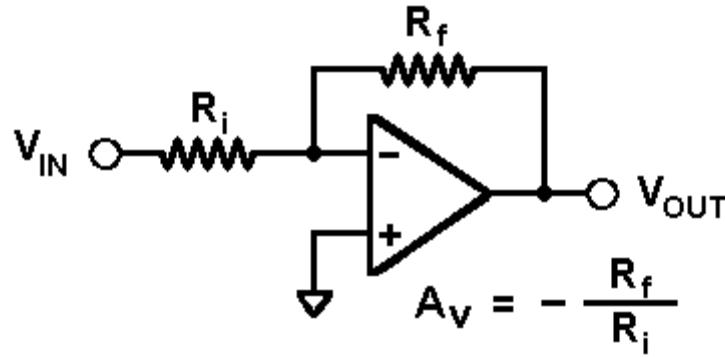


## Assembly Instructions:

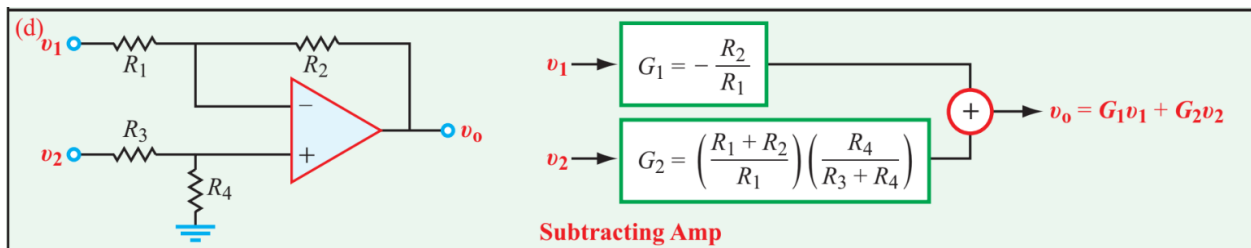
First we're going to assemble the message signal amplifier. We will use the OPA551PA (datasheet in references below) for both amplifications in this project for its high slew rate and bandwidth as we are dealing with high frequencies. We will use an inverting amplifier circuit where the gain is the ratio of two resistors in the circuit.



Inverting Amplifier [4]

We will be amplifying our signal by a factor of 10, where  $R_f = 10\text{k}\Omega$  and  $R_i = 1\text{k}\Omega$ . Our input will come from our audio signal. We used a computer and an aux cord that we stripped the wire to plug into our circuit. You should test this section of the circuit before moving onto the next part, checking that the  $V_{pp}$  is amplified by the appropriate amount. It is best to test multiple parts of the circuit as you make it to isolate and eliminate errors.

Next, we breadboard the subtracting amplifier that “modulates” the two signals.  $V_1$  in the picture below is our carrier frequency and  $V_2$  is the amplified message signal.

