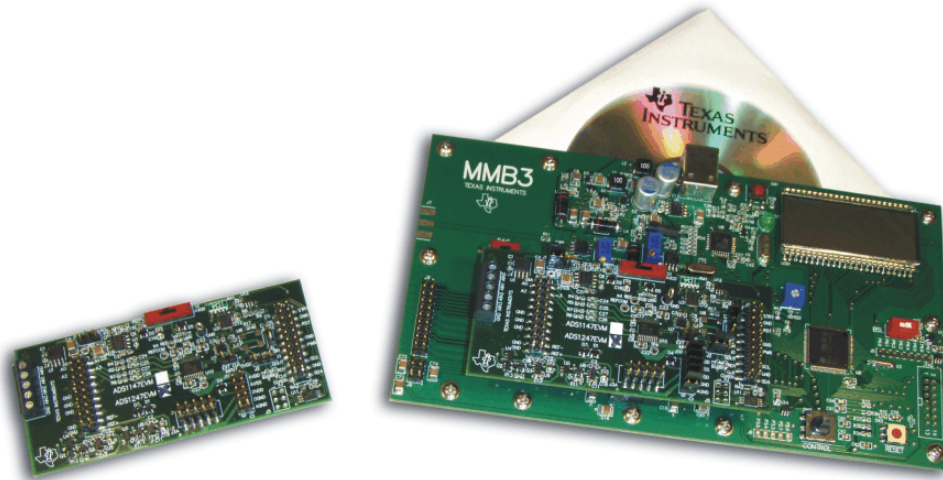


# **ADS1147EVM, ADS1247EVM, ADS1147EVM-PDK, ADS1247EVM-PDK**



**ADS1247EVM (Left) and ADS1247EVM-PDK (Right)**

This user's guide describes the characteristics, operation, and use of the ADS1147EVM and ADS1247EVM, both by themselves and as part of the ADS1147EVM-PDK or ADS1247EVM-PDK. These evaluation modules (EVMs) are evaluation boards for the [ADS1247](#), a 24-bit multi-channel, delta-sigma, analog-to-digital converter (ADC), and the [ADS1147](#), a 16-bit version of the ADS1247. This EVM allows evaluation of all aspects of the ADS1147 or ADS1247 devices. Complete circuit descriptions, schematic diagrams, and bill of materials are included in this document.

The following related documents are available through the Texas Instruments web site at <http://www.ti.com>.

### EVM-Compatible Device Data Sheets

Device	Literature Number
<a href="#">ADS1147</a>	<a href="#">SBAS453</a>
<a href="#">ADS1247</a>	<a href="#">SBAS426A</a>
<a href="#">REF5020</a>	<a href="#">SBOS410C</a>
<a href="#">OPA227</a>	<a href="#">SBOS110A</a>
<a href="#">TPS3836L30</a>	<a href="#">SLVS292D</a>
<a href="#">TPS79225</a>	<a href="#">SLVS337B</a>
<a href="#">TPS72325</a>	<a href="#">SLVS346B</a>
<a href="#">SN74LVC2G157</a>	<a href="#">SCES207K</a>
<a href="#">PCA9535</a>	<a href="#">SCPS129I</a>

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 Microsoft, Windows are registered trademarks of Microsoft Corporation.  
 I<sup>2</sup>C is a trademark of NXP Semiconductors.  
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## 1 EVM Overview

### 1.1 Features

#### ADS1147EVM/ADS1247EVM Features:

- Contains all support circuitry needed for the ADS1147/ADS1247
- $\pm 2.5V$  and  $+5V$  power-supply options for ADC
- Voltage reference options: external or onboard
- GPIO access
- Compatible with the TI Modular EVM System

#### ADS1147EVM-PDK/ADS1247EVM-PDK Features:

- Easy-to-use evaluation software for Microsoft® Windows® XP
- Data collection to text files
- Built-in analysis tools including scope, FFT, and histogram displays
- Complete control of board settings
- Easily expandable with new analysis plug-in tools from Texas Instruments

For use with a computer, the ADS1147EVM-PDK or ADS1247EVM-PDK is available. This kit combines the ADS1147/ADS1247EVM board with the MSP430-based MMB3 motherboard, and includes ADCPro™ software for evaluation.

The MMB3 motherboard allows the ADS1147/ADS1247EVM to be connected to the computer via an available USB port. This manual shows how to use the MMB3 as part of the ADS1147EVM-PDK/ADS1247EVM-PDK, but does not provide technical details about the MMB3 itself.

ADCPro is a program for collecting, recording, and analyzing data from ADC evaluation boards. It is based on a number of plug-in programs, so it can be expanded easily with new test and data collection plug-ins. The ADS1147EVM-PDK/ADS1247EVM-PDK is controlled by a plug-in running in ADCPro. For more information about ADCPro, see the [ADCPro™ Analog-to-Digital Converter Evaluation Software User's Guide](#) (literature number [SBAU128](#)), available for download from the TI web site.

This manual covers the operation of both the ADS1147/ADS1247EVM and the ADS1147EVM-PDK/ADS1247EVM-PDK. Throughout this document, the abbreviation *EVM* and the term *evaluation module* are synonymous with the ADS1147/ADS1247EVM. For clarity of reading, the rest of this manual will refer only to the ADS1247EVM or ADS1247EVM-PDK, but operation of the EVM and kit for the ADS1147 is identical, unless otherwise noted.

### 1.2 Introduction

The ADS1247EVM is an evaluation module built to the TI Modular EVM System specification. It can be connected to any modular EVM system interface card.

The ADS1247EVM is available as a stand-alone printed circuit board (PCB) or as part of the ADS1247EVM-PDK, which includes an MMB3 motherboard and software. As a stand-alone PCB, the ADS1247EVM is useful for prototyping designs and firmware

Note that the ADS1247EVM has no microprocessor and cannot run software. To connect it to a computer, some type of interface is required.

## 2 Analog Interface

For maximum flexibility, the ADS1247EVM is designed for easy interfacing to multiple analog sources. Samtec part numbers SSW-110-22-F-D-VS-K and TSM-110-01-T-DV-P provide a convenient 10-pin, dual-row, header/socket combination at J8. This header/socket provides access to the analog input pins of the ADS1247. Consult Samtec at <http://www.samtec.com> or call 1-800-SAMTEC-9 for a variety of mating connector options. These signals can also be connected to the terminal block J4.

All of the pins on J4 and J8 are connected with minimal filtering or protection. Use appropriate caution when handling these pins. Table 1 summarizes the pinouts for analog interfaces J4 and J8.

**Table 1. J8/J4: Analog Interface Pinout**

Pin Number	Signal	Description, ADS1147/ADS1247
J8.1, J4-1	A0(-)	AIN0
J8.2, J4-2	A0(+)	AIN1
J8.3, J4-3	A1(-)	AIN2
J8.4, J4-4	A1(+)	AIN3
J8.5-8	Unused	—
J8.18	REF-	External reference source input (- side of differential input)
J8.20	REF+	External reference source input (+ side of differential input)
J8.10-16 (even)	Unused	
J8.15	Unused	
J8.9-19 (odd), J4-9	AGND	Analog ground connections (except J8.15)

## 3 Digital Interface

### 3.1 Serial Data Interface

The ADS1247EVM is designed to easily interface with multiple control platforms. Samtec part numbers SSW-110-22-F-D-VS-K and TSM-110-01-T-DV-P provide a convenient 10-pin, dual-row, header/socket combination at J7. This header/socket provides access to the digital control and serial data pins of the ADC. Consult Samtec at <http://www.samtec.com> or call 1-800-SAMTEC-9 for a variety of mating connector options.

All logic levels on J7 are 3.3V CMOS, except for the I<sup>2</sup>C™ pins. These pins conform to 3.3V I<sup>2</sup>C rules. Table 2 describes the J7 serial interface pins.

**Table 2. J7: Serial Interface Pins**

Pin No.	Pin Name	Signal Name	I/O Type	Pullup	Function
J7.1	CNTL	$\overline{CS}$	In	High	
J7.2	GPIO0	START	In	High	
J7.3	CLKX	SCLK	In	None	ADS1247 SPI clock
J7.4	DGND	DGND	In/Out	None	Digital ground
J7.5	CLKR	Unused	—	None	
J7.6	GPIO1	$\overline{MR}$	In	High	Master reset
J7.7	FSX	Unused	—	None	
J7.8	GPIO2	Unused	—	None	
J7.9	FSR	DRDY	Out	None	
J7.10	DGND	DGND	In/Out	None	Digital ground
J7.11	DX	DIN	In	None	ADS1247 SPI data in
J7.12	GPIO3	PWRSEL	In	High	Selects $\pm 2.5V$ or +5V supply

**Table 2. J7: Serial Interface Pins (continued)**

Pin No.	Pin Name	Signal Name	I/O Type	Pullup	Function
J7.13	DR	DOUT/DRDY	Out	None	ADS1247 data out
J7.14	GPIO4	Unused	—	None	
J7.15	INT	DRDY	Out	None	
J7.16	SCL	SCL	I <sup>2</sup> C	High	I <sup>2</sup> C clock
J7.17	TOUT	CLK	In	None	Can be used to provide a clock from a processor
J7.18	DGND	DGND	In/Out	None	Digital ground
J7.19	GPIO5	CLK Select	—	None	
J7.20	SDA	SDA	I <sup>2</sup> C	High	I <sup>2</sup> C data

Many pins on J7 have weak pull-up resistors. These resistors provide default settings for many of the control pins. Many pins on J7 correspond directly to ADS1247 pins. See the [ADS1247 data sheet](#) for complete details on these pins.

#### 4 Power Supplies

J3 is the power-supply input connector. [Table 3](#) lists the configuration details for J3.

**Table 3. J3 Configuration: Power-Supply Input**

Pin No.	Pin Name	Function	Required
J3.1	+VA	Unused	No
J3.2	-VA	Unused	No
J3.3	+5VA	+5V analog supply	Always
J3.4	-5VA	-5V analog supply	Only in bipolar mode
J3.5	DGND	Digital ground input	Yes
J3.6	AGND	Analog ground input	Yes
J3.7	+1.8VD	1.8V digital supply	No
J3.8	VD1	Unused	No
J3.9	+3.3VD	3.3V digital supply	Always
J3.10	+5VD	+5V digital supply	No

All of the power supplies (AVDD, AVSS, and DVDD) have corresponding jumpers on J10 that can be replaced with a current meter to measure the respective supply currents.

### 4.1 Power Options

J10 is arranged as five rows, each of which can be shorted. [Table 4](#) lists the power option details for J10. For normal operation, J10.1-2, J10.3-4, and J10.5-6 must be connected (direct or through an ammeter), and either (or both) of J10.7-8 and J10.9-10 must be connected; otherwise, the board does not function.

**Table 4. J4 Configuration: Power Options**

Row	Name	Function
1-2	ADC AVDD	AVDD supply current measurement point for the ADC. Must be connected for operation.
3-4	ADC AVSS	AVSS supply current measurement point for the ADC. Must be connected for operation.
5-6	ADC DVDD	DVDD supply current measurement point for the ADC. Must be connected for operation.
7-8	DGND	Connects DGND to board ground.
9-10	AGND	Connects AGND to board ground.

## 5 Voltage Reference

The ADS1247 device has the option of selecting between two different references: REF0, and the internal reference, through registers in the ADS1247 chip. The EVM provides a 2.048V reference for REF0 from U1, filtered and buffered through U2. This 2.048V may be used to drive the REF0P input, or REF0P can be connected to the external reference input on J8 through switch S1. REF0P should not be connected to AVDD through switch S1 because this connection will violate the specification for the maximum reference input. [Figure 1](#) shows switch S1 as it appears on the EVM. The low side of the reference (REF0N) is tied to AVSS. The different reference options under different supply conditions are outlined in [Table 5](#).



**Figure 1. Reference Select Switch S1**

**Table 5. REF1 Reference Voltage Options**

AVDD	AVSS	J1 Setting	S1 Position <sup>(1)</sup>	REF0P	REF0N	REF0 Reference Voltage
5V	0V	1-2	BUFF	2.048V	0V	2.048V
5V	0V	2-3	BUFF	0V	0V	Invalid selection
5V	0V	—	Center	REF+ (J8.20)	0V	Up to AVDD – 1
2.5V	-2.5V	1-2	BUFF	-0.452V	-2.5V	2.048V
2.5V	-2.5V	2-3	BUFF	0V	-2.5V	2.5V
2.5V	-2.5V	—	Center	REF+ (J8.20)	-2.5V	Up to AVDD – AVSS – 1

<sup>(1)</sup> Switch S1 should not be set to AVDD.

