

## Evaluating the ADL8120 30 kHz to 20 GHz, Ultra-Wideband, Low Noise Amplifier

### FEATURES

- ▶ 4-layer, Isola 370HR evaluation board
- ▶ End launch, 2.9 mm RF connectors
- ▶ Through calibration path (depopulated connectors)

### EVALUATION KIT CONTENTS

- ▶ ADL8120-EVALZ 10 MHz to 20 GHz evaluation board or  
ADL8120-EVAL1Z 30 kHz to 20 GHz evaluation board

### EQUIPMENT NEEDED

- ▶ RF signal generator
- ▶ RF spectrum analyzer
- ▶ RF network analyzer
- ▶ 3.3 V, 100 mA power supply

### GENERAL DESCRIPTION

The ADL8120-EVALZ and ADL8120-EVAL1Z are 4-layer printed circuit boards (PCBs) fabricated from 0.254 mm (10 mil) thick, Isola 370HR, copper clad, forming a nominal thickness of 1.58 mm (62 mils). The ADL8120-EVALZ is designed to operate from 10 MHz to 20 GHz, whereas the ADL8120-EVAL1Z extends the frequency range down to 30 kHz and still supports operation up to 20 GHz. The RFIN and RFOUT ports on the ADL8120-EVALZ and ADL8120-EVAL1Z are populated with 2.9 mm, female coaxial connectors. The ADL8120-EVALZ and ADL8120-EVAL1Z are populated with components suitable for use over the entire  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  operating temperature range.

To calibrate out board trace losses, a through calibration path is provided between the J1 and J2 connectors. J1 and J2 must be populated with RF connectors to use the through calibration path. Refer to [Figure 11](#) and [Table 1](#) for the through calibration path performance for both the ADL8120-EVALZ and ADL8120-EVAL1Z.

Access the ADL8120-EVALZ and ADL8120-EVAL1Z ground and drain voltage through the surface-mount technology (SMT) test point connectors, GND and VDD. A supplementary test point for VRBIAS is included for simple access on the RBIAS pin (see [Figure 12](#) and [Figure 14](#) for the test point locations).

The RF traces on the ADL8120-EVALZ and ADL8120-EVAL1Z are  $50\ \Omega$ , grounded, coplanar waveguide. The package ground leads and the exposed pad connect directly to the ground plane. Multiple vias connect the top and bottom ground planes with particular focus on the area directly beneath the ground paddle to provide adequate electrical conduction and thermal conduction.

The power supply decoupling capacitors on the ADL8120-EVALZ and ADL8120-EVAL1Z represent the configuration used to characterize and qualify the device.

For full details on the [ADL8120](#), see the ADL8120 data sheet, which must be consulted in conjunction with this user guide when using the ADL8120-EVALZ and ADL8120-EVAL1Z.

**TABLE OF CONTENTS**

Features.....	1	Recommended Bias Sequencing for the ADL8120-EVALZ and ADL8120-EVAL1Z.....	4
Evaluation Kit Contents.....	1	Performance Comparison of the ADL8120- EVALZ and ADL8120-EVAL1Z.....	6
Equipment Needed.....	1	Through Calibration Path.....	7
General Description.....	1	Evaluation Board Schematics and Artwork.....	8
Evaluation Board Photographs.....	3	Ordering Information.....	10
Evaluation Board Hardware.....	4	Bill of Materials.....	10
Operating the ADL8120-EVALZ and ADL8120-EVAL1Z.....	4		

**REVISION HISTORY****10/2024—Rev. 0 to Rev. A**

Changed ADL8120ACPZN-EVALZ to ADL8120-EVALZ and ADL8120ACPZN-EVAL1Z to ADL8120- EVAL1Z (Throughout).....	1
Changes to General Description Section.....	1
Changes to Performance Comparison of the ADL8120-EVALZ and ADL8120-EVAL1Z Section.....	6
Changes to Figure 7 Caption to Figure 10 Caption.....	6

