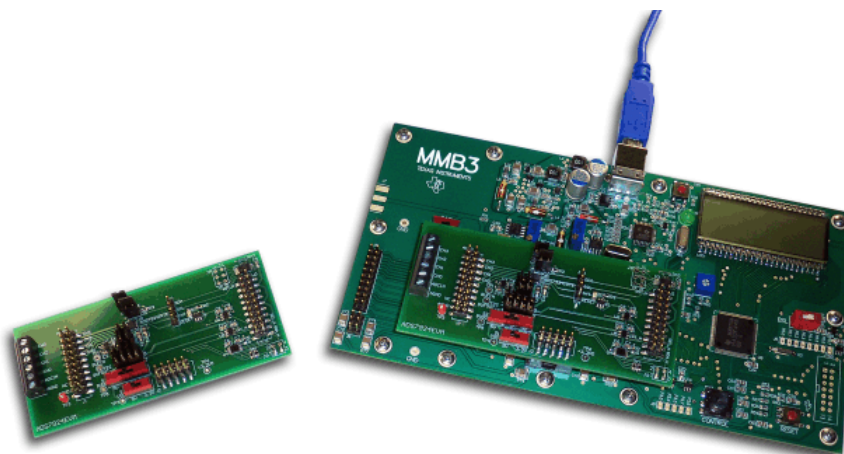


## **ADS7924EVM and ADS7924EVM-PDK User's Guide**



**ADS7924EVM (Left) and ADS7924EVM-PDK (Right)**

This user's guide describes the characteristics, operation, and use of the ADS7924EVM, both by itself and as part of the ADS7924EVM-PDK. This evaluation model (EVM) is an evaluation board for the [ADS7924](#), a 12-bit, sampling, low-power, analog-to-digital converter (ADC) with an I<sup>2</sup>C™ interface. The EVM-PDK allows evaluation of the ADS7924 in some modes of operation, but not all. Complete circuit descriptions, schematic diagrams, and bills of material are included in this document.

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

### **Related Documentation**

Device	Literature Number
<a href="#">ADS7924</a>	<a href="#">SBAS482</a>
<a href="#">OPA363</a>	<a href="#">SBOS259B</a>
<a href="#">PCA9306</a>	<a href="#">SCPS113I</a>
<a href="#">SN74LVC1T45</a>	<a href="#">SCES515I</a>

ADCPro is a trademark of Texas Instruments.  
 Microsoft, Windows are registered trademarks of Microsoft Corporation.  
 I<sup>2</sup>C is a trademark of NXP Semiconductors.  
 All other trademarks are the property of their respective owners.

## Contents

1	EVM Overview .....	3
2	Analog Interface .....	4
3	Digital Interface .....	5
4	Power Supplies .....	6
5	External Buffer .....	7
6	EVM Operation .....	7
7	ADS7924EVM-PDK Kit Operation .....	9
8	Evaluating Performance with the ADCPro Software .....	15
9	Schematics and Layout .....	21
10	Appendix: Setting Up the ADS7924EVM-PDK .....	22

## List of Figures

1	ADS7924EVM .....	4
2	Jumper J11 .....	7
3	ADS7924EVM Default Jumper Locations.....	8
4	Virtual COM Port Driver Installation Prompt.....	9
5	Virtual COM Port Driver Installation.....	10
6	Virtual COM Port Driver Uninstall Confirmation .....	10
7	ADCPro Software Start-up Display Window .....	11
8	ADS7924EVM-PDK Plug-In Display Window.....	12
9	EVM COM Port Autoscans Prompt Window .....	13
10	Manual COM Port Selection Window .....	13
11	Firmware Download Message .....	13
12	Firmware Download Progress Indicator .....	14
13	MMB3 Firmware Download Complete .....	15
14	AVDD Pull-Down Menu and Data Rate .....	15
15	ADC Tab.....	16
16	Interrupts Tab .....	17
17	Alarms Tab .....	18
18	About Tab .....	19
19	Progress Bar While Acquiring Data .....	20
20	MMB3 Initial Setup .....	22
21	Connecting ADS7924EVM to MMB3 .....	23
22	MMB3 Block Diagram.....	24
23	MMB3 .....	25

## List of Tables

1	J1, J4: Analog Interface Pinout .....	4
2	J3: Serial Interface Pins.....	5
3	J2 Configuration: Power-Supply Input.....	6
4	J7 Configuration: Power Options .....	6
5	List of Configured Jumpers .....	8
6	List of Switches.....	8
7	Bill of Materials .....	21

## 1 EVM Overview

### 1.1 Features

#### ADS7924EVM:

- Contains all support circuitry needed for the ADS7924
- Buffer options: Onboard analog input buffer can be bypassed
- Compatible with the TI Modular EVM System

#### ADS7924EVM-PDK:

- 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 ADS7924EVM-PDK is available. This kit combines the ADS7924EVM board with the MSP430-based MMB3 motherboard, and includes ADCPro™ software for device evaluation.

The MMB3 motherboard allows the ADS7924EVM to be connected to the computer via an available USB port. This manual shows how to use the MMB3 as part of the ADS7924EVM-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 ADS7924EVM-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 website.

This manual covers the operation of both the ADS7924EVM and the ADS7924EVM-PDK. Throughout this document, the abbreviation *EVM* and the term *evaluation module* are synonymous with the ADS7924EVM.

## 1.2 Introduction

The ADS7924EVM, shown in Figure 1, is an evaluation module built to the TI Modular EVM System specification. It can be connected to any modular EVM system interface card.

The ADS7924EVM is available as a stand-alone printed circuit board (PCB) or as part of the ADS7924EVM-PDK, which includes an MMB3 motherboard and software. As a stand-alone PCB, the ADS7924EVM is useful for prototyping designs and firmware.

Note that the ADS7924EVM has no microprocessor and cannot run software. To connect it to a computer, some type of interface is required.

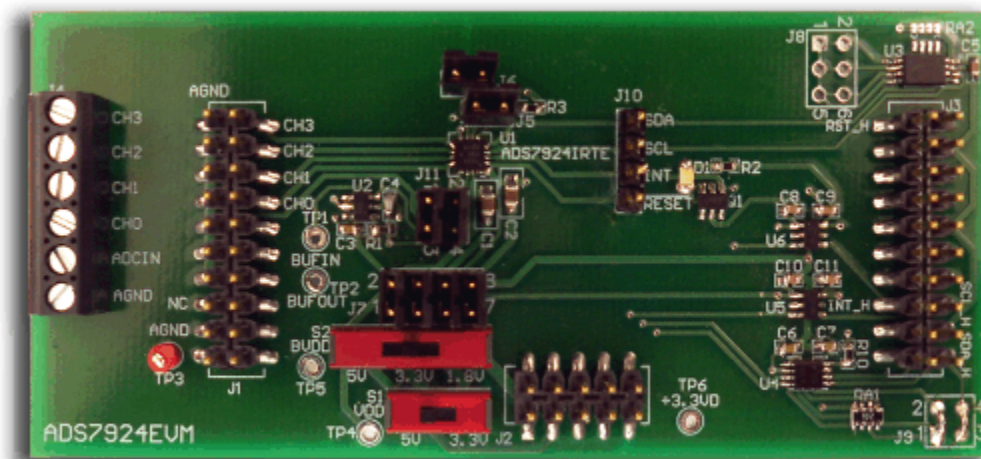


Figure 1. ADS7924EVM

## 2 Analog Interface

For maximum flexibility, the ADS7924EVM 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 J1. This header/socket provides access to the analog input pins of the ADS7924. 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 J1 and J4 are directly connected to the inputs of the ADS7924. Use appropriate caution when handling these pins. Table 1 summarizes the pinouts for analog interfaces J1 and J4.

Table 1. J1, J4: Analog Interface Pinout

Pin Number	Signal	Description
J1.2, J4-6	CH3	Analog input channel 3
J1.4, J4-5	CH2	Analog input channel 2
J1.6, J4-4	CH1	Analog input channel 1
J1.8, J4-3	CH0	Analog input channel 0
J4-2	ADCIN	ADC input
J1.18	REF-	Unused
J1.20	REF+	Unused
J1.10-16 (even)	Unused	Unused
J1.1-19 (odd), J4-1	AGND	Analog ground connections

## 3 Digital Interface

### 3.1 Serial Data Interface

The ADS7924EVM 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 J3. 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 J3 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 J3 serial interface pins.

**Table 2. J3: Serial Interface Pins**

Pin No.	Pin Name	Signal Name	I/O Type	Pull-Up	Function
J3.1	CNTL	RST_H	In	None	ADS7924 reset
J3.2	GPIO0	Unused	—	None	
J3.3	CLKX	Unused	—	None	
J3.4	DGND	DGND	In/Out	None	Digital ground
J3.5	CLKR	Unused	—	None	
J3.6	GPIO1	Unused	—	None	
J3.7	FSX	Unused	—	None	
J3.8	GPIO2	Unused	—	None	
J3.9	FSR	Unused	—	None	
J3.10	DGND	DGND	In/Out	None	Digital ground
J3.11	DX	Unused	—	None	
J3.12	GPIO3	Unused	—	None	
J3.13	DR	Unused	—	None	
J3.14	GPIO4	Unused	—	None	
J3.15	INT	INT_H	Out	None	ADS7924 interrupt
J3.16	SCL	SCL_H	I <sup>2</sup> C	High	I <sup>2</sup> C clock
J3.17	TOUT	Unused	—	None	
J3.18	DGND	DGND	In/Out	None	Digital ground
J3.19	GPIO5	Unused	—	None	
J3.20	SDA	SDA	I <sup>2</sup> C	High	I <sup>2</sup> C data

Some pins on J3 have weak pull-up resistors. These resistors provide default settings for many of the control pins. Many pins on J3 correspond to ADS7924 pins and are connected to them through either voltage-level translators or the I<sup>2</sup>C bus level translator. See the [ADS7924 product data sheet](#) for complete details on these pins.

