LMH3401EVM Evaluation Module (EVM)

The LMH3401EVM is an evaluation module for the single LMH3401 amplifier in a 14-lead high-performance RF package. This evaluation module is designed to quickly and easily demonstrate the functionality and versatility of the amplifier. The EVM is ready to connect to power, signal source, and test instruments through the use of onboard connectors. The EVM comes configured for easy connection with common 50-Ω laboratory equipment on its inputs and outputs. The amplifier is configured for single-ended input with gain of 16 dB (6.31 V/V). The board has differential outputs, one for each of the amplifier outputs. It can be easily configured for differential inputs, and single- or split-supply operation.

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1 Features

- Configured for split-supply operation and easily modified for single supply
- Single ended or differential input signals
- Fully differential output
- Designed for easy connection to standard 50-Ω input/output impedance test equipment
- Inputs and outputs include SMA connectors

2 EVM Specifications

V_S	Single-supply voltage range (V– = ground)	3.3 V to 5.25 V
V_S±	Split-supply voltage range	±1.65 V to ±2.625 V
GND	Ground reference pins	(V+ – 2 V) to V–
PD	Power down (PD) input voltage	GND to Vcc
I_S±	Supply current	58 mA
I_{IN}	Input voltage	V_S±, Max
I_{OUT}	Output drive	±40 mA

3 Power Connections

The LMH3401EVM is equipped with test loops for easy connection of power. The positive supply input is red and is labeled V+. The negative supply input is yellow and is labeled V–. Ground is black and is labeled GND.

3.1 Split-Supply Operation

To operate as split supply, apply the positive supply voltage to V+, negative supply voltage to V– , and the ground reference from supply to GND. Note that supply voltages do not need to be symmetrical, provided the total supply voltage is between 3.3 V and 5.25 V any combination of positive and negative supply voltages is acceptable. This feature is often used when the output common mode voltage must be set to a particular value. For best performance, the power supply voltages should be symmetrical around the desired output common mode voltage.

3.2 Single-Supply Operation

To operate as single supply, connect jumper V– to GND, and apply the positive supply voltage to V+. Inputs and outputs must be biased as in the LMH3401 datasheet (SBOS695) specifications for proper operation.

4 Input and Output Connections

The LMH3401EVM is equipped with SMA connectors for easy connection of signal generators and analysis equipment. As shipped, the EVM is configured for a gain of 16 dB, split supply, single-ended input and differential outputs each with 50-Ω termination. For best results, signals must be routed to and from the EVM with cables having 50-Ω characteristic impedance. IN+ and IN- are symmetrical and are the input connectors for single-ended input signals. OUT+ and OUT- are the output connectors. . See the LMH3401 datasheet applications section, schematics, and layouts for more detail and how to reconfigure the EVM.

4.1 CM (Output Common Mode Voltage) Input

The LMH3401 has an output common mode control pin that is used to set the output common mode voltage. The evaluation board is configured with a resistive divider to set the output common mode voltage at the mid supply voltage. If a different output common mode voltage is specified, the SMA connector can be used to connect an external voltage source. The valid voltage range for the CM pin is approximately (V+ – 2 V) to (V– + 2 V). See the LMH3401 datasheet (SBOS695) for performance curves that show how performance is impacted by an output common mode voltage that is not at the mid-supply voltage.

4.2 PD (Power Down) Input

The LMH3401 has a power down input pin that allows the amplifier to be put into a low power state when it does not need to be active. The LMH3401 PD pin is referenced to the GND pin. The threshold voltage is 1.1 V. Any voltage over 1.2 V above the ground reference pins will disable the amplifier. Any input below 1.0 V will enable the amplifier. Because the PD pin is not referenced to either of the supply pins the same logic level can be used for the PD function regardless of the configuration of the supply voltages. The LMH3401EVM has a jumper (JPD) that allows the amplifier to be manually disabled. In order to facilitate driving the PD pin with a high-speed signal source, the resistor/capacitor combination (Rsd/C9) provides high frequency termination for signals from a 50-Ω pulse generator.