**4/2024—Revision 0: Initial Version**

## EVALUATION BOARD PHOTOGRAPHS

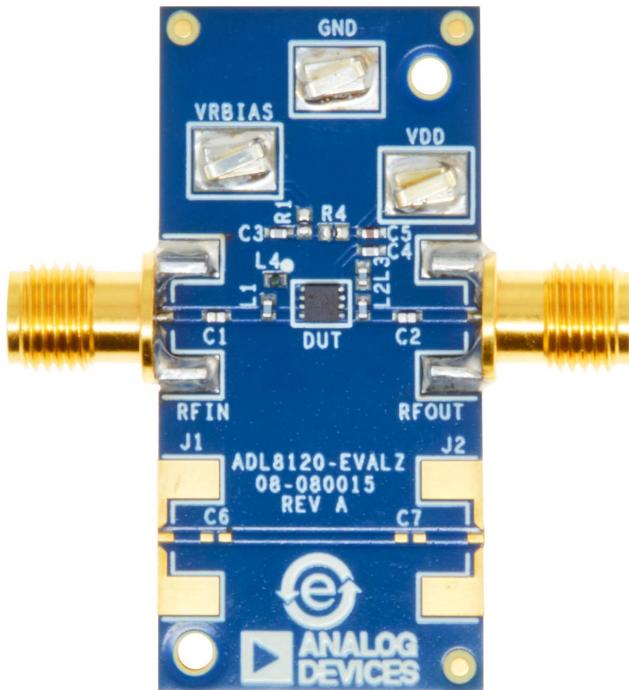


Figure 1. ADL8120-EVALZ Component Side  
(10 MHz to 20 GHz Evaluation Board)

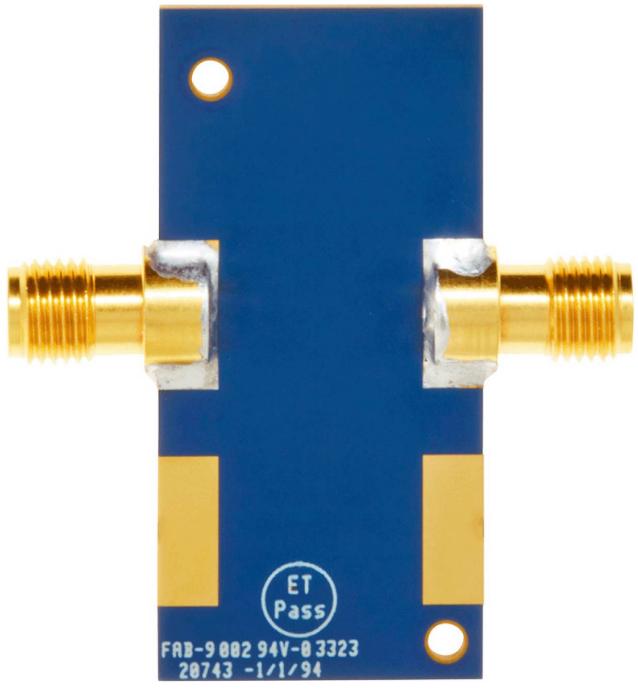


Figure 3. ADL8120-EVALZ Bottom Side  
(10 MHz to 20 GHz Evaluation Board)

