

### FEATURES

**Full-featured evaluation boards for the AD7476 and AD7477 devices**

**Evaluation control board (EVAL-CONTROL-BRD2) compatible**

**Standalone capability**

**On-board analog buffering and voltage reference**

**Various linking options**

**PC software for control and data analysis when used with EVAL-CONTROL-BRD2**

### GENERAL DESCRIPTION

This data sheet describes the evaluation boards for testing the AD7476 and AD7477 devices. The AD7476/AD7477 are, respectively, 12 bit and 10 bit, high speed, low power successive approximation ADCs. The devices operate from a single 2.35 V to 5.25 V power supply and feature throughput rates up to 1 MSPS. These ADCs contain a low noise, wide bandwidth track-and-hold amplifier to handle input frequencies in excess of 6 MHz. The [AD7476/AD7477](#) device data sheet should be used in conjunction with this data sheet.

On-board components for these evaluation boards include:

- One AD780, a pin programmable 2.5 V or 3 V ultrahigh precision band gap reference.
- One REF195 precision band gap voltage reference providing a 5 V reference voltage.
- One OP467 quad op amp to buffer the analog inputs.

Due to its standard pinout, the AD780 reference can be swapped for the AD680, a 2.5 V low power reference. Likewise, the REF195 can be easily interchanged for another reference within the same voltage range from the REF19x family.

Various link options are provided in Table 2.

These evaluation boards are equipped with a 96-way connector. This 96-way connector is compatible with the EVAL-CONTROL-BRD2, also available from Analog Devices, Inc. External sockets are provided for the  $A_{IN}$  input, the  $V_{IN}$  input and the  $V_{BIASED}$  input. Note that the EVAL-CONTROL-BRD2 operates with all Analog Devices evaluation boards with part numbers ending in the letters CB.

### FUNCTIONAL BLOCK DIAGRAM

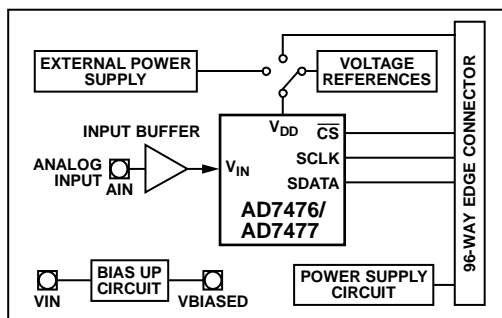


Figure 1.

#### Rev. 0

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## REVISION HISTORY

1/07—Revision 0: Initial Version

## EVALUATION BOARD HARDWARE

### POWER SUPPLIES

When using this evaluation board with the EVAL-CONTROL-BRD2, all supplies are provided from the controller board through the 96-way connector.

When using the board as a standalone unit, external supplies must be provided. This evaluation board has seven power supply inputs:  $AV_{DD}$ ,  $AGND$ , +12 V, -12 V,  $AGND$ ,  $DV_{DD}$  and  $D_{GND}$ . The  $V_{DD}$  for the AD7476/AD7477 can be supplied either from the EXT\_VDD external supply or from the selected reference chip. In addition, +12 V and -12 V are used to supply the AD780, the REF195, and the OP467 quad op amp.

0 V is connected to one or both of the  $AGND$  inputs. The  $DV_{DD}$  input can be used to supply a separate +5 V for the 74LS04  $DV_{DD}$  pin. The  $D_{GND}$  input must be tied to 0 V. The supplies are decoupled to the relevant ground plane with 10  $\mu$ F tantalum and 0.1  $\mu$ F multilayer ceramic capacitors at the entry point to the evaluation board. The supply pins of the quad op amp and

the references are also decoupled to  $AGND$  with 10  $\mu$ F tantalum and 0.1  $\mu$ F ceramic capacitors. The AD7476/AD7477  $AV_{DD}$  supply pin is decoupled to  $AGND$  with 10  $\mu$ F tantalum and 0.1  $\mu$ F multilayer ceramic capacitors.

Extensive ground planes are used on this board to minimize the effect of high frequency noise interference. There are two ground planes,  $AGND$  and  $D_{GND}$ . These are connected at one location in close proximity to the AD7476/AD7477.

### INITIAL SET-UP CONDITIONS

Care should be taken before applying power or signals to the evaluation board to ensure that all link positions are as per the required operating mode. Failure to do so could result in damage to the evaluation board.

Table 1 outlines the default positions of all links when the board is shipped. All links are set so that all power supplies and control signals are supplied by the EVAL-CONTROL-BRD2.

**Table 1. Initial Link and Switch Positions**

Link No.	Position	Function
LK1	Removed	50 $\Omega$ termination resistor is not applied to the input of the VIN circuit.
LK2	Removed	AD780 is set to provide a 2.5 V reference.
LK3	Removed	50 $\Omega$ termination resistor is not applied to the input of the bias-up circuit.
LK4	Removed	This is not relevant due to the position of LK12.
LK5	A	$V_{DD}$ is selected as the dc bias voltage for the bias-up circuit.
LK6	A	+12 V is supplied from the EVAL-CONTROL-BRD2 via J4.
LK7	A	-12 V is supplied from the EVAL-CONTROL-BRD2 via J4.
LK8 to LK9	B	SCLK signal from the EVAL-CONTROL-BRD2 is not inverted (for faster values of SCLK).
LK10	Removed	This is not relevant due to the position of LK8 and LK9 (the 74LS04 is not in use).
LK11	A	AIN SMB is connected to the input of the analog input buffer.
LK12	B	$V_{DD}$ for the AD7476/AD7477 is supplied from the EVAL-CONTROL-BRD2 via J4.

