User's Guide
SBAU167–March 2010

# ADS1209EVM

This user's guide describes the characteristics, operation, and use of the ADS1209EVM. This EVM is an evaluation module for the ADS1209, a two-channel, high-performance, delta-sigma (ΔΣ) modulator designed for use with the AMC1210, a four-channel digital filter designed specifically for current measurement and resolver position decoding in motor control applications. The ADS1209EVM is designed for prototyping and evaluation. A complete circuit description, schematic diagram, and bill of materials are included.

The following related documents are available through the Texas Instruments web site at www.ti.com.

| Device | Literature Number |
|---|---|
| ADS1209 | SBAS491 |
| AMC1210 | SBAS372 |

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# 1 ADS1209EVM Overview

## 1.1 Features

**ADS1209EVM:**

- Full-featured evaluation module for the ADS1209 two-channel, ΔΣ modulator
- 9-pin sub-D connector for interfacing to the AMC1210 digital filter evaluation module
- Screw terminals for easy access to analog inputs

## 1.2 Introduction

The ADS1209EVM is an evaluation board for the ADS1209 two-channel ΔΣ modulator. This EVM features a 9-pin, female sub-D connector that allows digital outputs from the ADS1209 to be fed directly to the AMC1210 digital filter chip.

The ADS1209 is a two-channel modulator that offers 86-dB dynamic performance, operating from a single 5-V supply. When used in combination with the AMC1210 or other digital filter, the ADS1209 can be used to achieve 16-bit analog-to-digital (A/D) conversion with no missing codes.

For use in high-resolution measurement applications, an effective accuracy of 14 bits can be obtained with a digital filter bandwidth of 20 kHz at a modulator rate of 10 MHz.

Throughout this document, the abbreviation *EVM* and the term *evaluation module* are synonymous with the ADS1209EVM.

# 2 Analog Interface

The analog input to the ADS1209 is routed from a five-wire screw terminal screw at J1. This screw terminal gives the user access to the inverting and noninverting inputs of both channels of the ADS1209. A convenient ground terminal is also provided.



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### 2.1 Analog Inputs

The analog input to the ADS1209EVM board consist of two simple R/C filter circuits. The input circuit for the ADS1209 is shown in Figure 1.

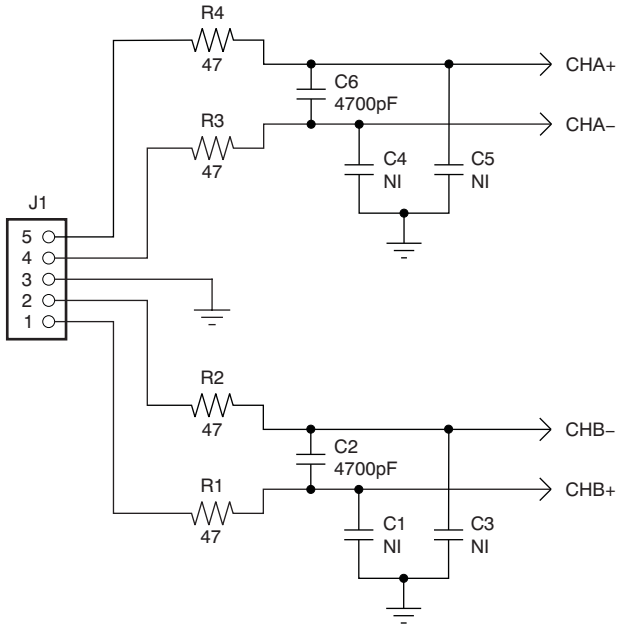



**Figure 1. ADS1209EVM Schematic: Analog Input Section**

## 3 Digital Interface

The ADS1209EVM is designed for use with digital filters such as the AMC1210. The output and power for the ADS1209 are routed to a 9-pin, female D-type connector. Both the analog and digital power for the ADS1209, as well as the modulator data and clock outputs from the device under test, are routed to J2, as Figure 2 illustrates.

