

Evaluating the ADMT4000 Zero Power Multiturn Sensor

FEATURES

- ▶ Full featured evaluation board for the [ADMT4000](#)
- ▶ Magnetic reset
- ▶ PC control with the [System Demonstration Platform, SDP \(EVAL-SDP-CS1Z\)](#)
- ▶ PC software for configuration and data measurement

EVALUATION KIT CONTENTS

- ▶ EVAL-ADMT4000SD1Z evaluation board
- ▶ Magnet stimulus
- ▶ Dipole magnet
- ▶ Hand movable mounting

HARDWARE REQUIRED

- ▶ The [EVAL-SDP-CS1Z](#) or [EVAL-SDP-CB1Z](#) controller board
- ▶ USB cable supplied with the [EVAL-SDP-CS1Z](#)

SOFTWARE REQUIRED

- ▶ EVAL-ADMT4000SD1Z software

GENERAL DESCRIPTION

The ADMT4000 is a magnetic turn, counter sensor capable of recording turns of an external magnetic field with zero power. The absolute position, including the number of turns, is reported via a serial peripheral interface (SPI). The EVAL-ADMT4000SD1Z evaluation board allows for the evaluation of the ADMT4000 zero power, multiturn sensor by providing a flexible hardware platform with accompanying graphical user interface (GUI). The

EVAL-ADMT4000SD1Z features the ADMT4000 in an end of shaft magnet configuration, [Figure 1](#). The evaluation kit is composed of an EVAL-ADMT4000SD1Z and a magnetic stimulus on a printed circuit board (PCB) mount. To operate with the provided GUI, the EVAL-SDP-CS1Z (SDP-S) or EVAL-SDP-CB1Z (SDP-B) is required, interchangeably referred to as the SDP controller board within this user guide.

The EVAL-ADMT4000SD1Z allows a detailed evaluation of the ADMT4000. The GUI demonstrates turn count, angular measurement, diagnostic measurements, system-level calibration, and device configuration. The EVAL-ADMT4000SD1Z is fitted with a coil to enable magnetic reset of the turn-count sensor. Time stamped captured data can be logged to a technical data management streaming (TDMS) file. The TDMS file format allows large data sets to be stored and indexed. Data logs contain the device settings in addition to time stamped data and fault status. The calibration function allows the user to store the detailed results of the calibration using data captured using the GUI or data captured using the measurement system of the user.

The EVAL-ADMT4000SD1Z also provides 2.54 mm headers for power and digital signals that allow the user to evaluate the EVAL-ADMT4000SD1Z with an external microcontroller platform and start the system software development. The PCB is designed so that the sensor board can be broken off of the SDP interface section to provide a smaller form factor. Power supplies can be sourced from either the USB port via the SDP controller board, or an external bench supply.

For full details of the EVAL-ADMT4000SD1Z, see the ADMT4000 data sheet, which must be consulted in conjunction with this user guide, when using the EVAL-ADMT4000SD1Z evaluation board.

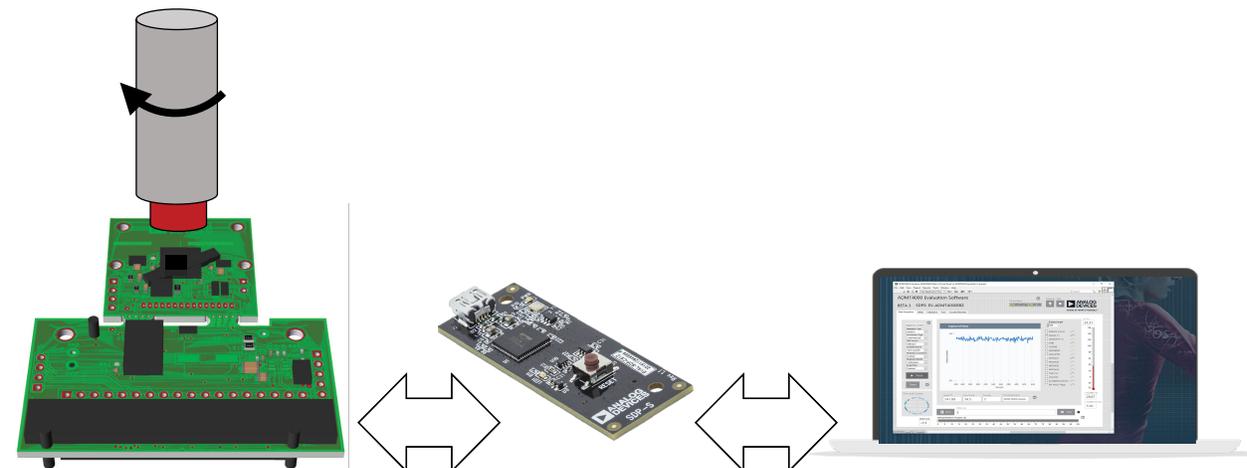


Figure 1. ADMT4000 End of Shaft Magnetic Evaluation System Comprises the EVAL-ADMT4000SD1Z, the SDP Interface, and the EVAL-ADMT4000SD1Z GUI

TABLE OF CONTENTS

Features.....	1	Software Installation.....	6
Evaluation Kit Contents.....	1	Installing the EVAL-ADMT4000SD1Z	
Hardware Required.....	1	Software.....	6
Software Required.....	1	Installing the System Demonstration	
General Description.....	1	Platform Board Drivers.....	6
Getting Started.....	3	EEPROM Configuration.....	8
Quick Start Steps.....	3	EVAL-ADMT4000SD1Z Software Operation.....	9
Evaluation Board.....	4	Starting the EVAL-ADMT4000SD1Z	
ADMT4000 Magnetic Sensing.....	4	Software.....	9
ADMT4000 Outputs.....	4	Overview of the ADMT4000 Evaluation GUI....	10
Power Supplies.....	4	Schematics and Board Dimensions.....	15
ADMT4000 Board Break Away Section.....	4	Ordering Information.....	18
Evaluation Kit Connectors.....	4	Bill of Materials.....	18

REVISION HISTORY**10/2024—Revision 0: Initial Version**

GETTING STARTED

QUICK START STEPS

The EVAL-ADMT4000SD1Z evaluation board, [Figure 2](#), connects to either the [EVAL-SDP-CS1Z \(SDP-S\)](#) or [EVAL-SDP-CB1Z \(SDP-B\)](#). In this user guide, SDP refers to either of these controller boards. The SDP is the communication link between the PC and the EVAL-ADMT4000SD1Z, and the SDP provides the SPI required to control the [ADMT4000](#) and send captured data directly to the host PC.

The EVAL-ADMT4000SD1Z evaluation software and drivers must be installed before connecting the evaluation board and SDP controller board to the USB port of the PC to ensure that the evaluation system is correctly recognized when it connects.

To begin using the EVAL-ADMT4000SD1Z, take the following steps:

1. Install the EVAL-ADMT4000SD1Z software. See the [Installing the EVAL-ADMT4000SD1Z Software](#) section for additional information.
2. Connect the SDP to the EVAL-ADMT4000SD1Z.
3. Slide the EVAL-ADMT4000SD1Z into the magnet mounting bracket. To correctly align the magnet with the ADMT4000 sensor, ensure that the EVAL-ADMT4000SD1Z is fully inserted into the magnet PCB mount.
4. Connect the SDP to the PC using the supplied USB cable (USB Type A to Mini-B).
5. Launch the EVAL-ADMT4000SD1Z software. Click the Windows[®] key to open the **Windows Start Menu** and **Programs** list. Navigate to **Analog Devices** and click **EVAL-ADMT4000SDZ**.



002

Figure 2. Hardware Configuration Showing the Demonstration Magnet Assembly and the EVAL-ADMT4000SD1Z

EVALUATION BOARD

The EVAL-ADMT4000SD1Z was designed to enable the user to get started quickly with the [ADMT4000](#) using the supplied evaluation software and SDP interface.

By making use of the headers on the EVAL-ADMT4000SD1Z, [Table 1](#), the user can connect an alternative microprocessor to develop custom software. The PCB section, where the ADMT4000 is mounted, was designed to allow the user to mount the board in a space limited environment by removing the break away section from the interface section. Headers are provided on the break away section to enable operation of the ADMT4000 with a microprocessor.

