

## Evaluating the 8-Channel, 12-Bit, Configurable ADC/DAC/GPIO **AD5592R** with On-Chip Reference and SPI Interface

### FEATURES

Full featured evaluation board for the **AD5592R**  
On-board reference  
Various link options  
PC control in conjunction with Analog Devices, Inc., system demonstration platform (**SDP-B**, **EVAL-SDP-CB1Z**)

### EQUIPMENT NEEDED

**AD5592R** evaluation board  
CD includes  
Self-installing software that allows users to control the board and exercise all functions of the device  
Electronic version of the **EVAL-AD5592RSDZ** user guide

### ADDITIONAL EQUIPMENT AND SOFTWARE NEEDED

**EVAL-SDP-CB1Z** system demonstration platform, includes a USB cable  
PC running Windows XP SP2, Windows Vista, or Windows 7 with USB 2.0 port

### ONLINE RESOURCES

#### Documents Needed

**AD5592R** data sheet  
**EVAL-AD5592RSDZ** user guide

#### Required Software

**AD5592R** evaluation software (download from the **EVAL-AD5592RSDZ** product page)

### TYPICAL SETUP

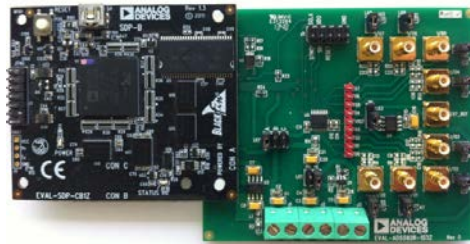


Figure 1.

**TABLE OF CONTENTS**

Features .....	1	Analog Input And Output Signals .....	5
Equipment Needed.....	1	Link Configuration Options .....	6
Additional Equipment and Software Needed.....	1	Setup Conditions.....	6
Online Resources.....	1	Evaluation Board Circuitry .....	7
Typical Setup .....	1	How to Use the Software .....	8
Revision History .....	2	Starting the Software.....	8
General Description .....	3	DAC Tab .....	8
Getting Started .....	4	ADC Tab.....	8
Installing the Software .....	4	GPIO Tab.....	9
Evaluation Board Setup Procedures.....	4	Simple Controls .....	9
Evaluation Board Hardware.....	5	Evaluation Board Schematics.....	10
Power Supplies .....	5	Ordering Information.....	12
Digital Input And Output Signals.....	5	Components List .....	12

**REVISION HISTORY**

10/14—Revision 0: Initial Version

## GENERAL DESCRIPTION

This user guide details the operation of the evaluation board for the [AD5592R](#) 8-channel, 12-bit, configurable analog-to-digital converter (ADC)/digital-to-analog converter (DAC)/general-purpose input/output (GPIO) with on-chip reference and SPI interface.

The evaluation board is designed to help customers quickly prototype new [AD5592R](#) circuits and reduce design time. The [AD5592R](#) operates from a single 2.7 V to 5.5 V supply and incorporates an internal 2.5 V reference to give an output voltage span of 0 V to 2.5 V or 0 V to 5 V. An external reference (a 2.5 V reference is provided on the evaluation board) can also be used to give an output from 0 V to  $V_{REF}$  or 0 V to  $2 \times V_{REF}$ .

Full data on the [AD5592R](#) can be found in the data sheet, available from Analog Devices. Consult the data sheet in conjunction with this user guide when using the evaluation board.

The evaluation board interfaces to the USB port of a PC via the [SDP-B](#). Software is supplied with the evaluation board to allow the user to program the [AD5592R](#).

This evaluation board requires the [EVAL-SDP-CB1Z](#) board ([SDP-B](#) controller board), which is available for order on the Analog Devices website at [www.analog.com](http://www.analog.com).

## GETTING STARTED

### INSTALLING THE SOFTWARE

The evaluation kit for the [AD5592R](#) includes self-installing software on a CD. The software is compatible with Windows® XP, Windows Vista (32-bit version), and Windows 7 (32- and 64-bit versions). The software must be installed before connecting the [SDP-B](#) board to the USB port of the PC to ensure that the [SDP-B](#) board is recognized when it is connected to the PC.

