Evaluating the ADL8101 10 kHz to 22 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

- ADL8101-EVALZ 10 MHz to 22 GHz evaluation board or ADL8101-EVAL1Z 10 kHz to 22 GHz evaluation board

EQUIPMENT NEEDED

- RF signal generator
- RF spectrum analyzer
- RF network analyzer
- 5 V, 300 mA power supply

GENERAL DESCRIPTION

The ADL8101-EVALZ and ADL8101-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 ADL8101-EVALZ is designed to support operation from 10 MHz to 22 GHz The ADL8101-EVAL1Z is designed to extend frequency operation down to 10 kHz and still operates up to 22 GHz. The RFIN and RFOUT ports on the ADL8101-EVALZ and ADL8101-EVAL1Z are populated with 2.9 mm, female coaxial connectors, and the respective RF traces have a 50 Ω characteristic impedance. The ADL8101-EVALZ and ADL8101-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 ADL8101-EVALZ and ADL8101-EVAL1Z.

Access the ADL8101-EVALZ and ADL8101-EVAL1Z ground and drain voltage through the surface-mount technology (SMT) test point connectors, GND and VDD. A supplementary test point for VBIAS 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 ADL8101-EVALZ and ADL8101-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 ADL8101-EVALZ and ADL8101-EVAL1Z represent the configuration used to characterize and qualify the device.

For full details on the ADL8101, see the ADL8101 data sheet, which must be consulted in conjunction with this user guide when using the ADL8101-EVALZ and/or ADL8101-EVAL1Z.

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REVISION HISTORY

8/2024—Revision 0: Initial Version

EVALUATION BOARD PHOTOGRAPHS

Figure 1. ADL8101-EVALZ Component Side

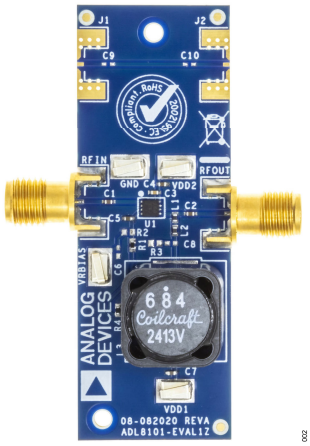

Figure 2. ADL8101-EVAL1Z (Low Frequency Extension) Component Side

Figure 3. ADL8101-EVAL1Z Bottom Side

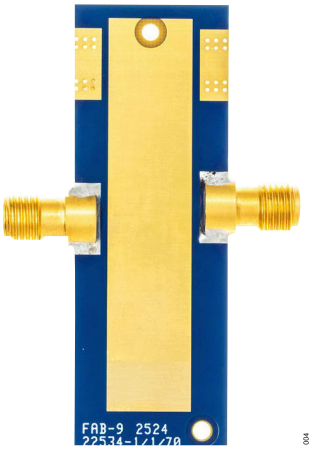

Figure 4. ADL8101-EVALZ Bottom Side

EVALUATION BOARD HARDWARE

OPERATING THE ADL8101-EVALZ AND ADL8101-EVAL1Z

A 5 V, 300 mA power supply is required to provide the bias to the ADL8101. Connect the 5 V power supply to the SMT test point, VDD. Connect the ground reference to the GND test point.

Refer to the ADL8101 data sheet for the recommended resistor values to achieve different supply currents. The default value of the bias resistor, R4, connected on both the ADL8101-EVALZ and ADL8101-EVAL1Z is 715 Ω, which is the same value used to characterize the ADL8101.

The following bias conditions are recommended to achieve the performance specified in the ADL8101 data sheet: supply voltage (V_{DD}) = 5 V, quiescent current (I_{DQ}) = 90 mA, and bias resistance (R_{BIAS}) = 715 Ω.