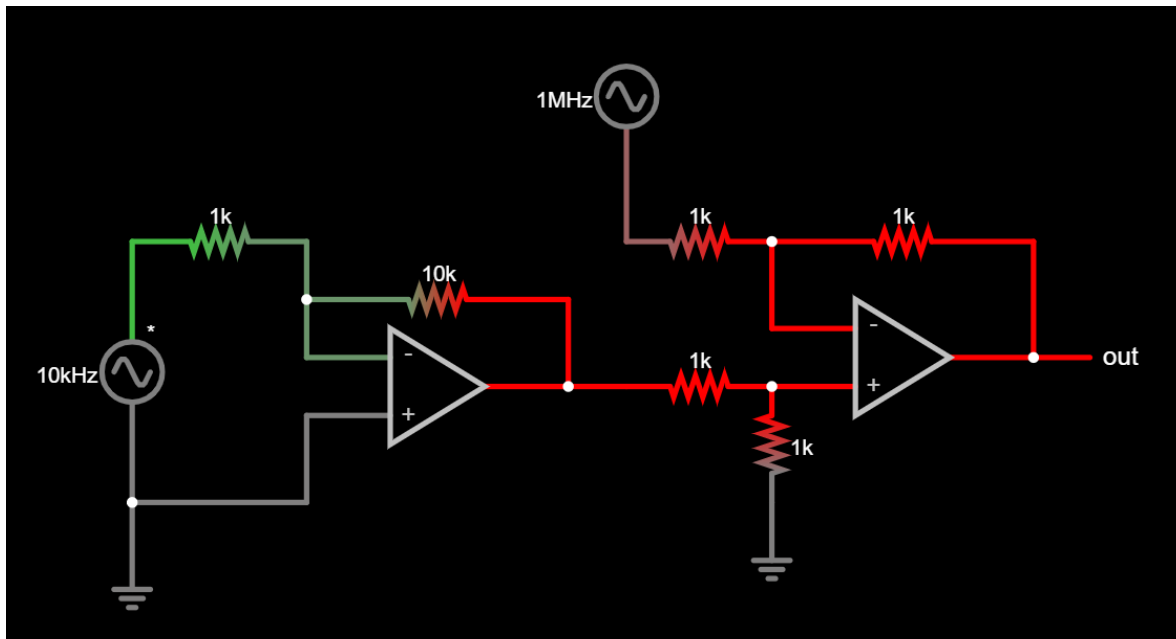


Subtracting Amplifier Equation and Subcircuit [5]

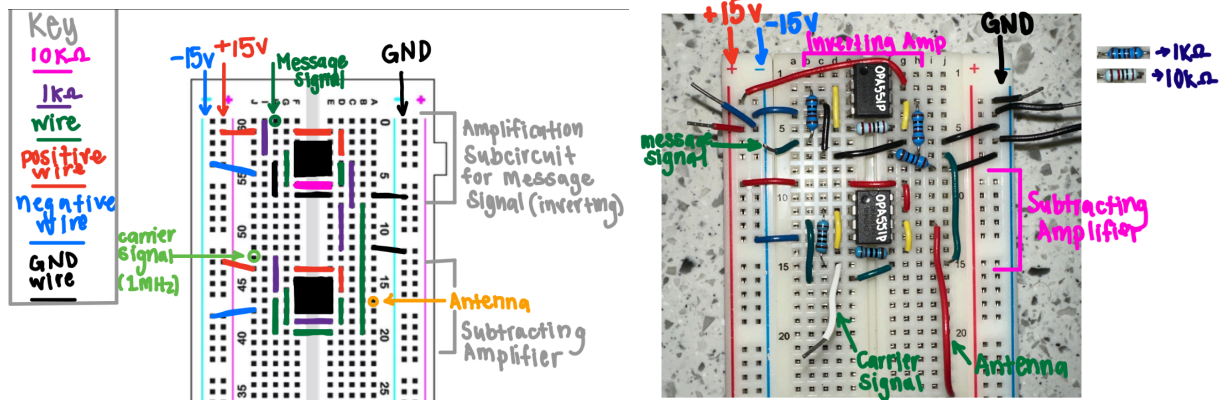
The value of all 4 resistors here is 1k because we only want the subtraction property of this circuit with a gain of 1 all the way through.

The  $V_{out}$  will contain our final amplified and modulated message and carrier signal. Here we use a length of wire that resonates with the frequency of the carrier signal. We are using a frequency of 1MHz, which has a wavelength of 300 meters. We can find this with this equation  $c = \lambda v$  (speed of light = wavelength\*frequency). While it's not very feasible to have a length of 300m wire, we can cut this value in half repeatedly until we reach a reasonable number. This is about 1.2m for us. This causes the signal to resonate in our wire which makes for a clearer signal.

Our final circuit looks like this:



And our breadboarding looks like this:



Here's a link to video explanation of this project!

Link:

<https://drive.google.com/file/d/1xxkcVSy-g7SKOfbBBB7SrKqRLmrQ0SQB/view?usp=sharing>