

ADS58H4x (ADS58H40/ADS58H43) EVM

This document serves as a user's guide for the ADS58H4x (ADS58H40/ADS58H43) Evaluation Module (EVM). The EVM provides a platform for evaluating the ADS58H40 or the ADS58H43, a quad-channel, 14-bit telecommunications analog-to-digital converter (ADC) operating at sampling rates of up to 250 MSPS. Designed for low-power consumption and high spurious free dynamic range (SFDR), the ADC has low-noise performance and outstanding SFDR over a large input-frequency range.

The four ADC channels are separated into two blocks with two ADCs each. Each block can individually be configured into three different operating modes: 11-bit Operating mode, 11-bit SNRBoost mode, 14-bit High Resolution Burst mode.

This EVM is ideally suited for mating with the TSW1400 Capture Card for performing a data capture into a capture buffer, uploading the sample data to a PC, performing an FFT, and reporting on SNR, SFDR, and other performance metrics.

For more information regarding the ADS58H4x and the related evaluation tools, please refer to the following:

- ADS58H40 – Quad 14-bit 250-MSPS ADC with SNRBoost and Burst Mode ([SBAS589](#))
- TSW1400 – High-Speed Data Capture and Pattern Generation Platform ([SLWU079](#))
- ADS58H40 EVM Configuration Software ([SLAC533](#)). This software is compatible for both ADS58H40 and ADS58H43.

Contents

1	Introduction	2
	1.1 EVM Block Diagram	2
	1.2 EVM Power Supply	3
	1.3 EVM Connectors and Jumpers	4
	1.4 EVM ADC Input Circuit Configurations	6
2	Software Control	7
	2.1 Installation Instructions	7
	2.2 Software Operation	7
3	Basic Test Procedure	10
	3.1 Test Block Diagram	10
	3.2 Test Set-up Connection	11
	3.3 ADS58H4x Software Quick Start Guide	11
	3.4 ADS58H4x and TSW1400 Setup Guide	11

List of Figures

1	Simplified ADS58H4x EVM Block Diagram.....	2
2	Simplified ADS58H4x EVM Power Supply	3
3	ADS58H4x EVM Connector and Jumper Locations.....	4
4	ADS58H4x ADC Input Circuit	6
5	ADS58H4x Clock Input Circuit	6
6	ADS58H4x Main Panel.....	8
7	ADS58H4x SNRBoost/Burst Mode Panel	9
8	ADS58H4x and TSW1400 Test Setup Block Diagram	10
9	Select ADS58H40 in the High Speed Converter Pro GUI Program	12

10	Load ADC Firmware Prompt	12
11	ADS58H4x 11-bit Operating Mode, Single Tone Test Result: $F_s = 245.76$ MSPS, $F_{in} = 170$ MHz.....	13
12	ADS58H4x 11-bit SNRBoost Mode, Single Tone Test Result: $F_s = 245.76$ MSPS, $F_{in} = 170$ MHz.....	14
13	TSW1400 Trigger Option	15
14	ADS58H4x 14-bit High-Resolution Mode, Single Tone Test Result: $F_s = 245.76$ MSPS, $F_{in} = 170$ MHz	16

List of Tables

1	Power Supply Options.....	3
2	ADS58H4x EVM Connectors	4
3	ADS58H4x EVM Jumper Options.....	5
4	ADS58H4x EVM Pushbutton Switches	5
5	ADS58H4x EVM LED Indicators	6

1 Introduction

1.1 EVM Block Diagram

Figure 1 shows a simplified block diagram of the default configuration of the EVM. The four analog inputs are supplied to the EVM through a single-ended SMA connection, then transformer coupled, turning the single-ended signal into a balanced differential signal, and then input to the ADS58H4x. A dual transformer input circuit provides better phase and amplitude balance of the input signal when compared to the performance delivered by a single transformer input circuit.

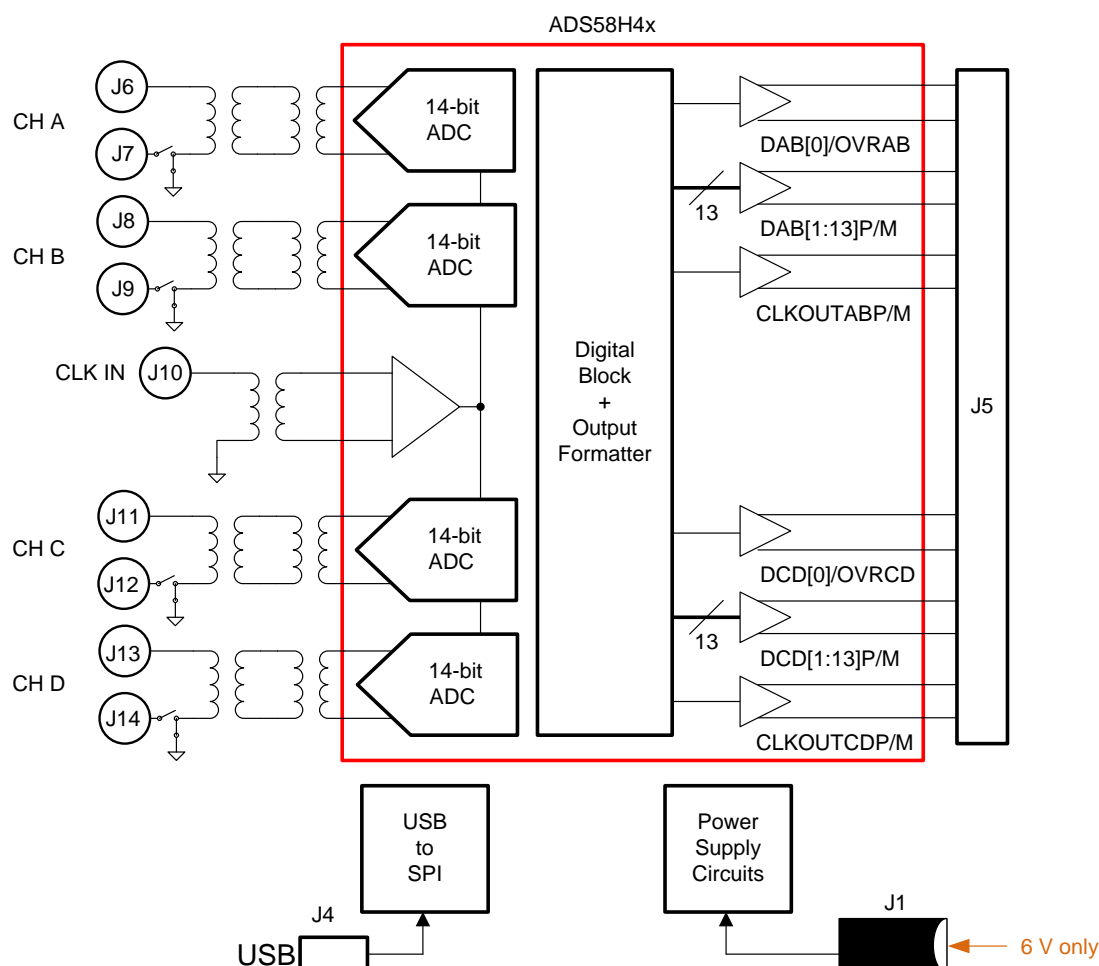


Figure 1. Simplified ADS58H4x EVM Block Diagram

The clock input is supplied by way of a single-ended signal to an SMA connector and transformer coupled producing a differential clock signal for the ADS58H4x.

Power to the EVM is typically supplied by a single 6-V power brick. Banana jacks may also be used to supply power to the EVM. All necessary voltages for the ADS58H4x are derived from the 6-V input connection.

