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Evaluation Board for the AD7780 24-Bit, Pin-Programmable, Low Power, Sigma-Delta ADC

FEATURES

Full-featured evaluation board for the AD7780
Standalone USB interface
Various linking options
PC software for control of AD7780

GENERAL DESCRIPTION

This user guide describes the evaluation board for the AD7780 which is a pin-programmable, low power, 24-bit sigma-delta (Σ-Δ) ADC. The AD7780 is a complete analog front end for low frequency measurement applications such as bridge sensor systems. It contains one differential input and includes a low noise instrumentation amplifier. The output data rate can be programmed to 10 Hz or 16.7 Hz. The AD7780 also has an on-board clock, eliminating the need for an external clock. It employs a Σ-Δ conversion technique to realize up to 24 bits of no missing codes performance. The input signal is applied to an analog modulator. The modulator output is processed by an on-chip digital filter. The analog input channel of the AD7780 accepts analog input signals of $\pm V_{REF}$ or $\pm V_{REF}/128$. With the update rate programmed to 10 Hz, the rms noise is 44 nV when the gain is 128. Simultaneous 50 Hz/60 Hz rejection is available at both output data rates.

Full data on the AD7780 is available in the AD7780 data sheet available from Analog Devices, Inc., and should be consulted in conjunction with this user guide when using the evaluation board.

The evaluation board interfaces to the USB port of an IBM®-compatible PC. Software is available with the evaluation board that allows users to easily communicate with the AD7780.

Note that the AD7780 evaluation board software should be installed before connecting the AD7780 evaluation board to the PC.

Another component on the AD7780 evaluation board is the ADP3303 high precision, low power, 3.3 V output voltage regulator, which is used to power the USB/SPI interface.

FUNCTIONAL BLOCK DIAGRAM

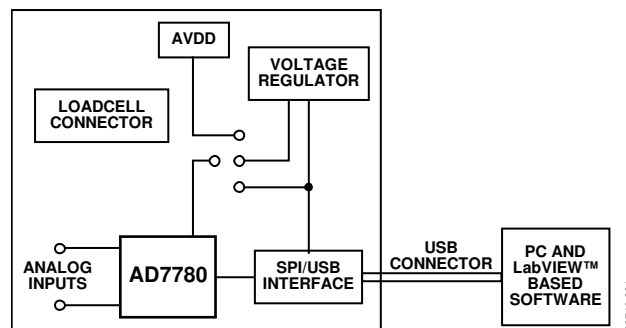*Figure 1.*

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REVISION HISTORY

2/10—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

POWER SUPPLIES

The AD7780 evaluation board is powered via the 5 V supply from the USB connector, J1. This 5 V supply can be used to power the AD7780 directly. A 3.3 V regulated voltage from the on-board ADP3303 (a high precision, low power, 3.3 V output voltage regulator) can also be used. Alternatively, the AD7780 can be powered using an external 3 V or 5 V power supply via J2.

LINKS

There are sixteen groups of link options that must be set for the required operating setup before using the evaluation board. The functions of these link options are outlined in Table 1.

