



Evaluation Board for 4 Channel, 1 MSPS, 12-/10-/8-Bit SAR ADCs

EVAL-AD7924/AD7914/AD7904

FEATURES

Full featured evaluation board for the AD7924, AD7914, and AD7904 devices

Evaluation control board (EVAL-CONTROL-BRD2) compatible

Standalone capability

On-board analog buffering and voltage reference

Various linking options

PC software for control and data analysis when used with the EVAL-CONTROL-BRD2

GENERAL DESCRIPTION

This data sheet describes the evaluation board used to test the AD7924, AD7914, and AD7904 ADCs. Packaged with each EVAL-AD7924/AD7914/AD7904 is a sample box containing one AD7924, one AD7914, and one AD7904 ADC. Place the ADC to be tested in the socket on the evaluation board.

The AD7924/AD7914/AD7904 ADCs are high speed, 12-bit, 10-bit, and 8-bit, respectively, successive approximation ADCs. These parts operate from a single 2.7 V to 5 V power supply and feature throughput rates of up to 1 MSPS.

Refer to the [AD7924/AD7914/AD7904](#) device data sheet in conjunction with this data sheet.

On-board components for this evaluation board include

- One AD780, which is a pin-programmable, 2.5 V or 3 V ultrahigh precision band gap reference
- One REF192 2.5 V reference
- One AD712 op amp
- One AD713 quad op amp

Various link options are provided in Table 1.

This evaluation board has a 96-way connector, that is compatible with the evaluation board controller (EVAL-CONTROL-BRD2), also available from Analog Devices, Inc.

External sockets are provided for the REF_{IN} , SCLK, DIN, DOUT, and $\overline{\text{CS}}$ signals, two bias-up circuits for bipolar input signals, and four sockets ($V_{\text{IN}0}$ to $V_{\text{IN}3}$) for the analog input channels.

FUNCTIONAL BLOCK DIAGRAM

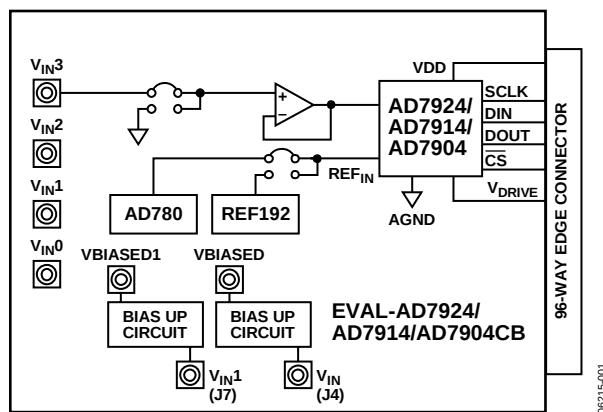


Figure 1.

Rev. 0

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REVISION HISTORY

12/06—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

LINK OPTIONS

There are 20 link options to be set before using the evaluation board. The functions of the options are outlined in Table 1.

Table 1. Link Functions

Link No.	Function
LK1 to LK4	Connects the inputs of the AD713 to the input sockets (V_{IN0} to V_{IN3}) or ties the AD713 inputs to AGND. In Position A, the relevant AD713 input is connected to the relevant input socket. In Position B, the relevant AD713 input is connected to AGND.
LK5	Selects the source of the REF_{IN} voltage to be applied to the REF_{IN} pin of the AD7924/AD7914/AD7904 and to the bias up circuits. In Position A, the REF192 supplies the +2.5 V reference to the AD7924/AD7914/AD790. In Position B, the AD780 supplies the +2.5 V reference to the AD7924/AD7914/AD790.
LK6	Selects the source of the V_{DD} supply to the AD7924/AD7914/AD7904. In Position A, the supply voltage, V_{DD} , is taken from an external source via J5. In Position B, the supply voltage is taken from the EVAL-CONTROL-BRD2 via the 96-way connector.
LK7	Selects the source of the $\overline{CS}$ signal for the AD7924/AD7914/AD790. In Position A, the $\overline{CS}$ signal is generated by the EVAL-CONTROL-BRD2 via the 96-way connector. In Position B, the $\overline{CS}$ signal is applied from an external source via the $\overline{CS}$ SMB socket.
LK8	Connects the data out pin, DOUT, of the AD7924/AD7914/AD790 to the EVAL-CONTROL-BRD2 to an external SMB socket. In Position A, the DOUT pin of the AD7924/AD7914/AD790 is connected to the EVAL-CONTROL-BRD2. In Position B, the DOUT pin of the AD7924/AD7914/AD790 is connected to the external DOUT SMB socket.
LK9	This link option selects the source of the data to be applied to the DIN pin of the AD7924/AD7914/AD7904. In Position A, the data being applied to the DIN pin of the AD7924/AD7914/AD7904 comes from the EVAL-CONTROL-BRD2. In Position B, the data being applied to the DIN pin of the AD7924/AD7914/AD7904 is from an external source applied via the DIN SMB socket.
LK10	Selects the source of the +12 V supply for the EVAL-AD7924/AD7914/AD7904. In Position A, the +12 V supply is sourced from the EVAL-CONTROL-BRD2 via the 96-way connector. In Position B, the +12 V supply is sourced externally via the J2 connector.
LK11	Selects the source of the -12 V supply for the EVAL-AD7924/AD7914/AD7904. In Position A, the -12 V supply is sourced from the EVAL-CONTROL-BRD2 via the 96-way connector. In Position B, the -12 V supply is sourced externally via the J2 connector.
LK12	Selects the source for the V_{DRIVE} voltage. In Position A, V_{DRIVE} is connected to AV_{DD} of the AD7924/AD7914/AD7904. In Position B, the V_{DRIVE} is taken from the Evaluation Controller Board via the 96-way connector. In Position C, the V_{DRIVE} is taken from an external source via the external J4 connector.
LK13	Selects the source for the SCLK signal applied to the SCLK pin of the AD7924/AD7914/AD7904. In Position A, SCLK is applied from an external source via the SCLK SMB connector. In Position B, the SCLK signal is an inverted signal from the EVAL-CONTROL-BRD2. In Position C, the SCLK is sourced directly from the EVAL-CONTROL-BRD2.
LK14	Controls the program pin of the AD780 voltage reference. When inserted, the AD780 output voltage is set to 3.0 V. When removed, the AD780 voltage is set to +2.5 V.
LK15 to LK20	Add a 51 Ω termination resistor to AGND at the V_{IN0} to V_{IN3} input sockets. When a 51 Ω termination is required, these links should be inserted.

