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## Evaluation Board for the AD5679R 16-Bit, 16-Channel, Voltage Output DAC

### FEATURES

**Full featured evaluation board for the AD5679R**
**Various link options**
**PC control in conjunction with the Analog Devices, Inc., SDP board**

### EVALUATION KIT CONTENTS

**EVAL-AD5679RSDZ**
**USB cable**

### HARDWARE REQUIRED

**EVAL-SDP-CB1Z (SDP-B) board, must be purchased separately**

### SOFTWARE REQUIRED

**Analysis | Control | Evaluation software, available for download from the EVAL-AD5679RSDZ product page**

### GENERAL DESCRIPTION

This user guide details the operation of the EVAL-AD5679RSDZ for the AD5679R 16-bit, 16-channel, voltage output, digital-to-analog converter (DAC).

The EVAL-AD5679RSDZ allows users to quickly prototype AD5679R circuits and reduce design time. The AD5679R operates from a single 2.7 V to 5.5 V supply range. The AD5679R incorporates an internal 2.5 V reference to give an output voltage of 2.5 V or 5 V. The EVAL-AD5679RSDZ also incorporates additional voltage references.

The EVAL-AD5679RSDZ interfaces to the USB port of a PC via a system demonstration platform (SDP-B) board. The Analysis | Control | Evaluation (ACE) software is available for download from the EVAL-AD5679RSDZ product page to use with the evaluation board to allow the user to program the AD5679R. A peripheral module interface (PMOD) connection is also available to allow the connection of microcontrollers to the evaluation board without the SDP-B board. When a microcontroller is used through the PMOD connection, the SDP-B board must be disconnected, and the user is unable to operate the ACE software.

The EVAL-AD5679RSDZ is compatible with any Analog Devices, Inc., SDP-B board, which can be purchased separately. A typical connection between the EVAL-AD5679RSDZ and the SDP-B controller board is shown in Figure 1.

For full details, see the AD5679R data sheet, which must be used in conjunction with this user guide when using the EVAL-AD5679RSDZ.

### EVALUATION BOARD PHOTOGRAPH

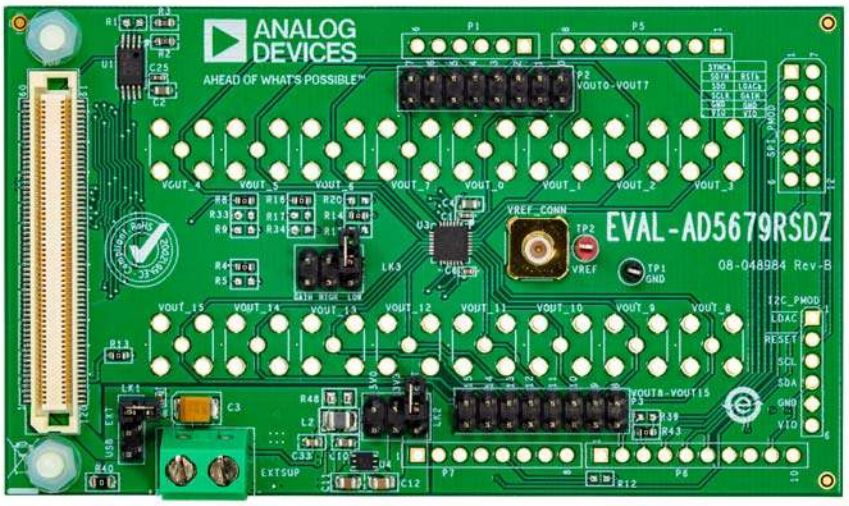


*Figure 1. EVAL-AD5679RSDZ*

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## REVISION HISTORY

**8/2019—Revision 0: Initial Version**

# EVALUATION BOARD SOFTWARE QUICK START PROCEDURES

## INSTALLING THE SOFTWARE

The EVAL-AD5679RSDZ uses the ACE evaluation software, which allows the evaluation and control of multiple evaluation systems.

The ACE installer installs the necessary SDP-B drivers and the Microsoft® .NET Framework 4 by default. The ACE software is available for download from the EVAL-AD5679RSDZ product page and 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 connected to the PC. For full instructions on how to install and use this software, see the ACE software page on the Analog Devices website.

After the installation is finished, the EVAL-AD5679RSDZ plug-in appears when the ACE software is opened.

## INITIAL SETUP

To set up the evaluation board, take the following steps:

1. Connect the evaluation board to the SDP-B board, and then connect the USB cable between the SDP-B board and the PC.
2. Run the ACE application. The EVAL-AD5679RSDZ plug-ins appear in the attached hardware section of the **Start** tab.
3. Double-click the board plug-in to open the board view seen in Figure 2.
4. Double-click the AD5679R chip to access the chip block diagram. This view provides a basic representation of the functionality of the board. The main functions of the board are labeled in Figure 3.

