Evaluation Board for Quad, 16-Bit, High Accuracy, Serial Input, Bipolar Voltage Output DAC

EVAL-AD5765

FEATURES

Full-featured evaluation board for the AD5765
On-board reference
On-board ADC for temperature readback
Link options
Direct hook-up to USB port of PC
PC software for control

EVALUATION BOARD DESCRIPTION

The EVAL-AD5765 is a full-featured evaluation board designed to allow the user to easily evaluate all features of the AD5765 quad-channel, 16-bit DAC. All of the AD5765 pins are accessible at on-board connectors for external connection. The board can be controlled by two means: via the on-board connectors or via the USB port of a Windows®-based PC using the AD5765 evaluation software. The default setup is for control via the USB port.

DEVICE DESCRIPTION

The AD5765 has a nominal output voltage span of ±4.096 V derived from a reference voltage of +2.048 V. The part also includes a 3-wire serial interface that is compatible with SPI®, QSPI™, MICROWIRE™, and DSP interface standards. Data is written to the AD5765 in a 24-bit word format, and a data output pin (SDO) is also offered for daisy-chaining or readback.

The DAC outputs are updated upon receipt of new data into the DAC registers. All the outputs can be simultaneously updated by taking the $\overline{\text{LDAC}}$ input low.

Each channel has a programmable gain and offset adjust register. Each DAC output is buffered on-chip.

Complete specifications for the AD5765 are available in the AD5765 data sheet available from Analog Devices, Inc., and should be consulted in conjunction with this data sheet when using the evaluation board.

FUNCTIONAL BLOCK DIAGRAM

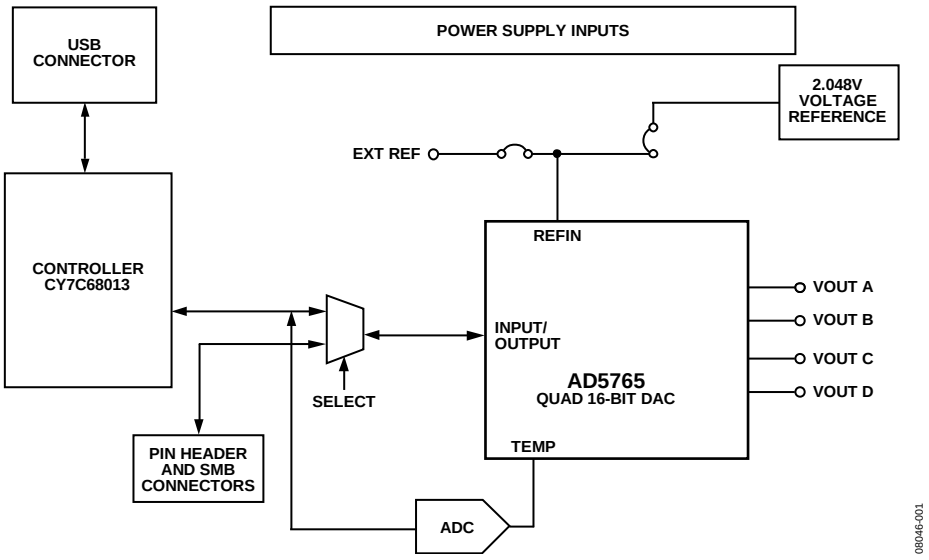

Figure 1.

Rev. 0

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REVISION HISTORY

4/09—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

POWER SUPPLIES

The following external supplies must be provided:

- 5 V between the 5 V and DGND inputs for the digital supply of the AD5765 and digital circuitry. Alternatively, place Link 1 in Position A to power the digital circuitry from the USB port (default).
- 4.5 V to 5.5 V between the AV_{DD} and AGND inputs for the positive analog supply of the AD5765.
- −4.5 V to −5.5 V between the AV_{SS} and AGND inputs for the negative analog supply of the AD5765.

Both AGND and DGND inputs are provided on the board. The AGND and DGND planes are connected at one location close to the AD5765. It is recommended not to connect AGND and DGND elsewhere in the system to avoid ground loop problems.

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 position of Link 11 configures the board for either PC control via the USB port (default setup) or for control by an external source via J21 or the SMB connectors. 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 4.

Default Link Option Setup

The default setup is for control by the PC via the USB port. The default link options are listed in Table 1.

