User's Guide
ADC128S102EVM Evaluation Module

![TEXAS INSTRUMENTS]

ABSTRACT

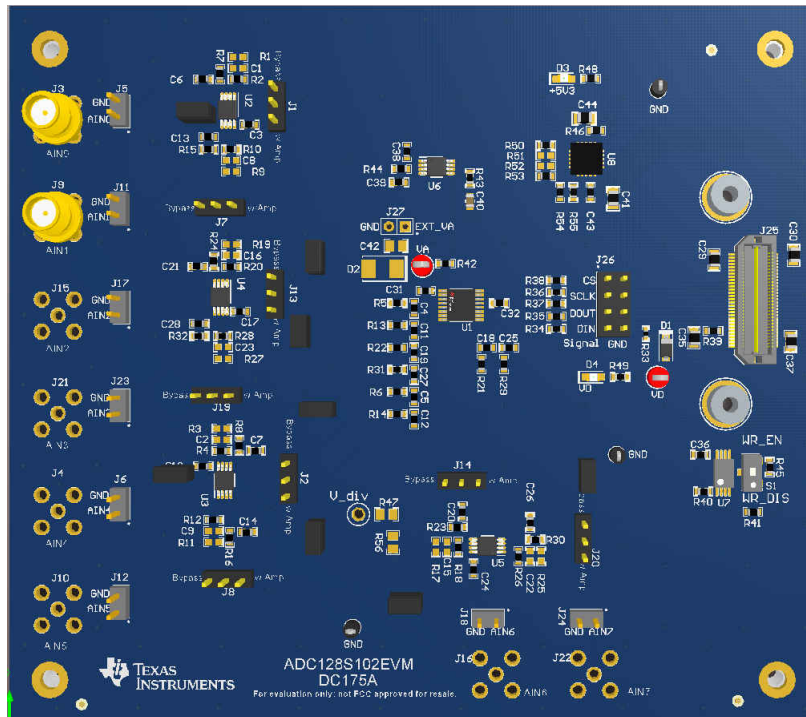**Figure 1-1. ADC128S102EVM Evaluation Board**

The ADC128S102EVM allows users to evaluate the functionality of Texas Instruments' ADC128, ADC102, and ADC088 family of devices. This user's guide describes both the hardware platform showcasing the device functionality and the graphical user interface (GUI) software used to configure the operation of these devices, by using the default device on the EVM, the ADC128S102.

Throughout this document, the terms *evaluation board*, *evaluation module*, and *EVM* are synonymous with the ADC128S102EVM.

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1 ADC128S102EVM Overview

The ADC128S102EVM has provisions to drive all eight analog input channels, the external power supply, and the connection to the precision host interface (PHI) motherboard to communicate with the user-friendly GUI. These section are outlined in red in Figure 1-1. The final section is the EEPROM section below the J25 PHI connector. The switch, S1, must be in the *WR_DIS* position and must not be changed.
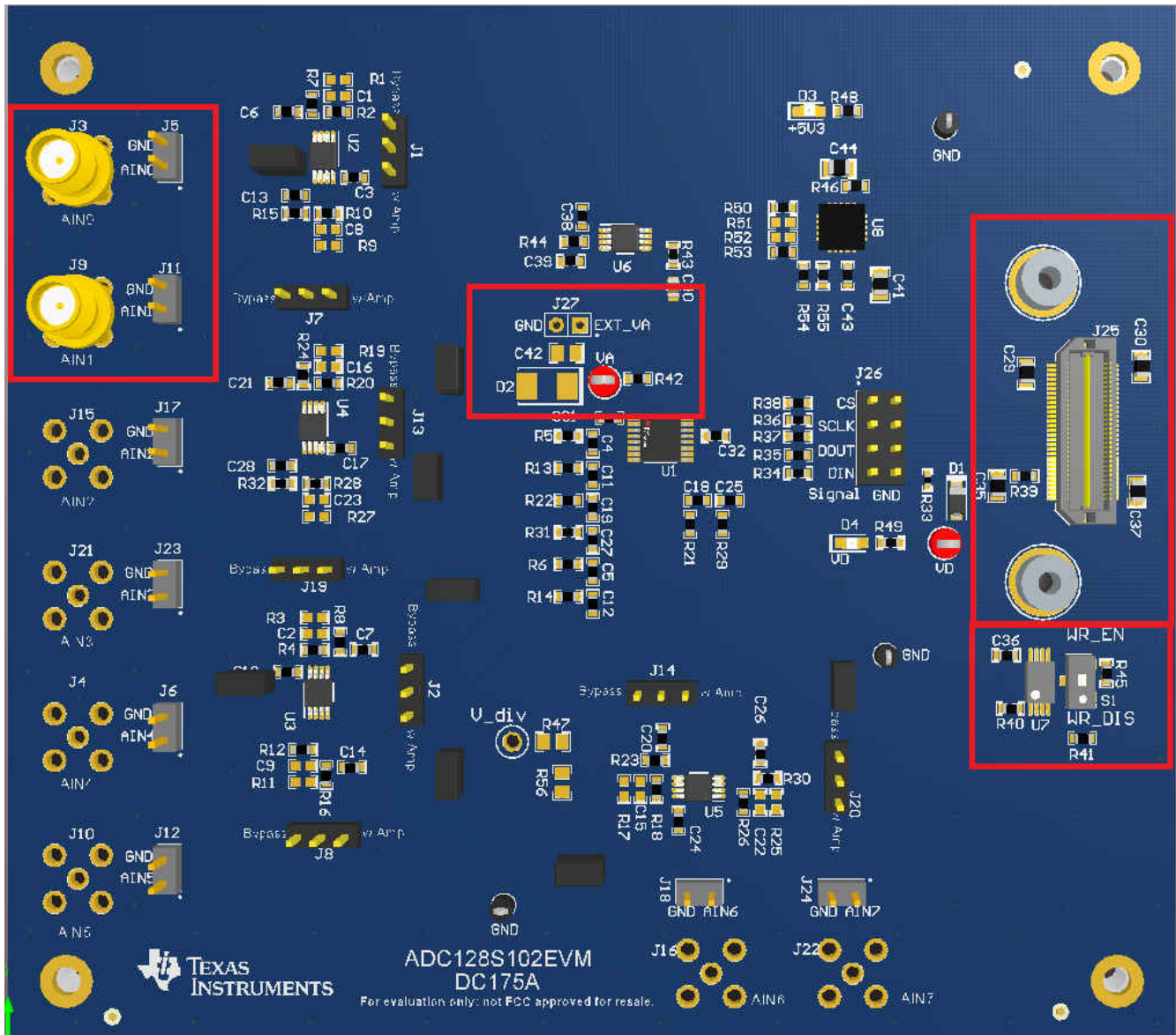

Figure 1-1. ADC128S102EVM Board Sections

Table 1-1 lists the related documents that are associated with the ADC128S102EVM.

