User's Guide

SBAU242–November 2014

ADS7044EVM-PDK



This user's guide describes the characteristics, operation and use of the ADS7044-EVM performance demonstration kit (PDK). This kit is an evaluation platform for the ADS7044 low power, 12-bit differential successive approximation register (SAR) analog-to-digital converters (ADCs) that support single-ended analog inputs.

This EVM eases the evaluation of the ADS7044 device with hardware and software for computer connectivity through universal serial bus (USB). This user's guide includes complete circuit descriptions, schematic diagrams, and a bill of materials.

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

Table 1. Related Documentation

Device	Literature Number
OPA316	SBOS703
TPS79101	SLVS325
REG71055	SBAS221
TPS62080	SLVSAE8
TPS3836K33	SGLS322

Contents

1 Overview 3
1.1 ADS7044EVM Features 3
1.2 ADS7044EVM-PDK Features 3
2 EVM Analog Interface 3
3 Power Supplies 4
4 Digital Interface 5
5 ADS7044EVM-PDK Initial Setup 5
5.1 Default Jumper Settings 5

Microsoft, Windows are registered trademarks of Microsoft Corporation.
All other trademarks are the property of their respective owners.

Copyright © 2014, Texas Instruments Incorporated

5.2 Software Installation 6
6 ADS7044EVM-PDK Kit Operation 12
6.1 About the SCC Controller Board 12
6.2 Loading the ADS7044EVM Software 12
6.3 Capturing Data with the ADS7044-PDK 13
6.4 FFT Analysis 15
6.5 Histogram Analysis 16
6.6 Offset Calibration 17
6.7 Estimated Current Consumption 18
6.8 Troubleshooting 18
7 Bill of Materials, PCB Layout, and Schematics 19
7.1 Bill of Materials 19
7.2 PCB Layout 20
7.3 Schematics 22

List of Figures

1 ADS7044EVM Analog Input Connections 3
2 ADS7044EVM Default Jumper Settings 5
3 Bottom View of Simple Capture Card with microSD Memory Card Installed 6
4 Bottom View of ADS7044EVM Board with microSD Memory Card Installed 7
5 Connecting ADS7044EVM Board to Simple Capture Card 8
6 LED Indicators on the Simple Capture Card 8
7 Welcome Screen and Destination Directory Screens 9
8 License Agreement and Start Installation Screens 9
9 Progress Bar and Installation Complete Screens 10
10 Windows 7 Driver Installation Warning 10
11 Simple Capture Card Driver Installation 11
12 Simple Capture Card Driver Completion 11
13 GUI Display Prompt 12
14 Open the Data Capture Page on the GUI 13
15 Data Capture Page 14
16 FFT Performance Analysis Page 15
17 Histogram Analysis Page 16
18 Offset Calibration Page 17
19 Estimated Current Consumption Page 18
20 ADS7044EVM PCB: Top Layer (L1) 20
21 ADS7044EVM PCB: GND Layer (L2) 20
22 ADS7044EVM PCB: Power Layer (L3) 21
23 ADS7044EVM PCB: Bottom Layer (L4) 21

List of Tables

1 Related Documentation 1
2 Analog Input Connections 4
3 AVDD Voltage Settings 4
4 Voltage Supply Options 4
5 Default Jumper Configurations 5
6 ADS7044EVM Bill of Materials 19

Copyright © 2014, Texas Instruments Incorporated

1 Overview

The ADS7044EVM-PDK is a platform for evaluation of the ADS7044 ADC. The evaluation kit combines the ADS7044EVM board with a Simple Capture Card controller board. This controller card consists of a TI Sitara embedded microcontroller (AM3352) and a field-programmable gate array (FPGA). It provides an interface from the EVM to the computer through a universal serial bus (USB) port. The included software communicates with the Simple Capture Card, and the controller card provides the power and digital signals used to communicate with the ADS7044EVM board. These demonstration kits include the ADS7044EVM board, the Simple Capture Card, a microSD memory card, and an A-to-micro-B USB cable.

1.1 ADS7044EVM Features

- Contains support circuitry as a design example to match ADC performance
- 3.3-V slave serial peripheral interface (SPI)
- Onboard 5-V analog supply
- Onboard OPA316 (10-MHz, low-power, low-noise, Rail-to-Rail Out (RRIO)) ADC input drivers

1.2 ADS7044EVM-PDK Features

- USB port for computer interface
- Easy-to-use evaluation software for Microsoft® Windows® XP, Windows 7, and Windows 8 operating systems
- Built-in analysis tools including scope, FFT, and histogram displays
- Data collection to text files supported

2 EVM Analog Interface

The ADS7044 is an extremely low-power, extremely small size ADC that supports single-channel ended analog inputs. The ADS7044EVM uses an OPA316 amplifier to drive the inputs of the ADC. The ADS7044EVM is designed for easy interfacing to multiple analog sources. SMA connector J3 (please refer to the schematics in Section 7.3) allows the EVM to have input signals connected through a coaxial cable. In addition, header connector P2 provides a convenient way to connect input signals. All analog inputs are buffered by the OPA316 amplifier in order to properly drive the ADS7044 ADC inputs.

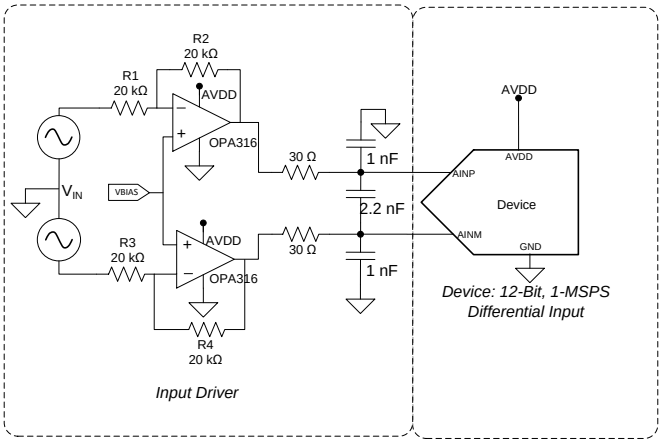


Figure 1. ADS7044EVM Analog Input Connections

lists the analog interface connectors available. The ADS7044EVM accepts a differential signal of –AVDD to AVDD on J1 and J3 with common mode of AVDD / 2. Since the AVDD supply functions as the reference for the ADC, the voltage provided on both J1 and J3 connectors can vary from 0 V to AVDD (with the two signals out-of-phase). Connecting an input signal greater than AVDD would cause the ADC output codes to saturate.

Copyright © 2014, Texas Instruments Incorporated

Table 2. Analog Input Connections

Reference Designator	Signal	Signal Description
J1	AINM	Negative input of the differential signal provided at the SMA
J2	AINM	Alternate location to provide the negative input of the differential signal
J3	AINP	Positive input of the differential signal provided at the SMA
J4	AINP	Alternate location to provide the positive input of the differential signal

3 Power Supplies

The ADS7044 supports a wide range of operation on its analog supplies. The AVDD can operate from 1.8 V to 3.6 V. The DVDD operates from 1.65 V to 3.6 V, independent of the AVDD supply.

The analog portion of the ADS7044EVM-PDK operates from a 5-V supply. The ADS7044EVM-PDK is configured to use the onboard regulated analog 5-V supply that in turn generates an AVDD analog supply using the low-noise TPS79101 LDO. This supply is nominally set to 3.3 V at the factory, but this voltage maybe changed to any value within the valid range, by modifying the value of R15 as per Table 3. In case any intermediate value needs to be set, the detailed formula to arrive at these values are available in the TPS79101 (SGLS160) datasheet.

Table 3. AVDD Voltage Settings

AVDD Voltage	R15	R19	C9
1.8 V	14.2 kΩ	30.1 kΩ	33 pF
2.0 V	19.1 kΩ	30.1 kΩ	27 pF
2.5 V	31.6 kΩ	30.1 kΩ	22 pF
3.0 V	43.7 kΩ	30.1 kΩ	15 pF
3.3 V (default)	51.1 kΩ	30.1 kΩ	15 pF
3.6 V	59.0 kΩ	30.1 kΩ	15 pF

By default, the OPA316 amplifier supplies, VDD_OPA and VSS_OPA, are tied to AVDD (supplied from the same LDO) and GND, respectively. DVDD_ADC is set at 3.3 V from the controller. These three supplies may be externally supplied by making the modifications described in Table 4.

Table 4. Voltage Supply Options

Supply	Supply Option	Source	Component	Setting
VDD_OPA	Onboard	AVDD LDO (U5)	R47	Assembled
	External	J7/pin1	R47	Disassembled
VSS_OPA	Onboard	GND	R48	Assembled
	External	J7/pin3	R48	Disassembled
DVDD_ADC	Onboard	3V3_SDCC supply from connector	R49	Assembled
	External	J9/pin1	R49	Disassembled

CAUTION

The external AVDD supply applied to external connector P3 must not exceed 3.6 V as this may damage the device. The external AVDD supply must be in the range of 1.8 V to 3.6 V for proper operation of the ADS7044EVM.

The digital portion of the ADS7044 ADC operates from a 3.3-V supply from the Simple Capture Card. The buffer U12 is included to ensure that the SDO can be driven to the controller with minimal distortion.

