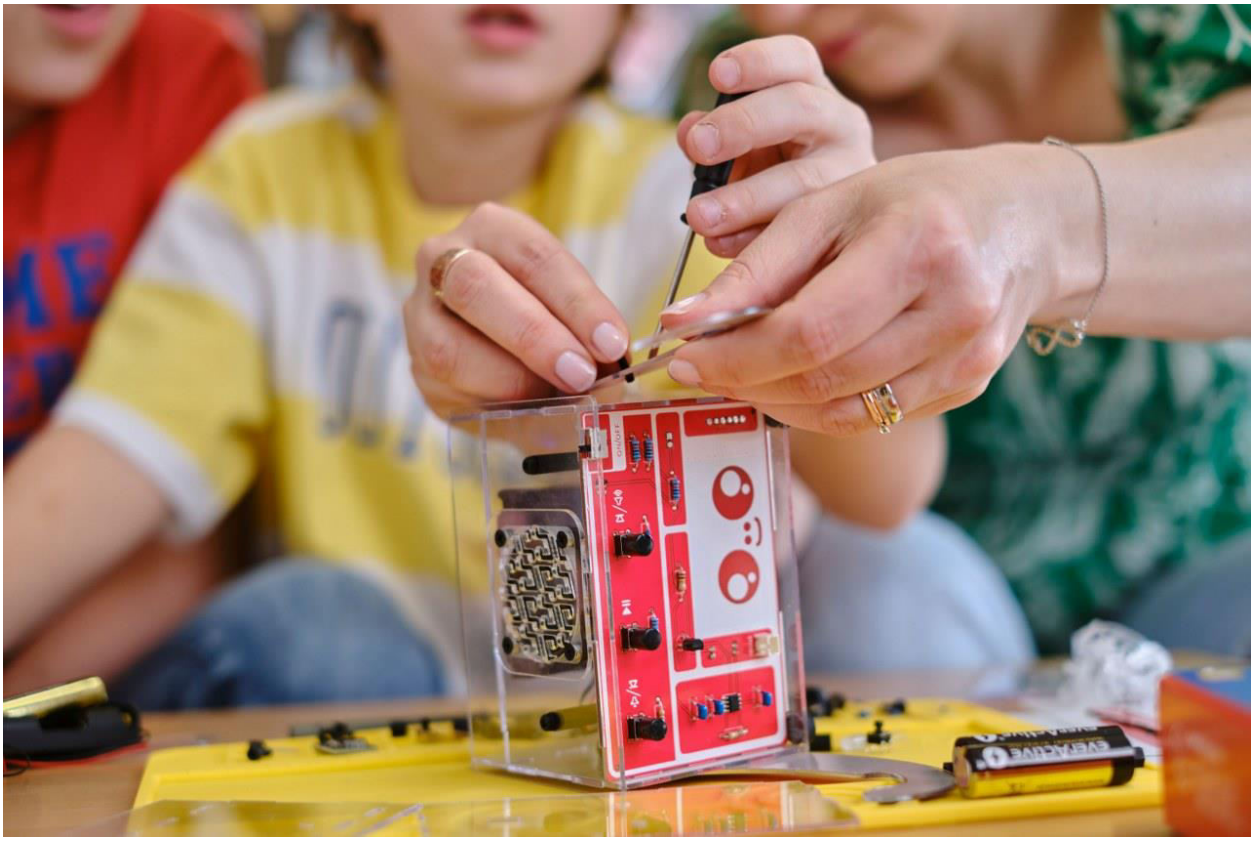
HERTZ, The Wacky Robot Build Guide

Introduction

Welcome to CircuitMess Hertz, the Wacky Robot build guide!

By following this build guide, you'll learn how to assemble your Wacky Robot Hertz!



Hertz is a beginner-friendly 21-piece kit.

With Hertz, you'll learn, except soldering, about different electronic components and the science of sound.

After you finish building Hertz, it'll act as a Bluetooth speaker and play your favorite music.

Age group

This product is 9+.

Make sure to have an adult helping you with the assembly process. It's okay to ask for help.

Assembly time

It should take you approximately 1 hour to fully assemble your Hertz.

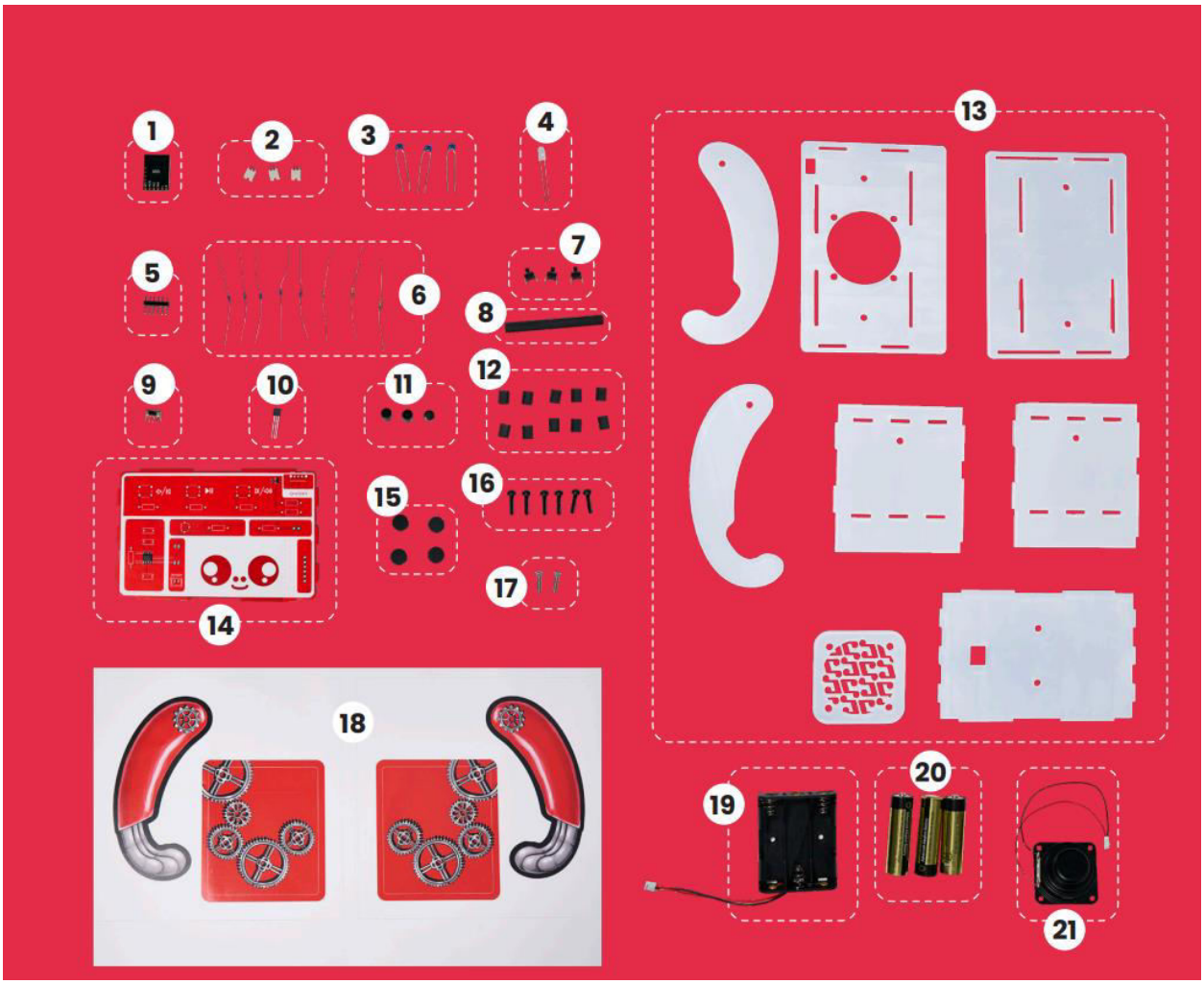
Skills

You don't need any specific skills before getting your hands dirty with this DIY project.

The main objective here is to have fun and learn something new.

What's in the box?

Let's meet all the components that arrived!



In case something is missing, please contact us at contact@circuitmess.com. Send us a photo of everything that came in the box, and we'll get back to you as soon as possible to resolve the issue.

Here's the list of components:

1. Bluetooth audio module
2. Connectors
3. Capacitors
4. RGB LED
5. Pin connector
6. Resistors
7. Push buttons
8. Large standoff
9. On/off switch
10. Transistor
11. Pushbutton caps
12. Standoffs

13. Plexiglass parts
14. Printed circuit board
15. Anti-slip pad
16. Nylon bolts
17. Metal bolts
18. Sticker sheet
19. Battery holder
20. Batteries
21. Speaker

Electronics 101

Let's learn something about the components you've got!

1. Circuit board

The red square-shaped thingy you've gotten in your kit is called a circuit board.

Professionals call this a printed circuit board or PCB.

A PCB is a laminated sandwich structure of conductive and insulating layers.

What does it do?

Your circuit board has two functions:

- It holds all the electronic components in place.
- It provides electrical connections between the electronic components.

Because of the circuit board, all electronic components can work together as a team.

What are those tiny lines on my circuit board?

They allow electrical charges to flow between components. This way, electronic components are powered, and they can do clever stuff using electricity.

What is my circuit board made of?

Circuit boards are usually made out of fiberglass-reinforced epoxy-laminated sheets.
These are also referred to as “FR4” sheets.
The FR4 sheets are used as the insulating non-conductive material, and copper is used as a conductive material.
If material is conductive, it conducts electricity; electrical charge can flow through that material easily.
FR4 and copper are both sandwiched together in thin sheets, and that’s how you get a circuit board.

Where are PCBs used?

They’re used everywhere!
In your phone, in your laptop, in your refrigerator, air conditioner. Basically, every electronic device you use has a unique printed circuit board that makes it work.

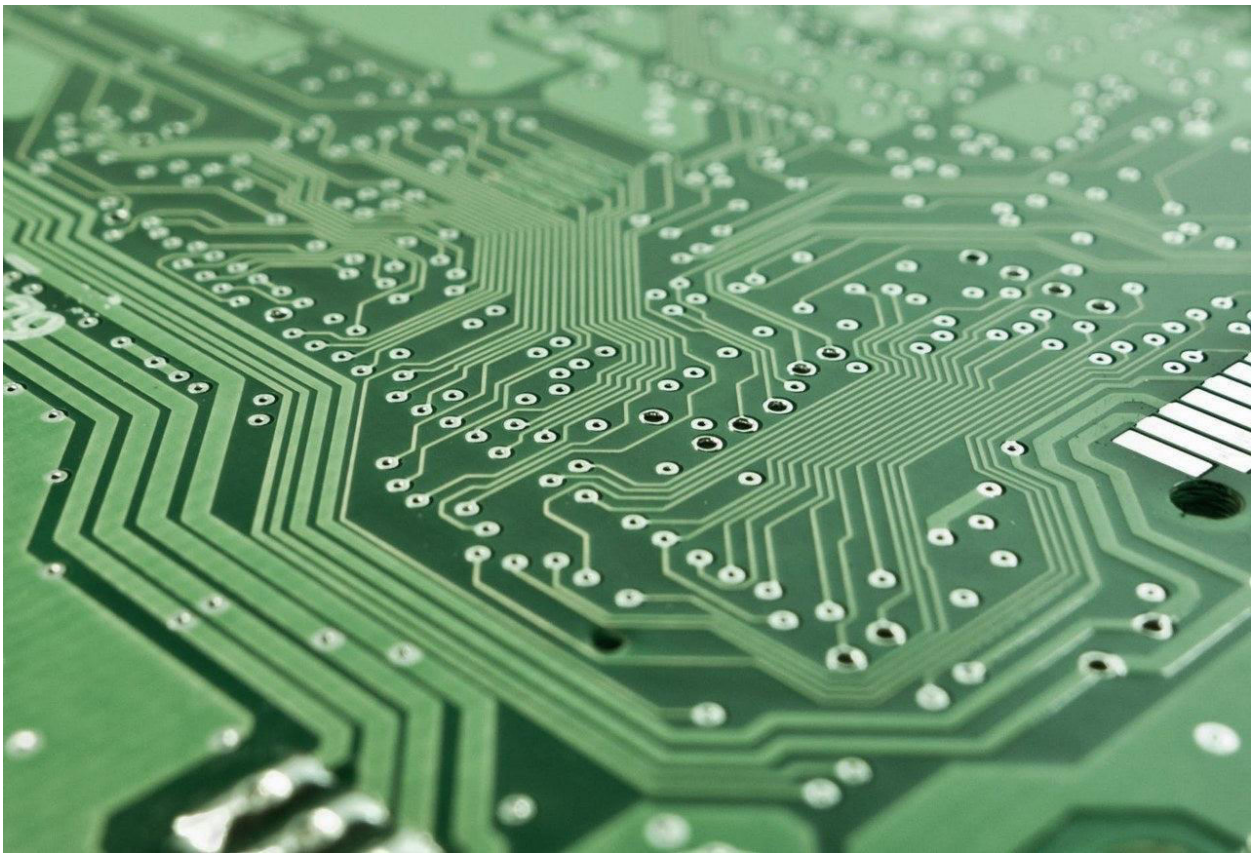
Did you know?

A PCB is one of the most important inventions of the last 100 years.

Space travel wouldn’t be possible without them.

PCBs were invented by Paul Eisler.

He invented it in the 1930s, but the predecessors of modern-day PCBs have been around since the age of gramophones and vacuum tube radios, just in a somewhat different form.



2. Resistors

Resistors are the most basic electronic components found in almost every electronic device.

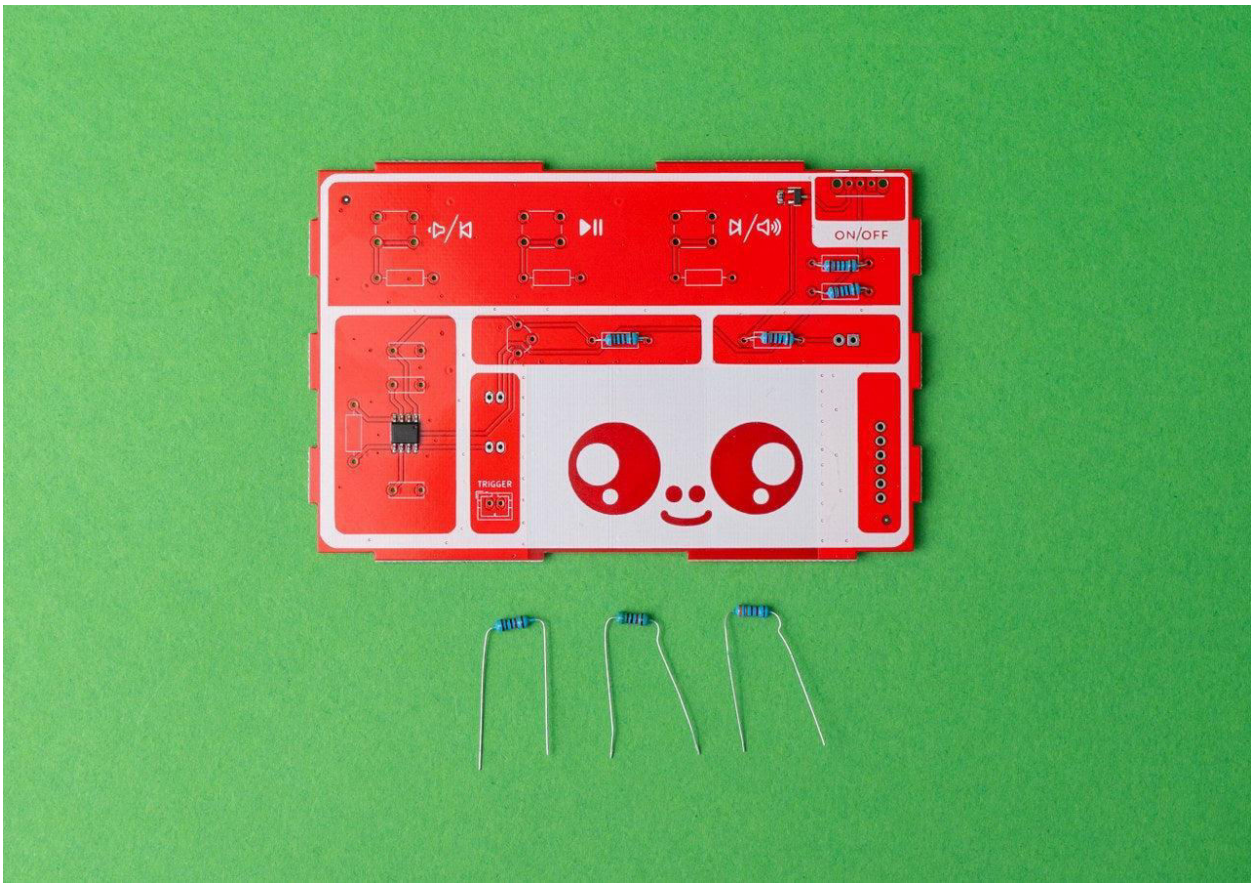
They fall in the category of passive electronic components.

Passive electronic components do not generate electrical power and do not need electrical power to work.

They just modify the flow of electrical energy in their own unique way.

Resistors that you have gotten in your package have a cylindrical shape and two tiny metal legs.

We call these legs "component leads".



Resistance

Resistors have a property of resistance - they lower the amount of electrical energy flowing through the circuit.

They “resist” the flow of electrical energy.

The unit of resistance is called ohm and it was named after German physicist Georg Simon Ohm.

Resistors are used for tasks such as adjusting the flow of electricity through an electronic circuit.

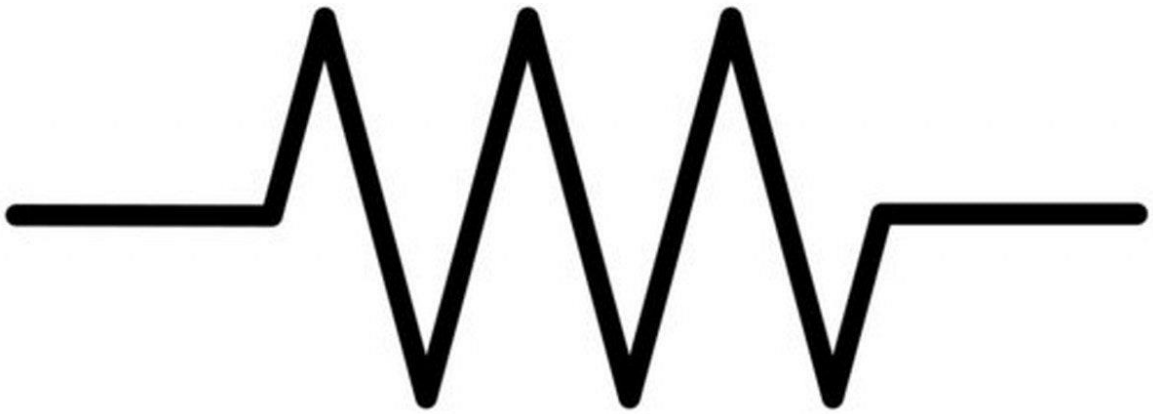
The exact value of a resistor is measured with a device called an ohmmeter.

Can we compare it to something we see in everyday life?

If we make an analogy to water flowing through pipes, the resistor is a thin pipe that reduces the water flow.

Scientists and engineers have come up with different symbols for each and every electronic component.

This is an electronic symbol for a resistor:



This is Georg Simon Ohm:

3. Switch

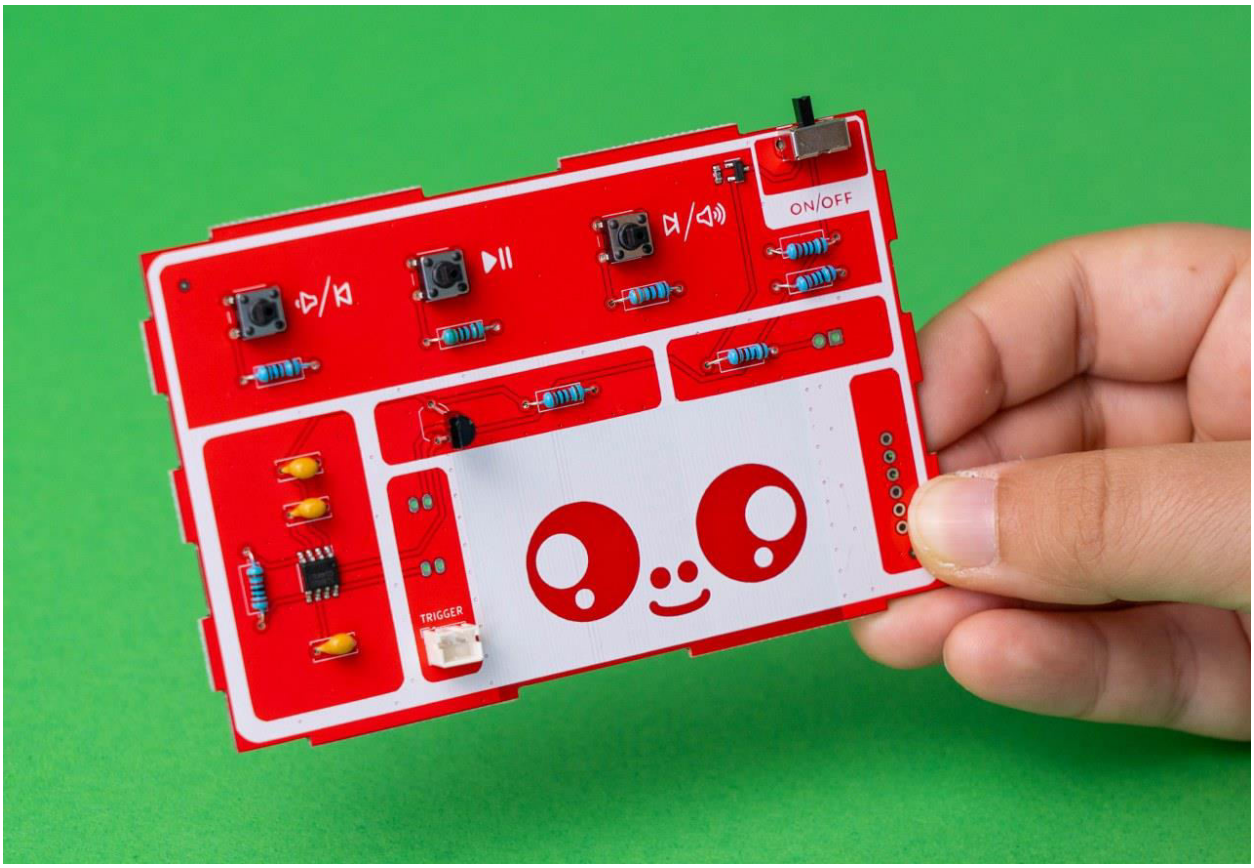
The switch you got in your kit helps you turn the device on and off. You can easily do so with one simple push.

A switch controls the flow of power to an electric device - in other words, it connects and disconnects an electrical circuit.

Switches are used in almost every electronic device. They are found in your mobile phone, computer, air conditioner, etc.

Historical fun fact:

An electrical switch was invented in 1884 by John Henry Holmes, who used it for turning lights on and off.



4. Pushbuttons

A pushbutton switch is a small, sealed mechanism that completes an electric circuit when you press on it.

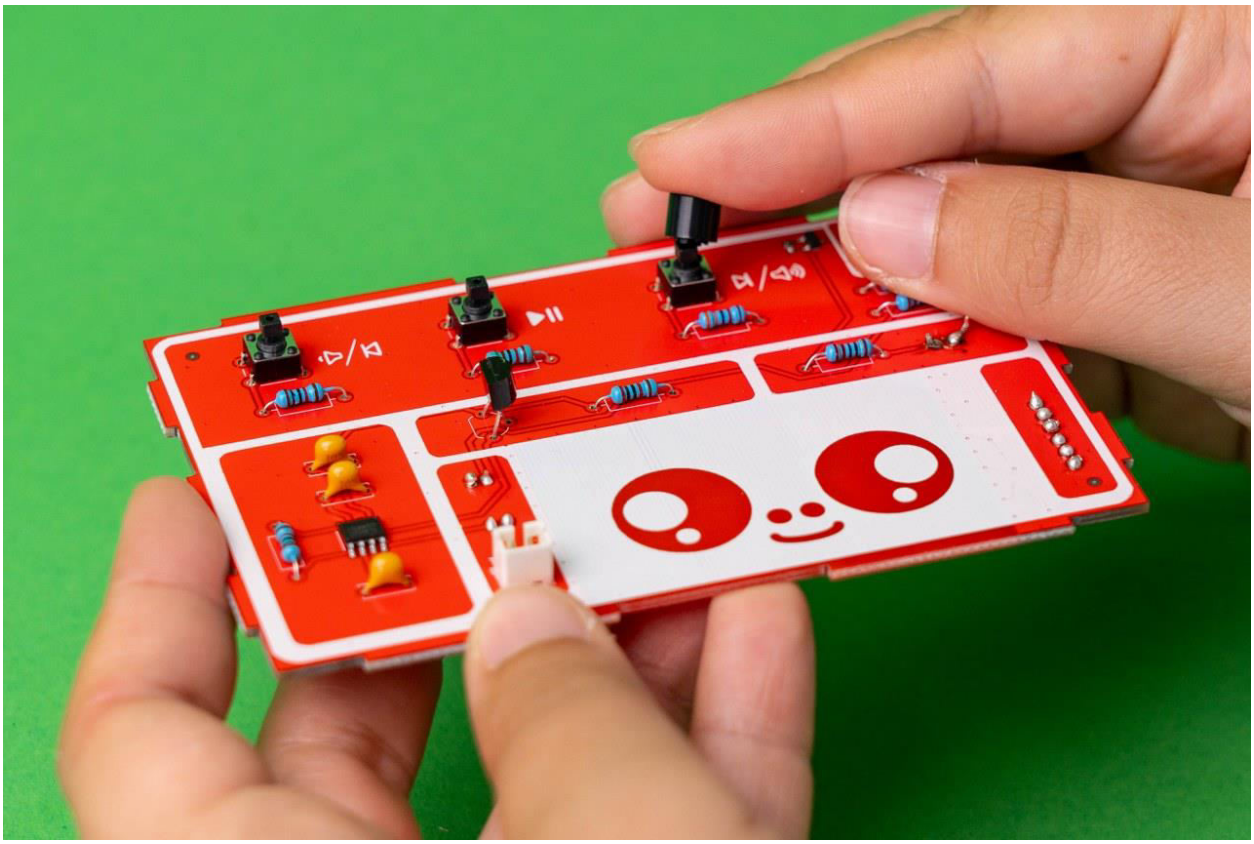
When a pushbutton is pressed, a small metal spring inside makes contact with two wires, allowing electrical energy to flow.

When you release your finger from the pushbutton, the spring retracts, the electrical contact is interrupted, and electrical energy won't flow through the switch.

What's the difference between a switch and a pushbutton?

Switches have an on and off state that can be switched between by pushing the switch with your finger.

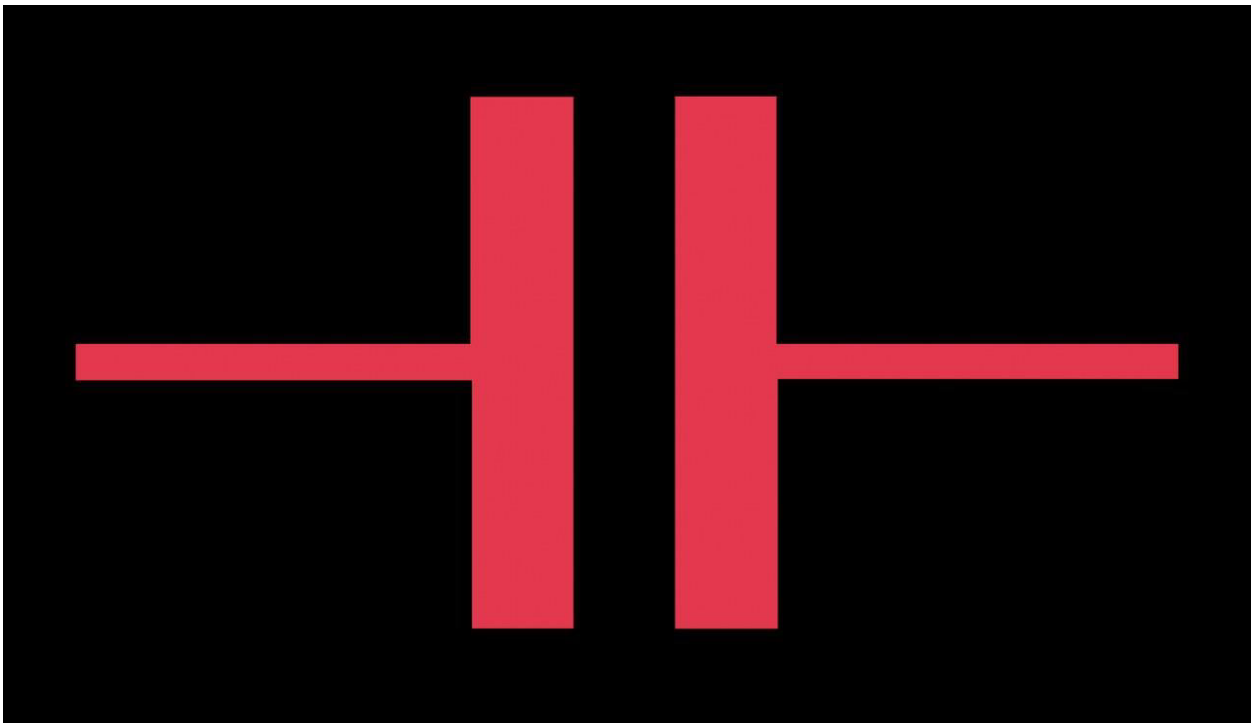
A pushbutton also has two states - on and off. A pushbutton will change its state if you push it with your finger, but it will automatically retract back to its original state when you remove your finger.

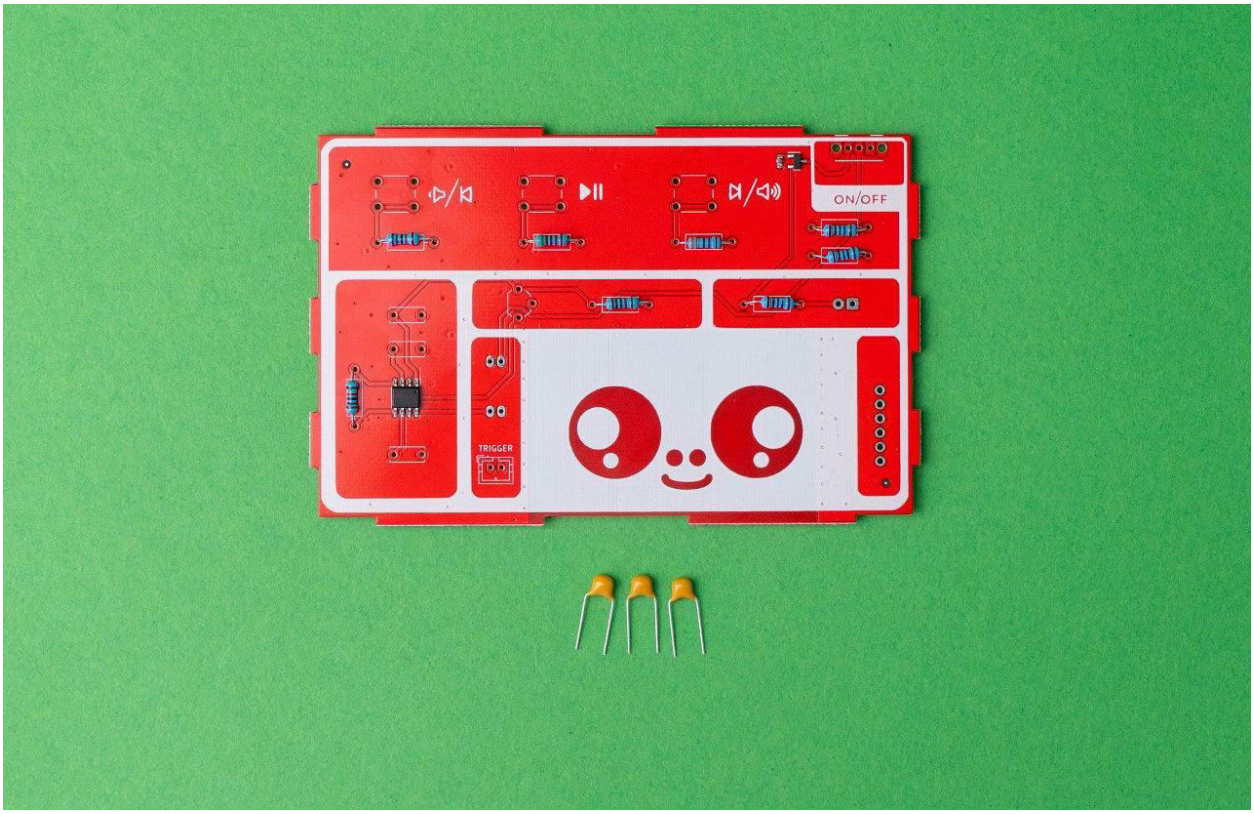


5. Capacitor

A capacitor is a component that has the ability to store energy, much like a small rechargeable battery.

This is an electronic symbol of a capacitor:





A capacitor can absorb energy from a circuit and store it temporarily.

Later on, this stored energy can be released back into the electronic circuit.

We can measure the ability of a capacitor to store electrical energy.

We call this property - capacitance.

The unit of capacitance is called Farad (we use the letter F as a short for Farads).

This unit was named after physicist Michael Faraday.

Historical fun facts:

Capacitors were discovered by Pieter van Musschenbroek a looong time ago - in 1746.

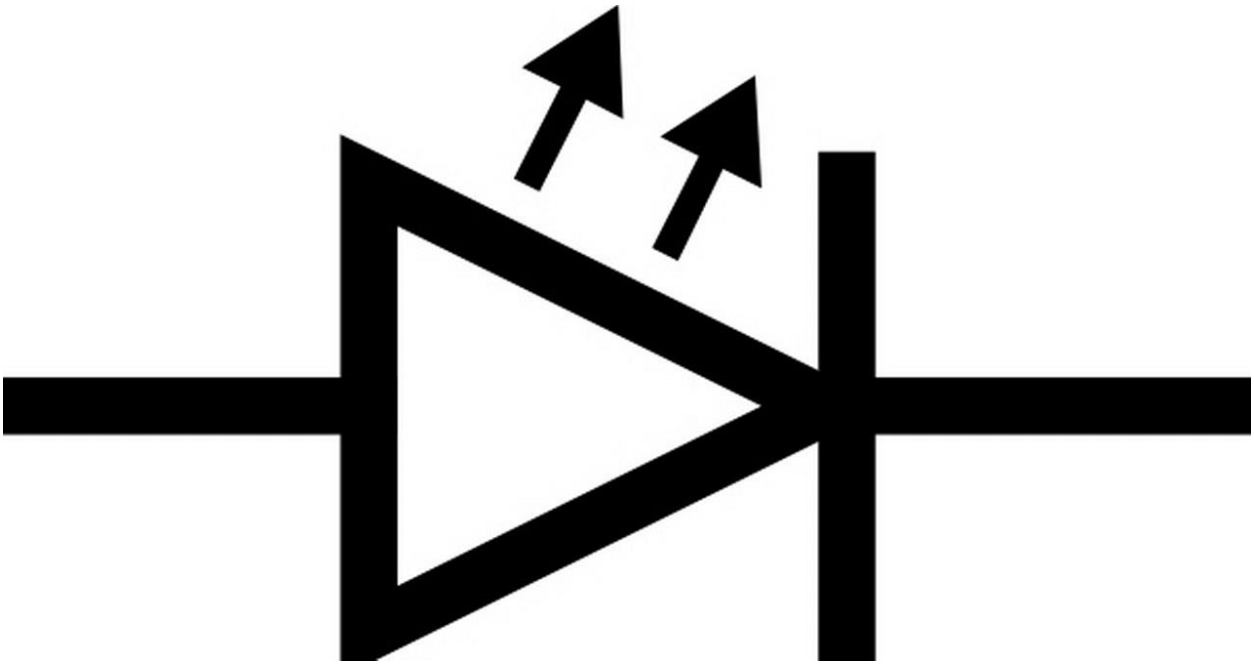
The first capacitor was a glass jar wrapped inside and out by a thin metal foil.

6. RGB LEDs with built-in color changing chip

LED stands for light-emitting diodes.

LEDs convert electrical energy into visible light.

This is an electronic symbol for a light-emitting diode:



RGB, in the name, stands for Red, Green, and Blue.

This means that these particular light-emitting diodes can light up in three different colors.

These LEDs are very special because they have a tiny built-in color-changing chip. Look closely into an LED, and you'll see a black dot - the chip that controls the colors.

Please, make sure to put the LEDs in the circuit board properly!

Watch out - LEDs are polarized!

Light-emitting diodes (LEDs) are polarized.

This means that they only allow current to flow in one direction.

Because of this, you need to pay attention to how you are going to place your

LED in the electronic circuit.

The tiny metal legs of every LED are not the same length.

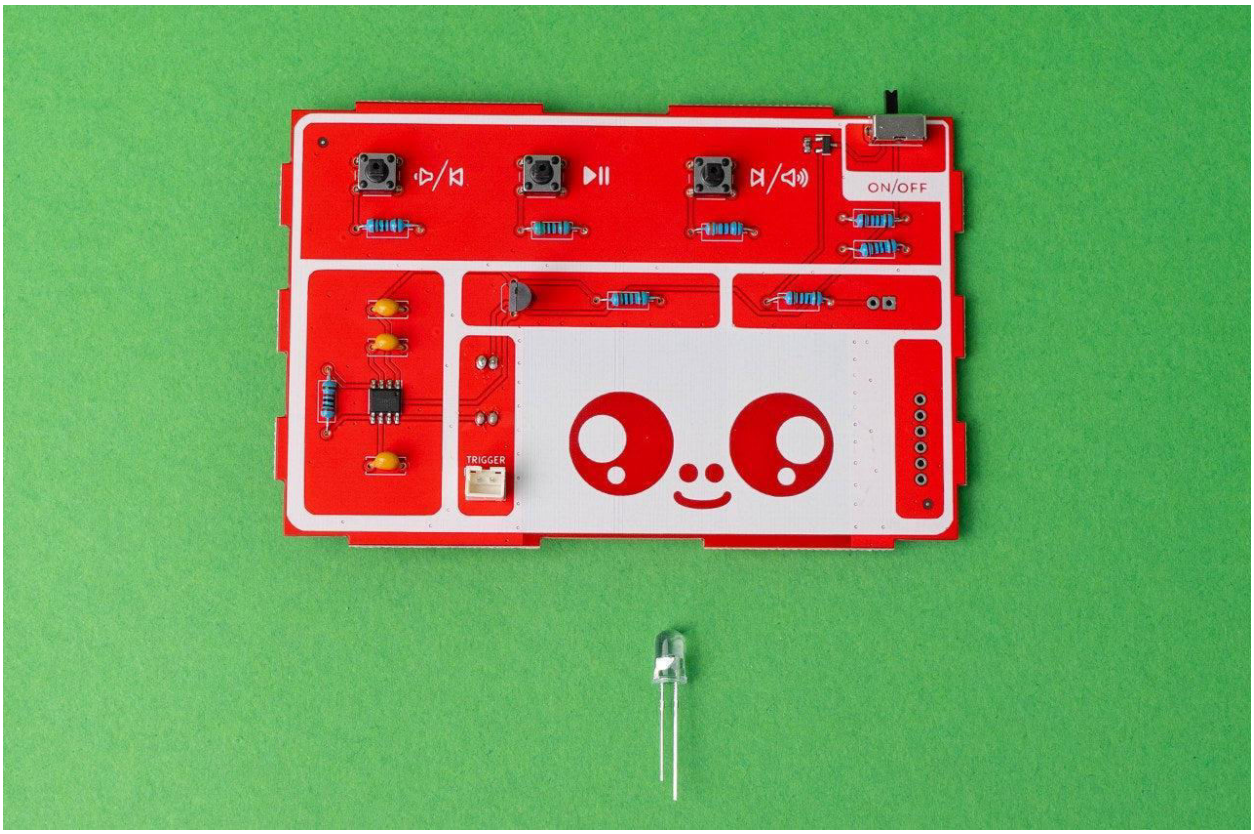
They mark polarity!

The positive leg is longer (we call this one the anode), and the shorter one is negative (this

one has a funny name - cathode).

Electrical energy flows from the anode to the cathode and not in the opposite direction.

If you put the LED in the wrong way, it won't light up because the electrical energy will not be able to flow through it.

