



# Evaluation Board for 5V, Serial, 14-Bit 333kSPS, Sampling ADC

## EVAL - AD7851CB

### FEATURES

- Full-Featured Evaluation Board for the AD7851
- Compatible with 5V Systems
- On-Board Reference and Digital Buffers.
- Various Linking options
- EVAL-CONTROL BOARD Compatability

### GENERAL DESCRIPTION

This Application Note describes the evaluation board for the AD7851 14-Bit A/D converter. The AD7851 is a high speed, low power ADC which operates from a single +5V supply. It features self-calibration and system calibration options and also includes a power down mode. It incorporates an on chip track/hold amplifier and a versatile serial I/O port. This flexible serial interface allows the AD7851 to connect directly to Digital Signal Processors (ADSP-2101, TMS320C25, etc.) and Microcontrollers (8XC51, 68HC11, etc.). Full data on the AD7851 is available in the AD7851 data sheet available from Analog Devices and should be consulted in conjunction with this Application Note when using the Evaluation Board.

On-board components include an REF198; +4.096V ultra high precision Low Power, Low Dropout reference, an AD845 and two OP-07's amplifiers, an SSM2141 line receiver, and a 74HC08 quad AND gate.

Interfacing to this board is through a 96-way connector. External sockets are provided for the clock input, conversion start input, analog input, and external supplies if required. The complete circuit diagram is given in Figure 10.

### OPERATING THE AD7851 EVALUATION BOARD.

#### Power Supplies

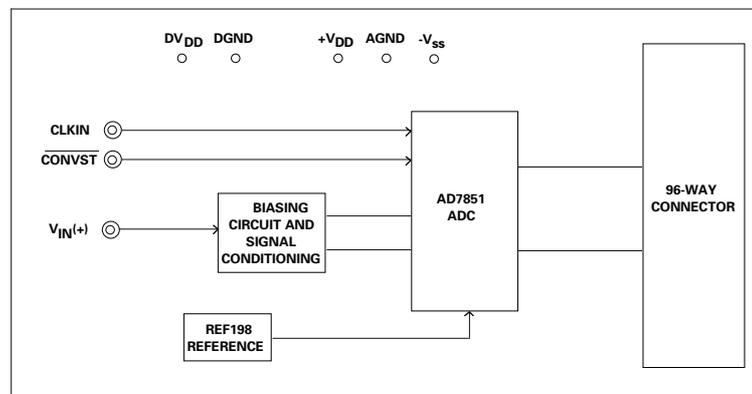
When using this evaluation board with the EVAL-CONTROL BOARD there will be no need to provide any external supplies. All supplies will be provided from the EVAL-CONTROL BOARD through the 96-way connector.

The evaluation board uses extensive ground planes to minimise high frequency noise interference from the on-board clocks or any other sources. The ground plane for the analog section is kept separate from that for the digital section and they are joined only at the AD7851 AGND and DGND pins. Therefore, it is recommended not to connect AGND and DGND elsewhere in the system to avoid ground loop problems.

When using this evaluation board as a stand alone unit external supplies must be provided. The AD7851 evaluation board has five power supply inputs:  $DV_{DD}$ ,  $+V_{DD}$ ,  $-V_{SS}$ , AGND and DGND. The  $DV_{DD}$  is used to supply both the  $AV_{DD}$  and the  $DV_{DD}$  of the AD7851 directly, and is also connected to the  $V_{CC}$  pin of the 74HC08. The  $+V_{DD}$  and  $-V_{SS}$  supply the different op amps, biasing circuit and external reference. The AGND input is connected to the analog ground plane and the DGND input is connected to the digital ground plane.

All analog supply pins are decoupled to AGND with 10 $\mu$ F tantalum capacitors in parallel with 0.1 $\mu$ F multilayer ceramic capacitors. These pins are the  $AV_{DD}$  pin of the AD7851, the  $+V_{DD}$  and  $-V_{SS}$  pins of the op amps, and SSM2141, and the  $+V_{IN}$  pin of the external reference. The digital supply for the AD7851 is decoupled to DGND with a 10 $\mu$ F tantalum capacitor in parallel with a 0.1 $\mu$ F disc ceramic capacitor at the power-supply terminals, and at the  $DV_{DD}$  pin of the AD7851. The logic chip, 74HC08, is decoupled with a 0.1 $\mu$ F disc ceramic capacitor to DGND.

### FUNCTIONAL BLOCK DIAGRAM



REV. A

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**SHORTING PLUG AND SWITCH OPTIONS:**

There are a number of link options on the evaluation board which should be set for the required operating setup before using the board. The function of these link options are described in detail below:

Link No.	Function
LK1	<p><b>This link must be unconnected if an external supply is used.</b> This link option is used to select between an external <math>V_{DD}</math> supply and the <math>V_{DD}</math> supply from the EVAL-CONTROL BOARD. The <math>V_{DD}</math> supplies the <math>AV_{DD}</math> and the <math>DV_{DD}</math> for the AD7851 and the <math>V_{CC}</math> for the 74HC08.</p> <p>With this link connected the <math>V_{DD}</math> is supplied from the EVAL-CONTROL BOARD.</p> <p>With this link unconnected the <math>V_{DD}</math> must be supplied externally at the <math>DV_{DD}</math> power supply terminal connector.</p>
LK2	<p>This link option is used to tie the DIN pin to DGND or to connect it to the 96-way connector.</p> <p>In position B, the DIN pin is connected to the 96-way connector and writing to the part will take place.</p> <p>In position A, the DIN pin is tied to DGND and there will be no writing to the part.</p> <p>When using the EVAL-CONTROL BOARD this link should be in position B.</p>
LK3	<p>This link option is in series with the BUSY output to the 96-way connector.</p> <p>This link has the function of connecting the BUSY output to the 96-way connector.</p>
LK4	<p>This link option is in series with the FL0 input from the 96-way connector. When using the EVAL-CONTROL BOARD this input supplies the conversion start signal for the <math>\overline{CONVST}</math> input of the AD7851.</p> <p>This link should be connected when using the EVAL-CONTROL BOARD and no external <math>\overline{CONVST}</math> signal.</p> <p>This link should be unconnected when using an external <math>\overline{CONVST}</math> signal.</p>
LK5	<p>This link option is in series with the SCLK1 input from the 96-way connector. When using the EVAL-CONTROL BOARD this input supplies the clock signal for the CLKIN input of the AD7851.</p> <p>This link should be connected when using the EVAL-CONTROL BOARD and no external CLKIN signal.</p> <p>This link should be unconnected when using an external CLKIN signal.</p>
LK6	<p>This link option adds a 50 <math>\Omega</math> termination to DGND to the CLKIN line.</p> <p>This link option should be unconnected when using the CLKIN from the EVAL-CONTROL BOARD.</p> <p>If a 50 <math>\Omega</math> termination is required when using an external CLKIN signal this link should be connected.</p>
LK7	<p>This link option adds a 50 <math>\Omega</math> termination to DGND to the <math>\overline{CONVST}</math> line.</p> <p>This link option should be unconnected when using the <math>\overline{CONVST}</math> from the EVAL-CONTROL BOARD.</p> <p>If a 50 <math>\Omega</math> termination is required when using an external <math>\overline{CONVST}</math> signal this link should be connected.</p>
LK8	<p>This link option is used to select between normal mode operation and sleep mode.</p> <p>With this link in position A, the <math>\overline{SLEEP}</math> pin is tied to a logic low and the part is put into sleep mode.</p> <p>With this link in position B, the <math>\overline{SLEEP}</math> pin is tied to a logic high and normal operation results.</p> <p>When using the EVAL-CONTROL BOARD with this evaluation board LK8 should be in position B to allow both normal mode operation and sleep mode to be programmed by the software.</p>

