

Evaluating the **ADM7160** Ultralow Noise, 200 mA, Linear Regulator

FEATURES

Power supply rejection ratio (PSRR) performance: 54 dB at
100 kHz

Ultralow noise independent of V_{OUT}

3 μV rms, 0.1 Hz to 10 Hz

9.5 μV rms, 0.1 Hz to 100 kHz

9 μV rms, 10 Hz to 100 kHz

17 μV rms, 10 Hz to 1 MHz

Low dropout voltage: 150 mV at $I_{LOAD} = 200$ mA

Maximum output current: 200 mA

Input voltage range: 2.2 V to 5.5 V

Low quiescent and shutdown current

Initial accuracy: $\pm 1\%$

Accuracy over line, load, and temperature: -2.5% to $+1.5\%$

5-lead TSOT package and 6-lead LFCSP package

EVALUATION KIT CONTENTS

ADM7160CP-EVALZ evaluation board or **ADM7160UJ-EVALZ**
evaluation board

ADDITIONAL EQUIPMENT NEEDED

A direct current (dc) power supply

Multimeters for voltage and current measurements

Electronic or resistive loads

GENERAL DESCRIPTION

The **ADM7160** evaluation boards demonstrate the operation and functionality of the **ADM7160** ultralow noise, 200 mA, linear regulator.

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

Complete specifications for the **ADM7160** ultralow noise, 200 mA, linear regulator are available in the **ADM7160** data sheet available from Analog Devices, Inc., and should be consulted in conjunction with this user guide when using the evaluation boards.

EVALUATION BOARDS

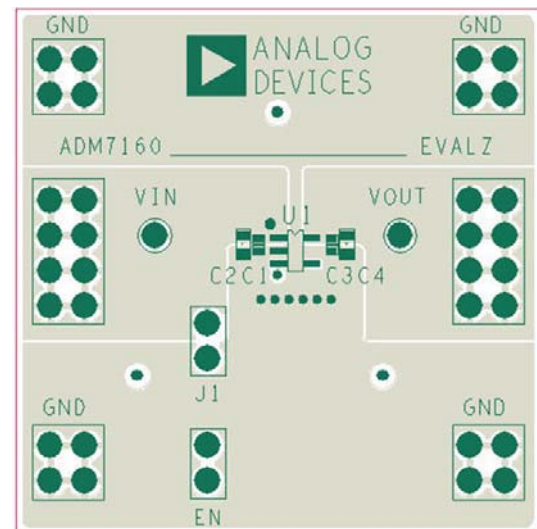


Figure 1. **ADM7160UJ-EVALZ** (5-Lead TSOT)
Printed Circuit Board (PCB) Layout

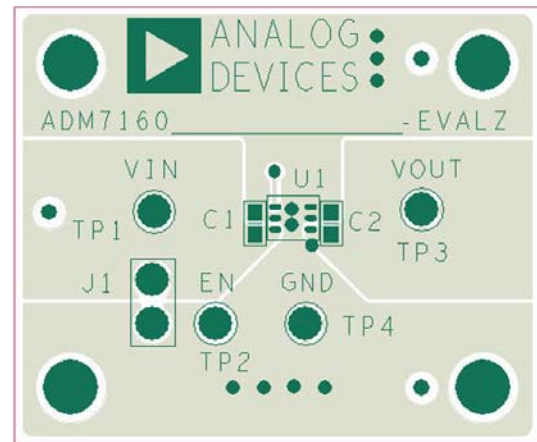


Figure 2. **ADM7160CP-EVALZ** (6-Lead LFCSP) PCB Layout

TABLE OF CONTENTS

| | | | |
|---------------------------------------|---|-----------------------------------|---|
| Features | 1 | Output Voltage Measurements | 4 |
| Evaluation Kit Contents..... | 1 | Line Regulation Measurements..... | 5 |
| Additional Equipment Needed..... | 1 | Load Regulation Measurements..... | 5 |
| General Description | 1 | Dropout Voltage Measurements..... | 5 |
| Evaluation Boards..... | 1 | Ground Current Measurements..... | 6 |
| Revision History | 2 | Ground Current Consumption | 7 |
| Evaluation Board Hardware..... | 3 | Ordering Information..... | 8 |
| Evaluation Board Configurations | 3 | Bill of Materials..... | 8 |

REVISION HISTORY

10/14—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

EVALUATION BOARD CONFIGURATIONS

The **ADM7160** evaluation boards come supplied with different components, 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 boards are shown in Table 1 and Table 2.

