Evaluating the ADL8122 10 kHz to 10 GHz, Wideband, Low Noise Amplifier

FEATURES

- 4-layer, Rogers 4350B and Isola 370HR evaluation board
- End launch, SMA RF connectors
- Through calibration path (depopulated connectors)

EVALUATION KIT CONTENTS

- ADL8122-EVALZ 10 MHz to 10 GHz evaluation board or ADL8122-EVAL1Z 10 kHz to 10 GHz evaluation board

EQUIPMENT NEEDED

- RF signal generator
- RF spectrum analyzer
- RF network analyzer
- 5 V, 200 mA power supply

GENERAL DESCRIPTION

The ADL8122-EVALZ and ADL8122-EVAL1Z are 4-layer printed circuit boards (PCBs) fabricated from 0.254 mm (10 mil) thick, Rogers 4350B and Isola 370HR, copper clad, forming a nominal thickness of 1.63 mm (64 mils). The ADL8122-EVALZ was designed to support operation from 10 MHz to 10 GHz, while the ADL8122-EVAL1Z was designed to extend frequency operation down to 10 kHz. The ADL8122-EVAL1Z still operates up to 10 GHz. The RFIN and RFOUT ports on the ADL8122-EVALZ and ADL8122-EVAL1Z are populated with Subminiature A (SMA), female coaxial connectors. The ADL8122-EVALZ and ADL8122-EVAL1Z are populated with components suitable for use over the entire −55°C to +125°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 ADL8122-EVALZ and ADL8122-EVAL1Z.

Access the ADL8122-EVALZ and ADL8122-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 ADL8122-EVALZ and ADL8122-EVAL1Z are 50 Ω, 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 ADL8122-EVALZ and ADL8122-EVAL1Z represent the configuration used to characterize and qualify the device.

For full details on the ADL8122, see the ADL8122 data sheet, which must be consulted in conjunction with this user guide when using the ADL8122-EVALZ and ADL8122-EVAL1Z.

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REVISION HISTORY

6/2024—Revision 0: Initial Version

EVALUATION BOARD PHOTOGRAPHS

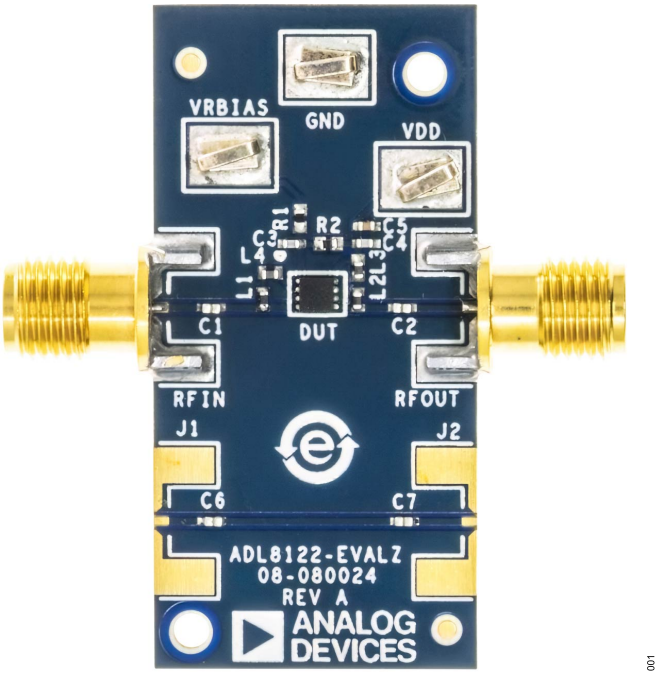

Figure 1. ADL8122-EVALZ Component Side (10 MHz to 10 GHz Evaluation Board)