4.3 Single-Ended Inputs

The LMH3401 was designed for use with 50-Ω single-ended inputs. Even though the board was designed for single-ended inputs, the board is fully symmetrical, so either input can be used. Connect a 50-Ω signal source to either IN+ or IN- and connect a 50-Ω SMA termination to the other input. This way both inputs have the same termination condition and the circuit is balanced. In the case where no SMA 50-Ω termination is available, it is acceptable to solder a 50-Ω resistor from the unused input signal trace to the ground plane. There is a small section of the ground plane with no solder mask that can be used for this purpose.

4.4 Differential Inputs

It is possible to use the LMH3401 for differential inputs. The LMH3401 has an internal resistance of 25 Ω (differential). In order to impedance match a 100-Ω differential source, cut the signal traces and solder 37.5-Ω resistors in place to create a 100-Ω input.

4.5 Differential Outputs

The LMH3401EVM has two output SMA connectors that are designed to mate to 50-Ω test equipment. By connecting both outputs to 50-Ω test equipment, the output load is 100-Ω differential. With the on chip and on board matching resistors, the total load to the amplifier is 200 Ω. The matching resistors cause a 6-dB loss in voltage gain. The evaluation board has 40-Ω resistors on the board because there are 10-Ω output resistors on chip inside the device.

4.6 Single-Ended Outputs

Using an external balun to combine the two differential outputs creates a single-ended signal that can be interfaced to most 50-Ω test equipment. This is the method used by TI engineers to create the datasheet plots. To match the performance of the LMH3401, a very broadband balun must be selected. We recommend the Marki B0100 or the PicoPulse Labs 5310A baluns.

5 LMH3401EVM Schematic, Layout, and Bill of Materials

This section contains the EVM schematic, PCB layouts, and the bill of materials (BOM).

5.1 Schematic

Figure 1 illustrates the LMH3401EVM schematic.

