User's Guide
SBAU289–October 2017

Precision Signal Injector EVM (PSIEVM)

This user's guide describes the characteristics, operation, and use of the *Precision Signal Injector* evaluation module (PSIEVM). The EVM facilitates the evaluation of single-ended, differential, and high-voltage SAR analog-to-digital converters (ADC) by generating a very low distortion, low-noise signal. This signal generator is powered by and controlled by the USB port. This user's guide provides a description of how to configure and control the hardware using the provided software GUI.

The following related documents are available through the Texas Instruments web site at www.ti.com.

Table 1. Associated Devices

Device	Literature Number
ADS8900BEVM-PDK	SBAU269
ADS8881EVM-PDK	SBAU281
ADS8681EVM-PDK	SBAU252
DAC8411	SBAS439
MSP430F5503	SLAS645
OPA1612	SBOS450
OPA1662	SBOS489
OPA227	SBOS110
OPA827	SBOS376
PCM5142	SLAS759
THS4131	SLOS318

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Trademarks

1 Overview

The *Precision Signal Injector Evaluation Module* (PSIEVM, or PSI for short) is a platform for testing and evaluating the performance of successive approximation register (SAR) ADCs. The board is strictly designed to provide a low distortion, low-noise, 2-kHz input signal for driving the input of the ADC and pairs with most of TI's SAR ADC evaluation modules (EVMs). The board is powered over a USB cable which also provides a user interface connection to a PC.

The software platform that accompanies the PSIEVM allows for the user to adjust the PSIEVM output through the graphical user interface (GUI) that is downloaded to the computer.

Along with the PSIEVM, this evaluation kit includes an A-to-micro-B USB cable to connect to a computer via USB 3.0 or below, as well as 2 SMA to SMA coaxial cables for EVM connectivity.

1.1 PSIEVM Features

The PSIEVM includes the following features:

- Software suite with a graphical tool for controlling the amplitude, frequency, and offset of the AC signal
- Onboard filter for generating a very low distortion, low-noise, 2-kHz signal
- Jumper-selectable options for filtering and offset voltage or common-mode voltage
- Single-ended or true differential signal output options.
- Easy-to-use evaluation software for Microsoft® Windows® 7, Windows 8, and Windows 10 64-bit operating systems
- Powered over a single USB cable

2 PSIEVM Initial Setup

This section explains the initial hardware and software setup procedure required for the proper operation of the PSIEVM.

2.1 Default Jumper Settings

Jumper settings are used to enable or disable filter stages, enable or disable EEPROM write, select internal or external power supplies, select internal or external analog signals, and adjust offset or common-mode voltage for the outputs. Jumper settings are described in and initial jumper position is shown in .

Table 2. Jumper Position Description

Designator	Position	Setting
JP1 and JP3	Filter	Enables filter following the audio DAC. The filter is used to minimize distortion and noise. When the filter is enabled, the PSI should only output 2 kHz.
JP2	Not Installed	If installed, this jumper can be used to allow for an external analog input signal. This option is intended for debug purposes only and is not required for normal operation. Connector P1 must be installed for the source of the signal (see Section 6.3).
JP4	Ground	Sets the offset to 0 V for single-ended output. To add a voltage offset, move this jumper to the SE_VOS side (see Section 3.2).
JP5	Not Installed	If installed, this jumper can be used to select external power supplies. Also install header P7 for the source of the power supplies. For general operation, the USB power is sufficient and external power is not required (see section Section 6.1).
JP7	Open	EEPROM in *Write Protect Mode*. The EEPROM is programmed during manufacturing with correction coefficients. To reprogram the correction coefficients, short jumper JP7. Since the EEPROM is programed in the factory, it is not necessary to recalibrate the PSI.
JP8	Ground	Sets VCM to 0 volts for *Differential Output*. To add a common-mode voltage, move this jumper to the DIF_VCM side (see Section 3.2).

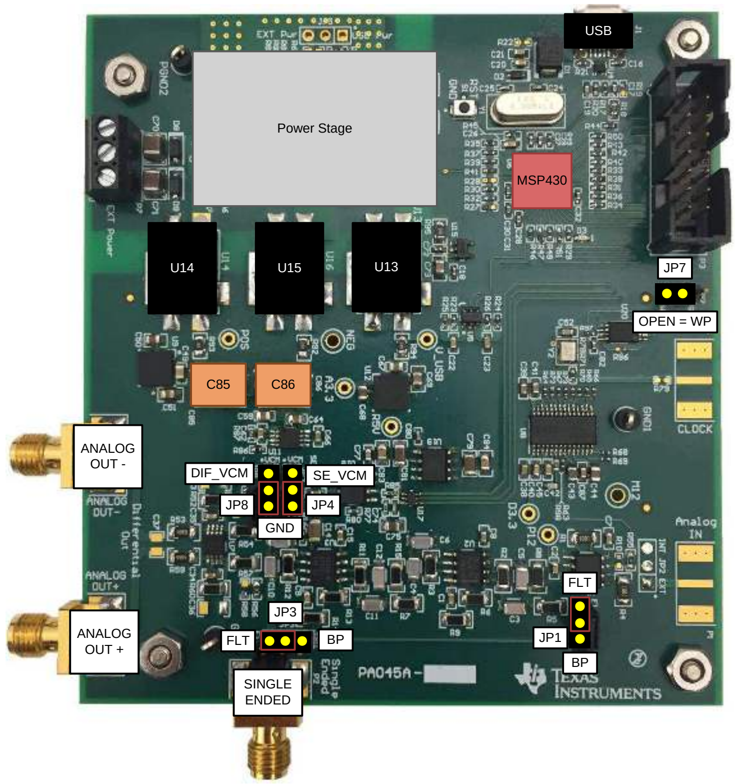

Figure 1. Initial Jumper Setting Illustration

2.2 EVM Graphical User Interface (GUI) Software Installation

Download the latest version of *ADS8900BEVM-PDK Precision Signal Injector (PSI) GUI Installer* from the Tools and Software folder of the PSIEVM and run the GUI installer to install the EVM GUI software on the user's computer.

NOTE: Manually disable any antivirus software running on the computer before downloading the EVM GUI installer onto the local hard disk. Otherwise, depending on the antivirus settings, an error message may appear or the installer.exe file may be deleted.

Accept the license agreements and follow the on-screen instructions to complete the installation.

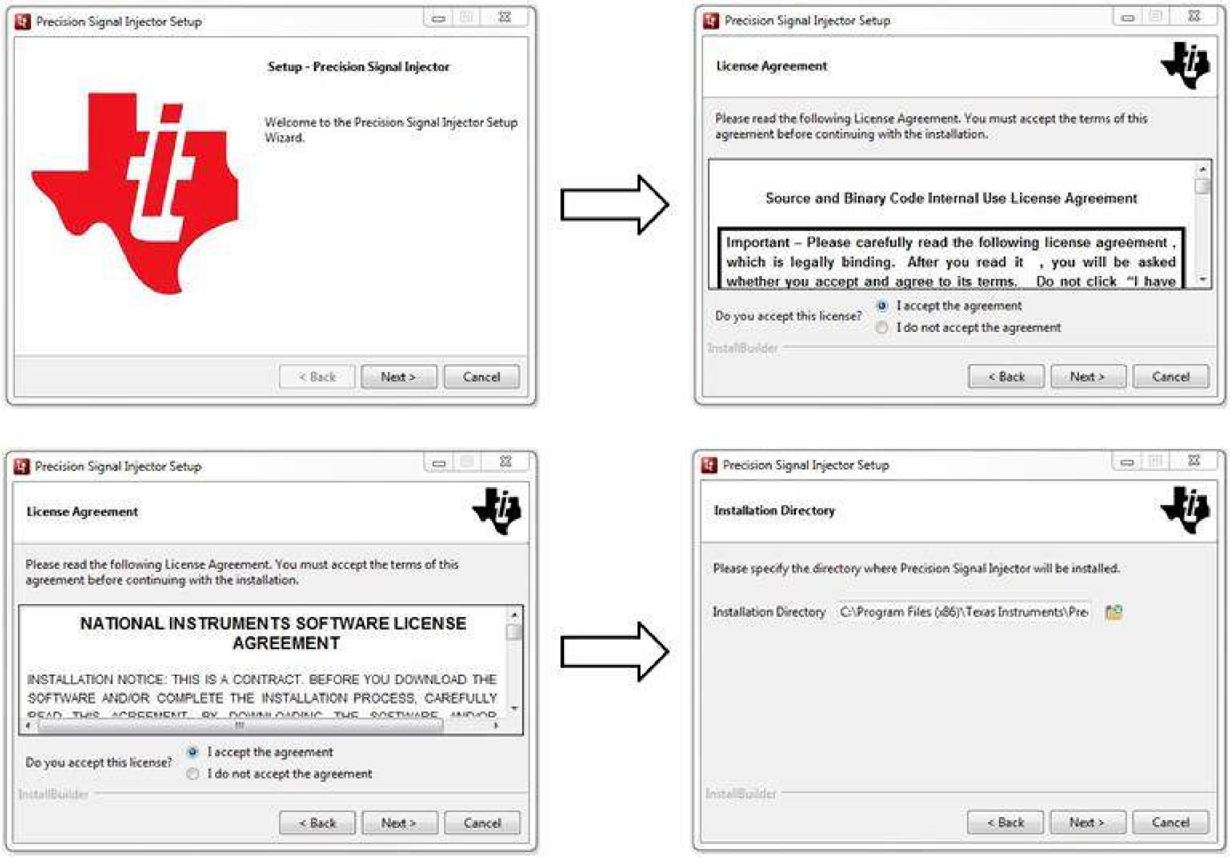

Figure 2. PSIEVM Software Installation Prompts

As part of the PSI GUI installation, a prompt with a *Device Driver* Installation appears on the screen. Click the *Next* > button to proceed.

NOTE: A notice may appear on the screen stating that *Windows* cannot verify the publisher of this driver software. Select Install this driver software anyway.

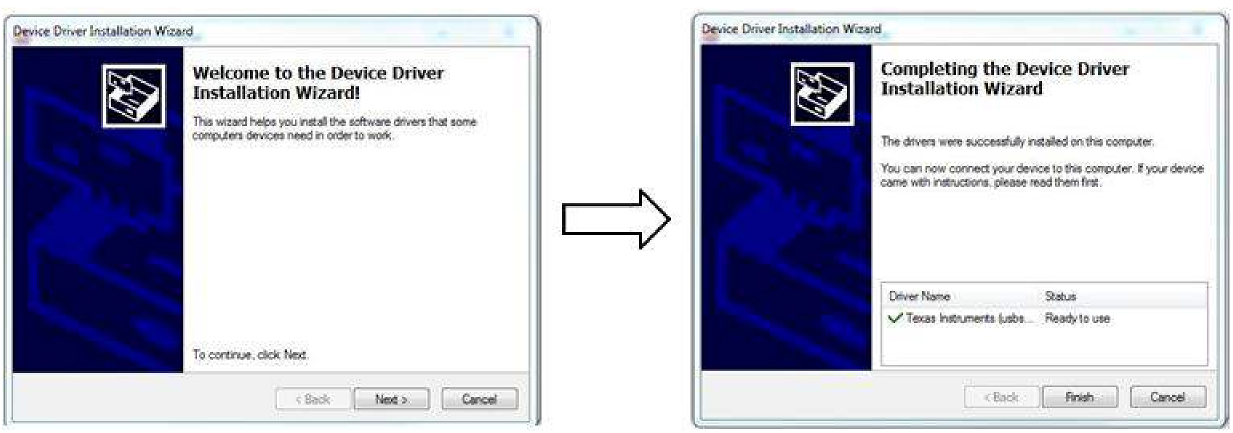

Figure 3. Device Driver Installation Wizard Prompts

The PSIEVM requires LabVIEW™ Run-Time Engine and may prompt for the installation of this software, if not already installed.

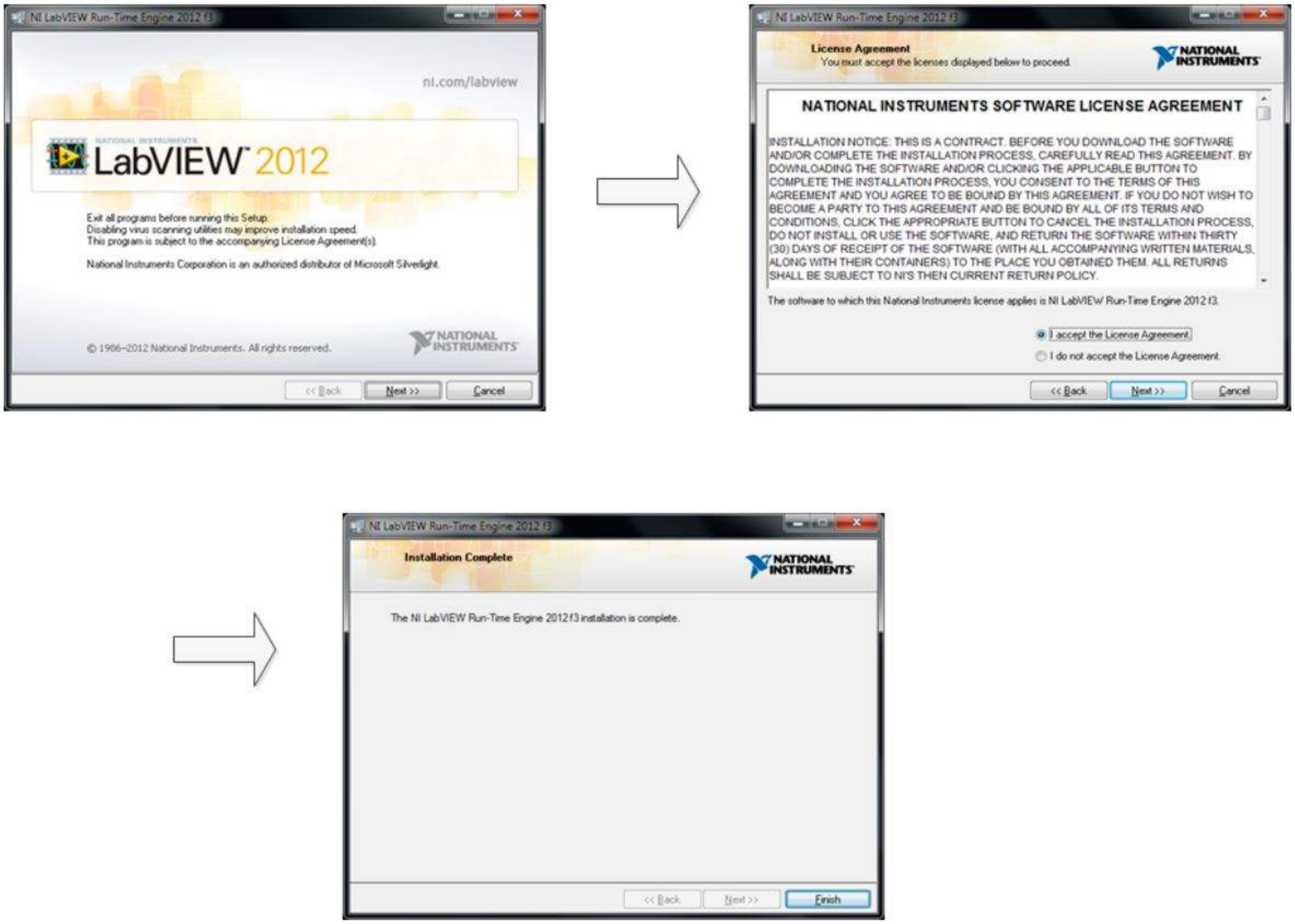

Figure 4. LabVIEW™ Run-Time Engine Installation

After these installations, verify that C:\Program Files (x86)\Texas Instruments\Precision Signal Injector is as shown in Figure 5.

