ANALOG DEVICES

AD7746 Evaluation Board
EVAL-AD7746EB

FEATURES

Full-featured evaluation board for the AD7746
**PC evaluation software for control and measurement
of the AD7746**
USB interface and cable in kit

APPLICATIONS

Capacitive length sensor demo
AD7746 performance evaluation
Platform to integrate the AD7746 into system design

EVALUATION BOARD DESCRIPTION

This data sheet describes the evaluation board for the AD7746. The evaluation board interfaces to the USB port of a PC. Evaluation software is available with the evaluation board which allows the user to easily communicate with the AD7746. **Note that the AD7746 evaluation board software should be installed before connecting the AD7746 evaluation board to the PC.**
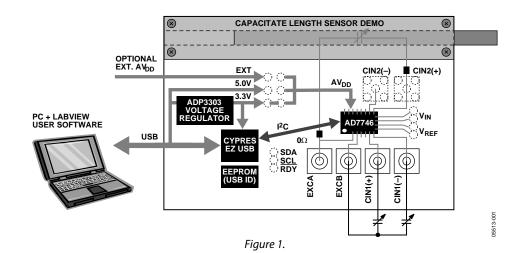
To properly use the evaluation board, see the current data sheet for the AD7746 on the ADI website. You can download the data sheet from www.analog.com/AD7746.

AD7746 DEVICE DESCRIPTION

The AD7746 is a high resolution, capacitance-to-digital converter (CDC). The capacitance to be measured is connected directly to the device inputs. The architecture features inherent high resolution (24-bit, no missing codes, up to 21-bit effective resolution), high linearity (0.01%), and high accuracy (±4 fF factory calibrated). The AD7746 capacitance input range is ±4 pF (changing), while it can accept up to 17 pF common-mode capacitance (not changing), which can be balanced by a programmable on-chip digital-to-capacitance converter (CAPDAC).

The AD7746 has two capacitive input channels. Each channel can be configured as single ended or differential. The AD7746 is designed for floating capacitive sensors. For capacitive sensors with one plate connected to ground, the AD7747 is recommended.

The AD7746 has an on-chip temperature sensor with resolution of 0.1°C and accuracy of ±2°C. The on-chip voltage reference and the on-chip clock generator eliminate the need for any external components in most capacitive sensor applications. The part has a standard voltage input, which together with the differential reference input, allow easy interface to an external temperature sensor such as an RTD or diode.

Figure 1.

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EVAL-AD7746EB

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REVISION HISTORY

5/05—Revision 0: Initial Version

EVALUATION BOARD SOFTWARE INSTALLATION

The AD7746 evaluation board software should be installed **before** connecting the AD7746 evaluation board to the PC.

Follow these instructions to install the AD7746 evaluation board software:

1. Place the AD7746 Evaluation Kit CD in the CD-ROM drive of the PC. The window shown in Figure 2 appears.

    If this window does not appear, navigate to the AD7746 Evaluation Kit CD-ROM on your PC and double-click the **Setup.exe** icon.

2. Follow the instructions on screen to install the AD7746 evaluation board software.

Figure 2. AD7746 Evaluation Software Kit Installation

EVALUATION BOARD HARDWARE AND INTERFACING

POWER SUPPLIES

The board is powered via the 5 V supply from the USB connector, J1. The 5 V supply may be used to power the AD7746 directly. A 3.3 V regulated voltage from the on-board ADP3303, high precision, low power, 3.3 V output voltage regulator may also be used. Alternatively, the AD7746 may be powered using an external 3 V or 5 V power supply via J2 (see Table 1).

LINK OPTIONS

There are two link options relevant to the operation of the AD7746 evaluation board. The function of these link options is outlined in Table 1.
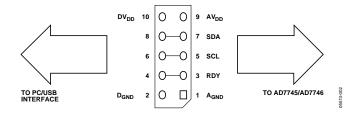

Figure 3. LK2 10-Pin (2 × 5) Header

USB CONNECTOR

A standard USB connector, J1, is used to connect the evaluation board to the USB port of a PC. A standard USB connector cable is included with the AD7746 evaluation board kit. Because the board is powered by the USB connector, there is no need for an external power supply, although one can be connected to J2.

