AFE5809EVM Evaluation Module

This document assists in evaluating the AFE5809 highly integrated analog front-end devices through the use of the AFE5809EVM Evaluation Module. Included are setup instructions, printed-circuit board art, bill of materials, and schematics.

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1   Overview

This document is intended as a step-by-step guide through the AFE5809EVM Evaluation Module (EVM) setup and test. The EVM is shipped with a default configuration from the manufacturer. With this configuration, the onboard CMOS clock is used for a analog-to-digital converter sampling clock; the onboard oscillator is used for CW mode operation. No external clock generator is required. Users need to provide the input signal for measurement from a signal generator.

Detail explanation regarding the jumpers, connectors, and test points appear in Section 11. The graphical user interface (GUI) can be downloaded from the TI Web site.

2   Default Configuration

Figure 1 shows the default configuration of the EVM from the factory. The accompanying list identifies the basic components on the EVM board.
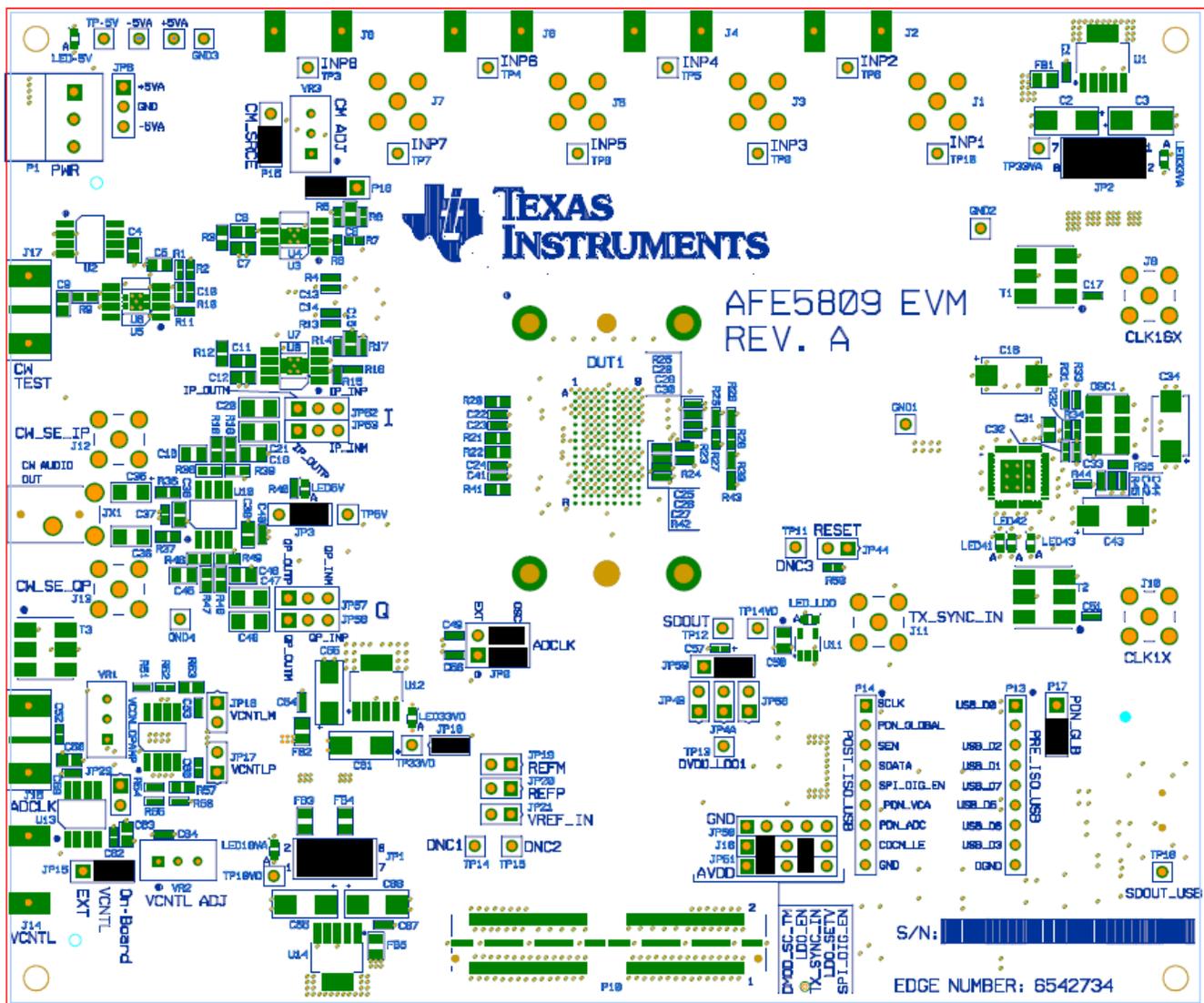
Figure 1. AFE5809EVM Basic Configuration

1. P1 – Power supplies connector ±5 V.
2. JP1, JP2, and JP3 are set to enable 3.3-V, 1.8-V, and 5-V power supplies to the device.
3. JP9: Enables onboard CMOS clock.
4. JP10: Power supply for onboard CMOS clock oscillator.
5. JP15: Enables onboard Vcntl.
6. JP59: Connects 1.4-V supply (LED_LDO should be lit).
7. P17: Disables PDN_Global.
8. P15: Choose the device Common Mode for the I/V Amp Common Mode.
9. P16: Chooses Vss as –5 V for low-side power supply on the I/V Amp.
10. JP16 is set to enable the demodulator internal LDO, as shown in Figure 1.

3   Software Installation and Operation

The AFE5809EVM GUI (SLOC254) can be downloaded from the TI Web site. Follow the directions in the Read Me First.pdf file to install the GUI and device driver.

4   Test Setup

Two EVMs are required to evaluate the AFE5809 device. Figure 2 shows the exact setup of these two boards and external connectors. For the default configuration shown in Figure 1, having an external sampling clock and external Vcntl supply is unnecessary. The onboard CMOS clock and onboard Vcntl are used.
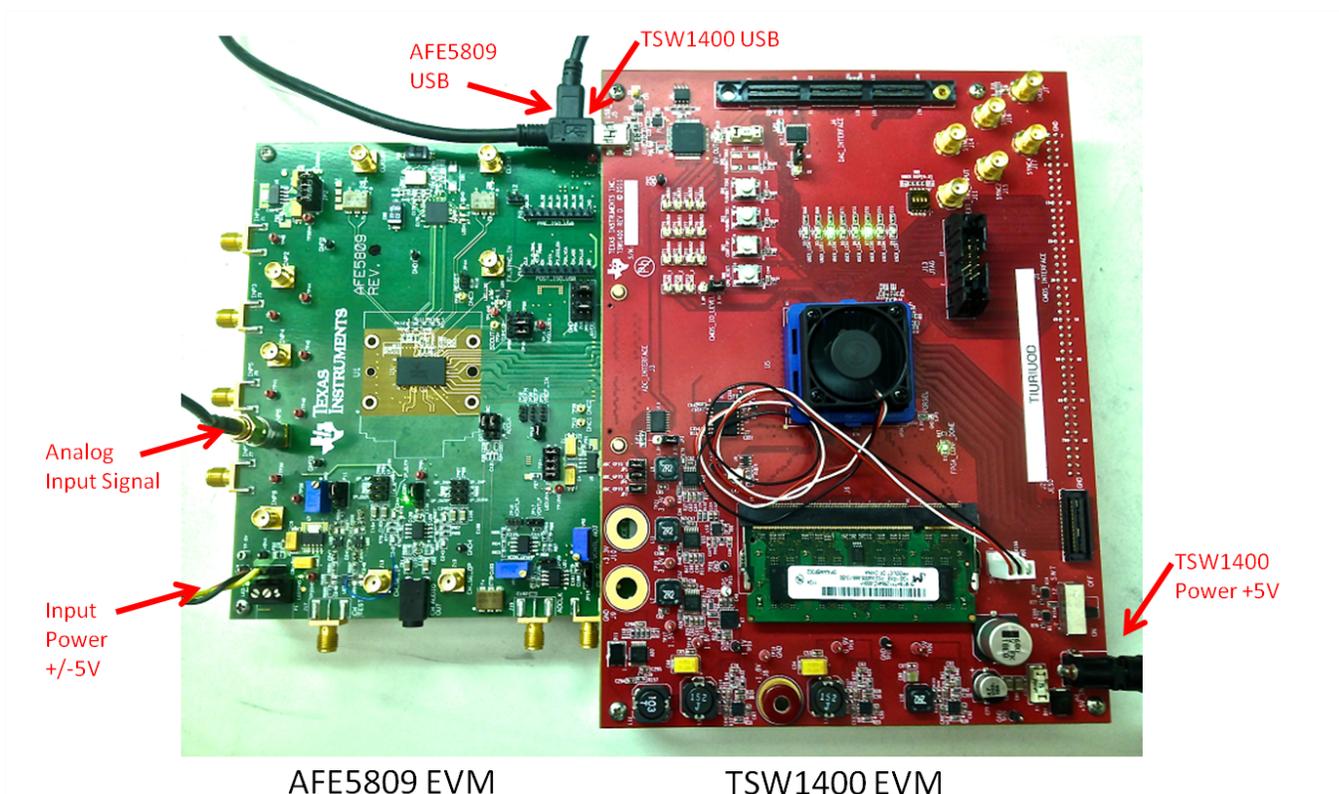
Figure 2. Default HW Setup With Connection Between TSW1400EVM and AFE5809

5 Power Up AFE5809

Power up the AFE5809EVM by applying +5 V and –5 V to the P1 connector. After power up is complete, five green LEDS and three red LEDS turn on as shown in Figure 3.

Figure 3. LED Placement

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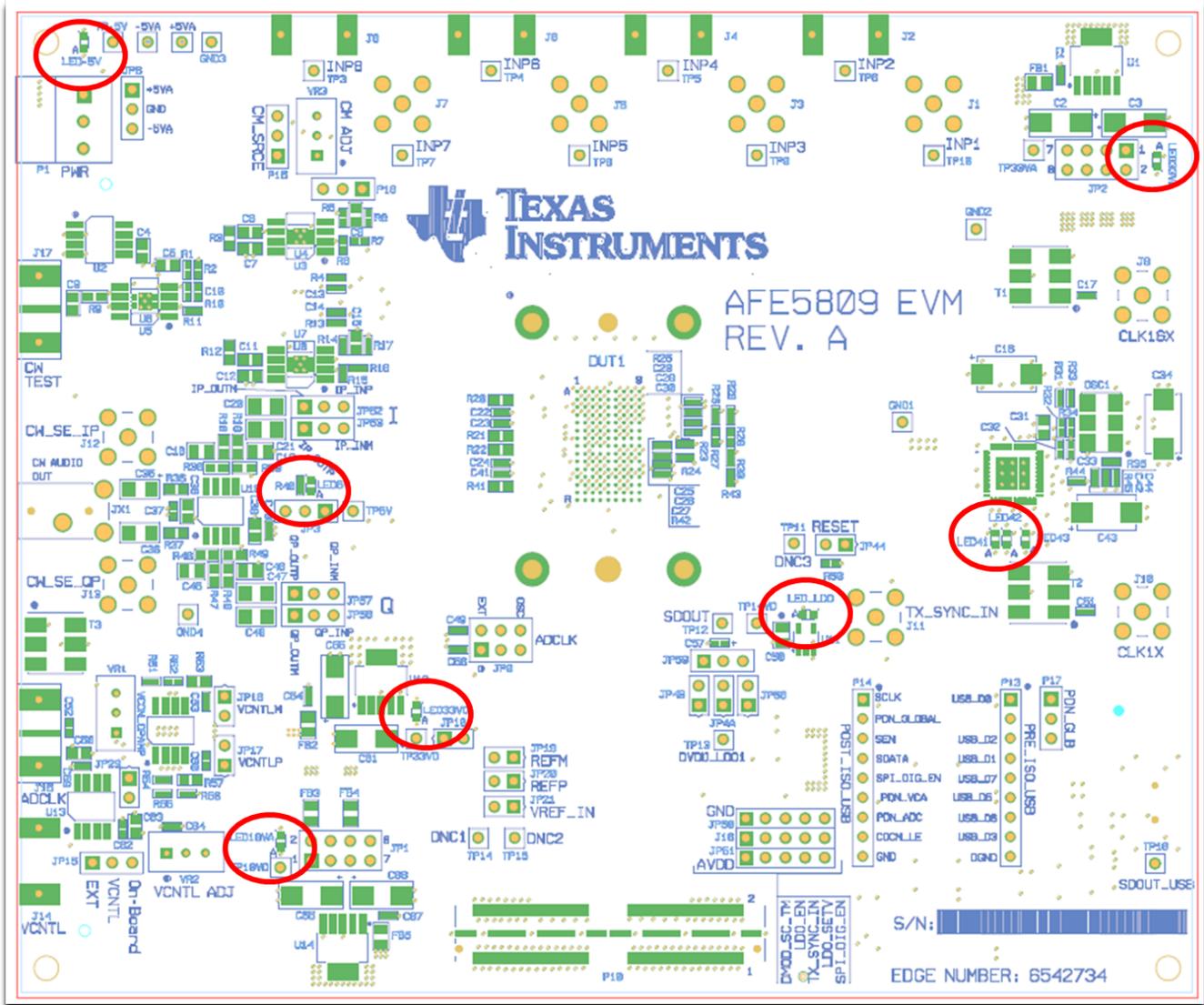
6   Launch AFE5809 GUI

Launch the AFE5809 graphic user interface (GUI), Figure 4. After successful launch, the status bar at the bottom should say "Ready for new command". Then, LED41 and LED42 turn off and the rest of the LEDS remain on. The GUI automatically configures the default setup. Select the ADC page to observe the default condition.
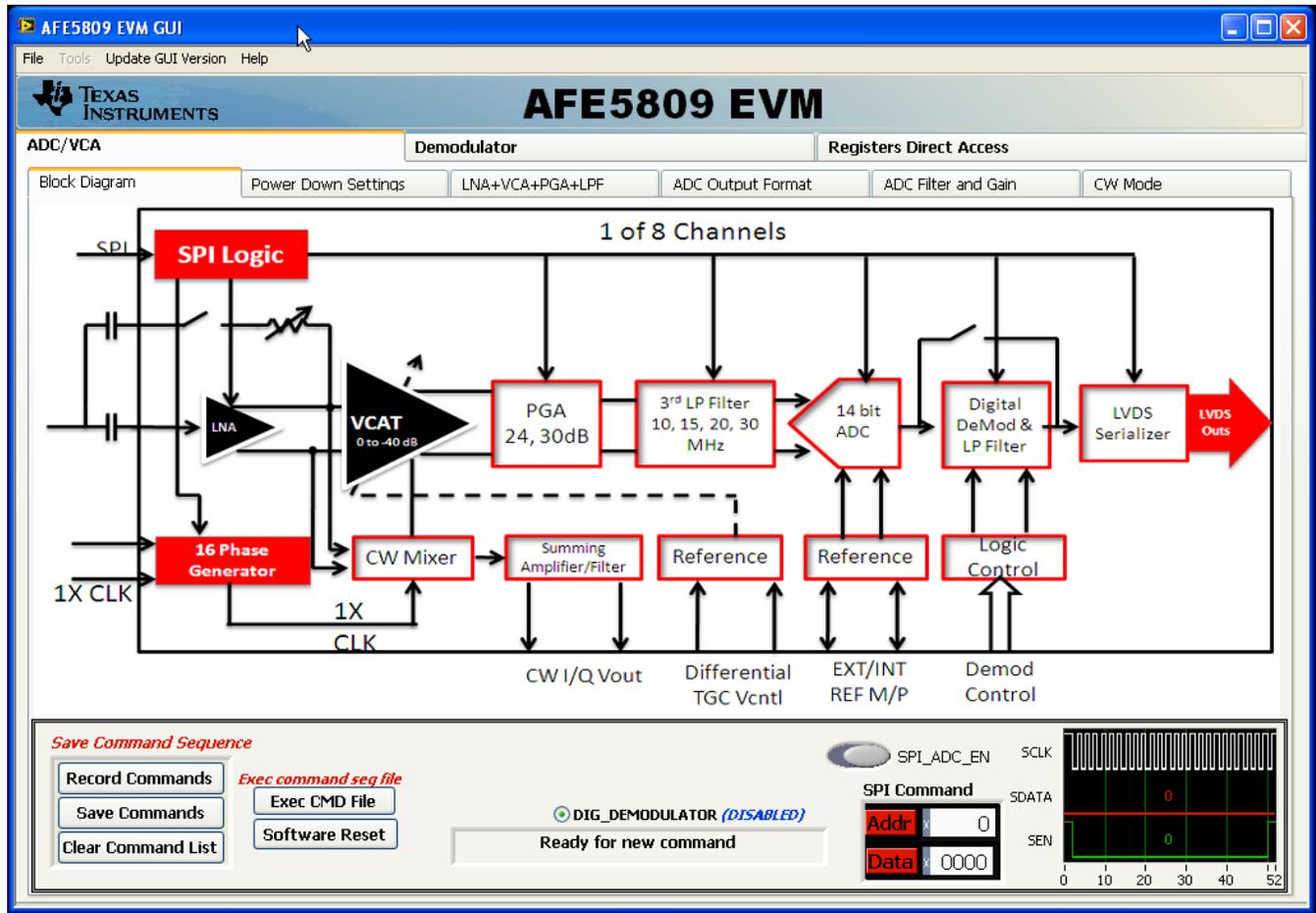
Figure 4. Default Page for AFE5809 GUI

Figure 5 shows the Default Condition on the ADC window.
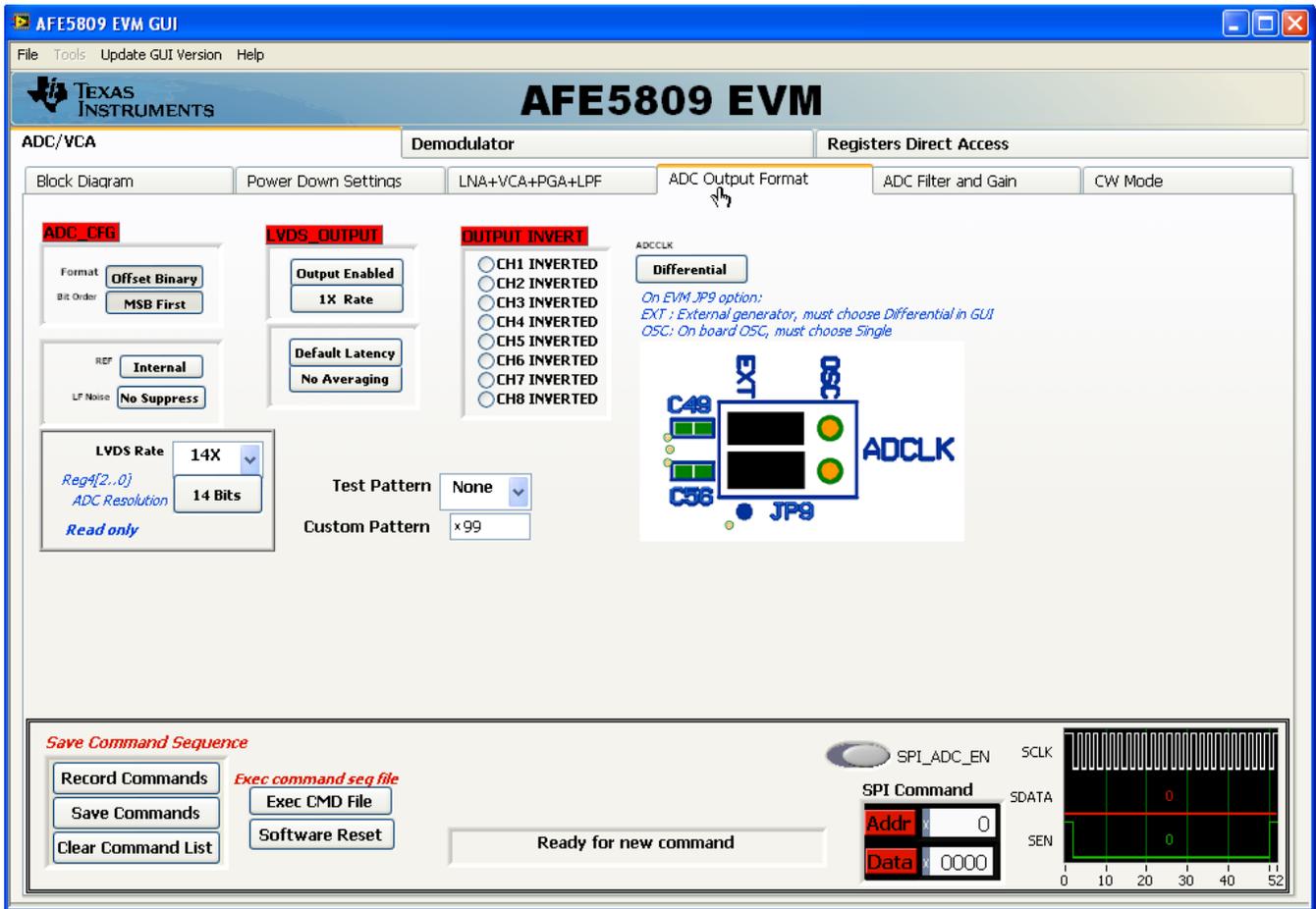
Figure 5. Default ADC State

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7 Launch TSW1400 GUI

Launch the TSW1400 GUI. A Pop-up window should prompt you to connect to the EVM if it is connected via USB. If a different message or an error message appears, contact the TI FAE. If the GUI connects properly, the status at the bottom says "Connected" in Green.

Select *AFE5809_09_14b* for the firmware by clicking the blue arrow.

Click *Yes* to update firmware on the board. This can take about 30 seconds.

ADC Sampling Rate in lower left should be set to 40 MHz; this is the onboard CMOS clock frequency. Set this appropriately if using an external clock.

ADC Input Frequency – enter 2M.

