

FEATURES

Full-Featured Evaluation Board for the AD7862

EVAL-CONTROL BOARD Compatible

Stand Alone Capability

On-Board Analog Buffers and Reference

Various Linking Options

PC Software for Control and Data Analysis when used with EVAL-CONTROL BOARD

Single Evaluation Board for AD7862-3 & AD7862-10

INTRODUCTION

This Application Note describes the evaluation board for the AD7862 dual 12-Bit A/D converter. The AD7862 is a high speed, low power, dual channel 12-bit A/D converter that operates from a single +5V supply. The part contains two 4 μ s successive approximation ADCs, two track/hold amplifiers, an internal +2.5V reference and a high speed parallel interface. Full data on the AD7862 is available in the AD7862 data sheet available from Analog Devices and should be consulted in conjunction with this Application Note when using the Evaluation Board.

The board is supplied with two versions of the AD7862. These are the AD7862-3 which is inserted in the U1 position on the board and the AD7862-10 which is in the antistatic box supplied with the evaluation board package. Either part can be evaluated by carefully removing the part on the board and inserting the other part.

On-board components include an AD780 pin programmable +2.5V

or +3V ultra high precision bandgap reference and an AD713 quad op-amp used to buffer the four 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-CONTROL BOARD which is also available from Analog Devices. External sockets are provided for the CONVST input, A0 input, VREF input/output and the four Analog inputs, VA1, VA2, VB1 and VB2.

OPERATING THE AD7862 EVALUATION BOARD

Power Supplies

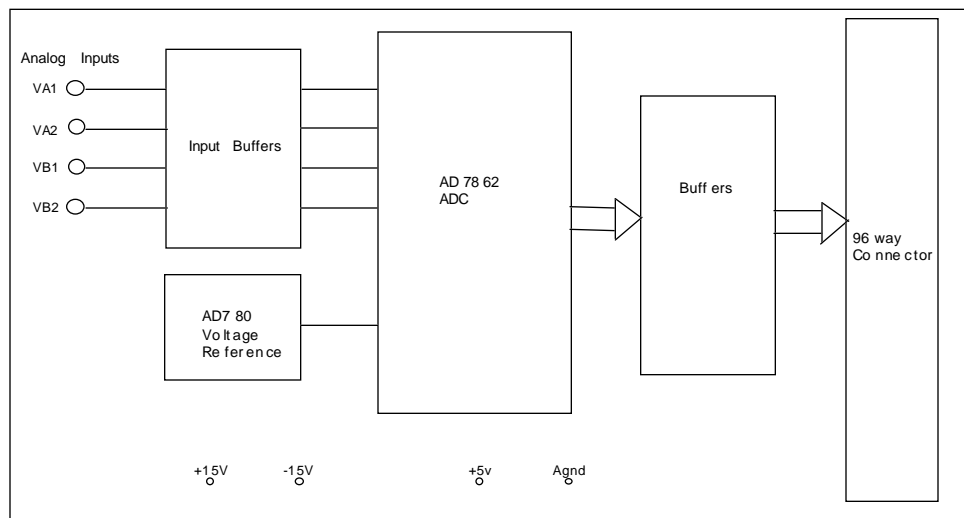
When using this evaluation board with the EVAL-CONTROL BOARD all supplies are provided from the EVAL-CONTROL BOARD through the 96 way connector.

When using the board as a stand alone unit external supplies must be provided. This evaluation board has four power supply inputs: +5V, AGND, +15V and -15V. +5V is used to supply the AD7862 and the 74HC245s bi-directional buffers. +15V and -15V are used to supply the AD780 voltage reference and the AD713 quad op-amp. The AGND input is connected to the AGND plane.

The supplies are decoupled to AGND with 47 μ F tantalum and 0.1 μ F ceramic disc capacitors at the point where they arrive on the eval board. The supply pins of each analog device are also decoupled to AGND with 10 μ F tantalum and a 0.1 μ F ceramic capacitor.

