

### FEATURES

**Full-featured evaluation board for the AD5420**

**On-board reference**

**Link options**

**Direct hook-up to USB port of PC**

**PC software for control**

### EVALUATION BOARD DESCRIPTION

The EVAL-AD5420 is a full-featured evaluation board, designed to allow the user to easily evaluate all features of the AD5420 current source, 16-bit DAC. All of the AD5420 pins are accessible at on-board connectors for external connection. The board can be controlled by two means, via the on-board connector (J8) or via the USB port of a Windows® 2000, NT®, XP®-based PC using the AD5420 evaluation software. The default setup is for control via the USB port.

### DEVICE DESCRIPTION

The AD5420 is a low cost, precision, fully integrated 16-bit converter, offering a programmable current source output designed to meet the requirements of industrial process control applications. The output current range is programmable to 4 mA to 20 mA, 0 mA to 20 mA, or an overrange function of 0 mA to 24 mA. The output is open-circuit protected. The device is specified to operate with a power supply range from 10.8 V to 40 V. Output loop compliance is 0 V to  $AV_{DD} - 2.5$  V.

Complete specifications for the AD5420 are available in the [AD5420](#) 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

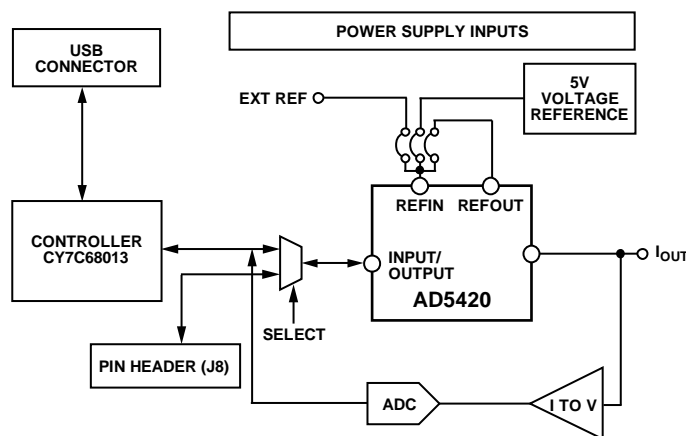


Figure 1.

#### Rev. 0

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TABLE OF CONTENTS

Features .....	1	Evaluation Board Software.....	5
Evaluation Board Description.....	1	Software Installation .....	5
Device Description .....	1	Software Operation .....	5
Functional Block Diagram .....	1	Evaluation Board Schematics and Artwork.....	7
Revision History .....	2	Ordering Information.....	10
Evaluation Board Hardware .....	3	Bill of Materials.....	10
Power Supplies .....	3	Ordering Guide .....	11
Link Options .....	3	ESD Caution.....	11

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 0 V inputs for the digital supply of the [AD5420](#) and digital circuitry. Alternatively, place Link 6 in Position A to power the digital circuitry from the USB port (default).
- 10.8 V to 40 V between the  $AV_{DD}$  and GND inputs for the analog supply of the AD5420.
- 10.8 V to 16.5 V between the V+ and AGND inputs for the analog supply of the [AD7321](#) (on-board ADC) and [ADR435](#) (on-board voltage reference). If the analog supply connected to the  $AV_{DD}$  input is less than 16.5 V, the AD7321 and ADR435 can be powered from this by placing Link 9 in Position A, and the V+ input can be left unconnected.

The analog and digital planes are connected at one location, close to the AD5420. 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  $\mu$ F and 0.1  $\mu$ F capacitors. Each device supply pin is again decoupled with a 10  $\mu$ F and 0.1  $\mu$ F capacitor pair to the relevant ground plane.

#### Excessive Power Supply

Note that, if a power supply in excess of 16.5 V is to be connected to the  $AV_{DD}$  input, LK9 must be in Position B to prevent potential damage to the 5 V voltage reference and to the ADC (see U2 and U6, respectively, in Figure 5).

