![ANALOG DEVICES logo]

EVAL-AD2S1210SDZ User Guide
UG-709

Evaluating the AD2S1210 10-Bit to16-Bit Resolver-to-Digital Converter

FEATURES

Full featured evaluation board for the AD2S1210
On-board power supplies
Standalone capability
System demonstration platform (SDP) compatible (EVAL-SDP-CB1Z)
PC software for control and data analysis

EVALUATION KIT CONTENTS

EVAL-AD2S1210SDZ evaluation board
Mains power supply adapter
Evaluation software CD

ADDITIONAL EQUIPMENT NEEDED

EVAL-SDP-CB1Z (must be ordered separately), includes a USB cable
Resolver
PC running Windows 7 or later, with CD-ROM drive and USB 2.0 port

GENERAL DESCRIPTION

The EVAL-AD2S1210SDZ is a full featured evaluation board designed to allow the user to easily evaluate all the features of the AD2S1210 resolver-to-digital converter (RDC). The evaluation board can be controlled via the SDP connector (J2) or via the J3 and J4 connectors. The SDP board (EVAL-SDP-CB1Z) allows the evaluation board to be controlled through the USB port of a PC using the evaluation board software available for download from the AD2S1210 product page.

The EVAL-AD2S1210SDZ on-board components include:

- The AD8662 low noise, precision 16 V rail-to-rail op amp
- The AD8397 high current, precision rail-to-rail op amp
- The ADP1621 constant frequency, current-mode step-up dc-to-dc converter
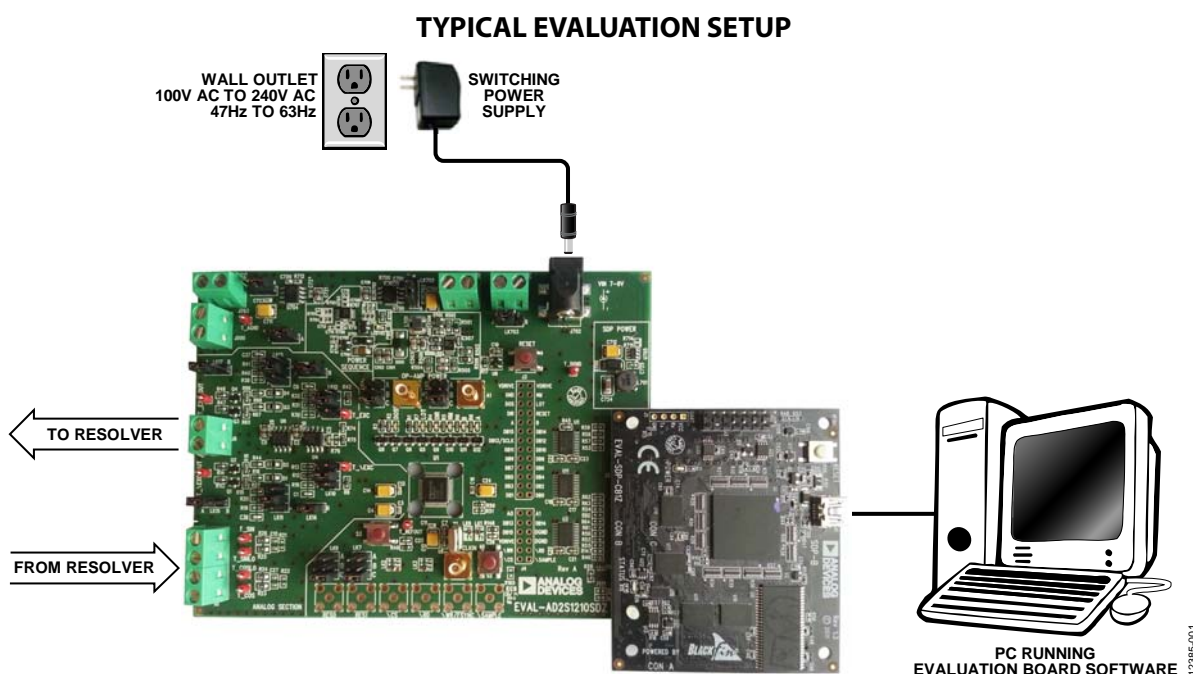- The ADP3303 200 mA low dropout linear regulator

TYPICAL EVALUATION SETUP

Figure 1. Typical Setup Using the EVAL-AD2S1210SDZ (Left) and the EVAL-SDP-CB1Z (Right)

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REVISION HISTORY

10/14—Revision 0: Initial Version

GETTING STARTED

QUICK START STEPS

Follow these steps to quickly evaluate the AD2S1210 RDC:

1. Install the evaluation software supplied on the included evaluation software CD. Ensure that the EVAL-SDP-CB1Z board is disconnected from the USB port of the PC while installing the software. The PC may need to be restarted after the installation.
2. Ensure that the various link options are configured as shown in Table 2.
3. Connect the EVAL-SDP-CB1Z board to the EVAL-AD2S1210SDZ evaluation board, as shown in Figure 2.
4. Connect the 9 V power supply adapter included in the kit to Connecter J702 on the evaluation board.
5. Connect the EVAL-SDP-CB1Z board to the PC via the USB cable.
6. Launch the evaluation software from the **Analog Devices** subfolder in the **Programs** menu.
7. Connect the EXC, $\overline{EXC}$, SIN, $\overline{SIN}$, COS, and $\overline{COS}$ wires of the resolver to Connector J5 and Connector J6, as shown in Figure 1.

Figure 2. Evaluation Board (Left) Connected to the SDP Board (Right)

SOFTWARE INSTALLATION PROCEDURES

The EVAL-AD2S1210SDZ kit includes a CD containing software to be installed on your PC before using the evaluation board.