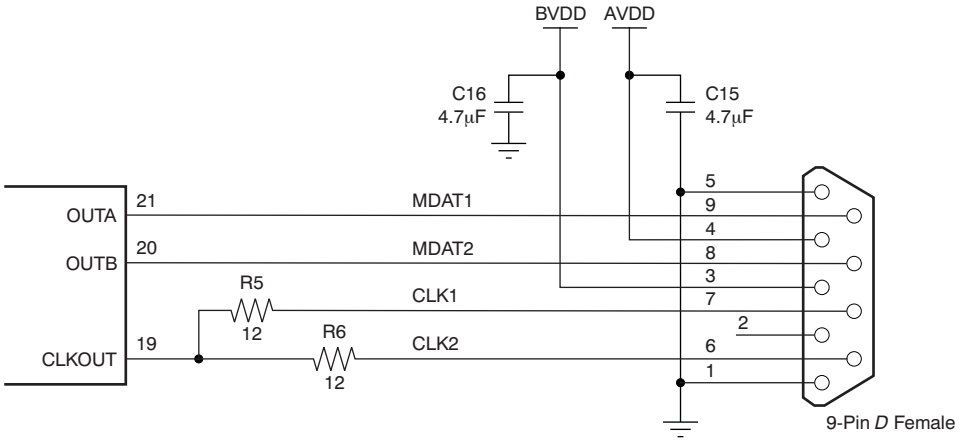



**Figure 2. Power and Digital Outputs**



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# 4 Power Supplies

J2 provides access to the +5 VA for the $AV_{DD}$ supply, and +2.7 to 5.5 VD for the $+BV_{DD}$ supply. It is recommended that all power to the board be sourced from a well-regulated linear supply with current-limiting capabilities. Power is to be applied through J2. Table 1 describes the pinout for J2.

**Table 1. J2: Power Supply and Digital Outputs**

| Signal | Pin Number | | Signal |
|---|---|---|---|
| Ground | 1 | 2 | Not used |
| 2.7 to 5.5 $+BV_{DD}$ Supply | 3 | 4 | +5 $AV_{DD}$ Supply |
| Ground | 5 | 6 | Clock OUT 2 |
| Clock OUT 1 | 7 | 8 | Modulator Data: CHB |
| Modulator Data: CHA | 9 | | |

For standalone operation, power sources can also be applied via a mating connector to J2, and the digital output data streams can be wired directly to an FPGA or other digital filter module for further processing. Refer to Figure 2 or the schematic appended to the end of this document for additional details.

# 5 EVM Operation

This section describes the general operation of the ADS1209EVM.

## 5.1 Analog Inputs: J1

The analog input to the ADS1209EVM printed circuit board (PCB) can be applied directly to J1, pins 1 and 2 for channel A and J1, pins 4 and 5 for channel B.

**CAUTION**

Carefully review the ADS1209 product data sheet for the limitations of the analog input range, and ensure that the appropriate analog/digital voltages are applied before connecting any analog input to the EVM.

Table 2 lists the details of J1.

**Table 2. J1: Analog Inputs**

| Pin Number | Signal | Description |
|---|---|---|
| J1.1 | CHA+ | Noninverting analog input to channel A |
| J1.2 | CHA– | Inverting input to channel A |
| J1.3 | GND | Ground |
| J1.4 | CHB– | Inverting input to channel B |
| J1.5 | CHB+ | Noninverting input to channel B |



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### 5.2 Device Operation

Once the analog and digital power sources are applied to the ADS1209EVM, the digital outputs become active. The ADS1209 is configured to use its onboard oscillator by tying the clock in (CLKIN) and clock select (CLKSEL) pins to the applied digital power supply. The internal reference of the ADS1209 is used as the conversion reference inputs by tying the REFOUT pin to both REFIN A and REFIN B.

Additionally, an analog input signal may be applied to the unipolar differential input pair of either channel at screw terminal J1. See Figure 1 and Table 2 for more details. The analog input range is $\pm 0.92 \times V_{REF}$ with a common mode input of +2.5 V. With the nominal internal reference voltage of +2.5 V, the maximum analog input voltage ranges from +0.125 V to +4.875 V.

As the input voltage approaches the maximum input level of +4.875 V, the 1s density of the modulator output approaches 92%. Likewise, when the input voltage approaches the lower limit of +0.124 V, the 1s density is approximately 8%.

## 6 BOM, Schematic, and Layout

This section contains the complete bill of materials, schematic diagram, and printed circuit board (PCB) layout for the ADS1209EVM.

