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Evaluating the HMC8342 GaAs MMIC ×2 Active Frequency Multiplier, 22 GHz to 42 GHz Output

FEATURES

- Self contained board that includes the HMC8342 active frequency ×2 multiplier
- Externally powered by a 5.0 V supply
- Controlled by two −2.0 V power supplies

EVALUATION KIT CONTENTS

- EV1HMC8342LS6 evaluation board

EQUIPMENT NEEDED

- Low noise, 5.0 V power supply
- 2 low noise, variable, −2.0 V power supplies
- Frequency generator
- Spectrum analyzer

ONLINE RESOURCES

- HMC8342 data sheet

GENERAL DESCRIPTION

The EV1HMC8342LS6 evaluates the performance of the HMC8342 microwave integrated circuit (MMIC), active frequency multiplier.

Figure 1 shows a photograph of the EV1HMC8342LS6. The EV1HMC8342LS6 contains the HMC8342 and two 2.92 mm K connectors. There is also a calibration path for use in calibrating out printed circuit board (PCB) trace delays at the RF input and RF output.

For full details on the HMC8342, see the HMC8342 data sheet. Consult this data sheet in conjunction with this user guide when using the EV1HMC8342LS6.

EV1HMC8342LS6 EVALUATION BOARD PHOTOGRAPH

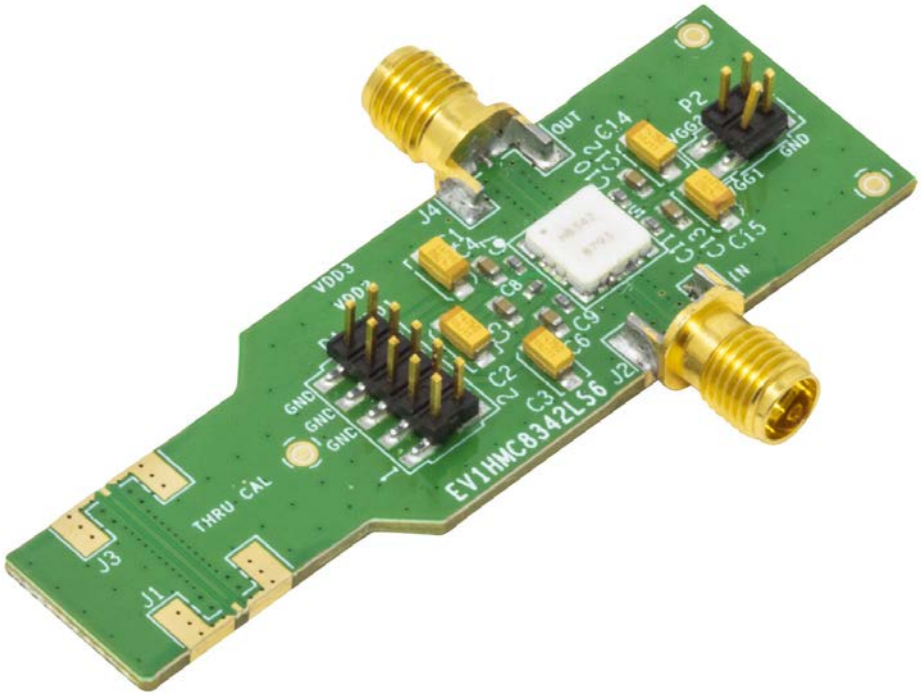

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Figure 1.

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REVISION HISTORY

6/2021—Revision 0: Initial Version

GETTING STARTED

EVALUATION BOARD SETUP PROCEDURE

To configure the EV1HMC8342LS6 for the first time, perform the following steps:

1. Verify that the power supply used for the V_{DDx} supplies can output 5.0 V and 250 mA of current.
2. Set the power supply voltage to 0 V or disable its output to prevent damage.
3. Connect a 50 Ω RF cable capable of mating to the 2.92 mm K connector at the RF input, IN (J2), and torque this connection to 8 in/lb. Connect the other end of the cable to a signal generator or other RF signal to be multiplied.
4. Connect another 2.92 mm, K connectorized, 50 Ω RF cable to the RF output, OUT (J4), and torque this connection to 8 in/lb. Connect the other end of the cable to a spectrum analyzer.
5. Using hook clips, connect a 5.0 V power supply to the VDD1, VDD2, and VDD3 headers. The corresponding header pins for each supply are marked on the silkscreen. Individual power supply channels can be used for each VDDx header if desired. Otherwise, each VDDx header can be combined together in series using a shorting jumper and connected to a single 5.0 V power supply channel.
6. Two additional power supply channels are required for the gate bias voltages, V_{GG1} and V_{GG2}. Confirm both channels are set up for −2.0 V, and then disable their outputs to avoid accidental damage.
7. Ensuring the V_{DDx} supplies are also still disabled, connect one of the negative supplies to the VGG2 header and the other to the VGG1 header of P2. The corresponding header pins are marked on the silkscreen.
8. Enable the output on both −2.0 V V_{GGx} supplies.
9. Enable the output on the 5.0 V V_{DDx} supplies.
10. Verify that the total current draw from all of the V_{DDx} supplies at this point is approximately 50 mA.
11. Increase the V_{GG2} supply to −0.8 V. Then, increase the V_{GG1} supply to −1.25 V.
    For further detail on the correct biasing sequence, and information on how to fine tune the gate bias controls, see the HMC8342 data sheet.
12. Verify that the output signal frequency is double the input frequency and the output power and isolation are within the specifications given in the HMC8342 data sheet. For an example output frequency, see Figure 2 in the Evaluation and Test section.
13. When powering down the device, ensure the V_{DDx} supplies are powered down before the V_{GGx} supplies to prevent excess current draw.

EVALUATION BOARD HARDWARE

The EV1HMC8342LS6 schematic, silkscreen, and bill of materials are available in the Evaluation Board Schematic and Artwork section and the Ordering Information section. The Gerber fabrication files are available on the HMC8342 product page.

POWER SUPPLIES

The EV1HMC8342LS6 is powered by a 5.0 V dc (170 mA typical draw) power supply connected to the V_{DD1}, V_{DD2}, and V_{DD3} pins on Header P1. The gate bias voltages, V_{GG1} and V_{GG2}, are applied to Header P2.

V_{GG1} biases the multiplier stage, and V_{GG2} biases the amplification stage.

Ensure the V_{GGx} gate voltages are applied before the V_{DDx} supply voltages. Otherwise, the device can be damaged.

For additional details on the active multiplier circuitry, consult the HMC8342 data sheet.

RF INPUT

The EV1HMC8342LS6 has one 50 Ω RF input port, IN (J2). IN is a single-ended input that operates from 11 GHz to 21 GHz. The maximum input drive level must not exceed 10 dBm.

RF OUTPUT

The EV1HMC8342LS6 has one 50 Ω RF output port, OUT (J4). J4 is a populated 2.92 mm K connector that is rated for up to 40 GHz when used with a 2.92 mm, K connectorized cable assembly.

Operation at output frequencies greater than 42 GHz do not cause damage to the main device or the EV1HMC8342LS6, but it is important to note that the output power and isolation may be outside of data sheet specification. Refer to the typical performance characteristics plots in the HMC8342LS6 data sheet for information on the losses expected outside of the specified frequency range.

CALIBRATION PATH

The EV1HMC8342LS6 has an on-board calibration path. To use the calibration path, the J1 and J3 connectors must each be populated with a 2.92 mm K connector. The electrical length of the calibration path is the same as the IN and OUT traces, but not including the length of the HMC8342.

The RF connections to the board (J1, J2, J3, and J4) all use the same footprint.

DECOUPLING

The EV1HMC8342LS6 by default comes with the recommended decoupling capacitors on its supply pins as per the HMC8342 data sheet.

DEFAULT CONFIGURATION

All components necessary for ×2 multiplication and amplification of RF signals are inserted on the EV1HMC8342LS6.

EVALUATION AND TEST

To configure the EV1HMC8342LS6 for the first time, follow Step 1 through Step 11 in the Evaluation Board Setup Procedure section. To evaluate and test the performance of the EV1HMC8342LS6, perform the following steps:

1. Connect a 15 GHz, 5 dBm signal from a signal generator to IN (J2). Observe OUT (J4) on a spectrum analyzer centered at 32 GHz. Refer to Figure 2.
2. Center the spectrum analyzer to 30 GHz and check the signal power. Refer to Figure 3. The difference in power between this signal and the signal from Step 1 is given as the fundamental input isolation.
3. Similarly, check the third and further input harmonic suppressions at the output as required by comparing the output power at these harmonics to the output signal at double the fundamental input from Step 1.
4. V_{GG2} = −0.8 V and V_{GG1} = −1.25 V are typical bias values that result in a V_{DDx} supply of between 160 mA and 190 mA for a 5 dBm input drive level. Observe that the supply current, the output power from Step 1, and the isolation from Step 2 varies if V_{GG1} and V_{GG2} are adjusted.
5. The exact gate bias voltages for optimum output power and isolation vary based on the application and input signal characteristics. However, it is possible to alternate between adjusting V_{GG1} and V_{GG2} to achieve the desired performance, ensuring the absolute maximum ratings from the HMC8342 data sheet are not exceeded.