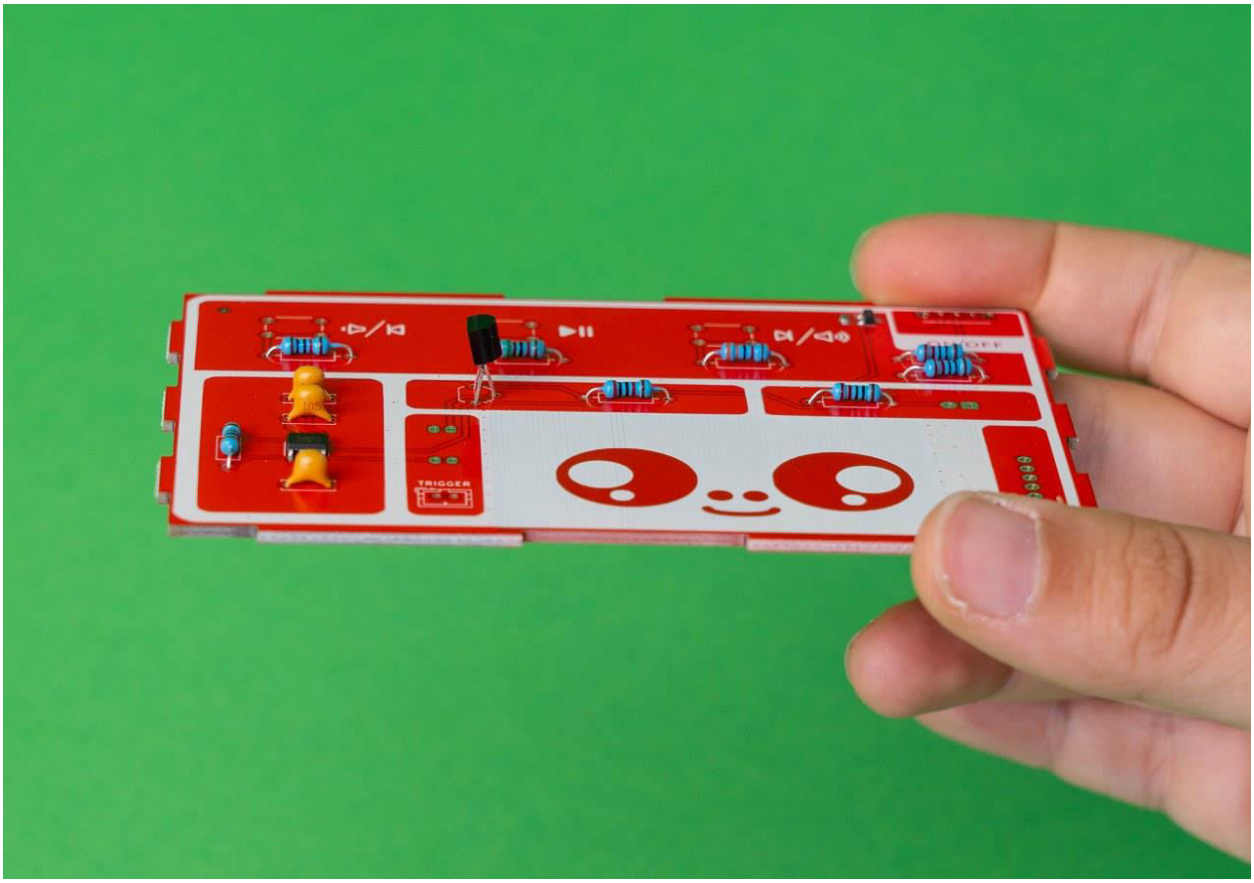


7. Transistor

The transistor is an electronic component that can be used as part of an amplifier or as a switch.

It is made of semiconductor material.

Transistors have 3 terminals: the emitter, the collector, and the base. When the emitter is connected to the negative terminal of the battery and the collector to the positive terminal, no electricity will flow in the circuit.
This is what a transistor looks like:



Meet the tools!

Soldering iron

For Hertz's assembly, any entry-level soldering iron will suffice.

Although, if you plan to dive into the world of DIY projects, you should consider getting a more expensive one with more features.

You'll also need a soldering iron stand and a small reel of rosin-cored solder.

Soldering sponge

Make sure your soldering toolkit has a sponge that can be used for wiping your soldering iron clean. Make sure that the sponge isn't dripping wet or bone dry - it should be damp.

Diagonal cutter pliers

We prefer this type shown in the picture (Plato, model 170), but any other type will do.

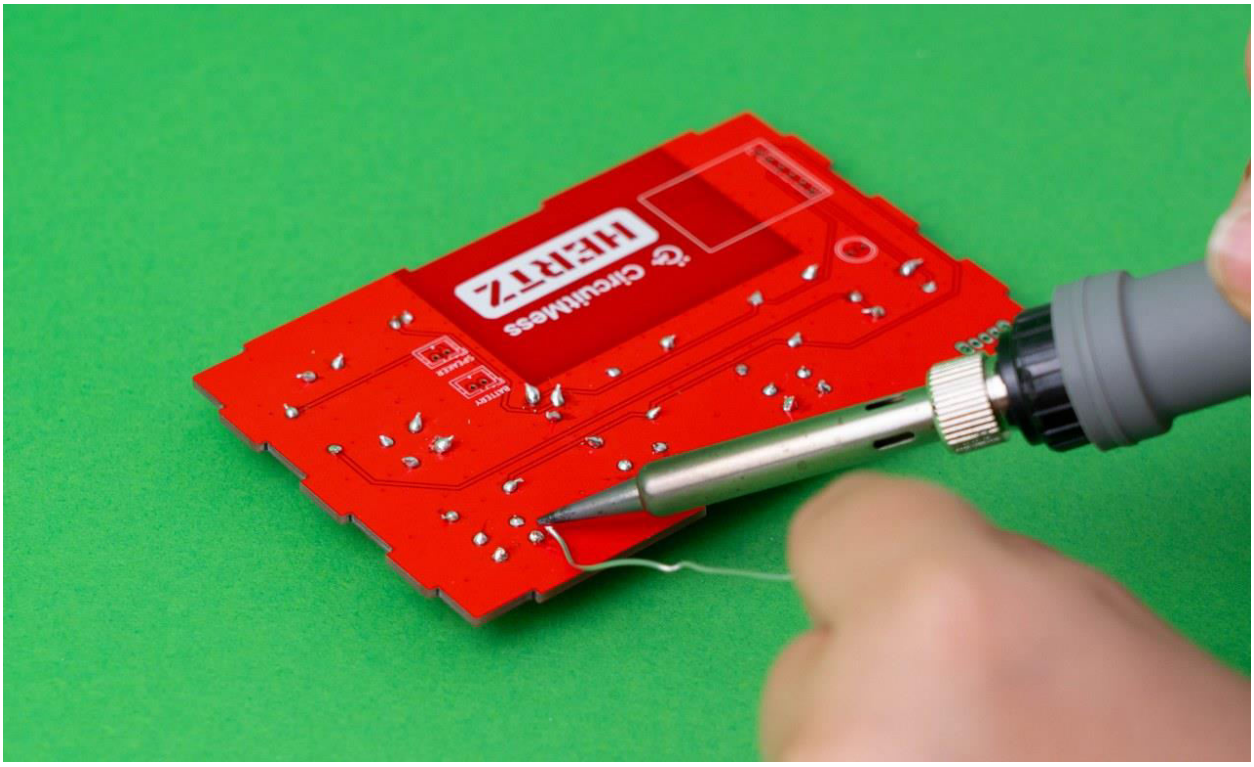
How do I solder?

One of the things you'll do as a part of Hertz's assembly process is soldering!

Have you ever done that before? If your answer is no, we suggest you look at the following few links where you'll find useful tutorials and blogs about soldering. It will only take you 10 minutes to get into the zone and understand how it's done. Here are the links:

- Adafruit's video tutorial featuring Collin Cunningham - A tutorial featuring Collin Cunningham, a super charismatic electronics guru.
- Adafruit's standard soldering tutorial - A great and thorough video tutorial. An absolute must-read, even if you know how to solder. Make sure to check the "common soldering mistakes" section at the end.

- Sparkfun’s video soldering tutorial - Another well-made how-to-solder video tutorial.
- Sparkfun’s standard soldering tutorial - A detailed tutorial made by Sparkfun.



Here are the pictures that can help you recognize good and bad solder joints:

1

HEAT PART AND PAD

2-3 sec

2

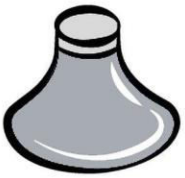
ADD SOLDER

3

CONTINUE HEATING

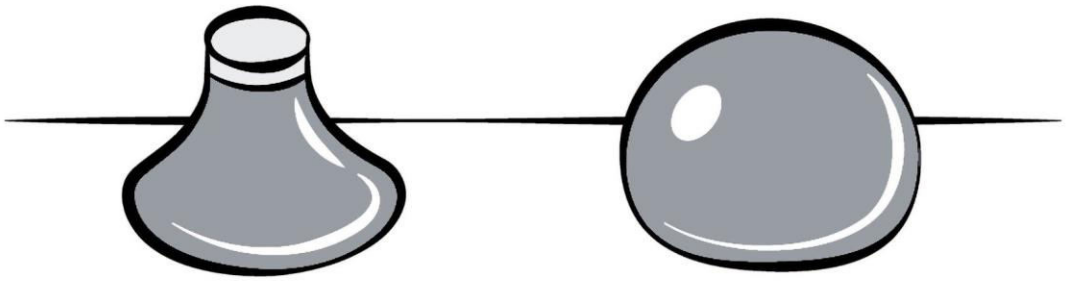
1-2 sec

4



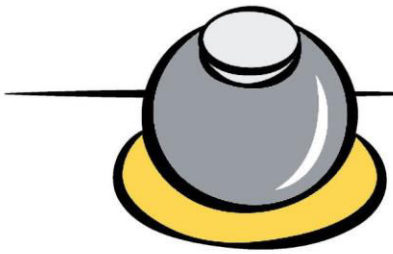
LET COOL

don't blow!

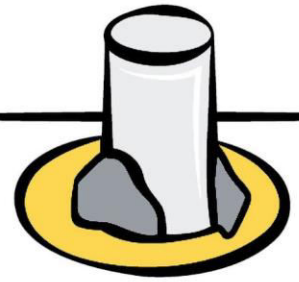


PERFECT

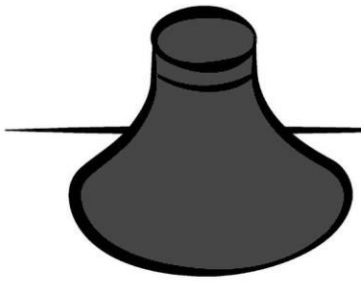
TOO MUCH SOLDER



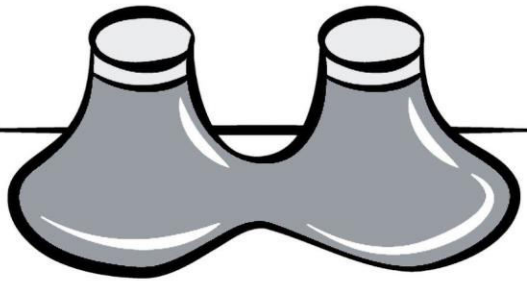
COLD JOINT



NOT ENOUGH SOLDER



TOO MUCH HEAT



SHORT

These are the rules for soldering you should follow every time:

- Never inhale the dust and the fumes that can be produced by the soldering iron!
- Soldering iron gets hot! Do not touch the tip of the soldering iron! Even if the soldering iron is turned off or completely disconnected from the power source, there is still a possibility that it's very hot and, therefore, can cause very uncomfortable pain if touched. Always keep the soldering iron facing away from your hands. If you're finished soldering, unplug the soldering iron from the power source and leave it to cool off for at least five minutes before putting it back in your toolbox.
- Clean the soldering iron! Make sure to use the sponge often and clean your soldering iron if you wish to have an easy and simple soldering experience. Carefully hold an end of the sponge with one hand and wipe the tip of the soldering iron on the other end of the sponge to remove the extra solder. Repeat the process until the tip of the iron is nice and clean.
- Check your solder joints twice (at least)!
- Keep the soldering iron on the stand when you're not using it.
- Know how much solder is needed! Make sure to put just enough solder. Not too much, and not too little, since both can cause your newly-made device to malfunction.
- Don't leave any residual solder on the board! The solder should only be on the parts where the pins connect to the board. Keep the rest of the board clean!

Using the soldering iron

If you're using your soldering iron for the first time or need help with cleaning its tip, check our video tutorial.

The soldering iron is very easy to use but only when used properly.

Step 1 - plug it in

Put the soldering iron on a soldering iron stand, and plug it into a power outlet.

Step 2 - Select the right temperature

The temperature will set to 390 degrees Celsius by turning the soldering iron on.

Step 3 - Don't forget to turn it off when you're finished

We'll tell you when you're done with soldering, and you'll unplug the iron from the power outlet to turn it off.

Please use the metal stand every time you are not using the soldering iron to make sure you don't burn the surface or the circuit board.

Make sure to not touch the soldering iron tip for at least five minutes after you have turned it off.

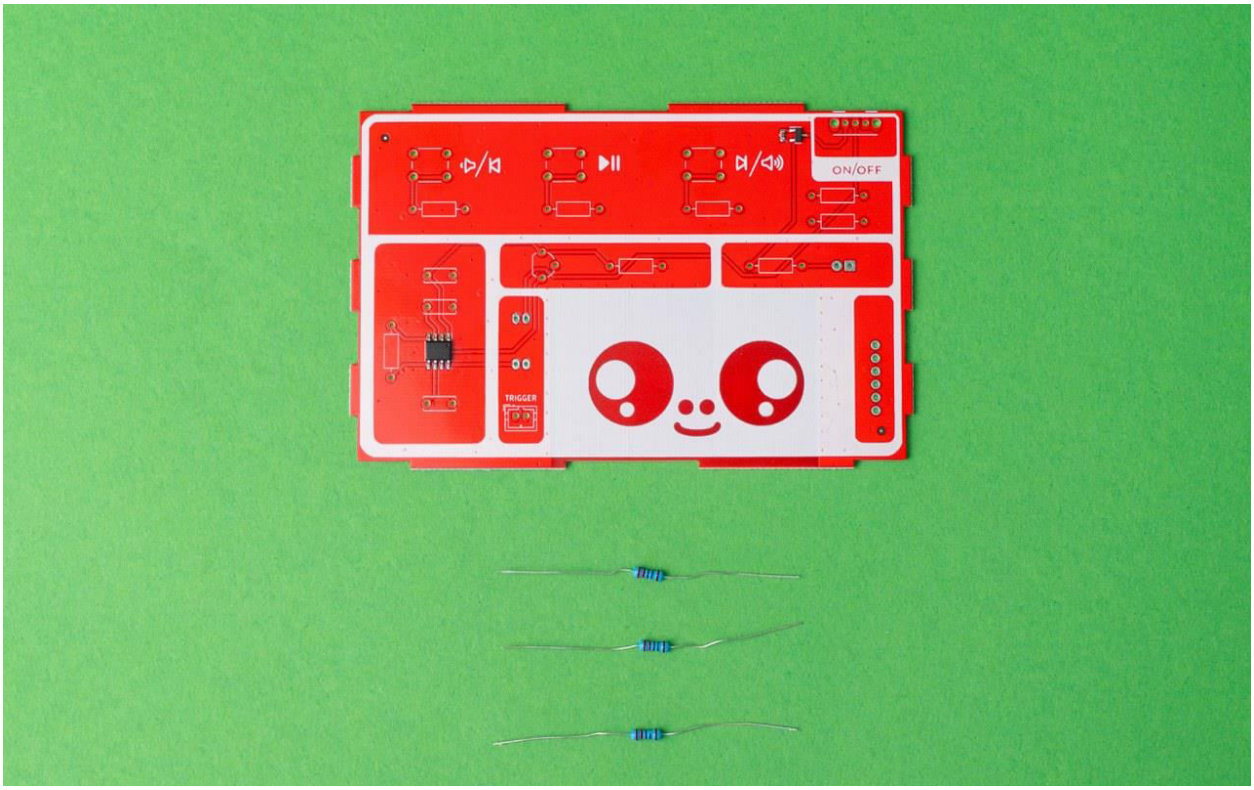
Hertz, meet your maker!

Part one - Resistors

The first components you will need while assembling Hertz are resistors.

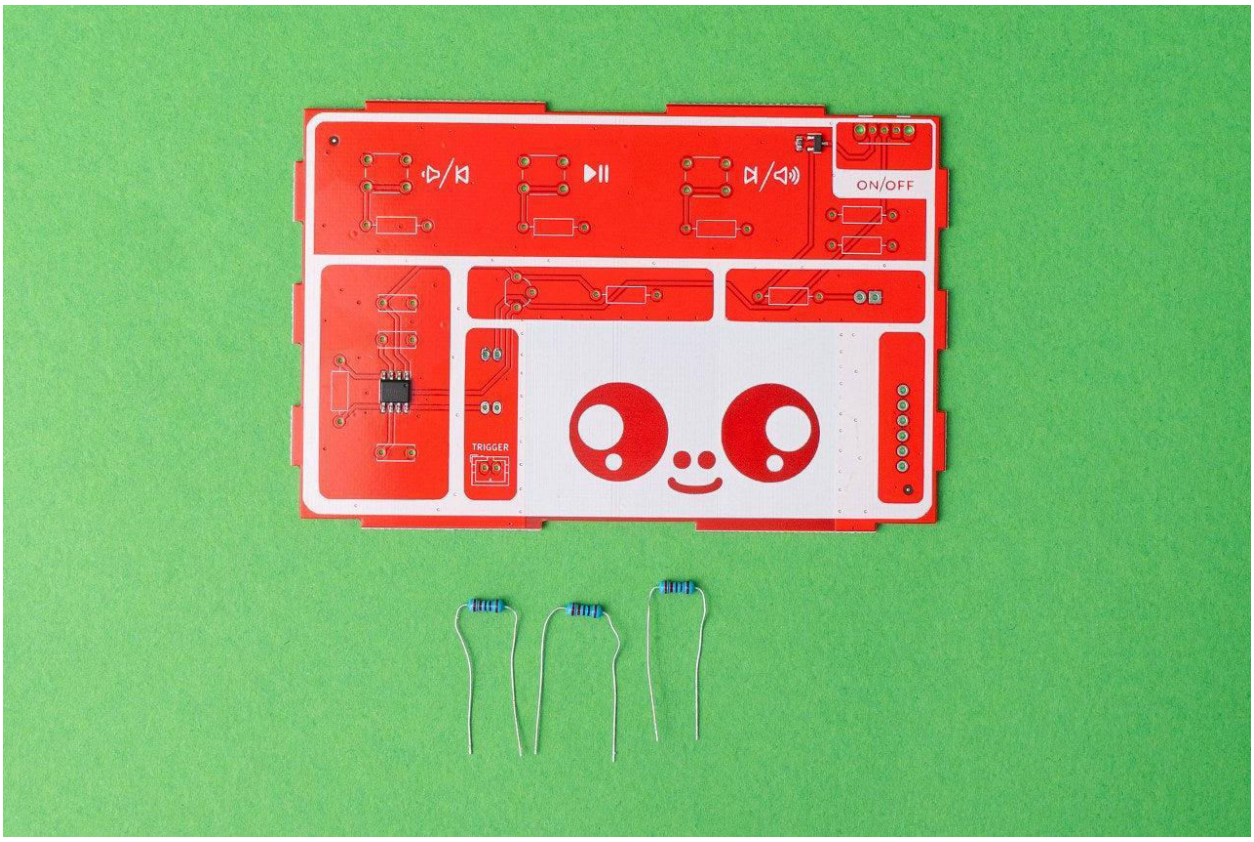
There are many different resistors you'll use, so firstly, make sure to group them based on their colors. These colors represent the resistance value, multiplier, and tolerance.

You'll need these three with the color band red-red-blue-blue-brown.

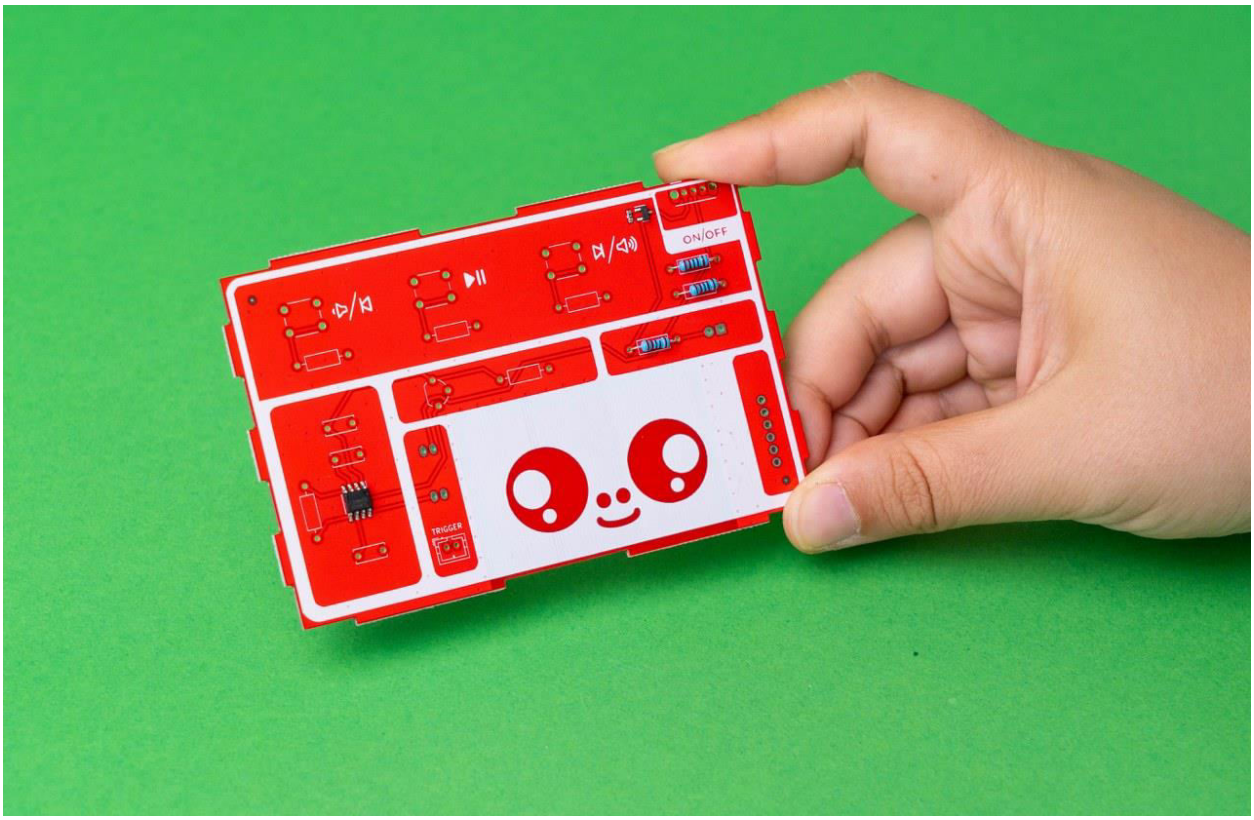


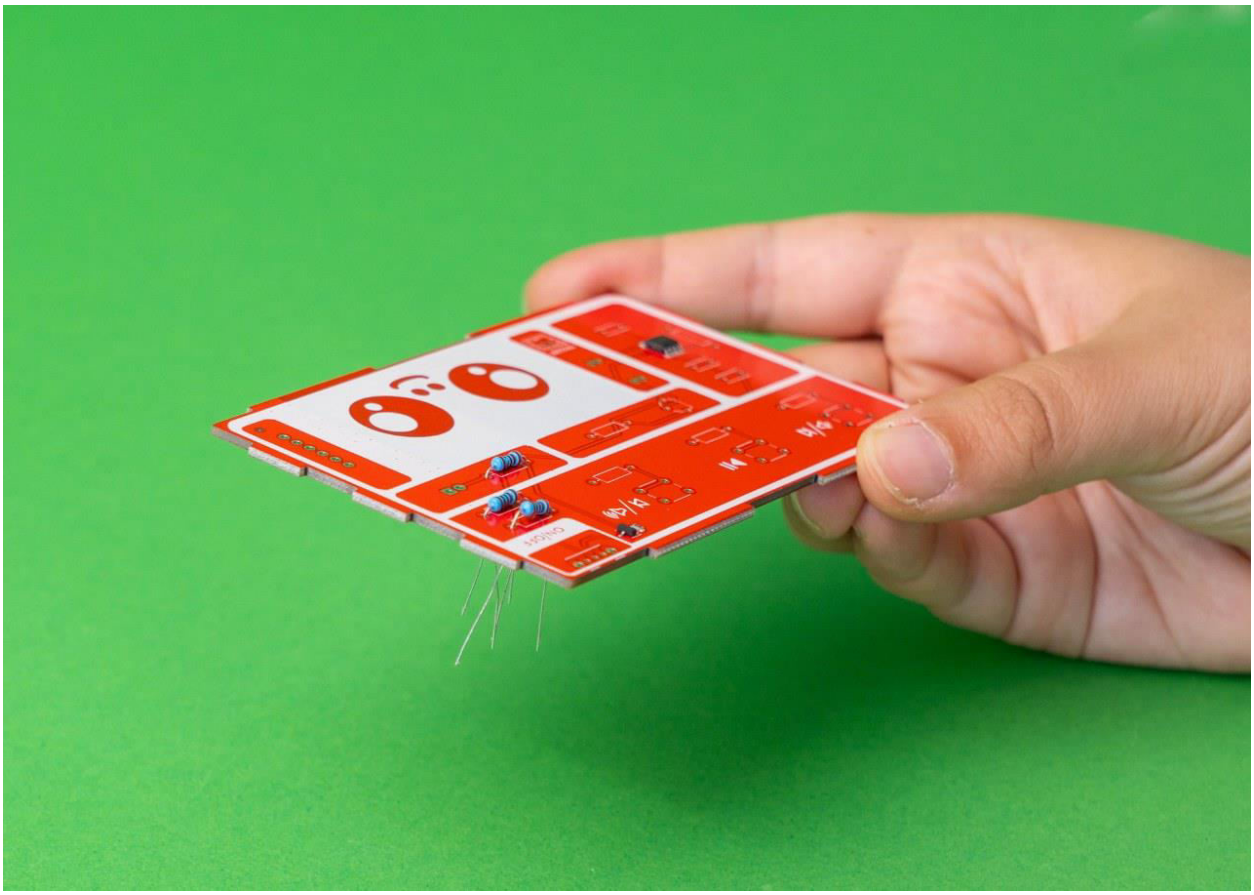
Carefully bend them into a U-shaped form.

Take them one by one, and place them onto the circuit board.



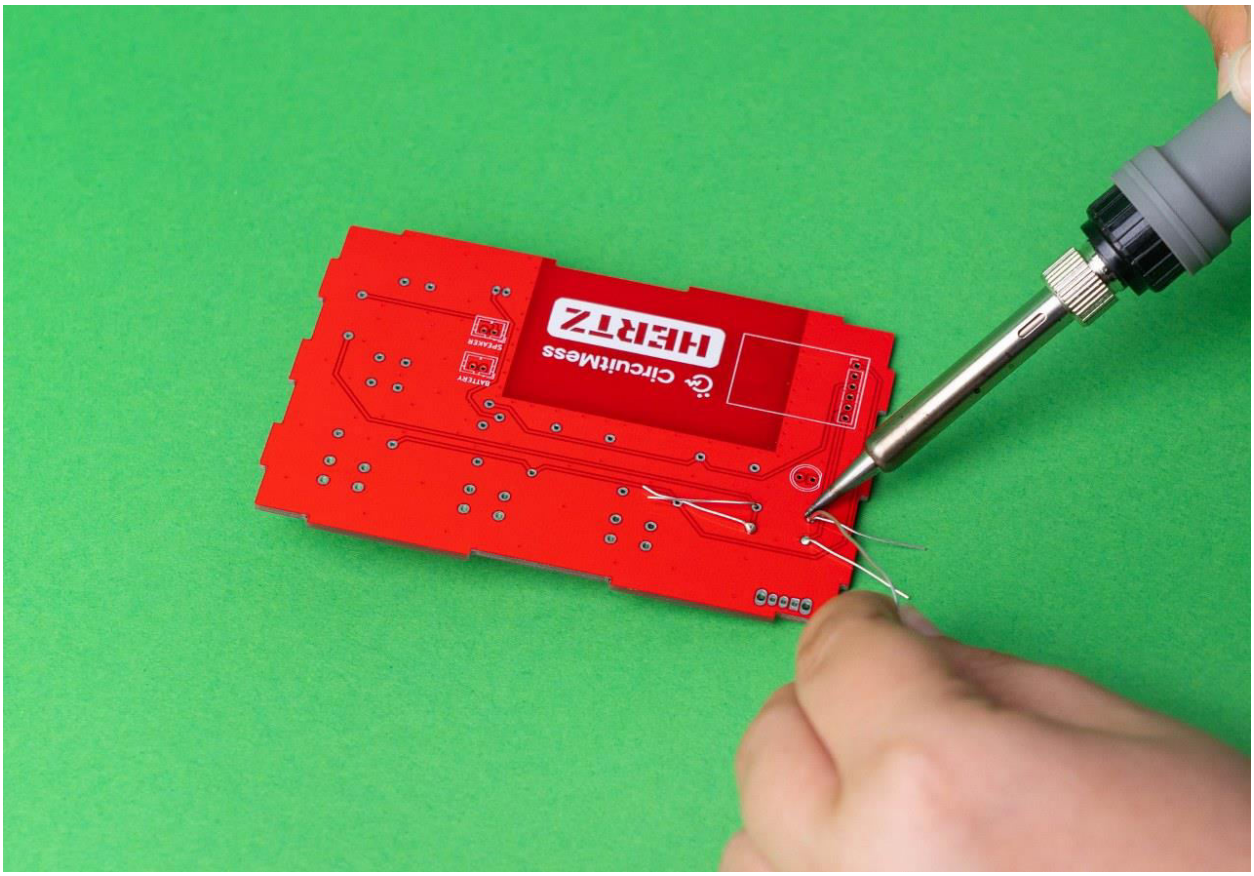
These three resistors will go here:


ON/OFF
TRIGGER



Insert it one at a time, or all three at once, making sure that they are pushed all the way to the board, and then turn the board around.

To ease the soldering process, you can bend the resistor's legs like this:



You can start soldering.

If this is your first time soldering, go over the rules, videos and photos once again.

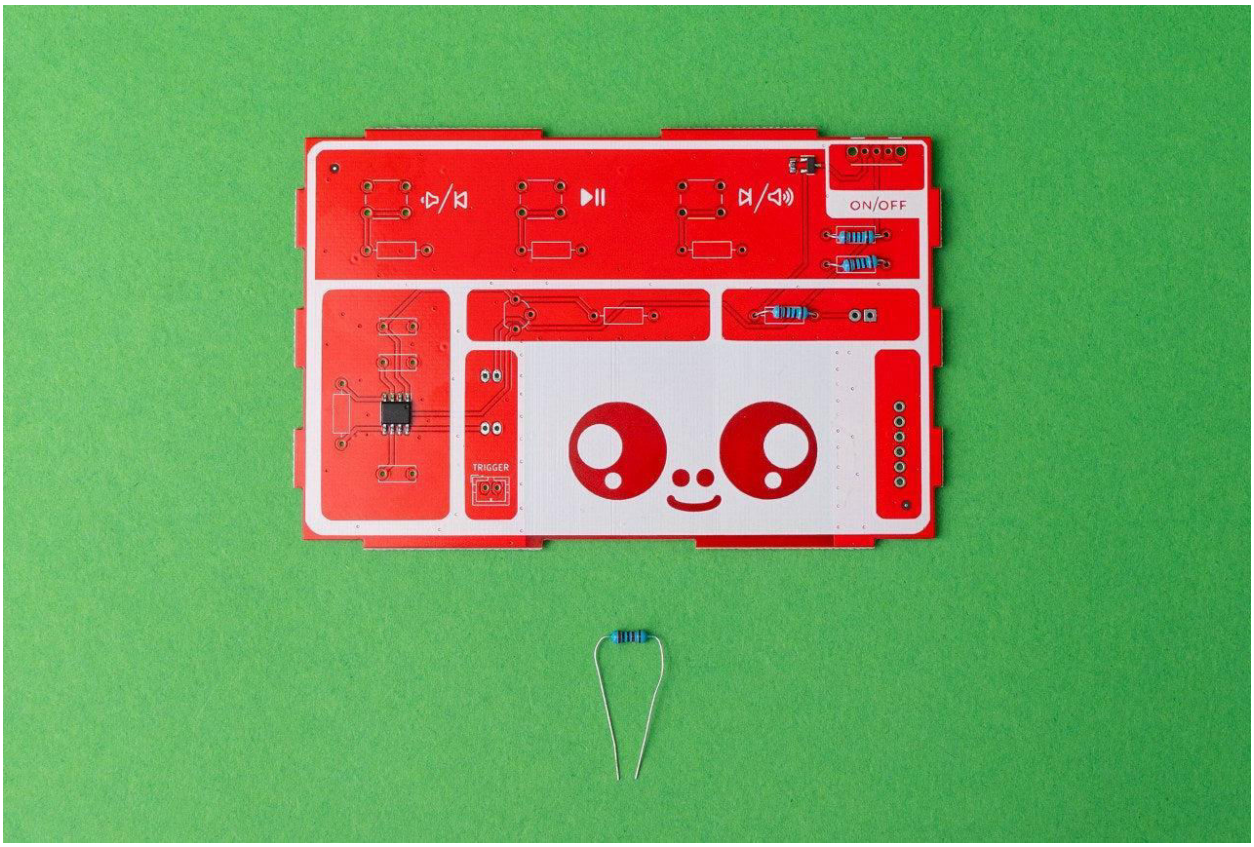
Your board should look like this after you soldered all three resistors:

Check if all the soldering joints look clean, and if there are no soldering bridges.

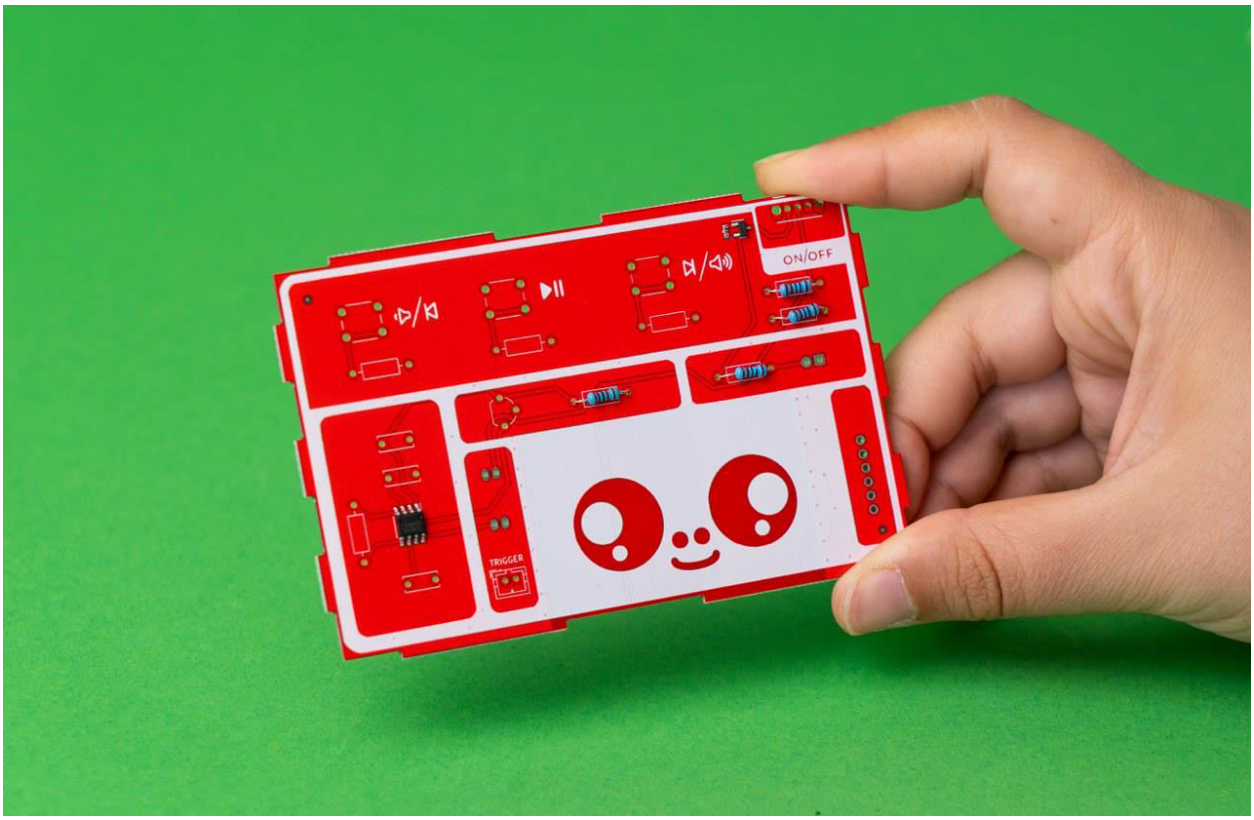
Straighten the resistor's legs, and take the cutter pliers.

Here, it is very important to turn the board around when cutting the legs off so that nothing gets in your eyes.

Another resistor you'll use now is the one with the color code red-blue-blue-red-brown.

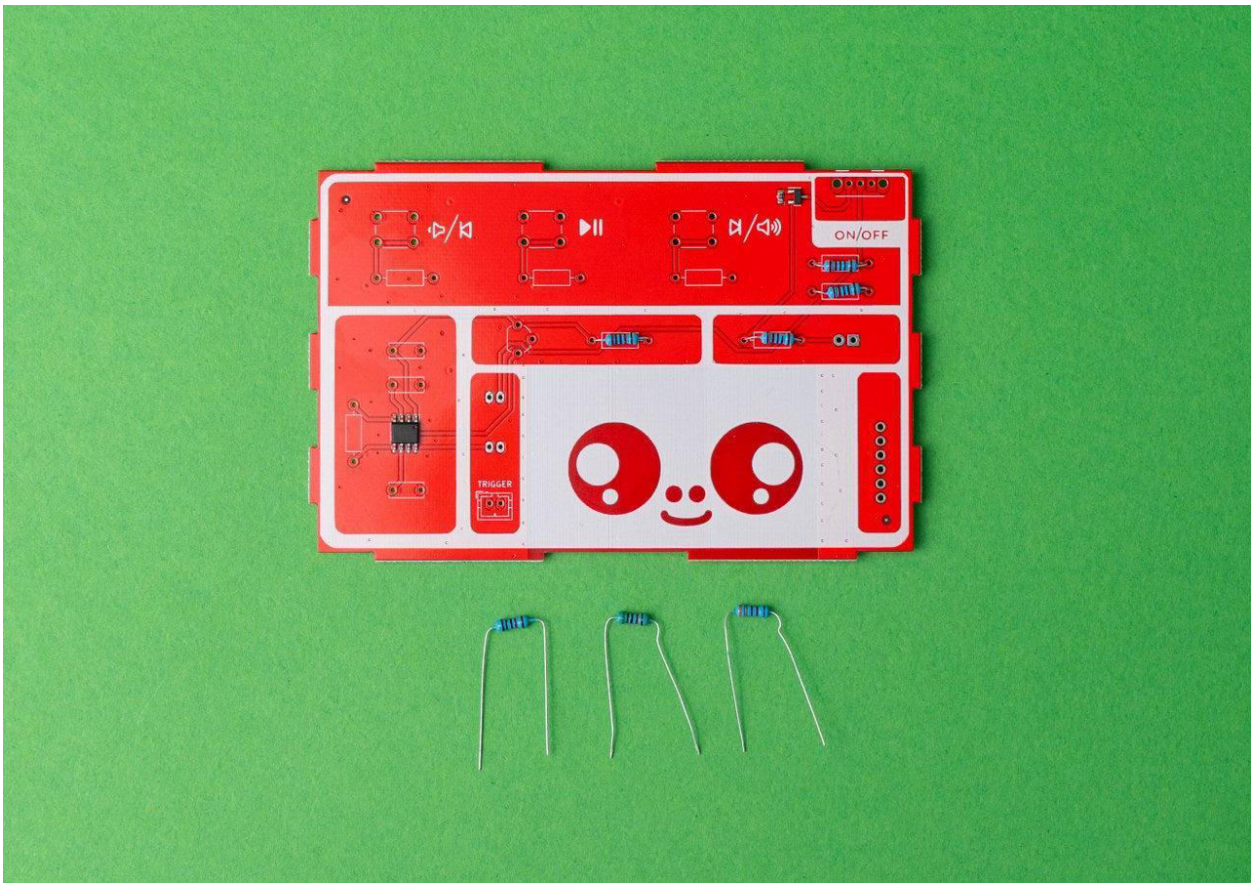


Bend it into the shape of the latter "U" and insert it here.



Flip the board around, and start soldering.