# EVAL-AD7476/AD7477

## LINK OPTIONS

Twelve link options must be set for the required operating setup before using the evaluation board. The functions of these options are outlined in Table 2.

Table 2. Link Functions

Link No.	Function
LK1	Selects a 50 $\Omega$ termination on the analog input buffer circuit, the AIN socket. When this link is installed, 50 $\Omega$ termination is applied. When this link is uninstalled, 50 $\Omega$ termination is removed.
LK2	Controls the program pin of the AD780 voltage reference. When this link is installed, the AD780 output voltage is set to 3 V. When this link is uninstalled, the AD780 output voltage is set to 2.5 V.
LK3	Selects a 50 $\Omega$ termination on the input of the bias-up circuit, the VIN socket. When this link is installed, the 50 $\Omega$ termination is applied. When this link is uninstalled, the 50 $\Omega$ termination is removed.
LK4	Connects the output of either the REF195 or the AD780 to the V <sub>DD</sub> pin of the AD7476/AD7477 (if Link 12 is in Position C). In Position A, the AD780 supplies the V <sub>DD</sub> voltage for the AD7476/AD7477. In Position B, the REF195 supplies the V <sub>DD</sub> voltage for the AD7476/AD7477.
LK5	Sets the dc bias voltage that is applied to the optional bias-up circuit. In Position A, the bias voltage is set to the same level as the voltage that is applied to the AD7476/AD7477 V <sub>DD</sub> pin. In this configuration, a bipolar analog input applied to the VIN SMB socket is biased up by the bias circuit and is presented at the V <sub>BIASED</sub> SMB as an unipolar signal biased around V <sub>DD</sub> /2. In Position B, the bias voltage is set to A <sub>GND</sub> . In this configuration, the bias-up circuit is not used.
LK6	Selects the source of the +12 V supply. In Position A, the +12 V is supplied from the EVAL-CONTROL-BRD2 through the 96-way connector. In Position B, the +12 V is supplied from an external source through the power connector, J6.
LK7	Selects the source of the –12 V supply. In Position A, the –12 V is supplied from the EVAL-CONTROL-BRD2 through the 96-way connector. In Position B, the –12 V is supplied from an external source through the power connector, J6.
LK8 to LK9	Controls the transfer of data from the AD7476/AD7477 during a conversion for various frequencies of SCLK. These links should be in Position A for slower SCLK frequencies, giving valid data on the rising edge. These links should be in Position B for fast SCLK frequencies, giving valid data on the falling edge.
LK10	Selects the source of the V <sub>CC</sub> +5 V supply for the 74LS04, an inverting buffer. In Position A, V <sub>CC</sub> power is supplied from the same power source supplying the AD7476/AD7477 V <sub>DD</sub> pin. In Position B, V <sub>CC</sub> power must be supplied from an external source via the power connector, J5.
LK11	Connects the input of the V <sub>IN</sub> analog buffer to the AIN input socket or to A <sub>GND</sub> . In Position A, the AIN socket is tied to the input of the V <sub>IN</sub> buffer. In this configuration, an analog signal applied to the AIN input socket is buffered and presented at the AD7476/AD7477 V <sub>IN</sub> input. In Position B, the V <sub>IN</sub> buffer input is tied to A <sub>GND</sub> .
LK12	Selects the source of the V <sub>DD</sub> supplied to the AD7476/AD7477. In Position A, the V <sub>DD</sub> must be supplied from an external source via J5. In Position B, the V <sub>DD</sub> is supplied from the EVAL-CONTROL-BRD2. In Position C, the V <sub>DD</sub> is supplied from one of the voltage references, the AD780 or the REF195.

## INTERFACING THE EVALUATION BOARDS

Interfacing the EVAL-CONTROL-BRD2 to the evaluation board is accomplished via a 96-way connector, J4.

Plug the 96-way connector on the evaluation board directly into the 96-way connector on the EVAL-CONTROL-BRD2.

Figure 2 shows the pinout for the 96-way connector.

Table 3 and Table 4 list the pin designations and descriptions. The unused pins of the 96-way connector are not shown.

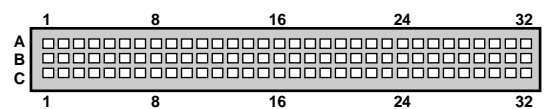


Figure 2. Pin Configuration for the 96-Way Connector

Table 3. 96-Way Connector Pin Description

Signal	Description
DR0	Data Receive Zero. This input is connected to the SDATA pin of the AD7476/AD7477.
TFS0/RFS0	Transmit/Receive Frame Sync Zero. These two outputs are connected to the CS pin of the AD7476/AD7477.
SCLK0	Serial Clock Zero. This serial clock is connected to the SCLK pin of the AD7476/AD7477 with the option of an inverting buffer.
DGND	Digital Ground. These lines are connected to the digital ground plane on the evaluation board. It allows the user to provide the digital supply via the connector along with the other digital signals.
AGND	Analog Ground. These lines are connected to the analog ground plane on the evaluation board.
AV <sub>DD</sub>	Analog +5 V Supply. These lines are connected to the AV <sub>DD</sub> supply line on the board.
+12 V	+12 V Supply. This line is connected to the +12 V supply line on the board via LK6.
−12 V	−12 V Supply. This line is connected to the −12 V supply line on the board via LK7.

