

Evaluating the **AD4111** with $\pm 10\text{ V}$ and 0 mA to 20 mA Inputs and Integrated Analog Front End for Industrial Automation Systems

FEATURES

Fully featured evaluation board for the **AD4111**
 PC control in conjunction with Analog Devices, Inc., **SDP-B**
 system demonstration platform (**EVAL-SDP-CB1Z**)
 PC software for control and data analysis (time domain)

EVALUATION KIT CONTENTS

EVAL-AD4111SDZ evaluation board

SOFTWARE NEEDED

AD411x Eval+ evaluation software

EQUIPMENT NEEDED

EVAL-SDP-CB1Z system demonstration platform
 DC signal source
 PC running Windows® with USB 2.0 port

GENERAL DESCRIPTION

The EVAL-AD4111SDZ is a full featured evaluation board that can be used to evaluate all the features of the **AD4111**. The **AD4111** is a 24-bit, 31.25 kSPS analog-to-digital converter (ADC) with a $\pm 10\text{ V}$ input voltage range (eight single-ended or four differential channels) with open wire detection and four current channels operating from 0 mA to 20 mA . All channels have on-board overvoltage and overcurrent protection.

The EVAL-AD4111SDZ board includes voltage reference, power, and data insulation and can be connected to the Analog Devices, Inc., **SDP-B** system demonstration platform (**EVAL-SDP-CB1Z**). The **SDP-B** board provides connection to a PC via a USB port and can provide power for the EVAL-AD4111SDZ board from the PC USB port.

The **AD411X Eval+** evaluation software configures the **AD4111** device functionality and provides open wire detection, dc time domain analysis in the form of waveform graphs, histograms, and associated noise analysis for ADC performance evaluation.

Full specifications for the **AD4111** are available in the **AD4111** data sheet, which must be consulted in conjunction with this user guide when working with this evaluation board.

EVALUATION BOARD PHOTOGRAPH

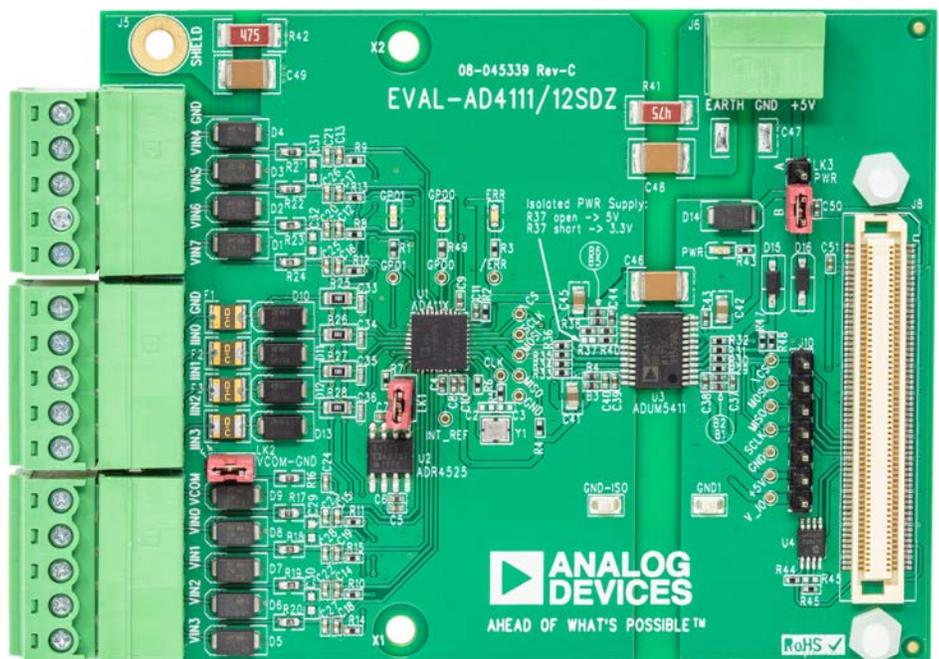


Figure 1.

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REVISION HISTORY

2/2019—Rev. 0 to Rev. A

Changes to Document Title, Equipment Needed Section, and General Description Section 1

Changed Required Software Section to Software Needed Section..... 1

Changes to Figure 2..... 3

Changed Eval-AD4111SDZ Eval+ Quick Start Guide Section to EVAL-AD4111SDZ Quick Start Guide Section 4

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Changes to Device Description Section, Hardware Link Options Section, and Table 1..... 5

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Changes to Figure 8, Figure 9 Caption through Figure 11 Caption, and Installing the Eval+ Dependencies Drivers Section..... 8

Moved Figure 15 9

Changes to Launching the Software Section..... 9

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Changes to Overview of the Main Window Section, Output Data Rate (ODR) and Measurement Time Section, and Reset Section..... 11

Changed Output Data Rate/Measurement Time Section to Output Data Rate (ODR) and Measurement Time Section 11

Changes to Figure 18 Caption, Display Units and Axis Controls Section, and Samples Section..... 12

Changes to Device Error Section, Figure 19 Caption, and Analysis Input Section 13

Changes to Device Error Section 14

Changes to Figure 20 Caption, Register Tree Section, Register Tree Search Section, Register and Bit Field Control Section, and Save and Load Section 15

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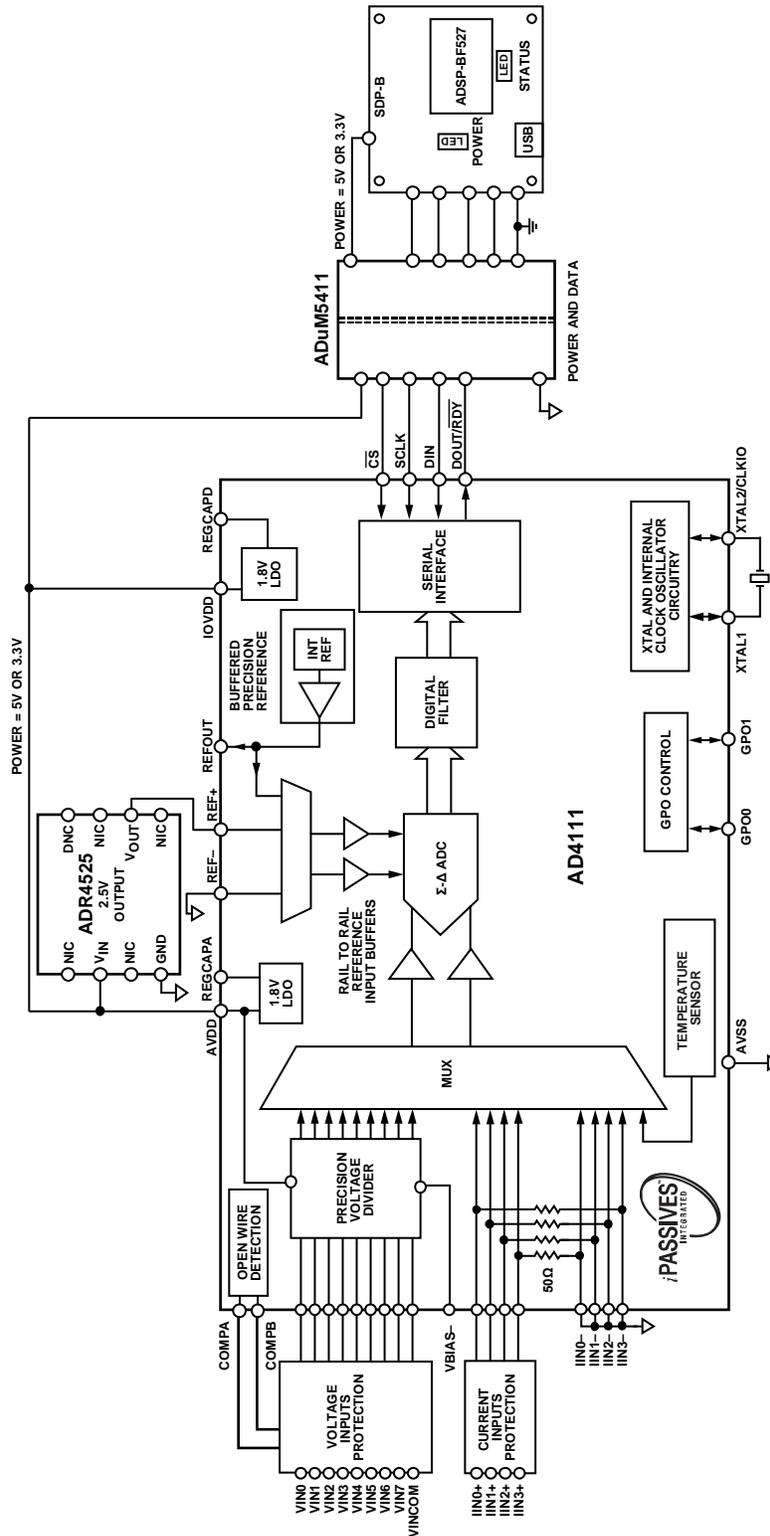
Changes to Figure 29..... 24

Changes to Table 3..... 25

Added I²C Note..... 26

8/2018—Revision 0: Initial Version

EVALUATION BOARD BLOCK DIAGRAM



15728-102

NOTES
1. FOR SIMPLICITY DECOUPLING IS NOT SHOWN.

Figure 2. Evaluation Board Block Diagram

EVAL-AD4111SDZ QUICK START GUIDE

RECOMMENDED QUICK START GUIDE

Use the following procedure to set up the evaluation board:

1. Disconnect the **SDP-B** board from the USB port of the PC. Install the **AD411x Eval+** software (available for download from the EVAL-AD4111SDZ product page). Restart the PC after installation.
2. Connect the **SDP-B** board to the EVAL-AD4111SDZ board, as shown in Figure 3.
3. Fasten the two boards together with the enclosed plastic screw washer set.
4. Connect the **SDP-B** board to the PC via the USB cable. For Windows® XP, the user may need to search for the SDP drivers. Choose to automatically search for the drivers for the **SDP-B** board if prompted by the operating system.
5. Launch the **AD411x Eval+** software from the **Analog Devices** subfolder in the **Programs** menu.

QUICK START MEASUREMENT

Use following procedure to quickly capture data and test open wire detection:

1. Connect the dc signal source to the selected voltage input (for example, VIN0 and VIN1 for differential input).
2. Launch the **AD411x Eval+** software and select **Quickstart** mode.
3. In the **Configuration** tab, under **Demo Mode**, click **All Single-Ended**, and click **Sample** (see Figure 16).
4. In the **Voltage Waveform** tab, the user can evaluate the measured data and see the open wire error flag for unconnected inputs.

The **Samples** numeric control in the top right corner of the main window sets the number of samples collected in each batch.

