

## Evaluation Board for the [ADA4571-2](#) 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

- [ADA4571-2](#) magnetic stimulus
  - Dipole magnet
  - Hand movable mounting
- Read back electronics

### ADDITIONAL EQUIPMENT NEEDED

- 6 V to 12 V bench supply (optional)
- [SDP-S](#) controller board
- USB cable (supplied with the [SDP-S](#) controller board)
- LabVIEW 2013 software downloadable from [ADA4571-2](#) product page

### GENERAL DESCRIPTION

The [EVAL-ADA4571-2](#) shows the [ADA4571-2](#) in an end of shaft magnet configuration. The evaluation kit is composed of an [ADA4571-2](#) motherboard, a magnetic stimulus on a hand turnable mount, a USB interface, and an [SDP-S](#) controller board. The required LabVIEW 2013 graphical user interface (GUI) software for Windows® is available on the [ADA4571-2](#) product page.

The [EVAL-ADA4571-2](#) features an on-board 5 V regulator, a 6-channel simultaneous sampling analog-to-digital converter (ADC), and jumpers for enabling the temperature compensation and power-down modes within the [ADA4571-2](#). The motherboard also features test points and unpopulated coaxial connectors for the six outputs of the device.

The [SDP-S](#) controller board controls the ADC on the motherboard reading back the [ADA4571-2](#) outputs, to change the digital inputs to the [ADA4571-2](#), interface with the GUI, and to supply power to the evaluation board through the USB connection.

### [ADA4571-2](#) END OF SHAFT EVALUATION SYSTEM

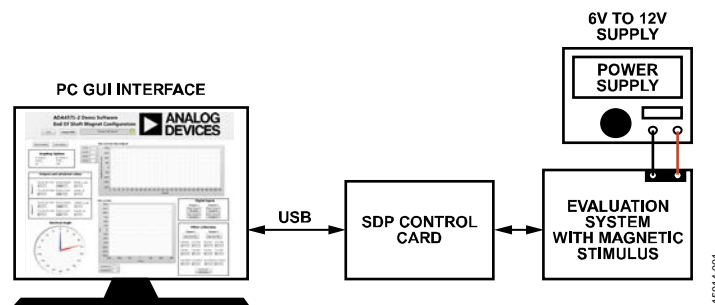


Figure 1.

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**REVISION HISTORY**

**12/2016—Revision 0: Initial Version**

# GETTING STARTED

## SOFTWARE INSTALLATION PROCEDURES

Before using the LabVIEW 2013 GUI, install the **SDP-S** controller board drivers and LabVIEW 2013 runtime engine.

### LabVIEW 2013 Runtime Engine

To install the LabVIEW 2013 runtime engine, follow the instructions on the National Instruments website.

### SDP Installation

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

1. Initialize installation by running **SDPDrivers.exe**.
2. When the SDP drivers setup wizard appears, click **Next** (see Figure 2).

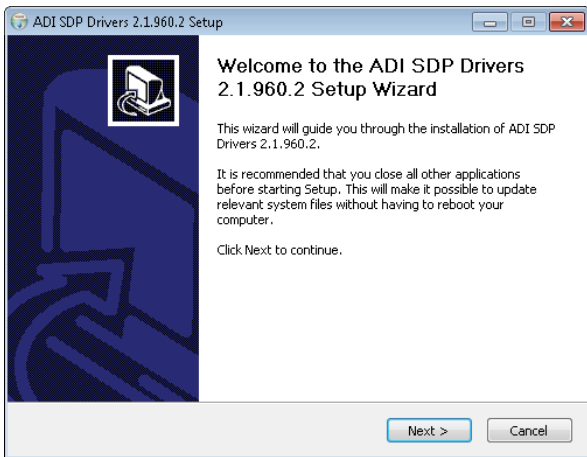


Figure 2. SDP Driver Installation

3. When the **Choose Install Location** window appears (see Figure 3), click **Install**. Clicking **Browse** allows the user to select a different destination folder, followed by clicking **Install**.