### 3.2 Data Output

All output data communications are directed through the I<sup>2</sup>C communication protocol. The data from all channels can be observed through monitoring SDA\_H and SCL\_H. These signals are used by the ADS7924EVM-PDK to read back and display all the channel data via the ADCPro Software.

## 4 Power Supplies

J2 is the power-supply input connector. [Table 3](#) lists the configuration details for J2.

**Table 3. J2 Configuration: Power-Supply Input**

Pin No.	Pin Name	Function	Required
J2.1	+VA	Unused	No
J2.2	–VA	Unused	No
J2.3	+5VA	+5V analog supply	Always
J2.4	–5VA	–5V analog supply	No
J2.5	DGND	Digital ground input	Yes
J2.6	AGND	Analog ground input	Yes
J2.7	+1.8VD	1.8V digital supply	Sometimes
J2.8	VD1	Unused	No
J2.9	+3.3VD	3.3V digital supply	Always
J2.10	+5VD	+5V	No

All of the power supplies (VDD and BVDD) have corresponding jumpers on J7 that can be replaced with a current meter to measure the respective supply currents.

### 4.1 Power Options

J7 is arranged as four rows, each of which can be shorted. [Table 4](#) lists the power option details for J10.

For normal operation, J7.1-2, J7.3-4, J7.5-6, and J7.7-8 must be connected (direct or through an ammeter otherwise, the board does not function).

**Table 4. J7 Configuration: Power Options**

Row	Name	Function
1-2	ADC VDD	VDD supply point for the ADC. Must be connected for operation.
3-4	ADC BVDD	BVDD supply point for the ADC. Must be connected for operation.
5-6	AGND	Connects AGND to board ground.
7-8	DGND	Connects AGND to board ground.

Switches S1 and S2 are also used to select the operational voltage of the EVM. Switch S1 selects the VDD voltage for the EVM from J2.3 (+5VA) or J2.9 (+3.3VD). Switch S2 selects the BVDD voltage for the EVM from J2.3 (+5VA), J2.7 (+1.8VD) or J2.9 (+3.3VD).

## 5 External Buffer

The ADS7924 device has the option of selecting an external buffer going from MUXOUT to ADCIN. An [OPA363](#) can be used as a buffer and is selected through the configuration of J11. Connecting pins 1 and 2 together will bypass the external buffer, while connecting pins 1 and 3 and pins 2 and 4 will complete the circuit for the buffer. [Figure 2](#) shows jumper J11 as it appears on the EVM in its default position, using the buffer.



**Figure 2. Jumper J11**

## 6 EVM Operation

This section provides information on the analog input, digital control, and general operating conditions of the ADS7924EVM.

### 6.1 Analog Input

Each of the analog input sources can be applied directly to J1 (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 J1.

### 6.2 Digital Control

The digital control signals can be applied directly to J3 (top or bottom side). The modular ADS7924EVM can also be connected directly to a DSP or microcontroller interface board, such as the [5-6K Interface EVM](#) or [HPA-MCU Interface](#) boards available from Texas Instruments, or the MMB3 if purchased as part of the ADS7924EVM-PDK. For a list of compatible interface and/or accessory boards for the EVM or the ADS7924, see the relevant product folder on the TI web site.

### 6.3 Default Jumper Settings and Switch Positions

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

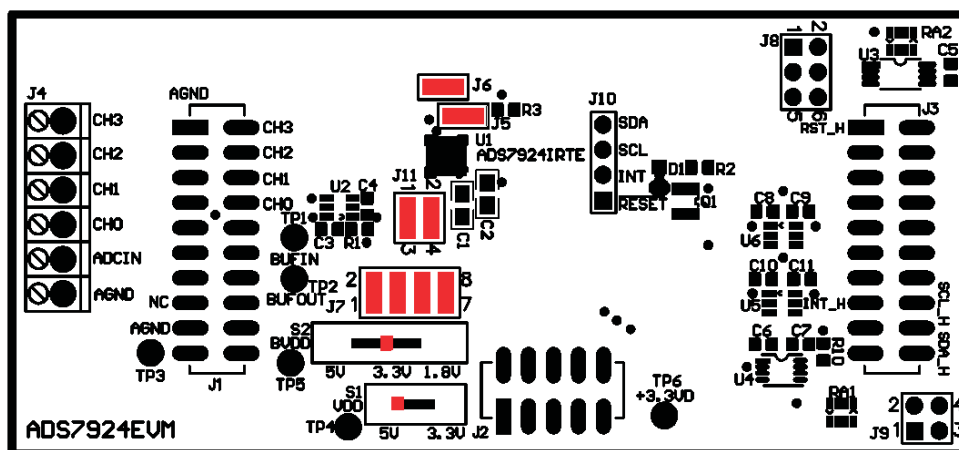


Figure 3. ADS7924EVM Default Jumper Locations

Table 5 lists the jumpers found on the EVM and the factory default conditions for each of the configurable jumpers.

Table 5. List of Configured Jumpers

Jumper	Default Position	Switch Description
J5.1-J5.2	Connected	I <sup>2</sup> C address selector
J6.1-J5.2	Connected	Analog and digital ground connector
J7.1-J7.2	Connected	VDD connector
J7.3-J7.4	Connected	BVDD connector
J7.5-J7.6	Connected	AGND connector
J7.7-J7.8	Connected	DGND connector
J11.1-J11.3	Connected	ADS7924 MUXOUT to buffer in
J11.2-J11.4	Connected	Buffer out to ADS7924 ADCIN

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	VDD = +5VA
S2	Center	BVDD = +3.3VD



## 7 ADS7924EVM-PDK Kit Operation

This section provides information on using the ADS7924EVM-PDK, including setup, program installation, and program usage.

To prepare to evaluate the ADS7924 with the ADS7924EVM-PDK, complete the following steps:

- Step 1. Install the ADCPro software (if not already installed) on a PC.
- Step 2. Install the ADS7924EVM-PDK EVM plug-in software.
- Step 3. Complete the USB driver installation process.
- Step 4. Set up the ADS7924EVM-PDK.
- Step 5. Connect the ADS7924EVM-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.

### 7.1 Installing the ADCPro Software

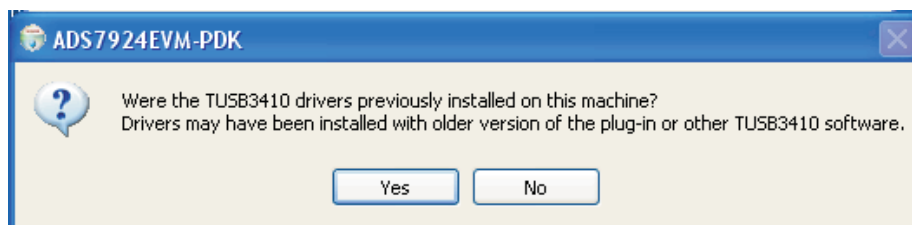
#### CAUTION

Do not connect the ADS7924EVM-PDK before installing the software on a suitable PC. Failure to observe this caution may cause Microsoft Windows to not recognize the ADS7924EVM-PDK as a connected device.

The CD-ROM shipped with the ADS7924EVM contains an installer for ADCPro as well as an installer for the ADS7924EVM plug-in for ADCPro. The latest software is available from the TI website at <http://www.ti.com/>. The updated ADCPro software can be downloaded directly from the TI web site (<http://www.ti.com/adcpro>) or the update check command can be used. Refer to the [ADCPro User Guide](#) for instructions on installing and using ADCPro.

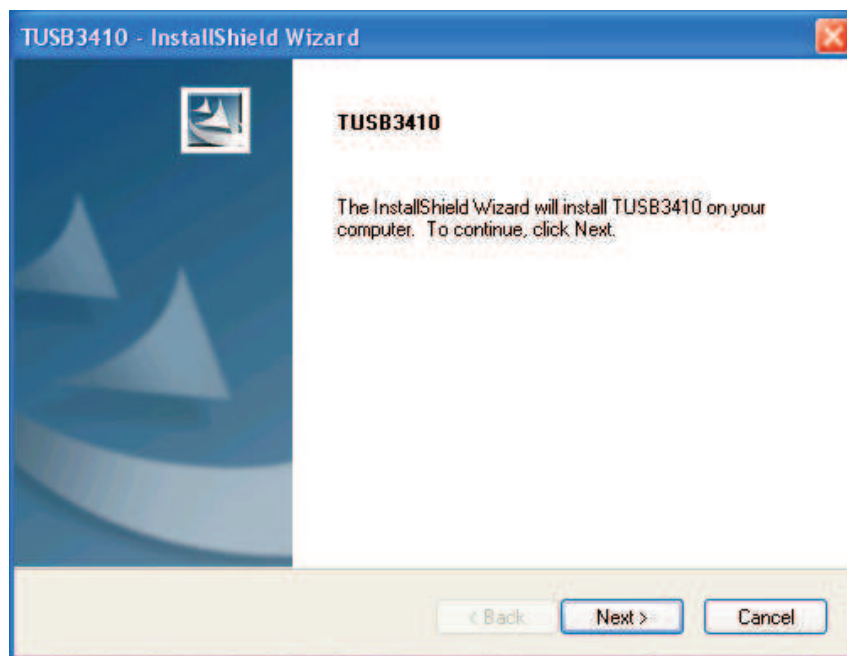
To install the ADS7924EVM-PDK plug-in, run the file: **ads7924evm-pdk-plug-in-1.0.0.exe** (1.0.0 is the version number, and increments with software version releases; you may have a different version on the CD). Double-click the file to run it; then follow the instructions shown. You can also use the ADCPro *Update Check* feature to check for newer versions of the ADS7924EVM-PDK plug-in, once you have installed one version of it.

