

## Evaluation Board for the **AD5110** Digital Potentiometer

### FEATURES

- Full-featured evaluation board for the **AD5110**
- Several test circuits
- Various ac/dc input signals
- PC control via a separately purchased system demonstration platform (**SDP**)
- PC control software
- Resistor tolerance error stored in EEMEM

### PACKAGE CONTENTS

- EVAL-AD511xSDZ evaluation board
- CD that includes
  - Self-installing software that allows users to control the board and exercise all functions of the device
  - Electronic version of the **AD5110** data sheet
  - Electronic version of the UG-322 user guide

### GENERAL DESCRIPTION

This user guide describes the evaluation board for evaluating the **AD5110**—a single-channel, 128-position, nonvolatile memory digital potentiometer.

The **AD5110** supports single-supply 2.3 V to 5.5 V operation, making the device suited for battery-powered applications and many other applications, offering guaranteed low resistor tolerance errors of  $\pm 8\%$  and high bandwidth while allowing up to  $\pm 6$  mA current density in the A, B, and W pins.

The logic voltage levels operate from single 1.8 V to 5.5 V supplies.

The versatile I<sup>2</sup>C-compatible digital interface allows readback of the wiper register and EEPROM content which contain the resistor tolerance, providing an end-to-end tolerance accuracy of 0.1%.

The **EVAL-AD5110SDZ** can operate in single-supply mode and incorporates an internal power supply from the USB.

Complete specifications for the **AD5110** part can be found in the **AD5110** data sheet, which is available from Analog Devices, Inc., and should be consulted in conjunction with this user guide when using the evaluation board.

### DIGITAL PICTURE OF EVALUATION BOARD WITH SYSTEM DEMONSTRATION PLATFORM

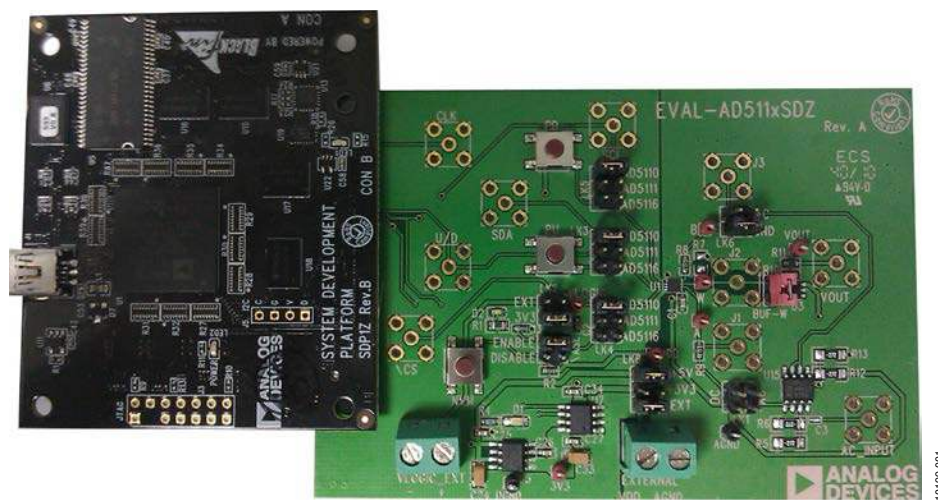


Figure 1.

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**REVISION HISTORY**

11/11—Revision 0: Initial Version

## EVALUATION BOARD HARDWARE

### POWER SUPPLIES

The [EVAL-AD5110SDZ](#) supports using single power supplies.

The evaluation board can be powered either from the [SDP](#) port or externally by the EXTERNAL-1 and EXTERNAL-2 connectors, as described in Table 2.

The digital logic levels can be powered either from the [SDP](#) port or externally by the VLOGIC\_EXT-1 and VLOGIC\_EXT-2 connectors, as described in Table 2.

All supplies are decoupled to ground using 10  $\mu$ F tantalum and 0.1  $\mu$ F ceramic capacitors.

