

## Evaluating the **ADP223/ADP225** Dual, 300 mA Output, Adjustable, Low Noise, High PSRR Voltage Regulator

### FEATURES

- Input voltage range:** 2.5 V to 5.5 V
- Output current range:** 0 mA to 300 mA per output
- Output voltage accuracy:**  $\pm 1\%$
- Operating temperature range:**  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$

### GENERAL DESCRIPTION

The **ADP223/ADP225** evaluation board is used to demonstrate the functionality of the **ADP223** and **ADP225** dual adjustable linear regulators. The **ADP223** and **ADP225** are identical except that the **ADP225** incorporates the quick output discharge (QOD) function.

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

For more information about the **ADP223/ADP225** linear regulator, see the **ADP222/ADP223/ADP224/ADP225** data sheet.

### ADP223/ADP225 EVALUATION BOARD

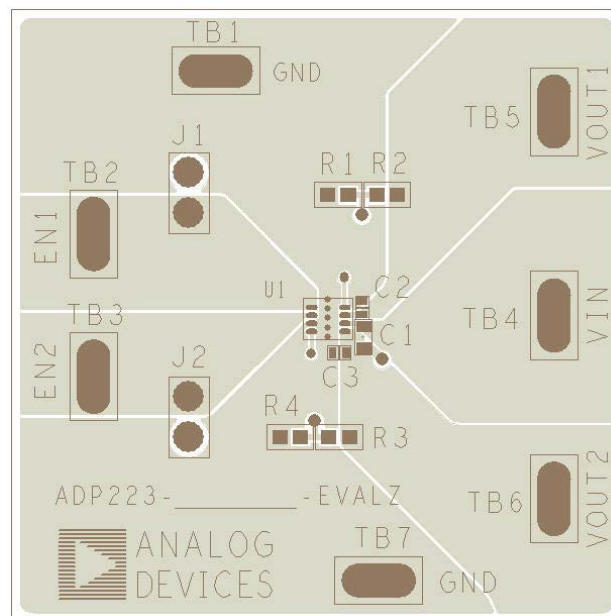


Figure 1. **ADP223/ADP225** Evaluation Board (**ADP223** Shown for Simplicity)

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**REVISION HISTORY**

<b>5/14—Rev. B to Rev. C</b>	
Change to Evaluation Board Configurations Section.....	3
Changes to Figure 2.....	3
<b>4/12—Rev. A to Rev. B</b>	
Change to Table 1 .....	3
Change to Table 2 .....	8
<b>11/11—Rev 0 to Rev. A</b>	
Added ADP225 .....	Universal

**5/11—Revision 0: Initial Version**

## EVALUATION BOARD HARDWARE AND SCHEMATIC

### EVALUATION BOARD CONFIGURATIONS

The ADP223/ADP225 evaluation board is supplied with different components. Components common to this version are C1, C2, C3, J1, and J2. Figure 2 shows the schematic of the evaluation board configuration.

The output voltages can be set according to the following equations:

$$V_{OUT1} = 0.5 V(1 + R2/R1)$$

$$V_{OUT2} = 0.5 V(1 + R3/R4)$$

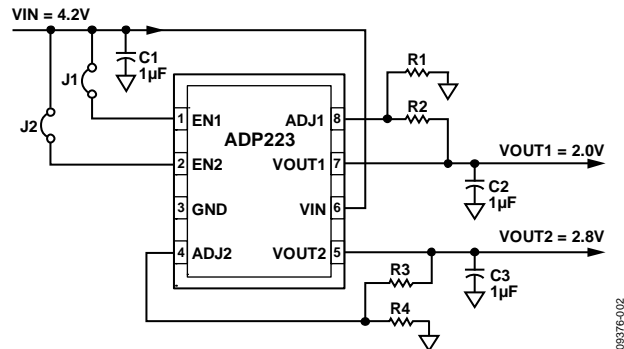


Figure 2. Evaluation Board Schematic (ADP223 Shown for Simplicity)

Table 1. Evaluation Board Hardware Components

Component	Function	Description
U1 <sup>1</sup>	Linear regulator	ADP223/ADP225 dual adjustable low dropout linear regulator.
C1	Input capacitor	1 µF input bypass capacitor, 0402 case.
C2, C3	Output capacitors	1 µF output capacitors, 0402 case. Required for stability and transient performance.
J1, J2	Jumpers	These jumpers connect EN1 and EN2 to VIN for automatic startup.
R1, R2, R3, R4	Resistors	Select R1 through R4 to set output voltages, 0603 case.