ADMT4000 MAGNETIC SENSING

The position of the ADMT4000 angle sensor with respect to the center of the IC package is detailed in the ADMT4000 data sheet. The magnet assembly correctly aligns the supplied magnet with the ADMT4000 sensor when the PCB is fully inserted into the magnet assembly. A diametrical oriented disk magnet (diameter 10 mm and height 5 mm) is supplied with the EVAL-ADMT4000SD1Z evaluation kit. The magnet is manufactured from samarium (Sm)₂-cobalt (Co)₁₇ with a remanence (Br) of 950 mT to 1020 mT.

ADMT4000 OUTPUTS

The ADMT4000 outputs angular position data, device status, and diagnostics over the SPI.

POWER SUPPLIES

The EVAL-ADMT4000SD1Z uses the 3.3 V supply from the SDP interface to power all the components on the board except for the [LT3461](#), which is powered from the 5 V USB. The LT3461 is a step up DC/DC converter used for the magnetic reset circuit.

It is possible to use external supplies by connecting through various headers, as shown in [Figure 24](#) and [Figure 25](#) and described in the [Table 1](#).

ADMT4000 BOARD BREAK AWAY SECTION

The EVAL-ADMT4000SD1Z includes a break away section. The SDP interface circuitry can be removed by snapping the narrow bridges of the evaluation board located in the middle of the EVAL-ADMT4000SD1Z. Removing the SDP interface circuitry allows the user to make use of a smaller standalone evaluation board. The ADMT4000 can be connected to an external system that supplies the power and controls the digital interfaces.

EVALUATION KIT CONNECTORS

The PCB headers for connecting external systems to the EVAL-ADMT4000SD1Z are listed in [Table 1](#).

Table 1. Summary of the EVAL-ADMT4000SD1Z Evaluation Kit Headers

Identifier	Description
P1	Socket for the SDP interface board
P2	Header for the RSTB, CNV, BUSY, and GPIO4 signals
P3	Header for the SPI signals
P4	Header that allows access to the I ² C, SPI, status, and control general-purpose input and output (GPIO) from the breakaway section
P5	Header for the magnetic reset coil
P6	Header for a differential coil to measure the current in magnetic reset coil
P7	Header for access to key signals on the breakaway section

[Table 2](#) through [Table 8](#) details the connections to the headers available on the EVAL-ADMT4000SD1Z.

Table 2. P1 Socket for the SDP Interface Controller Board

Pin Number	Mnemonic	Description
3, 4, 6, 11, 17, 23, 28, 36, 40, 46, 52, 58, 63, 69, 75, 81, 86, 93, 98, 104, 109, 115, 117, 118	GND	System ground
5	USB_V	5 V supply from the USB port of the connected PC
38	SPI_CSB	SPI chip select for the ADMT4000, SDP Chip Select Port C
43	GPIO3_ACALC	GPIO or angle calculation status
44	COIL_RS	Magnetic reset-coil reset enable
45	GPIO0_BUSY	GPIO or busy status output
46	V_EN	VDD enable for the ADMT4000
56	EEPROM_A0	Address A0 of the board identifier electrically erasable programmable read-only memory (EEPROM)
74	RSTB	ADMT4000 reset function
76	GPIO1_CNV	GPIO or convert start
77	BOOST_EN	Magnetic reset-coil boost circuit enable
78	GPIO4	GPIO or fault status
79	I2C_SCL_0	I ² C clock
80	I2C_SDA_0	I ² C data
82	SPI_SCLK	SPI clock
83	SPI_SDO	SPI subordinate data out
84	SPI_SDI	SPI subordinate data in
85	SPI_SEL_A_N	SPI chip select for the GPIO expander, SDP Chip Select A
116	3V3	Main supply for the ADMT4000 and supporting devices

EVALUATION BOARD

Table 3. P2 Header for the RSTB, CNV, BUSY, and GPIO4 Signal

Pin Number	Mnemonic	Description
1	RSTB	ADMT4000 reset function
2	GPIO1_CNV	GPIO1 and convert start
3	GPIO0_BUSY	GPIO0 and busy status output
4	GPIO4	GPIO4
5	GND	System ground

Table 4. P3 Header for SPI

Pin Number	Mnemonic	Description
1	I ² C SCLK	I ² C clock
2	SPI SDO	SPI data out
3	SPI SDI	SPI data in
4	SPI CSB	SPI chip select for the ADMT4000, SDP Chip Select Port C

Table 5. P4 External Interface Header

Pin Number	Mnemonic	Description
1	3V3	Main supply for the ADMT4000 and supporting devices
2	GND	System ground
3	5V	Supply for the magnetic reset coil
4	SPI SCLK	SPI clock
5	SPI SDO	SPI data out
6	SPI SDI	SPI data in
7	SPI CSB	SPI chip select
8	RSTB	ADMT4000 reset function
9	GPIO1_CNV	GPIO1 or convert start
10	GPIO0_BUSY	GPIO0 or busy status output
11	GPIO4	GPIO4
12	GPIO5_BOOTLOAD	GPIO5 or bootloader status
13	GPIO3_ACALC	GPIO3 or angle calculation status
14	I ² C SDA_0	I ² C data
15	I ² C SCL_0	I ² C clock
16	V_EN	VDD enable for the ADMT4000
17	BOOST_EN	Magnetic reset-coil boost circuit enable
18	COIL_RS	Magnetic reset-coil reset enable

Table 6. P5 Header for the Magnetic Reset Coil

Pin Number	Mnemonic	Description
1	COIL+	Positive terminal of the magnetic reset coil.
2	COIL-	Negative terminal of the magnetic reset coil.

Table 7. P6 Header for a Differential Coil to Measure the Current in Magnetic Reset Coil

Pin Number	Mnemonic	Description
1	COIL+	High-side sense resistor voltage
2	COIL++	Low-side sense resistor voltage

Table 8. P7 Header to Allow Access to the I²C, SPI, Status, and Control GPIO from the Breakaway Section

Pin Number	Mnemonic	Description
1	VDD	Direct power supply to the ADMT4000
2	5V	5 V supply for alternative VDRIVE level
3	GPIO2	GPIO
4	I ² C SCLK_I	SPI clock
5	SPI SDO_I	SPI data out
6	SPI SDI_I	SPI data in
7	SPI CSB_I	SPI chip select for the ADMT4000
8	RSTB_I	ADMT4000 reset function
9	CNV_I	Convert start
10	GPIO0_BUSY	GPIO or busy status output
11	GPIO4	GPIO
12	GPIO5_BOOTLOAD	GPIO or bootloader status
13	GPIO3_ACALC	GPIO or angle calculation status
14	GND	System ground
15	VDRIVE	ADMT4000 GPIO supply

SOFTWARE INSTALLATION

The [Installing the EVAL-ADMT4000SD1Z Software](#) and [Installing the System Demonstration Platform Board Drivers](#) sections outline the software installation process assuming that the SDP drivers have not been previously installed.

INSTALLING THE EVAL-ADMT4000SD1Z SOFTWARE

To install the EVAL-ADMT4000SD1Z software, take the following steps:

1. Run the **EVAL-ADMT4000SDZ.exe** file supplied on the [ADMT4000](#) product page to install the EVAL-ADMT4000SDZ software. If a dialog box appears to ask for permission to allow the program to make changes to the PC, click **Yes**.
2. Select the location to install the software to and then click **Next** (see [Figure 3](#)).

