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Evaluation Board for a 18-Bit Serial Input, Voltage Output DAC

FEATURES

Full-featured evaluation board for the AD5781
Link options
PC control in conjunction with Analog Devices, Inc., system development platform
PC software for control

EVALUATION BOARD DESCRIPTION

The EVAL-AD5781 is a full-featured evaluation board, designed to allow the user to easily evaluate all features of the AD5781 voltage output, 18-bit DAC. The AD5781 pins are accessible at on-board connectors for external connection. The board can be controlled by two means, via the on-board connector (J6) or via the system development platform connector (J3). The SDP board allows the evaluation board to be controlled through the USB port of a Windows® XP (SP2 or later) or Vista (32-bit) based PC using the AD5781 evaluation software.

DEVICE DESCRIPTION

The AD5781 is a high precision, 18-bit digital-to-analog converter (DAC), designed to meet the requirements of precision control applications. The output range of the AD5781 is configured by two reference voltage inputs. The device is specified to operate with a dual power supply of up to 33 V.

Complete specifications for the AD5781 are available in the AD5781 data sheet available from Analog Devices and should be consulted in conjunction with this user guide when using the evaluation board.

FUNCTIONAL BLOCK DIAGRAM

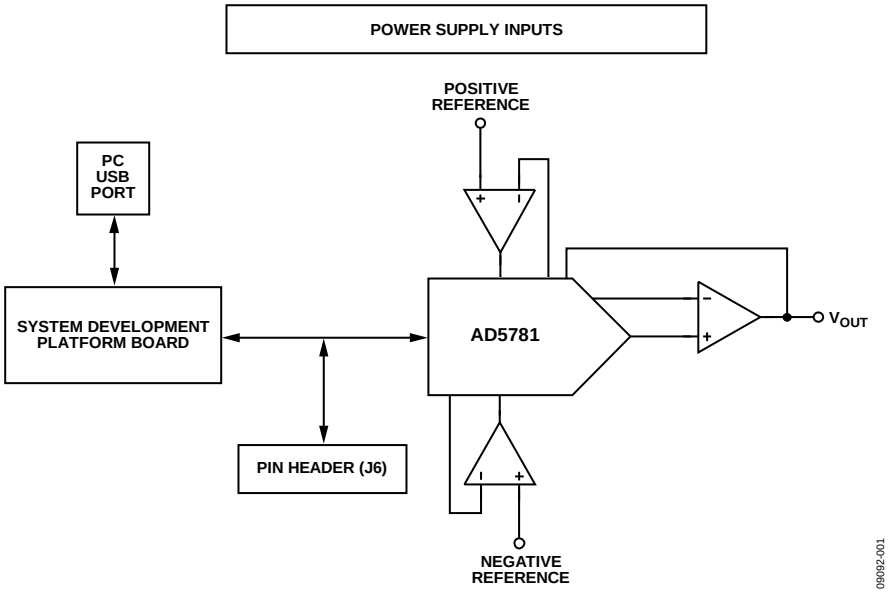


Figure 1.

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REVISION HISTORY

8/10—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

POWER SUPPLIES

The following external supplies must be provided:

- 5 V between the V_{CC} and DGND inputs for the digital supply of the AD5781. Alternatively, place Link 1 in Position A to power the digital circuitry from the USB port (default).
- 7.5 V to 16.5 V between the V_{DD} and AGND inputs for the positive analog supply of the AD5781.
- −2.5 V to −16.5 V between the V_{SS} and AGND inputs for the negative analog supply of the AD5781.

The analog and digital planes are connected at one location, close to the AD5781. To avoid ground loop problems, it is recommended not to connect AGND and DGND elsewhere in the system.

Each supply is decoupled to the relevant ground plane with 10 µF and 0.1 µF capacitors. Each device supply pin is again decoupled with a 10 µF and 0.1 µF capacitor pair to the relevant ground plane.

LINK OPTIONS

The link options on the evaluation board should be set for the required operating setup before using the board. The functions of the link options are described in Table 5.

Default Link Option Setup

The default link options are listed in Table 1.

Table 1. Default Link Options

Link No.	Option
LK1	A
LK3	A
LK4	Removed
LK5	Removed
LK6	Removed
LK8	A
LK9	C

Connector J6 Pin Descriptions

Table 2. Connector J6 Pin Configuration

9	7	5	3	1
10	8	6	4	2

Table 3. Connector J6 Pin Descriptions

Pin No.	Description
1	SDO
2	$\overline{\text{RESET}}$
3	DGND
4	$\overline{\text{CLR}}$
5	IOVCC
6	$\overline{\text{LDAC}}$
7	SDIN
8	DGND
9	SCLK
10	$\overline{\text{SYNC}}$

ON-BOARD CONNECTORS

There are nine connectors on the AD5781 evaluation board PCB as outlined in Table 4.

Table 4. On-Board Connectors

Connector	Function
J1	Analog power supply connector
J2	Digital power supply connector
J3	SDP board connector
J6	Digital interface pin header connector
VOUT	DAC output connector
VOUT_BUF	Buffered DAC output connector
VREF	5 V voltage reference input connector (+10 V and −10 V reference voltages are generated from 5 V input)
VREFN	DAC negative reference input connector
VREFP	DAC positive reference input connector

Table 5. Link Options

Link No.	Description
LK1	This link selects the source of the digital power supply. Position A selects the source from the SDP board. Position B selects the source from Connector J2.
LK3	This link selects the voltage source for the IOV_{CC} pin. Position A connects IOV_{CC} to V_{CC}. Position B selects an externally applied voltage at Pin 5 of J6.
LK4	This link selects the state of the $\overline{LDAC}$ pin. When this link is inserted, $\overline{LDAC}$ is at logic low. When this link is removed, $\overline{LDAC}$ is at logic high.
LK5	This link selects the state of the $\overline{CLR}$ pin. When this link is inserted, $\overline{CLR}$ is at logic low. When this link is removed, $\overline{CLR}$ is at logic high.
LK6	This link selects the state of the $\overline{RESET}$ pin. When this link is inserted, $\overline{RESET}$ is at logic low. When this link is removed, $\overline{RESET}$ is at logic high.
LK8	This link selects the positive reference source. Position A selects an on-board generated 10 V, derived from 5 V applied at Connector VREF. Position B selects an external voltage applied at Connector VREFP.
LK9	This link selects the negative reference source. Position A selects an external voltage applied at Connector VREFN. Position B selects AGND. Position C selects an on-board generated −10 V, derived from 5 V applied at Connector VREF.