Table 1. Link and Switch Options for PC Control

Link No.	Option
LK1	A
LK2	C
LK3	Inserted
LK4	B
LK5	A and B inserted
LK6	Removed
LK7	A
LK8	A
LK9	A
LK10	Removed
LK11	B
LK12	Inserted
LK13	Inserted
LK14	Inserted

Connector J21 Pin Descriptions

The pin configuration for J21 is shown in Table 2. Descriptions for the J21 pins are provided in Table 3.

Note that LK11 must be in Position A to enable the use of J21.

Table 2. Connector J21 Pin Configuration

13	11	9	7	5	3	1
14	12	10	8	6	4	2

Table 3. Connector J21 Pin Descriptions

Pin No.	Function
1	$\overline{\text{SYNC}}$
2	SCLK
3	SDIN
4	SDO
5	$\overline{\text{LDAC}}$
6	$\overline{\text{CLR}}$
7	D0
8	D1
9	$\overline{\text{RSTOUT}}$
10	$\overline{\text{RSTIN}}$
11	BIN/$\overline{\text{2sCOMP}}$
12	DGND
13	DGND
14	DGND

Table 4. Link Options

Link No.	Function
LK1	This link selects the +5 V power supply source for the digital circuitry: Position A selects the USB port as the +5 V digital circuitry power supply source. Position B selects J2 as the +5 V digital circuitry power supply source.
LK2	This link selects the value of the short-circuit protection for the four DAC outputs: Position A selects a resistor value of 120 kΩ, selecting a current value of 500 μA. Position B selects a resistor value of 24 kΩ, selecting a current value of 2.5 mA. Position C selects a resistor value of 6.2 kΩ, selecting a current value of 10 mA. Position D selects a user-defined resistor value, selecting a user-defined current value.
LK3	This link connects AGNDA to 0 V.
LK4	This link should be kept in Position B.
LK5	This link connects the on-board reference source to REFAB and REFCD: If sourcing REFAB external to the board via J3, Position B should not be inserted. If sourcing REFCD external to the board via J4, Position A should not be inserted. Position A connects REFCD to the on-board reference source. Position B connects REFAB to the on-board reference source.
LK6	This link connects the TEMP pin to the input of the on-board ADC: When inserted, the voltage at the TEMP pin can be readback to the PC. When removed, the voltage at the TEMP pin is disconnected from the on-board ADC input.
LK7	This link selects the digital supply voltage value for the AD5765, U7, U8, and U9: Position A selects +3.3 V as the supply value. Position B selects +5 V as the supply value.
LK8	This link selects the state of the $\overline{\text{LDAC}}$ pin: Position A allows the $\overline{\text{LDAC}}$ pin to be driven from either the PC or via J21 or the SMB connectors. Position B connects the $\overline{\text{LDAC}}$ pin to DGND.
LK9	This link selects the state of the BIN/$\overline{\text{2sCOMP}}$ pin when external control is selected via LK11: Position A connects the BIN/$\overline{\text{2sCOMP}}$ pin to DV_{CC} selecting straight binary as the data coding format. Position B connects the BIN/$\overline{\text{2sCOMP}}$ pin to DGND selecting twos complement as the data coding format. Removing LK9 allows the BIN/$\overline{\text{2sCOMP}}$ pin to be driven from J21.
LK10	This link selects the state of the $\overline{\text{CLR}}$ pin when external control is selected via LK11: When inserted, the $\overline{\text{CLR}}$ pin is connected to DGND and the four DAC outputs are cleared. When removed, the $\overline{\text{CLR}}$ pin is pulled to DV_{CC} through a 10 kΩ resistor.
LK11	This link selects whether the AD5765 evaluation board is controlled by the PC via the USB port or by an external source via J21 or the SMB connectors: Position A selects the evaluation board to be controlled by an external source via J21 or the SMB connectors. Position B selects the evaluation board to be controlled by the PC via the USB port.
LK12	This link connects AGNDB to 0 V.
LK13	This link connects AGNDC to 0 V.
LK14	This link connects AGNDD to 0 V.

EVALUATION BOARD SOFTWARE

SOFTWARE INSTALLATION

The AD5765 evaluation kit includes self-installing software on a CD. The software is compatible with Windows® 2000/NT/XP. If the setup file does not run automatically, **setup.exe** can be run directly from the CD.

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

After the installation from the CD is complete, power up the AD5765 evaluation board as described in the Power Supplies section.

1. Connect the AD5765 evaluation board to the USB port of your PC using the supplied cable.
2. When the evaluation board is detected, proceed through any dialog boxes that appear. This finishes the installation.