To install the software, take the following steps:

1. Start the Windows operating system and insert the CD.
2. The installation software opens automatically. If it does not open automatically, run the **setup.exe** file from the CD.
3. After installation is complete, power up the evaluation board as described in the Power Supplies section.
4. Connect the evaluation board to the [SDP-B](#) board, and connect the [SDP-B](#) board into the PC using the USB cable included in the box.
5. When the software detects the evaluation board, proceed through any dialog boxes that appear to finalize the installation.

### EVALUATION BOARD SETUP PROCEDURES

1. Connect the evaluation board to the [SDP-B](#) board, and connect the USB cable from the [SDP-B](#) board to the PC.
2. Power the [SDP-B](#) and evaluation boards by connecting 6 V to the J3 connector.

## EVALUATION BOARD HARDWARE

### POWER SUPPLIES

To use the evaluation board with the [SDP-B](#) board, a 6 V power supply is required, which is connected to Connector J3. The evaluation board can also be used without the [SDP-B](#) board. In this case, Connector J2 is the power supply input for the  $V_{DD}$  supply.

Both the AGND and the DGND inputs are provided on the board. The AGND and DGND planes are connected at one location close to the [AD5592R](#). It is recommended that AGND and DGND not be connected elsewhere in the system to avoid ground loop problems.

All supplies are decoupled to ground with 10  $\mu\text{F}$  tantalum and 0.1  $\mu\text{F}$  ceramic capacitors.

Table 1. Power Supply Connectors

Connector Name	Voltage
J1	Not used
J2	Analog power supply, $V_{DD}$
J3	6 V board positive power supply

### DIGITAL INPUT AND OUTPUT SIGNALS

When the [SDP-B](#) board is used to control the [AD5592R](#) evaluation board, the digital input signals are applied to Connector J4. When the [SDP-B](#) board is not being used, digital signals must be applied to the 10-way header, J5.

### ANALOG INPUT AND OUTPUT SIGNALS

The input/output pins of the [AD5592R](#) are available on SMB connectors, I/O0 to I/O7. These are analog inputs or outputs depending on whether the input/output pins are configured as ADCs or DACs, respectively. I/O0 to I/O7 are digital inputs or outputs if the input/output pins are configured as GPIOs.

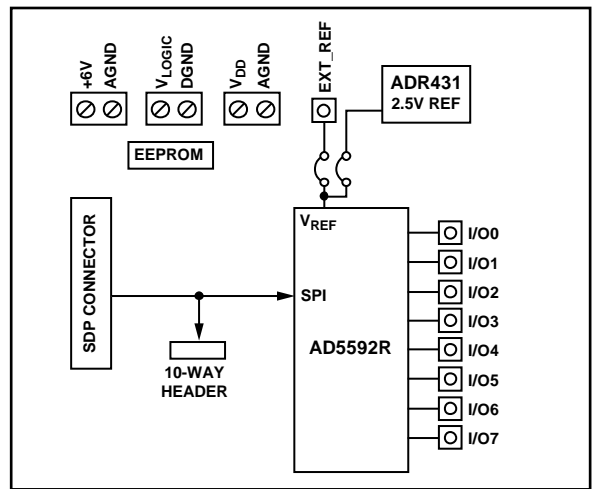


Figure 2. Evaluation Board Block Diagram

## LINK CONFIGURATION OPTIONS

A number of link options are incorporated in the evaluation board and must be set for the required operating conditions before using the board. The functions of these link options are described in detail in Table 2.

### SETUP CONDITIONS

Before applying power and signals to the evaluation board take care to ensure that all link positions are set as required by the

operating mode. The evaluation board operates in two different modes—SDP-B controlled mode and standalone mode.

The Default Position column of 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 assumed that the user intends to operate the evaluation board with the SDP-B board (SDP-B controlled mode).

