ANALOG DEVICES

Evaluation Board 400kSPS, 14-Bit ADC
EVAL-AD7899CB

FEATURES
Full-Featured Evaluation Board for the AD7899
Eval-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 Eval-Board Controller

INTRODUCTION
This Technical Note describes the evaluation board for the AD7899 high speed, low power, 14-bit A/D converter that operates from a single 5 V supply. Full data on the AD7899 is available in the AD7899 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 +2.5V ultra high precision bandgap reference and an op-amp for the analog inputs. 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 EVAL-BOARD CONTROLLER which is also available from Analog Devices. External sockets are provided for the optional, external, $\overline{\text{CONVST}}$ and CLKIN and V_{DRIVE} inputs and the VIN1-VIN4 inputs.

## OPERATING THE AD7899 EVALUATION BOARD

Power Supplies
When using this evaluation board with the EVAL-BOARD CONTROLLER all supplies are provided from the EVAL-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 seven power supply inputs: V_{DD}, A_{GND}, +12V, -12V, A_{GND}, V_{DRIVE} 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 AD7899 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 10µF tantalum and 0.1µF 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 10µF tantalum and a 0.1µF ceramic capacitor. The AD7899 AV_{DD} supply pin is decoupled to A_{GND} with 47uF tantalum and 0.1µF 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 AD7899.

Fig. 1: FUNCTIONAL BLOCK DIAGRAM
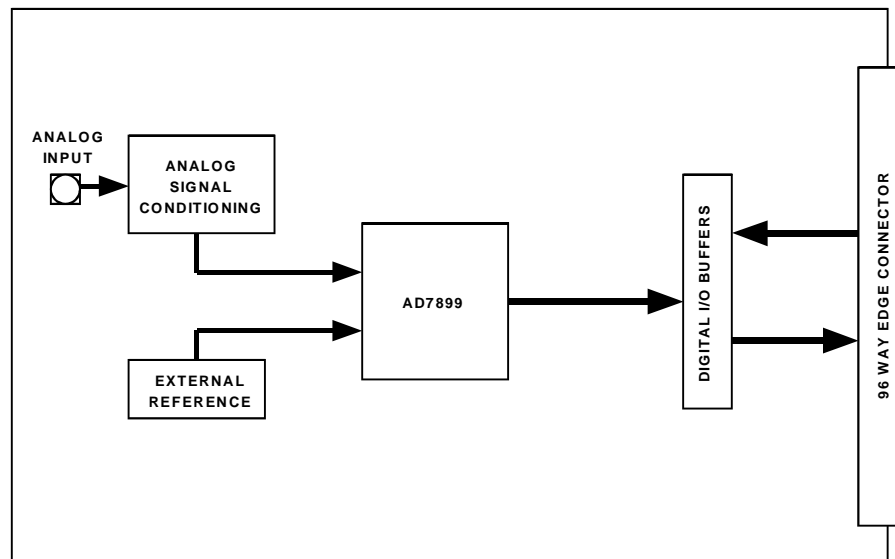
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Link and Switch Options

There are 9 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 option selects the input range of the ADC. The position of this link is determined by the input range required by the user. Please refer to the AD7899 data sheet for more information.
When this link is in position "A" V_{INB} is connected to V_{INA}.
When this link is in position "B" V_{INB} is connected toAGND.

LK2   This link selects the reference source for the AD7899.
When a link is in position "A" the AD780 is selected as the reference source.
When a link is in position "B" an external voltage applied to SK7 is selected as the reference source.
When the link is removed completly the internal reference of the AD7899 is used as the reference source.

LK3   This link selects the source of the +12V supply.
When this link is in position "A" an external +12V must be connected to J2-1.
When this link is in position "B" the EVAL-BOARD CONTROLLER will provide the +12V supply

LK4   This link selects the source of the VDD supply.
When this link is in position "A" an external +5V must be connected to J2-2.
When this link is in position "B" the EVAL-BOARD CONTROLLER will provide the +5V supply

LK5   This link selects the source of the -12V supply.
When this link is in position "A" an external -12V must be connected to J2-4.
When this link is in position "B" the EVAL-BOARD CONTROLLER will provide the -12V supply

LK6   This link selects the source of the V_{DRIVE} supply.

When this link is in position A the VDD supply is used as the V_{DRIVE} supply.
When this link is in position B the DVDD supply of the EVAL-BOARD CONTROLLER is used as the V_{DRIVE} supply.
When this link is in position C an external supply on SK6 is used as the V_{DRIVE} supply.

LK7   This link is used to select the source of the Conversion Start signal.
When this link is in position "A" the CONVST signal is generated by the EVAL-BOARD CONTROLLER.
When this link is in position "B" the CONVST signal is generated by an external signal connected to SK2.