Communication between the AD7746 evaluation board and the PC is over the USB interface. The on-board USB controller controls this communication.

SOCKETS

There are four sockets relevant to the operation of the AD7746 on this evaluation board. The functions of these sockets are outlined in Table 2.

If you want to interface to the AD7746 using the analog voltage input channel or the external temperature sensor and an external voltage reference, you can do so by using the unpopulated through-hole pads labeled AIN+, AIN−, REF+, and REF− located on the AD7746 evaluation board.

Table 1. Evaluation Board Link Settings

Link	Default	Description
LK1	3.3 V	LK1 is used to select the power source for the AD7746 device. LK1 in the 5.0 V position selects the 5 V supply from the USB connector, J1. LK1 in the 3.3 V position (default) selects the 3.3 V regulated output from the on-board ADP3303 voltage regulator. LK1 in the V_EXT position selects an external power supply, supplied via J3.
LK2	Not populated	LK2 is a 10-pin (2 × 5) straight header that may be optionally inserted by the user (see Figure 3). This link allows easy access to the power supply lines (AVDD, AGND, DVDD, and DGND) as well as to the 2-wire serial interface signals, SDA and SCL, and the data ready signal, RDY.
		It is recommended that the tracks connecting Pins 3 and 4, Pins 5 and 6, and Pins 7 and 8 are cut before inserting LK2. This isolates the AD7746 I²C device interface from the USB controller and allows them to be used separately. This means that the AD7746 device can be driven from an external I²C controller. The USB controller (and the PC-based evaluation software) can also control an external AD7746 located on a different board. To go back to the original evaluation board configuration, place three jumpers across Pins 3 and 4, Pins 5 and 6, and Pins 7 and 8 of LK2.

Table 2. Socket Functions

Socket	Function
CIN1+	Sub-Miniature BNC (SMB) Connector. The capacitive input signal for the CIN1+ input of the AD7746 is applied to this socket.
CIN1-	Sub-Miniature BNC (SMB) Connector. The capacitive input signal for the CIN1− input of the AD7746 is applied to this socket.
CIN2+[1]	Sub-Miniature BNC (SMB) Connector. The capacitive input signal for the CIN2+ input of the AD7746 is applied to this socket. On this evaluation board, the positive terminal of the capacitive length sensor demo is connected to CIN2+.
CIN2−[1]	Sub-Miniature BNC (SMB) Connector. The capacitive input signal for the CIN2− input of the AD7746 is applied to this socket.
EXCA	Sub-Miniature BNC (SMB) Connector. This socket is connected to the EXCA output on the AD7746. On this evaluation board the negative terminal of the capacitive length sensor demo is connected to EXCA. This provides excitation to the on-board capacitive length sensor demo.
EXCB	Sub-Miniature BNC (SMB) Connector. This socket is connected to the EXCB output on the AD7746.

[1] This socket is unpopulated on the AD7746 evaluation board.

CONNECTING THE BOARD TO THE PC

The AD7746 evaluation board software should be installed (using the AD7746 evaluation kit CD) before connecting the evaluation board to the PC.

Follow these instructions to connect the board to the PC:

1. Using the USB connector cable, connect **J1** on the evaluation board to the **USB port** on the PC. The green Power LED on the evaluation board illuminates. The PC automatically finds the new USB device and identifies it as the AD774x Evaluation Board.