Table 1-1. Related Documents

Device	Data sheet
ADC128S102	SNAS298
OPA2320	SBOS513
REF6050	SBOS708
TPS7A4700	SBVS204

1.1 Analog Input Circuit

The EVM board has two subminiature version A (SMA) connectors, with six other footprints to populate the remaining SMA connectors (if required) to connect to the eight analog input channels. Shunt headers are also available in parallel with each respective SMA connector. As shown in Figure 1-2, each shunt header is connected to an analog input channel of the ADC128S102 through an operational amplifier (op amp) driver circuit. An input circuit is connected to each ADC analog input. The driver circuit consists of an initial RC circuit for noise filtering, followed by an OPA2320 (a dual-channel op amp configured, by default, as a buffer). The board has provisions to change the buffer circuit configuration, by removing the 0-Ω resistor and adding the desired RC combination. At the output of each op amp, is a 3-pin header that provides the option to bypass the buffer.
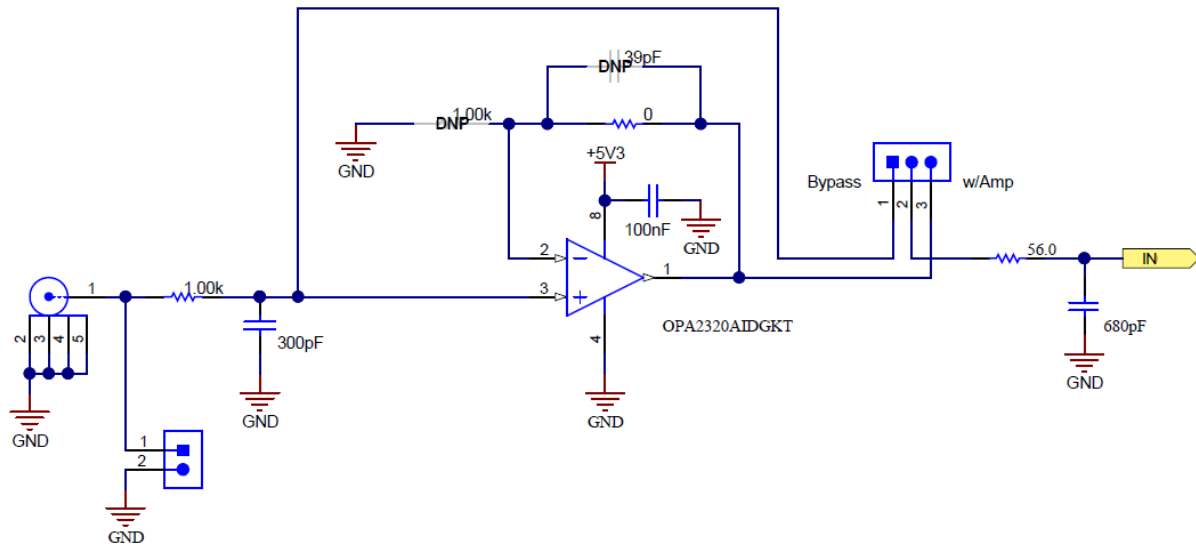

Figure 1-2. Analog Input Circuit

1.2 Power Supply

All power supplies required by the EVM are provided by the PHI motherboard. The ADC128S102 requires an analog power supply (VA) and a digital power supply (VD). The analog power supply is set at 5.5 V and is regulated down to 5.3 V using the TPS7A4700. From there, the REF6050 is used to set VA to 5 V. The ADC128S102 uses VA as the reference as well, which defines the analog full scale of the ADC. The EVM has a provision for an external VA. To use an external analog power supply, remove R42 at the REF5060 output, which disconnects the VA supplied by the EVM. Using jumper J27, which is unpopulated by default, an external supply can be connected. There are also footprints available for a decoupling capacitor and a protective diode that must be populated if an external supply is used.

The digital supply VD is set to 3.3 V and is supplied directly from the PHI motherboard.

1.3 Digital Bus Connections

The EVM is packaged with a PHI motherboard, which provides the required circuitry to connect the EVM to the graphical user interface (GUI). Connect the PHI board to the EVM using J25.

2 Hardware and Software Installation

The ADC128S102EVM is out of the box ready to use, and requires minimum set up.

1. Remove any screws from J25 on the EVM. Connect the PHI board on J25, and remove any stand offs on the PHI. Reinstall the screws to secure the PHI to J25, being sure not to overtighten. Figure 2-1 shows an example of the hardware set up.
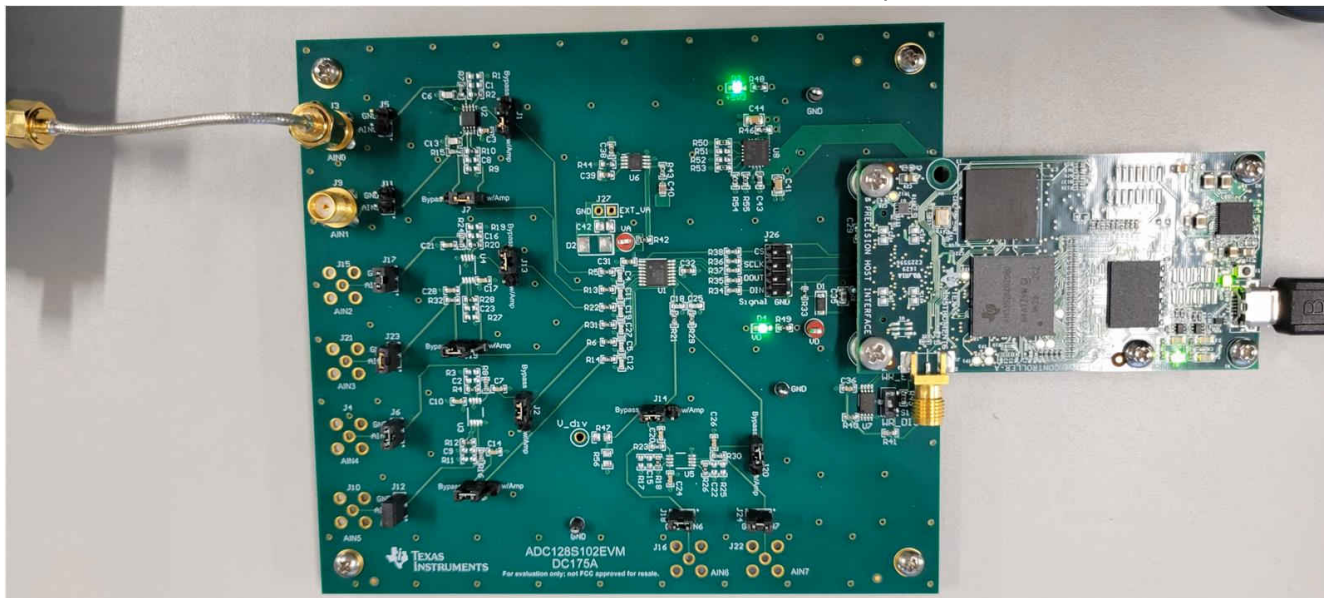2. Connect the micro USB cable to the PHI, and the other end to the computer to be used.