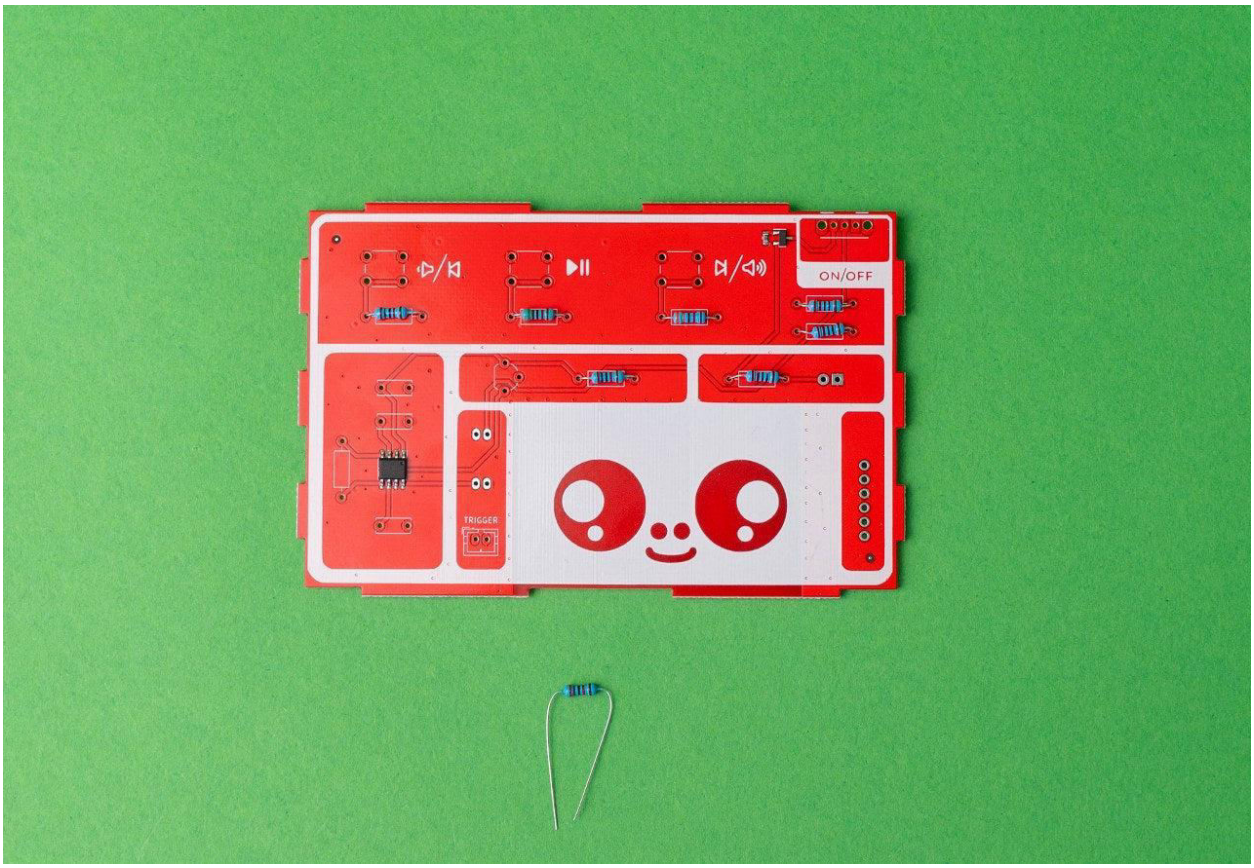
After checking the soldering joints, take these three resistors:



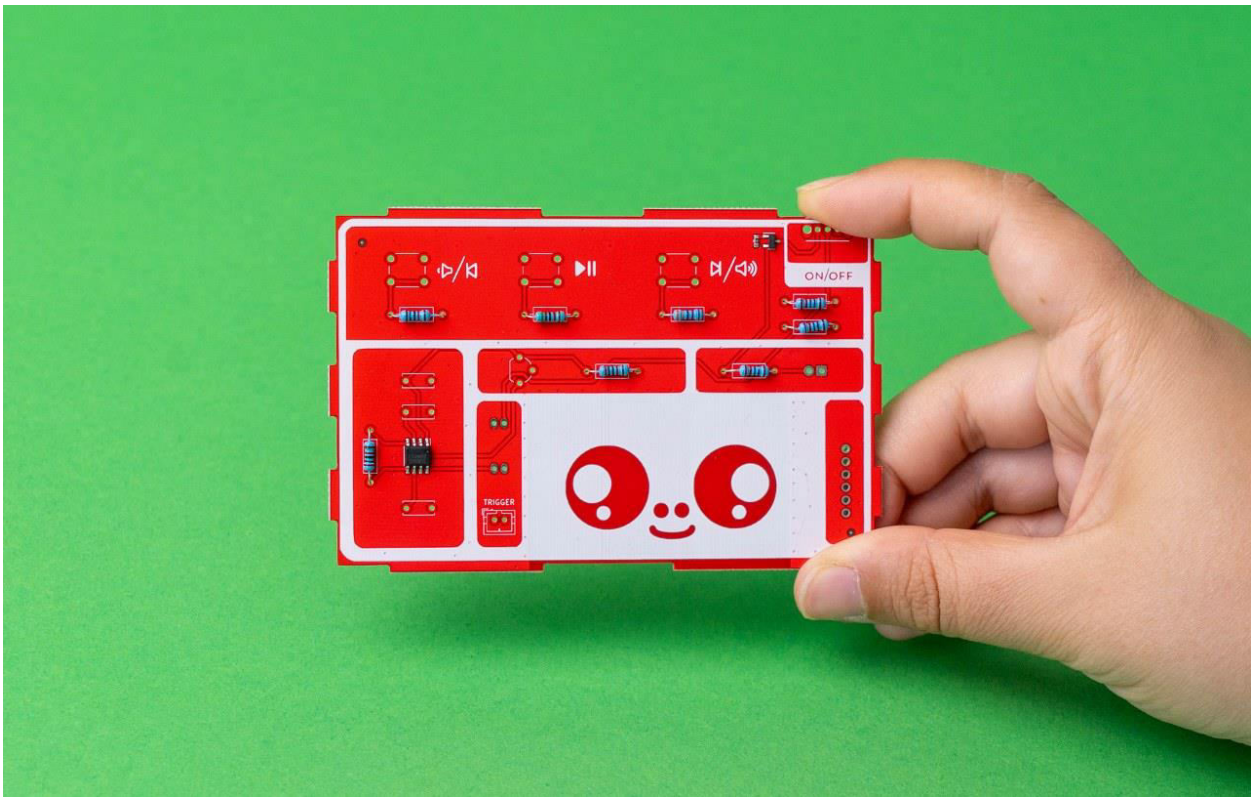
The color codes should be:

- brown-blue-blue-red-brown
- green-red-blue-red-brown
- orange-orange-blue-red-brown

Place them here (from right to left) and take the next resistor:



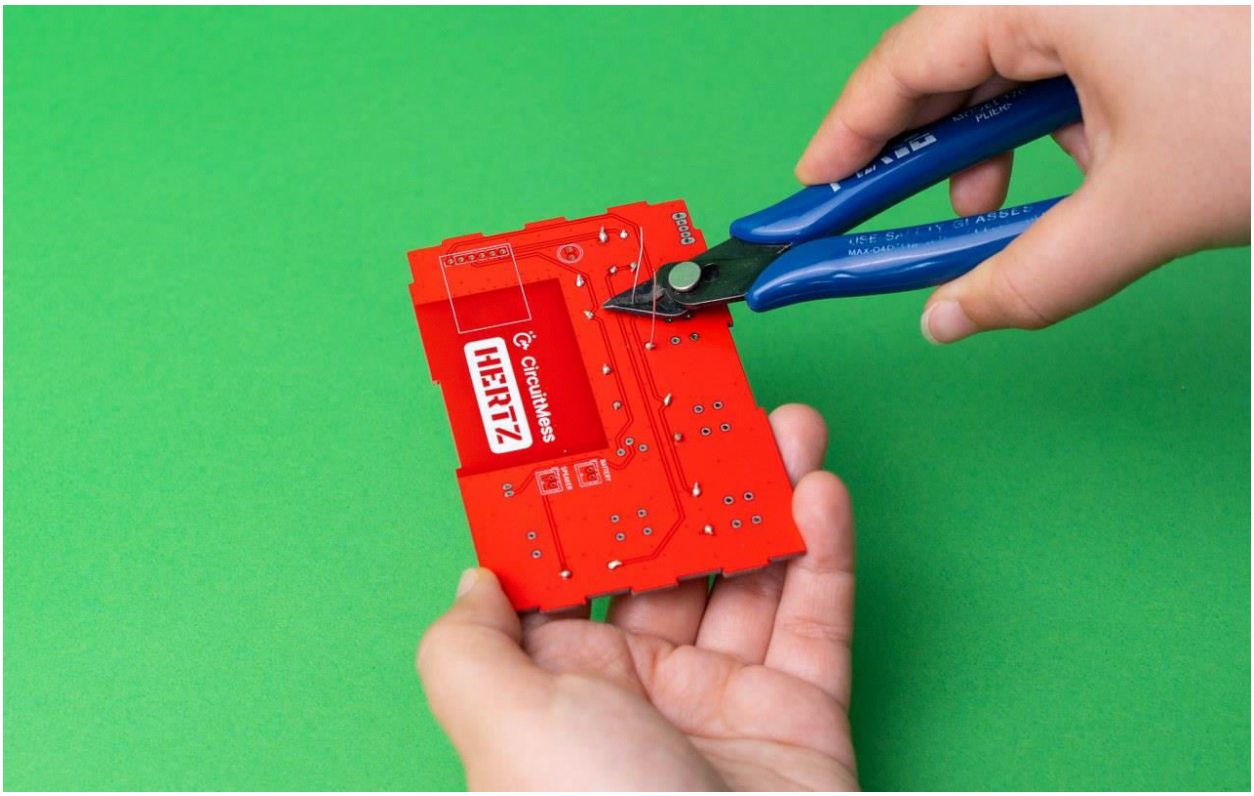
Place it here:



It's really important you place exactly those resistors in the places where we put them otherwise the pushbuttons won't work properly.

Flip the board around and start soldering:

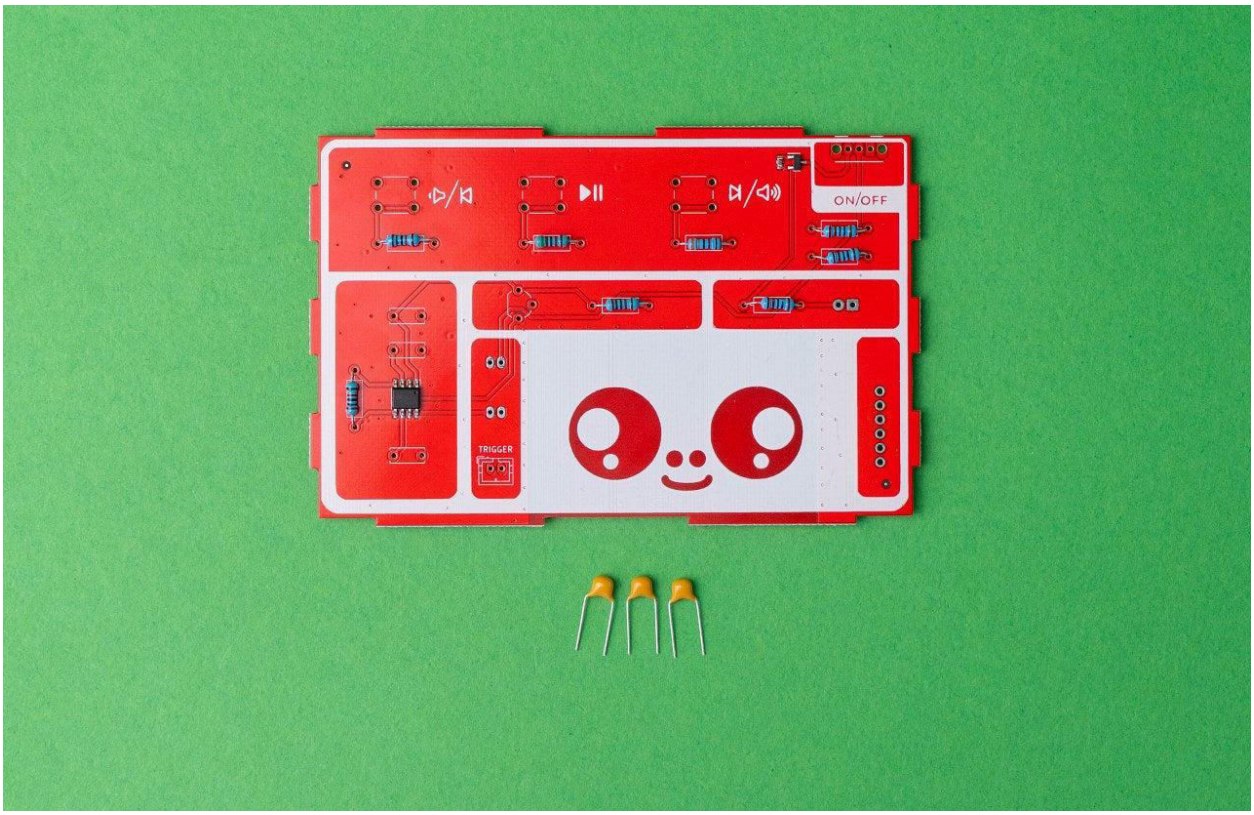
After you have soldered all three resistors, you can cut its legs.



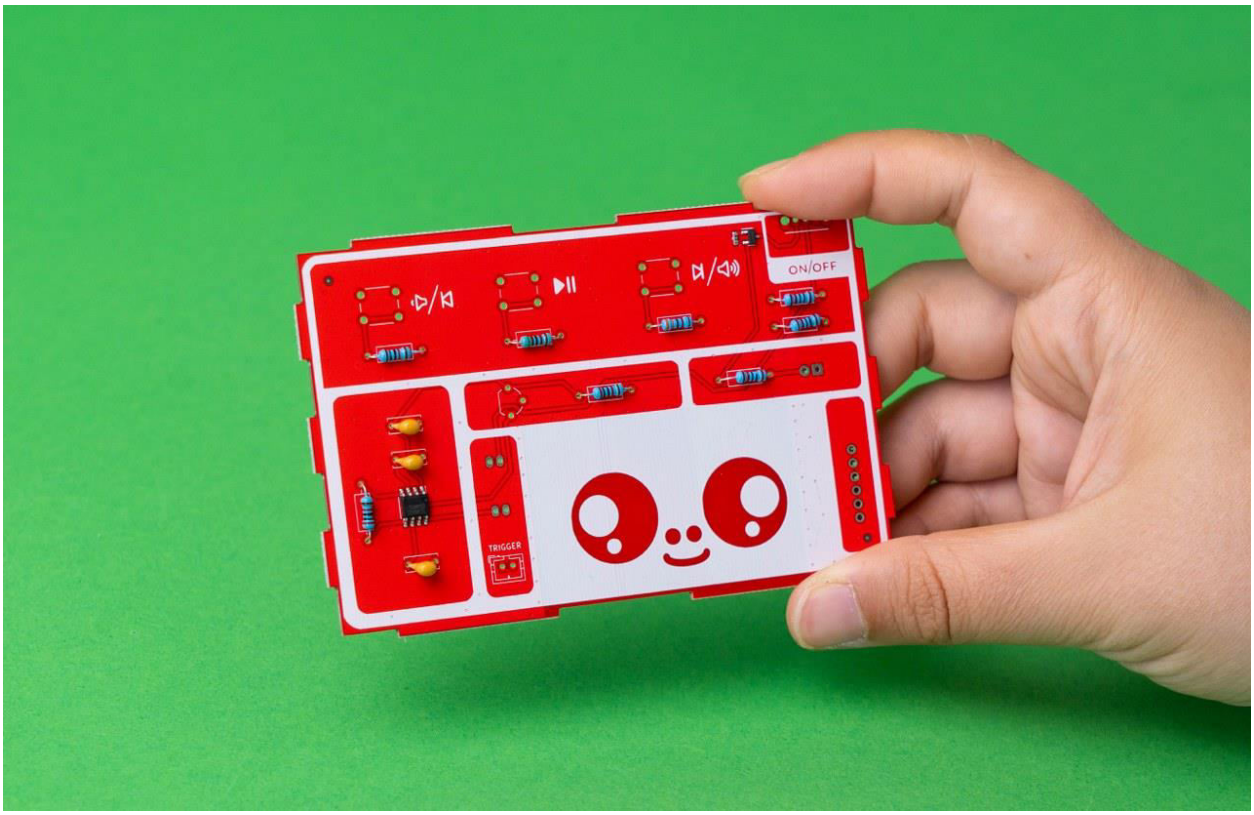
Part two - Capacitors

If you successfully soldered the resistors, it's time for the capacitors.

Those are these three components with beige heads.

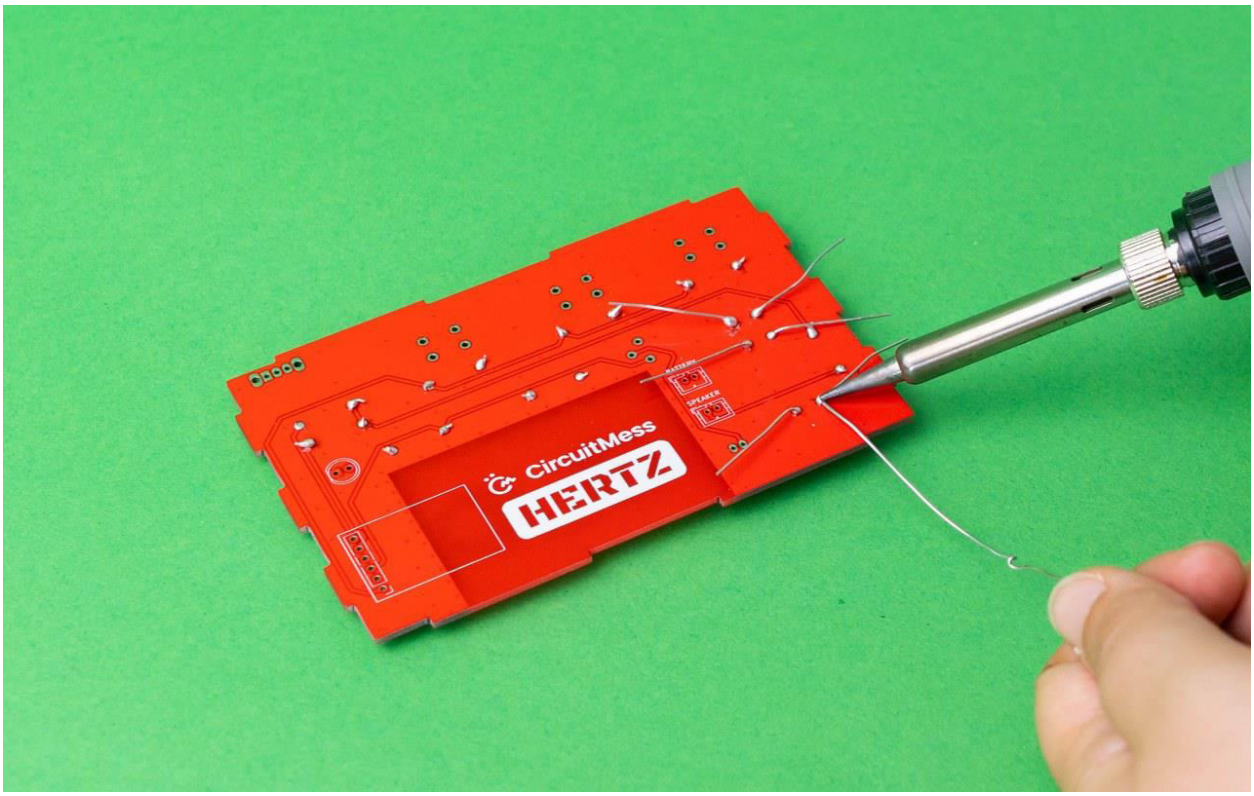


Place them here:

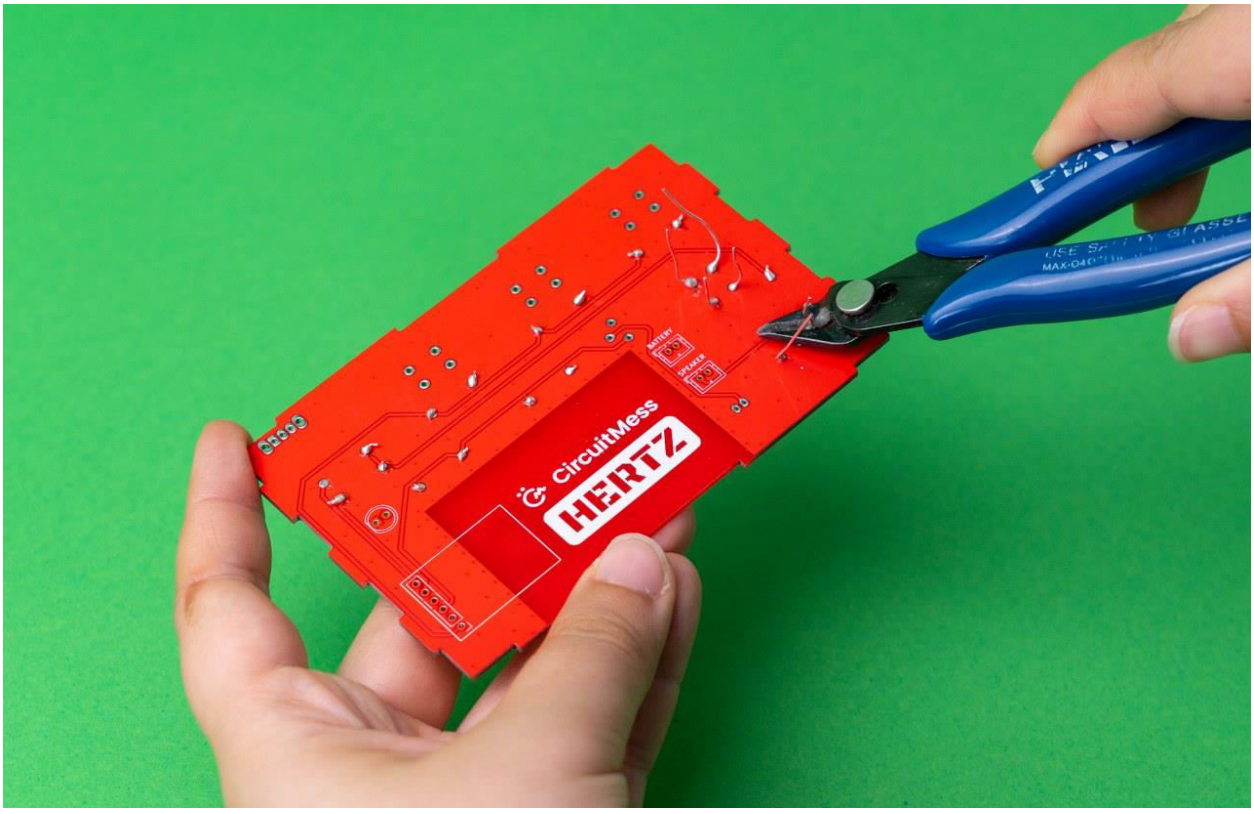


Don't worry if the capacitors don't go all the way to the board - they are supposed not to.

Flip the board around and start soldering.



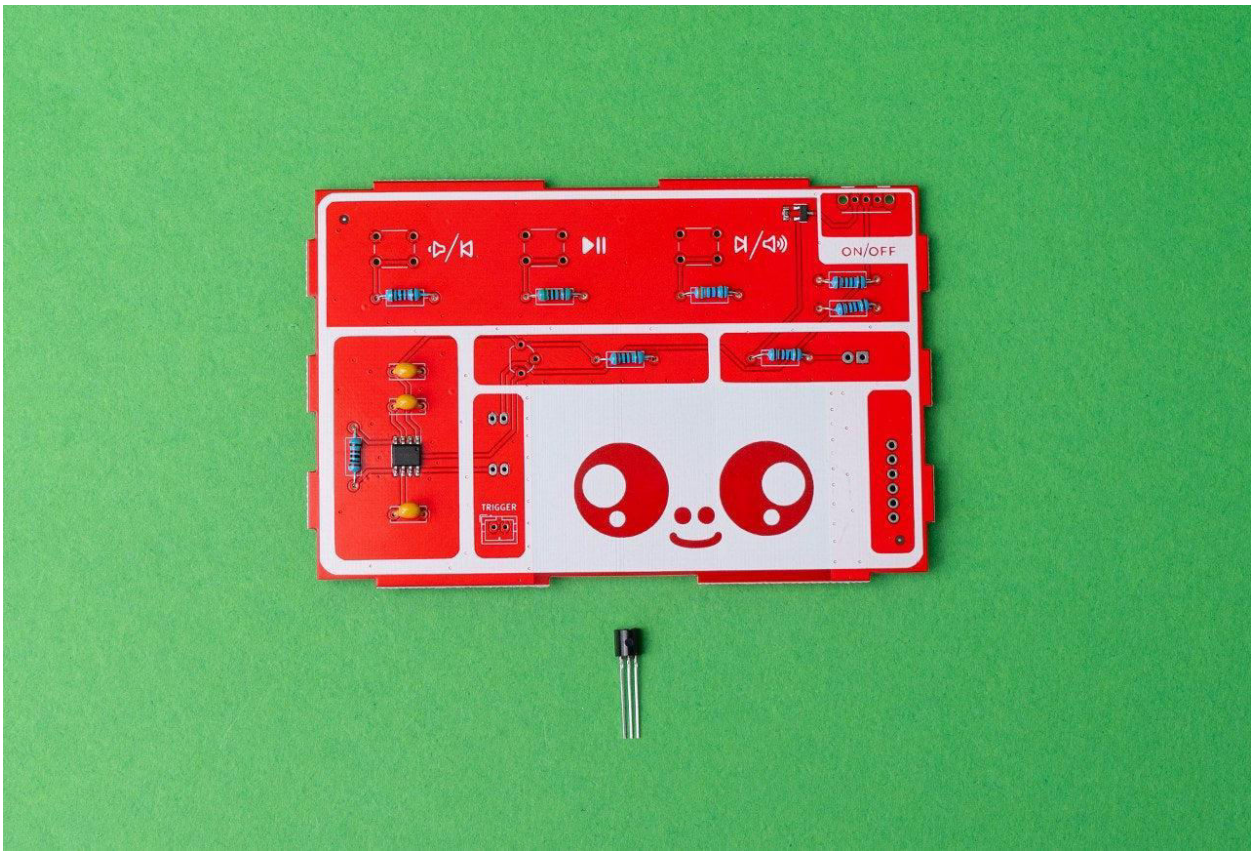
Once you check the soldering joints, you can cut its legs off:



Make sure that you turn the board around so the legs don't go into your eyes while cutting them.

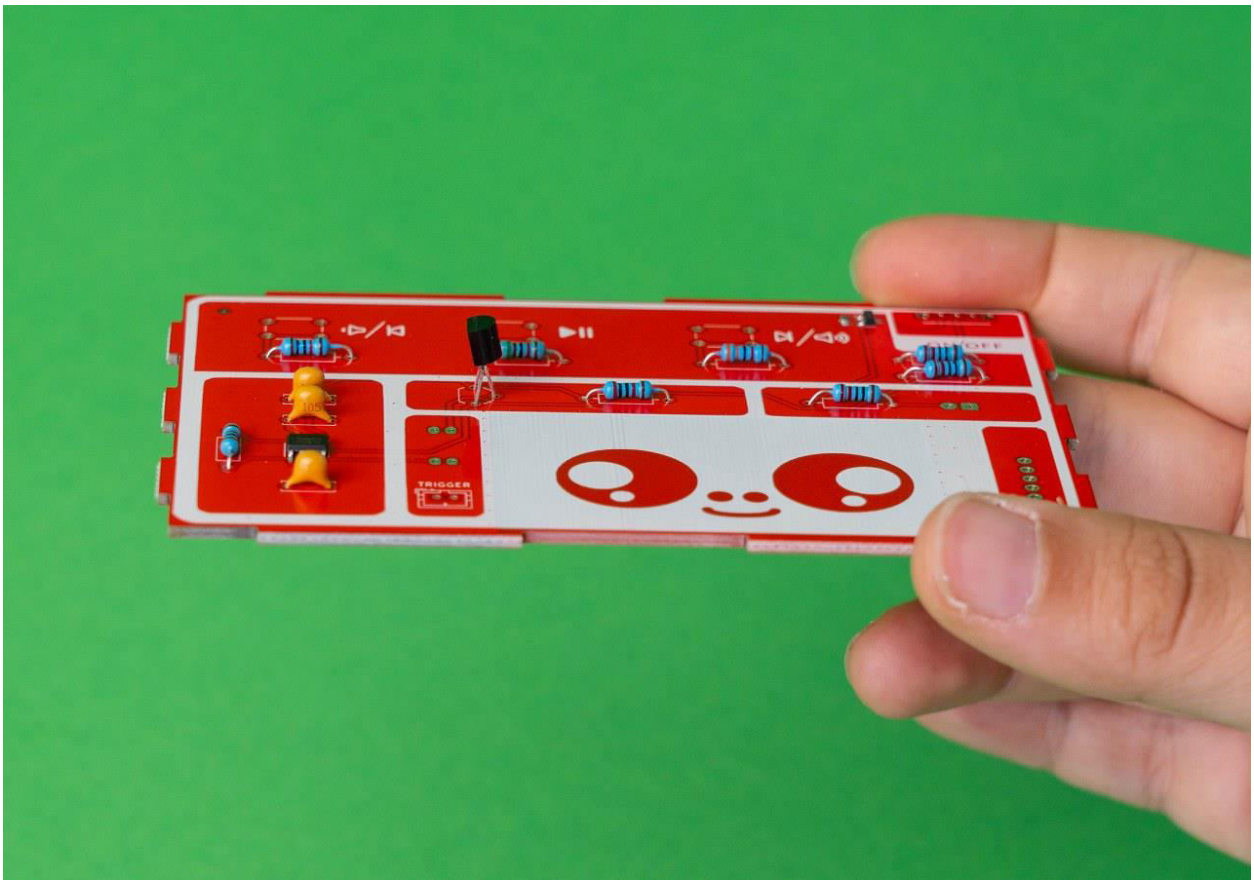
Part three - Transistor

Now is the time to take this component:



Place it here and make sure that the "cut-off" side is looking at the "cut-off" part on the board.

Check this photo closely to see how the transistor's legs should be positioned:



Solder, solder, solder.

And don't forget to cut its legs off:

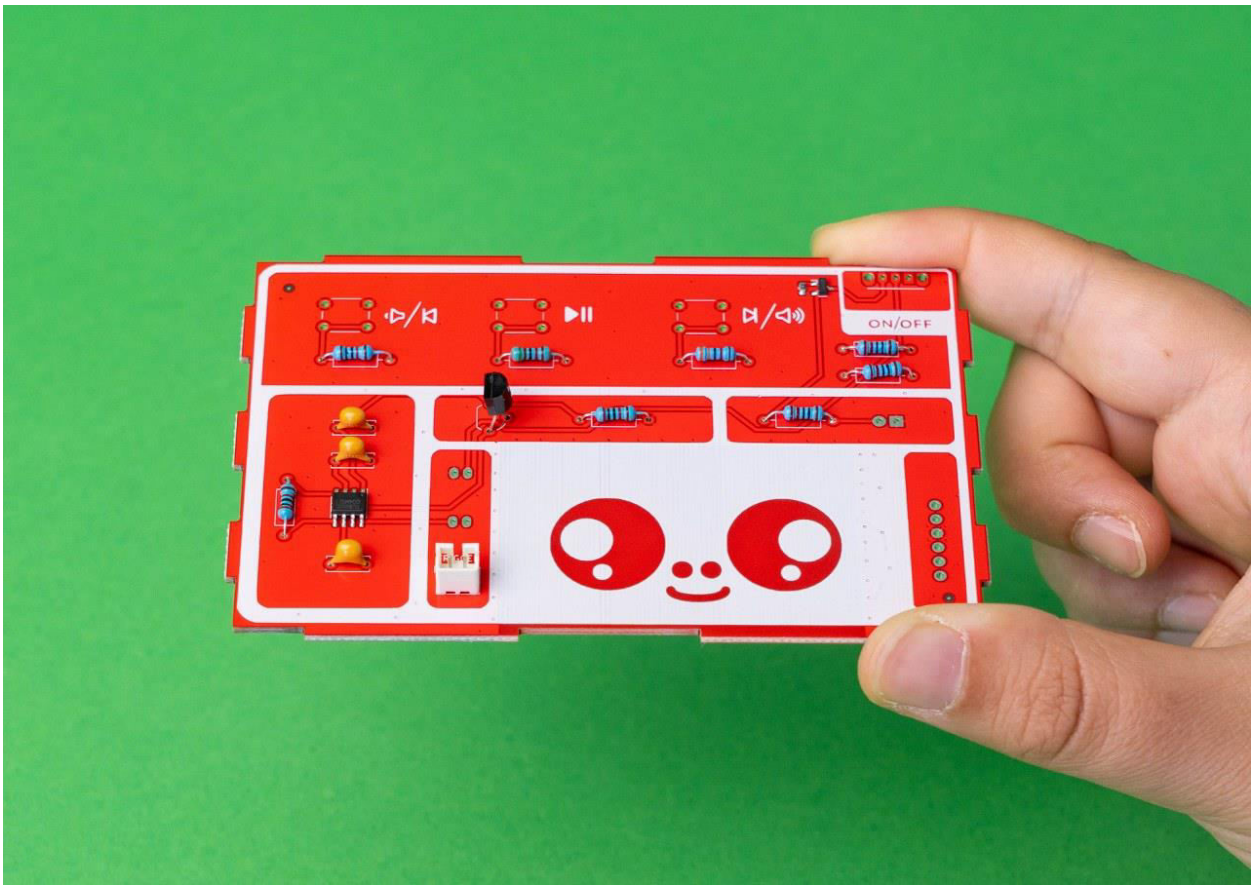
Part four - Connectors

Take one of the three connectors you got in the kit.

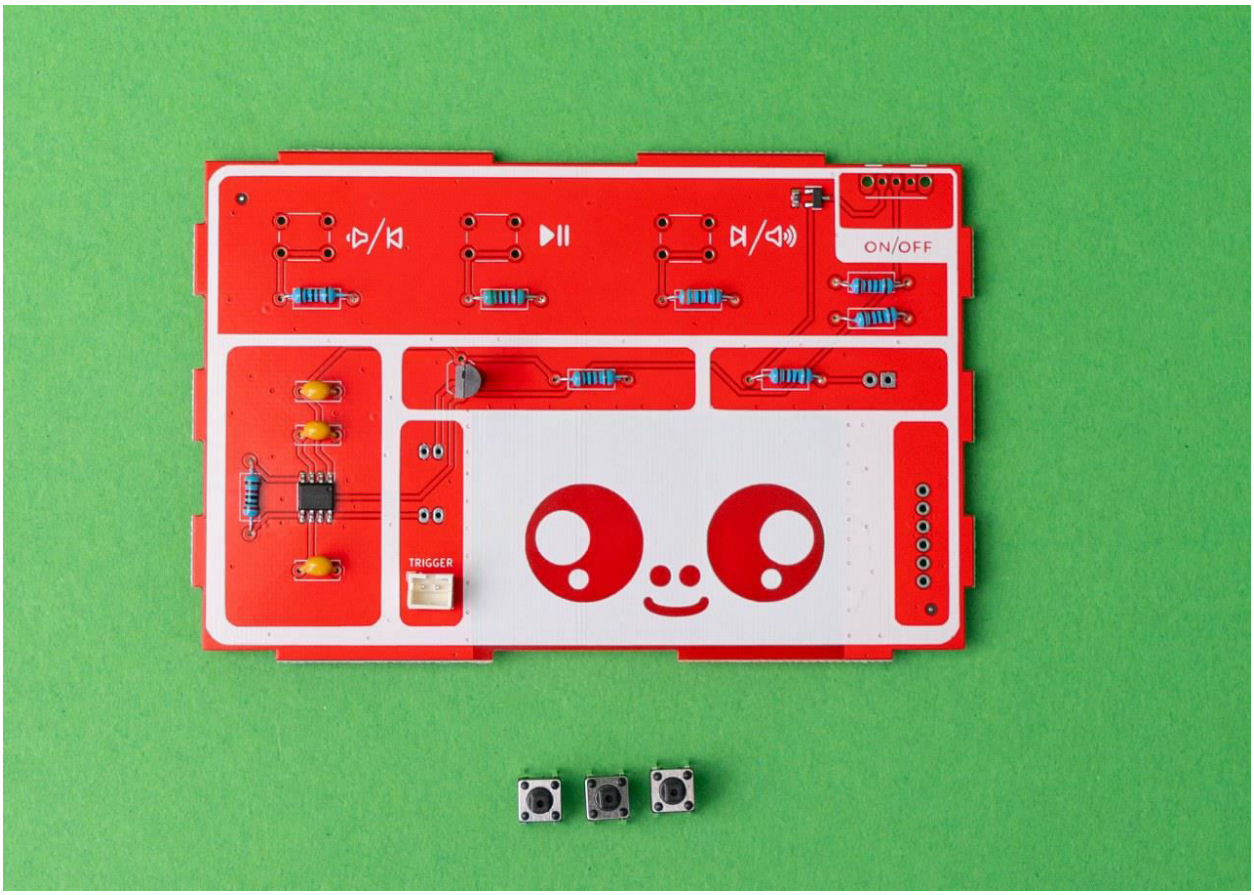
One of them will be looking at the front side of the PCB, while the other two will be looking at the back.

Let's first solder the front one.

Place it here, and you can start soldering:



Part five - Puhsbuttons

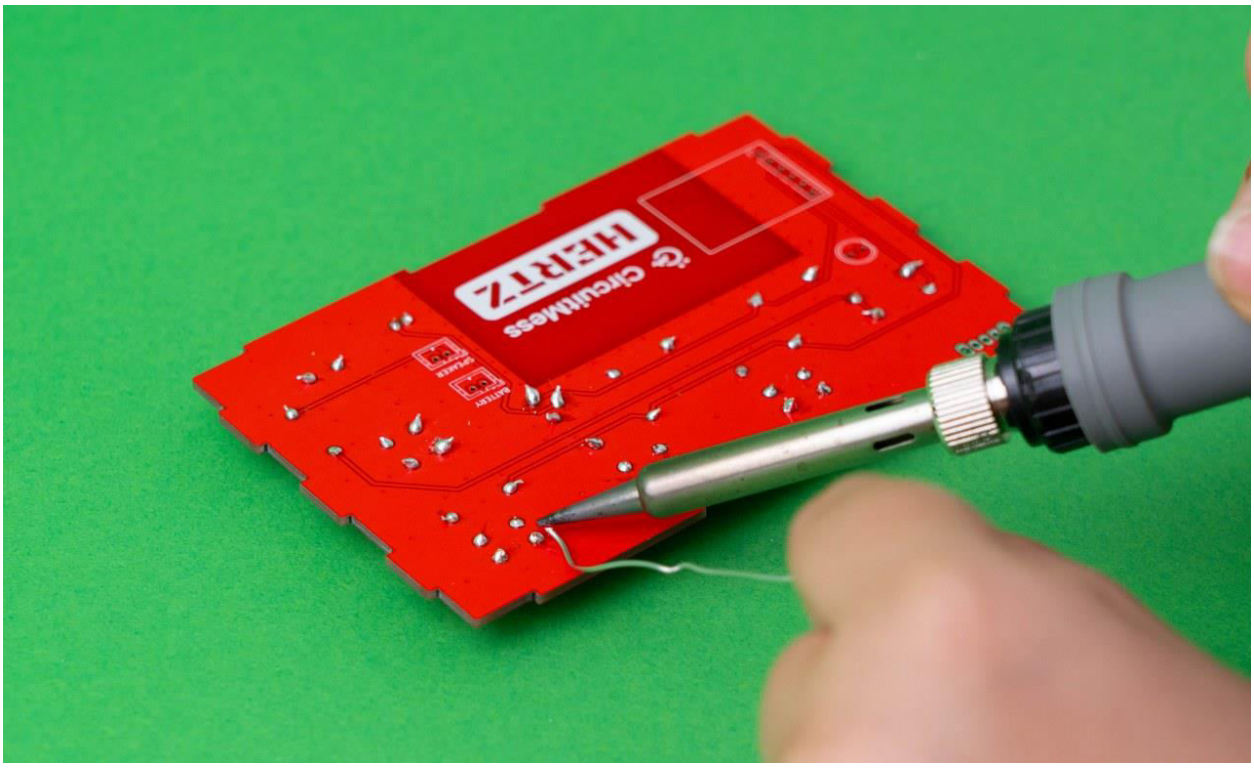


You'll place them above these three resistors:

Make sure that they are not tilted and that they are vertical to the board.

