555 Timer Applications

Making Music!

Build Together 5

The Toy Theremin

Build Together 5: The Toy Theremin

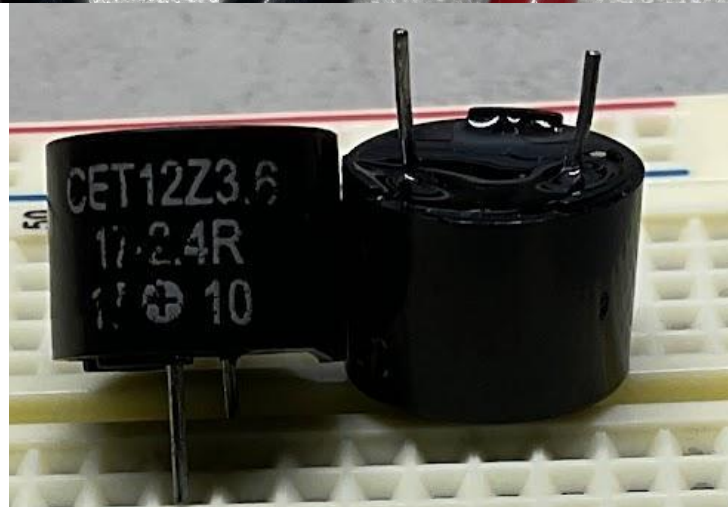
- A Theremin is a musical instrument that changes its pitch as you move your hand closer to the instrument. Simply waving your hand near the instrument can create different notes!
- We can use a 555 timer in astable mode to create an output frequency. In the past we used this frequency to turn a LED on/off. If we make the frequency high enough, we can use the 555 timer to drive a speaker.
- We can then vary that frequency using a LDR.

- As you are building, try to think about what you are doing and why the circuit is designed the way that it is.

ADVANCE to the next slide, let's build this together!

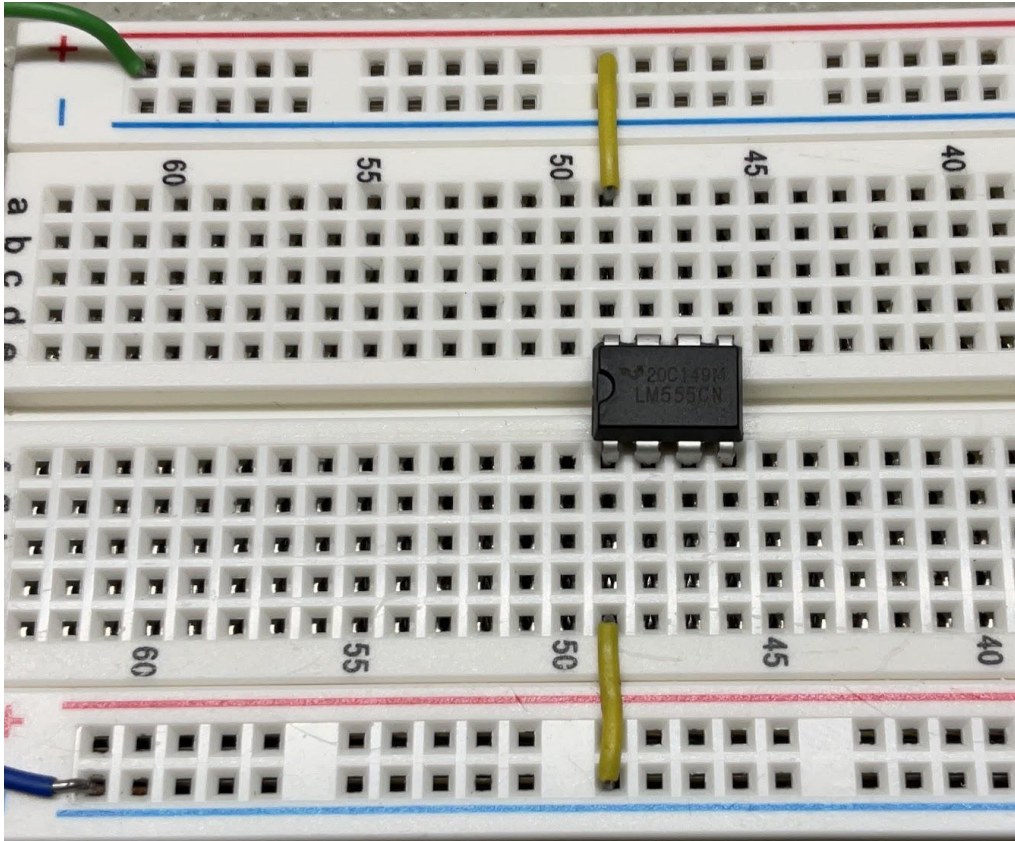
Making Music

- If the output frequency of a 555 timer gets to fast, we won't be able to see it with an LED; it will just look like the LED is always on.
- However, we may be able to hear the output frequency with a speaker or buzzer.
- A speaker can be connected to the breadboard via alligator clips while a buzzer will fit right into the breadboard.
- Note the anode and cathode of the buzzer.



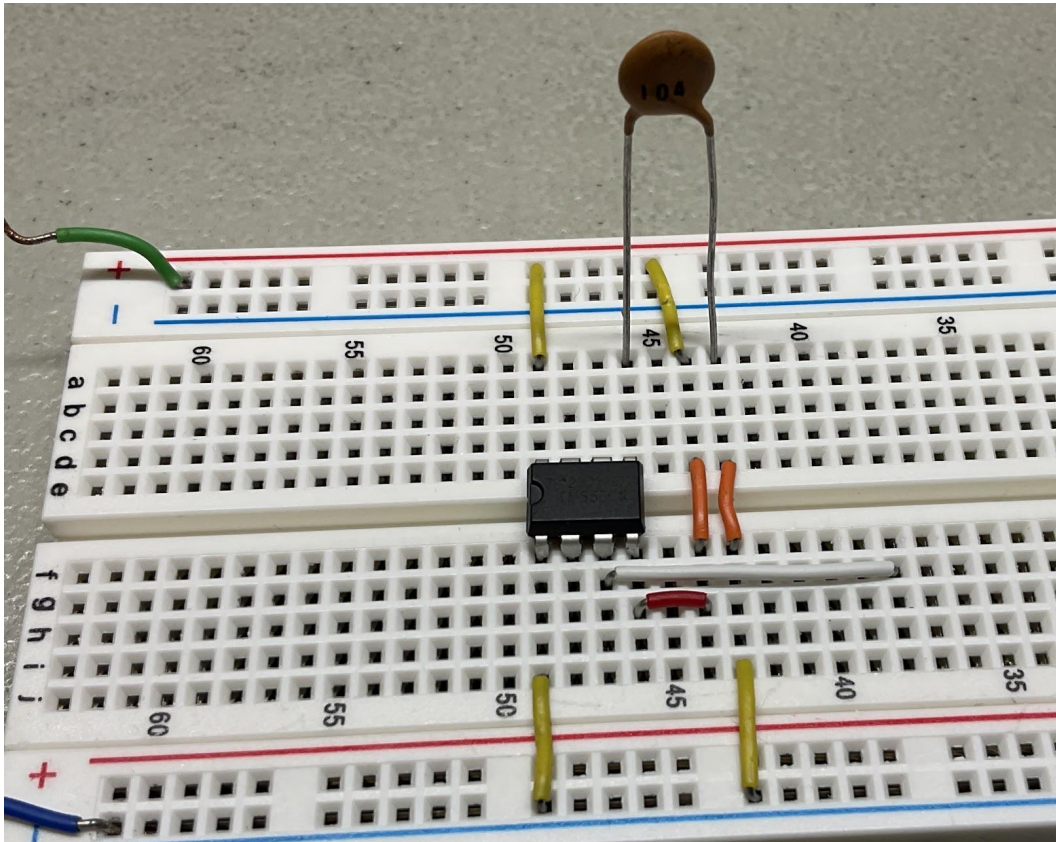
Making Music - Astable Mode

- In order to create music we need a fixed oscillation.
- A 555 timer in astable mode can provide just that.
- Connect pin 8 (Vcc) to Vcc.
- Connect pin 1 (ground) to ground.



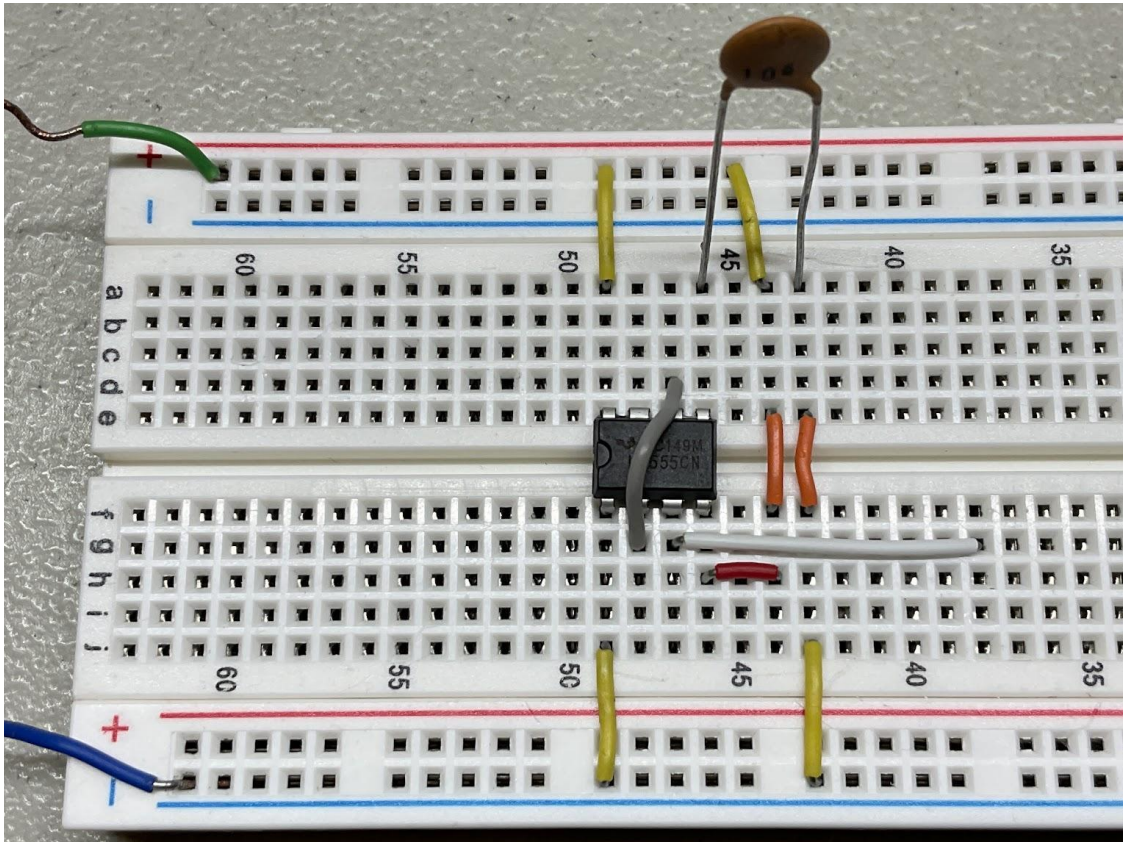
Making Music - Astable Mode

- Move pin 3 (output) away from the 555 timer for easy access.
- Connect pin 4 (reset) to Vcc to ensure that the chip does not reset.
- Connect pin 5 (control voltage) to ground through a 100 nanoFarad (104) capacitor as we will not be using the control voltage.



