ANALOG DEVICES

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Evaluation Board for the AD7194, 4.8 kHz, Ultralow Noise, 24-Bit Sigma-Delta (Σ-Δ) ADC

FEATURES

Full-featured evaluation board for the AD7194
PC software for the control of the AD7194 using a
   USB interface
Various linking options

INTRODUCTION

This user guide describes the EVAL-AD7194EBZ evaluation board. The AD7194 is a 4.8 kHz, ultralow noise, 24-bit Σ-Δ ADC. The AD7194 is a complete analog front end for low frequency measurement applications. It contains eight differential inputs/ 16 pseudo differential inputs and includes a low noise instrumentation amplifier and reference detect.

Full data on the AD7194 is available in the AD7194 data sheet available from Analog Devices, Inc., and should be consulted in conjunction with this user guide when using the evaluation board.

GENERAL DESCRIPTION

The AD7194 evaluation kit is a powerful tool for exploring and evaluating the AD7194 features.

When the board is connected to (and possibly powered from) a PC via a standard USB interface, the PC software allows for

- The graphical display of real-time data and logs this data into a text file.
- The modification of the internal settings of the AD7194.

This software also helps in understanding the part features and performance.

Finally, the flexible interface structure of the board allows it to be connected in a number of useful configurations. For example, the digital section of the evaluation board can be used independently as a convenient digital interface for a user's own sensor design printed circuit board (PCB) or module containing the AD7194. Alternatively, an external micro-controller can be interfaced to the AD7194, and the evaluation board can act as a complete analog front end for creating and debugging software on the digital platform of the user.

AD7194 EVALUATION BOARD

Figure 1.

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REVISION HISTORY

12/10—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

POWER SUPPLIES

There are several power supply options on the AD7194 evaluation board, which include the following:

- The EVAL-AD7194EBZ evaluation board is powered via the 5 V supply from the USB connector, J51. This 5 V supply can power the AD7194 directly. Place the J1 link in the **5 V USB** position.

- The 5 V supply from the USB connector can be regulated to 3.3 V using the on-board ADP3330ARTZ3.3, a high precision, low power, 3.3 V output voltage regulator. Therefore, using the J1 link, the 3.3 V can be used as the power supply to the AD7194. Place the J1 link in the **3.3 V** position.

- An external power supply can be applied via J6. Place the J1 link in the **EXT** position.

SOCKETS

There are five sockets relevant to the operation of the AD7194 on this evaluation board. The functions of these sockets are outlined in Table 1.

NOISE TEST

Header J5 allows the user to perform noise testing of the AD7194. Use Header J4 to apply the reference to the AD7194. With the links on both headers, as configured per Figure 2, the analog input and reference are applied to the AD7194, as shown in Figure 3.
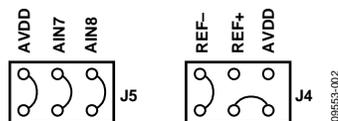
Figure 2. Link Positions for Noise Testing
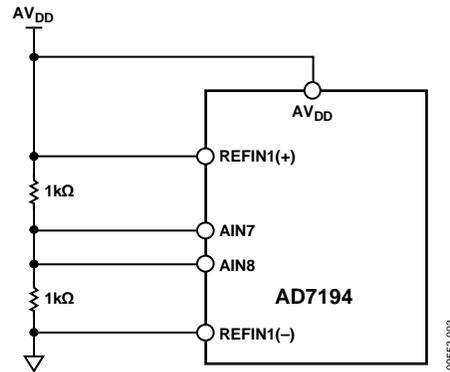
Figure 3. Noise Test Connections

As per Figure 2, inserting the links in Header J5 connects a resistor network to the AD7194. The reference to the ADC is provided by AV_{DD}. The resistor divider generates a bias voltage of approximately $AV_{DD}/2$. Channel AIN7 and Channel AIN8 are connected to this voltage. Conversions can now be performed using this external short to measure the rms noise, peak-to-peak noise, and peak-to-peak resolution.

USING AN ABSOLUTE REFERENCE

An ADR421 is included on the EVAL-AD7194EBZ so that the part can also be evaluated using an absolute reference. The reference can be connected to the REFIN1(+)/REFIN1(−) pins of the AD7194 by connecting the links of J4 as shown in Figure 4.
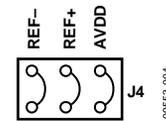
Figure 4. Connecting an Absolute Reference to the AD7194

CONNECTING THE AD7194 TO AN EXTERNAL MICROCONTROLLER

The EVAL-AD7194EBZ can be connected to an external micro-controller using Header J2. With all links in place, the AD7194 is connected to the on-board microcontroller. However, with these links removed, the AD7194 is disconnected from the evaluation board microcontroller. The user can then use Header J2 to interface the AD7194 to the external microcontroller.

Table 1. Socket Functions

Socket	Description
REFIN1(+)	Subminiature BNC (SMB) connector. This socket is used in conjunction with REFIN1(−) to apply an external reference to the AD7194. The voltage for the REFIN1(+) input of the AD7194 is applied to this socket.
REFIN1(−)	Subminiature BNC (SMB) connector. This socket is used in conjunction with REFIN1(+) to apply an external reference to the AD7194. The voltage for the REFIN1(−) input of the AD7194 is applied to this socket.
AIN7	Subminiature BNC (SMB) connector. Use this socket to apply an analog input signal to AIN7.
AIN8	Subminiature BNC (SMB) connector. Use this socket to apply an analog input signal to AIN8.
MCLK	Subminiature BNC (SMB) connector. Use this socket to apply an external clock source to the AD7194.

USING THE AD7194 EVALUATION BOARD WITH THE PC SOFTWARE

SOFTWARE INSTALLATION

The AD7194 evaluation board software must be installed before connecting the EVAL-AD7194EBZ to the PC.

