Evaluation Board for the AD7790/AD7791 16-/24-Bit, Low Power, Σ-Δ ADC

EVAL-AD7790-EB/EVAL-AD7791-EB

FEATURES

Full-featured evaluation board for the AD7790/AD7791
On-board reference and digital buffers
On-board 3 V battery
Various linking options
PC software for control of AD7790/AD7791

INTRODUCTION

This data sheet describes the evaluation board for the AD7790/AD7791 which is a low voltage, low power, 16-/24-bit Σ-Δ ADC. The AD7790/AD7791 is a complete analog front end for low frequency measurement applications. It is a low power device, consuming 65 μA typically with a 3 V power supply. It has an on-board clock, eliminating the need for an external clock. It uses a Σ-Δ conversion technique to realize up to 16 bits of no missing codes performance in the AD7790 and 24 bits of no missing codes performance in the AD7791. 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 AD7790 can accept analog input signals of 312.5 mV, 625 mV, 1.25 V, and 2.5 V, while the analog input channel of the AD7791 can accept an analog input signal of 2.5 V. The AD7790 has a peak to peak resolution of 16 bits when the data update rate is 16.6 Hz. For this update rate, the AD7791 has a peak-to-peak resolution of 19 bits. Simultaneous 50 Hz/60 Hz rejection is available at this data update rate also. For more information, see the AD7790/AD7791 data sheet available from Analog Devices. It should be consulted in conjunction with this data sheet 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 AD7790/AD7791.

Other components on the AD7790/AD7791 evaluation board include an ADR390 (low power, precision 2.048 V reference), two AAA batteries, which can be used to drive the evaluation board, and digital buffers to buffer signals to and from the PC.

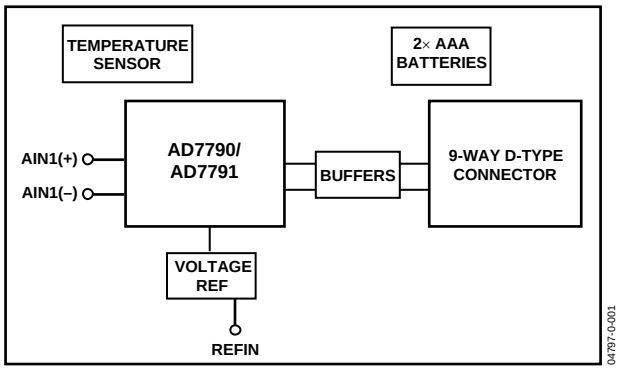

Figure 1. Evaluation Board Set-up

Rev. 0

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REVISION HISTORY

6/04—Revision 0: Initial Version

HARDWARE DESCRIPTION

POWER SUPPLIES

Two AAA batteries are provided with the evaluation board. These can be used to supply V_{DD} to the complete board. Alternatively, an external 3 V or 5 V supply can be used using Terminal J5 or via Connector J7. The battery/external power supply provides the V_{DD} for the reference, ADC, and buffers. V_{DD} is decoupled using a 10 μF tantalum capacitor and 0.1 μF ceramic capacitor at the ADC and the reference. It is again decoupled using a 0.1 μF capacitor as close as possible to the buffer.

LINK OPTIONS

Four link options (LK1, LK2, LK3, LK4, and LK5) must be set for the required operating setup before using the evaluation board. The functions of these link options are described below.

LK1–LK2

These links are in series with the AIN analog inputs.

With these links in Position A, the analog input is connected to the 1 kΩ thermistor. With LK3 and LK4 in Position A also, the demonstration circuit, which shows the AD7790/AD7791 measuring the ambient temperature, can be used. LK5 must be inserted to operate the demonstration circuit.

With LK1 and LK2 in Position B, both AIN+ and AIN− are connected to REFIN+. This allows the user to measure the AD7790/AD7791's rms noise.

With LK1 and LK2 open, an external voltage can be applied to the analog input. This voltage can be applied using the SMB connectors or via Terminal J7.

Some external filtering can be applied using Capacitors C3, C4, and C12, which are unpopulated on the board. The values of Resistors R1 and R2 can also be adjusted to provide adequate filtering. With the on-chip buffer enabled, the AD7790/AD7791 can tolerate any R-C values. However, with the buffer disabled, the user must ensure that the R-C values are not excessive as this causes gain errors. Consult the AD7790/AD7791 data sheet for appropriate R-C values.

