TEXAS INSTRUMENTS

ADS1110EVM

Evaluation Module

User's Guide

September 2003

Data Acquisition Products

SBAU089

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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 60°C. The EVM is designed to operate properly with certain components above 60°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.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

Preface

Read This First

About This Manual

This manual describes the ADS1110EVM evaluation fixture and how to use it. Throughout this document, the abbreviation EVM and the term *evaluation module* are synonymous with the ADS1110EVM.

Information About Cautions and Warnings

This book contains cautions.

> **This is an example of a caution statement.**
>
> **A caution statement describes a situation that could potentially damage your software or equipment.**

The information in a caution is provided for your protection. Please read each caution carefully.

Related Documentation From Texas Instruments

The following document provides information regarding Texas Instruments integrated circuits used in the assembly of the ADS1110EVM. This document is available from the TI web site. The last character of the literature number corresponds to the document revision, which is current at the time of the writing of this User's Guide. To obtain a copy of the following TI document, visit our website at http://www.ti.com/ or call the Texas Instruments Literature Response Center at (800) 477−8924 or the Product Information Center at (972) 644−5580. When ordering, identify the document by both title and literature number.

Data sheet	Literature number
ADS1110 Data Sheet	SBAS276

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Chapter 1

Overview

The ADS1110EVM is an evaluation fixture for the ADS1110 16-bit delta-sigma ($\Delta\Sigma$) analog-to-digital converter (ADC). Designed for prototyping and evaluation, it includes four ADS1110 devices, each with a different I^2C address.

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1.1 Introduction

Many data converter evaluation fixtures contain a computer interface or a microcontroller, but the ADS1110EVM contains only the ADS1110 device and a few support components. All ADS1110 pins are accessible through various pins on the ADS1110 analog and digital connectors.

The ADS1110EVM is designed using a simple card format developed by TI. This simple, consistent design makes the ADS1110EVM very easy to connect to your own prototype system. You can even think of the ADS1110EVM as an alternate package for the ADS1110—one much larger than the device itself, but also much easier to wire up by hand on your test bench.

The ADS1110EVM can be plugged directly into suitable motherboards such as the HPA449 MSP430 microcontroller development system from Soft-Baugh, Inc. (http://www.softbaugh.com/). See TI's web site for example code using the ADS1110EVM with the HPA449.

The ADS1110EVM, together with the HPA449 and the appropriate software, also forms a complete evaluation system for verifying the performance of the ADS1110. See the ADS1110 product information folder on the Texas Instruments web site.

1.2 Connectors

The ADS1110 devices on the ADS1110EVM are connected through three headers: the analog connector, the serial connector, and the power connector. Pinouts and locations for the connectors are given in the following chapter.

- The **analog** connector (J1) carries analog I/O.
- The **serial** connector (J2) carries the ADS1110 I^2C interface.
- The **power** connector (J4) carries the power supplies. The ADS1110EVM requires a +2.7V—+5V power supply. The power connector has dedicated connections for +5V and +3.3V. A slide switch connects the four ADS1110 devices to the analog, +5V digital, or +3.3V digital power-supply pins on J6.

The board is designed using a single ground net connected to DGND. An AGND pin is also provided; it can be connected to DGND using jumper J2.

A jumper is inserted in the supply line of each device. Another jumper carries the supply current for all four devices. These jumpers allow the current of each device to be measured independently or together.

1.3 Controls

The ADS1110EVM is configured using a slide switch and a jumper block.

Switch S1 is used to select between two digital power supply pins and one analog power supply pin provided on the power connector. One pin is used for +3.3V, and the other two are used for +5V; some motherboards, such as the HPA449, provide both voltages. This switch determines the logic levels that the ADS1110 will use to communicate, so it is important to set it correctly.

The jumper block is used mainly for current measurement. There is also a jumper used to short AGND to DGND.

1.4 Setting Up

The ADS1110EVM is configured according to its use. Thus, there is no single correct procedure to configure the test fixture.

Nevertheless, it is useful to remember the following things when you are setting up the board:

- Make certain that S1, the power supply select switch, is in the right position for your system, and that you have connected a power supply to the proper pins on the power connector.
- If you are not measuring the ADS1110 supply current, remember to place shorting blocks on jumper block J3. Without these shorting blocks, the ADS1110 will not be powered on.

Chapter 2

Circuit Description

This chapter describes the connectors, controls, and circuit design of the ADS1110EVM in detail.

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2.1 ADS1110 Devices

There are four ADS1110 devices installed on the ADS1110EVM. Each device has a different I^2C address. All four devices are connected to the same I^2C bus.

The addresses and part numbers of each device are listed in Table 2−1.

