Evaluating the HMC8414 Low Noise Amplifier with Bypass Switches, 100 MHz to 10 GHz

FEATURES

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

EVALUATION KIT CONTENTS

- HMC8414-EVALZ evaluation board

EQUIPMENT NEEDED

- RF signal generator
- RF spectrum analyzer
- RF network analyzer
- 5 V, 300 mA power supply
- 0 V/3 V, 100 mA power supply

GENERAL DESCRIPTION

The HMC8414-EVALZ is a 4-layer printed circuit board (PCB) fabricated from 10 mil (0.254 mm) thick, Rogers 4350B and Isola 370HR, copper clad, forming a nominal thickness of 62 mils (1.575 mm). The RFIN and RFOUT ports on the HMC8414-EVALZ are populated with SubMiniature Version A (SMA), female coaxial connectors, and the corresponding RF traces have a 50 Ω characteristic impedance. The HMC8414-EVALZ is populated with components suitable for use over the entire −40°C to +85°C operating temperature range of the HMC8414ACPZN. To calibrate board trace losses, a through calibration path is provided. Install RF connectors in the J1 and J2 positions to use the through calibration path. Refer to Figure 4 for the insertion loss and return loss of the through calibration path.

Access the HMC8414-EVALZ power supply and digital control pin through the surface-mount technology (SMT) test point connectors, VRBIAS, VCTRL, and VDD.

The RF traces on the HMC8414-EVALZ 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 to the HMC8414-EVALZ.

Figure 5 shows the HMC8414-EVALZ schematic and configuration used to characterize and qualify the device.

For full details on the HMC8414, see the HMC8414 data sheet, which must be consulted in conjunction with this user guide when using the HMC8414-EVALZ.

EVALUATION BOARD PHOTOGRAPHS

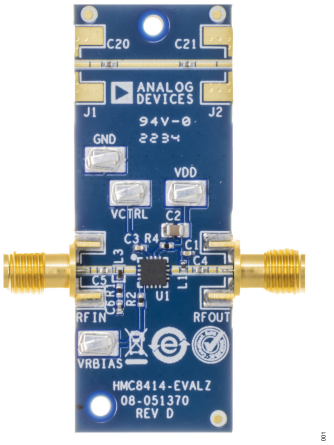

Figure 1. HMC8414-EVALZ Primary Side

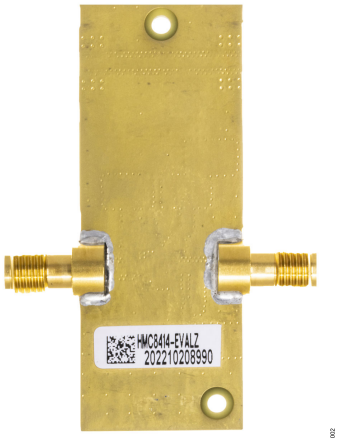

Figure 2. HMC8414-EVALZ Secondary Side

TABLE OF CONTENTS

REVISION HISTORY

10/2023—Revision 0: Initial Version

OPERATING THE HMC8414-EVALZ

To operate the HMC8414-EVALZ, perform the following steps:

1. Connect a 5 V, 300 mA power supply to the VDD and VRBIAS SMT test points.
2. Connect the power supply ground to the GND test point.
3. Connect the 0 V/3 V power supply to the VCTRL test point to operate the device in either amplifier or internal bypass mode.

Refer to the HMC8414 data sheet for the recommended resistor values to set different supply currents. The default value of the bias resistor, R1, connected on the HMC8414-EVALZ is 499 Ω, which is the same value used to characterize the HMC8414.

