

## **AFE5805EVM**

The AFE5805EVM is an evaluation tool designed for the ultrasound analog front-end (AFE) device AFE5805. In order to deserialize the outputs of the AFE5805, an ADSDeSer-50EVM or TSW1400EVM is needed during the evaluation.

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## 1 Introduction

The AFE5805 includes an 8-channel, voltage-controlled amplifier (VCA) and an 8-channel, 50-MSPS analog-to-digital converter (ADC). The outputs of the ADC are 8-channel LVDS outputs, which can be deserialized by the ADSDDeSer-50EVM or TSW1400EVM. The AFE5805 evaluation module (EVM) provides an easy way to examine the performance and functionalities of AFE5805.

### 1.1 AFE5805EVM Kit Contents

The AFE5805EVM kit contains the following:

- AFE5805 EVM board
- USB cable

### 1.2 Features

- Characterizes the AFE5805
- Supports CW functionalities test
- Provides 8-channel low-voltage differential signal (LVDS) outputs from the ADC
- Compatible with the standard TI LVDS deserializer ADSDDeSer-50EVM or TSW1400EVM
- Communicates with a personal computer (PC) through a USB interface
- RS-232 interface also can be configured in case users wish to control the AFE5805 with a microcontroller. MSP430 programming is required.

- Includes multiple power management solutions for the AFE5805 and other devices.
- Onboard Vcntl generator (0 V - 1.2 V).

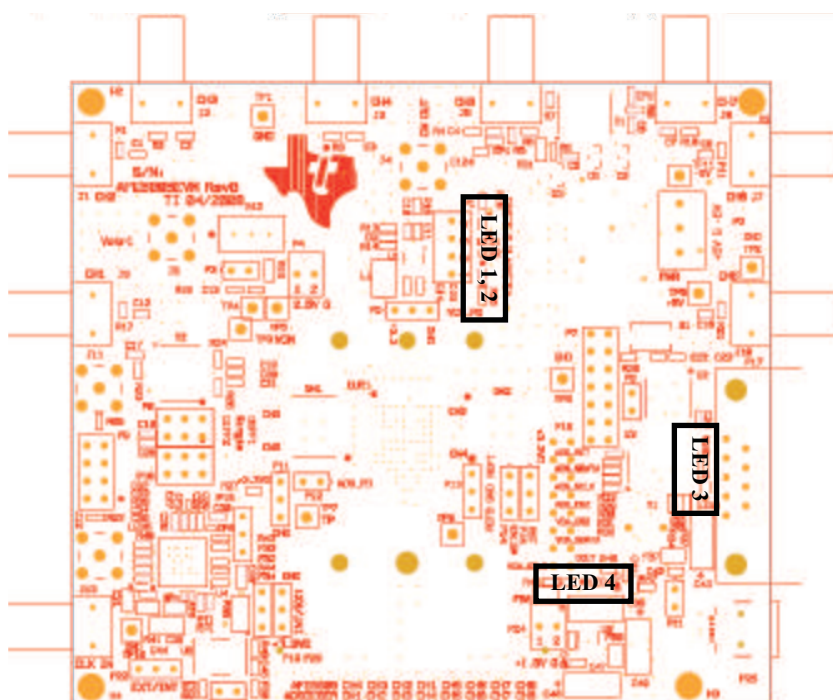
### 1.3 Power Supplies

The AFE5805EVM requires only  $\pm 5$ -V power supplies for operation.

### 1.4 Indicators

The AFE5805EVM has four LEDs onboard as shown in [Figure 1](#). The states of these LEDs demonstrate the normal operation of the AFE5805EVM.

- LED1, LED2: +3.3-VA and +3.3-VD power supply indicators. They show the normal operation of 3.3-V power regulators.
- LED 3: MCU operation indicator. Flashing state can indicate the normal operation of the MSP430 when the MSP430 is appropriately programmed.
- LED 4: 1.8-V power indicators



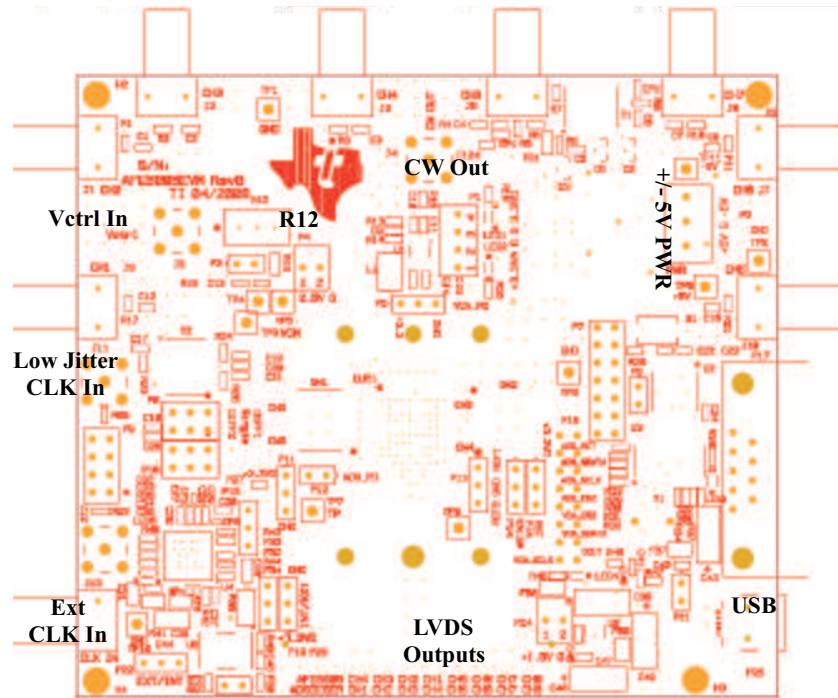
**Figure 1. AFE5805EVM LED Locations**

## 2 Board Configuration

This section describes in detail the locations and functionalities of inputs, outputs, jumpers, and test points of the AFE5805EVM.

### 2.1 I/O and Power Connectors

Pin A1 of the AFE5805 is marked by a white dot on its package as well as a white dot on the board. The positions and functions of the AFE5805EVM connectors are discussed in this section.

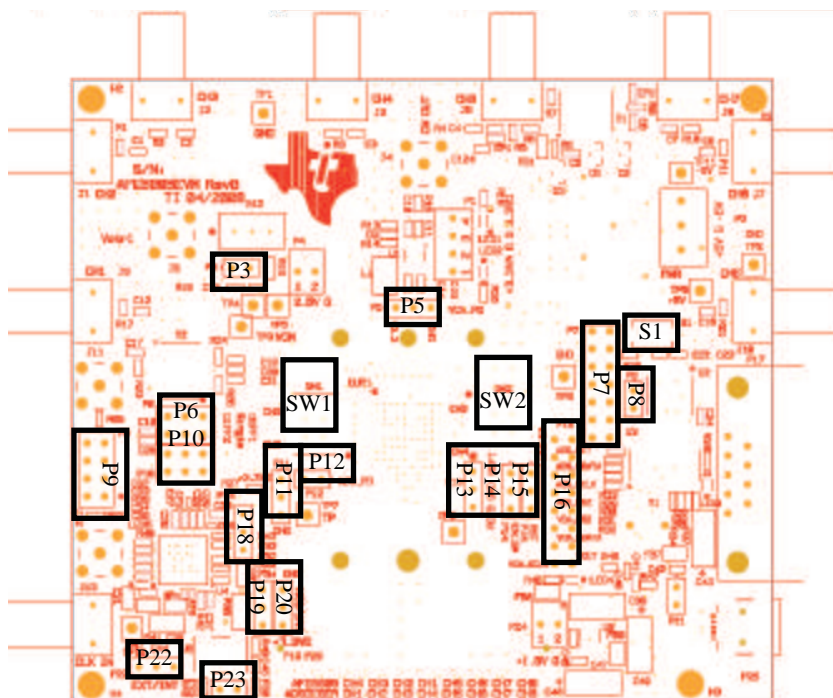


**Figure 2. AFE5805EVM I/O Connectors and Locations**

- Analog Inputs Ch1-Ch8 (J1-J3, J5-J7, J9, J10): Single-ended analog signal inputs with 50-Ω termination and AC-coupling
- CW Output (J4): CW output after I/V translator
- Vctrl Input (J8 optional): VCA gain control voltage of AFE5805, 0 V to 1.2 V, when this SMA connector is used, shunt P3 must be removed. .
- Low-Jitter CLK Source Input (J11): This input accepts clocks with low-jitter noise, such as HP8644 output. 20- to 50-MHz, 50% duty-cycle clock with 1- to 2-Vrms amplitude can be used. When J11 is used, ensure that shunts P18, P23, and P22 are removed.
- External CLK Input (J13): ADC Clock input, such as FPGA outputs. However, the AFE5805 does not achieve satisfactory performances due to the high-jitter noise of the clock.
- ±5-V PWR connector (P2): Power supply input
- Regulated power supply outputs (P1, P4, and P24): 3.3-VA, 3.3-VD, 2.5-VA, 1.8-VD outputs. Connectors need to be installed.
- RS-232 Input (P17): PC serial port interface for setting AFE5805
- USB input (P25): USB interface to control the AFE5805 (default)
- LVDS Outputs Ch1-Ch8 (P26): Differential LVDS data outputs
- R12 is used to adjust the onboard Vctrl from 0 V to 1.2 V. P3 must be shorted when onboard Vctrl is used.

## 2.2 Jumpers and Setup

In the following detailed description, the board has been set to default mode (see [Figure 3](#)).



**Figure 3. Locations of Jumpers, JTAG, and Switches on the AFE5805EVM**



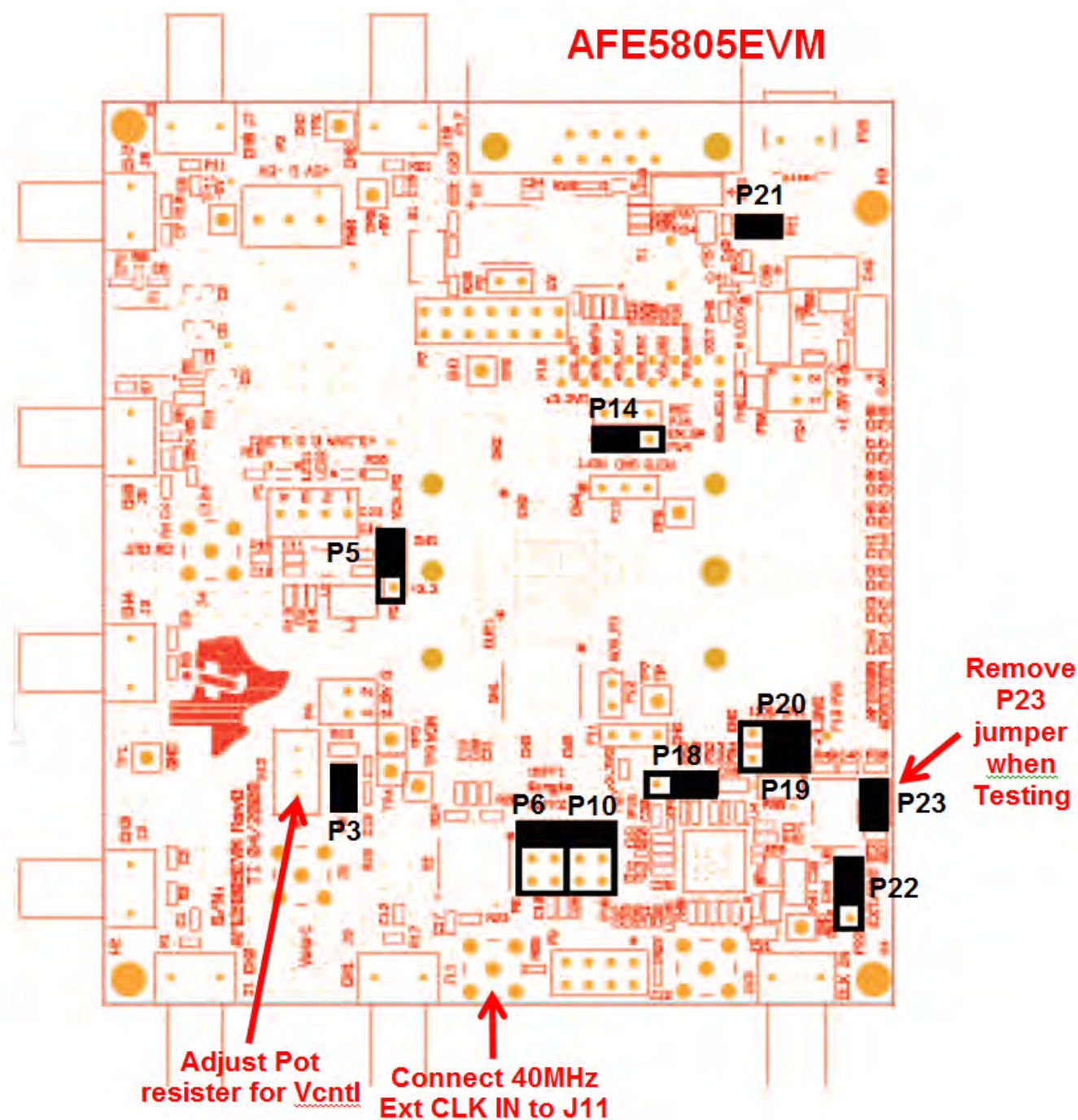


Figure 4. Default Setup for Jumpers

- P5: Power-down pin for the VCA section of the AFE5805. Grounded (default mode) or High (+3.3 VD) for power-down mode.
- P6, P10: AFE5805 ADC clock input selection: Transformer-based differential clock, single-ended LVCMOS clock, or future clock option (needs U4 for support). The default mode uses the transformer-based differential clock.
- P7: MSP430 microcontroller JTAG interface
- P8: MAX3221 (RS-232) power-off jumper. When the jumper is removed, MAX3221 is completely powered off. In the default mode, the jumper is uninstalled because the USB interface is used.
- P9: SPI™ interface for U4.
- P11: TI internal use. Default is floating.
- P12: Power-down pin for ADS. Active High (+3.3 VD). Floating for default mode.
- P13: External ADS reference voltage inputs. Floating in the internal reference mode.
- P14: EN\_SM: In the default mode, P14 connects to +3.3 VD, and the state machine is enabled. The AFE5805 is operated using only one SPI port (ADS SPI port).
- P15: RST pin; connects to H4 in the default mode through 0-Ω resistors.
- P16: Debug port for monitoring VCA and ADS SPI signals.
- P19: TI internal use. Connects to 3.3 VD.
- P20: INT/EXT reference mode selection. +3.3 VD for the internal reference mode (default); GND for the external reference mode.
- P22: Uses onboard 40-MHz clock or external clock through J13. The default mode uses the onboard clock
- P23: Power-on onboard 40-MHz clock generator. Default is on.
- P18: Because U4 is uninstalled, this jumper must be set as [Figure 4](#) shows
- S1: MSP430 reset button
- SW1, SW2: CW outputs summation switch. Individual CW output current can be summed through the I/V translator U1 when its corresponding switch is set to ON.

## 2.3 Test Points

Multiple test points are provided on the EVM. Detail descriptions follow. Under normal operation mode, it is unnecessary to measure voltages at most of these test points.

- TP1: GND
- TP2: GND
- TP3: VCM
- TP4: Vcntl test point
- TP5: GND
- TP6: GND
- TP7: Test point, TI internal only
- TP8: +5 V
- TP9: CM
- TP10: GND
- TP11: -5 V

### 3 Board Operation

This section describes how to operate the AFE5805EVM for evaluation purposes. Both software and hardware installation and operation are discussed.

#### 3.1 Software Installation and Operation

The AFE5805EVM USB SPI Ver1 software and AFE5805EVM driver can be downloaded from the TI website on the AFE5805 [product folder](#) under *Tools & software*. Run the AFE5805EVM driver install.exe and the setup.exe to install the driver and software, respectively. The personal computer (PC) should recognize the EVM after software installation.

To launch the software after successful installation, click:

Start Menu → All Programs → Texas Instruments → AFE5805EVM USB SPI → AFE5805EVM USB SPI

Three different modes are shown in [Figure 5](#), [Figure 6](#), and [Figure 7](#).

The software updates the AFE5805 registers as soon as users change any current setup (i.e., the program sends out new register values due to any value change). It is recommended that users change at least one register value before measurement. Therefore, the register values in a device can be synchronized to the displayed values on the software interface.

In most cases, users only need to change the VCA setup. The ADC setup can remain the same as the IC is powered up.