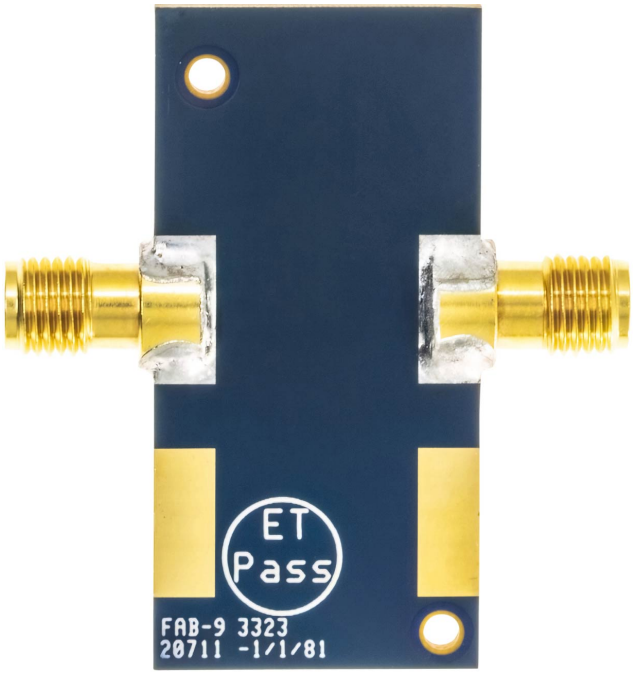

Figure 3. ADL8122-EVALZ Bottom Side (10 MHz to 10 GHz Evaluation Board)

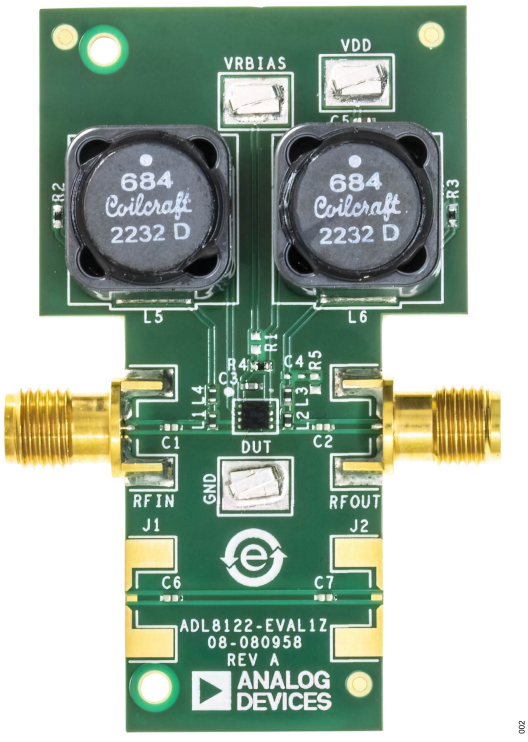

Figure 2. ADL8122-EVAL1Z Component Side (10 kHz to 10 GHz Evaluation Board)

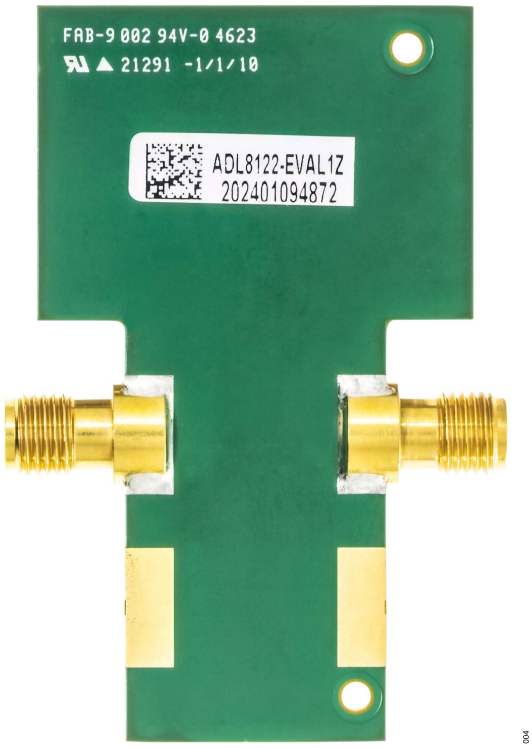

Figure 4. ADL8122-EVAL1Z Bottom Side (10 kHz to 10 GHz Evaluation Board)