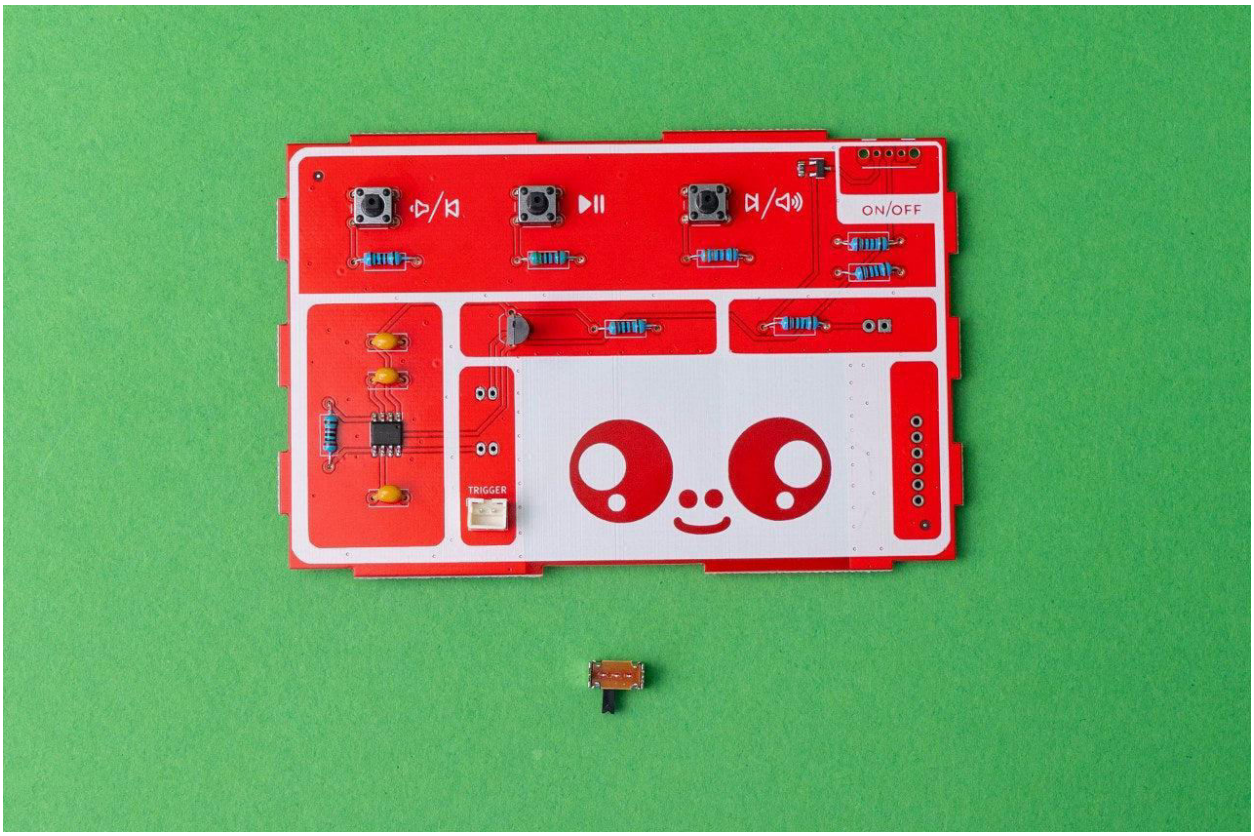
Once they sit properly, you should hear the click sound.

Flip the board and start soldering:

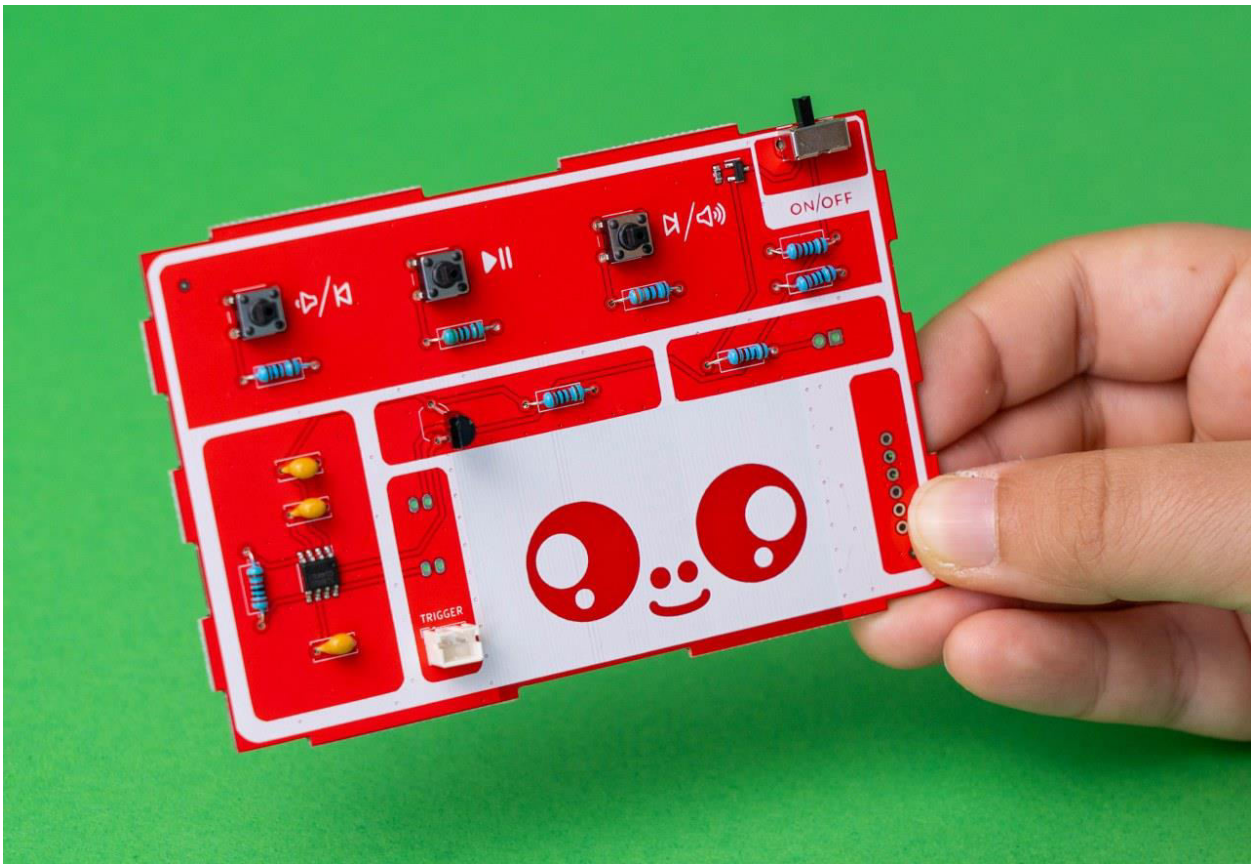


Part six- On/off switch

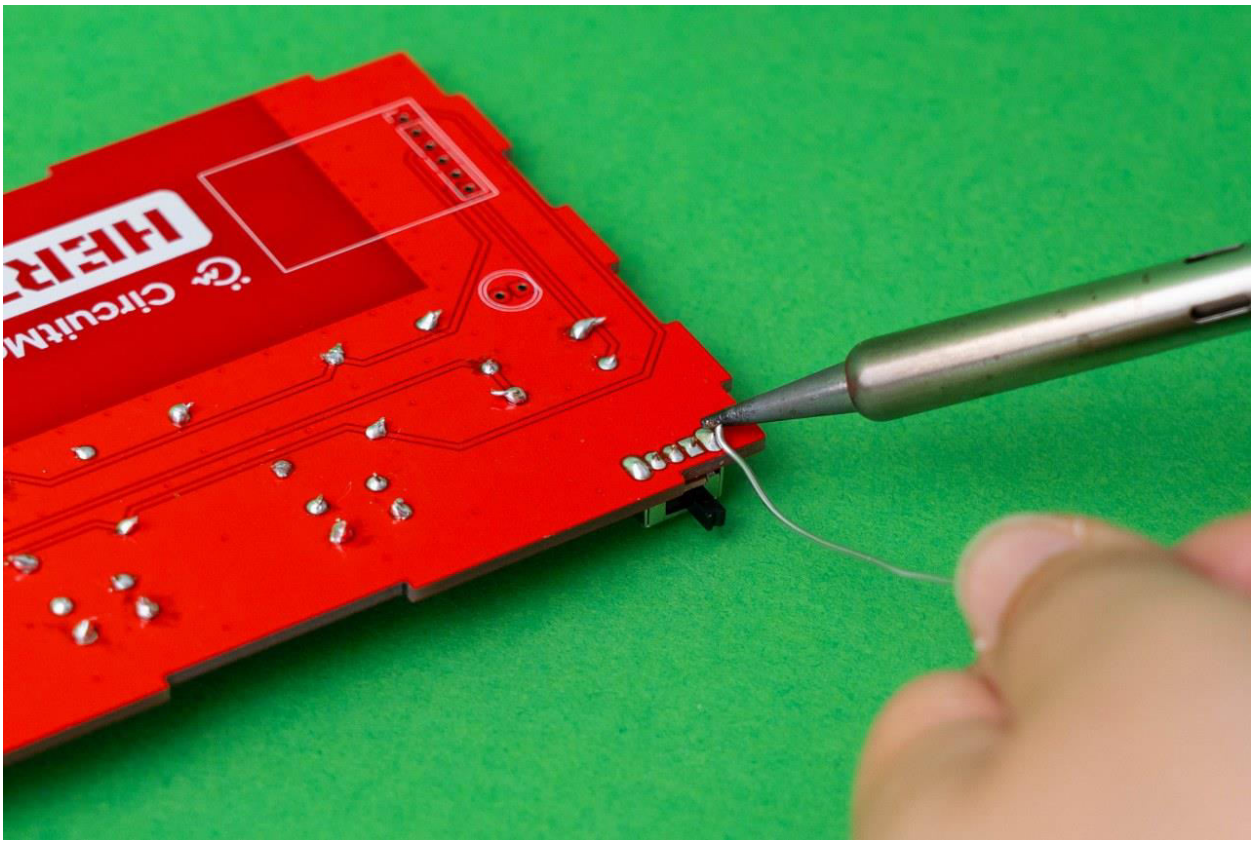
It's time to solder the switch that will give life to your Hertz.

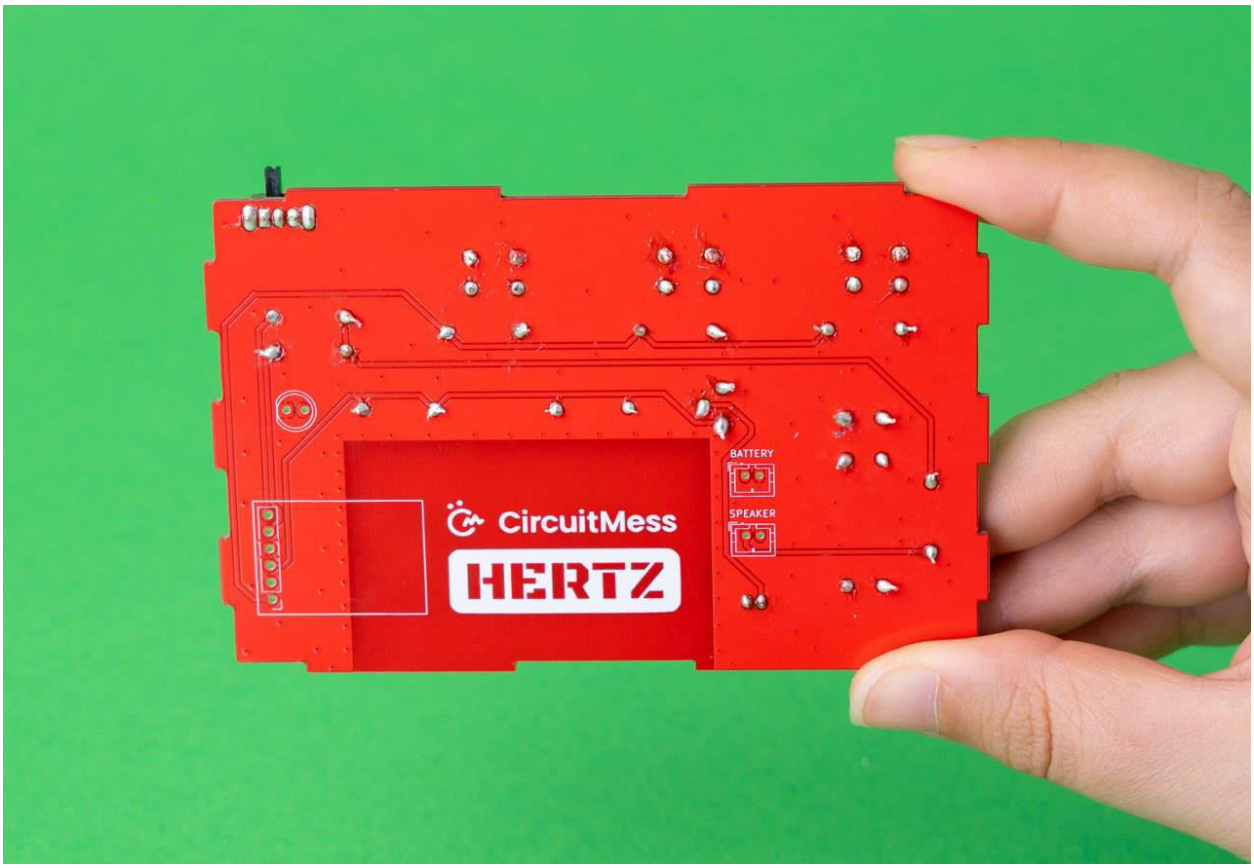


Place it here:



Now, it's extremely important not to make bridges while soldering pins, otherwise, you won't be able to turn Hertz on:



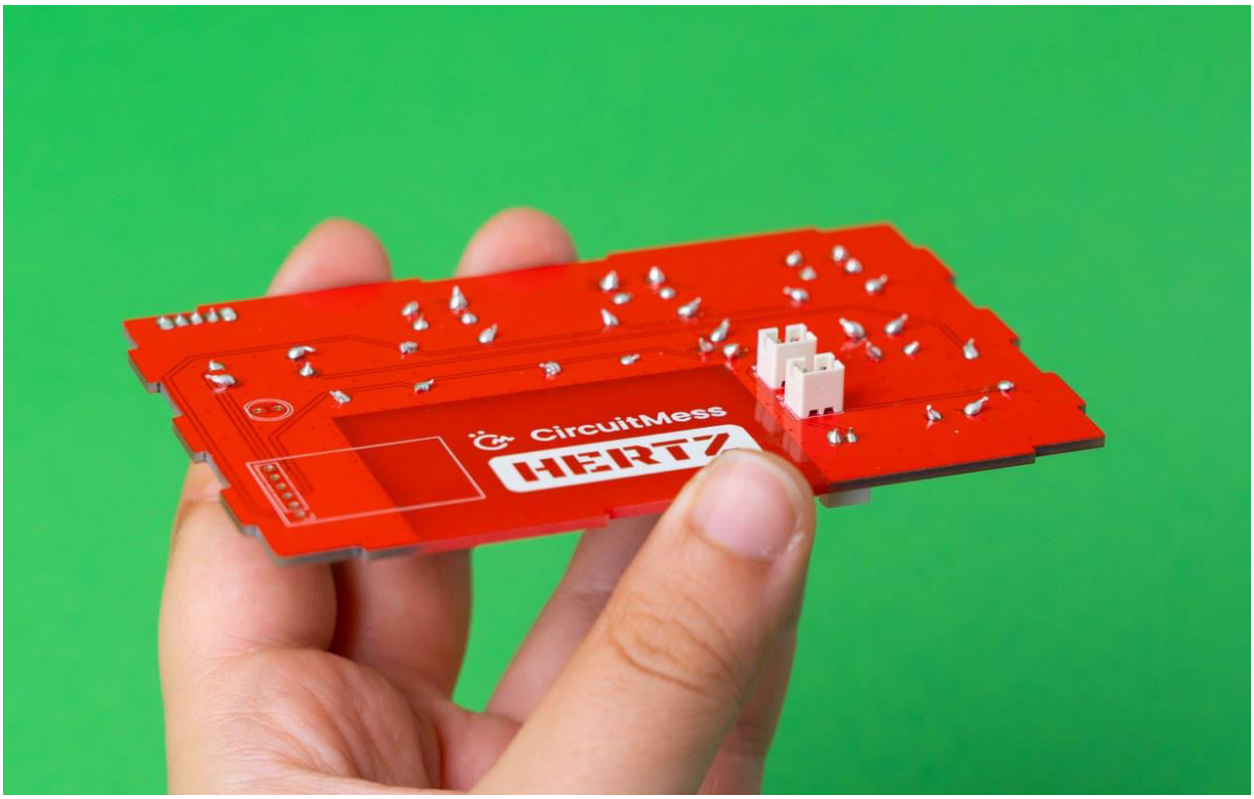


Part seven - Connectors

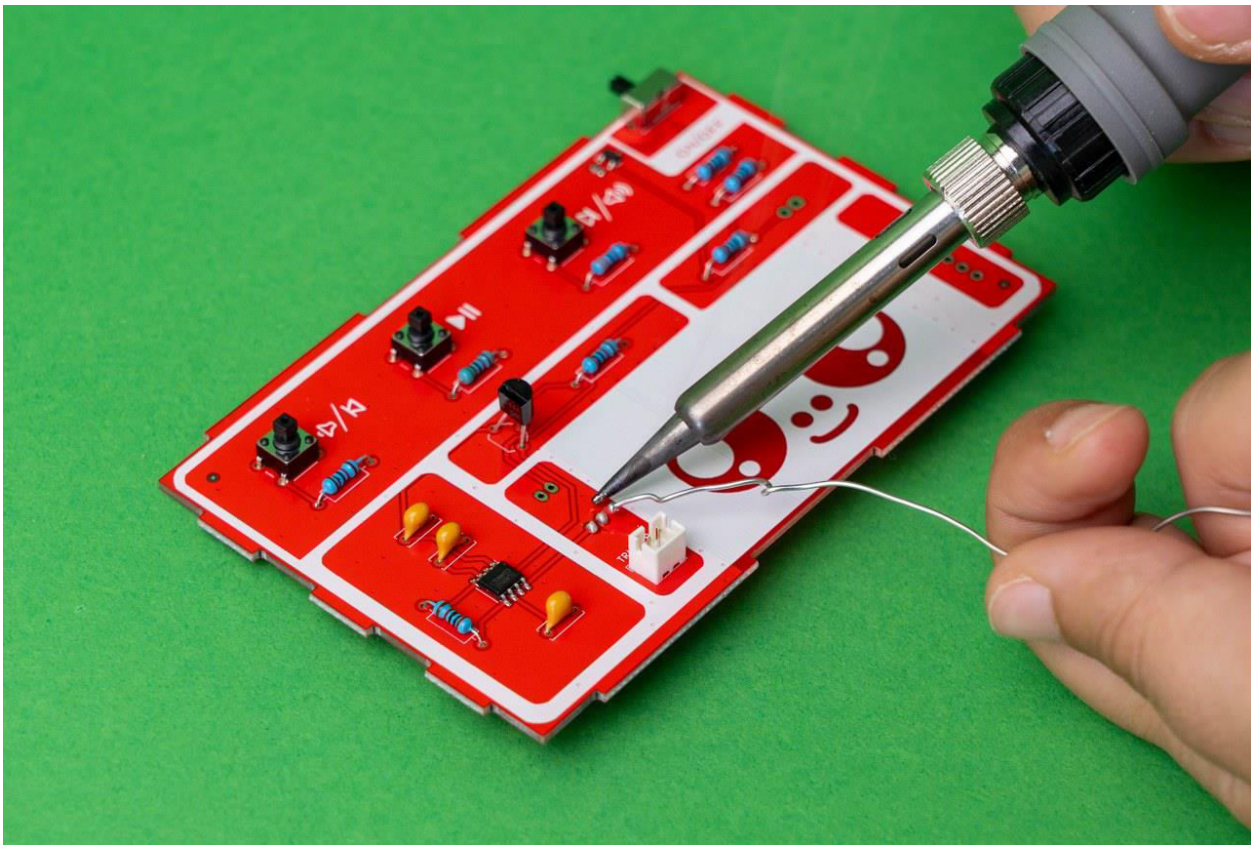
We are back at the connectors.

These two go on the backside of the board; the soldering will be done at the front.

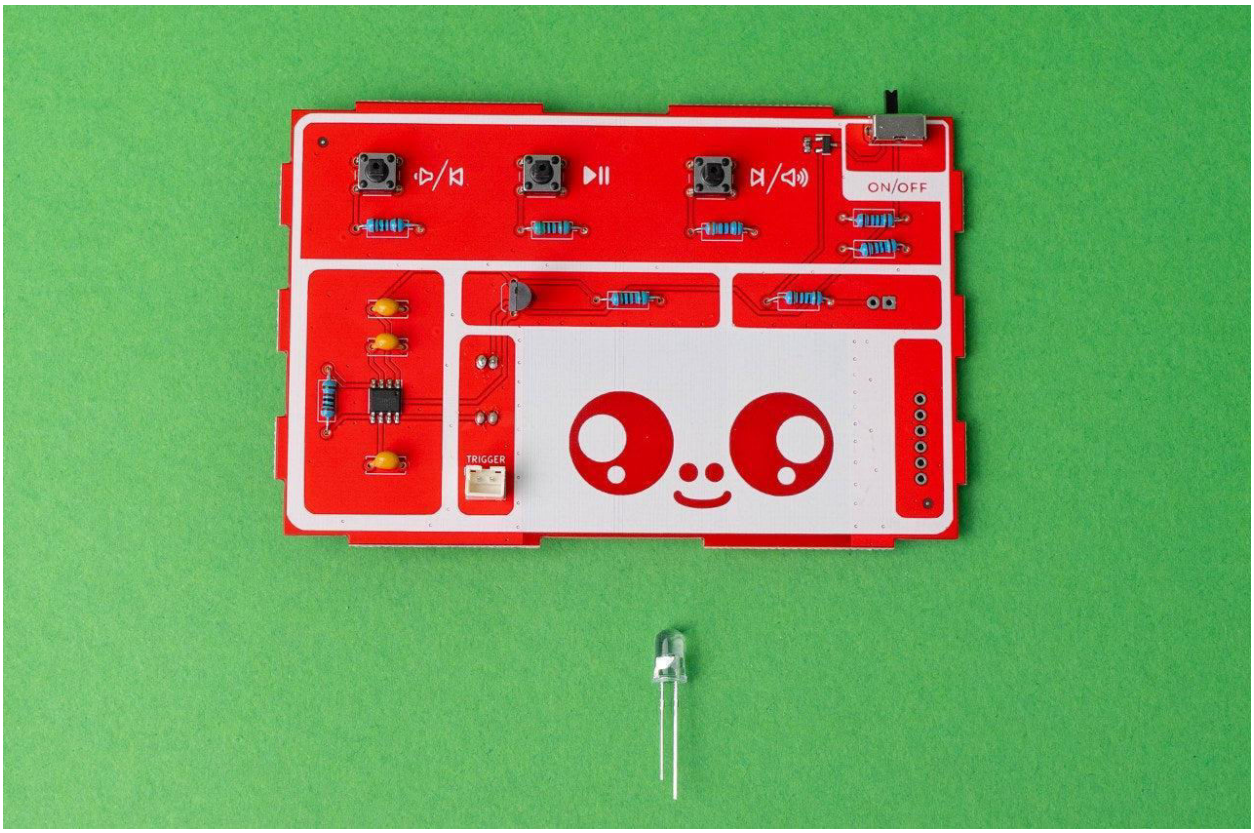
Make sure that the "cut-off" part of the connectors is looking at the "cut-off" part on the board.



Flip the board to the front, and start soldering:

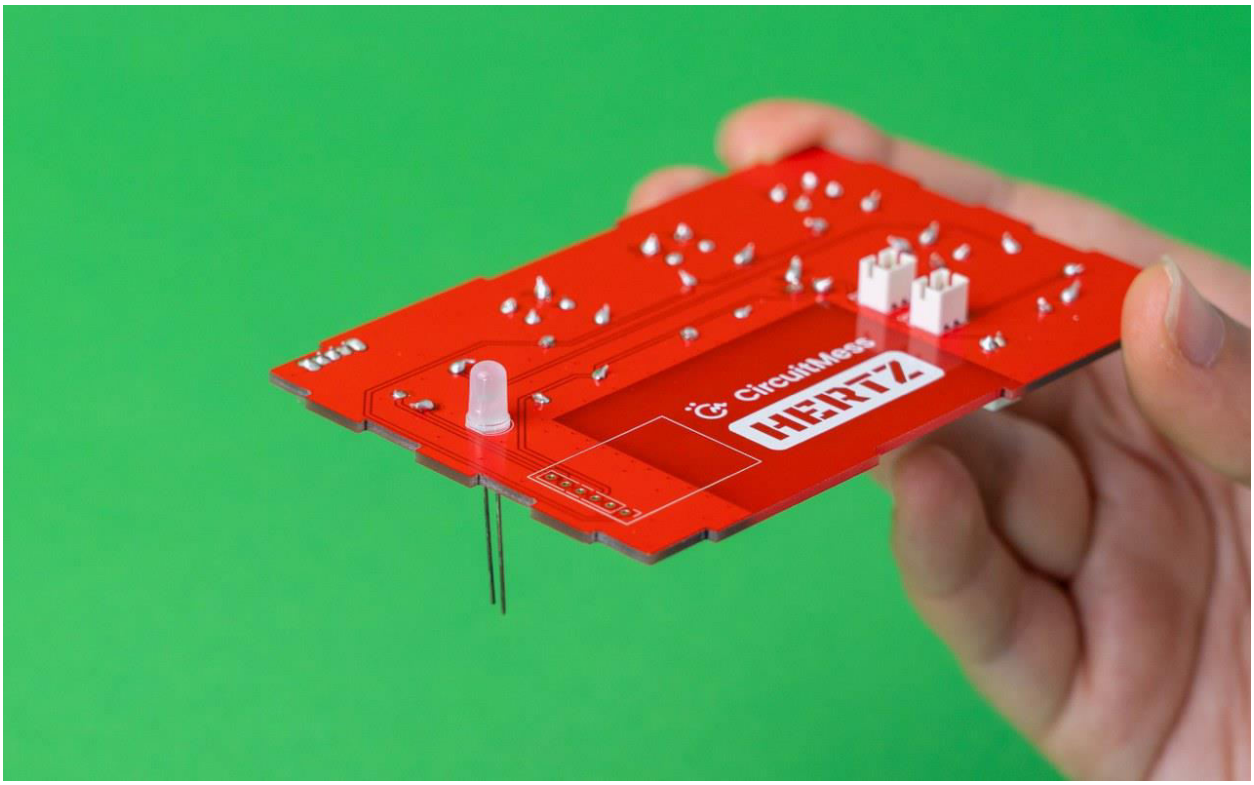


Part eight - LED

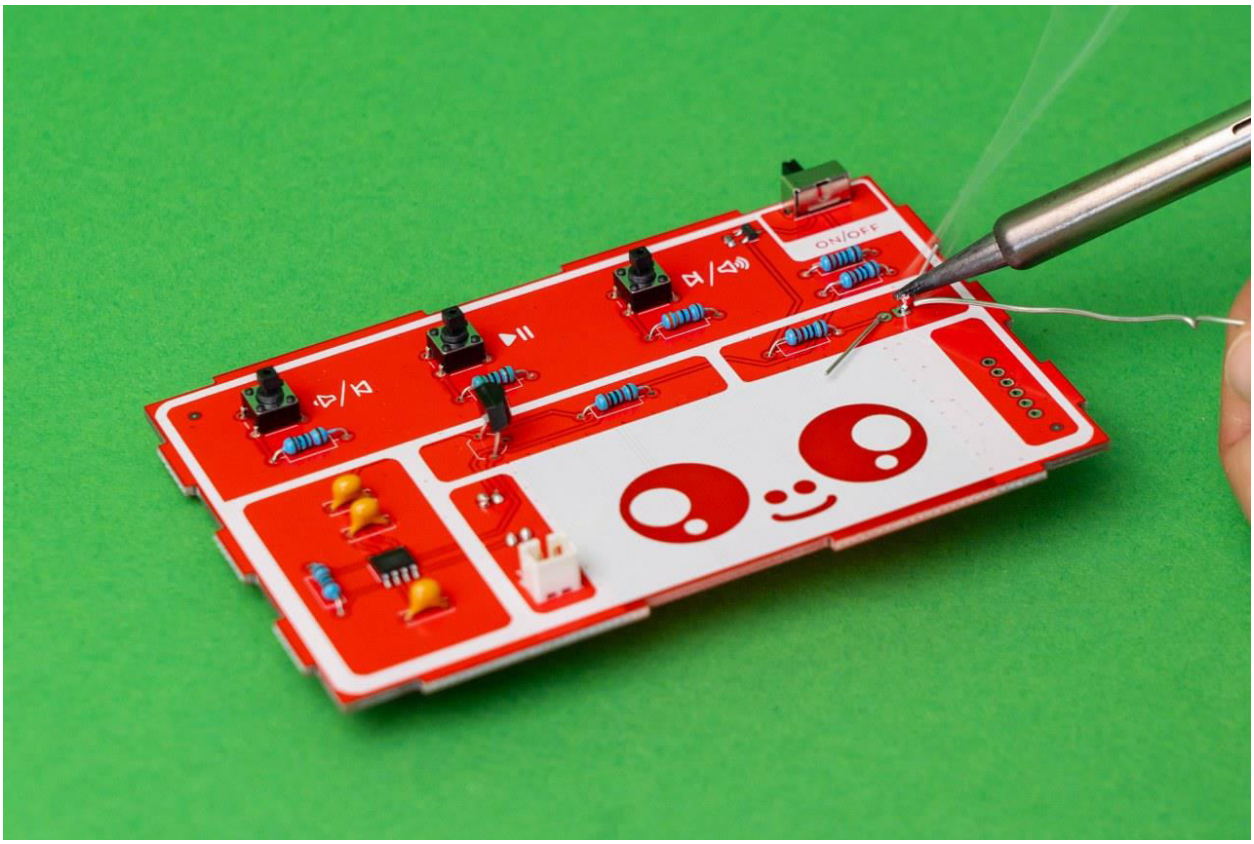


Place it here and make sure that the "cut-off" side of the LED is looking at the "cut-off" side on the board.

If you turn it the wrong way, the LED won't work.



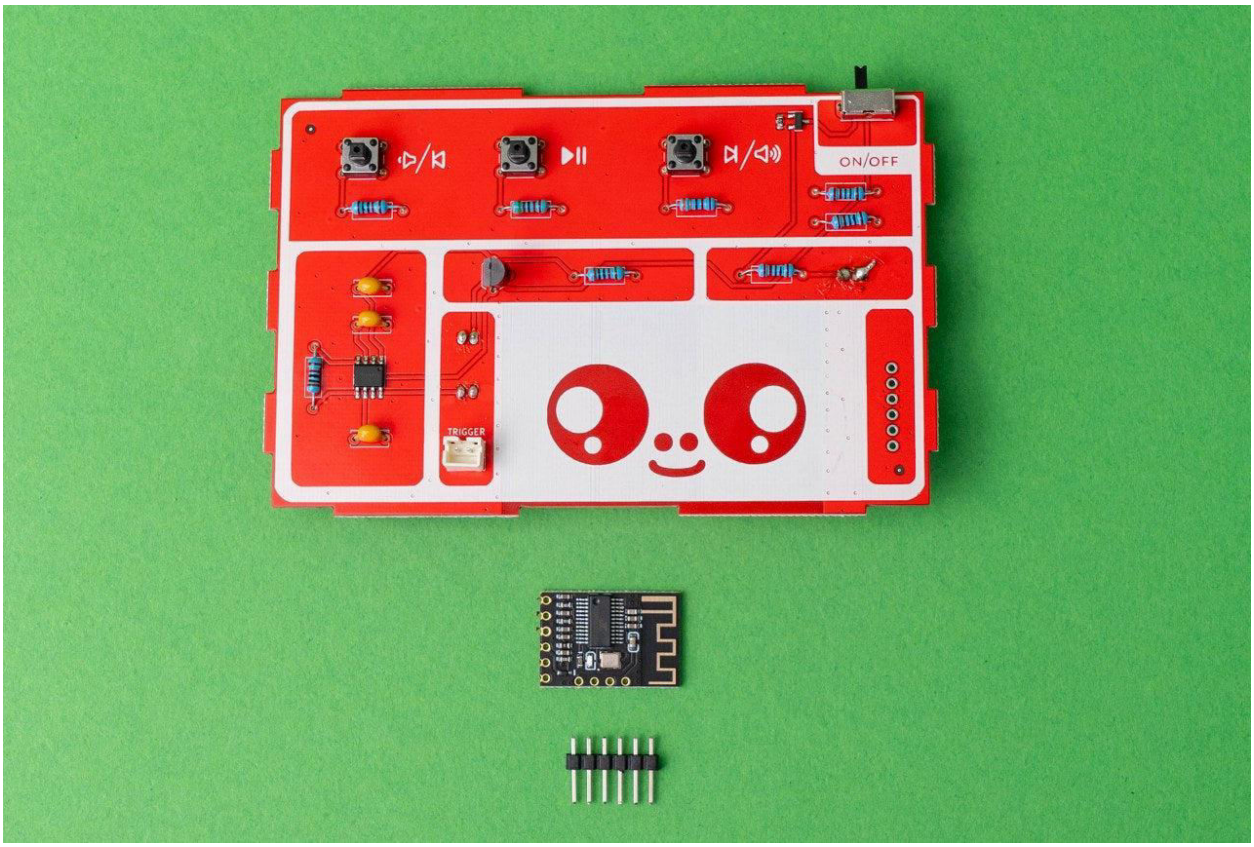
You have to solder it at the front side:


ON/OFF


BATTERY
SPEAKER
CircuitMess
HERTZ

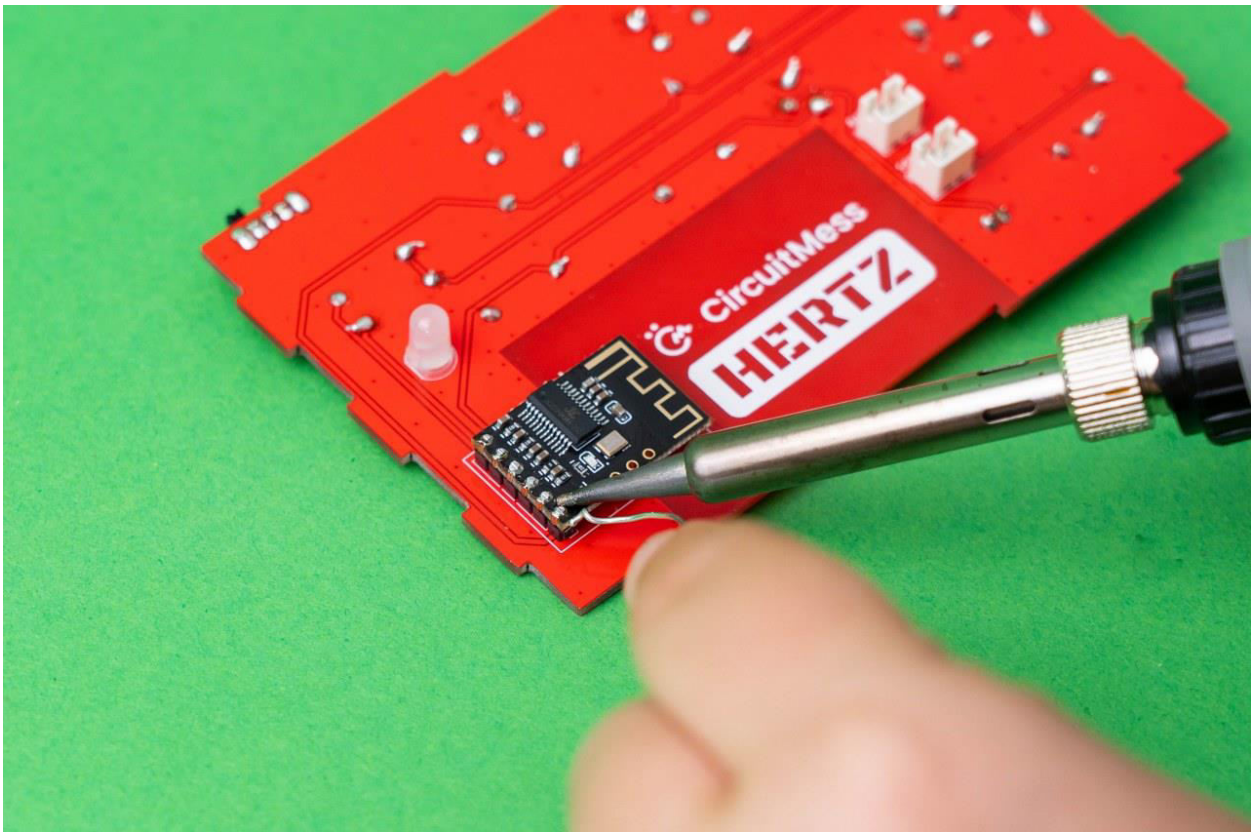
Cut off the legs of the LED and you can proceed.

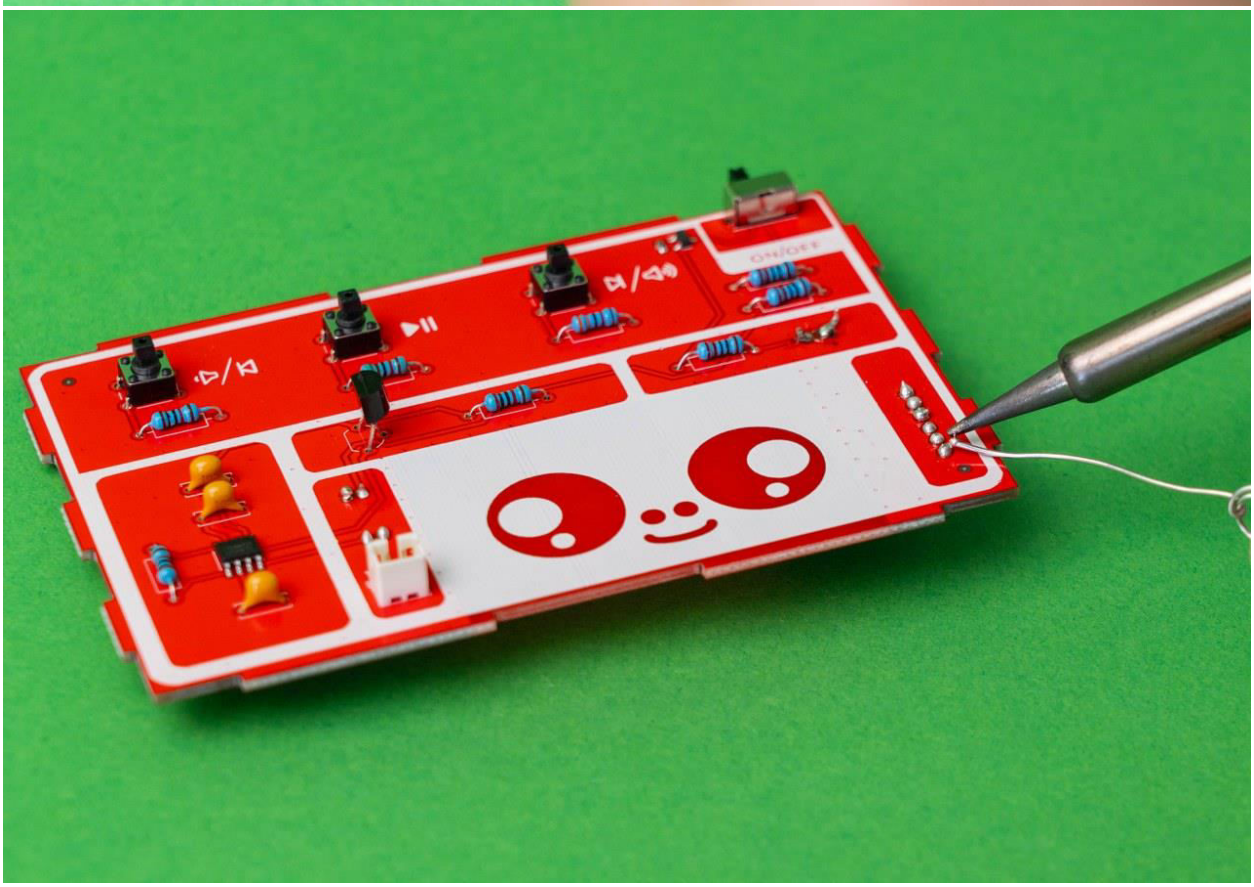
Part nine - Bluetooth audio module



This part goes to the back.

Make sure that the chip is looking up, and that the shorter pins are going through the PCB and the longer ones through the audio module.


CircuitMess
HERTZ



Amazing!

