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Evaluating the **AD5390/AD5392**: 16-/8-Channel, 14-Bit Voltage Output DACs with On-Chip Reference

FEATURES

Full featured evaluation board for the [AD5390/AD5392](#)
 On-board reference
 Various link options
 PC control in conjunction with Analog Devices, Inc., system demonstration platform ([SDP](#)), [EVAL-SDP-CB1Z](#)

EVALUATION KIT CONTENTS

[EVAL-AD5390EBZ/EVAL-AD5392EBZ](#) evaluation board
 CD includes

- Self-installing software that allows users to control the board and exercise all functions of the device
- Electronic version of the [EVAL-AD5390EBZ/](#)
[EVAL-AD5392EBZ](#) user guide

ADDITIONAL EQUIPMENT AND SOFTWARE NEEDED

[EVAL-SDP-CB1Z](#) system demonstration platform, includes a USB cable
 PC running Windows XP SP2, Windows Vista, or Windows 7 with USB 2.0 port

ONLINE RESOURCES

Documents Needed

[AD5390/AD5391/AD5392](#) data sheet
[EVAL-AD5390EBZ/EVAL-AD5392EBZ](#) user guide

Required Software

AD539x evaluation software (download from the [EVAL-AD5390EBZ/EVAL-AD5392EBZ](#) product page)

Design and Integration Files

[Schematics, layout files, bill of materials](#)

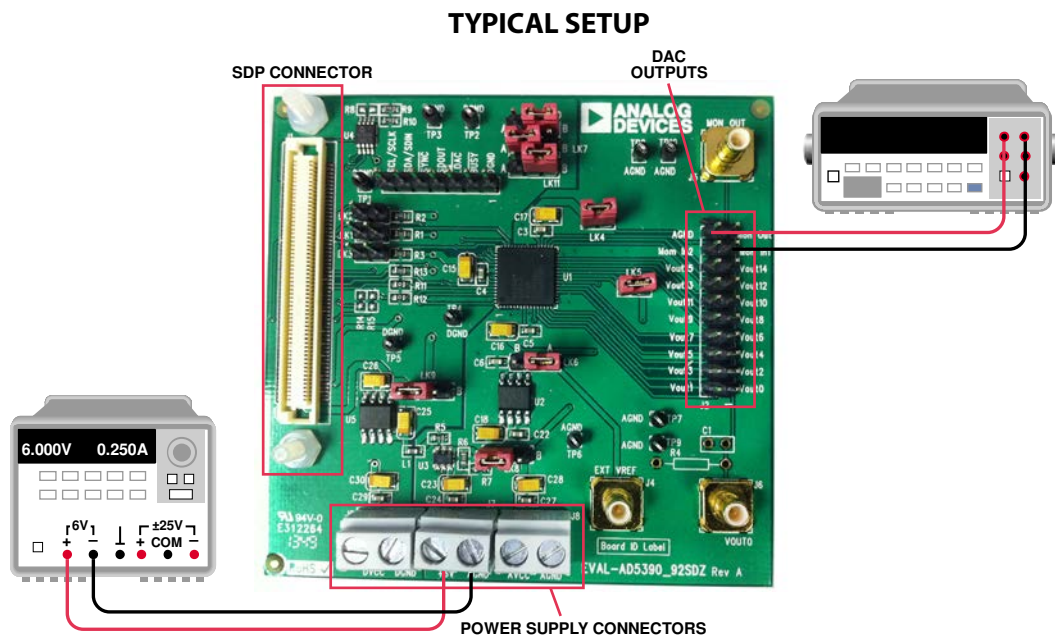


Figure 1.

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REVISION HISTORY

4/14—Revision 0: Initial Version

GENERAL DESCRIPTION

This user guide details the operation of the evaluation board for the [AD5390/AD5392](#) 16-/8-channel, 14-bit voltage output DAC with on-chip reference.