Follow the on-screen prompts. Once the ADCPro plug-in installs, a window will appear, asking if the Virtual COM Port driver has been previously installed on your PC, as shown in [Figure 4](#).



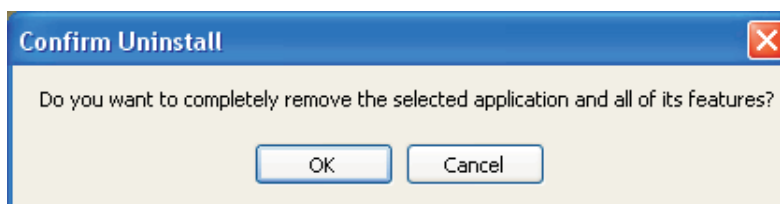
**Figure 4. Virtual COM Port Driver Installation Prompt**

If the Virtual COM Port driver has already been installed, press the *Yes* option. If not, press *No*; the software will continue with the TUSB3410 installation. The screen shown in [Figure 5](#) appears. The *Cancel* button will stop the installation process.



**Figure 5. Virtual COM Port Driver Installation**

Once the InstallShield wizard is complete, the software will first prompt an uninstall process that will remove any previous versions of the software. To continue, press *OK* as shown in [Figure 6](#).



**Figure 6. Virtual COM Port Driver Uninstall Confirmation**

To continue with the Virtual COM Port setup, follow the prompts presented to you through the licensing agreement and the rest of the software installation.

## 7.2 EVM Power Supply

The ADS7924EVM-PDK is powered completely from the USB connection on the MMB3. The MMB3 provides 3.3V and  $\pm 5V$  to the ADS7924EVM.

## 7.3 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.

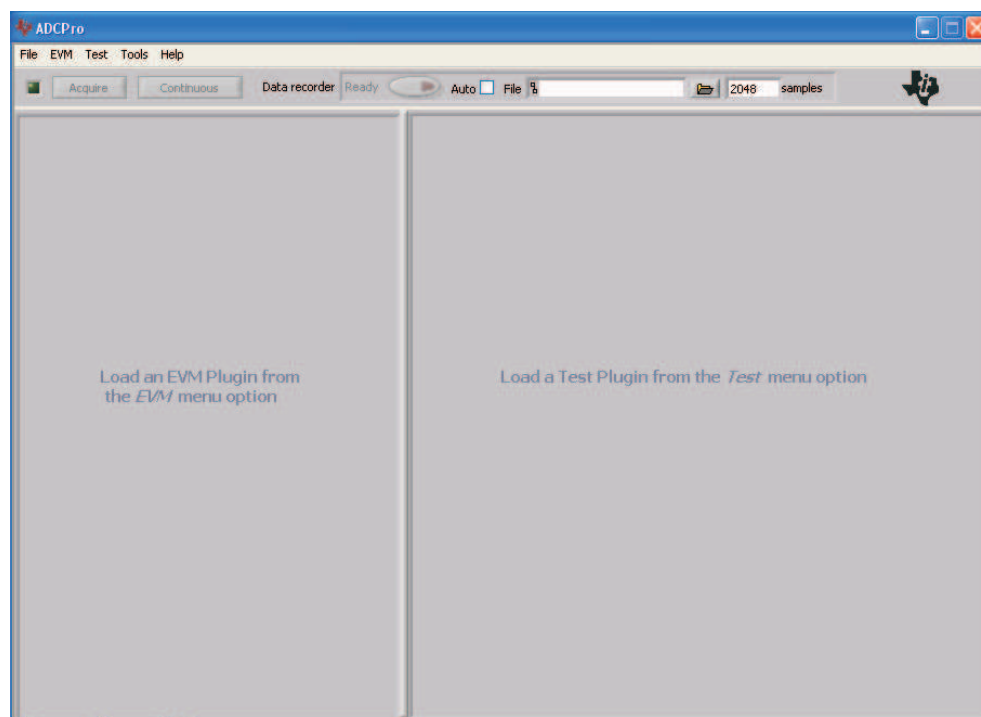
The program for evaluating the ADS7924EVM-PDK is called *ADCPro*. This program uses a series of software plug-ins to communicate with the EVM. The ADS7924EVM-PDK plug-in is included in the ADS7924EVM-PDK package.

If this is the first time to install ADCPro and the plug-ins, follow these procedures to run ADCPro and complete the necessary driver installation. Make sure the ADCPro software and device plug-in software are installed from the CD-ROM as described in [Section 7.1, Installing the ADCPro Software](#).

The program currently runs only on Microsoft Windows platforms of Windows XP; Windows Vista and Windows 7 are **NOT** supported.

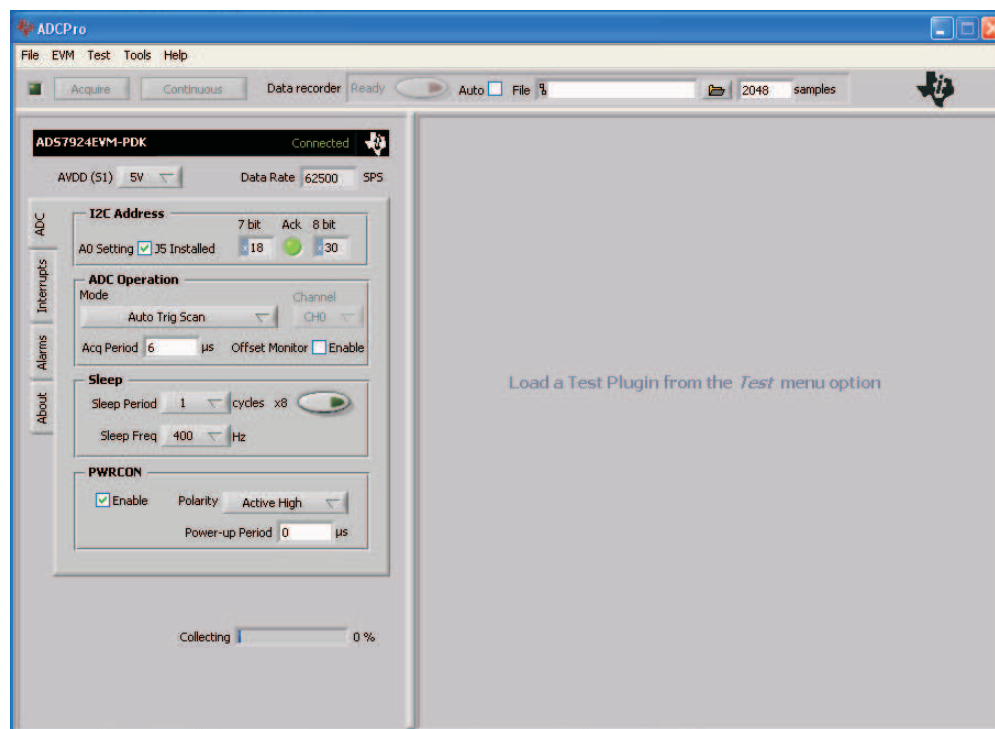
Follow this procedure to run the ADCPro software and download the firmware to the MMB3.

1. Start the software by selecting *ADCPro* from the Windows Start menu. The screen in [Figure 7](#) appears.



**Figure 7. ADCPro Software Start-up Display Window**

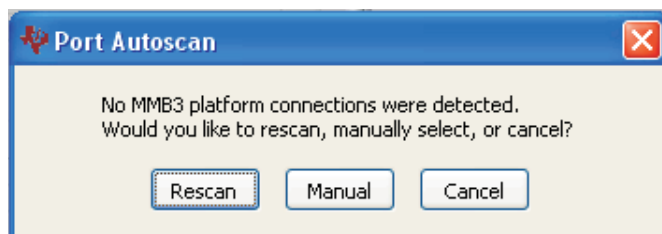
2. Select *ADS7924EVM* from the EVM drop-down menu. The ADS7924EVM-PDK plug-in appears in the left pane, as shown in [Figure 8](#).



**Figure 8. ADS7924EVM-PDK Plug-In Display Window**

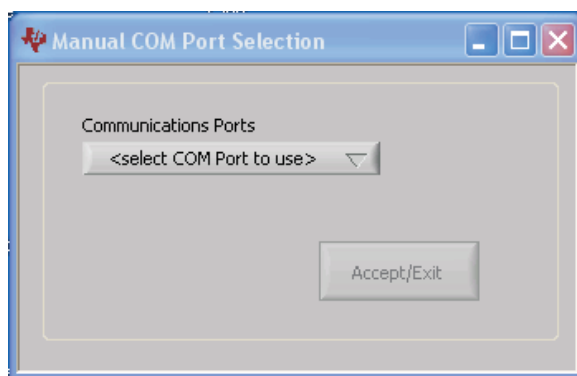
The ADS7924EVM-PDK plug-in window has a status area at the top of the screen. When the plug-in is first loaded, the plug-in searches for the board. You will see a series of messages in the status area indicating this action.

3. If the plug-in cannot connect to the EVM, you will see a window as shown in [Figure 9](#). This message indicates that the autoscan process for an available COM port has failed, giving you several different options.



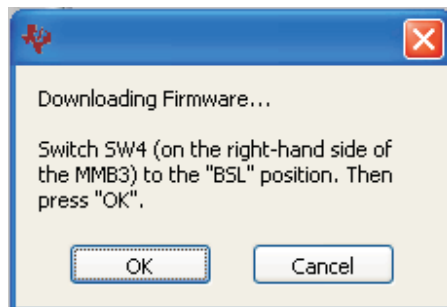
**Figure 9. EVM COM Port Autoscan Prompt Window**

4. If the *Rescan* option is unsuccessful, you can manually set the COM port to connect to the EVM. The Manual COM Port selection window is shown in [Figure 10](#).



