

Evaluating the ADA4351-2 Compact, Dual-Channel, Precision, Programmable Gain Transimpedance Amplifier (PGTIA)

FEATURES

- ▶ Full featured evaluation board for the [ADA4351-2](#), a dual-channel, PGTIA in a 3 mm × 3 mm, 16-lead LFCSP with no exposed pad
- ▶ Enables quick prototyping
- ▶ Provisions for user-defined circuit configuration, including provisions for photodiodes
- ▶ Available edge-mounted SMA connectors and test points for simple connection with test equipment

EVALUATION BOARD KIT CONTENTS

- ▶ 1 populated EVAL-ADA4351-2EBZ evaluation board
- ▶ 5 shunt connectors (2 usable and 3 extra)

DOCUMENTS NEEDED

- ▶ ADA4351-2 data sheet

EQUIPMENT NEEDED

- ▶ Hardware
 - ▶ Digital multimeter (Agilent 34401A)
 - ▶ Power supplies (Agilent E3631)
 - ▶ Source meter (Keithley 2400) for current source input
 - ▶ High precision voltage source (Datel DVC-8500) for voltage source input
- ▶ Cables and components
 - ▶ SMA (male) to BNC connector (male) cables
 - ▶ BNC connector (female) to dual banana plug adapter
 - ▶ Banana to grabber cables
 - ▶ SMA 50 Ω termination

GENERAL DESCRIPTION

The EVAL-ADA4351-2EBZ evaluation board is designed to help users evaluate the ADA4351-2, a two-channel programmable gain transimpedance amplifier (PGTIA) that features an integrated gain switching network with two user-defined gain states that can be set via external resistors, offered in a 3 mm × 3mm × 0.78 mm, 16-lead lead frame chip scale package (LFCSP).

The EVAL-ADA4351-2EBZ is a 4-layer printed circuit board (PCB) with dimensions at 2.9 inches x 2.25 inches. [Figure 1](#) and [Figure 2](#) shows the top and bottom view of the EVAL-ADA4351-2EBZ, respectively. The EVAL-ADA4351-2EBZ comes populated with the key components that allow users to run and to evaluate the board quickly and with relative ease. That aside, the EVAL-ADA4351-2EBZ also provides open resistor and capacitor slots on its input and output stages, allowing the user to install components

EVALUATION BOARD PHOTOGRAPHS

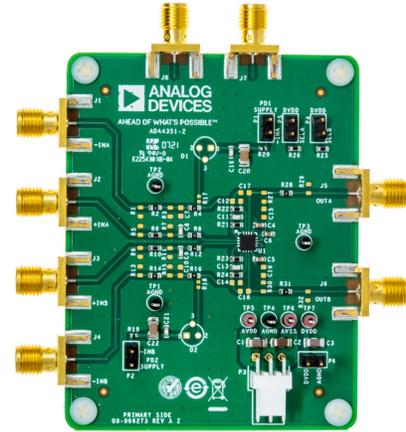


Figure 1. EVAL-ADA4351-2EBZ Photograph (Top View)

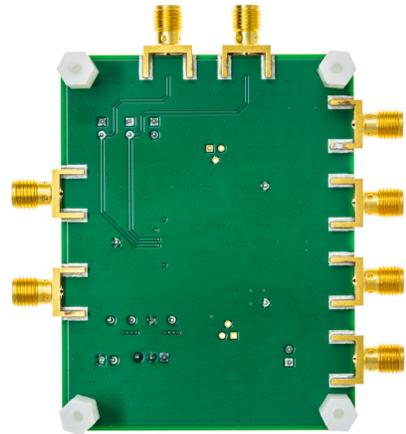


Figure 2. EVAL-ADA4351-2EBZ Photograph (Bottom View)

with user-defined values for connections such as a low-pass filter (LPF) or voltage divider.

The EVAL-ADA4351-2EBZ is accessible through Subminiature Version A (SMA) female socket edge mounts that allow users to directly connect test equipment to the inputs and outputs of both channels, as well as the gain switch control pins. The EVAL-ADA4351-2EBZ also comes with an unpopulated photodiode slot on each channel, allowing for quick prototyping.

For full details on the ADA4351-2, see the ADA4351-2 data sheet, which should be consulted in conjunction with this user guide when using the EVAL-ADA4351-2EBZ.