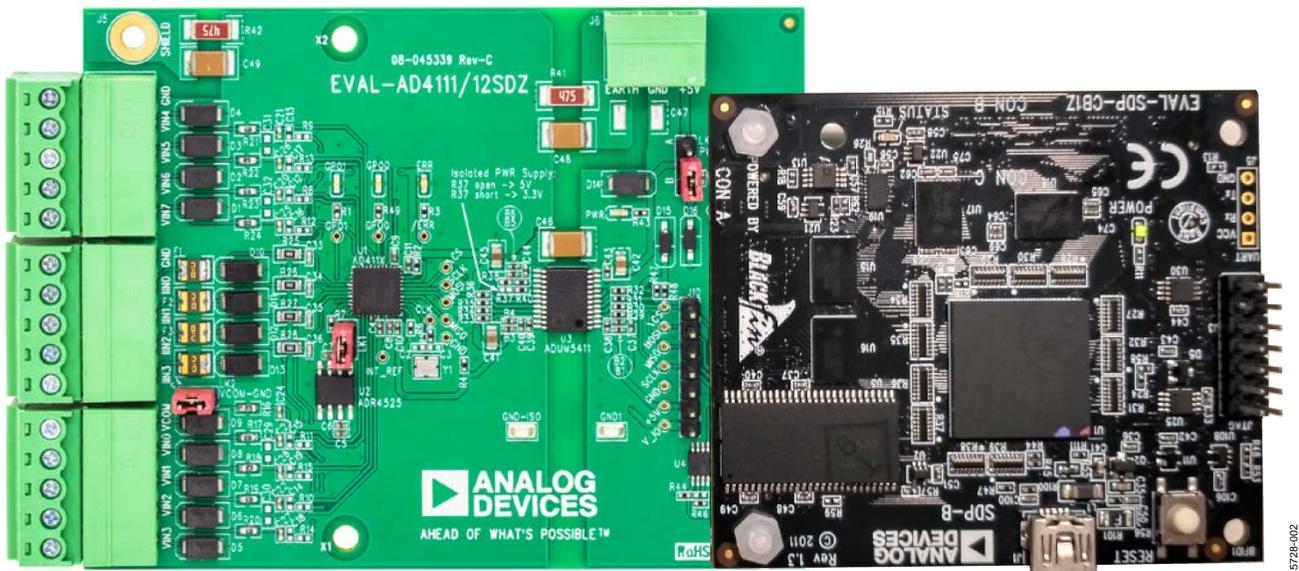


Figure 3. Hardware Configuration

EVALUATION BOARD HARDWARE

DEVICE DESCRIPTION

The [AD4111](#) is a highly accurate, high resolution, multiplexed, Σ - Δ ADC with eight single-ended or four differential voltage inputs and four current inputs, a voltage range of ± 10 V, and four current channels operating from the standard range of 0 mA to 20 mA (with an overrange of -0.5 mA to $+24$ mA). The [AD4111](#) features an open wire detection for voltage channels. The maximum channel to channel scan rate is 6.21 kSPS (161 μ s) for fully settled data. The output data rates range from 1.25 SPS to 31.25 kSPS. The device includes integrated analog reference buffers, an integrated precision 2.5 V reference, and an integrated oscillator.

See the [AD4111](#) data sheet for complete specifications. Full details on the EVAL-AD4111SDZ are available on the product page on the Analog Devices website.

HARDWARE LINK OPTIONS

See Table 1 for the default link options. By default, the board is powered from the [SDP-B](#) board connected to J8 ([EVAL-SDP-CB1Z](#)). The isolated voltage regulator (U3) output is set to 5 V.

Table 1. Default Link and Solder Link Options

Link	Default Option	Description
LK1	Inserted	Connects the on-board external reference ADR4525ARZ (U2) to AD4111BCPZ (U1). Remove LK1 if using a different single-ended external reference.
LK2	Inserted	Connects VCOM to GND_ISO. This configuration is typical for single-ended measurement. Remove LK2 to set the custom common analog input for single-ended channels. VCOM is available on Pin 5 of J1 or J4.
LK3	B (SDP)	Selects the power supply voltage. A: board is powered from the external dc power supply connector, J6 or J7. B: board is powered from the SDP connector, J8.
R37	Open	Sets the ADuM5411 (U3) isolated regulator output voltage. Open: +VA_ISO = 5 V. Short: +VA_ISO = 3.3 V.

EVALUATION BOARD SETUP PROCEDURE

After following the instructions in the Software Installation Procedures section, set up the evaluation board and the [SDP-B](#) board as detailed in this section.

The evaluation software and drivers must be installed before connecting the EVAL-AD4111SDZ and the [SDP-B](#) board to the USB port of the PC to ensure that the PC correctly recognizes the evaluation system.

Configuring the Evaluation and SDP Boards

Use the following procedure to configure the boards:

1. Connect the [SDP-B](#) board to Connector A or Connector B on the EVAL-AD4111SDZ board. Screw the two boards together using the plastic screw and washer set included in the evaluation board kit to connect the boards firmly together.
2. Ensure that LK3 is in Position B (SDP).
3. Connect the [SDP-B](#) board to the PC using the USB cable.

SERIAL INTERFACE

The EVAL-AD4111SDZ connects via the serial peripheral interface (SPI) to the Blackfin® [ADSP-BF527](#) on the [SDP-B](#) board. There are four primary signals: \overline{CS} , SCLK, DIN (all inputs), and DOUT/ \overline{RDY} (output from the ADC).

The EVAL-AD4111SDZ can be connected to the [EVAL-ADuCM3029 EZ-KIT](#) in the same way. Connecting the evaluation board to the [EVAL-ADuCM3029 EZ-KIT](#) allows the user to develop their own C code rather than using the provided evaluation software.

To operate the EVAL-AD4111SDZ in standalone mode, disconnect any board connected to J8 and use J10 to access all SPI signals and set the input/output voltage levels.

POWER SUPPLIES

By default, the board is powered from the [SDP-B](#) connector. The board can be also powered from J6 and J7 (set LK3 to Position A) or from Pin +5V on J10 (see Table 2).

The [ADuM5411](#) *isoPower*® digital isolator is used to isolate power and data lines up to 2.5 kV rms.

Table 2. Connector Details

Connector	Function	Connector Type	Manufacturer	Part Number
J1, J2, J4	Voltage inputs to ADC	Connector, header, 90°, 5-position, 3.81 mm	Phoenix Contact	MC 1, 5/5-G-3, 81
J3, J4	Current inputs to ADC	Connector, header, 90°, 5-position, 3.81 mm	Phoenix Contact	MC 1, 5/5-G-3, 81
J5	Earth for electrostatic discharge (ESD) testing	1.25-MS3 ring tongue terminal, M3, No. 5, 16 AWG, 1.65 mm ²	Japan Solderless Terminals	1.25-MS3
J6, J7	External supply voltage (optional)	Connector, header, 90°, 5-position, 3.81 mm	Phoenix Contact	MC1.5/3-G-3.81
J8	Connector to the EVAL-ADuCM3029 EZ-KIT or EVAL-SDP-CB1Z	120-way connector, 0.6 mm pitch	Hirose	FX8-120S-SV (21)
J10	SPI and power terminal	Header, in line, 7-position, 100 mil	Würth Elektronik	61300711121

ANALOG INPUTS

There are two types of analog inputs: voltage and current.

Eight voltage inputs are available on J1 and J2. Four current inputs are available on J3.

If a different common voltage must be set for single-ended measurement, remove LK2 and connect the desired voltage to VCOM on J1.

REFERENCE OPTIONS

The EVAL-AD4111SDZ includes an external 2.5 V reference, the [ADR4525ARZ](#). By default, LK1 is inserted, connecting the external reference to the REF+ pin of the [AD4111](#).

Remove LK1 if using a different single-ended external reference.

In the evaluation software, click the blue pop-up button associated with Setup 0 to Setup 7 to select the reference used for conversions by the [AD4111](#). The pop-up button is located below the external reference controls in the block diagram (Label 9 in Figure 16).

EVALUATION BOARD SOFTWARE SOFTWARE INSTALLATION PROCEDURES

The EVAL-AD4111SDZ evaluation kit includes a link to the software that must be installed before using the EVAL-AD4111SDZ.

There are two parts to the installation:

- **AD411x Eval+** software installation
- **Eval+ Dependencies** installation, including **SDP-B** board drivers

The evaluation software and drivers must be installed before connecting the EVAL-AD4111SDZ and **SDP-B** board to the USB port of the PC to ensure that the PC correctly recognizes the evaluation system.

Installing the AD411x Eval+ Software

To install the **AD411x Eval+** software, use the following procedure:

1. With the **SDP-B** board disconnected from the USB port of the PC, download and unzip the **AD411X Eval+** software installer file from the EVAL-AD4111SDZ product page.
2. Double-click the **setup.exe** file to begin the evaluation board software installation. The software then installs to the following default location: **C:\Program Files\Analog Devices\AD411x Eval+**.
3. A dialog box appears asking for permission to allow the program to make changes to the PC. Click **Yes**.



Figure 4. **AD411x Eval+** Software Installation: Granting Permission for the Program to Make Changes to the PC

4. Select a location to install the software and click **Next**. Figure 5 shows the default locations, which are displayed when the dialogue box opens, but another location can be selected by clicking **Browse**.

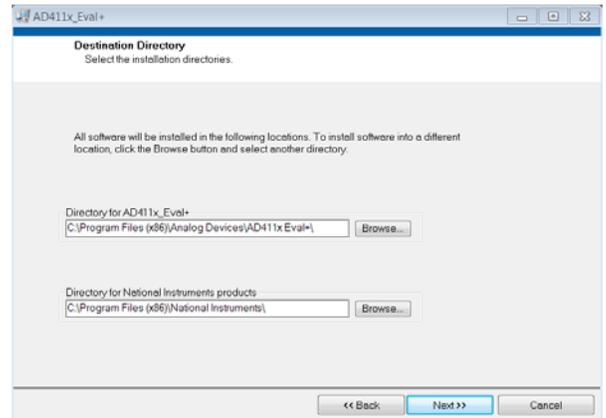


Figure 5. **AD411x Eval+** Software Installation: Selecting the Location for Software Installation

5. A license agreement appears. Read the agreement, select **I accept the License Agreement**, and click **Next**.

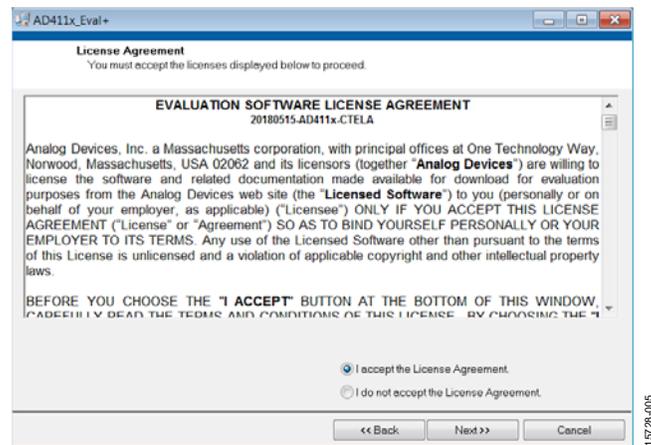


Figure 6. **AD411x Eval+** Software Installation: Accepting the License Agreement

6. A summary of the installation displays. Click **Next** to continue.

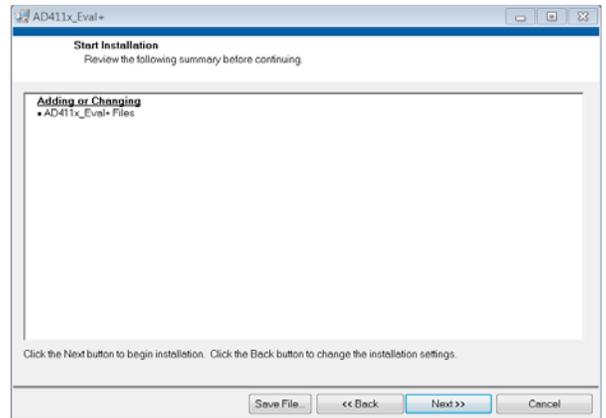


Figure 7. **AD411x Eval+** Software Installation: Reviewing a Summary of the Installation

7. The message in Figure 8 appears when the installation is complete. Click **Next**.

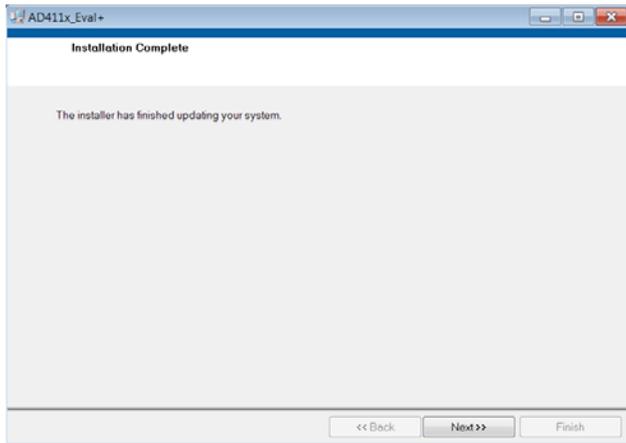


Figure 8. AD411x Eval+ Software Installation: Indicating When the Installation Is Complete

Installing the Eval+ Dependencies Drivers

After the installation of the evaluation software is complete, a welcome window displays for the installation of the Analog Devices Eval+ dependencies. Perform the following steps to install the dependencies drivers:

1. With the SDP-B board still disconnected from the USB port of the PC, ensure that all other applications are closed and click **Install**.