EVALUATION SOFTWARE INSTALLATION

To install the evaluation software, do the following:

1. Insert the *AD7194 Evaluation Kit CD* into the CD-ROM drive of your PC. The **Evaluation Software Installation Wizard** should start automatically. If it does not start automatically, navigate to the *AD7194 Evaluation Kit CD* on your PC and click **Setup.exe**.
2. It then prompts you to select a destination directory, which is **C:\Program Files\Analog Devices\AD7194** by default. When the directory is selected, the installation procedure copies the files into the relevant directories on the hard drive. The installation program creates a program group called **Analog Devices** with the subgroup **AD7194** in the **Start** menu of the taskbar.
3. When the installation procedure is complete, double-click the **AD7194** icon to start the program.

EVALUATION BOARD INSTALLATION

To connect the evaluation board, do the following:

1. Connect the EVAL-AD7194EBZ to your PC USB connector using the USB cable included in the evaluation kit. The **POWER** LED on the evaluation board should turn on and **Found new hardware wizard** should start automatically on the PC.
2. Follow the steps in the wizard until the installation is completed.

USING THE EVALUATION BOARD SOFTWARE

To start the AD7194 Evaluation Board Software on the PC

1. Click the Windows® Start button.
2. Go to All Programs/Analog Devices/AD7194/AD7194 Evaluation Board Software.

The software allows the user to configure the AD7194, gather samples, and analyze the data. Consult the AD7194 data sheet for further information on the register bits and their functions.

Figure 5 shows the main window that displays when the program starts. The Main Window section briefly describes the various menu and button options.

The data that has been read can be exported to other packages, such as MathCAD™ or Microsoft® Excel, for further analysis.
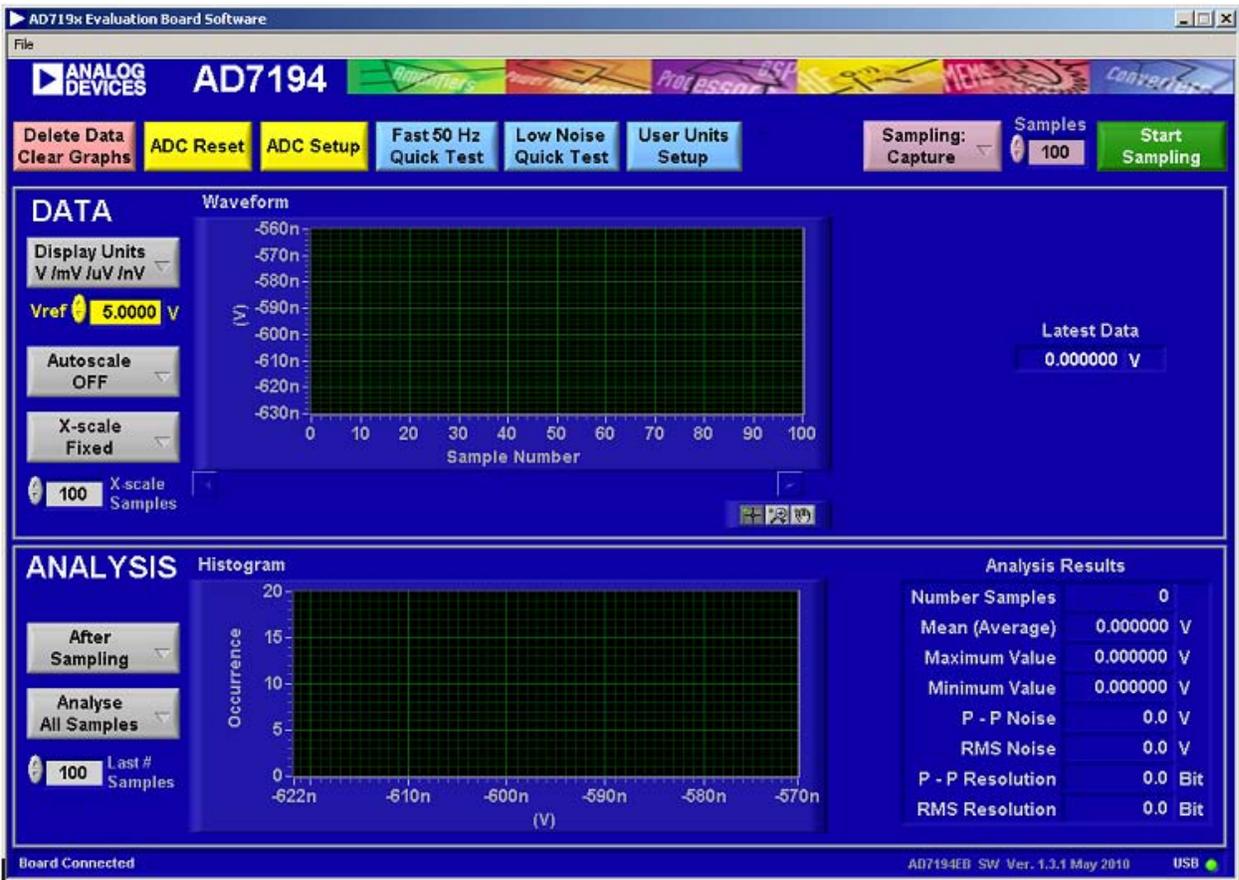
Figure 5. AD7194 Evaluation Software Main Window

MAIN WINDOW

Menu Bar

File

Selecting **File** allows the user to write the current set of data to a file for later use, log data as it is gathered, and exit the program.

Buttons

Delete Data/Clear Graphs

This button allows the user to delete the data displayed in the graph.

ADC Reset

This button allows the user to reset the AD7194 to its default (power on) settings.

ADC Setup

This button opens the **ADC Setup** window that allows the user to configure the AD7194.

Fast 50 Hz Quick Test

This button allows the user to easily select the fast filtering mode on the AD7194.

Low Noise Quick Test

This button allows the user to access the noise testing software.

User Units Setup

This button allows the user to change the display units on the graph and histogram.

