EVAL-AD5686RSDZ User Guide
UG-725

One Technology Way • P.O. Box 9106 • Norwood, MA 02062-9106, U.S.A. • Tel: 781.329.4700 • Fax: 781.461.3113 • www.analog.com

Evaluating the AD5686R 16-Bit, Quad Channel, Voltage Output DAC

FEATURES

- Full featured evaluation board for the AD5686R
- On-board references
- Various link options
- PC control in conjunction with the Analog Devices, Inc., System Demonstration Platform (SDP)

EVALUATION KIT CONTENTS

- EVAL-AD5686RSDZ (AD5686R 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 AD5686R data sheet
  - Electronic version of the EVAL-AD5686RSDZ user guide
- USB cable

GENERAL DESCRIPTION

This user guide details the operation of the evaluation board for the AD5686R quad channel, voltage output digital-to-analog converter (DAC).

The EVAL-AD5686RSDZ evaluation board is designed to help users quickly prototype new AD5686R circuits and reduce design time. The AD5686R operates from a single 2.7 V to 5.5 V supply. The AD5686R incorporates an internal 2.5 V reference to give an output voltage of 2.5 V or 5 V. The evaluation board also incorporates additional voltage references.

Full data on the AD5686R can be found in the data sheet, available from Analog Devices, which should be consulted in conjunction with this user guide when using the evaluation board.

The EVAL-AD5686RSDZ interfaces to the USB port of a PC via an SDP board. Software is supplied with the evaluation board to allow the user to program the AD5686R. A PMOD™ connection is also available for different microcontrollers.

This evaluation board is compatible with any Analog Devices SDP board, which can be purchased separately. For example, a typical connection between the EVAL-AD5686RSDZ and the EVAL-SDP-CS1Z board (SDP-S controller board) is shown in Figure 1.

EVAL-AD5686RSDZ CONNECTED TO THE SDP-S BOARD

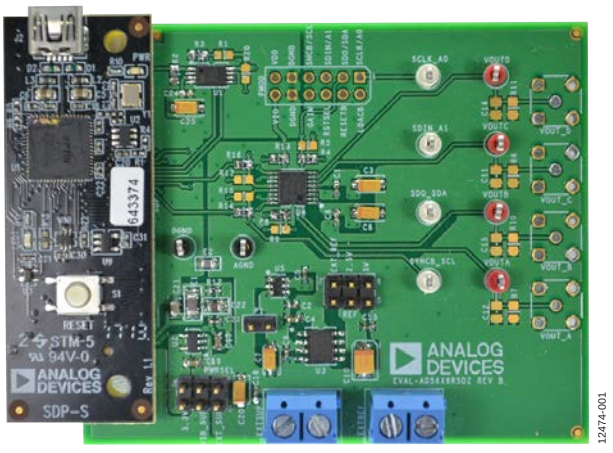

Figure 1.

TABLE OF CONTENTS

REVISION HISTORY

1/16—Rev.0 to Rev. A

Changes to Title 1
Changes to Running the Software Section 5
Added Figure 5; Renumbered Sequentially 5
Changes to Figure 6 6
Added LDAC Mask Register Section 7
Changes to Figure 7 8
Changes to Figure 8 9
Changes to Figure 9 and Figure 10 10
Changes to Figure 11 11
Changes to Table 5 12

5/15—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

POWER SUPPLIES

The EVAL-AD5686RSDZ provides an on-board, 3.3 V regulator powered through the USB supply. If a different supply is required or if the board is controlled through the PMOD, an external supply must be provided by the EXTSUP x connector. See Table 1 for more details.

Both AGND and DGND inputs are provided on the board. The AGND and DGND planes are connected at one location close to the AD5686R. To avoid ground loop problems, it is recommended that AGND and DGND not be connected elsewhere in the system.

All supplies are decoupled to ground with 10 µF tantalum and 0.1 µF ceramic capacitors.

LDO RECOMMENDATION

The ADP7118 low dropout (LDO) linear regulator (maximum V_{IN} = 20 V) is recommended to power the V_{DD} rail for maximal performance. A 4.7 Ω resistor in series with the input capacitor of the ADP7118 adds additional rejection at higher frequencies to reduce any power supply ripple artifacts below the noise floor. The ADP162 is recommended for powering the V_{LOGIC} rail.