The internal reference voltage can be measured between testpoints TP3 (Int REF) and TP5 (REFCOM).

## 6 Clock Source

The ADS1247 has an internal clock or can be provided an external clock. The EVM uses the internal clock mode only. Provision is made on the EVM circuit board, however, for an external clock source. A footprint is provided at U8 for a crystal oscillator to be mounted on the board. An external clock may also be provided by a processor on the TOUT pin (J7.17), or an external clock source connected to J9.1 (ground) and J9.2 (signal).

J2 controls how the clock source is selected. With pins J2.1 and J2.2 shorted, GPIO5 from J7.19 can control whether the A or B side of U7 is selected. If the A side is selected, the clock should come from an external source provided as described above. If the B side is selected, the clock should come from the crystal oscillator. If a selection is made and no clock is provided on that input, the ADS1247 detects that no external clock is present and enables its internal oscillator.

### 6.1 Usage in PDK

If using the ADS1247EVM as part of the ADS1247EVM-PDK, remove any shorting blocks on jumper J6, and make sure J2 has a jumper between pins 1 and 2 (the IO position). This configuration grounds the CLK input to the ADS1247 and ensures that the internal oscillator starts up.

### 6.2 Usage as a Stand-Alone EVM

If using the EVM in your own system and not with the PDK hardware and software, observe the following recommendations:

- J6 should be removed if the external clock source is used and the TOUT pin is still driven by a processor in order to avoid conflicts.
- Jumper J2 can be used to always select the U8 oscillator (DVDD position) or allow the onboard/external clock selection to be controlled by GPIO5 (J7.19) as shown in [Figure 2](#).



**Figure 2. Jumper J2**

## 7 EVM Operation

This section provides information on the analog input, digital control, and general operating conditions of the ADS1247EVM.

### 7.1 Analog Input

Each of the analog input sources can be applied directly to J8 (top or bottom side) or through signal-conditioning modules available for the modular EVM system. Terminal block J4 is connected in parallel with the analog signal connections to J8. Each input has a 47Ω/47pF RC filter in series with it, and a differential 0.1μF capacitor is across each input pair for use with differential signals.

### 7.2 Digital Control

The digital control signals can be applied directly to J7 (top or bottom side). The modular ADS1247EVM can also be connected directly to a DSP or microcontroller interface board, such as the [5-6K Interface](#) or [HPA-MCU Interface](#) boards available from Texas Instruments, or the MMB3 if purchased as part of the ADS1247EVM-PDK. For a list of compatible interface and/or accessory boards for the EVM or the ADS1247, see the relevant product folder on the TI web site.

### 7.3 Default Jumper Settings and Switch Positions

Figure 3 shows the jumpers found on the EVM and the respective factory default conditions for each.

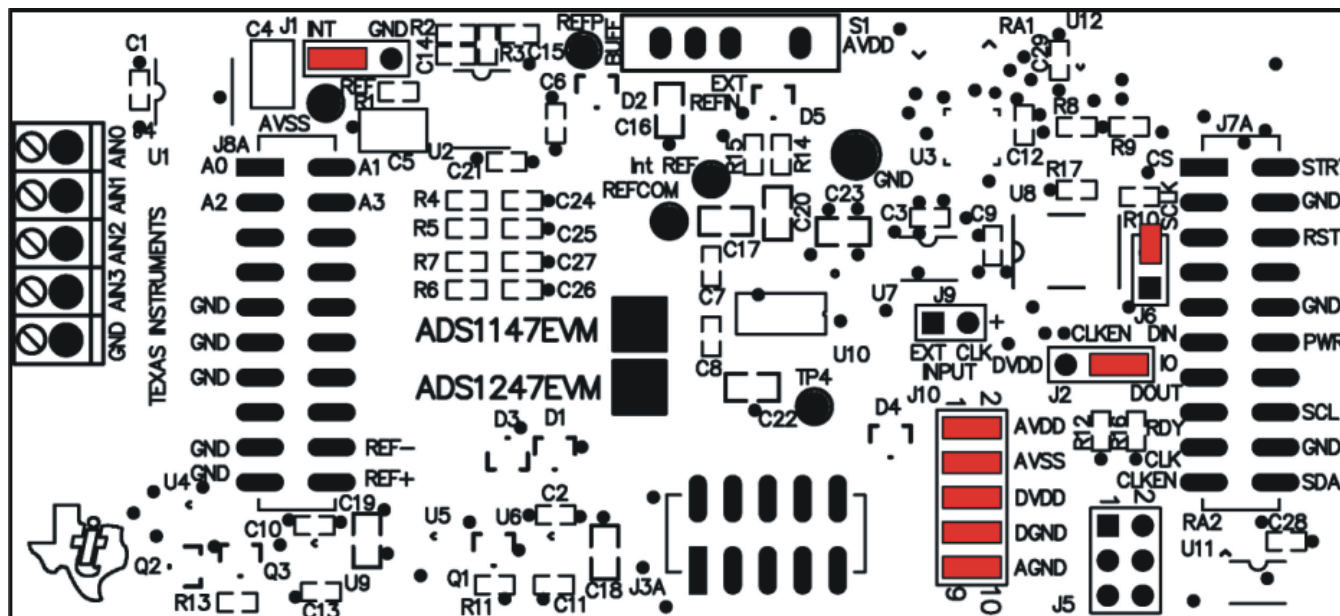


Figure 3. ADS1247EVM Default Jumper Locations

Table 6 lists the switches found on the EVM and the respective factory default conditions for each.

Table 6. List of Switches

Switch	Default Position	Switch Description
S1	Left	Onboard reference

## 8 ADS1247EVM-PDK Kit Operation

This section provides information on using the ADS1247EVM-PDK, including setup, program installation, and program usage.

To prepare to evaluate the ADS1247 with the ADS1247EVM-PDK, complete the following steps:

- Step 1. Install the ADCPro software (if not already installed) on a PC.
- Step 2. Install the ADS1247EVM-PDK EVM plug-in software.
- Step 3. Complete the USB driver installation process.
- Step 4. Set up the ADS1247EVM-PDK.
- Step 5. Connect the ADS1247EVM-PDK to the computer with a USB cable.
- Step 6. Run the ADCPro software.

Each task is described in the subsequent sections of this document.



## 8.1 Installing the ADCPro Software

### CAUTION

Do not connect the ADS1247EVM-PDK before installing the software on a suitable PC. Failure to observe this caution may cause Microsoft Windows to not recognize the ADS1247EVM-PDK as a connected device.

The CD-ROM shipped with the ADS1247EVM contains an installer for ADCPro as well as an installer for the ADS1247EVM plug-in. The latest software is available from the TI website at <http://www.ti.com/>. Refer to the [ADCPro User Guide](#) for instructions on installing and using ADCPro.

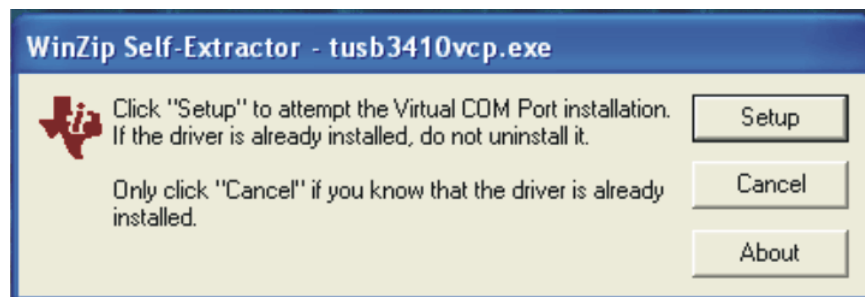
To install the ADS1247EVM-PDK plug-in, run the file: **ads1247evm-pdk-plug-in-1.0.0.exe** (1.0.0 is the version number, and increments with software version releases; you may have a different version on your CD). Double-click the file to run it; then follow the instructions shown. You can also use the ADCPro *Update Check* feature to check for newer versions of the ADS1247EVM-PDK plug-in, once you have installed a version of it.

Follow the on-screen prompts. Once the ADCPro plug-in installs, you will be prompted to install the Virtual COM port driver as shown in [Figure 4](#).



**Figure 4. Virtual COM Port Installer**

Press *OK* and the screen shown in [Figure 5](#) is displayed.



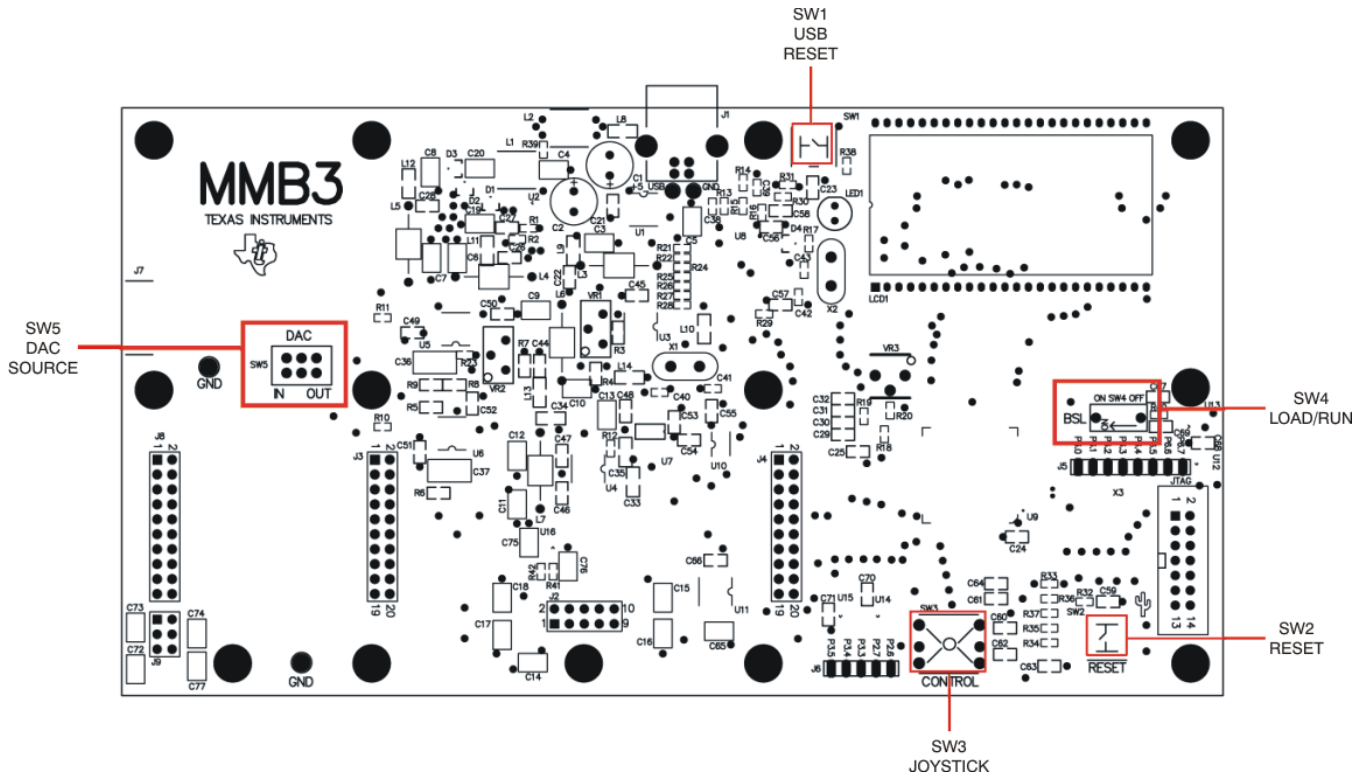
**Figure 5. Virtual COM Port Setup**

If you already have a TUSB3410 Virtual COM port driver installed on your system, select *Cancel*; otherwise, press *Setup* and follow the on-screen prompts. You may be notified that the driver is not digitally signed. If this message appears, select *Continue Anyway* and proceed.