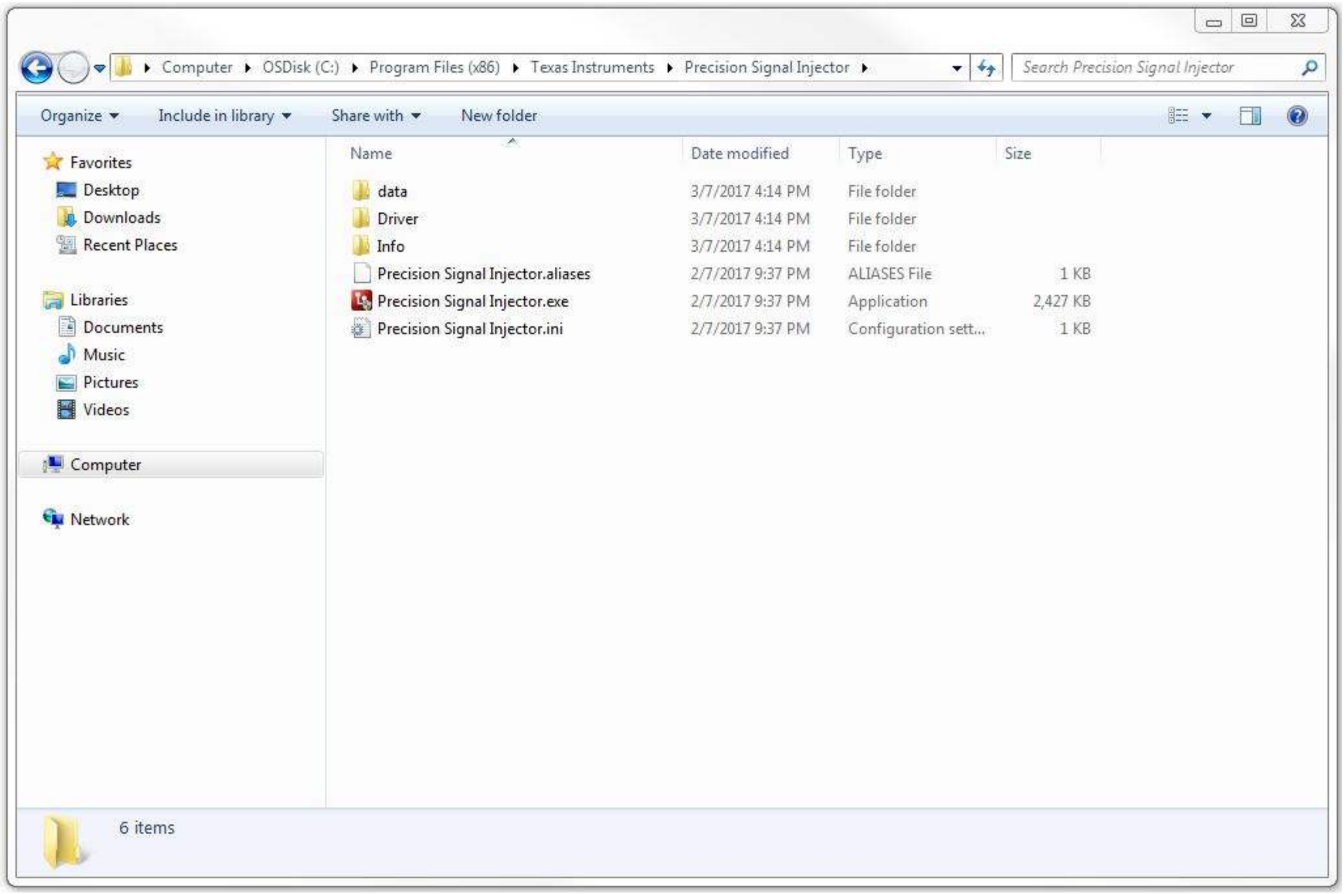

Figure 5. PSIEVM Folder Post-Installation

3 PSIEVM Operation

The following instructions are a step-by-step guide to connecting the PSIEVM to the computer and operating it to apply precision signals to a TI SAR ADC EVM (referred to as device under test (DUT)):

1. Use the provided USB cable to connect the PSIEVM to the computer.
   - LED D3 lights up indicating that the PSIEVM is powered up.
2. Launch the *Precision Signal Injector GUI* (PSI GUI) software.
3. Connect the PSIEVM to the desired DUT to connector P2 for single ended, or P4 and P5 for differential signal (see Table 3). Ensure a firm contact on these connectors for effective signal transmission.
4. Connect the DUT EVM to the computer. Launch the GUI for the DUT EVM.
5. Set the PSI GUI to have the desired output type (single ended or differential), peak-to-peak voltage, offset voltage or common-mode voltage, and frequency.
6. Enable to output for the PSIEVM.

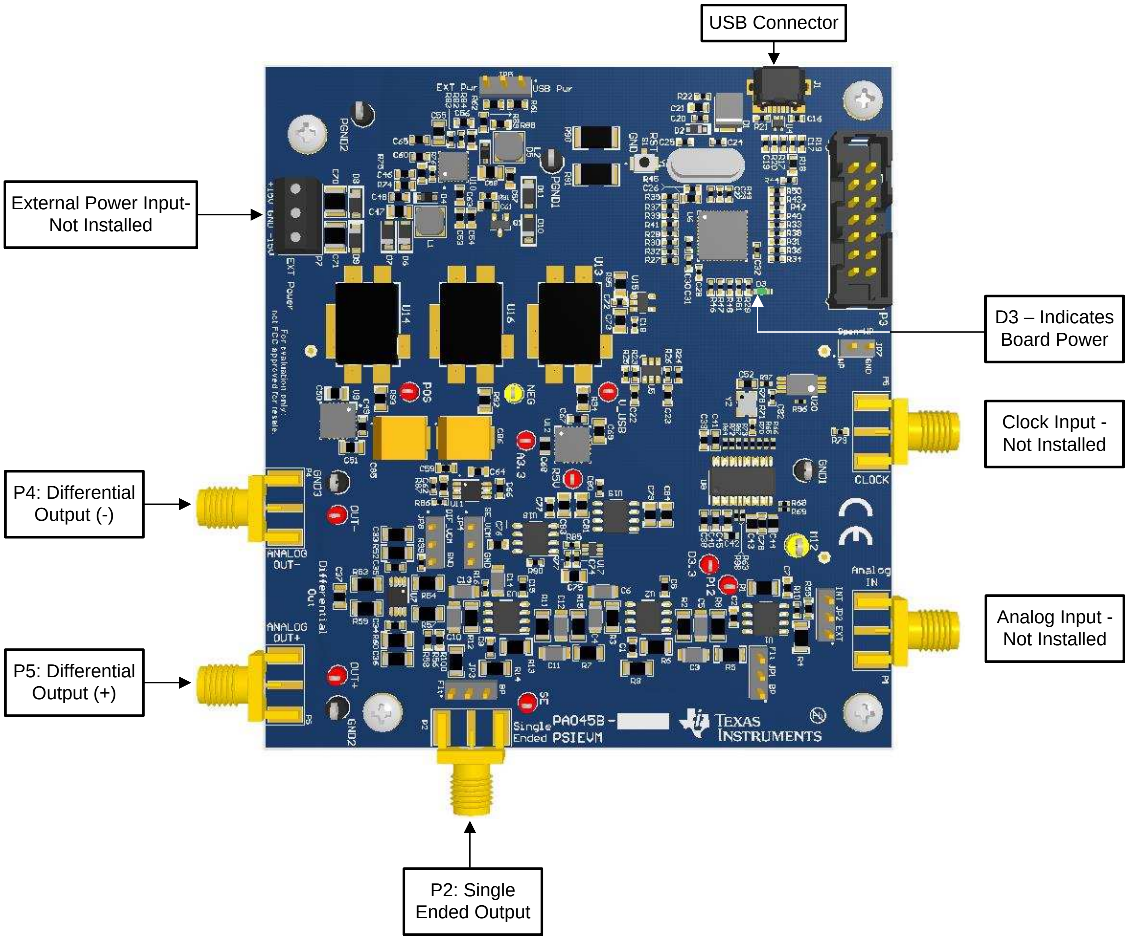

Figure 6. PSIEVM Hardware With Labels

Table 3. Output Connectors Description

Reference Designator	Signal	Description
P2	Single-ended output	Single-ended output
P4	Differential output (–)	Negative-differential output

3.1 Using the PSI GUI

Through the PSI GUI, the user is able to control the input signal amplitude, offset, frequency, and type (single ended or differential). The PSI GUI gives the user control over the signal being applied to the DUT.

Figure 7 shows the PSI GUI as it appears on the user's computer screen.

PSI GUI Operation:

1. Select either *Single Ended* or *Differential* to ensure the output from the PSIEVM is the type the DUT takes as an input. The plot on the GUI adjusts to match the output signal.
2. Adjust the signal amplitude, common mode, and frequency by either typing in the desired values or by using the up or down arrows next to the text boxes. Click the *Set* button next to the parameter to change the output.
3. Enable the output by clicking *Output Enable*. A green light appears on the PSI GUI showing the output is enabled.

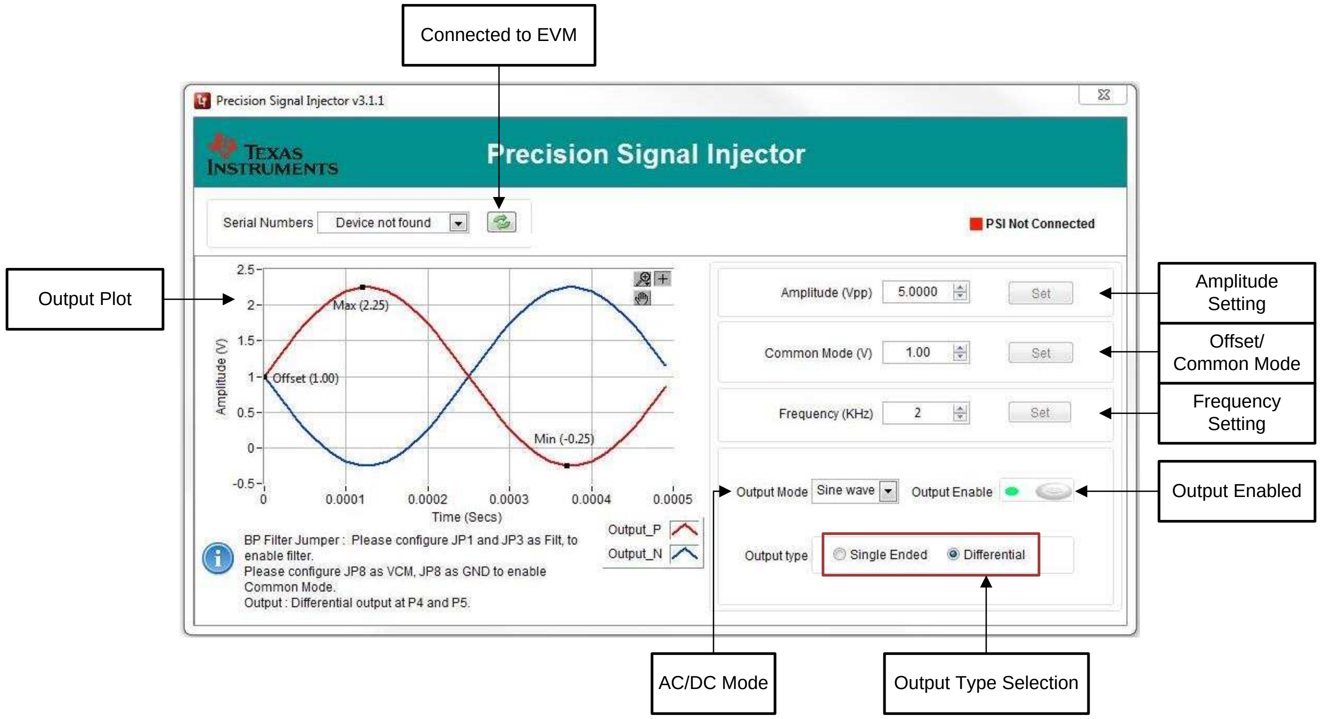

Figure 7. PSI GUI With Labels

3.2 *Setting the Offset Voltage or Common-Mode Voltage*

An offset voltage can be added to the single-ended output of the PSIEVM or a common-mode voltage can be added to the differential outputs. Table 4 shows the jumper combinations that are required to implement an offset or common-mode voltage. Once the jumpers are placed in the correct configuration, set the offset voltage or common-mode voltage through the GUI.

Table 4. Offset Voltage or Common-Mode Voltage Jumper Settings

Offset Voltage or Common-Mode Voltage Setting	JP4	JP8
VOS or VCM = 0 V	Ground	Ground
Single-ended offset	SE_VOS	Ground
Differential common-mode voltage	Ground	DIF_VCM

Figure 8 shows an example of the GUI with single-ended output and an added offset voltage. The GUI does all of the calculations for the given inputs and shows the expected output on the plot.

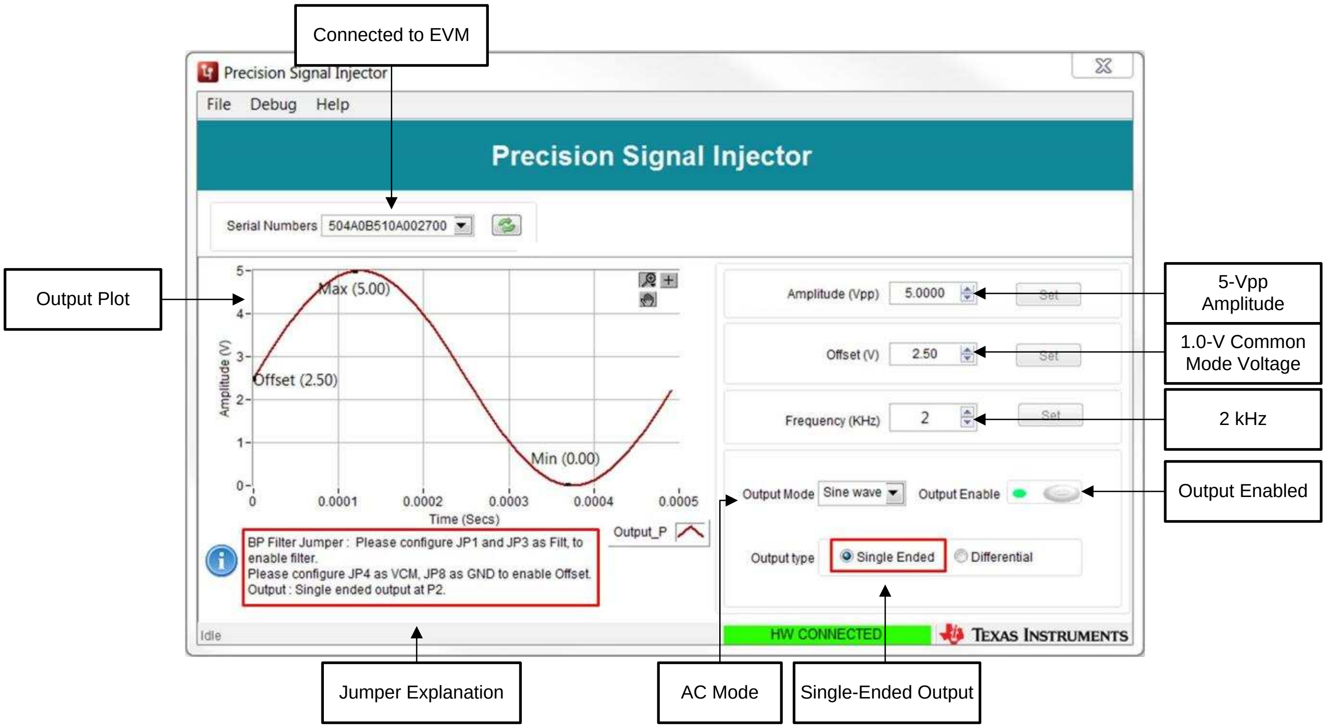

Figure 8. Offset Voltage Example

Figure 9 shows an example of the GUI with differential output and an added common-mode voltage. The GUI does all of the calculations for the given inputs and shows the expected outputs on the plot.

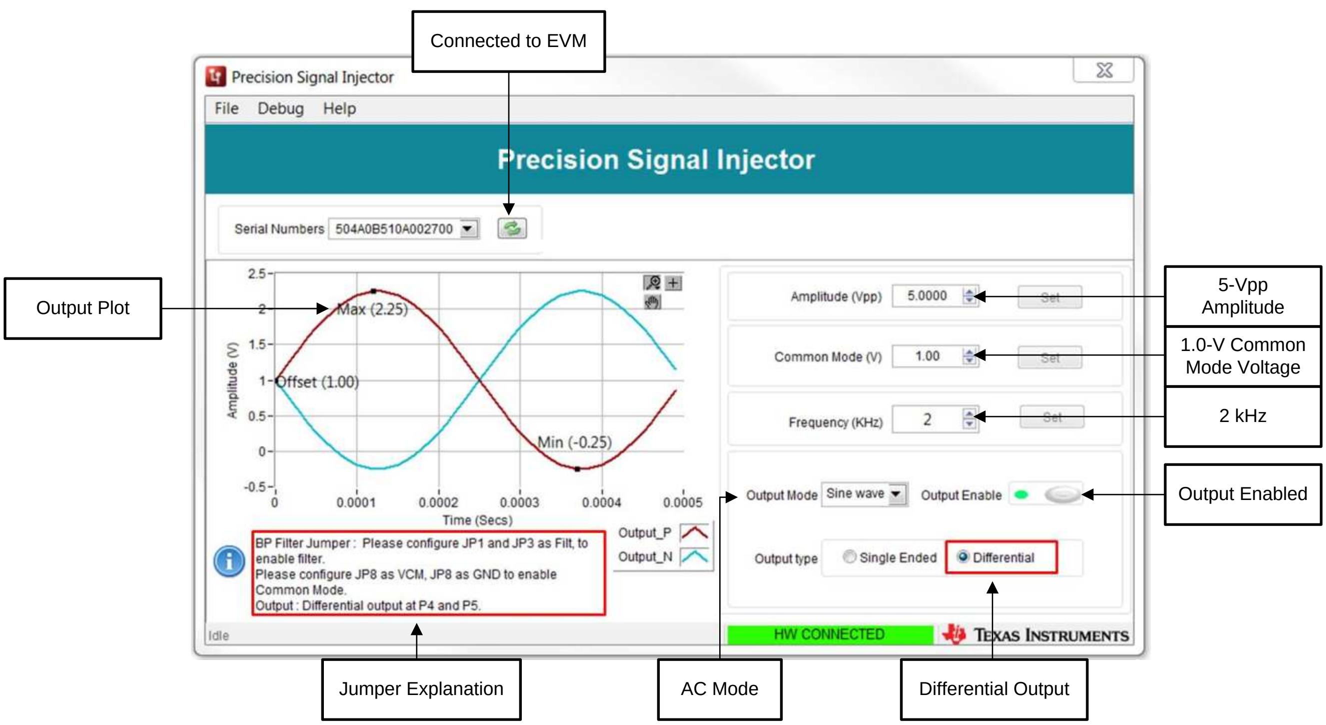

Figure 9. Common-Mode Voltage Example

3.3 AC versus DC Output

The PSIEVM is able to output a sine wave or a DC level. This change is made with the drop-down menu for *Output Mode*.

3.4 Amplitude Setting and Output Enable

The amplitudes selectable in the PSI GUI are available for AC single ended or differential as well as for DC output, see Table 5. Once all PSI GUI parameters have been selected, enabling the output allows for the selected signal to be produced from the PSIEVM. Disabling the output defaults the PSIEVM output to ground.