Sampling

This button allows the user to sample continuously or to sample a specific number of samples. When the option **Sampling: Capture Defined Sample Set** is selected, the sample size is entered in the **Samples** text box.

Start Sampling

This button allows the user to read samples from the AD7194.

Data

Display Units (V/mV/µV/nV)

This button allows the user to display the conversions in hexadecimal, decimal, volts, or in user-specified units. If the conversions are displayed in volts, the value of the reference voltage must be entered in the **Vref** text box.

Autoscale

This button allows the user to enable or disable the **Autoscale** function on the waveform plot.

X-scale

This button allows the user to have a fixed x-axis or a dynamic x-axis. When the x-axis is fixed, the number of samples to display is entered in the **X-scale Samples** text box.

Analysis

After Sampling

The software can process the conversions as they are gathered, or it can process the samples when the ADC has completed the selected number of conversions.

Analyse All Samples

This feature allows you to fix the sample size used for analyzing. Alternatively, the software can process all samples gathered. When the **Analyse Last # Samples** option is selected, the sample size must be entered in the **Last # Samples** text box.

The software captures all samples generated by the AD7194. If the software fails to gather all samples, then the message shown in Figure 6 appears. The software may drop samples for the following reasons:

- The data is being analyzed in parallel with the gathering of samples. You should delay the analysis until the samples are gathered.
- Other programs are running on the PC.
- PC is too slow.

Figure 6. Error Message when Samples Not Captured

ADC SETUP

The **ADC Setup** window gives the user access to the AD7194 registers. The user can write to the registers and read from the registers. This window operates even when an AD7194 evaluation board is not connected to the software. It operates as an AD7194 configuration tool.

ADC Reset

The ADC is reset to its default condition using this button.

ADC Read

Click this button to read the values of the registers on the AD7194. The **ADC Setup** window displays the hexadecimal values returned from the AD7194. The other panes of the **ADC Setup** window are also updated to reflect the AD7194 configuration.

ADC Write

The information displayed in the **Registers HEX values** pane is written to the AD7194.

Analog Inputs

Select the analog input channels using the **Channel Selection** buttons. The gain, polarity, and chopping can also be selected. The analog inputs can be buffered or unbuffered using the **Buffer** button. Finally, the **Diagnostics** button enables/disables the burnout currents.

Digital Filter

The **Output Data Rate (Hz)**, **Sinc Notch (Hz)**, the order of the sinc filter, **Averaging**, **Zero Latency**, and enabling/disabling the **60Hz Rejection** are programmed using these buttons. The user can enter the frequency of the sinc notch and the software calculates the value written to the FS[9:0] bits of the mode register. Alternatively, the user can enter the FS[9:0] value in decimal and the software calculates the sinc notch. When averaging is used, the first notch caused by the averaging is shown in the **Avg Notch (Hz)** text box.

The value written to the AD7194 is displayed in the **Registers HEX values** pane.

Voltage Reference

The reference source and reference value are programmed in this section. The user can select REFIN1 or REFIN2 (**Ref Selection**), enable/disable the reference detect function (**Ref Detect**), and set the voltage of the reference in the **V** text box..

When the reference setup is changed, the changes needed for the configuration register are shown in the **Registers HEX values** section of the **ADC Setup** pane.

Clock Configuration

The clock used by the AD7194 is selected in this pane. When an external master clock is selected, the clock frequency must be entered in the **MHz** text box.

Digital Outputs

The four digital outputs (**P0**, **P1**, **P2**, and **P3**) are programmed and enabled/disabled in this pane.

Mode of Operation

This pane allows the user to select continuous conversion, single cycle conversion, calibration, and so on.

Output Data Format

This pane allows the user to select the output format of the data conversions and to enable the parity.

Registers HEX values

This window displays the values to be written to the AD7194 registers. When features such as the analog input channel, gain, and mode of operation are changed, the values in the **Registers HEX** pane are updated automatically. You can write directly to the **Registers HEX** pane, altering the contents of any register. When the values in this section are altered, the other sections of the **ADC Setup** window are updated to reflect the changes.
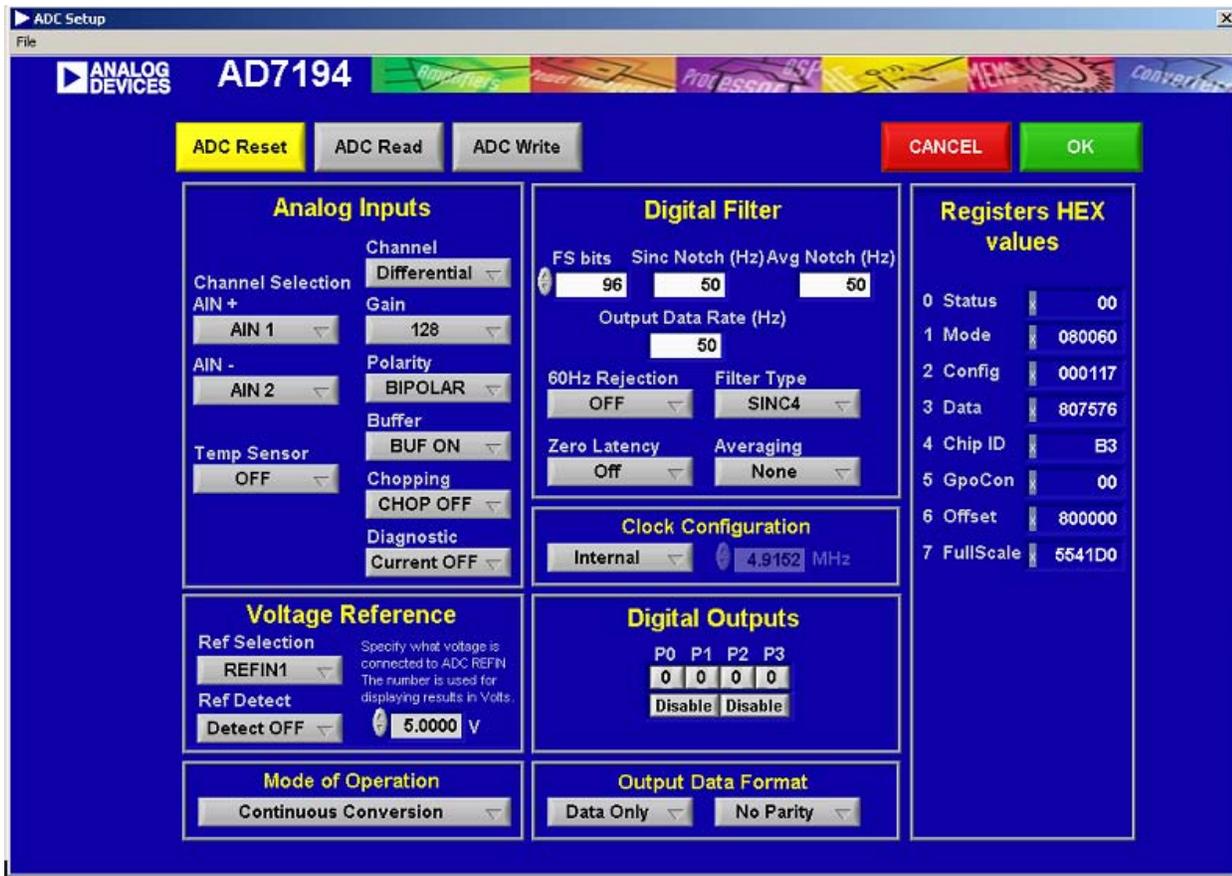
Figure 7. ADC Setup Window

