



EVAL-AD7475/AD7495CB

FEATURES

- Full-Featured Evaluation Board for the AD7475/95
- EVALUATION-BOARD CONTROLLER Compatible
- Stand Alone Capability
- On-Board Analog Buffering and Reference
- Various Linking Options
- PC Software for Control and Data Analysis when used with EVALUATION-BOARD CONTROLLER
- Patchwork Area for User Expansion

INTRODUCTION

This Technical Note describes the evaluation board for the AD7475/AD7495 which is a fast 12-bit high speed, low power successive-approximation ADCs. The parts operate from a single 2.7 V to 5.25 V power supply and feature throughput rates up to 1 MSPS. Full data on the AD7475/AD7495 is available in the AD7475/AD7495 data sheet available from Analog Devices and should be consulted in conjunction with this Technical Note when using the Evaluation Board.

On-board components include an AD780 which is a pin programmable +2.5V or +3V ultra high precision bandgap reference and an AD711 op-amp used to buffer the analog input. There are various link options which are explained in detail on page 2.

Interfacing to this board is through a 96-way connector. This 96-way connector is compatible with the EVALUATION-BOARD CONTROLLER which is also available from Analog Devices. External sockets are provided for the REFIN input and the VIN input.

OPERATING THE AD7475/AD7495 EVALUATION BOARD

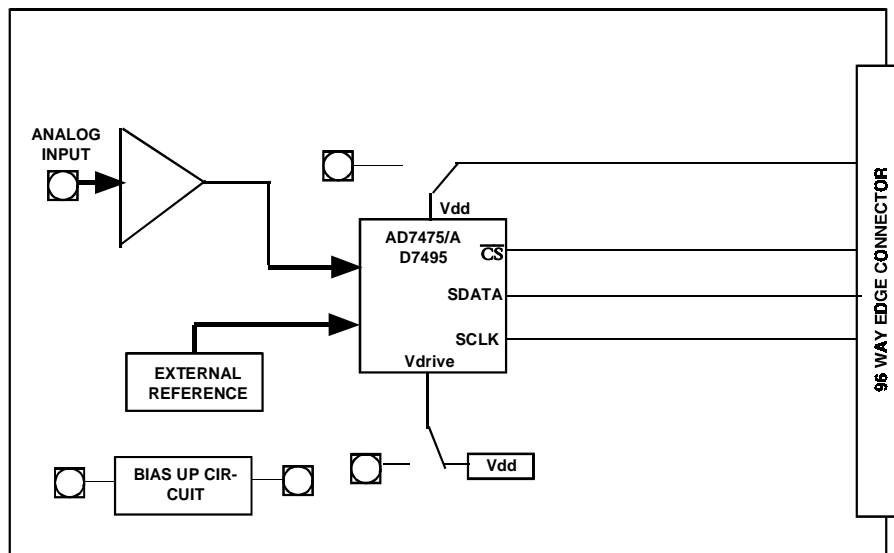
Power Supplies

When using this evaluation board with the EVALUATION-BOARD CONTROLLER all supplies are provided from the EVALUATION-BOARD CONTROLLER through the 96 way connector.

When using the board as a stand alone unit external supplies must be provided. This evaluation board has six power supply inputs: V_{DD} , A_{GND} , +12V, -12V, A_{GND} , and D_{GND} . If the evaluation board is used in stand-alone mode +5V must be connected to the V_{DD} input to supply the AD7475/AD7495 V_{DD} pin and the AD780 voltage reference. +12V and -12V are used to supply the op-amps. The V_{DRIVE} pin can be driven by a voltage between +3V and +5V allowing the evaluation board to be connected to both +3V and +5V systems. The supplies are decoupled to the relevant ground plane with 10 μ F tantalum and 0.1 μ F multilayer ceramic capacitors at the point where they enter the board. The supply pins of all the op-amps and reference are also decoupled to A_{GND} with 10 μ F tantalum and a 0.1 μ F ceramic capacitor. The AD7475/AD7495 $A_{V_{DD}}$ supply pin is decoupled to A_{GND} with 10 μ F tantalum and 0.1 μ F multilayer ceramic capacitors.

Extensive ground planes are used on this board to minimize the effect of high frequency noise interference. There are two ground planes, A_{GND} and D_{GND} . These are connected at one location close to the AD7475/AD7495.

FUNCTIONAL BLOCK DIAGRAM



REV. 0

Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices.

EVAL-AD7475/AD7495CB

LINK AND SWITCH OPTIONS

There are 12 link options which must be set for the required operating setup before using the evaluation board. The functions of these options are outlined below.