LINK 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 Table 3.

Table 2 lists the positions of the different links controlled by the PC via the USB port. An SDP board operating in single-supply mode is required.

VOLTAGE REFERENCES

The AD5686R provides an internal voltage reference. The evaluation board provides external references with values of 2.5 V and 5 V. Note that the ADR3450 requires the use of an external supply through the EXTSUP x connector (see Table 3).

TEST POINTS

The evaluation board has various test points for debugging and monitoring purposes. These test points are described in Table 4.

Table 1. Power Supply Connectors

Connector	Label	External Voltage Supplies Description
EXTSUP 1	EXTSUP	External analog power supply from 2.7 V to 5.5 V, V_{DD}.
EXTSUP 2		Analog ground.
EXTREF 1	EXTREF	External voltage reference, V_{LOGIC}. It is 3.3 V when the evaluation board is controlled through the SDP board. It is 1.8 V to 5.5 V when the evaluation board is controlled through an external connector.
EXTREF 2		Analog ground.

Table 2. Link Options Setup for SDP Control (Default)

Link	Option
PWRSEL	3.3 V
REF	Not connected
P1	Not connected

Table 3. Link Functions

Link	Description
PWRSEL	This link selects the DAC analog voltage source. Three options follow: The 3.3 V option selects the on-board voltage source from the ADP121. The USB_SUP option selects the USB supply from Pin 5 of the 120-pin connector of the SDP board. The EXT_SUP option selects an external supply voltage (EXTSUP x connector).
REF	This link selects the reference source. Four options follow: The not connected option uses the 2.5 V internal reference. The EXT_REF option selects an external reference source (EXTREF x connector). The 2.5 V option selects the on-board reference from the REF192. The 5 V option selects the on-board reference from the ADR3450. This reference requires an external supply.
P1	The P1 link selects the DAC digital voltage source. Two options follow: The connected option shorts V_{DD} and V_{LOGIC}. Use this option only when the SDP board is not connected. The not connected option opens the connection of V_{DD} and V_{LOGIC}. Use this option when using the SDP board.

Table 4. Test Point Descriptions

Test Point	Description
AGND	Analog ground.
DGND	Digital ground.
SCLK/A0	Serial clock input. Data is clocked into the input shift register on the falling edge of the serial clock input. Data can be transferred at rates of up to 50 MHz. This signal is named SCLK_A0 in Figure 7.
SDO/SDA	Serial data output. This output daisy chains a number of AD5686R/AD5685R/AD5684R devices together, or it can be used for read back. The serial data is transferred on the rising edge of SCLK and is valid on the falling edge of the clock. This signal is named SDO_SDA in Figure 7.
SYNCB/SCL	Active low control input. This is the frame synchronization signal for the input data. When SYNCB goes low, data is transferred in on the falling edges of the next 24 clocks. This signal is named SYNCB_SCL in Figure 7.
SDIN/A1	Serial data input. This device has a 24-bit input shift register. Data is clocked into the register on the falling edge of the serial clock input. This signal is named SDIN_A1 in Figure 7.
VOUTA to VOUTD	Analog output voltage from DAC A to DAC D, respectively. The output amplifier has rail-to-rail operation.

EVALUATION BOARD SOFTWARE

INSTALLING THE SOFTWARE

The evaluation kit for the AD5686R includes self installing software on the CD. The software is compatible with Windows® XP (32-bit), Windows Vista, and Windows 7 (32-bit and 64-bit). To ensure that the SDP board is recognized when it connects to the PC, the software must be installed before connecting the SDP board to the USB port of 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 board and the SDP board into the PC using the USB cable included in the box.
5. When the software detects the evaluation board, proceed through the dialog boxes that appear to finalize the installation.

RUNNING THE SOFTWARE

To run the program, take the following steps:

1. Connect the evaluation board to the SDP board and connect the USB cable between the SDP board and the PC.
2. Click **Start** > **All Programs** > **Analog Devices** > **AD56x6R Evaluation Software** > **AD56x6R Evaluation Software.exe** to run the software. When the software connects to the evaluation board, the message in Figure 2 displays.