**Table 2. Maximum and Minimum Voltages of the Connectors**

Connector Number	Label	Voltage
EXTERNAL-1	VDD	Analog positive power supply, $V_{DD}$ . If connected to the SDP, $V_{DD}$ is 3.3 V to 5.5 V. If controlled externally, $V_{DD}$ is 2.3 V to 5.5 V.
EXTERNAL-2	AGND	Analog ground, AGND.
VLOGIC_EXT-1	VLOGIC_EXT +	Logic positive power supply, $V_{LOGIC}$ . If connected to the SDP board, $V_{LOGIC}$ is 3.3 V. If controlled externally, $V_{LOGIC}$ is 1.8 V to $V_{DD}$ .
VLOGIC_EXT-2	VLOGIC_EXT –	Logic ground, DGND.

**Table 3. Link Functions**

Link Number	Power Supply	Option
LK2	$V_{LOGIC}$	This link selects one of the following as the logic power supply: 3V3 (from <a href="#">SDP</a> ). EXT (external supply from the VLOGIC_EXT connector).
LK8	$V_{DD}$	This link selects one of the following as the positive power supply: +5V (from <a href="#">SDP</a> ). +3V3 (from <a href="#">SDP</a> ). EXT <sup>1</sup> (external supply from the EXTERNAL connector).

<sup>1</sup> If the part is powered using the external connector without connecting the [SDP](#) board, +5V jumper must be connected as well.

### LINK OPTIONS

Several link and switch options are incorporated in the evaluation board and should be set up before using the board. Table 1 describes the positions of the links to control the evaluation board by a PC, via the SDP board, using the [EVAL-AD5110SDZ](#). The functions of these link and switch options are described in detail in Table 3.

**Table 1. Link Options Setup for SDP Control (Default)**

Link No.	Option
LK2	3V3
LK8	+5V

**TEST CIRCUITS**

The EVAL-AD5110SDZ incorporates several test circuits to evaluate the AD5110 performance.

**DAC**

The AD5110 can be operated as a digital-to-analog converter (DAC), as shown in Figure 2.

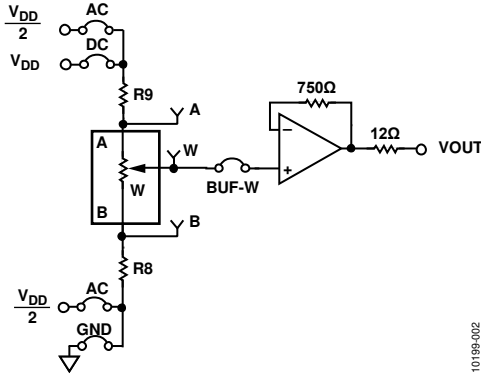


Figure 2. DAC

Table 4 shows the options available for the voltage references.

**Table 4. DAC Voltage References**

Terminal	Link	Options	Description
A	LK1	AC DC	Connects Terminal A to V <sub>DD</sub> /2 Connects Terminal A to V <sub>DD</sub>
W	BUF-W		Connects Terminal W to an output buffer
B	LK6	AC GND	Connects Terminal B to V <sub>DD</sub> /2 Connects Terminal B to analog ground

The output voltage is defined in Equation 1.

$$V_{OUT} = (V_A - V_B) \times \frac{RDAC}{256} \tag{1}$$

where:

- RDAC is the code loaded in the RDAC register.
- V<sub>A</sub> is the voltage applied to Terminal A (LK1 link).
- V<sub>B</sub> is the voltage applied to Terminal B (LK6 link).

However, by using the R8 and R9 external resistors, the user can reduce the voltage of the voltage references. In this case, use the A and B test points to measure the voltage applied to the A and B terminals and recalculate V<sub>A</sub> and V<sub>B</sub> in Equation 1.

**AC Signal Attenuation**

The AD5110 can be used to attenuate an ac signal, which must be provided externally using the AC\_INPUT connector, as shown in Figure 3.

