Evaluation Board for 2.7V to 5.25V, Micro Power, 2-Channel, 125 kSPS, 12-Bit ADC

EVAL-AD7887CB

FEATURES

Full-Featured Evaluation Board for the AD7887
EVAL-CONTROL BOARD Compatible
Stand Alone Capability
On-Board Analog Buffering and Reference
Optional On-Board Biasing/Filter Circuit
Various Linking Options
PC Software for Control and Data Analysis when used with EVAL-CONTROL BOARD

INTRODUCTION

This Technical Note describes the evaluation board for the AD7887, high speed, low power, 12-bit ADC that operates from a single 2.7 V to 5.25 V power supply. The AD7887 is capable of 125 ksps throughput rate. The input track-and-hold acquires a signal in 500 ns and features a single ended sampling scheme. The output coding for the AD7887 is straight binary and the part is capable of converting full power signals up to 2.5MHz. Full data on the AD7887 is available in the AD7887 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, an OP467 quad op-amp and a 74LS04 inverting buffer. 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-CONTROL BOARD which is also available from Analog Devices. External sockets are provided for the AIN0 and AIN1 inputs.

OPERATING THE AD7887 EVALUATION BOARD

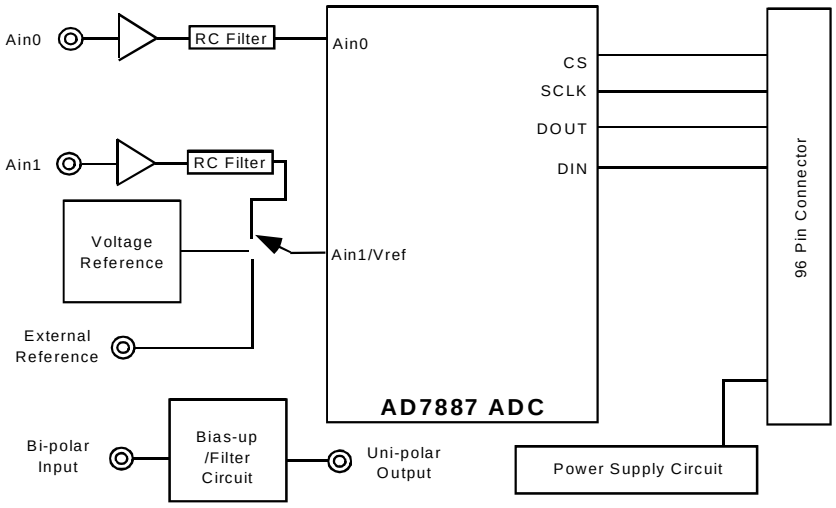
Power Supplies

When using this evaluation board with the EVAL-CONTROL BOARD all supplies are provided from the EVAL-CONTROL BOARD 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}, DV_{DD} and D_{GND}. +5V/+3V must be connected to the V_{DD} input to supply the AD7887 V_{DD} pin. +12V and -12V are used to supply the OP467 quad op-amp and the AD780 voltage reference. 0V is connected to one or both of the A_{GND} inputs. The DV_{DD} input can be used to supply a separate +5V for the 74LS04 and the D_{GND} input must be tied to 0V. Alternatively the 74LS04 can be supplied from the same +5V as the AD7887 supply by inserting LK15 . 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 the AD7887, quad op-amp and reference are also decoupled to A_{GND} with 10µF tantalum and a 0.1µF ceramic capacitor.

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 AD7887 GND pin.