Table 1. Evaluation Board Link Settings

Link	Default	Description
LK1, LK2	In	These links are used to connect the AIN(+) and AIN(−) inputs to $AV_{DD}/2$. With this configuration, a noise analysis can be performed. With these links removed, an external voltage may be applied to AIN using the SMB connectors.
LK3, LK4	In	With LK3 and LK4 in place, AV_{DD} is used as the reference to the AD7780. REFIN(+) is connected to AV_{DD} and REFIN(−) is connected to GND. To use another reference source, remove LK3 and LK4.
LK5	3.3 V	LK5 is used to select the power source for AV_{DD} on the AD7780.
		In Position A, LK5 selects an external power supply, supplied via J2.
		In Position B, LK5 selects the 3.3 V regulated output from the on-board ADP3303 voltage regulator.
		In Position C, LK5 selects the 5 V supply from the USB connector, J1.
LK6 to LK11	In	These links connect the serial interface pins of the AD7780 to the SPI interface of the microcontroller. The links should be in place to use the AD7780 evaluation board software. With these links removed, the AD7780 can be interfaced to an external microcontroller.
LK12, LK13, LK14	In	These links are used for the bridge power-down switch. With LK12 inserted, the bridge power-down switch is connected to AV_{DD} through an LED. When the bridge power-down switch is closed, the LED turns on. LK13 should be open when LK12 is inserted.
		LK13 and LK14 are used when a load cell is connected to Header J4. LK12 should be left open. With LK13 inserted, the bridge power-down switch is connected to Header J4. The low side of the load cell can be connected to GND through the bridge power-down switch. With LK14 inserted, the low side of the load cell is connected directly to GND. The REFIN(−) terminal should be shorted to the GND/PSW terminal on Header J4 to enable the previous functions.
LK15	10 Hz	LK15 is used to select the output data rate for the AD7780. With LK15 in Position 10 Hz, the output data rate is set to 10 Hz. When LK15 is in Position 16.7 Hz, the output data rate is set to 16.7 Hz.
LK16	128	LK16 is used to select the gain of the AD7780. With LK16 in Position 1, the gain is set to 1. With LK16 in Position 128, the gain of the AD7780 is set to 128.

SETUP CONDITIONS

Take care before applying power and signals to the evaluation board to ensure that all link positions are set per the required operating mode. Table 2 shows the position in which all the links are initially set.

SOCKETS

There are five sockets relevant to the operation of the AD7780 on this evaluation board. The functions of these sockets are outlined in Table 3.

Table 2. Initial Links and Positions

Link No.	Position	Function
LK1, LK2	In	AIN(+) and AIN(−) are shorted to $AV_{DD}/2$.
LK3, LK4	In	The reference voltage is set to 3.3 V (AV_{DD}).
LK5	B	The 3.3 V supply is used as AV_{DD} for the AD7780.
LK6 to LK11	In	The AD7780 is interfaced to the on-board microcontroller.
LK12	In	The bridge power-down switch is connected to AV_{DD}.
LK13	Out	The bridge power-down switch is disconnected from Header J4.
LK14	In	Terminal GND/PSW of Header J4 is connected to GND.

Table 3. Socket Functions

Socket	Description
AIN+	Subminiature BNC (SMB) connector. The analog input signal for the AIN(+) input of the AD7780 is applied to this socket.
AIN−	Subminiature BNC (SMB) connector. The analog input signal for the AIN(−) input of the AD7780 is applied to this socket.
REFIN+	Subminiature BNC (SMB) connector. This socket is used in conjunction with REFIN− to apply an external reference to the AD7780. The voltage for the REFIN(+) input of the AD7780 is applied to this socket.
REFIN−	Subminiature BNC (SMB) connector. This socket is used in conjunction with REFIN+ to apply an external reference to the AD7780. The voltage for the REFIN(−) input of the AD7780 is applied to this socket.
J4	6-pin terminal block. This is used to connect an external load cell to the AD7780 evaluation board.

INTERFACING TO THE EVALUATION BOARD

Interface to the evaluation board via a standard USB connector, J1. J1 is used to connect the evaluation board to the USB port of a PC. A standard USB connector cable is included with the AD7780 evaluation board to allow the evaluation board to interface with the USB port of the PC. Because the board is powered via the USB connector, there is no need for an external power supply, although if preferred, one may be connected via J2.

Communicate between the AD7780 and the PC via the USB/SPI interface. The on-board USB controller (U2) handles this communication.

To set up the USB/SPI interface, use the following procedure:

1. Install the AD7780 evaluation board software using the supplied AD7780 evaluation board CD before connecting the board to the PC.
2. After the AD7780 evaluation board software is installed, connect the board to the PC via J1 on the AD7780 evaluation board and via the USB port on the PC using the supplied USB connector cable. The PC automatically finds the new USB device and identifies it as the **AD779x Evaluation Board**.
3. Follow the on-screen instructions that appear. During the installation process, if the **Hardware Installation Wizard** appears as shown in Figure 2, click **Continue Anyway** to complete the installation of the AD7780 evaluation board.