**Table 2. Link Functions**

Link Name	Option	Default Position
LK1	This link selects the V <sub>DD</sub> source for the <a href="#">AD5592R</a> . Position A selects the internal voltage source (5V_VDD) from the <a href="#">ADP3331</a> . Position B selects an external supply voltage (EXT_VDD).	A
LK2, LK4, LK4-LK9, LK20	These links connect 100 kΩ pull-down resistors from the input/output pins to AGND. When the link is removed, the level of associated pins is determined by the configuration of the <a href="#">AD5592R</a> .	IN
LK3	This link selects the reference source for the <a href="#">AD5592R</a> . Position A selects the on-board 2.5 V reference as the reference source. Position B selects an off-board voltage reference via the EXT_REF connector. Select this option if the internal reference is to be used.	A
LK11	This link is not used for the <a href="#">AD5592R</a> .	OUT

## EVALUATION BOARD CIRCUITRY

The [AD5592R](#) evaluation board allows the function and performance of the device to be easily tested. The evaluation board contains two voltage regulators that not only generate the analog and digital power supplies but also power the [SDP-B](#) board if it is connected. The two regulators are powered via a 6 V supply attached to Connector J3. Alternatively, a separate supply can be attached via Connector J2.

The [SDP-B](#) board typically controls the [AD5592R](#) and is attached to Connector J4. The [SDP-B](#) board allows the software

provided with the kit to be used to configure the [AD5592R](#) as well as write and read data to and from the [AD5592R](#).

When the [SDP-B](#) is not required, the control signals can be applied to the [AD5592R](#) by connecting them to the relevant pins on Connector J5.

In addition to the on-chip reference of the [AD5592R](#), an external, 2.5 V reference is also provided and can be connected to the  $V_{REF}$  pin of the [AD5592R](#) using Link LK3.

# HOW TO USE THE SOFTWARE

## STARTING THE SOFTWARE

To run the program, do the following:

1. Connect the evaluation board to the **SDP-B** board, and connect the USB cable from the **SDP-B** board to the PC.
2. Power the **SDP-B** and evaluation boards by connecting 6 V to the J3 connector.
3. Click **Start > All Programs > Analog Devices > AD5592R > AD5592R Evaluation Software**. When the software connects to the evaluation board, the message shown in Figure 3 displays.

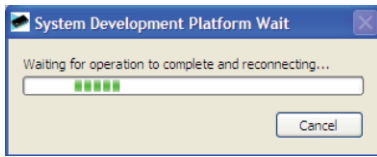


Figure 3. Connection Message

If the **SDP-B** board is not connected to the USB port when the software is launched, a connectivity error displays (see Figure 4). Simply connect the evaluation board to the USB port of the PC, wait a few seconds, click **Rescan**, and follow the instructions.

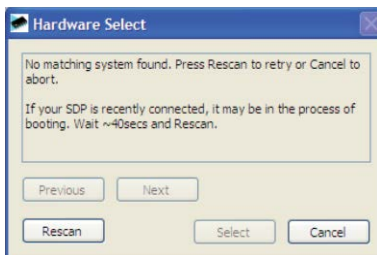


Figure 4. Connectivity Error

Alternatively, the software can be used without an evaluation board. The software runs in simulation mode, displaying

expected outputs based on the input data. When the software runs, the user is first prompted to configure the **AD5592R** input/output pins as shown in Figure 5. The main window of the **AD5592R** evaluation software then opens, as shown in Figure 6. The user can click on the block diagram to access the DAC, ADC, and GPIO functions, as well as other options such as enabling the internal reference.

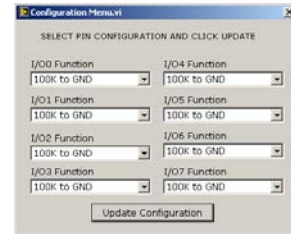


Figure 5. Configuration Menu

### DAC TAB

The DAC tab gives the user access to the DAC functions. Each DAC has its own numeric control where a value can be loaded to the appropriate DAC. Clicking **Update DAC Registers** loads the data appropriately as determined by the setting of the **LDAC Mode** control.