Check the "Auto Calculation of Coherent Frequency" box in the lower left to display actual coherent frequency based on user input. This is only needed for signal integrity testing like SNR.
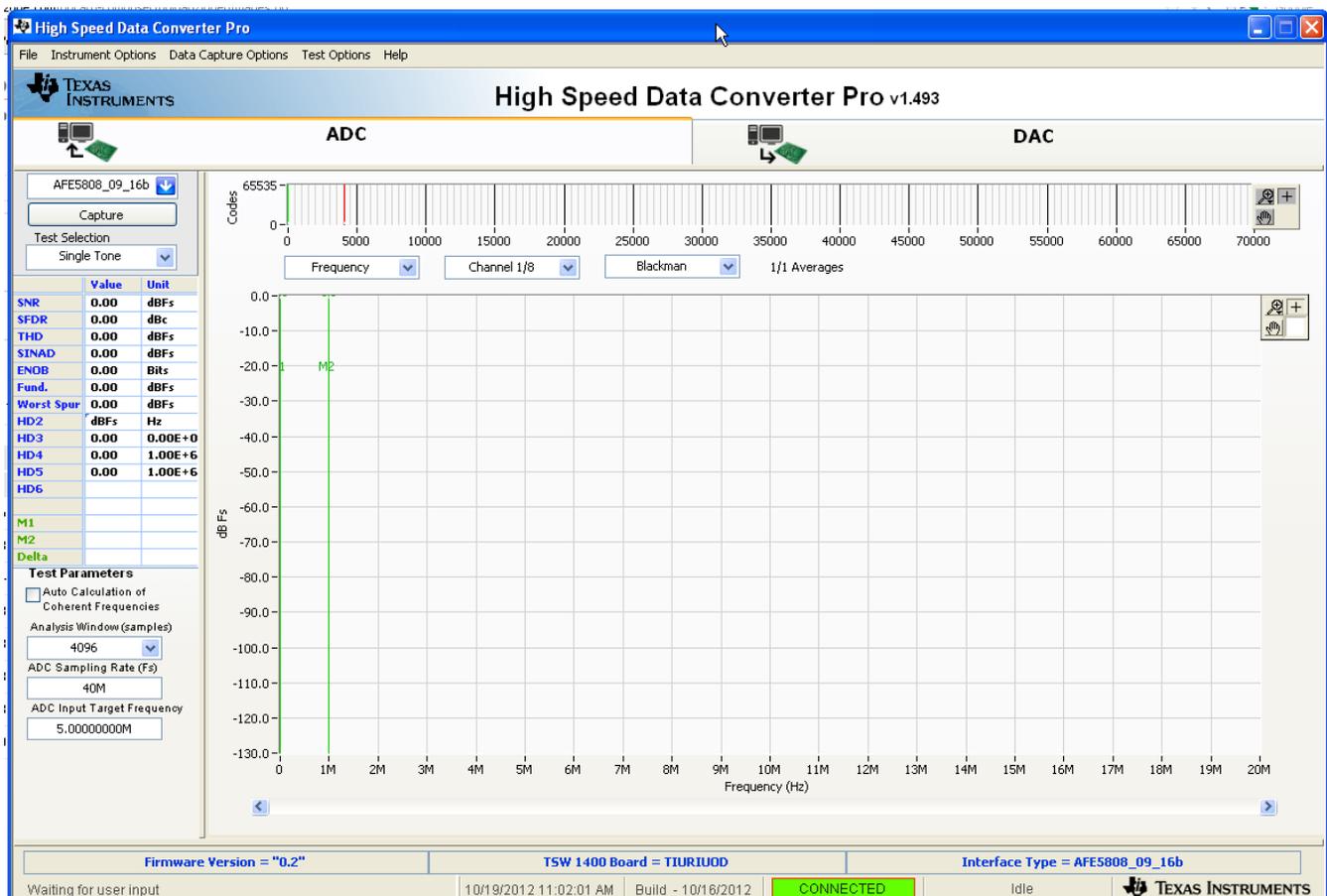
Figure 6. TSW1400 GUI Load

8 TEST AFE5809

8.1 Step 1: Time Domain

- Select the Time Domain page from the TSW1400 GUI.
- Uncheck *Overlay 'Unwrap Waveform'*.
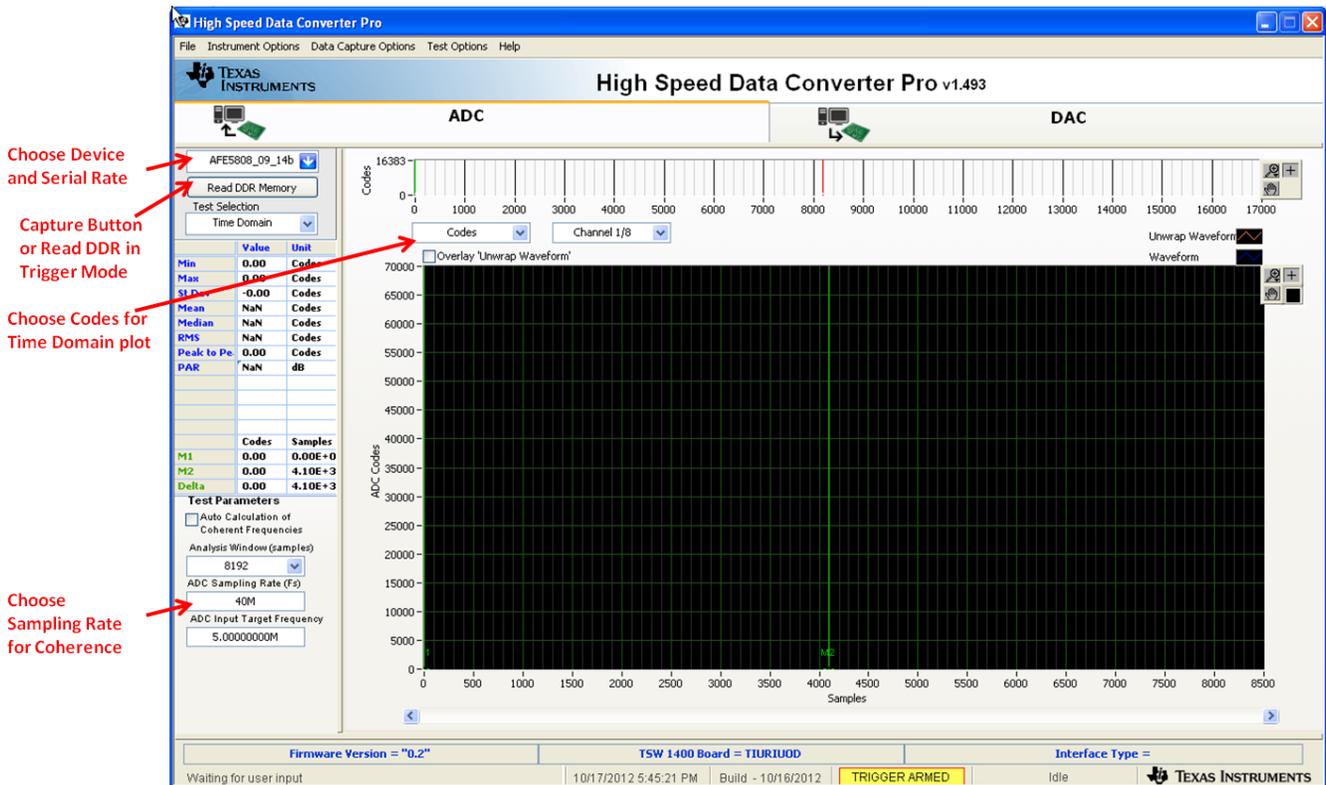
Figure 7. TSW1400 GUI Configuration

- From the AFE5809 GUI, go to the *ADC* page, and then select Ramp.
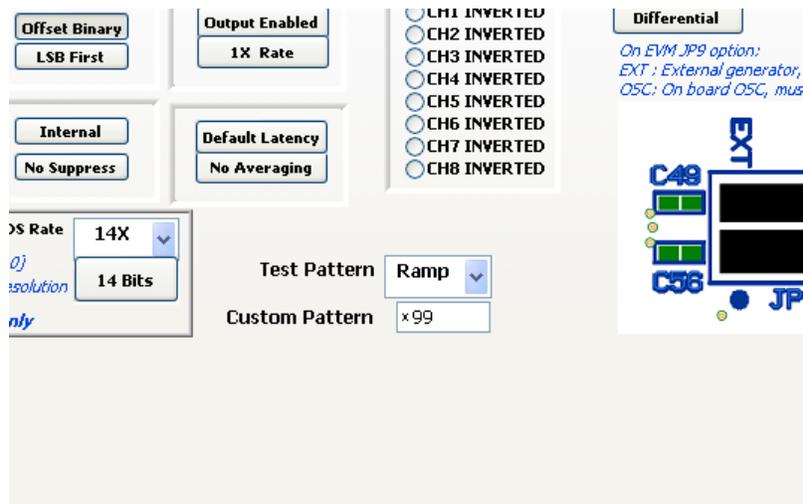
- Press the Capture button on the TSW1400 GUI. This displays a ramping waveform on the TSW1400 GUI display area as shown in Figure 8.
- Verify that Maximum value is 16383 for 14-bit mode.
- Repeat for Channel 2 and Channel 8.
- *If each channel has the output as shown in Figure 8, proceed with the next step; otherwise, contact the TI FAE to troubleshoot the problem.*
- On the AFE5809 GUI, change Test Pattern from *Ramp* to *None* for the next step.
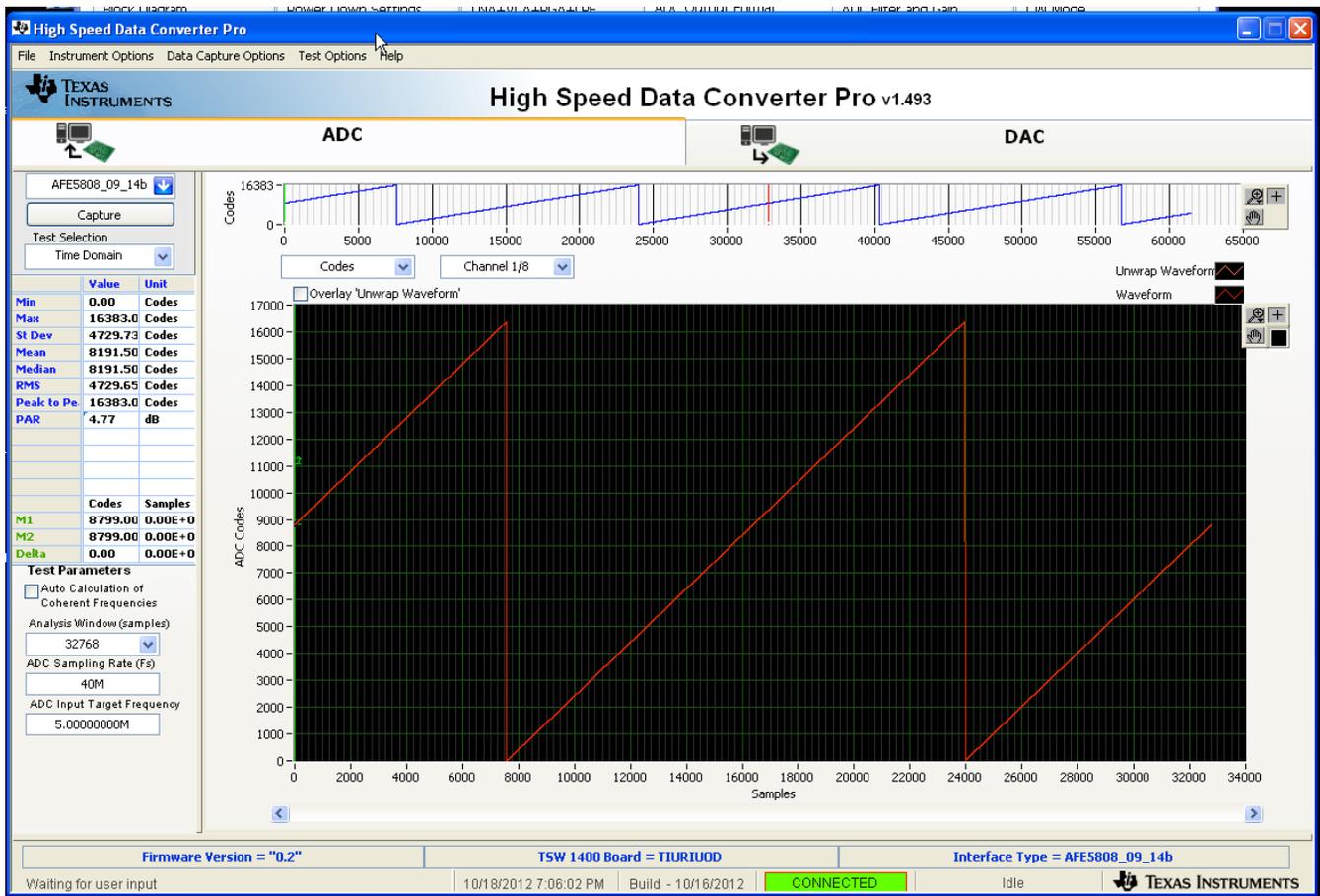
Figure 8. Ramp Waveform Output

8.2   Step 2: Single Tone FFT

- Select *Frequency* from the display control on the TSW1400 GUI to display the FFT.
- Connect Channel 1 of the AFE5809EVM to a signal generator through a *BP filter*. If a BP filter is not present, the result is not good.
- Set the amplitude of the signal generator to *-25 dBm*.
- Set the frequency of the signal generator to the value in the "ADC Input Target Frequency" field of the TSW GUI.
- Change the window option to *Hanning* if using the onboard clock. This is because the input signal and the onboard CMOS clock are noncoherent.
- Press the *Capture* button to get the test result.
- Repeat for Channel 2 through Channel 8.
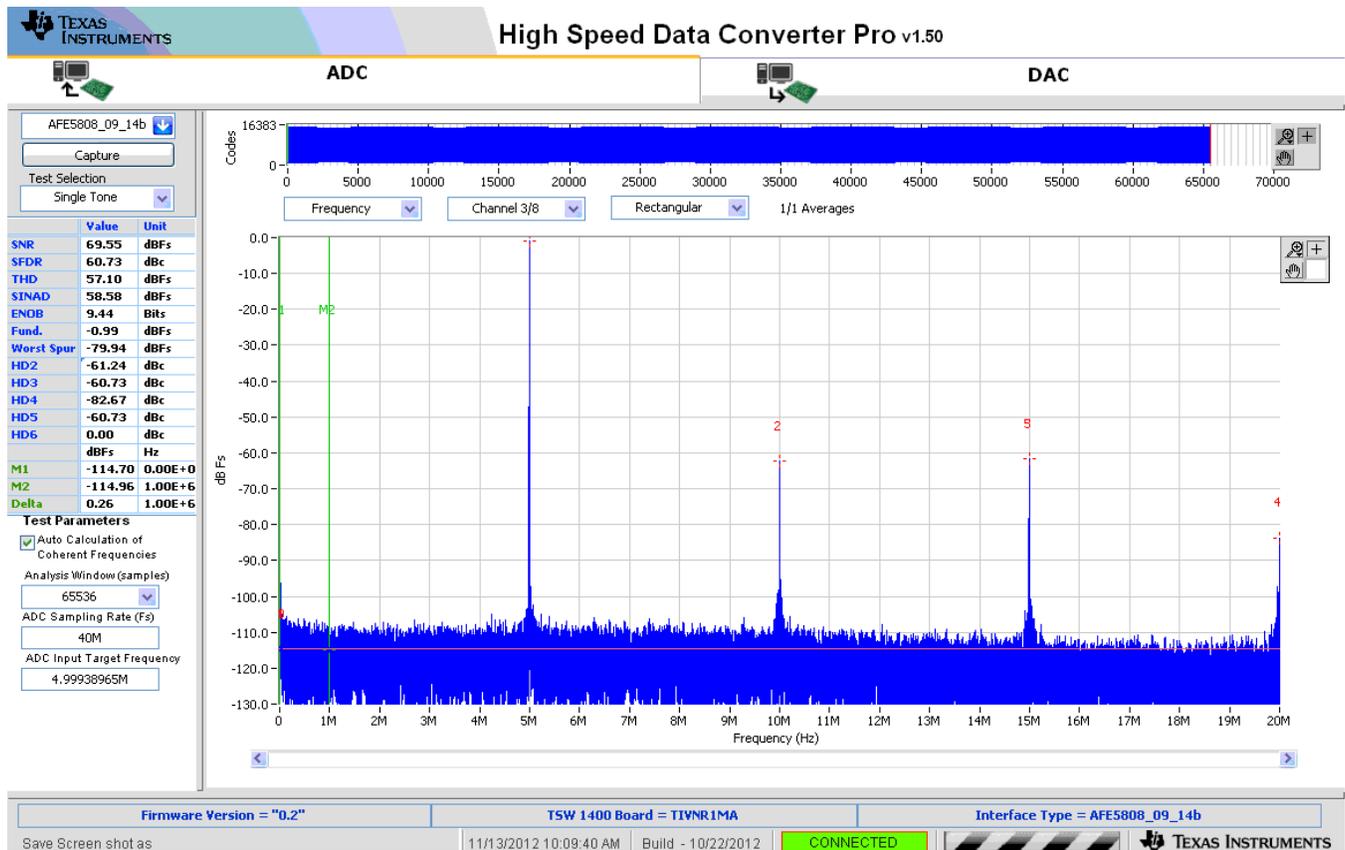
Figure 9. GUI: Single FFT Format

8.3   Step 3: Demodulator Mode

The AFE5809 has a special demodulation and decimation mode whose main purpose is to reduce the LVDS data rate and improve overall system power efficiency. The device includes some built-in test modes to verify that demodulator block is working correctly.

First, setup hardware as follows:

- USB cable connected to both EVMs
- External ADC clock enabled and used
- Sync external clock to analog sine burst source
- Connect analog input waveform to input channel 1
- Connect trigger from sine burst source that is synced with the analog signal to TX_Sync_in at J11
- Connect same trigger to TSW1400 EVM trigger input at J11
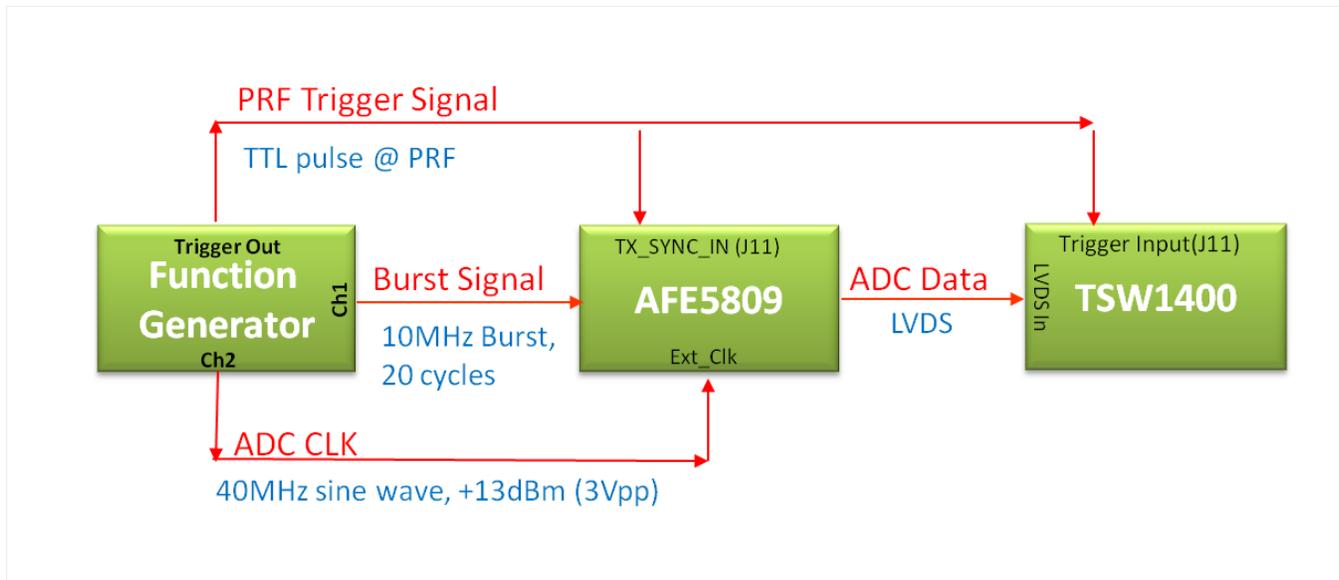
Figure 10. Hardware Setup for Demodulation Mode Capture

First, setup an analog input waveform at 10 MHz and 20 cycles similar to Figure 11 (Tektronix AFG3102 is recommended). Adjust amplitude until there is no clipping of waveform.
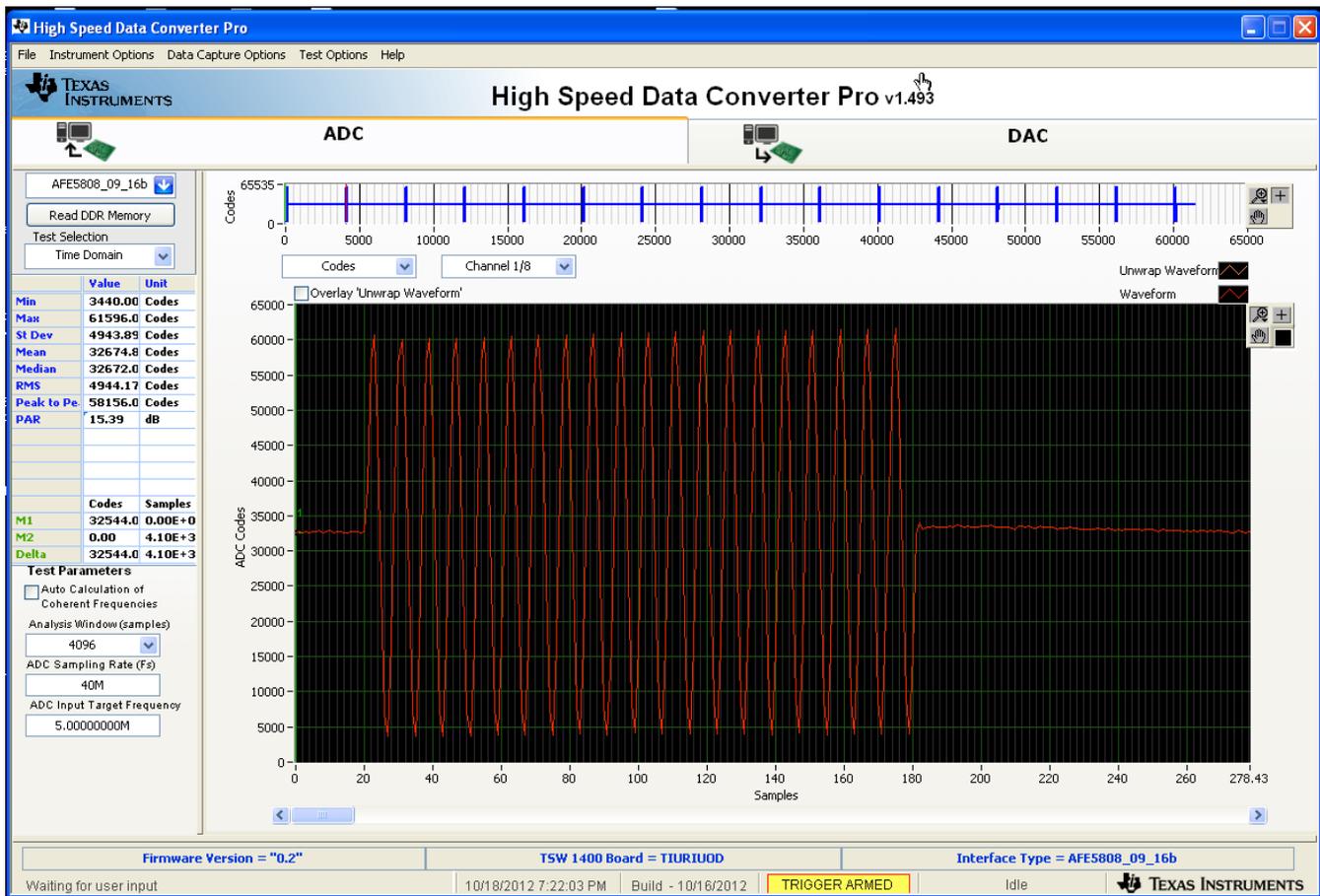
Figure 11. Analog Sine Burst with 20 Cycles at 10 MHz

The ADC must be set to the proper configuration for Demodulation:

- ADC format must be MSB First, 2's Complement
- LVDS Rate must be set to 16X
- Choose any demodulator test mode from the following buttons: Sine Test Mode, RF Test Mode, Coefficient Test Mode and Demod M=4 I/Q Test Mode.
- For modes and options, load a text using "Exec CMD File".
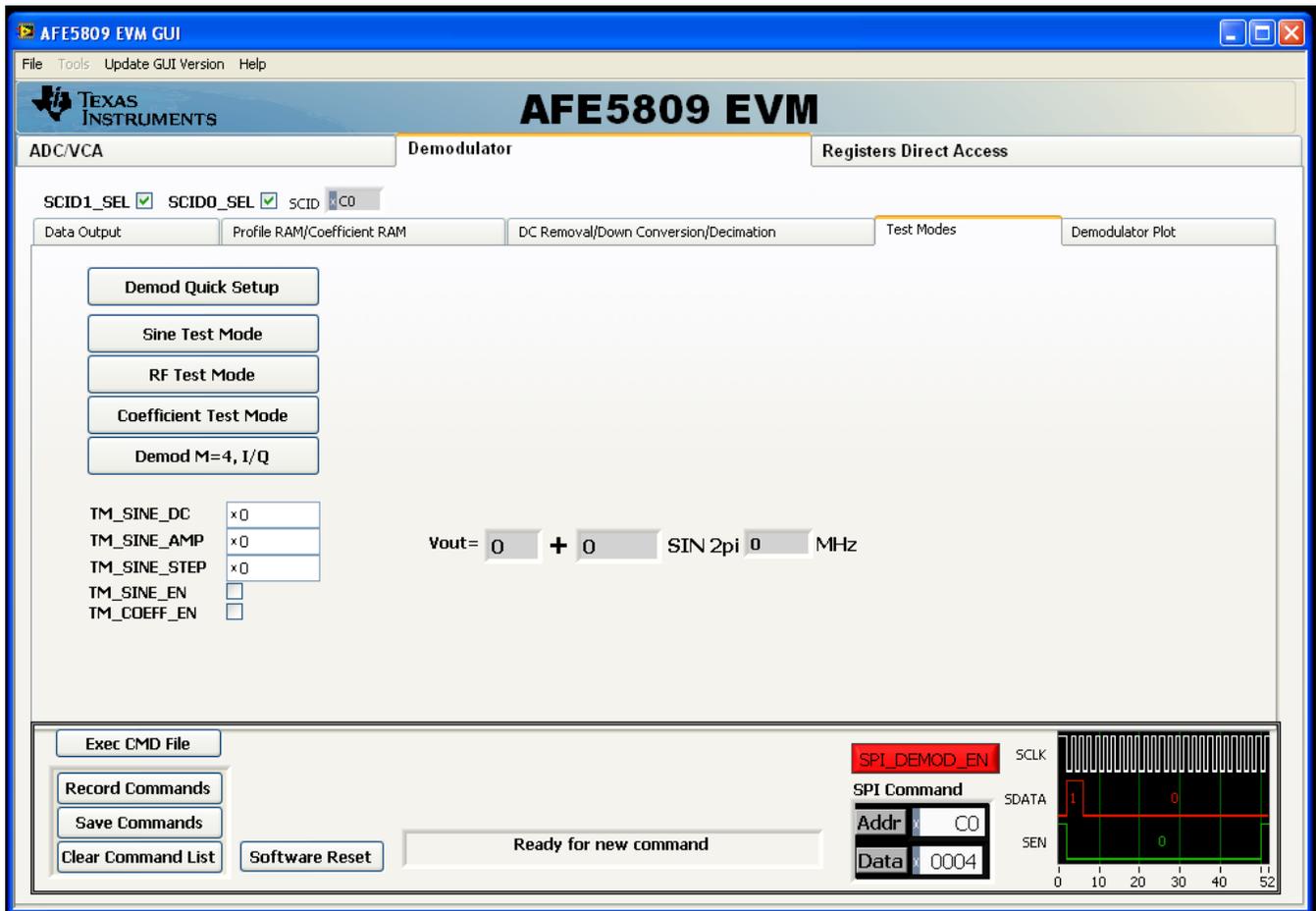
Figure 12. Demod Quick Load Buttons

Next, capture triggered data from the TSW capture card:

- Change TSW1400 GUI Firmware setting to "AFE5808_09_16b"
- Enable Trigger Mode in TSW GUI
- Capture data by pressing the Read DDR Memory button. (In triggered mode, press this button twice to capture updated data). The output on the plot does not make any sense because of the LSB and MSB disconnect between the AFE5809 GUI and the TSW GUI. Also, if the trigger is not strong enough to drive a 50-Ω load, the R83 may need to be removed from the AFE EVM.