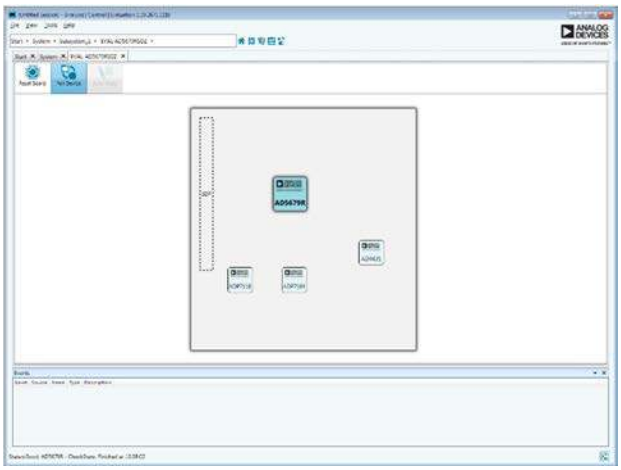


*Figure 2. Board View of the EVAL-AD5679RSDZ*

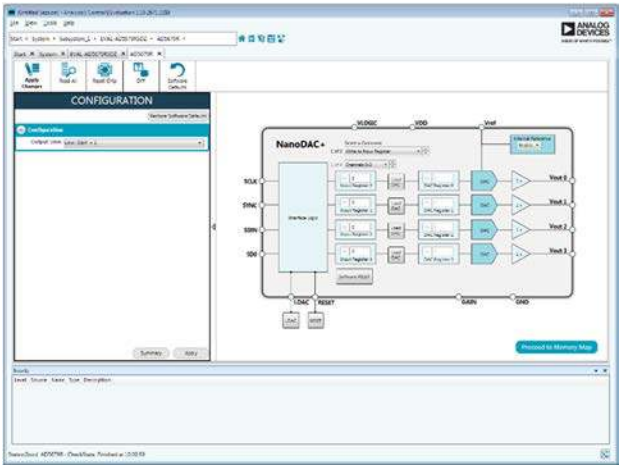


*Figure 3. Chip Block Diagram of the AD5679R*

# FUNCTIONAL BLOCK DIAGRAM AND DESCRIPTION

The EVAL-AD5679RSDZ software is organized to appear similarly to the functional block diagram shown in the AD5679R data sheet, which simplifies correlating the functions on the EVAL-AD5679RSDZ with the description in the AD5679R data sheet.

For a full description of each block, register, and its settings, see the AD5679R data sheet.

Some of the blocks and their functions are described in this section as they pertain to the evaluation board. The full screen block diagram is shown in Figure 4. Table 1 describes the functionality of each block.