### ADC TAB

The ADC tab allows the user to select ADC channels on which to perform conversions. The **Repeat Sequence** checkbox should be set to take multiple samples. The user can select the number of samples per channel and the sample frequency. Clicking **Take Samples** programs the **AD5592R** for the desired sequence and takes the appropriate number of samples. The data collected from the **AD5592R** is split into separate channels and displayed on the graph as voltage. The user has the option to save the data to a comma delimited spreadsheet file.

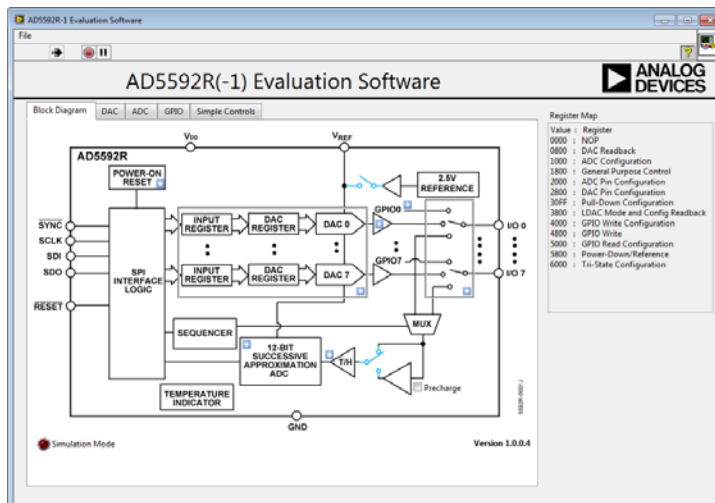


Figure 6. Main Window, Block Diagram View



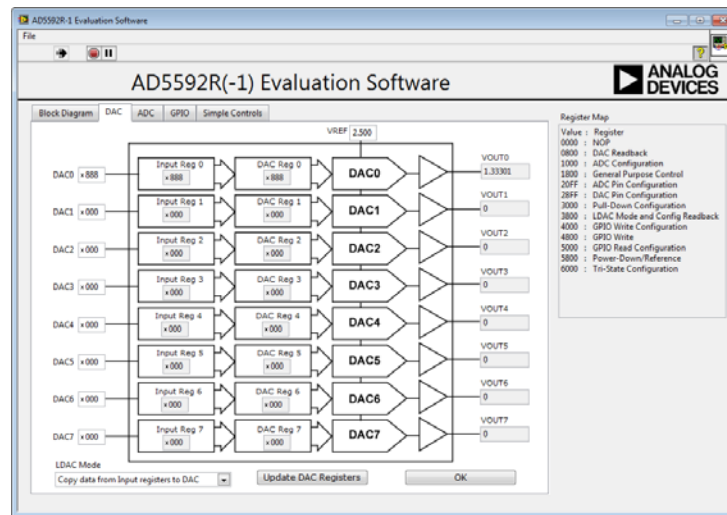


Figure 7. DAC Tab

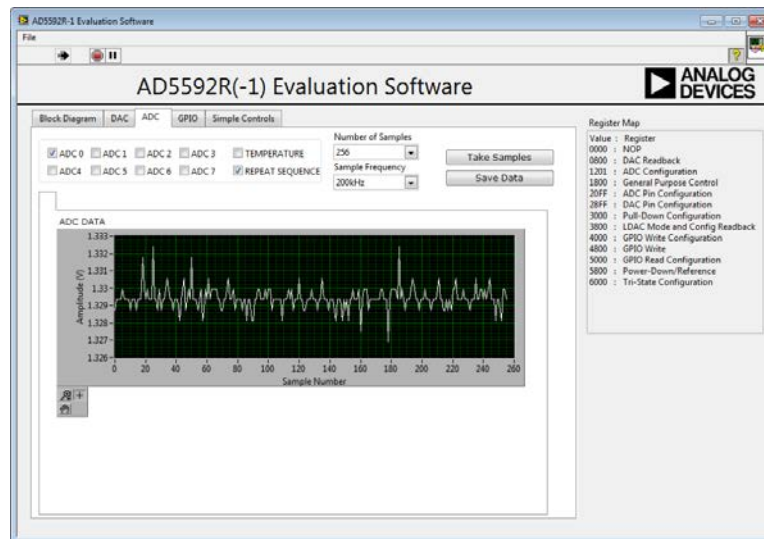


Figure 8. ADC Tab

### GPIO TAB

The GPIO tab allows the user to set the output levels for pins set as general-purpose outputs and read the levels of pins set as general-purpose inputs.