Internally, the **ADM7160** consists of a reference, an error amplifier, a feedback voltage divider, and a positive metal-oxide semiconductor (PMOS) pass transistor. The **ADM7160** is available in 16 fixed output voltage options, ranging from 1.1 V to 3.3 V.

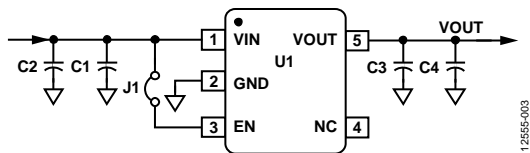


Figure 3. **ADM7160UJ-EVALZ** (5-Lead TSOT) Schematic

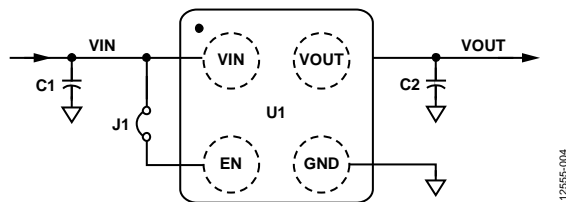


Figure 4. **ADM7160CP-EVALZ** (6-Lead LFCS) Schematic

Table 1. **ADM7160UJ-EVALZ** Hardware Components

| Component | Description |
|-----------|---|
| U1 | ADM7160 low dropout linear regulator |
| C1 | Input bypass capacitor (C_{IN}), 4.7 μ F, 0402 size |
| C2 | Input bypass capacitor (C_{IN}), 4.7 μ F, 0603 size (not installed in the evaluation board) |
| C3 | Output capacitor (C_{OUT}), 4.7 μ F, 0402 size |
| C4 | Output capacitor (C_{OUT}), 4.7 μ F, 0603 size (not installed in the evaluation board) |
| J1 | Jumper (connects the EN pin to the VIN pin for automatic startup) |

Table 2. **ADM7160CP-EVALZ** Hardware Components

| Component | Description |
|-----------|---|
| U1 | ADM7160 low dropout linear regulator |
| C1 | Input bypass capacitor (C_{IN}), 4.7 μ F, 0603 size |
| C2 | Output capacitor (C_{OUT}), 4.7 μ F, 0603 size |
| J1 | Jumper (connects the EN pin to the VIN pin for automatic startup) |