Figure 2-1. ADC128S102EVM Connected to PHI

3. On the ADC128S102EVM Product folder, download the user-friendly GUI. This action prompts a file download. Open the folder when available and run the executable file.
4. You may be prompted to download and install LabView™, in particular for first-time users. Complete the necessary installations by accepting any pop-up windows.
5. When the install is complete, the option to run the GUI or create a desktop short cut is offered. If a shortcut is not created, the GUI can be accessed at *C:\Program Files (x86)\Texas Instruments\ADC128S102 EVM*.
6. On the bottom panel, as shown in Figure 2-2, the GUI displays a green ball next to *HW Connected* when the GUI successfully connects to the hardware. Also, the hardware has two green LEDs illuminated after a successful connection is made.

Figure 2-2. GUI Successfully Connected

3 Graphical User Interface (GUI)

After following the installation instructions outlined in Section 2, open the ADC128S102EVM GUI software. The GUI window (as shown in Figure 3-1) is divided into two main sections, the left most section where display and configuration options are available, and the right most, larger section where capture data are displayed.

The *Pages* section is on the top left of the GUI window, and lists the available views and measurements supported by the GUI.

On the left, there are also three other sections available for user configuration: Interface Configuration, the SCLK Frequency, and the Data Rate (SPS). All these sections are editable by the user.
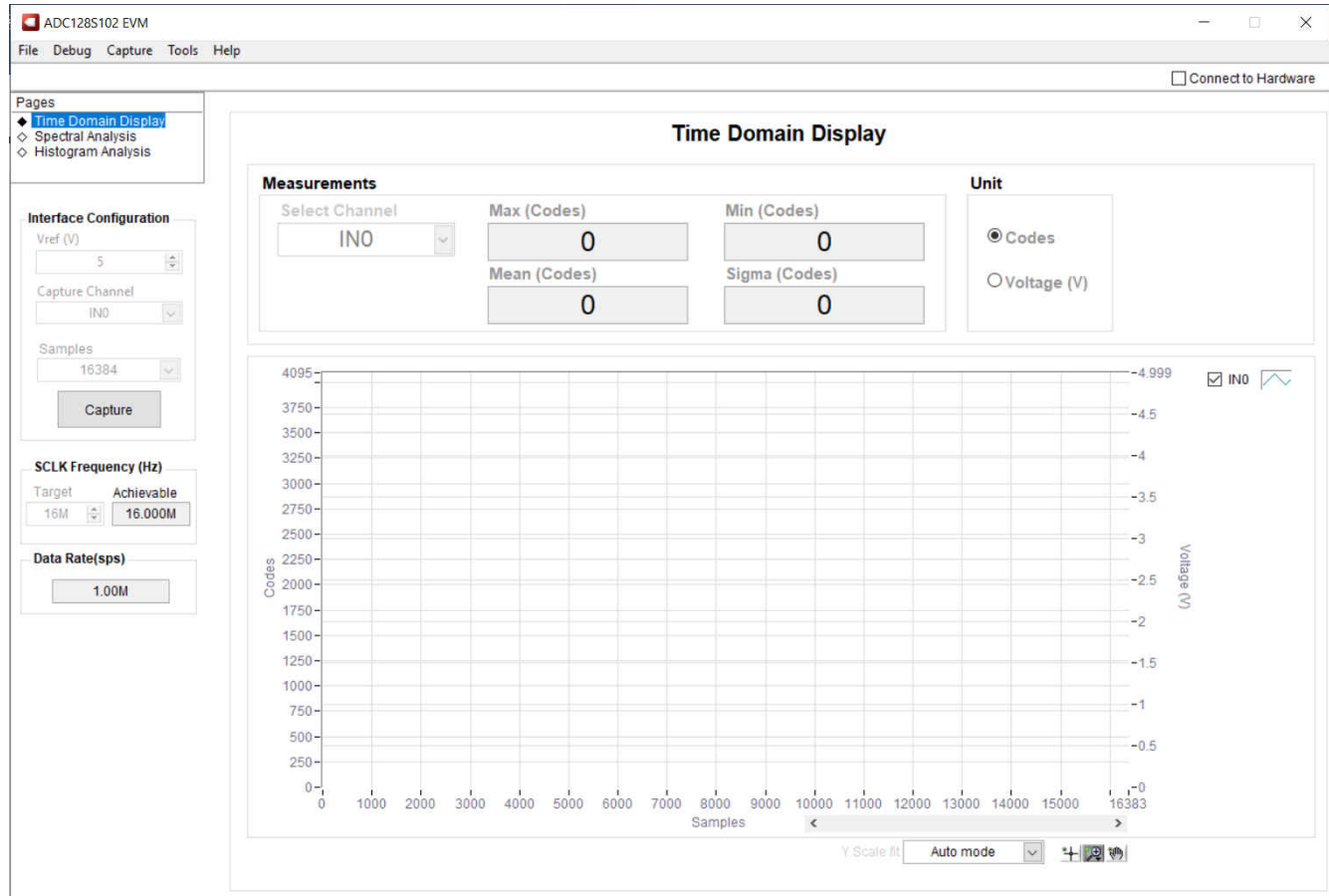

Figure 3-1. ADC128S102EVM GUI Display

3.1 User Configuration

This section describes how to use the GUI user configuration to program the device on the ADS128S102EVM.

3.1.1 Interface Configuration

Within the interface configuration section of the GUI, three different configurations are available: Vref (V), Capture Channel, and Samples. The **Capture** button begins ADC conversions based on the configuration options selected.

The Vref (V) drop down is by default set to 5 V to match the VA voltage provided on the EVM. Only change this option if an external VA is used. Enter the voltage used in the Vref (V) input to assure measurements made by the GUI reflect the external VA.

The Capture Channel drop down allows a single channel to be sampled from the eight ADC analog input channels. There is also an option to select all channels, which consecutively sequences all eight channels.

The Samples drop down selects the number of samples to be captured in the next set of measurements.

3.1.2 Clock Frequency and Sample Data Rate

The final two configuration options available, the SCLK frequency (Hz) and the data rate (SPS), dictate the sample rate for the device. The sample rate can be defined by inputting the clock frequency to be used, or the desired sample rate. When either is modified, the corresponding parameter reflects the change.

3.2 Time Domain

The time domain display page (as shown in Figure 3-2) displays the data captured in the time domain. Data are displayed in both codes or voltage, based on the voltage selected in the Vref (V) drop down.