Extensive ground planes are used on this board to minimize the effect of high frequency noise interference. There are two ground planes, AGND and DGND. These are connected at one location under the AD7862.

FIG. 1: FUNCTIONAL BLOCK DIAGRAM



REV. 0

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EVAL-AD7862CB

Link and Switch Options

There are fourteen 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 either ground the input to the VA1 analog buffer or connect it to the VA1 input socket. With this link position A, the VA1 input socket is connected to the VA1 analog buffer. With this link position B, the input to the VA1 analog buffer is connected to AGND.
LK2	This link option is used to either ground the input to the VB1 analog buffer or connect it to the VB1 input socket. With this link position A, the VB1 input socket is connected to the VB1 analog buffer. With this link position B, the input to the VB1 analog buffer is connected to AGND.
LK3	This link option is used to either ground the input to the VA2 analog buffer or connect it to the VA2 input socket. With this link position A, the VA2 input socket is connected to the VA2 analog buffer. With this link position B, the input to the VA2 analog buffer is connected to AGND.
LK4	This link option is used to either ground the input to the VB2 analog buffer or connect it to the VB2 input socket. With this link position A, the VB2 input socket is connected to the VB2 analog buffer. With this link position B, the input to the VB2 analog buffer is connected to AGND.
LK5	This link option is used to select the source of the positive supply for the AD780 and the AD713. In position A, the positive supply is connected to the +5V V_{DD} line. In position B, the positive supply must be supplied via the external connector, J3. In position C, the positive supply is supplied by the EVAL-CONTROL BOARD.
LK6	This link option is used to select the source of the negative supply for the AD713. In position A, the negative supply pin is connected to AGND. In position B, the negative supply must be supplied via the external connector, J3. In position C, the negative supply is supplied by the EVAL-CONTROL BOARD.
LK7	This link option selects a 2.5V or 3.0V reference from the AD780. This link is permanently "OUT" when evaluating the AD7862. This selects a 2.5V reference from the AD780.
LK8	This link option is used to select between the internal reference on the ADC or the on-board reference. With this link "IN" the 2.5V reference generated by the AD780 is selected. With this link "OUT", the ADC uses its internal reference.
LK9	This link option is used to select an external reference supplied via the external VREF socket (SMB1). With this link "IN" an external reference can be supplied via SMB1.
LK10	This link option is used to select the source of the V_{DD} supply for the AD7862 and the digital buffers. With this link "IN" V_{DD} is supplied by the EVAL-CONTROL BOARD. With this link "OUT" V_{DD} must be supplied from an external source through the power connector, J2.
LK11	This link option selects the source of the <u>CONVST</u> input. With this link "IN" <u>CONVST</u> is supplied by the EVAL-CONTROL BOARD. With this link "OUT" <u>CONVST</u> must be supplied from an external source via SMB2.
LK12	This link option controls the input to the A0 pin of the AD7862. In position A, the A0 input is controlled by the EVAL-CONTROL BOARD. In position B, the A0 pin is controlled externally via SMB3. In position C, the A0 pin is connected to V_{DD} . In position D, the A0 pin is connected to Agnd.
LK13,LK14	These link options are permanently "IN" when evaluating the AD7862. They connect the inputs of the unused digital buffers to Dgnd.

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	VA1 analog input is connected to it's Analog input buffer.
LK2	B	The input to the VB1 analog buffer is conncted to AGND.
LK3	A	VA2 analog input is connected to it's Analog input buffer.
LK4	B	The input to the VB2 analog buffer is conncted to AGND.
LK5	C	The positive supply for the analog circuitry is supplied by the EVAL CONTROL BOARD
LK6	C	The negative supply for the analog circuitry is supplied by the EVAL CONTROL BOARD
LK7	OUT	The AD780 generates a 2.5V reference.
LK8	IN	The 2.5V reference generated by the AD780 is applied to the AD7862 VREF pin.
LK9	OUT	The external VREF socket is not used.
LK10	IN	V_{DD} for the ADC and the digital buffers is supplied by the EVAL CONTROL BOARD
LK11	IN	<u>CONVST</u> is supplied by the EVAL-CONTROL BOARD.
LK12	A	A0 is controlled by the EVAL-CONTROL BOARD.
LK13	IN	Unused digital buffer input is connected to DGND.
LK14	IN	Unused digital buffer input is connected to DGND.