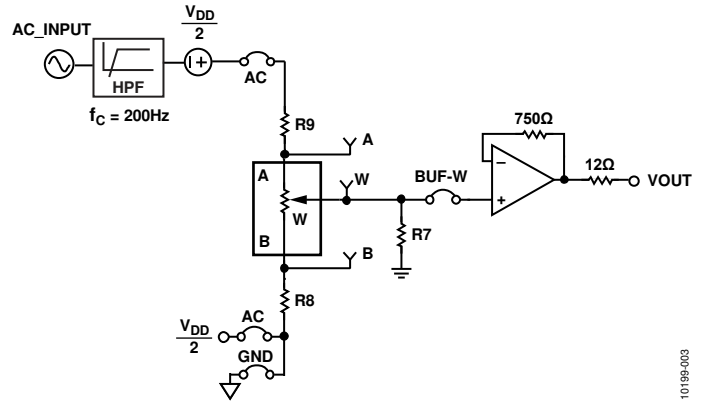


Figure 3. AC Signal Attenuator

Depending on the voltage supply rails and the dc offset voltage of the ac signal, various configurations can be used as described in Table 5.

**Table 5. AC Signal Attenuation Link Options**

Terminal	Link	Options	Description
A	LK1	AC	Remove dc voltage and biased the signal to V <sub>DD</sub> /2
W	BUF-W		Connects Terminal W to an output buffer
B	LK6	AC <sup>1</sup> GND	Connects Terminal B to V <sub>DD</sub> /2 Connects Terminal B to analog ground

<sup>1</sup> Recommended to ensure optimal total harmonic distortion (THD) performance.

The signal attenuation is defined in Equation 2.

$$Attenuation \text{ (dB)} \approx 20 \times \log\left(\frac{RDAC}{128}\right) \tag{2}$$

where:

RDAC is the code loaded in the RDAC register.

In addition, R7 can be used to achieve an exponential attenuation. To do so, adjust the R7 resistor until a desirable transfer function is found, typically around 1.6 kΩ for a 10 kΩ potentiometer.

## EVALUATION BOARD SOFTWARE

### INSTALLING THE SOFTWARE

The [EVAL-AD5110SDZ](#) evaluation kit includes evaluation board software provided on a CD. The software is compatible with Windows® XP, Windows Vista, and Windows 7 (both 32 and 64 bits).

Install the software before connecting the [SDP](#) board to the USB port of the PC to ensure that the [SDP](#) board is recognized when it is connected to the PC.

1. Start the Windows operating system and insert the CD.
2. The installation software opens automatically. If it does not, run the **setup.exe** file from the CD.
3. After the installation is completed, power up the evaluation board as described in the Power Supplies section.
4. Plug the EVAL-AD511xSDZ into the [SDP](#) board and the [SDP board](#) into the PC using the USB cable included in the box.
5. When the software detects the evaluation board, follow the instructions that appear to finalize the installation.

To uninstall the program, click **Start > Control Panel > Add or Remove Programs > AD5110 Eval Board**.

### RUNNING THE SOFTWARE

To run the evaluation board software, use the following steps:

1. Click **Start > All Programs > Analog Devices > AD5110 > AD5110 Eval Board**.
2. If the [SDP](#) board is not connected to the USB port when the software is launched, a connectivity error is displayed (see Figure 4). Connect the evaluation board to the USB port of the PC, wait a few seconds, click **Rescan**, and follow the instructions.

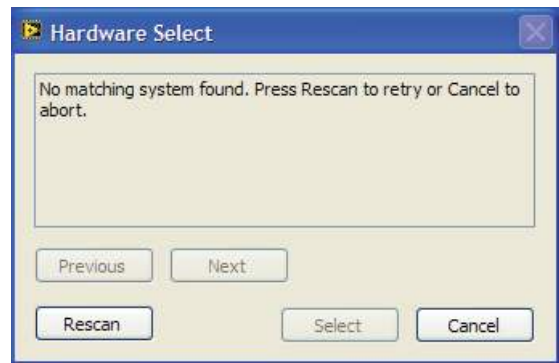


Figure 4. Pop-Up Window Error

The main window of the [EVAL-AD5110SDZ](#) evaluation software then opens, as shown in Figure 5.

