

User's Guide

LMH32404 Evaluation Module



ABSTRACT

This user's guide describes the characteristics, operation, and use of the LMH32404RHFEVM. This evaluation module (EVM) is an evaluation and development kit for the LMH32404RHF device, a quad-channel, single-ended input to differential output transimpedance amplifier for light detection and ranging (LIDAR) applications and laser distance measurement systems. A circuit description as well as schematic diagram, layout prints, and bill of materials are included in this document.

Throughout this document, the abbreviation *EVM* and the term *evaluation module* are synonymous with the LMH32404RHFEVM.

See [LMH32404 250 MHz, Quad-channel, Differential Output Transimpedance Amplifier data sheet](#) for more information on the LMH32404 device.

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1 Trademarks

All trademarks are the property of their respective owners.

2 Introduction

The LMH32404RHFEVM is an evaluation module (EVM) for the LMH32404RHF differential output transimpedance amplifier. The EVM features a transformer to convert the output to a 50- Ω single-ended connection for easy measurement with standard test equipment, and the option to convert to fully-differential DC-coupled signals. The input is 50- Ω matched and configured by default to receive a voltage input that is converted to a current through a 2-k Ω resistor, but can be reconfigured to receive a true current input with optional photodiode bias connections on the back of the board. The EVM also includes easy-to-use jumpers to control the device gain, input bias current cancellation, and shutdown functions.

2.1 Features

- Configured for single-ended voltage input and output with 50- Ω matched SMA connections
- Optional DC-coupled differential output configuration
- Jumpers included for easy control of channel mode, bias current cancellation, and whole chip power-down
- Designed for single 3.3-V supply operation

2.2 EVM Specifications

Table 2-1 lists the typical performance specifications for the LMH32404RHFEVM.

Table 2-1. LMH32404RHFEVM Specifications

| Specification | Typical Value Range |
|---|---------------------|
| Single-supply voltage range (VEE = ground) | 3 V to 3.65 V |
| Quiescent current per channel | 28 mA |
| Differential output voltage swing (VCC = 3.3 V, 100- Ω load) | 5 V _{PP} |
| Linear output current (VCC = 3.3 V, 25- Ω load) | 26.6 mA |

3 Power Connections

The LMH32404RHFEVM is equipped with a wire socket to easily connect power. The positive supply input is labeled VDD and ground is labeled GND.

4 Input and Output Connections

The LMH32404RHFEVM is equipped with SMA connectors for easy connection of signal generators and analysis equipment. As shipped, the EVM is configured for a single-ended input and output, both with 50- Ω termination. The differential output of the amplifier is converted to a single-ended output through transformer T1 on the board. OUT+ is the output connector for single-ended output signals, and is terminated to 50- Ω single-ended. To use the EVM with a DC-coupled differential output, remove resistor R7 and transformer T1, and short the connections across the removed transformer input and outputs. When converting to differential, the output resistors may need to be modified to achieve a desired impedance match. See [LMH32404 250 MHz, Quad-channel, Differential Output Transimpedance Amplifier](#) applications section, schematics, and layouts for more details and instructions on how to reconfigure the EVM.

4.1 Channel Multiplexer Mode Control

The LMH32404 device is a highly integrated transimpedance amplifier with four independent channels. Each channel has its own single-ended input, differential output stage, and multiplexing switch. The integrated switch can be used to disconnect the differential output amplifier from the output pin, thereby enabling high-impedance output for the respective channel. This feature is useful in order to multiplex all multiple output channels together to form a single output. The pins M1 through M4 control the multiplexer switches for channels one through four respectively. The multiplexer pins will default to logic low which places the channel in the standby mode if left unconnected. The corresponding multiplexer pin must be connected to a logic high value to enable the channel. The EVM features four easy to use jumpers labeled M1 through M4 that control the multiplexer functions for channels one through four respectively. The EVM ships by default with the multiplexer pins set to logic high, which enables all four channels. Any channel can be easily disabled or enabled by changing its corresponding jumper pin position.