Table 5. Amplitude Range

Output Type	Minimum	Maximum
AC Single Ended or Differential	0 Vpp	11.88 Vpp
DC Single Ended or Differential	0 V	11.88 V

3.5 Frequency Selection

The eighth-order filter implemented on the PSIEVM and explained in Section 5.4, is optimized for a 2-kHz signal. The PSIEVM can create signals at other frequencies to effectively use a signal frequency other than 2 kHz, the filter must be bypassed by placing JP1 and JP3 into bypass mode. Note that the signal is not filtered when bypassing the eighth-order onboard filter, and consequently, THD and SNR are degraded. The PSI GUI allows input of any frequency, up to 20 kHz.

3.6 Typical Performance

Table 6 shows typical performance seen using the PSIEVM with the ADS8900BEVM with full scale signals.

Table 6. Typical Performance

Measurement	Value
SNR	101 dB
THD	–123 dB
SNR without filter	63.8 dB
THD without filter	–86.3 dB
DC resolution	36 codes = 0.34 mV

4 Examples Using PSIEVM to Drive TI Data Converter EVMs

In this section the PSIEVM is used to drive three different examples of SAR ADC evaluation modules. This includes both single-ended and differential cases.

4.1 Example of Single-Ended Operation With ADS8881EVM

To explain the single-ended output mode of operation, an example using the ADS8881EVM follows. The hardware setup is shown in Table 7 and Figure 10. First, download the ADS8881EVM GUI to use the ADC to acquire the PSIEVM output signals. Then, connect the PSIEVM to the ADS8881EVM by having P2 on the PSIEVM attached to J1 on the ADS8881EVM, also tie JP2 to ground on the ADS8881EVM and have no jumper installed on JP3. Next, select the output parameters as shown in Table 8. Lastly, enable the output on the PSI GUI and use the ADS8881EVM to acquire the signal. Figure 11 and Figure 12 show the two GUIs for this test. Table 9 shows the expected results for this test setup.

Table 7. Example 1 Hardware Setup

Reference Designator	Position or Connection
ADS8881EVM J1	PSIEVM P2
ADS8881EVM JP-2	Ground
ADS8881EVM JP-3	Open
PSIEVM P2	ADS8881EVM J1
PSIEVM JP1, JP3	Filter
PSIEVM JP4	Ground

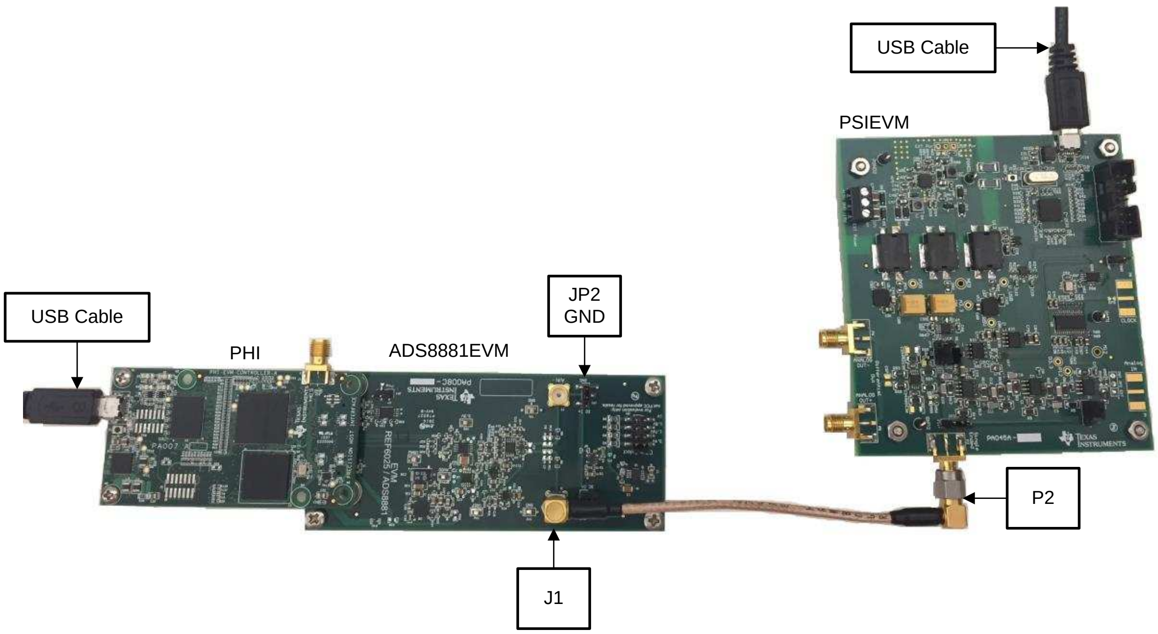

Figure 10. ADS8881EVM Connected to PSIEVM

Table 8. ADS8881EVM Example Parameters

Parameter	Value
ADS8881EVM input type	Single ended
PSI GUI output type	Single ended
ADS8881EVM maximum input range	(–VREF to VREF) –4.5 V to 4.5 V
PSI GUI amplitude	8.8 Vpp
PSI GUI common mode	0 V
PSI GUI frequency	2 kHz

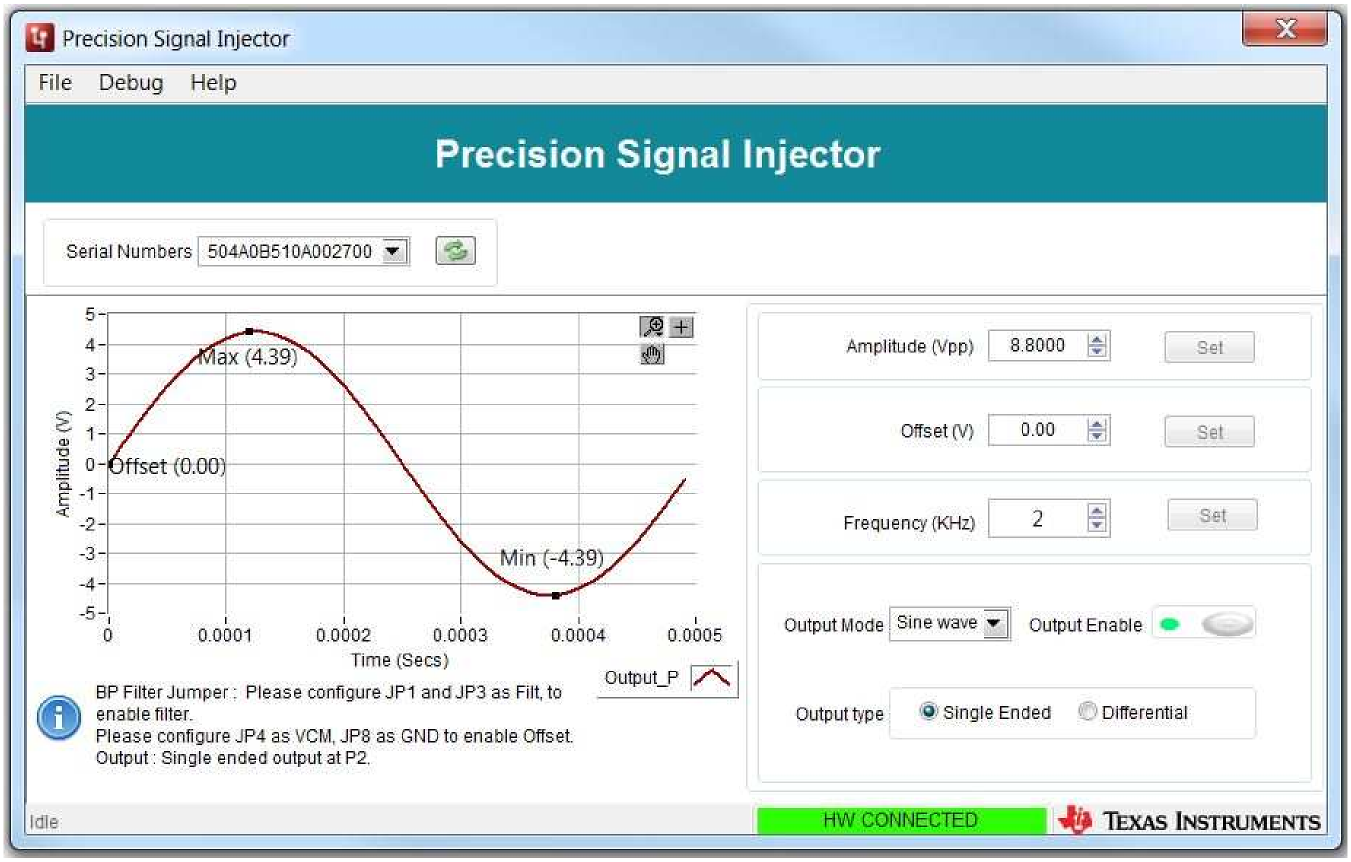

Figure 11. PSI GUI Setup for ADS8881EVM

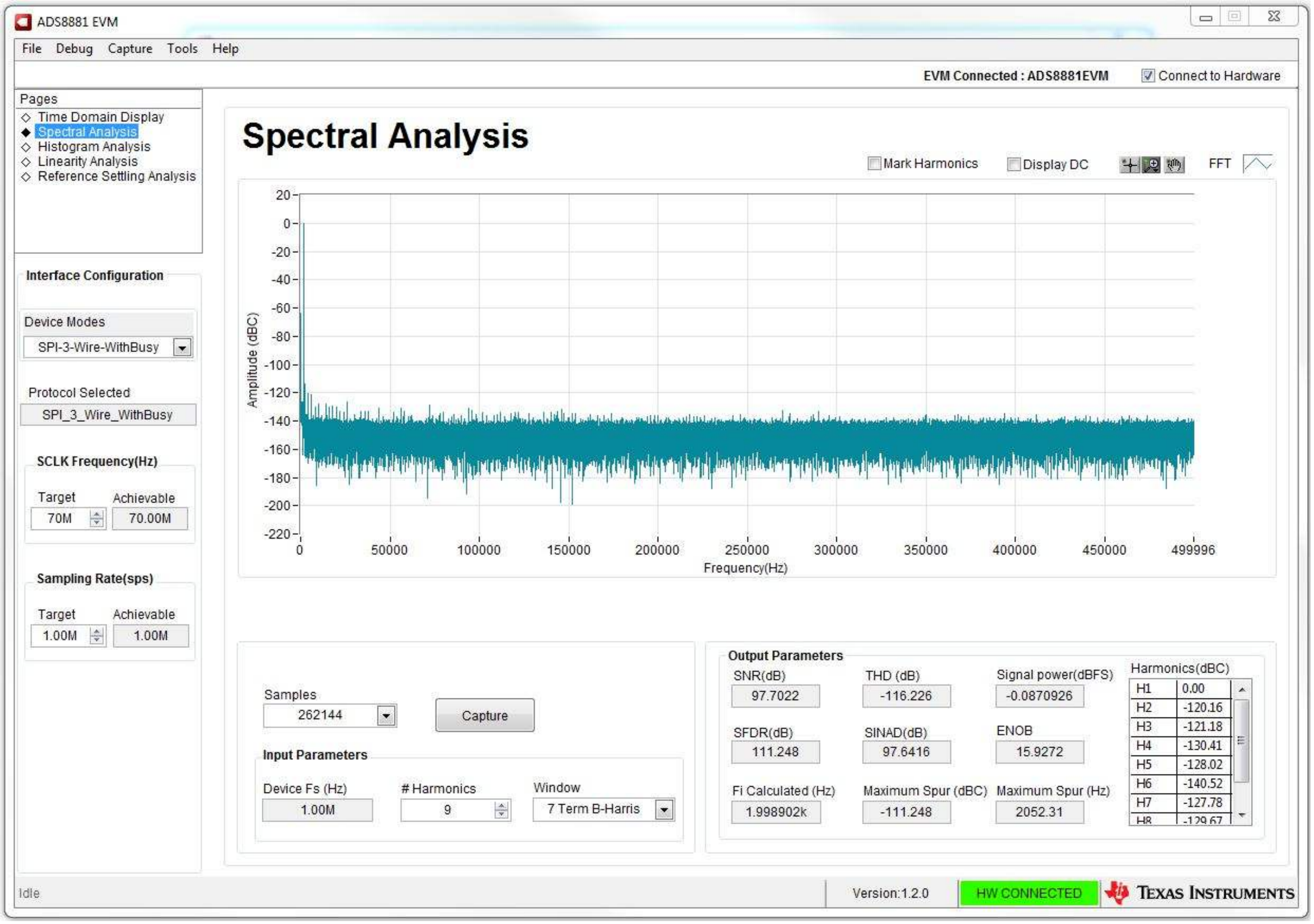

Figure 12. ADS8881EVM GUI Spectral Analysis for PSIEVM Input

Table 9. Example 1 Results

Measurement	Value
SNR	97.7 dB
THD	–116.2 dB

4.2 Example of Differential Operation With ADS8900BEVM

To explain the differential output mode of operation, an example using the ADS8900BEVM follows. First, download the ADS8900BEVM GUI to use the ADC to acquire the PSIEVM output signals. Then, connect the PSIEVM to the ADS8900BEVM by having P4 and P5 on the PSIEVM attached to J7 and J3, respectively, on the ADS8900BEVM, using equal length cables, as shown in Table 10 and Figure 13. Next, the output parameters should be selected as shown in Table 11. Lastly, enable the output on the PSI GUI and use the ADS8900BEVM to acquire the signal. Figure 14 and Figure 15 show the two GUIs for this test. Table 12 shows expected results for this test setup.

Table 10. Example 2 Hardware Setup

Reference Designator	Position or Connection
ADS8900BEVM J3	PSIEVM P5
ADS8900BEVM J7	PSIEVM P4
PSIEVM P5	ADS8900BEVM J3
PSIEVM P4	ADS8900BEVM J7
PSIEVM JP1, JP3	Filter
PSIEVM JP8	Ground

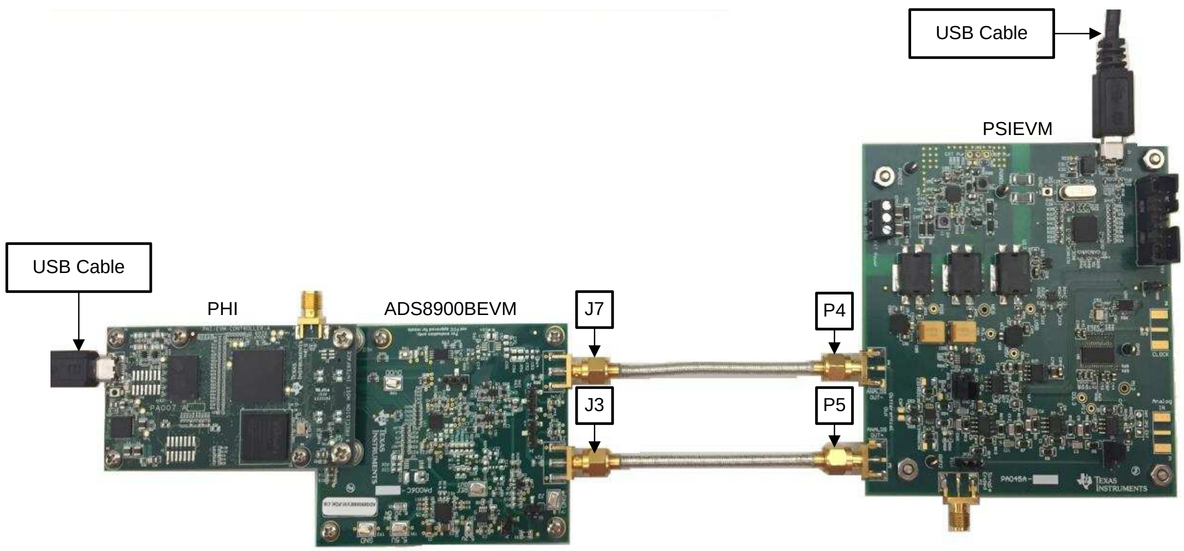

Figure 13. ADS8900BEVM Connected to PSIEVM

Table 11. ADS8900BEVM Examples Parameters

Parameter	Value
ADS8900BEVM input type	Differential
PSI GUI output type	Differential
ADS8900BEVM maximum input range	(–VREF to +VREF) –5 V to 5 V
PSI GUI amplitude	9.8 Vpp
PSI GUI common mode	0 V
PSI GUI frequency	2 kHz