EVAL-AD7924/AD7914/AD7904

OPERATING WITH THE EVAL-CONTROL-BRD2

The evaluation board can be used either as a standalone board or it can be operated in conjunction with the EVAL-CONTROL-BRD2. When operated with the EVAL-CONTROL-BRD2, all supplies and control signals to operate the AD7924/AD7914/AD7904 are provided by the EVAL-CONTROL-BRD2.

Software to communicate between the controller board and the [AD7924/AD7914/AD7904](#) is provided with the AD79x4 evaluation board kit. The EVAL-CONTROL-BRD2 operates with all Analog Devices evaluation boards with model numbers ending in the letters CB.

POWER SUPPLIES

When using this evaluation board with the EVAL-CONTROL-BRD2, all supplies are provided from the controller board through a 96-way connector.

When using the board as a standalone unit, external supplies are required. This evaluation board has seven power supply inputs: EXT_V_{DD}, AGND, +12 V, –12 V, AGND, V_{DRIVE}, and

DGND. If the evaluation board is used in standalone mode, a 2.7 V to 5 V supply must be connected to the EXT_V_{DD} input. The +12 V and –12 V supplies are required for the op amps. The V_{DRIVE} input connects to a supply from 2.7 V to 5 V allowing the evaluation board to be connected to both 3 V and 5 V systems. The supplies are decoupled to the ground plane with 10 µF tantalum and 0.1 µF multilayer ceramic capacitors at the entry point to the board. The supply pins of all the op amps, reference, and the AD7924/AD7914/AD7904 are decoupled with 10 µF tantalum and 0.1 µF ceramic capacitors.

INITIAL SETUP CONDITIONS

Care should be taken before applying power or signals to the evaluation board to ensure that all link positions are set up per the required operating mode. Failure to do so could result in damage to the evaluation board.

Table 2 outlines the default positions of all links when the board is shipped. All links are set so that all power supplies and control signals are supplied by the EVAL-CONTROL-BRD2.

Table 2. Initial Link Positions

Link No.	Position	Function
LK1	A	Input of AD713 is connected to the V _{IN0} SMB socket.
LK2 to LK4	B	AD713 inputs are connected to GND.
LK5	B	The AD780 supplies the 2.5 V reference to the AD7924/AD7914/AD7904.
LK6	B	V _{DD} is supplied from the EVAL-CONTROL-BRD2.
LK7	A	CS signal is generated by the EVAL-CONTROL-BRD2.
LK8	A	DOUT pin is connected to the EVAL-CONTROL-BRD2.
LK9	A	Data applied to the DIN pin of the AD7924/AD7914/AD7904 is generated by the EVAL-CONTROL-BRD2.
LK10	A	+12 V supply is generated by the EVAL-CONTROL-BRD2.
LK11	A	–12 V supply is generated by the EVAL-CONTROL-BRD2.
LK12	B	V _{DRIVE} is generated by the EVAL-CONTROL-BRD2.
LK13	C	SCLK signal is sourced directly from the EVAL-CONTROL-BRD2.
LK14	OUT	AD780 voltage is set to 2.5 V.
LK15 to LK20	OUT	Inputs not terminated.

INTERFACING THE EVALUATION BOARDS

Interfacing the EVAL-CONTROL-BRD2 to the evaluation board is accomplished via a 96-way connector, J1. Plug the 96-way connector on the evaluation board directly into the 96-way connector on the EVAL-CONTROL-BRD2.

The 96-way connector is powered from a 12 V ac transformer. Suitable transformers are available from Analog Devices as an accessory under the following part numbers:

- EVAL-110VAC-US (for use in the U.S. or Japan)
- EVAL-220VAC-UK (for use in the U.K.)
- EVAL-220VAC-EU (for use in Europe)

These transformers are also available from Digi-Key Corp. (U.S.) and Campbell Collins, Ltd. (U.K.).

Connection between the EVAL-CONTROL-BRD2 and the parallel port of a PC is accomplished via a standard Centronics, Inc. printer port cable, which is provided as part of the EVAL-CONTROL-BRD2 kit.

Figure 2 shows the pinout for the 96-way connector. Table 3 and Table 4 list the pin designations and descriptions. The unused pins of the 96-way connector are not shown.