1.2 EVM Power Supply

Figure 2 illustrates the power supply options available on the EVM. Jumpers are used to choose the power supply options, with the default jumper positions indicated by the darker portion of the jumper that represents the presence of the jumper. For jumper and feedback resistor configuration, see Table 1.

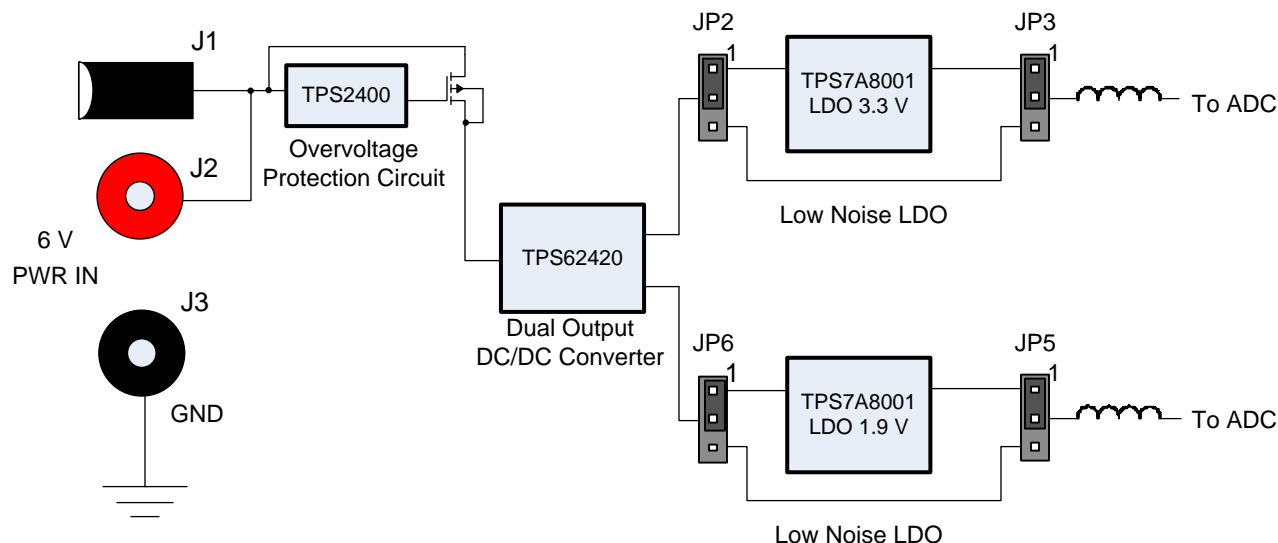


Figure 2. Simplified ADS58H4x EVM Power Supply

Table 1. Power Supply Options

Power Supply Options	JP2	JP3	JP4	JP5	R3	R7	Comment
Option #1 (Default)	1-2	1-2	1-2	1-2	649 kΩ	536 kΩ	Dual outputs DC/DC converter supplies 3.85 V and 2.4 V to two low-noise LDOs. The low-noise LDOs output 3.3 V and 1.9 V, respectively.
Option #2	2-3	2-3	2-3	2-3	536 kΩ	390 kΩ	Low-noise LDOs are bypassed. DC/DC converter powers the ADC directly.

The default power path has an efficient dual output DC-DC switching power supply to first step down the input supplies for the low-noise LDOs. The low-noise LDOs generate the 3.3 V and 1.9 V for the ADC power.

The low-noise LDOs can be bypassed, allowing the DC/DC power supply to directly power the ADC. In this implementation, adjust the feedback resistors of the DC/DC converter accordingly.

1.3 EVM Connectors and Jumpers

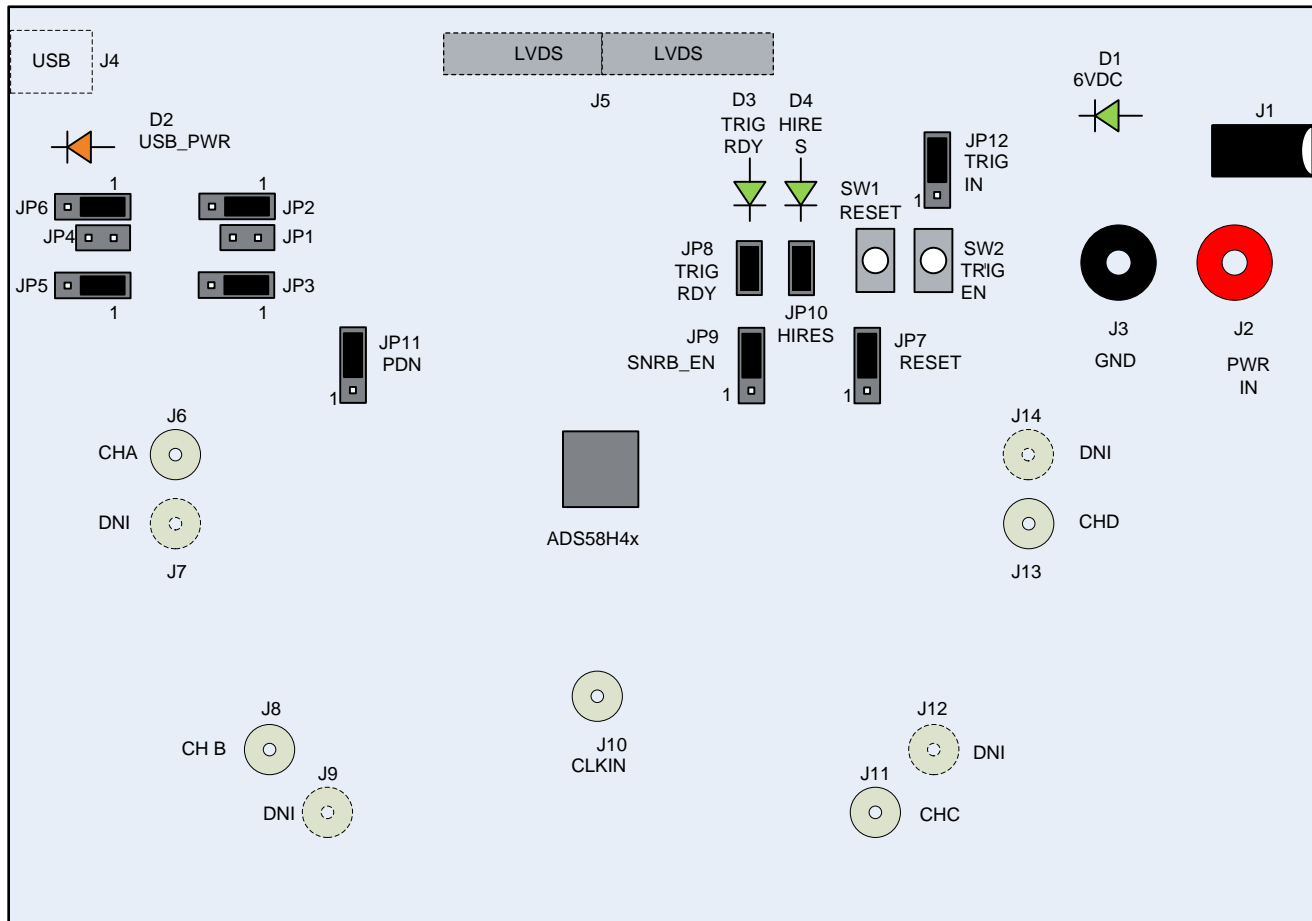


Figure 3. ADS58H4x EVM Connector and Jumper Locations

The locations of the connectors, jumpers, pushbutton switches, and LEDs are shown in [Figure 3](#). The EVM has power connectors or banana jacks connecting the main power for power distribution. The SMA connectors connect the ADC input and ADC clock input to the ADC. Typically, the ADC inputs are transformer coupled, accepting single-ended connections. The input circuit can be configured to connect to two SMA connectors for differential signaling. [Table 2](#) lists the connector information for the EVM.