RECOMMENDED BIAS SEQUENCING FOR THE ADL8101-EVALZ AND ADL8101-EVAL1Z

To power up both the ADL8101-EVALZ and ADL8101-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 ADL8101-EVALZ and ADL8101-EVAL1Z, follow the recommended power-down sequence:

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

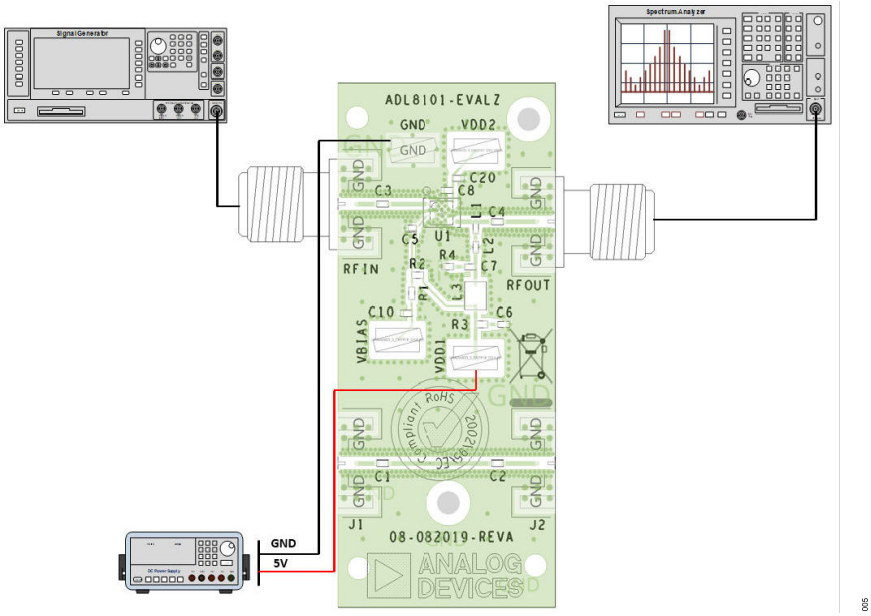

Figure 5. ADL8101-EVALZ Operating Block Diagram

EVALUATION BOARD HARDWARE

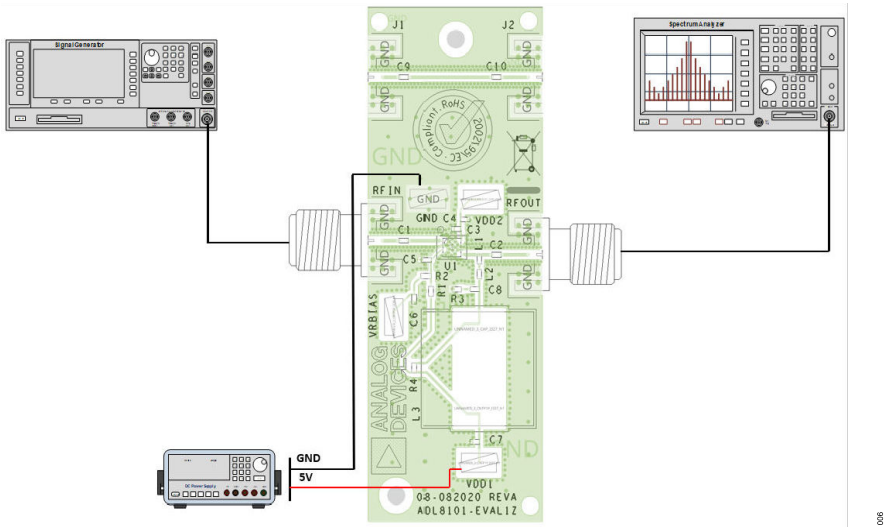

Figure 6. ADL8101-EVAL1Z Operating Block Diagram

EVALUATION BOARD HARDWARE

PERFORMANCE COMPARISON OF THE ADL8101-EVALZ AND ADL8101-EVAL1Z

Figure 7 and Figure 8 show the gain, input return loss, and output return loss for the ADL8101-EVALZ and ADL8101-EVAL1Z at frequencies up to 200 MHz. For the ADL8101-EVALZ, the gain and return loss rolls off at around 4 MHz. This roll-off is caused by the biasing network. On the ADL8101-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 ADL8101-EVALZ and ADL8101-EVAL1Z up to 22 GHz. The gain and return loss performance of ADL8101-EVALZ and ADL8101-EVAL1Z are similar, and both hold up well to 22 GHz.

