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Evaluating the AD5420 Single-Channel, 16-Bit, Serial Input, Current Source DAC

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 digital-to-analog converter (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 from 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 user guide when using the evaluation board.

FUNCTIONAL BLOCK DIAGRAM

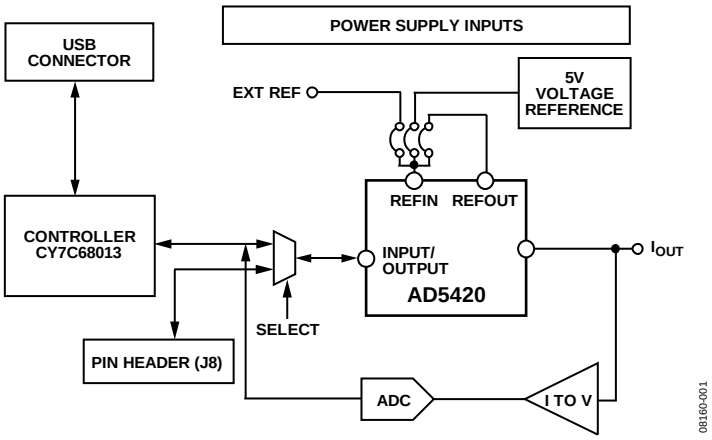


Figure 1.

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REVISION HISTORY

10/13—Rev. C to Rev. D

Added Text to Evaluation Board Schematics and Artwork Section 7
Changes to C3 Supplier Number; Table 5 10

3/13—Rev. B to Rev. C

Change to Control Register Section and Added Figure 4; Renumbered Sequentially 6

11/12—Rev. A to Rev. B

Change to Table 5 10

7/12—Rev. 0 to Rev. A

Document Title Changed from EVAL-AD5420 to UG-441 ..... Universal
Changes to Figure 3 5
Changes to Figure 4 7
Changes to Figure 5 8
Changes to Figure 6 to Figure 8 9
Changes to Table 5 10

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 LK6 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 analog-to-digital converter [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 LK9 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 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.

Excessive Power Supply

If a power supply in excess of 16.5 V is 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 6).

LINK OPTIONS

The position of LK7 configures the board for either PC control via the USB port (default setup) or for control by an external source via J8. Set the link options on the evaluation board 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 Pin Descriptions

Table 2. Connector J8[1] Pin Configuration

2	4	6	8	10
1	3	5	7	9

[1] 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

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_{CC}.
LK3	This link selects the state of the DV_{CC} SELECT pin. When this link is inserted, the DV_{CC} SELECT pin is tied to 0 V, disabling the internal supply; an external supply must be connected to the DV_{CC} pin via LK17. When this link is removed, the DV_{CC} 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_{OUT} current loop return is connected to ground on the evaluation board. Position A connects the I_{OUT} current loop return directly to ground. Position B connects the I_{OUT} current loop return input to GND through a 51 Ω resistor. The high side of the resistor is connected to the $V_{IN}1$ 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_{DD} input as the positive power supply source (use only if the power supply applied to AV_{DD} 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_{DD} 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 this link is inserted, the external boost transistor is disabled. When this link is removed, the external boost transistor is enabled.
LK11	Not applicable.
LK12	Not applicable.
LK13	This link connects the I_{OUT} connector directly to the GND connector. When this link is inserted, the I_{OUT} connector is connected directly to the GND connector. When this link is removed, the I_{OUT} 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 AD5420 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_{CC} pin of the AD5420 to the on-board digital power supply. When this link is inserted, the DV_{CC} 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 this link is removed, the DV_{CC} 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_{DD} pin of the AD5420 to the power supply applied at the AV_{DD} 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, run the **setup.exe** file from the CD.