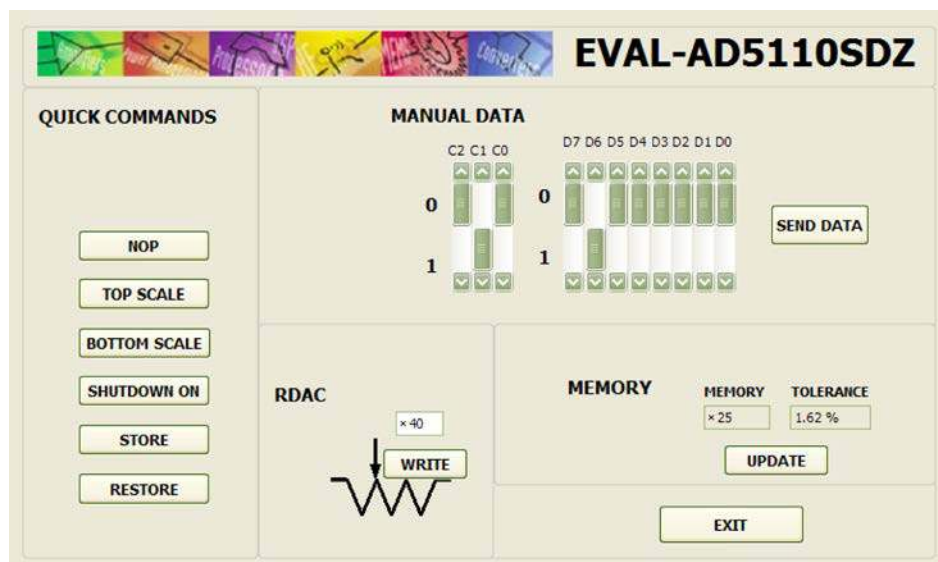


Figure 5. EVAL-AD5110SDZ Evaluation Board Software Main Window

## OPERATING THE SOFTWARE

The main window of the [EVAL-AD5110SDZ](#) software is divided into the following sections: **QUICK COMMANDS**, **MANUAL DATA**, **RDAC**, and **MEMORY**. The features of the main window are as follows:

- The **QUICK COMMANDS** section allows you to send quick commands directly to the [AD5110](#).
- The **RDAC** section can be used to update the RDAC registers by typing a value into a text box and clicking **WRITE**. When **WRITE** is clicked or a quick command is executed, a write-read operation is performed and the values displayed in this section are updated with the actual RDAC register values.
- The **MANUAL DATA** can be used to send a customized I<sup>2</sup>C data word by manually switching the scroll bars from 0 to 1 or from 1 to 0, as desired, and then clicking **SEND DATA**. The scroll bars are updated upon each write transfer.
- The **MEMORY** section displays the data stored in the memory block. The data can be updated manually by clicking **UPDATE**.
- Clicking **EXIT** closes the program but does not reset the part.