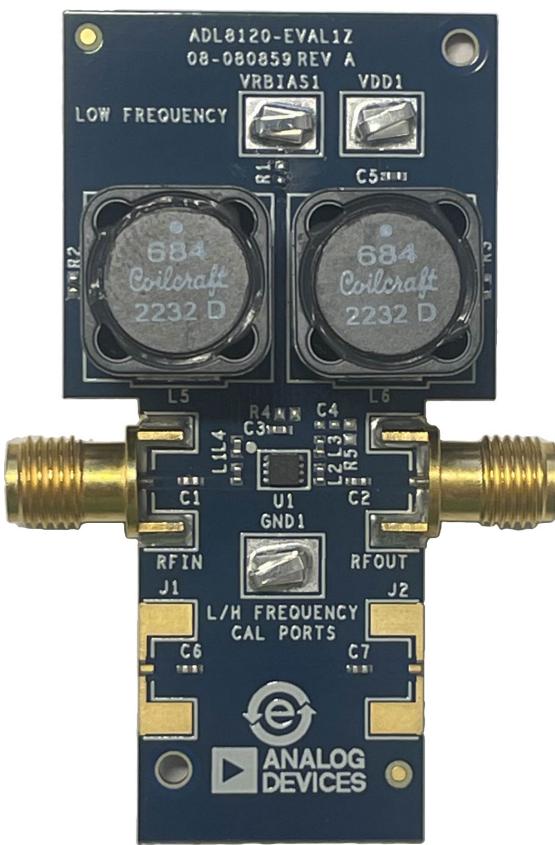


Figure 2. ADL8120-EVAL1Z Component Side  
(30 kHz to 20 GHz Evaluation Board)



Figure 4. ADL8120-EVAL1Z Bottom Side  
(30 kHz to 20 GHz Evaluation Board)

## EVALUATION BOARD HARDWARE

### OPERATING THE ADL8120-EVALZ AND ADL8120-EVAL1Z

A 3.3 V, 100 mA power supply is required to provide the bias to the **ADL8120**. Connect the 3.3 V power supply to the SMT test point, VDD. Connect the ground reference to the GND test point.

Refer to the ADL8120 data sheet for the recommended resistor values to achieve different supply currents. The default value of the bias resistor, R4, connected on both the ADL8120-EVALZ and ADL8120-EVAL1Z is 542  $\Omega$ , which is the same value used to characterize the ADL8120.

The following bias conditions are recommended to achieve the performance specified in the ADL8120 data sheet:  $V_{DD} = 3.3$  V, quiescent current ( $I_{DQ}$ ) = 55 mA, and  $R_{BIAS} = 542 \Omega$ .

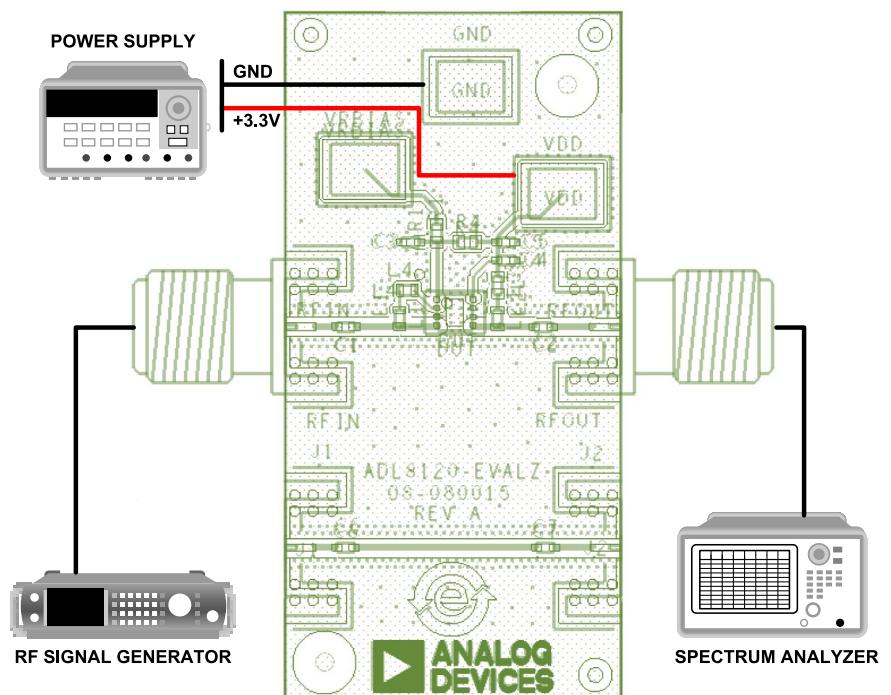
### RECOMMENDED BIAS SEQUENCING FOR THE ADL8120-EVALZ AND ADL8120-EVAL1Z

