![Texas Instruments logo]

ADS1672EVM and ADS1672EVM-PDK User's Guide

ADS1672EVM (Left) and ADS1672EVM-PDK (Right)

This user's guide describes the characteristics, operation, and use of the ADS1672EVM, both by itself and as part of the ADS1672EVM-PDK. This evaluation module (EVM) is an evaluation platform for the ADS1672, a high-speed, single-channel, 24-bit, 625kHz delta-sigma analog-to-digital converter (ADC). The EVM allows evaluation of all aspects of the ADS1672 device using a standard serial CMOS interface. A complete circuit description, schematic diagram, and bill of materials are included.

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

EVM-Compatible Device Data Sheets

Device	Literature Number
ADS1672	SBAS402
REF5030	SBOS410
THS4520	SLOS503
REF5025	SBOS410
OPA211	SBOS377
PCA9535	SCPS129

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1   EVM Overview

ADS1672EVM Features:

- Contains all support circuitry needed for the ADS1672
- Voltage references onboard
- Clock options: onboard 20MHz ceramic oscillator or adjustable frequency
- GPIO access
- Compatible with the TI Modular EVM System

ADS1672EVM-PDK Features:

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

As a stand-alone unit, you can use the ADS1672EVM as a prototyping or troubleshooting tool.

For use with a computer, the ADS1672EVM-PDK is available. This kit combines the ADS1672EVM board with the DSP-based MMB0 motherboard, and includes ADCPro™ software for evaluation.

You can connect the ADS1672EVM through the MMB0 motherboard and then to a computer via an available USB port. This manual shows how to use the MMB0 as part of the ADS1672EVM-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. ADCPro has a number of plug-in programs, so it can be expanded easily with new test and data collection plug-ins. You control the ADS1672EVM-PDK with a plug-in that runs 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 ADS1672EVM and the ADS1672EVM-PDK. It does not describe the MMB0 motherboard in detail. Throughout this document, the abbreviation *EVM* and the term *evaluation module* are synonymous with the ADS1672EVM.

2   Introduction

The ADS1672EVM is an evaluation module built to the TI Modular EVM System specification. You can connect the ADS1672EVM to any Modular EVM System interface card.

The ADS1672EVM is available as a stand-alone printed circuit board (PCB) or as part of the ADS1672EVM-PDK, which includes an MMB0 motherboard and software. As a stand-alone PCB, the ADS1672EVM is useful for prototyping designs and firmware development.

Note that the ADS1672EVM cannot run software. To connect it to a computer, some type of interface is required.

3   Analog Interface

The ADS1672EVM board applies 5V of power (VCC) to the ADS1672 (U6) and THS4520 (U2). The THS4520, a wideband, fully-differential amplifier, drives the differential inputs of the ADS1672. This device was selected because of its slew rate (570V/µs), settling time (7ns to 0.1%), low noise (2nV/$\sqrt{Hz}$) and low harmonic distortion (HD3: –123dBc at 100kHz).

Analog input signals to the THS4520/ADS1672 signal chain can be applied at connectors J1 (inverting input, −IN) and J2 (noninverting input, +IN) or P3-1 (−IN) and P3-2 (+IN). The P3 connector is an SMT plug on the top side of the PCB (as Figure 1 shows). The signal at +IN and −IN should be differential and centered at 2.5V.
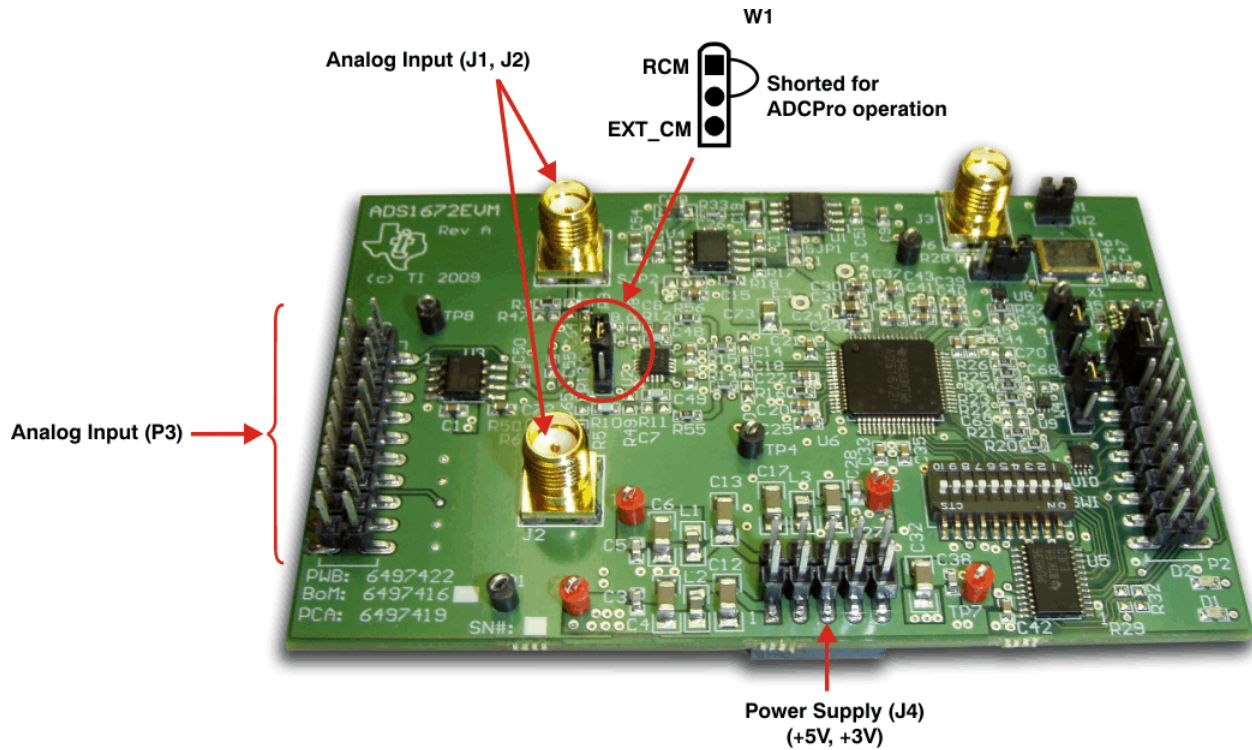
Figure 1. Location of Onboard Connectors J1, J2, W1, P1, P2, SW1, and P3

At the analog board inputs, +IN and −IN, there are termination resistors (R3, R6 = 49.9Ω) installed on the board at J1 and J2 (as Figure 2 illustrates). These resistors are followed by a capacitor between the inputs (C55 = 750pF) and resistors (R8, R10 = 383Ω) to the THS4520. Additional pads are available at the inputs of the THS4520 to allow insertion of capacitor and/or resistor networks.

Figure 2. ADS1672EVM Input Signal Path

NOTE: If you are connecting the ADS1672EVM through the MMB0 board to ADCPro, there are no modifications required.

Following the THS4520, an R-C network connects directly to the ADS1672. This R-C network (R56, R15, C18, R55, and R14) acts as a first-order, anti-aliasing filter for the ADS1672. The corner frequency of the installed first-order filter is 1/[2π × (10Ω + 10Ω) × 750pF] or 10.6MHz. Pads are available to install more resistors and capacitors, as needed.

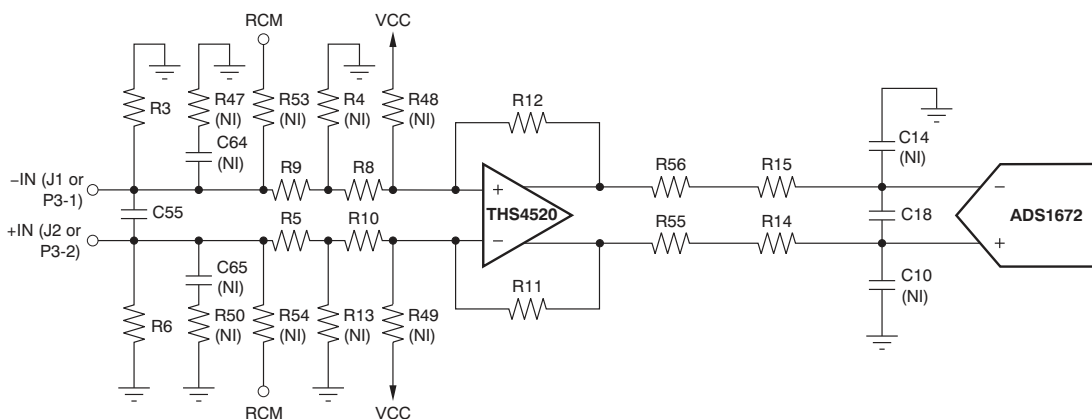The common-mode voltage to the THS4520 is set at R_{CM} and can be connected to the analog board inputs +IN and –IN through R53 and R54 as shown in Figure 2. The output signal from the onboard REF5025 (U3) establishes this voltage at 2.5V. You can inject an external common-mode voltage into the THS4520 through P3-15 (as Table 1 shows). If this option is used, the shunt on W1 (an onboard jumper) must be moved to position 2-3 (see Figure 1). With this reconfiguration, R_{CM} in the input circuitry does not change, as shown in Figure 2. If the common-mode of the input signals center at a voltage other than VCC/2, pull-up resistors (R48 and R49) must be installed to maintain the proper input common-mode range to the THS4520 amplifier. The THS4520 performance degrades if operated beyond its specified range of 1.2V to 4.25V (when powered with 5V).

Samtec part number TSM-110-01-T-DV-P provides a convenient 20-pin, dual-row, header/socket combination at P3. As shown in Figure 1, the P3 header provides access to –IN and +IN of the ADS1672EVM board as well as the common-mode pins of the THS4520 (pins 4 and 9, CM). Consult Samtec at http://www.samtec.com or call 1-800-SAMTEC-9 for a variety of mating connector options. There is no filtering or protection on the P3 pins. Use appropriate caution when handling these pins. Table 1 summarizes the pin assignments for the analog interfaces on P3.

Table 1. P3: External Analog Input Connector

Pin Number	Signal	Description
P3.1	–IN	Inverting analog input
P3.2	+IN	Noninverting analog input
P3.3	NC	No connection
P3.4	NC	No connection
P3.5	NC	No connection
P3.6	NC	No connection
P3.7	NC	No connection
P3.8	NC	No connection
P3.9	NC	No connection
P3.10	NC	No connection
P3.11	GND	System ground
P3.12	NC	No connection
P3.13	GND	System ground
P3.14	NC	No connection
P3.15	EXT_COM	External common-mode voltage; connect to THS4520
P3.16	NC	No connection
P3.17	GND	System ground
P3.18	NC	No connection
P3.19	GND	System ground
P3.20	NC	No connection

4 Reference Buffer

The ADS1672 reference pins have switched capacitor inputs. At a clock rate of 20MHz (X1), a charge injection in and out of the ADS1672 reference input occurs. The external reference voltage that drives the ADS1672 reference pin must settle in less than 50ns. The REF5030 (U1) generates the 3.0V reference signal (Figure 3). The output of the REF5030 is heavily filtered to remove noise. The onboard OPA211 (U4) again filters and buffers the reference signal so that the reference signal noise to the ADS1672 is less than the noise generated by the converter itself. The OPA211 is a low-noise, unity-gain stable amplifier that provides a reliable current source for the ADS1672 reference input. The OPA211 and output decoupling capacitors work together to settle the VREFP (ADS1672) reference input voltage to within ±1/2 LSB, every 50ns. This board uses a 22µF ceramic capacitor with a 0.1µF ceramic capacitor directly across the reference inputs, VREFP and VREFN. Note that the 22µF and 0.1µF capacitors are placed as close to the ADS1672 reference pins as possible. These capacitors further reduce noise that is common to both inputs. The ADS1672 VREFN pin goes to ground.
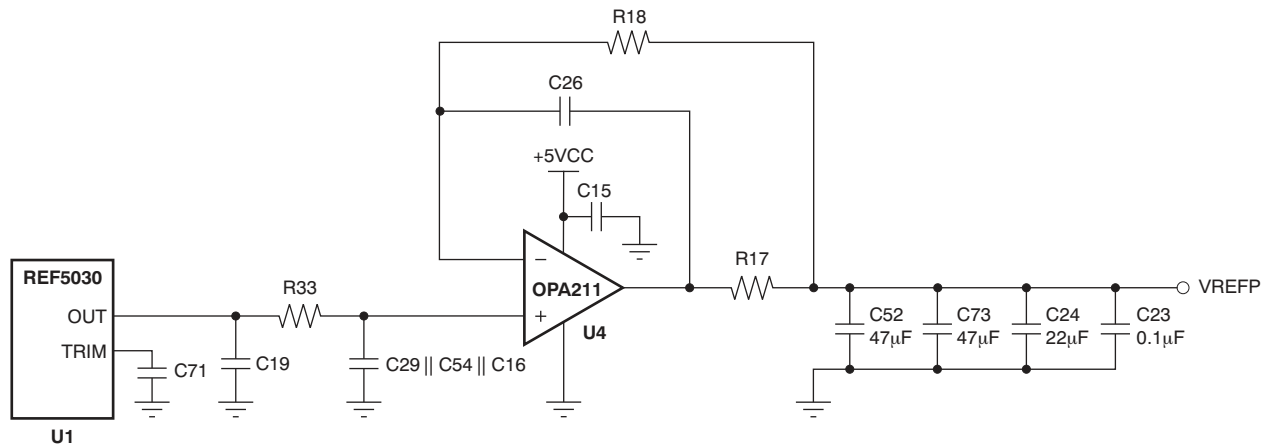
Figure 3. ADS1672 External Reference and Buffer

5 Power Supplies

J4 (see Figure 1) is the power-supply input connector. Table 2 lists the configuration details for J4.