Link No.	Function.
LK1	This link is used to connect the input of the AD711 op-amp to ground if the user needs to do this. When this link is in position "A" a signal applied to the AIN socket is routed to the input of the AD711 op-amp. This is the normal application for this link. When this link is in position "B", the input of the AD711 op-amp is tied to GND.
LK2	This link option controls the program pin of the AD780 voltage reference. When this link is "inserted" the AD780 output is set to +3.0 V. When this link is "removed" the AD780 output is set to +2.5 V
LK3	This link is used to select the source of the reference voltage applied to the AD7475 REFIN pin. When this link is in position "A", the AD780 provides the 2.5V reference to the AD7475. When this link is in position "B" an external reference must be supplied to the AD7475 via J5. For the AD7495 this pin must be removed
LK4	This link selects the source of the $V_{DD} +5V$ supply. When this link is in position "A" the +5V is supplied from an external source via J6. When this link is in position "B" the +5V must be supplied from the EVALUATION-BOARD CONTROLLER
LK5	This link option selects the source of the VDRIVE input. When this link is in position "A" the VDRIVE supply voltage is provided from VDD. When this link is in position "B" the VDRIVE supply voltage is provided from the EVALUATION-BOARD CONTROLLER. When this link is in position "C" an external VDRIVE supply voltage must be supplied via J7.
LK6	This link option is used to select the source of the +12V supply. In position A, the +12V is supplied from the EVALUATION-BOARD CONTROLLER through the 96 way connector. In position B, the +12V is supplied from an external source through the power connector, J8.
LK7	This link option is used to select the source of the -12V supply. In position A, the -12V is supplied from the EVALUATION-BOARD CONTROLLER through the 96 way connector. In position B, the -12V is supplied from an external source through the power connector, J8.
LK8	This link option sets the dc bias voltage applied to the optional bias-up/filter circuit. When the link is in position "A", the bias voltage is set to the same level as the voltage that is applied to the REF IN on the AD7475 and the REF OUT pin on the AD7495. In this configuration a bipolar analog input applied to the Vin SMB socket as a unipolar signal biased around $V_{ref}/2$. When in position "B", the bias voltage is set to A_{GND} . In this configuration the bias up circuit is not used.
LK9	This link option adds a 50 Ohm termination to AGND at the Ain socket. In most applications this link will be left unconnected. If a 50 Ohm termination is required, this link should be inserted.
LK10	This link option adds a 50 Ohm termination to AGND at the Vin socket. In most applications this link will be left unconnected. If a 50 Ohm termination is required, this link should be inserted.
LK11, LK12	When both these links are in position "A", for slower SCLK frequencies, giving valid data on the rising edge. When both these links are in position "B", for fast SCLK frequencies, giving valid data on the falling edge, the SCLK signal is connected directly to the AD7898 SCLK pin. This is the normal position for these 2 link options.

SET-UP CONDITIONS

Care should be taken before applying power and signals to the evaluation board to ensure that all link positions are as per the required operating mode. Table I shows the position in which all the links are set when the evaluation board is sent out.

Table I. Initial Link and Switch Positions

Link No.	Position	Function.
LK1	A	Ain is tied to the input of the AD711 buffer op-amp.
LK2	removed	AD780 is set to provide a + 2.5 V reference.
LK3	A removed	The on-board AD780 voltage reference supplies the REFIN pin of the AD7475. The internal + 2.5V reference on the AD7495 is used on the AD7495 control board
LK4	B	V _{DD} (+5V) supplied by the EVALUATION-BOARD CONTROLLER via J5.
LK5	A	VDRIVE pin of the AD7475/AD7495 is connected to V _{DD} (+5V)
LK6	A	+12V supplied from EVAL-CONTROL BOARD via J5.
LK7	A	-12V supplied from EVAL-CONTROL BOARD via J5.
LK8	A	Vref is chosen as the dc bias voltage for the bias-up circuit.
LK9	removed	50 Ohm termination is not selected.
LK10	removed	50 Ohm termination is not selected.
LK11, LK12	B	SCLK signal from EVALUATION-BOARD CONTROLLER is not inverted, (for faster values of SCLK).

EVAL-AD7475/AD7495CB

EVALUATION BOARD INTERFACING

Interfacing to the evaluation board is via a 96-way connector, J1. J1 is used to connect the evaluation board to the EVAL-CONTROL BOARD or other system. The pinout for the J5 connector is shown in Figure 1 and its pin designations are given in Table II.

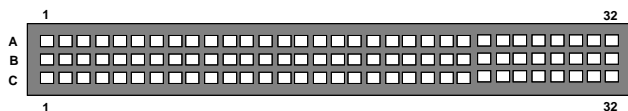


Figure 1. Pin Configuration for the 96-Way Connector, J5

96-Way Connector Pin Description

- DR0** DATA RECEIVE ONE: Serial Data from the AD7898 is provided at this output. Sixteen bits of data are provided with four leading zeroes followed by twelve bits of conversion data which is provided MSB first.
- SCLK0** SERIAL CLOCK ZERO: This continuous clock is connected to the SCLK pin of the AD7898 via LK7 to obtain serial data from the AD7898.
- $\overline{\text{TFS0}}$ TRANSMIT FRAME SYNC ZERO,
- $\overline{\text{RFS0}}$ RECEIVE FRAME SYNC ZERO: Both of these inputs are connected to the AD7898 $\overline{\text{CS}}$ /CONVST pin via LK5 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 +5V Supply. These lines are connected to the AV_{DD} supply line on the board via LK4.
- +12V** +12V Supply. This line is connected to the +12V supply line on the board via LK8.
- 12V** -12V Supply. This line is connected to the -12V supply line on the board via LK9.

Table II. 96-Way Connector Pin Functions.