EVALUATION BOARD SOFTWARE

SOFTWARE INSTALLATION

The AD5781 evaluation kit includes self-installing software on a CD. The software is compatible with Windows XP (SP2) and Vista (32-bit). If the setup file does not run automatically, you can run **setup.exe** from the CD.

Install the evaluation software before connecting the evaluation board and SDP board to the USB port of the PC to ensure that the evaluation system is correctly recognized when connected to the PC.

1. After installation from the CD is complete, power up the AD5781 evaluation board as described in the Power Supplies section. Connect the SDP board (Connector A) to the AD5781 evaluation board and then to the USB port of your PC using the supplied cable.
2. When the evaluation system is detected, proceed through any dialog boxes that appear. This completes the installation.

SOFTWARE OPERATION

To launch the software, complete the following steps:

1. From the **Start** menu, select **Analog Devices – AD5781** > **AD5781 Evaluation Software.** The main window of the software is displayed (see Figure 3).
2. If the evaluation system is not connected to the USB port when the software is launched, a connectivity error is displayed (see Figure 2). Connect the evaluation board to the USB port of the PC, wait a number of seconds, and click **Rescan.** Follow the instructions.

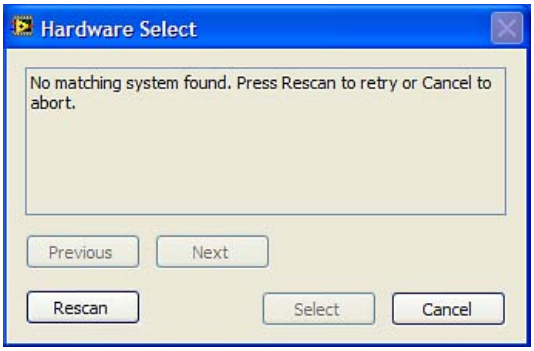


Figure 2. Connectivity Error Alert

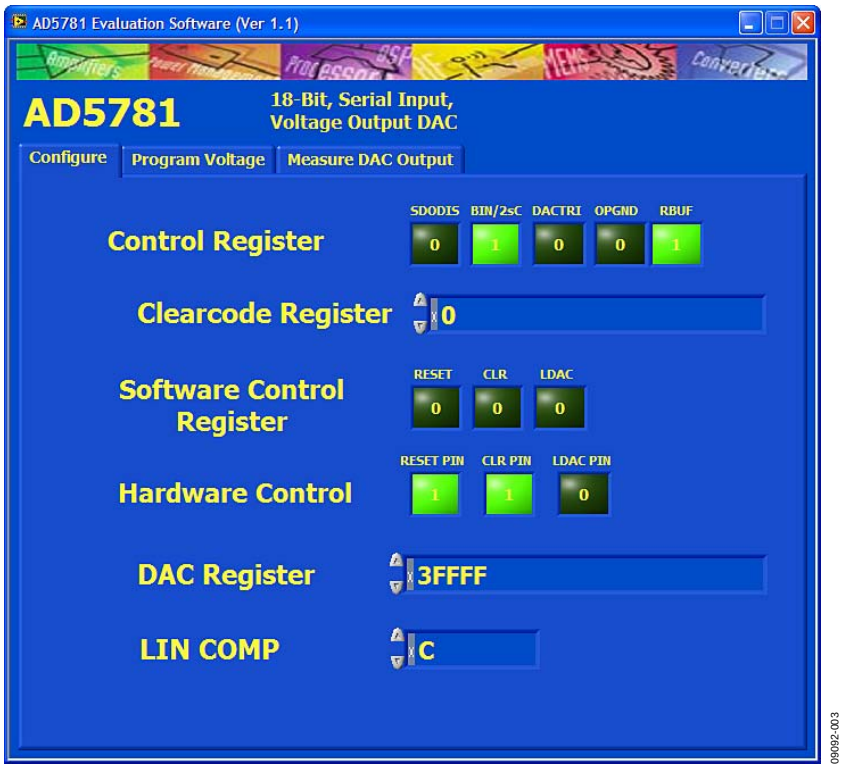


Figure 3. Main Window

MAIN WINDOW

The main window is divided into three tabs: **Configure**, **Program Voltage**, and **Measure DAC Output**.

Configure

The **Configure** section allows access to the control register, clearcode register, software control register, and DAC register and also allows control of the $\overline{\text{RESET}}$, $\overline{\text{CLR}}$, and $\overline{\text{LDAC}}$ pins.

Program Voltage

The **Program Voltage** section programs the DAC register with a value calculated from the entered values: the positive voltage reference (VREFP), the negative voltage reference (VREFN), and the desired output voltage (see Figure 4).

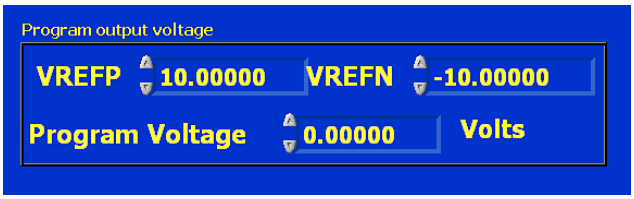


Figure 4. Program Voltage Window

Measure DAC Output

The **Measure DAC Output** section allows the PC to control an Agilent 3458A multimeter to measure and log the DAC output voltage.