FUNCTIONAL BLOCK DIAGRAM



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LINK AND SWITCH OPTIONS

There are nine 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 is used to connect the input of the AIN0 analog buffer to the AIN0 input socket or to Agnd. When this link is in position "A" the AIN0 socket is tied to the input of the AIN0 buffer. In this configuration, an analog signal applied to the AIN0 input socket is buffered and presented at the AD7887 AIN0 input. When this link is in position "B" the AIN0 buffer input is tied to Agnd.
LK2	This link option is used to connect the input of the AIN1 analog buffer to the AIN1 input socket or to Agnd. When this link is in position "A" the AIN1 socket is tied to the input of the AIN1 buffer. In this configuration, an analog signal applied to the AIN1 input socket is buffered and can be presented at the AD7887 AIN1 input pin by placing LK3 in position "A". The AD7887 must be cofigured for dual input channel operation before using the AIN1 input. When this link is in position "B" the AIN1 buffer input is tied to Agnd.
LK3	This link option is used to select the source of the input signal that is applied to the AIN1/VREF pin. When this link is in position "A" the output of the AIN1 input buffer is tied to the AIN1/VREF pin. The AD7887 must be configured for dual channel operation before using this option. LK5 also needs to be placed in position "B" for dual channel operation. When this link is in position "B" the AD780 provides the reference voltage for the ADC. The AD7887 must be configured for single channel operation before using this option. When this link is in position "C" an exteranl reference voltage can be supplied to the ADC via the VREF SMB connector. The AD7887 must be configured for single channel operation before using this option. Placing this link is in position "D" selects VDD as the reference voltage for the ADC. The AD7887 must be configured for single channel operation before using this option. Removing this link option causes the ADC to use its own internal reference as the reference voltage. Once again the AD7887 must be configured for single channel operation before using this option.
LK4	This link option controls the program pin of the AD780 voltage reference. When this link is "inserted" the AD780 output voltage is set to +3.0V. When this link is "removed" the AD780 output voltage is set to +2.5V.
LK5	This link option sets the DC bias voltage that is applied to the optional bias-up/filter circuit. When this link is in position "A", the bias voltage is set to the same level as the voltage that is applied to the ADC VREF pin. In this configuration a bipolar analog input applied to the Vin SMB socket is passed through the lo-pass filter circuit and is presented at thet Vbiased SMB as a uni-polar signal biased around Vref/2. When this link option is placed in position "B", the bias voltage is set to VDD. In this configuration a bipolar analog input applied to the Vin SMB socket is passed through the lo-pass filter circuit and is presented at thet Vbiased SMB as a uni-polar signal biased around Vdd/2. This option must be selected if dual channel operation is required. When this link is removed, 0V is selected as the DC bias voltage. In this configuration the optional bias-up/ filter circuit acts as a low pass filter only.
LK6	This link option is used to select the source of the +12V supply In position A, the +12V is supplied from the EVAL-CONTROL BOARD 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 EVAL-CONTROL BOARD through the 96 way connector. In position B, the -12V is supplied from an external source through the power connector, J8.
LK8	This link selects the source of the V_{dd} supply to the AD7887. from the EVAL-CONTROL BOARD. When this link is in position "A" the V_{DD} must be supplied from an external source via J7 . When this link is in position "B" the V_{DD} is supplied from the EVAL-CONTROL BOARD
LK9	This link selects the source of the DV_{DD} +5V supply for the 74LS04 digital buffers. When this link is in position "A", DV_{DD} power is supplied from the same power source supplying the AD7887 V_{DD} pin. When this link is in position "B", DV_{DD} power must be supplied from an external source via the power connector, J9.

SETUP 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	AIN0 SMB connected to the input of the AIN0 analog buffer.
LK2	B	The input of the AIN1 analog buffer is tied to A_{GND}.
LK3	B	The AD780 reference voltage is applied to the AD7887 AIN1/VREF pin.
LK4	Removed	AD780 is set to provide a +2.5V reference.
LK5	A	VREF is selected as the DC bias voltage for the optional bias-up/filter circuit.
LK6	A	+12V supplied from EVAL-CONTROL BOARD via J1.
LK7	A	-12V supplied from EVAL-CONTROL BOARD via J1.
LK8	B	V_{DD} for the AD7887 is supplied by the EVAL-CONTROL BOARD via J1.
LK9	A	74LS04 is powered from the same power source as the AD7887.

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 J1 connector is shown in Figure 2 and its pin designations are given in Table II.

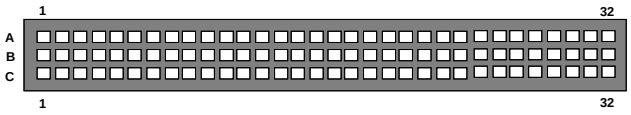

Figure 2. Pin Configuration for the 96-Way Connector, J1

96-Way Connector Pin Description

DTO — Data Transmit Zero. This output is connected to the DIN pin of the AD7887.

DRO — Data Receive Zero. This input is connected to the DOUT pin of the AD7887 via two inverting buffers.

SCLK0 — Serial Clock Zero. This serial clock is connected to the SCLK pin of the AD7887 via an inverting buffer.

TFSO/RFS0 — Transmit/Receive Frame Sync Zero. These two outputs are connected to the $\overline{CS}$ pin of the AD7887.

DGND — Digital Ground. These pins 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 pins are connected to the analog ground plane on the evaluation board.

AV_{DD} — Analog VDD Supply. These pins are connected to the V_{DD} pin of the AD7887 via LK12.

+12V — +12V Supply. This pin is connected to the V+ supply line on the board via LK13.

-12V — -12V Supply. This line is connected to the V- supply line on the board via LK14.

Table II. 96-Way Connector Pin Functions.

	ROWA	ROWB	ROWC
1			
2			
3			
4	DGND	DGND	DGND
5	DT0		DR0
6	TFS0		RFS0
7			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.

SOCKETS

There are nine input sockets relevant to the operation of the AD7887 on this evaluation board. The function of these sockets is outlined in Table III.

Table III. Socket Functions

Socket	Function
J1	Sub-Miniature BNC Socket for AIN0 channel.
J2	Sub-Miniature BNC Socket for AIN1 channel.
J3	Sub-Miniature BNC Socket for external reference voltage input.
J4	Sub-Miniature BNC Socket for Analog input to bias-up circuit.
J5	Sub-Miniature BNC Socket for Analog output from bias-up circuit.