Next, import the TSW data into the AFE5809GUI for data processing:

- Go back to the AFE GUI and choose under the Demodulator main tab, choose "Demodulator Plot". This should be set-up for M=4, Channel 1, MSB mode, Record size should be 2000. If a capture has taken place in the TSW GUI, then click "TSW capture" on the Demodulator Plot Tab and the Raw Data Plot updates with the data from the TSW memory. If the "MSB" button is true, then the raw data should make sense. Note: Do not choose "2's complement" in Sine Test Mode.
- Try this process (TSW GUI Capture twice -> AFE GUI "TSW Capture") for the other test modes.
- Under RF Test Mode, the output should look similar to the input.

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- Under Demod M=4 I/Q Test Mode, also look at the "Separate Data" tab to view the I/Q separated Data.
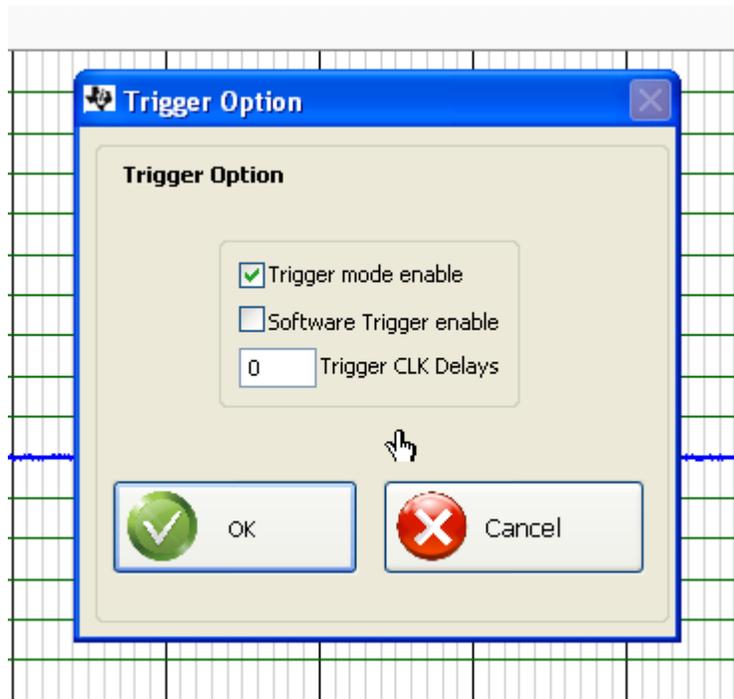
Figure 13. Choose Trigger Mode
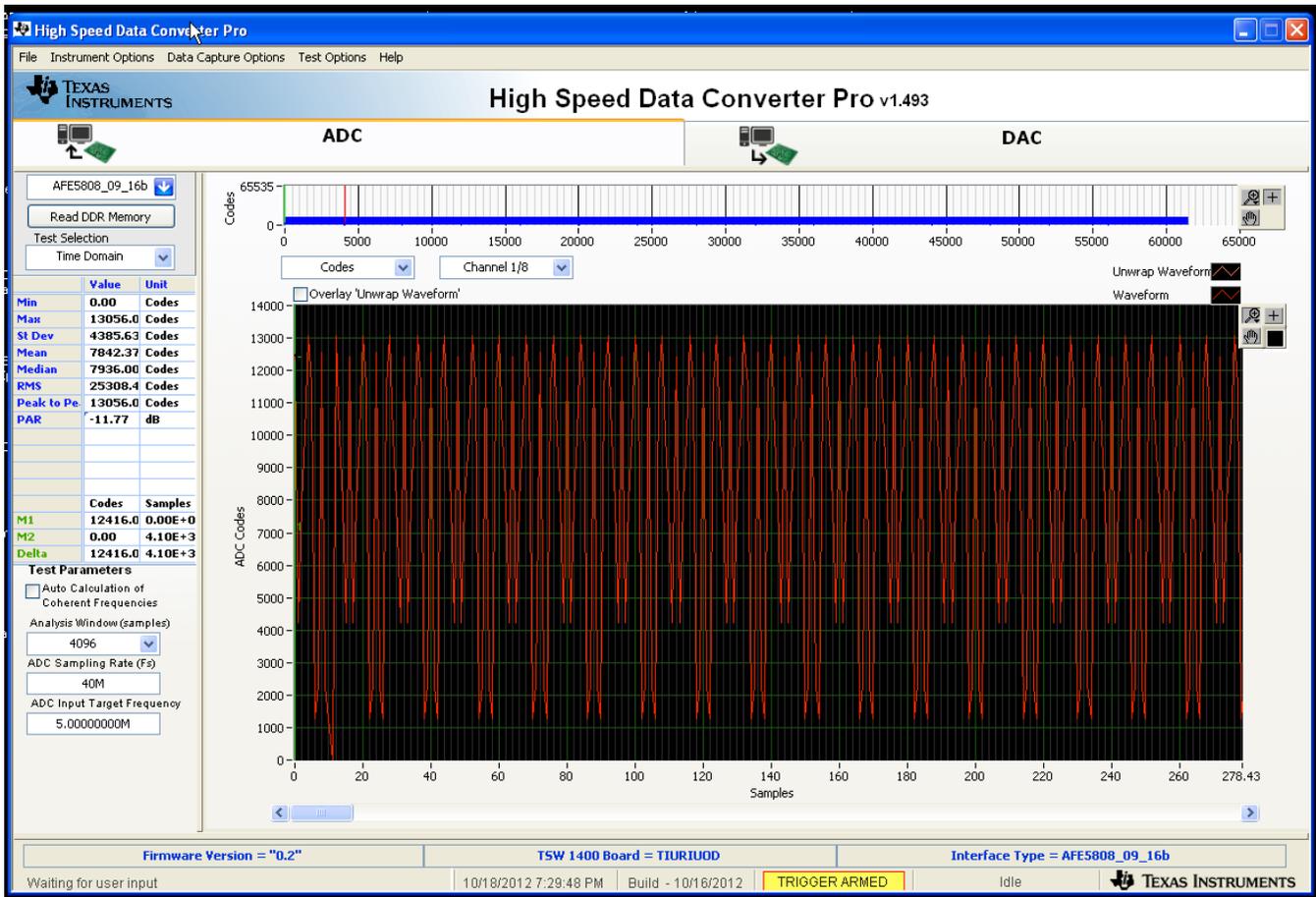
Figure 14. MSB and LSB Mismatch Raw Data for Sine Test Mode
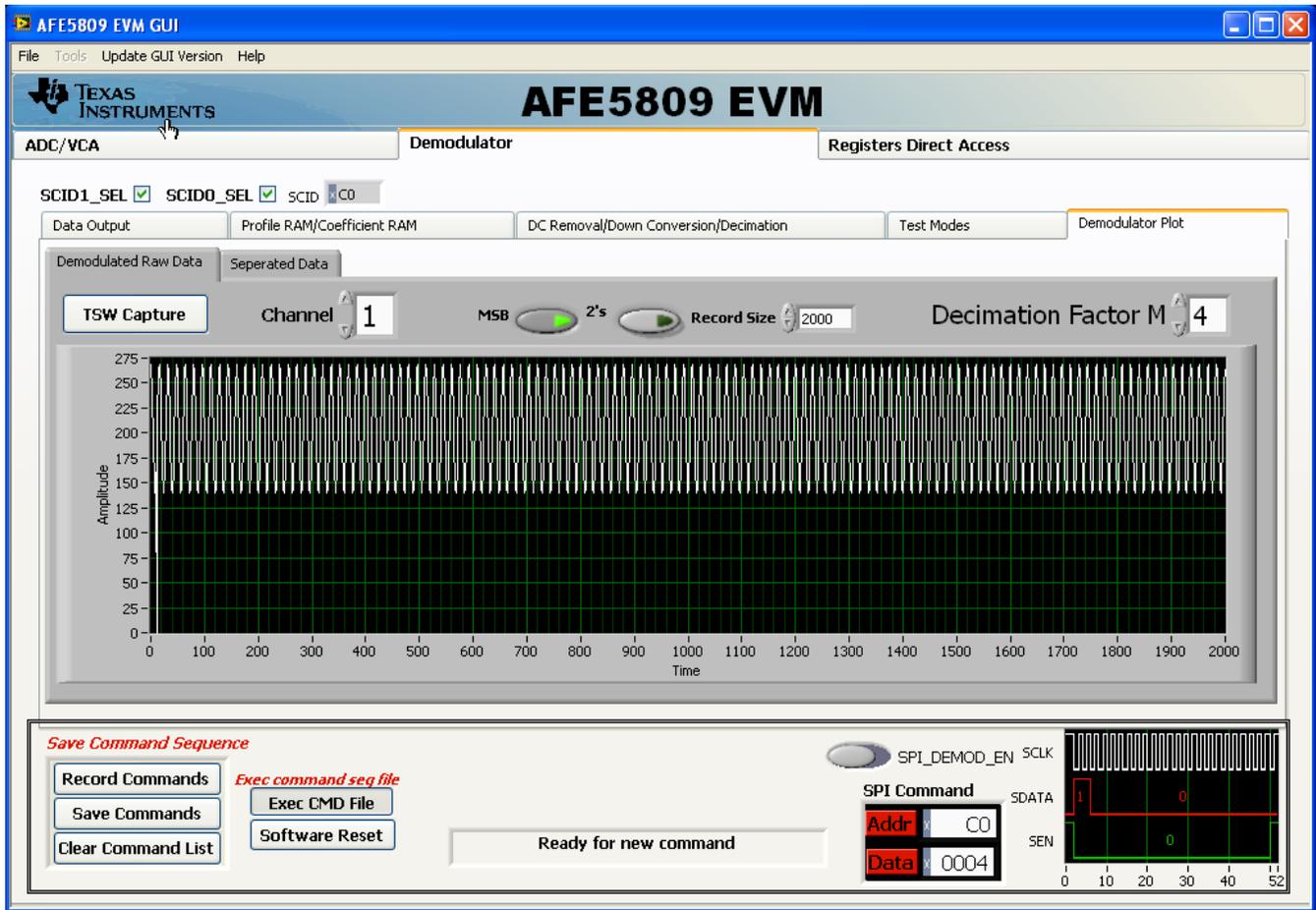
Figure 15. Sine Test Mode Output Seen in the Demodulator Plot
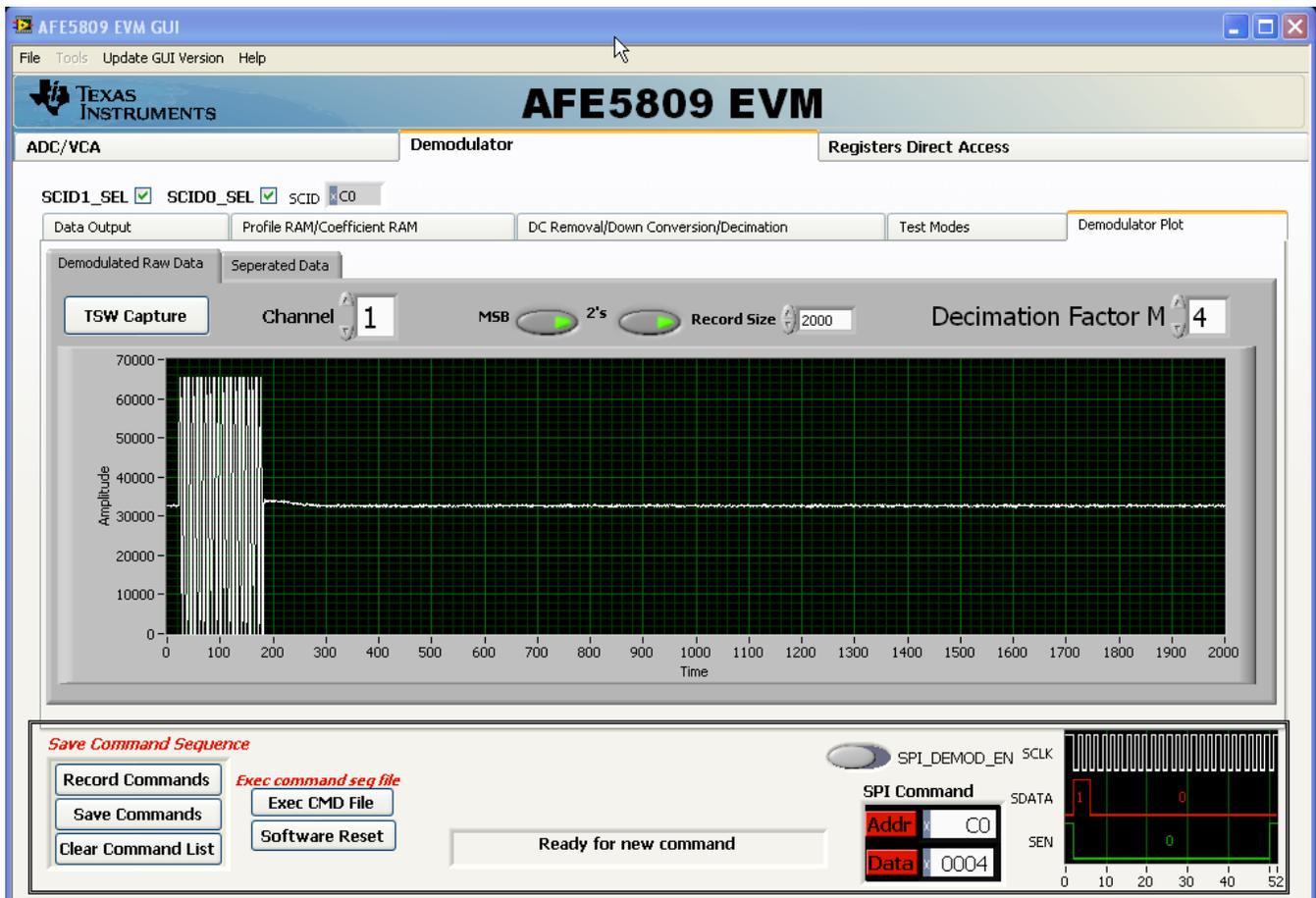
Figure 16. RF Test Mode Output

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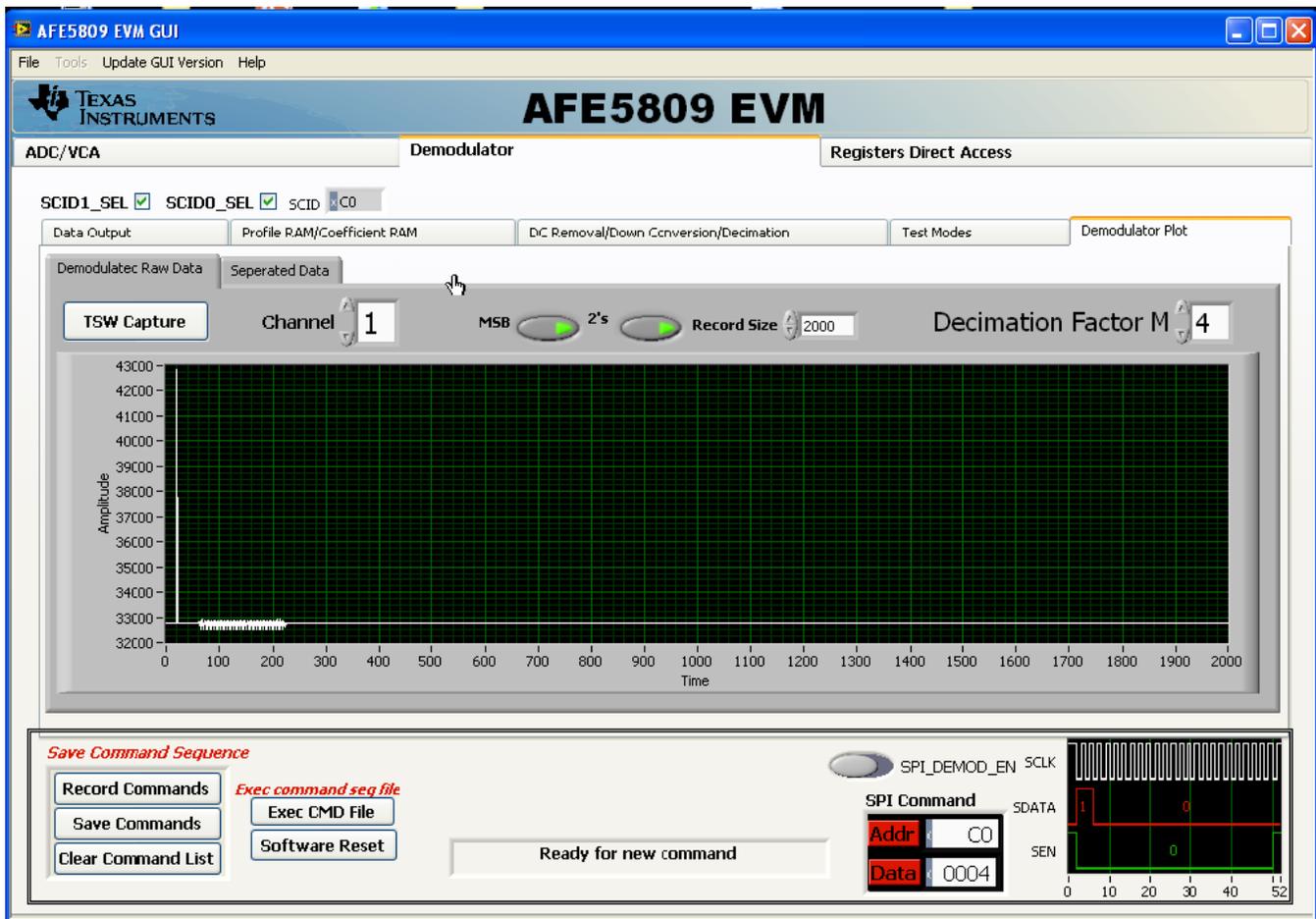
Figure 17. Demod M=4, Both I and Q Data Test Mode Output Raw Data
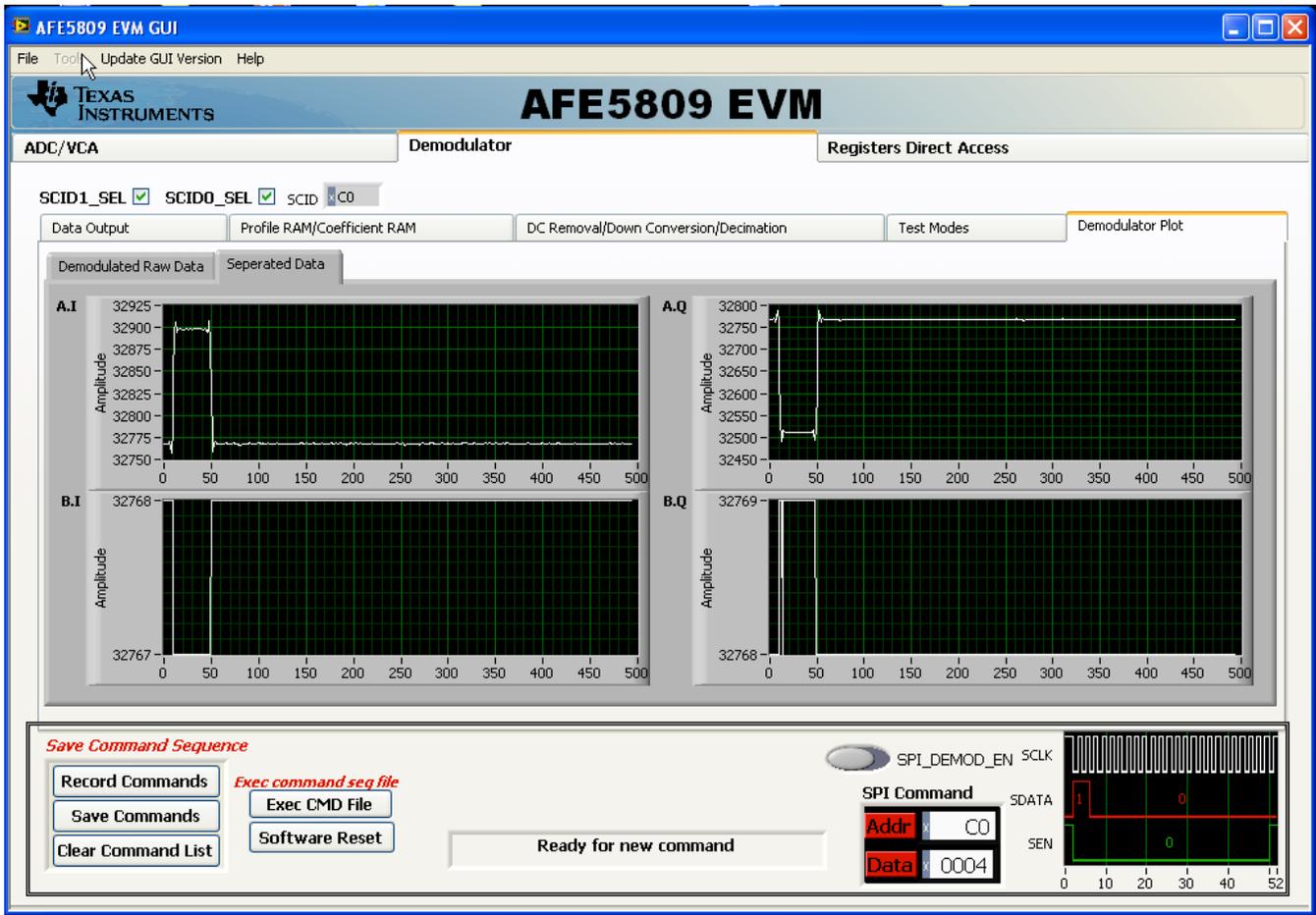
Figure 18. Demod M=4 I/Q Test Mode, Separated Data