Figure 2. Hardware Installation Window

EVALUATION BOARD SOFTWARE

SOFTWARE DESCRIPTION

The AD7780 evaluation board is shipped with a CD containing software that can be installed onto a standard PC to control the AD7780. The software communicates with the AD7780 through the USB cable, which accompanies the board. The software allows you to read conversion data from the AD7780. Data can be read from the AD7780 and displayed or stored for later analysis. For further information, see the AD7780 data sheet available from Analog Devices.

INSTALLING THE SOFTWARE

Use the following steps to install the software:

1. Start Windows® and insert the CD.
2. The installation software should launch automatically. If it does not, use Windows Explorer to locate the **setup.exe** file on the CD. Double-click this file to start the installation procedure.

3. At the prompt, select a destination directory, which is **C:\Program Files\Analog Devices\AD7780** by default. Once the directory is selected, the installation procedure copies the files into the relevant directories on the hard drive. The installation program creates a program group called **Analog Devices** with the subgroup **AD7780** in the **Start** menu of the taskbar.
4. Once the installation procedure is complete, double-click on the **AD7780** icon to start the program.

USING THE SOFTWARE

Figure 3 shows the main window that is displayed when the program starts. The Main Window section briefly describes the various menu and button options in the main window.

The data that has been read can be exported to other packages, such as MathCAD™ or Microsoft® Excel, for further analysis.
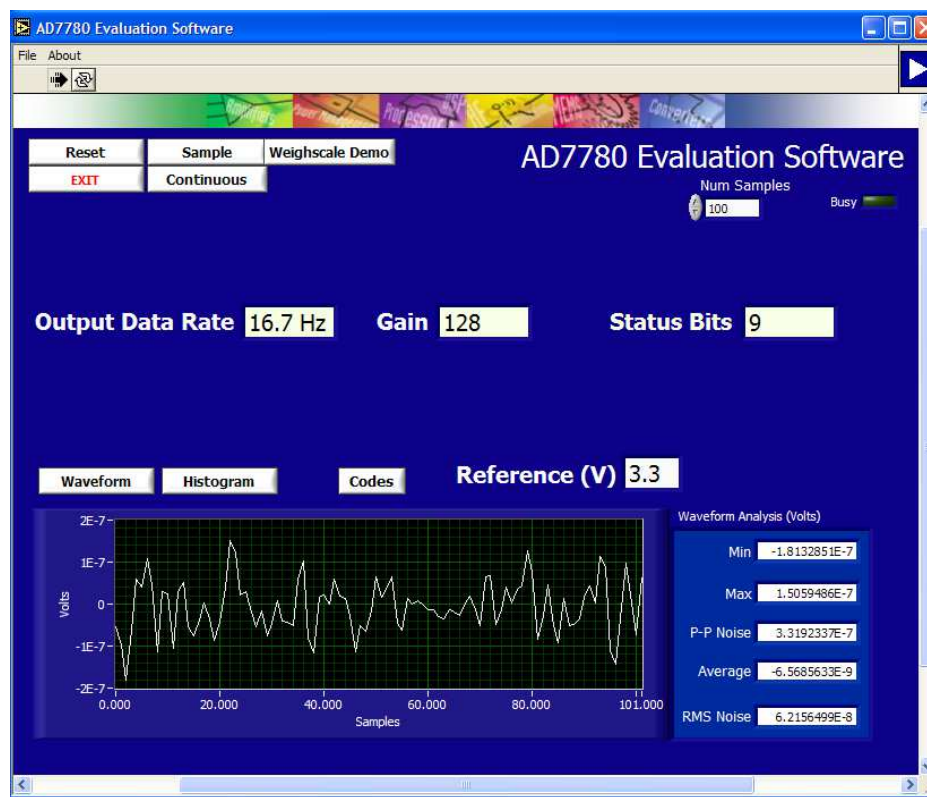

Figure 3. AD7780 Evaluation Software Main Window

MAIN WINDOW

Menu Bar

File

The **File** menu allows the user to read previously stored data for display or analysis, write the current set of data to a file for later use, and exit the program.