EVAL-AD7862CB

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.

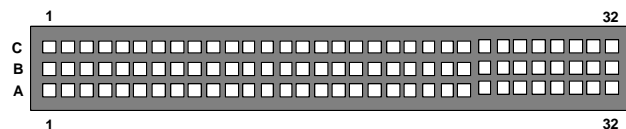


Figure 2. Pin Configuration for the 96-Way Connector, J1

96-Way Connector Pin Description

- D0-D11** Data Bus. Data from the AD7862 is transferred to these pins via the digital buffers. The data coding is 2's complement for the AD7862-10 and the AD7862-3. Output coding is straight binary for the AD7862-2
- DGND** Digital Ground. These lines are connected to the DGND plane on the evaluation board. It allows the user to provide the digital supply via the connector along with the other digital signals.
- FL0** Flag zero. This is a logic input and is connected to the CONVST logic input on the AD7862 via LK11. A high to low transition on this input puts both track/holds into their hold mode and starts conversion on both channels
- IRQ2** Interrupt Request 2. This is a logic output and is connected to the BUSY logic output on the AD7862. This output will go high on the falling edge of CONVST and will remain high until the conversion is complete.
- FL1** Flag one. This is a logic input and is connected to the A0 pin of the AD7862 via LK12. This input is used in conjunction with RD and CS low to enable the data outputs. With A0 logic low, the data is read from Channel A in the sequence, VA1, VA2. With A0 logic high, the data from Channel B is read in the sequence, VB1 and VB2.
- CS** Chip Select. this active low input is connected to the CS pin of the AD7862 and the OE pins of the digital buffers. The AD7862 is selected, and the 74HC245 outputs are enabled, when this input is active.
- RD** Read. This active low logic input is connected to RD pin on the AD7862. This input is used in conjunction with A0 and CS to enable the data outputs.
- AGND** Analog Ground. These lines are connected to the AGND plane on the evaluation board.
- AV_{DD}** Analog +5V Supply. These lines are connected to the V_{DD} supply line on the board via LK10.
- +12V** +12V Supply. This line is connected to the +12V supply line on the board via LK5.

-12V

-12V Supply. This line is connected to the -12V supply line on the board via LK6.

Table II. 96-Way Connector Pin Functions.

	ROW A	ROWB	ROWC
1		FL1	
2		D 0	
3		D 1	
4	DGND	DGND	DGND
5		D 2	
6		D 3	
7		D 4	
8			
9	<u>RD</u>	D 5	
10		D 6	<u>CS</u>
11		D 7	
12	DGND	DGND	DGND
13		D 8	
14		D 9	
15		D 10	
16	DGND	DGND	DGND
17	FL0	D 11	<u>IRQ2</u>
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 seven input sockets relevant to the operation of the AD7862 on this evaluation board. The function of these sockets is outlined in Table III.

Table III. Socket Functions

Socket	Function
SMB1	Sub-Miniature BNC Socket for external VREF.
SMB2	Sub-Miniature BNC Socket for <u>CONVST</u> input.
SMB3	Sub-Miniature BNC Socket for A0 input.
VA1	Sub-Miniature BNC Socket for VA1 input.
VA2	Sub-Miniature BNC Socket for VA2 input.
VB1	Sub-Miniature BNC Socket for VB1 input.
VB2	Sub-Miniature BNC Socket for VB2 input.

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.

CONNECTORS

There are three connectors on the AD7862 evaluation board as outlined in Table IV.

