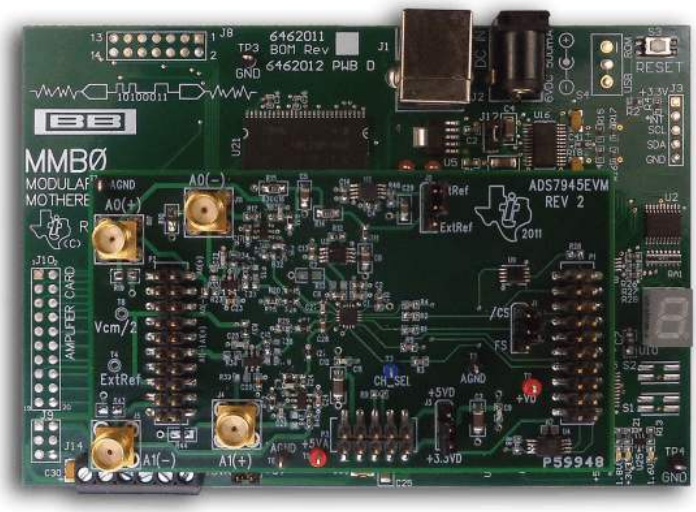
ADS794xEVM and ADS794xEVM-PDK



ADS794xEVM-PDK

This user's guide describes the characteristics, operation, and use of the ADS794xEVM by itself and as part of the ADS794xEVM-PDK kit. These evaluation modules (EVMs) allow evaluation of all aspects of either the ADS7946 or ADS7945 devices (ADS794x). Both devices are 14-bit, dual-channel, ultralow-power, differential successive-approximation-register (SAR) analog-to-digital converters (ADCs) with a maximum throughput rate of 2 MSPS. The ADS7945 offers fully-differential input voltages while the pseudo-differential inputs of the ADS7946 offer single-ended input voltages with small common-mode noise-cancelling capabilities. Complete circuit descriptions, schematic diagrams, and bill of materials are included in this document.

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

Table 1. Related Documentation

Device	Literature Number
ADS7945	SBAS539
ADS7946	
OPA350	SBOS099C
OPA836	SLOS712B
REF5040	SBOS410E
SN74LVC2G74	SCES203M

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1 EVM Overview

1.1 Features

ADS794xEVM Features:

- Contains all support circuitry needed for the ADS7946/ADS7945 (ADS794x)
- 5-V, 3.3-V, and 1.8-V logic compatible with 16-bit, 40-MHz SPI™ serial interface
- Simple channel selection with a single 16-bit word command
- Serial interface header for easy connection to TI DSP-based communication systems
- Compatible with the TI Modular EVM System
- Voltage reference options: onboard REF5040 (4.096-V) reference or external reference
- Voltage reference buffering with OPA350
- Onboard OPA836 (200-MHz BW, 1-mA quiescent current) ADC input drivers
- Jumper-selectable bipolar ($-V_{REF}/2$ to $+V_{REF}/2$) or unipolar (0 V to V_{REF}) input range

ADS794xEVM-PDK Features:

- Easy-to-use evaluation software for Microsoft Windows XP® operating system PCs
- 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

The ADS794xEVM-PDK is available for use with a computer. This kit combines the ADS794xEVM board with the DSP-based MMB0 motherboard, and includes ADCPro™ software for evaluation.

The MMB0 motherboard allows the ADS794xEVM to be connected to the computer via an available USB port. This manual shows how to use the MMB0 as part of the ADS794xEVM-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 ADS794xEVM-PDK is controlled by a plug-in running in ADCPro. For more information about ADCPro, see the ADCPro™ Analog-to-Digital Converter Evaluation Software User's Guide (literature number SBAU128), available for download from the TI web site.

This manual covers the operation of both the ADS794xEVM and the ADS794xEVM-PDK. Throughout this document, the abbreviation *EVM* and the term *evaluation module* are synonymous with the ADS794xEVM. Operation of the EVM and kit for both the ADS7946 and the ADS7945 devices is identical, unless otherwise noted.

1.2 Introduction

The ADS794xEVM is an evaluation module built to the TI Modular EVM System specifications. It can be connected to any modular EVM system interface card.

The ADS794xEVM is available as a stand-alone printed circuit board (PCB) or as part of the ADS794xEVM-PDK, which includes an MMB0 motherboard and software. As a stand-alone PCB, the ADS794xEVM is useful for prototyping designs and firmware because it offers circuitry that meets the product data sheet specifications of either the ADS7946 or ADS7945 devices.

The ADS7945 and ADS7946 are 14-bit, 2-MSPS ADCs with fully differential and pseudo-differential unipolar inputs, respectively. These devices operate at a 2-MSPS sample rate with a 16-clock SPI data frame that features both outstanding dc and excellent dynamic performance. These devices also include a two-channel input multiplexer and a low-power SAR ADC with an inherent sample-and-hold (S/H) input stage. During normal operation at 2 MSPS, the ADS794x dissipates a mere 11.6 mW.

Note that the ADS794xEVM has no microprocessor and cannot run software. Therefore, some type of interface is required to connect the ADS794xEVM to a computer. In the ADS794xEVM-PDK kit, the MMB0 motherboard serves as the interface between the computer and the ADS794xEVM board.

2 Analog Interface

The ADS794xEVM is designed for easy interfacing to multiple analog sources. SMA connectors allow the EVM to have input signals connected via coaxial cables. In addition, the Samtec connector provides a convenient 10-pin, dual-row, header/socket combination at P2. This header/socket provides access to the analog input pins of the ADS794x. Consult Samtec at http://www.samtec.com or call 1-800-SAMTEC-9 for a variety of mating connector options. All analog inputs are buffered by OPA836 high-speed operational amplifiers in order to properly drive the ADS794x ADC inputs.

Use appropriate caution when handling these pins. Table 2 summarizes the pinout for analog interface P2.

Table 2. P2: Analog Interface Pinout (Samtec 10 x 2)

Pin Number	Signal	Description
P2.2	A0(+) / OPEN	CH0 positive differential input for ADS7945; open if ADS7946 is installed
P2.4	A0(–)	CH0 negative differential input for ADS7945; single-ended input for ADS7946
P2.10	A1(+) / OPEN	CH1 positive differential input for ADS7945; open if ADS7946 is installed
P2.12	A1(–)	CH1 negative differential input for ADS7945; single-ended input for ADS7946
P2.1-19 (odd)	GND	Analog ground connections (except J1.15)
P2.6 and P2.8	GND	Analog ground connections
P2.14, P2.16, and P2.18	GND	Analog ground connections
P2.15	$V_{REF}/4$ or $V_{REF}/2$	Unbuffered output. $V_{REF}/4$ (J6 open) or $V_{REF}/2$ (J6 closed)
P2.20	Ext V_{REF}	External reference voltage input

Table 3 lists the SMA analog inputs.

Table 3. SMA Analog Inputs

Pin Number	Signal	Description
J10	A0(+) / No SMA	CH0 positive differential input for ADS7945; no SMA if ADS7946 is installed
J11	A0(–)	CH0 negative differential input for ADS7945; single-ended input for ADS7946
J4	A1(+) / No SMA	CH1 positive differential input for ADS7945; no SMA if ADS7946 is installed
J5	A1(–)	CH1 negative differential input for ADS7945; single-ended input for ADS7946

As noted in Table 2 and Table 3, there are different hardware configurations depending on the installed converter. The ADS7945 uses two inputs per channel because of its fully differential inputs. The ADS7946 uses one input per channel for its pseudo-differential inputs.

2.1 ADS794xEVM Analog Inputs with ADS7945 Installed

Each channel of the ADS7945 uses two OPA836 operational amplifiers to drive the fully differential inputs. The input signals can be applied to either the SMA or P2 header connectors. These operational amplifiers offset the input signal to use an inverting configuration with a single supply. The *EVM Operation* section explains in detail how this offset is used to allow bipolar signals for the ADS7945 with jumper J6.

Figure 1 illustrates the ADS794xEVM analog inputs with the ADS7945 installed.