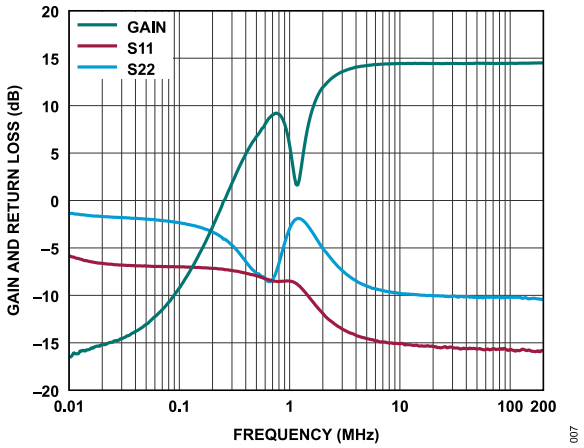

Figure 7. ADL8101-EVALZ Sub 200 MHz Performance (Baseline Evaluation Board)

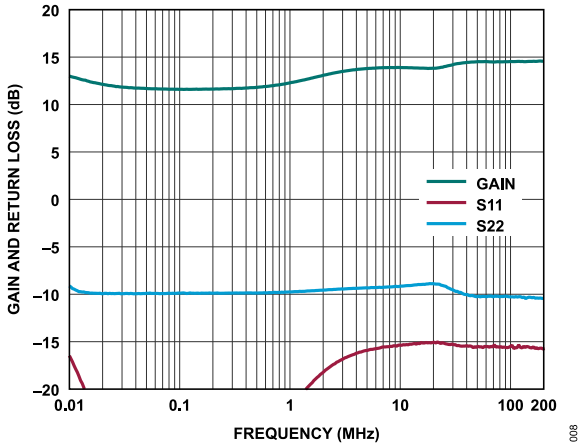

Figure 8. ADL8101-EVAL1Z Sub 200 MHz Performance (Low Frequency Extension Evaluation Board)

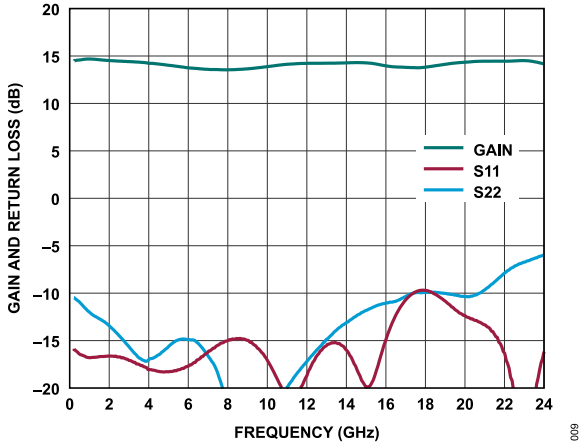

Figure 9. ADL8101-EVALZ 200 MHz to 22GHz Performance (Baseline Evaluation Board)

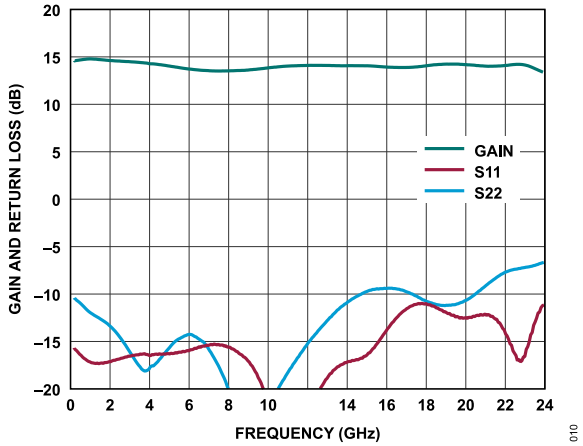

Figure 10. ADL8101-EVAL1Z 200 MHz to 22GHz Performance (Low Frequency Extension Evaluation Board)

EVALUATION BOARD HARDWARE

THROUGH CALIBRATION PATH

The ADL8101-EVALZ and ADL8101-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 ADL8101-EVALZ and ADL8101-EVAL1Z, the through calibration paths includes two AC coupling capacitors (not populated) to mimic the AC coupling capacitors in the main signal path.

