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Evaluating the ADP7159 Ultralow Noise, 2 A, Adjustable Output, RF Linear Regulator

FEATURES

Power supply rejection ratio (PSRR)
68 dB from 1 kHz to 100 kHz; 45 dB at 1 MHz,
V_{OUT} = 3.3 V, V_{IN} = 3.8 V
Low noise
0.9 μV rms total integrated noise from 100 Hz to 100 kHz
1.6 μV rms total integrated noise from 10 Hz to 100 kHz
Noise spectral density: 1.7 nV/√Hz from 10 kHz to 1 MHz
Low dropout voltage: 200 mV typical at V_{OUT} = 3.3 V, I_{OUT} = 2 A
Maximum output current: 2 A
Input voltage range: 2.3 V to 5.5 V
Low quiescent and shutdown current
Initial accuracy: ±0.6% at I_{LOAD} = 10 mA
Accuracy over line, load, and temperature: ±1.5%
10-lead, 3 mm × 3 mm LFCSP and 8-lead SOIC packages

EVALUATION KIT CONTENTS

ADP7159CP-04-EVALZ or ADP7159RD-04-EVALZ
evaluation board

ADDITIONAL EQUIPMENT NEEDED

A dc power supply
Multimeters for voltage and current measurements
Electronic or resistive loads

GENERAL DESCRIPTION

The ADP7159CP-04-EVALZ and ADP7159RD-04-EVALZ evaluation boards demonstrate the operation and functionality of the ADP7159 ultralow noise, 2 A, adjustable output, radio frequency (RF) linear regulator.

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

Complete specifications for the ADP7159 ultralow noise, 2 A, adjustable output, radio frequency (RF) linear regulator are available in the ADP7159 data sheet available from Analog Devices, Inc., and should be consulted in conjunction with this user guide when using the evaluation boards.