There are two parts to the installation:

- EVAL-AD2S1210SDZ evaluation software installation
- EVAL-SDP-CB1Z driver installation

Warning

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

Installing the Evaluation Board Software

To install the EVAL-AD2S1210SDZ evaluation board software, take the following steps:

1. Insert the included evaluation software installation CD into the CD drive of a Windows®-based PC, and open the contents of the CD.
2. Double-click the **setup.exe** file to begin the installation. By default, the software is saved to the following location: **C:\Program Files\Analog Devices\AD2S1210**.
3. A dialog box appears asking for permission to allow the program to make changes to your computer. Click **Yes** to begin the installation process.
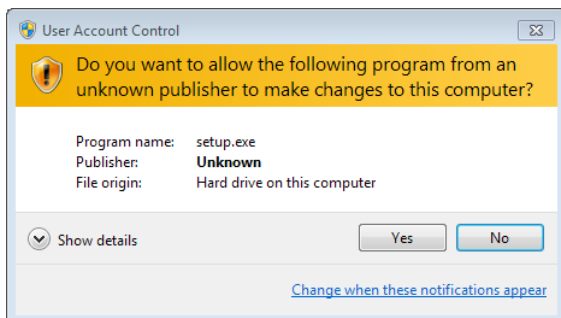
Figure 3. Evaluation Software Installation—User Account Control

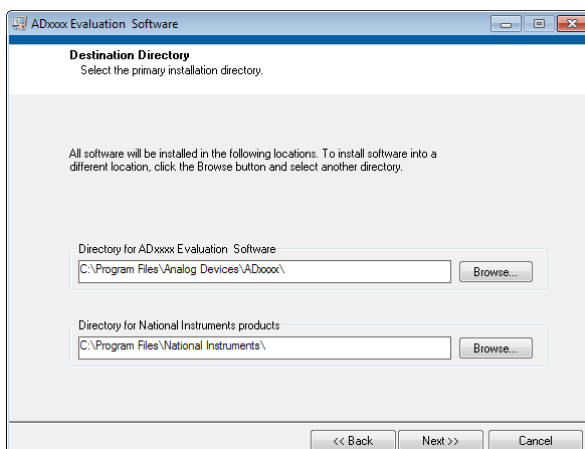4. Select the location to install the software, and then click **Next**.

Figure 4. Evaluation Software Installation—Destination Directory

5. A license agreement appears. Read the agreement, select **I accept the License Agreement**, and click **Next**.
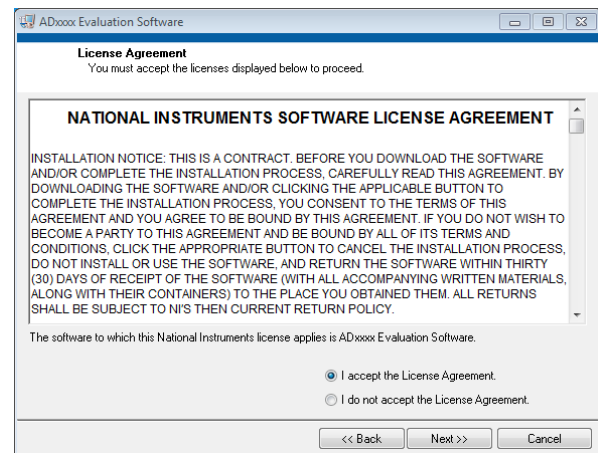
Figure 5. Evaluation Software Installation—License Agreement

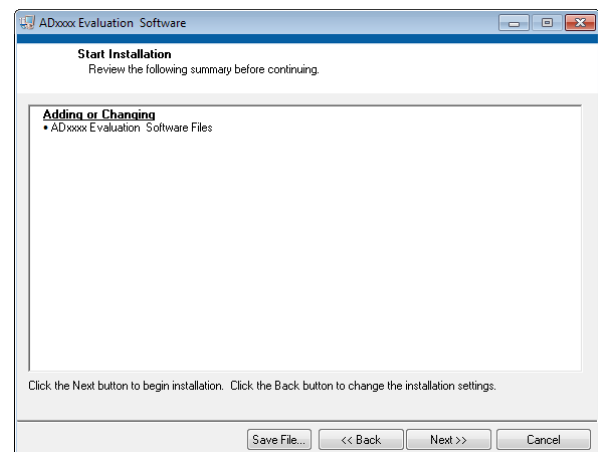6. An installation summary appears. Click **Next** to continue.

Figure 6. Evaluation Software Installation—Start Installation

7. A dialog box informs you when the evaluation software installation is complete. Click **Next** to proceed with the installation of the drivers.
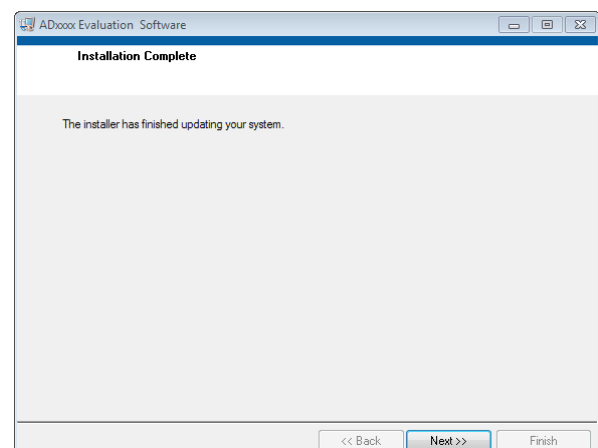
Figure 7. Evaluation Software Installation—Installation Complete

Installing the System Demonstration Platform Board Drivers

After the installation of the evaluation board software is complete, the **ADI SDP Drivers Setup** wizard window opens for the installation of the EVAL-SDP-CB1Z system demonstration platform board drivers.

