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Evaluating the ADP7183 Ultralow Noise, High PSRR, Low Dropout Linear Regulator

FEATURES

Input voltage range: −2.0 V to −5.5 V
Output current range: 0 mA to −300 mA
Output voltage accuracy: ±2.6%
Operating temperature range: −40°C to +125°C
Adjustable option voltage set with two external resistors (R1 and R2), V_{OUT} = −0.5 V × (1 + R1/R2)

GENERAL DESCRIPTION

The ADP7183 evaluation board demonstrates the functionality of the ADP7183 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, an ammeter, and load resistors.

For full details on the ADP7183 line regulator see the ADP7183 data sheet, which should be consulted in conjunction with this user guide when using this evaluation board.

ADP7183 EVALUATION BOARDS

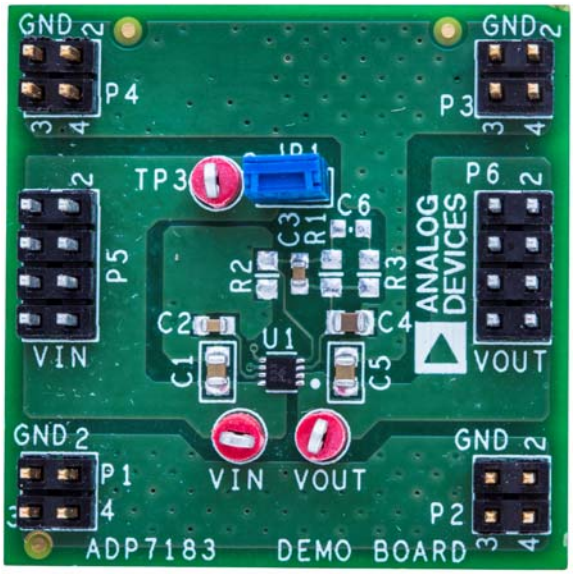


Figure 1. ADP7183 Fixed V_{OUT} Board

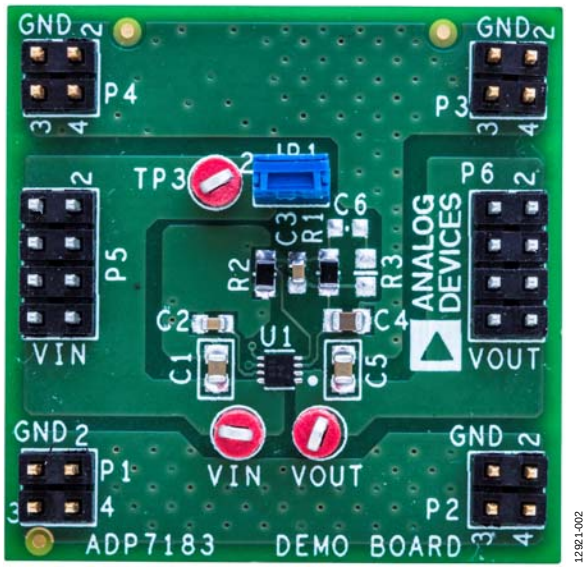


Figure 2. ADP7183 Adjustable V_{OUT} Board

PLEASE SEE THE LAST PAGE FOR AN IMPORTANT WARNING AND LEGAL TERMS AND CONDITIONS.

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REVISION HISTORY

10/2016—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

EVALUATION BOARD CONFIGURATIONS

The ADP7183 evaluation board comes supplied with different components, depending on which version (fixed or adjustable) of the ADP7183 evaluation board is ordered. Components common to both versions are C1, C2, C3, C4, C5, and JP1. The R1 and R2 resistors set the output voltage of the adjustable evaluation board. Figure 9 and Figure 10 show the schematics of these evaluation board configurations, and Table 1 describes the hardware components.

The ADP7183 fixed option uses a −3.3 V output model. Do not connect R1 and R2 for the fixed output option.

