

## Evaluation Board for the **AD5668** Octal, 16-Bit, Serial Voltage Output DAC

### FEATURES

- Full-featured evaluation board for the **AD5668**
- On-board reference
- Various link options
- PC control in conjunction with Analog Devices, Inc.
- System development platform (SDP)
- PC software for control of DACs
- On-board ADC for voltage readback

### EVALUATION KIT CONTENTS

- EVAL-AD5668SDCZ/EVAL-AD5668SDRZ** evaluation board
- AD5668** device
- CD including
  - Self-installing software that allows users to control the board and exercise all functions of the device
  - Electronic version of the **AD5668** data sheet
  - Electronic version of the **UG-155** user guide

### ADDITIONAL EQUIPMENT NEEDED

- USB cable available in the **SDP-B** kit or the **SDP-S** kit

### GENERAL DESCRIPTION

The Analog Devices **AD5668** evaluation boards, the **EVAL-AD5668SDCZ** and **EVAL-AD5668SDRZ**, are designed to help customers quickly prototype new **AD5668** circuits and reduce design time. The **AD5668** operates from a single 2.7 V to 5.5 V supply. The device incorporates an internal 1.25 V or 2.5 V on-board reference to give an output voltage span of 2.5 V or 5 V, respectively. The on-board reference is off at power-up allowing the use of an external reference; the **REF195** is used on this evaluation board. The device must be written to after power-up to turn on the internal reference.

Consult the **AD5668** data sheet, available from Analog Devices, 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. Software is available with the evaluation board, which allows the user to easily program the **AD5668**.

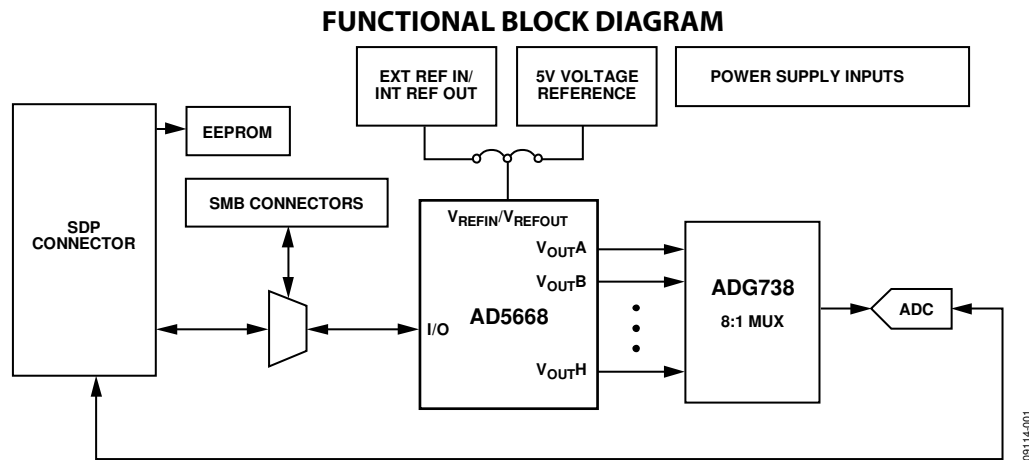


Figure 1.

09114-001

**TABLE OF CONTENTS**

Features .....	1	Evaluation Board Software .....	4
Evaluation Kit Contents.....	1	Installing the Software .....	4
Additional Equipment Needed.....	1	Running the Software .....	4
General Description .....	1	Software Operation .....	5
Revision History .....	2	Evaluation Board Schematics and Artwork .....	6
Evaluation Board Hardware .....	3	Ordering Information.....	10
Power Supplies .....	3	Bill of Materials.....	10
Link Options .....	3		