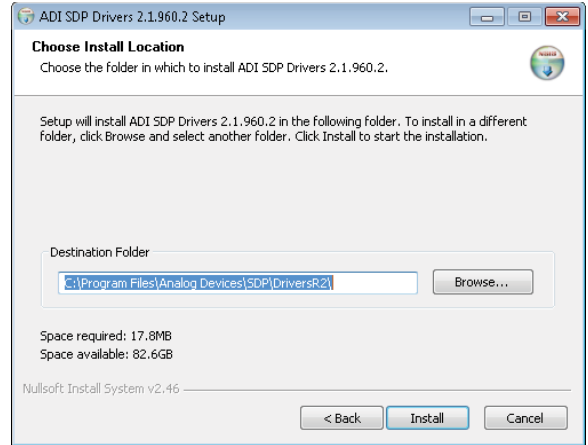


Figure 3. Choose Install Location

4. Click **Finish** to complete the installation of the SDP drivers.
5. 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 GUI can be opened to continue.

### Running the GUI

To run the GUI, first download the LabVIEW GUI software from the **ADA4571-2** 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 does not run

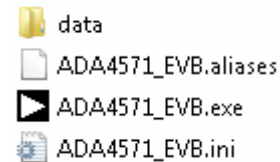


Figure 4. Placing Downloaded Files onto the PC

2. Double-click the executable to launch the evaluation program.

## EVALUATION BOARD HARDWARE

The [EVAL-ADA4571-2](#) end of shaft evaluation system comprises of a PCB with the [AD7266](#) ADC and an external mountable magnetic stimulus.

The [ADA4571-2](#) evaluation system can be powered directly from the host PC USB, directly from an external bench supply, or through the on-board 5 V regulator, the [ADP3336](#).

To power the motherboard through an on-board 5 V reference, apply 6 V to 12 V across P3 to P5 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 [ADA4571-2](#) 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 VBUS and BRD\_SUPPLY to power the evaluation board through the USB connection at the PC.
- Alternatively, install a jumper on P10 between BRD\_SUPPLY and \_SUPPLY to power the evaluation board through the external bench supply

## DEVICE UNDER TEST (DUT) OUTPUTS

The outputs of the [ADA4571-2](#) can be monitored at the test points located on the Evaluation board.

All outputs from the [ADA4571-2](#) are also sampled by the on-board ADC and are available in the GUI.

# EVALUATION BOARD SOFTWARE

## STARTING UP THE EVALUATION GUI

To power the evaluation board using the [ADP3336](#) on-board 5 V supply install a jumper on P10 connecting SUPPLY and BRD\_SUPPLY. Using an external power supply, plug the positive supply for the evaluation board into the red terminal, P3, and the negative terminal into P5 on the motherboard. The evaluation board requires between 6 V to 12 V, which is then regulated to 5 V on the motherboard using the on-board [ADP3336](#). This supply powers both the on-board ADC, [AD7266](#), as well as the [ADA4571-2](#).

To use the [EVAL-ADA4571-2](#) evaluation board with full USB power, install a jumper on P10, connecting VBUS and BRD\_SUPPLY. The 5 V USB power supplies the ADC reference pin on the [AD7266](#) as well as the [ADA4571-2](#).

## OVERVIEW OF THE MAIN GUI WINDOW

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

When first launching the program, the [SDP-S](#) controller board must be recognized by the GUI before proceeding. Clicking the **Connect SDP** button reads the EEPROM identification of the motherboard to ensure the correct program is being used. If the [SDP-S](#) controller board is not connected or if the drivers are not installed correctly, an error message appears. Ensure the drivers are installed correctly and the PC recognizes the [SDP-S](#) controller board if this occurs.

After 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.