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REVISION HISTORY**10/2023—Revision 0: Initial Version**

EVALUATION BOARD HARDWARE

The EVAL-ADA4351-2EBZ provides users with features that make for easier evaluation and operation. Figure 3 shows the key components of the EVAL-ADA4351-2EBZ and Table 1 details their designators and descriptions.

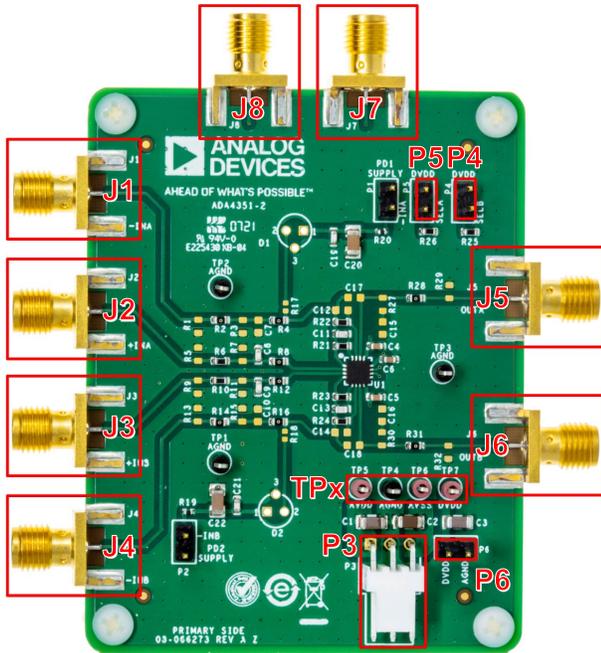


Figure 3. Designator Map of the EVAL-ADA4351-2EBZ

Table 1. Designator Lookup Table

Designator	Description
J1	The inverting input terminal on the Channel A amplifier
J2	The noninverting input terminal on the Channel A amplifier
J3 ¹	The noninverting input terminal on the Channel B amplifier
J4	The inverting input terminal on the Channel B amplifier
J5	The Channel A amplifier output
J6	The Channel B amplifier output
J7	The SMA input used to set the SW SEL B value to digital 0 or 1
J8	The SMA input used to set the SW SEL A value to digital 0 or 1
P3	The analog power supplies, 3-pin connector (from left to right, AVDD, AGND, and AVSS)
P4	The jumper used for manually setting the SW SEL B value to digital 0 or 1
P5	The jumper used for manually setting the SW SEL A value to digital 0 or 1
P6 ¹	The digital power supplies, 2-pin connector (from left to right, DVDD and AGND)
TPx	The test points (TP5 through TP7) that connect to the digital and analog power supplies

¹ Do not install a shunt connector in this header.

POWER SUPPLIES

The ADA4351-2 uses two supplies: an analog supply that powers up the PGTIA itself, thereby setting the rails, and a digital supply that is used to power up the switches for both Channel A and Channel B. The two supplies share a common ground plane. Table 2 details the supply ranges accepted by the device. Refer to the ADA4351-2 data sheet for the absolute maximum ratings.

Table 2. Analog and Digital Supply Ranges for the EVAL-ADA4351-2EBZ

Supply	Supply Range
Analog	AVDD to AVSS = 2.7 V to 5.5 V AVSS = -0.5 V to 0 V (GND)
Digital	DVDD to DVSS = 1.62 V to 5.5 V DVSS = 0 V (GND)

The EVAL-ADA4351-2EBZ provides two ways to power up the part: through pin headers or through test points.

Powering Up Through Pin Headers

The EVAL-ADA4351-2EBZ provides a 3-pin header for analog supplies and a 2-pin header for digital supplies. For proper connection, see P3 for the analog supplies and P6 for the digital supplies as shown and detailed in Figure 3 and Table 1.

Powering up Through Test Points

Though the test points are intended for measuring the supply voltages, the provided test points can also be used as a means to access the supply planes. Refer to TPx in Figure 3 for their location and to Table 3 for their proper connections.

Table 3. Designated Test Points for Analog and Digital Supplies

Test Points	Power Supply
TP5	AVDD (analog positive supply voltage)
TP6	AVSS (analog negative supply voltage)
TP7	DVDD (digital positive supply voltage)
Not Applicable (Soldered to GND)	DVSS (digital negative supply voltage)

EVALUATION BOARD HARDWARE

GAIN SWITCH CONTROL

The ADA4351-2 has two channels, A and B. Each channel is connected to two feedback paths that can each be accessed by toggling the switch control pins, SW SEL A (SELA) for Channel A and SW SEL B (SELB) for Channel B, to either low or high.