### SIMPLE CONTROLS

The simple controls tab allows the user to enter 16-bit values directly into the **Write Array** control. These values can then be

written to the [AD5592R](#) by clicking the **Write and Read** button. Data that appears on the SDO pin of the [AD5592R](#) is shown in the **Read Array** control. Note that the data displayed in the **Read Array** control will be invalid if it is not part of a read operation from the [AD5592R](#). Any commands sent to the [AD5592R](#) that change the configuration of the [AD5592R](#) will not be reflected in the other tabs.

EVALUATION BOARD SCHEMATICS

600-0081

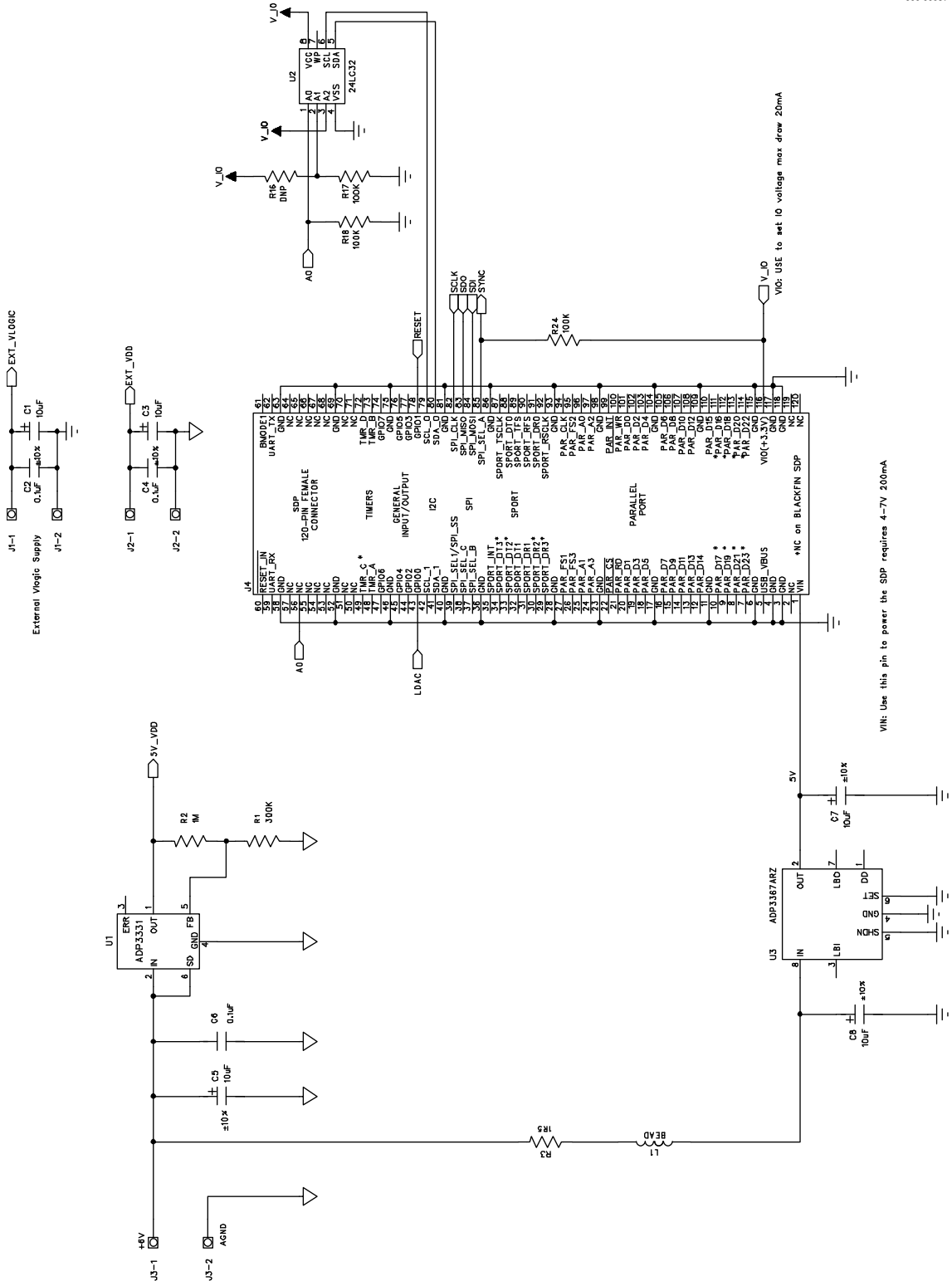


Figure 9. AD5592R Schematic (Page 1 of 2)

