



# Evaluation Board for 5V, 12-Bit, Serial 220kSPS ADC in 8-Pin Package

## EVAL-AD7898CB

### FEATURES

Full-Featured Evaluation Board for the AD7898  
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 AD7898 which is a fast 12-bit ADC that operates from a single +5 V supply and is housed in an 8-pin SOIC. Full data on the AD7898 is available in the AD7898 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  $\overline{CS}/\overline{CONVST}$  input, VDRIVE input, SDATA input, SCLK input, REFIN input and the VIN input.

### OPERATING THE AD7898 EVALUATION BOARD

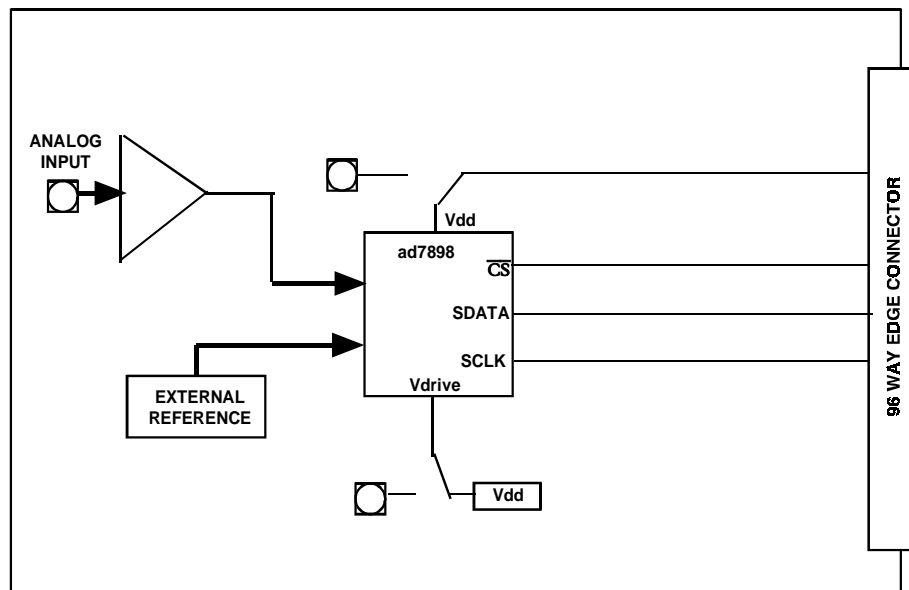
#### Power Supplies

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 seven power supply inputs:  $V_{DD}$ ,  $A_{GND}$ , +12V, -12V,  $A_{GND}$ , and  $V_{DRIVE}$ . If the evaluation board is used in stand-alone mode +5V must be connected to the  $V_{DD}$  input to supply the AD7898  $V_{DD}$  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 $\mu$ F tantalum and 0.1 $\mu$ 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 $\mu$ F tantalum and a 0.1 $\mu$ F ceramic capacitor. The AD7898  $AV_{DD}$  supply pin is decoupled to  $A_{GND}$  with 10  $\mu$ F tantalum and 0.1 $\mu$ 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 AD7898.