To install the evaluation software, do the following:

1. 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.
2. After installation from the CD is complete, power up the AD5420 evaluation board as described in the Power Supplies section.
3. Connect the board to the USB port of the PC using the supplied cable.
4. 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/ AD5420 Evaluation Software.** The main window of the software then displays (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.**

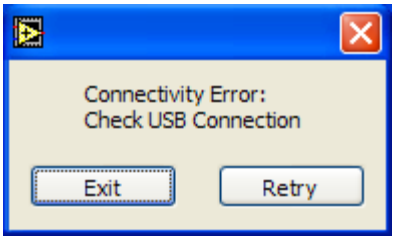


Figure 2. Connectivity Error Alert

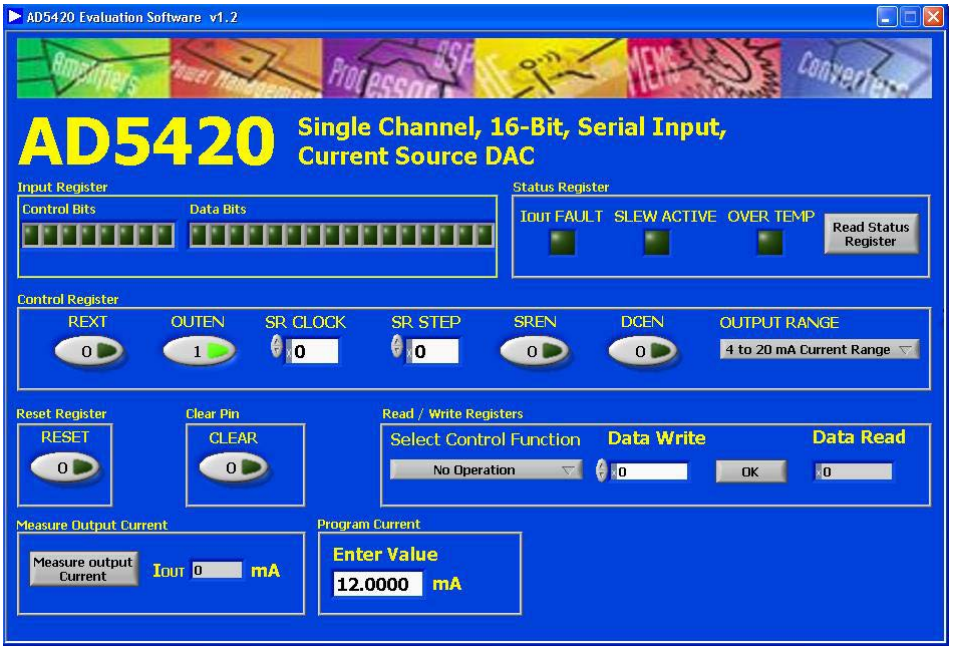


Figure 3. Main Window

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 a read or a write operation is requested via the main window controls. It allows users 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 of 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.

When using an external current setting resistor, it is recommended to only set REXT when also setting the OUTEN bit. Alternately, REXT can be set before the OUTEN bit is set, but the range must be changed on the write in which the output is enabled. The Read/Write Registers section should be used for these commands (see Figure 4).

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 and 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 $\mathbf{I}_{OUT}$ box. The output current is measured with an accuracy of approximately 1% and is 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.