EVALUATION BOARD HARDWARE

OPERATING THE ADL8122-EVALZ AND ADL8122-EVAL1Z

A 5 V, 200 mA power supply is required to provide the bias to the ADL8122. Connect the 5 V power supply to the SMT test point, VDD. Connect the ground reference to the GND test point.

Refer to the ADL8122 data sheet for the recommended resistor values to achieve different supply currents. The default value of the bias resistor, R2, connected on both the ADL8122-EVALZ and ADL8122-EVAL1Z is 620 Ω, which is the same value used to characterize the ADL8122.

The following bias conditions are recommended to achieve the performance specified in the ADL8122 data sheet: supply current (V_{DD}) = 5 V, quiescent current (I_{DQ}) = 95 mA, and bias resistance (R_{BIAS}) = 620 Ω.

RECOMMENDED BIAS SEQUENCING FOR THE ADL8122-EVALZ AND ADL8122-EVAL1Z

To power up both the ADL8122-EVALZ and ADL8122-EVAL1Z, follow the recommended power-up sequence:

1. Connect the VDD power supply.
2. Set the VDD supply to 5 V.
3. Apply the RF signal.

To power down both the ADL8122-EVALZ and ADL8122-EVAL1Z, follow the recommended power-down sequence:

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

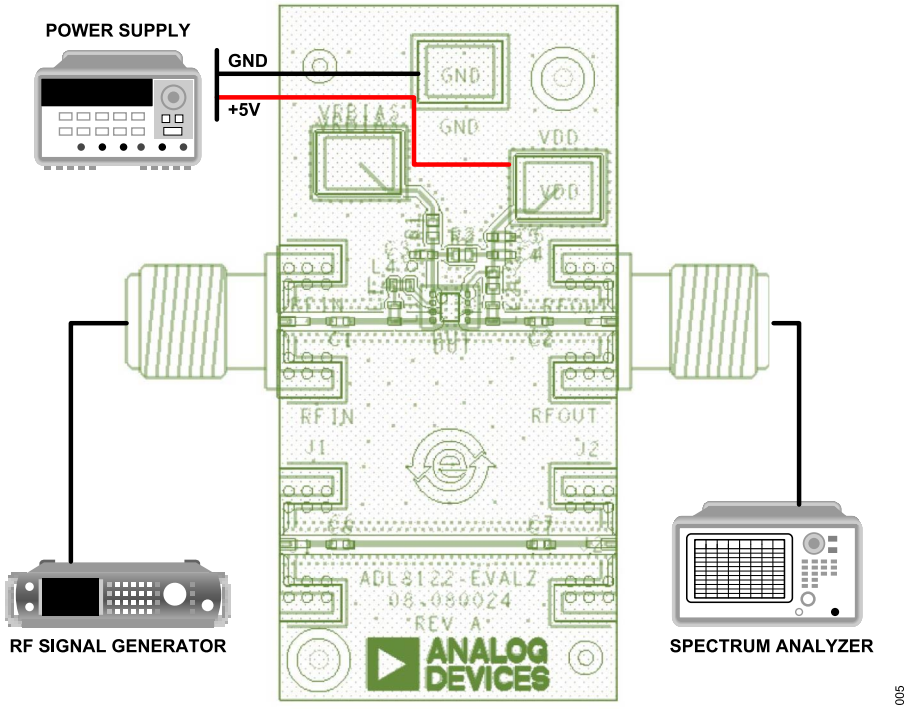

Figure 5. ADL8122-EVALZ Operating Block Diagram

EVALUATION BOARD HARDWARE

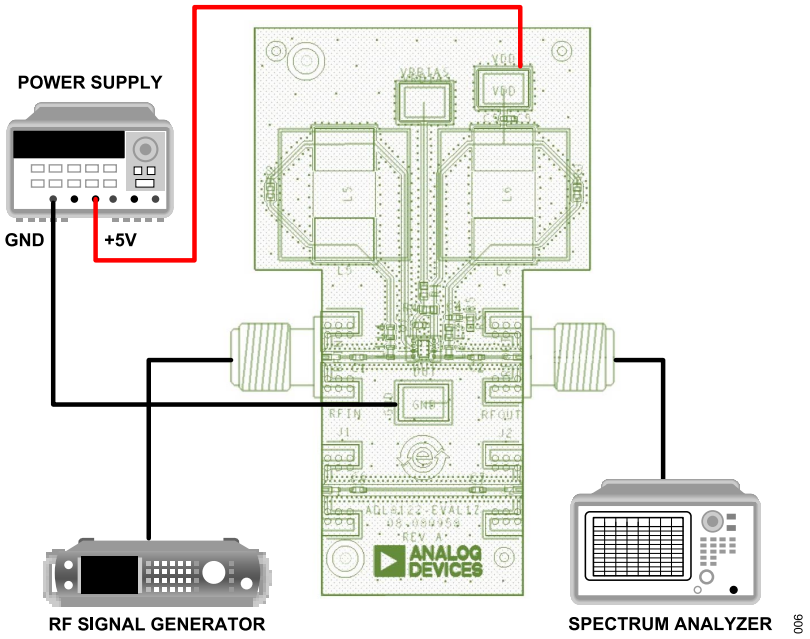

Figure 6. ADL8122-EVAL1Z Operating Block Diagram

EVALUATION BOARD HARDWARE

PERFORMANCE COMPARISON OF THE ADL8122-EVALZ AND ADL8122-EVAL1Z

Figure 7 and Figure 8 show the gain, input return loss (S11), and output return loss (S22) for the ADL8122-EVALZ and ADL8122-EVAL1Z at frequencies up to 200 MHz. For the ADL8122-EVALZ, the gain and return loss rolls off at around 4 MHz. This roll-off is caused by the biasing network. On the ADL8122-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 ADL8122-EVALZ and ADL8122-EVAL1Z up to 10 GHz. The gain and return loss performance of the ADL8122-EVALZ and ADL8122-EVAL1Z are similar, and both hold up well to 10 GHz.

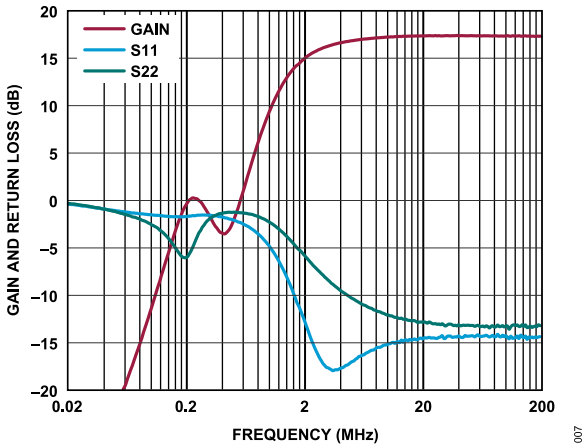

Figure 7. Gain and Return Loss of ADL8122-EVALZ (10 MHz to 10 GHz Evaluation Board)