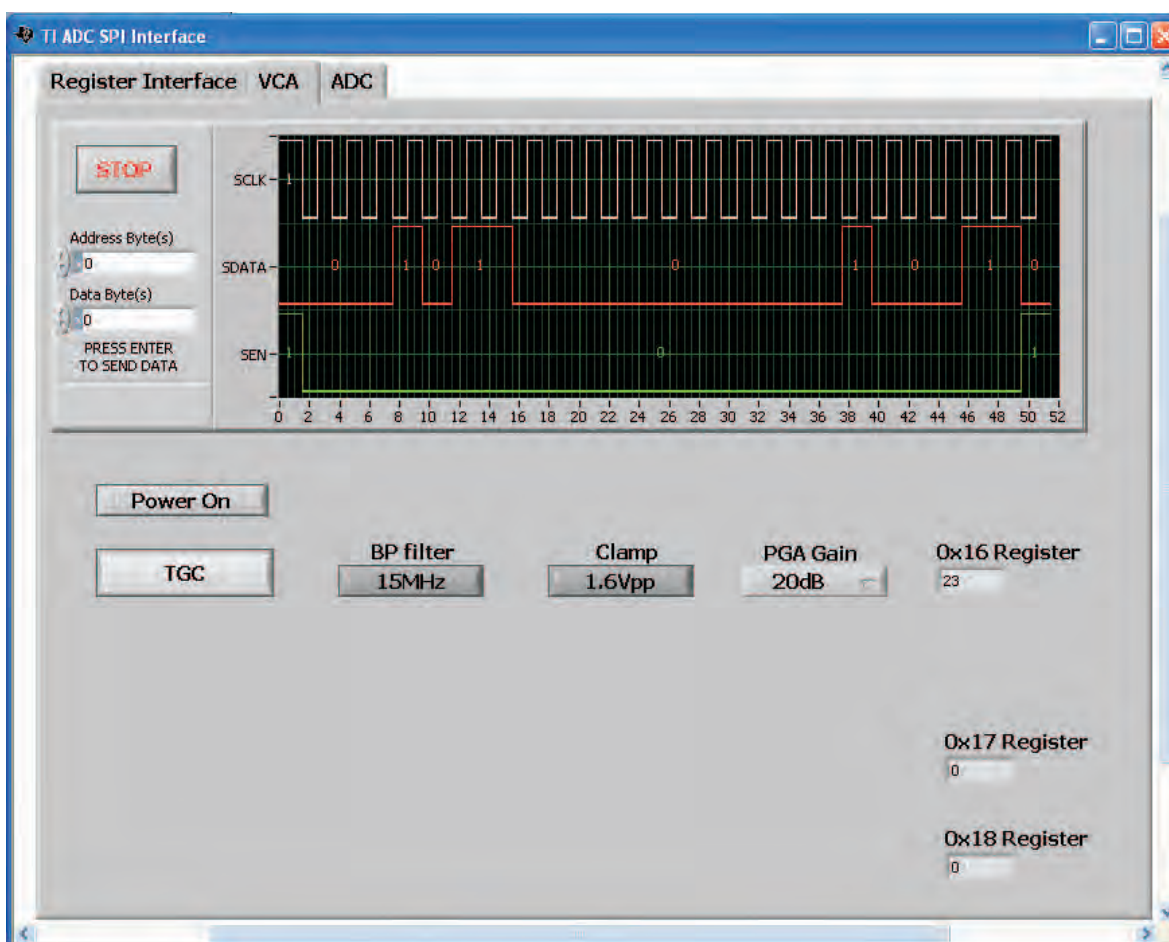


Figure 5. AFE5805EVM USB SPI Interface for TGC Mode



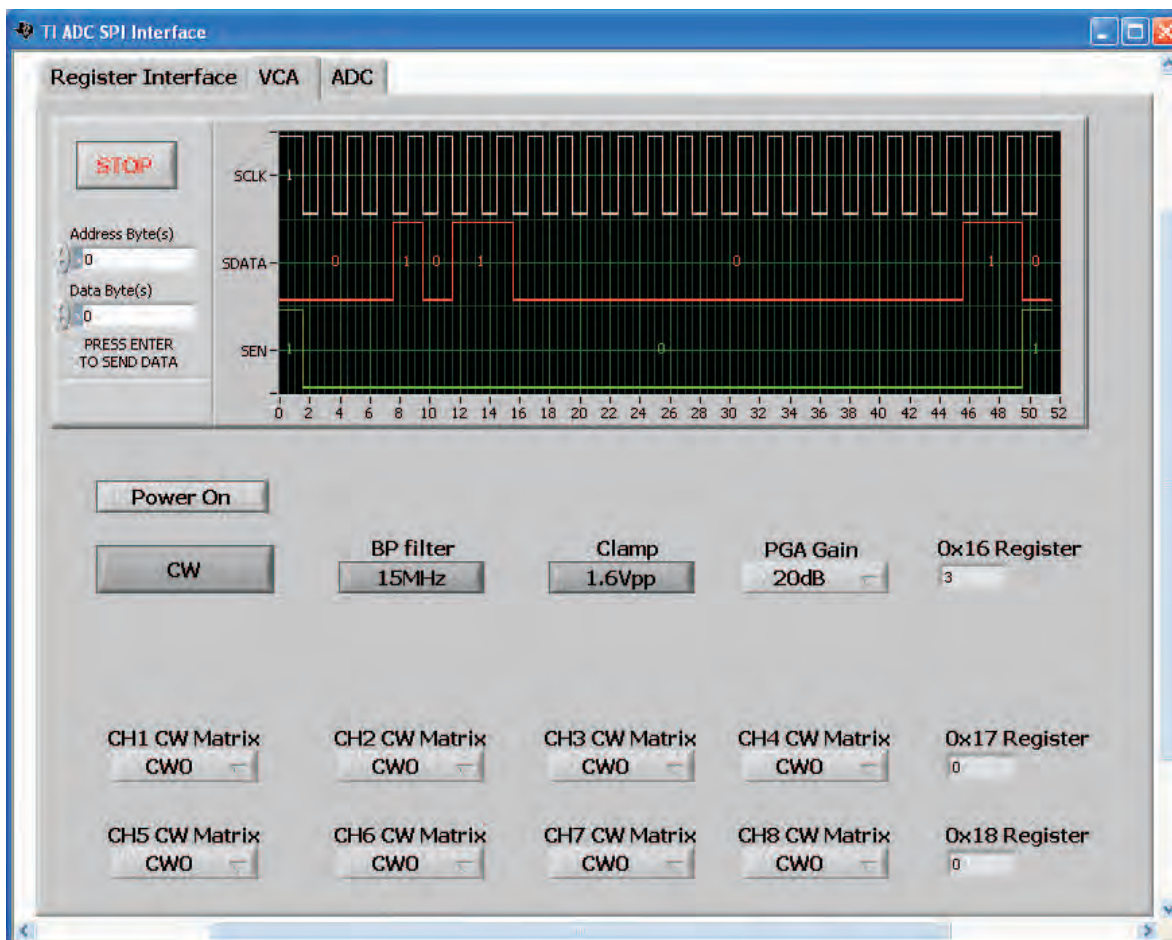


Figure 6. AFE5805EVM USB SPI Interface for CW Mode

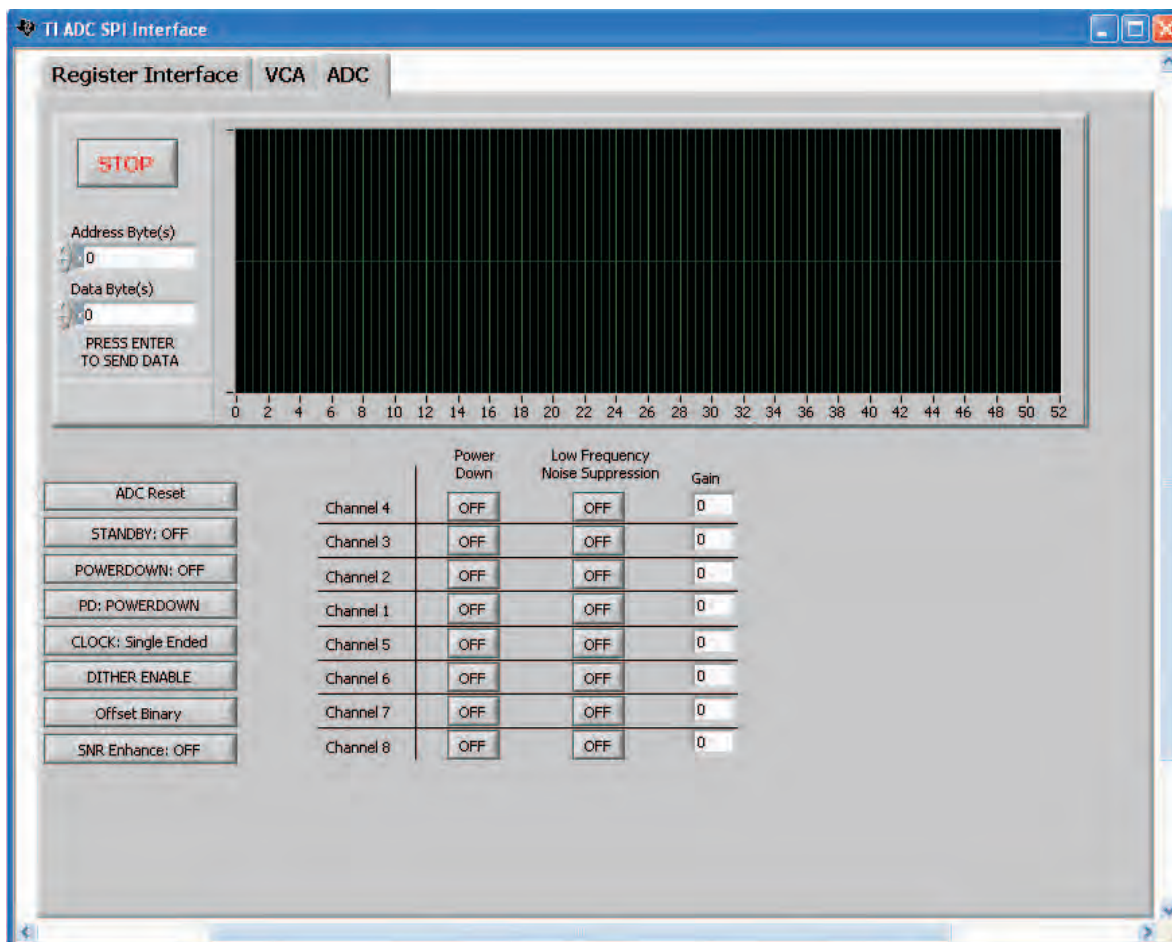


Figure 7. AFE5805EVM USB SPI Interface for ADC Setup

### 3.2 Hardware Setup

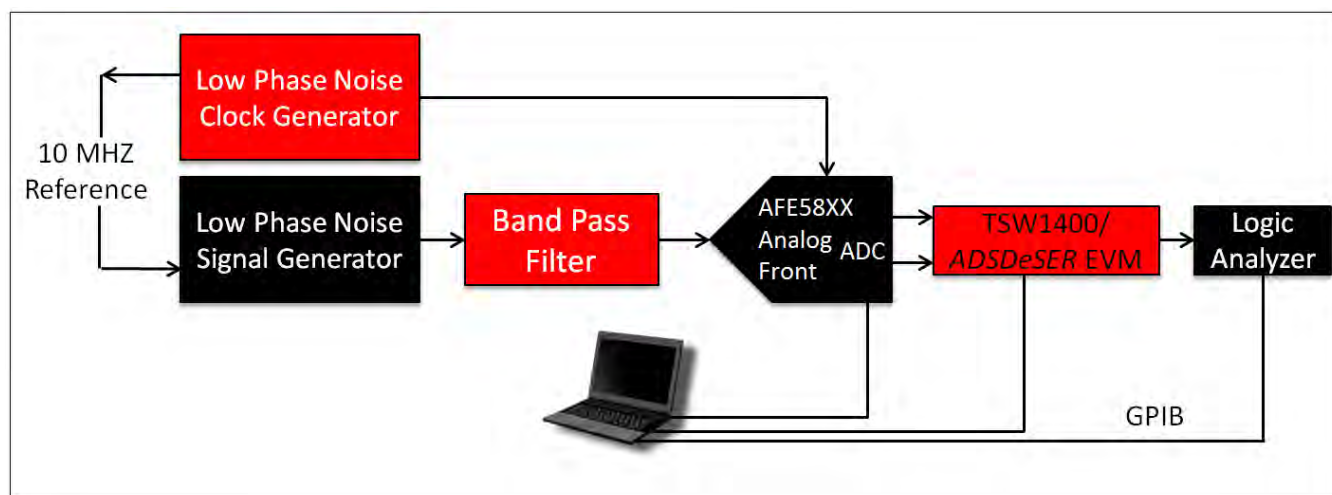
When the AFE5805EVM is powered on in the default mode, the AFE5805 is set as described in [Table 1](#).

Table 1. AFE5805EVM Default Settings When Powered On

VCA	ADS
TGC mode	Differential clock
PGA = 20 dB	Digital Gain = 0
Clamp=Enable	Other parameters are as stated in data sheet
Filter = 15 MHz	

Initial measurements can be made under these default settings. See the AFE5805 data sheet ([SBOS5805](#)) for additional settings.

As previously mentioned, the deserializer ADSDeSER-50EVM or TSW1400EVM is required. See details in the ADSDeSER-50EVM user's guide ([SBAU091](#)) or TSW1400EVM user's guide ([SLWU087B](#)). An example bench setup is shown in [Figure 8](#). Band-pass filters are required for signal source in order to ensure the correct SNR measurements of the AFE5805.



#### AFE58XX Evaluation Setup Best Practice

- (1) Select the lowest phase noise models
- (2) An additional Bandpass filter after the signal source is needed. This serves to filter the harmonic distortion of the signal generator and band-limit the noise. Without using filter; the SNR and SFDR will be that of the signal generator, not that of AFE58XX.
- (3) For a coherent AFE58XX evaluation, connect the 10M reference on the back of the clock and to the 10M reference input on the back of the analog input source. For some equipment, one must also use the on-screen menus to select "ext Reference"
- (4) The Logic Analyzer is used when a large amount of data (> 64K samples) is needed.
- (5) If ADSDeSER EVM is chosen then the Logic Analyzer is a must, ADSDeSER EVM does not provide the function to transfer the data back to PC directly.

**Figure 8. Typical AFE5805 Bench Setup**

The channel order of the AFE5805 outputs is not the same as that of the ADS527x outputs. Consequently, the channel number on the ADSDeSER-50EVM or AFE5805EVM can be misleading. [Table 2](#) provides channel-to-channel sequence matching between the ADSDeSER-50EVM and the AFE5805EVM.

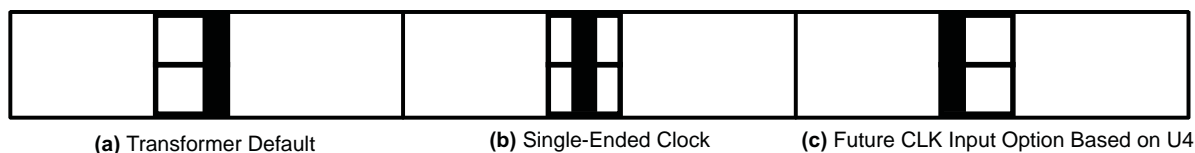
**Table 2. Channel-to-Channel Matching Between the AFE5805EVM and ADSDeSER-50EVM**

AFE5805	FCLK	CH4	CH3	CH2	CH1	CH5	CH6	CH7	CH8	LCLK
ADSDeSER	FCLK	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8	LCLK

For example, when an analog signal is present on CH1 of the AFE5805EVM, the corresponding 12-bit digital output can be seen on CH4 of the ADSDeSER-50EVM.

### 3.3 Clock Selection

The AFE5805 can be clocked through a transformer-based differential clock, single-ended clock, or future clock input options provided by U4 as [Figure 9](#) shows.



**Figure 9. Clock Selection Jumper Configurations**

The clock source of the EVM can be the onboard 40-MHz clock, HP8644 low-jitter clock source, or external clock source. The best performance of this EVM is achieved when the low-jitter clock source HP8644 is used. P22, P23, and P18 should be removed in order to disable the onboard clock.

When HP8644 or similar clock sources are unavailable, the onboard 40-MHz clock is the desirable source. The jumpers P22, P23, and P18 should be configured as shown in [Figure 4](#) (i.e., the default setup for AFE5805EVM). In this mode, the transformer-based differential clock is used.

### 3.4 Data Analysis

Based on the data file acquired by a logic analyzer, the performance of AFE5805 can be evaluated.

Appendix A provides a solution (TI TSW1400EVM) to analyze the data file using the PC. Appendix B provides a step by step process on how to download the HSDCPro software. Coherent sampling is recommended, but is not mandatory. Due to the frequency accuracy requirement of coherence sampling, two HP8644s are required for generating an ADC clock and analog signal. For most users, this may be infeasible. Data analysis based on windowing is a more suitable approach.

## 4 Schematics and Layout

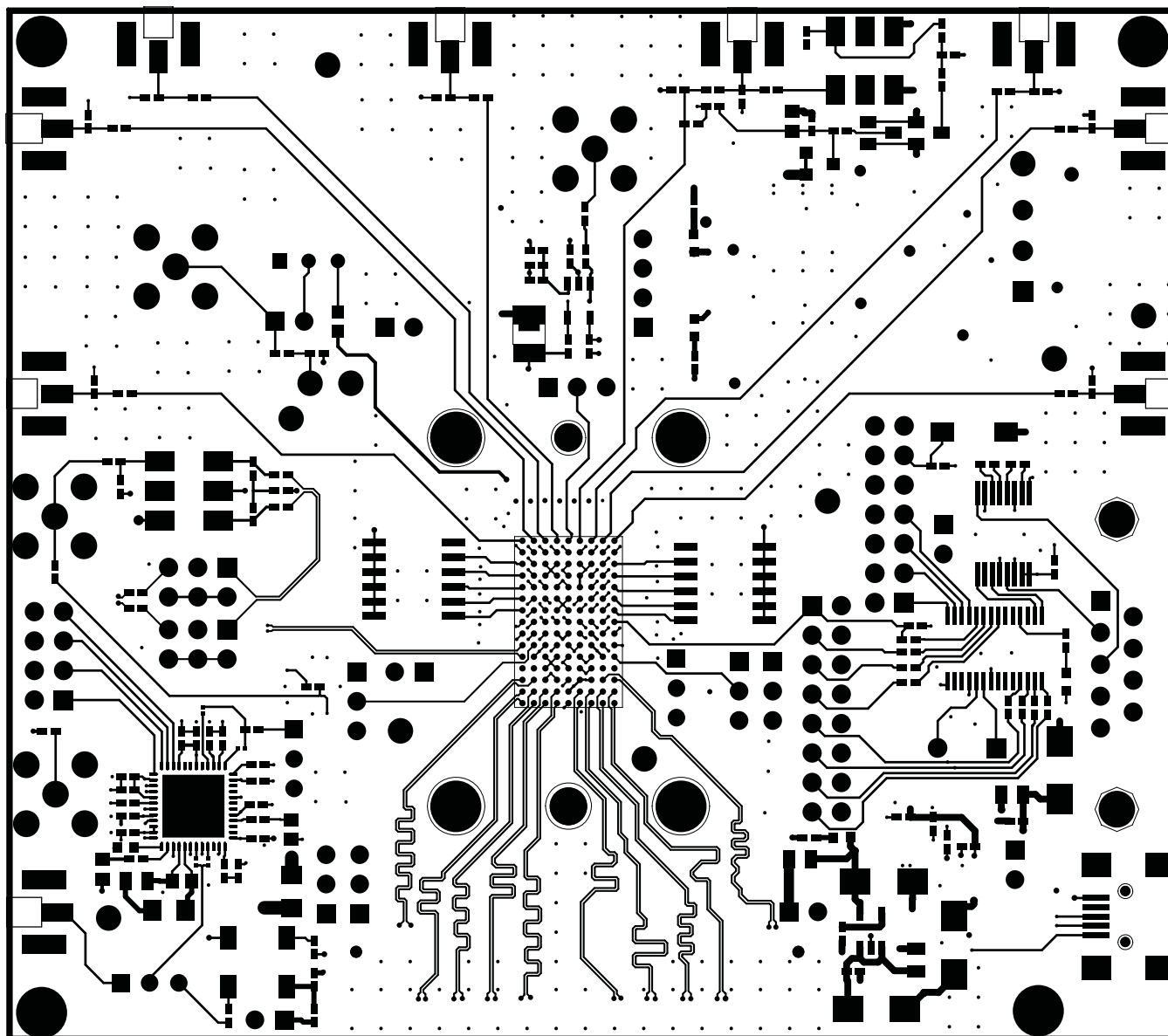
This section provides the schematics, the AFE5805EVM board layout, and the bill of materials.

### 4.1 Schematics

The schematics appear at the end of the document.