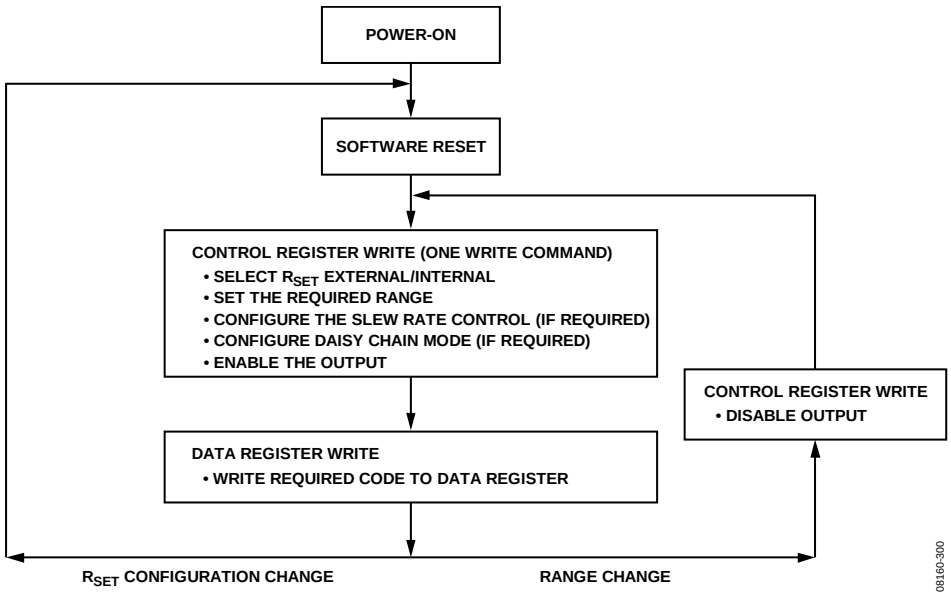


Figure 4. Programming Sequence to Write/Enable the Output Correctly

EVALUATION BOARD SCHEMATICS AND ARTWORK

Because the AD5422 and AD5420 share the same schematic, U1 is shown as AD5422. Reference the AD5420 data sheet for the equivalent pins.