### LINK OPTIONS

The position of Link 7 configures the board for either PC control via the USB port (default setup) or for control by an external source via J8. 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	Not applicable
LK2	A
LK3	Inserted
LK4	Not applicable
LK5	B
LK6	A
LK7	A
LK8	A
LK9	A
LK10	Inserted
LK11	Not applicable
LK12	Not applicable
LK13	Inserted
LK14	Not applicable
LK15	C
LK16	Not applicable
LK17	Inserted
LK18	Inserted

#### Connector J8<sup>1</sup> Pin Descriptions

**Table 2. Connector J8 Pin Configuration**

2	4	6	8	10
1	3	5	7	9

<sup>1</sup> LK7 must be in Position B to enable the use of J8.

**Table 3. Connector J8 Pin Descriptions**

Pin No.	Description
1	SDO
2	Not applicable
3	Digital ground
4	Clear
5	Digital ground
6	Fault
7	SDIN
8	Digital ground
9	SCLK
10	Latch

# EVAL-AD5420

**Table 4. Link Options**

Link No.	Description
LK1	Not applicable.
LK2	This link selects the state of the CLEAR pin (when the evaluation board is configured for external control). Position A ties the CLEAR pin to 0 V. Position B ties the CLEAR pin to DV <sub>CC</sub> .
LK3	This link selects the state of the DV <sub>CC</sub> SELECT pin. When inserted, the DV <sub>CC</sub> SELECT pin is tied to 0 V, disabling the internal supply; an external supply must be connected to the DV <sub>CC</sub> pin via LK17. When removed, the DV <sub>CC</sub> SELECT pin is unconnected, enabling the internal supply. Removing the requirement for an external digital supply, LK17 can be removed.
LK4	Not applicable.
LK5	This link selects how the I <sub>OUT</sub> current loop return is connected to ground on the evaluation board. Position A connects the I <sub>OUT</sub> current loop return directly to ground. Position B connects the I <sub>OUT</sub> current loop return input to GND through a 51 Ω resistor. The high side of the resistor is connected to the V <sub>IN1</sub> input of the on-board ADC, allowing readback to the PC of the output current.
LK6	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 J7 as the 5 V digital circuitry power supply source.
LK7	This link selects whether the AD5420 evaluation board is controlled by the PC via the USB port or by an external source via J8. Position A selects the evaluation board to be controlled by the PC via the USB port. Position B selects the evaluation board to be controlled by an external source via J8.
LK8	This link selects the digital supply voltage value for the AD5420 and the on-board ADC (U6): Position A selects 5 V as the supply value. Position B selects 3.3 V as the supply value.
LK9	This link selects the positive power supply source for U2 and U6. Position A selects the AV <sub>DD</sub> input as the positive power supply source (use only if the power supply applied to AV <sub>DD</sub> is less than 16.5 V). Position B selects the V+ input as the positive power supply source (use if the power supply applied to AV <sub>DD</sub> input is greater than 16.5 V). A power supply voltage of 10.8 V to 16.5 V can be applied to V+.
LK10	This link is used to enable/disable the external boost transistor. When inserted, the external boost transistor is disabled. When removed, the external boost transistor is enabled.
LK11	Not applicable.
LK12	Not applicable.
LK13	This link connects the I <sub>OUT</sub> connector directly to the GND connector. When inserted, the I <sub>OUT</sub> connector is connected directly to the GND connector. When removed, the I <sub>OUT</sub> connector is disconnected from the GND connector (an external load must be connected).
LK14	Not applicable.
LK15	This link selects the voltage reference source. Position A selects the internal voltage reference of the <a href="#">AD5420</a> as the voltage reference source. Position B selects an external source that can be applied at Connector J3. Position C selects the on-board ADR435 as the voltage reference source.
LK16	Not applicable.
LK17	This link connects the DV <sub>CC</sub> pin of the AD5420 to the on-board digital power supply. When inserted, the DV <sub>CC</sub> pin of the AD5420 is connected to the on-board digital power supply (LK3 must be inserted to disable the AD5420 internal digital power supply) When removed, the DV <sub>CC</sub> pin of the AD5420 is disconnected from the on-board digital power supply (LK3 should be removed to enable the AD5420 internal digital power supply).
LK18	This link connects the AV <sub>DD</sub> pin of the AD5420 to the power supply applied at the AV <sub>DD</sub> input connector, J2 (LK18 must be inserted for operation of the AD5420).