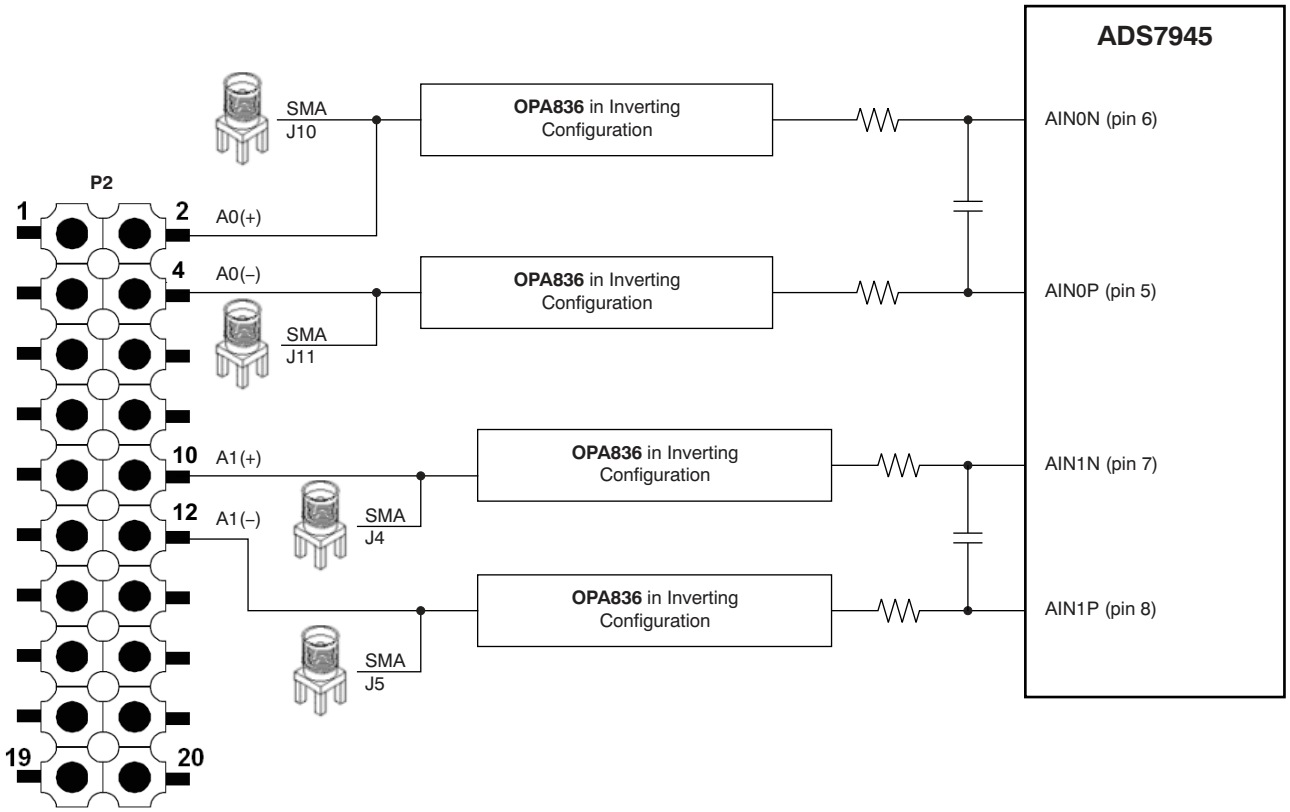

Figure 1. ADS794xEVM and ADS7945 Analog Inputs

2.2 ADS794xEVM Analog Inputs with ADS7946 Installed

Each channel of the ADS7946 uses one OPA836 to drive a single-ended input voltage. The input signals can be applied to either the SMA or P2 header connectors. These operational amplifiers offset the input signal to use an inverting configuration with a single supply. The *EVM Operation* section explains in detail how this offset is used to allow bipolar signals for the ADS7946 with jumper J6.

Figure 2 shows the ADS794xEVM analog inputs with the ADS7946 installed.

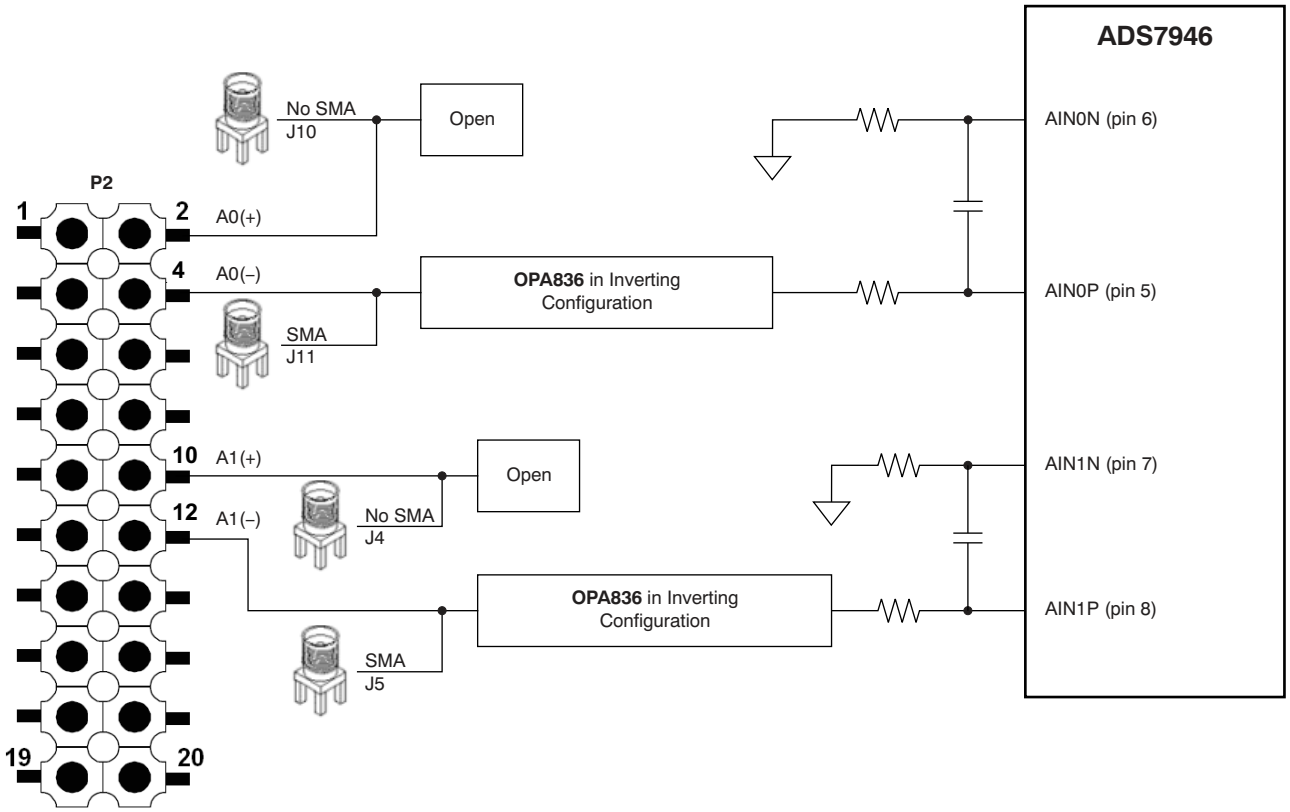

Figure 2. ADS794xEVM and ADS7946 Analog Inputs

2.3 External Reference Input

Pin P2.20 is an analog input for an external reference voltage when J2 is in position 2-3. The source that provides this external reference should have a voltage between 2.5 V and the analog power-supply voltage.

3 Digital Interface

Samtec part numbers SSW-110-22-F-D-VS-K and TSM-110-01-L-DV-P provide a convenient 10-pin, dual-row, header/socket combination at P1. This header/socket provides access to the digital control pins of the ADC. Consult Samtec at http://www.samtec.com or call 1-800-SAMTEC-9 for a variety of mating connector options.

Table 4 summarizes the pinouts for digital interface P1.

