ANALOG DEVICES

EV-ADA4571RSDZ User Guide
UG-1169

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Evaluating the ADA4571 Integrated AMR Angle Sensor and Signal Conditioner

FEATURES

USB 2.0 interface
Jumper or computer controlled temperature compensation mode enable
Jumper or computer controlled power-down mode enable
Measurement test points and coaxial connectors

EVALUATION KIT CONTENTS

ADA4571 magnetic stimulus
  Dipole magnet
  Hand movable mounting
Readback electronics

ADDITIONAL HARDWARE REQUIRED

6 V to 12 V bench supply (optional)
SDP-S controller board
  USB cable (supplied with the SDP-S controller board)

ADDITIONAL SOFTWARE REQUIRED

LabVIEW 2015 software downloadable from the EV-ADA4571RSDZ product page

GENERAL DESCRIPTION

The EV-ADA4571RSDZ evaluation board features the ADA4571 in an end of shaft magnet configuration, as shown in Figure 1. The evaluation kit is composed of an ADA4571 motherboard, a magnetic stimulus on a hand turnable mount, a USB interface, and an SDP-S controller board. The required LabVIEW 2015 graphical user interface (GUI) software for Windows® is available for download from the EV-ADA4571RSDZ product page.

The EV-ADA4571RSDZ evaluation board features an on-board 5 V regulator; a 4-channel simultaneous sampling, analog-to-digital converter (ADC); and jumpers for enabling the temperature compensation and power-down modes within the ADA4571. The ADA4571 motherboard also features test points and unpopulated coaxial connectors for the three outputs of the device.

The SDP-S controller board controls the ADC on the ADA4571 motherboard, reading back the ADA4571 outputs to change the digital inputs to the ADA4571, interface with the GUI, and supply power to the evaluation board through the USB connection.

For full details, see the ADA4571 data sheet, which must be used in conjunction with this user guide when using the evaluation board.

ADA4571 END OF SHAFT MAGNETIC EVALUATION SYSTEM

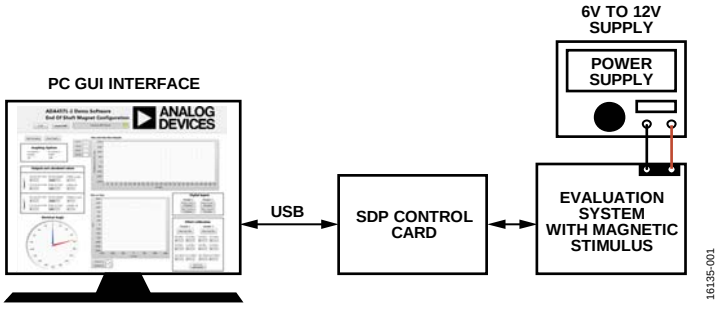

Figure 1.

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REVISION HISTORY

8/2017—Revision 0: Initial Version

EVALUATION BOARD QUICK START PROCEDURES

SOFTWARE INSTALLATION PROCEDURES

Install the SDP-S controller board drivers and LabVIEW 2015 runtime engine before using the LabVIEW 2015 GUI.

LabVIEW 2015 Runtime Engine

To install the LabVIEW 2015 runtime engine, follow the instructions on the National Instruments website.

SDP Installation

To install the SDP drivers, download the **SDPDrivers.exe** file from the SDP-S product page and complete the following steps:

1. To initialize the installation, run the **SDPDrivers.exe** executable file.
2. When the SDP drivers setup wizard appears, click **Next** (see Figure 2).