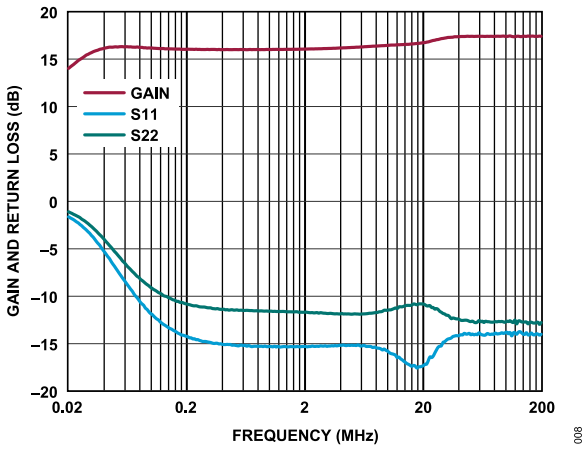

Figure 8. Gain and Return Loss of ADL8122-EVAL1Z (10 kHz to 10 GHz Evaluation Board)

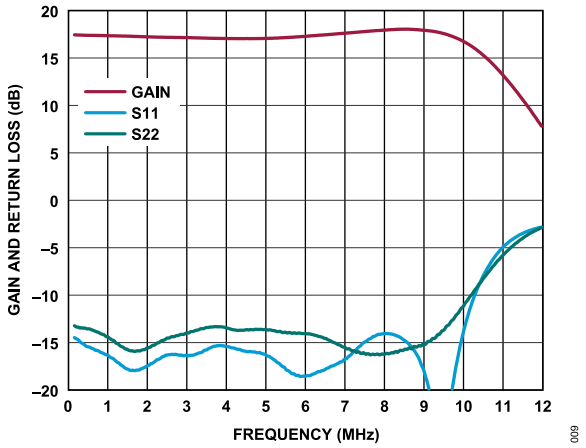

Figure 9. Gain and Return Loss of ADL8122-EVALZ (10 MHz to 10 GHz Evaluation Board)

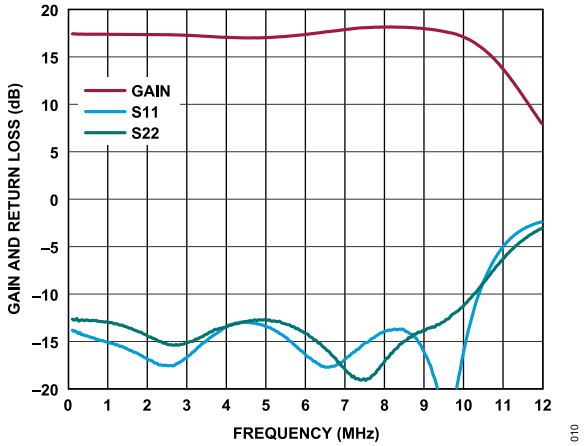

Figure 10. Gain and Return Loss of ADL8122-EVAL1Z (10 kHz to 10 GHz Evaluation Board)

EVALUATION BOARD HARDWARE

THROUGH CALIBRATION PATH

The ADL8122-EVALZ and ADL8122-EVAL1Z include a calibration path (see Figure 11 and Table 1). THRUCAL (J1 and J2) must be populated with RF connectors to use the through calibration path. For both the ADL8122-EVALZ and ADL8122-EVAL1Z, the through calibration paths includes two AC coupling capacitors (populated) to mimic the AC coupling capacitors in the main signal path.

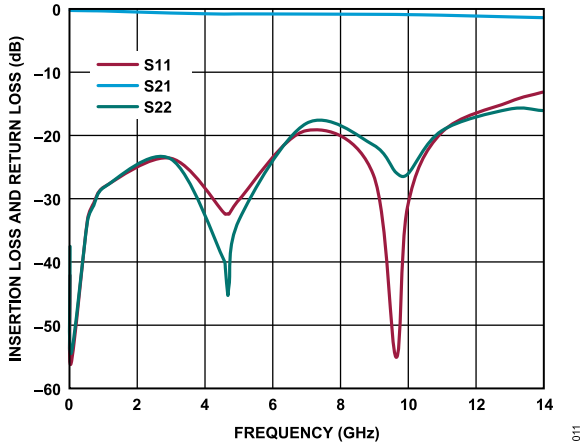

Figure 11. Insertion Loss (S21) and Return Loss (Input and Output) of the Through Calibration Path (ADL8122-EVALZ and ADL8122-EVAL1Z)