TABLE IV. CONNECTOR FUNCTIONS

Connector	Function
J1	96-Way Connector for Parallel Interface connections.
J2	External +5V & AGND power connector.
J3	External +15V & -15V 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 for operating the AD7862 are provided by the EVAL-CONTROL BOARD when it is run under control of the AD7862 software which is provided with the AD7862 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-AD7862CB 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-AD7862CB. 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-AD7862CB

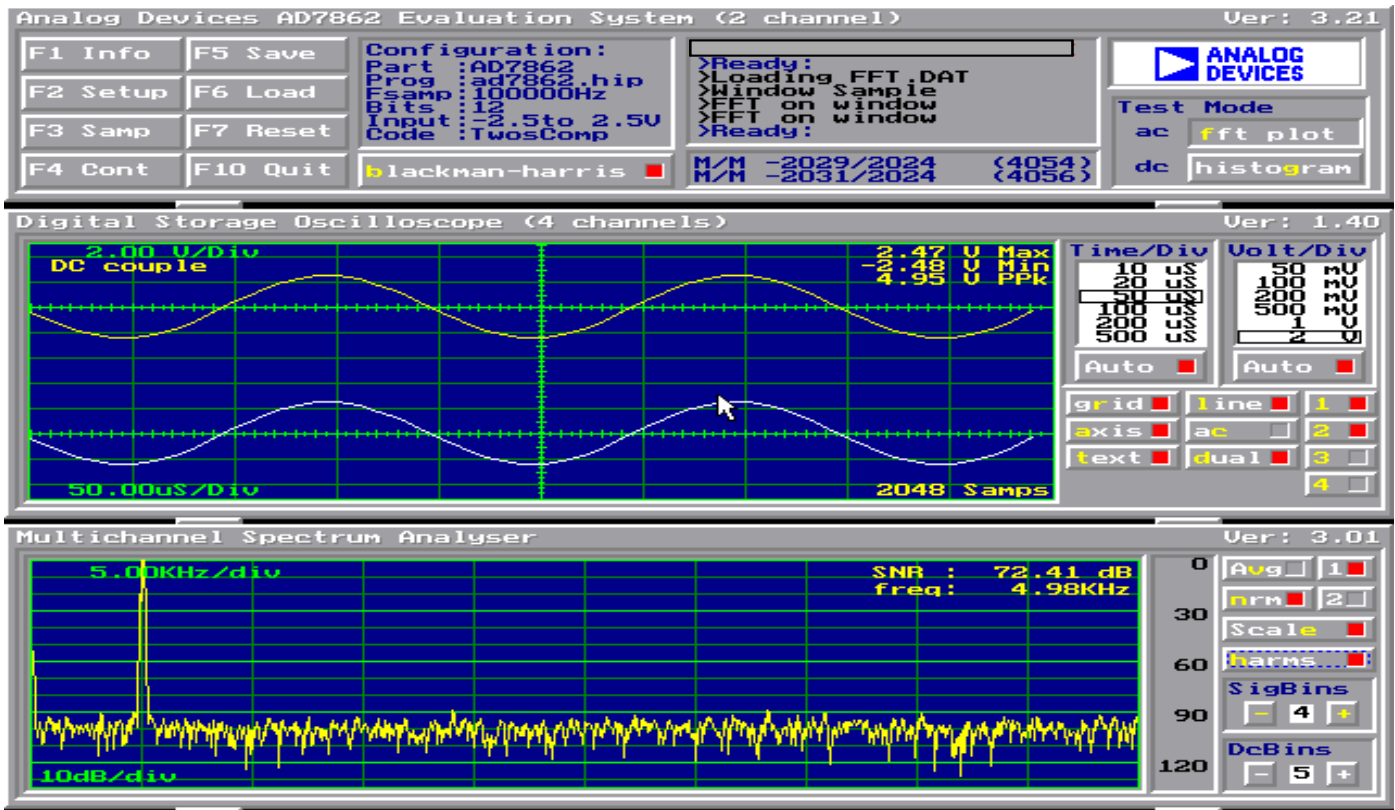


Figure 3. FFT Screen

SOFTWARE DESCRIPTION

Included in the EVAL-AD7862CB evaluation board package is a PC-compatible disk which contains software for controlling and evaluating the performance of the AD7862 when it is operated with the EVAL-CONTROL BOARD. The EVAL-AD7862CB 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 AD7862.