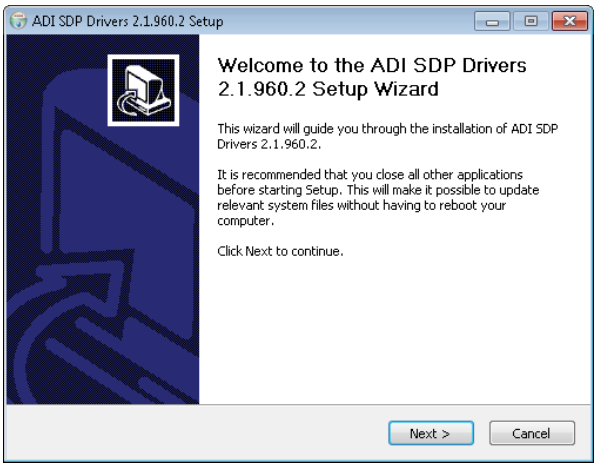

Figure 2. SDP Driver Installation Wizard

3. When the **Choose Install Location** window appears (see Figure 3), click **Install**. To select a different destination folder, click **Browse,** select a destination, then click **Install**.

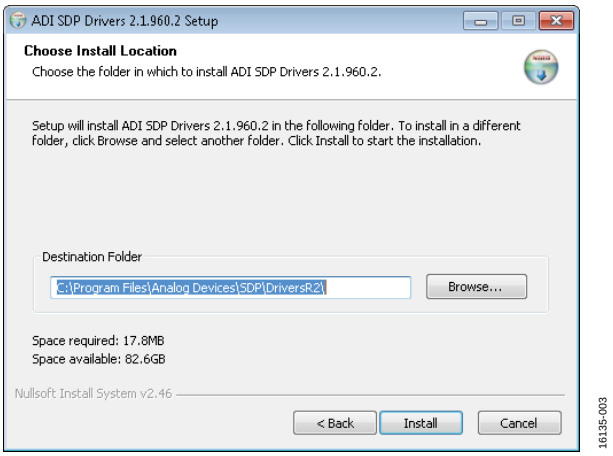

*Figure 3. **Choose Install Location** Window*

4. Click **Finish** to complete the installation of the SDP drivers.
5. Before running the LabVIEW GUI, Connect the SDP-S controller board to the motherboard and plug the SDP-S controller board into the PC with the supplied USB cable. The computer now recognizes the SDP-S controller board, and the LabVIEW 2015 GUI can be opened.

Running the LabVIEW GUI

To run the GUI, download the LabVIEW GUI software from the ADA4751 product page and complete the following steps:

1. Place the downloaded executable file and supporting files in a convenient location for use (see Figure 4). It is recommended to place these files on the root C drive of the PC. Do not separate the executable file from the other files that are downloaded or the executable file cannot run.

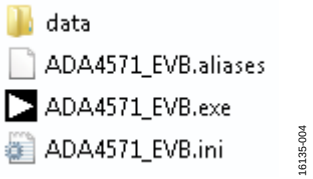

Figure 4. Place Downloaded Files on the PC

2. Double click the **ADA4571_EVB.exe** file to launch the LabVIEW GUI.

EVALUATION BOARD HARDWARE

The EV-ADA4571RSDZ end of shaft evaluation system comprises of a printed circuit board (PCB) with the AD7866 ADC and an external mountable magnetic stimulus.

The ADA4571 evaluation system can be powered directly from the host PC USB, from an external bench supply, or through the on-board 5 V regulator (ADP3336).

To power the motherboard through an on-board 5 V reference, apply 6 V to 12 V across the P7 to P8 connectors and configure the jumpers accordingly. If the bench supply features current limiting, it is recommended to set the current limit to 100 mA as a precaution.

JUMPER CONFIGURATION

Refer to the ADA4571 motherboard schematic (see Figure 13) to understand the purpose of each jumper.

Configure the P10 motherboard default jumper as follows:

- Install a jumper on P10 between the USB_VBUS supply and the +5V_ANALOG supply to power the evaluation board through the USB connection at the PC.
- Alternatively, install a jumper on P10 between +5V_REG supply and the +5V_ANALOG supply to power the evaluation board through the external bench supply

DEVICE UNDER TEST (DUT) OUTPUTS

The outputs of the ADA4571 can be monitored at the test points located on the evaluation board.

All outputs from the ADA4571 are also sampled by the on-board ADC and are available in the LabVIEW GUI.