9   Hardware Setup, CW Mode
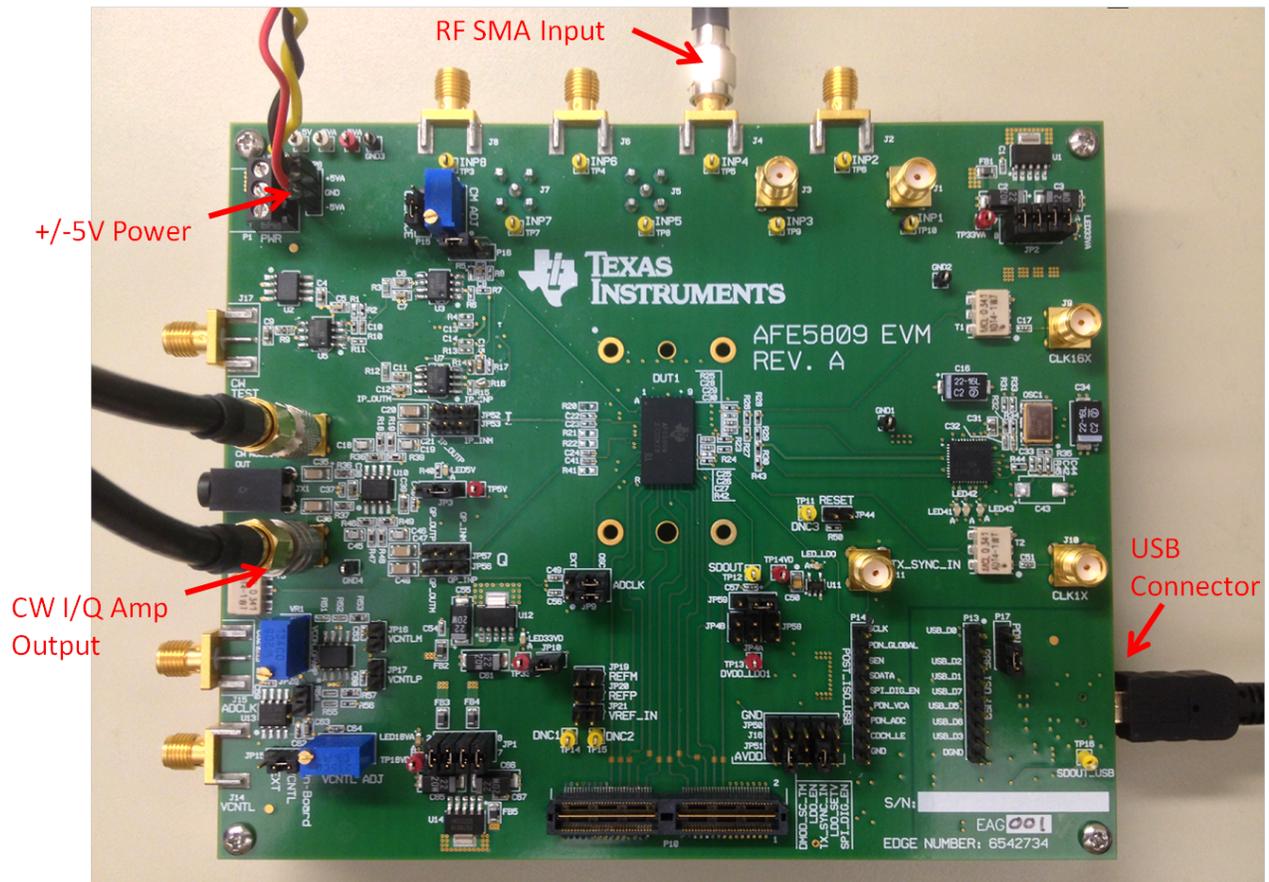
Figure 19. Setup for CW Mode

9.1 Step 1: Switch to CW Mode

- Go to the *CW Mode* page.
- Check *CW Mode Enable*. Then LED41, LED42, and LED43 on AFE5809EVM all illuminate.
- Select 500 Ω for the gain control feedback resistor.
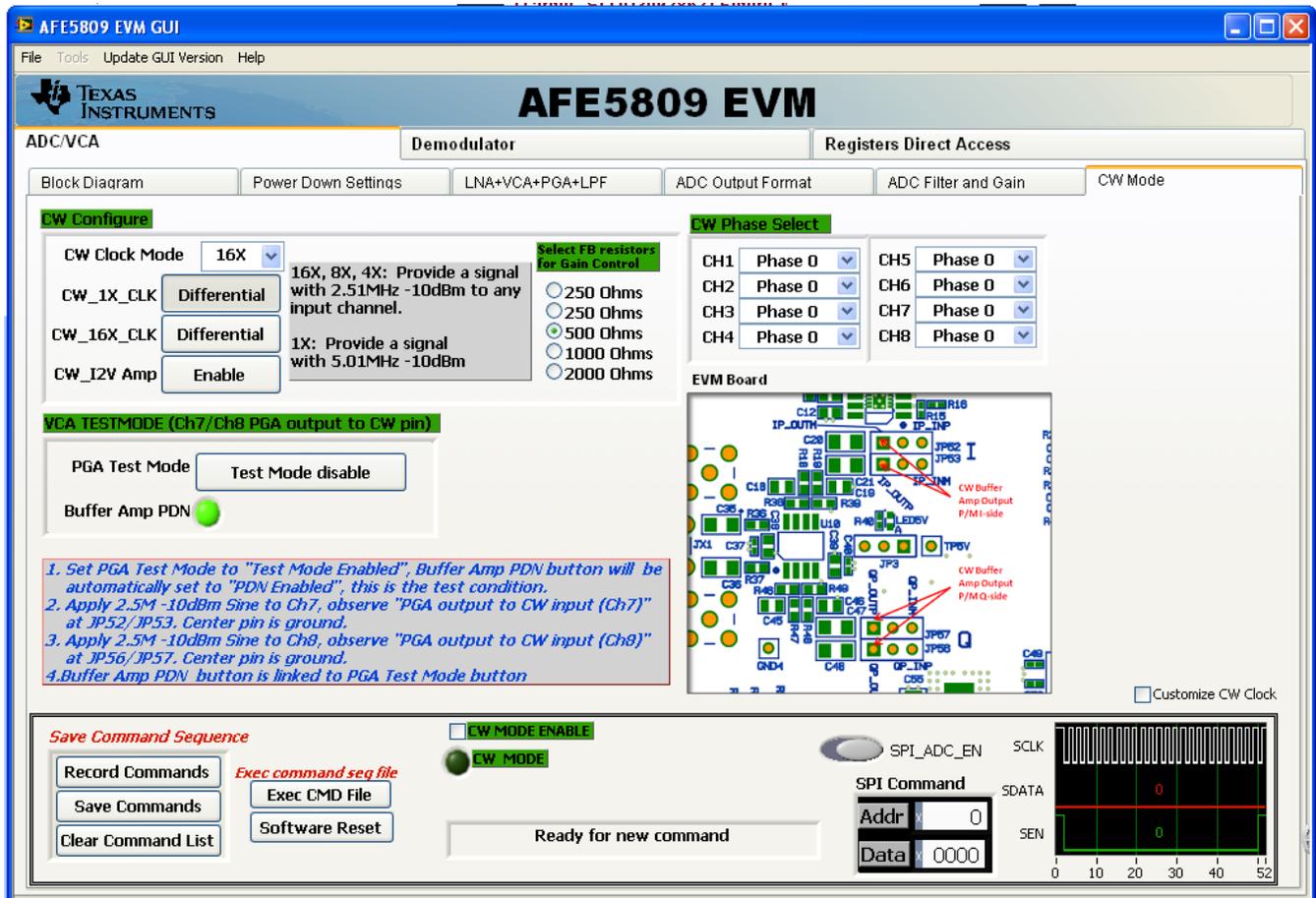
Figure 20. Switching From Default (ADC) Mode Panel to CW Mode Panel

9.2 Step 2: Apply Input and Observe Outputs

- Apply an analog signal (2.51 M, –10 dBm) to any analog input SMA.
- The CW outputs (J12, J13) display the frequency I and Q signals at 10 kHz as shown in Figure 21. The GUI *Gain Control Feedback Resistor* can be used to vary the amplitude of the outputs.
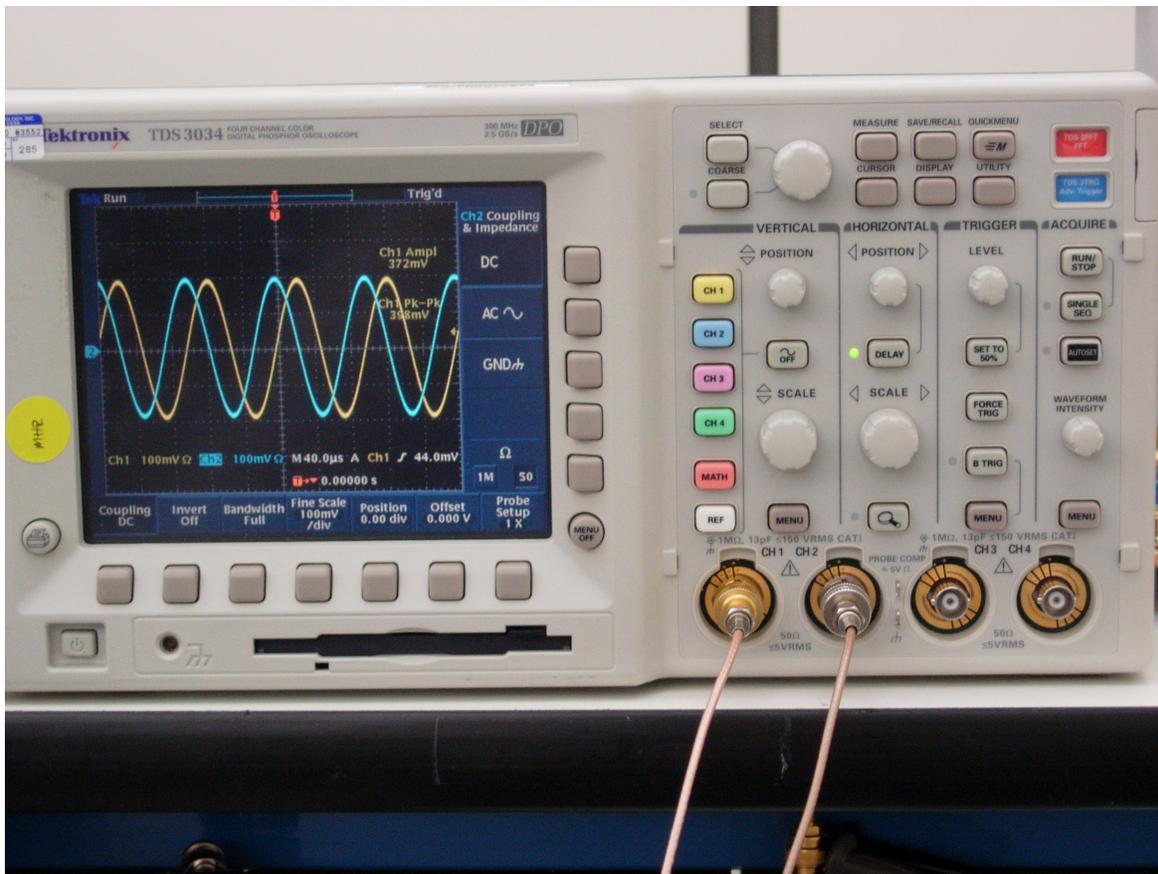
Figure 21. CW Outputs

9.3 External Clock for CW Mode

The CW mode clocks can be supplied from J9 (X16/X8/X4/X1) and J10 (X1) using external signal generators. The manufacture default setup uses ON BOARD CLOCK, with which C154, C155, C156, and C157 are installed. To switch to an external clock, these four capacitors must be uninstalled and capacitors C49,C50,C52, and C53 must be installed. The following table shows the configuration for these eight capacitors.

Table 1. Configuration for Clock Capacitors

Capacitor	Onboard Clock	External Clock	Comments
C27	Uninstalled	Installed	Top layer of the EVM
C28	Uninstalled	Installed	Bottom layer of the EVM
C100	Uninstalled	Installed	Bottom layer of the EVM
C102	Uninstalled	Installed	Top layer of the EVM
C29	Installed	Uninstalled	Top layer of the EVM
C30	Installed	Uninstalled	Top layer of the EVM
C25	Installed	Uninstalled	Top layer of the EVM
C26	Installed	Uninstalled	Top layer of the EVM
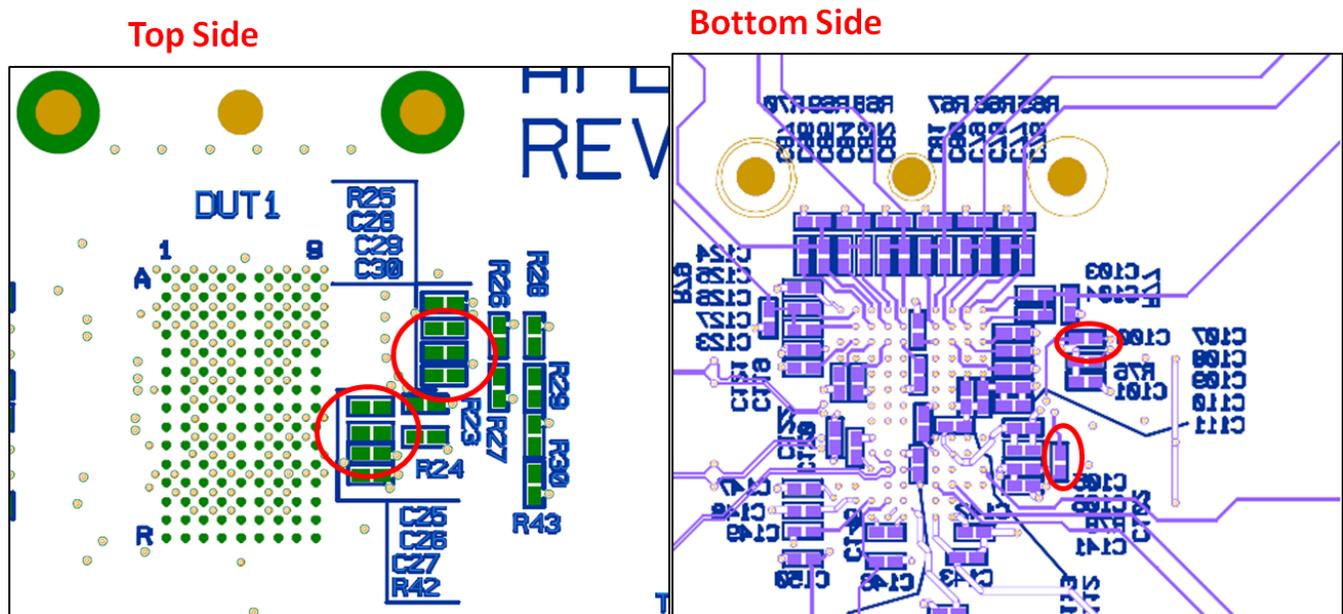
Figure 22. Relevant Capacitors for CW Mode, Top and Bottom Side

9.4 External ADC Sampling Clock

To use the external clock generator to test the AFE5809, perform the following steps.

1. Reconfigure JP9 as shown in Figure 23. The rest of the jumpers remain the same.
2. Connect the external generator as shown in Figure 23.
3. Set the generator output to 65 MHz, 13 dBm.
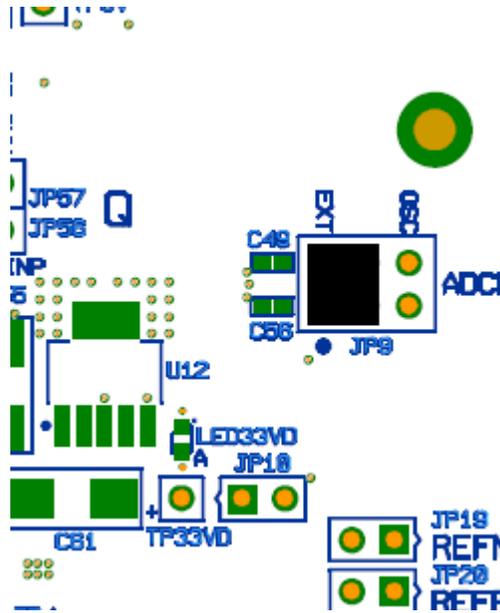
Figure 23. External ADC Sampling Clock Configuration

4. If the generators for the ADC clock and input signal are synchronous, then choose *Rectangular* as the Windowing option; otherwise, use *Hanning* or *Hamming*. Notice the spectrum spreading with non-coherence.
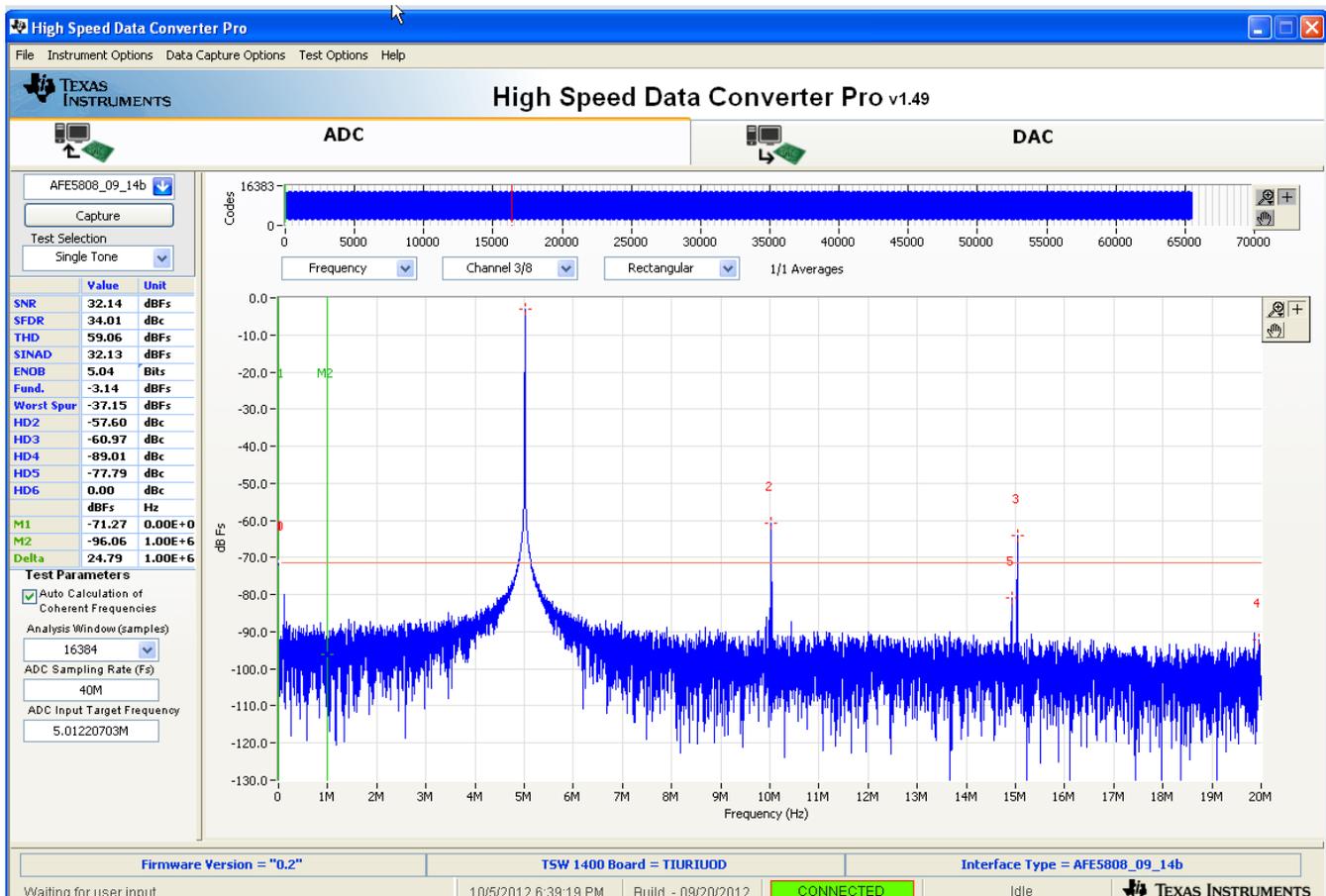
Figure 24. GUI Screen for Windowing Option Selection

5. The test procedure is the same for the CMOS ADC clock.

10 External Vcntl

- JP15 needs to be reconfigured to short the leftmost two pins.
- A DC Voltage source is required to be connected to J14.
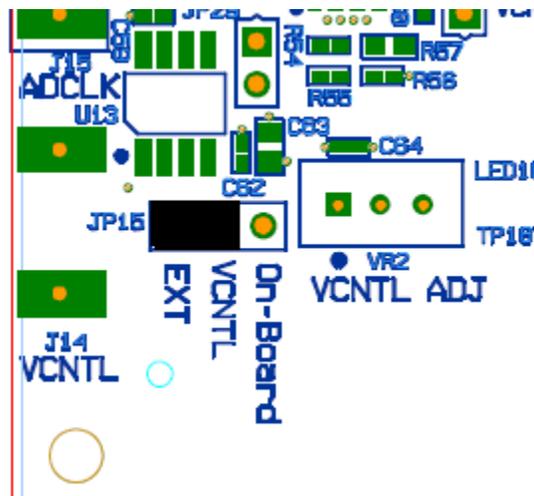
Figure 25. External Vcntl Configuration