SOFTWARE OPERATION

To launch the software, use the following steps:

1. Select the **AD5765** submenu from the **Analog Devices** menu.
2. Click **AD5765 Evaluation Software.** Figure 2 displays the main window.

This window is divided into five sections: **Read/Write Registers**, **Function Register Configuration**, **Hardware Configuration**, **Measure AD5765 Core Temperature**, and **Calibration**.

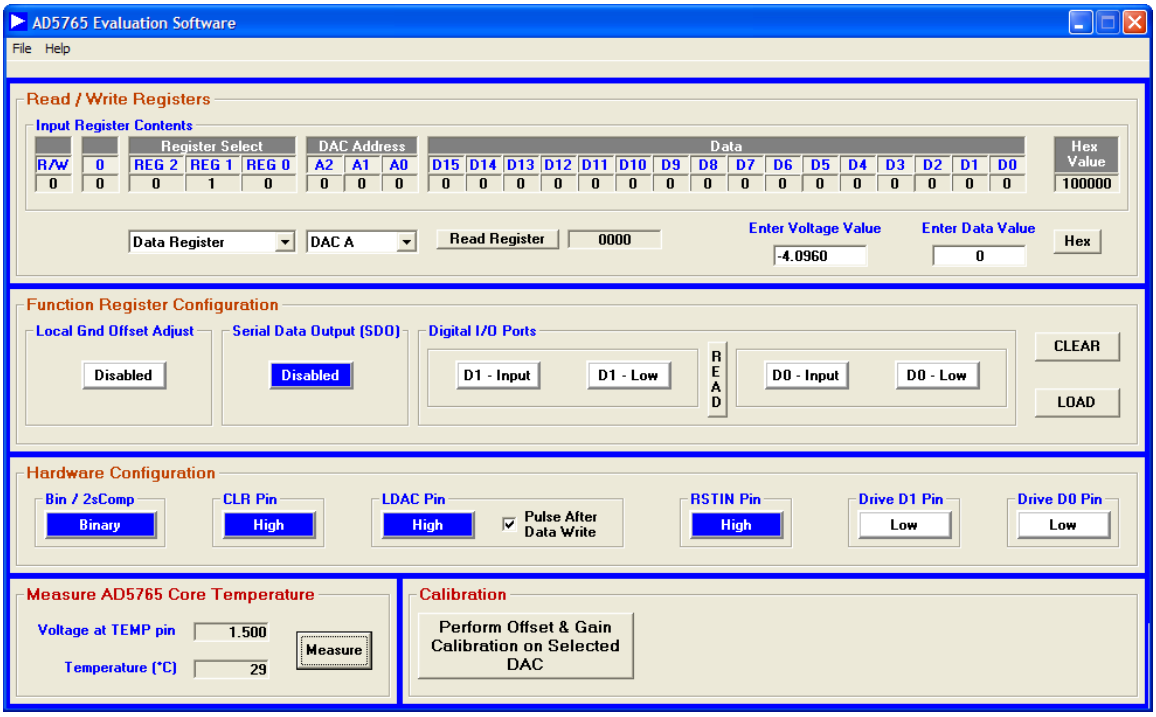

Figure 2. Main Window

Read/Write Registers

The **Read/Write Registers** section allows you to write a value to, or read a value from, all of the AD5765 registers. The logic values of all bits in the input register are also displayed. Access to the registers is via two drop-down boxes. The first drop-down box lets you select the required register, and the second drop-down box lets you select one of the four DAC channels. In the case of the function register, the second drop-down box is not available. Depending on the register selected, either another drop-down box (if coarse gain register is selected) or a text box is displayed. For instance, to write to the data register of DAC A, select **Data Register** from the first drop-down box and **DAC A** from the second drop-down box (see Figure 2). Two text boxes are now displayed where you can type a voltage value, **Enter Voltage Value**, or a 16-bit data value, **Enter Data Value** (the toggle button to the right selects whether the entry is in hex or decimal). Clicking the **Enter** key completes the write operation.

Configuring the Function Register

The **Function Register Configuration** section allows you to define the configuration of the function register, that is to enable/disable the **Local Gnd Offset Adjust** feature, enable/disable the **Serial Data Output (SDO)** pin, set the D0 and D1 **Digital I/O Ports** as inputs or outputs and read/set their values. The **CLEAR** button initiates a software clear operation and the **LOAD** button initiates a software load operation. See the AD5765 data sheet for further information.