## 8.2 Setting Up the ADS1247EVM-PDK

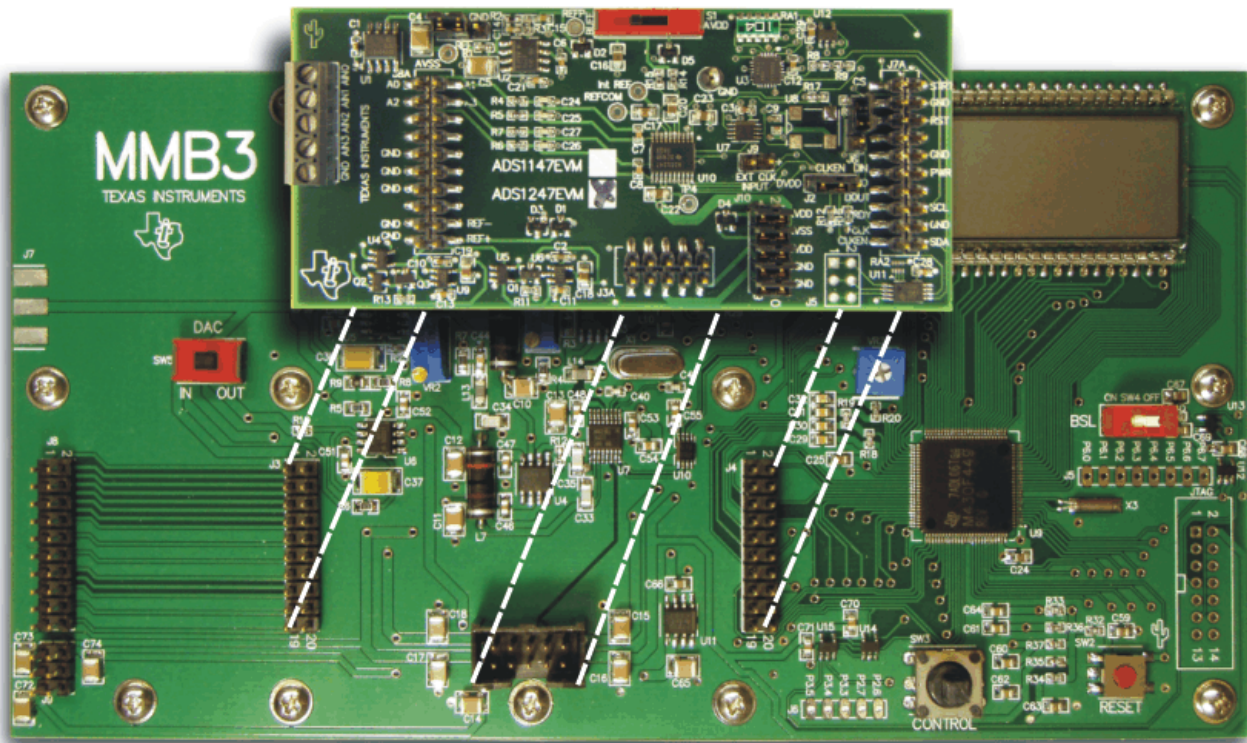
The ADS1247EVM-PDK contains both the ADS1247EVM and the MMB3 motherboard; however, the devices are shipped unconnected. Follow these steps to set up the ADS1247EVM-PDK.

- Step 1. Unpack the ADS1247EVM-PDK kit.
- Step 2. Set the switches on the MMB3 as described below, as shown in [Figure 6](#).
  - Set switch SW4 to the right.
  - Set the DAC switch (SW5) to the OUT position (to the right).



**Figure 6. MMB3 Switch Locations**

Step 3. Plug the ADS1247EVM into the MMB3 as [Figure 7](#) illustrates.



**Figure 7. Connecting ADS1247EVM to MMB3**

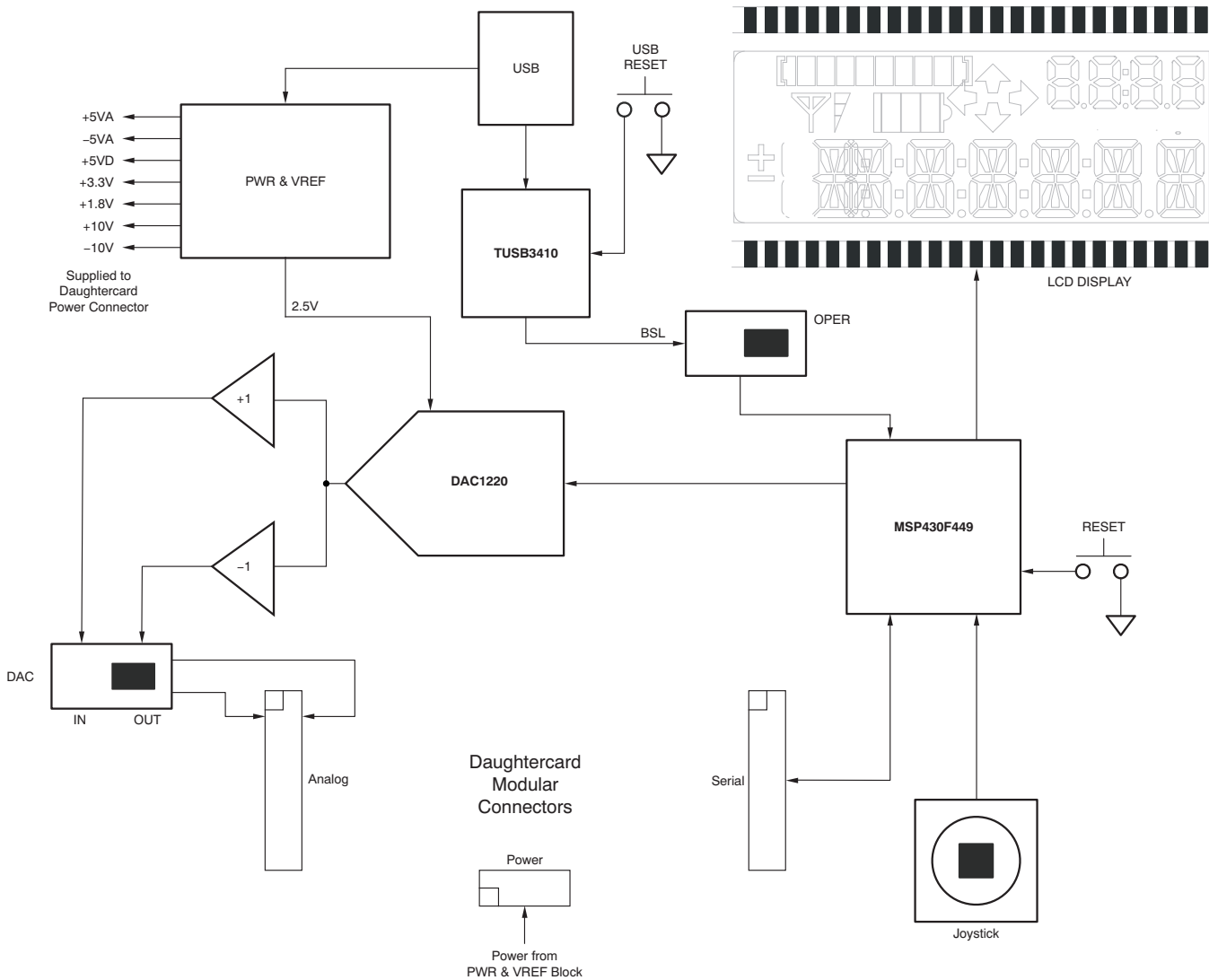
**CAUTION**

Do not misalign the pins when plugging the ADS1247EVM into the MMB3. Check the pin alignment carefully before applying power to the PDK.

Step 4. Set the jumpers and switches on the ADS1247EVM as shown in [Figure 3](#) (note that these settings are the factory-configured settings for the EVM).

### 8.2.1 About the MMB3

The MMB3 is a Modular EVM System motherboard. It is designed around the [MSP430F449](#), a low-power microcontroller from Texas Instruments. [Figure 8](#) shows a block diagram of the MMB3.



**Figure 8. MMB3 Block Diagram**

The MMB3 was designed to be used as a stand-alone demonstration platform for low-speed data converters. It features an onboard, 20-bit digital-to-analog converter (DAC) that can be used as a signal source for an ADC under test, and has a joystick for control of functions on the board when it is not controlled by a PC. **These features are experimental and not supported in the ADS1247EVM-PDK at this time.**

The MMB3 derives power from the USB interface, and generates +5VD, 3.3V, and 1.8V, as well as +5VA, -5VA, and  $\pm 10V$ . The  $\pm 10V$  is supplied to the daughtercard power connector as +VA and -VA.

The MMB3 is not sold as a microcontroller development board, and it is not available separately. TI cannot offer support for the MMB3 except as part of an EVM kit. For schematics or other information about the MMB3, contact Texas Instruments.

### 8.3 EVM Power Supply

The ADS1247EVM-PDK is powered completely from the USB connection on the MMB3. The MMB3 provides 3.3V and  $\pm 5V$  to the ADS1247EVM.

### 8.4 Running the Software and Download of Firmware to MMB3

---

**NOTE:** The software is continually under development. These instructions and screen images are current at the time of this writing, but may not exactly match future releases.

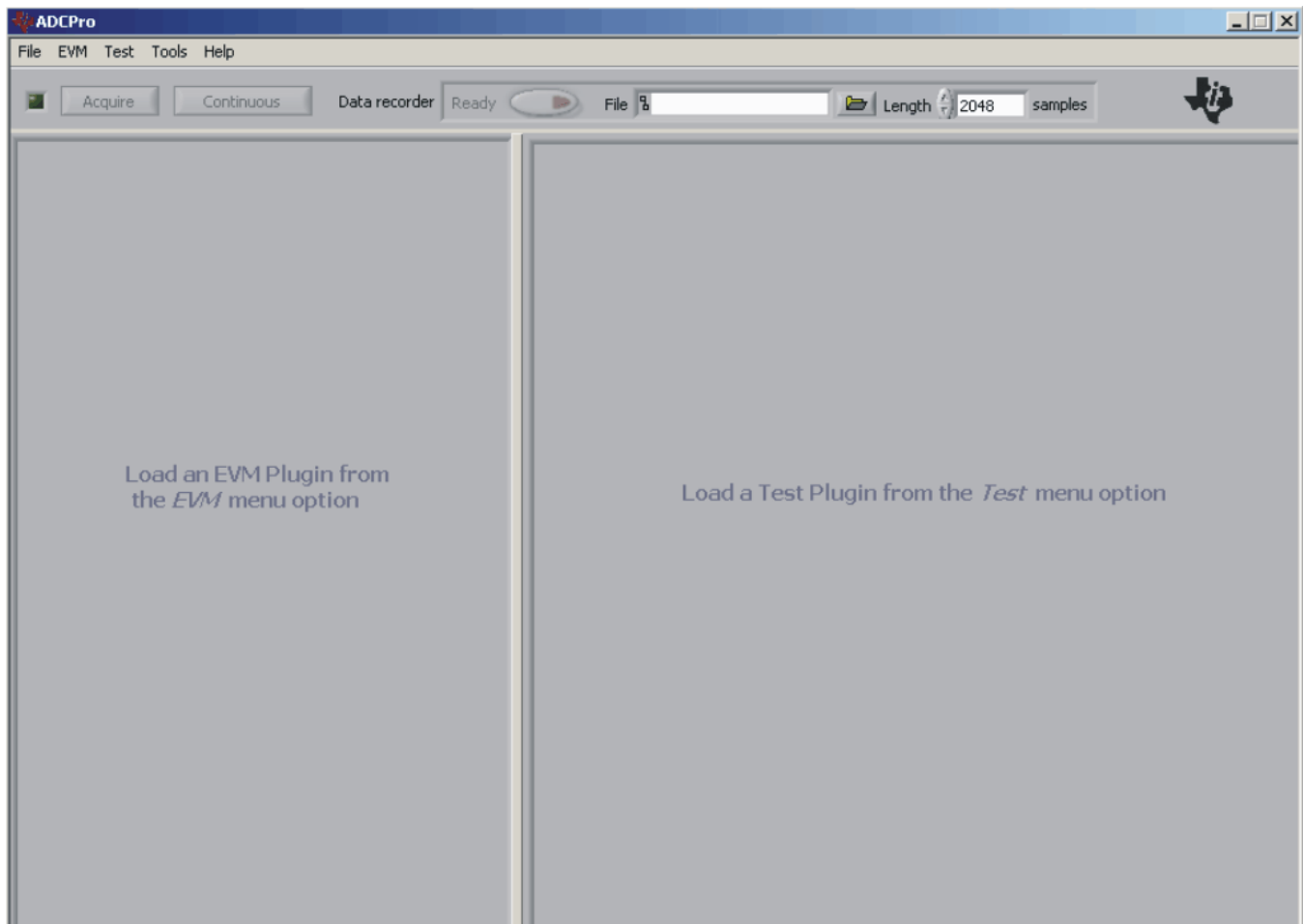
---

The program for evaluating the ADS1247EVM-PDK is called *ADCPro*. This program uses plug-ins to communicate with the EVM. The ADS1247EVM-PDK plug-in is included in the ADS1247EVM-PDK package.