11   Board Configuration

11.1   I/O, Power Supply, and USB
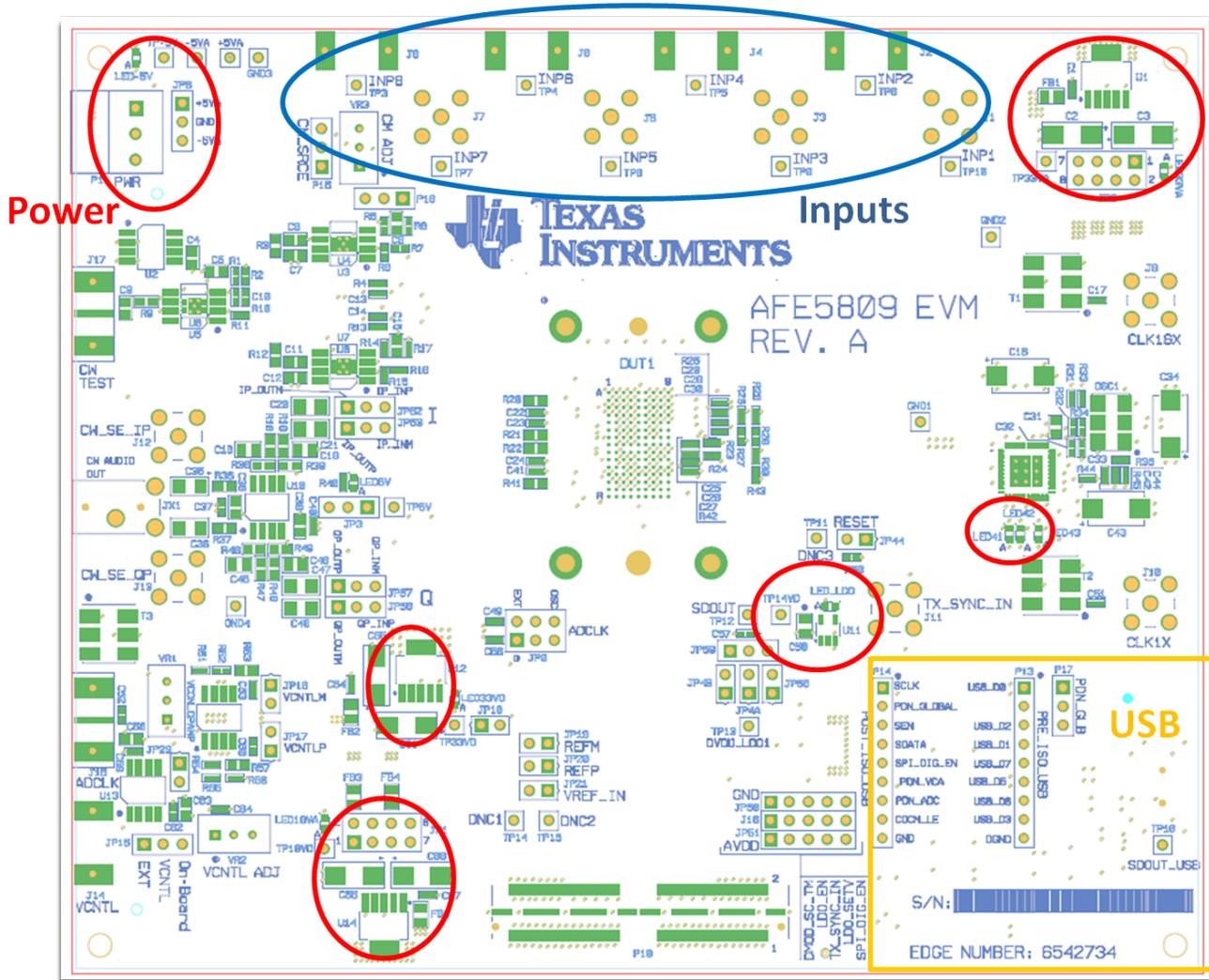
Figure 26. I/O, PWR, and USB Connector

Table 2. I/O, Power, and USB

Connector	Description
J1 through J8	Analog Input signals for Ch1 through Ch8. Connect to a signal generator. A bandpass filter must be applied between the generator and the SMA to get a better result. (See Figure 1.)
P1/JP6	P1 is the +5-V and –5-V power supply connector. JP6 is the test point for +5-V/-5-V power supply.
JP3	Onboard 5-V enable. The configuration must be set up as shown in Figure 2 in order to use onboard 5-V supply.
TP-5V	-5-V supply test point
+5VA	+5-V supply test point
JP1	Onboard +1.8-V enable. The configuration must be set up as shown in Figure 2 in order to use the onboard +1.8 V.
JP2	Onboard 3.3-VA enable. The configuration must be set up as shown in Figure 2 in order to use the onboard 3.3 V.
TP18VD	+1.8-VD supply test point

Table 2. I/O, Power, and USB (continued)

Connector	Description
TP33VD	+3.3-VD supply test point
TP33VA	+3.3-VA supply test point
TP14VD	+1.4-VD supply test point
TP1 through TP4	Ground test points
USB1	USB interface connector
P13,P14	Test points for USB data bus: From pin 1 to pin 9, the signals are D0, D4, D2, D1, D7, D5, D6, and D3

11.2 CW Mode, ADC Clock
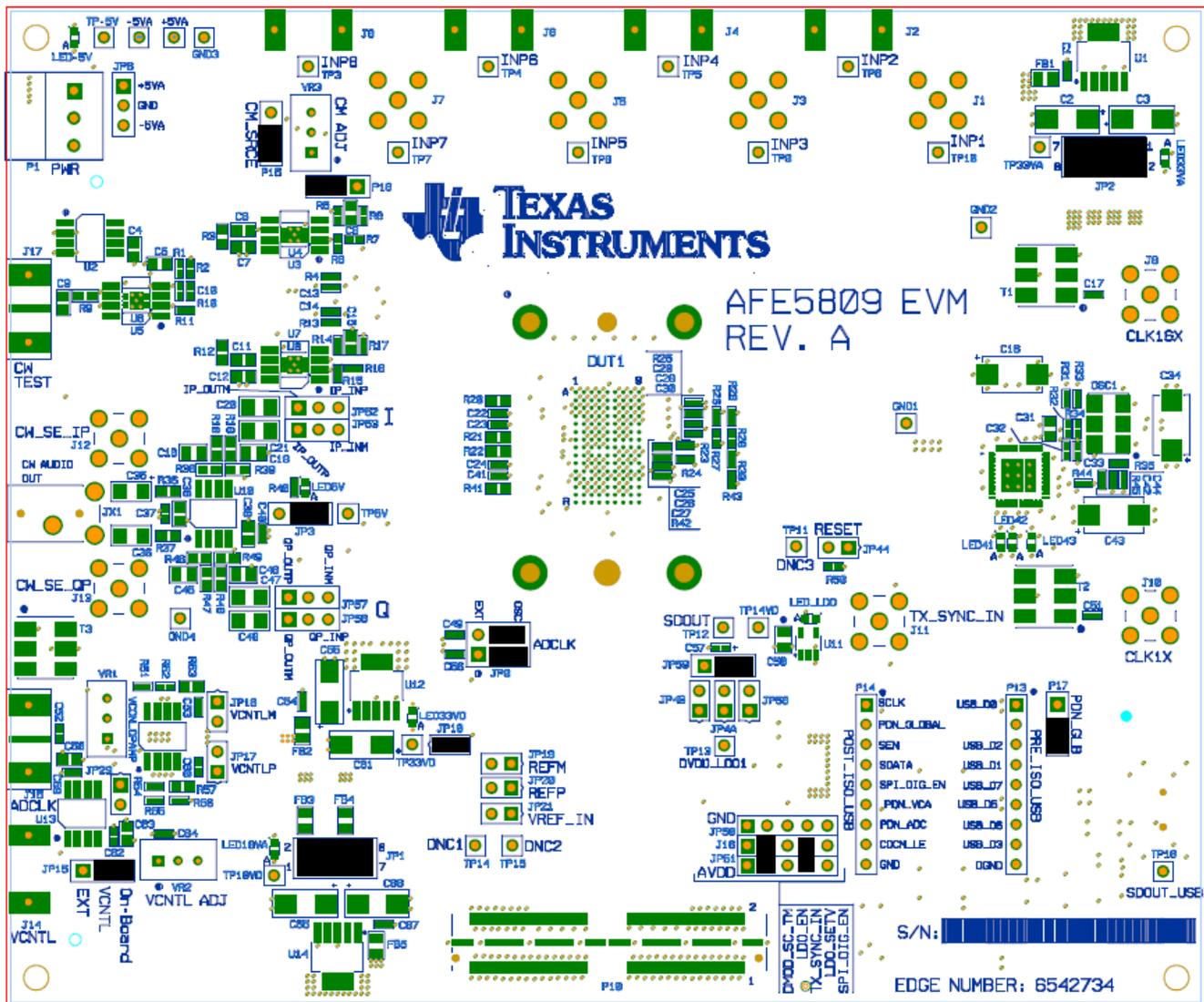
Figure 27. AFE5809EVM Jumper Locations

Table 3. CW Mode, ADC Clock

Clock Type	Reference Designator	Description
CW Mode	J9/J10	External CW Mode clock. The default is using onboard oscillator.
	J12 JP52/JP53	CW output for I-channel via an external operational amplifier. The EVM has converted the differential signal CW_IP_OUTP and CW_IP_OUTM into this single-ended output through an operational amplifier.
		To observe CW_IP_OUTP and CW_IP_OUTM before the external operational amplifier, probe JP52 and JP53.
	J13 JP56/JP57	CW output for V-channel via an external operational amplifier. The EVM has converted the differential signal CW_VP_OUTP and CW_VP_OUTM into this single-ended output through an operational amplifier.
		To observe CW_VP_OUTP and CW_VP_OUTM before the external operational amplifier, probe JP56 and JP57.
	JX1	This connector shows the signals of J12 and J13 simultaneously.
ADC	JP9/JP10	JP9 selects on_board_ADC CMOS clock or external clock from J14. Default setup in Figure 19 uses onboard CMOS clock. Set it to the other side to use the external clock source.
		Short to power up onboard CMOS clock
	J14	External ADC clock Input

11.3 Vcntl Control Input
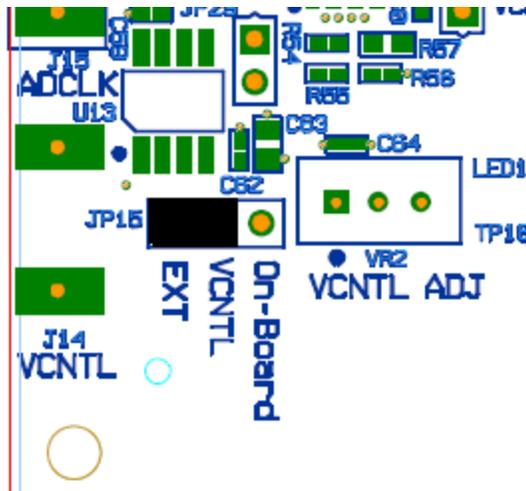
Figure 28. Vcntl

Table 4. CW Mode and Vcntl

Connector	Description
JP15	Choose onboard Vcntl or external Vcntl. The default setup uses onboard Vcntl.
J14	External Vcntl input. The range is from 0 V to 1.5 V.
VR2	Onboard Vcntl adjustment. Use JP15 pin 3 which has the text *On-Board* to monitor the Vcntl voltage level.

11.4 LEDs

The AFE5809EVM has seven LEDs. Their locations are shown in Figure 29. Their ON and OFF states demonstrate the normal operation of the power supplies and the PLL status of the clock buffer.
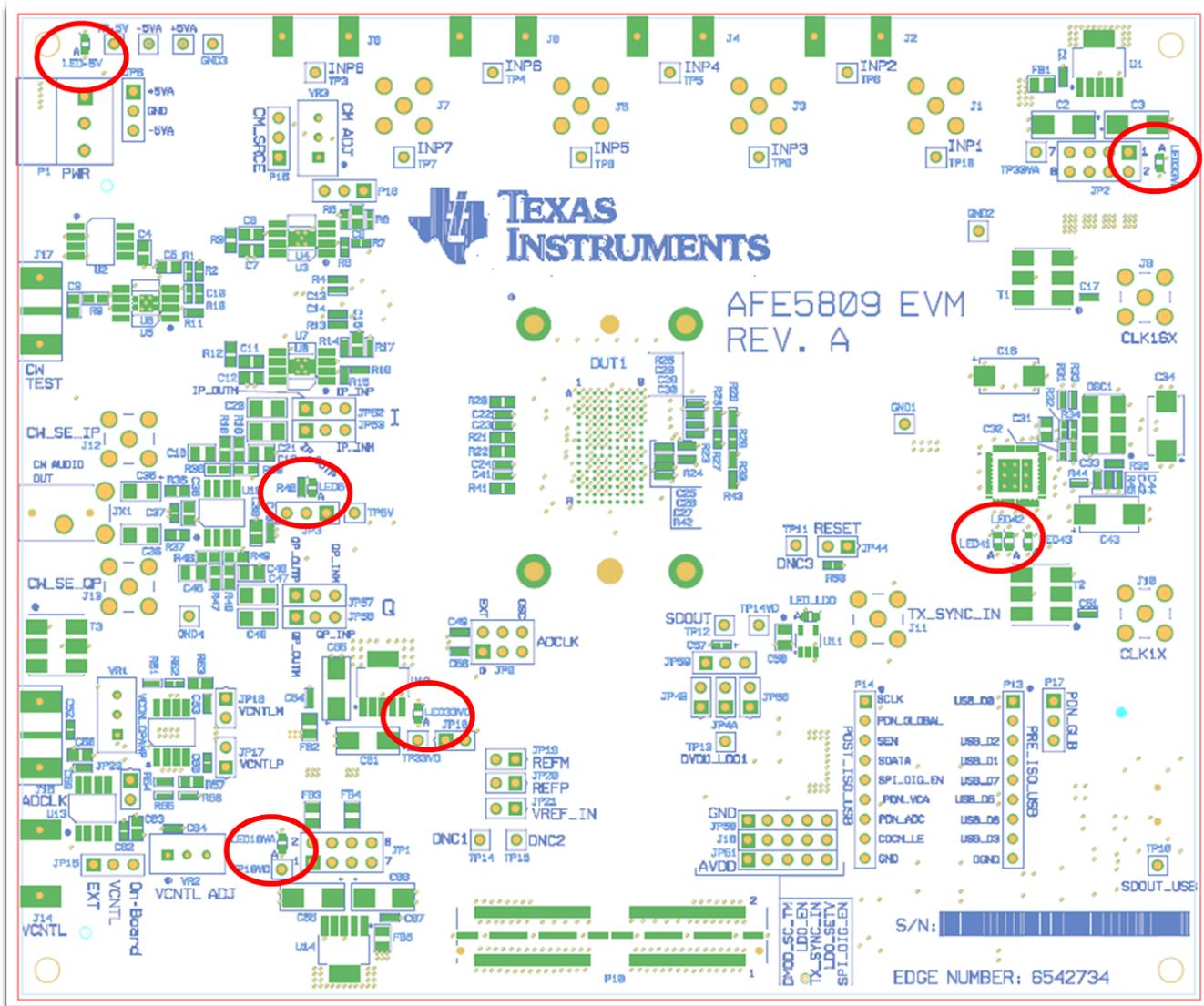
Figure 29. AFE5809EVM LED Location

Table 5. LED Indicators

Reference Designator	Power Supply	Color
LED-5V	−5 V	Green
LED5V	+5 V	Green
LED3.3VD	+3.3 VD	Orange
LED3.3VA	+3.3 VA	Green
LED1.8V	+1.8 V	Green
LED_LDO	+1.4V	Green
LED41	Clock Buffer Status Indicator	Red
LED42		Red

11.5   Miscellaneous Test Points
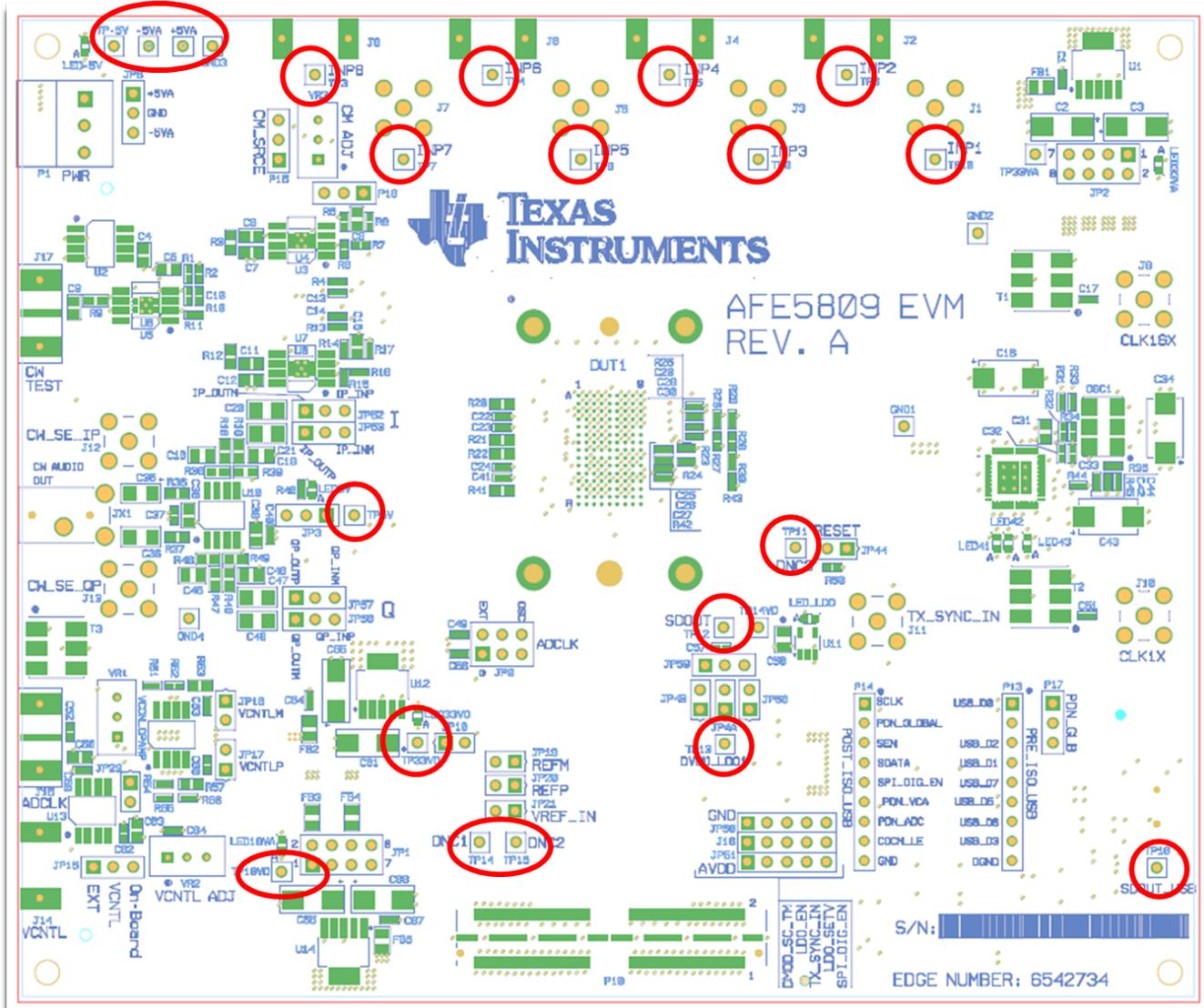
Figure 30. AFE5809EVM Test Point Locations

Table 6. Test Points

Reference Designator	Description
TP11,TP14.TP15	AFE5809 device test pin DNC1, 2, and 3. Pins L5, M5 and M8
JP19	REFM voltage input
JP44	RESET input. Short to reset AFE5809.
JP20	REFP voltage input
JP21	REF_IN voltage input
TP12	SDOUT
TP3-9	SMA input probes
TP5V, TP18VD, TP33VD, TP33VA, TP-5V, -5VA, +5VA, TP14VD, DVDD_LDO1	Power supply test points

12 EVM Printed-Circuit Board Layouts and Schematics

Figure 31 through Figure 36 show the six layers of the AFE5809EVM board.
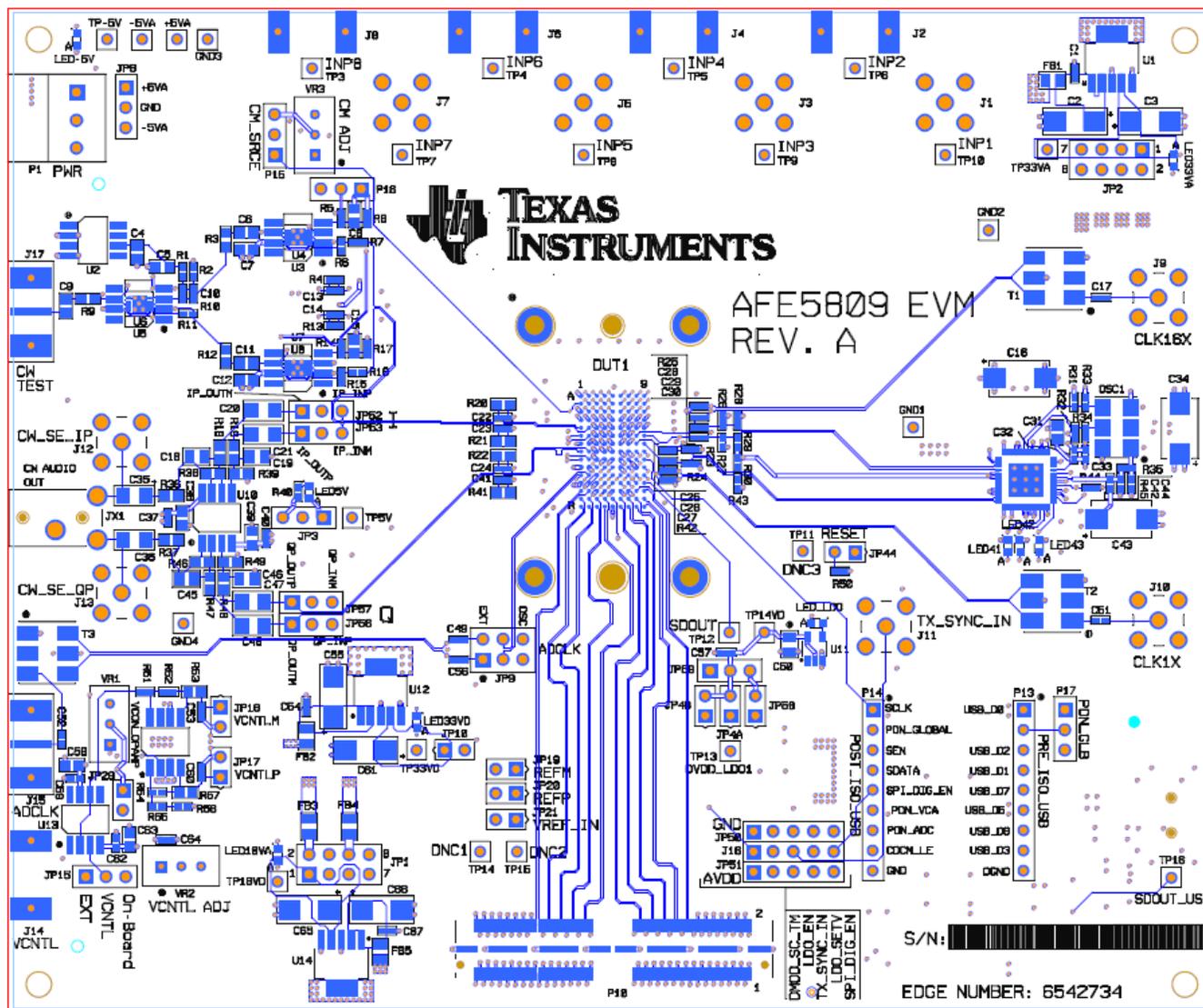
Figure 31. Top Layer - Signal