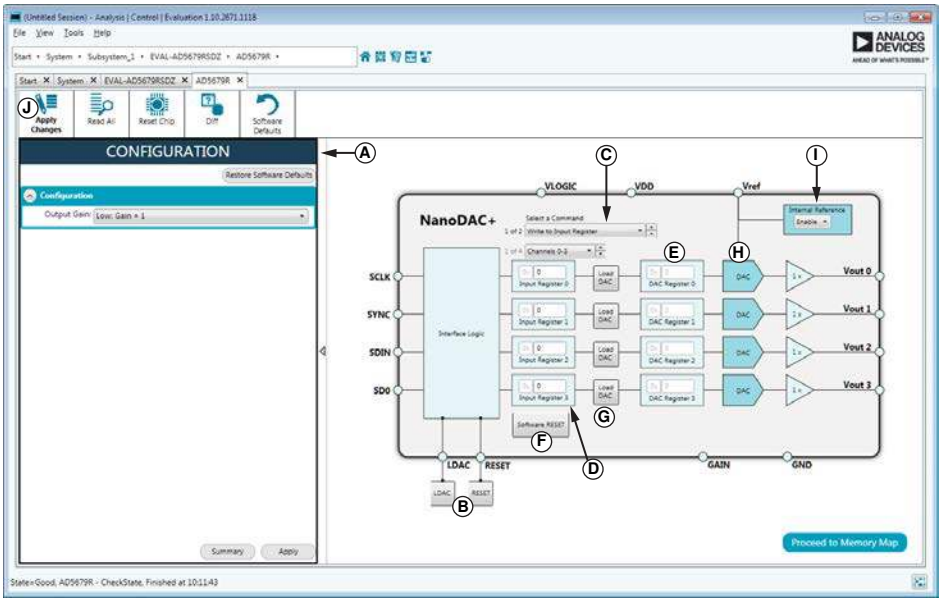


*Figure 4. AD5679R Block Diagram with Labels*

**Table 1. Block Diagram Functions (See Figure 4)**

| Label | Button/Function Name | Function |
|---|---|---|
| A | **CONFIGURATION** wizard | Used to set the initial configuration for the board. Select the reference gain case from the **Output Gain** dropdown menu. A gain of 1 is the default. After setting up the initial configuration, click **Apply** to apply the values. These settings can be modified at any stage while evaluating the board. |
| B | **LDAC** and **RESET** (GPIO buttons) | Act as external GPIO pulses to the $\overline{\text{LDAC}}$ pin and $\overline{\text{RESET}}$ pin. The **LDAC** button pushes data from both input registers (**Label D**) to the DAC registers (**Label E**). The **RESET** button clears all data from input registers and DAC registers. These buttons are live and there is no need to click **Apply Changes** (**Label J**). |
| C | **Select a Command** | Command option dropdown menu selects how the data being transferred to the device affects the input registers and DAC registers. After a data value is entered in an input register (**Label D**), this menu determines if the data is transferred to the input register only, or to the channel input register (**Label D**) and the channel DAC register (**Label E**). |
| D | **Input Register 0** through **Input Register 3** | 16-bit data word to be transferred to the device. Click **Apply Changes** (**Label J**) to transfer this 16-bit data word to the device. |
| E | **DAC Register 0** through **DAC Register 3** | Displays the value that is currently present in the DAC register on the device. Update the DAC registers by selecting the appropriate command option or by toggling **LDAC** (**Label B**). |
| F | **Software RESET** | Returns the evaluation board and software to default values. This button is live. Therefore, there is no need to click **Apply Changes**. |
| G | **Load DAC** | Users can individually control which channel loads the values from the input registers to the DAC register. |
| H | **DAC** | DAC configuration options provide access to individual channel configuration options such as power-down options and hardware LDAC mask enable and disable settings. |
| I | **Internal Reference** | Select **Enable** from this setting to enable the on-chip reference for the evaluation board. If **Disable** is selected, an external reference must be applied. This control is only available on the AD5679R. |
| J | **Apply Changes** | Applies all modified values to the device. Note that if an evaluation board is not connected, values entered in the input registers are not transferred to the DAC registers. |

## MEMORY MAP

All registers are fully accessible from the **AD5679R Memory Map** tab, shown in Figure 5. This tab allows registers to be edited at bit level. The bits shaded in dark gray are read-only bits and cannot be accessed from the ACE software. All other bits are toggled.

Clicking the **Apply Changes** button transfers data to the device. All changes made in the memory map tab correspond to the block diagram. For example, if the internal register bit is enabled, it displays as enabled on the block diagram. Any bits or registers that are shown in bold in the memory map tab are modified values that have not been transferred to the evaluation board (see Figure 6). Click **Apply Changes** to transfer the data to the evaluation board.

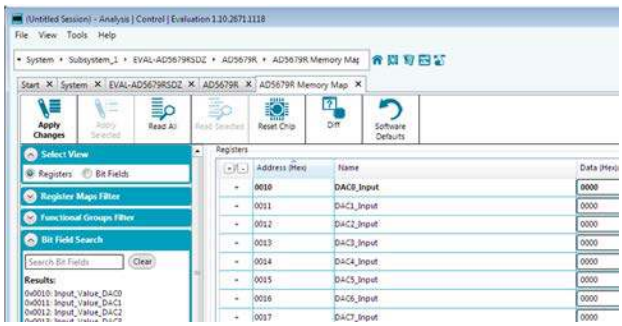


*Figure 5. **AD5679R Memory Map** Tab*


*Figure 6. AD5679R Memory Map with Unapplied Changes in the **DAC0_Input** Register*

# EVALUATION BOARD HARDWARE

## POWER SUPPLIES

The EVAL-AD5679RSDZ provides on-board 3.3 V and 5 V regulators powered through the USB supply or from an external source. If a different supply is required or if the evaluation board is controlled through the PMOD connector, an external supply must be provided by the external supply voltage (EXTSUP) connector. See Table 2 for more details.

Every supply is decoupled to ground with 10 µF tantalum and 0.1 µF ceramic capacitors.

## LINK OPTIONS

A number of link options are incorporated on the EVAL-AD5679RSDZ and must be set for the required operating conditions before using the board. The functions of these link options are described in Table 3.