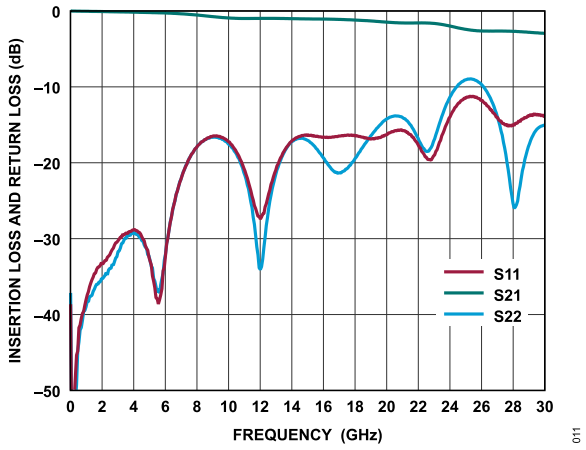

Figure 11. Insertion Loss and Return Loss (Input and Output) of the Through Calibration Path (ADL8101-EVALZ and ADL8101-EVAL1Z)

Table 1. Insertion Loss of the Through Calibration Path (ADL8101-EVALZ and ADL8101-EVAL1Z)

Frequency (GHz)	Insertion Loss (dB)
0.01	−0.009
0.20	−0.022
0.5	−0.029
0.70	−0.039
1	−0.044
3	−0.129
5	−0.221
7	−0.391
9	−0.758
11	−1.015
13	−1.001
15	−1.078
17	−1.147
19	−1.352
21	−1.619
23	−1.696