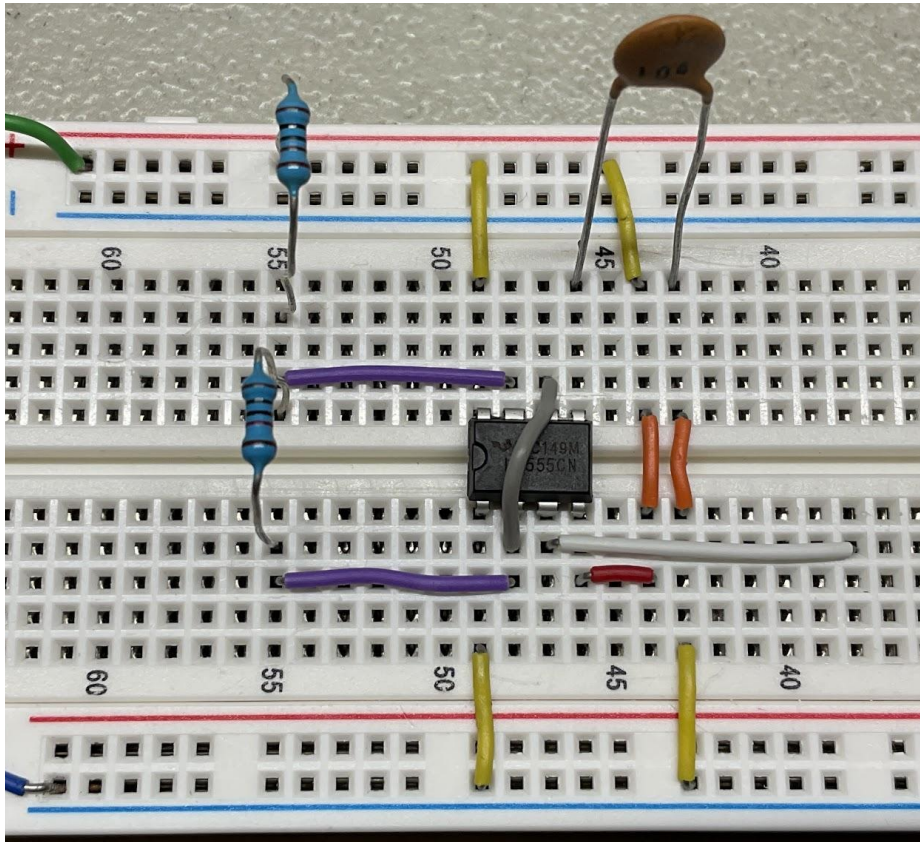
Making Music - Astable Mode

- Connect pin 2 (trigger) and pin 6 (threshold) together.
- As the voltage varies between these two points the chip will turn on/off at ⅓ Vcc and ⅔ Vcc.
- This will give us our oscillation that we hope to hear.



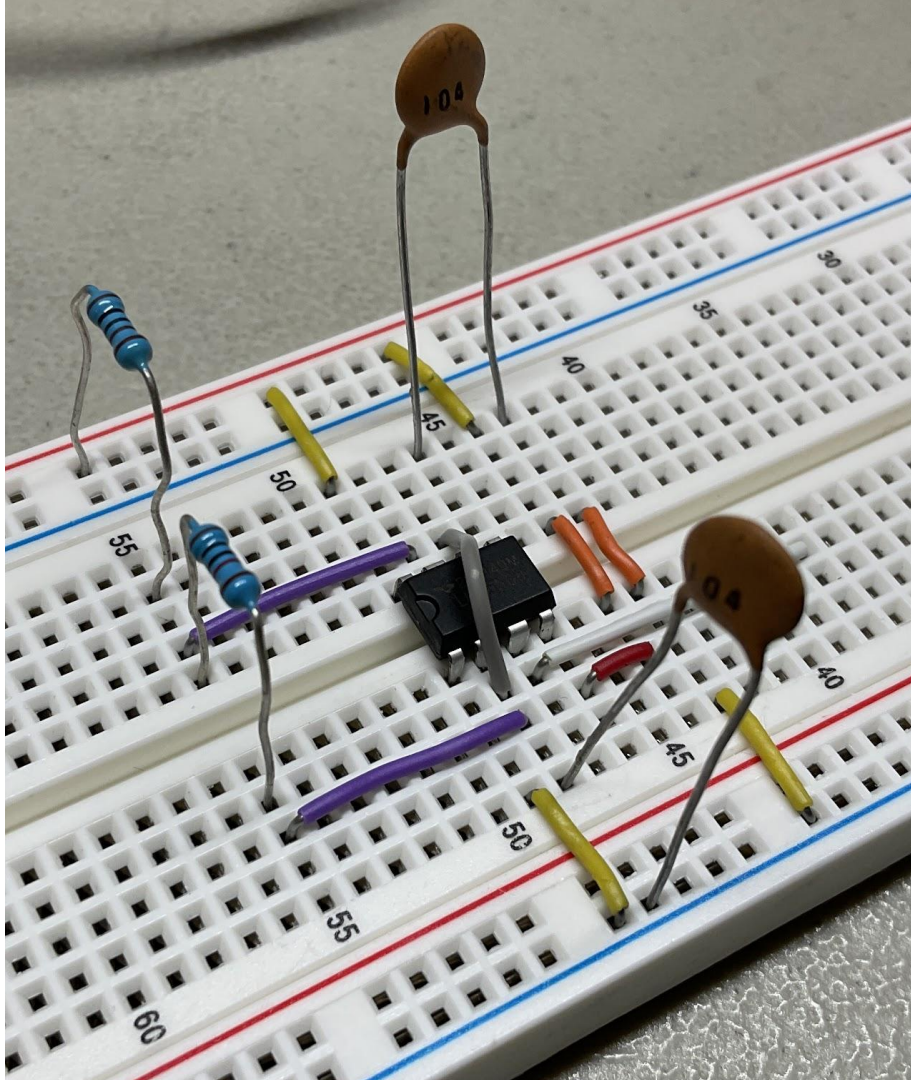
Making Music - Astable Mode

- Create a voltage divider using a 1K (brown, black, black, brown) and 10K (brown, black, black red) resistor.
- At the midpoint of the voltage divider connect pin 7 (discharge).
- At the bottom of the voltage divider connect pin 2 (trigger).



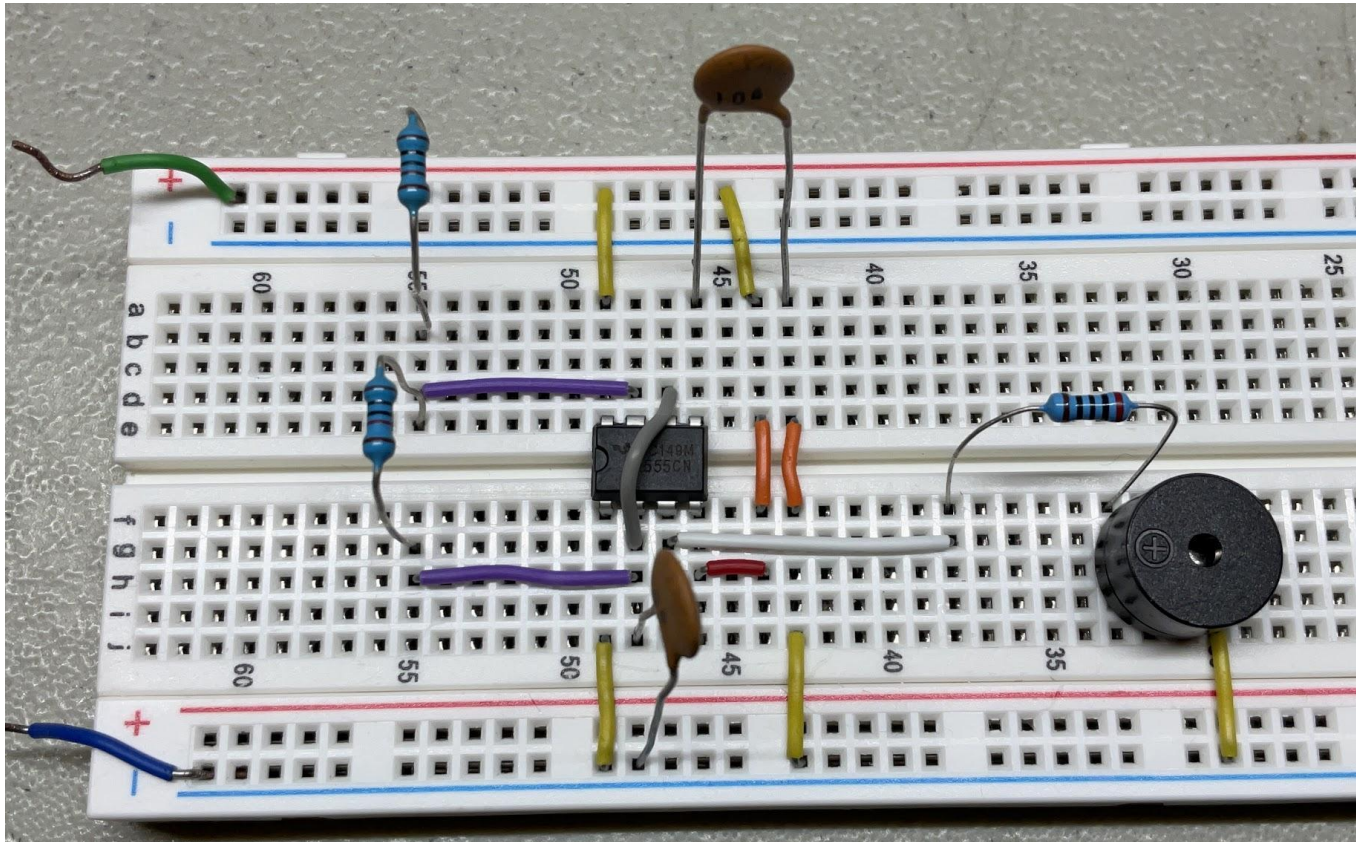
Making Music - Astable Mode

- To ensure that the voltage varies at pins 2 (trigger) and 6 (threshold) connect a 100 nanoFarad capacitor (104) to pin 2/6 going to ground.