<sup>1</sup> Component varies depending on the evaluation board type ordered.

## OUTPUT VOLTAGE MEASUREMENTS

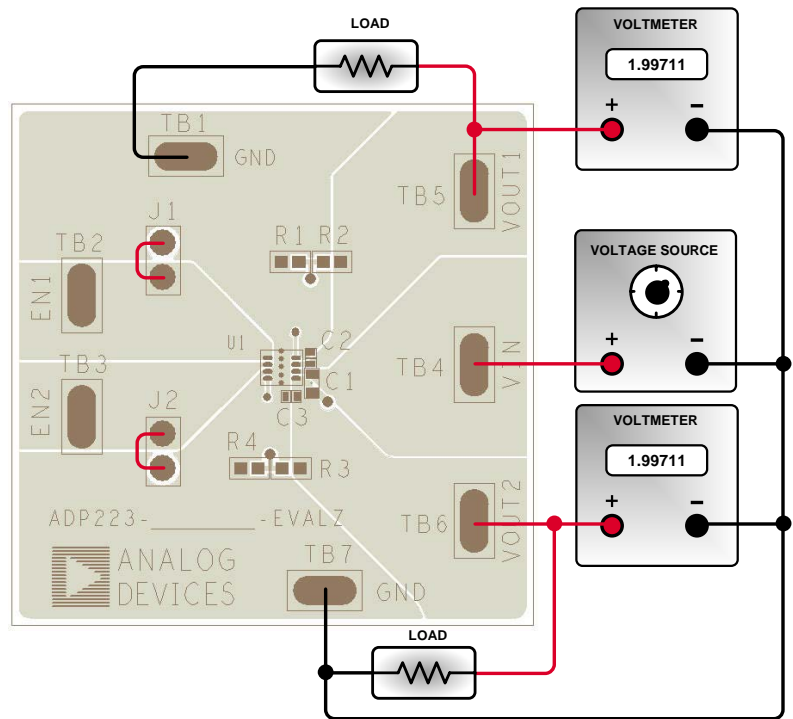


Figure 3. Output Voltage Measurement Setup

Figure 3 shows the [ADP223/ADP225](#) evaluation board connected to a voltage source and voltmeters for basic output voltage accuracy measurements. Resistors can be used as the load for the regulator. Ensure that the resistors have a power rating adequate to handle the power expected to be dissipated across them. An electronic load can also be used as an alternative. In addition, ensure that the voltage source can supply enough current for the expected load levels.

Follow these steps to connect to a voltage source and voltmeters:

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 VOUT1 pad and GND pad and the VOUT2 pad and GND pad.
4. Connect the negative terminals (–) of the voltmeters to one of the GND pads.
5. Connect the positive terminals (+) of the voltmeters to TB5 (VOUT1) and TB6 (VOUT2).

The voltage source can now be turned on. If J1 or J2 is inserted (connecting EN1 or EN2 to VIN for automatic startup), the regulator powers up.

### LINE REGULATION

For line regulation measurements, the outputs of the regulator are monitored while the input of the regulator is varied. For good line regulation, the outputs 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  $V_{OUTNOM} + 0.5\text{ V}$  (or 2.5 V, whichever is greater) and  $V_{INMAX}$ . For example, for an [ADP223/ADP225](#) with 1.8 V outputs,  $V_{IN}$  must be varied between 2.5 V and 5.5 V. This measurement can be repeated under different load conditions. Figure 4 shows the typical line regulation performance of a single 1.8 V output of an [ADP223/ADP225](#).