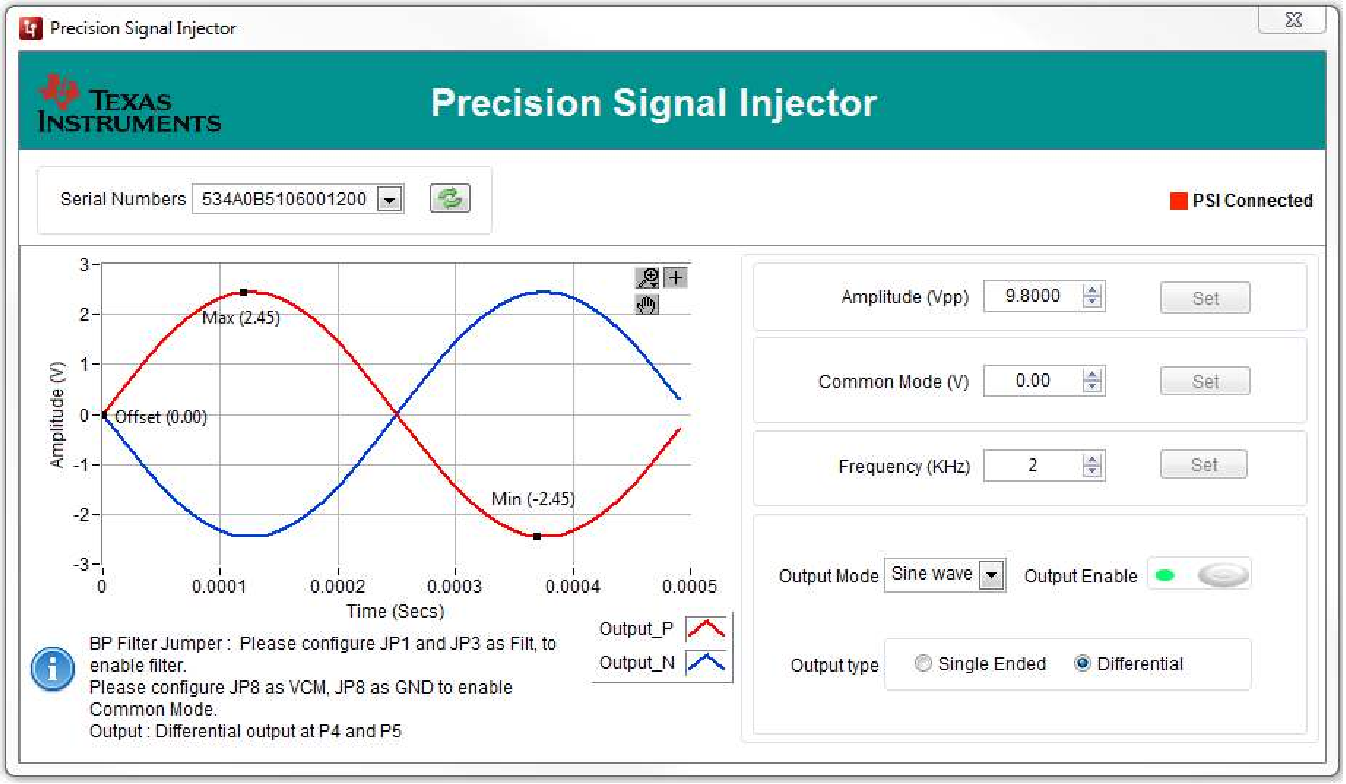

Figure 14. PSI GUI Setup for ADS8900BEVM

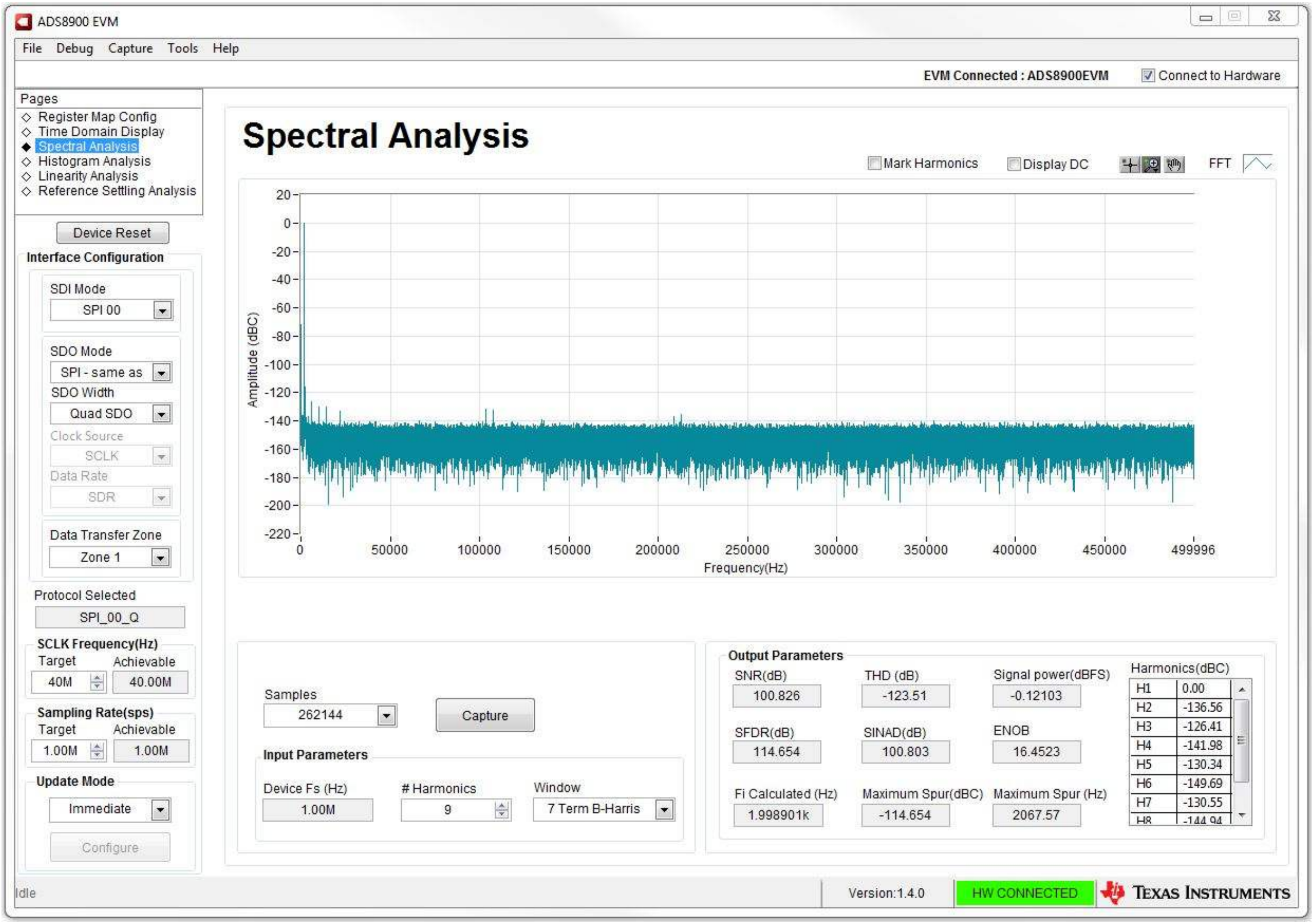

Figure 15. ADS8900BEVM GUI Spectral Analysis for PSIEVM Input

Table 12. Example 2 Results

Measurement	Value
SNR	100.8 dB
THD	–123.5 dB

4.3 Example of Single-Ended, High-Voltage Operation With ADS8681EVM

To explain the single-ended output mode of operation with a high-voltage SAR ADC, an example using the ADS8681EVM follows. First, download the ADS8681EVM GUI to use the ADC to acquire the PSIEVM output signals. Then, connect the PSIEVM to the ADS8681EVM by having P2 on the PSIEVM attached to J1 on the ADS8681EVM as shown in Table 13 and Figure 16. Next, select the output parameters as Table 14 shows. Lastly, enable the output on the PSI GUI and use the ADS8681EVM to acquire the signal. Figure 17 and Figure 18 show the two GUIs for this test. The output range of the PSIEVM is limited to 11.88 V peak to peak. To test SAR ADC at higher voltages than ±5.93 V, use the common-mode offset. To implement an offset in single-ended mode, JP4 on the PSIEVM must be moved to SE_VOS, see Section 3.2. Table 15 shows the expected results for this test setup.

NOTE: To make the ADS8681EVM function properly using the PSIEVM, remove capacitor C1 on the ADS8681EVM. This is because the PSIEVM does not function properly when driving a capacitive load, see Section 7.1.

Table 13. Example 3 Hardware Setup

Reference Designator	Position or Connection
ADS8681EVM J1	PSIEVM P2
PSIEVM P2	ADS8681EVM J1
PSIEVM JP1, JP3	Filter
PSIEVM JP4	Ground

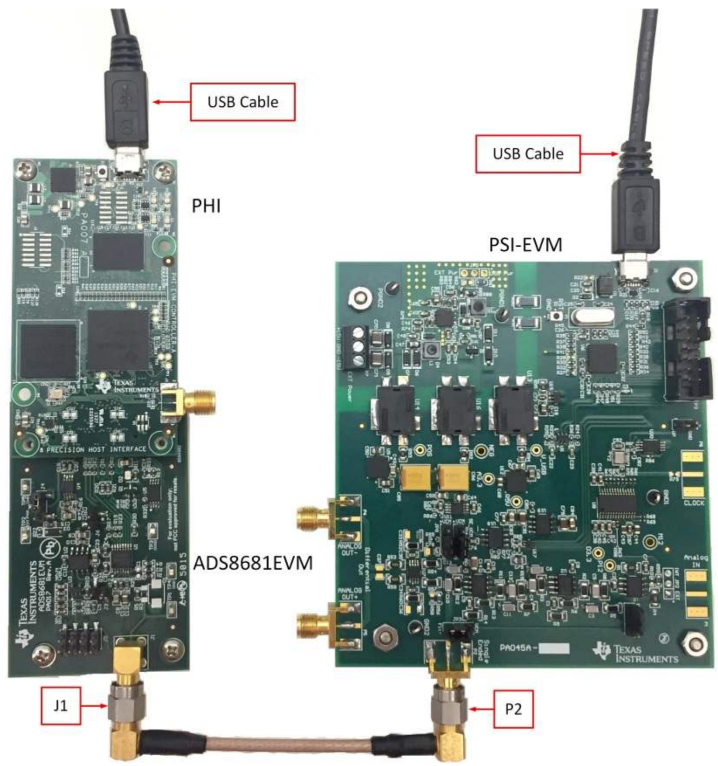

Figure 16. ADS8681EVM Connected to the PSIEVM

Table 14. ADS8681EVM Example Parameters

Parameter	Value
ADS8681EVM input type	Single ended
PSI GUI output type	Single ended
ADS8681EVM maximum input range	–3 × VREF to 3 × VREF = –12 V to 12 V
PSI GUI amplitude	11.88 Vpp (maximum setting)
PSI GUI common mode	0 V
PSI GUI frequency	2 kHz
PSIEVM connectors	P3

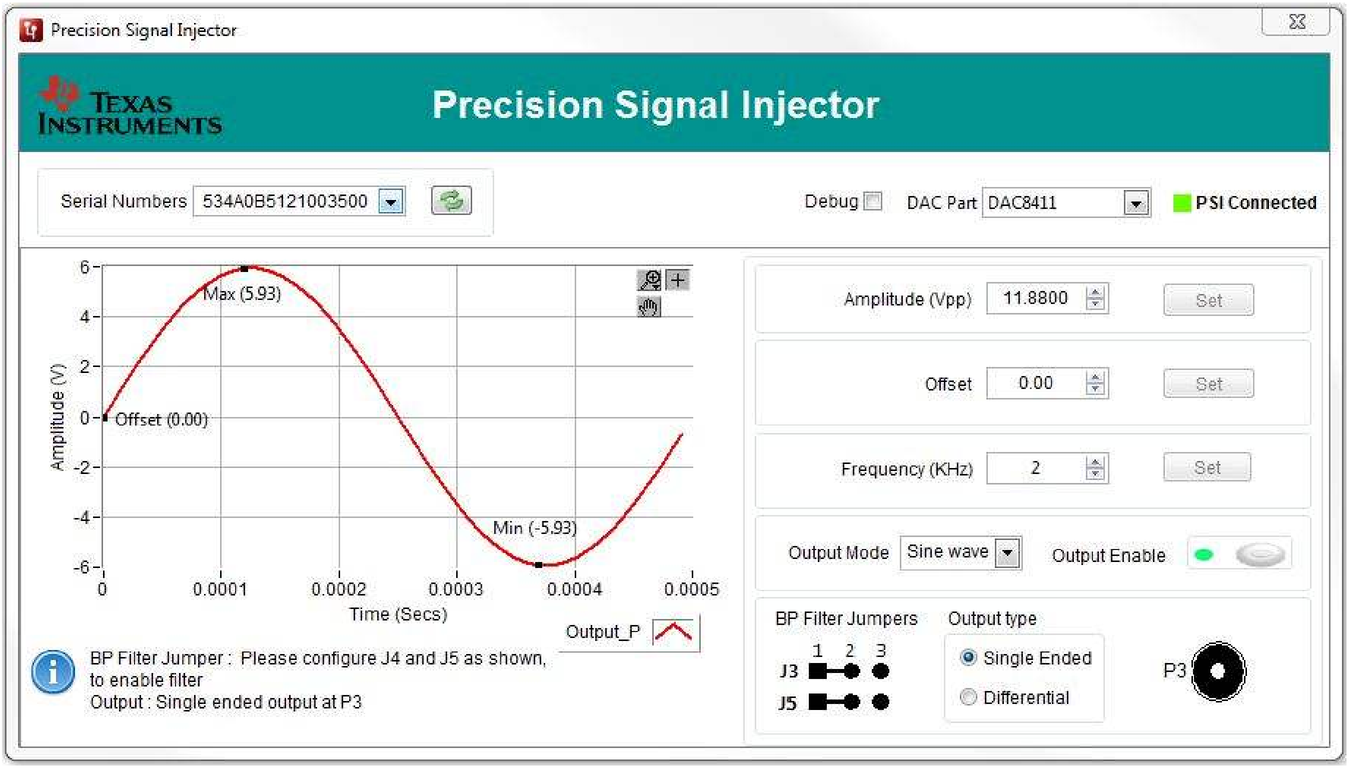

Figure 17. PSI GUI Setup for ADS8681EVM

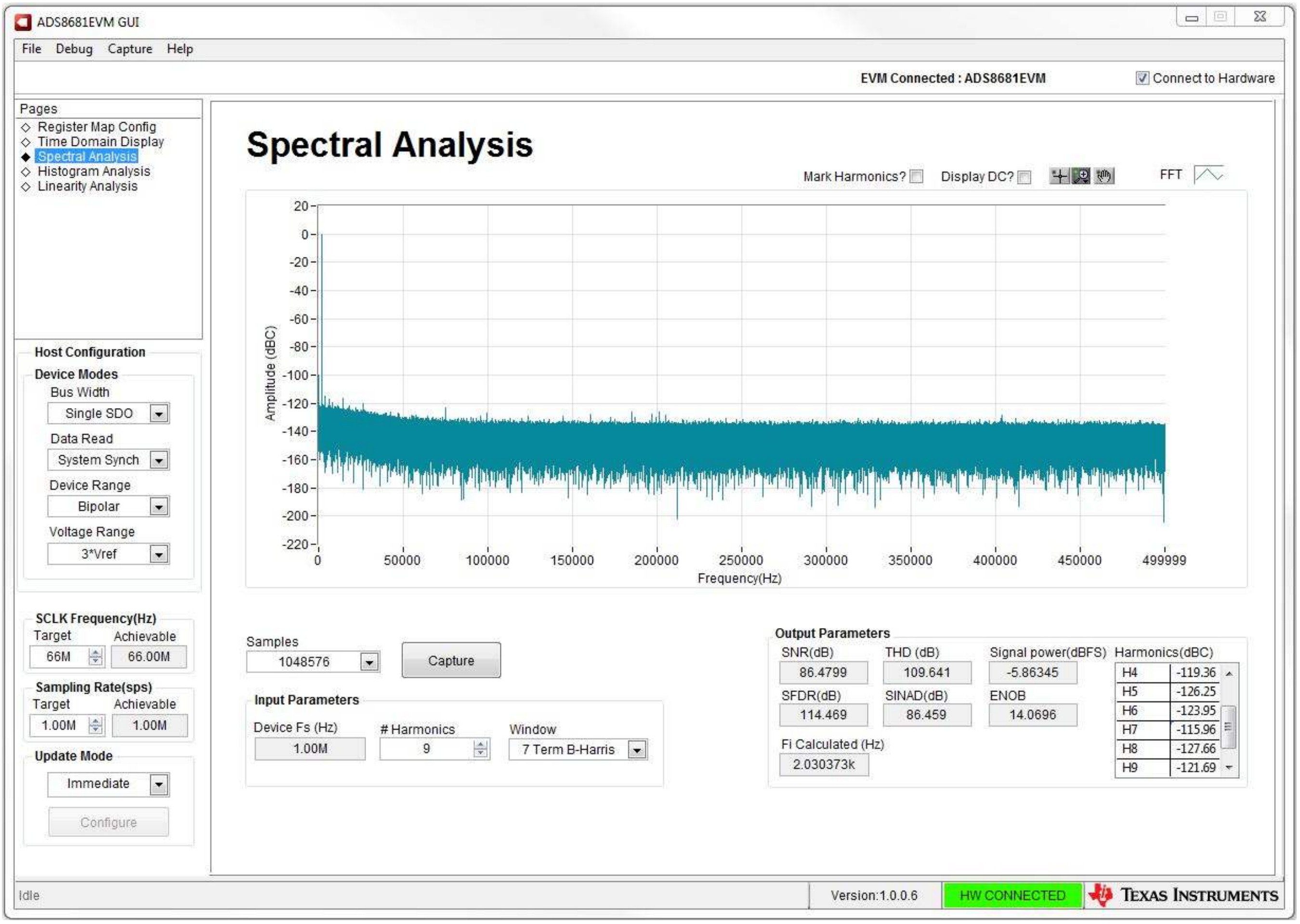

Figure 18. ADS8681EVM GUI Spectral Analysis for PSIEVM Input

Table 15. Example 3 Results

Measurement	Value
SNR	86.4 dB
THD	–109.6 dB

5 PSIEVM Design Overview

5.1 Analog Interface

The evaluation board uses a variety of amplifiers in different configurations to compose the output signal based on the user inputs through the GUI. The signal path is explained fully in Section 5.4.

5.2 Digital Interface

The EVM communicates with the computer over USB. There are two devices on the EVM that communicate to the computer: the MSP430F5503 and the electrically erasable programmable read-only memory (EEPROM). The EEPROM comes pre-programmed with calibration coefficients and is ready to use out-of-the-box.

