ECE394 – Lab 8-7

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1 Introduction

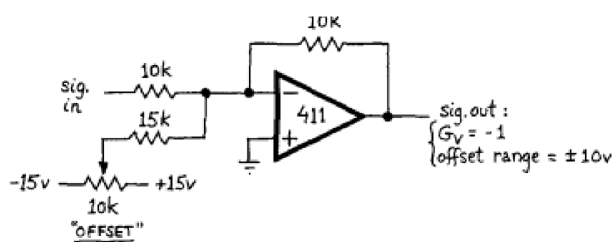

Figure L8.14: Summing circuit: DC offset added to signal

Figure 1: Textbook schematic of adder circuit. "The circuit in the figure sums a DC level with the input signal. Thus it lets you add a DC offset to a signal. (Could you devise other op amp circuits to do the same task?)"

2 Theoretical analysis

To simplify the analysis, we treat the offset voltage simply as a (variable) DC voltage source, and denote it V_{off}. This disregards the resistance of the potentiometer, which is small enough that we approximate it away.

Then we have an input circuit to an inverting op-amp circuit, which can further be simplified by viewing its Thevenin equivalent. This is:

$$V_{\text{th}} = V_{\text{in}} - (V_{\text{in}} - V_{\text{off}})\frac{R_1}{R_1 + R_2}$$
$$R_{\text{th}} = R_1 || R_2$$

What is important is that V_{th} is related linearly to V_{off}. This then gets passed through a inverting or non-inverting amplifier, which have gains of

$$A_{V_{\text{invert}}} = -\frac{R_F}{R_{\text{th}}}$$
$$A_{V_{\text{noninvert}}} = \frac{R_2 + R_F}{R_2}$$

See Figure 2 for a sketch of this analysis.

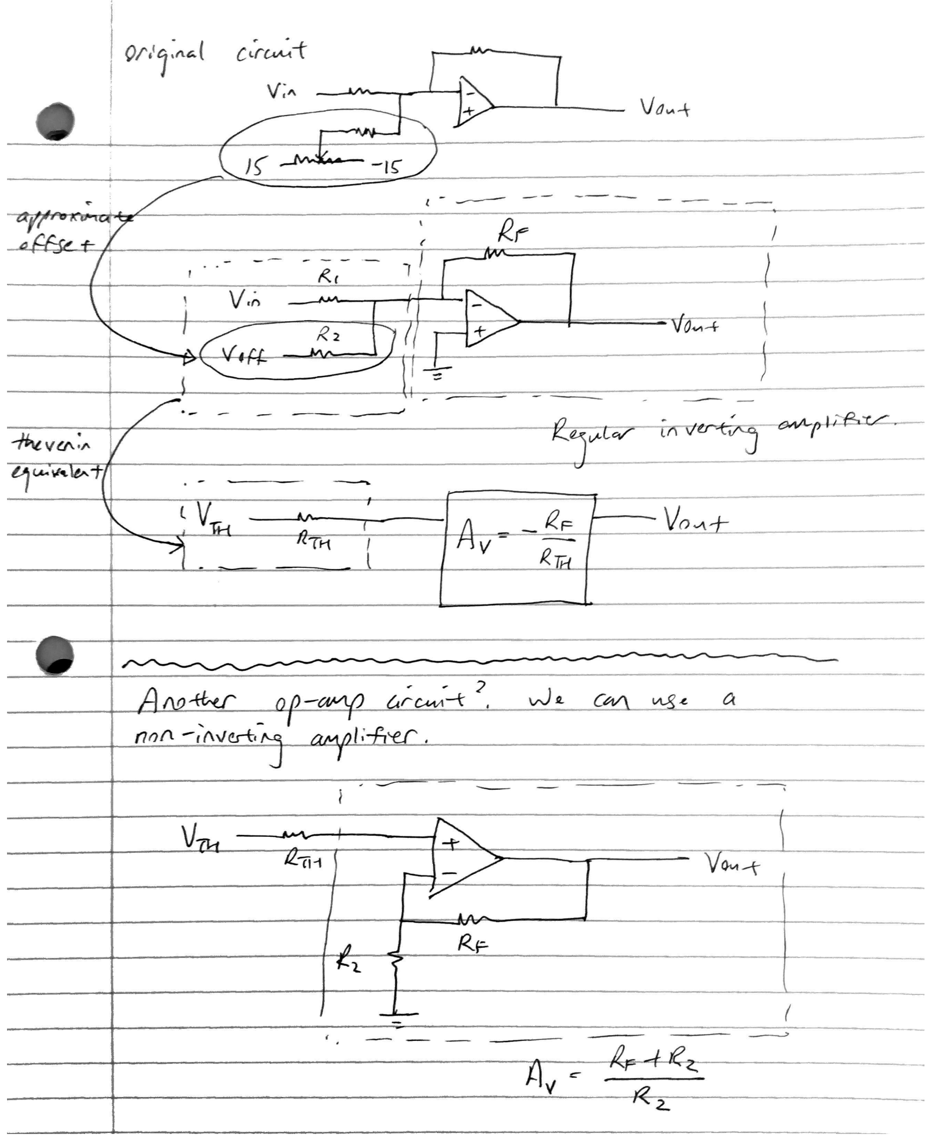

Figure 2: Theoretical analysis and simplifications made.