1. Make sure that all other applications are closed, and then click **Next** to begin the driver installation process.
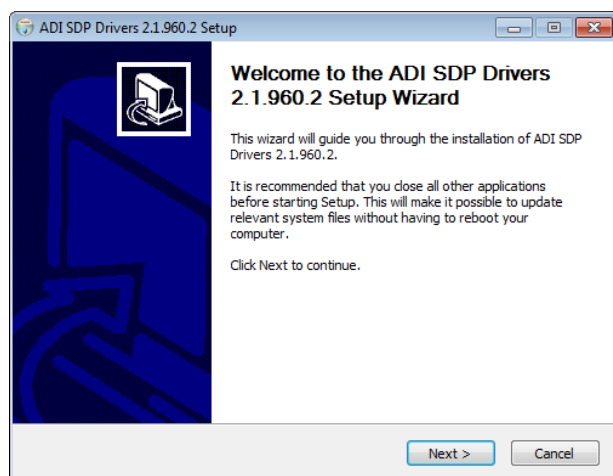
Figure 8. EVAL-SDP-CB1Z Drivers Installation—Setup Wizard

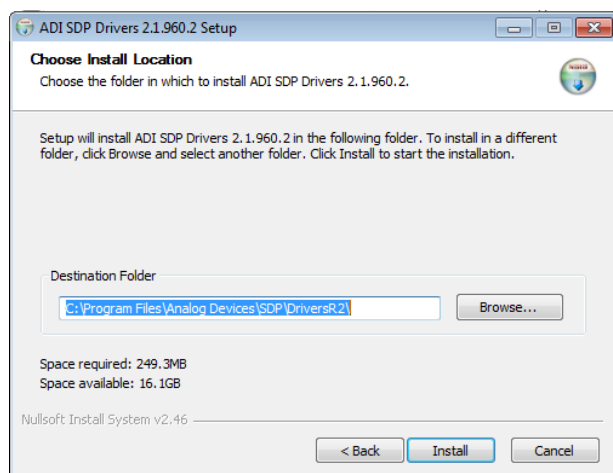2. Select the location to install the drivers, and then click **Install**.

Figure 9. EVAL-SDP-CB1Z Drivers Installation—Choose Install Location
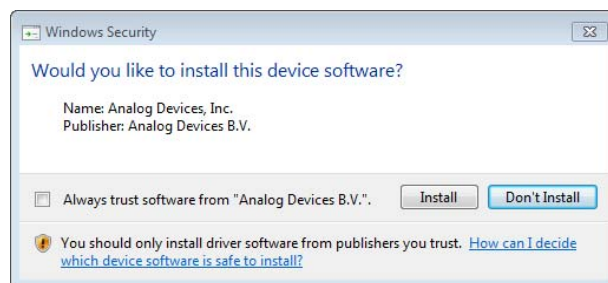
3. Click **Install** to proceed with the installation.

Figure 10. EVAL-SDP-CB1Z Drivers Installation—Windows Security

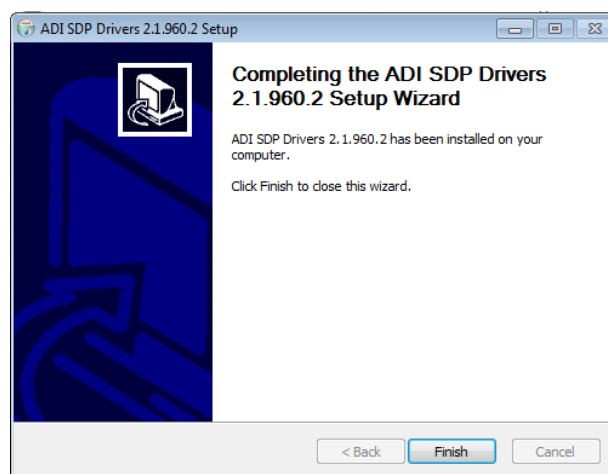4. To complete the drivers installation, click **Finish**, which closes the installation wizard.

Figure 11. EVAL-SDP-CB1Z Drivers Installation—Complete

EVALUATION BOARD SETUP PROCEDURES

The EVAL-AD2S1210SDZ connects to the EVAL-SDP-CB1Z system demonstration platform. The EVAL-SDP-CB1Z board is the controller board, which provides the communication link between the PC and the main evaluation board.

Figure 2 shows a photograph of the connections between the EVAL-AD2S1210SDZ daughter board and the EVAL-SDP-CB1Z board.

To evaluate the AD2S1210, an external resolver must be connected to the EVAL-AD2S1210SDZ. Connect EXE and $\overline{EXC}$ signal wires from the resolver to the J6 screw terminal. Connect the SIN, $\overline{SIN}$, COS, and $\overline{COS}$ resolver wires to the J5 screw terminal.

There are two excitation driver options provided on the EVAL-AD2S1210SDZ. Use Link 14 to Link 17 to select the desired driver (see Table 2). The default excitation driver combines an AD8662 precision, rail-to-rail, dual op-amp with a push-pull transistor network. An alternative driver available employs the AD8397 high current, precision rail-to-rail op-amp to drive the excitation signals. In both driver options, a dc bias of 3.75 V is applied to the EXE and $\overline{EXC}$ signals. Link 10 to Link 13 are used to adjust the excitation gain for each of the drivers (see Table 2).

Before connecting the power supply, connect the EVAL-AD2S1210SDZ evaluation board to Connector A or Connector B on the EVAL-SDP-CB1Z board. A nylon screw/nut set is included in the evaluation kit and can be used to ensure that the evaluation board and the EVAL-SDP-CB1Z board are connected firmly together.

After the evaluation board and the EVAL-SDP-CB1Z board are connected securely, connect the power supply to the evaluation board. The EVAL-AD2S1210SDZ evaluation board requires an external 9 V power supply adapter, which is included in the evaluation board kit. Connect this power supply to Connector J702 on the evaluation board. For further details on the required power supply connections and options, see the Power Supplies section.

Before connecting the EVAL-SDP-CB1Z board to the PC, ensure that the evaluation software has been installed. The full software installation procedure is detailed in the Software Installation Procedures section.

Finally, connect the EVAL-SDP-CB1Z board to the PC via the USB cable enclosed in the EVAL-SDP-CB1Z kit.

