

# ISL26134AV28EV1Z Evaluation Board User Guide

## General Description

The ISL26134AV28EV1Z provides a means to evaluate the functionality and performance of the ISL26134 A/D converter.

The board includes an AT90USB162 microcontroller with a USB interface. The microcontroller interfaces to the ISL26134 ADC via a galvanically-isolated interface and provides serial communication via USB between the board and the PC.

Software for the PC provides a GUI (graphical user interface) that allows the user to perform data capture, and then to process and plot the results of the time domain analysis, the histogram analysis, and/or the frequency domain analysis on the captured data. The GUI also enables the user to save conversion data from the ADC to a file, or to save the results of the analyzed conversion data.

## Features

- Galvanically-isolated USB Communication with PC
- On-board Microcontroller
- On-board Voltage Reference
- Evaluation Software
  - Time Domain Analysis
  - Noise Histogram Analysis
  - FFT Analysis

## Ordering Information

ISL26134AV28EV1Z

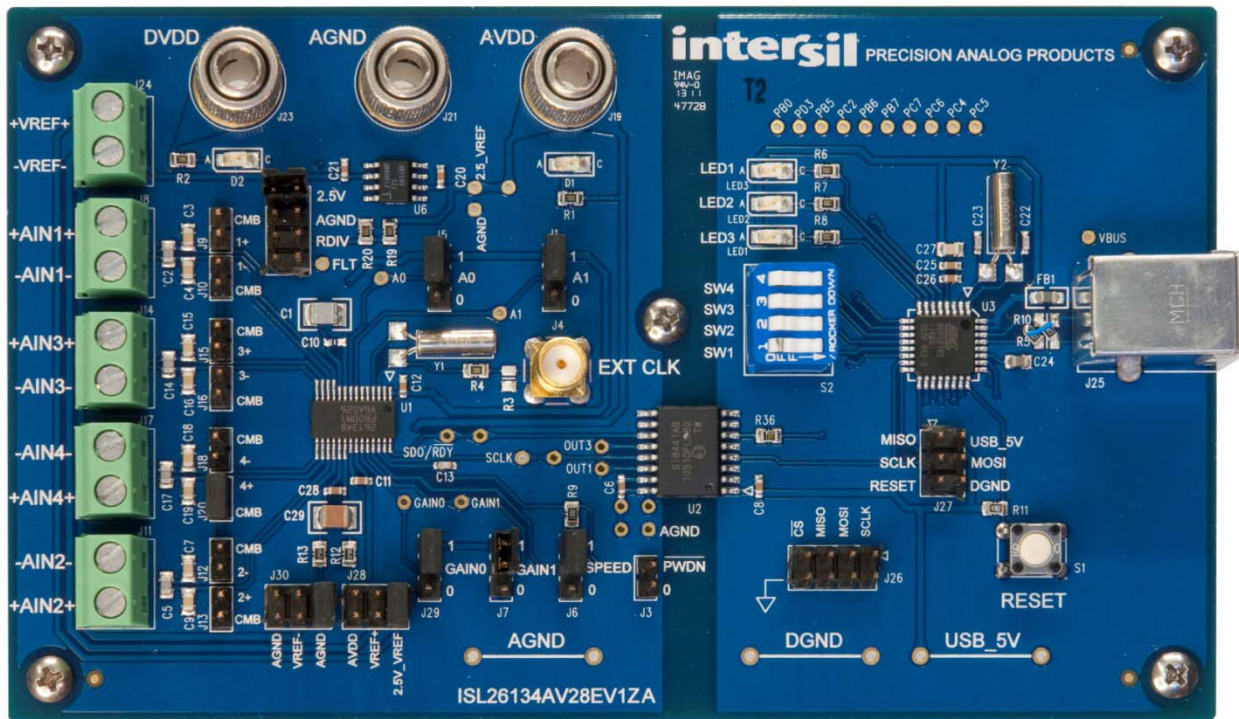


FIGURE 1. IMAGE OF THE EVALUATION BOARD FOR THE ISL26134

# Application Note 1672

## Hardware

The ISL26134AV28EV1Z evaluation board provides the user a means of evaluating the ISL26134 Analog-to-Digital Converter (ADC). The ISL26134 is a high performance 24-bit ADC that includes a very low noise programmable gain amplifier. The ISL26134 offers gain selections of 1x, 2x, 64x and 128x. It offers word rates of 10 Sps and 80 Sps (clock = 4.9152 MHz). Gain and word rate selections are made by pin function control through jumper selections.

The board comes with an ISL26134 soldered in place. This can be removed and an ISL26132 soldered in its place.

## Evaluation Board Overview

The ISL26134AV28EV1Z evaluation board is segmented into two sections. These sections are galvanically isolated with a multi-channel isolation chip. The ISL26134 ADC and its associated circuitry (voltage reference and input signal components) are isolated from the microcontroller-USB interface to the PC. The

ADC and its associated circuitry are powered by a laboratory supply. The microcontroller with its USB interface is powered from the USB connection. Galvanic isolation is not necessary in every application. The purpose of the isolation is to eliminate noise from the USB ground power connection from affecting the sensitive measurements made by the ADC when used in the 64X or 128X gain settings.

The ADC section of the evaluation board has three banana jack power connections. One of these is AGND, which serves as the power supply ground connection for the ADC segment of the board. The DVDD jack is to supply the digital side of the ADC (3.3V to 5V). The AVDD jack is to supply the analog portion of the ADC and to power the voltage reference (5V). The voltage reference is an Intersil ISL21009BFZ25 2.5V reference. A header is provided to also use an external voltage reference for the ADC.

The microcontroller provides the USB interface to the PC. A software GUI is available to communicate with the microcontroller and provides the means to collect and analyze data for the ADC.

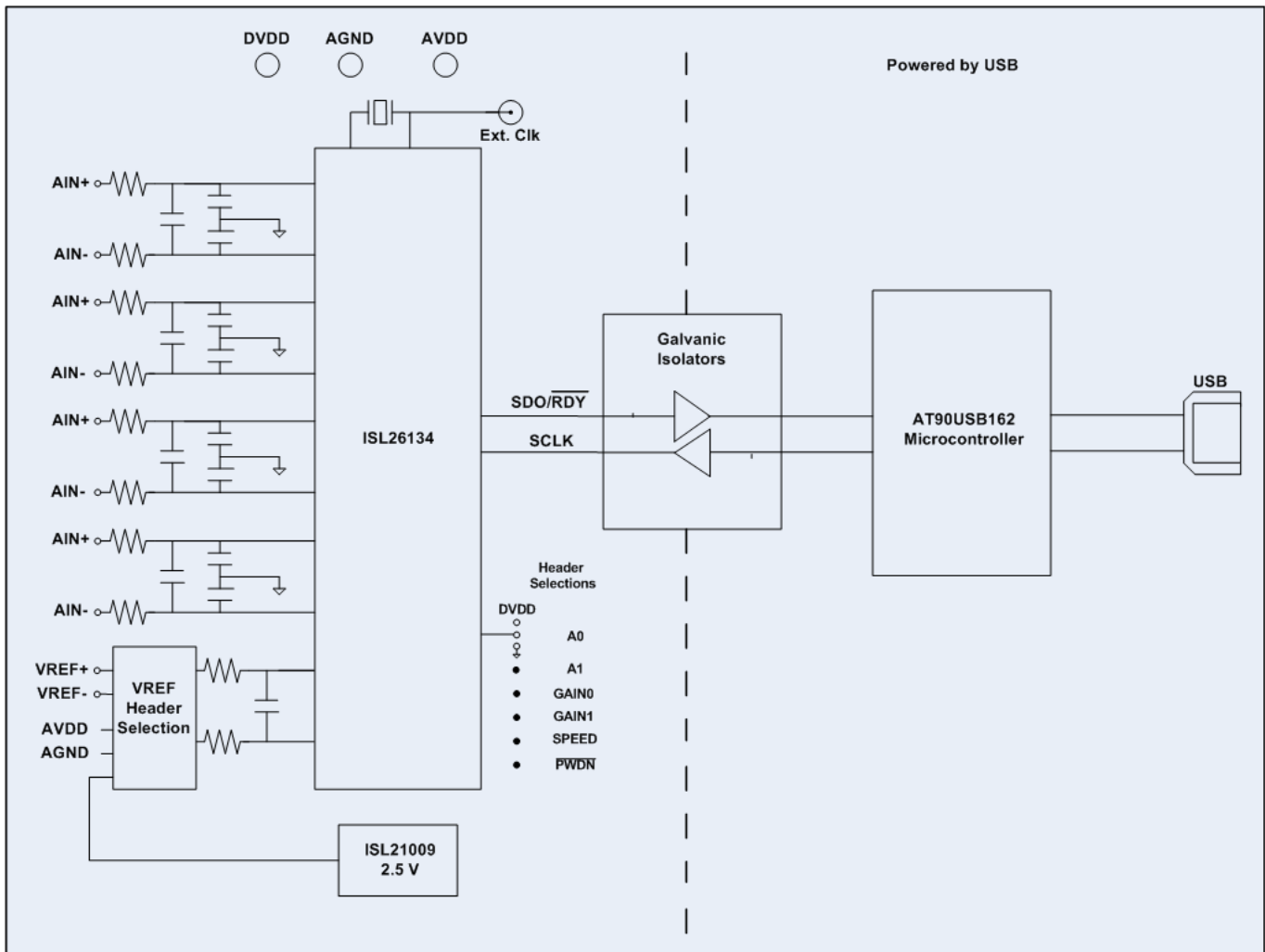


FIGURE 2. BLOCK DIAGRAM OF THE EVALUATION BOARD FOR THE ISL26134

## ADC Section

The ADC offers different sample rates, gain, and input channel options. These are selected by setting jumpers on headers (1 = positive supply; 0 = ground) as shown in Table 1 at the bottom of Figure 3.

The ADC uses a 4.9152MHz crystal operating with an on-chip amplifier for its clock source. This can be disconnected and an external clock can be sourced to drive the clock input to the chip. Alternately, the XTALIN/CLOCK pin can be grounded and the ADC will operate from an on-chip RC type oscillator.

The board provides a 2.5V reference IC as the voltage reference for the ADC, or an external voltage can be connected to a terminal block and selected through jumpers on headers J28 and J30 as shown in Figure 5. These headers also provide the option of selecting AVDD and AGND as the inputs to VREF+ and VREF- on the ADC.