CONFIGURATION ASSIST TOOL

The AD7194 **Evaluation Software** can be used as a configuration assist tool, even when an AD7194 evaluation board is not connected.

The configuration assist tool can be used by doing the following:

1. When the AD7194 **Evaluation Software** opens, click the **ADC Setup** button.
2. The message in Figure 8 appears.
3. Click **Ignore**.
4. The **ADC Setup** window then opens. In the **ADC Setup** window, the user can determine the values written to the AD7194 on-chip registers for different configurations.

The **Registers HEX values** pane can be used. When the values in this section are altered, the other sections of the **ADC Setup** window are updated so that the user easily sees the impact of the register changes. Alternatively, the user can alter the **Analog Inputs**, **Digital Filter**, **Voltage Reference**, **Mode of Operation**, **Clock Configuration**, **Digital Outputs**, and **Output Data Format** panes. The **Registers HEX values** pane is updated with changes; therefore, the user can easily calculate the values written to the AD7194 for different configurations.

Figure 8. Configuration Tool

FAST 50 Hz QUICK TEST

From the **AD719x Evaluation Board Software** main window, click the **Fast 50Hz Quick Test** button to configure the AD7194 to operate with the fast filter. When the **Fast 50Hz Quick Test** button is clicked, the AD7194 is configured to operate with the fast filter. The software configures the AD7194 to have a gain of 128, the sinc³ filter is selected with the first sinc filter notch at 800 Hz, and the averaging block is programmed to 16 to place a notch at 50 Hz. Channel **AIN7–AIN8** is selected and REFIN1 is

selected as the reference source. The software also provides instructions on the link positions for the AD7194 evaluation board. When the instructions given on each window are completed, click **OK**. The AD7194 gathers 100 samples, displays the results in the waveform, and analyzes the data to calculate the maximum conversion, minimum conversion, and average conversion. The rms noise, peak-to-peak noise, and resolution are also calculated.
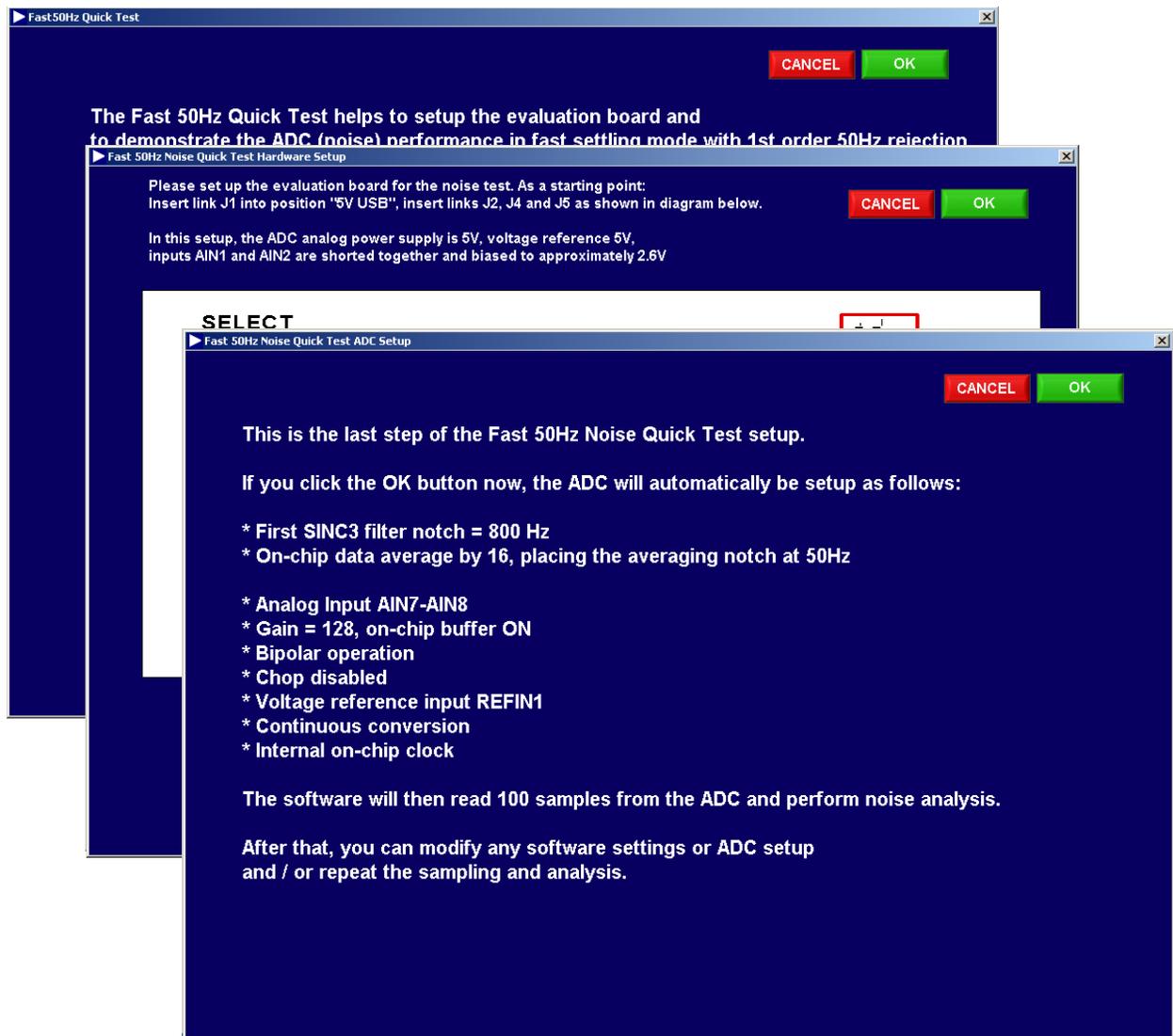
Figure 9. Fast 50 Hz Quick Test