Verifying the Board Connection

1. Allow the **Found New Hardware Wizard** to run after the EVAL-SDP-CB1Z board is plugged into your PC. Check that the board is connected to the PC correctly using the **Device Manager** of the PC.
   a. Access the **Device Manager** as follows:
      i. Right-click **My Computer** and then click **Manage**.
      ii. A dialog box appears asking for permission to allow the program to make changes to your computer. Click **Yes**.
      iii. The **Computer Management** box appears. From the list of **System Tools**, click **Device Manager**.
   b. Under **ADI Development Tools**, **Analog Devices System Development Platform SDP-B** appears (see Figure 12), indicating that the EVAL-SDP-CB1Z driver software is installed and that the board is connected to the PC correctly.
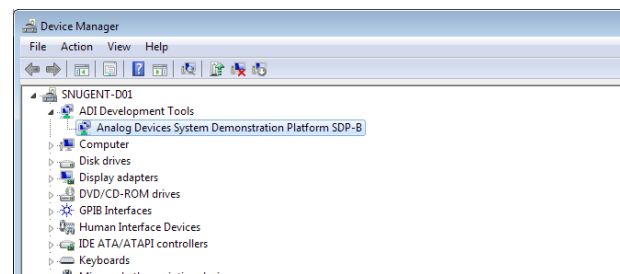

Figure 12. Device Manager

EVALUATION BOARD HARDWARE

AD2S1210 DESCRIPTION

The AD2S1210 is a complete 10-bit to 16-bit, resolution tracking RDC, integrating an on-board programmable sinusoidal oscillator that provides sine wave excitation for resolvers. The converter accepts 3.15 V p-p ± 27% input signals, in the range of 2 kHz to 20 kHz on the sine and cosine inputs. A Type II servo loop is employed to track the inputs and converts the input sine and cosine information into a digital representation of the input angle and velocity. The maximum tracking rate is 3125 RPS.

Complete specifications for the AD2S1210 are available in the AD2S1210 data sheet, which should be consulted in conjunction with this user guide when using the evaluation board. Full details on the EVAL-SDP-CB1Z are available at the SDP board product page.

HARDWARE LINK OPTIONS

The functions of the link options are described in Table 2. The default setup is configured to operate the EVAL-AD2S1210SDZ evaluation board with the mains power supply adapter and to interface to the EVAL-SDP-CB1Z board.

POWER SUPPLIES

Before applying power and signals to the evaluation board, ensure that all link positions are set according to the required operating mode. See Table 2 for the complete list of link options.

The EVAL-AD2S1210SDZ evaluation board is supplied with a wall-mountable switching power supply that provides a 9 V dc output. Connect the supply to a 100 V to 240 V ac wall outlet at 50 Hz to 60 Hz. The output from the supply is provided through a 2.0 mm inner diameter jack that connects to the evaluation board at J702. When supplied via J702, the evaluation board uses the ADP1621 and the ADP3303 to supply the various rails on the board.

If the evaluation board is used without the 9 V adapter, an external power supply in the range of 4.75 V to 5.25 V must be connected to the DV_{DD} and AV_{DD} connectors to supply the AD2S1210 DV_{DD} and AV_{DD} pins. In addition, an external 12 V supply must be connected to the 12 V input to supply the excitation drivers. V_{DRIVE} is by default supplied from the DV_{DD} connector. Optionally, V_{DRIVE} can be supplied by connecting an external supply in the range of 2.3 V to 5.25 V to the V_{DRIVE} input. Consult Table 2 and Table 3 when externally supplying the EVAL-AD2S1210SDZ.

There are two main ground planes, AGND and DGND. These ground planes are connected at one location close to the RDC. AV_{DD} and DV_{DD} are both decoupled using 10 μF tantalum and 10 nF multilayer ceramic capacitors.

Table 1. External Power Supplies

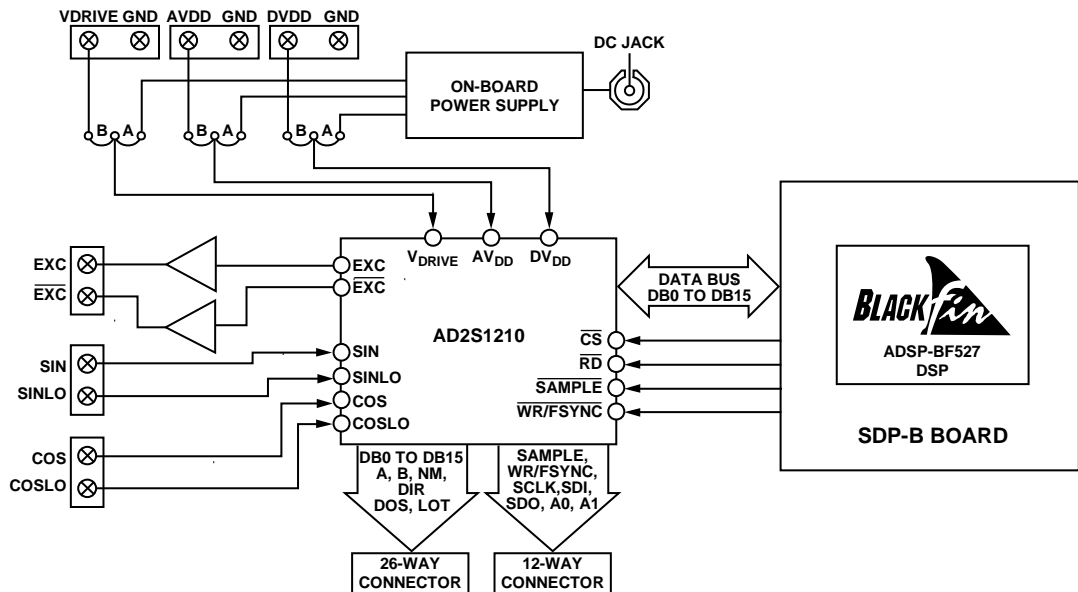| Power Supply	Voltage Range	Purpose
DC Jack	9 V ± 5%	Supplies power to on-board power management devices
DV_{DD}	4.75 V to 5.25 V	AD2S1210 digital supply rail
AV_{DD}	4.75 V to 5.25 V	AD2S1210 analog supply rail
V_{DRIVE}	2.3 V to 5.25 V	Digital interface supply rail
12 V	12 V ± 5%	Excitation driver supply

Figure 13. EVAL-AD2S1210SDZ Functional Block Diagram

LINK CONFIGURATION OPTIONS

Multiple link options must be set correctly to select the appropriate operating setup before using the evaluation board. The functions of these options are described in Table 2.

SETUP CONDITIONS

Before applying power and signals to the evaluation board, ensure that all link positions are configured as required by the operating mode. There are two modes in which to operate the evaluation board. The evaluation board can be operated in SDP-B controlled mode to be used with the EVAL-SDP-CB1Z board, or the evaluation board can be used in standalone mode.