The evaluation board is designed to help customers quickly prototype new [AD5390/AD5392](#) circuits and reduce design time. Each [AD5390/AD5392](#) operates from a single 2.7 V to 5.5 V supply and incorporates an internal 1.25 V/2.5 V reference to attain an output voltage span of 2.5 V or 5 V. An external reference (a 2.5 V reference is provided on the evaluation board) can also be used to attain an output from 0 V to V_{REF} .

Full data on the [AD5390/AD5392](#) can be found in the [AD5390/AD5391/AD5392](#) data sheet, available from Analog

Devices, and should be consulted in conjunction with this user guide when using the evaluation board.

The evaluation board interfaces to the USB port of a PC via the [EVAL-SDP-CB1Z](#) board ([SDP-B](#) controller board), which is available for order on the Analog Devices website at www.analog.com. Software is supplied with the evaluation board to allow the user to program the [AD5390/AD5392](#). Only the SPI interface is supported by the software.

The evaluation board can be used without the [SDP-B](#) controller board. Digital control signals can be applied via Connector J3, and power supplies can be connected to the J8 and J9 connectors.

GETTING STARTED

INSTALLING THE SOFTWARE

The evaluation kit for the [AD5390/AD5392](#) includes self-installing software on a CD. The software is compatible with Windows® XP, Windows Vista (32-bit version), and Windows 7 (32- and 64-bit versions). The software must be installed before connecting the [SDP](#) board to the USB port of the PC to ensure that the [SDP](#) board is recognized when it is connected to the PC.

To install the software, take the following steps:

1. Start the Windows operating system and insert the CD.
2. The installation software should open automatically. If it does not open automatically, run the **setup.exe** file from the CD.

3. After installation is completed, power up the evaluation board as described in the Power Supplies section.
4. Connect the evaluation board to the [SDP](#) board and connect the [SDP](#) board into the PC using the USB cable included in the box.
5. When the software detects the evaluation board, proceed through any dialog boxes that appear to finalize the installation.

EVALUATION BOARD SETUP PROCEDURES

1. Connect the evaluation board to the [SDP](#) board, and connect the USB cable between the [SDP](#) board and the PC.
2. Power the [SDP](#) and evaluation boards by connecting 6 V to the J3 connector.

EVALUATION BOARD HARDWARE

POWER SUPPLIES

To use the evaluation board with the SDP board, a 6 V power supply is required. The supply is connected to Connector J7. Two voltage regulators on the evaluation board generate the 5 V analog and digital supplies. These supplies are applied to the AD5390/AD5392 when the LK8 and LK9 links are in Position A. The digital supply is also used to power the SDP board.

The evaluation board can be used without the SDP board. In this case, Connector J8 is the AV_{CC} power supply input, and Connector J9 is the DV_{CC} power supply input. The LK8 and LK9 links should be in Position B.

AGND and DGND inputs are provided on the board. The AGND and DGND planes are connected at one location close to the AD5390/AD5392. It is recommended that AGND and DGND not be connected elsewhere in the system to avoid ground loop problems.

All supplies are decoupled to ground using 10 μF tantalum and 0.1 μF ceramic capacitors.

Table 1. Power Supply Connectors

Connector Number	Voltage
J7	6 V board positive power supply
J8	Analog power supply, AV _{CC}
J9	Digital power supply, DV _{DD}

INPUT SIGNALS

When the SDP board is used to control the AD5390/AD5392 evaluation board, the digital input signals are applied to Connector J1. When the SDP board is not being used, the digital signal should be applied to the 7-way header, J4.

OUTPUT SIGNALS

The DAC output voltages are available on the 20-way header, J2. VOUT 0 is also available on J6. MON_OUT is available on J5.