Table 2. ADS58H4x EVM Connectors

Reference Designator	Description
J1	6 V (main) power input
J2	6 V (main) power input
J3	Ground return
J4	USB Mini-B connector
J5	SAMTEC high-speed LVDS connector
J6	CH A input (positive)
J7	CH A input (negative) DNI
J8	CH B input (positive)
J9	CH B input (negative) DNI
J10	ADC clock input
J11	CH C input (positive)
J12	CH C input (negative) DNI

Table 2. ADS58H4x EVM Connectors (continued)

Reference Designator	Description
J13	CH D input (positive)
J14	CH D input (negative) DNI

The on-board jumper options allow configuration of on-board power supplies and ADC options. Many of the jumper selections that involve DC inputs or static control signals are by way of push-on square post jumpers. The jumper options are listed in [Table 3](#). The table indicates the default settings of the jumpers as the EVM is normally shipped. Some of the jumpers are open circuit by default.

Table 3. ADS58H4x EVM Jumper Options

Reference Designator	Default Setting	Function	Optional Setting	Function
JP1	DNI	Connects low-noise LDO (U2) input to main power input	N/A	
JP2	1-2	Connects DC/DC converter (U3) output to low-noise LDO (U2) input	2-3	Connects DC/DC converter (U3) output directly to the ADC
JP3	1-2	Connects low-noise LDO (U2) output to ADC	2-3	Connects DC/DC converter (U3) output directly to the ADC
JP4	DNI	Connects low-noise LDO (U4) input to main power input	N/A	
JP5	1-2	Connects DC/DC converter (U3) output to low-noise LDO (U4) input	2-3	Connects DC/DC converter (U3) output directly to the ADC
JP6	1-2	Connects low-noise LDO (U4) output to ADC	2-3	Connects DC/DC converter (U3) output directly to the ADC
JP7	2-3	Connects ADC RESET pin G6 to SW1 RESET switch	1-2	Connects ADC RESET pin G6 to DRVDD
JP8	1-2	Connects ADC TRIG_RDY pin G4 to LED circuit	Open	ADC TRIG_RDY pin G4 is open
JP9	2-3	Disables ADC SNRBoost	1-2	Enables ADC SNRBoost
JP10	1-2	Connects ADC HIRES pin G5 to LED circuit	Open	ADC HIRES pin G5 is open
JP11	2-3	Enables ADC	1-2	Power down the ADC or allows the ADC to standby (configured by CONFIG 0x45, bit D0)
JP12	2-3	Connects trigger signal from SW2 switch to ADC trigger input. This can be used to start the auto-burst process.	1-2	Connects trigger signal from TSW1400 rev. E to the ADC trigger input

There are two pushbuttons on the EVM. While JP7 is set in the 2-3 position, the pushbutton switch, SW1, provides a hardware reset to the ADS58H4x. Upon powering up, the ADC can either accept a hardware reset by pressing SW1 or by toggling the software reset switch on the EVM GUI. [Table 4](#) lists the descriptions of each pushbutton switch.

If the ADS58H4x is configured for high resolution burst mode, pressing SW2 while JP12 is set to the 2-3 position allows the ADC to enter burst mode. The SW2 pushbutton also provides the initial pulse needed to start the auto-burst mode process after the ADC is configured in *High Resolution Auto-Burst* mode.

Table 4. ADS58H4x EVM Pushbutton Switches

Reference Designator	Purpose
SW1	While JP7 is set in the 2-3 position, pressing SW1 resets the ADC. The ADC can be reset either by pressing SW1 or with a software reset in the GUI.
SW2	While JP12 is set in the 2-3 position, pressing SW2 allows the ADC to enter burst mode. This can also provide the initial pulse needed start the auto-burst process.

LED D1 is lit indicating the presence of the 6-V supply voltage to the EVM, while LED D2 is lit indicating the presence of the USB to serial converter power. LEDs D3 and D4 indicate the status of the ADS58H4x High Resolution Burst Mode. Table 5 lists the description of each LED indicator.

Table 5. ADS58H4x EVM LED Indicators

Reference Designator	Description
D1	When lit, D1 shows the presence of the 6-V (main) power supply
D2	When lit, D2 shows the presence of the USB to serial converter power
D3	When lit, D3 indicates that the ADC is ready to enter trigger mode
D4	When lit, D4 indicates that the ADC is in high resolution burst mode

1.4 EVM ADC Input Circuit Configurations

Figure 4 shows the ADS58H4x ADC input circuit. The default setup has a dual 1:1 impedance ratio transformer input circuit, which achieves better phase and amplitude balance of the input signal than is typically produced by a single transformer input circuit. Third-order bandpass filter component pads are available for installing bandpass filter components. The default components for the bandpass filter are either zero Ω or open circuit.

The default input termination is 50 Ω , which is formed by two 25- Ω resistors connected to the ADC VCM node. If the user chooses to use 100- Ω termination with the 1:2 impedance transformer, the optional RLR differential arm can be used to tune the in-band flatness.

The ADC analog input consists of a switched-capacitor-based, differential sample-and-hold (S/H) architecture. Due to the opening and closing of the sampling glitches, the kick-back noise from the S/H circuit may affect the ADC performance. Besides the on-chip R-C filter of the ADC input, the external RLCR circuit provides additional filtering of the glitches. The default RLCR components have been optimized for input bandwidth centered at 185 MHz. For additional RLCR components of different center frequencies, refer to the ADS58H40 datasheet (SBAS589).

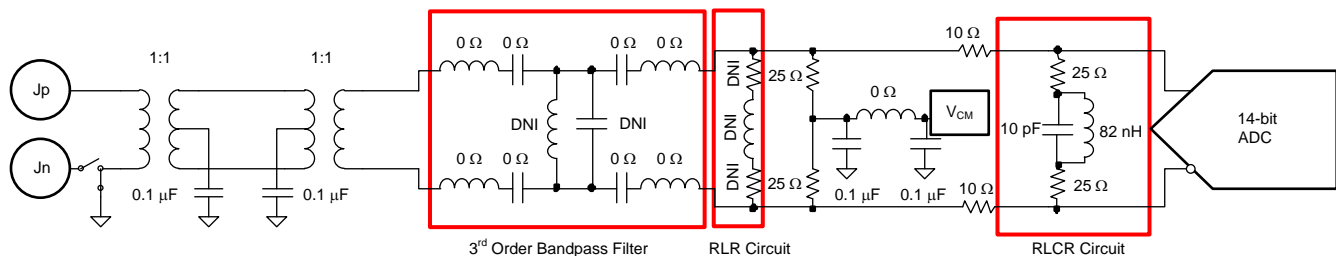


Figure 4. ADS58H4x ADC Input Circuit

Figure 5 shows the ADS58H4x clock input circuit. The clock signal goes through the 1:4 impedance ratio transformer increasing the clock amplitude by two (1:4 impedance ratio equals to 1:2 voltage ratio). The two 121- Ω resistors will impedance transform back to the primary side as 50- Ω load impedance for the signal source generator. For ADC evaluation, set the signal generator output to 10 dBm.