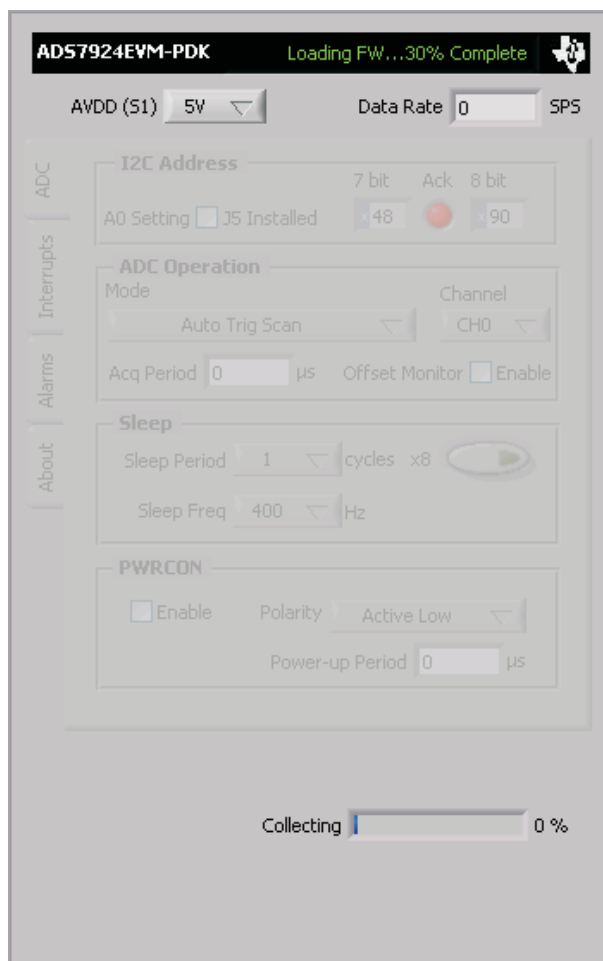
**Figure 10. Manual COM Port Selection Window**

5. The plug-in will detect whether or not the board has the correct firmware loaded. The first time you use the ADS7924EVM-PDK, the firmware for the MMB3 may need to be downloaded to the MMB3. If the firmware must be loaded, you will see a screen as shown in [Figure 11](#).



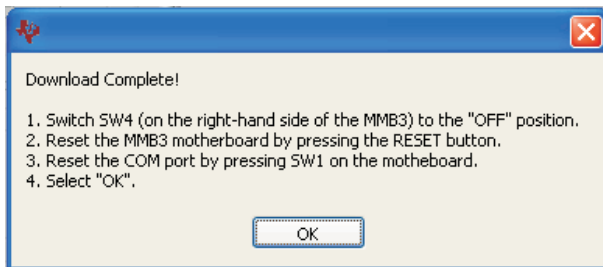
**Figure 11. Firmware Download Message**

6. 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 ADS7924 plug-in window (as [Figure 12](#) shows). The firmware is saved in flash memory on the MMB3, so this operation should need to only be performed once.



**Figure 12. Firmware Download Progress Indicator**

7. When the firmware download completes, the message box shown in [Figure 13](#) appears. Follow the on-screen instructions and the plug-in should now connect to the EVM.



**Figure 13. MMB3 Firmware Download Complete**

## 8 Evaluating Performance with the ADCPro Software

The evaluation software is based on ADCPro, a program that operates using a variety of plug-ins. (The ADS7924EVM plug-in is installed as described in the installation section, [Section 7.3, Running the Software and Download of Firmware to MMB3.](#))

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.

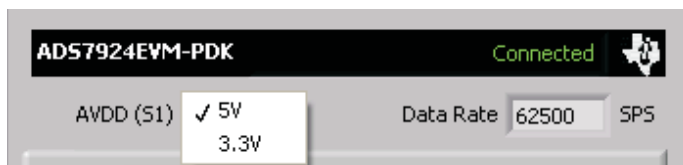
Only one of each kind of plug-in can be loaded at a time. If you select a different plug-in, the previous plug-in is unloaded.

### 8.1 Using the ADS7924EVM-PDK Plug-in

The ADS7924EVM-PDK plug-in for ADCPro provides complete control over all settings of the ADS7924. It consists of a tabbed interface (see [Figure 8](#)), with different functions available on different tabs. These controls are described in this section.

At the top of the plug-in is a pull-down menu indicating AVDD. Make sure that the switch S1 on the EVM matches the setting shown in the menu. This voltage is used in calculating the voltage based on the output data when using the MultiHistogram tester plug-in.

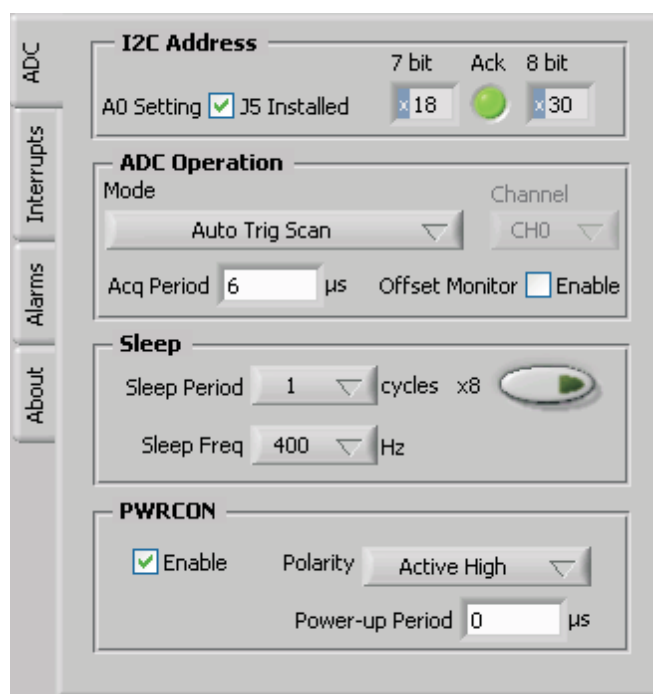
The data rate is also displayed at the top of the plug-in window. This rate is calculated based on the ADC Operation mode, the Acq Period and the Power-up Period of PWRCON in the *ADC* tab of the plug-in. The AVDD pull-down menu and data rate window are shown in [Figure 14](#).



**Figure 14. AVDD Pull-Down Menu and Data Rate**

### 8.1.1 ADC Configuration Tab

The first tab of the ADS7924EVM plug-in is the ADC tab. This tab controls the I<sup>2</sup>C selection, ADC operation, sleep functions, and the PWRCON control for the external buffer. There are four sections within this tab. The ADC tab is shown in Figure 15.



**Figure 15. ADC Tab**

The first section controls the I<sup>2</sup>C address. Select the I<sup>2</sup>C address used to communicate with the part (either 18h or 19h as the 7-bit address, depending on the installation of jumper J5). The Ack indicator indicates the slave acknowledge with a green light. If the slave does not acknowledge the master, then a red light appears.

The second section shows the controls for ADC operation. While the *Manual Trigger* modes are not available in this plug-in, the five auto-trigger modes can be set by the pulldown menu. *Auto bursttrig/sleep scan*, *Auto trig/sleep scan*, *Auto trig/sleep single*, *Auto trig scan*, and *Auto trig single* are all available. To the right of the mode selection, a particular channel (CH0-CH3) can be selected for the *Auto trig/sleep single* and the *Auto trig single* modes. For data rate timing, the acquisition period can be set from 6µs to 62µs in factors of 2µs. The *Offset Monitor Enable* corresponds to bit 7 of the PWRCONFIG register and is used for routing the multiplexer. This option will either route channel 3 or AGND to the MUXOUT. This feature can also be used in the calibration process to monitor the offset.

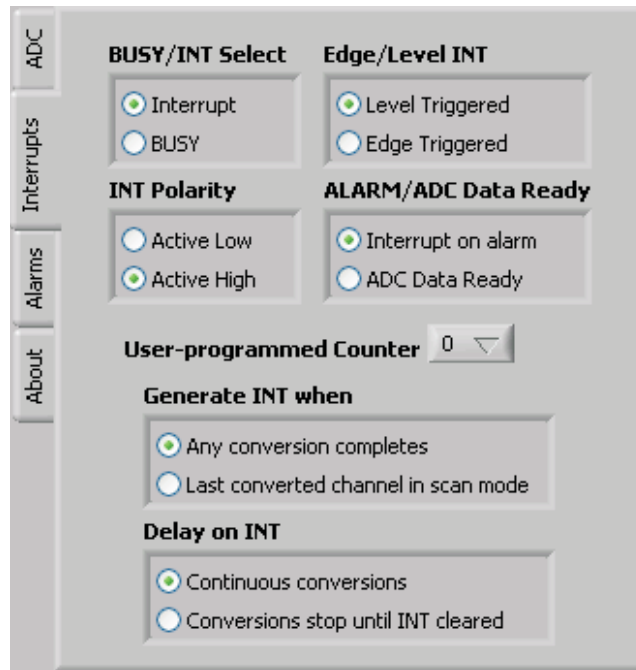
The third section is used for Sleep Control. The first tab is the Sleep Period; this period can be set from one internal clock cycle to 128 internal clock cycles. The Sleep Frequency can be set at either 400Hz or 1.6kHz.