**LK9** This link option is used to select between the two analog input ranges of the AD7851: the unipolar input range and bipolar input range.

With this link in position A, the AMODE pin is tied to a logic low and the unipolar input range is selected; in this case LK18 should be in position B tying AIN(-) to AGND.

With this link in position B, the AMODE pin is tied to a logic high and the bipolar input range is selected; in this case LK18 should be in position A tying AIN(-) to  $V_{REF}/2$ .

When using the EVAL-CONTROL BOARD this link should be in position A.

**LK10** This link controls the polarity of the serial clock, SCLK.

With this link in position A, the POLARITY pin is tied to a logic low. With this input low, the first transition of a serial clock in a data operation will be from low to high.

With this link in position B, the POLARITY pin is tied to a logic high. With this input high, the first transition of the serial clock in a data operation is from a high to a low.

**LK11,LK12** These links control the serial interface mode of the part.

With both these links in position B, the SM1 and SM2 pins will be connected to a logic high and with both these links in position A, the SM1 and SM2 pins will be connected to a logic low.

There are three external clocking modes (the user must provide the serial clock and frame sync) and two internal clocking modes (the part provides the serial clock, and frame sync). Table I details the link positions for selecting the different interface modes. Please see the AD7851 data sheet for further information on the different serial interface modes.

When using the EVAL-CONTROL BOARD with this evaluation board both LK11 and LK12 should remain in position B for correct operation.

**TABLE I. INTERFACE MODES**

LK11	LK12	INTERFACE MODE
A	A	1,2 (External Clocking)
A	B	3 (External Clocking)
B	A	4 (Internal Clocking)
B	B	5 (Internal Clocking)

**LK13** **This link must be unconnected if an external supply is used.** Otherwise, if the supply from the EVAL-CONTROL BOARD is used this link should be connected.

With this link connected the +12 V is supplied from the EVAL-CONTROL BOARD.

With this link unconnected the +12 V must be supplied externally at the +12 V power supply terminal connector.

**LK14** **This link must be unconnected if an external supply is used.** Otherwise, if the supply from the EVAL-CONTROL BOARD is used this link should be connected.

With this link connected the -12 V is supplied from the EVAL-CONTROL BOARD.

With this link unconnected the -12 V must be supplied externally at the -12 V power supply terminal connector.

**LK15,LK20** These link options are used to select between two different voltage ranges at the  $V_{IN}$  socket (0 to  $V_{REF}$  volts or  $\pm V_{REF}/2$  volts). The voltage range is changed by connecting the biasing circuit on the evaluation board in or bypassing it.

LK20 should only be connected when LK15 is in position B.

With LK15 in position A, LK20 should be left unconnected, the biasing circuit is bypassed and the signal at the  $V_{IN}$  socket should be in the range 0 to  $V_{REF}$  volts.

With LK15 in position B, LK20 should be connected, the biasing circuit is connected in and the signal at the  $V_{IN}$  socket should be in the range  $\pm V_{REF}/2$  volts.

- LK16 This link option is used to connect the signal from the AD845 buffer amplifier to the AIN(+) pin of the AD7851. With this link connected the output of the AD845 buffer amplifier is connected to the 120  $\Omega$ , 6.8 nF filter to the AIN(+) pin of the AD7851. With this link unconnected, the output of the AD845 is disconnected from the RC filter and thus from the AIN(+) pin of the AD7851. Note that the analog input may also be connected to a component grid for extra signal conditioning.
- LK17 This link is used to short the analog inputs, AIN(+) and AIN(-), together. With this link connected the AIN(+) and AIN(-) pins are shorted together. With this link unconnected the AIN(+) and AIN(-) are not shorted together.
- LK18 This link is used to tie the AIN(-) pin to AGND or to  $V_{REF}/2$ . With this link in position A, the AIN(-) pin is tied to  $V_{REF}/2$  (in this case the bipolar analog input range should be selected by having LK9 in position B). With this link in position B, the AIN(-) pin is tied to AGND (in this case the unipolar analog input range should be selected by having LK9 in position A).  
  
When performing a histogram of codes LK17 should be connected, LK9 should be in position B and LK18 should be in position A. **(In this case care should be taken to ensure that LK16 is unconnected to avoid shorting the output of the AD845 buffer to AGND through the 50  $\Omega$  resistor).**
- LK19 This link option is used to select between the external reference and the internal reference. With this link connected the external reference is selected and this is the default setting. With this link unconnected the internal 4.096 V reference is used.
- LK20 See LK15 on previous page.
- LK21 This link option adds a 50  $\Omega$  termination to AGND at the  $V_{IN}$  socket. In most applications this link will be left unconnected. If a 50  $\Omega$  termination is required this link should be connected. Care must be taken when connecting this link in case the signal source driving the  $V_{IN}$  socket cannot drive a 50  $\Omega$  load. When the signal source driving the  $V_{IN}$  socket has a 50  $\Omega$  output impedance it may be advantageous to connect this link to give the correct termination to AGND.
- SW1 This is a push button switch which is used to manually calibrate the AD7851.

## 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 II shows the position in which all the links are set when the evaluation board is sent out. These links settings are consistent when operating with the EVAL-CONTROL BOARD.

