

Evaluating the ADL6331, 0.38 GHz to 15 GHz TxVGA**FEATURES**

- ▶ Full featured evaluation boards for the ADL6331-EVALZA and the ADL6331-EVALZB
- ▶ Single-supply operation
- ▶ Easy to use interface with [Analysis | Control | Evaluation \(ACE\)](#) software

EQUIPMENT NEEDED

- ▶ 3.3 V DC power supply
- ▶ [EVAL-SDP-CS1Z \(SDP-S\)](#)
- ▶ Signal generator
- ▶ Spectrum analyzer
- ▶ Network analyzer (optional)
- ▶ Microsoft Windows PC with a USB port

DOCUMENTS NEEDED

- ▶ [ADL6331](#) data sheet

SOFTWARE NEEDED

- ▶ ACE software
- ▶ ACE ADL6331 plugin software

GENERAL DESCRIPTION

The ADL6331-EVALZA and ADL6331-EVALZB evaluation boards allow the manual control of the ADL6331 through the USB port on a Microsoft® Windows® PC via an SDP-S interface board.

Additional information on the ADL6331 is provided in the ADL6331 data sheet. Consult the data sheet in conjunction with this user guide when using the ADL6331-EVALZA and ADL6331-EVALZB evaluation boards.

TABLE OF CONTENTS

Features.....	1	Installing the ACE Software and ADL6331	
Equipment Needed.....	1	Plugins.....	5
Documents Needed.....	1	Single-Tone Demonstration with ACE.....	5
Software Needed.....	1	Losses and Signal-to-Noise Ratio (SNR)	
General Description.....	1	Degradation.....	7
Evaluation Board Connection Diagram.....	3	Evaluation Board Schematics and Artwork.....	8
Evaluation Board Hardware.....	4	Bill of Materials.....	16
Hardware Setup.....	4		
Evaluation Board Software Quick Start			
Procedures.....	5		

REVISION HISTORY

8/2024—Rev. A to Rev. B	
Change to User Guide Title.....	1
Changes to Figure 2.....	3
Changes to Single-Tone Demonstration with ACE Section.....	5
Changes to Table 4.....	7
Change to Table 6.....	16
5/2024—Rev. 0 to Rev. A	
Added ADL6331-EVALZB (Universal).....	1
Moved Figure 1.....	3
Added Figure 2; Renumbered Sequentially.....	3
Changes to Hardware Setup Section and Table 1.....	4
Added Figure 4 and Figure 6.....	4
Changes to Single-Tone Demonstration with ACE Section.....	5
Changes to Figure 8 and Figure 9.....	6
Changes to Losses and Signal-to-Noise Ratio (SNR) Degradation Section.....	7
Added Figure 11.....	7
Added Table 4; Renumbered Sequentially.....	7
Added Figure 17 to Figure 21.....	12
Added Table 6.....	16
2/2024—Revision 0: Initial Version	

EVALUATION BOARD CONNECTION DIAGRAM

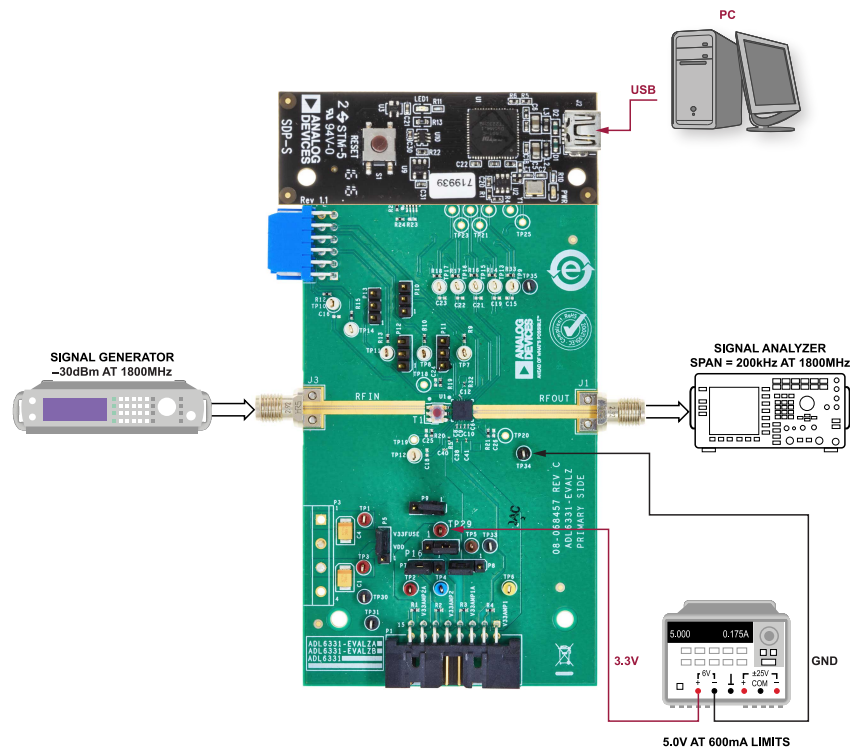


Figure 1. ADL6331-EVALZA Typical Measurement Setup (Option 1)

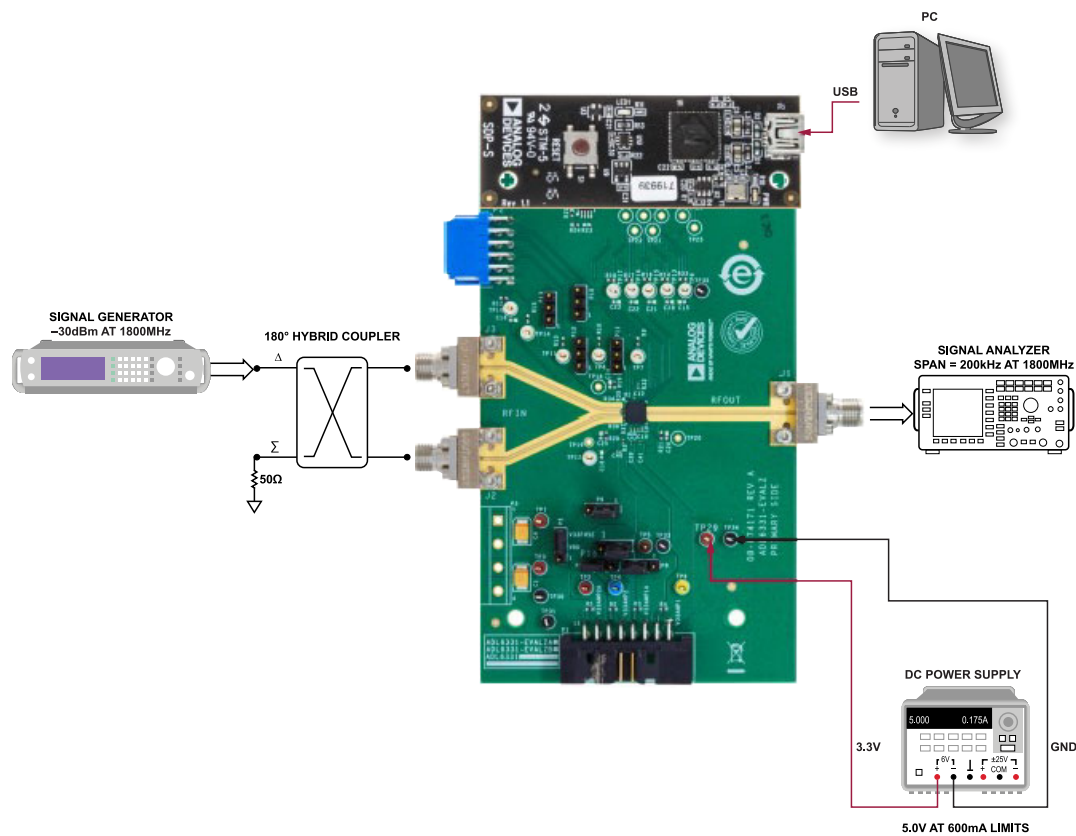


Figure 2. ADL6331-EVALZB Typical Measurement Setup (Option 1)

EVALUATION BOARD HARDWARE

HARDWARE SETUP

The hardware is connected as shown in [Figure 3](#) and [Figure 4](#). To power up the ADL6331-EVALZA and the ADL6331-EVALZB, use a 5 V at 600 mA DC power supply. Connect the [SDP-S](#) to the PC through a USB cable.