Table 4. 96-Way Connector Pin Functions, J4<sup>1</sup>

Pin	ROW A	ROW B	ROW C
1			
2			
3			
4	DGND	DGND	DGND
5			DR0
6	TFS0		RFS0
7	SCLK0		SCLK0
8			
9			
10			
11			
12	DGND	DGND	DGND
13			
14			
15			
16	DGND	DGND	DGND
17			
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	−12 V	AGND	+12 V
31			
32	AV <sub>DD</sub>	AV <sub>DD</sub>	AV <sub>DD</sub>

<sup>1</sup> Note : The unused pins of the 96-way connector are not shown.

# EVAL-AD7476/AD7477

## SOCKETS

There are three input sockets relevant to the operation of the AD7476/AD7477 on these evaluation boards. The functions of these sockets are outlined in Table 5.

**Table 5. Socket Functions**

Socket	Function
J1	Subminiature BNC socket for AIN analog input.
J2	Subminiature BNC socket for analog input to bias-up circuit, $V_{IN}$ .
J3	Subminiature BNC socket for analog output from bias-up circuit, $V_{BIASED}$ .

## CONNECTORS

There are three connectors on the AD7476/AD7477 evaluation boards as outlined in Table 6.

**Table 6. Connector Functions**

Connector	Function
J4	96-way connector used to Interface to the EVAL-CONTROL-BRD2.
J5	External $V_{DD}$ and $A_{GND}$ power connector.
J6	External +12 V, -12 V, and $A_{GND}$ power connector.

## OPERATING THE EVAL-AD7476/AD7477

The evaluation board can be operated as a standalone unit or in conjunction with the EVAL-CONTROL-BRD2.

When operated with the EVAL-CONTROL-BRD2, all supplies and control signals to operate the AD7476/AD7477 are provided by the EVAL-CONTROL-BRD2. Software to communicate between the controller board and the AD7476/AD7477 is provided with the AD7476/AD7477 evaluation board kit. The EVAL-CONTROL-BRD2 operates with all Analog Devices evaluation boards with model numbers ending in the letters CB.

The 96-way connector is powered from a 12 V ac transformer. Suitable transformers are available from Analog Devices as an accessory under the following part numbers:

- 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 from Digi-Key Corp. (U.S.) and Campbell Collins, Ltd. (U.K.).

Connection between the EVAL-CONTROL-BRD2 and the serial port of a PC is accomplished via a standard printer port cable, provided as part of the EVAL-CONTROL-BRD2 kit.

## EVALUATION BOARD SOFTWARE

### INSTALLING THE SOFTWARE

The EVAL-AD7476/AD7477CB kit includes self-installing software on CD-ROM. This CD-ROM contains software for controlling and evaluating the performance of the AD7476/AD7477 when operated in conjunction with the EVAL-CONTROL-BRD2.

Simply insert the CD into the drive on your PC, and an installation program automatically begins. This program installs the evaluation software onto the PC as well as electronic versions of the evaluation board data sheets, the AD7476/AD7477 device data sheet, and the EVAL\_CONTROL-BRD2 data sheet.

### CHECKING THE EVAL-CONTROL-BRD2

The EVAL-CONTROL-BRD2 and evaluation board should be connected together as described in the Interfacing the Evaluation Boards section.

At this stage, the red LED on the EVAL-CONTROL-BRD2 should be flashing. This indicates that the EVAL-CONTROL-BRD2 is functional and ready to receive instructions.

Note that the software should be installed before the printer port cable is connected between the EVAL-CONTROL-BRD2 and the PC. This ensures that the printer port has been initialized properly.

### THE MAIN SCREEN

The Main Screen, shown in Figure 3, allows you to read a predetermined number of samples from the evaluation board and display them in both the time and frequency domain. This screen can be divided into three sections.

The upper portion of the screen contains the control buttons, the menu bar, and the status windows.

#### Control Buttons

Use control buttons to take samples (**Sample**), reset the board (**Reset**), and quit the program (**Quit**).

The **Reset** button resets EVAL-CONTROL-BRD2. The power supplies are turned off and the program in DSP memory is lost. Repeat the set up instructions to download another program if required.

The **Quit** button exit the software, however programs running on the EVAL-CONTROL-BRD2 is not terminated.

**Power Down** and **Power Up** buttons allow you to power down and then power up the device (see the [AD7476/AD7477](#) data sheet).