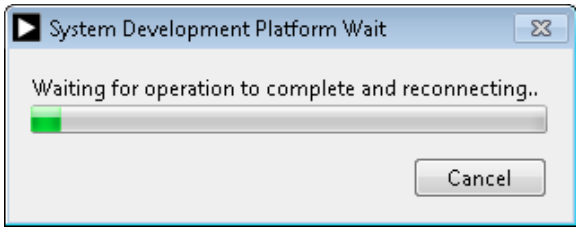

Figure 2. Connection Message

3. If the SDP board is not connected to the USB port when the software is launched, a connectivity error displays (see Figure 3). Connect the evaluation board to the USB port of the PC, wait a few seconds, click **Rescan**, and follow the on-screen instructions.

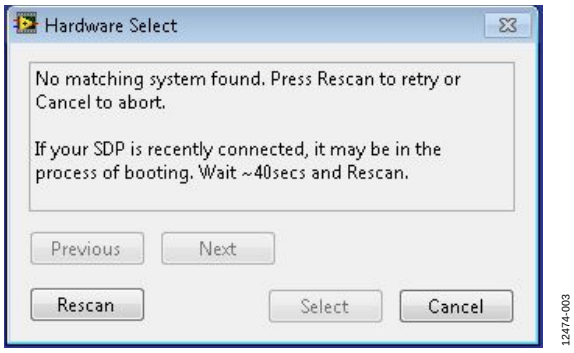

Figure 3. Connectivity Error

4. Alternatively, you can use the software without an evaluation board. The software runs in simulation mode, displaying expected outputs based on the input data (see Figure 4). Note that a 2.5 V reference voltage is used in simulation mode. A screen similar to Figure 5 in which the user chooses which device the simulation should run appears. The main window of the AD5686R evaluation software then opens, as shown in Figure 6.