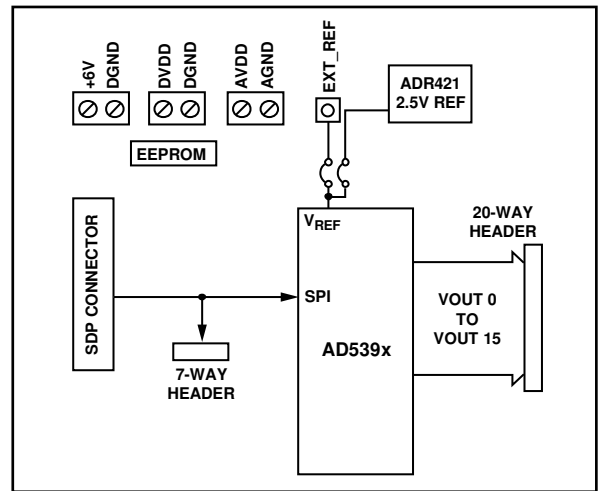


Figure 2. Evaluation Board Block Diagram

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LINK CONFIGURATION OPTIONS

There are multiple jumper (LKx) options that must be set correctly to select the appropriate operating setup before you begin using the evaluation board. The functions of these options are outlined in Table 2.

SETUP CONDITIONS

Care should be taken before applying power and signals to the evaluation board to ensure that all link positions are as required by the operating mode. There are two modes in which to

operate the evaluation board. The evaluation board can be operated in [SDP](#) controlled mode to be used with the [SDP](#) board, or the evaluation board can be used in standalone mode.

The Default Position column of Table 2 shows the default positions in which the links are set when the evaluation board is packaged. When the board is shipped, the evaluation board is set up to operate with the [SDP](#) board ([SDP](#) controlled mode).

Table 2. Link Functions

Link No.	Function	Default Position
LK1 to LK3	These links select the logic level for $\overline{\text{RESET}}$, $\overline{\text{CLR}}$, and $\overline{\text{LDAC}}$, respectively. When a link is inserted, the relevant pin is connected to DGND. When the link is removed, the relevant pin is pulled to DV _{CC} . Remove these links when using the SDP controller board.	Removed
LK4	This link selects the input source for the MON_IN 1 pin. When the link is inserted, AV _{CC} is the input source. When the link is removed, any voltage connected to Pin 17 of Connector J2 is the input source.	Inserted
LK5	This pin selects the input source for the MON_IN 2 pin. When the link is inserted, the reference voltage, V _{REF} , is the input source. When the link is removed, any voltage connected to Pin 18 of Connector J2 is the input source.	Inserted
LK6	This link selects the source for the REFOUT/REFIN pin. In Position A, an external reference source can be connected to Connector J4. This option should also be used if the AD5390 or AD5392 internal is being used. In Position B, the reference source comes from the ADR421 2.5 V reference.	B
LK7	This link selects the SPI or I ² C interface mode of the AD5390/AD5392 . Position A selects the SPI interface mode. Select this option when the evaluation board is used with the SDP controller board. Position B selects the I ² C interface mode.	A
LK8	This link selects the source of the AV _{CC} supply. Position A selects a 5 V supply from the ADP3331 (U3). Position B selects the external power supply connected to J8.	A
LK9	This link selects the source of the DV _{CC} supply. Position A selects a 5 V supply from the ADP3367 (U5). Position B selects the external power supply connected to J9.	A
LK10	This link sets the logic level of the DCEN/AD1 pin and is used in conjunction with LK7. When LK7 is in Position A, LK10 enables (Position A) or Disables (Position B) daisy-chain mode. Select Position B when using the SDP board. When LK7 is in Position B, LK10 sets the logic level for the A1 I ² C address bit.	B
LK11	This link sets the logic level of the PD pin. Position A puts the AD5390/AD5392 into power-down mode. Position B puts the AD5390/AD5392 into normal operating mode.	B

EVALUATION BOARD CIRCUITRY

This evaluation board allows the function and performance of the [AD5390/AD5392](#) to be easily tested. The evaluation board contains two voltage regulators that generate the analog and digital power supplies and that also power the SDP board if it is connected. The two regulators are powered via a 6 V supply attached to Connector J7. Alternatively, separate analog and digital supplies can be attached via Connectors J8 and J9, respectively.

