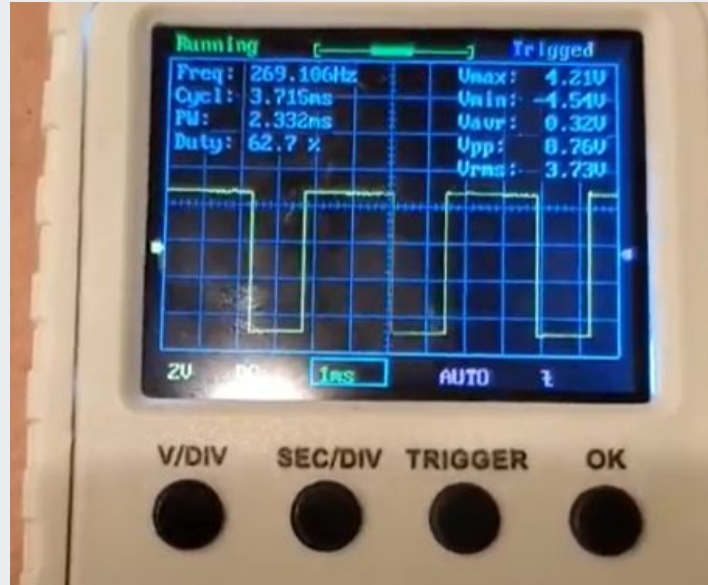


Analog Step Sequencer

Lesson 3: Sound Synthesis





Agenda

Part 1: (30 min)

- How do we generate sound
- Why and how do we use two 555 ICs

Part 2: (Rest of the time)

- You build the circuits on a breadboard
- Get assistance

Generating Sound

To create sound we need to vibrate an object. As the object vibrates, it causes the air around it to vibrate which creates a sound wave that we can hear. A couple questions?

1. What object are we vibrating?

- The circuit we build cannot actually generate sound itself, but rather it generates an electric signal that gets transformed into sound using a speaker or earbuds.
- The object that vibrates is a flexible plastic "cone" inside the speaker or earphone