Configuring the Hardware Setup

The **Hardware Configuration** section lets you configure the hardware setup of the AD5765, that is, to set the configuration of the BIN/2sCOMP, $\overline{\text{CLR}}$, $\overline{\text{LDAC}}$ and $\overline{\text{RSTIN}}$ pins. Also, when the D0 and D1 ports are defined as inputs, you can then drive the D0 and D1 pins high or low and read their values in the **Function Register Configuration** section.

Measuring AD5765 Core Temperature

Using the on-board ADC, the voltage at the TEMP pin can be measured. The value of this voltage is related to the AD5765 core temperature.

Calibrating

The **Calibration** section allows you to remove any offset or gain errors that exist on each of the DACs. The procedure to calibrate a DAC channel is as follows:

1. Select the DAC to be calibrated in the **Read/Write Registers** section.
2. In the **Calibration** section, click the **Perform Offset & Gain Calibration on Selected DAC** button. The calibration section display changes as shown in Figure 3.
3. In the **Read/Write Registers** section**,** load 0 V to the DAC and measure the output voltage of the DAC.
4. Enter the measured value in the **Calibration** section.
5. Click **Done**. The offset error should now have been reduced and the **Calibration** section display changes as shown in Figure 4.
6. In the **Read/Write Registers** section, load zero scale to the DAC (−4.096 V, −4.201 V, or −4.311 V).
7. Measure the output voltage of the DAC and enter the measured value in the **Calibration** section.
8. Click **Done**. The gain error should now have been reduced.
9. Repeat this procedure for the other three DACs.

