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

<table>
<thead>
<tr>
<th>Device</th>
<th>Literature Number</th>
<th>Device</th>
<th>Literature Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADS1281</td>
<td>SBAS378B</td>
<td>SN74LVC2G157</td>
<td>SCES207K</td>
</tr>
<tr>
<td>REF5025</td>
<td>SBOS410C</td>
<td>SN74LVC1G07</td>
<td>SCES296W</td>
</tr>
<tr>
<td>REF5050</td>
<td>SBOS410C</td>
<td>SN74AHC1G04</td>
<td>SCLS319N</td>
</tr>
<tr>
<td>OPA2350</td>
<td>SBOS099C</td>
<td>TPS79225</td>
<td>SLVS337B</td>
</tr>
<tr>
<td>OPA1632</td>
<td>SBOS286A</td>
<td>TPS72325</td>
<td>SLVS346B</td>
</tr>
<tr>
<td>PCA9535</td>
<td>SCPS129H</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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I²C is a trademark of NXP Semiconductors.
NI-VISA is a trademark of National Instruments.
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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](http://www.ti.com/lit/an/sbav399/sbav399.pdf) (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](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

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

### 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](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 I2C pins. These pins conform to 3.3V I2C™ rules. Table 2 describes the J5 serial interface pins.

### Table 2. J5: Serial Interface Pins

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Pin Name</th>
<th>Signal Name</th>
<th>I/O Type</th>
<th>Pull-Up</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>J5.1</td>
<td>CNTL</td>
<td>Unused</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J5.2</td>
<td>GPIO0</td>
<td>M0</td>
<td>In/Out</td>
<td>Low</td>
<td>Data rate select input / Modulator data output</td>
</tr>
<tr>
<td>J5.3</td>
<td>CLKX</td>
<td>SCLK</td>
<td>In</td>
<td>None</td>
<td>ADS1281 SPI™ clock</td>
</tr>
<tr>
<td>J5.4</td>
<td>DGND</td>
<td>DGND</td>
<td>In/Out</td>
<td>None</td>
<td>Digital ground</td>
</tr>
<tr>
<td>J5.5</td>
<td>CLKR</td>
<td>Unused</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J5.6</td>
<td>GPIO1</td>
<td>M1</td>
<td>In/Out</td>
<td>High</td>
<td>Data rate select input / Modulator data output</td>
</tr>
<tr>
<td>J5.7</td>
<td>FSX</td>
<td>Unused</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J5.8</td>
<td>GPIO2</td>
<td>MCLK</td>
<td>Out</td>
<td>Low</td>
<td>Modulator clock output</td>
</tr>
<tr>
<td>J5.9</td>
<td>FSR</td>
<td>DDDY</td>
<td>Out</td>
<td>None</td>
<td>Data ready signal</td>
</tr>
<tr>
<td>J5.10</td>
<td>DGND</td>
<td>DGND</td>
<td>In/Out</td>
<td>None</td>
<td>Digital ground</td>
</tr>
<tr>
<td>J5.11</td>
<td>DX</td>
<td>MOD/DIN</td>
<td>In</td>
<td>None</td>
<td>ADS1281 SPI data in</td>
</tr>
<tr>
<td>J5.12</td>
<td>GPIO3</td>
<td>SUPSOR</td>
<td>In</td>
<td>High</td>
<td>Power-supply regulator Hi = 5 V Lo = ±2.5 V</td>
</tr>
<tr>
<td>J5.13</td>
<td>DR</td>
<td>DOUT</td>
<td>Out</td>
<td>None</td>
<td>ADS1281 data out</td>
</tr>
<tr>
<td>J5.14</td>
<td>GPIO4</td>
<td>PDWN</td>
<td>In</td>
<td>High</td>
<td>Power-down input</td>
</tr>
<tr>
<td>J5.15</td>
<td>INT</td>
<td>DDDY</td>
<td>Out</td>
<td>None</td>
<td>Data Ready signal</td>
</tr>
<tr>
<td>J5.16</td>
<td>SCL</td>
<td>SCL</td>
<td>I2C</td>
<td>—</td>
<td>I2C clock</td>
</tr>
</tbody>
</table>
Table 2. J5: Serial Interface Pins (continued)

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Pin Name</th>
<th>Signal Name</th>
<th>I/O Type</th>
<th>Pull-Up</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>J5.17</td>
<td>TOUT</td>
<td>CLK</td>
<td>In</td>
<td>None</td>
<td>Can be used to provide a clock from a processor</td>
</tr>
<tr>
<td>J5.18</td>
<td>DGND</td>
<td>DGND</td>
<td>In/Out</td>
<td>None</td>
<td>Digital ground</td>
</tr>
<tr>
<td>J5.19</td>
<td>GPIO5</td>
<td>EXTCLK</td>
<td>In</td>
<td>None</td>
<td>External clock input</td>
</tr>
<tr>
<td>J5.20</td>
<td>SDA</td>
<td>SDA</td>
<td>I²C</td>
<td>—</td>
<td>I²C data</td>
</tr>
</tbody>
</table>

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

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

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, ±5V supplies must be connected to pins J8.3 and J8.4. The ±5V is regulated down to ±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\(^2\)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\(^2\)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 I²C 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 I²C 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](image)

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 website (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](image-url)
3. Plug the ADS1281EVM into the MMB0 as Figure 6 illustrates.

![Figure 6. Connecting ADS1281EVM to MMB0](image)

**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 ±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: ≥ 2 A
- Output connector: barrel plug (positive center), 2.0-mm I.D. × 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.

9.3.3 Connecting the External Bipolar Supplies

An external bipolar supply of ±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](image)
Figure 10. NI-VISA Driver Installation Question

Figure 11. NI-VISA Driver Installing
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.

![ADCPro Software Start-up Display Window](image-url)

*Figure 14. ADCPro Software Start-up Display Window*
2. Select \textit{ADS1281EVM} from the EVM drop-down menu. The ADS1281EVM-PDK plugin appears in the left pane, as shown in Figure 15.

![Image of ADS1281EVM-PDK Plug-In Display Window]

\textbf{Figure 15. ADS1281EVM-PDK Plug-In Display Window}

\textbf{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.

\textbf{Step 3.} If you have not yet loaded the operating system drivers, Windows will display the \textit{Windows Install New Driver Wizard} sequence (illustrated in Figure 16 through Figure 20). Accept the default settings.

\textbf{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.
Running the Software and Completing Driver Installation

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
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](image)

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](image)

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](image)

### 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](image)

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.)

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<td>Shorting blocks</td>
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Revision History

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

<table>
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<td>• Changed function parameters on the J5.12 row in the J5: Serial Interface Pins table. ........................................ 4</td>
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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.

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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.

2 **Limited Warranty and Related Remedies/Disclaimers:**

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/sds/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/sds/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.
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2. 実験局の免許を取得後ご使用いただく。
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西新宿三井ビル

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http://www.tij.co.jp/lsds/ti_ia/general/eStore/notice_02.page

4 EVM Use Restrictions and Warnings:
4.1 EVMs ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.
4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.
4.3 Safety-Related Warnings and Restrictions:
4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user 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, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.
4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

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