LK3–LK4

These links are used to provide the reference to the AD7790/AD7791. With LK3 and LK4 in Position A, the reference is provided by the resistor R5 in the demonstration circuit. LK1 and LK2 should also be in Position A to run the demonstration.

With LK3 and LK4 in Position B, the reference is provided by the ADR390. REFIN+ is connected to the ADR390 while REFIN− is connected to ground.

With LK3 and LK4 in Position C, the reference is provided by V_{DD}. REFIN+ is connected to V_{DD} while REFIN− is connected to ground.

If LK3 and LK4 is left open, the user can supply a reference via the SMB Connectors J3 and J4.

LK5

This link connects the batteries to the temperature sensor demonstration circuit. To operate the demonstration circuit, insert LK5. Remove LK5 when the demonstration circuit is not being used.

In summary, to run the demonstration, LK1 to LK4 should be in Position A and LK5 should be inserted.

To measure the rms noise, LK1 to LK4 should be in Position B. This shorts both AIN+ and AIN− to REFIN+ and the reference is supplied by the ADR390.

To measure another analog voltage, remove LK1 and LK2.

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

Table 1. Initial Link Positions

Link No.	Initial Position	Function
LK1–LK2	B	AIN+ and AIN− are connected to REFIN(+).
LK3–LK4	B	The ADR390 provides the reference to the AD7790/AD7791.
LK5	OUT	The demo circuit is not being powered.

EVALUATION BOARD INTERFACING

Interfacing to the evaluation board is via a 9-way d-type connector, J6. The pinout for the J6 connector is shown in Figure 2 and its pin designations are given in Table 2. J6 is used to connect the evaluation board to the parallel (printer) port of a PC. A 9-way to 25-way cable is included with the board to allow the evaluation board to interface with the PC's parallel printer port. The evaluation board should be powered up before a cable is connected to the connector.

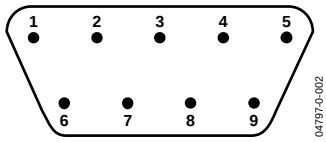

Figure 2. Pin Configuration for the 9-Way D-Type Connector, J6

Table 2. J6 Pin Description

Pin No.	Mnemonic	Function
1	$\overline{CS}$	Chip Select. The signal on this pin is buffered before being applied to the $\overline{CS}$ pin on the AD7790/ AD7791. $\overline{CS}$ is an active low logic input used to select the AD7790/AD7791.
2	SCLK	Serial Clock. The signal on this pin is buffered before being applied to the SCLK pin of the AD7790/AD7791. An external serial clock is applied to this input to read serial data from the AD7790/AD7791. This serial clock can be continuous with all data transmitted in a continuous train of pulses. Alternatively, it can be noncontinuous with the information being transmitted from the AD7790/AD7791 in smaller batches of data.
4	$\overline{RDY}$	Logic Output. This is a buffered version of the $\overline{RDY}$ signal from the AD7790/AD7791'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 returns high upon completion of a read operation of a full output word. If data is not read, $\overline{RDY}$ returns high prior to the next update indicating to the user that a read operation should not be initiated.
5	DIN	Data In. The signal on this pin is buffered before being applied to the DIN pin of the AD7790/ AD7791.
6	GND	Ground Reference Point. Connects to the GND plane on the evaluation board.
7	$\overline{SHDN}$	Reference Shutdown. The signal on this pin is buffered before being applied to the $\overline{SHDN}$ pin on the ADR390. When the ADC is not converting, the reference is placed in shutdown mode to minimize the current consumed on the evaluation board.
8	GND	Ground Reference Point. Connects to the GND plane on the evaluation board.
9	DOUT	Serial Data Output. This is a buffered version of the DOUT signal from the AD7790/AD7791 DOUT/$\overline{RDY}$ pin, the serial data being obtained from the output shift register on the AD7790/AD7791.

SOCKETS

The seven sockets relevant to the operation of the AD7790/AD7791 on this evaluation board are described in Table 3.

