Evaluating the **ADP7183** and **ADP7185** Ultralow Noise, High PSRR, Low Dropout Linear Regulators

**FEATURES**

- Input voltage range: $-2.0 \, \text{V}$ to $-5.5 \, \text{V}$
- Output current range:
  - **ADP7183**: 0 mA to −300 mA
  - **ADP7185**: 0 mA to −500 mA
- Output voltage accuracy
  - **ADP7183**: ±2.6%
  - **ADP7185**: ±2.2%
- Operating temperature range: $-40^\circ \text{C}$ to $+125^\circ \text{C}$
- Adjustable option voltage set with two external resistors (R1 and R2), $V_{OUT} = -0.5 \, \text{V} \times (1 + R1/R2)$

**GENERAL DESCRIPTION**

The **ADP7183** and **ADP7185** evaluation boards demonstrate the functionality of the **ADP7183** and **ADP7185** 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** and **ADP7185** linear regulators, see **ADP7183** and **ADP7185** data sheet, which must be consulted in conjunction with this user guide when using these evaluation boards.

---

**ADP7183 AND ADP7185 EVALUATION BOARDS**

**Figure 1. ADP7183 and ADP7185 Fixed V_{OUT} Board**

**Figure 2. ADP7183 and ADP7185 Adjustable V_{OUT} Board**
TABLE OF CONTENTS

Features .............................................................................................. 1
General Description ......................................................................... 1
ADP7183 and ADP7185 Evaluation Boards ........................................ 1
Revision History ............................................................................... 2
Evaluation Board Hardware ............................................................ 3
Evaluation Board Configurations .............................................. 3
Voltage, Regulation, and Current Measurements ......................... 4
  Output Voltage Measurements ...................................................... 4
  Dropout Voltage Measurements ............................................... 4
  Line Regulation Measurements ............................................... 5
  Load Regulation Measurements ........................................... 5
  Ground Current Measurements .............................................. 6
Evaluation Board Schematics and Artwork ....................................... 7
Ordering Information ........................................................................ 9
Bill of Materials .............................................................................. 9

REVISION HISTORY

5/2017—Rev. 0 to Rev. A
Added ADP7185 ............................................................ Throughout
Changes to Title, Features Section, and General Description ... 1
Changes to Figure 1 and Figure 2 ................................................... 1
Changes to Figure 5, Load Regulation Measurements Section, and Figure 6 ................................................................. 5
Changes to Ground Current Consumption Section and Figure 8 ... 6

10/2016—Revision 0: Initial Version

Changed Schematics and Silkscreens Section to Evaluation
Board Schematics and Artwork Section........................................... 7
Changes to Figure 9 and Figure 10 .................................................. 7
Changes to Table 2 ............................................................................. 9
EVALUATION BOARD HARDWARE

EVALUATION BOARD CONFIGURATIONS

The ADP7183 and ADP7185 evaluation boards are supplied with different components, depending on which version (fixed or adjustable) of the 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 and ADP7185 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 and ADP7185 has a range of −0.5 V to −4.5 V. The output voltage is set by

\[ V_{OUT} = -0.5 \, V \times (1 + \frac{R1}{R2}) \]

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

Table 1. Evaluation Board Hardware Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>U1</td>
<td>ADP7183 and ADP7185 linear regulators. For the fixed output option, U1 uses the −3.3 V output option of the ADP7183 and ADP7185. For the adjustable output option, U1 uses the adjustable option of the ADP7183 and ADP7185 and is set to −2.5 V.</td>
</tr>
<tr>
<td>C1</td>
<td>Input bypass capacitor (C\text{IN}), 4.7 µF, 0805 size.</td>
</tr>
<tr>
<td>C2</td>
<td>Regulator capacitor (C\text{REG}), 1 µF, 0603 size.</td>
</tr>
<tr>
<td>C3</td>
<td>Output voltage reference feedback capacitor (C\text{AFB}), 0.01 µF, 0603 size.</td>
</tr>
<tr>
<td>C4</td>
<td>Low noise reference voltage capacitor (C\text{A}), 1 µF, 0805 size.</td>
</tr>
<tr>
<td>C5</td>
<td>Output capacitor (C\text{OUT}), 4.7 µF, 0805 size.</td>
</tr>
<tr>
<td>JP1</td>
<td>Jumper (connects EN to VIN for automatic startup).</td>
</tr>
<tr>
<td>R1, R2</td>
<td>Part of the external resistor divider (composed of R1 and R2 that sets the output voltage for the adjustable option).</td>
</tr>
</tbody>
</table>
VOLTAGE, REGULATION, AND CURRENT MEASUREMENTS

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 and ADP7185 enter dropout mode only for output voltages of at least −2.5 V. For lower voltage outputs, the ADP7183 and ADP7185 enter 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.
LINE REGULATION MEASUREMENTS

For line regulation measurements, the output of the regulator is monitored while its input is varied. For optimal 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, $V_{\text{IN}}$ must be varied between $V_{\text{OUT}} - 0.5$ V (or $-2$ V, whichever is greater) and $-5.5$ V. For example, for an ADP7183 or ADP7185 with a fixed $-3.3$ V output, $V_{\text{IN}}$ 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 or ADP7185 with a fixed $-3.3$ V output.

