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Evaluating the ADP1761/ADP1762/ADP1763 Low V_{IN}, Low Noise, CMOS Linear Regulators

FEATURES

Input voltage range: 1.1 V to 1.98 V
Output current range
- **ADP1761: 0 mA to 1 A**
- **ADP1762: 0 mA to 2 A**
- **ADP1763: 0 mA to 3 A**

Output voltage accuracy: ±1.5%
Operating temperature range: −40°C to +125°C

GENERAL DESCRIPTION

The ADP1761, the ADP1762, and the ADP1763 evaluation boards demonstrate the functionality of the ADP1761, the ADP1762, and the ADP1763 series of linear regulators.

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

For full details on the ADP1761, the ADP1762, and the ADP1763 line regulators, see the ADP1761, the ADP1762, and the ADP1763 data sheets, which should be consulted in conjunction with this user guide when using this evaluation board.

ADP1761, ADP1762, AND ADP1763 EVALUATION BOARDS

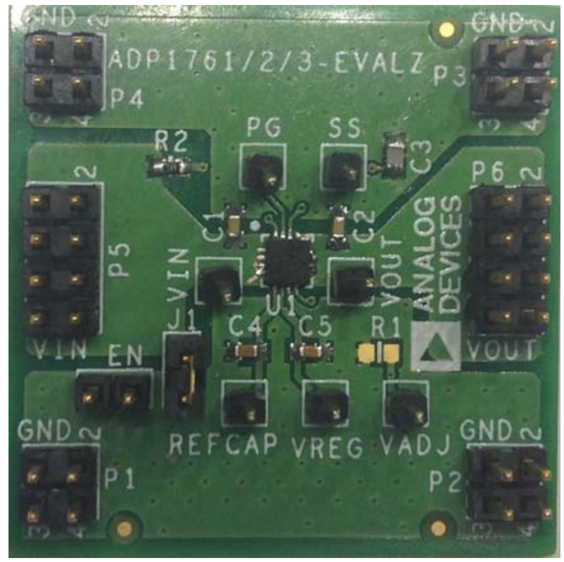

Figure 1. The ADP1761, the ADP1762, and the ADP1763 Fixed Board

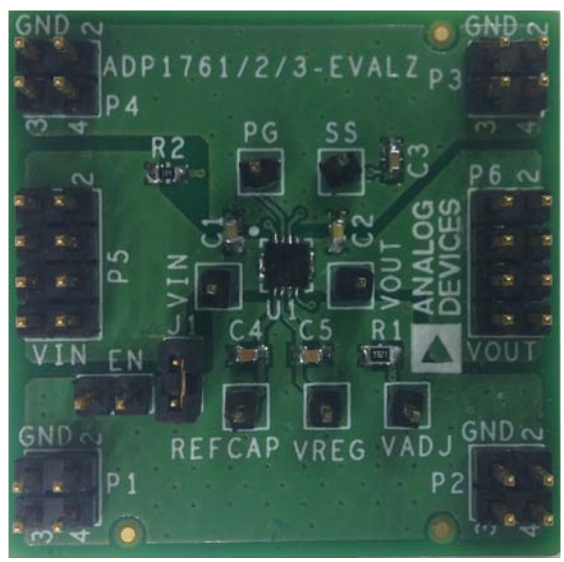

Figure 2. The ADP1761, the ADP1762, and the ADP1763 Adjustable Board

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REVISION HISTORY

4/16—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

EVALUATION BOARD CONFIGURATIONS

The ADP1761, the ADP1762, and the ADP1763 evaluation boards come supplied with different components, depending on the version ordered. Components common to all versions are C1, C2, C3, C4, C5, J1, and R2. Use R1 for the adjustable output version of the ADP1761, the ADP1762, and the ADP1763 evaluation boards. Figure 9 and Figure 10 show the schematics of these evaluation board configurations, and Table 1 describes the hardware components.

The ADP1761, the ADP1762, and the ADP1763 adjustable option has an output voltage range of 0.5 V to 1.5 V. The output voltage is set to 1.1 V by the external 7.32 kΩ adjust resistor.