Table 2−1. ADS1110 Devices

Reference Number	Part Number	I^2C Address
U1	ADS1110A0	1001000
U2	ADS1110A1	1001001
U3	ADS1110A2	1001010
U4	ADS1110A3	1001011

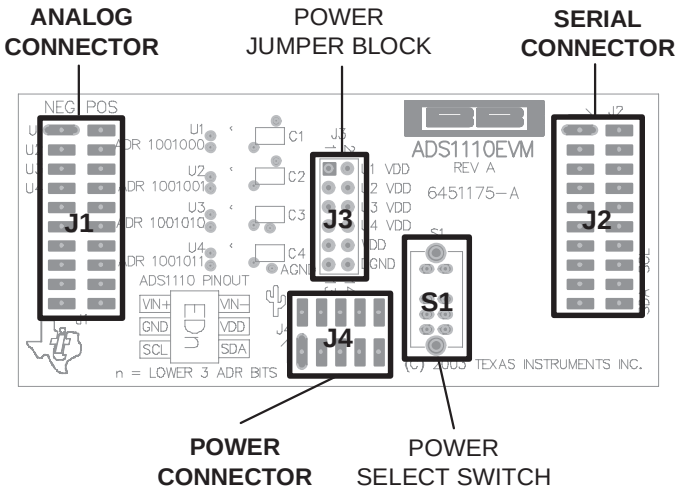
Each ADS1110 has a bypass capacitor placed near the device power supply pins. Although these capacitors are not strictly necessary, they can help performance somewhat when using low-quality power supplies.

In many applications, one bypass capacitor (or none at all) may be sufficient for a group of ADS1110 devices.

2.2 I/O Connectors and Testpoints

The positions and functions of the connectors and testpoints are shown in Figure 2−1.

Figure 2−1. Connectors and Jumpers



Many of the pins on the connectors are not used. On the pinout diagrams, unused pins are not marked. In the pin description tables, unused pins are not listed, and ground pins are listed together, with the exception of the power connector.

J1, J2, and J4, although each treated as a single connector, are actually mounted as connector pairs in a pass-through configuration. Each pair has a male surface-mount header on the top (component) side of the board, and a corresponding female surface-mount socket on the bottom (solder) side of the board. The headers, mounted on top, are suffixed A; the sockets, mounted on bottom, are suffixed B.

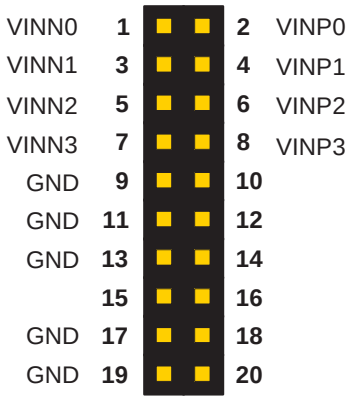
In the schematic, the connector pairs are shown as one symbol. For J1, J2, and J4, all bottom-side pins are connected to their corresponding top-side pins; for example, J1B pin 1 connects to J1A pin 1, J1B pin 2 connects to J1A pin 2, etc. This convention holds true for every pin on connectors J1, J2, and J4.

In the following descriptions, the connector pairs will be treated as a single connector.

2.2.1 J1: Analog Connector

The analog connector pinout is shown in Figure 2−2 and described in Table 2−2.

Figure 2−2. Analog Connector Pinout



Although certain pins are described as "negative," *never* apply voltages less than −0.3V to these pins. The ADS1110 is not a bipolar-input device, and it cannot accept negative voltages below −0.3V without damaging the functional operation of the unit.

The negative input pins are so named because the voltage on such a pin is subtracted from a positive input pin during a reading.

Table 2−2. Analog Connector Pin Descriptions

Pin Number	Pin Name	Standard Name	Direction	Function
1	VINN0	AN0−	Input	Negative Analog Input, device U1
2	VINP0	AN0+	Input	Positive Analog Input, device U1
3	VINN1	AN1−	Input	Negative Analog Input, device U2
4	VINP1	AN1+	Input	Positive Analog Input, device U2
5	VINN2	AN2−	Input	Negative Analog Input, device U3
6	VINP2	AN2+	Input	Positive Analog Input, device U3
7	VINN3	AN3−	Input	Negative Analog Input, device U4
8	VINP3	AN3+	Input	Positive Analog Input, device U4
9, 11, 13, 17, 19	GND	AGND	Power	Signal Ground

2.2.2 J2: Serial Connector

The serial connector pinout diagram is shown in Figure 2−3 and described in Table 2−3.