LOW NOISE QUICK TEST

From the **AD719x Evaluation Board Software** main window, click the **Low Noise Quick Test Hardware Setup** button. When the **Low Noise Quick Test Hardware Setup** button is clicked, the user can quickly and easily measure the rms noise of the AD7194. The software configures the AD7194 to have a gain of 128, an output data rate of 4.7 Hz, Channel **AIN7–AIN8** is selected, and the reference voltage is set to 5 V (the software assumes that the 5 V from the USB is used as the reference to the AD7194).

The software also provides instructions on the link positions for the AD7194 evaluation board. When the instructions given on each window are completed, click **OK**. The AD7194 gathers 100 samples, displays the results in the waveform, and analyzes the data to calculate the maximum conversion, minimum conversion, and average conversion. The rms noise, peak-to-peak noise, and resolution are also calculated.

Figure 10. Low Noise Quick Test Hardware Setup

USER UNITS SETUP

From the **AD719x Evaluation Board Software** main window, click the **User Units Setup** button to open the **User Units Setup** window. The **User Units Setup** window allows the user to define the display units for the conversions. The offset and gain error of the system can also be calibrated. The user can perform a system offset and system full-scale calibration. The resulting coefficients are held in memory; they are not written to the calibration registers of the ADC.
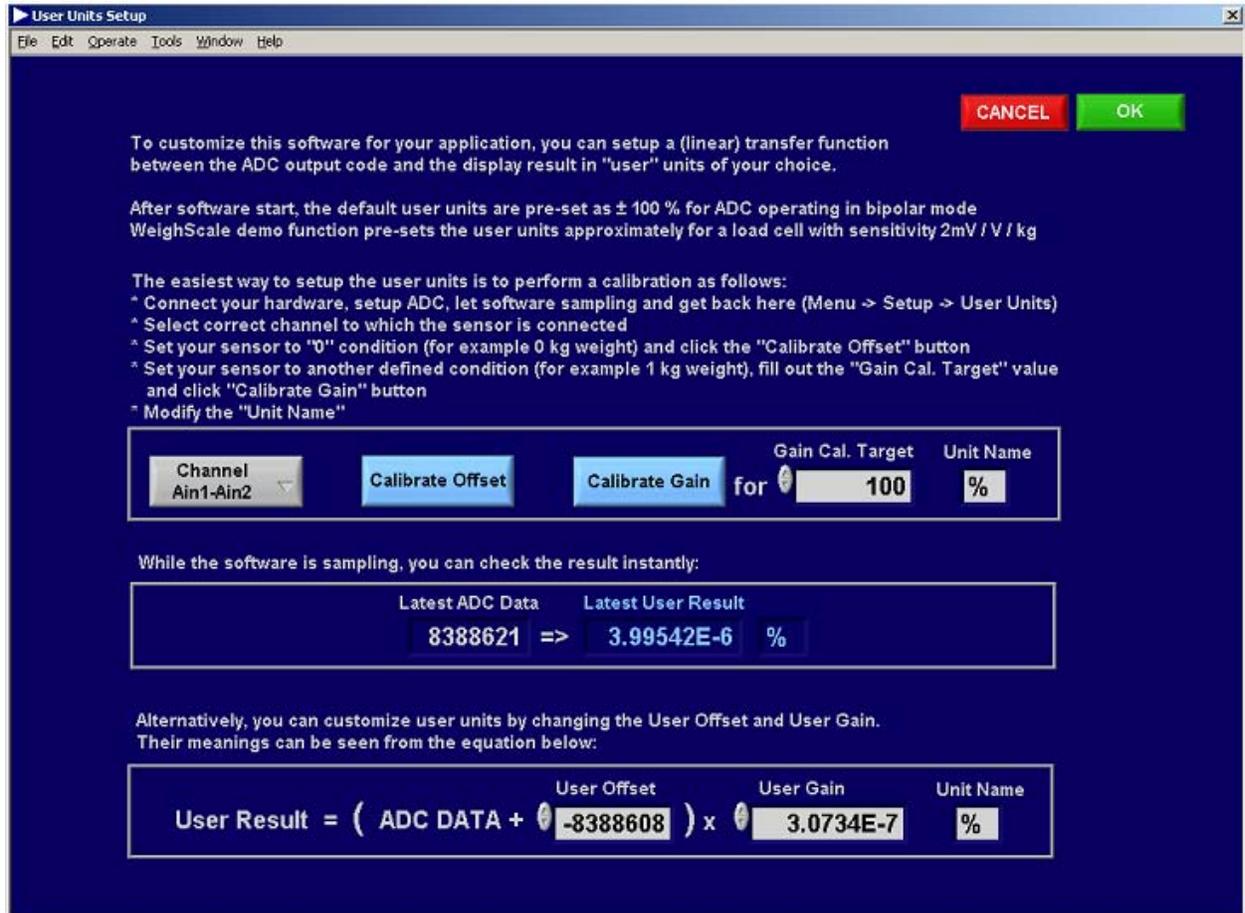
Figure 11. User Units Setup Window