4.2 Input DC Current Cancellation

The LMH32404 device features an input DC current cancellation circuit that is designed to remove any DC current that is present from a typical current input device such as a photodiode exposed to ambient light. The DC current cancellation circuit does increase the current noise and should be disabled to achieve maximum SNR performance. This feature can be enabled or disabled using the IDC_EN jumper on the board. The DC current cancellation circuit is enabled by default.

4.3 Enable Function

The LMH32404 device includes an optional disable function to put the entire device in a low-power mode when it is not being used. The EVM ships with jumper EN that can be used to easily enable and disable the device. The board ships with the device enabled by default.

4.4 Optional VOCM Pin Connection

The common-mode voltage of the differential outputs of all four amplifier channels can be controlled simultaneously using the test point (TP2) or optional resistor divider formed by R17 and R33. If left unconnected, the amplifier output common mode will default to 1.1 V. By default, the transformers on the EVM will AC couple the outputs of the device and remove the effect of the output common-mode voltage. The transformer must be removed and shorts installed between the transformer input and output pads to match the board to a device that requires DC outputs with a specified common mode (such as an analog to digital converter).

4.5 Option VOD Connection

The LMH32404 device also features a differential output offset pin that controls the DC differential offset of the each channel's two outputs. The EVM features a test point (TP1) as well as an optional resistor divider formed by R18 and R24 to set the voltage on the VOD pin. The DC output differential voltage defaults to approximately 500 mV if left floating. This feature is designed to compensate for unipolar input signals to achieve the maximum dynamic range of the differential outputs. See [LMH32404 250 MHz, Quad-channel, Differential Output Transimpedance Amplifier](#) data sheet for more information.

5 Board Layout

Figure 5-1 to Figure 5-4 illustrate the board layers in top-to-bottom order.

