

EVM User's Guide: ADS9219EVM

ADS9219 Evaluation Module



Description

The ADS9219EVM is a platform for evaluating the performance of the ADS9219. The ADS9219 is a 2-channel, 18-bit resolution, 20-MSPS successive approximation register (SAR) analog-to-digital converter (ADC). An integrated ADC driver simplifies external signal-chain design which can be optimized for wide bandwidth and AC performance.

Get Started

1. Order [ADS9219EVM](#) and [TSWDC155EVM controller](#) on [ti.com](#).
2. Visit the [ADS9219EVM tool folder](#) to download the ADS92xx EVM GUI.

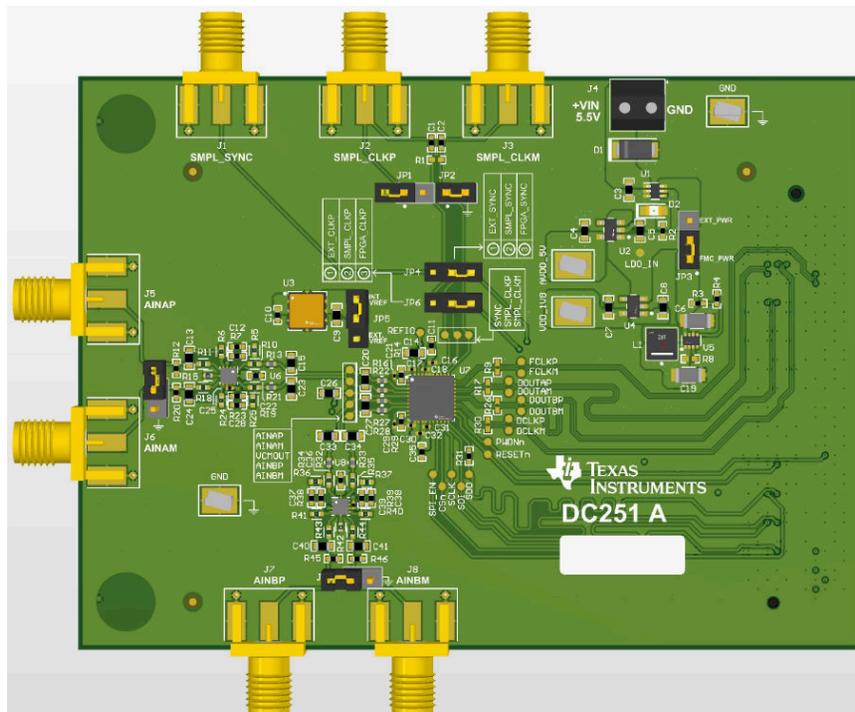
Features

- ADS9219EVM has the hardware required for diagnostic testing and accurate performance evaluation of the ADS9219 ADC.

- TSWDC155EVM controller (sold separately) provides all necessary digital I/O signals and power rails required for operating the ADS9219EVM.
- Easy-to-use evaluation GUI for Microsoft® Windows® 10, 64-bit operating systems requires the TSWDC155EVM (sold separately) for operation.
- The included software suite features graphical tools for data capture, histogram analysis, spectral analysis, and linearity measurements.

Applications

- [Power analyzers](#)
- [Source measurement units \(SMU\)](#)
- [Marine equipment](#)
- [Servo drive position feedback](#)
- [DC power supplies, AC sources, electronic loads](#)



ADS9219 Evaluation Module

1 Evaluation Module Overview

1.1 Introduction

This user's guide describes the characteristics, operation, and use of the ADS9219 evaluation module (EVM). This is an evaluation platform for the ADS9219 device. The EVM eases the evaluation of the ADS9219 with hardware, software, and computer connectivity through the universal serial bus (USB) interface. This user's guide includes complete circuit descriptions, schematic diagrams, and a bill of materials (BOM). Throughout this document, the terms *evaluation module* and *EVM* are synonymous with the ADS9219EVM.

1.2 Kit Contents

The ADS9219EVM includes a standard FMC connector on the bottom of the PCB. The FMC connector can be used to mate with standard FPGA kits, including the TSWDC155EVM (sold separately). The TSWDC155EVM is a digital controller board that is necessary for the included EVM software GUI to communicate with the device, graph measured results, and compute common figures of merit (for example, SNR and THD).

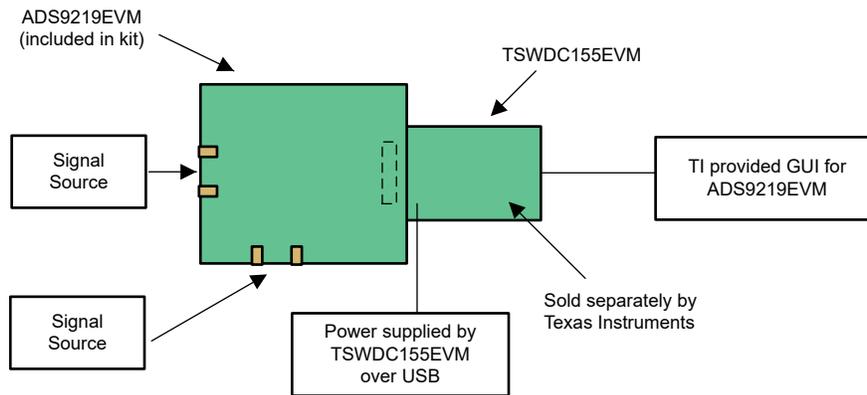


Figure 1-1. Block diagram of EVM Setup: ADS9219EVM, TSWDC155EVM, and GUI

1.3 Specification

The block diagram in Figure 1-2 depicts the connections and basic subsystems of the ADS9219EVM.

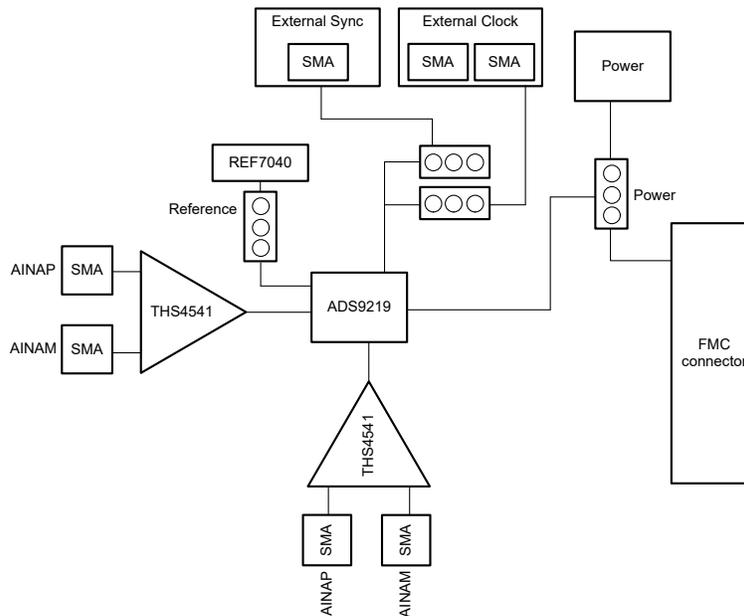


Figure 1-2. ADS9219EVM Block Diagram

1.4 Device Information

The ADS9219 is an 18-bit, 20-MSPS per channel, dual-channel, simultaneous-sampling, analog-to-digital converter (ADC). The ADS9219 integrates an ADC driver, precision voltage reference, reference buffer, and common mode voltage output buffer. Combined with low conversion latency, high sampling rates, minimal AC and DC errors, and low temperature drift, the ADS9219 is a high-performance design for applications requiring both precision and speed.

The serial LVDS (SLVDS) digital interface reduces board layout complexities, relaxes FPGA timing closures, simplifies firmware, and supports full throughput at lower clock speeds.

2 Hardware

2.1 ADS9219EVM Quick Start Guide

The following instructions are a step-by-step guide to connecting the ADS9219EVM to the computer and evaluating the performance of the ADS9219.

1. Review the default jumper settings and power guidelines in [Figure 2-1](#) below.
2. Physically connect J1 of the TSWDC155EVM to J9 of the ADS9219EVM. This component is the digital communications and power signal connection in default configuration.
3. Set jumper JP3 to the FMC_PWR [1-2] position so that the TSWDC155EVM provides power to the on-board DC/DC and LDO circuits. Otherwise, set JP3 to EXT_PWR [2-3] and connect an external 5.2V to 5.5V supply on screw terminal connection J4.
4. Bypass any external USB hub and connect the USB on the TSWDC155EVM directly to the computer.

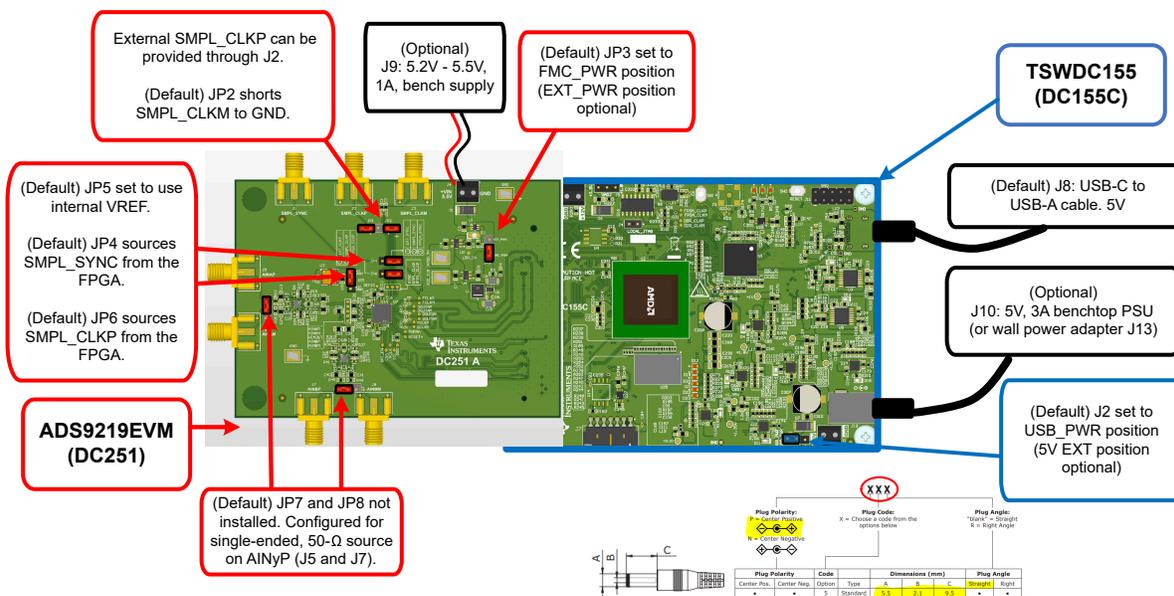


Figure 2-1. Connecting the Hardware

1. Install the GUI as described in [Section 3.2.1](#).
2. Install the necessary USB drivers as described in [Section 3.2.2](#).
3. Launch the GUI.
4. Press the Initialize USB, Power Up, Program FPGA, and Initialize ADS92xx buttons, in order from top to bottom, on the Config tab to power up and configure the EVM. (See [Section 3.2.3](#) for details.)
5. Connect a 1 VPP, single-ended sine wave signal from a function generator to any AINxP SMA input connector.
6. Select the number of samples to be at least 128k points, and choose the *Hanning* window type for best frequency domain results.
7. Press the *Start Capture* button to collect and analyze the data displayed on the appropriate CHx tab; see [Section 3.2.4](#).