In the *Measurements* box above the graph, user configuration options and measurements are available. If all channels are sampled, the drop down box provides an option to change the respective channel measurement data to be displayed.
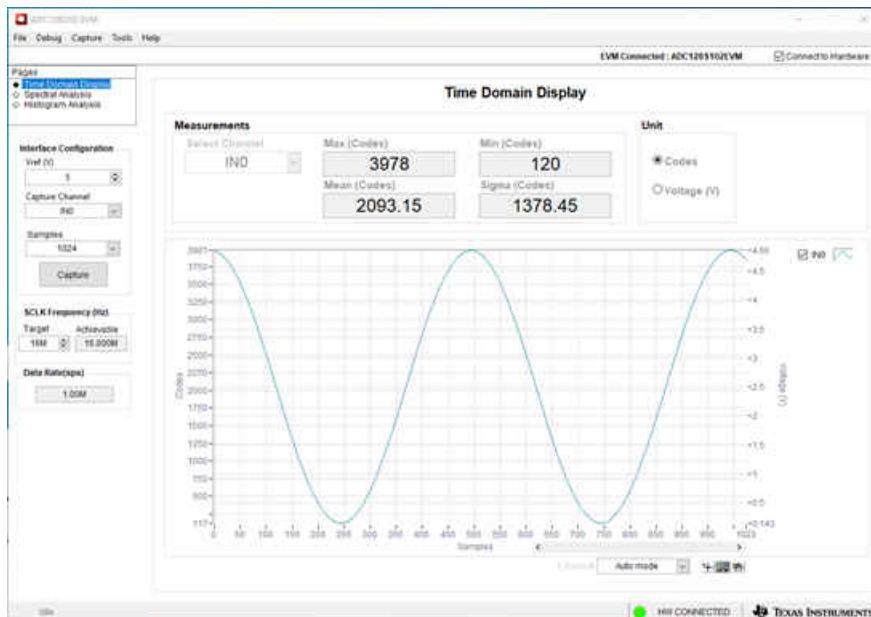
Figure 3-2. Time Domain Display

3.3 Spectral Analysis

In the spectral analysis page, the fast Fourier transform (FFT) of the data capture is displayed. Because of the nature of an FFT, the minimum number of samples for accurate measurements is 32768. As shown in Figure 3-3, select any sample number count of 32768 or larger in the drop down for *Samples*.
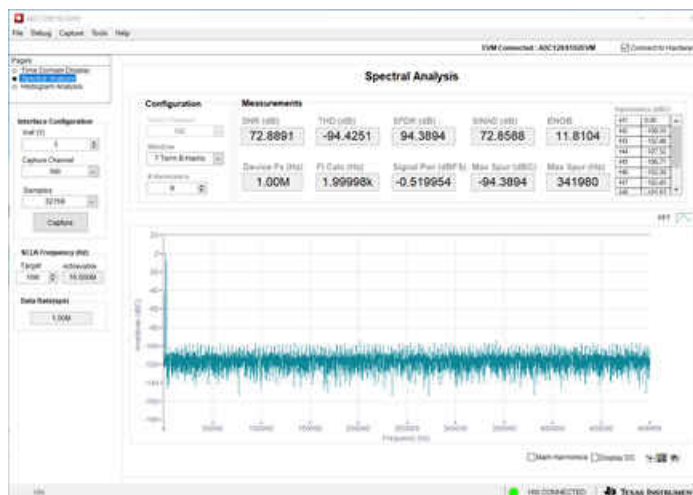
Figure 3-3. Spectral Analysis

3.4 Histogram Analysis

In the histogram analysis page, the data captured is displayed in a histogram (as shown in Figure 3-4) using digital code as the x-axis.
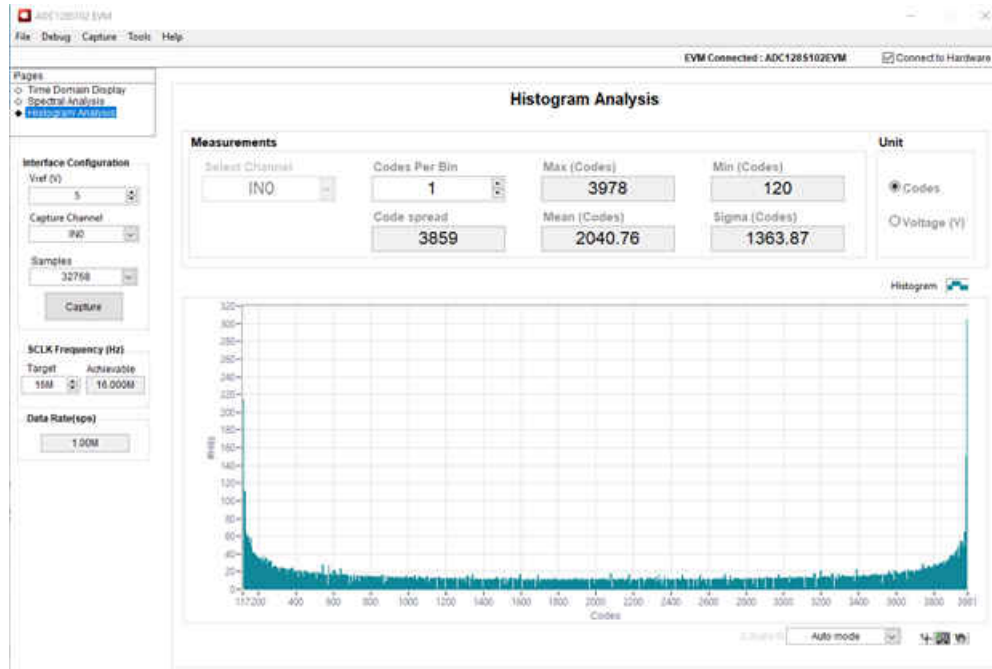
Figure 3-4. Histogram of Sine Wave Input