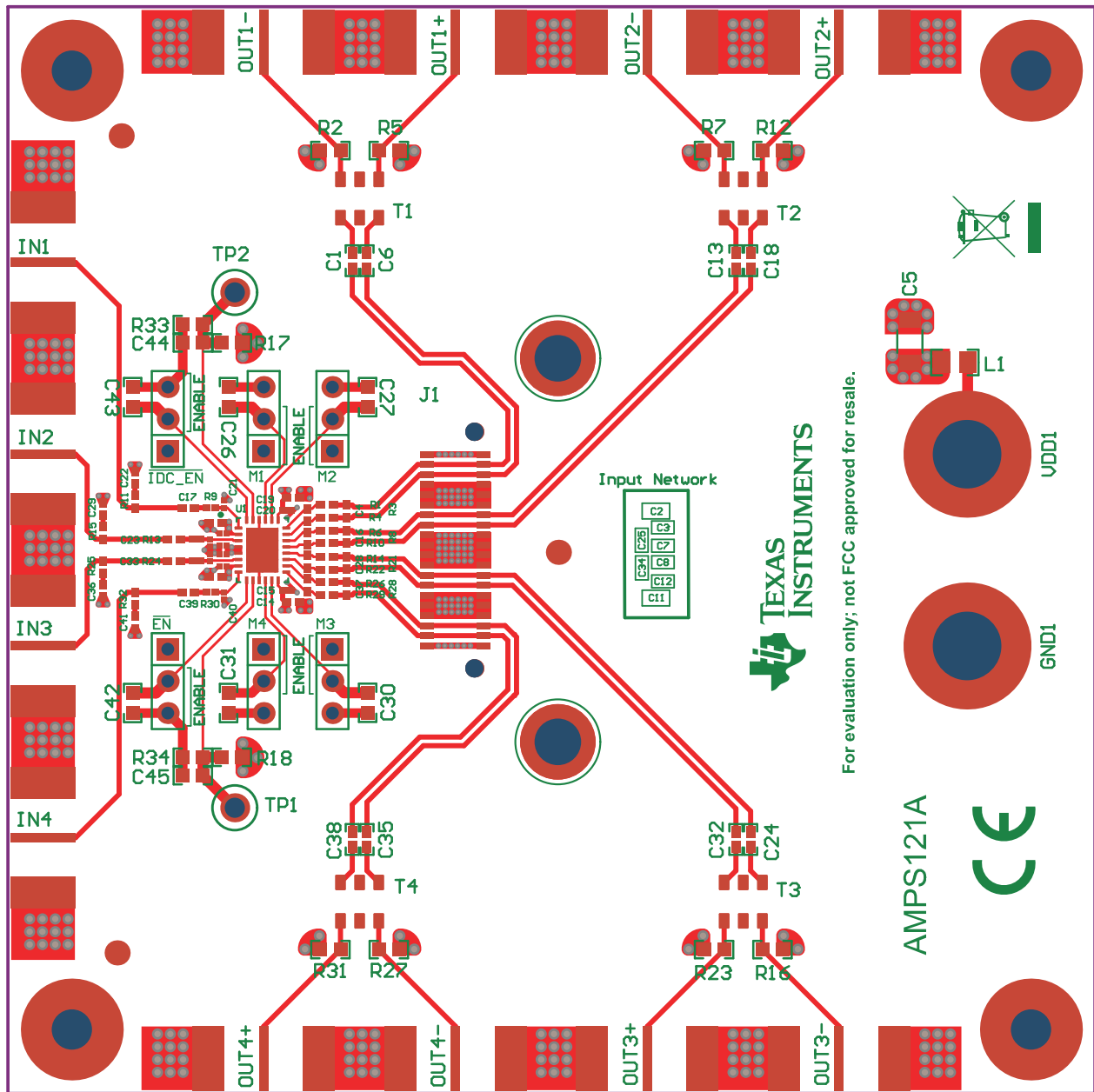


Figure 5-1. Top Layer

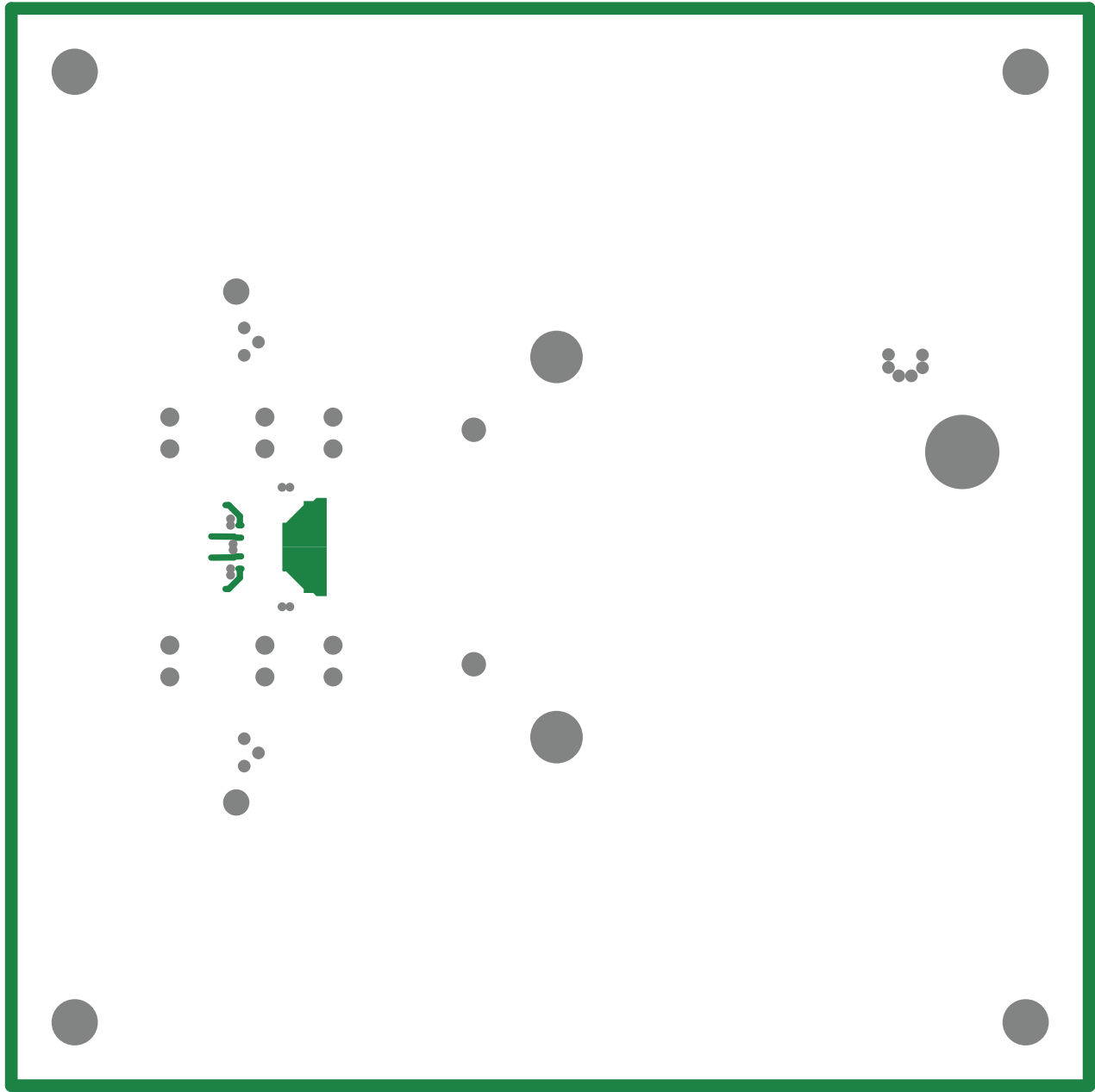