The adjustable output of the ADP7183 has a range of −0.5 V to −4.5 V. The output voltage is set by

$$V_{OUT} = -0.5\ V \times (1 + R1/R2)$$

With the values shown in Figure 10, the output voltage is approximately −2.5 V.

Table 1. Evaluation Board Hardware Components

Component	Description
U1	ADP7183 linear regulator. For the fixed output option, U1 uses the −3.3 V output option of the ADP7183. For the adjustable output option, U1 uses the adjustable option of the ADP7183 and is set to −2.5 V.
C1	Input bypass capacitor (C_{IN}), 4.7 µF, 0805 size
C2	Regulator capacitor (C_{REG}), 1 µF, 0603 size.
C3	Output voltage reference feedback capacitor (C_{AFB}), 0.01 µF, 0603 size.
C4	Low noise reference voltage capacitor (C_A), 1 µF, 0805 size.
C5	Output capacitor (C_{OUT}), 4.7 µF, 0805 size.
JP1	Jumper (connects EN to VIN for automatic startup).
R1, R2	Part of the external resistor divider (composed of R1 and R2 that sets the output voltage for the adjustable option).

VOLTAGE, REGULATION, AND CURRENT MESUREMENTS

OUTPUT VOLTAGE MEASUREMENTS

Figure 4 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 boards to a voltage source and voltmeter:

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

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.

DROPOUT VOLTAGE MEASUREMENTS

Use the configuration shown in Figure 4 to measure the dropout voltage. The dropout voltage is defined as the input to output voltage differential when the input voltage is set to the nominal output voltage. The ADP7183 only enters dropout mode for output voltages of at least −2.5 V. For lower voltage outputs, the ADP7183 enters undervoltage lockout (UVLO) and shuts 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 3 shows the typical curve of the dropout voltage measurements with different load currents.

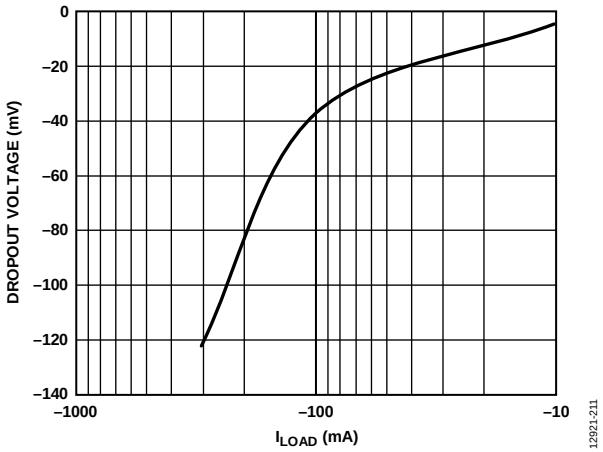


Figure 3. Dropout Voltage vs. Load Current (I_{LOAD}), V_{OUT} = −3.3 V, T_A = 25°C