5.3 Connectors for Signal Output

The PSIEVM is designed to be easily interfaced with a TI SAR ADC EVM via a subminiature version A (SMA) connector. P2, P4, and P5 are SMA connectors that allow analog output connectivity through coaxial cables.

5.4 Signal Path

The PSIEVM takes user inputs from the GUI and transforms them into a highly-precise output signal. This process starts with the MSP430F5503 taking the user inputs and sending them to an audio digital-to-analog converter (DAC). The output of the audio DAC is then driven through a non-inverting topology op amp with a set gain of 2 volts-per-volt. The resulting signal is then placed through an eighth-order filter and this is the single-ended output signal. For the differential output, the single-ended output is driven into a fully differential amplifier.

The offset or common-mode voltage is controlled by a DAC, which takes input from the MSP430 and produces a voltage that drives into the filter to add single-ended offset and into the fully differential amplifier to add differential output common mode. Figure 19 helps visualize the explained signal path.

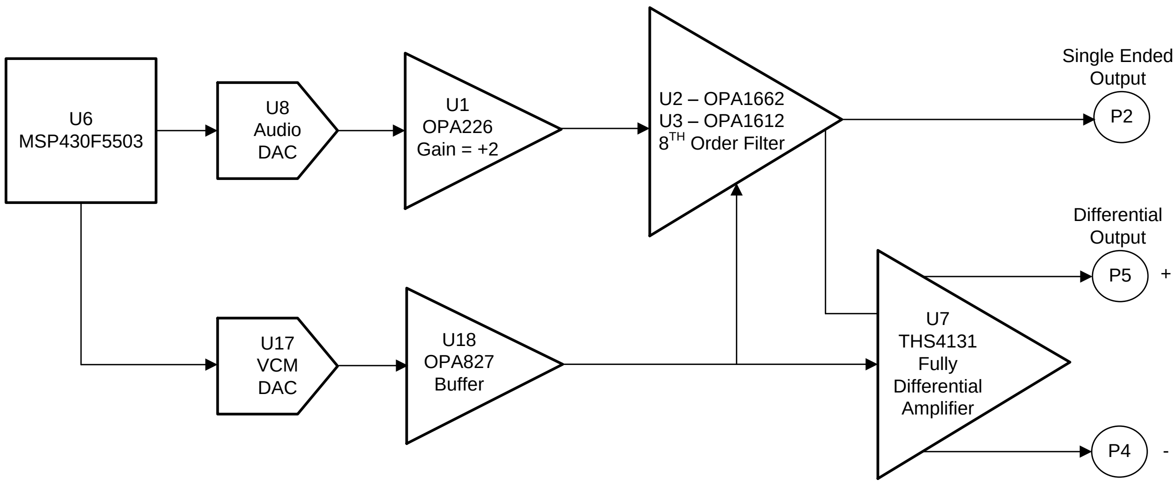

Figure 19. Signal Path Illustration

5.5 Power Supplies

The USB supply is used to provide power to the analog power rail, digital power rail, positive amplifier supply, and negative amplifier supply. The power tree is shown in Table 16 and in Figure 20. External power supplies are not required but are an available option, see Section 6.1.

Table 16. Power Supplies

Power Rail	Voltage	Test Point
USB supply	4.75 V to 5.25 V	V_USB – TP3
Analog 3.3 (AV 3.3)	3.3 V	A3.3 – TP4
Digital 3.3 (DV 3.3)	3.3 V	D3.3 – TP5
Positive supply from switching regulator (POS SUP)	13.5 V	POS – TP1
Negative supply from switching regulator (NEG SUP)	–13.5 V	NEG – TP2
Positive supply from linear regulator (V_12)	12 V	P12 – TP6
Negative supply from linear regulator (VM_12)	–12 V	M12 – TP7

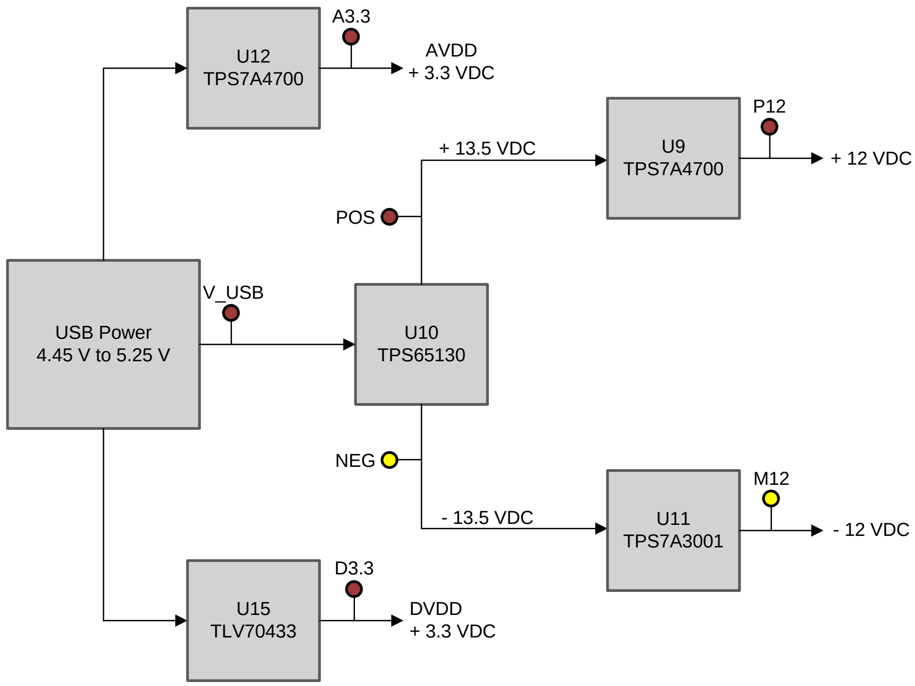

Figure 20. Power Tree

6 Optional Features

In this section the options that are not installed on the PSIEVM are explained.

6.1 Using External Power Supplies

External power supplies are not required as the USB provides sufficient power for normal operation. This feature is included for debug. To use external power, install jumper JP5 and header P7. Place JP5 in external mode. Connect a 15-VDC supply and a –15-VDC supply to terminal block P7. The voltage input at header P7 is directly applied to the linear regulators.

CAUTION

Ensure the connected power supply is at a maximum of 15 V. Fluctuating above 15 V could result in component damage.

The PSIEVM must still be connected to the computer via the USB cable but this is only used for data from the GUI and not power.

6.2 Using an External Clock

The audio DAC, PCM5142, runs off the 20-MHz clock produced by the onboard crystal. Future developments may allow for an external clock input. Currently this hardware is not populated (P6).

6.3 Using an External Input Signal

The PSIEVM generates an output signal without requiring an analog input signal. An external analog input connection is available for debug purposes. This connection (P1) is not populated, and is not required for normal operation.

7 Other Considerations

7.1 Output Impedance

The output for the single ended and differential both have the option to populate output resistance. This feature can be used to help the PSI drive a capacitive load or to help minimize reflections through the coaxial cabling. Typically, a 50-Ω resistor for the output resistance will improve stability for driving a capacitive load and matches the impedance of the coaxial cabling. Note that by adding output resistance, there will be a voltage divider from the output resistance of the PSI and the input resistance of the DUT. The PSIEVM is fully calibrated with R53, R59, and R100 as 0-Ω resistors.

7.2 Cable Selection

It is best practice to minimize the length of the cabling used between the PSI and the DUT. It is also best to ensure a properly tightened connection between the SMA and the coaxial cable. A loose connection can lead to a low-quality signal transmission. The use of a torque wrench can help to ensure consistent tightness.

8 Bill of Materials, PCB Layout, and Schematics

This section contains the PSIEVM bill of materials, PCB layout, and the EVM schematics.

8.1 Bill of Materials

Table 17. PSIEVM Bill of Materials

Item #	Designator	Quantity	Value	Part Number	Manufacturer	Description	Package Reference
1	!PCB1	1		PA045	Any	Printed Circuit Board for PrecisionSignalEVM	
2	C1, C2, C7, C8, C9, C15, C34, C35, C76, C77	10	0.1uF	06033C104JAT2A	AVX	CAP, CERM, 0.1 µF, 25 V, ±5%, X7R, 0603	0603
3	C3, C4, C5, C6, C10, C11, C12, C13	8	0.1uF	C3216NP01H104J160AA	TDK	CAP, CERM, 0.1 µF, 50 V, ±5%, C0G/NP0, 1206_190	1206_190
4	C14, C70, C71	3	10uF	GRM32ER7YA106KA12L	Murata	CAP, CERM, 10uF, 35V, ±10%, X7R, 1210	1210
5	C16, C18, C28, C30, C31, C32, C72, C82	8	0.1uF	GRM155R61A104KA01D	Murata	CAP, CERM, 0.1 µF, 10 V, ±10%, X5R, 0402	0402
6	C17, C19	2	10pF	GRM1555C1H100FA01D	Murata	CAP, CERM, 10 pF, 50 V, ±1%, C0G/NP0, 0402	0402
7	C20	1	0.1uF	GRM155R61E104KA87D	Murata	CAP, CERM, 0.1 µF, 25 V, ±10%, X5R, 0402	0402
8	C21, C22, C23, C46, C53, C54, C56, C63	8	4.7uF	GRM188R61A475MAAJ	Murata	CAP, CERM, 4.7 µF, 10 V, ±20%, X5R, 0603	0603
9	C24, C25	2	47pF	GRM1555C1H470JA01D	Murata	CAP, CERM, 47 pF, 50 V, ±5%, C0G/NP0, 0402	0402
10	C26	1	0.1uF	GRM188R70J104KA01D	Murata	CAP CER 0.1UF 16V 5% X7R 0603	0603
11	C27, C29	2	0.22uF	GRM155R71C224KA12D	Murata	CAP CER 0.22UF 16V 10% X7R 0402	0402
12	C38, C39, C41, C78	4	0.1uF	C0603C104J4RACTU	Kemet	CAP, CERM, 0.1 µF, 16 V, ±5%, X7R, 0603	0603
13	C40, C45	2	2.2uF	GRM188R61C225KE15D	Murata	CAP, CERM, 2.2 µF, 16 V, ±10%, X5R, 0603	0603
14	C42	1	2200pF	GRM1885C1H222JA01D	Murata	CAP, CERM, 2200 pF, 50 V, ±5%, C0G/NP0, 0603	0603
15	C43, C44, C75	3	10uF	GRM219R60J106KE19D	Murata	CAP CER 10UF 10V 10% X5R 0805	0805
16	C47, C58	2	10uF	C2012X5R1E106K125AB	TDK	CAP, CERM, 10 µF, 25 V, ±10%, X5R, 0805	0805
17	C48, C57, C61	3	0.1uF	GCM188R71H104KA57D	Murata	CAP, CERM, 0.1 µF, 50 V, ±10%, X7R, 0603	0603
18	C49, C59, C64, C67	4	10uF	GRM188R61C106MAALD	Murata	CAP, CERM, 10 µF, 16 V, ±20%, X5R, 0603	0603
19	C50, C68	2	22uF	C2012X5R1C226K125AC	TDK	CAP, CERM, 22 µF, 16 V, ±10%, X5R, 0805	0805
20	C51, C69, C73	3	1uF	0805YD105KAT2A	AVX	CAP, CERM, 1 µF, 16 V, ±10%, X5R, 0805	0805
21	C52	1	0.01uF	GRM188R71E103KA01D	Murata	CAP, CERM, 0.01 µF, 25 V, ±10%, X7R, 0603	0603
22	C55	1	0.22uF	GRM21BR71H224KA01L	Murata	CAP, CERM, 0.22 µF, 50 V, ±10%, X7R, 0805	0805
23	C60	1	0.01uF	06031C103JAT2A	AVX	CAP, CERM, 0.01 µF, 100 V, ±5%, X7R, 0603	0603
24	C62, C66	2	0.01uF	GRM188R71H103KA01D	Murata	CAP, CERM, 0.01 µF, 50 V, ±10%, X7R, 0603	0603
25	C65	1	0.047uF	06033C473JAT2A	AVX	CAP, CERM, 0.047 µF, 25 V, ±5%, X7R, 0603	0603
26	C74	1	200pF	GRM1555C1H201JA01D	Murata	CAP, CERM, 200 pF, 50 V, ±5%, C0G/NP0, 0402	0402
27	C79, C81	2	10uF	GRM21BZ71E106KE15L	Murata	CAP, CERM, 10 µF, 25 V, ±10%, X7R, 0805	0805
28	C80	1	1uF	EMK105BJ105KVHF	Taiyo Yuden	CAP, CERM, 1 µF, 16 V, ±10%, X5R, 0402	0402
29	C83, C84	2	0.1uF	08053C104KAT2A	AVX	CAP, CERM, 0.1 µF, 25 V, ±10%, X7R, 0805	0805
30	C85, C86	2	100uF	TPSV107K025R0100	AVX	CAP, TA, 100 µF, 25 V, ±10%, 0.1 ohm, SMD	7361-38
31	D1	1	15V	LSM115JE3/TR13	Microsemi	Diode, Schottky, 15 V, 1 A, DO-214BA	DO-214BA

Table 17. PSIEVM Bill of Materials (continued)

Item #	Designator	Quantity	Value	Part Number	Manufacturer	Description	Package Reference
32	D2	1	5.42V	DDZ5V6ASF-7	Diodes Inc.	Diode, Zener, 5.42 V, 500 mW, SOD-323F	SOD-323F
33	D3	1	Green	LG L29K-G2J1-24-Z	OSRAM	LED, Green, SMD	1.7x0.65x0.8mm
34	D4, D5	2	30V	BAT48JFILM	STMicroelectronics	Diode, Schottky, 30 V, 0.35 A, SOD-323	SOD-323
35	D6, D7, D10, D11	4	40V	1N5819HW-7-F	Diodes Inc.	Diode, Schottky, 40 V, 1 A, SOD-123	SOD-123
36	D8, D9	2	27V	MMSZ4711-V	Vishay-Semiconductor	Diode, Zener, 27V, 500mW, SOD-123	SOD-123
37	H1, H2, H3, H4	4		NY PMS 440 0025 PH	B&F Fastener Supply	Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw
38	H5, H6, H7, H8	4		1891	Keystone	Hex Standoff, #4-40, Aluminum, 1/4"	1/4 inch Aluminum Hex Standoff
39	J1	1		10103592-0001LF	FCI	Receptacle, USB 2.0, Micro B, 5 Position, R/A, SMT	Receptacle, USB 2.0, Micro B, 5 Pos, 0.65mm Pitch, R/A, SMT
40	JP1, JP3, JP4, JP8	4		HTSW-103-07-G-S	Samtec	Header, 100mil, 3x1, Gold, TH	Header, 100mil, 3x1, TH
41	JP7	1		HTSW-102-07-G-S	Samtec	Header, 100mil, 2x1, Gold, TH	Header, 100mil, 2x1, TH
42	L1, L2	2	4.7uH	744031004	Wurth Elektronik	Inductor, Shielded Drum Core, Ferrite, 4.7 µH, 0.9 A, 0.09 ohm, SMD	WE-TPC-S
43	P2, P4, P5	3		142-0701-851	Emerson Network Power	Connector, End launch SMA, 50 ohm, SMT	SMA End Launch
44	P3	1		N2514-6002-RB	3M	Header (shrouded), 100mil, 7x2, Gold, TH	7x2 Header
45	P7	1		ED555/3DS	On-Shore Technology	Terminal Block, 3.5mm Pitch, 3x1, TH	10.5x8.2x6.5mm
46	Q1	1	-20V	SI2323DS	Vishay-Siliconix	MOSFET, P-CH, -20 V, -3.7 A, SOT-23	SOT-23
47	R1, R4	2	1.00k	RP73D2B1K0BTG	TE Connectivity	RES, 1.00 k, 0.1%, 0.25 W, 1206	1206
48	R2	1	6.34k	ERA-8APB6341V	Panasonic	RES, 6.34 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206	1206
49	R3	1	3.32k	ERA-8APB3321V	Panasonic	RES, 3.32 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206	1206
50	R5	1	3.16k	ERA-8APB3161V	Panasonic	RES, 3.16 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206	1206
51	R6	1	1.65k	ERA-8APB1651V	Panasonic	RES, 1.65 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206	1206
52	R7	1	1.33k	ERA-8APB1331V	Panasonic	RES, 1.33 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206	1206
53	R8	1	102	RT1206BRC07102RL	Yageo America	RES, 102, 0.1%, 0.25 W, 1206	1206
54	R9	1	215	RT1206BRC07215RL	Yageo America	RES, 215, 0.1%, 0.25 W, 1206	1206
55	R11	1	5.49k	ERA-8APB5491V	Panasonic	RES, 5.49 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206	1206
56	R12	1	8.25k	ERA-8APB8251V	Panasonic	RES, 8.25 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206	1206
57	R13	1	2.05k	ERA-8APB2051V	Panasonic	RES, 2.05 k, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206	1206
58	R14	1	121	RT1206BRC07121RL	Yageo America	RES, 121, 0.1%, 0.25 W, 1206	1206
59	R15	1	80.6	ERA-8AEB80R6V	Panasonic	RES, 80.6, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206	1206
60	R16, R30, R31, R32, R33, R45, R63, R64, R65, R66, R67, R68, R69, R70, R72, R73, R86, R96, R97	19	10.0k	CRCW040210K0FKED	Vishay-Dale	RES, 10.0 k, 1%, 0.063 W, 0402	0402
61	R17, R20	2	27.4	CRCW040227R4FKED	Vishay-Dale	RES, 27.4, 1%, 0.063 W, 0402	0402
62	R18	1	1.37k	RT0603BRD071K37L	Yageo America	RES, 1.37 k, 0.1%, 0.1 W, 0603	0603
63	R21, R46, R48, R49, R50, R78, R99	7	0	CRCW04020000Z0ED	Vishay-Dale	RES, 0, 5%, 0.063 W, 0402	0402
64	R23, R24	2	100k	CRCW0402100KJNED	Vishay-Dale	RES, 100 k, 5%, 0.063 W, 0402	0402
65	R25, R26	2	150k	CRCW0402150KJNED	Vishay-Dale	RES, 150 k, 5%, 0.063 W, 0402	0402
66	R29, R34, R36, R38, R40, R42, R43, R71	8	51.1	CRCW040251R1FKED	Vishay-Dale	RES, 51.1, 1%, 0.063 W, 0402	0402
67	R35, R37, R39, R41	4	33	CRCW040233R0JNED	Vishay-Dale	RES, 33, 5%, 0.063 W, 0402	0402