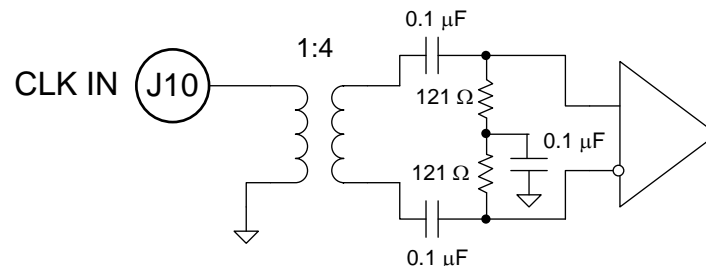


Figure 5. ADS58H4x Clock Input Circuit

2 Software Control

2.1 Installation Instructions

- Open the ADS58H40_Installer_vxpx folder (xpx represents the latest version, which is 2.0 at the time of this writing)
- Run Setup.exe
- Follow the on-screen instructions
- Once installed, launch by clicking on the ADS58H40_GUI_vxpx program in Start → All Programs → Texas Instruments ADCs
- When plugging in the USB cable for the first time, the Found-New-Hardware-Wizard prompts to install the USB drivers
 - When a pop-up screen opens, select *Continue Downloading*
 - Follow the on-screen instructions to install the USB drivers
 - If needed, access the drivers directly in the install directory

2.2 Software Operation

The ADS58H40 EVM GUI is compatible for both ADS58H40 and ADS58H43 EVMs. The software allows programming control of the ADS58H4x device. The front panel provides a tab for common control of the ADS58H4x and a SNRBoost/Burst Mode tab for control of the special data capture modes. The GUI tabs provide a convenient and simplified interface to the most-used registers of each device.