About

The **About** menu provides information on the revision of software used.

Buttons

Reset

This button allows you to reset the AD7780 software.

Exit

This button allows you to exit the software. It serves the same purpose as **Quit** in the **File** pull-down menu.

Sample

This button allows you to read a number of samples from the AD7780. Noise analysis is then performed on the samples. These samples can be stored for further analysis. The sample size is entered in the **Num Samples** text box.

Continuous

This button allows you to read a number of samples continuously. The software gathers a number of samples as specified by the **Num Samples** text box, performs noise analysis on the samples, and gathers the next group of samples.

Weighscale Demo

This button allows you to access the weighscale demonstration software.

Output Data Rate

This text box displays the output data rate of the AD7780.

Gain

This text box displays the gain of the AD7780.

Status Bits

This text box displays the status bits of the AD7780.

Waveform

The gathered conversions are displayed in graph form.

Histogram

The gathered samples are used to generate a histogram.

Codes

The gathered samples can be displayed in codes or in voltage format. When the **Codes** button is selected, the values are displayed as code. The **Codes** button changes to **Volts**. To display the information in volts, click **Volts**.

Reference

Enter the value of the external reference in the **Reference (V)** text box.

WEIGHSCALE DEMO WINDOW

Click **Weighscale Demo** (in the main window) to access the weighscale demo window (see Figure 4). The AD7780 evaluation board has a header, J3/J4, which allows you to interface the ADC to a load cell. To connect a load cell to the AD7780 evaluation board, LK1, LK2, LK3 and LK4 must be removed. A 6-wire load cell can be connected to Header J3/J4. With the load cell connected to the evaluation board, click the **RUN** button (the button changes to a **STOP** button after being clicked). The software then begins reading conversions from the AD7780. The output data rate and gain are continuously monitored so you can change either the gain or output data

rate within the weighscale demo window. The output data rate and gain being used by the AD7780 are reflected in the **Output Data Rate** and **Gain** text boxes. The maximum weight being applied to the loadcell must be entered in the **Full-Scale Weight (Kg)** text box. The **Zero-Scale Calibration** button performs an offset calibration, which is useful to remove the TARE of the load cell. With the full-scale weight placed on the load cell, a full-scale calibration is performed by clicking the **Full-Scale Calibration** button.

To stop conversions, click the **STOP** button. To exit the **Weighscale Demo**, click the **BACK** button.