OUTPUT VOLTAGE MEASUREMENTS

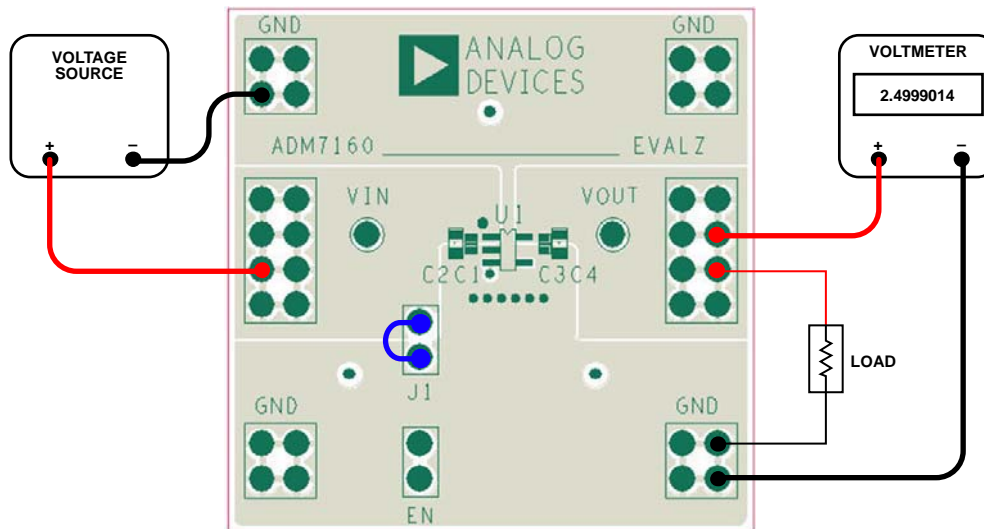


Figure 5. Output Voltage Measurement Setup, [ADM7160UJ-EVALZ](#) (5-Lead TSOT)

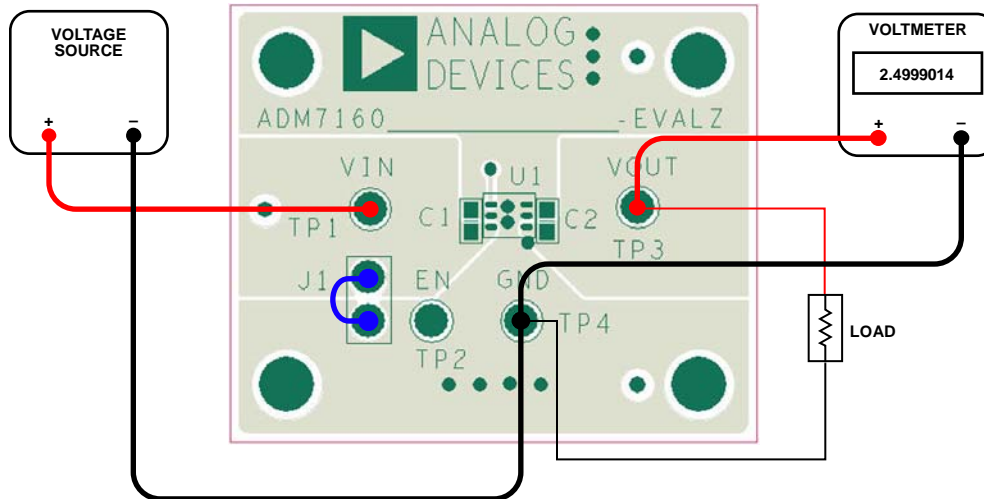


Figure 6. Output Voltage Measurement Setup, [ADM7160CP-EVALZ](#) (6-Lead LFCSP)

The connections of the [ADM7160](#) evaluation boards to a voltage source and a voltmeter for basic output voltage accuracy measurements are shown in Figure 5 and Figure 6. A resistor can be used as the load for the regulator. Ensure that the resistor has a power rating that can handle the power dissipated 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.

The steps on how to connect either of the [ADM7160](#) evaluation boards 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 [ADM7160](#) evaluation board.
2. Connect the positive terminal (+) of the voltage source to the VIN pin of the [ADM7160](#) evaluation board.

3. Connect a load between the VOUT pin and one of the GND pins.
4. Connect the negative terminal (–) of the voltmeter to one of the GND pins.
5. Connect the positive terminal (+) of the voltmeter to the VOUT pin.

When these steps are completed, the voltage source can be turned on. If J1 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 output of the regulator is monitored while its input is varied. For good line regulation, the output must maintain a minimal change in voltage with respect to varying the input voltage levels. To ensure that the device is not in dropout mode during this measurement, vary V_{IN} between $V_{OUT_NOM} + 0.4\text{ V}$ (or 2.2 V, whichever is greater) and V_{IN_MAX} . For example, for an ADM7160 with a fixed 2.5 V output, vary V_{IN} between 2.9 V and 5.5 V. This measurement can be repeated under different load conditions. The typical line regulation performance of an ADM7160 with a fixed 2.5 V output is shown in Figure 7.