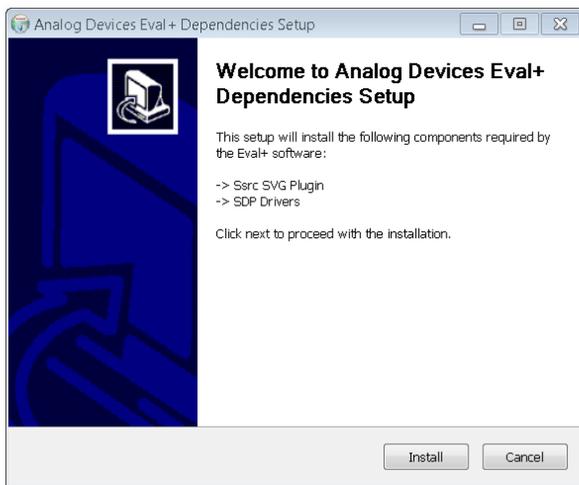


Figure 9. Analog Devices Eval+ Dependencies Setup: Beginning the Drivers Installation

2. To complete installation of the drivers, click **Close**, which closes the installation setup wizard.

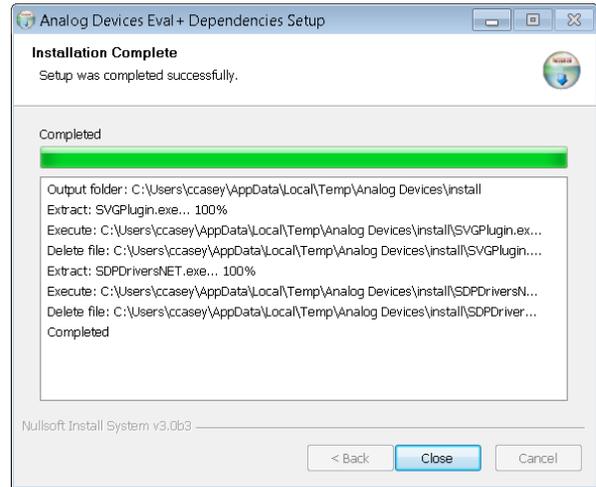


Figure 10. Analog Devices Eval+ Dependencies Setup: Completing the Drivers Setup Wizard

3. Before using the evaluation board, restart the PC.

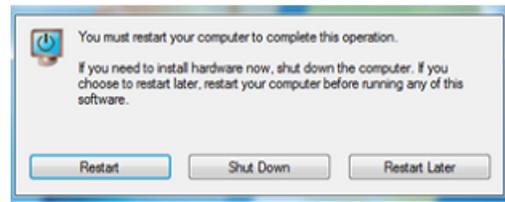


Figure 11. Analog Devices Eval+ Dependencies Setup: Restarting the PC

Setting Up the System for Data Capture

After completing the steps in the Software Installation Procedures section and the Evaluation Board Hardware section, set up the system for data capture as follows:

1. Allow the **Found New Hardware Wizard** to run after connecting the **SDP-B** board to the PC. For Windows® XP, the user may need to search for the SDP drivers. Choose to automatically search for the drivers for the **SDP-B** board if prompted by the operating system.
2. Check that the board is connecting to the PC correctly using the **Device Manager** of the PC. Access the **Device Manager** as follows:
 - a. Right-click **My Computer** and then click **Manage**.
 - b. A dialog box appears asking for permission to allow the program to make changes to the PC. Click **Yes**.
 - c. The **Computer Management** box appears. Click **Device Manager** from the list of **System Tools** (see Figure 12).
 - d. The **SDP-B** board appears under **ADI Development Tools**, which indicates that the driver software has been installed, and that the board is connected to the PC correctly.

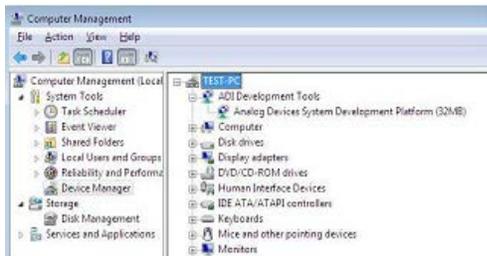


Figure 12. **Device Manager**: Checking if the Board is Connected to the PC Correctly

Launching the Software

After completing the steps in the Setting Up the System for Data Capture section, launch the **AD411x Eval+** software as follows:

1. From the **Start** menu, click **Programs > Analog Devices > AD411x Eval+ > AD411x Eval+**. The dialog box in Figure 13 appears. Select **AD4111 Evaluation Board**, and the main window of the software appears as shown in Figure 16.

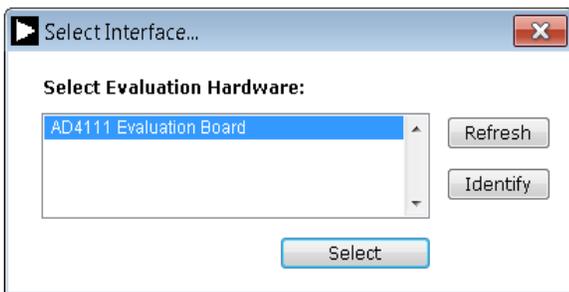


Figure 13. **AD4111 Evaluation Board Selection**

2. If the EVAL-AD4111SDZ evaluation system is not connected to the USB port via the **SDP-B** when the software is launched, the software displays the dialog box shown in Figure 14. Connect the evaluation board to the USB port of the PC, wait a few seconds, click **Refresh**, and the option shown in Figure 13 appears.

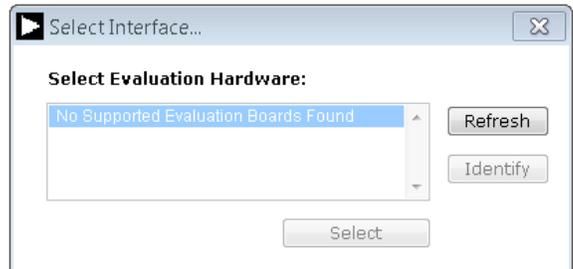


Figure 14. **Evaluation Board Selection: No Board Connected**

3. If Step 1 was completed correctly, the dialog box shown in Figure 15 appears. Quickstart mode provides a simplified version of the software that can be used as a starting point for evaluating the **AD4111**. This mode provides a graphical user interface (GUI) for setting up inputs, as shown in Figure 16, and allows the user to further configure the device using the blue configuration buttons (Label 8 in Figure 16).

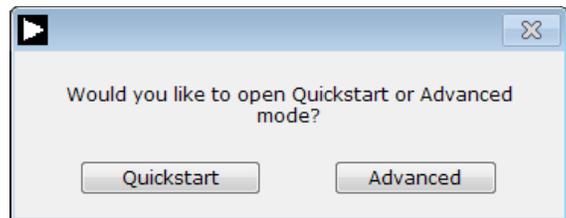


Figure 15. **AD411x Eval+ Startup Mode Selection**

Advanced mode can be used when more configurability of the inputs is required. In this mode, the input GUI is not available. However, the user has access to the **Register** tab, which provides full control of the **AD4111** register map. When operating in advanced mode, the user must consult with and have a good understanding of the **AD4111** data sheet.