Table 17. PSIEVM Bill of Materials (continued)

Item #	Designator	Quantity	Value	Part Number	Manufacturer	Description	Package Reference
68	R44	1	1.1Meg	CRCW04021M10JNED	Vishay-Dale	RES, 1.1 M, 5%, 0.063 W, 0402	0402
69	R52, R54, R57, R60	4	665	ERA-8APB6650V	Panasonic	RES, 665, 0.1%, 0.25 W, AEC-Q200 Grade 0, 1206	1206
70	R53, R59, R100	3	0	RCA12060000ZSEA	Vishay-Dale	RES, 0, 5%, 0.25 W, AEC-Q200 Grade 0, 1206	1206
71	R55, R56, R61, R89	4	0	ERJ-3GEY0R00V	Panasonic	RES, 0, 5%, 0.1 W, 0603	0603
72	R74, R84	2	100k	RC0603FR-07100KL	Yageo America	RES, 100 k, 1%, 0.1 W, 0603	0603
73	R75	1	86.6k	RG1608P-8662-B-T5	Susumu Co Ltd	RES, 86.6 k, 0.1%, 0.1 W, 0603	0603
74	R76	1	887k	CRCW0402887KFKED	Vishay-Dale	RES, 887 k, 1%, 0.063 W, 0402	0402
75	R77, R80, R85	3	1.00k	ERA-2APB102X	Panasonic	RES, 1.00 k, 0.1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402
76	R81	1	2.21Meg	CRCW04022M21FKED	Vishay-Dale	RES, 2.21 M, 1%, 0.063 W, 0402	0402
77	R82	1	1.00Meg	CRCW04021M00FKED	Vishay-Dale	RES, 1.00 M, 1%, 0.063 W, 0402	0402
78	R83	1	86.6k	ERA-2AEB8662X	Panasonic	RES, 86.6 k, 0.1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402
79	R87	1	93.1k	CRCW040293K1FKED	Vishay-Dale	RES, 93.1 k, 1%, 0.063 W, 0402	0402
80	R90, R91	2	0	MCR50JZHJ000	Rohm	RES, 0, 5%, 0.5 W, AEC-Q200 Grade 0, 2010	2010
81	R92, R93, R94, R95	4	1.0	CRCW08051R00JNEA	Vishay-Dale	RES, 1.0, 5%, 0.125 W, 0805	0805
82	R98	1	470	ERJ-2RKF4700X	Panasonic	RES, 470, 1%, 0.1 W, AEC-Q200 Grade 0, 0402	0402
83	S1	1		B3U-1100P	Omron Electronic Components	Switch, SPST-NO, Off-Mom, 12 V, SMD	SMD, 3-Leads, Body 3x2.5mm
84	SH-J1, SH-J2, SH-J3, SH-J4	4		881545-2	TE Connectivity	Shunt, 100mil, Gold plated, Black	Shunt 2 pos. 100 mil
85	TP9, TP10, TP11	3		5000	Keystone	Test Point, Miniature, Red, TH	Red Miniature Testpoint
86	TP12, TP13, TP14, TP15, TP16	5		5006	Keystone	Test Point, Compact, Black, TH	Black Compact Testpoint
87	U1	1		OPA227U	Texas Instruments	High Precision, Low Noise Operational Amplifier, 5 to 36 V, -55 to 125 degC, 8-pin SOIC (D0008A), Green (RoHS & no Sb/Br)	D0008A
88	U2	1		OPA1662AID	Texas Instruments	Sound Plus Low-Power, Low-Noise and Distortion, Audio Operational Amplifier, 3 to 36 V, -40 to 85 degC, 8-pin SOIC (D0008A), Green (RoHS & no Sb/Br)	D0008A
89	U3	1		OPA1612AID	Texas Instruments	High-Performance, Bipolar-Input Audio Operational Amplifier, D0008A	D0008A
90	U4	1		TPD2E001DRL	Texas Instruments	Low-Capacitance 2-Channel ±15-kV ESD-Protection Array For High-Speed Data Interfaces, DRL0005A	DRL0005A
91	U5	1		LMV761MFX/NOPB	Texas Instruments	Low-Voltage, Precision Comparator With Push-Pull Output, DBV0006A (SOT-23-6)	DBV0006A
92	U6	1		MSP430F5503IRGZT	Texas Instruments	25 MHz Mixed Signal Microcontroller with 32 KB Flash, 4096 B SRAM and 31 GPIOs, -40 to 85 degC, 48-pin QFN (RGZ), Green (RoHS & no Sb/Br)	RGZ0048A
93	U7	1		THS4131IDGNR	Texas Instruments	HIGH-SPEED, LOW-NOISE, FULLY-DIFFERENTIAL I/O AMPLIFIER, DGN0008D	DGN0008D
94	U8	1		PCM5142PWR	Texas Instruments	2VRMS DirectPath, 112/106dB Audio Stereo DAC with 32-bit, 384kHz PCM Interface, PW0028A	PW0028A
95	U9	1		TPS7A4700RGWR	Texas Instruments	36-V, 1-A, 4.17-uVRMS, RF LDO Voltage Regulator, RGW0020A	RGW0020A
96	U10	1		TPS65130RGER	Texas Instruments	Postive and Negative Output DC-DC Converter, 2.7 to 5.5 V, -40 to 85 degC, 24-pin QFN (RGE24), Green (RoHS & no Sb/Br)	RGE0024B
97	U11	1		TPS7A3001DGNR	Texas Instruments	Single Output High PSRR LDO, 200 mA, Adjustable -1.18 to -33 V Output, -3 to -36 V Input, with Ultra-Low Noise, 8-pin MSOP (DGN), -40 to 125 degC, Green (RoHS & no Sb/Br)	DGN0008D
98	U12	1		TPS7A4700RGWR	Texas Instruments	36-V, 1-A, 4.17-uVRMS, RF LDO Voltage Regulator, RGW0020A (VQFN-20)	RGW0020A
99	U13, U14, U16	3	100kHz to 1GHz	BNX024H01L	Murata	FLTR EMI 15A 50V 100KHZ-1GHZ SMD	12.1x3.1x9.1

Table 17. PSIEVM Bill of Materials (continued)

Item #	Designator	Quantity	Value	Part Number	Manufacturer	Description	Package Reference
100	U15	1		TLV70433DBVR	Texas Instruments	Single Output LDO, 150 mA, Fixed 3.3 V Output, 2.5 to 24 V Input, with Ultra-Low IQ, 5-pin SOT-23 (DBV), -40 to 125 degC, Green (RoHS & no Sb/Br)	DBV0005A
101	U17	1		DAC8411IDCKR	Texas Instruments	2.0V to 5.5V, 80uA, 16-Bit, Low-Power, Single-Channel, Digital-to-Analog Converter, DCK0006A	DCK0006A
102	U18	1		OPA827AIDR	Texas Instruments	Low-Noise, High-Precision, JFET-Input OPERATIONAL AMPLIFIER, D0008A (SOIC-8)	D0008A
103	U19	1		REF5050AID	Texas Instruments	Low Noise, Very Low Drift, Precision Voltage Reference, -40 to 125 degC, 8-pin SOIC (D), Green (RoHS & no Sb/Br)	D0008A
104	U20	1		BR24G32FVT-3AGE2	Rohm	I2C BUS EEPROM (2-Wire), TSSOP-B8	TSSOP-8
105	Y1	1		AS-4.000MAHK-B	TXC Corporation	Crystal, 4 MHz, TH	11.5x5mm
106	Y2	1		ASTX-H11-20.000MHZ-T	Abracon Corporation	Oscillators, 20 MHz, HCMOS, 3.3V, SMD	3.2x2.5mm
107	C33, C36	0	1000pF	12061A102FAT2A	AVX	CAP, CERM, 1000 pF, 100 V, ±1%, C0G/NP0, 1206	1206
108	C37	0	10uF	GRM219R60J106KE19D	Murata	CAP CER 10UF 10V 10% X5R 0805	0805
109	FID1, FID2, FID3	0		N/A	N/A	Fiducial mark. There is nothing to buy or mount.	Fiducial
110	JP2, JP5	0		HTSW-103-07-G-S	Samtec	Header, 100mil, 3x1, Gold, TH	Header, 100mil, 3x1, TH
111	P1, P6	0		142-0701-851	Emerson Network Power	Connector, End launch SMA, 50 ohm, SMT	SMA End Launch
112	R10	0	1.00Meg	CRCW12061M00FKEA	Vishay-Dale	RES, 1.00 M, 1%, 0.25 W, 1206	1206
113	R19, R22	0	1.1Meg	CRCW04021M10JNED	Vishay-Dale	RES, 1.1 M, 5%, 0.063 W, 0402	0402
114	R27, R28	0	10.0k	CRCW040210K0FKED	Vishay-Dale	RES, 10.0 k, 1%, 0.063 W, 0402	0402
115	R47, R51	0	0	CRCW04020000Z0ED	Vishay-Dale	RES, 0, 5%, 0.063 W, 0402	0402
116	R58, R62, R88	0	0	ERJ-3GEY0R00V	Panasonic	RES, 0, 5%, 0.1 W, 0603	0603
117	R79	0	33	CRCW040233R0JNED	Vishay-Dale	RES, 33, 5%, 0.063 W, 0402	0402
118	TP1, TP3, TP4, TP5, TP6, TP8	0		5000	Keystone	Test Point, Miniature, Red, TH	Red Miniature Testpoint
119	TP2	0		5004	Keystone	Test Point, Miniature, Yellow, TH	Yellow Miniature Testpoint
120	TP7	0		5009	Keystone	Test Point, Compact, Yellow, TH	Yellow Compact Testpoint

8.2 PCB Layers

Figure 21 through Figure 25 illustrate the EVM PCB layout.

