

## **ADS1281EVM and ADS1281EVM-PDK**



**ADS1281EVM (Left) and ADS1281EVM-PDK (Right)**

This user's guide describes the characteristics, operation, and use of the ADS1281EVM, both by itself and as part of the ADS1281EVM-PDK. This evaluation model (EVM) is an evaluation board for the [ADS1281](#), a high-performance, 32-bit, single-channel, delta-sigma analog-to-digital converter (ADC). The EVM allows evaluation of all aspects of the ADS1281. 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>.

### **EVM-Compatible Device Data Sheets**

Device	Literature Number	Device	Literature Number
<a href="#">ADS1281</a>	<a href="#">SBAS378B</a>	<a href="#">SN74LVC2G157</a>	<a href="#">SCES207K</a>
<a href="#">REF5025</a>	<a href="#">SBOS410C</a>	<a href="#">SN74LVC1G07</a>	<a href="#">SCES296W</a>
<a href="#">REF5050</a>	<a href="#">SBOS410C</a>	<a href="#">SN74AHCT1G04</a>	<a href="#">SCLS319N</a>
<a href="#">OPA2350</a>	<a href="#">SBOS099C</a>	<a href="#">TPS79225</a>	<a href="#">SLVS337B</a>
<a href="#">OPA1632</a>	<a href="#">SBOS286A</a>	<a href="#">TPS72325</a>	<a href="#">SLVS346B</a>
<a href="#">PCA9535</a>	<a href="#">SCPS129H</a>		

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## 1 EVM Overview

### 1.1 Features

#### ADS1281EVM:

- Contains all support circuitry needed for the ADS1281
- Voltage reference options: external or onboard
- Clock options: External clock source or 4.096MHz onboard crystal oscillator
- Compatible with the TI Modular EVM System

#### ADS1281EVM-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 ADS1281EVM-PDK is available. This kit combines the ADS1281EVM board with the DSP-based MMB0 motherboard, and includes ADCPro™ software for device evaluation.

The MMB0 motherboard allows the ADS1281EVM to be connected to the computer via an available USB port. This manual shows how to use the MMB0 as part of the ADS1281EVM-PDK, but does not provide technical details about the MMB0 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 ADS1281EVM-PDK is controlled by a plugin 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 for the TI web site.

This manual covers the operation of both the ADS1281EVM and the ADS1281EVM-PDK. Throughout this document, the abbreviation *EVM* and the term *evaluation module* are synonymous with the ADS1281EVM.

### 1.2 Introduction

The ADS1281EVM is an evaluation module built to the TI Modular EVM System specification. It can be connected to any modular EVM system interface card.

The ADS1281EVM is available as a stand-alone printed circuit board (PCB) or as part of the ADS1281EVM-PDK, which includes an MMB0 motherboard and software. As a stand-alone PCB, the ADS1281EVM is useful for prototyping designs and firmware.

Note that the ADS1281EVM 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 ADS1281EVM 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 J6. This header/socket provides access to the analog input pins of the ADS1281. Consult Samtec at <http://www.samtec.com> or call 1-800-SAMTEC-9 for a variety of mating connector options.

The input pins on the ADS1281EVM are directly connected to the part, with no filtering or protection. It is important to take appropriate caution when handling the pins. Table 1 summarizes the pinouts for analog interfaces J6.

**Table 1. J6: Analog Interface Pinout**

Pin Number	Signal	Description
J6.1	A1N	AINN, ADS1281
J6.2	A1P	AINP, ADS1281
J6.9-13 (odd)	AGND	Analog ground connections
J6.15	VCOM	
J6.17-19 (odd)	AGND	Analog ground connections
J6.18	REFN	External reference source input (– side of differential input)
J6.20	REFP	External reference source input (+ side of differential input)
J6.3-8	Unused	
J6.10-16 (even)	Unused	

### 3 Digital Interface

#### 3.1 Serial Data Interface

The ADS1281EVM 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 J5. 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 J5 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 J5 serial interface pins.

**Table 2. J5: Serial Interface Pins**

Pin No.	Pin Name	Signal Name	I/O Type	Pull-Up	Function
J5.1	CNTL	Unused			
J5.2	GPIO0	M0	In/Out	Low	Data rate select input / Modulator data output
J5.3	CLKX	SCLK	In	None	ADS1281 SPI™ clock
J5.4	DGND	DGND	In/Out	None	Digital ground
J5.5	CLKR	Unused			
J5.6	GPIO1	M1	In/Out	High	Data rate select input / Modulator data output
J5.7	FSX	Unused			
J5.8	GPIO2	MCLK	Out	Low	Modulator clock output
J5.9	FSR	$\overline{\text{DRDY}}$	Out	None	Data ready signal
J5.10	DGND	DGND	In/Out	None	Digital ground
J5.11	DX	MOD/DIN	In	None	ADS1281 SPI data in
J5.12	GPIO3	SUPSOR	In	High	Power-supply regulator Hi = 5 V Lo = ±2.5 V
J5.13	DR	DOUT	Out	None	ADS1281 data out
J5.14	GPIO4	PDWN	In	High	Power-down input
J5.15	INT	$\overline{\text{DRDY}}$	Out	None	Data Ready signal
J5.16	SCL	SCL	I <sup>2</sup> C	—	I <sup>2</sup> C clock

**Table 2. J5: Serial Interface Pins (continued)**

Pin No.	Pin Name	Signal Name	I/O Type	Pull-Up	Function
J5.17	TOUT	CLK	In	None	Can be used to provide a clock from a processor
J5.18	DGND	DGND	In/Out	None	Digital ground
J5.19	GPIO5	EXTCLK	In	None	External clock input
J5.20	SDA	SDA	I <sup>2</sup> C	—	I <sup>2</sup> C data

Many pins on J5 have weak pull-up/-down resistors. These resistors provide default settings for many of the control pins. Additionally, many pins on J5 correspond directly to ADS1281 pins. See the [ADS1281 product data sheet](#) for complete details on these pins.

## 4 Power Supplies

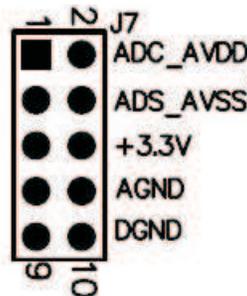
J8 is the power-supply input connector. [Table 3](#) lists the configuration details for J8. Analog inputs to the ADC can be applied directly to the device (see [Section 8.1, Analog Input](#)). An additional bipolar supply is needed to power the bipolar amplifiers. For optimum noise performance, the external supplies (+VA and -VA) should be used.

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

Pin No.	Pin Name	Function	Required
J8.1	+VA	+10V to +15V	Yes
J8.2	-VA	-10V to -15V	Yes
J8.3	+5VA	+5V analog supply	Always
J8.4	-5VA	-5V analog supply	No; only for bipolar mode
J8.5	DGND	Digital ground input	Yes
J8.6	AGND	Analog ground input	Yes
J8.7	+1.8VD	1.8V digital supply	No
J8.8	VD1	Not used	No
J8.9	+3.3VD	3.3V digital supply	Always
J8.10	+5VD	+5V	No

### 4.1 Bipolar Power Options

The voltage used to power the op amps is +10V and -10V pins J8.1 and J8.2. If using bipolar mode,  $\pm 5V$  supplies must be connected to pins J8.3 and J8.4. The  $\pm 5V$  is regulated down to  $\pm 2.5V$  with U10 and U13 in bipolar mode. Jumpers must be properly placed across J7.1 and J7.2 as well as J7.3 and J7.4 to properly power the ADS1281 (shown in [Figure 1](#)).


**Figure 1. Connectors for J7**

## 5 Voltage Reference

The ADS1281EVM has many options for supplying a reference voltage to the ADS1281. Jumper J1 can select the voltage from the REF5050 (U1) or use ground. The REF5050 supplies 5.0V to the reference for unipolar mode. If ground is selected, then the voltage reference becomes 2.5V in bipolar mode. This configuration comes from the voltage difference across the VREFP and VREFN pins on the ADS1281. The voltage is filtered and buffered by U3 before it is used as a reference for the ADS1281.

The ADS1281 can also be referenced by an external reference voltage using pins J6.18 (REF-) and J6.20 (REF+). Switch S1 chooses either the onboard reference or the external reference voltage that is connected to the pins of J6. [Figure 2](#) shows switch S1 as it appears on the EVM.



Figure 2. Switch S1

## 6 Power-Down, Mode and Format Control

The power-down functionality of the ADS1281 is controlled by GPIO4 (J5.14) on the EVM. The ADS1281EVM-PDK uses the I<sup>2</sup>C port expander on the EVM to allow the software to control this pin.

## 7 Clock Source

The ADS1281 clock can come from one of two sources: the onboard 4.096MHz crystal oscillator, or a clock supplied by a processor on the TOUT pin (J5.17).

### 7.1 Usage in PDK

If using the ADS1281EVM as part of the ADS1281EVM-PDK, the J3 jumper should be set to the DVDD position. Using the onboard 4.096MHz crystal oscillator allows the the ADS1281EVM-PDK software to recognize the EVM using the software provided.

### 7.2 Usage as a Stand-Alone EVM

If using the EVM within your own system and not with the PDK hardware and software, jumper J3 can be used to select the clock. The jumper can be used to always select the 4.096MHz crystal (DVDD position) or allow the onboard clock to be controlled by GPIO5 (J5.19), as shown in [Figure 3](#). The P05 (U7.6) pin allows the I<sup>2</sup>C interface to program a clock to GPIO5.



Figure 3. Jumper J3

## 8 EVM Operation

This section provides information on the analog input, digital control, and general operating conditions of the ADS1281EVM.

### 8.1 Analog Input

A single-channel differential input source can be applied directly to J6 (top or bottom side) or through several different signal-conditioning modules available for the modular EVM system. The input is connected directly through an OPA1632 buffer before reaching the ADS1281. The common-mode voltage ( $V_{COM}$ ) for the input buffer op amps is 2.5V supplied from the REF5025.

### 8.2 Digital Control

The digital control signals can be applied directly to J5 (top or bottom side). The modular ADS1281EVM 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 MMB0 if purchased as part of the ADS1281EVM-PDK. For a list of compatible interface and/or accessory boards for the EVM or the ADS1281, see the relevant product folder on the TI web site. Some of the digital signals are controlled directly with pins on J5. Other signals, such as SYNC, MFLAG, PMODE, and RESET controls, can only be controlled by U7. These signals are configured and read using the I<sup>2</sup>C signals on pins 16 and 20 of J5. The Format and Mode pins can be controlled by both methods (GPIO pins on J5, and the I<sup>2</sup>C control from U7).

### 8.3 Default Jumper Settings and Switch Positions

Figure 4 shows the jumpers found on the EVM and the respective factory default conditions for each.