The multimeter is controlled over a general-purpose interface bus (GPIB). Once connected to the PC, the multimeter should first be configured via its front panel before taking a measurement. Figure 6 shows the measurement options. The software runs through a sequence of steps, programming the DAC register and measuring the DAC output voltage. The sequence begins with the software programming the DAC with the **Start Code** value, incrementing the programmed value at each step by the **Code Step** value, and finishing when the programmed value reaches the **Stop Code** value. A delay between measurements can be inserted if required. The GPIB address of the multimeter must be specified.

To begin the measurement, click the **START** button. The measurement can be halted at anytime by clicking the **STOP** button. When the measurement is completed, a dialog box appears to allow the data to be saved as a spreadsheet file with three columns of data. The first column is DAC code, the second column is DAC voltage in volts, and the third column is INL error in LSBs, as shown in Figure 5. A graph of both DAC output voltage vs. DAC code and INL error vs. DAC code is displayed on-screen (see Figure 6). In the measurement example shown in Figure 6 measurements are taken in 256 code steps beginning at Code 0 and finishing at Code 261,888, in total 1023 measurements. With the number of power line cycles (NPLC) setting on the multimeter set to 1, the measurement takes ~75 sec to complete. To complete an all codes measurement requiring 262,144 measurement points takes ~6 hours to complete.

	A	B	C
	0	-10.0002	0
	1024	-9.98066	0.120122
	2048	-9.96113	0.086736
	3072	-9.9416	0.13781
	4096	-9.92206	0.150508
	5120	-9.90253	0.109467
	6144	-9.883	0.183557
	7168	-9.86347	0.157878
	8192	-9.84394	0.201298
0	9216	-9.8244	0.252373
1	10240	-9.80487	0.242002
2	11264	-9.78534	0.085883
3	12288	-9.76581	0.090874
4	13312	-9.74628	-0.03458

09092-006

Figure 5. Saved Data Format

If an Agilent 3458A multimeter is not connected to the PC, the software steps through the codes without taking any measurements.

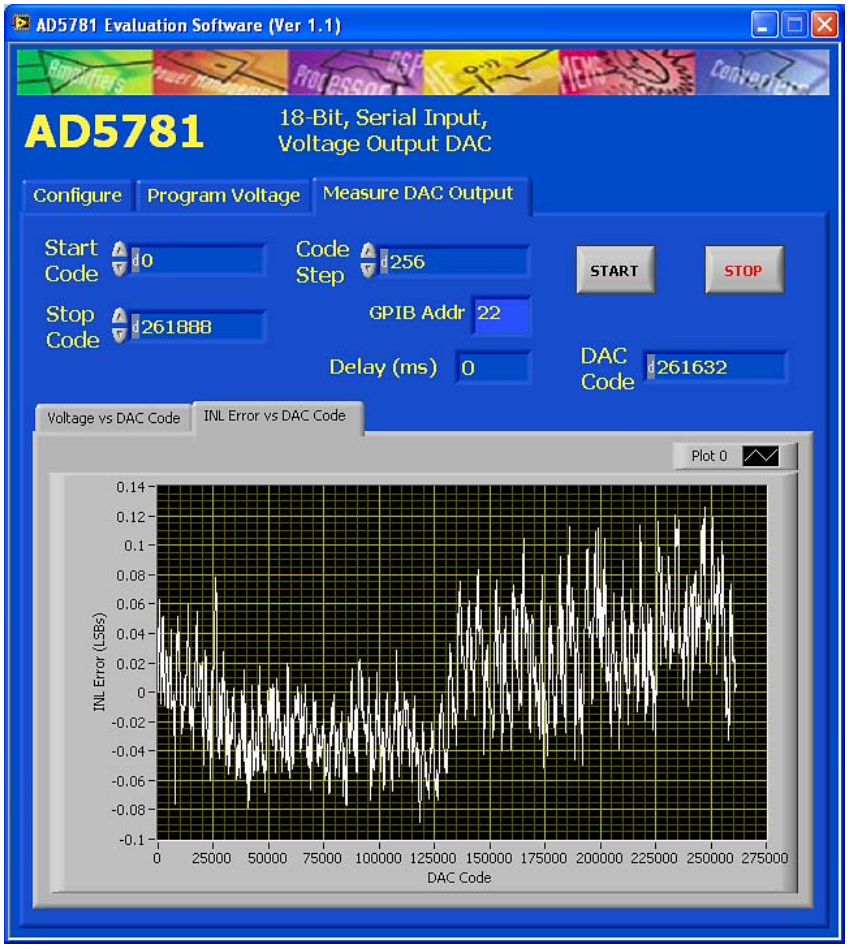


Figure 6. Measure DAC Output Window

EVALUATION BOARD PERFORMANCE

The following data demonstrates the measured linearity performance of the AD5781 evaluation board circuit. The board is powered from V_{DD} = +15 V, V_{SS} = −15 V, and V_{REF} = +5 V.