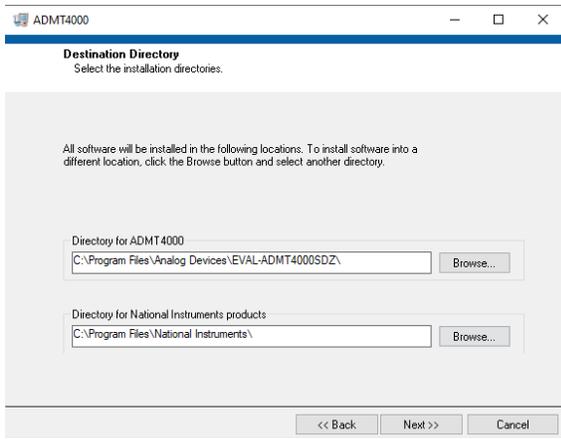


Figure 3. ADMT4000 Installation Path

3. A summary of the installation then displays. Click **Next** to continue (see [Figure 4](#)).

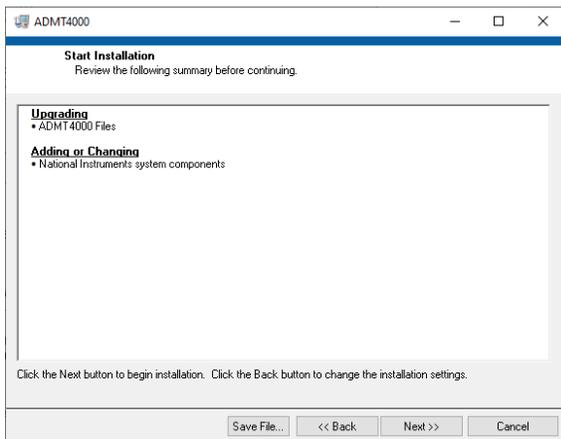


Figure 4. ADMT4000 Installation Summary

4. When the installation completes, click **Finish** (see [Figure 5](#)).

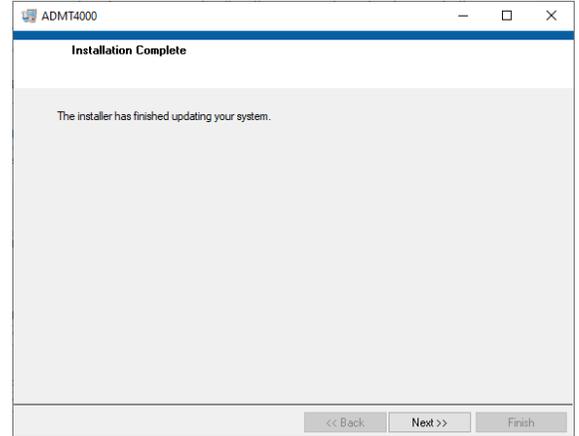


Figure 5. ADMT4000 Installation Complete

INSTALLING THE SYSTEM DEMONSTRATION PLATFORM BOARD DRIVERS

After the installation of the EVAL-ADMT4000SD1Z software is complete, a welcome window displays (see [Figure 6](#)) for the installation of the SDP drivers.

Take the following steps to install the SDP drivers:

1. With the SDP board disconnected from the USB port of the PC, make sure that all other applications are closed, and then click **Next**.



Figure 6. SDP Platform Installation

2. A license agreement then appears. Read the agreement, select **I accept the License Agreement**, and click **Next** and then **I Agree** (see [Figure 7](#)).

SOFTWARE INSTALLATION

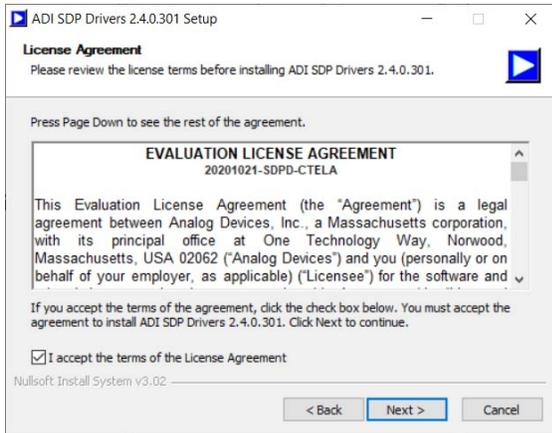


Figure 7. SDP Platform License

- 3. The **Choose Components** window then appears with default components preselected. Click **Next** (see Figure 8).

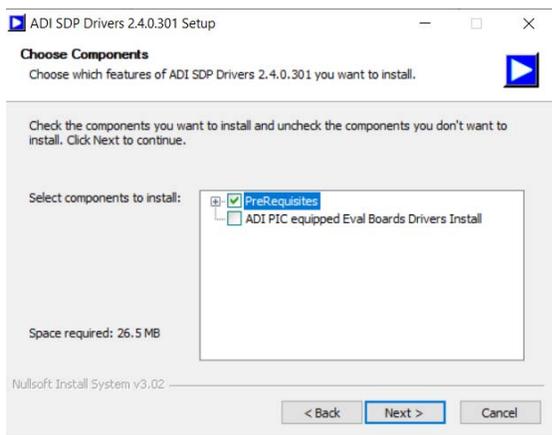


Figure 8. SDP Component Selection

- 4. Select the location to install the drivers, and then click **Install** (see Figure 9).

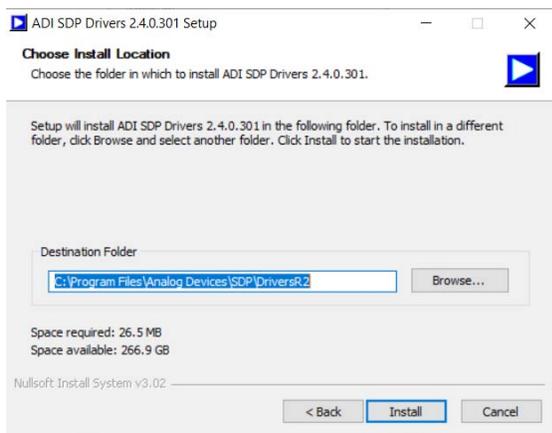


Figure 9. SDP Platform Installation Folder

- 5. To complete the installation of the driver, click **Close**, which closes the installation wizard (see Figure 10).

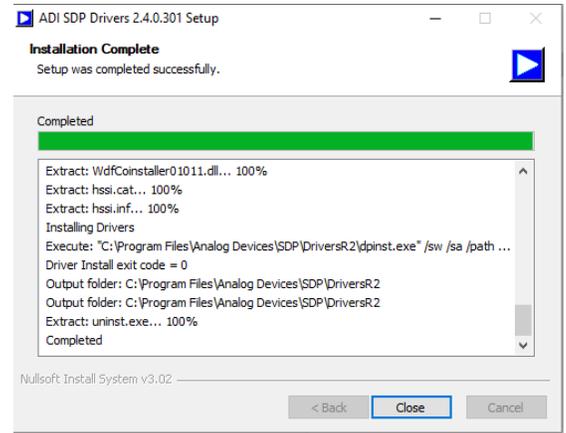


Figure 10. SDP Installation Complete

- 6. The driver installation then installs the Windows drivers. If **Windows Security** requests permission to install, click **Install** (see Figure 11).

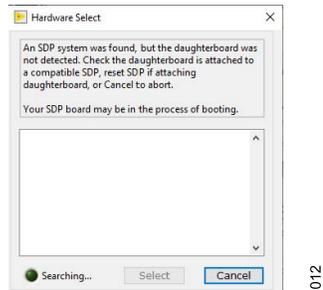


Figure 11. SDP Drivers Install

SOFTWARE INSTALLATION

EEPROM CONFIGURATION

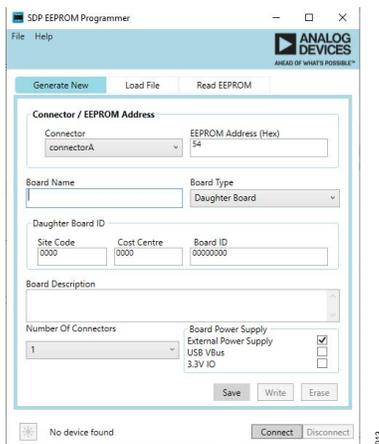
The EEPROM on the EVAL-ADMT4000SD1Z daughter board stores the daughter board type and is factory set. If the EEPROM is not programmed, or an invalid daughter board is connected, a dialog box as shown in [Figure 12](#) appears.



