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)

TYPICAL SETUP

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 × 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.
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 VDD supply. A separate VLOGIC supply can be connected to J1 if required. LK11 selects the source for the AD5593R VLOGIC 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 µF tantalum and 0.1 µF ceramic capacitors.

Table 1. Power Supply Connectors

<table>
<thead>
<tr>
<th>Connector Number</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>External, VLOGIC supply</td>
</tr>
<tr>
<td>J2</td>
<td>Analog power supply, VDD</td>
</tr>
<tr>
<td>J3</td>
<td>6 V board positive power supply</td>
</tr>
</tbody>
</table>

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](image-url)
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

<table>
<thead>
<tr>
<th>Link Number</th>
<th>Option</th>
<th>Default Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>LK1</td>
<td>This link selects the VDD source for the AD5593R.</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Position A selects the internal voltage source (5V_VDD) from the ADP3331.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Position B selects an external supply voltage (EXT_VDD).</td>
<td></td>
</tr>
<tr>
<td>LK2, LK4 to LK9, LK20</td>
<td>These links connect a 100 kΩ 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 AD5593R.</td>
<td>Inserted</td>
</tr>
<tr>
<td>LK3</td>
<td>This link selects the reference source for the AD5593R.</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Position A selects the on-board 2.5 V reference as the reference source.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>LK11</td>
<td>This link selects the source of the VLOGIC supply for the AD5593R.</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Position A selects the 3.3 V supply from the SDP board.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Position B selects the VLOGIC supply from Connector J1.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Position C selects the VDD supply determined by LK1.</td>
<td></td>
</tr>
</tbody>
</table>
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_{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](image)

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](image)

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](image)

![Figure 6. Main Window, Block Diagram Tab](image)
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.
# ORDERING INFORMATION

## BILL OF MATERIALS

Table 3.

<table>
<thead>
<tr>
<th>Qty</th>
<th>Reference Designator</th>
<th>Description</th>
<th>Supplier/Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>C1, C3, C5, C7, C8, C16, C20</td>
<td>Capacitor, Case A, 10 µF, 10 V</td>
<td>FEC 197-130</td>
</tr>
<tr>
<td>7</td>
<td>C2, C4, C6, C11, C12, C15, C21</td>
<td>Capacitor, 100 nF, 50 V, 0603</td>
<td>FEC 8820023</td>
</tr>
<tr>
<td>8</td>
<td>C9, C10, C13, C17 to C19, C22, C23</td>
<td>0603 capacitor location</td>
<td>Do not insert</td>
</tr>
<tr>
<td>1</td>
<td>C14</td>
<td>Capacitor, 0603, 1 µF, 10 V</td>
<td>FEC 318-8840</td>
</tr>
<tr>
<td>1</td>
<td>EXT_REF</td>
<td>Straight PCB mount SMB jack, 50 Ω</td>
<td>FEC 1206013</td>
</tr>
<tr>
<td>1</td>
<td>GL1</td>
<td>Copper short</td>
<td>N/A</td>
</tr>
<tr>
<td>8</td>
<td>I/O0 to I/O7</td>
<td>50 Ω straight SMB jack</td>
<td>FEC 1111349</td>
</tr>
<tr>
<td>3</td>
<td>J1 to J3</td>
<td>2-pin terminal block (5 mm pitch)</td>
<td>FEC 151789</td>
</tr>
<tr>
<td>1</td>
<td>J4</td>
<td>120-way female connector, 0.6 mm pitch</td>
<td>FEC 1324660 or Digi-Key H1219-ND</td>
</tr>
<tr>
<td>1</td>
<td>J5</td>
<td>10 pin (2 x 5) 0.1&quot; pitch SMT header</td>
<td>FEC 1022244 (36-pin strip)</td>
</tr>
<tr>
<td>1</td>
<td>L1</td>
<td>Ferrite bead</td>
<td>Digi-Key 490-1024-1-ND</td>
</tr>
<tr>
<td>1</td>
<td>LK1</td>
<td>4-pin (2 x 2) 0.1&quot; header and shorting block</td>
<td>FEC 1022244 and FEC 150-411 (36-pin strip)</td>
</tr>
<tr>
<td>8</td>
<td>LK2, LK4 to LK9, LK20</td>
<td>2-pin (0.1&quot; pitch) header and shorting shunt</td>
<td>FEC 1022247 and FEC 150-411</td>
</tr>
<tr>
<td>1</td>
<td>LK3</td>
<td>Jumper block using 3-pin SIP header</td>
<td>FEC 1022248 and FEC 150-410</td>
</tr>
<tr>
<td>1</td>
<td>LK11</td>
<td>3-way link option, insert 0 Ω in Position B</td>
<td>FEC 9331662</td>
</tr>
<tr>
<td>1</td>
<td>R1</td>
<td>Resistor 300 kΩ 1/10 W 1%</td>
<td>Digi-Key 541-300KHC-T-ND</td>
</tr>
<tr>
<td>1</td>
<td>R2</td>
<td>Resistor, 1 MΩ, 1%, 0.063 W, 0603</td>
<td>Digi-Key RMCF1/161MFCT-ND</td>
</tr>
<tr>
<td>1</td>
<td>R3</td>
<td>Resistor, 1.5 Ω, 5%, 0.063 W, 0603</td>
<td>FEC 9331832</td>
</tr>
<tr>
<td>9</td>
<td>R4, R6, R8, R10, R13, R15, R16, R20, R22</td>
<td>0603 resistor location</td>
<td>Do not insert</td>
</tr>
<tr>
<td>13</td>
<td>R5, R7, R9, R12, R14, R17 to R19, R21, R23, R24, R26, R27</td>
<td>Resistor, 0603 100 kΩ, 0.063 W, 1%</td>
<td>FEC 9330402</td>
</tr>
<tr>
<td>1</td>
<td>R11</td>
<td>Resistor, 0805 0.0 Ω</td>
<td>FEC 9333681</td>
</tr>
<tr>
<td>1</td>
<td>R25</td>
<td>Resistor, 0603 2.2 kΩ, 0.063 W, 1%</td>
<td>FEC 9330810</td>
</tr>
<tr>
<td>9</td>
<td>T00 to T07, TVREF</td>
<td>Red testpoint</td>
<td>FEC 8731144 (pack)</td>
</tr>
<tr>
<td>1</td>
<td>U1</td>
<td>High accuracy, low quiescent current, LDO</td>
<td>ADP3331ARTZ</td>
</tr>
<tr>
<td>1</td>
<td>U2</td>
<td>32K I²C serial EEPROM</td>
<td>FEC 1313130</td>
</tr>
<tr>
<td>1</td>
<td>U3</td>
<td>+5 V fixed, adjustable voltage regulator</td>
<td>ADP3367ARZ</td>
</tr>
<tr>
<td>1</td>
<td>U4</td>
<td>Ultralow noise XFET voltage references</td>
<td>ADR431ARZ</td>
</tr>
<tr>
<td>1</td>
<td>U5</td>
<td>12-bit configurable ADC/DAC</td>
<td>AD5593BRUZ</td>
</tr>
<tr>
<td>2</td>
<td>Screw1, Screw2</td>
<td>Screw, cheese, nylon, M3X10, PK100</td>
<td>FEC 7070597</td>
</tr>
<tr>
<td>2</td>
<td>Nut1, Nut2</td>
<td>Nut/washer, nylon, M3, PK100</td>
<td>FEC 7061857</td>
</tr>
</tbody>
</table>

1. 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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