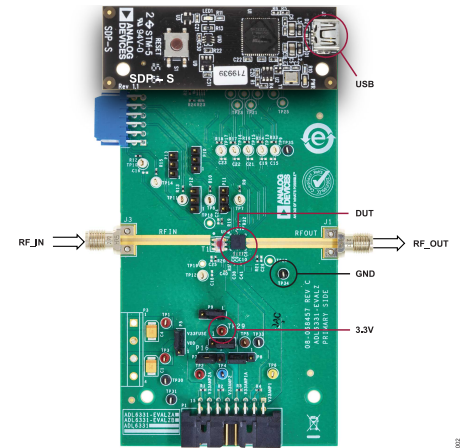


Figure 3. ADL6331-EVALZA and SDP-S Connections

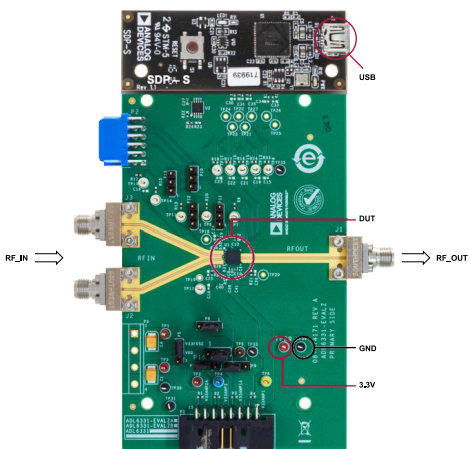


Figure 4. ADL6331-EVALZB and SDP-S Connections

See [Table 1](#) to connect the equipment needed to evaluate the ADL6331-EVALZA and the ADL6331-EVALZB.

Table 1. ADL6331-EVALZA and ADL6331-EVALZB Equipment Connections	
Equipment	Connection
Power Supply	TP29 (3.3 V) TP34 (GND)
Signal Source	RF_IN
Network Analyzer	Connect to one port or two ports on the network analyzer (see Figure 5 and Figure 6)
Signal Generator	Set the source to -20 dBm output signal level (see Figure 1 and Figure 2)
SDP-S	P4
Signal Analyzer	RF_OUT
Spectrum Analyzer	Connect to port (see Figure 1 and Figure 2)

Table 2. SDP-S Connections	
Equipment	Connection
PC USB Cable	J2

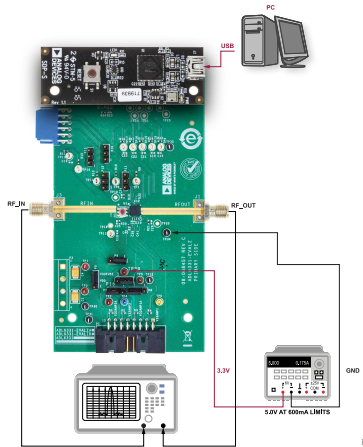


Figure 5. ADL6331-EVALZA Measurement Setup with Network Analyzer (Option 2)

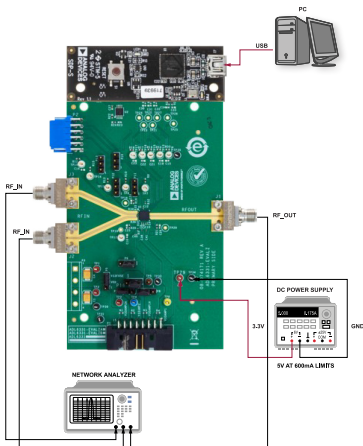


Figure 6. ADL6331-EVALZB Measurement Setup with Network Analyzer (Option 2)

EVALUATION BOARD SOFTWARE QUICK START PROCEDURES

INSTALLING THE ACE SOFTWARE AND ADL6331 PLUGINS

The ADL6331-EVALZA and the ADL6331-EVALZB connect to the SDP-S controller board for quick evaluation of the ADL6331. The ADL6331-EVALZA and the ADL6331-EVALZB are configured over a USB from a panel within the ACE software, which can be downloaded from the ACE website. When the ACE software installations are complete, the user must install the evaluation board ACE plugins that are provided with the evaluation package to the hard drive of the PC.

Double click the **Board.ADL6331.1.2022.xxxxx.acezip** file to install the evaluation board plugins.

Ensure that the **Board.ADL6331.1.2022.xxxxx** and the **Chip.ADL6331.1.2022.xxxxx** folders are located inside the **C:\Program-Data\Analog Devices\ACE\Plugins** folder.

SINGLE-TONE DEMONSTRATION WITH ACE

Use the following settings to configure the ADL6331-EVALZA and the ADL6331-EVALZB. The following is an example to amplify a 2000 MHz sine wave using the ACE software:

1. Configure the hardware according to the [Hardware Setup](#) section and shown in [Figure 1](#) and [Figure 2](#), or [Figure 5](#) and [Figure 6](#).
2. Set the frequency of the signal generator to 2000 MHz and the output level to -20 dBm. Connect the spectrum analyzer to the RF_OUT connector.
3. Launch the ACE application. This action displays the initial ACE **Start** page as shown in [Figure 7](#). The ADL6331 is detected

automatically and displays under **Attached Hardware**. As soon as the ADL6331 is detected by the ACE software, the ACE software automatically sets ENP to high. However, since the AMP1, AMP2, and DSA blocks are all disabled by default, the current consumption is very low. Approximately 3 mA is observed at the 3.3 V supply.

4. Click the **ADL6331 Board** icon shown in [Figure 7](#) to open the evaluation board level view (see [Figure 8](#)). After opening, click **Reset Chip** before starting configurations.
5. Enable each block of AMP1, AMP2, and DSA. Configure the four RF preconfigurations by selecting the AMP1 and AMP2 bypass modes, as well as setting up the DSA attenuation levels. Use default settings for the bias trim with **Use Fused** boxes checked for the ADL6331-EVALZA only. For the ADL6331-EVALZB, to achieve the optimal OIP3 performance, **CROSS_Z** of both **AMP1** and **AMP2** need to be set to 0 (see [Figure 9](#)).
6. Click **Apply Configuration** for the configurations to take effect.
7. If factory programmed values for the bias trim are needed, click **Read Configuration** with the **Use Fused** boxes checked. See the applications information section of the ADL6331 data sheet for more details.
8. Measure the signal levels with a signal analyzer. The gain of the ADL6331 is derived from the following formula:

$$\text{Gain} = \text{Signal Level at SA} - \text{Input Signal Level} + \text{Board Loss (see Table 3 and Table 4)} + \text{Cable Loss} + \text{External Hybrid Coupler Loss (ADL6331-EVALZB only)} \quad (1)$$