LK8   This link selects the source of the CLKIN signal for the AD7899.
When this link is in position "A" the CLKIN signal is provided by the EVAL-BOARD CONTROLLER.
When this link is in position "B" the CLKIN signal can be provided by a signal applied to SK3. If no signal is applied to SK3 the pin is pulled low and the internal oscillator is is used to control the conversion.

LK9   This link sets the logic level of the STBY pin.
When a link is in position "A" the STBY pin is controlled by the FL1 flag pin of the EVAL-BOARD CONTROLLER.
When a link is in position "B" the STBY pin is tied to VDD and the part is in normal operating mode.
When a link is in position "C" the STBY pin is tied to DGND and the part is in standby mode.

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 shipped. The board is compatible with the EVAL-BOARD CONTROLLER when shipped.

Table I. Initial Link and Switch Positions

Link No.	Position	Function.
LK1	B	The largest voltage range for the part is selected.
LK2	A	The AD780 is selected as the reference source for the AD7899.
LK3-5	B	The EVAL-BOARD CONTROLLER is used to provide the supply voltages for the evaluation board.
LK6	A	The V_{DRIVE} pin is connected to the VDD supply.
LK7	B	The CONVST signal is provided by the EVAL-BOARD CONTROLLER.
LK8	B	The CLKIN can be supplied either by an external signal connected to SK3 or by the AD7899s internal oscillator.
LK9	B	The STBY pin is tied to VDD

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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-BOARD CONTROLLER or other system. The pinout for the J1 connector is shown in Figure 2 and its pin designations are given in Table II.
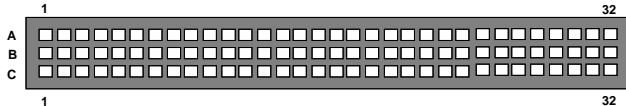
Fig. 2. Pin Configuration for the 96-Way Connector, J1

96-Way Connector Pin Description

FL1   Flag one. This is a logic input and is connected to the $\overline{STBY}$ pin of the AD7899. A logic high on this pin allows normal operation of the AD7899. A logic low on this pin puts the AD7899 into standby mode.

D0-D13   Data Bit 0 to Data Bit 13. Bi-directional data pins. These data bits provide the ADC conversion results during a read operation.

$\overline{RD}$ Read. This is an active low logic input which is used in conjunction with the $\overline{CS}$ pin to enable the data outputs.

$\overline{WR}$ Write. A logic input. A rising edge on this input, with $\underline{CS}$ low and $\underline{RD}$ high latches the logic state on D0-D3 into the channel select register. Software selection of channels is not supported by this evaluation board.

$\overline{CS}$ Chip Select. An active low logic input. A low level on this input selects the AD7899.

FL0   Flag zero. This logic input is connected to the $\overline{CONVST}$ input of the AD7899 via LK7. A low to high transition on this input puts all the track/holds into their hold mode and starts conversion on the selected channels. In addition the state of the channel sequence selection is also latched on the rising edge of this input

$\overline{IRQ2}$ Interrupt Request 2. This is a logic output and is connected to the BUSY logic output on the AD7899. This output will go high on the rising edge of $\overline{CONVST}$ and will return low when conversion is completed on all selected channels.

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 V_{DD} supply line on the board via LK4.

+12V   +12V Supply. This line is connected to the +12V supply line on the board via LK3.

-12V   -12V Supply. This line is connected to the -12V supply line on the board via LK5.

Table II. 96-Way Connector Pin Functions.

	ROW a	RowB	RowC
1		FL1	
2		D0	
3	SCLK1	D1	SCLK1
4	DGND	DGND	DGND
5		D2	
6		D3	
7		D4	
8			
9	$\overline{RD}$	D5	$\overline{WR}$
10		D6	$\overline{CS}$
11		D7	
12	DGND	DGND	DGND
13		D8	
14		D9	
15		D10	
16	DGND	DGND	DGND
17	FL0	D11	$\overline{IRQ2}$
18	D12	D13	
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.

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SOCKETS

There are six input sockets relevant to the operation of the AD7899 on this evaluation board. The function of these sockets is outlined in Table III.

Table III. Socket Functions

Socket	Function
SK1	Sub-Miniature BNC Socket for the analog input.
SK2	Sub-Miniature BNC Socket for the external reference
SK3	Sub-Miniature BNC Socket for external V_{DRIVE} supply.
SK4	Sub-Miniature BNC Socket for BUSY output.
SK5	Sub-Miniature BNC Socket for external $\overline{CONVST}$ input.
SK6	Sub-Miniature BNC Socket for the external CLKIN input.

CONNECTORS

There are two connectors on the AD7899 evaluation board as outlined in Table IV.