EVALUATION BOARD SCHEMATICS AND ARTWORK

09553-012
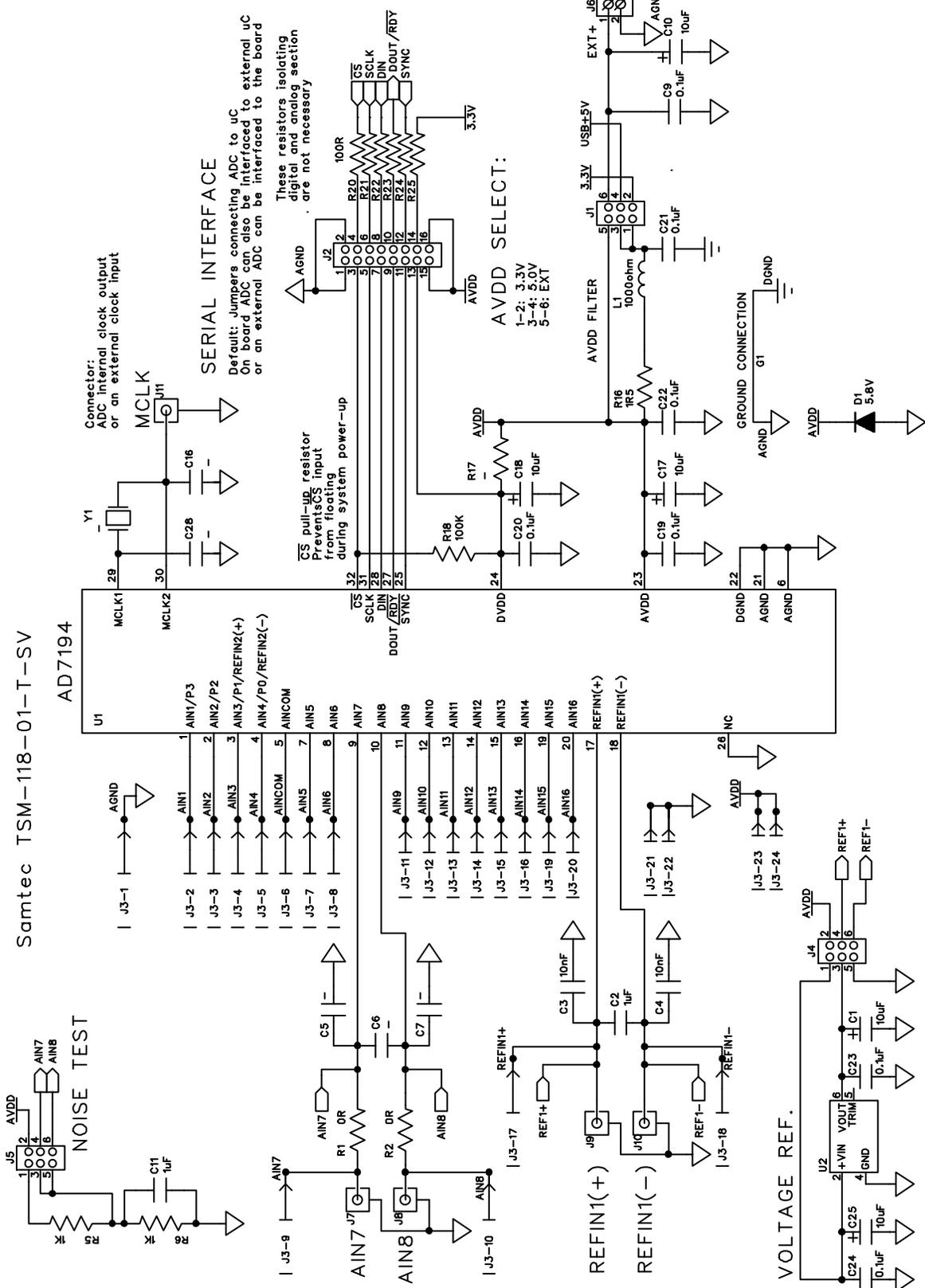
Figure 12. EVAL-AD7194EBZ Schematic, Analog Part
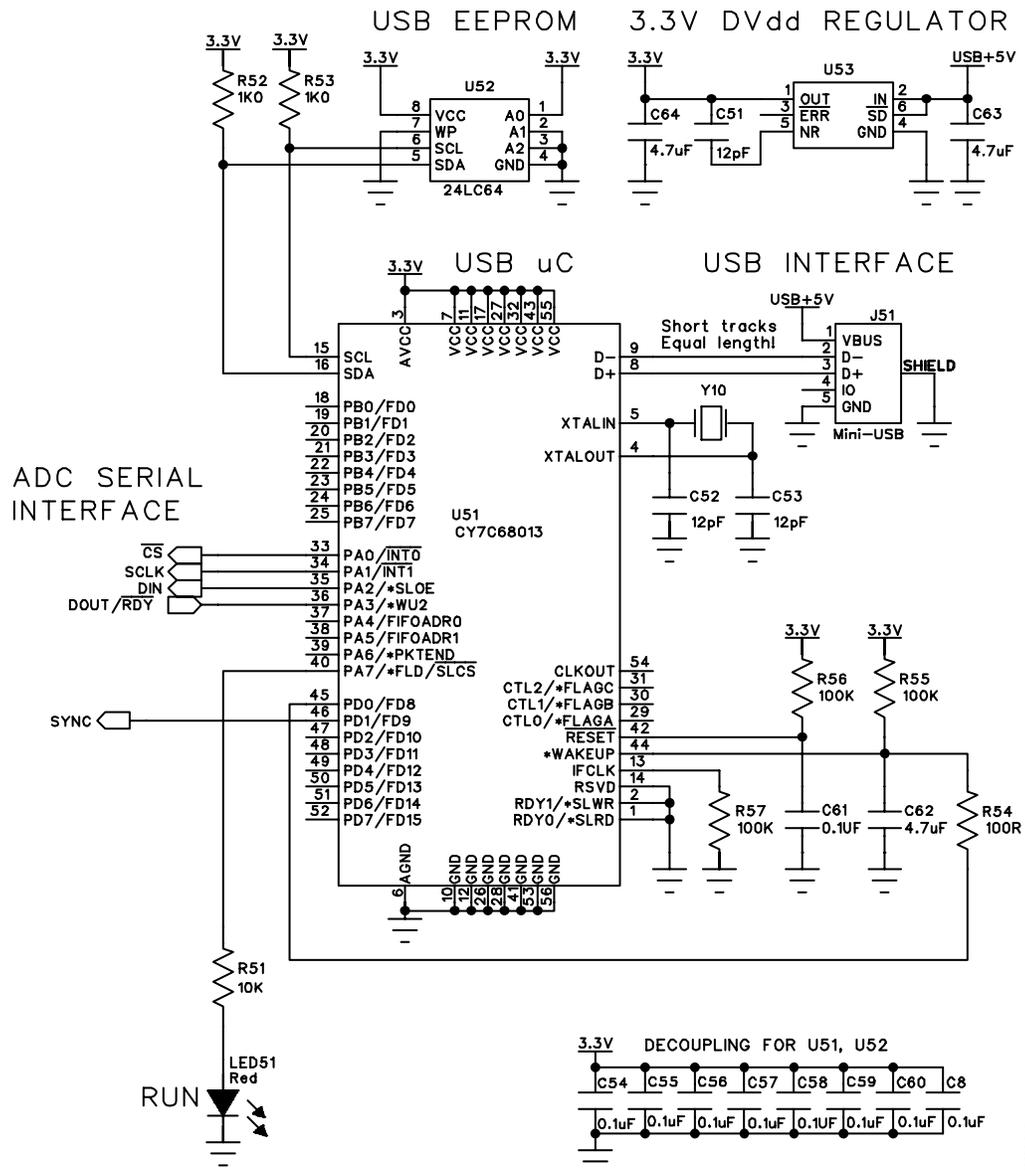
Figure 13. EVAL-AD7194EBZ Schematic, Digital Part
