Evaluation Board for the AD7783, 24-Bit, Sigma Delta ADC

EVAL-AD7783-EB

FEATURES

Full-Featured Evaluation Board for the AD7783
On-Board Reference and Digital Buffers
Various Linking Options
PC Software for Control of AD7783

INTRODUCTION

This Technical Note describes the evaluation board for the AD7783, Low Voltage, Low Power, 24-Bit, Sigma Delta ADC. The AD7783 is a complete analog front end for low frequency measurement applications. The part does not require software control as all programmable functions are hardware controlled. The device can accept low level input signals directly from a transducer and produce a serial digital output. It employs a sigma-delta conversion technique to realize up to 24 bits of no missing codes performance. The input signal is applied to a proprietary programmable gain front end based around an analog modulator. The modulator output is processed by an on-chip digital filter. The analog input channel can accept analog input signals of ±160 mV or ±2.56 V. Full data on the AD7783 is available in the AD7783 datasheet available from Analog Devices and should be consulted in conjunction with this Technical Note when using the evaluation board.

The evaluation board interfaces to the parallel port of an IBM compatible PC. Software is available with the evaluation board which allows the user to easily communicate with the AD7783.

Other components on the AD7783 Evaluation Board include an AD780 (precision 2.5V reference), a 32.7680 kHz crystal and digital buffers to buffer signals to and from the PC.

OPERATING THE AD7783 EVAL BOARD

Power Supplies

This evaluation board has four power supply inputs: V_{DD}, GND, DV_{DD} and DGND. An external +5V must be applied between V_{DD} and GND which is used to provide the V_{DD} for the AD7783, the reference and some digital buffers. Digital Power connections can be obtained via the edge connector or they can be derived from V_{DD}. The DV_{DD} is used to provide the DV_{DD} for the AND gates. DGND and GND are connected together at the AD7783 GND pin. Therefore, it is recommended not to connect GND and DGND elsewhere in the system.

All power supplies are decoupled to their respective grounds. V_{DD} is decoupled using a 10µF tantalum capacitor and 0.1µF ceramic capacitor at the input to the evaluation board. It is again decoupled using 0.1µF capacitors as close as possible to each device.

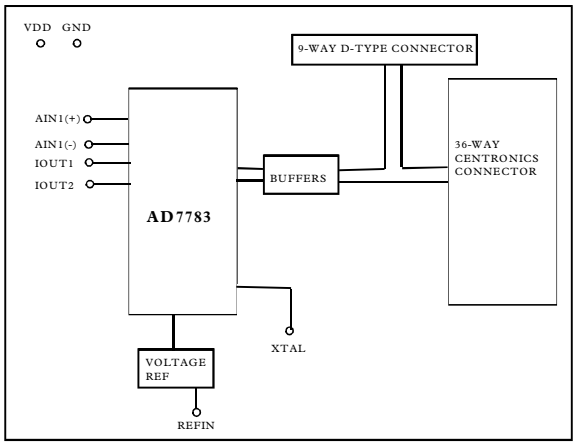

Fig. 1. Evaluation Board Set-up

REV. 0

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LINK AND SWITCH OPTIONS

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

Link No.	Function
LK1-LK2	These links are in series with the AIN analog inputs. With these links in place, the analog inputs on the relevant SKT input is connected directly to the respective AIN input on the part. For example, with LK1 in place, the analog input applied to SKT1 is connected directly to AIN(+) of the AD7783.
LK3	This link is irrelevant when operating the AD7783.
LK4	This link is irrelevant when operating the AD7783.
LK5	This link is in position "B" permanently. The current source at IOUT1 is available at J5. With LK10 and LK11also in place and LK8 in position "B", the current source at IOUT1 can be used to generate the reference to the AD7783 via the 6 kW resistor.
LK6	This link is in position "B" permanently. The current source connected to IOUT2 is available at J6.
LK7	This link is used to select the reference source for the REFIN(+) input of the AD7783. With this link in position "A", REFIN(+) is connected to the output of the on-board reference (AD780 - U2). With this link in position "B", REFIN(+) is connected to V_{DD}. When both link '"A" and link "B" are open, REFIN(+) is connected to J7. An external voltage applied to J7 can now be used as the REFIN(+) for the AD7783. With links LK9 and LK10 in place and LK8 in position "B", the current source at IOUT1 generates the reference for the AD7783.
LK8	This link is used to select the reference source for the REFIN(-) input of the AD7783. With this link in position "A", REFIN(-) is connected directly to J8. An external voltage applied to J8 can now be used as the REFIN(-) for the AD7783. With this link in position "B", the reference is generated from IOUT1 if links LK9 and LK10 are in place. With this link in position "C", the REFIN(-) is connected to GND.
LK9	This link must be closed if the reference for the AD7783 is being derived from the AD7783's current source. If the reference is being derived from another source, this link must be left open.
LK10	This link must be closed if the reference for the AD7783 is being derived from the AD7783's current source. If the reference is being derived from another source, this link must be left open.
LK11	This link must be closed if the reference for the AD7783 is being derived from the AD7783's current source. If the reference is being derived from another source, this link must be left open.
LK12	This link connects V_{DD} to DV_{DD}. The link is closed when a logic power supply is not available from P3 or P2.