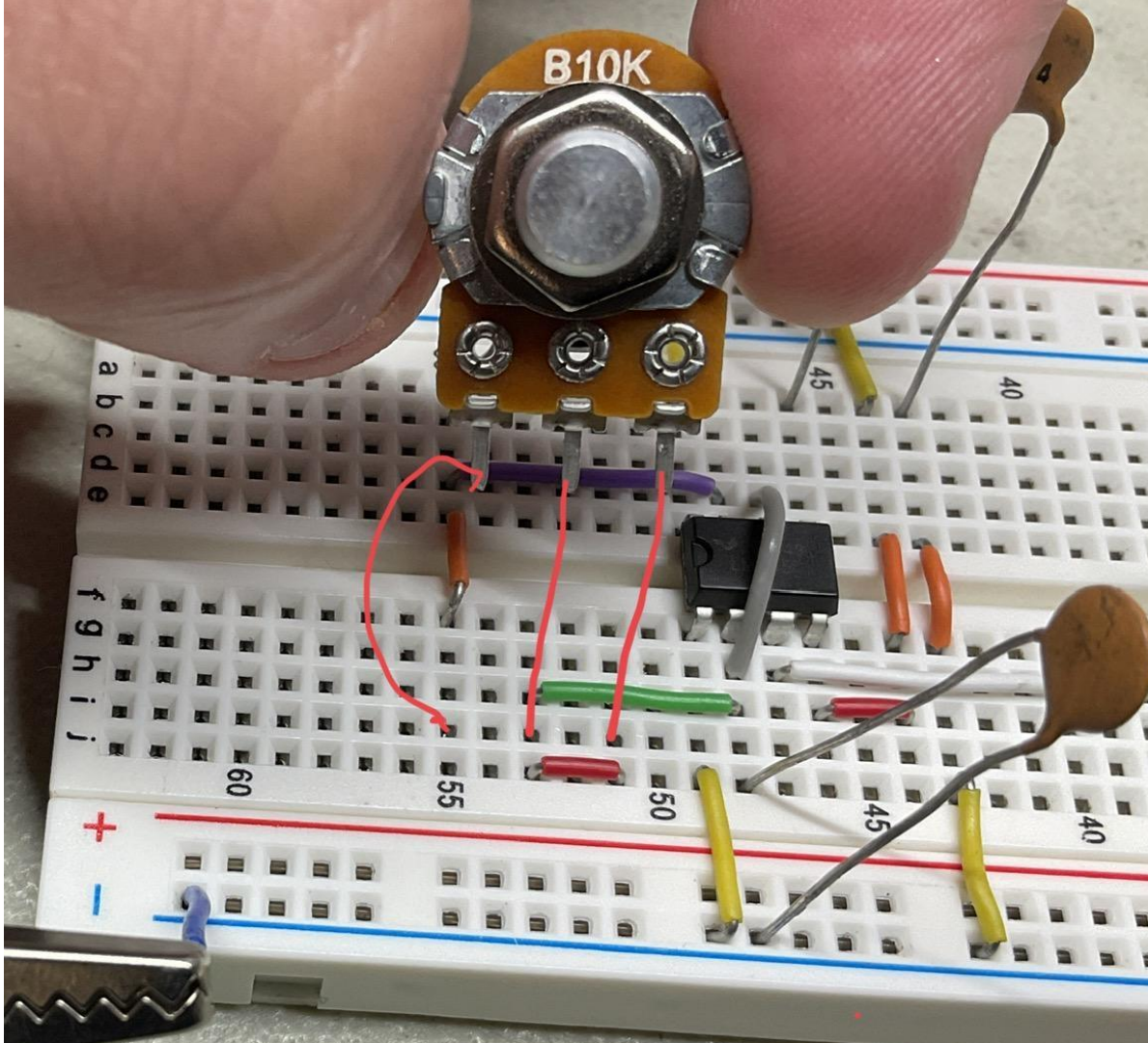
Making Music - Astable Mode

- Connect a 200 ohm (red, black, black, black) resistor to pin 3 (output) via your jumper wire.
- Connect a buzzer or speaker to this resistor going to ground.
- Note the polarity of the buzzer.
- Connect your power supply. You should now hear a tone!



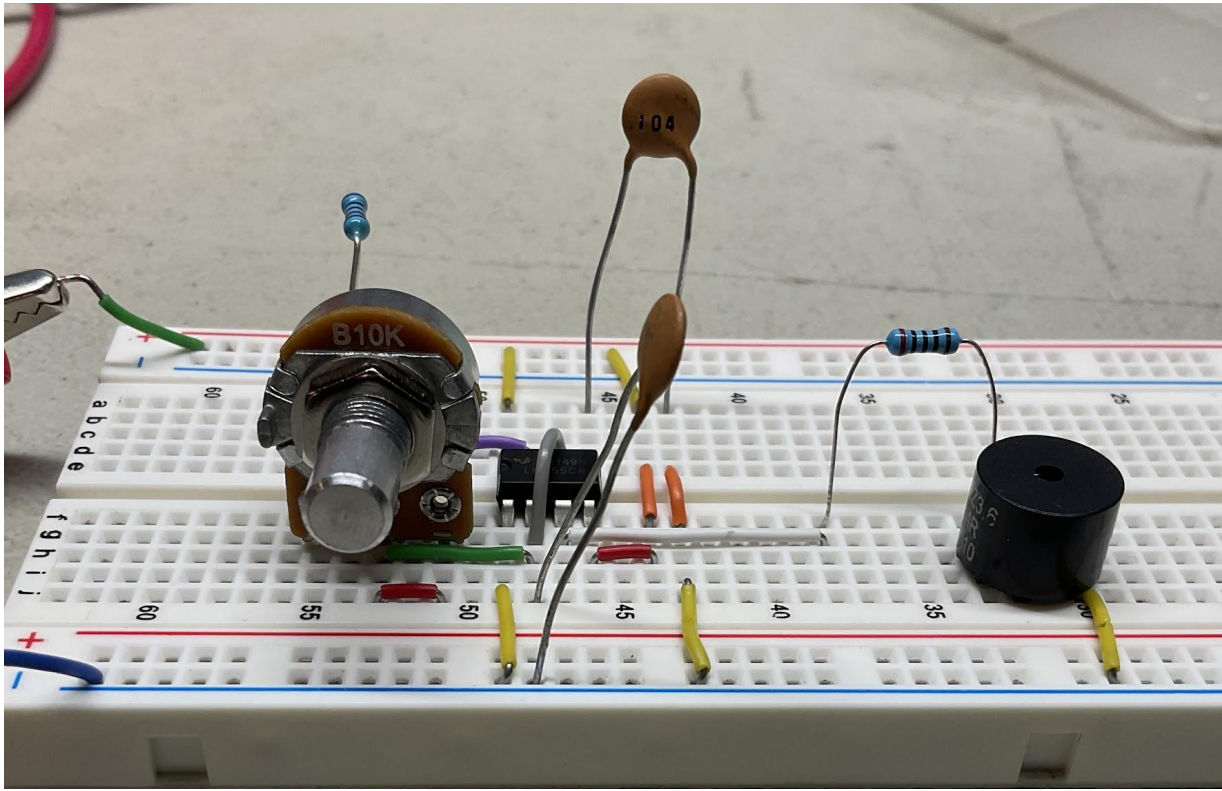
Varying the Note

- One single note makes for some rather boring music!
- Replace the 10K resistor in your voltage divider with a 10K potentiometer.
- We will wire the potentiometer up as a variable resistor by connecting the second and third terminals (red jumper wire).
- You can see the connections on the breadboard.



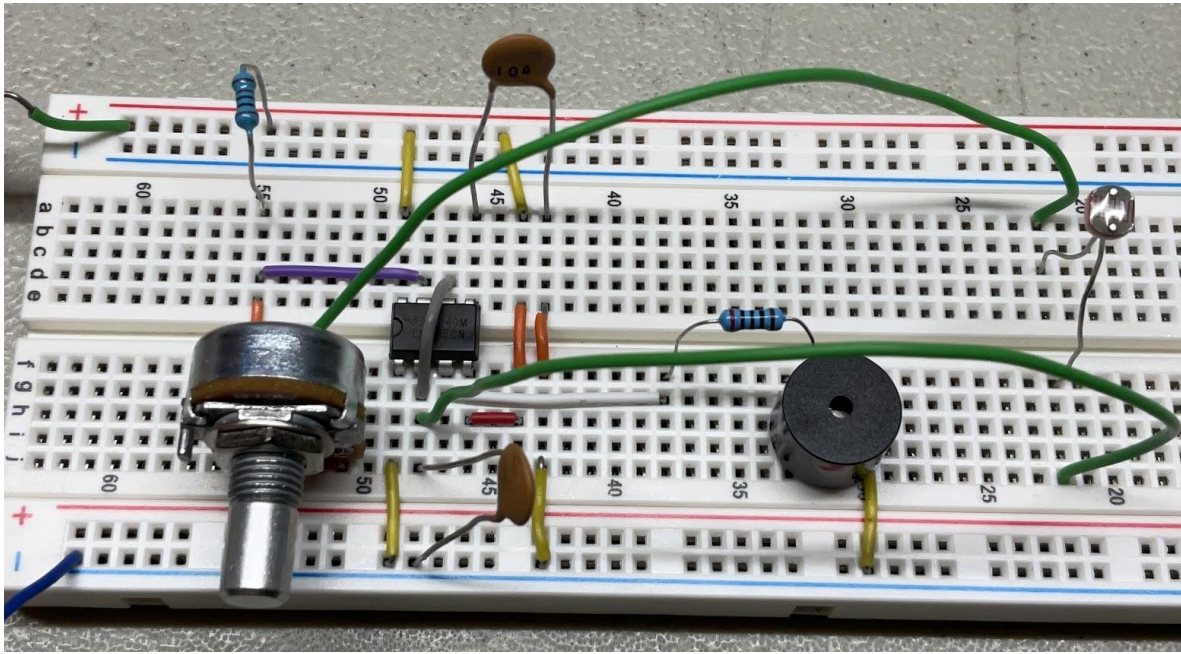
Varying the Note

- Now, as you play your tone, varying the potentiometer should vary the output tone's frequency.



Build Together 5: Final Circuit

- By removing the jumper wire connecting the potentiometer to pin 2 (trigger) and adding a LDR in series to pin 2 (trigger) we can now vary the frequency by moving our hand closer to the circuit.
- The resistance R2 has a great effect on the output frequency.
- This resistance is now the series resistance of the 10K potentiometer and the LDR.



