

## Evaluating the AD5593R: 8-Channel, 12-Bit, Configurable ADC/DAC with On-Chip Reference

### FEATURES

Full featured evaluation board for the [AD5593R](#)  
On-board reference  
Various link options  
PC control in conjunction with Analog Devices, Inc., system demonstration platform ([SDP](#)), [EVAL-SDP-CB1Z](#)

### EVALUATION KIT CONTENTS

[AD5593R](#) 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-AD5593RSDZ](#) 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

[AD5593R](#) data sheet  
[EVAL-AD5593RSDZ](#) user guide

Required Software

[AD5593R](#) evaluation software (download from the [EVAL-AD5593RSDZ](#) product page)

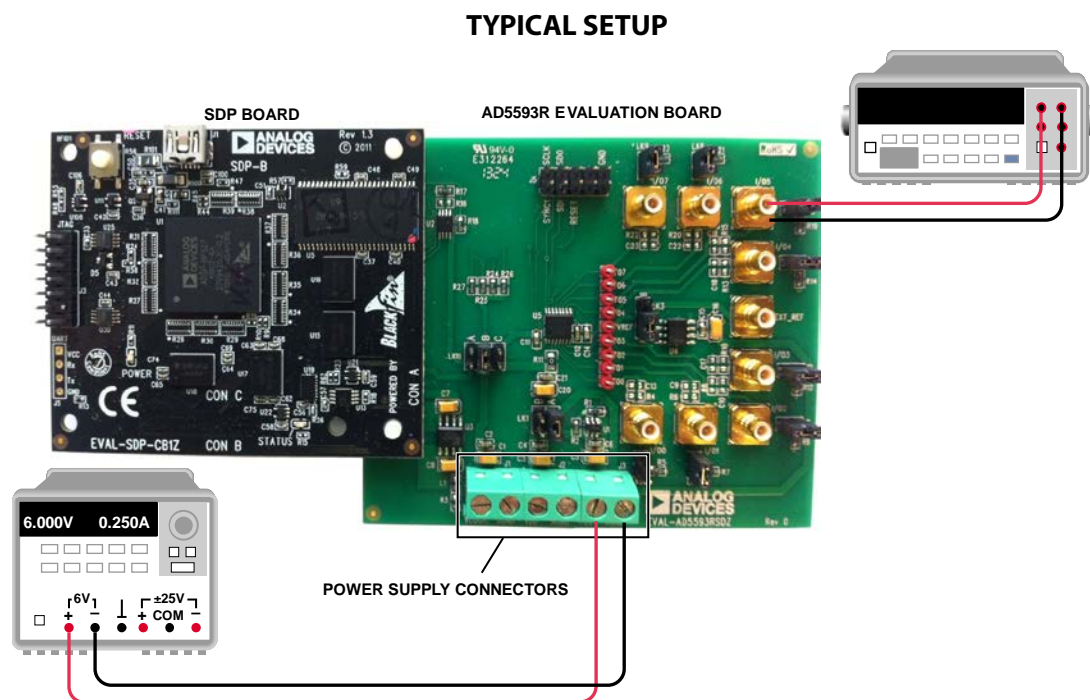


Figure 1.

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## REVISION HISTORY

9/14—Revision 0: Initial Version

## GENERAL DESCRIPTION

This user guide details the operation of the evaluation board for the [AD5593R](#) 8-channel, 12-bit, configurable ADC/DAC with on-chip reference and SPI interface.

The evaluation board is designed to help customers quickly prototype new [AD5593R](#) circuits and reduce design time.

The [AD5593R](#) 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 2.5 V or 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 [AD5593R](#) can be found in the [AD5593R](#) data sheet, available from Analog Devices and should be consulted 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](#) board. Software is supplied with the evaluation board to allow the user to program the [AD5593R](#).

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 [AD5593R](#) 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](#) board to the USB port of the PC to ensure that the [SDP](#) 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 should open automatically. If it does not open automatically, run the **setup.exe** file from the CD.

3. After installation is completed, power up the evaluation board as described in the Power Supplies section.
4. Connect the evaluation board to the [SDP](#) board and connect the [SDP](#) 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](#) board, and connect the USB cable between the [SDP](#) board and the PC.
2. Power the [SDP](#) and evaluation boards by connecting 6 V to the J3 connector.