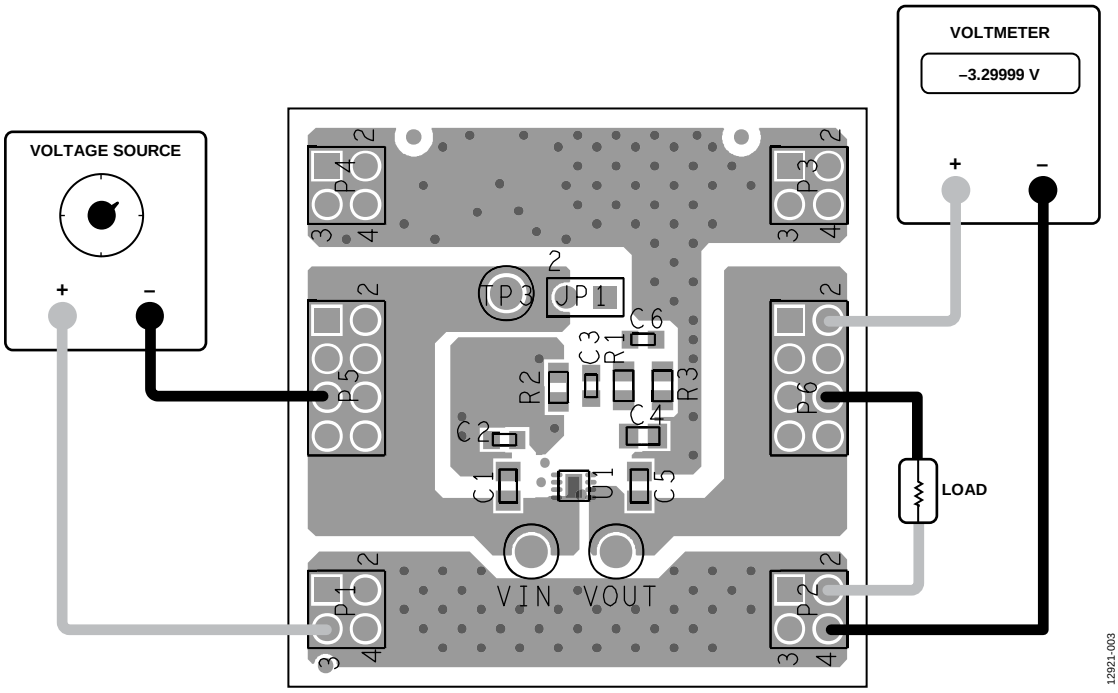


Figure 4. Output Voltage Measurement Setup

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} − 0.5 V (or −2 V, whichever is greater) and −5.5 V. For example, for an ADP7183 with a fixed −3.3 V output, VIN must vary between −3.8 V and −5.5 V. Note that this measurement can be repeated under different load conditions. Figure 5 shows the typical line regulation performance of an ADP7183 with a fixed −3.3 V output.

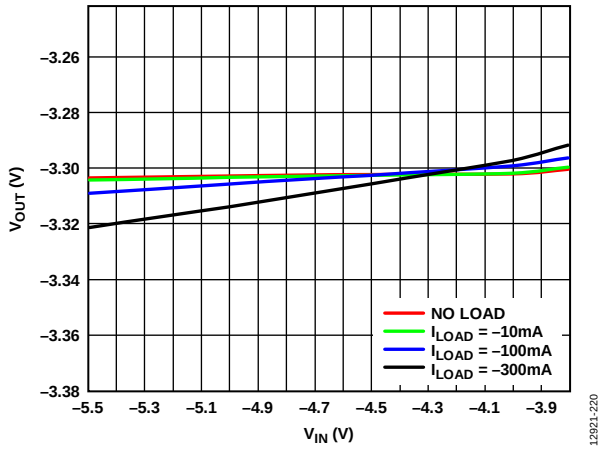


Figure 5. Output Voltage (V_{OUT}) vs. Input Voltage (V_{IN}) at V_{OUT} = −3.3 V, T_A = 25°C

LOAD REGULATION MEASUREMENTS

For load regulation measurements, while the load varies, monitor the output of the regulator. For good load regulation, the output must change as little as possible with varying loads. Hold the input voltage constant during load regulation measurement. The load current can be varied from 0 mA to −300 mA. Figure 6 shows the typical load regulation performance of an ADP7183 with a fixed −3.3 V output for an input voltage of −3.8 V.