2.2 Analog Interface

This section details the analog input connections to the ADS9219EVM.

2.2.1 High-bandwidth, Fully-Differential Circuit: THS4541

Figure 2-2 shows the schematic for the THS4541 input circuit connected to each ADC channel. The THS4541 is a high-speed, fully differential amplifier with a gain-bandwidth product of 850MHz. This circuit is configured for a gain of 5V/V and can accept both single-ended and differential inputs. By default, the THS4541 circuit is tuned for a single-ended input signal up to 1MHz with 50Ω output impedance. For other input source impedances, or for differential inputs, TI recommends to remove the termination resistors at the FDA inputs or short across them using the provided jumper.

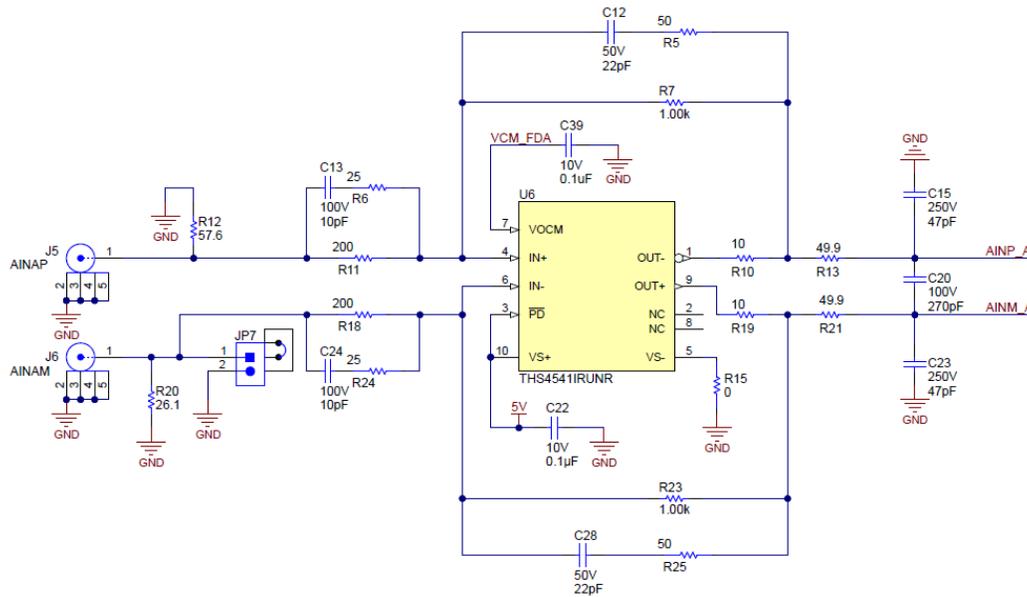


Figure 2-2. THS4541 Fully-Differential Circuit for ADC A

The OPA320, shown in Figure 2-3, is used as the VCMOUT buffer to drive the output common-mode voltage on both ADC A and ADC B input circuits.

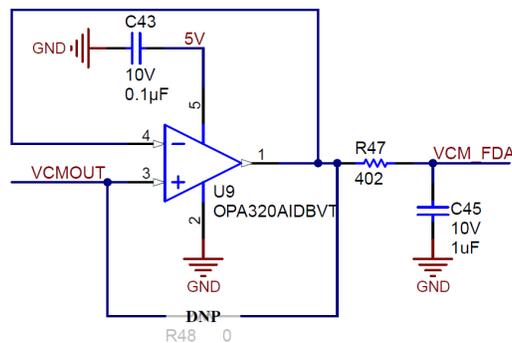


Figure 2-3. OPA320 Circuit to Buffer the ADS9219 VCMOUT Voltage

2.2.2 Voltage Reference

The ADS9219 uses an internal 4.096V reference voltage, which can be measured on the REFIO pin when configured as an output (default). For applications which require improved drift performance, configure the REFIO pin as an input and apply an external reference voltage to the pin.

The ADS9219EVM include a provision for evaluating the REF7040 reference IC. The REF70xx family of high precision series voltage references offers the industry's lowest noise (0.23ppm_{p-p}), very low temperature drift coefficient (2ppm/°C), and high accuracy (±0.025%). In addition, these precision reference devices feature high PSRR, low drop-out voltage and excellent load and line regulation to help meet strict transient requirements. The REF7040 on the EVM is the 4.096V output voltage option. To connect the REF7040 to the ADS9219, configure the REFIO pin as an input via the GUI and then install a shunt on jumper JP5 in the [1-2] position.

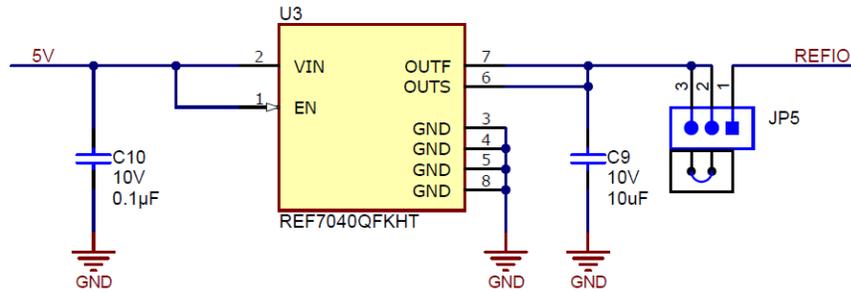


Figure 2-4. External Reference Voltage Using REF7040

2.3 Power Supplies

By default, the TSWDC155EVM provides the ADS9219EVM with a 3.3V supply ("3P3V"). The ADS9219EVM has a TPS61033 boost converter which increases the 3.3V supply to 5.5V. The 5.5V supply is applied to the input of two independent low-dropout regulators (LDOs) to derive the required analog and digital supplies for the ADS9219 when JP3 is in the [1-2] position. U2 (TPS7A2050) outputs 5V, which is used for the AVDD_5V supply. U4 (TPS7A2018) outputs 1.8V, which is shared between the AVDD_1V8 and DVDD_1V8 supplies.

The LDO input voltage (LDO_IN) can be changed to an external source ranging from 5.2V to 5.5V by configuring the shunt on JP3 in the [2-3] position and connecting the external supply to terminal block J4. In this setup, U1 (LM66100) provides reverse polarity protection in the event that the connection is wired incorrectly.

Figure 2-5 shows the power tree schematic for the ADS9219EVM.

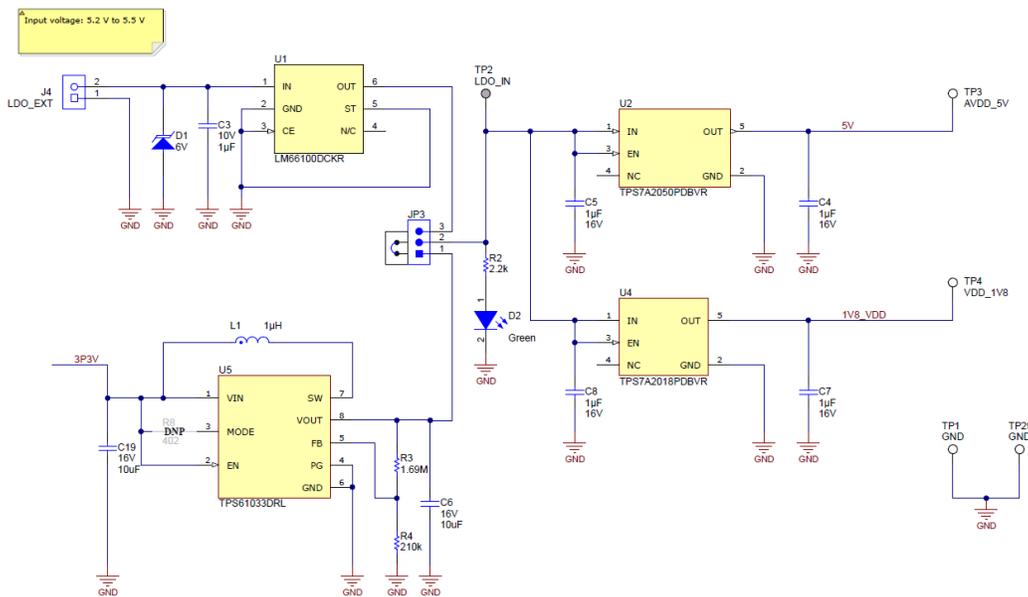


Figure 2-5. Power Entry and Regulators

2.3.1 USB Power and When to Power the Board Externally

As discussed in [Section 2.1](#), the USB-C® connector is able to provide power to the TSWDC155EVM and ADS9219EVM using the default configuration. The combined peak current consumption reaches 600mA (typical) during the ADC conversion process and 520mA RMS (typical) after the ADS9219EVM is initialized in the GUI, as described in [Section 3.2.3](#).

The TWDC155EVM is a high-power SuperSpeed (USB 3.0) device. This means a PC supplies up to 900mA from a compliant USB 3.0 port. However, many PC USB port configurations allow much less than this limit depending on the unit load handshake process, usually resulting from other devices on the bus. Tripping the current limit on a USB can result in cutting power to the USB port, excessive power dissipation or heating, depending on the PC port configuration. As a result, TI highly recommends to consider switching to an externally powered ADS9219EVM or TSWDC155EVM if:

- Only USB 1.0 or USB 2.0 ports are available.
- There are multiple devices connected to the PC by USB at the same time.
- The USB 3.0 port configuration for the PC is unknown.