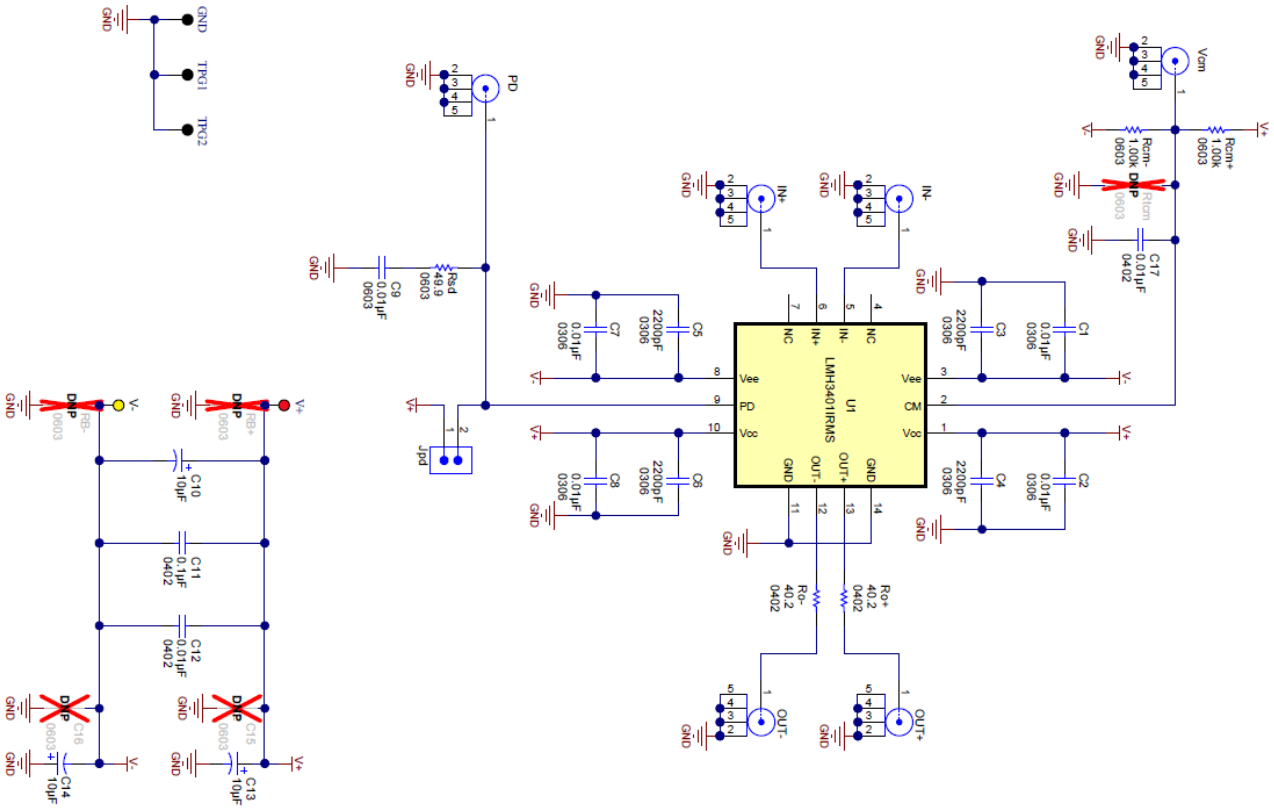

Figure 1. LMH3401EVM Schematic

5.2 LMH3401EVM Layers

Figure 2 through Figure 7 show the LMH3401EVM layers.