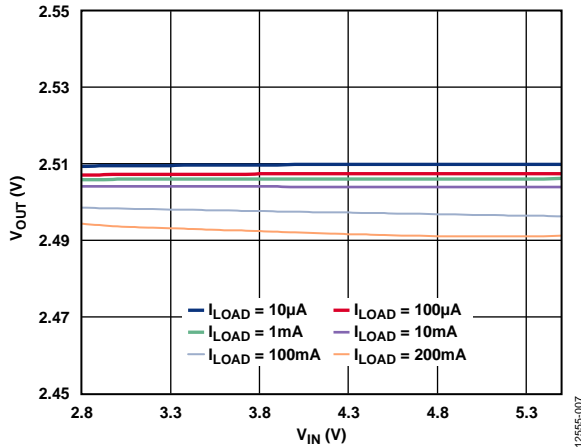


Figure 7. Output Voltage (V_{OUT}) vs. Input Voltage (V_{IN}), $V_{OUT} = 2.5\text{ V}$, $T_A = 25^\circ\text{C}$, $C_{IN} = C_{OUT} = 4.7\ \mu\text{F}$

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 be varied from 0 mA to 200 mA. The typical load regulation performance of an ADM7160 with a fixed 2.5 V output for an input voltage of 2.9 V is shown in Figure 8.

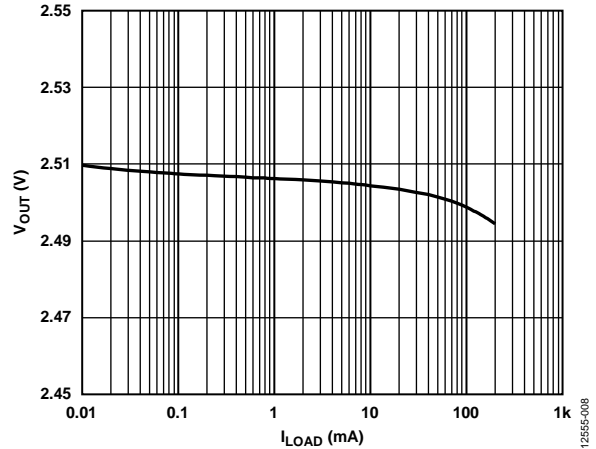


Figure 8. Output Voltage (V_{OUT}) vs. Load Current (I_{LOAD}), $V_{OUT} = 2.5\text{ V}$, $T_A = 25^\circ\text{C}$, $C_{IN} = C_{OUT} = 4.7\ \mu\text{F}$

DROPOUT VOLTAGE MEASUREMENTS

Dropout voltage is the amount of voltage above the rated output voltage that is needed to maintain a fixed output voltage. It can be measured as the difference of the input to the output voltage of the regulator. This definition is only applicable to output voltages above 2.2 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 need to be adjusted for voltage drops, especially if large load currents are used. The typical curve of dropout voltage measurements over varying load current levels is shown in Figure 9.