Figure 4. AD7780 Evaluation Software Weighscale Demo Window
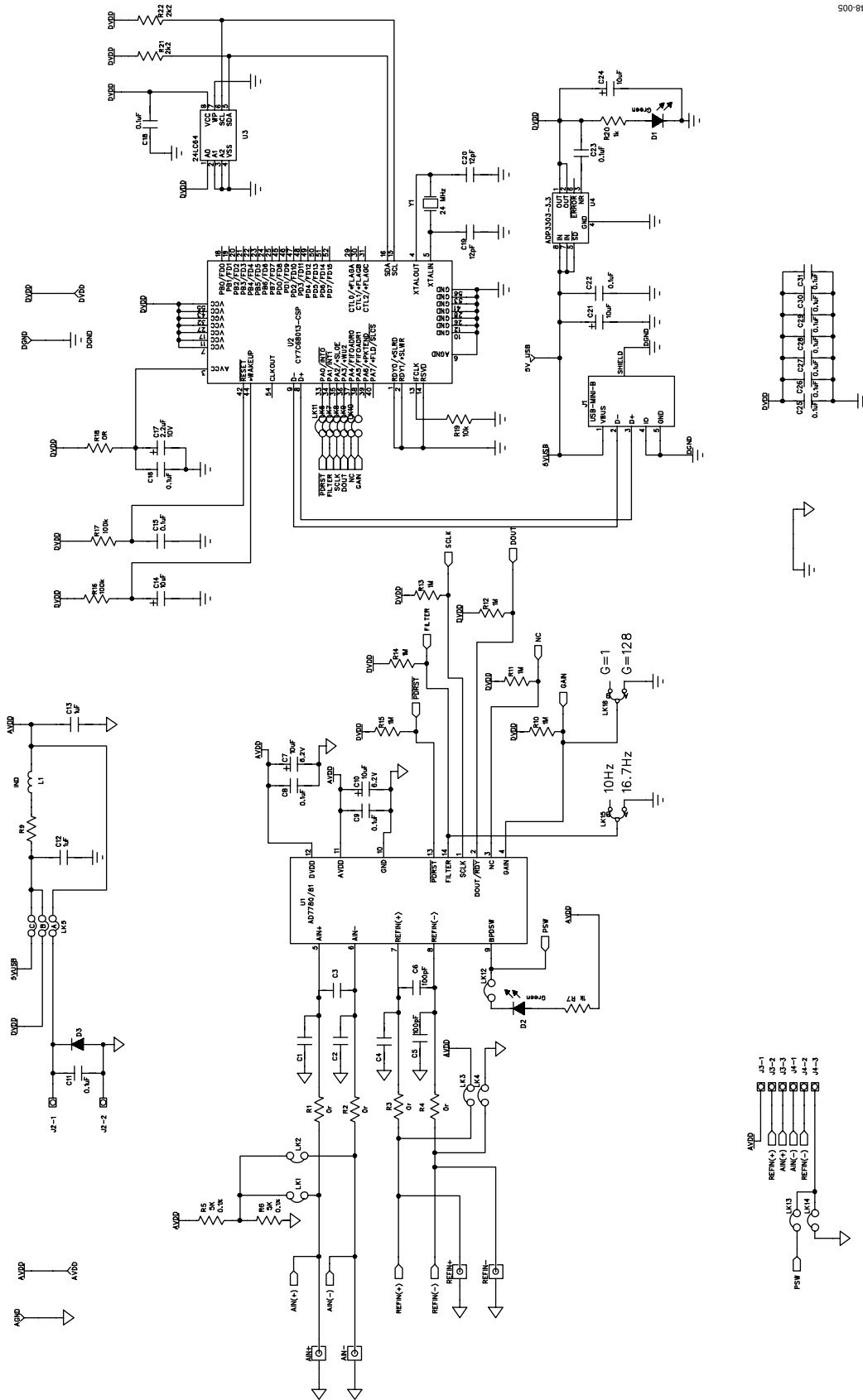
EVALUATION BOARD SCHEMATIC AND ARTWORK
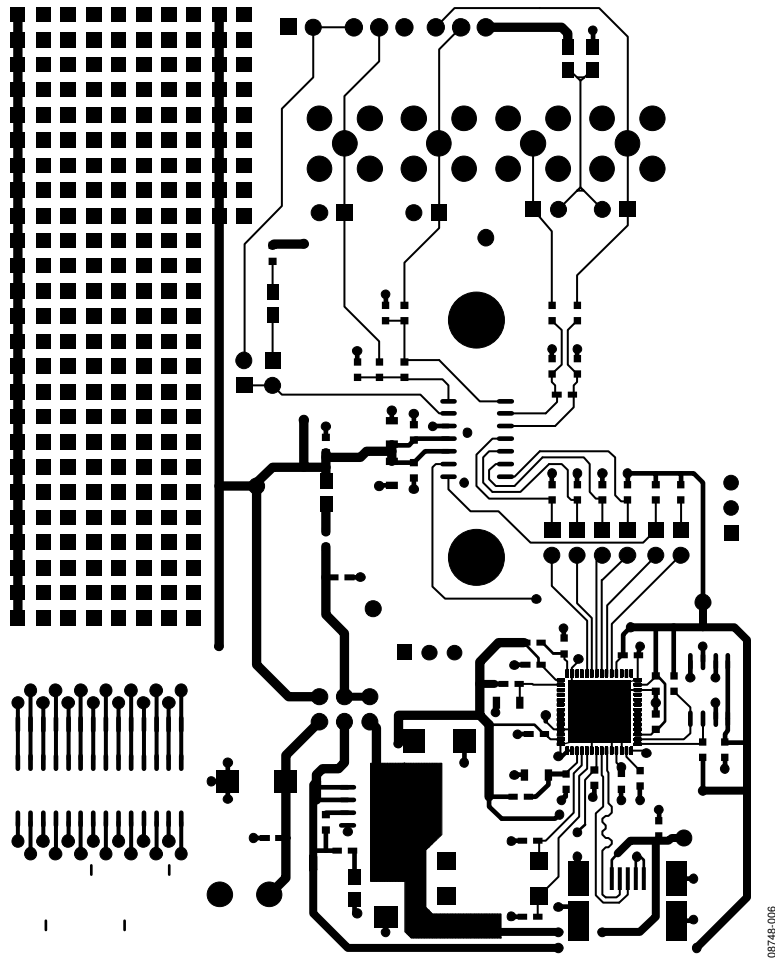
Figure 5. AD7780 Evaluation Board Schematic
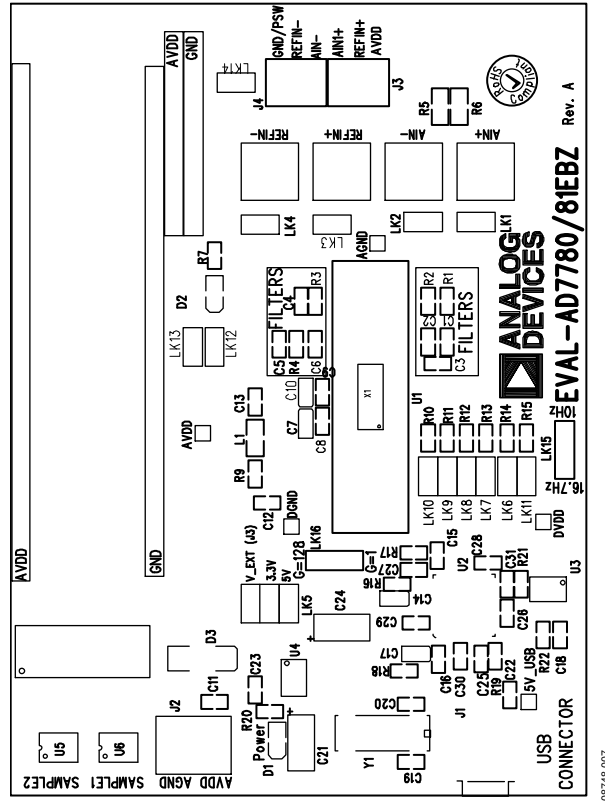
Figure 6. AD7780 Evaluation Board—Solder Side View