The AD7783 has five on-board switches. The functions of these switches are outlined below.

Switch	Function
S1	This switch connects the MODE pin to V_{DD} or GND. With S1 in position '"A", the AD7783 is tied to V_{DD} and is configured for slave mode. With S1 in position "B", MODE is tied to GND and the AD7783 is configured for master mode. The AD7783 software assumes that the AD7783 is configured for slave mode.
S2	This switch connects IPIN to V_{DD} or GND. With S2 in position "A", IPIN is connected to V_{DD} so that IEXC1 is routed to IOUT2 and IEXC2 is routed to IOUT1. With S2 in position "B", IPIN is connected to GND so that IEXC1 is routed to IOUT1 and IEXC2 is routed to IOUT2.
S3	This switch connects RANGE to V_{DD} or GND. With S3 in position "A", RANGE is tied to V_{DD} and the fullscale analog input range is $\pm$2.56 V. With S3 in position "B", RANGE is tied to GND and the fullscale analog input range is $\pm$160 mV.
S4A/S4B	These switches are used to select the clock source for XTAL1. With both switches in position "A", XTAL1 is connected to J9. An external clock source can be connected to J9.

With both switches in position "B", the on-board 32.768 kHz crystal is used as the clock source to the AD7783.

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 1 shows the position in which all the links are set when the evaluation board is sent out.

Table 1: Initial Link and Switch Positions

Link No.	Position	Function
LK1-LK2	IN	Connects analog inputs from J1 and J2 to the input pins AIN(+) and AIN(-).
LK3-LK4	OUT	These links are irrelevent when operating the AD7783.
LK5	B	IOUT1 is connected to J5.
LK6	B	IOUT2 is connected to J6.
LK7	A	The on-board reference (U2) provides the reference voltage for the REFIN(+) input of the AD7783.
LK8	C	This connects the REFIN(-) input of the AD7783 to GND.
LK9	OUT	Since the AD780 is providing the reference, this is open.
LK10	OUT	Since the AD780 is providing the reference, this link is open.
LK11	OUT	Since the AD780 is providing the reference, this link is open.
LK12	IN	V_{DD} is connected to DV_{DD}.
S1	A	The AD7783 is operated in slave mode.
S2	A	IEXC1 is routed to IOUT2 and IEXC2 is routed to IOUT1.
S3	A	The part is configured to operate with a fullscale analog input range of $\pm$2.56 V.
S4A/S4B	B	The on-board 32.768 kHz crystal provides the clock for the AD7783.

EVALUATION BOARD INTERFACING

Interfacing to the evaluation board is via either a 9-way d-type connector, P3 or a 36-way centronics connector, P2. The pin-out for the P3 connector is shown in Fig. 2 and its pin designations are given in Table 2. The pin-out for the P2 connector is shown in Fig. 3 and its pin designations are given in Table 3.

P2 is used to connect the evaluation board to the parallel (printer) port of a PC. Connection is via a standard printer cable. P3 is used to connect the evaluation board to any other system. The evaluation board should be powered up before a cable is connected to either of these connectors.

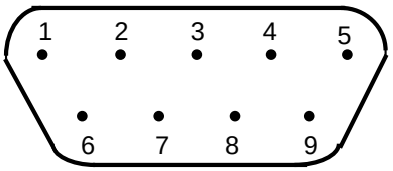

Fig. 2: Pin Configuration for the 9-Way D-Type Connector, P3.

Table 2.: P3 Pin Description [1]

1	SCLK	Serial Clock. The signal on this pin is buffered before being applied to the SCLK pin of the AD7783.
2	$\overline{RDY}$	Logic output. This is a buffered version of the signal on the AD7783 $\overline{RDY}$ pin
3	$\overline{CS}$	Chip Select. The signal on this pin is buffered before being applied to the $\overline{CS}$ pin on the AD7783.
4	NC	Not Connected.
5	NC	Not Connected.
6	GND	Ground reference point for the AND gates. Connects to the GND plane on the Evaluation board.

7 DOUT Serial Data Output. This is a buffered version of the signal on the AD7783 DOUT pin.

8 DV_{DD} Digital Supply Voltage. If link LK12 is open, the voltage applied to this pin will supply the DV_{DD} for the digital AND gates.

9 NC Not Connected.

Note

[1] An explanation of the AD7783 functions mentioned here is given in Table 3 as part of the P2 pin descriptions.