The evaluation board provides separate terminal connections for each of the differential signals into the ADC. These terminals are shown in Figure 4. Be attentive of the labeling of the connections and their polarities when connecting external signals. The channel numbers on the terminal blocks are not in numeric order and some have their polarities labeled opposite of others.

Header connector J22 in Figure 4 allows the user to select one of the following options for the common mode voltage; the 2.5V voltage reference output, ground (AGND), a voltage generated by a resistor divider that divides the AVDD supply using two 1k $\Omega$  resistors, or to a voltage determined by the user, which must be connected to the hole next to the header connection labeled FLT (Floating Input).

Each of the input channels have jumpers to allow the user to connect the common mode voltage to either the AIN+ or the AIN- input. This enables the external circuit to be biased to a common mode value supplied by the board. If both jumpers are put in place, the inputs will be shorted to the common mode voltage. This provides a means for testing the noise performance of the ADC with its inputs shorted.

The ADC interfaces to the microcontroller through the galvanic isolators. The ADC side of the isolator chip is powered by the same supply that powers the DVDD supply of the ADC.

Power from an external supply must be provided to the DVDD (3.3V to 5V), AVDD (5V) and AGND banana plug connectors for the ADC portion of the board to function. LEDs will be illuminated by DVDD and AVDD when they are powered. Note that these supplies can be applied and removed without regard to whether the USB interface is connected and powered or not.

## The Microcontroller Section

Figure 6 illustrates the microcontroller circuitry. There is a reset button provided, but it is seldom necessary because the microcontroller has its own power-on reset which will initialize the microcontroller when the USB interface is connected to a powered PC. Power for the microcontroller section comes from the USB interface. The microcontroller circuit includes a DIP switch and some LEDs.

The microcontroller circuit includes a header through which the flash memory on the microcontroller is programmed. A second header provides a means for the user to monitor the signals (SCLK and SDO/ RDYb - on the J22 header these are labeled as MOSI and MISO [Master Out, Slave In and Master In, Slave Out], respectively) from the microcontroller that communicate with the ADC.

One LED lights to indicate when power is applied to the USB interface. A second LED indicates when the microcontroller is available to collect data from the ADC. The microcontroller communicates with the ADC via the galvanic isolator chip. The microcontroller side of the isolator is powered by the voltage from the USB connection. The USB connection can be powered or unpowered without regard to the supplies to the ADC side of the board. There is no power sequence requirement between the two sections of the board.

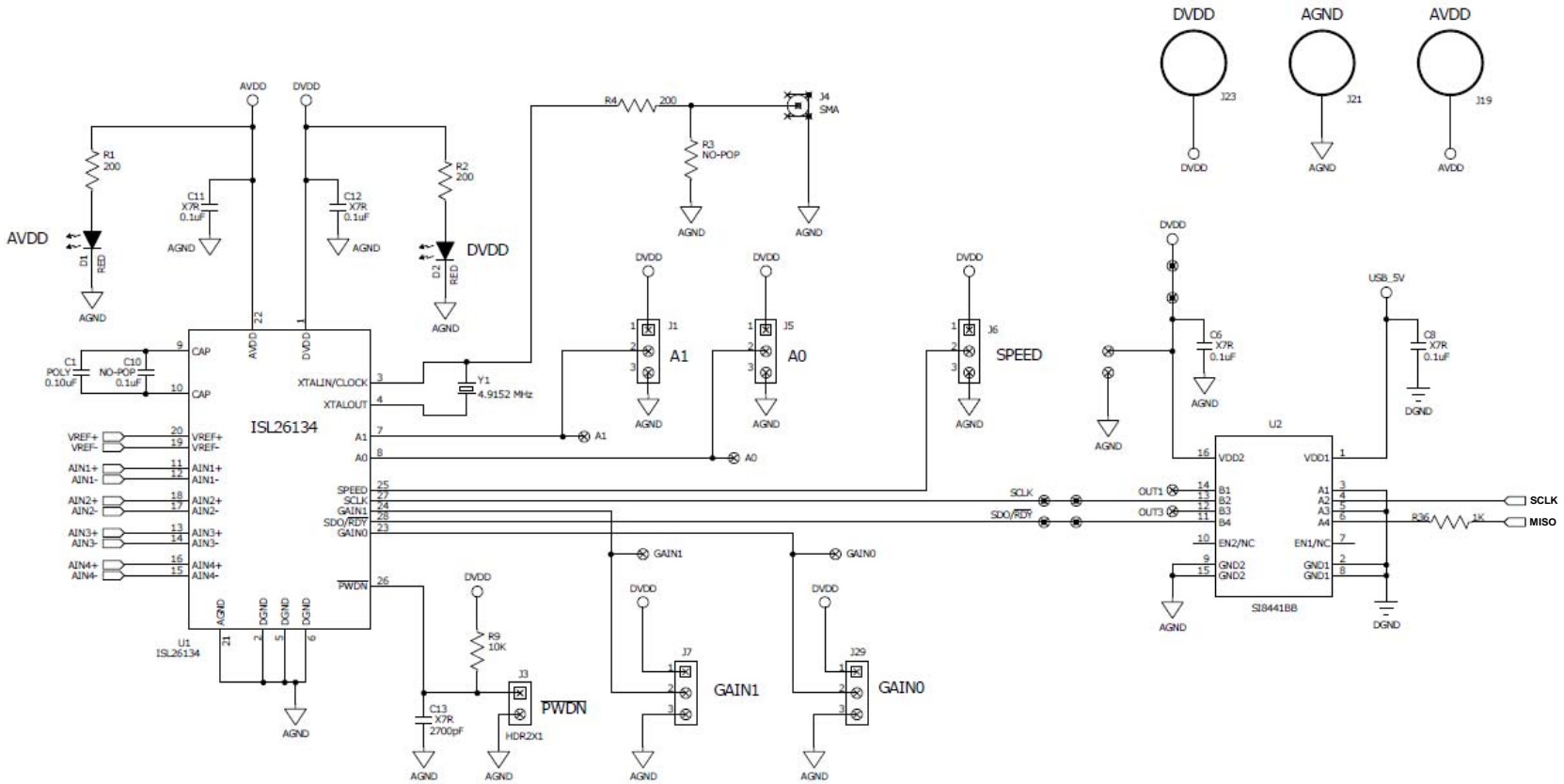


TABLE 1.