Table 2 shows the default positions in which the links are set when the evaluation board is packaged. When the board is shipped, it is set up to operate in SDP-B controlled mode, with the power supplied from the included 9 V dc switching power supply.

Table 2. Link Options

Category	Link	Default Position	Function
Power Supplies	LK701	A	This link is used to select the source of the AV_{DD} supply for the AD2S1210. In Position A, AV_{DD} is supplied via the on-board ADP3303 linear regulator. In Position B, AV_{DD} is supplied via Connector J703.
	LK702	A	This link is used to select source of the DV_{DD} supply for the AD2S1210. In Position A, DV_{DD} is supplied via the on-board ADP3303 linear regulator. In Position B, DV_{DD} is supplied via Connector J701.
	LK703	A	This link is used to select the source of the V_{DRIVE} supply for the AD2S1210. In Position A, V_{DRIVE} is tied to DV_{DD}. In Position B, the V_{DRIVE} is supplied externally via Connector J704.
	LK501	A	This link is used to select the source of the 12 V supply for the excitation drivers. In Position A, 12 V is supplied via the on-board ADP1621 dc-to-dc converter. In Position B, 12 V must be supplied externally via Connector J500.
Excitation Driver Selection	LK14 to LK17	A	These links select the excitation drivers used. In Position A, the AD8662 in conjunction with a push-pull driver circuit is used. In Position B, the high current AD8397 op amp is used. LK14 to LK17 must be placed in the same position.
Excitation Driver Gain	LK10 to LK13	B	These links select the gain applied to the EXC and $\overline{EXC}$ signals. In Position A, the user can set the gain. Gain = R/10 kΩ, where R = R1 = R4. In Position B, a gain of 1.54 is applied. In Position C, a gain of 0.866 is applied.
AD2S1210 Configuration Pins	LK4	C	A0: In Position A, A0 is tied to V_{DRIVE}. In Position B, A0 is tied to D_{GND}. In Position C, A0 is controlled via J2 or J4
	LK5	C	A1: In Position A, A1 is tied to V_{DRIVE}. In Position B, A1 is tied to D_{GND}. In Position C, A1 is controlled via J2 or J4.
	LK6	C	RES0: In Position A, RES0 is tied to V_{DRIVE}. In Position B, RES0 is tied to D_{GND}. In Position C, RES0 is controlled via J2.
	LK7	C	RES1: In Position A, RES1 is tied to V_{DRIVE}. In Position B, RES1 is tied to D_{GND}. In Position C, RES1 is controlled via J2.
	LK9	A	$\overline{SOE}$: In Position A, $\overline{SOE}$ is tied to V_{DRIVE} In Position B, $\overline{SOE}$ is tied to D_{GND}

Category	Link	Default Position	Function
Digital Interface Options	LK2	C	$\overline{CS}$ source: In Position A, $\overline{CS}$ is controlled via tact switch S2. In Position B, $\overline{CS}$ is tied to D$_{GND}$. In Position C, $\overline{CS}$ is controlled via J2 or J4.
	LK3	C	$\overline{RD}$ source: In Position A, $\overline{RD}$ is tied to $\overline{CS}$. In Position B, $\overline{RD}$ is tied to V$_{DRIVE}$. In Position C, $\overline{RD}$ is controlled via J2 or J4.
	L1	B	$\overline{SAMPLE}$ source: In Position A, $\overline{SAMPLE}$ is controlled via tact switch S2. In Position B, $\overline{SAMPLE}$ is controlled via J2 or J4.

EVALUATION BOARD CIRCUITRY

SOCKETS/CONNECTORS

The connectors and sockets on the EVAL-AD2S1210SDZ are described in Table 3.

The default interface to this evaluation board is via the 120-way Connector J2, which connects the AD2S1210 to the EVAL-SDP-CB1Z board.

Table 3. On-Board Connectors

Connector	Function
J2	EVAL-SDP-CB1Z connector
J3	Parallel interface
J4	Serial interface
J5	Resolver input to AD2S1210
J6	Excitation signal output
J500	External 12 V supply
J701	External DV_{DD} supply
J702	9 V dc barrel socket
J703	External AV_{DD} supply
J704	External V_{DRIVE} supply

TEST POINTS

There are numerous test points on the EVAL-AD2S1210SDZ board. These test points provide easy access to the signals from the evaluation board for probing, evaluation, and debugging.

LAUNCHING THE EVALUATION SOFTWARE

After the evaluation board and the EVAL-SDP-CB1Z board are correctly connected to the PC, the evaluation software can be launched.

From the **Start** menu, go to **Programs** > **Analog Devices** > **AD2S1210**. The main window of the software then opens (see Figure 15).