Table 3. Socket Functions

Socket	Function
J1	Subminiature BNC (SMB) Connector. The analog input signal for the AIN+ input of the AD7790/AD7791 is applied to this socket.
J2	Subminiature BNC (SMB) Connector. The analog input signal for the AIN– input of the AD7790/AD7791 is applied to this socket.
J3	Subminiature BNC (SMB) Connector. The voltage for the REFIN(+) input of the AD7790/AD7791 is applied to this socket.
J4	Subminiature BNC (SMB) Connector. The voltage for the REFIN(–) input of the AD7790/AD7791 is applied to this socket.
J5	PCB Mounting Terminal Block. The power supply for the AD7790/AD7791 reference and buffers can be provided via this connector.
J6	9-Way D-Type Connector. This connector is used to interface to the PC via the parallel printer port.
J7	10-Way Header. This header is useful if the AD7790/AD7791 analog pins are being interfaced.

SOFTWARE DESCRIPTION

The AD7790/AD7791 evaluation board is shipped with a CD-ROM containing software that can be installed onto a standard PC to control the AD7790/AD7791.

The software uses the printer port of the PC to communicate with the AD7790/AD7791, via the cable which accompanies the board.

The same software is used to communicate with the AD7790 or AD7791. The software reads the status register of the AD7790/AD7791 on power-up. The WL bit in the status register is zero if the device is an AD7790; this bit is one if the device is an AD7791. The software is then modified automatically to suit the device being evaluated.

The software allows the user to read conversion data from the AD7790/AD7791.

Data can be read from the AD7790/AD7791 and displayed or stored for later analysis.

For further information, see the AD7790/AD7791 data sheet available on the ADI website.

SOFTWARE REQUIREMENTS AND INSTALLATION

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

To install the software:

1. Start Windows and insert the CD-ROM.

   The installation software should launch automatically. If it does not, use Windows Explorer to locate the file setup.exe on the CD-ROM. Double-clicking on this file starts the installation procedure.

2. At the prompt, select a destination directory, which is C:\Program Files\Analog Devices\AD7790 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 subgroup **AD7790** in the **Start** menu of the taskbar.

3. Once the installation procedure is complete, double-click on the **AD7790 icon** to start the program.

USING THE EVALUATION BOARD INTERFACE

Figure 3 shows the main window that is displayed when the program starts. Table 4 briefly describes the drop-down menus on the main window. Following Table 4 are descriptions of the most commonly used evaluation software dialog boxes.

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

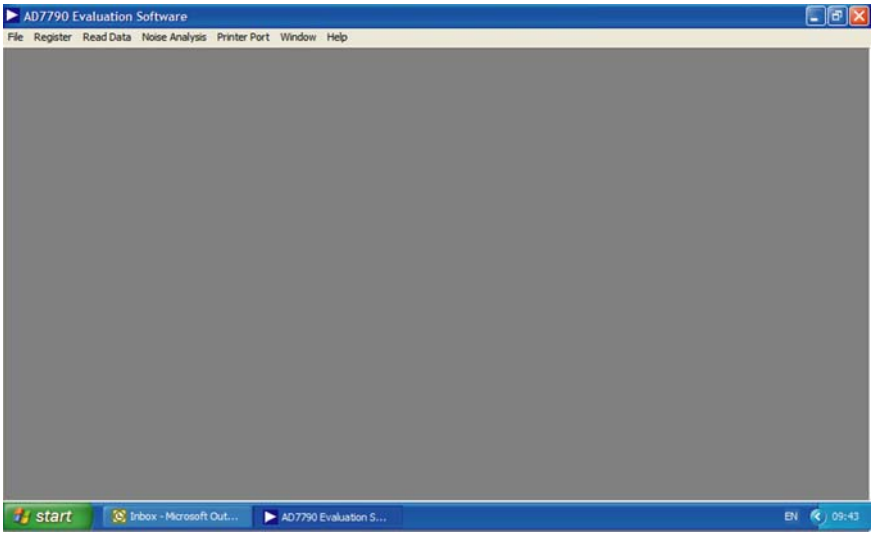

Figure 3. AD7790 Evaluation Software Main Window

Table 4. Main Window Menus

Menu	Description
File	Allows the user to: • read previously stored data for display or analysis. • write the current set of data to a file for later use. • exit the program.
Register	Allows the user to access the status register and mode register on the AD7790/AD7791 devices, and allows the user to reset the device.
Read Data	Allows the user to read a number of samples from the AD7790/AD7791. 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	The printer port that is used by the software is determined automatically. The Printer Port menu allows the user to select different printer ports. The choices are LPT1 (standard), LPT2, or PRN.
Window	Lists the windows that are opened when running the AD7790/AD7791 evaluation board software.
Help	Provides information on the revision of software being used.