2. Click **Next** and follow the instructions that appear on screen.

3. During the installation process, if the following window appears, click **Continue Anyway** to complete the installation of the AD7746 evaluation board.
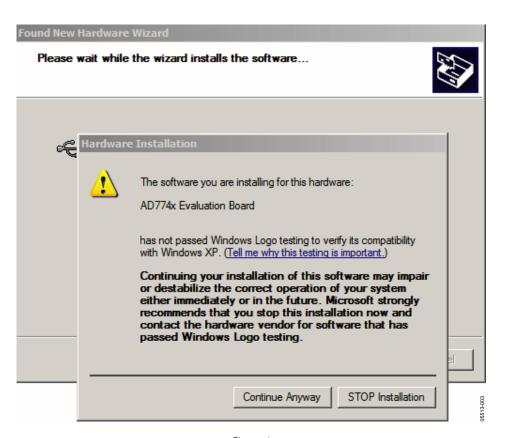

Figure 4.

EVALUATION BOARD SOFTWARE

CONFIGURING THE EVALUATION BOARD

The evaluation board is initially configured to allow the user to interface any capacitive input directly to CIN1 of the AD7746 device. To do this, connect one end of the capacitive input to the SMB connector labeled CIN1+ or CIN1−. Then connect the other end of the capacitive input to the SMB connector labeled EXCB.

The AD7746 provides a second capacitive channel, CIN2. On the AD7746 evaluation board, the second capacitive channel is used with the on-board capacitive length sensor demo. To disable the capacitive length sensor demo, disconnect the two

0 Ω SMD resistors, R1 and R2. Any capacitive sensor may then be directly interfaced to CIN2 of the AD7746 by connecting one end of the capacitive input to either of the SMB connectors labeled CIN2+ or CIN2− and the other end to either of the SMB connectors labeled EXCA or EXCB. Note that once the capacitive length sensor demo has been disabled, either of the excitation output pins (EXCA or EXCB) may be used as the excitation source, irrespective of which capacitive channel is enabled. These settings are configurable using the evaluation board software.

GETTING STARTED WITH THE SOFTWARE

Follow these instructions to run the AD7746 evaluation board software.

1. From the Start Menu, select **Program Files > Analog Devices\AD7746 Evaluation Software.** The window shown in Figure 5 appears. The application opens by default to the Real Time tab.
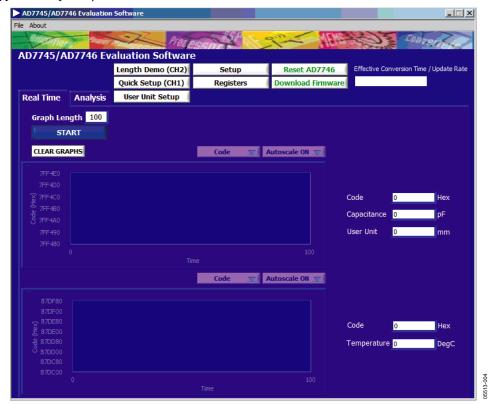

Figure 5. AD7746 Evaluation Software

2. Click the **Length Demo** (CH2) button. This enables continuous conversions on Capacitive Channel 2 in single-ended mode, enables EXC A as the excitation output pin, sets the update rate, and initializes CAP DAC A. The dialog box shown in Figure 6 appears.
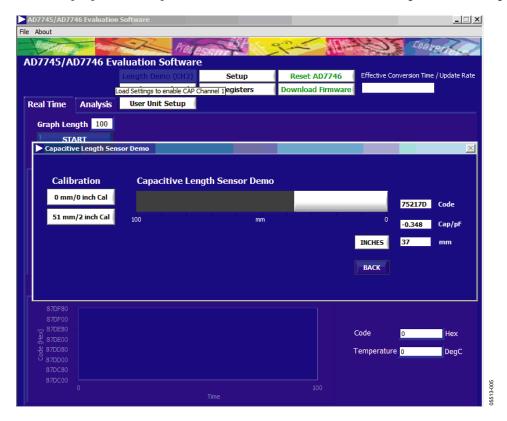

Figure 6. Capacitive Length Sensor Demo

3. Slide the ruler on the evaluation board to mimic this action on the screen. The code, capacitance, and length (in inches or mm) appear on the right side of the dialog box. These values change as you slide the ruler.