Table 1. Insertion Loss of the Through Calibration Path (ADL8122-EVALZ and ADL8122-EVAL1Z)

Frequency (GHz)	Insertion Loss (dB)
0.01	−0.010
0.40	−0.0125
0.50	−0.0535
0.70	−0.0675
1.0	−0.092
3.0	−0.4195
4.5	−0.585
4.6	−0.5815
4.7	−0.581
4.8	−0.578
5.0	−0.557
7.0	−0.582
9.0	−0.624
9.6	−0.642
10.0	−0.6715
11.0	−0.762
13.0	−1.0235
14.0	−1.151

EVALUATION BOARD SCHEMATICS AND ARTWORK

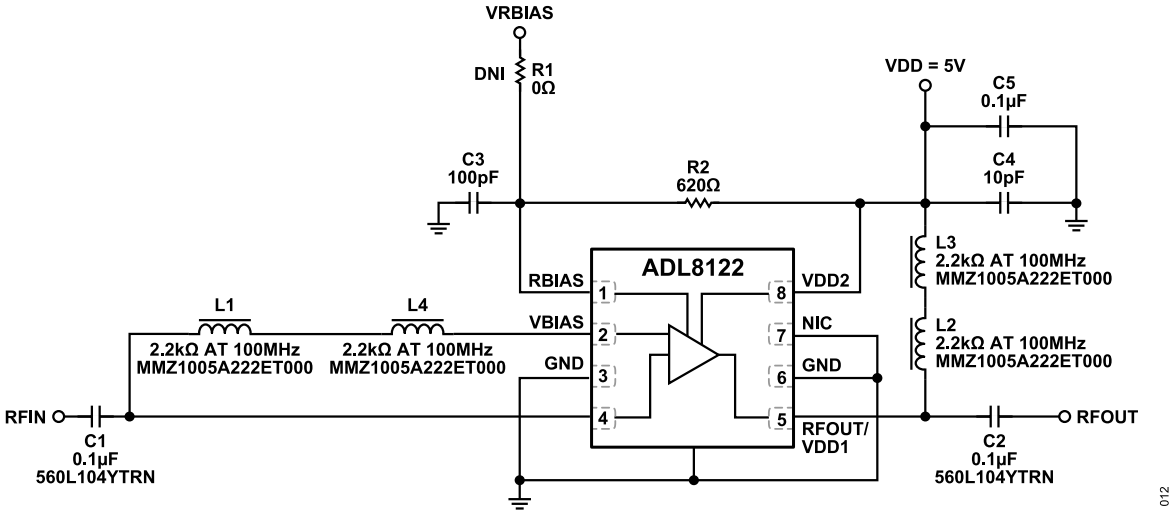

Figure 12. ADL8122-EVALZ Schematic

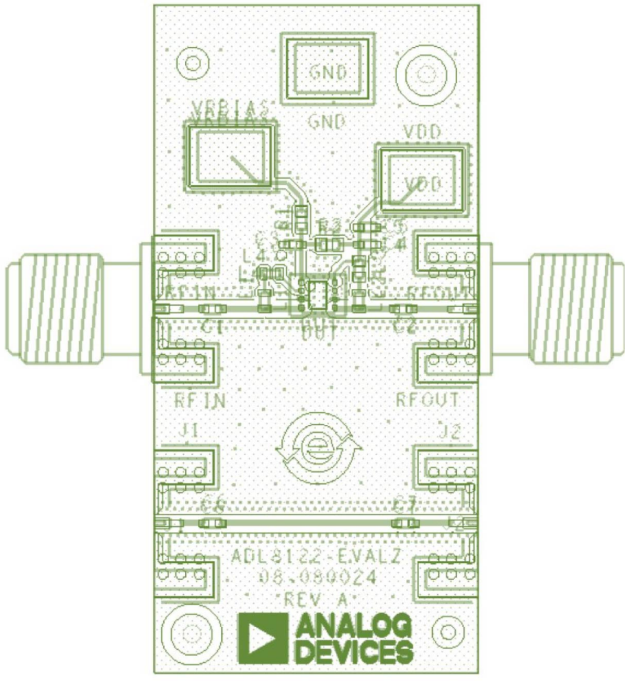

Figure 13. ADL8122-EVALZ Assembly Drawing (J1 and J2 Not Installed)