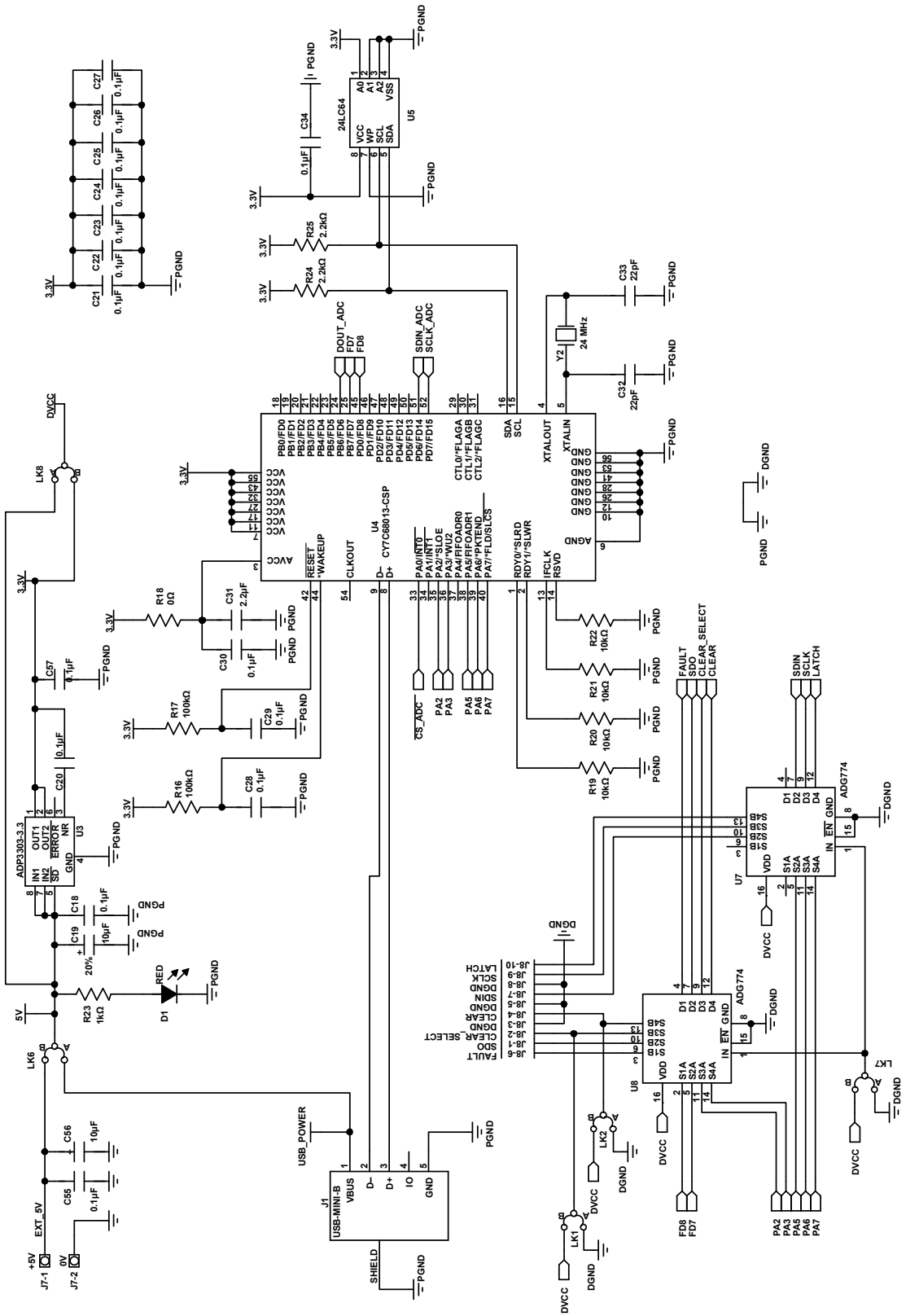


Figure 5. Schematic of the Controller Circuitry

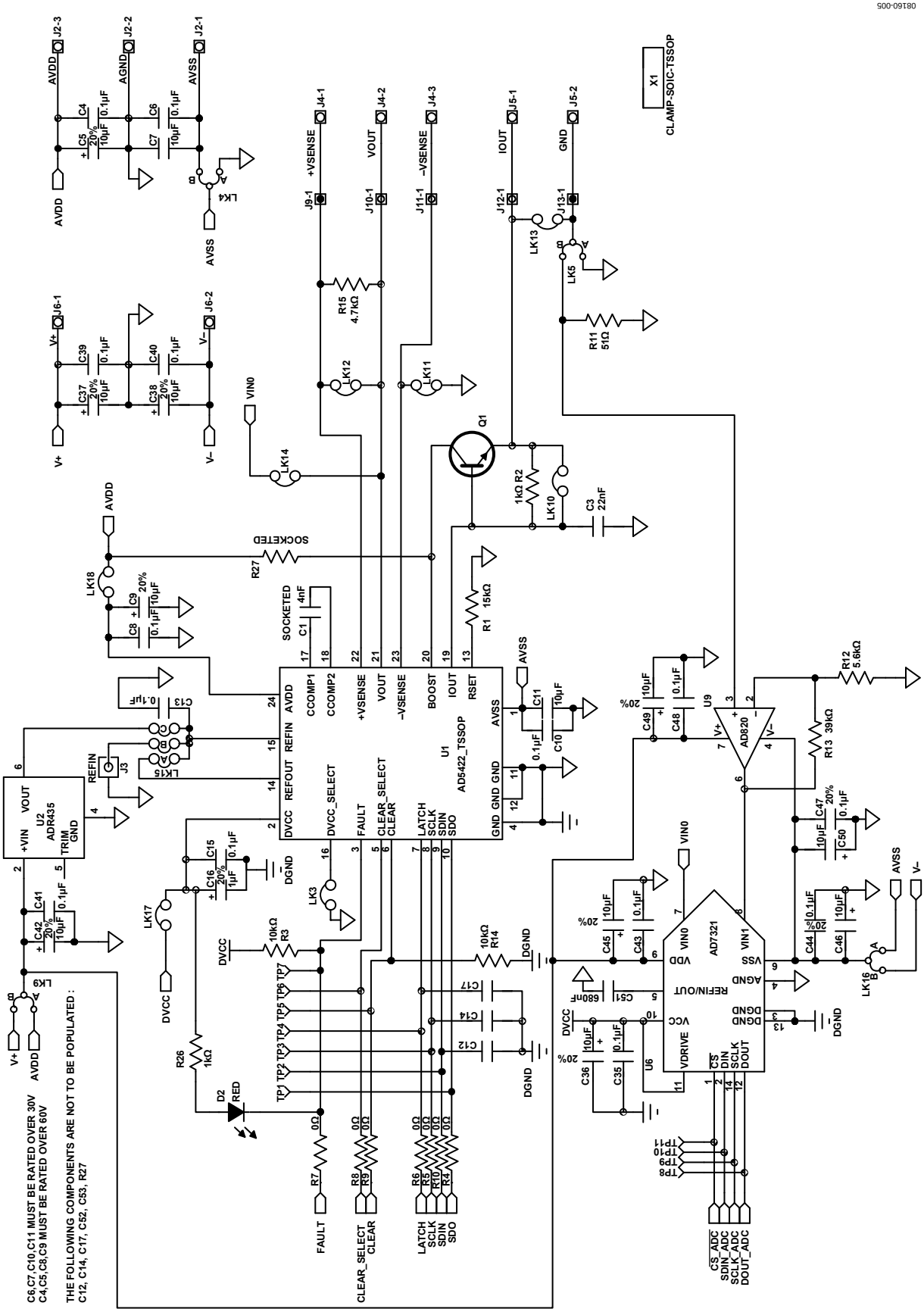


Figure 6. Schematic of the AD5420 Circuitry

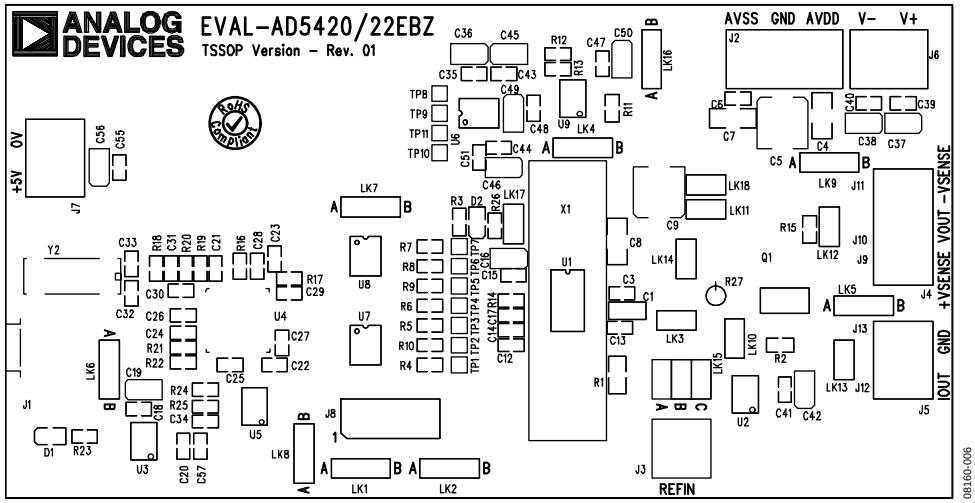


Figure 7. Component Placement

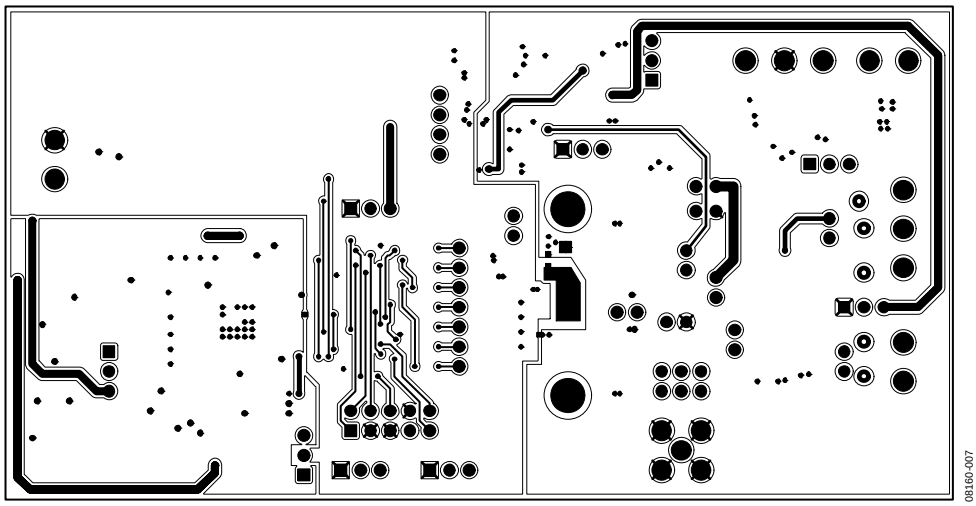


Figure 8. Solder Side PCB

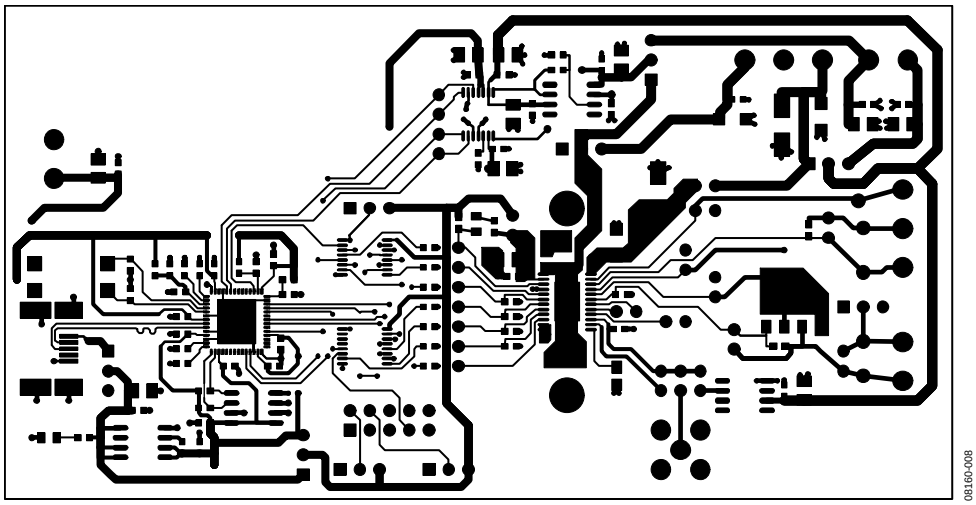


Figure 9. Component Side PCB

ORDERING INFORMATION

BILL OF MATERIALS

Table 5.

Qty	Reference Designator	Description	Supplier/Number
1	U1	16-bit current source DAC	Analog Devices/AD5420AREZ
1	U2	5 V voltage reference	Analog Devices/ADR435ARZ
1	U3	3.3 V low dropout voltage regulator	Analog Devices/ADP3303ARZ-3.3
1	U4	USB microcontroller	Cypress Semiconductor Corporation/CY7C68013-56LFC