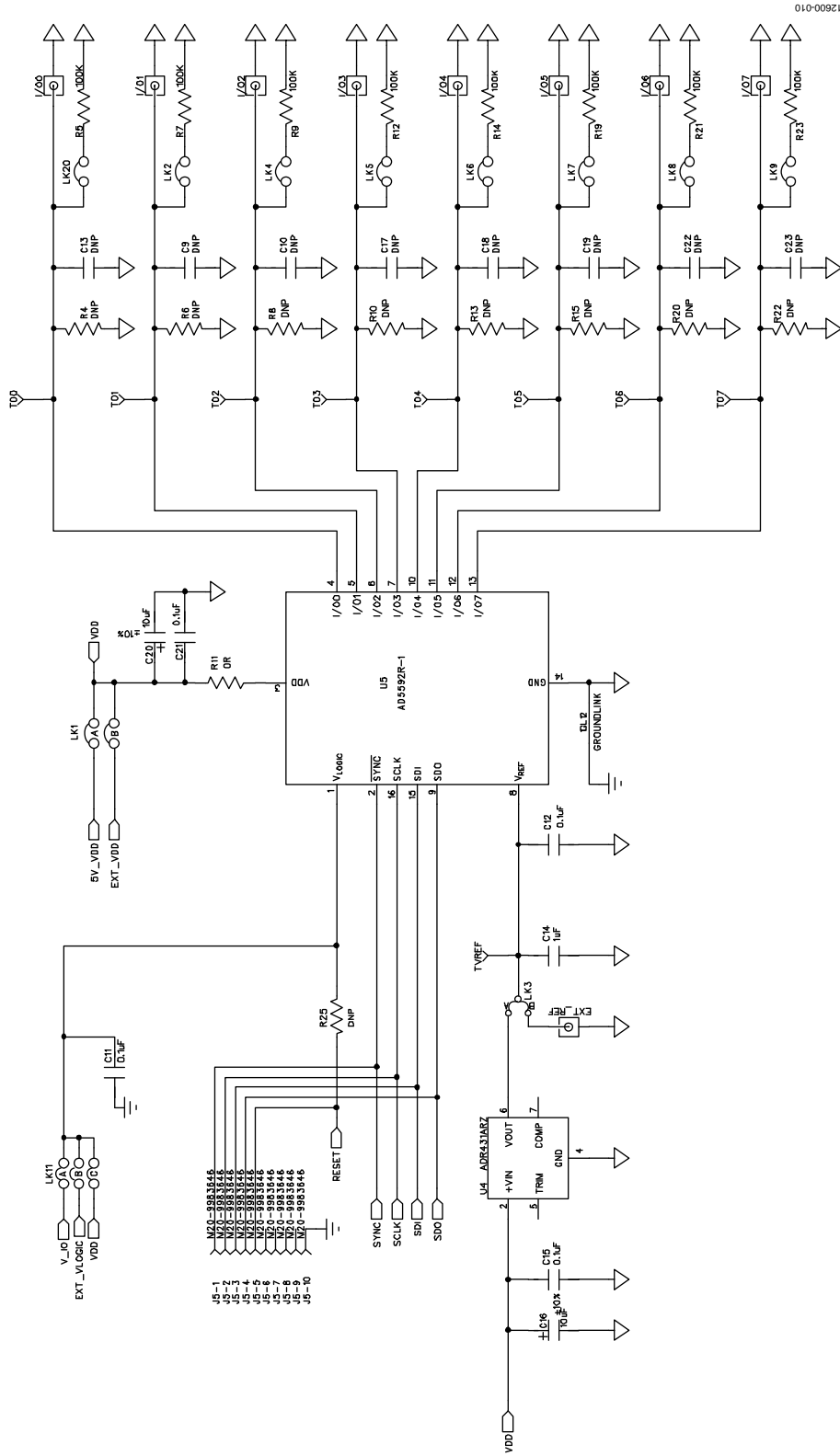


Figure 10. AD5592R Schematic (Page 2 of 2)

## ORDERING INFORMATION

## COMPONENTS LIST

Table 3.

Qty	Reference Designator	Description	Supplier/Part Number <sup>1</sup>
1	C1	Noninserted through-hole capacitor location; do not insert	Not applicable
8	C3 to C6, C22, C24, C27, C29	Capacitor, 100 nF, 50 V, 0603	FEC 8820023
9	C15 to C18, C23, C25, C26, C28, C30	Capacitor, Case A, 10 $\mu$ F, 10 V	FEC 197-130
1	J1	120-way female connector, 0.6 mm pitch	FEC 1324660 or Digi-Key H1219-ND
1	J2	20-pin (2 $\times$ 10) header, 0.1" pitch	FEC 1022242
1	J3	7-pin (1 $\times$ 7) header, 0.1" pitch	FEC 1022257
3	J4 to J6	50 $\Omega$ straight SMB jack	FEC 1111349
3	J7 to J9	2-pin terminal block (5 mm pitch)	FEC 151789
1	L1	Ferrite bead	Digi-Key 490-1024-1-ND
5	LK1 to LK5	2-pin SIL header, 0.1" pitch, red jumper	FEC 1022247 and FEC 150-411
6	LK6 to LK11	3-pin SIL header, 0.1" pitch, red jumper	FEC 1022248 and FEC 150411
4	R1 to R3, R13	SMD resistor 0603	FEC 933-0399
1	R4	Noninserted through-hole resistor location; do not insert	Not applicable