**TABLE II. INTIAL LINK POSITIONS**

Link No.	Position	Function
LK1	Connected	$V_{DD}$ is supplied via the 96-way connector. Sets up the board for $V_{DD}$ generated from the EVAL-CONTROL BOARD.
LK2	B	DIN pin is connected to the DT0 pin of the 96-way connector. Sets up the board for the DIN generated from the EVAL-CONTROL BOARD.
LK3	Connected	<u>BUSY</u> pin is connected to the <u>IRQ2</u> pin of the 96-way connector.
LK4	Connected	<u>CONVST</u> pin is connected to the FL0 pin of the 96-way connector. Sets up the board for the <u>CONVST</u> being generated from the EVAL-CONTROL BOARD.
LK5	Connected	CLKIN pin is connected to the SCLK1 pin of the 96-way connector. Sets up the board for the CLKIN being generated from the EVAL-CONTROL BOARD.
LK6	Unconnected	This ensures there is no 50 $\Omega$ termination on the CLKIN line.
LK7	Unconnected	This ensures there is no 50 $\Omega$ termination on the <u>CONVST</u> line.
LK8	B	This connects the <u>SLEEP</u> pin to DVDD and allows the EVAL-CONTROL BOARD to program the different power down modes.
LK9	A	This selects the unipolar analog input range. Sets up the board for the correct input range when interfacing to the EVAL-CONTROL BOARD.
LK10	B	Sets POLARITY pin high such that the first transition of the serial clock in a data transfer is from a high to a low.
LK11	B	This connects SM1 and SM2 pins to a logic high selecting interface mode 5 (Internal clocking). Sets up the board for interfacing to the EVAL-CONTROL BOARD.
LK12	B	
LK13	Connected	+12 V supplied via the 96-way connector. Sets up the board for +12 V generated from EVAL-CONTROL BOARD.
LK14	Connected	-12 V supplied via the 96-way connector. Sets up the board for -12 V generated from EVAL-CONTROL BOARD.
LK15	B	These connect the biasing circuit on the evaluation board and sets the analog input range at the $V_{IN}$ socket to $\pm V_{REF}/2$ .
LK20	Connected	
LK16	Connected	This connects the signal at the $V_{IN}$ socket via the biasing circuit to the AIN(+) pin of the AD7851. When performing a histogram of codes with the EVAL-CONTROL BOARD this link should be unconnected.
LK17	Unconnected	This ensures that the AIN(+) and AIN(-) pins are not shorted together. When performing a histogram of codes test with the EVAL-CONTROL BOARD this link should be connected.
LK18	B	AIN(-) tied to AGND.
LK19	Connected	External Reference selected
LK21	Unconnected	This ensures that there is no 50 $\Omega$ termination from the $V_{IN}$ socket to AGND.

## EVALUATION BOARD INTERFACING

Interfacing to the evaluation board is via a 96-way connector, J1. The 96-way connector is used for connecting the evaluation board to the EVAL-CONTROL BOARD or other system. The pinout for the 96-way connector is shown in Figure 1 and its pin designations are given in Table 2.

It is important to note that **the evaluation board is only setup for the AD7851 interface modes 4 and 5** (LK11 always in position B and LK12 in position A or B). This means that the SCLK, and SYNC are always outputs and DIN is always an input. Both the SCLK and SYNC are buffered from the AD7851 to the 96-way connector. The 74HC08 only buffers the SCLK and SYNC in one direction and assumes that the signals are outputs from the AD7851. If the AD7851 is required to operate in interface mode 1, 2, or 3, the 74HC08 should first be removed from the circuit. Failure to remove the 74HC08 from the board before configuring the AD7851 in interface mode 1, 2 or 3 may result in the AD7851 and the other IC's on the board being permanently damaged.

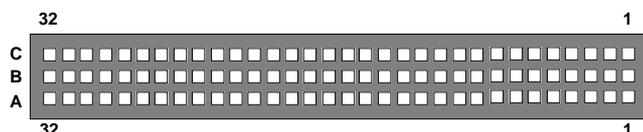


Figure 1. Pin Configuration for the 96-Way Connector (looking in to the AD7851 evaluation board)

SCLK1	Serial Clock 1. This is a logic input and is connected to CLKIN pin on the device via LK5. This is the master clock signal for the device. It sets the conversion and calibration times.
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.
DT0	Data Transmit 0. This line is connected to the DIN pin of the AD7851 via LK2. The data to be loaded to the control register of the device is applied to this pin in serial form. (This pin can act as an input pin or an I/O pin depending on the mode that the part is in. When using the EVAL-CONTROL BOARD this pin should always be configured as an input).
DR0	Data Receive 0. The buffered output data from the AD7851 is received at this pin as a 16-bit serial word.
TFS0, RFS0	Transmit Frame Synchronisation 0, Receive Frame Synchronisation 0. These pins are tied together on the connector and buffered from the SYNC pin on the AD7851. The SYNC pin on the device can be a level triggered active low input (similar to a chip select in one case and to a frame sync in another case) or an output (similar to a frame sync)

SCLK0

depending on the interface mode that the part is in (See Table 1). With the 74HC08 buffer in place the SYNC should only be configured as an output from the AD7851.

Serial Clock 0. This is a logic input/output and is buffered from the SCLK pin on the device. This is the serial port clock and it can be configured as an input or I/O, depending on interface mode that the part is in. The SCLK clock edge on which the data is latched is determined by the POLARITY

TABEL III. 96-WAY CONNECTOR PIN FUNCTIONS

ROW	PIN NO.	MNEMONIC
A	3	SCLK1
A	4	DGND
B	4	DGND
C	4	DGND
A	5	DT0
C	5	DR0
A	6	TFS0
C	6	RFS0
C	7	SCLK0
A	12	DGND
B	12	DGND
C	12	DGND
A	17	FL0
C	17	IRQ2
A	20	DGND
B	20	DGND
C	20	DGND
A	21	AGND
A	22	AGND
A	23	AGND
A	24	AGND
A	25	AGND
A	26	AGND
A	29	AGND
B	29	AGND
C	29	AGND
A	32	AV <sub>DD</sub>
B	32	AV <sub>DD</sub>
C	32	AV <sub>DD</sub>

Note : The remainder of the pins on the 96-way connector are no connects.

input logic level. With the buffer in place the SCLK should only be configured as an output from the AD7851.

FL0	Flag zero. This is a logic input and is connected to the CONVST logic input on the device via LK4. A high to low transition on this input resets the AD7851 data register. A low to high transition on this input puts the track/hold amplifier into its hold mode and starts a conversion.
$\overline{\text{IRQ2}}$	Interrupt Request 2. This is a logic output and is connected via LK3 to the BUSY logic output on the device. The output goes high when a conversion begins and stays high until the conversion is complete, at which time it goes low. This output also indicates when the AD7851 has completed its on-chip calibration sequence.
AGND	Analog Ground. These lines are connected to the analog ground plane on the evaluation board.
AV <sub>DD</sub>	Analog +5V Supply. This line is connected to both the AV <sub>DD</sub> and DV <sub>DD</sub> (via LK1) supply lines on the board.