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

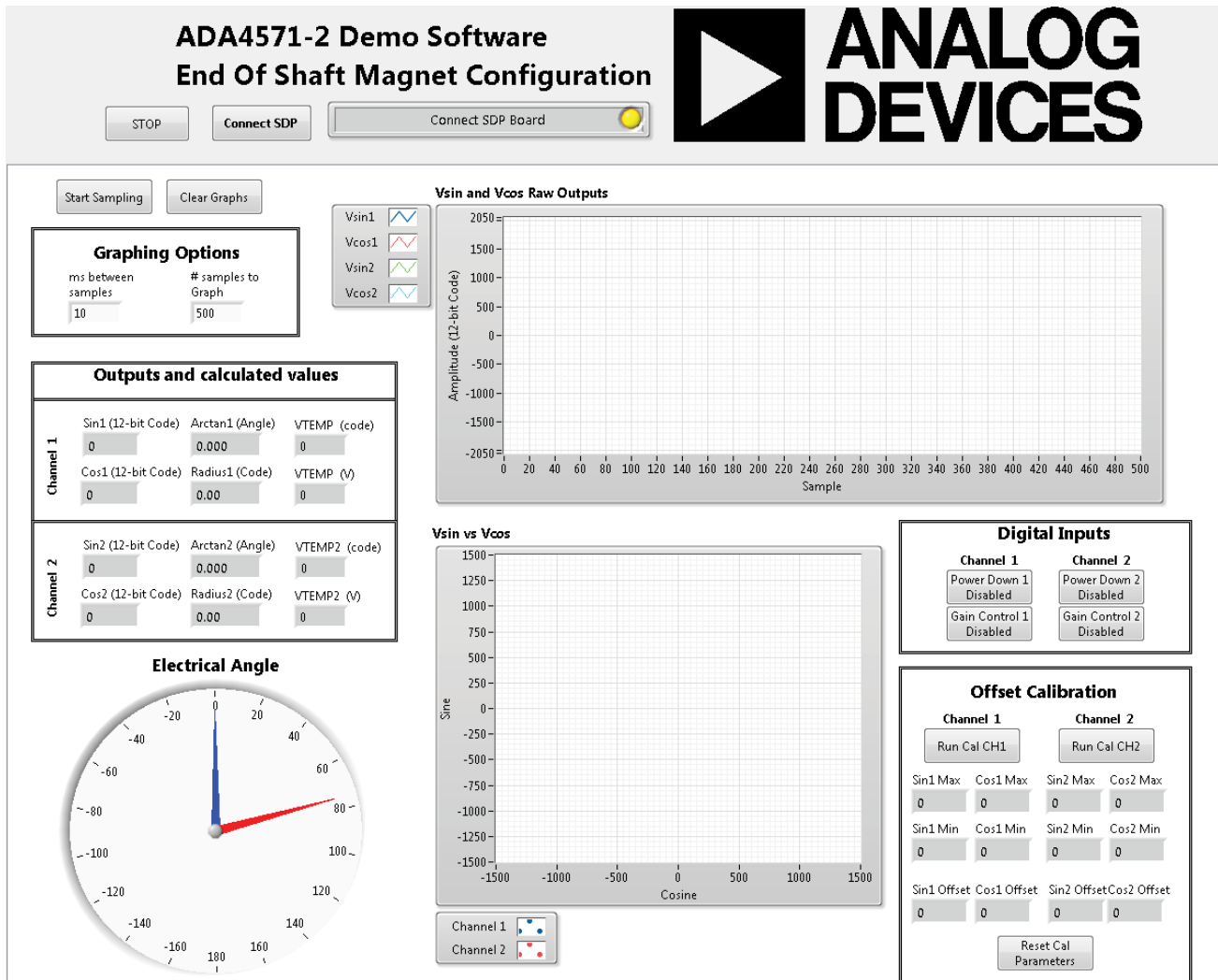


Figure 5. ADA4571-2 Evaluation Board Software Main Window

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**Vsin, Vcos, and VTEMP Raw Outputs**

The **Vsin, Vcos and VTEMP Raw Outputs** graph shows all six outputs from the [ADA4571-2](#) dual-channel magnetic angle sensor (see Figure 6).

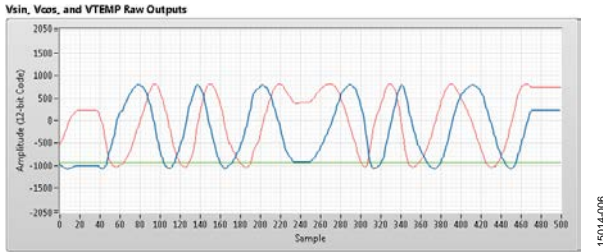


Figure 6. **Vsin, Vcos, and VTEMP Raw Outputs** Graph

The blue and red waveforms indicate the  $V_{SINx}$  and  $V_{COSx}$  outputs, respectively, and the green waveform indicates the VTEMP output. As the magnet is rotated above the [ADA4571-2](#) the  $V_{SINx}$  and  $V_{COSx}$  outputs change while staying 90° out-of-phase. The two channels report similar results that differ by the relative rotation of the sensor die and the voltage offset differences for the sine and cosine channels.

This plot shows the output waveforms sampled by the [AD7266](#) ADC. The waveforms are plotted in 12-bit code. The [AD7266](#) simultaneously samples  $V_{SIN1}$  and  $V_{COS1}$  then switches inputs to sample  $V_{SIN2}$  and  $V_{COS2}$ . An internal reference of 2.5 V is subtracted in the hardware as 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 or extra errors introduced from the phase delay between the sampling of the individual channels. Every 50 samples of the  $V_{SIN1}$ ,  $V_{COS1}$ ,  $V_{SIN2}$ , and  $V_{COS2}$ , the [AD7266](#) samples VTEMP1 and VTEMP2.