Figure 5-2. Ground Layer

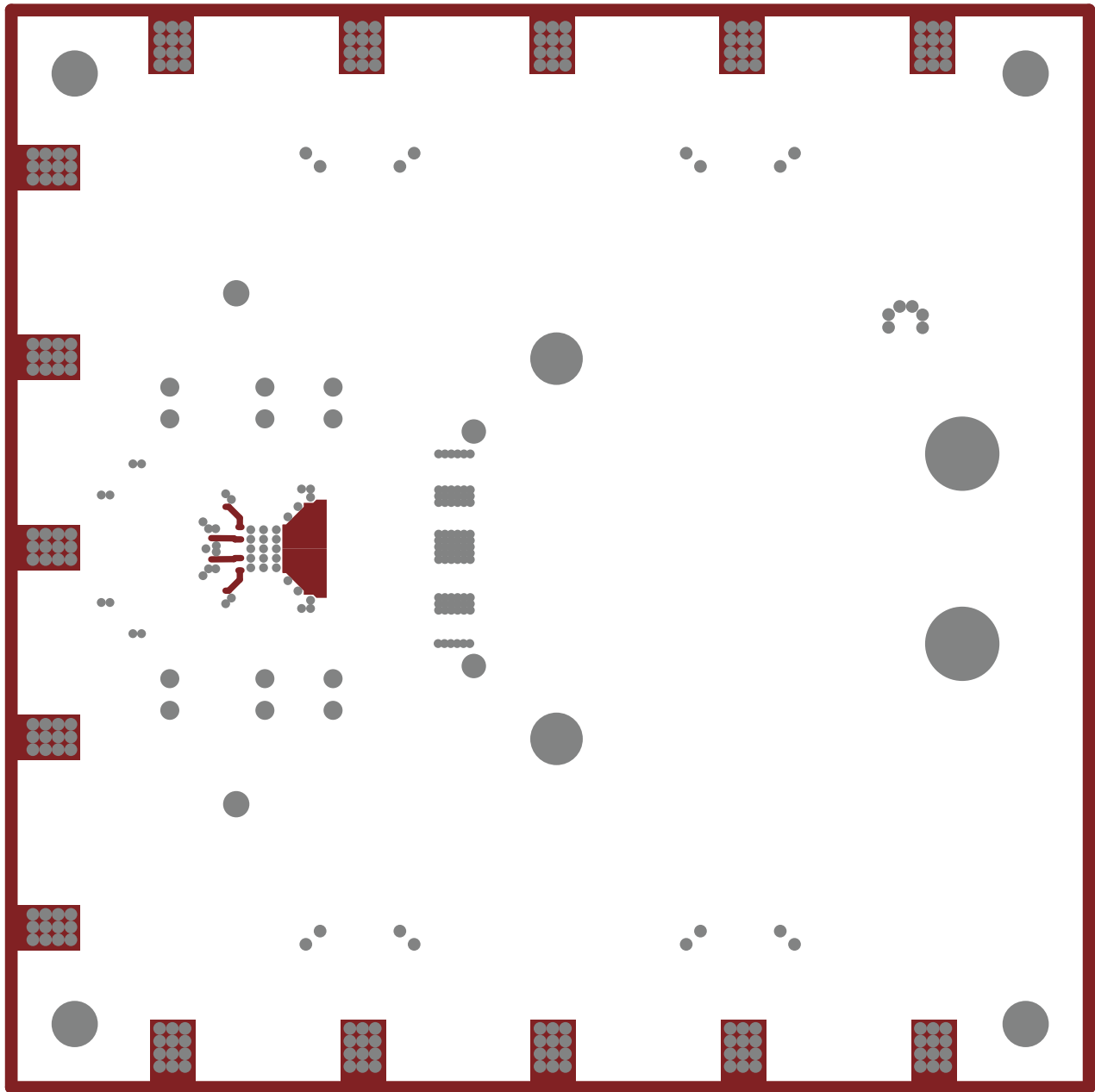


Figure 5-3. Power Layer

