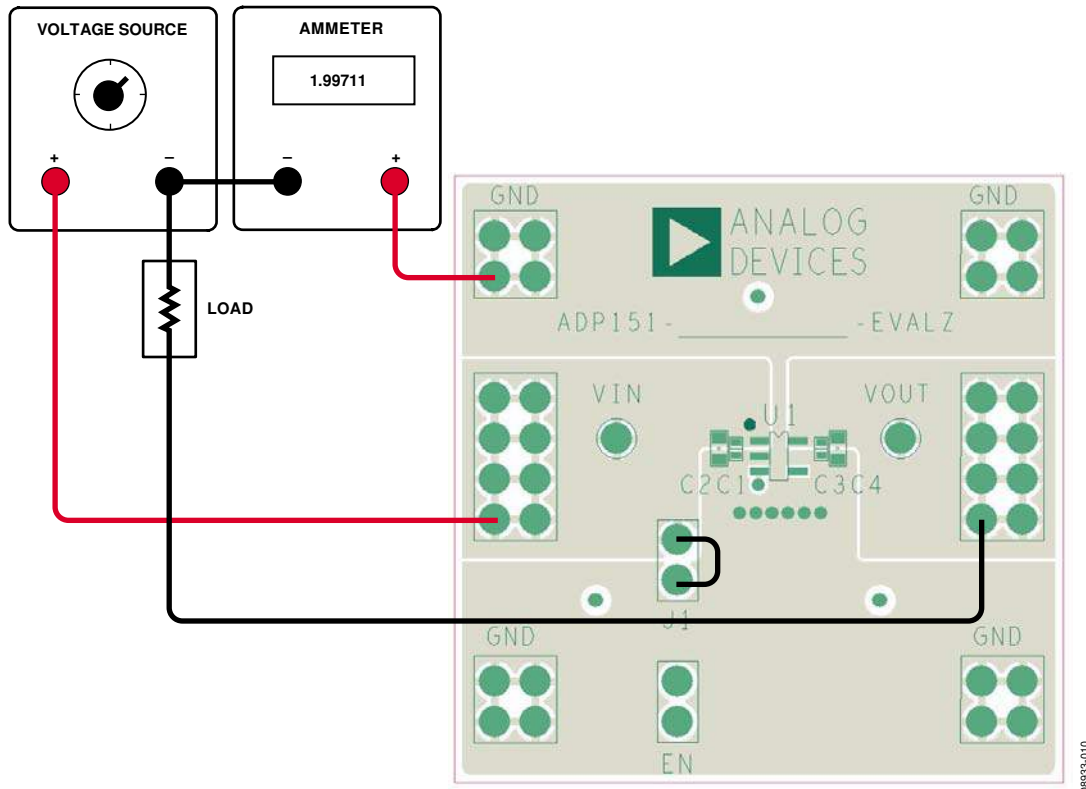


Figure 13. Ground Current Measurement Setup, TSOT

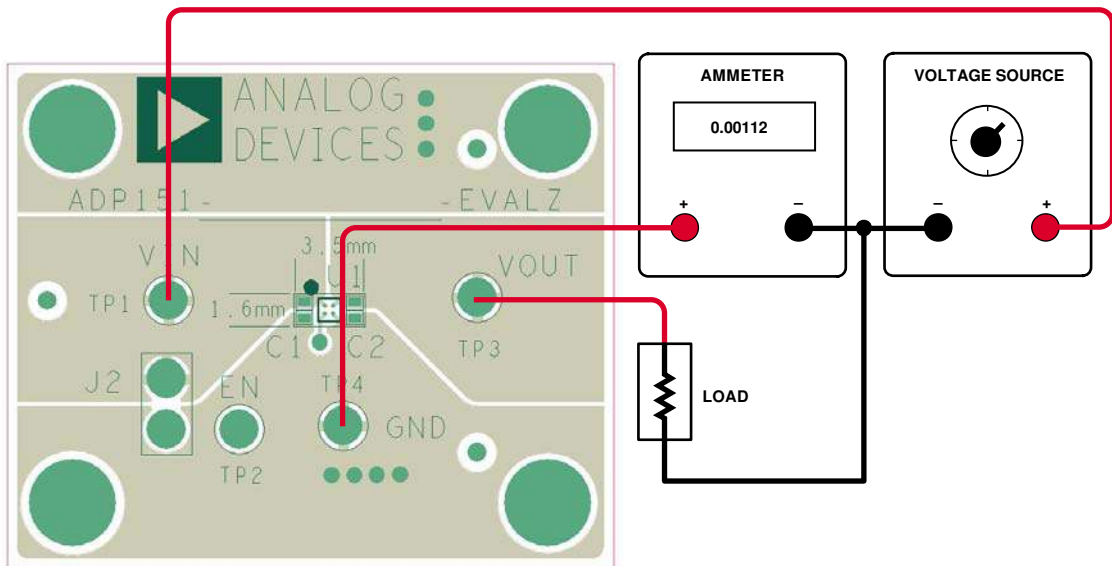


Figure 14. Ground Current Measurement Setup, WLCSP

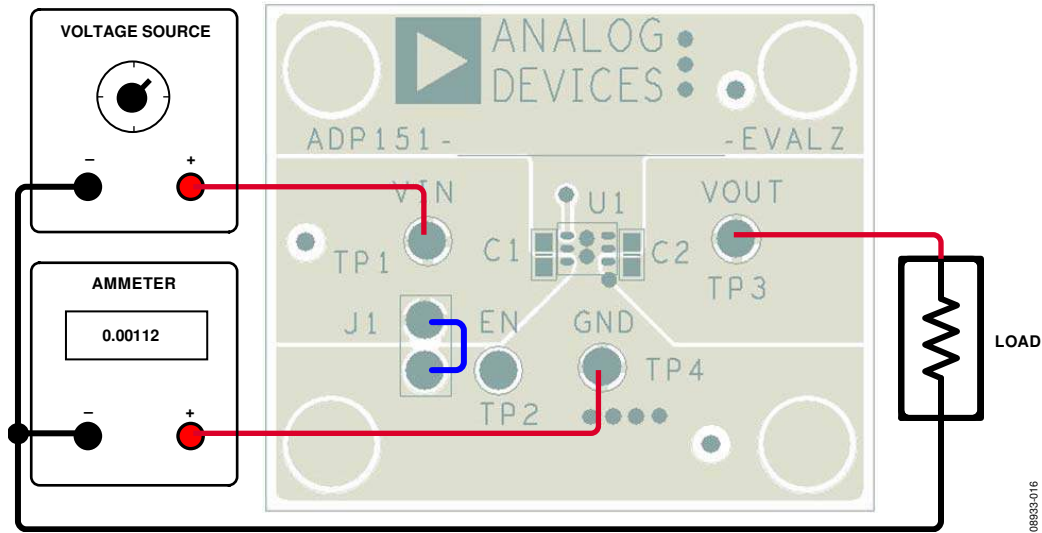


Figure 15. Ground Current Measurement Setup, LFCSP

Figure 13 and Figure 14 show how the evaluation board can be connected to a voltage source and an ammeter for ground current measurements. A resistor can be used as the load for the regulator. Ensure that the resistor has a power rating that is adequate to handle the power expected to be dissipated across it. An electronic load can be used as an alternative. Ensure that the voltage source can supply enough current for the expected load levels.

Use the following steps to connect to a voltage source and ammeter:

1. Connect the positive terminal (+) of the voltage source to the VIN pad on the evaluation board.
2. Connect the positive terminal (+) of the ammeter to one of the GND pads of the evaluation board.
3. Connect the negative terminal (-) of the ammeter to the negative (-) terminal of the voltage source.
4. Connect a load between the VOUT pad of the evaluation board and the negative (-) terminal of the voltage source.