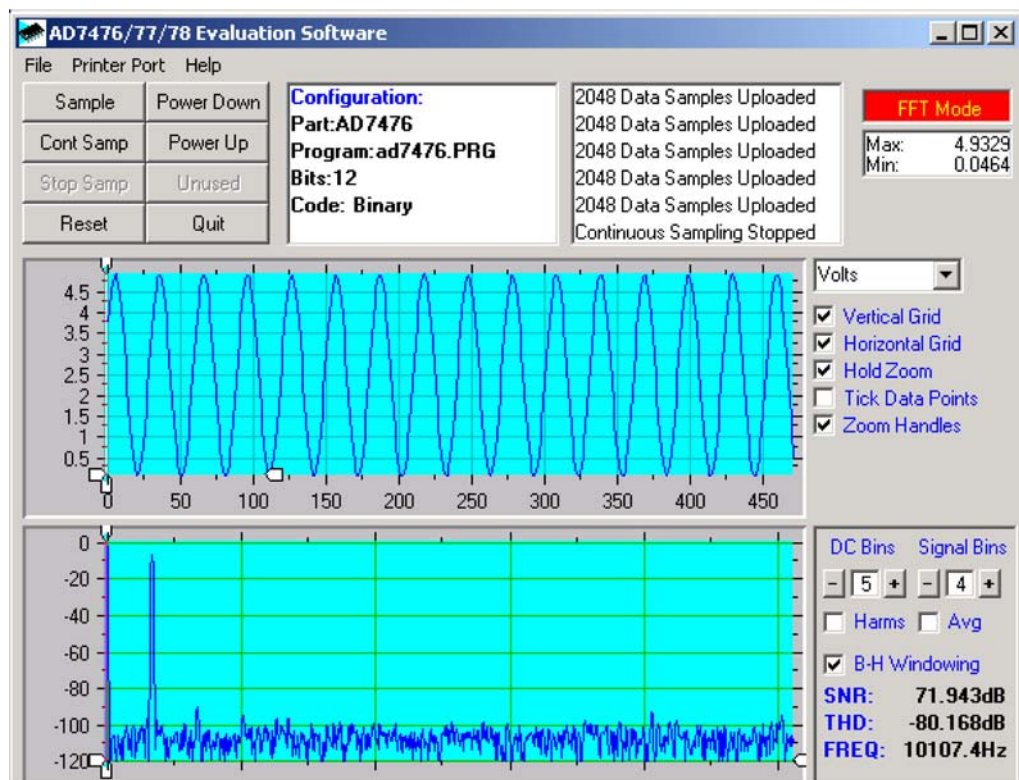


Figure 3. Main Screen

## Menu Bar

The menu bar consists of the **File**, **Printer Port**, and **Help** menus.

The **File** menu offers the following selections:

- **Setup Menu.** Select this option to display the Setup Menu as shown in Figure 5.
- **Load Raw Data.** Select this option to load data saved by the software during a previous session.
- **Save Raw Data.** Select this option to save the current set of sample data points. The data can be reloaded to the EVAL-CONTROL-BRD2 software later or used by other programs for further analysis
- **Save Binary Data.** Select this option to save the current set of sample data points. The data is saved in binary format as a text file. This method can be useful for examining code flicker and looking for stuck bits.
- **Save FFT Data.** Select this option to save the current set of FFT data points. FFT data cannot be reloaded into the EVAL-CONTROL-BRD2 software, but can be loaded into other software packages for further analysis.
- **Exit.** Quits the program.

The **Printer Port** menu allows you to select which printer port to use to communicate with the EVAL-CONTROL-BRD2.

- **LPT1.** This option selects 0x378 as the printer port address. This is the default option.

- **LPT2.** This option selects 0x278 as the printer port address.
- **PRN.** This option selects 0x3BC as the printer port address.

The **Help** menu provides information about the current version of evaluation board software.

## Status Windows

The status windows display the setup of the evaluation board and the device, along with the number of samples taken, and other information, such as error messages generated.

## Oscilloscope

The middle portion of the Main Screen is a Digital Storage Oscilloscope (DSO). Samples uploaded from the EVAL-CONTROL-BRD2 are displayed here. Samples can be displayed as integer values or as voltages. Once the samples are displayed, clicking any point in the graph displays the sample number and the value of the point directly beneath the cursor.

Zoom handles, which appear along the axis of the graph, allow you to zoom in and out to get a closer look at a particular sample. When another set of samples is taken, the graph attempts to display all values collected unless the **Hold Zoom** check box is checked. The graph retains the same axis settings as for the previous set of data samples. Additional check boxes are providing allowing you to control the vertical and horizontal grids and data points.