Status Register Contents

The status register of the AD7790/AD7791 can be viewed by selecting **Status Register** from the **Register** pull-down menu. When this option is selected, the evaluation board software reads the current contents of the AD7790/AD7791 status register and displays this information here. The status register is read-only. It flags AD7790/AD7791 operating conditions, such as data read (RDY) or ADC error (ERR).

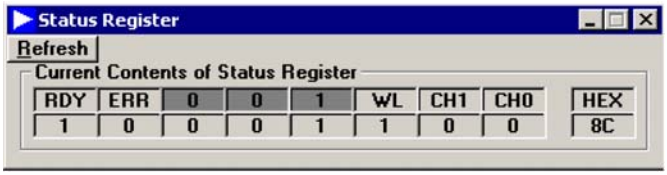

Figure 4. Status Register Properties

Filter Register Dialog

The filter register of the AD7790/AD7791 can be viewed by selecting **Filter Register** from the **Register** pull-down menu.

When this option is selected, the software reads the current contents from the filter register of the AD7790/AD7791 and change the display accordingly. The filter register is used to changes the update rate of the AD7790/AD7791, which is the allowable range for the update rate being from 9.5 Hz to 120 Hz in normal mode. The dialog displays the corresponding settling time and 3 dB frequency for the selected update rates. This register is also used to place the device in the low power modes. The update rate, settling time, and 3 dB frequency scale accordingly.

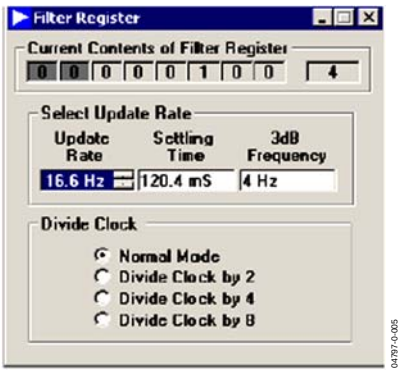

Figure 5. Filter Register Dialog

Program Mode Register Dialog

The mode register of the AD7790/AD7791 can be viewed by selecting **Mode Register** from the **Register** pull-down menu. From the Program Mode Register dialog, you can control bipolar/unipolar operation, enable or disable the burnout currents, buffered/unbuffered mode, and range selection for the AD7790. The operation mode is also selected in this register. When this option is selected, the software reads the current contents from the mode register of the AD7790/AD7791 and displays the information here. Every time the user changes the contents of the mode register, the software writes the new conditions to the AD7790/AD7791 and then reads back from the mode register for confirmation.

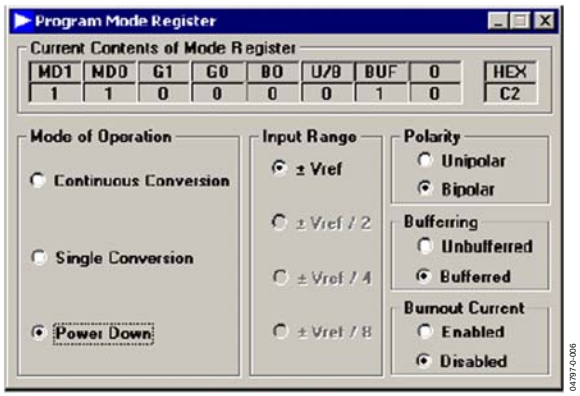

Figure 6. Program Mode Register Dialog

Read Data for Display Dialog

The Read Data for Display option is available from the **Read Data** pull-down menu. When the Read Data button in this dialog is clicked, the evaluation board software reads one sample from the ADC and displays its value in the Current Data Code text box of the Read Data for Display dialog. The voltage on the analog input channel or from the VDD monitor can be read. The software continues to read and display the samples until a key is pressed. To add a delay to the read cycle, enter the required number of milliseconds between reading samples in the Delay Between Reads text box. However, the accuracy of the time delay can be affected by other programs running under Windows; thus, this method is not suitable when equidistant sampling is required.

