8-Pin PSOP Differential Amplifier Evaluation Board

National Semiconductor
Application Note 1834
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June 10, 2008

General Description

The 55600191 evaluation board is designed to aid in the characterization of National Semiconductor's LMH6553 high speed fully differential amplifier with output limiting clamp in an 8-pin PSOP package.

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 below in *Figure 1*. Refer to the product datasheets for recommended component values.

Basic Operation

The 55600191™ evaluation board has been set up to provide maximum flexibility for evaluating the LMH6553 in an 8-pin PSOP package. 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, in the case of the LMH6553 PSOP device the recommended R_F=324Ω. If a gain of 2 V/V is desired, R_5 = = 28.7Ω, $R_1 = R_2$ = 150Ω, $R_3 = R_4$ = 324Ω, and R_6 = 66.5Ω. Which will make R_{IN} = 50Ω at the most positive node of R_5 looking into R_2. Further details of single-ended input mode calculations for the LMH6553 can be found in the datasheet.

For differential output applications, load R_7 and R_8 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_7 and R_8 empty and load R_{10}, R_{11} and an output transformer such as the ETK4-2T from M/A-com. The ETK4-2T has a 4:1 impedance ratio (2:1 turns/voltage ratio). This is particularly useful for interfacing to 50Ω test equipment. When referencing the transformer datasheet, the LMH6553 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 5 of the transformer to the load.

Layout Considerations

Printed circuit board 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 (~ 6.8 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 LMH6553 8-pin PSOP Evaluation board is included on the next page in *Figure 2*.

Measurement Hints

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

The LMH6553 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_7 and R_8 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 = M/A-Com ETK4-2T

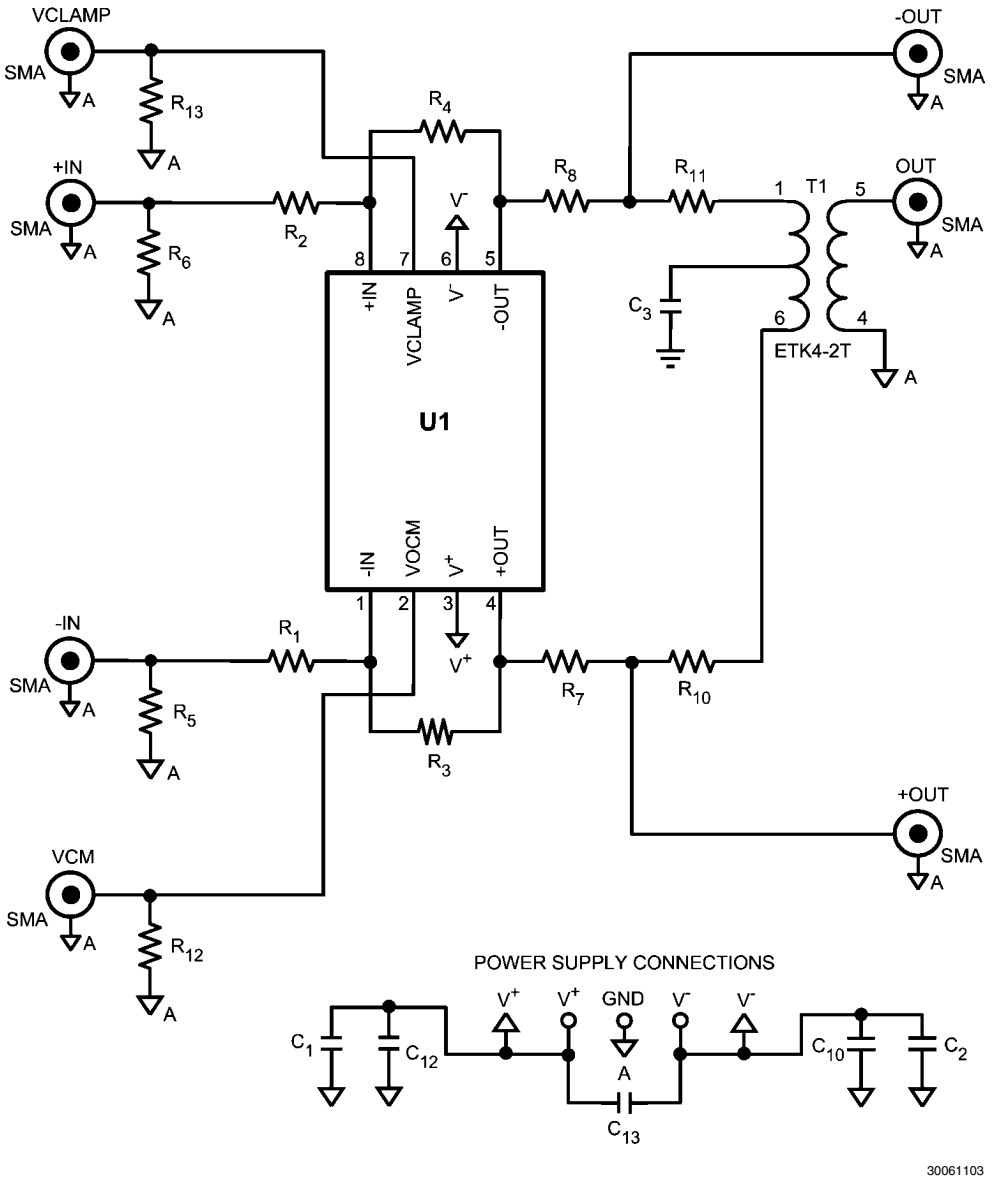
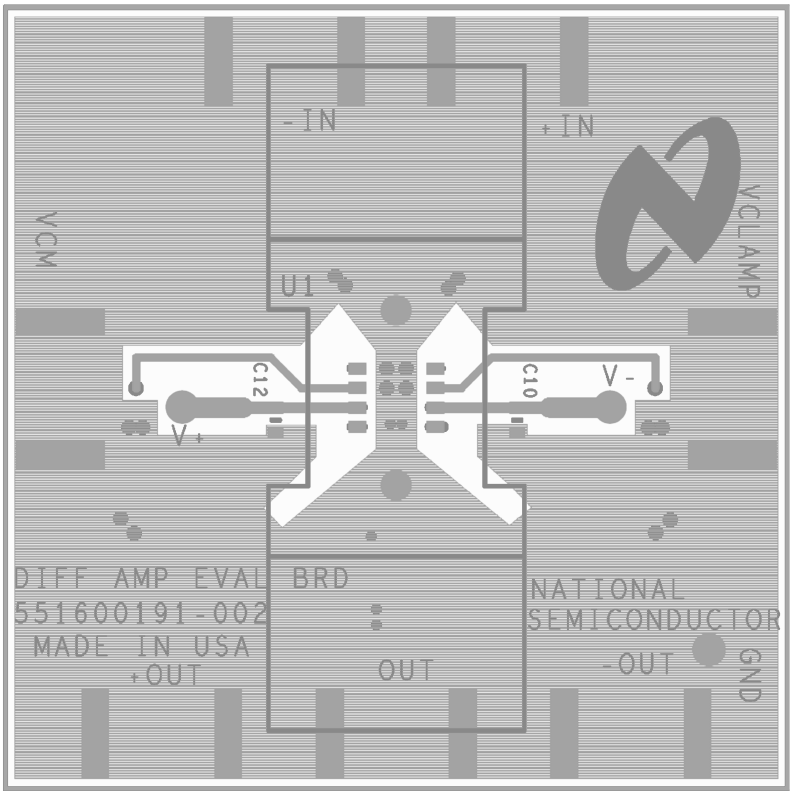