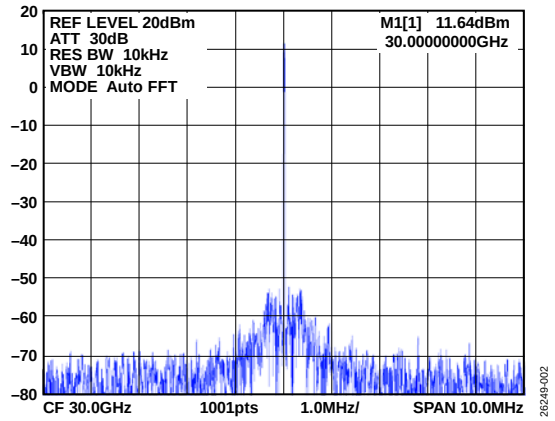

Figure 2. EV1HMC8342LS6 OUT (J4) RF Output, Input Frequency = 15 GHz, Input Power = 5 dBm, V_{GG2} = −0.8 V, V_{GG1} = −1.25 V, Includes Insertion Loss of the RF Cable

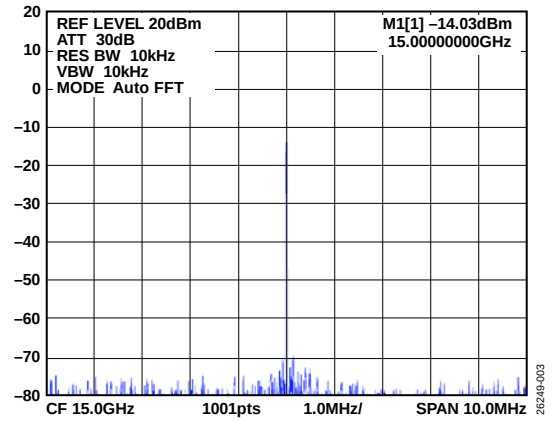

Figure 3. EV1HMC8342LS6 OUT (J4) Isolation, Input Frequency = 15 GHz, Input Power = 5 dBm, V_{GG2} = −0.8 V, V_{GG1} = −1.25 V, Includes Insertion Loss of the RF Cable