Control of the [AD5390/AD5392](#) is typically performed by the SDP board, which is attached to Connector J1. The SDP board

allows the software provided with the kit to be used to load register values, set the voltage of the DAC outputs, and write to the control register of the [AD5390/AD5392](#). When the SDP board is not required, the control signals can be applied to the [AD5390/AD5392](#) by connecting them to the relevant pins on Connector J3.

In addition to the on-chip reference of the [AD5390/AD5392](#), an external 2.5 V reference is also provided and can be connected to the REFOUT/REFIN pin of the [AD5390/AD5392](#) using Link LK6.

The DAC output voltages are available on the 20-way header, J2.

HOW TO USE THE SOFTWARE

STARTING THE SOFTWARE

To run the program, do the following:

3. Connect the evaluation board to the [SDP](#) board, and connect the USB cable between the [SDP](#) board and the PC.
4. Power the [SDP](#) and evaluation boards by connecting 6 V to the J3 connector.
5. Click **Start > All Programs > Analog Devices > AD539x > AD539x Evaluation Software**. When the software connects to the evaluation board, the message shown in Figure 3 displays.

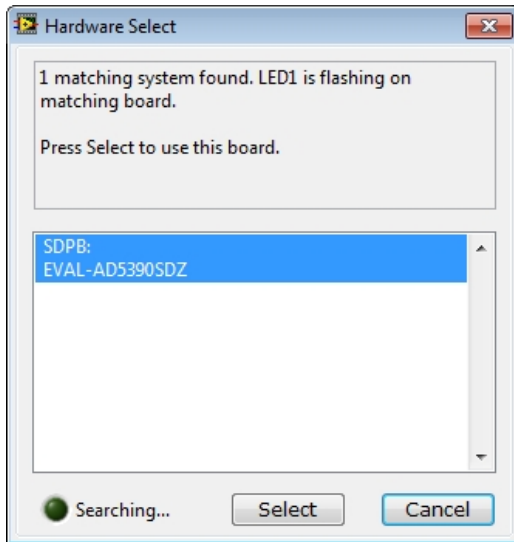


Figure 3. Connection Message

If the [SDP](#) board is not connected to the USB port when the software is launched, a connectivity error displays (see Figure 4) and the software continues to operate in

simulation mode. In simulation mode, the user can exercise all the functionality of the [AD5390/AD5392](#). Expected output voltages are displayed based on the input data, and the 24 bits of data that would have been sent to the [AD5390/AD5392](#) are displayed at the bottom right of the screen.

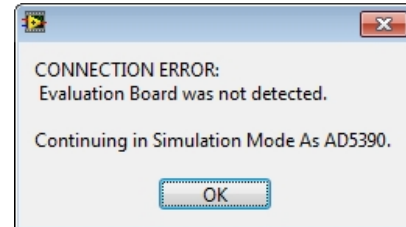


Figure 4. Connectivity Error

OVERVIEW OF THE MAIN WINDOW

The main window of the [AD5390/AD5392](#) evaluation software is shown in Figure 5. The **DAC Registers** tab allows the X, M, and C registers of individual DACs to be programmed. LDAC is high by default. Click **Pulse LDAC** to update the outputs. The software displays the expected output voltages based on the register contents and the voltage reference value.

The **Control & Special Function Registers** tab is shown in Figure 6. This tab allows the user to select the functions contained in the control register of the [AD5390/AD5392](#). It also allows control of the LDAC and CLR pins.

The user can reset the [AD5390/AD5392](#) by selecting a **Hardware Reset** or **Software Reset** from the **File** menu.