Copyright © 2014, Texas Instruments Incorporated

4 Digital Interface

The ADS7044 digital output is available in SPI-compatible format, which makes interfacing with microprocessors, digital signal processors (DSPs) and FPGAs easy. The ADS7044EVM offers 50-Ω resistors between the SPI signals and edge connector J1 to aid with signal integrity. Typically, in high-speed SPI communication, fast signal edges can cause overshoot; these resistors slow down the signal edges in order to minimize signal overshoot.

The ADS7044EVM has clearly marked test points for all the SPI signals to allow observation of the interface signals using an oscilloscope.

5 ADS7044EVM-PDK Initial Setup

This section presents the steps required to set up the ADS7044EVM-PDK kit before operation.

5.1 Default Jumper Settings

A silkscreen plot detailing the default jumper settings is shown in Figure 2.

explains the configuration for these jumpers.

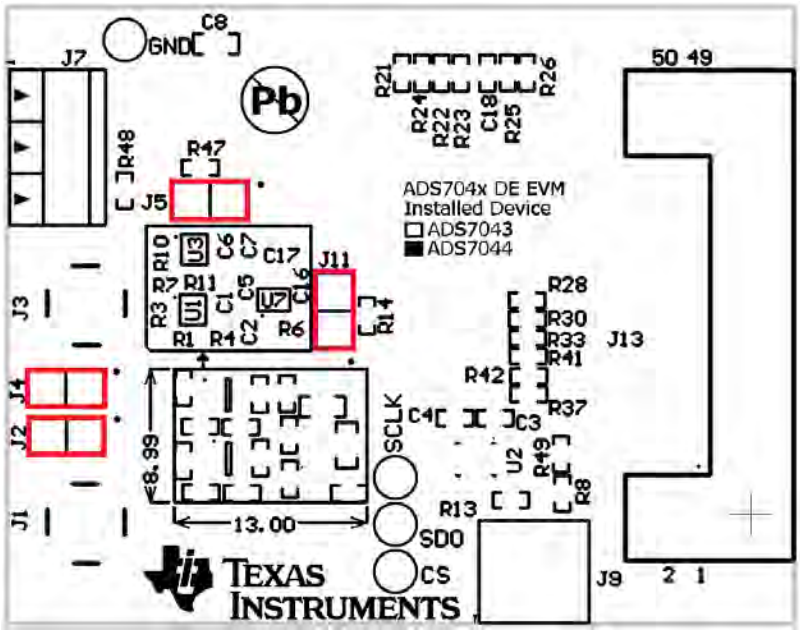


Figure 2. ADS7044EVM Default Jumper Settings

Table 5. Default Jumper Configurations

Reference Designator	Default Position	Description
J2	Open	Alternate location to provide the negative input of the differential signal
J4	Open	Alternate location to provide the positive input of the differential signal
J5	Closed	Point to insert an ammeter to measure VDD_ADC current, if required
J11	Closed	Point to insert an ammeter to measure VDD_OPA current, if required

Copyright © 2014, Texas Instruments Incorporated

5.2 Software Installation

This section presents the steps required to the install the software. Section 6 explains how to operate the software to acquire data.

NOTE: Ensure the microSD memory card included in the kit is installed in the microSD socket (P6) on the back of the Simple Capture Card as well as the microSD socket (J2) before connecting the EVM to the PC. Also ensure that the cards are not swapped or overwritten. If the contents of these cards are not available during boot up, Windows will not recognize the ADS7044EVM-PDK as a connected device.

Complete the following steps to install the software:

Step 1. Ensure that the microSD memory cards on both the Simple Capture Card and ADS7044 are installed.

Step 2. Verify jumpers are in the factory-default positions and connect the hardware.

Step 3. Locate, copy and install the ADS7044EVM software to the PC.

Step 4. Complete the device driver installation.

Each of these steps is described in the following subsections.

5.2.1 Install the microSD Memory Cards on the Simple Capture Card Controller Board

As mentioned in the previous section, the ADS7044EVM-PDK includes two microSD memory cards. One is installed on the microSD socket (P6) at the back of the Simple Capture Card as shown in Figure 3. The second microSD memory card is installed on the mircoSD socket (J2) at the back of the ADS7044EVM as shown in Figure 4.

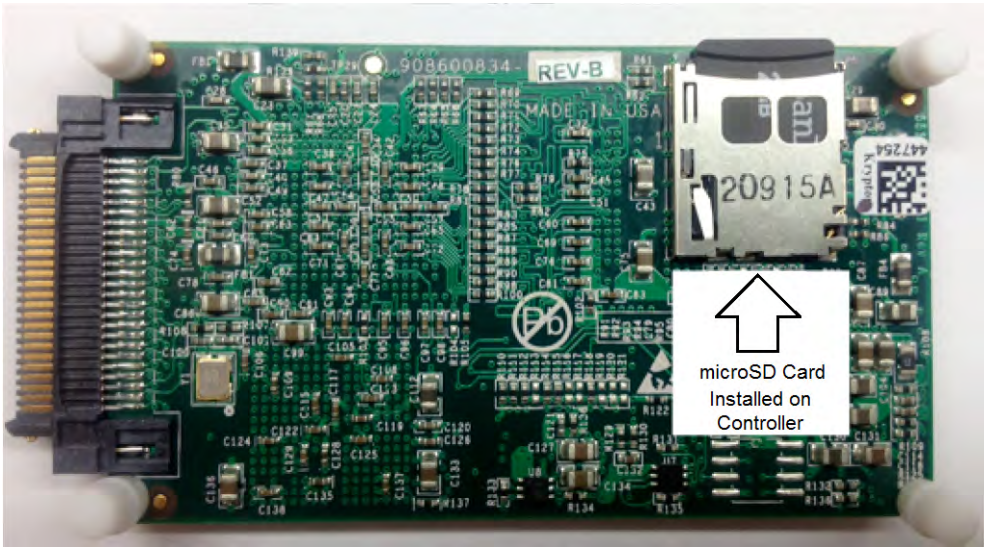


Figure 3. Bottom View of Simple Capture Card with microSD Memory Card Installed

Copyright © 2014, Texas Instruments Incorporated



Figure 4. Bottom View of ADS7044EVM Board with microSD Memory Card Installed

The microSD memory card is formatted at the factory with the necessary firmware files for the Simple Capture Card to boot properly. In addition to this the microSD card on the EVM contain Simple Capture Card firmware files (app and MLO files) and the ADS7044EVM-PDK software installation files inside the ADS7044 EVM V#.#.# folder. <V#.#.#> refers to the installation software version number, and increments with software installer releases.

5.2.2 Verify Jumpers are in the Factory-Default Position and Connect the Hardware

The ADS7044EVM-PDK includes both the ADS7044EVM and the Simple Capture Card; however, the boards are shipped unconnected.

Follow these steps to verify that ADS7044EVM-PDK kit is configured and connected properly:

Step 1. Verify the ADS7044EVM jumpers are configured as shown in Figure 2.

Step 2. Verify the microSD card is installed on the back of the Simple Capture Card, as shown in Figure 3.

Step 3. Verify the microSD card is installed on the back of the EVM board, as shown in Figure 4.

Step 4. Connect the ADS7044EVM board to the Simple Capture Card as Figure 5 illustrates.

Copyright © 2014, Texas Instruments Incorporated



Figure 5. Connecting ADS7044EVM Board to Simple Capture Card

Step 5. Connect the Simple Capture Card to the PC through the micro USB cable.

Step 6. Verify that the LED D5 Power Good indicator is illuminated. Wait approximately ten seconds and verify that diode D2 blinks, indicating that USB communication with the host PC is functioning properly. Figure 6 shows the location of the LED indicators in the Simple Capture Card.

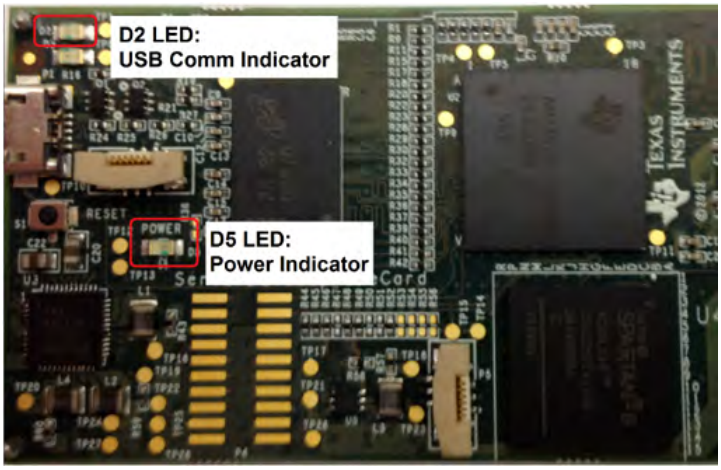


Figure 6. LED Indicators on the Simple Capture Card

5.2.3 Install the ADS7044EVM-PDK Software

The ADS7044 EVM V#.#.# software must be installed on the PC. This software supports the ADS7044-PDK. Administrator privileges are required to install the EVM software. The following steps list the directions to install the software:

Step 1. Open Windows Explorer and find the microSD memory card in the browser as a storage device.

Step 2. Navigate to the ...*ADS7044 EVM Vx.x.x**Volume*\ folder.

Step 3. Run the installer by double-clicking the file *setup.exe*. This action installs the EVM GUI software and the required and device driver components.

Step 4. After the installer begins, a welcome screen displays. Click *Next* to continue.

Step 5. A prompt appears with the destination directory; select the default directory under: ...*Program Files(x86)**Texas Instruments**ADS7044evm*\.