FUNCTIONAL BLOCK DIAGRAM



REV. 0

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# EVAL-AD7898CB

## LINK AND SWITCH OPTIONS

There are 11 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 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.
LK2	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 VIN 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.
LK3	This link is used to select the source of the reference voltage applied to the AD7898 REFIN pin. When this link is in position "A", the AD780 provides the 2.5V reference to the AD7898. When this link is in position "B" an external reference must be supplied via J5.
LK4	This link selects the source of the $V_{DD} +5V$ supply. When this link is in position "A" the +5V is supplied from the EVALUATION-BOARD CONTROLLER. When this link is in position "B" the +5V must be supplied from an external source via J2.
LK5	This link option selects the source of the $\overline{CS/CONVST}$ input. When this link is in position "A" the $\overline{CS/CONVST}$ input is provided by the EVALUATION-BOARD CONTROLLER. When this link is in position "B" the $\overline{CS/CONVST}$ input is provided via the external socket, J6.
LK6	This link option selects the source of the $\overline{VDRIVE}$ input. When this link is in position "A" the $\overline{VDRIVE}$ supply voltage is provided from VDD. When this link is in position "B" an external VDRIVE supply voltage must be supplied via J7.
LK7	This link link option selects the source of the SCLK input. When this link is in position "A" the SCLK input is provided by the EVALUATION-BOARD CONTROLLER. When this link is in position "B" the SCLK input is provided via the external socket, J9.
LK8	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, J3.
LK9	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, J3.
LK10 LK11	These two link options are used to add an inverter to the SCLK path. 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. "B" 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	Removed	50Ω termination is not selected.
LK2	A	Vin Jack, J4 is tied to the input of the AD711 buffer op-amp.
LK3	A	The on-board AD780 voltage reference supplies the REFIN pin of the AD7898.
LK4	A	V <sub>DD</sub> (+5V) supplied by the EVALUATION-BOARD CONTROLLER via J1.
LK5	A	$\overline{\text{CS/CONVST}}$ is supplied from the EVALUATION-BOARD CONTROLLER via J1.
LK6	A	VDRIVE pin of the AD7898 is connected to V <sub>DD</sub> (+5V)
LK7	A	SCLK input is supplied from the EVALUATION-BOARD CONTROLLER via J1.
LK8	A	+12V supplied from EVALUATION-BOARD CONTROLLER via J1.
LK9	A	-12V supplied from EVALUATION-BOARD CONTROLLER via J1.
LK10 LK11	B & B	SCLK generated by the EVALUATION-BOARD CONTROLLER is not inverted.

# EVAL-AD7898CB

## 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 EVALUATION-BOARD CONTROLLER or other systems. The pinout for the J1 connector is shown in Figure 1 and its pin designations are given in Table II.

It is important to note that **the evaluation board is set-up for Mode 1 operation only**. This means that the  $\overline{\text{CONVST}}/\overline{\text{CS}}$  will always be  $\overline{\text{CS}}$  ( see AD7898 datasheet - modes of operation section).

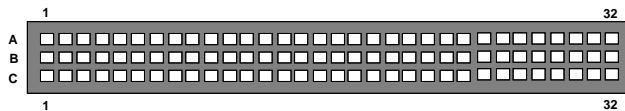


Figure 1. Pin Configuration for the 96-Way Connector, J1

## 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 $\overline{\text{CS}}/\overline{\text{CONVST}}$ 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 <sub>DD</sub>	Analog +5V Supply. These lines are connected to the AV <sub>DD</sub> 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 AD7898 on this evaluation board. The function of these connectors is outlined in Table III.

**Table III. Connector Functions**

Connector	Function
J1	96-Way Connector for Serial Interface & Power Supply connections.
J2	External $V_{DD}$ & GND power connector.
J3	External +12V, -12V & AGND power connector
J4	Sub-Miniature BNC socket for $V_{in}$ input.
J5	Sub-Miniature BNC socket for optional Refin input.
J6	Sub-Miniature BNC socket for optional $\overline{CS}/\overline{CONVST}$ input.
J7	Sub-Miniature BNC socket for optional external VDrive input.
J8	Sub-Miniature BNC socket for optional SData output.
J9	Sub-Miniature BNC socket for optional SCLK input.

**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 AD7898 software which is provided with the AD7898 evaluation board package (mode 1 operation only). 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-AD7898CB plugs directly into the 96-way connector on the EVALUATION-BOARD CONTROLLER. No power supplies are required in the system. The EVALUATION-BOARD CONTROLLER generates all the required supplies for itself and the EVAL-AD7898CB. 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-AD7898CB