CONNECTORS

There are four connectors on the AD7887 evaluation board as outlined in Table IV.

Table IV. Connector Functions

Connector	Function
J6	96-Way Connector used to interface to EVAL-CONTROL BOARD
J7	External VDD & AGND power connector.
J8	External +12V, -12V & AGND power connector.
J9	External DVDD & DGND power connector.

OPERATING WITH THE EVAL-CONTROL BOARD

The evaluation board can be operated in a stand-alone mode or operated in conjunction with the EVAL-CONTROL BOARD. This EVAL-CONTROL BOARD is available from Analog Devices under the order entry "EVAL-CONTROL BOARD". When operated with this control board, all supplies and control signals to operate the AD7887 are provided by the EVAL-CONTROL BOARD when it is run under control of the AD7887 software which is provided with the AD7887 evaluation board package. This EVAL-CONTROL BOARD 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-AD7887CB plugs directly into the 96-way connector on the EVAL-CONTROL BOARD. No power supplies are required in the system. The EVAL-CONTROL BOARD generates all the required supplies for itself and the EVAL-AD7887CB. The EVAL-CONTROL BOARD 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 EVAL-CONTROL BOARD and the serial port of a PC is via a standard RS-232 cable which is provided as part the EVAL-CONTROL BOARD package. Please refer to the manual which accompanies the EVAL-CONTROL BOARD for more details on the EVAL-CONTROL BOARD package.

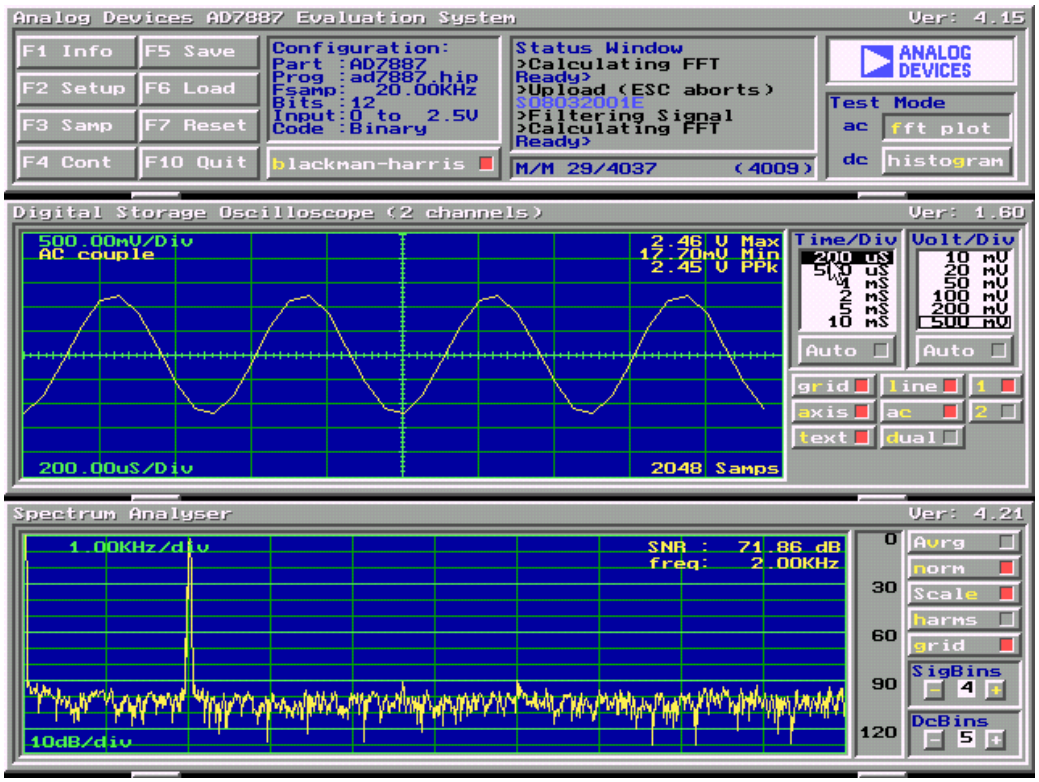

Figure 3. Main Screen

SOFTWARE DESCRIPTION

Included in the EVAL-AD7887CB evaluation board package is a PC-compatible disk which contains software for controlling and evaluating the performance of the AD7887 when it is operated with the EVAL-CONTROL BOARD. The EVAL-AD7887CB Demonstration/Evaluation Software runs under DOS 4.0 or later and requires a minimum of a 386-based machine with 400kB of base RAM and 500kB of free hard disk space. The user interface on the PC is a dedicated program written especially for the AD7887.

The disk which accompanies the EVAL-AD7887CB contains several files. The user should create a new directory on the main PC drive and label this "AD7887". Then, all files on the EVAL-AD7887CB disk should be copied into this directory. The Mouse Driver on the PC should be enabled before running the software. If this has not been loaded, the program will not run.