Copyright © 2014, Texas Instruments Incorporated

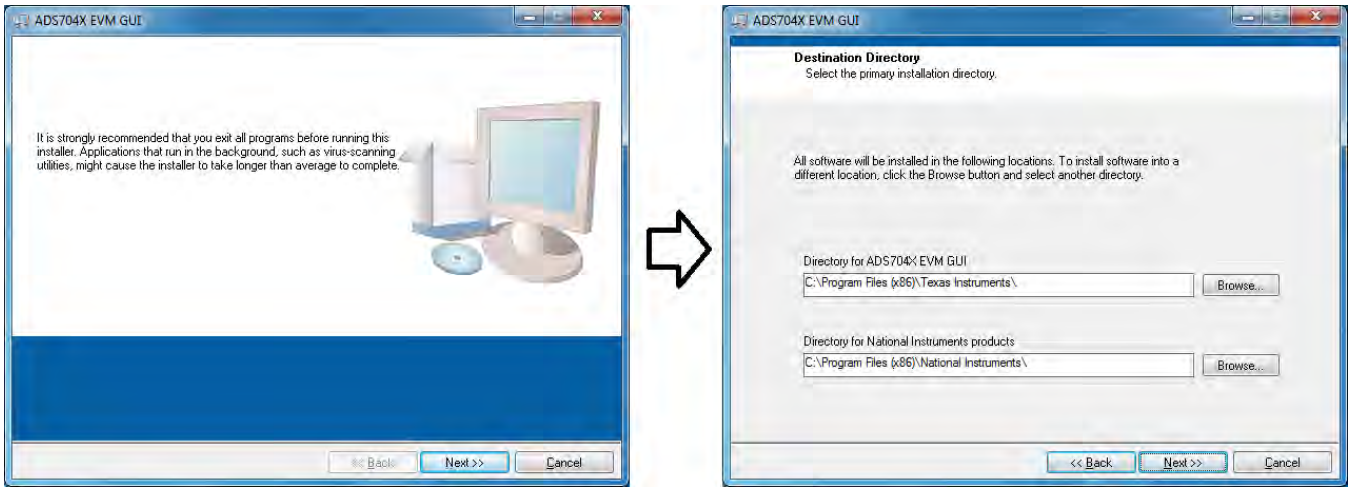


Figure 7. Welcome Screen and Destination Directory Screens

Step 6. One or more software license agreements appear. Select *I Accept the License Agreement* and click *Next*.

Step 7. The *Start Installation* screen appears. Click *Next*.

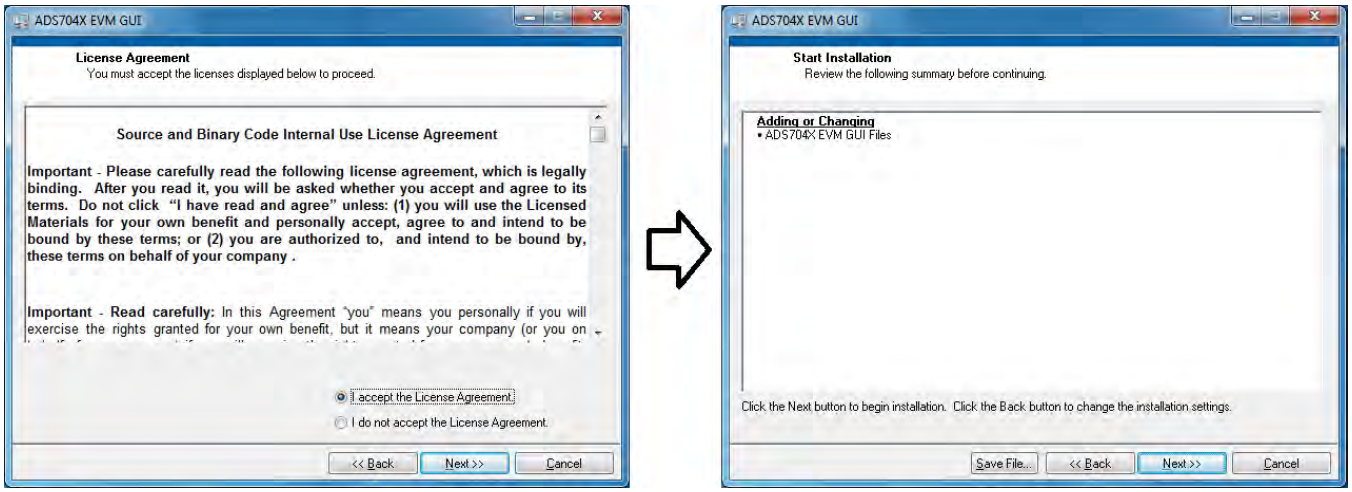


Figure 8. License Agreement and Start Installation Screens

Step 8. A progress bar appears; this step takes a few minutes.

Step 9. The progress bar is followed by an *Installation Complete* notice.

Copyright © 2014, Texas Instruments Incorporated

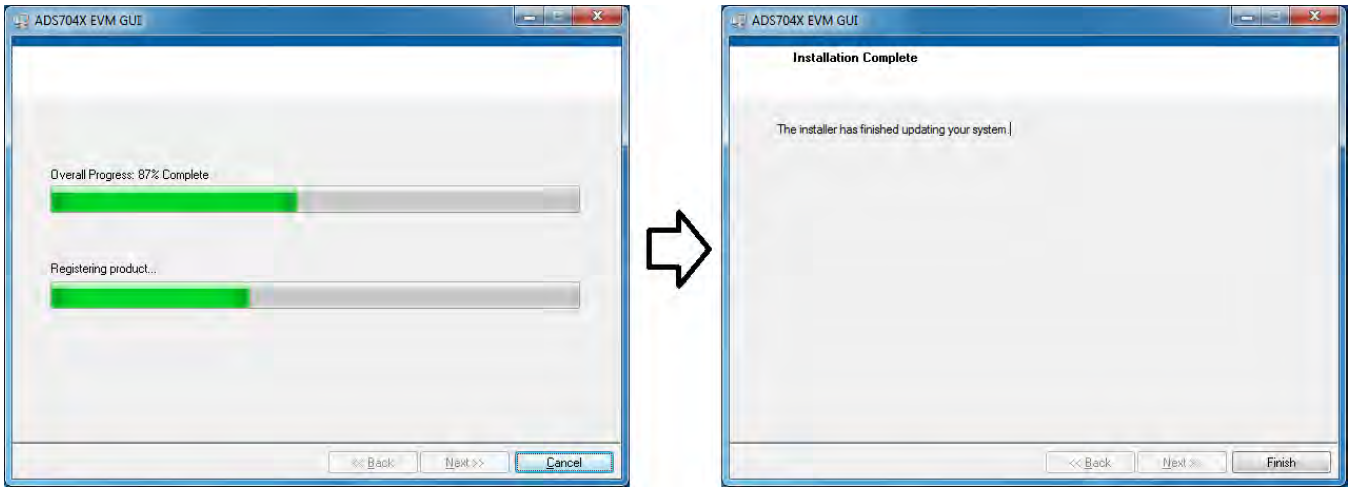


Figure 9. Progress Bar and Installation Complete Screens

5.2.4 Complete the Simple Capture Card Driver Installation

During installation of the Simple Capture Card driver, a prompt may appear with the Windows security message shown in Figure 10. Select *Install this driver software anyway* to install the driver required for proper operation of the software. The drivers contained within the installers are safe for installation to your system.

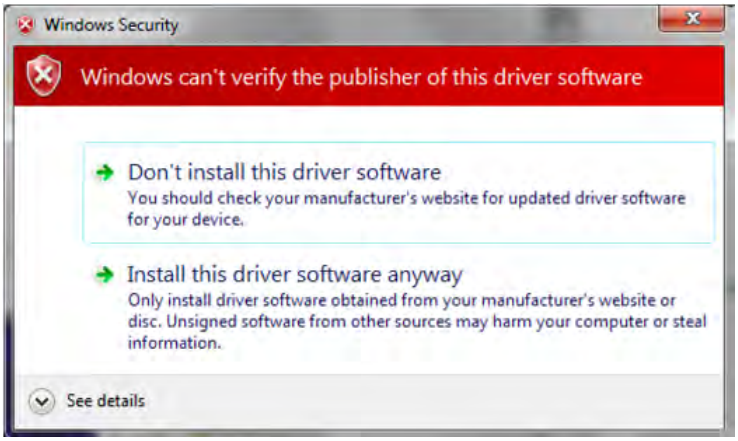


Figure 10. Windows 7 Driver Installation Warning

NOTE: Driver installation prompts do not appear if the Simple Capture Card driver has been installed on your system previously.

Copyright © 2014, Texas Instruments Incorporated

The following steps describe how to install the Simple Capture Card driver:

Step 1. Immediately after the ADS7044 EVM software installation is complete, prompts appear to install the Simple Capture Card driver, as shown in Figure 11 and Figure 12.

Step 2. A computer restart may be required to finish the software installation. If prompted, restart the PC to complete the installation.