The program currently runs only on Microsoft Windows platforms of Windows XP; Windows Vista is **NOT** supported.

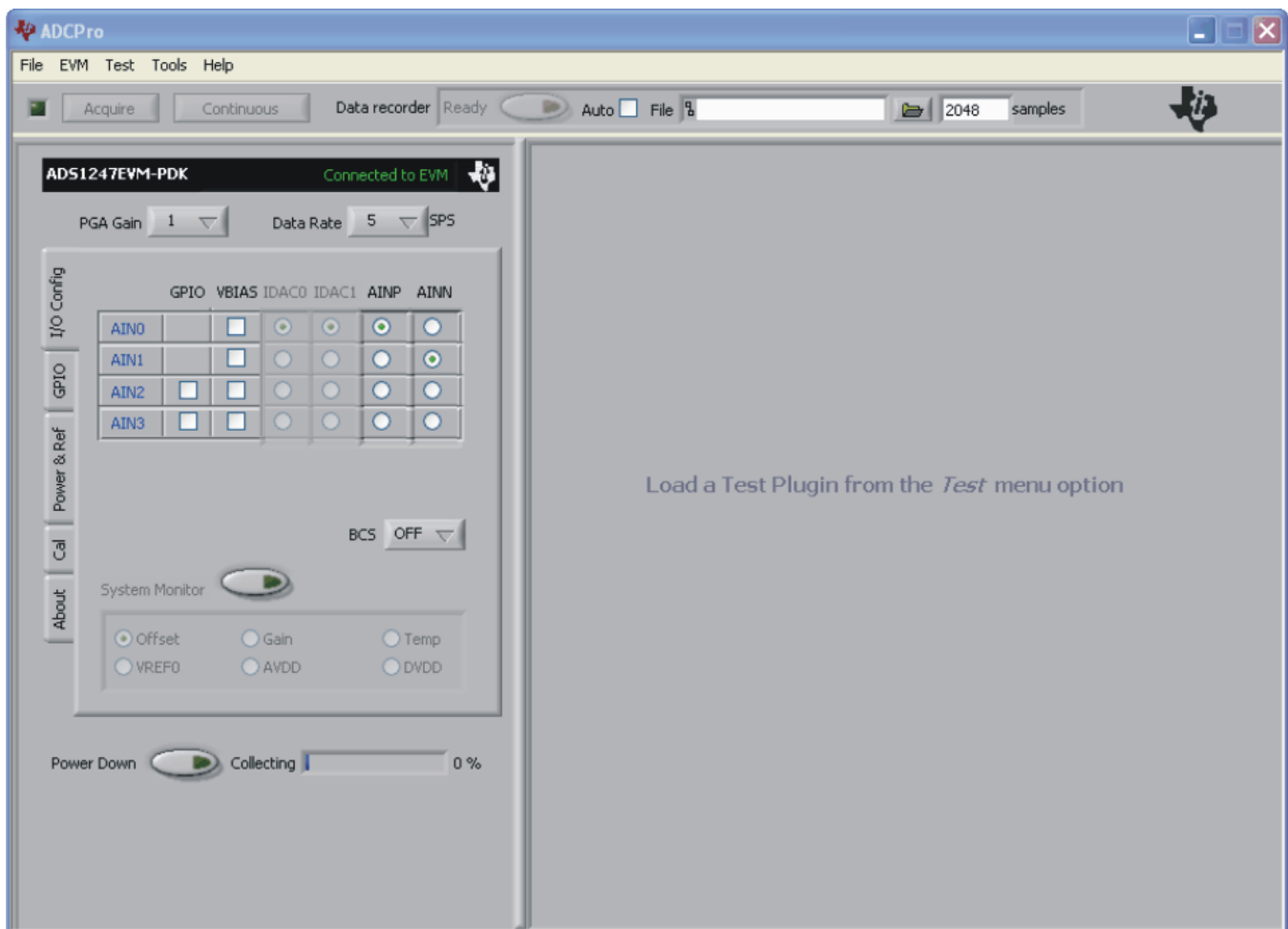
If this is the first time installing ADCPro and plug-ins, follow these procedures to run ADCPro and perform any necessary firmware installations. Make sure the ADCPro software and device plug-in software are installed from the CD-ROM as described in [Section 8.1, Installing the ADCPro Software](#).

Step 1. Start the software by selecting *ADCPro* from the Windows Start menu. The screen in [Figure 9](#) appears.



**Figure 9. ADCPro Software Start-up Display Window**

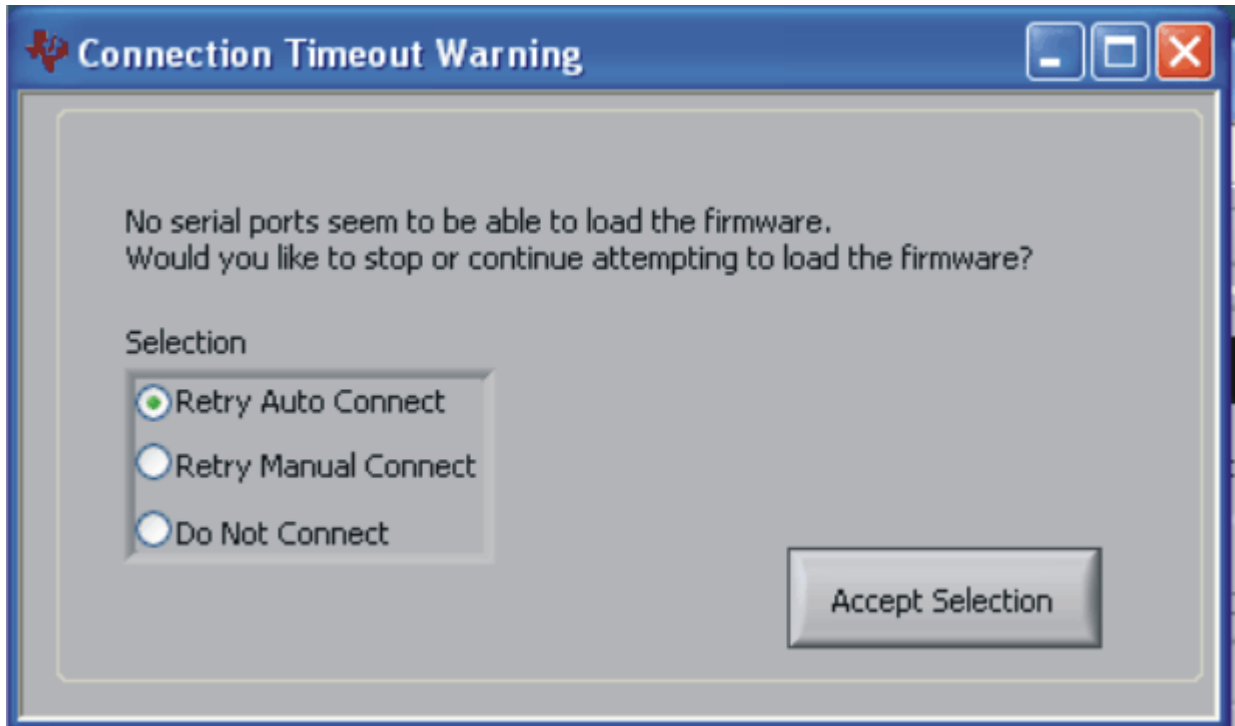
Step 2. Select *ADS1247EVM* from the EVM drop-down menu. The ADS1247EVM-PDK plug-in appears in the left pane, as shown in [Figure 10](#).



**Figure 10. ADS1247EVM-PDK Plug-In Display Window**

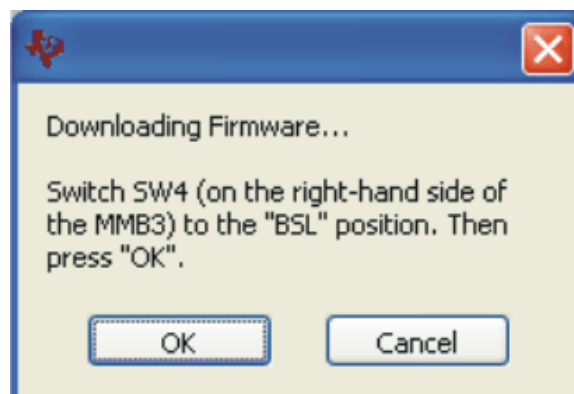
Step 3. The ADS1247EVM-PDK plug-in window has a status area at the top of the screen. When the plug-in is first loaded, the plug-in searches for the board. You will see a series of messages in the status area indicating this action.

- Step 4. If the plug-in cannot connect to the EVM, you will see a window as shown in [Figure 11](#). This message may indicate that the firmware is not loaded on the MMB3. You may select *Retry Auto Connect*; if that action fails, select *Retry Manual Connect* and specify the COM port to be used.



**Figure 11. Connection Timeout**

- Step 5. The plug-in detects whether or not the board has the correct firmware loaded. The first time you use the ADS1247EVM-PDK, the firmware for the MMB3 may need to be downloaded to the MMB3. If the firmware needs to be loaded, you will see a screen similar to that shown in [Figure 12](#).



**Figure 12. Firmware Download Message Box**

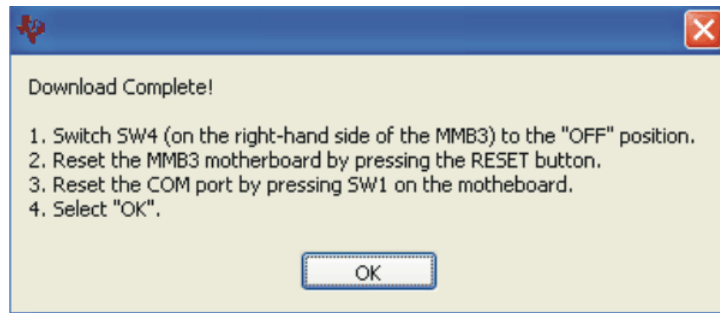
Switch the BSL switch (SW4) on the MMB3 to the BSL position (to the left) as instructed, then press **OK**. The plug-in will download the firmware to the MMB3. This operation may take a couple of minutes, so the progress is updated in the message at the top of the ADS1247 plug-in window (as [Figure 13](#) shows). The firmware is saved in flash memory on the MMB3, so this operation should only need to be performed once.



**Figure 13. Firmware Download Progress Indicator**



When the firmware download completes, the message box shown in [Figure 14](#) appears. Follow the on-screen instructions and the plug-in should now connect to the EVM.



**Figure 14. Firmware Download Complete Message Box**

## 9 Evaluating Performance with the ADCPro Software

The evaluation software is based on ADCPro, a program that operates using a variety of plug-ins. To use ADCPro, load an EVM plug-in and a test plug-in. To load an EVM plug-in, select it from the *EVM* menu. To load a test plug-in, select it from the *Test* menu. To unload a plug-in, select the *Unload* option from the corresponding menu.

Only one of each kind of plug-in can be loaded at a time. If you select a different plug-in, the previous plug-in is unloaded.

### 9.1 Using the ADS1247EVM-PDK Plug-in

The ADS1247EVM-PDK plug-in for ADCPro provides complete control over all settings of the ADS1247. It consists of a tabbed interface (see [Figure 16](#)), with different functions available on different tabs. These controls are described in this section.

You can adjust the ADS1247EVM settings when you are not acquiring data. During acquisition, all controls are disabled and settings may not be changed.