# EVALUATION BOARD SCHEMATICS AND ARTWORK

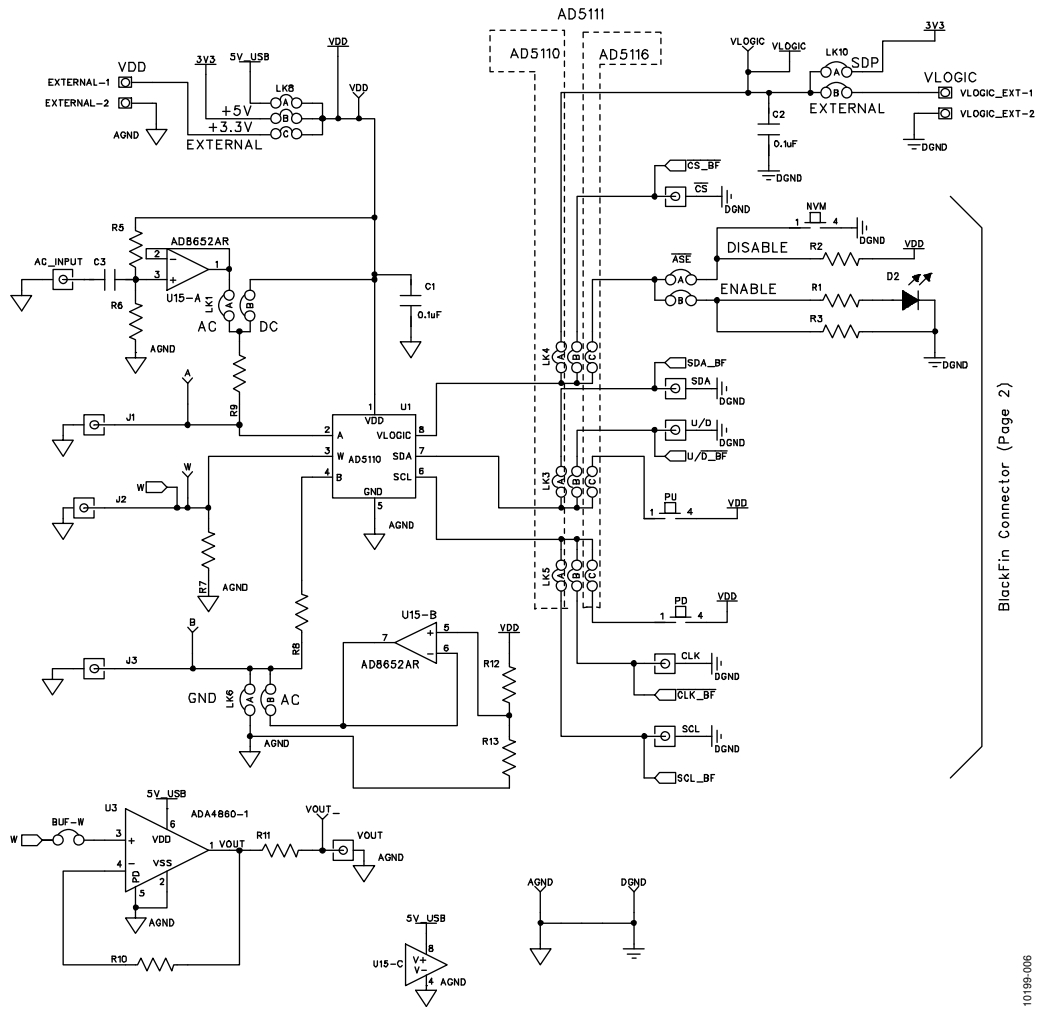


Figure 6. Schematic of the AD5110 Circuitry

10199-006

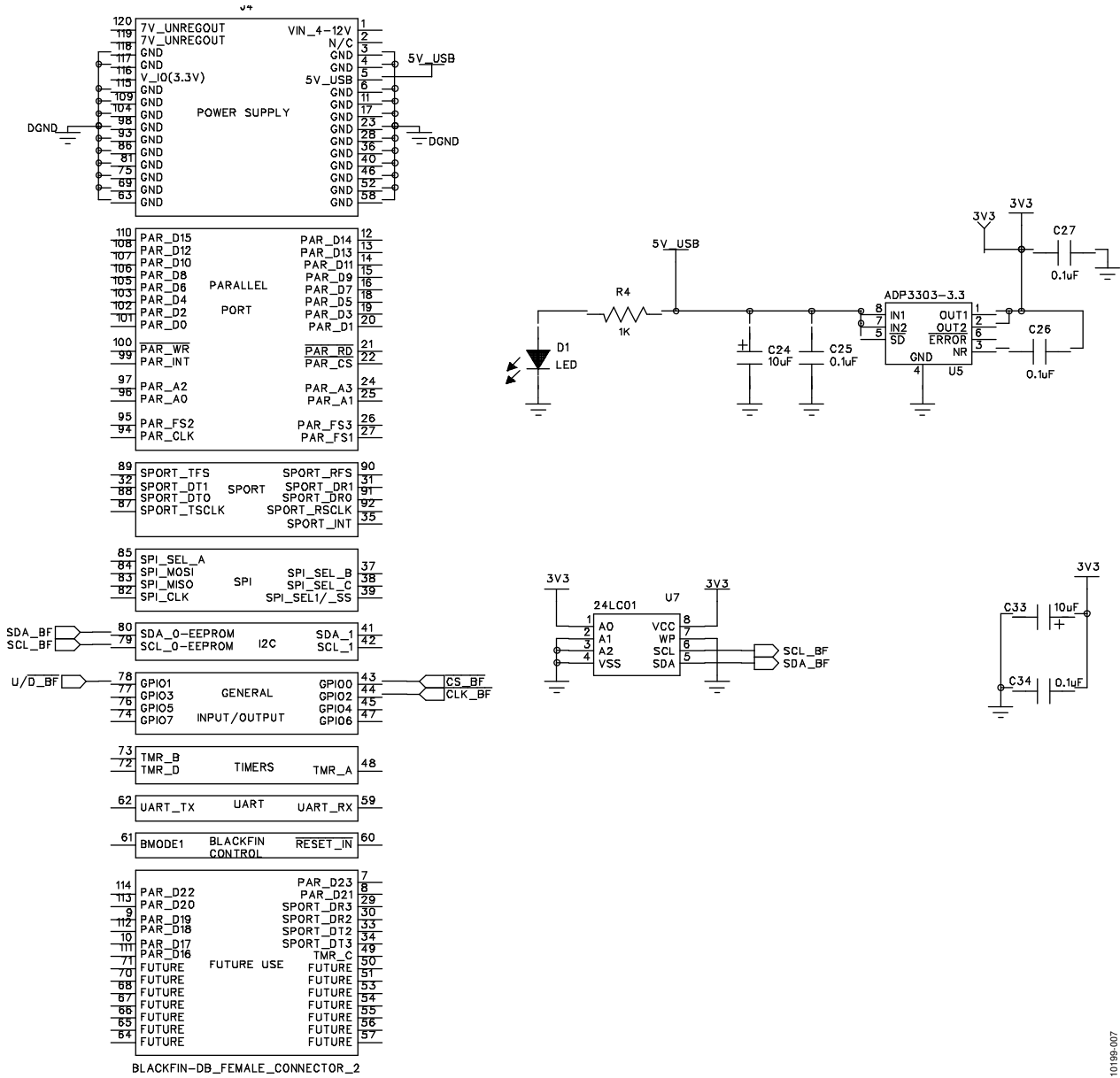


Figure 7. Schematic of SDP Connector

10195E-007



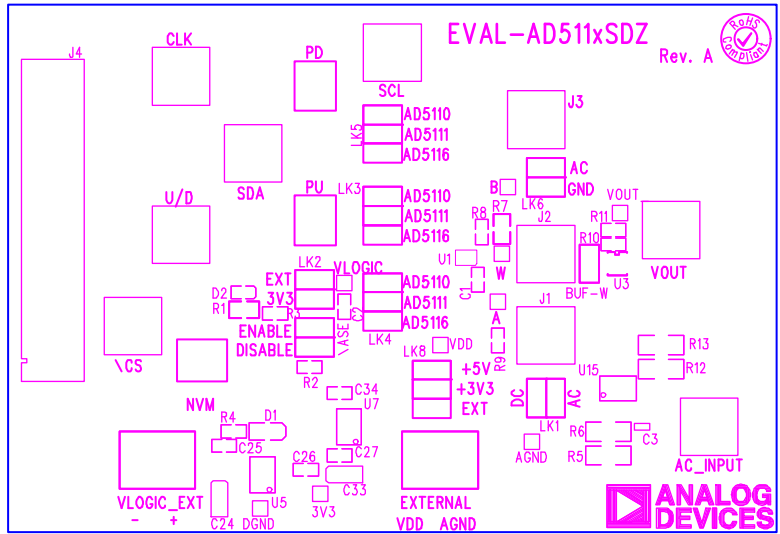


Figure 8. Component Placement Drawing

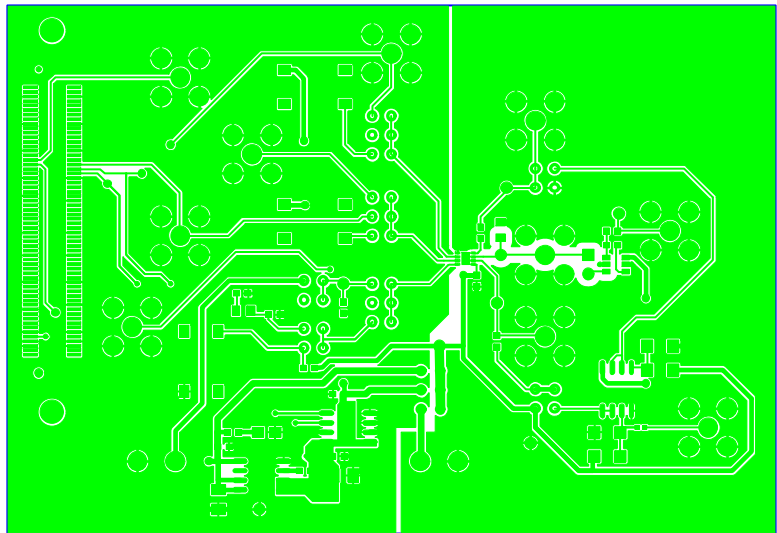
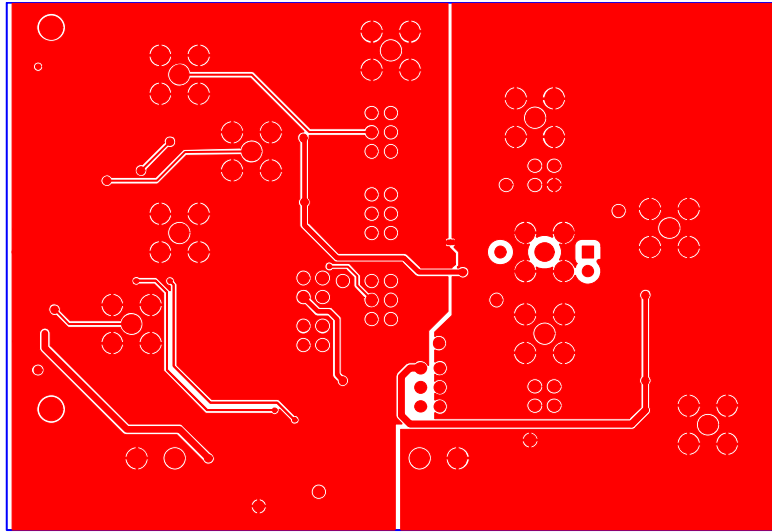


Figure 9. Component Side PCB Drawing



10199-010

Figure 10. Solder Side PCB Drawing

**ORDERING INFORMATION****BILL OF MATERIALS**

Table 6.

Qty	Reference Designator	Description	Supplier <sup>1</sup> /Part Number
1	C3	100 nF, 0402 capacitor	FEC 1414580
2	C1,C2	0.1 $\mu$ F, 0603 capacitor	FEC 138-2224