Figure 11. Simple Capture Card Driver Installation

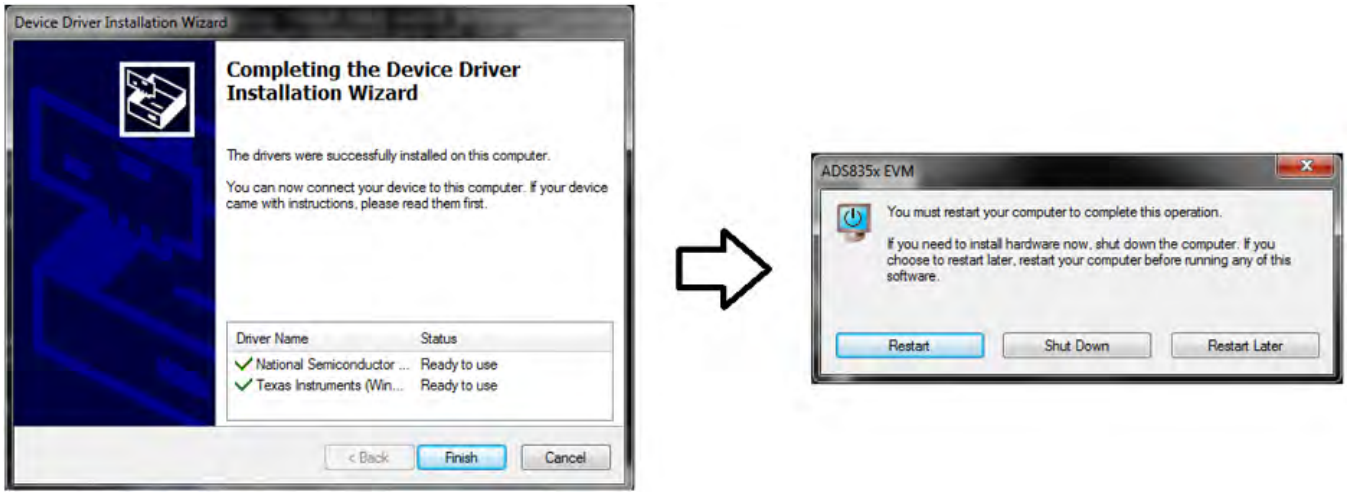


Figure 12. Simple Capture Card Driver Completion

Copyright © 2014, Texas Instruments Incorporated

6 ADS7044EVM-PDK Kit Operation

This section describes how to use ADS7044EVM-PDK and the ADS7044EVM software to configure the EVM and acquire data.

6.1 About the SCC Controller Board

The SCC controller board provides the USB interface between the PC and the ADS7044. The controller board is designed around the AM335x processor, a USB 2.0 high-speed capability, 32-bit ARM core. The SCC controller board incorporates an onboard FPGA subsystem and 256MB of onboard DDR SRAM memory. The SCC controller board is not sold as a development board, and it is not available separately. TI cannot offer support for the SCC controller` board except as part of this EVM kit.

6.2 Loading the ADS7044EVM Software

The ADS7044 EVM software provides the ability to capture and analyze data from the ADS7044.

To load the ADS7044 EVM software, follow these steps:

Step 1. Make sure the EVM kit is configured and powered up as explained in Section 5.

Step 2. Start the ADS7044 EVM software. Go to Start → All Programs →Texas Instruments → ADS7044 EVM and click ADS7044 EVM to run the software.

Step 3. Verify that the software detects the ADS7044. The GUI identifies the EVM hardware that is connected to the controller board and displays the *ADS7044EVM Front Page*. After the settings are loaded, *ADS7044EVM GUI* is displayed at the top of the GUI screen, which the device identified indicated at the right hand top corner as shown in Figure 13.



Figure 13. GUI Display Prompt

Copyright © 2014, Texas Instruments Incorporated

6.3 Capturing Data with the ADS7044-PDK

Access the *Data Capture* page in the GUI to monitor data acquired by the ADS7044. This GUI page displays the acquired data versus time. To access the *Data Capture* page, hover the cursor over the blue arrow at the left center side of the GUI screen; a menu with different GUI pages appears. Click on the *Data Capture* option in the menu as shown in Figure 14.



Figure 14. Open the Data Capture Page on the GUI

Copyright © 2014, Texas Instruments Incorporated

Figure 15 shows the *Data Capture* page of the EVM GUI. The device SCLK frequency and capture settings can be configured at the top right hand corner of the *Data Capture* page. Changes made to the configuration settings are executed on pressing the *Capture* button. The following list describes the different options available on the *Data Monitor* page.

- **SCLK:** This control sets the clock frequency used by the SPI interface to capture data. By configuring the SCLK frequency, the sampling rate of the ADS7044 is set. The ADS7044EVM-PDK software supports SCLK frequencies of 3.2 MHz to 16 MHz. In case the input in this field is beyond the capability of the device, it will be adjusted to the nearest value that can be supported.
- **Sampling Rate:** The upper limit of the sampling rate (displayed in ksps) is set based on the SCLK frequency selected. However, sampling rates lower than this displayed value may be set. The GUI supports these lower rates by increasing the CS high time between frames. Details of the interface protocol can be studied in the serial interface timing diagrams in the ADS7044 datasheet (SBAS608). In case the input to this field is beyond the capability calculated based on SCLK, it will be constrained to the maximum sampling rate possible at that SCLK frequency.
- **Sample Count:** This option is used to select the number of contiguous samples captured in a block. The drop-down menu can be used to select a data block in the range of 1024 samples to 1,048,576 samples per channel. The interface provides a drop-down list for values restricted to 2n, where n is an integer.

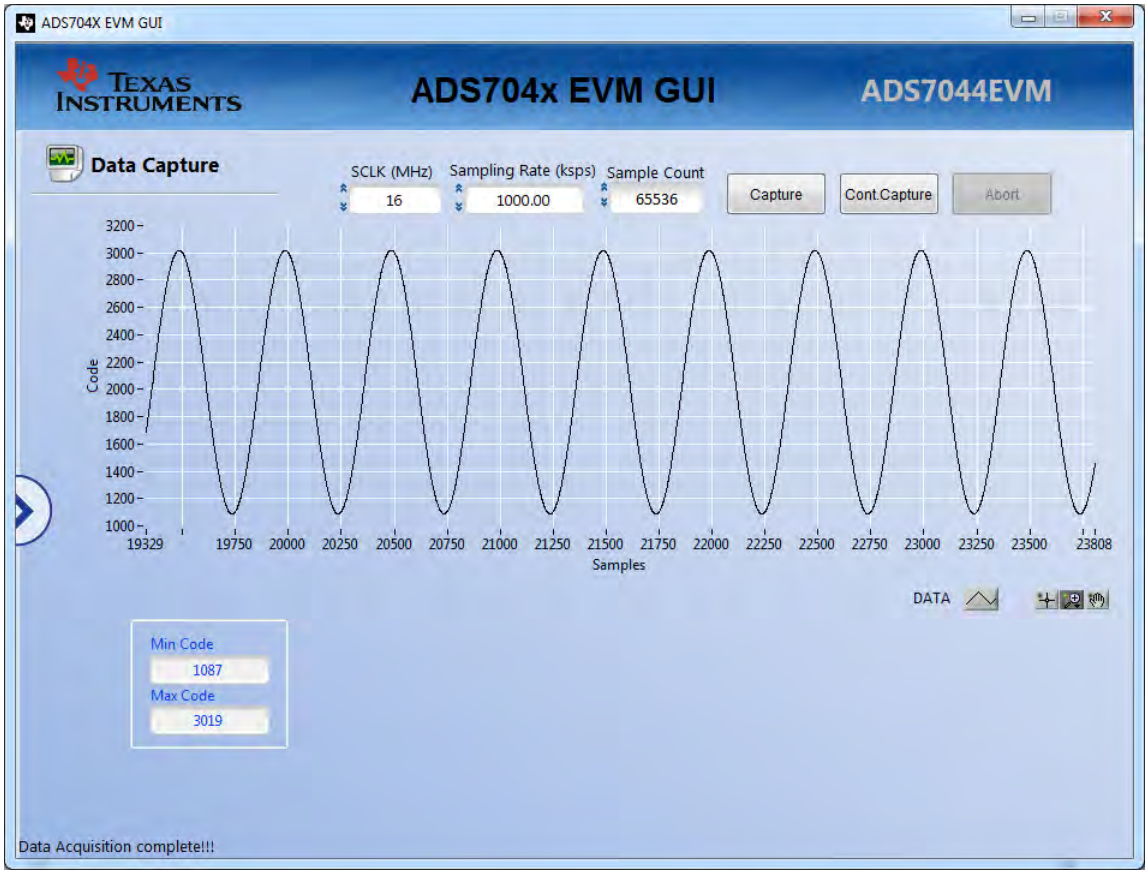


Figure 15. Data Capture Page

Once the ADC data is captured by the GUI using either of the *Capture* buttons, it is displayed on the graph area on this tab as shown in Figure 15. Once plotted, the graph can be zoomed into, panned, or resized by using the controls at the bottom of the graph area. The data captured may also be transferred to a file for further analysis by right clicking on the body of the graph and using the various options listed under *Export*.

Copyright © 2014, Texas Instruments Incorporated

6.4 FFT Analysis

The *Performance Analysis* page in the GUI performs the fast Fourier transform (FFT) of the captured data and displays the resulting frequency domain plot. This page also calculates key ADC dynamic performance parameters, such as signal-to-noise ratio (SNR), total harmonic distortion (THD), signal-to-noise and distortion ratio (SINAD), and spurious-free dynamic range (SFDR). Figure 16 shows the FFT performance analysis display. The FFT calculated parameters are shown on the bottom right side of the display.