2.2.1 Control Options

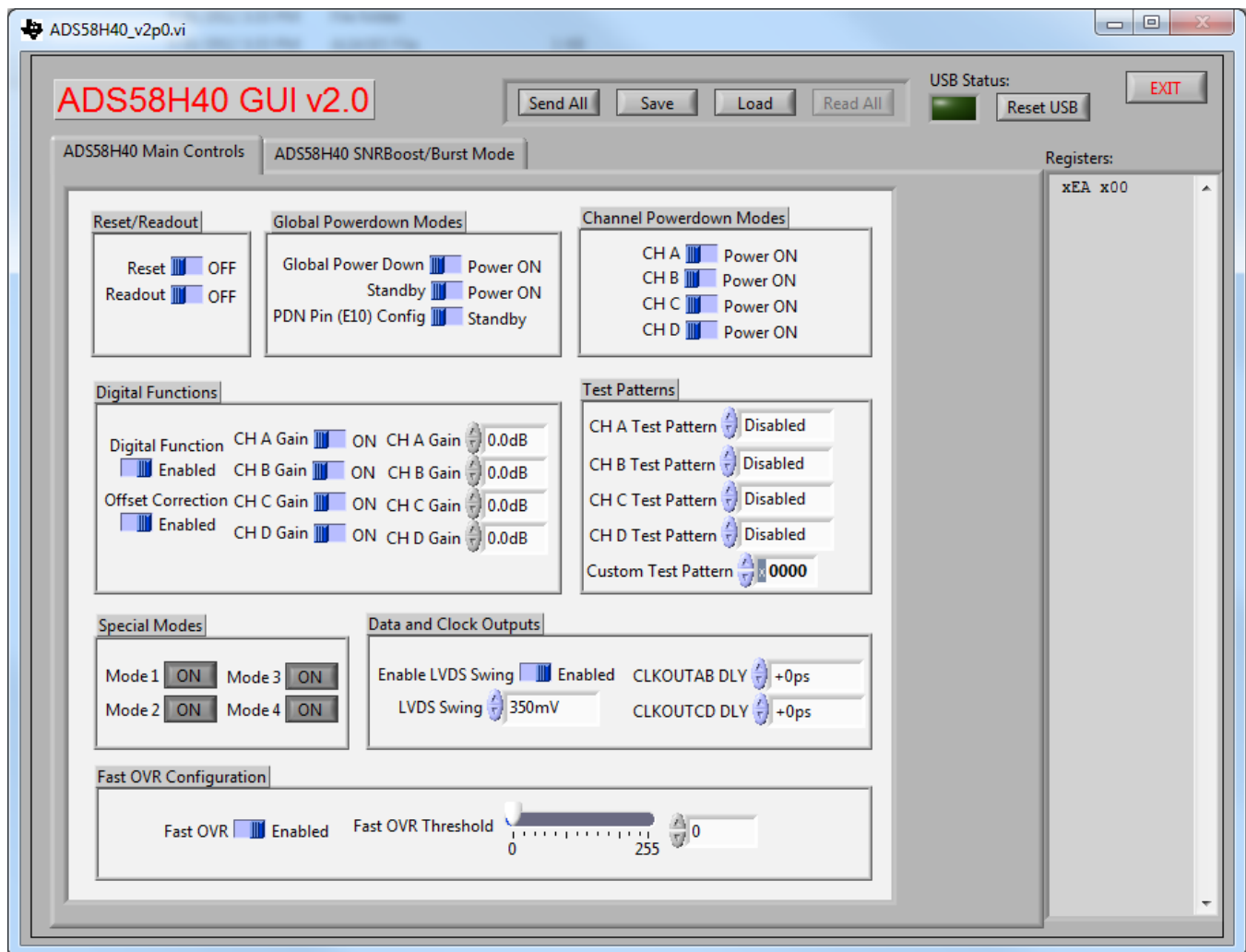


Figure 6. ADS58H4x Main Panel

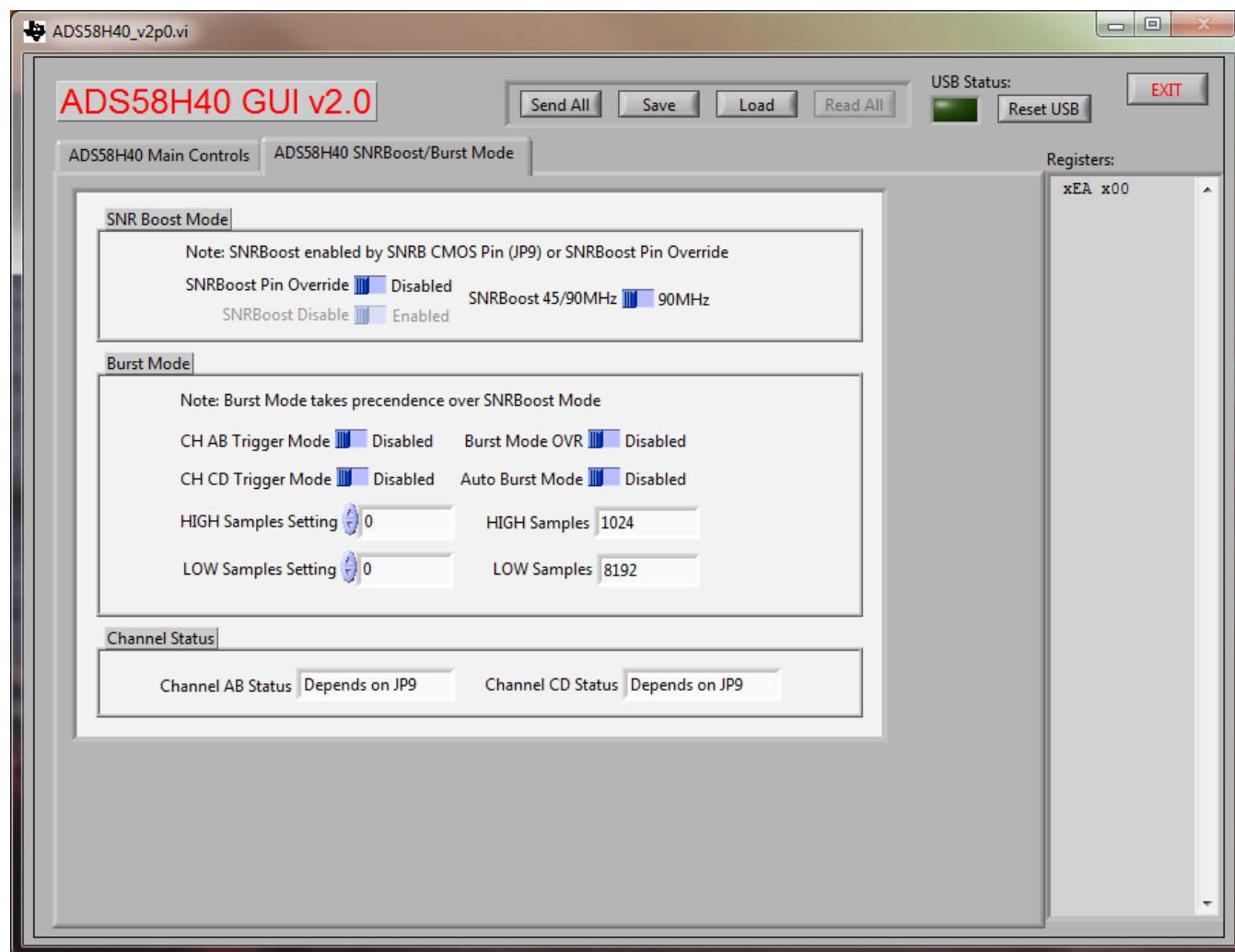


Figure 7. ADS58H4x SNRBoost/Burst Mode Panel

2.2.2 Register Control

- **Send All:** Sends the register configuration to all devices
- **Save Regs:** Saves the register configuration for all devices
- **Load Regs:** Load a register file for all devices.
 - Select *Load Regs* button
 - Double click on the *data* folder
 - Double click on the desired register file
 - Click *Send All*, ensuring all of the values are loaded properly

2.2.3 Miscellaneous Settings

- **Reset USB:** Toggle this button if the USB port is not responding. This generates a new USB handle address

Note: Reset the board after every power cycle and click the **Reset USB** button on the GUI
- **Exit:** Stops the program

3 Basic Test Procedure

This section outlines the basic test procedure for testing the EVM.

3.1 Test Block Diagram

The test set-up for evaluation of the EVM with the TSW1400 Capture Card is shown in Figure 8. As seen in this figure, the evaluation setup involves a clock from a high-quality signal generator and a sine wave for the analog input from a high-quality signal generator. High-order, narrow-bandpass filters are usually required on clock and input frequency to remove phase noise and harmonic content from the input sine waves. If the two signal generators are not synchronized by an external reference signal to make the clock and input frequency coherent, then the resulting FFT first needs a windowing function, such as Hanning or Blackman-Harris, applied to the data.

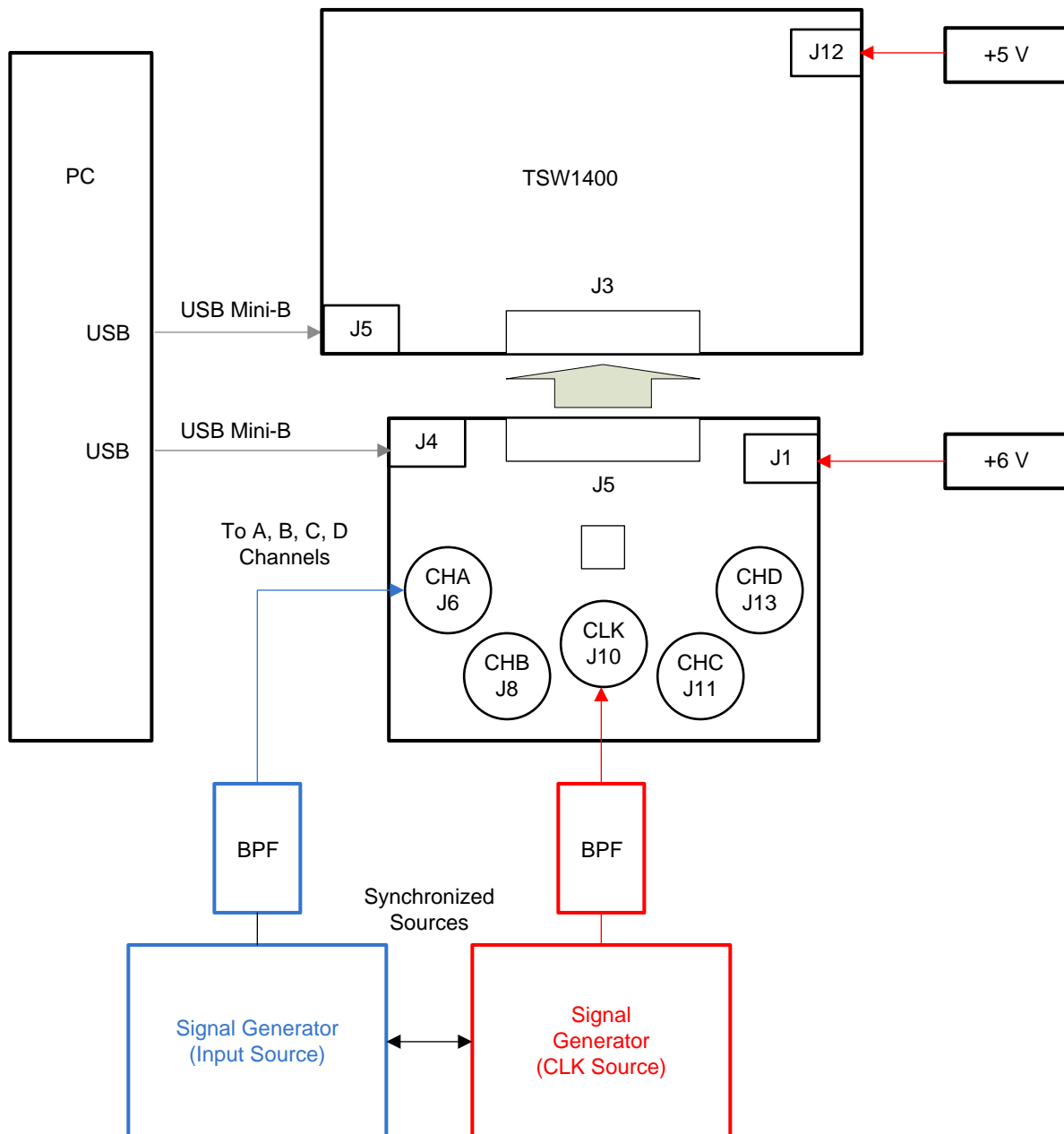


Figure 8. ADS58H4x and TSW1400 Test Setup Block Diagram

3.2 Test Set-up Connection

1. Connect the J5 connector of the EVM to the J3 connector of TSW1400 EVM
2. Connect 5 V to the J12 supply input connector of the TSW1400 and 6 V to the J1 supply input connector of the EVM
3. Provide a sample clock at J10 SMA connector of the EVM
4. Provide a sine wave for the analog input at J6, J8, J11, or J13 SMA connectors of the EVM
5. Connect a USB cable from the TSW1400 to the programming computer
6. Connect a USB cable from the EVM to the computer
7. Ensure the initial jumper settings of ADS58H4x, as per [Table 3](#) (if default usage of the ADS58H4x is desired)

3.3 ADS58H4x Software Quick Start Guide

[Figure 6](#) introduced the front panel of the ADS58H4x SPI GUI. This section covers the initial use of the SPI GUI necessary for most evaluations of the ADS58H4x.