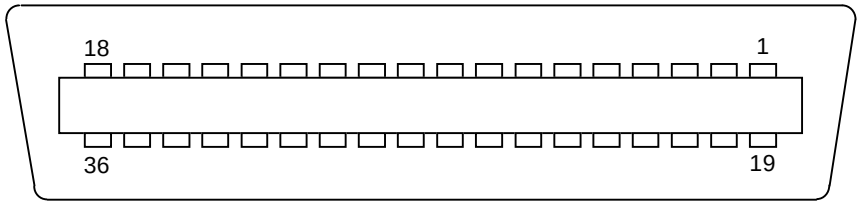

Fig. 3: 36-way Centronics (P2) Pin Configuration

Table 3: 36-Way Connector Pin Description

1	NC	No Connect. This pin is not connected on the evaluation board.
2	NC	No Connect. This pin is not connected on the evaluation board.
3	NC	No Connect. This pin is not connected on the evaluation board.
4	$\overline{CS}$	Chip Select/Powerdown. The signal on this pin is buffered before being applied to the $\overline{CS}$ pin of the AD7783. $\overline{CS}$ is an active low Logic Input used to select the AD7783. When $\overline{CS}$ is low, the AD7783 begins converting. When $\overline{CS}$ is high, the AD7783 is placed in powerdown mode with SCLK and DOUT three-stated.
5	SCLK	Serial Clock. The signal on this pin is buffered before being applied to the SCLK pin of the AD7783. An external serial clock is applied to this input to read serial data from the AD7783. This serial clock can be continuous with all data transmitted in a continuous train of pulses. Alternatively, it can be non-continuous with the information being transmitted from the AD7783 in smaller batches of data.
6-8	NC	No Connect. These pins are not connected on the evaluation board.
9	DV_{DD}	Digital Supply Voltage. This provides the supply voltage for the digital chip U4, which buffers the SCLK and $\overline{CS}$ signals between the AD7783 and P2 when link LK12 is open.
10	$\overline{RDY}$	Logic output. This is a buffered version of the RDY signal from the AD7783's DOUT/$\overline{RDY}$ pin. A logic low on this output indicates that the ADC has valid data in its data register. The $\overline{RDY}$ pin will return high upon completion of a read operation of a full output word. If data is not read $\overline{RDY}$ will return high prior to the next update indicating to the user that a read operation should not be initiated.
11-12	NC	No Connect. These pins are not connected on the evaluation board.
13	DOUT	Serial Data Output. This is a buffered version of the DOUT signal from the AD7783's DOUT/$\overline{RDY}$ pin, the serial data being obtained from the output shift register on the AD7783.
14-18	NC	No Connect. These pins are not connected on the evaluation board.
19-30	DGND	Ground reference point for digital circuitry. Connects to the GND plane on the evaluation board.
31-36	NC	No Connect. These pins are not connected on the evaluation board.

SOCKETS

There are nine sockets relevant to the operation of the AD7783 on this evaluation board. The functions of these sockets are outlined in Table 4.

Table 4. Socket Functions

Socket	Function
J1	Sub-Miniature BNC (SMB) Connector. The analog input signal for the AIN(+) input of the AD7783 is applied to this socket.
J2	Sub-Miniature BNC (SMB) Connector. The analog input signal for the AIN(-) input of the AD7783 is applied to this socket.
J3	Not used for evaluating the AD7783.
J4	Not used for evaluating the AD7783.
J5	Sub-Miniature BNC (SMB) Connector. The output from IOUT1 is available from this socket.
J6	Sub-Miniature BNC (SMB) Connector. The output from IOUT2 is available from this socket.
J7	Sub-Miniature BNC (SMB) Connector. The voltage for the REFIN(+) input of the AD7783 is applied to this socket.
J8	Sub-Miniature BNC (SMB) Connector. The voltage for the REFIN(-) input of the AD7783 is applied to this socket.
J9	Sub-Miniature BNC (SMB) Connector. The master clock signal for the XTAL1 input of the AD7783 is applied to this socket when the board is configured for an externally applied master clock.The AD7783 can be operated with internal clock frequencies in the range 32.768 kHz +/- 10%.

CONNECTORS

There are three connectors on the AD7783 evaluation board as outlined in Table 5.

Table 5. Connector Functions

Connector	Functions
P1	PCB Mounting Terminal Block. The Power Supply for the AD7783, reference and some digital chips must be provided via this Connector.
P2	36-way centronics connector used to interface to PC via parallel printer port.
P3	9-way D-Type connector used to interface to other systems.

AD7783 SOFTWARE DESCRIPTION

The AD7783 evaluation board is shipped with a CD-ROM containing software that can be installed onto a standard PC to control the AD7783.

The software uses the printer port of the PC to communicate with the AD7783, so a Centronics printer cable is used to connect the PC to the evaluation board.

Software Requirements and Installation

The software runs under Windows ME 2000 NT™ and typically requires 8Mb of RAM.