EVALUATION BOARD SCHEMATICS AND ARTWORK

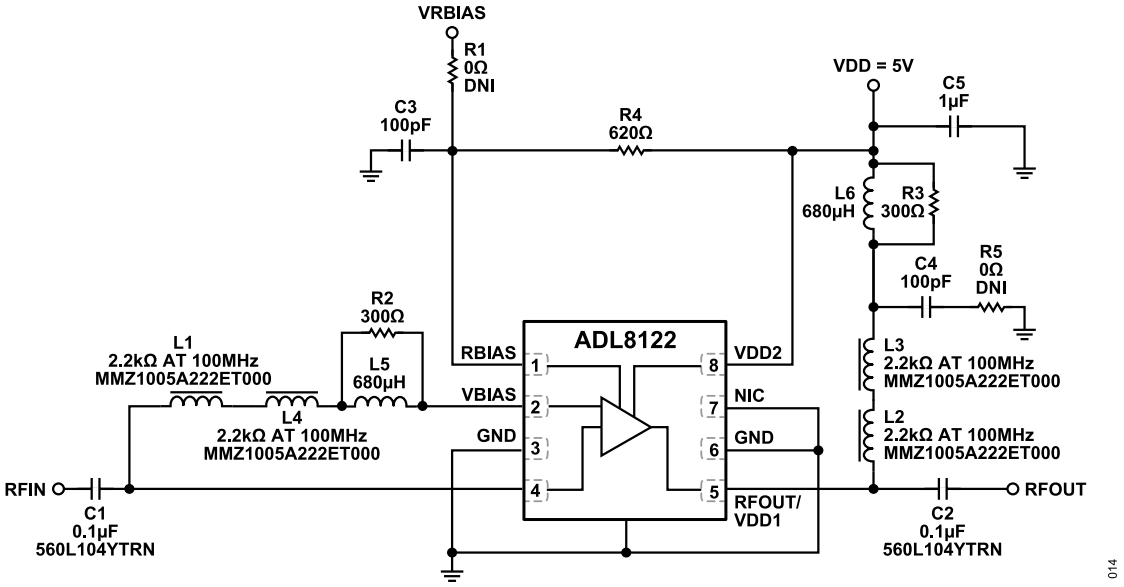

Figure 14. ADL8122-EVAL1Z Schematic

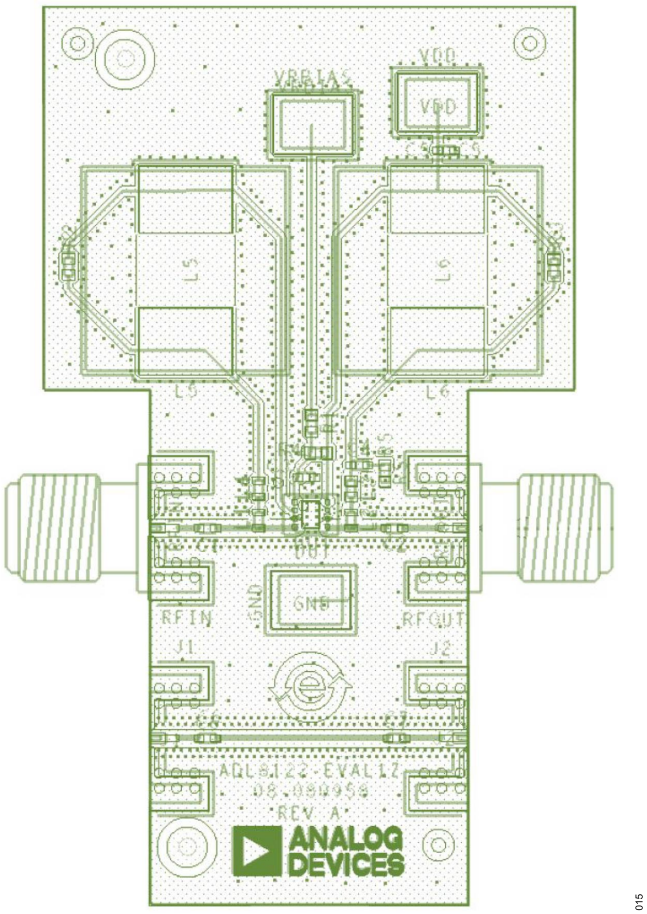

Figure 15. ADL8122-EVAL1Z Assembly Drawing (J1 and J2 Not Installed)

ORDERING INFORMATION

BILL OF MATERIALS

Table 2. ADL8122-EVALZ Bill of Materials

Reference Designator	Description	Manufacturer	Manufacturer Number
C1, C2	Ceramic capacitors, 0.1 µF, 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 µF, 50 V, 10%, X7R, 0402	TDK	C1005X7R1H104K050BE
L1, L2, L3, L4	Inductors, ferrite bead, 2.2 kΩ, 25%, 100 MHz, 0.15 A, 2.2 Ω, 0402	TDK	MMZ1005A222ET000
R1	Resistor SMD, 0 Ω jumper, 1/16 W, 0402	Yageo	RC0402JR-070RL
R2	Resistor SMD, 620 Ω, 5%, 1/10 W, 0402	Panasonic	ERJ-2GEJ621X
C6, C7	Ceramic capacitors, 0.1 µF, 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	10 kHz to 10 GHz, wideband, low noise amplifier	Analog Devices, Inc.	ADL8122ACPZN

Table 3. ADL8122-EVAL1Z Bill of Materials

Reference Designator	Description	Manufacturer	Manufacturer Number