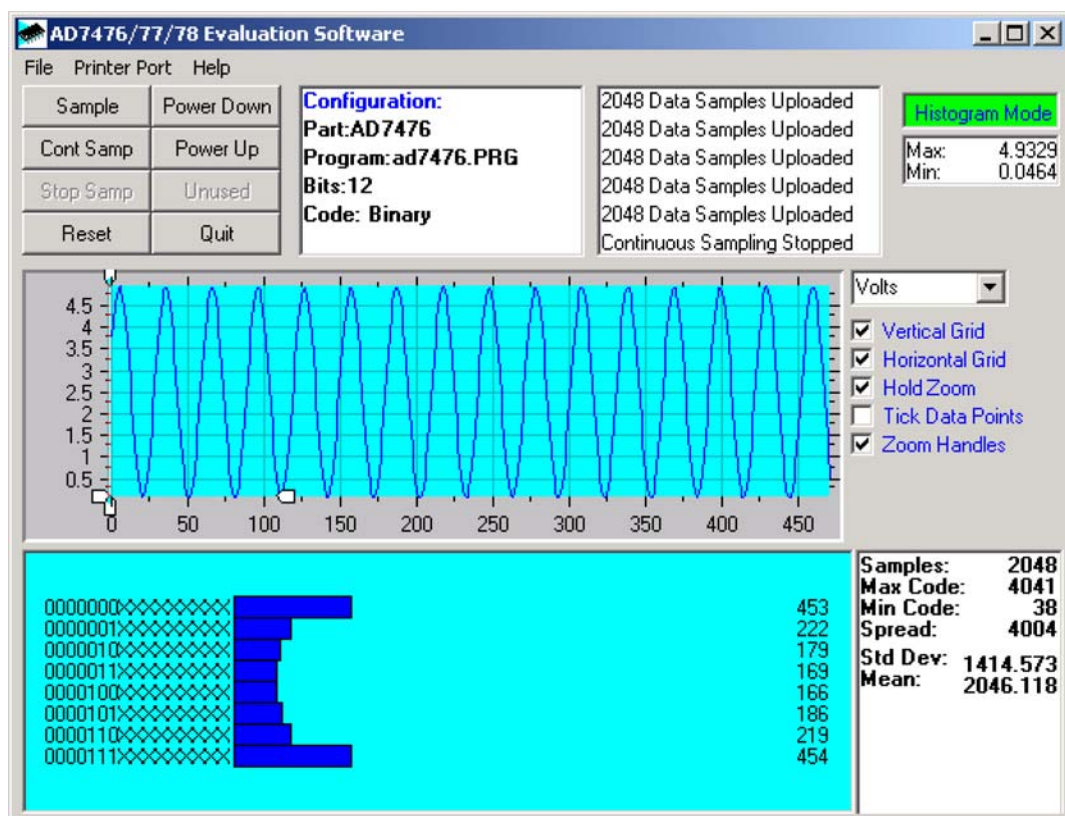


Figure 4. Main Screen, Histogram Mode

### Fast Fourier Transform/Histogram

The lower portion of the main screen shows either a Fast Fourier Transform (FFT) of the data or a histogram, which shows the number of occurrences of each particular code read back. The FFT (the default option) is typically used if you are concerned with examining an ADC's performance in the frequency domain, while the histogram indicates the ADC's performance with DC signals. The option displayed can be changed by clicking on the **FFT Mode/Histogram Mode** button at the top right of the screen. Figure 4 shows the Main Screen with the histogram mode is selected.

### SETUP MENU

The Setup Menu, shown in Figure 5, allows you to load the required configuration file for the evaluation board. Once the configuration file is loaded, the software acquires detailed information about the AD7476/AD7477 evaluation board and the device connected to the EVAL-CONTROL-BRD2. This includes information such as the number of bits, maximum sampling rate, output coding, maximum analog input, and power supply requirement.

The configuration file also communicates to the software the name of the DSP program file to download to the EVAL-CONTROL-BRD2.

The Setup Menu allows you to choose the sampling frequency and the number of samples to take.

### RUNNING THE SOFTWARE

Once the software is installed and running, perform Step 1 through Step 3.

1. From the **File** menu, select **Setup**.

The Setup Menu displays. Notice that the **Select a Configuration File** window lists all the available configuration files. The configuration files are text-based files containing information about the device to be tested. The information includes the part name, number of samples to be taken, default and maximum sampling frequency, and power supply settings. The configuration file also contains the name of the DSP program file to be downloaded to the EVAL-CONTROL-BRD2.

2. Select the relevant configuration file and then click **Load**.

Choose the configuration file depending upon which device is in the socket of the evaluation board. The EVAL-CONTROL-BRD2 is then reset and the DSP program is downloaded. Once the download is complete, the power supply settings indicated in the configuration file are set and you may hear some of the relays clicking. The pull-down menus, **Select No. Of Samples** and **Select Sample Frequency**, are set to the default values specified in the configuration file. Note that you can change these settings at any point.

## EVAL-AD7476/AD7477

- Once all the settings are set, click **Close** to return to the Main Screen.

### SOFTWARE CONFIGURATION FILES

Software configuration files provide the EVAL-CONTROL-BRD2 software with information on how the software and hardware should perform. These files contain information, such as the name of the DSP program to download, the default and maximum sample frequencies, the number of samples to take, and the power supply settings to use.

#### Typical Configuration File

A typical Software Configuration File (\*.cfg) is shown here.

```
[EVAL-CONTROL BOARD]
partname:AD7476
programname:ad7476.PRG

samplefrequency:100000
maxsamplefrequency:1000000
samples:2048

+/-15V:on
dvdd:5:on
avdd:5:on
bus:on
;options 2scomp, binary
dataformat:binary
number of bits:12
inputVmax:5
inputVmin:0
```

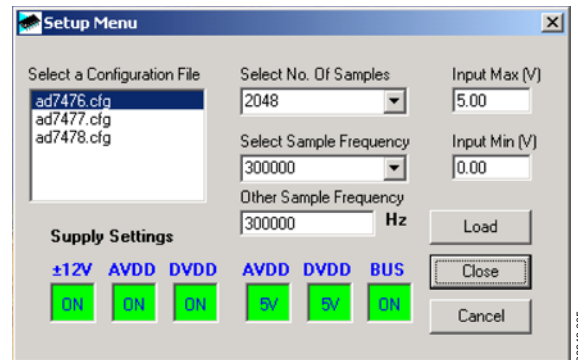


Figure 5. The Setup Menu

### TAKING SAMPLES

To instruct the EVAL-CONTROL-BRD2 to take the required number of samples at the required frequency, follow these steps using the Main Screen shown in Figure 3:

- Click **Sample**.