EVALUATION BOARD SCHEMATIC AND ARTWORK

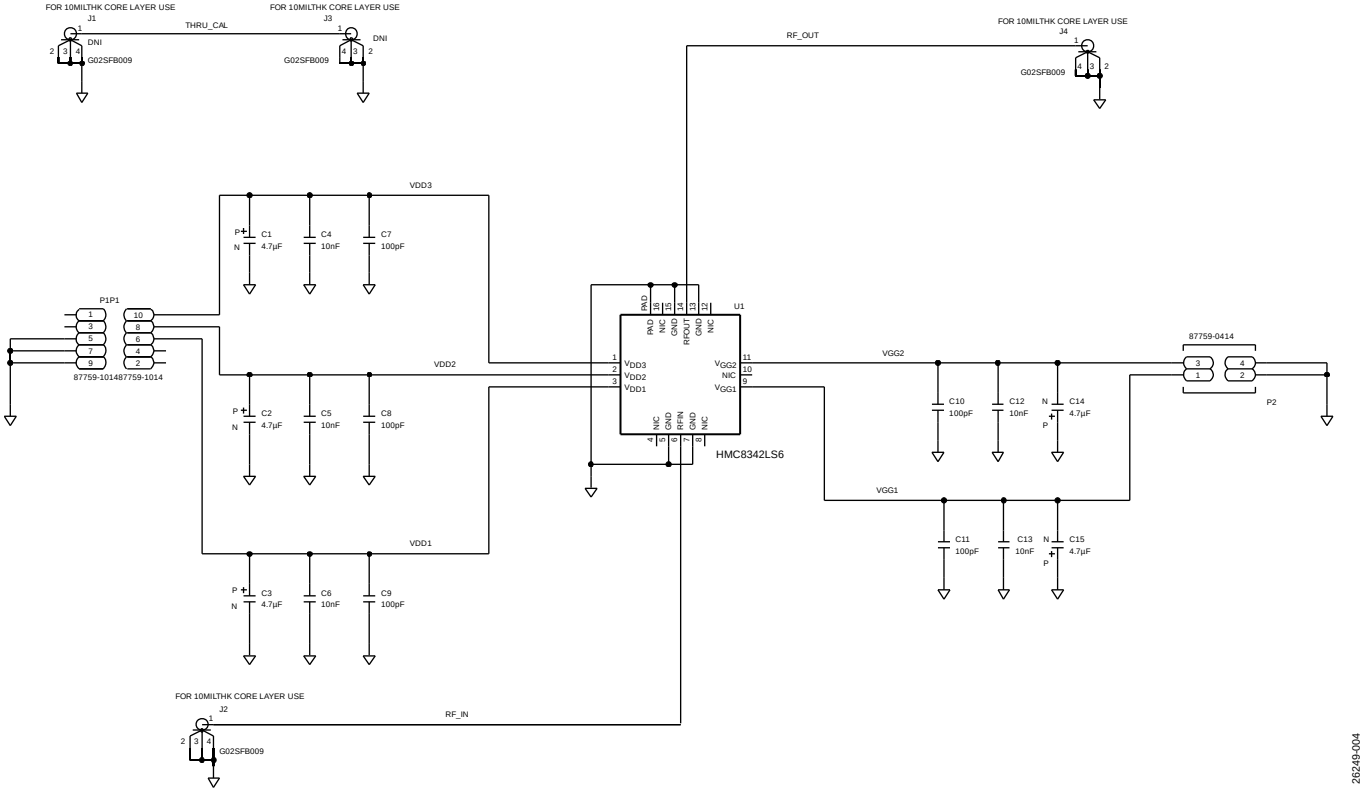

Figure 4. EV1HMC8342LS6 Schematic

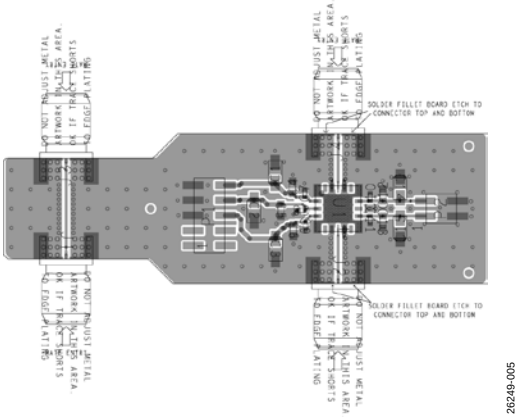

Figure 5. EV1HMC8342LS6 Silk Screen and Metal 1, Top Side

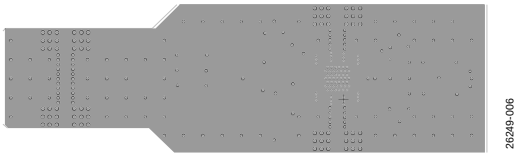

Figure 6. EV1HMC8342LS6 Metal 2, Ground

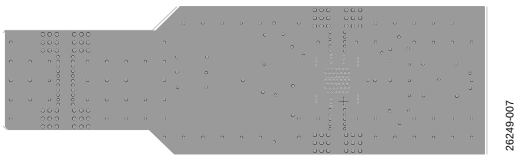

Figure 7. EV1HMC8342LS6 Metal 3, Ground

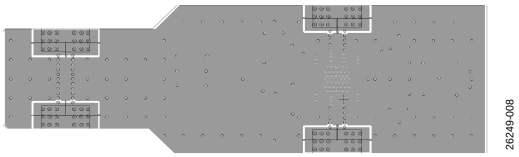

Figure 8. EV1HMC8342LS6 Metal 4, Backside

ORDERING INFORMATION

BILL OF MATERIALS

Table 1. Bill of Materials

Reference Designator	Description	Value	Manufacturer	Part Number
C1, C2, C3, C14, C15	Capacitors, tantalum, 10%, 3216	4.7 µF	AVX	TAJA475K020RNJ
C7, C8 ,C9, C10 ,C11	Capacitors, ceramic, 5%, C0G, 0402	100 pF	TDK	C1005NP01H101J050BA
C4, C5, C6, C12, C13	Capacitors, ceramic, 10%, X7R, 0603	10 nF	Murata	GCM188R72A103KA37J
J2, J4	2.92 mm, K connectorized coaxial edge mount jack	Not applicable	Gigalane	G02SFB009
P1	10-position male header, unshrouded, double row, 2 mm pitch	Not applicable	Molex	87759-1014
P2	4-position male header, unshrouded, double row, 2 mm pitch	Not applicable	Molex	87759-0414
U1	GaAs, MMIC, ×2 active frequency multiplier, 22 GHz to 42 GHz output	Not applicable	Analog Devices, Inc.	HMC8342