When powering the board through the USB connector attached to the [SDP-S](#) controller board there is some variation in the supply voltage of the [ADA4571-2](#). Due to the readout of the [AD7266](#) in twos complement form, with respect to the internal 2.5 V reference, the offset of these waveforms are higher than the inherent offset of the [ADA4571-2](#). 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 running, the evaluation board constantly samples the  $V_{SIN1}$ ,  $V_{COS1}$ ,  $V_{SIN2}$ , and  $V_{COS2}$  before sampling the VTEMP1 and VTEMP2 channel every 50 iterations.

The interval between sampling is chosen by inputting different values into the **ms between samples** field (see Figure 7). The default is 10 ms. This is a delay set after information is transferred from the [AD7266](#).

The **# samples to graph** field sets the number of samples to save and show in the graphs. The default is 200 samples.

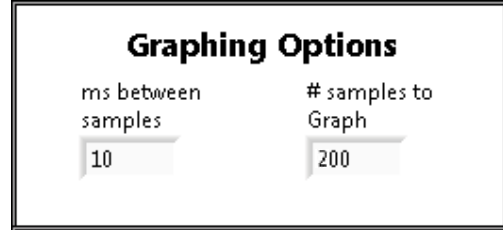


Figure 7. **Graphing Options** Pane

**Outputs and Calculated Values**

Output and calculated values give the sensor information in number format (see Figure 8). Again, the  $V_{SINx}$ ,  $V_{COSx}$ , and VTEMP outputs are in 12-bit twos complement form with respect to the 2.5 V internal reference of the [AD7266](#) ADC.

Outputs and calculated values			
Channel 1	Sin1 (12-bit Code)	Arctan1 (Angle)	VTEMP (code)
	600	-51.512	-813
Channel 2	Cos1 (12-bit Code)	Radius1 (Code)	VTEMP (V)
	-754	963.28	1.50757
Channel 1	Sin2 (12-bit Code)	Arctan2 (Angle)	VTEMP2 (code)
	557	-55.286	-815
Channel 2	Cos2 (12-bit Code)	Radius2 (Code)	VTEMP2 (V)
	-804	978.09	1.50513

Figure 8. **Outputs and calculated values** Pane for Channel 1 and Channel 2

A calculated angle value is also shown, given by the **Arctan1 (Angle)** and **Arctan2 (Angle)** function field, and a calculated radius, given by the square root of the sum of squares for each  $V_{SINx}$  and  $V_{COSx}$  channel in the **Radius1 (Code)** and **Radius2 (Code)** field.

**Electrical Angle**

The electrical angle plot gives the calculated **Arctan1 (Angle)** and **Arctan2 (Angle)** values in a visual format seen in Figure 9. As the magnetic field angle changes at the anisotropic magneto resistive (AMR) sensors, the electrical angle changes. Both channels give approximately the same information.

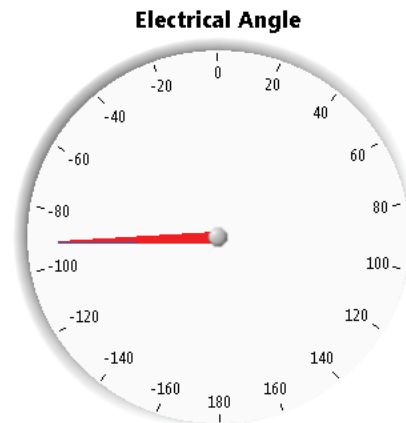


Figure 9. **Electrical Angle**

**Vsin vs Vcos**

The **Vsin vs Vcos** graph is another way to visualize the electrical angle from the [ADA4571-2](#). However, there is more information given in Figure 10, showing the radius of the output values which 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 [ADA4571-2](#) data sheet for the temperature coefficient values for the output amplitude for the  $V_{SINx}$  and  $V_{COSx}$  channels.