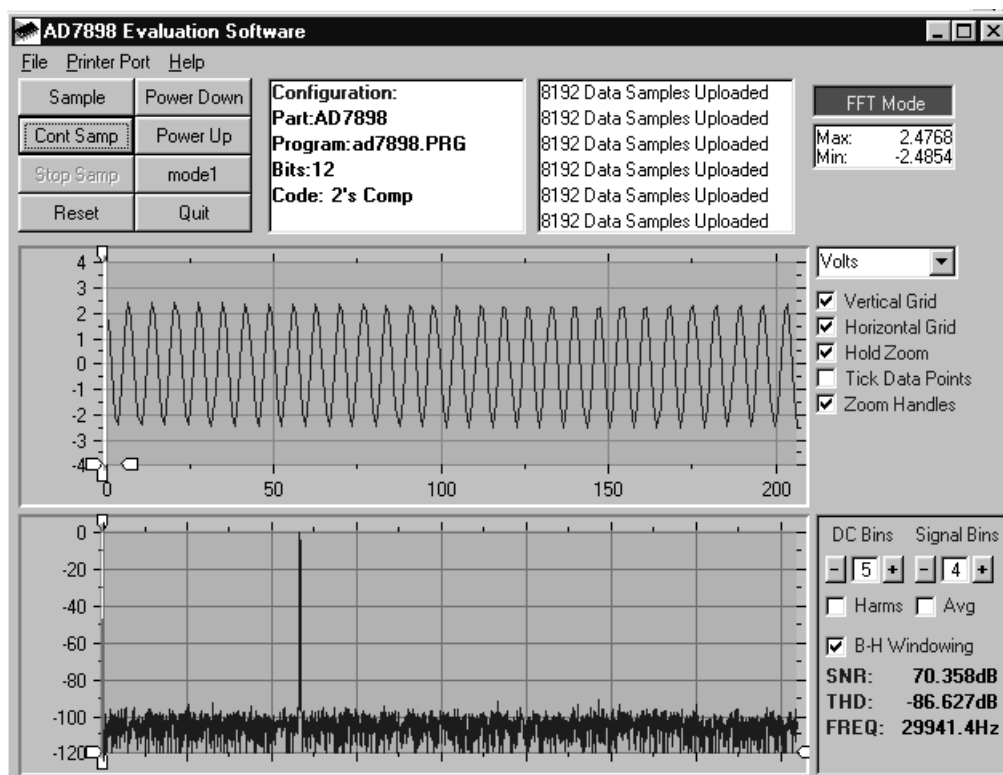


Figure 2. AD7898 Main Screen - FFT Mode

## SOFTWARE DESCRIPTION FOR MODE 1 OPERATION

Included in the EVAL-AD7898CB evaluation board package is a CD ROM which contains software for controlling and evaluating the performance of the AD7898 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 AD7898 evaluation board as well as the datasheet for the AD7898. All literature on the CD is in Adobe's Portable Document 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 AD7898.

The software which controls the Evaluation Board Controller and hence the AD7898 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 control buttons allow the user to enter the set-up menu, take samples, and get information about the software. The control buttons also allow the user change from mode 0, ( the default mode on power up ) to Mode 1 , the operating mode of the AD7898 evaluation board. 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. **When the AD7898 evaluation board is first powered up and the AD7898.cfg file is loaded, the Mode 1 option button should be pressed, this places the AD7898 into Mode 1 (the mode of operation of the evaluation board).**

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 AD7898 evaluation board, the number of samples taken and any information messages that are generated.

The middle section of the AD7898 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 (  $\pm 2.5$  V for the AD7898 -3 and  $\pm 10$  V for AD7898-10 ). 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 occurrences of each particular code read back. The FFT ( default option ) is typically used when the user is concerned with examining the AD7898's performance in the frequency domain, while the Histogram will give an indication of the AD7898'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.