C1, C2	Ceramic capacitors, 0.1 µF, 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 µF, 10 V, 10%, X7S, 0402	TDK	C1005X7S1A105K050BC
L1, L2, L3, L4	Inductors, ferrite bead, 2.2 kΩ, 25%, 100 MHz, 0.15 A, 2.2 Ω, 0402	TDK	MMZ1005A222ET000
L5, L6	Inductors, power shielded, 680 µH, 10%, 100 kHz, 1.17 A, 0.596 Ω, DCR	Coilcraft, Inc.	MSS1210H-684KED
R2, R3	Resistor SMD, 300 Ω, 5%, 1/10 W, 0402	Panasonic	ERJ-2GEJ301X
R4	Resistor SMD, 620 Ω, 0.1%, 1/16 W, 0402	Panasonic	ERA-2AEB621X
C4	Ceramic capacitor, 100 pF, 25 V, 10%, C0G, 0402 (do not install, DNI)	AVX Corporation	04023A101KAT2A
C6, C7	Ceramic capacitors, 0.1 µF, 16 V, 20% to 25%, 0402 (DNI)	American Technical Ceramics	560L104YTRN
R1	Resistors, SMD, 0 Ω jumper, 1/16 W, 0402 (DNI)	Yageo	RC0402JR-070RL
R5	Resistors, SMD, 0 Ω jumper, 1/10 W, 0402 (DNI)	Panasonic	ERJ-2GE0R00X
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	10 kHz to 10 GHz, wideband, low noise amplifier	Analog Devices, Inc.	ADL8122ACPZN

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.