Figure 2−3. Serial Connector Pinout

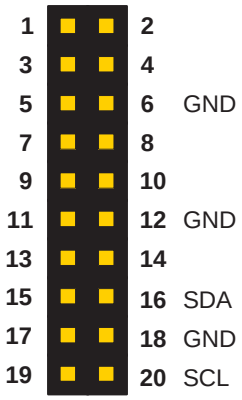


Table 2−3. Serial Connector Pin Descriptions

Pin Number	Pin Name	Standard Name	Direction	Function
16	SCL	SCL	I/O	I^2C Clock Line
20	SDA	SDA	I/O	I^2C Clock Line
6, 12, 18	GND	DGND	Power	Signal Ground

The ADS1110 I^2C interfaces are connected through pins 16 and 20. The other pins are not used.

Note: There are no pullup resistors on the I^2C lines. These must be connected externally.

2.2.3 J4: Power Connector

The power connector pinout diagram is shown in Figure 2−4 and described in Table 4.

Figure 2−4. Power Connector Pinout

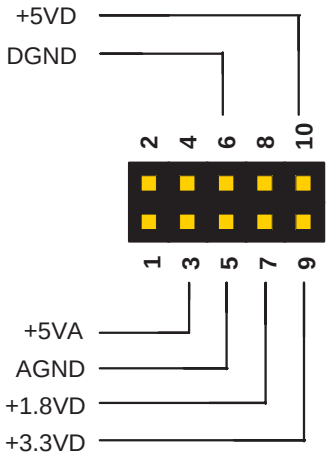


Table 2−4. Power Connector Pin Descriptions

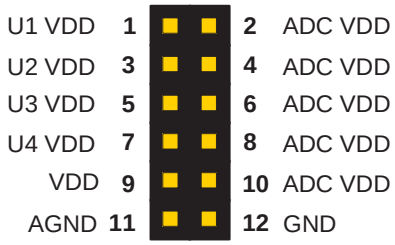
Pin Number	Pin Name	Function	Usage on ADS1110EVM
1	+VA	Positive Analog Supply, +5V to +18V	Optional Use as ADS1110 Power Supply
2	−VA	Negative Analog Supply, −5V to −18V	Not Used
3	+5VA	Positive Analog Supply, +5V	Not Used
4	−5VA	Negative Analog Supply, −5V	Not Used
5	AGND	Analog Ground	Optional Connection to DGND through J4 pins 11−12
6	DGND	Digital Ground	Ground
7	+1.8VD	Positive Digital Supply, +1.8V	Not Used
8	VD1	Positive Digital Supply	Not Used
9	+3.3VD	Positive Digital Supply, +3.3V	Optional Use as ADS1110 Power Supply
10	+5VD	Positive Digital Supply, +5.5V	Optional Use as ADS1110 Power Supply

The ADS1110EVM always uses DGND for its single ground domain. The AGND pin may optionally be connected to DGND through jumper J2.

2.3 Jumpers

The jumper block, J3, is shown in Figure 2−5.

Figure 2−5. Jumper Block J3



2.3.1 Individual Current Measurement Jumpers

Jumper block pins 1−8 are used to measure the current consumption of each ADS1110 device individually.

For normal operation, short each pair together.

2.3.2 Total ADC Current Measurement Jumper

Jumper block pins 9−10 are used to measure the current consumption of all four ADS1110 devices.

For normal operation, short this pair together.

2.3.3 Analog-Digital Ground Jumper

Jumper block pins 11−12 are used to connect the AGND pin on J4 (pin 5) to the DGND pin on J4 (pin 6). The ADS1110EVM uses DGND as its ground.

2.4 Switches

There is one switch on the ADS1110EVM. It selects the source pin for the ADS1110 power supply.

2.4.1 S1: Power Supply Level

This switch selects from one of three power supply pins on J4 that can be used to power the ADS1110 devices. The positions of the switch are described in Table 2−5.

Table 2−5. Digital Power Supply Level Select Switch

Board Marking	Switch Position	Power Supply Source
+3.3VD	Top	+3.3V typical (J4 pin 9)
+5VD	Middle	+5V typical (J4 pin 10)
+5VA	Bottom	+5V typical (J4 pin 1)

This switch determines the logic level at which the devices will communicate. Make certain it is set correctly before you power the board on.

Chapter 3

Schematic and Layout

This chapter contains the complete bill of materials, schematic diagram, and printed circuit board (PCB) layout for the ADS1110EVM.

The schematic diagram is shown in Figure 3−1 on page 3-2. The top (component) side layout is shown in Figure 3−2 on page 3-3. The bottom (solder) side layout is shown in Figure 3−3 on page 3-3. The bill of materials is shown in Table 3−1 on page 3-4.

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 ADS1110EVM PCBs.