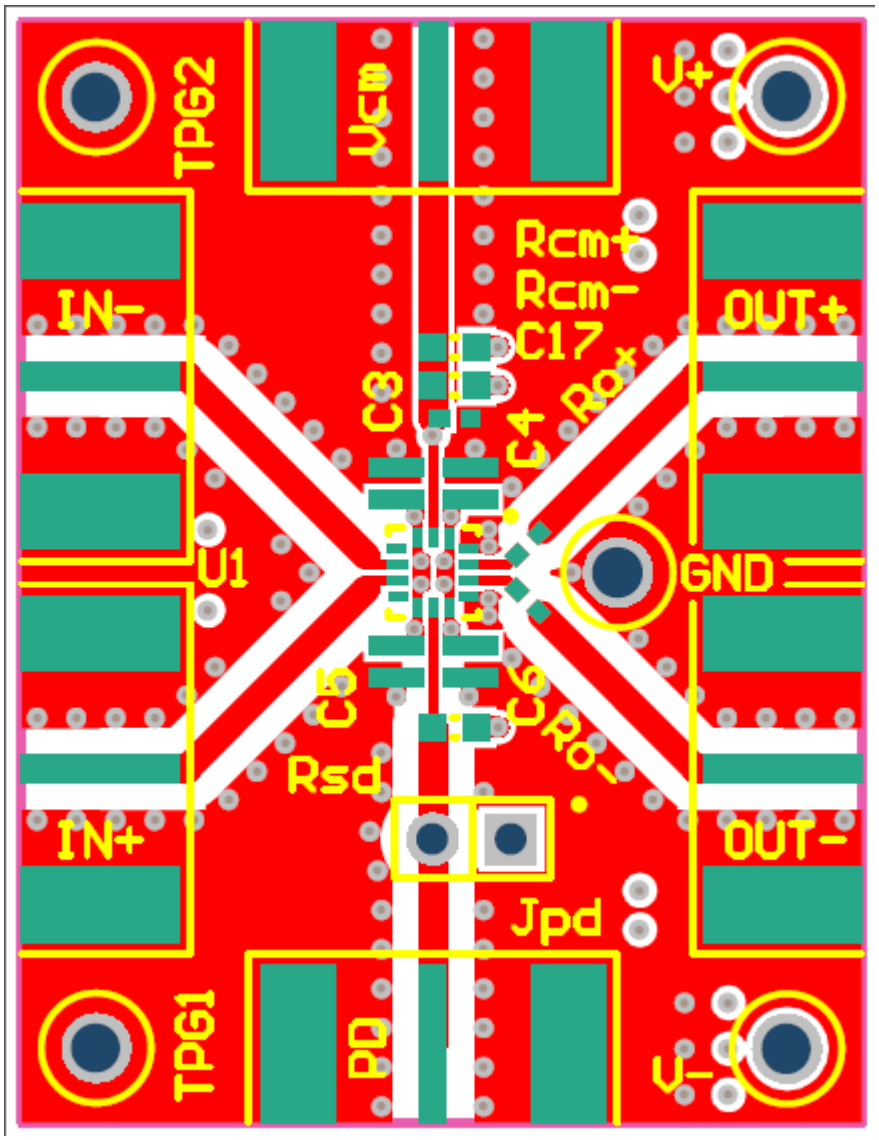

Figure 2. LMH3401EVM Top Layer

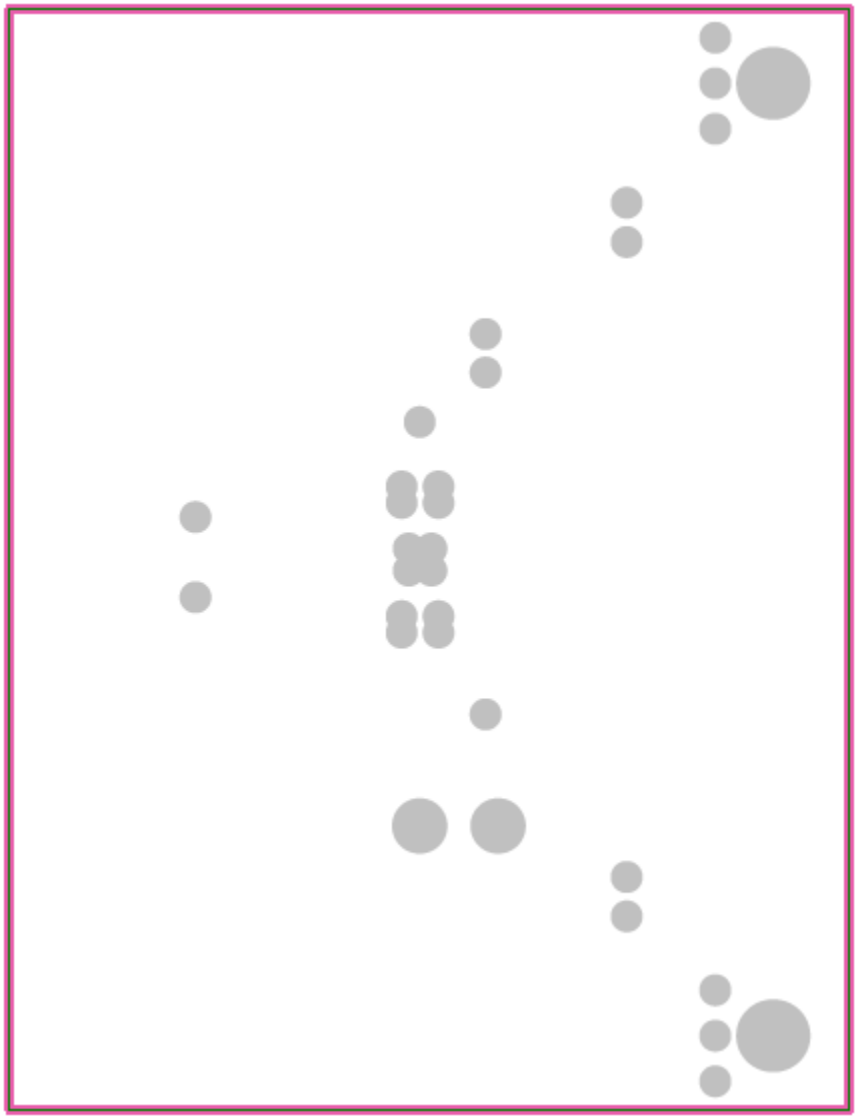

Figure 3. Layer 2

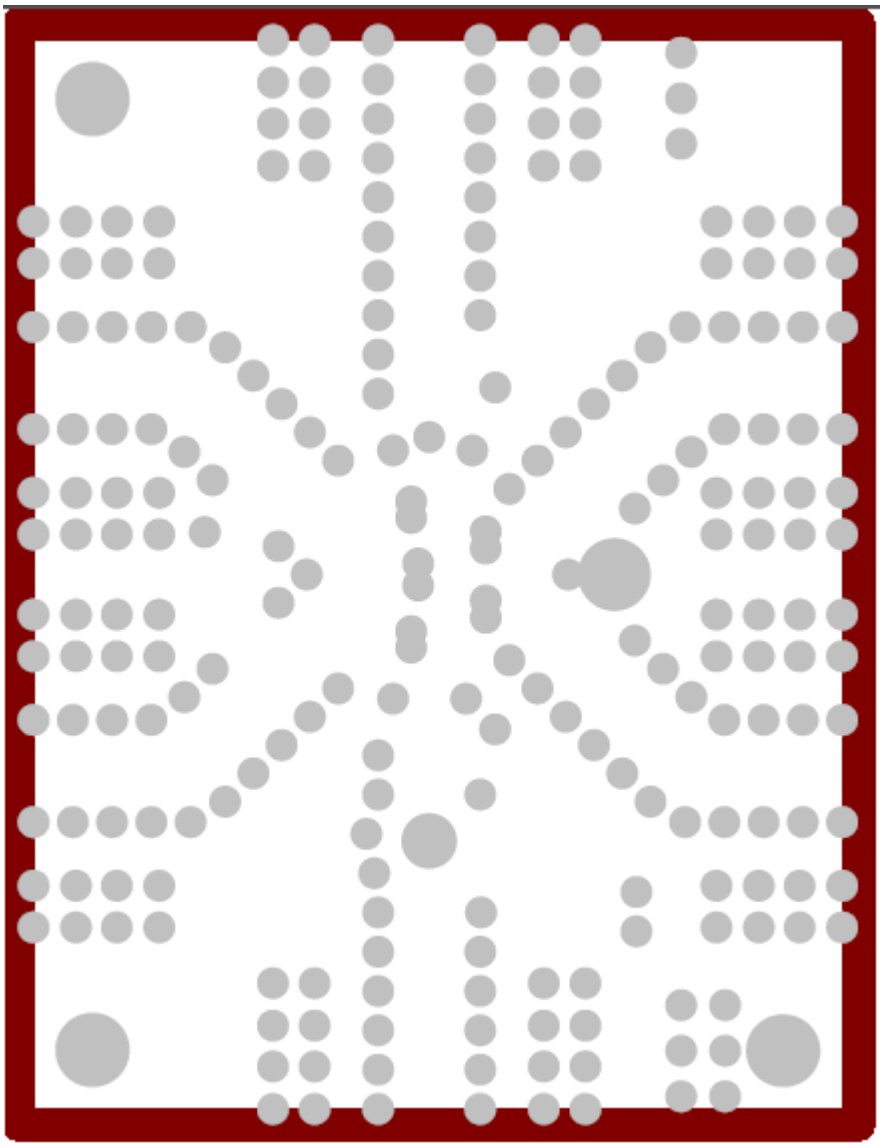

Figure 4. Layer 3

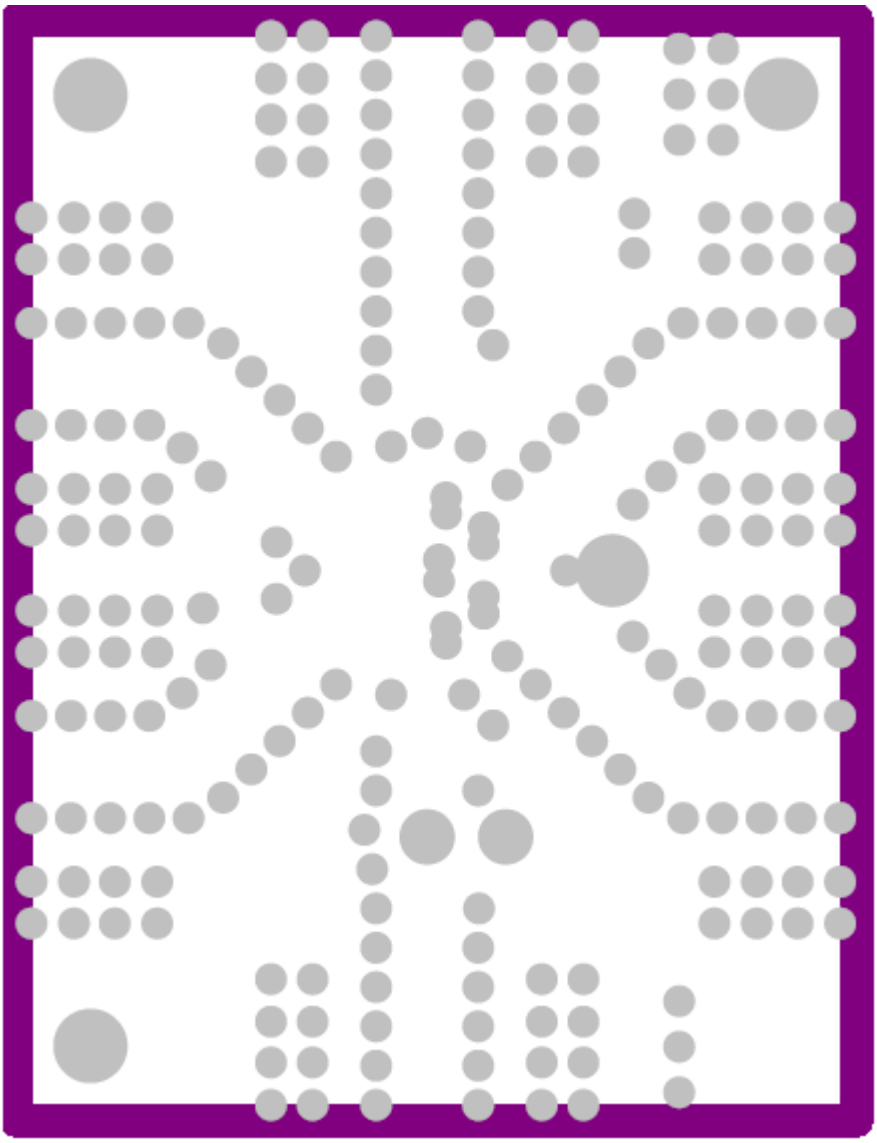

Figure 5. Layer 4

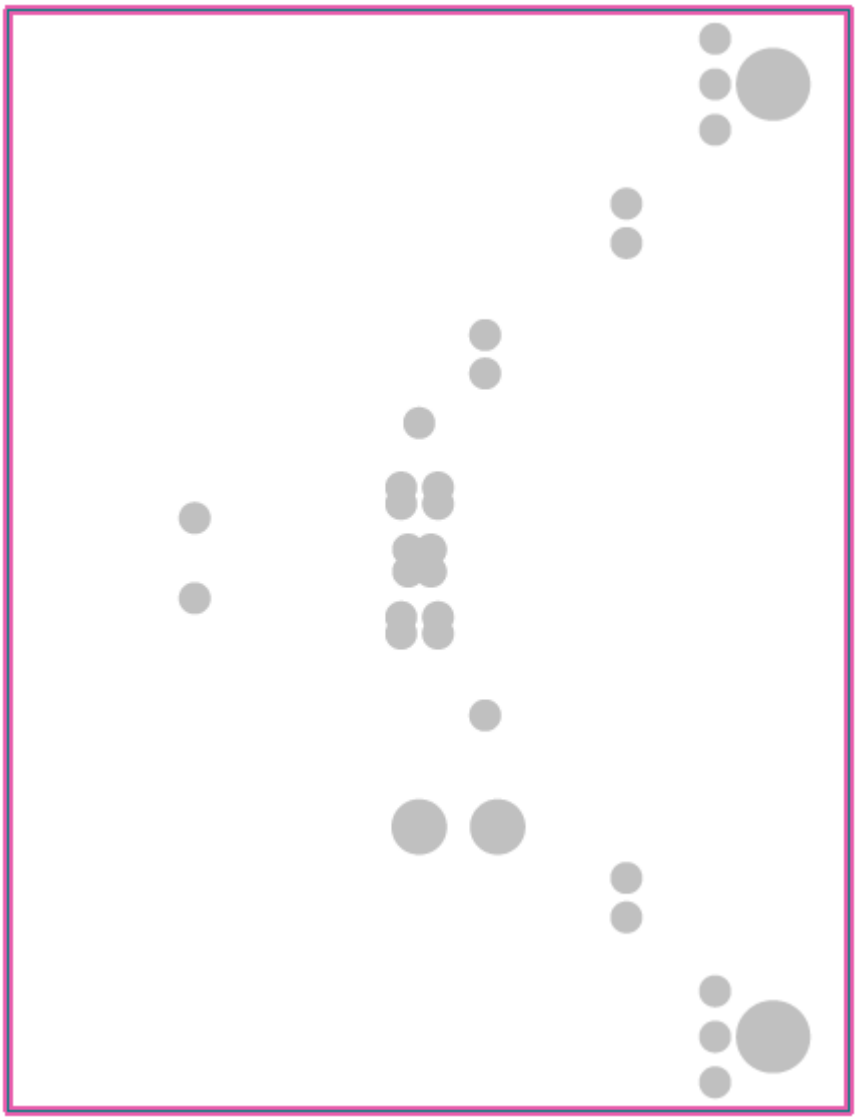

Figure 6. Layer 5

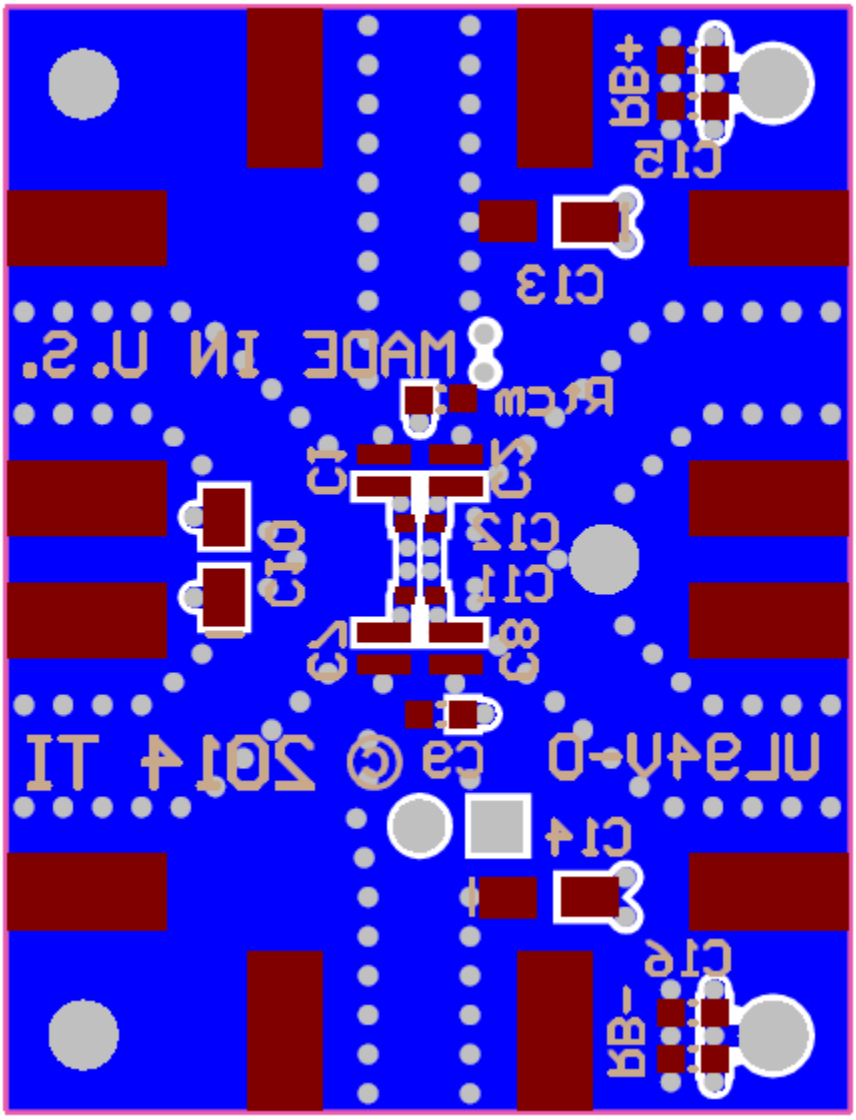

Figure 7. Bottom Layer

5.3 Bill of Materials

Table 1 lists the EVM BOM.

Table 1. LMH3401EVM Bill of Materials