EVALUATION BOARD SOFTWARE

STARTING THE EVALUATION GUI

To power the evaluation board using the ADP3336 on-board 5 V supply, install a jumper on P10, connecting the +5V_REG supply and the +5V_ANALOG supply. Using an external power supply, plug the positive supply for the evaluation board into the red terminal, P7, and plug the negative terminal into P8 on the ADA4571 motherboard. The evaluation board requires between 6 V and 12 V, which is then regulated to 5 V on the ADA4571 motherboard using the on-board ADP3336. This supply powers both the on-board ADC (AD7866) as well as the ADA4571.

To use the EV-ADA4571RSDZ evaluation board with full USB power, install a jumper on P10, connecting the USB_VBUS supply and the +5V_ANALOG supply. The 5 V USB power supplies the ADA4571.

OVERVIEW OF THE MAIN ADA4571 GUI WINDOW

Figure 5 shows the main ADA4571 GUI window after launching it.

When launching the GUI, the SDP-S controller board must be recognized by the GUI before proceeding. Click the **Connect SDP** button to read the EEPROM identification of the motherboard and ensure that the correct program is in use. If the SDP-S controller board is not connected, or if the drivers are not installed correctly, an error message appears. Ensure that the drivers are installed correctly, and that the PC recognizes the SDP-S controller board, if this occurs.

When the SDP-S controller board is properly connected, and the program recognizes the motherboard, the status bar reads **SDP Board Ready** and the yellow LED turns green (see Figure 5).

Initially, all figures are blank. Click **Start Sampling** to begin sampling the ADA4571.