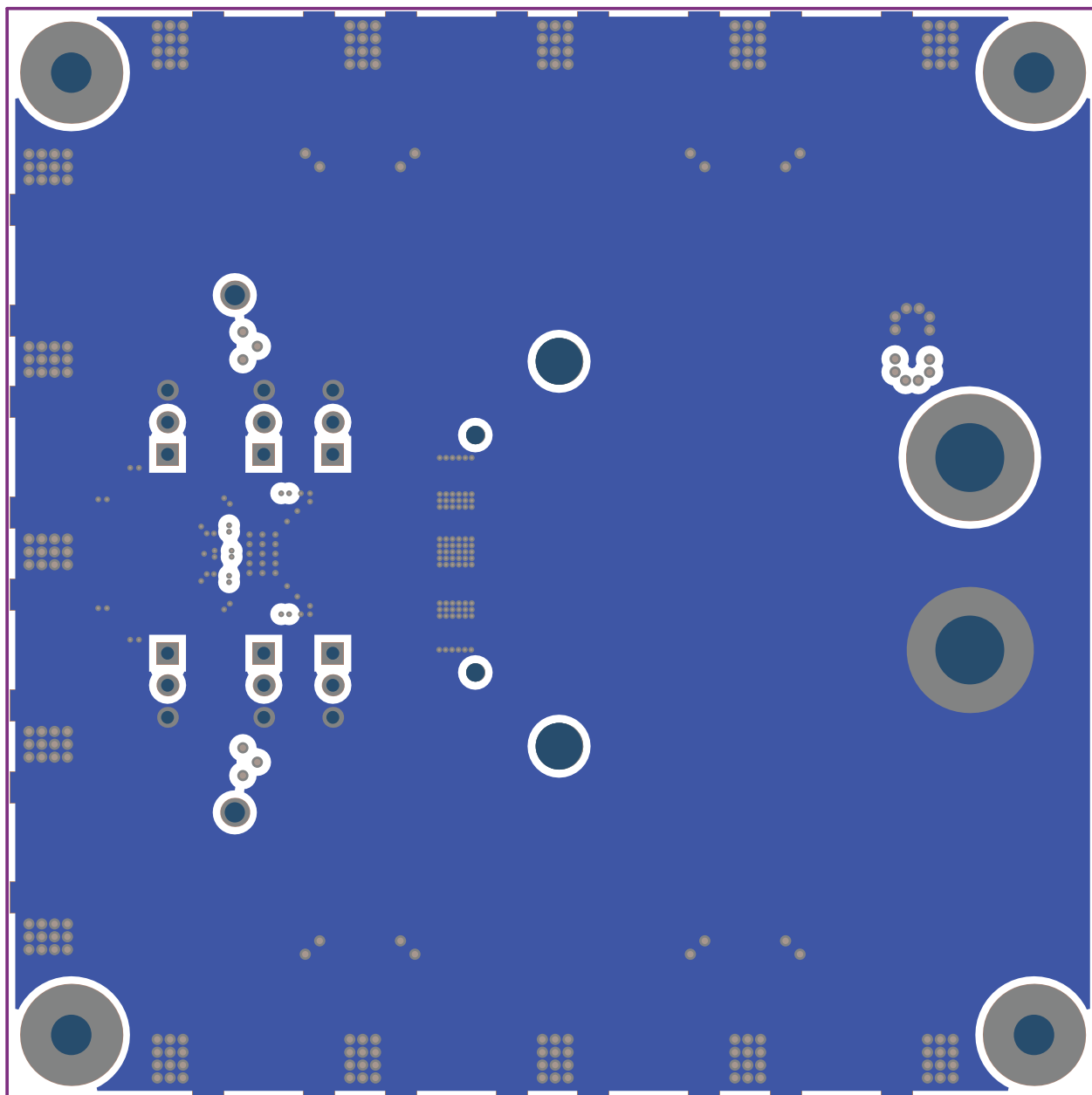


Figure 5-4. Bottom Layer

6 Schematic and Bill of Materials

This section provides the schematic and bill of materials (BOM) for the LMH32404RHFEMV.

Schematic

Figure 6-1 shows the EVM schematic.