To power up both the ADL8120-EVALZ and ADL8120-EVAL1Z, follow the recommended power-up sequence:

1. Connect the VDD power supply.
2. Set the VDD supply to 3.3 V.
3. Apply the RF signal.

To power down both the ADL8120-EVALZ and ADL8120-EVAL1Z, follow the recommended power-down sequence:

1. Turn off the RF signal.
2. Set the VDD supply to 0 V.



005

Figure 5. ADL8120-EVALZ Operating Block Diagram

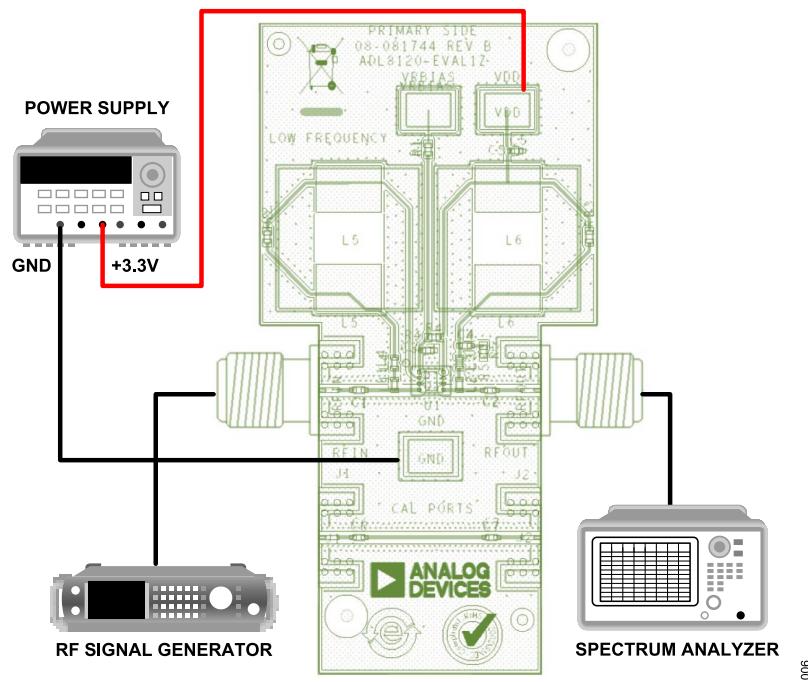
**EVALUATION BOARD HARDWARE**

Figure 6. ADL8120-EVAL1Z Operating Block Diagram

## EVALUATION BOARD HARDWARE

### PERFORMANCE COMPARISON OF THE ADL8120-EVALZ AND ADL8120-EVAL1Z

Figure 7 and Figure 8 show the gain, input return loss, and output return loss for the ADL8120-EVALZ and ADL8120-EVAL1Z at frequencies up to 500 MHz. For the ADL8120-EVALZ, the performance of the device experiences a cutoff around 4 MHz. This roll-off is caused by the biasing network. On the ADL8120-EVAL1Z, the low frequency response has been extended by incorporating additional biasing components.

Figure 9 and Figure 10 show the gain, input return loss, and output return loss for the ADL8120-EVALZ and ADL8120-EVAL1Z at higher frequencies up to 20 GHz. The gain and return loss performance of the ADL8120-EVALZ and ADL8120-EVAL1Z are similar, and both hold up well to 20 GHz.