Select a sampling frequency up to the rate of 1 MSPS.

Samples are uploaded and displayed. An FFT and histogram are also calculated and displayed.

- Click **Cont Samp** to continue taking samples.
- Click **Stop Samp** when you are finished taking samples.

## EVALUATION BOARD SCHEMATICS AND ARTWORK

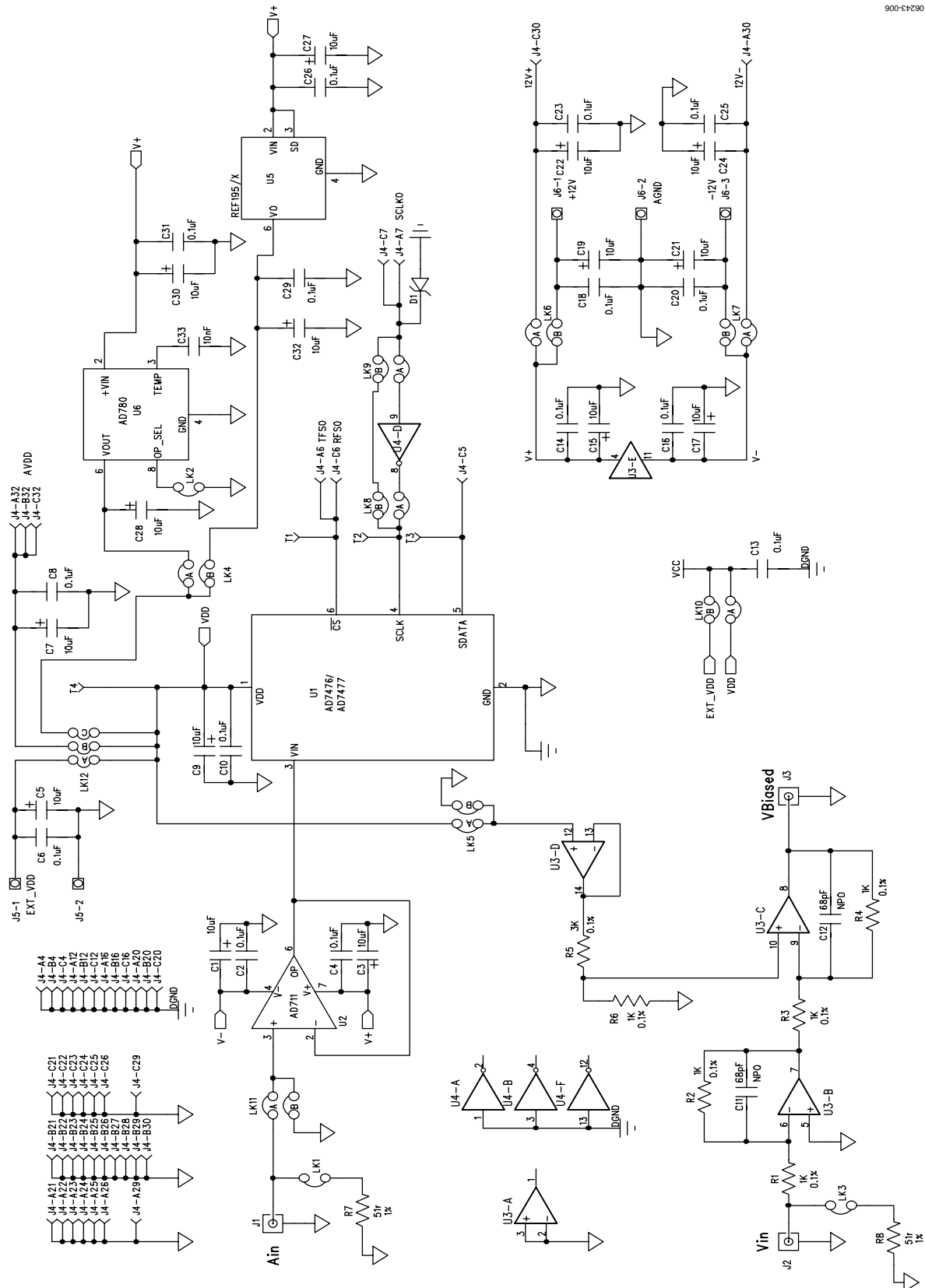


Figure 6. AD7476/AD7477 Evaluation Board Circuit Diagram

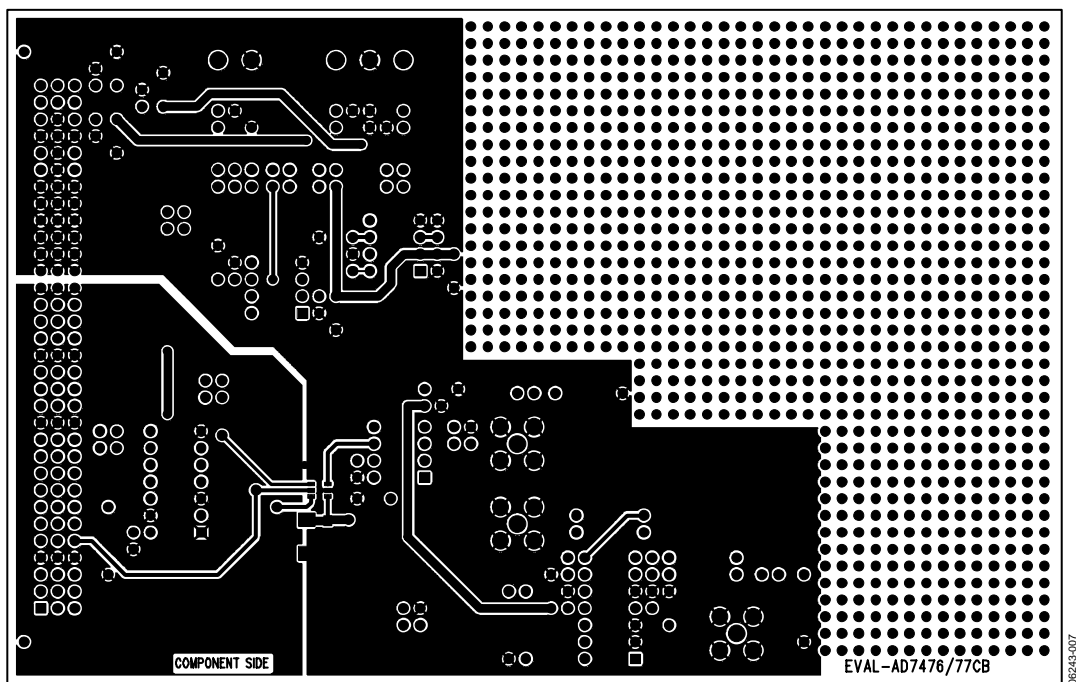


Figure 7. Component Side Artwork

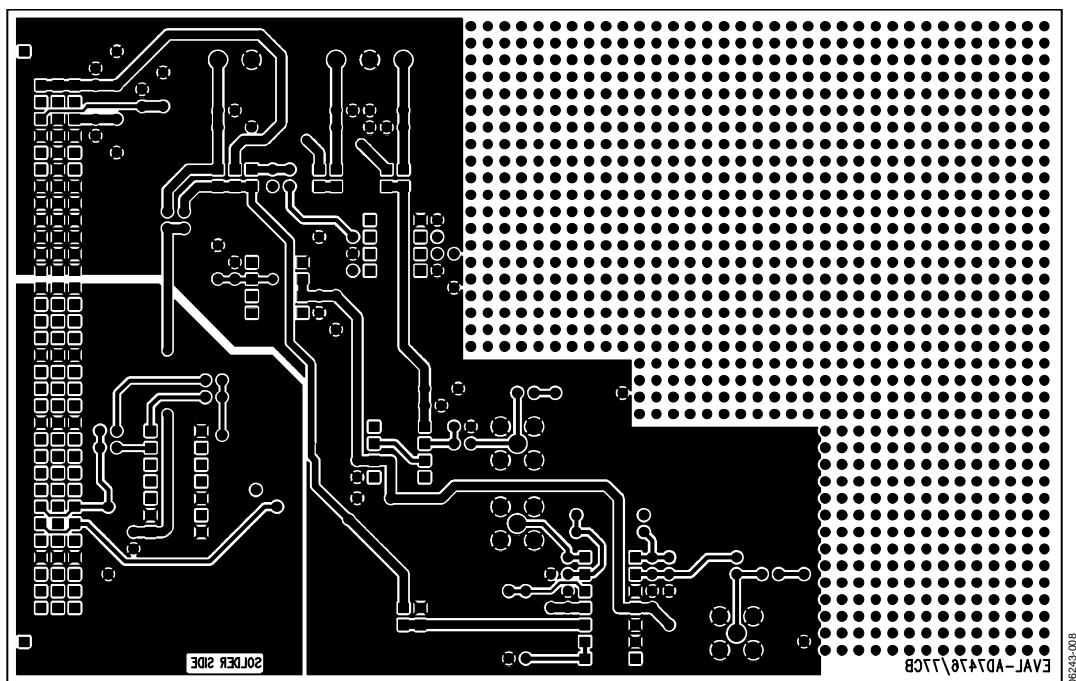


Figure 8. Solder Side Artwork

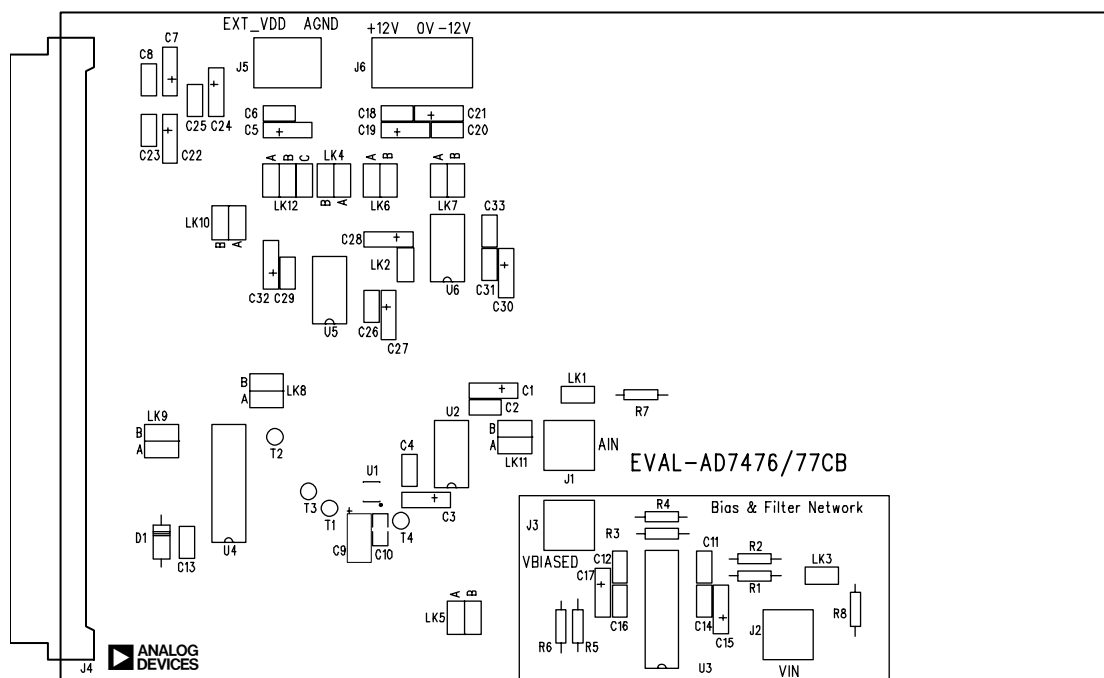


Figure 9. AD7476/AD7477 Evaluation Board Component Placement Drawing

# EVAL-AD7476/AD7477

## ORDERING INFORMATION

### BILL OF MATERIALS

Table 7. Components Listing


Qty.	Reference Designator	Part Type	Manufacturing Information	Order No. <sup>1</sup>
1	U1	AD7476/AD747677	Analog Devices	AD7476ABKS/AD7477AAKS
1	U2	AD711	Analog Devices	AD711KN