Table IV. Connector Functions

Connector	Function
J1	96-Way Connector for Parallel Interface connections.
J2	External +12V, -12V +5V & A_{GND} 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 EVAL-BOARD CONTROLLER. The EVAL-BOARD CONTROLLER is available from Analog Devices under the order entry "EVAL-BOARD CONTROLLER". When operated with this control board, all supplies and control signals to operate the AD7899 are provided by the EVAL-BOARD CONTROLLER. Software to communicate with the Control Board and AD7899 is provided with the AD7899 evaluation board package. This EVAL-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-AD7899CB plugs directly into the 96-way connector on the EVAL-BOARD CONTROLLER. The EVAL-BOARD CONTROLLER provides all the supplies for the evaluation board. It is powered from a 12VAV 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 for other suppliers including Digikey (U.S.) and Campbell Collins (U.K.).

Connection between the EVAL-BOARD CONTROLLER and the serial port of a PC is via a standard Centronics printer port cable which is provided as part the EVAL-BOARD CONTROLLER package. Please refer to the manual which accompanies the EVAL-BOARD CONTROLLER for more details on the EVAL-BOARD CONTROLLER package.
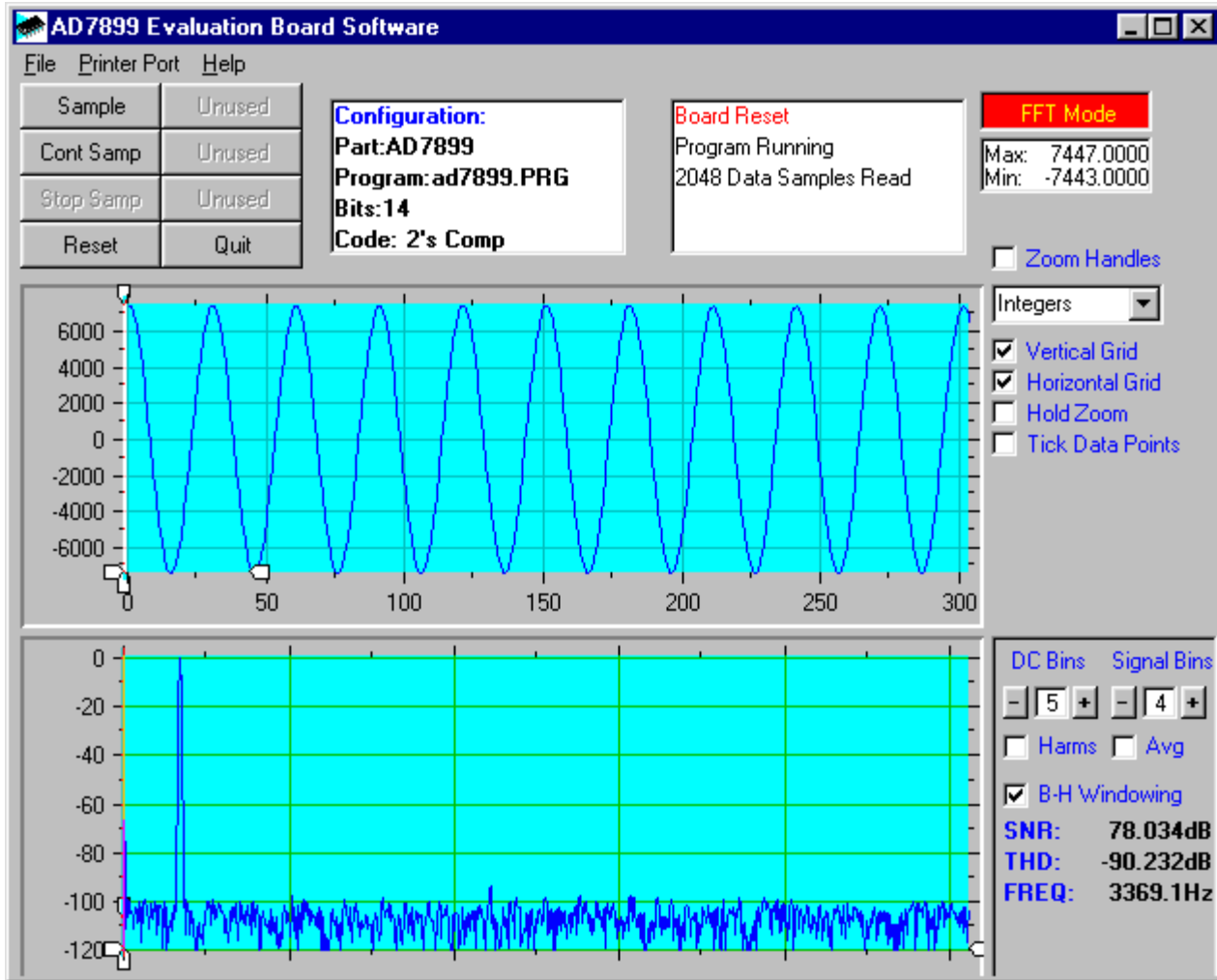
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Figure 2. AD7899 Main Screen

SOFTWARE DESCRIPTION

The software which controls the Evaluation Board Controller and hence the evaluation board has three main screens. The screen shown in Figure 1 shows the screen which appears when the software is run. The main function of this 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 third of the screen contains the control buttons, the menu bar and various status windows. The control buttons allow the user to enter the setup menu, take samples and get information about the software. 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 windows indicate the setup of the evaluation board/device, number of samples taken and any information/error messages that are generated.