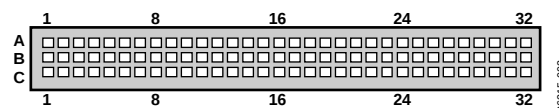


Figure 2. Pin Configuration for the 96-Way Connector

Table 3. Pin Descriptions

Signal	Description
DR0	Data Receive. Serial data from the device is provided at this output. Sixteen bits of data are provided with a leading zero, three channel address bits, followed by twelve bits of conversion data, which is provided MSB first (for the AD7924). Refer to the AD7924/AD7914/AD7904 data sheets.
DT0	Data Transmit. Serial data from the DSP is provided at this pin. Twelve bits of data are provided MSB first.
SCLK0	Serial Clock Zero. This continuous clock is connected to the SCLK pin of the device via LK13 to obtain serial data from the ADC.
TFS0	Transmit Frame Sync Zero.
RFS0	Receive Frame Sync Zero. Both of these inputs, TRS0 and RFS0, are connected to the ADC CS pin to initiate conversions and to frame the serial data transfer.
DGND	Digital Ground. These lines are connected to the digital ground plane on the evaluation board. It allows the user to provide the digital supply via the connector along with the other digital signals.
AGND	Analog Ground. These lines are connected to the analog ground plane on the evaluation board.
AV _{DD}	Analog +5 V Supply. These lines are connected to the AV _{DD} supply line on the evaluation board via LK6.
+12 V	+12 V Supply. This line is connected to the +12 V supply line on the evaluation board via LK10.
−12 V	−12 V Supply. This line is connected to the −12 V supply line on the evaluation board via LK11.

Table 4. 96-Way Connector Pin Functions

Pin No.	Row A	Row B	Row C
1			
2			
3			
4	DGND	DGND	DGND
5	DT0		DR0
6	TFS0		RFS0
7	SCLK0		SCLK0
8			
9			
10			
11			
12	DGND	DGND	DGND
13			
14			
15			
16	DGND	DGND	DGND
17			
18			
19			
20	DGND	DGND	DGND
21	AGND	AGND	AGND
22	AGND	AGND	AGND
23	AGND	AGND	AGND
24	AGND	AGND	AGND
25	AGND	AGND	AGND
26	AGND	AGND	AGND
27		AGND	
28		AGND	
29	AGND	AGND	AGND
30	−12 V	AGND	+12 V
31			
32	AV _{DD}	AV _{DD}	AV _{DD}

EVAL-AD7924/AD7914/AD7904

SOCKETS

There are eight input/output sockets relevant to the operation of the AD7924/AD7914/AD7904 on this evaluation board. The functions of these sockets are outlined in Table 5.

Table 5. Socket Functions

Socket	Function
J1	The 96-way connector for serial interface and power supply connections.
J2	External +12 V, –12 V, and AGND power connector.
J3	External V_{DRIVE} connector.
J4	Subminiature BNC socket for bipolar input signal to bias up circuit 0.
J5	External V_{DD} and AGND power connector.
J6	Subminiature BNC socket for output from bias up Circuit 0. Unipolar signal.
J7	Subminiature BNC socket for bipolar input signal to bias up Circuit 1.
J8	Subminiature BNC socket for output from bias up Circuit 1. Unipolar signal.
$V_{\text{IN}0}$ to $V_{\text{IN}3}$	Subminiature BNC sockets for analog input Channel 0 to Channel 3.
REF_{IN}	Subminiature BNC socket for REF_{IN} voltage.
SCLK	Subminiature BNC socket for external SCLK.
$\overline{\text{CS}}$	Subminiature BNC socket for external $\overline{\text{CS}}$.
DIN	Subminiature BNC socket for external DIN.
DOUT	Subminiature BNC socket for DOUT signal.

EVALUATION BOARD SOFTWARE

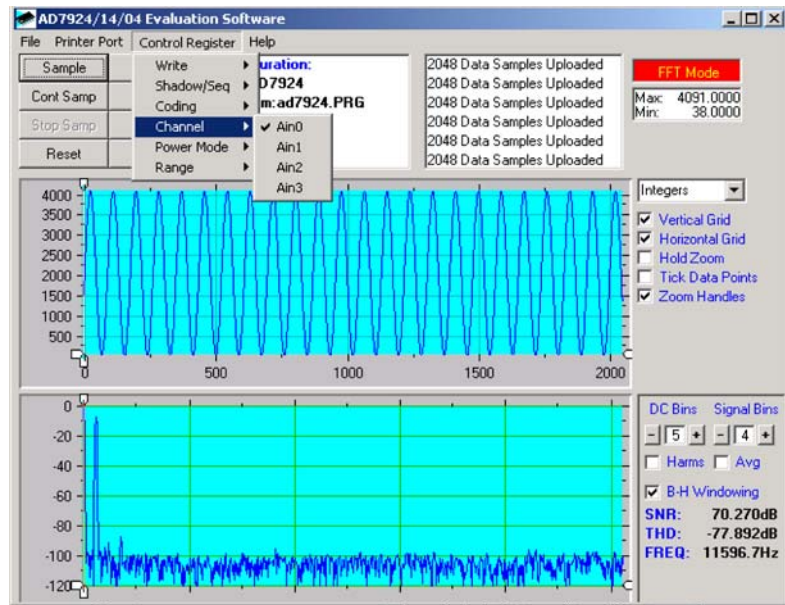


Figure 3. Main Dialog Box

INSTALLING THE SOFTWARE

The EVAL-AD79x4 kit includes a CD-ROM.

When the CD is inserted into the PC, an installation program automatically begins. This program installs the evaluation software.

THE MAIN DIALOG BOX

The software that controls the EVAL-CONTROL-BRD2 and, therefore, the AD79x4 evaluation board consists of three dialog boxes. The main dialog box, shown in Figure 3, allows you to read a predetermined number of samples from the evaluation board and display them in both the time and frequency domain. This dialog box can be divided into three sections.