The disk which accompanies the EVAL-AD7862CB contains several files. The user should create a new directory on the main PC drive and label this "AD7862". Then, all files on the EVAL-AD7862CB 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 AD7862 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 AD7862 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 prog" 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 figure 4). This menu sets up the EVAL-CONTROL BOARD for use with the EVAL-AD7862CB.

Firstly, a configuration file must be chosen. 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 AD7862.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 prog" button is off, so when the configuration file is loaded, the .HIP file is automatically downloaded to the ADSP-2111. However, if the "no prog" button is on, then the .HIP file is not downloaded to the ADSP-2111.

There are two configuration files for the AD7862. These are 7862-10 and 7862-3 and each one is particular to one of the two versions of AD7862 device which are supplied with the EVAL-AD7862CB package. For example if the AD7862-3 part is being evaluated the mouse or the keyboard is used to highlight the "7862-3" option and the "load" button is pressed. The other configuration file option is chosen when evaluating the AD7862-10 version of the part.

After the configuration file is loaded, the sample rate and number of samples can be changed. The CONVST frequencies are limited to frequencies of the form 16 MHz/N, where N is an integer in the range 1 to 65536. If a frequency other than one of these frequencies is chosen, then the EVAL-CONTROL BOARD generates the next lowest available frequency.

The channel select section allows the user to select between the two analog input channels, Channel A and Channel B. Use the mouse to select either channel. Channel A is the default channel when any of the three configuration files are loaded.

The Analog In section allows the user to set the voltage range and offset of the analog input. These are all set automatically by loading the relevant configuration file.

The coding section allows the user to select between unipolar (straight binary coding) or bipolar (2's complement coding). This is also set automatically when the relevant configuration file is loaded.

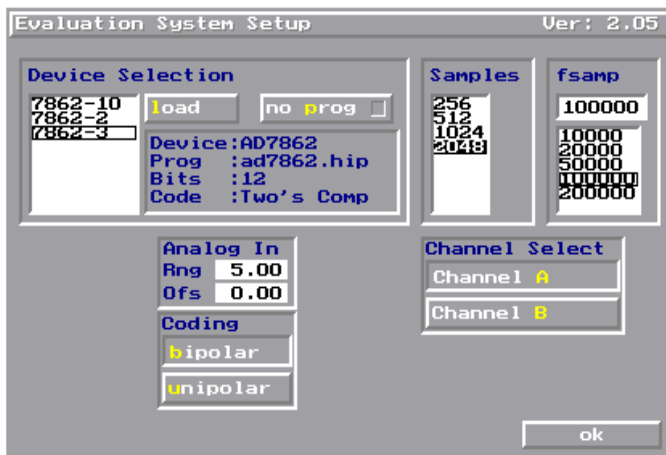


Figure 4. Setup Menu.

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. Activating this button provides information on the software.
- F2: Setup . Pressing this button pops up the Setup Menu. This menu is described above.
- F3: Samp. When this key is pressed, the software causes the AD7862 to perform a number of conversions as determined by the setup menu (see above). The data from these conversions is then analyzed by the AD7862 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 AD7862 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 prog" 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 AD7862 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 the 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 maximum and minimum values of the most recently captured samples.

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.
- histogram: Choosing this button causes the Histogram Analyzer to be displayed at the bottom of the screen.

There is one other button at the top of the screen. This is blackman-harris. When performing a fourier transform of the sampled data, this button determines if 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.

EVAL-AD7862CB

Digital Storage Oscilloscope.

When samples of data are captured, they are displayed on the Digital Storage Oscilloscope. If the blackman-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:

- grid 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.
- ac 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 ac display option is useful for zooming in on a low-level signal that has a large dc offset.
- dual When the "dual" 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 "dual" button is off, both traces are centered on the same horizontal axis.