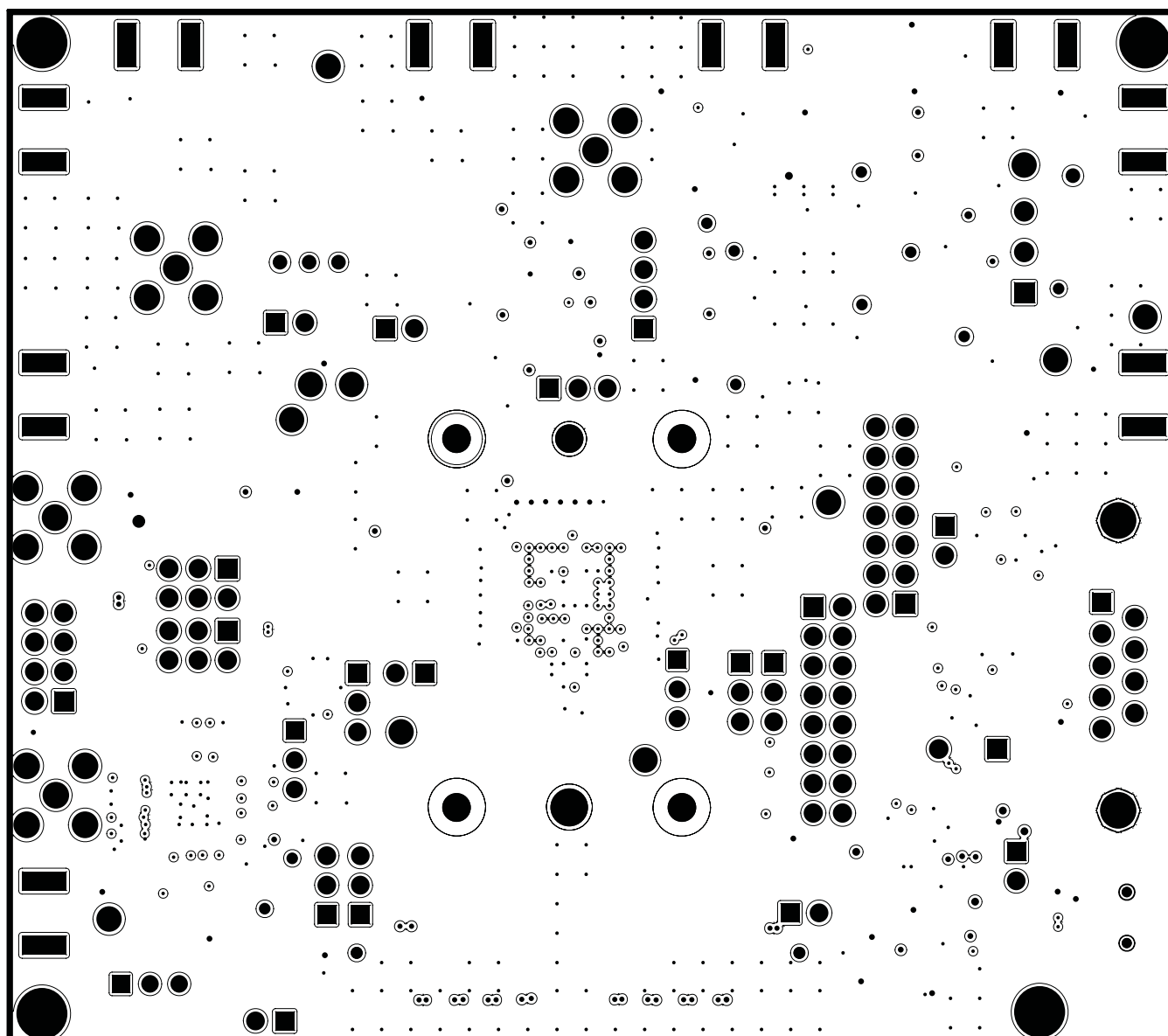
### 4.2 PCB Layout

The AFE5805EVM uses a six-layer printed-circuit board. The following figures show each layer.