To switch to the external power configuration on the ADS9219EVM, move the jumper on JP3 to the EXT_PWR position and use the J4 terminal block to provide the required 5.2V to 5.5V supply. To switch to the external power configuration on TSWDC155EVM, move the jumper on J2 to the 5V (external) position and use the J10 terminal block or barrel jack connector to provide the required 5V supply.

USB hubs can cause possible device enumeration issues and are not recommended when communicating through the TSWDC155EVM.

3 Software

3.1 Digital Interface and Clock Inputs

This section details the digital interface connections and clocking options for the ADS9219EVM.

3.1.1 Digital Interface Connections

The ADS9219 uses both SPI and LVDS type interfaces. The SPI is a CMOS interface that is used to configure the internal device registers and consists of SCLK, SDI, SDO, CS, and SPI_EN. For data capture, the ADS9219 uses a source-synchronous LVDS interface. Data for each channel are output on a dedicated differential signal pair (DOUTP/M_A and DOUTP/M_B). In addition, the device outputs both a differential frame clock (FCLKP/M) and data clock (DCLKP/M) back to the host with the conversion data. This type of interface makes sure that propagation delays are consistent between the data output, frame clock, and data clock, improving timing closures at the host. Both the SPI and LVDS interface signals connect to the FMC connector on the EVM. [Figure 3-1](#) provides the FMC connector signal definition. These signals are also available via test points for scope measurements as indicated in PCB silkscreen.

The FMC connector pinout below can also be interfaced with standard FPGA development kits. Note that the TI-provided software GUI is only compatible with the TSWDC155EVM and third-party software development is not supported.

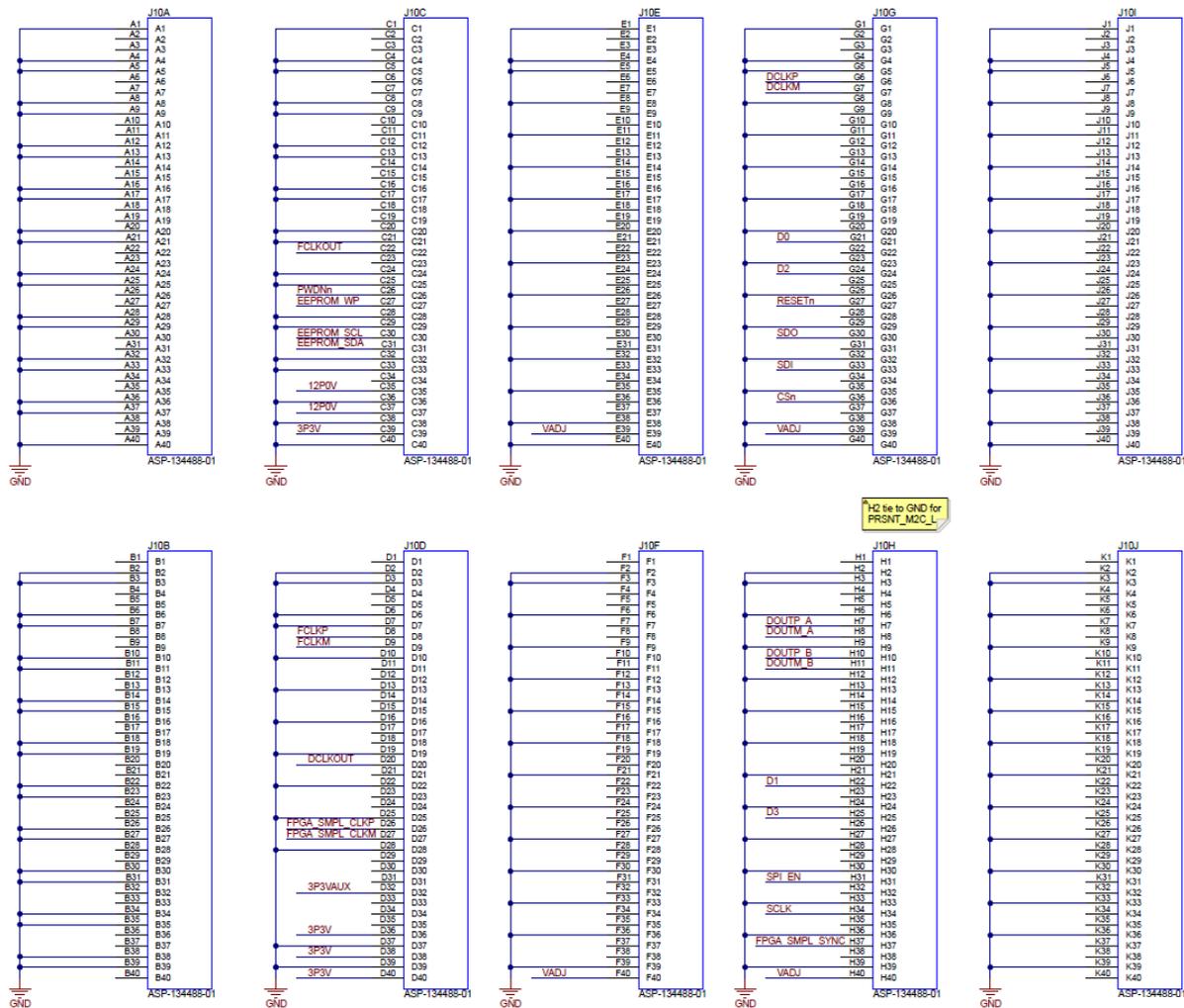


Figure 3-1. Digital I/O

3.1.2 Clock Select

The ADS9219EVM offers the following options for providing the conversion clock to the ADS9219: a CMOS clock from the TSWDC155EVM, a CMOS clock from an external source, and an LVDS clock from external source. Table 3-1 and Figure 3-2 provide an overview of the ADS9219 sample clock options available on the EVM. By default, the FPGA controller on the TSWDC155EVM (sold separately) sources a single-ended CMOS clock that can be connected directly to the SMPL_CLKP pin on the ADS9219 by configuring JP6 in the [2-3] position. Connect SMPL_CLKM to GND by installing a shunt on JP2. Lastly, install a jumper on JP4 in the [2-3] position to provide a SMPL_SYNC input from the FPGA controller, which is used to synchronize the internal averaging filter on the ADS9219 at the start of data capture. This default configuration allows the user to select the clock frequency from the options listed in the EVM GUI.

When using an external CMOS clock, move JP6 into the [1-2] position, install a shunt on JP1, and connect the external clock source to the SMA connector, J2. To use an LVDS clock, remove the jumper from JP1 and install a 100Ω resistor on the footprint for R1. Make sure that any external clock source has low jitter to maximize the performance of the ADS9219.

Table 3-1. Sample Clock Settings for ADS9219EVM

Sample Clock (SMPL_CLK)	JP1	JP6 (SMPL_CLKP)	JP2 (SMPL_CLKM)	R1
TSWDC155EVM (CMOS)	—	[2-3]	Installed	Not installed
External (CMOS - J2)	Installed	[1-2]	Installed	Not installed
External (LVDS - J2/J3)	Not installed	[1-2]	Not installed	Installed (100Ω)

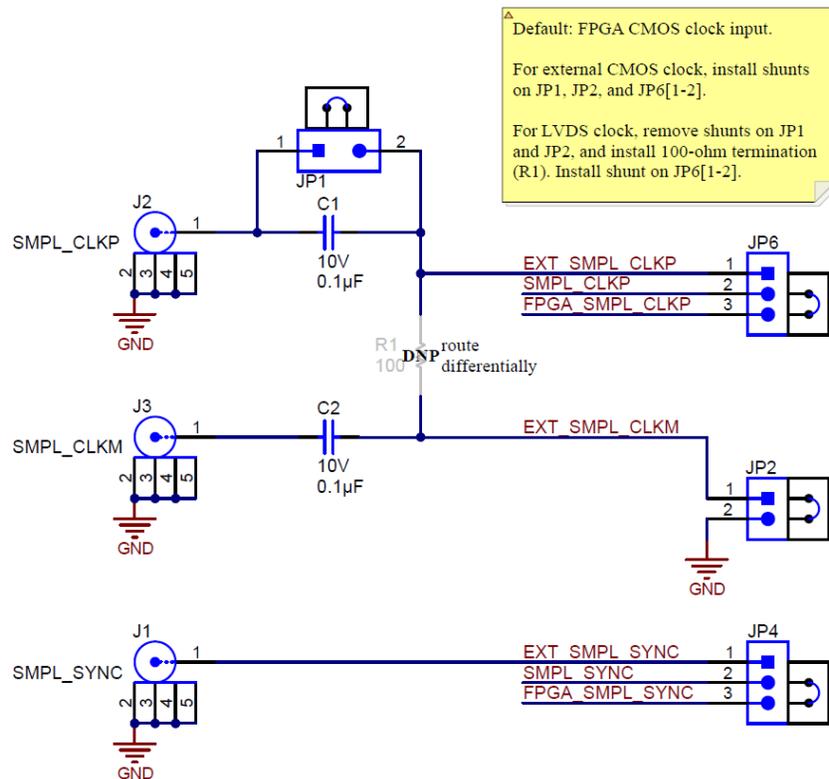


Figure 3-2. Sample Clock Selection

3.2 ADS9219EVM Software Reference

3.2.1 ADS9219EVM-GUI Software Installation

This section details the installation and operation of the ADS9219EVM software graphical user interfaces (GUI). These software require the TSWDC155EVM (sold separately) controller to operate. The first step to installing the software (as shown in [Figure 3-3](#)) is to download the latest version of the EVM GUI installer as per [Table 3-2](#).

Table 3-2. EVM GUI Installer

EVM	Software Download Link
ADS9219EVM	ADS9219EVM-GUI

Accept all the license agreements and choose the destination location, project directory, and start menu. Typically, the default values work, but these values can be customized as needed based on the user's requirements. Next, the installer prompts the user to create a desktop icon and summarize the installation plan. Clicking *Install* begins copying software onto the computer. This process takes a few minutes. At completion, the user can launch a readme text file and the application. [Figure 3-3](#) and [Figure 3-4](#) show these steps.

Note

The GUI installer and GUI buttons can differ slightly depending on which specific GUI is being installed.