4 Board Layout

Figure 4-1 through Figure 4-3 illustrate the ADC128S102EVM board layout.
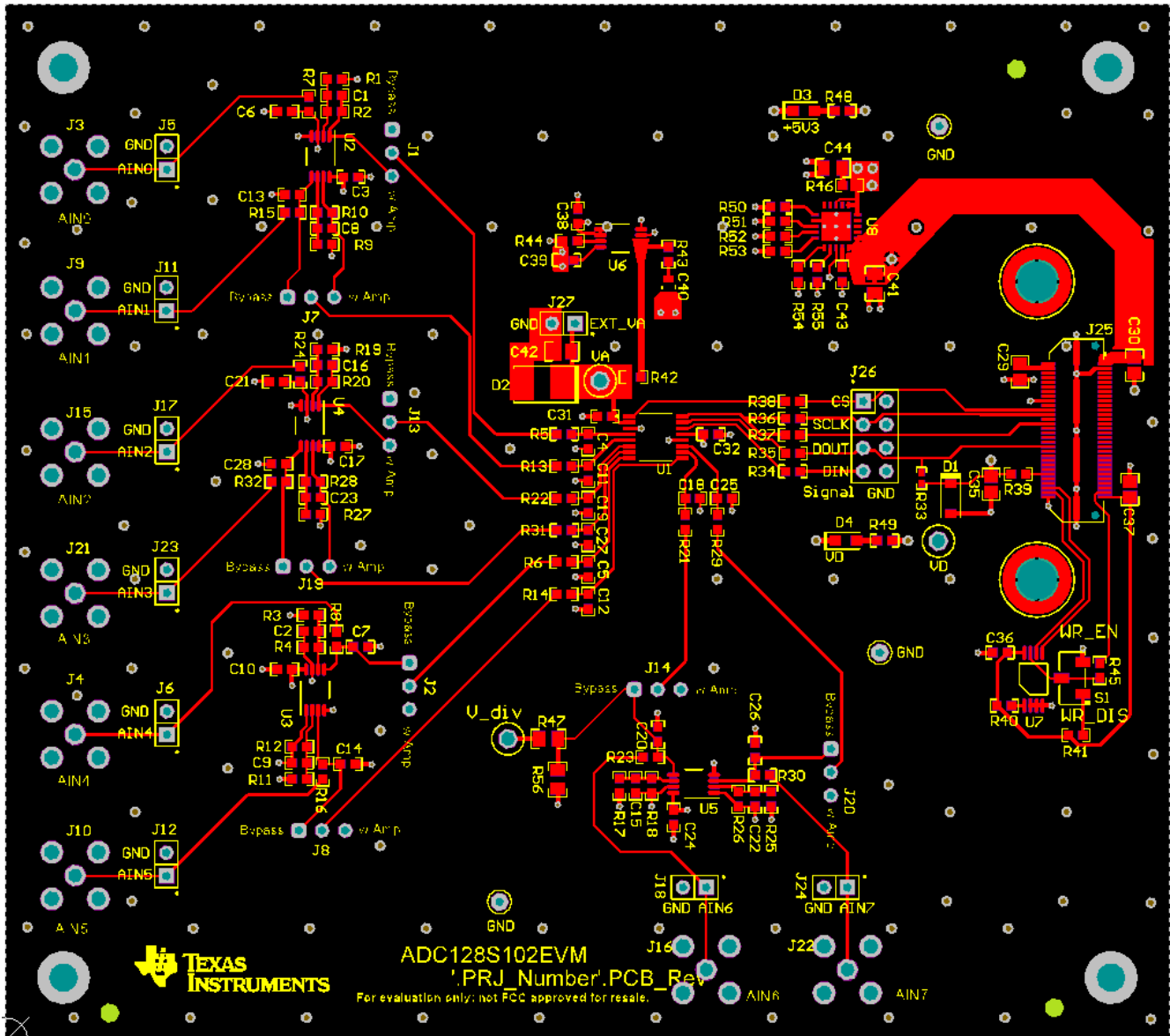
Figure 4-1. Top Layer and Assembly
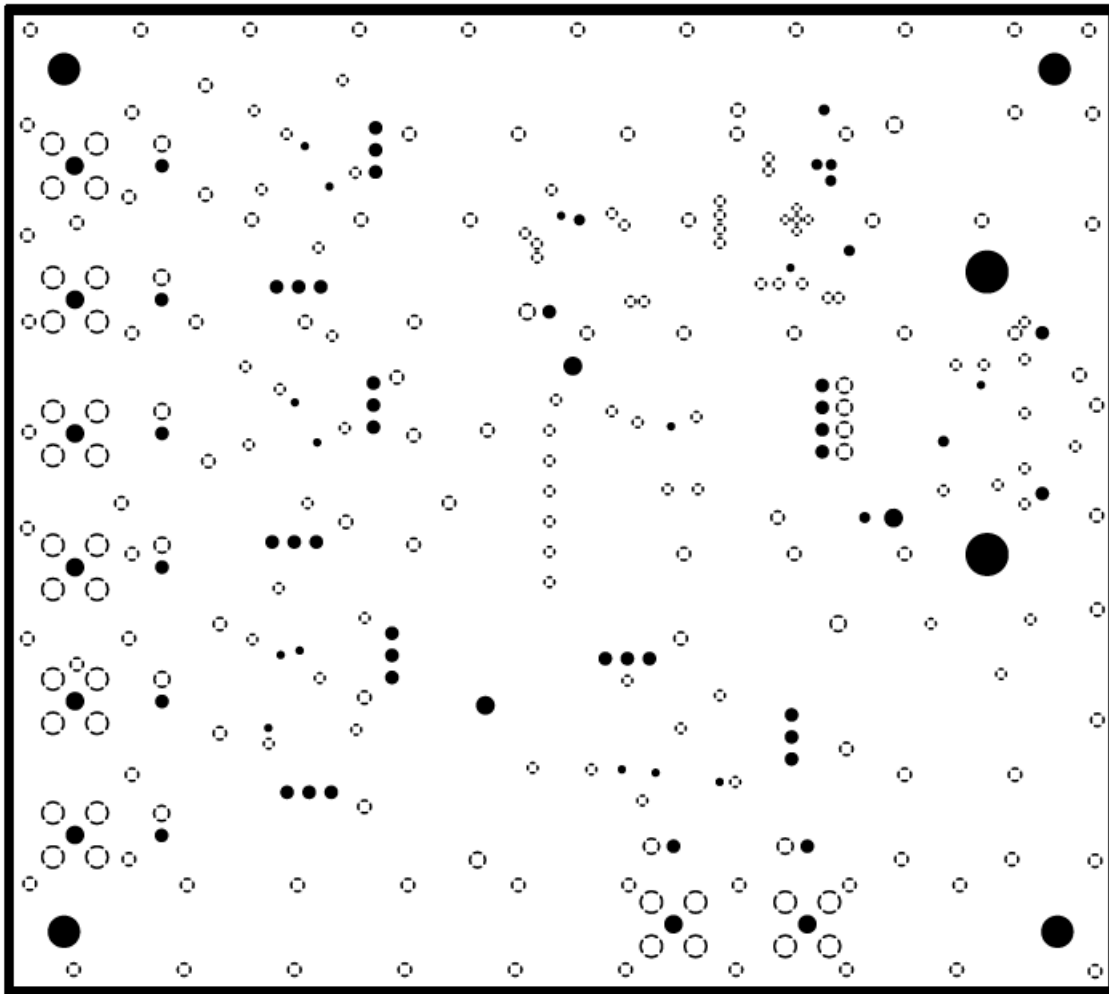
Figure 4-2. Inner Ground Layers 2 and 3
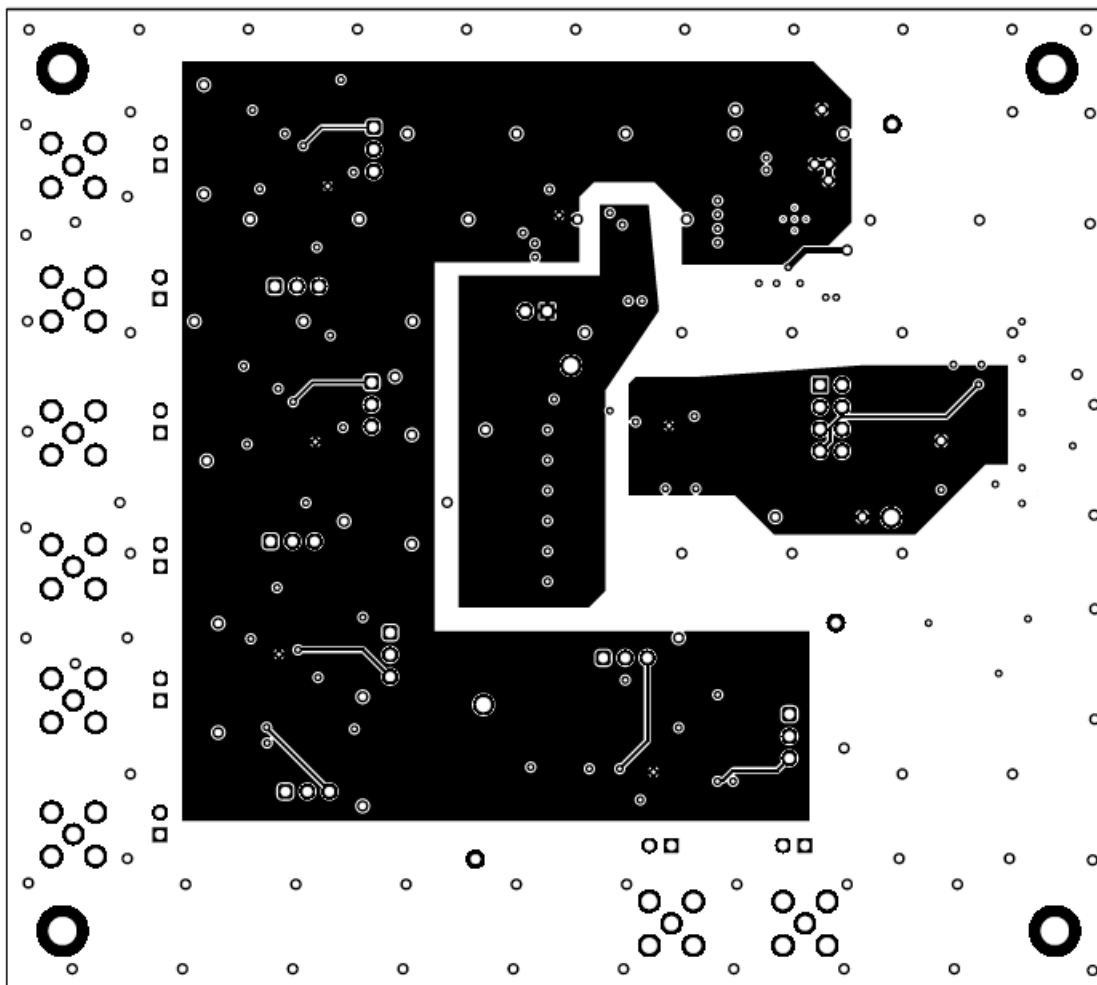
Figure 4-3. Bottom Layer