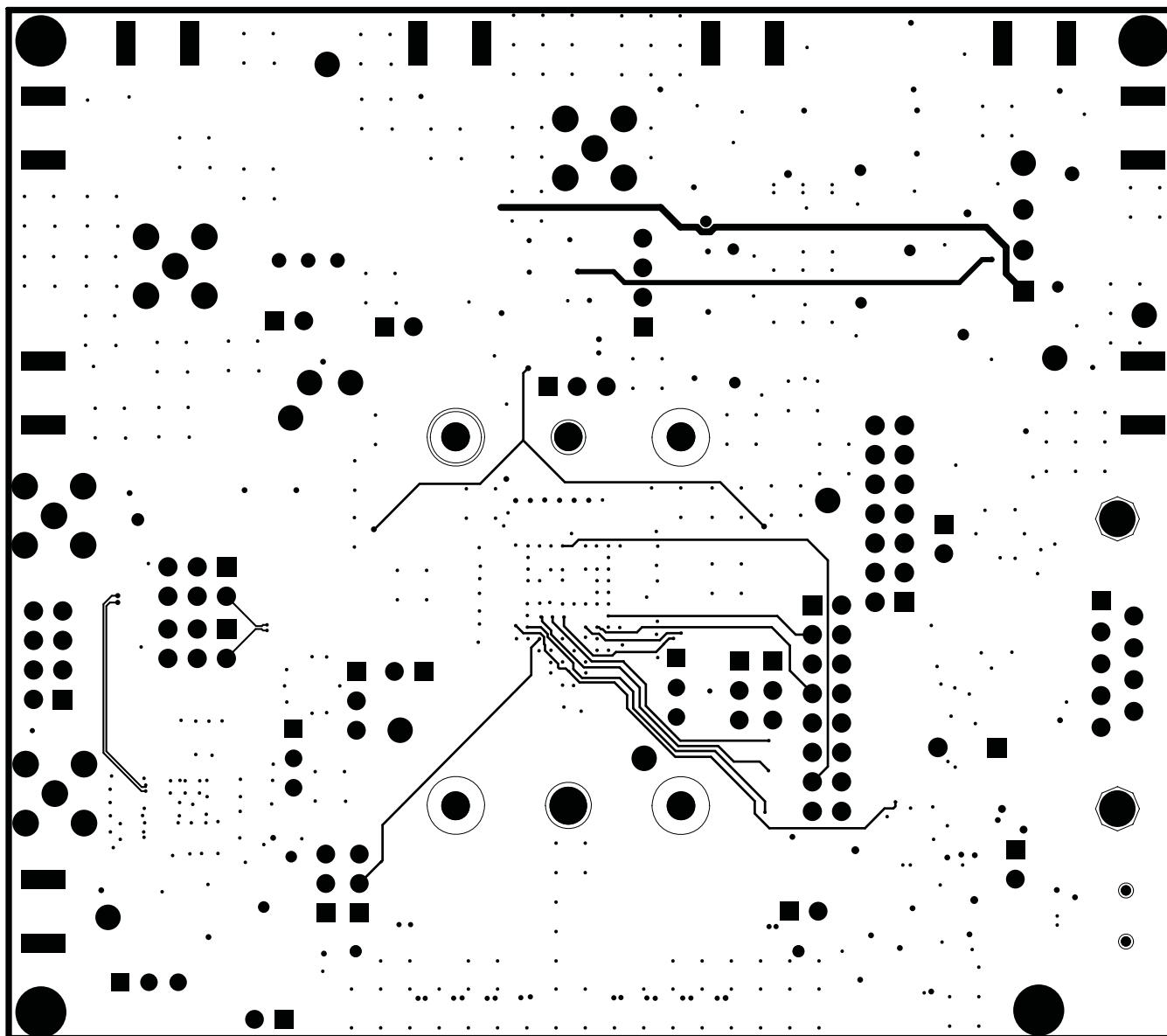


**Figure 10. Top Layer, Signal**

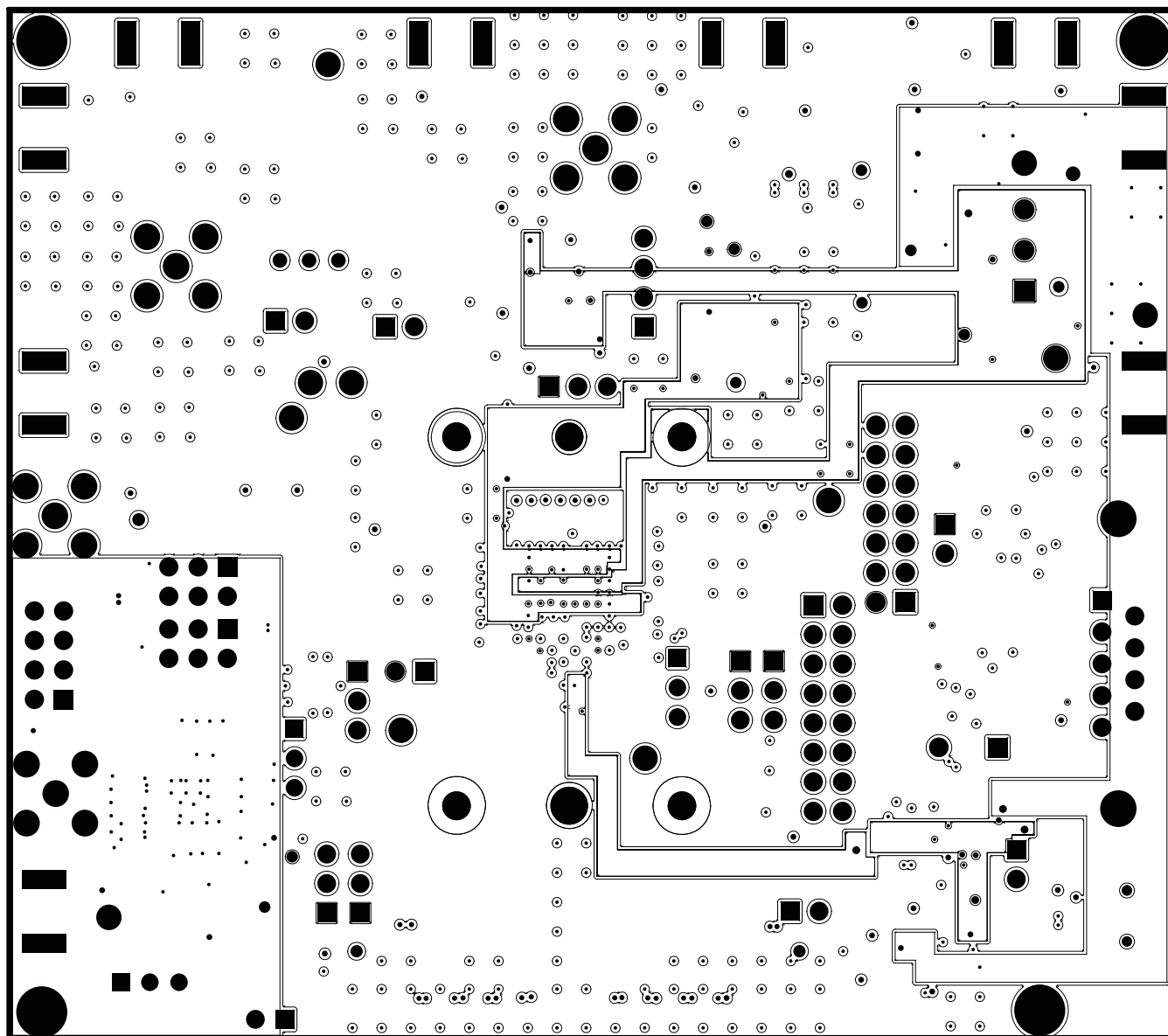




**Figure 11. Inner Layer 1, Ground**



**Figure 12. Inner Layer 2, Signal**



**Figure 13. Inner Layer 3, Power**

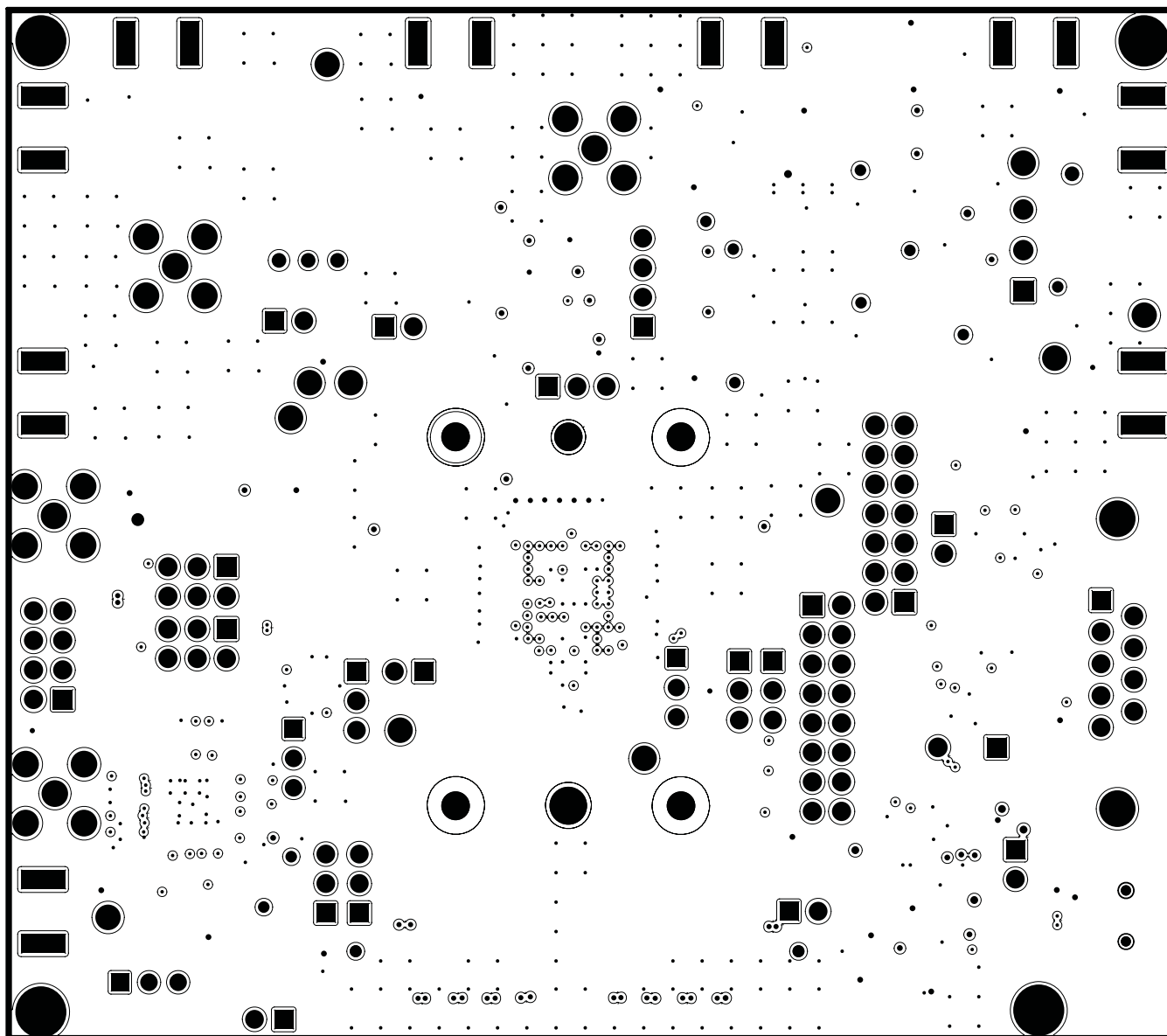


Figure 14. Inner Layer 4, Ground

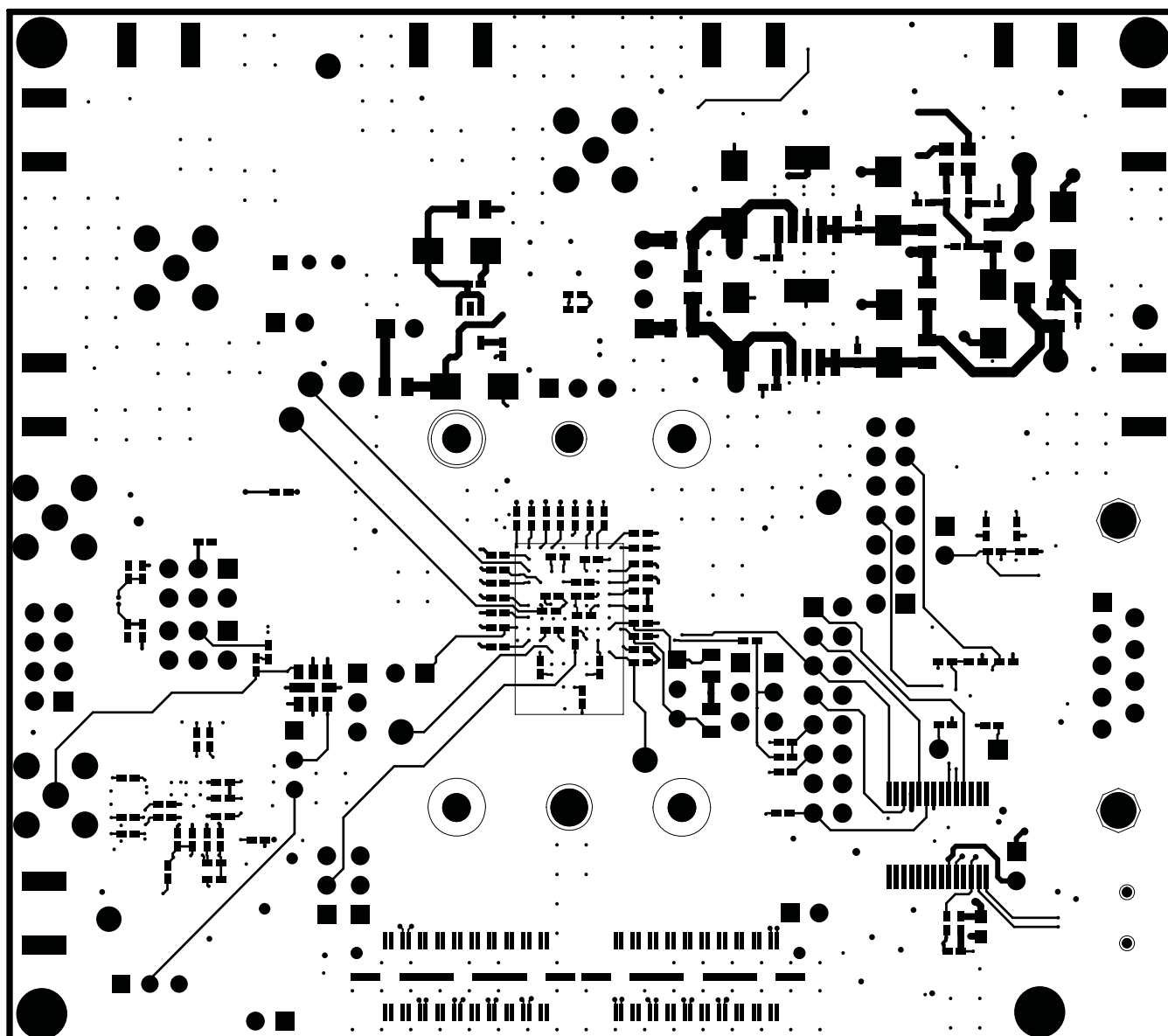


Figure 15. Bottom Layer, Signal



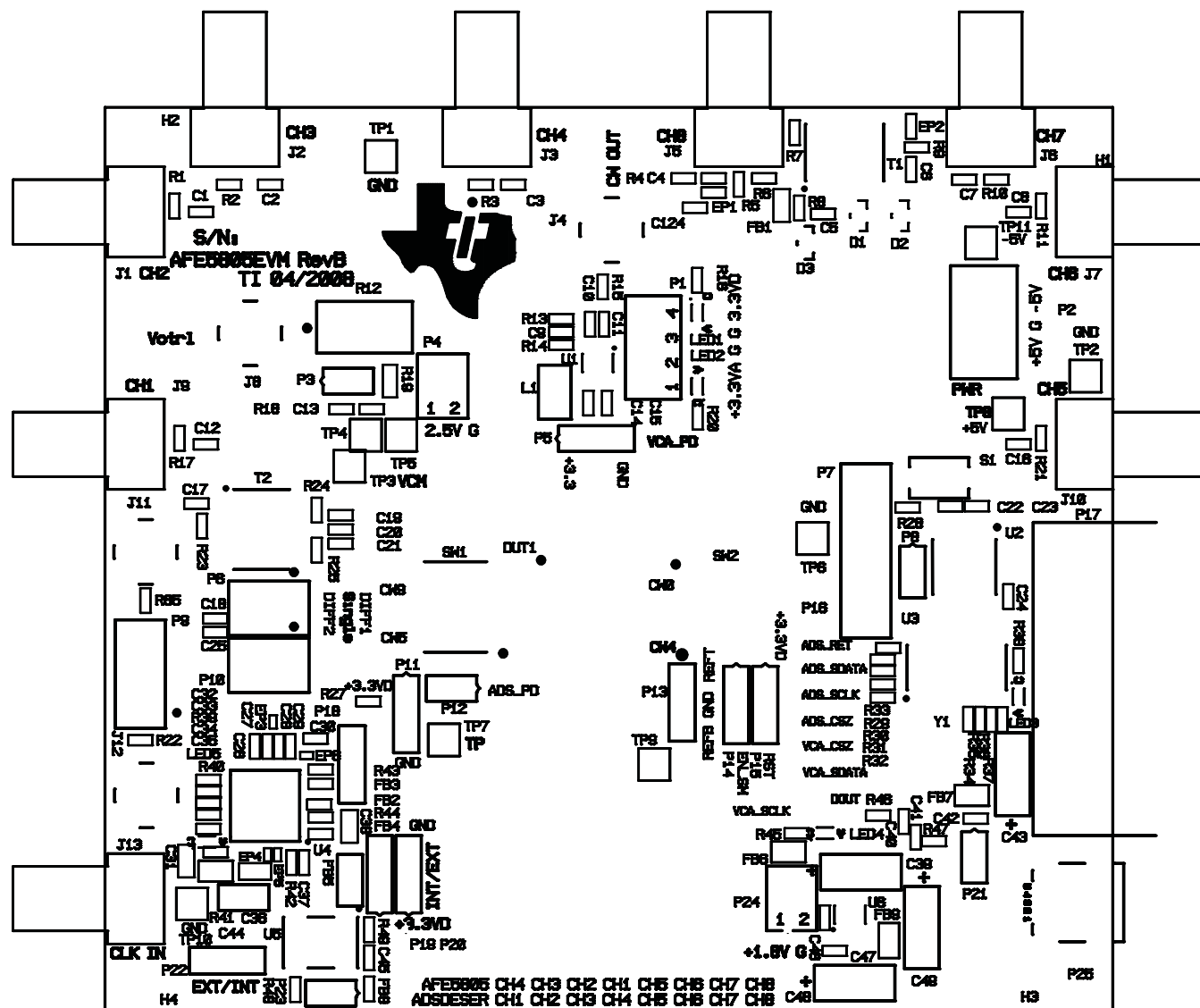


Figure 16. Top Silk Screen Layer



## 4.3 Bill of Materials

**Table 3. Bill of Materials**

Item	MFG	MFG Part Number	RefDes	Value or Function
1	TI	MSP430F1232IPW	U3	MIXED SIGNAL MICROCONTROLLER
2	KEMET	C0402C103K3RAC	C9	CAPACITOR,SMT,0402,CER,0.01µF,25V,10%,X7R
3	KEMET	C0402C104K8PAC	C1, C2, C3, C4, C5, C6, C7, C8, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25, C26, C27, C28, C29, C30, C32, C33, C34, C35, C40, C41, C42, C45, C46, C47, C51, C52, C53, C55, C56, C58, C60, C63, C64, C67, C69, C70, C71, C72, C73, C74, C75, C76, C77, C78, C79, C80, C81, C82, C83, C84, C85, C86, C87, C88, C89, C90, C91, C93, C94, C96, C100, C101, C102, C103, C104, C105, C106, C107, C108, C109, C110, C111, C112, C113, C114, C115, C116, C117, C118, C119, C120, C121, C122, C123, C124	CAPACITOR,SMT,0402,CER,0.1µF,10V,10%,X5R
4	PANASONIC	ECJ-0EC1H100D	C66, C95, C97	CAPACITOR,SMT,0402,CER,10pF,50V,±0.5pF,NPO
5	MURATE	GRM155R60J225ME15D	C37, C92	CAPACITOR,SMT,0402,CERAMIC,2.2µF,6.3V,20%,X5R
6	PANASONIC	ECJ-1VB0J475K	C36	CAPACITOR,SMT,0603,CER,4.7µF,6.3V,10%,X5R
7	TAIYO YUDEN	JMK107BJ106MA-T	C31, C38	CAPACITOR,SMT,0603,CER,10µF,6.3V,20%,X5R
8	MURATA	GRM31CR60J476ME19B	C44	CAPACITOR,SMT,CER,1206,47µF,6.3V,20%,X5R
9	AVX	TACR475M020R	C98, C99	CAP,SMT,TAN,0805,4.7µF,20V,20%,R-CASE
10	AVX	TPSC226K016R0375	C39, C43, C48, C49, C50, C54, C57, C59, C61, C62, C65, C68	10%, 16V, 22µF
11	SAMTEC	SMA-J-P-X-ST-EM1	J1, J2, J3, J5, J6, J7, J9, J10, J13	SMA JACK EDGE MOUNT,062PCB,BRASS/GOLD,STRAIGHT,50 Ω
12	SAMTEC	SMA-J-P-H-ST-TH1	J4, J8, J11, J12	SMA COAX STRAIGHT PCB JACK,SMT,175TL,50 Ω,GOLD
13	TYCO ELECTRONICS	745781-4	P17	DSUB, 9 PIN, R/A FEM
14	ADVANCED CONNECTER	MNE20-5K5P10	P25	MINI-AB USB OTG RECEPTACLE R/A SMT TYPE
15	USCC	HC-18/U-4.1943M	Y1	4.194300 MHz
16	EPSON	HF-372A(UNINSTALLED)	F1	CRYSTAL FILTER UNINSTALLED
17	TI	CDCE62005	U4	(UNINSTALLED)
18	Not Installed	PAD0201(UN)	EP4, EP6	( Uninstalled Part ) EMPTY
19	Not Installed	PAD0402(UN)	EP1, EP2	( Uninstalled Part ) EMPTY
20	MURATA	BLM15BD102SN1D	FB2, FB3, FB4, FB8, FB22, FB23, FB24, FB25, FB26, FB27, FB28, FB29, FB30	FERRITE BEAD,SMT,0402,1 kΩ,200mA
21	MURATA	BLM18EG601SN1D	FB31	FERRITE BEAD,SMT,0603,600 Ω at 100MHz,25%,500mA
22	STEWART	HI0805R800R-00	FB6, FB7, FB9, FB10, FB13, FB14, FB15, FB16, FB17, FB18, FB19, FB20, FB21	FERRITE,SMT,0805,80 Ω at 100MHz
23	STEWART	LI1206H151R-00	FB5	FERRITE,SMT,1206,150 Ω at 100MHz,0.8A
24	MOLEX	39357-0003	P2	HEADER, THRU, POWER, 3P,3.5MM, EUROSTYLE
25	SAMTEC	QTH-040-01-L-D-DP-A	P26	HEADER,SMT,80P,0.5mm,FEM,DIFF PAIR,RECEPTACLE,168H
26	SAMTEC	SSQ-104-02-F-D	P9	HEADER,THU,8P,2x4,100LS,FEM,VERT,194TL
27	SAMTEC	TSW-103-08-G-D	P6, P10	HEADER,THU,6P,2x3,MALE,DUAL ROW,100LS,200TL
28	SAMTEC	TSW-107-07-G-D	P7	HEADER,THU,14P,2x7,MALE,DUAL ROW,100LS,100TL
29	SAMTEC	TSW-108-07-G-D	P16	HEADER,THU,16P,2x8,MALE,DUAL ROW,100LS,100TL(UNINSTALLED)
30	TYCO ELECTRONICS	103321-2	P3, P8, P12, P21, P23	HEADER W/SHUNT,2P,100LS

**Table 3. Bill of Materials (continued)**

Item	MFG	MFG Part Number	RefDes	Value or Function
31	MOLEX	22-23-2021-P	P4, P24	MALE,2PIN,.100CC W/ FRICTION LOCK
32	MILL-MAX	350-10-103-00-006	P13, P18, P22	HEADER,THU,MAL,0.1LS,3P,1x3,284H,110TL
33	MOLEX	22-23-2041	P1	4P, VERT, FRICTION LOCK
34	TYCO ELECTRONICS	4-103239-0x3	P5, P11, P14, P15, P19, P20	HEADER,THU,MAL,0.1LS,3P,1x3
35	TI	AFE5805	DUT1	AFE5805 8-CH ULTRASOUND ANALOG FRONT END
36	MAXIM	MAX3221CAE	U2	RS-232 TRANSCEIVERS
37	MOTOROLA	MMBD7000LT1	D1, D2	DUAL SWITCHING DIODE
38	NXP	BAS40-04	D3	PIN DIODE SOT 23 SINGLE JUNCTION
39	TI	TPS79633DCQR	U7(UNINSTALLED), U8	ULTRALOW-NOISE HI PSRR FAST RF 1-A LDO LINEAR REGULATOR,3.3V
40	TI/BURR-BROWN	OPA820IDBV	U1	UNITY-GAIN STABLE LOW NOISE VOLTAGE FEEDBACK OPAMP
41	TI	TPS79318DBV	U6	1.8V,ULTRALOW-NOISE HI PSRR FAST RF 200mA LDO LINEAR REGULATOR
42	TI	TPS79325DBV	U9	2.5V,ULTRALOW-NOISE HI PSRR FAST RF 200mA LDO LINEAR REGULATOR
43	FUTURE TECHNOLOGY DEVICE INT.	FT245RL	U10	USB FIFO IC INCORPORATE FTDICHIP-ID SECURITY DONGLE
44	PANASONIC	ELJFA221J	L1	220µH, 5%
45	TAIYO-YUDEN	LK 1608 330M	FB1, FB11, FB12	INDUCTOR,SMT0603,33.0µH,20%
46	PANASONIC	LNJ308G8PRA	LED1, LED2, LED3, LED5	LED,SMT,0603,PURE GREEN,2.03V
47	PANASONIC	LNJ808R8ERA	LED4	LED,SMT,0603,ORANGE,1.8V
48	ECS	ECS-3953M-400-BN	U5	OSC,SMT,3.3V,50ppm,-40~85C,5nS,40.000 MHz
49	PANASONIC	ERJ-2GE0R00X	R26, R27, R40, R42, R44, R48, R53, R55, R56, R63, R65	RESISTOR/JUMPER,SMT,0402,0 Ω,5%,1/16W
50	PANASONIC	ERJ-2GEJ0000(UN)	R6, R7, R29, R30, R31, R32, R34, R35, R36, R37, R39, R43, R46, R49, R54, R59, R60, R62, R64	UNINSTALLED PART
51	PANASONIC	ERJ-2GEJ131	R66, R69	RESISTOR, SMT, 0402, ±1%,130 Ω
52	PANASONIC	ERJ-2GEJ49R9(UN)	R4, R9, R22	UNINSTALLED PART
53	PANASONIC	ERJ-2GEJ563	R57	RESISTOR, SMT, 0402, 5%,56K Ω
54	PANASONIC	ERJ-2GEJ820	R67, R68	RESISTOR, SMT, 0402, ±5%,82
55	PANASONIC	ERJ-2RKF1000X	R24, R25	RESISTOR,SMT,0402,100 Ω,1%,1/16W
56	PANASONIC	ERJ-2RKF1001X	R13, R14, R18, R47	RESISTOR,SMT,0402,1.00K,1%,1/16W
57	PANASONIC	ERJ-2RKF1002X	R33, R58	RESISTOR,SMT,0402,10.0K,1%,1/16W
58	PANASONIC	ERJ-2RKF2000X	R52	RES,SMT,0402,200 Ω,1%,1/16W
59	PANASONIC	ERJ-2RKF3320X	R16, R20, R38, R45	RES,SMT,0402,332 Ω,1%,1/16W
60	PANASONIC	ERJ-2RKF4020X	R8	RES,SMT,0402,402 Ω,1%,1/16W
61	PANASONIC	ERJ-2RKF4992X	R28	RESISTOR,SMT,0402,49.9K,1%,1/16W
62	PANASONIC	ERJ-2RKF49R9X	R1, R2, R3, R5, R10, R11, R15, R17, R21, R23, R61	RESISTOR,SMT,0402,49.9 Ω,1%,1/16W
63	PANASONIC	ERJ-2RKF7500X	R50, R51	RES,SMT,0402,750 Ω,1%,1/16W
64	VISHAY	CRCW06031742F	R19	RES,SMT,0603,17.4K Ω, 1%
65	PANASONIC	ERJ-6RQF5R1V	R41	SMT,RES,0805,1/8W, 1%, 5.1 Ω
66	PANASONIC	ERJ-1GE0R00C	EP3, EP5	RESISTOR,SMT,0201,THICK FILM,0 Ω,5%,0 Ω JUMPER,1/20W
67	C&K	TD06H0SK1	SW1, SW2	DIP SWITCH,SMT,6POS,SPST,MINIATURE
68	PANASONIC	EVQPE104K	S1	SQUARE LIGHT TOUCH
69	KEYSTONE ELECTRONICS	5005	TP8	TESTPOINT,THU,COMPACT,0.125LS,130TL, RED
70	KEYSTONE ELECTRONICS	5006	TP1, TP2, TP5, TP6, TP10	TESTPOINT,THU,COMPACT,0.125LS,130TL, BLACK
71	KEYSTONE ELECTRONICS	5006(UN)	TP3, TP4, TP7, TP9	UNINSTALLED PART ( TEST POINT )

**Table 3. Bill of Materials (continued)**

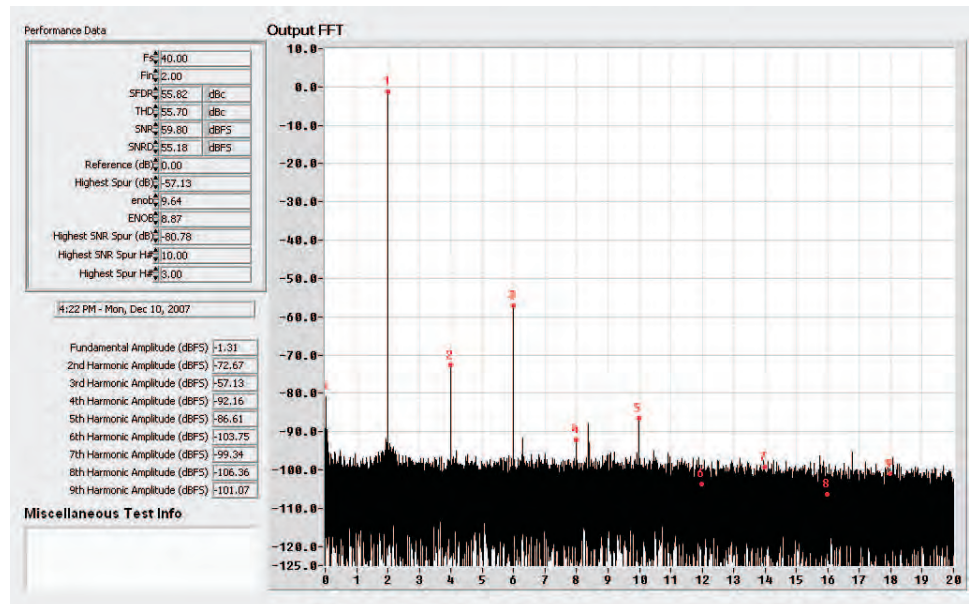
Item	MFG	MFG Part Number	RefDes	Value or Function
72	KEYSTONE ELECTRONICS	5007	TP11	TESTPOINT,THU,COMPACT,0.125LS,130TL, WHITE
73	MINI-CIRCUITS	ADTI-6T	T1(UNINSTALLED), T2	RF TRANSFORMER WIDEBAND, 0.03-125 MHz
74	BOURNS	3296W-1-103	R12	TRIMPOT,THU,10K,10%,0.5W,100ppm,25T
75	AMP	531220-2	P3, P8, P12, P21, P23	
76	KEYSTONE ELECTRONICS	1892	H1, H2, H3(UNINSTALLED), H4(UNINSTALLED)	STANDOFF HEX 4-40 THR 0.250"L ALUM
SPECIAL NOTES AND INSTRUCTIONS: 1: ITEM 26 , 27, 28, and 29 ARE STRAIGHT DUAL ROW 72 POSITION HEADER QUANTITY OF STRIPS WILL CHANGE WITH NUMBER OF BOARDS BEING BUILT. 2: ITEM 30, 32, and 34 ARE STRAIGHT SINGLE ROW 36 POSITION HEADER QUANTITY OF STRIPS WILL CHANGE WITH NUMBER OF BOARDS BEING BUILT.				



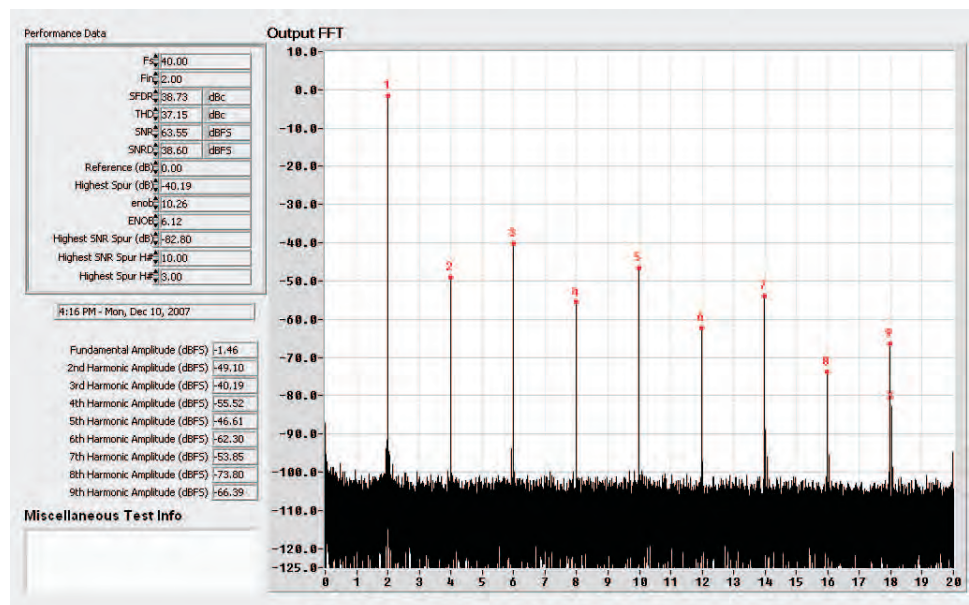
## 5 Typical Performance

This section provides some typical performance characteristics of the AFE5805EVM to assist users in verifying their setup.

After analysis of the data file acquired by a logic analyzer, the SNR of the AFE5805 should be better than 59 dB when the PGA is set to 30 dB and Vcntl is set as 1 V. A typical performance plot of the AFE5805 is shown in Figure 18.