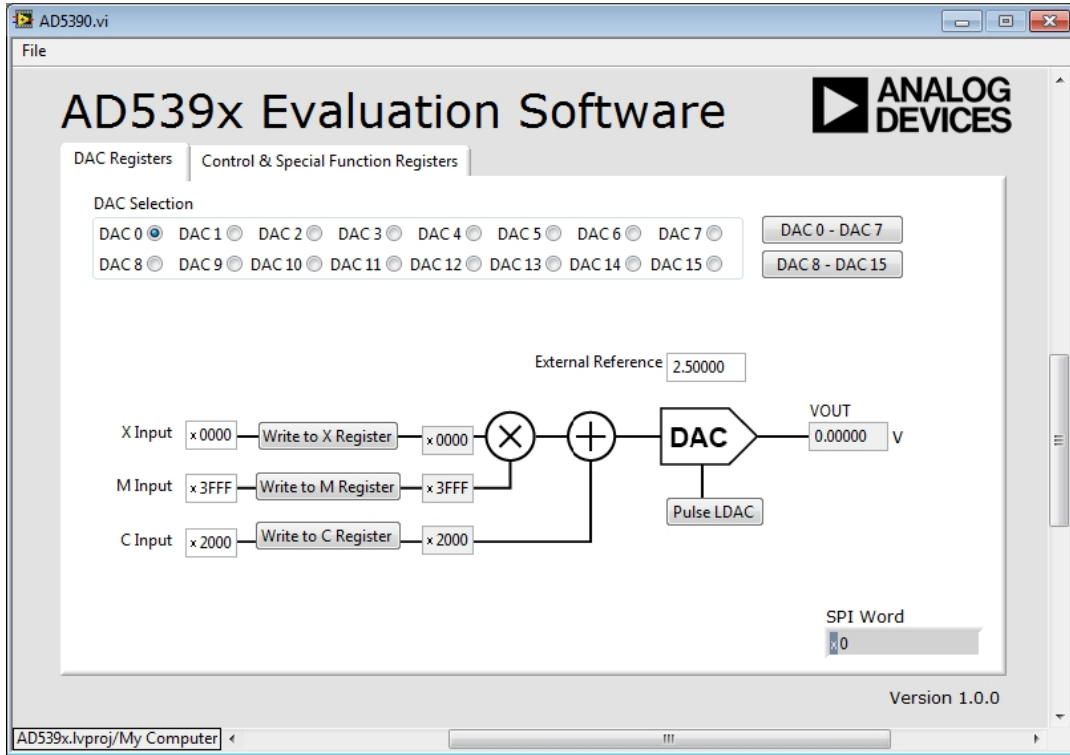


Figure 5. Main Window, DAC Registers Tab

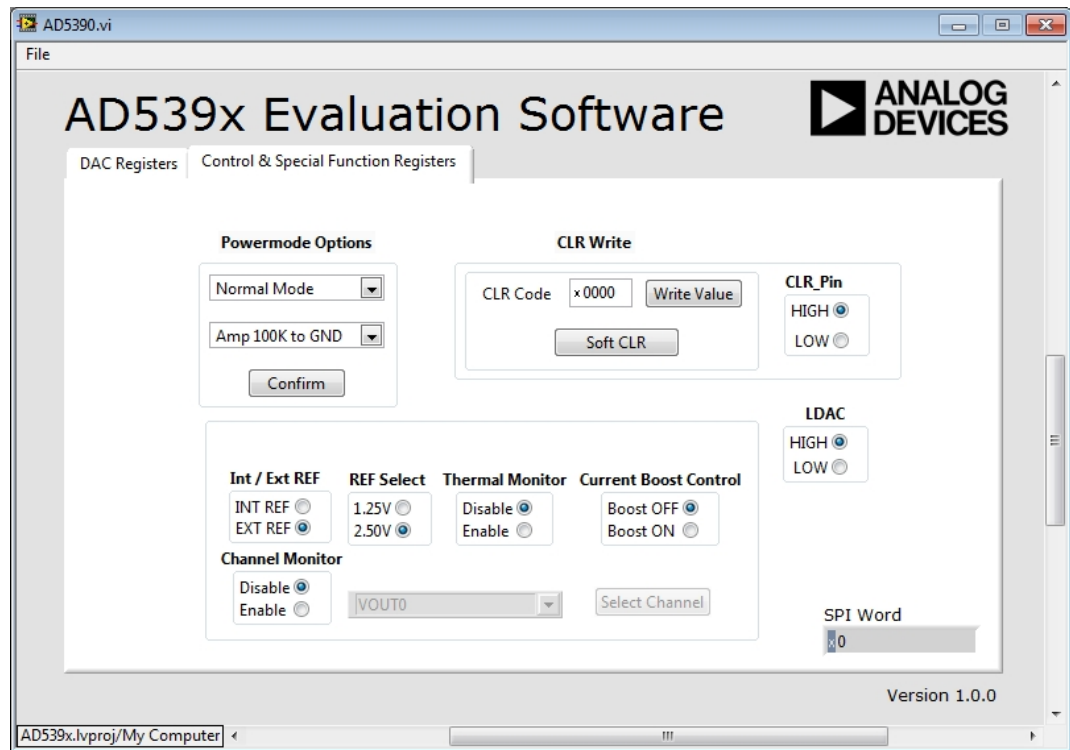