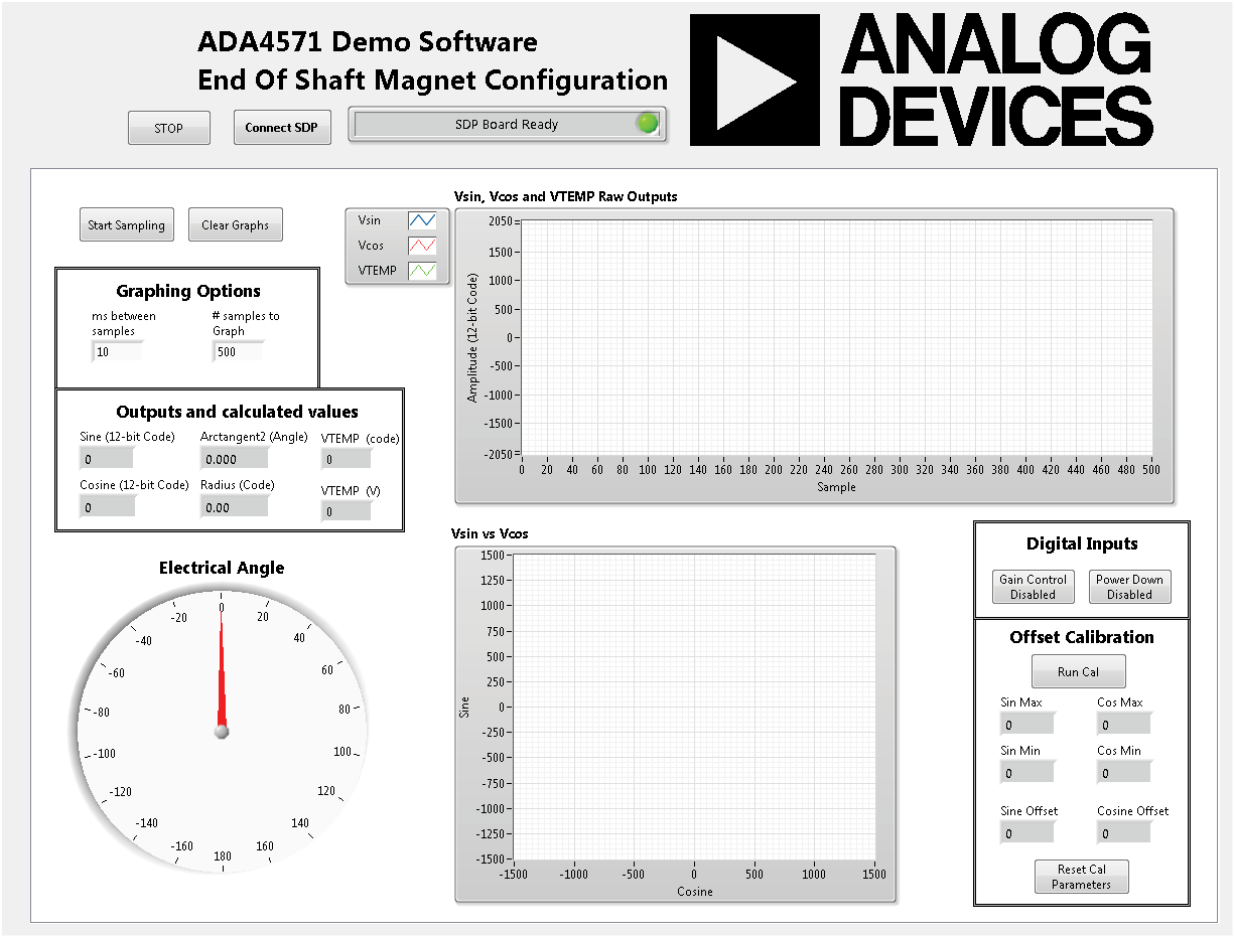

Figure 5. ADA4571 Evaluation Board Software Main Window

V_{SIN}, V_{COS}, and VTEMP Raw Outputs

The **Vsin, Vcos and VTEMP Raw Outputs** graph shows the three outputs from the ADA4571 magnetic angle sensor (see Figure 6).

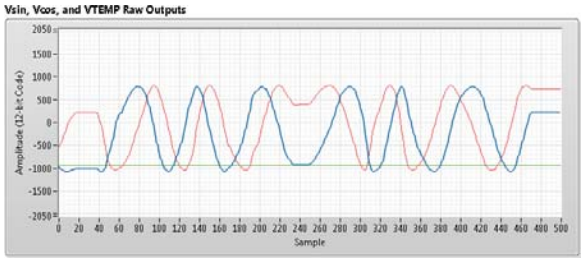

*Figure 6. **Vsin, Vcos, and VTEMP Raw Outputs** Graph*

In Figure 6, the blue and red waveforms indicate the V_{SIN} channel and V_{COS} channel outputs, respectively, and the green waveform indicates the VTEMP channel output. As the magnet rotates above the ADA4571, the V_{SIN} and V_{COS} outputs change while staying 90° out of phase. These two channels ,V_{COS} and V_{SIN}, report similar results that differ by the relative rotation of the sensor die and the voltage offset differences for the sine and cosine channels.

Figure 6 shows the output waveforms sampled by the AD7866 ADC. The waveforms are plotted in 12-bit code. The AD7866 simultaneously samples V_{SIN} and V_{COS}. An internal reference of 2.5 V is subtracted in the hardware because the readout of the ADC is in twos complement. Therefore, the two signals center around 0 in the raw waveform plot. In a real application, it is important that these two channels are simultaneously sampled because extra errors can be introduced from the phase delay between the sampling of the individual channels. For every 50 samples of the V_{SIN} and V_{COS}, the AD7866 samples the VTEMP channel.

When powering the EV-ADA4571RSDZ evaluation board through the USB connector attached to the SDP-S controller board, some variation appears in the supply voltage of the ADA4571. Because the readout of the AD7866 is in twos complement format, with respect to the internal 2.5 V reference, the offset of these waveforms is higher than the inherent offset of the ADA4571. After offset correction of the sine and cosine signals, which is recommended for the end use of the sensor, the offsets due to the ADC reference, as well as the sensor offset, are removed.