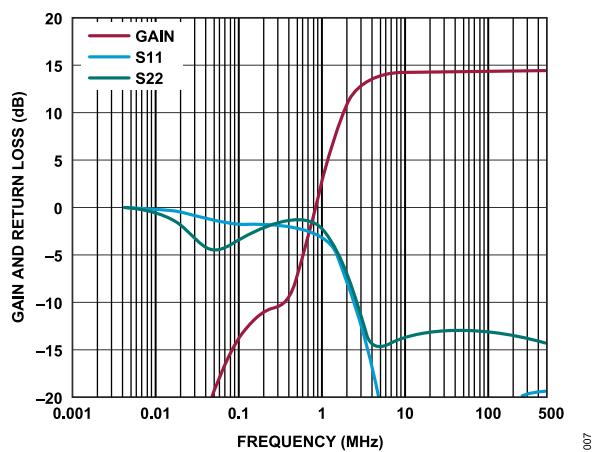


Figure 7. Gain and Return Loss of ADL8120-EVALZ (10 MHz to 20 GHz Evaluation Board)

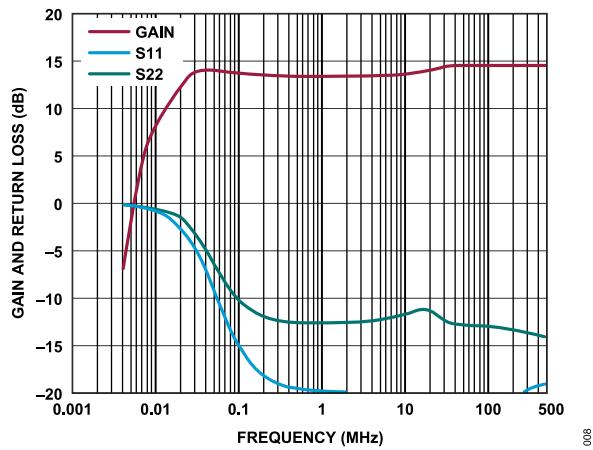


Figure 8. Gain and Return Loss of ADL8120-EVAL1Z (30 kHz to 20 GHz Evaluation Board)

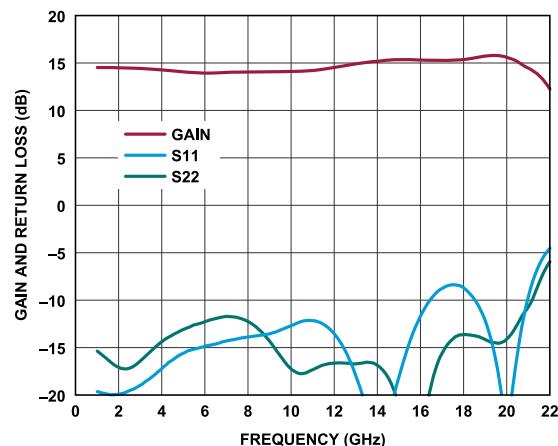


Figure 9. Gain and Return Loss of ADL8120-EVALZ (10 MHz to 20 GHz Evaluation Board)

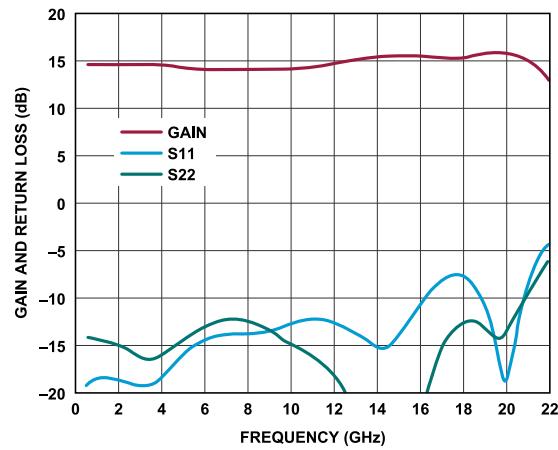


Figure 10. Gain and Return Loss of ADL8120-EVAL1Z (30 kHz to 20 GHz Evaluation Board)

## EVALUATION BOARD HARDWARE

### THROUGH CALIBRATION PATH

The ADL8120-EVALZ and ADL8120-EVAL1Z include a calibration path (Figure 11 and Table 1). THRUCAL (J1 and J2) must be populated with RF connectors to use the through calibration path. For both the ADL8120-EVALZ and ADL8120-EVAL1Z, the through calibration paths include two AC coupling capacitors (populated) to mimic the AC coupling capacitors in the main signal path.