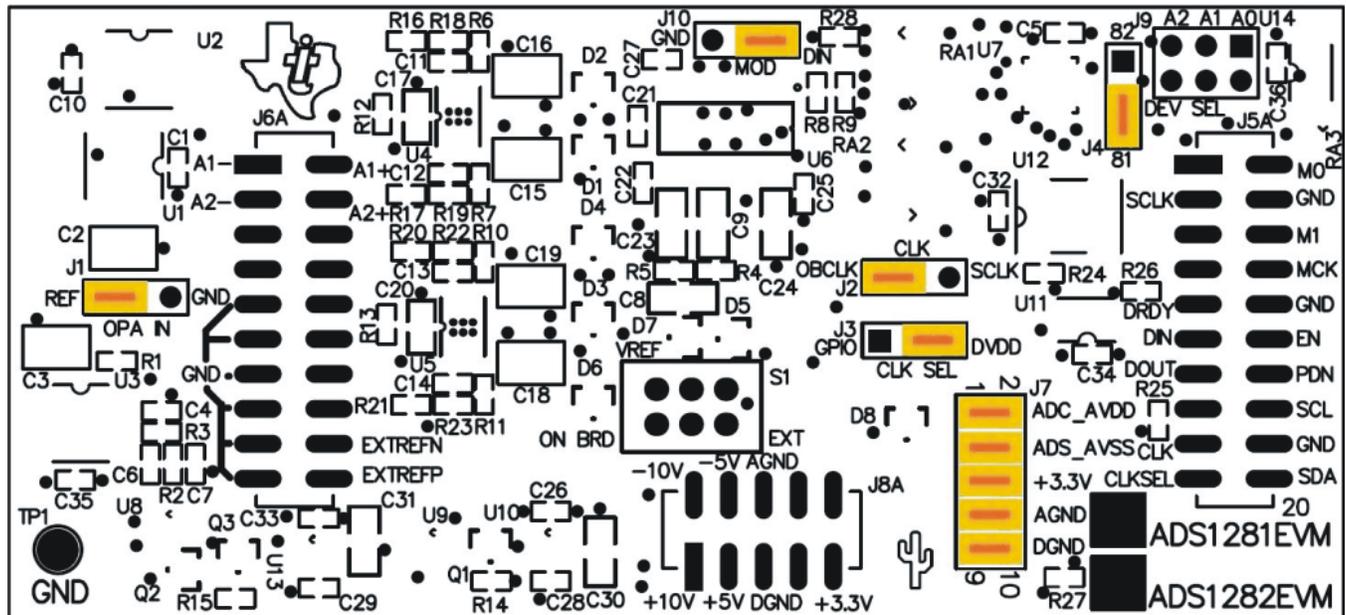


Figure 4. ADS1281EVM Default Jumper Locations

There is only one switch, S1, located on the ADS1281EVM; it is used to set VREF. The default position is to the left, indicating the EVM is to use the onboard reference voltage.

## 9 ADS1281EVM-PDK Kit Operation

This section provides information on using the ADS1281EVM-PDK, including setup, program installation, and program usage.

To prepare to evaluate the ADS1281 with the ADS1281EVM-PDK, complete the following steps:

- Step 1. Install the ADCPro software (if not already installed) on a PC.
- Step 2. Install the ADS1281EVM-PDK EVM plug-in software.
- Step 3. Set up the ADS1281EVM-PDK.
- Step 4. Connect a proper power supply or ac adapter.
- Step 5. Complete the NI-VISA™ USB driver installation process.
- Step 6. Run the ADCPro software.
- Step 7. Complete the Microsoft Windows USB driver installation process.

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

### 9.1 Installing the ADCPro Software

#### CAUTION

Do not connect the ADS1281EVM-PDK before installing the software on a suitable PC. Failure to observe this caution may cause Microsoft Windows to not recognize the ADS1281EVM-PDK as an connected device.

The latest software is available from the TI website at <http://www.ti.com/tool/ADS1281EVM-PDK>. The ADCPro software can be downloaded directly from the TI web site (<http://www.ti.com/adcpro>). Refer to the [ADCPro User Guide](#) for instructions on installing and using ADCPro.

To install the ADS1281EVM-PDK plug-in, run the file: **ads1281evm-pdk-plugin-1.0.0.exe** (1.0.0 is the version number, and increments with software version releases). Double-click the file to run it; then follow the instructions shown.

The software should now be installed, but the USB drivers may not yet have been loaded by the PC operating system. This step will complete when the ADCPro software is executed; see [Section 10, Running the Software and Completing Driver Installation](#).

## 9.2 Setting Up the ADS1281EVM-PDK

The ADS1281EVM-PDK contains both the ADS1281EVM and the MMB0 motherboard; however, the devices are shipped unconnected. Follow these steps to set up the ADS1281EVM-PDK.

- Step 1. Unpack the ADS1281EVM-PDK kit.
- Step 2. Set the jumpers and switches on the MMB0 as shown in [Figure 5](#).
  - Set the Boot Mode switch to USB.
  - Set jumper J4 low to indicate that the EVM board is a ADS1281EVM.

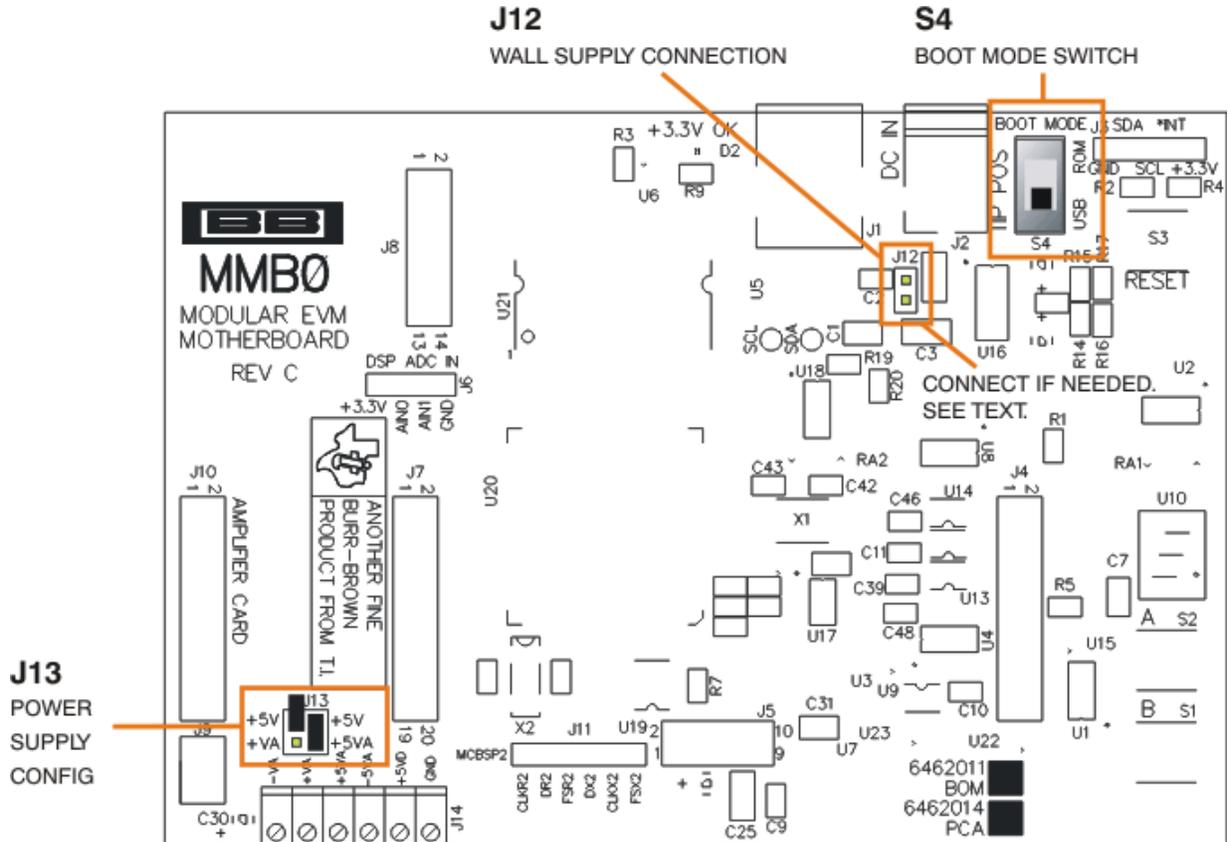
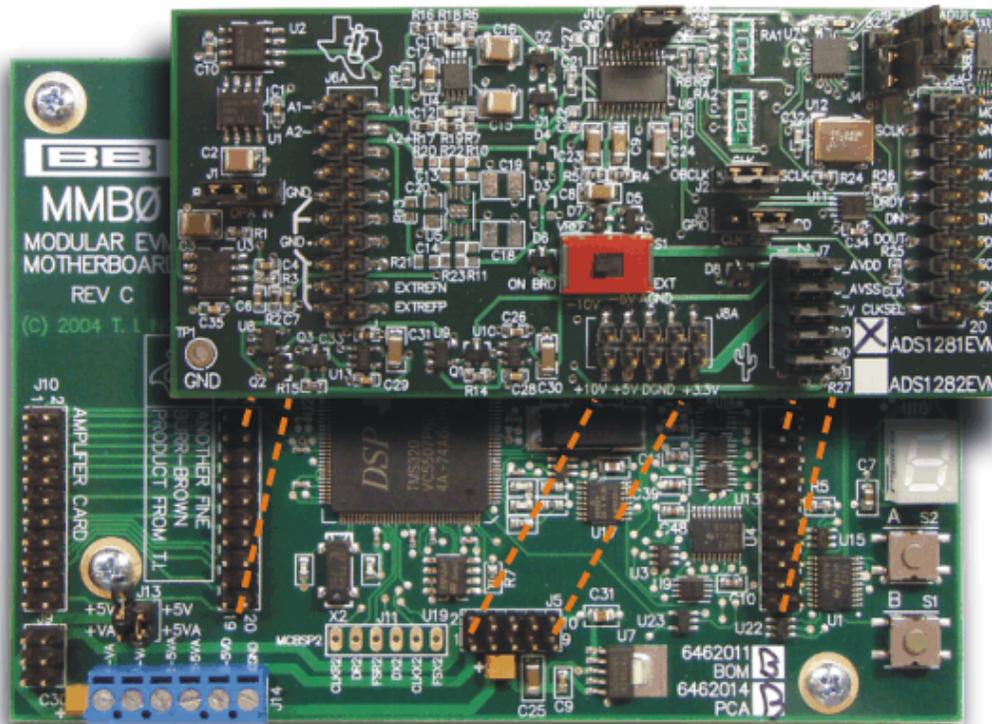


Figure 5. MMB0 Initial Setup

3. Plug the ADS1281EVM into the MMB0 as [Figure 6](#) illustrates.



**Figure 6. Connecting ADS1281EVM to MMB0**

**CAUTION**

Do not misalign the pins when plugging the ADS1281EVM into the MMB0. Check the pin alignment carefully before applying power to the PDK.

### 9.2.1 About the MMB0

The MMB0 is a Modular EVM System motherboard. It is designed around the [TMS320VC5507](#), a DSP with an onboard USB interface from Texas Instruments. The MMB0 also has 16MB of SDRAM installed.

The MMB0 is not sold as a DSP development board, and it is not available separately. TI cannot offer support for the MMB0 except as part of an EVM kit. For schematics or other information about the MMB0, contact Texas Instruments.

### 9.3 Connecting the Power Supply

The ADS1281EVM-PDK requires both a +5-V supply and a bipolar  $\pm 10$ -V supply to operate. The +5V supply can be provided by either a wall supply or bench power supply.

When the MMB0 DSP is powered properly, LED D2 glows green. The green light indicates that the 3.3V supply for the MMB0 is operating properly. (It does **not** indicate that the EVM power supplies are operating properly.)

#### 9.3.1 Using a Wall Supply for +5V

An ac wall supply can be connected to barrel jack J2 on the MMB0 to supply the +5V required for operation. J2 is located next to the USB connector.

Jumper J12 on the MMB0 connects a wall-mounted power supply to the board. To use a wall-mount supply, J12 must be shorted. [Figure 7](#) illustrates how to connect an ac adapter to the MMB0.