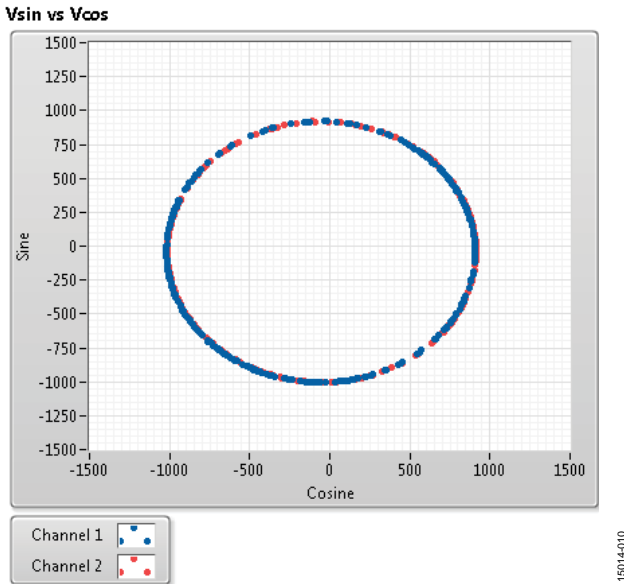


Figure 10. **Vsin vs Vcos** Graph

**Digital Inputs**

Four digital inputs on the [ADA4571-2](#) can be toggled using the **Digital Inputs** buttons.

The power-down button for each channel puts the devices into a low power state by disabling the internal circuitry for that channel and placing the outputs into a high impedance mode. See the [ADA4571-2](#) data sheet for the power-down current per channel in the device. The power-down function of each channel can be toggled separately.

The **Gain Control 1 Disabled** and **Gain Control 2 Disabled** buttons put the device into the gain control mode (see Figure 11). This mode alters bridge supply voltage based on the internal temperature value of the device.

Through this mode, the output amplitude temperature coefficient of the [ADA4571-2](#) reduces. See the [ADA4571-2](#) data sheet for output amplitude vs. temperature with the gain control enabled and disabled.

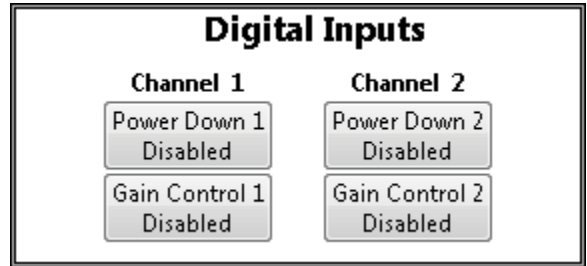


Figure 11. **Digital Inputs** Pane

**Offset Calibration**

An offset calibration is required to maximize the accuracy of the [ADA4571-2](#). The  $V_{SIN1}$ ,  $V_{COS1}$ ,  $V_{SIN2}$ , and  $V_{COS2}$  channels have inherent voltage offsets due to resistor mismatch within the AMR sensor bridges. See the [ADA4571-2](#) data sheet offset voltage ranges for the outputs.

There are a few methods that can null the offsets for the outputs. To run an offset calibration on Channel 1, click **Run Cal CH1** (see Figure 12). Once clicked, rotate the magnetic stimulus slowly through an entire mechanical rotation. This ensures the maximum and minimum output voltages are found for each channel.