EVALUATION BOARD LAYOUTS

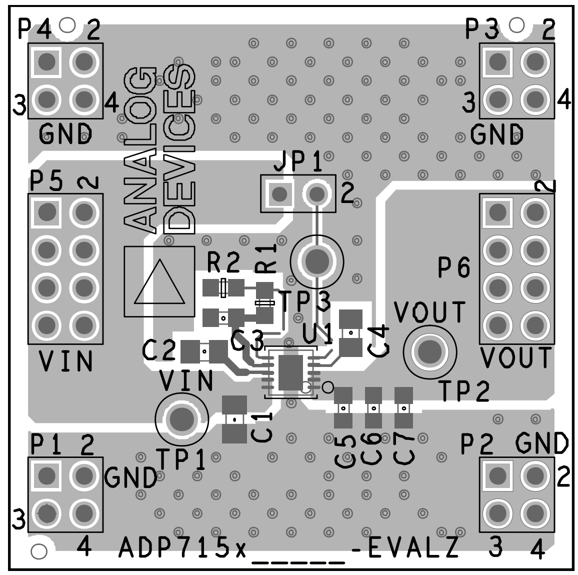

Figure 1. ADP7159CP-04-EVALZ (10-Lead LFCSP) Printed Circuit Board (PCB) Layout

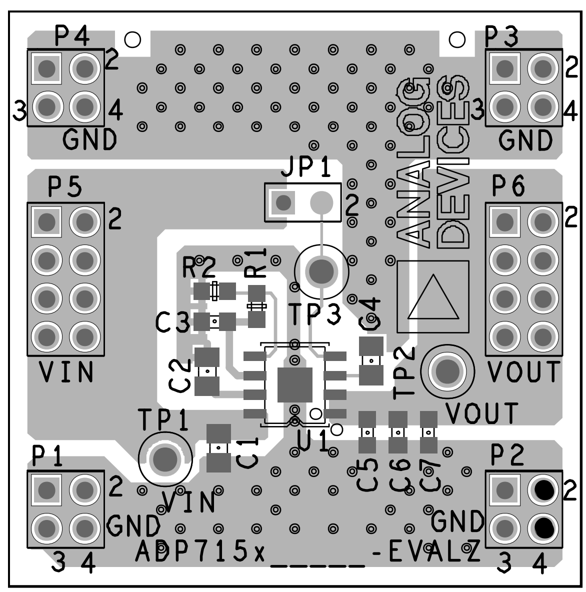

Figure 2. ADP7159RD-04-EVALZ (8-Lead SOIC) PCB Layout

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REVISION HISTORY

3/16—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

EVALUATION BOARD CONFIGURATIONS

The ADP7159 evaluation boards come supplied with either the ADP7159ACPZ-04-R7 or ADP7159ARDZ-04-R7 linear regulator, depending on the version ordered. The schematics of these evaluation board configurations are shown in Figure 3 and Figure 4, and the components installed in the board are shown in Table 1.

The ADP7159 is available in four models that optimize power dissipation and PSRR performance as a function of input and output voltage. See Table 2 for selection guides.

Resistors R1 and R2 set the output voltage. The output voltage (V_{OUT}) is determined by

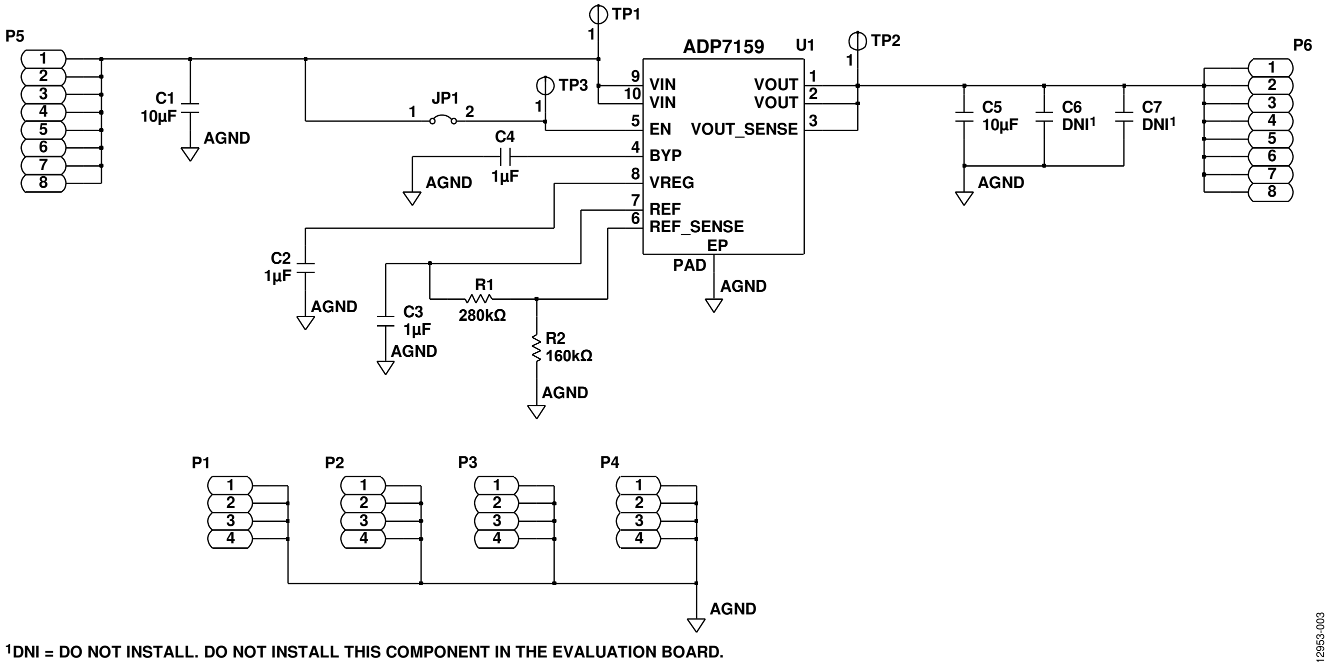
$$V_{OUT} = 1.2\ \text{V} \times (1 + \text{R1}/\text{R2})$$