## SOCKETS

There are three input sockets on the AD7851 evaluation board. The function of these sockets is outlined in Table 4.

**Table IV. Socket Functions**

Socket	Function
SK1	Sub-Minature BNC Socket for CLKIN input.
SK2	Sub-Minature BNC Socket for $\overline{\text{CONVST}}$ input.
SK3	Sub-Minature BNC Socket for V <sub>IN</sub> input.

## CONNECTORS

There is one connector on the AD7851 evaluation board as outlined in Table V.

**Table V. Connector Functions**

Connector	Function
J1	96-Way Connector for Serial Interface connections.

## OPERATING WITH THE EVAL-CONTROL BOARD

The evaluation board can be operated in a stand-alone mode or operated in conjunction with the EVAL-CONTROL BOARD. This EVAL-CONTROL BOARD is available from Analog Devices under the order entry "EVAL-CONTROL BOARD". When operated with this control board, all supplies and control signals for operating the AD7851 are provided by the EVAL-CONTROL BOARD. Software for the EVAL-CONTROL BOARD is provided with the AD7851 evaluation board package. This EVAL-CONTROL BOARD will also operate with all Analog Devices evaluation boards which end with the letters CB in their title.

The 96-way connector on the EVAL-AD7851CB plugs directly into the 96-way connector on the EVAL-CONTROL BOARD. The EVAL-CONTROL BOARD is powered from a 12V ac transformer. This is a standard 12V ac 1A transformer. These can also be ordered from Analog Devices under the order entry "EVAL-110AC" for a 110V compatible transformer and "EVAL-220AC" for a 220V compatible transformer. These transformers are also available for other suppliers including Digikey (110V models) and Campbell Collins (220V models). The EVAL-CONTROL BOARD generates all the required supplies for itself and for the EVAL-AD7851CB.

Connection between the EVAL-CONTROL BOARD and the serial port of a PC is via a standard RS-232 cable which is provided as part the EVAL-CONTROL BOARD package. Please refer to the manual which accompanies the EVAL-CONTROL BOARD for more details on the EVAL-CONTROL BOARD package.

## SOFTWARE DESCRIPTION

Included in the EVAL-AD7851CB evaluation board package is a PC-compatible disk which contains software for controlling and evaluating the performance of the AD7851 when it is operated with the EVAL-CONTROL BOARD. The EVAL-AD7851CB Demonstration/Evaluation Software runs under DOS 4.0 or later and requires a minimum of a 386-based machine, with 500kB of RAM and 500kB of free hard disk space. It may be necessary to disable some TSR's or load the TSR's into high memory, like a network TSR for example, to ensure that adequate base memory is available. Operation under Windows is not recommended since the Windows COM interrupt can interfere with communication between the PC and the EVAL-CONTROL BOARD. The user interface on the PC is via a dedicated program written especially for the AD7851.

The disk which accompanies the EVAL-AD7851CB contains several files. The user should create a new directory on the main PC drive and label this "AD7851". Then, all files on the EVAL-AD7851CB disk should be copied into this directory. The Mouse Driver on the PC should be enabled before running the software. If this has not been loaded, the program will not run.

To run the software, simply make the AD7851 directory the current directory and type "go". When the software is running, the user sees the screen shown on Figure 3 (without any FFT or scope waveforms). This is the FFT screen and is the default start-up for the software. There are six menus available: The Setup Menu; The AC Test Menu; The DC Test Menu; The Calibration Options Menu; The Calibration Registers Menu, and the Power-Down Options Menu. A combination of the

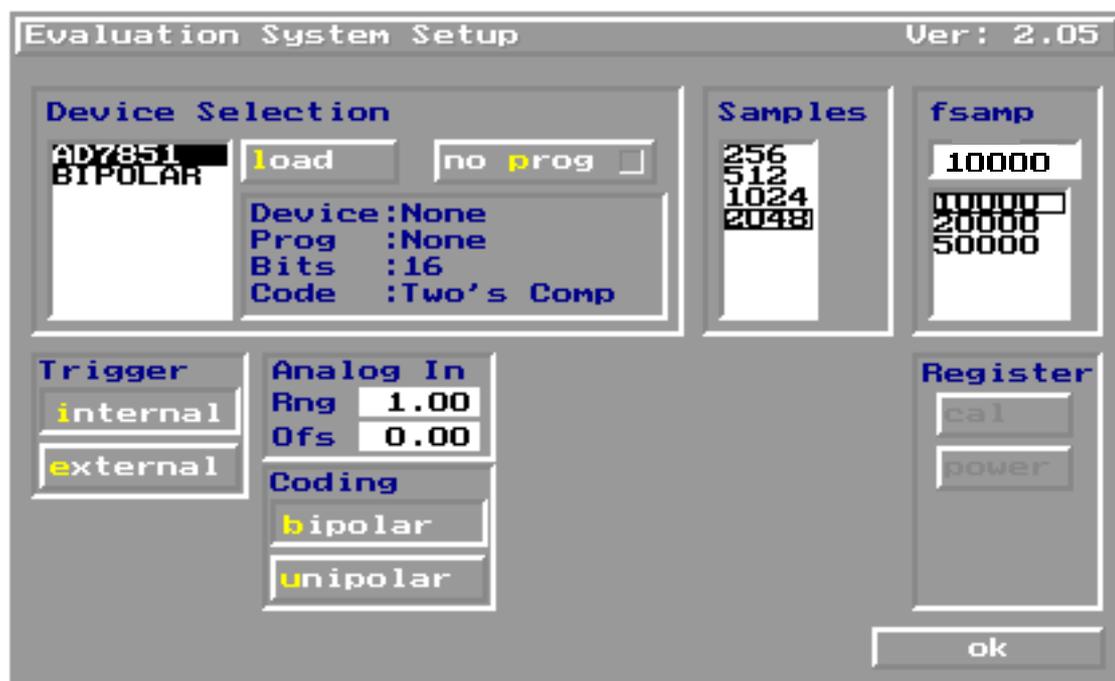


Figure 2. Setup Menu

mouse and various Function Keys are used to navigate the menus. The Function Keys can be used to activate the appropriate Buttons (the appropriate character is highlighted in each button, lower case must be used.)