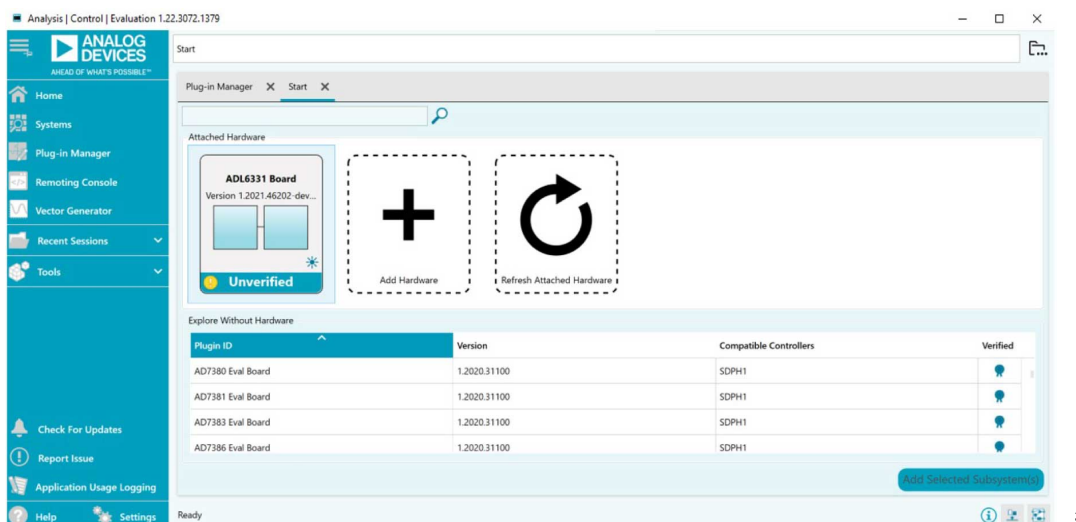


Figure 7. Initial ACE Start Page

EVALUATION BOARD SOFTWARE QUICK START PROCEDURES

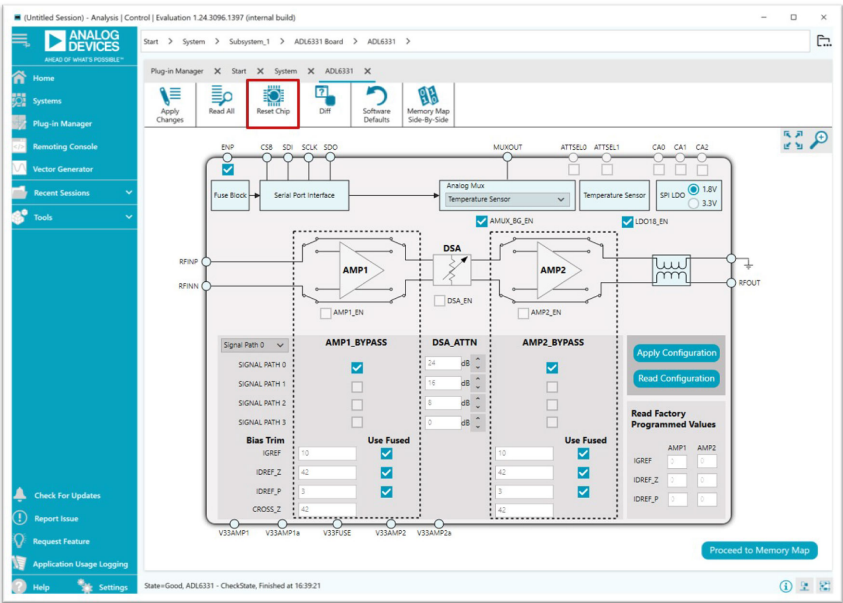


Figure 8. ADL6331-EVALZA and ADL6331-EVALZB Board Level View (After Reset Chip and ENP Set to High)

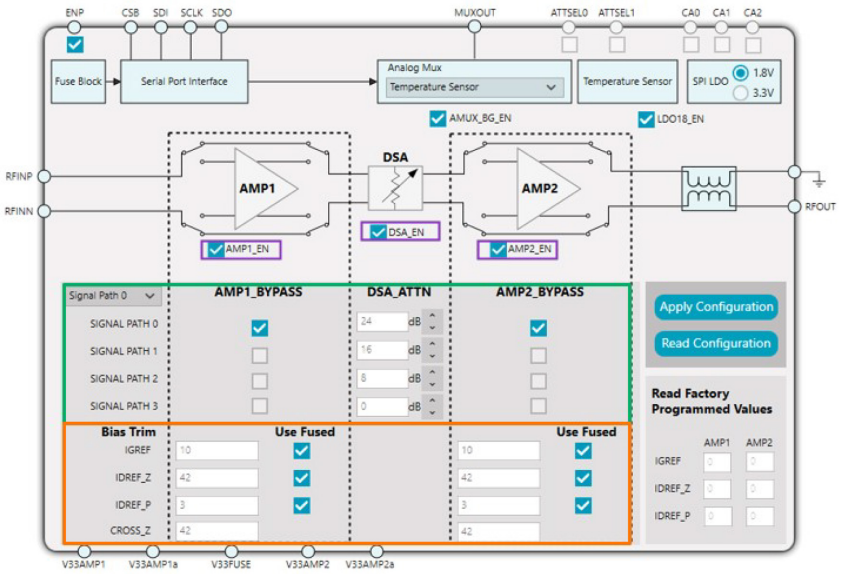


Figure 9. ADL6331 IC Level View (ENP Set to High)

EVALUATION BOARD SOFTWARE QUICK START PROCEDURES

LOSSES AND SIGNAL-TO-NOISE RATIO (SNR) DEGRADATION

The on-board balun MABA-011082 (Macom) is used to transform the single-ended board input to the differential inputs of the ADL6331 for the ADL6331-EVALZA only (see Figure 10). For the ADL6331-EVALZB, the on-board resistive matching network is used to transform the 100 Ω differential board inputs to the 50 Ω differential inputs of the IC (see Figure 11). Consider the board losses to derive the accurate RF performance, conversion gain, noise figure, and output third-order intercept (OIP3) of the device. Table 3 details the board losses including the balun and 2.92 mm connectors on the ADL6331-EVALZA, whereas Table 4 details the differential board losses including the 2.92 mm connectors and resistive matching network on the ADL6331-EVALZB.

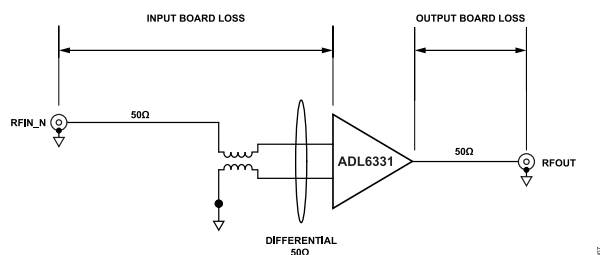


Figure 10. Losses and SNR Degradation for ADL6331-EVALZA

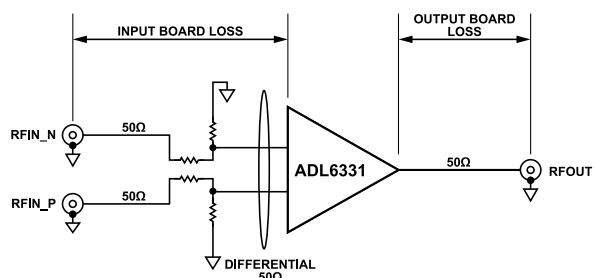


Figure 11. Losses and SNR Degradation for ADL6331-EVALZB

Table 4. Board Loss Table for the ADL6331-EVALZB

Frequency (GHz)	Loss (dB)		
	Input	Output	Total
1	7.89	0.24	8.13
2	8.07	0.42	8.49
3	8.06	0.48	8.54
4	8.11	0.57	8.68
5	8.19	0.65	8.84
6	8.18	0.72	8.90
7	8.21	0.84	9.05
8	8.30	0.97	9.27
9	8.22	1.03	9.25
10	8.26	1.17	9.43
11	8.37	1.30	9.67
12	8.18	1.33	9.51
13	8.27	1.47	9.74
14	8.29	1.55	9.84
15	8.11	1.57	9.68