Table 1. ADP7159CP-04-EVALZ and ADP7159RD-04-EVALZ Hardware Components

Component	Description
U1	ADP7159ACPZ-04-R7 or ADP7159ARDZ-04-R7
C1	Input bypass capacitor (C_{IN})
C2	V_{REG} bypass capacitor (C_{REG})
C3	V_{REF} bypass capacitor (C_{REF})
C4	Bypass capacitor (C_{BYP})
C5	Output capacitor (C_{OUT})
C6, C7	Optional output capacitors (not installed in the evaluation board)
R1, R2	Output resistor divider (sets the output voltage)
JP1	Jumper (connects the EN pin to the VIN pin for automatic startup)

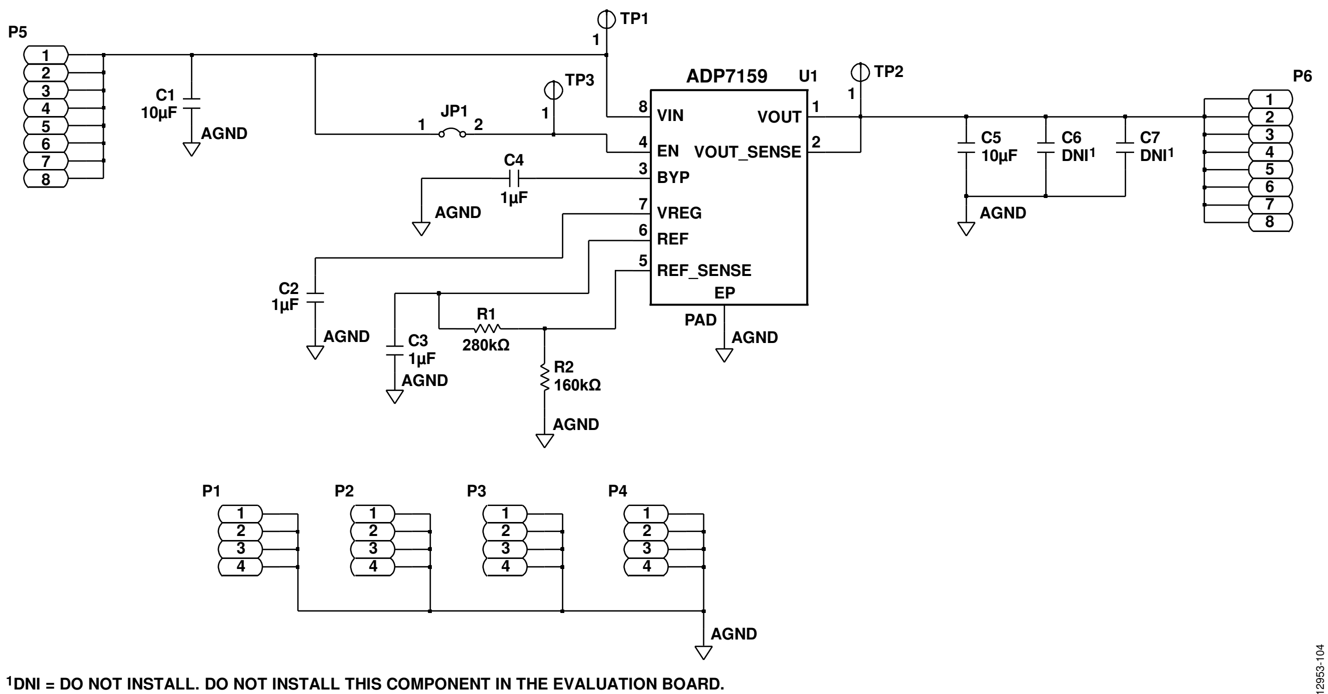
Table 2. Model Selection Guide for Input Voltage