## EVALUATION BOARD HARDWARE

### POWER SUPPLIES

To use the evaluation board with the [SDP](#) board, a 6 V power supply is required, which is connected to Connector J3. The evaluation board can also be used without the [SDP](#) board. In this case, J2 is the power supply input for the  $V_{DD}$  supply. A separate  $V_{LOGIC}$  supply can be connected to J1 if required. LK11 selects the source for the [AD5593R](#)  $V_{LOGIC}$  supply.

Both AGND and DGND inputs are provided on the board. The AGND and DGND planes are connected at one location close to the [AD5593R](#). 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  $\mu$ F tantalum and 0.1  $\mu$ F ceramic capacitors.

**Table 1. Power Supply Connectors**

Connector Number	Voltage
J1	External, $V_{LOGIC}$ supply
J2	Analog power supply, $V_{DD}$
J3	6 V board positive power supply

### DIGITAL INPUT AND OUTPUT SIGNALS

When the [SDP](#) board is used to control the [AD5593R](#) evaluation board, the digital input signals are applied to Connector J4. When the [SDP](#) board is not being used, digital signals should be applied to the 10-way header, J5.

### ANALOG INPUT AND OUTPUT SIGNALS

The I/O pins of the [AD5593R](#) are available on SMB connectors, I/O0 to I/O7. These will be analog inputs or outputs depending on whether the I/O pins are configured as ADCs or DACs, respectively. I/O0 to I/O7 will be digital inputs or outputs if the I/O pins are configured as GPIOs.

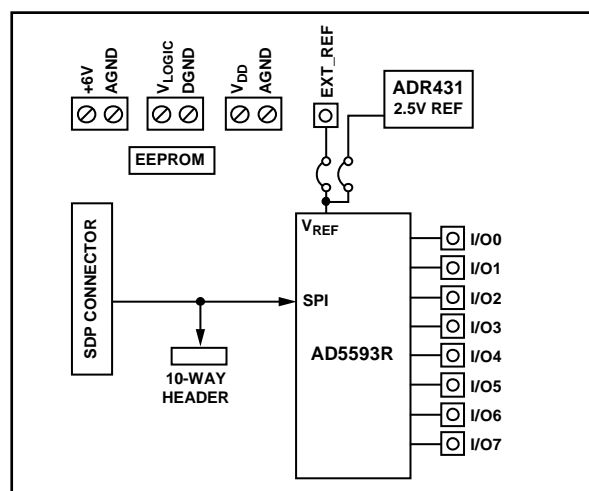


Figure 2. Evaluation Board Block Diagram

## 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

Take care before applying power and signals to the evaluation board to ensure that all link positions are 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](#) controlled mode to be used with the [SDP](#) 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 assumed that you are going to operate the evaluation board with the [SDP](#) board ([SDP](#) controlled mode).

Table 2. Link Functions

Link Number	Option	Default Position
LK1	This link selects the $V_{DD}$ source for the <a href="#">AD5593R</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 to LK9, LK20	These links connect a 100 k $\Omega$ pull-down resistor from the I/Ox pins to AGND. When a link is removed, the level of associated pin is determined by the configuration of the <a href="#">AD5593R</a> .	Inserted
LK3	This link selects the reference source for the <a href="#">AD5593R</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. This option should also be selected if the internal reference is to be used.	A
LK11	This link selects the source of the $V_{LOGIC}$ supply for the <a href="#">AD5593R</a> . Position A selects the 3.3 V supply from the <a href="#">SDP</a> board. Position B selects the $V_{LOGIC}$ supply from Connector J1. Position C selects the $V_{DD}$ supply determined by LK1.	A

## EVALUATION BOARD CIRCUITRY

The [AD5593R](#) evaluation board allows the function and performance of the [AD5593R](#) to be easily tested. The evaluation board contains two voltage regulators, which generate the analog and digital power supplies and also power the [SDP](#) 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. An optional  $V_{\text{LOGIC}}$  supply can be connected to J1 if required.

Control of the [AD5593R](#) is typically performed by the [SDP](#) board, which is attached to J4. The [SDP](#) board allows the

software provided with the kit to be used to configure the [AD5593R](#) and write/read data to/from the [AD5593R](#).

When the [SDP](#) is not required, the control signals can be applied to the [AD5593R](#) by connecting them to the relevant pins on Connector J5.