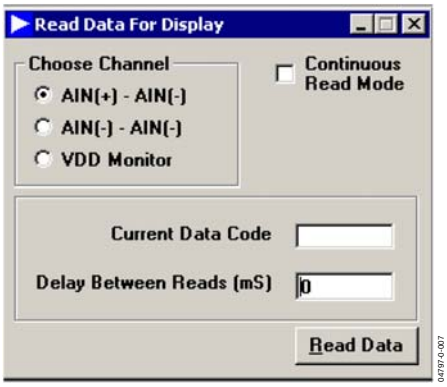

Figure 7. Read Data for Display Dialog

Read Data for Analysis Dialog

The Read Data for Analysis option is available from the **Read Data** pull-down menu. In this dialog, the user can read many samples for future processing. The number of samples to be read is entered in the Number of Codes to Read text box, while the value of the reference being used is entered in the Voltage Reference text box. When the Read Data button is clicked, the evaluation board software reads the specified number of samples from the AD7790/AD7791 ADC and stores them in an array so that they can be graphed or analyzed later. Up to 5000 samples can be read at a time. You can interrupt the read by pressing any key. The collected data is then analyzed by clicking **Noise Analysis.**

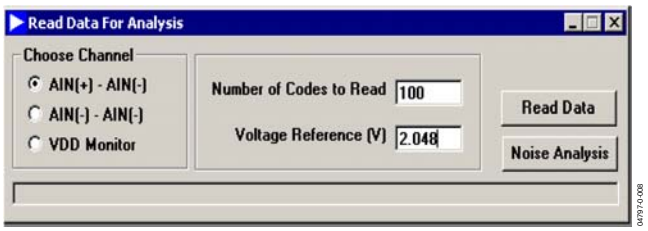

Figure 8. Read Data for Analysis

Noise Analysis Dialog

Once data is read from the AD7788/AD77889 ADC, it can be analyzed. Click **Noise Analysis** in the **Read Data For Analysis** dialog to display the Noise Analysis dialog. This dialog displays the maximum and minimum codes read from the AD7790/AD7791 ADC (in decimal or hexadecimal), as well as the average code, the average value, and the rms and peak-to-peak noise values. To display the data on a graph or as a histogram of the codes, click **Plot Graph** or **Plot Histogram** in this dialog. Figure 10 and Figure 11 show the Graph and Histogram screens.