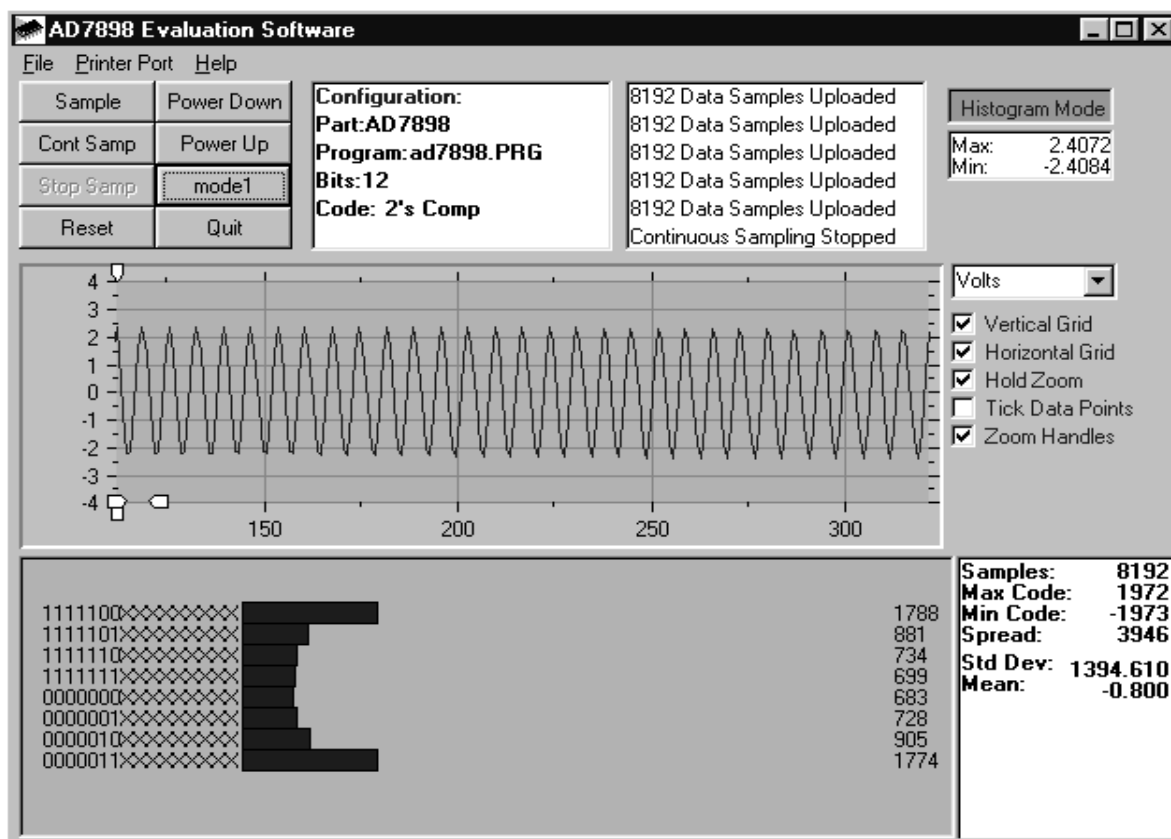


Figure 3 AD7898 Main Screen - Histogram Mode

### Setup Screen

The Setup Screen is responsible for allowing the user to load the AD7898 configuration file for the evaluation board. The configuration file will give the software detailed information about the AD7898 evaluation board and part connected to the Evaluation Board Controller such as number of bits, maximum sampling rate, power supply requirements etc. The AD7898 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, the Evaluation Board Controller and how AD7898 software should be set up for the user to begin using the complete system. The Evaluation Board Controller and AD7898 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 AD7898 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 AD7898 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 lists all the available configuration files. The configuration files are text based files which contain information about the particular evaluation board to be tested - AD7898.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 AD7898.cfg 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. The user should next select the Mode 1 option button to place the part into Mode 1 operation (the mode of operation of the evaluation board).