The top section of the dialog box contains the control buttons, the menu bar, and the status windows.

Control Buttons

Use the control buttons to take samples (**Sample**), reset the board (**Reset**), and get information about the software.

Click the **Reset** button for the EVAL-CONTROL-BRD2 to perform a reset. When this happens, the power supply to the evaluation board is turned off, and the program in the DSP memory is lost. If required, set up the board again to download another program. Click the **Quit** button to exit. Note, however, that the program running on the EVAL-CONTROL-BRD2 is not terminated.

Menu Bar

The menu bar consists of the **File**, **Printer Port**, **Control Register**, and **Help** drop-down menus.

The **File** drop-down menu offers the following selections:

- **Setup Menu.** Select this option to display the Setup Menu as shown in Figure 5.
- **Load Raw Data.** Select this option to load data saved by the software during a previous session.
- **Save Raw Data.** Select this option to save the current set of sample data points. The data can be reloaded to the evaluation software later or can be used by other programs for analysis.
- **Save Binary Data.** Select this option to save the current set of sample data points. The data is saved in binary format as a text file. This method can be useful for examining code flicker and looking for stuck bits.
- **Save FFT Data.** Select this option to save the current set of FFT data points. FFT data cannot be reloaded into the EVAL-CONTROL BRD2 software, but can be loaded into other software packages for further analysis.
- **Exit.** Quits the program.

The **Printer Port** drop-down menu allows you to select which printer port to use for communication with the EVAL-CONTROL BRD2.

SETUP MENU

The **Setup Menu**, shown in Figure 5, allows you to load the required configuration file for the evaluation board. When the configuration file is loaded, the software acquires detailed information about the evaluation board and the ADC connected to the EVAL-CONTROL-BRD2. This includes information such as the number of bits, maximum sampling rate, output coding, maximum analog input, and power supply requirements.

The configuration file also indicates to the software the name of the DSP program file to download to the EVAL-CONTROL-BRD2. The **Setup Menu** allows you to choose the sampling frequency and the number of samples to take.

CHECKING THE EVAL-CONTROL-BRD2

The EVAL-CONTROL-BRD2 and the evaluation board should be connected together as described in the Interfacing the Evaluation Boards section.

At this stage, the red LED on the EVAL-CONTROL-BRD2 should be flashing. This indicates that the EVAL-CONTROL-BRD2 is functional and ready to receive instructions.

Note that the software should be installed before the printer port cable is connected between the EVAL-CONTROL-BRD2 and the PC. This ensures that the printer port has been initialized correctly.

USING THE SOFTWARE

Once the hardware and software is set up:

1. From the **File** menu, select **Setup**.

A set up form displays. A list box on the **Setup Menu** lists the available configuration files. The configuration files are text-based files containing information about the ADC to be tested (**AD7924.cfg**, **AD7914.cfg**, and **AD7904.cfg**).

2. Select the relevant configuration file and click **Load**.

Choose the configuration file depending upon which device is in the socket of the evaluation board. The EVAL-CONTROL-BRD2 is reset and the DSP program is downloaded. Once the download is complete, the power supply settings indicated in the configuration file are set and you may hear some of the relays clicking. The drop-down list boxes, **Select No. Of Samples** and **Select Sample Frequency**, are set to the default values specified in the configuration file. Note that you can change these settings at any point.

3. Once all the settings are set, click **Close** to return to the main dialog box.

Default Conditions

The EVAL-AD7924/AED7914/AD7902 is configured to convert on Channel 0, 0 to REF_{IN} input range, normal mode with straight binary output coding. If no changes are made to the control register via the **Control Register** drop-down menu on the main dialog box, clicking **Sample** yields conversion results from Channel 0.

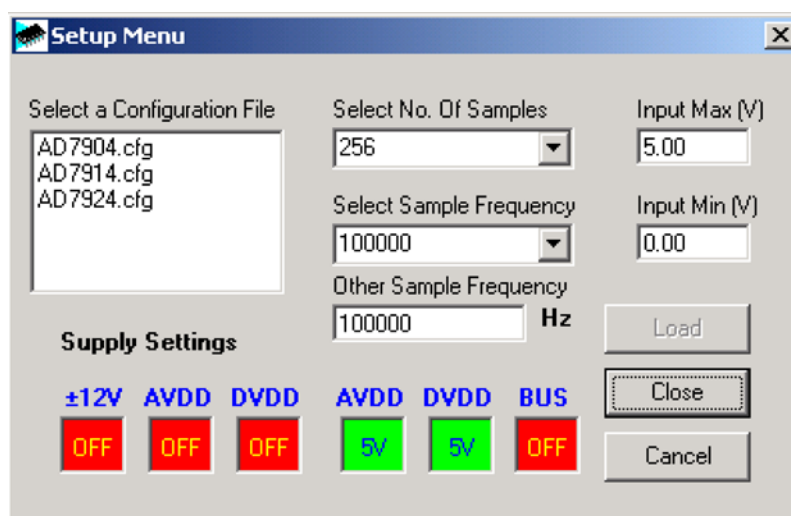


Figure 5. Setup Menu

Taking Samples

To instruct the EVAL-CONTROL BRD2 to take the required number of samples at the required frequency, follow these steps using the Main Screen shown in Figure 3:

1. Click **Sample**.

Select a sampling frequency up to the rate of 1 MSPS.

Samples are uploaded and displayed. An FFT and histogram are also calculated and displayed.