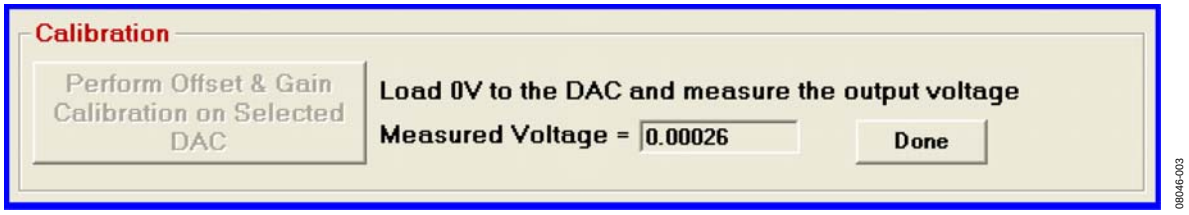

Figure 3. Calibrating For Offset Error

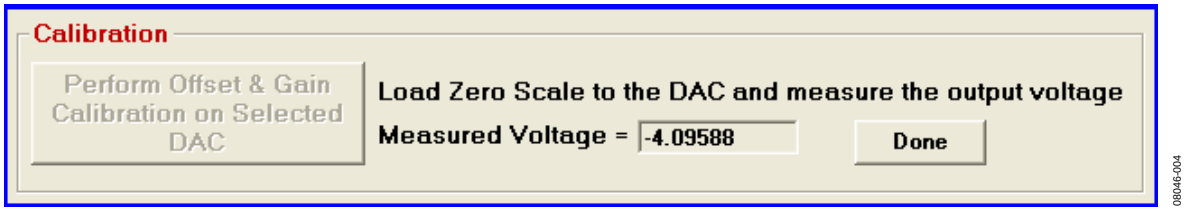

Figure 4. Calibrating for Gain Error

EVALUATION BOARD SCHEMATICS AND ARTWORK

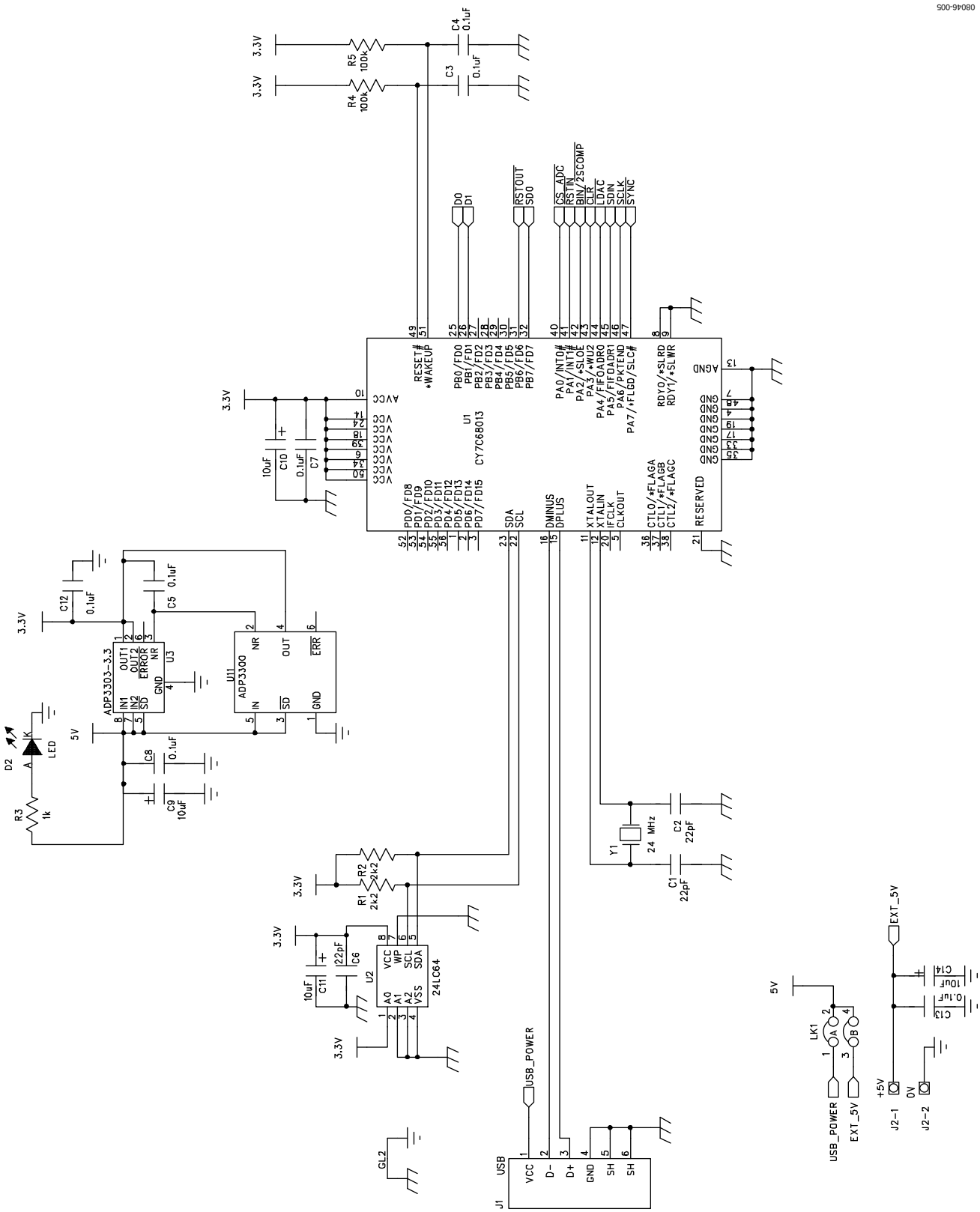

Figure 5. Schematic of Controller Circuitry

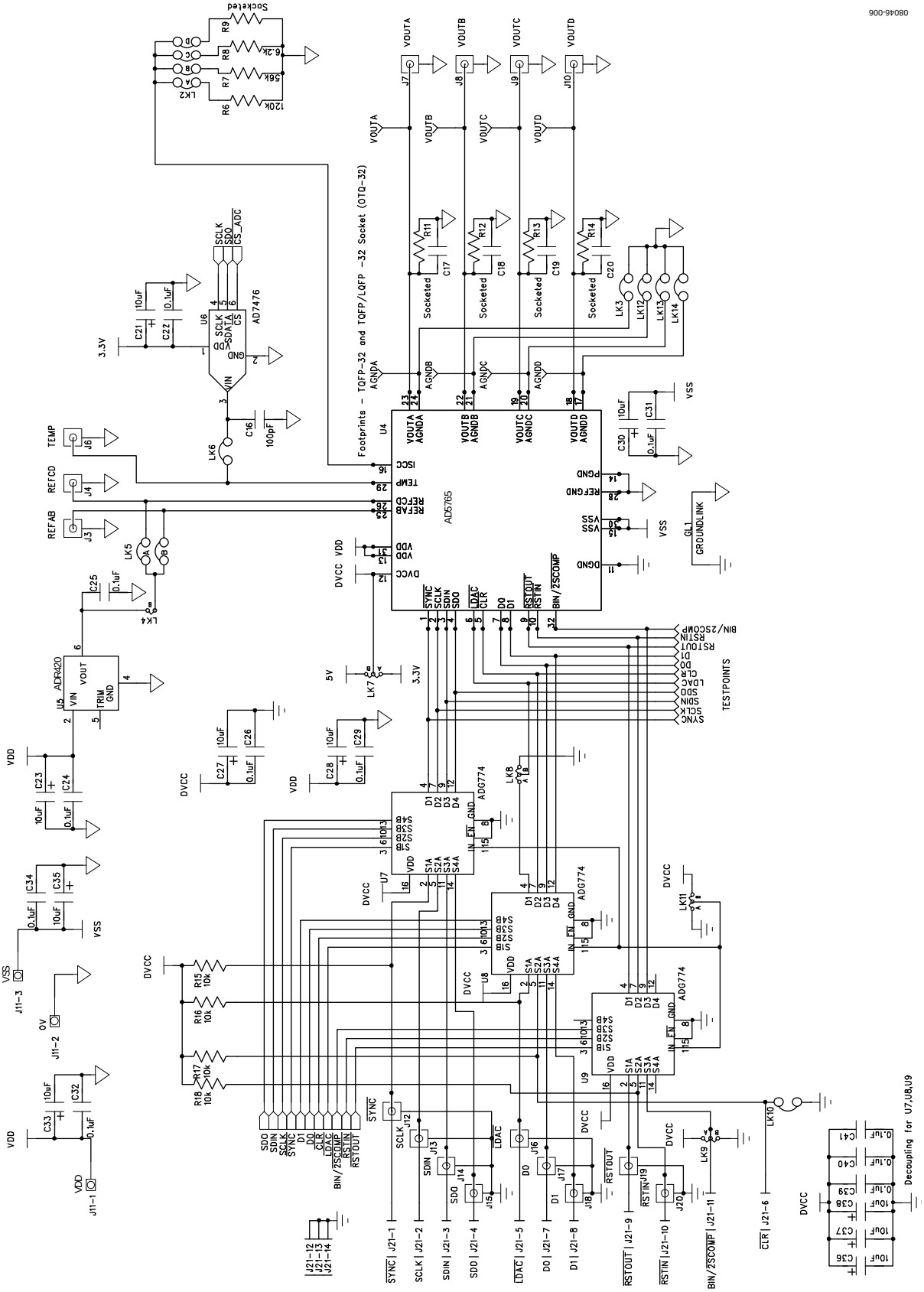

Figure 6. Schematic of AD5765 Circuitry

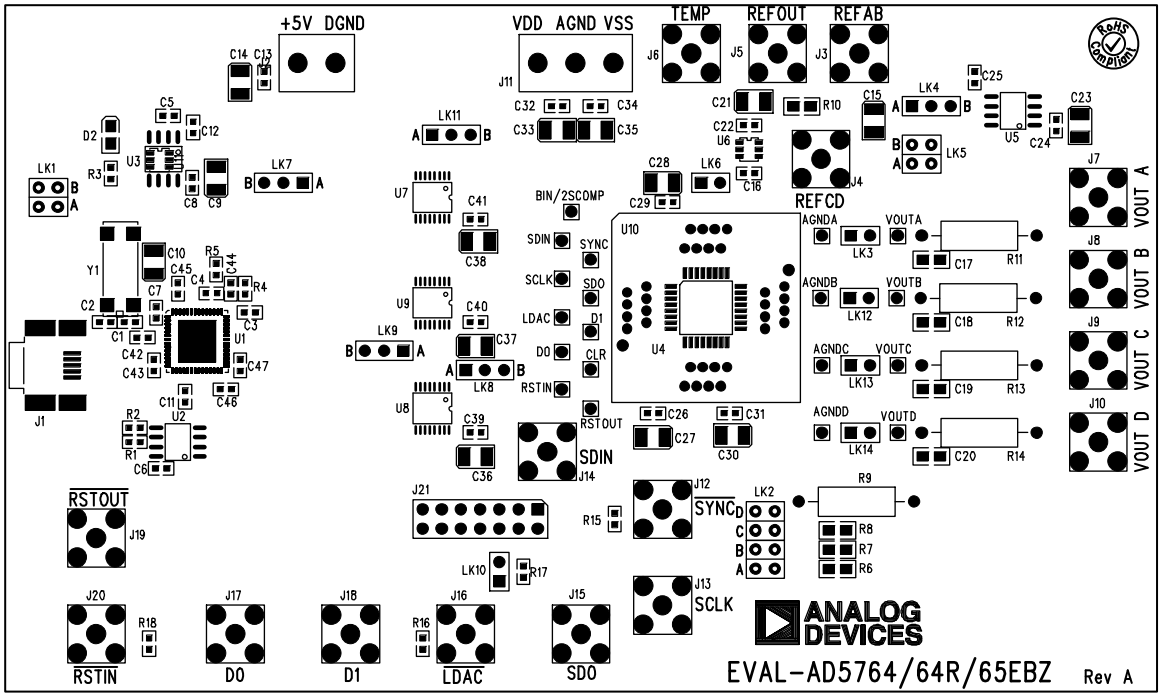

Figure 7. Component Placement Drawing

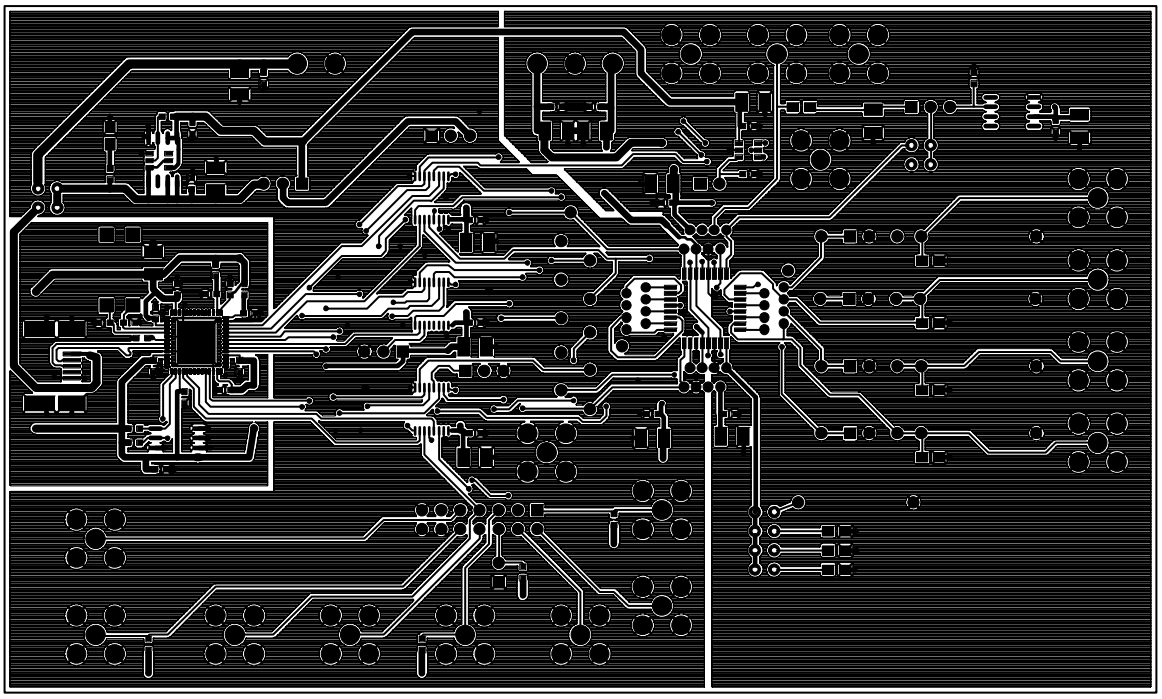

Figure 8. Solder Side PCB Drawing

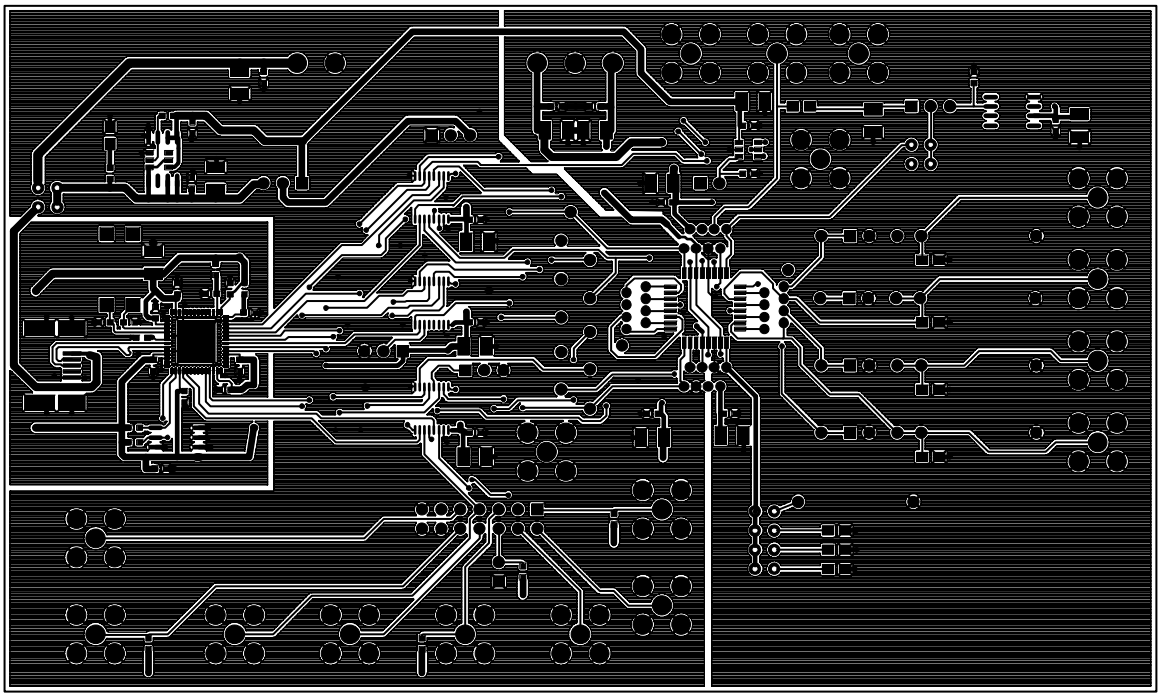

Figure 9. Component Side PCB Drawing

ORDERING INFORMATION

BILL OF MATERIALS

Table 5.