1	R5	Resistor, 1.5 $\Omega$ , 5%, 0.063 W, 0603	FEC 9331832
1	R6	Resistor, 1 M $\Omega$ , 1%, 0.063 W, 0603	Digi-Key RMCF1/161MFRCT-ND
1	R7	SMD resistor 0603	Digi-Key 541-300KHCT-ND
3	R8, R14, R15	SMD resistor 0603; do not insert	Not applicable
2	R9, R10	SMD resistor	FEC 9330402
2	R11, R12	SMD resistor 0603	FEC 933-1662
1	R25	Resistor, 0 $\Omega$ , 5%, 0.063 W, 0603	
10	TP1 to TP10	Black test point	FEC 8731128
1	U1	8-/16-channel 14-bit voltage output DAC	<a href="#">AD5592RRBCPZ-1</a>
1	U2	2.5 V reference	<a href="#">ADR431ARZ</a>
1	U3	Adjustable LDO regulator	<a href="#">ADP3331ARTZ</a>
1	U4	32k I2C serial EEPROM	FEC 1331330
1	U5	5 V fixed, adjustable voltage regulator	<a href="#">ADP3367ARZ</a>
2	Screw 1, Screw 2	Screw, cheese, nylon, M3X10, PK100	FEC 7070597
2	Nut 1, Nut 2	Nut/washer, nylon, M3, PK100	FEC 7061857

<sup>1</sup>FEC is Farnell Electronics Components.

## NOTES



### 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 One Technology Way, Norwood, MA 02062, USA. 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.