**REVISION HISTORY**

**6/2016—Rev. 0 to Rev. A**

Changed EVAL-AD5668EBRZ to EVAL-AD5668SDCZ and EVAL-AD5668EBCZ to EVAL-AD5668SDRZ .....	Throughout
Changes to Evaluation Kit Contents Section.....	1
Added Additional Equipment Needed Section .....	1
Changes to Table 3 .....	3
Changes to Installing the Software Section and Running the Software Section.....	4
Changes to Figure 4 and Software Operation Section.....	5
Changes to Figure 5 .....	6
Changes to Figure 6 .....	7
Changes to Figure 7 and Figure 8.....	8
Changes to Figure 9 .....	9
Changes to Table 4.....	10

**6/2010—Revision 0: Initial Version**

## EVALUATION BOARD HARDWARE

### POWER SUPPLIES

To power the [AD5668](#) evaluation board, supply 5.5 V between the AVDD and AGND inputs for the analog supply, and supply 5 V between DVDD and DGND inputs for the digital supply. Refer to Table 1 for information on the power supply connectors.

Both AGND and DGND inputs are provided on the evaluation board. The AGND and DGND planes are connected at one location close to the [AD5668](#). It is recommended not to connect AGND and DGND 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 No.	Voltage
J1	Analog positive supply and ground, AVDD and AGND. For single-supply operation, supply 5.5 V.
J2	Digital positive power supply, DVDD. For single-supply operation, supply 5 V.

**Table 3. Link Functions**

Link No.	Option
LK1	This link selects the AVDD power supply source for the analog circuitry: Position A selects the J1 terminal block as the AVDD analog circuitry power supply source. Position B selects the DVDD source as the AVDD analog circuitry power supply source (see LK6).
LK2	This link connects the $V_{OUTG}$ pin of the <a href="#">AD5668</a> to the input pin of the <a href="#">ADG738</a> demultiplexer, so the DAC output value can be monitored using the on-board <a href="#">AD7476</a> ADC.
LK3	This link connects the $V_{OUTH}$ pin of the <a href="#">AD5668</a> to the input pin of the <a href="#">ADG738</a> demultiplexer, so the DAC output value can be monitored using the on-board <a href="#">AD7476</a> ADC.
LK4	This link connects a 0.1 $\mu$ F capacitor to AGND on the $V_{REFIN}/V_{REFOUT}$ pin. It is recommended to connect this when using the internal reference.
LK5	This link selects the reference source: Position A selects the internal reference as the reference source. The device must be written to via software to turn on the internal reference. Position B selects the on-board 5 V reference as the reference source.
LK6	This link selects the 5 V power supply source for the digital circuitry: Position A selects $V_{IO}$ on the evaluation board as the 5 V digital circuitry power supply source. Position B selects the J2 terminal block as the 5 V digital circuitry power supply source.
LK7	This link selects the DAC voltage source: Position A selects the AVDD analog circuitry power supply source. Position B selects the on-board 5 V reference as the power supply source.
LK8	This link sets the $\overline{RESET}$ pin on the <a href="#">ADG738</a> : Position A allows normal operation of the switch. Position B resets the switch.
LK9 to LK14	This link connects the $V_{OUTA}$ to $V_{OUTF}$ pins of the <a href="#">AD5668</a> to the input pins of <a href="#">ADG738</a> demultiplexer, so the DAC output value can be monitored using the on-board <a href="#">AD7476</a> ADC.

### LINK OPTIONS

A number of link and switch options are incorporated in the evaluation board and must be set for the required operating setup before using the evaluation board. Table 2 describes the positions of the different links to control the evaluation board by the PC, via the USB port, using the [AD5668](#) in single-supply mode. The functions of these link options are described in detail in Table 3.

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

Link No.	Option
LK1	A
LK2 to LK3	Inserted
LK4	Inserted
LK5	B
LK6	A
LK7	A
LK8	A
LK9 to LK14	Inserted

## EVALUATION BOARD SOFTWARE

### INSTALLING THE SOFTWARE

The [AD5668](#) evaluation kit includes self-installing software on the provided CD. The software is compatible with Windows® XP, Windows Vista (32 bits), and Windows 7 (32 bits).

To obtain drivers for 64-bit operating systems, download them from the [AD5668](#) product page.