Table 2. J4 Configuration: Power-Supply Input

Pin No.	Pin Name	Function	Required
J4.1	+VA	+VCC	Optional
J4.2	–VA	–VCC	Optional
J4.3	+5VA	+5VCC	Always
J4.4	NC	No connection	No
J4.5	NC	No connection	No
J4.6	AGND	Analog ground input	Always
J4.7	NC	No connection	No
J4.8	NC	No connection	No
J4.9	+3.3V	3.3V digital supply	Always
J4.10	NC	No connection	No

6   Digital Interface

It is easy to interface the ADS1672EVM board to multiple control platforms. The P2 connector (Figure 4, Samtec part number SSW-110-22-S-D-VS) provides a convenient digital access to the key ADS1672 I/O pins. Consult Samtec at http://www.samtec.com or call 1-800-SAMTEC-9 for a variety of mating connector options.

SW1, a 10-position DIP switch (Figure 4), gives users the ability to change the setting of the ADS1672 digital configuration pins when the EVM is used as a stand-alone evaluation board. Pull-up/-down resistors are provided to set the static state of the digital configuration pins. All position settings for SW1 must be off (factory default state) when the board is configured for use with ADCPro. The ADCPro software uses the PCS9535 at U5, a remote I^2C I/O expander at address 32 (20h), to control the configuration pins. In addition, the pin setting for the SW1 switches must be off when using the I^2C function for stand-alone systems. The ADS1672EVM does not support LVDS interface mode; only the standard 3.3V CMOS interface is supported.
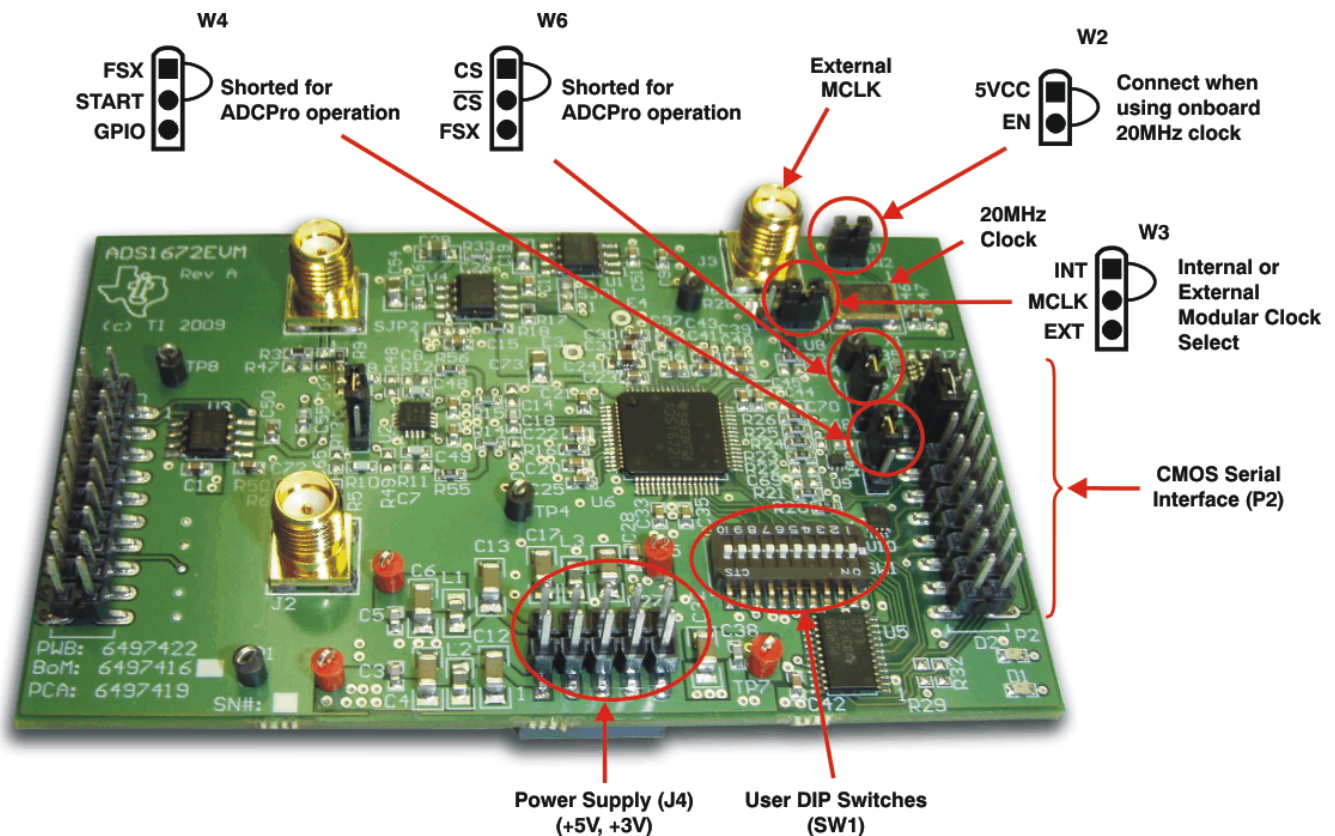

Figure 4. Digital Interface Connectors and Jumpers

6.1 Serial Data Interface, P2

The P2 connector (Table 3) is used for the digital interface to MMB0 and ADCPro. All logic levels on P2 are 3.3V CMOS.

Table 3. P2: External Digital I/O Connector

Pin Number	Signal	Description
P2.1	$\overline{CS}$	Chip select, active low
P2.2	OTRD	Digital filter out-of-range indicator. High on rising edge of $\overline{DRDY}$. If conversion is in range, OTRD returns low on next rising edge of $\overline{DRDY}$.
P2.3	CLKX	Serial transmit clock from processor. Jumper connect to P2.5 installed at factory.
P2.4	GND	System ground
P2.5	CLKR	Serial receive clock from ADS1672EVM
P2.6	NC	No connection
P2.7	FSX	Frame sync signal from processor
P2.8	NC	No connection
P2.9	FSR	Frame sync return to processor (sourced from the $\overline{DRDY}$ output of the ADS1672)
P2.10	GND	System ground
P2.11	NC	No connection
P2.12	NC	No connection
P2.13	DRR	Serial data into processor
P2.14	NC	No connection
P2.15	$\overline{DRDY}$	Interrupt source to processor (sourced from the $\overline{DRDY}$ output pin)
P2.16	SCL	I²C serial shift clock (NOTE: For this function to work, all SW1 switches should be in the off position)
P2.17	GPIO	General-purpose pin. Can be used to toggle start.
P2.18	GND	System ground
P2.19	NC	No connection
P2.20	SDA	I²C data signal (NOTE: For this function to work, all SW1 switches should be in the off position)

6.2 Digital Control Signal PIN Configuration, SW1

When using the I²C function through U5 (with or without ADCPro connected), all SW1 switches should be in the OFF position (see Figure 4).

The data clock and data out communications are directed through P2. All remaining ADS1672 digital control pins are configured with SW1. Table 4 describes the settings of the digital configuration switches.

The shunt on W3 must be moved to cover pin positions 2 and 3 in order to use the external clock applied to J3. The control signal operating modes in Table 4 are further explained in the ADS1672 data sheet.

> NOTE: All SW1 switches must be configured in the OFF position when using ADCPro software.

Table 4. SW1: Supplemental Analog Interface Pinout

Pin Number	Signal	Description
SW1.1	DRATE2	Data rate selection, bit 1 (oversampling ratio select pin)
SW1.2	DRATE1	Data rate selection, bit 0 (oversampling ratio select pin)
SW1.3	NC	No connection
SW1.4	FPATH	Digital filter path selection: If FPATH = '0', then path is wide-bandwidth; if FPATH = '1', then path is low-latency
SW1.5	LL_CONFIG	Configure low-latency digital filter: If LL_CONFIG = '0', then single-cycle settling is selected; if LL_CONFIG = '1', the fast-response is selected
SW1.6	$\overline{\text{LVDS}}$	This pin should always be in its off position or '0'. The LVDS interface is not supported on this EVM.
SW1.7	SCLK_SEL	Shift-clock source select: If SCLK_SEL = '0', then SCLK is internally generated; if SCLK_SEL - '1', then SCLK must be externally generated
SW1.8	$\overline{\text{PDWN}}$	Power-down control; active low
SW1.9	NC	No connection
SW1.10	NC	No connection

7 Clock Source

You can either select the onboard 20MHz crystal oscillator as the master clock for the ADS1672, or apply an external clock signal through J3. When the onboard 20MHz clock is used, the W2 jumper must be installed (Figure 5). W2 is an *enable* function for the onboard crystal oscillator (X1). W3 in positions 1-2 sends the onboard clock to the DUT by way of the buffer, U8. When using an external clock, move the W3 jumper (see Figure 4 and Figure 5) on pins 1-2 to cover pins 2-3, and remove the W2 jumper (see Figure 6) to disable X1. Then apply your clock source to J3. Otherwise, simply remove the jumper when an external clock is inserted at J3.
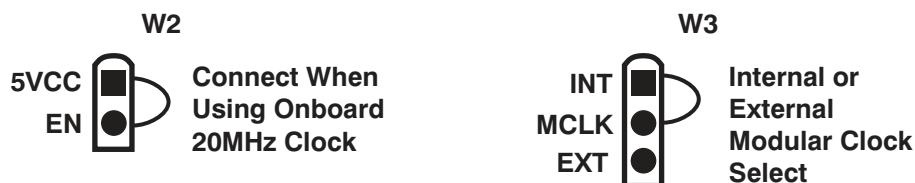

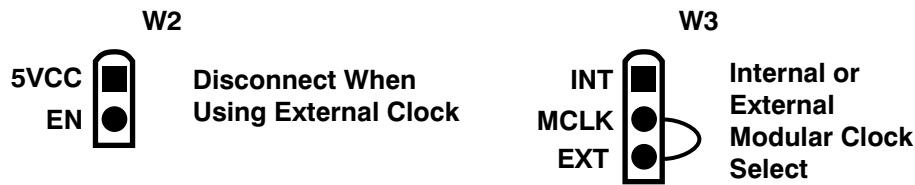**Figure 5. W2 and W3 Jumpers for Onboard Clock**

Figure 6. W2 and W3 Jumpers for External Modulator Clock

8 Use as a Stand-Alone EVM

The ADS1672EVM can be used as a stand-alone EVM, provided that the proper control signals are applied to serial input connector P2 (top or bottom side). The required power supplies (+5VA and +3.3VD) can be connected directly to J4 pins 3 and 9 or test points TP5 and TP7, respectively. Both supplies are referenced to J4 pin 6 or TP8, and should be sourced from clean, well-regulated lab supplies for best performance. The minimum control lines necessary are the active-low chip select ($\overline{CS}$) and START inputs, which are applied to P2 pins 1 and 7. If an external serial clock is desired, the signal is applied to P2 pin 5. The ADS1672 digital configuration pins can be set statically by using SW1, or can be manipulated through U5 by an I^{2}C controller connected to P2 pins 16 and 20 (all SW1 positions must be set to off when using U5). For additional details, please see section Section 9 of this document and review the ADS1672 datasheet.

9 EVM Operation

This section provides information on the analog input, digital control, and general operating conditions of the ADS1672EVM.

9.1 Analog Input

The differential analog input to the ADS1672EVM board is applied through J1 (–IN) and J2 (+IN) or P3.1 (–IN) and P3.2 (+IN).

9.2 Digital Control

The digital control signals can be applied directly to P2 (top or bottom side). The modular ADS1672EVM 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. For a complete list of compatible interface and/or accessory boards for the EVM or the ADS1672, see the relevant product folder on the TI web site.

Some of the digital signals to the ADS1672 are controlled using three methods: SW1 slide switches, GPIO pins through P2.17 (W4 configured to GPIO), or I^{2}C control using U5.