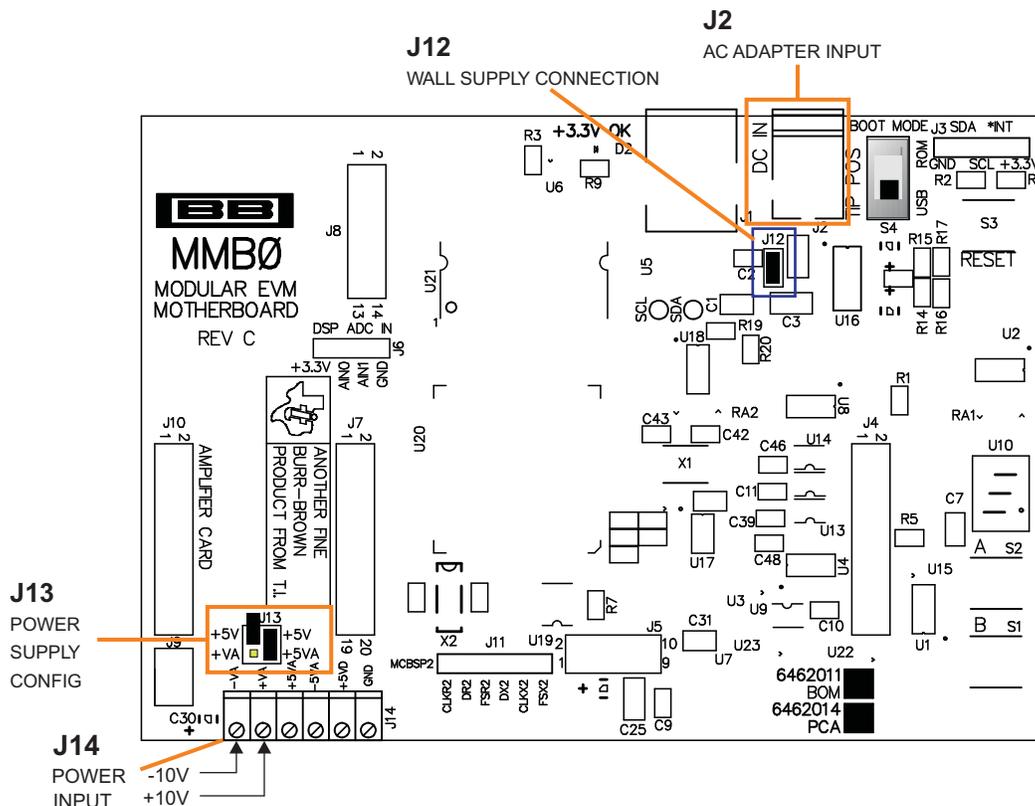


Figure 7. Using the +6V Wall Supply for +5V

#### 9.3.1.1 External Wall-Adapter Power-Supply Requirements

The external wall-adapter power-supply requirements are as follows:

- Output voltage: 6 VDC to 7 VDC
- Maximum output current:  $\geq 2$  A
- Output connector: barrel plug (positive center), 2.0-mm I.D.  $\times$  5.5-mm O.D. (9-mm insertion depth)

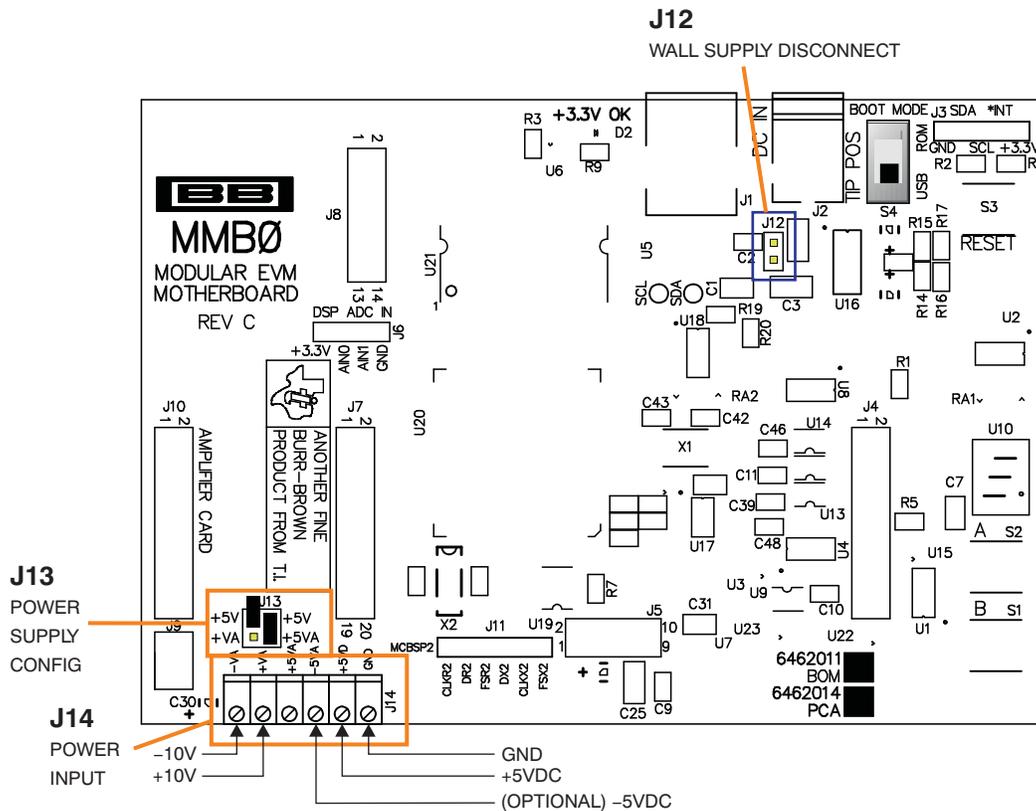
**NOTE:** Use an external power supply that complies with applicable regional safety standards; for example, UL, CSA, VDE, CCC, PSE, and so forth.

### 9.3.2 Using an External Supply For +5V

A laboratory power supply can be connected through terminal block J14 on the MMB0, as shown in [Figure 8](#), to provide the +5V required for operation.

To use a lab power supply for +5V:

- Disconnect J12 on the MMB0. This disconnect the barrel jack, J2, from powering the +5V supply.
- Connect a +5V dc supply to the +5VA and GND terminals on J14.
- Make sure that the external supply can source 2A of current to the board.



**Figure 8. Using a External Supply For +5V**

### 9.3.3 Connecting the External Bipolar Supplies

An external bipolar supply of  $\pm 10V$  is required for proper operation of the EVM. These supplies can be connected to the terminal block J14 on the MMB0.

Connect the  $-10V$  dc supply to  $-VA$ , and  $+10V$  dc to  $+VA$  terminals on J14.

### 9.3.4 Power For Bipolar Mode versus Unipolar Mode

The ADS1252EVM allows for operation of the device in either unipolar or bipolar mode. Depending on the mode, the power supply requirements can differ.

For operation in unipolar mode, no additional supplies are required other than those specified in [Section 9.3.1](#) to [Section 9.3.3](#).

For operation in bipolar mode, an additional  $-5V$  supply is required. Connect at  $-5V$  supply to  $-5VA$  terminal of J14. It is not necessary to connect a  $+5V$  dc supply voltage to the  $+5VA$  terminal on J14 if the  $+5V/+5VA$  position on J13 is shorted.

## 10 Running the Software and Completing Driver Installation

**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.

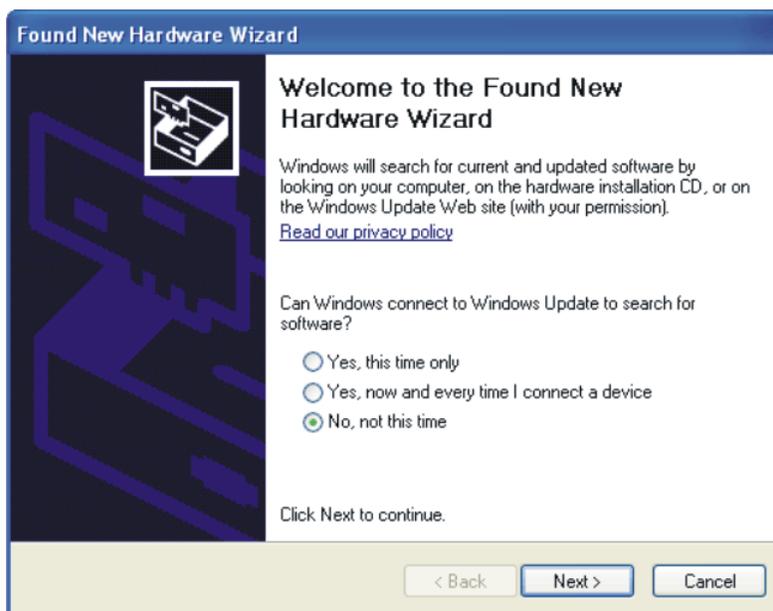
The program for evaluating the ADS1281EVM-PDK is called *ADCPro*. This program uses a series of software plug-ins to communicate with the EVM. The ADS1281EVM-PDK plug-in is included in the ADS1281EVM-PDK package.

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

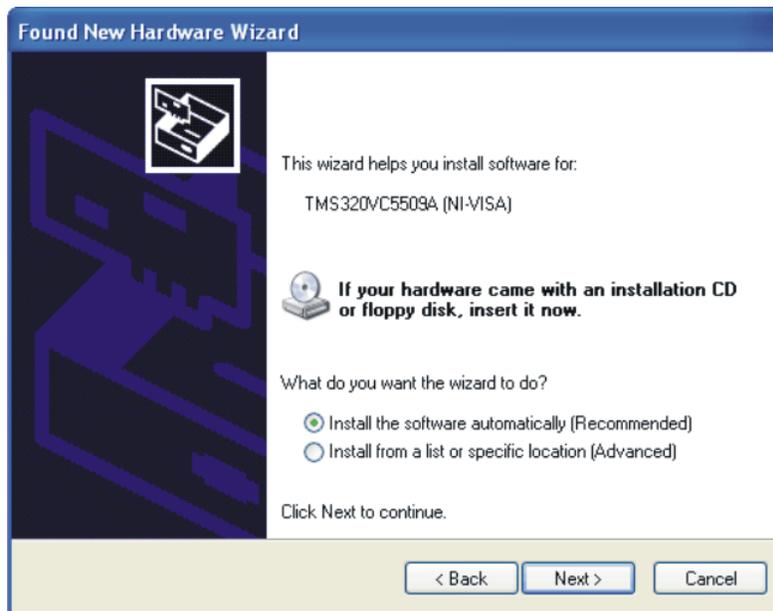
If this is the first time to install ADCPro and the plug-ins, follow these procedures to run ADCPro and complete the necessary driver installation. Make sure the ADCPro software and device plug-in software are installed from the CD-ROM as described in [Section 9.1](#), *Installing the ADCPro Software*.

### 10.1 NI-VISA USB Device Driver Installation

1. After the ADCPro software is installed, apply power to the PDK and connect the board to an available PC USB port.
2. The computer should recognize new hardware and begin installing the drivers for the hardware. [Figure 9](#) through [Figure 12](#) are provided for reference to show the installation steps.
  - For the first screen, [Figure 9](#), it is not necessary to search for the software; it has already been installed to your PC.
  - For the remaining steps, accept the default settings.