Graphing Options

When the EV-ADA4571RSDZ evaluation board is operating, it constantly samples the V_{SIN} channel and V_{COS} channel, and it samples the VTEMP channel after every 50 samples of the V_{SIN} and the V_{COS} channels.

To choose the interval between samples, enter different values in the **ms between samples** text box (see Figure 7). The default interval is 10 ms. This delay is set after information is transferred from the AD7866.

The **# samples to Graph** field sets the number of samples to save and display in the graphs. The default number of samples saved and displayed is 200 samples.

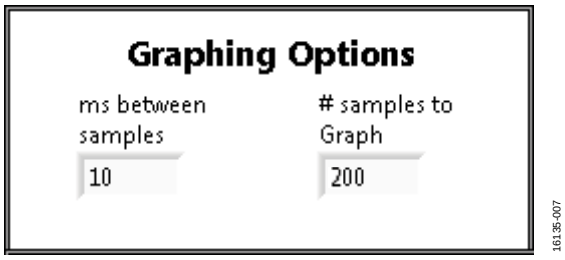

*Figure 7. **Graphing Options** Pane*

Outputs and Calculated Values

The values shown in the **Output and calculated values** pane show the ADA4571 output information in number format (see Figure 8). Again, the V_{SIN}, V_{COS}, and VTEMP outputs are in 12-bit, twos complement format with respect to the 2.5 V internal reference of the AD7866 ADC.

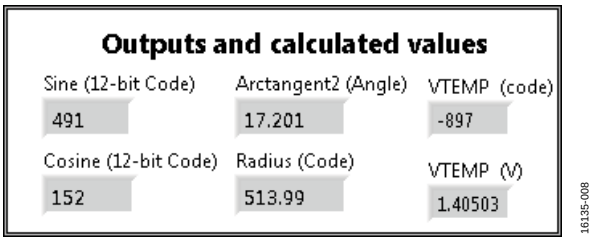

*Figure 8. **Outputs and calculated values** Pane*

A calculated angle value is also shown in Figure 8, given by the **Arctangent2 (Angle)** function field, and a calculated radius, given by the square root of the sum of squares for V_{SIN} channel and V_{COS} channel in the **Radius (Code)** field.

Electrical Angle

The electrical angle plot gives the calculated **Arctangent2 (Angle)** value in a visual format, as shown in Figure 9. As the magnetic field angle changes at the anisotropic magneto resistive (AMR) sensors, the electrical angle changes.

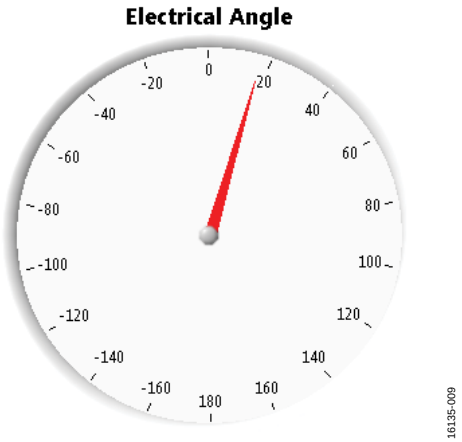

*Figure 9. **Electrical Angle** Plot*

Vsin vs. Vcos Plot

The **Vsin vs Vcos** graph shows the electrical angle from the ADA4571. However, there is more information shown in Figure 10, such as the radius of the output values that can give further diagnostic information to system. As long as the sensor is fully saturated, or the applied magnetic field strength exceeds 25 kA/m, the radius value remains unchanged at a constant temperature. As the AMR effect is smaller at high temperatures, the radius value changes with respect to temperature. See the ADA4571 data sheet for the temperature coefficient values for the output amplitude for the V_{SIN} and the V_{COS} channels.