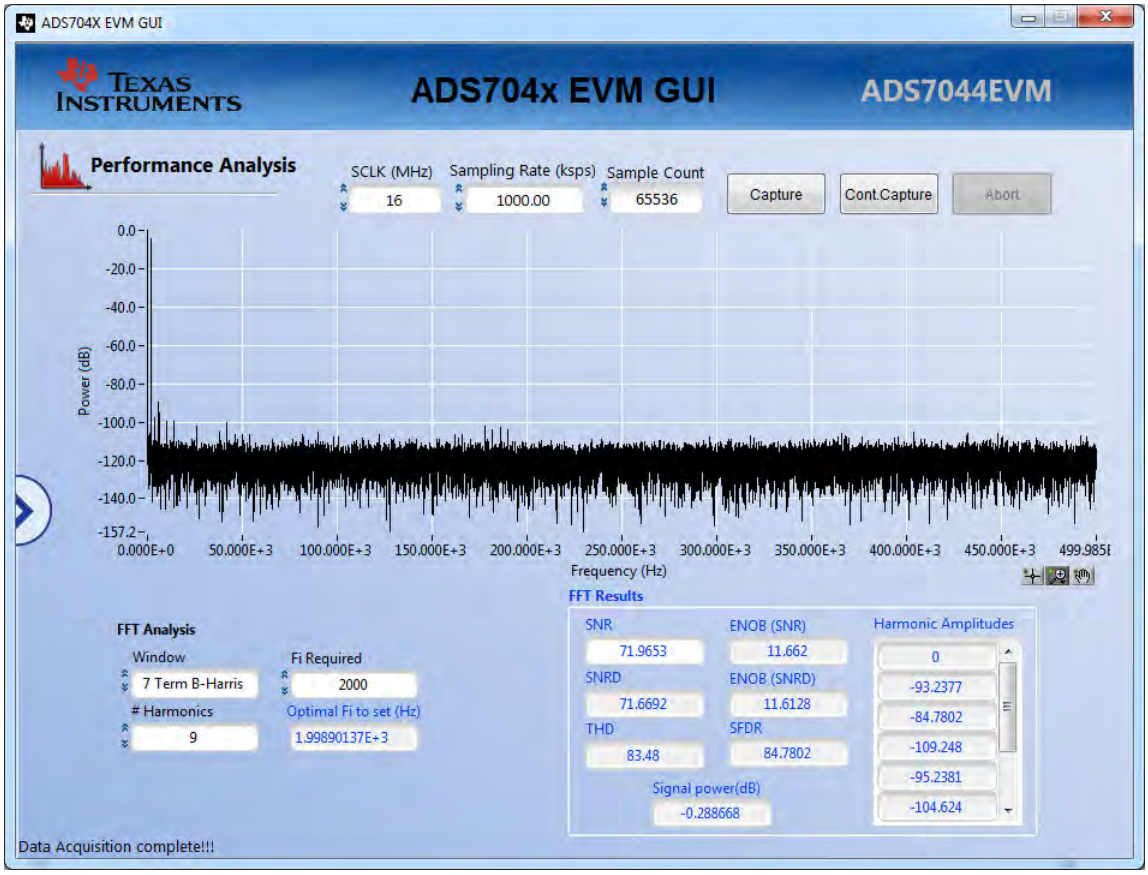


Figure 16. FFT Performance Analysis Page

6.4.1 FFT Analysis Settings and Controls

The SCLK, Sampling Rate and Sample Count fields are the same as described in Section 6.3.

Fi Required: Enter the frequency of the largest amplitude analog input signal here.

Optimal Fi to set: Adjust your input frequency from the signal source to this value computed by the GUI based on the *Fi Required* value entered. A minor difference from *Fi Required* will be seen here to enable a system to be coherent in nature.

Window: The window function is a mathematical function that reduces the signal to zero at the end points of the data block. In applications where coherent sampling cannot be achieved, a window-weighting function can be applied to the data to minimize spectral leakage. The following options are available:

- No windowing (no window weighting function applied; use for coherent data)
- Windowing. In this case the 7-Term Blackman-Harris window is applied by default. For a more thorough discussion of windowing, refer to IEEE1241-2000.
- # Harmonics: This field sets the number of harmonics to be included in the calculations of the harmonic distortion. Any harmonic signal greater than this number is treated as noise in the performance calculations. The typical value used in this analysis is 9 as per the ADS7044 datasheet (SBAS608).

Copyright © 2014, Texas Instruments Incorporated

6.5 Histogram Analysis

Histogram testing is commonly used when characterizing ADCs. A histogram is merely a count of the number of times a code has occurred in a particular data set. The *Histogram Analysis* page of the GUI creates a histogram of the data of the acquired data set and displays it. Figure 17 shows the *Histogram Analysis* page of the GUI.

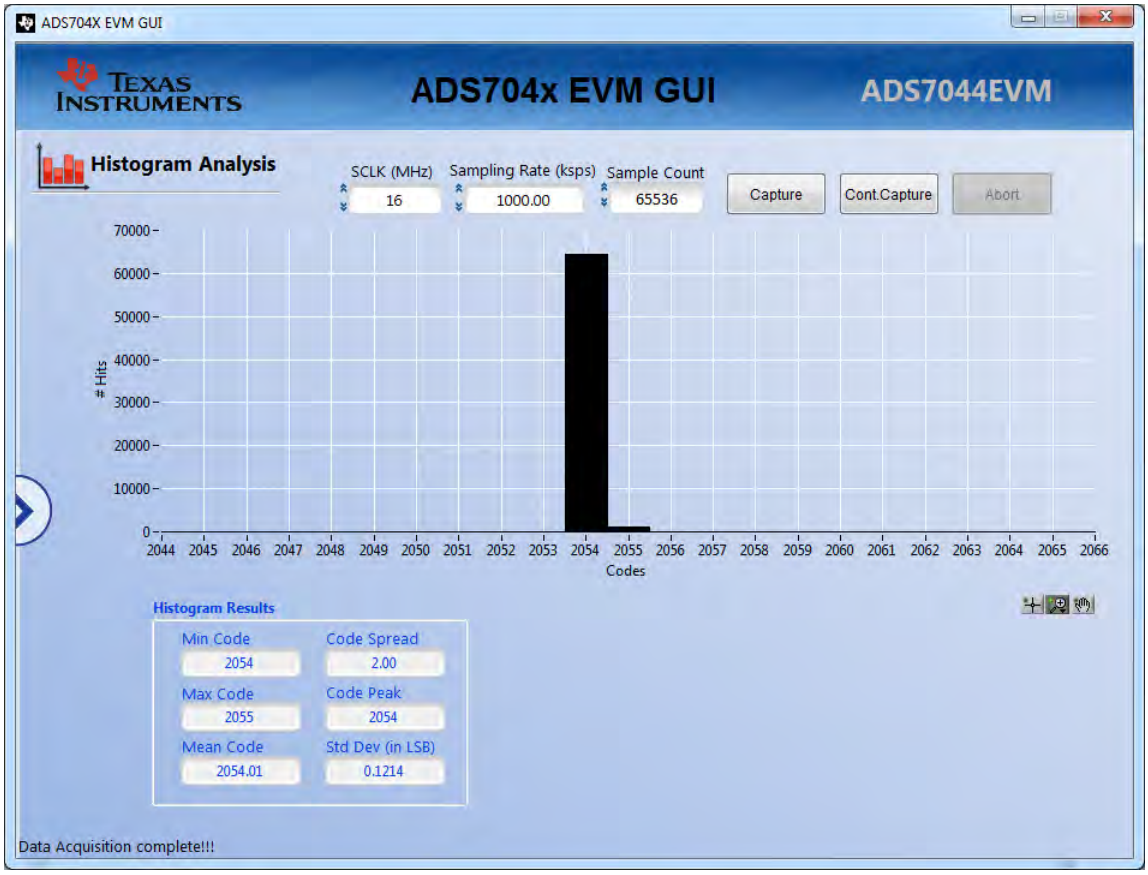


Figure 17. Histogram Analysis Page

The Histogram *Analysis* table shown in Figure 17 displays several parameters of the captured data set as described in the following list. Please note, all results displayed in this page are in LSBs.

- The *Min Code*, *Max Code*, and *Mean Code* indicators display the minimum, maximum and average value of the captured data set.
- The *Code Spread* column shows the peak-to-peak spread of the codes in the data set.
- The *Sigma* indicator displays standard deviation of the data set. This value is equivalent to the RMS noise of the signal when analyzing a dc data set.

Copyright © 2014, Texas Instruments Incorporated

6.6 Offset Calibration

The ADS7044 device has the ability to calibrate its internal offset. The offset calibration can be initiated by the user either on power-up or during normal operation. During offset calibration, the analog input pins (AINP and AINM) are disconnected from the sampling stage and connected to an internal reference. The result of the offset calibration in stored in an internal register. For subsequent conversions, the device adjusts the conversion results provided on the SDO output with the value stored in this internal register.

The ADS7044 GUI implements offset calibration as described in the *Offset Calibration During Normal Operation* section of ADS7044 datasheet (SBAS608). Figure 18 depicts the *Offset Calibration* page of the GUI.