Figure 6. Main Window, Control & Special Function Registers Tab

EVALUATION BOARD SCHEMATICS

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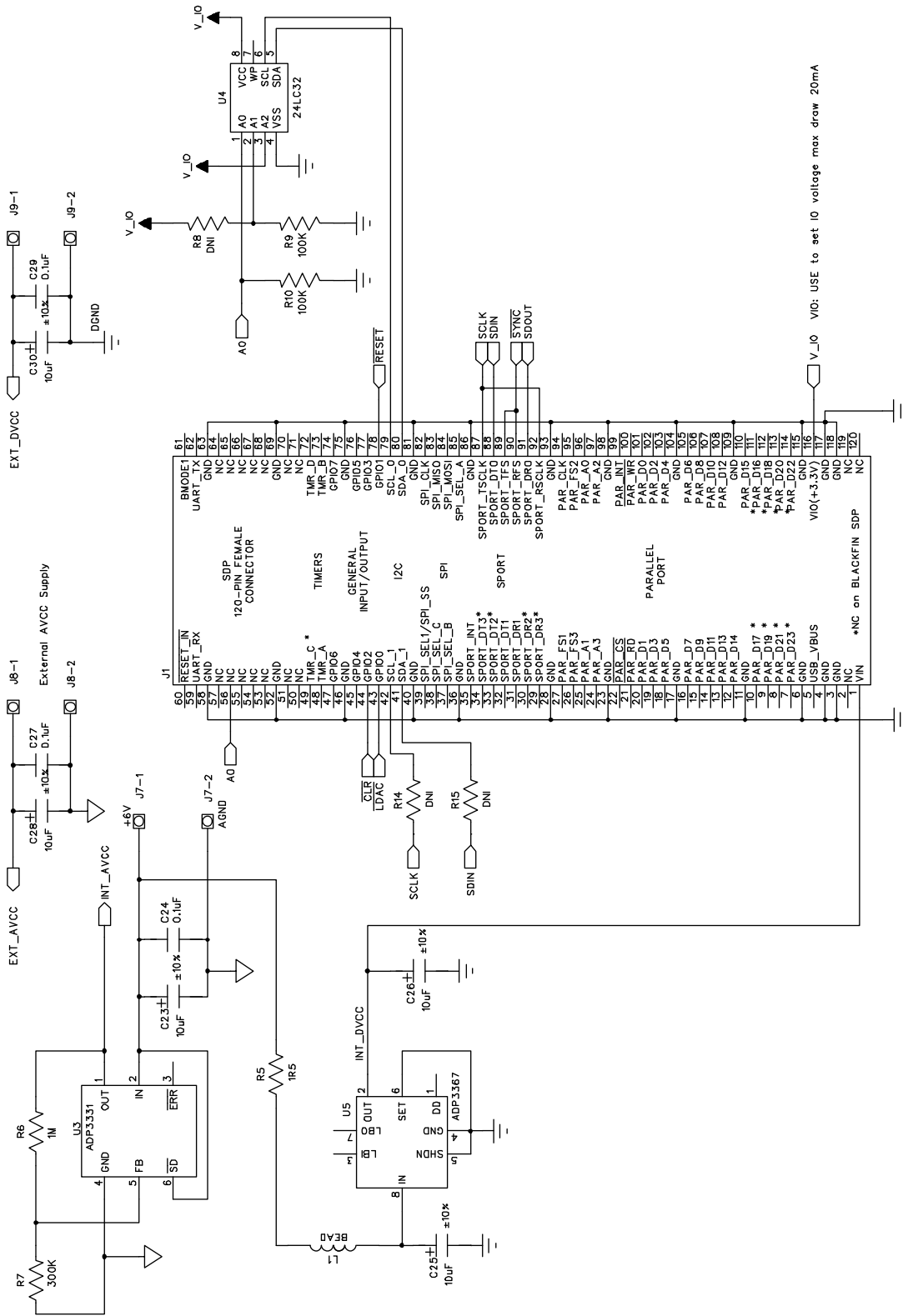
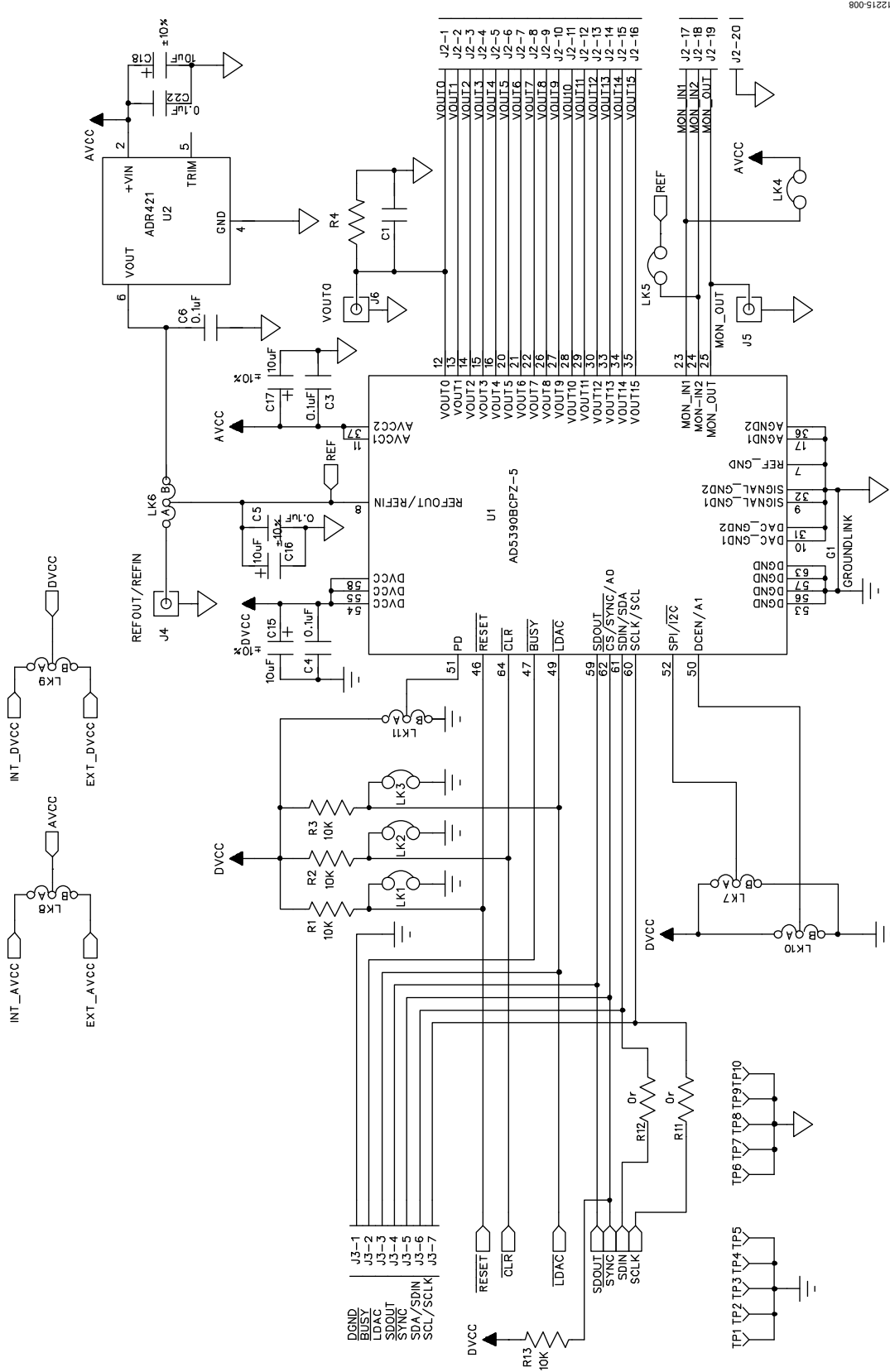