Model	Adjustable V_{OUT} Range (V)	V_{OUT} Range (V) for Optimized PSRR	V_{REG} (V)	V_{IN} Range (V)
ADP7159-01	1.2 to 1.8	1.2 to 1.8	2.1	2.3 to 5.5
ADP7159-02	1.2 to 2.3	1.8 to 2.3	2.6	2.8 to 5.5
ADP7159-03	1.2 to 2.9	2.3 to 2.9	3.2	3.4 to 5.5
ADP7159-04	1.2 to 3.3	2.9 to 3.3	3.6	3.8 to 5.5



1DNI = DO NOT INSTALL. DO NOT INSTALL THIS COMPONENT IN THE EVALUATION BOARD.

Figure 3. ADP7159CP-04-EVALZ Evaluation Board Schematic (10-Lead LFCSP)



1DNI = DO NOT INSTALL. DO NOT INSTALL THIS COMPONENT IN THE EVALUATION BOARD.

Figure 4. ADP7159RD-04-EVALZ Evaluation Board Schematic (8-Lead SOIC)

OUTPUT VOLTAGE MEASUREMENTS

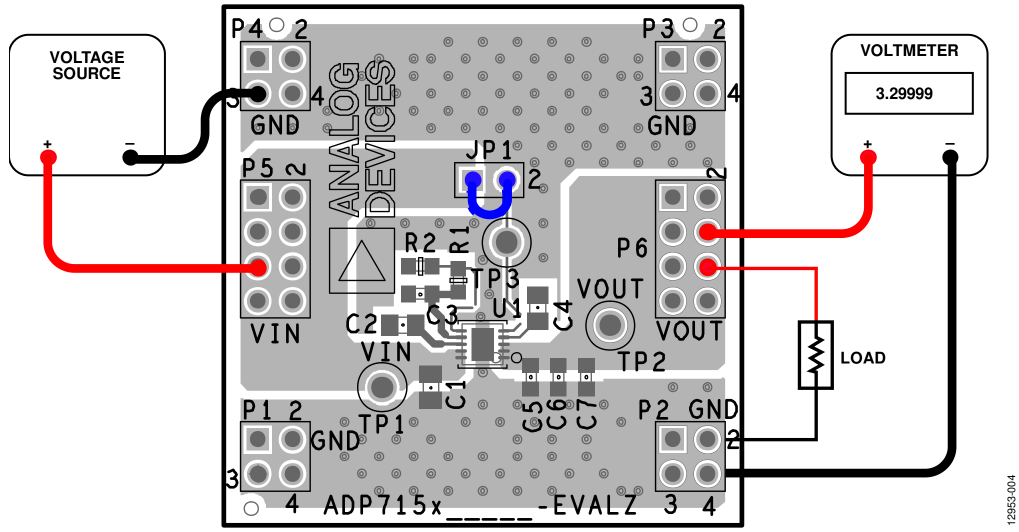


Figure 5. Output Voltage Measurement Setup, ADP7159CP-04-EVALZ (10-Lead LFCSP)