(a) PGA = 30 dB, Vcntl = 1 V, Vin = 10 mVpp

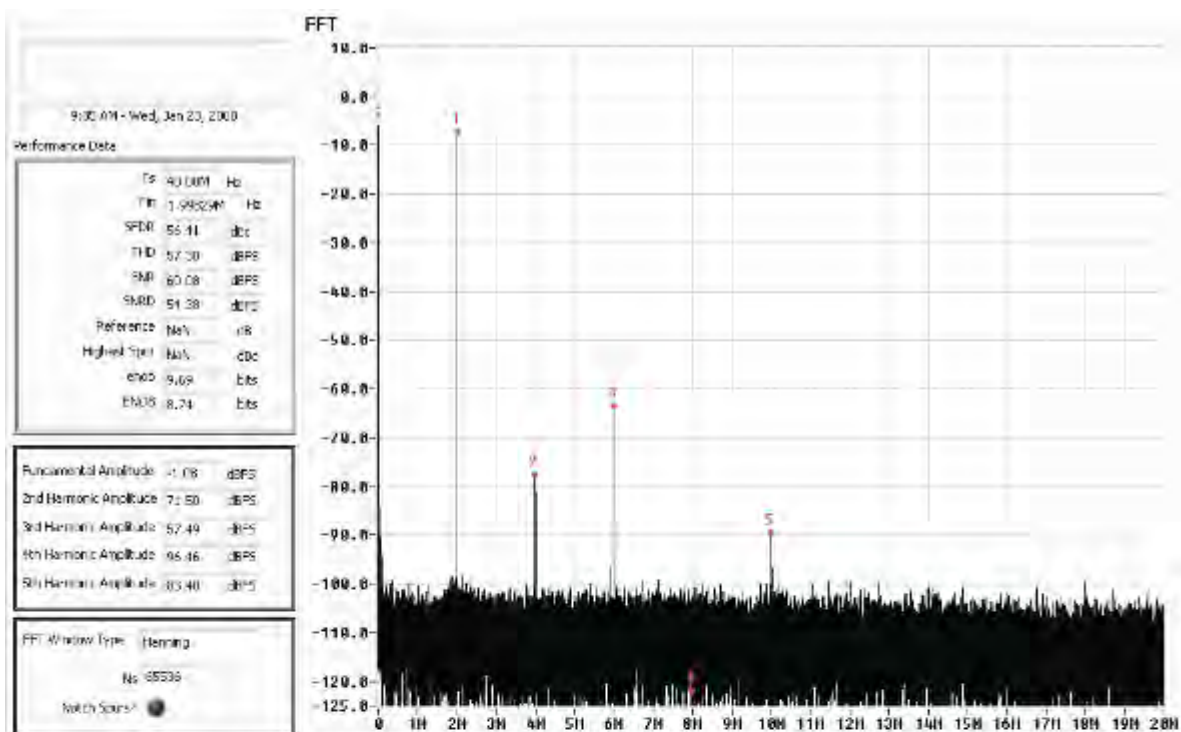


(b) PGA = 30 dB, Vcntl = 0.3 V, Vin = 250 mVpp

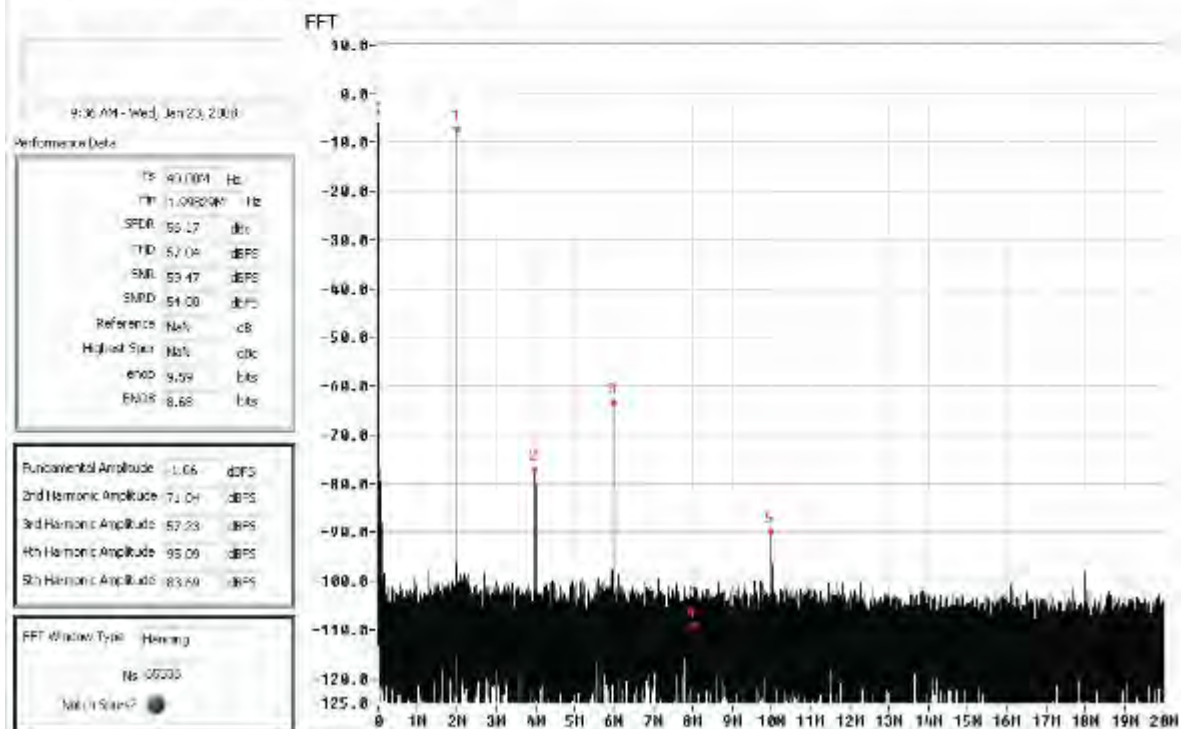
Figure 18. Typical Performances of AFE5805

As Figure 18 shows, the SNR degrades as the gain increases; the HD degrades as the input signal increases.

When the onboard 40-MHz clock is used, the measured SNR of the AFE5805 degrades, but the degradation is insignificant. In the example of Figure 19, the settings are PGA=30 dB, Vcntl=1 V, and LPF=15 MHz.



(a) HP8644 is used. SNR = 60.08 dBFS



(b) Onboard 40-MHz clock is used. SNR = 59.47 dBFS. 0.6-dBFS degradation is observed when the onboard 40-MHz clock is used. Hanning window is applied.

Figure 19. Typical Performance of AFE5805 With (a) HP8644 and (b) Onboard 40-MHz Clock



## TSW1400 for Evaluating AFE5805

This application note demonstrates typical steps of evaluating the AFE5805 using the TSW1400EVM and its associated data.

### A.1 Step 1: Hardware Setup

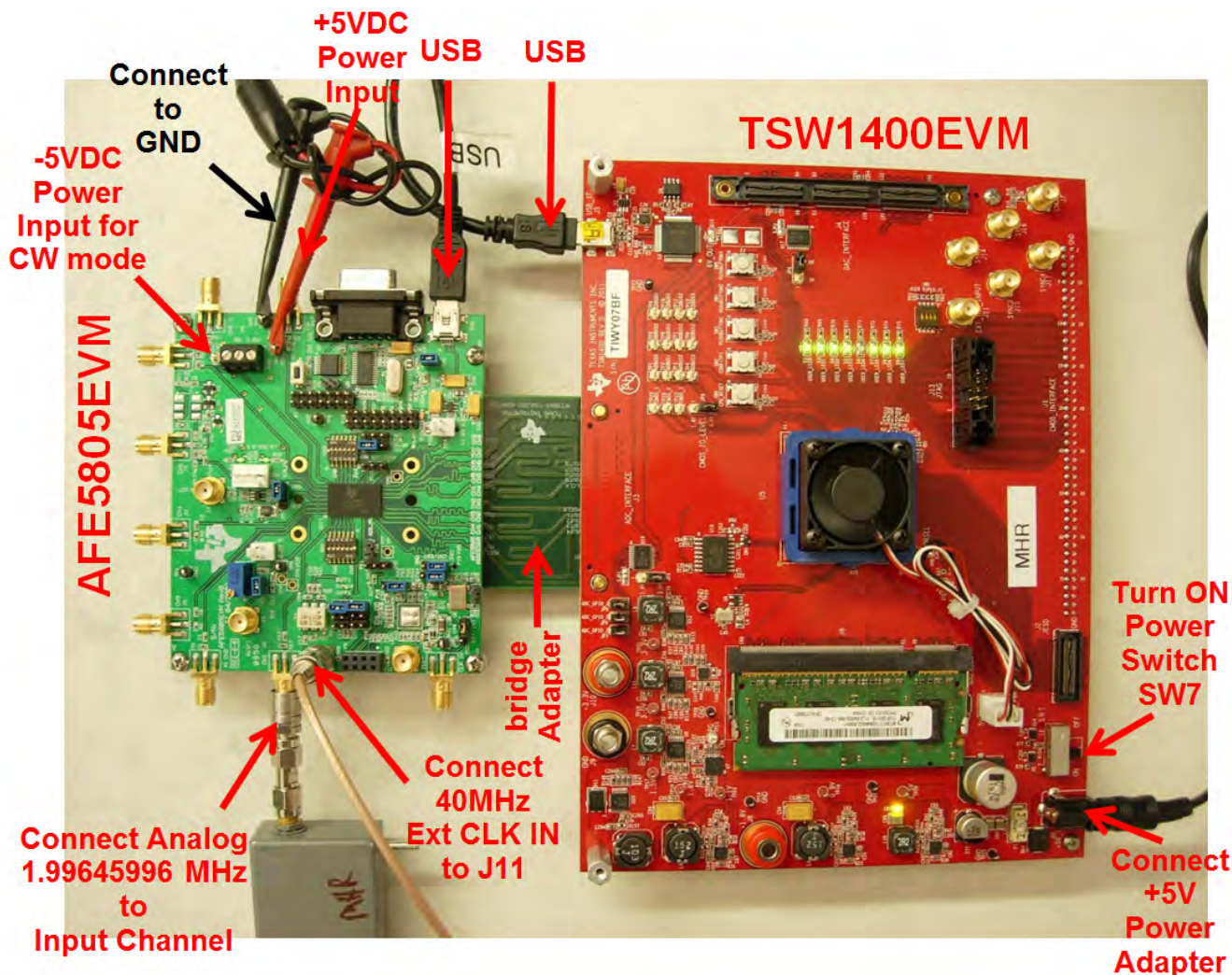


Figure 20. Connection between TSW1400EVM and AFE5805

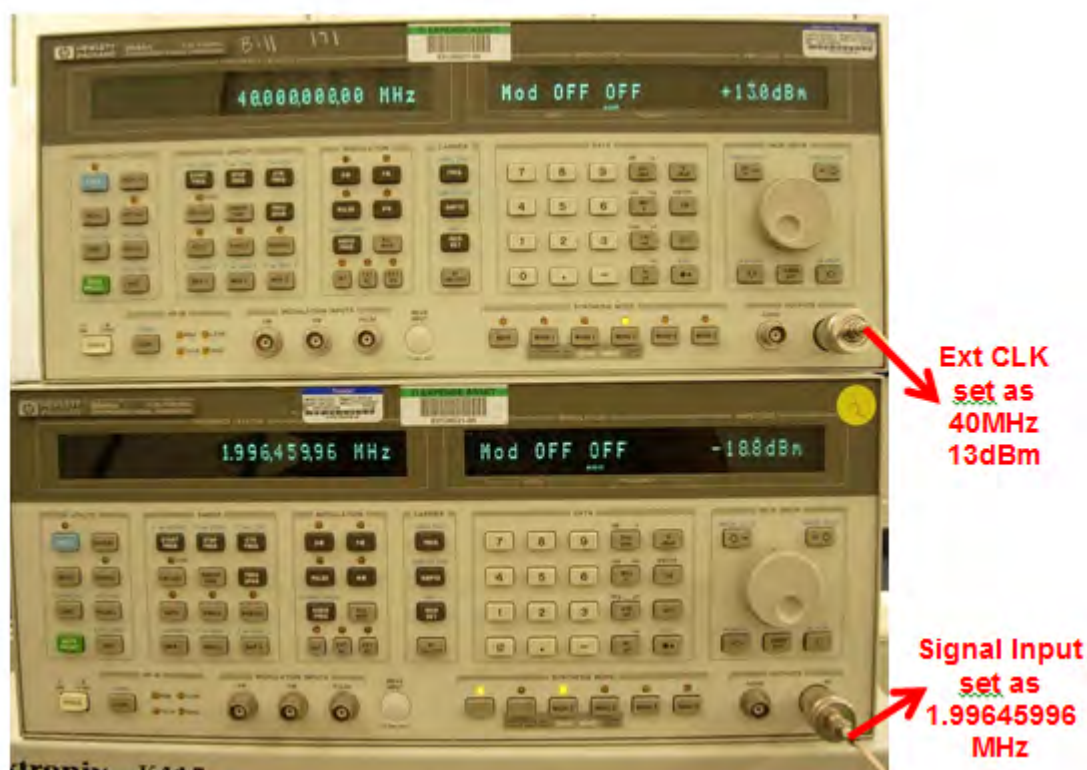


Figure 21. Connection of the Instruments

## A.2 Step 2: Launch AFE5805 GUI



**Figure 22. AFE5805 EVM GUI**

### Initial COMMANDS to the AFE5805 GUI:

This step is used to adjust ADC input and output configuration. Therefore, TSW1400 can correctly capture data.

1. Set Address Byte(s) = 0 Data Byte(s) = 1. Click any space area to send command to AFE5805.
2. Set Address Byte(s) = 42 Data Byte(s) = 8081. Click any space area.
3. Set Address Byte(s) = 46 Data Byte(s) = 8208. Click any space area.

### Configure AFE5805 for Test

1. Press TGC button twice to observe it toggle to CW and then back to TGC. This ensures the device is in the TGC mode.
2. Press BP filter button to set it to 15MHz. If it is already at 15MHz during the startup, then press several times to cycle through different modes then back to 15 MHz.
3. Press Clamp button to set it to NO Clamp. If it is already at No Clamp during the startup, then press several times to cycle through different modes then back to No Clamp.
4. Press PGA to set it to 30dB. If it is already at 30dB during the startup, then press several times to cycle through different modes then back to 30dB.

At this stage, the AFE5805 is ready to work with TSW1400.

### Instruments

Set the frequency of the signal generator to the frequency displayed in the GUI (2.00439453MHz).

Set Amplitude of the signal generator to about -3dBm – -33dBm

Set the Frequency of the Clock Generator to 40MHz.

Set Amplitude of the Clock Generator to 13 dBm.



### A.3 Launch TSW1400 GUI

#### Test Condition

Following the steps in the orders as indicated in the following figure to set the test condition.

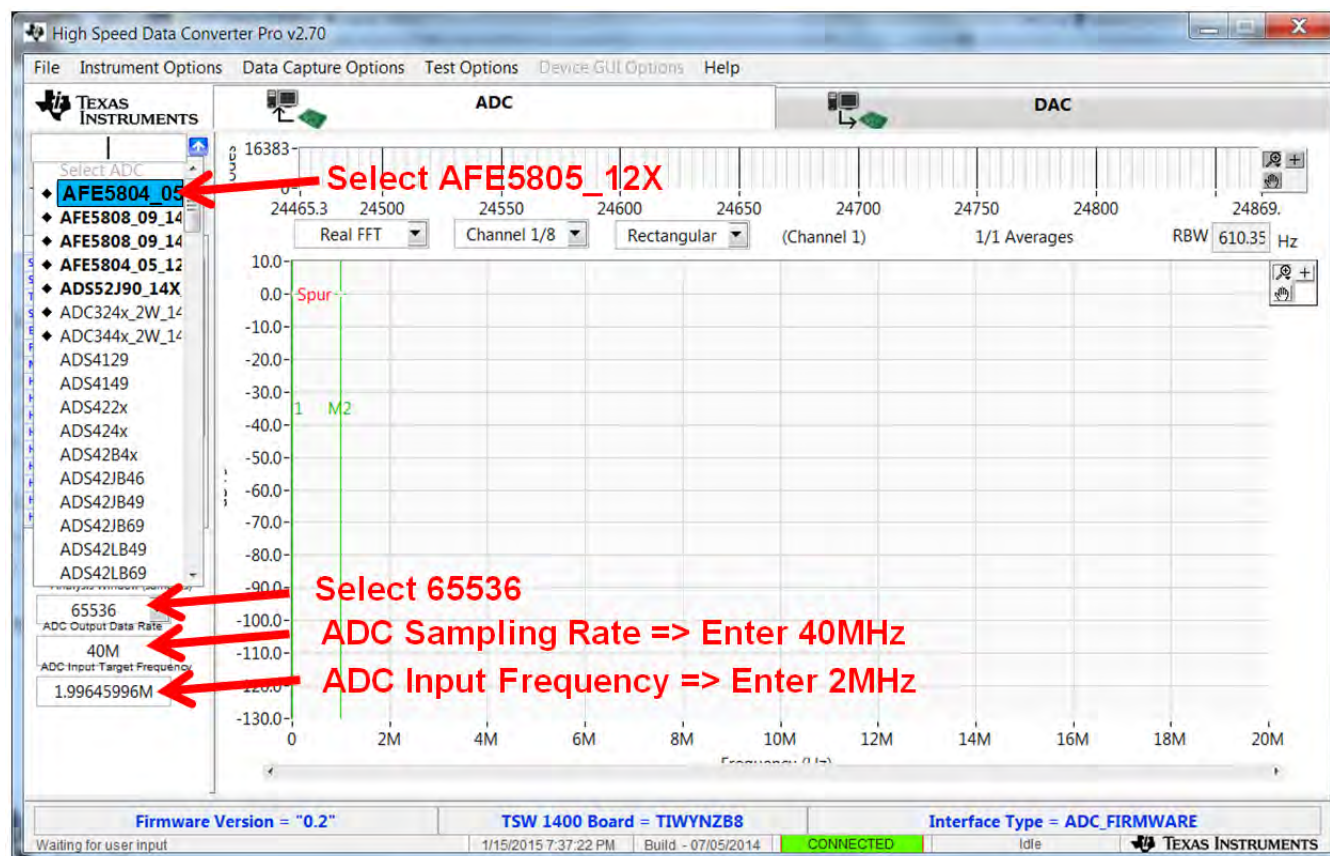


Figure 23. User Interface: Step-by-Step setup

After the above steps are complete; the following figure appears.

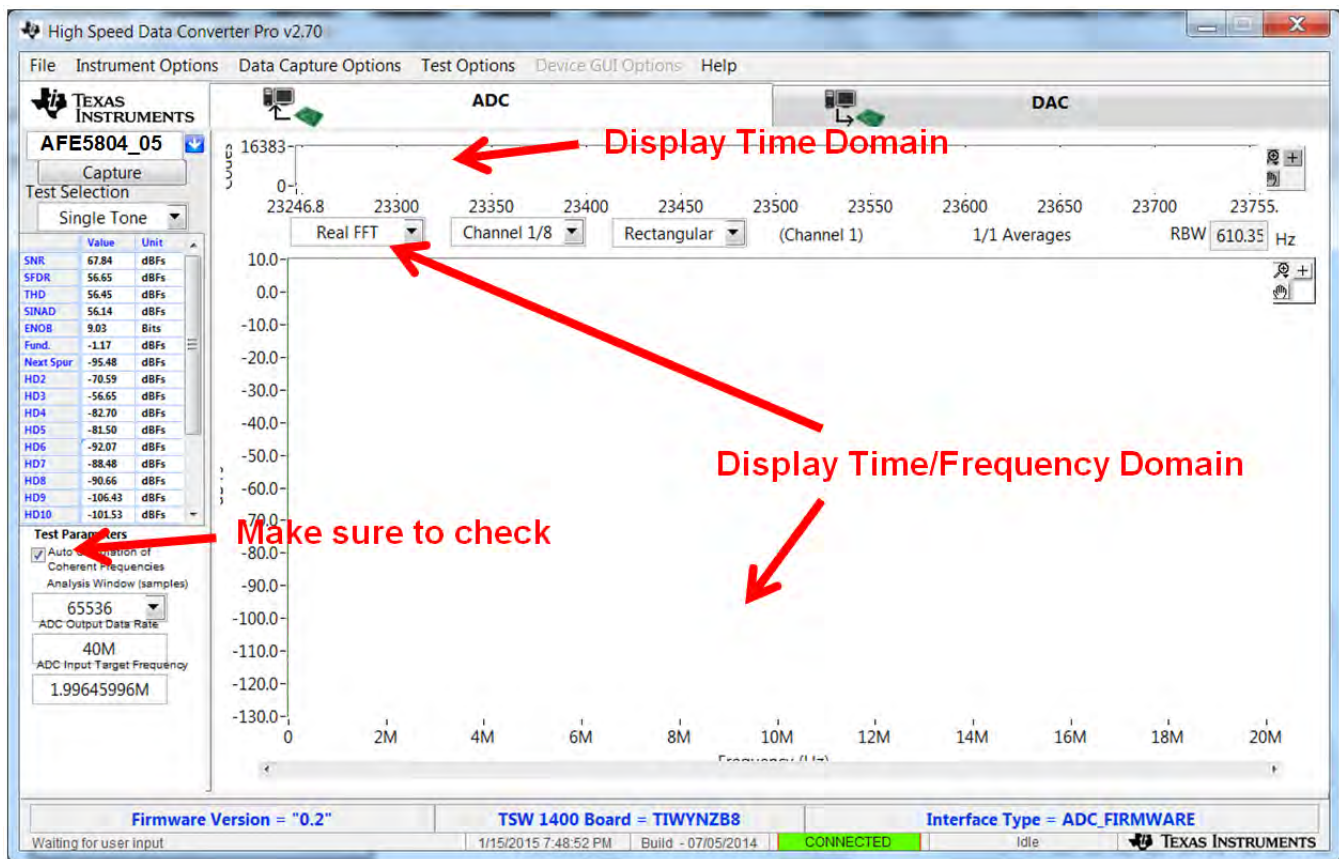


Figure 24. User Interface: Frequency Load Value to Signal Generator

### Command to Run Test

Set the test channel

Select the Window type to Rectangular.