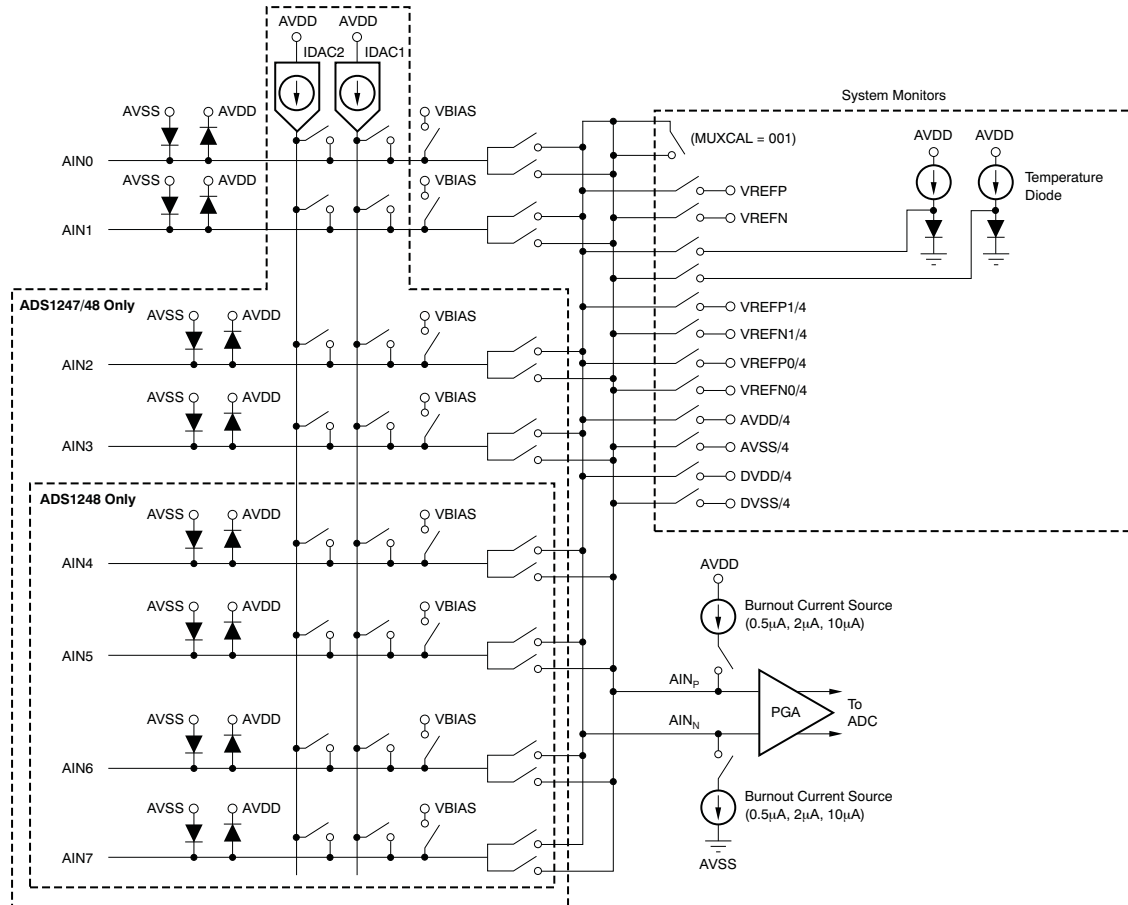
When you change a setting on the ADS1247EVM plug-in, the setting immediately updates on the board.

Settings on the ADS1247EVM correspond to settings described in the [ADS1247 data sheet](#) (available for download at <http://www.ti.com>); see the data sheet for details.

The ADS1247EVM-PDK plug-in has a tabbed interface, with five different tabs to control the functions of the ADS1247. These tabs are described below.

### 9.1.1 I/O Config Tab

This tab is the primary tab that controls the function of the multiplexer in the ADS1247. Recall that the ADS1247 multiplexer is configured as shown in [Figure 15](#). By default, all channels are set as analog input; the IDACs are not routed to any channel and the **IDAC** controls are disabled. These controls are enabled when the correct IDAC settings are made on the Power & Ref tab (see [Section 9.1.3](#)).



**Figure 15. ADS1247 Multiplexer**

The radio buttons at the far right of the panel (see [Figure 16](#)) select which pair of inputs are connected to the PGA. Note that you may select the same input for both the positive (**AINP**) and negative (**AINN**) input; this configuration is often selected to perform a noise test on the ADC itself.

Input pins **AIN2-AIN3** can be selected to be an analog input or GPIO. If an input is to be used as a GPIO, check the **GPIO** box as shown in [Figure 16](#).

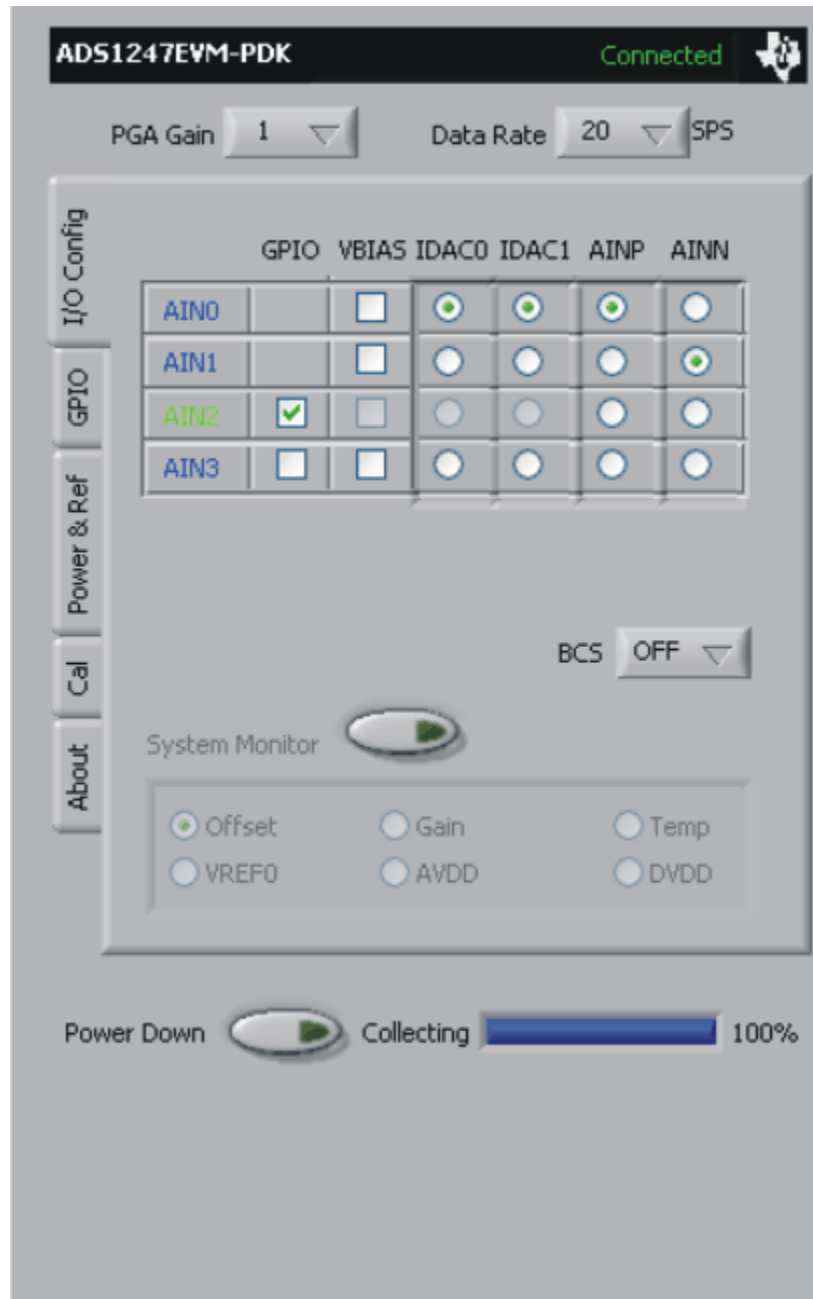
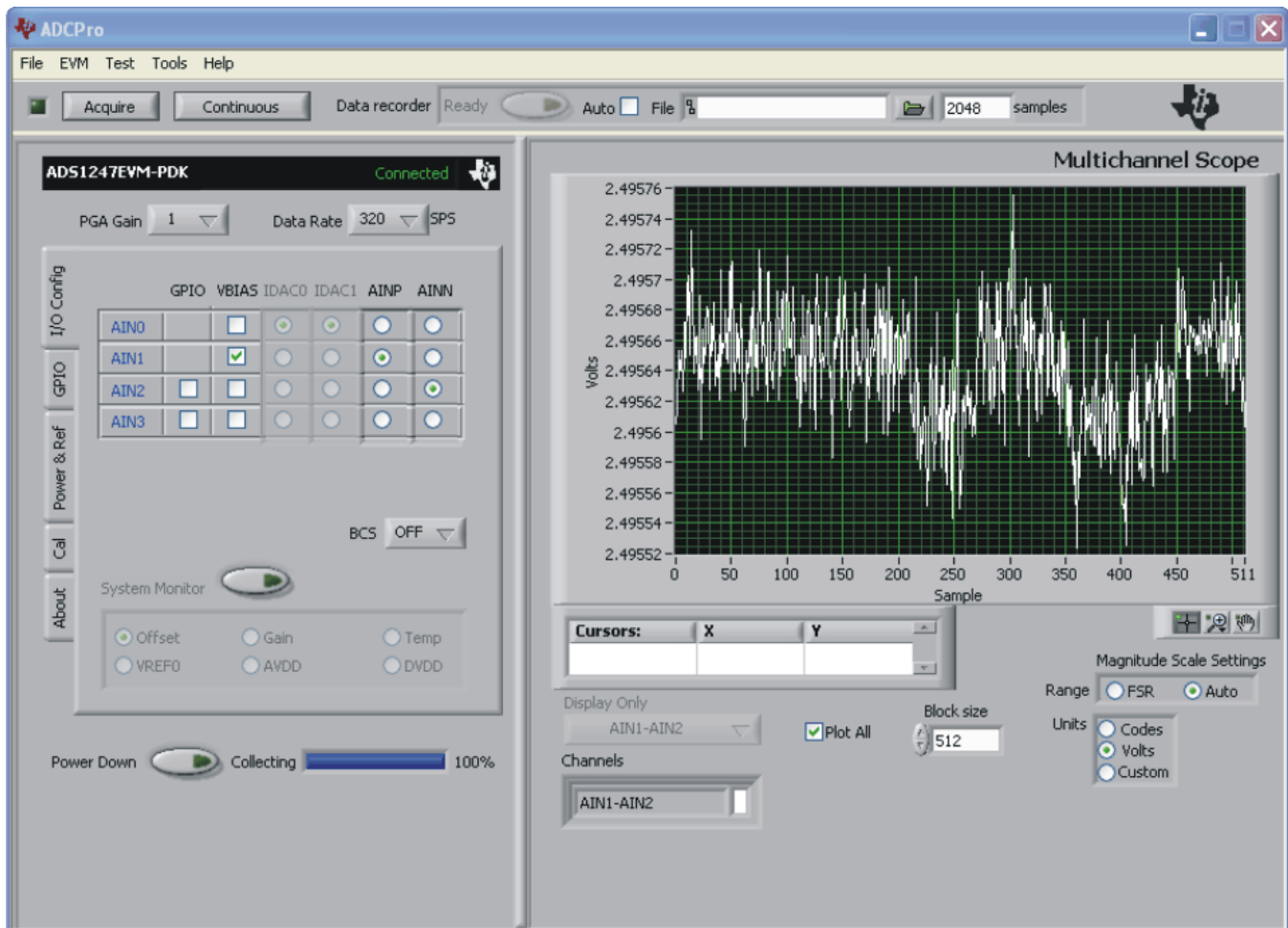


Figure 16. I/O Config Tab

When an input is selected as a GPIO, its label turns **green** and the **IDAC** controls for that channel are disabled.

Each input channel can also have a VBIAS applied to it. Checking the **VBIAS** box on a channel applies the VBIAS voltage, which is approximately half the value of the supply. You can test this option as shown in [Figure 17](#), using one channel tied to something close to ground (make sure you observe the common-mode restrictions listed in the [ADS1247 device data sheet](#)) as a reference for this signal.



**Figure 17. Enabling VBIAS on a Channel**

The **System Monitor** button allows you to access the internal system monitor channels of the ADS1247. When pressed, this button disables the other analog input channel controls, and the system monitor channel selections are enabled. You can select *Offset*, *Gain*, *Temperature*, *VREF0*, *AVDD* or *DVDD* as the channel to convert. Note that some of these channels are scaled by a factor when read; refer to the ADS1247 data sheet to determine these factors.