To run the software, simply make the AD7887 directory the current directory and type "go". When the evaluation program starts, the user sees the screen shown on Figure 3 (without any FFT or scope waveforms). This is the main screen and it is divided into three parts. The top part provides the main control interface for the AD7887 evaluation software. The middle part of the main screen functions as a Digital Storage Oscilloscope and the bottom part of the main screen operates as either a Digital Spectrum Analyzer or a Histogram analyzer.

Each part of the screen has several buttons that can be pressed by using the mouse or the keyboard. To press a button using the mouse, simply use it to move the on-screen pointer to the button to be activated and click. To use the keyboard, simply press the appropriate key as highlighted on the button. Lower case letters must be used. When a button is pressed, it is highlighted on the screen. The next button can be highlighted by using the Tab key or the previous button by holding down the shift key and the Tab key together. The highlighted button can also be pressed by pressing the space bar. Pressing the ESC key halts any operation currently in progress. In this document, if a button can be activated from the keyboard then the key used is shown in bold in the button name. For example, "no **p**rog" has the "p" highlighted in bold, indicating that the button can be activated by pressing the p key.

Some buttons have a red indicator. A red indicator on the button means that the function associated with that button is on. Absence of the red indicator light means that the function associated with the button is off. The on/off status of these buttons is changed simply by selecting the button.

Setting up the EVAL-CONTROL BOARD

When the software is run, the **"F2** Setup" button in the top left of the screen should be selected to pop up the setup menu (see fig. 4). This menu sets up the EVAL-CONTROL BOARD for use with the EVAL-AD7887CB.

Firstly, the configuration file must be loaded. The configuration file contains the default configuration information for the EVAL-CONTROL BOARD, the Digital Spectrum Analyzer and the Digital Storage Oscilloscope. It also tells the AD7887.EXE software which .HIP file to download to the ADSP-2111. The .HIP file contains the DSP code which is executed by the ADSP-2111. Normally, the "no **p**rog" button is off, so when the configuration file is loaded, the .HIP file is automatically downloaded to the ADSP-2111. However, if the "no **p**rog" button is on, then the .HIP file is not downloaded to the ADSP-2111.

To load the configuration file, click the "**l**oad" button on the screen. After the configuration file is loaded, the sample rate and number of samples can be changed. Due to the nature of the DSP interface, and depending on the selected mode of operation care must be taken when choosing sample frequencies. There are four operating modes available on the AD7887. The default operating mode is Mode 2, Normal Mode. In this mode the device never enters power down. On the eval board system, the maximum allowable throughput rate(fsampl) for this mode is 65kSPS. If Mode 1 or Mode 3 is selected then the part will enter full shutdown between conversions. Due to the power up time required for both of these modes it is necessary to allow a dummy conversion between every valid conversion. This is explained in more detail in the 'Modes of Operation' section in the AD7887 datasheet . The maximum throughput rate allowed for this system when using either of these modes is 30kSPS. Mode 4 is an Auto-Standby Mode. In this mode the power up time is much quicker than that from full shutdown, therefore the dummy conversion is not necessarily required but may be used in this set-up. This mode is not functional at present but updated software will be available on the website in the near future.

Figure 4. Setup Menu Screen

Single channel operation is selected by depressing the "Single" button. Dual channel operation is selected by depressing the "Dual" button. This in turn allows the user to select between the 2 input channels using the "1" and "2" buttons. When using dual channel mode, the user must ensure that the on-chip reference is disabled as the AD7887 uses VDD as the reference internally.l

The "Analog in" section shows the analog input range and DC offset voltage.

MAIN SCREEN

The top left part of the main screen contains eight buttons which are selected using the mouse or by using the function keys from the keyboard. These buttons and the actions they perform are:

F1: Info. This button shows information on the software.

F2: Setup. This button activates the setup menu.

F3: Samp. When this key is pressed, the software causes the AD7887 to perform a number of conversions as determined by the setup menu (see above). The data from these conversions is then analyzed by the AD7887 evaluation software. Another set of samples may be taken by pressing the **F3** key again.

F4: Cont. Pressing this button causes the software to repeatedly perform conversions and analyze them. Once the conversions and analysis has been done for one set of samples, the software automatically repeats the process. It continues to do this until the ESC key is pressed.

F5: Save. This saves a set of samples to a file for use either at a later date or with other software. The samples can be saved either as "volts", "ints" or "binary". The format of all these files is ASCII text. Note that the AD7887 software can only load files saved in the "ints" format. Files saved in the "volts" and "ints" formats can be used with packages such as Mathcad. Files saved in the "binary" format are for viewing purposes only.

F6: Load. This allows the user to load data from a file with a .DAT extension. Only data that was saved as ints can be loaded and analyzed. A configuration file must be loaded via the **"F2** Setup" menu before the data file can be analyzed. If there is no EVAL-CONTROL BOARD connected to the PC, then the "no **p**rog" button in the **"F2** Setup" menu must be on. Once a configuration file has been loaded, the data loaded from the .DAT file is analyzed according to the settings in the **"F2** Setup" menu.