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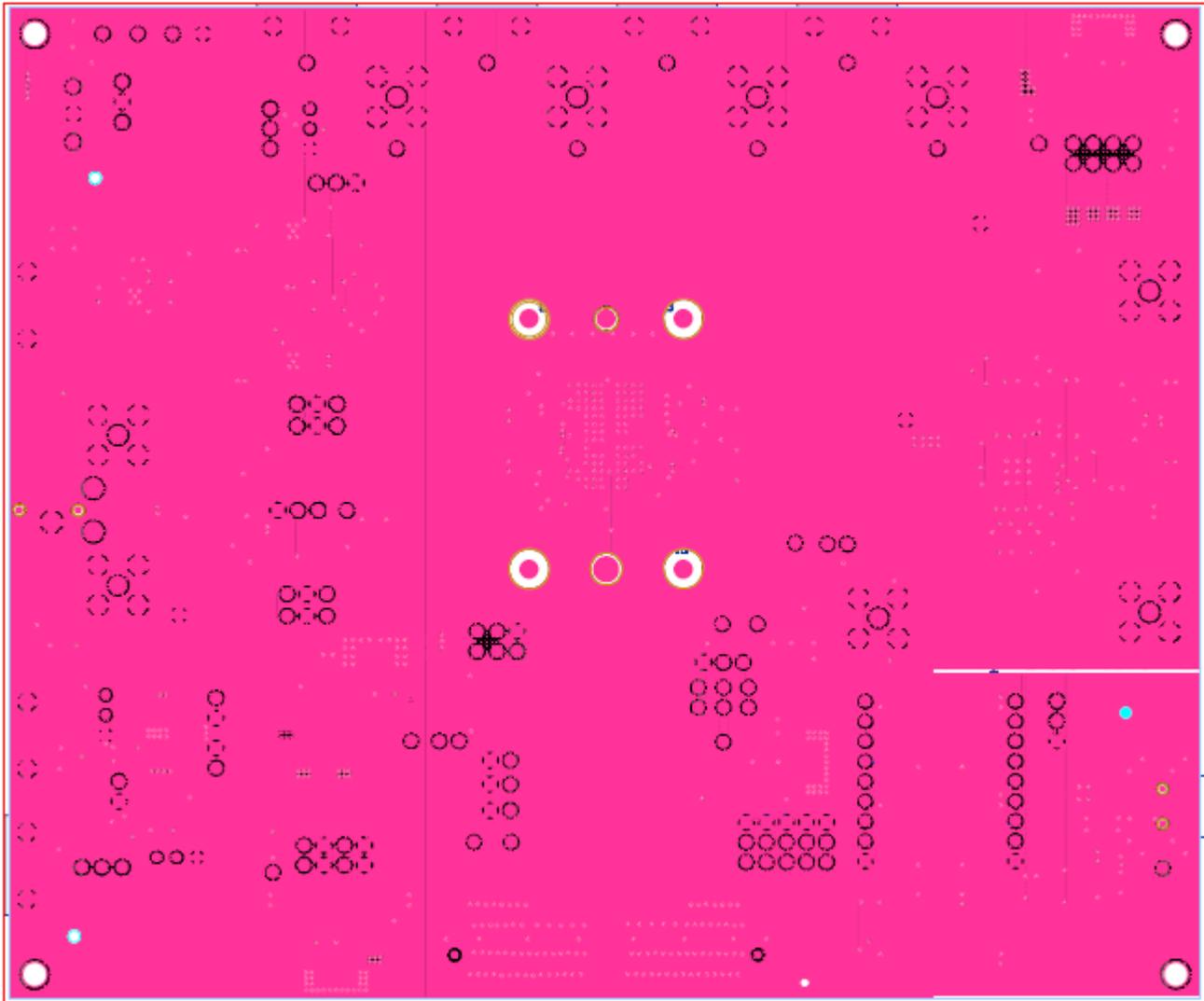
Figure 32. Second Layer - Ground
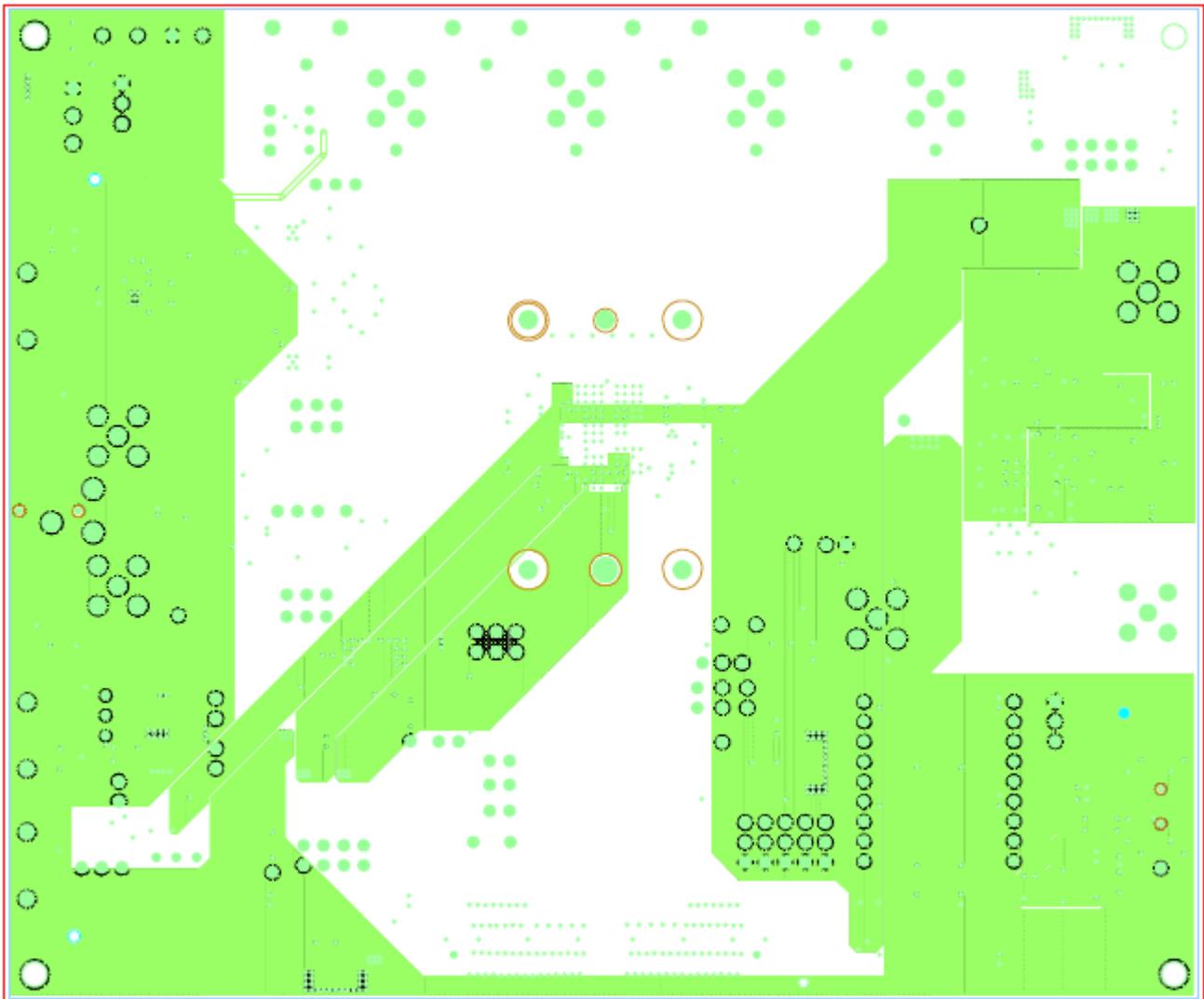
Figure 33. Third Layer - Power
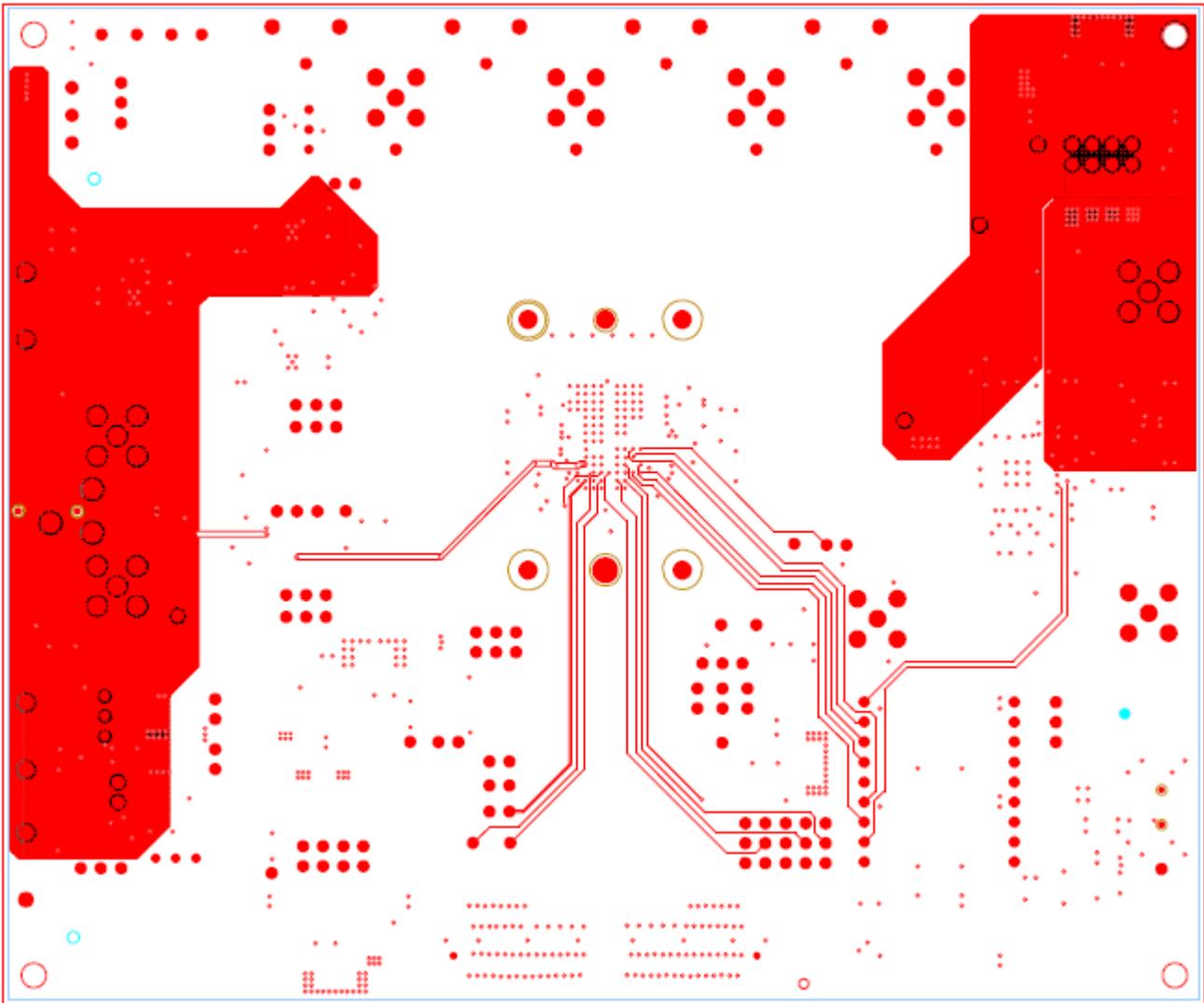
Figure 34. Fourth Layer - Signal
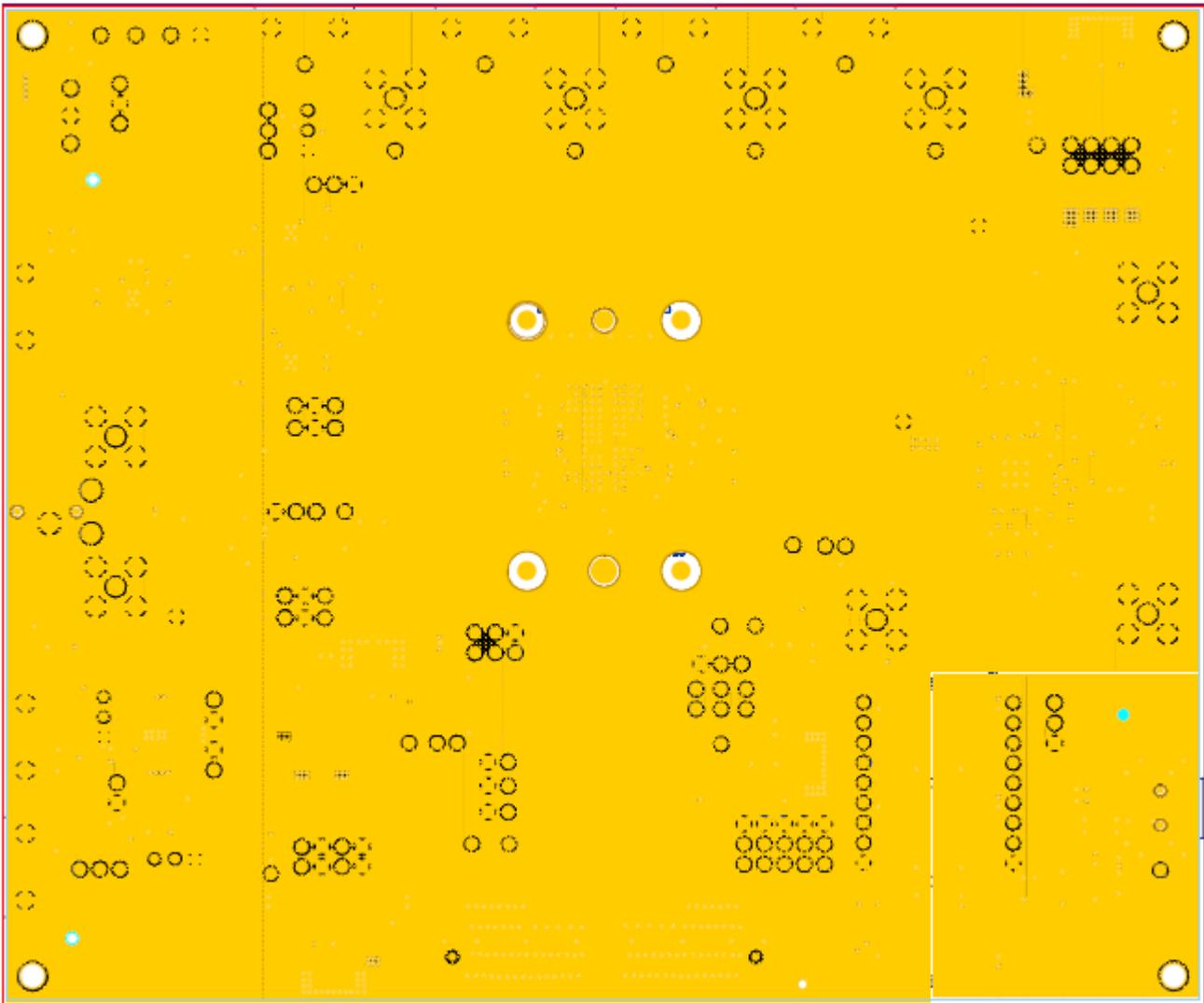
Figure 35. Fifth Layer - Ground
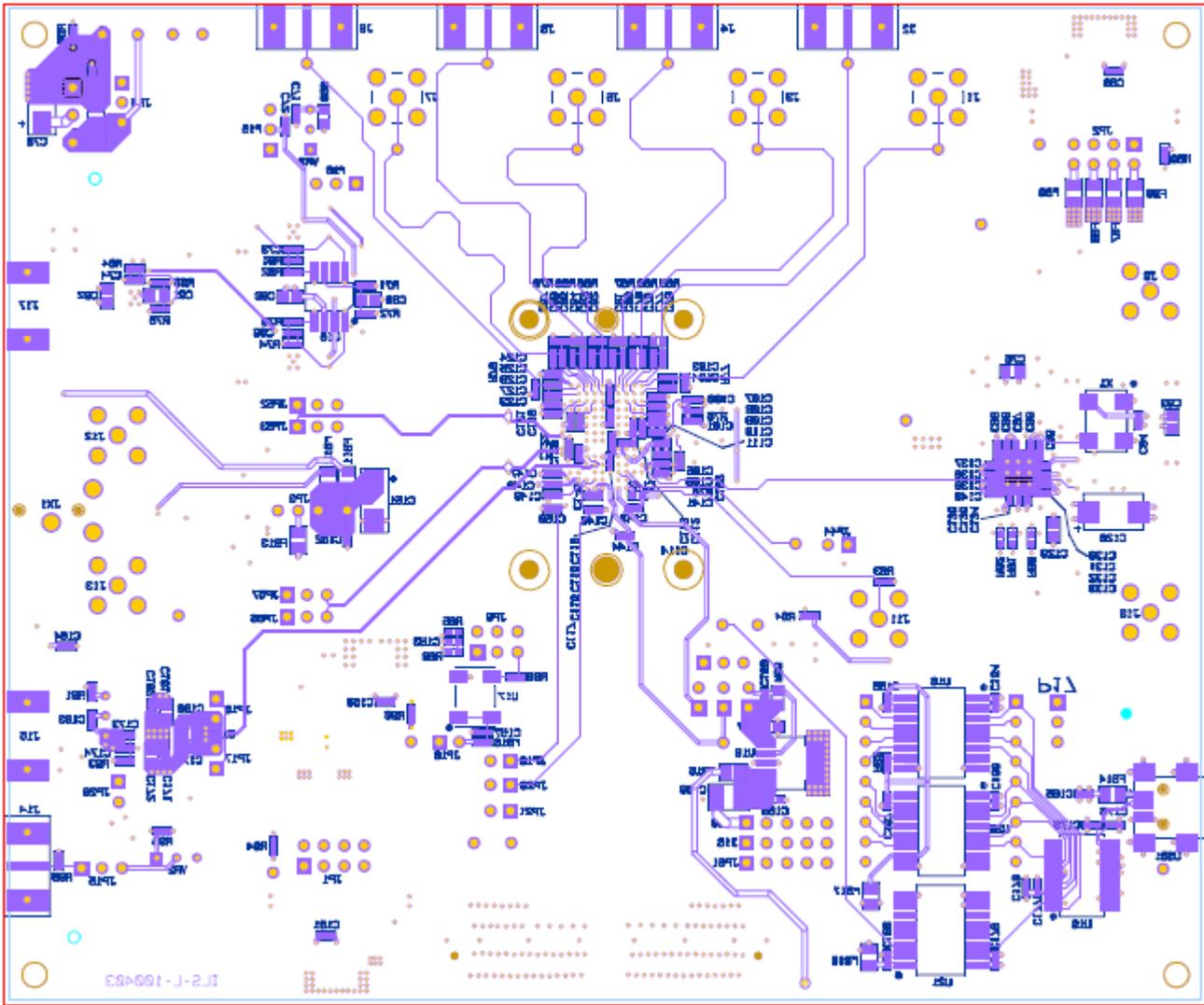
Figure 36. Bottom Layer - Signal

12.1 Schematics

Power
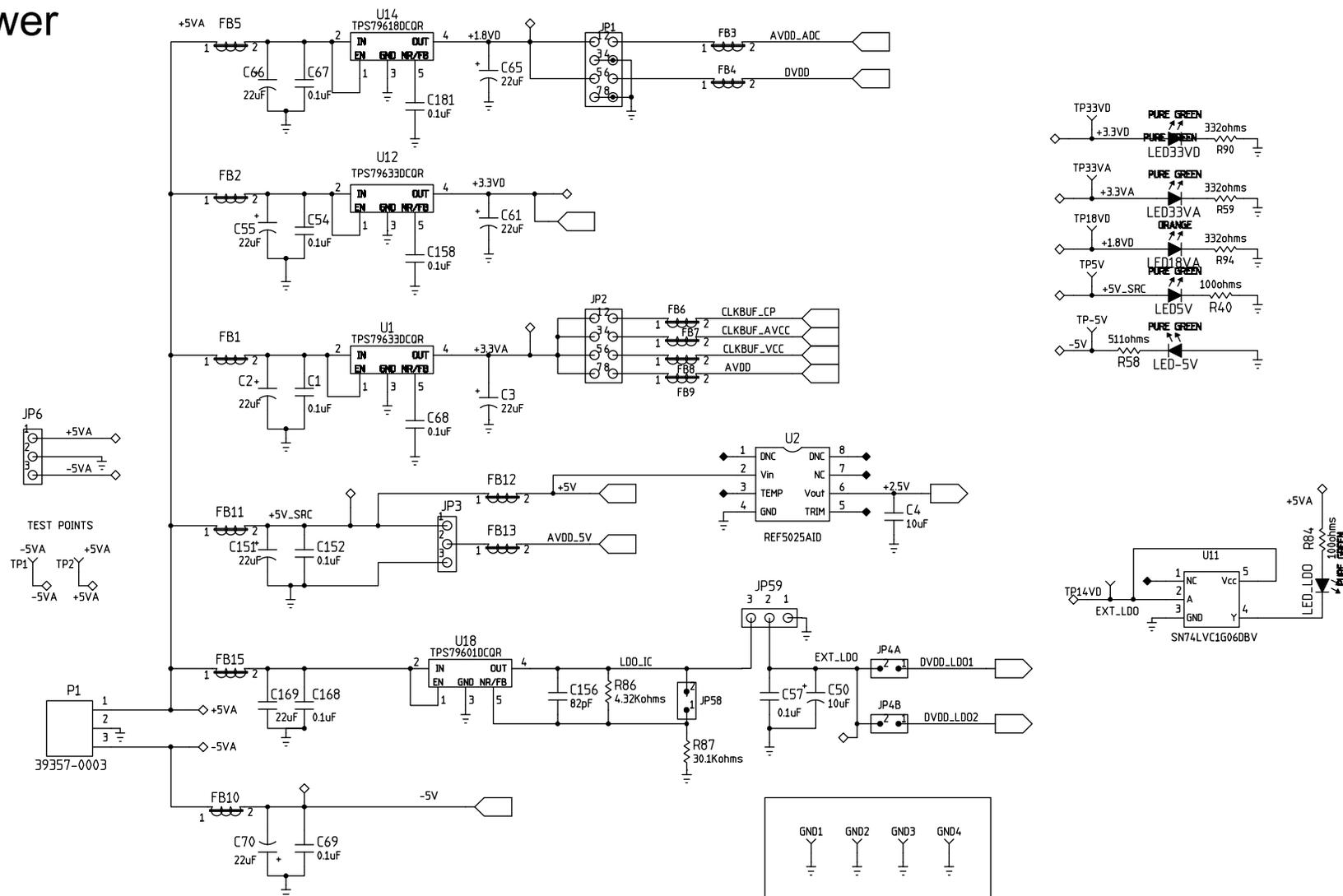
Figure 37. Schematic (Sheet 1 of 10)