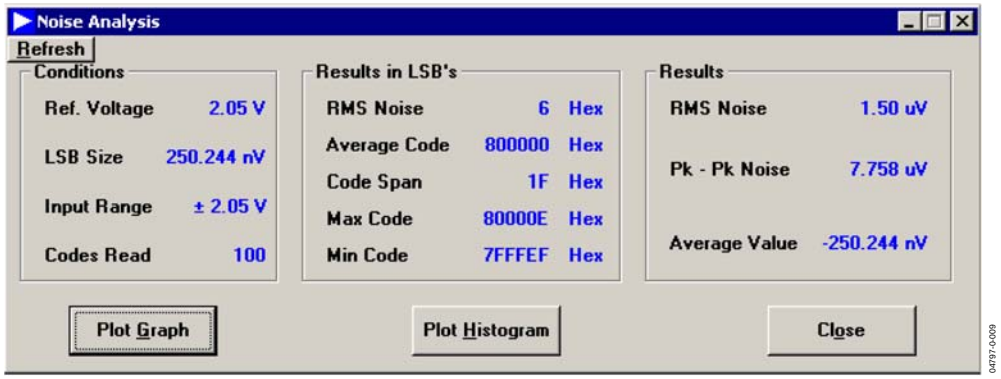

Figure 9. Noise Analysis Dialog

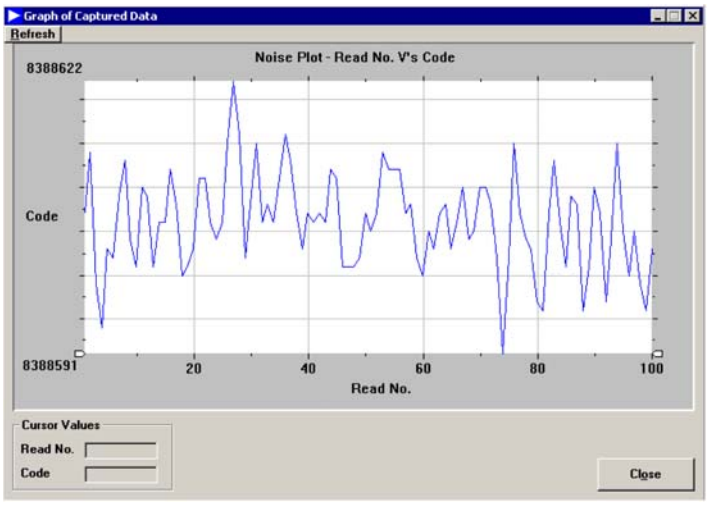

Figure 10. Graph Screen

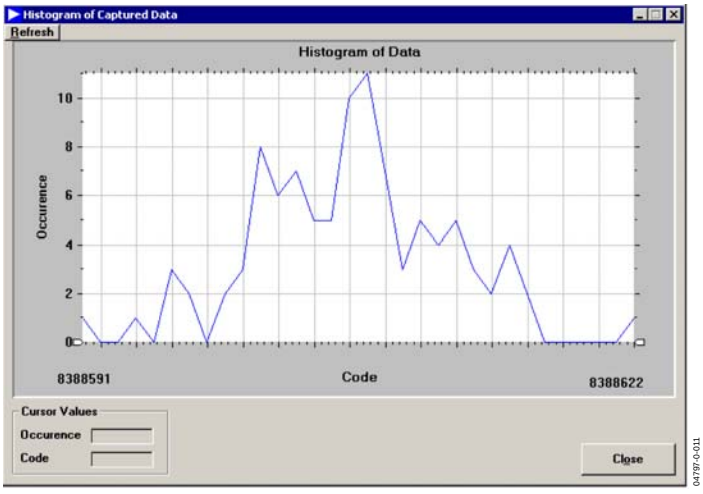

Figure 11. Histogram Screen

SCHEMATIC AND COMPONENTS

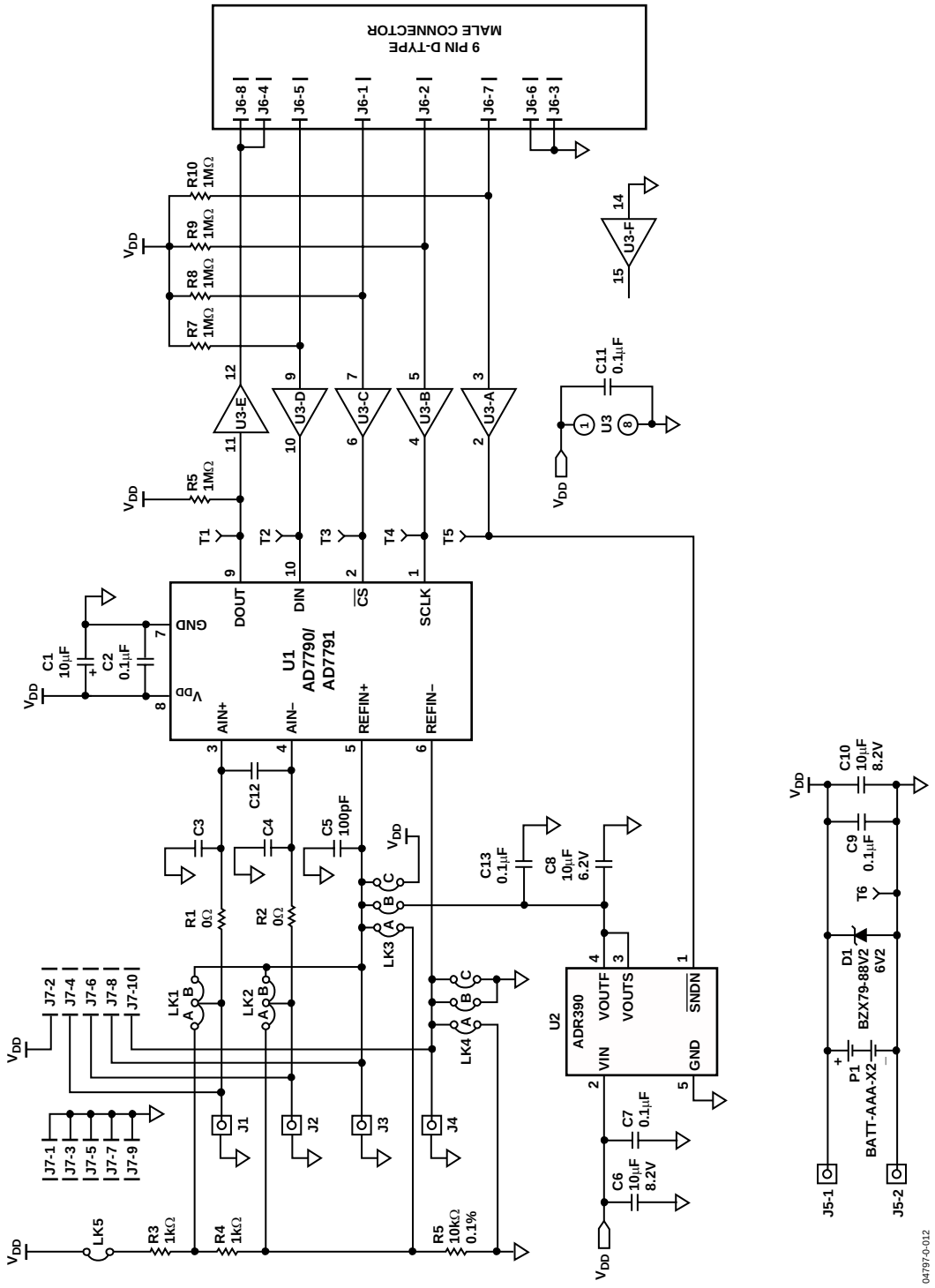

Figure 12. Evaluation Board Schematic

COMPONENT LISTING

Table 5.

Component	Location	Vendor
Integrated Circuits		
AD7790/AD7791	U1	Analog Devices
ADR390ART	U2	Analog Devices
MM74HC4050M	U3	Fairchild Semiconductor
6.2 V Zener Diode	D1	FEC No. 316-2436
CAPACITORS		
10 µF ± 20% Tantalum (16 V)	C1, C6, C8, C10	AVX-Kyocera
0.1 µF Ceramic	C2, C7, C9, C11, C13	FEC No. 499-687
100 pF Ceramic	C5	FEC No. 499-122
RESISTORS		
Short Circuits	R1, R2	Multicomp
1 kΩ SMD Resistor	R3, R12	Multicomp
1 kΩ Thermistor	R4	FEC No. 732-084
10 kΩ SMD Resistor	R5	Multicomp
1 MΩ SMD Resistor	R6–R11	
Link Options		
Pin Headers	LK1 LK2 (3×1 way), LK3 LK4 (3×2 way), LK5 (2×1 way)	Harwin Mftrs No. M20-9983606
Shorting Plugs	Pin Headers (4 required)	Harwin Mftrs No. M7571-05
SOCKETS		
SMB Connectors	J1–J4	M/A - Com Greenpar Mftrs No. B65N07G999X99
2-Way Terminal Block	J5	Augat
9-Way D-Type Connector	J6	McMurdo Mftrs No. SDE9PNTD
10-Lead Header	J7	FEC No. 511-808
2 × AAA size Battery Holder	P1	Digikey 2462K-ND