F7: Reset. Choosing this option resets the EVAL-CONTROL BOARD.

F10: Quit. This quits the AD7887 evaluation software and returns control to the operating system.

INFORMATION WINDOWS

There are three information windows at the top of the main screen. The left-hand window is the configuration window and gives details about part being evaluated. It shows the name of the program that has been downloaded to the EVAL-CONTROL BOARD, the sampling frequency, the number of bits, the analog input range of the part and the output code format of the part. The right-hand large window is the Status window. This window provides feedback to the user as to what operations are currently being performed by the software and also displays error messages. Directly underneath the status window is a small window that shows the selected conversion sequence and the maximum and minimum values of the most recently captured samples for all channels in the conversion sequence.

Test Mode

At the top right of the main screen are the Test Mode buttons. These buttons determine what sort of testing is done on the samples captured by the software. Both an ac analysis and dc analysis can be performed. The function of these buttons are:

fft plot Choosing this button causes the Digital Spectrum Analyzer to appear at the bottom of the screen.

Histo**g**ram: Choosing this button causes the Histogram Analyzer to be displayed at the bottom of the screen.

There is one other button near the top of the screen, beside the **"F10** Quit" button. This is:

blackman-harris: When performing a Fourier transform of the sampled data, this button determines whether or not the data is windowed by a blackman-harris window before the transform. When this button is on, the data is windowed. When this button is off, the data isn't windowed. See the Digital Spectrum Analyzer section for more details.

DIGITAL STORAGE OSCILLOSCOPE.

When samples of data are captured, they are displayed on the Digital Storage Oscilloscope. If the **b**lackman-harris button is turned on then the windowed data is also displayed on the oscilloscope. The 'scope has been designed to act in a similar way as a conventional oscilloscope. To the right of the oscilloscope are several buttons that control the manner in which data is displayed on the 'scope. The timebase for the oscilloscope is automatically chosen by the software if the Time/Div "Auto" button is on. The user can also select the timebase by clicking in the Time/Div window and scrolling up and down through the possible timebases. Similarly, the vertical scale of the oscilloscope is chosen automatically if the Volt/Div "Auto" button is on. The user also has the option of selecting the desired vertical scale in a similar manner to selecting the timebase.

The other buttons associated with the oscilloscope are:

g**r**id This button toggles the grid display of the oscilloscope on and off.

axis This button toggles the axis display of the oscilloscope on and off

text This button toggles the text displayed on the oscilloscope screen on and off.

line When the line button is on, the displayed samples are joined together by lines. When this button is off, the samples are displayed as points.

a**c** When this button is on, the dc component of the sampled signal is removed and the signal is displayed. This has the effect of centering the signal vertically on the oscilloscope screen. When this button is off, the dc component is not removed and the signal is displayed with its horizontal axis corresponding to a code of 0. The a**c** display option is useful for zooming in on a low-level signal that has a large dc offset.

dual When the **"d**ual" button is on, the oscilloscope screen is divided into two parts with the sampled data display centered on one horizontal axis and the windowed data display centered on another. When the **"d**ual" button is off, both traces are centered on the same horizontal axis.

1 This button toggles the sampled data trace on and off.

2 This button toggles the windowed data trace on and off.

HISTOGRAM ANALYZER

The histogram analyzer counts the number of occurrences of each code in the captured samples and displays a histogram of these counts. The most frequently occurring code is displayed in the center of the histogram. The analyzer is normally used with a dc input signal and calculates the mean and the standard deviation of the sampled data. The mean and standard deviation are displayed in both volts and in units of the lsb size of the converter. The histogram gives a good indication of the dc noise performance of the ADC. The standard deviation shows directly the noise introduced in the conversion process. Each channel is the sequence can be viewed in turn using the 4 channel select buttons on the right of the histogram screen