Figure 4. Simulation Mode

Figure 5. Device Selection for Simulation Mode

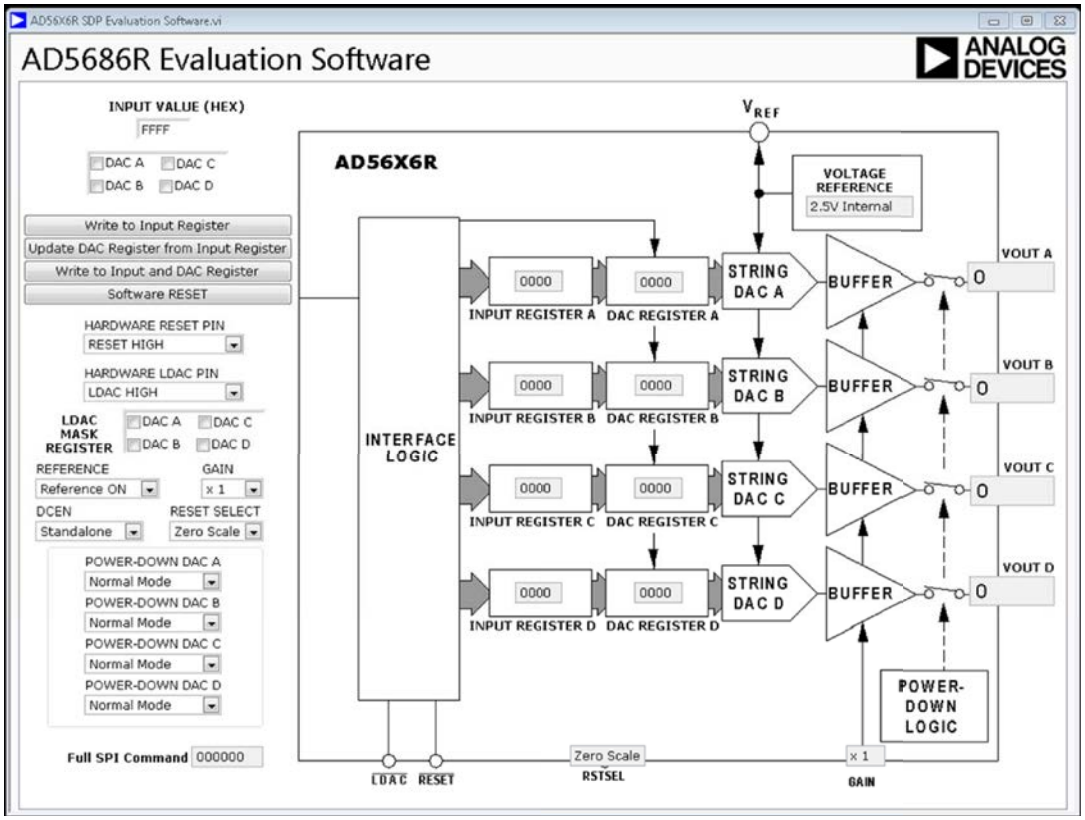

Figure 6. AD5686R Evaluation Software Main Window

SOFTWARE OPERATION

The software for the AD5686R allows the user to program values to the input and DAC registers of each DAC individually or collectively.

Write to Input Register

Click **Write to Input Register** to load the value into the **INPUT VALUE (HEX)** box for the input register of any DACs selected in the **DAC A**, **DAC B**, **DAC C**, and **DAC D** boxes.

Write to Input and DAC Register

Click **Write to Input and DAC Register** to load the value into the input data control for the DAC registers selected in the **DAC A**, **DAC B**, **DAC C**, and **DAC D** boxes. The DAC outputs are updated automatically with the appropriate voltage.

Update DAC Register from Input Register

Click **Update DAC Register from Input Register** to copy the value in the DAC input register to the corresponding DAC register. DAC outputs are updated automatically with the appropriate voltage.

LDAC CONTROL

Within the **HARDWARE LDAC PIN** drop-down menu, select **LDAC LOW** to bring the LDAC pin low, and then select **LDAC HIGH** to return it to high. This action copies the data from the input registers to the DAC registers, updating the outputs accordingly.

GAIN Control

The GPIO of the SDP sets the logic level of the GAIN pin and the software controls it. To display the correct voltage, set the gain selection to match the level of the GAIN pin. Select **× 1** or **× 2** from the **GAIN** drop-down menu to set the gain.

Reference Control

The AD5686R has an on-chip reference that can be disabled to reduce power consumption. Select **Reference OFF** from the **REFERENCE** drop-down menu to disable the on-chip reference.

Power-Down Control

Each of the DACs can be powered down individually. Each of the DACs has an associated **POWER-DOWN DAC x** drop-down menu that allows the device to operate in normal mode, be powered down with either a 1 kΩ or a 100 kΩ resistor to ground, or be three-stated. When power-down mode is selected, the software sends the appropriate command to the AD5686R and sets the appropriate channel to the selected power-down mode.

LDAC Mask Register

When the **LDAC MASK REGISTER** boxes are checked, it forces the DAC channels to ignore transitions on the $\overline{\text{LDAC}}$ pin, regardless of the state of the hardware $\overline{\text{LDAC}}$ pin.

FULL SPI COMMAND

The SPI commands sent to the DAC are displayed in the **Full SPI Command** box. This command is in hexadecimal format and shows what must be written to the AD5686R to replicate the function of the evaluation board if a different controller is used.