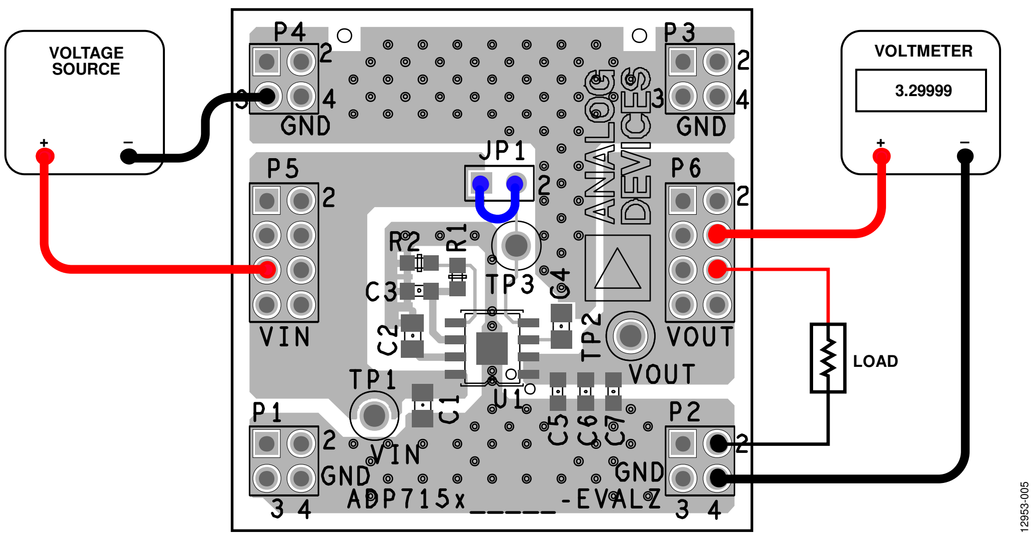


Figure 6. Output Voltage Measurement Setup, ADP7159RD-04-EVALZ (8-Lead SOIC)

Figure 5 and Figure 6 show the connections to a voltage source and a voltmeter for basic output voltage accuracy measurements for the ADP7159CP-04-EVALZ and ADP7159RD-04-EVALZ. Use a resistor as the load for the regulator. Ensure the resistor has a power rating that can handle the power dissipated across it. An electronic load can also be used as an alternative to using a resistor load. Ensure that the voltage source supplies enough current for the expected load levels.

The steps on how to connect either the ADP7159CP-04-EVALZ or ADP7159RD-04-EVALZ to a voltage source and a voltmeter are as follows:

1. Connect the negative terminal of the voltage source to one of the GND pins on the evaluation board.
2. Connect the positive terminal of the voltage source to the VIN pin on the evaluation board.
3. Connect a load between the evaluation board VOUT pin and one of the GND pins.
4. Connect the negative terminal of the voltmeter to one of the GND pins on the evaluation board.
5. Connect the positive terminal of the voltmeter to the VOUT pin on the evaluation board.

When these steps are complete, turn on the voltage source. If the JP1 jumper is inserted (connecting the EN pin to the VIN pin for automatic startup), the regulator powers up.

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

LINE REGULATION MEASUREMENTS

For line regulation measurements, the change in the output of the regulator is measured when the input is varied. For good line regulation, the output must maintain a minimal change in voltage with respect to varying input voltage levels. To ensure that the device is not in dropout mode during this measurement, vary V_{IN} between V_{IN_MIN} and V_{IN_MAX}. See Table 2 for selection guides. For example, for the ADP7159-04, V_{IN} can vary from 3.8 V to 5.5 V. This measurement can be repeated under different load conditions. The typical line regulation performance of an ADP7159 with a 3.3 V output is shown in Figure 7.

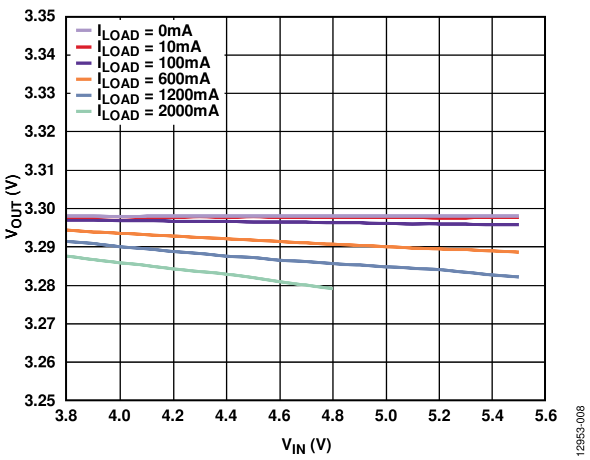


Figure 7. Output Voltage (V_{OUT}) vs. Input Voltage (V_{IN}), V_{OUT} = 3.3 V, T_A = 25°C, C_{IN} = C_{OUT} = 10 µF

LOAD REGULATION MEASUREMENTS

For load regulation measurements, the output voltage of the regulator is monitored while the load current is varied. For a good load regulation, the output must maintain a minimal voltage change with respect to varying load current levels. Hold the input voltage constant during this measurement. The load current can vary from 0 mA to 2 A. The typical load regulation performance of an ADP7159 with a 3.3 V output for an input voltage of 3.8 V is shown in Figure 8.