In addition to the on-chip reference of the [AD5593R](#) an external, 2.5 V reference is also provided and can be connected to the [AD5593R](#) reference input/output pin ( $V_{\text{REF}}$ ) using LK3.

## HOW TO USE THE SOFTWARE

### STARTING THE SOFTWARE

To run the program, do the following:

3. Connect the evaluation board to the **SDP** board, and connect the USB cable between the **SDP** board and the PC.
4. Power the **SDP** board and evaluation board by connecting 6 V to the J3 connector.
5. Click **Start > All Programs > Analog Devices > AD5593R > AD5593R Evaluation Software**. When the software connects to the evaluation board, the message shown in Figure 3 displays.

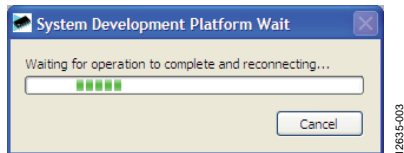


Figure 3. Connection Message

If the **SDP** 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.

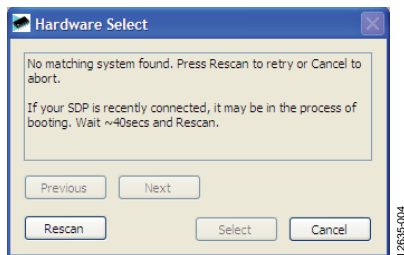


Figure 4. Connectivity Error

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 **AD5593R** I/O pins as shown in Figure 5. The main window of the **AD5593R** 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.

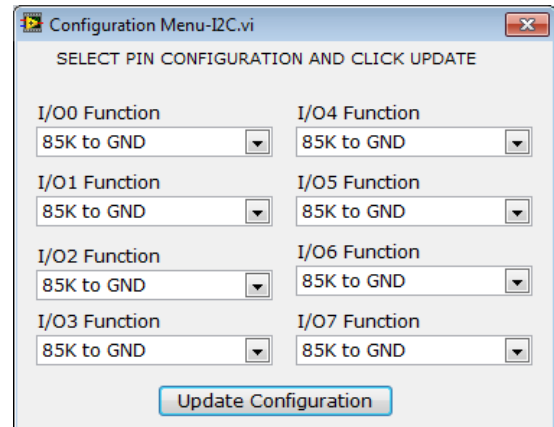


Figure 5. Configuration Menu

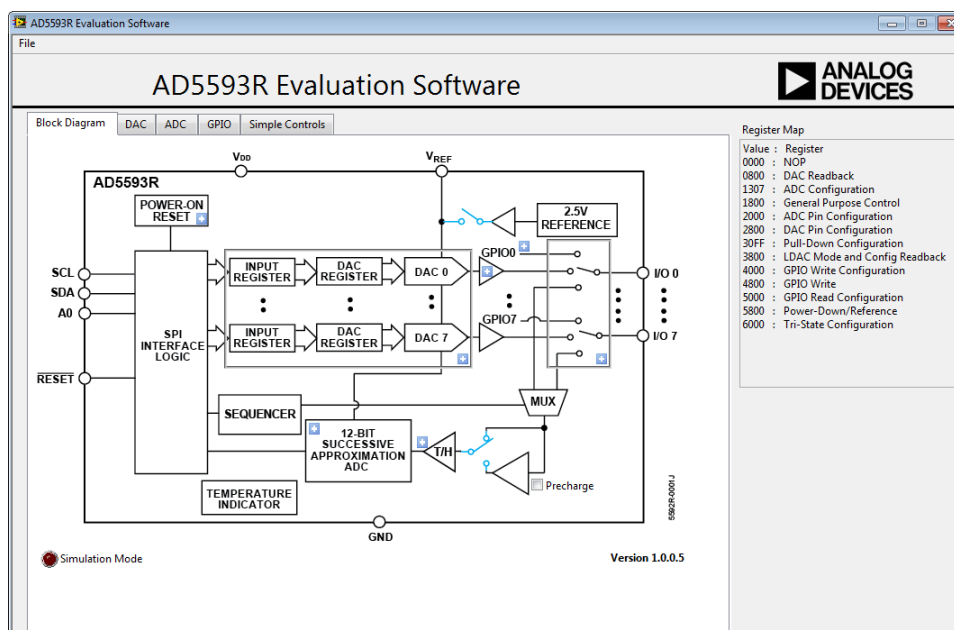


Figure 6. Main Window, **Block Diagram** Tab



## DAC TAB

The **DAC** tab (see Figure 7) 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** will load the data appropriately as determined by the setting of the **LDAC Mode** control box.