012

Figure 12. Pop-Up Window Indicating That Either an Unexpected Daughter Board Is Attached to the SDP or That the EVAL-ADMT4000SD1ZEEPROM Was Incorrectly Programmed

To configure the EEPROM, launch the **SDP EEPROM Programmer (.NET)** utility, which is available from [Analog Devices, Inc., Sales](#). The appropriate **.dat** file is also available upon request to configure the **Load File** tab, as shown in [Figure 13](#), which uses Address 54.



013

Figure 13. SDP EEPROM Configuration Utility

EVAL-ADMT4000SD1Z SOFTWARE OPERATION

The [Overview of the ADMT4000 Evaluation GUI](#) and the [Starting the EVAL-ADMT4000SD1Z Software](#) sections describes how to operate the GUI provided in the EVAL-ADMT4000SD1Z software.

STARTING THE EVAL-ADMT4000SD1Z SOFTWARE

After completing the steps in the [Software Installation](#) section, launch the EVAL-ADMT4000SD1Z software as follows:

- ▶ Connect the SDP with the EVAL-ADMT4000SD1Z to the PC using the provided USB cable.
- ▶ Click the Windows icon to open the **Windows Start** menu and **Programs** list. Select **Analog Devices/EVAL-ADMT4000SD1Z**.
- ▶ If the **ADMT4000 Evaluation GUI** is successfully installed and the EVAL-ADMT4000SD1Z is detected, the EVAL-ADMT4000SD1Z evaluation software automatically opens (see [Figure 14](#)). The evaluation board name displays on the front panel of the GUI (see [Label 1](#) in [Figure 14](#)).

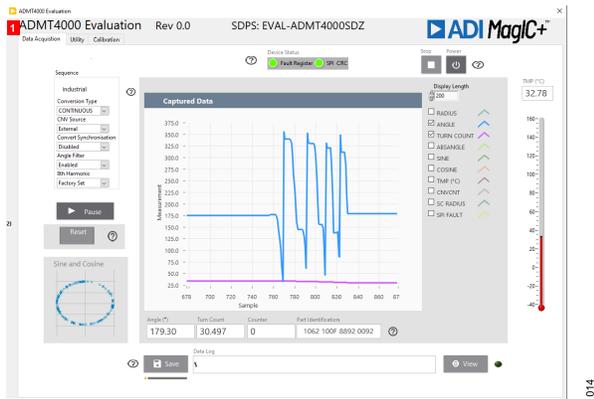


Figure 14. ADMT4000 Evaluation GUI Showing the Connected EVAL-ADMT4000SD1Z Evaluation Kit

- ▶ If the EVAL-ADMT4000SD1Z evaluation system is not connected to the USB port via the SDP, the evaluation board name does not display on the front panel. After a few seconds, the **Hardware Select** window appears (see [Figure 15](#)). Connect the EVAL-ADMT4000SD1Z evaluation system to the USB port of the PC and wait a few seconds. The **Hardware Select** window then shows the SDP evaluation kits connected to the PC. Select the **EVAL-ADMT4000SD1Z** and click **Select** (see [Figure 16](#)).

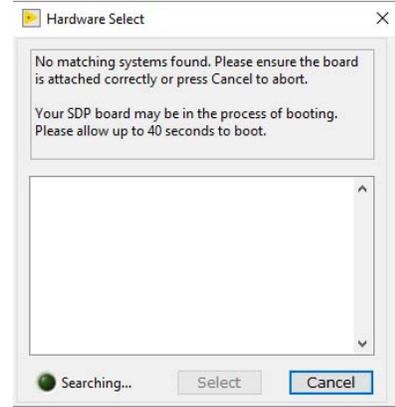


Figure 15. Hardware Select Window That Appears When the GUI Starts Without the EVAL-ADMT4000SD1Z Connected to the PC

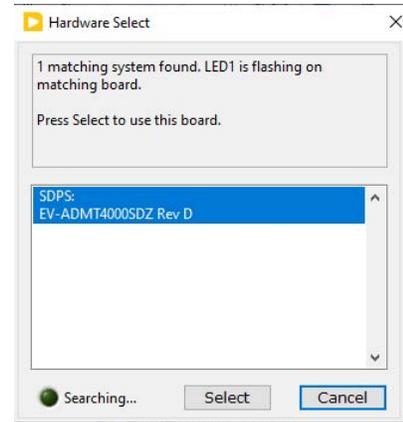


Figure 16. Hardware Select Window That Appears When the EVAL-ADMT4000SD1Z Connects to the PC

- ▶ On startup, the **ADMT4000 Evaluation GUI** automatically begins to acquire and display data from the **ADMT4000**. The initial sequence settings are defined in the supplied configuration file **C:\Program Files\Analog Devices\EVAL-ADMT4000SDZ 0.0.0\dataADMT4000 Config.csv**. To start the GUI in a user-defined configuration, the user must modify the configuration file.

EVAL-ADMT4000SD1Z SOFTWARE OPERATION

OVERVIEW OF THE ADMT4000 EVALUATION GUI

The ADMT4000 Evaluation GUI provides a series of tabs to allow the user to evaluate the features of the ADMT4000. The GUI tabs are shown and labeled in Figure 17. Table 9 outlines the key function accessed in the tabs.

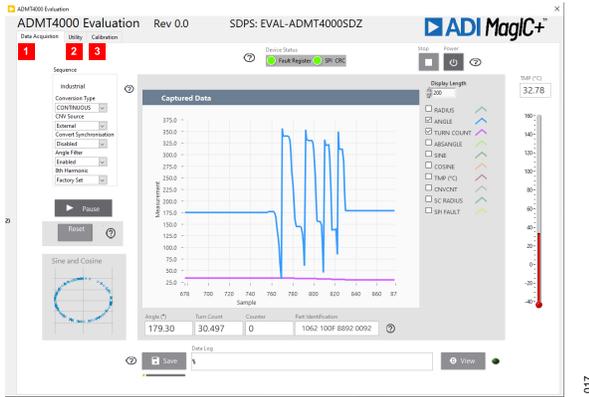


Figure 17. GUI Tab Menu

Table 9. Descriptions of the ADMT4000 Evaluation GUI Tabs with Labels

Label Number	Tab Name	Description
1	Data Acquisition	The Data Acquisition tab is the primary user tab for monitoring the output from the ADMT4000 and for configuring the acquisition sequence.
2	Utility	The Utility tab displays the details of the FAULT register status and allows the upload of the user configuration and logging of SPI commands.
3	Calibration	The Calibration tab is where the user configures system-level calibration.

Data Acquisition Tab

The Data Acquisition tab (see Figure 18) displays sensor measurements and gives access to the sensor diagnostics.

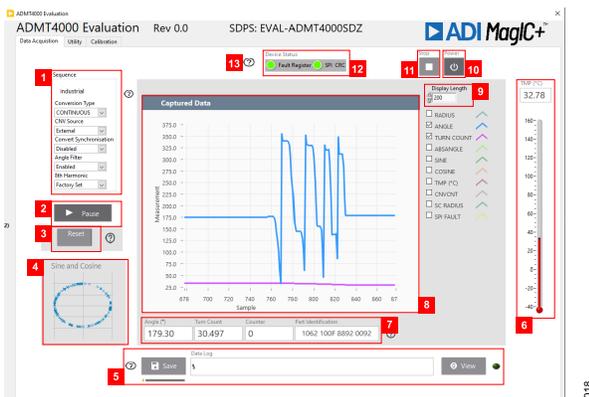


Figure 18. Data Acquisition Tab

Table 10 gives a description of the labels in the Data Acquisition tab, Figure 18.

Table 10. Descriptions for the Data Acquisition Tab Labels

Label Number	Label Name	Description
1	Sequence control	Controls for selecting the measurement sequence settings.
2	Start or Pause	Begins the configured sequence or pauses the current sequence.
3	Reset	Performs a magnetic reset with the coil integrated into the evaluation kit.
4	Sine and Cosine	Plots the sine output vs. the cosine output.
5	Data Log	Enables data logging of the samples.
6	TMP (°C)	Is the internal temperature sensor display
7	Latest measurement	Displays the latest angle, turn count, and SPI frame counter. The device identification is updated on startup only.
8	Captured Data	Plot area for the sampled data. Displays the turn count, angle, and available diagnostic values.
9	Display Length	Controls the number of data points displayed on the Captured Data plot.
10	Power	. Controls the application of power to the ADMT4000.
11	Stop	Quits the GUI
12	Device Status	Indicators that turn red if a fault flag is detected on a SPI frame (Not active for Industrial applications), a cyclic redundancy check (CRC) error is detected on a SPI frame, or a fault flag is set in the FAULT register.
13	Help (?) icon	An example of the help icons that provide additional information for the user.