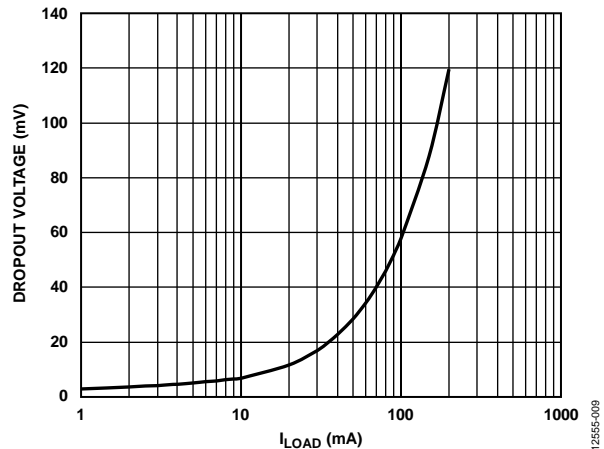
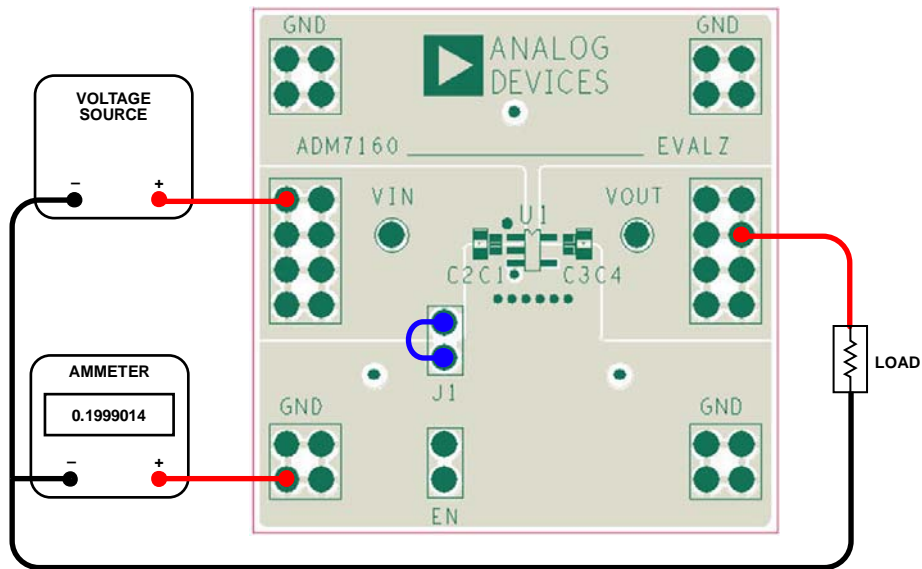
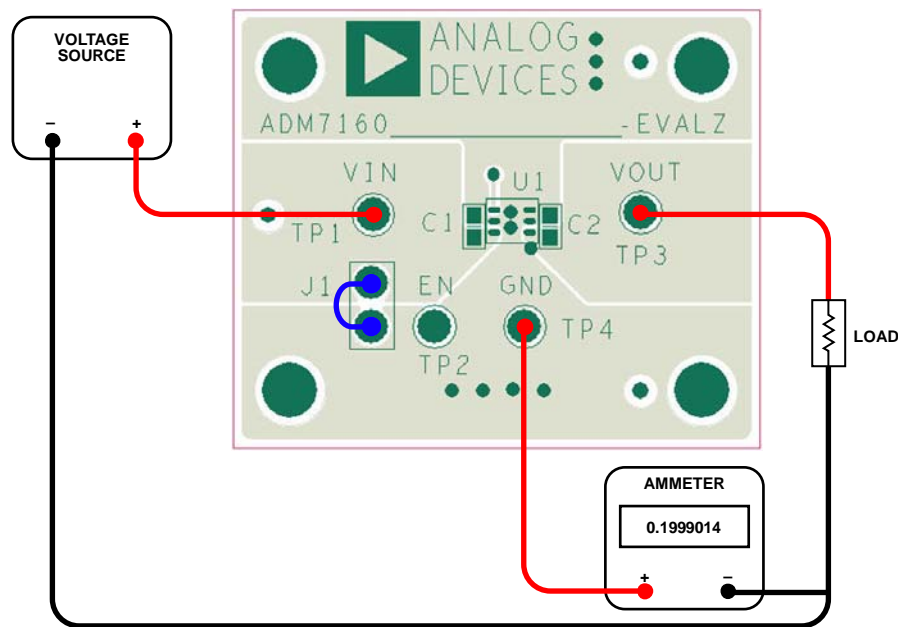


Figure 9. Dropout Voltage vs. Load Current (I_{LOAD}), $V_{OUT} = 2.5\text{ V}$, $T_A = 25^\circ\text{C}$, $C_{IN} = C_{OUT} = 4.7\ \mu\text{F}$

GROUND CURRENT MEASUREMENTS

Figure 10. Ground Current Measurement Setup, *ADM7160UJ-EVALZ* (5-Lead TSOT)

12555-010

Figure 11. Ground Current Measurement Setup, *ADM7160CP-EVALZ* (6-Lead LFCSP)

12555-011

The connections of the [ADM7160](#) evaluation boards to a voltage source and an ammeter for ground current measurements are shown in Figure 10 and Figure 11. A resistor can be used as a load for the regulator. Ensure that the resistor has a power rating that can handle the power 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.