Calculate the output voltage (V_{OUT}) by

$$V_{OUT} = A_D \times (R_{ADJ} \times I_{ADJ})$$

where:
A_D is the gain factor with a typical value of 3 between the VADJ pin and VOUT pin.
R_{ADJ} is the resistor connected between the VADJ pin and ground.
I_{ADJ} is the 50 µA constant current out of the VADJ pin.

The ADP1761, the ADP1762, and the ADP1763 fixed option uses a 1.3 V output model. Do not connect R1 for the fixed output option.

Calculate the start-up time of the regulator by

$$t_{START\text{-}UP\_FIXED} = t_{DELAY} + V_{REF} \times (C_{SS}/I_{SS})$$

$$t_{START\text{-}UP\_ADJ} = t_{DELAY} + V_{ADJ} \times (C_{SS}/I_{SS})$$

where:
t_{DELAY} is a fixed delay of 100 µs.
V_{REF} is a 0.5 V internal reference for the fixed output model option.
C_{SS} is the soft start capacitance from SS to GND.
I_{SS} is the current sourced from SS (10 µA).
V_{ADJ} is the voltage at the VADJ pin equal to $R_{ADJ} \times I_{ADJ}$.

Table 1. Evaluation Board Hardware Components

Component	Description
U1	ADP1761, ADP1762, and ADP1763 low dropout linear regulators. For the fixed output option, U1 uses the 1.3 V output option of the ADP1761, the ADP1762, and the ADP1763. For the adjustable output option, U1 uses the adjustable option of the ADP1761, the ADP1762, and the ADP1763 and is set to 1.1 V.
C1	Input bypass capacitor (C_{IN}), 10 µF, 0603 size.
C2	Output capacitor (C_{OUT}), 10 µF, 0603 size.
C3	Soft start capacitor (C_{SS}), 10 nF, 0603 size.
C4	Regulator capacitor (C_{REG}), 1 µF, 0603 size.
C5	Reference capacitor (C_{REG}), 1 µF, 0603 size.
J1	Jumper (connects EN to VIN for automatic startup)
R1	Adjust resistor (R_{ADJ}) used to set the output voltage of the adjustable version of the ADP1761, the ADP1762, and the ADP1763.
R2	Pull-up resistor ($R_{PULL\text{-}UP}$) used for the open-drain PGOOD output pin.

OUTPUT VOLTAGE MEASUREMENTS

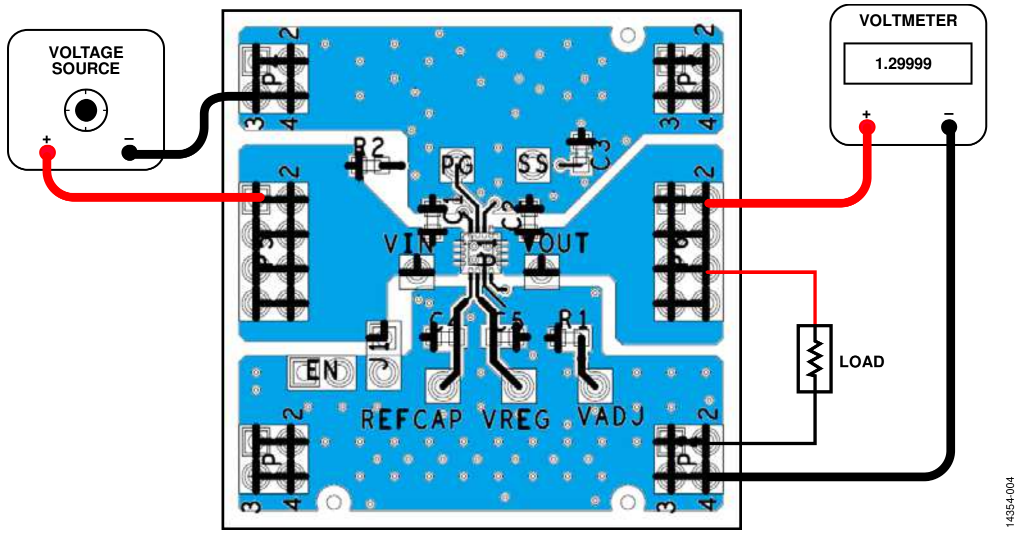

Figure 3. Output Voltage Measurement Setup

Figure 3 shows how the evaluation boards 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 expected to dissipate 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.