A0	A1	CHANNEL	GAIN0	GAIN1	GAIN	SPEED
0	0	AIN1	0	0	1	0
1	0	AIN2	1	0	2	1
0	1	AIN3	0	1	64	
1	1	AIN4	1	1	128	

FIGURE 3. ADC WITH POWER SUPPLY CONNECTIONS, JUMPER SELECTIONS, AND ISOLATOR INTERFACE

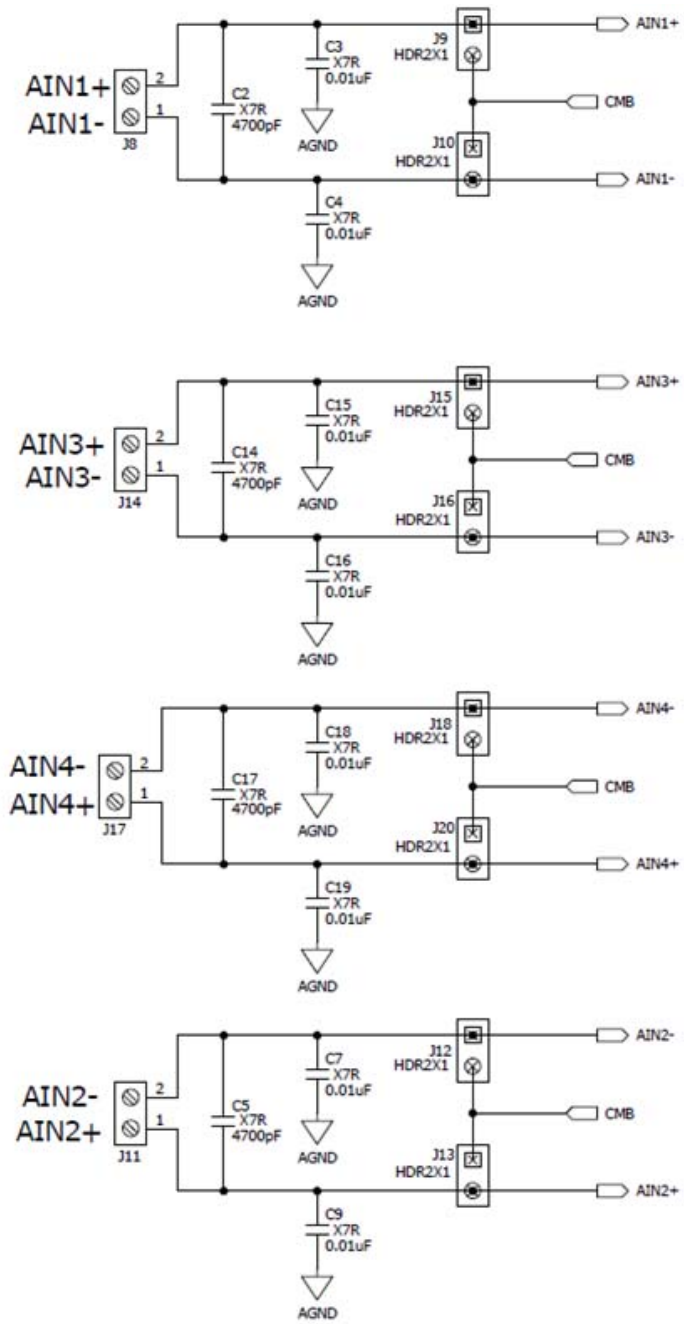
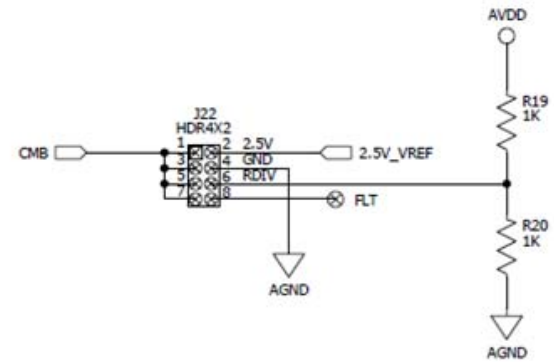
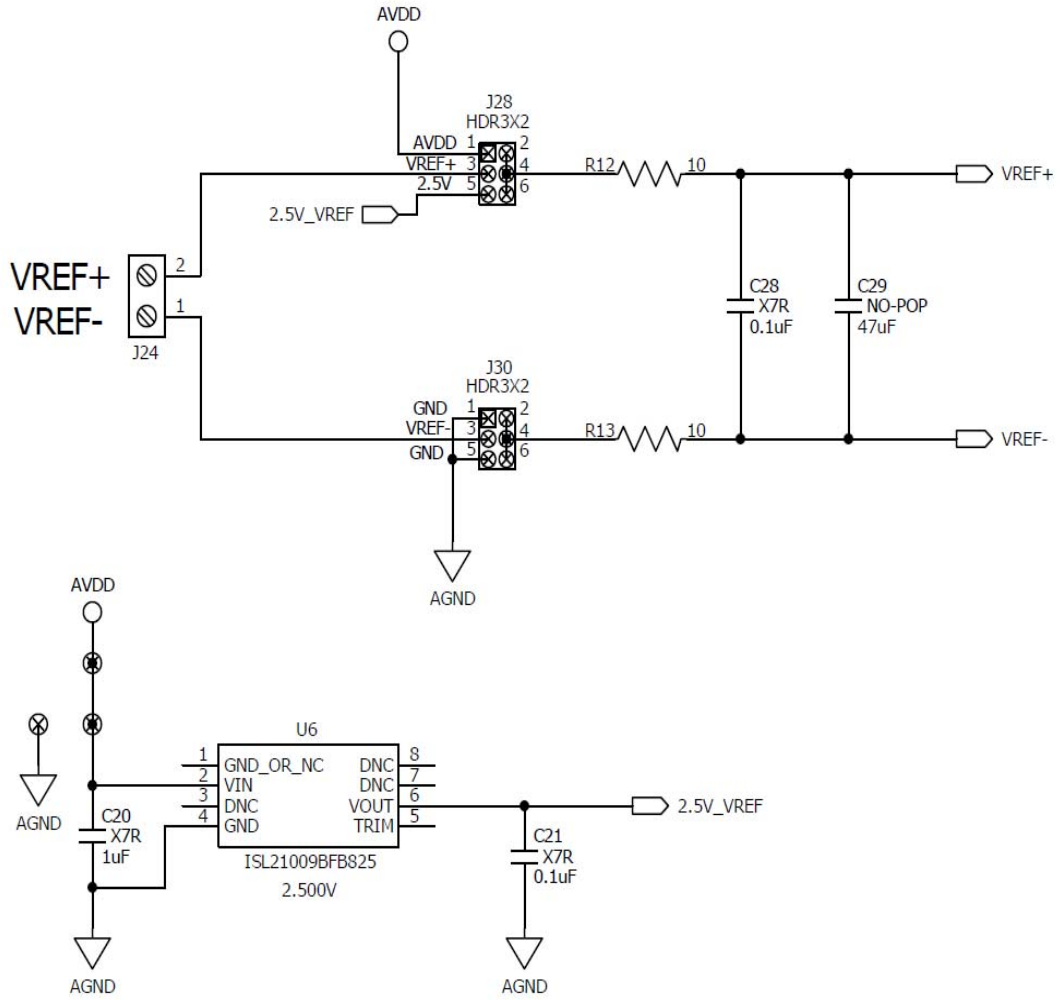
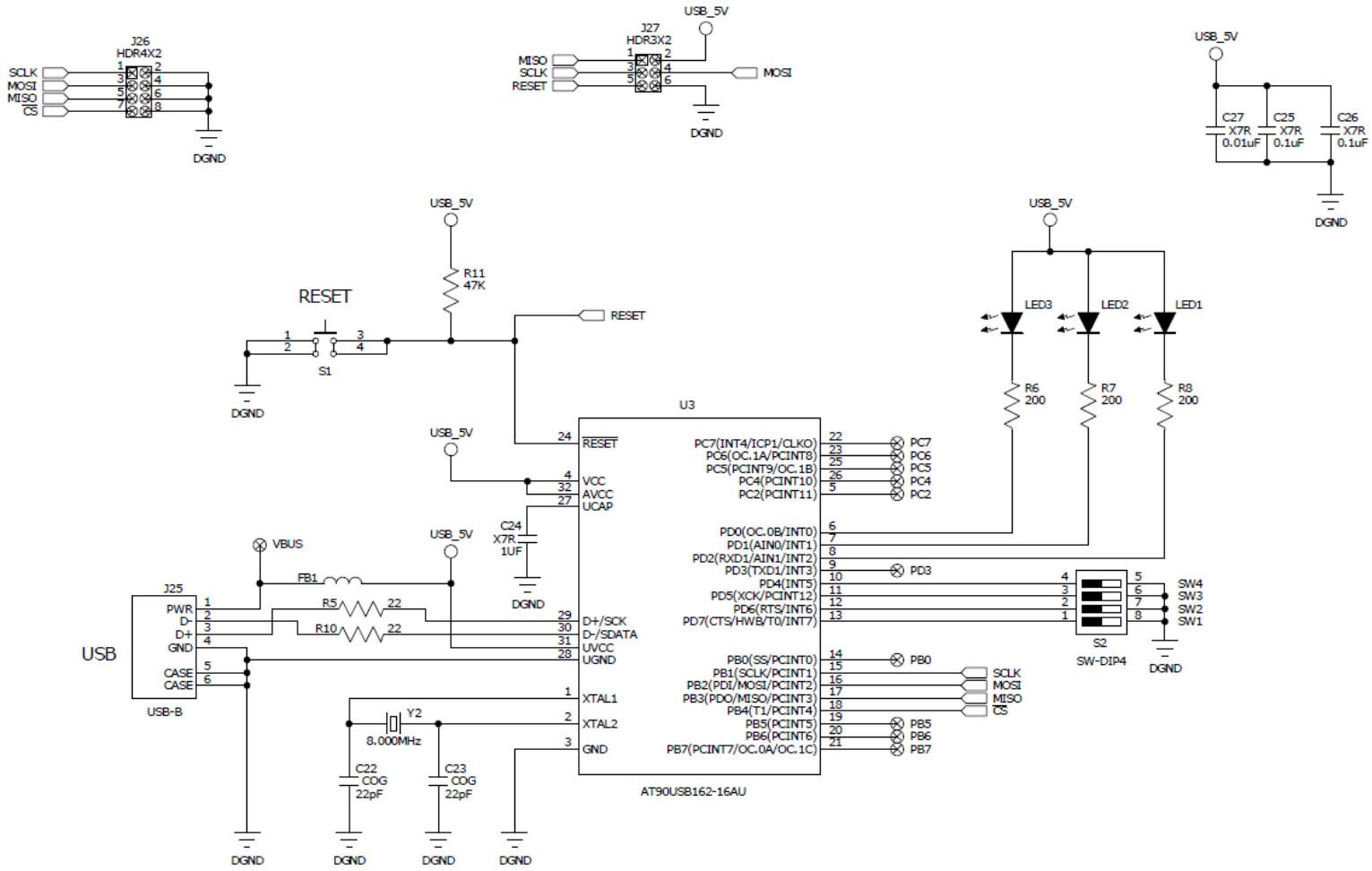


FIGURE 4. ANALOG INPUTS AND COMMON MODE SELECTION SELECTIONS





**FIGURE 5. VOLTAGE REFERENCE AND VOLTAGE REFERENCE SELECTION OPTIONS**



**FIGURE 6. MICROCONTROLLER WITH USB INTERFACE**

## Software

The evaluation board has GUI software available that runs on the PC. The software is designed to operate under Windows XP or later.

**Read Appendix #1 to obtain the internet link to download the GUI software.**

Once the PC GUI software is copied onto the PC, click on the setup.exe file and follow the on-screen instructions to load the software. Note that the software uses the USB interface to communicate with the evaluation board. The software uses the USB HID driver that is part of the Windows operating system so it is not necessary to load any other drivers for the USB interface.

## Running the GUI

Before starting the GUI software the evaluation board should connect to the PC by means of a USB cable.

With the board connected via USB, run the GUI program by selecting *Start* ⇒ *All Programs* ⇒ *Intersil ADC Eval*

If the software is started before the connection to the board is made, the GUI will output an error message as shown in Figure 7.

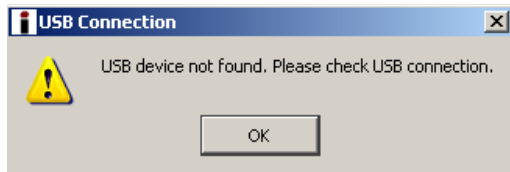


FIGURE 7.

If this occurs, connect the evaluation board to the PC with the USB cable and click the 'OK' button.

## Using the GUI Software

When the GUI software is started and the USB connection is established, the GUI will present a menu as shown in Figure 8. The **Initialize** button is colored red to indicate that it is waiting for a part number to be selected in the **Device Selection** window.

The user must select a part number from the **Device Selection** window and click on the **Initialize** button. This causes the software GUI to be configured to support the selected device. The ISL2613X number represents the ISL26132 or ISL26134.

Once the **Initialize** button is clicked with the ISL2613X selection, the screen will change slightly to indicate the output word rate options of the ISL2613X ADC. Note that the actual word rate used by the ADC is selected by a jumper on the evaluation board. The selection here in the **Sample Rate** window only tells the GUI software what sample rate is to be used for the frequency axis when graphing the spectrum for the spectral (FFT) plot.

The top line of the menu page has two options, **File** and **About**. The **File** selection will be discussed after the **Time Domain**, **Histogram** and **Frequency Domain** windows are selected. When the GUI is started it sends a command to the evaluation board and tells the microcontroller to send back the version of the code that is in the microcontroller. If **About** is selected, the GUI will open a window that indicates the version number of the GUI software and the version number of the microcontroller code.