You can access a general-purpose input/output (GPIO) port through P2.17 by also connecting W4.2 (START) to W4.3 (GPIO), as shown in Figure 7. Otherwise, for proper ADCPro operation, pin 1 (FSX) is connected by a jumper to pin 2 (START).
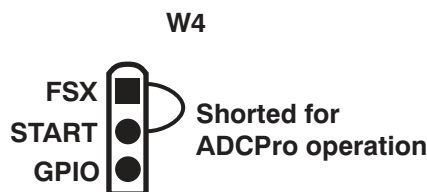

Figure 7. Connector W4 for GPIO Communication

9.3 ADS1672EVM-PDK Power Supply

The ADS1672EVM can be powered with the J4 connector or by attaching the MMB0 board. The MMB0 board provides the 5-V and 3.3-V power to the ADS1672EVM. Because the circuitry is provided on the ADS1672EVM, the complete system can be powered by an external AC adapter (not included) that meets the following requirements:

- Output voltage: 5.5 VDC to 15 VDC
- Maximum output current: ≥ 500 mA
- Output connector: barrel plug (positive center), 2.5-mm I.D. × 5.5-mm O.D. (9-mm insertion depth)
- Complies with applicable regional safety standards

9.4 Default Jumper Settings and Switch Positions

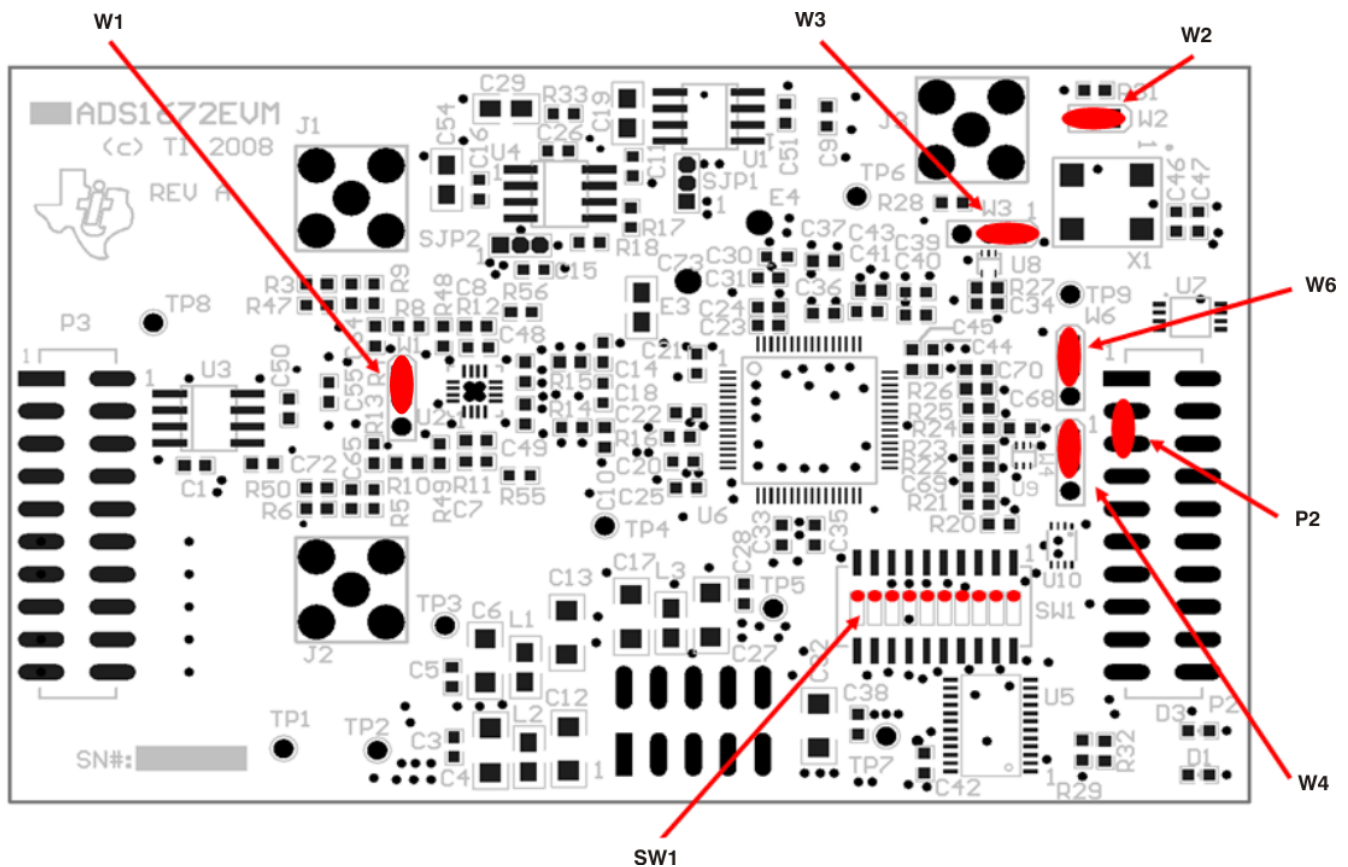Figure 8 shows the jumpers found on the EVM and the factory default conditions for each.

Figure 8. ADS1672EVM Default Jumper Locations

Table 5 provides a list of switches found on the EVM and the factory default conditions for each.

Table 5. List of Switches

Switch	Default Position	Switch Description
W1	Not installed	Selects U2 (THS4520) CM input source
W2	Short across pins	Onboard 20MHz Oscillator
W4	Top two pins shorted	Configures board for ADCPro operation
W6	Top two pins shorted	Configures board for ADCPro operation
SW1	All 10 switches in OFF position	Configures board for ADCPro operation
P2	Pins 3 and 5 shorted	Connects CLKX TO CLKR

10   ADS1672EVM-PDK Kit Operation

This section provides information on using the ADS1672EVM-PDK, including setup, program installation, and program usage.

> **CAUTION**
>
> Do not connect the ADS1672EVM-PDK before installing the ADCPro software on a suitable PC. Failure to observe this caution may cause Windows to not recognize the ADS1672EVM-PDK as a connected device.

To prepare to evaluate the ADS1672 with the ADS1672EVM-PDK, complete the following steps:

Step 1.   Install the ADCPro software (if not already installed) on a PC.

Step 2.   Install the ADS1672EVM-PDK EVM plug-in software.

Step 3.   Set up the ADS1672EVM-PDK.

Step 4.   Connect a proper power supply or use an AC adapter (not included).

Step 5.   Run the ADCPro software.

Step 6.   Complete the Microsoft Windows USB driver installation process.

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

10.1 Installing the ADCPro Software

The latest software is available from Texas Instruments' website at http://www.ti.com/. The CD-ROM shipped with the ADS1672EVM may not contain the latest software, but the ADCPro installer will check for updates when executed (if connected to the Internet), and then give you the option of downloading and installing the latest version. Refer to the http://focus.ti.com/lit/ug/sbau128/sbau128.pdf for instructions on installing and using ADCPro.

To install the ADS1672EVM-PDK plug-in, run the file: **ads1672evm-pdk-plug-in-1.0.0.exe** (*1.0.0* is the version number, and increments with software version releases; you may have a different version on your CD). Double-click the file to run it; then follow the instructions shown. After installation, you can use the ADCPro *Update Check* feature to check for newer versions of the ADS1672EVM-PDK plug-in.

The software should now be installed, but the USB drivers may not have been loaded by the PC operating system. The USB driver upload step will complete when the ADCPro software is executed (see Section 11.2, *Running the Software and Completing the Driver Installation*).

10.2 Setting Up the ADS1672EVM-PDK

The ADS1672EVM-PDK contains both the ADS1672EVM and the MMB0 motherboard; however, the devices are shipped unconnected. Follow these steps to set up the ADS1672EVM-PDK:

Step 1.   Unpack the ADS1672EVM-PDK kit.

Step 2.   Set the jumpers and switches on the MMB0 as shown in Figure 9.

- Set the Boot Mode switch to USB.

- Connect +5V and +5VA on jumper block J13 (if +5V is supplied from J14 +5VA).

- Leave +5V and +VA disconnected on jumper block J13.

- If the PDK will be powered from an ac adapter, connect J12. If the PDK will be powered through the terminal block, disconnect J12. See Section 9.3 for details on connecting the power supply.
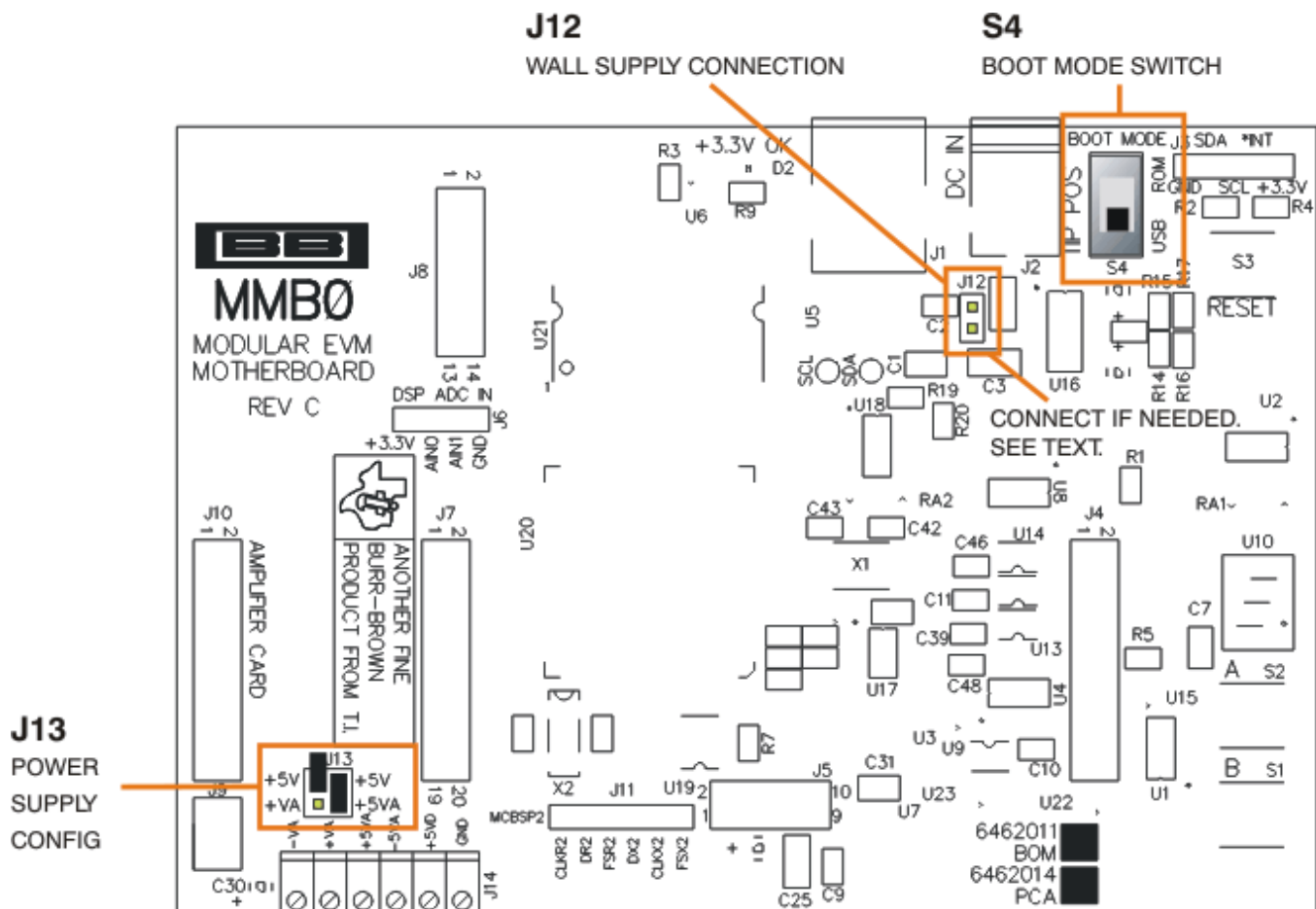
Figure 9. MMB0 Initial Setup

Step 3.   Plug the ADS1672EVM into the MMB0 as Figure 10 illustrates.

Figure 10. Connecting ADS1672EVM to MMB0

CAUTION
Do not misalign the pins when plugging the ADS1672EVM into the MMB0. Check the pin alignment carefully before applying power to the PDK.

Step 4.   Set the jumpers and switches on the ADS1672EVM as shown in Figure 8 (note that these settings are the factory-configured settings for the EVM).