Press the Capture Data button to start the test.

For noisy conditions, the amplitude of the signal may be too large; continue decrement the signal generator amplitude by 1dBm until the desired results are achieved.

### A.3.1 Single Tone FFT Data

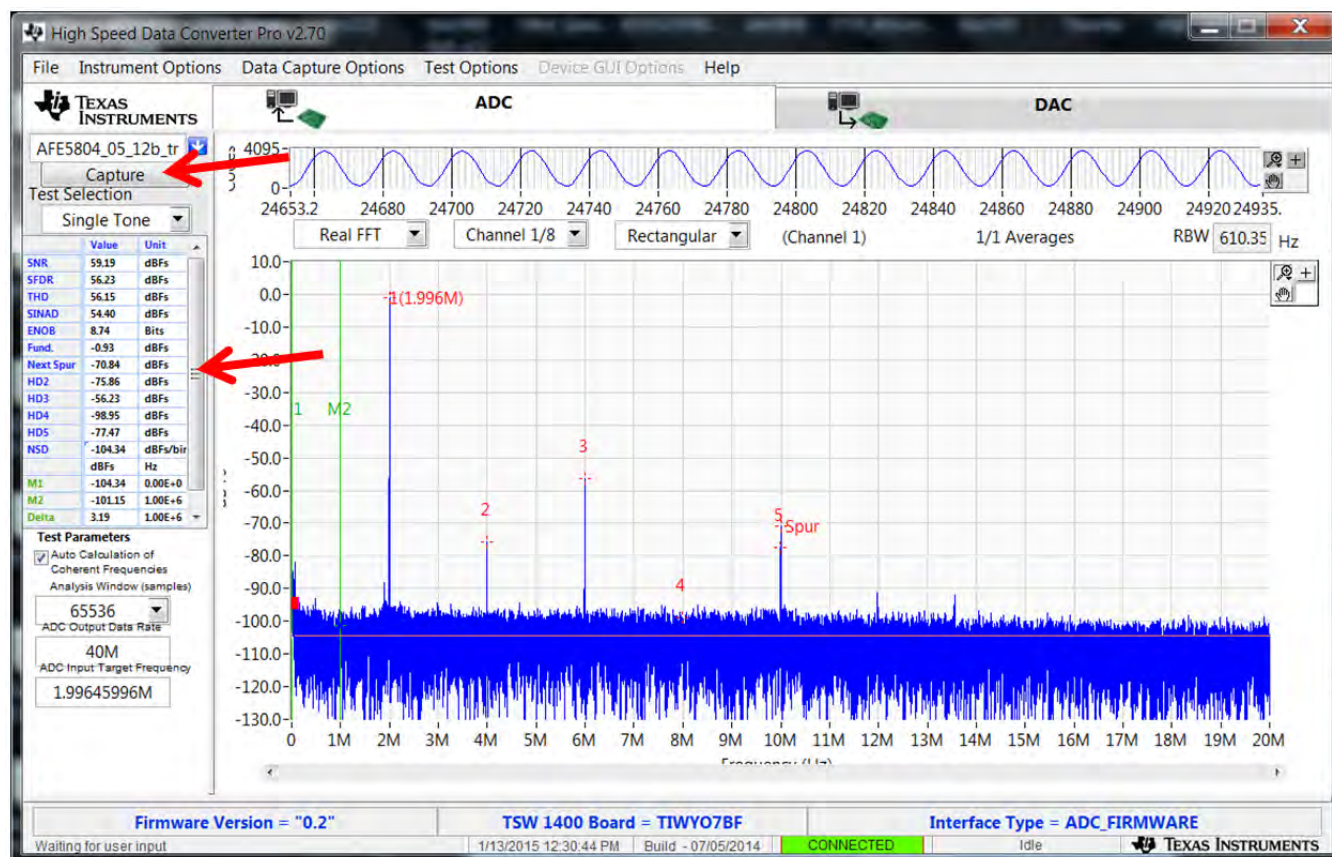
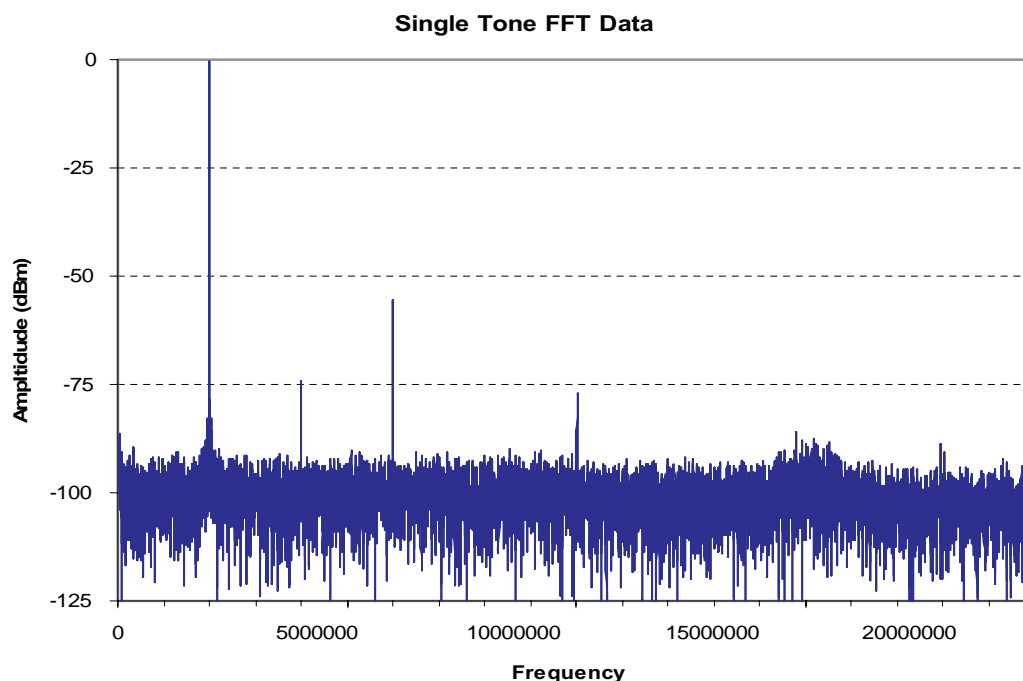


Figure 25. Typical Performance of AFE5805

### A.3.2 Single Tone FFT Data to XCELL

The test data can be saved to a spread sheet file for further processing.

1. Click File from the GUI. A pull down listing shows up.
2. Select "Save Single Tone Data". This example used the name single\_tone.csv
3. In this example, the saved data was brought up to excel to plot as shown in [Figure 26](#).



**Figure 26. Single Tone FFT Test Data Plot in EXCELL**



### A.3.3 Single Tone FFT Data Saved as Hardcopy

The test data can be saved as a hard copy. This can be used later to see the setup parameters.

1. Click File from the GUI. A pull down listing shows up.
2. Select "Save Capture As" and "Save as JPEG"
3. The whole picture includes the setup parameter are saved.

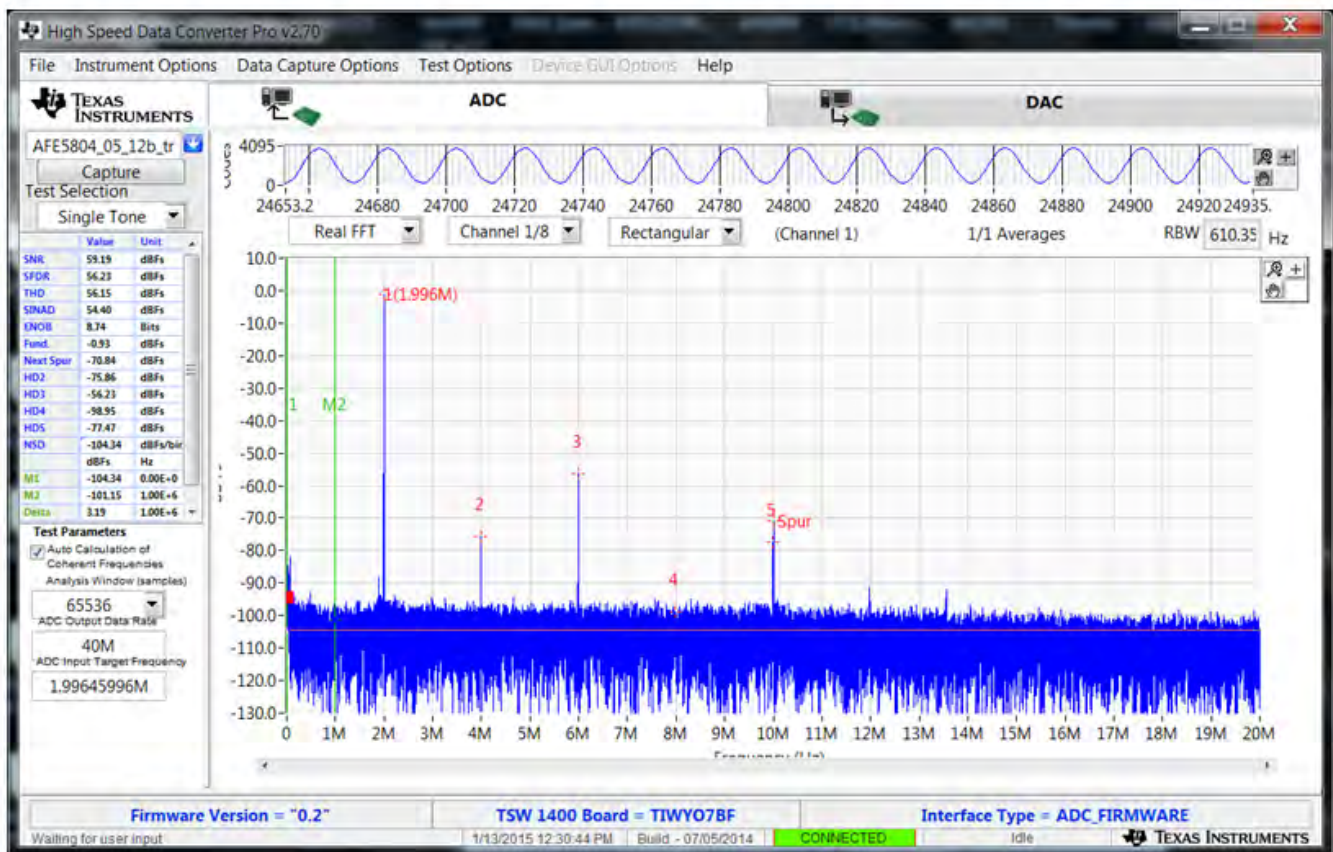
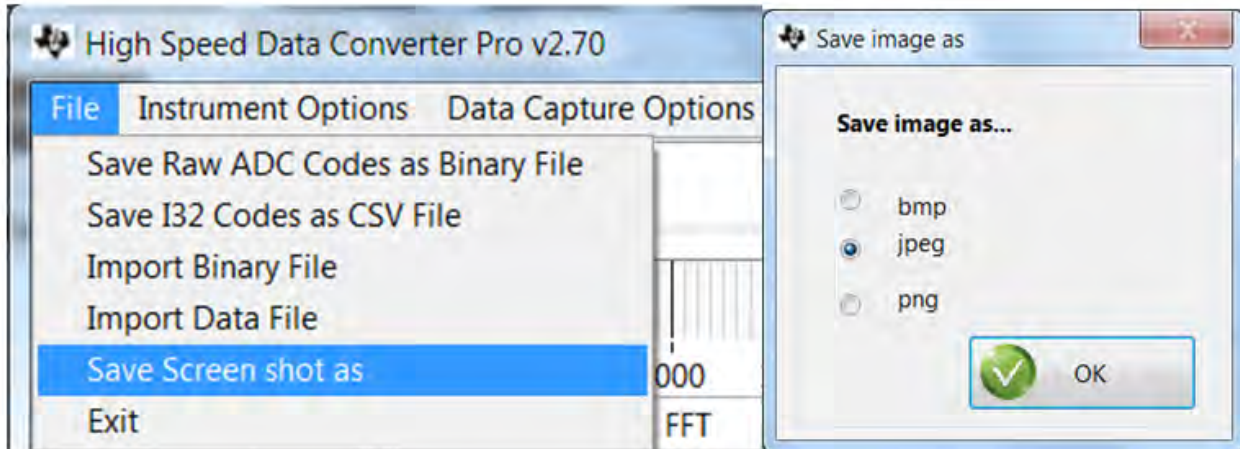


Figure 27. Single Tone FFT Test Data Saved as filename.jpeg

### A.3.4 Single Tone FFT With on Board Crystal Oscillator

The AFE5805 has an on board crystal oscillator; the user can use it as the clock source instead of a clock generator. Since this is a non-coherent condition; it is necessary to choose a Window type different from Rectangular for the test. For this particular one, the Window is set to HANNING.

The signal generator is still required for the signal source.

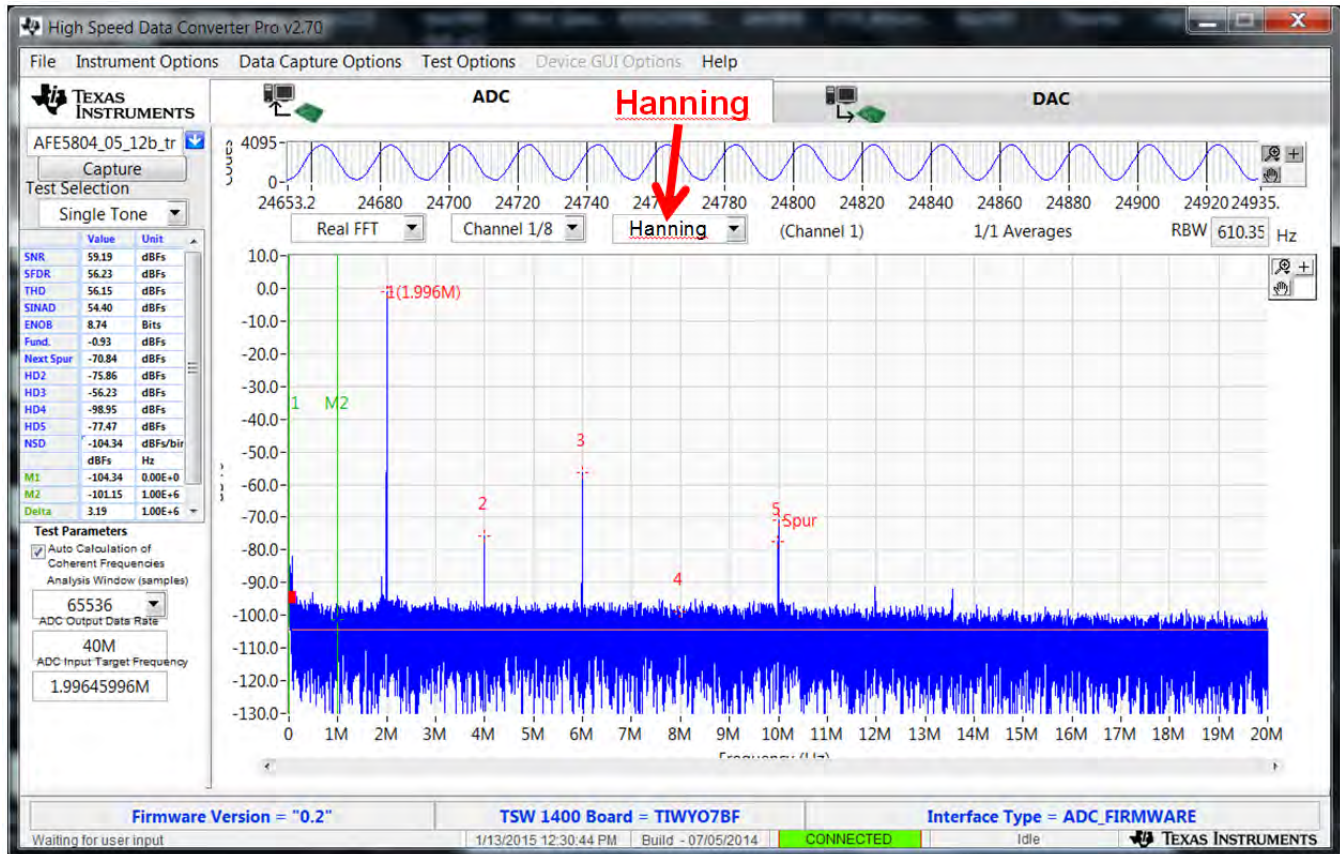


Figure 28. Typical Performance of AFE5805 in Non-Coherent Case



### A.3.5 Time Domain

The Time Domain test is shown in Figure 29. The larger central pane displays the raw sampled data whereas the calculated statistics are grouped into categories on the right of the screen. Settings and inputs relevant to the test are entered in drop-down menus or text input boxes on the left portion of the window.