Table 3. Board Loss Table for the ADL6331-EVALZA

Frequency (MHz)	Loss (dB)		
	Input	Output	Total
400	1.63	0.03	1.66
1000	1.58	0.12	1.70
2000	1.54	0.26	1.80
3000	1.69	0.34	2.03
4000	1.69	0.40	2.09
5000	1.68	0.49	2.17
6000	1.79	0.56	2.35
7000	2.31	0.66	2.97
8000	2.80	0.73	3.53

EVALUATION BOARD SCHEMATICS AND ARTWORK

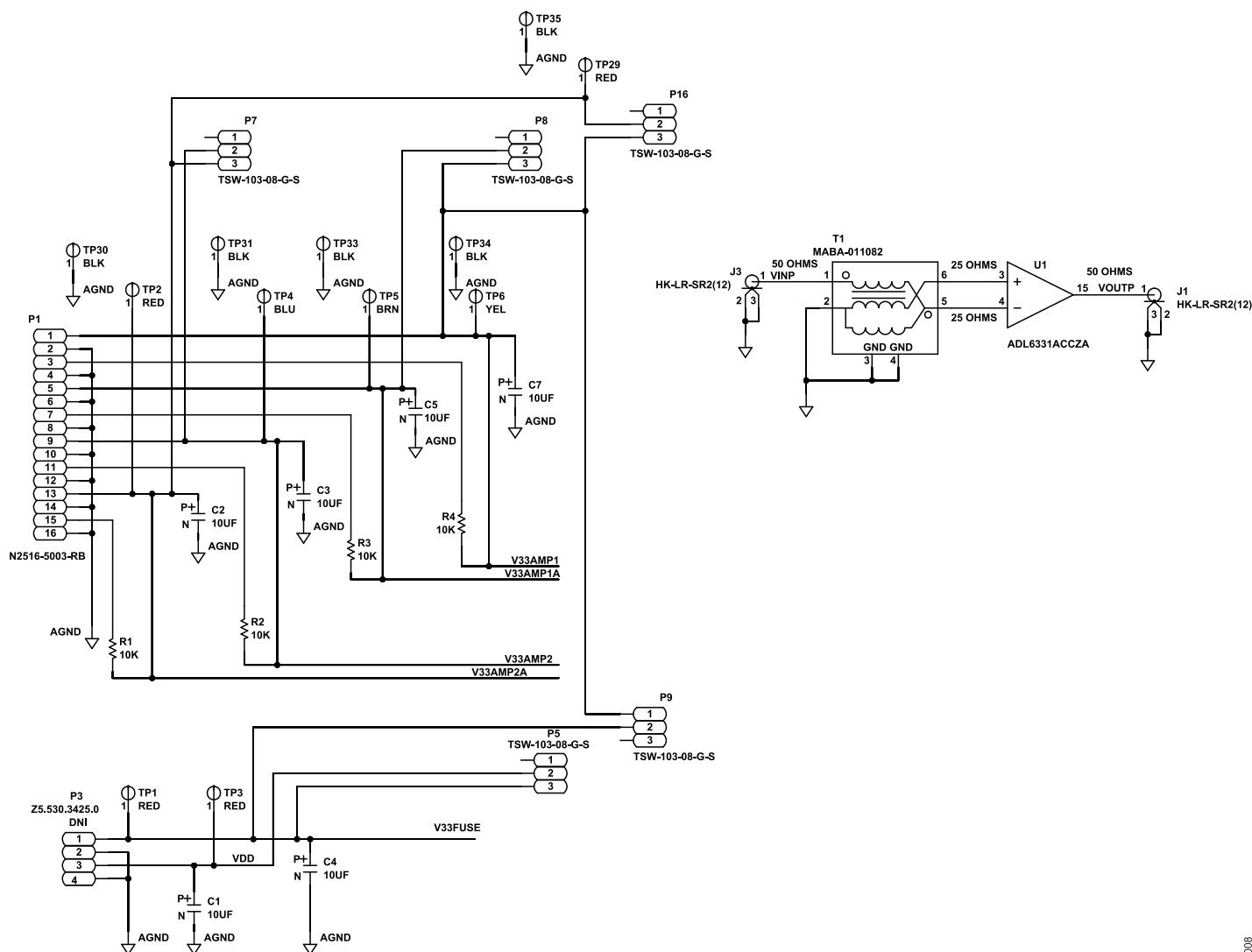


Figure 12. ADL6331-EVALZA Schematic

008

EVALUATION BOARD SCHEMATICS AND ARTWORK

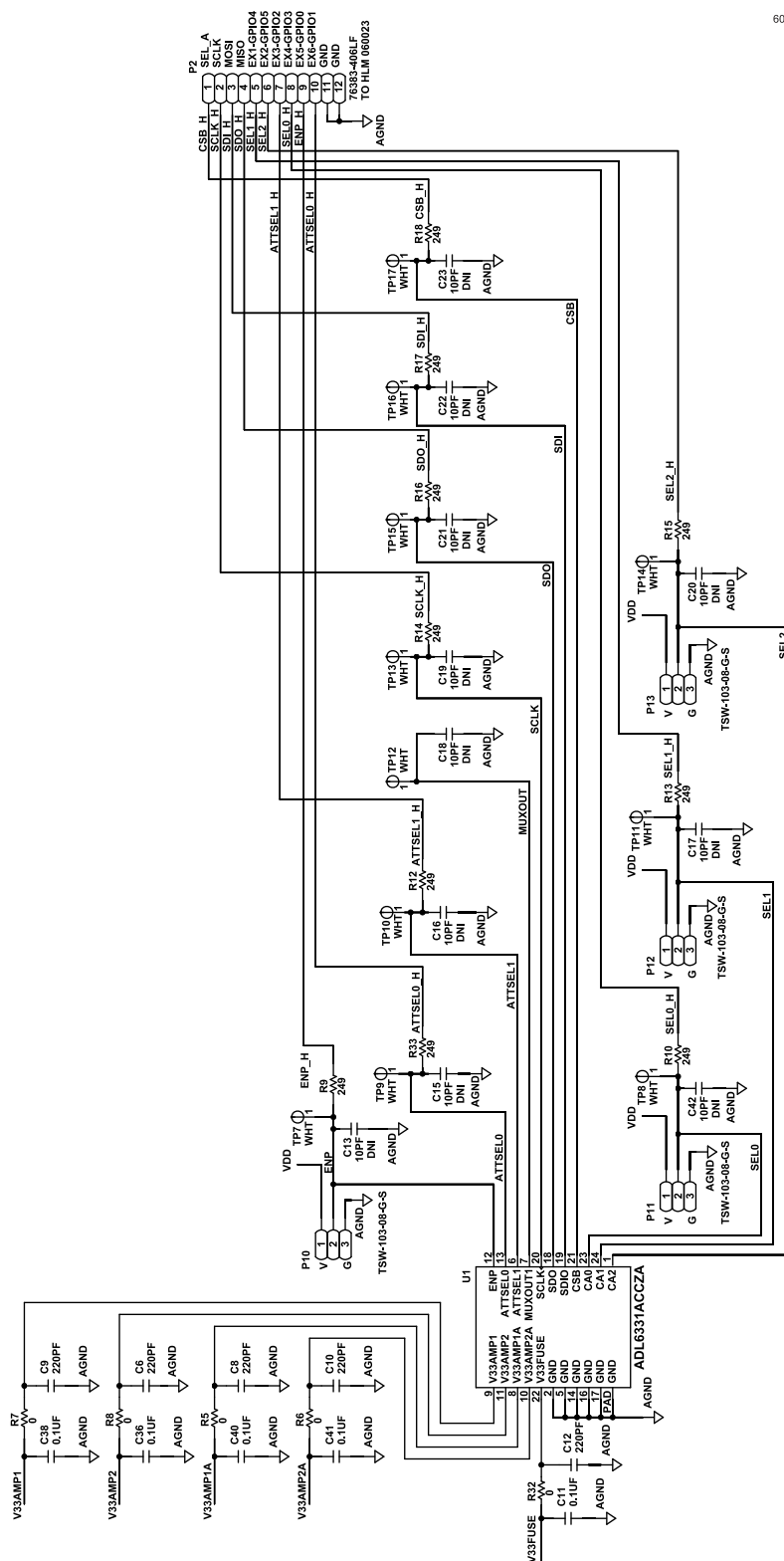


Figure 13. ADL6331-EVALZA Schematic 2

EVALUATION BOARD SCHEMATICS AND ARTWORK

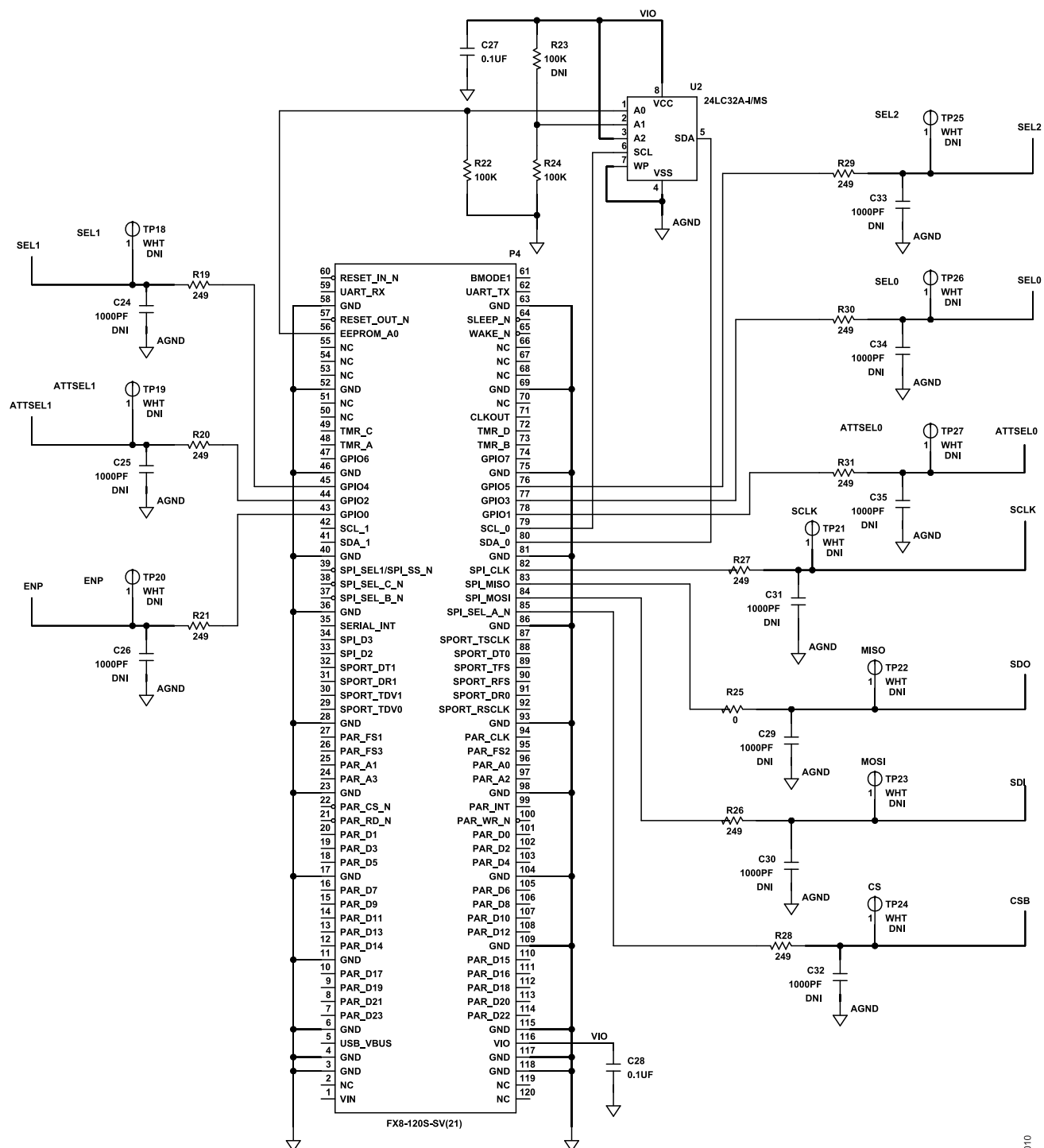


Figure 14. ADL6331-EVALZA Schematic 3

EVALUATION BOARD SCHEMATICS AND ARTWORK

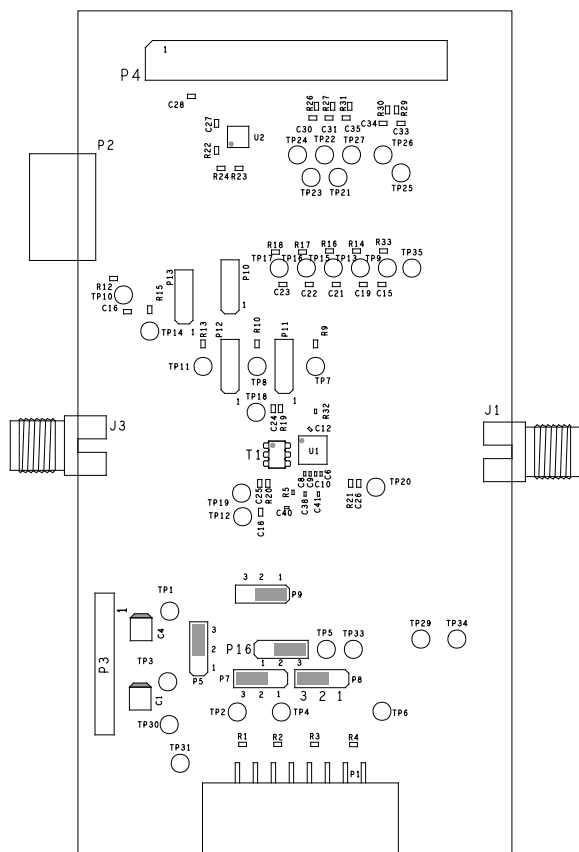


Figure 15. ADL6331-EVALZA Front Side

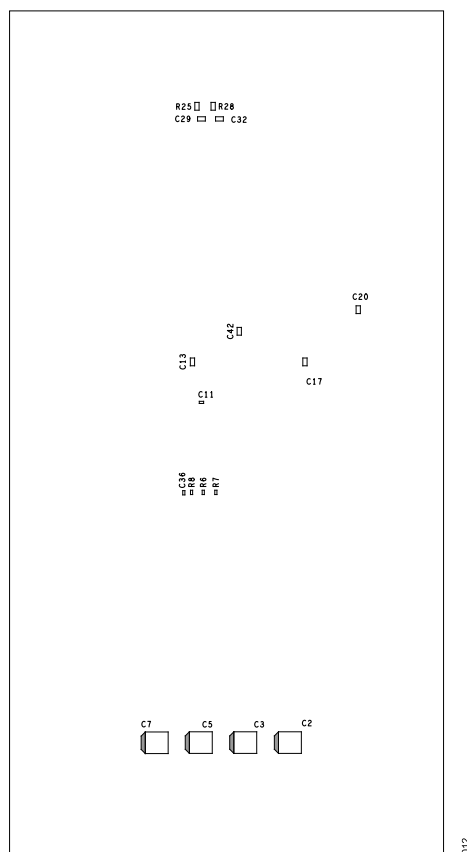


Figure 16. ADL6331-EVALZA Back Side

EVALUATION BOARD SCHEMATICS AND ARTWORK

235

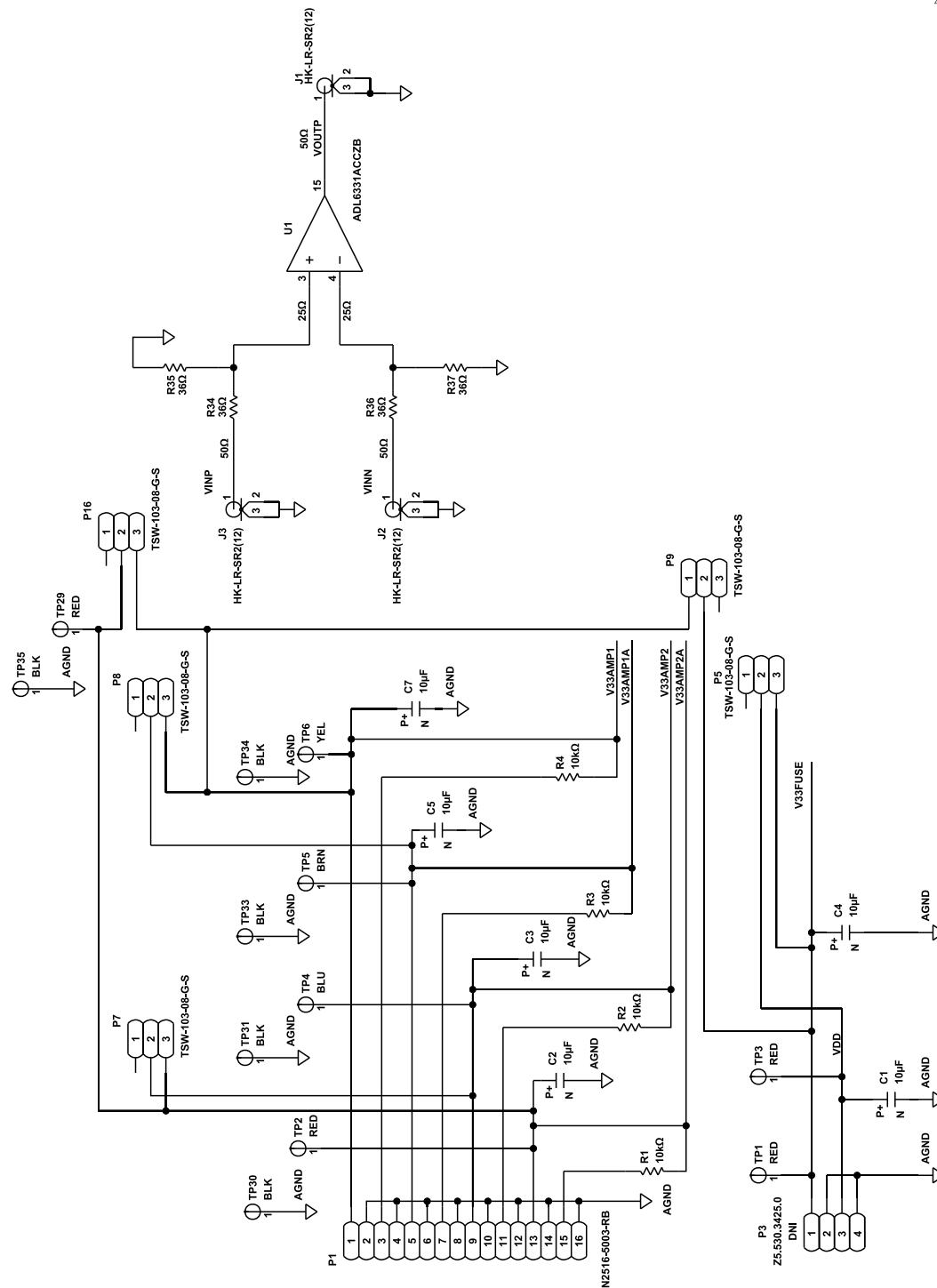


Figure 17. ADL6331-EVALZB Schematic