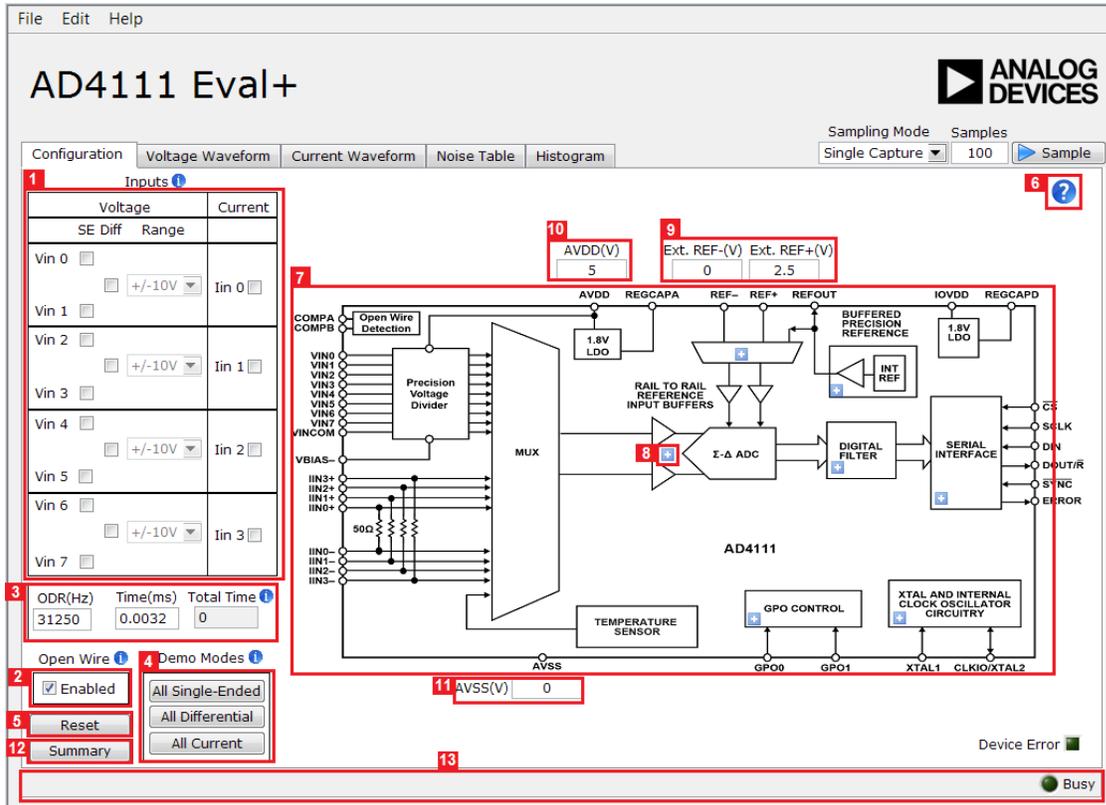


Figure 16. Configuration Tab of the AD4111 Eval+ Software in Quickstart Mode

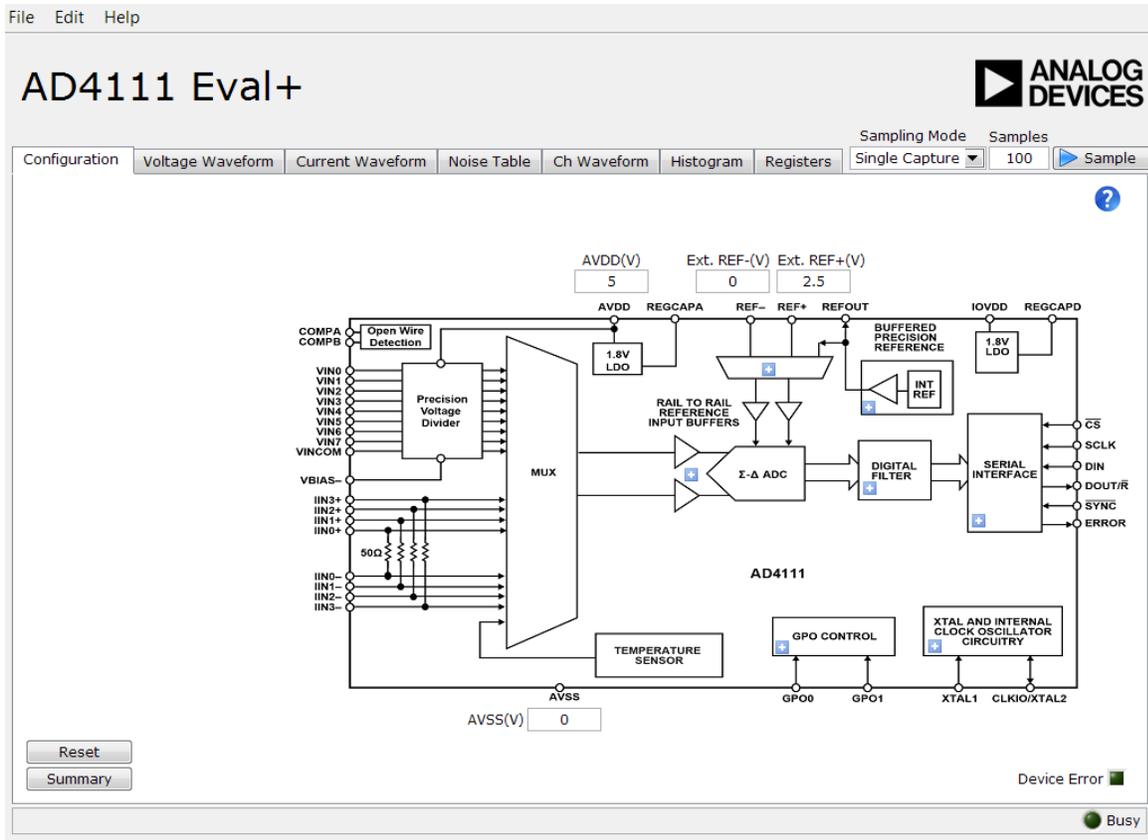


Figure 17. Configuration Tab of the AD4111 Eval+ Software in Advanced Mode

SOFTWARE OPERATION

Overview of the Main Window

After selecting **AD411x Evaluation Board**, the main window of the evaluation software appears, as shown in Figure 16. The **Configuration** tab shows the control buttons and analysis indicators of the **AD411x Eval+** software. The main window of the **AD411x Eval+** software in quickstart mode contains five tabs: **Configuration**, **Voltage Waveform**, **Current Waveform**, **Noise Table**, and **Histogram**.

In advanced mode, two additional tabs are available: **Ch Waveform** and **Registers**.

CONFIGURATION TAB

The **Configuration** tab shows a block diagram of the **AD4111**. This tab allows the user to select inputs, set up the ADC, reset the ADC, and view errors present, as well as configure the device for different demonstration modes. Figure 16 shows the **Configuration** tab in detail, and the following sections discuss the different elements on the **Configuration** tab of the software window.

Inputs and Open Wire Detection (Quickstart Mode Only)

The **AD4111** has eight voltage inputs, which can be configured as single-ended or fully differential pairs, and four current inputs (Label 1 in Figure 16).

One of the features of the **AD4111** is its ability to perform open wire detection on voltage inputs while using a single power supply. This feature can be toggled on and off as required (Label 2 in Figure 16). If seven or all eight of the voltage inputs are enabled as single-ended, current inputs are restricted to two or none, respectively. After an input is selected, the software automatically assigns the input to the correct channel(s). Click **Summary** (Label 12 in Figure 16) to see what channels an input has been assigned to.

The voltage range can also be set per input to ± 10 V, ± 5 V, 0 V to 10 V, or 0 V to 5 V. Changing this to the appropriate range gives more realistic values for the **P - P Resolution** and **RMS Resolution** shown in the **Noise Analysis** (see Figure 18).

Output Data Rate (ODR) and Measurement Time

The ODR can be set for all inputs in the **Configuration** tab (Label 3 in Figure 16). Set the ODR by entering a value in Hz into the **ODR(Hz)** box or a measurement time in ms into the **Time(ms)** box. If an ODR is entered, the software calculates the measurement time. If a time is entered, the software calculates the fastest ODR that can achieve the required measurement time.

The device only supports a certain number of ODRs. Therefore, the software rounds up to the closest available value. The ODR values depend on if a single or multiple channels are enabled. The fastest ODRs are available if only one channel is enabled. The values represent the sinc5 + sinc1 filter, which is enabled by default. If the sinc3 filter is enabled instead, refer to the **AD4111** data sheet to see the corresponding values.

The value in **Time(ms)** represents time taken for one sample for one enabled channel. If open wire is enabled, voltage inputs take twice as long.

The value in the **Total Time** box represents the total time to take one sample for all enabled inputs.

Demo Modes

The **AD411x Eval+** software contains a number of demonstration modes in the **Demo Modes** area (Label 4 in Figure 16). These demonstration modes configure the **AD4111** for each of the input types (voltage fully differential, voltage single-ended, and current measurements).

Reset

Click **Reset** (Label 5 in Figure 16) to perform a software reset of the **AD4111**. There is no hardware reset pin on the **AD4111**.

To perform a hard reset, remove power from the board. The software reset has the same effect as a hard reset.

Tutorial Button

Click the tutorial button (Label 6 in Figure 16) to open a tutorial on using the software and additional information on using the **AD411x Eval+** software. Click the information buttons for further information on different elements of the **Configuration** tab.

Functional Block Diagram

The functional block diagram of the **AD4111** (Label 7 in Figure 16) shows each of the functional blocks within the **AD4111**. Clicking a configuration button on this diagram opens the configuration pop-up window for that block.

Configuration Pop-Up Button

Each configuration pop-up button (Label 8 in Figure 16) opens a different window to configure the relevant functional block.

External Parameters

There are three external parameters that are set by the EVAL-AD4111SDZ but must be entered into the software: the external reference (Label 9 in Figure 16), AVDD (Label 10 in Figure 16), and AVSS (Label 11 in Figure 16). The external reference on the EVAL-AD4111SDZ is set to 2.5 V by using an **ADR4525**. If bypassing the **ADR4525** on the board, change the external reference voltage value in the software to ensure correct calculation of results in the **Voltage Waveform**, **Current Waveform**, and **Histogram** tabs.

Configuration Summary

Clicking **Summary** (Label 12 in Figure 16) displays the input configuration, channel configuration, and information on each of the individual setups as well as information on any error present. These tabs can be used to quickly check how the ADC inputs and channels are configured, as well as any errors that are present.

Status Bar

The status bar (Label 13 in Figure 16) displays status updates such as **Analysis Completed**, **Reset Completed**, **Writing to Registers** during software use, and the **Busy** indicator.

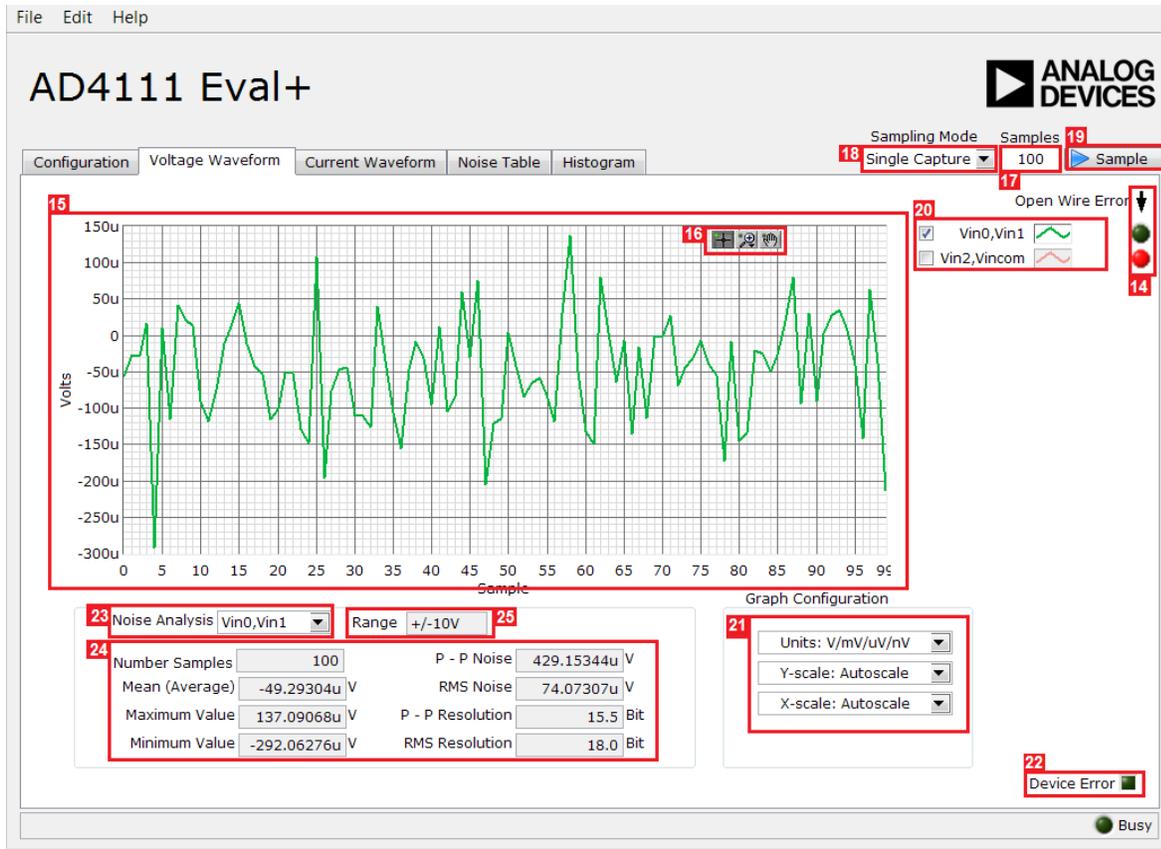


Figure 18. Voltage Waveform Tab of the AD4111 Eval+ Software

WAVEFORM TABS

The AD411x Eval+ software has three different waveform tabs: for voltage inputs, **Voltage Waveform**; for current inputs, **Current Waveform**; and a per channel **Ch Waveform** tab (advanced mode only). The waveform tabs graph the conversions gathered and processes the data, calculating the peak-to-peak noise, rms noise, and resolution (see Figure 18). The **Voltage Waveform** tab graphs the data at the voltage inputs. This tab is where open wire is flagged (Label 14 in Figure 18). The **Current Waveform** tab graphs the data at the current inputs, which are displayed in amps. Both tabs share the functionalities described in the following sections. The **Ch Waveform** tab displays both voltage and current inputs as voltages.