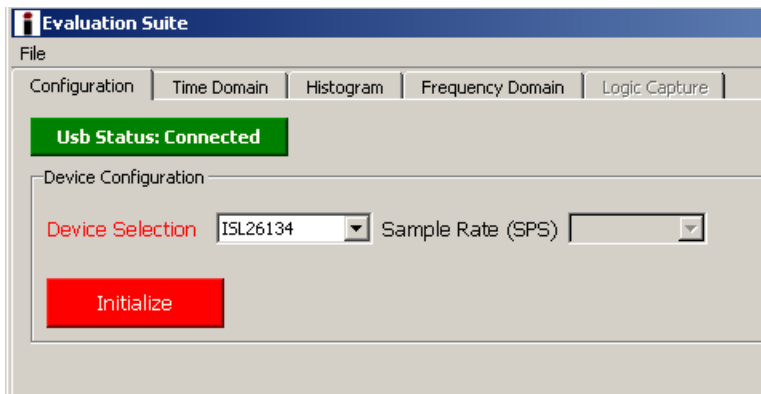


FIGURE 8.

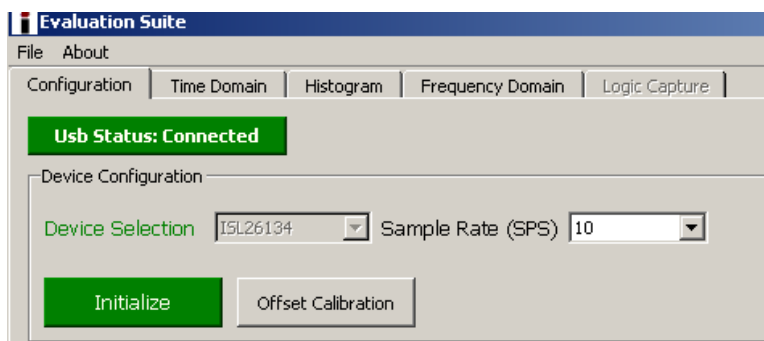


FIGURE 9.



## Time Domain Window

The **Time Domain** window allows the user to collect samples from the ADC on the evaluation board and display them in the time domain. The number of samples is initially defaulted at 64, but can be set in a pull down window from 1 to 1048576. Realize the time involved if a large number of samples is requested on an ADC with a slow sample rate. When the **Acquire** button is clicked, the

samples will be collected and the samples up to 256 will be displayed in the graphing window. If greater than 256 samples are collected, then, after the samples are captured and the first 256 are displayed, the time plot of the entire sample set can be displayed by clicking on the **Pop Out** button. Figures 10 and 12 illustrate the capture of 4096 samples. The window in Figure 10 displays only the first 256 samples. Figure 12 illustrates the results when the **Pop Out** button has been selected.

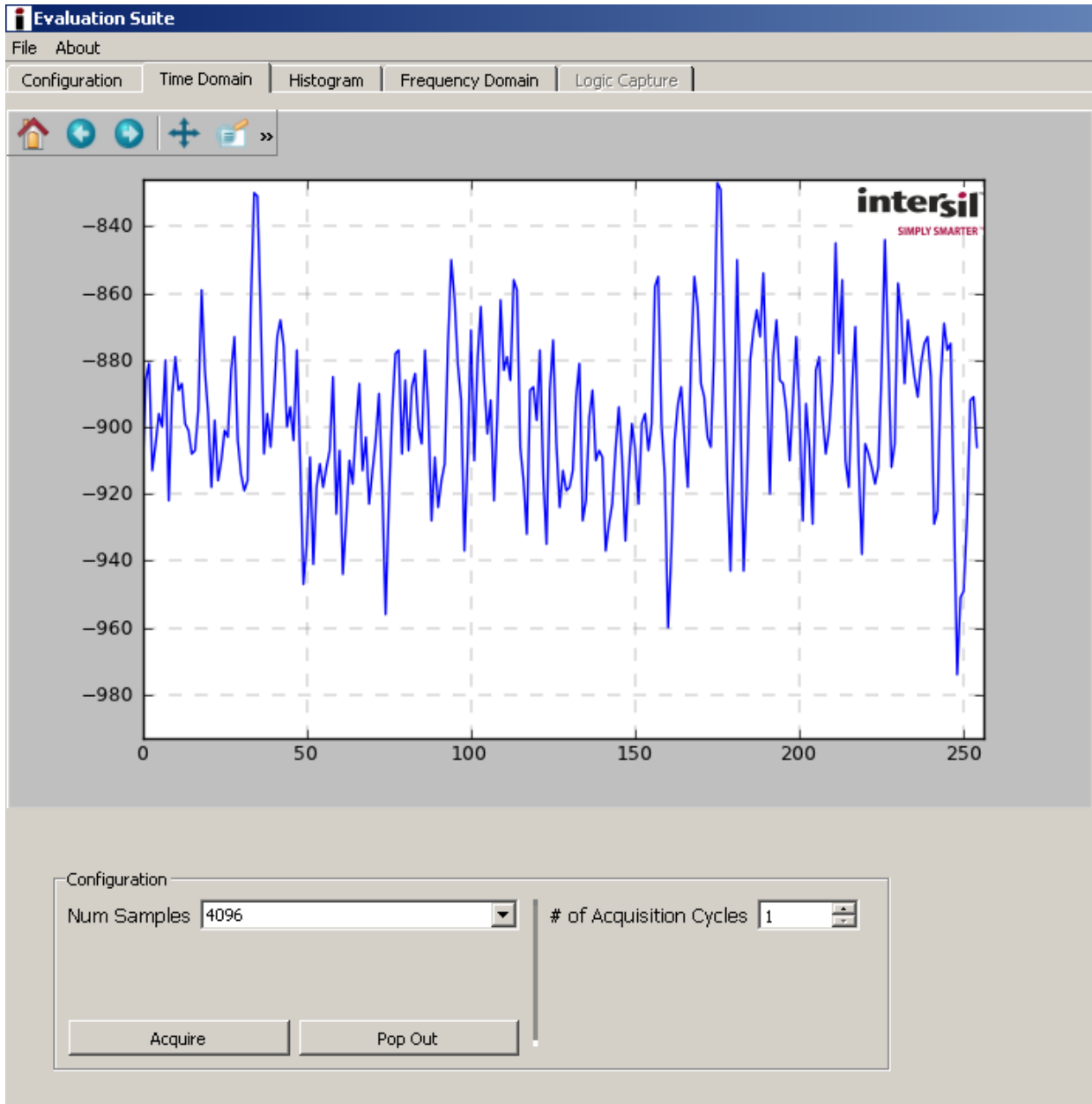


FIGURE 10.

Buttons at the top of the plot provide several user graph tool functions as follows:



FIGURE 11.

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These are also available in the **Histogram** and **Frequency Domain** windows.

**House:** Zooms to the original zoom scale factor.

**Left/Right:** Goes back/forward 1 zoom command. So if you zoom in twice and want to go back to the first zoom, you'd click the left arrow.

**Four Points:** Moves the axes around.

**Magnifying Glass:** Zoom box.

**Scaling Icon (Up/down/left/right):** Changes the size of the plot in the window. You can scale the graph as large as the border.

**Check Box:** Allows customization of axis labels/plot title as shown in Figure 12.

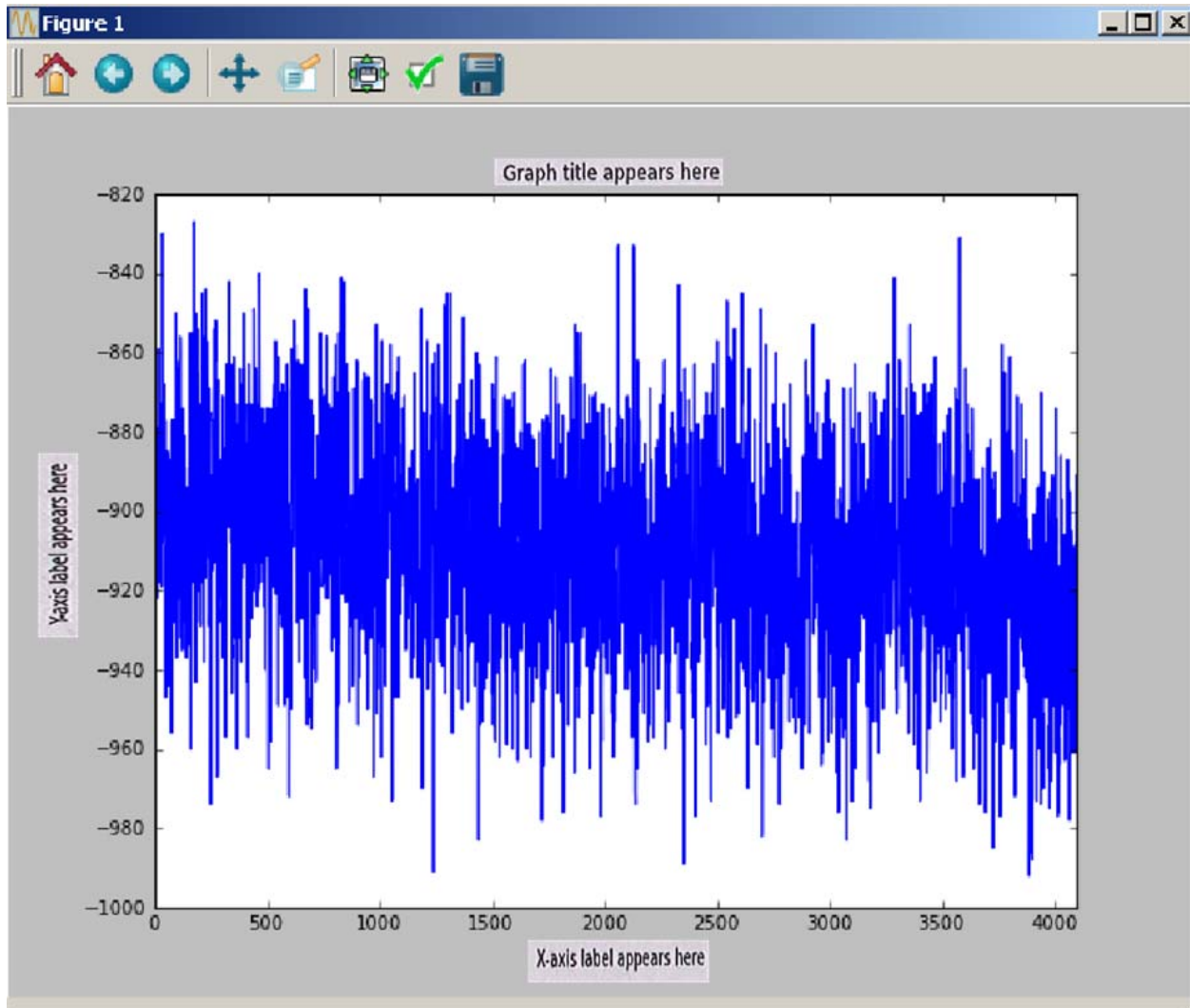


FIGURE 12. EXPANDED VIEW OF FIGURE 10

## Application Note 1672

**Disk:** Saves the plot as an image. When selected, a window will open that offers several image format options.

Once the data from the ADC has been captured, the data can be saved to a file. The histogram data and the spectrum data can also be saved. See Appendix 2 on page 17 for a discussion of the

formats of the saved files. Note that the raw data (conversion words from the ADC) files can also be read back into the GUI once saved. Or data collected from another source can be read into the GUI software for analysis if the proper data format is used. See Appendix 2 on page 17 for details.