EVALUATION BOARD SCHEMATICS AND ARTWORK

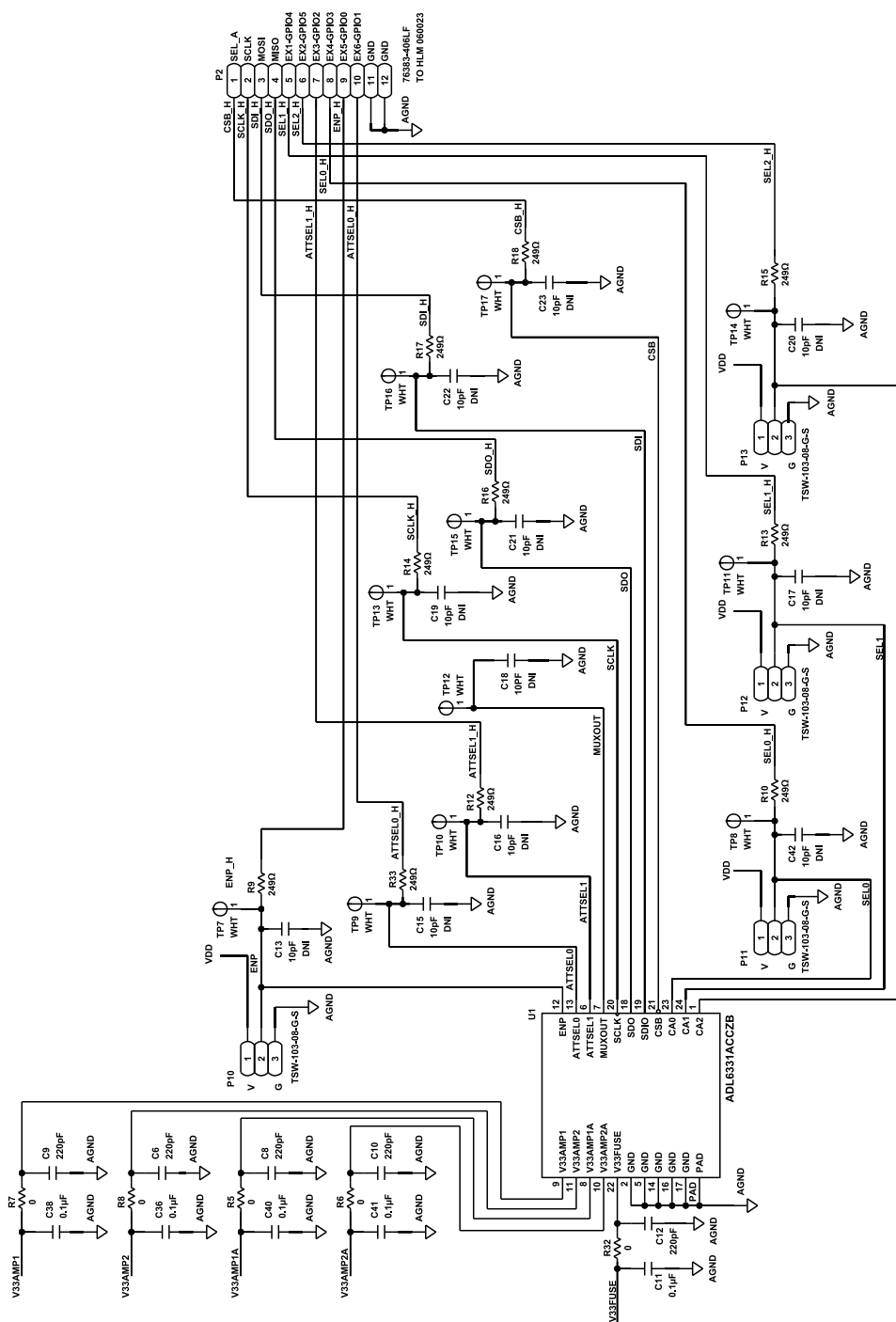


Figure 18. ADL6331-EVALZB Schematic 2

The schematic diagram illustrates the connection of the FX8-120S-SV(21) module to the FX8-120S-SV(21) board. The module's pinout is shown on the left, with pins 1 through 120. The board's components and their connections are detailed on the right.

Power Supply Connections:

- VIO:** Connected to pin 116 (VIO) and pin 117 (GND). A 0.1μF capacitor (C27) is connected to pin 116.
- AGND:** Connected to pins 118 (GND), 119 (GND), and 120 (NC). A 0.1μF capacitor (C28) is connected to pin 118.
- ENP:** Connected to pin 39 (ENP) and pin 40 (GND). A 1000pF capacitor (C26) is connected to pin 39.
- ATTSEL1:** Connected to pin 51 (ATTSEL1) and pin 52 (GND). A 1000pF capacitor (C25) is connected to pin 51.
- SEL1:** Connected to pin 53 (SEL1) and pin 54 (GND). A 1000pF capacitor (C24) is connected to pin 53.

Signal Connections:

- RESET_IN_N:** Connected to pin 60 (RESET_IN_N) and pin 61 (GND). A 100kΩ resistor (R22) is connected to pin 60.
- RESET_OUT_N:** Connected to pin 57 (RESET_OUT_N) and pin 58 (GND). A 100kΩ resistor (R23) is connected to pin 57.
- EEPROM_A0:** Connected to pin 56 (EEPROM_A0) and pin 57 (GND). A 100kΩ resistor (R24) is connected to pin 56.
- CLKOUT:** Connected to pin 71 (CLKOUT) and pin 72 (GND). A 100kΩ resistor (R25) is connected to pin 71.
- SCLK:** Connected to pin 79 (SCLK) and pin 80 (GND). A 1000pF capacitor (C31) is connected to pin 79.
- MISO:** Connected to pin 88 (MISO) and pin 89 (GND). A 1000pF capacitor (C29) is connected to pin 88.
- MOSI:** Connected to pin 97 (MOSI) and pin 98 (GND). A 1000pF capacitor (C30) is connected to pin 97.
- CS:** Connected to pin 104 (CS) and pin 105 (GND). A 1000pF capacitor (C32) is connected to pin 104.
- SCLK:** Connected to pin 79 (SCLK) and pin 80 (GND). A 1000pF capacitor (C31) is connected to pin 79.
- MISO:** Connected to pin 88 (MISO) and pin 89 (GND). A 1000pF capacitor (C29) is connected to pin 88.
- MOSI:** Connected to pin 97 (MOSI) and pin 98 (GND). A 1000pF capacitor (C30) is connected to pin 97.
- CS:** Connected to pin 104 (CS) and pin 105 (GND). A 1000pF capacitor (C32) is connected to pin 104.

Other Connections:

- TP18:** Connected to pin 53 (SEL1) and pin 54 (GND). A 1000pF capacitor (C24) is connected to pin 53.
- TP19:** Connected to pin 51 (ATTSEL1) and pin 52 (GND). A 1000pF capacitor (C25) is connected to pin 51.
- TP20:** Connected to pin 39 (ENP) and pin 40 (GND). A 1000pF capacitor (C26) is connected to pin 39.
- TP21:** Connected to pin 79 (SCLK) and pin 80 (GND). A 1000pF capacitor (C31) is connected to pin 79.
- TP22:** Connected to pin 88 (MISO) and pin 89 (GND). A 1000pF capacitor (C29) is connected to pin 88.
- TP23:** Connected to pin 97 (MOSI) and pin 98 (GND). A 1000pF capacitor (C30) is connected to pin 97.
- TP24:** Connected to pin 104 (CS) and pin 105 (GND). A 1000pF capacitor (C32) is connected to pin 104.