LOAD REGULATION MEASUREMENTS

For load regulation measurements, while the load varies, monitor the output of the regulator. For optimal 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 for the ADP7183 and from $0$ mA to $-500$ mA for the ADP7185. Figure 6 shows the typical load regulation performance of an ADP7183 or ADP7185 with a fixed $-3.3$ V output for an input voltage of $-3.8$ V.
GROUND CURRENT MEASUREMENTS

Figure 7 shows how to connect the ADP7183 and ADP7185 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 and −500 mA for the ADP7185).

Figure 8 shows the typical ground current consumption for the various load levels at VOUT = −3.3 V and TA = 25°C.

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

Figure 9. ADP7183 and ADP7185 Evaluation Board Fixed Output Schematic

Figure 10. ADP7183 and ADP7185 Evaluation Board Adjustable Output Schematic
Figure 11. ADP7183 and ADP7185 Evaluation Board Top Layer

Figure 12. ADP7183 and ADP7185 Evaluation Board Bottom Layer
ORDERING INFORMATION
BILL OF MATERIALS

Table 2.

<table>
<thead>
<tr>
<th>Reference Designator</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1, C5</td>
<td>Capacitors, multilayer ceramic capacitor (MLCC), 4.7 µF, 25 V, 0805, X5R</td>
<td>Murata (or equivalent)</td>
<td>GRM218R61E470K12L</td>
</tr>
<tr>
<td>C2</td>
<td>Capacitor, MLCC, 1 µF, 25 V, 0603, X5R</td>
<td>Murata (or equivalent)</td>
<td>GRM18R861E105K12D</td>
</tr>
<tr>
<td>C3</td>
<td>Capacitor, MLCC, 0.01 µF, 16 V 0603, X7R</td>
<td>Murata (or equivalent)</td>
<td>GRM18R871C103K</td>
</tr>
<tr>
<td>C4</td>
<td>Capacitor, MLCC, 1 µF, 25 V, 0805, X7R</td>
<td>Murata (or equivalent)</td>
<td>GCM218R71E105K56L</td>
</tr>
<tr>
<td>C6</td>
<td>Do not install (DNI)</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>JP1</td>
<td>Header/jumper, single, straight, two pins</td>
<td>FCI</td>
<td>69157-102HLF</td>
</tr>
<tr>
<td>R1</td>
<td>Resistor, 0805, 100 kΩ, 1% tolerance (do not install on the fixed model)</td>
<td>Any manufacturer</td>
<td>Depends on manufacturer</td>
</tr>
<tr>
<td>R2</td>
<td>Resistor, 0805, 24.9 kΩ, 1% tolerance (do not install on the fixed model)</td>
<td>Any manufacturer</td>
<td>Depends on manufacturer</td>
</tr>
<tr>
<td>R3</td>
<td>Do not install (DNI)</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>U1</td>
<td>Analog Devices IC, ultralow noise, high PSRR, LDO linear regulators that include the following devices:</td>
<td>Analog Devices, Inc.</td>
<td>ADP7183ACPZN3.3-R</td>
</tr>
<tr>
<td></td>
<td>ADP7183-3.3-EVALZ</td>
<td></td>
<td>ADP7183ACPZN3.3-R</td>
</tr>
<tr>
<td></td>
<td>ADP7183-ADJ-EVALZ</td>
<td></td>
<td>ADP7185ACPZN3.3-R</td>
</tr>
<tr>
<td></td>
<td>ADP7185-3.3-EVALZ</td>
<td></td>
<td>ADP7185ACPZN3.3-R</td>
</tr>
<tr>
<td></td>
<td>ADP7185-ADJ-EVALZ</td>
<td></td>
<td>ADP7185ACPZN3.3-R</td>
</tr>
</tbody>
</table>

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, deconstruct 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 NONINFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMERS’ 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.

©2016–2017 Analog Devices, Inc. All rights reserved. Trademarks and registered trademarks are the property of their respective owners.

UG12921-0-5/17(A)