	ROW A	ROWB	ROWC
1			
2			
3			
4	DGND	DGND	DGND
5			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	-12V	AGND	+12V
31			
32	AVDD	AVDD	AVDD

Note : The unused pins of the 96-way connector are not shown.

CONNECTORS

There are nine input/output connectors relevant to the operation of the AD7475/AD7495 on this evaluation board. The function of these connectors is outlined in Table III.

Table III. Connector Functions

Connector	Function
J1	Sub-Miniature BNC socket for Ain input.
J2	Sub-Miniature BNC socket for Ext Vref input.
J3	Sub-Miniature BNC socket for Vin input.
J4	Sub-Miniature BNC socket for Vbiased output.
J5	96-Way Connector for Serial Interface & Power Supply connections.
J6	External V_{DD} & GND power connector.
J7	External V_{DRIVE} & GND input power connector.
J8	External +12V, -12V & AGND power connector

OPERATING WITH THE EVAL-BOARD CONTROLLER

The evaluation board can be operated in a stand-alone mode or operated in conjunction with the EVALUATION-BOARD CONTROLLER. This EVALUATION-BOARD CONTROLLER is available from Analog Devices under the order entry "EVAL-CONTROL BRD2". When operated with this control board, all supplies and control signals to operate the AD7898 are provided by the EVALUATION-BOARD CONTROLLER when it is run under control of the AD7475/AD7495 software which is provided with the AD7475/AD7495 evaluation board package. This EVALUATION-BOARD CONTROLLER will also operate with all Analog Devices evaluation boards which end with the letters CB in their title.

The 96-way connector on the EVAL-AD7475/AD7495CB plugs directly into the 96-way connector on the EVALUATION-CONTROL BOARD. No power supplies are required in the system. The EVALUATION-BOARD CONTROLLER generates all the required supplies for itself and the EVAL-AD7475/AD7495CB. The EVALUATION-BOARD CONTROLLER is powered from a 12V ac transformer. This is a standard 12V ac transformer capable of supplying 1A current and is available as an accessory from Analog Devices 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 for other suppliers including Digikey (U.S.) and Campbell Collins (U.K.).

Connection between the EVALUATION-BOARD CONTROLLER and the serial port of a PC is via a standard RS-232 cable which is provided as part the EVALUATION-BOARD CONTROLLER package. Please refer to the manual which accompanies the EVALUATION-BOARD CONTROLLER for more details on the EVALUATION-BOARD CONTROLLER package.

EVAL-AD7475/AD7495CB

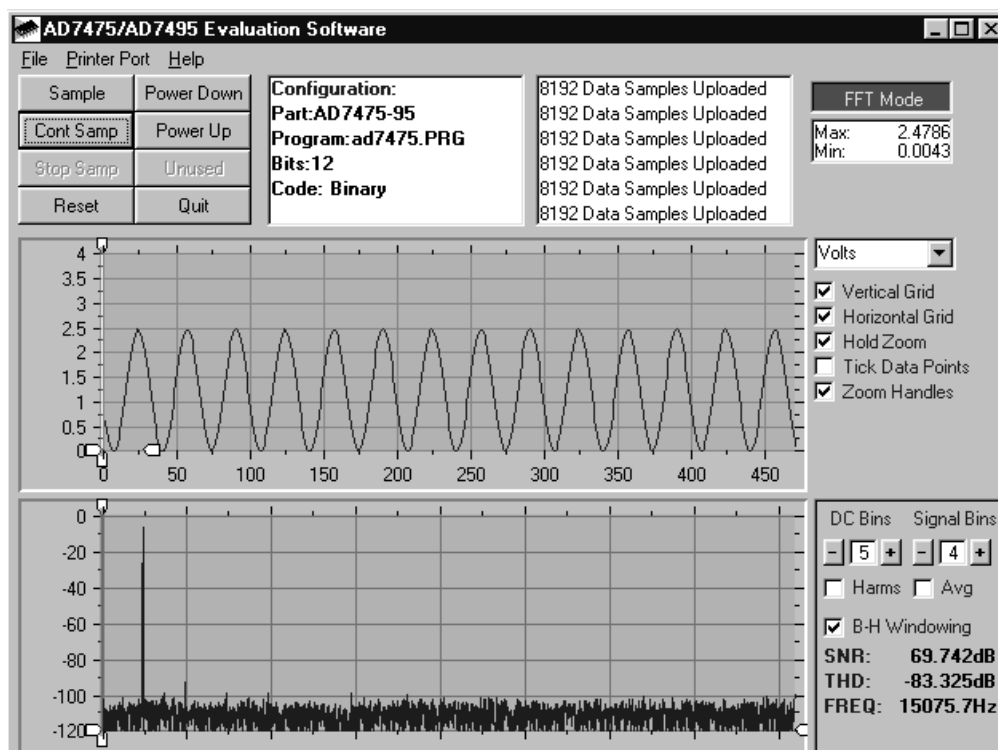


Figure 2. AD7475/AD7495 Main Screen - FFT Mode

SOFTWARE DESCRIPTION

Included in the EVAL-AD7475/AD7495CB evaluation board package is a CD ROM which contains software for controlling and evaluating the performance of the AD7475/AD7495 when it is operated with the EVALUATION-BOARD CONTROLLER. When the CD is inserted into the PC an installation program will automatically begin. This program will install the evaluation software onto the users machine and will also install the technical Note for the AD7475/AD7495 evaluation board as well as the datasheet for the AD7475/AD7495. All literature on the CD is in Adobe's Portable Documation format (PDF) and will require Acrobat Reader™ to be viewed or printed. The user interface on the PC is a dedicated program written especially for the AD7475/AD7495.