Build Together 6

The Toy Piano

Build Together 6: The Toy Piano

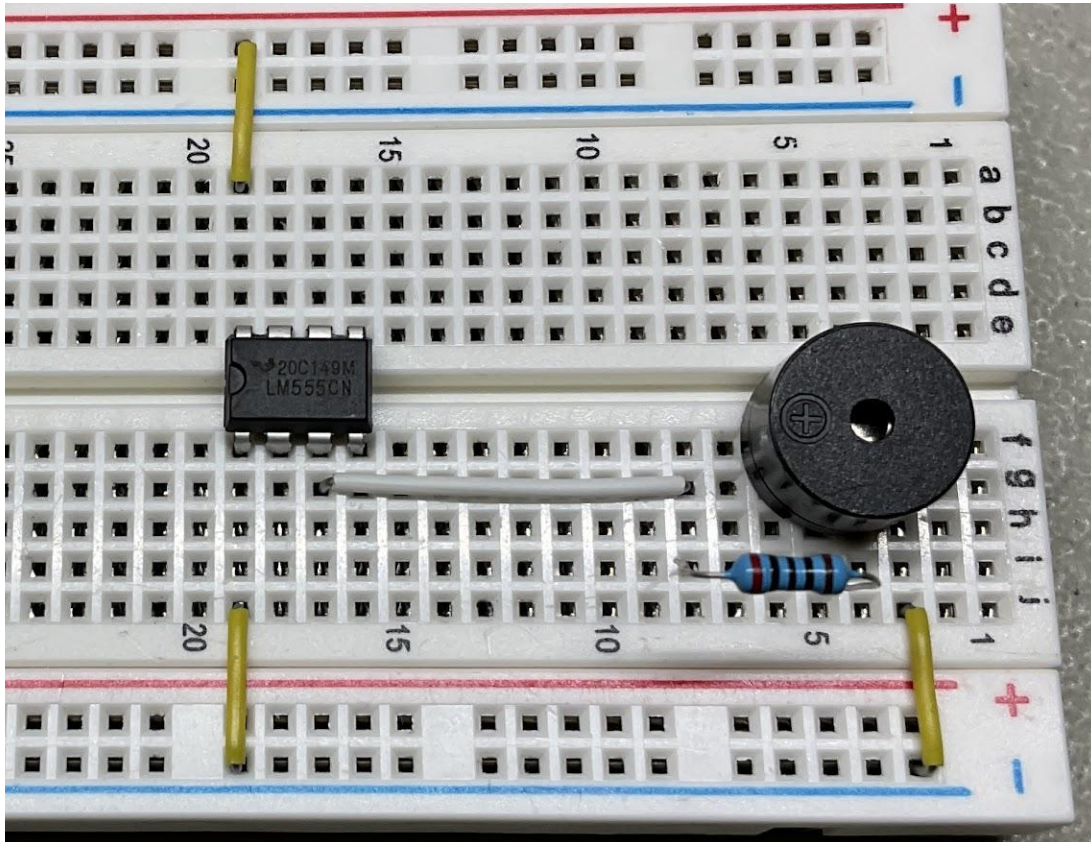
- A piano is a musical instrument that changes pitch depending on the key of the piano you press.
- We can use a 555 timer in astable mode to create an output frequency.
- We can then vary that frequency by using multiple push buttons as keys.

- As you are building, try to think about what you are doing and why the circuit is designed the way that it is.

ADVANCE to the next slide, let’s build this together!

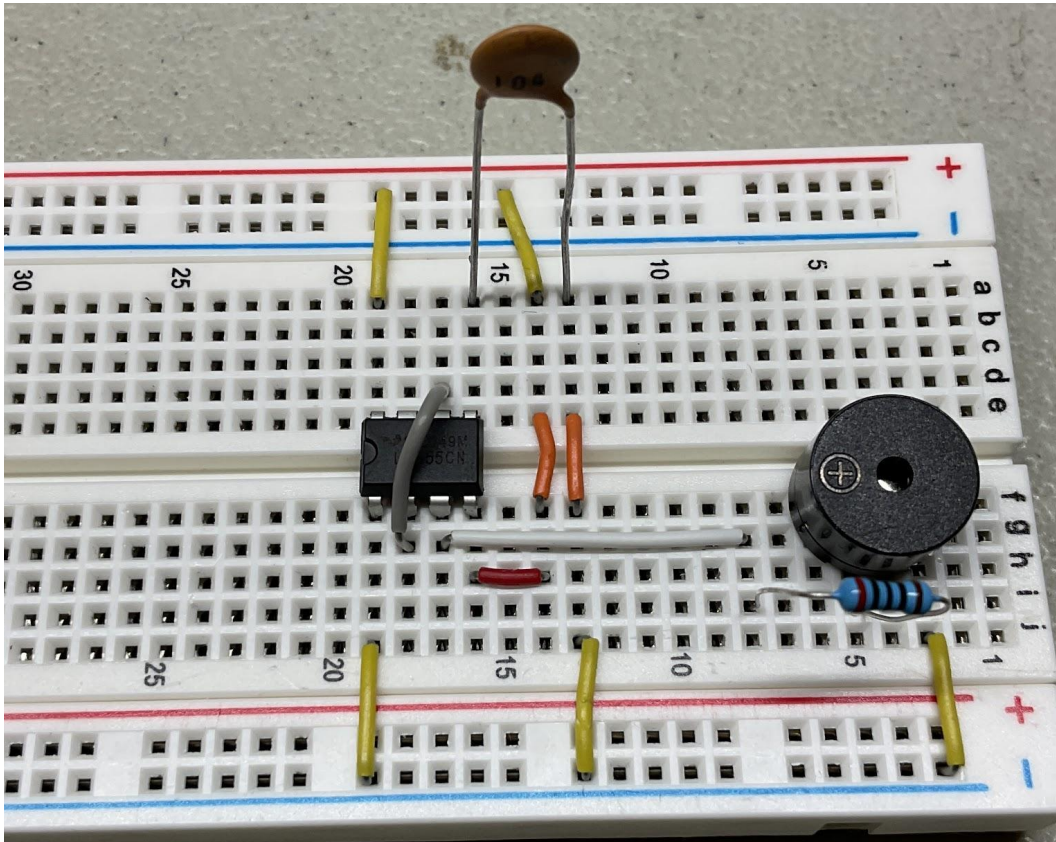
Making Music - Astable Mode

- We will again be using a 555 timer in astable mode to generate a constant output frequency that we can hear.
- Place the 555 timer on the far right of the bread board.
- Connect pin 8 (Vcc) to Vcc.
- Connect pin 1 (ground) to ground.
- Move pin 3 (output) away from the chip for easy access and connect a 200 ohm (red, black, black, black) resistor to a buzzer to ground.



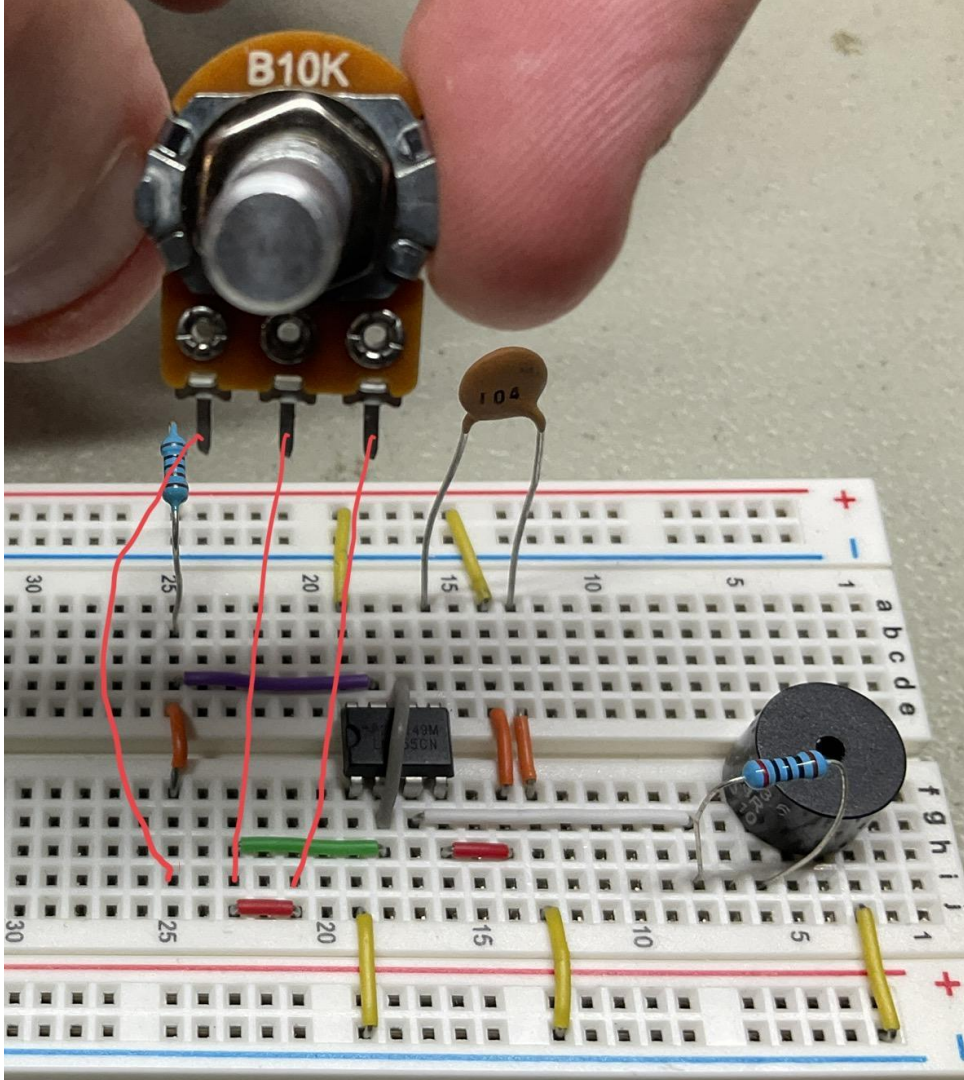
Making Music - Astable Mode

- Connect pin 2 (trigger) and pin 6 (threshold) together.
- Connect pin 4 (reset) to Vcc to ensure the chip does not reset.
- Connect pin 5 (control voltage) to ground through a 100 nanoFarad (104) capacitor.



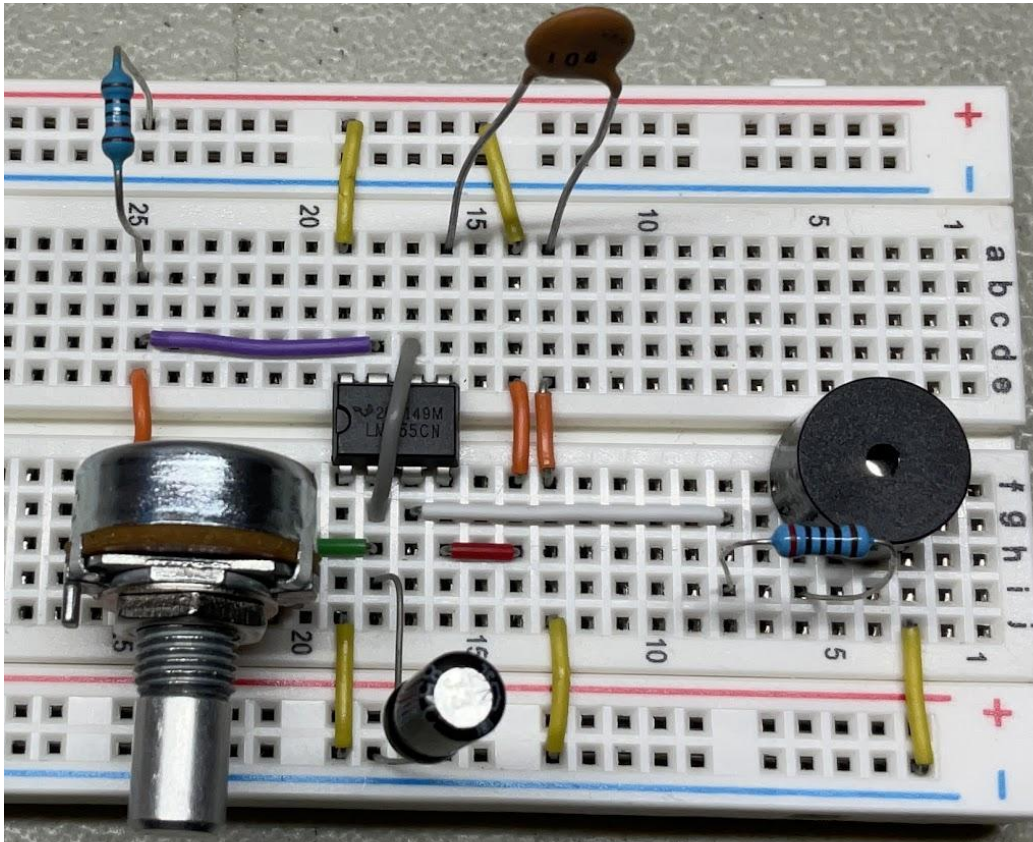
Making Music - Astable Mode

- Create a voltage divider using a 1K (brown, black, black, brown) resistor and a 10K potentiometer.
- We will wire up the potentiometer as a variable resistor.
- Connect the midpoint of the voltage divider to pin 7 (discharge).
- Connect the bottom of the voltage divider to pin 2 (trigger).