Install the software before connecting the SDP to the USB port of the PC. This ensures that the SDP is recognized when it connects to the PC. Follow these steps:

1. Start the Windows operating system and insert the provided CD. The installation software opens automatically. If it does not, run the **setup.exe** file from the CD.
2. After installation is completed, power-up the evaluation board as described in the Power Supplies section.
3. Plug the [AD5668](#) evaluation board into the SDP, and plug the SDP into the PC using the USB cable available in the **SDP-B** kit or the **SDP-S** kit.
4. When the software detects the evaluation board, proceed through any dialog boxes that appear to finalize the installation.

### RUNNING THE SOFTWARE

To run the program, do the following:

1. Click **Start > All Programs > Analog Devices > AD5668 > AD5668 Evaluation Software**. To uninstall the program, click **Start > Control Panel > Add or Remove Programs > AD5668 Evaluation Software**.
2. Determine if the SDP is connected to the USB port. If the SDP is not connected to the USB port when the software is launched, a connectivity error dialog box displays (see Figure 2). Connect the evaluation board to the USB port of the PC, wait a few seconds, click **Rescan**, and follow the instructions shown in the **Hardware Select** dialog box.

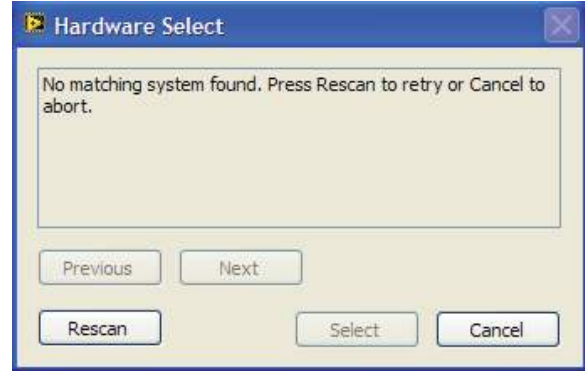


Figure 2. Error Dialog Box

3. Determine if the SDP is connected to the evaluation board in use. If the SDP is not connected to the evaluation board, a dialog box appears, shown in Figure 3. Check the connection between the SDP and [AD5668](#) evaluation boards and run the program again.



Figure 3. Error Message

4. The main window of the [AD5668](#) evaluation software then displays, as shown in Figure 4.

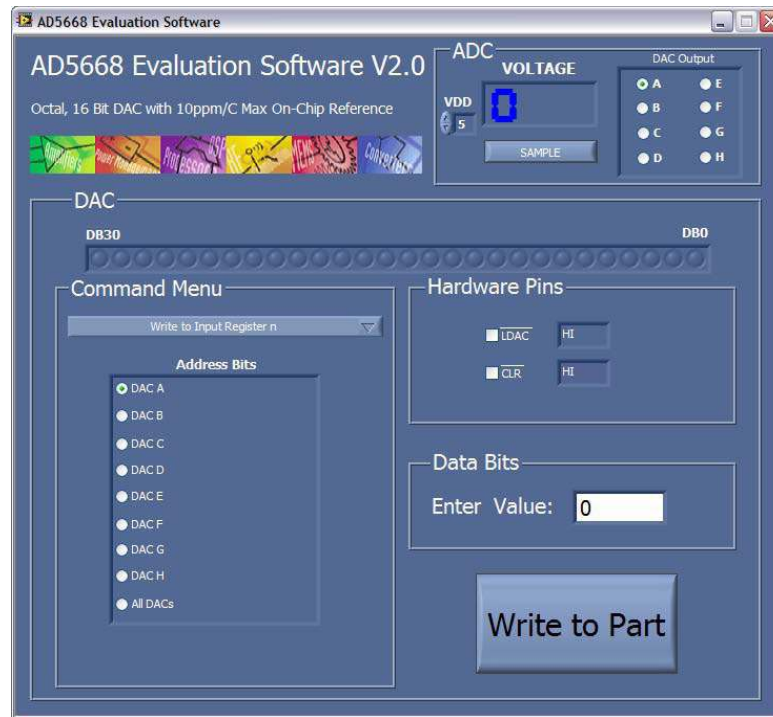


Figure 4. AD5668 Evaluation Board Main Window

## SOFTWARE OPERATION

Take the following steps to operate the software:

1. Click **Start > All Programs > Analog Devices > AD5668 > AD5668 SDP Evaluation Software**.

For PC operating systems running Windows XP or older, click **Start > Programs > Analog Devices > AD5668 > AD5668 SDP Evaluation Software**.