Table 4. P1: Serial Interface Header

Pin Number	Signal	Description
P1.1	$\overline{CS}$	Chip select input. Pulled high with 10-kΩ resistor.
P1.3	SCLK	Serial clock input
P1.7	$\overline{CS}$	Chip select input. This pin is intended to be used by the MMB0 motherboard
P1.11	SDI or MOSI	SDI or MOSI input
P1.13	SDO or MISO	SDO or MISO output
P1.19	PDEN	Power-down input (active high). Pulled down with 10-kΩ resistor.
P1.4, P1.10, and P1.18	GND	Digital ground connections
P1.16, P1.20	I^2C bus	I^2C bus; used only used to program the U4 EEPROM on the EVM board
P1.2, P1.5-6, P1.8-9, P1.12, P1.14-15, and P1.17	Unused	Unused

3.1 Serial Interface (SPI)

The ADS794x ADC uses SPI serial communication in mode 0 (CPOL = 0, CPHA = 0). Because the serial clock (SCLK) frequency can be as fast as 40 MHz, the ADS794xEVM offers 47-Ω resistors between the SPI signals and P1 to aid with signal integrity. Typically, in high-speed SPI communication, fast signal edges can cause overshoot; these 47-Ω resistors slow down the signal edges in order to minimize signal overshoot.

3.2 ADS794x Channel Select as SDI (MISO)

The ADS794x ADC offers direct control over the internal multiplexer using pin 11. The ADS794xEVM uses a flip-flop (see U9 in the attached schematic) to convert this pin into a typical SPI SDI (MOSI) pin. This architecture takes advantage of the SPI full-duplex data transmission sequence to control channel selection at the same time conversion data are acquired. The digital word *0x000* can be used to select channel 0, and the word *0xFFFF* can be used to select channel 1.

3.3 I^2C Bus for Onboard EEPROM

The ADS794xEVM has an I^2C bus to communicate with the onboard EEPROM that records the board name and assembly date. It is not used in any form by the ADS794x converter.

4 Power Supplies

P3 is the power-supply input connector. Table 5 lists the configuration details for P3.

Table 5. P3 Configuration: Power-Supply Interface Header

Pin Number	Pin Name	Function	Required
P3.3	+5VA	5-V analog supply	Yes
P3.5	GND	Digital ground input	Yes
P3.6	GND	Analog ground input	Yes
P3.7	+1.8VD	1.8-V digital supply	Yes/Optional
P3.9	+3.3VD	3.3-V digital supply	Yes/Optional
P3.10	+5VD	5-V digital supply	Yes/Optional
P3.1-2, P3.4, and P3.7-8	Unused	Unused	No

4.1 Analog Power Options

The ADS794xEVM board is designed to work with a 5-V analog power supply connected to P3.3.

4.2 Digital Power Options

The ADS794xEVM uses a jumper in J3 to connect the digital power supply to either +3.3 VD (P3.10) or +5 VD (P3.9). J3 in position 1-2 connects the digital power supply to +5 VD; position 2-3 connects the digital power supply to +3.3 VD. Without a jumper in J3, the digital power supply can be connected to +1.8 VD(P3.7) with a jumper wire to pin J3.2. The jumper in J3 must always be in position 2-3 (+3.3 VD) while using the MMB0 with the EVM.

4.3 Reference Voltages

The ADS794xEVM uses a jumper in J2 to select between the internal (REF5040) and external voltage reference sources. J2 in position 1-2 selects the internal reference; position 2-3 selects the external reference. The selected reference is cleaned with a RC filter and buffered with a OPA350 operational amplifier.

CAUTION

Digital supply and reference voltage must be at or below the analog supply voltage at all times.

5 EVM Operation

This section provides information on the analog input, digital control, and general operating conditions of the ADS794xEVM without the MMB0 motherboard. Software operation is presented in Section 7.

5.1 Analog Input

The ADS794xEVM offers three different analog input modes, selectable with jumper J6 and the type of input signal. Note that the ADS794x converter by itself only allows dc-coupled unipolar signals. The two additional input modes are available because OPA836 operational amplifiers drive the analog inputs. It is preferable for external signal drivers or filters to have low output impedance to reduce gain errors.

Mode 1: DC-Coupled Unipolar Inputs (J6 Closed)

DC-coupled unipolar signals are typically produced by single-supply signal drivers. To allow dc-coupled unipolar signals, J6 should be closed. This mode allows an input signal range from 0 V to V_{REF} for all EVM analog inputs. In this mode, the voltage read at the ADC is equal to ($V_{REF} – V_{IN}$).

Mode 2: DC-Coupled Bipolar Inputs (J6 Open)

DC-coupled bipolar signals are typically produced by dual-supply signal drivers. To allow dc-coupled bipolar signals, J6 should be open. This mode allows an input signal range from $–V_{REF}/2$ to $+V_{REF}/2$ for all EVM analog inputs. In this mode, the voltage read at the ADC is equal to ($V_{REF}/2 – V_{IN}$).

Mode 3: AC-Coupled Inputs (J6 Closed)

AC-coupled signals are typically produced by high-pass filters. To allow ac-coupled bipolar signals, J6 should be closed. This mode allows an input signal range from $–V_{REF}/2$ to $+V_{REF}/2$ for all EVM analog inputs. In this mode, the voltage read at the ADC is equal to ($V_{REF}/2 – V_{IN}$).

5.2 Digital Control

The digital control signals can be applied directly to the P1 header (top or bottom side). The modular ADS794xEVM can also be connected directly to a DSP or microcontroller interface board, such as the 5-6K Interface or HPA-MCU Interface boards available from Texas Instruments, or the MMB0 if purchased as part of the ADS794xEVM-PDK. For a list of compatible interface and/or accessory boards for the EVM or the ADS794x, see the relevant product folder on the TI web site.

5.3 Default Jumper Settings

Figure 3 shows the jumper locations on the EVM board and the respective factory default conditions for each.

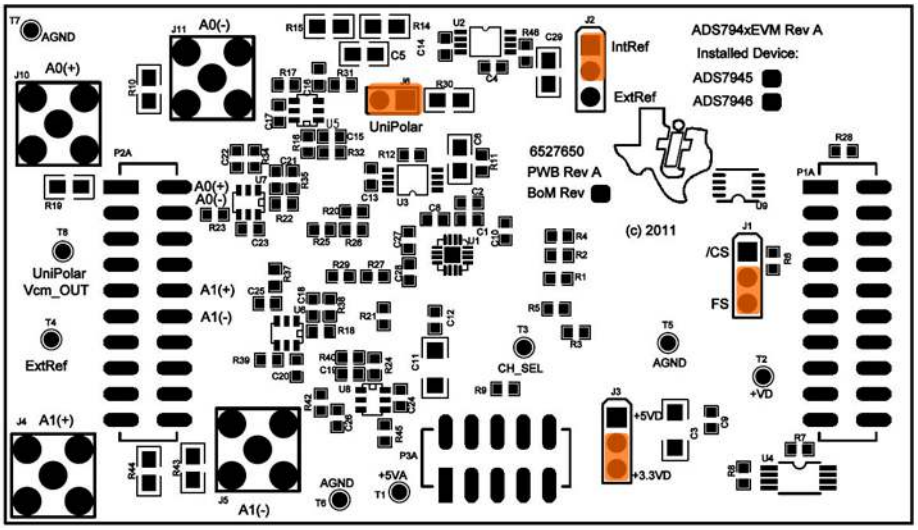

Figure 3. ADS794xEVM Default Jumper Locations

There are four jumpers on the ADS794xEVM board. These jumpers are used to set the $\overline{CS}$ signal entry pin (J1), select the digital logic level (J3), select the reference (J2), and to establish the input signal range type (J6). The default parameters are:

- The $\overline{CS}$ signal entry pin is P1.7 (J1: 2-3).
- The logic level is 3.3 V (J3: 2-3).
- The onboard 4.096 V is selected as the reference voltage (J1: 1-2).
- Analog input range is 0 V to V_{REF} (4.096 V) with dc-coupled signals (J6: closed)

6 ADS794xEVM-PDK: Software Installation

This section presents the steps required to the install the software. Section 7 explains how to operate the software to acquire data.

Complete the following steps to install the software:

Step 1. Install the ADCPro software (if not already installed) on a PC.
Step 2. Install the ADS794xEVM-PDK EVM plug-in software.
Step 3. Set up the ADS794xEVM-PDK hardware.
Step 4. Power up the ADS794xEVM-PDK.
Step 5. Connect the ADS794xEVM-PDK to the computer with a USB cable.
Step 6. Complete the USB driver installation process.