To install the software the user should start Windows and insert the CD-ROM disc. The installation software should launch automatically. It not, use Windows Explorer to locate the file 'setup.exe' on the CD-ROM. Double clicking on this file will start the installation procedure. The user is prompted for a destination directory which is "C:\Program Files\Analog Devices\AD7783" by default. Once the directory has been selected the installation procedure will copy the files into the relevant directories on the hard drive. The installation program will create a Program Group called "Analog Devices" with sub-group 'AD7783' in the "Start" taskbar. Once the installation procedure is complete the user can double click on the AD7783 icon to start the program.

Features of the Software

1. The software will allow the user to read conversion data from the AD7783.

2. Data can be read from the AD7783 and displayed or stored for later analysis.

3. The data that has been read can be exported to other packages such as Mathcad or Excel for further analysis.

What follows is a description of the various windows that appear while the software is being used. Fig. 4. shows the main screen that appears once the program has started. The printer port that will be used by the software is determined automatically. There are three possible printer ports that can be handled by the software, LPT1 (standard), LPT2 and PRN. The user can change to another printer port by clicking on the 'Printer Port' dropdown menu. A brief description of each of the dropdown menus on the main screen follows:

File	Allows the user to - read in previously stored data for display or analysis, - write the current set of data to a file for later use, - exit the program.
Read Data	Allows the user to read a number of samples from the AD7783. These samples can be stored for further analysis or just displayed for reference.
Noise Analysis	Allows the user to perform noise analysis on the data that has been read in from the ADC.
Printer Port	Allows the user to select any of the three printer ports.
Help	Provides information on the revision of software being used.

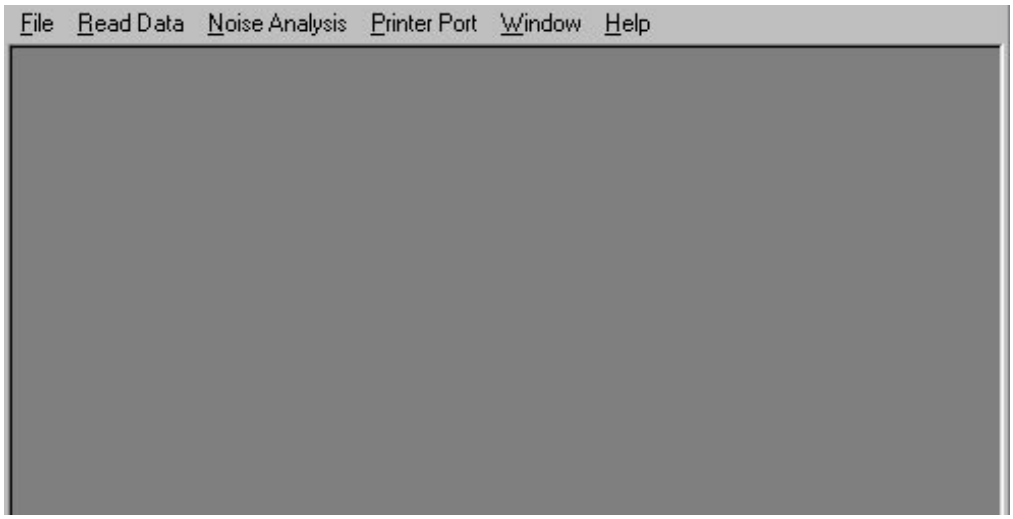

Fig. 4. The Main Screen

The Read Data from ADC Screen

Fig. 5. shows the ADC Read Data screen. This is where the user can read a number of samples from the AD7782 ADC. The user has the option of either reading data for analysis or display.

When the Read For Analysis button is selected the software will read the required number of samples from the AD7782 ADC and store them in an array so that they can be graphed or analysed later. It is possible to read and graph up to 5000 samples at any one time. The read can be interrupted with a user key press.

When the Read for Display button is selected the software will read one sample from the AD7782 and display its value in the Current Code text box. The software will continue to read and display the samples until a key has been pressed. It is possible to add a delay to the read cycle by entering the required number of milliseconds between reading samples. It should be noted however that the accuracy of the time delay can be affected by other programs running under Windows, therefore this method is not suitable where equidistant sampling is required.

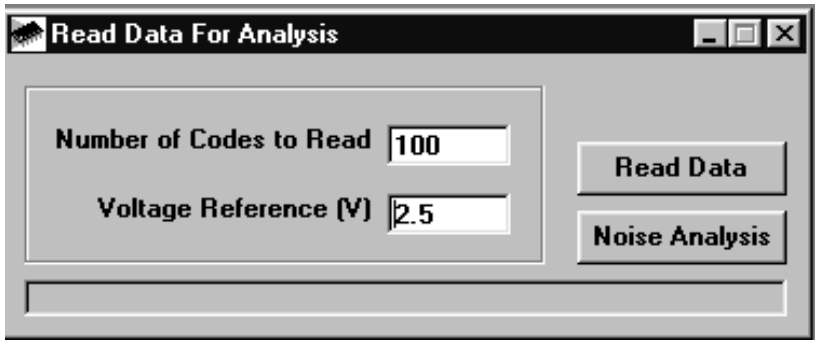

Fig. 12. The Read Data from Main ADC Screen

The Noise Analysis Screen

Once data has been read from the AD7782 ADC, it is possible to perform some analysis on it. Fig. 6 shows the ADC Noise Analysis Screen. This screen displays the maximum and minimum codes read from the AD7782 ADC (in decimal and hexadecimal), as well as the average code, the average value and the RMS and Peak-Peak noise values. From this screen it is possible to display the data on a graph or as a histogram of codes. Figures 7 & 8 show the Graph and Histogram screens.