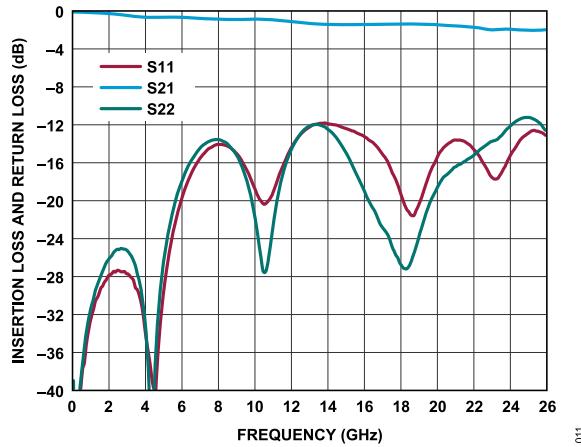


Figure 11. Insertion Loss and Return Loss (Input and Output) of the Through Calibration Path (ADL8120-EVALZ and ADL8120-EVAL1Z)

Table 1. Insertion Loss of the Through Calibration Path (ADL8120-EVALZ and ADL8120-EVAL1Z)

Frequency (GHz)	Insertion Loss (dB)
0.01	-0.024
0.20	-0.031
0.5	-0.049
0.70	-0.066
1	-0.085
3	-0.406
5	-0.571
7	-0.7
9	-0.812
11	-0.848
13	-1.235
15	-1.361
17	-1.32
19	-1.291
21	-1.497
23	-1.911
25	-1.953
26	-1.889

## EVALUATION BOARD SCHEMATICS AND ARTWORK

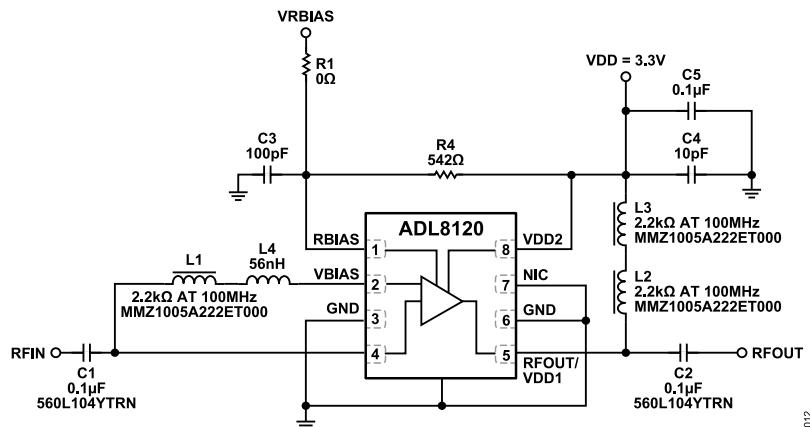


Figure 12. ADL8120-EVALZ Schematic

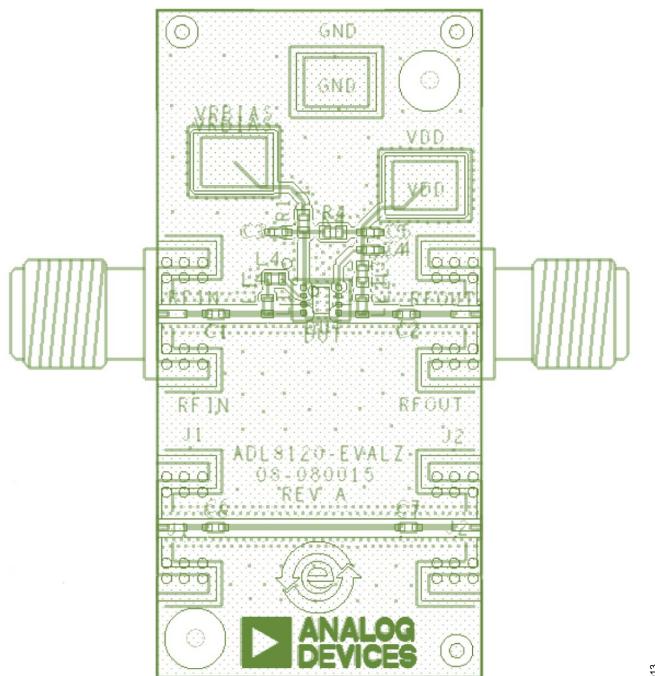


Figure 13. ADL8120-EVALZ Assembly Drawing (J1 and J2 Not Installed)