Follow these steps to connect the evaluation board 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 on the evaluation board.
3. Connect a load between the VOUT pad and one of the GND pads on the evaluation board.
4. Connect the negative terminal (−) of the voltmeter to one of the GND pads on the evaluation board.
5. Connect the positive terminal (+) of the voltmeter to the VOUT pad on the evaluation board.

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 voltage 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 line regulation measurement, V_{IN} must be varied between V_{OUT} + 0.2 V (or 1.1 V, whichever is greater) and 1.98 V. For example, for an ADP1761, an ADP1762, or an ADP1763 device with a fixed 1.3 V output, VIN must be varied between 1.5 V and 1.98 V. This measurement can be repeated under different load conditions. Figure 4 shows the typical line regulation performance of an ADP1761, an ADP1762, and an ADP1763 with a fixed 1.3 V output.

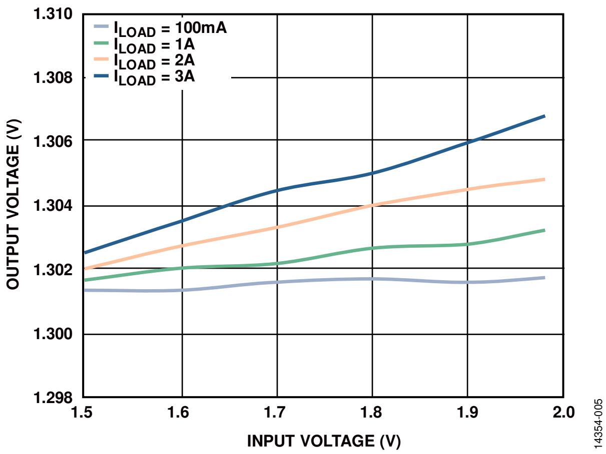

Figure 4. Output Voltage vs. Input Voltage at V_{OUT} = 1.3 V, T_A = 25°C

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 load regulation measurement. The load current can be varied from 0 mA to 1 A for the ADP1761, 0 mA to 2 A for the ADP1762, and 0 mA to 3 A for the ADP1763. Figure 5 shows the typical load regulation performance of an ADP1761, an ADP1762, and an ADP1763 with a fixed 1.3 V output for an input voltage of 1.5 V.

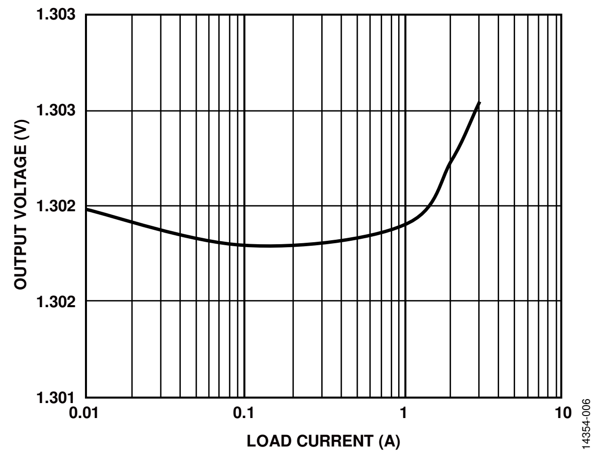

Figure 5. Output Voltage vs. Load Current at V_{IN} = 1.5 V, V_{OUT} = 1.3 V, T_A = 25°C

DROPOUT VOLTAGE MEASUREMENTS

The 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. The ADP1761, the ADP1762, and the ADP1763 only enter dropout mode for output voltages of at least 1.2 V. For lower voltage outputs, the ADP1761, the ADP1762, and the ADP1763 enter undervoltage lockout and shut down. The dropout voltage increases with larger loads.