# EVAL-AD7898CB

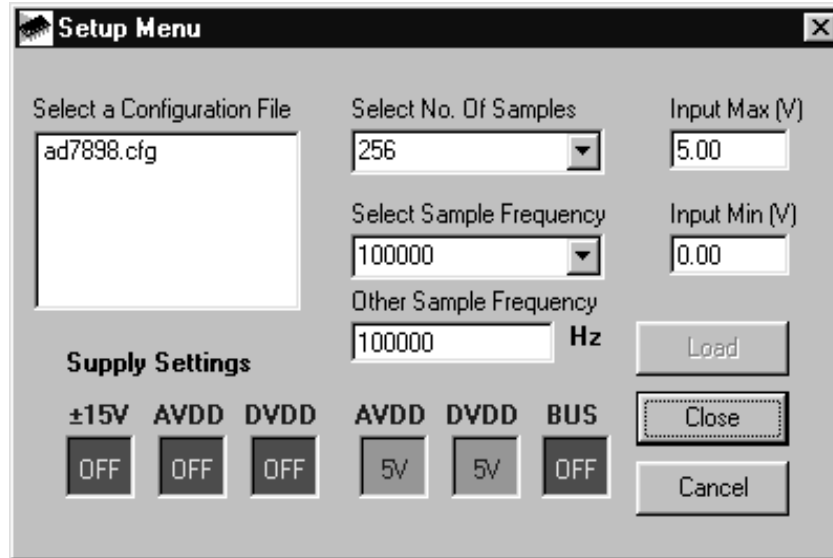


Figure 4. The Setup Screen

## 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. This is the AD7898-3 configuration file.

```
[EVAL-CONTROL BOARD]
partname:AD7898
programname:ad7898.PRG

samplefrequency:100000
maxsamplefrequency:220000
samples:2048

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

# EVAL-AD7898CB

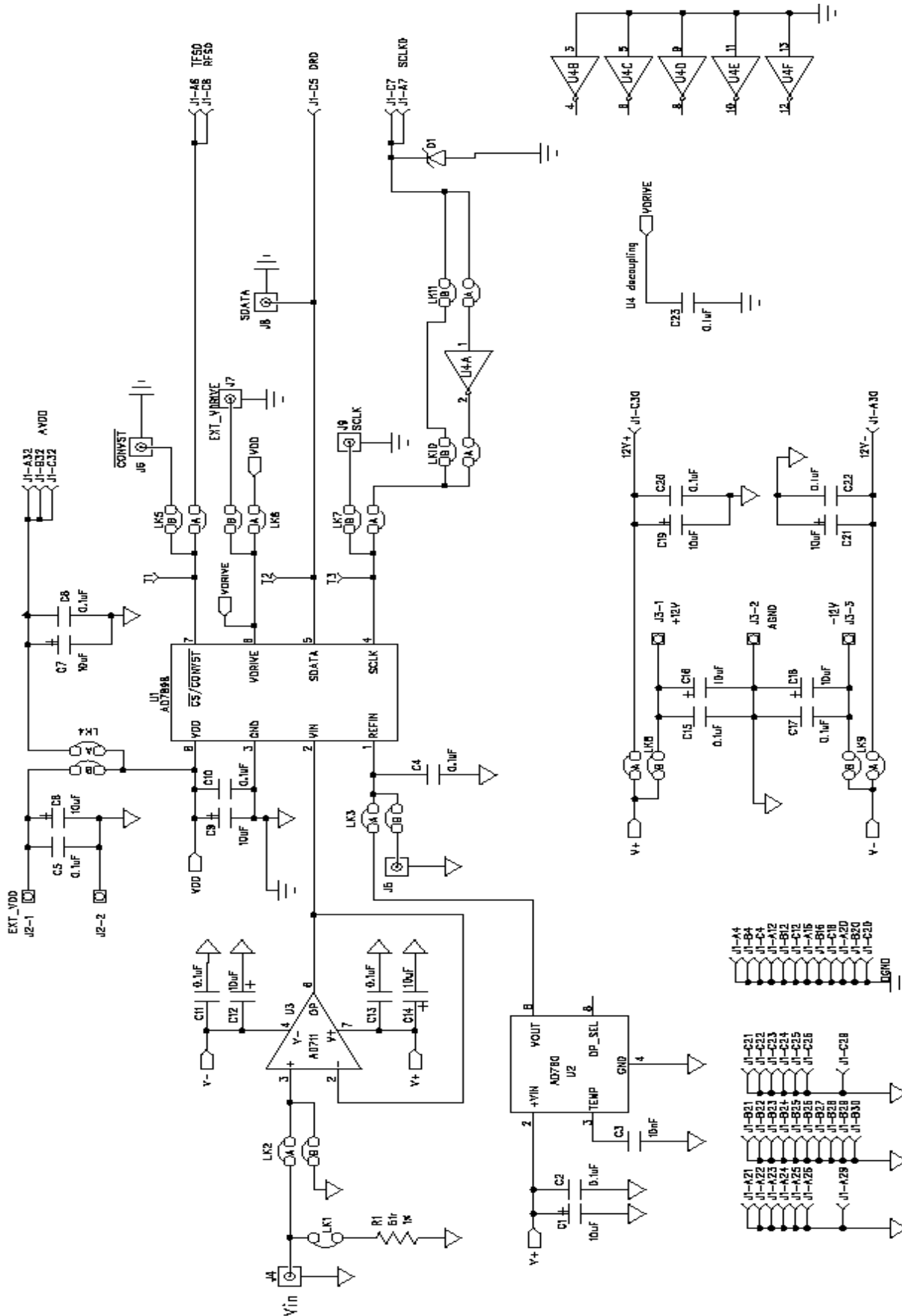


Figure 5. AD7898 Evaluation Board Circuit Diagram

<b>RefDes</b>	<b>Description</b>	<b>Manufacturer/Disti</b>	<b>Disti Number</b>