1	U3	OP467G	Analog Devices	OP467G
1	U4	74LS04	DM74LS04	FEC 373-450
1	U5	ADREF195	Analog Devices	ADREF195GP
1	U6	AD780	Analog Devices	AD780AN
5	R1 to R4, R6	1 k $\Omega$ 0.25W 0.1% RC55	Welwyn Components Ltd.	FEC 339-179
1	R5	3 k $\Omega$ 0.25W 0.1% RC55	Welwyn Components Ltd.	FEC 339-635
2	R7, R8	51 $\Omega$ 0.25W 1%	MultiComp	FEC 543-070
1	C10	0.1 $\mu$ F ceramic 1206 case	12065C104KATDA	FEC 895-210
1	C9	10 $\mu$ F 20 V TAJ-C case	TAJC106K020X	FEC 498-798
2	C11, C12	68 pF ceramic	MR051A680JTA	FEC 669-714
1	C33	0.01 $\mu$ F ceramic 50 V	MCDR25103X7RK0050	FEC 750-890
14	C2, C4, C6, C8, C13, C14, C16, C18, C20, C23, C25, C26, C29, C31	0.1 $\mu$ F ceramic 50 V	MCDR25104X7RK0050	FEC 750-920
14	C1, C3, C5, C7, C15, C17, C19, C21, C22, C24, C27, C28, C30, C32	10 $\mu$ F 35 V tantalum	TAP10K35CCSY	FEC 664-881
1	D1	SD103C Schottky diode		SD103C
3	J1, J2, J3	50 $\Omega$ gold plated SMB	M/A-COM	FEC 310-682
1	J4	96-pin 90° DIN41612 plug	Siemens AG	FEC 269-931