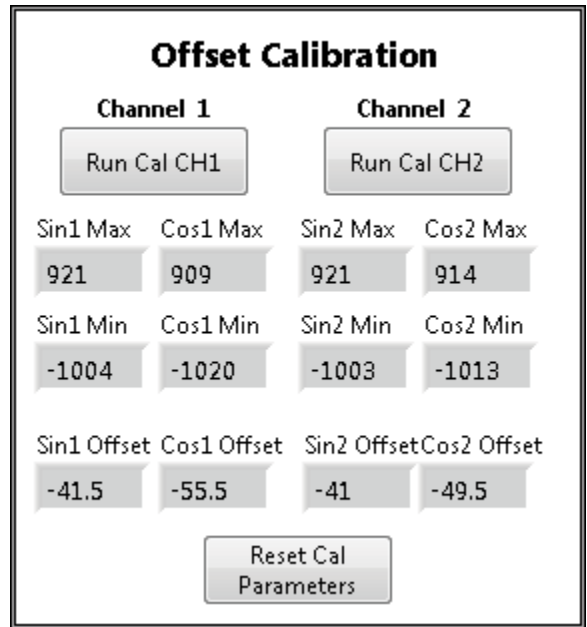


Figure 12. **Offset Calibration** Pane

EVALUATION BOARD SCHEMATIC AND ARTWORK

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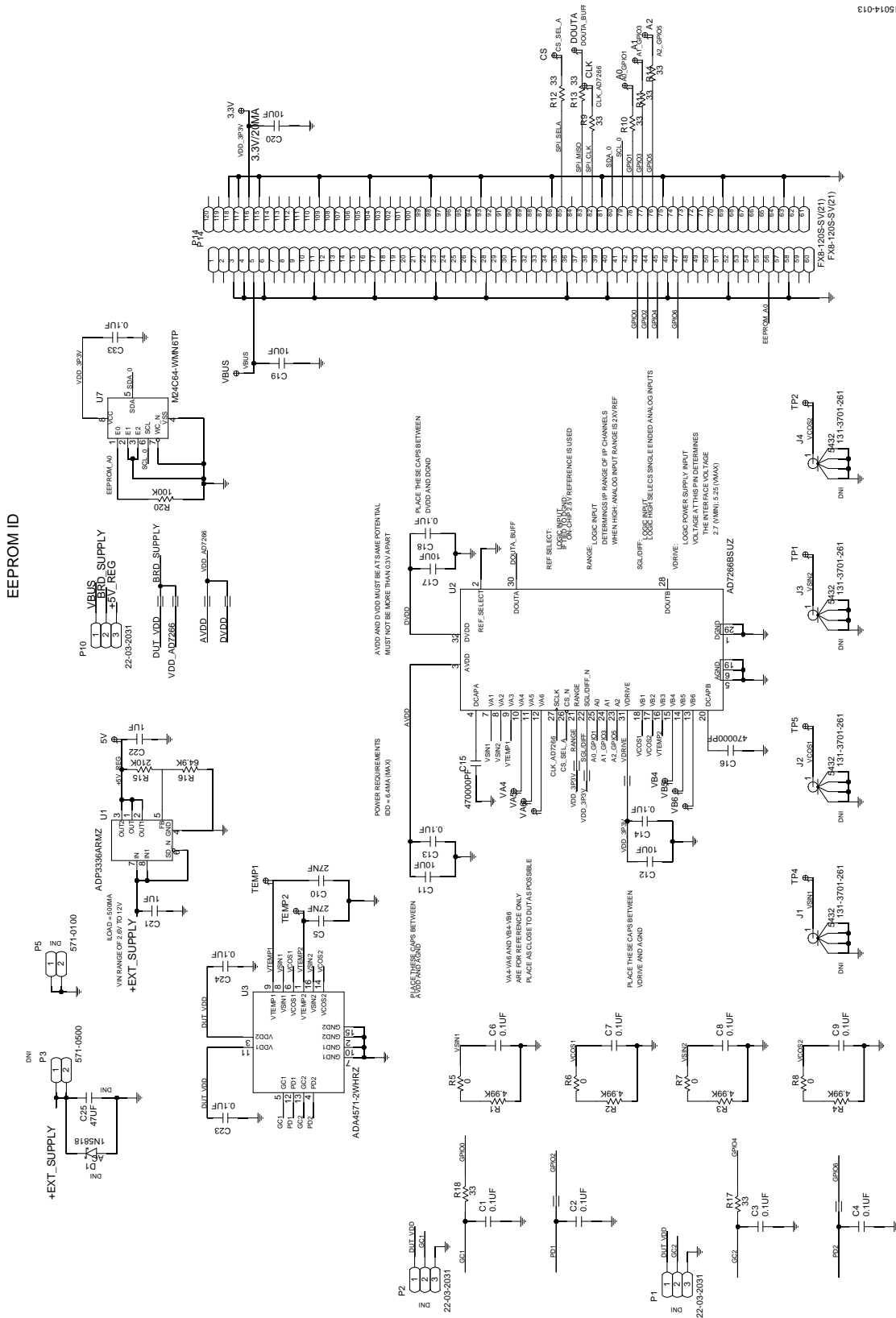


Figure 13. ADA4571-2 Evaluation Motherboard Schematic



# ORDERING INFORMATION

## RELATED LINKS

Resource	Description
<a href="#">ADA4571-2</a>	Integrated AMR Angle Sensor and Signal Conditioner
<a href="#">ADP3336</a>	High Accuracy Ultralow I <sub>o</sub> , 500 mA anyCAP® Adjustable Low Dropout Regulator
<a href="#">AD7266</a>	Differential/Single-Ended Input, Dual 2 MSPS, 12-Bit, 3-Channel SAR ADC



**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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