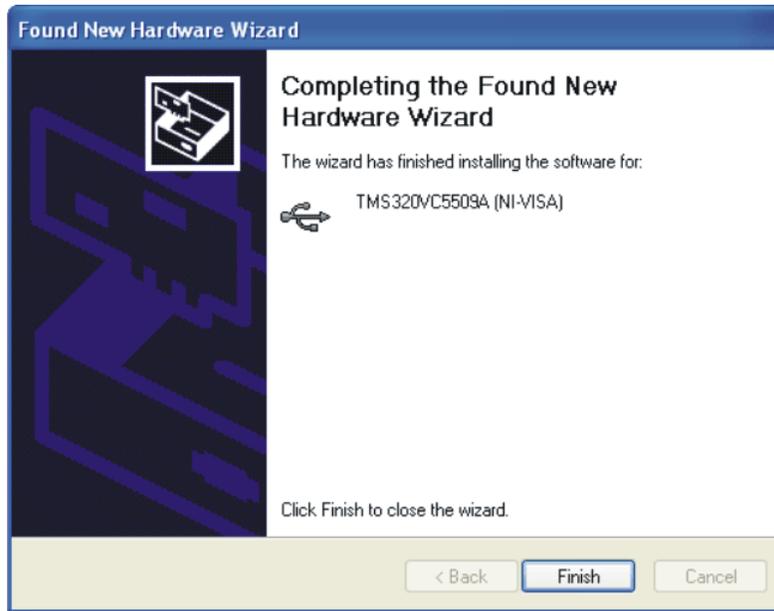
**Figure 9. NI-VISA Driver Installation**



**Figure 10. NI-VISA Driver Installation Question**



**Figure 11. NI-VISA Driver Installing**



**Figure 12. NI-VISA Driver Complete Installation**

This process should complete the installation of the NI-VISA drivers. You can verify proper installation by opening the Device Manager and locating the hardware as shown in [Figure 13](#).



**Figure 13. NI-VISA Driver Verification Using Device Manager**

## 10.2 USBStyx Driver Installation

Step 1. Start the software by selecting *ADCPro* from the Windows Start menu. The screen in [Figure 14](#) appears.

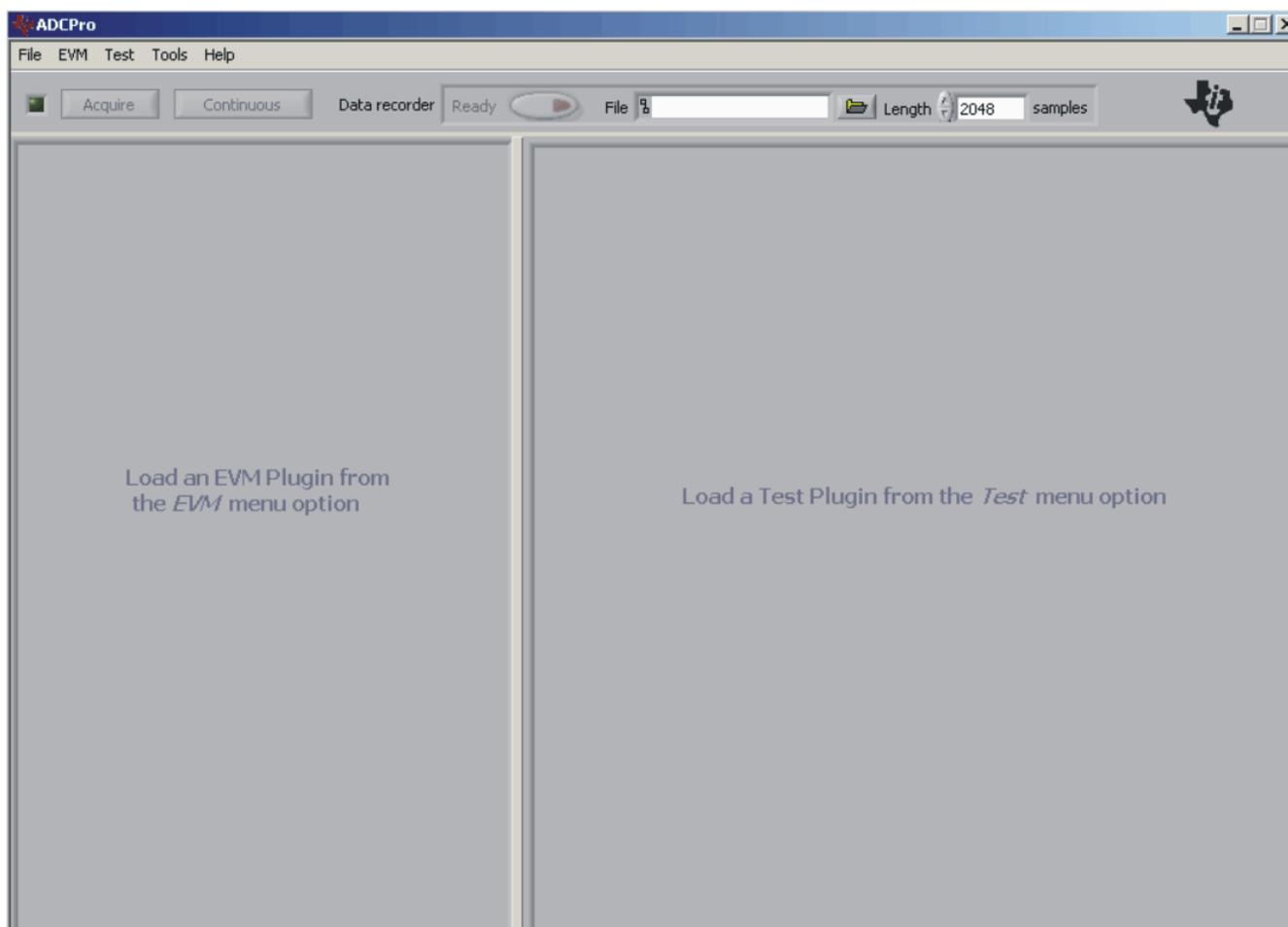
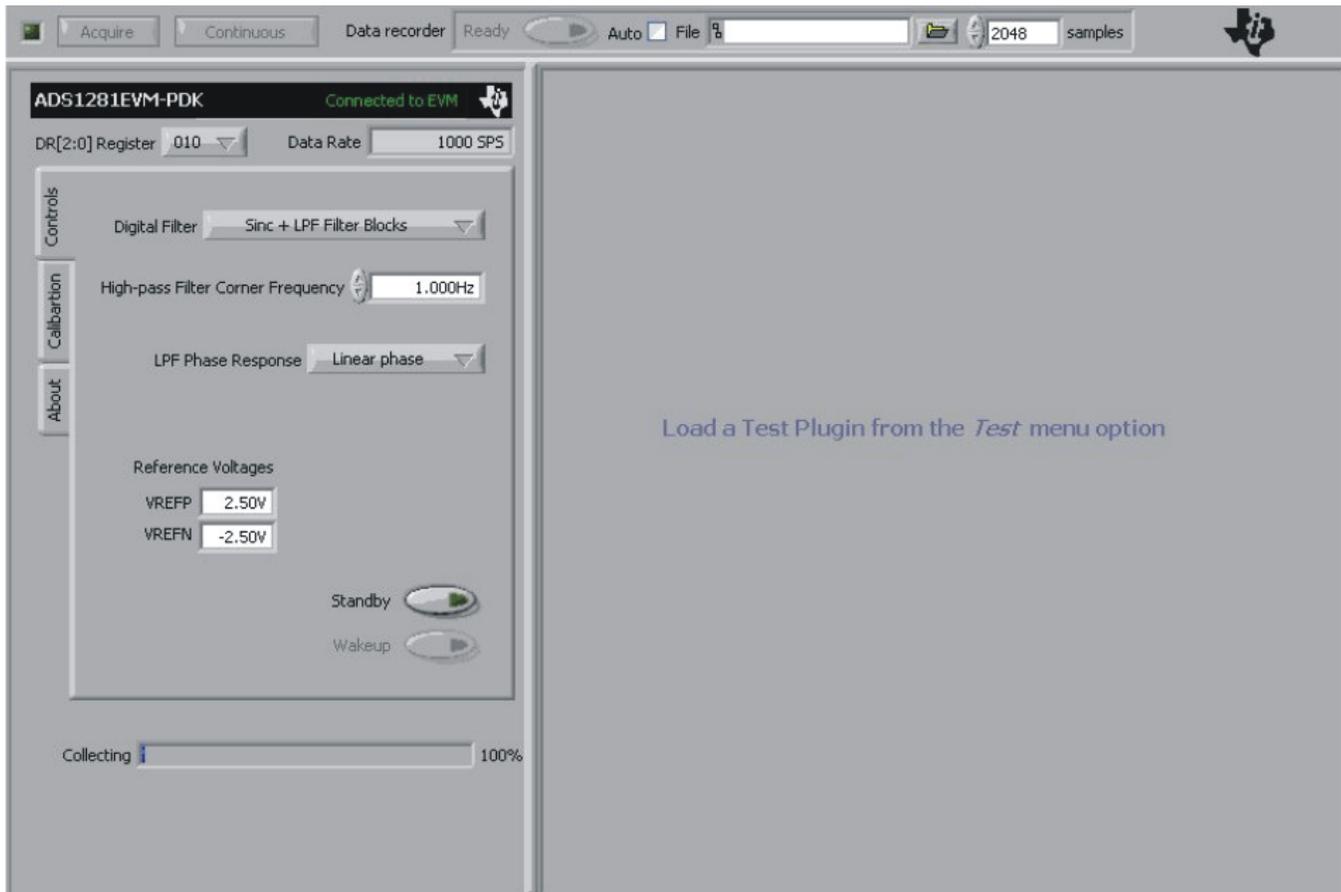


Figure 14. ADCPro Software Start-up Display Window

2. Select *ADS1281EVM* from the EVM drop-down menu. The ADS1281EVM-PDK plugin appears in the left pane, as shown in [Figure 15](#).



**Figure 15. ADS1281EVM-PDK Plug-In Display Window**

- Step 2. The ADS1281EVM-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 3. If you have not yet loaded the operating system drivers, Windows will display the *Windows Install New Driver Wizard* sequence (illustrated in [Figure 16](#) through [Figure 20](#)). Accept the default settings.

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**NOTE:** During the driver installation, a message may appear indicating the firmware load has timed out. Click OK and continue driver installation. The plug-in will attempt to download the firmware again once the driver installation completes.

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Figure 16. Install New Driver Wizard Screen 1