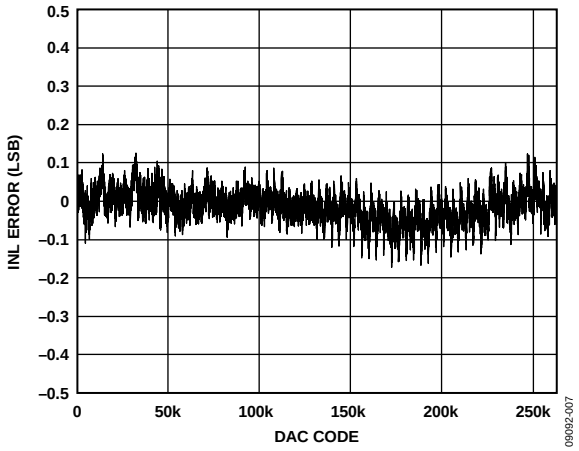


Figure 7. INL Error vs. DAC Code

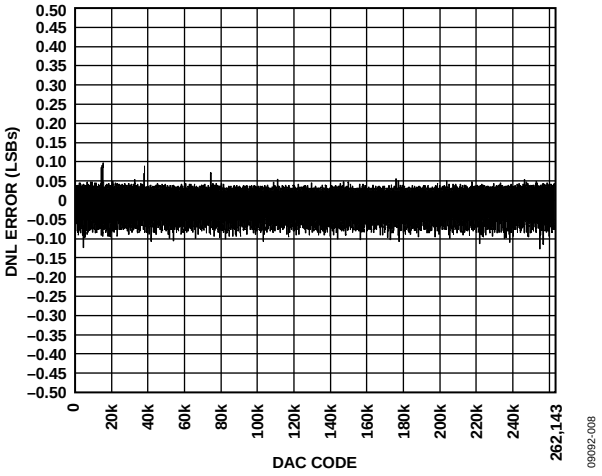


Figure 8. DNL Error vs. DAC Code

EVALUATION BOARD SCHEMATICS AND ARTWORK

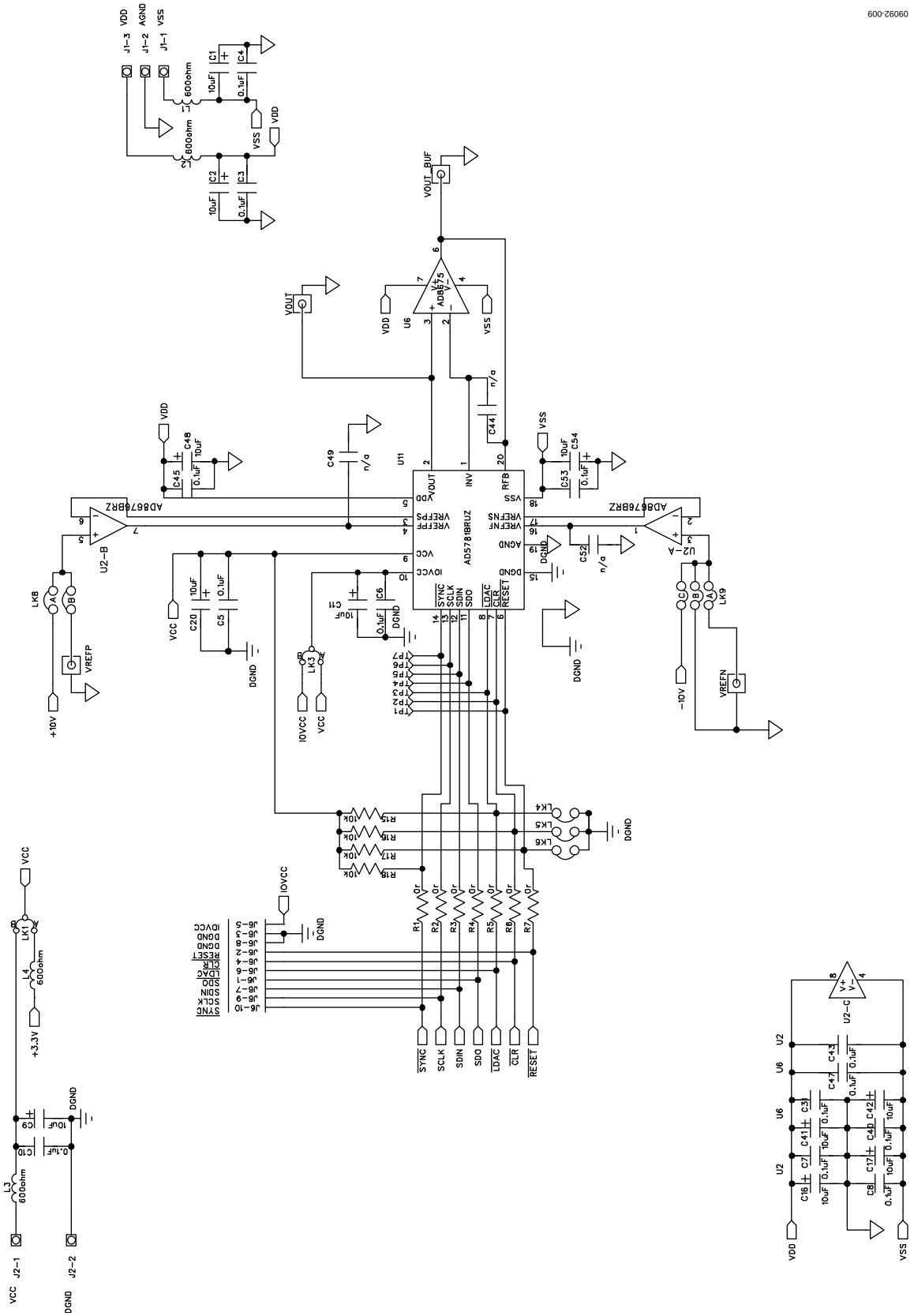


Figure 9. Schematic of the AD5781 Circuitry

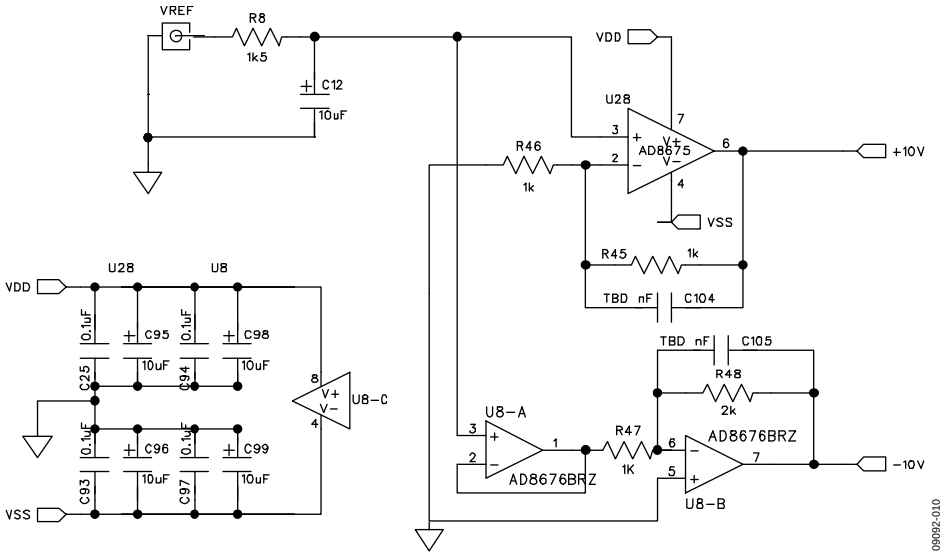


Figure 10. Schematic of the Voltage Reference Scaling Circuitry

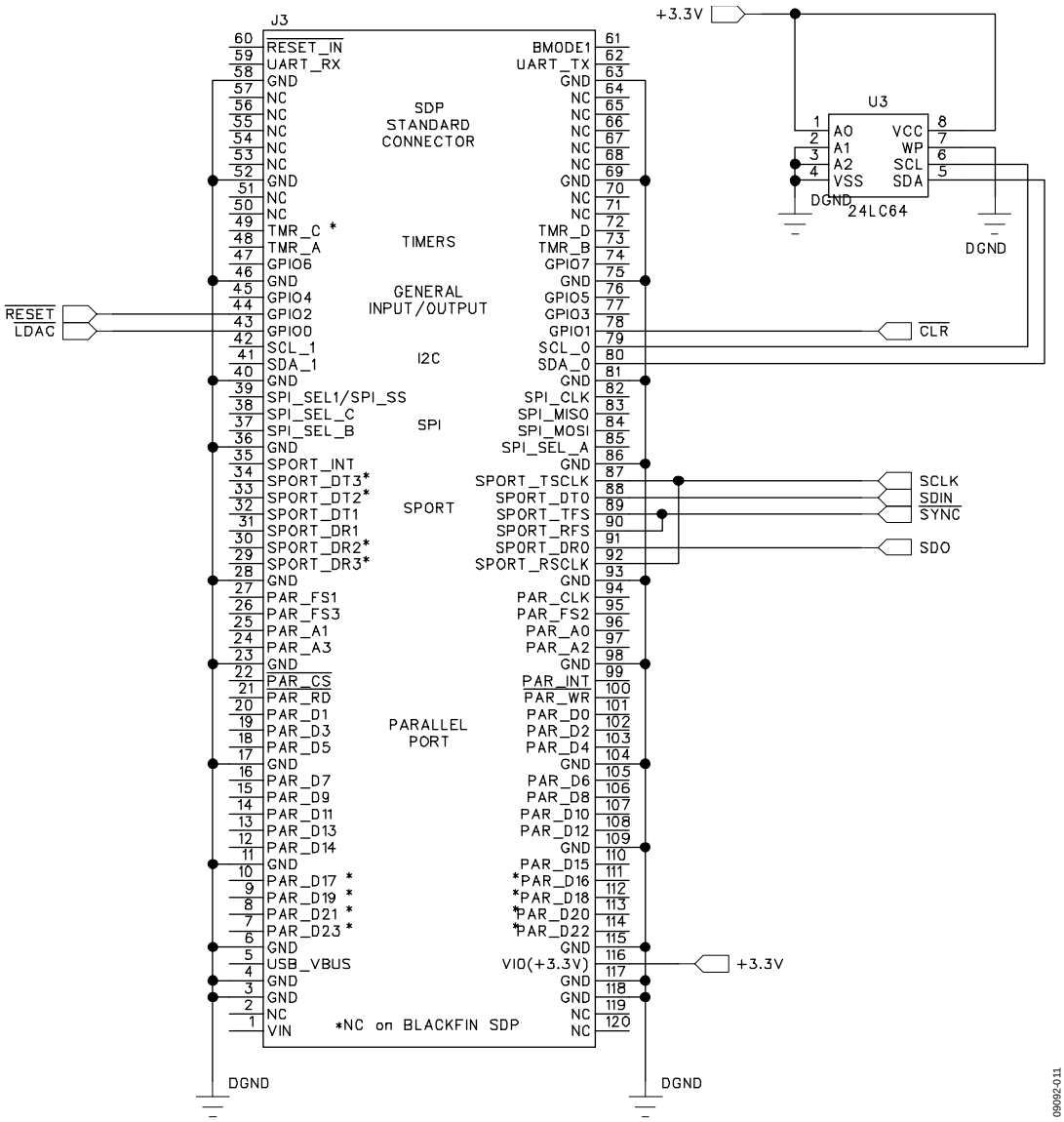


Figure 11. Schematic of the SDP Board Connector

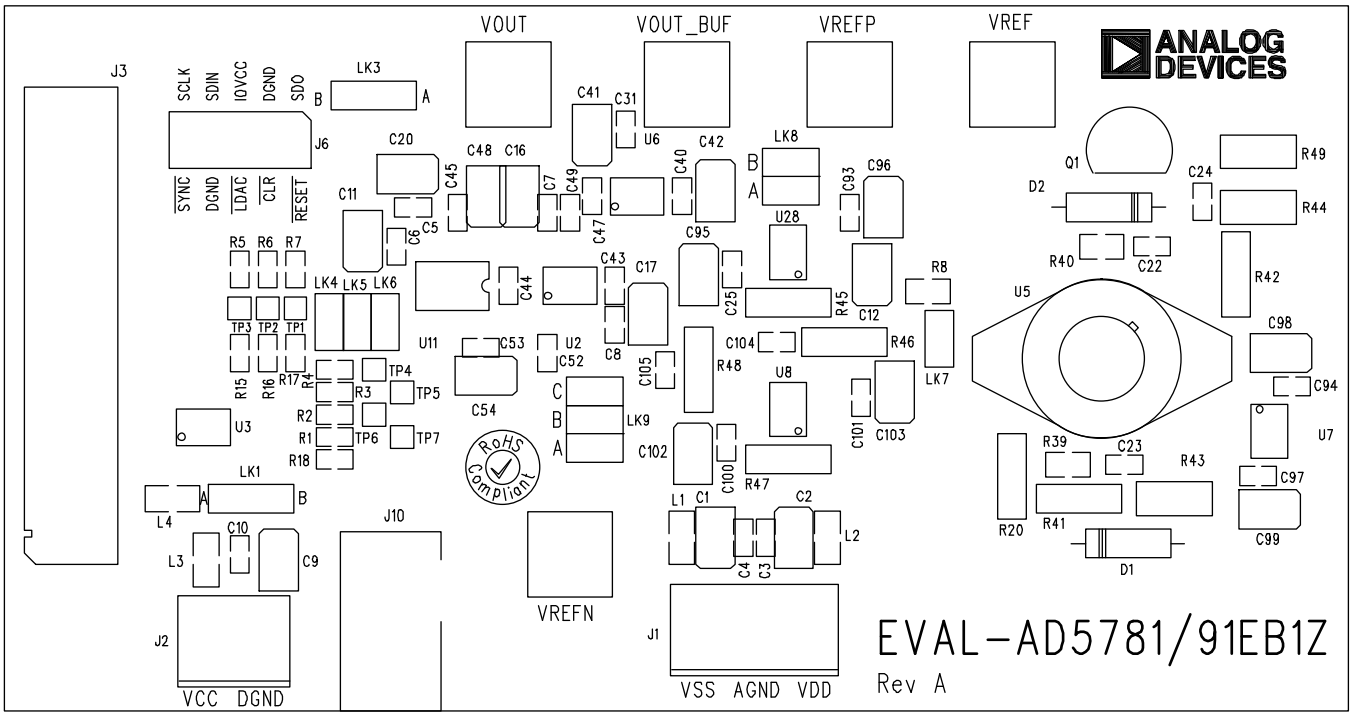


Figure 12. Component Placement Schematic