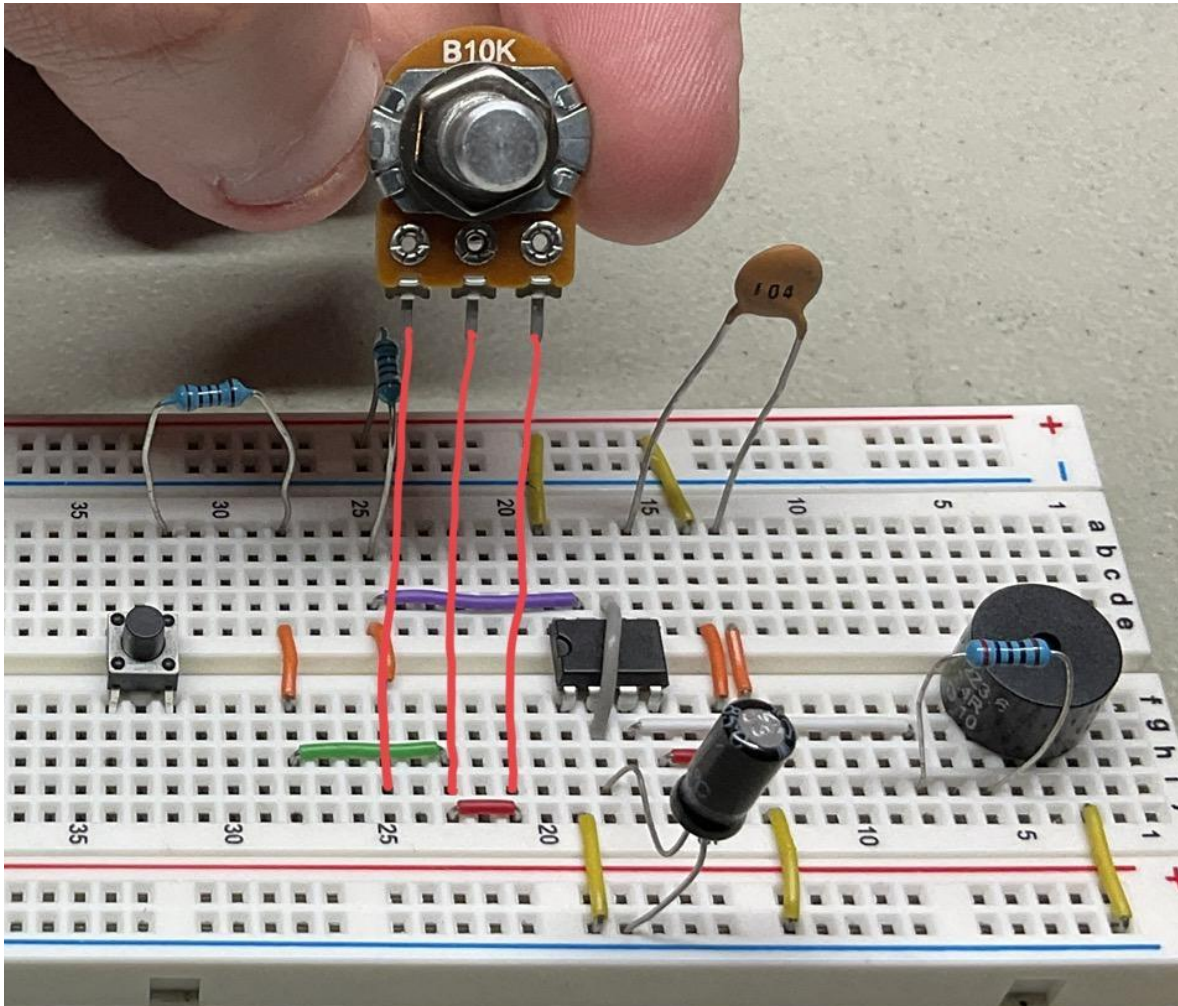
Making Music - Astable Mode

- Connect a 1 microFarad capacitor from pin 2 (trigger) to ground.
- If you connect power, you should hear a tone. You can vary the tone with the potentiometer.



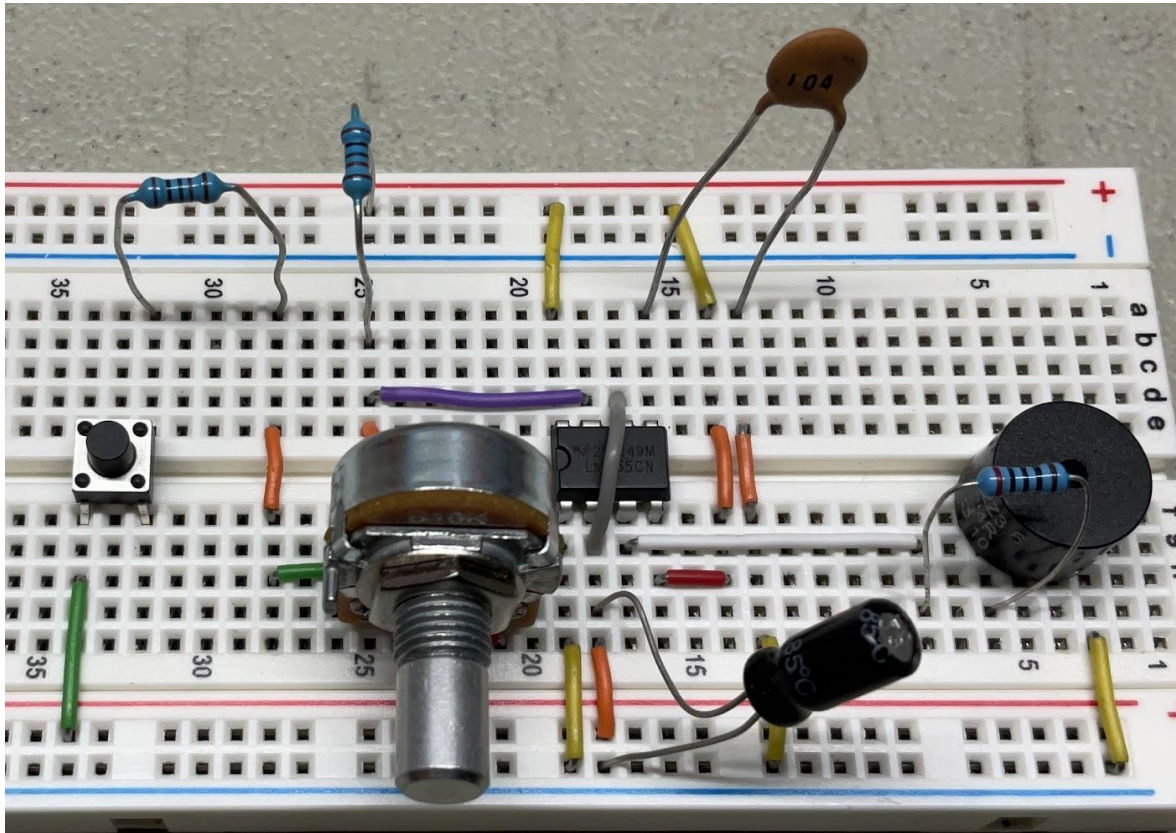
Adding a Piano Key

- Pianos have keys that make music only when you press them!
- Disconnect the 10K potentiometer from pin 2 (trigger).
- Instead, connect the potentiometer to a 1K (brown, black, black, brown) resistor on the top side of the bread board.
- Connect the other side of the 1K resistor to a push button that will serve as our piano key.



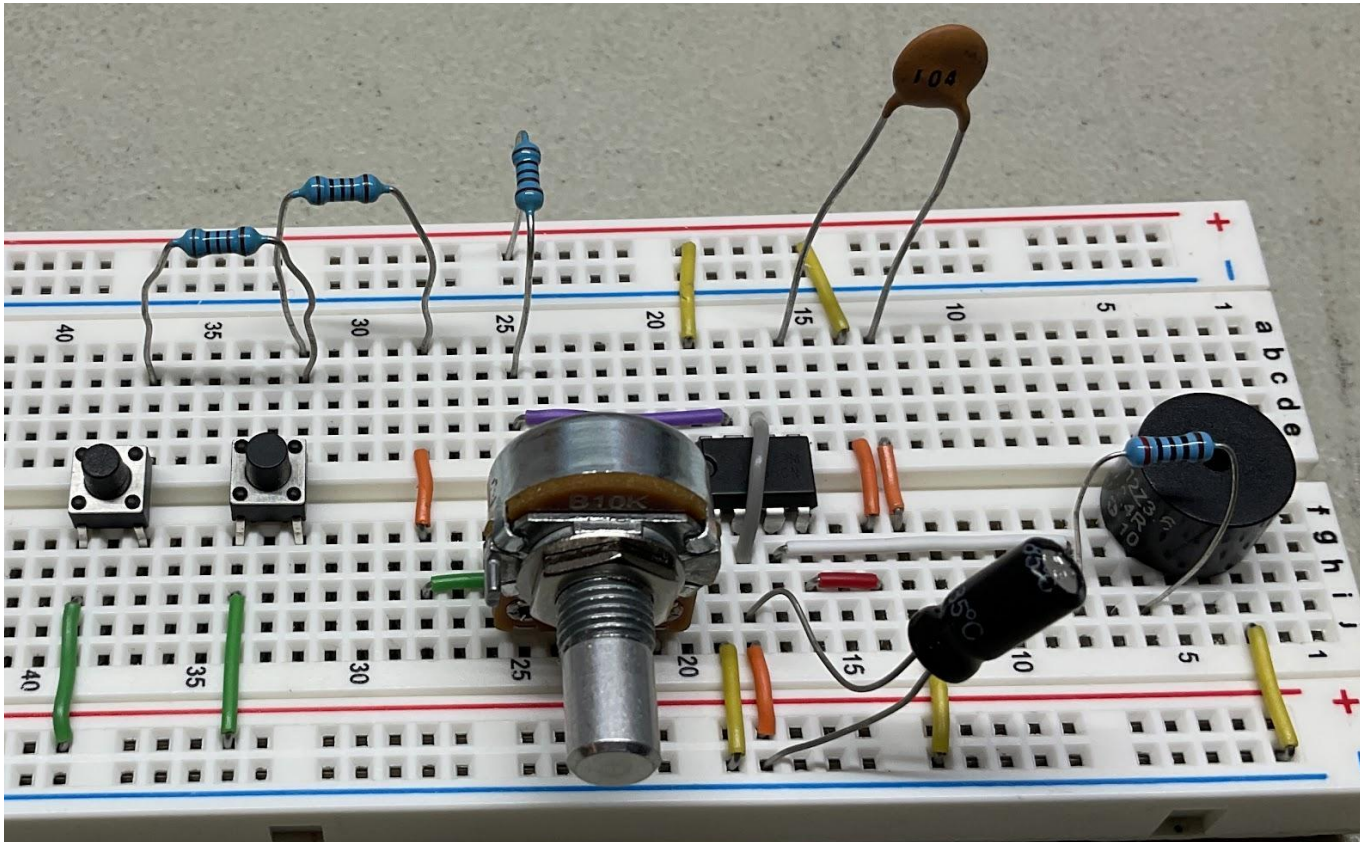
Adding a Piano Key

- We need to ensure that the bottom of our voltage divider is somehow brought back to pin 2 (trigger).
- Connect the push button on the opposite side of the 1K resistor to one of the “rails” at the bottom of the board; the one you are not using for ground!
- Connect this rail to pin 2 (trigger).
- Since every connection on this rail is connected, we will use it for ALL of our push buttons to send a voltage back to pin 2 (trigger).
- You should now only hear a sound when you press your ‘key’.