**Table 2. Power Supply Connectors**

| Connector Label | External Voltage Supplies Description |
|---|---|
| EXTSUP, Pin 1 | External analog power supply from 2.7 V to 5.5 V. |
| EXTSUP, Pin 2 | Analog ground. |
| VREF_CONN | External voltage reference. |

**Table 3. Link Functions**

| Link | Description |
|---|---|
| LK1 | This link selects the primary analog voltage source for the 3.3 V output and 5 V output for LK2. There are two options, as follows:<br>The USB option selects the USB supply from Pin 5 of the 120-pin connector of the SDP-B board.<br>The EXT option selects an EXTSUP connector. Voltage applied to EXTSUP must be between 2.7 V to 5.5 V. |
| LK2 | This link selects the DAC analog voltage source. There are three options, as follows:<br>The 5V0 option selects the on-board 5 V source from the LTC3536.<br>The 3V3 option selects the on-board 3.3 V source from the ADM7160.<br>The EXT option selects an EXTSUP connector. Voltage applied to EXTSUP must be between 2.7 V to 5.5 V. |
| LK3 | This link selects the gain setting for the DAC. There are three options, as follows:<br>The gain option allows the ACE plugin to control the gain setting of the device.<br>The high option selects gain = 2.<br>The low option selects gain = 1. |

## ON-BOARD CONNECTORS

Table 4 shows the connectors on EVAL-AD5679RSDZ.

**Table 4. On-Board Connectors**

| Connector | Function |
|---|---|
| EXTSUP | External analog power supply from 2.7 V to 5.5 V. |
| VREF_CONN | External voltage reference. |
| P2 | DAC outputs from $V_{OUT}0$ to $V_{OUT}7$. |
| P3 | DAC outputs from $V_{OUT}8$ to $V_{OUT}15$. |