The following bias conditions are recommended to achieve the performance specified in the HMC8414 data sheet:

- V_{DD} = 5 V
- V_{RBIAS} = 5 V
- V_{CTRL} = 0 V or 3 V (bypass or amplifier mode)
- Total supply current (I_{DQ}) = 90 mA
- Bias resistance (R_{BIAS}) = 499 Ω

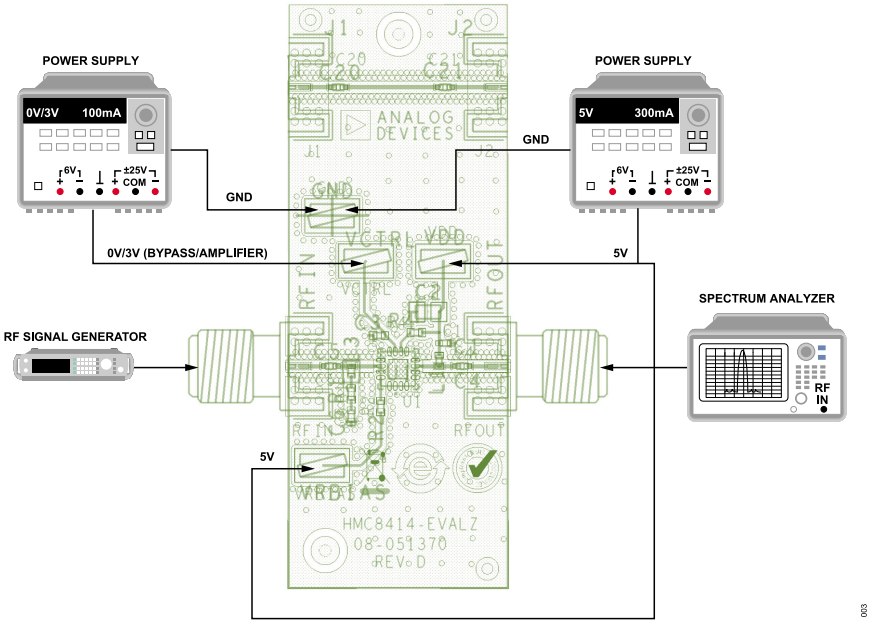

Figure 3. HMC8414-EVALZ Operating Block Diagram

OPERATING THE HMC8414-EVALZ

RECOMMENDED BIAS SEQUENCING

During Power-Up

To power up the HMC8414-EVALZ, take the following bias sequencing steps:

1. Set the V_{DD} supply to 5 V.
2. Set the V_{RBIAS} supply to 5 V.
3. Set the V_{CTRL} supply to 0 V for internal bypass mode or 3 V for internal amplifier mode.
4. Apply the RF input signal.

During Power-Down

To power down the HMC8414-EVALZ, take the following bias sequencing steps:

1. Turn off the RF input signal.
2. Set the V_{CTRL} supply to 0 V.
3. Set the V_{RBIAS} supply to 0 V.
4. Set the V_{DD} supply to 0 V.

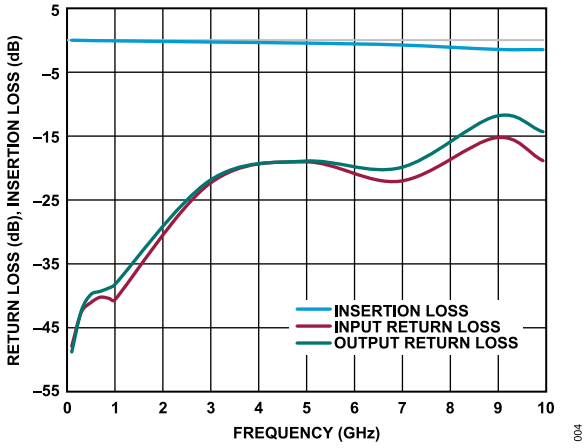

Figure 4. Insertion Loss and Return Loss of the J1 to J2 Through Calibration Path

Table 1. Insertion Loss and Return Loss of the J1 to J2 Through Calibration Path

Frequency (GHz)	Insertion Loss (dB)	Input Return Loss (dB)	Output Return Loss (dB)
0.1	−0.02	−48.16	−49.08
0.3	−0.05	−42.82	−42.63
0.5	−0.08	−41.31	−40.04
0.7	−0.09	−40.45	−39.53
0.9	−0.11	−40.67	−38.95
1.0	−0.12	−40.92	−38.51
3.0	−0.31	−22.53	−22.05
5.0	−0.48	−19.15	−19.04
7.0	−0.77	−22.19	−20.09
9.0	−1.46	−15.38	−12.00
10	−1.51	−18.98	−14.43