Waveform Graph and Controls

The data waveform graph (Label 15 in Figure 18) shows each successive sample of the ADC output. Zoom in on the data in the graph using the control toolbar (Label 16 in Figure 18). Change the scales on the graph by typing values into the x-axis and y-axis fields.

Samples

The **Samples** numeric control and **Sampling Mode** box (Label 17 and Label 18 in Figure 18) set the number of samples gathered per batch. If **Sampling Mode** is set to **Single Capture**, the ADC returns the number of samples specified by the

Samples control. If **Sampling Mode** is set to **Continuous** mode, the ADC continuously returns samples until stopped by the user. **Samples** specifies the amount of samples to be shown on the data graph. This control is unrelated to the ADC mode.

Sample

Click **Sample** (Label 19 in Figure 18) to start gathering ADC results. Results appear in the waveform graph (Label 15 in Figure 18).

Plot Selection

The plot selection control (Label 20 in Figure 18) selects which inputs display on the data waveform and shows the name of the input next to the on and off controls.

These controls only affect the waveform graphs and have no effect on the channel settings in the ADC register map.

Display Units and Axis Controls

Click the **Units** dropdown box (Label 21 in Figure 18) to select whether the data graph displays in units of voltages/amps or codes. This control is independent for each graph. The axis controls switch between autoscale and fixed. When autoscale is selected, the axis automatically adjusts to show the entire range of the ADC results after each batch of samples. When fixed is selected, the axis range can be set by the user. However, these ranges do not automatically adjust after each batch of samples.

Device Error

The **Device Error** indicator (Label 22 in Figure 18) illuminates in the waveform tabs when a cyclic redundancy check (CRC) error or an error in the ADC is detected. More specific information of the error can be found by clicking **Summary** in the **Configuration** tab (Label 12 in Figure 16).

Analysis Input

The **Noise Analysis** box shows the analysis of the input selected via the analysis control (Label 23 in Figure 18).

Noise Analysis

The **Noise Analysis** section (Label 24 in Figure 18) displays the results of the noise analysis for the selected analysis input, including both noise and resolution measurements.

Input Range

Range (Label 25 in Figure 18) is an indicator in quickstart mode. The value is selected per the inputs on the **Configuration** tab (Label 1 in Figure 16). In advanced mode, **Range** is a control that allows the user to select an input range for the input chosen for **Noise Analysis** (Label 23 in Figure 18).

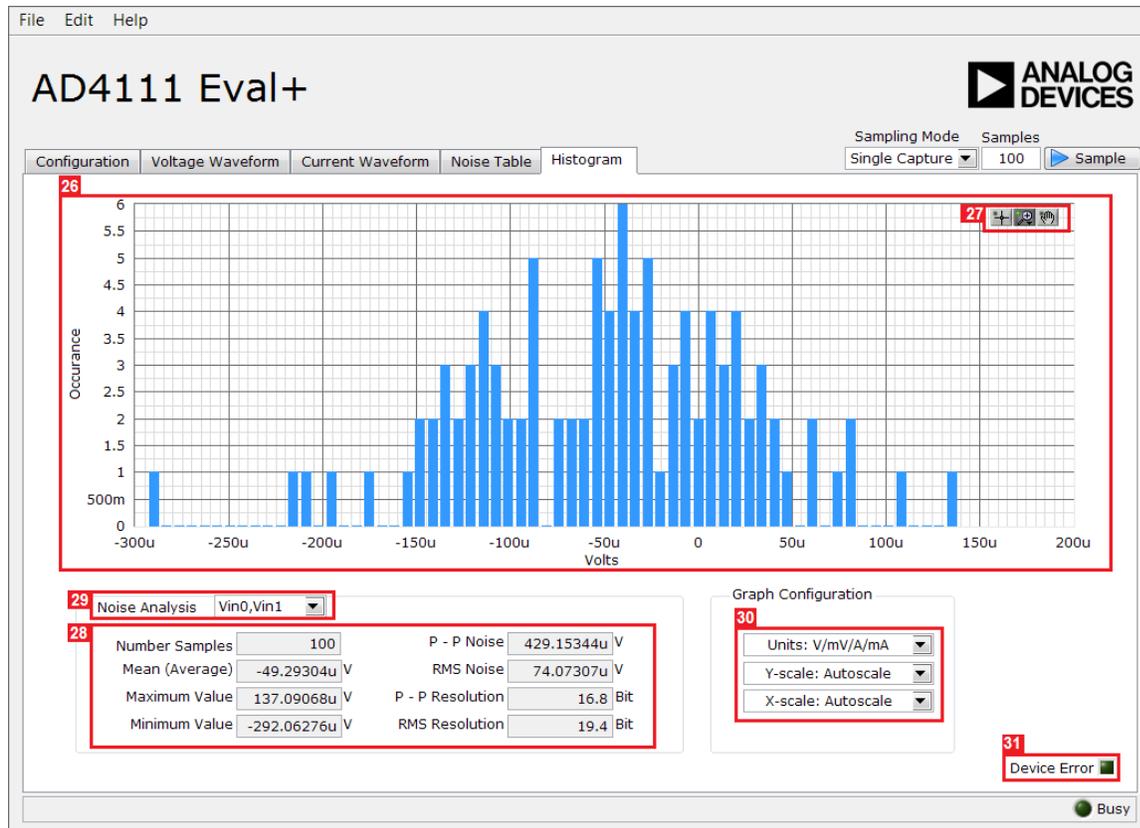


Figure 19. Histogram Tab of the AD4111 Eval+ Software

HISTOGRAM TAB

The **Histogram** tab generates a histogram using the gathered samples and processes the data, calculating the peak-to-peak noise, rms noise, and resolution (see Figure 19). There is only one histogram tab for current and voltage inputs.

Histogram Graph and Controls

The data histogram graph (Label 26 in Figure 19) shows the number of times each sample of the ADC output occurs. Zoom in on the data using the control toolbar (Label 27 in Figure 19) in the graph. Change the scales on the graph by typing values into the x-axis and y-axis.

Analysis Input

The data used to generate the histogram graph (Label 26 in Figure 19) and the **Noise Analysis** section (Label 28 in Figure 19) is set by the **Noise Analysis** box (Label 29 in Figure 19). All the enabled inputs appear here in the **Noise Analysis** box.

Noise Analysis

The **Noise Analysis** section (Label 28 in Figure 19) displays the results of the noise analysis for the selected analysis input, including both noise and resolution measurements.

Display Units and Axis Controls

Click the **Units** dropdown box (Label 30 in Figure 19) to select whether the data graph displays in units of voltages/amps or codes. This control is independent for each graph. The axis controls switch between autoscale and fixed. When autoscale is selected, the axis automatically adjusts to show the entire range of the ADC results after each batch of samples. When fixed is selected, the axis range can be set by the user. However, these ranges do not automatically adjust after each batch of samples.

Device Error

The **Device Error** indicator (Label 31 in Figure 19) illuminates in the **Histogram** tab when a CRC error or an error in the ADC is detected. More specific information of the error can be obtained by clicking **Summary** in the **Configuration** tab (Label 12 in Figure 16).

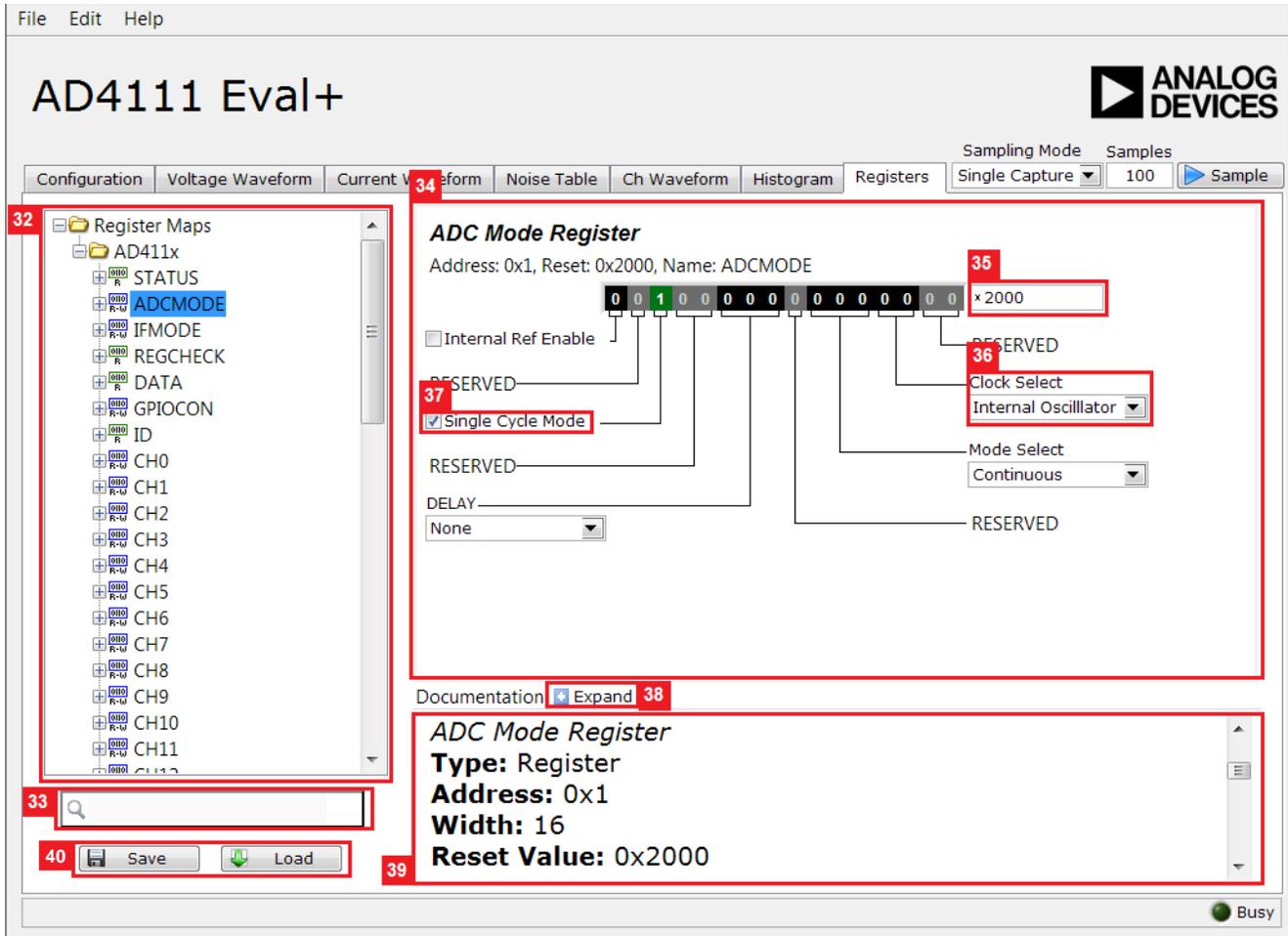


Figure 20. Registers Tab of the AD4111 Eval+ Software

REGISTER MAP TAB (ADVANCED MODE ONLY)

Register Tree

The register maps nested list (Label 32 in Figure 20) shows the full register map in a tree control. Each register is shown. Clicking the expand button next to each register shows all the bit fields contained within that register.