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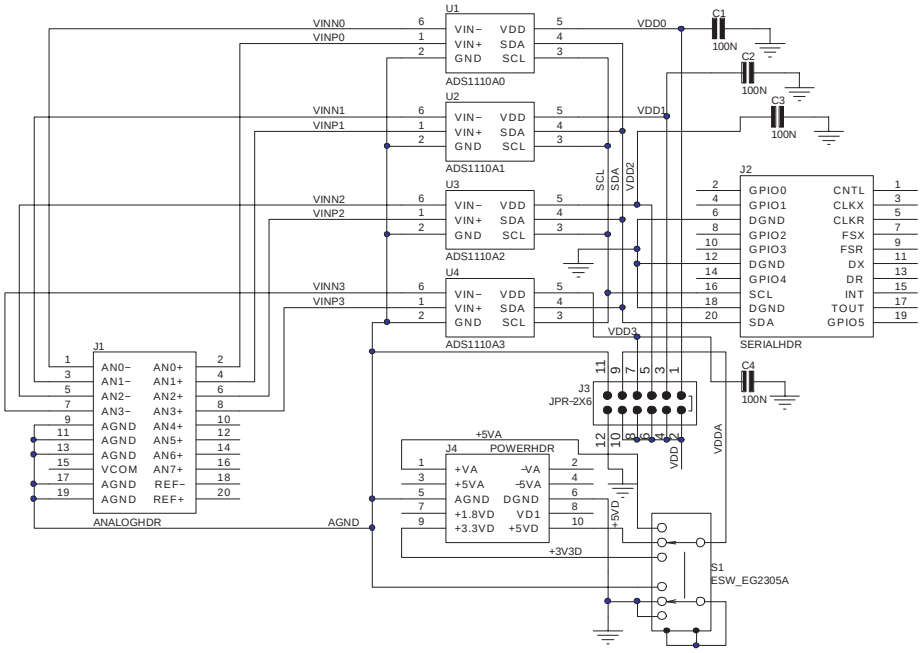
3.1 Schematic

Figure 3−1. Schematic



3.2 Board Layout

Figure 3−2. Top Side Layout

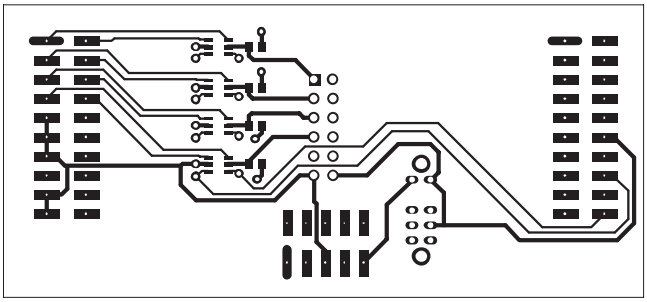
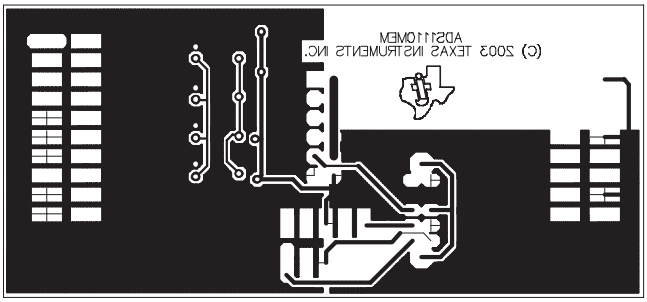


Figure 3−3. Bottom Side Layout (as viewed from the top side)



3.3 Bill of Materials

Table 3−1. Bill of Materials

Reference Designator	Description	Vendor	Part Number
C1, C2, C3, C4	16V 0.1µF ceramic capacitor, X7R	Panasonic	ECJ−1VB1C104K
U1	Analog-to-digital converter	Texas Instruments	ADS1110A0IDBT
U2	Analog-to-digital converter	Texas Instruments	ADS1110A0IDBT
U3	Analog-to-digital converter	Texas Instruments	ADS1110A0IDBT
U4	Analog-to-digital converter	Texas Instruments	ADS1110A0IDBT
N/A	ADS1110EVM PCB	Texas Instruments	6451173
J1A, J2A	Header, SMT, 20 pin	Samtec	TSM−110−01−T−DV−P
J1B, J2B	Socket, SMT, 20 pin	Samtec	SSW−110−22−F−D−VS−K
J3	2x6 pin header, 0.1” spacing	Samtec	TSW−106−07−L−D
J4A	Header, SMT, 10 pin	Samtec	TSM−105−01−T−DV−P
J4B	Socket, SMT, 10 pin	Samtec	SSW−105−22−F−D−VS−K
S1	DP3T slide switch	E-Switch	EG2305A