Qty	Reference Designator	Description	Supplier/Number
1	U1	CY7C68013	Digi-Key 428-1332-ND
1	U2	24LC64	Digi-Key 24LC64-1/SN-ND
1	U3	ADP3303-3.3	Analog Devices
1	U4	AD5765CSUZ	Analog Devices
1	U5	ADR420BRZ	Analog Devices
1	U6	AD7476ART	Analog Devices
3	U7, U8, U9	ADG774BRQ	Analog Devices
1	U10	32-pin QFP socket	32QFP-SKT-OTQ-32-08-02
2	R1, R2	2.2 kΩ resistor 0603 package	FEC 9330810
1	R3	1 kΩ resistor 0603 package	FEC 9330380
2	R4, R5	100 kΩ resistor 0603 package	FEC 9330402
1	R6	120 kΩ resistor 0805 package	FEC 9332510
1	R7	56 kΩ resistor 0805 package	FEC 9333380
1	R8	6.2 kΩ resistor 0805 package	FEC 9333428
1	R10	0 Ω resistor 0805 package	FEC 9333681
4	R15, R16, R17, R18	10 kΩ resistor 0603 package	FEC 9330399
3	C1, C2, C6	22 pF ceramic capacitor 0603 package	FEC 722005
18	C3, C4, C5, C7, C8, C12, C13, C22, C24, C25, C26, C29, C31, C32, C34, C39, C40, C41	0.1 µF ceramic capacitor 0603 package	FEC 1216538
15	C9, C10, C11, C14, C15, C21, C23, C27, C28, C30, C33, C35, C36, C37, C38	10 µF tantalum capacitor TAJ_B package	FEC 498737
1	C16	100 pF ceramic capacitor 0603 package	FEC 499122
2	LK1, LK5	4-pin dil header and shorting link	FEC 1022233 and FEC 150411
1	LK2	8-pin dil header and shorting link	FEC 1022233 and FEC 150411
6	LK3, LK6, LK10, LK12, LK13, LK14	2-pin sil header and shorting link	FEC 1022247 and FEC 150411
5	LK4, LK7, LK8, LK9, LK11	3-pin sil header and shorting link	FEC 1022249 and FEC 150411
1	J1	USB receptacle B	FEC 9786490
1	J2	2-way screw terminal	FEC 151789
17	J3 to J10, J12 to J20	Sub-miniature BNC connector (SMB)	FEC 310682
1	J11	3-way screw terminal	FEC 151790
1	J21	14-pin dil header	FEC 5217842
19	AGNDA, AGNDB, AGNDC, AGNDD, BIN/2sCOMP, CLR, D0, D1, RSTIN, LDAC, RSTOUT, SCLK, SDIN, SDO, SYNC, VOUTA, VOUTB, VOUTC, VOUTD	Testpoint	FEC 240333
1	D2	LED 0805 package	FEC 5790840
1	Y1	24 MHz crystal HC49 package	FEC 569-860

ORDERING GUIDE

Model	Package Description
EVAL-AD5765EBZ[1]	AD5765 Evaluation Board

[1] Z = RoHS Compliant Part.

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.

NOTES

EB08046-0-4/09(0)