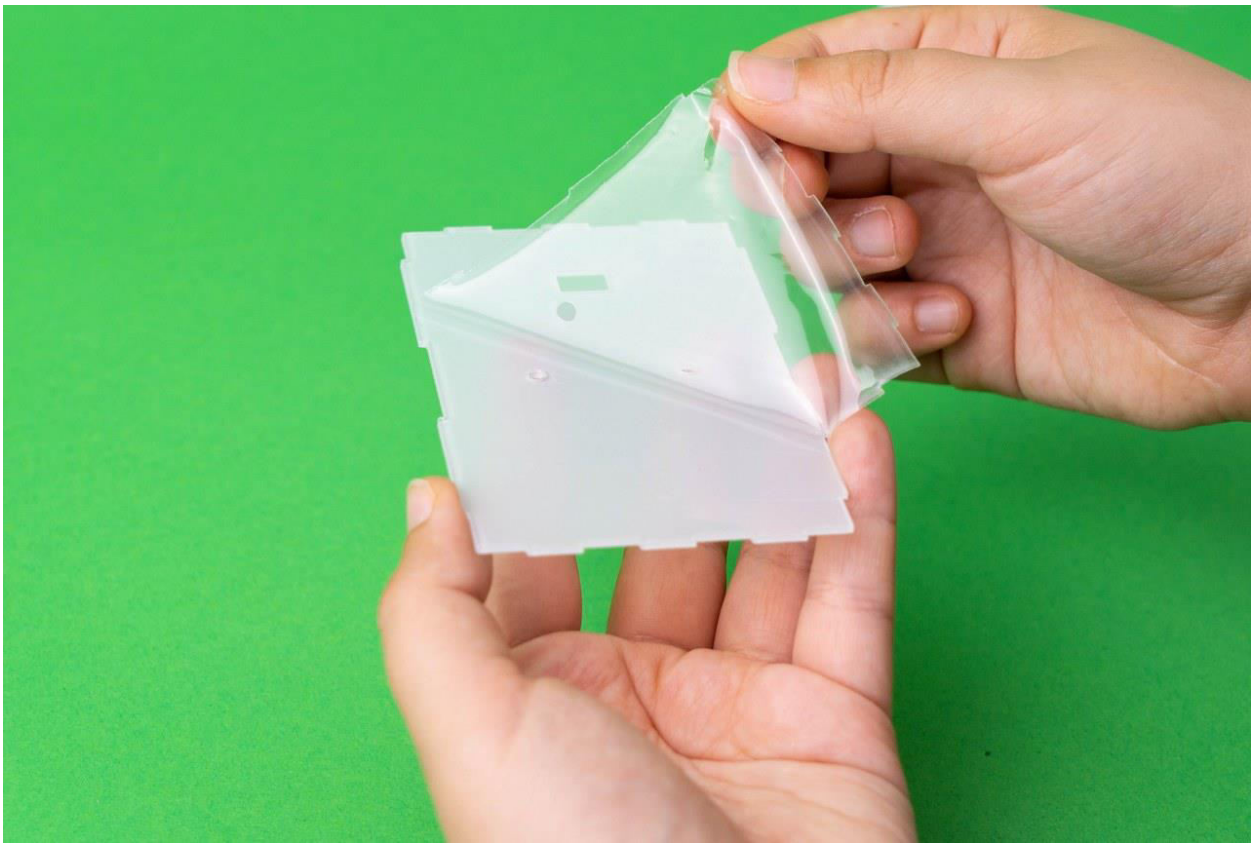
You successfully soldered everything on your Hertz.

Turn off the soldering iron, and unplug it from the socket.
Don't forget to leave it to cool off for 10 minutes.

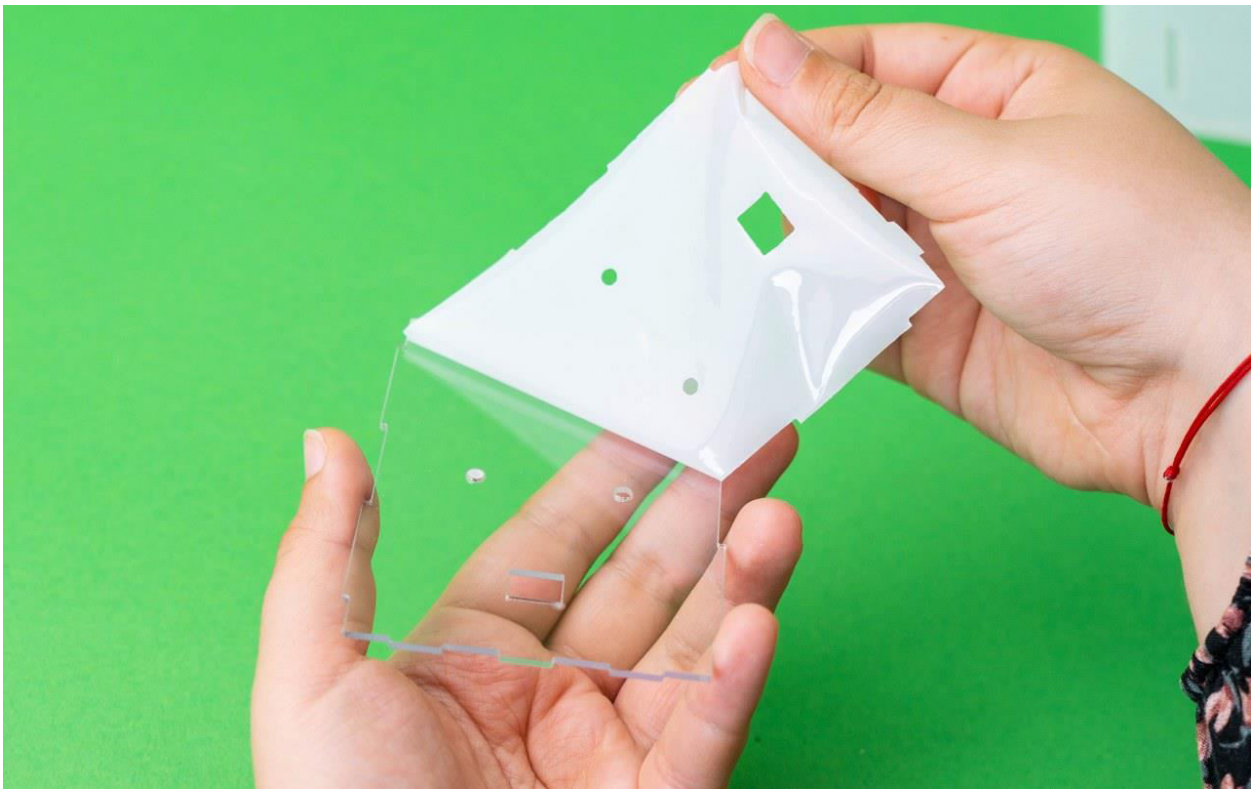
Casing up

Now is the time to put the casings on your Hertz.

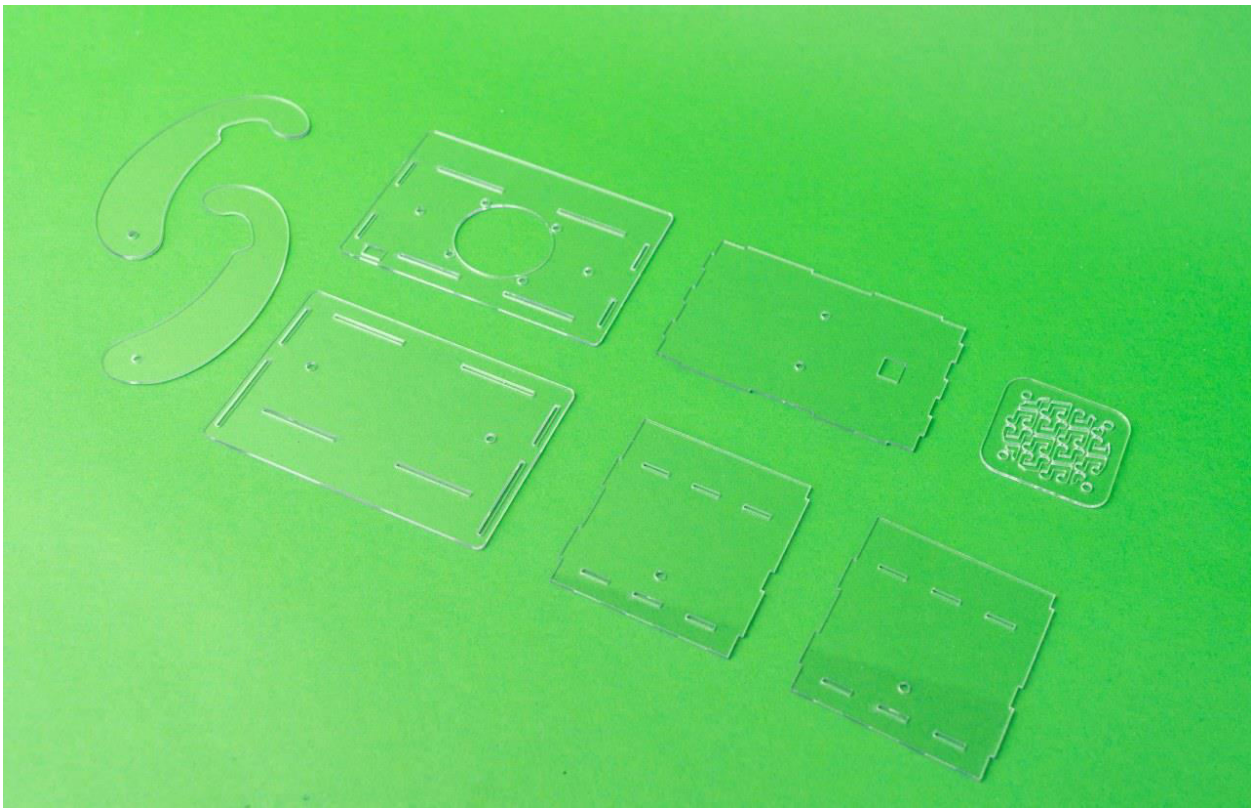
Take all the acrylic casings you have, and start peeling off the protective foil.



The casings have foil on both sides.

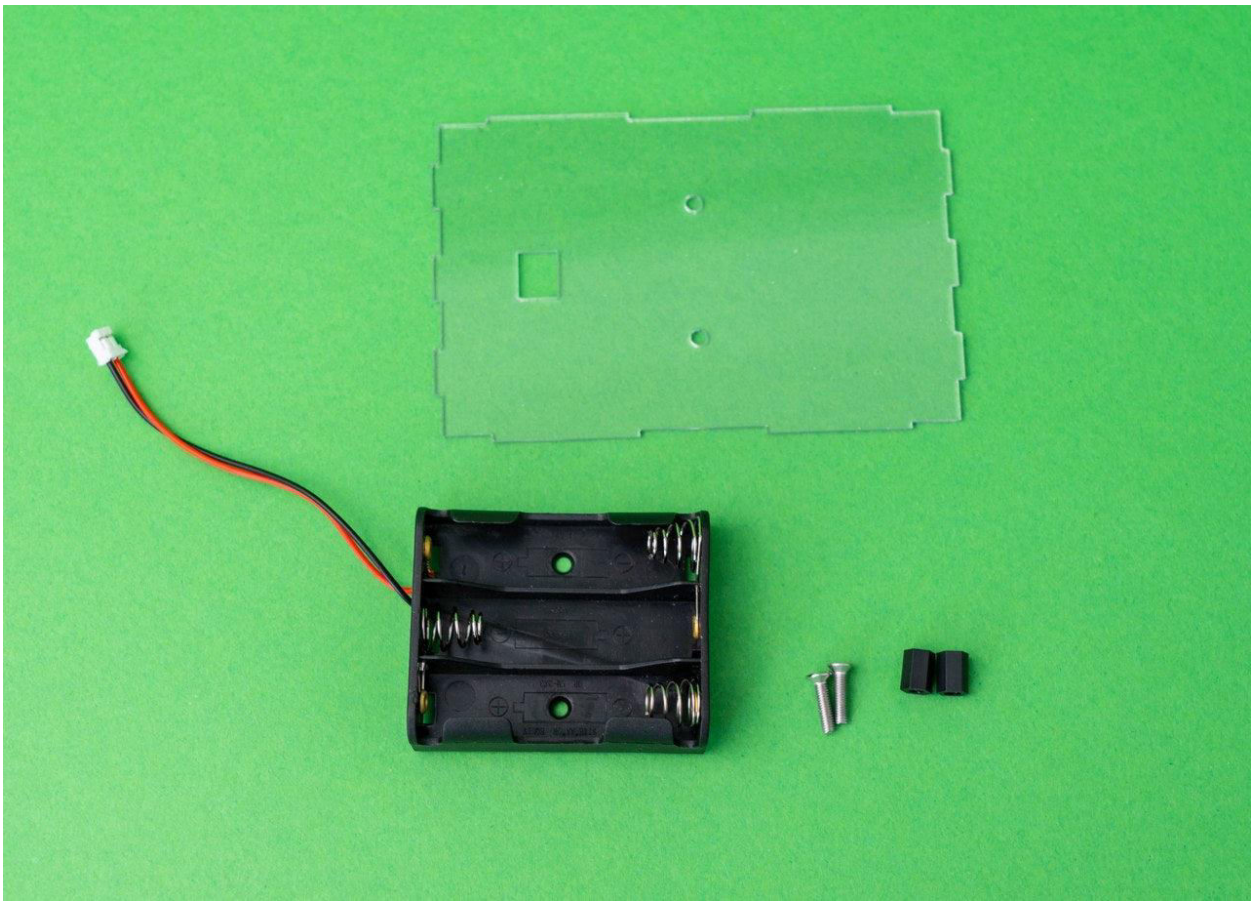


These are what the casing should look like after you finish peeling the foil off - everything should be transparent.

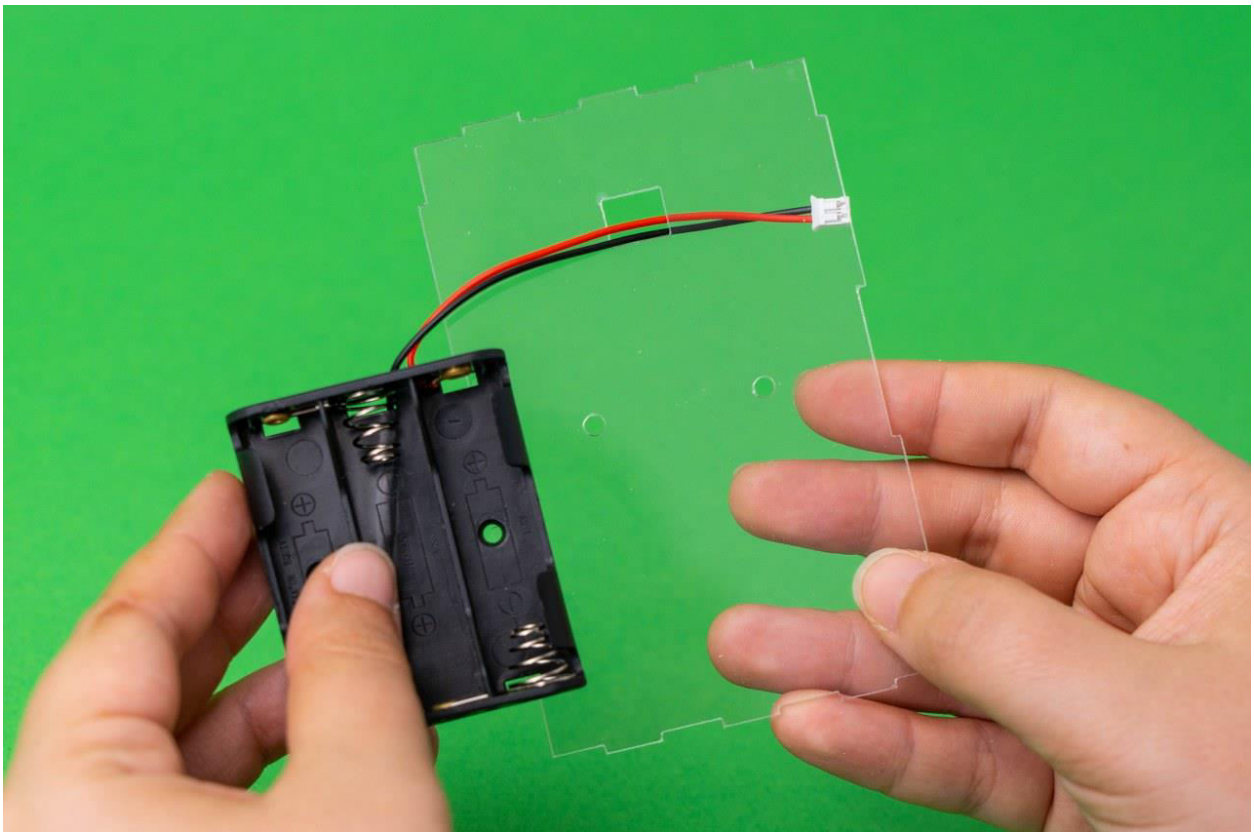


This is the first part we'll assemble.

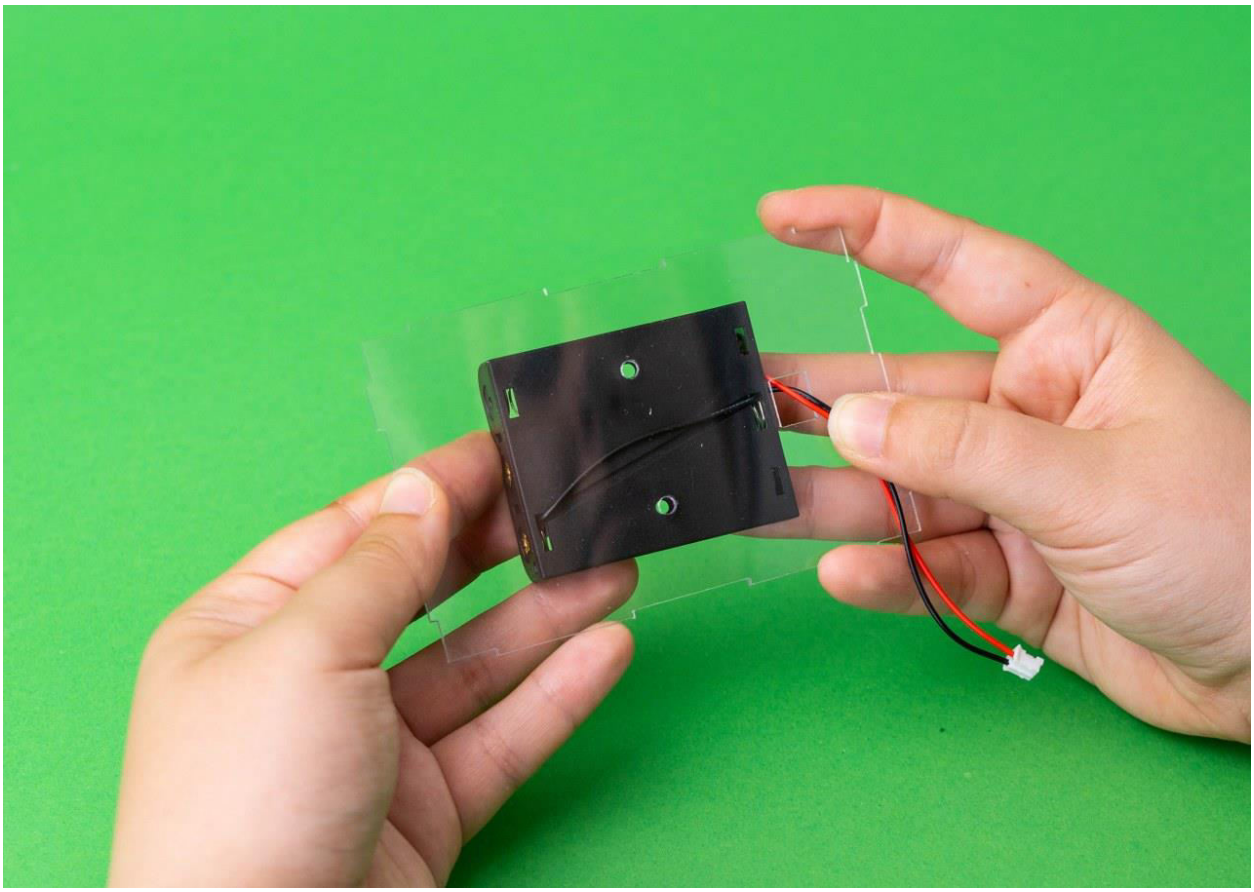
Take a battery holder, two metal screws, two spacers, and this particular casing.



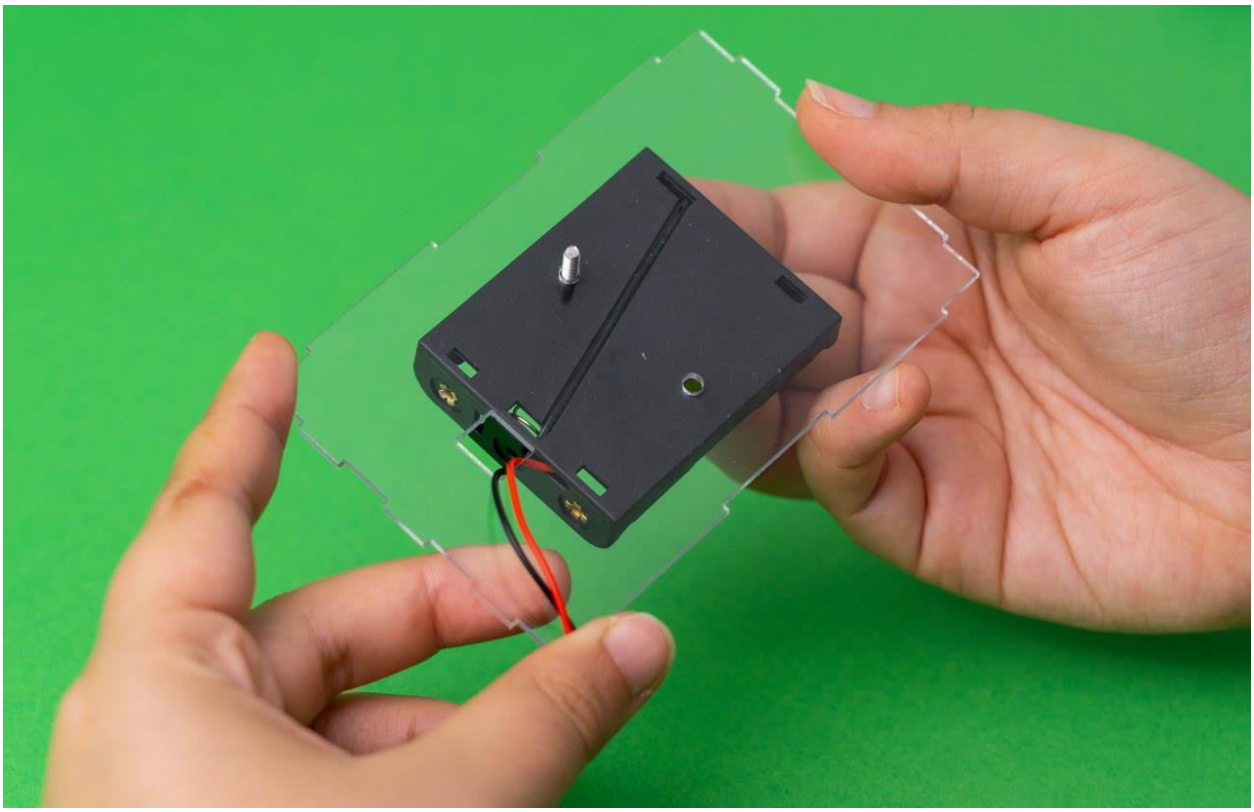
Firstly, pull the battery holder's wire through this hole:



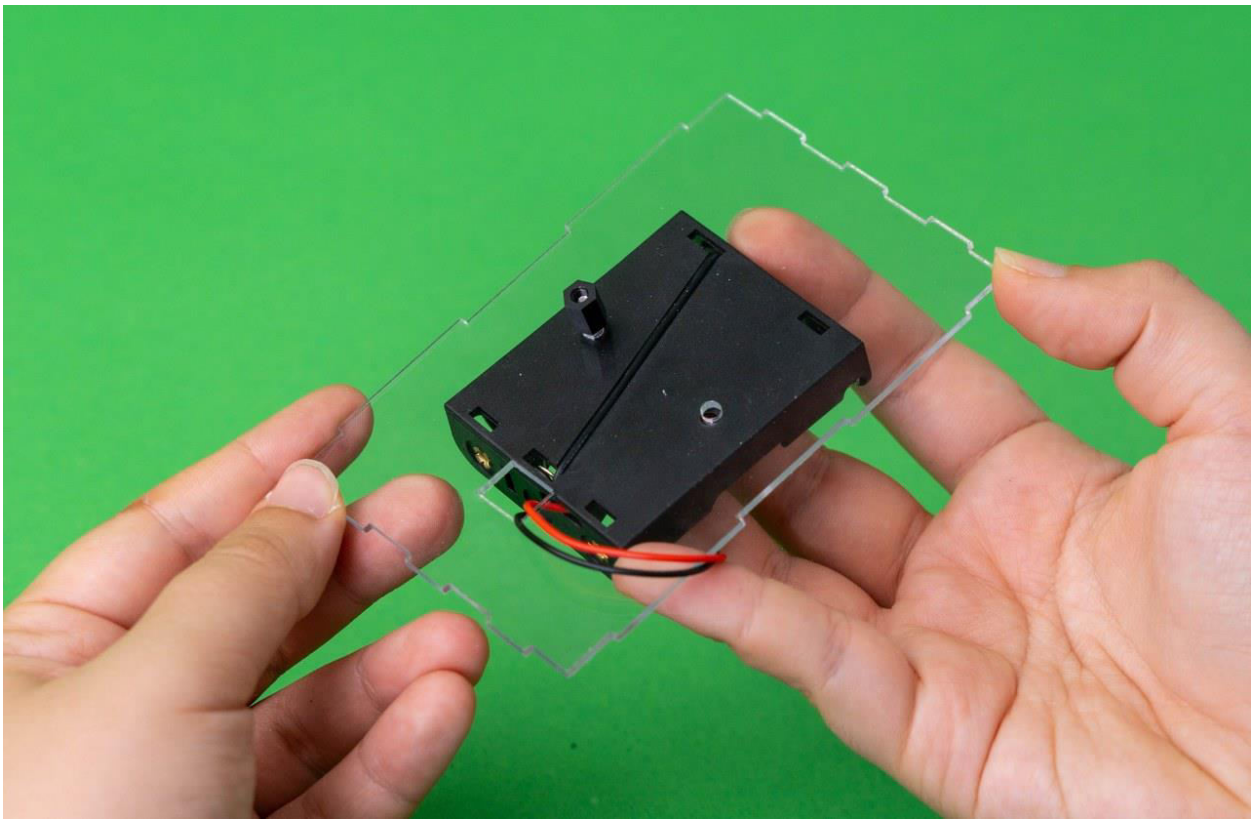
The holes on the battery holder should be where the holes of the casing are:



Put the metal screw in like this:



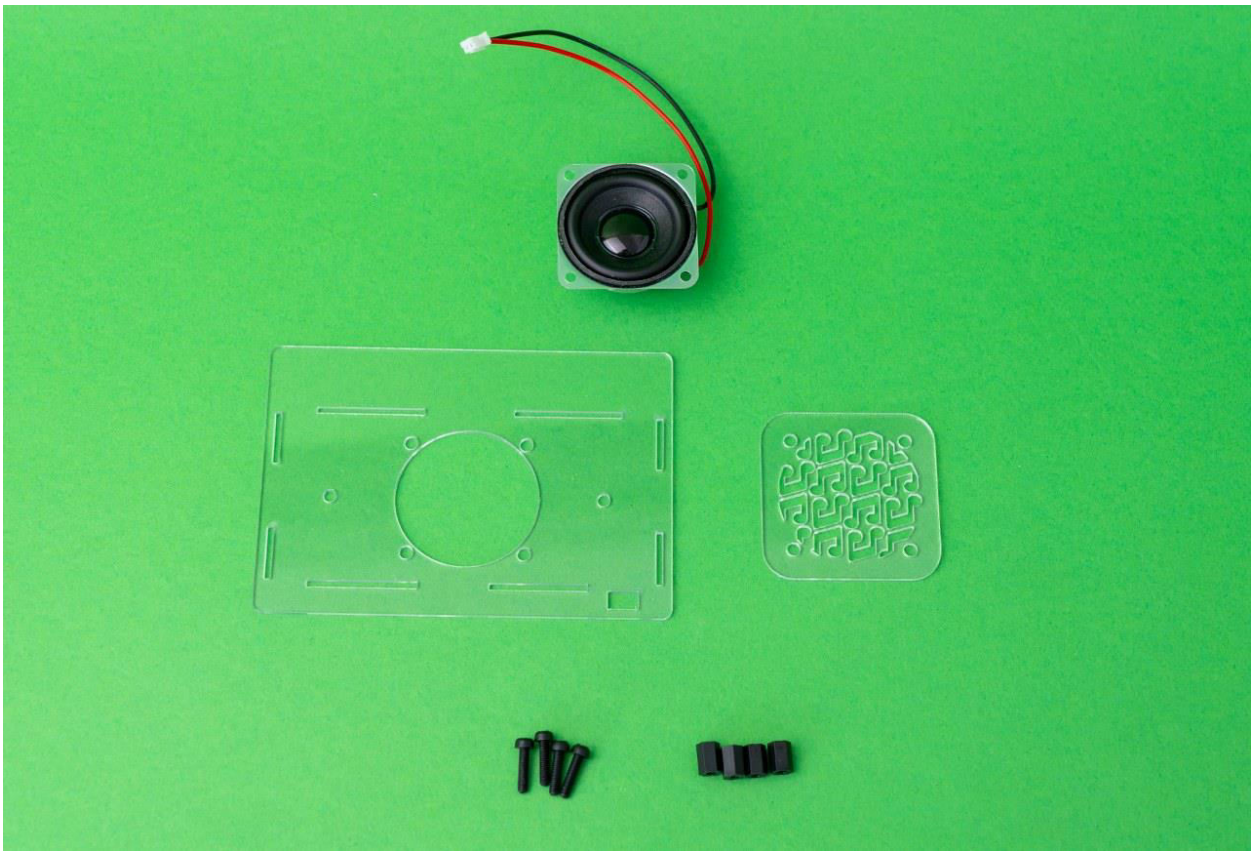
Take the spacer and fasten it with your fingers:



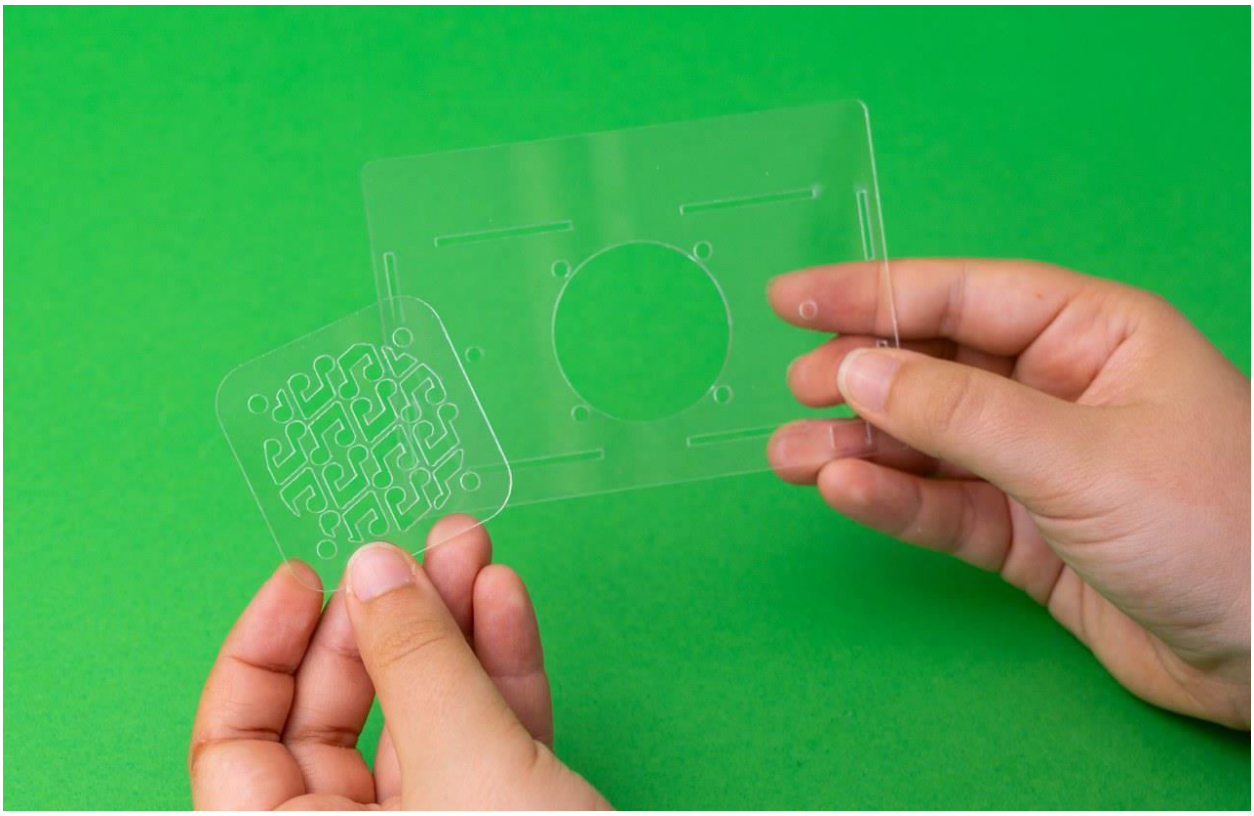
Repeat this for the second spacer/screw.

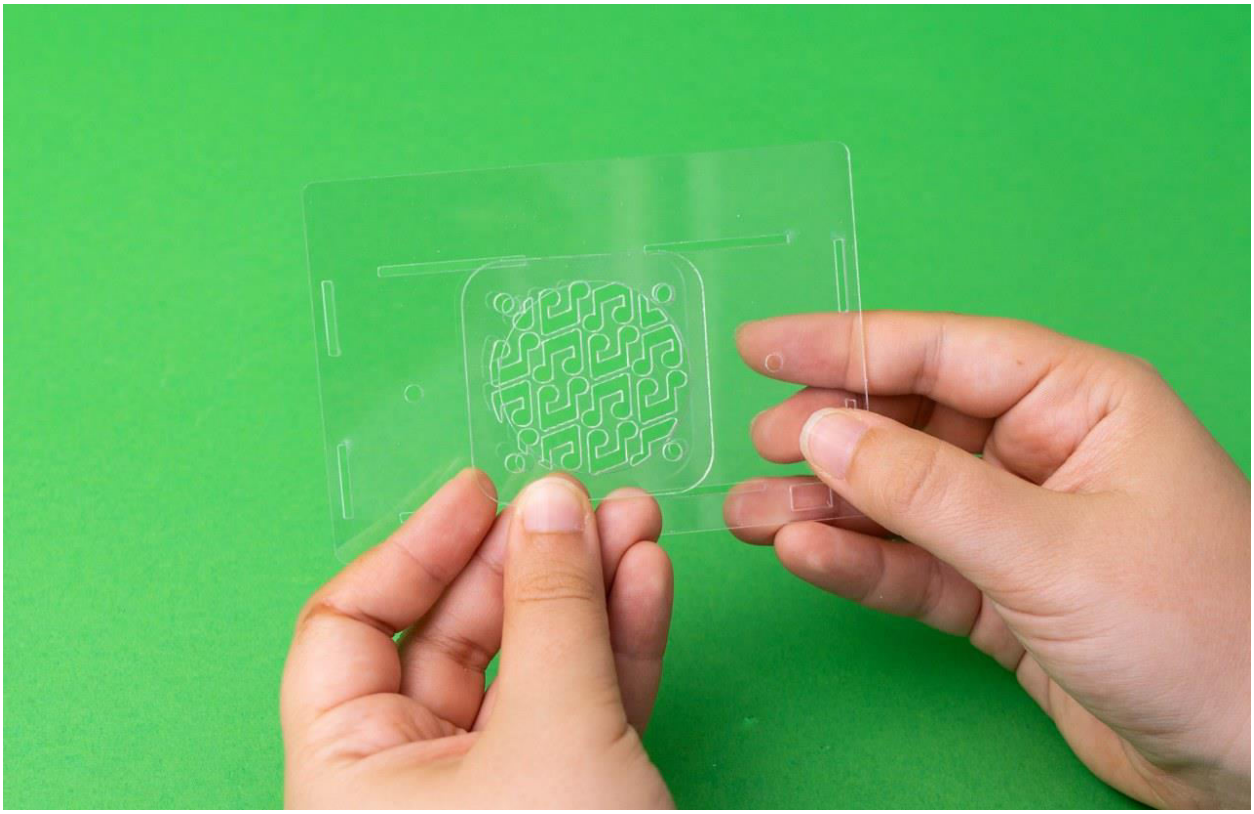
Now, let's assemble the part with the speaker.