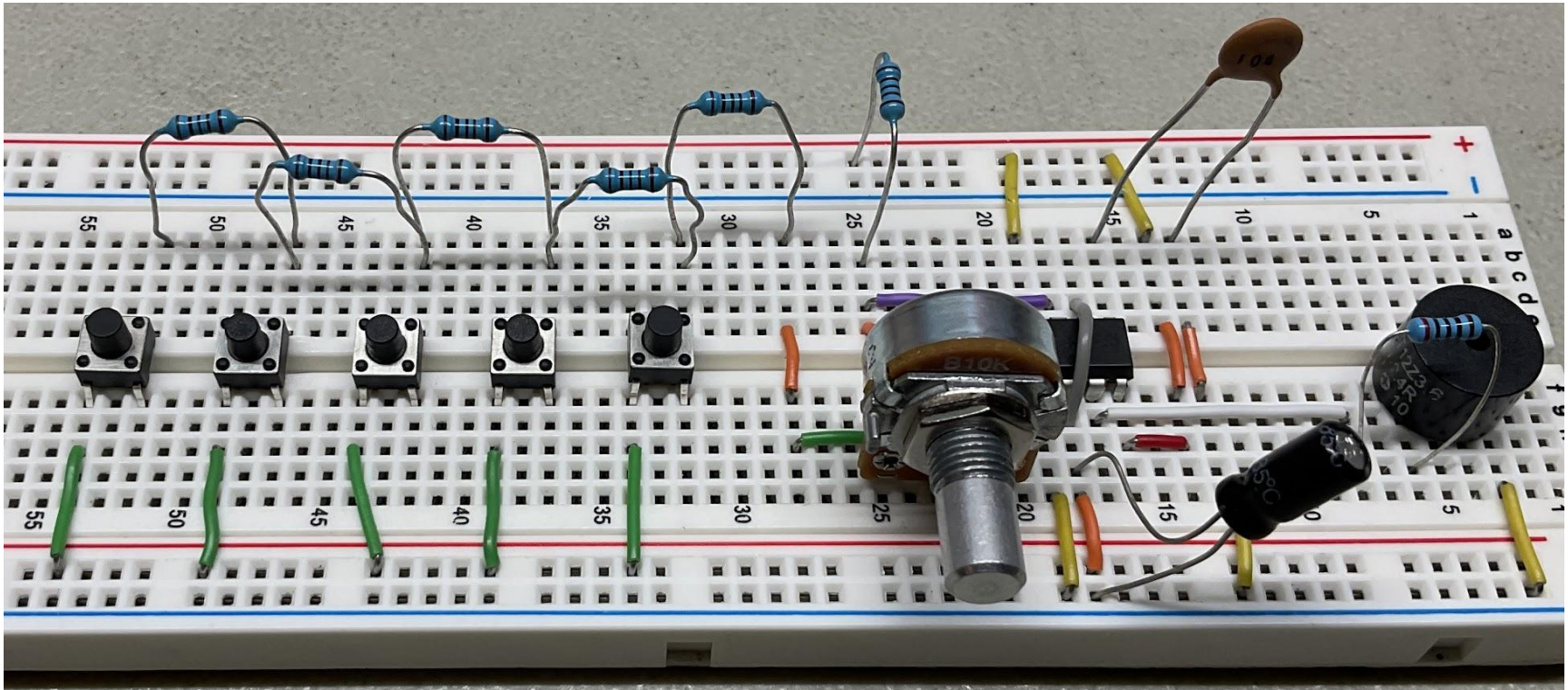
Adding a Second Key

- Add a second key by placing another 1K (brown, black, black, brown) resistor from our first button into the right side of a second button.
- Connect the left side of the button into the non ground rail.
- Now, when you press each button you should hear a different output frequency!
- This is because the first button only sees one of the 1K resistors, while the 2nd button sees two!



Build Together 6: Final Circuit

- I have added the remaining three buttons in a similar manner.
- I have used 1K (brown, black, black brown) resistors for all keys.



Build Together 7

The Atari Punk Console

Build Together 7: The Atari Punk Console

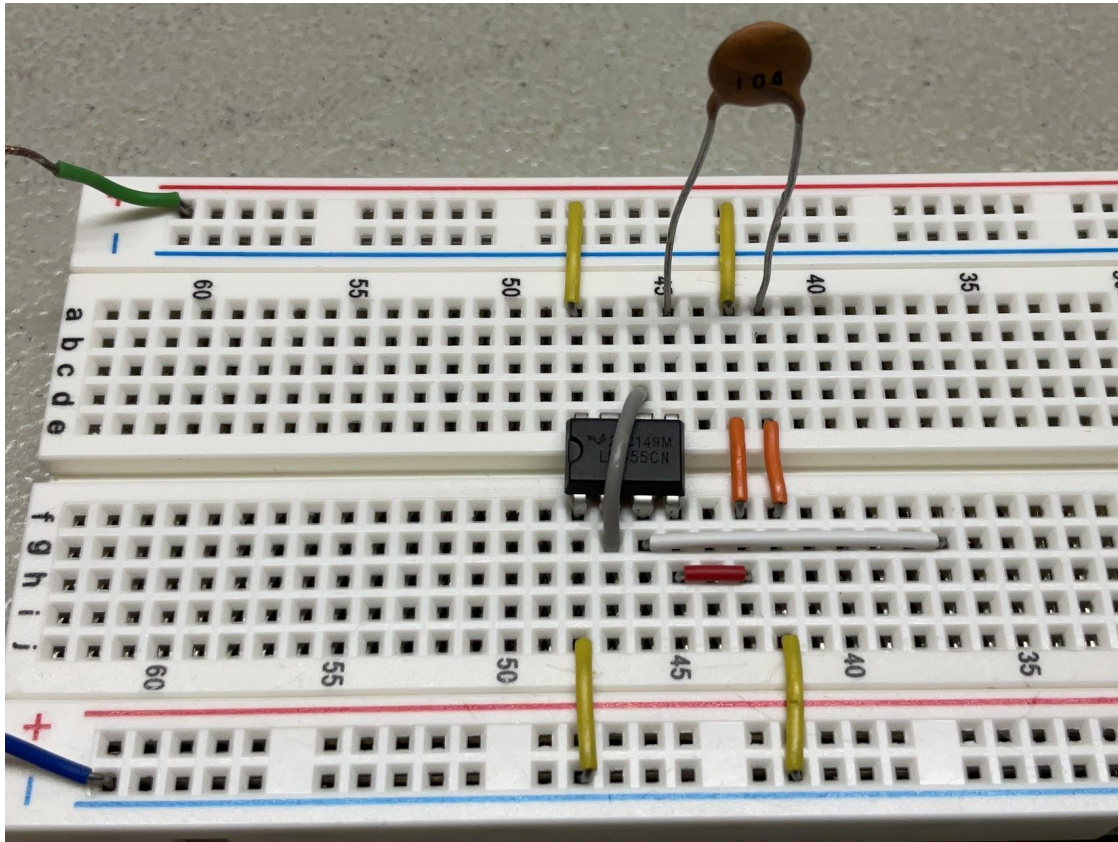
- The Atari Punk Console (APC) is based off a well known circuit by Forrest Mims.
- The APC uses two 555 timers; one 555 timer in astable mode that creates a stable frequency to drive another 555 timer in monostable mode that is used to create an audible tone.
- The APC got its name because its low-fi sounds resemble the sounds from classic 1980s game consoles such as the Atari 2600.
- This is more than just a tone generator; it is a synthesiser!

- As you are building, try to think about what you are doing and why the circuit is designed the way that it is.

ADVANCE to the next slide, let's build this together!