When these connection steps are completed, the voltage source can be turned on. If J1 is inserted (connecting EN to VIN for automatic startup), the regulator powers up.

## GROUND CURRENT CONSUMPTION

Ground current measurements can determine how much current the internal circuits of the regulator consume while the circuits perform the regulation function. To be efficient, the regulator must consume as little current as possible. Typically, the regulator uses the maximum current when supplying its largest load level (200 mA). Figure 16 shows the typical ground current consumption for various load levels at  $V_{OUT} = 2.8\text{ V}$  and  $T_A = 25^\circ\text{C}$ .

When the device is disabled ( $EN = GND$ ), ground current drops to less than  $1\ \mu\text{A}$ .

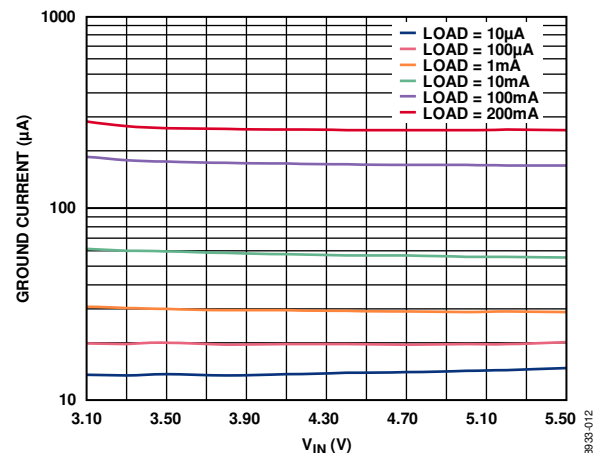


Figure 16. Ground Current vs. Input Voltage,  $V_{OUT} = 2.8\text{ V}$ ,  $T_A = 25^\circ\text{C}$



**BILL OF MATERIALS**

Table 2.

<b>Reference Designator</b>	<b>Description</b>	<b>Manufacturer</b>	<b>Part No.</b>
C1, C2	Capacitor, MLCC, 1 $\mu$ F, 10 V, 0402, X5R	Murata (or equivalent)	
J1	Header, single, STR, 2 pins	Sullins Connector Solutions	PEC02SAAN
U1	IC, LDO regulator	Analog Devices, Inc.	ADP151

**NOTES**

**NOTES**

## NOTES

**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.