On initially entering the front panel, the user should hit the "F2" key to go to the Setup Menu. The Setup Menu is shown in Figure 2. The first option that the user should choose in the Setup Menu is the internal or external CLKIN and CONVST signals. To select the internal CLKIN and CONVST signals (signals generated from the EVAL-CONTROL BOARD) the internal trigger button should be pressed (Function key "i"). To select external CLKIN and CONVST signals (signals are externally supplied by the user) the external trigger button should be pressed (Function key "e") (note that LK5 and LK14 should also be disconnected before the external signals are applied). After this option is selected the next choice is to choose from the Unipolar analog input mode, the Unipolar button should be pressed (Function Key "u") and for the Bipolar analog input mode the Bipolar button should be pressed (Function Key "b"). Once these options are selected, the sample rate and number of samples to be taken are selected. Hit the return key or click the OK Button when the desired operating conditions have been chosen. The default settings are for bipolar mode, CLKIN and CONVST signals provided by the EVAL-CONTROL BOARD, and 2048 samples with a sample rate of 200 kHz. **Remember to check the link options LK13 and LK9 for the correct settings before performing any ac or dc testing.**

The Function Keys on the front panel are described below. All Function Keys are available as On-Screen Buttons.

#### Function Keys

- F1:** Info. This is basic information on the software.
- F2:** Setup Menu as described above.
- F3:** Samp. When this key is pressed, the software takes one set of samples. When the samples have been taken they are displayed on the Digital Storage Oscilloscope. After this, either the ac or dc analysis is done. If ac Test Mode is chosen, then the Digital Spectrum Analyzer displays the FFT of the sampled data. If the dc Test Mode is chosen, the Histogram Analyzer displays the spread of codes on the input. Another set of samples may be taken by pressing the F3 key again.
- F4:** Cont. When this key is pressed, the software takes a set of samples of the input and analyzes them. Once the analysis has been done the process is repeated. It will continue to do this until the ESC key is pressed.
- F5:** Save. This allows the user to save a set of samples to a file for use either at a later date or with other software. The data can be saved in integer, binary or voltage format.
- F6:** Load. This allows the user to load data from a file. Before loading data, the AD7851 file must be loaded to the device in the setup menu and the bipolar or unipolar format selected. Once loaded, it can be analyzed in the same fashion as the sampled sets of data. The file must have a .DAT extension.

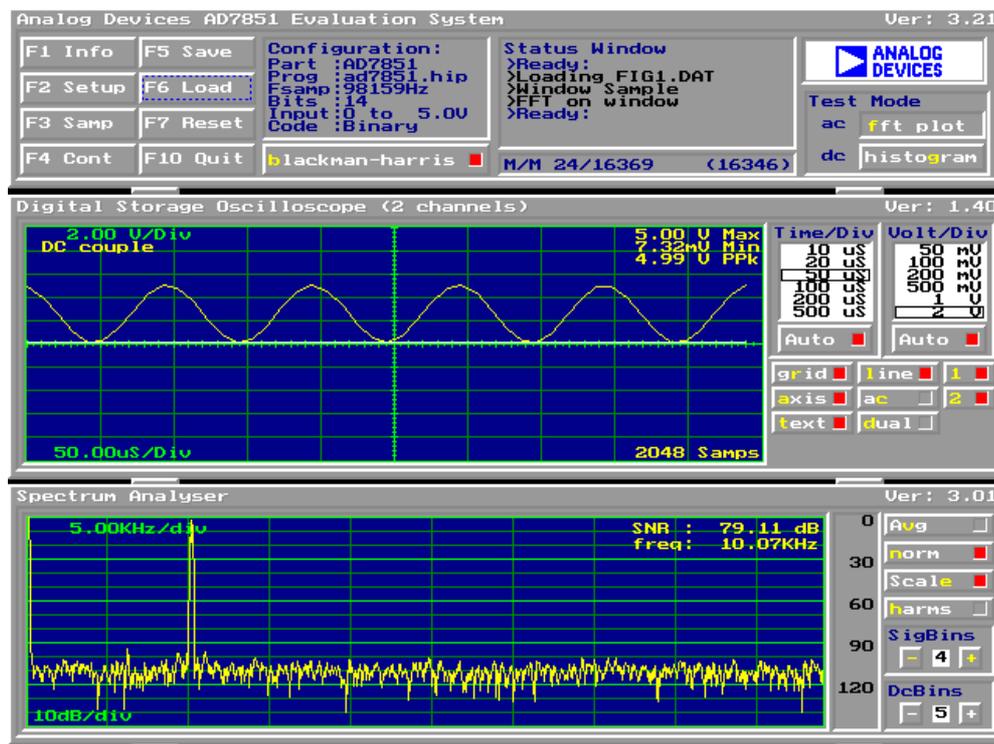


Figure 3. FFT Screen

**F7:** Board Reset.

**F10:** Quit. This quits the AD7851 evaluation program and returns control to the PC operating system.

**ESC:** Stop Current Operation.

### Other Function keys

As well as using the Function Keys mentioned above to run the software, extensive use is made of other "Function Keys". The Function Key has one letter highlighted (for example, the "b" in "blackman-harris" button) and pressing this key is the same as clicking on the equivalent on-screen button. When the button is activated, there is a red square indication, or the button stays depressed. All Function Keys listed in this section are also available as On-Screen Buttons.

**blackman-harris:** Pressing the "b" key toggles the Blackman-Harris Window On/Off. When doing ac analysis (FFT) in a non-coherent setup, this should be On.

**fft:** Pressing the "f" key selects the ac Test Mode. When an input is sampled, the software produces an FFT Plot of the sampled data. It gives the SNR(Signal-to-Noise Ratio) in dB's. This is the ratio of the rms input signal to the rms sum of all the noise bins.

**histogram:** Pressing the "g" key selects the dc Test Mode. When an input is sampled, the software does a Histogram of the codes. The standard deviation (which is the equivalent to rms noise) is computed and displayed in LSBs

and mV. The mean code, max code, min code and spread of codes are also displayed in LSBs.

**avg:** Pressing the "v" key selects averaging in the ac Test Mode. The software must be set up for Cont. operation. Then, with each new set of samples, an averaged FFT is produced. With each new set of samples, the number of averages is displayed on the FFT.

**scale:** Pressing the "c" key turns the frequency scaling of the FFT OFF/ON.

**harms:** Pressing the "h" key includes/excludes the harmonics in the FFT SNR calculation. This should only be used with coherent sampling.

### On-Screen Buttons

The following two functions are only available as On-Screen Buttons.

**SigBins:** This allows control of the number of bins included for the signal in the FFT.

**DcBins** This allows control of the number of bins included for the dc component in the FFT.

The procedure from power-on to performing AC or DC tests is detailed by the flowchart in Figure 5. This flowchart is only accurate when using the EVAL-CONTROL BOARD in conjunction with the AD7851 evaluation board.

