

Evaluating the **HMC8412** Low Noise Amplifier, 0.4 GHz to 11 GHz

FEATURES

4-layer, Rogers 4350B and Isola 370HR evaluation board
End launch, 3.5 mm RF connectors
Through calibration path (depopulated)

EVALUATION KIT CONTENTS

EV1HMC8412LP2F evaluation board

EQUIPMENT NEEDED

RF signal generator
RF spectrum analyzer
RF network analyzer
5 V, 100 mA power supply

GENERAL DESCRIPTION

The EV1HMC8412LP2F consists of a 4-layer printed circuit board (PCB) fabricated from 10 mil thick, Rogers 4350B and Isola 370HR, copper clad, forming a nominal thickness of 62 mils. The RFIN and RFOUT ports on the EV1HMC8412LP2F are populated with 3.5 mm, female coaxial connectors, and the corresponding RF traces have a 50 Ω characteristic impedance. The EV1HMC8412LP2F is populated with components suitable for use over the entire -40°C to $+85^{\circ}\text{C}$ operating temperature range of the **HMC8412**. To calibrate 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 Table 1 and Figure 3 for the through calibration path performance.

Access the EV1HMC8412LP2F ground path and V_{DD} pin 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 R_{BIAS} pin (see Figure 5 for the test point assembly).

The RF traces on the EV1HMC8412LP2F 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 heat sink.

The power supply decoupling capacitors on the EV1HMC8412LP2F represent the configuration used to characterize and qualify the device. It is possible to reduce the number of capacitors, but this reduction varies from system to system. It is recommended to first remove or combine the largest capacitors that are farthest from the **HMC8412** when reducing the number of capacitors.

EVALUATION BOARD PHOTOGRAPHS



Figure 1. EV1HMC8412LP2F Primary Side



Figure 2. EV1HMC8412LP2F Secondary Side

For full details on the **HMC8412**, see the **HMC8412** data sheet, which must be consulted in conjunction with this user guide when using the EV1HMC8412LP2F.

TABLE OF CONTENTS

| | | | |
|------------------------------------|---|---|---|
| Features | 1 | Operating the EV1HMC8412LP2F..... | 3 |
| Evaluation Kit Contents..... | 1 | Evaluation Board Schematic and Artwork..... | 4 |
| Equipment Needed..... | 1 | Ordering Information..... | 5 |
| General Description | 1 | Bill of Materials..... | 5 |
| Evaluation Board Photographs | 1 | | |
| Revision History | 2 | | |

REVISION HISTORY

5/2020—Revision 0: Initial Version

OPERATING THE EV1HMC8412LP2F

A 5 V, 100 mA power supply is required to provide the bias to the HMC8412 when using the EV1HMC8412LP2F. Connect the 5 V power supply to the SMT test point labeled VDD. Connect the ground reference to the GND test point.

Refer to the HMC8412 data sheet for the recommended resistor values to achieve different supply currents.

See the HMC8412 data sheet for the bias sequencing information. The following bias conditions are recommended to achieve optimal performance: $V_{DD} = 5\text{ V}$ and supply current (I_{DQ}) = 60 mA.

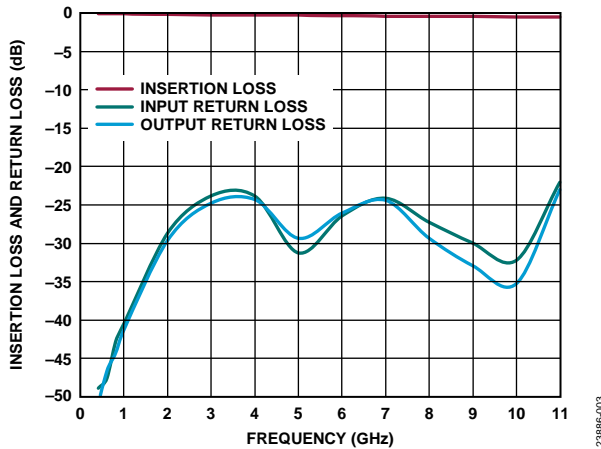


Figure 3. Insertion Loss and Return Loss of the Through Calibration Path

Table 1. Insertion Loss of the Through Calibration Path

| Frequency (GHz) | Insertion Loss (dB) | Input Return Loss (dB) | Output Return Loss (dB) |
|-----------------|---------------------|------------------------|-------------------------|
| 0.4 | 0.0 | -49.0 | -51.1 |
| 0.6 | 0.0 | -47.7 | -46.8 |
| 0.8 | 0.0 | -42.9 | -44.4 |
| 1.0 | -0.1 | -40.4 | -41.2 |
| 2.0 | -0.1 | -28.7 | -29.6 |
| 3.0 | -0.2 | -23.8 | -24.8 |
| 4.0 | -0.2 | -23.9 | -24.3 |
| 5.0 | -0.2 | -31.3 | -29.4 |
| 6.0 | -0.3 | -26.5 | -26.1 |
| 7.0 | -0.3 | -24.2 | -24.4 |
| 8.0 | -0.4 | -27.3 | -29.4 |
| 9.0 | -0.4 | -30.0 | -33.0 |
| 10.0 | -0.4 | -32.2 | -35.3 |
| 11.0 | -0.5 | -22.1 | -23.0 |

ORDERING INFORMATION

BILL OF MATERIALS

Table 2.

| Reference Designator | Description | Manufacturer | Part Number |
|----------------------|--|------------------------|-------------------------|
| C1, C3 | Ceramic capacitors, 0402, surface-mount device (SMD), 0.1 μ F | Taiyo Yuden | UMK105BJ104KVHF |
| C2 | Ceramic capacitors, 0402, SMD, multilayer, NP0, high temperature, 100 pF | TDK Corporation | C1005NP01H101J050BA |
| RFIN, RFOUT | Connectors, 3.5 mm, jack edge | SRI Connector Gage Co. | 21-146-1000-01 |
| VDD, GND, VBIAS | Connectors, SMT test points | Keystone Electronics | 5016 |
| J1, J2 | Connectors, 3.5 mm, jack edge, do not install | SRI Connector Gage Co. | 21-146-1000-01 |
| R1 | Resistor, 0402, SMD chip jumper, 1.47 k Ω | Panasonic | ERJ-2RKF1471X |
| U1 | Gallium arsenide (GaAs), pseudomorphic high electron mobility transistor (pHEMT), monolithic microwave integrated circuit (MMIC), 0.4 GHz to 11 GHz, low noise amplifier | Analog Devices, Inc. | HMC8412 |



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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