If the evaluation board is not connected to the USB port via the EVAL-SDP-CB1Z when the software is launched, a connectivity error displays (see Figure 14). Connect the evaluation board to the USB port of the PC, wait a few seconds, click **Rescan**, and follow the instructions that appear.
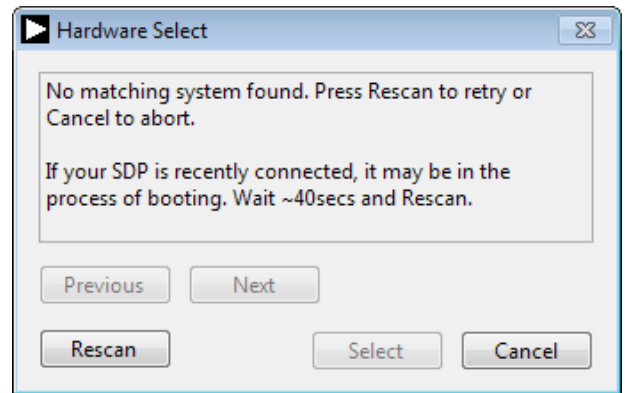
Figure 14. Connectivity Error Alert
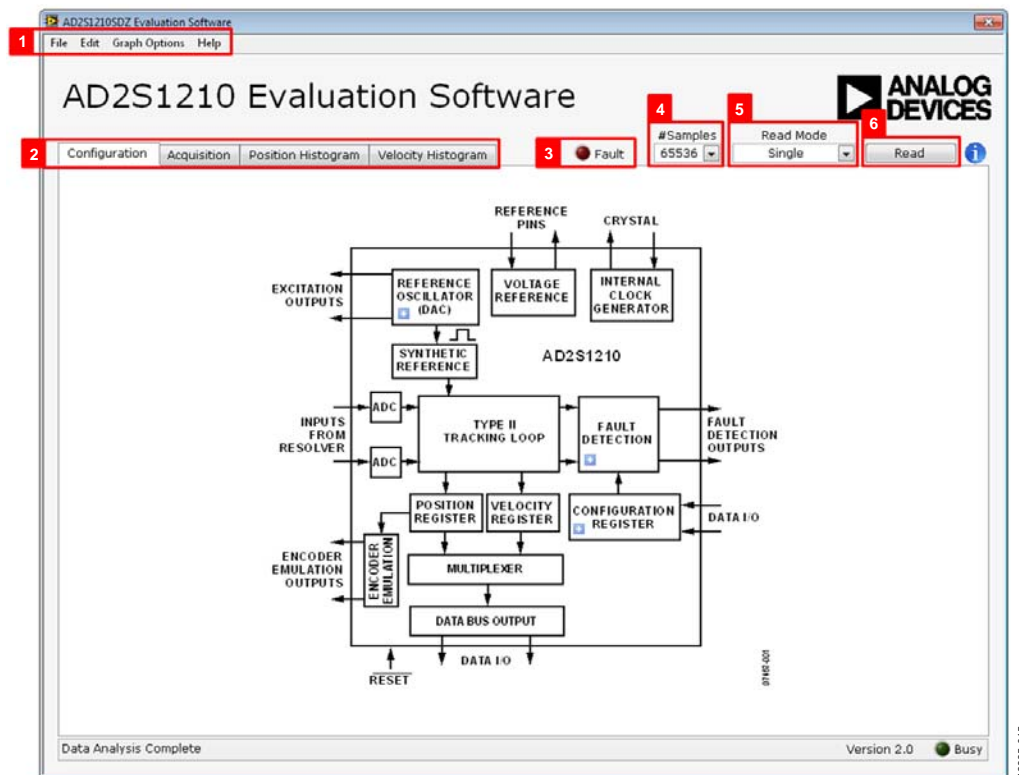
Figure 15. Evaluation Software Main Window

DESCRIPTION OF MAIN WINDOW

When the software is launched, the main software window opens (see Figure 15).

The main software window shown in Figure 15 has the following features:

- Menu bar
- Control buttons
- Configuration display
- Data capture display (position and velocity)
- Fault register display

Menu Bar

The menu bar, Label 1 in Figure 15, consists of the **File**, **Edit**, **Graph Options**, and **Help** menus.

File Menu

- **Save Data.** Saves captured data in comma separated values (CSV) format for future analysis.
- **Save Register Configuration**. Saves the current device configuration as an XML file for later use.
- **Load Data.** Loads previously captured data in CSV format for analysis.
- **Save Register Configuration**. Loads a previously saved AD2S1210 register configuration.
- **Save Screenshot**. Saves a screenshot of the current window as a JPEG file.
- **Exit.** Exits the program.

Edit Menu

- **Reinitialize to default**. Places the evaluation board and software in a known default state.

Graph Options

- **AutoScale X.** Toggles AutoScale on the x-axis.
- **AutoScale Y.** Toggles AutoScale on the y-axis.
- **Clear Graphs/Data.** Clears all graphs and numeric indicators.

Help Menu

- **Context Help.** Turns on context sensitive help.
- **User Guide.** Opens the evaluation kit webpage with a link to the evaluation board user guide.
- **About.** Provides evaluation software version information.

Control Buttons, Drop-Down Boxes, and Indicators

The evaluation software includes the following control buttons, drop-down boxes, and indicators.

- **#Samples**. Label 4. Selects the number of samples to be obtained in a single acquisition.
- **Read Mode**. Label 5. Selects between the two read modes:
  - **Continuous Acquisition**. Repeatedly acquires data from the part one sample at a time. This mode has no fixed sampling rate and streams data from the part as fast as the software will allow.
  - **Single Acquisition.** Captures a defined sample set with the number of samples per acquisition defined in the **#Samples** control, then transfers the data back to the software for display and analysis. This mode has a fixed sampling rate of 500 kHz.
- **Read**. Label 6. Initiates acquisition from the RDC. Click a second time to stop data acquisition when in **Continuous Acquisition** mode.
- **Fault.** Label 3. Displays the status of the fault register. The LED is active when fault bits are set in the fault register.

Configuration Buttons

There are three configuration register buttons contained within the block diagram under the **Configuration** tab. Clicking the blue button (see Figure 16) produces a pop-up box that allow the user to configure the respective section of the block diagram.

Figure 16. Configuration Register Button

The three buttons control the **Excitation Outputs** (**Reference Oscillator (DAC)**), the **Configuration Registers**, and the **Fault Detection**. Refer to the AD2S1210 data sheet for details on available configuration options.

Data Capture Display

There are four tabs (Label 2) to choose from in the software: **Configuration**, **Acquisition**, **Position Histogram**, and **Position Histogram**. See Label 2 in Figure 15.

The tools shown in Figure 17 allow user control of the different chart displays within the **Acquisition**, **Position Histogram**, and **Position Histogram** tabs.
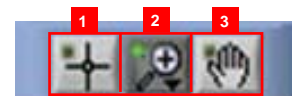
1. USED FOR CONTROLLING THE CURSOR, IF PRESENT.
2. USED FOR ZOOMING IN AND OUT.
3. USED FOR PANNING.

Figure 17. Chart Tools

ACQUISITION

Figure 18 illustrates the tab used for **Acquisition**.

The two charts under this tab show the position and velocity data acquired from the AD2S1210. The units for these charts are selected using the **Units** drop-down box (Label 1 in Figure 18). Two options for units are available: **Decimal** and **Deg/RPS**.

Indicators on the rights of this tab (Label 2) provide statistics on the acquired data, including maximum, minimum, and mean.