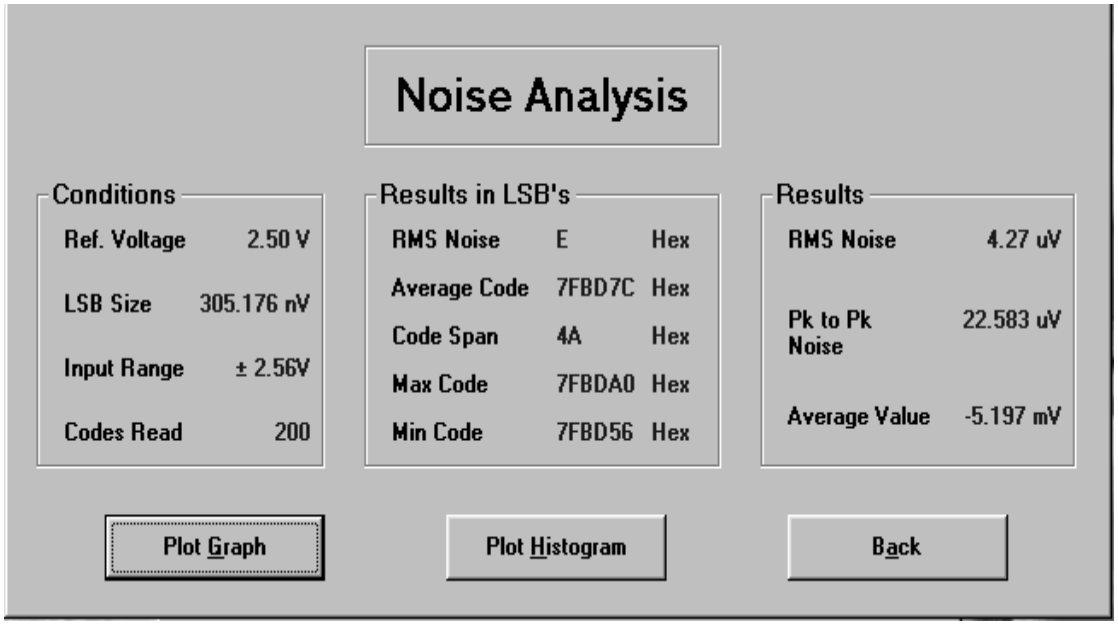

Fig. 6. The ADC Noise Analysis Screen

The Graph Screen

Fig. 7 shows the Graph Screen. This screen displays the data in a graph format.