The EVAL-ADA4351-2EBZ provides two methods for controlling the gain switch: through pin headers or through mounted SMA jack connectors. In addition, the ADA4351-2 has a pull-down feature that automatically sets the switch control to low when connections to both switch control methods are open. [Table 4](#) details which feedback path is active based on the state of the switch control.

Switch Control via Pin Headers

The EVAL-ADA4351-2EBZ provides pin headers that, when shorted, connects to the DVDD supply to change the switch state from low to high. The pin header for Channel A is P5 (SELA), as shown in [Figure 3](#), while the pin header for Channel B is P4 (SELB).

Switch Control via SMA Jack Connectors

The EVAL-ADA4351-2EBZ comes with a mounted SMA female jack for each channel; these can connect power supplies or any other voltage sources, such as pulse generators or batteries, to the

switch control pins. The SMA jack for Channel A is J8 (SELA), and the SMA jack for Channel B is J7 (SELB)(see [Figure 3](#)).

GAIN SETTING

As mentioned, each channel of the [ADA4351-2](#) has two feedback paths accessible by selecting their designated switch state. Each path, SW0 x and SW1 x (where x equals the channel letter), contains a resistor that declares the gain of the channel.

By default, the EVAL-ADA4351-2EBZ has both channels populated with 40.2 k Ω resistors for SW0 x (R21 for Channel A and R23 for Channel B) and 499 k Ω resistors for SW1 x (R22 for Channel A and R24 for Channel B). In addition, the 40.2 k Ω resistor of each channel is compensated with a 3.3 pF capacitor (C11 for Channel A and C13 for Channel B), as shown in [Figure 8](#).

These resistors can be replaced on the board for different gain settings by swapping out R21 for the feedback path of SW0 A or R22 for the feedback path of SW1 A for Channel A, and R23 for the feedback path of SW0 B or R24 for the feedback path of SW1 B of Channel B. When swapping out the default resistors, be aware that the compensation capacitors (C11 and C12 for Channel A and C13 and C14 for Channel B) may require adjustment for optimal system performance. Refer to [Table 4](#) on how to access a specific gain setting.

Table 4. Switch Control and Gain Setting

Channel	Default Gain Setting (Feedback Path)	Designator	Gain Switch Control State	Switch Setting Methods	
				Pin Header Connection	SMA Connection
A	40.2 k Ω (SW0 A)	R21	SW SEL A = low	Leave P5 open.	Set the voltage level to less than DVSS + 0.5 V for J8.
	499 k Ω (SW1 A)	R22	SW SEL A = high	Install jumper at P5.	Set the voltage level to greater than DVDD - 0.7 V for J8.
B	40.2 k Ω (SW0 B)	R23	SW SEL B = low	Leave P4 open.	Set the voltage level to less than DVSS + 0.5 V for J7.
	499 k Ω (SW1 B)	R24	SW SEL B = high	Install jumper at P4.	Set the voltage level to greater than DVDD - 0.7 V for J7.

GETTING STARTED

Take the following steps to simply get the EVAL-ADA4351-2EBZ up and running using a current source as input, as well as to perform quick functionality tests. Figure 4 shows the TIA circuit employed in the EVAL-ADA4351-2EBZ. When using a voltage source as an input is required, refer to the [Using Voltage Source as Input](#) section for additional information.