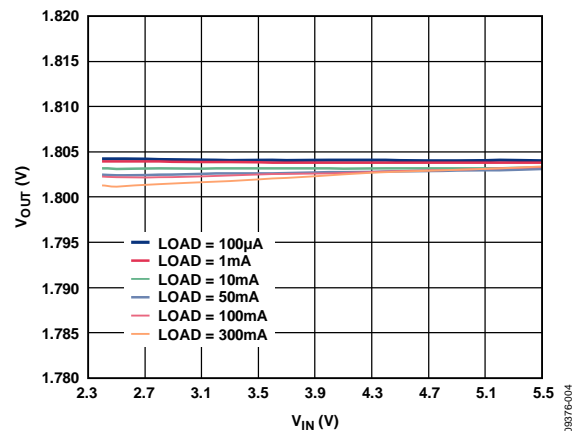


Figure 4. Output Voltage ( $V_{OUT}$ ) vs. Input Voltage ( $V_{IN}$ )

**LOAD REGULATION**

For load regulation measurements, the outputs of the regulator are monitored while the loads are varied. For good load regulation, the outputs must change as little as possible with varying load. The input voltage must be held constant during this measurement. The load currents can be varied from 0 mA to 300 mA per output. Figure 5 shows the typical load regulation performance of a single 1.8 V output of the ADP223/ADP225 for an input voltage of 2.5 V over the load current range of 100  $\mu$ A to 300 mA.

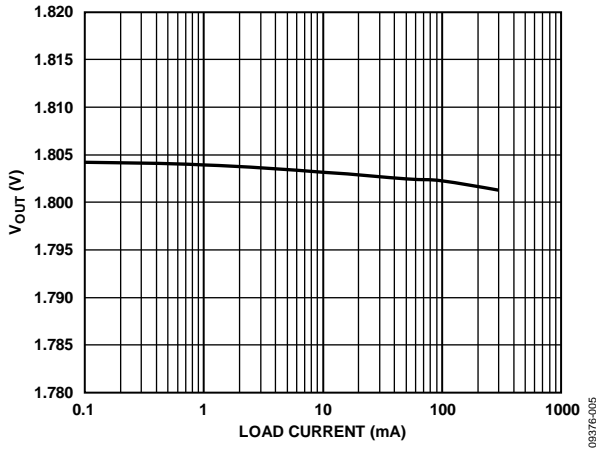


Figure 5. Output Voltage vs. Load Current

**DROPOUT VOLTAGE**

Dropout voltage can be measured using the configuration shown in Figure 3. 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 for output voltages above 2.5 V. Dropout voltage increases with larger loads. For more accurate measurements, an additional 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 6 shows the typical curve of the dropout voltage measurement with different load currents.

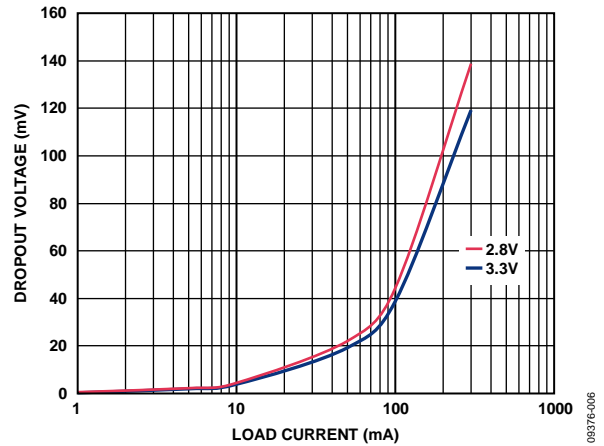


Figure 6. Dropout Voltage vs. Load Current, V<sub>OUT</sub> = 2.8 V and V<sub>OUT</sub> = 3.3 V