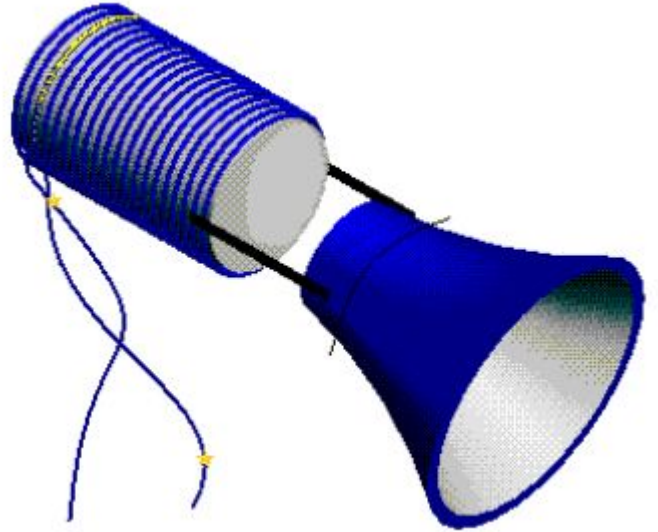


Speaker Components

Continued

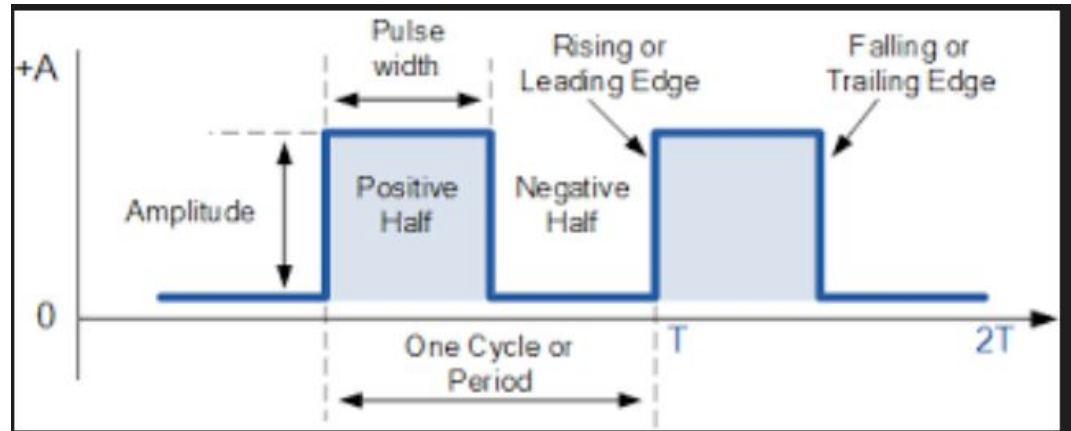
2. How do we generate those vibrations?

- If you remember from lesson 2, we created a square wave. This wave is an oscillating voltage which essentially results in oscillating current. When the current travels through a coil it essentially creates an electromagnet which interacts with a permanent magnet attached to the cone.
- As the current oscillates, it flips the polarity of the electromagnet, which pushes and pulls the permanent magnet which oscillates the cone, creating sound.