The software which controls the Evaluation Board Controller and hence the AD7475/AD7495 evaluation board has three main screens. The screen shown in Figure 2 shows the screen which appears when the software is run. The main function of the screen is to allow the user to read a predetermined number of samples from the evaluation board and display them in both the time and frequency domain. The screen can be divided into 3 sections. The upper most section of the screen contains the control buttons, the menu bar and the status windows. The controll buttons allow the user to enter the set-up menu, take samples, and get information about the software. There are also power down/up options in the control buttons. These buttons allow the user to place the part into power down, and power the part up again. There are two powerdown modes associated with the AD7475/AD7495, partial powerdown and full powerdown. To enter partial power down the ' PowerDown ' button should be pressed once. To enter Full power down the ' PowerDown ' button should be pressed twice(see modes of operating section of the AD7475/AD7495 datasheet).

The menu bar allows the user to select which printer port is to be used to control the Evaluation Board Controller, load and save data etc. The status window indicates the set up of the AD7475/AD7495 evaluation board, the number of samples taken and any information messages that are generated.

The middle section of the AD7475/AD7495 Main Screen is a Digital Storage Oscilloscope (DSO). When samples are uploaded from the Evaluation Board Controller they are displayed here. The samples can be displayed as either interger values or as voltages . Once the samples are displayed clicking any point on the graph will display the sample number and the value of the point directly beneath the cursor. Along the axis of the graph are the " zoom handles ". These allow the user to zoom in and out to get a closer look at a particular sample if required. When another set of samples are taken the graph will attempt to display all values collected unless the Hold Zoom check box is ticked. If the Hold zoom box is ticked the graph will keep the same axis settings as for the previous set of data samples. There are additional check boxes in this section to give the user control over the vertical and horizontal grids and data points.

The lowest section of the screen will show either a Fast Fourier Transform (FFT) of the data, or a histogram, which shows the number of occurances of each particular code read back. The FFT (default option) is typically used when the user is concerned with examining the AD7475/AD7495's performance in the frequency domain, while the Histogram will give an indication of the AD7475/AD7495's performance to dc signals. The option displayed can be changed by clicking on the FFT Mode/Histogram Mode button in the top right of the screen. Figure 3 shows how the Main Screen would look if the Histogram Mode was selected.