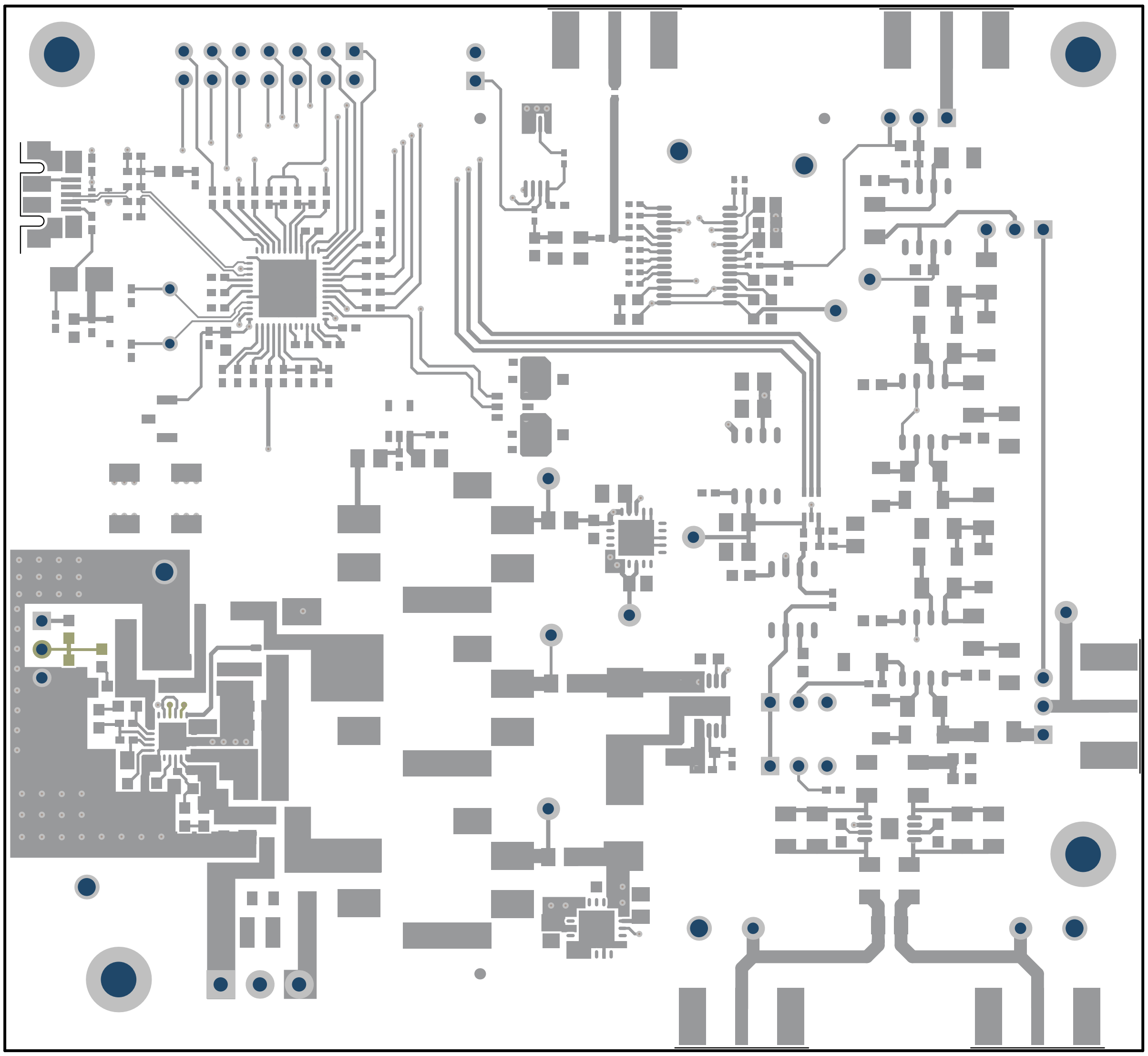

Figure 21. PCB Layer 1: Top Layer

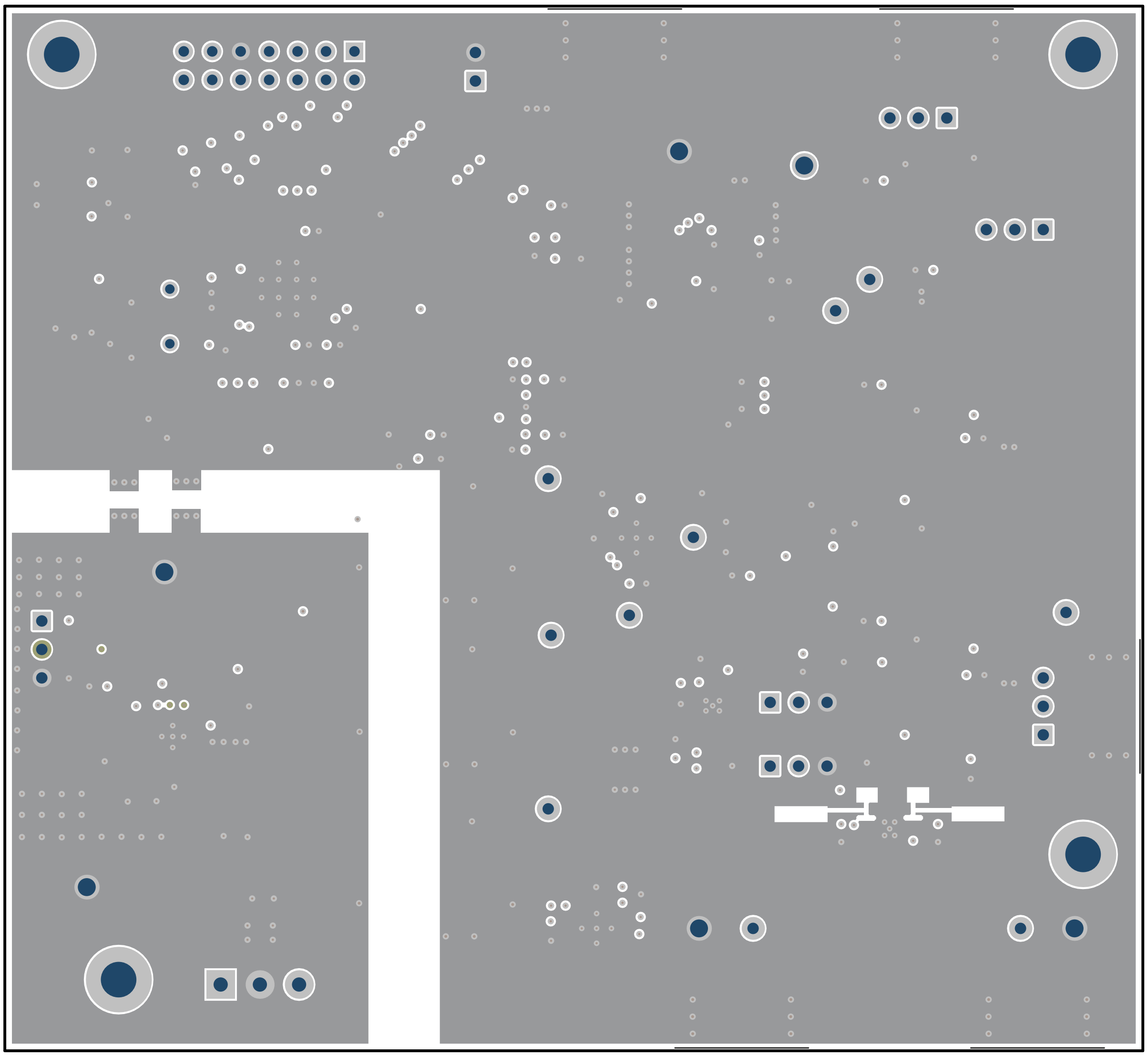

Figure 22. PCB Layer 2: Ground Layer

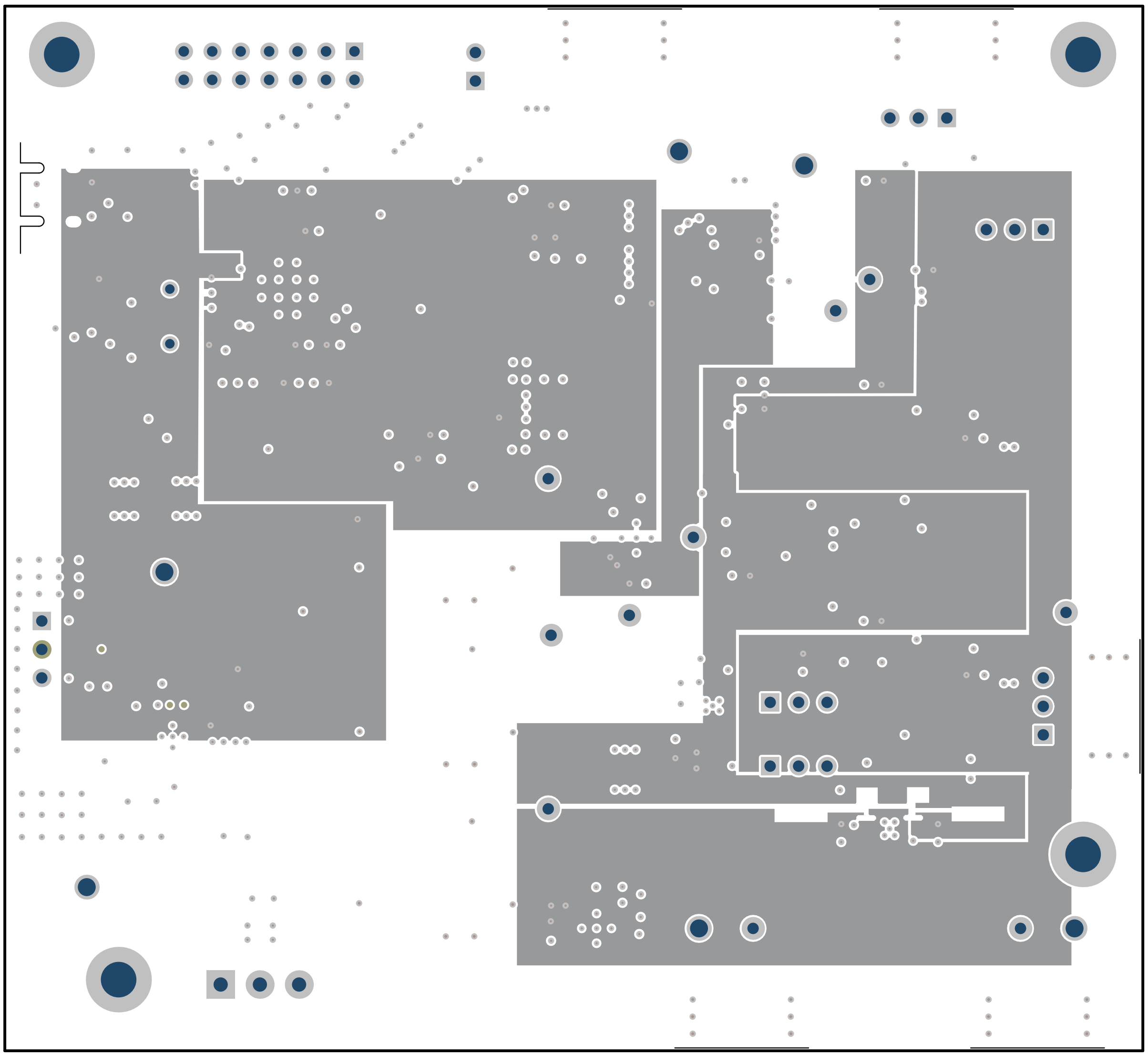

Figure 23. PCB Layer 3: Power Layer

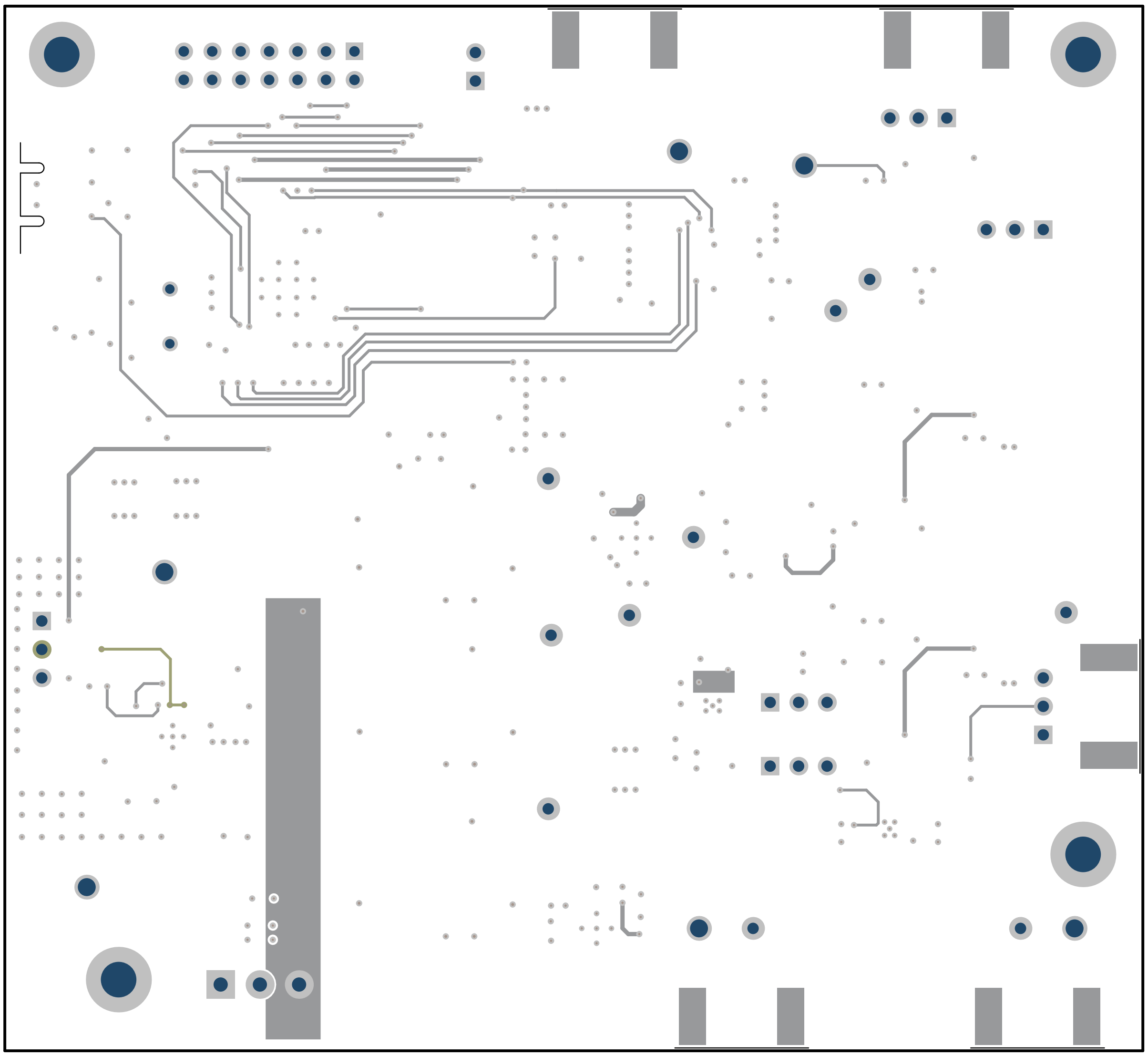

Figure 24. PCB Layer 4: Bottom Layer

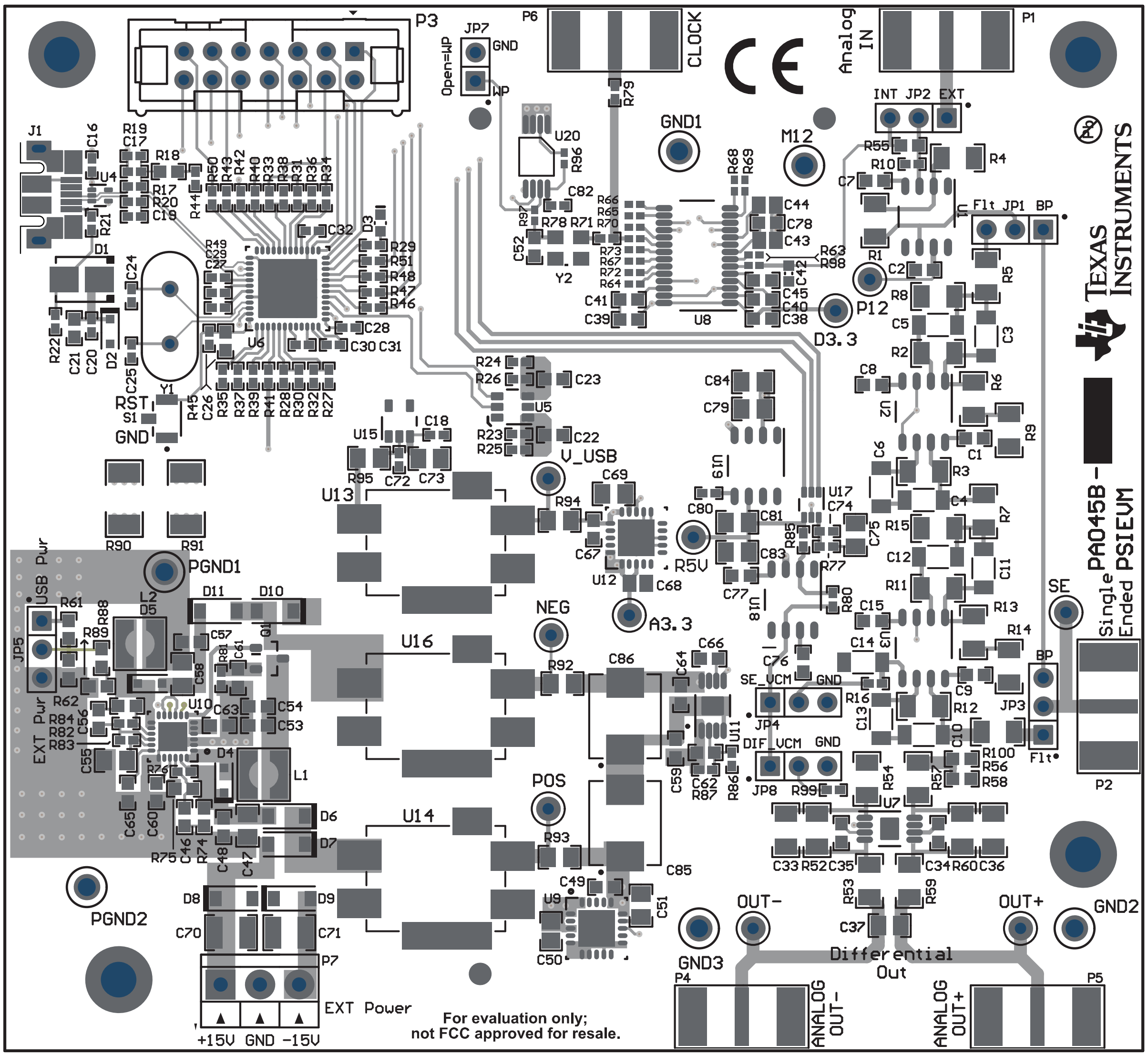

Figure 25. PCB: Top Silk Screen

8.3 *Schematic*

Figure 26 through Figure 32 illustrate the EVM schematics.