1. Press the **Reset USB Port** button if the USB connection has been disrupted since last use, or if an error message pops up warning that the USB connection is not valid.
2. Use the mouse to select the *reset* position of the reset switch. This switch is self-clearing.
3. Press **Send All** to send all the register settings.
4. From this point, select digital functions as desired such as SNRBoost, or set test pattern modes if desired. All register bits listed in the register map of the ADS58H4x data sheet have a *switch* on the front panel of the SPI GUI for easy configuration of the ADS58H4x.

Note that any greyed-out front panel switches are unavailable for use because they have a dependency upon other switch settings, as indicated in the ADS58H4x datasheet. For example, the Channel A Gain selection is unavailable because the default state of the Channel A Gain Enable switch is off. Select the Channel A Gain Enable switch, toggling the switch to the enabled state, and then the Channel A Gain selection becomes available for use.

3.4 ADS58H4x and TSW1400 Setup Guide

Reference the TSW1400 User's Guide ([SLWU079A](#)) for more detailed explanations of the TSW1400 set-up and operation. This document assumes the High Speed Data Converter Pro software and the TSW1400 hardware are installed and functioning properly. This EVM requires High Speed Data Converter Pro software version 1.5 with TSW1400 hardware of Rev D (or higher).

Single-tone FFT test (ADS58H4x 11-bit Operating Mode)

1. Start the High Speed Converter Pro GUI program. **When the program starts, select the ADC tab and then select either the ADS58H40-11b or the ADS58H40-14b device in the Select ADC menu. The selections are compatible for both ADS58H40 and ADS58H43 devices.** For this example, select the *ADS58H40-11b* device.
 - (a) For 11-bit Operating Mode or 11-bit SNRBoost Mode, select the *ADS58H40-11b* device.
 - (b) For 14-bit High Resolution Burst Mode, select the *ADS58H40-14b* device.

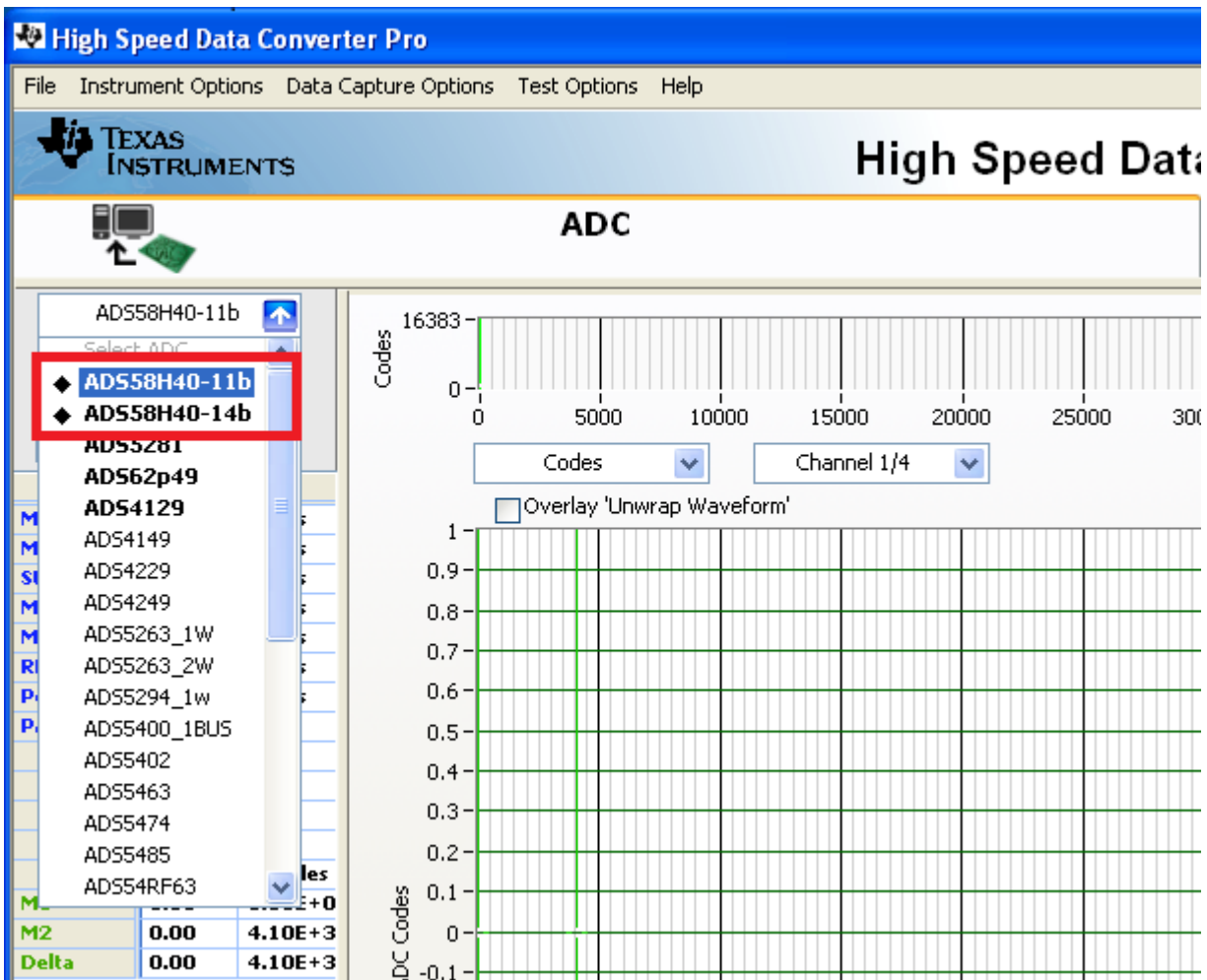


Figure 9. Select ADS58H40 in the High Speed Converter Pro GUI Program

2. When prompted *Do you want to update the Firmware for ADC?*, select **Yes**

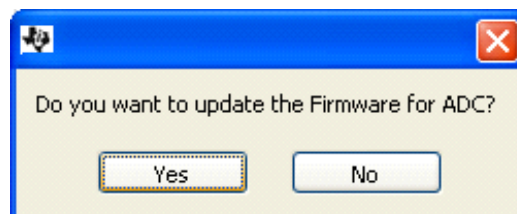


Figure 10. Load ADC Firmware Prompt

3. Select *Single Tone FFT Test* under *Test Selection*
4. Select the number of sample points (and resulting number of FFT bins). The example shown in [Figure 11](#) has 65536 samples.
5. Enter the ADS58H4x sampling rate. The example shown in [Figure 11](#) has the sample rate set at 245.76 MSPS.
6. Enter the input frequency desired. If the clock and input frequency signal generators are synchronized, then make sure the checkbox for coherent frequency is checked and set the input frequency signal generator to the input frequency displayed. The example shown in [Figure 11](#) has the input frequency set at 170 MHz.
7. Select channel A, B, C, or D depending on which channel is connected to the signal generator.

8. Press the **Capture** button on the High Speed Data Converter Pro GUI.
Observe an FFT result similar to that of [Figure 11](#).