The [AD5668](#) main window opens, as shown in Figure 4. The data programmed into the 32-bit input shift register is displayed. The user can select the command bits, the address bits, and the data bits by clicking the appropriate button under each area.

2. To select a command to program the device, select the appropriate option from the drop-down menu under **Command Menu**. For example, to program all DAC outputs with full scale, select **Write to and Update DAC channel n** and then click **All DACs** under **Address Bits**.
3. Under **Data Bits**, enter the data in decimal format in the **Enter Value** field. To execute, click **Write to Part**. Note that the user must click **Write to Part** to execute all writes to the device.
4. The voltage output on each DAC channel is monitored using the on-board ADC. To read the output voltage, click **SAMPLE**, under **ADC**.
5. To set up the power-down DAC bits, the clear code register bits, and the LDAC register bits, select the appropriate option from the drop-down menu under **Command Menu** and click **Write to Part**. The user can also set the register bits for the required mode of operation. Consult the [AD5668](#) data sheet for details.
6. To set  $\overline{\text{LDAC}}$  and  $\overline{\text{CLR}}$  pins to high or low, click the corresponding check box under **Hardware Pins**. Because this command is executed immediately, there is no need to click **Write to Part**.

EVALUATION BOARD SCHEMATICS AND ARTWORK

9014-008

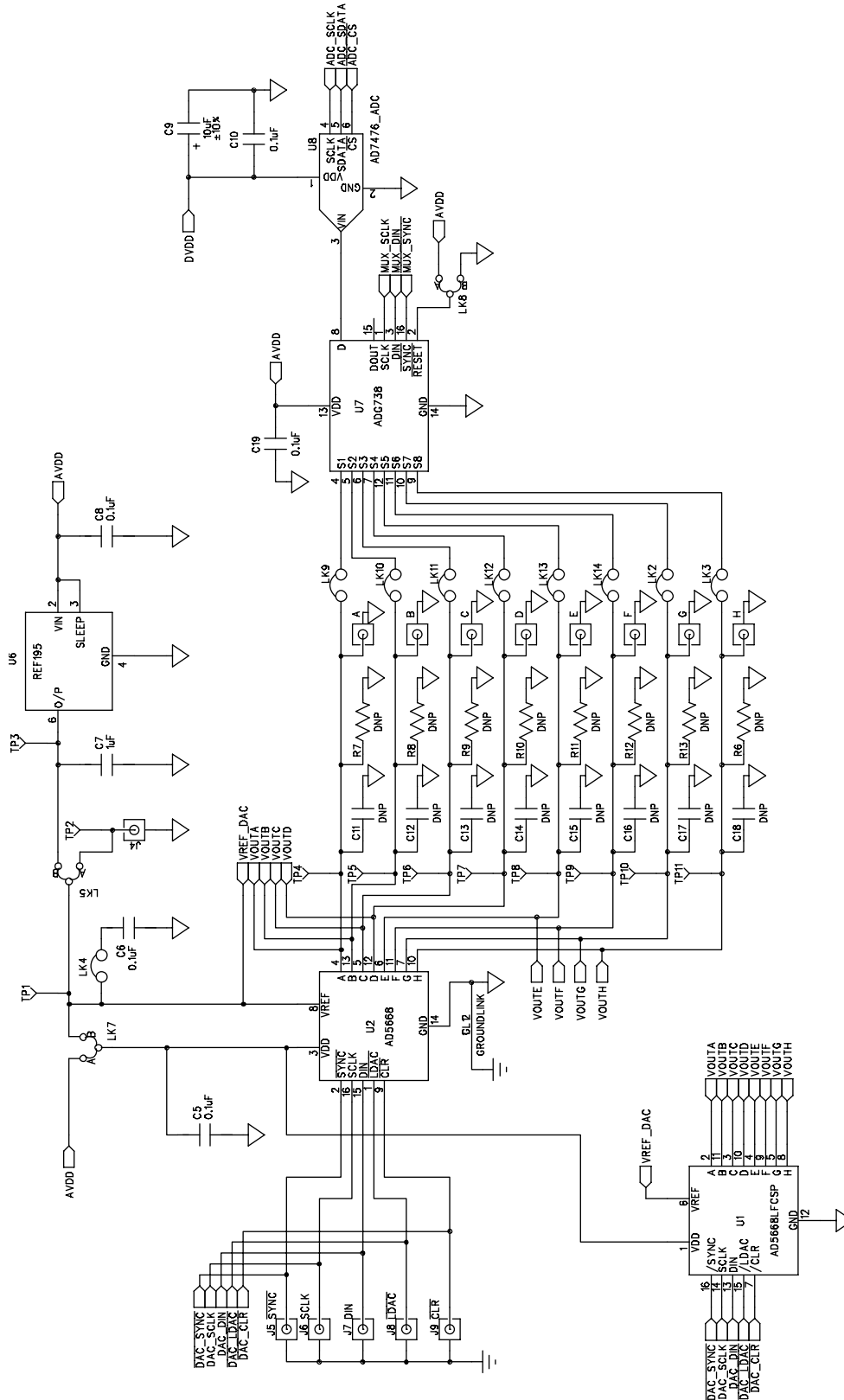


Figure 5. Schematic of AD5668 Evaluation Circuitry

09114-007

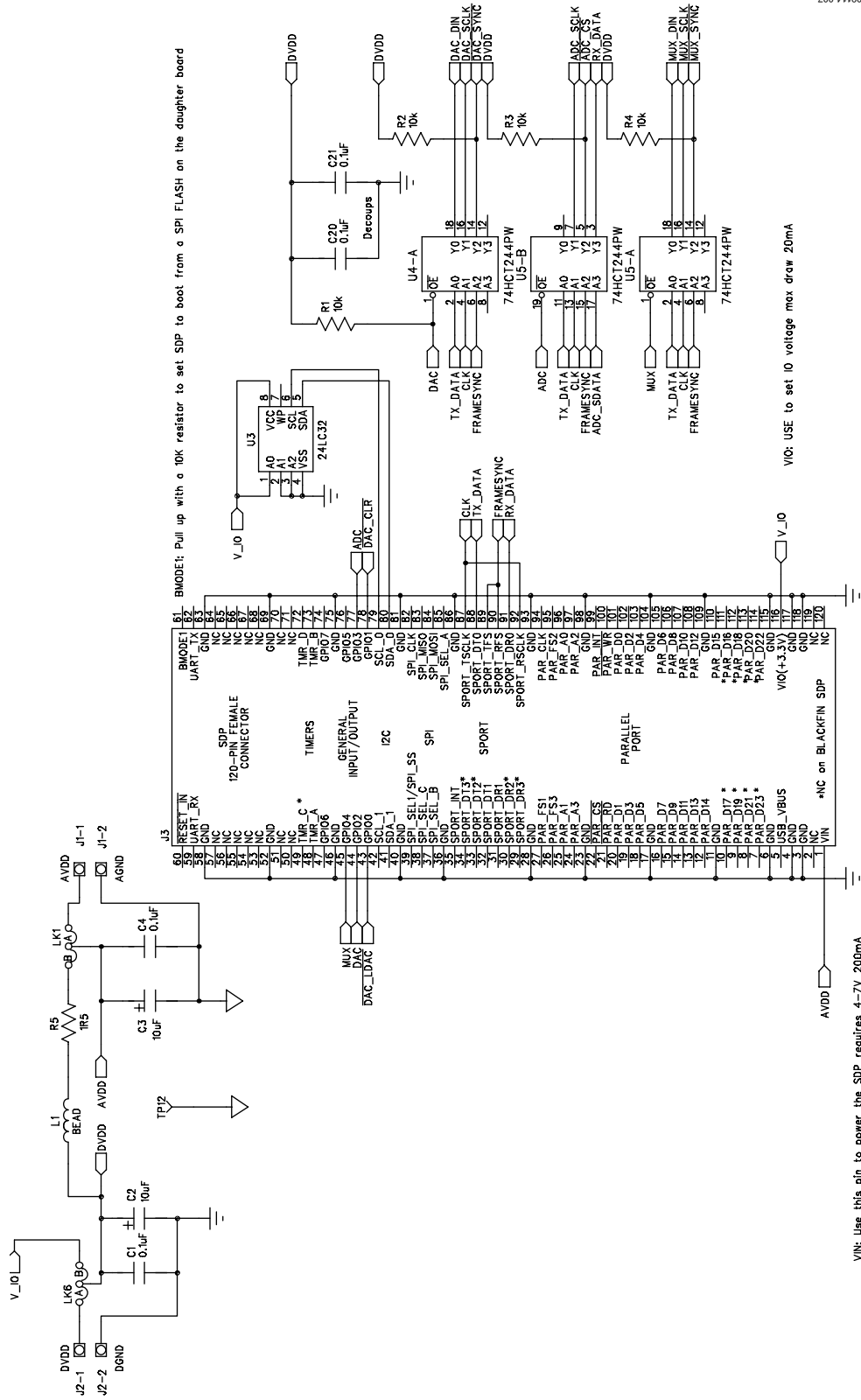
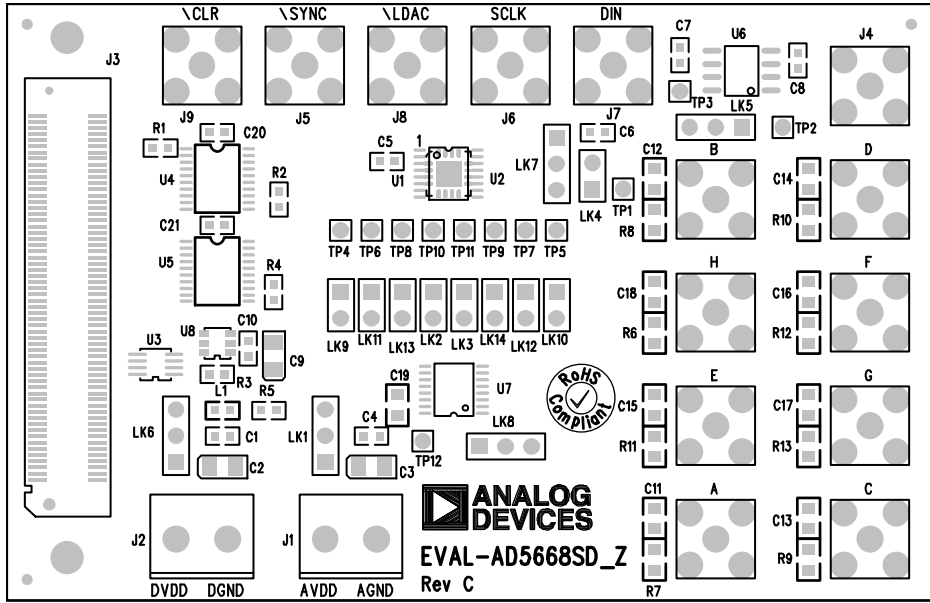
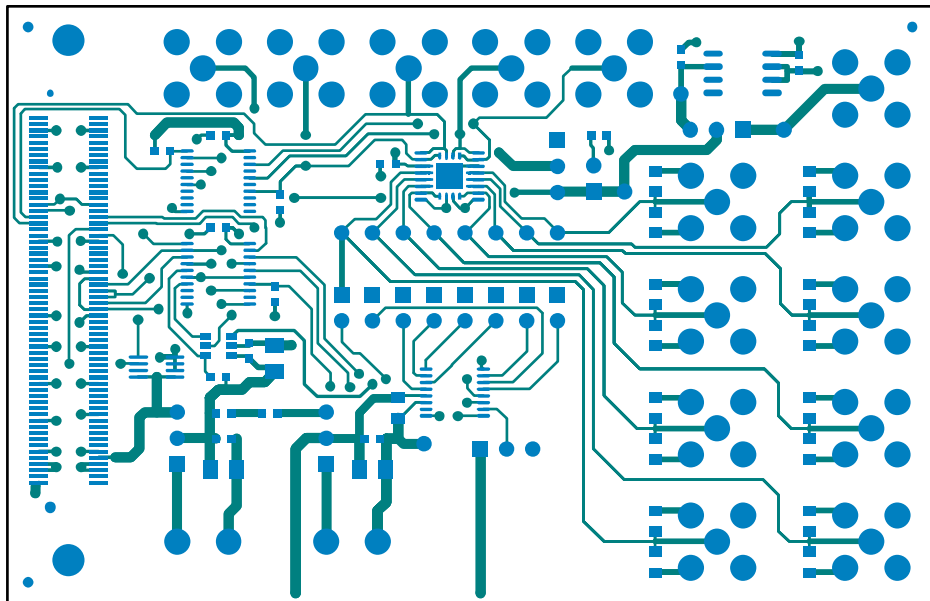