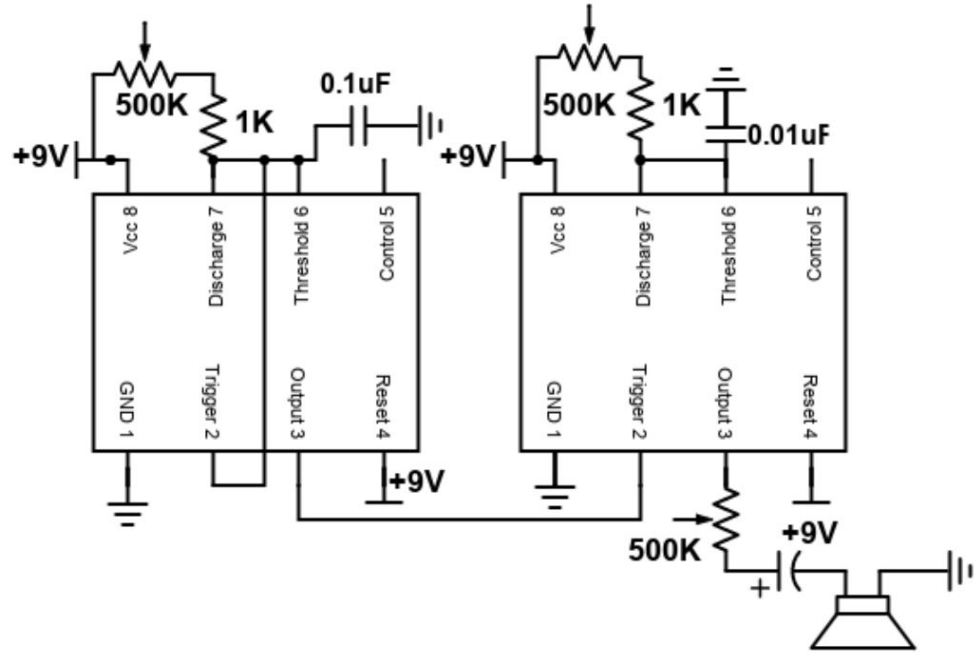
Square Wave vs Pulse Wave

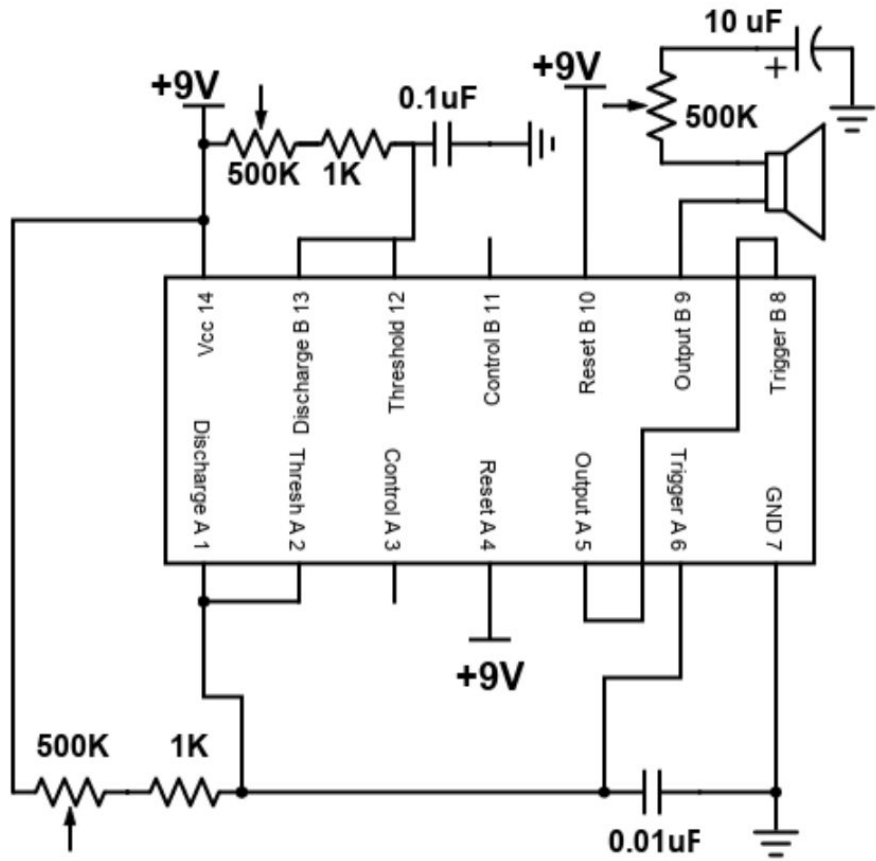
- If you recall from the previous lesson, the timing capacitor took the same amount of time to charge and discharge because both the charge and discharge paths were through the 500K potentiometer
- This created a square wave which has a ****duty cycle*** of 50% meaning the time the wave was high and low was equal



Two 555 ICs

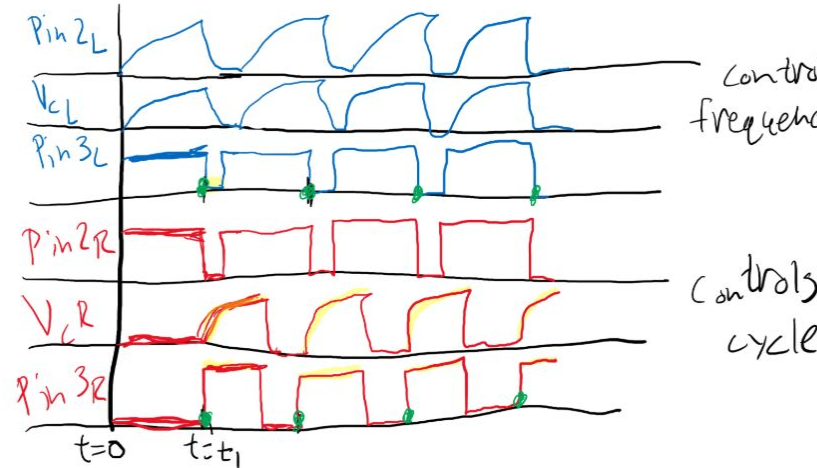
- One will control the frequency and the other will control the duty cycle
- We can attempt to do this with one 555 IC but we won't be able to control these two characteristics separately
- If you look at the circuit closely you will see that there isn't anything new except the output to the speaker/earbuds
- Essentially we just build the same circuit as last lesson but cascade two of them in a row.