The middle third of the 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 either as integer values or as voltages (determined by the input range of the device in question). Once samples have been displayed clicking at any point in the graph will display the sample number and 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 is taken the graph will attempt to display all values collected unless the **Hold Zoom** check box is ticked. In this case the graph will keep the same axis settings as for the previous set of data samples. Additional check boxes are provided to give the user control over the vertical and horizontal grids and data points.

The lower third of the screen will show either a Fast Fourier Transform (FFT) of the data or a Histogram which shows the number of occurrances of each particular code read back. The FFT (the default option) is typically used when the user is concerned with examining an ADC's performance in the frequency domain while the Histogram will give an indication of the ADC's performance to DC signals. The option displayed can be toggled by clicking on the FFT Mode/Histogram Mode button in the top right of the screen. Figure 3 shows how the main screen looks when the Histogram Option is selected.
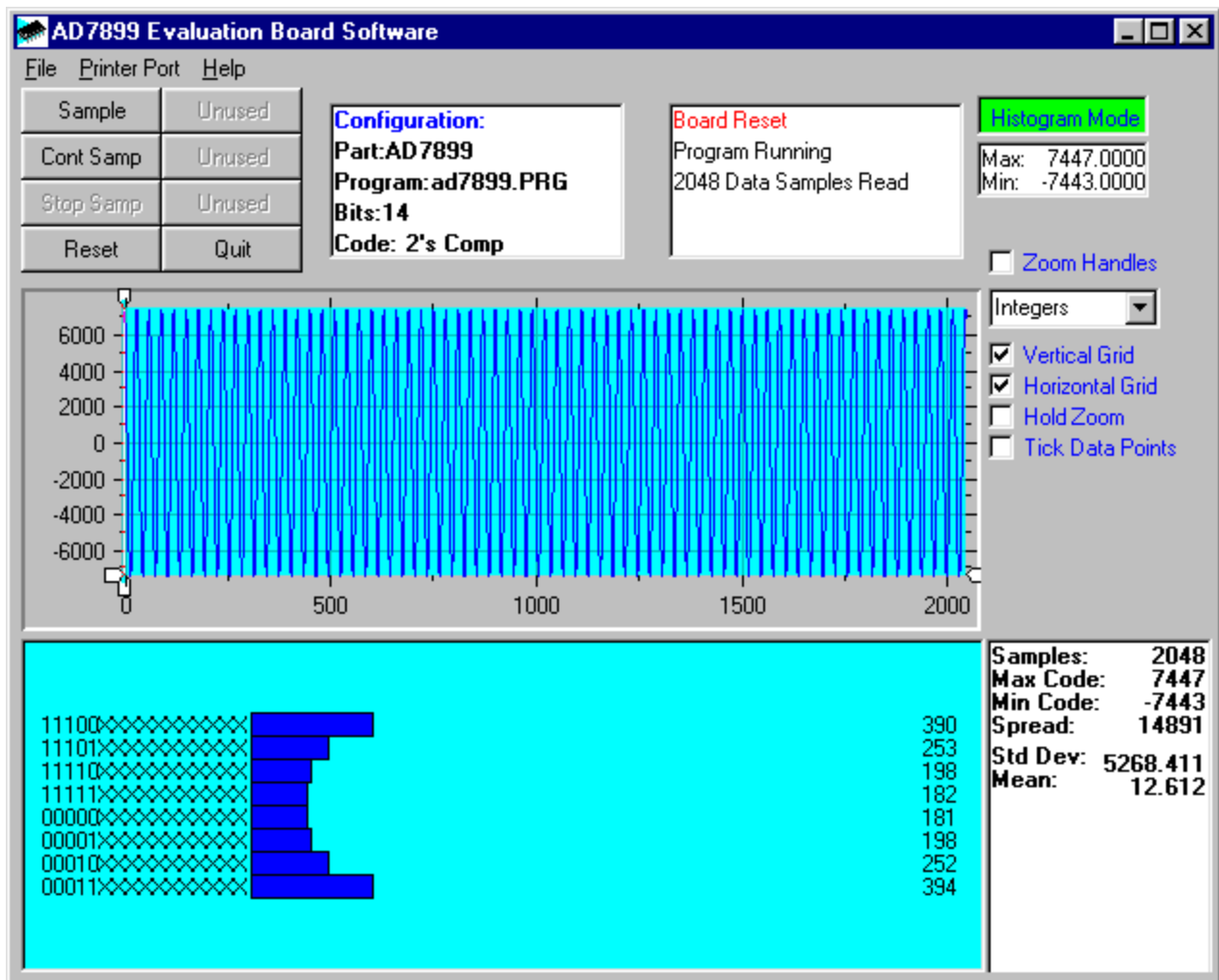
Figure 3. AD7899 Main Screen - Histogram Mode