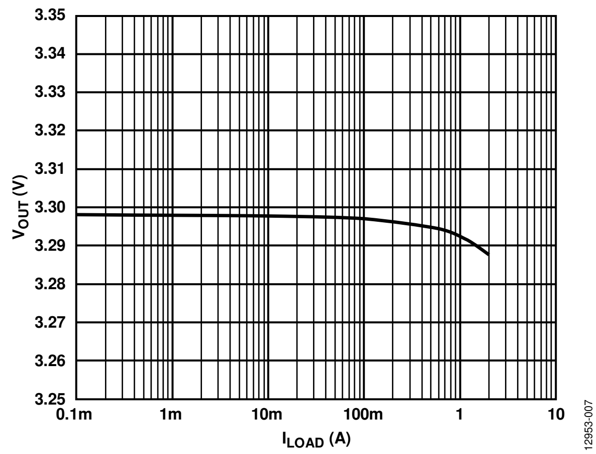


Figure 8. Output Voltage (V_{OUT}) vs. Load Current (I_{LOAD}), V_{OUT} = 3.3 V, T_A = 25°C, C_{IN} = C_{OUT} = 10 µF

DROPOUT VOLTAGE MEASUREMENTS

Dropout voltage is defined as the input to output voltage differential when the input voltage is set to the nominal output voltage. This definition is only applicable to output voltages above 2.3 V. Dropout voltage increases with larger loads. Figure 5 and Figure 6 show the configuration for measuring dropout voltage.

For more accurate measurements, use a second voltmeter to monitor the input voltage across the input capacitor. The input supply voltage may require adjusting for voltage drops, especially if using large load currents. The typical curve of dropout voltage measurements over varying load current levels is shown in Figure 9.

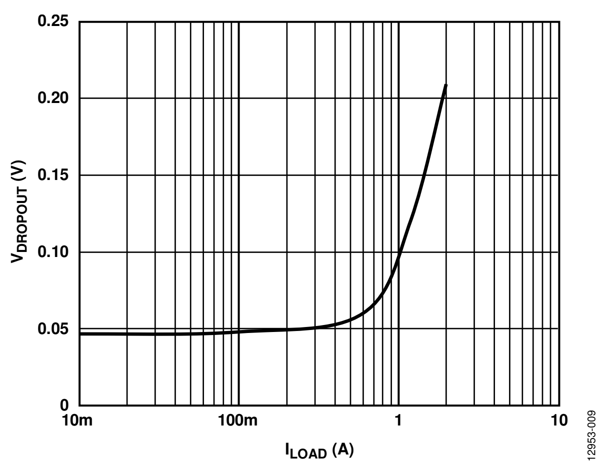


Figure 9. Dropout Voltage vs. Load Current (I_{LOAD}), V_{OUT} = 3.3 V, T_A = 25°C, C_{IN} = C_{OUT} = 10 µF