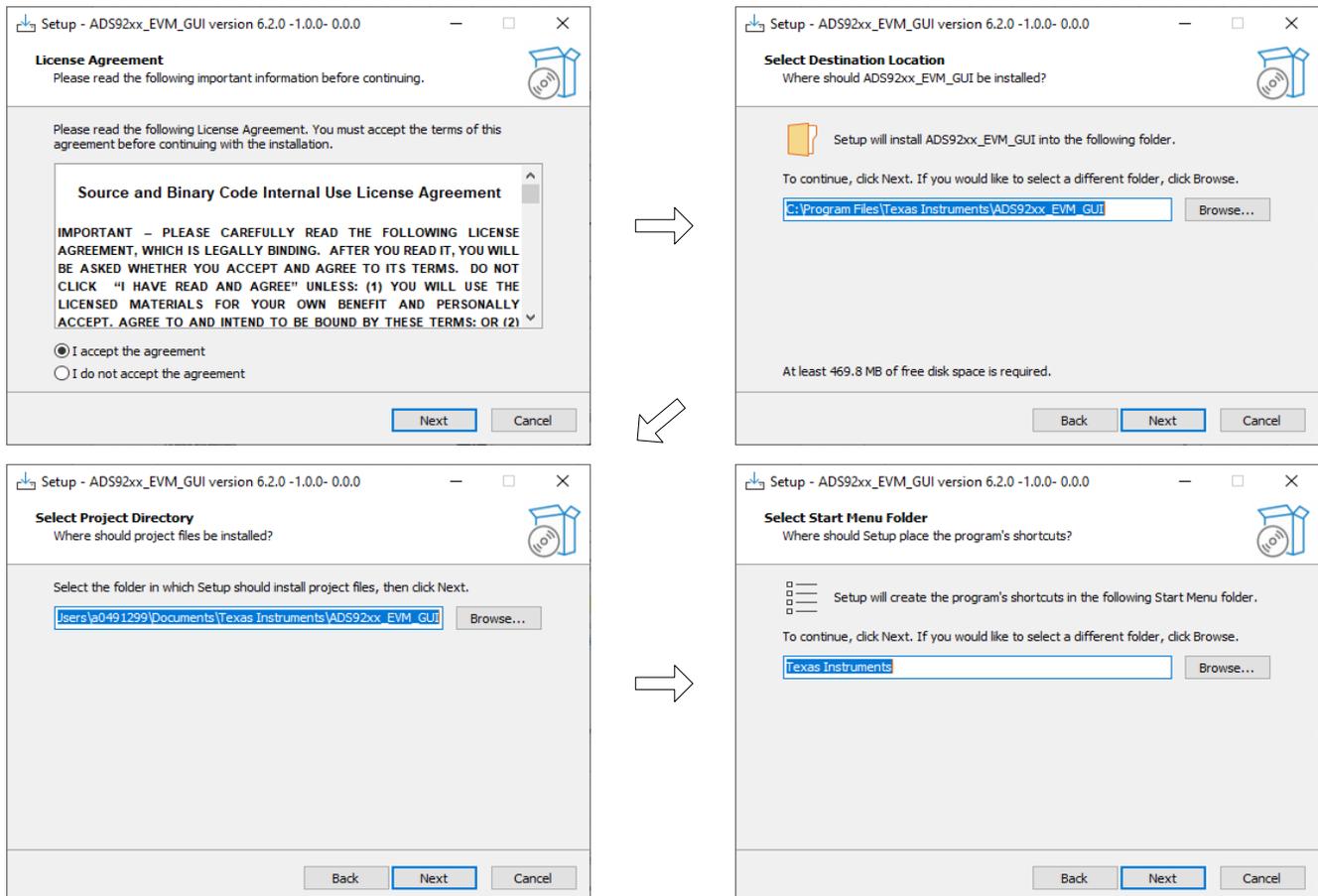


Figure 3-3. Software Installation - Part 1

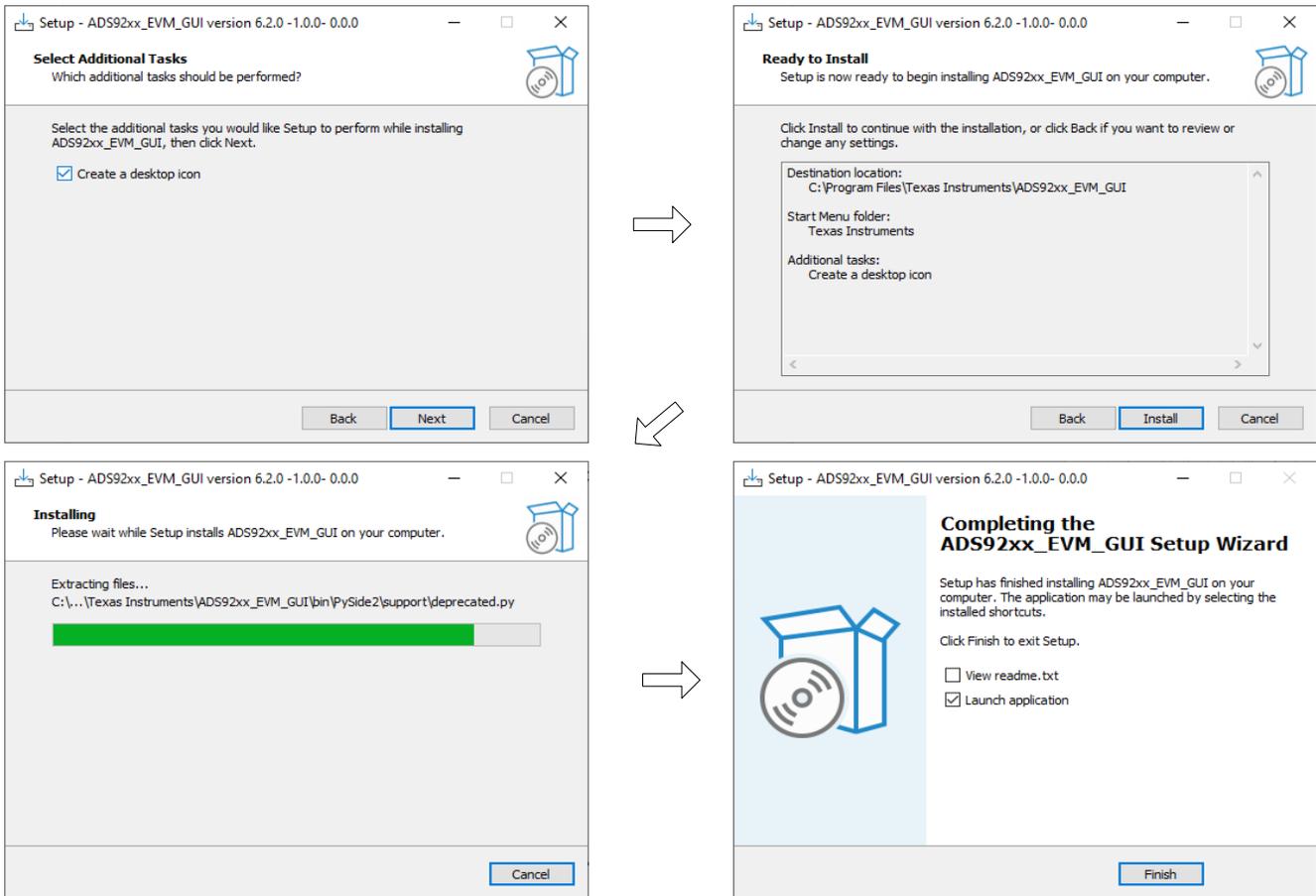


Figure 3-4. Software Installation - Part 2

3.2.2 USB Driver Installation

This section describes the steps for installing the USB driver.

1. For the TSWDC155EVM, connect J8 to the workstation using a USB-C to USB-A cable.
2. Bypass any USB hub and connect directly to the computer.
3. Open the Windows® Device Manager, as shown in [Figure 3-5](#), and right-click on the WestBridge folder in the Device Manager window and select the Update Driver button (see [Figure 3-6](#)).
4. In the next window that appears, select Browse my computer for driver software.
5. Then select Let me pick from a list of available drivers on my computer in the next pop-up window.
6. Click on Have Disk in the pop-up window and navigate to: *C:\Program Files\Texas Instruments\ADS92xx\bin\proj_lib\Sparrow\Bootloader*

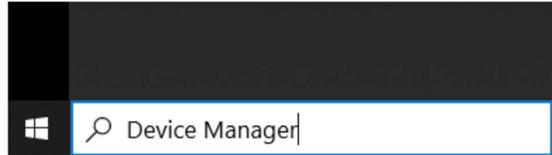


Figure 3-5. Update Driver With Device Manager



Figure 3-6. Open Device Manager

3.2.3 Using the CONFIG Tab

After the EVM GUI starts, press the following buttons in the order shown in [Figure 3-7](#) below. Confirm that each step is completed before proceeding by monitoring the Status message. For the *Power Up* and *Program FPGA* buttons, some status LEDs on the hardware illuminate. After all four buttons are pressed, the power on the ADS9219EVM is on and the ADS9219 device registers are configured.