Sequence Control

The Sequence control area in the Data Acquisition tab enables the user to configure the ADMT4000 acquisition mode as follows:

- ▶ Within the Conversion Type dropdown menu, select either CONTINUOUS or ONE SHOT acquisitions.
- ▶ Within CNV Source dropdown menu, select either the software-generated convert start or an externally generated CNV. The external CNV signal is generated by the SDP controller board.
- ▶ Within the Convert Synchronization dropdown menu, the use of an external source to synchronize angle measurements is available.
- ▶ Within the Angle Filter dropdown menu, enable or disable the infinite impulse response (IIR) angle filter.
- ▶ Within the 8th Harmonic dropdown menu, select between the factory set 8th harmonic coefficient or a user-defined value coefficient in the ADMT4000 Config.csv configuration file.

EVAL-ADMT4000SD1Z SOFTWARE OPERATION

Start

The **Start** button is used to initiate or pause a measurement sequence. Note that the label on the **Start** button changes to **Pause** once an acquisition is in progress.

Reset

The **RESET** button initiates a magnetic reset of the turn-count sensor using the coil on the EVAL-ADMT4000SD1Z as follows:

- ▶ Start a conversion sequence.
- ▶ Click **Reset**.

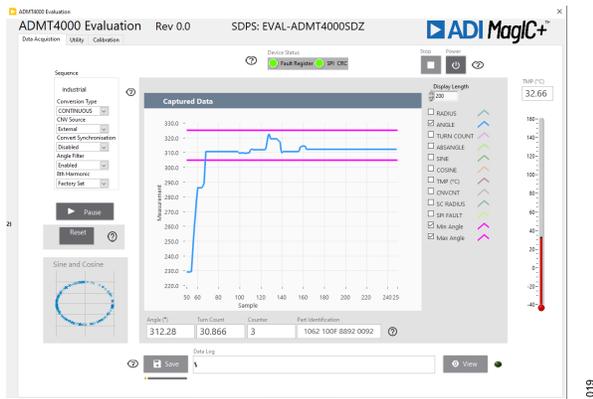


Figure 19. Captured Data Display Showing the Acquired Angle (Blue) and the Target Maximum and Minimum Angle (Magenta) for the Magnetic Reset

- ▶ The **Captured Data** display then shows the **ANGLE** measurement and a **Min Angle** and **Max Angle** target (see [Figure 19](#)).
- ▶ Rotate the magnet until the **ANGLE** measurement is within the limits shown in [Figure 19](#).
- ▶ Click **Reset**, Label 3 in [Figure 18](#).
 - ▶ When operating in the **ONE SHOT** conversion type, the **Turn Count** indicator displays a value close to 46. Note that the exact value depends on the exact angle of the magnet.
 - ▶ When operating in the **CONTINUOUS** conversion type, the user must restart the conversion sequence to observe the reset turn count.
- ▶ Turn the magnet counterclockwise to observe the turn counts decrementing.

Sine and Cosine

This area displays the magnitude of the sine vs. cosine measurements.

Data Log

The **Data Log** area, [Figure 20](#), allows the user to save the captured data to an NI TDMS log file as follows:



Figure 20. Captured Data Log Area of the Data Acquisition Tab

- ▶ The **Save** function can be started before or during an acquisition sequence. Note that it does not save any data gathered by the GUI before the save function is activated.
- ▶ Click **Save** (Label 1 in [Figure 20](#)) and a window then appears. The user can modify the file name and save location within this window. Ensure that the file extension is **.tdms**.
- ▶ The file path for the logged data is displayed in the **Data Log** indicator (Label 2 in [Figure 20](#)), and the save active indicator (Label 3 in [Figure 20](#)) changes from dark green to light green.
- ▶ To stop the save function, click **Save** (Label 1 in [Figure 20](#)).
- ▶ The save active indicator (Label 3 in [Figure 20](#)) then changes from light green to dark green.
- ▶ To optimize the TDMS file, the GUI automatically defragments the file, and the progress of this defragmentation process is shown in the progress bar (see Label 4 in [Figure 20](#)).
- ▶ To open the file location, click **VIEW** (Label 5 in [Figure 20](#)).

The TDMS file can be imported to Excel by using a free NI TDM Excel Add-In for Microsoft Excel, which can be downloaded from the NI website. The log file stores the device configuration, measured data, and fault status for each acquisition.

Temperature Sensor

The junction temperature is reported as both a thermometer display and digital display.

Latest Measurement

The last **Angle** and **Turn Count** data is displayed in the **Latest Measurement** area of the **Data Acquisition** tab (Label 7 in [Figure 18](#)).

- ▶ The **Angle** indicator shows the **ANGLE** data in degrees.
- ▶ The **Turn Count** indicator shows the number of turns.
- ▶ The **Counter** indicator shows the SPI frame count.
- ▶ The **Part Identification** indicator shows the unique identifier of the device connected to the EVAL-ADMT4000SD1Z.

Captured Data

The **Captured Data** section (Label 8 in [Figure 18](#)) displays a history of the data acquisitions. The tick boxes on the plot legend can control the visibility of data items on the plot. Note that the logged data contains all the data shown in the plot legend irrespective of the state of the check box next to the plot name.

EVAL-ADMT4000SD1Z SOFTWARE OPERATION

Display Length

The **Display Length** control (Label 9 in Figure 18) is used to control the number of data points displayed on the **Captured Data** plot.

Power

Click **Power** (Label 10 in Figure 18) to control the power mode of the **ADMT4000**.



021

Figure 21. Power Button

The GUI attempts to read from the ADMT4000 irrespective of its power state.

Stop

Click **Stop** (Label 11 in Figure 18) to stop and quit the GUI.

Device Status

The following three fault status indicators (Label 13 in Figure 18) within the **Device Status** area display the fault statuses of the latest SPI frame:

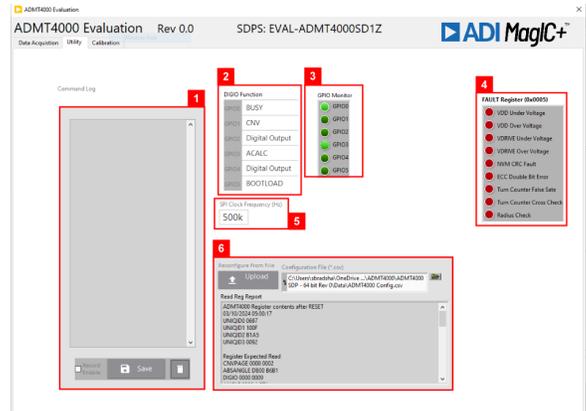
- ▶ **Fault Register** indicates that a flag is set in the FAULT register.
- ▶ **SPI CRC** indicates if a SPI frame CRC fault is detected.
- ▶ **SPI Flag** is the fault flag, which is contained within the ADMT4000 SPI frame that indicates that a flag is set in the FAULT register of the ADMT4000.

Help

There are several **HELP** buttons distributed around the **ADMT4000 Evaluation** GUI, for example, see Label 13 in Figure 18. Help features like this one are designed to aid the user with selected features.

Utility Tab

The **Utility** tab (see Figure 22) gives access to the **FAULT** register and allows control of the **GPIOs** of the **ADMT4000**, in addition to other resources, which are outlined in the following sections.



022

Figure 22. Utility Tab

Table 11 gives a description of the labels in the **Utility** tab (see Figure 22).