Figure 19. ADL6331-EVALZB Schematic 3

EVALUATION BOARD SCHEMATICS AND ARTWORK

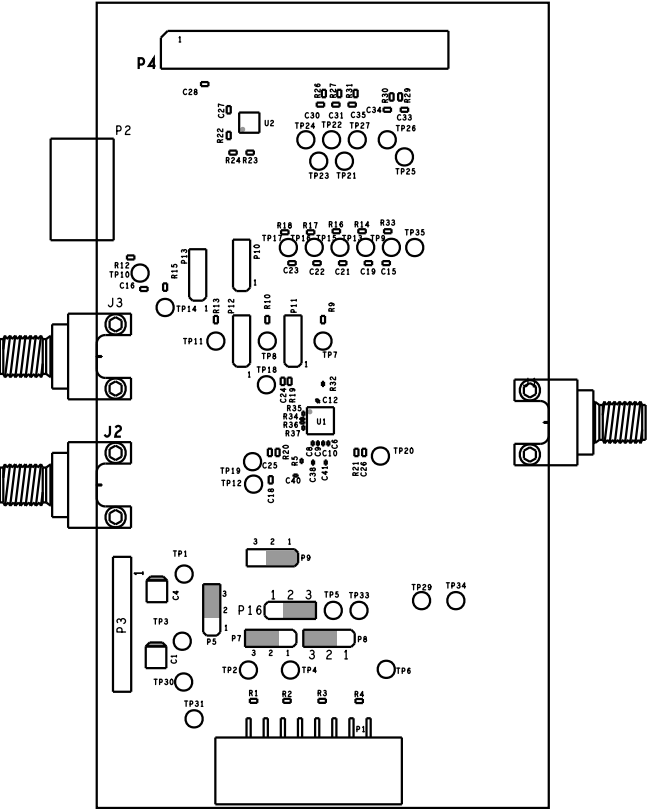


Figure 20. ADL6331-EVALZB Front Side

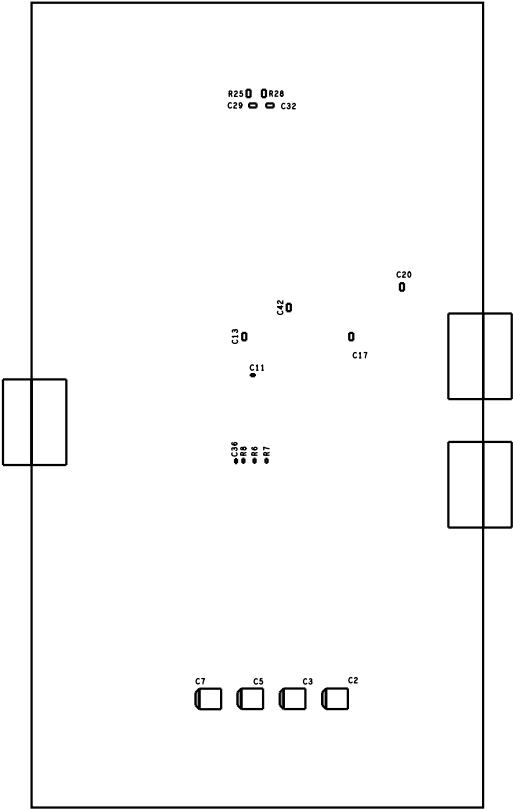


Figure 21. ADL6331-EVALZB Back Side

BILL OF MATERIALS

Table 5. Bill of Materials for ADL6331-EVALZA

Quantity	Reference Designator	Description	Manufacturer	Part Number
6	C1, C2, C3, C4, C5, C7	Capacitors, 10 μ F, 16 V, C3528 package	AVX	TAJB106K016RNJ
5	C6, C8, C9, C10, C12	Capacitors, 220 pF, 50 V, C0201 package	MURATA	GRM0335C1H221JA01D
5	C11, C36, C38, C40, C41	Capacitors, 0.1 μ F, 16 V, C0201 package	MURATA	GRM033Z71C104ME14D
2	C27, C28	Capacitors, 0.1 μ F, 16 V, C0402 package	KEMET	C0402C104J4RACTU
2	J1, J3	Edge mount, 2.92 mm connectors	Hirose Electric CO.	HK-LR-SR2(12)
1	P1	Connector header through hole, right angle 16 position	3M	N2516-5003-RB
9	P5, P7, P8, P9, P10, P11, P12, P13, P16	Connector headers through hole, 3 position	SAMTEC	TSW-103-08-G-S
1	P2	Connector header through hole, right angle 12 position	AMPHENOL FCI	76383-406LF
1	P4	120 position connector receptacle, center strip contacts	Hirose Electric CO.	FX8-120S-SV(21)
4	R1, R2, R3, R4	Resistors, 10 k Ω , 0.1 W, 0402 package	Panasonic	ERJ-2RK1002X
10	R9, R10, R12, R13, R14, R15, R16, R17, R18, R33	Resistors, 249 Ω , 0.063 W, 0402 package	VENKEL	CR0402-16W-2490FT
9	R19, R20, R21, R26, R27, R28, R29, R30, R31	Resistors, 249 Ω , 0.1 W, 0402 package	Panasonic	ERJ-2RK12490X
2	R22, R24	Resistors, 100 k Ω , 0.1 W, 0402 package	Panasonic	ERJ-2RK1003X
1	R25	Resistor, 0 Ω , 0.063 W, 0402 package	SAMSUNG	RC1005J000CS
5	R5, R6, R7, R8, R32	Resistors, 0 Ω , 0.05 W, 0201 package	Panasonic	ERJ-1GN0R00C
1	T1	Transformer balun, 1:1 ratio, 5 to 8000 MHz	MACOM	MABA-011082
18	TP1 to TP17, TP29	PCB test point connectors	KEYSTONE ELECTRONICS	5xxx
5	TP30, TP31, TP33, TP34, TP35	PCB Test Point Connector	COMPONENTS CORPORATION	TP-105-01-00
1	U2	32 K bit, serial electrically erasable programmable read-only memory (EEPROM)	MICROCHIP TECHNOLOGY	24LC32A-I/MS
1	U1	0.38 GHz to 8.0 GHz TxVGA	Analog Devices, Inc.	ADL6331ACCZA
1	PCB	Evaluation board	Analog Devices	ADL6331-EVALZA

Table 6. Bill of Materials for ADL6331-EVALZB

Quantity	Reference Designator	Description	Manufacturer	Part Number
6	C1, C2, C3, C4, C5, C7	Capacitors, 10 μ F, 16 V, C3528 package	AVX	TAJB106K016RNJ
5	C6, C8, C9, C10, C12	Capacitors, 220 pF, 50 V, C0201 package	MURATA	GRM0335C1H221JA01D
5	C11, C36, C38, C40, C41	Capacitors, 0.1 μ F, 16 V, C0201 package	MURATA	GRM033Z71C104ME14D
2	C27, C28	Capacitors, 0.1 μ F, 16 V, C0402 package	KEMET	C0402C104J4RACTU
2	J1, J2, J3	Edge mount, 2.92 mm connectors	Hirose Electric CO.	HK-LR-SR2(12)
1	P1	Connector header through hole, right angle 16 position	3M	N2516-5003-RB
9	P5, P7, P8, P9, P10, P11, P12, P13, P16	Connector headers through hole, 3 position	SAMTEC	TSW-103-08-G-S
1	P2	Connector header through hole, right angle 12 position	AMPHENOL FCI	76383-406LF
1	P4	120 position connector receptacle, center strip contacts	Hirose Electric CO.	FX8-120S-SV(21)
4	R1, R2, R3, R4	Resistors, 10 k Ω , 0.1 W, 0402 package	Panasonic	ERJ-2RK1002X
10	R9, R10, R12, R13, R14, R15, R16, R17, R18, R33	Resistors, 249 Ω , 0.063 W, 0402 package	VENKEL	CR0402-16W-2490FT
9	R19, R20, R21, R26, R27, R28, R29, R30, R31	Resistors, 249 Ω , 0.1 W, 0402 package	Panasonic	ERJ-2RK12490X
2	R22, R24	Resistors, 100 k Ω , 0.1 W, 0402 package	Panasonic	ERJ-2RK1003X
1	R25	Resistor, 0 Ω , 0.063 W, 0402 package	SAMSUNG	RC1005J000CS
5	R5, R6, R7, R8, R32	Resistors, 0 Ω , 0.05 W, 0201 package	Panasonic	ERJ-1GN0R00C
4	R34, R35, R36, R37	Resistors, 36 Ω , 0.05 W, 0201 package	Panasonic	ERJ-1GNF36R0C

BILL OF MATERIALS

Table 6. Bill of Materials for ADL6331-EVALZB (Continued)

Quantity	Reference Designator	Description	Manufacturer	Part Number
18	TP1 to TP17, TP29	PCB test point connectors	KEYSTONE ELECTRONICS	5xxx
5	TP30, TP31, TP33, TP34, TP35	PCB Test Point Connector	COMPONENTS CORPORATION	TP-105-01-00
1	U2	32 K bit, serial electrically erasable programmable read-only memory (EEPROM)	MICROCHIP TECHNOLOGY	24LC32A-I/MS
1	U1	1.0 GHz to 15.0 GHz TxVGA	Analog Devices, Inc.	ADL6331ACCZB
1	PCB	Evaluation board	Analog Devices	ADL6331-EVALZB

**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.

Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. CONFIDENTIALITY. This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. ADDITIONAL RESTRICTIONS. Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. TERMINATION. ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. LIMITATION OF LIABILITY. THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS (\$100.00). EXPORT. Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. GOVERNING LAW. This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.