## EVALUATION BOARD SOFTWARE

### SOFTWARE INSTALLATION

The AD5420 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, you can run **setup.exe** 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.

1. After installation from the CD is complete, power up the AD5420 evaluation board as described in the Power Supplies section. Then, connect the 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, complete the following steps:

1. From the **Start** menu, select **Analog Devices – AD5420**; then select **AD5420 Evaluation Software**. The main window of the software is displayed (see Figure 3).
2. If the evaluation board is not connected to the USB port when the software is launched, a connectivity error is displayed (see Figure 2). Simply connect the evaluation board to the USB port of the PC and click **Retry**.

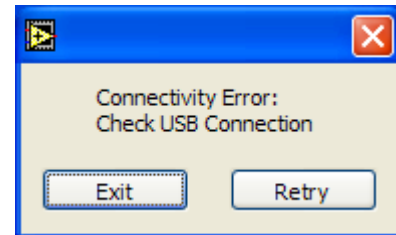


Figure 2. Connectivity Error Alert

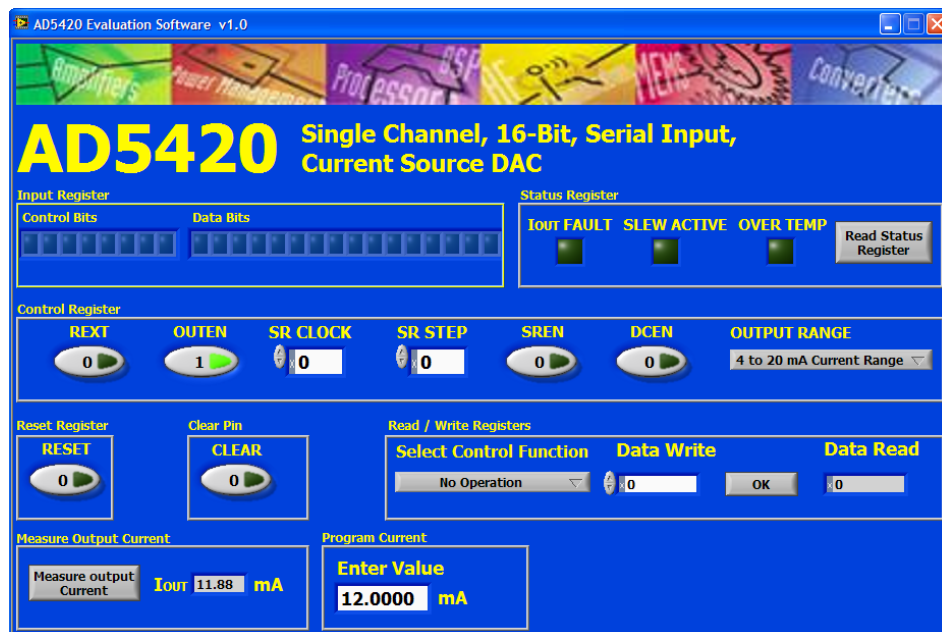


Figure 3. Main Window

## EVAL-AD5420

The main window is divided into eight sections: **Input Register**, **Status Register**, **Control Register**, **Reset Register**, **Clear Pin**, **Read/Write Registers**, **Measure Output Current**, and **Program Current**.