Figure 7. AD5390/AD5392 Schematic (Page 1 of 2)



SPI / I2C Interface

Figure 8. AD5390/AD5392 Schematic (Page 2 of 2)

ORDERING INFORMATION

BILL OF MATERIALS

Table 3. EVAL-AD5390EBZ/EVAL-AD5392EBZ Bill of Materials

Qty	Reference Designator	Description	Supplier/Part Number ¹
1	C1	Noninserted through-hole capacitor location	Do not insert
8	C3 to C6, C22, C24, C27, C29	Capacitor, 100 nF, 50 V, 0603	FEC 8820023
9	C15 to C18, C23, C25, C26, C28, C30	Capacitor, Case A, 10 μ F, 10 V	FEC 197-130
1	J1	120-way female connector, 0.6 mm pitch	FEC 1324660 or Digi-Key H1219-ND
1	J2	20-pin (2 \times 10) header, 0.1" pitch	FEC 1022242
1	J3	7-pin (1 \times 7) header, 0.1" pitch	FEC 1022257
3	J4 to J6	50 Ω straight SMB jack	FEC 1111349
3	J7 to J9	2-pin terminal block (5 mm pitch)	FEC 151789
1	L1	Ferrite bead	Digi-Key 490-1024-1-ND
5	LK1 to LK5	2-pin SIL header, 0.1" pitch, red jumper	FEC 1022247 and FEC 150-411
6	LK6 to LK11	3-pin SIL header, 0.1" pitch, red jumper	FEC 1022248 and FEC 150411
4	R1 to R3, R13	SMD resistor 0603	FEC 933-0399
1	R4	Noninserted through-hole resistor location	Do not insert
1	R5	Resistor, 1.5 Ω , 5%, 0.063 W, 0603	FEC 9331832
1	R6	Resistor, 1 M Ω , 1%, 0.063 W, 0603	Digi-Key RMCF1/161MFRCT-ND
1	R7	SMD resistor 0603	Digi-Key 541-300KHCT-ND
3	R8, R14, R15	SMD resistor 0603	Do not insert
2	R9, R10	SMD resistor	FEC 9330402
2	R11, R12	SMD resistor 0603	FEC 933-1662
10	TP1 to TP10	Black test point	FEC 8731128
1	U1	8-/16-channel 14-bit voltage output DAC	AD5392BCPZ-5 or AD5390BCPZ-5
1	U2	2.5 V reference	ADR421ARZ
1	U3	Adjustable LDO regulator	ADP3331ARTZ
1	U4	32k I ² C serial EEPROM	FEC 1331330
1	U5	5 V fixed, adjustable voltage regulator	ADP3367ARZ
2	Screw1, Screw2	Screw, cheese, nylon, M3X10, PK100	FEC 7070597
2	Nut1, Nut2	Nut/washer, nylon, M3, PK100	FEC 7061857

¹ FEC is Farnell Electronics Components.

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**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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