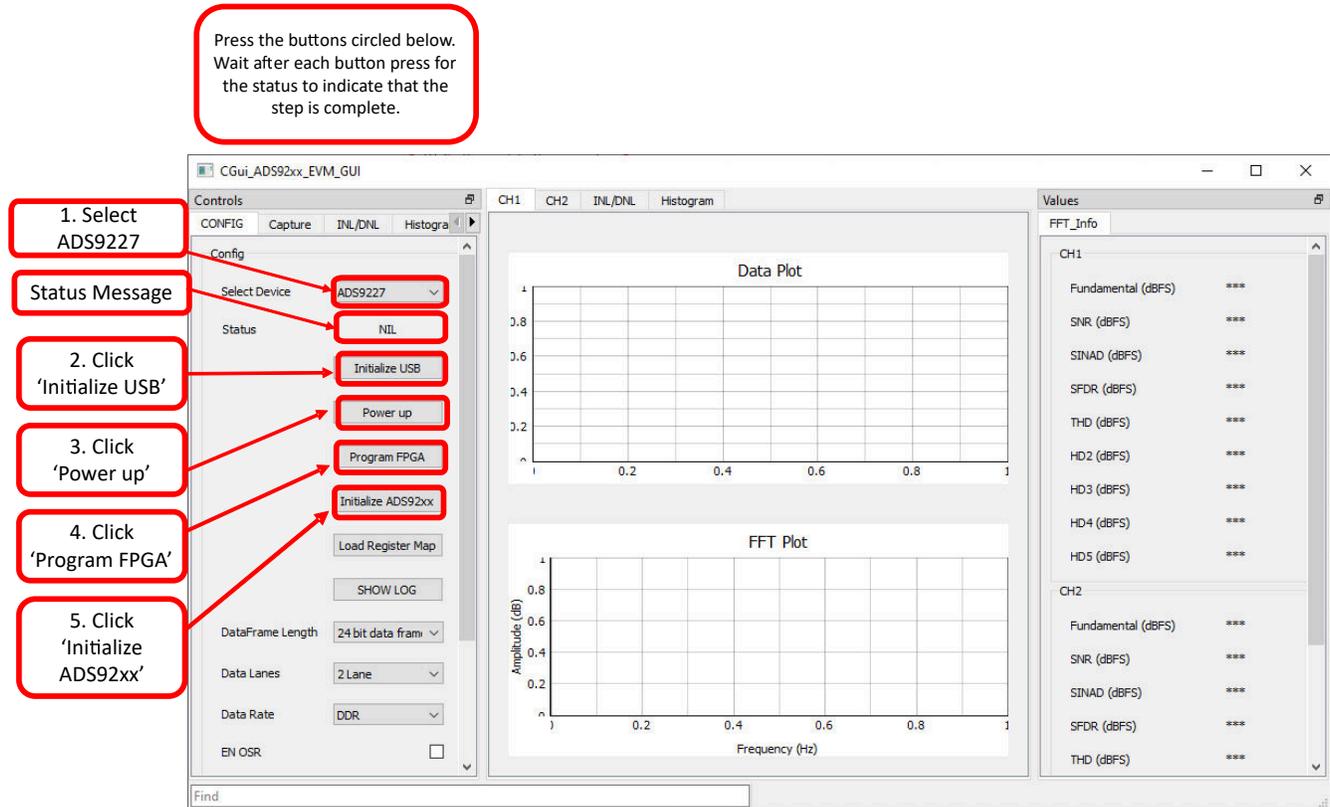


Figure 3-7. Initial Required Setup on the Config Tab

3.2.4 Using the Capture Tab

In Figure 3-8, shows an example data capture display. In this step, the necessary updates to the *Capture* settings are made to capture the time domain data and to get a good frequency domain result. First, update the number of samples to at least 32k to get good frequency domain results (for example, accurate FFT display, SNR data, and THD data). Finally, select the Hanning type window to eliminate spectral leakage in the FFT result.

When these changes are made, press the *Start Capture* button to collect time domain and frequency domain data. Select the appropriate tab to view data for channel 1 or channel 2.

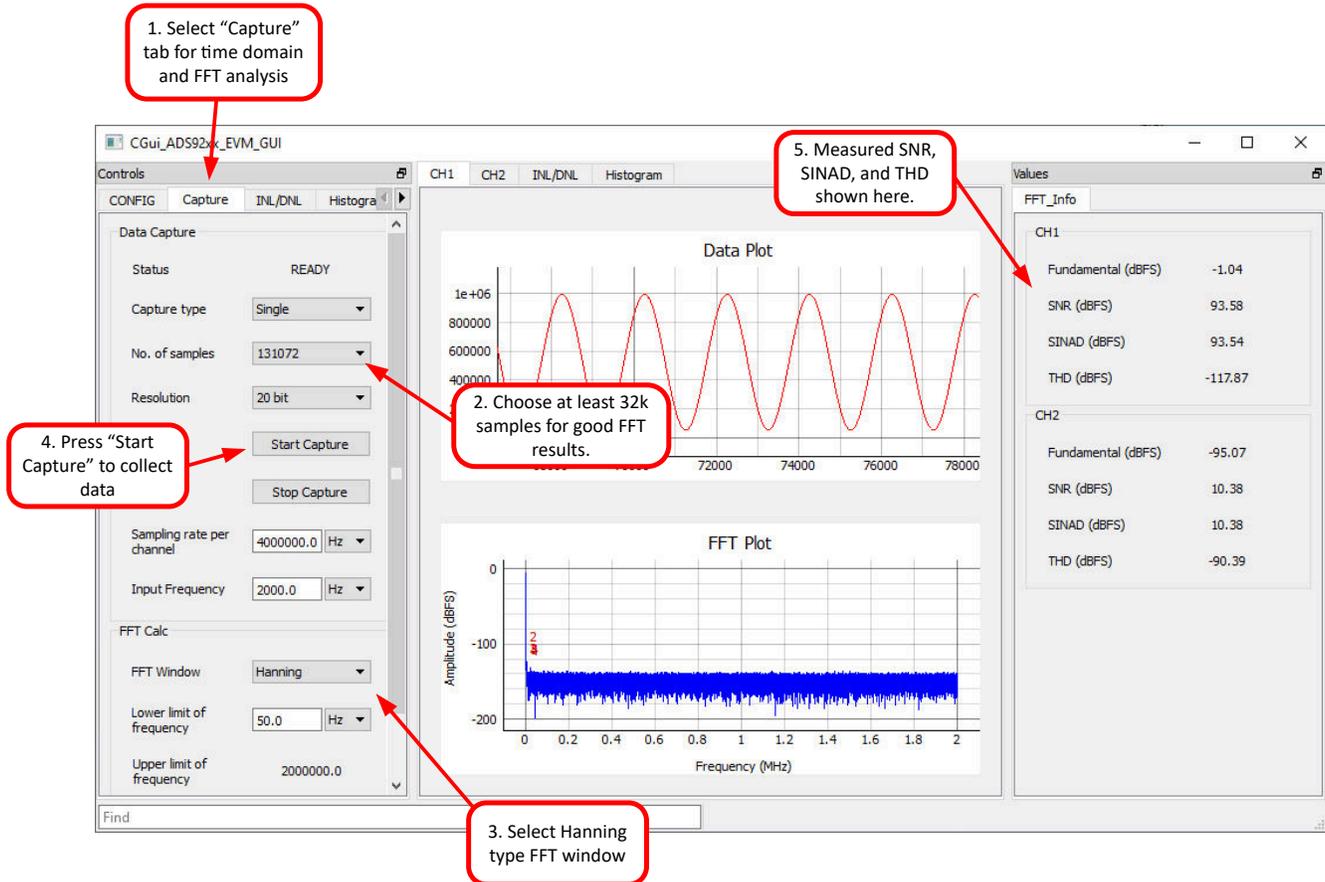


Figure 3-8. Initial Required Setup on the Capture Tab

3.2.5 Using the INL/DNL Tool

The INL/DNL tool measures the linearity of the of the ADS9219EVM by applying a full-scale, low-distortion sinusoidal input signal. The accuracy improves if the number of *hits per code* is increased at the cost of extra test time. Select the channel to measure and the *hits per code*. An input signal greater than full-scale is required to verify that all ADC codes are tested. An input signal of +0.1 dBFS is sufficient. Then press the *GET INL/DNL* button to run this tool as shown in [Figure 3-9](#).

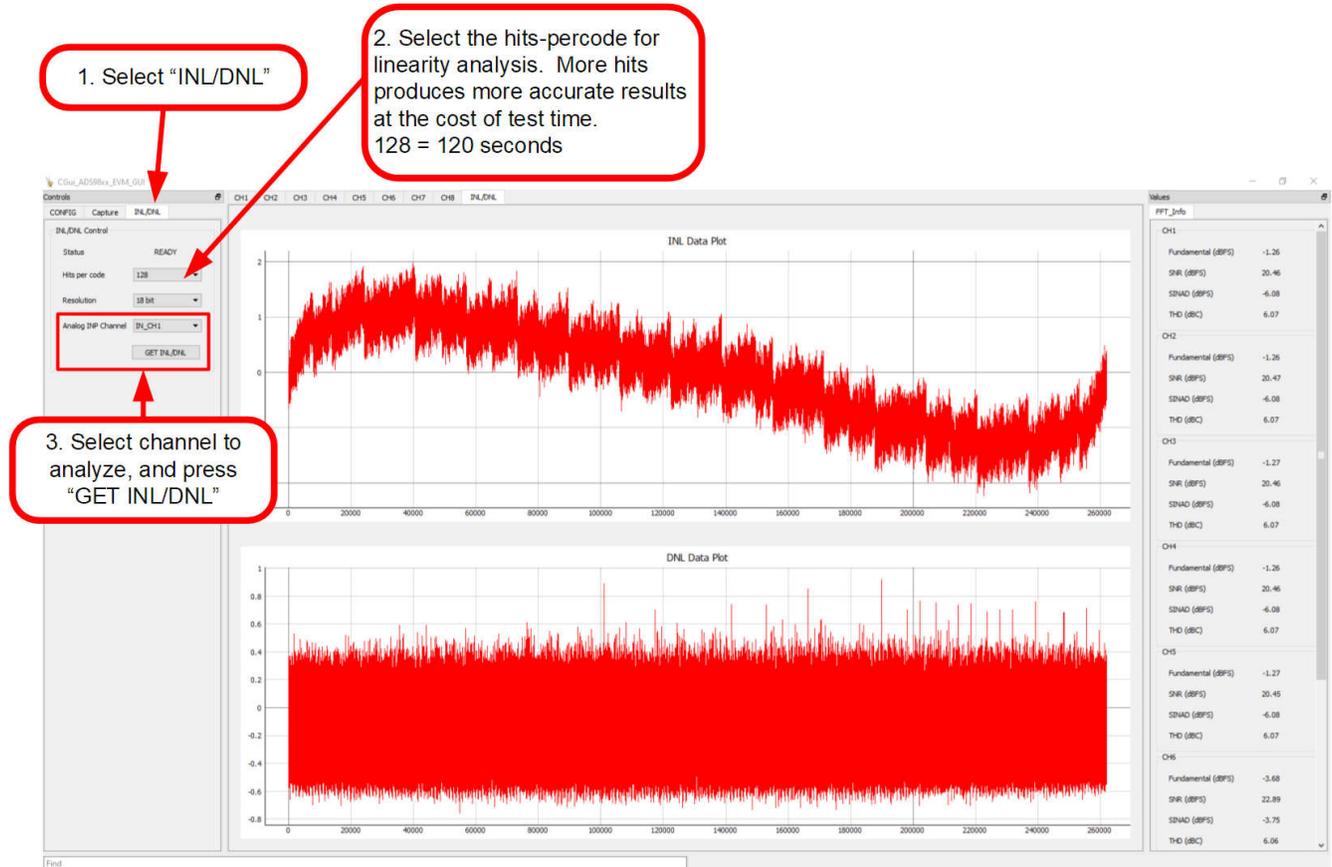


Figure 3-9. Using the INL/DNL Tool

3.2.6 Using the Histogram Tab

The Histogram tool represents the distribution of ADC output codes for a given sample set. The accuracy of the statistical summary can be improved by increasing *hits per code*, which increases the sample size at the cost of extra test time. Select the channel to measure and configure the *hits per code*, *channel*, *resolution*, and enter the reference voltage value. Then, press the **GET HISTOGRAM** button as shown in [Figure 3-10](#).