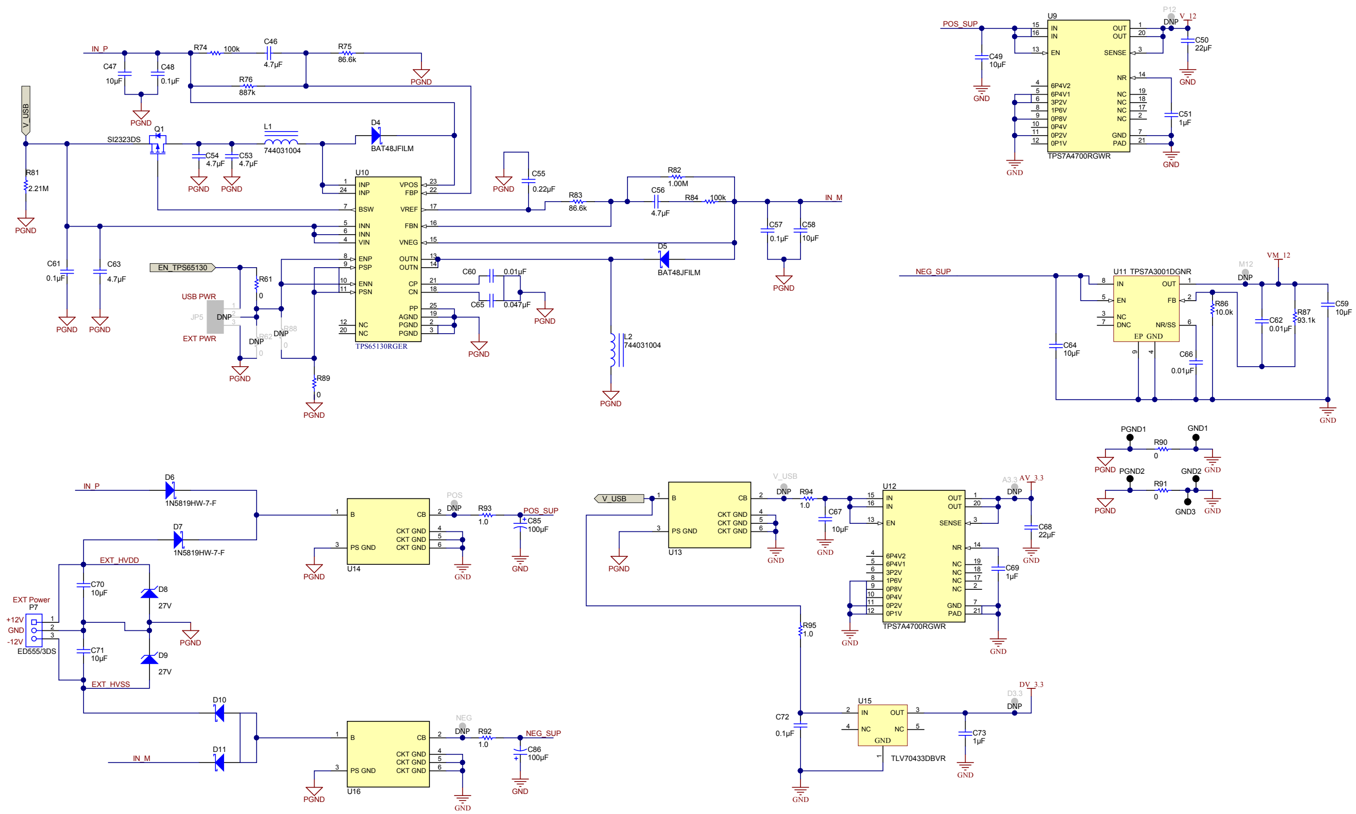

Figure 26. Schematic Page 1

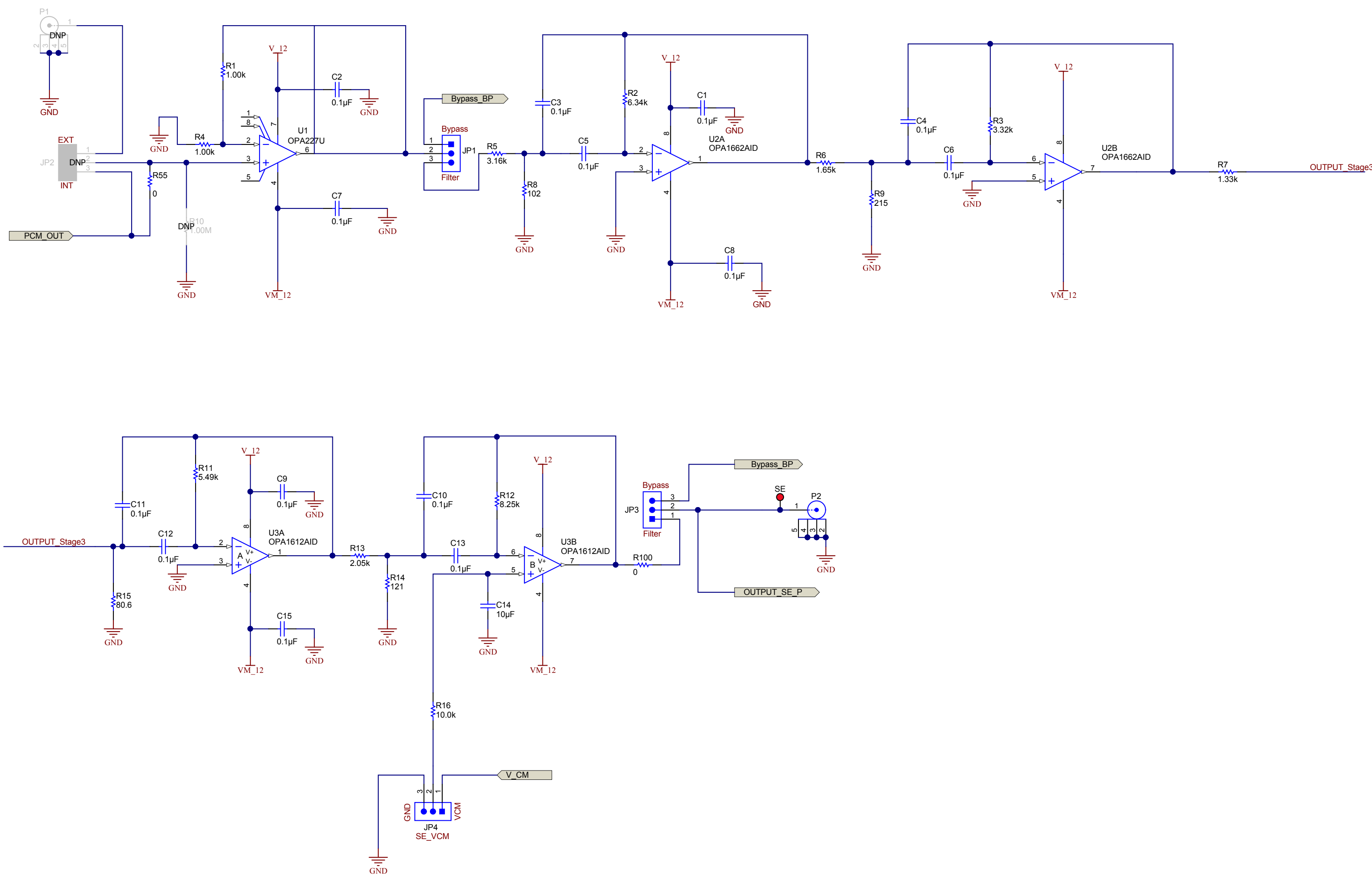

Figure 27. Schematic Page 2

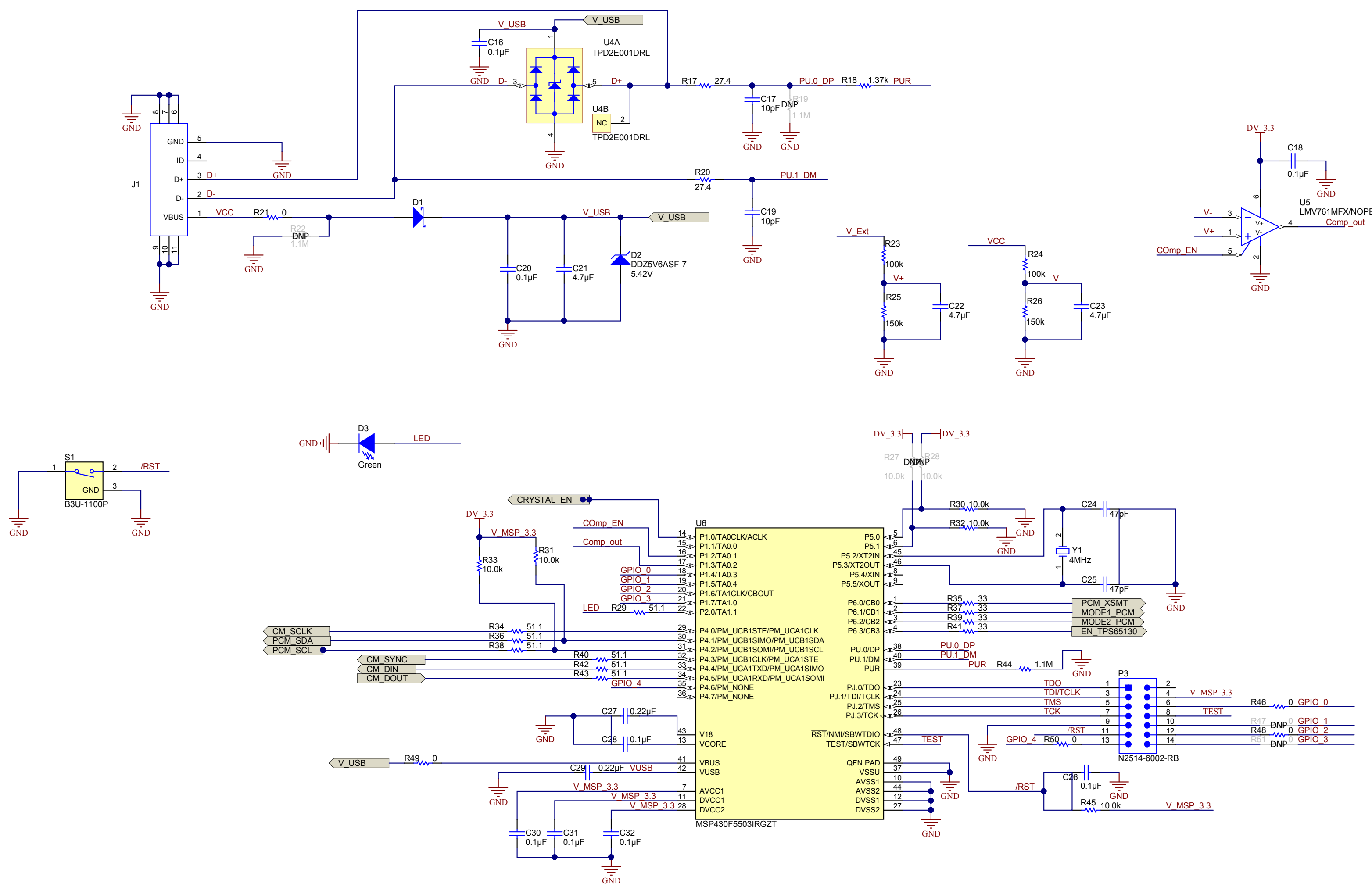

Figure 28. Schematic Page 3

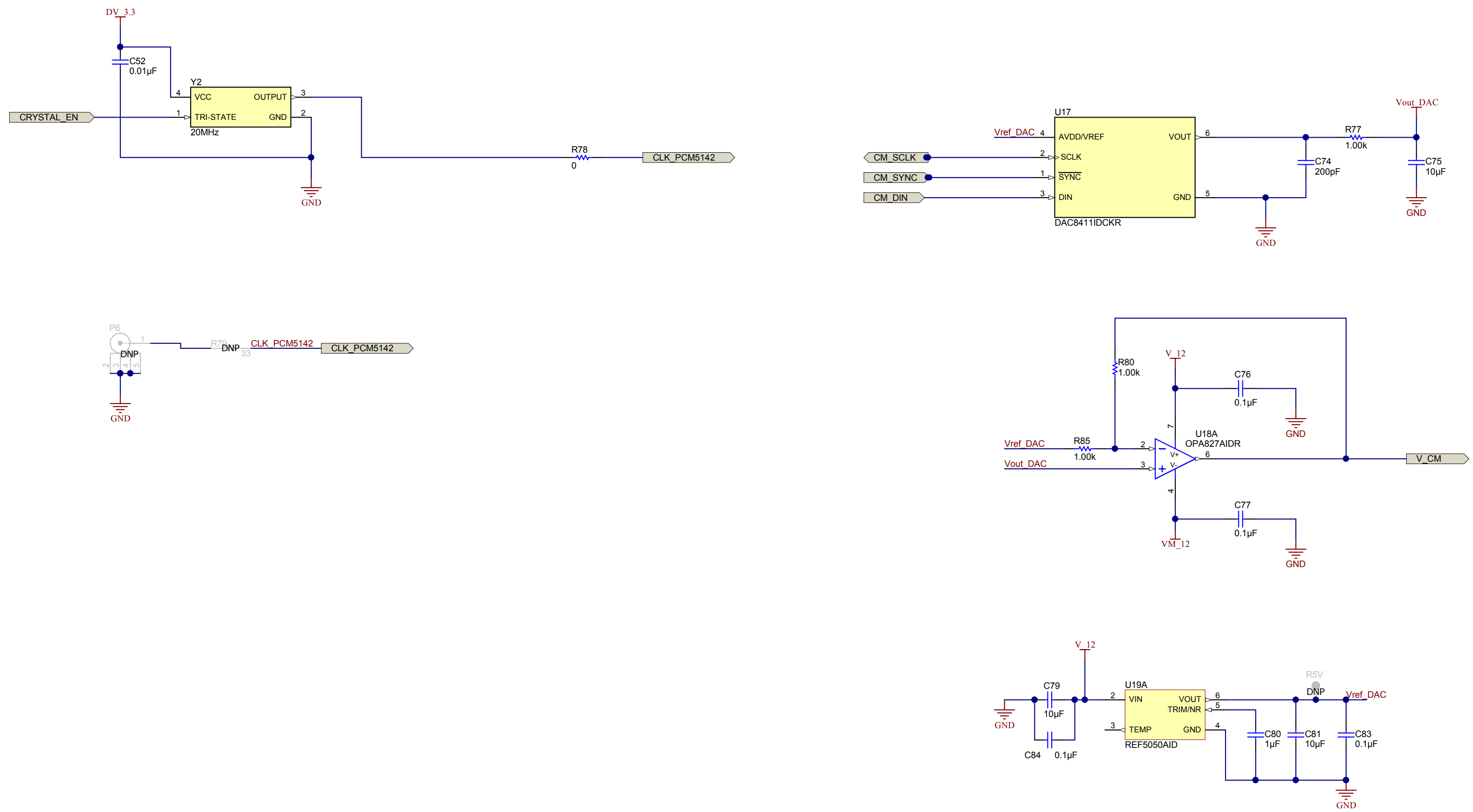

Figure 29. Schematic Page 4

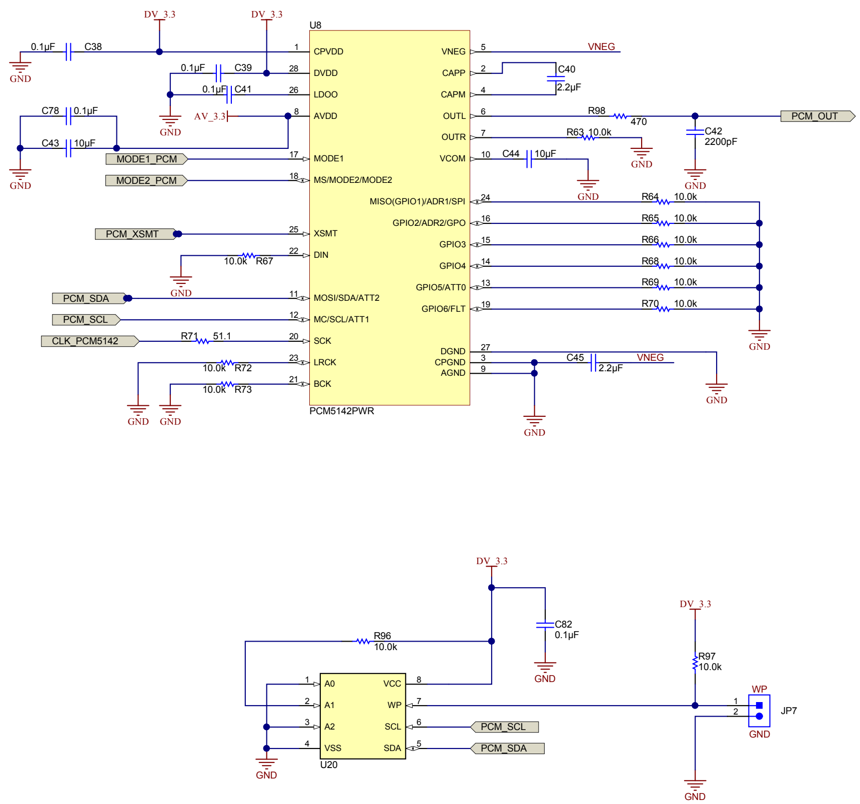

Figure 30. Schematic Page 5

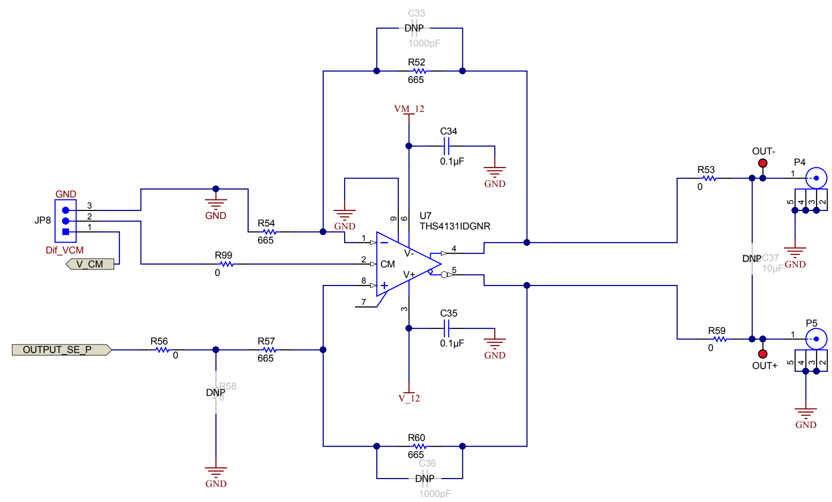

Figure 31. Schematic Page 6

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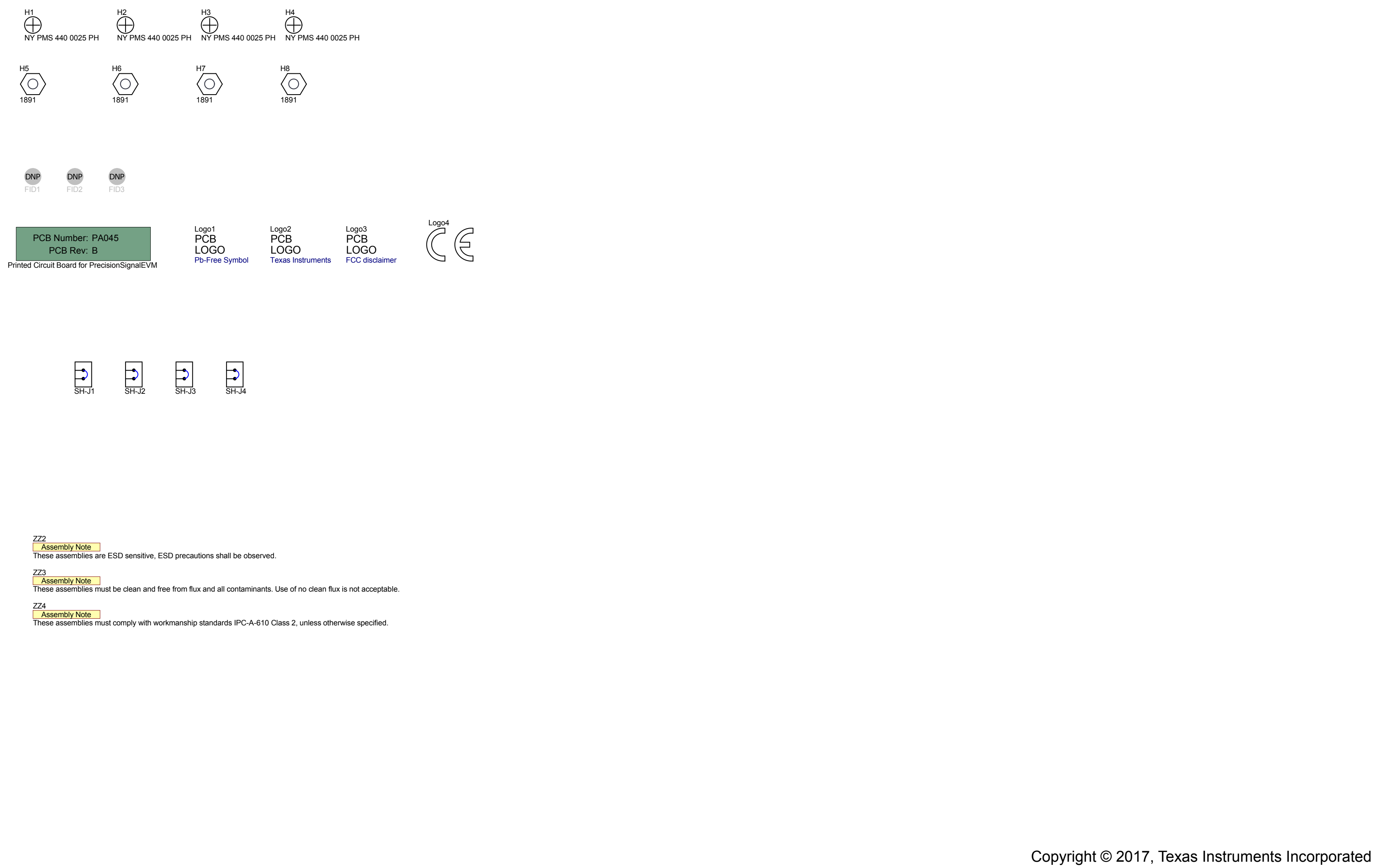

Figure 32. Schematic Page 7

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2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms 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 a nonconforming EVM if (a) the nonconformity was 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, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, 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:*

   FCC NOTICE: 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 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. 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 to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

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

3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

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 MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS 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 EPIDEMIC FAILURE WARRANTY OR 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 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, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.
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. 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 OR THE USE OF THE EVMS , 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 TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.
   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM 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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

IMPORTANT NOTICE FOR TI DESIGN INFORMATION AND RESOURCES