You'll need these parts:

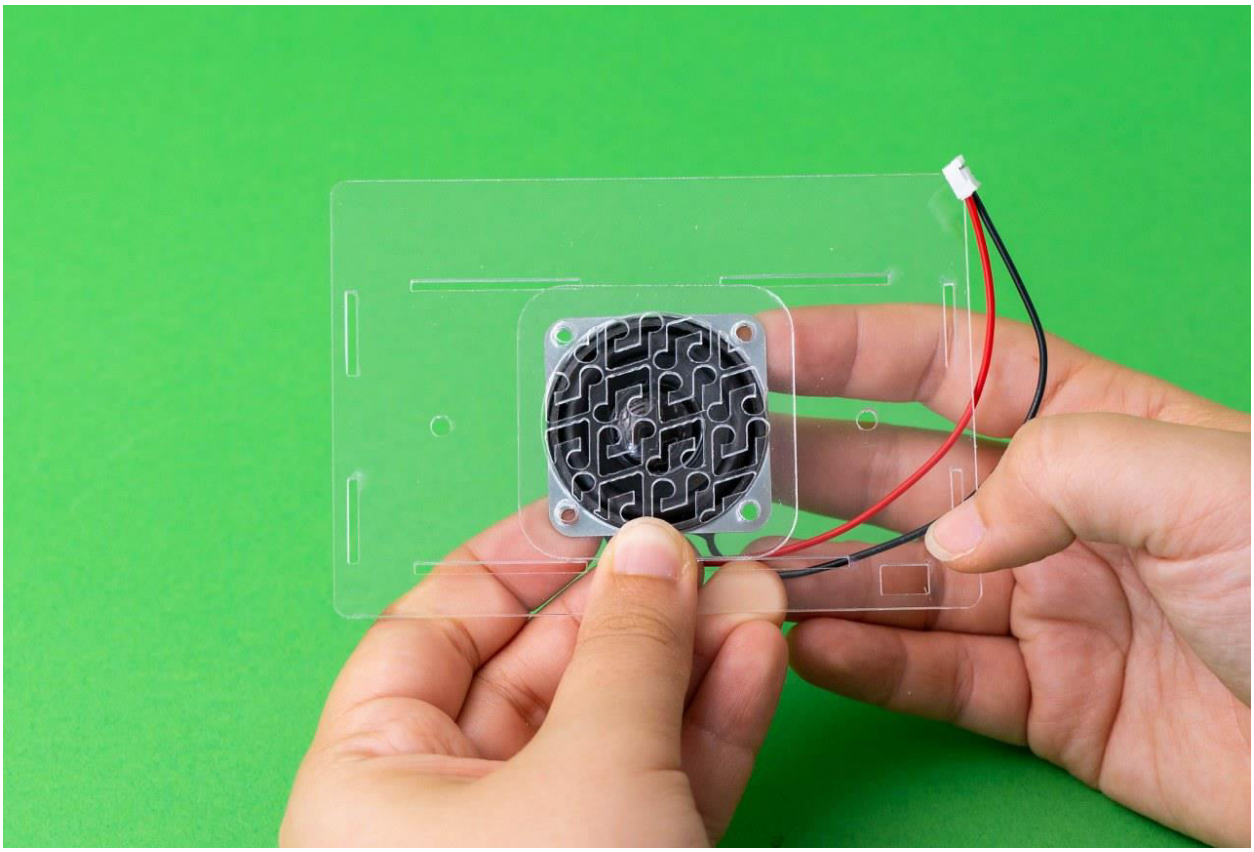


Take the casings and put them one on another like this:

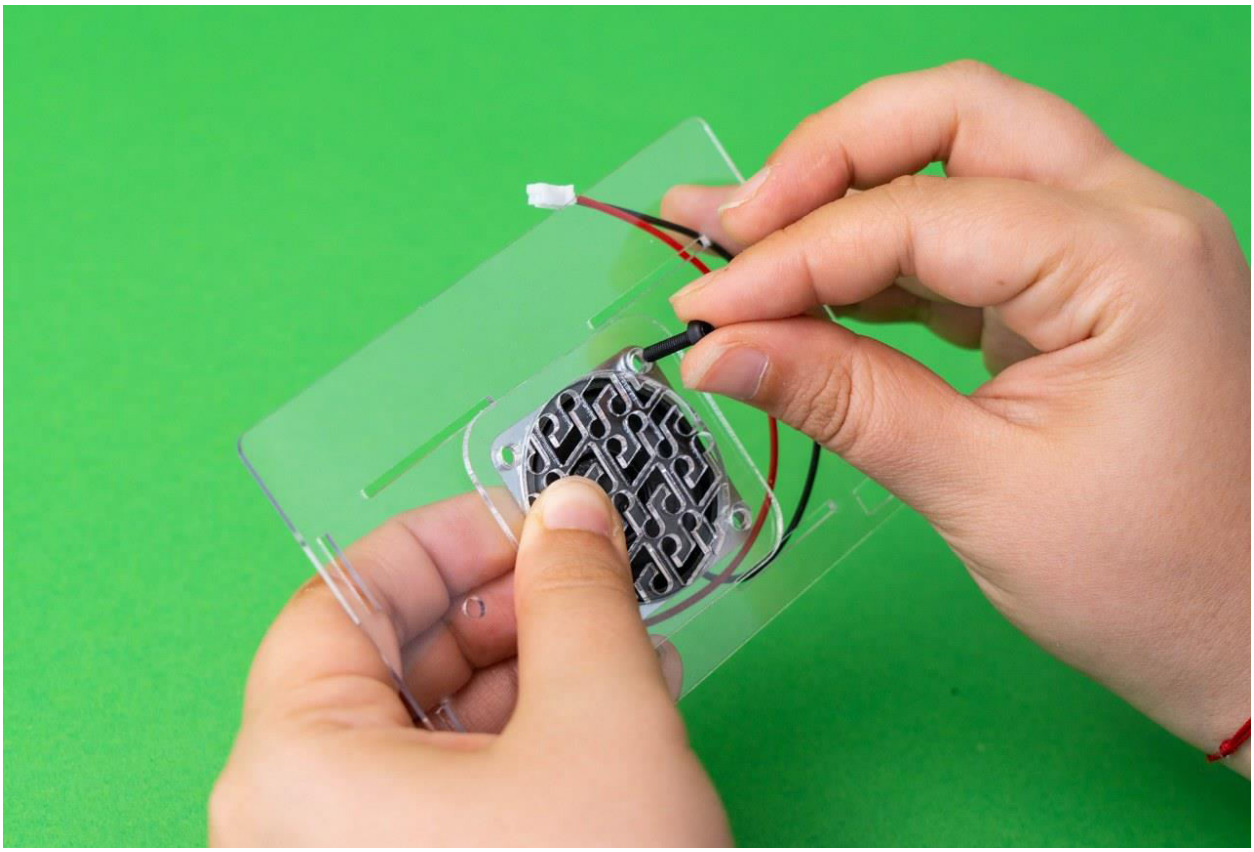




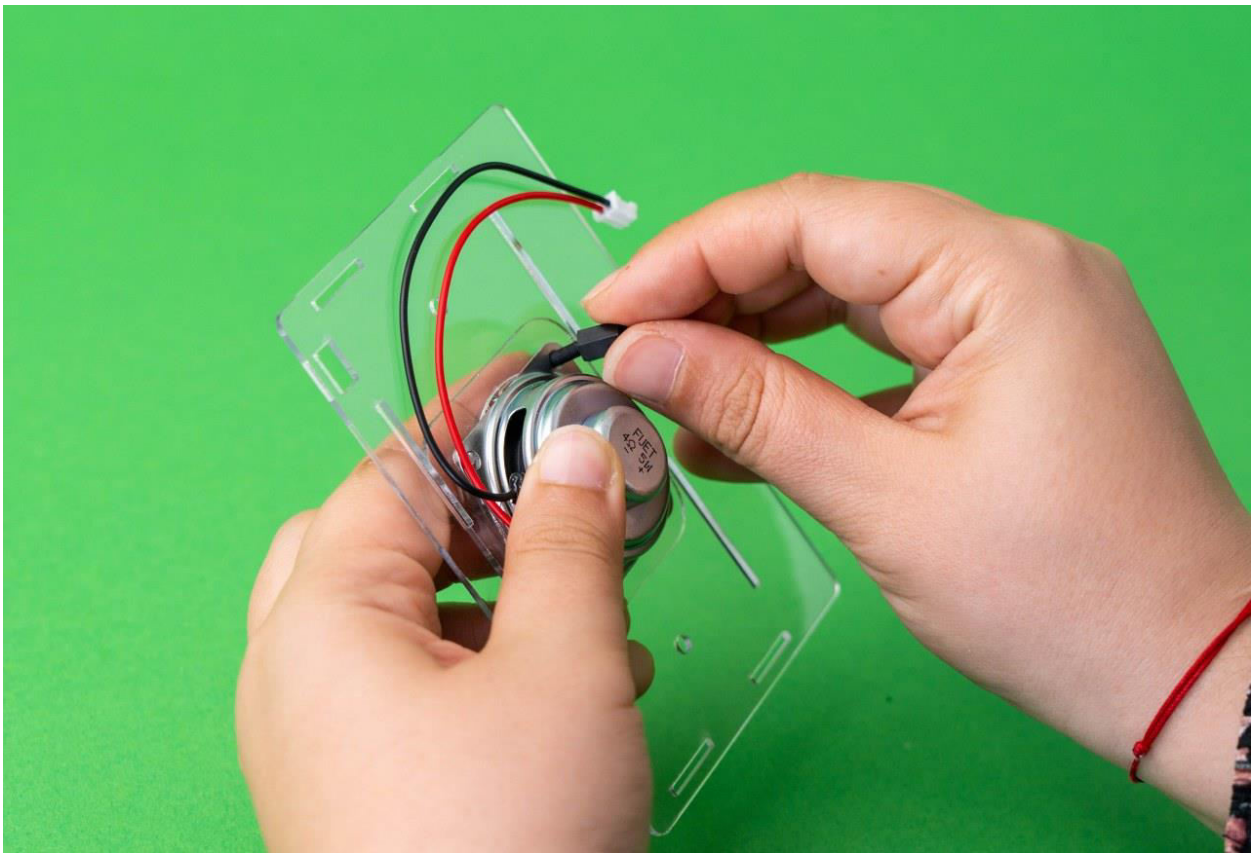
The speaker goes at the back like this:

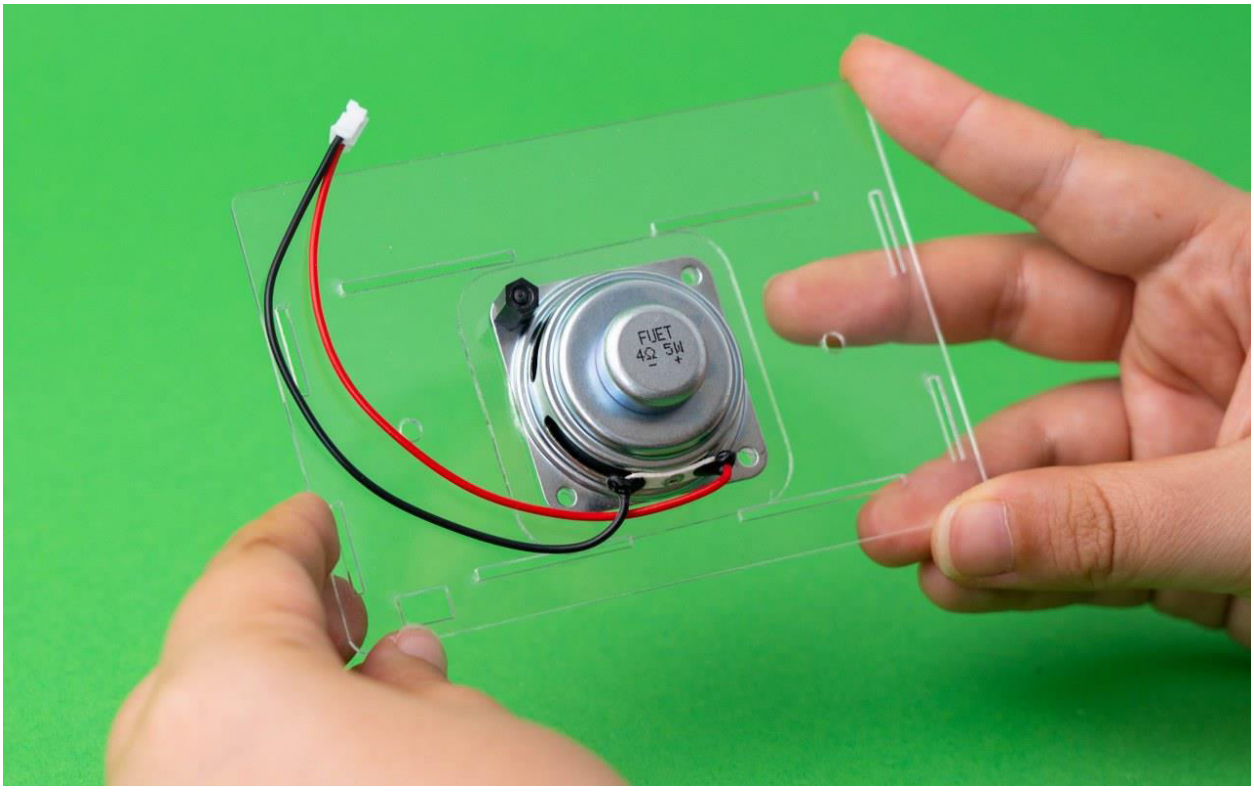


Now, take the four black bolts, and four spacers and place them like this:

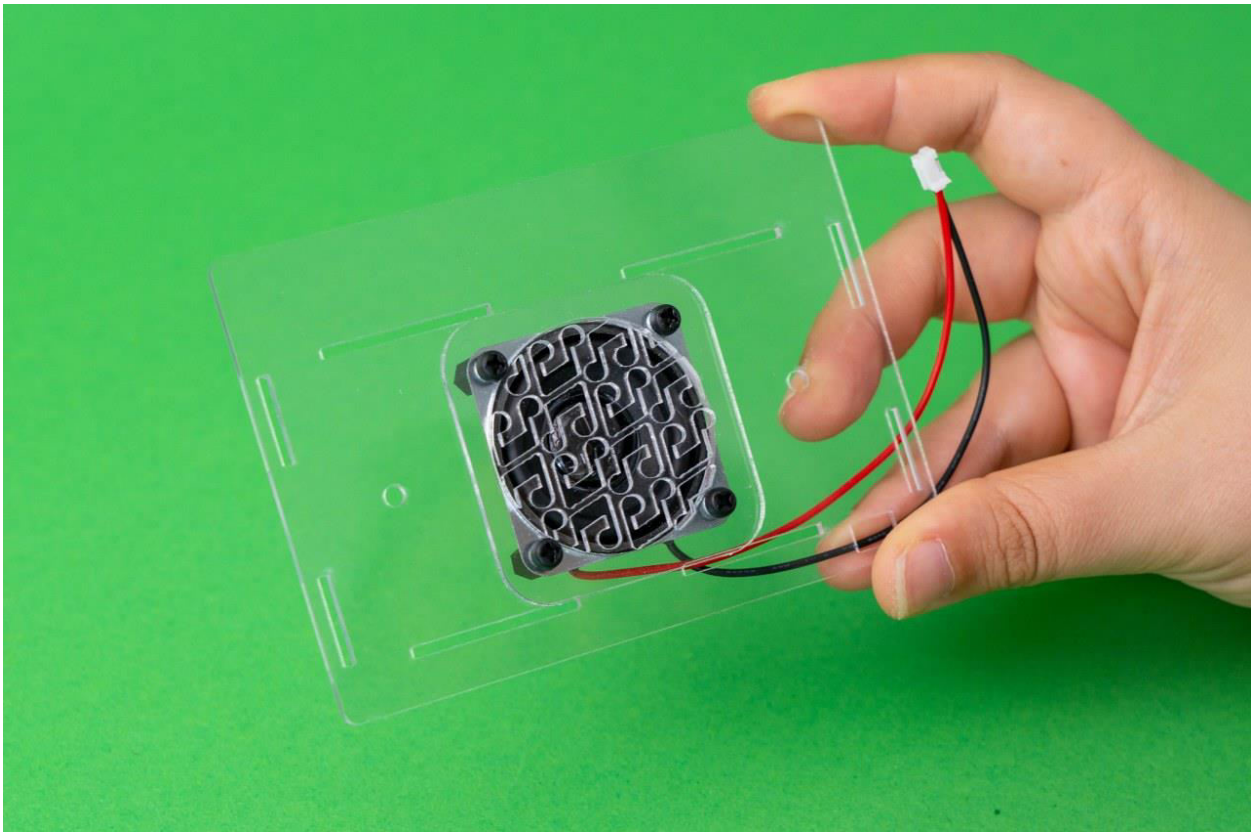


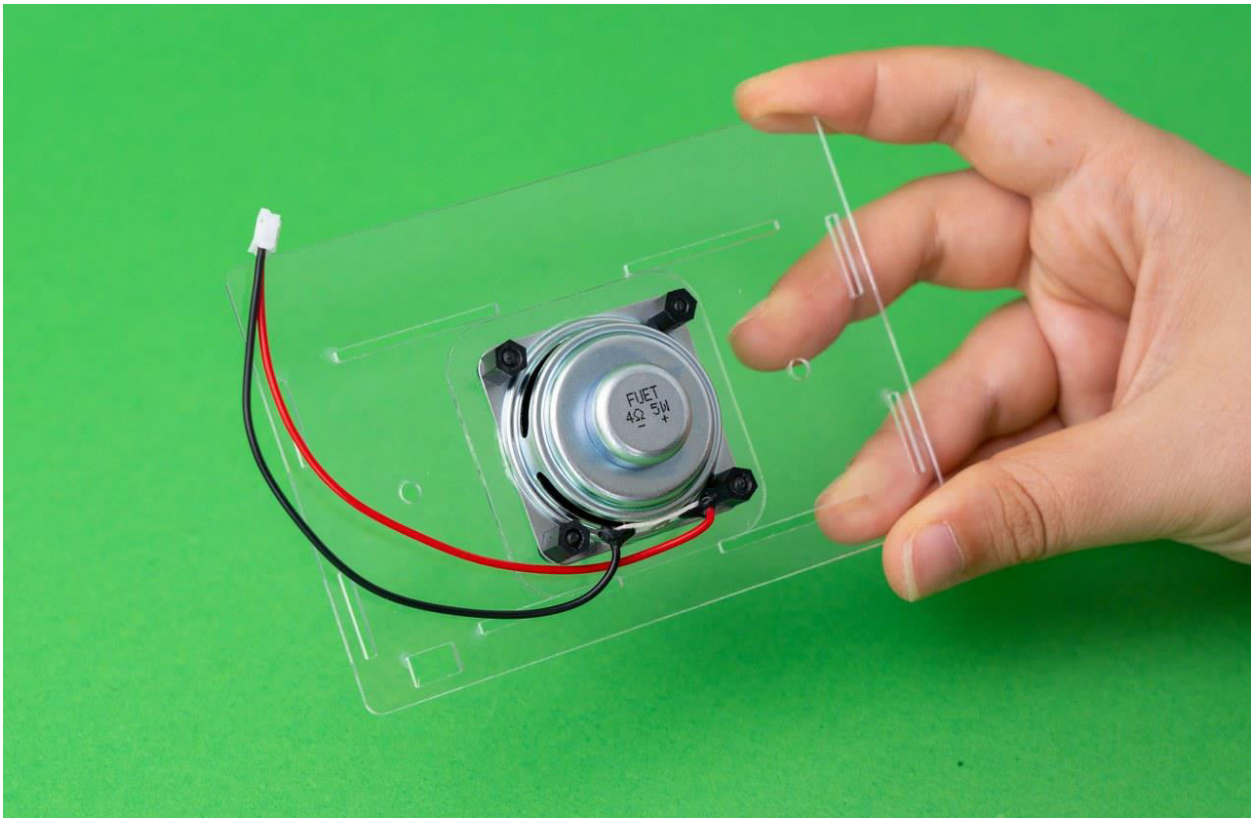
Fasten the spacer with your fingers:





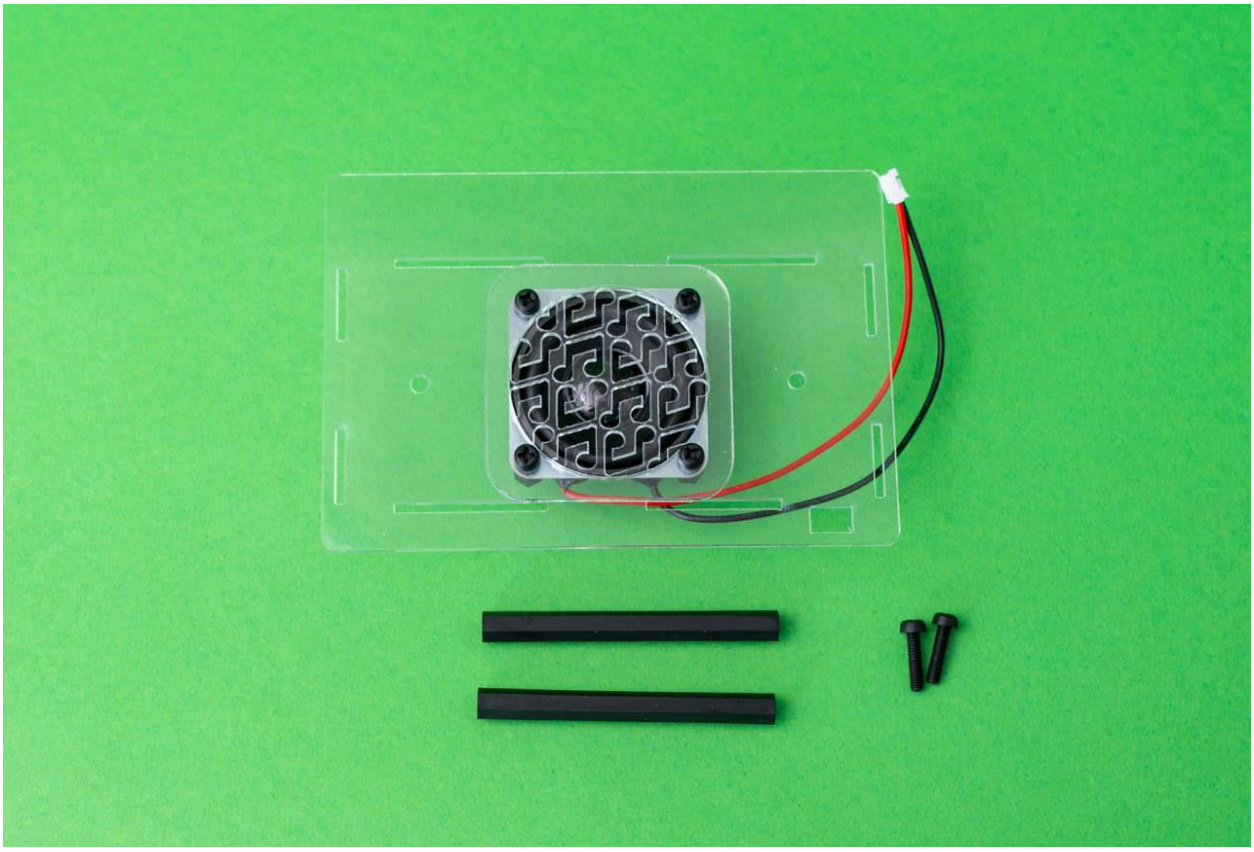
Repeat this process for all four bolts.



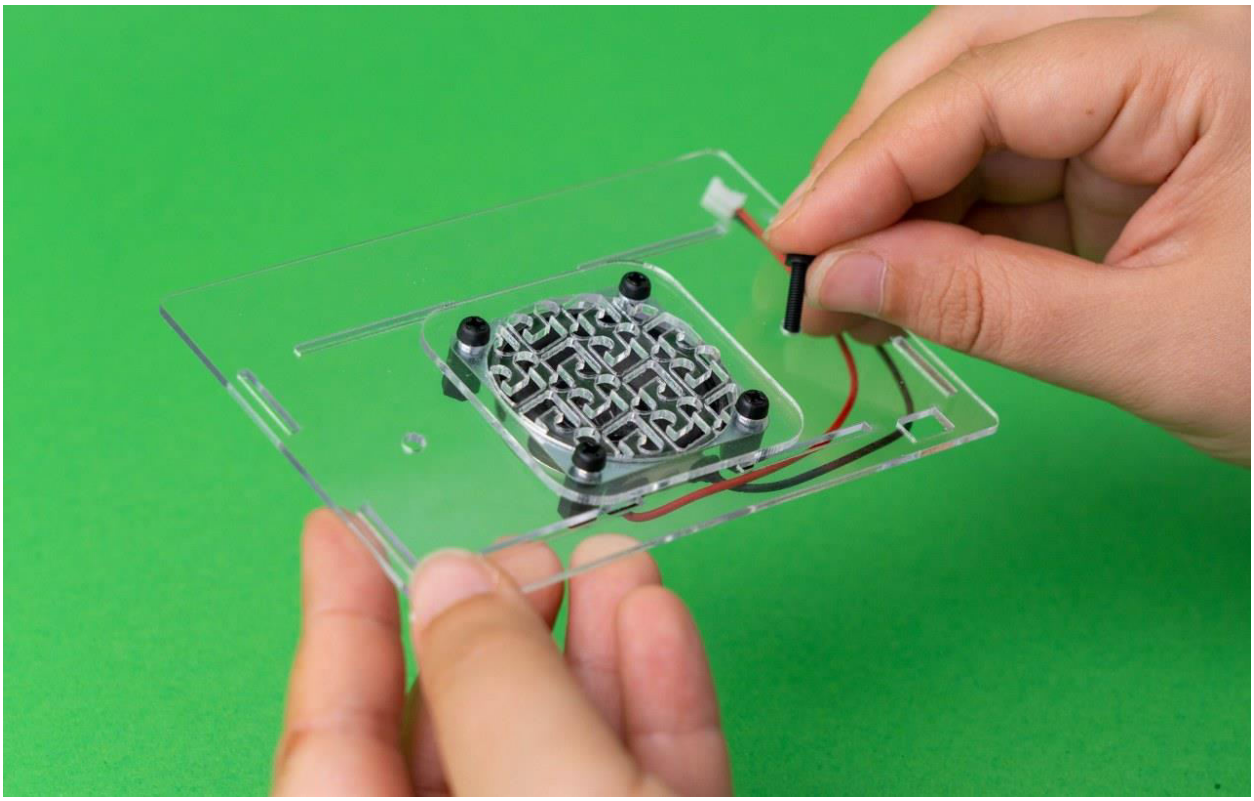

FUET
4Ω 5W

Don't put this casing away yet.

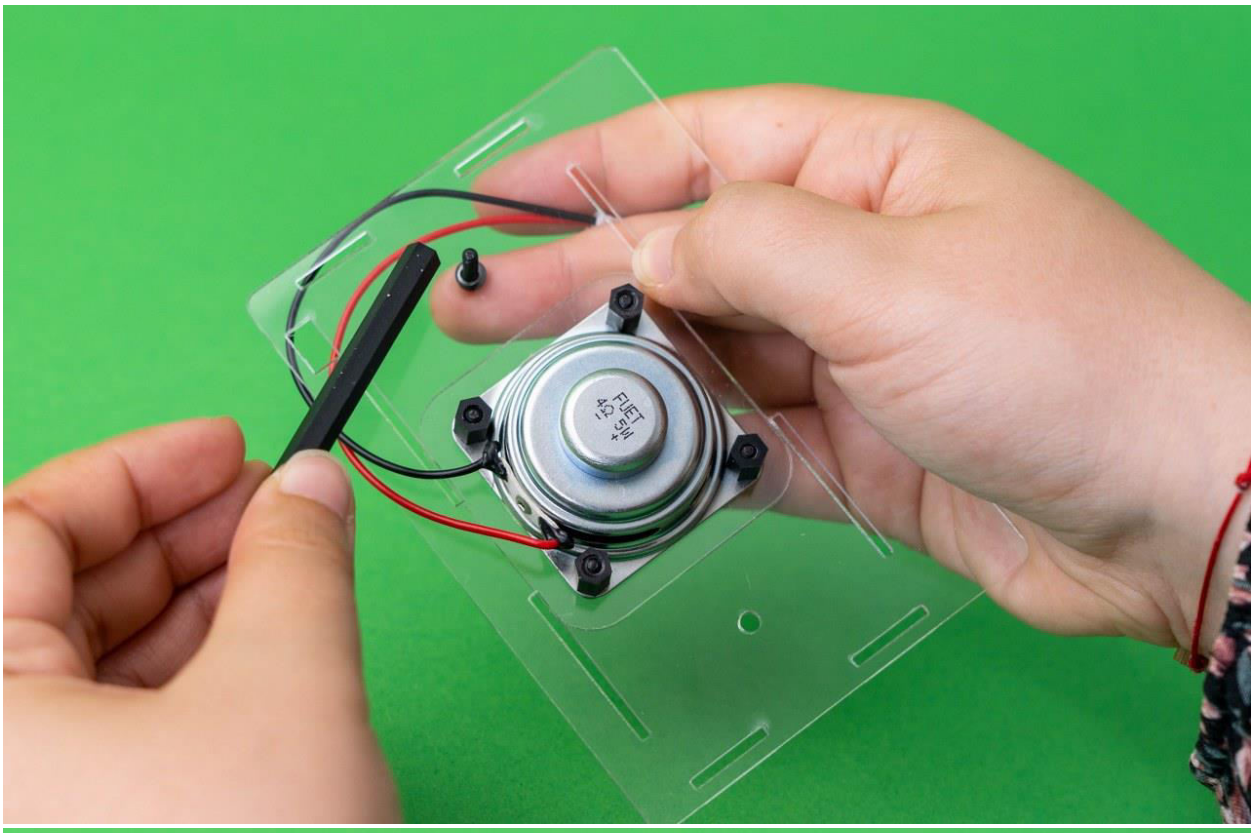
We'll have to take these long spacers and two more black bolts.

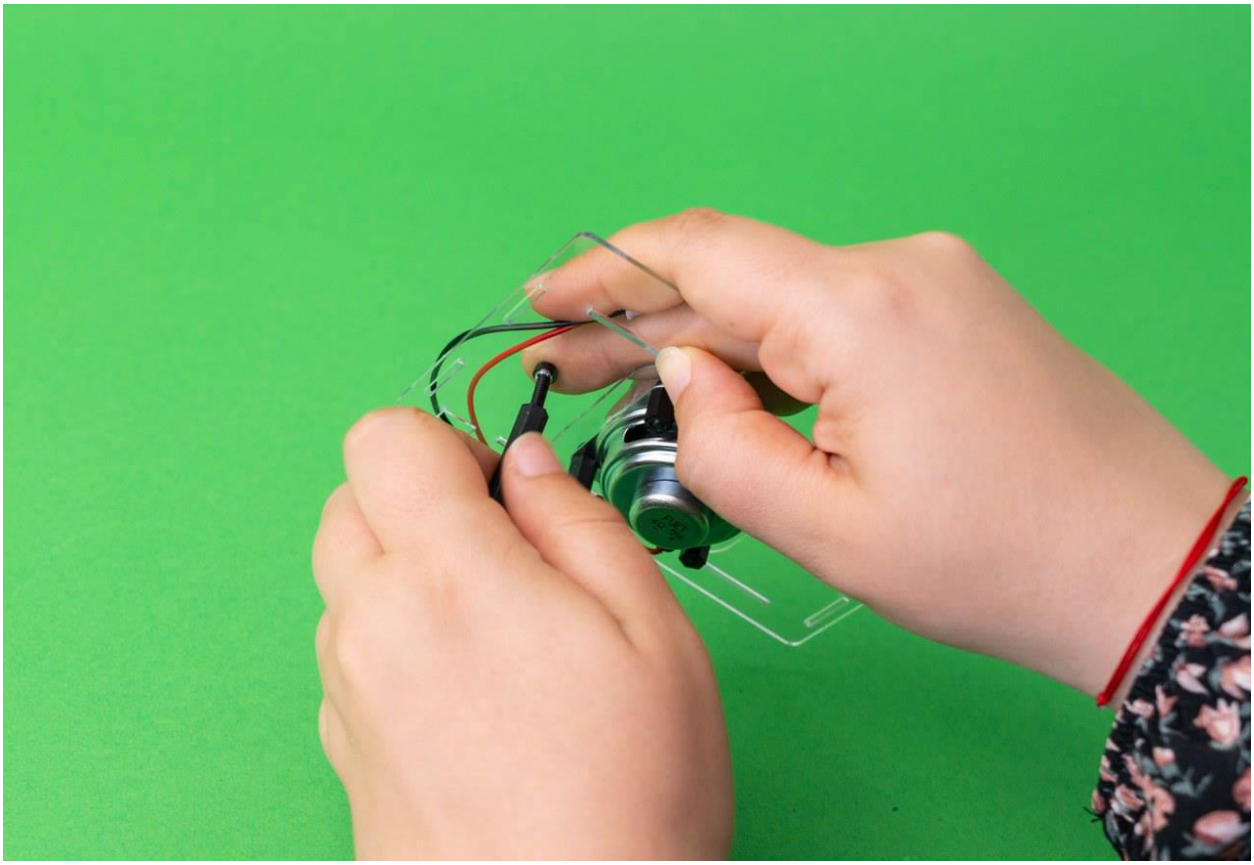


These bolts go from the front side like this:

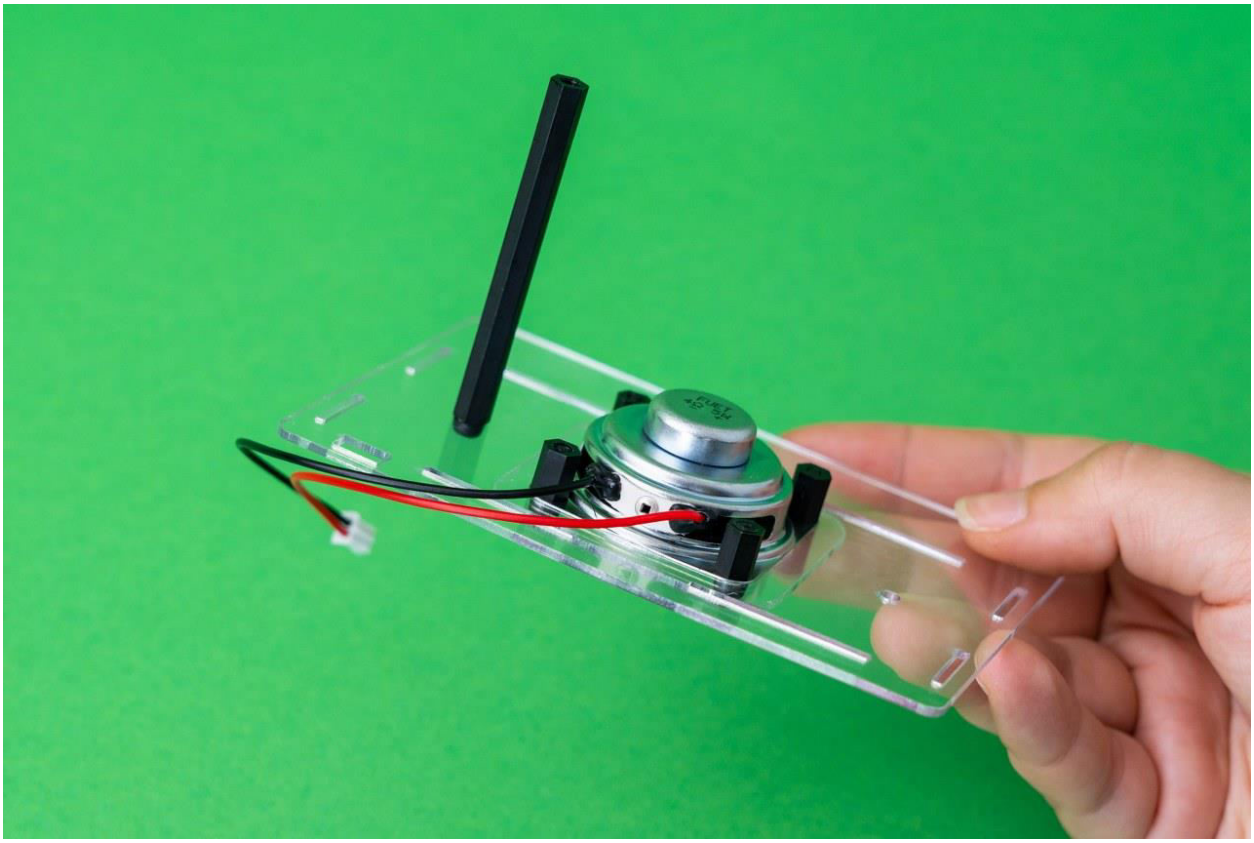


Fasten the spacers with your fingers.

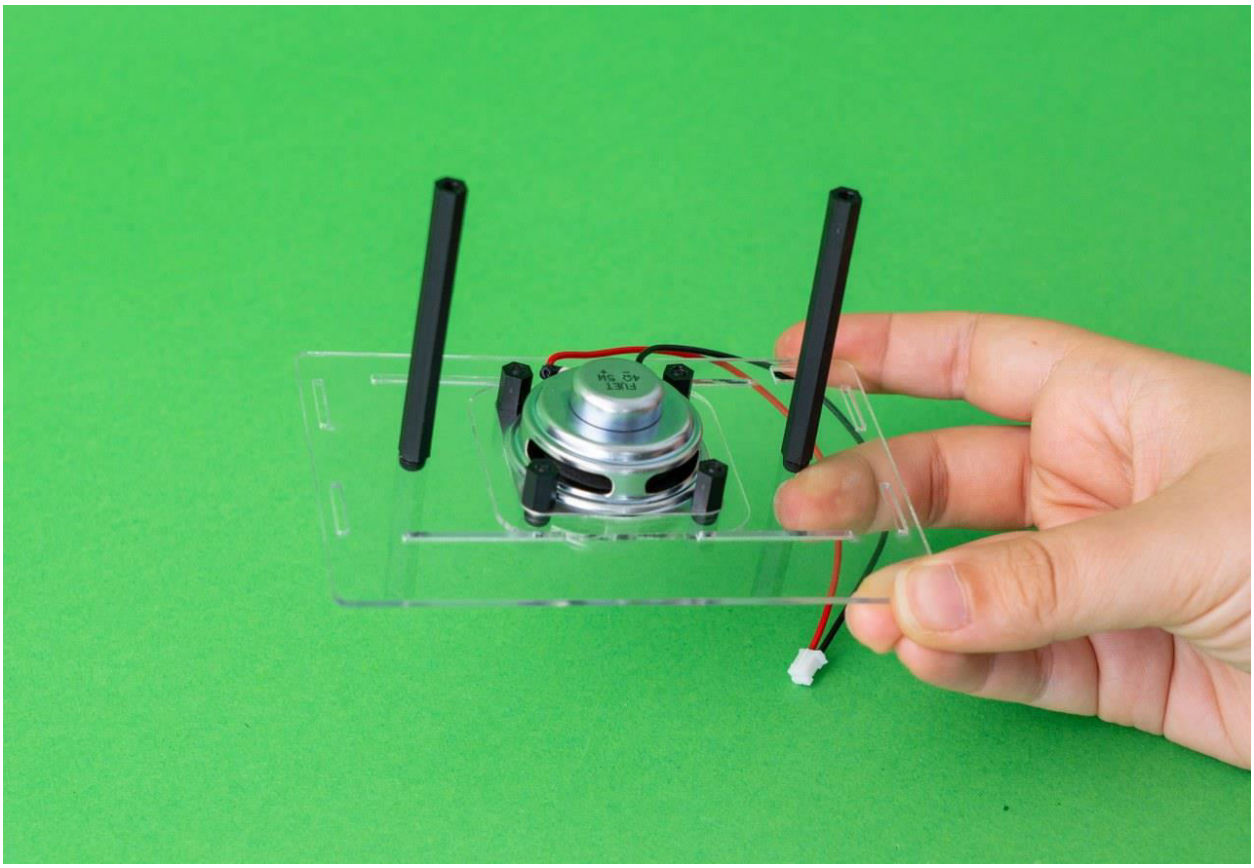

FUET
4Ω 5W



Until it looks like this and nothing's falling off:

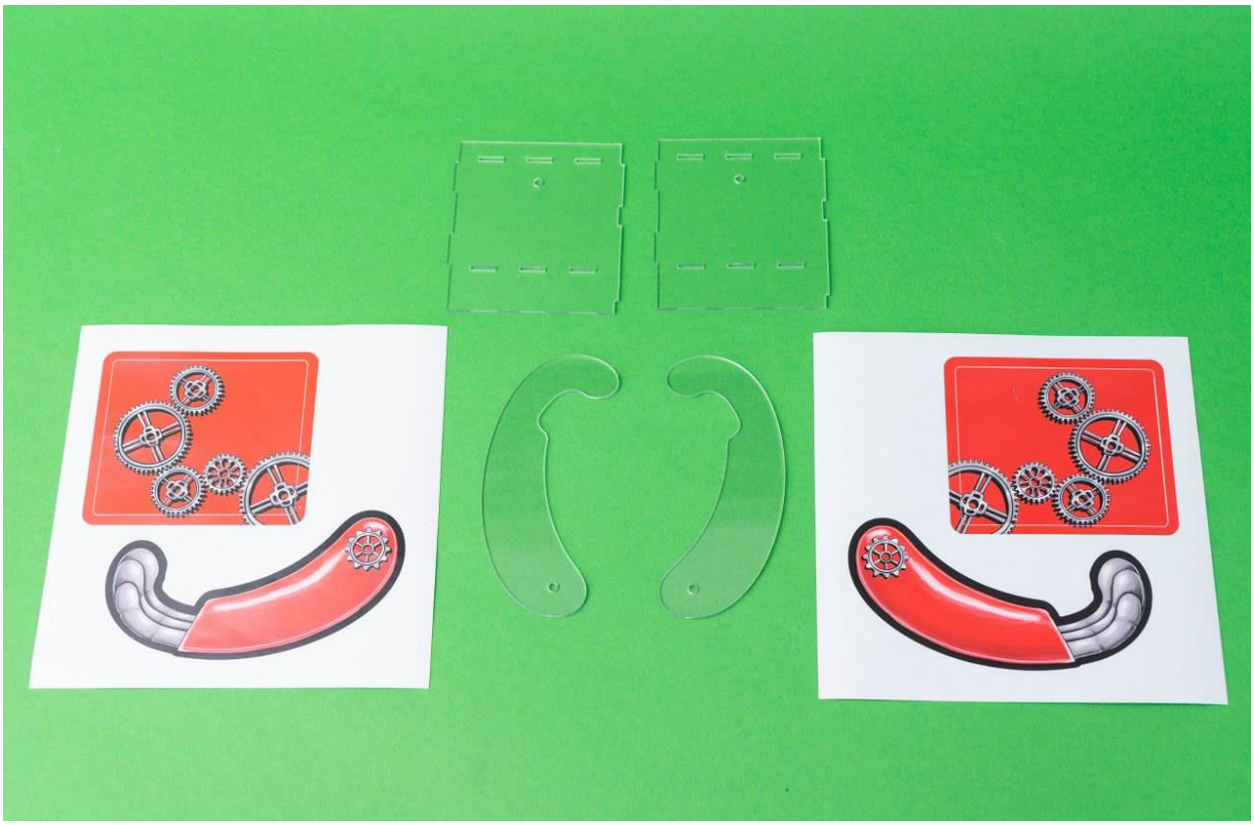


Repeat this step for the second spacer/bolt:



Now, the fun part - the stickers!

Find these components:



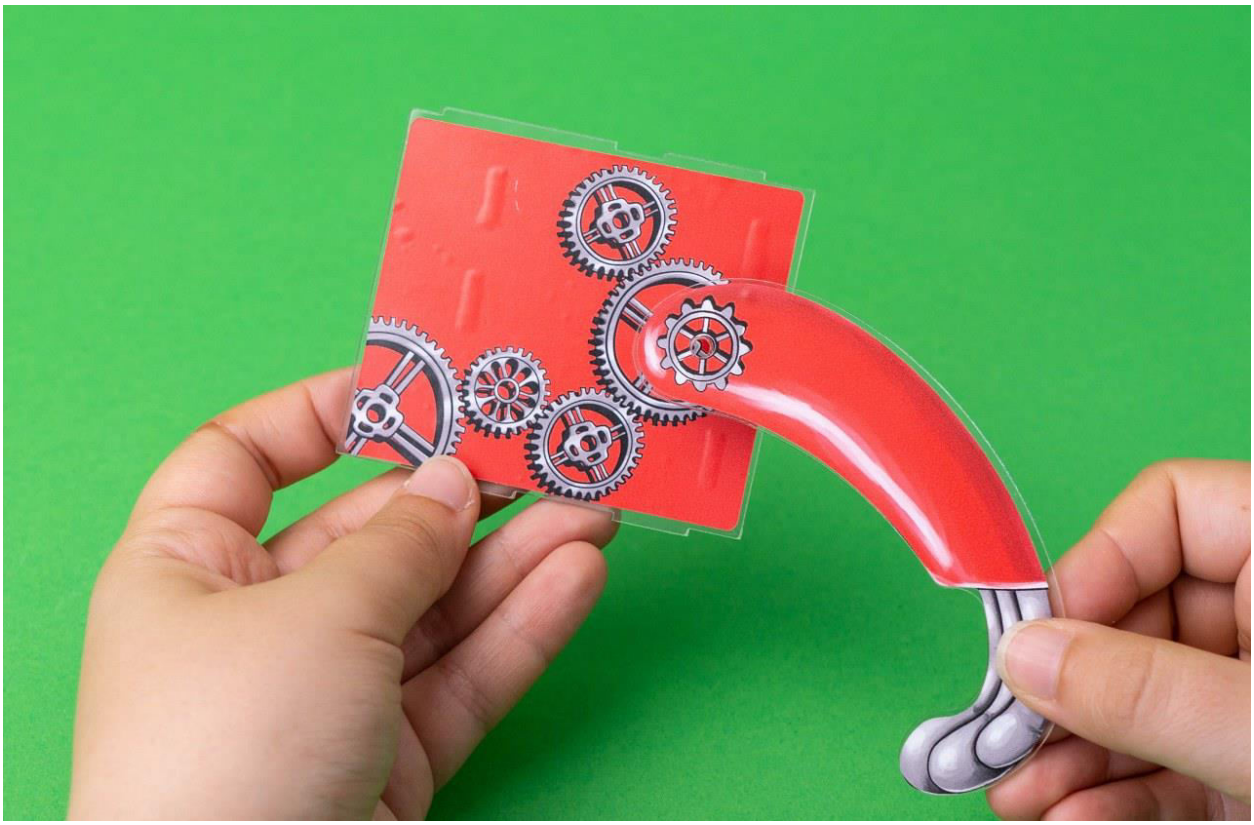
Peel the stickers from the paper and start playing with it.