AFE5809 DEVICE
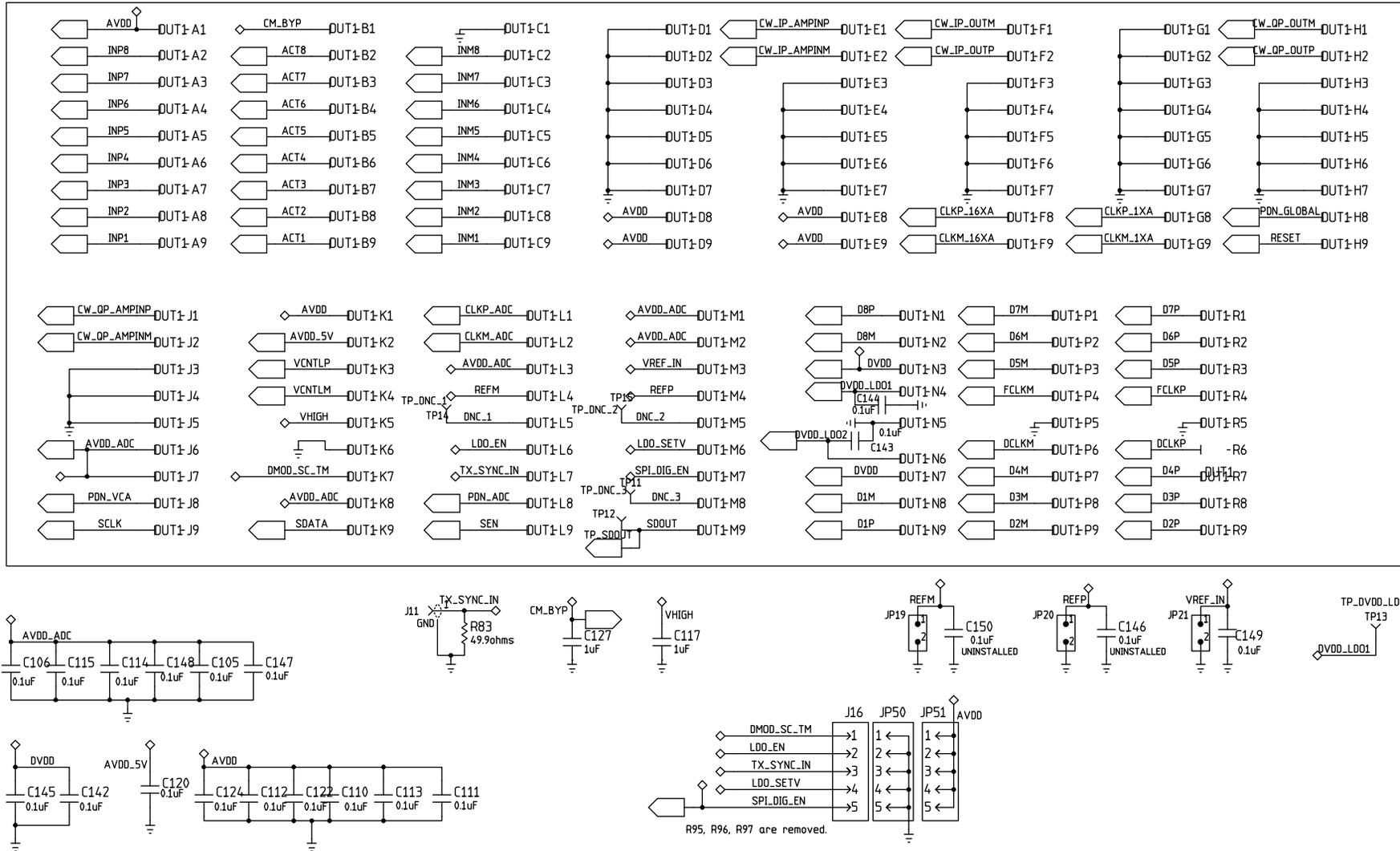
Figure 38. Schematic (Sheet 2 of 10)

VCA INPUT
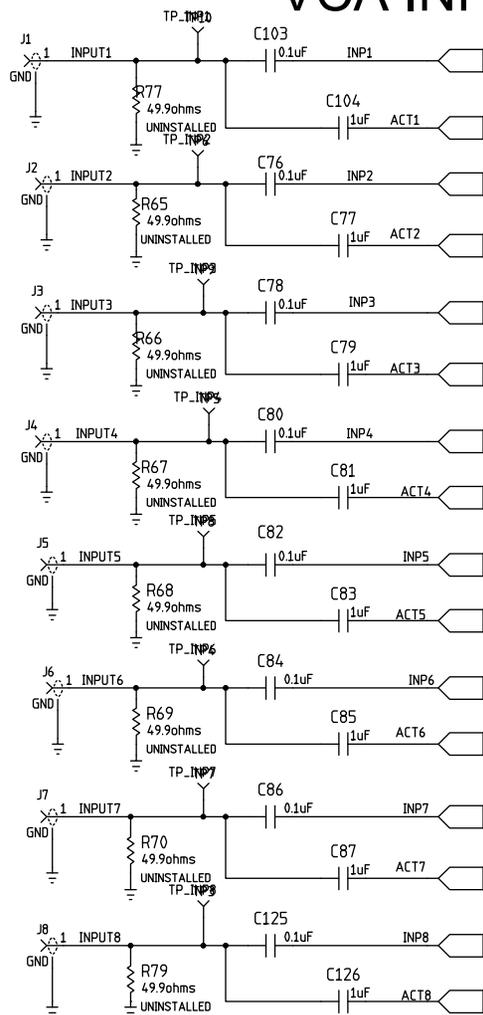
ADC OUTPUT
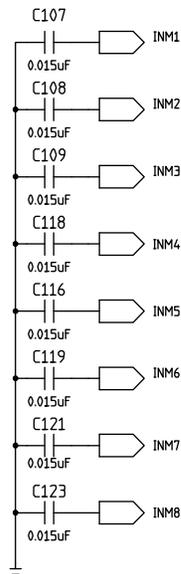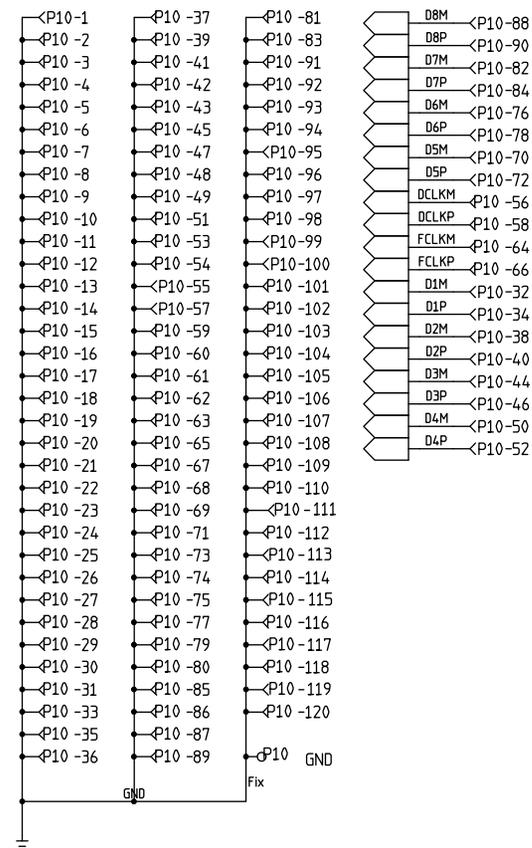
Figure 39. Schematic (Sheet 3 of 10)

Clock Buffer
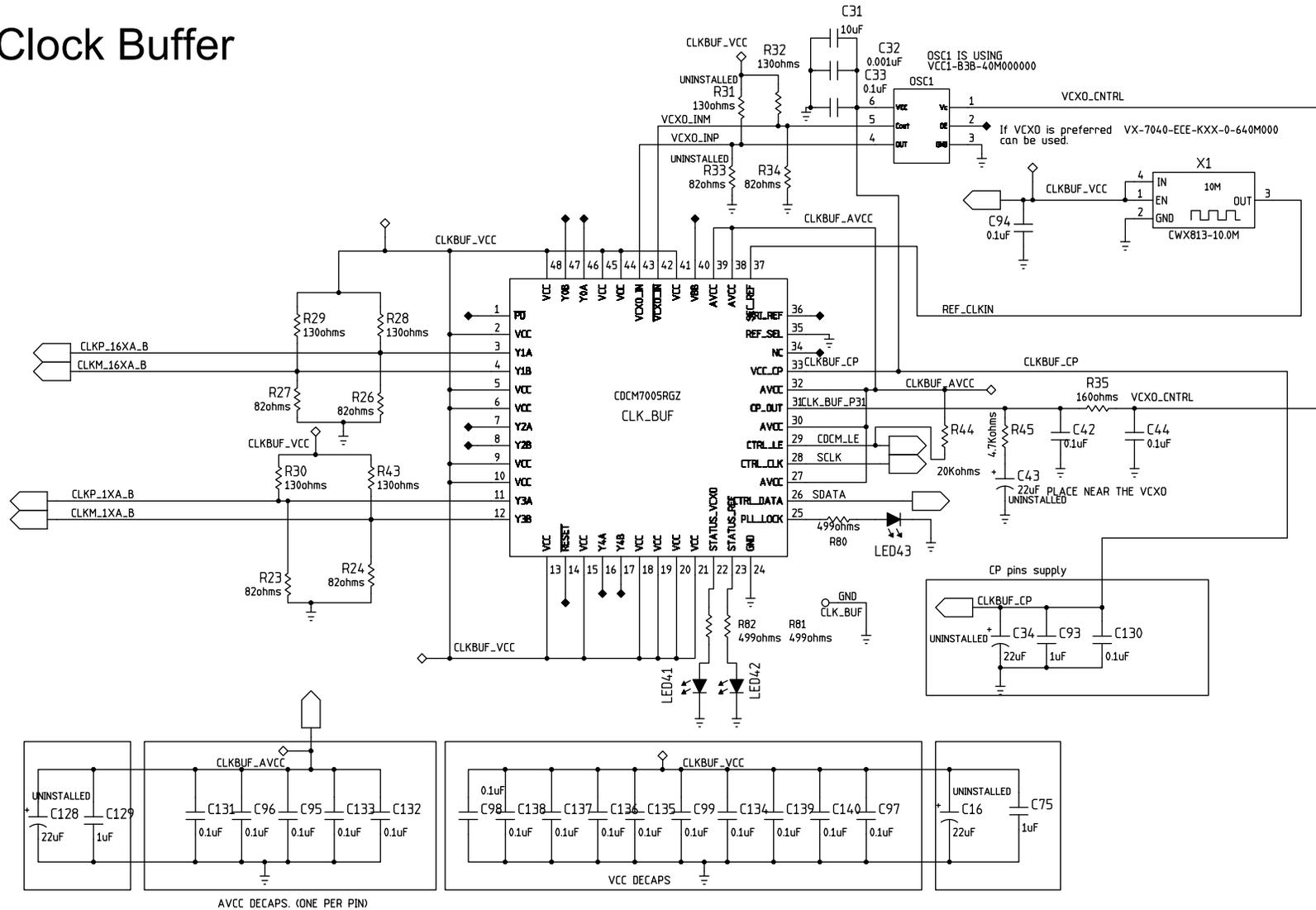
Figure 40. Schematic (Sheet 4 of 10)

ADC CLOCK
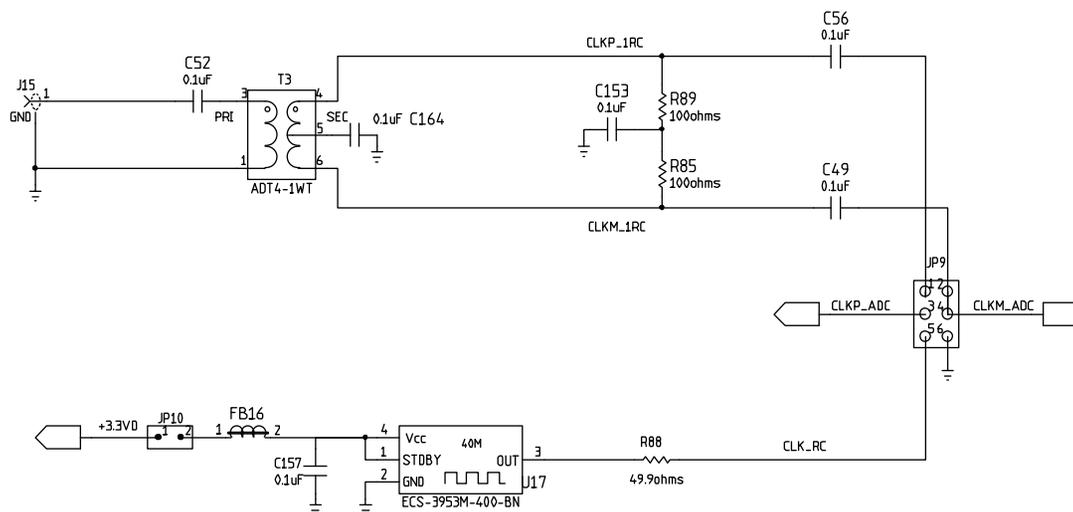
Figure 41. Schematic (Sheet 5 of 10)

CW CLK
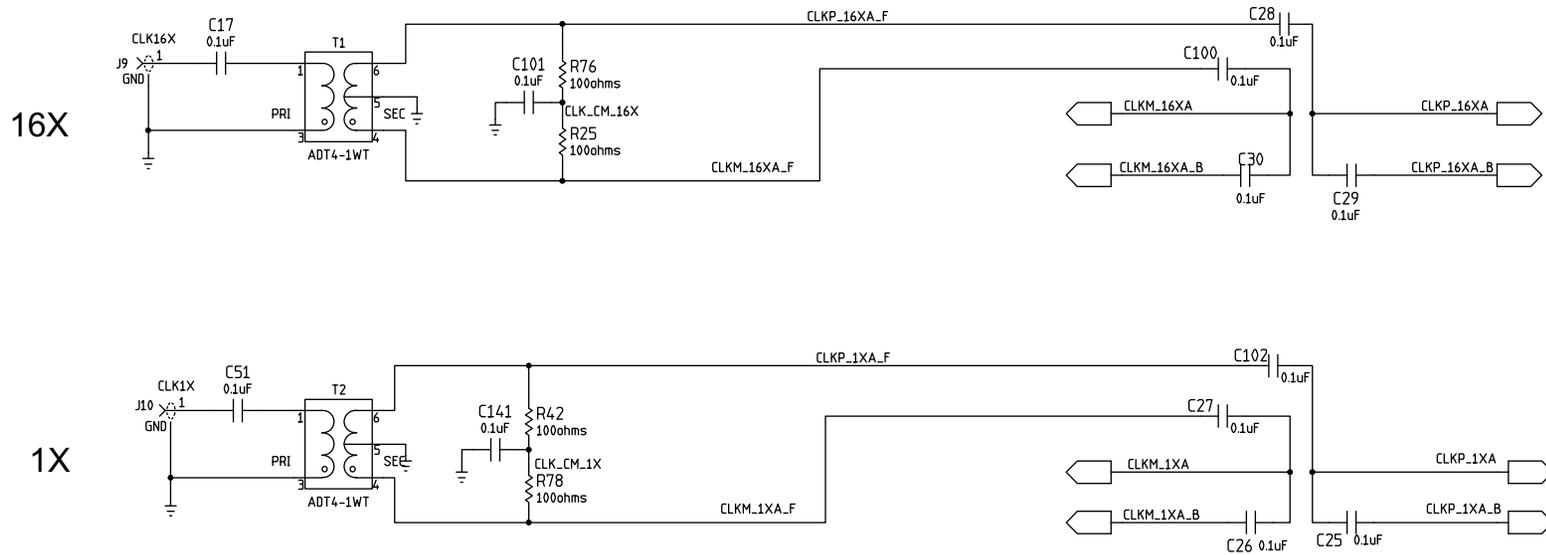
Figure 42. Schematic (Sheet 6 of 10)

VCON SINGLE TO DIFFERENTIAL CONVERTER
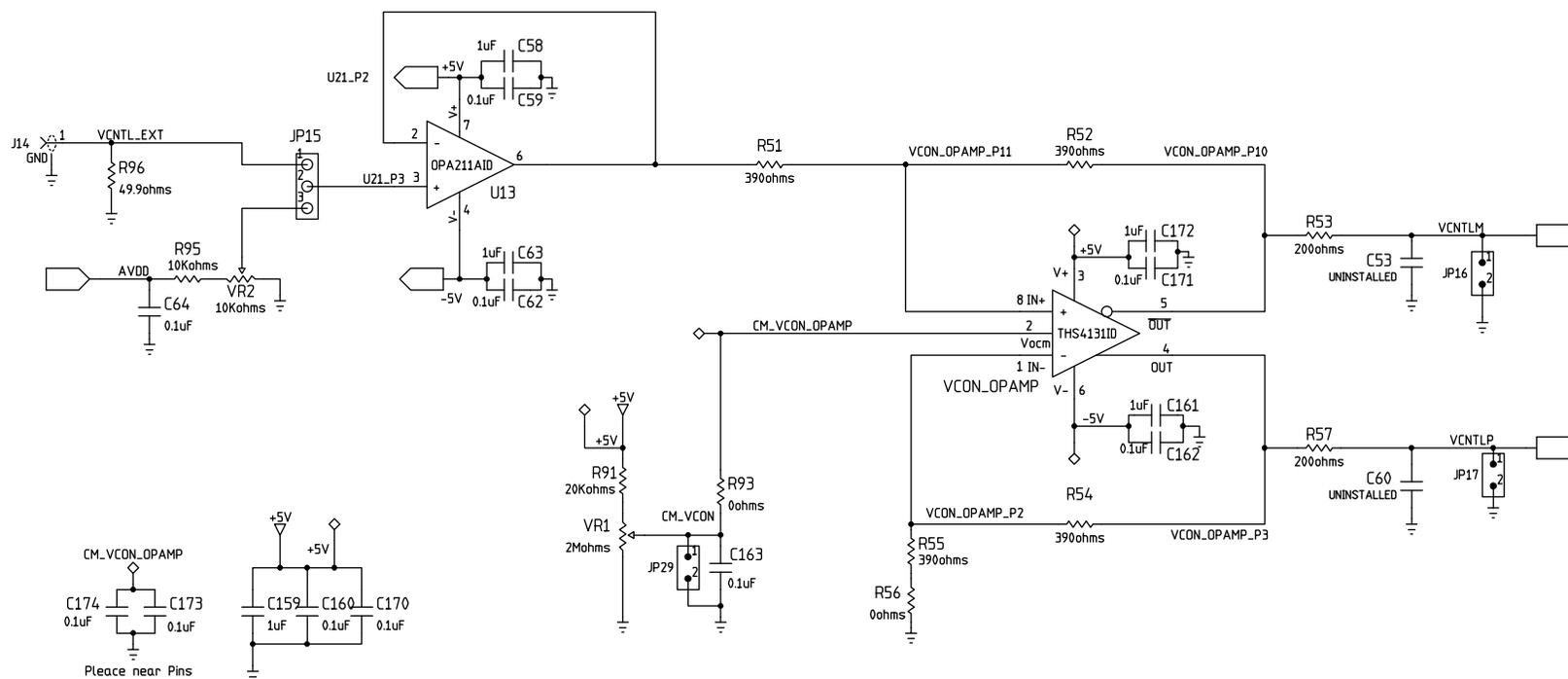
Figure 43. Schematic (Sheet 7 of 10)

CW Mixer Out

Figure 44. Schematic (Sheet 8 of 10)

Serial Interface
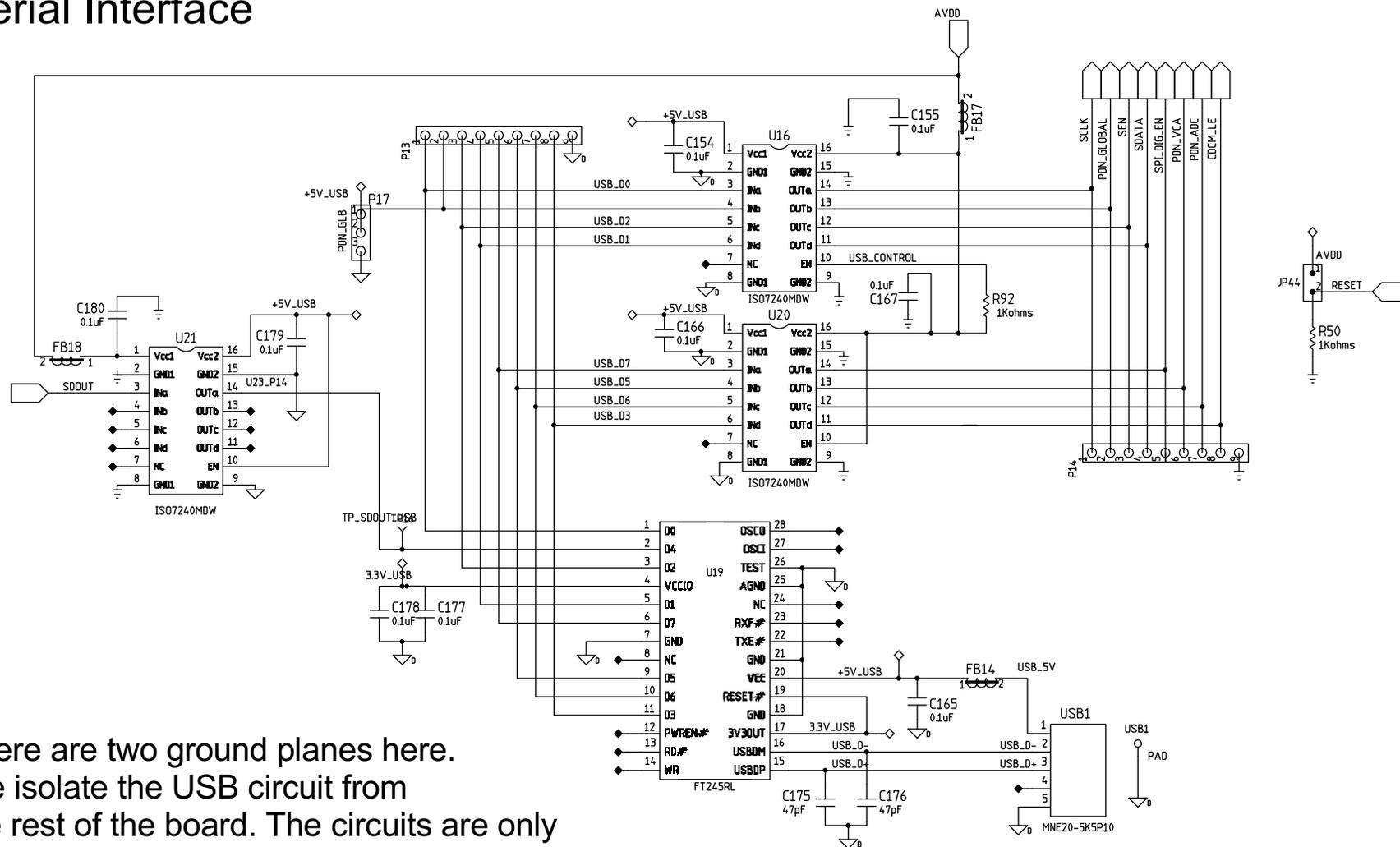
There are two ground planes here.
We isolate the USB circuit from
the rest of the board. The circuits are only
coupled through the opto-isolators.

Figure 45. Schematic (Sheet 9 of 10)

CW I/V Amp
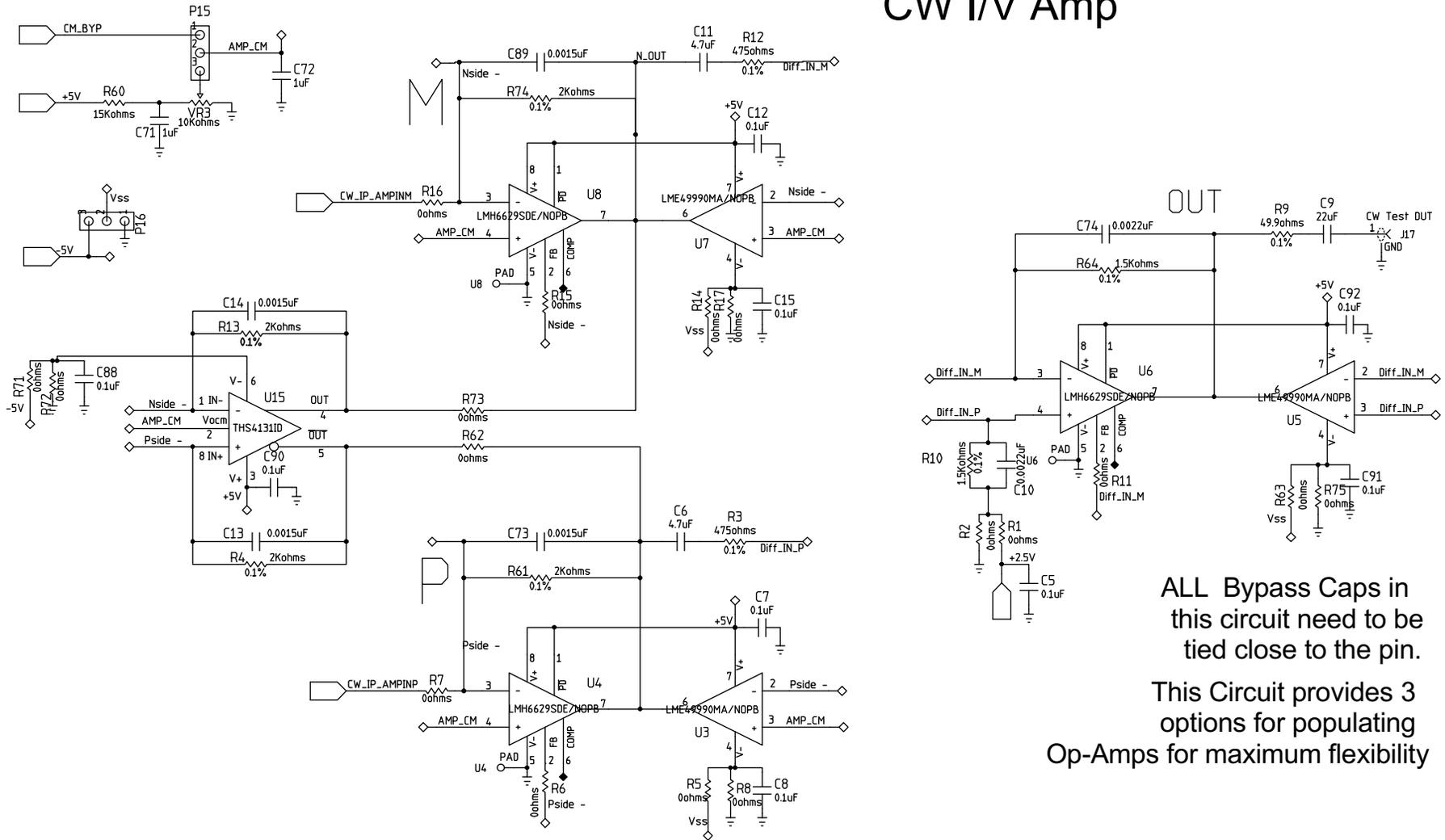
ALL Bypass Caps in this circuit need to be tied close to the pin.