Item	Designator	Description	Manufacturer	Part Number	Quantity
1	!PCB	Printed Circuit Board	Any	XX####	1
2	C1, C2, C7, C8	CAP, CERM, 0.01uF, 25V, +/-20%, X7R, 0306	MuRata	LLL185R71E103MA01L	4
3	C3, C4, C5, C6	CAP, CERM, 2200pF, 50V, +/-20%, X7R, 0306	MuRata	LLL185R71H222MA01L	4
4	C9	CAP, CERM, 0.01uF, 16V, +/-10%, X7R, 0603	MuRata	GRM188R71C103KA01D	1
5	C10, C13, C14	CAP, TA, 10uF, 10V, +/-10%, 0.9 ohm, SMD	AVX	TPSA106K010R0900	3
6	C11	CAP, CERM, 0.1uF, 10V, +/-10%, X5R, 0402	TDK	C1005X5R1A104K	1
7	C12, C17	CAP, CERM, 0.01uF, 25V, +/-10%, X7R, 0402	TDK	C1005X7R1E103K	2
8	GND, TPG1, TPG2	Test Point, TH, Multipurpose, Black	Keystone Electronics	5011	3
9	IN+, IN-, OUT+, OUT-, PD, Vcm	Connector, SMT, End launch SMA 50 ohm	Emerson Network Power	142-0701-851	6
10	Jpd	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	Samtec, Inc.	TSW-102-07-G-S	1
11	Rcm+, Rcm-	RES, 1.00k ohm, 1%, 0.1W, 0603	Vishay-Dale	CRCW06031K00FKEA	2
12	Ro+, Ro-	RES, 40.2 ohm, 1%, 0.063W, 0402	Vishay-Dale	CRCW040240R2FKED	2
13	Rsd	RES, 49.9 ohm, 1%, 0.1W, 0603	Vishay-Dale	CRCW060349R9FKEA	1
14	V+	Test Point, TH, Multipurpose, Red	Keystone Electronics	5010	1
15	V-	Test Point, Multipurpose, Yellow, TH	Keystone	5014	1
16	C15, C16, RB+, RB-, Rtcm	These components are not loaded.	N/A	N/A	0
17	U1	5 GHz Ultra Wideband Fully Differential Amplifier	TI	LMH3401IRMS	1

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- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

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2. Use EVMs only after user obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after user obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless user gives the same notice above to the transferee. Please note that if user does not follow the instructions above, user will be subject to penalties of Radio Law of Japan.

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