Make sure that you put it on the right side.

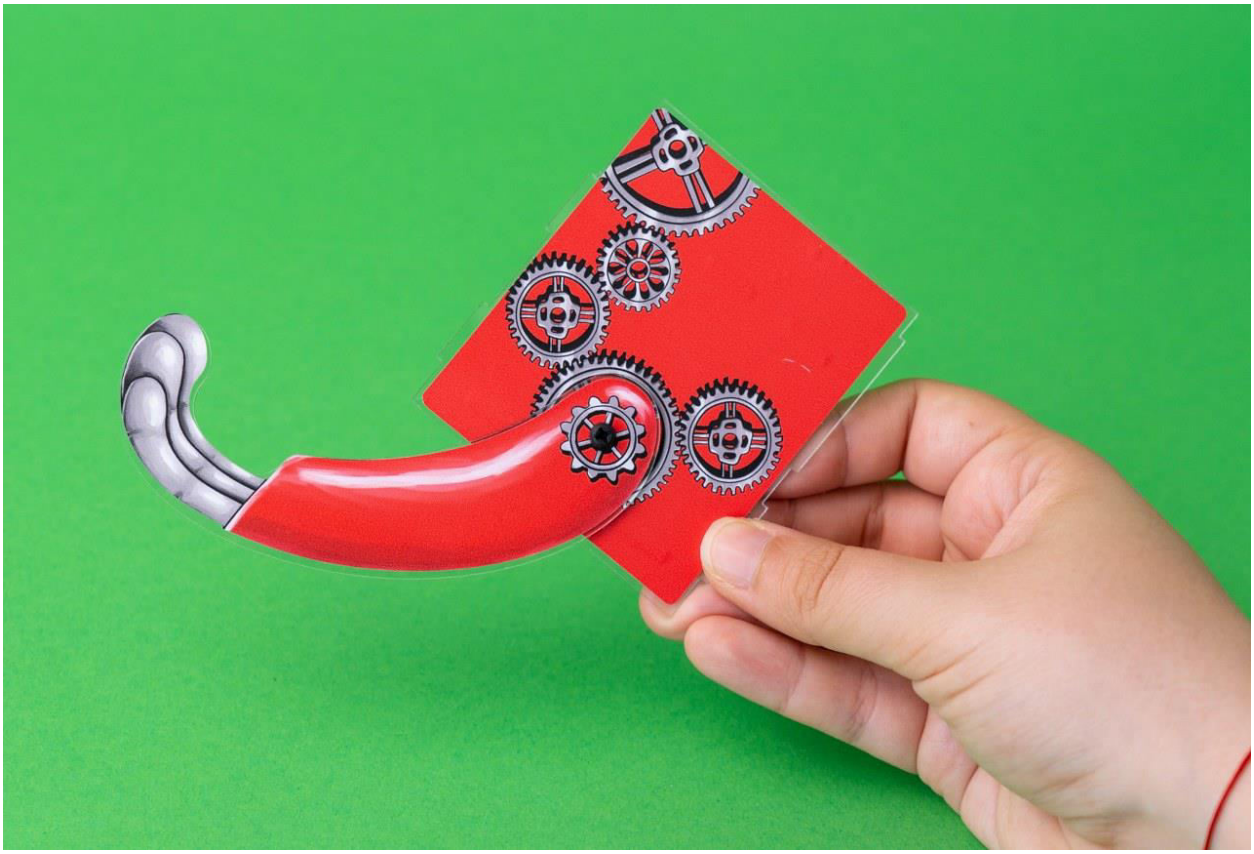
Check the photo below:

Let's assemble the parts with the stickers.

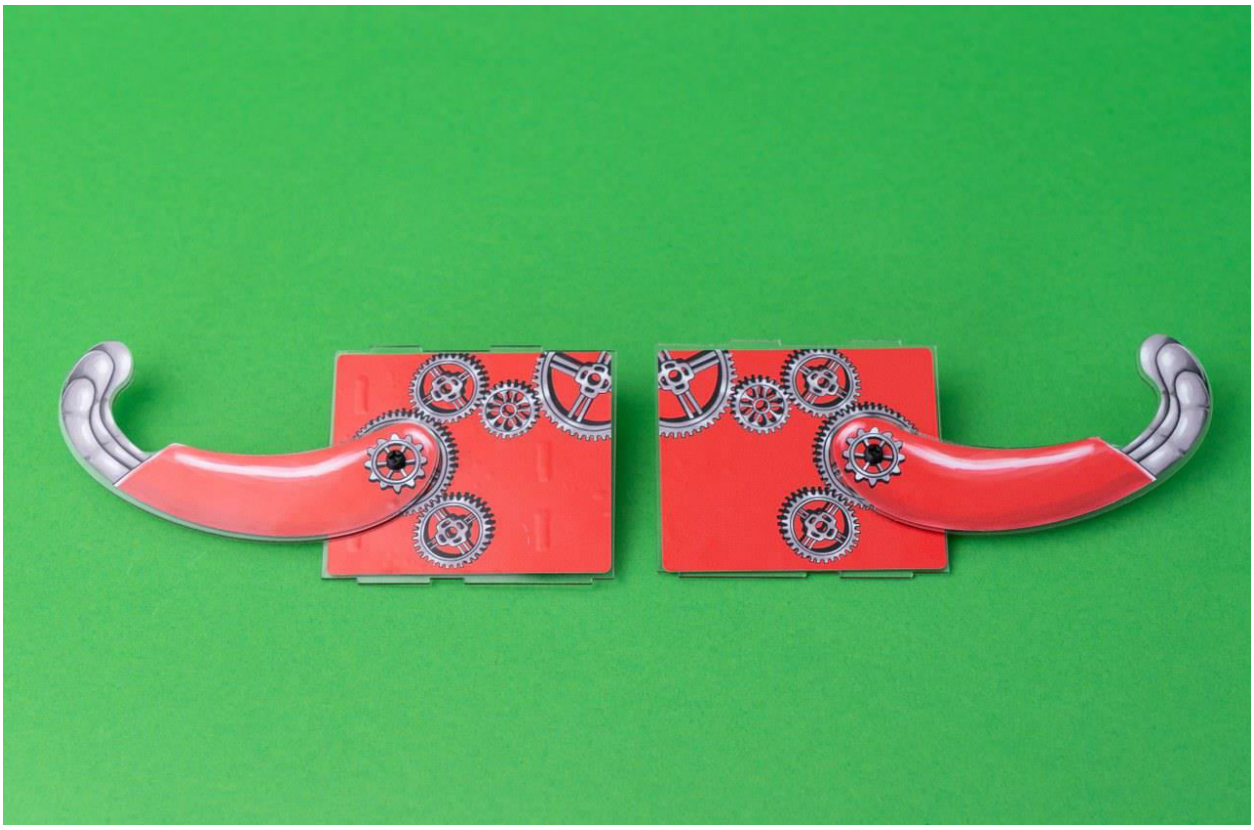
These parts go one over another like this:



Take the bolts and the spacers and fasten it:

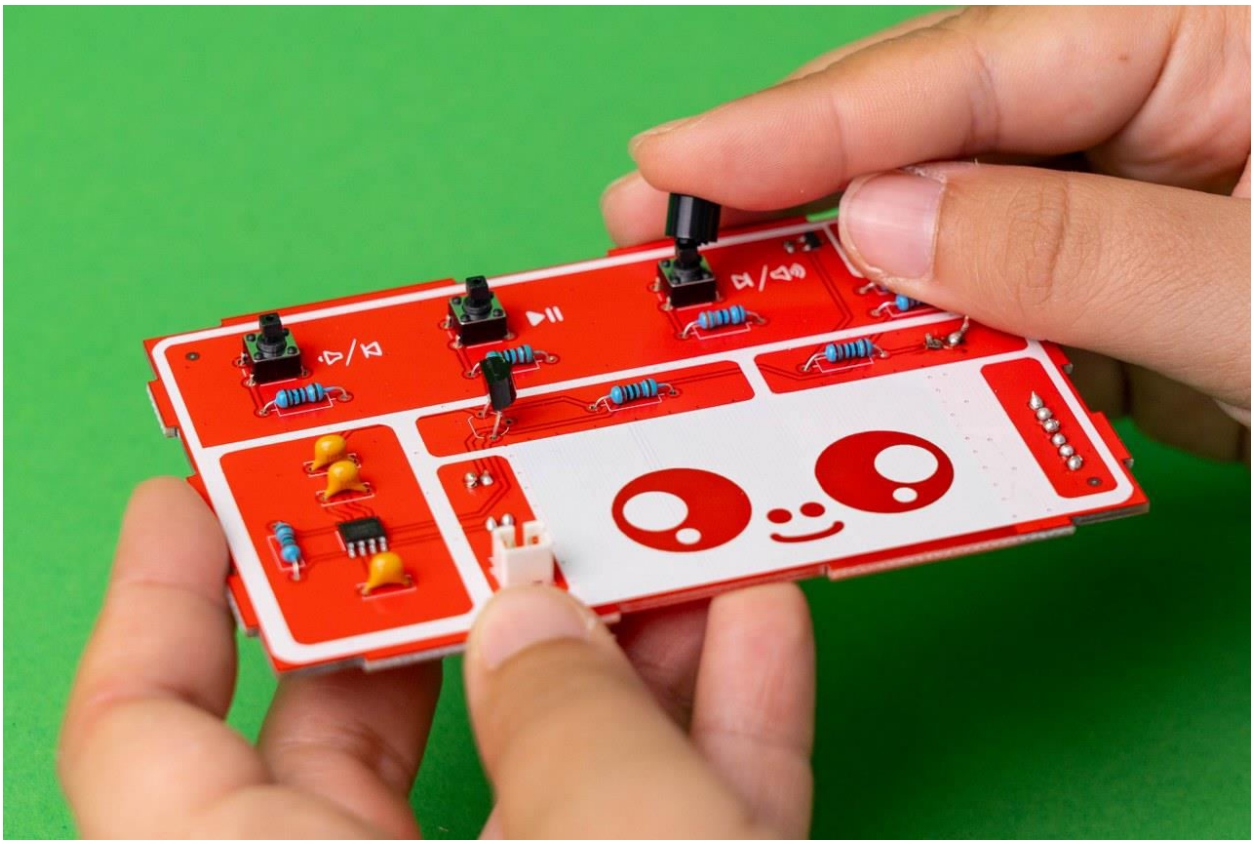


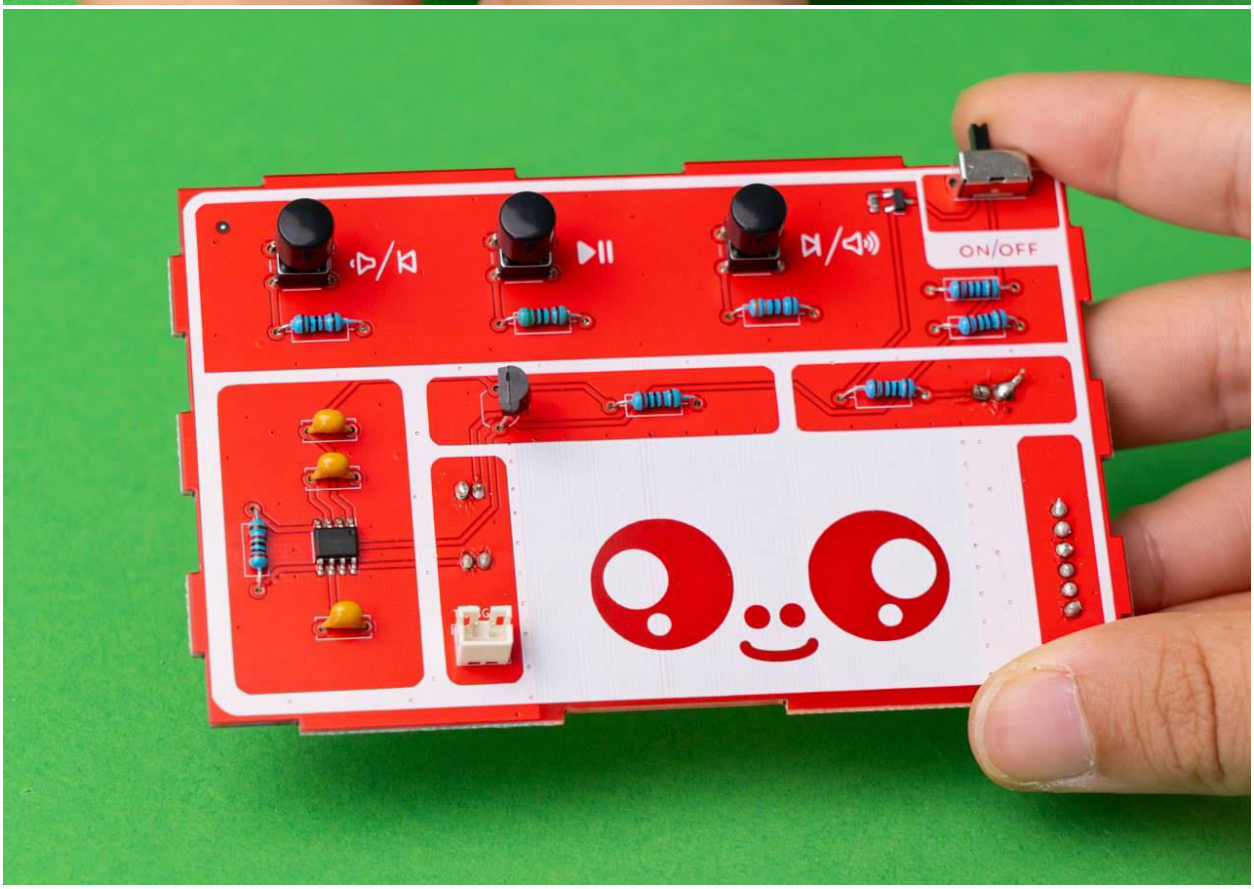
Repeat this process:



Make sure that your parts are looking just like ours.

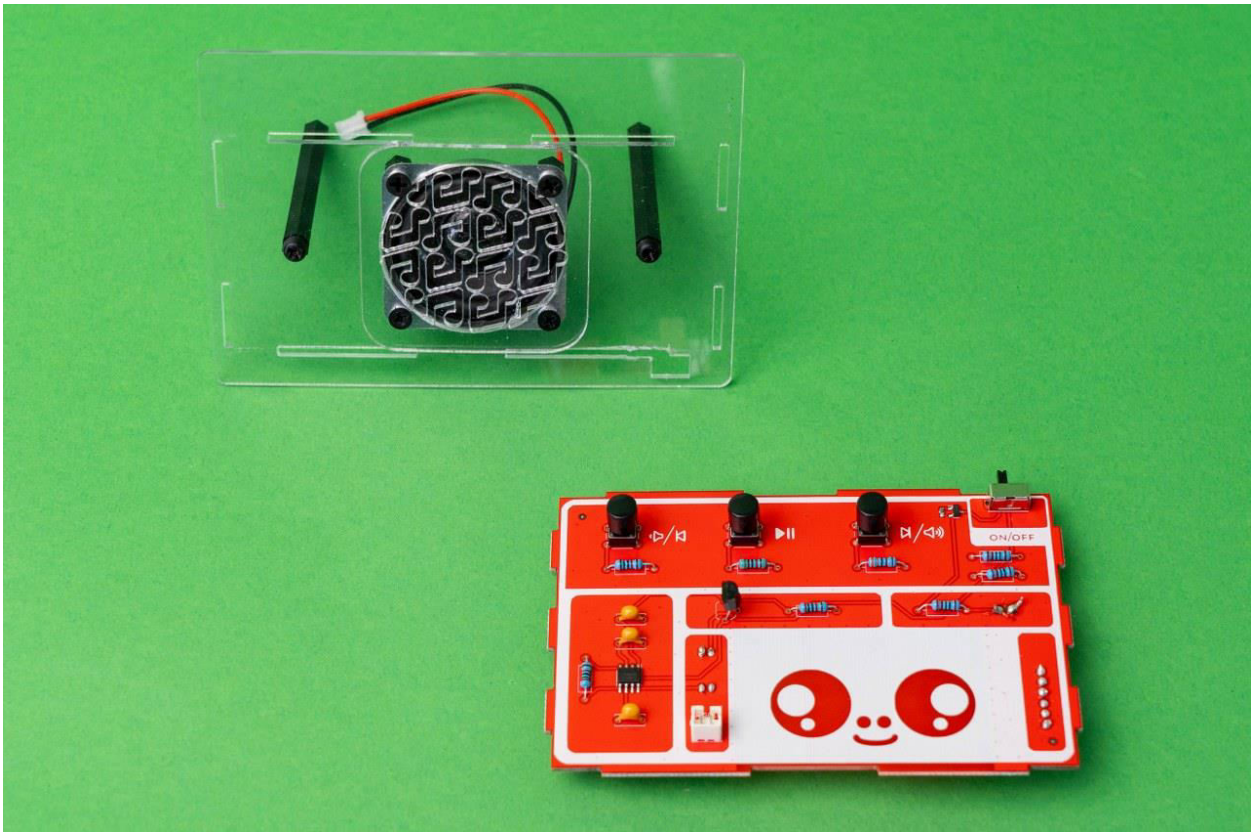
Now, find the three pushbutton caps and place them on top of each pushbutton:



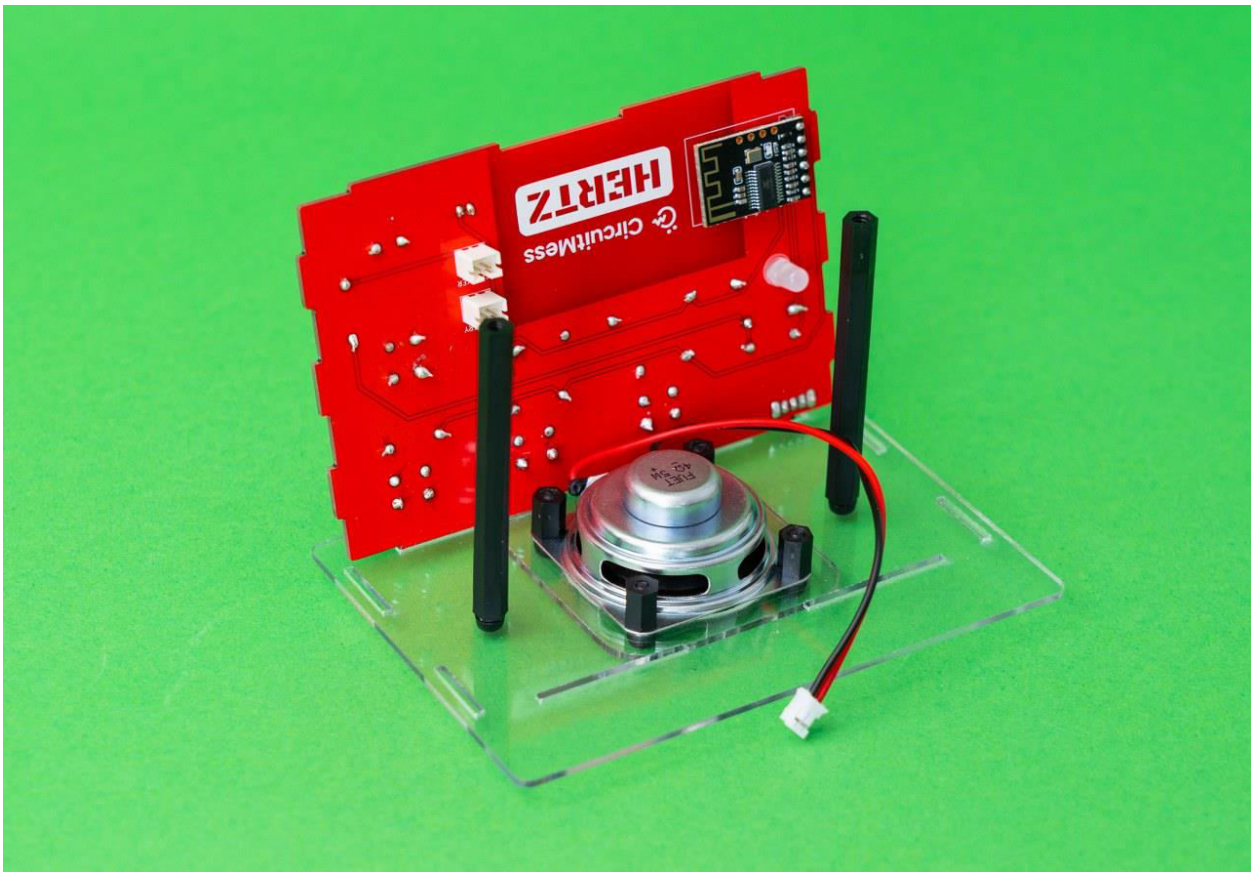

ON/OFF

This will ensure that you don't hurt your fingers while playing the music.

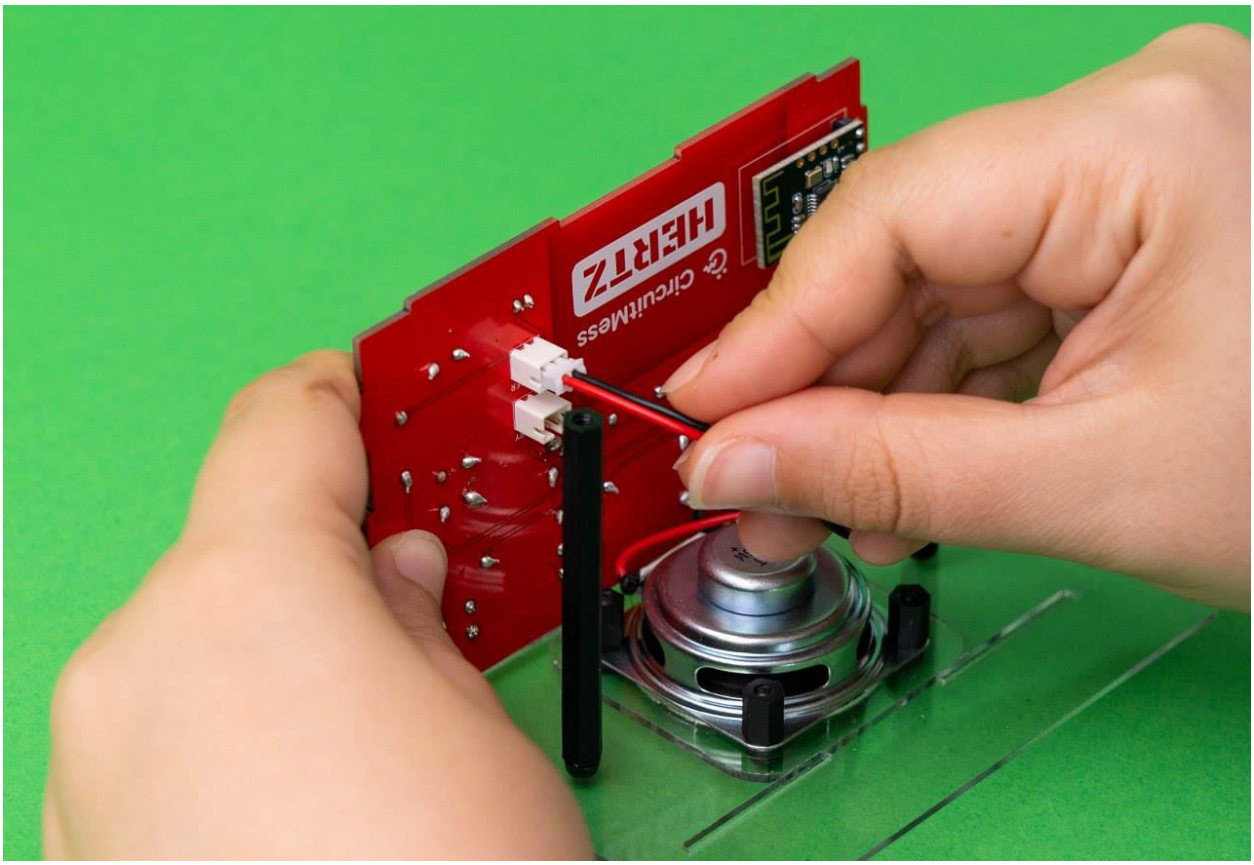
Take these two parts:

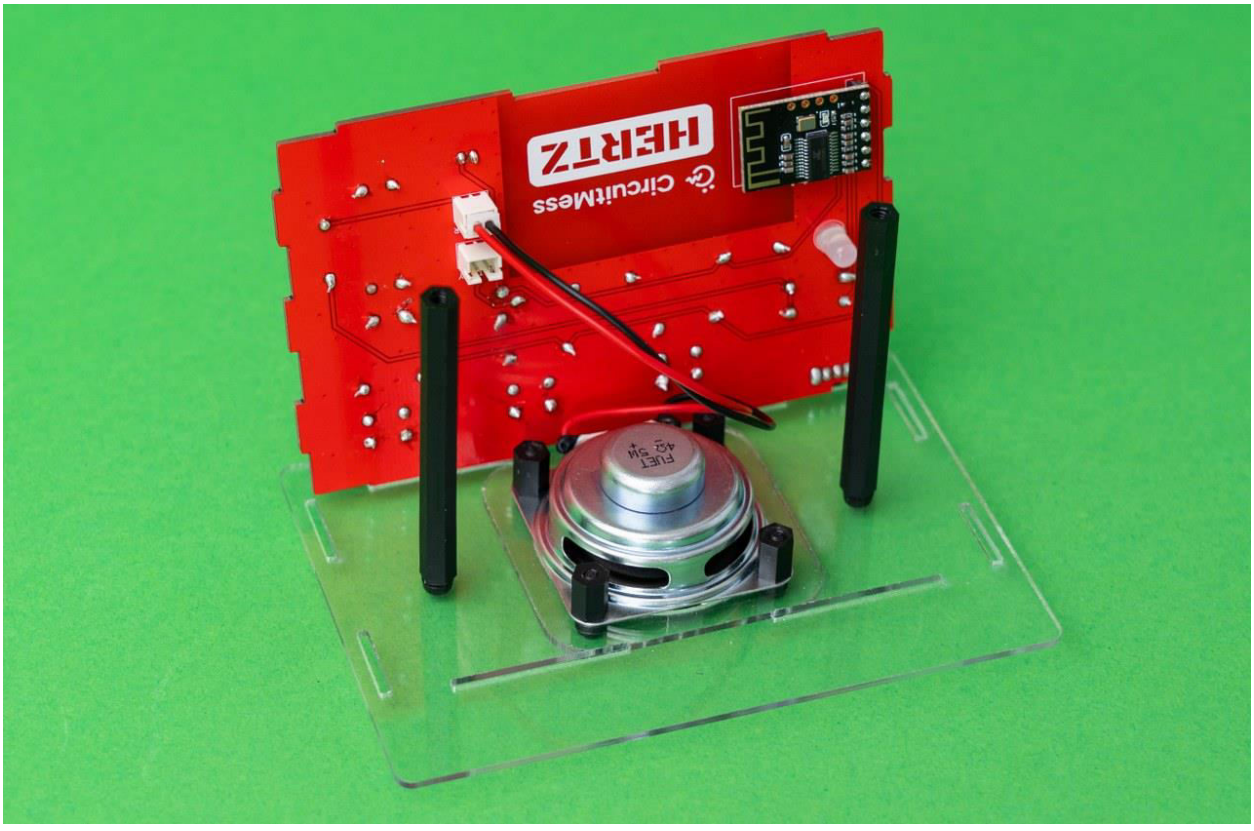


And place them like this:

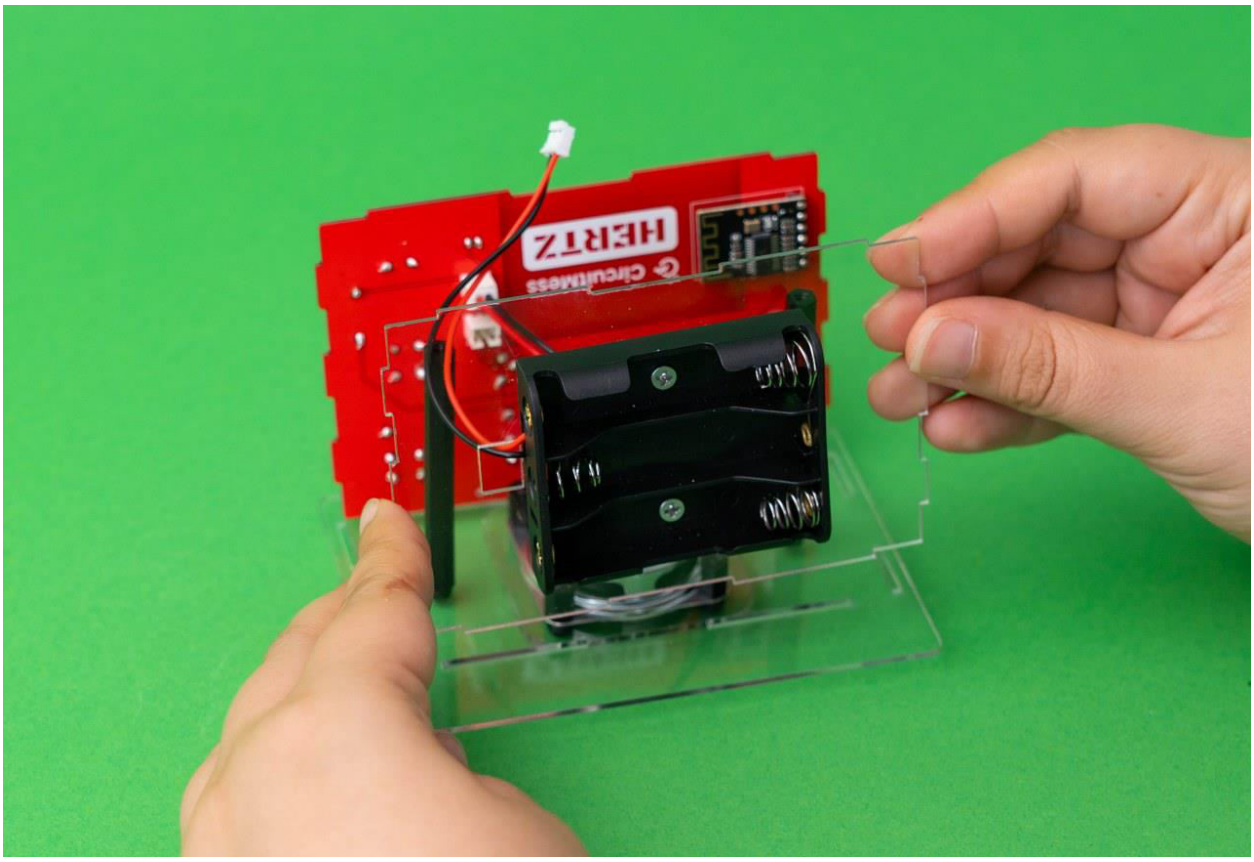


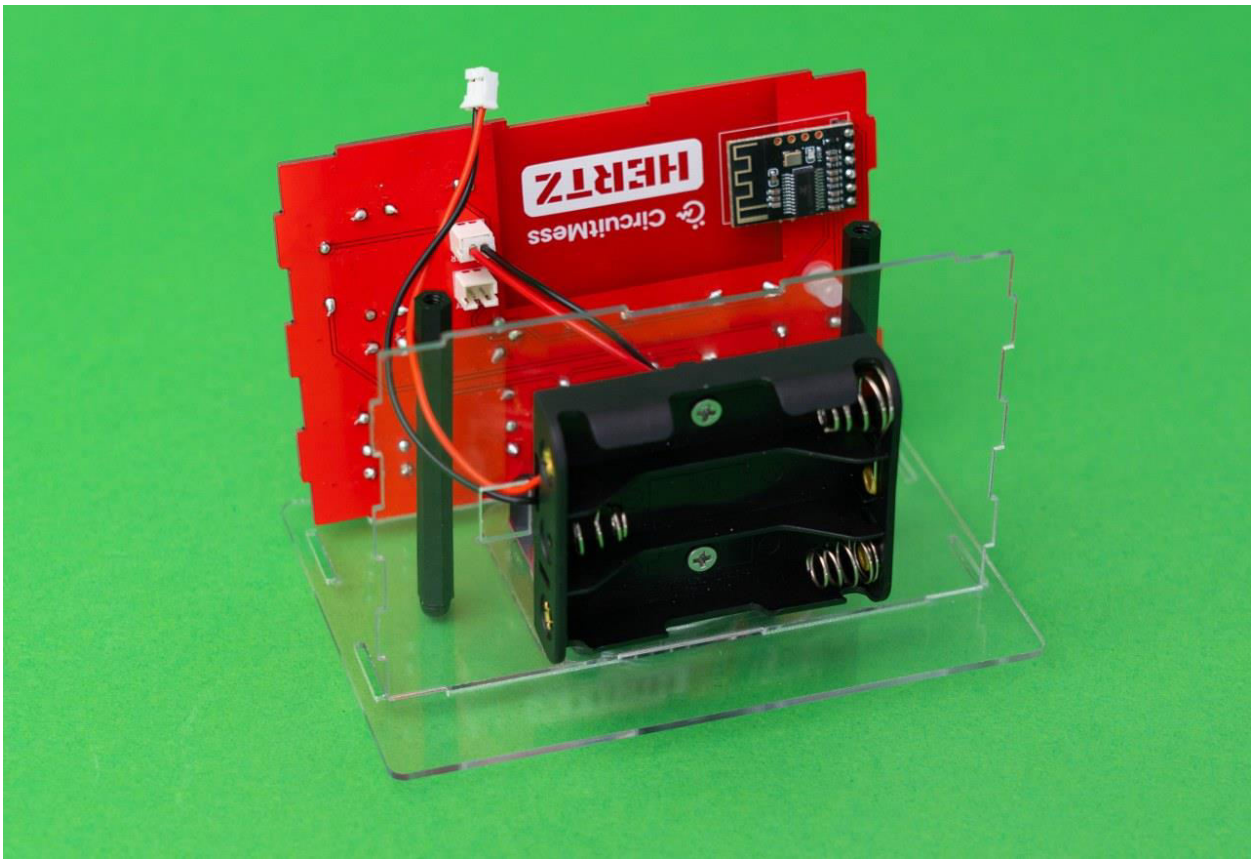
Connect the speaker's wire to the port labeled "Speaker".


HERTZ
CircuitMess

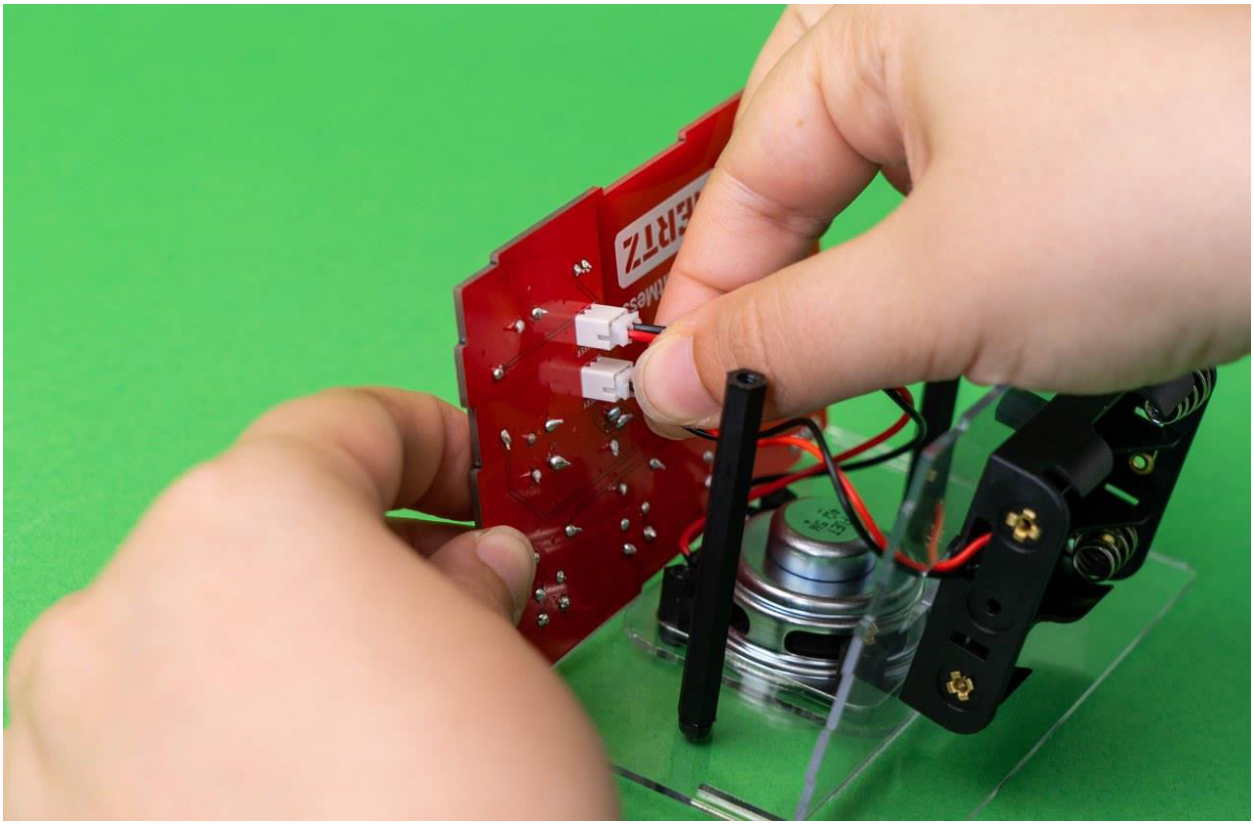

HERTZ
CircuitMess

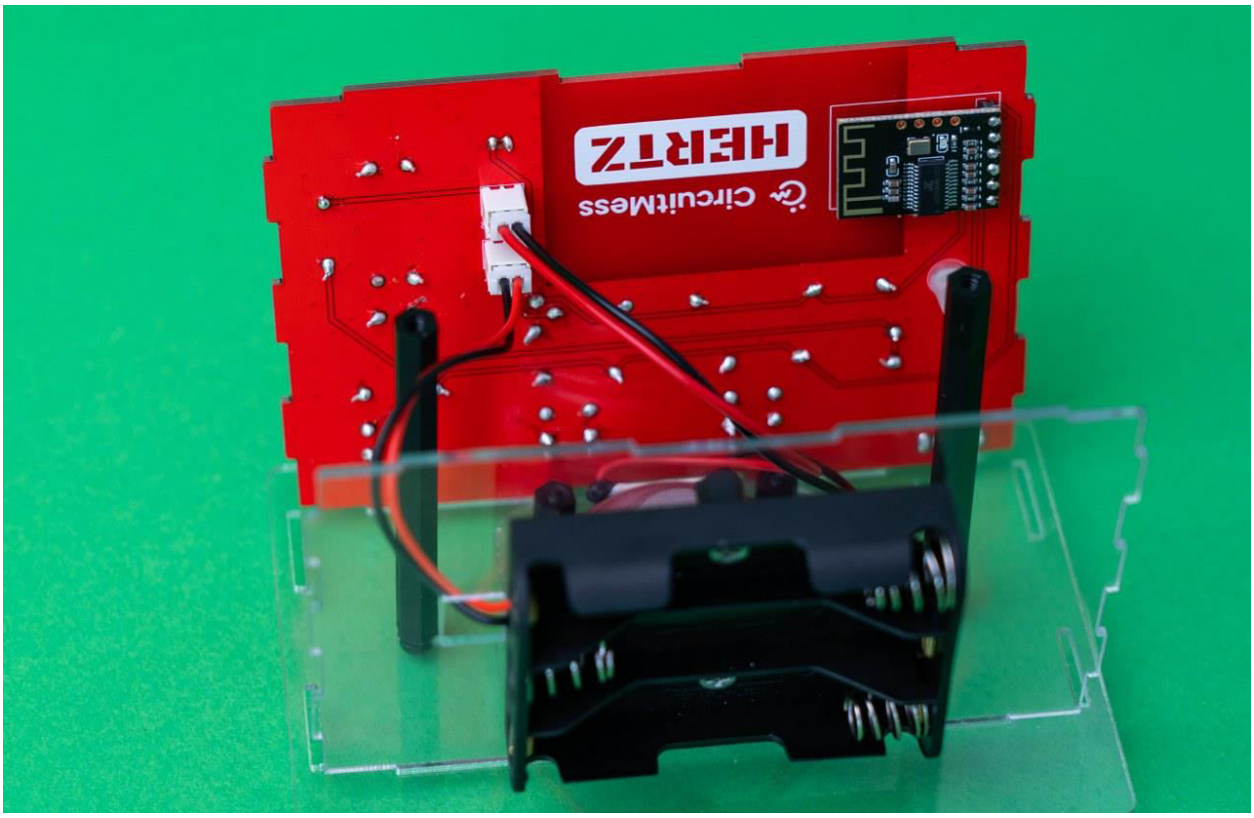
The casing with the battery holder goes here:





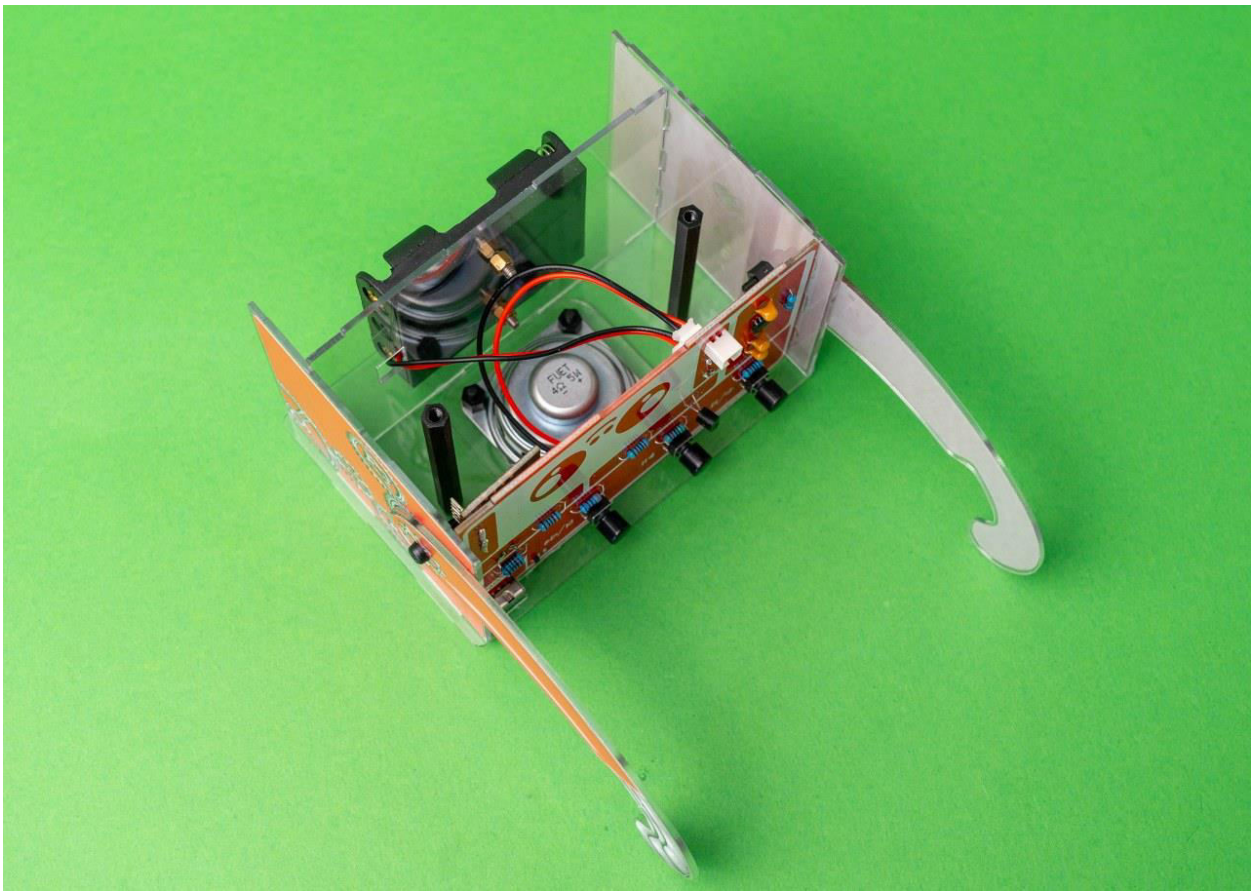
Connect the battery holder's wire to the port labeled "Battery holder".



