National Semiconductor

December 2004

LMH730154 High Speed Differential Amplifier Evaluation Board

General Description

The LMH™730154 evaluation board is designed to aid in the characterization of National Semiconductor's High Speed fully differential amplifiers.

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 data sheets for recommendations for component values.

Basic Operation

The LMH730154 evaluation board has been set up to provide maximum flexibility for evaluating National's differential operational amplifiers. 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 RIN and R4 to set the input impedance of the amplifier. Input resistance will be equal to 2*RIN || 2*R17. Where RIN = R4 and R17= R18. For single ended mode input resistance = RIN || R17, and R4 should be equal to RIN/2. In all modes resistors R17, R18, R19 and R20 set the gain of the amplifier. Amplifier gain = RG/RG = R19/R17, where R19 = R20 and R17 = R18.

For differential output, load R15 and R16 with the desired values to match the output load and leave R22 and R23 empty.

If single ended output is desired leave R15 and R16 empty and load R22, R23 and an output transformer such as the TC 4-1W from Mini Circuits. The TC 4-1W 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 LMH730154 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 = (R22 + R23 + RL*4), where RL is the impedance from pin 5 of the transformer to the load. The component marked R12 is not normally used.

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 (C1 & C2).
5. Near the device use 0.01 µF ceramic capacitors from both supplies to ground (C10, C12).
6. A capacitor between V^+ and V^- (C13) 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 LMH730154 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 LMH730154 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 R15 and R16 empty. Likewise, when making single ended output measurements leave R22 & R23 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.

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T1= Mini Circuits TC 4-1W

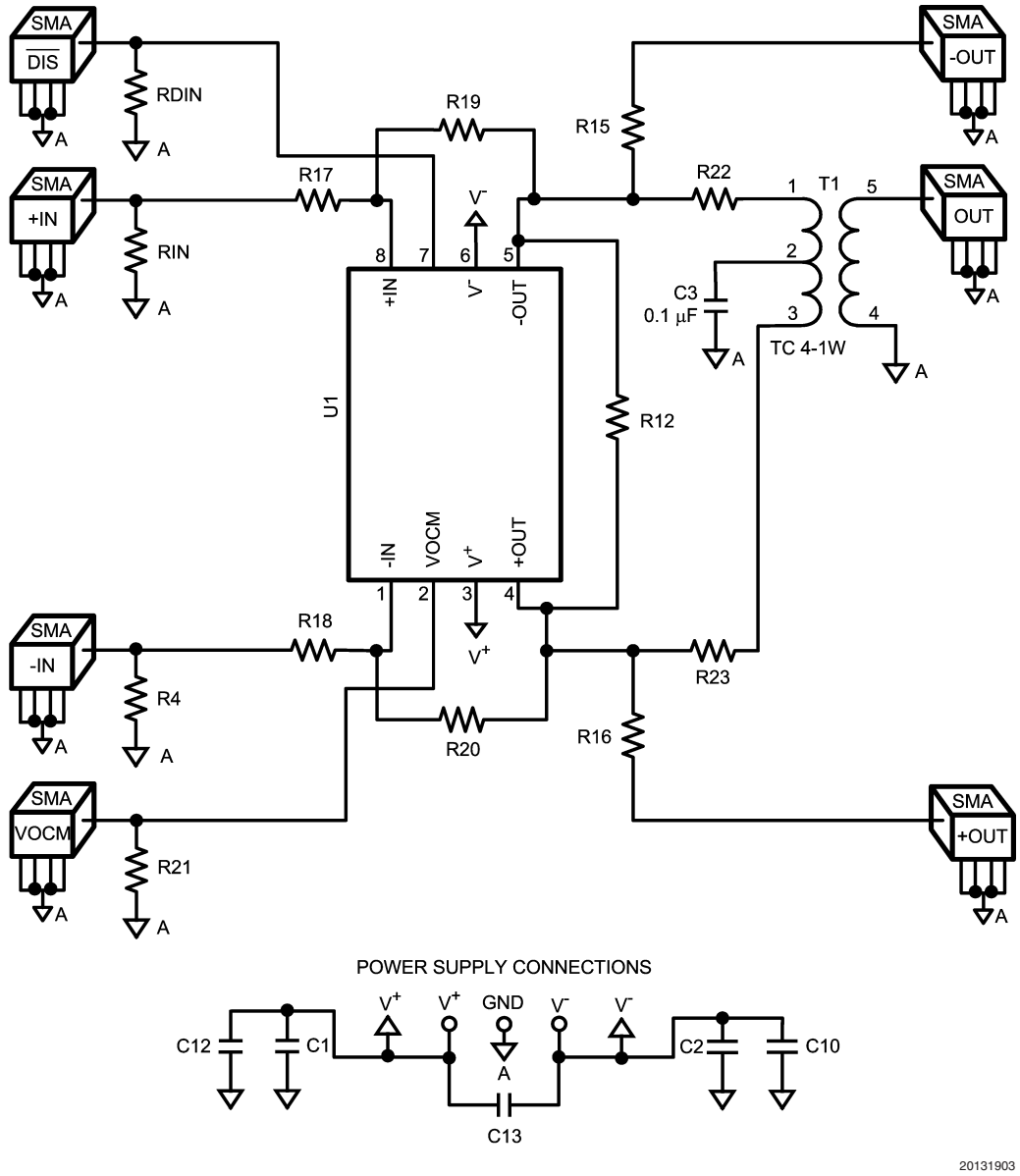
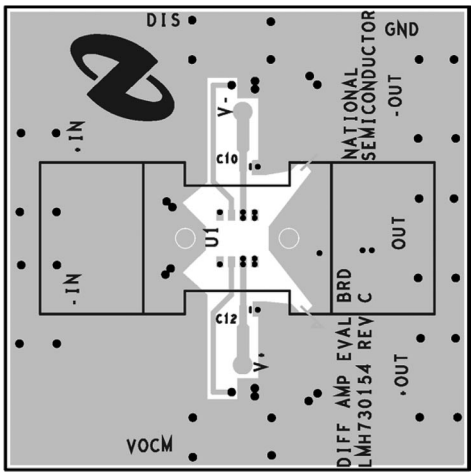


FIGURE 1. Board Schematic



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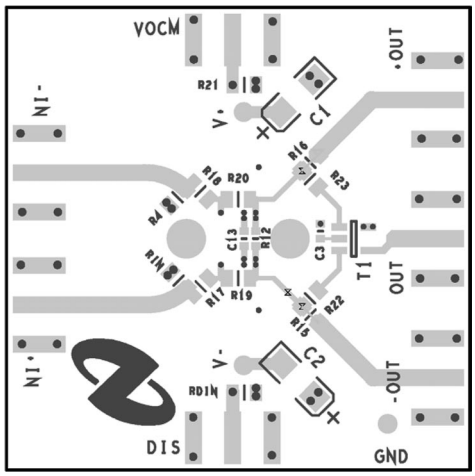

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FIGURE 2. Board Layout

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