1	J5	2-pin power connector	Lumberg Group (KRM2)	FEC 151-785
1	J6	3-pin power connector	Lumberg Group (KRM3)	FEC 151-786
3	LK1, LK2, LK3	2-way jumper (2 x 1)	Harwin, Inc.	FEC 511-705
7	LK4 to LK11	2-way jumper (2 x 2)	Harwin, Inc.	FEC 511-791
1	LK12	2-way jumper (2 x 3)	Harwin, Inc.	FEC 511-780
11	LK1 to LK12	Shorting links	Berg Electronics	FEC 528-456
4	T1, T2, T3, T4	White testpoint	W Hughes	FEC 240-333
52	U2, U3, U4, U5, U6	Ultralow profile socket pins	Harwin, Inc.	FEC 519-959
4	Each Corner	Rubber stick-on feet	3M	FEC 148-922
1	PCB	Evaluation Board	Analog Devices	EVAL-AD7476/AD7477CB

<sup>1</sup> Farnell Electronic Components.

## ORDERING GUIDE

Model	Description
EVAL-AD7476CB	AD7476 Evaluation Board
EVAL-AD7477CB	AD7477 Evaluation Board

## ESD CAUTION

	<b>ESD (electrostatic discharge) sensitive device.</b> Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.
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**NOTES**

## **NOTES**