Figure 5 Histogram Screen

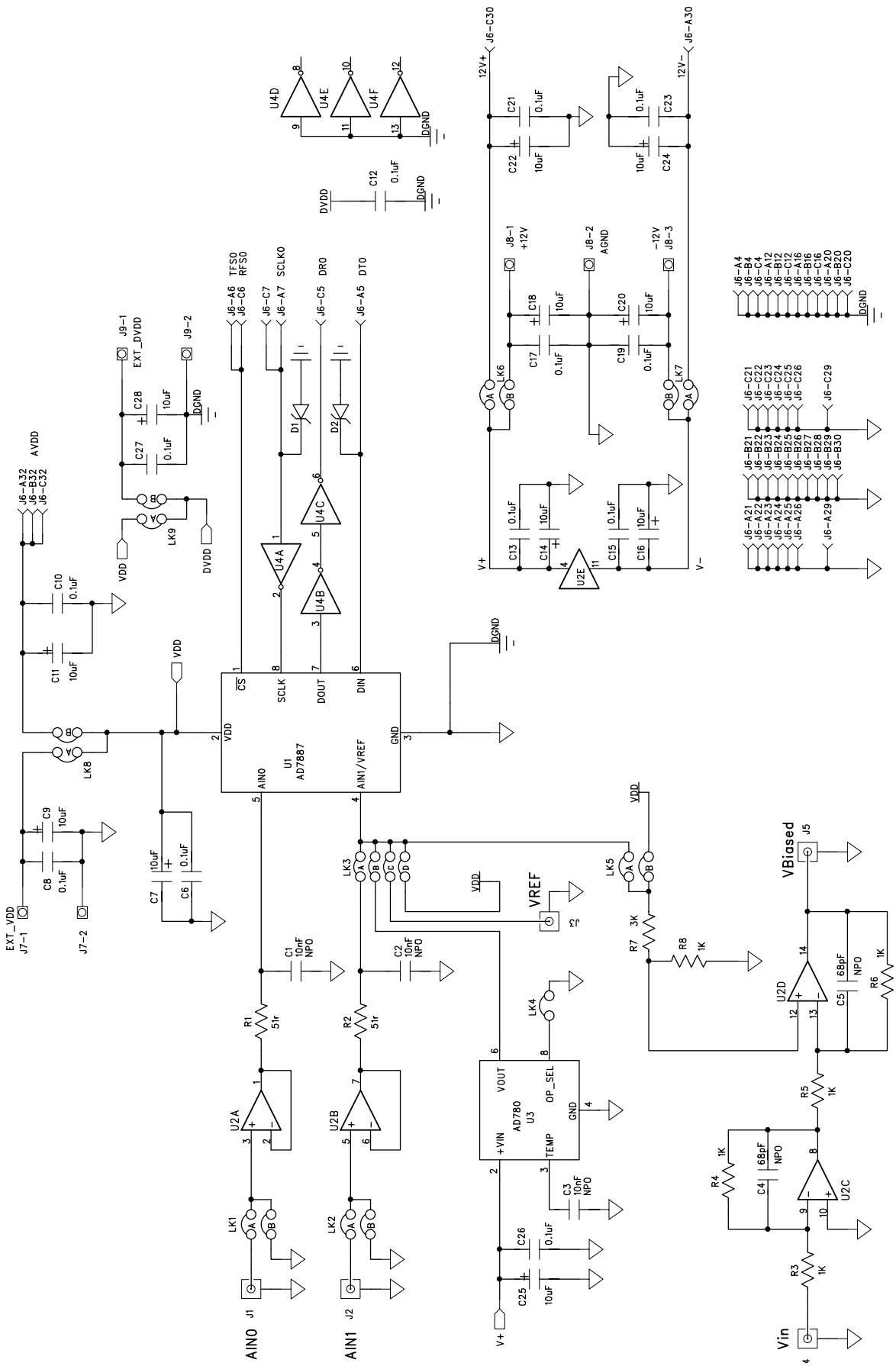

Figure 5. AD7887 Evaluation Board Circuit Diagram

Table V. - Eval-AD7887CB Bill Of Materails.

Qty	Reference	Part Description	Manufacturer	Supplier Part No
Semiconductors:				
1	U1	AD7887BR	ADI	
1	U2	OP467GP	ADI	
1	U3	AD780AN	ADI	
1	U4	74HC04N	Fairchild	FEC 378-252
2	D1 D2	SD103C	ITT/Cannon	
Capacitors:				
3	C1 C2 C3	10nf Multilayer Ceramic	Philips	FEC 143-729
2	C4 C5	68pf Multilayer Ceramic	Philips	FEC 237-024
12	C6 C8 C10 C12 C13 C15 C17 C19 C21 C23 C26 C27	0.1uF Multilayer Ceramic	Philips	FEC 262-257
11	C7 C9 C11 C14 C16 C18 C20 C22 C24 C25 C28	10uF 16V Tantalum	AVX	FEC 643-683
Resistors:				
2	R1 R2	51Ω 0.5W 1% (MF50 Series)	Multicomp	FEC 544-280
5	R3 R4 R5 R6 R8	1.21KΩ 0.25W 0.1% (RC55 Series)	Welwyn	FEC 544-080
1	R7	3.65KΩ 0.25W 0.1% (RC55 Series)	Welwyn	FEC 544-546
Miscelleanous:				
7	LK1 LK2 LK5-9	2 way jumper	Harwin	FEC 511-833
1	LK3	4 way jumper	Harwin	FEC 511-833
1	LK4	1 way jumper	Harwin	FEC 511-833
9	LK1-9	Shorting shunt	Harwin	FEC 150-410
5	J1-5	50Ω gold SMB socket	M/Acom	FEC 310-682
1	J6	96 pin DIN41612 rt. Angle PCB plug	Harting	FEC 104-986
2	J7 J9	2 pin terminal block	Augat	FEC 151-789
1	J8	3 pin terminal block	Augat	FEC 151-790
36	U2 U3 U4	Ultra Low profile socket pins	Harwin	FEC 519-959
4	Each Corner	Rubber Stick-on Feet	3M	FEC 148-922