The steps on how to connect either of the [ADM7160](#) evaluation boards to a voltage source and an ammeter are as follows:

1. Connect the positive terminal (+) of the voltage source to the VIN pin of the [ADM7160](#) evaluation board.
2. Connect the positive terminal (+) of the ammeter to one of the GND pins of 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 pin of the [ADM7160](#) evaluation board and the negative (–) terminal of the voltage source.

When these steps are completed, the voltage source can be turned on. If J1 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. 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 (200 mA). The typical ground current consumption for various load current levels at $V_{OUT} = 2.5\text{ V}$ and $T_A = 25^\circ\text{C}$ is shown in Figure 12.

When the device is disabled ($EN = GND$), the ground current typically drops to $0.2\ \mu\text{A}$.

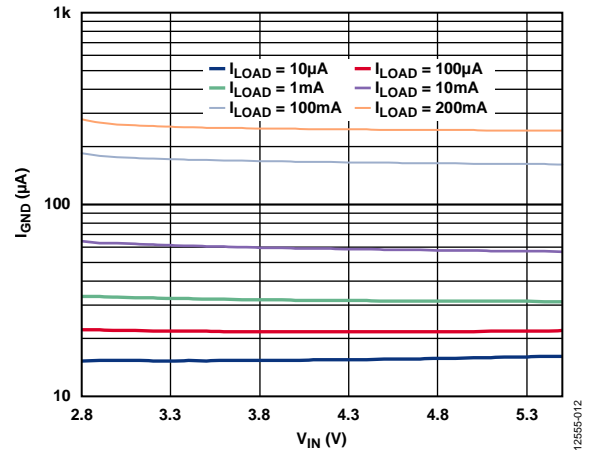


Figure 12. Ground Current (I_{GND}) vs. Input Voltage (V_{IN}), $V_{OUT} = 2.5\text{ V}$, $T_A = 25^\circ\text{C}$, $C_{IN} = C_{OUT} = 4.7\ \mu\text{F}$

ORDERING INFORMATION

BILL OF MATERIALS

Table 3. ADM7160UJ-EVALZ (5-Lead TSOT)

| Reference Designator | Description | Manufacturer | Manufacturing Part No. |
|----------------------------------|--|------------------------|---|
| U1 | ADM7160, IC, ultralow noise LDO, 2.5 V | Analog Devices, Inc. | ADM7160AUJZ-2.5-R7 ADM7160UJ-EVALZ |
| C1, C3 | Capacitor, MLCC, 4.7 μ F, 10 V, 0402, X5R, 10% | TDK or equivalent | C1005X5R1A475K050BC |
| C2, ¹ C4 ¹ | Capacitor, MLCC, 4.7 μ F, 10 V, 0603, X5R, 10% | TDK or equivalent | CGB3B1X5R1A475K055AC |
| J1, VIN, VOUT, GND | Header 0.100, single, STR, two pins | Sullins Electronics/3M | S1012E-36-ND |

¹ Not installed in the evaluation board.

Table 4. ADM7160CP-EVALZ (6-Lead LFCSP)

| Reference Designator | Description | Manufacturer | Manufacturing Part No. |
|----------------------|--|------------------------|---|
| U1 | ADM7160, IC, ultralow noise LDO, 2.5 V | Analog Devices, Inc. | ADM7160ACPZN2.5-R7 ADM7160CP-EVALZ |
| C1, C2 | Capacitor, MLCC, 4.7 μ F, 10 V, 0603, X5R, 10% | TDK or equivalent | CGB3B1X5R1A475K055AC |
| J1, VIN, VOUT, GND | Header 0.100, single, STR, two pins | Sullins Electronics/3M | S1012E-36-ND |



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.

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, decompile 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 NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S 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.