

AN-1743 LMH6552SDEVAL High Speed Differential Amplifier Evaluation Board

1 General Description

The LMH6552SDEVAL evaluation board is designed to aid in the characterization of Texas Instruments LMH6552 fully differential amplifier in an 8-pin LLP package. The LMH6552 is part of the LMH™ high-speed amplifier family.

Use the evaluation board as a guide for high frequency layout and as a tool to aid in device testing and characterization.

The evaluation board schematic is shown in [Figure 1](#). For recommended for component values, see the device-specific data sheets.

2 Basic Operation

The LMH6552SDEVAL evaluation board has been set up to provide maximum flexibility for evaluating TI's differential LMH6552 operational amplifier. The board supports fully differential operation as well as single-ended to differential and single-ended to single-ended operation. For fully differential operation, use resistors R_5 and R_6 to set the input impedance of the amplifier. Input resistance will be equal to $2 * R_5 \parallel 2 * R_1$. Where $R_5 = R_6$ and $R_1 = R_2$. In this mode resistors R_1 , R_2 , R_3 and R_4 set the gain of the amplifier. Amplifier gain = $R_F/R_G = R_4/R_2$ where $R_1 = R_2$ and $R_3 = R_4$. For single-ended input mode of operation, the input and termination resistance must be properly configured to give the correct gain and R_{IN} . For example, if a gain of 2 V/V is desired, $R_5 = 28.7 \Omega$, $R_1 = R_2 = 127 \Omega$, $R_3 = R_4 = 275 \Omega$, and $R_6 = 68.1 \Omega$, which will make $R_{IN} = 50 \Omega$ at the most positive node of R_5 looking into R_2 . For more details of single-ended input mode calculations, see the [LMH6552 1.5 GHz Fully Differential Amplifier Data Sheet \(SNOSAX9\)](#). Components R_7 , R_8 , C_6 , and C_7 should be used for AC-couple applications otherwise they can be left empty.

For differential output applications, load R_{12} and R_{13} with the desired values to match the output load and leave R_{10} and R_{11} empty.

If single-ended output is desired leave R_{12} and R_{13} empty and load R_{10} , R_{11} and an output transformer such as the ADT4-1WT from mini circuits. The ADT4-1WT has a 4:1 impedance ratio (2:1 turns/voltage ratio). This is particularly useful for interfacing to 50 Ω test equipment. When referencing the transformer data sheet, the evaluation board has the primary windings on the output side of the evaluation board and the amplifier is driving the secondary windings. This provides a step down transformation from the differential amplifier output to the test equipment. The center-tapped secondary winding also allows a differential to single ended conversion (Balun). The impedance seen by the differential amplifier = $(R_{10} + R_{11} + R_L * 4)$, where R_L is the impedance from pin 3 of the transformer to the load.

Pin 7 on the LMH6552 device is the enable (EN) pin that can be used to disable the device with an external signal. For more details, see the [LMH6552 1.5 GHz Fully Differential Amplifier Data Sheet \(SNOSAX9\)](#).

3 Layout Considerations

Printed circuit board (PCB) layout and supply bypassing play major roles in determining high frequency performance. When designing your own board use these evaluation boards as a guide and follow these steps to optimize high frequency performance:

1. Symmetry is of the utmost importance.
2. Use precision resistors 0.1% or 0.01%.
3. Use a ground plane.
4. Include large ($\sim 10 \mu\text{F}$) capacitors on both supplies (C_1 and C_3).
5. Near the device use 0.01 μF ceramic capacitors from both supplies to ground (C_2 , C_4).
6. A capacitor between V^+ and V^- (C_5) is optional, but will help lower distortion.
7. Remove the ground and power planes from under and around the part, especially the input and output pins.
8. Minimize all trace lengths.
9. Use terminated transmission lines for long traces.

Sample artwork for the LMH6552SDEVAL evaluation board is included in [Figure 2](#).

4 Measurement Hints

Balance, CMRR and HD2 are highly dependent on resistor matching. Use 0.1 or 0.01% resistors.

The LMH6552SDEVAL evaluation board is designed for differential or single-ended output measurements, but not both at the same time. When not using the transformer make sure to leave R_{10} and R_{11} empty. Likewise, when making single-ended output measurements leave R_{12} and R_{13} empty.

Many differential amplifiers are optimized for the higher impedances represented by most ADCs.

On a differential amplifier both inputs are inverting, keep parasitic capacitance to a minimum on both inputs. Also, using probes of any kind on a differential circuit is not recommended.