11 About the MMB0

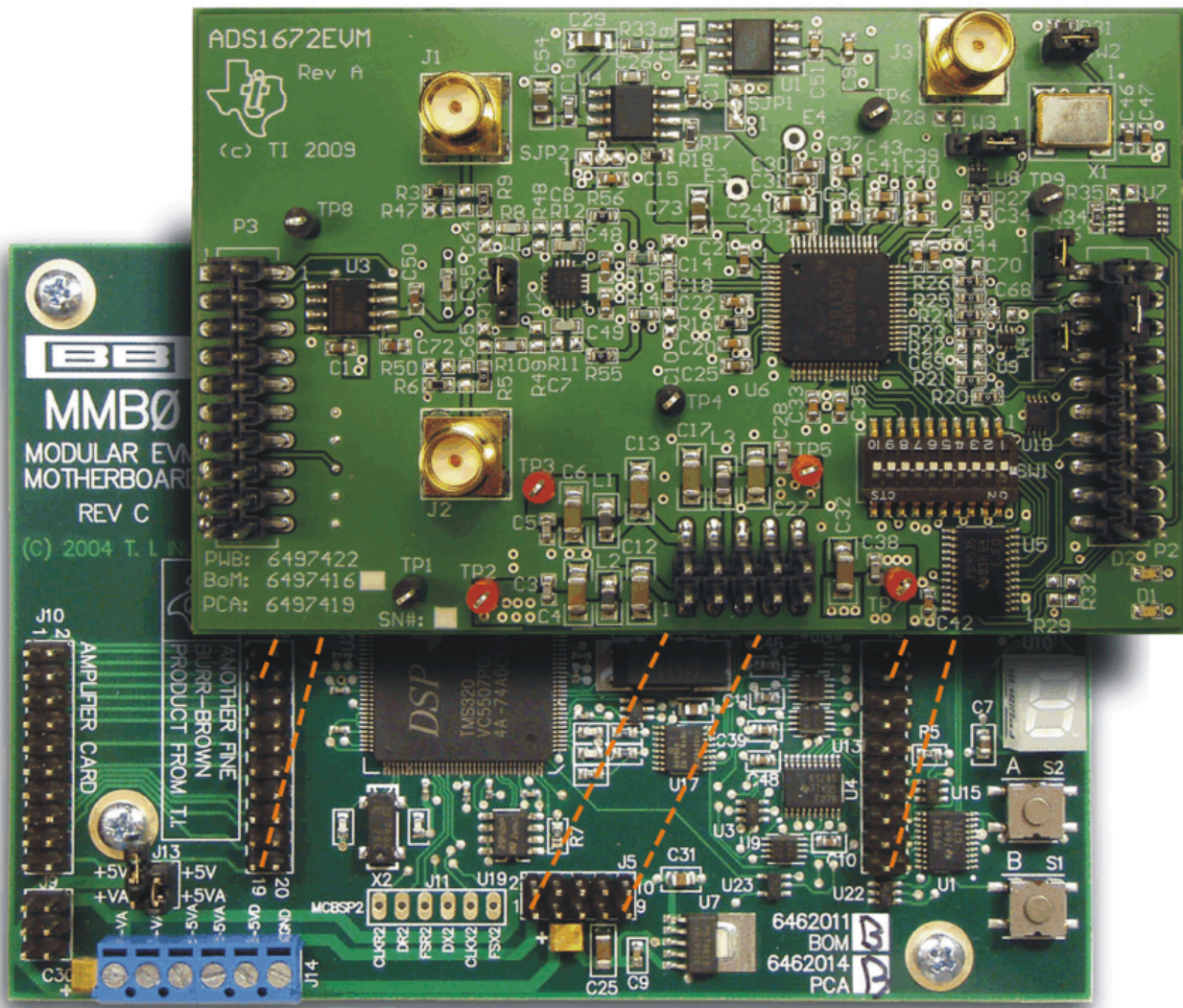The MMB0 is a Modular EVM System motherboard. It is designed around the TMS320VC5507, a DSP from Texas Instruments that has an onboard USB interface. The MMB0 also has 16MB of SDRAM installed.

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.

11.1 Connecting the Power Supply

The ADS1672EVM-PDK can be operated with a unipolar +5V 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; however, it does **not** indicate that the EVM power supplies are operating properly.

11.1.1 Connecting an AC Adapter

An AC adapter can be connected to barrel jack J2 on the MMB0. J2 is located next to the USB connector. The adapter must output 6V to 7V dc. The connector must be sleeve-negative, tip-positive and it should have a current rating of at least 500 mA.

Jumper J12 on the MMB0 connects a wall-mounted power supply to the board. To use the wall-mount supply, J12 must be shorted. Figure 11 illustrates how to connect an ac adapter to the MMB0.
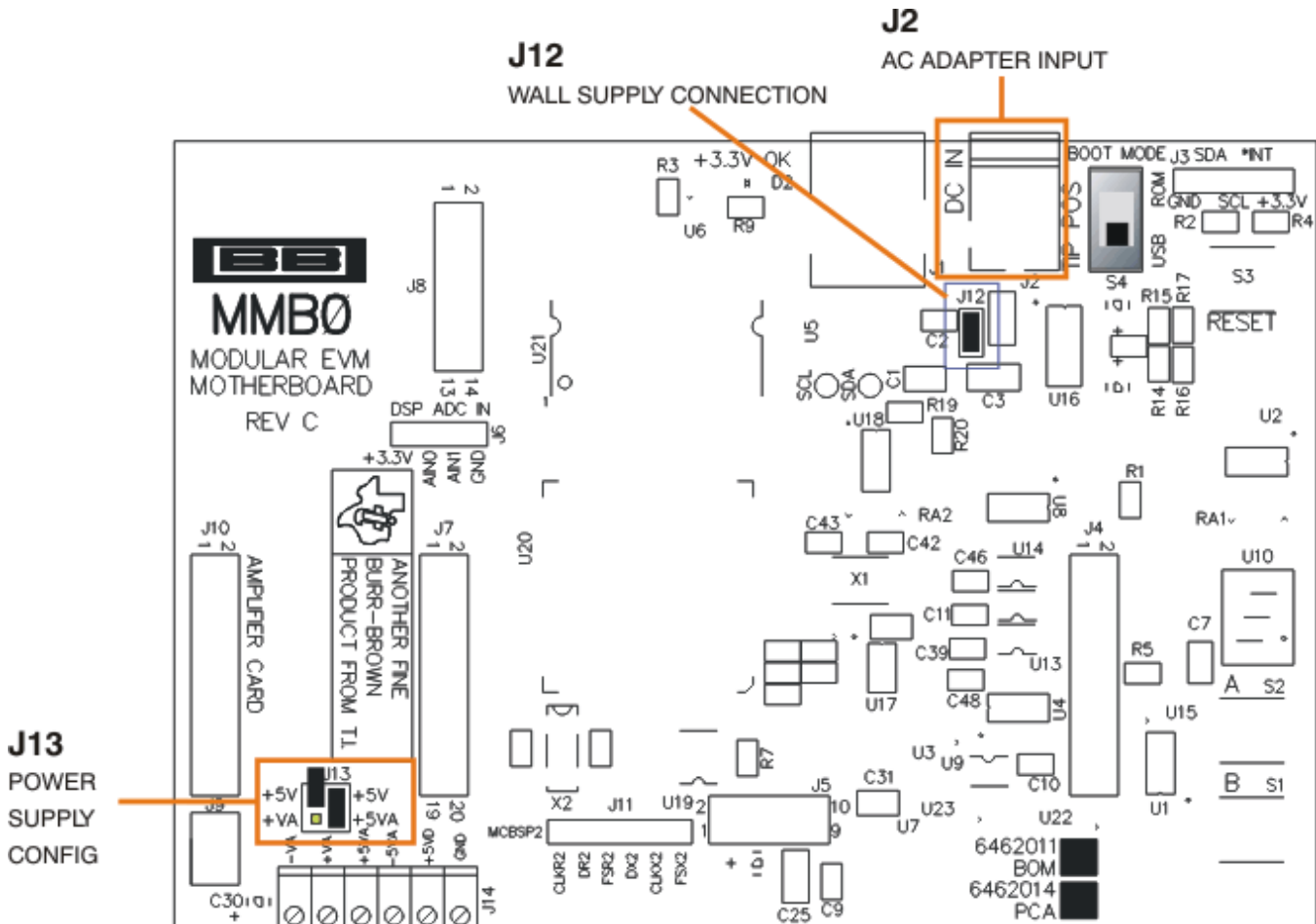
Figure 11. Connecting an AC Adapter

11.1.2 Connecting a Laboratory Power Supply

A laboratory power supply can be connected through terminal block J14 on the MMB0, as shown in Figure 12.

To use a unipolar lab power supply configuration:

- Disconnect J12 on the MMB0.
- Connect a +5V dc supply to the +5VD terminal on J14.
- Connect ground of the dc supply to the GND terminal on 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.

Figure 12. Laboratory Power-Supply Connection

11.2 Running the Software and Completing the Driver Installation

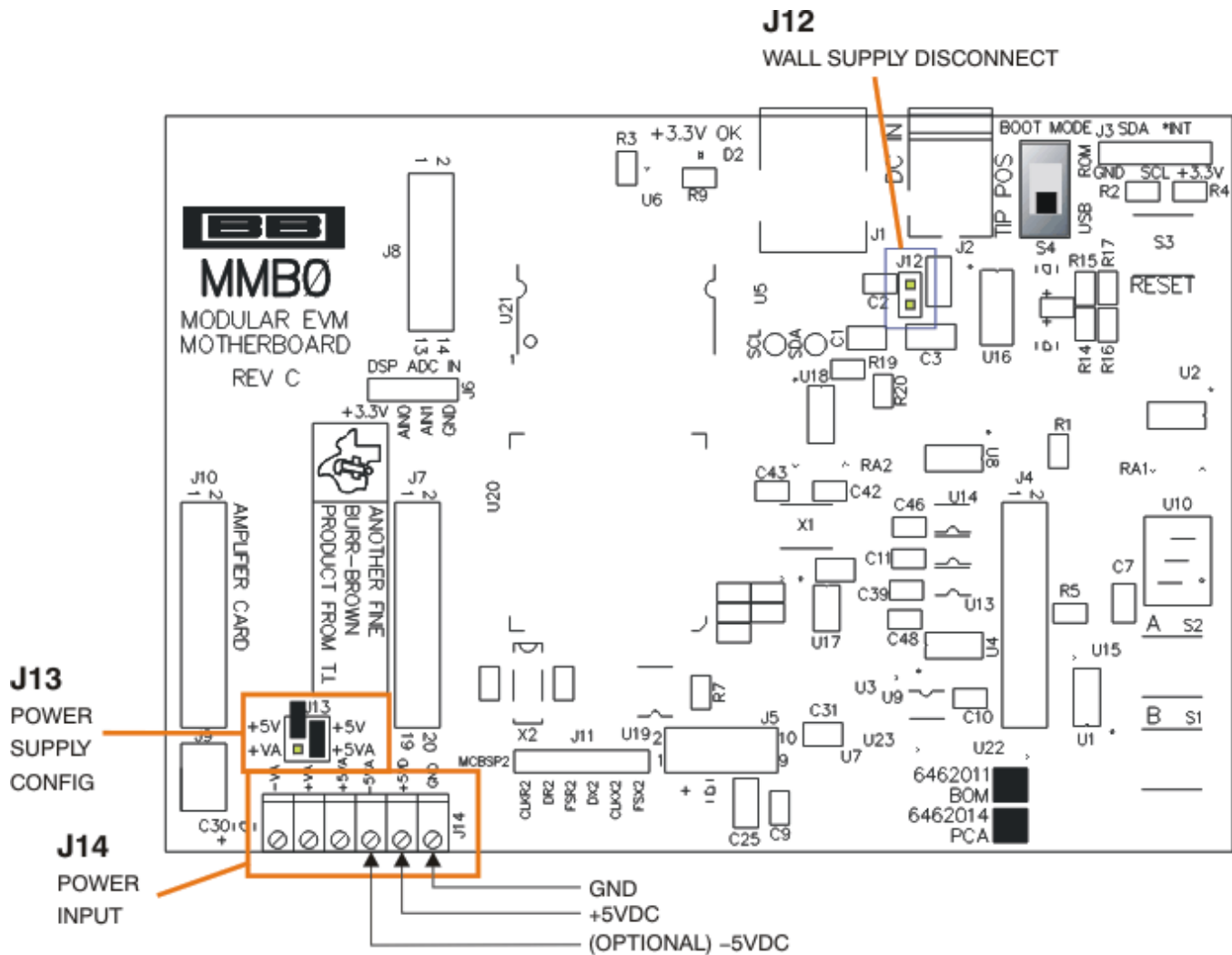> **NOTE:** The software is continually under development. These instructions and screen images are current at the time of this writing, but may not exactly correspond to future releases.

The program for evaluating the ADS1672EVM-PDK is called ADCPro. This program uses plug-ins to communicate with the EVM. The ADS1672EVM-PDK plug-in is included in the ADS1672EVM-PDK package.

The program currently runs only on Microsoft Windows platforms of WindowsXP.

Follow these procedures to run ADCPro and complete the necessary driver installation.