Setup Screen
The Setup Screen is responsible for allowing the user to load a configuration file for the evaluation board. The configuration file will give the software detailed information about the evaluation board and part connected to the Evaluation Board Controller such as number of bits, maximum sampling rate, power supply requirements etc. The 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 software should be set up for the user to begin using the complete system. The Evaluation Board Controller and 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 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 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. 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 relevant
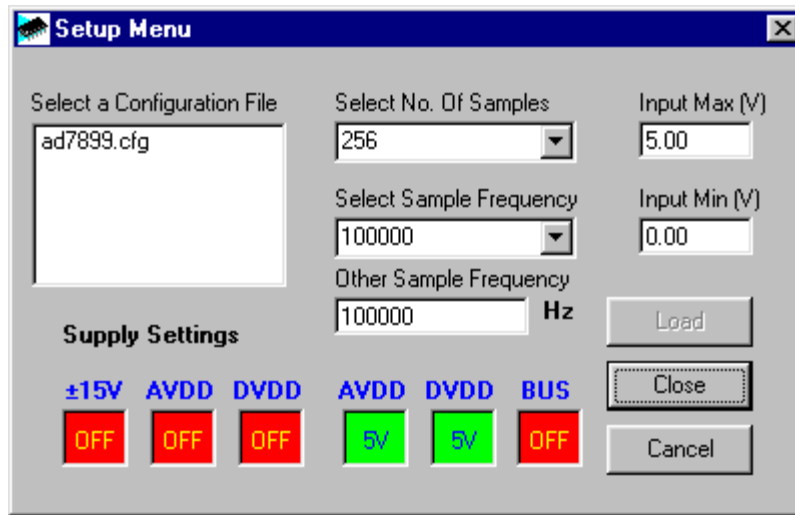
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Figure 4. The Setup Screen

configuration file and click **Load**. 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.

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 3.

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.

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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 Table V.

Table V.: Typical Software Configuration File.

[EVAL-CONTROL BOARD]

partname:AD7899

programname:ad7899.PRG

samplefrequency:100000

maxsamplefrequency:380000

samples:2048

+/-15V:on

dvdd:5:on

avdd:5:on

bus:on

;options 2scomp, binary

dataformat:2scomp

numberofbits:14

inputVmax:2.5

inputVmin:-2.5

Table VI.: Eval-AD7899CB Bill Of Materials.

Item	Qty	RefDes	Description	Manufacturer/Disti	Disti Number
1	6	C1 C4 C5 C7 C9 C12	10uF 16V TAJ_B Tantalum cap	AVX/FEC	FEC 498-737
2	16	C2 C3 C6 C8 C10 C11 C13 C14 C15 C16 C18 C20 C22 C24 C26 C28	100nF 0805 Ceramic Capacitor	AVX/FEC	FEC 499-687
3	6	C17 C19 C21 C23 C25 C27	47uF 16V TAJ_C Tantalum cap	AVX/FEC	FEC 197-32
5	3	C30 C31 C32	22pF 0805 Ceramic Capacitor	AVX/FEC	FEC 317-500
6	2	R1 R2	0w 0.1W 0805 Resistor	Multicomp/FEC	FEC 772-239
7	3	R3 R4 R5	180w 0.1W 0805 Resistor	Multicomp/FEC	FEC 911-768
8	1	R6	10kw 0.1W 0805 Resistor	Multicomp/FEC	FEC 911-975
9	1	J1	DIN41612-96	Harting/FEC	FEC 104-986
10	1	J2	4 pin terminal block	Augat/FEC	FEC 151-787
11	7	LK1 LK2 LK3 LK4 LK5 LK7 LK8	4 pin header (2x2)	Harwin/FEC	FEC 148-535
12	2	LK6 LK9	6 pin header 3x2)	Harwin/FEC	FEC 148-535
13	9	LK1-9	"0.1"" pitch Jumper Socket"	Harwin/FEC	FEC 150-410
14	6	SK1 SK2 SK3 SK4 SK5 SK6	50w SMB socket (vertical)	MACOM/FEC	FEC 310-682
15	1	U1	AD7899AR-1	Analog Devices	ADI Free Issue
16	1	U2	74HC04N	Philips/FEC	FEC 380-362
17	1	U3	AD845KN	Analog Devices	ADI Free Issue
18	1	U4	AD780AN	Analog Devices	ADI Free Issue
19	2	U5 U6	74HC541D	Philips/FEC	FEC 492-607
20	1	U1	28 pin SOIC Socket	Yamaichi/Radiatron	IC179-28375-300
21	1	U2	14 pin DIP solder socket	Harwin/FEC	FEC 738-529
22	16	U3 U4	Ultra low profile sockets	Harwin/FEC	FEC 519-935
23	4		Rubber stick-on feet	3M/FEC	FEC 148-922