The units pertaining to these statistics are specified in the **Units** drop-down box.

The **Fault Register** indicator (Label 3) provides a detailed view of the AD2S1210 fault register status. Clicking the **Clear Fault Register** button (Label 4) runs through a sequence to clear the AD2S1210 fault register.

The fault register is read during software initialization, after each acquisition, and after clearing the fault register.
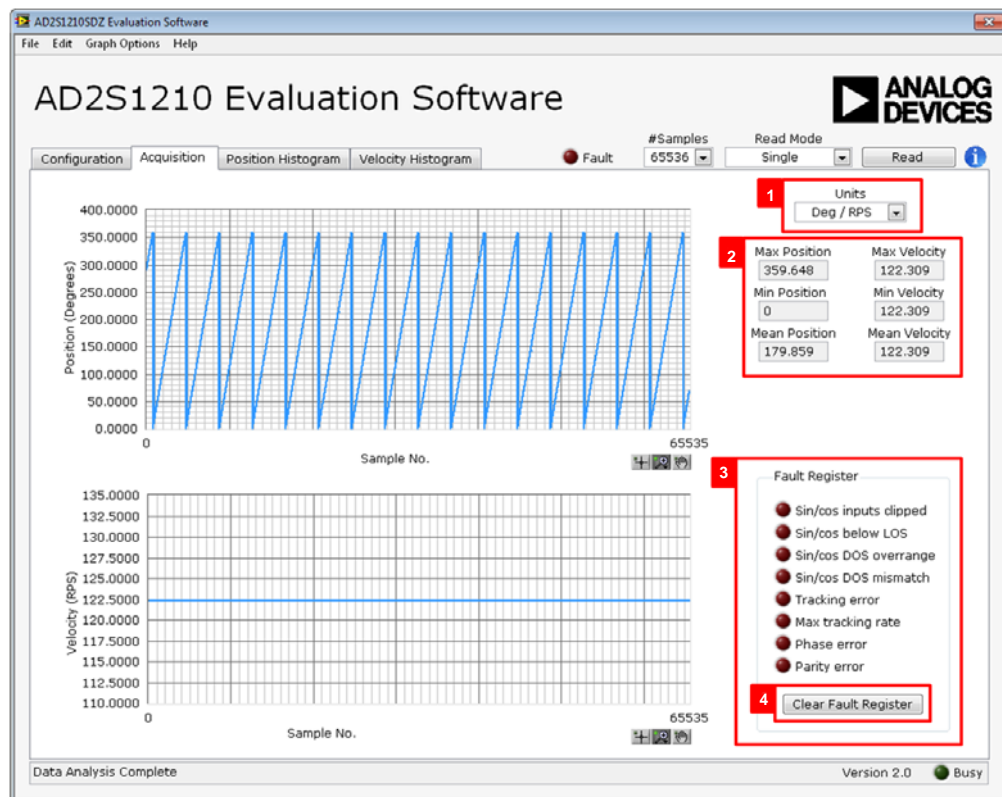
*Figure 18. **Acquisition** Tab*

POSITION/VELOCITY—HISTOGRAM

Figure 19 shows the **Position Histogram** tab. The **Velocity Histogram** tab follows the same format.

The graph shown in each of these tabs displays a histogram of the position or velocity data acquired. Below the graph are three indicators (Label 1) providing statistics on the acquired data.
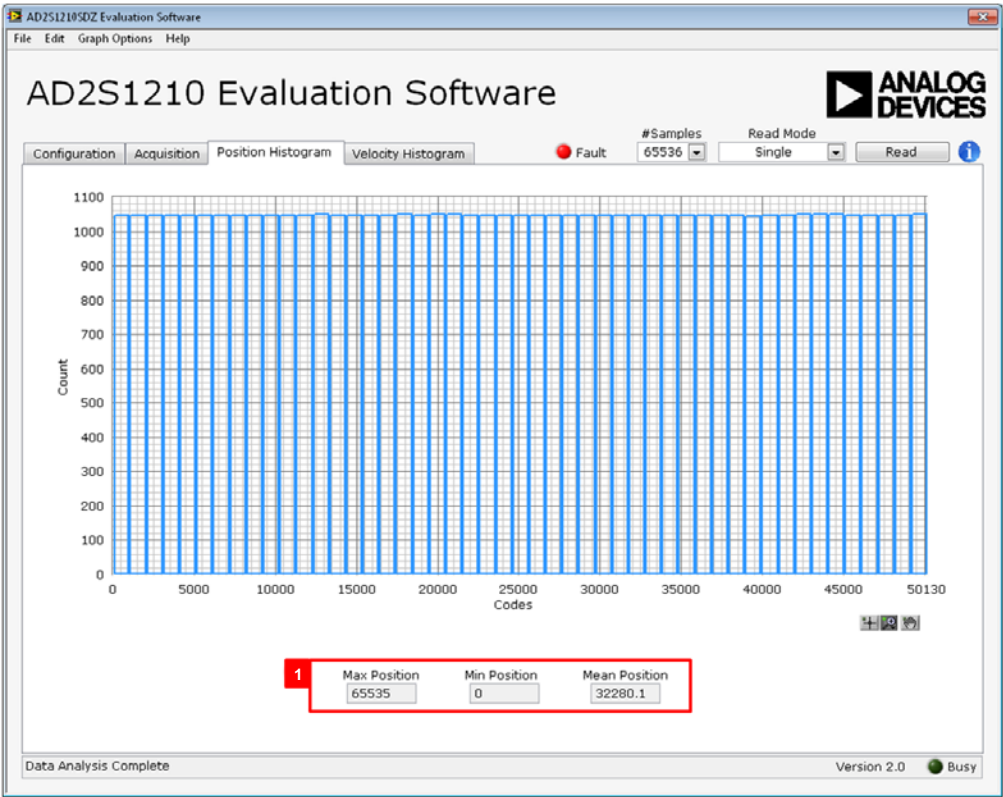
*Figure 19. **Position Histogram** Tab*

SAVING FILES

The evaluation software can save the current captured data for future analysis. The software can save the current device configuration, the position and velocity data, and a screenshot of the current window