- 1 This button toggles the sampled data trace for channel A on and off.
- 2 This button toggles the sampled data trace for channel B on and off.
- 3 This button toggles the windowed data trace for channel A on and off.
- 4 This button toggles the windowed data trace for channel B 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.

STORED DATA FORMAT.

Conversion data can be stored in a number of different formats for use at a later date or with other software. This is done by pressing the F5 function key as described earlier. The data stored in these files is in ASCII format with the samples from both channels interleaved in one column. This format is not compatible with spreadsheet software packages.

To split this information into two columns (one column for each channel), use the program CONVERT.EXE which is supplied on the diskette in the EVAL-AD7862CB evaluation board package. For example, if you want to convert the data in a file called "sample.dat" and store it in a new file called "2column.dat" use the following command.

```
convert sample.dat 2column.dat
```

The information in the "2column.dat" file will be split into two separate columns and can easily be read into a spreadsheet package.

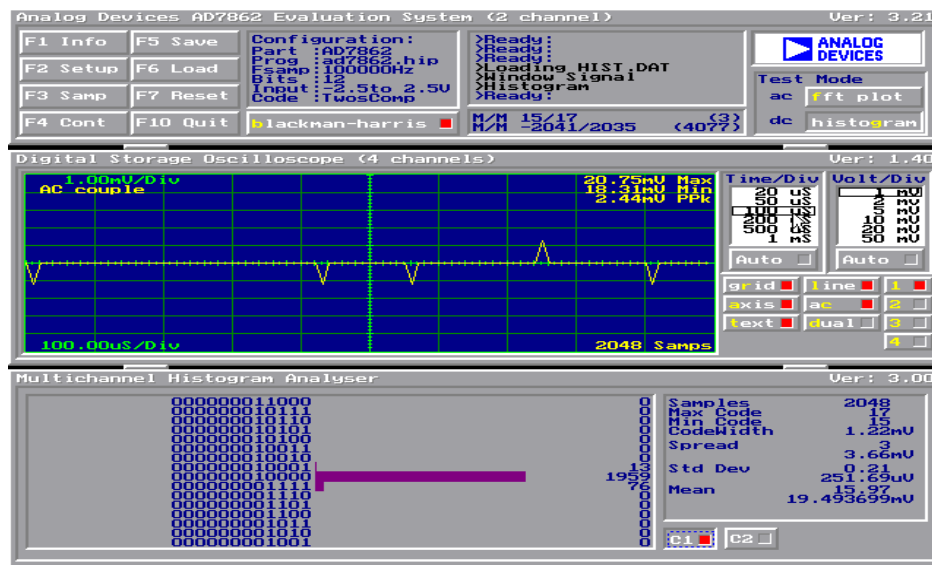


Figure 5. Histogram Screen.