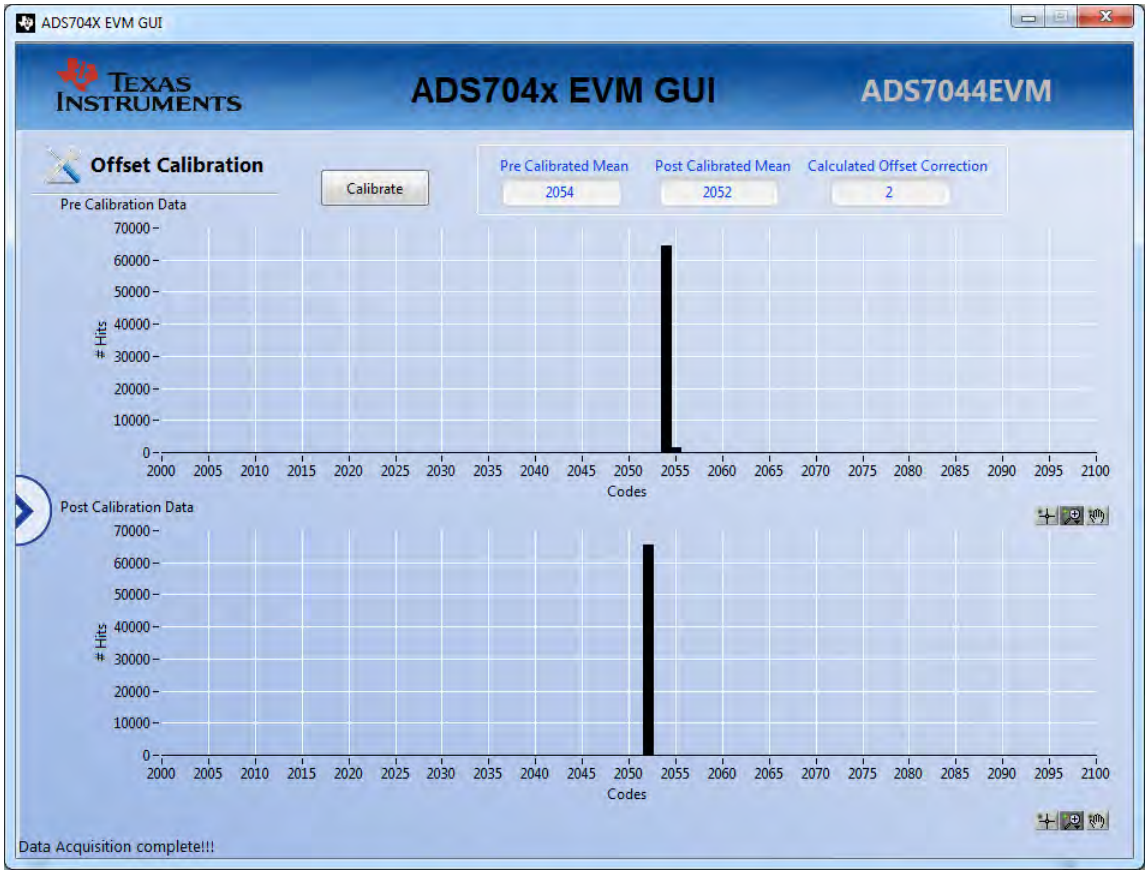


Figure 18. Offset Calibration Page

The Offset Calibration test is best conducted with a DC input at the Analog Input Terminal of the ADS7044EVM. Simply click the *Calibrate* button. The GUI first performs a histogram test for the device described in Section 6.5 and populates the first of the two graphs. The pre-calibrated Mean code is inserted in the indicator. Next, the calibration frame is sent to the ADS7044 device that enables the internal offset calibration logic. The GUI performs the histogram test for a second time and the second graph is populated and Post Calibrated Mean value computed. Finally, the difference between the first and second computed mean is populated in the Calculated Offset Correction indicator.

The computed offset for all subsequent attempts to calibrate the device will always yield a result of within the limits specified in the datasheet. This indicates that after the calibration is performed for the first time, the offset is actually being applied on all subsequent conversions. This computed offset will remain fixed, unless the device is reset or there is a significant change in operating temperature or analog supply voltage.

Copyright © 2014, Texas Instruments Incorporated

6.7 Estimated Current Consumption

The last tab in the GUI tabs menu opens up an *Estimated Current Consumption* tab as shown in Figure 19. This tab highlights the extremely low current and power consumption of the ADS7044 device and its scaling with sampling rate and AVDD voltage. This is computed based on characterization data collected across multiple devices at room temperature and it not based on data from the actual board connected to the GUI.

Set the desired Sampling rate and AVDD using the two dial in the right hand side of the page and observe the estimated current and power on the graph and the indicators on this page.

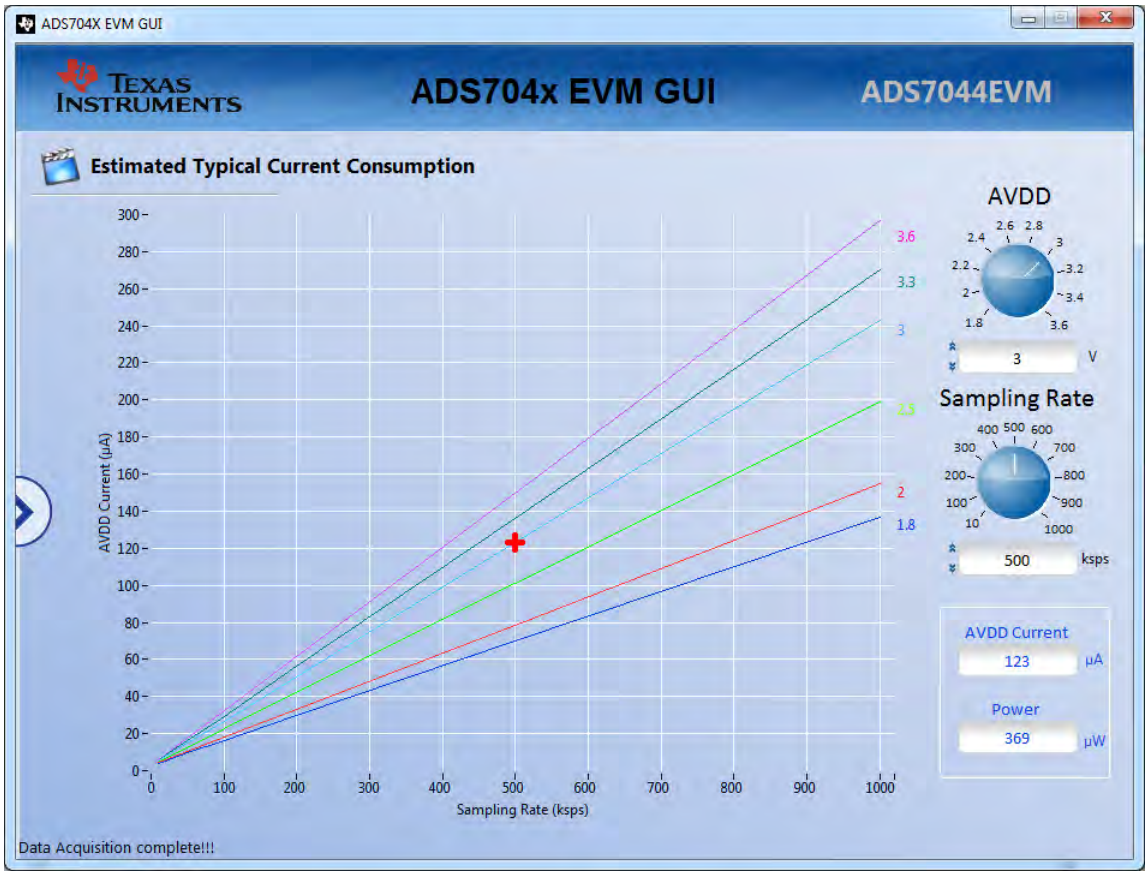


Figure 19. Estimated Current Consumption Page

6.8 Troubleshooting

Although the ADS7044EVM GUI rarely stops responding while the ADS7044EVM-PDK is connected, in case this does happen, unplug the USB cable from the EVM, unload the ADS7044EVM-PDK software, reconnect the ADS7044EVM-PDK to the PC and reload the ADS7044EVM software.

When initially setting up the EVM, the software detects the EVM hardware, and loads the appropriate hardware settings. If the EVM hardware is not detected, the GUI defaults to the *Capture Mode: Simulation* mode of operation using a preloaded captured data file for demonstration purposes.

Copyright © 2014, Texas Instruments Incorporated

7 Bill of Materials, PCB Layout, and Schematics

This section lists the bill of materials of the ADS7044EVM, shows the printed circuit board (PCB) layout for the ADS7044EVM. The schematics for the ADS7044EVM are appended to the end of this user's guide.

7.1 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.