The final section of the ADC tab is the PWRCON section. This section controls the external buffer. A check button enables this function. The polarity of the PWRCON pin is selected to be Active High or Active Low, while the timing of the Power-up Period can be set from 0µs to 62µs in factors of 2µs.



### 8.1.2 Interrupts Tab

The second tab of the ADS7924EVM plug-in is the Interrupts tab. This tab corresponds primarily to the Interrupt CONFIG Register of the ADS7924. A set of pushbuttons are used to control the bit selections within this register. The Interrupts tab is shown in [Figure 16](#).



**Figure 16. Interrupts Tab**

The *BUSY/INT Select* allows the user to generate an interrupt or a BUSY signal. The *Edge/Level INT* can be programmed to either be level-triggered or edge-triggered. The *INT Polarity* can be set to be either active low or active high. *ALARM/ADC Data Ready* is used to program the pin to generate an interrupt on an alarm or as the ADC data are ready.

The *User-programmed Counter* (three bits) programs a count from 0 to 7. This function is a programmable global alarm threshold to filter false alarms.

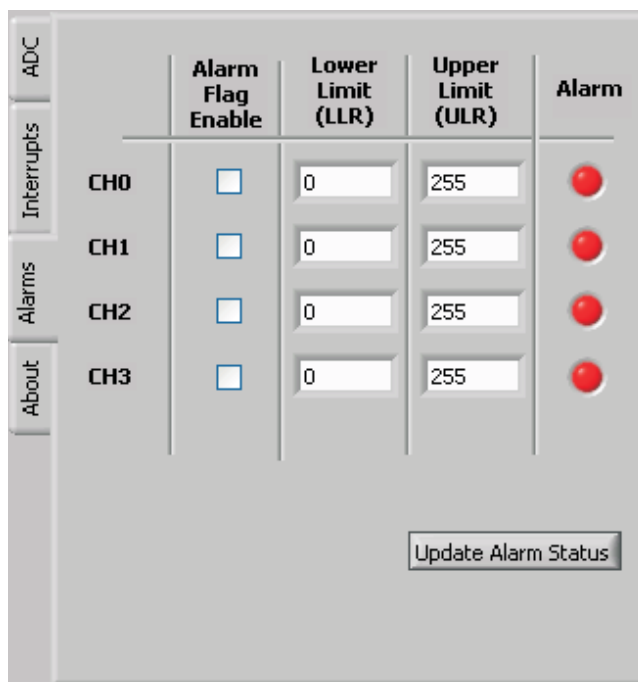
When the INT pin is programmed as the ADC data ready, the interrupt can be programmed to be generated after a conversion is complete from any channel or after the last converted channel in scan mode.

*Delay on INT* corresponds to a bit in the Sleep Control Register of the ADS7924. This bit controls whether the conversions continue independently of alarms and the conversion overwrites previous data, or if future conversions are stopped until the interrupt is cleared.

### 8.1.3 Alarms Tab

The Alarms tab of the ADS7924EVM plug-in is shown in [Figure 17](#). The ADS7924 offers an independent alarm control that can be enabled for each channel. An 8-bit upper limit and lower limit can be set independently. An alarm indicator shows the alarm status.

Once you have configured the ADS7924 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 ADS7924EVM-PDK plug-in disables all the front panel controls while acquiring, and displays a progress bar as shown in [Figure 17](#).



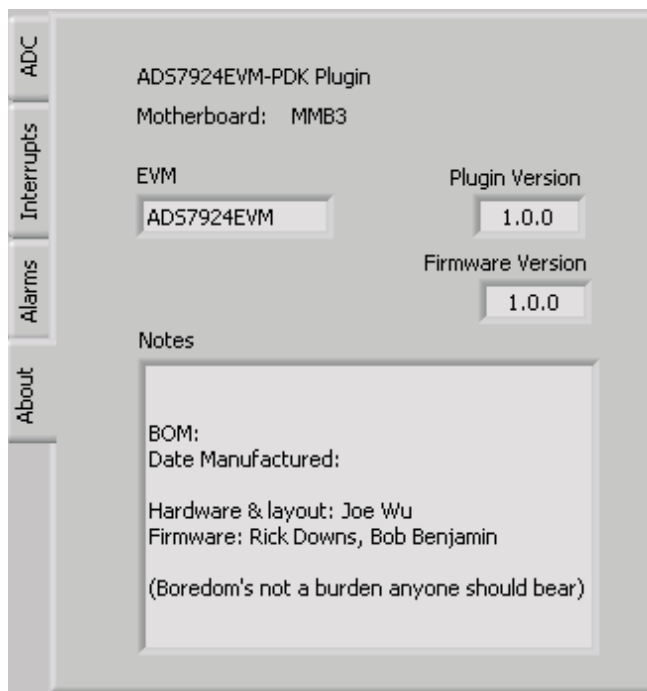
	Alarm Flag Enable	Lower Limit (LLR)	Upper Limit (ULR)	Alarm
CH0	<input type="checkbox"/>	0	255	<span style="color: red;">●</span>
CH1	<input type="checkbox"/>	0	255	<span style="color: red;">●</span>
CH2	<input type="checkbox"/>	0	255	<span style="color: red;">●</span>
CH3	<input type="checkbox"/>	0	255	<span style="color: red;">●</span>

Update Alarm Status

**Figure 17. Alarms Tab**

#### 8.1.4 About Tab

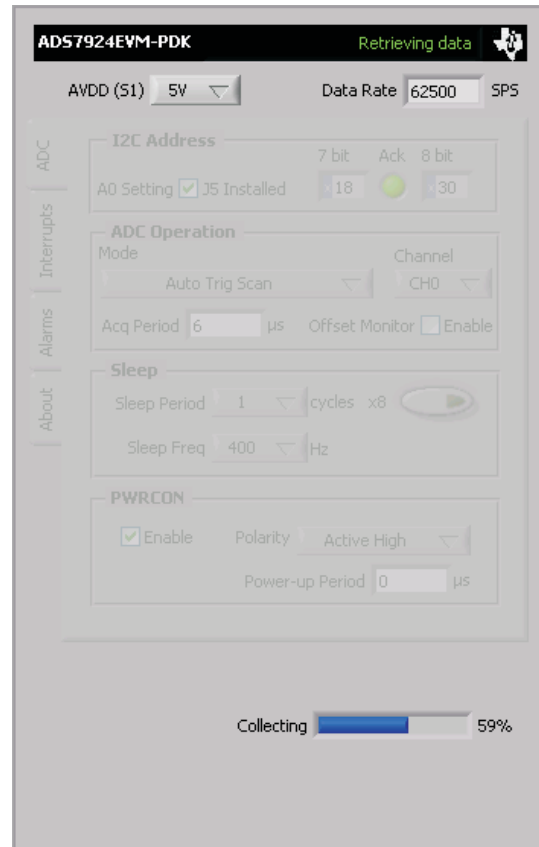
The About tab displays information about the EVM and software, as shown in [Figure 18](#). The **Plugin Version** and **Firmware Version** indicators show the version numbers of the plug-in and firmware code, respectively. The **Notes** indicator may show relevant notes about the released plug-in or firmware code, if any are available.



**Figure 18. About Tab**

## 8.2 Collecting Data

Once you have configured the ADS7924 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 ADS7924EVM-PDK plug-in disables all the front panel controls while acquiring data, and displays a progress bar as [Figure 19](#) shows.



**Figure 19. Progress Bar While Acquiring Data**

## 8.3 Troubleshooting

If the ADS7924EVM plug-in cannot find the ADS7924EVM-PDK, press the **USB RESET** button on the MMB3 (refer to [Figure 22](#)) and try again.

If ADCPro stops responding while the ADS7924EVM-PDK is connected, try unplugging the USB cable from the MMB3. Unload and reload the plug-in before reapplying power to the PDK. 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 Schematics and Layout

Schematics for the ADS7924EVM are appended to this user's guide. The bill of materials is provided in [Table 7](#).