EVALUATION BOARD SCHEMATICS AND ARTWORK

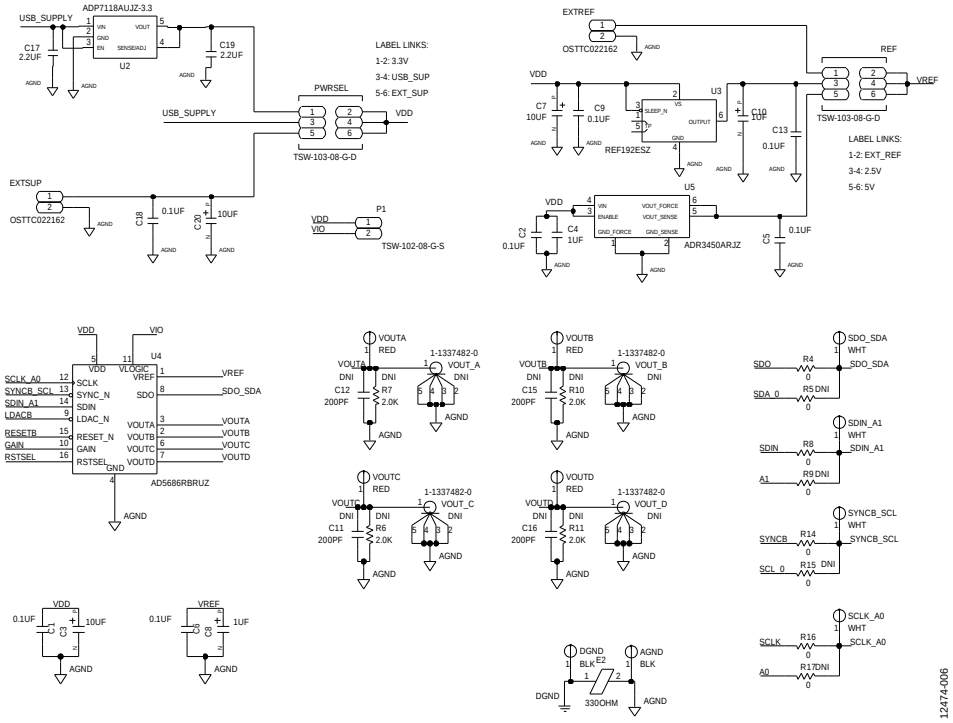

Figure 7. EVAL-AD5686RSDZ Schematic—Power Supply and Signal Routes

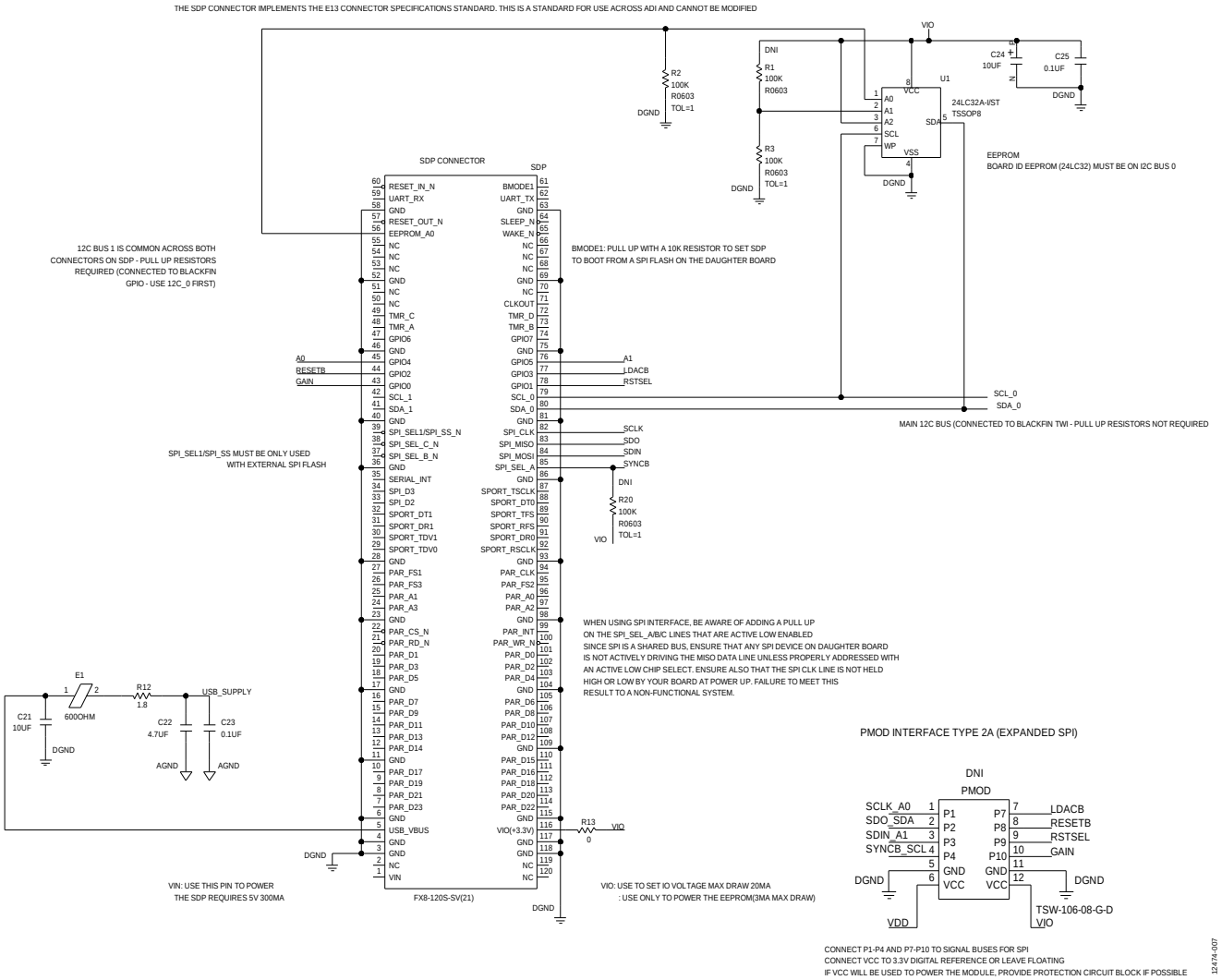

Figure 8. EVAL-AD5686RSDZ Schematic—SDP Connector

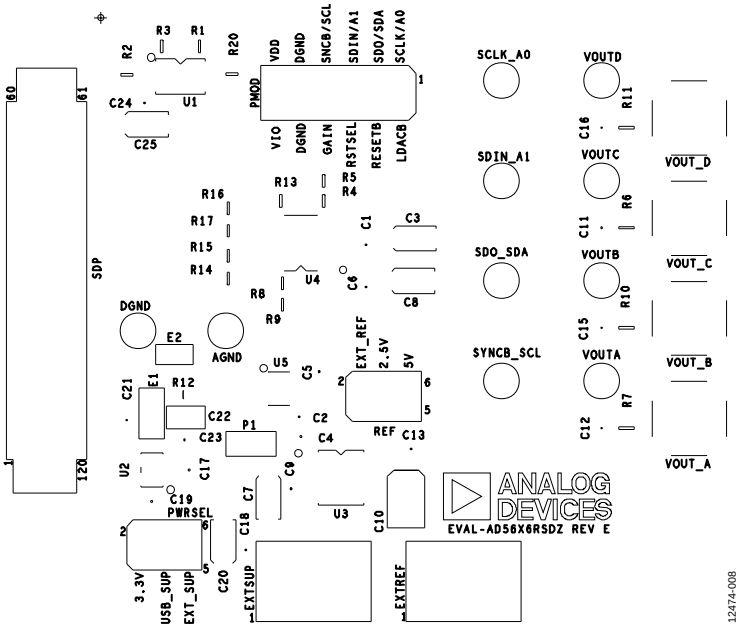

Figure 9. EVAL-AD5686RSDZ Component Placement

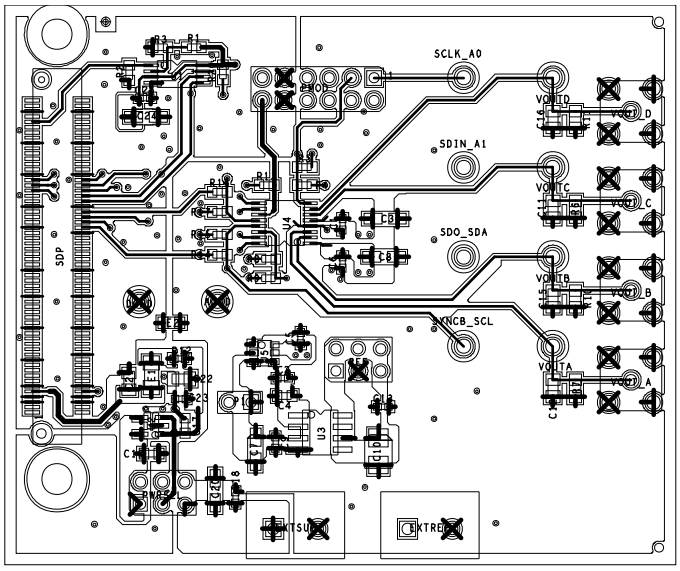

Figure 10. EVAL-AD5686RSDZ Top Side Routing

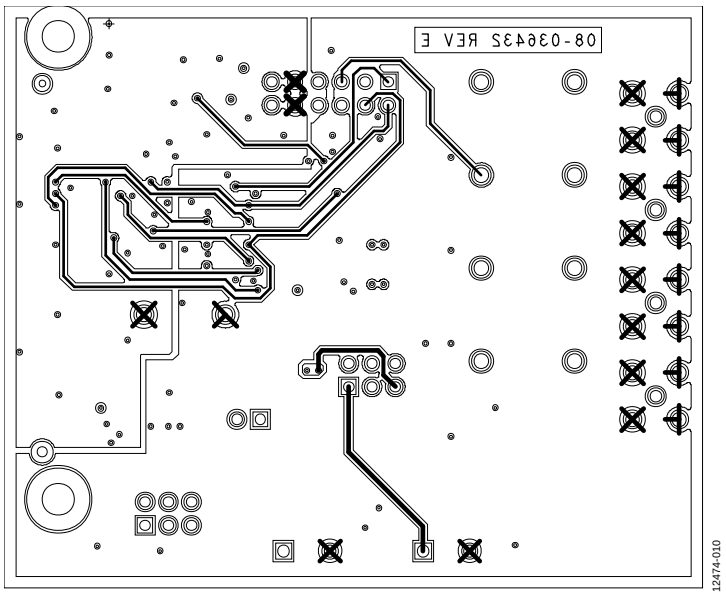

Figure 11. EVAL-AD5686RSDZ Bottom Side Routing

ORDERING INFORMATION

BILL OF MATERIALS

Table 5.

Quantity	Reference Designator	Description	Supplier/Part Number[1]
1	U1	32 kΩ, I²C serial EEPROM (24LC32)	FEC 1331330
1	U2	150 mA, low quiescent current, CMOS linear regulator	Analog Devices ADP121