For accurate measurements, use a second voltmeter to monitor the input voltage across the input capacitor. The input supply voltage may need adjusting to account for IR drops, especially when using large load currents. Figure 6 shows the typical curve of dropout voltage measurements with different load currents.

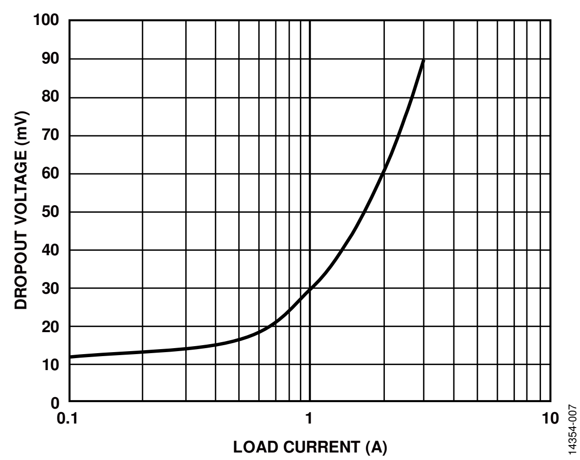

Figure 6. Dropout Voltage vs. Load Current, V_{OUT} = 1.3 V, T_A = 25°C

GROUND CURRENT MEASUREMENTS

Figure 8 shows how the ADP1761, the ADP1762, or the ADP1763 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.

Follow these steps to connect the evaluation board 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 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 VOUT pad on 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 (1 A for the ADP1761, 2 A for the ADP1762, and 3 A for the ADP1763). Figure 7 shows the typical ground current consumption for various load levels at V_{OUT} = 1.3 V and T_A = 25°C.

When the device is disabled (EN = GND), the ground current drops to less than 2 μA.