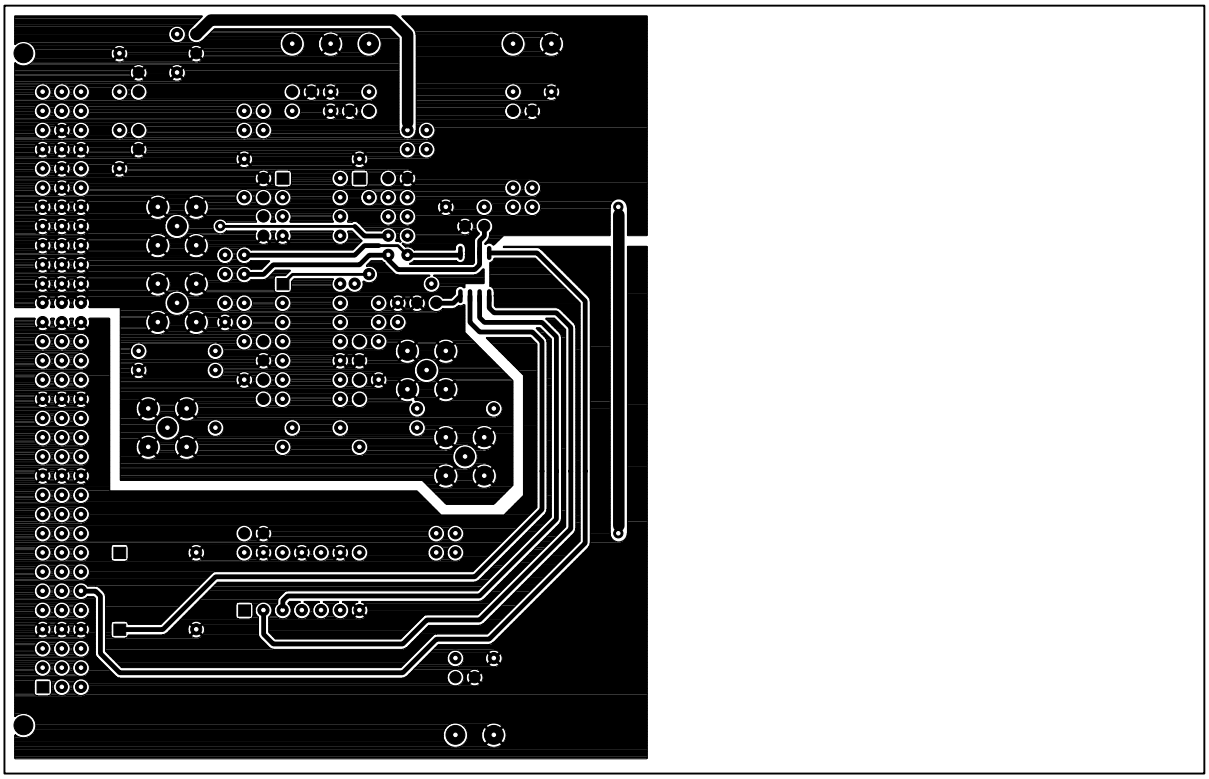

Figure 6. Component Side Artwork

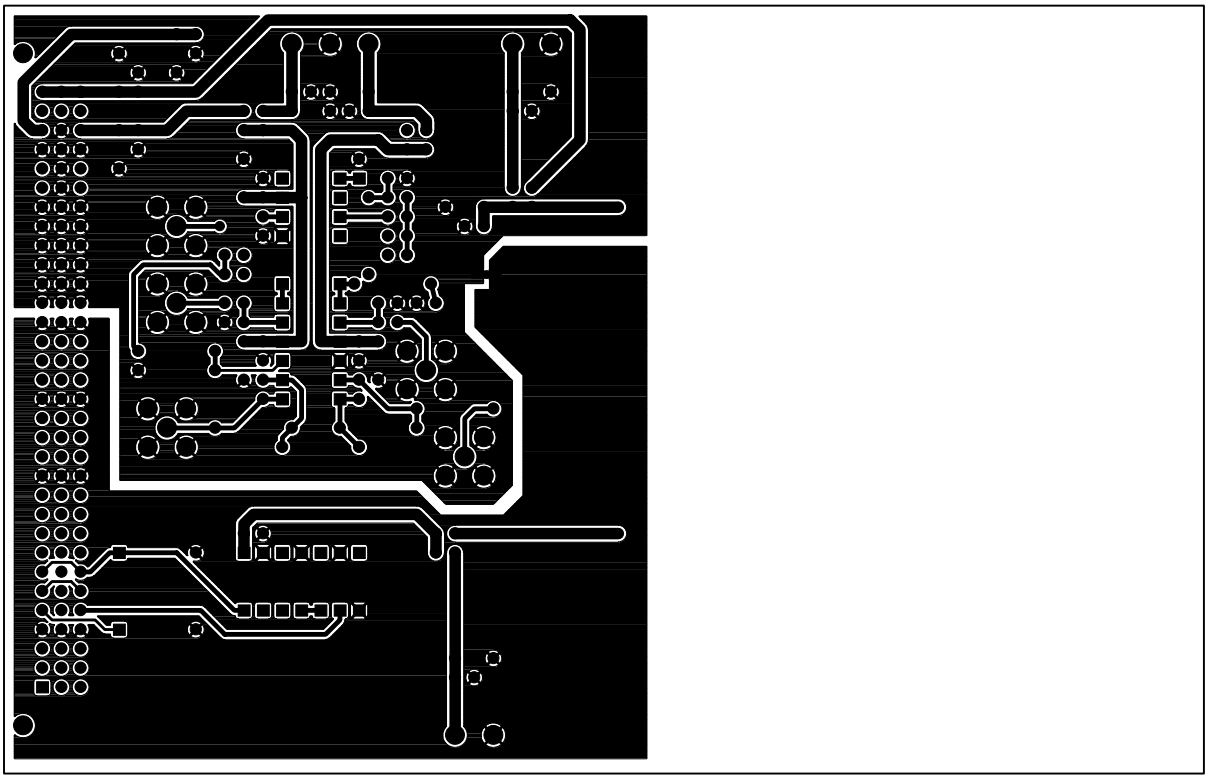