Step 1. Start the software by selecting ADCPro from the Windows Start menu. The screen in Figure 13 appears.
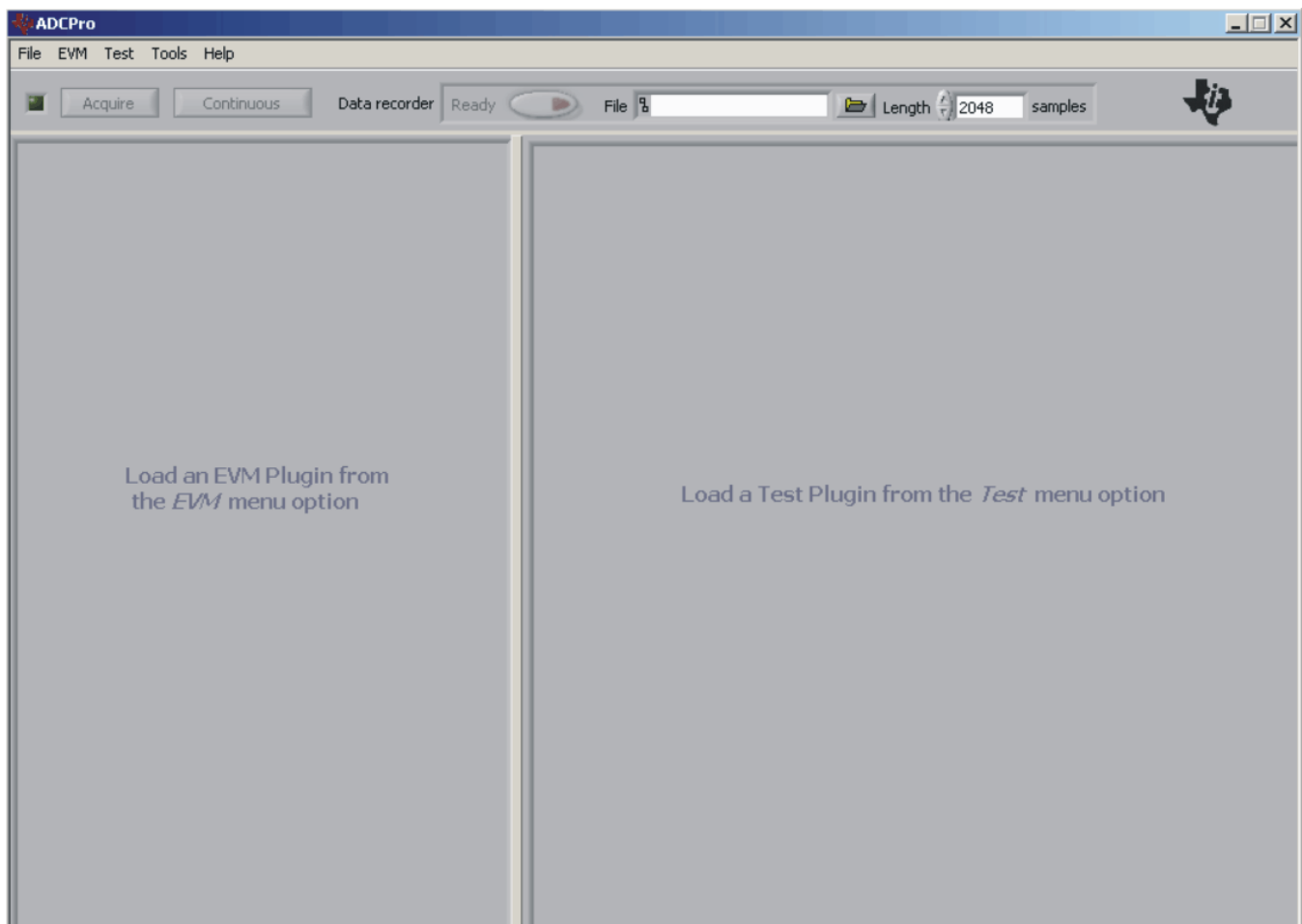
Figure 13. ADCPro Software Start-up Display Window

Step 2.   Select *ADS1672EVM* from the EVM drop-down menu. The ADS1672EVM-PDK plug-in appears in the left pane, as shown in Figure 14.
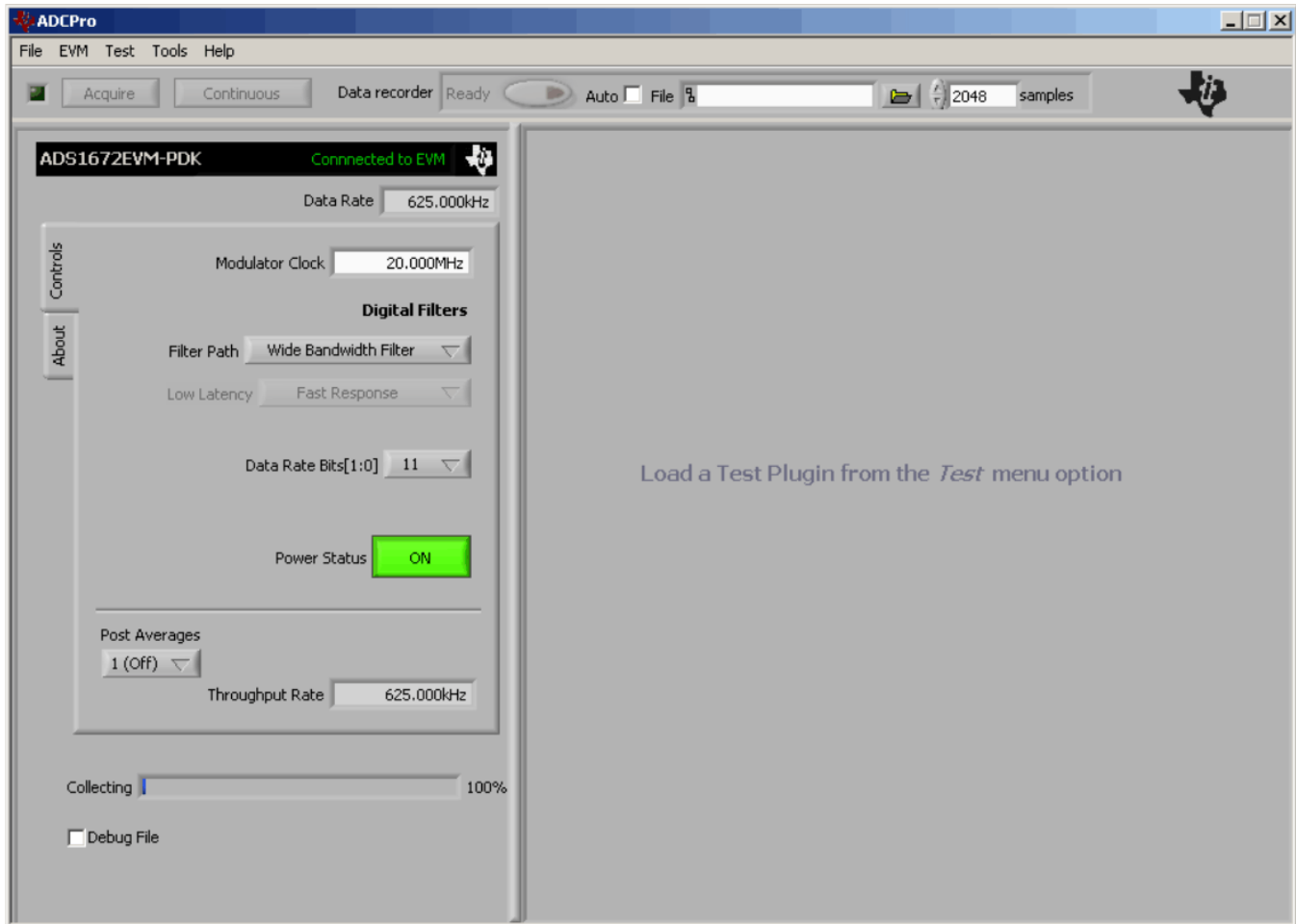
Figure 14. ADS1672EVM-PDK Plug-In Display Window

Step 3.   The ADS1672EVM-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 that indicate this action.

Step 4.   Apply power to the PDK and connect the board to an available PC USB port.

Step 5.   If you have not yet loaded the operating system drivers, Windows will display the Windows *Found New Driver Wizard* sequence (illustrated in Figure 15 through Figure 19). Accept the default settings.

Figure 15. Found New Driver Wizard, Screen 1

Figure 16. Found New Driver Wizard, Screen 2

Figure 17. Found New Driver Wizard, Screen 3

Figure 18. Found New Driver Wizard, Screen 4

Figure 19. Found New Driver Wizard, Screen 5

Step 6.   When Windows installs the software driver, the plug-in downloads the firmware to the MMB0.

Step 7.   Windows will display the installation wizard a second time. Again, accept the default settings.

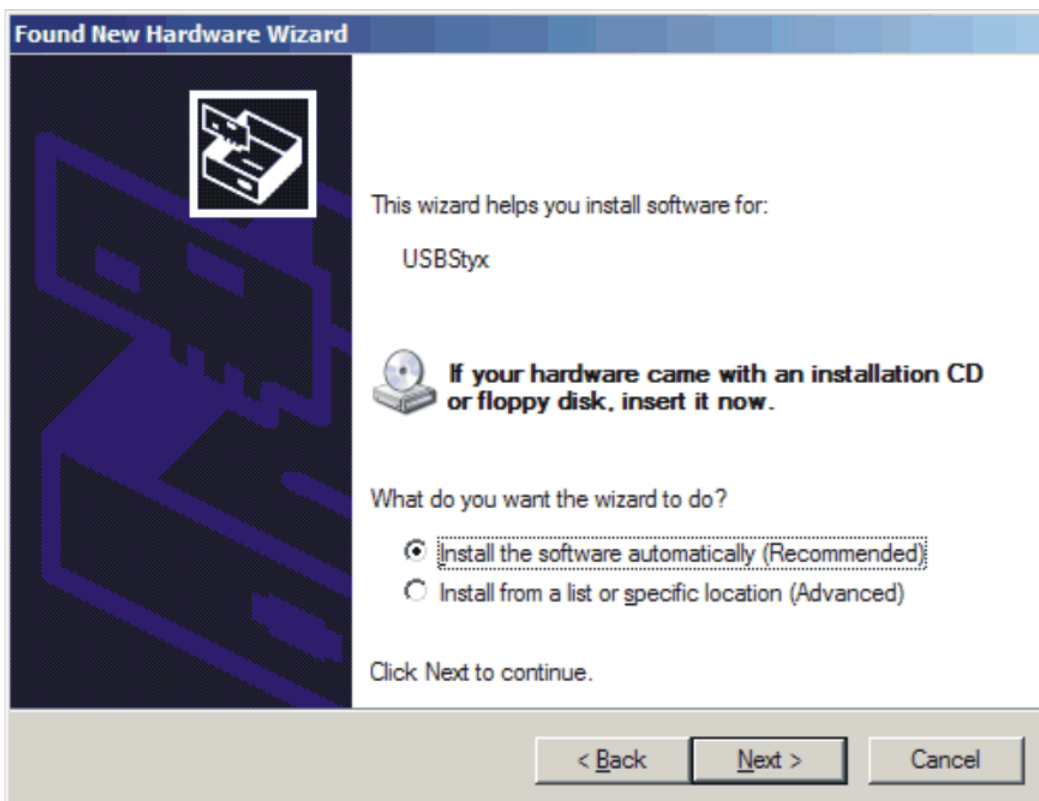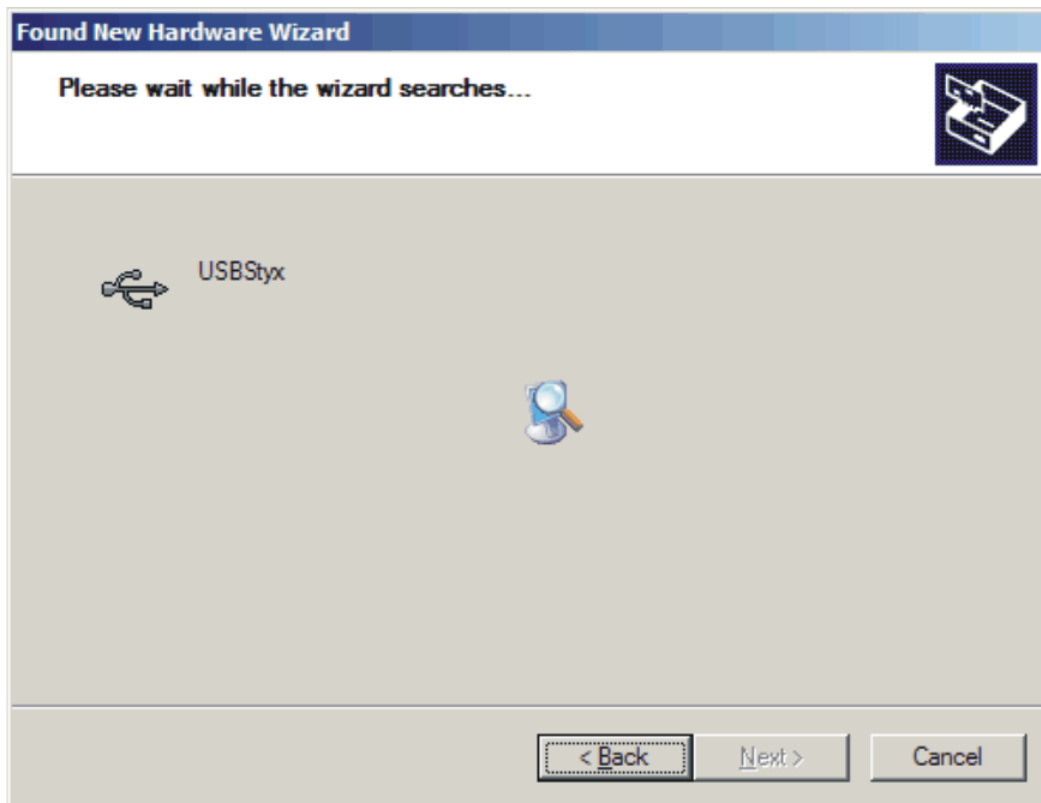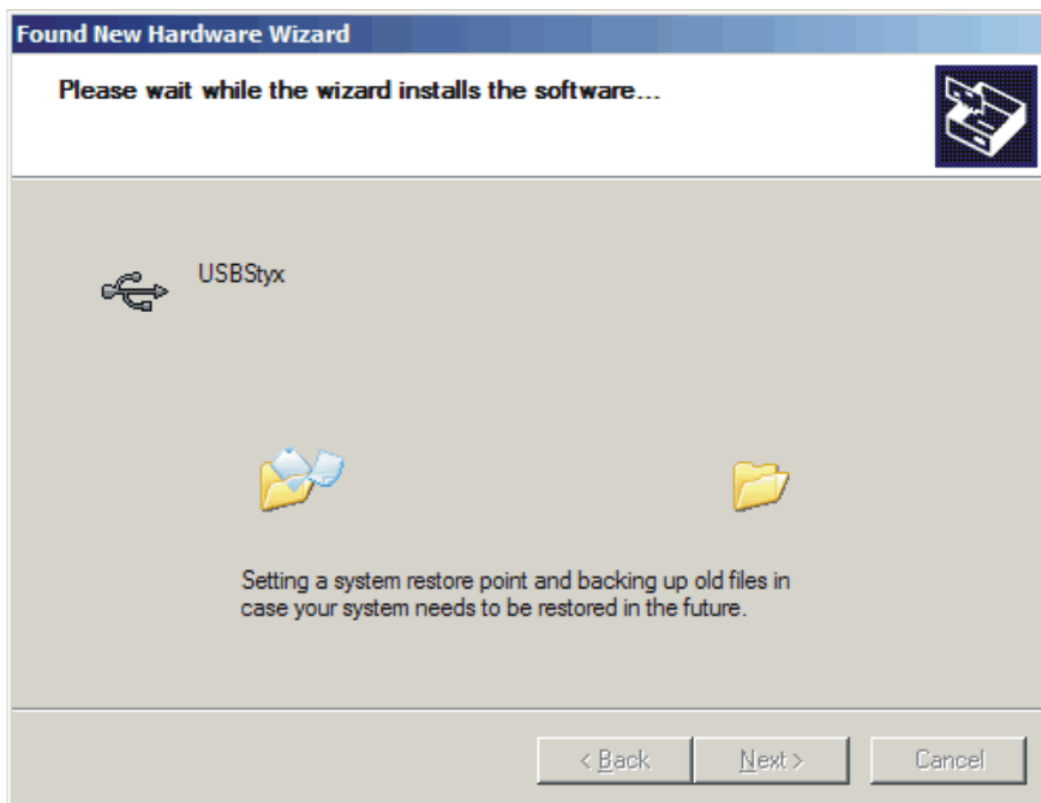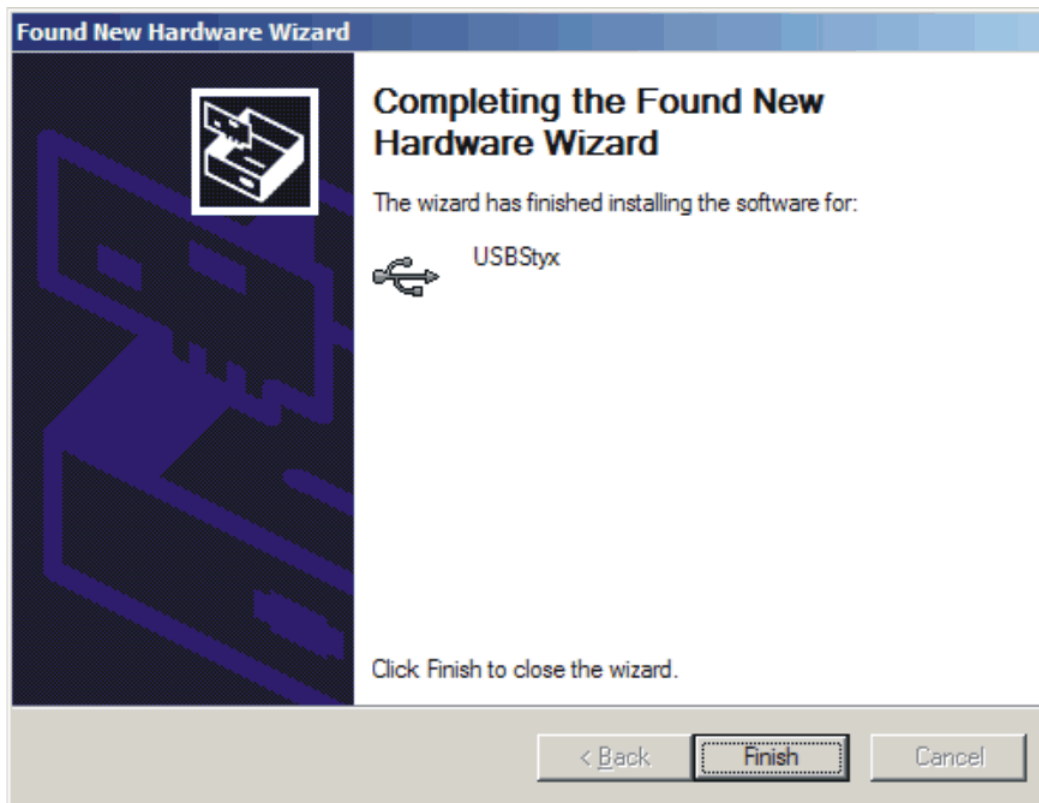Step 8.   The status area displays a *connected* message. The software is now ready to use.