4. Remove the ruler completely. Click the **0 mm/0 inch Cal** button.

5. Place the ruler at 51 mm/2 inch mark. Click the **51 mm/2 inch Cal** button. The part is now calibrated to the length of the ruler. Notice that when the ruler length exceeds 80 mm, the demo can no longer measure the ruler length because the input capacitance range (±4 pF) has been exceeded.

6. Click **BACK** to return to the Real Time tab.

SETUP MENU

Follow these procedures after running the capacitive length sensor demo to check the settings and familiarize yourself with the software:

1. On the Real Time tab, click **Setup**. The Setup dialog box appears.
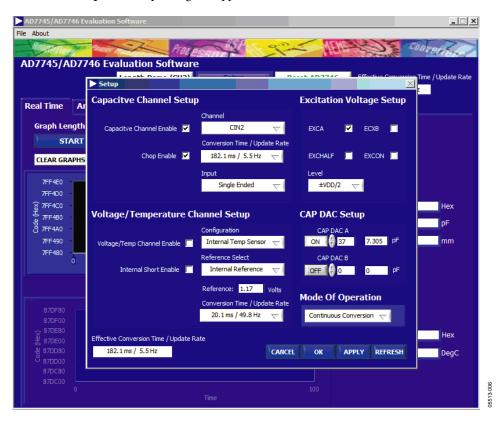

Figure 7. Setup Window

In this dialog box, you can configure the capacitive channel, the voltage/temperature channel, the output pin for the excitation source, CAP DACs, and the AD7746 operating mode.

Notice how the dialog box reflects the settings established during the capacitive length sensor demo. Capacitive Channel 2 is enabled in single-ended mode, EXC A is enabled as the excitation output pin, CAPDAC A has been set to a value determined by the demo calibration routine, and the part is in continuous conversion mode.

2. Click **OK** to return to the Real Time tab.

USER UNIT SETUP AND REAL TIME

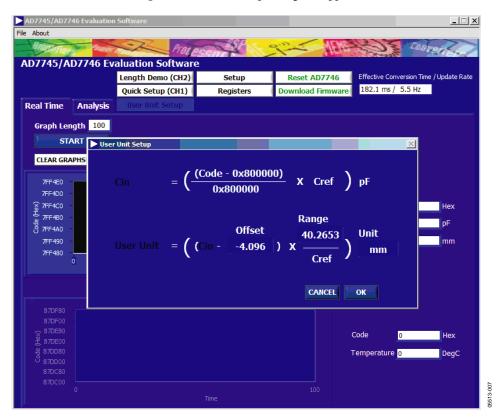1. On the **Real Time** tab, click **User Unit Setup.** The User Unit Setup dialog box appears.

Figure 8. User Unit Setup Dialog Box

Within this window, a unit that reflects the nature and sensitivity of the capacitive sensor connected to the selected capacitive input can be configured. This is then reflected in the Real Time tab and the Analysis tab. After running the capacitive length sensor demo, the user unit defaults to reflect the capacitive length sensor.

2. Click **OK** to return to the Real Time tab.

3. Click **START.** Notice how this tab reflects the settings established during the capacitive length sensor demo. The samples gathered are displayed graphically in real time. The samples are also displayed in hexadecimal format and capacitance. Notice that when you move the ruler, the tab is updated in real time and the input capacitance changes when the ruler is moved. Also, the User Unit field displays the length of the ruler in mm.

4. Click **STOP** to stop displaying the data.

5. Click **Quick Setup (CH1).** This enables Capacitive Channel 1, enables EXCB as the excitation output pin, and places the part in continuous conversion mode. This enables the part to measure directly any capacitance placed across the CIN1+/CIN- and the EXCB pins.