Figure 7. Solder Side Artwork

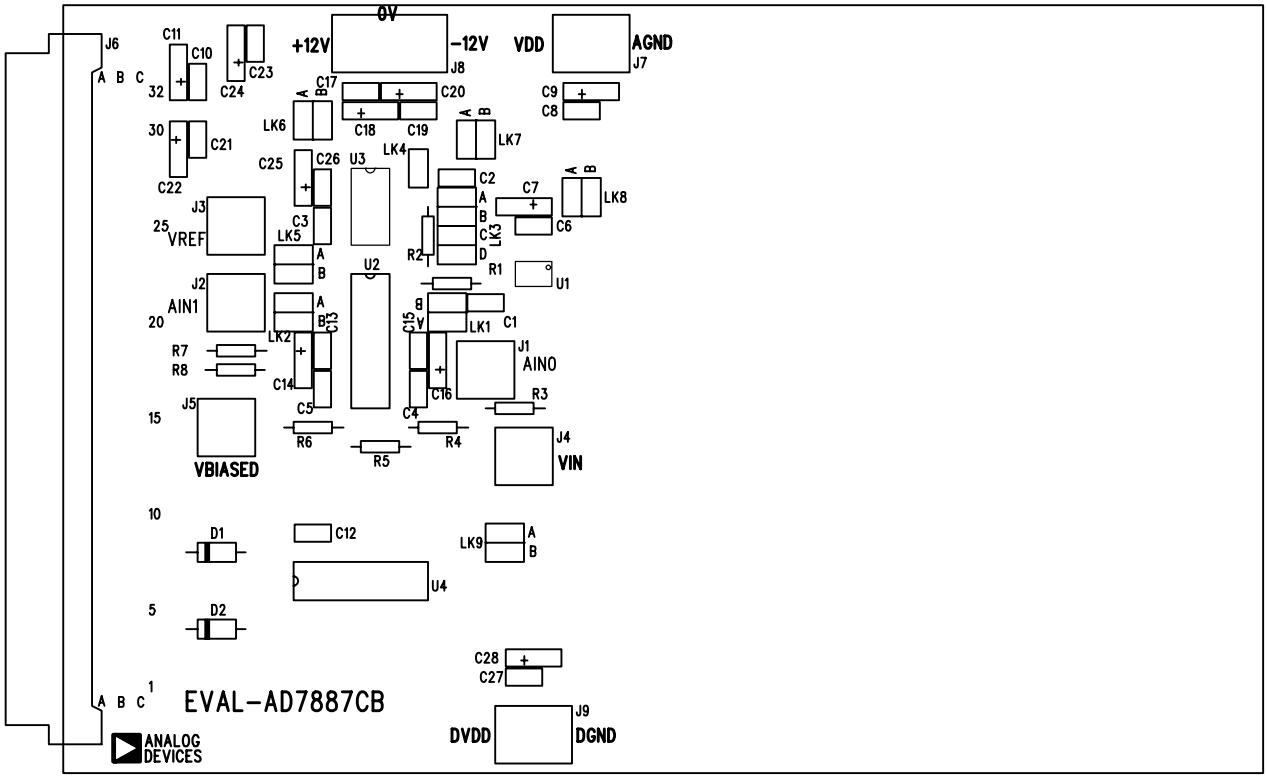

Figure 8. AD7887 Evaluation Board Component Placement Drawing.