EVALUATION BOARD SCHEMATICS AND ARTWORK

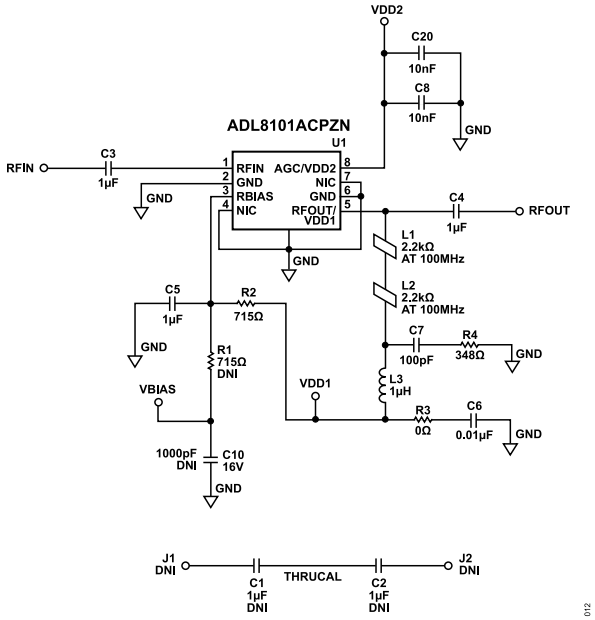

Figure 12. ADL8101-EVALZ Schematic

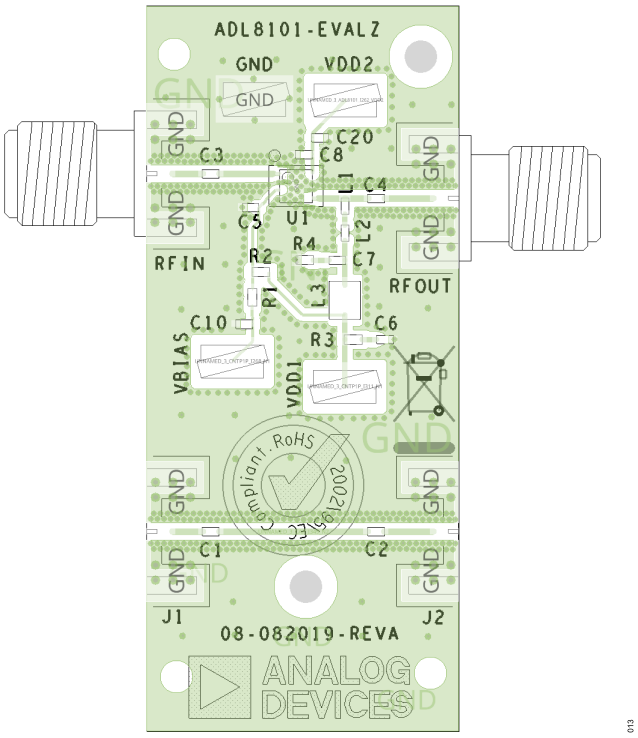

Figure 13. ADL8101-EVALZ Assembly Drawing (J1 and J2 Not Installed)

EVALUATION BOARD SCHEMATICS AND ARTWORK

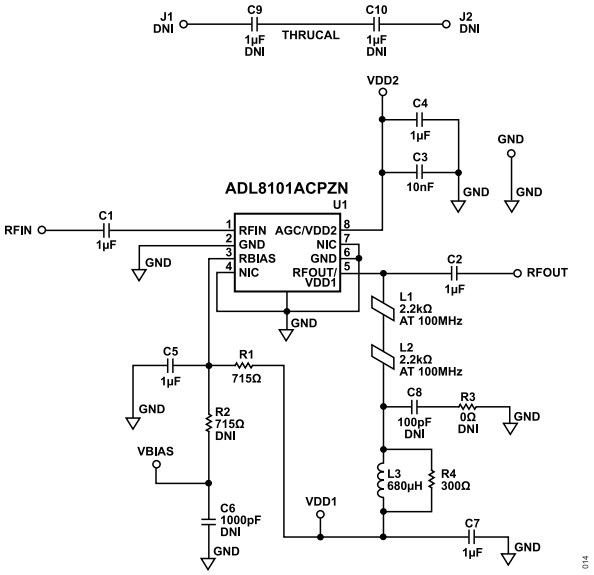

Figure 14. ADL8101-EVAL1Z Schematic

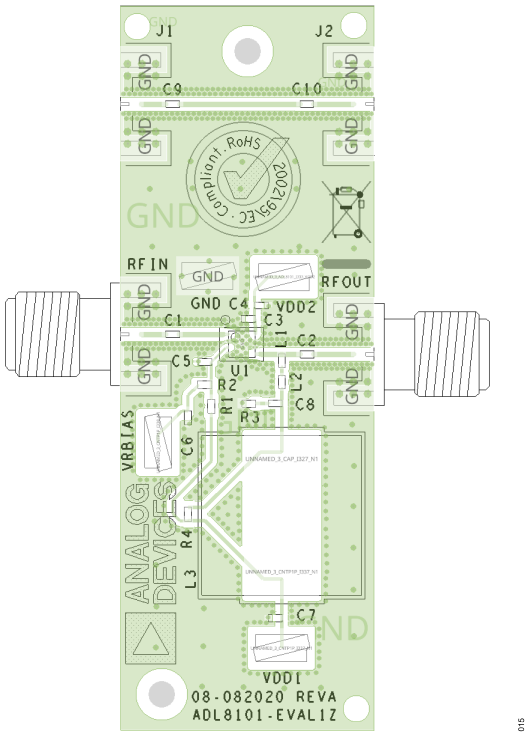

Figure 15. ADL8101-EVAL1Z Assembly Drawing (J1 and J2 Not Installed)