Register Tree Search

The register tree search box (Label 33 in Figure 20) allows the user to search the tree for any register or bit field. Enter a value into this field to filter the register tree.

Register and Bit Field Control

The register and bit field control section (Label 34 in Figure 20) allows the user to change the individual bit of the register selected in the register tree by clicking the bits or by programming the register value directly into the number control field (Label 35 in Figure 20). This control also shows all bit fields for the selected register. Change the values by using a dropdown box (Label 36 in Figure 20) or by selecting or clearing a checkbox (Label 37 in Figure 20).

Documentation

The **Documentation** field (Label 39 in Figure 20) contains the documentation for the register or the bit field selected. This field can be updated by selecting a register or bit field in the register tree or hovering over the register or bit field in the register tree or register control. This documentation can also be displayed in a separate window by clicking the expand button (Label 38 in Figure 20).

Save and Load

Save and **Load** (Label 40 in Figure 20) allow the user to save the current register map setting to a file and to load the setting from the same file, respectively.

EXITING THE SOFTWARE

To exit the software, click the **Close** button at the top right corner of the main window.

EVALUATION BOARD SCHEMATICS AND ARTWORK

15728-017

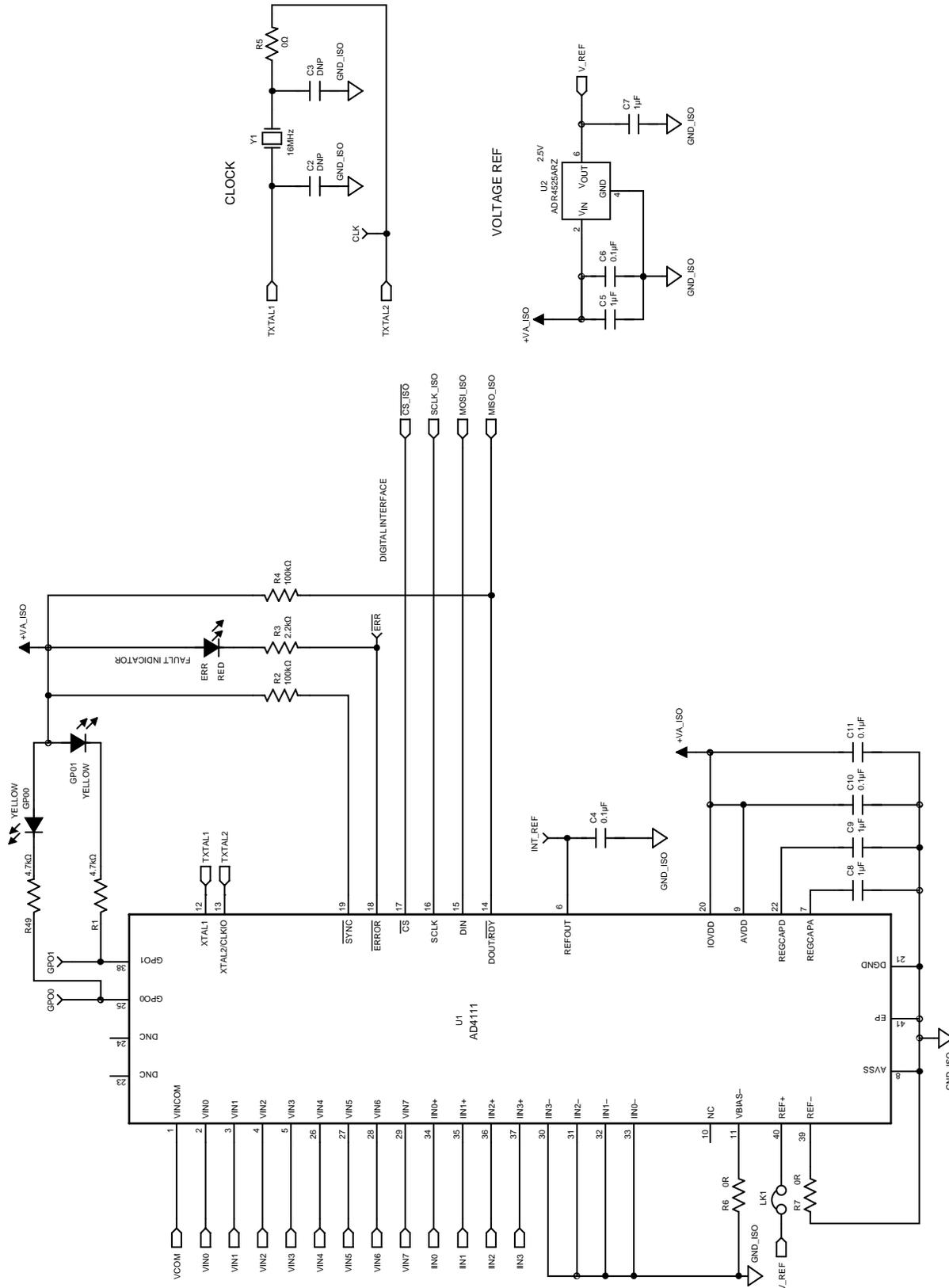


Figure 21. AD4111 Schematic on the EVAL-AD4111SDZ

15728-018

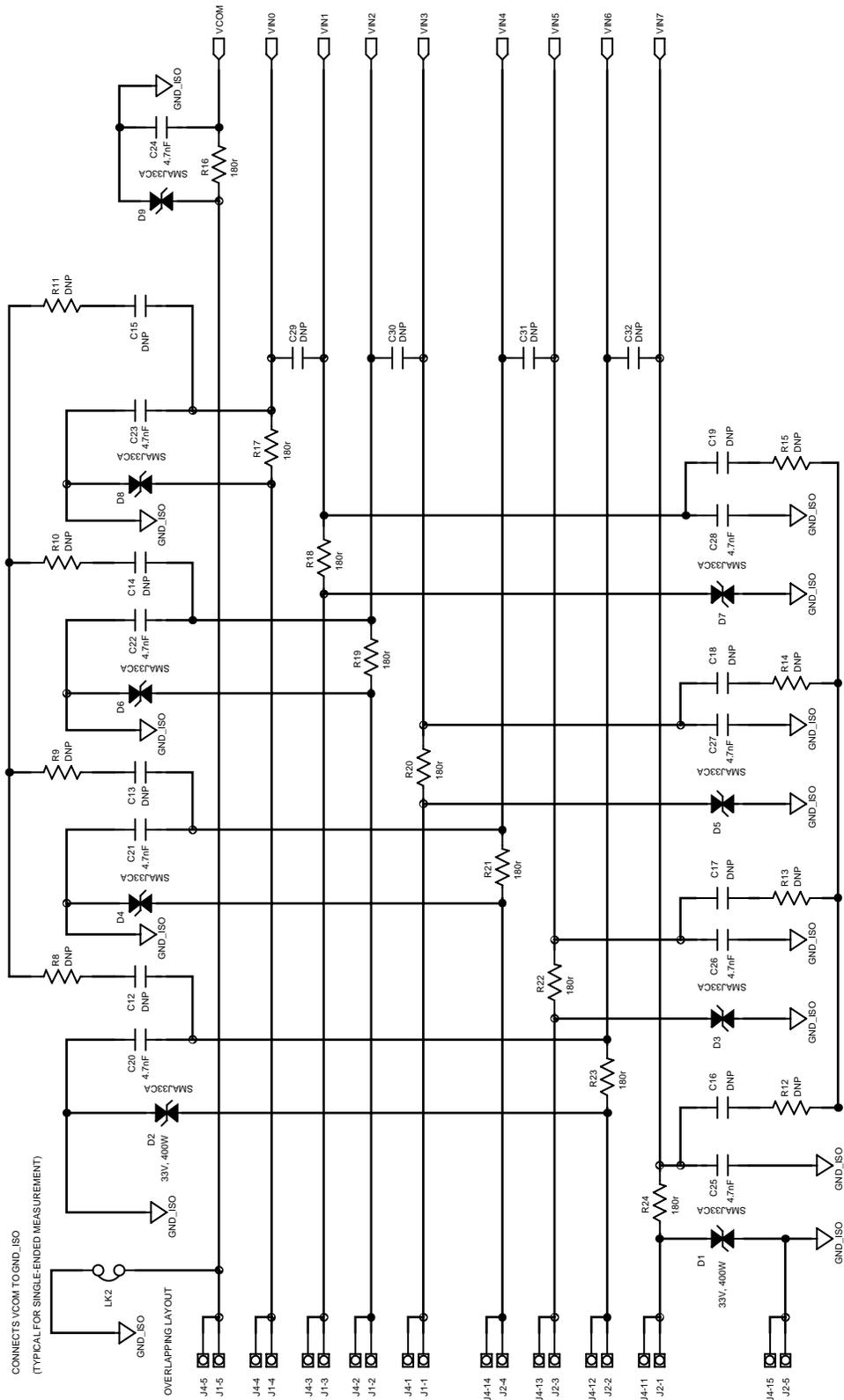


Figure 22. Voltage Input Front End Schematic

CURRENT INPUTS

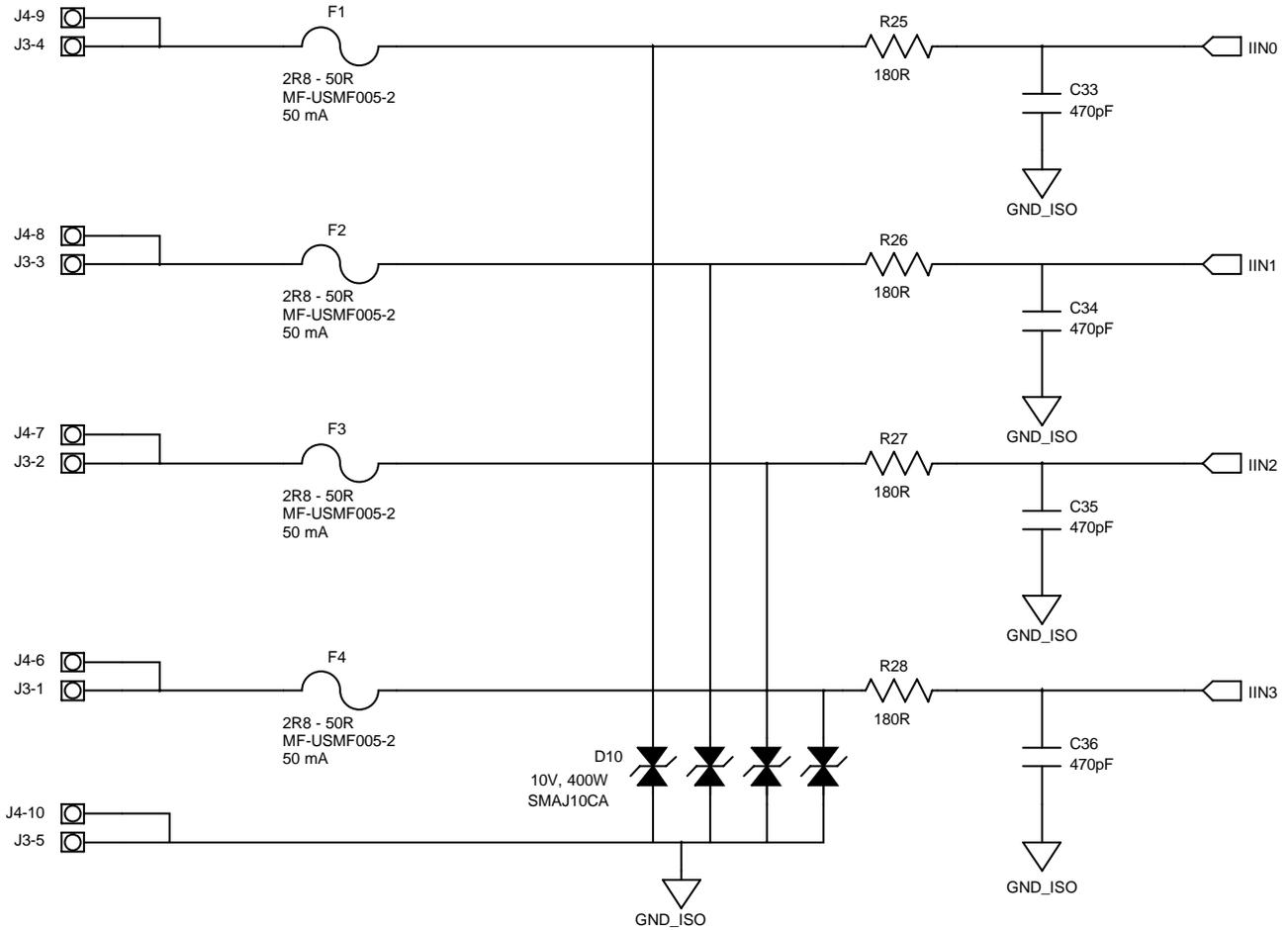
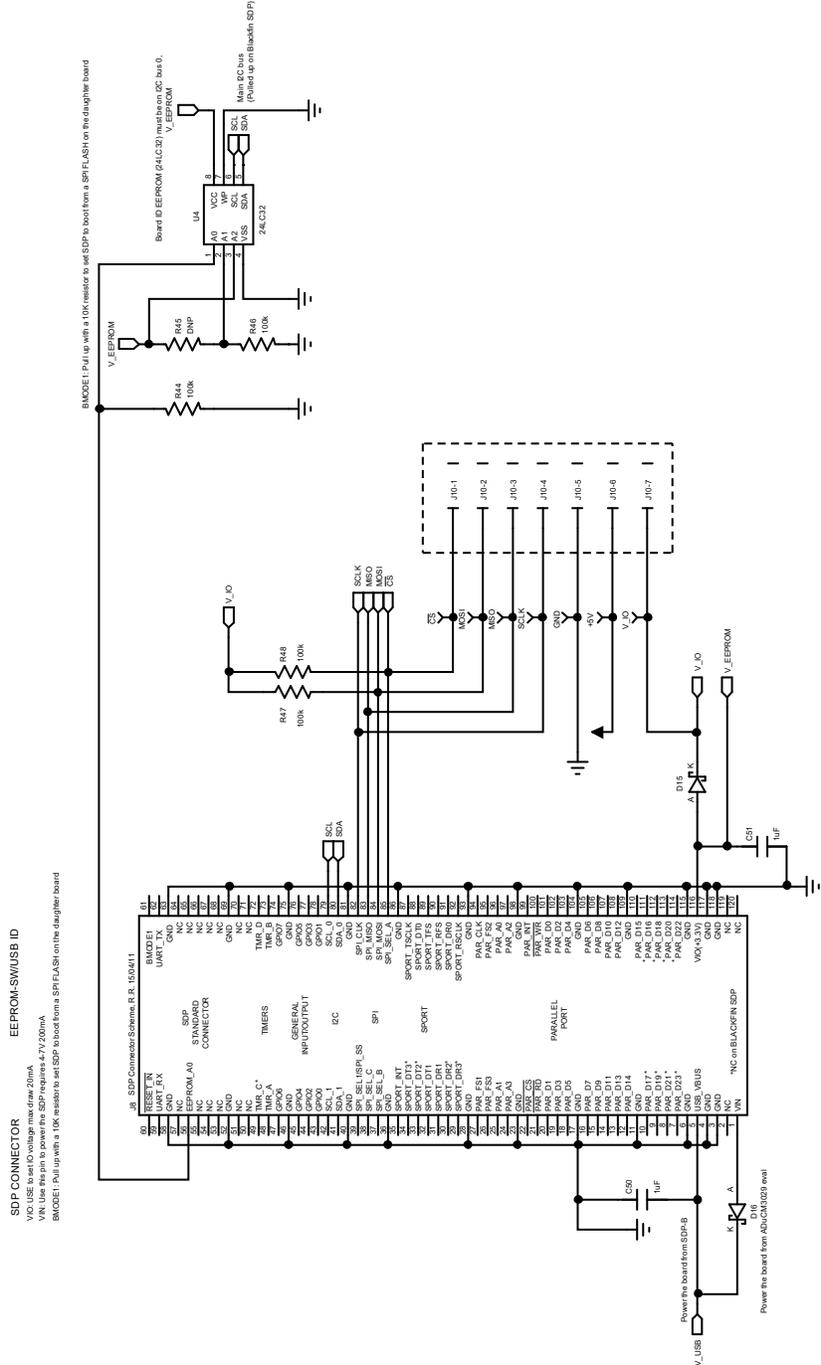


Figure 23. Current Input Front End Schematic

15728-019



SDP CONNECTOR
EEPROM-SW/USB ID

VIO: Use this pin to set I/O voltage max draw 200mA
 VIN: Use this pin to power the SDP requires 4.7V/200mA
 BMODE1: Pull up with a 10K resistor to set SDP to boot from a SPI FLASH on the daughter board

BMODE1: Pull up with a 10K resistor to set SDP to boot from a SPI FLASH on the daughter board

Figure 24. System Demonstration Platform Connector Schematic

151728-020

VIO: Use this pin to power the SDP requires 200mA
 VIN: Use this pin to power the SDP requires 4.7V/200mA
 BMODE1: Pull up with a 10K resistor to set SDP to boot from a SPI FLASH on the daughter board