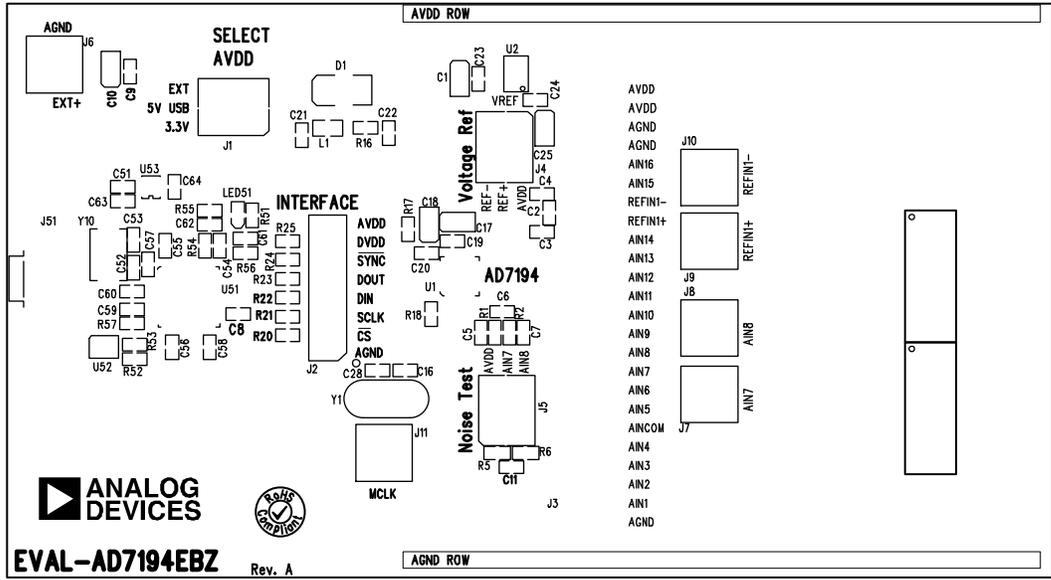
Figure 14. EVAL-AD7194EBZ Silkscreen
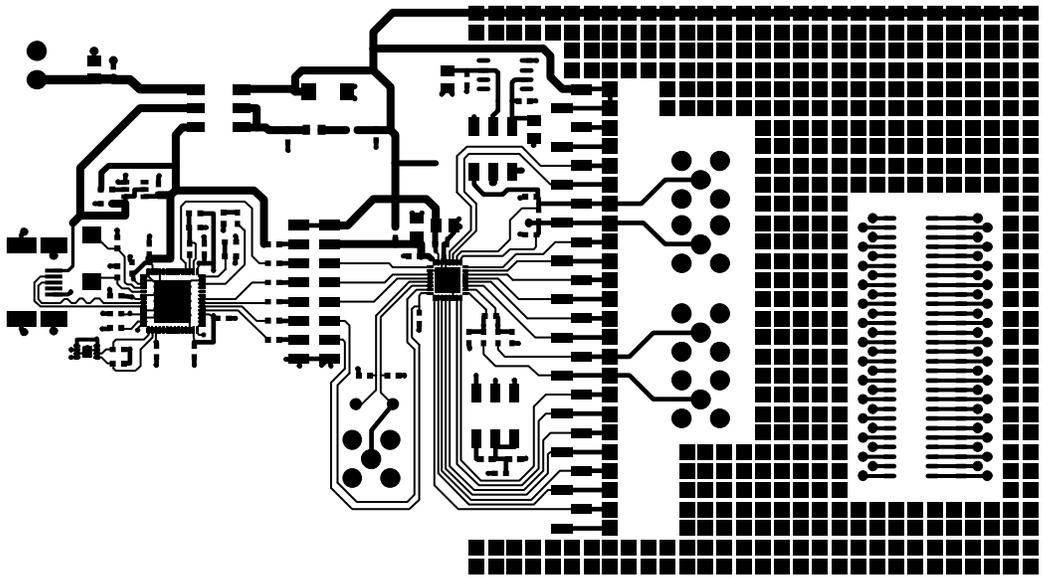
Figure 15. EVAL-AD7194EBZ Component Side View
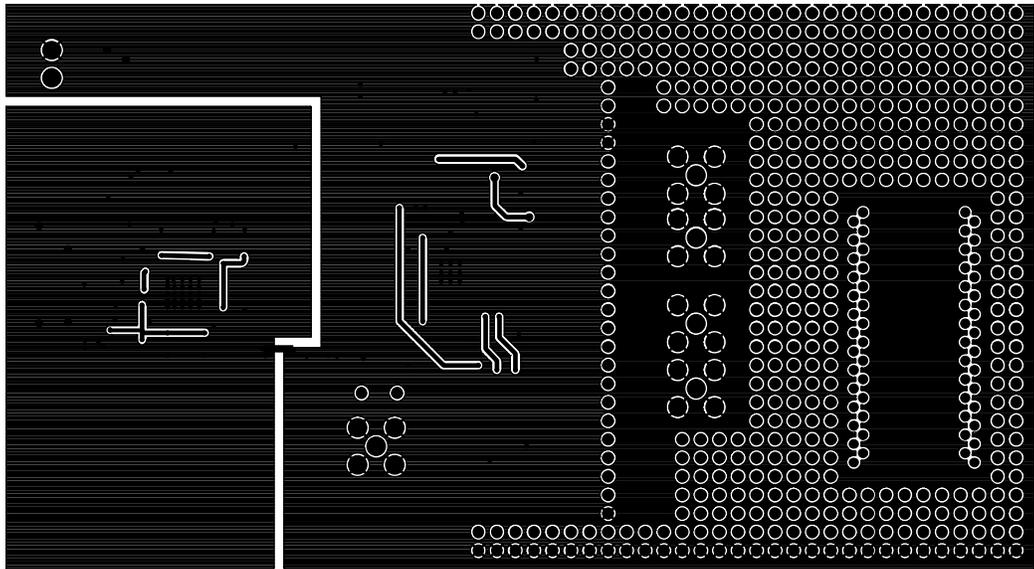
Figure 16. EVAL-AD7194EBZ Solder Side View