GROUND CURRENT MEASUREMENTS

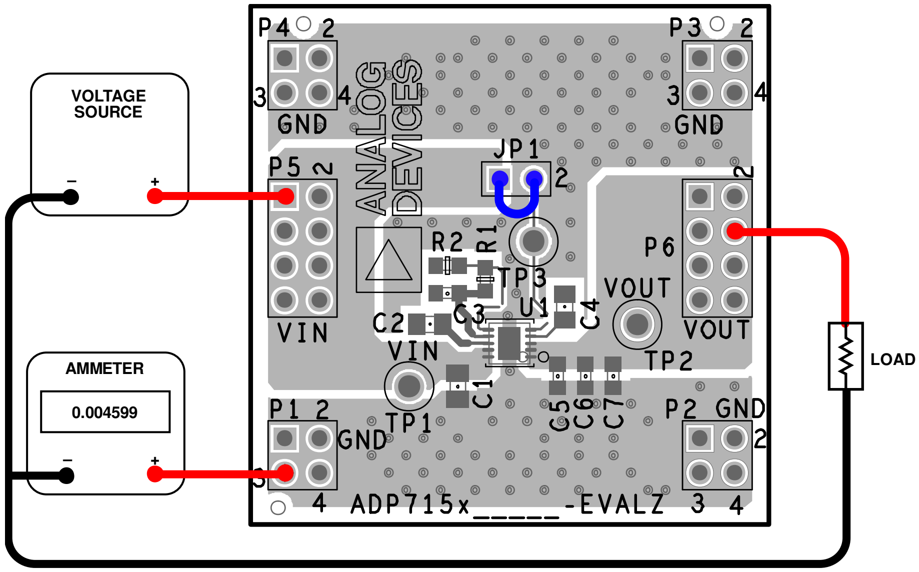


Figure 10. Ground Current Measurement Setup, ADP7159CP-04-EVALZ (10-Lead LFCSP)

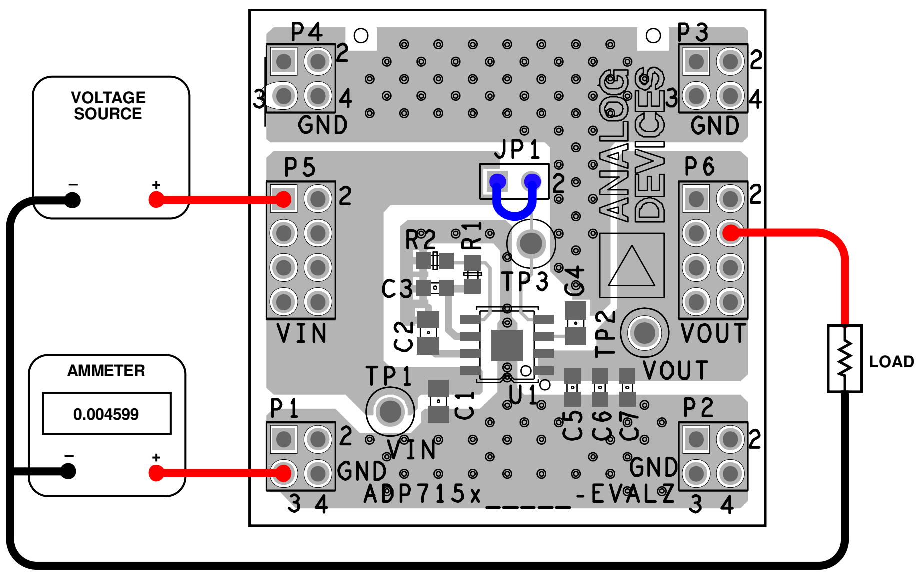


Figure 11. Ground Current Measurement Setup, ADP7159RD-04-EVALZ (8-Lead SOIC)

Figure 10 and Figure 11 show the connections to a voltage source and an ammeter for ground current measurements for the ADP7159CP-04-EVALZ and ADP7159RD-04-EVALZ. Use a resistor as the load for the regulator. Ensure the resistor has a power rating that can handle the power dissipated across it. An electronic load can also be used as an alternative to using a resistor load. Ensure the voltage source supplies enough current for the expected load levels.

The steps on how to connect either of the ADP7159CP-04-EVALZ and ADP7159RD-04-EVALZ to a voltage source and an ammeter are as follows:

1. Connect the positive terminal the voltage source to the VIN pin on the evaluation board.
2. Connect the positive terminal of the ammeter to one of the GND pins on 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 evaluation board VOUT pin and the negative terminal of the voltage source.