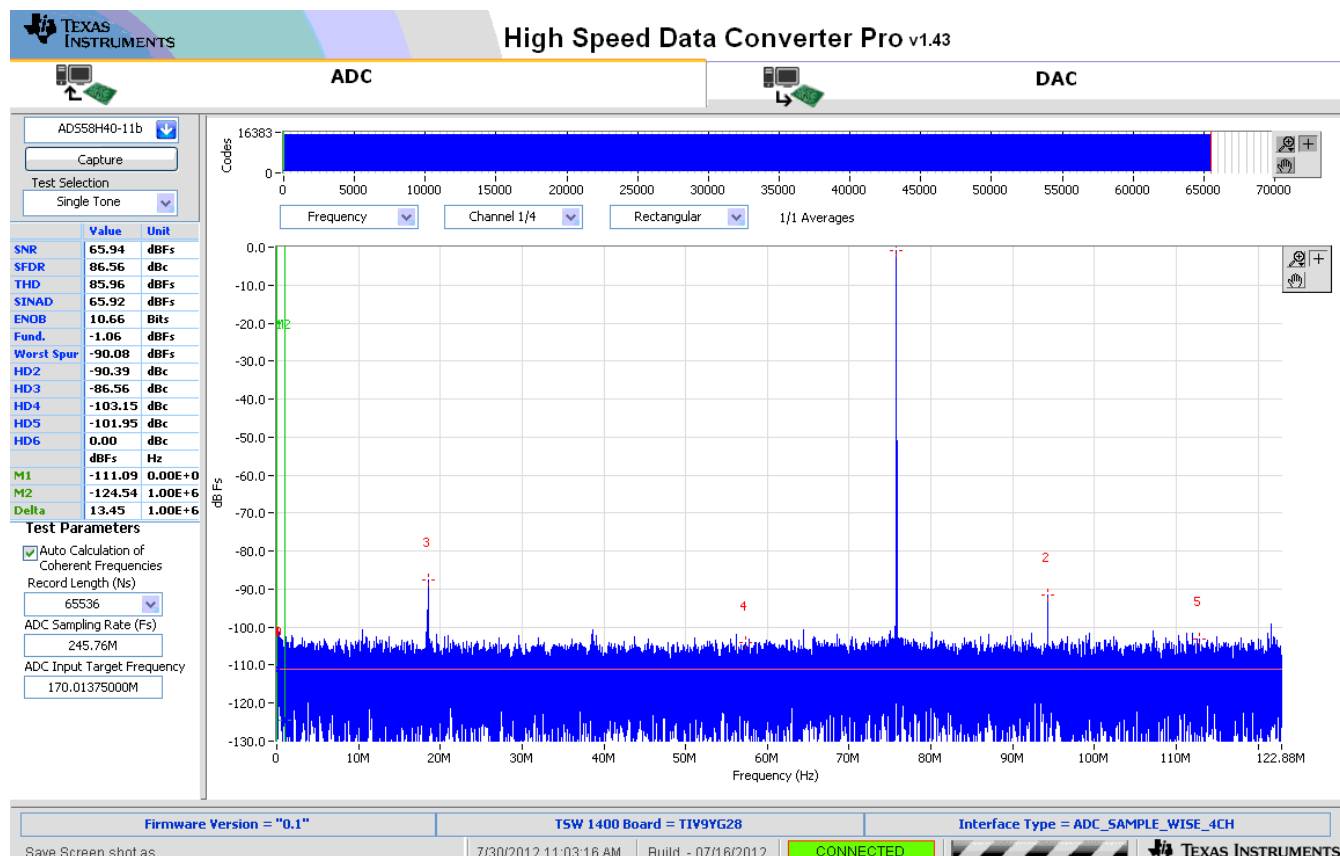


Figure 11. ADS58H4x 11-bit Operating Mode, Single Tone Test Result: $F_s = 245.76$ MSPS, $F_{in} = 170$ MHz

If the basic capture at this point is correct, then the front panel options of the SPI GUI and the front panel options of the TSW1400 GUI may be varied. The two examples below show the 11-bit SNRBoost mode and the 14-bit High Resolution Burst Mode.

Single tone FFT test (ADS58H4x 11-bit SNRBoost Mode)

1. Select the ADS58H40-11b device.
2. After selecting Single Tone FFT Test under *Test Selection*, enter the sample rate, input frequency, and the number of samples.
3. Select channel A, B, C, or D depending on which channel is connected to the signal generator.
4. To enable the SNRBoost Mode, set the JP9 connector to 1-2 position or enable *SNRBoost Pin Override* in the ADS58H40 GUI. Also, in the ADS58H40 EVM GUI, disable High Resolution Burst Mode of the channels under evaluation since High Resolution Burst Mode takes precedence over SNRBoost Mode.
5. Press the **Capture** button on the High Speed Data Converter Pro GUI.
6. Observe an FFT result similar to that of [Figure 12](#).
7. Select *Bandwidth Integration Markers* option under *Test Options* to set the proper integration calculation for SNR. Set the bandwidth integration markers, BM0 and BM1, by either dragging the markers on the FFT screen or by entering the frequency location at the lower left-hand side of the High Speed Data Converter GUI.

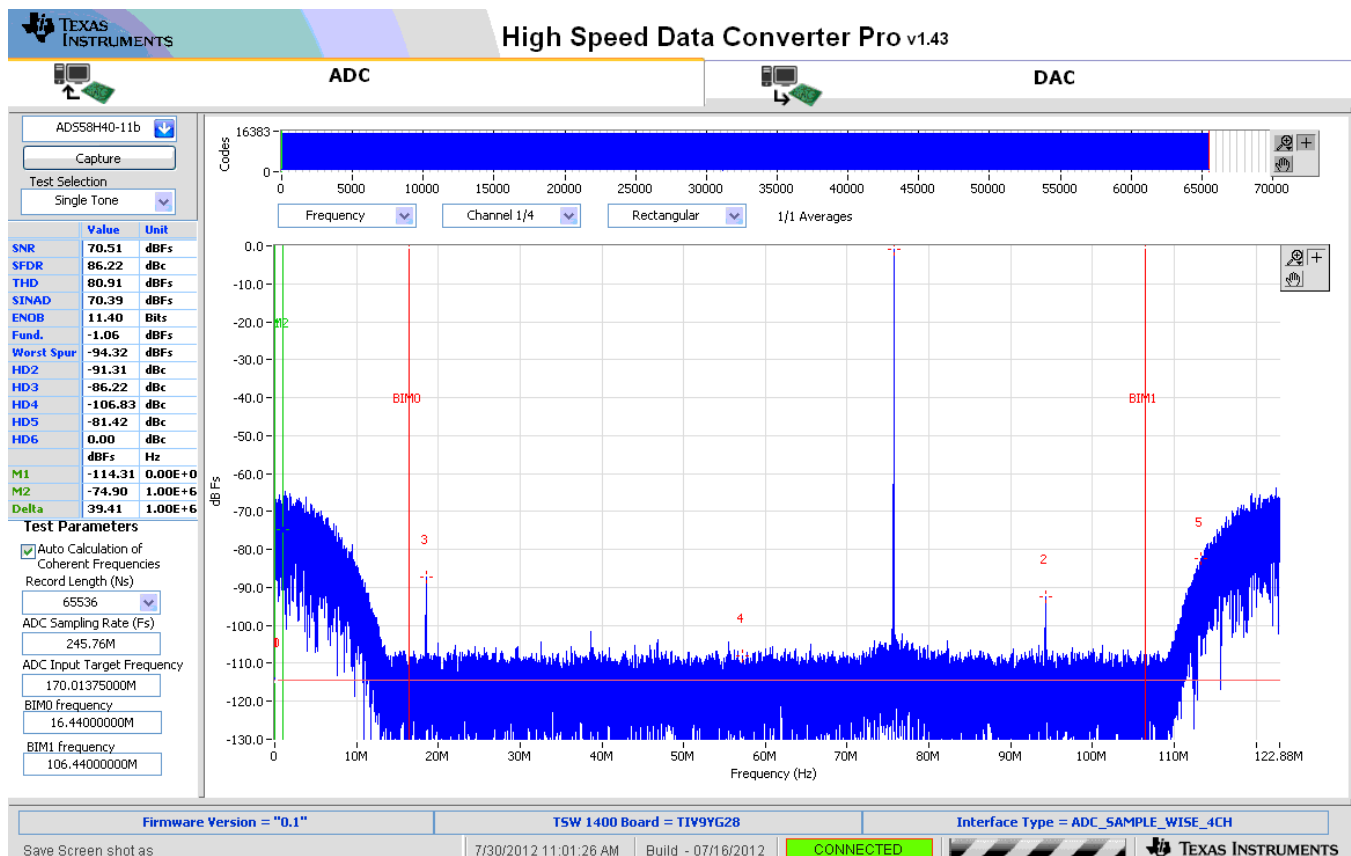


Figure 12. ADS58H4x 11-bit SNRBoost Mode, Single Tone Test Result: $F_s = 245.76$ MSPS, $F_{in} = 170$ MHz