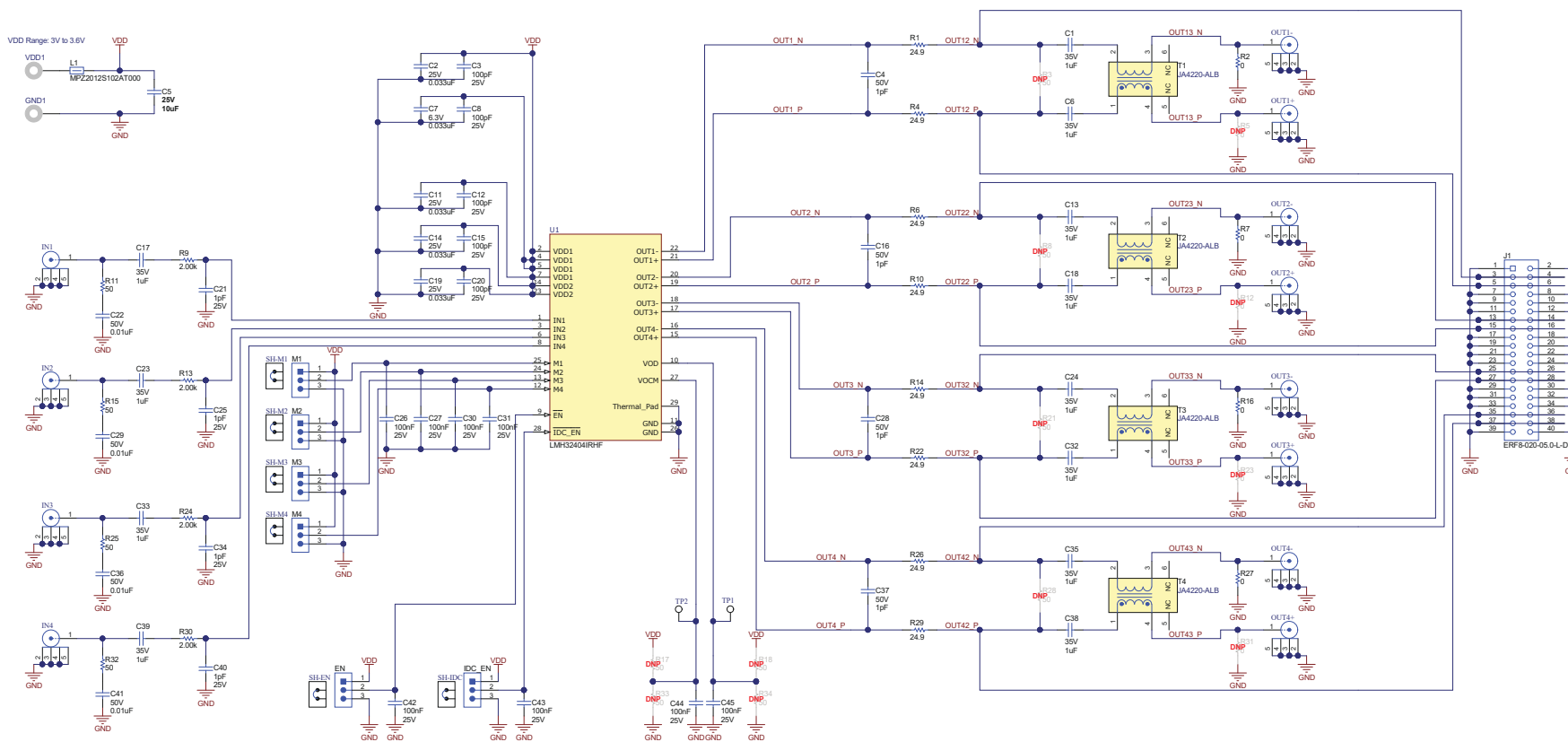


Figure 6-1. LMH32404RHFEMV Schematic

6.1 Bill of Materials

Table 6-1 lists the EVM BOM.