ORDERING INFORMATION

BILL OF MATERIALS

Table 2. ADL8101-EVALZ Bill of Materials

Reference Designator	Description	Manufacturer	Manufacturer Number
C1, C2,	Ceramic capacitor, 1 µF, 25 V, 10%, X5R, 0402 (DNI)	TDK	C1005X5R1E105K050BC
C3, C4, C5, C20	Ceramic capacitor, 1 µF, 25 V, 10%, X5R, 0402	TDK	C1005X5R1E105K050BC
C7	Ceramic capacitors, 100 pF, 50 V, 5%, C0G, 0402	Yageo	CC0402JRNPO9BN101
C6	Ceramic capacitor, 0.01 µF, 25 V, 10%, X8R, 0402	TDK	C1005X8R1E103K050BA
C8	Ceramic capacitor, 10 nF, 25 V, 10%, X7R, 0402	TDK	CGA2B2X7R1E103K050BA
C10	Ceramic capacitor, 1000 pF, 16 V, 10%, X7R, 0402 (DNI)	Yageo	CC0402KRX7R7BB102
L1, L2	Inductors, ferrite bead, 2.2 kΩ, 25%, 100 MHz, 0.15 A, 0402	TDK	MMZ1005A222ET000
L3	Inductor chip, 1 µH, 5%, 0.069 Ω, 0.5 A, 0805, AEC-Q200	Coilcraft, Inc.	0805LS-102XJLC
R1	Resistor SMD, 715 Ω, 1%, 1/10 W, 0402 (do not install, DNI)	Panasonic	ERJ-2RKF7150X
R2	Resistor SMD, 715 Ω, 1%, 1/10 W, 0402	Panasonic	ERJ-2RKF7150X
R3	Resistor SMD, 0 Ω jumper, 1/10 W, 0402	Panasonic	ERJ-2GE0R00X
R4	Resistor SMD, 348 Ω, 1%, 1/10 W, 0402	Panasonic	ERJ2RKF3480X
VBIAS, GND, VDD1, VDD2	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 MHz to 22 GHz, ultrawideband, low noise amplifier	Analog Devices, Inc.	ADL8101ACPZN

Table 3. ADL8101-EVAL1Z Bill of Materials

Reference Designator	Description	Manufacturer	Manufacturer Number
C1, C2, C4, C5, C7	Ceramic capacitors, 1 µF, 25 V, 10%, X5R, 0402	TDK	C1005X5R1E105K050BC
C9, C10	Ceramic capacitors, 1 µF, 25 V, 10%, X5R, 0402 (DNI)	TDK	C1005X5R1E105K050BC
C3	Ceramic capacitor, 10 nF, 25 V, 10%, X7R, 0402	TDK	CGA2B2X7R1E103K050B
L1, L2	Inductors, ferrite bead, 2.2 kΩ, 25%, 100 MHz, 0.15 A, 0402	TDK	MMZ1005A222ET000
L3	Inductor, power shielded, 680 µH, 10%, 100 kHz, 1.17 A, 0.596 Ω	Coilcraft, Inc.	MSS1210H-684KED
R1	Resistor SMD, 715 Ω, 1%, 1/10 W, 0402	Panasonic	ERJ-2RKF7150X
R2	Resistor SMD, 715 Ω, 1%, 1/10 W, 0402 (do not install, DNI)	Panasonic	ERJ-2RKF7150X
R3	Resistor SMD, 0 Ω jumper, 1/10 W, 0402 (do not install, DNI)	Panasonic	ERJ-2GE0R00X
R4	Resistor SMD, 300 Ω, 1%, 1/10 W, 0402	Panasonic	ERJ-2GEJ301X
C6	Ceramic capacitor, 1000 pF, 16 V, 10%, X7R, 0402 (do not install, DNI)	Yageo	CC0402KRX7R7BB102
C8	Ceramic capacitor, 100 pF, 50 V, 5% C0G, 0402 (do not install, DNI)	Yageo	CC0402JRNPO9BN101
VRBIAS, GND, VDD1, VDD2	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 22 GHz, ultrawideband, low noise amplifier	Analog Devices, Inc.	ADL8101ACZPN

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.