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

6.1 Installing the ADCPro Software

CAUTION

Do not connect the ADS794xEVM-PDK to a PC before completing Section 6.2 through Section 6.4. Failure to observe this caution may cause Microsoft Windows to not recognize the ADS794xEVM-PDK as a connected device.

ADCPro is the primary program used to evaluate ADCs. The latest software version of ADCPro is available from the TI website at www.ti.com. Refer to the ADCPro User Guide for instructions on installing and using ADCPro.

6.2 Installing ADS794xEVM-PDK Plug-In Software

The ADS794xEVM-PDK plug-in uses ADCPro; you must install ADCPro before uploading the plug-in.

To install the ADS794xEVM-PDK plug-in, run the file: **ads794X-adcproplugin-<version #>.exe** (*<version #>* refers to the installation file version number, and increments with software version releases). Double-click the file to run it; then follow the instructions as shown. You can also use the ADCPro *Update Check* feature to check for newer versions of the ADS794xEVM-PDK plug-in, once you have installed a version of it.

Figure 4 and Figure 5 show the initial and completed installer screenshots, respectively.

Figure 4. ADS794xEVM-PDK Plug-In Installer

Figure 5. Completed ADS794xEVM-PDK Installer

6.3 Configuring the ADS794xEVM-PDK Hardware

The ADS794xEVM-PDK contains both the ADS794xEVM and the MMB0 motherboard; however, the devices may be shipped unconnected or configured incorrectly. Follow these steps to verify that ADS794xEVM-PDK kit is properly configured and connected.

Step 1. Unpack the ADS794xEVM-PDK kit.

Step 2. Set the three jumpers on the MMB0 REV D as shown in Figure 6. Below Figure 6, there is a check list that explains the functionality of each jumper.

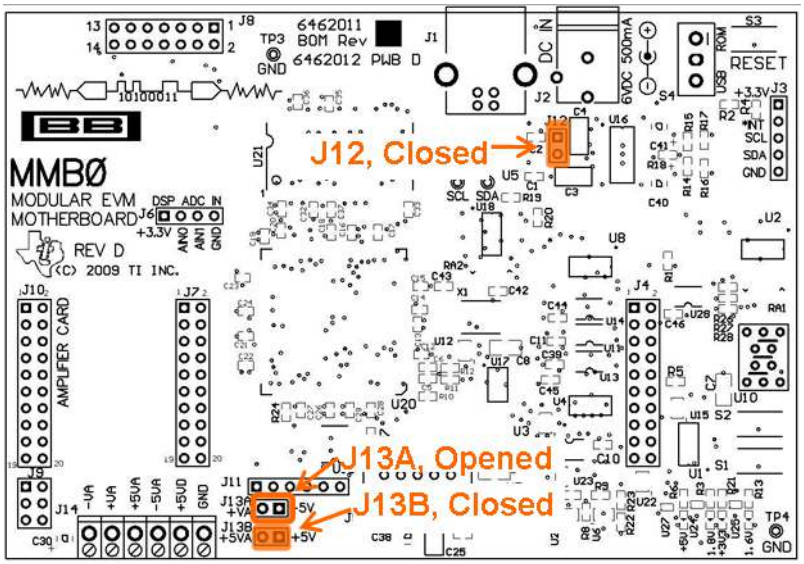

Figure 6. MMB0 Jumper Locations

Follow this check list to ensure proper operation of the MMB0 with the ADS794xEVM:

- J12 must be closed. This setting allows the external supply to power up the MMB0 and the ADS794xEVM through J2 (6-VDC input), and regulate down to +5 V, 3.3 V, and 1.8 V.
- J13B must be closed. This configuration connects the 5-V analog power supply with the 5-V digital power supply.
- J13A must be opened. This setting allows the 5-V analog power supply to be regulated onboard.

Step 3. Plug the ADS794xEVM into the MMB0, as Figure 7 illustrates.

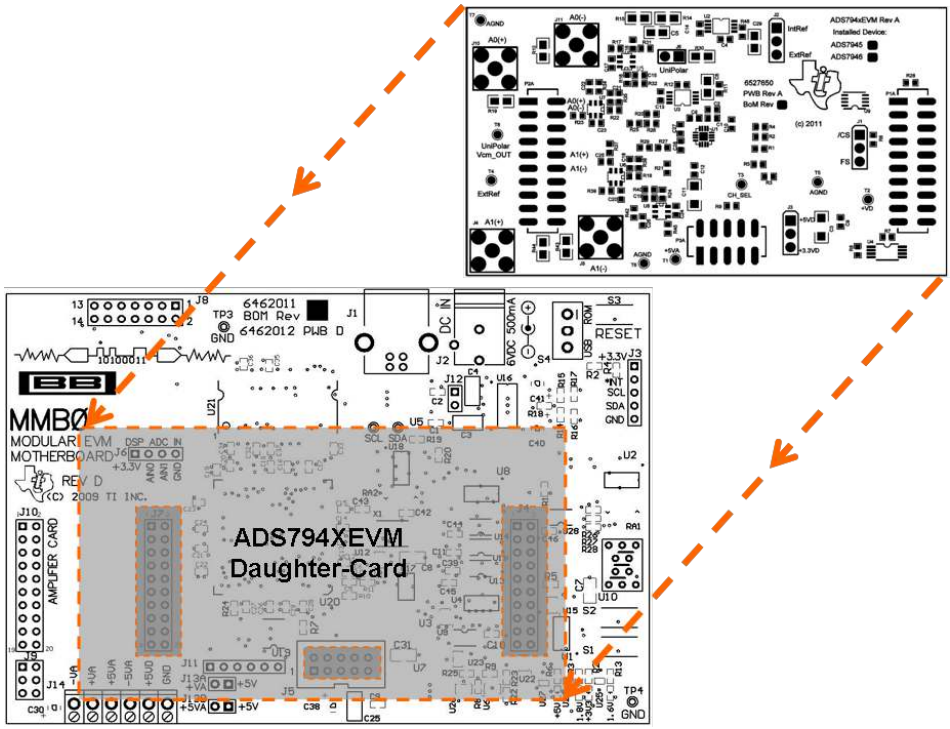

Figure 7. Connecting ADS794xEVM to MMB0

CAUTION

Do not misalign the pins when plugging the ADS794xEVM into the MMB0. Check the pin alignment carefully before applying power to the PDK.

Step 4. Set jumper J3 on the ADS794xEVM to position 2-3 in order to set the ADS794xEVM logic voltage to 3.3 V. The MMB0 uses 3.3-V logic to communicate with the ADS7945xEVM.

Step 5. Set jumper J1 on the ADS794xEVM to position 2-3 in order to place the $\overline{CS}$ signal in P1.7 of the EVM. The MMB0 sends the $\overline{CS}$ signal via P1.7.

Step 6. Set jumper J2 on the ADS794xEVM to position 1-2 if the 4.096-V internal (onboard) reference is used. If an external reference is used, set J2 to the 2-3 position.

CAUTION

If an external reference is used, please do not apply external reference voltage before the power is applied to the MMB0 motherboard.

Step 7. Set jumper J6 to match the correct type of input signal, as explained in Section 5.1:

- For dc-coupled unipolar input signals, J6 must be closed.
- For dc-oupled bipolar input signals, J6 must be opened.
- For ac-coupled signals, J6 must be closed.

6.4 Powering Up the ADS794xEVM-PDK

Once the ADS794xEVM-PDK kit is configured, power can be applied to the MMB0. This power comes from an external supply that delivers +6 VDC to the MMB0 using the included CA-2186 cable via J2 on the MMB0 motherboard. No wall power supply is included with the PDK; an external power supply should be connected via the included CA-2186 cable where Figure 8 indicates.