C1 C6 C7 C9 C12 C14 C16 C18 C19 C21	10uF 16V Tantalum (0.2" Pitch)	AVX/FEC	FEC 643-683
C2 C4 C5 C8 C10 C11 C13 C15 C17 C20 C22 C23	0.1uF Multilayer Ceramic	AVX/FEC	FEC 108-941
C3	0.01uF Multilayer Ceramic (0.1" Pitch)	AVX/FEC	FEC 108-938
R1	51R 1% 0.125W resistor	Multicomp/FEC	FEC 770-462
D1	SD103C Schottky Diode		
J1	DIN41612-96	Harting/FEC	FEC 104-986
J2	2 pin terminal block	Augat/FEC	FEC 151-785
J3	3 pin terminal block	Augat/FEC	FEC 151-786
J4 J5 J6 J7 J8 J9	50 Ohm SMB socket (vertical)	MACOM/FEC	FEC 310-682
LK1	2 pin header (1x2)	Harwin/FEC	FEC 148-535
LK2 - LK11	4 pin header (2x2)	Harwin/FEC	FEC 148-535
LK1-11	0.1" pitch Jumper Socket	Harwin/FEC	FEC 150-410
T1 T2 T3	TESTPOINT	W Hughes/FEC	FEC 240-345
U1	AD7898AR-3	Analog Devices	ADI Free Issue
U2	AD780AN	Analog Devices	ADI Free Issue
U3	AD711AN	Analog Devices	ADI Free Issue
U4	DM74LS04N	Fairchild/FEC	FEC 373-450
U1	8 pin SOIC clamp		
U2 U3	Ultra low profile sockets	Harwin/FEC	FEC 519-935
U4	14 pin DIP solder socket	Harwin/FEC	FEC 738-529
Rubber stick-on feet		3M/FEC	FEC 148-922
CD	Eval-AD7898CB Distribution CD	Analog Devices	ADI Free Issue
Label	Eval-AD7898CB Barcode Box label	Analog Devices	ADI Free Issue
Box	Small Evaluation Board Box	Europaks	Europaks K-645/1