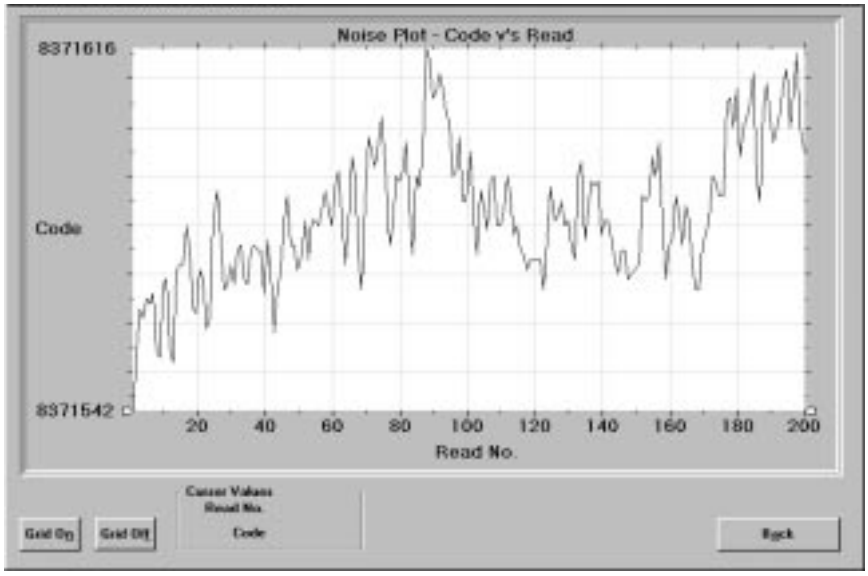

Fig. 7. The Graph Screen

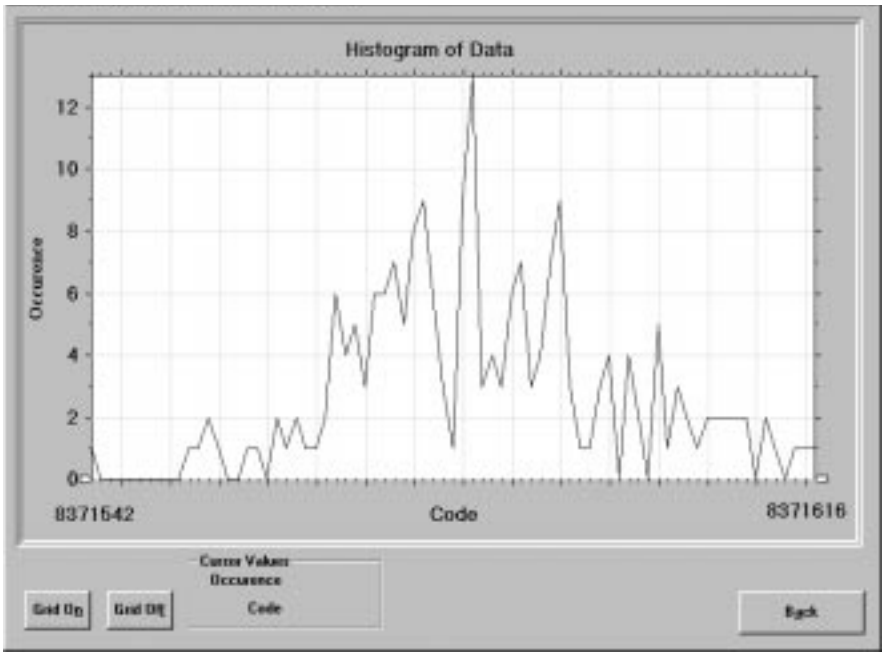

Fig. 8. The Histogram Screen

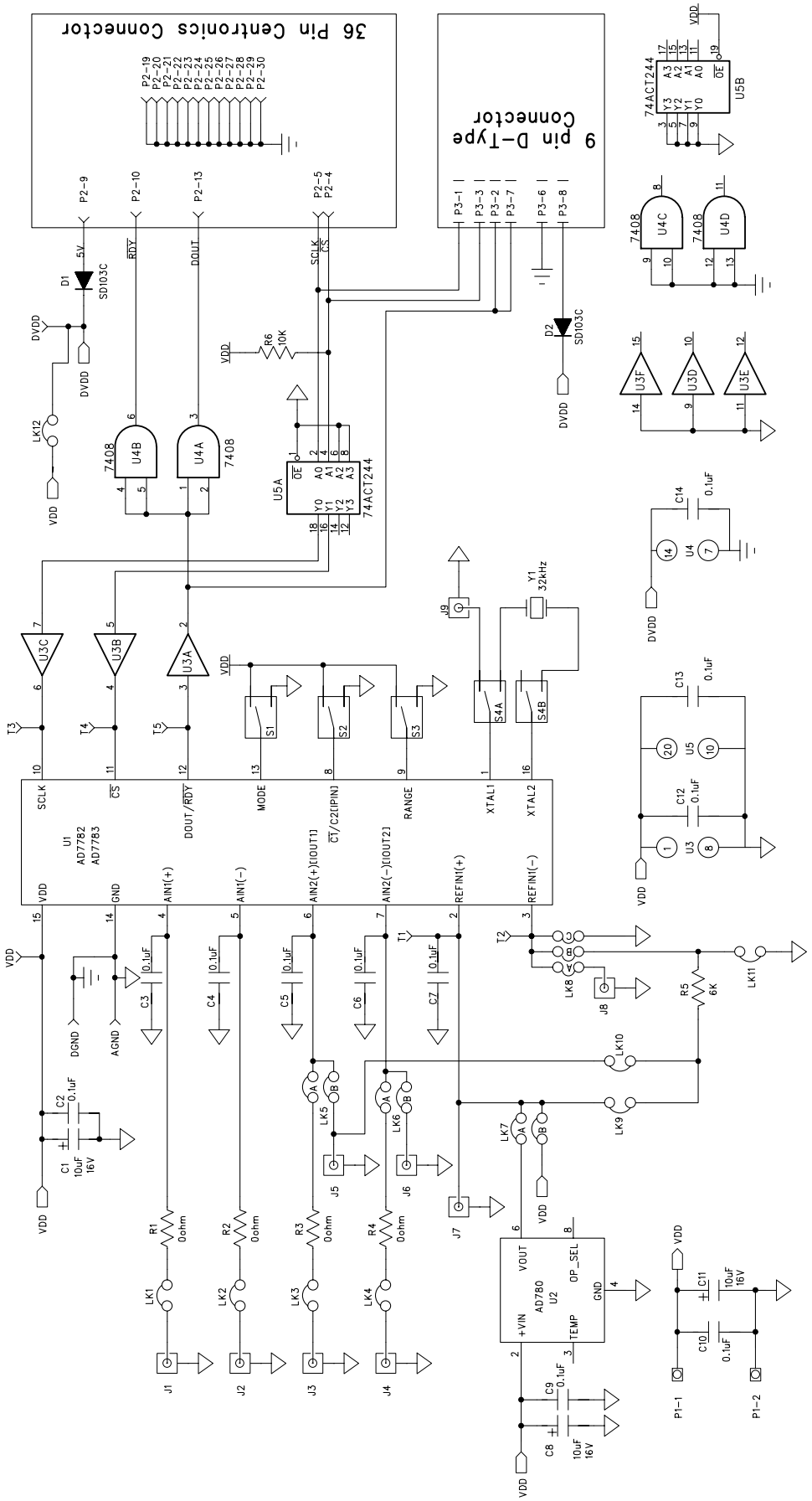

Fig. 21. The Evaluation Board Schematic

Table 6. Component Listing and Manufacturers

INTEGRATED CIRCUITS

Component	Location	Vendor
AD7783	U1	Analog Devices
AD780AR	U2	Analog Devices
MM74HC4050M	U3	Fairchild Semiconductor
MM74C08M	U4	Fairchild Semiconductor
CD74ACT244M	U5	Texas Instruments
SD103C	D1/D2	Diodes Inc.

CAPACITORS

Component	Location	Vendor
10µF ± 20% Tantalum (16 V)	C1 C8 C11	AVX-Kyocera
0.1µF Ceramic (0805 SMD)	C2-C7 C9-C10 C12-C14	FEC No. 499-687

RESISTORS

Component	Location	Vendor
Short Circuits	R1-R4	Multicomp
6kW SMD Resistor	R5	Multicomp
10kW SMD Resistor	R6	Multicomp

LINK OPTIONS

Component	Location	Vendor
Pin Headers	Lk1-Lk4 Lk9-Lk12 (1x2 way) Lk5-Lk7 (2x2 way) Lk8 (3x2 way)	Harwin Mftrs No. M20-9983606
Shorting Plugs	Pin Headers (12 required)	Harwin Mftrs No. M7571-05

SWITCH

Component	Location	Vendor
Button Switch	S1-S3	ERG Components
Dual Button Switch	S4	ERG Components

SOCKETS

Component	Location	Vendor
SMB Connectors	J1-J9	M/A - Com Greenpar Mftrs No. B65N07G999X99
2 Way Terminal Block	P1	Augat
36 Way Centronics Connector	P2	Multicomp
9-Way D-Type Connector	P3	McMurdo Mftrs No. SDE9PNTD