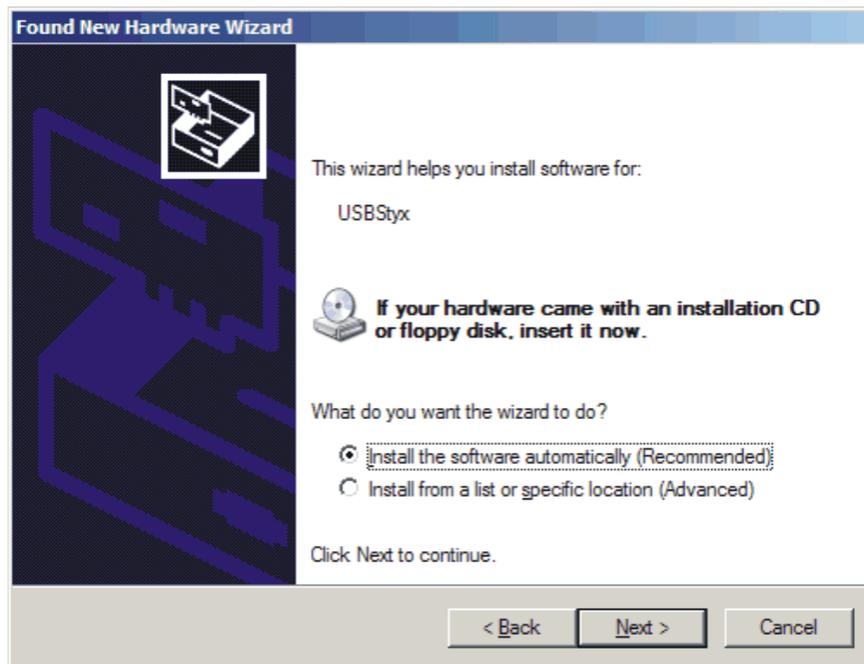


Figure 17. Install New Driver Wizard Screen 2

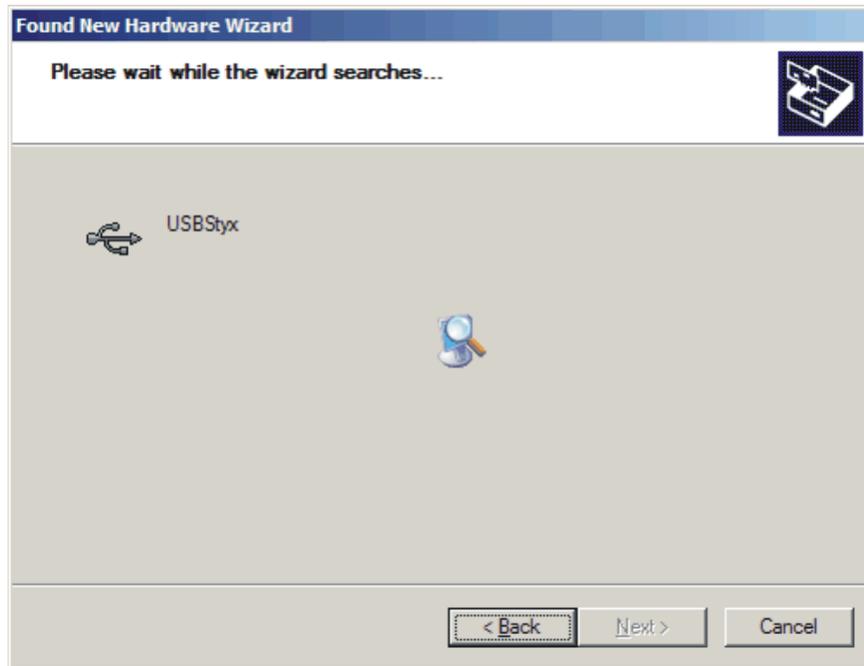


Figure 18. Install New Driver Wizard Screen 3

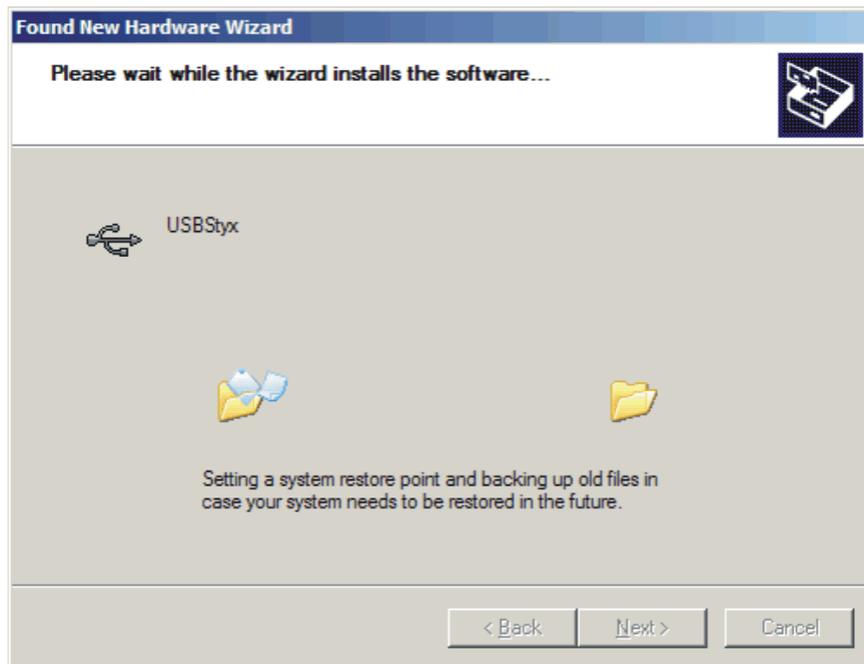
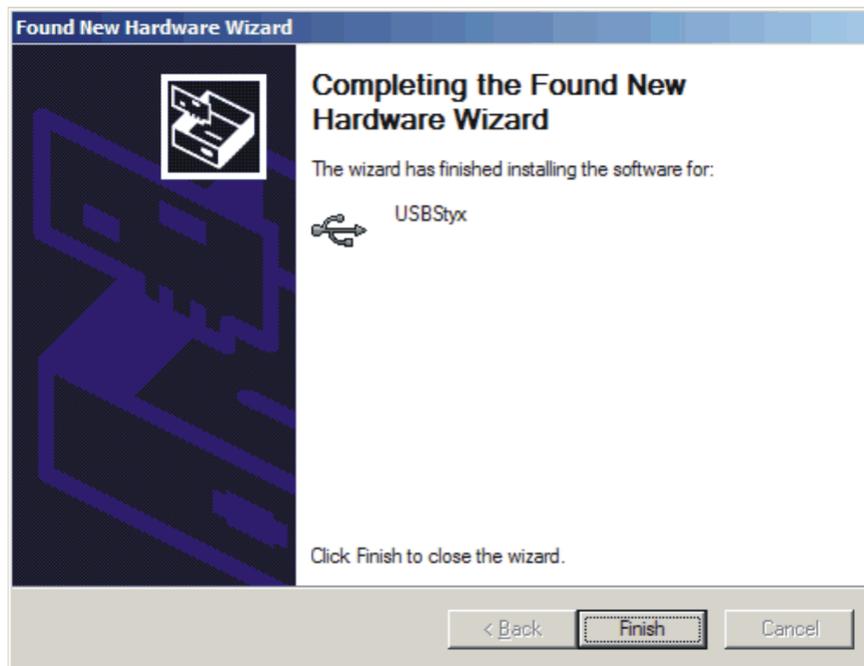


Figure 19. Install New Driver Wizard Screen 4



**Figure 20. Install New Driver Wizard Screen 5**

- Step 4. Once Windows finishes installing the software driver, the plug-in downloads the firmware to the MMB0. The status area will display *Connected to EVM* when the device is connected and ready to use. If the firmware does not load properly, you can try resetting the MMB0 by pressing Reset and then reloading the plug-in.
- Step 5. You can verify the proper installation of the USBStyx driver using the Device Manager. Note that the first driver item, **NI-VISA USB Devices**, will disappear and a new item, **LibUSB-Win32 Devices** will appear, as [Figure 21](#) shows.



**Figure 21. USBStyx Driver Verification Using Device Manager**

The driver installation wizard sequence should not appear again, unless you connect the board to a different USB port.

## 11 Evaluating Performance with the ADCPro Software

The evaluation software is based on ADCPro, a program that operates using a variety of plug-ins. (The ADS1281EVM plug-in is installed as described in the installation section, [Section 10](#).)

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.

## 11.1 Using the ADS1281EVM-PDK Plug-in

The ADS1281EVM-PDK plug-in for ADCPro provides complete control over all settings of the ADS1281. It consists of a tabbed interface (see Figure 15), with different functions available on different tabs. These controls are described in this section.

You can adjust the ADS1281EVM 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 ADS1281EVM plug-in, the setting immediately updates on the board.

Settings on the ADS1281EVM correspond to settings described in the ADS1281 product data sheet; see the ADS1281 data sheet (available for download at the TI web site) for details.

### 11.1.1 Controls Tab

ADCPro can receive data from the ADS1281 at five different data rates. The data rate is controlled by the **DR[2:0] Register** control (shown in Figure 22). The data rate choices are determined by the digital filter that is used. The setting of the register is used to choose the data rate and display it to the right of the screen.

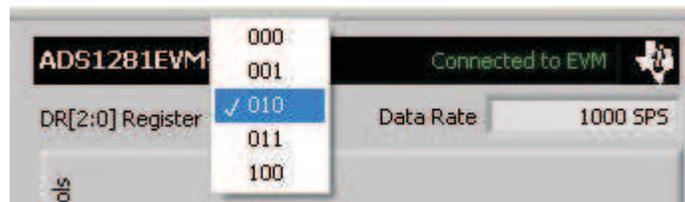


Figure 22. Data Rate Select

There are three different digital filter options in ADCPro. The *Sinc Filter + LPF Filter Blocks* option is the default filter. The Low-Pass Filter (LPF) can be removed or a High-Pass Filter (HPF) can be added (as shown in Figure 23).

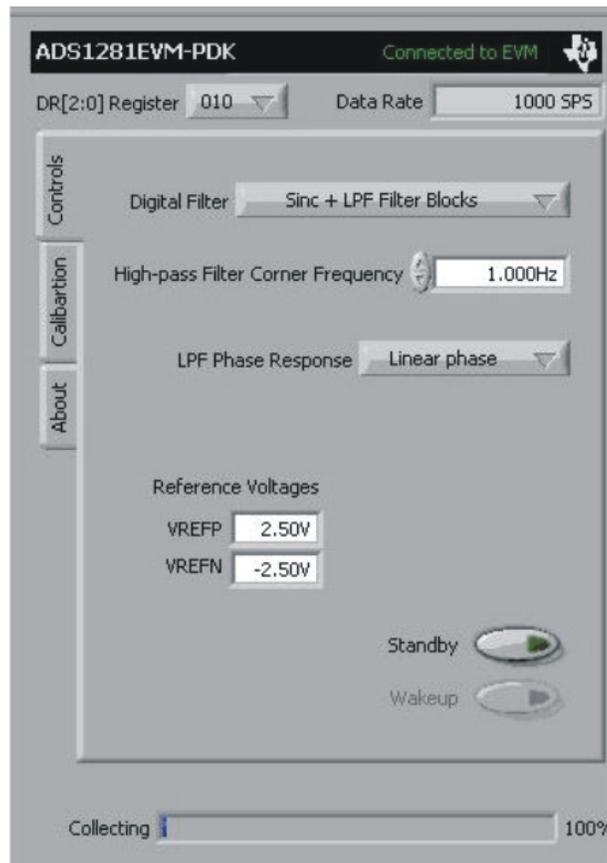


Figure 23. Digital Filter

The **LPF Phase Response** control can be set to either *Linear Phase* or *Maximum Phase*.

When switch S1 is switched to external VREF, **VREFP** and **VREFN** control the bounds for the reference voltage.

The **Standby** and **Wakeup** controls send the corresponding commands to the ADS1281 (shown in Figure 24). Data cannot be collected while the device is in the Standby mode.



**Figure 24. Controls**

### 11.1.2 Calibration Tab

A calibration feature is integrated into the ADS1281 to correct for offset and gain errors. The ADS1281EVM-PDK software is designed to allow the user to use either the built-in system calibration commands or manually calibrate the device by directly entering the values for the offset and gain registers of the ADS1281.

#### 11.1.2.1 System Calibration

The **Start Calibration** button is used for system calibration by sending the Offset and Gain Calibration commands to the ADS1281. Which command is sent is determined by the radio buttons in the **Calibration Type** groupbox (see Figure 25). The calibrations should be performed separately before testing. See the [ADS1281](#) product data sheet for more information on calibration.

A zero input signal must be applied before performing offset calibration. The *Offset* radial button should be selected. When **Start Calibration** is pushed, the offset calibration is performed and the resulting value is reflected in the **OFC** register display (in hex).

A full-scale dc input should be applied for gain calibration. The *Gain* radio button should be selected. When **Start Calibration** is pushed, the gain calibration is performed and the resulting value is reflected in the **FSC** register display (in hex).

### 11.1.2.2 Manual Calibration

The values of the offset (**OFC**) and full-scale (**FSC**) calibration registers can be written to directly if there are different offset and gain values desired to be used. The **OFC** or **FSC** registers are written to the ADS1281 when the value in these controls changes and the user deselects the text box. For ease of entry, the gain or offset values are entered only in the **OFC** or **FSC** controls; the actual values placed in each of the three corresponding registers on the ADS1281 are displayed on this tab, as [Figure 25](#) illustrates.