### **Input Register**

The **Input Register** section displays the contents of the input register. The 24-bit display is updated each time you request a read or a write operation via the main window controls. It allows you to associate the value written to the [AD5420](#) with the various programmable functions.

### **Status Register**

The **Status Register** section displays the states of the three bits of the read-only status register. To read the register, click the **Read Status Register** button.

### **Control Register**

The **Control Register** section facilitates programming of the control register on an individual bit basis. To change the value for a bit, click the relevant button. Each button also displays the current state of the bit. You can also enter code in the **SR CLOCK** and **SR STEP** text boxes and select an output range from the **OUTPUT RANGE** drop-down box.

### **Reset Register**

The sole function of the **Reset Register** section is to allow the AD5420 to be reset to its power-on state. To change the value of the reset bit, click the **RESET** button.

### **Clear Pin**

In the **Clear Pin** section, you can change the state of the CLEAR pin by clicking the **CLEAR** button.

### **Read/Write Registers**

In the **Read/Write Registers** section, you can read and write to all registers in the AD5420. To select a register and request a read or write, click the **Select Control Function** box. Then, to write data to the register, click the **Data Write** button until the desired data is displayed in the **Data Write** text box; then click **OK**. Register data is updated and displayed for you to read in the **Data Read** text box each time you click **OK**.

### **Measure Output Current**

To display the programmed output current in the **Measure Output Current** section, click the **Measure output Current** button. The output current is measured using the on-board ADC and is displayed in milliamperes (mA) in the **I<sub>OUT</sub>** box. The output current is measured with an accuracy of approximately 1% and is, therefore, not intended as precise, but rather as an approximate, feedback of the programmed current.

### **Program Current**

To program a current output value, enter the value in milliamperes (mA) in the **Enter Value** text box of the **Program Current** section, and press **Enter**. The output must first be enabled, and the output range must be selected via the **Control Register** section.

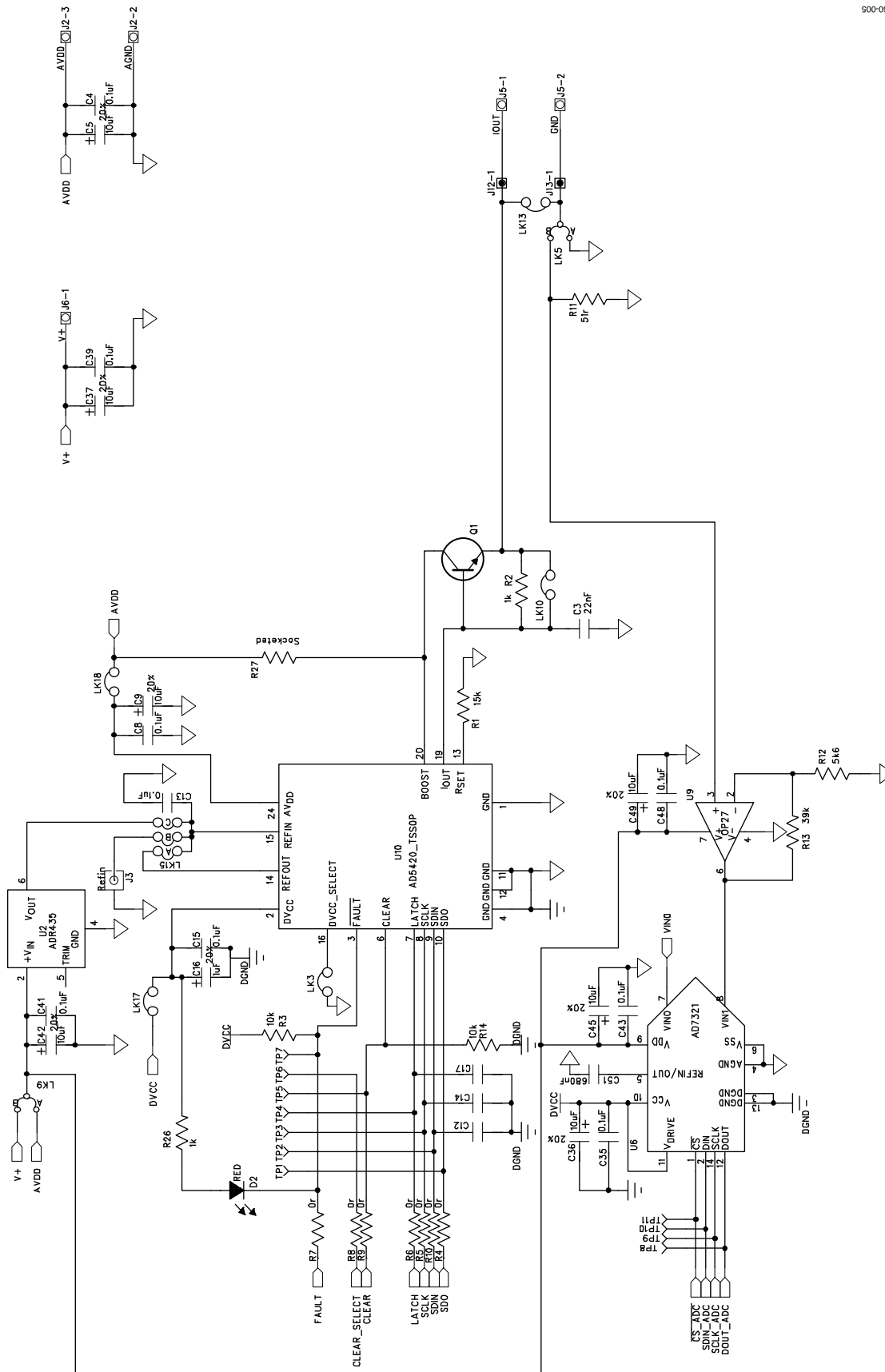
The schematic diagram illustrates the electrical connections for the AD9361 evaluation board. Key components include:

- USB-MINI-B Port:** Connected to the board's VBUS, D+, D-, and GND pins.
- Power Regulation:** A 5V input is connected to a voltage divider (R23, R24) and a diode (D1). The output is connected to the EXT\_5V pin. A 0V input is connected to the EXT\_0V pin. A 3.3V input is connected to the EXT\_3.3V pin.
- AD9361 IC:** The central component, with pins for PA0/PIN0 through PA7/PIN7, PD0/PIN0 through PD7/PIN7, and various control signals like RESET, CLKOUT, and SDA/SCL.
- AD9374 and AD9375 ICs:** These ICs are used for signal processing and are connected to the AD9361 via I2C or SPI interfaces.
- Connectors:** Various connectors are shown, including LK6, LK7, LK8, and LK9, which provide access to different parts of the circuit.
- Passive Components:** Numerous capacitors (C1 through C27) and resistors (R1 through R25) are used for decoupling, timing, and signal conditioning.

The diagram also shows the connection of the board to a host system via the USB-MINI-B port and the power supply requirements for the various components.

Rev. 0 | Page 7 of 12

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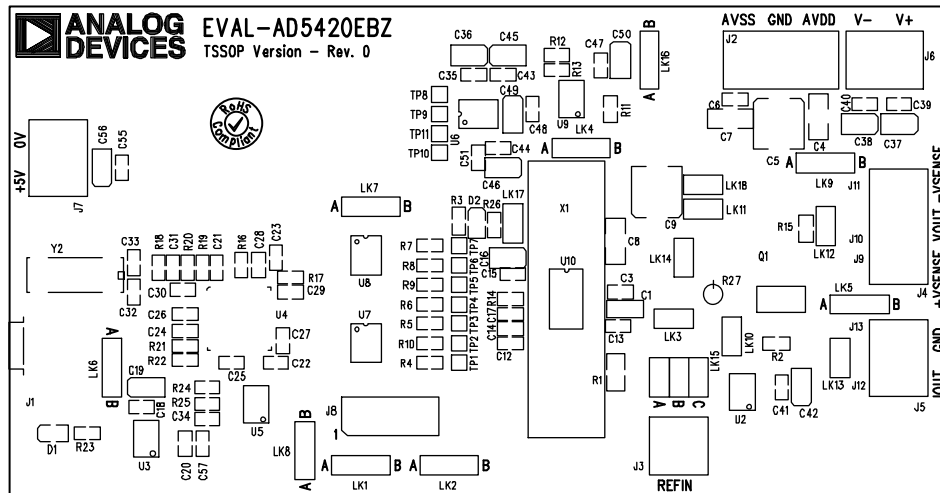


Figure 6. Component Placement

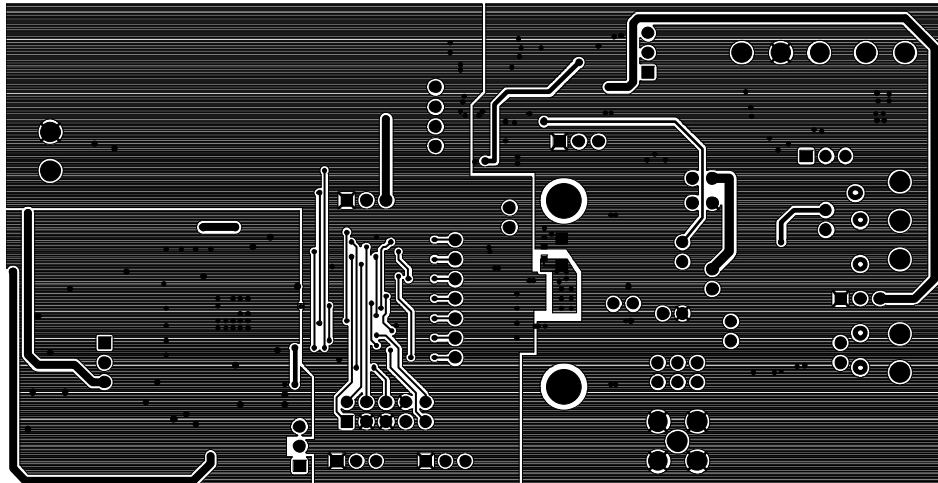


Figure 7. Solder Side PCB

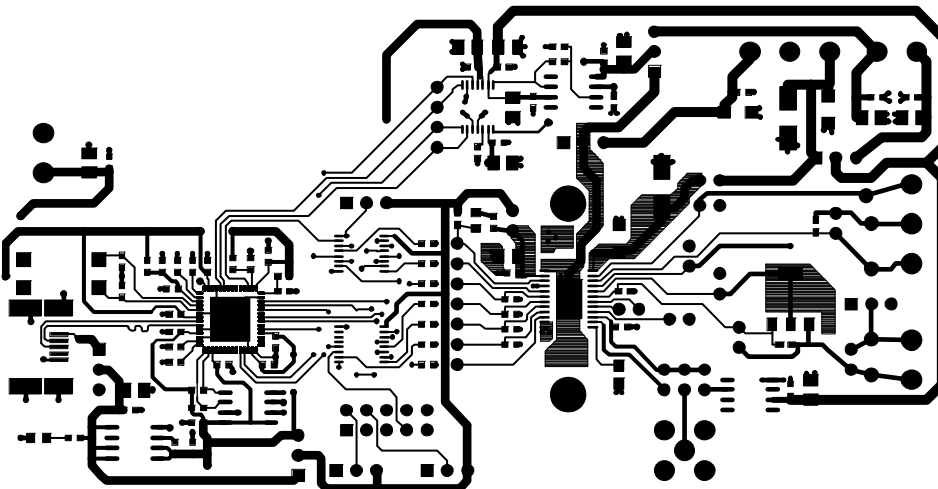


Figure 8. Component Side PCB

## ORDERING INFORMATION

## BILL OF MATERIALS

Table 5.