4	C25, C26, C27, C34	0.1 $\mu$ F, 0603 capacitor	FEC 301-9482
2	C24, C33	10 $\mu$ F, 1206 capacitor	FEC 197-130
1	D1	Green LED	FEC 579-0852
2	VLOGIC_EXT, EXTERNAL	2-pin connector	FEC 151789
1	J4	Receptacle, 0.6 mm, 120 way	Digi-Key H1219-ND
8	LK1, LK2, LK3, LK4, LK5, LK6, LK8, $\overline{ASE}$	Header, 2-row, 36 + 36 way, and jumper socket, black	FEC 148-535 and FEC 150-411
1	BUF-W	Header, 1-row, 2-way, and jumper socket, black	FEC 102-2247 and FEC 150-411
1	R11	12 $\Omega$ , 0603, 1% resistor	FEC 9330534
1	R10	750 $\Omega$ , 0603, 1% resistor	FEC 9331506
1	R4	1 k $\Omega$ , 0603, 0.01% resistor	FEC 9330380
4	R5, R6, R12, R13	2.7 k $\Omega$ , 1206, 1% resistor	FEC 9337288
2	R8, R9	0 $\Omega$ , 0603 resistor	FEC 9331662
2	DGND, AGND	Test point, PCB, black, PK100	FEC 873-1128
7	3V3, A, B, VDD, VLOGIC, VOUT, W	Test point, PCB, red, PK100	FEC 873-1144
1	U1	<a href="#">AD5110</a>	Analog Devices <a href="#">AD5110</a>
1	U3	<a href="#">ADA4860</a>	Analog Devices <a href="#">ADA4860</a>
1	U5	<a href="#">ADP3303</a>	Analog Devices <a href="#">ADP3303</a>
1	U7	24LC64 serial EEPROM	FEC 9758070
1	U15	<a href="#">AD8652</a>	Analog Devices <a href="#">AD8652</a>

<sup>1</sup> FEC refers to Farnell Electronic Component Distributors.

## NOTES

I<sup>2</sup>C 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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