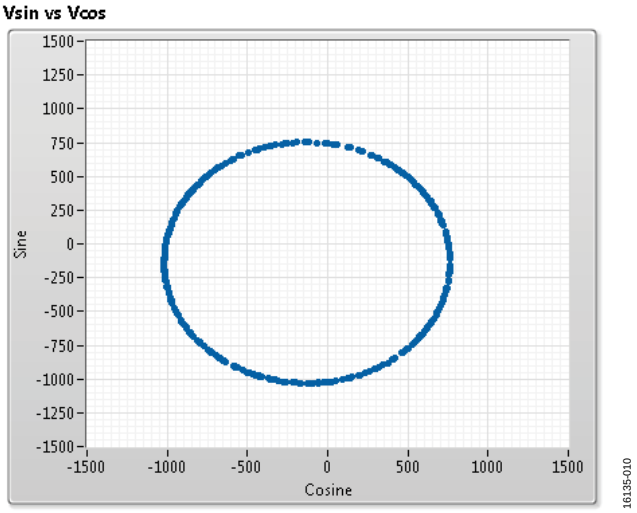

Figure 10. ***Vsin vs Vcos*** *Graph*

Digital Inputs

To toggle two digital inputs on the ADA4571, click the buttons in the **Digital Inputs** pane (see Figure 11).

The **Power Down Disabled** button puts the ADA4571 in a low power state by disabling the internal circuitry and placing the outputs in a high impedance state. See the ADA4571 data sheet for full details on the power-down current of the device.

The **Gain Control Disabled** button puts the device in gain control mode (see Figure 11). This mode alters the bridge supply voltage based on the internal temperature value of the ADA4571.

Through gain control mode, the output amplitude temperature coefficient of the ADA4571 reduces. See the ADA4571 data sheet for full details on output amplitude vs. temperature with the gain control mode enabled and disabled.

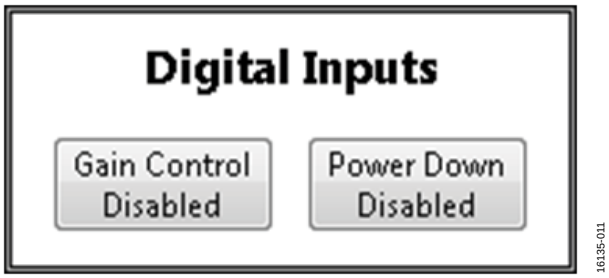

Figure 11. ***Digital Inputs*** *Pane*

Offset Calibration

An offset calibration is required to maximize the accuracy of the ADA4571. The V_{SIN} and V_{COS} channels have inherent voltage offsets due to a resistor mismatch within the AMR sensor bridges. See the ADA4571 data sheet for full details on the offset voltage ranges for the outputs.

There are a few methods that can null the offsets for the outputs. The ADA4571 GUI uses a maximum/minimum value to calculate these offsets. To run an offset calibration, click **Run Cal** (see Figure 12). When **Run Cal** is clicked, rotate the magnetic stimulus slowly through an entire mechanical rotation. This slow rotation ensures that the maximum and minimum output voltages are found for each channel.

The offset of each channel is calculated as the midpoint between the maximum and mid values captured during the calibration cycle. During normal operation, the offset value for each channel is subtracted from the current value before calculating the magnetic angle.