Single tone FFT test (ADS58H4x 14-bit High Resolution Burst Mode)

1. Select the ADS58H40-14b device.
2. After selecting Single Tone FFT Test under *Test Selection*, enter the sample rate, input frequency, and the number of samples.
3. Select channel A, B, C, or D depending on which channel is connected to the signal generator.
4. On the High Speed Data Converter Pro menu, select *Data Capture Options* → *Trigger Option*. Check both *Trigger Mode Enable* and *Software Trigger Enable*.

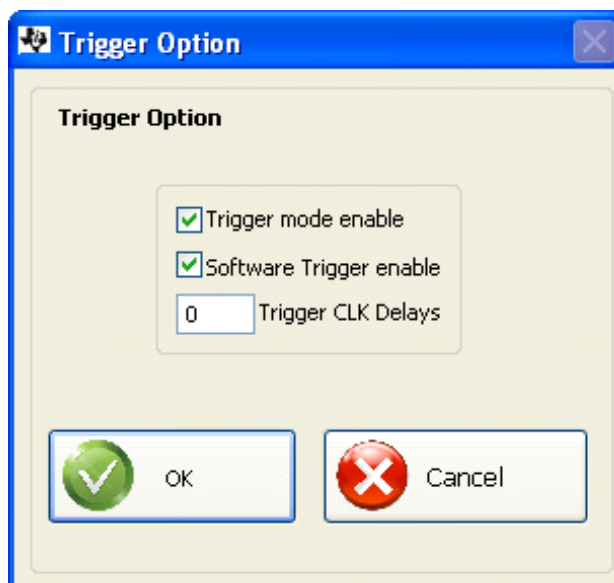


Figure 13. TSW1400 Trigger Option

5. In the EVM GUI, enable High Resolution Burst Mode of the channels under evaluation. Set the desired high- and low-resolution samples. The example shown in [Figure 14](#) has both high samples and low samples set to maximum. This ensures that the entire FFT is analyzed with 14-bit capture for accurate SNR and SFDR calculations.
6. ADS58H4x Trigger Options
 - If the ADS58H4x has auto-trigger enabled, set the J12 jumper to the 2-3 position. Start the auto-trigger process by pressing the SW2 pushbutton.
 - TSW1400 Trigger Generation (External Trigger)
 - On the EVM, remove the jumper at J12, ensuring the ADS58H4x TRIG_EN (pin G3) is floating.
 - Using an SMA to grabber cable, connect SYNC1 SMA connector at J14 of the TSW1400 to jumper J2, pin 2 header of the EVM.
 - Using an SMA to SMA cable, connect SYNC3 SMA connector at J16 to EXT_TRIG_INPUT SMA connector at J11 of the TSW1400.
7. Press the **Capture** button on the High Speed Data Converter Pro GUI.
8. Observe an FFT result similar to that of [Figure 14](#).

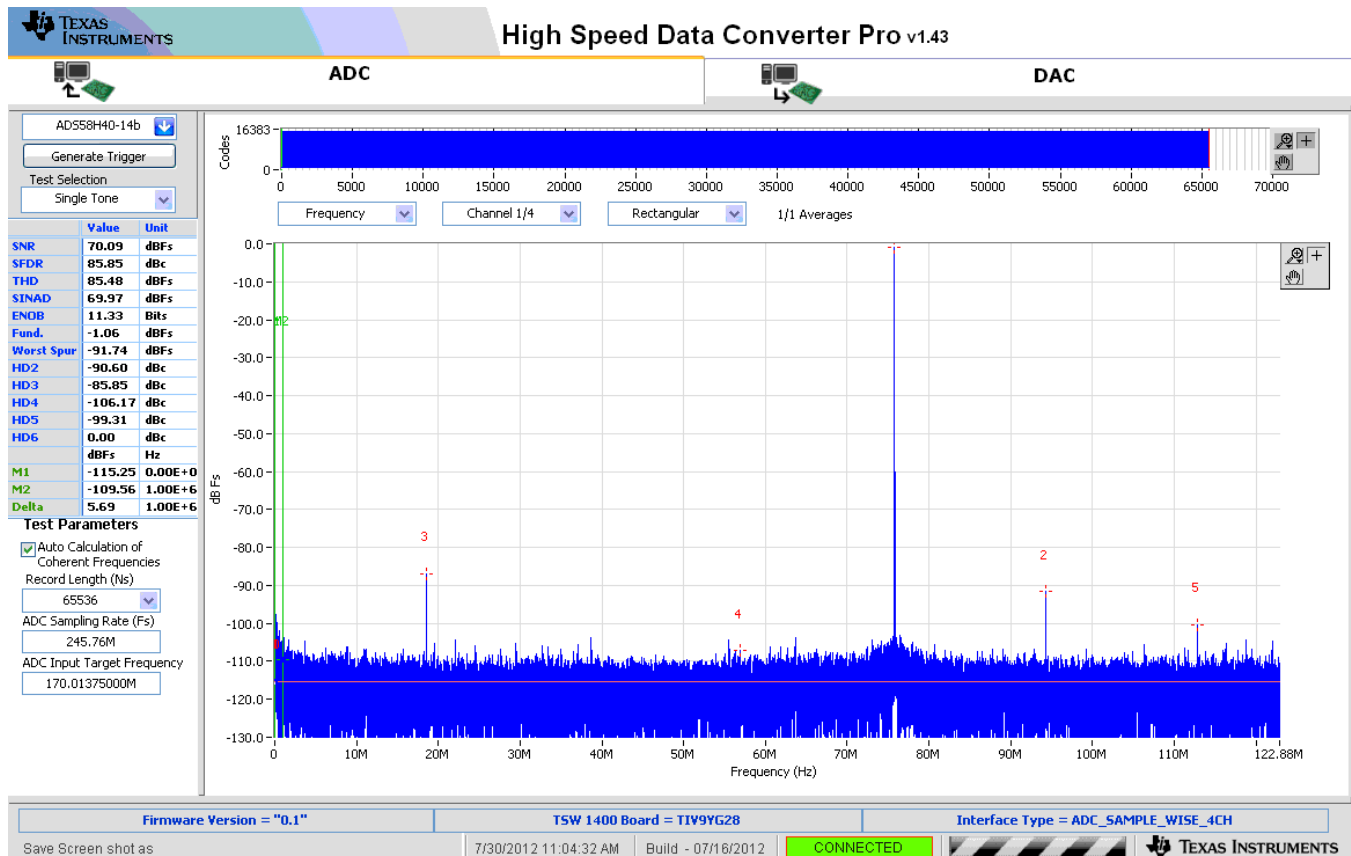


Figure 14. ADS58H4x 14-bit High-Resolution Mode, Single Tone Test Result:
Fs = 245.76 MSPS, Fin = 170 MHz

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Caution

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs including detachable antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

Concernant les EVMs avec appareils radio

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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EVALUATION BOARD/KIT/MODULE (EVM) WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

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