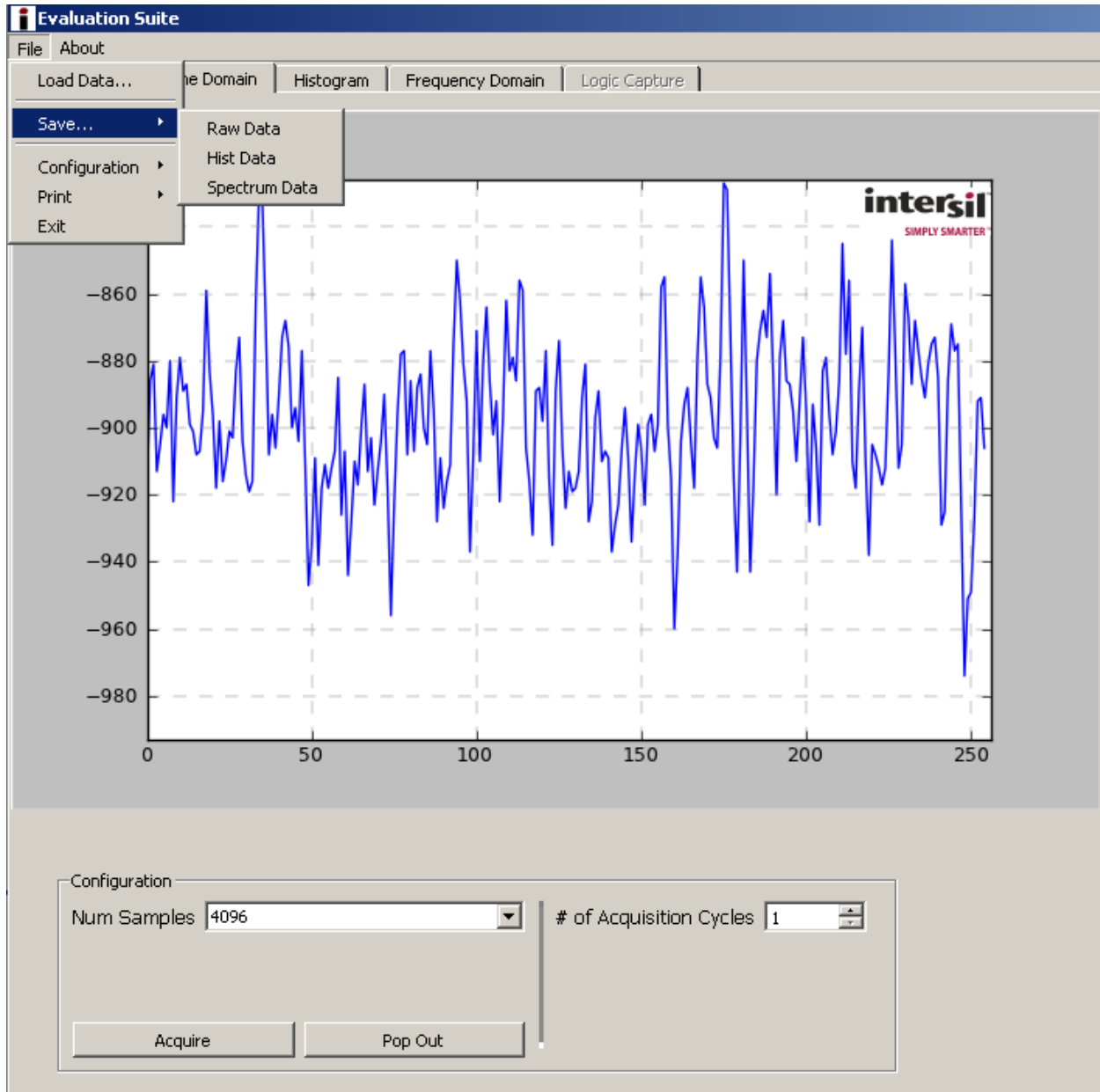


FIGURE 13.

## Histogram Window

If the user clicks on the **Histogram** window after collecting data using the **Time Domain** window, the histogram of the time domain data will be plotted. Alternatively, the **Histogram** window provides the user options to set the number of samples to be collected and to acquire a new sample set based upon this selection. The **Bin Width** window allows the user to set the

number of converter codes that are counted in one bin of the histogram. This number is defaulted to "1".

When the histogram is plotted, the plot includes markers for the mean value (red vertical line) and for one standard deviation from the mean on each side (green dashed lines). Signal statistics are listed in the plot itself and in the text boxes below the graph. The **Pop Out** button shows the graph without the statistics listed.

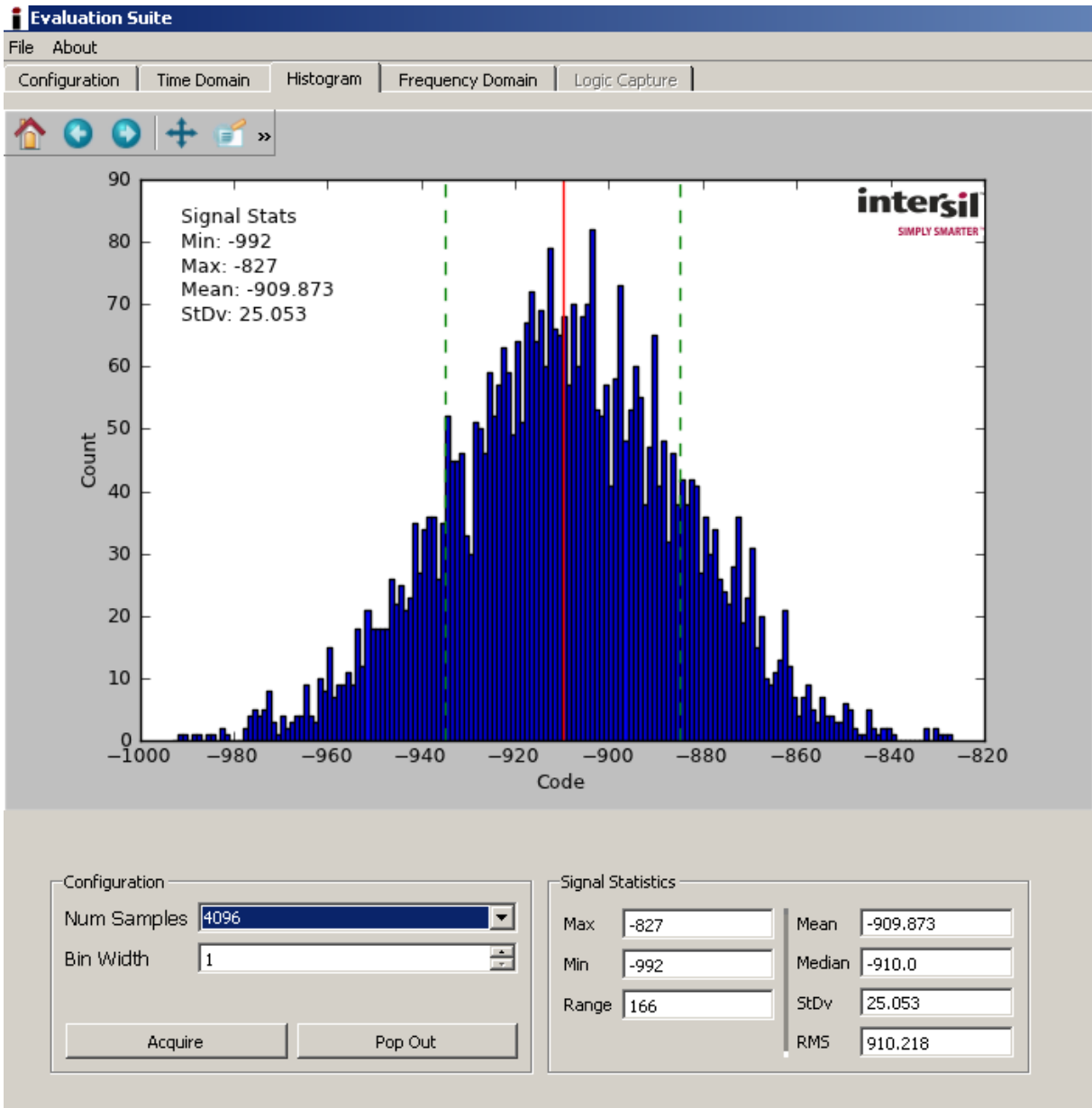


FIGURE 14.

## Frequency Domain

If the user has collected data in either the **Time Domain** window or the **Histogram** window, and then clicks on the **Frequency Domain** menu option, the data will be processed with the FFT algorithm and the resulting spectral information will be displayed, as shown in Figure 15. The red lines mark harmonics. If no signal is present, the software assumes the highest point in the spectrum is the fundamental. If the **log(freq)** check box is checked, the spectral plot will be graphed with the frequency axis on a Log scale, as shown in Figure 18. If the **Grounded Input Test**

check box is checked, and data is collected with the input to the converter shorted, the GUI software will calculate the various parameters such as SNR (signal to noise ratio) by computing the ratio of an artificial full scale sine wave to the total noise in the bandwidth. The **Grounded Input Test** check box should only be checked if there is no actual signal input into the converter. Note that if the **Grounded Input Test** check box is not checked, the software will compute parameters such as SNR, by calculating the ratio of the largest magnitude component in the spectrum (other than the DC offset) to the noise.