For complete details of this setup, click **Setup.** Alternatively, you can click **Registers.** This displays a detailed register map of all available registers and reflects the current user settings. The Registers window may be used if a more detailed configuration of the AD7746 device is required.

PERFORMING A NOISE ANALYSIS

1. With the quick setup for Capacitive Channel 1 still in place, click the **Analysis** tab. The following window appears.

Figure 9. Analysis Window

2. Type the number of samples required and click **START.** Once the samples have been gathered they may be displayed as a waveform or as a histogram. The Average, RMS noise, p-p Noise, RMS Resolution and p-p Resolution figures relating to the gathered set of samples appear in the Analysis (Codes) box on the right side of the screen. These figures may be displayed in Code, Capacitance, or in the User Configured Unit.

3. To save this set of gathered samples, select **File > Save Binary Data**.

4. Select the **directory** and **file name** where you want to save the data. The default file name is **Binary Data.txt**.
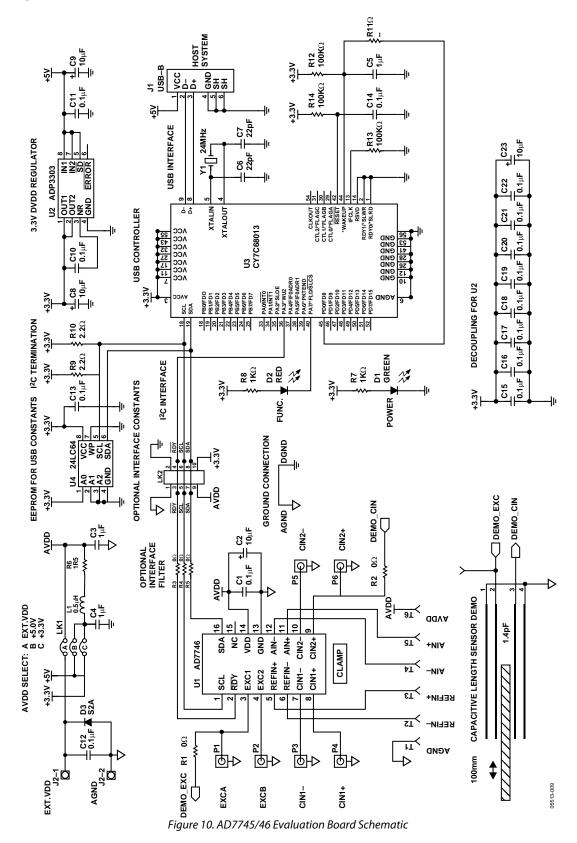
A summary of the current configuration as well as the data for the selected number of samples in hexadecimal format is saved to the file.

SAVING AND RELOADING USER CONFIGURATIONS

You can save a configuration and reload it at a later time. To save any configuration:

1. Select **File > Save Settings.**

2. Select the **directory** and **file name** where you want to save the current user configuration. The default file name is **Settings.txt**. The User Unit, User offset, and User range are saved together with the complete register map as it appears in the registers window.

3. To reload these settings at any time, select **File > Load Settings**. A prompt appears and points, by default, to the previously saved user configuration **Settings.txt**.
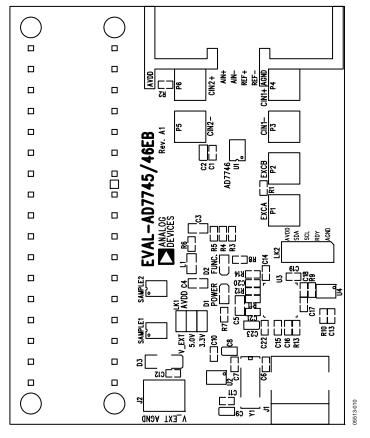
SCHEMATIC

Figure 10. AD7745/46 Evaluation Board Schematic

LAYOUT

Figure 11. AD7746 Evaluation Board Layout

ORDERING GUIDE

Model	Description
EVAL-AD7746EB	Evaluation Board

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