# EVALUATION BOARD SCHEMATICS AND ARTWORK

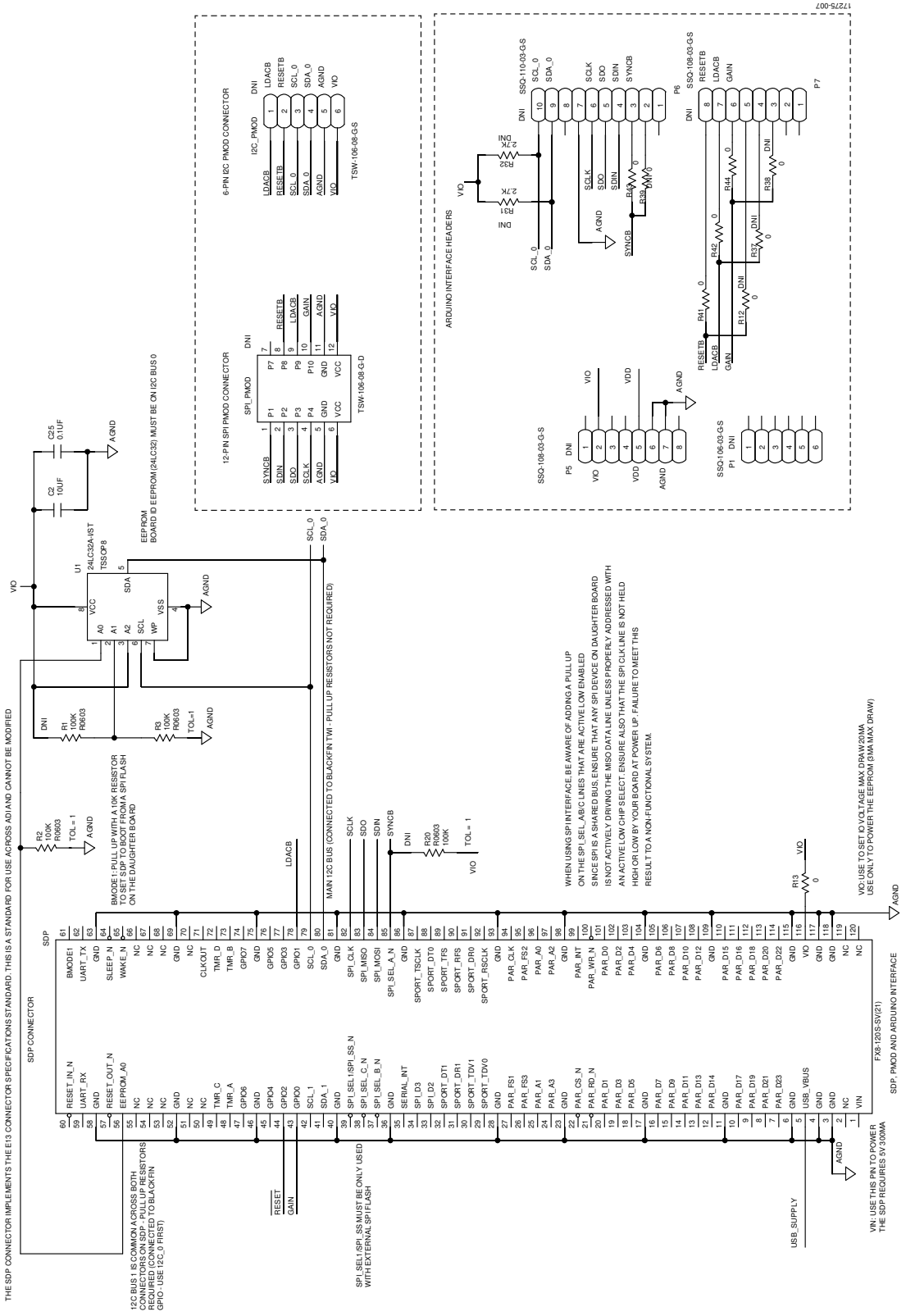


*Figure 7. EVAL-AD5679RSDZ Schematic, SDP, Arduino®-Compatible, PMOD Connectors*

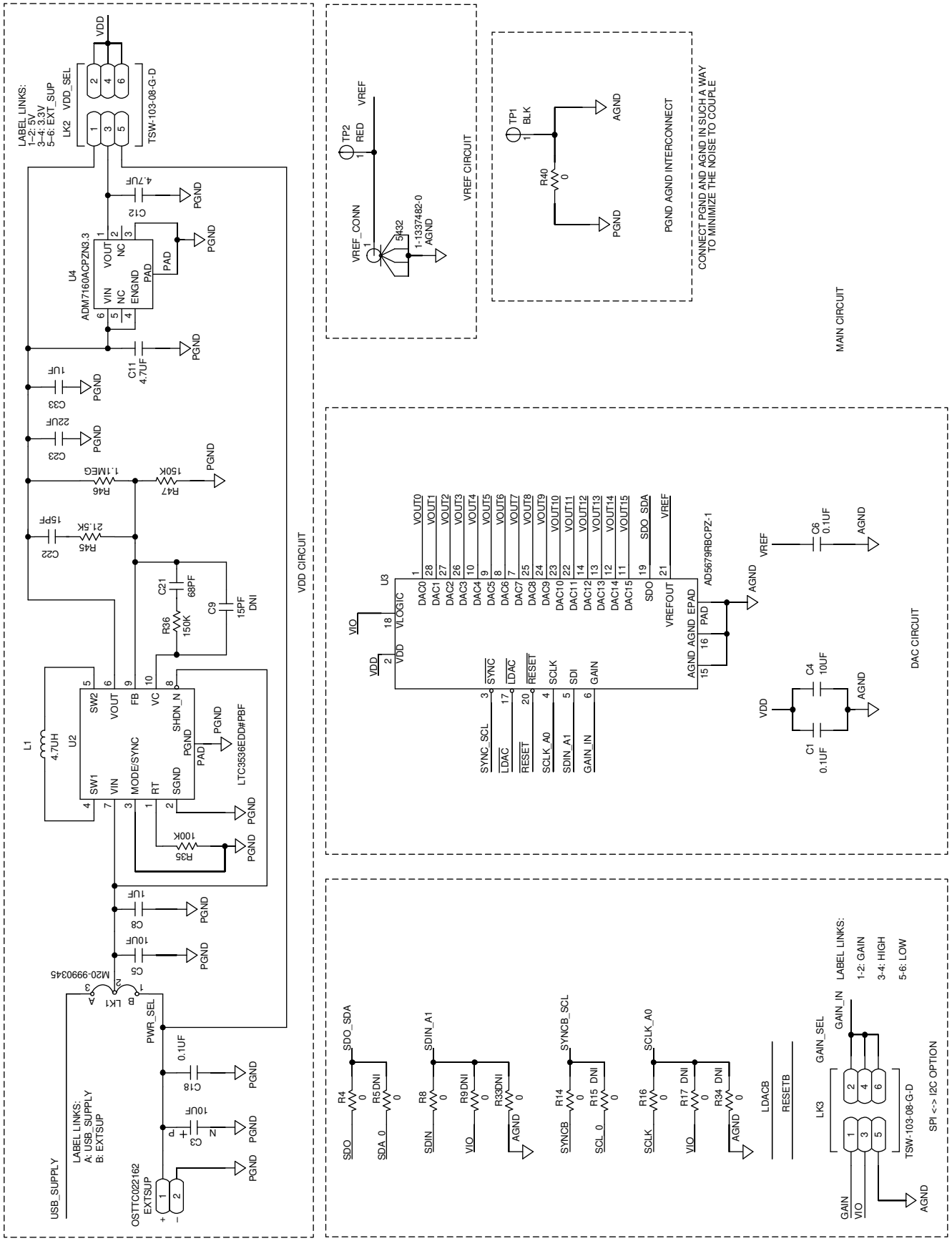


*Figure 8. EVAL-AD5679RSDZ Schematic, Main Circuit*

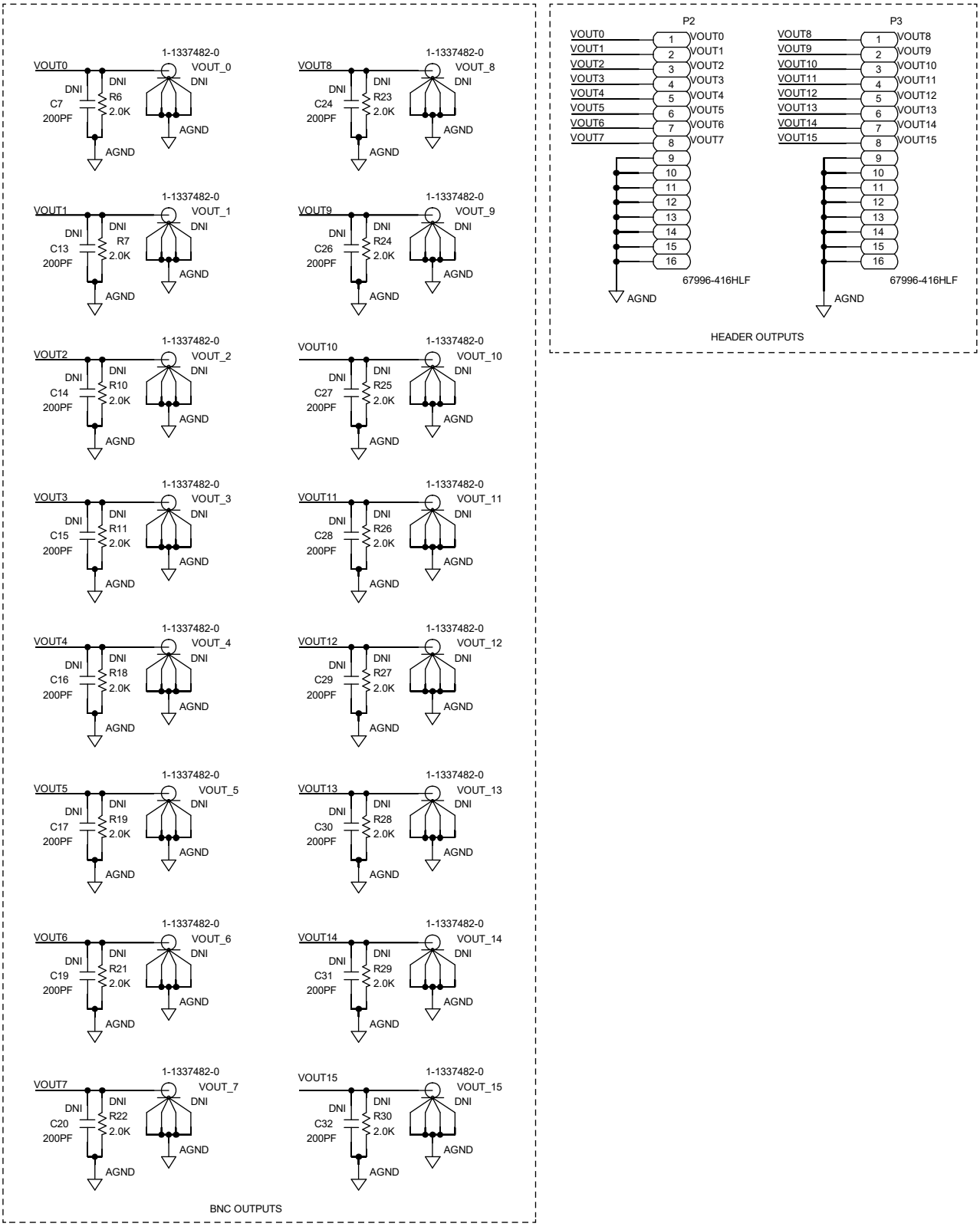


*Figure 9. EVAL-AD5679RSDZ Schematic, Output Connectors*

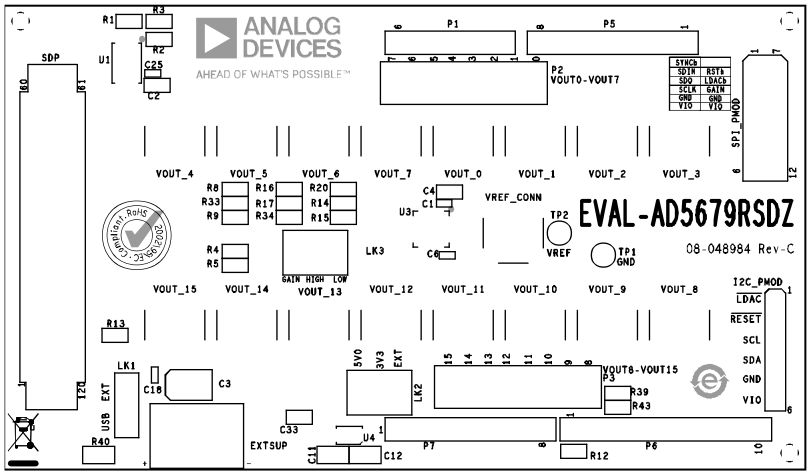


Figure 10. EVAL-AD5679RSDZ Top Side Component Placement

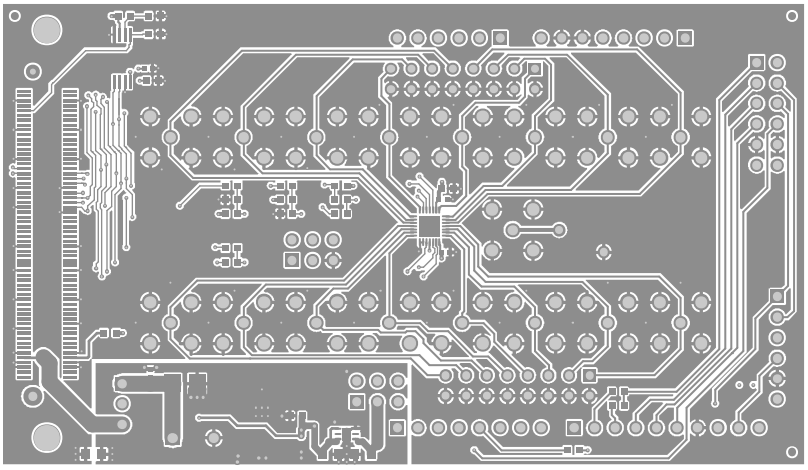


Figure 11. EVAL-AD5679RSDZ Top Side Routing

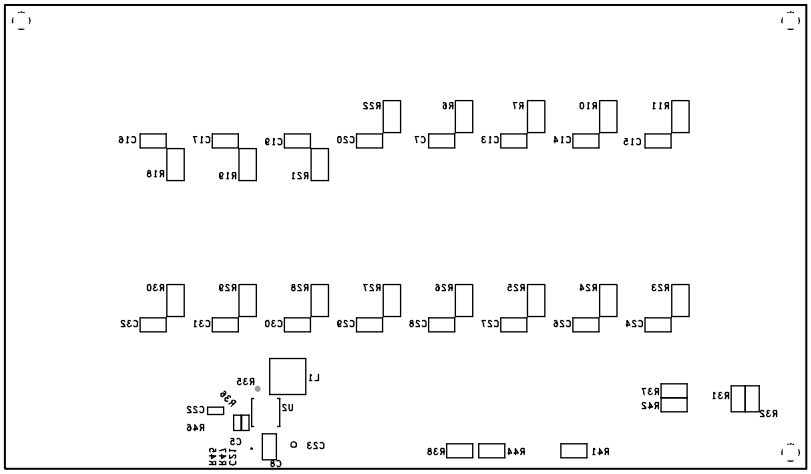


Figure 12. EVAL-AD5679RSDZ Bottom Side Component Placement

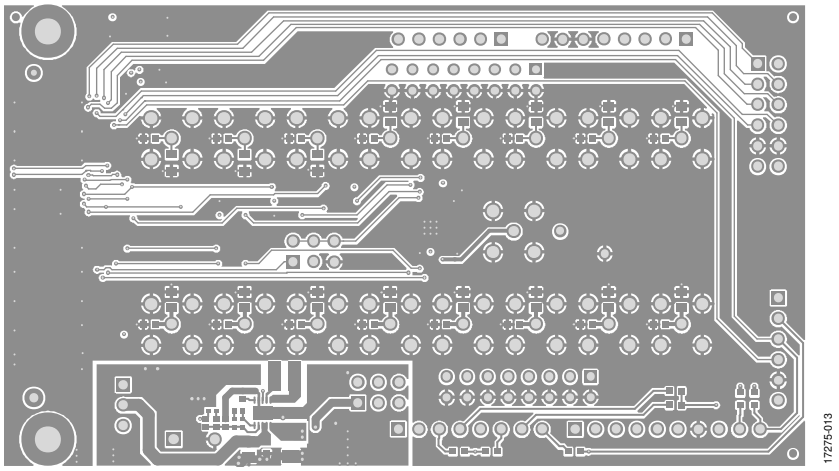


*Figure 13. EVAL-AD5679RSDZ Bottom Side Routing*

# ORDERING INFORMATION

## BILL OF MATERIALS

**Table 5.**

| Qty | Reference Designator | Description | Supplier/Part Number[1, 2] |