- Configure and connect the power supplies to be used.
 - For this quick start, use the following configuration:
 - AVDD (analog positive supply voltage): 2.5 V, 0.1 A
 - AVSS (analog negative supply voltage): -2.5 V, 0.1 A
 - DVDD (digital positive supply voltage): 1.8 V, 0.1 A
 - Connect the supplies to their designated test points (see TPx in [Figure 3](#)).
 - Refer to the [Power Supplies](#) section for the different ways to power up the EVAL-ADA4351-2EBZ. [Table 2](#) shows the analog and digital supplies operation range.
- Configure the source meter for the input; set it as current source.
 - For this quick start, set the current source to $-4\ \mu\text{A}$ to test both a low gain state or a high gain state and $-50\ \mu\text{A}$ to test the low gain state. Refer to [Table 5](#) for the expected outputs of each setting.
 - Alternatively, a voltage source in series with a resistor of choice can be used, but the amplifier in turn operates as an inverting amplifier rather than a TIA.
 - For this configuration, refer to the [Using Voltage Source as Input](#) section.
- Connect the current source to the inverting pin of the amplifier through the SMA inputs.
 - For Channel A, connect to J1.
 - For Channel B, connect to J4.
 - If the current source has more than 10 pF of capacitance, add a compensation capacitor on C12 or C14. Refer to the [ADA4351-2](#) data sheet for more details.
- Select the desired gain for each channel by configuring the switch control (SW SEL x).
 - For this quick start, leave the switch control at its default state, which is configured as a quick functionality test (see [Table 4](#)).
 - By default, SW SEL A for Channel A and SW SEL B for Channel B are set as low.
 - Install one of the provided jumpers on P5 to set SW SEL A to high.
 - Install one of the provided jumpers on P4 to set SW SEL B to high.
 - A low input on SW SEL x activates the SW0 x feedback path, while high input activates the SW1 x feedback path.

- Refer to the [Gain Switch Control](#) section for details and other ways to set the gain states. [Table 4](#) provides details for feedback path selection and activation.
- Ground the noninverting input pin of the amplifier using a $0\ \Omega$ or $50\ \Omega$ SMA termination.
 - For Channel A, install the termination at J2.
 - For Channel B, install the termination at J3.
 - Connect a digital multimeter to the SMA output of the EVAL-ADA4351-2EBZ.
 - For Channel A, connect the DMM to J5.
 - For Channel B, connect the DMM to J6.
 - Enable the sources as follows:
 - Turn on the power supply for the analog and digital supplies.
 - Turn on the current source for the input.
 - Toggle the switch control (SW SEL x) to high to satisfy the third test seen in [Table 5](#).
 - Record the measured output as shown in the digital multimeter.
 - The current input and expected output is shown at [Table 5](#).
 - When using a voltage source, refer to [Table 7](#) for the expected output for the voltage source input test.

[Figure 5](#) shows the full physical setup of one of the ways to get the EVAL-ADA4351-2EBZ up and running. Follow this quick start guide to see results like those detailed in [Table 5](#); values must $\pm 10\%$ of the expected outputs detailed in [Table 5](#).

For further understanding of the EVAL-ADA4351-2EBZ, see the EVAL-ADA4351-2EBZ schematic in [Figure 8](#).

Table 5. Expected Outputs

Current Input (μA)	SW SEL x	Expected Output (V)
4	Low (no jumper)	0.1608
50	Low (no jumper)	2.01
4	High (jumper installed)	1.996

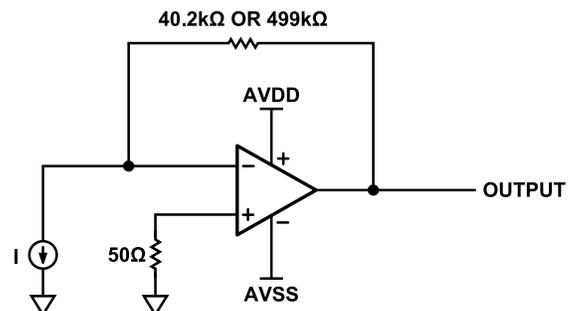


Figure 4. EVAL-ADA4351-2EBZ Test Circuit (I Is the Current Source.)