3 Circuit implementation

A LM741 was used in place of a LM411 because the LM411 was not available.

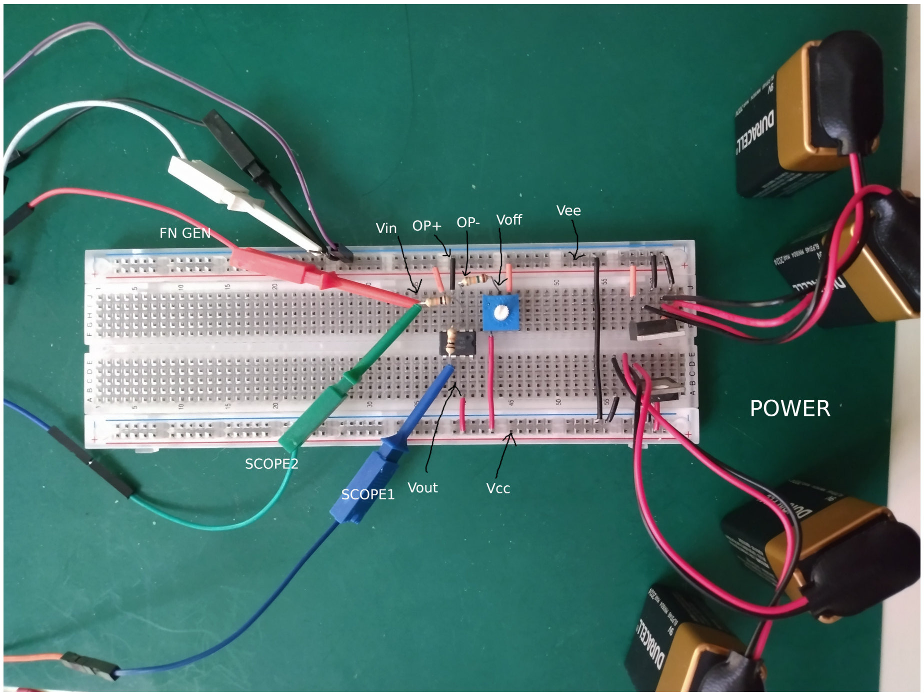

Figure 3: Implementation of circuit on the breadboard.

4 Results

See this video for a demonstration of the DC offset.