**NOTE:** Board layouts are not to scale. These are intended to show how the board is laid out; they are not intended to be used for manufacturing ADS1209EVM PCBs.

### 6.1 Schematic

The ADS1209EVM schematic is appended to this document.

### 6.2 Printed Circuit Board Layout

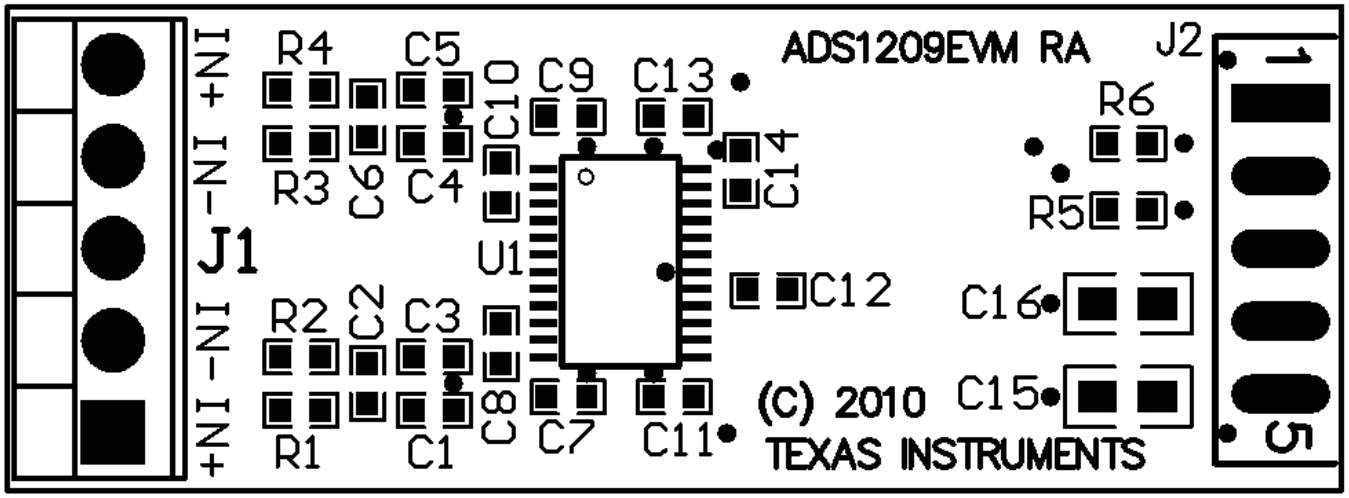



**Figure 3. ADS1209EVM Silk Screen Drawing**



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## 6.3 Bill of Materials

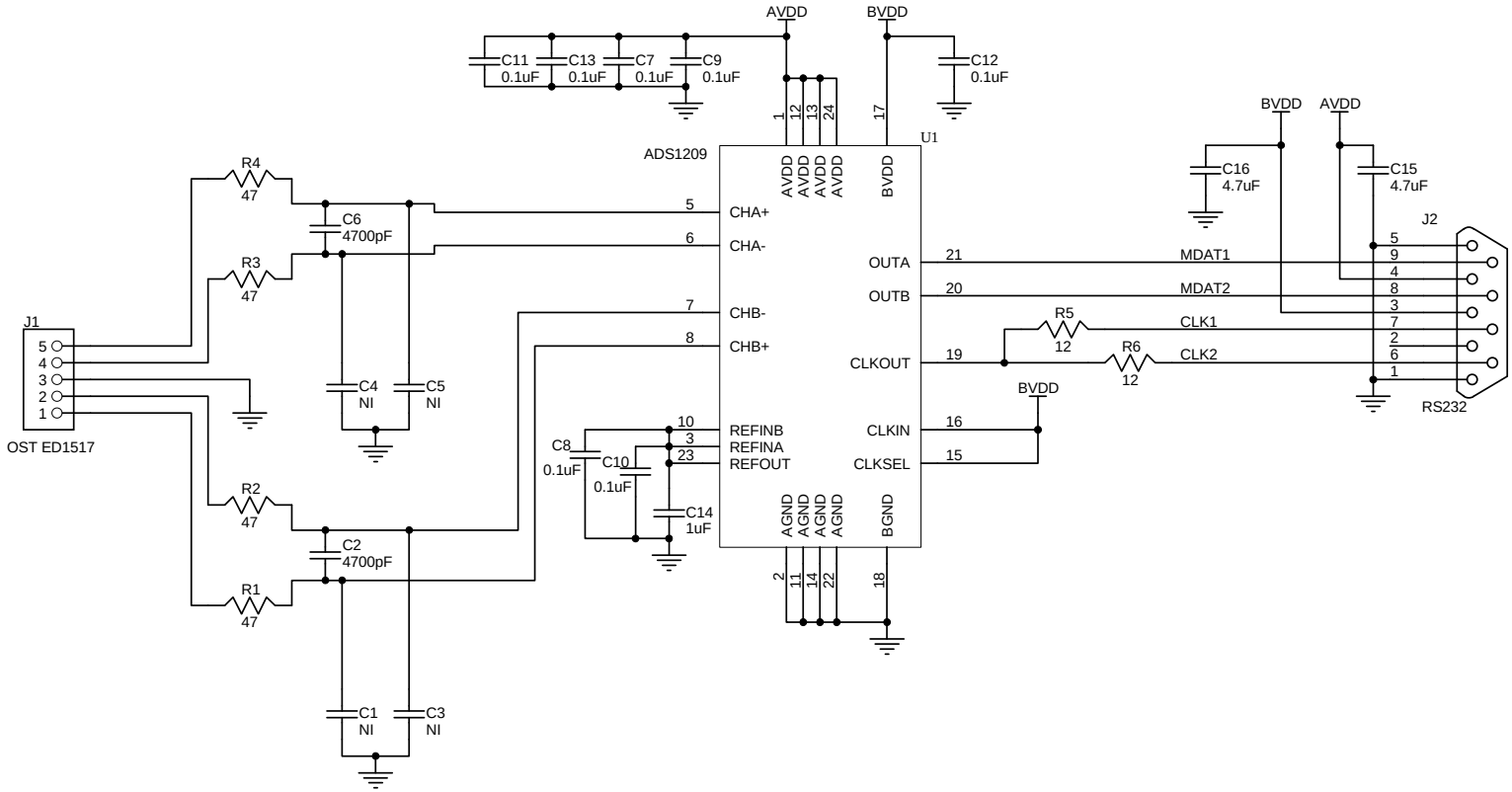
**Table 3. ADS1209EVM Bill of Materials**

| Reference Designator | Description | Vendor | Part Number |
|---|---|---|---|
| C1, C3, C4, C5 | Not installed | — | — |
| C2, C6 | Capacitor, ceramic 4700pF 50V 10% X7R 0603 | Murata | GRM188R71H472KA01D |
| C7 - C13 | Capacitor, ceramic 0.1μF 50V 10% X7R 0603 | Murata | GRM188R71H104KA93D |
| C14 | Capacitor, ceramic 1μF 25V 10% X5R 0603 | Murata | GRM188R61E105KA12D |
| C15, C16 | Capacitor, ceramic 4.7μF 16V 10% X5R 0805 | Murata | GRM21BR61C475KA88L |
| J1 | Terminal block, 3.5MM, 5-Pos PCB | On Shore | ED555/5DS |
| J2 | Connector, DB-9 Female solder cup, Tin | Norcomp | 172-009-202R001 |
| R1, R2, R3, R4 | Resistor, 47.0Ω 1/10W 1% 0603 SMD | Yageo | RC0603FR-0747RL |
| R5, R6 | Resistor, 12.0Ω 1/10W 1% 0603 SMD | Yageo | RC0603FR-0712RL |
| U1 | ADS1209, ADS1209SPW | TI | ADS1209SPW |



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| REVISION HISTORY | | |
|---|---|---|
| REV | ENGINEERING CHANGE NUMBER | APPROVED |
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|---|---|---|---|
| ENGINEER **Tom Hendrick** | | TITLE **ADS1209EVM** | |
| DRAWN BY **Tom Hendrick** | | | |
| DOCUMENT CONTROL NO. **6516845** | SIZE **A** | DATE **2/17/2010** | REV **A** |
| SHEET **1** OF **1** | FILE **ADS1209_sch_a** | | |


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## EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 0V to 5V and the output voltage range of 0V to 5V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than +30°C. The EVM is designed to operate properly with certain components above +30°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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