|---|---|---|---|
| 4 | C1, C6, C18, C25 | Ceramic capacitors, 0.1 µF, 16 V, X7R, 0402 | GRM155R71C104KA88D |
| 2 | C11, C12 | Ceramic capacitors, 4.7 µF, 10 V, X7R, 0805 | C2012X7R1A475M085AC |
| 2 | C2, C4 | Ceramic capacitors, 10 µF, 10 V, X5R, 0603 | GRM188R61A106KE69D |
| 1 | C21 | Ceramic capacitor, 68 pF, 50 V, NP0, 0402 | GCM1555C1H680JA16D |
| 1 | C22 | Ceramic capacitor, 15 pF, 50 V, C0G, 0402 | CGA2B2C0G1H150J050BA |
| 1 | C23 | Ceramic capacitor, 22 µF, 25 V, X5R, 1206 | CL31A226KAHNNNE |
| 1 | C3 | Tantalum capacitor, 10 µF, 16 V, 1411 | TAJB106K016RNJ |
| 2 | C8, C33 | Ceramic capacitors, 1 µF, 10 V, X7R, 0603 | CL10B105KP8NNNC |
| 1 | C5 | Ceramic capacitor, 10 µF, 25 V, X5R, 0805 | GRM21BR61E106KA73L |
| 1 | EXTSUP | Terminal block, 5.08 mm pitch | OSTTC022162 |
| 1 | L1 | Inductor, 4.7 µH, 5 A, 57.4 mΩ direct current resistance (DCR) | XFL4020-472MEB |