## EVALUATION BOARD SCHEMATICS AND ARTWORK

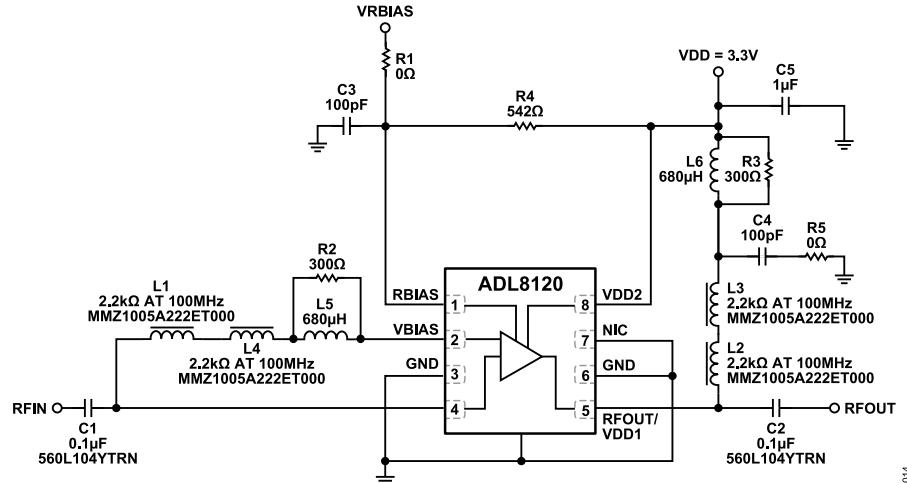
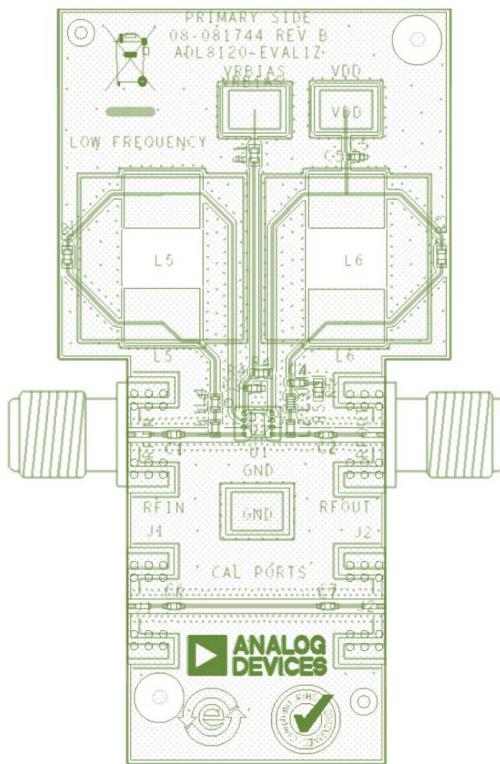