The **PGA Gain** control sets the PGA gain, and the **Data Rate** control sets the data rate for the device. Note that the data rate can go quite low; therefore, if the block size is large, the time it takes to collect a block of data can be quite long. It is advisable to first test collection at the higher data rates. Once a test is known to work properly, drop down to the lower data rate and allow sufficient time to collect the data.

The **BCS** control sets the current level of the burnout current sources; it may be set *Off*, or to  $0.5\mu\text{A}$ ,  $2\mu\text{A}$ , or  $10\mu\text{A}$ .

The **Power Down** control powers down the ADS1247. Note that no data can be collected if the **Power Down** button is activated.

### 9.1.2 GPIO Tab

When an input is selected to be a GPIO, its controls are enabled on the GPIO tab, shown in [Figure 18](#). By default, the GPIOs are enabled as inputs. Pressing the **Input** button reads the state of the enabled inputs; if the input is high, the corresponding light turns green.

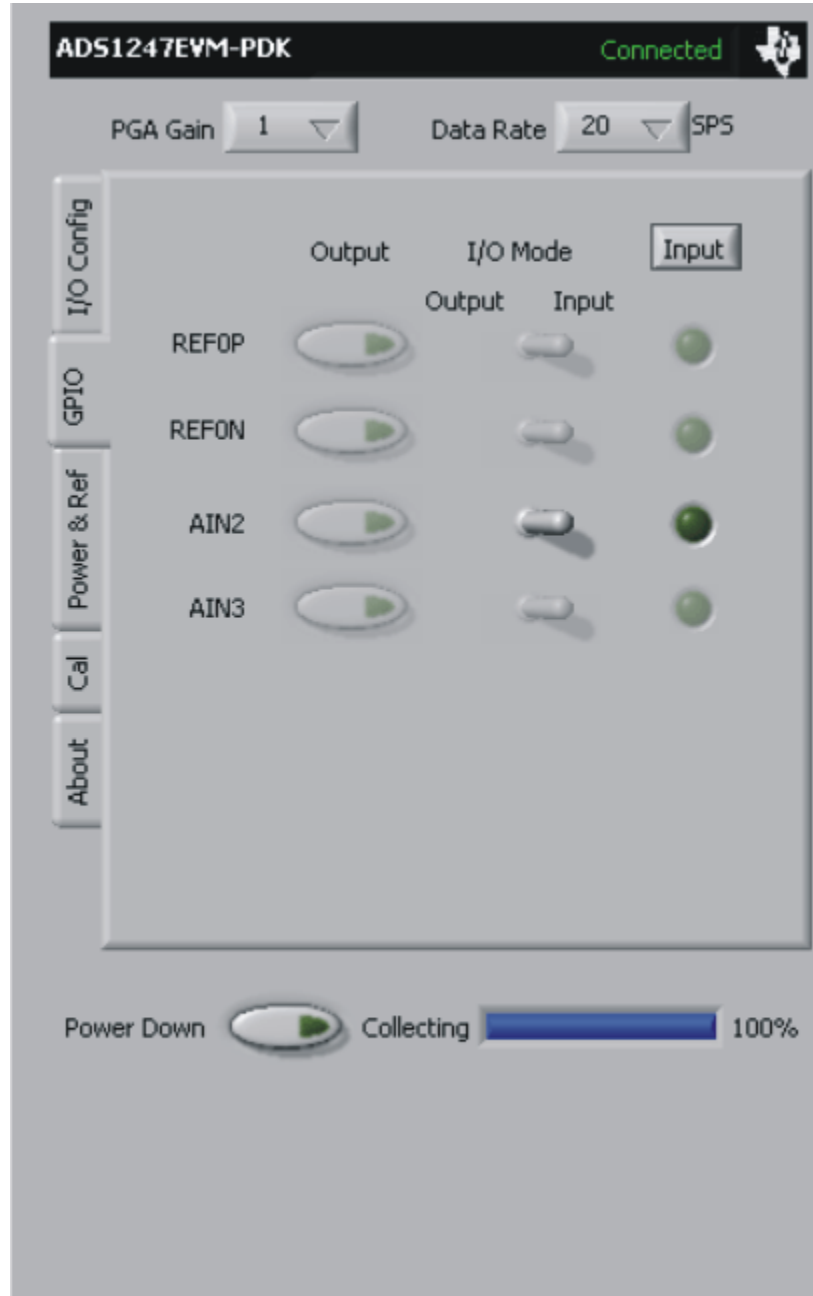


Figure 18. GPIO Tab

To make the GPIO an an output, the toggle switch can be switched to output mode, as shown in Figure 19.

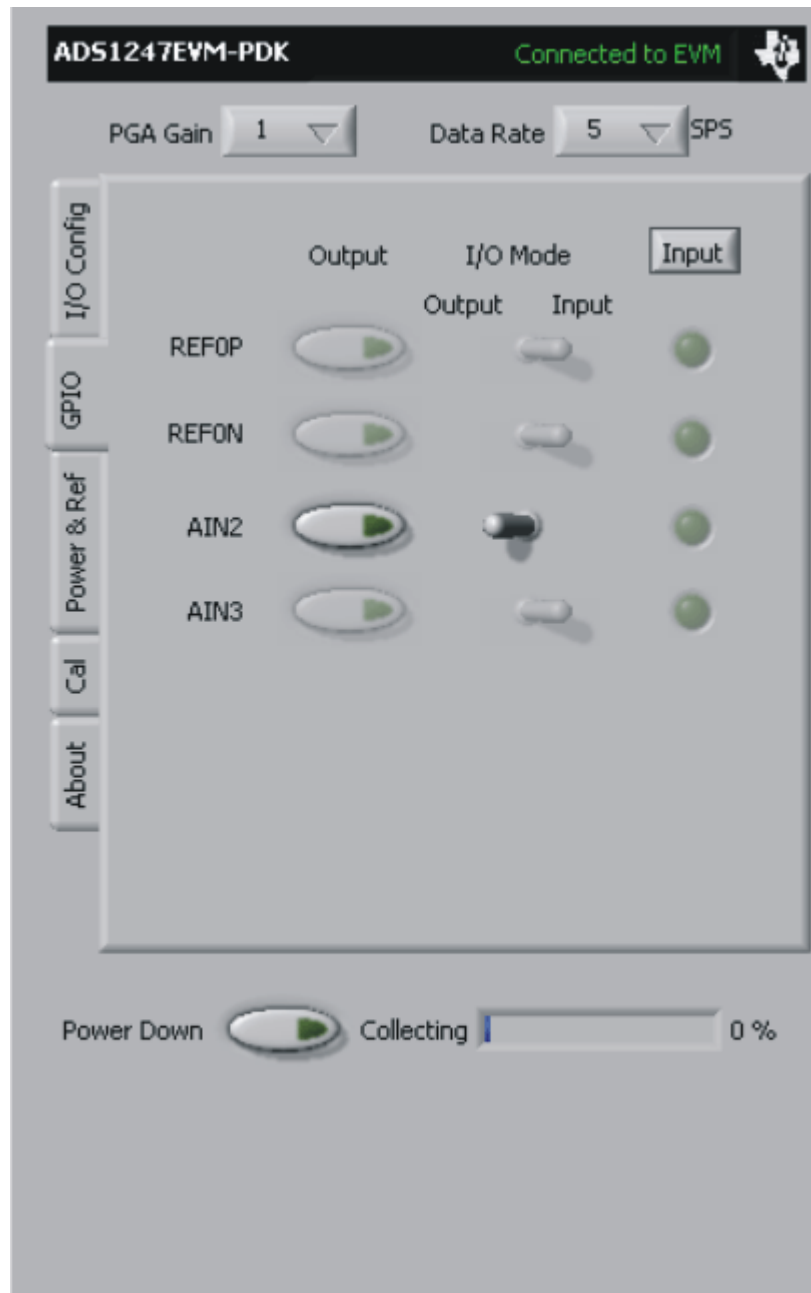
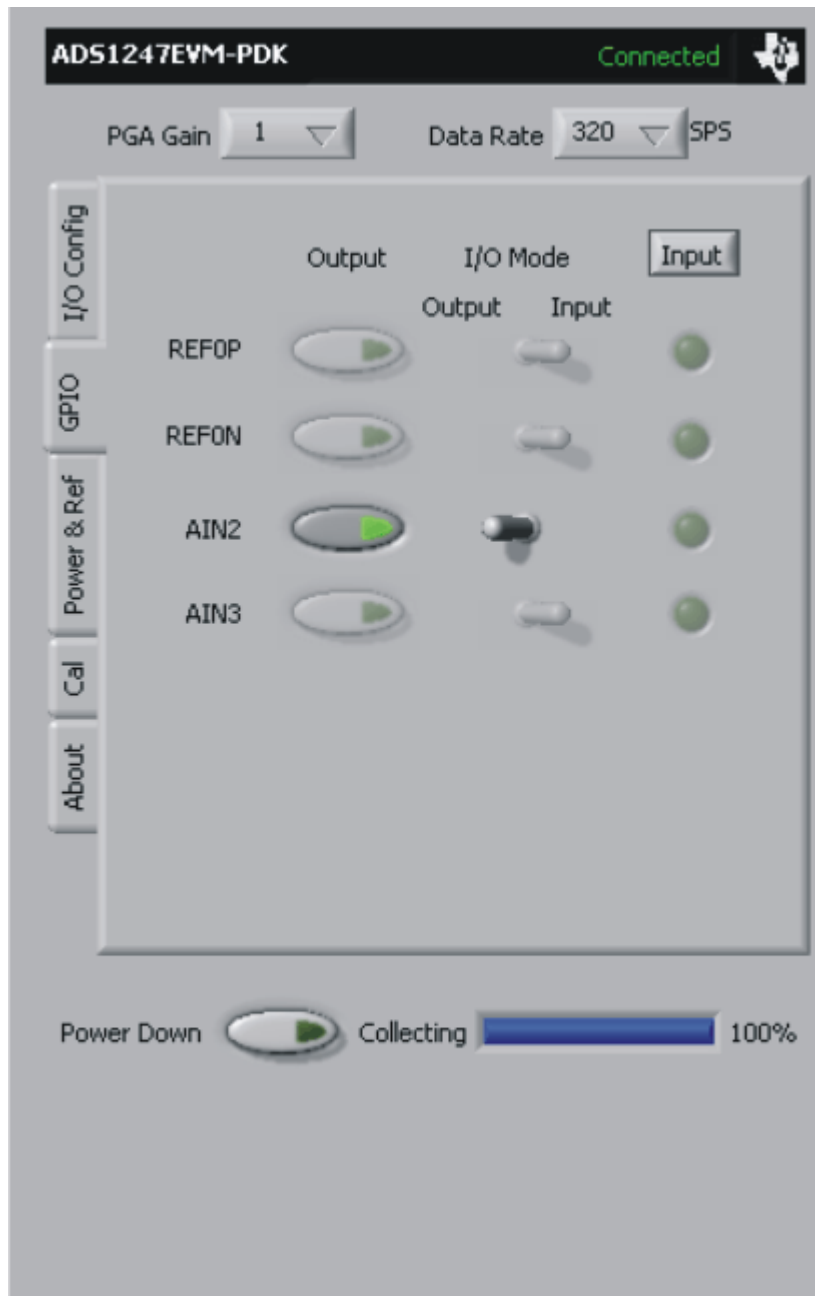