Saving Data

To save data, go to the **File** menu, click **Save**, and click **Save Data**. This option saves both the position and velocity data captured (as seen in the **Acquisition** tab) to a CSV file. When **Save Data** is clicked, the **Save As** dialog box in Figure 20 opens, prompting for a location to save the CSV file.
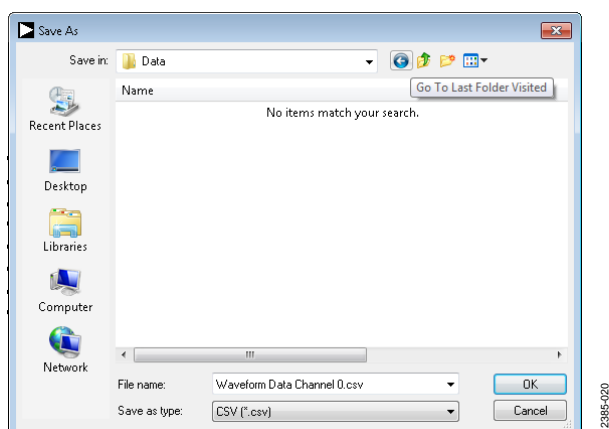
Figure 20. Save File Dialog Box

Saving Screenshots

To save a screenshot of the current window, go to the **File** menu and click **Save Screenshot**. The **Save As** dialog box in Figure 21 opens, prompting for a location to save the JPEG file.

The images are saved in JPEG format and do not contain any raw data information.
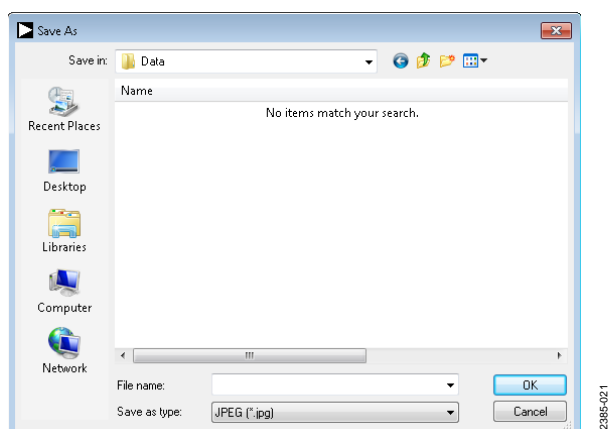
Figure 21. Save Image Dialog Box

Saving Device Configurations

To save the current device configuration in XML format, go to the **File** menu, click **Save**, and then click **Save Register Configuration**. The **Save As** dialog box in Figure 22 opens, prompting for a location to save the XML file.
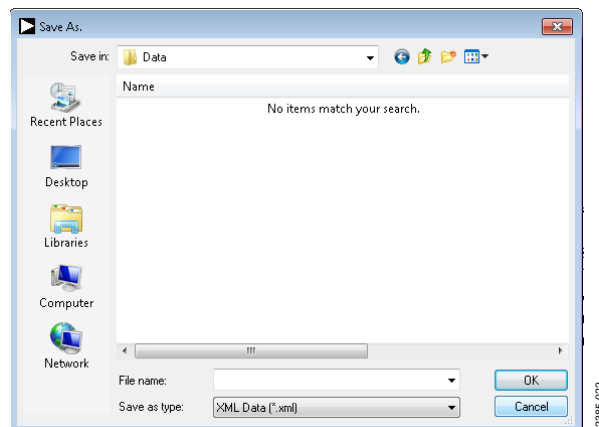
Figure 22. Save Register Configuration Dialog Box

OPENING FILES

Loading Captured Data

The software can load previously captured data for analysis.

Go to the **File** menu, click **Load**, and click **Load Data**. The waveform data is a raw data capture that rebuilds the histogram analysis upon being loaded into the evaluation platform.

When **Load Data** is clicked, the **open** dialog box in Figure 23 appears for loading an appropriate CSV file.
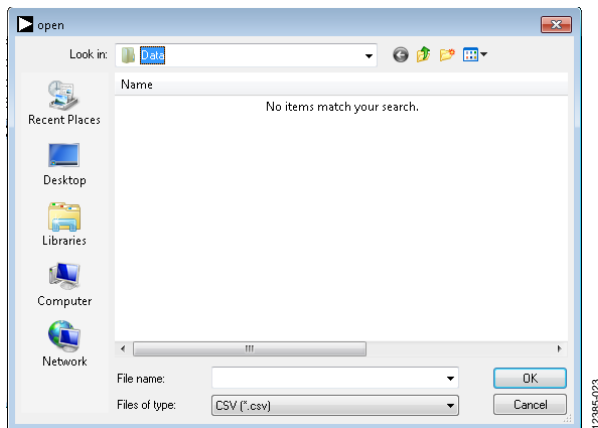
Figure 23. Open File Dialog Box

Loading Device Configurations

The software can load a previously used device configuration.

Go to the **File** menu, click **Load**, and click **Load Register Configuration**. The software loads all previously used device settings to the RDC and updates the evaluation platform appropriately.

When **Load Register Configuration** is clicked, the **Open** dialog box in Figure 24 appears for loading an appropriate XML file.
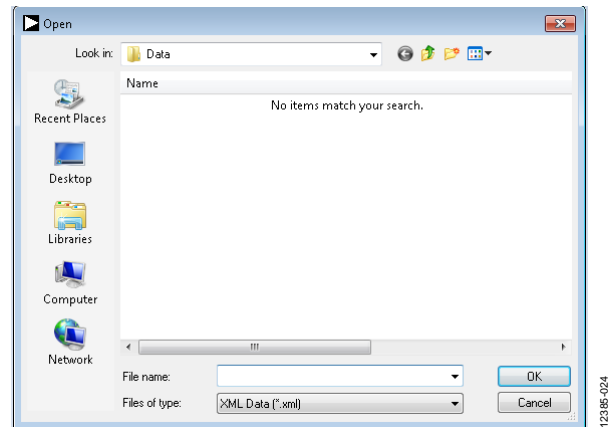
Figure 24. Open Configuration Dialog Box

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.

ANALOG DEVICES

www.analog.com