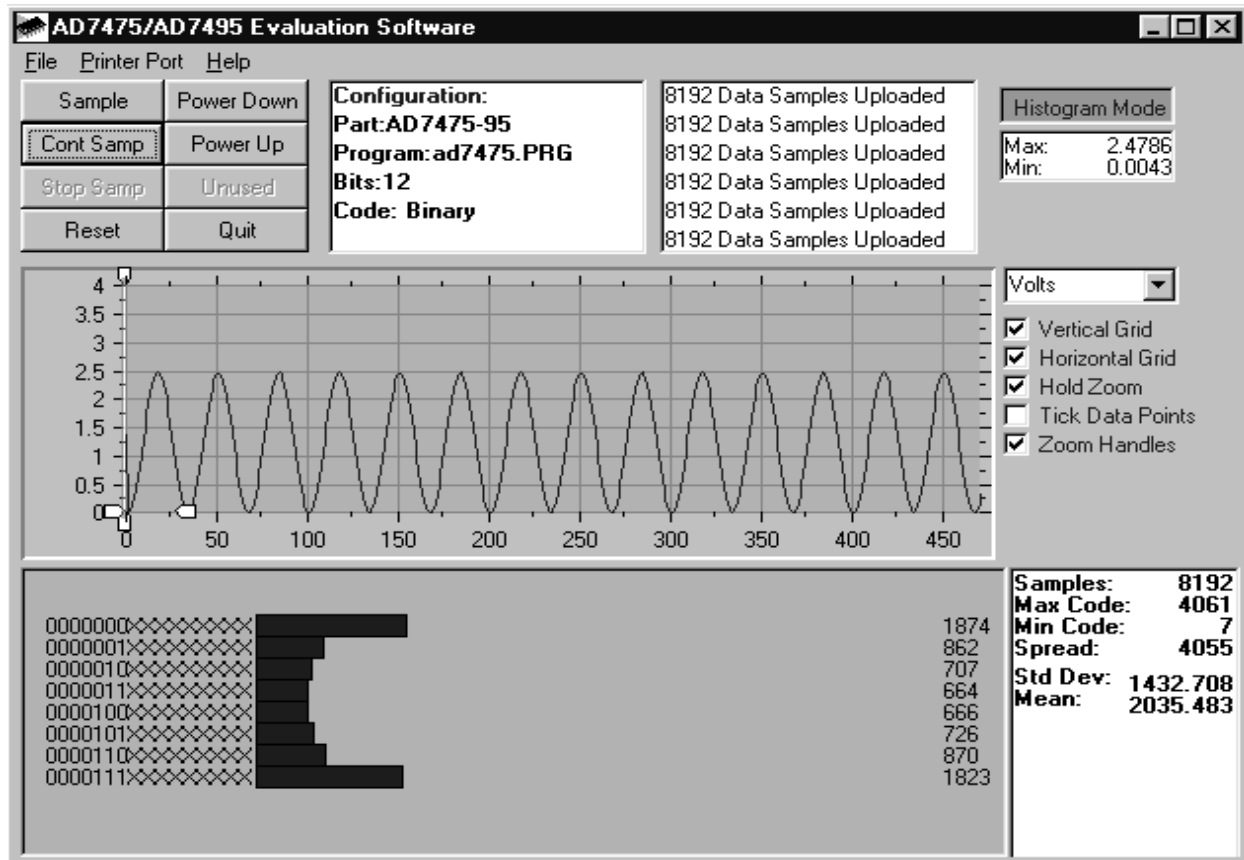


Figure 3 AD7898 Main Screen - Histogram Mode

Setup Screen

The Setup Screen is responsible for allowing the user to load the AD7475/AD7495 configuration file for the evaluation board. The configuration file will give the software detailed information about the AD7475/AD7495 evaluation board and part connected to the Evaluation Board Controller such as number of bits, maximum sampling rate, power supply requirements etc. The AD7475/AD7495 configuration file also tells the software the name of the DSP program file which it should download to the Evaluation Board Controller. These files are supplied by Analog Devices with the evaluation board. Figure 4 shows the Setup Screen.

SETTING UP THE EVALUATION BOARD CONTROLLER

The following text describes how the evaluation board Evaluation Board Controller and how AD7475/AD7495 software should be set up for the user to begin using the complete system. The Evaluation Board Controller and AD7475/AD7495 evaluation board should be connected together (via the 96 way connector). The power should be applied to the Evaluation Board Controller. At this stage the red LED should be flashing which indicates that the Evaluation Board Controller is functional and ready to receive instructions. The AD7475/AD7495 software which should have been installed should be loaded before the printer port cable is connected between the Evaluation Board Controller and the PC. This will ensure that the printer port has been initialized properly. The printer port cable can then be

connected between the PC and the Evaluation Board Controller.

Running the AD7475/AD7495 Software

With the hardware setup the user is now in a position to use the software to control the Evaluation Board Controller and evaluation board. In the software the user should select the **File** menu and click on **Setup**. This will display the setup form. A window on the left of the setup form list all the available configuration files. The configuration files are text based files which contain information about the particular evaluation board to be tested - AD7475/AD7495.cfg. The information will cover such things as the part name, number of samples to be taken, default and maximum sampling frequency power supply settings etc. The configuration file also contains the name of the DSP program file which is to be downloaded to the Evaluation Board Controller. The user should select the AD7475.cfg configuration file and click **Load**. The AD7475.cfg file will work for both the AD7475 and the AD7495. The Evaluation Board Controller will be reset and the DSP program will be downloaded. When the download has been completed the power supply settings indicated in the configuration file are set and the user may hear some of the relays clicking. The pull-down menus items such as number of samples and sampling frequency will have been set to the default values specified by the configuration file. The user is free to change these at will. Once all the settings had been decided the user can click **Close** to return to the main form.

EVAL-AD7475/AD7495CB

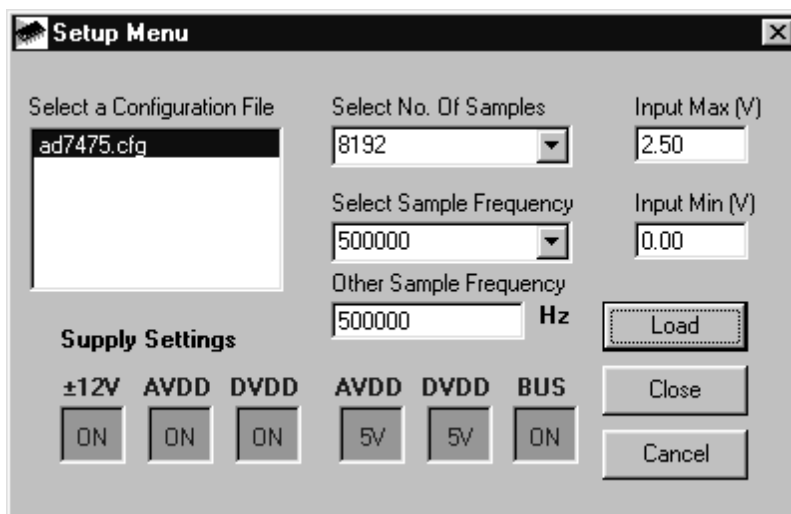


Figure 4. The Setup Screen

Taking Samples

When the user clicks **Sample** the software will instruct the Evaluation Board Controller to take the required number of samples at the required frequency from the evaluation board. These samples are then uploaded and displayed. An FFT and Histogram are also calculated and displayed. If the user clicks **Cont Samp** the software will repeat the process indefinitely until the user clicks the button again. While the software is continuously sampling data the other control buttons are disabled.