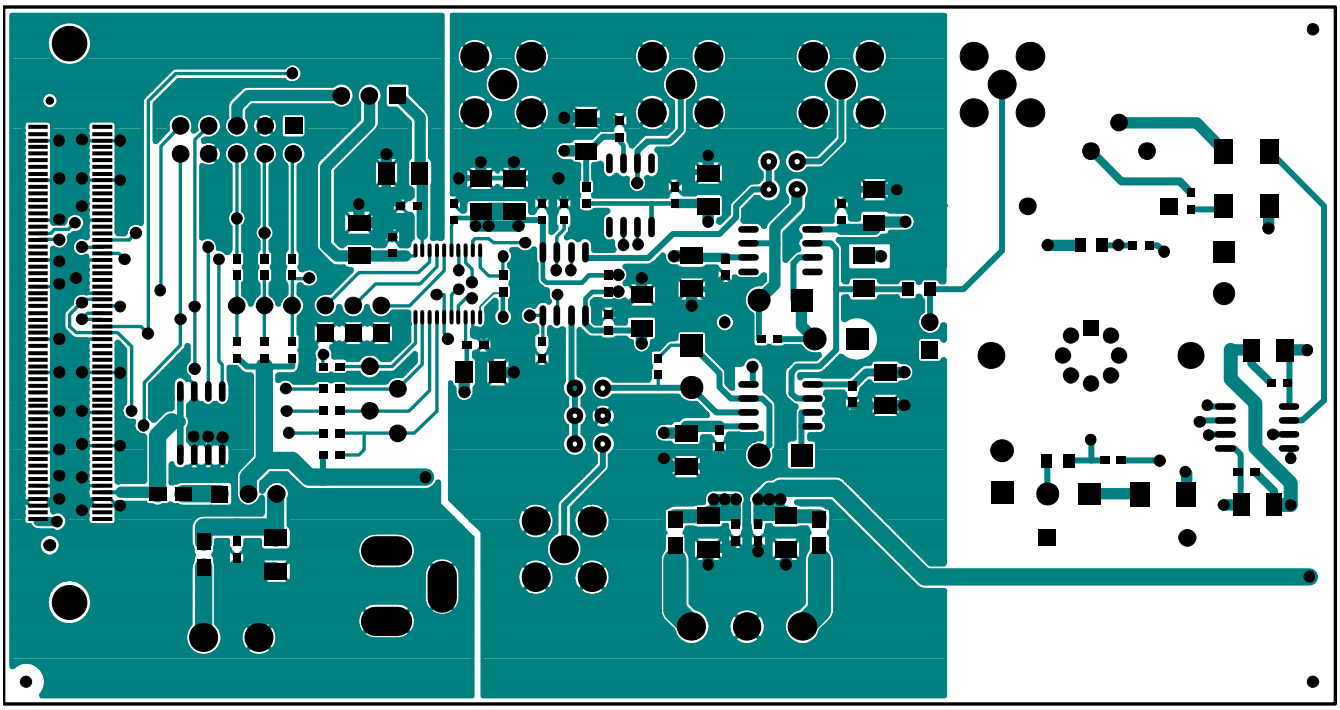


Figure 13. Top PCB Layer Schematic

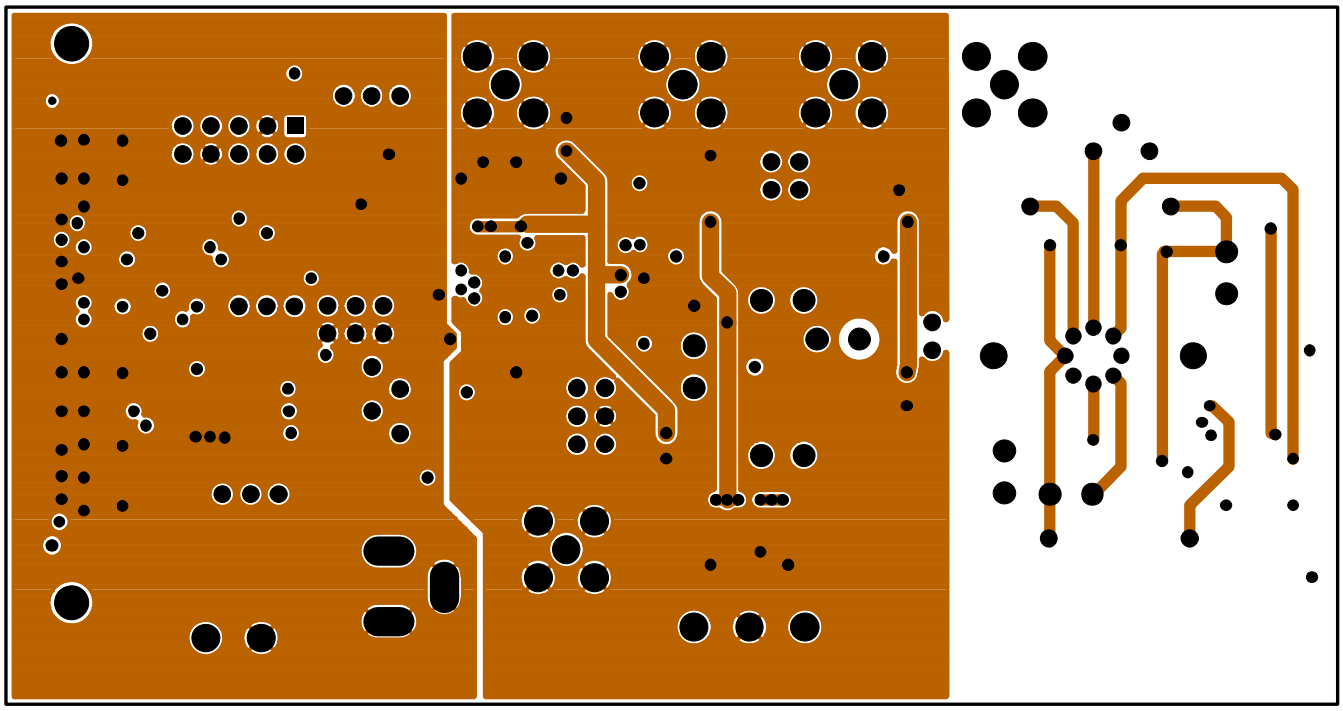


Figure 14. Inner First PCB Layer Schematic

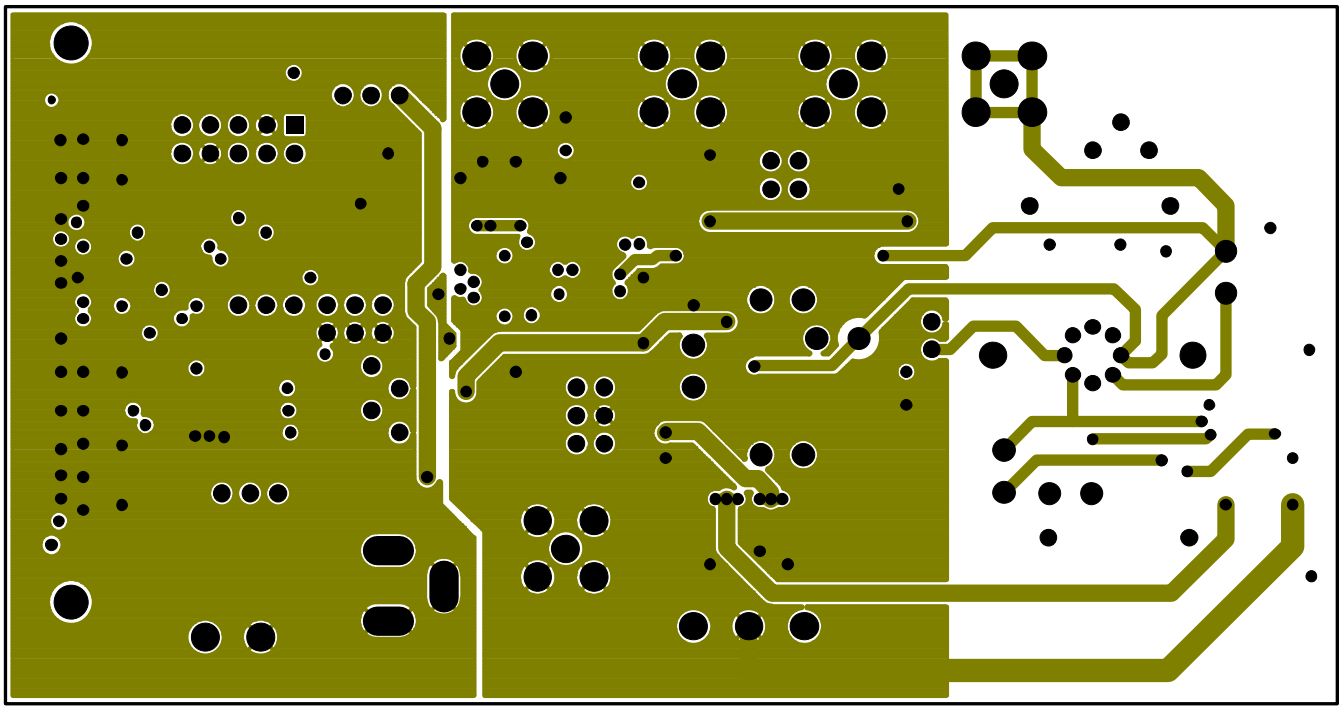


Figure 15. Inner Second PCB Layer Schematic

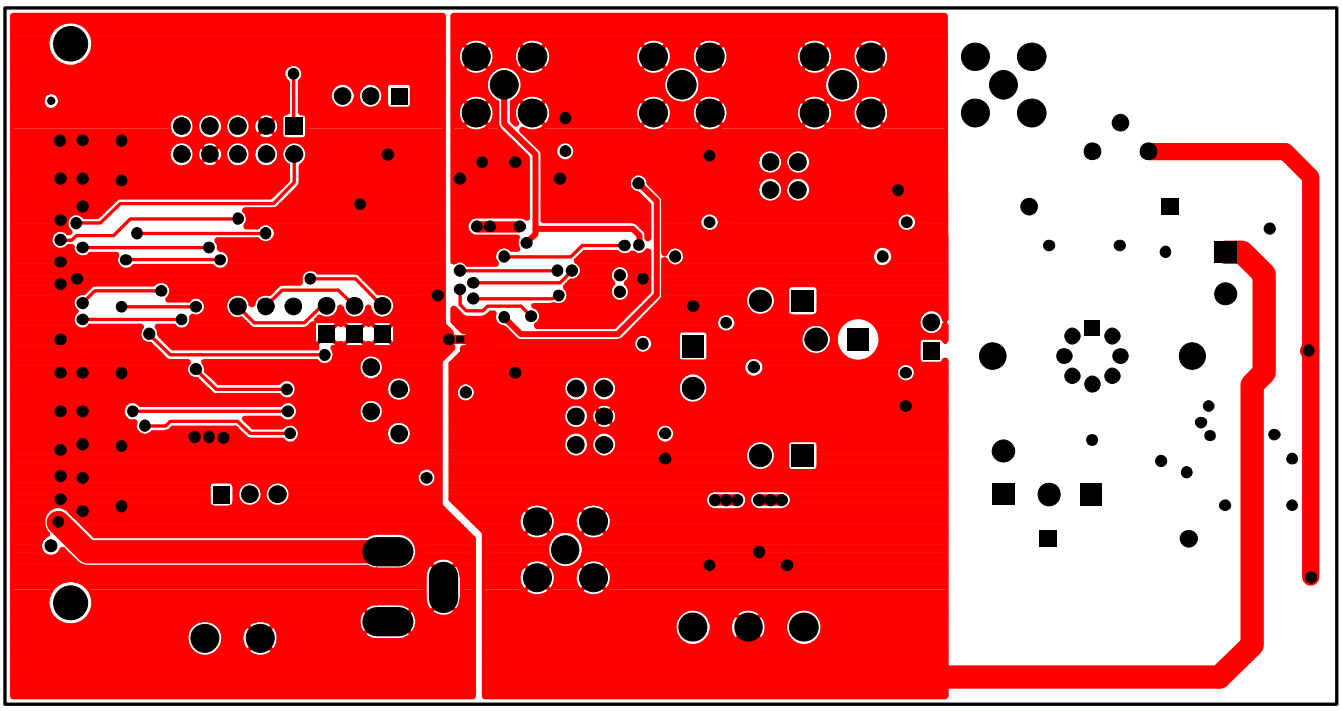


Figure 16. Bottom PCB Layer Schematic

ORDERING INFORMATION

BILL OF MATERIALS

Table 6.

Reference Designator	Part Description	Part Number	Stock Code
C1, C2, C9, C11, C12, C16, C17, C20, C41, C42, C48, C54, C95, C96, C98, C99, C102, C103	Capacitor, 10 µF, 16 V, 10%, Case B	TAJB106K016R	FEC 498737