Table 11. Descriptions for the Utility Tab Labels

Label Number	Label Name	Description
1	Command Log	Logs the SPI commands generated by the GUI
2	DIGIO Functions	Enables control of the GPIO port functions
3	GPIO Monitor	GPIO current status
4	FAULT Register	FAULT register status
5	SPI Clock Frequency (Hz)	SPI clock frequency control
6	User configuration	User configuration control

Command Log

The **Command Log** (Label 1 in Figure 22) can capture the SPI commands issued by the GUI for controlling the **ADMT4000**. To enable this feature, select the **Record Enable** check box. Click **SAVE** to save the log, and click the **Recycle Bin** icon to clear the log.

DIGIO Function

The **GPIO** ports on the **ADMT4000** can be configured with the **DIGIO Function** control (Label 2 in Figure 22). When the **ADMT4000 Evaluation** GUI starts, the **GPIO** ports step up according to the **ADMT4000 Config.csv** configuration file. Note that it is possible to select the functions in the **Port** dropdown menu to change operation of these ports.

GPIO Monitor

The **GPIO Monitor** (Label 3 in Figure 22) displays the current logic level of the **GPIO** ports. Light green indicates a high state on the port, and dark green indicates a low state.

EVAL-ADMT4000SD1Z SOFTWARE OPERATION

FAULT Register

The **FAULT Register** (Label 4 in Figure 22) displays the latest status of the FAULT register of the ADMT4000, light red indicates that the FAULT flag is set, and dark red indicates that a fault is detected. In Figure 22, the FAULT register shows that no faults are detected.

SPI Clock Frequency (Hz)

To modify the SDP SPI clock, update the **SPI Clock Frequency (Hz)** box (Label 5 in Figure 22).

User Configuration

To upload a configuration file at any time, go to the **User Configuration** area of the **Utility** tab (Label 6 in Figure 22) and do the following:

- ▶ Select the required user configuration file.
- ▶ Click **Upload**.
- ▶ Once the configuration file uploads, the ADMT4000 is reconfigured. Note that the **Read Reg Report** window displays the state of the user registers following a reconfiguration.

Configuration File

The configuration file for the EVAL-ADMT4000SD1Z contains the **ADMT4000 Evaluation** GUI start-up settings, which set the ADMT4000 to a user-defined state at the launch of the application. The register names cannot be altered; however, the user is free to modify the register settings that follow the register name. The file must be saved in a comma separated *.csv format.

The contents of the supplied configuration file (**ADMT4000 Config.csv**) contains the following content:

```
Device,ADMT4000
File Revision,0
H1MAG,0x0
H1PH,0x0
H2MAG,0x0
H2PH,0x0
H3MAG,0x0
H3PH,0x0
H8MAG,0x00
H8PH,0x00
GENERAL,0x1200
DIGIOEN, 0x3D00
```

Calibration Tab

The **Calibration** tab allows the user to access the calibration features of the ADMT4000. To perform a calibration, the ADMT4000 must be configured in a system containing a motor with an end of shaft magnet, which is not provided in the evaluation kit. The

ADMT4000 sensor must be aligned accurately with the center of the motor shaft and the center of the magnet.

The calibration process in the GUI consists of the following steps:

1. Activate the motor with a continuous speed.
2. Collect calibration sample data.
3. Generate the calibration coefficients.
4. Test angular performance with the calibration coefficients.
5. Configure the ADMT4000 with the generated calibration coefficients.

The calibration coefficients consist of system corrections for the 1st, 2nd, 3rd, and 8th harmonics of the sampled data. Harmonic errors are produced by system tolerances, including the x-axis and y-axis displacement between the sensor and the magnet.

The user can inspect the result of the calibration and reconfigure the ADMT4000 with the generated coefficients.

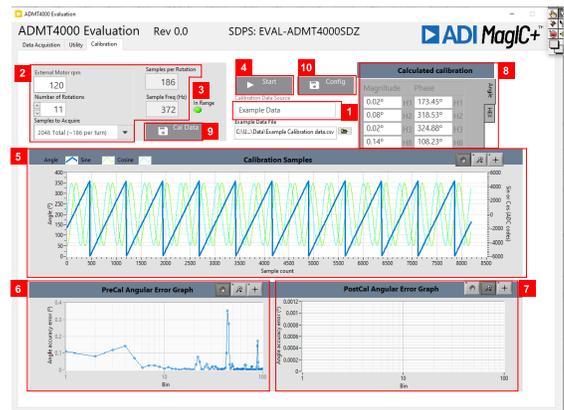


Figure 23. Calibration Tab

The **Calibration** tab is shown in Figure 23. Table 12 gives a description of the labels in the **Calibration** tab (see Figure 23).

Table 12. Descriptions for the Calibration Tab Labels

Label Number	Label Name	Description
1	Calibration Data Source	Controls the source of the calibration data
2	Sample control	Controls the External Motor rpm , Number of Rotations for the motor, total number of Samples to Acquire , Samples per Rotation , and Sample Freq (Hz)
3	In Range indicator	Turns from dark green to light green when a valid sample configuration is selected
4	Start	Begins the calibration routine
5	Calibration Samples	Chart of the sample data used to calculate the coefficients
6	PreCal Angular Error Graph	Plot area for the precalibration data, and displays the system angular errors

EVAL-ADMT4000SD1Z SOFTWARE OPERATION

Table 12. Descriptions for the Calibration Tab Labels (Continued)

Label Number	Label Name	Description
7	PostCal Angular Error Graph	in the frequency domain and time domain Plot area for the post calibration data, and displays the system angular errors in either time domain or frequency domain
8	Calculated calibration	Displays the calibration coefficients from the last calibration routine calculations
9	Cal Data	Click Cal Data to save the sample data to a file
10	Config	Click Config to reconfigure the ADMT4000 with the latest calibration coefficients

Calibration Data Source

To perform a user calibration, the EVAL-ADMT4000SD1Z must be configured with a motor, and the **Calibration Data Source** control must be set to ADMT4000.

The following two additional modes of operation for the calibration routine are available and can be selected within the **Calibration Data Source** controls:

- ▶ **User Harmonic Coefficients** allows the user to enter custom coefficients (see the [Calculated Calibration](#) section) and observe the resulting errors; however, a motor is required for this function.
- ▶ **Example Data** provides a typical data set. The fast Fourier transform (FFT) and calculated calibration coefficients are displayed in the **ADMT4000 Evaluation** GUI. Note that, in this case, the post calibration cannot be displayed.

Sample Control

Configure the sample control area when the GUI operates with a motor, as follows:

- ▶ **External Motor rpm** is the speed of the external motor.
- ▶ **Number of Rotations** is the number of rotations used to capture the angle data from the ADMT4000.
- ▶ **Samples to Acquire** is the total number of samples to acquire.
- ▶ **Samples per Rotation** is the total number of samples per rotation.
- ▶ **Sample Freq (Hz)** is the sample frequency in Hz.

It is recommended that 11 magnetic rotations are used for the calibration routine. The total number of samples captured across the 11 rotations must be a power of 2 to ensure a coherent FFT. The recommended minimum total number of samples is 2^{10} (1024) across the 11 rotations. It is important to note that, during the calibration process, the magnet must turn at a constant speed. Otherwise, the motor speed error adds to the angular error.

The **In Range** indicator (Label 3 in [Figure 23](#)) turns from dark green to light green when a valid sample configuration is selected.

Start

Click **Start** to start the calibration process. Before clicking **Start**, ensure that the external motor has reached a steady state before starting the calibration process.

Calibration Samples

The **Calibration Samples** plot displays the captured sine and cosine in ADC codes and the angle calculated from the sine and cosine.

PreCal Angular Error Graph

The **PreCal Angular Error Graph** displays the FFT of the captured data or the FFT of the data supplied in the example data file.

PostCal Angular Error Graph

The **PostCal Angular Error Graph** displays the FFT of the ADMT4000 with the calculated coefficients configured.

Calculated Calibration

The **Calculated calibration** area has a tab that enables the user to observe the calculated coefficients in either degrees or the **HEX** code used to configure the ADMT4000 calibration coefficient registers.

When **User Harmonic Coefficients** is selected in the **Calibration Data Source** control area, the user can enter values into the **HEX** code tab of the **Calculated calibration** area. When the calibration runs in this mode, the resulting angular error displays with the user coefficients.