Figure 19. GPIO Set to Output Mode

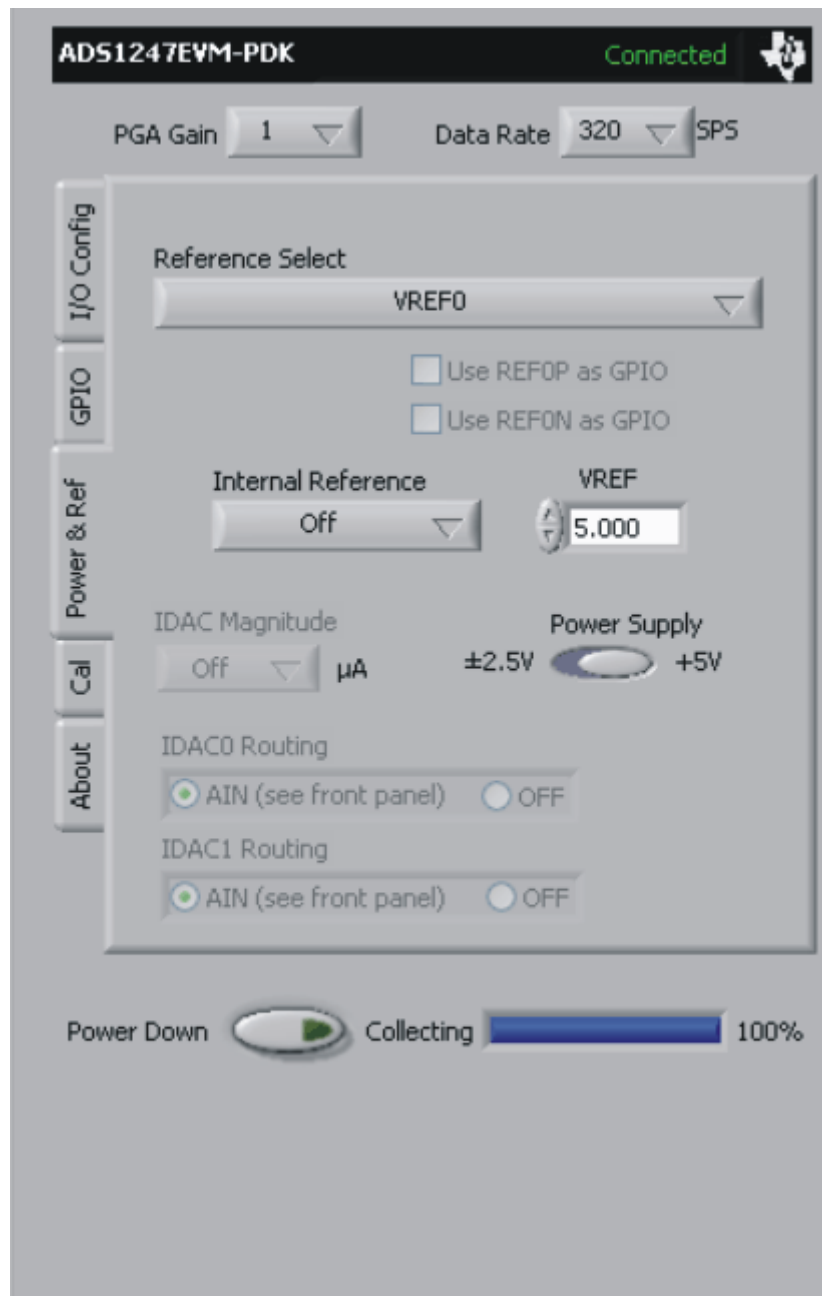
With the GPIO configured as an output, the pushbutton switch controls the state of the output pin. When pressed (as illustrated in Figure 20), the button lights up and the GPIO is set to a high state; when the switch is dark (as Figure 19 shows), the GPIO is in a low state.



**Figure 20. GPIO Output Set to High**

### 9.1.3 Power & Ref Tab

The Power & Ref tab is shown in [Figure 21](#). This tab controls the selection of the power-supply mode, reference sources, and IDACs.



**Figure 21. Power & Ref Tab**



Note that with the **Internal Reference** off, the **IDAC** controls are disabled, because the IDACs cannot be used unless the internal reference is turned on.

The **Power Supply** control selects between single supply (+5V) mode and bipolar supply ( $\pm 2.5V$ ) mode. The EVM draws its supply voltages from the MMB3 motherboard, and has onboard circuitry to select between the +5V and bipolar supplies.

The **Reference Select** control selects between *VREF0* and the *Internal Reference*. When *VREF0* is selected, the **VREF** value is set to 2.048V, with switch S1 set to BUFF. S1 should not be set to the AVDD position, in order to prevent the reference from exceeding the maximum specified input.

There are two checkboxes that, when enabled, allow the **REF0P** and **REF0N** pins to be selected as GPIOs. These checkboxes are enabled only in modes that allow these pins to be used as GPIOs.

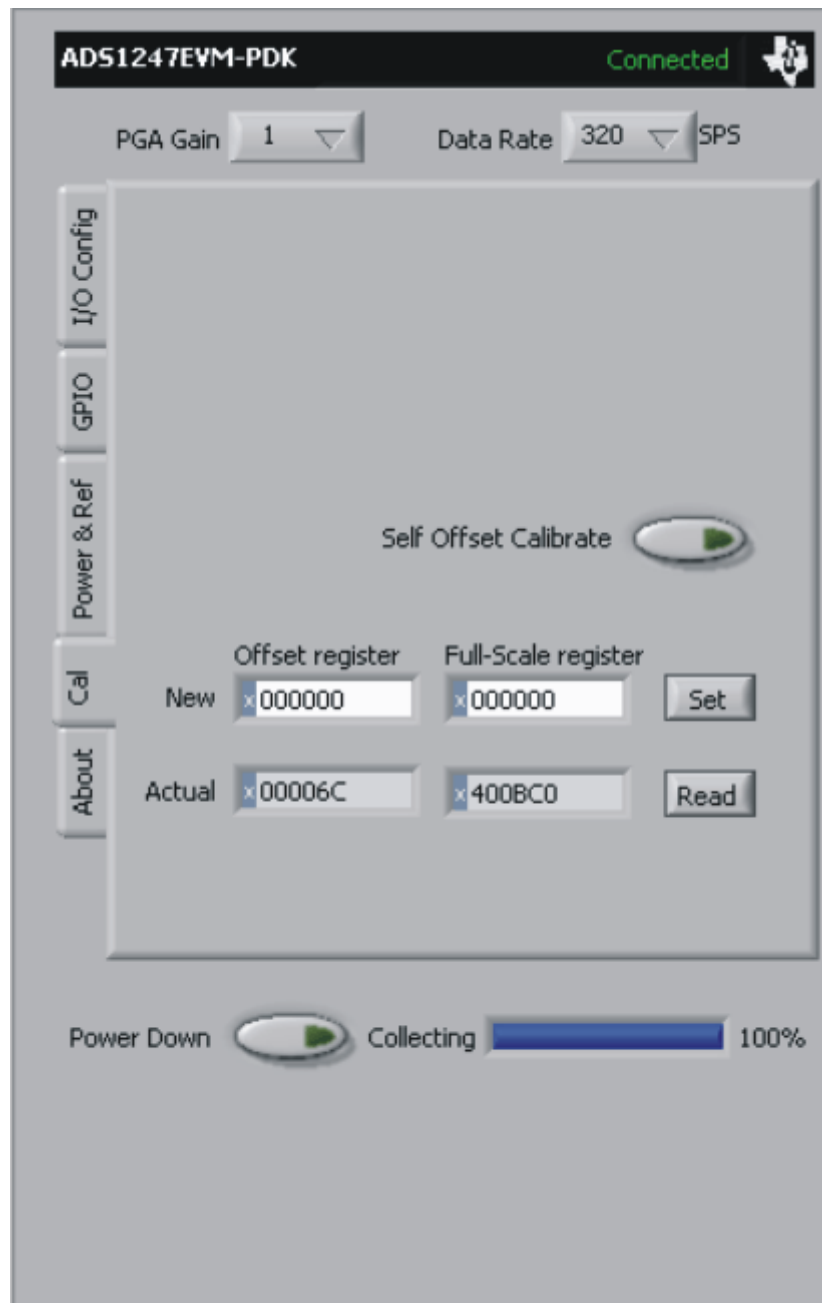
The **Internal Reference** control selects whether the reference is *off*, *on*, or *follows the START signal* (refer to the ADS1247 data sheet for more details on these choices). When the internal reference is enabled, the **IDAC** controls are enabled as well, because the IDACs cannot function unless the internal reference is turned on. Note that the internal reference does not necessarily have to be used as the ADC reference in order to use the IDACs, but it does need to be turned on.

The **IDAC Magnitude** control sets the amount of current each of the two IDACs provide.

The **IDAC0** and **IDAC 1 Routing** controls allow you to specify whether the IDAC0 or IDAC1 currents go to the *Analog inputs* or turn the IDAC *off*. If the *A/N* button is selected, this option enables the corresponding **IDAC** controls on the I/O Config tab.

### 9.1.4 Cal Tab

The Cal tab (Figure 22) controls the calibration functions of the ADS1247.

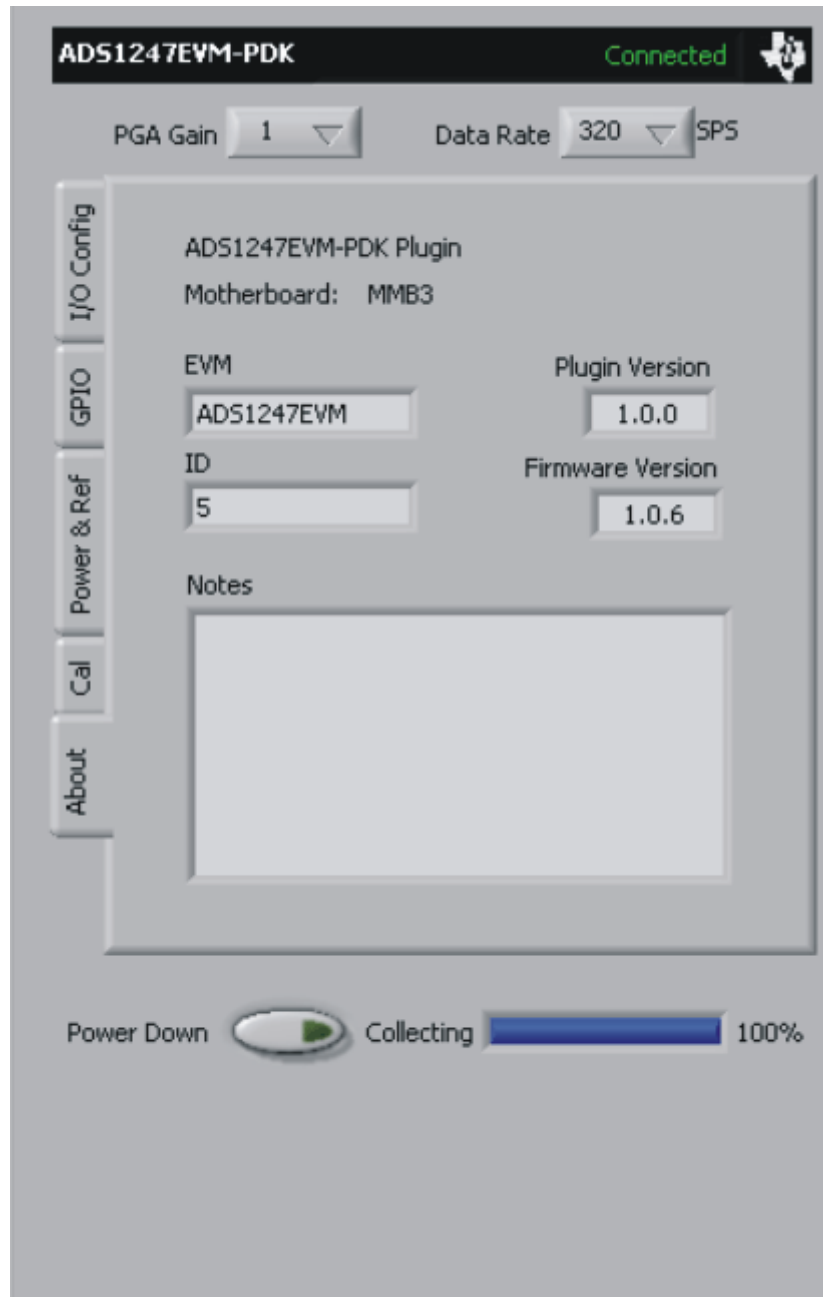


**Figure 22. Cal Tab**

Pressing the **Self Offset Calibrate** button causes the ADS1247 to perform a self calibration; the offset and full-scale register values are then updated on the plug-in screen. You may also write to these registers by typing in hex values in the **New** fields, then pressing the **Set** button. You may read the values at any time by pressing the **Read** button.

### 9.1.5 About Tab

The About tab displays information about the EVM and software, as shown in [Figure 23](#).



**Figure 23. About Tab**

The **Plugin Version** and **Firmware Version** indicators show the version numbers of the plug-in and firmware code, respectively.

The **ID** indicator shows the value of the ID [3:0] bits in the ADS1247 ID register.

The **Notes** indicator may show relevant notes about the plug-in or firmware code, if there are any.

### 9.1.6 Collecting Data

Once you have configured the ADS1247 for your test scenario, press the ADCPro **Acquire** button to start the collection of the number of datapoints specified in the Test plug-in *Block Size* control. The ADS1247EVM-PDK plug-in disables all the front panel controls while acquiring, and displays a progress bar as shown in [Figure 24](#).