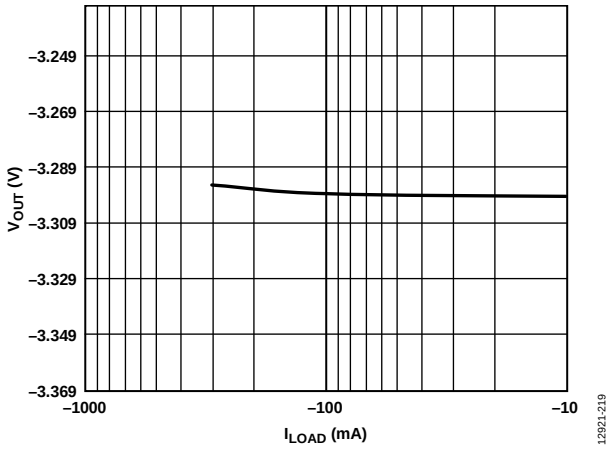


Figure 6. Output Voltage (V_{OUT}) vs. Load Current (I_{OUT}) at V_{IN} = −3.8 V, V_{OUT} = −3.3 V, T_A = 25°C

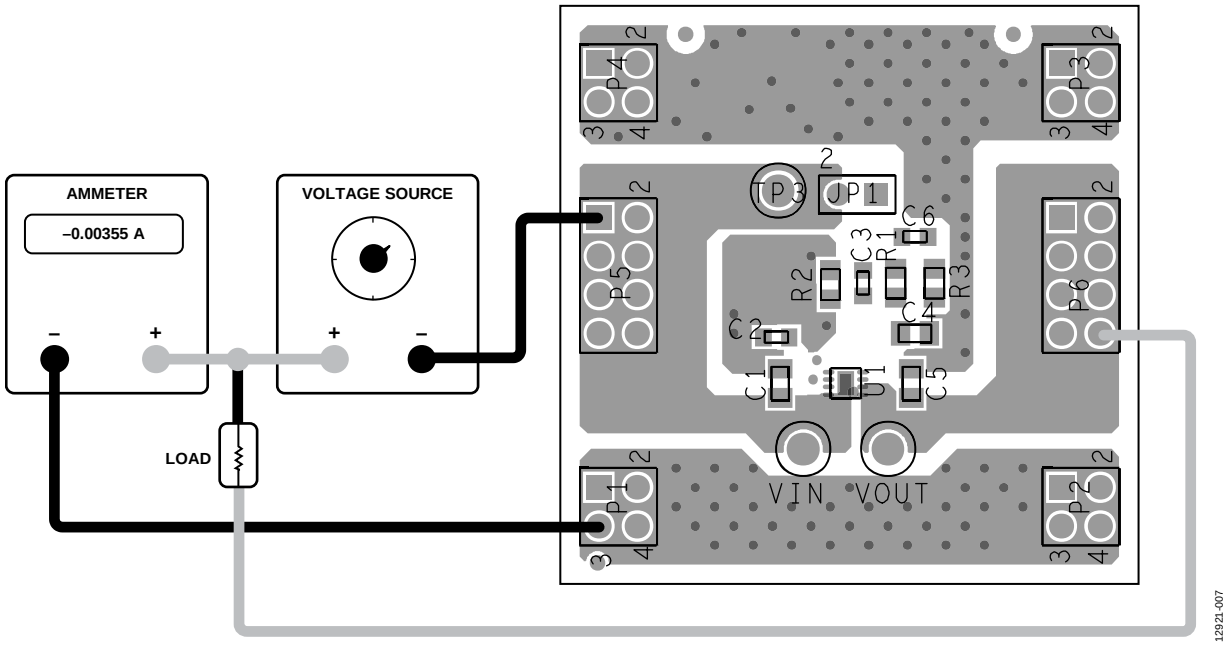


Figure 7. Ground Current Measurement Setup

GROUND CURRENT MEASUREMENTS

Figure 7 shows how to connect the ADP7183 evaluation board to a voltage source and an ammeter for ground current measurements.

Use a resistor 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. As an alternative, use an electronic load. 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 negative terminal (−) of the voltage source to the VIN pad on 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 positive terminal (+) of the voltage source.
4. Connect a load between the positive terminal (+) of the voltage source and the VOUT pad of the evaluation board.