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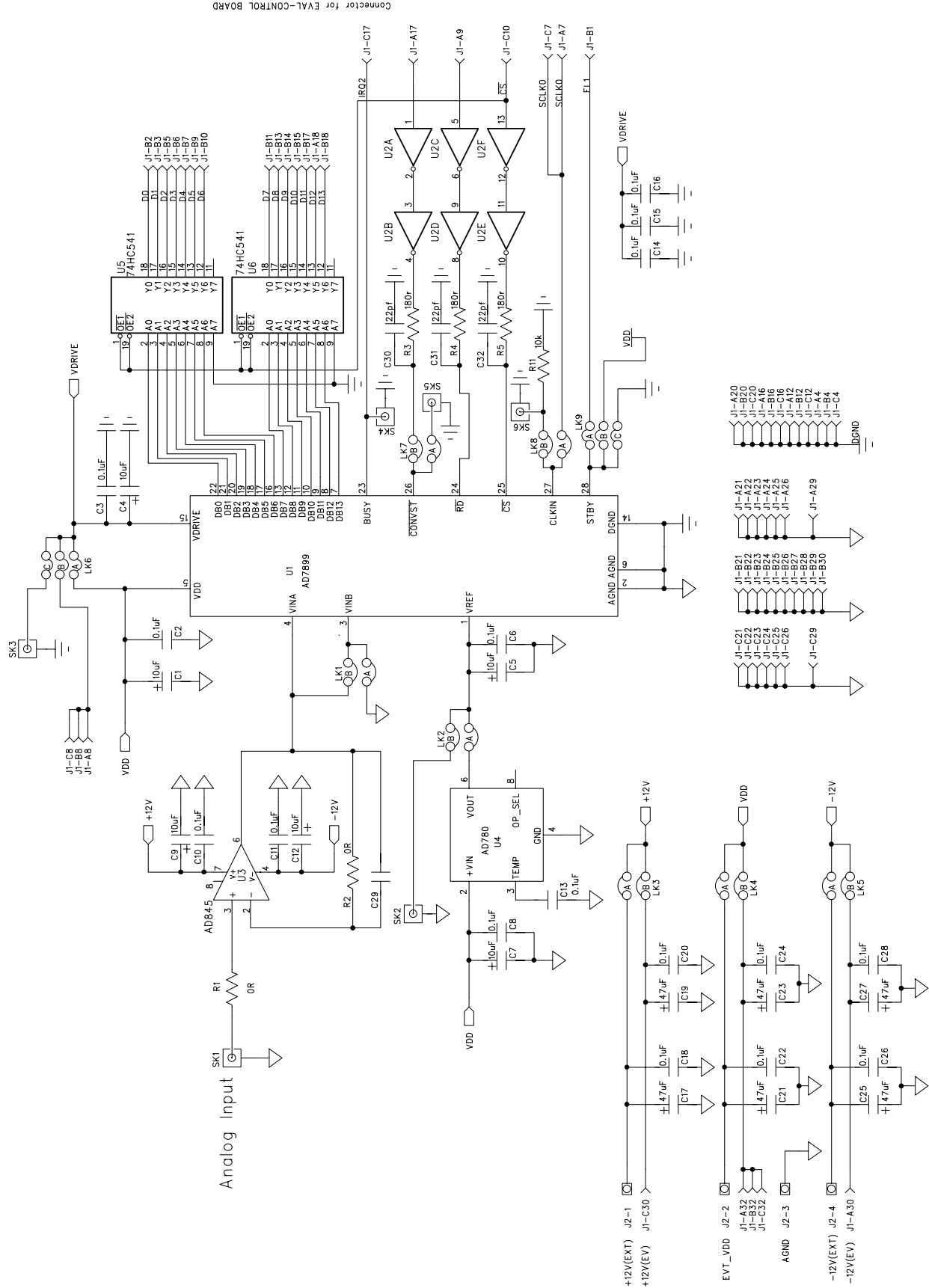
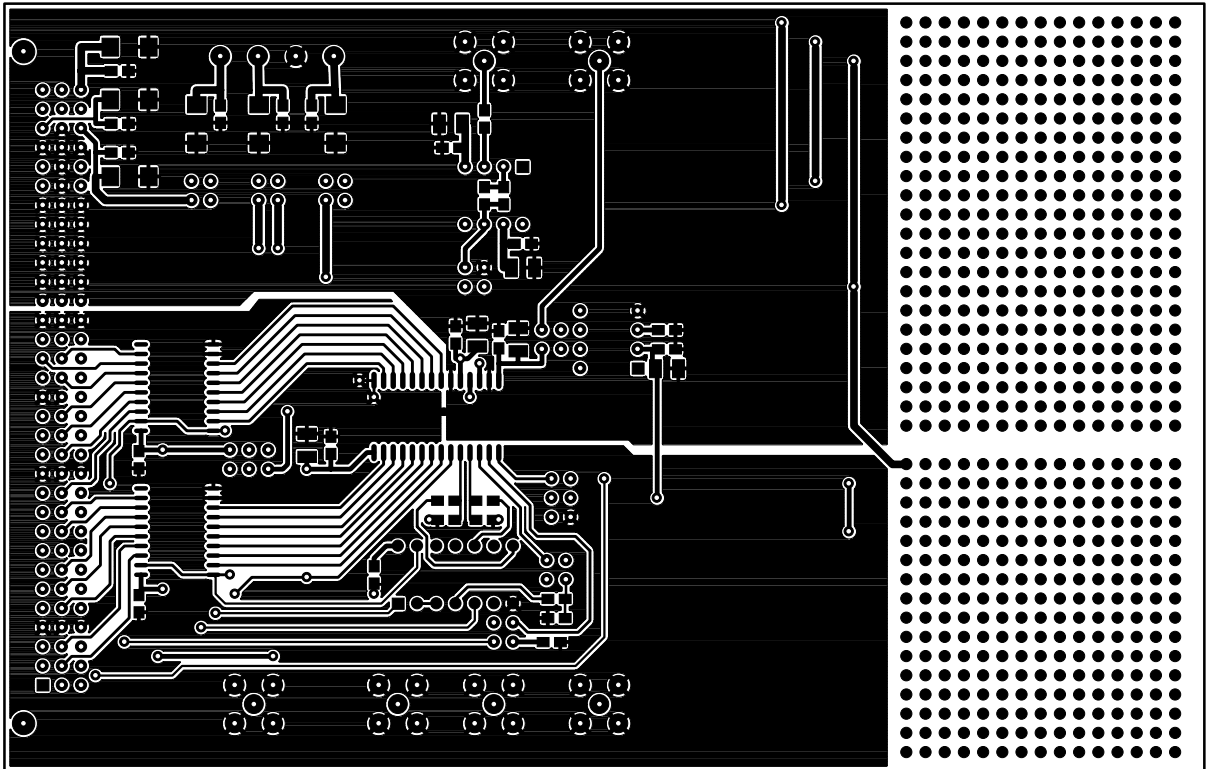*Figure 5. AD7899 Evaluation Board Circuit Diagram.