The *Found New Driver* wizard sequence should not appear again, unless you connect the board to a different USB port.

12   Evaluating with the ADCPro Software

The evaluation software is based on ADCPro, a program that operates using a variety of plug-ins. The ADS1672EVM plug-in is installed as described in Section 11.2, *Running the Software and Completing the Driver Installation*.

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 type of plug-in (EVM and Test) can be loaded at a time. If you select a different plug-in, the previous plug-in is unloaded.

12.1   Using the ADS1672EVM-PDK Plugin

The ADS1672EVM-PDK plug-in for ADCPro provides complete control over all settings of the ADS1672. It consists of a tabbed interface (see Figure 14), with all of the functions available on the main tab. The controls on the main tab are described in this section.

You can adjust the ADS1672EVM 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 ADS1672EVM plug-in, the setting is immediately updated on the board.

Settings on the ADS1672EVM correspond to settings described in the ADS1672 data sheet; see the ADS1672 data sheet (available for download at the www.ti.com) for details.

Because the effective data rate of the ADS1672 depends on settings of the Modulator Clock and the operating modes of FPATH, LL_CONFIG, and the Data Rate Bits, the **Data Rate** indicator (in the upper right corner of the plug-in interface) is always visible and updated whenever a setting is changed that affects the data rate.

12.1.1   Settings Tab

The FPATH control (illustrated in Figure 20) can configure the ADS1672 digital filter as a Wide-Bandwidth Filter or Low-Latency Filter setting.

Figure 20. FPATH settings

The LL_CONFIG control can configure the ADS1672 in a Single Cycle Settling mode or Fast Response. Figure 21 shows the LL_CONFIG options.
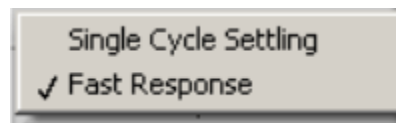
Figure 21. LL_CONFIG Settings

The Data Rate Bits can be configured as 00b, 01b, 10b, or 11b. Figure 22 shows the Data Rate Bits options.
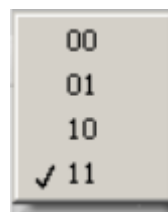
Figure 22. Data Rate Bits Setting Options

The Modulator Clock can be configured to match the onboard oscillator (20MHz) or the external clock. The setting of the Modulator clock in ADCPro will change the Data Rate indicator in the top right corner of the plug-in interface. The Post Averages option is used to average the data output results after data have been collected. Figure 23 shows the Modulator Clock and Post Averages options.
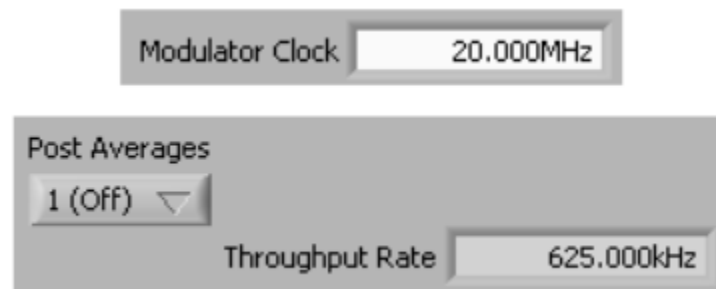
Figure 23. Modulator Clock and Post Averages Options

The Data Rate of a conversion is posted in the upper left corner of the ADC1672 plug-in screen. Under the Date Rate, a power-down switch can be implemented. This power-down affects the ADS1672 on the EVM board. Figure 24 shows the power-down option.
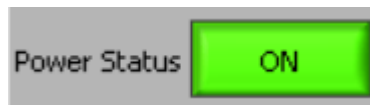
Figure 24. Power-Down Option

12.1.2 Collecting Data

After you have configured the ADS1672 for your test scenario, pressing the ADCPro **Acquire** button will start the collection of the number of data points specified in the test plug-in *Block Size* control. The ADS1672EVM-PDK plug-in disables all the front panel controls while acquiring data, and displays a progress bar as shown in Figure 25.
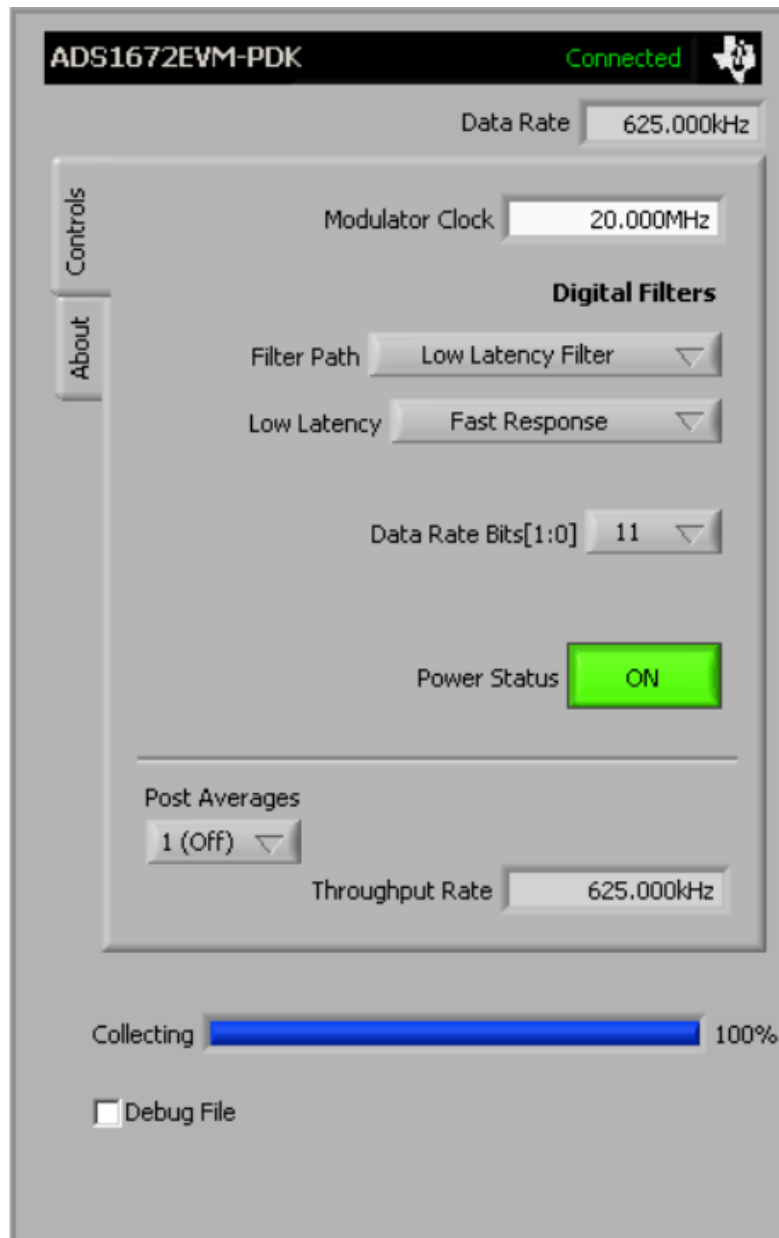
Figure 25. Progress Bar while Collecting Data

For more information on testing analog-to-digital converters in general and using ADCPro and test plug-ins, refer to the ADCPro™ Analog-to-Digital Converter Evaluation Software User's Guide.

12.2 Troubleshooting

If ADCPro stops responding while the ADS1672EVM-PDK is connected, try unplugging the power supply from the PDK, making sure to unload and reload the plug-in before reapplying power to the PDK.

13   Schematics and Layout

Schematics for the ADS1672EVM are appended to this user's guide. The bill of materials is provided in Table 6.

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 ADS1672EVM PCBs.

13.1 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 compiance, see the Quality and Eco-Info information on the TI web site.)