1	U5	64 K EEPROM	Digi-Key/24LC64-I/SN-ND
1	U6	12-bit ADC	Analog Devices/AD7321BRUZ
1	U7, U8	Quad 2:1 multiplexers	Analog Devices/ADG774BRQZ
1	U9	Low power, precision operational amplifier	AD820ARZ
1	C51	680 nF, 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 and FEC 150-411
7	LK1, LK2, LK5, LK6, LK7, LK8, LK9	3-pin (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 1658869
7	C19, C36, C37, C42, C45, C49, C56	10 µF, 10 V SMD tantalum capacitors	FEC 1135234
1	R1	15 kΩ 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 capacitors	FEC 1216538
2	C4, C8	0.1 µF, 100 V ceramic capacitors	FEC 1288275
4	J2, J5, J6, J7	2-pin terminal blocks (5 mm pitch)	FEC 151789
1	C16	1 µF, 10 V SMD tantalum capacitor	FEC 197099
2	D1, D2	Red SMD LEDs	FEC 5790840
2	C32, C33	22 pF, 50 V, NPO ceramic capacitors	FEC 722005
11	TP1 to TP11	Black test points	FEC 8731128
3	R2, R23, R26	1 kΩ SMD resistors	FEC 9330380
6	R3, R14, R19, R20, R21, R22	10 kΩ SMD resistors	FEC 9330399
2	R16, R17	100 kΩ SMD resistors	FEC 9330402
2	R24, R25	2.2 kΩ SMD resistors	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 capacitors	FEC 9402098
1	Y2	24 MHz plastic SMD crystal	FEC 9509658
2	C5, C9	10 µF, 63 V (FK series) electrolytic capacitors	FEC 9696008
1	J1	USB Mini-B connector (USB-OTG)	FEC 9786490
1	Q1	NPN transistor, PBSS8110Z	FEC 8736677

NOTES

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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