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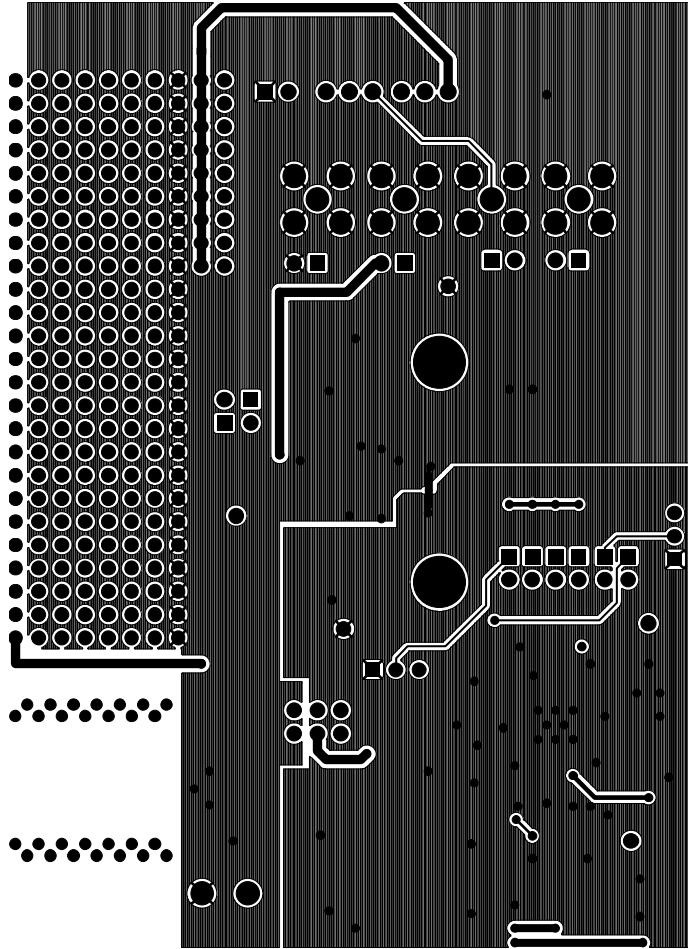
Figure 7. AD7780 Evaluation Board—Component Side View