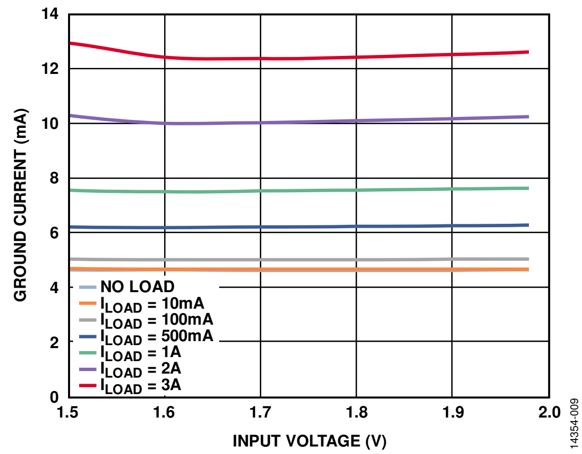

Figure 7. Ground Current vs. Input Voltage, V_{OUT} = 1.3 V, T_A = 25°C

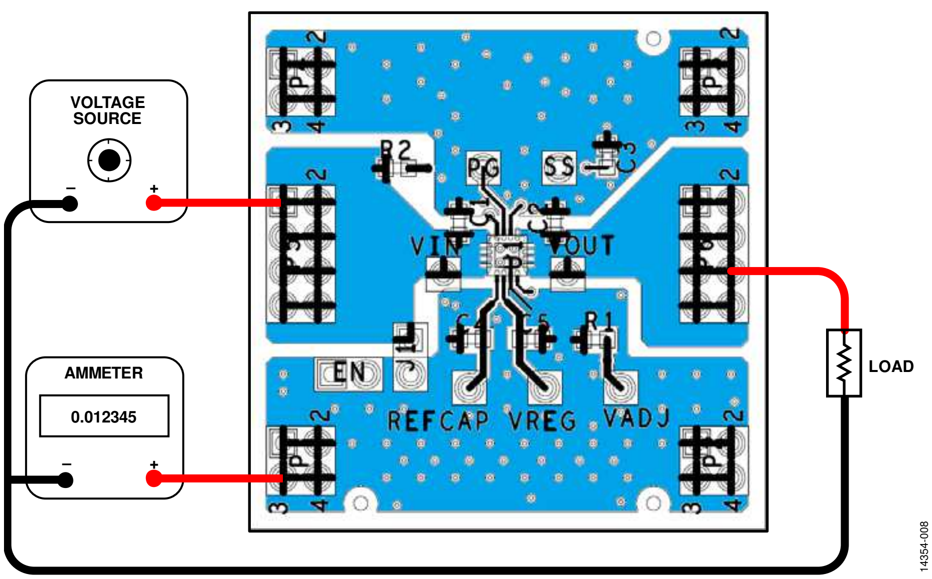

Figure 8. Ground Current Measurement Setup

SCHEMATICS AND SILKSCREENS

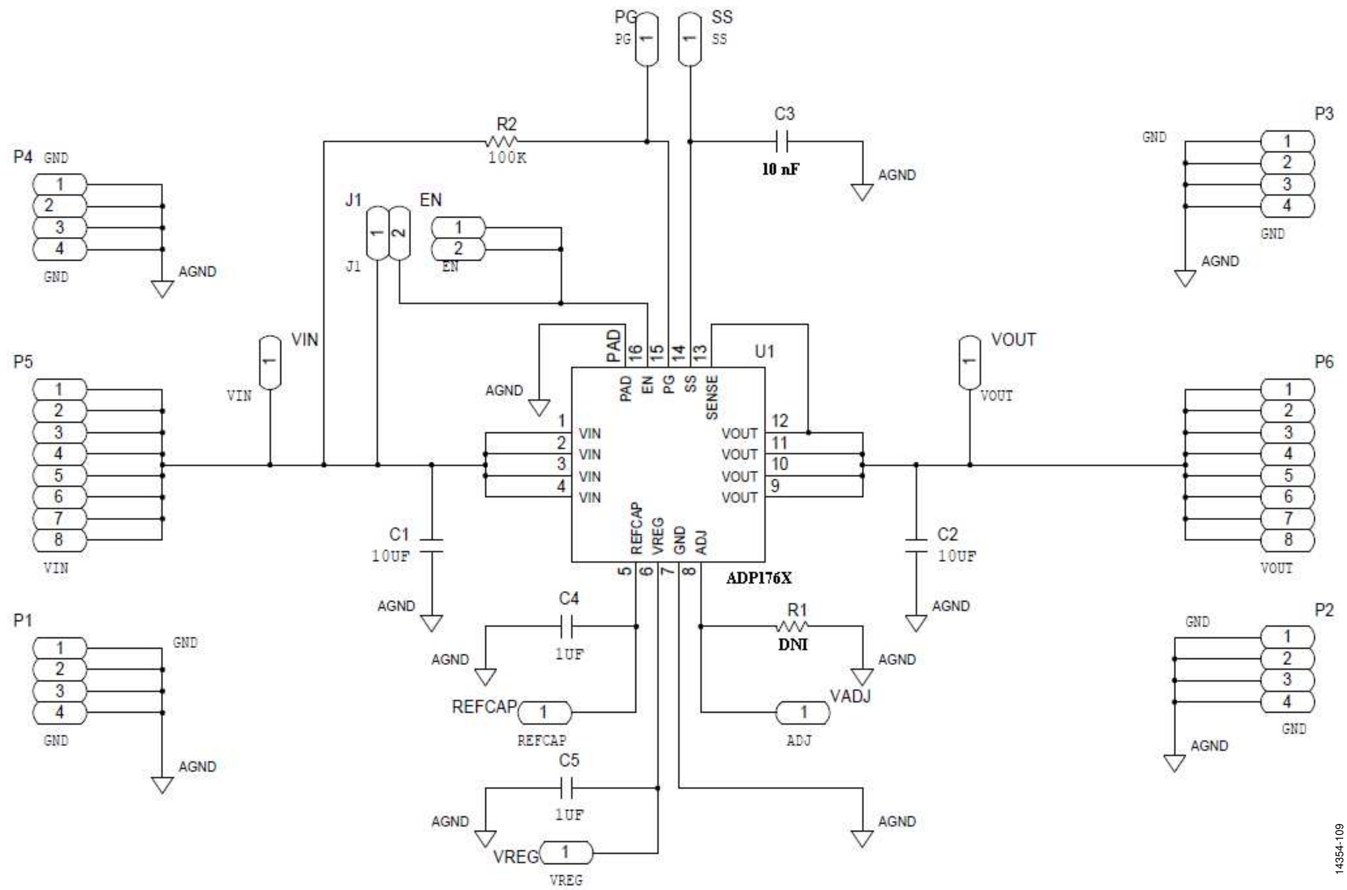

Figure 9. Fixed Output Schematic

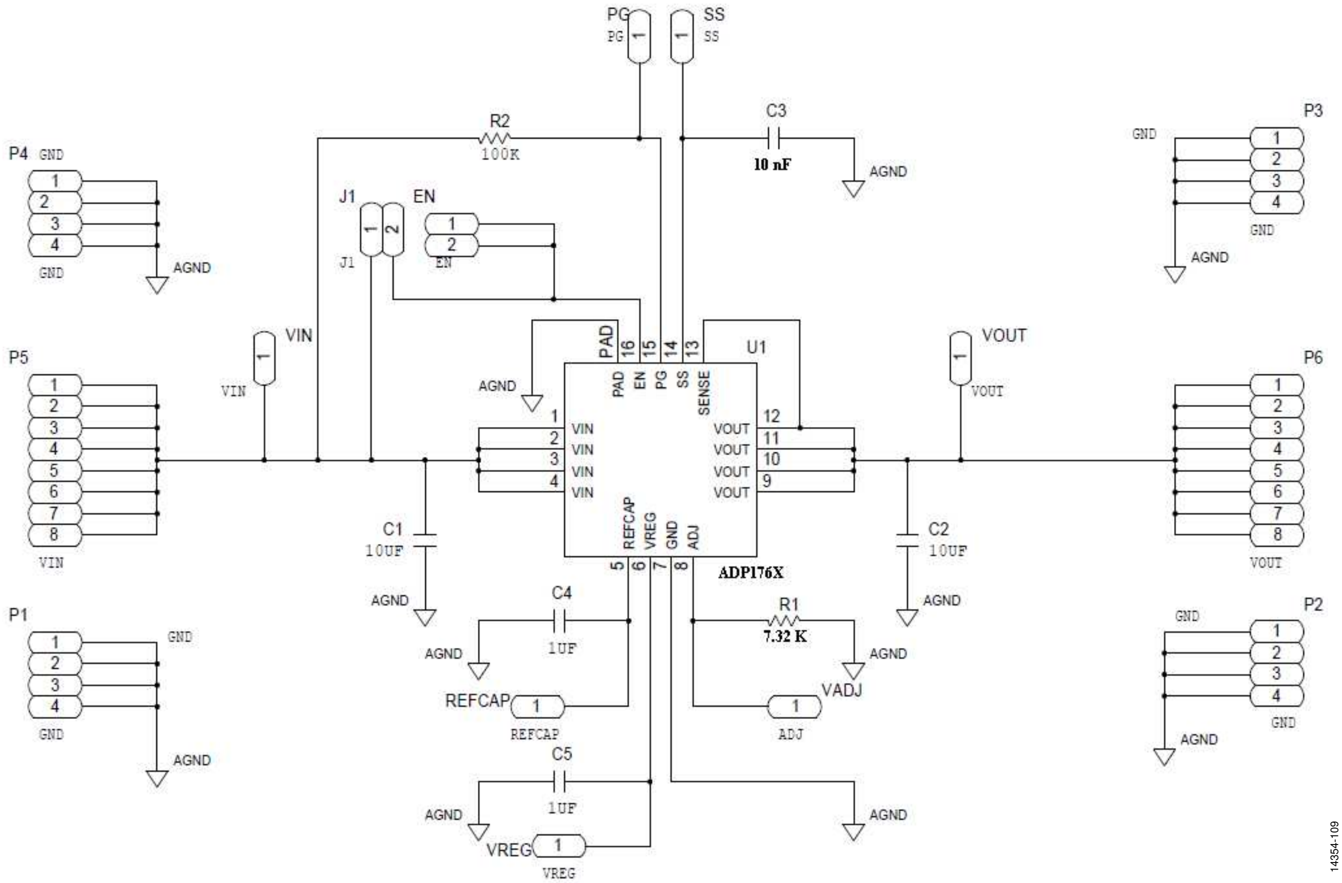

Figure 10. Adjustable Output Schematic

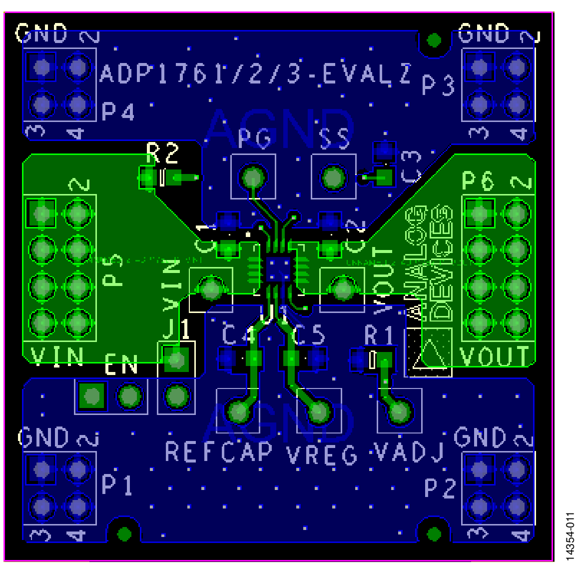

Figure 11. Top Layer

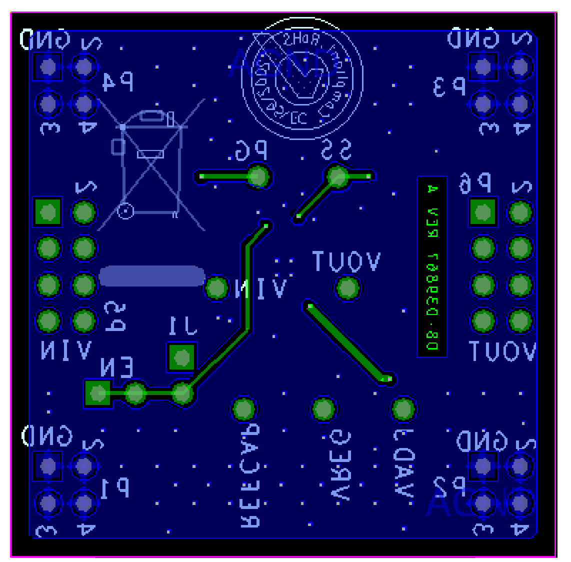