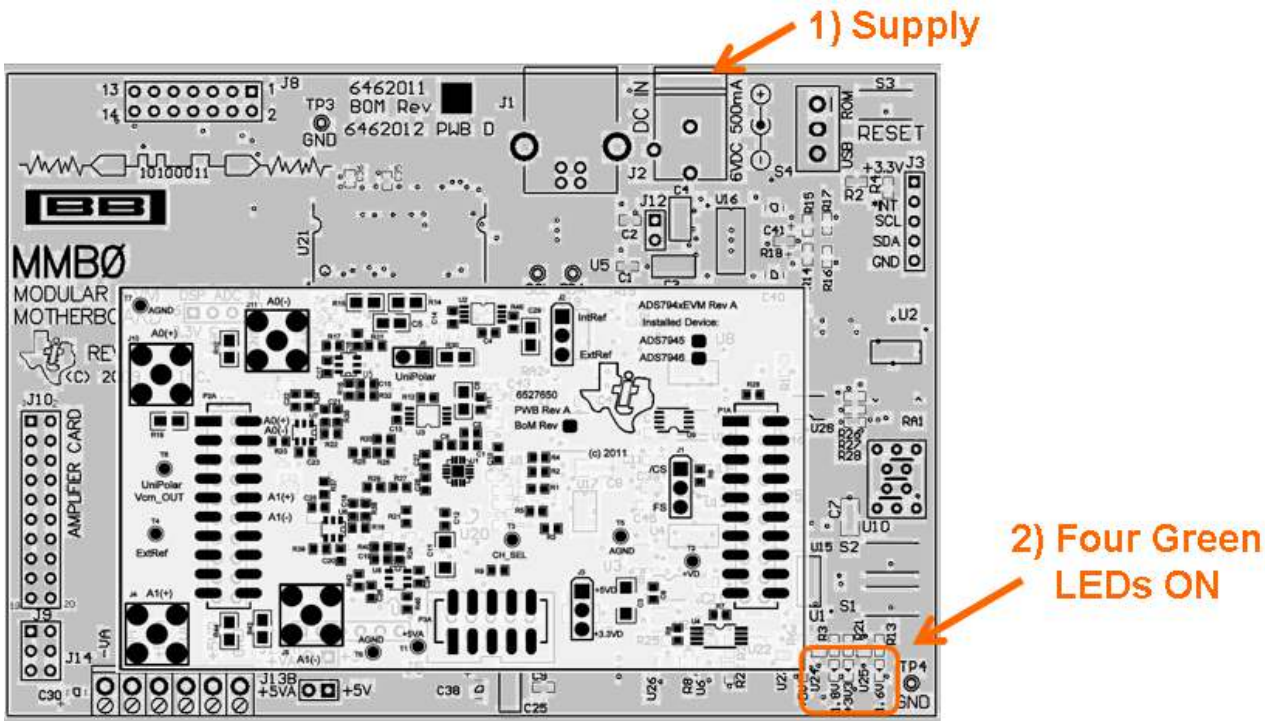

Figure 8. Powering Up ADS794xEVM-PDK

After the power supply is connected, four green LEDs in the bottom right-hand corner of the MMB0 motherboard should light up. If these LEDs do not light up, disconnect the power and verify that J12 is closed.

6.5 First-Time Connection: ADS794xEVM-PDK to PC, Completing Driver Installation

The first time that the ADS794xEVM-PDK kit is connected to the PC via USB, the PC prompts the user for two drivers. At this point, it is presumed that the ADCPro software and the ADS794xEVM plug-in have been installed, and that the ADS794xEVM-PDK kit is properly configured and powered up (refer to Section 6.1 through Section 6.4). The following sections show how to install these drivers.

NOTE: Driver prompts may not appear if another PDK kit has been used on the PC before.

6.5.1 NI-VISA USB Device Driver Installation

Follow these procedures to install the NI-VISA USB device driver, if prompted.

Step 1. With power applied to the PDK kit, connect the PDK kit to the PC via USB.

Step 2. The computer should recognize the new hardware and prompt the user for drivers, as shown in Figure 9. This driver should be present in the PC hard drive with the ADCPro files. Direct the PC to search the driver and install it by clicking *Next -->* at every prompt.

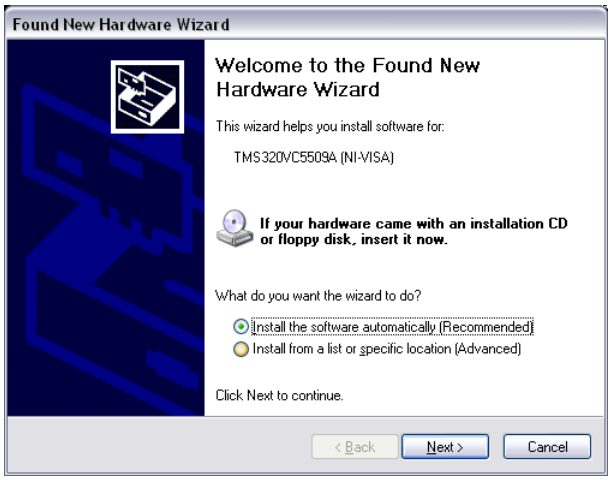

Figure 9. NI-VISA Driver Installation Prompt

6.5.2 USBStyx Driver Installation

The USBStyx driver prompt only appears when the ADCPro software uses the ADS794xEVM plug-in to communicate with the PDK hardware for the first time. Follow these procedures to install the USBStyx driver.

Step 1. Make sure that the PDK kit is configured and powered up as explained in Section 6.3 and Section 6.4. Then, press the **Reset** button on the MMB0 upper right-hand corner once.

Step 2. Start ADCPro from the Windows *Start* menu.

Step 3. Load the ADS794xEVM plug-in from the ADCPro EVM drop-down menu as Figure 10 illustrates.

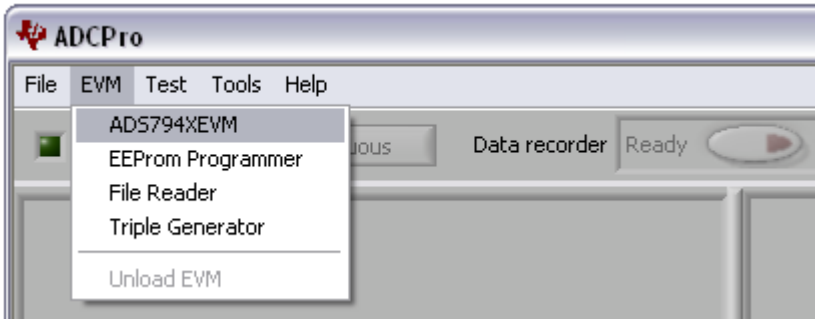

Figure 10. Loading ADS794xEVM Plug-in From ADCPro

Step 4. Wait for the driver prompt window to appear. 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; eventually, the driver prompt window will appear, as Figure 11 shows.

Figure 11. USBStyx Driver Installation Prompt

NOTE: If the USBStyx driver was previously installed on the PC, the status area should show the message *Select Device* without prompting for the driver. If this message appears, close ADCpro and proceed to Section 7.

Step 5. This driver should be present in the PC hard drive with the ADCPro files. Direct the PC to search the driver and install it by clicking *Next* --> at every prompt. Be patient; it may take some time for the PC to find the driver.

NOTE: During the driver installation, a small pop-up window may appear indicating that the firmware load has timed out. Ignore this pop-up. Continue with the USBStyx driver installation. Once driver installation has finished, click the **Exit** button in the small-pop up window.

Step 6. Close ADCPro after the USBStyx driver has been installed.

7 ADS794xEVM-PDK Kit Operation

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

The following sections describe how to use ADCPro and the ADS794xEVM plug-in to acquire data.

7.1 About the MMB0

The MMB0 provides the USB interface between the PC and the ADS794xEVM. 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 16 MB 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.

7.2 Loading the ADS794xEVM-PDK Plug-in

The ADS794xEVM-PDK plug-in for ADCPro provides complete control over all settings of the ADS794x. You can adjust the ADS794xEVM 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 ADS794xEVM plug-in, the setting immediately updates on the board.

Settings on the ADS794xEVM correspond to settings described in the ADS794x product data sheet (available for download at http://www.ti.com); see the product data sheet for details.

To load the ADS794xEVM plug-in, follow these steps.

Step 1. Make sure the PDK kit is configured and powered up as explained in Section 6.3 and Section 6.4. Then, press the **Reset** button on the MMB0 (in the top right-hand corner) once to clear the board memory.

Step 2. Start ADCPro from the Windows *Start* menu.