FIGURE 1. Board Schematic



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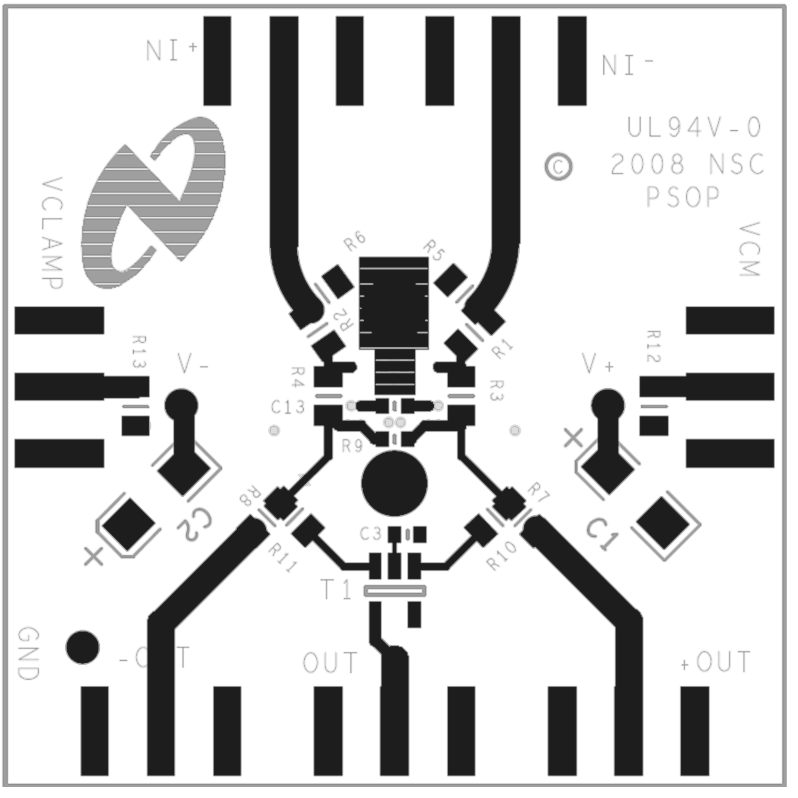

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FIGURE 2. Board Layout

Notes

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Products		Design Support	
Amplifiers	www.national.com/amplifiers	WEBENCH	www.national.com/webench
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Data Converters	www.national.com/adc	Distributors	www.national.com/contacts
Displays	www.national.com/displays	Green Compliance	www.national.com/quality/green
Ethernet	www.national.com/ethernet	Packaging	www.national.com/packaging
Interface	www.national.com/interface	Quality and Reliability	www.national.com/quality
LVDS	www.national.com/lvds	Reference Designs	www.national.com/refdesigns
Power Management	www.national.com/power	Feedback	www.national.com/feedback
Switching Regulators	www.national.com/switchers		
LDOs	www.national.com/ldo		
LED Lighting	www.national.com/led		
PowerWise	www.national.com/powerwise		
Serial Digital Interface (SDI)	www.national.com/sdi		
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