Figure 6. Schematic of SDP Connector



09114-008

Figure 7. Component Placement Drawing



09114-009

Figure 8. Component Side PCB Drawing



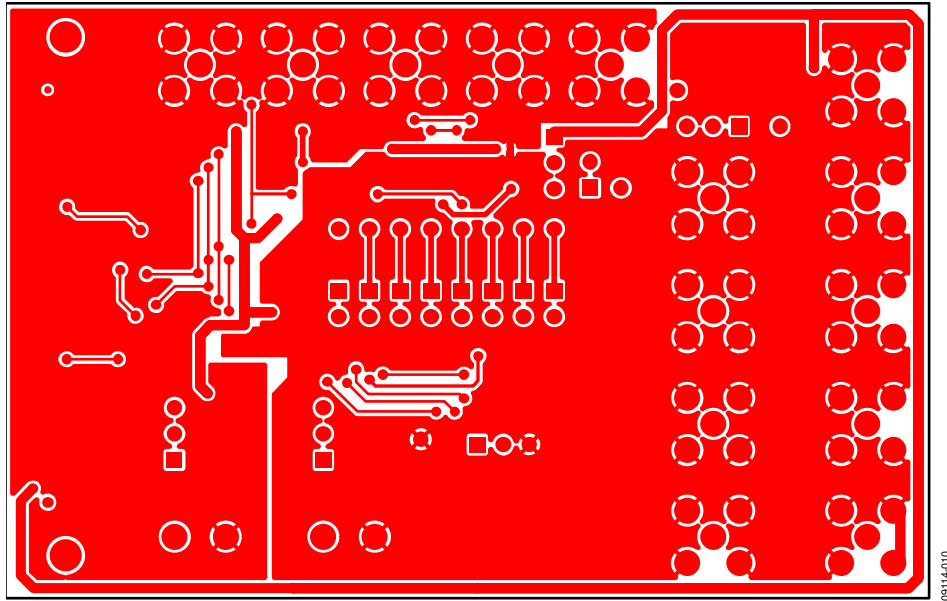


Figure 9. Solder Side PCB Drawing

## ORDERING INFORMATION

## BILL OF MATERIALS

Table 4.