When these connection steps are completed, turn on the voltage source. 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 regulators consume while the circuits perform the regulation function. To be efficient, the regulators must consume as little current as possible. Typically, the regulators use the maximum current when supplying their largest load level (−300 mA for the ADP7183). Figure 8 shows the typical ground current consumption for the various load levels at V_{OUT} = −3.3 V and T_A = 25°C.

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

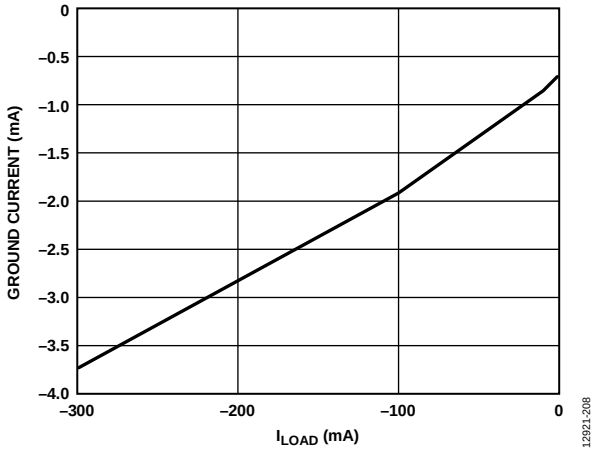


Figure 8. Ground Current vs. Load Current (I_{LOAD}), V_{OUT} = −3.3 V, T_A = 25°C