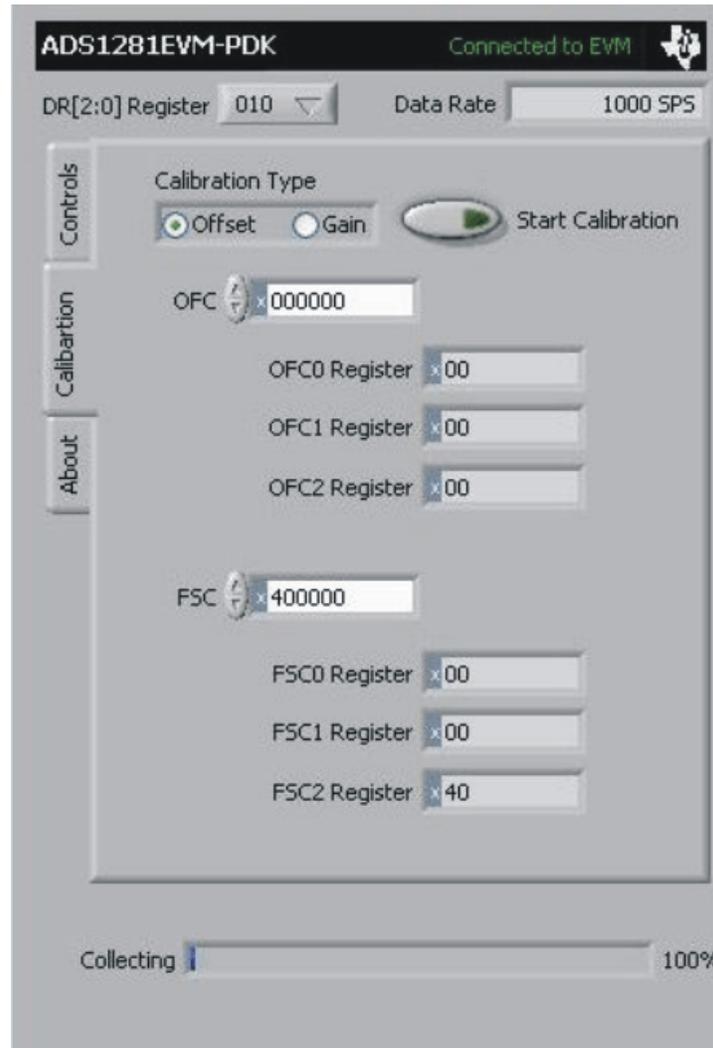
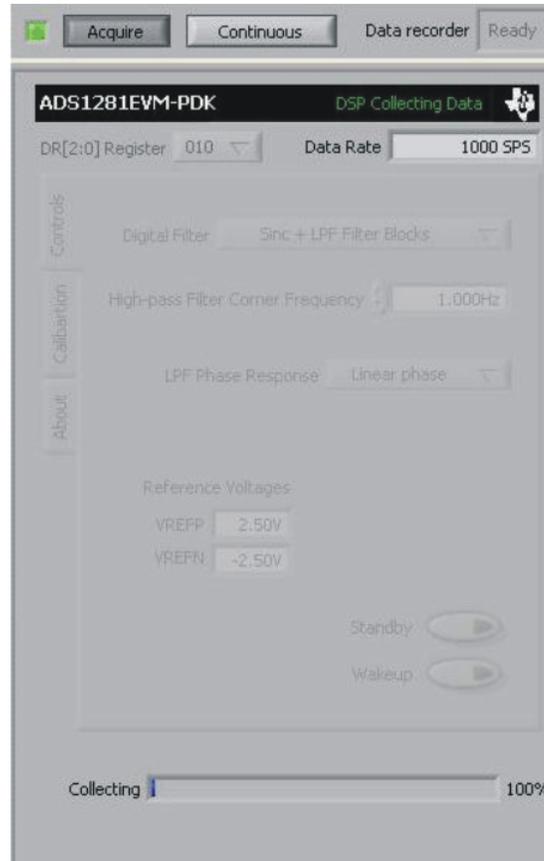


Figure 25. Calibration

### 11.1.3 Collecting Data

Once you have configured the ADS1281 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 ADS1281EVM-PDK plug-in disables all the front panel controls while acquiring, and displays a progress bar as shown in [Figure 26](#).



**Figure 26. 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](#).

### 11.2 Troubleshooting

If ADCPro stops responding while the ads1281EVM-PDK is connected, try unplugging the power supply from the PDK. Unload and reload the plug-in before reapplying power to the PDK.

## 12 Schematics and Layout

Schematics for the ADS1281EVM are appended to this user's guide. The bill of materials is provided in [Table 4](#).

### 12.1 Bill of Materials

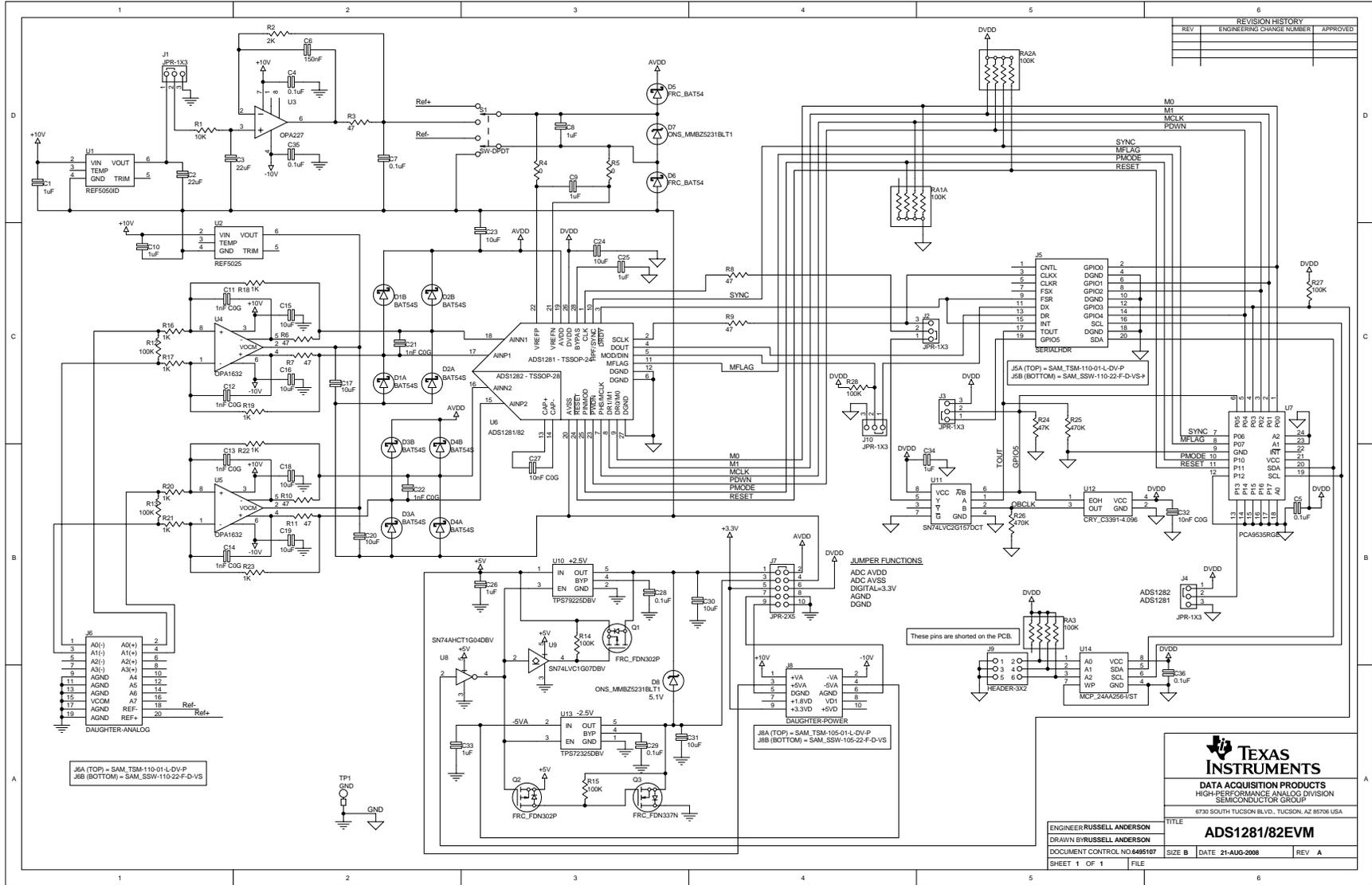
**NOTE:** All components should be compliant with the European Union Restriction on Use of Hazardous Substances (RoHS) Directive. Some part numbers may be either leaded or RoHS. Verify that purchased components are RoHS-compliant. (For more information about TI's position on RoHS compliance, see the [Quality and Eco-Info information on the TI web site](#).)

**Table 4. Bill of Materials**

Item No.	Qty	Value	Ref Des	Description	Vendor	Part Number
1	2	0	R4, R5	Resistor, Thick Film Chip 0Ω, 5%, 1/10W, Size = 0603	Panasonic	ERJ-3GEY0R00V
2	5	47	R3, R6 to R9	Resistor, Thick Film Chip 47Ω, 5%, 1/10W, Size = 0603	Panasonic	ERJ-3GEYJ470V
Not Installed	2	47	R10, R11	Resistor, Thick Film Chip 47Ω, 5%, 1/10W, Size = 0603	Panasonic	ERJ-3GEYJ470V
3	4	1k	R16 to R19	Resistor, Thick Film Chip 1kΩ, 1%, 1/16W, Size = 0603	Panasonic	ERJ-3EKF1001V
Not Installed	4	1k	R20 to R23	Resistor, Thick Film Chip 1kΩ, 1%, 1/16W, Size = 0603	Panasonic	ERJ-3EKF1001V
4	1	2k	R2	Resistor, Thick Film Chip 2kΩ, 1%, 1/16W, Size = 0603	Panasonic	ERJ-3EKF2001V
5	1	10k	R1	Resistor, Thick Film Chip 10kΩ, 5%, 1/10W, Size = 0603	Panasonic	ERJ-3GEYJ103V
6	1	47k	R24	Resistor, Thick Film Chip 47kΩ, 5%, 1/10W, Size = 0603	Panasonic	ERJ-3GEYJ473V
7	5	100k	R12, R14, R15, R27, R28	Resistor, Thick Film Chip 100kΩ, 5%, 1/10W, Size = 0603	Panasonic	ERJ-3GEYJ104V
Not Installed	1	100k	R13	Resistor, Thick Film Chip 100kΩ, 5%, 1/10W, Size = 0603	Panasonic	ERJ-3GEYJ104V
8	2	470k	R25, R26	Resistor, Thick Film Chip 470kΩ, 5%, 1/10W, Size = 0603	Panasonic	ERJ-3GEYJ474V
9	2	100k	RA1, RA2	Resistor, 8 Thick Film Chip Array 100kΩ, 5%, 63mW	CTS	745C101104JPTR
Not Installed	1	100k	RA3	Resistor, Chip Array 4 Independent Bus 100kΩ, 5%, 1/16W, SMD	CTS	741C083104JP
10	3	1nF	C11, C12, C21	Capacitor, C0G Ceramic 1nF ±5%, 50WV, Size = 0603	TDK	C1608C0G1H102JT
Not Installed	3	1nF	C13, C14, C22	Capacitor, C0G Ceramic 1nF ±5%, 50WV, Size = 0603	TDK	C1608C0G1H102JT
11	1	10nF	C32	Capacitor, C0G Ceramic 10nF ±5%, 25WV, Size = 0603	TDK	C1608C0G1E103JT
Not Installed	1	10nF	C27	Capacitor, C0G Ceramic 10nF ±5%, 25WV, Size = 0603	TDK	C1608C0G1E103JT
12	7	0.1μF	C4, C5, C7, C28, C29, C35, C36	Capacitor, X7R Ceramic 0.1μF ±10%, 25WV, Size = 0603	TDK	C1608X7R1E104KT
13	1	0.15μF	C6	Capacitor, X7R Ceramic 0.15μF ±10%, 25WV, Size = 0603	TDK	C1608X7R1E154KT
14	6	1μF	C1, C10, C25, C26, C33, C34	Capacitor, X7R Ceramic 1μF ±10%, 16WV, Size = 0603	TDK	C1608X7R1C105KT
15	2	1μF	C8, C9	Capacitor, X7R Ceramic 1μF ±10%, 50WV, Size = 1206	TDK	C3216X7R1H105KT
16	1	10μF	C17	Capacitor, X5R Ceramic 10μF ±20%, 6.3WV, Size = 0805	TDK	C2012X5R0J106MT
Not Installed	1	10μF	C20	Capacitor, X5R Ceramic 10μF ±20%, 6.3WV, Size = 0805	TDK	C2012X5R0J106MT