Qty.	Reference Designator	Description	Manufacturer	Part Number	Stock Code
1	U8	AD7476, 1 MSPS, 12-bit ADC in 6-lead SOT-23	Analog Devices, Inc.	AD7476BRTZ	AD7476BRTZ
1	U7	ADG738, CMOS, low voltage, 3-wire, serially-controlled, matrix switch	Analog Devices, Inc.	ADG738BRUZ	ADG738BRUZ
1	L1	Ferrite bead, 600 $\Omega$ at 100 MHz, 0603	Murata Electronics	BLM18BD102SN1D	490-1024-1-ND
9	LK2 to LK4, LK9 to LK14	Jumper blocks, 2-way, 2.54 mm pitch spacing, Shoring Block IN	Harwin	M20-9990246	FEC 1022247 and 150-411
2	LK7, LK8	Jumper blocks, 3-way, 2.54 mm pitch spacing, Shoring Block Position A	Harwin	M20-9990345 and M7567-05	FEC 1022248
1	LK5	Jumper blocks, 3-way, 2.54 mm pitch spacing, Shoring Block Position B	Harwin	M20-9990345 and M7567-05	FEC 1022248 and 150410
6	J4 to J9	SMB jacks, 50 $\Omega$	TYCO	1-1337482-0	FEC1206013
1	J3	120-way female connector	Hirose	FX8-120S-SV(21)	FEC 1324660
1	U3	32 kB I <sup>2</sup> C serial EEPROM	Microchip	24LC32A-I/MS	FEC 1331330
2	J1, J2	Terminal blocks, 2-way, 5 mm pitch	Camden	CTB5000/2	FEC 151789
3	C2, C3, C9	Capacitors, Case A, 10 $\mu$ F, 10 V, $\pm$ 10%	AVX	TAJA106K010R	FEC 197-130
1	C7	Capacitor, 0603, 1 $\mu$ F, 10 V, +80%/–20%	Phycomp	2238 246 19863	FEC 318-8840
2	LK1, LK6	SIL headers, 3-way, Shoring Block Position A	Harwin	M20-9990345 and M7567-05	FEC 512-047 and 150-411
13	TP1 to TP12	Red test points	Vero	20-313137	FEC 8731144 (pack)
9	C1, C4 to C6, C8, C10, C19 to C21	Capacitors, 0603, 100 nF, 0.1 $\mu$ F, $\pm$ 10%	Murata	GRM188R71H104KA93D	FEC 8820023
4	R1 to R4	SMD resistors, 10 k $\Omega$ , 1%, 0603	Multicomp	MC 0.063W 0603 10K	FEC 933-0399
1	R5	Resistor, 0603, 1.5 $\Omega$ , 5%	Multicomp	MC 0.063W 0603 5% 1R5	FEC 9331832
	R6 to R13	Resistor, do not populate, 0805	Not applicable	Not applicable	Do not insert
2	U4, U5	Octal buffer/line drivers	Texas Instruments, Inc.	SN74HCT244PW	FEC 9591915
1	U1	AD5668, octal 16-bit SPI voltage output <i>dense</i> DAC with 5 ppm/ $^{\circ}$ C on-chip reference in LFCSP	Analog Devices, Inc.	AD5668BCPZ-1	AD5668BCPZ-1
1	U2	AD5668, octal 16-bit SPI voltage output <i>dense</i> DAC with 5 ppm/ $^{\circ}$ C on-chip reference in TSSOP, do not populate	Analog Devices, Inc.	AD5668BRUZ-2	Do not insert
1	U6	REF195, precision micropower, low dropout voltage reference	Analog Devices, Inc.	REF195ESZ	REF195ESZ
3	A to H	SMB connector, do not populate	Not applicable	Not applicable	Do not insert
	C11 to C18	Capacitors, do not populate, 0805	Not applicable	Not applicable	Do not insert
	SCREW1, SCREW2	Screw, cheese, nylon, M3X10, PK100	ALLTHREAD	119030010	FEC 7070597
	NUT1, NUT2	Nut/wascher, nylon, M3, PK100	Duratool	1140030	FEC 7061857

**NOTES**

## NOTES

I<sup>2</sup>C 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.

**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.