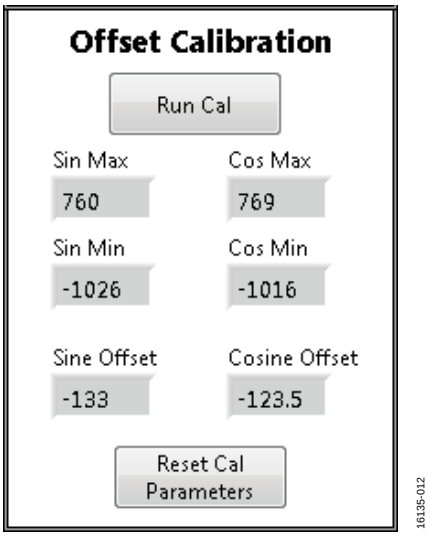

Figure 12. ***Offset Calibration*** *Pane*

MOTHERBOARD SCHEMATIC

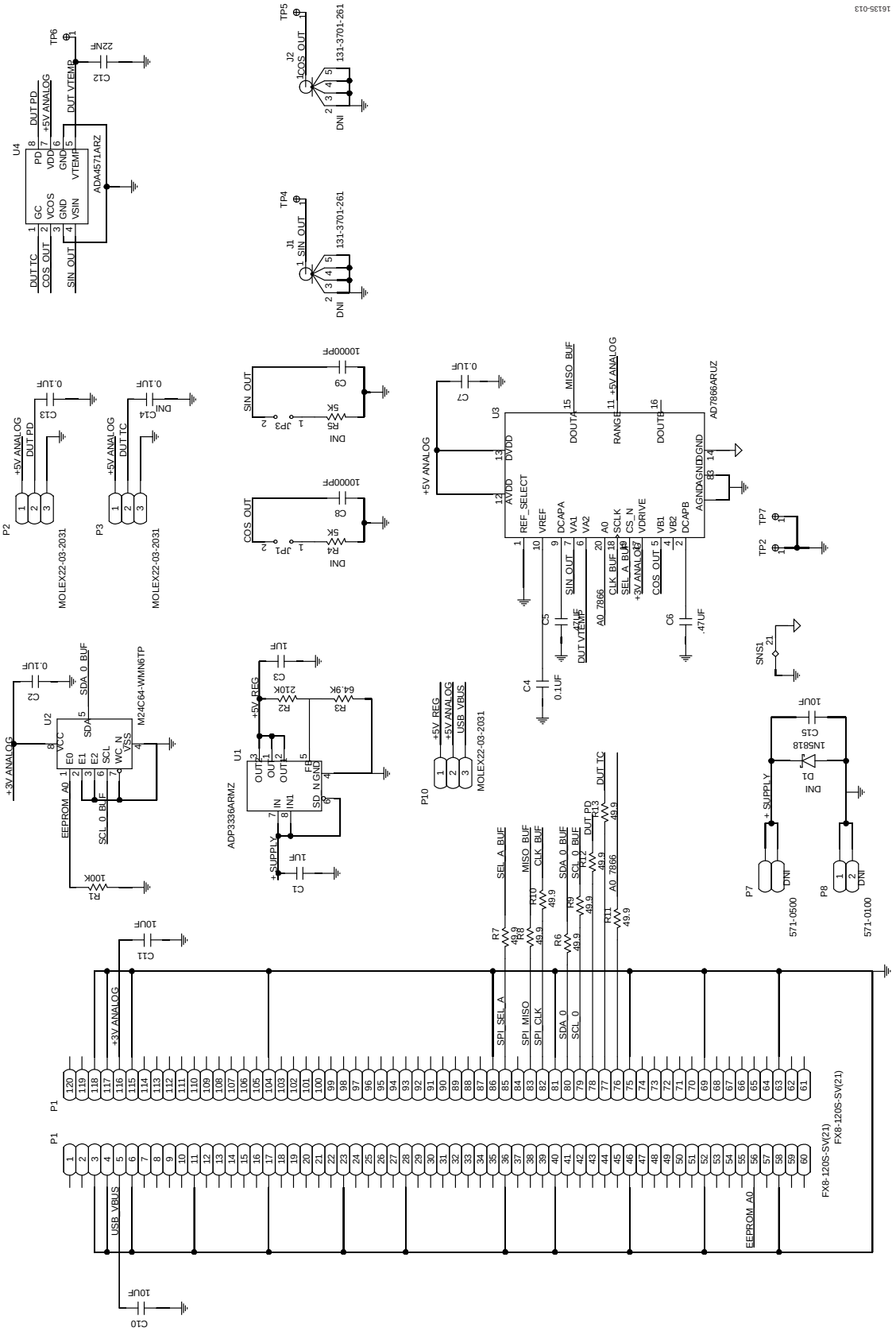

Figure 13. ADA4571 Evaluation Motherboard Schematic

NOTES

ESD Caution
ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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