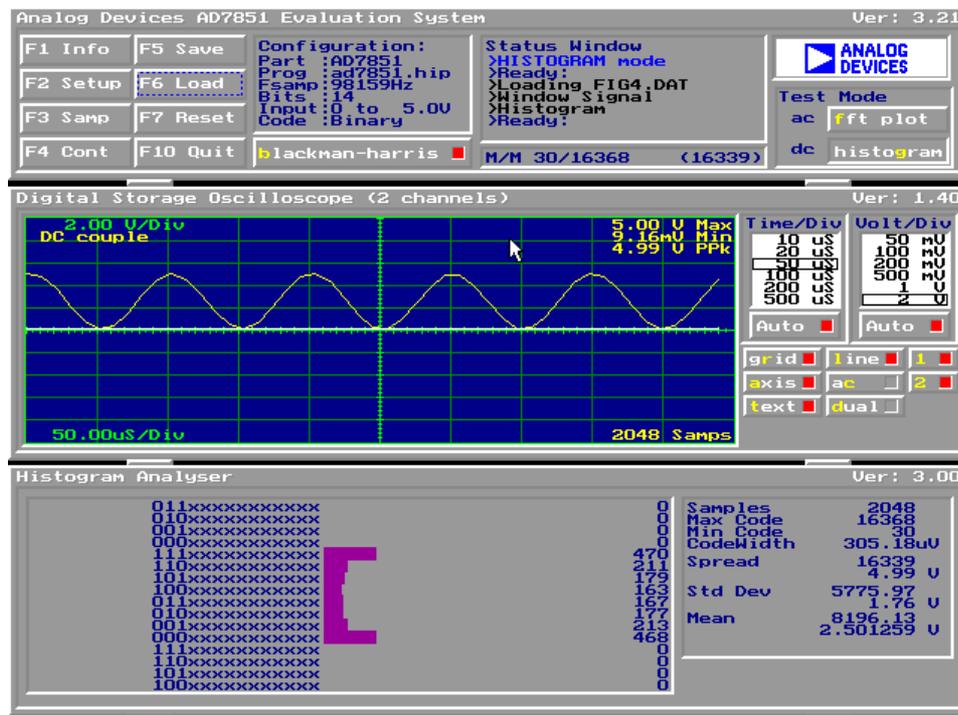


Figure 4 Histogram Screen

Included in the Setup menu (obtained by pressing F2 key when in the front panel) is the Calibration options button and the Power-Down options button. Pressing the Calibration Options button brings the user into the Calibration Options Menu.

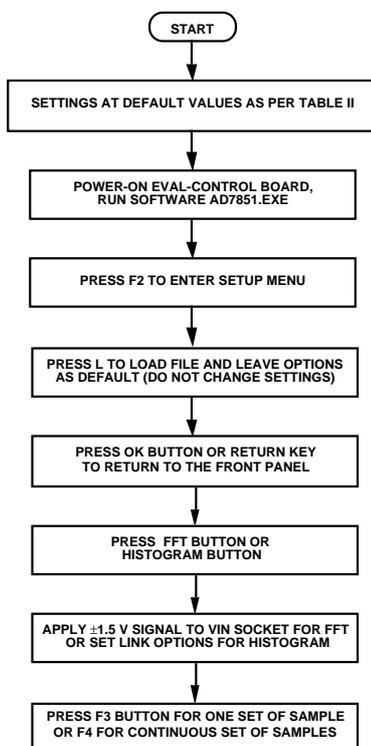


Figure 5. Flowchart for performing AC and DC tests after power-on.

Several calibration options are presented in the Calibration Options Menu as shown in Figure 6. These options include Full self calibration, Self gain calibration, Self offset calibration, System gain calibration, System offset calibration, and Calibration registers. On selecting any one of the three Self calibration buttons the part is calibrated appropriately. On selecting one of the System calibration buttons the user will be prompted by an extra pop-up window to apply the required system voltage across the AIN(+) and AIN(-) pins of the AD7851. Upon hitting the OK button in this prompt window the part is calibrated and the software returns to the Calibration Options Menu. At this point the user can select OK to return to the Setup menu or select another calibration option. Please see the AD7851 data sheet for more information on system calibration.

On selecting the Calibration registers button, the offset, gain and DAC calibration registers contents will be displayed as shown in Figure 7. The calibration register values shown in Figure 7 are typical values and will vary from device to device.

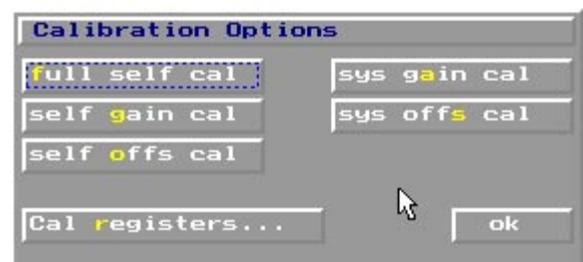


Figure 6. Calibration Options Menu

The contents of the gain calibration register is listed first, second is the offset calibration register followed by the 8 DAC calibration registers. For the DAC calibration registers, the DAC 1st MSB calibration register contents is listed first, the DAC 2nd MSB calibration register contents second, and so on down to the DAC 8th MSB calibration register contents. The contents of any of the calibration registers can be altered if so required. In most applications there will be no need to alter the register contents. Once the contents of the register are altered the new values will not be loaded to the AD7851 until the ok button is pressed (Function key "o"). If the cancel button is pressed (Function key "c") then no data will be loaded to the AD7851. Once the ok or cancel buttons are pressed the software will return to the Calibration Options Menu. At this point the user can select ok to return to the Setup Menu or select another calibration option.

To demonstrate the workings of the calibration registers the user can change the offset calibration register contents and then perform a self offset calibration which will cause the offset calibration register to return to its initial value. A similar approach can be used on the Gain and DAC calibration registers to see how the registers change when a self gain calibration and full self calibration are performed respectively.

Also included in the Setup menu is the Power-Down Options button. **Link LK8 should be in position B to allow correct operation of the Power-Down functions.** When this button is pressed several Power-Down Options will be presented in the

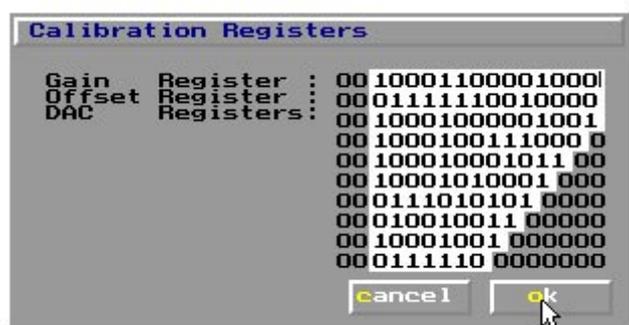


Figure 7. Calibration Registers

Power-Down Options Menu as shown in Figure 8. The options include Normal operation (default mode), Full power-down, and Partial power-down. The option of turning off the master clock, CLKIN, (when the CLKIN and CONVST signals are provided by the EVAL-CONTROL BOARD) is also available. Each of these options is selected by clicking the appropriate tick box and pressing the ok button. By monitoring the supply current while programming the different power down modes demonstrates how the supply current can be reduced significantly (e.g. 1-2  $\mu$ A in Full power-down mode with the clock disabled). Please see the AD7851 data sheet for more information on the Power-Down modes of the AD7851.