### 9.1 Bill of Materials

**Table 7. Bill of Materials**

Item No.	Qty	Value	Ref Des	Description	Manufacturer	Part Number
1	1	2.2 $\mu$ F	C4	50V ceramic chip capacitor, $\pm$ 5%, C0G 0603		GRM1885C1H222JA01D
2	8	0.1 $\mu$ F	C3, C5, C6, C7, C8, C9, C10, C11	25V ceramic chip capacitor, $\pm$ 10%, 0603	TDK	C1608X7R1E104K
3	2	10 $\mu$ F	C1, C2	16V ceramic chip capacitor, $\pm$ 20%, X5R 0805	TDK	C2012X5R1C106M
4	1		D1	Light-emitting diode, red 0805	Lumex	SML-LXT0805IW-TR
5	2		J1A, J3A	20-pin SMT plug	Samtec	TSM-110-01-L-DV-P
6	2		J1B, J3B	20-pin SMT socket	Samtec	SSW-110-22-F-D-VS-K
7	1		J2A	10-pin SMT plug	Samtec	TSM-105-01-L-DV-P
8	1		J2B	10-pin SMT socket	Samtec	SSW-105-22-F-D-VS-K
9	3		J4	3.5mm PCB terminal position block, 6	On Shore Technology	ED555/6DS
10	2		J5, J6	1 $\times$ 2 header	Samtec	TSW-102-07-G-S
11	1		J7	2 $\times$ 4 header	Samtec	TSW-104-07-G-D
12	0		J8	Not installed	—	—
13	0		J9	Not installed	—	—
14	1		J11	2 $\times$ 2 header	Samtec	TSW-102-07-G-D
15	2		J10	1 $\times$ 4 header	Samtec	TSW-104-07-G-S
16	1		Q1	N-Channel MOSFET	Fairchild Semiconductor	FDN337N
17	1	100 $\Omega$	R1	1/10W 1% chip resistor 0603	Panasonic	ERJ-3EKF1000V
18	1	470 $\Omega$	R2	1/10W 1% chip resistor 0603	Panasonic	ERJ-3EKF4700V
19	1	10k $\Omega$	R3	1/10W 1% chip resistor 0603	Panasonic	ERJ-3EKF1002V
20	1	200k $\Omega$	R4	1/10W 1% chip resistor 0603	Panasonic	ERJ-3EKF2003V
21	1	1k $\Omega$	RA1	Resistor array, 100 $\Omega$ , eight-terminal, four-resistor SMD	CTS	742C083102JPTR
22	1	100k $\Omega$	RA2	Resistor array, 100k $\Omega$ , eight-terminal, four-resistor SMD	CTS	742C083104JPTR
23	1		S1	SPDT slide switch, top actuator	NKK	SS12SDP2
24	1		S2	SP3T Switch slide ultra miniactuator, top	NKK	SS14MDP2
25	0		TP1, TP2, TP4, TP5, TP5, TP6	Not installed	—	—
26	2		TP3, TP7	Testpoint	Keystone Electronics	5011
27	1		U1	12-bit, analog-to-digital converter, four-channel	Texas Instruments	ADS7924IRTER
28	1		U2	Op-amp, single w/enableSOT23-6	Texas Instruments	OPA363IDBVR
29	1		U3	EEPROM, 1.8V, 256k	Microchip	24AA256-I/ST
30	1		U4	I <sup>2</sup> C bus level translator	Texas Instruments	PCA9306DCTR
31	2		U5, U6	Single split-rail level shifter	Texas Instruments	SN74LVC1T45DBV
32	1		N/A	ADS7924 EVM PWB	Texas Instruments	6516247
33	8		N/A	Shorting block	Samtec	SNT-100-BK-G

## 10 Appendix: Setting Up the ADS7924EVM-PDK

The ADS7924EVM-PDK contains both the ADS7924EVM and the MMB3 motherboard; the devices are shipped connected. However, if you only order the ADS7924EVM and already have the MMB3, you must make sure the MMB3 is set back to its default conditions in order to load the firmware onto the motherboard. Follow these steps to set up the ADS7924EVM-PDK

- Step 1. Unpack the ADS7924EVM kit.
- Step 2. Set the jumpers and switches on the MMB3 as shown in [Figure 20](#).
  - Set switch SW4 to the right.
  - Set the DAC switch (SW5) to the OUT position (to the right).

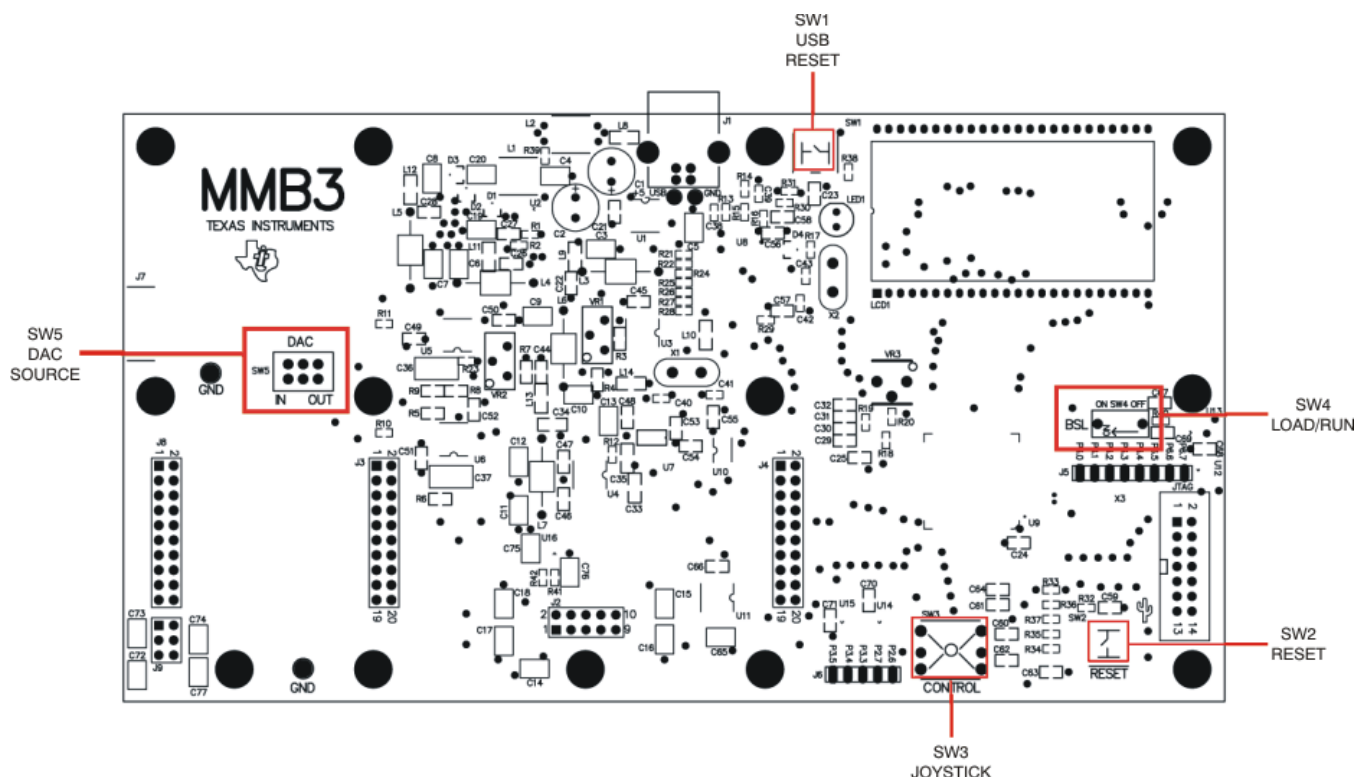
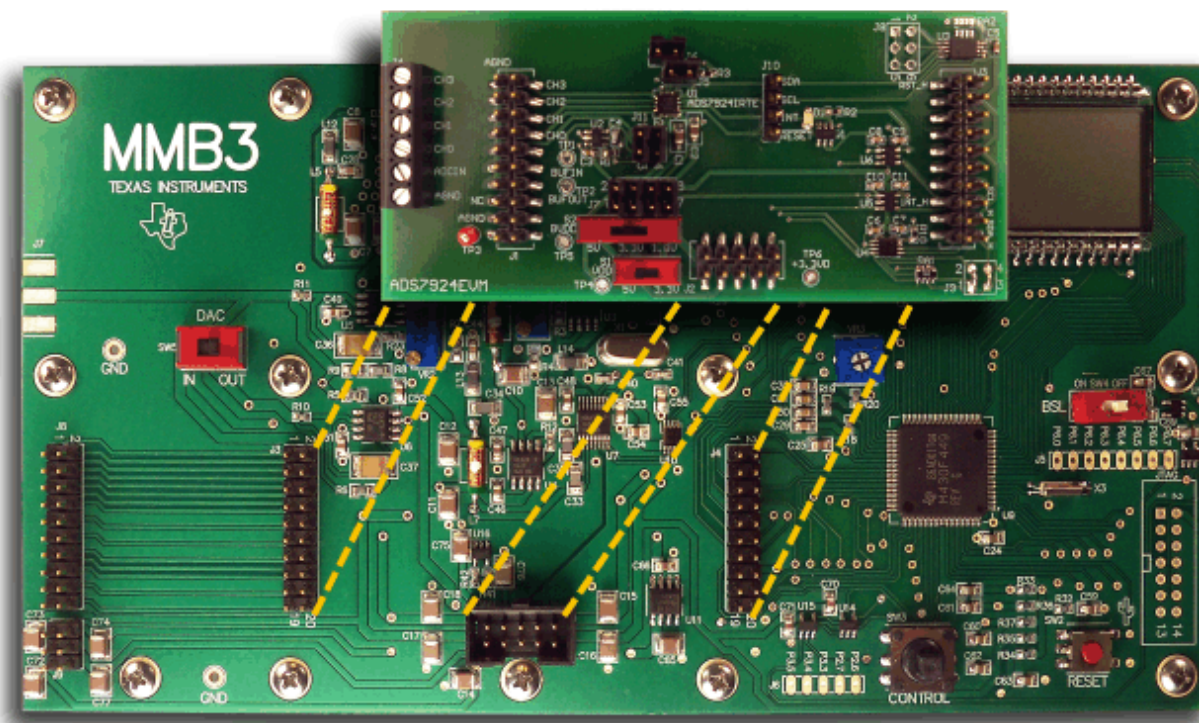