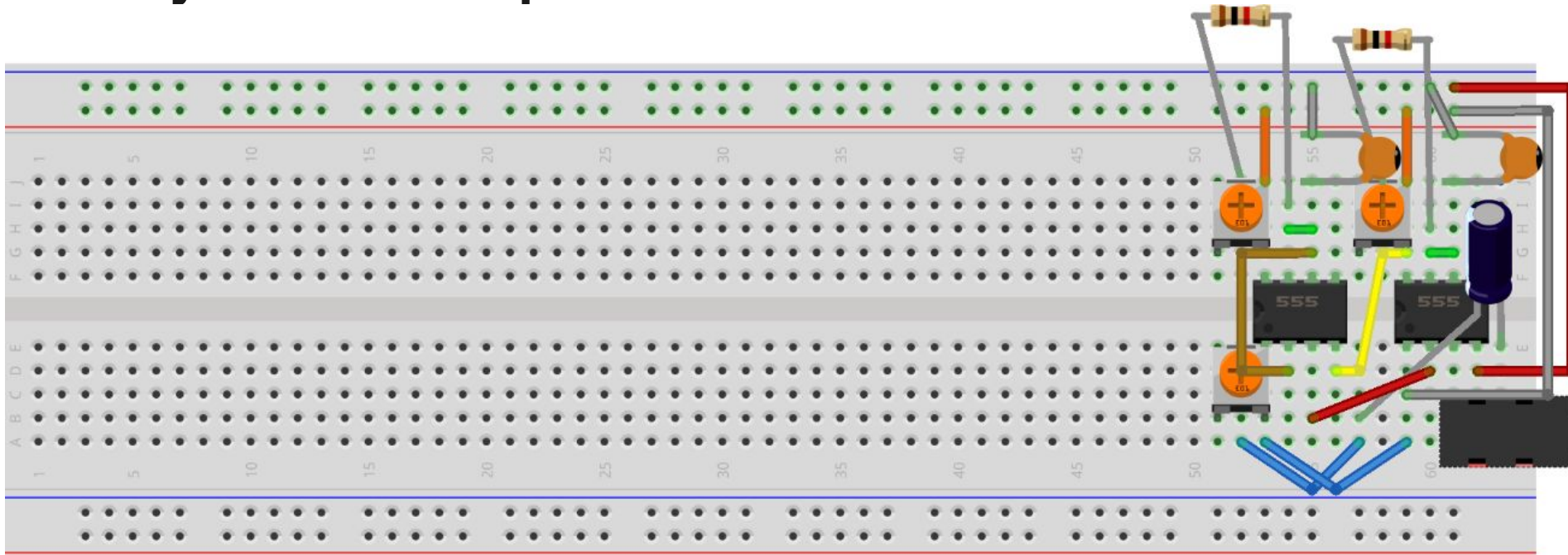


What is Happening

1. At time $t=0$ the left capacitor is discharged meaning that pin 2 is low
2. Pin 2 low triggers pin 7 to "turn off" so that the capacitor starts charging through the potentiometer. Also the output at 3 goes high
3. The output at 3 now goes into the input at 2. This 555 behaves in a similar manner, meaning that when pin 2 goes low pin 7 turns off and the capacitor starts charging and the output goes high
4. So currently the output on 3 for the left 555 is high meaning that pin 2 on the second 555 is also high which does not trigger anything
5. At some later time t_1 the left capacitor charges to the threshold which causes pin 7 to turn on, the capacitor to discharge, and the output at 3 to go low
6. This low output at 3 triggers the right 555 timer to start
7. The right 555 timer now starts charging and the output at its pin 3 goes high
8. Since this 555 has no feedback, once the capacitor reaches the threshold pin 3 will go low until the left 555 timer triggers the whole process again




If you ordered parts from me



If you ordered parts on your own