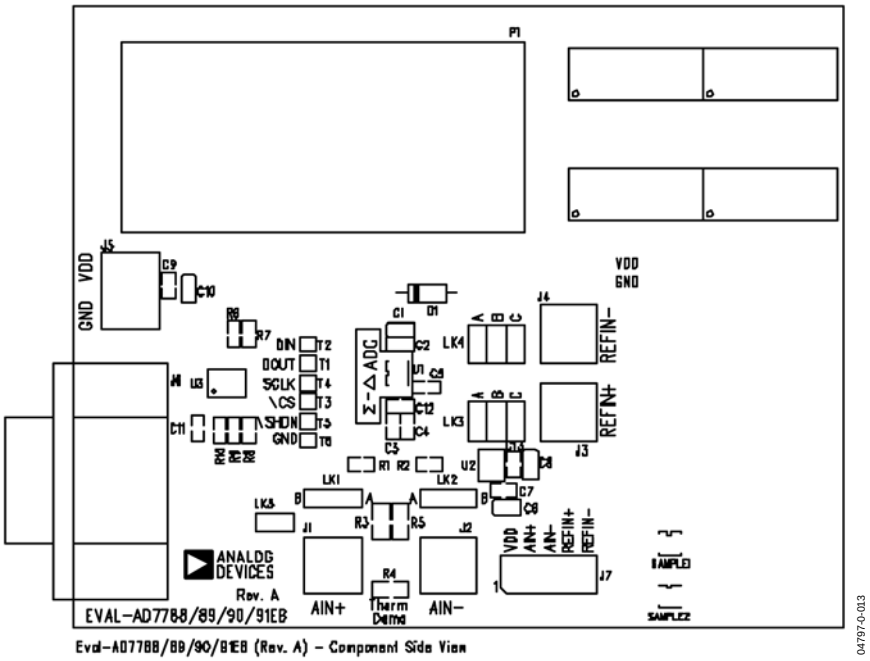

Figure 13. Evaluation Board Component Layout Diagram

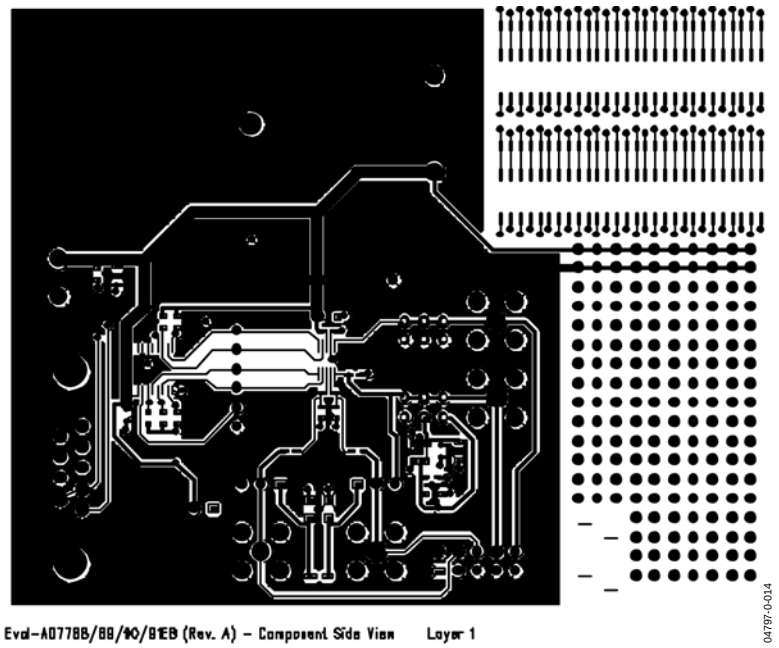

Figure 14. Evaluation Board Component Side Artwork

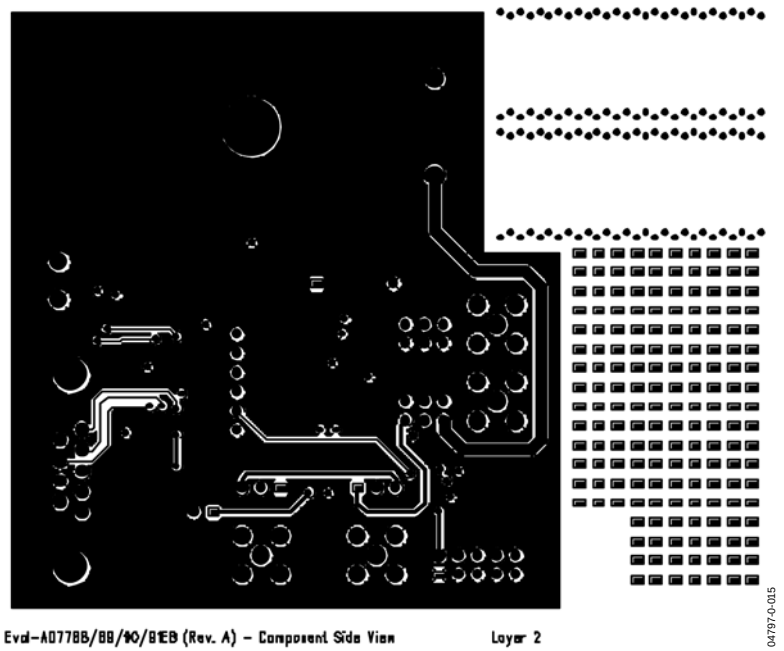

Figure 15. Evaluation Board Solder Side Artwork

ORDERING GUIDE

Model	Description
EVAL-AD7790EB	Evaluation Board
EVAL-AD7791EB	Evaluation Board

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although this product features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

D04797-0-6/04(0)

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