Qty	Reference Designator	Description	Supplier/Number
1	U10	16-bit current source DAC	Analog Devices/AD5420AREZ
1	U6	12-bit ADC	Analog Devices/AD7321BRUZ
2	U7, U8	Quad 2:1 multiplexer	Analog Devices/ADG774BRQZ
1	U3	3.3 V low dropout voltage regulator	Analog Devices/ADP3303ARZ-3.3
1	U2	5 V voltage reference	Analog Devices/ADR435ARZ
1	U4	USB microcontroller	Cypress Semiconductor Corporation/CY7C68013-56LFXC
1	U5	64 K EEPROM	Digi-Key/24LC64-I/SN-ND
1	C51	16 V, Y5V, ceramic capacitor	Digi-Key/490-1581-1-ND
1	LK15	6-pin (3 × 2) 0.1" header and shorting bar	FEC 1022231 and FEC 150411
1	J8	2-row, 36+36 header	FEC 1022244 (36 + 36 pin strip)
5	LK3, LK10, LK13, LK17, LK18	2-pin (0.1" pitch) header and shorting shunt	FEC 1022247 FEC 150-411
7	LK1, LK2, LK5, LK6, LK7, LK8, LK9	3pin (0.1" pitch) header and shorting shunt	FEC 1022249 and FEC 150-411
1	J3	50 Ω SMB jack	FEC 1111349
1	C3	22 nF, 16 V, X7R ceramic capacitor	FEC 1294640
7	C19, C36, C37, C42, C45, C49, C56	10 V SMD tantalum capacitor	FEC 1135234
1	R1	SMD precision resistor	FEC 1140932
22	C13, C15, C18, C20, C21, C22, C23, C24, C25, C26, C27, C28, C29, C30, C34, C35, C39, C41, C43, C48, C55, C57	0.1 μF, 16 V, X7R ceramic capacitor	FEC 1216538
2	C4, C8	0.1 μF, 100 V ceramic capacitor	FEC 1288275
4	J2, J5, J6, J7	2-pin terminal block (5 mm pitch)	FEC 151789
1	C16	1 μF, 10 V SMD tantalum capacitor	FEC 197099
2	D1, D2	Red SMD LED	FEC 5790840
2	C32, C33	22 pF, 50 V, NPO ceramic capacitor	FEC 722005
11	TP1 to TP11	Black test point	FEC 8731128
3	R2, R23, R26	1 kΩ SMD resistor	FEC 9330380
6	R3, R14, R19, R20, R21, R22	10 kΩ SMD resistor	FEC 9330399
2	R16, R17	100 kΩ SMD resistor	FEC 9330402
2	R24, R25	2.2 kΩ SMD resistor	FEC 9330810
1	R13	39 kΩ SMD resistor	FEC 9331158
1	R11	51 Ω SMD resistor	FEC 9331336
1	R12	5.6 kΩ SMD resistor	FEC 9331352
8	R4 to R10, R18	0 Ω SMD resistor	FEC 9331662
1	C31	2.2 μF, 10 V, Y5V ceramic capacitor	FEC 9402098
1	Y2	24 MHz plastic SMD crystal	FEC 9509658
2	C5, C9	10 μF, 63 V (FK series) electrolytic capacitor	FEC 9696008
1	J1	USB Mini-B connector (USB-OTG)	FEC 9786490
1	Q1	NPN transistor, PBSS8110Z	FEC 8736677
1	U9	Low noise, precision operational amplifier	Analog Devices/OP27GSZ

**ORDERING GUIDE**

Model	Package Description
EVAL-AD5420EBZ <sup>1</sup>	AD5420 Evaluation Board

<sup>1</sup> 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**