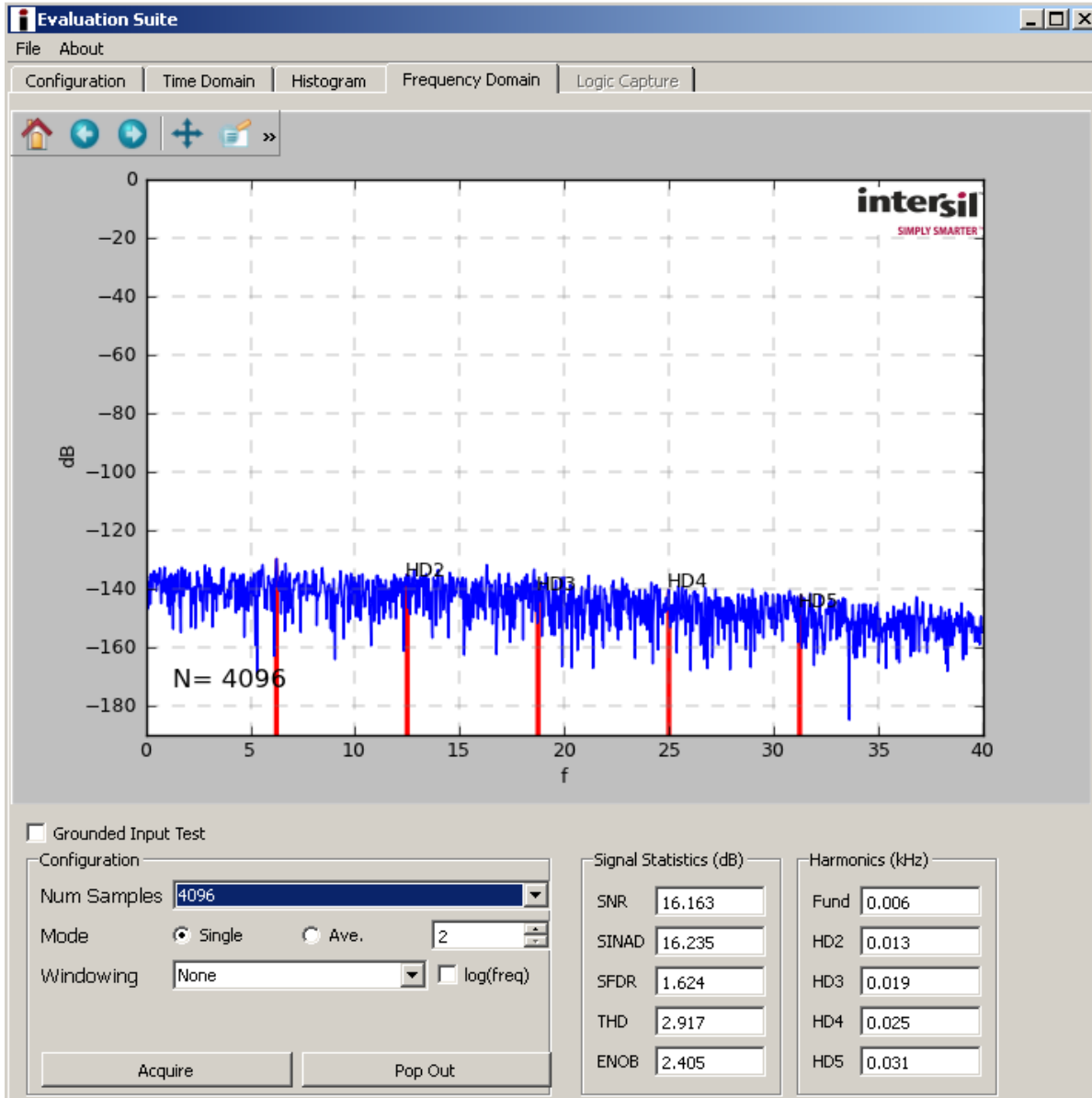


FIGURE 15.

## Application Note 1672

There are several different selectable options in the **Frequency Domain** window. The number of samples can be set up to 1048576 using a pull down menu as shown in Figure 16. Note that the Frequency Domain software must have at least 1024 samples to compute a proper spectral plot.

The software also allows a number of different window functions to be used. The different windowing options can be selected in the **Windowing** pull-down menu as shown in Figure 17. These are normally used when testing is performed with a sine wave as the input signal. This same software GUI supports other ADC platforms (high speed SAR ADCs) where these windowing options are more commonly used.

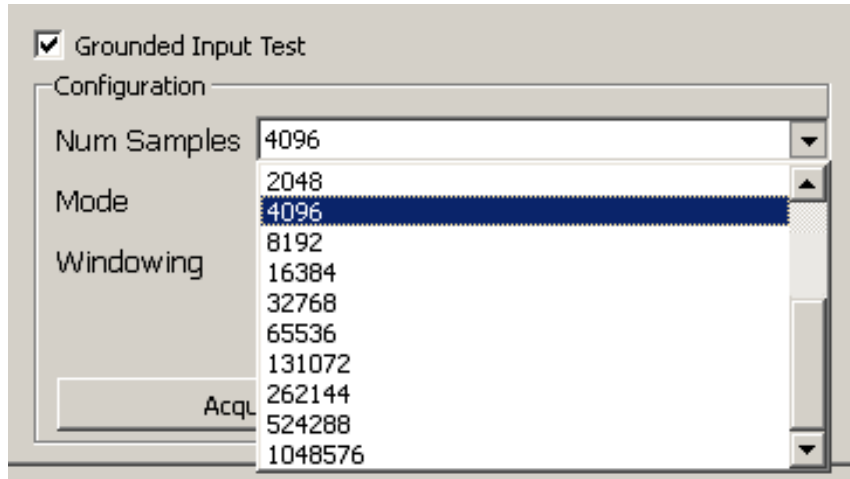


FIGURE 16.

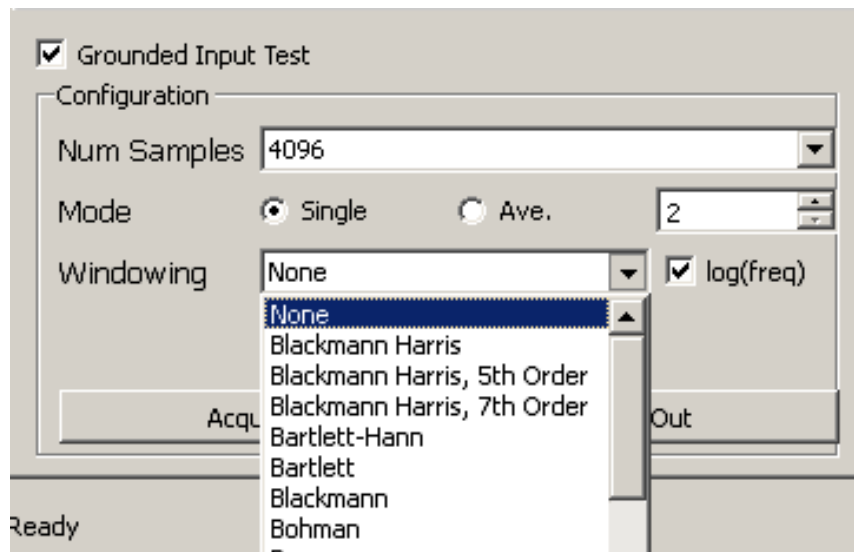


FIGURE 17.

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Figure 18 illustrates the spectral plot of one data set of 4096 samples. The results of the FFT can be averaged by setting the **Mode** radio button option to **Ave.** and then using the window next to the **Ave.** button to set the number of data sets to be averaged. When averaging is performed, the output results of many FFTs

are averaged and produce a spectral plot with smoothed (averaged) spectrum as shown in Figure 19.

Recall that the spectrum plot data can be saved by clicking on the **File=>Save=>Spectrum Data** option at the top of the window.

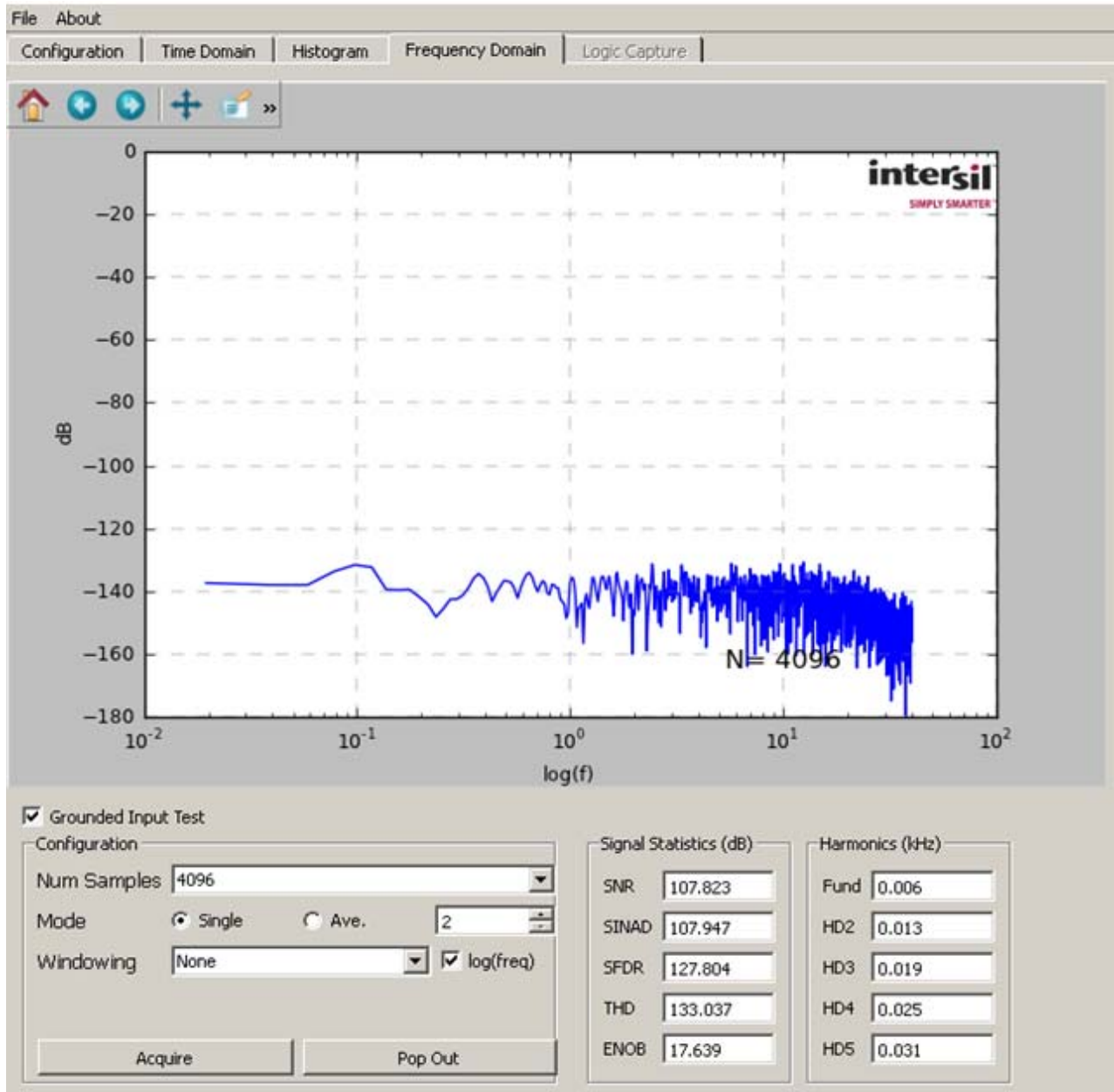


FIGURE 18.

