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 Ω, $R_1 = R_2$ = 127 Ω, $R_3 = R_4$ = 275 Ω, and R_6 = 68.1 Ω, which will make R_{IN} = 50 Ω 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 (~ 10 µF) 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

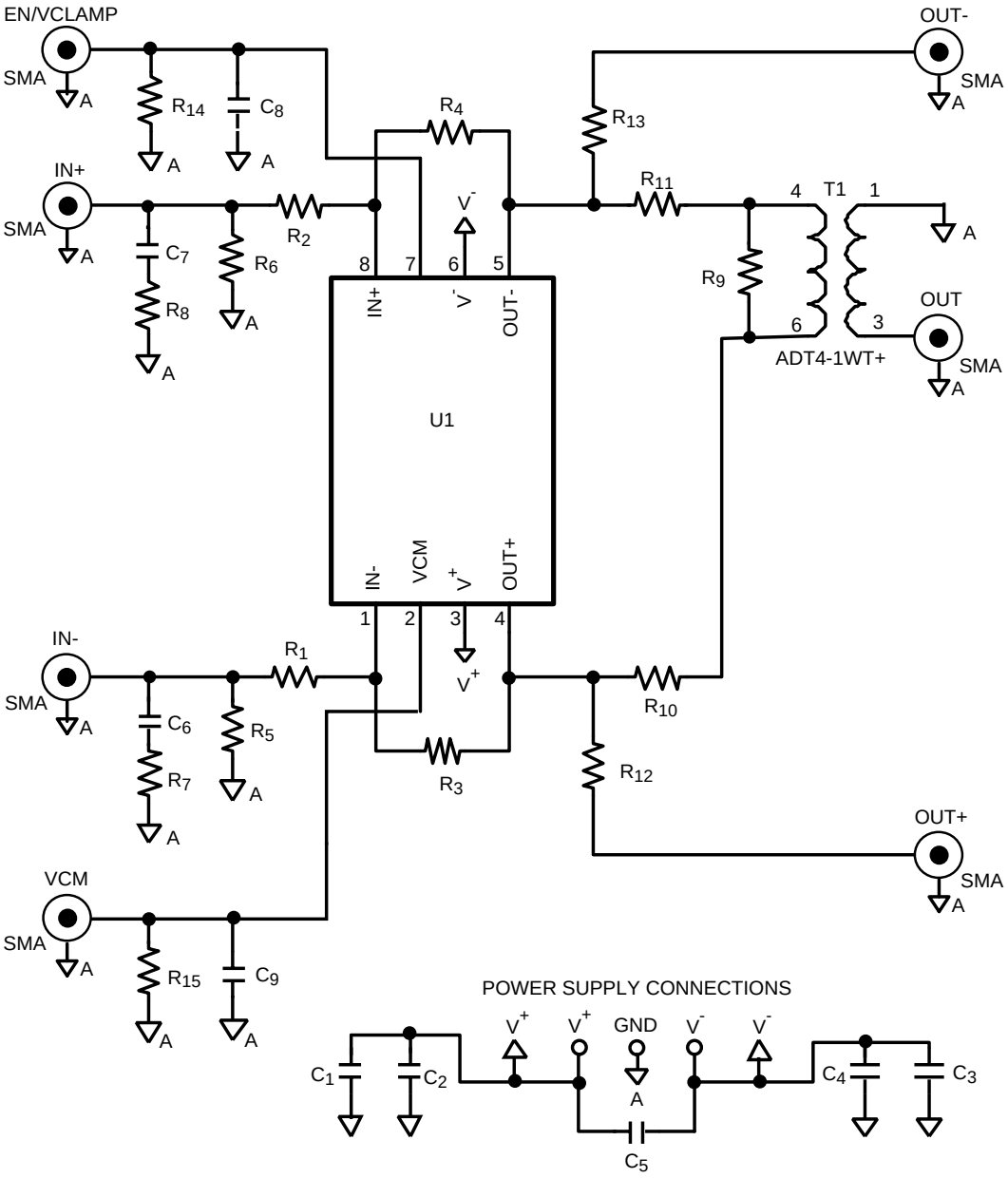

Figure 1. Board Schematic

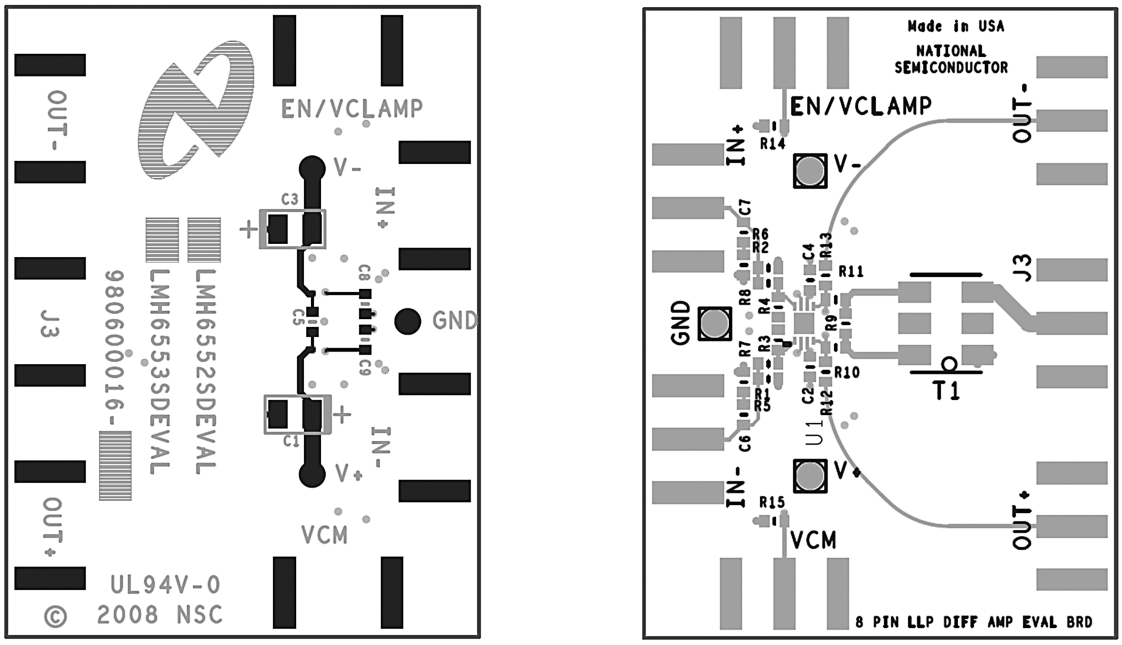

Figure 2. Board Layout

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