2. Click **Cont Sample** to continue taking samples.

To stop sampling, click **Cont Sample** again. Note that while the software is continuously sampling data the other control buttons are disabled.

3. Click **Exit** to stop the process.

Software Configuration Files

Software configuration files provide the EVAL-CONTROL-BRD2 software with information on how the software and hardware should perform. These files contain information, such as the name of the DSP program to download, the default and maximum sampling frequencies, the number of samples to take, and the power supply settings to use.

What follows is a typical Software Configuration File (*.cfg).

```
[EVAL-CONTROL BOARD]
partname:AD7924
programname:ad7924.PRG

samplefrequency:100000
maxsamplefrequency:1000000
samples:2048
```

```
+/-15V:on
dvdd:5:on
avdd:5:on
bus:on
;options 2scomp, binary
dataformat:binary
numberofbits:12
inputVmax:2.5
inputVmin:0
[endofconfig]
```

Sequencer Modes: FFT Mode and Histogram Mode

FFT Mode

To operate the EVAL-AD7924/AD7914/AD7904 in FFT mode with the sequence and shadow bits set to 11 in the Control Register, follow these steps:

1. Select the 11 combination from **Shadow/Seq** bits in the **Control Register** drop-down menu.
2. Select the final channel in the sequence.
3. Click **Sample**, once the control register configuration is set.

When the evaluation board is finished taking samples on the selected channels in the sequence, the resulting FFTs are displayed in the bottom section of the main dialog box. The **SNR:**, **THD:**, and **FREQ:** results correspond to the final channel in the programmed sequence.

If individual **SNR:**, **THD:** and **FREQ:** results are required from each individual channel, operate the device in normal mode with the sequence and shadow (**Shadow/Seq**) bits set to 00 and select the individual channel in the Control Register.

Histogram Mode

When operating the evaluation board in histogram mode with the sequence and shadow bits set to 11 in the Control Register, follow these steps:

1. Select the 11 combination for **Shadow/Seq** in the Control Register drop-down menu.
2. Select the final channel in the sequence.
3. Select **Sample** once the Control Register configuration is set.

When the evaluation board is finished taking samples on the selected channels in the sequence, the resulting histogram displays in the third portion of the Main Screen. The histogram corresponds to the first channel in the programmed sequence. The **Max Code:**, **Min Code:**, **Spread:**, **Std Dev:**, and **Mean:** results correspond to the first channel in the programmed sequence.

If you would like the codes, such as the **Max Code:** and **Min Code:**, to correspond to a particular channel, operate the ADC in normal mode with the sequence and shadow (**Shadow/Seq**) bits set to 00, and select the individual channel in the **Control Register** drop-down menu.