# Application Note 1672

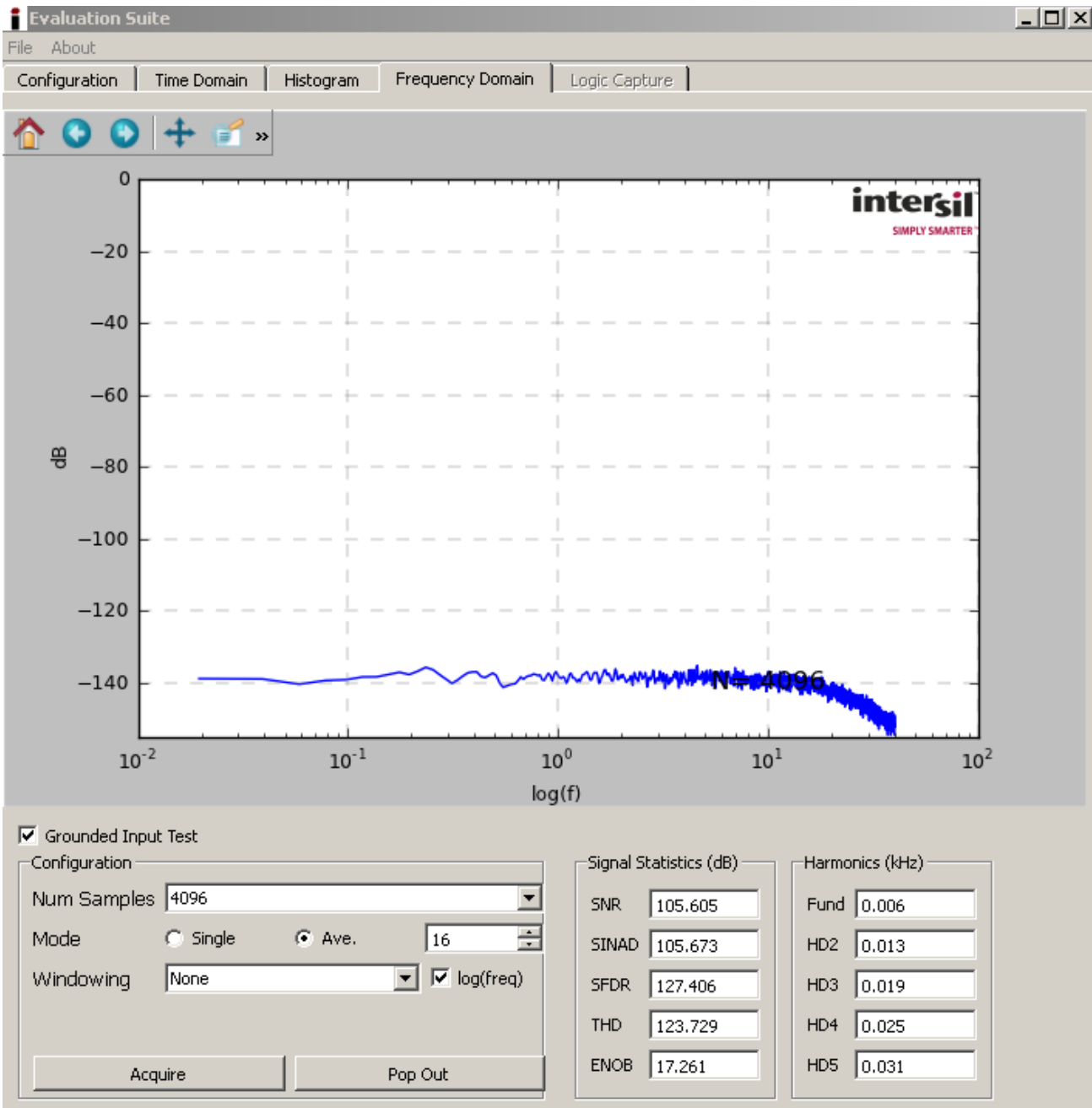


FIGURE 19.



## Appendix #1 How to Obtain and Install the GUI Software

See the ISL26134 Device Information page on the Intersil web site at:  
<http://www.intersil.com/products/deviceinfo.asp?pn=ISL26134>

Go to this link to find the tab where the PC GUI software installer can be downloaded. Note that the software installer does have a license agreement that will be presented when the software is installed onto your PC.

## Appendix #2 Data File Formats

The GUI software allows the user to save data from the time domain (raw data), data from the histogram processing, and data from the spectrum processing segments of the software. It also allows raw data (time domain data) files to be read back into the GUI if they have the proper header and format.

### Raw Data

As an example, a time domain collection of only 8 samples has been collected and saved to a file. The content of the file that is saved has the following format:

```
ISL2613X
80.0
24
8
-394
-361
-405
-411
-397
-416
-423
-416
```

The file has a header that consist of the part number (ISL26134), the sample rate (80), the number of bits in the conversion word (24), and the number of samples in the file (8). The header is followed by the 8 conversion words in signed decimal format.

### Histogram Data

A data collection of 1024 data words was collected and the histogram performed. The histogram data was then saved into a file. The content of the file has the following format. The histogram statistics are listed first, followed by the converter codes and their respective histogram counts.

```
Signal Statistics
Min: -486
Max: -462
Range: 25
Mean: -472.762
StDv: 3.631
```

Code	Hits
-488	0
-487	0
-486	1
-485	0
-484	0
-483	4
-482	4

-481	7
-480	15
-479	29
-478	47
-477	54
-476	79
-475	84
-474	96
-473	112
-472	107
-471	99
-470	87
-469	71
-468	57
-467	40
-466	14
-465	11
-464	2
-463	3
-462	1
-461	0

### Spectrum Data

A data set of 1024 points was collected at a sample rate of 80 Sps. The FFT output will produce a spectrum plot with 512 Bins of magnitude data. Only the beginning and ending portion of the data file has been reproduced here. Note that the Bins start at 0 frequency and increase to one half the sample rate (40Hz). Note that the magnitude in dB is the magnitude of the noise in dB below full scale rms but it is scaled based upon magnitude/ $\sqrt{\text{BIN}}$ , not magnitude/ $\sqrt{\text{Hz}}$ .

Freq	Magnitude(dB)
0.0	-152.176082921
0.078125	-150.765450438
0.15625	-151.161495054
0.234375	-161.302103964
0.3125	-152.403880548
0.390625	-153.371854853
0.46875	-147.933929413
0.546875	-140.814871676
XX	
39.375	-158.163736345
39.453125	-186.035243892
39.53125	-162.574730282
39.609375	-161.238997758
39.6875	-160.482611598
39.765625	-157.776276313
39.84375	-156.626469649
39.921875	-158.855304029

### Load Data Function

The GUI allows raw (time domain) data to be loaded back into the GUI. Alternately, the user might collect data in another system and import the conversion word data into the GUI to perform analysis. To be able to read the data the file must have the proper header (as discussed in the "Raw Data" section of this appendix).

The header must have a header with a part number (this can be something other than a chip number), sample rate, number of bits in the converter, and the number of samples, followed by the data in decimal format. The largest value of any reading cannot exceed one half  $2^{\text{number of bits in the converter}}$ . For example, if the number of bits in the converter is 12, then the largest reading can be no greater than  $(2^{12})/2$  or 2048.

# Application Note 1672

```
ISL2613X > part number
80.0 > sample rate
24 > number of bits in the converter
8 > number of data samples in the file
-394 > conversion data in signed decimal
format
-361
-405
-411
-397
-416
-423
-416
```

## Appendix #3 Evaluation Board Factory Jumper Settings

Figure 20 indicates the position of the header shunts when the board is shipped from the factory.

Header J22 is connected with the 2.5V reference selected as the common mode voltage.

Headers J9 and J10 are shorted with shunts to connect the common mode voltage to the AIN1+ and AIN1- signals coming from the terminal block connector. This effectively shorts both inputs to channel 1 on the ADC to the common mode voltage and enables the ADC to be tested with a shorted input. One or both of these jumpers must be removed if the ADC is to measure a signal on this channel.

Headers J1 and J5: These are set to select logic 0, A0 = A1 = 0 => Channel = 1.

Headers J 29 and J7: These are set to select logic 1, Gain0 = Gain1 = 1 => => Gain = 128X.

Header J6: Set to select logic 1. Speed = 1 => 80 Sps.

Headers J28 and J30: the 2.5V\_VREF option is selected on J28. The AGND option is selected on J30. These enable to 2.5V voltage reference chip to be the voltage reference for the ADC.

DIP switch: Switches S2-1, S2-2, S2-3 and S2-4 cannot be in the closed (ON) position. With all four switches in this position the board is in a factory test mode and will not function properly with the PC software GUI. If the factory test mode is selected LED3 will be blinking.