To monitor the supply current, when using this evaluation board with the EVAL-CONTROL BOARD, LK16 should be unconnected and an ammeter should be connected across the

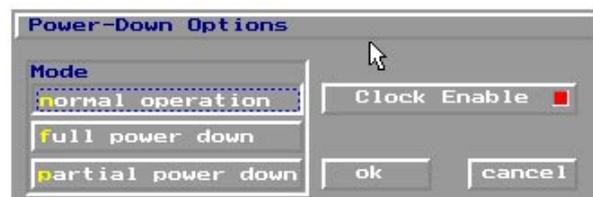


Figure 8. Power Down menu

link, LK16. This has the effect of connecting the ammeter in series with the  $V_{DD}$  supply from the EVAL-CONTROL BOARD. If the  $V_{DD}$  is supplied via socket 3 and not from the EVAL-CONTROL BOARD the ammeter should be connected externally and LK16 unconnected. This  $V_{DD}$  supplies only the AD7851 and the 74HC08. Since the 74HC08 takes significantly less current than the AD7851 the current measured by the ammeter represents the AD7851 supply current. A typical procedure for evaluating how the current reduces, when using the EVAL-CONTROL BOARD to supply the  $V_{DD}$ , is shown by the flowchart in Figure 9 on the next page.

To return to normal operation, return to the power down menu, select normal operation, ensure that the clock is enabled and press the ok button.

Note that the AD7851 should be set to Normal Operation mode before AC or DC tests are performed.

For the full power down the current should be in the 1-2  $\mu$ A range typically (clock disabled).

For the partial power down the current should be in the 300-350  $\mu$ A range typically (clock disabled).

In normal mode operation the supply current should be at the 12mA level typically (clock disabled).

Enabling the clock in both the partial and normal modes of operation will cause the current to increase by the order of 1.5 mA. This is because the driver for the SCLK will be enabled and consumes 1.5 mA typically. In the Full power down mode then with the clock enabled the current should be in the range 10-20  $\mu$ A. The reason for only the small increase here is that the SCLK driver will always be disabled internally by the device when in Full power down mode.

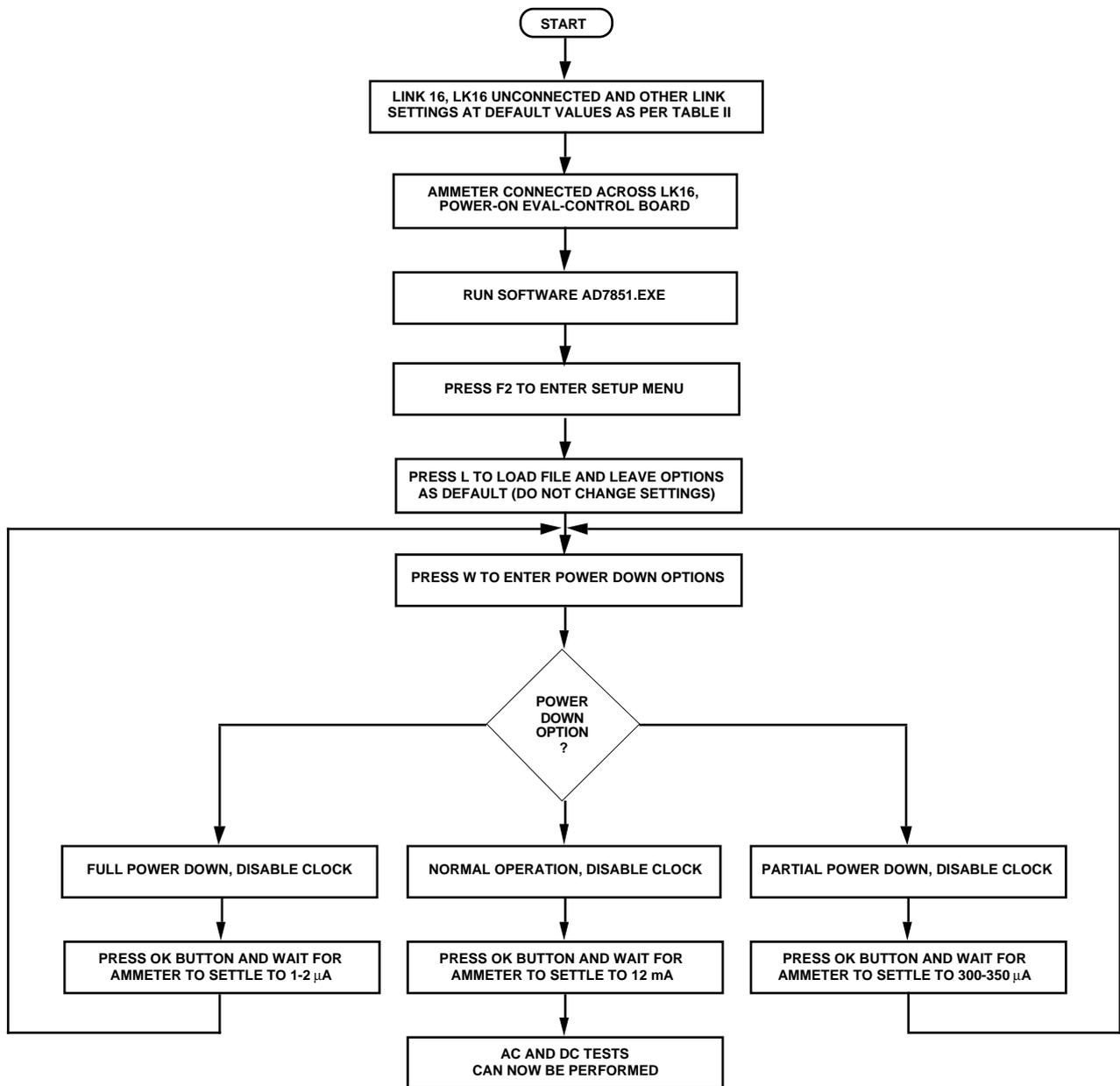


Figure 9. Flowchart for monitoring the current in power down modes.