5 Schematics

Figure 5-1 through Figure 5-3 illustrate the schematics for the ADC128S102EVM.

Figure 5-1. ADC128S102EVM Schematic Page 1: Analog Inputs

Figure 5-2. ADC128S102EVM Schematic Page 2: ADC and Digital Communications

Figure 5-3. ADC128S102EVM Schematic Page 3: Power Tree

6 ADC128S102EVM Bill of Materials

Table 6-1 lists the bill of materials (BOM) for the ADC128S102EVM.

Table 6-1. Bill of Materials

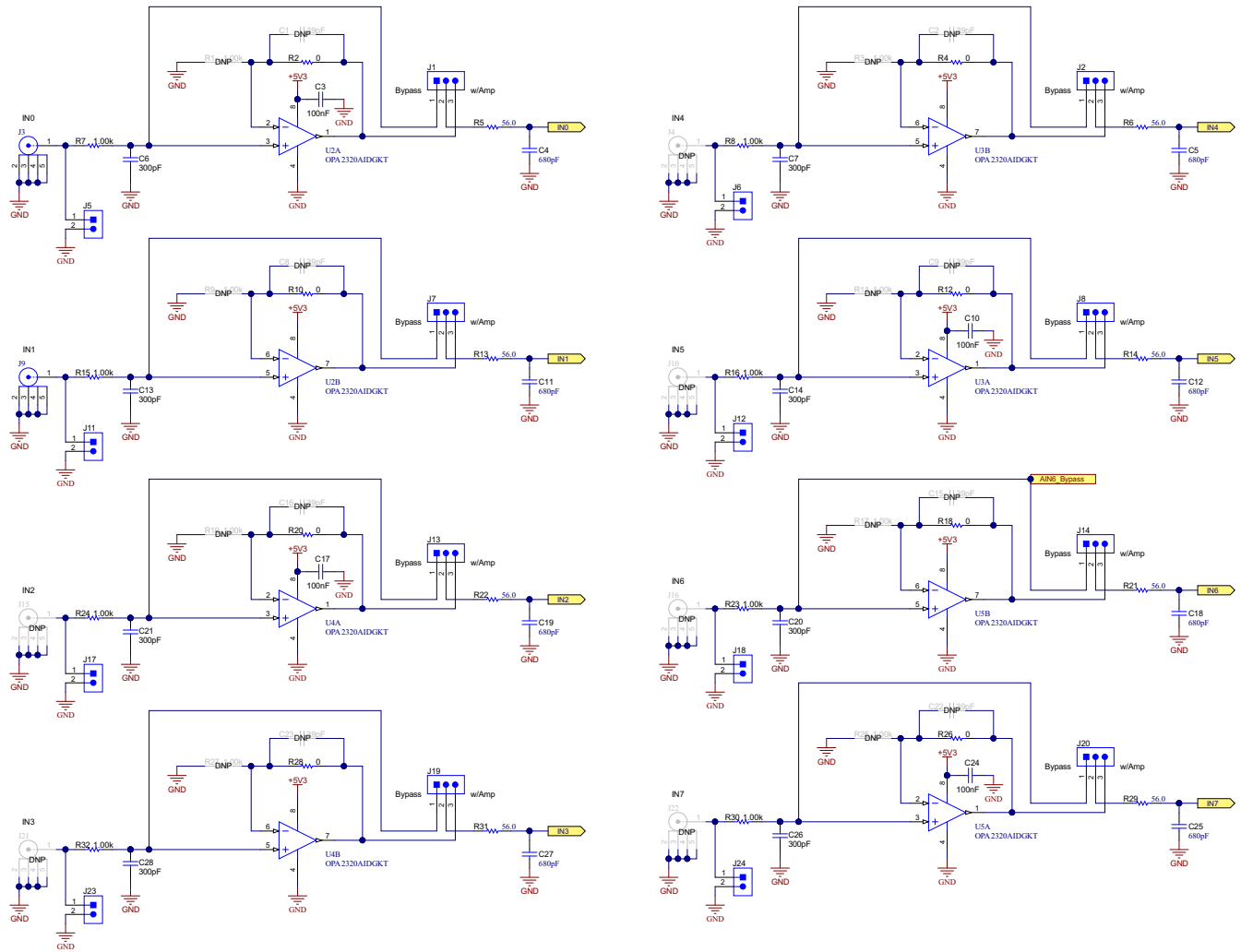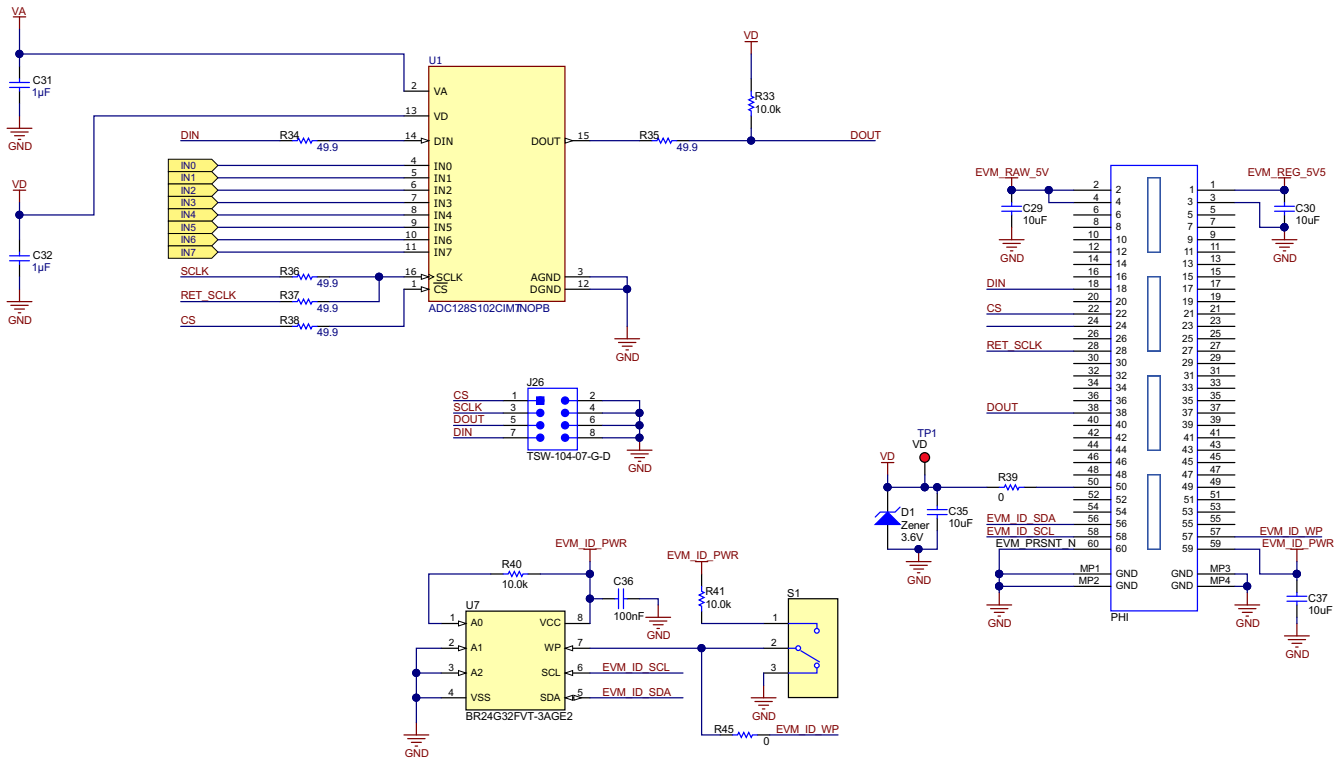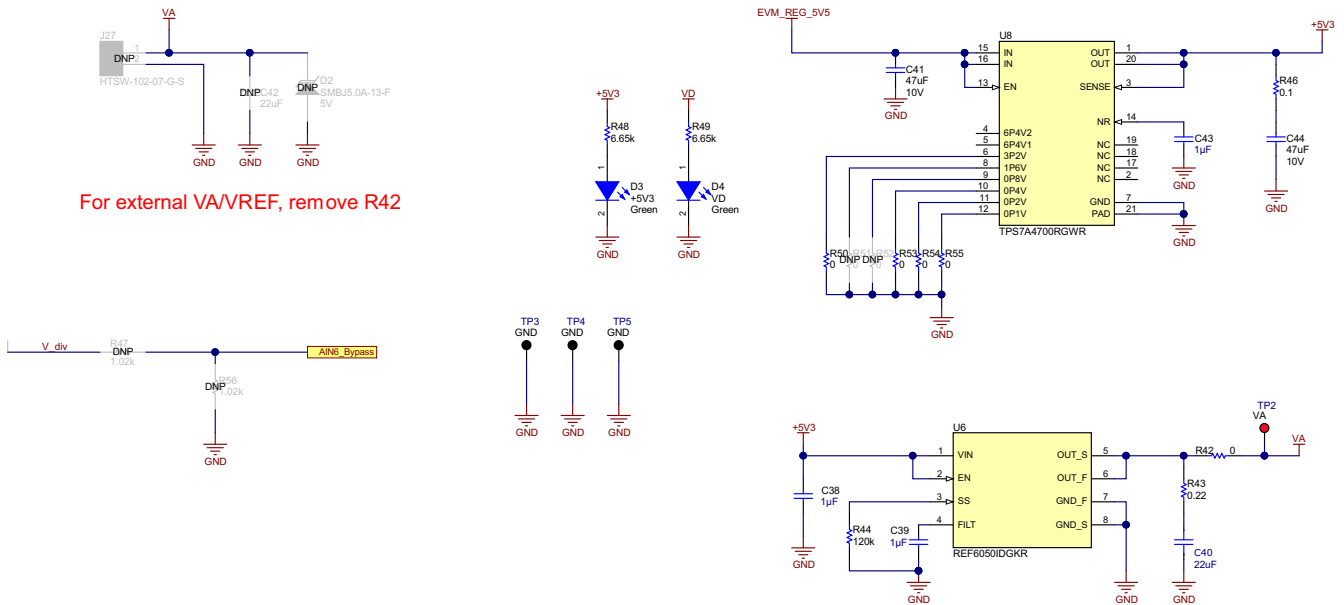| Description	Designator	PartNumber	Quantity	Manufacturer	PackageReference	Value
CAP, CERM, 0.1 uF, 50 V, +/- 10%, X7R, 0603	C3, C10, C17, C24, C36	C0603C104K5RACTU	5	Kemet	0603	0.1uF
CAP, CERM, 680 pF, 50 V, +/- 5%, C0G/NP0, 0603	C4, C5, C11, C12, C18, C19, C25, C27	C0603C681J5GACTU	8	Kemet	0603	680pF
CAP, CERM, 300 pF, 10 V, +/- 5%, X8R, 0603	C6, C7, C13, C14, C20, C21, C26, C28	C0603C301J8HAC7867	8	Kemet	0603	300pF
CAP, CERM, 10 uF, 25 V, +/- 10%, X5R, 0805	C29, C30, C35, C37	CL21A106KAFN3NE	4	Samsung Electro-Mechanics	0805	10uF
CAP, CERM, 1 µF, 16 V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	C31, C32, C38, C39, C43	CGA3E1X7R1C105K080AC	5	TDK	0603	1uF
22µF ±20% 25V Ceramic Capacitor X5R 0805 (2012 Metric)	C40	C2012X5R1E226M125AC	1	TDK Corporation	0805	
CAP, CERM, 47 uF, 10 V, +/- 20%, X5R, 0805	C41, C44	C2012X5R1A476M125AC	2	TDK	0805	47uF