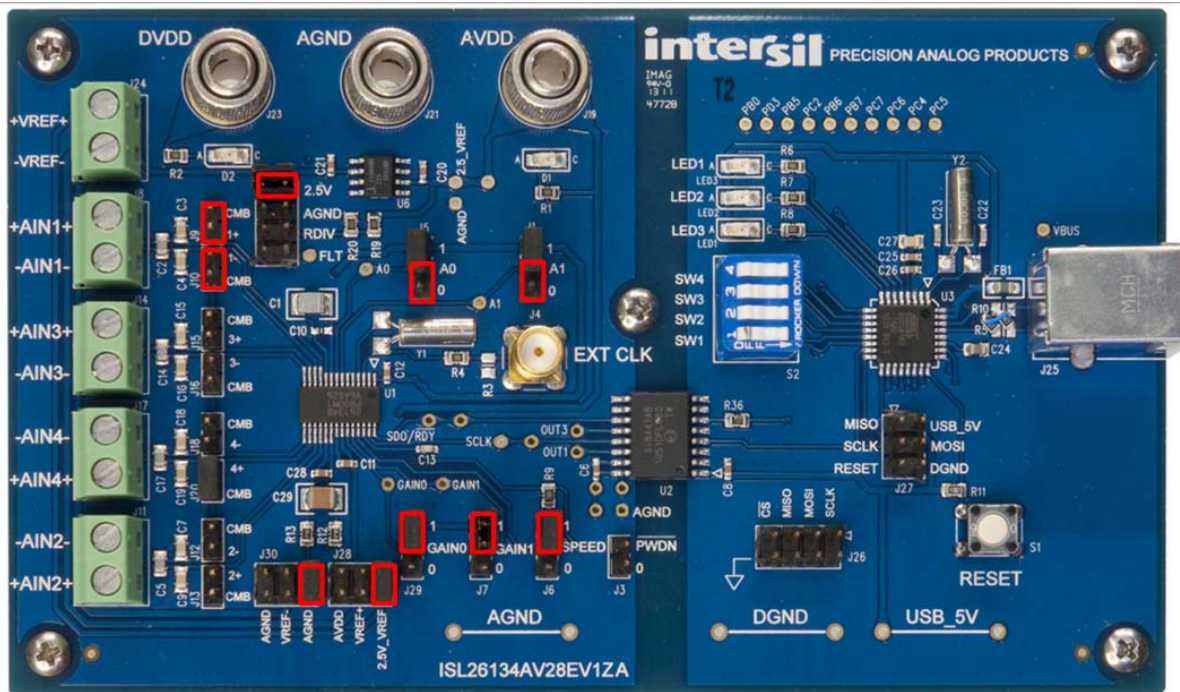


FIGURE 20.

Intersil Corporation reserves the right to make changes in circuit design, software and/or specifications at any time without notice. Accordingly, the reader is cautioned to verify that the Application Note or Technical Brief is current before proceeding.

For information regarding Intersil Corporation and its products, see [www.intersil.com](http://www.intersil.com)

# Appendix #4 Evaluation Board Layout and Component Placement

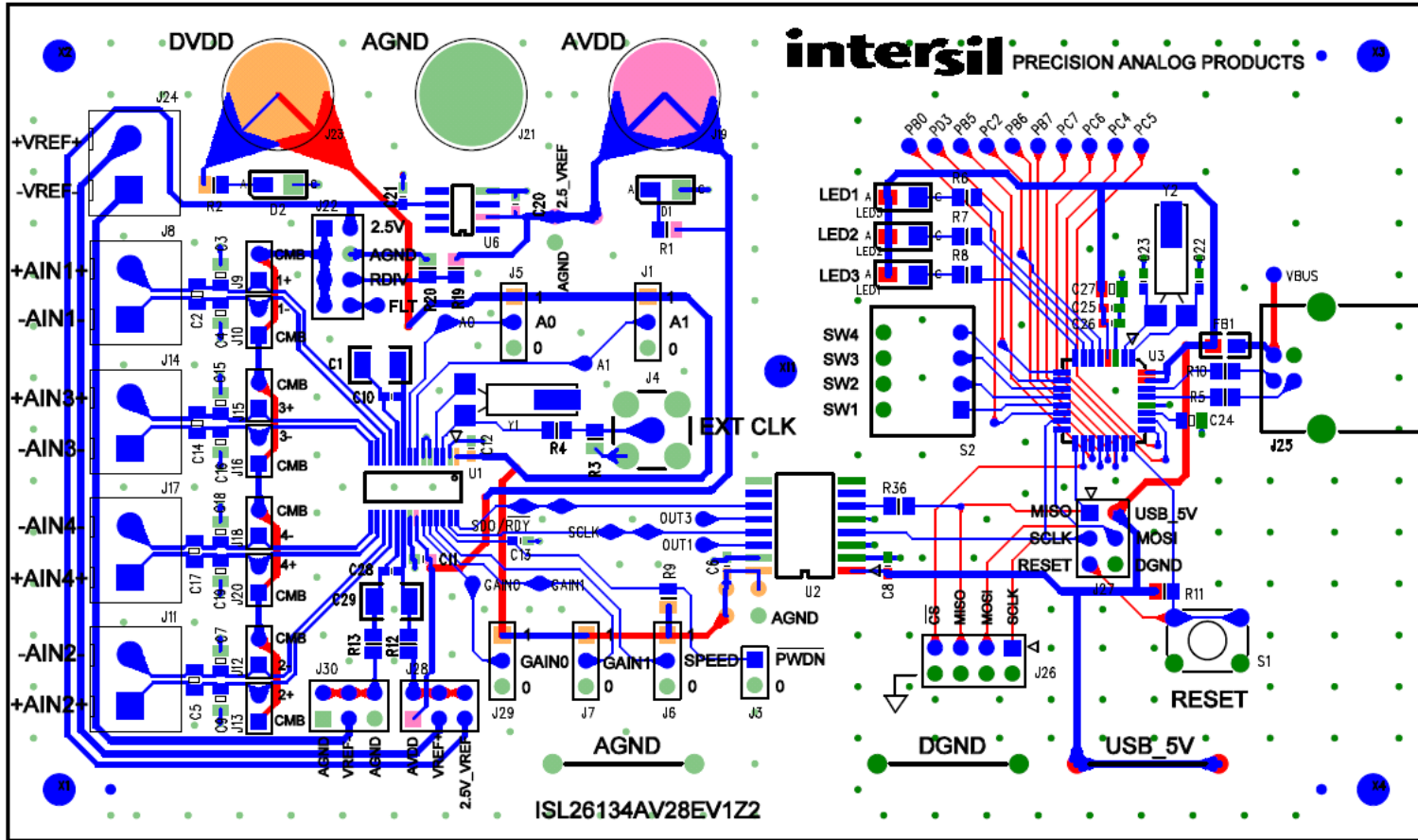


FIGURE 21.

# Appendix #4 Evaluation Board Layout and Component Placement (Continued)

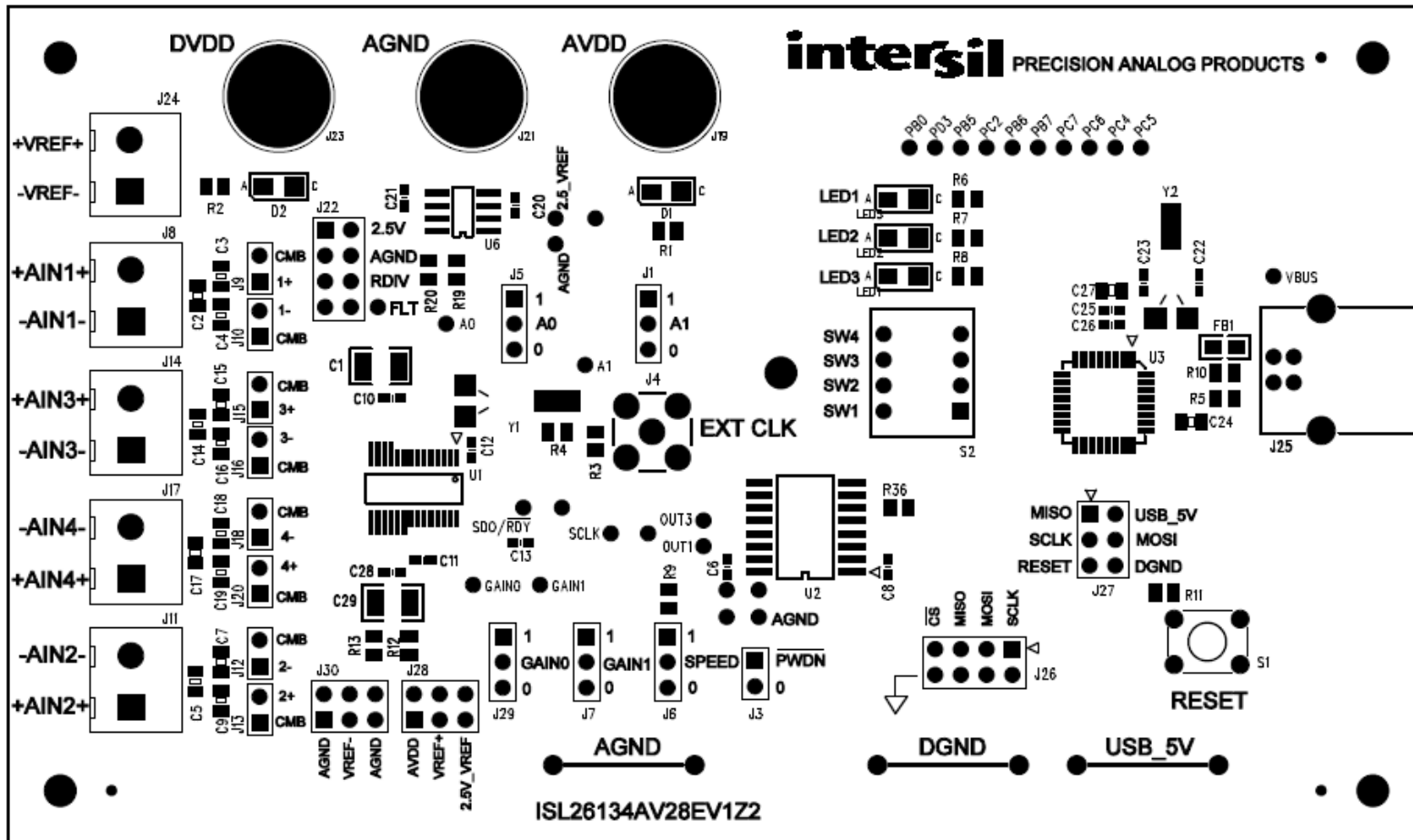


FIGURE 22.