Cal Data

Following a calibration routine, click **Cal Data** to save the captured data.

Configuration

Click **Config** to update the ADMT4000 with the calibration coefficients entered into the **Calculated calibration** control area.

SCHEMATICS AND BOARD DIMENSIONS

The PCB schematics for the EVAL-ADMT4000SD1Z are shown in Figure 24 and Figure 25. The PCB dimensions are shown in Figure

26. The position of the AMR sensor must be as close as possible to the center of the rotating axis.

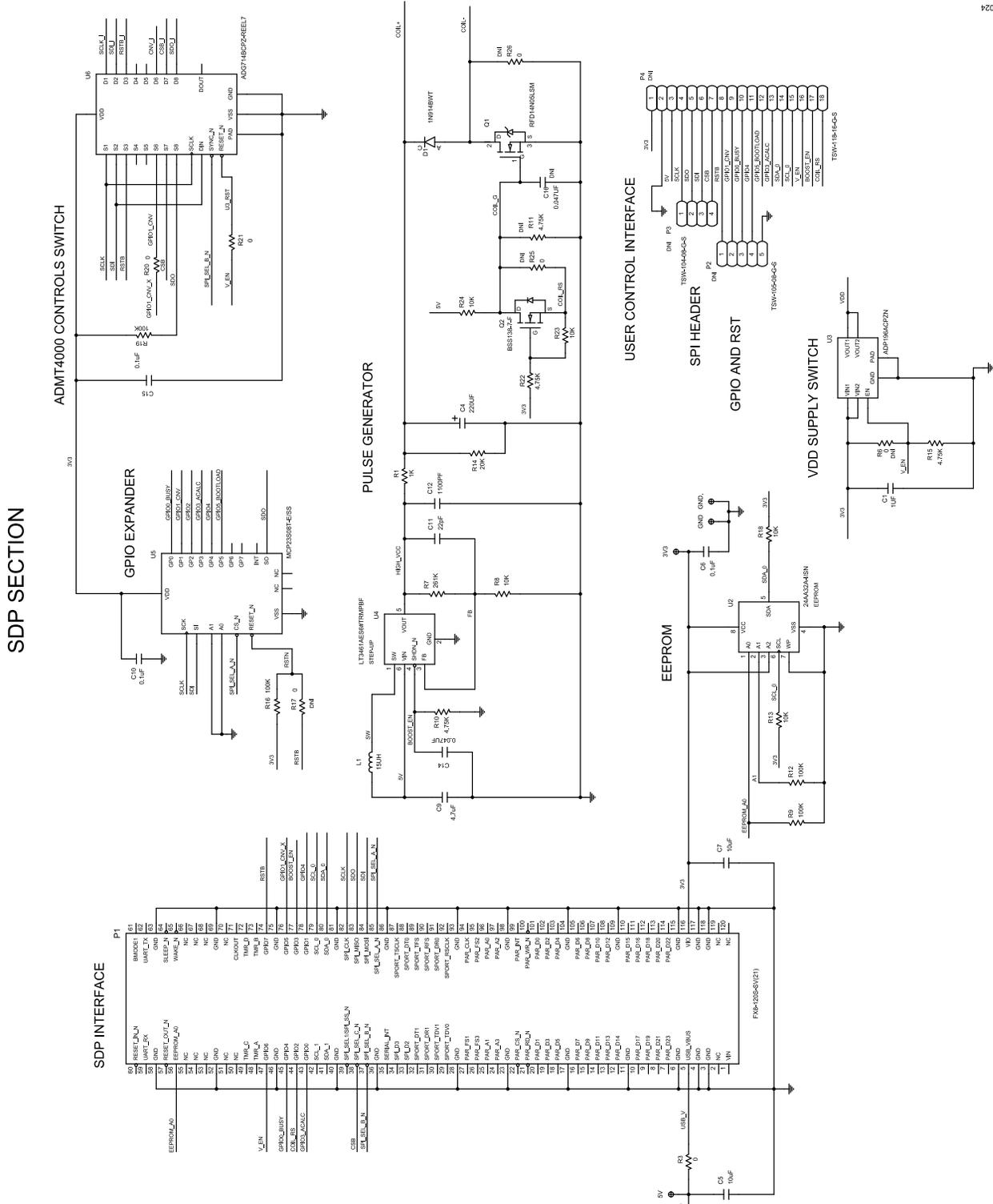


Figure 24. EVAL-ADMT4000SD1Z, SDP Interface Section Schematic

SCHEMATICS AND BOARD DIMENSIONS

BREAK OFF SECTION

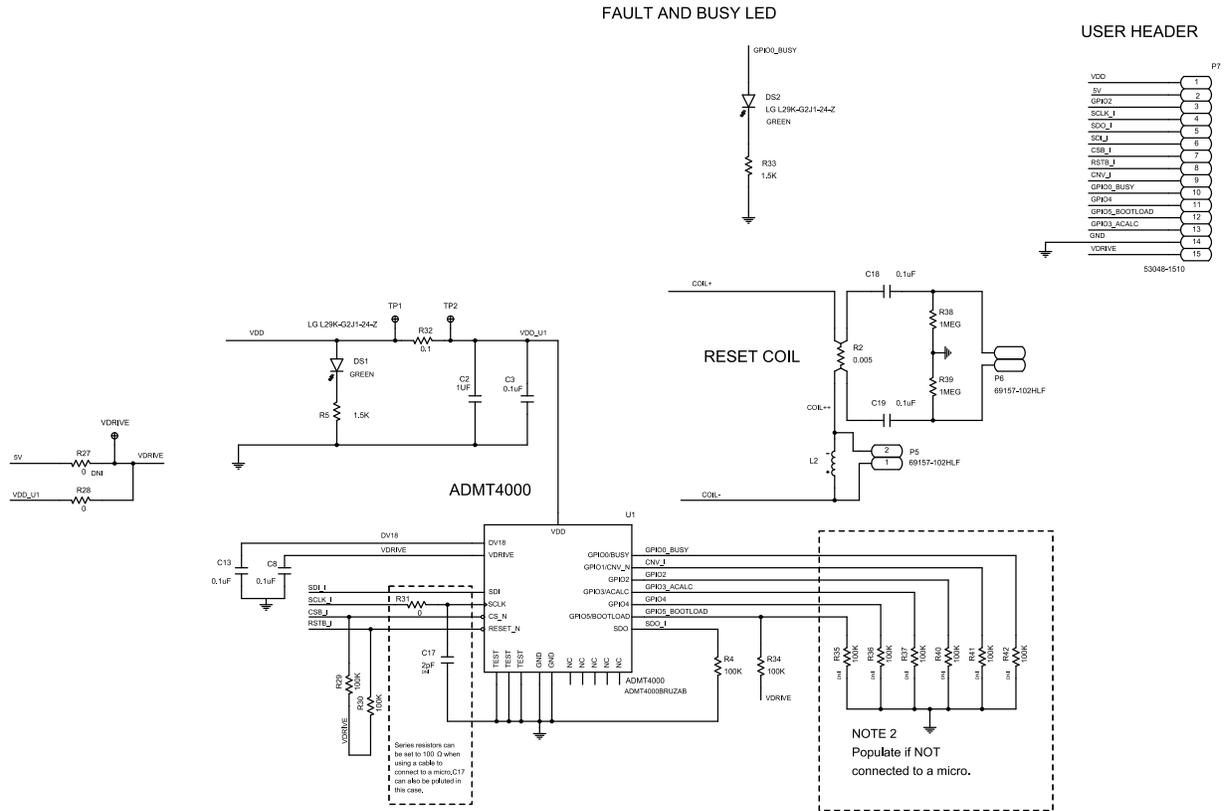


Figure 25. EVAL-ADMT4000SD1Z, Board Break Off Section Schematic

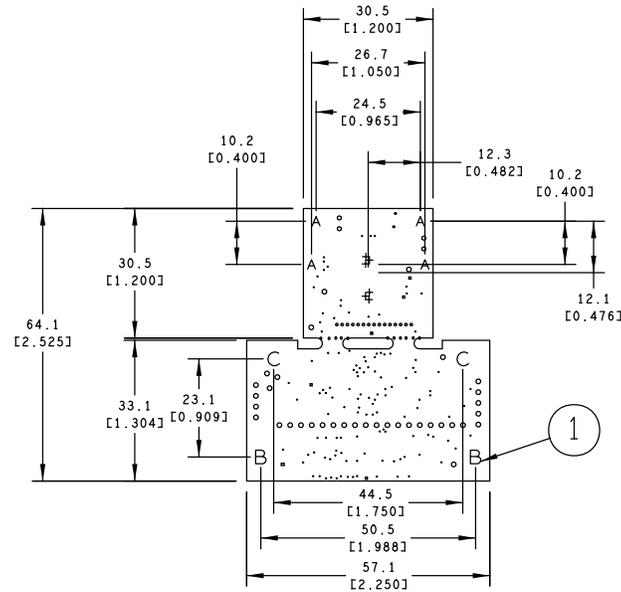


Figure 26. EVAL-ADMT4000SD1Z Dimensions, Units Are Millimeters [Inches]