Other Buttons

The **Reset** button will cause the Evaluation Board Controller to perform a reset function. When this happens the power supplies are turned off and the program in DSP memory is lost. The user should repeat the setup instructions to download another program if required.

The **Quit** button will exit the software, the program running on the Evaluation Board Controller is not terminated.

MENU BAR ITEMS

The main screen of the Evaluation Board Controller contains a number of options available as pull-down menu items. The functions of these are listed below.

File Menu:

Setup Menu: Selecting this option displays the Setup Screen as shown in Figure 4.

Load Raw Data: Selecting this option allows the user to load data which had been saved by the software during a previous session.

Save Raw Data: Selecting this option allows the user to save the current set of sample data points. The data can be reloaded to the Evaluation Board Controller software at a later date or can be used by other programs for further analysis

Save Binary Data: Selecting this option allows the user 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, looking for stuck bits etc.

Save FFT Data: Selecting this option allows the user to save the current set of FFT data points. FFT data cannot be reloaded into the Evaluation Board Controller software but can be loaded into other software packages for further analysis.

Exit: Quits the program.

Printer Port:

This menu item allows the user to select which printer port should be used for communication with the Evaluation Board Controller.

LPT1: This option selects 0x378 as the printer port address. This is the default option.

LPT2: This option selects 0x278 as the printer port address.

PRN: This option selects 0x3BC as the printer port address.

Help:

This menu item gives information about the current revision of software for the particular evaluation board being used.

SOFTWARE CONFIGURATION FILES

Software Configuration Files give the Evaluation Board Controller software information on how the software and hardware should perform . They contain information such as the name of the DSP program to download, the default and maximum sample frequencies, the number of samples to take and the power supply settings to use. A typical Software Configuration File (*.cfg) is shown in Listing 1.

```
[EVAL-CONTROL BOARD]
partname:AD7475
programname:ad7475.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
```