## GROUND CURRENT MEASUREMENTS

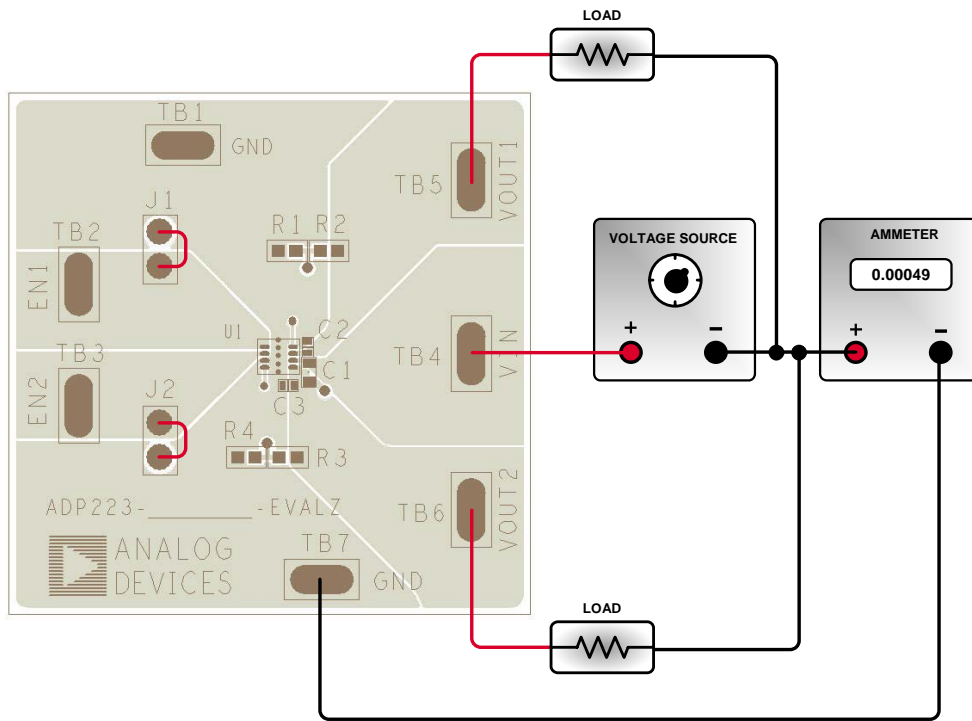


Figure 7. Ground Current Measurement Setup

Figure 7 shows how the [ADP223/ADP225](#) evaluation board can be connected to a voltage source and an ammeter for ground current measurements. Resistors can be used as the load for the regulator. Ensure that the resistors have a power rating adequate to handle the power expected to be dissipated across them. An electronic load can be used as an alternative. Ensure that the voltage source can supply enough current for the expected load levels.

Follow these steps to connect to a voltage source and ammeter:

1. Connect the positive terminal (+) of the voltage source to the VIN pad of the evaluation board.
2. Connect the negative terminal (-) of the ammeter to one of the GND pads of the evaluation board.
3. Connect the positive terminal (+) of the ammeter to the negative (-) terminal of the voltage source.
4. Connect a load between the VOUT1 pad and/or the VOUT2 pad of the evaluation board and the negative (-) terminal of the voltage source.

The voltage source can now be turned on. If J1 or J2 is inserted (connecting EN1 or EN2 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 are consuming 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 (300 mA per output). Figure 8 shows the typical ground current consumption for various load levels at an input voltage of 2.5 V for the single and dual output configurations. The current shown in Figure 8 does not include the current due to the output voltage setting dividers.

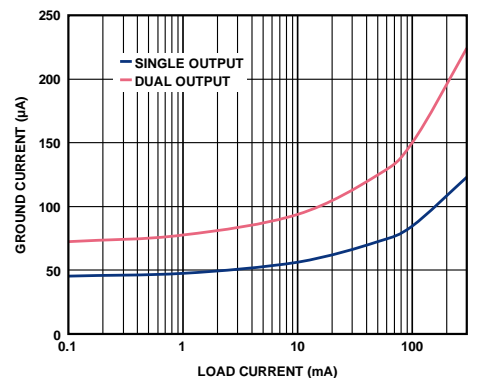


Figure 8. Ground Current vs. Load Current

When the device is disabled (EN1 and EN2 = GND), ground current drops to less than 1 µA.

**PRINTED CIRCUIT BOARD LAYOUT CONSIDERATIONS**

Heat dissipation from the package can be improved by increasing the amount of copper attached to the pins of the ADP223/ADP225.