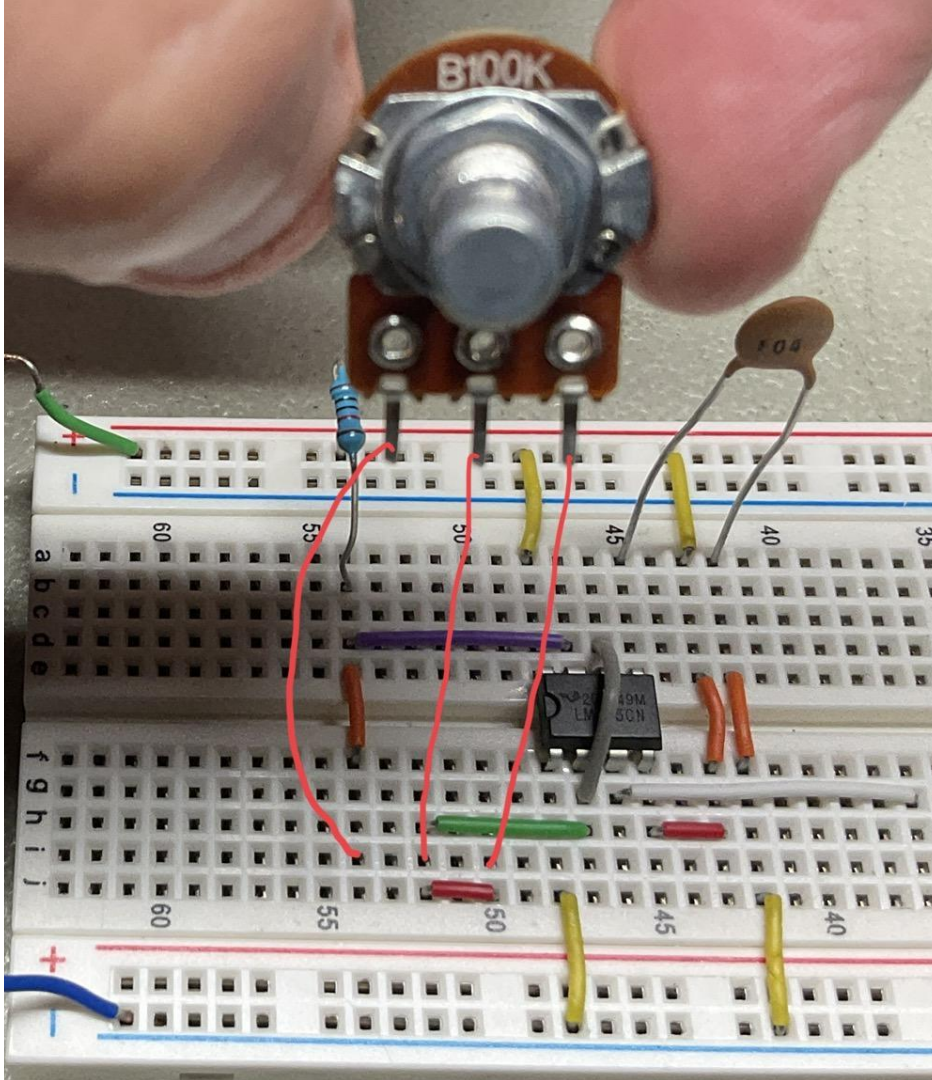
APC - Astable Mode

- Place a 555 timer on the breadboard. We will wire this up in astable mode.
- Connect pin 8 (Vcc) to Vcc.
- Connect pin 1 (ground) to ground.
- Move pin 3 (output) away from the chip for easy access via a jumper.
- Connect pin 4 (reset) to Vcc to ensure that the chip does not reset.
- Connect pin 5 (control voltage) to ground through a 100 nanoFarad (104) capacitor.
- Connect pin 2 (trigger) and pin 6 (threshold) together.



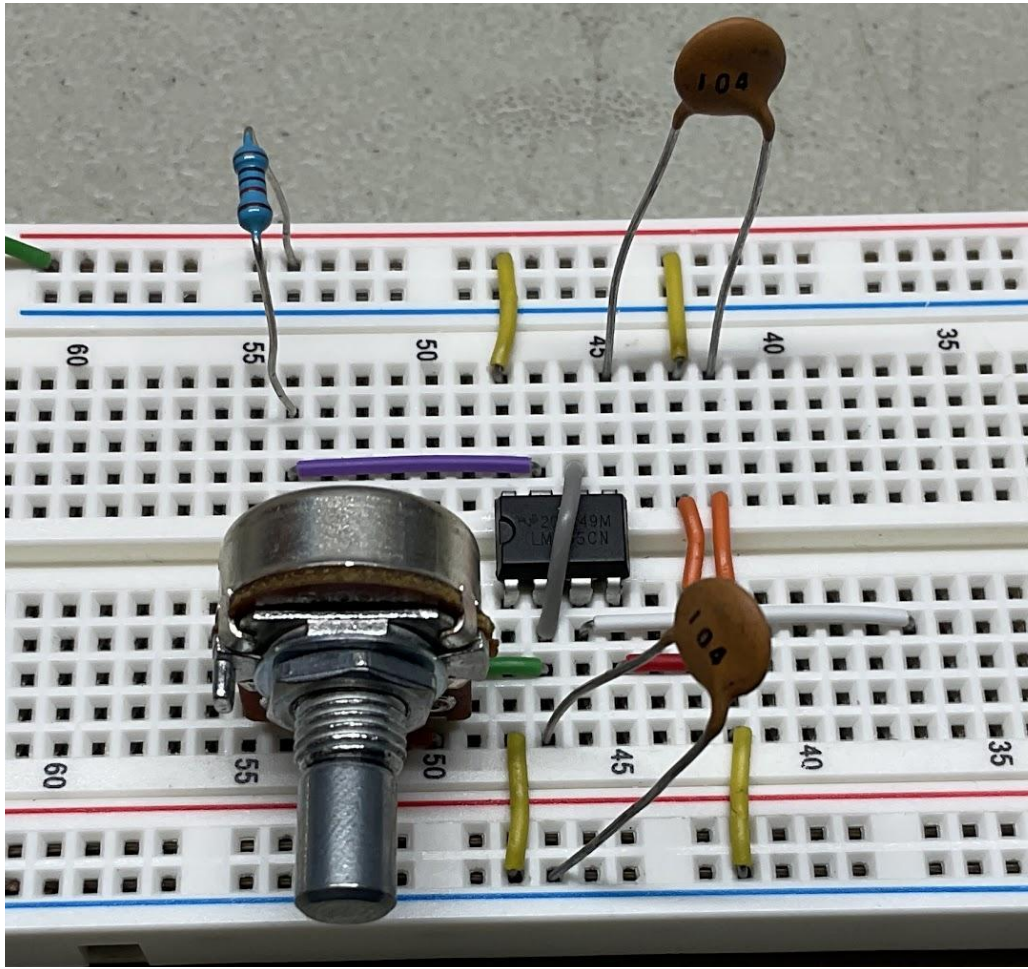
APC - Astable Mode

- Begin building the RC network to control the output frequency of the astable mode timer.
- Connect a 10K (brown, black, black, red) resistor from Vcc to pin 7 (discharge).
- We will then wire up a 100K potentiometer as a variable resistor going into pin 2 (trigger).



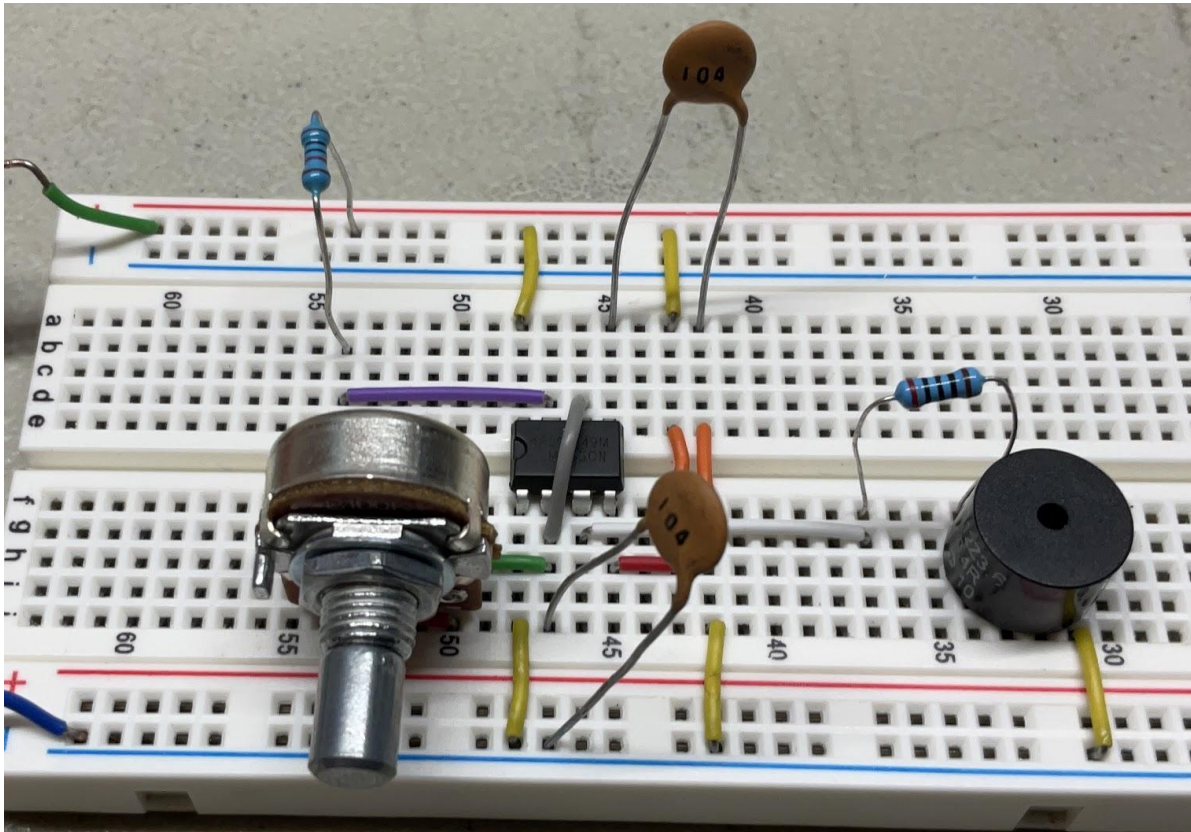
APC - Astable Mode

- Connect the 100K potentiometer.
- Connect pin 2 (trigger) to ground through a 100 nanoFarad (104) capacitor.
- The RC network to control output frequency is now complete.



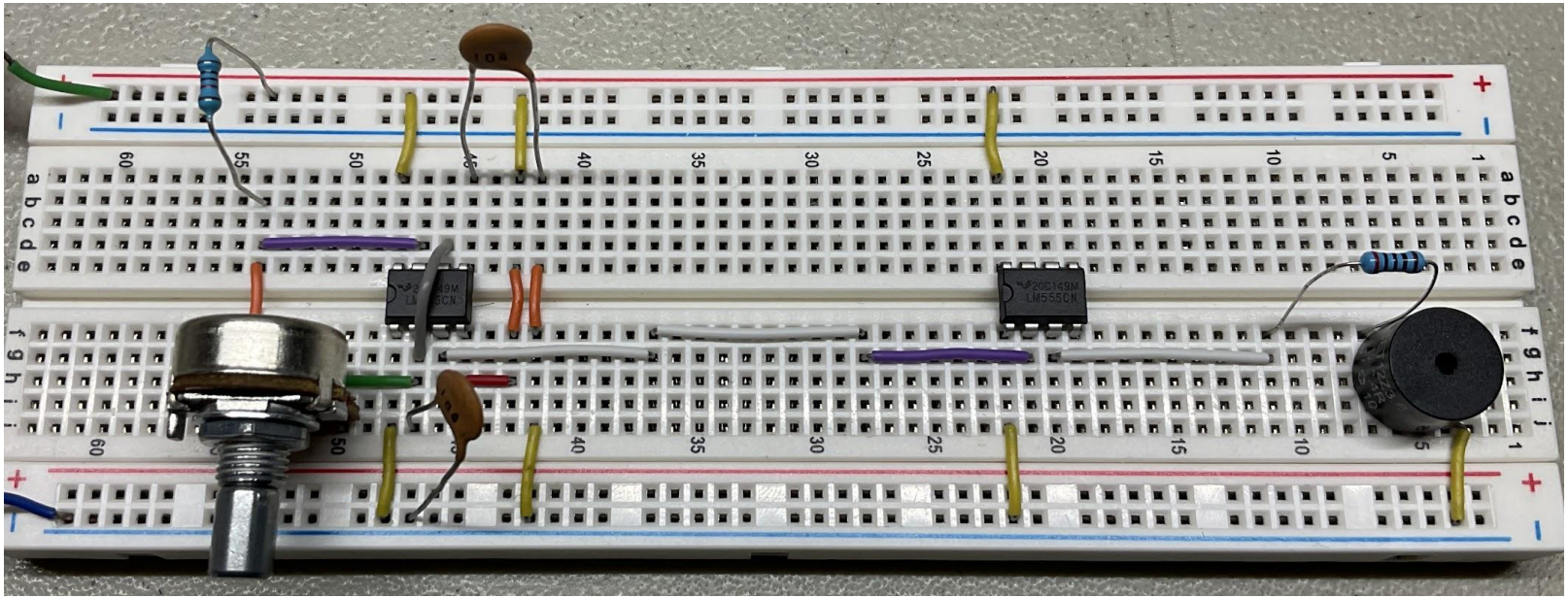
APC - Astable Mode

- Test the astable mode circuit.
- Hook a 200 ohm (red, black, black, black) resistor up to pin 3 (output) via your jumper wire.
- Connect a buzzer going to ground.
- You should hear an output frequency and have great control over the frequency via the potentiometer.