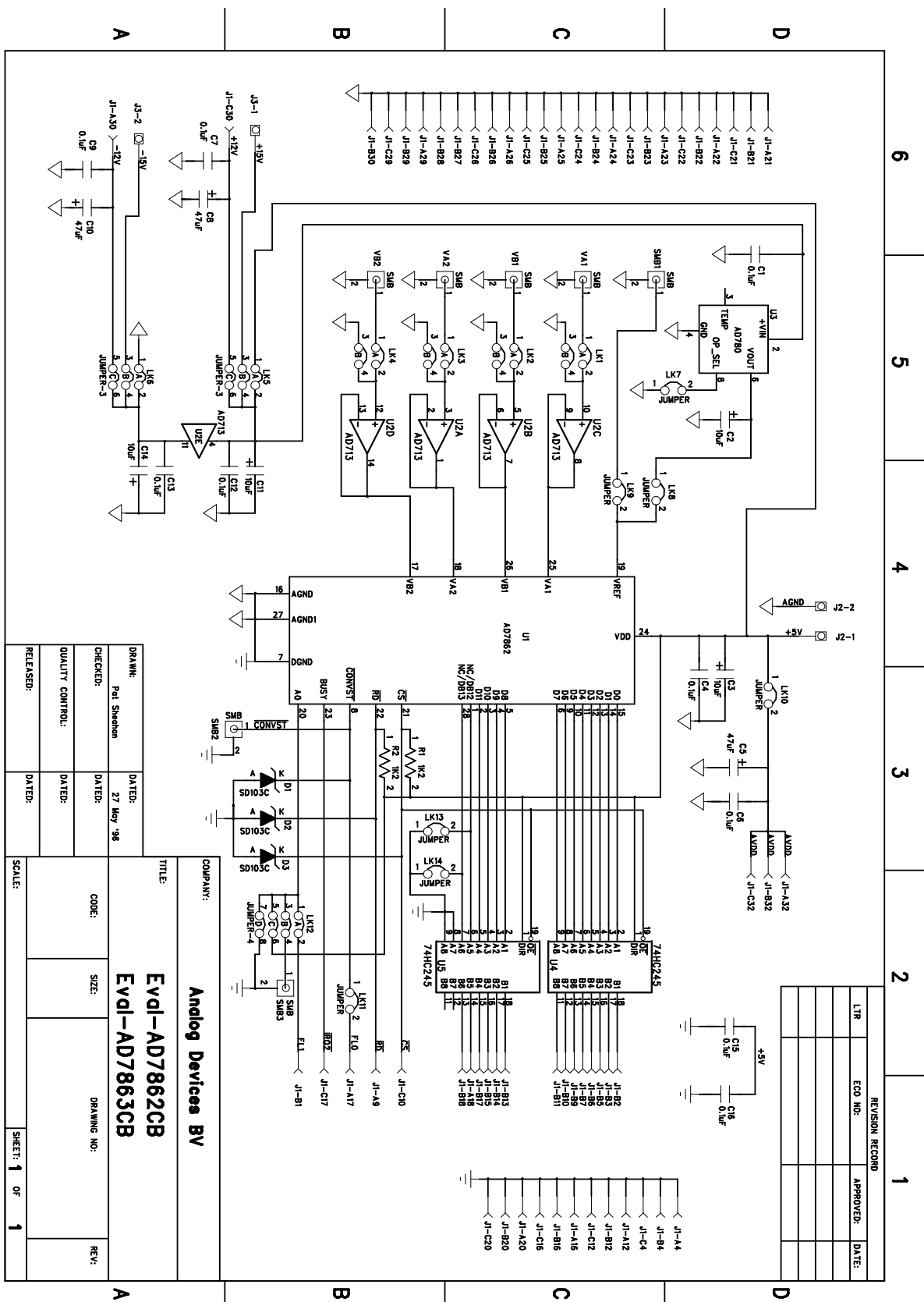


Figure 6. AD7862 Evaluation Board Circuit Diagram

COMPONENT LISTING AND MANUFACTURERS**Intergrated Circuits**

Component	Location	Vendor
AD7862AN-10	U1	Analog Devices
AD713	U2	Analog Devices
AD780	U3	Analog Devices
74HC245	U4 U5	Texas Instruments
SD103C	D1 D2 D3	Hewlett Packard

Capacitors

Component	Location	Vendor
0.1 μ F Ceramic(X7R \pm 20%)	C1 C4 C6 C7 C9 C12 C13 C15 C16	Philips Mftrs No. CW20C 104M
10 μ F \pm 20% Tantalum (16 V)	C2 C3 C11 C14	AVX- Kyocera Mftrs No TAG106MO16
47 μ F \pm 20% Tantalum (16 V)	C5 C8 C10	AVX- Kyocera Mftrs No TAG476MO16

Resistors

Component	Location	Vendor
1.2KW \pm 1% 0.25W	R1 R2	Multicomp

Link Options

Component	Location	Vendor
Pin Headers (2x2 way)	Lk1 Lk2 Lk3 Lk4	Harwin
Pin Headers (3x2 way)	Lk5 Lk6	Mftrs No. M20-9993606
Pin Headers (1x2 way)	Lk7 Lk8 Lk9 Lk10 Lk11 Lk13 Lk14	
Pin Headers (4x2 way)	Lk12	
Shorting Plugs	Pin Headers (14 required)	Harwin Mftrs No. M7571-05