CRYSTAL OSCILLATOR

Component	Location	Vendor
32.768 kHz Oscillator	Xtal 1	CMAC FEC No. 221-533

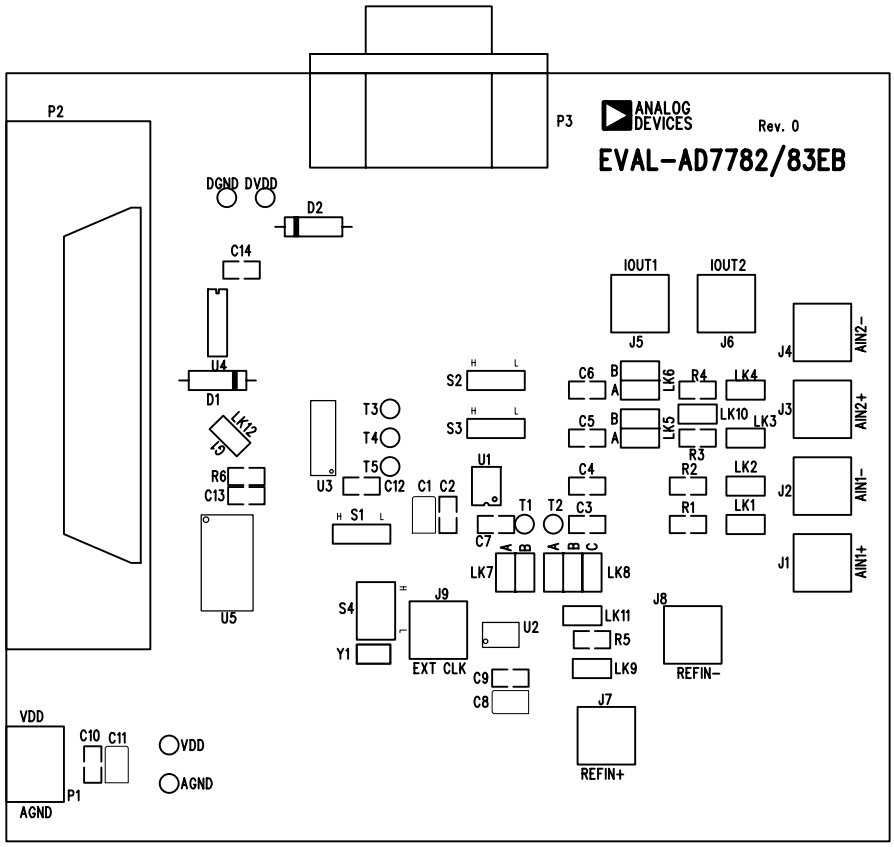

Fig. 22. The Evaluation Board Component Layout Diagram

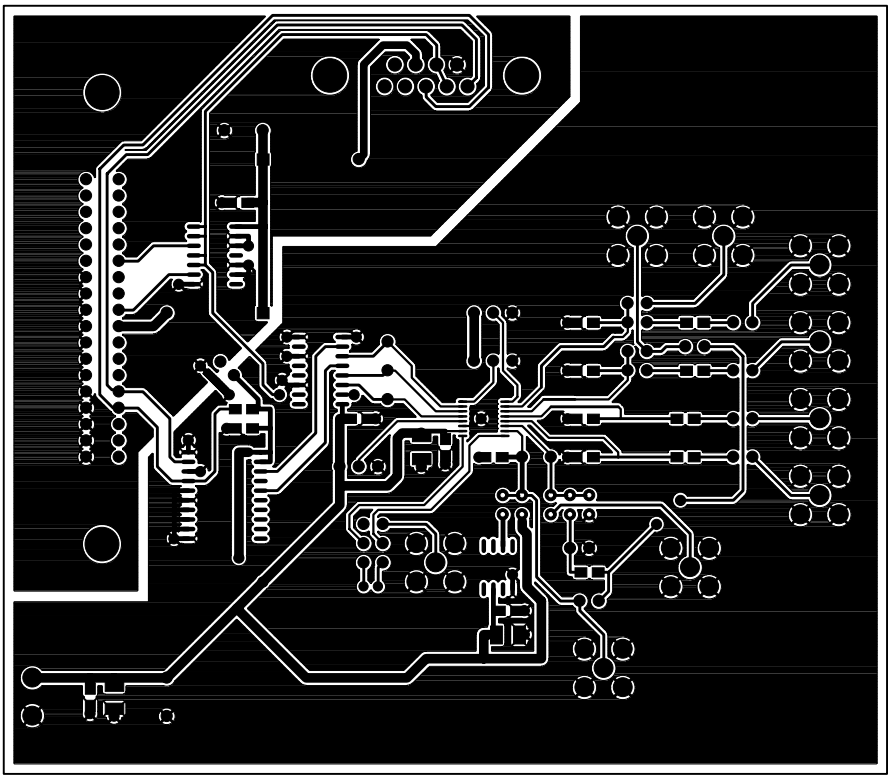

Fig. 23. The Evaluation Board Component Side Artwork

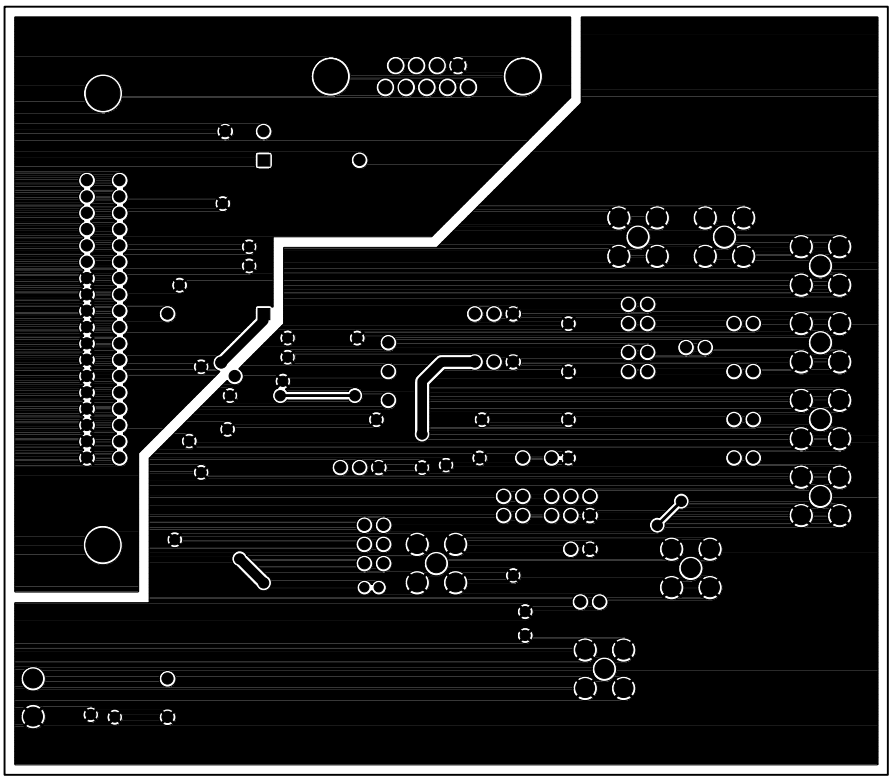

Fig. 23. The Evaluation Board SolderSide Artwork