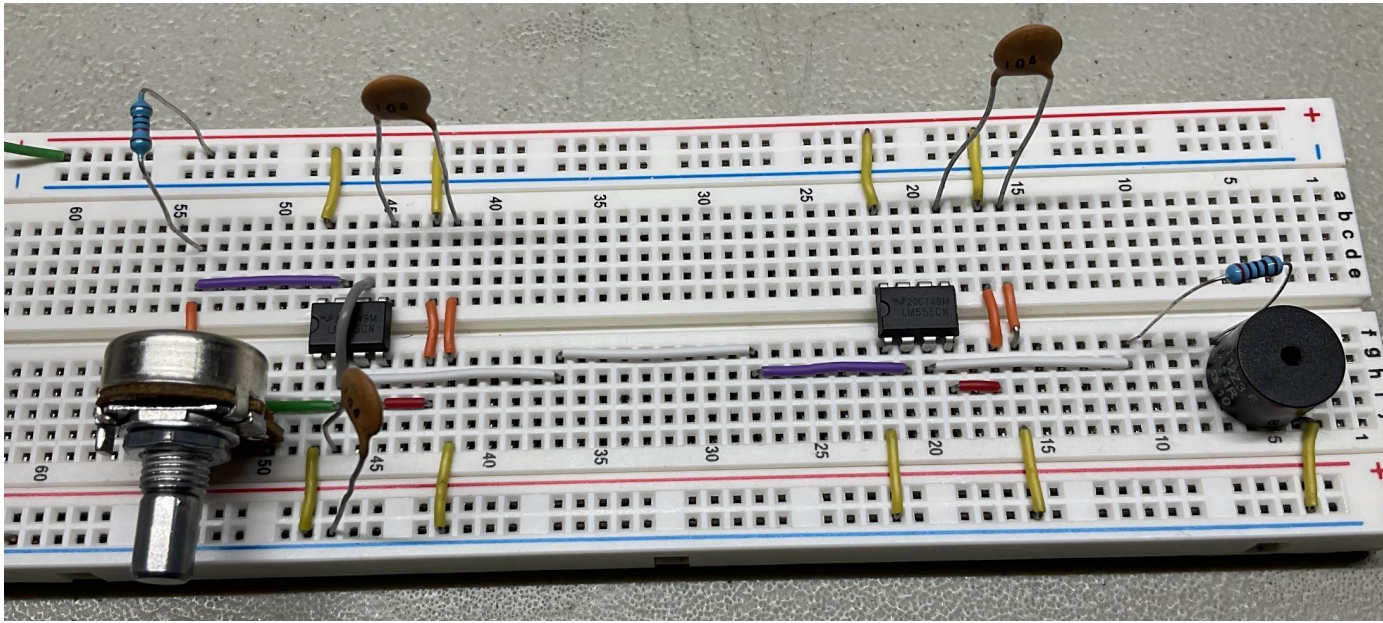
APC - Monostable Mode

- Put a second 555 timer on the right hand side of the bread board. We will wire this up in monostable mode.
- Connect pin 8 (Vcc) to Vcc and pin 1 (ground) to ground.
- Connect the output of the first 555 timer in astable mode to pin 2 (trigger) on the second 555 timer in monostable mode.
- Move pin 3 (output) of the second 555 timer away from the chip for easy access and connect a 200 ohm (red, black, black, black) resistor to a buzzer to ground.



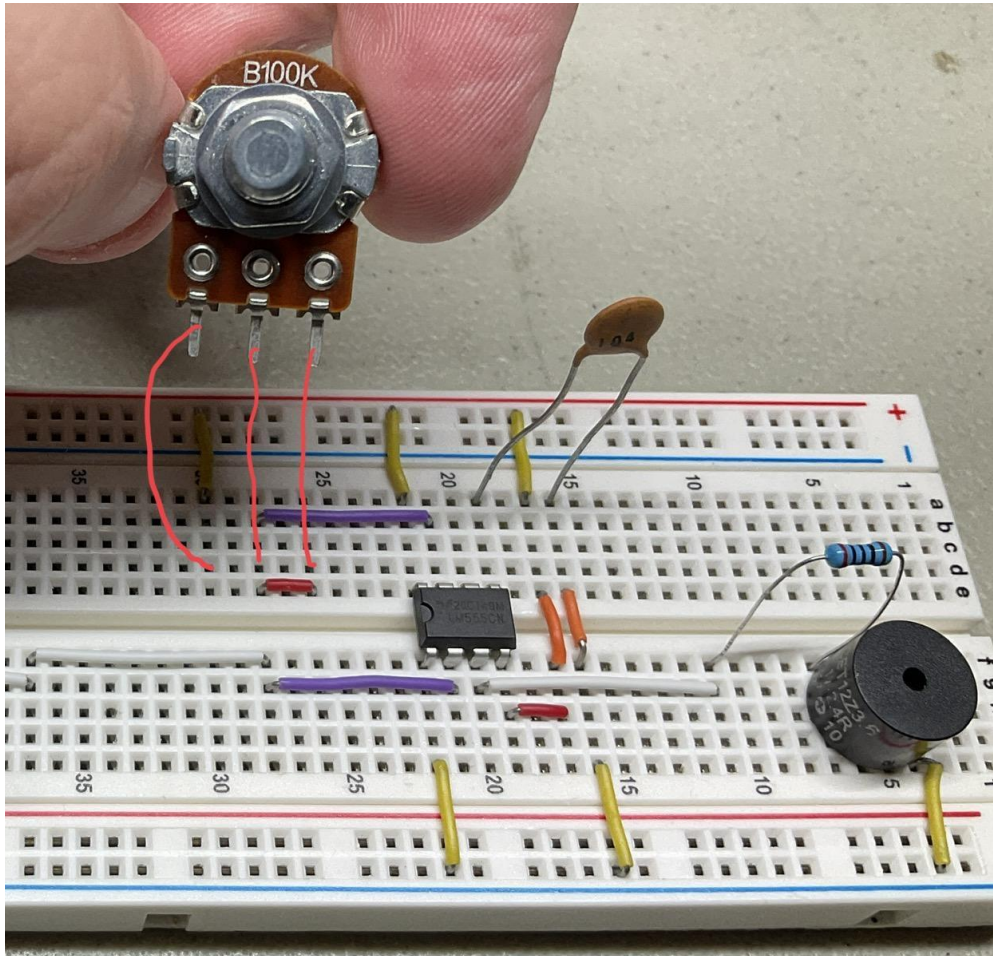
APC - Monostable Mode

- Connect pin 4 (reset) to Vcc to ensure that the chip does not reset.
- Connect pin 5 (control voltage) to ground via a 100 nanoFarad (104) capacitor.



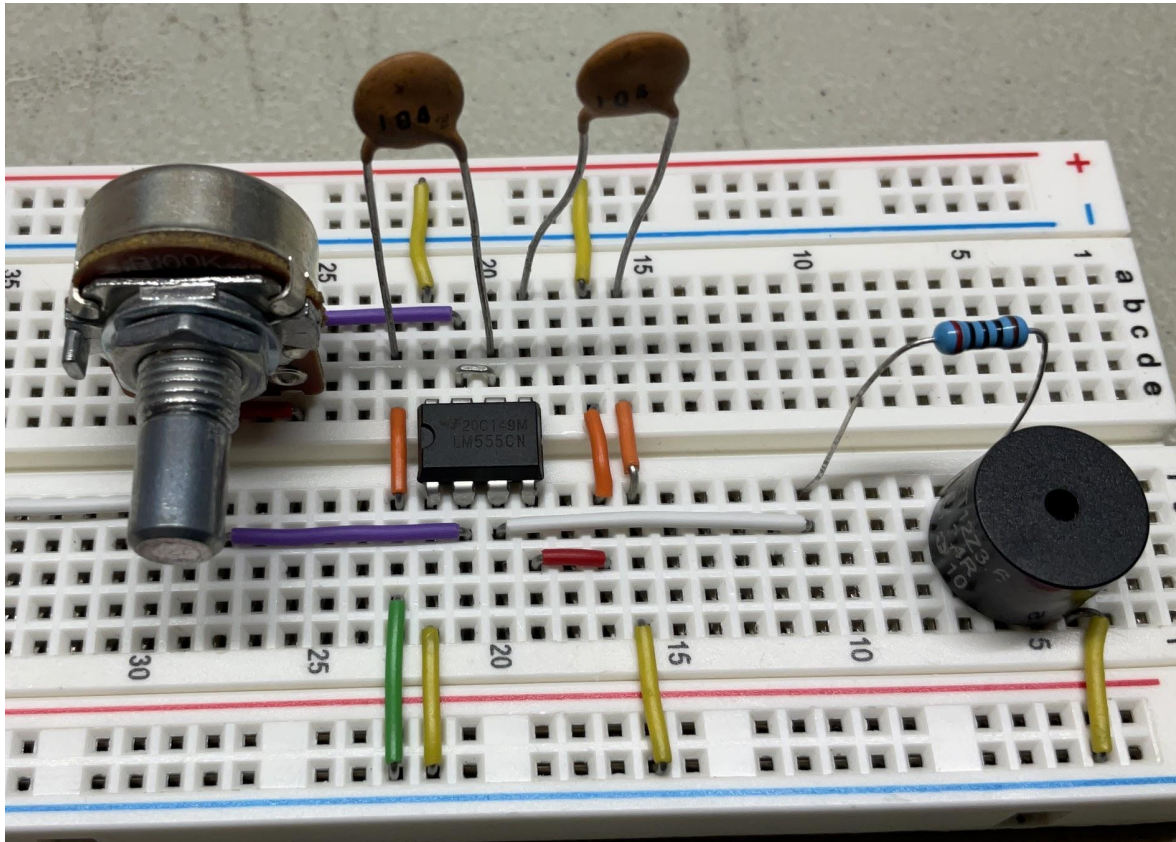
APC - Monostable Mode

- Wire up a 100K potentiometer as a variable resistor.
- The output of the potentiometer should go into pin 7 (discharge) of the monostable 555 timer.



APC - Monostable Mode

- Connect pin 7 (discharge) and pin 6 (threshold) via a jumper.
- Connect pin 6 (threshold) to ground via a 100 nanoFarad (104) capacitor.
- The RC network to control output frequency is now complete.



Build Together 7: Final Circuit

- Play around with the potentiometers.
- What effect is each one having on the output frequency?