Sockets

Component	Location	Vendor
SMB Connectors	SMB1 SMB2 SMB3 VA1-1 VA1-2 VB1-1 VB1-2	M/A - Com Greenpar Mftrs No. B65N07G999X99
96 Way 90° DIN41612 Plug	J1	Harting Mftrs No. 09031966921
2 Way Terminal Block	J2 J3	Bulgin RIA
Low profile socket	U1 - U5	Harwin (88 pins needed)Farnell No. 519-959

Component	Location	Vendor
Rubber Stick-on-feet	each corner	Farnell 148-922

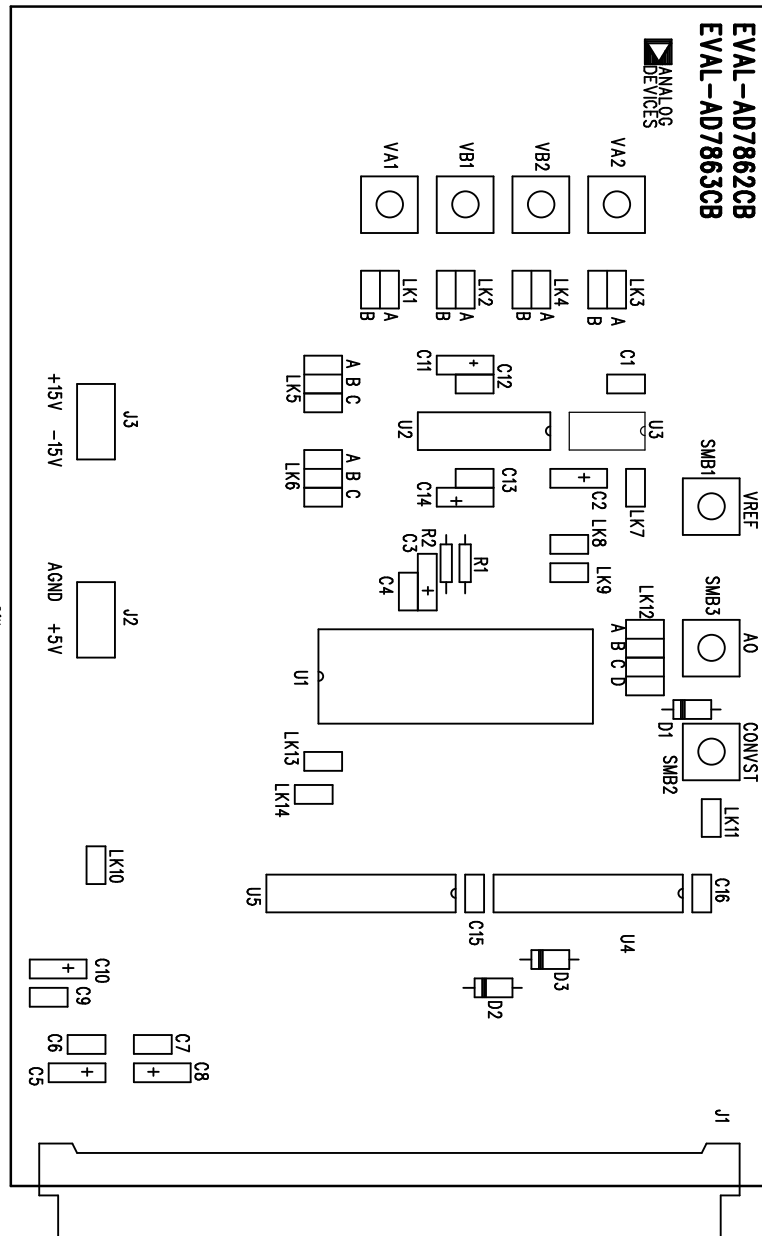


Figure 7. Component Layout Diagram