Table 6. ADS1672EVM Bill of Materials

| Item No.	Qty	Value	Reference Designators	Description	Vendor	Part Number
1	12	0	R5, R9, R20, R21 R22, R24, R25, R26, R27, R33, R55, R56	RES 0Ω 1/16W 5% 0603 SMD	Panasonic: ECG or Alternate	ERJ-3GEY0R00V
2	3	10	R14, R15, R17	RES 10.0Ω 1/10W 0.1% 0603 SMD	Vishay Dale	TNPW030610R0BT9
3	3	49.9	R3, R6, R18	RES 49.9Ω 1/10W 1% 0603 SMD	Panasonic: ECG or Alternate	ERJ-3EKF49R9V
4	3	150	R44, R45, R46	RES 150Ω 1/10W 1% 0603 SMD	Panasonic: ECG or Alternate	ERJ-3EKF1500V
5	2	383	R8 R10	RES 383Ω 1/10W 0.1% 0603 SMD	BCC	2312-201-73831
6	2	392	R11 R12	RES 392Ω 1/10W 0.1% 0603 SMD	BCC	2312-201-73921
7	1	6.04k	R16	RES 6.04kΩ 1/10W 1% 0603 SMD	Panasonic: ECG or Alternate	ERJ-3EKF6041V
8	13	10k	R7, R19, R30, R31, R35, R36, R37, R38, R40, R41, R42, R43, R51	RES 10.0lΩ 1/10W 1% 0603 SMD	Panasonic: ECG or Alternate	ERJ-3EKF1002V
9	17	—	R1, R2, R4, R13, R23, R28, R29, R32, R34, R39, R47, R48, R49, R50, R52, R53, R54		Not Installed	Not Installed
10	1	750pF	C18, C55	CAP CER 820pF 50V C0G 5% 0603	TDK Corporation	C1608C0G1H821J
11	4	1000pF	C3, C5, C28, C38	CAP CER 1000pF 50V C0G 5% 0603	TDK Corporation or Alternate	C1608C0G1H102J
12	2	0.01µF	C16, C26	CAP CER 0.01µF 25V C0G 5% 0603	TDK Corporation or Alternate	C1608C0G1E103J
13	19	0.1µF	C11, C15, C20, C21, C22, C23, C33, C35, C36, C37, C40, C41, C42, C45, C47, C48, C51, C66, C67	CAP CER 0.10µF 25V X7R 10% 0603	TDK Corporation or Alternate	C1608X7R1E104K
14	8	1µF	C1, C25, C30, C31, C46, C50, C63, C72	CAP CER 1.0µF 10V X5R 10% 0603	TDK Corporation or Alternate	C1608X5R1A105KT
15	8	4.7µF	C39, C43, C44, C56, C57, C58, C60, C62	CAP CER 4.7µF 6.3V X5R 20% 0603	TDK Corporation or Alternate	C1608X5R0J475M
16	5	10µF	C9, C24, C49, C53, C61	CAP CER 10µF 6.3V X5R 0603 ±20%	Murata Electronics North America	GRM188R60J106ME47D
17	7	10µF	C4, C6, C12, C13, C17, C27, C32	CAP CER 10µF 16V X5R 20% 1206	TDK Corporation or Alternate	C3216X5R1C106M
18	7	47µF	C2, C19, C29, C52, C54, C59, C71, C73	CAP CER 47µF 6.3V X5R 0805	Taiyo Yuden or Alternate	JMK212BJ476MG-T
19	11	—	C7, C8, C10, C14, C34, C64, C65, C68, C69, C70		Not Installed	Not Installed
20	3		D1, D2, D3	LED 565NM GRN DIFF 0603 SMD	Lumex	SML-LX0603GW-TR
21	4		L1, L2, L3, L4	FERRITE CHIP 600 OHM 500MA 0805	TDK Corporation	MMZ2012R601A

Table 6. ADS1672EVM Bill of Materials (continued)

Item No.	Qty	Value	Reference Designators	Description	Vendor	Part Number
22	1		U1	REF5030 Low-noise, low-drift precision reference	Texas Instruments	REF5030AID
23	1		U2	Rail-to-rail output, wideband, fully differential amplifier	Texas Instruments	THS4520RGTT
24	1		U3	REF5025 low-noise, low-drift precision reference	Texas Instruments	REF5025IDG4
25	1		U4	1.1nV/$\sqrt{Hz}$ Noise, low-power, precision operational amplifier	Texas Instruments	OPA211AIDR
26	1		U5	16-BIT I^{2}C I/O expander	Texas Instruments	PCA9535PWR
27	1		U6	ADS1672 24-bit 625kSPS	Texas Instruments	
28	1		U7	IC SRL EE 256K 2.5V 8MSOP	Microchip Technology	24LC256T-I/
29	1		P1	0.025 SMT SOCKET: BOTTOM SIDE OF PWB	Samtec	SSW-110-22-S-D-VS
30	1		P2	0.025 SMT SOCKET: BOTTOM SIDE OF PWB	Samtec	SSW-110-22-S-D-VS
31	1			0.025 SMT PLUG: TOP SIDE of PWB	Samtec	TSM-110-01-T-DV-P
32	1		P3	0.025 SMT PLUG: TOP SIDE of PWB	Samtec	TSM-110-01-T-DV-P
33	3		J1 , J2, J3	CONN RECEPT STRAIGHT PCB .155NI	Emerson Network Power Connectivity Solutions	142-0701-206
34	1		J4	0.025 SMT SOCKET: BOTTOM SIDE OF PWB	Samtec	SSW-105-22-S-D-VS
35	1			0.025 SMT PLUG: TOP SIDE of PWB	Samtec	TSM-105-01-T-DV-P
36	1		W2	2mm low profile	Samtec	TMM-102-03-T-S
37	5		W1, W3, W4, W5, W6	2mm low profile	Samtec	TMM-103-03-T-S
38	4		TP2, TP3, TP5, TP7	TEST POINT PC MINI .040D RED	Keystone Electronics	5000K-ND
39	5		TP1, TP4, TP6, TP8, TP9	TEST POINT PC MINI .040D BLACK	Keystone Electronics	5001K-ND
40	6		E1, E2, E3, E4, E5, E6		Not Installed	Not Installed
41	2		SJP1, SJP2		Not Installed	Not Installed
42	1		SW1	DIP Switch 10-Position	CTS Corporation Resistor/Electrocomponents	CT21810LPST
43	1		X1	20MHz, Ceramic SMD 3-state Oscillator	Valpey Fisher	VF1SH-1-20.0MHz
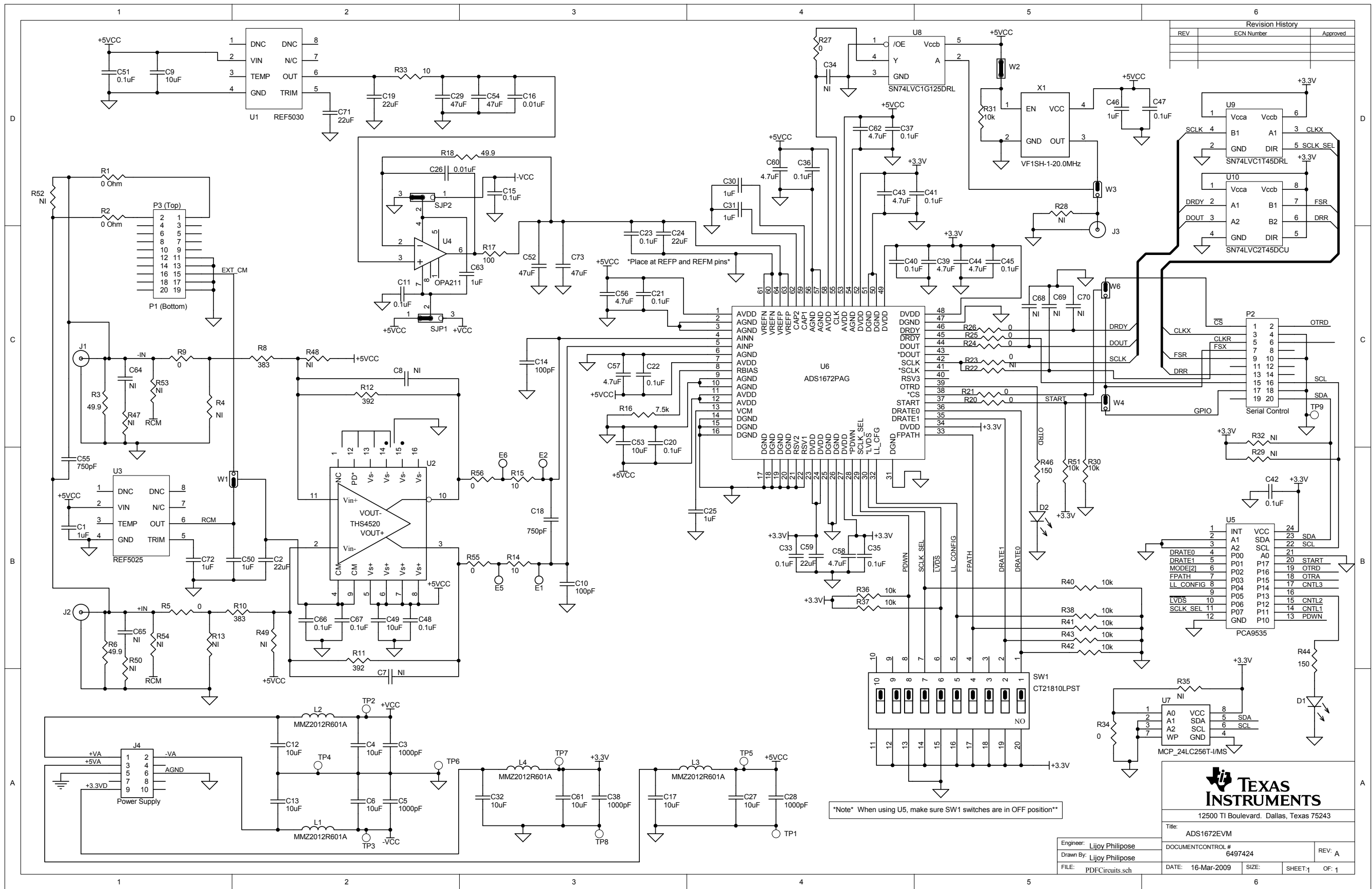
Revision History

REV	ECN Number	Approved

Place at REFP and REFM pins

Note When using U5, make sure SW1 switches are in OFF position**

ADS1672EVM

Rev A

(c) TI 2009

R31 W2 C46 C47 U7
X1 R35 R34 W6
R27 C34 U8 TP9

P2 D2 D1
R3 R29 U5

J3 W3 R28 TP6
C37 C43 C39 C41 C40
C70 C68 C44 C45
C36 R26 R25 R24 R23 R22 R21 R20
C69 W4 U9
C30 C31 C23 C24 U10 SW1
U1 SJP1 E4
C9 C2 C5 C11
R17 E3 C21 C14 C18 C22 C16 C20 C25
R18 C15 C73
R33 R19 C26 C29 C1 TP5
U4 SJP2 R56 R12 C48 C49 R55 C27
C54 R8 R4 C7 TP4 C17 L3
W1 R9 R13 R10 R11 C13
J1 C64 C55 C65 TP3 C6 L1 C12 L2 C4
U3 C72 R50 R6 C5 C3
C1 R3 R47 C50 J2 TP2 C3
P3 TP8 R7 U2 TP1