## ADC TAB

The **ADC** tab (see Figure 8) 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** will program the [AD5593R](#) for the desired sequence and take the appropriate number of samples. The data collected from the [AD5593R](#) is split into separate channels and displayed on the graph as a voltage. The user has the option to save the data to a comma delimited spreadsheet file.

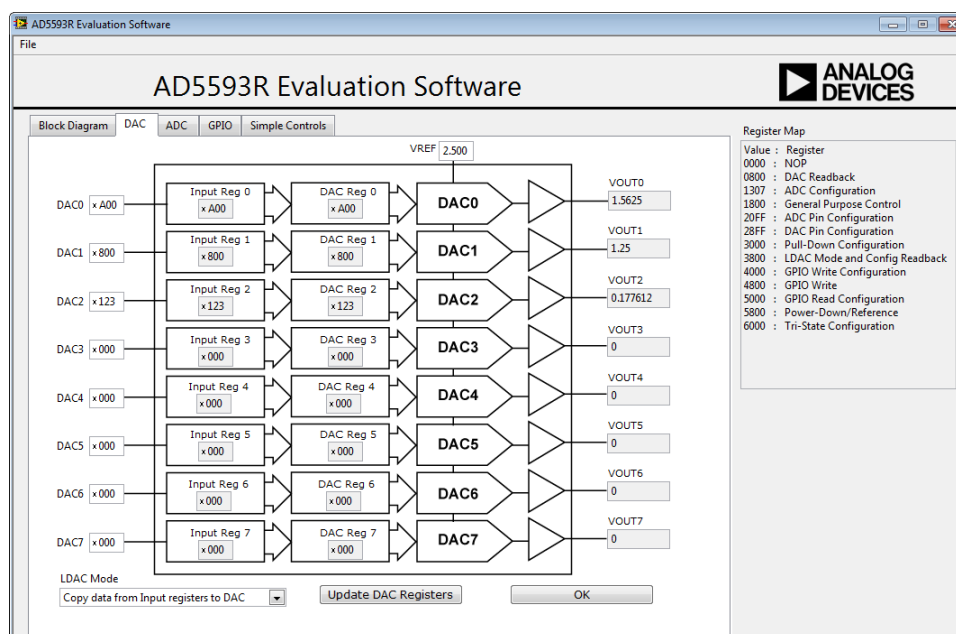


Figure 7. DAC Tab

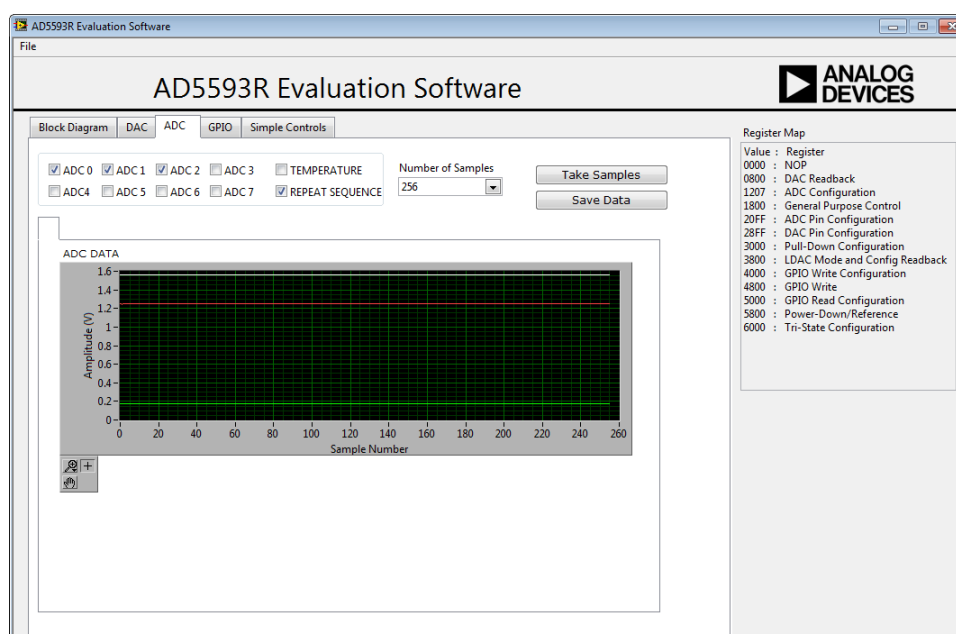


Figure 8. ADC Tab

# **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 (see Figure 9).

# **SIMPLE CONTROLS TAB**

The **Simple Controls** tab allows the user to enter 24-bit values directly into the **Write Array** control. The 24-bit values are

configured as the Pointer Byte followed by the most significant and least significant bytes respectively (see Figure 10).