EVALUATION BOARD SCHEMATICS AND ARTWORK

900-51290

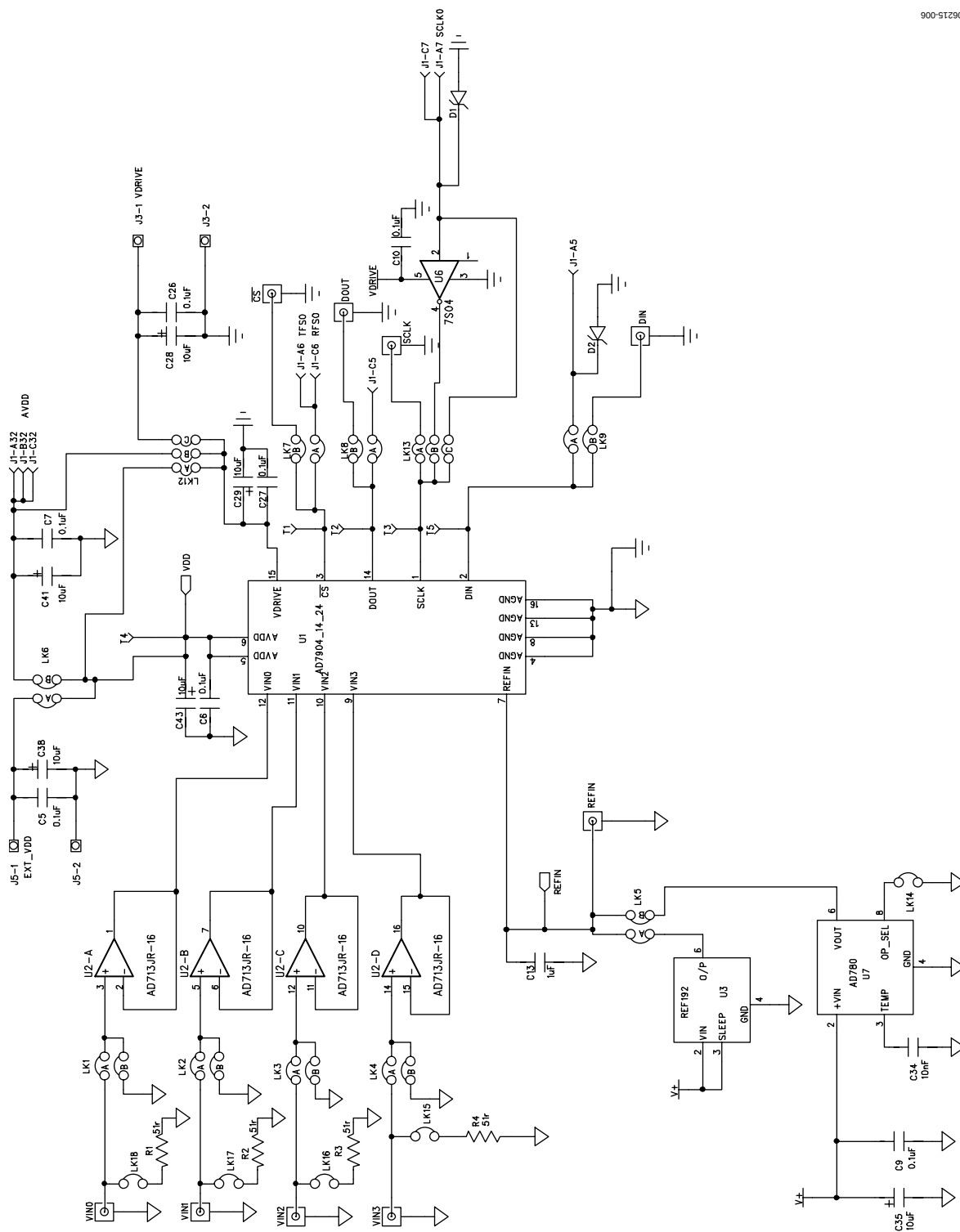


Figure 6. Schematic 1

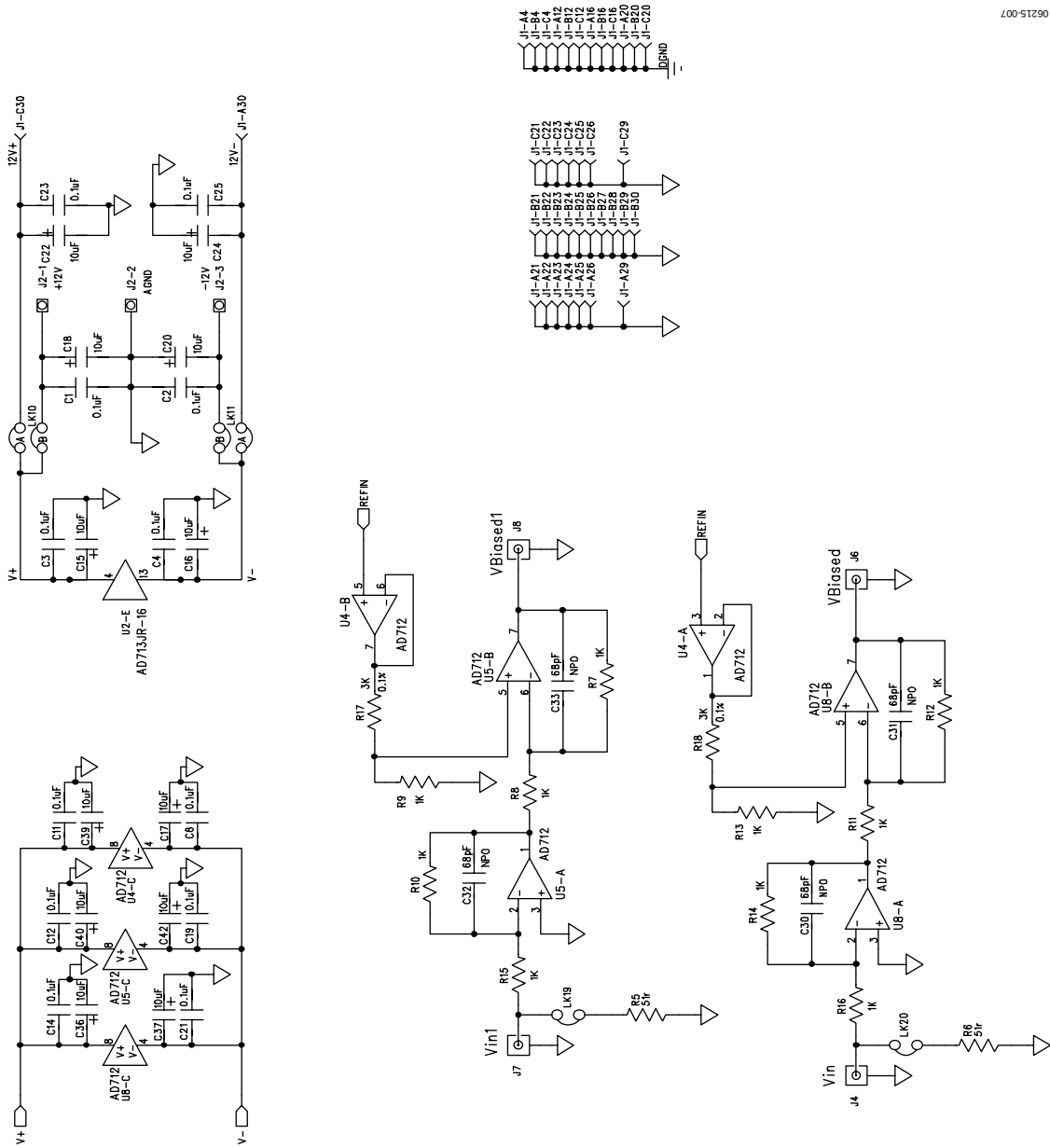


Figure 7. Schematic 2

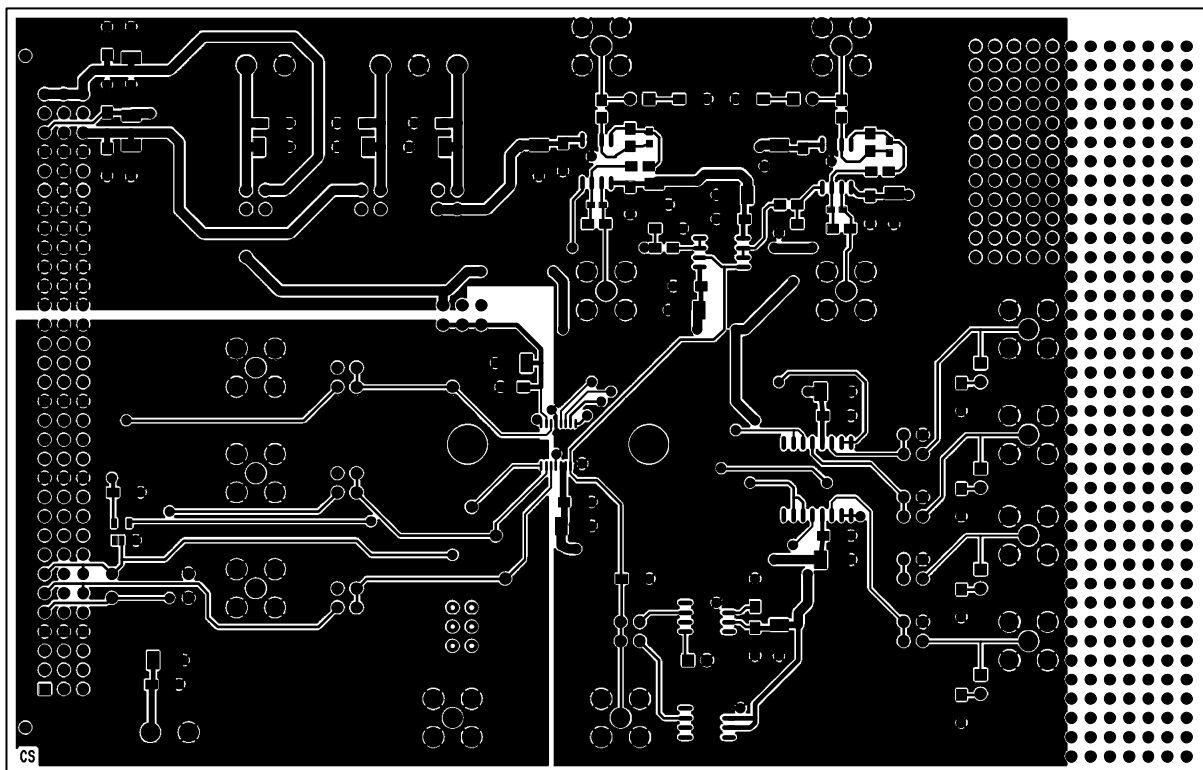


Figure 8. Component Side Artwork

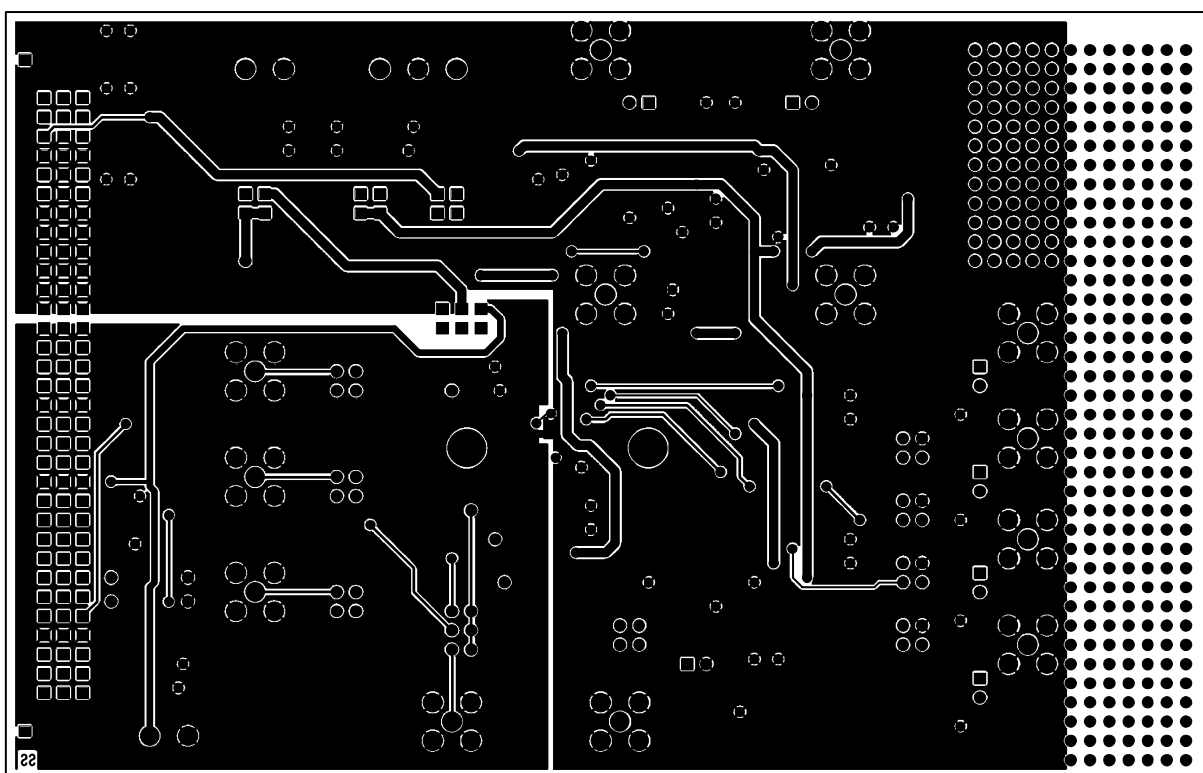


Figure 9. Solder Side Artwork

EVAL-AD7924/AD7914/AD7904

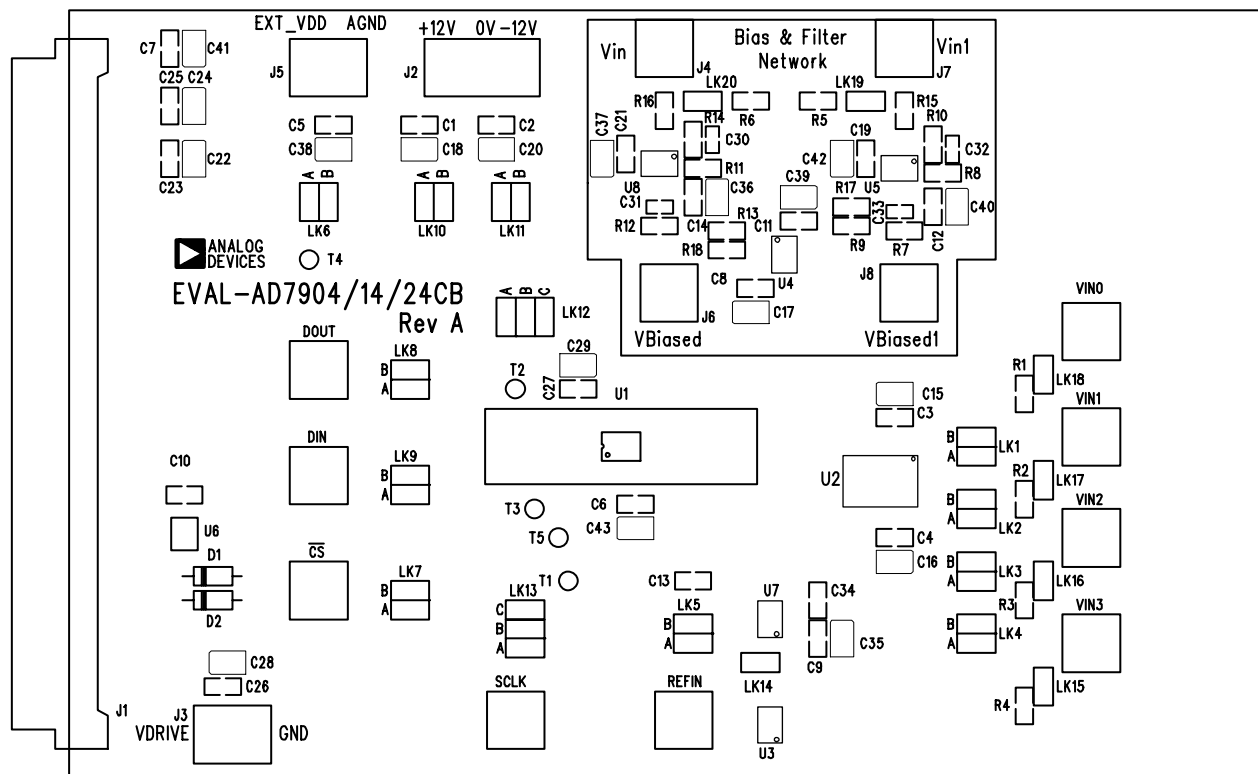


Figure 10. Component Placement Drawing

ORDERING INFORMATION

Table 6. Bill of Materials

Qty.	Reference Designator	Part Type	Order Number ¹
1	U1	AD7924, AD7914, AD7904	AD7924, AD7914, AD7904
1	U2	AD713	AD713