Figure 8. AD7780 Evaluation Board—Component Layout Diagram

ORDERING INFORMATION

BILL OF MATERIALS

Table 4.

Qty	Reference Designator	Description	Manufacturer, Part No.
	Integrated Circuits		
3	U1, U5, U6	24-bit Σ-Δ ADC	Analog Devices, AD7780BRZ
1	U2	USB controller	Cypress Semiconductor Corporation, CY7C68013A-56LFXC
1	U3	EEPROM	Microchip Technology, Inc., 24LC64-I/SN
1	U4	3.3 V Regulator	Analog Devices, ADP3303ARZ-3.3
1	Y1	24 MHz crystal	AEL Crystals, X24M000000S244
2	D1, D2	Green LED	Kingbright, Elec. Co., Ltd, KP-2012SGC
1	L1	Ferrite bead	Meggitt Sigma, BMB2A0300AN1
1	D3	Diode	Micro Commercial Components Corp., DL4001-TP
	Capacitors		
4	C1 to C4	Capacitors	Not inserted
2	C5, C6	100 pF ceramic	AVX Corporation, 06035A101JAT2A
15	C8, C9, C11, C15, C16, C18, C22, C23, C25 to C31	0.1 µF ± 10% ceramic	AVX Corporation, CM105X7R104K16AT
3	C7, C10, C14, C21, C24	10 µF tantalum	AVX Corporation, TAJA106M016R
2	C12, C13	1 µF ceramic	Yageo Corporation, 2238 246 19863
1	C17	2.2 µF tantalum	EPCOS AG, B45196E2225K109
2	C19, C20	12 pF ceramic	Phycomp, 2238 867 15129
	Resistors		
7	R1 to R4, R9, R18	0 Ω resistor	Phycomp, 232270296001
2	R5, R6	5 kΩ resistor	Tyco Electronics, RN73C2A4K99BTG
4	R10 to R15	1 MΩ resistor	Multicomp, MC 0.063W 0603 1% 1M
2	R16, R17	100 kΩ resistor	Multicomp, MC 0.063W 0603 1% 100K
4	R19	10 kΩ resistor	Multicomp, MC 0.063W 0603 1% 10K
1	R7, R20	1 kΩ resistor	Multicomp, MC 0.063W 0603 1% 1K
2	R21, R22	2.2 kΩ resistor	Multicomp, MC 0.063W 0603 1% 2K2
	Links		
13	LK1 to LK4, LK6 to LK14, (2 × 1 way)	Pin headers	Harwin Plc, M20-9990246
2	LK15, LK16 (3 × 1 way)	Pin headers	Harwin Plc, M20-9990246
1	LK5 (3 × 2 way)	Pin headers	Harwin Plc, M20-9980346
16	At LK1 to LK16	Shorting plugs	Harwin Plc, M7566-05
	Connectors		
4	AIN+, AIN−, REFIN+, REFIN−	SMB connector	Not inserted
1	J1	USB Mini-B connector	Molex, 565790576
2	J3, J4	3-way terminal block	Phoenix, 1725672
1	J2	2-way terminal block	Camden Electronics Ltd., CTB5000/2

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