Anti-static bag	Anti-static bag	Vermason/FEC	FEC 522-764
Bare Board	Eval-AD7898CB Bare Board		
Anti-static Plastic Box	Conductive Storage Box	Vermason/FEC	FEC 175-842
Foam for anti-static box	Conductive Foam (90 x 65 x 6mm )	VITACORTEX	
AD7898AR-10	Placed in anti-static box	Analog Devices	ADI Free Issue

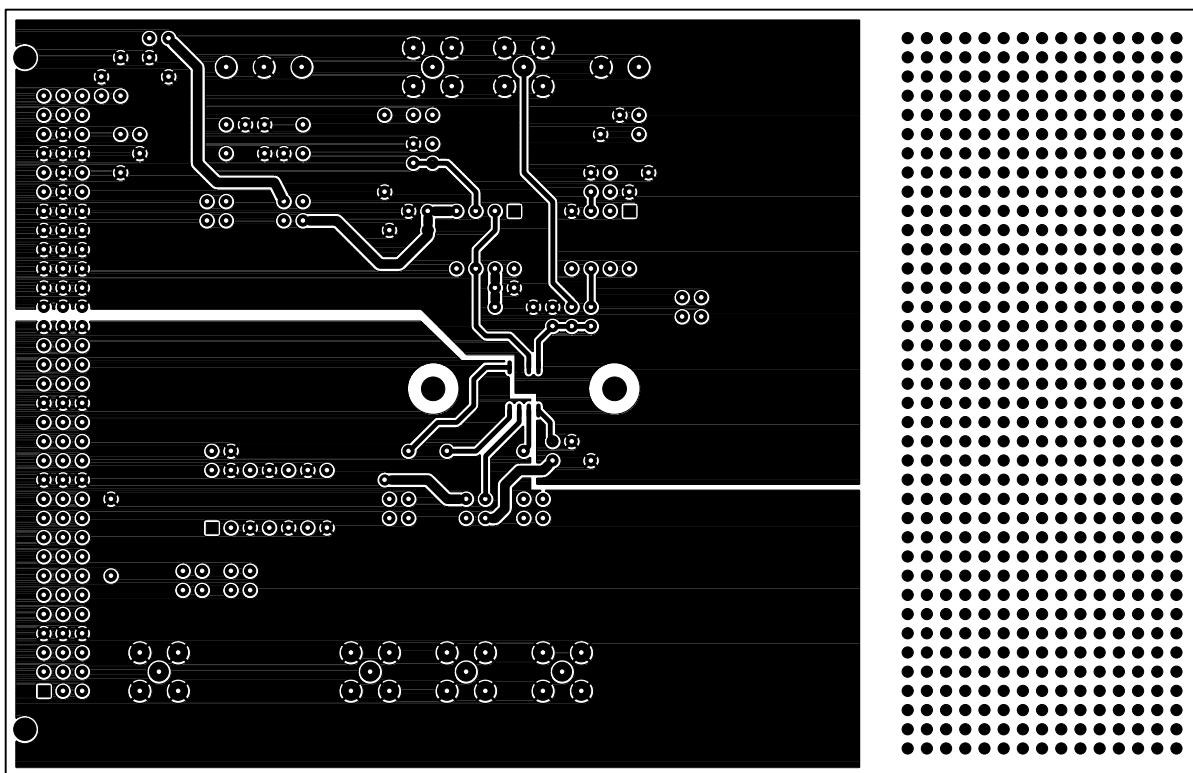


Figure 6. Component Side Artwork

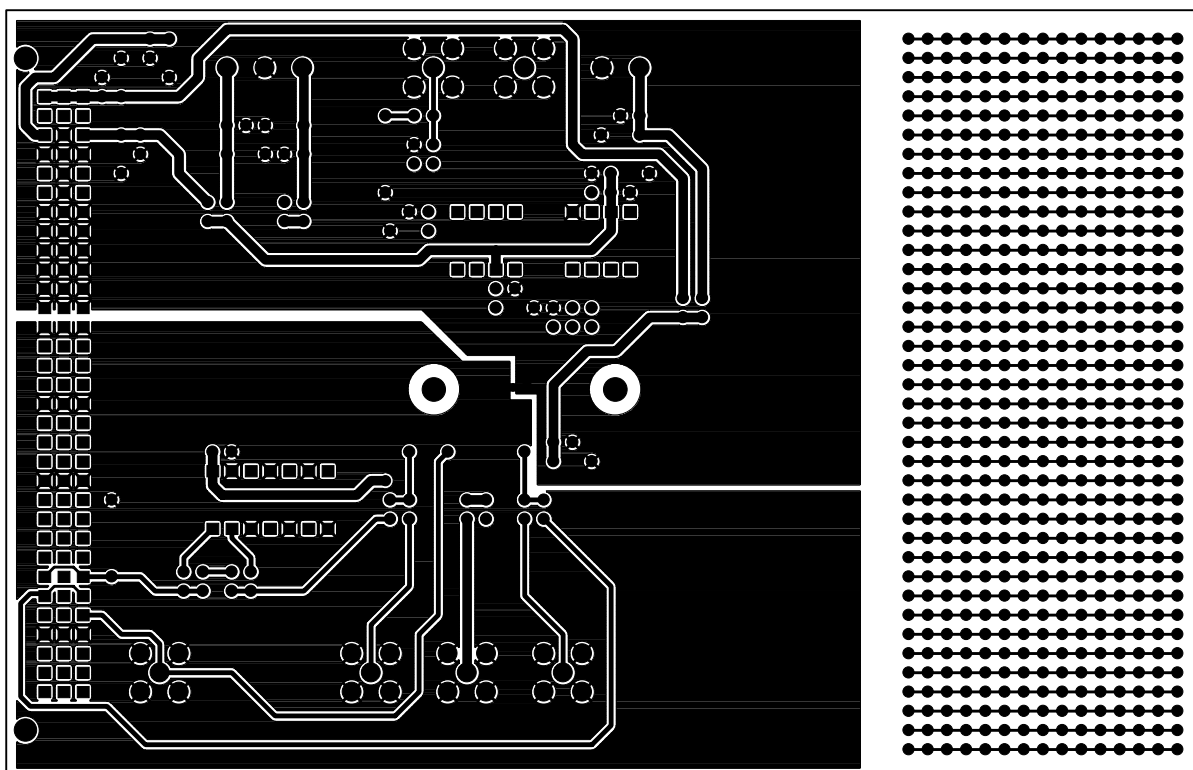


Figure 7. Solder Side Artwork

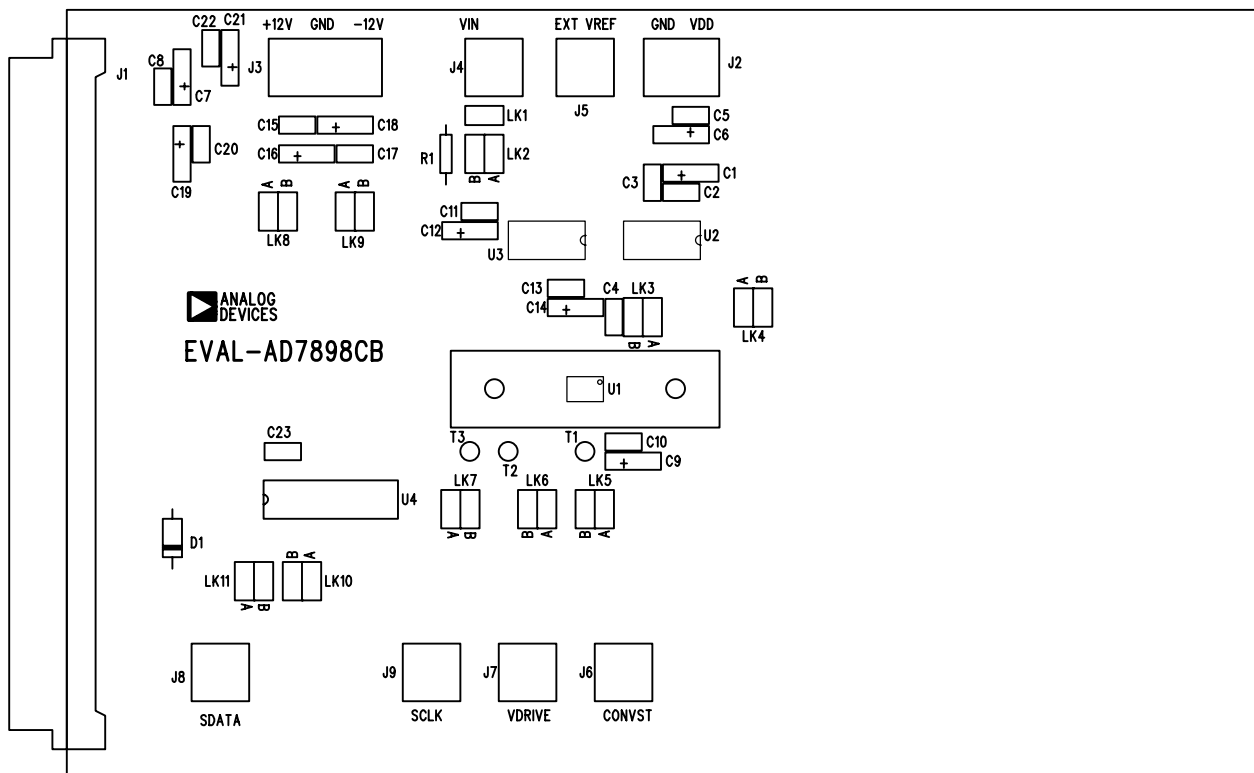


Figure 8. AD7898 Evaluation Board Component Placement Drawing.