Diode, Zener, 3.6 V, 500 mW, SOD-123	D1	MMSZ4685T1G	1	ON Semiconductor	SOD-123	3.6V
LED, Green, SMD	D3, D4	APT2012LZGCK	2	Kingbright	LED_0805	Green
Fiducial mark. There is nothing to buy or mount.	FID1, FID2, FID3	N/A	3	N/A	N/A	
Hex Standoff Threaded #4-40 Aluminum 0.250" (6.35mm) 1/4"	H1, H2, H3, H4	1891	4	Keystone	HEX_THREAD	
MACHINE SCREW PAN PHILLIPS, 5/16", 4-40	H5, H6, H7, H8	PMSSS 440 0031 PH	4	B&F Fastener Supply		
ROUND STANDOFF M3 STEEL 5MM	H9, H10	9774050360R	2	Wurth Elektronik	ROUND STANDOFF M3 STEEL 5MM	
Machine Screw Pan PHILLIPS M3	H11, H12	RM3X4MM 2701	2	APM HEXSEAL		
Cable, USB-A to micro USB-B, 1 m - Kitting item	H13	102-1092-BL-00100	1	CnC Tech		
PHI-EVM Controller Kitting item Edge# 6591636	H14	PA007	1	Texas Instruments		
Header, 100mil, 3x1, Gold, TH	J1, J2, J7, J8, J13, J14, J19, J20	TSW-103-07-G-S	8	Samtec	3x1 Header	
Connector, SMA, TH	J3, J9	142-0701-201	2	Cinch Connectivity	SMA	
Header, 100mil, 2x1, Gold, TH	J5, J6, J11, J12, J17, J18, J23, J24	HTSW-102-07-G-S	8	Samtec	Header, 100mil, 2x1, TH	
Header(Shrouded), 19.7mil, 30x2, Gold, SMT	J25	QTH-030-01-L-D-A	1	Samtec	Header (Shrouded), 19.7mil, 30x2, SMT	
Header, 100mil, 4x2, Gold, TH	J26	TSW-104-07-G-D	1	Samtec	4x2 Header	
Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	LBL1	THT-14-423-10	1	Brady	PCB Label 0.650 x 0.200 inch	