T1 = Mini Circuits ADT4-1WT

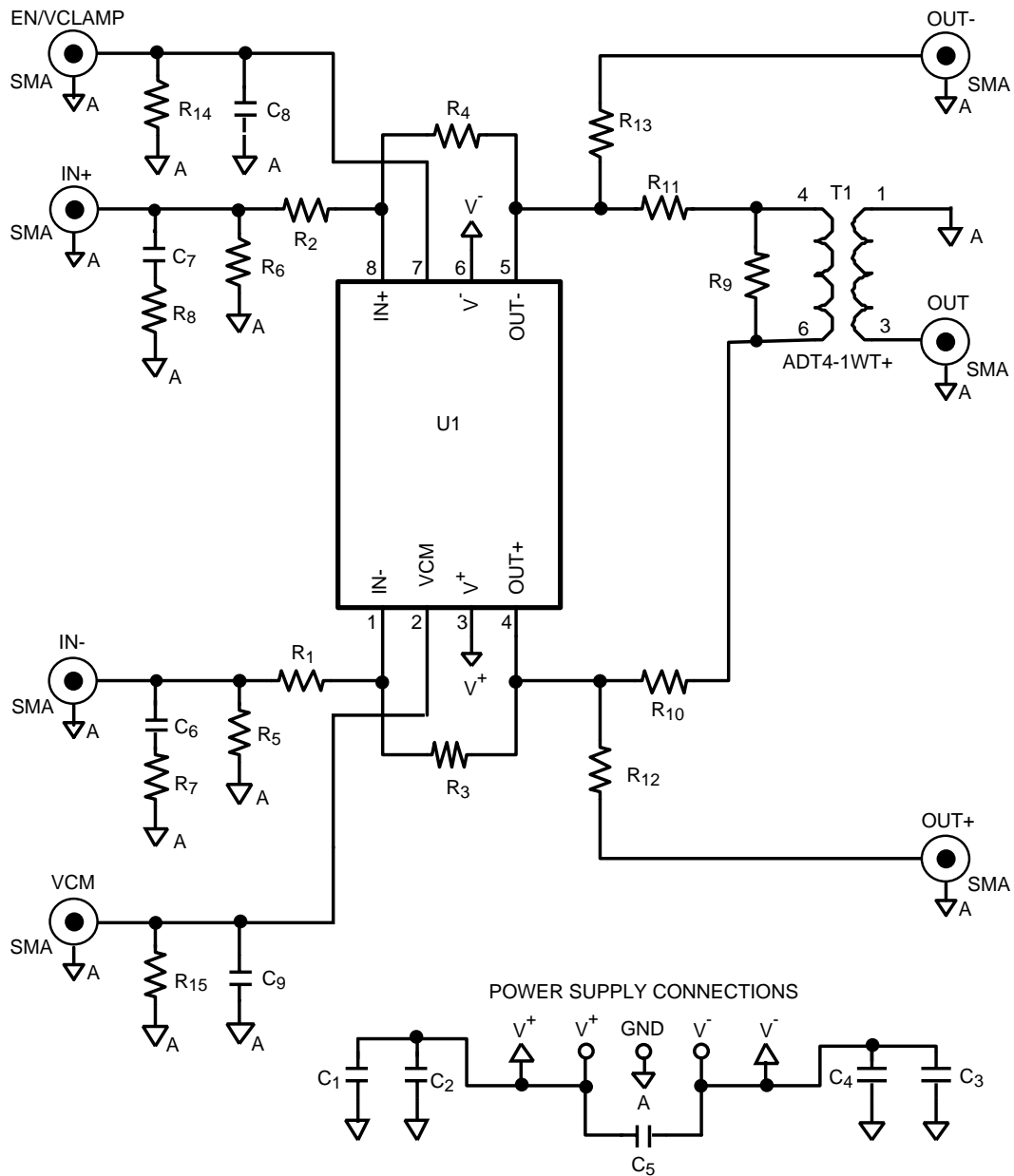


Figure 1. Board Schematic

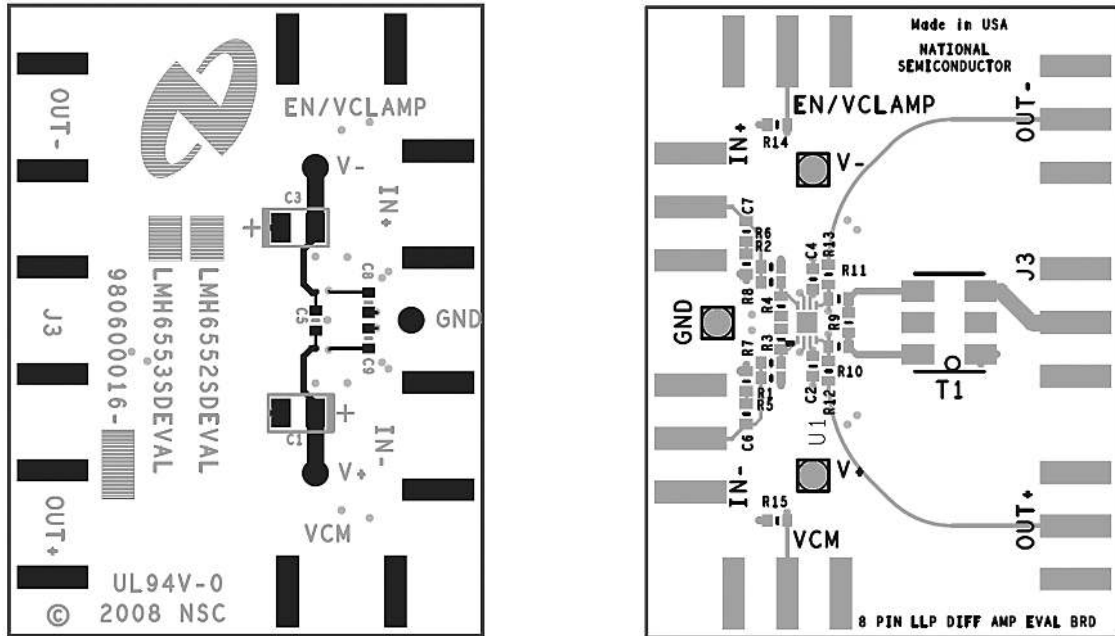


Figure 2. Board Layout

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com