**Figure 24. Progress Bar While Collecting Data**

For more information on testing analog-to-digital converters in general and using ADCPro and Test plug-ins, refer to the [ADCPro User Guide](#).

## 9.2 Troubleshooting

If the ADS1247EVM plug-in cannot find the ADS1247EVM-PDK, press the *USB RESET* button on the MMB3 (refer to [Figure 6](#)) and try again.

If ADCPro stops responding while the ADS1247EVM-PDK is connected, try unplugging the USB cable from the PDK. Unload and reload the plug-in before reapplying power to the PDK.

## 10 Schematics and Layout

Schematics for the ADS1147EVM and ADS1247EVM are appended to this user's guide. The bill of materials is provided in [Table 7](#).

### 10.1 Bill of Materials

**NOTE:** All components should be compliant with the European Union Restriction on Use of Hazardous Substances (RoHS) Directive. Some part numbers may be either leaded or RoHS. Verify that purchased components are RoHS-compliant. (For more information about TI's position on RoHS compliance, see the <http://www.ti.com>.)

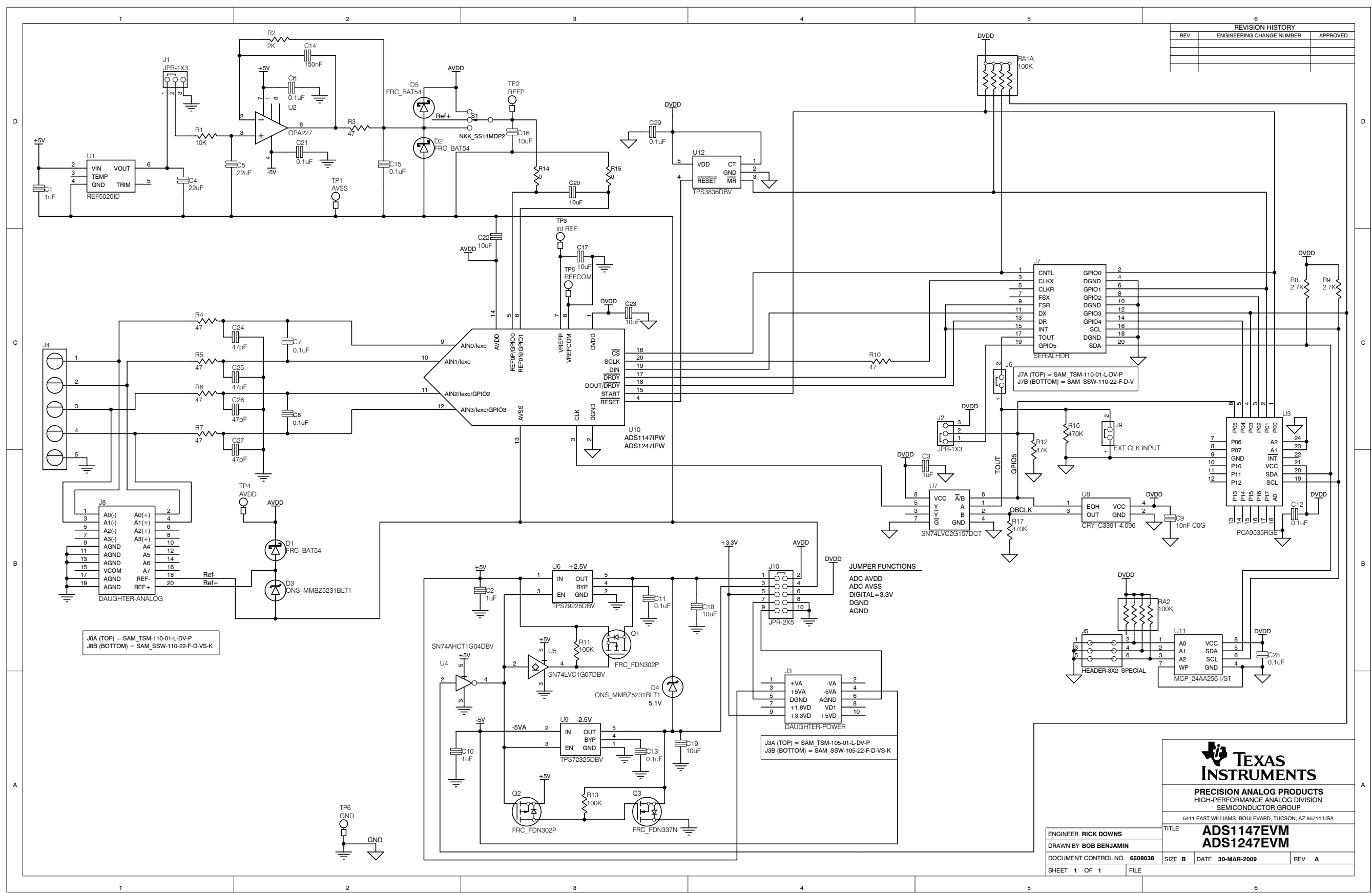
**Table 7. ADS1147EVM/ADS1247EVM Bill of Materials**

Item No.	Qty	Value	Ref Des	Description	Vendor	Part Number
1	1		N/A	ADS1247 EVM PWB	Texas Instruments	6508039
2	4	1 $\mu$ F	C1-C3, C10	Capacitor, X7R Ceramic 1 $\mu$ F $\pm$ 10%, 16WV, Size = 0603	TDK	C1608X7R1C105KT
3	2	22 $\mu$ F	C4, C5	Capacitor, X5R Ceramic 22 $\mu$ F $\pm$ 20%, 16WV, Size = 1210	TDK	C3225X5R1C226MT
4	10	0.1 $\mu$ F	C6-C8, C11-C13, C15, C21, C28, C29	Capacitor, X7R Ceramic 0.1 $\mu$ F $\pm$ 10%, 25WV, Size = 0603	TDK	C1608X7R1E104KT
5	1	0.15 $\mu$ F	C14	Capacitor, X7R Ceramic 0.15 $\mu$ F $\pm$ 10%, 16WV, Size = 0603	Murata	GRM188R71C154KA01D
6	7	10 $\mu$ F	C16-C20, C22, C23	Capacitor, X5R Ceramic 10 $\mu$ F $\pm$ 20%, 6.3WV, Size = 0805	TDK	C2012X5R0J106MT
7	4	47pF	C24-C27	Capacitor, C0G Ceramic 47pF $\pm$ 5%, 50WV, Size = 0603	TDK	C1608C0G1H470JT
8	1	10nF	C9	Capacitor, C0G Ceramic 10nF $\pm$ 5%, 25WV, Size = 0603	TDK	C1608C0G1E103JT
9	3		D1, D2, D5	Diode Schottky 30V 200mA SOT-23	Fairchild	BAT54
10	2		D3, D4	5.1V, Zener Diode	On Semiconductor	MMBZ5231BLT1G
11	2		J1, J2	Header Strip, 3-pin ( )	Samtec	TSW-103-07-L-S
12	1		J3A	10-pin SMT Plug	Samtec	TSM-105-01-L-DV-P
13	1		J3B	10-pin SMT Socket	Samtec	SSW-105-22-F-D-VS-K
14	1		J4	Terminal Block, 5 position	On Shore Technology	ED555/5DS
15	0		J5	Header Strip, 6-pin ( )		
16	2		J6, J9	Header Strip, 2-pin ( )	Samtec	TSW-102-07-L-S
17	2		J7A, J8A	20-pin SMT Plug	Samtec	TSM-110-01-L-DV-P
18	2		J7B, J8B	20-pin SMT Socket	Samtec	SSW-110-22-F-D-VS-K
19	1		J10	Header Strip, 10-pin ( )	Samtec	TSW-105-07-L-D
20	2		Q1, Q2	MOSFET, P-Channel, 2.5V	Fairchild	FDN302P
21	1		Q3	Enhancement Mode FET, N-Channel	Fairchild	FDN337N
22	1	100k $\Omega$	RA1	Resistor, 8 Thick Film Chip Array 100k $\Omega$ , 5%, 63mW	CTS	745C101104JPTR

**Table 7. ADS1147EVM/ADS1247EVM Bill of Materials (continued)**

Item No.	Qty	Value	Ref Des	Description	Vendor	Part Number
23	0		RA2	Resistor, Chip Array Four Independent Bus 100k $\Omega$ , 5%, 1/16W, SMD		
24	1	10k $\Omega$	R1	Resistor, Thick Film Chip 10k $\Omega$ , 5%, 1/10W, Size = 0603	Panasonic	ERJ-3GEYJ103V
25	1	2k $\Omega$	R2	Resistor, Thick Film Chip 2k $\Omega$ , 1%, 1/16W, Size = 0603	Panasonic	ERJ-3EKF2001V
26	6	47 $\Omega$	R3-R7, R10	Resistor, Thick Film Chip 47 $\Omega$ , 5%, 1/10W, Size = 0603	Panasonic	ERJ-3GEYJ470V
27	2	2.7k $\Omega$	R8, R9	Resistor, Thick Film Chip 2.7k $\Omega$ , 5%, 1/10W, Size = 0603	Panasonic	ERJ-3GEYJ272V
28	2	100k $\Omega$	R11, R13	Resistor, Thick Film Chip 100k $\Omega$ , 5%, 1/10W, Size = 0603	Panasonic	ERJ-3GEYJ104V
29	1	47k $\Omega$	R12	Resistor, Thick Film Chip 47k $\Omega$ , 5%, 1/10W, Size = 0603	Panasonic	ERJ-3GEYJ473V
30	2	0	R14, R15	Resistor, Thick Film Chip 0 $\Omega$ , 5%, 1/10W, Size = 0603	Panasonic	ERJ-3GEY0R00V
31	2	470k $\Omega$	R16, R17	Resistor, Thick Film Chip 470k $\Omega$ , 5%, 1/10W, Size = 0603	Panasonic	ERJ-3GEYJ474V
32	1		S1	Switch, Mini Slide, SP3T	NKK	SS14MDP2
33	0		TP1-TP5	PCB Test Point, Mini Loop, Through-Hole		
34	1		TP6	PCB Test Point, Large Loop, Through-Hole	Keystone Electronics	5011
35	1		U1	Precision Voltage Reference, 2.048V	Texas Instruments	REF5020ID
36	1		U2	Precision Operational Amplifier	Texas Instruments	OPA227U
37	1		U3	16-Bit I <sup>2</sup> C I/O Expander	Texas Instruments	PCA9535RGE
38	1		U4	Inverter, Single Gate	Texas Instruments	SN74AHCT1G04DBVR
39	1		U5	Buffer, Open Drain, Single Gate	Texas Instruments	SN74LVC1G07DBVRG4
40	1		U6	LDO Voltage Regulator, 2.5V, 100mA	Texas Instruments	TPS79225DBVRG4
41	1		U7	Single, 2-Line to 1 Data Selector/Multiplexer	Texas Instruments	SN74LVC2G157DCT
42	0		U8	3.3 V Oscillator		
43	1		U9	LDO Voltage Regulator, 2.5V, 200mA	Texas Instruments	TPS72325DBVTG4
44	1		U10	Precision Delta-Sigma ADC, 24-bit/16-bit	Texas Instruments	ADS1247IPW/ADS1147IPW
45	1		U11	EEPROM, 1.8V, 256K	Microchip	24AA256-I/ST
46	1		U12	Supervisor, 2.64V Threshold	Texas Instruments	TPS3836L30DBVT
47	8		N/A	Shorting Blocks	Samtec	SNT-100-BK-T

REVISION HISTORY		
REV	ENGINEERING CHANGE NUMBER	APPROVED



J8A (TOP) = SAM\_TSM-110-01-L-DV-P  
 J8B (BOTTOM) = SAM\_SSW-110-22-F-D-VS-K

JUMPER FUNCTIONS  
 ADC AVDD  
 ADC AVSS  
 DIGITAL = 3.3V  
 DGND  
 AGND

J3A (TOP) = SAM\_TSM-105-01-L-DV-P  
 J3B (BOTTOM) = SAM\_SSW-105-22-F-D-VS-K



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TITLE **ADS1147EVM**  
**ADS1247EVM**

ENGINEER RICK DOWNS	SIZE B	DATE 30-MAR-2009	REV A
DRAWN BY BOB BENJAMIN	FILE		
DOCUMENT CONTROL NO. 6508038			
SHEET 1 OF 1			

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