Place the input capacitor as close as possible to the VIN and GND pins. Place the output capacitors as close as possible to the VOUT1, VOUT2, and GND pins. Use 0402 or 0603 size capacitors and resistors to achieve the smallest possible footprint solution on boards where area is limited.

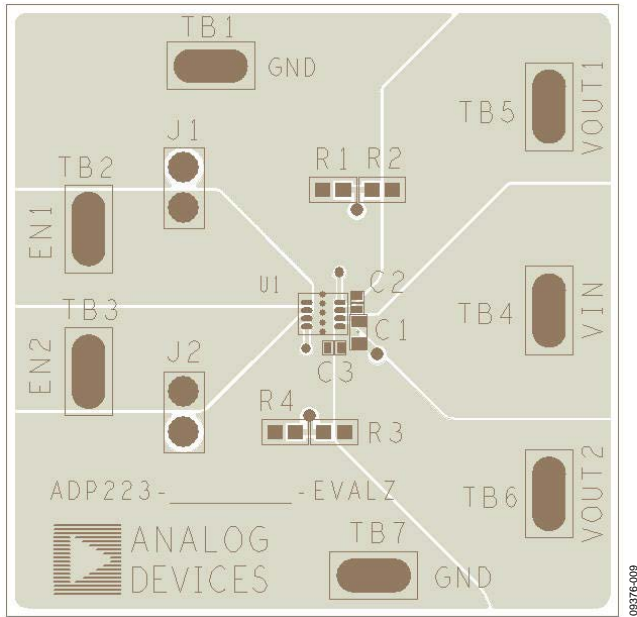


Figure 9. Typical Board Layout, Top Side

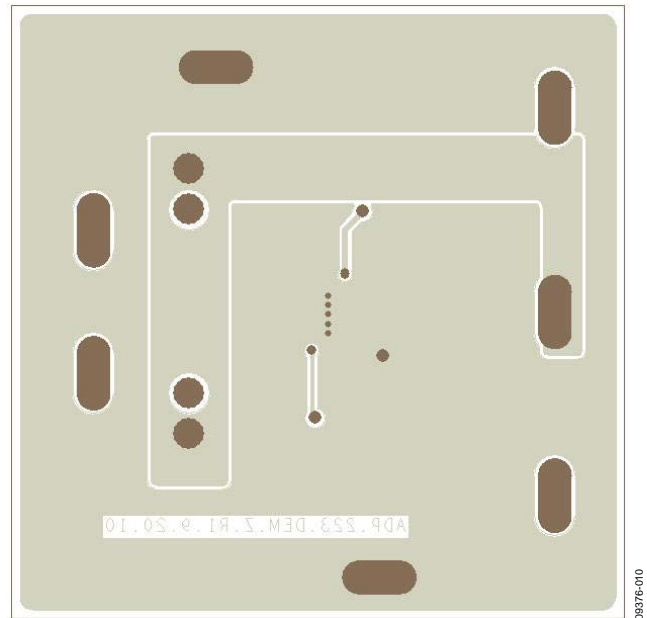


Figure 10. Typical Board Layout, Bottom Side

## ORDERING INFORMATION

### BILL OF MATERIALS

Table 2.

Qty	Reference Designator	Description	Manufacturer/Vendor	Vendor Part No.
1	C1	Capacitor, MLCC, 1.0 $\mu$ F, 10 V, 0402, X5R	Murata or equivalent	GRM155R61A105KE15
2	C2, C3	Capacitor, MLCC, 1 $\mu$ F, 4 V, 0402, X5R	Murata or equivalent	GRM155R60G225ME15
2	J1, J2	Header, single, STR, 36-position	Digi-Key Corp.	S1012E-36-ND
1	U1	IC, LDO regulator	Analog Devices, Inc.	<a href="#">ADP223ACPZ-R7</a> , <a href="#">ADP225ACPZ-R7</a>
4	R1, R2, R3, R4	Resistor, 1%, 0603, select values for output voltage	Vishay	CRCW0603xxxxF

### RELATED LINKS

Resource	Description
<a href="#">ADP223/ADP225</a>	Product Page, Dual, 300 mA Output, Adjustable, Low Noise, High PSRR Voltage Regulator



#### 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.

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