**Table 4. Bill of Materials (continued)**

Item No.	Qty	Value	Ref Des	Description	Vendor	Part Number
17	4	10µF	C23, C24, C30, C31	Capacitor, X7R Ceramic 10µF ±20%, 16WV, Size = 1206	TDK	C3216X7R1C106MT
18	2	10µF	C15, C16	Capacitor, X7R Ceramic 10µF ±20%, 25WV, Size = 1210	TDK	C3225X7R1E106MT
Not Installed	2	10µF	C18, C19	Capacitor, X7R Ceramic 10µF ±20%, 25WV, Size = 1210	TDK	C3225X7R1E106MT
19	2	22µF	C2, C3	Capacitor, X5R Ceramic 22µF ±20%, 16WV, Size = 1210	TDK	C3225X5R1C226MT
20	1		U6	Precision Delta-Sigma ADC, 1 Differential Input, 24-bit	Texas Instruments	ADS1281IPW
21	1		U3	Precision Operational Amplifier	Texas Instruments	OPA227U
22	1		U4	Fully-Differential Amplifier	Texas Instruments	OPA1632DGN
Not Installed	1		U5	Fully-Differential Amplifier	Texas Instruments	OPA1632DGN
23	1		U2	Precision Voltage Reference, 2.5V	Texas Instruments	REF5025ID
24	1		U1	Precision Voltage Reference, 5V	Texas Instruments	REF5050ID
25	1		U8	Inverter, Single Gate	Texas Instruments	SN74AHCT1G04DBVT
26	1		U9	Buffer, Open Drain, Single Gate	Texas Instruments	SN74LVC1G07DBVT
27	1		U11	Single, 2-Line to 1 Data Selector/Multiplexer	Texas Instruments	SN74LVC2G157DCTR
28	1		U13	LDO Voltage Regulator, 2.5V, 200mA	Texas Instruments	TPS72325DBVT
29	1		U10	LDO Voltage Regulator, 2.5V, 100mA	Texas Instruments	TPS79225DBVT
30	1		U7	16-Bit I <sup>2</sup> C I/O Expander	Texas Instruments	PCA9535RGE
31	1	4.096MHz	U12	3.3 V Oscillator	Crystek	C3391-4.096
32	2		Q1, Q2	MOSFET, P-Channel, 2.5V	Fairchild Semiconductor	FDN302P
33	1		Q3	Enhancement Mode FET, N-Channel	Fairchild Semiconductor	FDN337N
34	1		U14	EEPROM, 1.8V, 256K	Microchip	24AA256-I/ST
35	2		J5A, J6A	20 pin SMT plug	Samtec	TSM-110-01-L-DV-P
36	2		J5B, J6B	20 pin SMT socket	Samtec	SSW-110-22-F-D-VS-K
37	1		J8A	10 pin SMT plug	Samtec	TSM-105-01-L-DV-P
38	1		J8B	10 pin SMT socket	Samtec	SSW-105-22-F-D-VS-K
39	5		J1 to J4, J10	Header strip, 3 pin ( )	Samtec	TSW-103-07-L-S
Not Installed	1		J9	Header strip, 6-pin ( )	Samtec	TSW-103-07-L-D
40	1		J7	Header strip, 10-pin ( )	Samtec	TSW-105-07-L-D
41	1		N/A	ADS1281_82 EVM PWB	Texas Instruments	6495106
42	2		D5, D6	Schottky diode	Fairchild	BAT54
43	2		D1, D2	Schottky diode, stacked	Fairchild	BAT54S
Not Installed	2		D3, D4	Schottky diode, stacked	Fairchild	BAT54S
44	2		D7, D8	5.1V Zener diode	On Semiconductor	MMBZ5231BLT1G
45	1		S1	Switch, Mini dslide, DPDT	NKK	SS22SDP2
46	1		TP1	PCB Test Point, Large Loop, Through-Hole	Keystone Electronics	5011
47	9		N/A	Shorting blocks	Samtec	SNT-100-BK-G-H



REVISION HISTORY		
REV	ENGINEERING CHANGE NUMBER	APPROVED

J5A (TOP) = SAM\_TSM-110-01-L-DV-P  
 J5B (BOTTOM) = SAM\_SSW-110-22-F-D-V-S

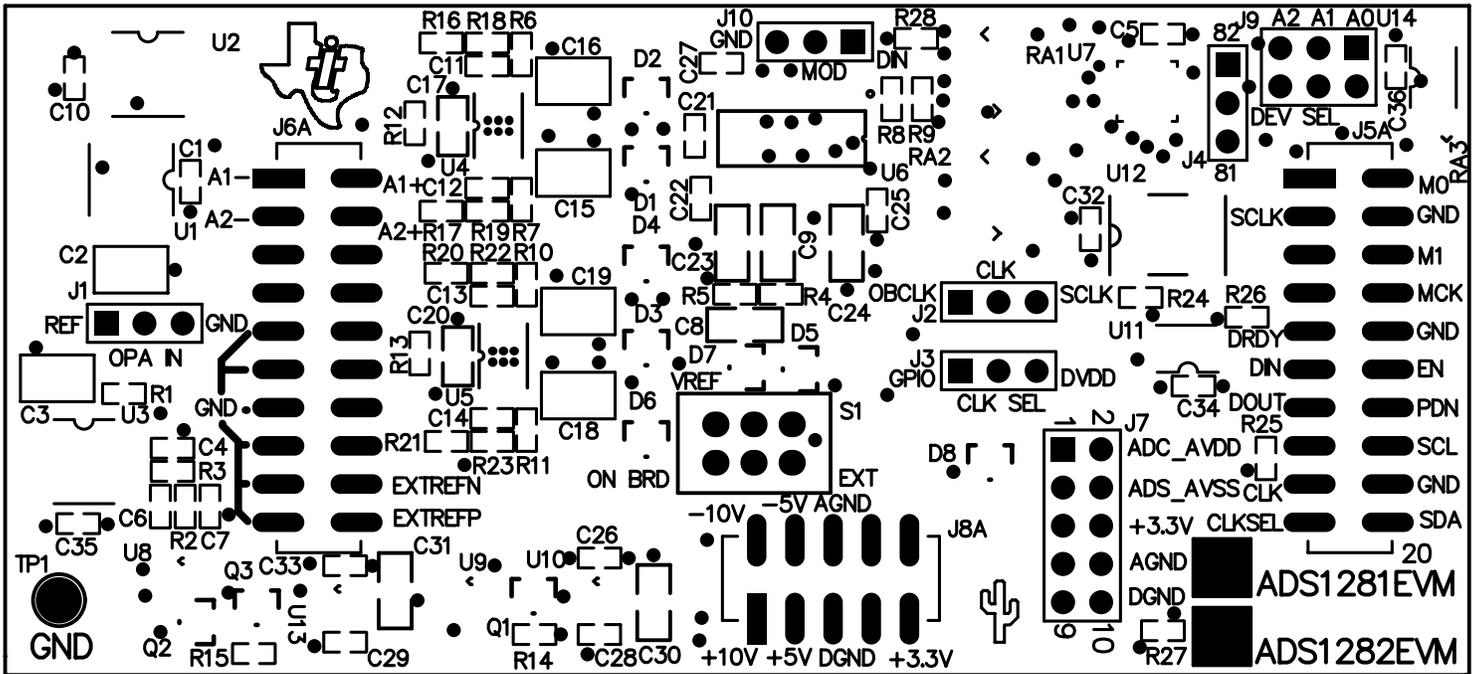
J6A (TOP) = SAM\_TSM-105-01-L-DV-P  
 J6B (BOTTOM) = SAM\_SSW-105-22-F-D-V-S

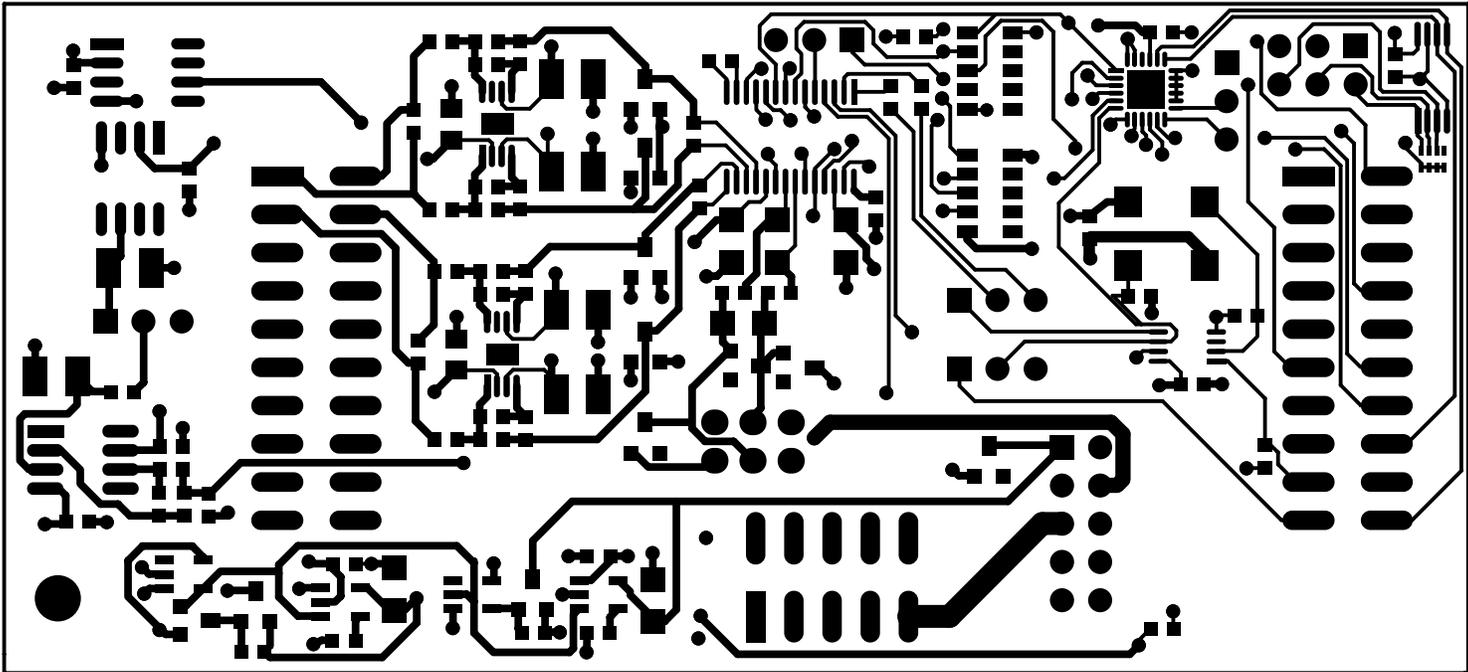
JUMPER FUNCTIONS  
 ADC AVDD  
 ADC AVSS  
 DIGITAL=3.3V  
 AGND  
 DGND