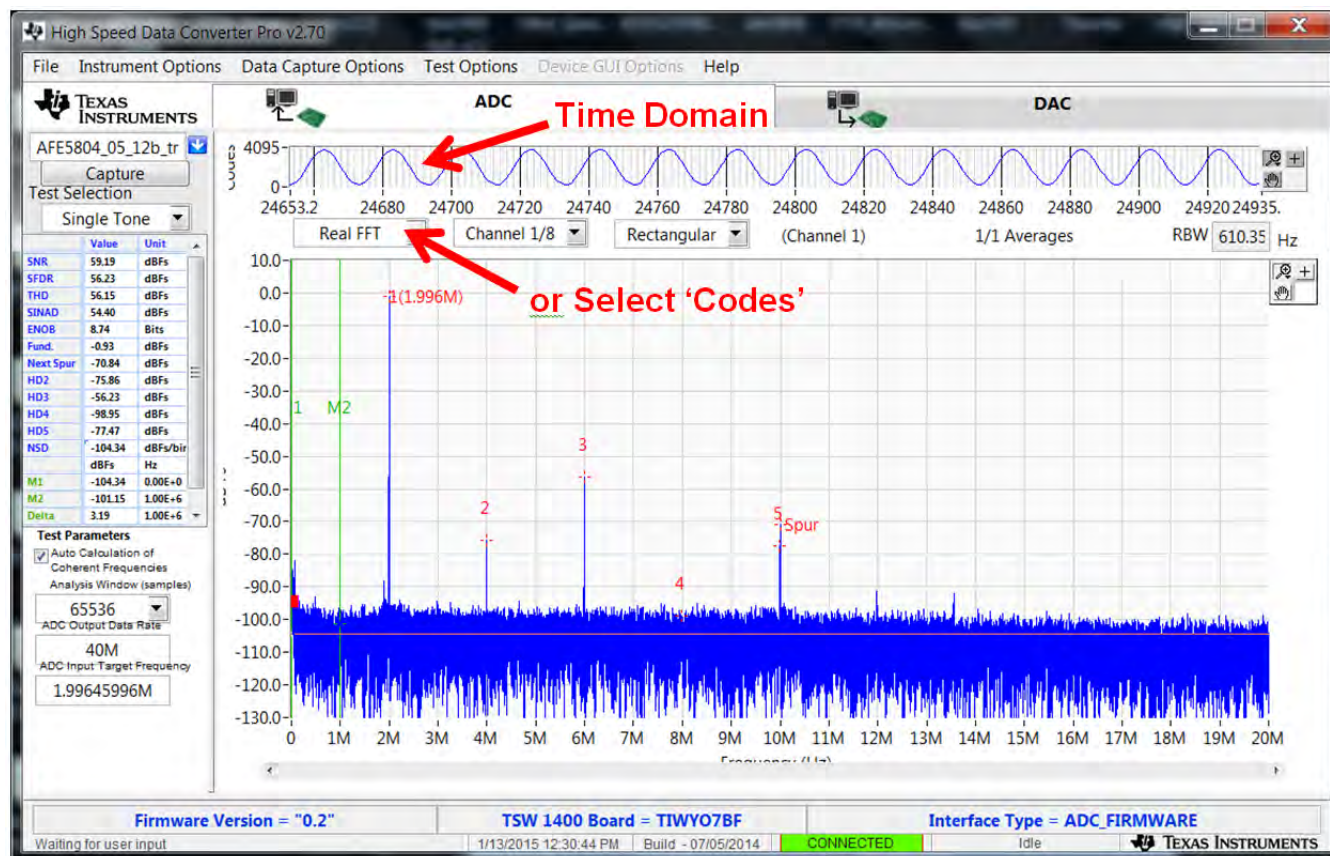
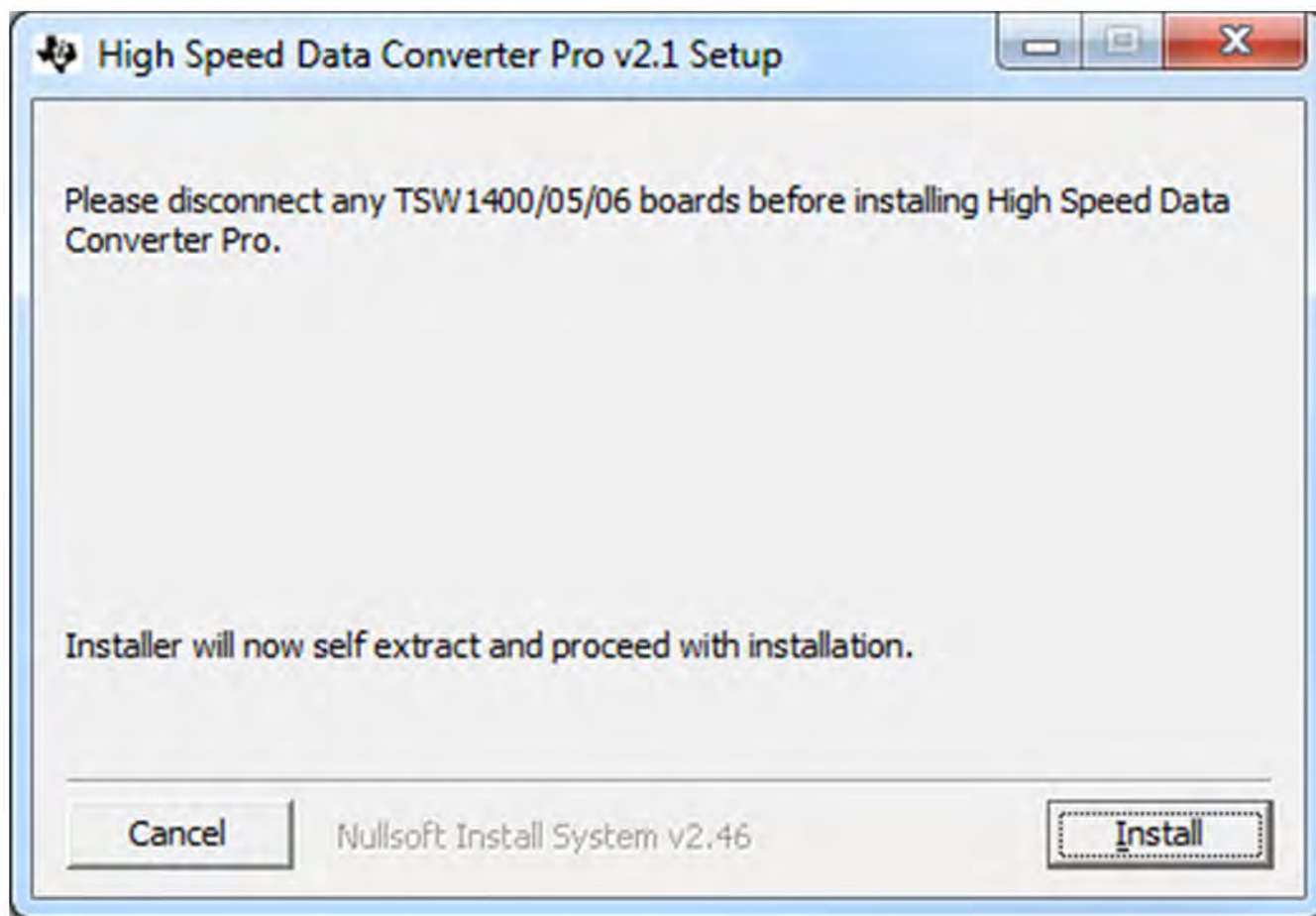


Figure 29. User Interface: Time Domain Format

## High Speed Data Converter Pro (HSDCPro) GUI Installation

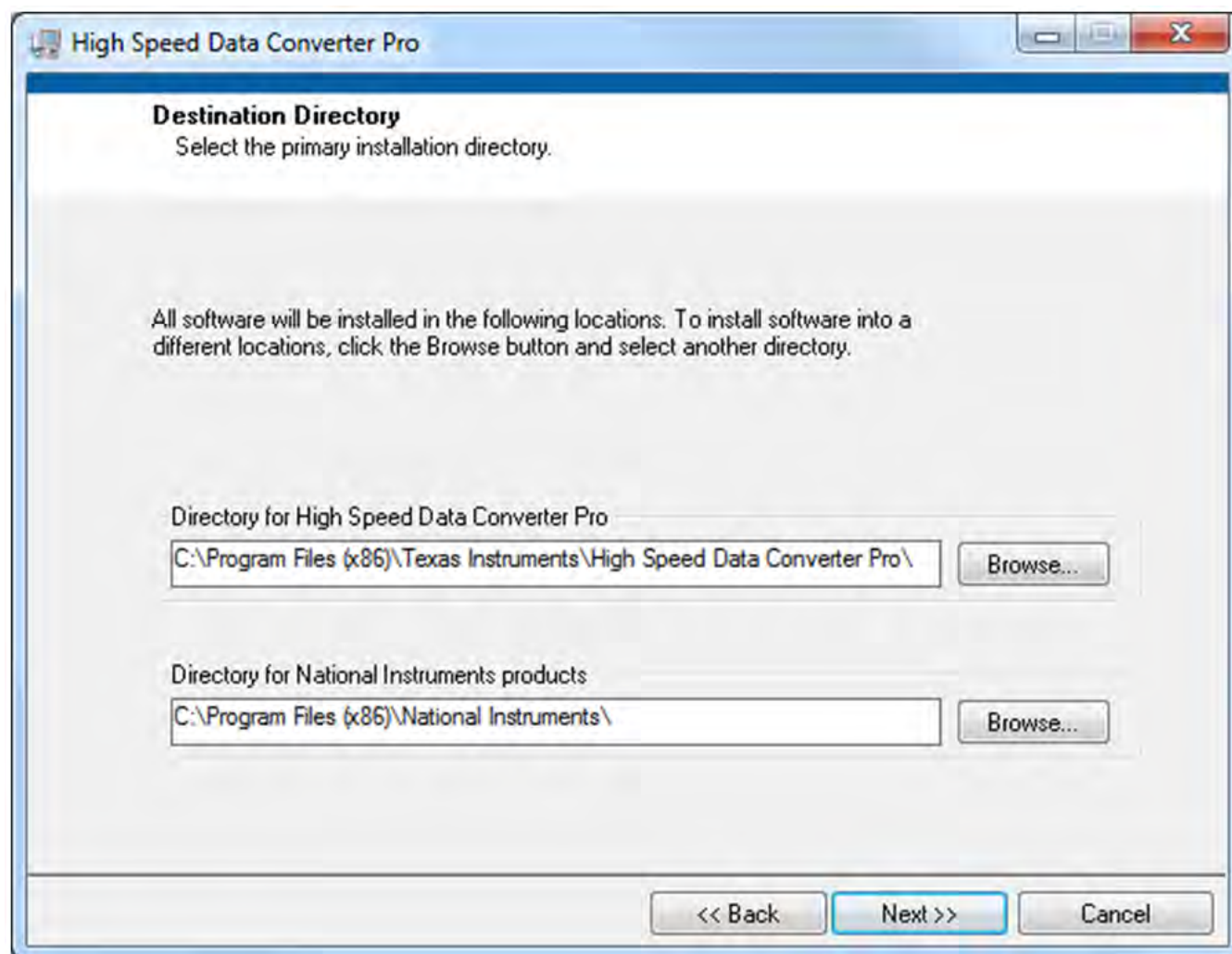
Download the HSDCPro GUI Installer using this link: [HSDCPro GUI](#)

- Unzip the saved folder and run the installer executable to obtain the pop-up shown in [Figure 30](#).
- Click the *Install* button.



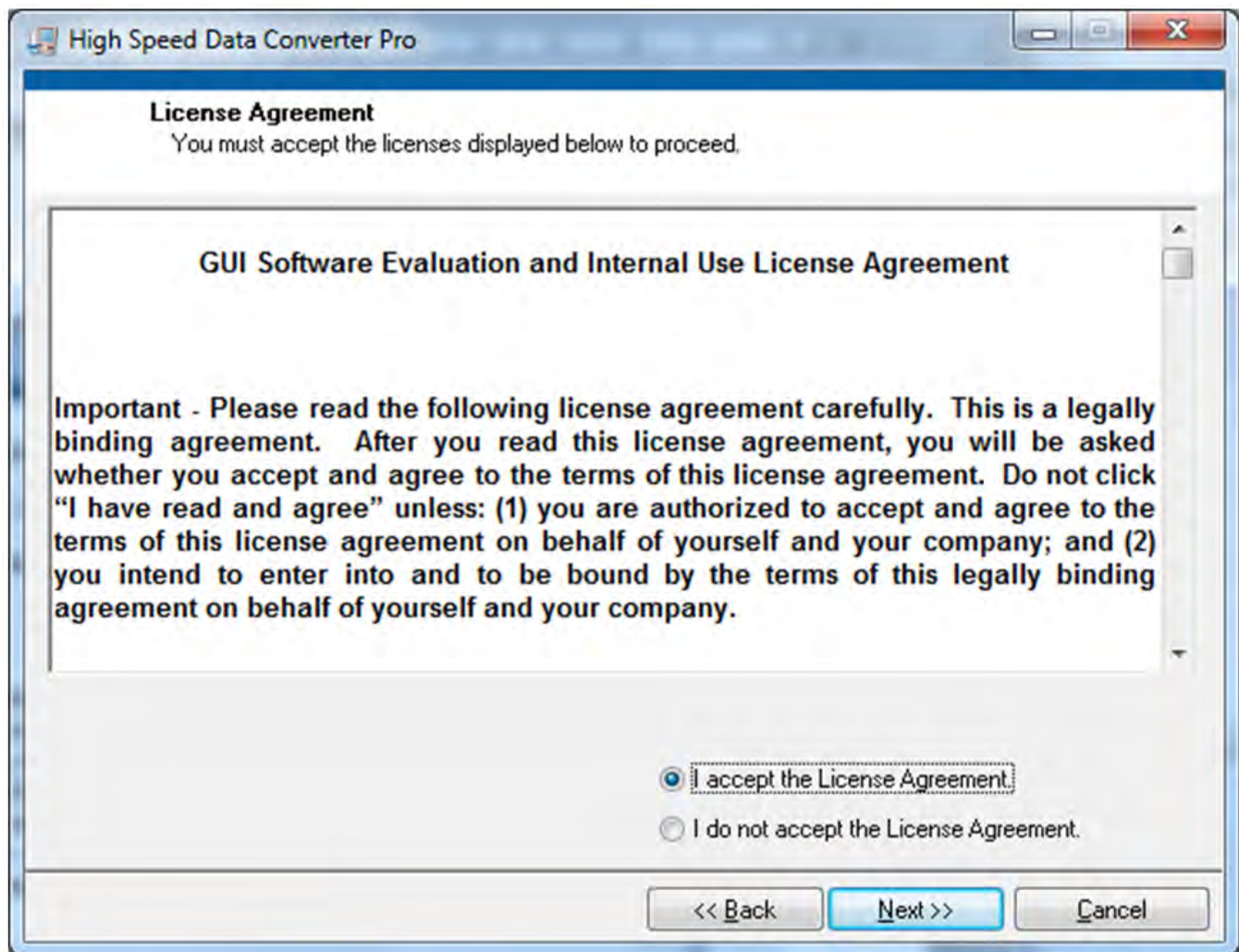
**Figure 30. HSDCPro Install (Begin)**

- Leave the destination directories as the default location, for the TSW1400GUI installation and press the NEXT button as shown in [Figure 31](#).



**Figure 31. HSDCPro Install (Install Directory)**

- Read the License Agreement from Texas Instruments and select *I accept the License Agreement* and press the *Next* button as shown in [Figure 32](#).



**Figure 32. HSDCPro Install (TI License Agreement)**

- Read the License Agreement from National Instruments and select *I accept the License Agreement* and press the *Next* button as shown in [Figure 33](#).



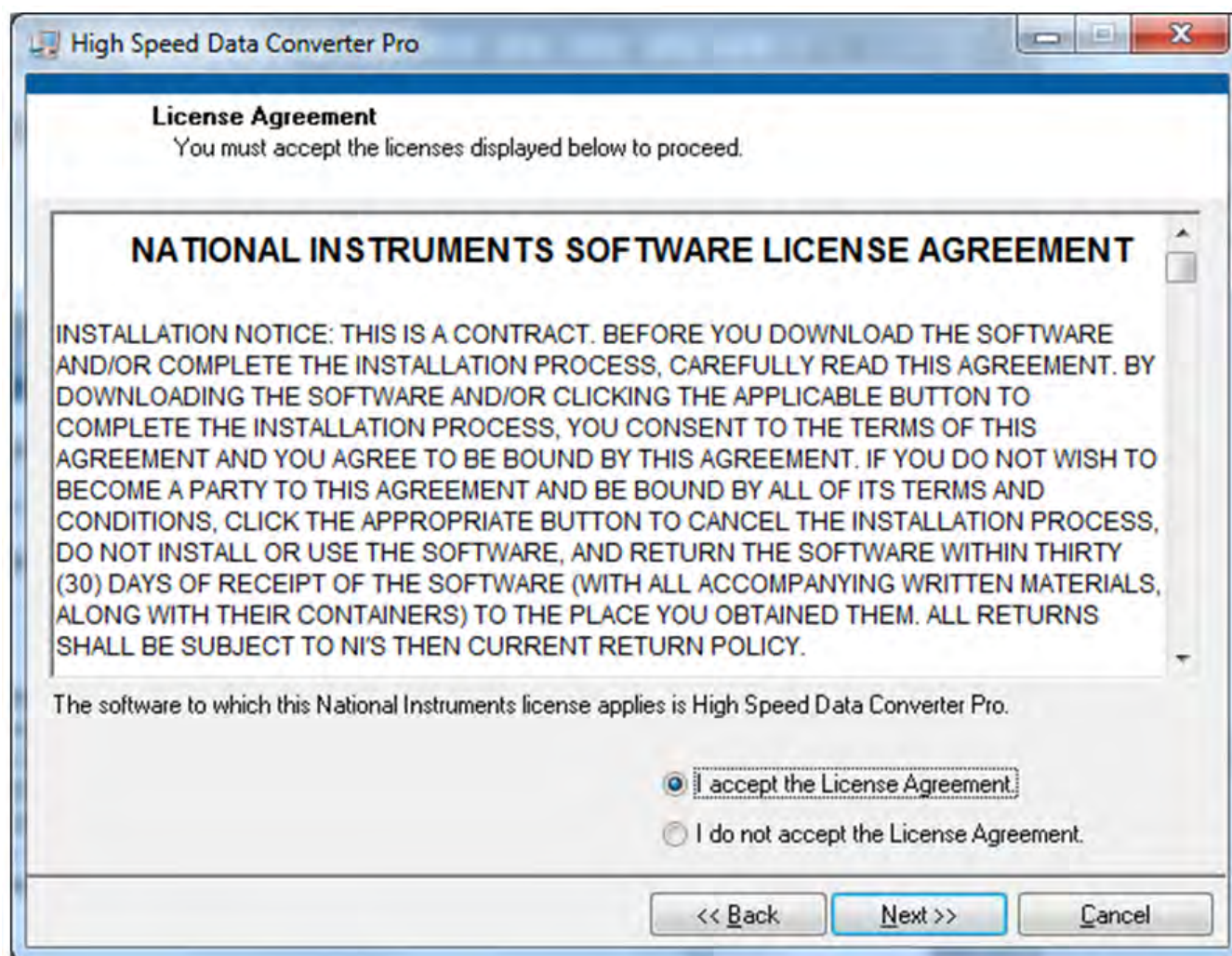
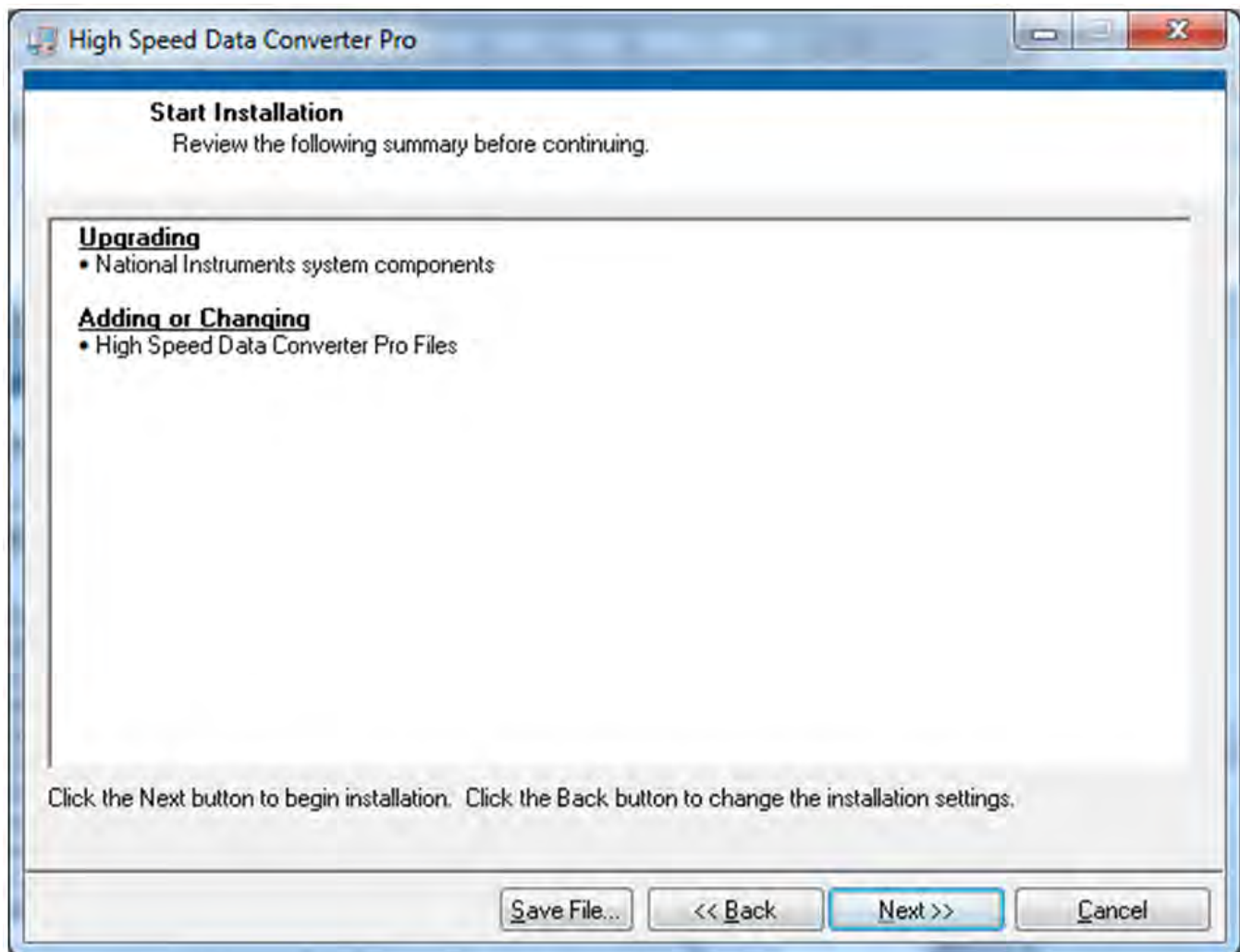