EVALUATION BOARD SCHEMATIC AND ARTWORK

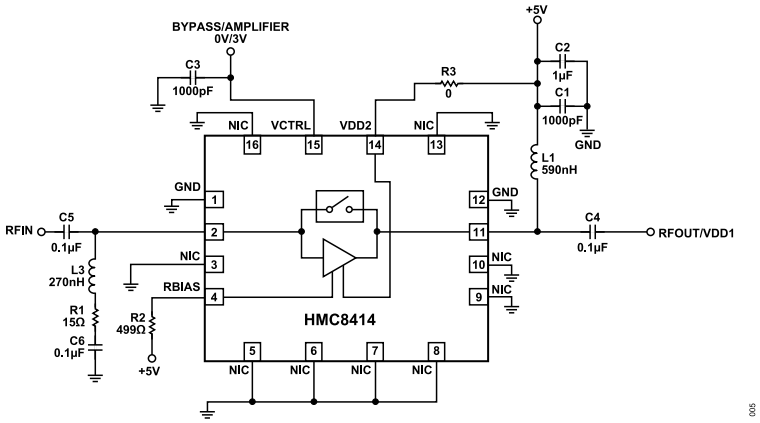

Figure 5. HMC8414-EVALZ Schematic

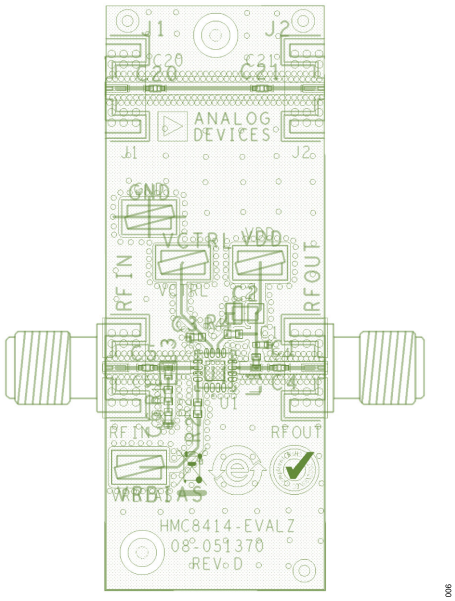

Figure 6. HMC8414-EVALZ Assembly Drawing (J1 and J2 Are Not Installed)

ORDERING INFORMATION

BILL OF MATERIALS

Table 2. Bill of Materials

Reference Designator	Description	Manufacturer	Part Number
C1, C3	Capacitor, ceramic, 1000 pF, 6 V, 10%, X7R, 0402	Yageo	AC0402KRX7R7BB102
C2	Capacitor, ceramic, 1 µF, 16 V, 10%, X8R, 0805	TDK	C2012X8R1C105K125AB
C4, C5, C20, C21	Capacitor, ceramic, 0.1 µF, 25 V, 10%, X5R, 0402	Yageo	CC0402KRX5R8BB104
L1	Inductor, ferrite bead, 590 nH, 470 Ω, 25%, 100 MHz, 0.2 A, 1.3 Ω, DC resistance (DCR), 0402	Murata	BLM15GG471SZ1D
L3	Inductor, chip, 270 nH, 0.265 Ω, DCR, 0.59 A	Coilcraft	0402DF-271XJRW
R1	Resistor, surface-mounted device (SMD), 15 Ω, 1%, 1/10 W, 0402	Panasonic	ERJ-2RKF15R0X
R2	Resistor, SMD, 499 Ω, 1%, 1/10 W, 0402	Panasonic	ERJ-2RKF4990X
R3	Resistor, SMD, 0 Ω jumper, 1/16 W, 0402	Yageo	RC0402JR-070RL
VCTRL, VDD, VRBIAS, GND	Connectors, SMT test points	Keystone Electronics	5016
RFIN, RFOUT, J1 (Unpopulated), J2 (Unpopulated)	Connectors, SMA, jack edge	SRI Connector Gage Co.	21-146-1000-01