These values can then be written to the [AD5593R](#) by clicking the **Write Data** button. Data can be read from the [AD5593R](#) registers using the **Read Data** button. The pointer byte determines which register is to be read and the data appears in the **Read Array** numeric indicator.

Any commands sent to the [AD5593R](#) that change the configuration of the [AD5593R](#) will not be reflected in the other tabs.

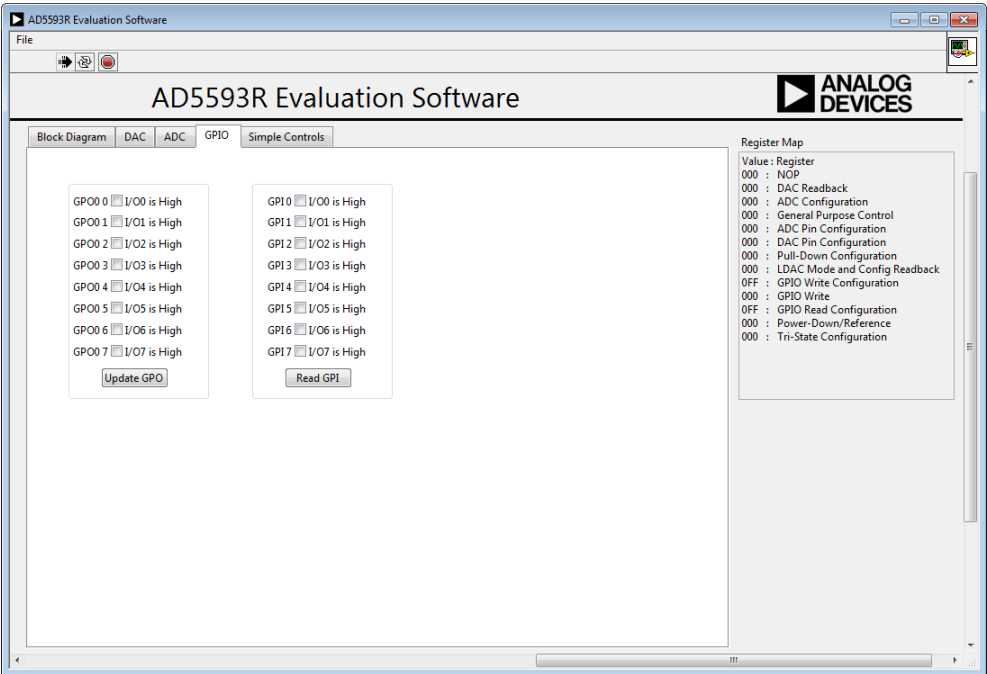


Figure 9. **GPIO Tab**

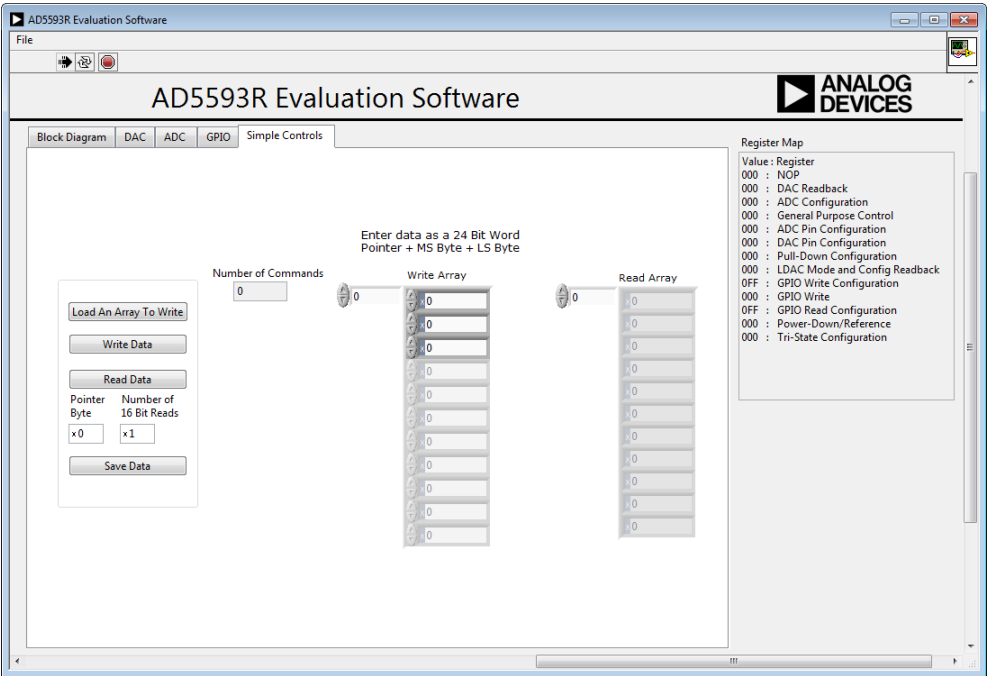
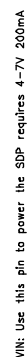


Figure 10. **Simple Controls Tab**

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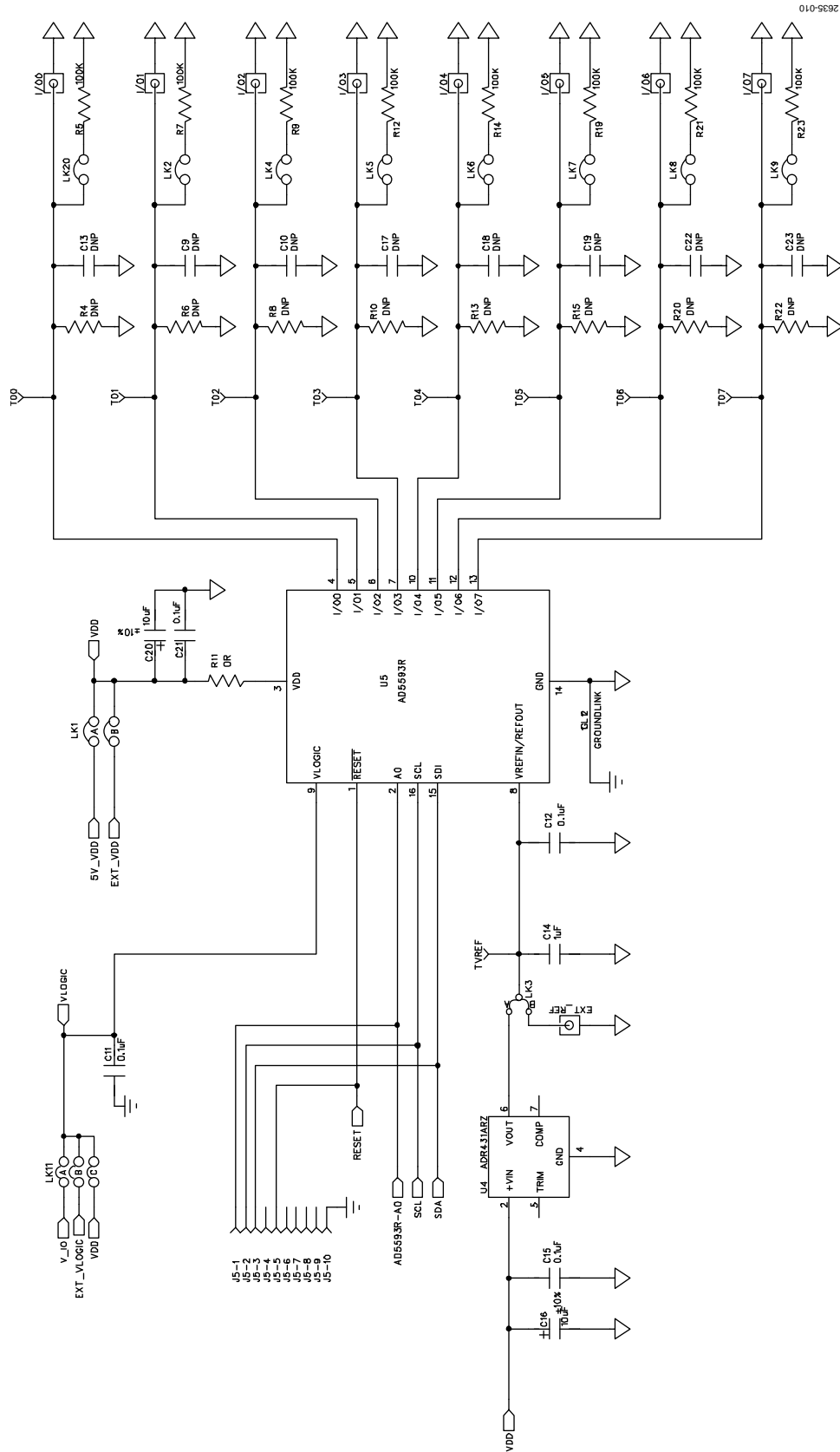