Figure 14. ADL8120-EVAL1Z Schematic



**Figure 15. ADL8120-EVAL1Z Assembly Drawing (J1 and J2 Not Installed)**

## ORDERING INFORMATION

## BILL OF MATERIALS

Table 2. ADL8120-EVALZ Bill of Materials

Reference Designator	Description	Manufacturer	Manufacturer Number
C1, C2	Ceramic capacitors, 0.1 $\mu$ F, 16 V, 20% to 25%, 0402	American Technical Ceramics	560L104YTRN
C3	Ceramic capacitor, 100 pF, 25 V, 10%, C0G, 0402	AVX Corporation	04023A101KAT2A
C4	Ceramic capacitor, 10 pF, 50 V, 5%, C0G, 0402	Murata	GCM1555C1H100JA16D
C5	Ceramic capacitor, 0.1 $\mu$ F, 50 V, 10%, X7R, 0402	TDK	C1005X7R1H104K050BE
L1, L2, L3	Inductors, ferrite bead, 2.2 k $\Omega$ , 25%, 100 MHz, 0.15 A, 2.2 $\Omega$ , 0402	TDK	MMZ1005A222ET000
L4	Inductor chip, 56 nH, 5%, 0.061 $\Omega$ , DCR, 1.2 A	Coilcraft, Inc.	0402DF-560XJR
R1	Resistor SMD, 0 $\Omega$ jumper, 1/16 W, 0402	Yageo	RC0402JR-070RL
R4	Resistor SMD, 542 $\Omega$ , 0.1%, 0.13 W, 0402	Vishay	TNPW040254RBEED
C6, C7	Ceramic capacitors, 0.1 $\mu$ F, 16 V, 20% to 25%, 0402 (do not install, DNI)	American Technical Ceramics	560L104YTRN
VRBIAS, GND, VDD	SMT test points	Keystone Electronics	5016
RFIN, RFOUT	Connectors, K jack edge	SRI Connector Gage Co.	25-146-1000-92
J1, J2	Connectors, K jack edge (unpopulated)	SRI Connector Gage Co.	25-146-1000-92
U1	30 kHz to 20 GHz, ultra-wideband, low noise amplifier	Analog Devices, Inc.	ADL8120ACPZN

Table 3. ADL8120-EVAL1Z Bill of Materials

Reference Designator	Description	Manufacturer	Manufacturer Number
C1, C2	Ceramic capacitors, 0.1 $\mu$ F, 16 V, 20% to 25%, 0402	American Technical Ceramics	560L104YTRN
C3	Ceramic capacitor, 100 pF, 25 V, 10%, C0G, 0402	AVX Corporation	04023A101KAT2A
C5	Ceramic capacitor, 1 $\mu$ F, 10 V, 10%, X7S, 0402	TDK	C1005X7S1A105K050BC
L1, L2, L3, L4	Inductors, ferrite bead, 2.2 k $\Omega$ , 25%, 100 MHz, 0.15 A, 2.2 $\Omega$ , 0402	TDK	MMZ1005A222ET000
L5, L6	Inductors, power shielded, 680 $\mu$ H, 10%, 100 kHz, 1.17 A, 0.596 $\Omega$ , DCR	Coilcraft, Inc.	MSS1210H-684KED
R2, R3	Resistor SMD, 300 $\Omega$ , 5%, 1/10 W, 0402	Panasonic	ERJ-2GEJ301X
R4	Resistor SMD, 542 $\Omega$ , 0.1%, 0.13 W, 0402	Vishay	TNPW040254RBEED
C4	Ceramic capacitor, 100 pF, 25 V, 10%, C0G, 0402 (do not install, DNI)	AVX Corporation	04023A101KAT2A
C6, C7	Ceramic capacitors, 0.1 $\mu$ F, 16 V, 20% to 25%, 0402 (DNI)	American Technical Ceramics	560L104YTRN
R1, R5	Resistors, SMD, 0 $\Omega$ jumper, 1/16 W, 0402 (DNI)	Yageo	RC0402JR-070RL
VRBIAS, GND, VDD	SMT test points	Keystone Electronics	5016
RFIN, RFOUT	Connectors, K jack edge	SRI Connector Gage Co.	25-146-1000-92
J1, J2	Connectors, K jack edge (unpopulated)	SRI Connector Gage Co.	25-146-1000-92
U1	30 kHz to 20 GHz, ultra-wideband, low noise amplifier	Analog Devices, Inc.	ADL8120ACZPN

## ORDERING INFORMATION

## 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.

### 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 NONINFRINGEMENT 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.