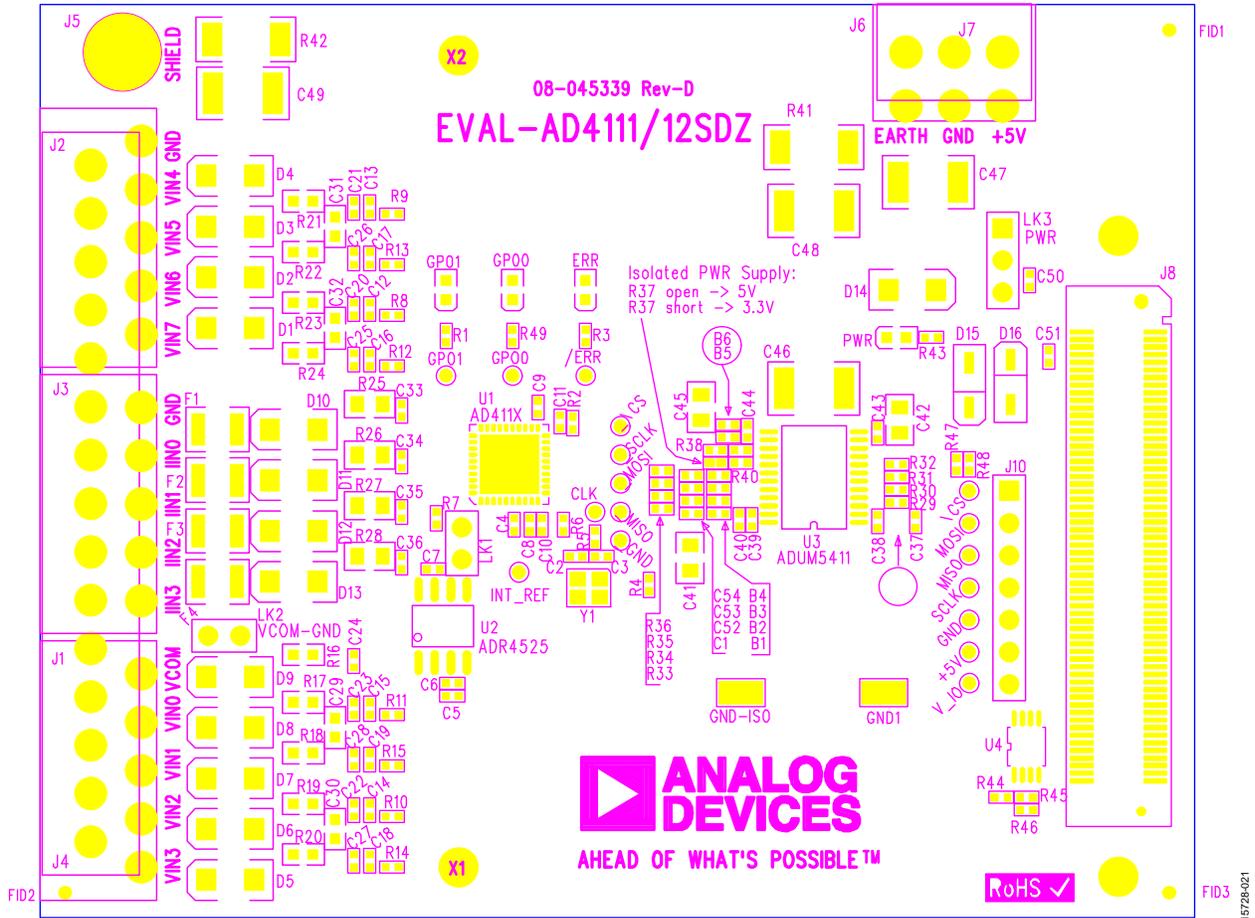


Figure 26. Printed Circuit Board (PCB), Top

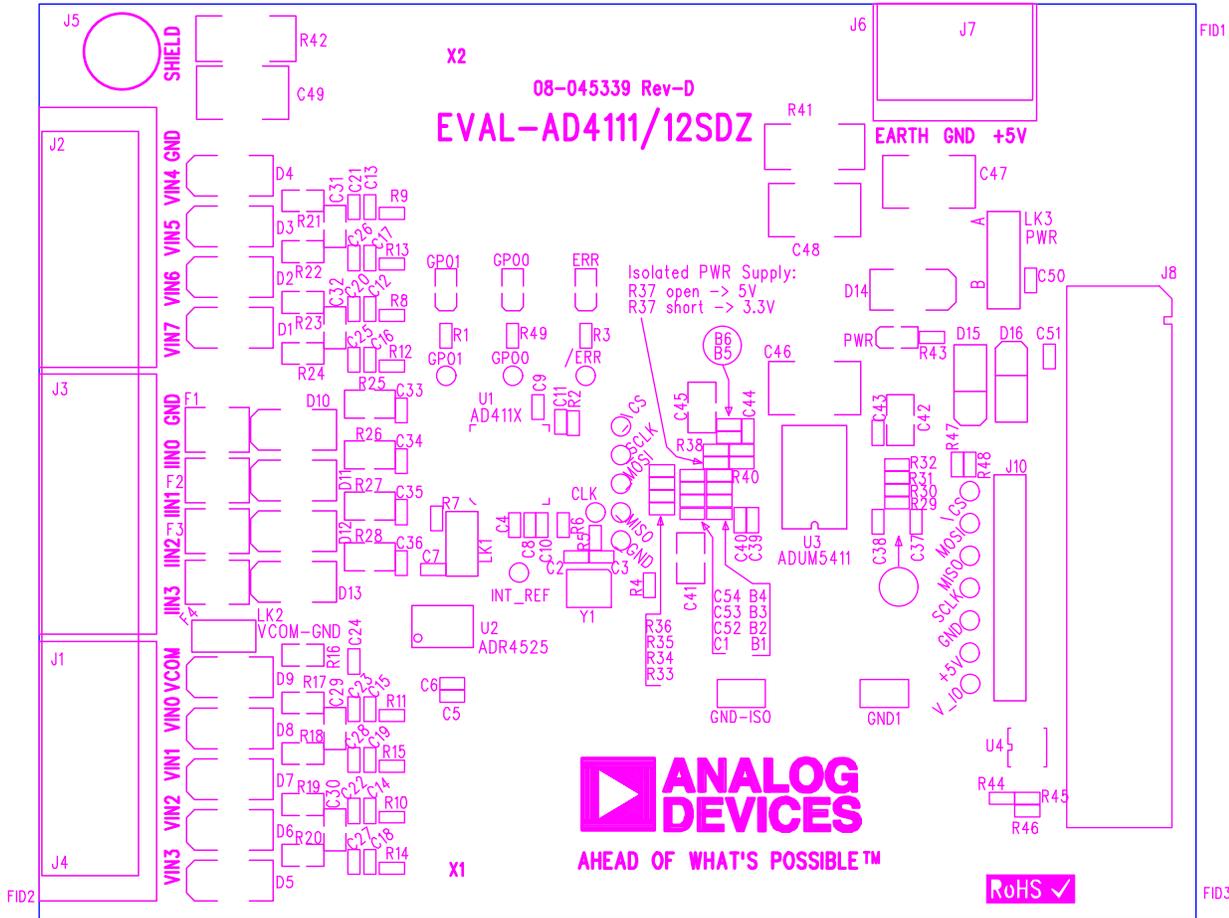


Figure 27. Component Side, Silkscreen, Top

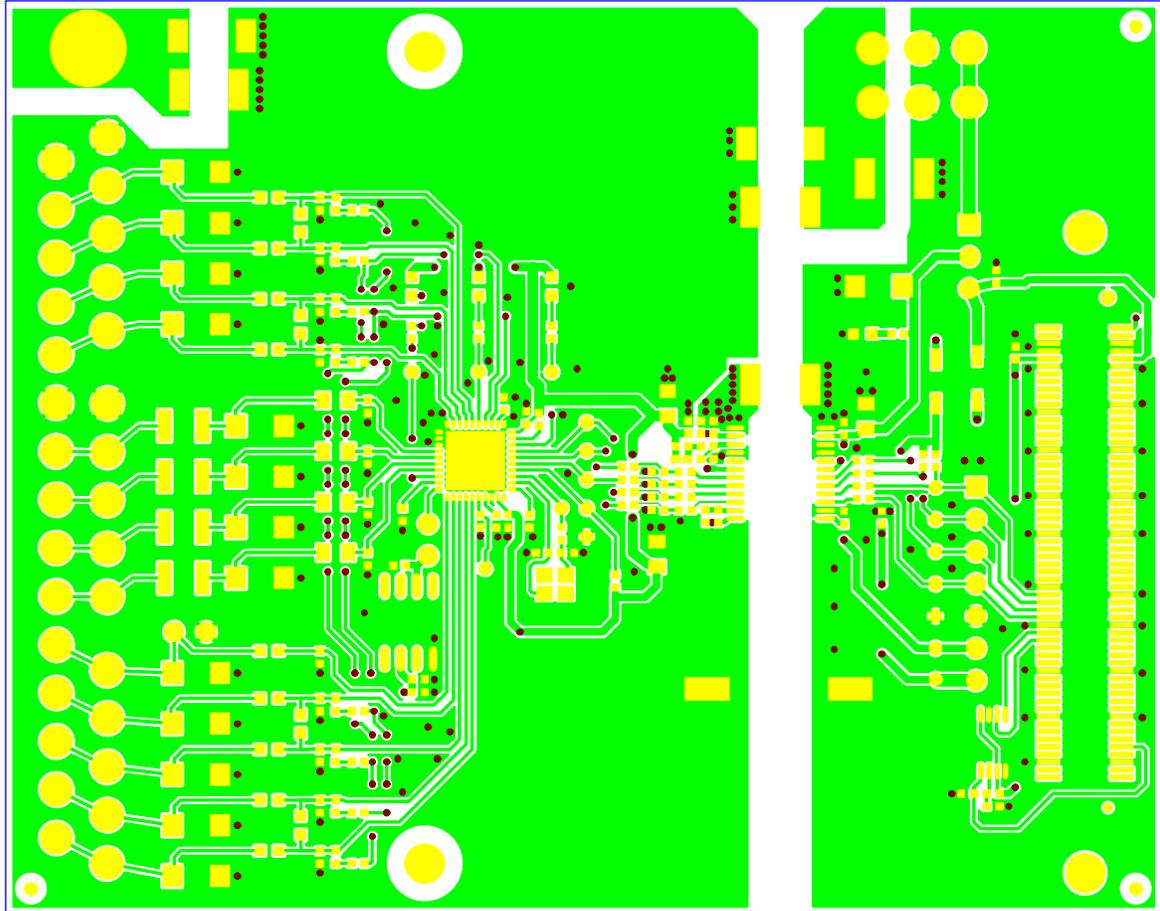


Figure 28. Layer 1, Component Side

15725-023

ORDERING INFORMATION

BILL OF MATERIALS

Table 3. Bill of Materials

Reference Designator	Description	Manufacturer	Part Number
B1 to B6	B0402, 1800 Ω at 100 MHz, 200 mA	Murata	BLM15HD1825N1D
C2	C0402, do not place	Not applicable	Not applicable
C3	C0402, do not place	Not applicable	Not applicable
C4, C6, C10, C11, C38, C39, C43, C44	C0402, 0.1 μF, 50 V, X5R	Murata	GRM155R61H104KE19D
C5, C7, C8, C9, C37, C40, C50, C51	C0402, 1 μF, 16 V, X5R	Taiyo Yuden	EMK105BJ105KV-F
C12 to C19	C0402, 680 pF, 50 V, X7R	Murata	GRT155R71H681KE01D
C20 to C28	C0402, 4.7 nF, 50 V, X7R	Murata	GRT155R71H472KE01D
C29 to C32	C0603, do not place	Not applicable	Not applicable
C33 to C36	C0402, 470 pF, 50 V, C0G/NP0	Murata	GRM1555C1H471JA01D
C41, C42, C45	C0805, 10 μF, 10 V, X7R	Würth Elektronik	885012207026
C46 to C49	C1812, 4.7 nF, 2 kV, X7R	Yageo	1812GC472KAZ1A
D1 to D9	Diode, TVS bipolar, 33 V, 400 W	STMicroelectronics	SMAJ33CA
D10 to D13	Diode, TVS bipolar, 10 V, 400 W	STMicroelectronics	SMAJ10CA
D14	Diode, TVS unipolar, 5 V, 400 W	STMicroelectronics	SMAJ5.0A
D15	Diode, Schottky, 30 V, 0.5 A, SOD123	Diodes, Inc.	B0530W-7-F
D16	Diode, Schottky, 30 V, 0.5 A, SOD123	Diodes, Inc.	B0530W-7-F
ERR	Light emitting diode (LED), 0603, red	Osram	LSQ976-Z
F1 to F4	Fuse, 50 mA, 30 V, 10 A maximum	Bourns	MF-USMF005-2
J1 to J3	Connector, header, 90°, 5 position, 3.81 mm	Phoenix Contact	MC 1,5/ 5-G-3,81
J4	3.81 mm pitch	Not applicable	Not applicable
J5	1.25-MS3, ring tongue terminal, M3, No. 5, 16 AWG, 1.65 mm ² , do not place	Japan Solderless Terminals	1.25-MS3
J6	Power socket block, 3-way, 3.81 mm pitch	Phoenix Contact	MC1.5/3-G-3.81
J7	Header, R/A, 3.81 mm, 3-way	Phoenix Contact	MC 1,5/ 3-G-3,81
J8	120-way connector, 0.6 mm pitch	Hirose	FX8-120S-SV(21)
J10	7-pin inline header, 100 mil centers	Würth Elektronik	61300711121
LED	LED, 0603, red	Osram	LSQ976-Z
LK1, LK2	2-pin (0.1") header and shorting shunt	Harwin	M20-9990246
LK3	3-pin (3x1) 0.1", Header B	Harwin	M20-9990346 M7566-05
PWR	LED, green, surface mount device (SMD), 20 mA, 2.1 V, 566 nm	Vishay	TLMP1100-GS08
R1, R49	Resistors, 4.7 kΩ, 0.063 W, 1%, 0402	Multicomp	MCWR04X4701FTL
R2	Resistor, 100 kΩ, 0.063 W, 1%, 0402	Multicomp	MC00625W04021100K
R3	Resistor, 2.2 kΩ, 0.063 W, 1%, 0402	Multicomp	MC00625W040212K2
R4	Resistor, 100 kΩ, 0.063 W, 1%, 0402	Multicomp	MC00625W04021100K
R5 to R7	Resistors, 0402, 1%, 0 Ω	Multicomp	MC00625W040210R
R8 to R15	Resistors, 1 kΩ, 0.063 W, 1%, 0402	Multicomp	MC00625W040211K
R16 to R24	Resistors, 180 Ω, 0.1 W, 1%, 0603	Multicomp	MCWR06X1800FTL
R25 to R28	Resistors, 180 Ω, 0.1 W, 1%, 0805	Panasonic	ERJ-P06J181V
R29 to R36	Resistors, 33 Ω, 0.063 W, 1%, 0402	Multicomp	MC00625W0402133R
R37	Resistor, do not place, 0402	Not applicable	Not applicable
R38	Resistor, 14 kΩ, 0.063 W, 1%, 0402	Multicomp	MC00625W0402114K
R39	Resistor, 16.9 kΩ, 0.063 W, 1%, 0402	Multicomp	MC00625W0402116K9
R40	Resistor, 10 kΩ, 0.063 W, 1%, 0402	Multicomp	MC00625W0402110K
R41, R42	Resistors, 4.7 MΩ, 0.5 W, 5%, 2010	BOURNS	CHV2010-JW-475ELF
R43	Resistor, 1 kΩ, 0.063 W, 1%, 0402	Multicomp	MC00625W040211K
R44	Resistor, 100 kΩ, 0.063 W, 1%, 0402	Multicomp	MC00625W04021100K
R45	Resistor, do not place, 0402	Not applicable	Not applicable

Reference Designator	Description	Manufacturer	Part Number
R46 to R48	Resistors, 100 k Ω , 0.063 W, 1%, 0402	Multicomp	MC00625W04021100K
U1	± 10 V and 0 mA to 20 mA, analog front end for industrial automation systems	Analog Devices	AD4111BCPZ
U2	2.5 V voltage reference, ± 4 ppm/ $^{\circ}$ C $\pm 0.04\%$	Analog Devices	ADR4525ARZ
U3	Digital isolator, 4-channel, <i>isoPower</i>	Analog Devices	ADuM5411BRSZ
U4	32 kb I ² C serial electronically erasable programmable read-only memory (EEPROM)	Microchip	24LC32A-I/MS
Y1	Miniature crystal, SMD, 16 MHz	Epson Toyocom	FA-20H, 16MHZ, 10PPM

I²C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors).



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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