Table 6-1. Bill of Materials (continued)

Description	Designator	PartNumber	Quantity	Manufacturer	PackageReference	Value
RES, 0, 5%, 0.1 W, 0603	R2, R4, R10, R12, R18, R20, R26, R28, R42	RC0603JR-070RL	9	Yageo	0603	0
RES, 56.0, 1%, 0.1 W, 0603	R5, R6, R13, R14, R21, R22, R29, R31	RC0603FR-0756RL	8	Yageo	0603	56.0
RES, 1.00 k, 1%, 0.1 W, 0603	R7, R8, R15, R16, R23, R24, R30, R32	RC0603FR-071KL	8	Yageo	0603	1.00k
RES, 10.0 k, .1%, .0625 W, 0402	R33	RT0402BRD0710KL	1	Yageo America	0402	10.0k
RES, 49.9, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	R34, R35, R36, R37, R38	CRCW060349R9FKEA	5	Vishay-Dale	0603	49.9
RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	R39, R45, R50, R53, R54, R55	CRCW06030000Z0EA	6	Vishay-Dale	0603	0
RES, 10.0 k, 1%, 0.1 W, 0603	R40, R41	RC0603FR-0710KL	2	Yageo	0603	10.0k
RES, 0.22, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	R43	ERJ-3RQFR22V	1	Panasonic	0603	0.22
RES, 120 k, 1%, 0.1 W, 0603	R44	RC0603FR-07120KL	1	Yageo	0603	120k
RES, 0.1, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	R46	ERJ-3RSFR10V	1	Panasonic	0603	0.1
RES, 6.65 k, 1%, 0.1 W, 0603	R48, R49	RC0603FR-076K65L	2	Yageo	0603	6.65k
Switch, Slide, SPDT 100mA, SMT	S1	CAS-120TA	1	Copal Electronics	Switch, 5.4x2.5x2.5mm	
Shunt, 100mil, Flash Gold, Black	SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8	SPC02SYAN	8	Sullins Connector Solutions	Closed Top 100mil Shunt	1x2
Test Point, Compact, Red, TH	TP1, TP2	5005	2	Keystone	Red Compact Testpoint	
Test Point, Miniature, Black, TH	TP3, TP4, TP5	5001	3	Keystone	Black Miniature Testpoint	
12 Bit Analog to Digital Converter 8 Input 1 SAR 16-TSSOP	U1	ADC128S102CIMT/NOPB	1	Texas Instruments	TSSOP16	
Precision, Zero-Crossover, 20MHz, 0.9pA Ib, RRIO, CMOS Operational Amplifier, DGK0008A (VSSOP-8)	U2, U3, U4, U5	OPA2320AIDGKT	4	Texas Instruments	DGK0008A	
5ppm/C High-Precision Voltage Reference with Integrated High-Bandwidth Buffer, DGK0008A (VSSOP-8)	U6	REF6050IDGKR	1	Texas Instruments	DGK0008A	
I2C BUS EEPROM (2-Wire), TSSOP-B8	U7	BR24G32FVT-3AGE2	1	Rohm	TSSOP-8	
36V, 1A, 4.17µVRMS, RF Low-Dropout (LDO) Voltage Regulator, RGW0020A (VQFN-20)	U8	TPS7A4700RGWR	1	Texas Instruments	RGW0020A	
CAP, CERM, 39 pF, 50 V, +/- 5%, C0G/NP0, 0603	C1, C2, C8, C9, C15, C16, C22, C23	GRM1885C1H390JA01D	0	MuRata	0603	39pF
CAP, CERM, 22 uF, 25 V, +/- 20%, X5R, 0805	C42	CL21A226MAQNNNE	0	Samsung Electro-Mechanics	0805	22uF
Diode, TVS, Uni, 5 V, 9.2 Vc, SMB	D2	SMBJ5.0A-13-F	0	Diodes Inc.	SMB	5V
Connector, SMA, TH	J4, J10, J15, J16, J21, J22	142-0701-201	0	Cinch Connectivity	SMA	

Table 6-1. Bill of Materials (continued)

Description	Designator	PartNumber	Quantity	Manufacturer	PackageReference	Value
Header, 100mil, 2x1, Gold, TH	J27	HTSW-102-07-G-S	0	Samtec	Header, 100mil, 2x1, TH	
RES, 1.00 k, 1%, 0.1 W, 0603	R1, R3, R9, R11, R17, R19, R25, R27	RC0603FR-071KL	0	Yageo	0603	1.00k
RES, 1.02 k, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	R47, R56	ERJ-6ENF1021V	0	Panasonic	0805	1.02k
RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	R51, R52	CRCW06030000Z0EA	0	Vishay-Dale	0603	0
Test Point, Compact, Red, TH	TP6	5005	0	Keystone	Red Compact Testpoint	

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