1	U3	2.5 V precision micropower, low dropout, low voltage reference	Analog Devices REF192
1	U4	Quad, 16-bit *nano*DAC+ with 2 ppm/°C on-chip reference and SPI interface	Analog Devices AD5686R
1	U5	Micropower, high accuracy, 5.0 V voltage reference	Analog Devices ADR3450
6	C1, C2, C5, C6, C18, C25	Capacitors, 0.1 µF, 16 V, 0402	Generic
3	C4, C17, C19	Capacitors, 1 µF, 25 V, X5R	Generic
3	C3, C20, C24	Capacitors, 10 µF, 10 V, tantalum	Generic
1	C8	Capacitor, 1 µF, 16 V, tantalum	Generic
1	C21	Capacitor, 10 µF, 25 V, X5R	Generic
1	C22	Capacitor, 4.7 µF, 25 V, X5R	Generic
1	C23	Capacitor, 0.1 µF, 25 V, X8R	Generic
1	E1	Ferrite bead, 600 Ω	Generic
1	E2	Ferrite bead, 330 Ω	Generic
2	EXTREF, EXTSUP	2-pin terminal blocks	Generic
1	P1	2-pin link/jumper	Generic
2	REF, PWRSEL	6-pin link/jumpers	Generic
1	R12	Resistor, 1.8 Ω, 5%, 1/10 W, thick film chip	Generic
1	R13	Resistor, 0 Ω, SMD	Generic
4	R4, R8, R14, R16	Resistors, 0 Ω, 5%, 1/16 W, 0603	Generic
2	R2, R3	Resistors, 100 kΩ, 1%, 1/10 W	Generic
1	SDP	120-pin female connector	FEC 1324660 or Digi-Key H1219-ND
2	AGND, DGND	Black test points	Generic
4	SCLK_A0, SDIN_A1, SDO_SDA, SYNCB_SCL	White test points	Generic
4	VOUTA to VOUTD	Red test points	Generic
19	PMOD, C11, C12, C15, C16, R1, R5 to R7, R9 to R11, R15, R17, R20, VOUT_A to VOUT_D	Do not insert/populate (DNI)	Not inserted

[1] Generic indicates that any part with the specified value, size, and rating can be used.

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.

UG12474-0-1/16(A)

www.analog.com