The cumulative effect of noise coupling to the ADC output comes from sources such as the input drive circuits, the reference drive circuit, the ADC power supply, and the ADC. The total noise is reflected in the standard deviation of the ADC output code histogram that is obtained by performing multiple conversions of a DC input applied to a given channel. Selecting the correct reference voltage gives the result in units of voltage instead of codes.

Note that any data collected the histogram tab is not saved or stored on the *Capture Tab*. As a result, switching between the tabs results in lost data. Saving data on this screen does not provide the raw ADC codes but instead saves the histogram data presented on this tab in codes per bin. To save the raw ADC output values, use the *Capture tab*.



Figure 3-10. Using the Histogram Tab

4 Hardware Design Files

4.1 Schematics

The ADS9219EVM schematics are contained in the figures below. [Figure 4-1](#) shows the various connections to the ADS9219 device, including the recommended decoupling capacitors, as well as optional connections for external clock and reference voltage inputs. The analog signals connect to SMA connectors and the input signal chain shown in [Figure 4-2](#). The digital signals connect to J9, as shown in [Figure 4-4](#).

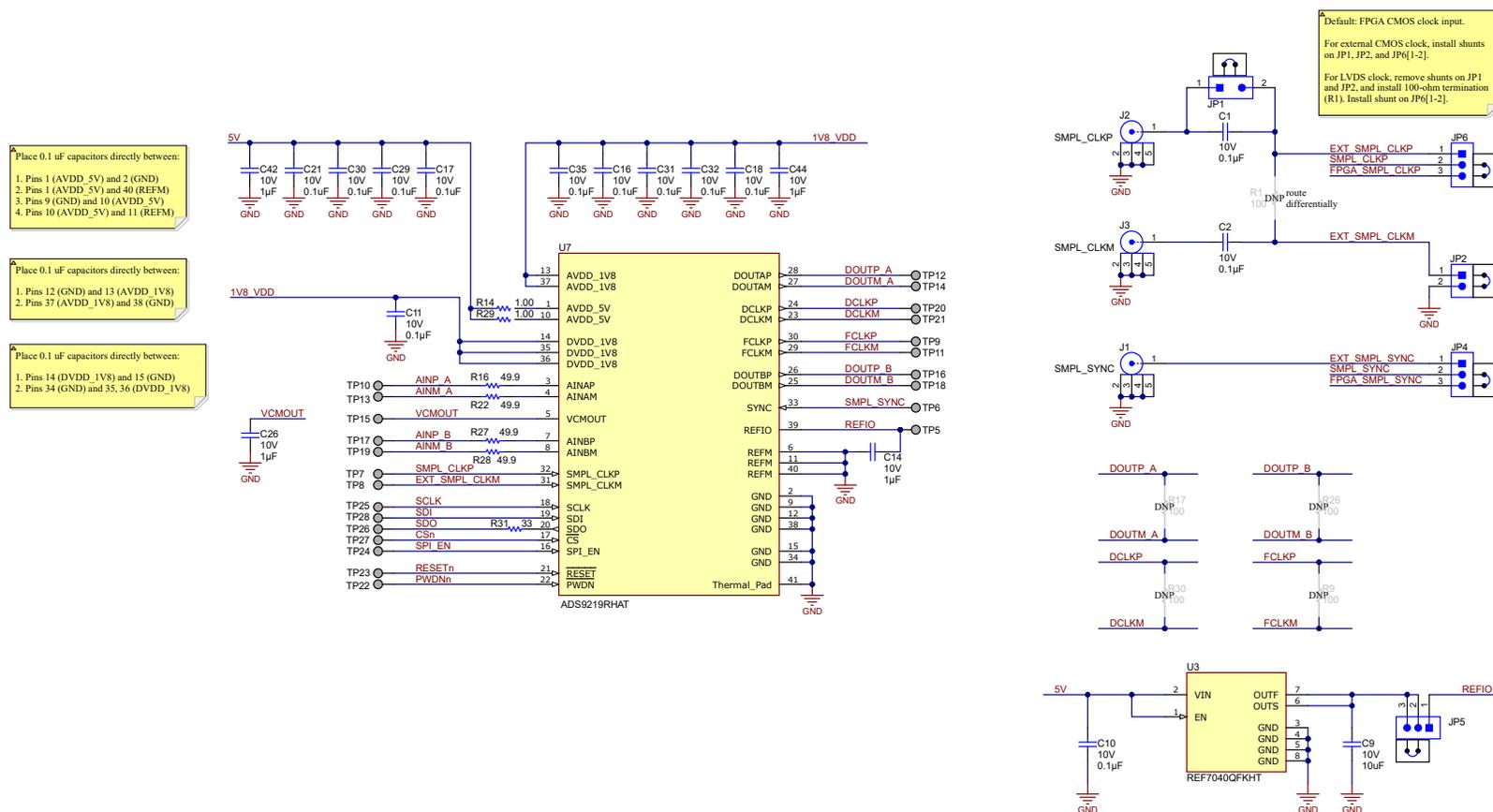


Figure 4-1. ADS9219 Device Connections Schematic

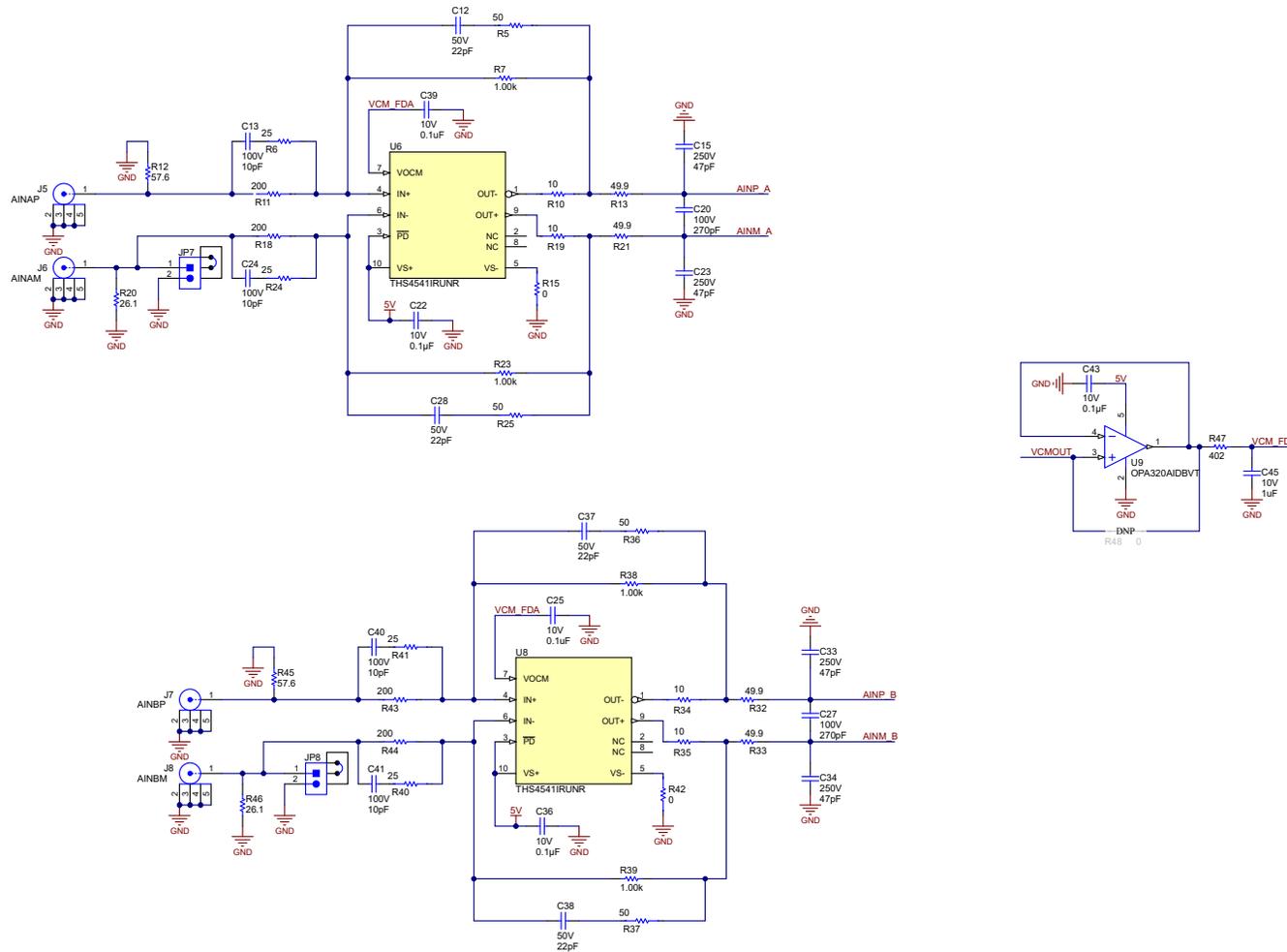


Figure 4-2. Input Connections

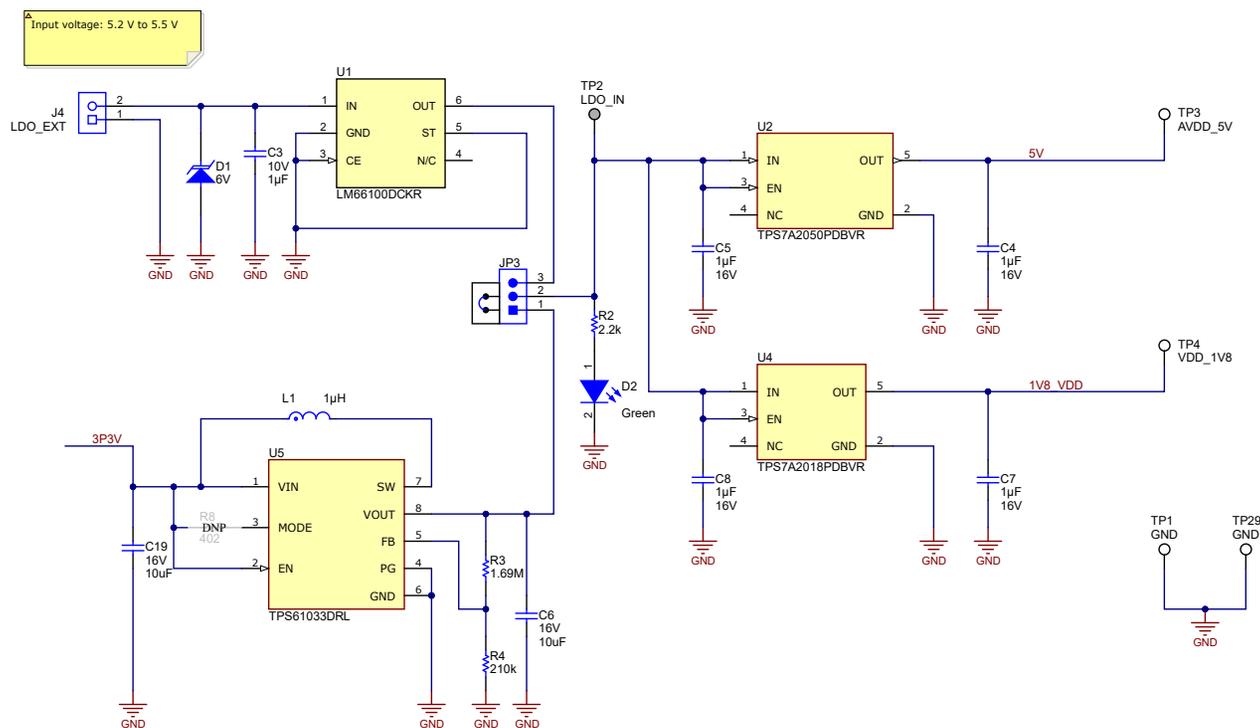


Figure 4-3. Power Connections and Regulators Schematic

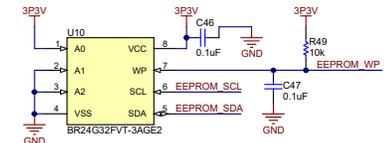
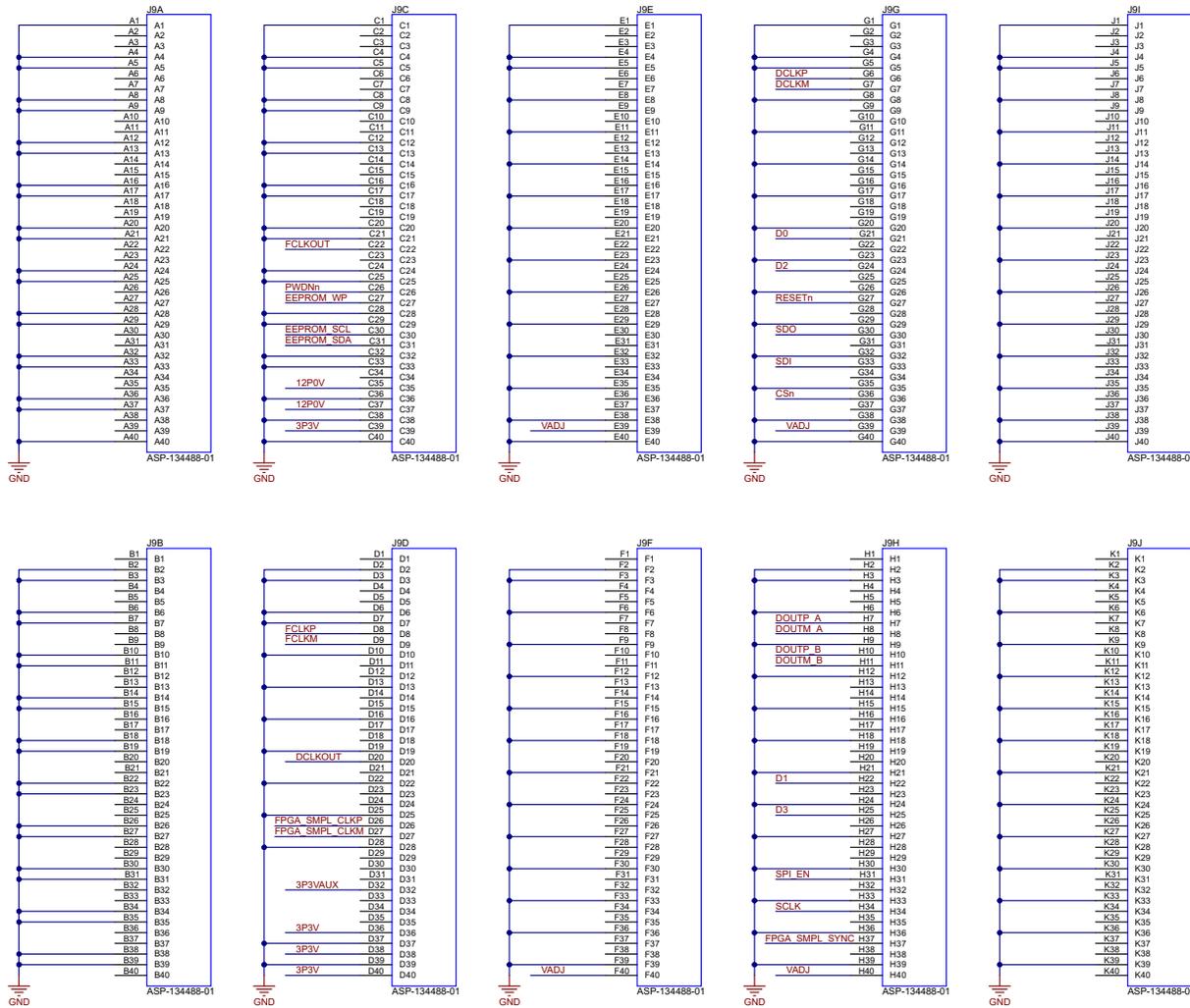


Figure 4-4. Digital Connector Schematic

4.2 PCB Layout

The figures below show the PCB layer plots for the ADS9219EVM.

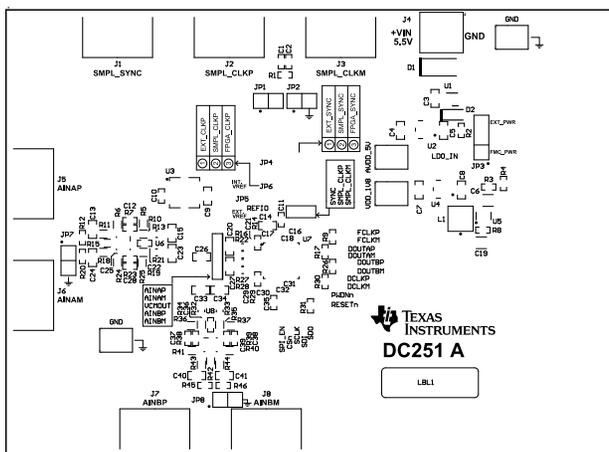


Figure 4-5. Top Overlay

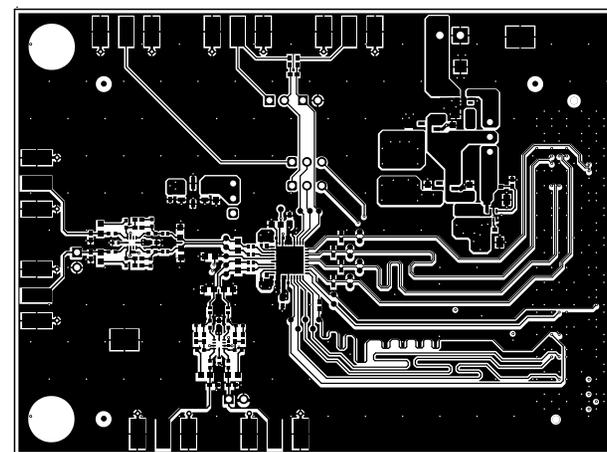


Figure 4-6. Top Layer

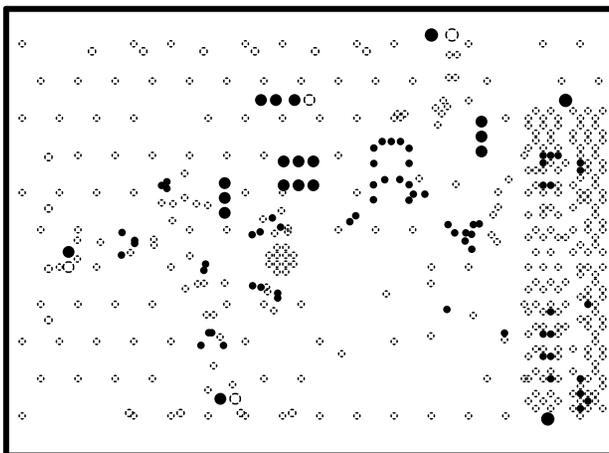


Figure 4-7. Ground Layer (negative plane)

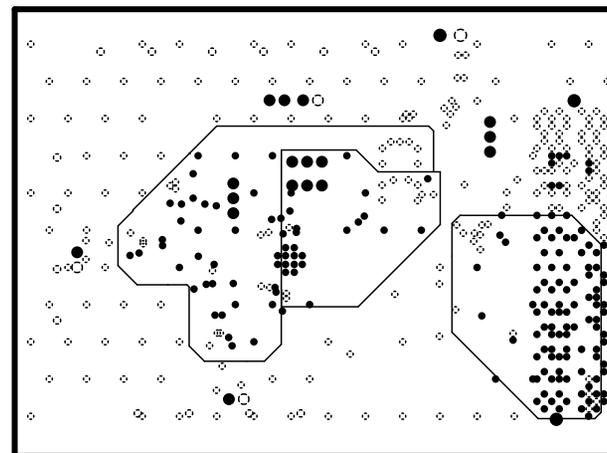


Figure 4-8. Power Layer (negative plane)