Figure 20. MMB3 Initial Setup

3. Plug the ADS7924EVM into the MMB3 as [Figure 21](#) illustrates.



**Figure 21. Connecting ADS7924EVM to MMB3**

**CAUTION**

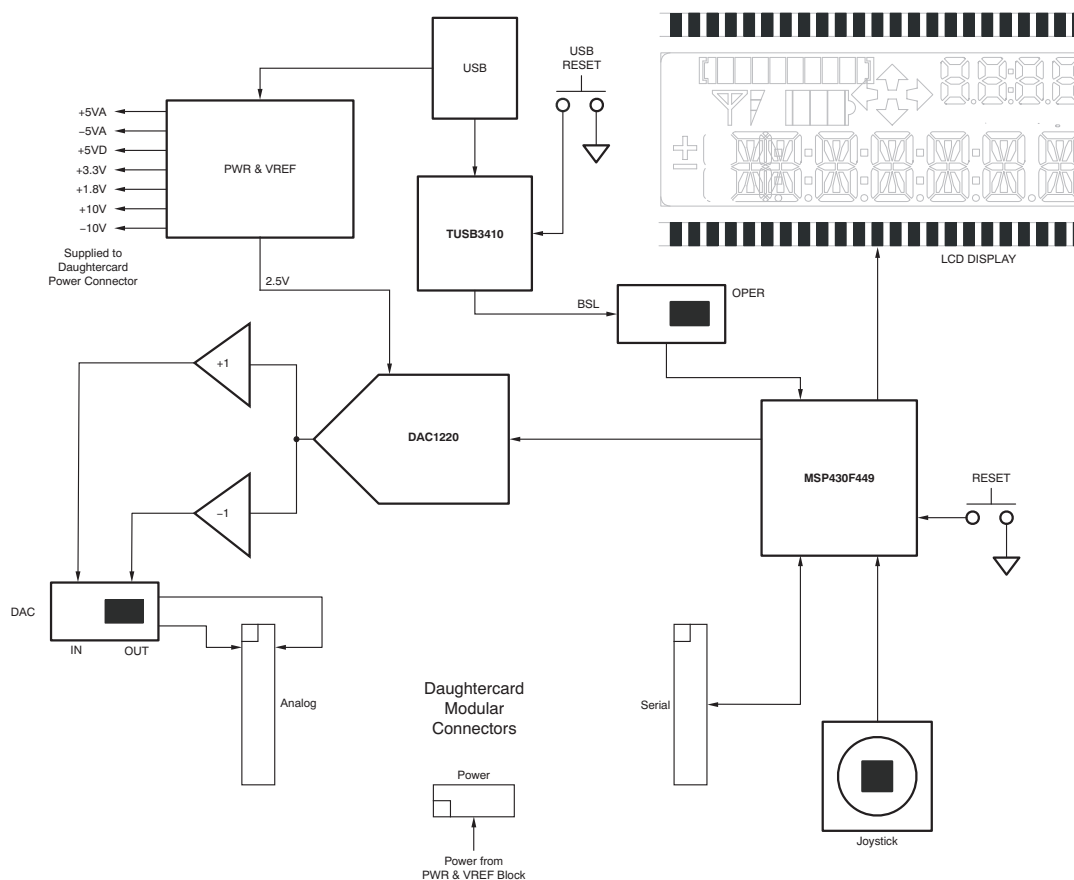
Do not misalign the pins when plugging the ADS7924EVM into the MMB3. Check the pin alignment carefully before applying power to the PDK.

- Step 3. Set the jumpers and switches on the ADS7924EVM as shown in [Figure 3](#) (note that these settings are the factory-configured settings for the EVM).

Once this is completed, then load the ADS7924EVM plug-in and follow the instructions (refer to [Section 7.3](#)) to load the firmware.

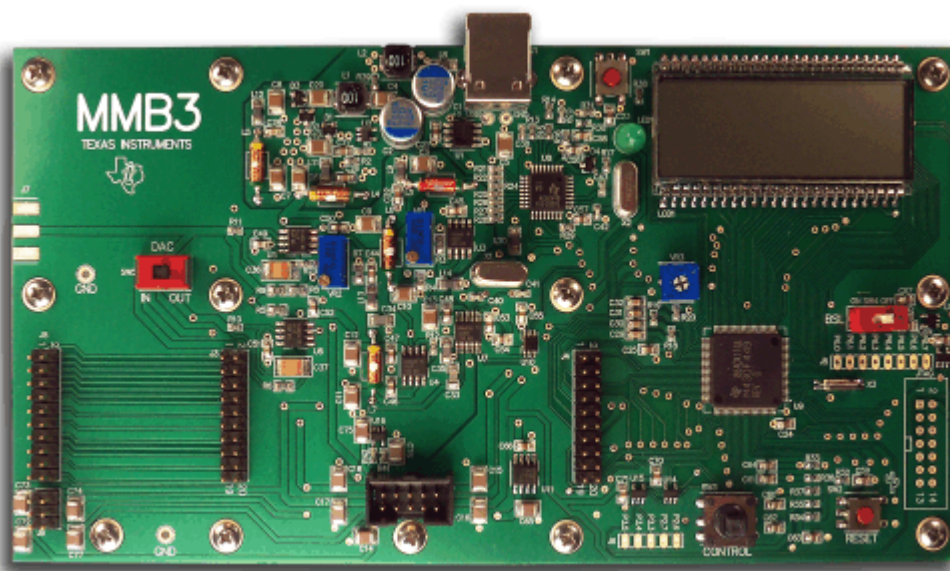
## 10.1 About the MMB3

The MMB3 is a Modular EVM System motherboard. It is designed around the [MSP430F449](#), a low-power microcontroller from Texas Instruments. [Figure 22](#) shows a block diagram of the MMB3. [Figure 23](#) illustrates the MMB3.



**Figure 22. MMB3 Block Diagram**





**Figure 23. MMB3**

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 user control of functions on the board when it is not controlled by a PC. ***These features are experimental and not supported in the ADS7924EVM-PDK at this time.***

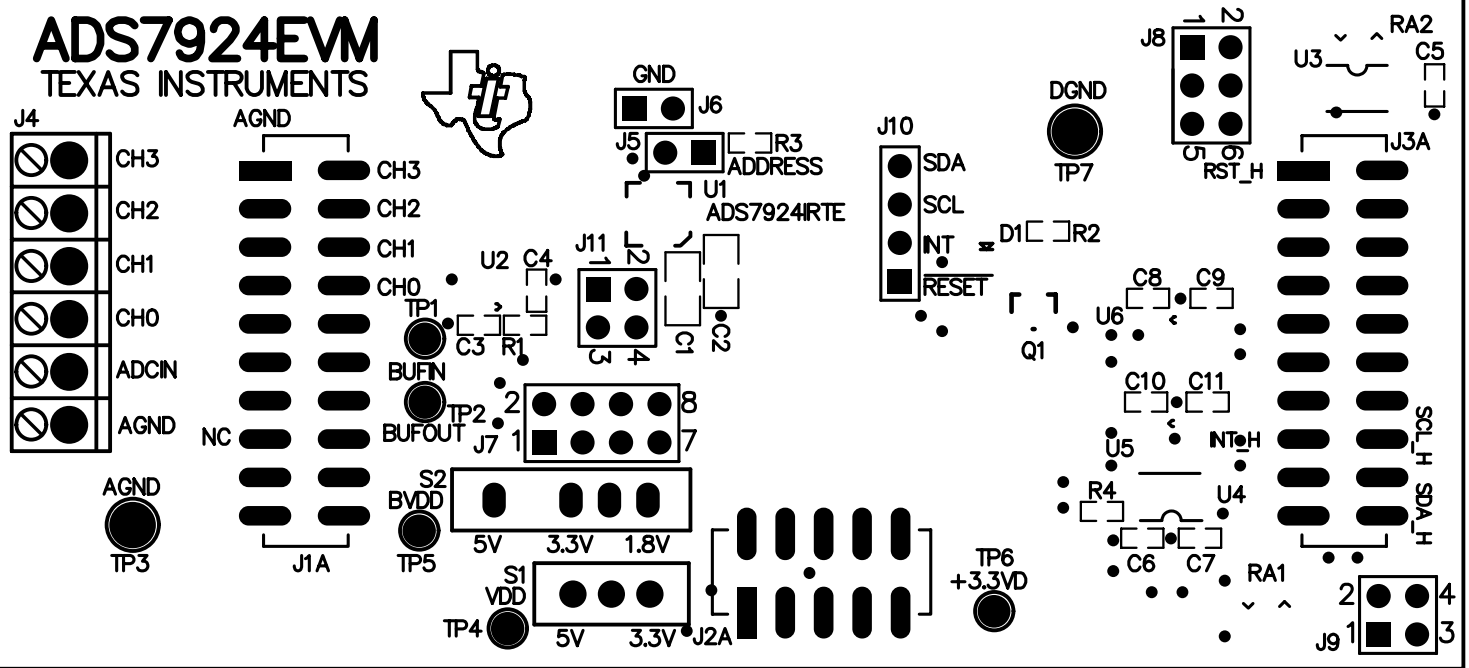
The MMB3 derives power from the USB interface, and generates +5VD, 3.3V, and 1.8V, as well as +5VA and –5VA  $\pm 10V$ . The  $\pm 10V$  is supplied to the daughtercard power connector as +VA and –VA.

The MMB3 is not sold as a DSP 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.