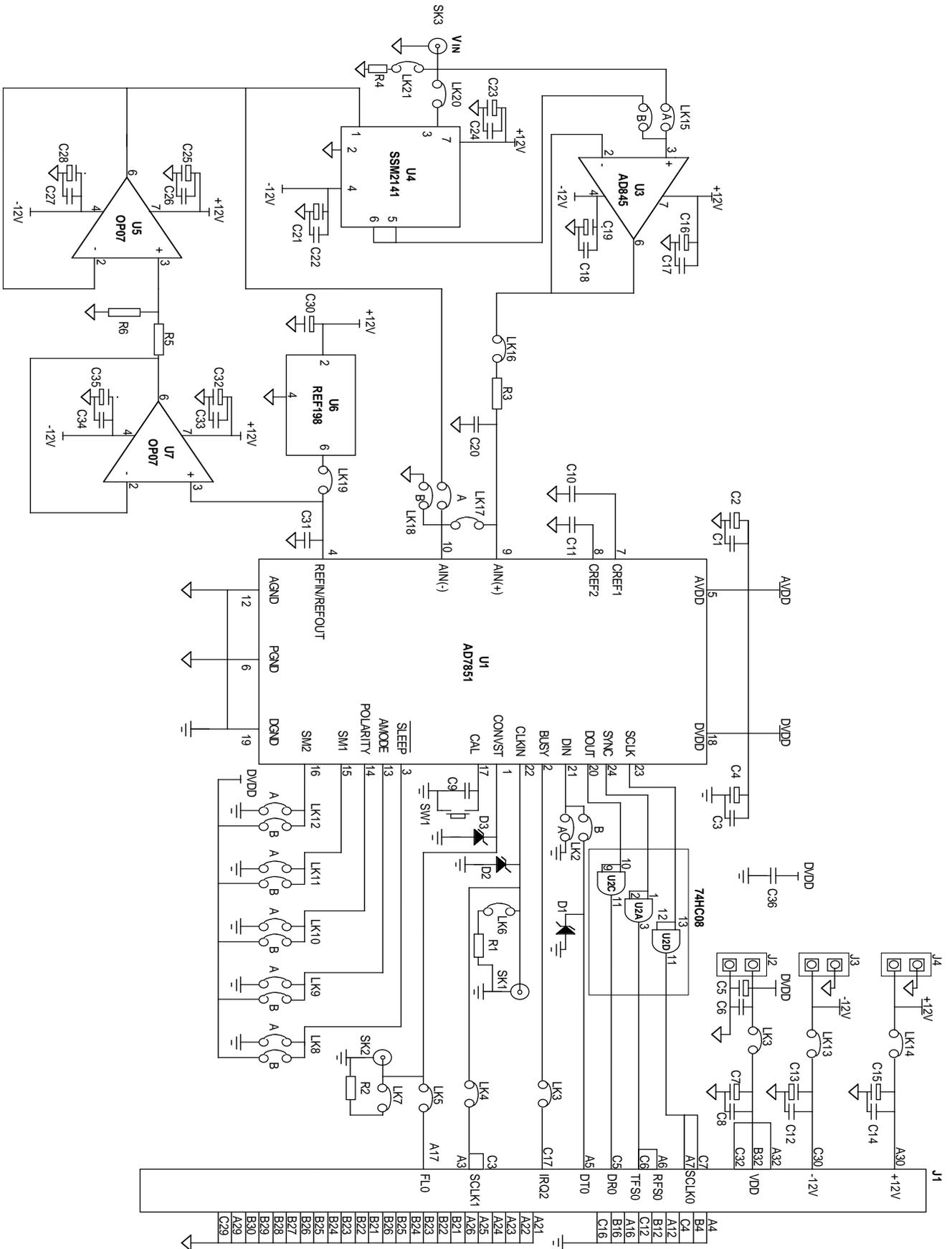


Figure 10. Evaluation Board Circuit Diagram

**COMPONENT LISTING AND MANUFACTURERS**

**Intergrated Circuits**

<b>Component</b>	<b>Location</b>	<b>Vendor</b>
AD78651	U1	Analog Devices
74HC08	U2	Texas Instruments
AD845	U3	Analog Devices
SSM2141	U4	Analog Devices
OP07CN	U5 U7	Analog Devices
REF198	U6	Analog Devices
SD103C	D1 D2 D3	Hewlett Packard

**Capacitors**

<b>Component</b>	<b>Location</b>	<b>Vendor</b>
0.1 $\mu$ F Ceramic(X7R $\pm$ 20%)	C1 C3 C5 C8 C9 C10 C12 C14 C17 C18 C22 C24 C26 C27 C31 C33 C34 C36	Philips Mftrs No. CW20C 104M
10 $\mu$ F $\pm$ 20% Tantalum (16V)	C2 C4 C16 C19 C21 C23 C25 C28 C29 C32 C35	AVX- Kyocera Mftrs No TAP106MO16
47 $\mu$ F $\pm$ 20% Tantalum (16V)	C6 C7 C13 C15	AVX- Kyocera Mftrs No TAP476MO16
0.01 $\mu$ F Ceramic(X7R $\pm$ 20%)	C11	Philips Mftrs No. CW15C 103M
6800pF Polystyrene	C20	Philips Mftrs No. 425 46802
1 $\mu$ F $\pm$ 20% Tantalum (35V)	C30	AVX- Kyocera Mftrs No TAP105MO35

**Resistors**

<b>Component</b>	<b>Location</b>	<b>Vendor</b>
51 $\Omega$ $\pm$ 1% 0.25W	R1 R2 R4	Multicomp
120 $\Omega$ $\pm$ 1% 0.25W	R3	Multicomp
10K $\Omega$ $\pm$ 1% 0.25W	R5 R6	Welwyn RC55 Series

**Link Options**

<b>Component</b>	<b>Location</b>	<b>Vendor</b>
Pin Headers (2x2 way) LK12 LK15 LK18	LK2 LK8 LK9 LK10 LK11 Mftrs No. M20-9993606	Harwin
Pin Headers (1x2 way)	LK1 LK3 LK4 LK5 LK6 LK7 LK13 LK14 LK16 LK17 LK19 LK20 LK21	
Shorting Plugs	Pin Headers (21 required)	Harwin Mftrs No. M7571-05

## Sockets

<b>Component</b>	<b>Location</b>	<b>Vendor</b>
SMB Connectors	SK1 SK2 SK3	M/A - Com Greenpar Mfrs No. B65N07G999X99
96 Way 90° DIN41612 Plug	J1	Harting Mfrs No. 09031966921
2 Way Terminal Block	J2 J3 J4	Bulgin RIA
Low profile socket	U1 - U7 (78 pins needed)	Harwin Farnell No. 519-959

## Switch

<b>Component</b>	<b>Location</b>	<b>Vendor</b>
Sealed Push Button Switch	SW1	Omron Mfrs No. B3W1000

<b>Component</b>	<b>Location</b>	<b>Vendor</b>
Rubber Stick-on-feet	each corner	Farnell 148-922