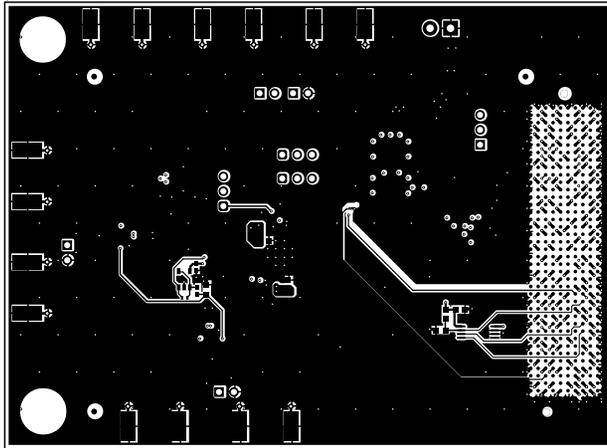


Figure 4-9. Bottom Layer

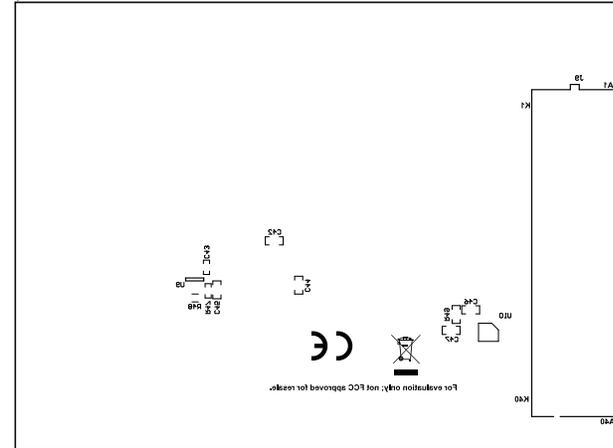


Figure 4-10. Bottom Overlay

4.3 Bill of Materials (BOM)

Table 4-1 lists the ADS9219EVM bill of materials.

Table 4-1. ADS9219EVM Bill of Materials

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
C1, C2	2	0.1uF	CAP, CERM, 0.1μF, 10V,+/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	C0402C104K8RACAUTO	Kemet
C3, C14, C26, C42, C44	5	1uF	CAP, CERM, 1μF, 10V,+/- 10%, X7R, 0603	0603	0603ZC105KAT4A	AVX
C4, C5, C7, C8	4	1uF	CAP, CERM, 1uF, 16V, +/- 10%, X7R, 0603	0603	C1608X7R1C105K080AC	TDK
C6, C19	2	10uF	CAP, CERM, 10uF, 16V, +/- 10%, X7R, 1206	1206	GRM31CR71C106KAC7L	MuRata
C9	1	10uF	CAP, CERM, 10uF, 10V, +/- 20%, X6S, 0603	0603	GRM188C81A106MA73D	MuRata
C10, C11, C22, C35, C36, C43	6	0.1uF	CAP, CERM, 0.1μF, 10V,+/- 10%, X7R, 0402	0402	C0402C104K8RACTU	Kemet
C12, C28, C37, C38	4	22pF	CAP, CERM, 22pF, 50V, +/- 5%, C0G/NP0, 0402	0402	GRM1555C1H220JA01D	MuRata
C13, C24, C40, C41	4	10pF	CAP, CERM, 10pF, 100V,+/- 5%, C0G/NP0, 0603	0603	8.85012E+11	Wurth Elektronik
C15, C23, C33, C34	4	47pF	CAP, CERM, 47pF, 250V,+/- 5%, C0G/NP0, AEC-Q200 Grade 1, 0603	0603	AC0603JRNPOYBN470	Yageo America
C16, C17, C18, C21, C25, C29, C30, C31, C32, C39	10	0.1uF	CAP, CERM, 0.1uF, 10V, +/- 10%, X5R, 0201	0201	CL03A104KP3NNNC	Samsung Electro-Mechanics
C20, C27	2	270pF	CAP, CERM, 270pF, 100V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C2A271JA01D	MuRata
C45	1	1uF	CAP, CERM, 1uF, 10V, +/- 10%, X5R, 0603	0603	C0603C105K8PACTU	Kemet
C46, C47	2	0.1uF	CAP, CERM, 0.1uF, 25V, +/- 5%, X7R, 0603	0603	06033C104JAT2A	AVX
D1	1	6V	Diode, TVS, Uni, 6V, 10.3 Vc, 400W, 38.8A, SMA	SMA	SMAJ6.0A	Littelfuse
D2	1	Green	LED, Green, SMD	LED_0805	APT2012LZGCK	Kingbright
H1, H2	2		Standoff, Hex,25mm Length, M3, Aluminum	Standoff M3	24438	Keystone
H3, H4	2		MACHINE SCREW PAN PHILLIPS M3	M3 Screw	RM3X8MM 2701	APM HEXSEAL
J1, J2, J3, J5, J6, J7, J8	7		Connector, End launch SMA, 50 ohm, SMT	End Launch SMA	142-0701-801	Cinch Connectivity
J4	1		Terminal Block, 3.5mm Pitch, 2x1, TH	7.0x8.2x6.5mm	ED555/2DS	On-Shore Technology
J9	1		Connector, 1.27mm, 40x10, Black, SMT	Connector, 1.27mm, 40x10, SMT	ASP-134488-01	Samtec

Table 4-1. ADS9219EVM Bill of Materials (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
JP1, JP2, JP7, JP8	4		Header, 100mil, 2x1, Gold, TH	Header, 100mil, 2x1, TH	HTSW-102-07-G-S	Samtec
JP3	1		Header, 100mil, 3x1, Gold, TH	Header, 100mil, 3x1, TH	HTSW-103-07-G-S	Samtec
JP4, JP5, JP6	3		Header, 100mil, 3x1, Gold, TH	3x1 Header	TSW-103-07-G-S	Samtec
L1	1		Shielded Power Inductors	SMT_IND_4MM0_4MM0	XGL4020-102MEC	Coilcraft
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650 x 0.200 inch	THT-14-423-10	Brady
R2	1	2.2k	RES, 2.2 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04022K20JNED	Vishay-Dale
R3	1	1.69Meg	RES, 1.69M, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW04021M69FKED	Vishay-Dale
R4	1	210k	RES, 210 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0402	0402	ERJ-2RKF2103X	Panasonic
R5, R25, R36, R37	4	50	Res Thin Film 0402 50 Ohm 0.1% 0.05W(1/20W) ±25ppm/C Pad SMD T/R	0402	FC0402E50R0BST0	Vishay
R6, R24, R40, R41	4	25	Res Thin Film 0402 25 Ohm 0.1% 0.05W(1/20W) ±25ppm/C Pad SMD T/R	0402	FC0402E25R0BST0	Vishay Dale
R7, R23, R38, R39	4	1.00k	RES, 1.00 k, 0.1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	ERA-2APB102X	Panasonic
R10, R19, R34, R35	4	10	10 Ohms ±0.1% 0.05W, 1/20W Chip Resistor 0402 (1005 Metric) RF, High Frequency Thin Film	0402	FC0402E10R0BST0	Vishay Dale
R11, R18, R43, R44	4	200	200 Ohms ±0.1% 0.05W, 1/20W Chip Resistor 0402 (1005 Metric) RF, High Frequency Thin Film	0402	FC0402E2000BST0	Vishay Dale
R12, R45	2	57.6	RES, 57.6, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040257R6FKED	Vishay-Dale
R13, R16, R21, R22, R27, R28, R32, R33	8	49.9	RES, 49.9, 0.1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	TNPW040249R9BEED	Vishay-Dale
R14, R29	2	1	RES, 1.00, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04021R00FKED	Vishay-Dale
R15, R42	2	0	Jumper 0.063W, 1/16W Chip Resistor 0402 (1005 Metric) - Thick Film	0402	CRCW04020000Z0EDC	Vishay
R20, R46	2	26.1	RES, 26.1, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040226R1FKED	Vishay-Dale
R31	1	33	RES, 33, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040233R0JNED	Vishay-Dale
R47	1	402	RES, 402, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW0402402RFKED	Vishay-Dale
R49	1	10k	RES, 10 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060310K0JNEA	Vishay-Dale

Table 4-1. ADS9219EVM Bill of Materials (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8	8	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec
TP1, TP3, TP4, TP29	4		Test Point, Compact, SMT	Testpoint_Keystone_Compact	5016	Keystone Electronics
U1	1		+/-6V, Low IQ Ideal Diode with Input Polarity Protection, DCK0006A (SOT-SC70-6)	DCK0006A	LM66100DCKR	Texas Instruments
U2	1		300mA, ultra-low-noise, low-IQ, low-dropout (LDO) linear regulator with high PSRR 5-SOT-23 -40 to 125	SOT23-5	TPS7A2050PDBVR	Texas Instruments
U3	1		2ppm/°C Maximum Drift, 0.23 ppm-p 1/f Noise, Precision Voltage Reference	LCCC8	REF7040QFKHT	Texas Instruments
U4	1		Linear Voltage Regulator IC Positive Fixed 1 Output 300mA SOT-23-5	SOT23-5	TPS7A2018PDBVR	Texas Instruments
U5	1		5.0A 2.4MHz High Efficiency Boost Converter	SOT-5X3	TPS61033DRL	Texas Instruments
U6, U8	2		High-Speed Differential I/O Amplifier, RUN0010A (WQFN-10)	RUN0010A	THS4541IRUNR	Texas Instruments
U7	1		Dual, Simultaneous Sampling, 18-bit, 20-MSPS SAR ADC with Fully Differential ADC Input Driver	VQFN40	ADS9219RHAT	Texas Instruments
U9	1		Precision, 20MHz, 0.9pA Ib, RRIO, CMOS Operational Amplifier, 1.8V to 5.5V, -40°C to 125°C, 5-pin SOT23 (DBV5), Green (RoHS & no Sb/Br)	DBV0005A	OPA320AIDBVT	Texas Instruments
U10	1		I2C BUS EEPROM (2-Wire), TSSOP-B8	TSSOP-8	BR24G32FVT-3AGE2	Rohm

5 Additional Information

5.1 Trademarks

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6 Related Documentation

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

Table 6-1. Related Documentation

Device	Literature Number
TSWDC155EVM	SLAU870
TPS61033	SLVSGI6
TPS7A20	SBVS338
LM66100	SLVSEZ8
REF7040	SNAS781

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 - 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 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.

WARNING

Evaluation Kits 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 shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGRADATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

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/lstds/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。

<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html>

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.

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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page

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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.
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