Table 6-1. Bill of Materials

| Item # | Designator | Qty | Value | Part Number | Manufacturer | Description | Package Reference |
|--------|--|-----|---------------|----------------------|-----------------------------|---|-------------------------|
| 1 | C1, C6, C13, C18, C24, C32, C35, C38 | 8 | 1 μ F | GRM155R6YA105KE11D | MuRata | CAP, CERM, 1 μ F, 35 V, \pm 10%, X5R, 0402 | 0402 |
| 2 | C2, C11, C14, C19 | 4 | 0.033 μ F | CGA2B1X7R1E333K050BC | TDK | CAP, CERM, 0.033 μ F, 25 V, \pm 10%, X7R, AEC-Q200 Grade 1, 0402 | 0402 |
| 3 | C3, C8, C12, C15, C20 | 5 | 100 pF | CC0201JRNPO8BN101 | Yageo | CAP, CERM, 100 pF, 25 V, \pm 5%, C0G/NP0, 0201 | 0201 |
| 4 | C4, C16, C28, C37 | 4 | 1 pF | GJM1555C1H1R0BB01D | MuRata | CAP, CERM, 1 pF, 50 V, \pm 10%, C0G/NP0, 0402 | 0402 |
| 5 | C5 | 1 | 10 μ F | GRM31CR71E106KA12L | MuRata | CAP, CERM, 10 μ F, 25 V, \pm 10%, X7R, 1206 | 1206 |
| 6 | C7 | 1 | 0.033 μ F | GRM033C80J333KE01D | MuRata | CAP, CERM, 0.033 μ F, 6.3 V, \pm 10%, X6S, 0201 | 0201 |
| 7 | C17, C23, C33, C39 | 4 | 1 μ F | C1005X5R1V105K050BC | TDK | CAP, CERM, 1 μ F, 35 V, \pm 10%, X5R, 0402 | 0402 |
| 8 | C21, C25, C34, C40 | 4 | 1 pF | GJM0335C1E1R0WB01D | MuRata | CAP, CERM, 1 pF, 25 V, \pm 5%, C0G/NP0, 0201 | 0201 |
| 9 | C22, C29, C36, C41 | 4 | 0.01 μ F | GCM155R71H103KA55D | MuRata | CAP, CERM, 0.01 μ F, 50 V, \pm 10%, C0G/NP0, 0402 | 0402 |
| 10 | C26, C27, C30, C31, C42, C43, C44, C45 | 8 | 0.1 μ F | 06033C104KAT2A | AVX | CAP, CERM, 0.1 μ F, 25 V, \pm 10%, X7R, 0603 | 0603 |
| 11 | EN, IDC_EN, M1, M2, M3, M4 | 6 | | PBC03SAAN | Sullins Connector Solutions | Header, 100 mil, 3x1, Gold, TH | PBC03SAAN |
| 12 | FID1, FID2, FID3 | 3 | | N/A | N/A | Fiducial mark. There is nothing to buy or mount. | N/A |
| 13 | GND1, VDD1 | 2 | | 575-4 | Keystone | Standard Banana Jack, Uninsulated, 5.5 mm | Keystone_575-4 |
| 14 | H1, H2, H3, H4 | 4 | | NY PMS 440 0025 PH | B&F Fastener Supply | Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead | Screw |
| 15 | H5, H6, H7, H8 | 4 | | 1902C | Keystone | Standoff, Hex, 0.5 in L #4-40 Nylon | Standoff |
| 16 | IN1, IN2, IN3, IN4, OUT1-, OUT1+, OUT2-, OUT2+, OUT3-, OUT3+, OUT4-, OUT4+ | 12 | | 142-0701-851 | Cinch Connectivity | Connector, End launch SMA, 50 Ω , SMT | SMA End Launch |
| 17 | J1 | 1 | | ERF8-020-05.0-L-DV-K | Samtec | CONN RCPT 40POS 0.8MM GOLD SMD | CONN_SMT_40 |
| 18 | L1 | 1 | 1000 Ω | MPZ2012S102AT000 | TDK | Ferrite Bead, 1000 Ω at 100 MHz, 1.5 A, 0805 | 0805 |
| 19 | MP1, MP2 | 2 | | 9774070151R | Würth Electronics | | SPACER_RADIAL_M2 |
| 20 | R1, R4, R6, R10, R14, R22, R26, R29 | 8 | 24.9 | CRCW040224R9FKED | Vishay-Dale | RES, 24.9, 1%, 0.063 W, AEC-Q200 Grade 0, 0402 | 0402 |
| 21 | R2, R7, R16, R27 | 4 | 0 | CRCW06030000Z0EA | Vishay-Dale | RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603 | 0603 |
| 22 | R9, R13, R24, R30 | 4 | 2.00 k | RC0201DR-7D2KL | Yageo America | RES, 2.00 k, 0.5%, 0.05 W, 0201 | 0201 |
| 23 | R11, R15, R25, R32 | 4 | 50 | FC0402E50R0BTBST1 | Vishay Thin Film | RES, 50, 0.1%, 0.5 W, 0402 | 0402 |
| 24 | SH-EN, SH-IDC, SH-M1, SH-M2, SH-M3, SH-M4 | 6 | 1x2 | SNT-100-BK-G | Samtec | Shunt, 100 mil, Gold plated, Black | Shunt |
| 25 | T1, T2, T3, T4 | 4 | 15 μ H | JA4220-ALB | Coilcraft CPS | Transformer, 15 μ H, SMT | 3.81x3.81 mm |
| 26 | TP1, TP2 | 2 | | 5007 | Keystone | Test Point, Compact, White, TH | White Compact Testpoint |
| 27 | U1 | 1 | | LMH32404IRHF | Texas Instruments | Four-Channel, Differential Output Transimpedance Amplifier With Integrated Multiplexing | VQFN28 |

Related Documentation

- Texas Instruments, [LMH32404 250 MHz, Quad-channel, Differential Output Transimpedance Amplifier data sheet](#)

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