C3, C4, C5, C6, C7, C8, C10, C25, C31, C40, C43, C45, C47, C53, C93, C100, C101	Capacitor, 0603, 0.1 µF, 16 V	B0603R104KCT	FEC 9406140
J1	3-pin terminal block (5 mm pitch)	CTB5000/3	FEC 151790
J2	2-pin terminal block (5 mm pitch)	CTB5000/2	FEC 151789
J3	120-way connector (0.6 mm pitch)	FX8-120S-SV(21)	FEC 1324660
J6	20-pin (2 × 10) header	N/A	FEC 1022244 (36 + 36 pin strip)
L1, L2, L3, L4	Ferrite bead 600 Ω	74279204	FEC 1635719
LK1, LK3	3-pin SIL header and shorting link	M20-9990345 and M7567-05	FEC 1022248 and FEC 150410
LK4, LK5, LK6	2-pin (0.1" pitch) header and shorting shunt	M20-9990246 and M7566-05	FEC 1022247 and FEC 150-411
LK8, LK9	4-pin (2 × 2) 0.1" header and shorting shunt	M20-9983646 and M7566-05	FEC 1022244 and 150-411 (36 pin strip)
R1, R2, R3, R4, R5, R6, R7	SMD resistor, 0 Ω	MC 0.063W 0603 0R	FEC 9331662
R8	SMD resistor, 1.5 kΩ	MC 0.1W 0805 5% 1K5	FEC 9333924
R15, R16, R17, R18	SMD resistor, 10 kΩ	MC 0.063W 0603 10k	FEC 9331700
R45, R46, R47	Precision resistor, 1 kΩ	PCF0805-13-1K-B-T1	FEC 1108863
R48	Precision resistor, 2 kΩ	PCF0805-13-2K-B-T1	FEC 1108872
TP1 to TP7	Black testpoint	20-2137	FEC 240-333
U2	Dual op amp	AD8676BRZ	AD8676BRZ
U3	64K I^2C serial EEPROM	24LC64-ISN	FEC 9758070
U6	Single op amp, 8-pin	AD8675ARZ	AD8675ARZ
U8	Dual op amp	AD8676BRZ	AD8676BRZ
U11	18-bit, ±1 LSB INL, voltage output DAC	AD5781BRUZ	AD5781BRUZ
U28	Single op amp, 8-pin	AD8675ARZ	AD8675ARZ
VOUT, VOUT_BUF, VREF, VREFN, VREFP	Straight PCB mount SMB jack, 50 Ω	1-1337482-0	FEC 1206013

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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