Figure 12. AD5593R Schematic (Page 2 of 2)

## ORDERING INFORMATION

### BILL OF MATERIALS

Table 3.

Qty	Reference Designator	Description	Supplier/Part Number <sup>1</sup>
7	C1, C3, C5, C7, C8, C16, C20	Capacitor, Case A, 10 $\mu$ F, 10 V	FEC 197-130
7	C2, C4, C6, C11, C12, C15, C21	Capacitor, 100 nF, 50 V, 0603	FEC 8820023
8	C9, C10, C13, C17 to C19, C22, C23	0603 capacitor location	Do not insert
1	C14	Capacitor, 0603, 1 $\mu$ F, 10 V	FEC 318-8840
1	EXT_REF	Straight PCB mount SMB jack, 50 $\Omega$	FEC 1206013
1	GL1	Copper short	N/A
8	I/O0 to I/O7	50 $\Omega$ straight SMB jack	FEC 1111349
3	J1 to J3	2-pin terminal block (5 mm pitch)	FEC 151789
1	J4	120-way female connector, 0.6 mm pitch	FEC 1324660 or Digi-Key H1219-ND
1	J5	10 pin (2 $\times$ 5) 0.1" pitch SMT header	FEC 1022244 (36-pin strip)
1	L1	Ferrite bead	Digi-Key 490-1024-1-ND
1	LK1	4-pin (2 $\times$ 2) 0.1" header and shorting block	FEC 1022244 and FEC 150-411 (36-pin strip)
8	LK2, LK4 to LK9, LK20	2-pin (0.1" pitch) header and shorting shunt	FEC 1022247 and FEC 150-411
1	LK3	Jumper block using 3-pin SIP header	FEC 1022248 and FEC 150410
1	LK11	3-way link option, insert 0 $\Omega$ in Position B	FEC 9331662
1	R1	Resistor 300 k $\Omega$ 1/10 W 1% 0603	Digi-Key 541-300KHCT-ND
1	R2	Resistor, 1 M $\Omega$ , 1%, 0.063 W, 0603	Digi-Key RMCF1/161MFRCT-ND
1	R3	Resistor, 1.5 $\Omega$ , 5%, 0.063 W, 0603	FEC 9331832
9	R4, R6, R8, R10, R13, R15, R16, R20, R22	0603 resistor location	Do not insert
13	R5, R7, R9, R12, R14, R17 to R19, R21, R23, R24, R26, R27	Resistor, 0603 100 k $\Omega$ , 0.063 W, 1%	FEC 9330402
1	R11	Resistor, 0805 0.0 $\Omega$	FEC 9333681
1	R25	Resistor, 0603 2.2 k $\Omega$ , 0.063 W, 1%	FEC 9330810
9	T00 to T07, TVREF	Red testpoint	FEC 8731144 (pack)
1	U1	High accuracy, low quiescent current, LDO	<a href="#">ADP3331ARTZ</a>
1	U2	32K I <sup>2</sup> C serial EEPROM	FEC 1331330
1	U3	+5 V fixed, adjustable voltage regulator	<a href="#">ADP3367ARZ</a>
1	U4	Ultralow noise XFET voltage references	<a href="#">ADR431ARZ</a>
1	U5	12-bit configurable ADC/DAC	<a href="#">AD5593RBRUZ</a>
2	Screw1, Screw2	Screw, cheese, nylon, M3X10, PK100	FEC 7070597
2	Nut1, Nut2	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.

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