SCHEMATICS AND SILKSCREENS

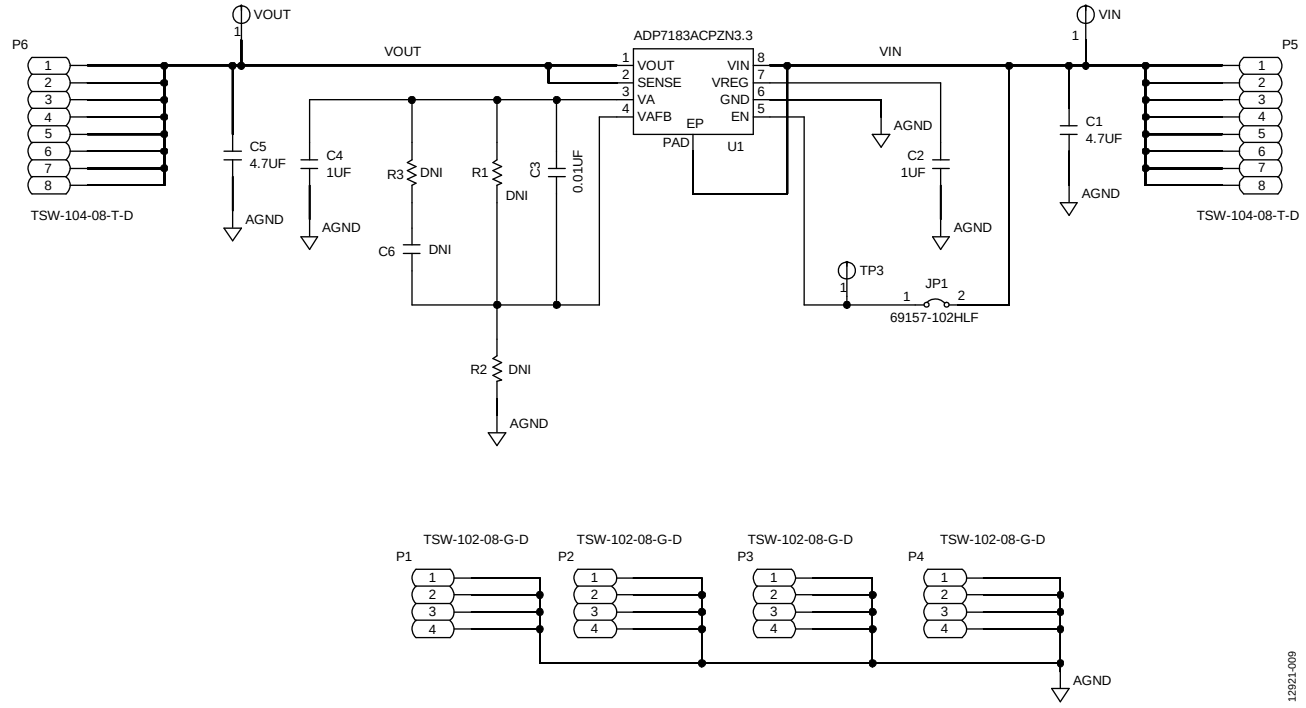


Figure 9. ADP7183 Evaluation Board Fixed Output Schematic

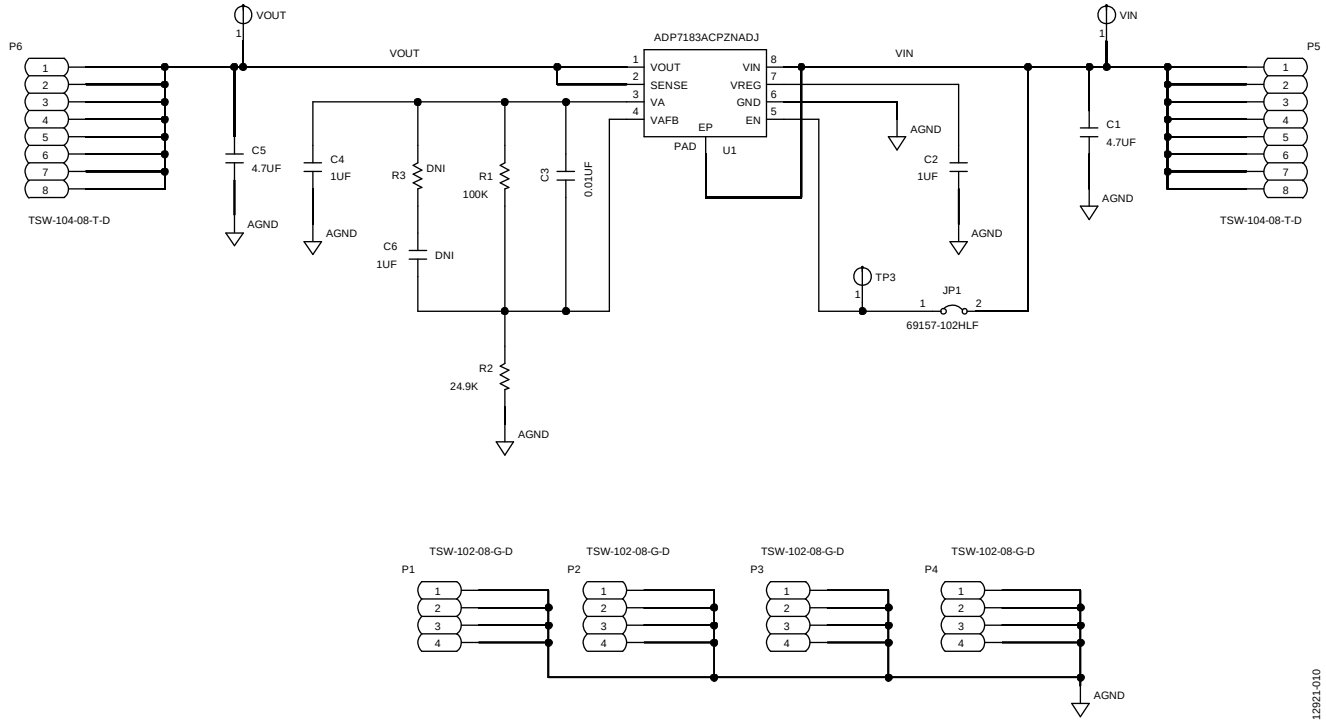


Figure 10. ADP7183 Evaluation Board Adjustable Output Schematic

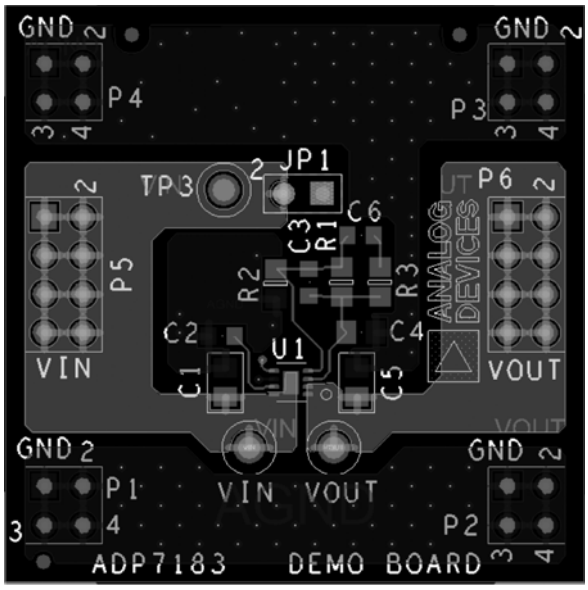


Figure 11. ADP7183 Evaluation Board Top Layer

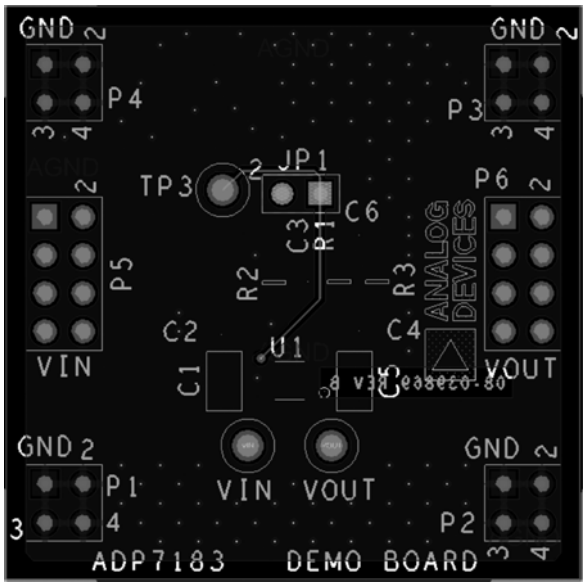


Figure 12. ADP7183 Evaluation Board Bottom Layer

ORDERING INFORMATION

BILL OF MATERIALS

Table 2.

Reference Designator	Description	Manufacturer	Part No.
C1, C5	Capacitors, MLCC, 4.7 µF, 25 V, 0805, X5R	Murata (or equivalent)	GRM21BR61E475KA12L
C2	Capacitor, MLCC, 1 µF, 25 V, 0603, X5R	Murata (or equivalent)	GRM188R61E105KA12D
C3	Capacitor, MLCC, 0.01 µF, 16 V 0603, X7R	Murata (or equivalent)	GRM188R71C103KA
C4	Capacitor, MLCC, 1 µF, 25 V, 0805, X7R	Murata (or equivalent)	GCM21BR71E105KA56L
C6	Do not install (DNI)	Not applicable	Not applicable
JP1	Header/jumper, single, STR, two pins	FCI	69157-102HLF
R1	Resistor, 0805, 100 kΩ, 1% tolerance (do not install on the fixed model)	Any manufacturer	Depends on manufacturer
R2	Resistor, 0805, 24.9 kΩ, 1% tolerance (do not install on the fixed model)	Any manufacturer	Depends on manufacturer
R3	Do not install (DNI)	Not applicable	Not applicable
U1	Analog Devices IC ultralow noise, high PSRR, LDO linear regulators, that includes the following devices: ADP7183-3.3-EVALZ ADP7183-ADJ-EVALZ	Analog Devices, Inc.	 ADP7183ACPZN3.3-R7 ADP7183ACPZN-R7



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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