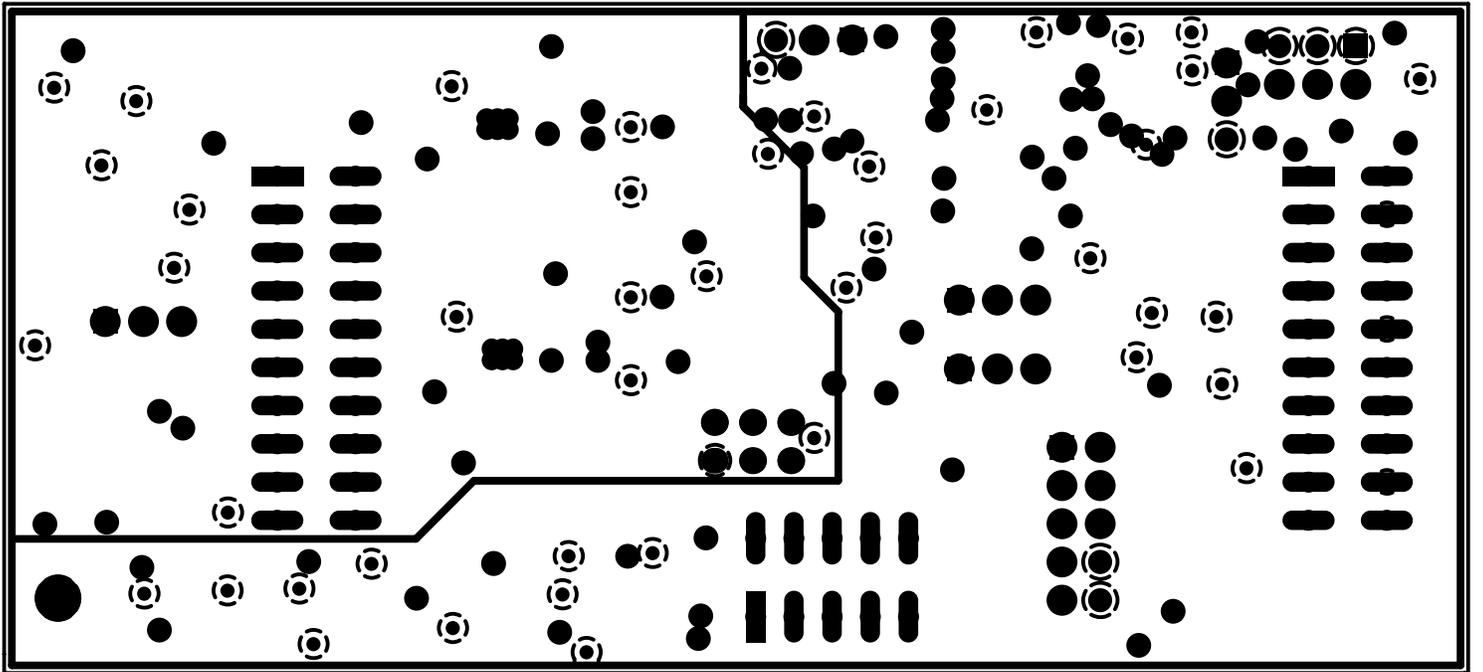
These pins are shorted on the PCB.

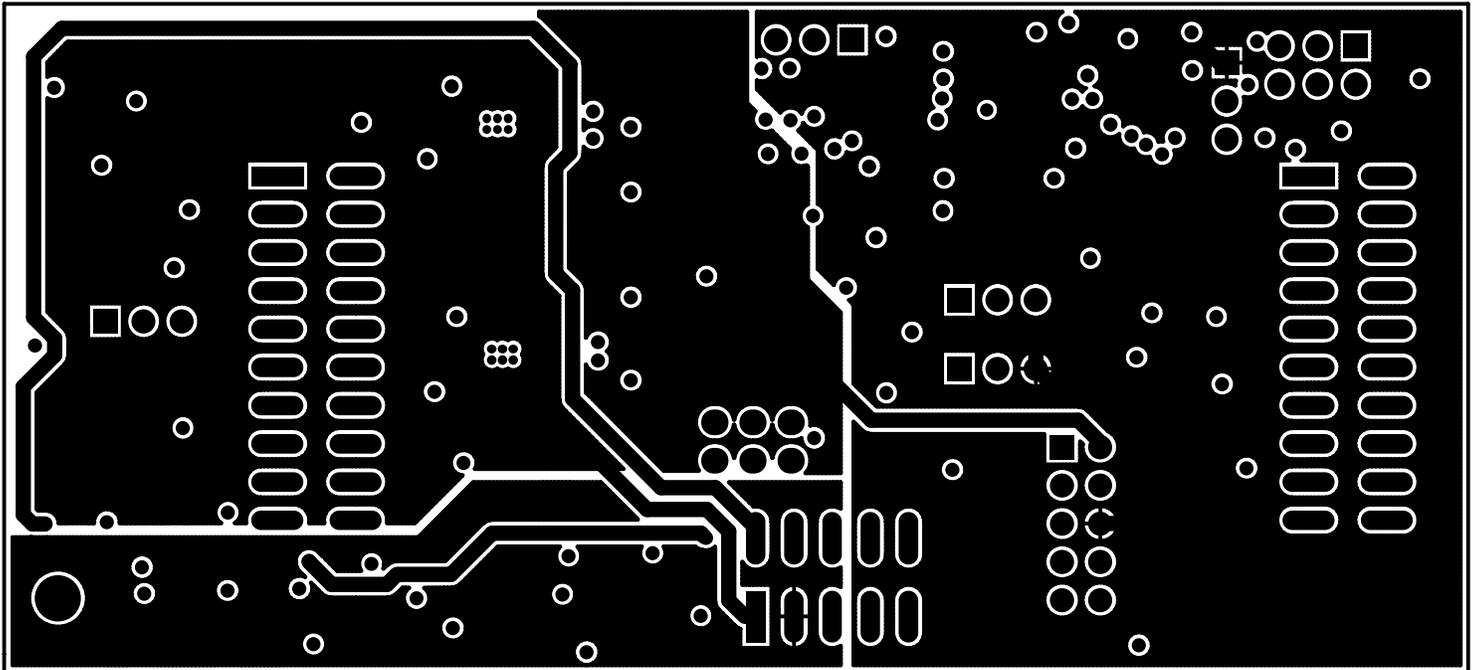
**TEXAS INSTRUMENTS**  
 DATA ACQUISITION PRODUCTS  
 HIGH-PERFORMANCE ANALOG DIVISION  
 SEMICONDUCTOR GROUP  
 6730 SOUTH TUCCSON BLVD., TUCSON, AZ 85706 USA

ENGINEER RUSSELL ANDERSON	TITLE	<b>ADS1281/82EVM</b>	
DRAWN BY RUSSELL ANDERSON	DATE	21-AUG-2008	REV A
DOCUMENT CONTROL NO. 6495107	SIZE B		
SHEET 1 OF 1	FILE		

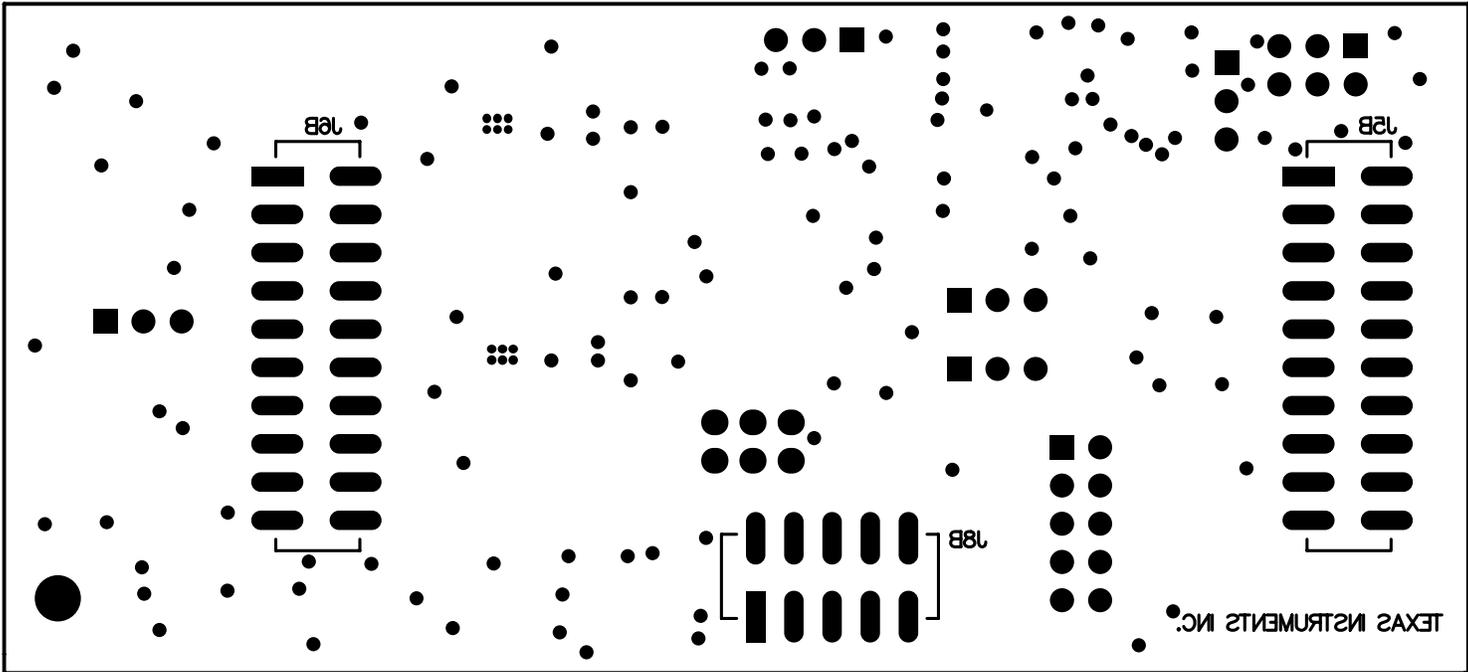












TEXAS INSTRUMENTS INC.

## Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

<b>Changes from C Revision (May 2011) to D Revision</b>	<b>Page</b>
• Changed function parameters on the J5.12 row in the <i>J5: Serial Interface Pins</i> table. ....	4
• Added <i>External Wall-Adapter Power-Supply Requirements</i> section. ....	11
• Changed text of first paragraph in the <i>Connecting the External Bipolar Supplies</i> section. ....	12

## STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, or documentation (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.
  - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms and conditions that accompany such Software
  - 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.
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  - 2.1 These terms and conditions do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
  - 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for any defects that are caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.
  - 2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.
3. *Regulatory Notices:*
  - 3.1 *United States*
    - 3.1.1 *Notice applicable to EVMs not FCC-Approved:*

This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.
    - 3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

### CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### FCC Interference Statement for Class A EVM devices

*NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.*

## **FCC Interference Statement for Class B EVM devices**

*NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:*

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

### 3.2 Canada

#### 3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210

##### **Concerning EVMs Including Radio Transmitters:**

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

##### **Concernant les EVMs avec appareils radio:**

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

##### **Concerning EVMs Including Detachable Antennas:**

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

##### **Concernant les EVMs avec antennes détachables**

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

### 3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see [http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page) 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。  
[http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page)

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。技術適合証明を受けていないものご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

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