Figure 33. HSDCPro Install (NI License Agreement)

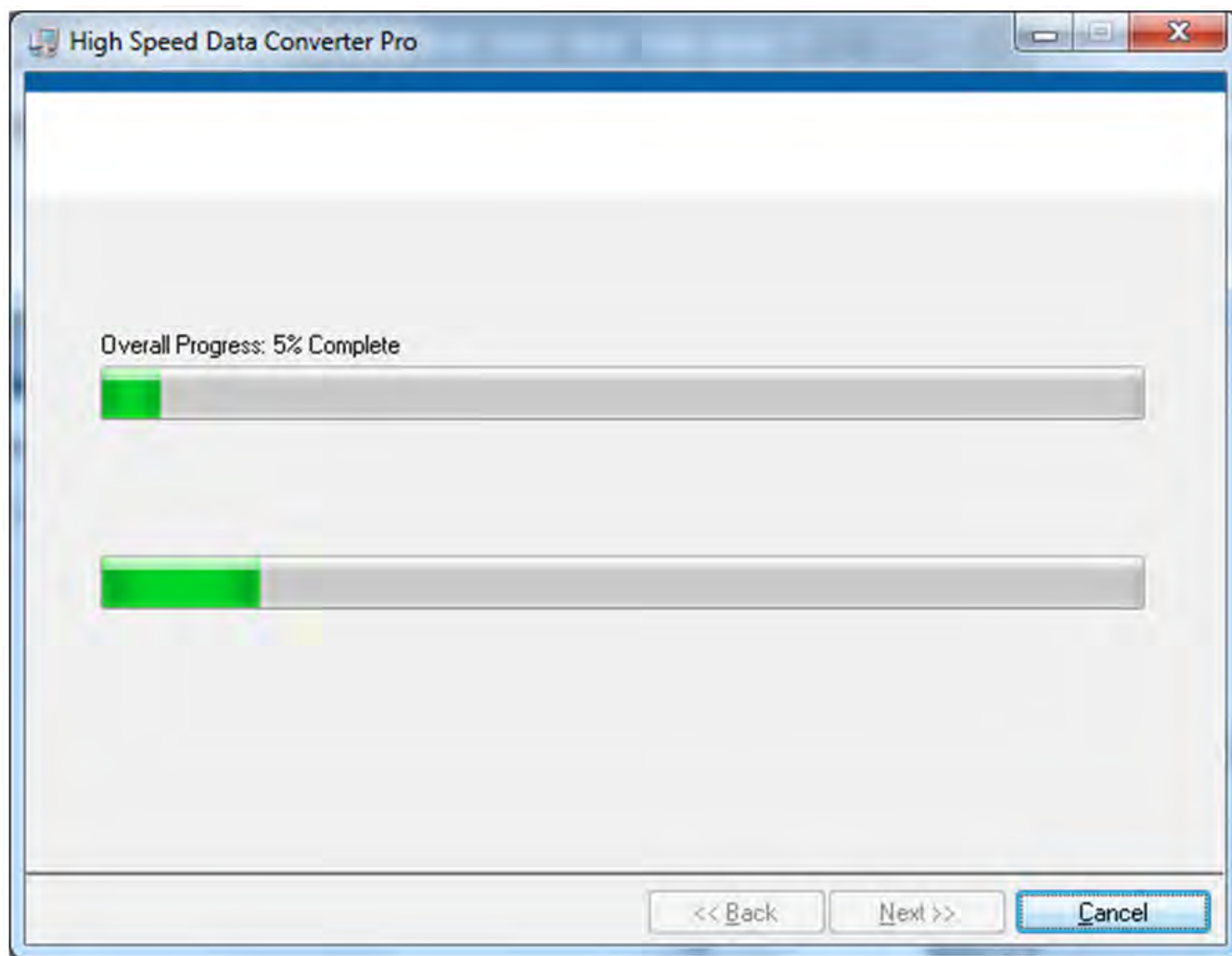
- Press the *Next* button as shown in [Figure 34](#).



**Figure 34. HSDCPro Install (Start Installation)**

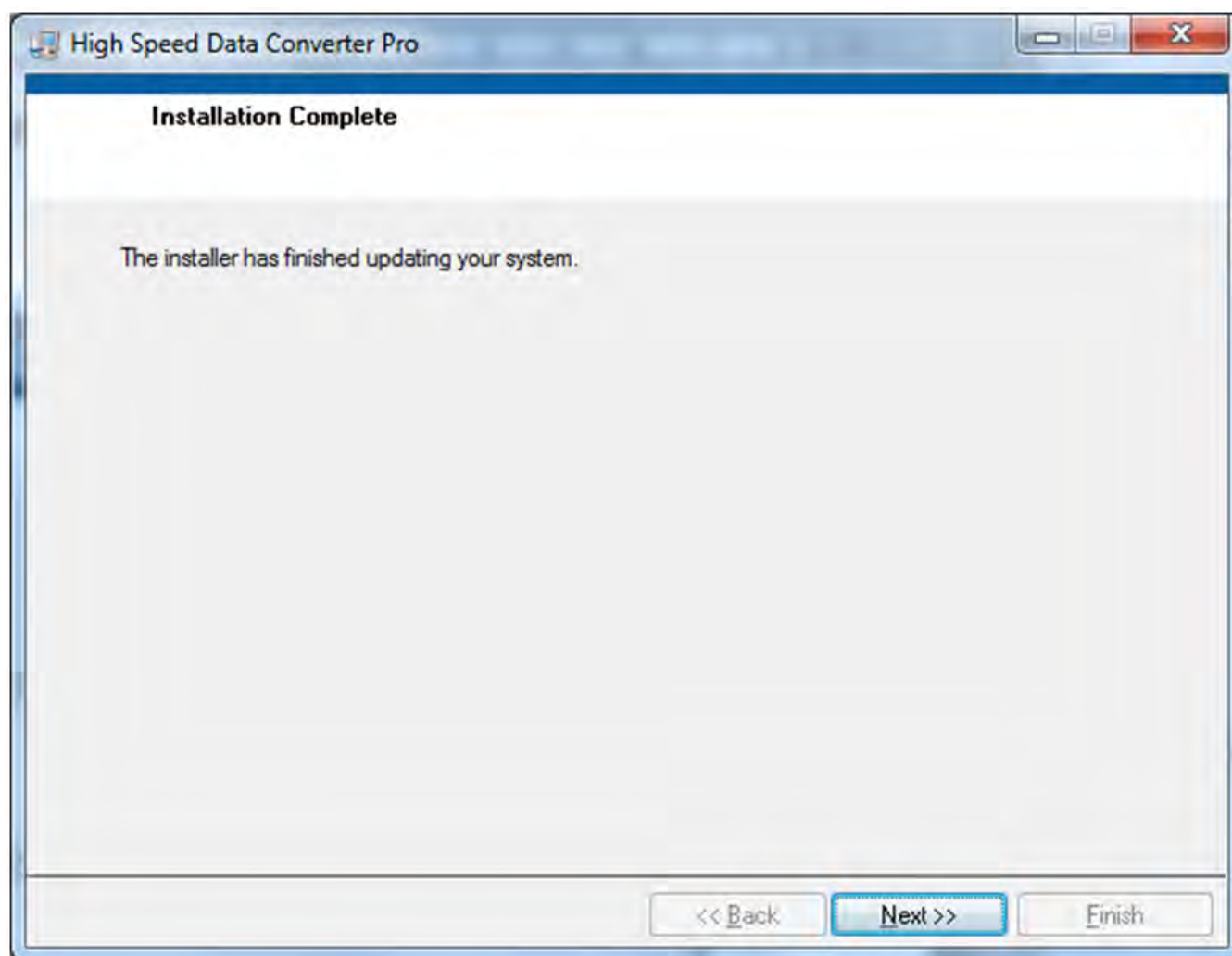
- The window shown in [Figure 35](#) should appear indicating that the installation is in progress.





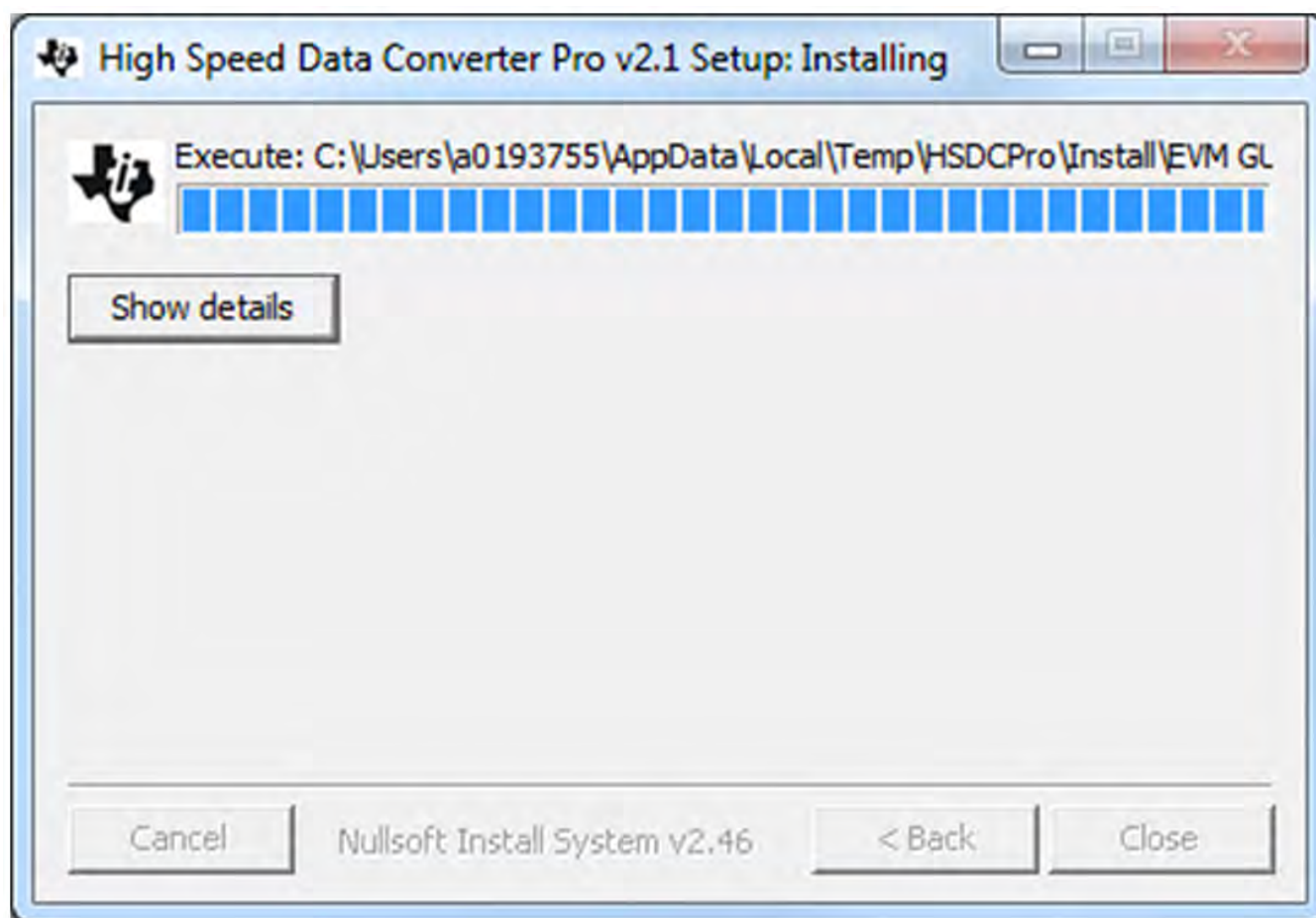
**Figure 35. HSDCPro Install (Installation Progress)**

- The window shown in [Figure 36](#) appears indicating *Installation Complete*. Press the *Next* button.



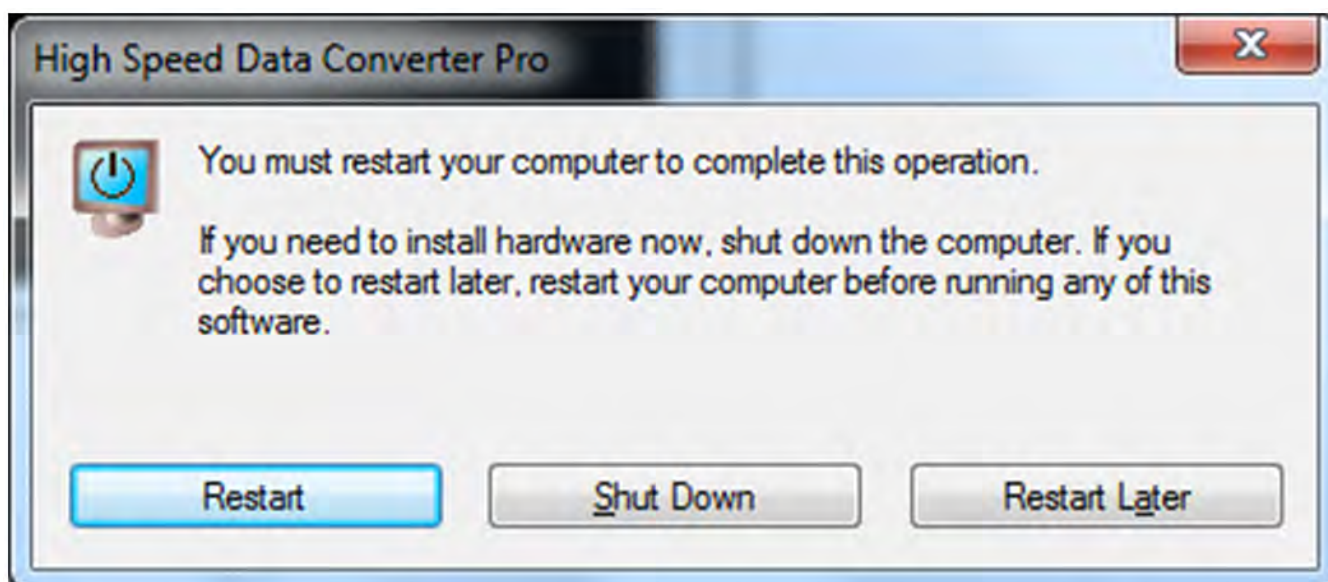
**Figure 36. HSDCPro Install (Installation Complete)**

- The window shown in [Figure 37](#) appears briefly to complete the process.



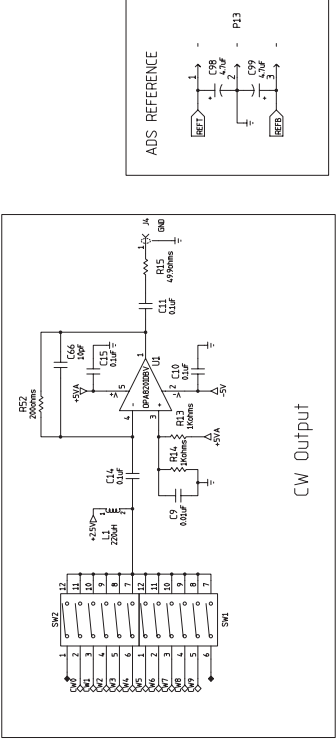
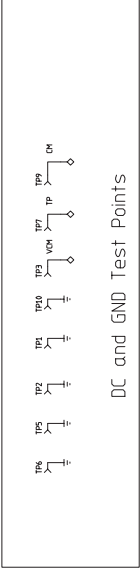
**Figure 37. HSDCPro Install (h)**

- As shown in [Figure 38](#) a restart might be requested depending on whether or not the PC already had the National Instruments MCR Installer. If requested, hit the *Restart* button to complete the installation.



**Figure 38. HSDCPro Install**





## Revision History

Changes from B Revision (August 2011) to C Revision	Page
• Changed text To: an ADSDer-50EVM or TSW1400EVM is needed during the evaluation .....	1
• Added AFE5805EVM Kit Contents .....	2
• Changed <i>Default Setup for Jumpers</i> image.....	6
• Changed Figure - Typical AFE5805 Bench Setup .....	11
• Changed paragraph text .....	12
• Changed Appendix A: TSW1400 for Evaluating AFE5805.....	26
• Added Appendix B: High Speed Data Converter Pro (HSDCPro) GUI Installation. ....	36

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.



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- 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms and conditions that accompany such Software
- 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

- 2 *Limited Warranty and Related Remedies/Disclaimers:*

- 2.1 These terms and conditions do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
- 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for any defects that are caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.
- 2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

- 3 *Regulatory Notices:*

- 3.1 *United States*

- 3.1.1 *Notice applicable to EVMs not FCC-Approved:*

This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

- 3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

### 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.

### FCC Interference Statement for Class A EVM devices

*NOTE: 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

*NOTE: 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.*

### 3.2 Canada

#### 3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210

##### Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-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.

##### 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.

##### 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.

##### 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.

### 3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see [http://www.tij.co.jp/llds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/llds/ti_ja/general/eStore/notice_01.page) 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。  
[http://www.tij.co.jp/llds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/llds/ti_ja/general/eStore/notice_01.page)

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan are NOT certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs 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 EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】

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