This Circuit provides 3 options for populating Op-Amps for maximum flexibility

Figure 46. Schematic (Sheet 10 of 10)

13   Bill of Materials

Table 7. Bill of Materials

ITEM	QTY	MFG	MFG PART#	REF DES	DESCRIPTION	VALUE or FUNCTION
1	82	AVX	0402YC104KAT2A	C17, C25, C26, C29, C30, C33, C37, C40, C49, C51, C52, C56, C59, C62, C64, C76, C78, C80, C82, C84, C86, C94, C95, C96, C97, C98, C99, C101, C103, C105, C106, C110, C111, C112, C113, C114, C115, C120, C122, C124, C125, C130, C131, C132, C133,C134, C135, C136, C137, C138, C139, C140, C141, C142, C143, C144, C145, C146, C147, C148, C149, C150, C153, C154, C155, C160, C162, C163, C164, C165, C166, C167, C170, C171, C173, C174, C177, C178, C179, C180	CAP,SMT,0402	CAPACITOR,SMT,0402,CER,16V,10%,0.1uF
2	2	AVX	0402YC471KAT2A	C53,C60	CAP,SMT,0402	CAPACITOR,SMT,0402,CER,16V,10%,470pF
3	2	AVX	0402YC222KAT2A	C10, C74	CAP,SMT,0402	CAPACITOR,SMT,0402,CER,16V,10%,2200pF
4	11	KEMET	C0402C104K8PAC	C1, C54, C57, C67, C68, C69, C152, C157, C158, C168, C181	CAP,SMT,0402	CAPACITOR,SMT,0402,CER,0.1uF,10V,10%,X5R
5	4	KEMET	C0402C152J5GACTU	C73, C89	CAP,SMT,0402	CAPACITOR,SMT,0402,CERAMIC,1500pF,50V,5%,C0G/NP0
6	8	TDK	C1005X5R0J105M	C77, C79, C81, C83, C85, C87, C104, C126	CAP,SMT,0402	CAPACITOR,SMT,0402,CER,1.0uF,6.3V,20%,X5R
7	4	PANASONIC	ECJ-0EB1A105M	C71, C72, C117, C127	CAP,SMT,0402	CAPACITOR,SMT,0402,CERAMIC,1.0uF,10V,20%,X5R
8	8	PANASONIC	ECJ-0EB1C153K	C107, C108, C109, C116, C118, C119, C121, C123	CAP,SMT,0402	CAPACITOR,SMT,0402,CER,15000pF,16V,10%,X7R
9	1	PANASONIC	ECJ-0EB1H102K	C32	CAP,SMT,0402	CAPACITOR,SMT,0402,CER,1000pF,50V,10%,X7R
10	4	PANASONIC	ECJ-0EB1H332K	C22, C23, C24, C41	CAP,SMT,0402	CAPACITOR,SMT,0402,CER,3300pF,50V,10%,X7R
11	2	PANASONIC	ECJ-0EC1H470J	C175, C176	CAP,SMT,0402	CAPACITOR,SMT,0402,CER,47pF,50V,5%,NPO
12	1	PANASONIC	ECJ-0EC1H820J	C156	CAP,SMT,0402	CAPACITOR,SMT,0402,CER,82pF,50V,5%,NPO
13	9	AVX	06033C104JAT2A	C5, C7, C8, C12, C15, C88, C90, C91, C92	CAP,SMT,0603	CAPACITOR,SMT,0603,CERAMIC,0.1uF,25V,5%,X7R

Table 7. Bill of Materials (continued)

14	7	AVX	0603YD105KAT2A	C38, C39, C58, C63, C159, C161, C172	CAP,SMT,0603	CAPACITOR,SMT,0603,CERAMIC,1.0uF,16V,10%,X5R
15	1	TAIYO YUDEN	AMK107BJ226MA-T	C9	CAP,SMT,0603	CAPACITOR,SMT,0603,CERAMIC,22uF,4V,20%,X5R
16	1	PANASONIC	ECJ-1VB0J106M	C4	CAP,SMT,0603	CAPACITOR,SMT,0603,CERAMIC,10uF,6.3V,20%,X5R
17	3	PANASONIC	ECJ-1VB1C105K	C75, C93, C129	CAP,SMT,0603	CAPACITOR,SMT,0603,CERAMIC,1.0uF,16V,10%,X5R
18	2	MURATA	GRM188C80G475KE19	C6, C11	CAP,SMT,0603	CAPACITOR,SMT,0603,CERAMIC,4.7uF,4V,10%,X6S (TI-F)
19	1	TAIYO YUDEN	JMK107BJ106MA-T	C31	CAP,SMT,0603	CAPACITOR,SMT,0603,CERAMIC,10uF,6.3V,20%,X5R
20	4	KEMET	C0805C332F3GACTU	C18, C19, C45, C46	CAP,SMT,0805	CAPACITOR,SMT,0805,CERAMIC,3300pF,25V,1%,C0G(NP0)
21	6	KEMET	C1206C226K8PAC	C20, C21, C35, C36, C47, C48	CAP,SMT,1206	CAPACITOR,SMT,1206,CERAMIC,22uF,10V,10%,X5R
22	1	AVX	1210ZG226ZAT2A	C169	CAP,SMT,1210	CAP,22uF,10V,+80~-20%
23	4	VISHAY SPRAGE	293D226X9016D2T	C43	CAP,SMT,7343	CAP,TAN,SMT, 22uF,16V,+/-10%,-55~85C
24	4	VISHAY SPRAGE	293D226X9016D2T	C16, C34, C128	CAP,SMT,7343	CAP,TAN,SMT, 22uF,16V,+/-10%,-55~85C
25	1	AVX	TACH106M010R	C50	CAP,SMT,TAN,0805	CAP,SMT,TAN,0805,10uF, 10V,20%,H-CASE
26	8	AVX	TPSC226K016R0375	C2, C3, C55, C61, C65, C66, C70, C151	CAPACITOR,SMT,TANT	10%, 16V, 22uF
27	9	AMPHENOL	901-144-8	J1, J3, J5, J7, J9, J10, J11, J12, J13	CONNECTOR,SMA	SMA COAX STRAIGHT PCB CURRENT P/N IS 901-144-8RFX
28	1	MURATA	BLM15BD102SN1D	FB16	FERRITE BEAD,SMT,0402	FERRITE BEAD,SMT,0402,1K OHM,200mA
29	17	STEWARD	HI0805R800R-00	FB1, FB2, FB3, FB4, FB5, FB6, FB7, FB8, FB9, FB10, FB11, FB12, FB13, FB14, FB15, FB17, FB18	FERRITE BEAD,SMT,2P	FERRITE,SMT,0805,80 OHM@100MHz,5A

Table 7. Bill of Materials (continued)

30	1	MOLEX	39357-0003	P1	HEADER, THRU, 3P	HEADER, THRU, POWER, 3P,3.5MM, EUROSTYLE
31	1	SAMTEC	QTH-060-01-L-D-A	P10	HEADER,SMT,120P	HEADER,SMT,120P,0.5mm,FEM,2BANK,RECEPTACLE,168/198H
32	1	SAMTEC	TSW-103-07-G-D	JP9	HEADER,THU	HEADER,THU,6P,2X3,MALE,DUAL ROW,100LS,100TL
33	2	SAMTEC	TSW-104-07-G-D	JP1, JP2	HEADER,THU	HEADER,THU,8P,2X4,MALE,DUAL ROW,100LS,100TL
34	3	TYCO ELECTRONICS	4-103239-0X5	J16, JP50, JP51	HEADER,THU,5P	HEADER, 1X5 .1CTRS
35	2	SPC TECH	8431-1x9	P13, P14	HEADER,THU,9P	HEADER,THU,MALE,0.1LS,9P,1X9,335H,120TL
36	11	TYCO ELECTRONICS	4-103239-0x2	JP10, JP16, JP17, JP19, JP20, JP21, JP29, JP44, JP58, JP4A, JP4B	HEADER,THU,JUMPER	MALE,2PIN,.100CC MAKE FROM 4-103239-0x2
37	11	TYCO ELECTRONICS	4-103239-0x3	JP3, JP6, JP15, JP52, JP53, JP56, JP57, JP59, P15, P16, P17	HEADER,THU,JUMPER	MAKE FROM 4-103239-0
38	3	NATIONAL SEMI	LME49990MA/NOPB	U3, U5, U7	IC,SMT,8P	ULTRA LOW DISTORTION ULTRA LOW NOISE OPAMP
39	1	TEXAS INSTRUMENTS	CDCM7005RGZ	CLK_BUF	IC,SMT,QFN-48	3.3-V HIGH PERFORMANCE CLOCK SYNTHESIZER AND JITTER CLEANER
40	3	TI	ISO7240MDW	U16, U20, U21	IC,SMT,SOIC-16W	QUAD DIGITAL ISOLATORS
41	1	TI / BURR-BROWN	OPA211AID	U13	IC,SMT,SOIC-8	1.1nV/Hz NOISE LOW POWER PRECISION OPERATIONAL AMPLIFIER
42	1	TI	OPA2614ID	U10	IC,SMT,SOIC-8	DUAL HI GAIN BWIDTH HI OUTPUT CURRENT OPAMP WITH CURRENT LIMIT
43	1	BURR-BROWN / TI	REF5025AID	U2	IC,SMT,SOIC-8	LOW-NOISE VERY LOW DRIFT PRECISION VOLTAGE REFERENCE,2.5V
44	1	TI	TPS79601DCQR	U18	IC,SMT,SOT223-6	ULTRALOW-NOISE HI PSRR FAST RF 1-A LDO LINEAR REGULATOR,1.2-5.5V

Table 7. Bill of Materials (continued)

45	1	TI	TPS79618DCQR	U14	IC,SMT,SOT223-6	ULTRALOW-NOISE HI PSRR FAST RF 1-A LDO LINEAR REGULATOR,1.8V
46	2	TI	TPS79633DCQR	U1, U12	IC,SMT,SOT223-6	ULTRALOW-NOISE HI PSRR FAST RF 1-A LDO LINEAR REGULATOR,3.3V
47	1	TI	SN74LVC1G06DBV	U11	IC,SMT,SOT23-5	SINGLE INVERTER BUFFER / DRIVER WITH OPEN-DRAIN OUTPUT
48	1	FTDI	FT245RL	U19	IC,SMT,SSOP-28	USB FIFO IC INCORPORATE FTDICHIP-ID SECURITY DONGLE
49	3	PANASONIC	LNJ208R82RA	LED41, LED42, LED43	LED,SMT,0603	LED,SMT,0603,ULTRA BRIGHT RED,1.92V
50	5	PANASONIC	LNJ308G8PRA	LED-5V, LED33VA, LED33VD, LED5V, LED_LDO	LED,SMT,0603	LED,SMT,0603,PURE GREEN,2.03V
51	1	PANASONIC	LNJ808R8ERA	LED18VA	LED,SMT,0603	LED,SMT,0603,ORANGE,1.8V
52	1	ECS	ECS-3953M-400-BN	U17	OSCILLATOR,SMT,4P	OSC,SMT,3.3V,50ppm,-40~85C,5nS,40.000 MHz
53	7	VENKEL	CR0402-16W-000T	R2, R5, R14, R63, R71, R93	RES,SMT,0402	RESISTOR,SMT,0402,0 OHM,1/16W,ZERO JUMPER
54	2	VISHAY	CRCW04021001F100	R50, R92	RES,SMT,0402	RESISTOR,SMT,0402,1K,1/16W,1%,100ppm
55	1	VISHAY	CRCW04021002F100	R95	RES,SMT,0402	RESISTOR,SMT,0402,10K,1/16W,1%,100ppm
56	2	VISHAY	CRCW04022002F100	R44, R91	RES,SMT,0402	RESISTOR,SMT,0402,20K,1/16W,1%,100ppm
57	3	VISHAY	CRCW04024990F100	R80, R81, R82	RES,SMT,0402	RESISTOR,SMT,0402,499 OHM,1/16W,1%,100ppm
58	1	VISHAY	CRCW04025110F100	R58	RES,SMT,0402	RESISTOR,SMT,0402,511 OHM,1/16W,1%,100ppm
59	1	PANASONIC	ERJ-2GE0R00X	R56	RES,SMT,0402	RESISTOR/JUMPER,SMT,0402,0 OHM,5%,1/16W
60	6	PANASONIC	ERJ-2GEJ131	R28, R29, R30, R32, R43	RES,SMT,0402	RESISTOR,SMT,0402,THICK FILM,5%,1/16W,130
61	4	PANASONIC	ERJ-2GEJ391	R51, R52, R54, R55	RES,SMT,0402	RESISTOR,SMT,0402,THICK FILM,5%,1/16W,390
62						

Table 7. Bill of Materials (continued)

63	6	PANASONIC	ERJ-2GEJ820	R23, R24, R26, R27, R34	RES,SMT,0402	RESISTOR,SMT,0402,THICK FILM,5%,1/16W,82
64	8	PANASONIC	ERJ-2RKF1000X	R25, R40, R42, R76, R78, R84, R85, R89	RES,SMT,0402	RESISTOR,SMT,0402,100 OHM,1%,1/10W
65	3	PANASONIC	ERJ-2RKF3320X	R59, R90, R94	RES,SMT,0402	RESISTOR,SMT,0402,332 OHM,1%,1/16W
66	3	PANASONIC	ERJ-2RKF49R9X	R83, R88, R96	RES,SMT,0402	RESISTOR,SMT,0402,49.9 OHM,1%,1/16W
67	2	VISHAY	CRCW0603200F	R53, R57	RES,SMT,0603	RESISTOR,SMT,0603,1%,1/10W,200 OHM
68	1	VISHAY	CRCW06033012F	R87	RES,SMT,0603	RESISTOR,SMT,0603,1%,1/10W,30.1K
69	1	VISHAY	CRCW06034321F	R86	RES,SMT,0603	RESISTOR,SMT,0603,1%,1/10W,4.32K
70	1	PANASONIC	ERJ-3GSYJ153	R60	RES,SMT,0603	RESISTOR,SMT,0603,5%,1/10W,15K
71	2	VISHAY	TNPW06034750BT9	R3, R12	RES,SMT,0603	RESISTOR,SMT,0603,THIN FILM,475 OHM 0.1%,1/10W,25ppm
72	8	VISHAY	TNPW06034990BT9	R18, R19, R38, R39, R46, R47, R48, R49	RES,SMT,0603	RESISTOR,SMT,0603,THIN FILM,499 OHM 0.1%,1/10W,25ppm
73	3	VISHAY	TNPW060349R9BEEN	R9, R36, R37	RES,SMT,0603	RESISTOR,SMT,0603,THIN FILM,49.9 OHM,0.1%,1/10W
74	1	KYCON	STX-3000	JX1	STEREO PHONE JACK,THU,3 PIN	STEREO PHONE JACK,THU,3 PIN,3.5mm
75	7	KEYSTONE ELECTRONICS	5000	TP2, TP13, TP14VD, TP18VD, TP33VA, TP33VD, TP5V	TESTPOINT,THU,1P	TESTPOINT,THU,MINIATURE,0.1LS,120TL, RED
76	4	KEYSTONE ELECTRONICS	5001	GND1, GND2, GND3, GND4	TESTPOINT,THU,1P	TESTPOINT,THU,MINIATURE,0.1LS,120TL, BLACK
77	2	KEYSTONE ELECTRONICS	5002	TP1, TP-5V	TESTPOINT,THU,1P	TESTPOINT,THU,MINIATURE,0.1LS,120TL, WHITE
78	13	KEYSTONE ELECTRONICS	5004	TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP14, TP15, TP16	TESTPOINT,THU,1P	TESTPOINT,THU,MINIATURE,0.1LS,120TL, YELLOW
79	3	MINI-CIRCUITS	ADT4-1WT	T1, T2, T3	TRANSF,SMT,6P	RF TRANSFORMER WIDEBAND, 2-775 MHz, 50 OHM
80	2	BOURNS	3296W-1-103	VR2, VR3	TRIMPOT,THU,3P	TRIMPOT,THU,10K,10%,0.5W,100ppm,25T

Table 7. Bill of Materials (continued)

81	1	BOURNS	3296W-1-205	VR1	TRIMPOT,THU,3P	TRIMPOT,THU,2M,10%,0.5W,100ppm,25T
82	4	Digi-Key	29311K-ND		SCREW STEEL M3 THR 6MM	SCREW STEEL M3 THR 6MM
83	4	Digi-Key	24436K-ND		STANDOFF HEX M3 THR ALUM 18MM	STANDOFF HEX M3 THR ALUM 18MM
84	20	Molex	15-29-1025		SHUNT-JUMPER	CONN SHUNT CLOSED TOP .100 GOLD
85	2	SUSUMU	RG1005N152B	R10, R64	RES,SMT,0402	RESISTOR,SMT,0402,THIN FILM,1.5 K,0.1%,1/16W,10ppm,Tolerance important
86	4	SUSUMU	RG1005N202B	R61, R74	RES,SMT,0402	RESISTOR,SMT,0402,THIN FILM,2 K,0.1%,1/16W,10ppm,Tolerance important
87	4	SUSUMU	RG1005N202B	R4, R13	UNINSTALLED	RESISTOR,SMT,0402,THIN FILM,2 K,0.1%,1/16W,10ppm,UNINSTALLED
88	2	TI	THS4131ID	U15, VCON_OPAMP	UNINSTALLED	HIGH-SPEED LOW NOISE DIFFERENTIAL I/O AMPLIFIERS UNINSTALLED
89	6	UNINSTALLED	0402YC104KAT2A(UN)	C27, C28, C42, C44, C100, C102,C13, C14	UNINSTALLED	UNINSTALLED
90	11	UNINSTALLED	CRCW04020000Z0ED(UN)	R1, R6, R7, R8, R11, R15, R16, R17, R62, R72, R73, R75	UNINSTALLED	UNINSTALLED
91	6	PANASONIC	ERJ-2GEJ820	R33	RES,SMT,0402	RESISTOR,SMT,0402,THICK FILM,5%,1/16W,82 (UNINSTALLED)
92	6	PANASONIC	ERJ-2GEJ131	R31	RES,SMT,0402	RESISTOR,SMT,0402,THICK FILM,5%,1/16W,130 (UNINSTALLED)
93	1	PANASONIC	ERJ-2GEJ161	R35	RES,SMT,0402	RESISTOR,SMT,0402,THICK FILM,5%,1/16W,160 (UNINSTALLED)
94	3	TI	LMH6629SDE/NOPB	U4, U6, U8	IC,SMT,DFN-8	ULTRA-LOW NOISE,PRECISION OPERATIONAL AMPLIFIERS
95	4	PANASONIC	ERJ-3GSYJ102(UN)	R20, R21, R22, R41	RES,SMT,0603	(UNINSTALLED PART)
96	8	PANASONIC	ERJ-2GEJ49R9(UN)	R65, R66, R67, R68, R69, R70, R77, R79	RES,SMT,0402	(UNINSTALLED PART)

Table 7. Bill of Materials (continued)

97	1	VISHAY	CRCW04024701F100	R45	RES,SMT,0402	RESISTOR,SMT,0402,4.7K,1/16W,1%,100ppm (UNINSTALLED)
98	1	ADVANCED CONNECTEK	MNE20-5K5P10	USB1	CONN,SMT,5P	MINI-AB USB OTG RECEPTACLE R/A SMT TYPE Use 670-1523-1-ND instead.
99	7	EFJOHNSON	EFJOHNSON	J2, J4, J6, J8, J14, J15, J17	CONN,THU,SMA JACK	SMA JACK END LAUNCH, 0.080 PCB THICK. Use J630-ND for board thickness of .042 or J502-ND for .062 or J992-ND for .068
100	1	CONNOR WINFIELD	CWX813-10.0M	X1	OSC,SMT,4P	OSCILLATOR,SMT,4P,3.3V,+/-25ppm,-20~70C,10.000 MHz. Use FVXO-PC73B-640-ND instead
101	1	Texas Instruments	AFE5809	DUT1	TI Provided part	SMT,135P,BGA,1mmLS,022PAD (TI Provided part)
102	1	OSC,SMT,6P	VX-7040-ECE-KXX-0-640M000	OSC1	OSC,SMT,6P	VCXO,SMT,3.3V,640Mhz 5.0x7.5x1.8mm (TI Provided part)

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.

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REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

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

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.

Texas Instruments Japan Limited
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http://www.tij.co.jp

【ご使用にあたっての注】

本開発キットは技術基準適合証明を受けておりません。

本製品のご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。
1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。

日本テキサス・インスツルメンツ株式会社
東京都新宿区西新宿６丁目２４番１号
西新宿三井ビル
http://www.tij.co.jp

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.

STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, or documentation (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.

    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/lsds/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/lsds/ti_ja/general/eStore/notice_01.page

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

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of 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】 開発キットの中には技術基準適合証明を受けていないものがあります。 技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。
上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・インスツルメンツ株式会社
東京都新宿区西新宿６丁目２４番１号
西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page
電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

4   *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should 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 also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user 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, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure 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. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*

   6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY WRITTEN DESIGN MATERIALS PROVIDED WITH THE EVM (AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

   6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS AND CONDITIONS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT MADE, CONCEIVED OR ACQUIRED PRIOR TO OR AFTER DELIVERY OF THE EVM.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL 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 HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS AND CONDITIONS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

   8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS ANDCONDITIONS OR THE USE OF THE EVMS PROVIDED HEREUNDER, REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN ONE YEAR AFTER THE RELATED CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY WARRANTY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS AND CONDITIONS, OR ANY USE OF ANY TI EVM PROVIDED HEREUNDER, EXCEED THE TOTAL AMOUNT PAID TO TI FOR THE PARTICULAR UNITS SOLD UNDER THESE TERMS AND CONDITIONS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM AGAINST THE PARTICULAR UNITS SOLD TO USER UNDER THESE TERMS AND CONDITIONS SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

IMPORTANT NOTICE

Products		Applications	
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Wireless Connectivity	www.ti.com/wirelessconnectivity		