GETTING STARTED

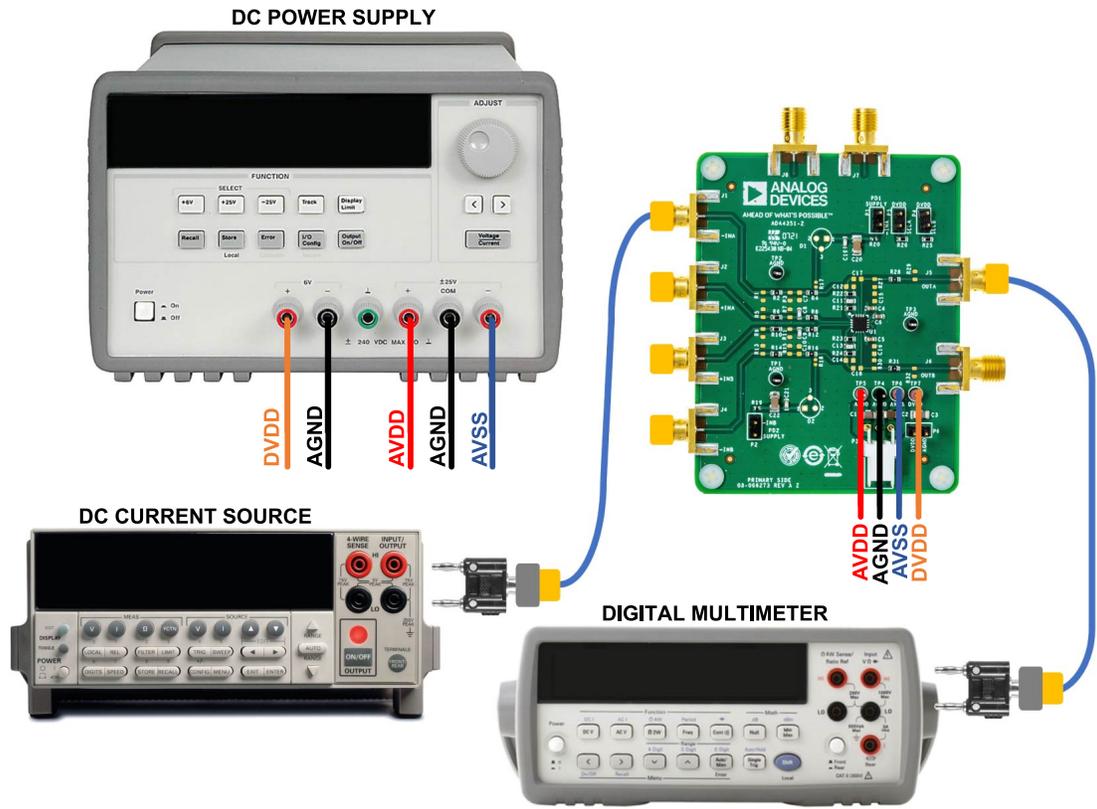


Figure 5. EVAL-ADA4351-2EBZ Full Setup for Current Source Input

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GETTING STARTED

USING VOLTAGE SOURCE AS INPUT

Because the ADA4351-2 is a PGTIA, the EVAL-ADA4351-2EBZ is configured by default to follow a TIA circuit, expecting a current input. The EVAL-ADA4351-2EBZ, however, provides options which allow user to configure the circuit differently. To cater to voltage inputs, the user can make changes and setup the circuit as an inverting amplifier.

Take the following steps to simply setup the EVAL-ADA4351-2EBZ as an inverting amplifier with a gain of -0.08 and a gain of -1:

1. Configure and connect the power supplies to be used. For this quick start, set the supplies to single-supply operation by using the following settings:
 - ▶ AVDD (analog positive supply voltage): 5 V, 0.1 A
 - ▶ AVSS (analog negative supply voltage): 0 V, 0.1 A
 - ▶ DVDD (digital positive supply voltage): 1.8 V, 0.1 A
2. Install a new resistor on the input of each channel (R4 for Channel A and R16 for Channel B).
 - ▶ Note that by default, R4 and R16 have a 0 Ω resistor installed. Change the resistor values on R4 and R16 to 499 kΩ to get a gain of -0.08 and -1, respectively.
3. Configure the DC voltage source for use as input. Set this source to 2 V. Connect this source to J1 for Channel A or J4 for Channel B.
4. Configure another DC voltage source for use as reference voltage. Set this source to 1.25 V. Connect this source to J2 for Channel A or J3 for Channel B.
 - ▶ With the default gain setting (P5 or P4 open), the reference sets to 1.35 V.
 - ▶ With a shunt installed at P5 for Channel A or P4 for Channel B, the reference sets 2.5 V.
5. Connect the output, J5 for Channel A or J6 for Channel B, to a DMM.
6. Retain the default gain settings. Leave P5 or P4 open for a gain of -0.08. The equivalent test circuit is shown in [Figure 6](#).
7. Enable the sources as follows:
 - ▶ Turn on the power supply for the analog and digital supplies.
 - ▶ Turn on the DC voltage source used as a reference voltage.
 - ▶ Turn on the DC voltage source for the input.
8. Record the measured output as shown in the DMM.
9. Install a shunt on P5 or P4 to set the gain to -1. The equivalent test circuit is shown in [Figure 7](#).
10. Record the measured output as shown in the DMM.

[Table 6](#) provides the summary of the initial setup for the DC voltage source input configuration. The expected results for both tests are shown in [Table 7](#).