Table 6. ADS7044EVM Bill of Materials

Qty	Designator	Description	Manufacturer	PartNumber
8	C1, C3, C4, C6, C13, C18, C19, C20	CAP, CERM, 0.1uF, 50V, +/-10%, C0G/NP0, 0402	TDK	C1005X7R1H104K
2	C2, C7	CAP CER 1000PF 16V 5% NP0 0402	Samsung	CL05C102JO5NNNC
1	C5	CAP, CERM, 2200pF, 50V, +/-5%, C0G/NP0, 0402	Kemet	C0402C222K4RACTU
2	C8, C12	CAP, CERM, 0.01uF, 25V, +/-10%, X7R, 0603	MuRata	GRM188R71E103KA01D
1	C9	CAP, CERM, 15pF, 16V, +/-2%, C0G/NP0, 0402	MuRata	GRM0222C1C150GD05
4	C10, C11, C16, C17	CAP, CERM, 1uF, 16V, +/-10%, X7R, 0603	Taiyo Yuden	EMK107B7105KA-T
1	C14	CAP, CERM, 10uF, 10V, +/-10%, X7R, 0805	MuRata	GRM21BR71A106KE51L
1	C15	CAP, CERM, 0.1uF, 50V, +/-10%, X7R, 0603	AVX	06035C104KAT2A
4	CS, GND, SCLK, SDO	Test Point, Miniature, Black, TH	Keystone	5001
2	J1, J3	Connector, TH, SMA	Emerson Network Power	142-0701-201
4	J2, J4, J5, J11	Header, 100mil, 2x1, Gold, TH	Samtec	TSW-102-07-G-S
1	J7	Terminal Block, 6A, 3.5mm Pitch, 3-Pos, TH	On-Shore Technology	ED555/3DS
1	J9	Terminal Block, 6A, 3.5mm Pitch, 2-Pos, TH	On-Shore Technology	ED555/2DS
1	J13	Receptacle, Micro High Speed Socket Strip, 0.8mm, 25x2, R/A, SMT	Samtec, Inc.	ERF8-025-01-L-D-RA-L-TR
1	J14	SD Memory Card Connector	Molex	502570-0893
4	R1, R3, R7, R10	RES, 20.0k ohm, 1%, 0.063W, 0402	Vishay-Dale	CRCW040220K0FKED
10	R2, R5, R28, R29, R30, R33, R38, R39, R40, R42	Resistor, Uninstalled	NI	NI
2	R4, R11	RES 30.0 OHM 1/16W 1% 0402 SMD	Vishay-Dale	CRCW040230R0FKED
7	R6, R8, R13, R31, R34, R35, R46	RES, 49.9 ohm, 1%, 0.063W, 0402	Vishay-Dale	CRCW040249R9FKED
1	R9	RES, 30.1k ohm, 1%, 0.063W, 0402	Vishay-Dale	CRCW040230K1FKED
2	R12, R14	RES, 10.0, 1%, 0.063 W, 0402	Vishay-Dale	CRCW040210R0FKED
1	R15	RES, 51.1k ohm, 1%, 0.063W, 0402	Vishay-Dale	CRCW040251K1FKED
2	R17, R20	RES, 100k ohm, 1%, 0.063W, 0402	Vishay-Dale	CRCW0402100KFKED
7	R18, R36, R37, R41, R47, R48, R49	RES, 0 ohm, 5%, 0.063W, 0402	Yageo America	RC0402JR-070RL
1	R19	RES, 30.1k ohm, 1%, 0.063W, 0402	Vishay-Dale	CRCW040230K1FKED
7	R21, R22, R23, R24, R25, R26, R27	RES, 10.0k ohm, 1%, 0.063W, 0402	Vishay-Dale	CRCW040210K0FKED
2	U1, U3	IC, OPAMP GP 10MHZ RRO, SC-70	Texas Instruments	OPA316IDCK
1	U2	IC, 4-bit Dual Supply Bus Transceiver with Configurable Voltage Translation and 3-State Outputs, UQFN-16	Texas Instruments	SN74AVC4T245RSVR
1	U4	Nanopower Supervisory Circuits, 2.93 V, DBV0005A	Texas Instruments	TPS3837K33QDBV
1	U5	Single Output High PSRR LDO, 100 mA, Adjustable 1.2 to 5.5 V Output, 2.7 to 5.5 V Input, 6-pin SOT-23 (DBV), -40 to 125 degC, Green (RoHS & no Sb/Br)	Texas Instruments	TPS79101DBVR
1	U6	IC, 2K, Serial EEPROM	Atmel	AT24C02B
1	U7	IC, ULTRA-LOW POWER, 1-MSPS, SAR ADC, X2QFN-8	TEXAS INSTRUMENTS	ADS7044IRUG

Copyright © 2014, Texas Instruments Incorporated

7.2 PCB Layout

Figure 20 through Figure 23 show the PCB layouts for the ADS7044EVM.

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 ADS7044EVM PCBs.

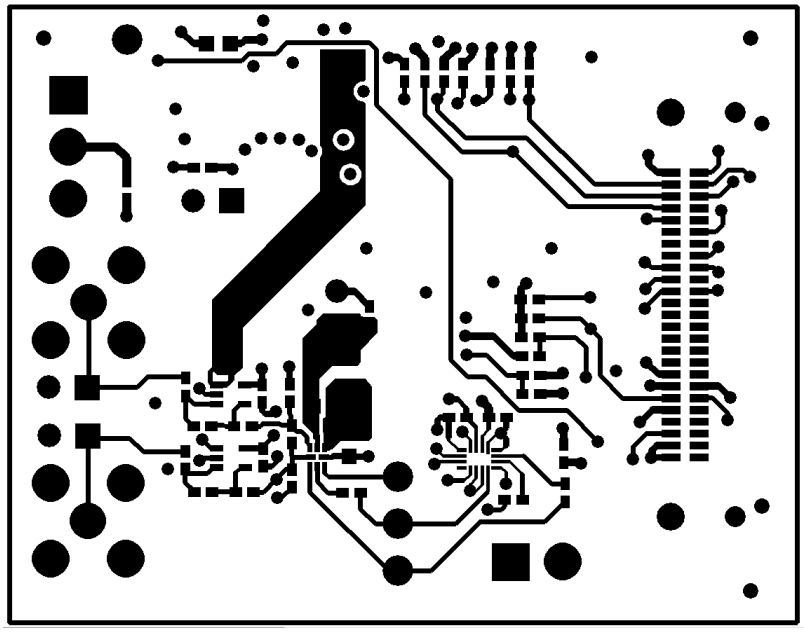


Figure 20. ADS7044EVM PCB: Top Layer (L1)

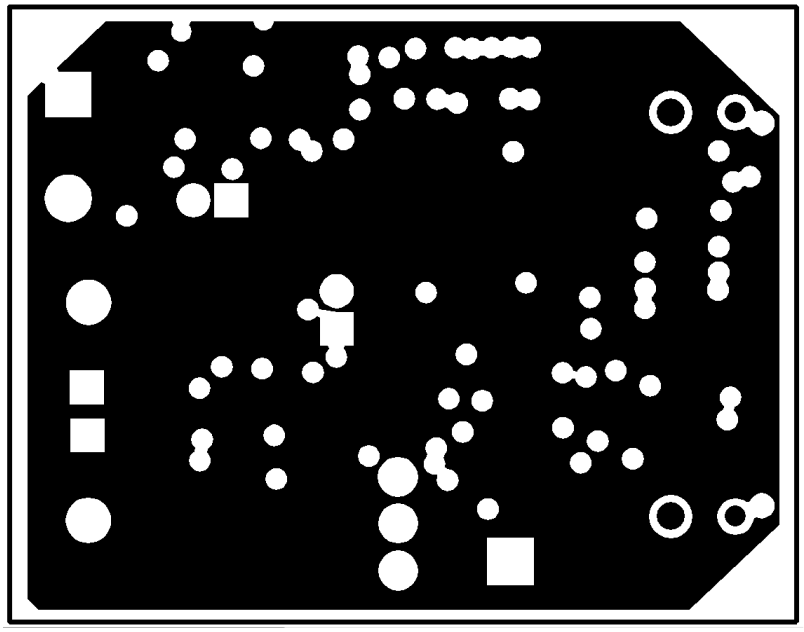


Figure 21. ADS7044EVM PCB: GND Layer (L2)

Copyright © 2014, Texas Instruments Incorporated

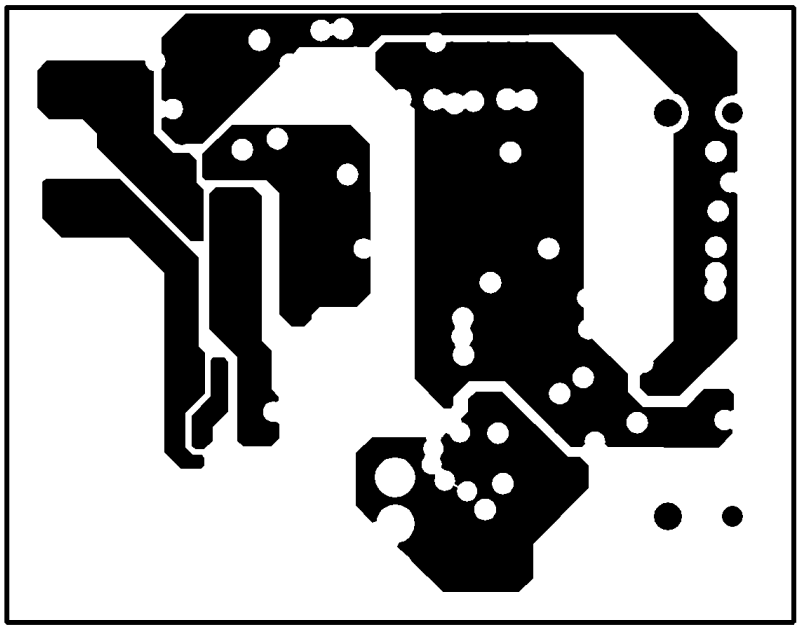


Figure 22. ADS7044EVM PCB: Power Layer (L3)