When these steps are complete, turn on the voltage source. If the JP1 jumper is inserted (connecting the EN pin to the VIN pin 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. For efficiency, the regulator must consume as little current as possible. Typically, the regulator uses the maximum current when supplying the largest load level (2 A). The typical ground current consumption for various load current levels at V_{OUT} = 3.3 V and T_A = 25°C is shown in Figure 12.

When the device is disabled (EN = GND), the ground current typically drops to 0.2 µA.

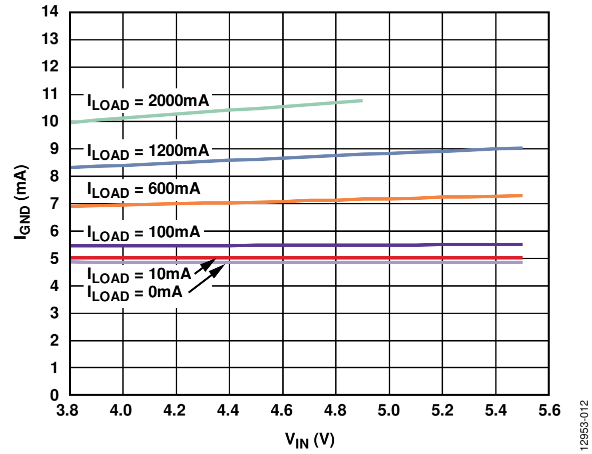


Figure 12. Ground Current (I_{GND}) vs. Input Voltage (V_{IN}), V_{OUT} = 3.3 V, T_A = 25°C, C_{IN} = C_{OUT} = 10 µF

ORDERING INFORMATION

BILL OF MATERIALS

Table 3. ADP7159CP-04-EVALZ (10-Lead LFCSP)

Reference Designator	Description	Manufacturer	Part Number
U1	ADP7159, IC, ultralow noise, low dropout, linear regulator	Analog Devices, Inc.	ADP7159ACPZ-04-R7
C1, C5, C6[1], C7[1]	Capacitor, MLCC, 10 µF, 10 V, 0805, X5R, 10%	TDK or equivalent	C2012X5R1A106K125AB
C2, C4	Capacitor, MLCC, 1 µF, 10 V, 0805, X5R, 10%	TDK or equivalent	C2012X5R1A105K/10
C3	Capacitor, MLCC, 1 µF, 10 V, 0603, X5R, 10%	TDK or equivalent	C1608X5R1A105K080AC
R1, R2	Resistor, 1%, 0603 case	Vishay Dale	CRCW0603xxxxF
JP1	Jumper, PLUG, 2-position, single row	Omron Electronics Inc-EMC Div	XG8S-0241
VIN, VOUT, GND	Header 0.100, single, straight, two pins	Sullins Electronics/3M	S1012E-36-ND

[1] Not installed in the evaluation board.

Table 4. ADP7159RD-04-EVALZ (8-Lead SOIC)

Reference Designator	Description	Manufacturer	Part Number
U1	ADP7159, IC, ultralow noise, low dropout, linear regulator	Analog Devices, Inc.	ADP7159ARDZ-04-R7
C1, C5, C6[1], C7	Capacitor, MLCC, 10 µF, 10 V, 0805, X5R, 10%	TDK or equivalent	C2012X5R1A106K125AB
C2, C4	Capacitor, MLCC, 1 µF, 10 V, 0805, X5R, 10%	TDK or equivalent	C2012X5R1A105K/10
C3	Capacitor, MLCC, 1 µF, 10 V, 0603, X5R, 10%	TDK or equivalent	C1608X5R1A105K080AC
R1, R2	Resistor, 1%, 0603 case	Vishay Dale	CRCW0603xxxxF
JP1	Jumper, PLUG, 2-position, single row	Omron Electronics Inc-EMC Div	XG8S-0241
VIN, VOUT, GND	Header 0.100, single, straight, two pins	Sullins Electronics/3M	S1012E-36-ND

[1] Not installed in the evaluation board.

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