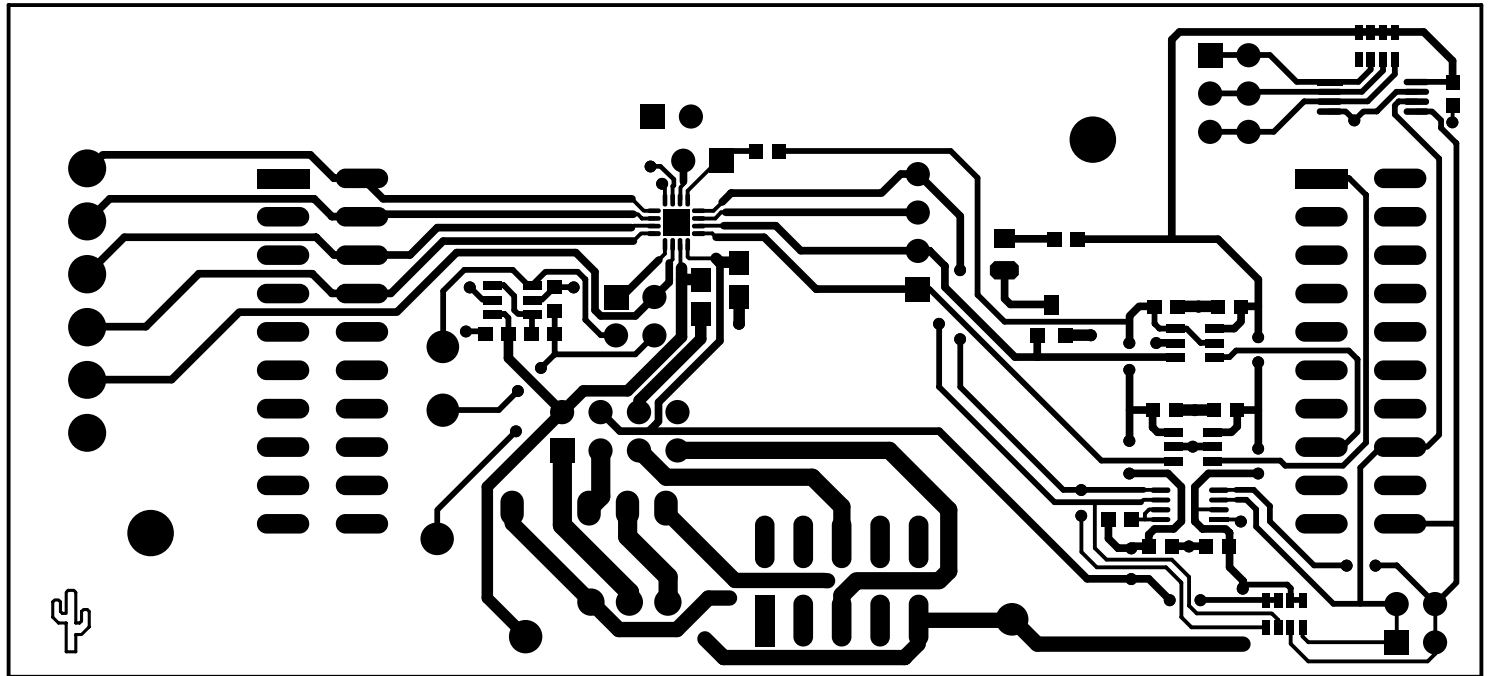


# ADS7924EVM

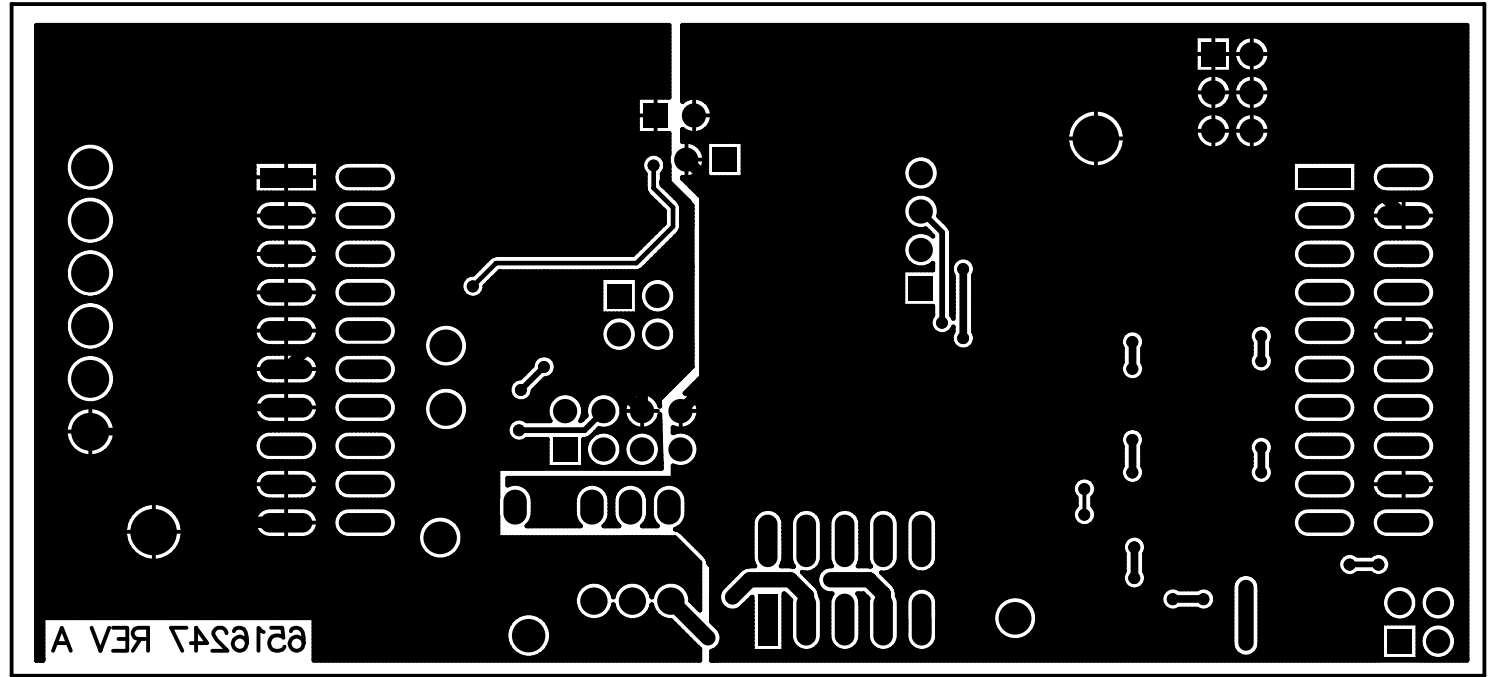
## TEXAS INSTRUMENTS

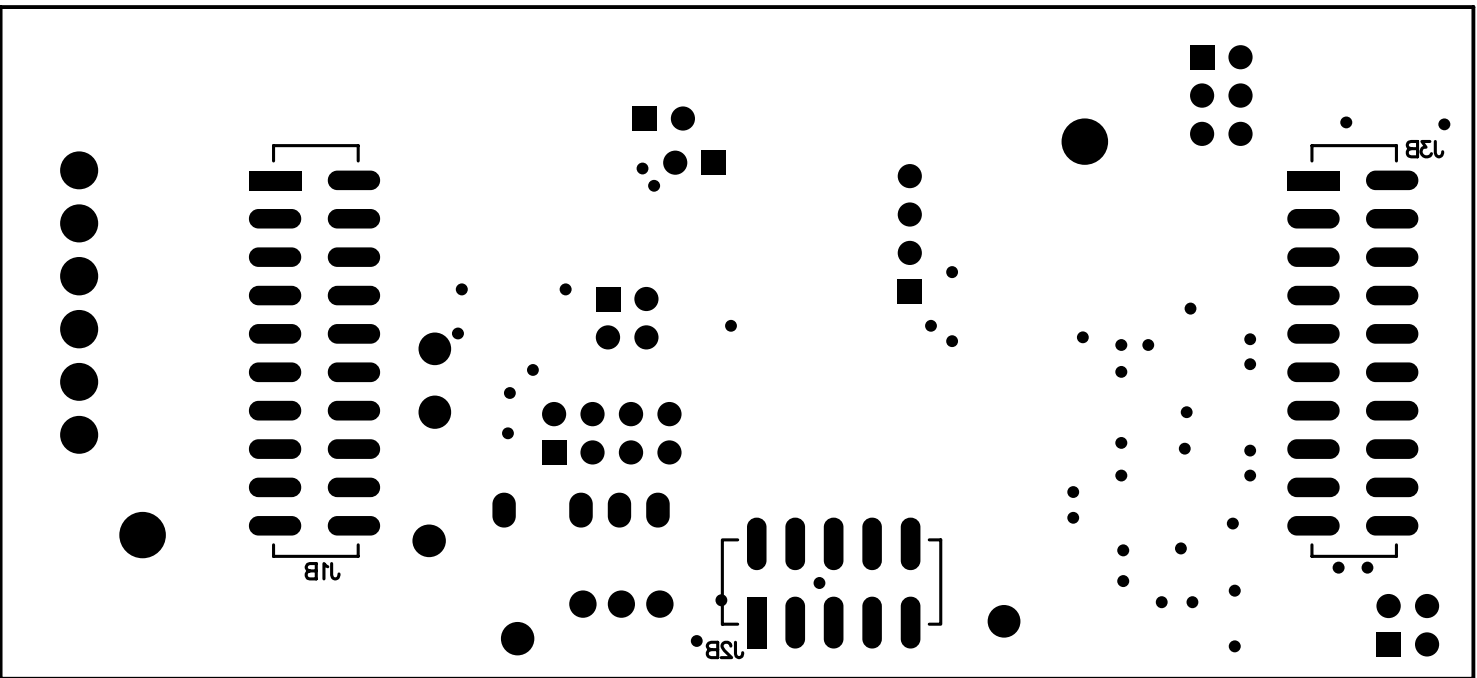


Top Layer 1



Bottom Layer 2





## Evaluation Board/Kit Important Notice

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. Persons handling the product(s) must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and therefore may not meet the technical requirements of these directives or other related directives.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. **THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.**

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

**EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.**

TI currently deals with a variety of customers for products, and therefore our arrangement with the user **is not exclusive**.

TI assumes **no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.**

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please contact the TI application engineer or visit [www.ti.com/esh](http://www.ti.com/esh).

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used.

## FCC Warning

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

## EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of +3.3V 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 +35°C. The EVM is designed to operate properly with certain components above +35°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  
Copyright © 2010, Texas Instruments Incorporated

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		Applications	
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>	Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>	Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>	Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>	Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>	Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>	Energy	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>	Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>	Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>	Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>	Space, Avionics & Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
RF/IF and ZigBee® Solutions	<a href="http://www.ti.com/lprf">www.ti.com/lprf</a>	Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
		Wireless	<a href="http://www.ti.com/wireless-apps">www.ti.com/wireless-apps</a>