1	U3	REF192	REF192
3	U4, U5, U8	AD712	AD712
1	U6	DM74LS04N	FEC 685-914
1	U7	AD780	AD780
6	R1 to R6	51r resistor	FEC 321-7905
10	R7 to R17	1 k Ω resistor	FEC 911-859
2	R18	3 k Ω resistor	FEC 321-8119
19	C1 to C11, C12, C14, C19, C21, C23, C25 to C27	0.1 μ F capacitor	FEC 499-687
18	C15 to C18, C20, C22, C24, C28, C29, C35 to C43	10 μ F capacitor	FEC 197-427
1	C13	1 μ F capacitor	FEC 317-640
4	C30 to C33	68 pF capacitor	FEC 722-066
1	C34	10 nF capacitor	FEC 499-225
2	D1, D2	SD103C	
13	DIN, CS, DOUT, J4, J6, J7, J8, REFIN, SCLK, VIN0 to VIN3	50 Ω gold plated PCB SMB jack	FEC 310-682
1	J1	CON\41612\96	FEC 104-986
1	J2	3-pin power connector	FEC 151-786
2	J3, J5	2-pin power connector	FEC 151-785
11	LK1 to LK11	2x2 way jumper	FEC 511-791
2	LK12, LK13	2x3 way jumper	FEC 511-780
1	LK14	Jumper	FEC 511-705
6	LK15 to LK20	Jumper	FEC 511-705
14	LK1 to LK14	Shorting links	FEC 528-456
5	T1 to T5	Testpoint	FEC 240-333
1		U1 SOCKET CLAMP-SOIC-TSSOP	
4	Each corner	Stick-on feet	FEC 651-813
1	EVAL-AD7924/AD7914/AD7904	PCB	EVAL-AD7924/ AD7914/ AD7904

¹ FEC = Farnell Electronic Components®.

ORDERING GUIDE

Model	Description
EVAL-AD79X4CB	Evaluation Board for the AD7904/14/24

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.

NOTES