SCHEMATICS AND BOARD DIMENSIONS

For details on the sensor position within the package, refer to the [ADMT4000](#) data sheet. Referring to the label numbers in [Figure 26](#), Label 1 shows the SDP mounting holes.

The mounting holes sizes are shown in [Figure 26](#) and [Table 13](#).

Table 13. EVAL-ADMT4000SD1Z Mounting Hole Dimensions

Symbol	Diameter (mm)	Plating
A	2.2	Nonplated
B	3.175	Nonplated
C	3.2	Nonplated

ORDERING INFORMATION

BILL OF MATERIALS

Table 14. Bill of Materials

Component	Description	Manufacturer	Part Number
C1, C2	1 μ F ceramic capacitors, 10 V, 5%, X8L, 0805, AEC-Q200	Kemet	C0805C105J8NACAUTO
C3, C8, C13	0.1 μ F ceramic capacitors, 35 V, 10%, X7R, 0402, AEC-Q200 LOW ESR	TDK	CGA2B3X7R1V104K050BB
C4	220 μ F aluminium electrolytic capacitor, 50 V, 20%, 12.5 mm \times 16 mm, AEC-Q200, 550 mA	Vishay	MAL216099103E3
C5, C7	10 μ F ceramic capacitors, 6.3 V, 20%, X7R, 0603	Samsung	CL10B106MQ8NRNC
C6, C10, C15, C18, C19	0.1 μ F ceramic capacitors, 50 V, 10%, X8R, 0603, AEC-Q200	TDK	CGA3E3X8R1H104K080AB
C9	4.7 μ F ceramic capacitor, 16 V, 5%, X7R, 0805, AEC-Q200	Kemet	C0805X475J4RACAUTO
C11	22 pF ceramic capacitor, 100 V, 5%, C0G, 0603, AEC-Q200	TDK	CGA3E2NP02A220J080AA
C12	1100 pF ceramic capacitor, 50 V, 1%, X8G, 0603, AEC-Q200	Murata	GCM1885G1H112FA16D
C14	0.047 μ F ceramic capacitor, 25 V, 10%, X8R, 0402, AEC- Q200, soft termination	TDK	CGA2B1X8R1E473K050BE
C16	0.047 μ F ceramic capacitor, 0.047 μ F, 25 V, 10% X8R, 0402, AEC-Q200	TDK	CGA2B1X8R1E473K050BE
C17	2 pF ceramic capacitor, 25 V, 0.1 pF, C0G, 0402	AXV	04023U2R0BAT2A
D1	Diode, high conductance fast switching	Fairchild Semiconductor	1N914BWT
DS1, DS2	Diodes, hyper bright, low current, light emitting diode (LED), green	Osram Opto Semiconductors	LGL29K-G2J1-24-Z
L1	Inductor, wirewound, 15 μ H, 10%, 2.52 MHz, 0.6 A, 0.5 Ω , 1812, AEC-Q200	TDK	B82432T1153K000
P1	120-position board to board connector receptacle, 0.6 mm pitch	HR	FX8-120S-SV(21)
P3	4-position PCB header strip, 0.100" pitch	Samtec	TSW-104-08-G-S
P2	5-position PCB header strip, 0.100" pitch	Samtec	TSW-105-08-G-S
P4	18-position PCB header strip, 0.100" pitch	Samtec	TSW-118-16-G-S
P5, P6	2-position PCB header strips, 0.100" pitch	Amphenol	9157-102HLF
P7	15-position PCB header, right angle 0.100" pitch	Molex	53048-1510
Q1	N-channel MOSFET, 14 A, 50 V, 3-pin DPAK	Onsemi	RFD14N05LSM
Q2	N-channel MOSFET, 200 mA, 50 V, 3-pin SOT-23	Diodes Incorporated	BSS138-7-F
R1	1 k Ω SMD resistor, 1%, 1/8 W, 0805, AEC-Q200	Panasonic	ERJ-6ENF1001V
R2	0.005 Ω SMD resistor, 1%, 2 W, 2512, wide terminal	Ohmite	LVK25R005FER
R3, R6, R17, R20, R21, R25, R26 to R28, R31	0 Ω SMD resistors, jumper, 1/10 W, 0402, AEC-Q200	Panasonic	ERJ-2GE0R00X
R4, R9, R12, R16, R19, R29, R30, R34 to R37, R40 to R42	100 k Ω SMD resistors, 5%, 1/10 W, 0402, AEC-Q200	Panasonic	ERJ-2GEJ104X
R5, R33	1.5 k Ω SMD resistors, 1%, 1/10 W, 0603, AEC-Q200	Panasonic	ERJ-3EKF1501V
R7	261 k Ω SMD resistor, 0.1%, 1/8 W, 0805, AEC-Q200	Panasonic	ERA-6AEB2613V
R8	10 k Ω SMD resistor, 0.1%, 1/8 W, 0805, AEC-Q200	Panasonic	ERA-6AEB103V
R10, R11, R15, R22	4.75 k Ω SMD resistors, 1%, 1/10 W, 0402, AEC-Q200	Panasonic	ERJ-2RKF4751X
R13, R18	10 k Ω SMD resistors, 1%, 1/8 W, 0805, AEC-Q200	Panasonic	ERJ-6ENF1002V
R14	20 k Ω SMD resistor, 1%, 1/8 W, 0805, AEC-Q200	Panasonic	ERJ-6ENF2002V
R23, R24	10 k Ω SMD resistors, 5%, 1/10 W, 0603, AEC-Q200	Panasonic	ERJ-3GEYJ103V
R32	0.1 Ω SMD resistor, 1%, 1/6 W, 0402, AEC-Q200	Panasonic	ERJ-2BSFR10X
R38, R39	1 M Ω SMD resistors, 1%, 1/10 W, 0603, AEC-Q200	Panasonic	ERJ-3EKF1004V
U1	True power-on multiturn sensor	Analog Devices	ADMT4000BRUZAB
U2	IC 32 kBIT serial EEPROM	Microchip Technology	24AA32A-I/SN
U3	5 V, 3 A logic-controlled high-side power switch	Analog Devices	ADP196ACPZN-R7

ORDERING INFORMATION

Table 14. Bill of Materials (Continued)

Component	Description	Manufacturer	Part Number
U4	3 MHz step-up DC/DC converters with integrated Schottky in thin SOT	Analog Devices	LT3461AES6#TRMPBF
U5	IC expander serial peripheral interface (SPI), general-purpose input and output (GPIO), 8 bit	Microchip Technology	MCP23S08T-E/SS
U6	CMOS, low voltage, SPI/QSPI/Microwire-compatible interface, serially controlled, octal SPST switches	Analog Devices	ADG714BCPZ-REEL7

**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.

Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. CONFIDENTIALITY. This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. ADDITIONAL RESTRICTIONS. Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. TERMINATION. ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. LIMITATION OF LIABILITY. THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS (\$100.00). EXPORT. Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. GOVERNING LAW. This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.