| 1 | LK1 | 3-pin male header, 2.54 mm pitch | M20-9990345 |
| 2 | LK2, LK3 | 6-pin male headers, 2.54 mm pitch | TSW-103-08-G-D |
| 2 | P2, P3 | 16-pin male headers, 2.54 mm pitch | 67996-416HLF |
| 1 | R13 | Resistor, SMD, 0 Ω, 1%, 1/10 W, 0603, thick film | CRCW0603000ZRT1 |
| 8 | R4, R8, R14, R16, R41, R42, R43, R44 | Resistors, SMD, 0 Ω, 1/16 W, 0603, thick film | MC0603WG00000T5E-TC |
| 2 | R2, R3 | Resistors, SMD, 100 kΩ, 5%, 1/10 W, 0603, thick film | RC0603JR-07100KL |
| 1 | R35 | Resistor, SMD, 100 kΩ, 1%, 1/5 W, 0402, thick film | ERJ-PA2F1003X |
| 2 | R36, R47 | Resistors, SMD, 150 kΩ, 1%, 1/10 W, 0402, thick film | ERJ-2RKF1503X |
| 1 | R40 | Resistor, SMD, 0 Ω, 1/10 W, 0805, thick film | MC 0.1W 0805 0R |
| 1 | R45 | Resistor, SMD, 21.5 kΩ, 1%, 1/10 W, 0402, thick film | ERJ-2RKF2152X |
| 1 | R46 | Resistor, SMD, 1.1 MΩ, 1%, 1/16 W, 0402, thick film | AC0402FR-071M1L |
| 1 | SDP | SDP connector | FX8-120S-SV(21) |
| 1 | TP1 | Test point, black | 20-2137 |
| 1 | TP2 | Test point, red | 20-313137 |
| 1 | VREF_CONN | SubMiniature version B (SMB) connector | 1-1337482-0 |
| 1 | U1 | 32 kΩ, I²C electronically erasable programmable read-only memory (EEPROM) | 24LC32A-I/ST |
| 1 | U2 | 1 A low noise, buck-boost dc-to-dc converter | LTC3536EDD#PBF |
| 1 | U3 | 16-Channel, 16-Bit, *nano*DAC+ | AD5679RBCPZ-1 |
| 1 | U4 | Ultralow noise, 200 mA linear regulator | ADM7160ACPZN3.3-R7 |

[1] FEC refers to Farnell Electronic Component Distributors.
[2] Generic indicates that any device with the specified value, size, and rating can be used.

# NOTES

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.



**UG17275-0-8/19(0)**

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