Step 3. Load the ADS794xEVM plug-in from the ADCPro drop-down *EVM* menu; see Figure 10. Note that only one EVM plug-in can be loaded at a time. If a different plug-in is selected, the previous plug-in is unloaded.

Step 4. When the plug-in is loaded, the plug-in searches for the board. A series of messages in the status area will indicate this action, eventually showing *Select Device...*

The plug-in is now loaded and ready to work with the ADS794xEVM.

7.3 Using the ADS794xEVM Plug-in

The ADS794xEVM plug-in allows the user to evaluate the ADS794x ADC. Figure 12 shows the device configuration tab of the ADS794xEVM Plug-in. Use this tab of the ADCPro software to configure the ADS794x.

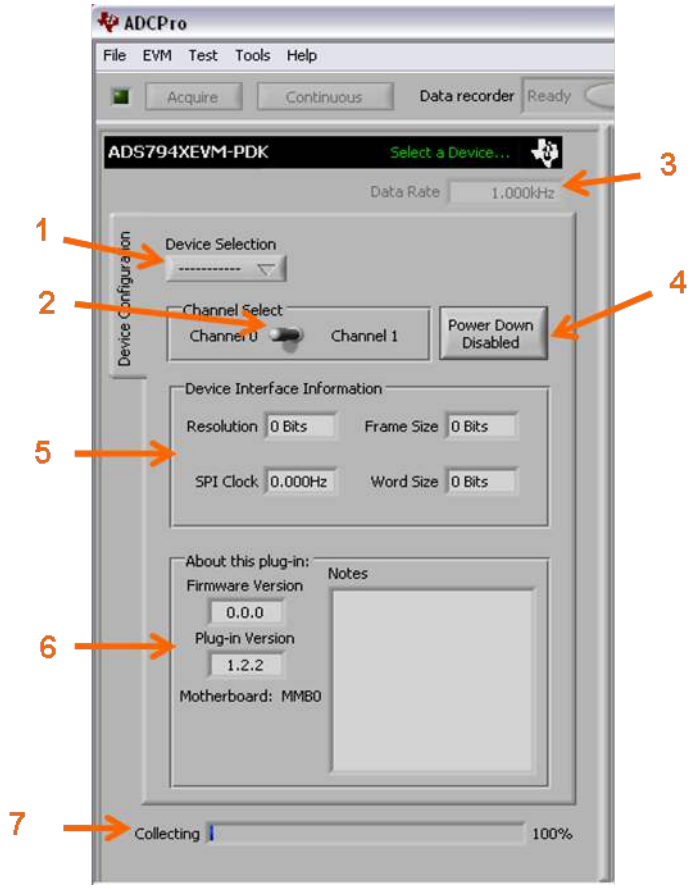

Figure 12. ADS794xEVM Plug-in: Device Configuration Tab

The device configuration tab contains the following controls.

(1) Device Selection: This control is a user input that must be set by the user, to identify whether the ADS7945 or ADS7946 is installed on the board.

(2) Channel Select: This user input selects the channel to be sampled.

(3) Data Rate: This control shows the data rate or sampling frequency used by the ADC to acquire data.

(4) Power Down: This option controls the power-down mode of the ADC.

(5) Device Interface Information: This option shows the SPI parameters that are in use while sampling data. These parameters should appear after a device is selected.

(6) About: This control shows the plug-in version, MMB0 firmware version, ADS794xEVM assembly date, and ADS794xEVM board revision information. This information should appear after a device is selected.

(7) Collection Bar: This feature shows the percentage of data collected during an acquisition session.

7.4 Loading the Test Plug-in

Once the ADS794xEVM plug-in is configured in ADCPro, one of the four test plug-ins must be loaded in ADCPro using the drop-down *Test* menu, as shown in Figure 13. Note that only one Test plug-in can be loaded at a time. If a different plug-in is selected, the previous plug-in is unloaded.

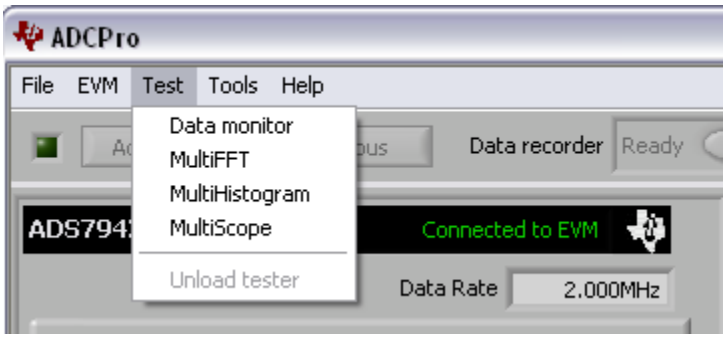

Figure 13. ADCPro Test Plug-ins

There are four different test options available for the ADS794xEVM:

- **Data monitor:** This test acquires data and exports it in table format as hexadecimal data.
- **MultiFFT:** This test allows the user to acquire data and create an FFT graph of power vs. frequency to display data
- **MultiHistogram:** This option acquires data and creates a histogram of code values.
- **MultiScope:** This feature acquires data and displays it in a graph of voltage vs. time.

For further details regarding how to set up and use the various test plug-ins, refer to the ADCPro User Guide.

7.5 Acquiring Data

Once the ADS794xEVM is configured for the desired test scenario, press the **Acquire** button to start the data collection process; the software collects the number of data points specified in the *Test* plug-in **Block Size** control. While acquiring data, the ADS794xEVM plug-in disables all front panel controls, and the collection process bar displays the completion progress.

7.6 Troubleshooting

If the ADS794xEVM plug-in cannot find the ADS794xEVM-PDK, press the **RESET** button on the MMB0 and try again.

If ADCPro stops responding while the ADS794xEVM-PDK is connected, shut down and restart the ADCPro software. Also, try unplugging the USB cable from the PDK. Unload and reload the plug-in before reapplying power to the PDK.

8 Bill of Materials, Board Layout, and Schematic

Schematics for the ADS794xEVM are appended to this user's guide. The bill of materials is provided in Table 6. Section 8.2 shows the PCB layouts for the ADS794xEVM.

8.1 Bill of Materials

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

Table 6. ADS794xEVM Bill of Materials

Item No.	Qty		Ref Des	Description	Vendor	Part Number
	ADS7945	ADS7946				
1	1	1	N/A	Printed Circuit Board	Texas Instruments	6527650
2	4	4	C1, C13, C17, C24	Capacitor, X7R Ceramic ±10%, 16WV, 0603	Murata	GRM188R71C104KA01D
	2	0	C20, C23			
3	4	4	C2, C4, C10, C14	Capacitor, X7R Ceramic ±10%, 10WV, 0603	TDK	C1608X7R1A105K
4	2	2	C3, C11	Capacitor, X7R Ceramic ±20%, 6.3WV, 1206	Taiyo Yuden	JMK316B7226ML-T
5	3	3	C5, C6, C29	Capacitor, X7R Ceramic ±10%, 6.3WV, 0805	Taiyo Yuden	JMK212B7106KG-T
6	1	1	C8	Capacitor, X7R Ceramic ±10%, 10WV, 0603	Murata	GRM188R71A225KE15D
7	6	6	C9, C12, C16, C26, C27, C28	Capacitor, C0G Ceramic ±5%, 50WV, 0603	Murata	GRM1885C1H102JA01D
	2	0	C22, C25			
8	2	2	C15, C19	Capacitor, C0G Ceramic ±0.1p, 50WV, 0603	TDK	C1608C0G1H2R2B
	2	0	C18, C21			
9	2	2	P1A, P2A	Header, 20-Pin SMT Plug, .100" Gold (2x10)	Samtec	TSM-110-01-L-DV-P
10	2	2	P1B, P2B	Header, 20-pin SMT Socket, .100" Gold (2x10)	Samtec	SSW-110-22-F-D-VS-K
11	1	1	P3A	Header, 10-Pin SMT Plug, .100" Gold (2x5)	Samtec	TSM-105-01-L-DV-P
12	1	1	P3B	Header, 10-pin SMT Socket, .100" Gold (2x5)	Samtec	SSW-105-22-F-D-VS-K
13	3	3	J1, J2, J3	Header, Strip, 3-pin .100" Gold (1x3)	Samtec	TSW-103-07-L-S
14	2	2	J5, J11	Connector, SMA Jack Straight PCB	Amphenol	132134
	2	0	J4, J10		Emerson	142-0701-201
15	1	1	J6	Header Strip, 2-pin .100" Gold (1x2)	Samtec	TSW-102-07-L-S
16	8	8	R1, R2, R3, R4, R8, R28, R31, R42	Resistor, Thick Film Chip, 1%, 1/10W, 0603	Panasonic	ERJ-3EKF47R0V
	2	0	R34, R37			
17	1	1	R14	Resistor, Metal Film Chip, 0.1%, 1/8W, 0805	Panasonic	ERA-6AEB302V
18	1	1	R30	Resistor, Metal Film Chip, 0.1%, 1/8W, 0805	Panasonic	ERA-6AEB152V
19	1	1	R15	Resistor, Metal Film Chip, 0.1%, 1/8W, 0805	Panasonic	ERA-6AEB102V
20	1	1	R11	Resistor, Metal Film Chip, 0.1%, 1/10W, 0603	Panasonic	ERA-3AEB102V
21	2	2	R5, R6	Resistor, Thick Film Chip, 1%, 1/10W, 0603	Panasonic	ERJ-3EKF1002V