EVAL-AD7475/AD7495CB

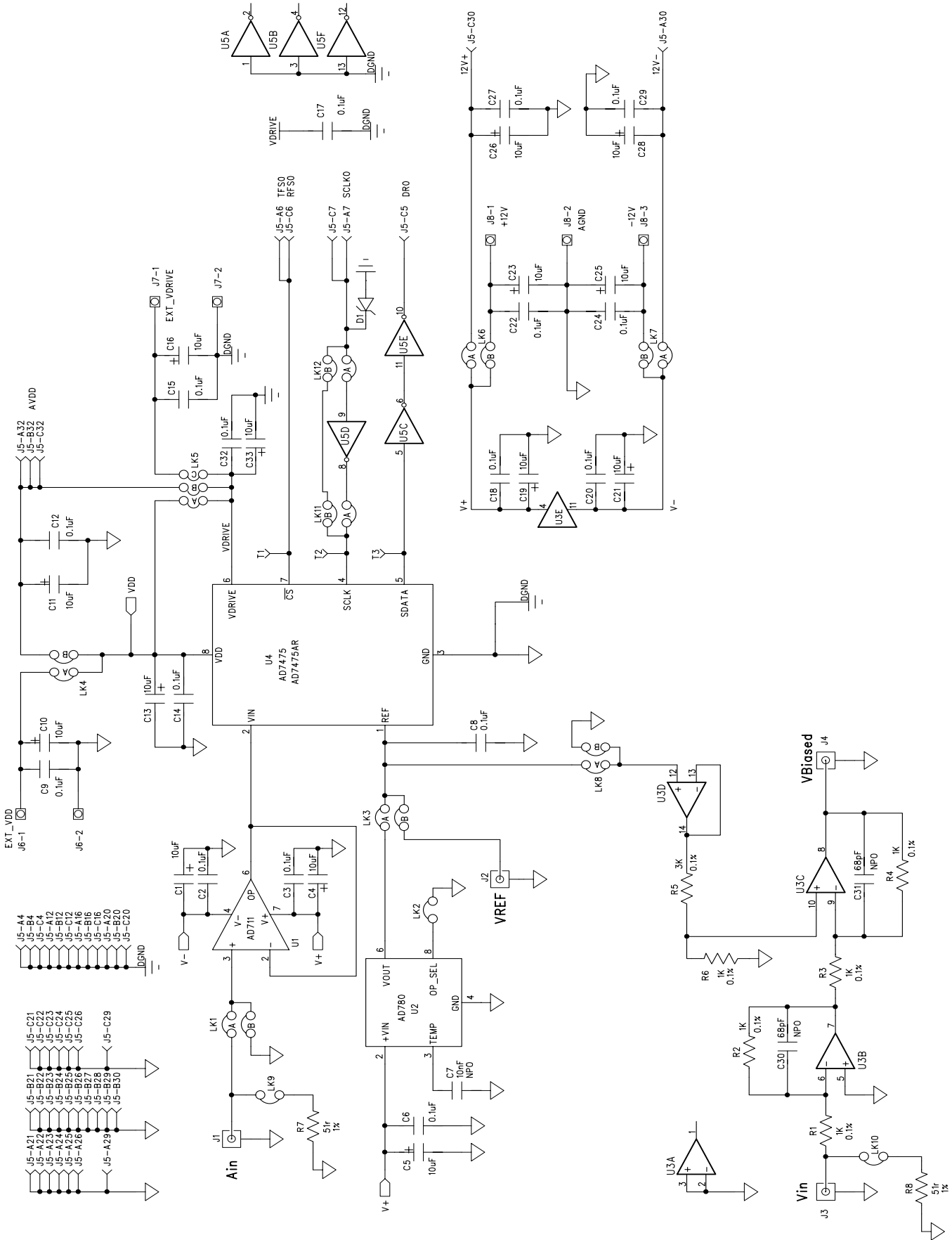


Figure 4. AD7475/95 Evaluation Board Circuit Diagram

EVAL-AD7475/AD7495CB

Qty	Reference Designator	Description/Value	Manuf. No.	Supplier No.
14	C1 C4 C5 C10 C11 C13 C16 C19 C21 C23 C25 C26 C28 C33	10uF 35V Tant.	TAP10K35CCSY	FEC 664-881
15	C2 C3 C6 C9 C12 C14 C15 C17 C18 C20 C22 C24 C27 C29 C32	0.1uF Ceramic 50 V	MCDR25104X7RK0050	FEC 750-920
1	C7	0.01uF Ceramic 50 V	MCDR25103X7RK0050	FEC 750-890
1	C8	0.22uF Ceramic 50 V	MCDR50224X7RK0050	FEC 750-967
1	C8	0.1uF Ceramic 50 V	MCDR50104X7RK0050	FEC 750-955
2	C30 C31	68pF Ceramic	MR051A680JT0001	FEC 669-714
5	R1 R2 R3 R4 R6	1K 0.25W 0.1% RC55	Welwyn	FEC 339-179
1	R5	3K 0.25W 0.1% RC55	Welwyn	FEC 339-635
2	R7 R8	51 \bar{w} 0.25W 1%	Multicomp	FEC 543-070
1	D1	SD103C Schottky Diode	DO35	
1	U1	AD711KN Op-Amp	ADI AD711KN	ADI
1	U2	AD780AN Voltage Reference	ADI AD780AN	ADI
1	U3	ADOP467G	ADI ADOP467G	ADI
1	U4	AD7495AR	SO8NB	ADI
1	U5	74LS04N	DM74LS04N	FEC 373-450
3	J1 J2 J3 J4	50 \bar{w} Gold Plated PCB SMB JackM/ACOM		FEC 310-682
1	J5	DIN41612 C96 900 plug	Siemens	FEC 104-986
2	J6 J7	2 Pin Power Connector	Lumberg KRM2	FEC 151-785
1	J8	3 PIN Power Connector	Lumberg KRM3	FEC 151-786
8	LK1 LK3 LK4 LK6-LK8 LK11 LK12	2x2 Way Jumper	Harwin	FEC 511-791
3	LK2 LK9 LK10	2 Way Jumper	Harwin	FEC 511-705
1	LK5	2x3 way jumper	Harwin	FEC 511-780
3	T1 T2 T3	Black Testpoint	W Huges	FEC 240-333
2	U1 U2 U3 U5	Ultra low profile socket strip	Harwin	FEC 519-959
4	Each corner	Stick on feet	3M	FEC 651-813
1	EVAL-AD7495CB	P.C.B.		