*
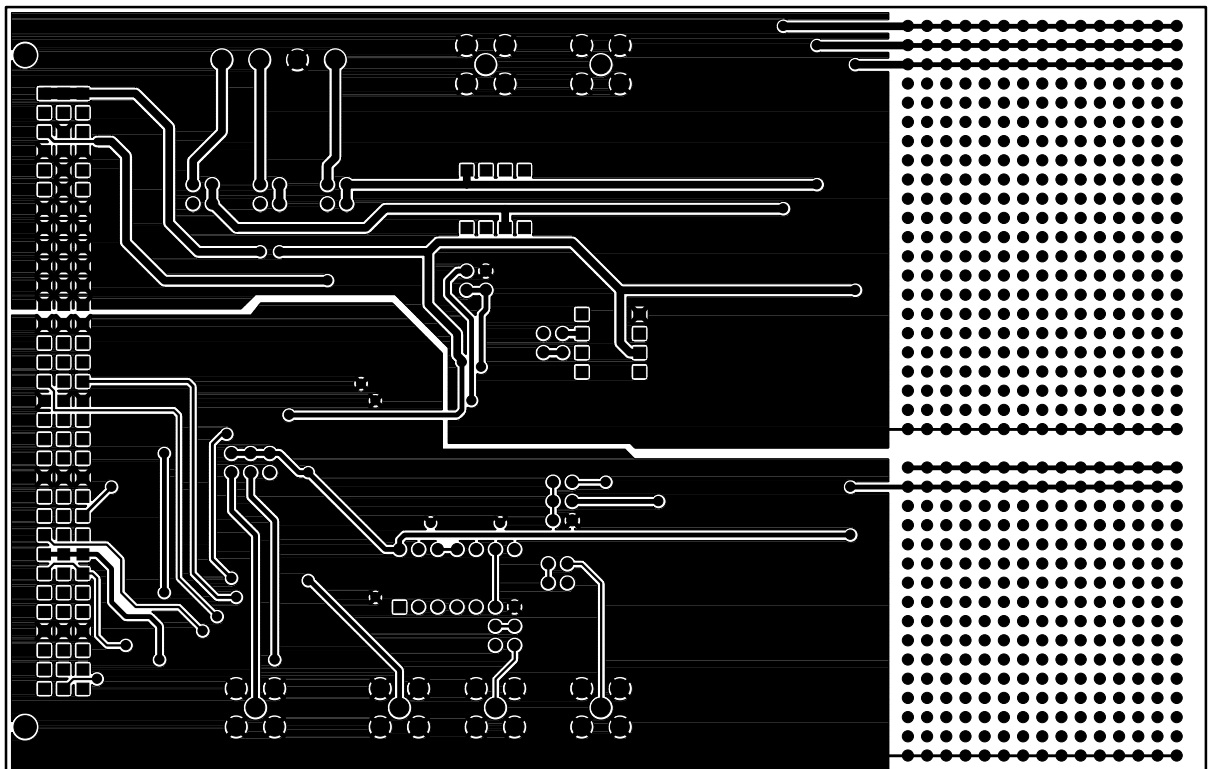
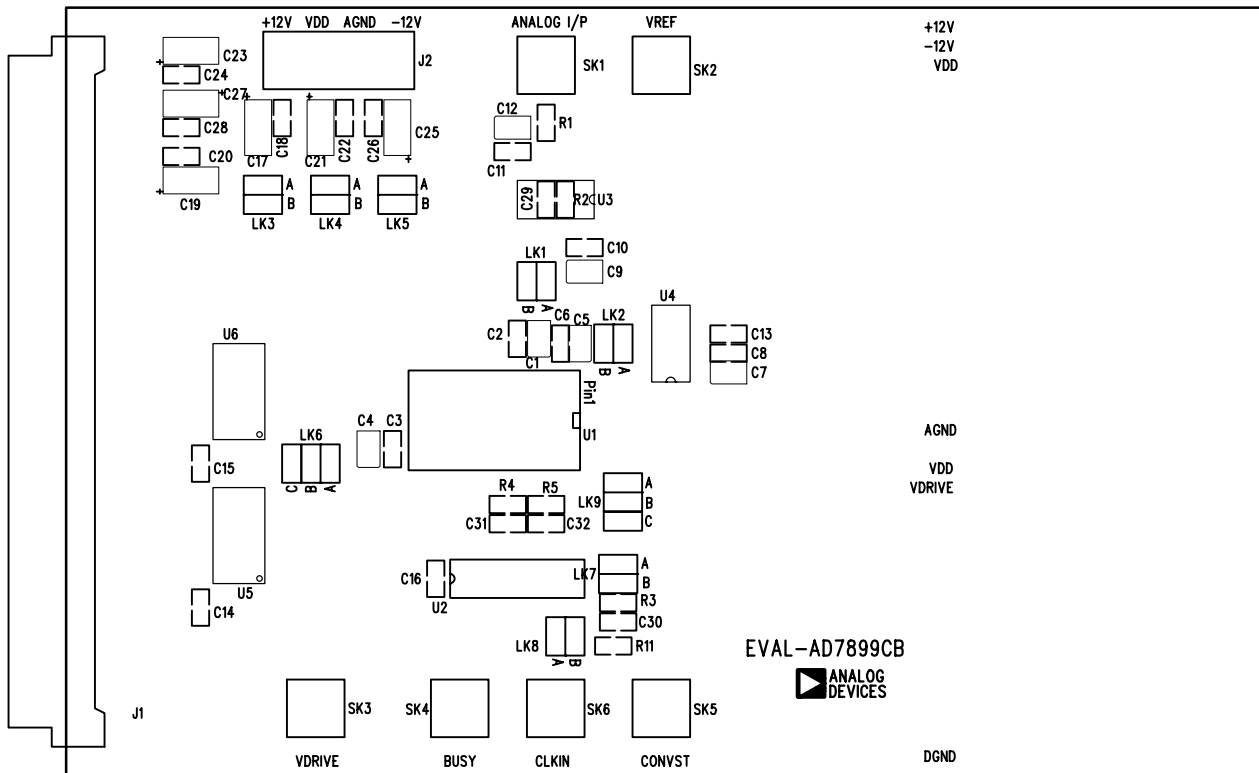Figure 6. Component Side Artwork.

Figure 7. Solder Side Artwork.

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Figure 8. Component Side Silkscreen Artwork.

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