Table 6. Configuring the ADA4351-2 for Single-Supply Operation

Parameter	Status	Description
AVDD	5 V.	Single-supply operation.

Table 6. Configuring the ADA4351-2 for Single-Supply Operation (Continued)

Parameter	Status	Description
AVSS	0 V.	Single-supply operation.
DVDD	5 V.	Single-supply operation.
P5 and P4	Open.	Default feedback resistor (R _F) setting.
R4 and R16	Install 499 kΩ on these resistors.	Sets the inverting gain.
J2 and J3	Set DC inputs to 1.25 V.	Sets the reference.
J1 and J4	Set the DC source inputs to 2 V.	Sets the input.
J5 and J6	Connect both to a DMM.	Displays the output.

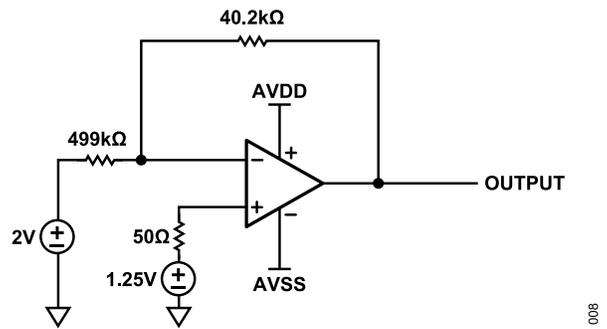


Figure 6. DC Voltage Source Input Test Circuit, Default Gain State

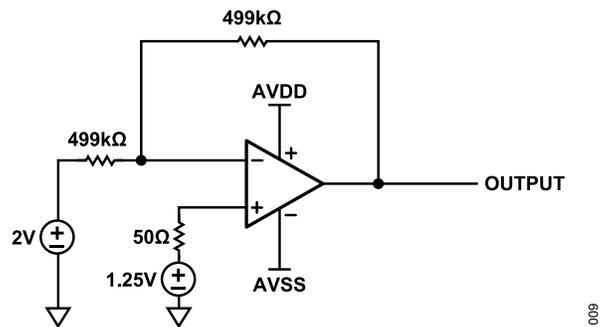


Figure 7. DC Voltage Source Input Test Circuit, Shunt installed at P4 and P4

Table 7. Expected Outputs for the Voltage Source Input Test

Voltage Input (V)	SW SEL x	Expected Output (V)
2	Low (no jumper)	1.1896
2	High (jumper installed)	0.5