Table 6. ADS794xEVM Bill of Materials (continued)

Item No.	Qty		Ref Des	Description	Vendor	Part Number
	ADS7945	ADS7946				
22	4	4	R20, R21, R26, R27	Resistor, Thick Film Chip, 1%, 1/10W, 0603	Vishay/Dale	CRCW06034R99FKEA
23	4	4	R16, R17, R24, R45	Resistor, Metal Film Chip, 0.1%, 1/10W, 0603	Panasonic	ERA-3AEB103V
	4	0	R18, R22, R23, R39			
24	3	3	R32, R40, R46	Resistor, Thick Film Chip, 1%, 1/10W, 0603	Vishay/Dale	CRCW06031R00FKEA
	2	0	R35, R38			
25	2	2	R9, R12	Resistor, Thick Film Chip, 1/10W, 0603	Panasonic	ERJ-3GEY0R00V
	0	2	R25, R29			
26	3	3	T1, T2, T4	Test point PC Mini .040" D Red	Keystone	5000
27	3	3	T5, T6, T7	Test point PC Mini .040" D Black	Keystone	5001
28	1	1	T8	Test point PC Mini .040" D Yellow	Keystone	5004
29	1	0	U1	IC ADC, 14-bit, 2.5 MSPS, Full-Diff, QFN-16	Texas Instruments	ADS7945SRTE
	0	1		IC ADC, 14-bit, 2.5 MSPS, Pseudo-Diff, QFN-16	Texas Instruments	ADS7946SRTE
30	1	1	U2	IC Prec Volt Ref, 4.096 V LN/LD 8-MSOP	Texas Instruments	REF5040IDGKT
31	1	1	U3	IC Op Amp, GP, R-R 38 MHz Single, 8-MSOP	Texas Instruments	OPA350EA/250
32	1	1	U4	IC EEPROM, 256kBit, 400 kHz, 8-TSSOP	Microchip	24LC256-I/ST
33	1	1	U9	IC D-Type, F-F w/CLR Preset SM8	Texas Instruments	SN74LVC2G74DCTR
34	2	2	U5, U8	IC Op Amp, R-R Out, 200 MHz, SOT-23	Texas Instruments	OPA836IDBVT
	2	0	U6, U7			
35	4	4	N/A	0.100 Shunt, Black	3M	969102-0000-DA

8.2 Board Layouts

Figure 14 through Figure 17 show the PCB layouts for the ADS794xEVM.

NOTE: Board layouts are not to scale. These figures are intended to show how the board is laid out; they are not intended to be used for manufacturing ADS794xEVM PCBs.