ORDERING INFORMATION

BILL OF MATERIALS

Table 2.

Qty.	Designator	Description	Manufacturer	Order No.
1	U1	AD7194	Analog Devices	AD7194BCPZ
1	U2	ADR421 reference	Analog Devices	ADR421BRZ
1	U51	USB controller	Cypress Semiconductor	CY7C68013-56LFXC
1	U52	64 K I^{2}C EEPROM	Microchip Technology, Inc.	24LC64-I/MC
1	U53	3.3 V voltage regulator	Analog Devices	ADP3330ARZ-3.3
1	LED51	LED red, high intensity (>90 mCd), 0603	Avago Technologies	HSMC-C191
1	Y1	4.9152 MHz crystal	Not inserted	
1	Y10	24 MHz crystal	AVX Corporation	CX5032GB24000H0PESZZ
1	D1	Diode	ON Semiconductor	P6SMB6.8AT3G
8	C2 to C7, C16, C28	Ceramic capacitor	Not inserted	
5	C1, C11, C17, C18, C25	10 µF tantalum capacitor	AVX Corporation	TAJA106M016R
17	C8 to C10, C19 to C24, C54 to C61	0.1 µF ceramic capacitor	Phycomp (Yageo)	2238 786 15649
3	C51 to C53	12 pF ceramic capacitor	Phycomp (Yageo)	2238 867 15129
3	C62 to C64	4.7 µF ceramic capacitor	Phycomp (Yageo)	2255 206 13672
1	L1	Ferrite bead	Tyco Electronics	BMB2A1000LN2
2	R1, R2	0 Ω resistor	Phycomp (Yageo)	232270296001
7	R20 to R25, R54	100 Ω resistor	Phycomp (Yageo)	RC0603FR-07100RL
4	R5, R6, R52, R53	1 kΩ resistor	Phycomp (Yageo)	RC0603FR-071KL
1	R51	10 kΩ resistor	Phycomp (Yageo)	RC0603FR-0710KL
1	R16	1.5 Ω resistor	Phycomp (Yageo)	RC0603FR-071R5L
1	R17	Resistor	Not inserted	
4	R18, R55 to R57	100 kΩ resistor	Phycomp (Yageo)	RC0603FR-07100KL
3	J1, J4, J5	2 × 3 way header	Tyco Electronics	1241050-3
1	J2	2 × 8 way header	Tyco Electronics	1241050-8
1	J3	1 × 24 way header	Tyco Electronics	1-1241050-2 (x2)
1	J6	Screw terminal block	Phoenix Contact	1727010
5	J7 to J11	Connector, 50 Ω, straight, SMB,	Amphenol	SMB1251B1-3GT30G-50
1	J51	Connector, USB Mini-B, SMD	Molex	548190572

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ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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