EVALUATION BOARD SCHEMATIC

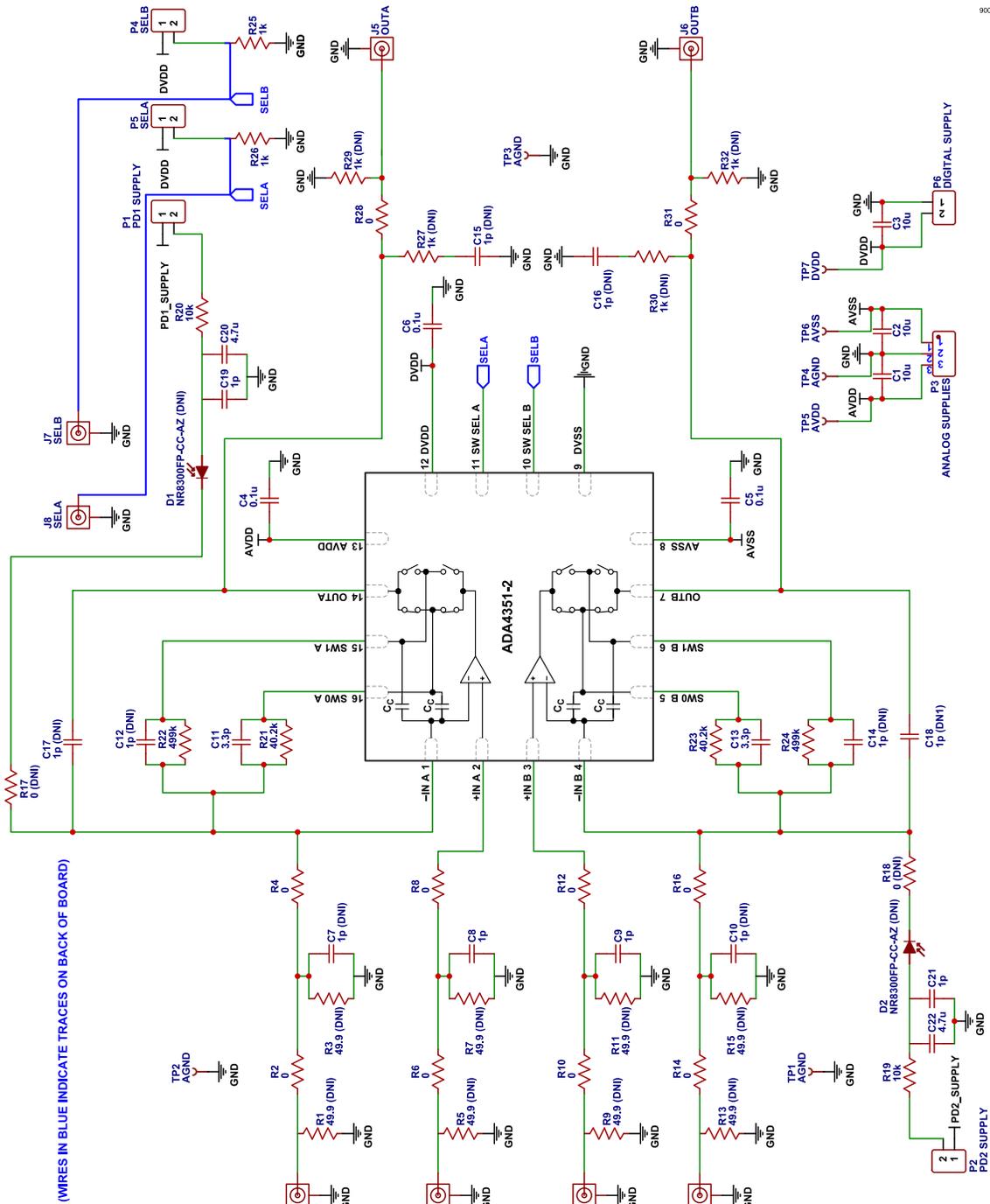


Figure 8. EVAL-ADA4351-2EBZ Evaluation Board Schematic

ORDERING INFORMATION

BILL OF MATERIALS

Table 8. Bill of Materials

Quantity	Designator	Description	Manufacturer and Part Number
1	U1	Compact, dual-channel, precision, PGTIA	Analog Devices, Inc., ADA4351-2ACPZ
3	C1, C2, C3	10 μ F capacitors, 1206	YAGEO, CC1206KRX5R7BB106
3	C4, C5, C6	0.1 μ F capacitors, 0603	TDK Corporation, C1608X8R1E104K080AA
4	C8, C9, C19, C21	1 pF capacitor, 0603	AVX Corporation, 06031A1R0BAT2A
2	C11, C13	3.3 μ F capacitors, 0603	Murata, GQM1875C2E3R3BB12D
2	C20, C22	4.7 μ F capacitors, 1206	Murata, GRM31CR71H475KA12L
8	J1 to J8	SMA female, edge-mounted sockets	Cinch Connectivity Solutions, 142-0701-851
5	P1, P2, P4, P5, P6	2-pin headers, 2.54 mm through hole, vertical	Ampenol Communications Systems FCI, 69157-102HLF
1	P3	3-pin header, 2.54 mm through hole, vertical	Samtec, TSW-103-23-F-S
8	R2, R4, R6, R8, R10, R12, R14, R16, R28, R31	0 Ω resistors, 0603	Panasonic, ERJ-3GEY0R00V
4	R25, R26	1 k Ω resistors, 0603	Panasonic, ERJ-3EKF1001V
2	R19, R20	10 k Ω resistors, 0402	Panasonic, ERJ-2RKF1002X
2	R21, R23	40.2 k Ω resistors, 0603	VISHAY, CRCW060340K2FKEA
2	R22, R24	499 k Ω resistors, 0603	Panasonic, ERJ-3EKF4993V
4	TP1, TP2, TP3, TP4	Black test points, through hole, 1.02 mm diameter	Vero Technologies, 20-2137
3	TP5, TP6, TP7	Red test points, through hole, 1.02 diameter	Vero Technologies, 20-313137
1	Not applicable	ADA4351-2 evaluation board	EVAL-ADA4351-2EBZ
4	Not applicable	Standoffs	Keystone Electronics, 1902C
4	Not applicable	Screws	B&F Fastener Supply, NY PMS 440 0025 PH

**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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