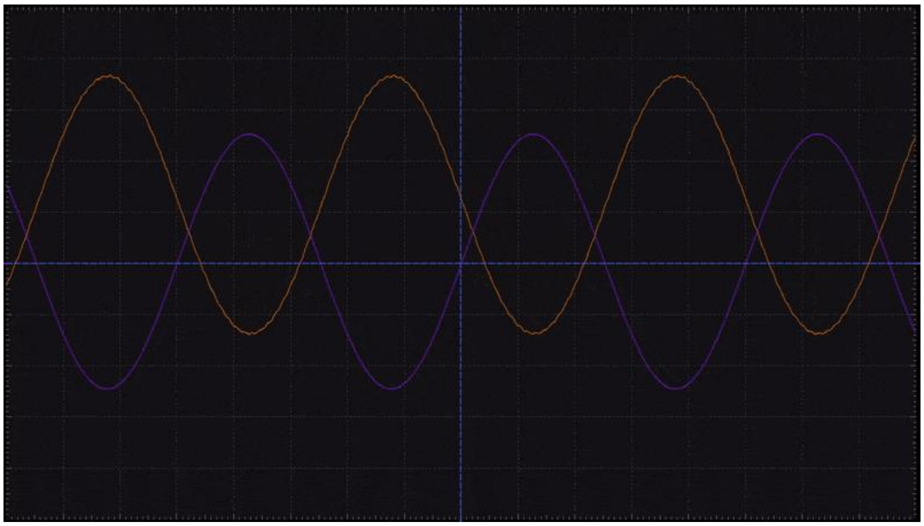

Figure 4: Screenshot of Scopy showing input signal and DC-offset output signal

5 LTSpice implementation

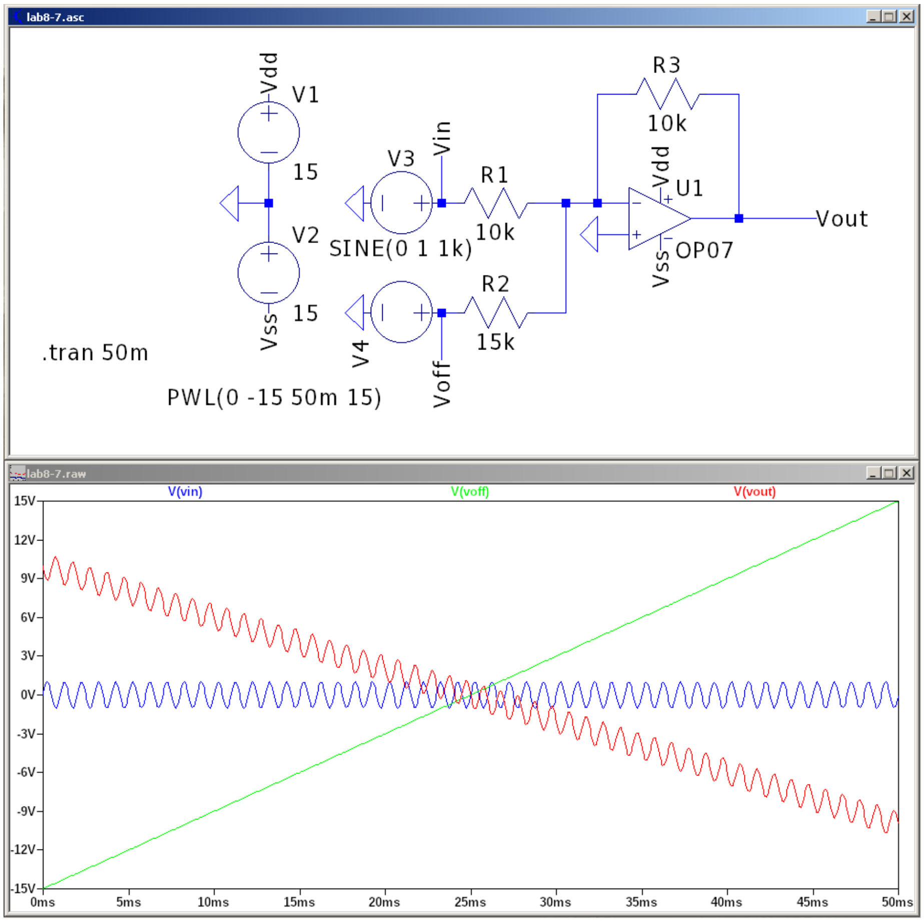

Figure 5: LTSpice inverting summing amplifier

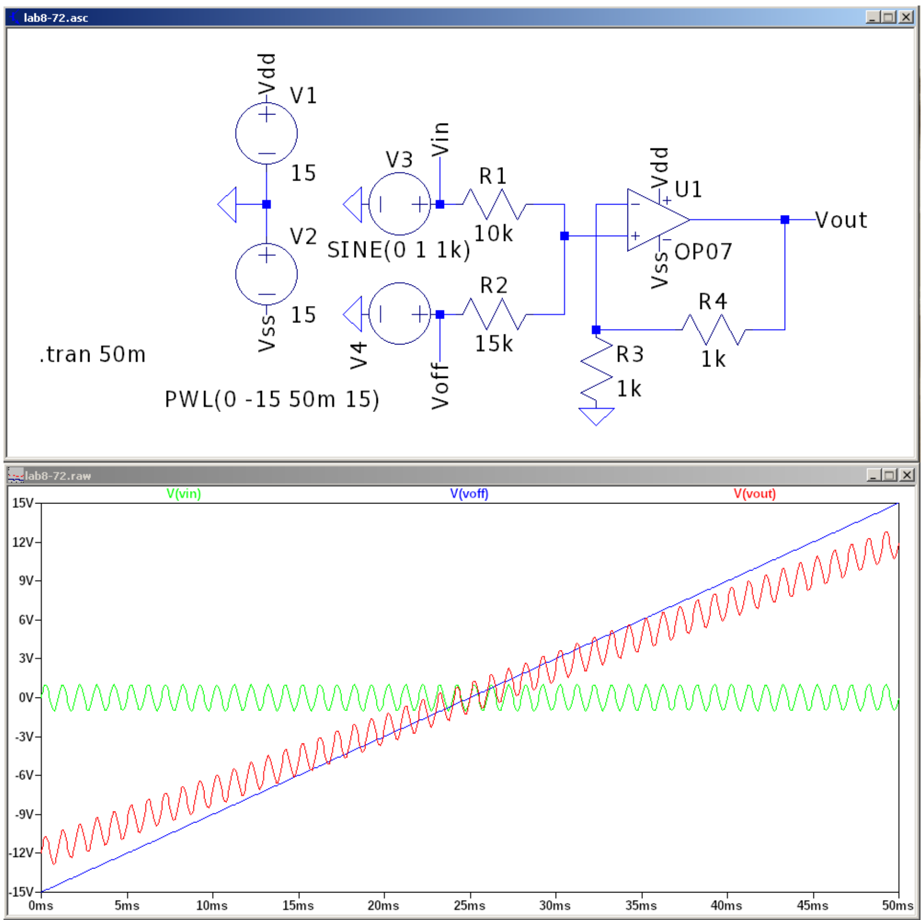

Figure 6: LTSpice non-inverting summing amplifier