Figure 4. AD7475/95CB Bill of Materials

EVAL-AD7475/AD7495CB

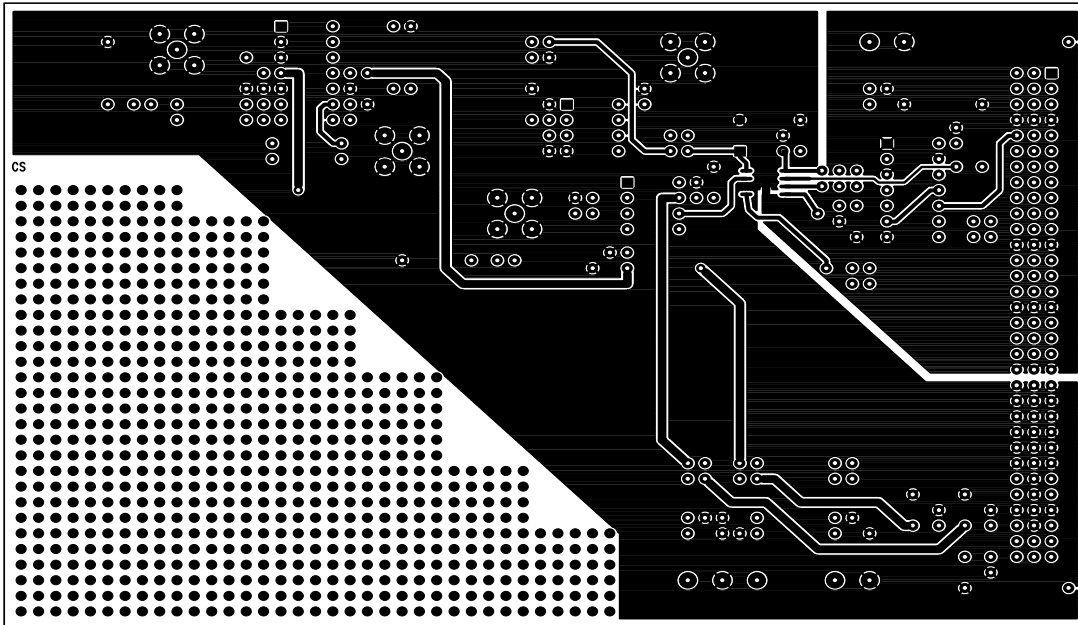


Figure 5. Component Side Artwork

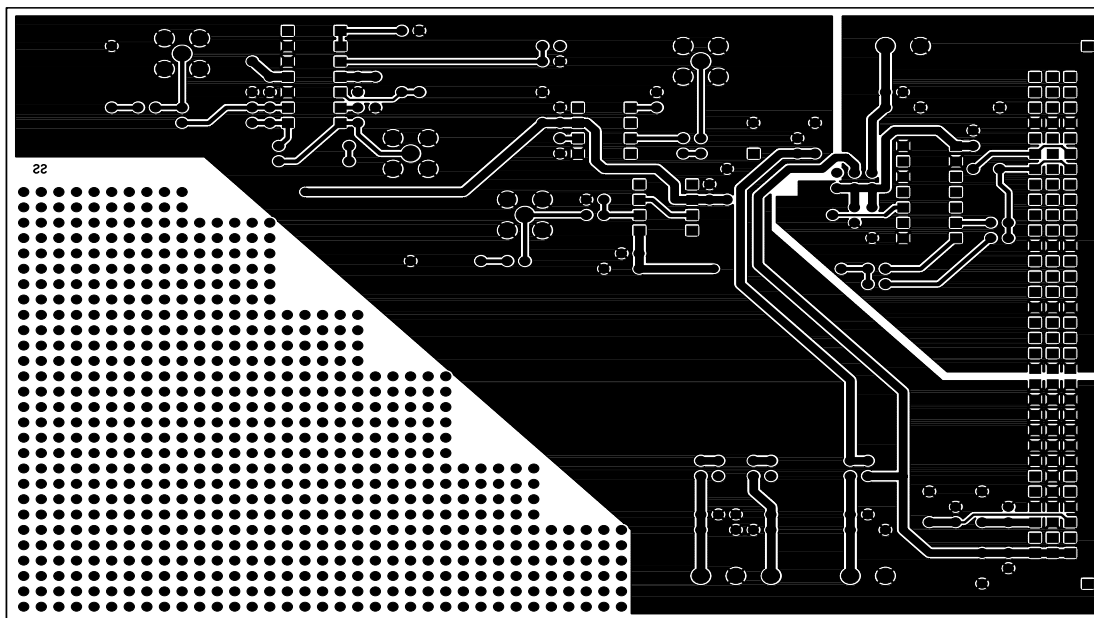


Figure 6. Solder Side Artwork

EVAL-AD7475/AD7495CB

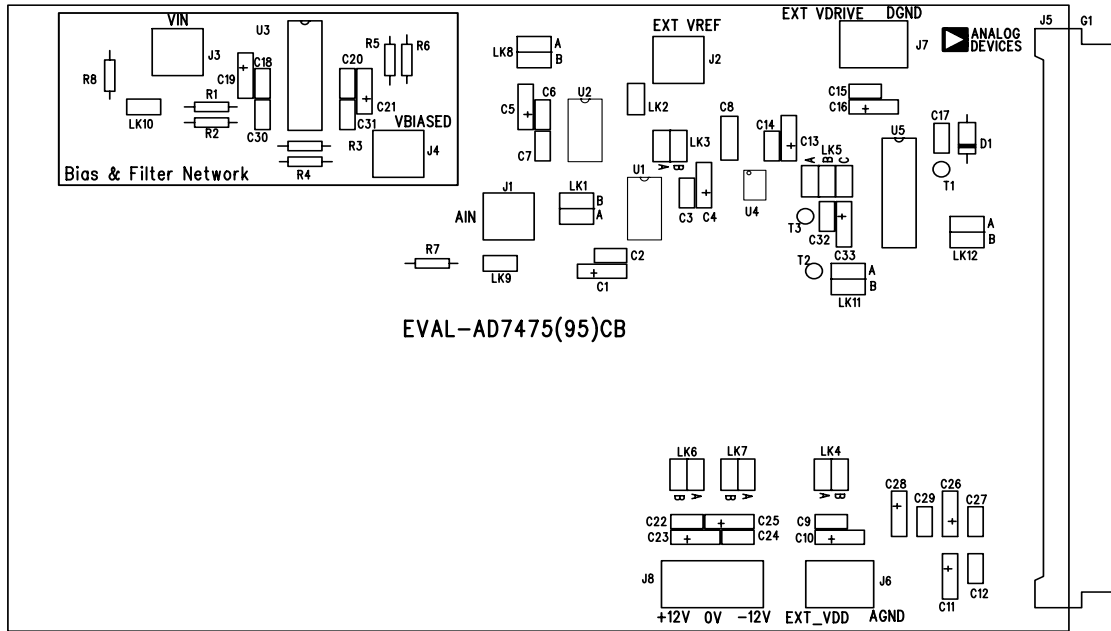


Figure 7. AD7475/AD7495 Evaluation Board Component Placement Drawing.