Figure 12. Bottom Layer

ORDERING INFORMATION

BILL OF MATERIALS

Table 2.

Reference Designator	Description	Manufacturer	Part Number
C1, C2	Capacitors, MLCC, 10 µF, 6.3 V, 0603, X5R	Murata (or equivalent)	GRM188R60J106ME47D
C3	Capacitor, MLCC, 10 nF, 25 V, 0603, X7R	Murata (or equivalent)	GRM188R71E103KA0
C4, C5	Capacitors, MLCC, 1 µF, 10 V, 0603, X7R	Murata (or equivalent)	GRM188R71A105KA61D
J1	Header/jumper, single, STR, two pins	FCI	69157-102HLF
R1	Resistor, 0603, 7.32 kΩ, 1% tolerance (do not install on the fixed model)	Any manufacturer	Depends on manufacturer
R2	Resistor, 0603, 100 kΩ, 1% tolerance	Any manufacturer	Depends on manufacturer
U1	IC, low input, low dropout regulators, including the following devices: ADP1761-1.3-EVALZ ADP1762-1.3-EVALZ ADP1763-1.3-EVALZ ADP1761-ADJ-EVALZ ADP1762-ADJ-EVALZ ADP1763-ADJ-EVALZ	Analog Devices, Inc.	 ADP1761ACPZ-1.3-R7 ADP1762ACPZ-1.3-R7 ADP1763ACPZ-1.3-R7 ADP1761ACPZ-R7 ADP1762ACPZ-R7 ADP1763ACPZ-R7

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