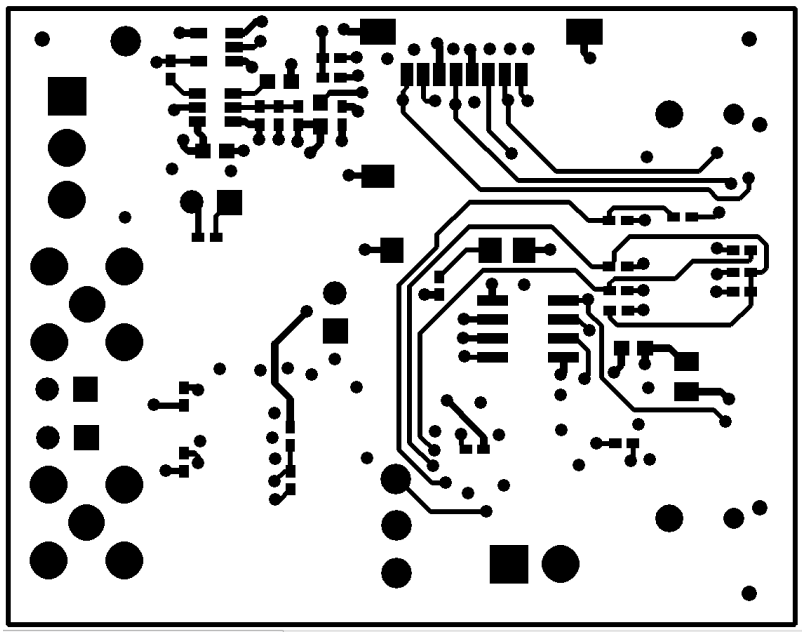


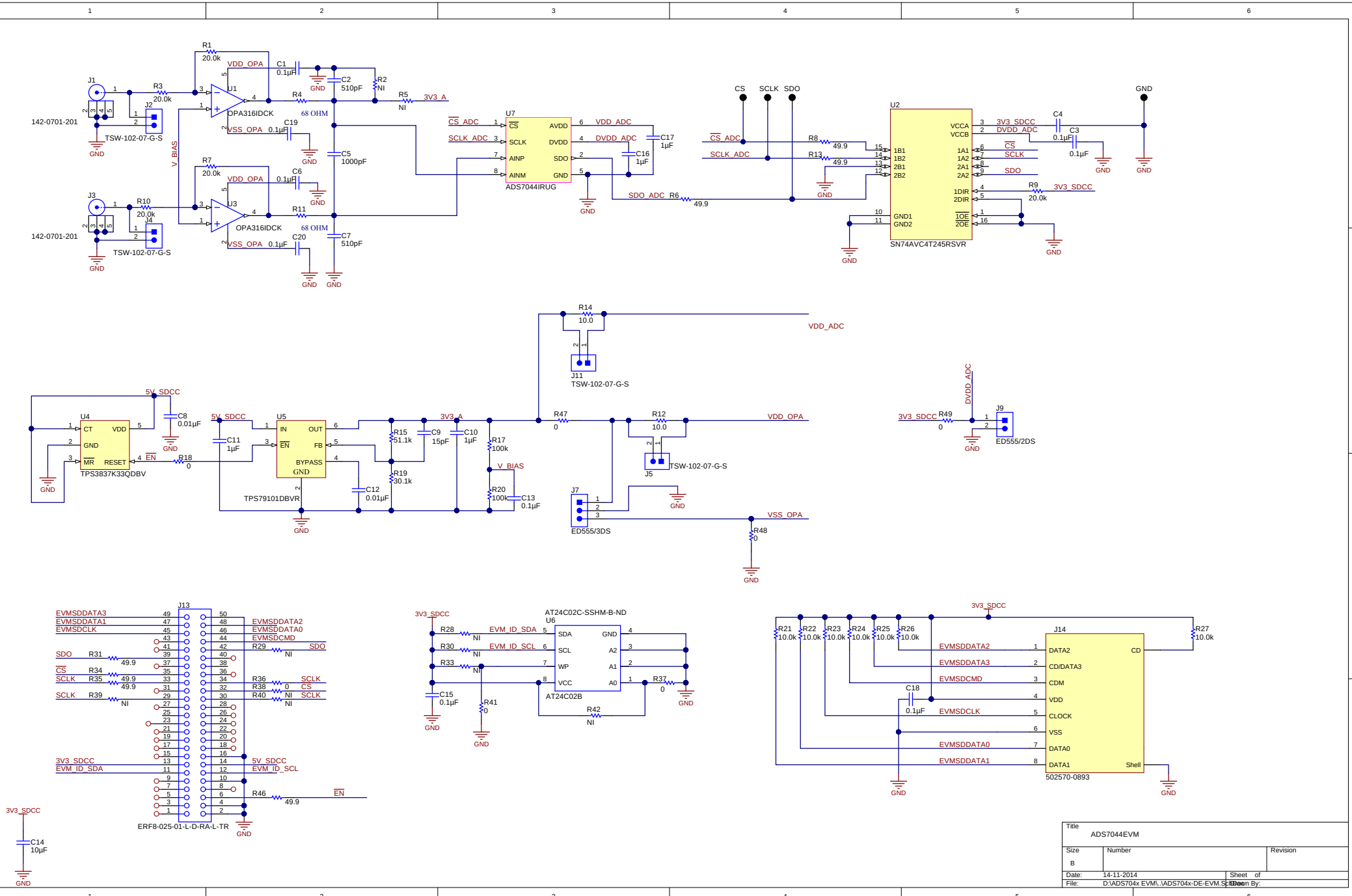
Figure 23. ADS7044EVM PCB: Bottom Layer (L4)

Copyright © 2014, Texas Instruments Incorporated

7.3 Schematics

The schematics for the ADS7044EVM are appended to the end of this user's guide.

Copyright © 2014, Texas Instruments Incorporated


J1
J2
J3
J4
142-0701-201
TSW-102-07-G-S
R1
20.0k
R2
NI
R3
20.0k
R4
68 OHM
R5
NI
3V3_A
R7
20.0k
R10
20.0k
R11
68 OHM
V_BIAS
VDD_OPA
VSS_OPA
C1
0.1µF
C2
510pF
C5
1000pF
C6
0.1µF
C7
510pF
C19
0.1µF
C20
0.1µF
U1
U3
OPA316IDCK
GND
U7
CS_ADC
SCLK_ADC
SDO_ADC
AVDD
DVDD
SDO
AINP
AINM
VDD_ADC
DVDD_ADC
C16
1µF
C17
1µF
ADS7044IRUG
R6
49.9
CS
SCLK
SDO
U2
R8
49.9
R13
49.9
VCCA
VCCB
1B1
1B2
2B1
2B2
1A1
1A2
2A1
2A2
1DIR
2DIR
1OE
2OE
GND1
GND2
3V3_SDCC
DVDD_ADC
C4
C3
0.1µF
R9
20.0k
SN74AVC4T245RSVR
R14
10.0
J11
TSW-102-07-G-S
5V_SDCC
U4
TPS3837K33QDBVR
C8
0.01µF
R18
0
C11
1µF
U5
TPS79101DBVR
IN
OUT
EN
FB
BYPASS
R15
51.1k
C9
15pF
C10
1µF
R17
100k
R19
30.1k
R20
100k
C12
0.01µF
C13
0.1µF
R47
0
R12
10.0
J5
TSW-102-07-G-S
J7
ED555/3DS
R48
0
VSS_OPA
DVDD_ADC
J9
ED555/2DS
R49
0
J13
ERF8-025-01-L-D-RA-L-TR
EVMSDDATA3
EVMSDDATA1
EVMSDCLK
EVMSDDATA2
EVMSDDATA0
EVMSDCMD
SDO
CS
SCLK
R31
R34
R35
R39
R29
R36
R38
R40
R46
EN
3V3_SDCC
EVM_ID_SDA
5V_SDCC
EVM_ID_SCL
U6
AT24C02C-SSHM-B-ND
AT24C02B
SDA
SCL
WP
VCC
GND
A2
A1
A0
R28
R30
R33
R41
0
R42
NI
C15
0.1µF
R37
0
J14
502570-0893
DATA2
CD/DATA3
CDM
VDD
CLOCK
VSS
DATA0
DATA1
CD
Shell
R21
10.0k
R22
10.0k
R23
10.0k
R24
10.0k
R25
10.0k
R26
10.0k
R27
10.0k
C18
0.1µF
C14
10µF
Title
ADS7044EVM
Size
B
Number
Revision
Date:
14-11-2014
Sheet of
File:
D:\ADS704x EVM\..\ADS704x-DE-EVM.SchDoc
Drawn By:

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 are NOT certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in 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】

本開発キットは技術基準適合証明を受けておりません。

本製品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:*

   6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY WRITTEN DESIGN MATERIALS PROVIDED WITH THE EVM (AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

   6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS AND CONDITIONS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT MADE, CONCEIVED OR ACQUIRED PRIOR TO OR AFTER DELIVERY OF THE EVM.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS AND CONDITIONS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

   8.1 *General Limitations*. IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS ANDCONDITIONS OR THE USE OF THE EVMS PROVIDED HEREUNDER, REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN ONE YEAR AFTER THE RELATED CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY WARRANTY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS AND CONDITIONS, OR ANY USE OF ANY TI EVM PROVIDED HEREUNDER, EXCEED THE TOTAL AMOUNT PAID TO TI FOR THE PARTICULAR UNITS SOLD UNDER THESE TERMS AND CONDITIONS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM AGAINST THE PARTICULAR UNITS SOLD TO USER UNDER THESE TERMS AND CONDITIONS SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2014, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

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

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

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

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

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2014, Texas Instruments Incorporated