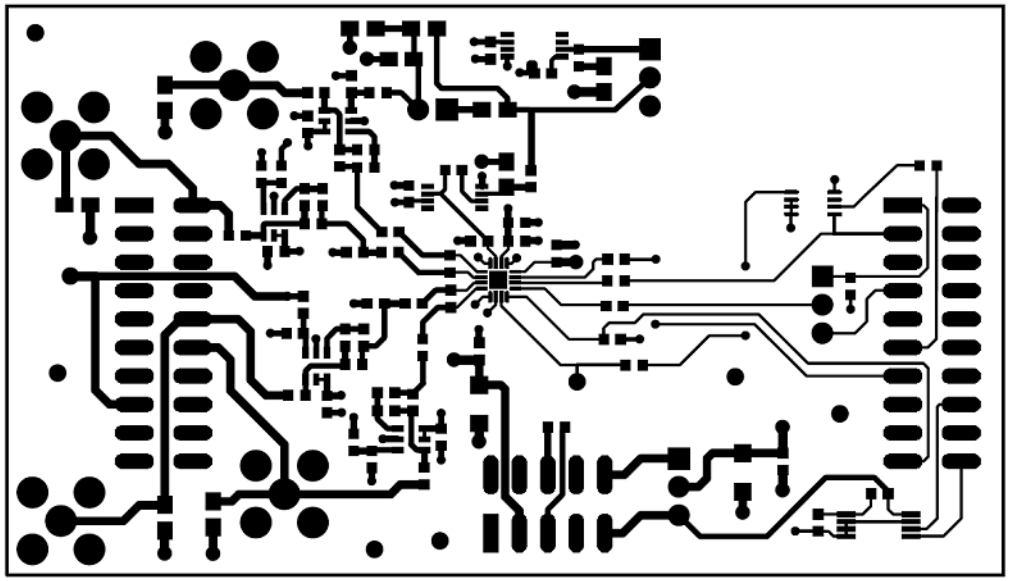

Figure 14. ADS794xEVM PCB: Top Layer

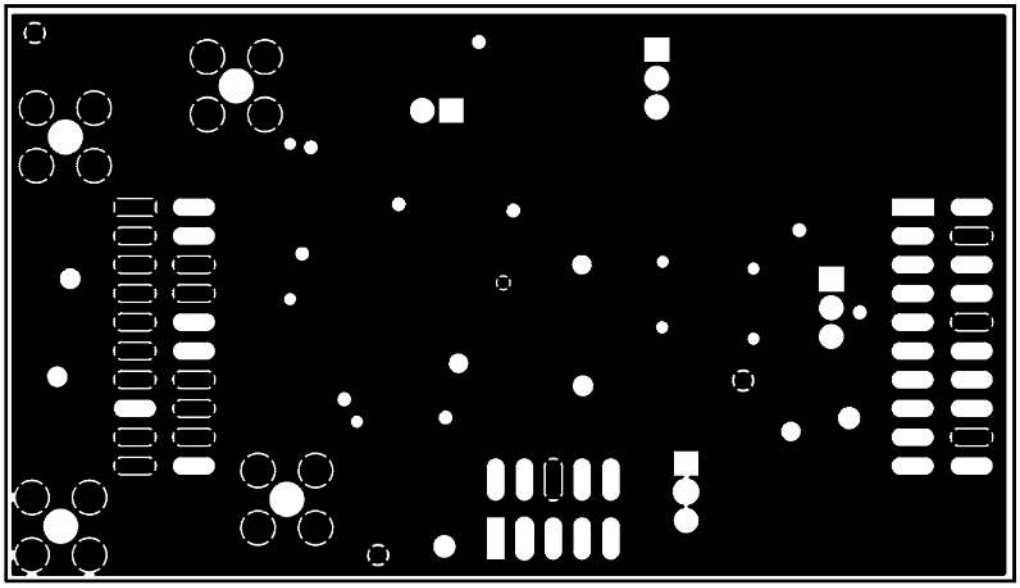

Figure 15. ADS794xEVM PCB: Ground Layer

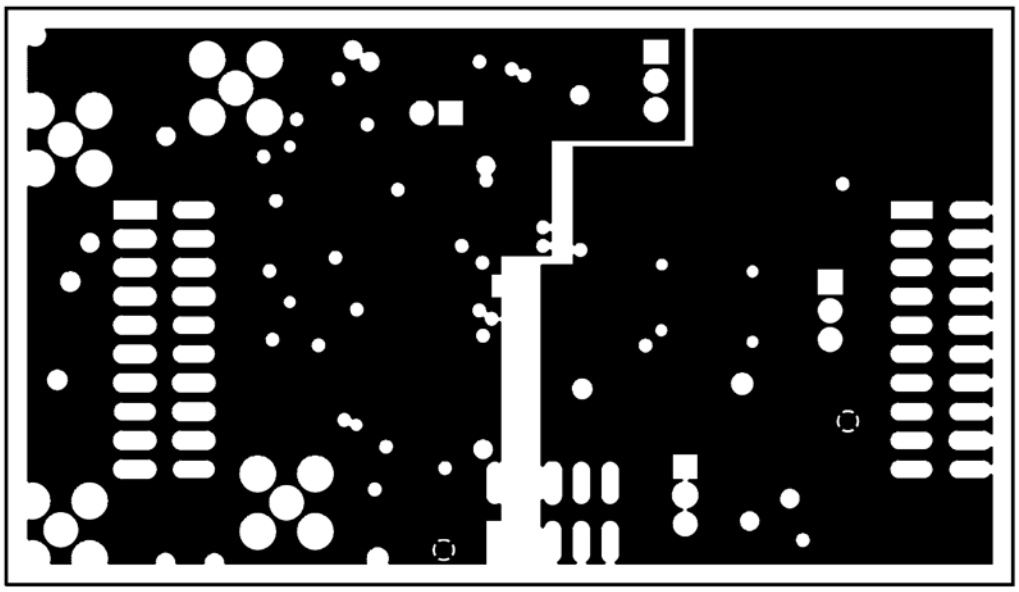

Figure 16. ADS794xEVM PCB: Power Layer

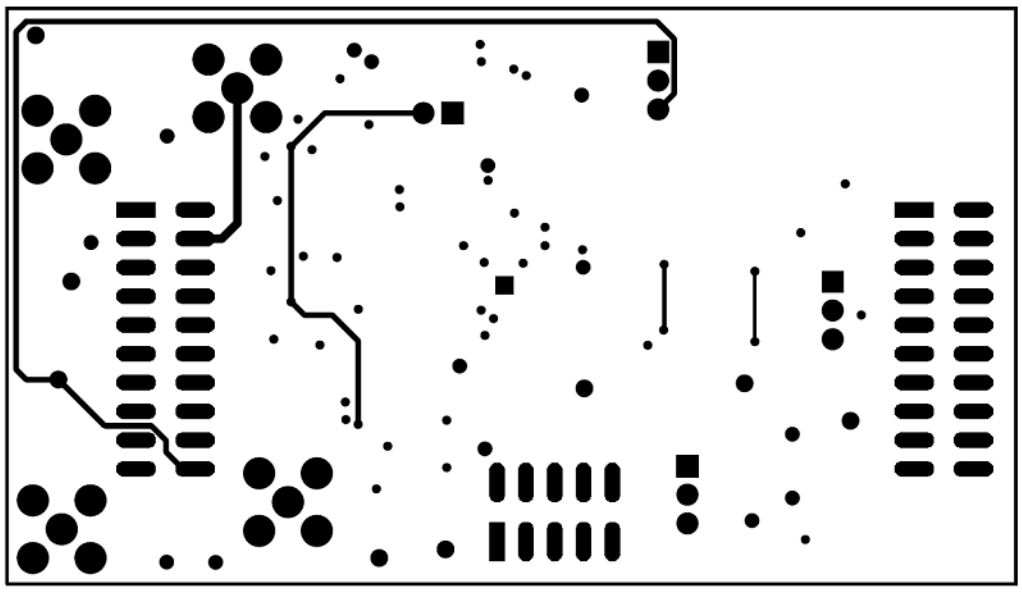

Figure 17. ADS794xEVM PCB: Bottom Layer

9 Schematic

Figure 18 shows the EVM schematic.

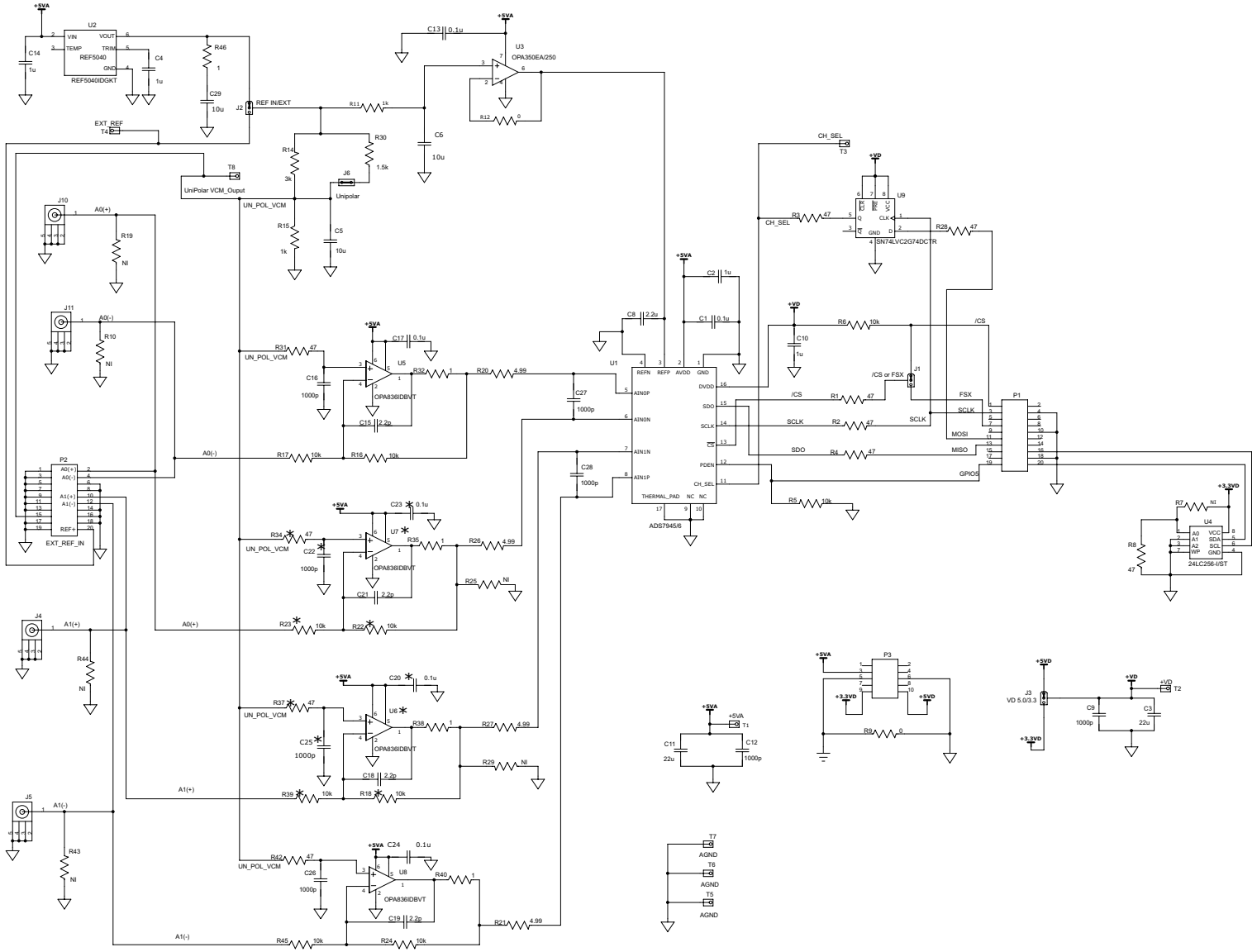

Figure 18. EVM Schematic

Revision History

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

Changes from A Revision (February 2016) to B Revision	Page
• Added missing schematic diagram	24

Changes from Original (August 2011) to A Revision	Page
• Replaced reference of wall supply to external supply.	12
• Replaced reference of wall supply to external supply.	14
• Modified *Powering Up ADS794xEVM-PDK* image.	14

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3 *Regulatory Notices:*

   3.1 *United States*

      3.1.1 *Notice applicable to EVMs not FCC-Approved:*

      FCC NOTICE: 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 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. 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/lsds/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/lsds/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 to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

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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3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

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.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

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