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BoM: 6497416
PCA: 6497419
SN#:
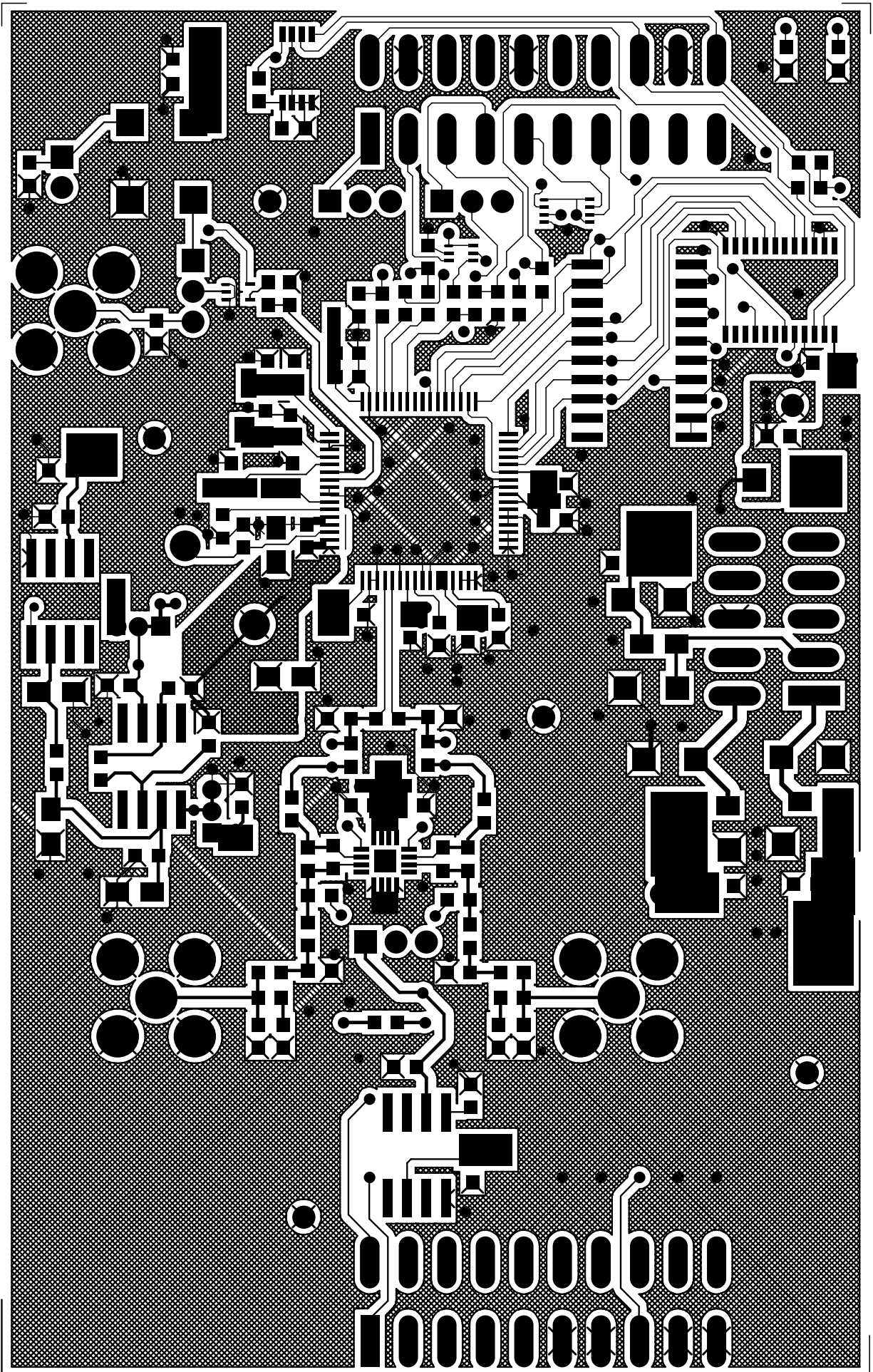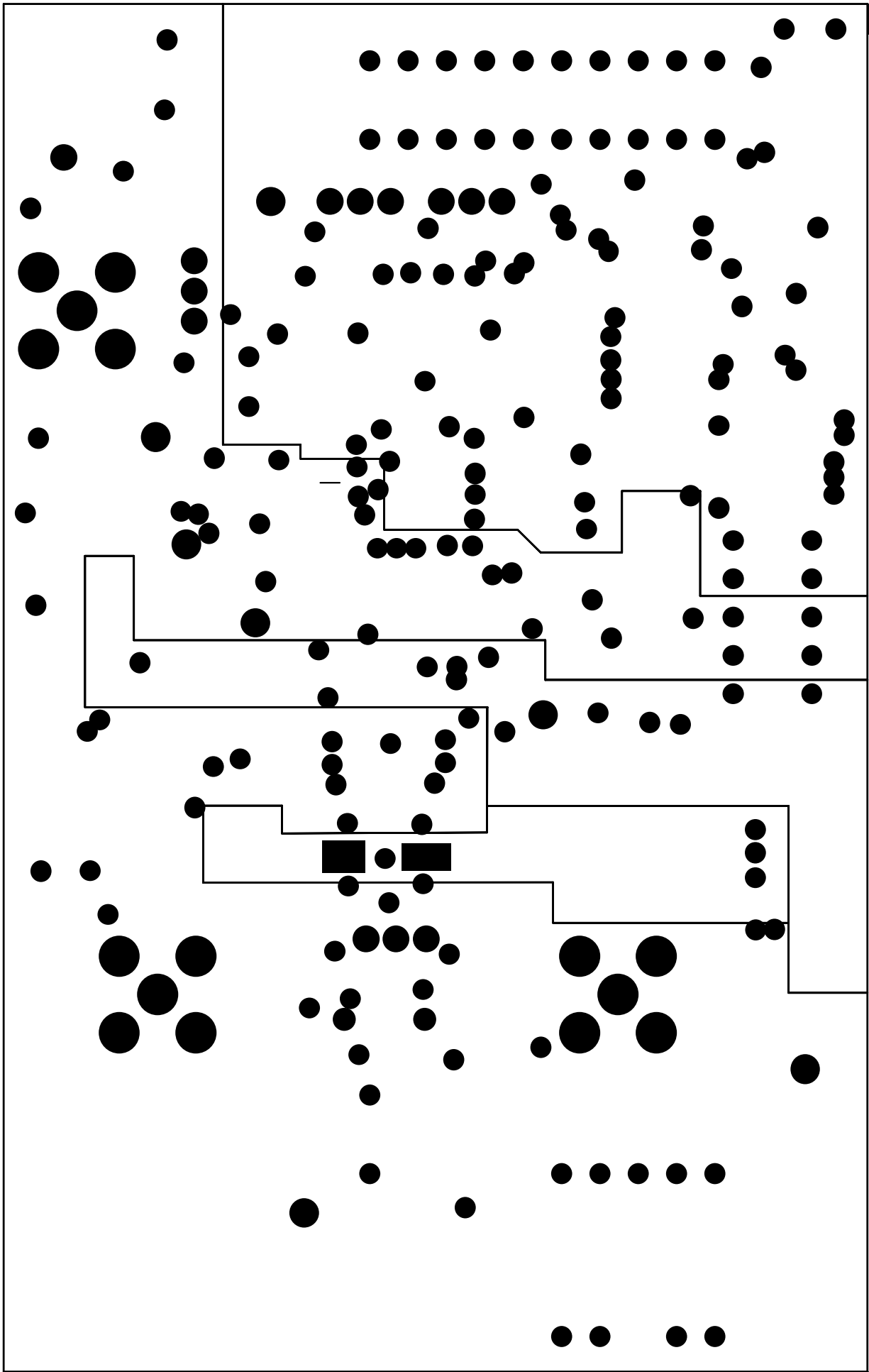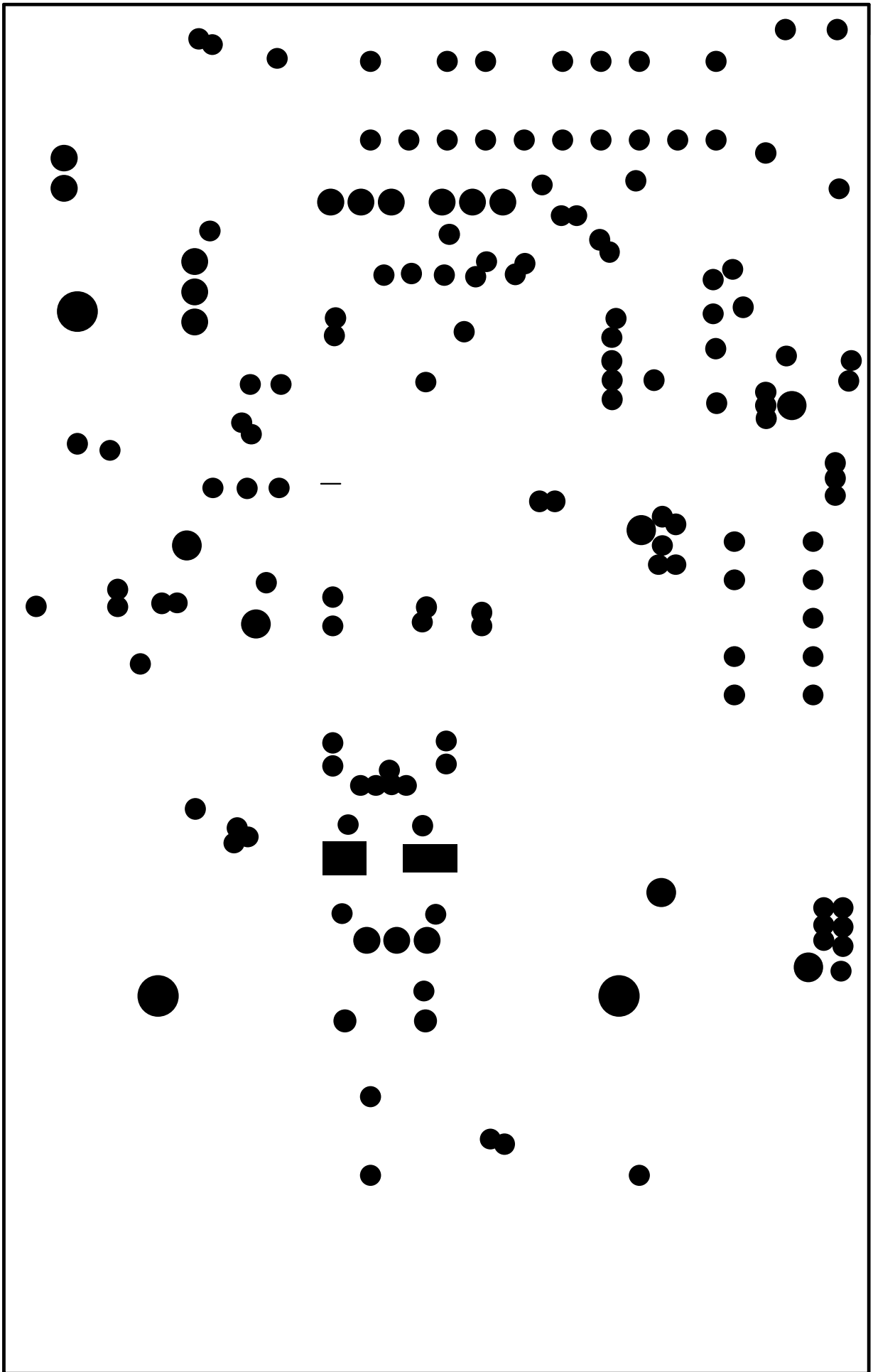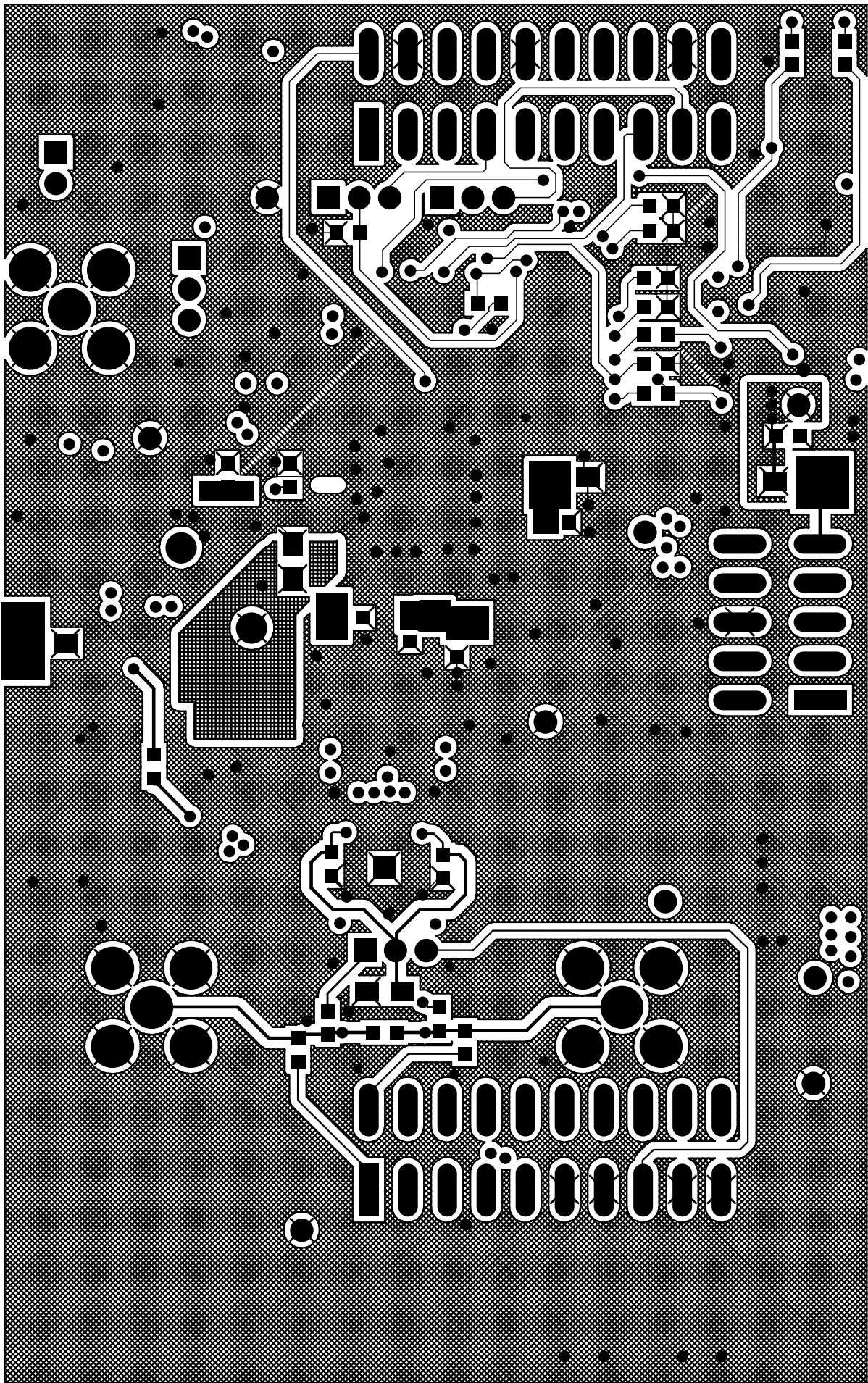
U6 C33 C38 C42 TP7
C2 C1

TP8

JP46
JP44
R42
R43
R30
R41
R38
R37
R40
R39
R31
CR1
J4
C29
JC28
J1
CR0E
CR2
C53
C51
JC25
C52
CR3
CR6
CR7
CR51
C2
R54
P2
R52
JR53
JP1
P1

Revision History

Changes from Original (March 2009) to A Revision   **Page**

- Removed adapter from image on the first page. 1
- Changed adapter requirements in the *ADS1672EVM-PDK Power Supply* section. 11
- Changed 4th step of the ordered list in the *ADS1672EVM-PDK Kit Operation* section. AC adapter now *not included*.... 12
- Changed current rating in the 1st paragraph of the *Connecting an AC Adapter* section from 2 A, to 500 mA. 15

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

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.

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/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 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。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。
　　　　上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・イ

ンスツルメンツ株式会社

東京都新宿区西新宿６丁目２４番１号

西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page
電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧くださ
い。http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_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.

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.

6. *Disclaimers:*

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