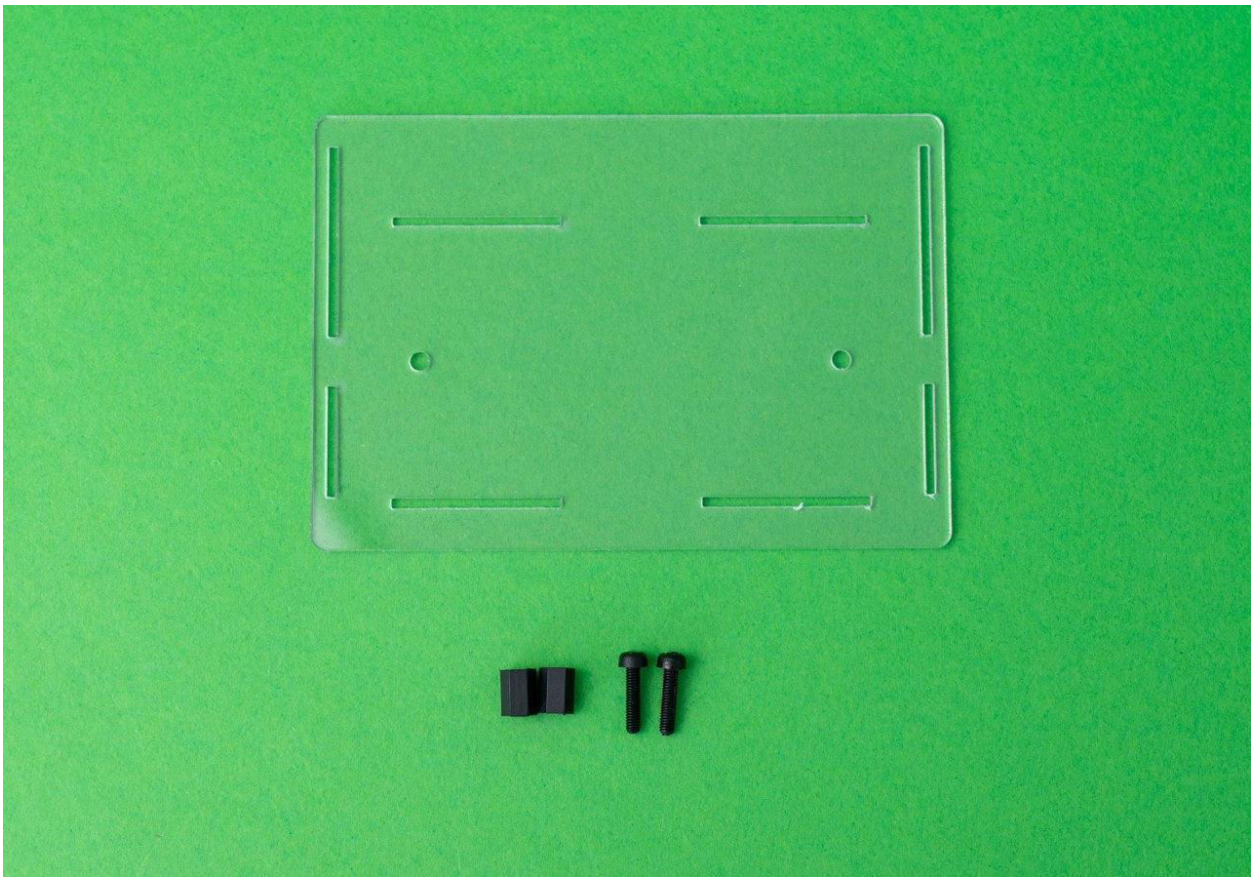


Add the casings with the stickers on the side.

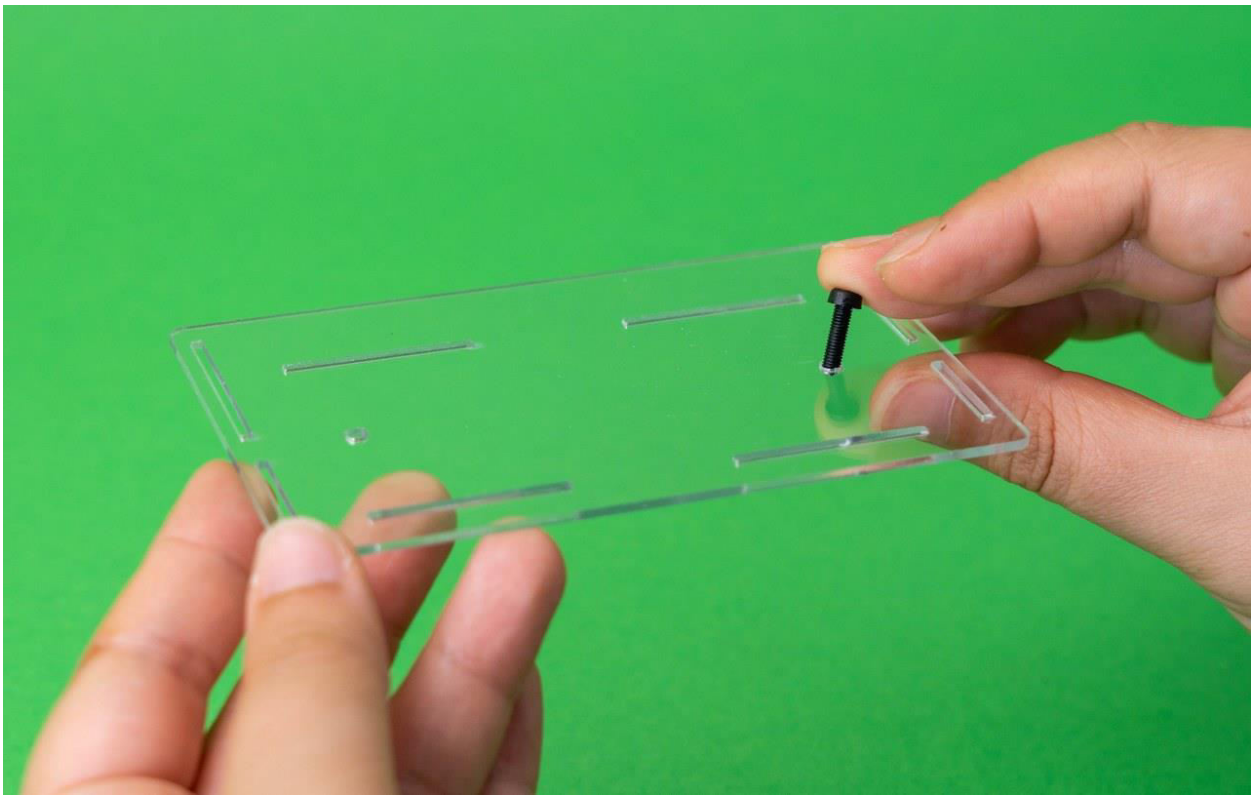
Make sure that they are positioned just like this:



Now, take the last casing, two bolts, and two spacers.

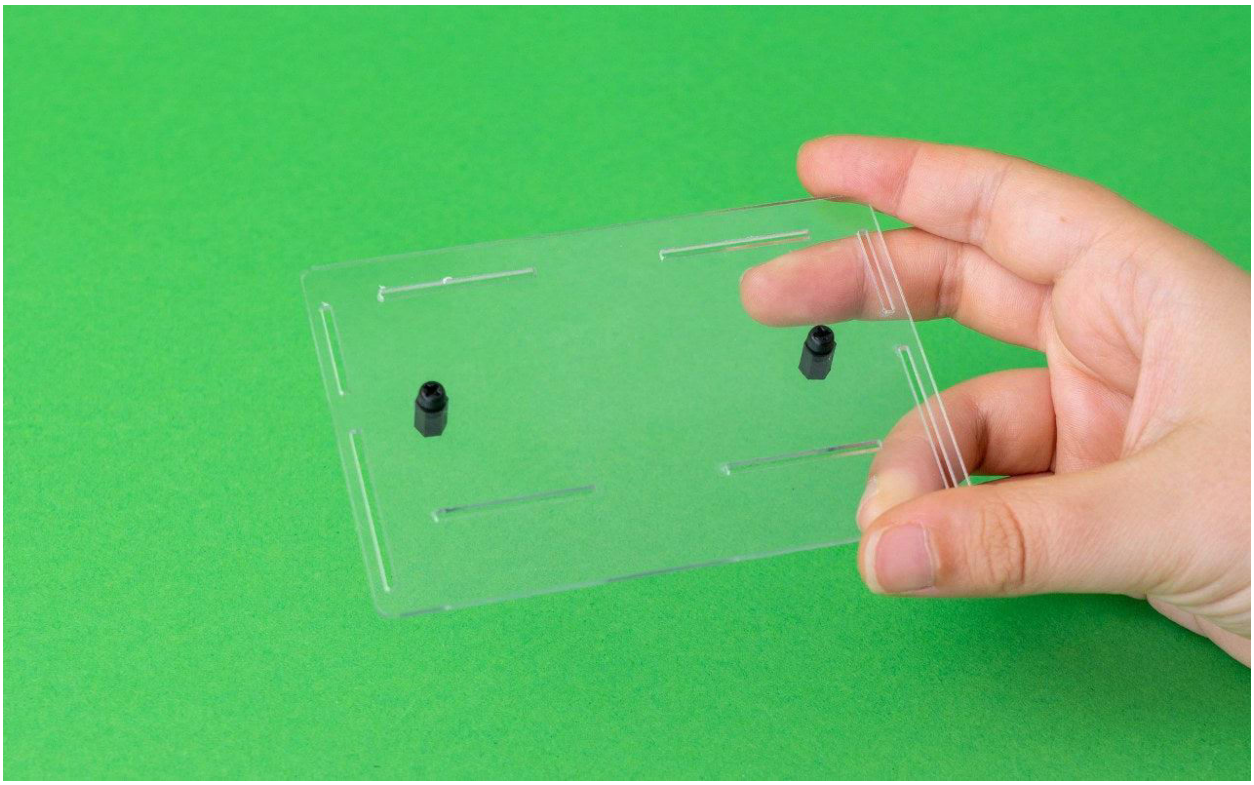


Place the bolts like this:

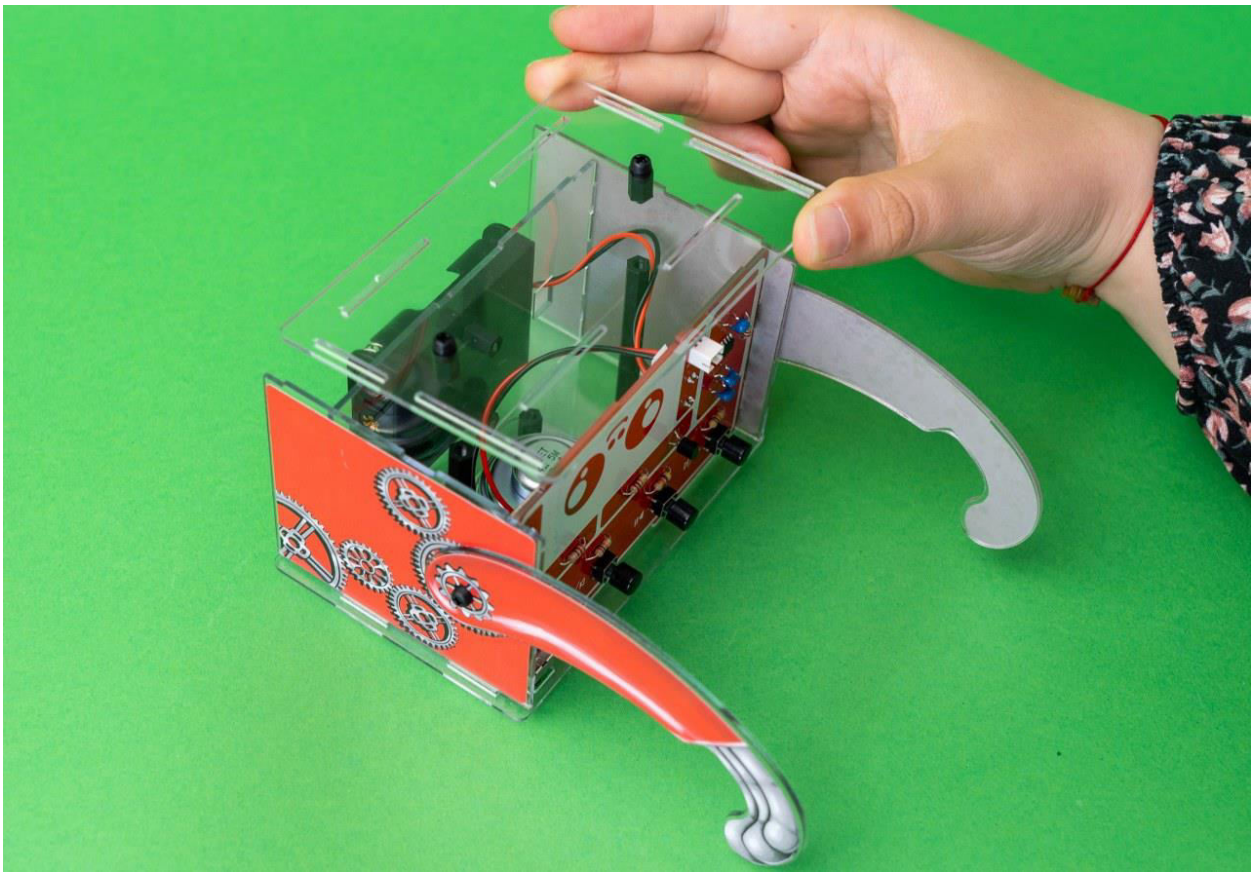


Add the spacers, and fasten them with your fingers:

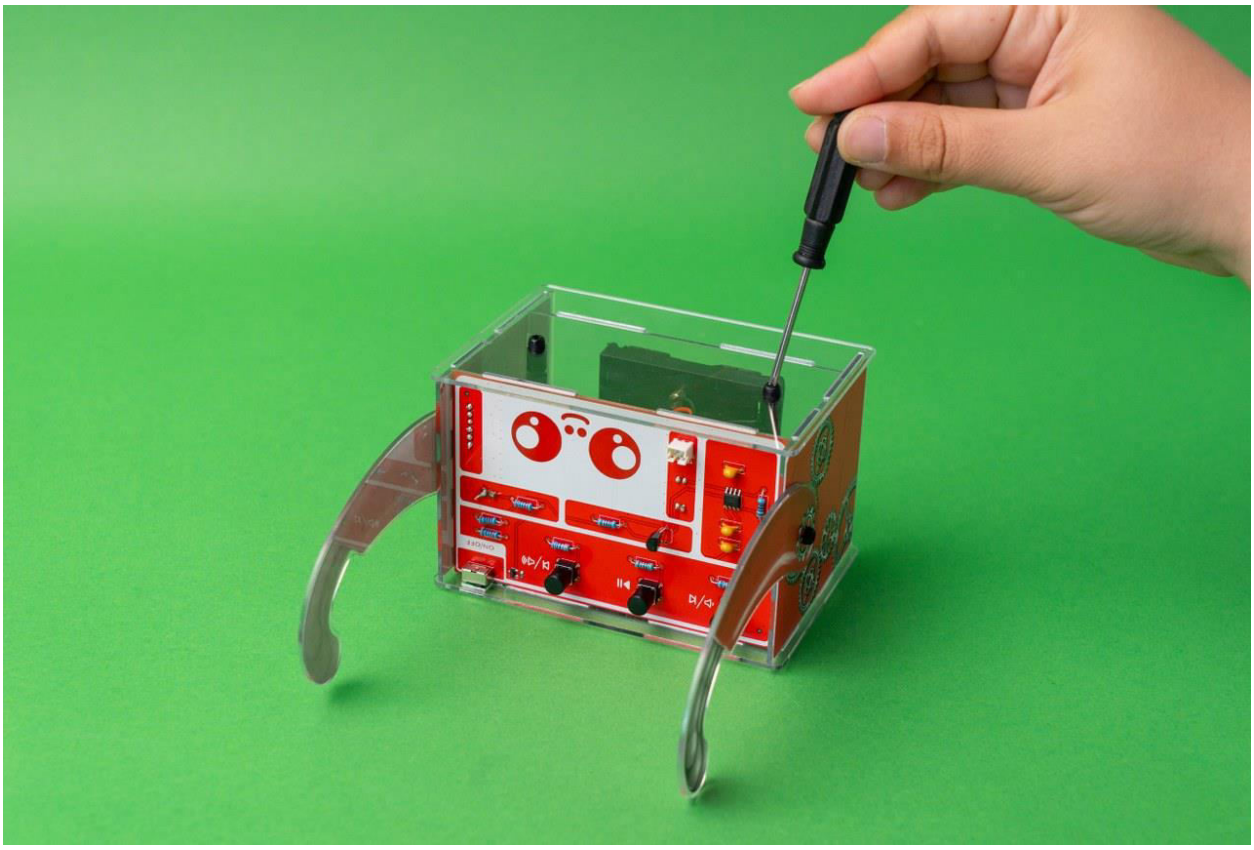
The casing should look like this:



Add it on the top like this:

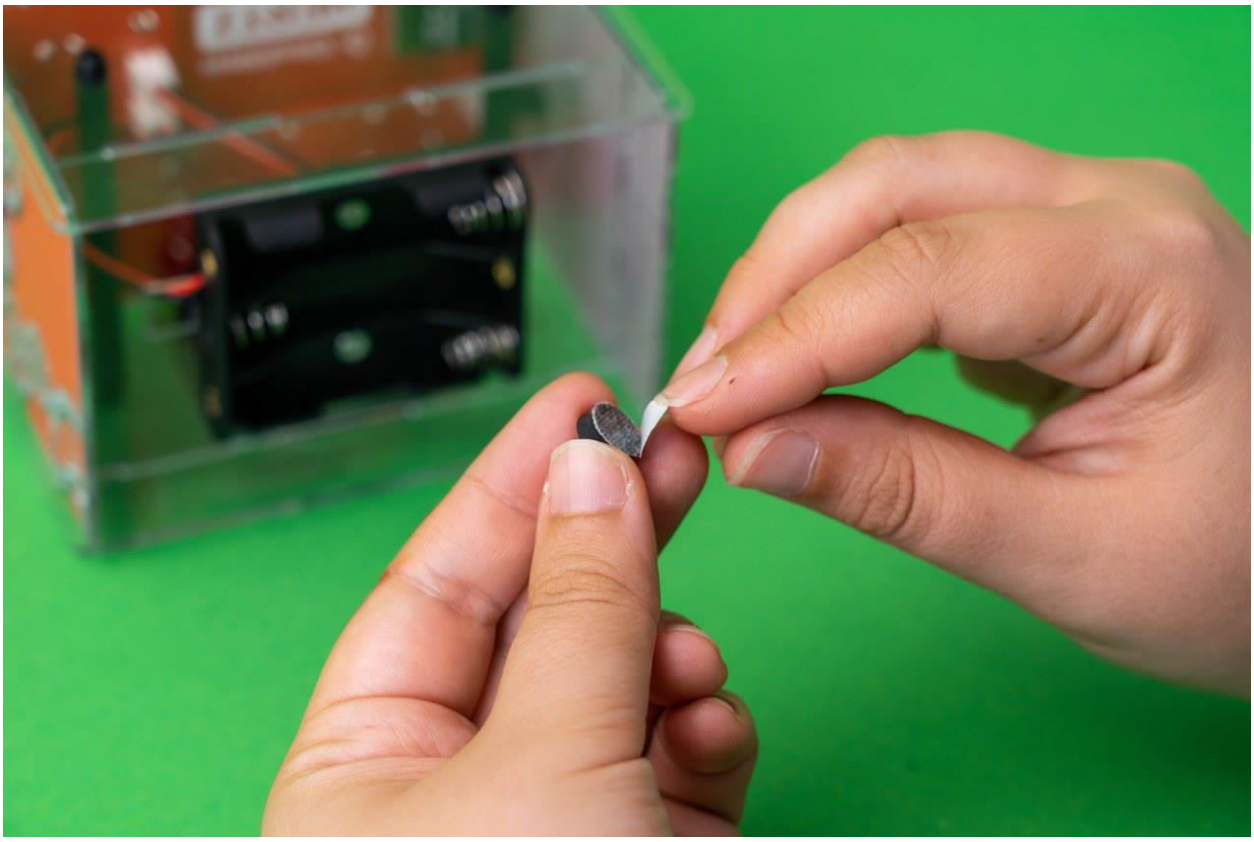


Take the screwdriver:

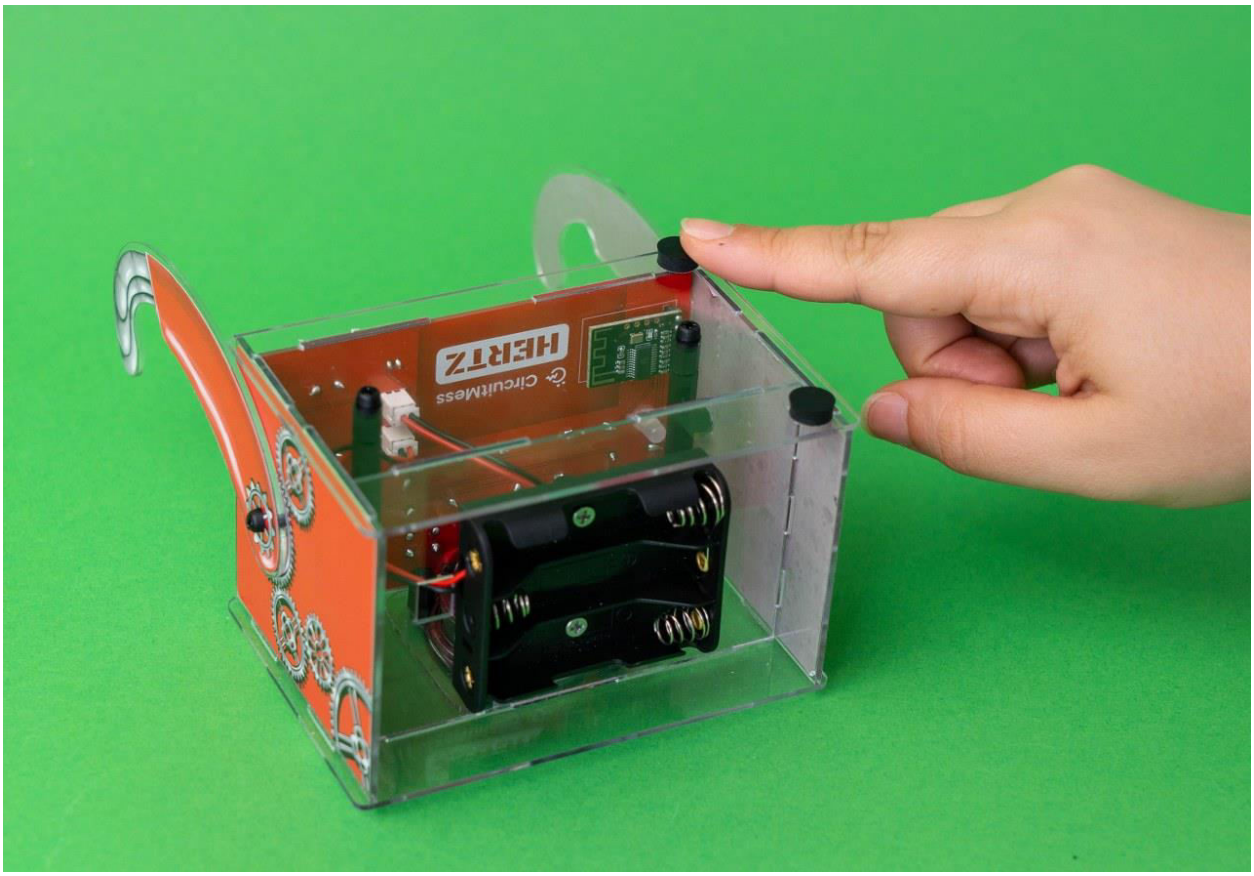


After you make sure that nothing's falling off, you can take the pads.

Take the sticky part off:

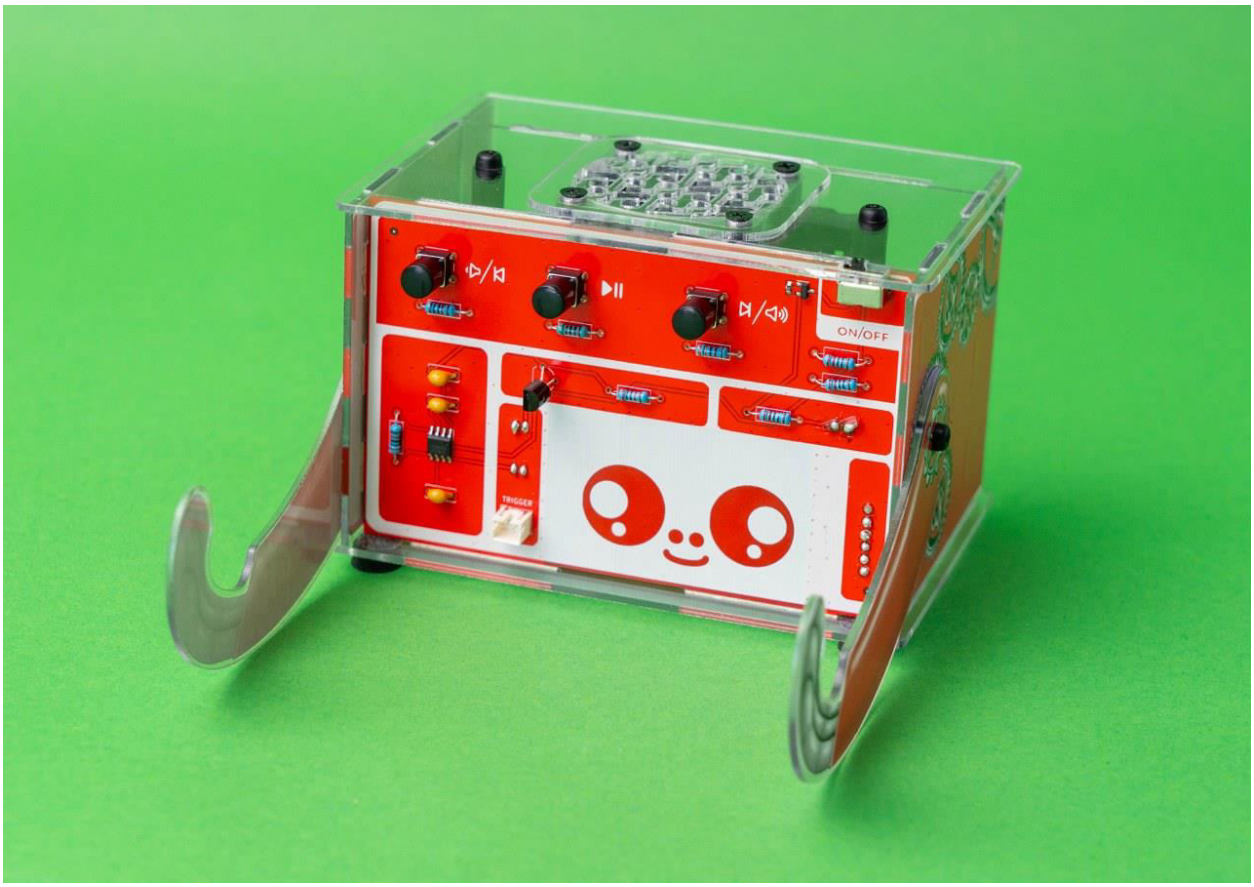


And stick the pads on the casing:

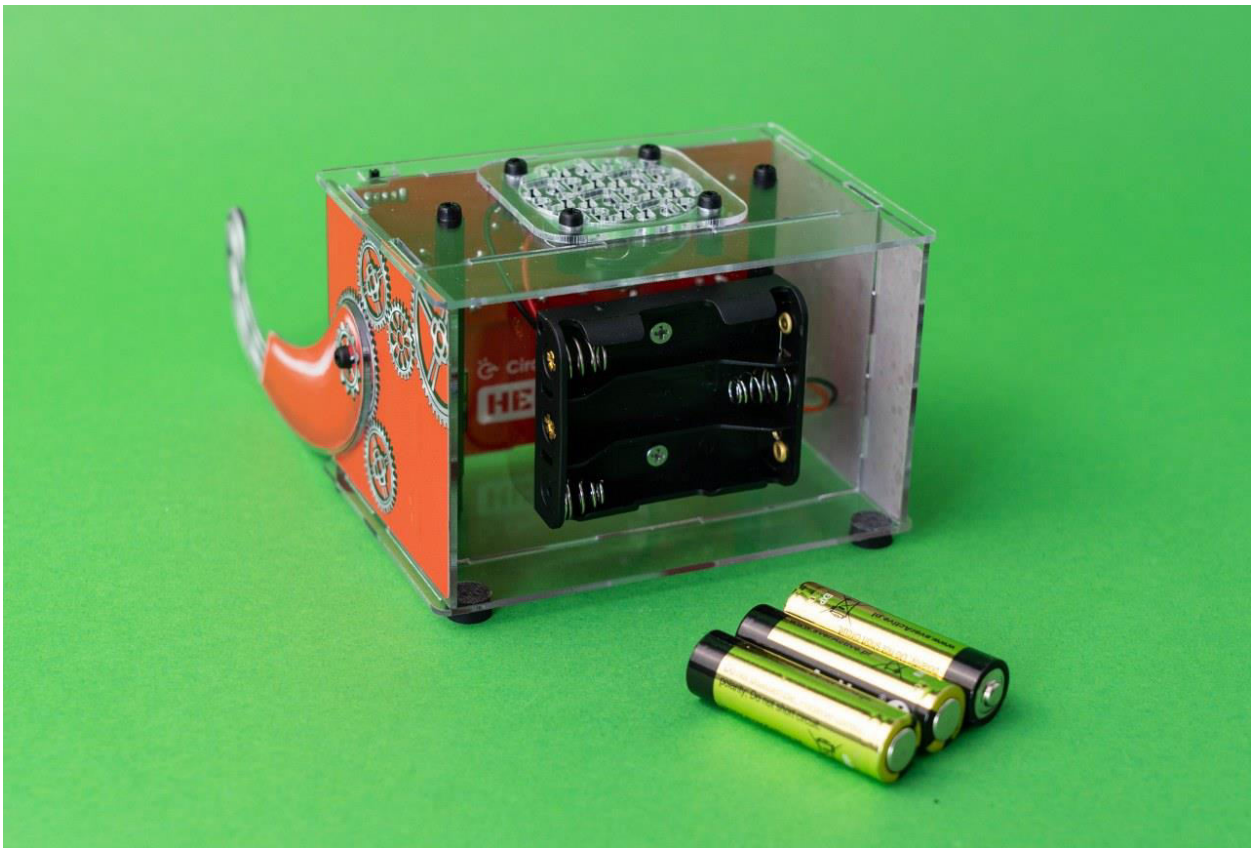


Well done!

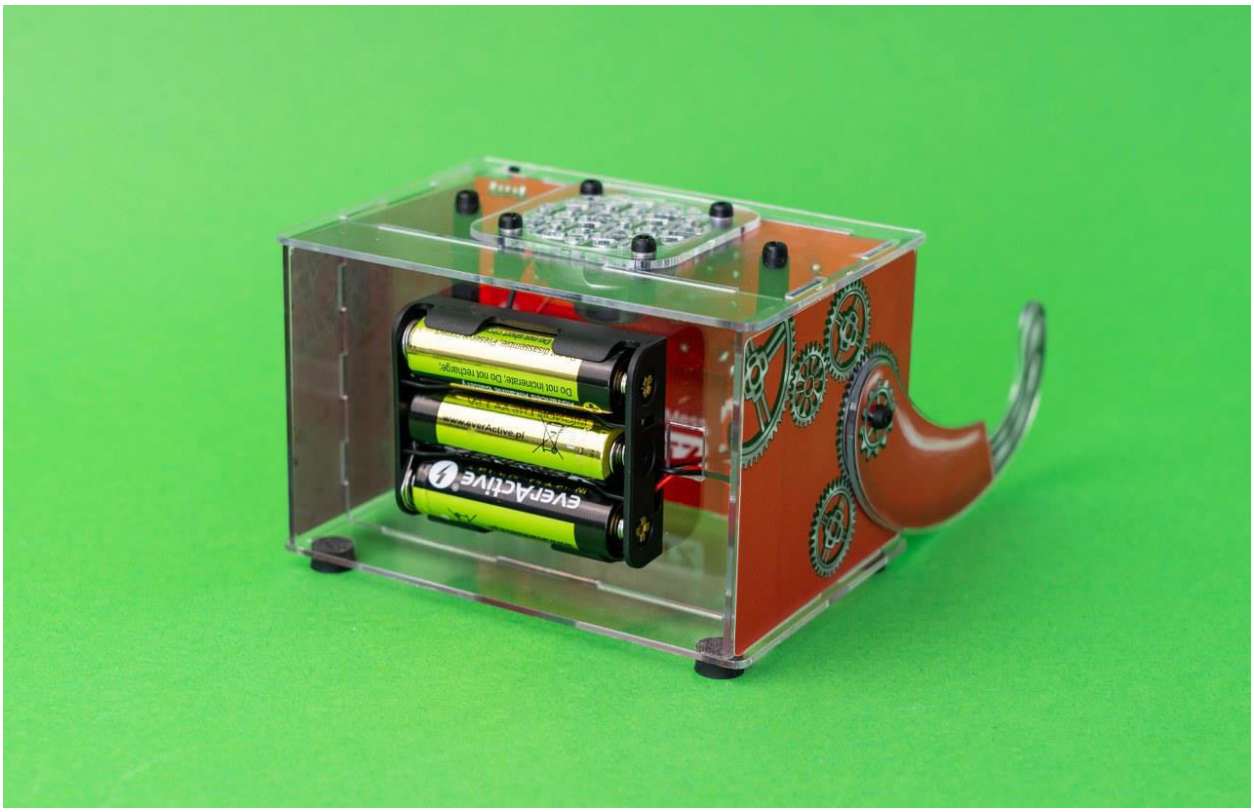
You successfully assembled Hertz.



Now is the time to add the batteries and to start playing music.



Pay attention to plus and minus signs on the batteries.



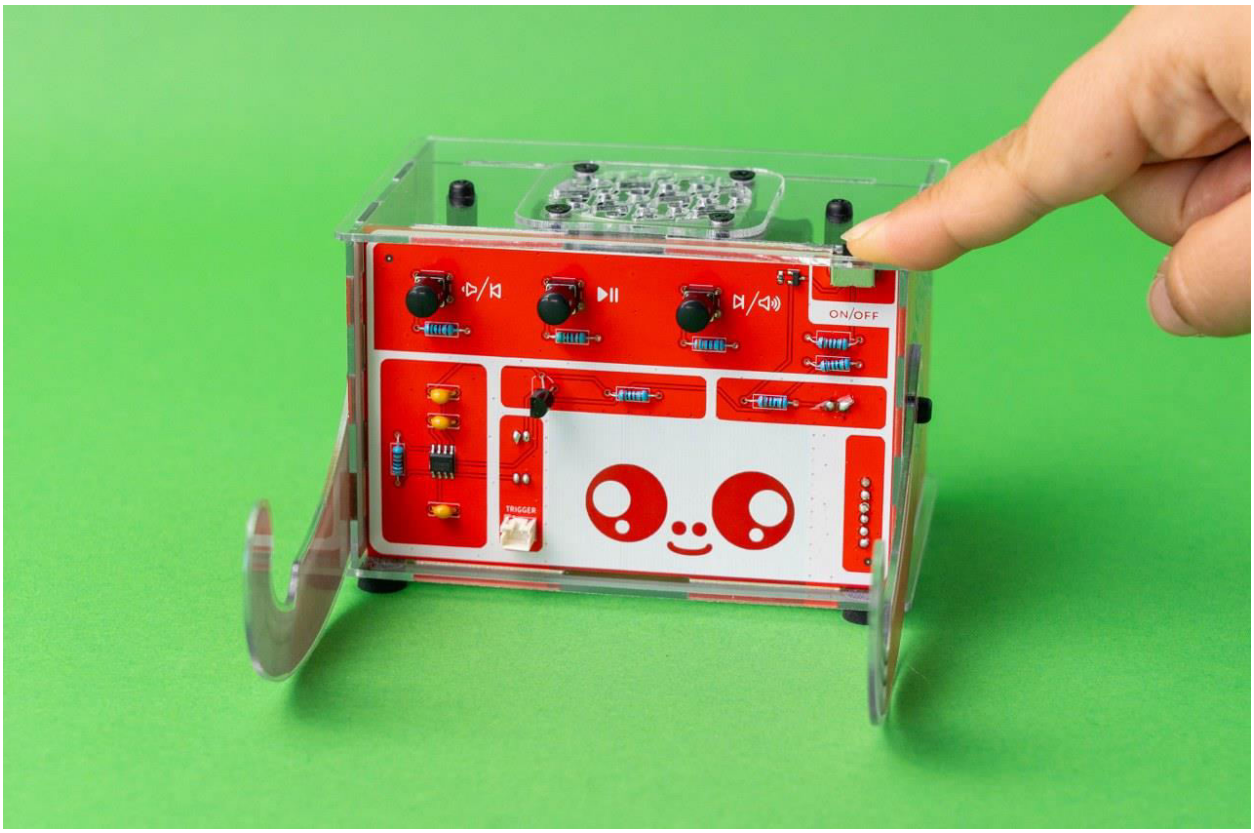
Amazing.

In the next chapter, we'll go over how to use your Hertz.

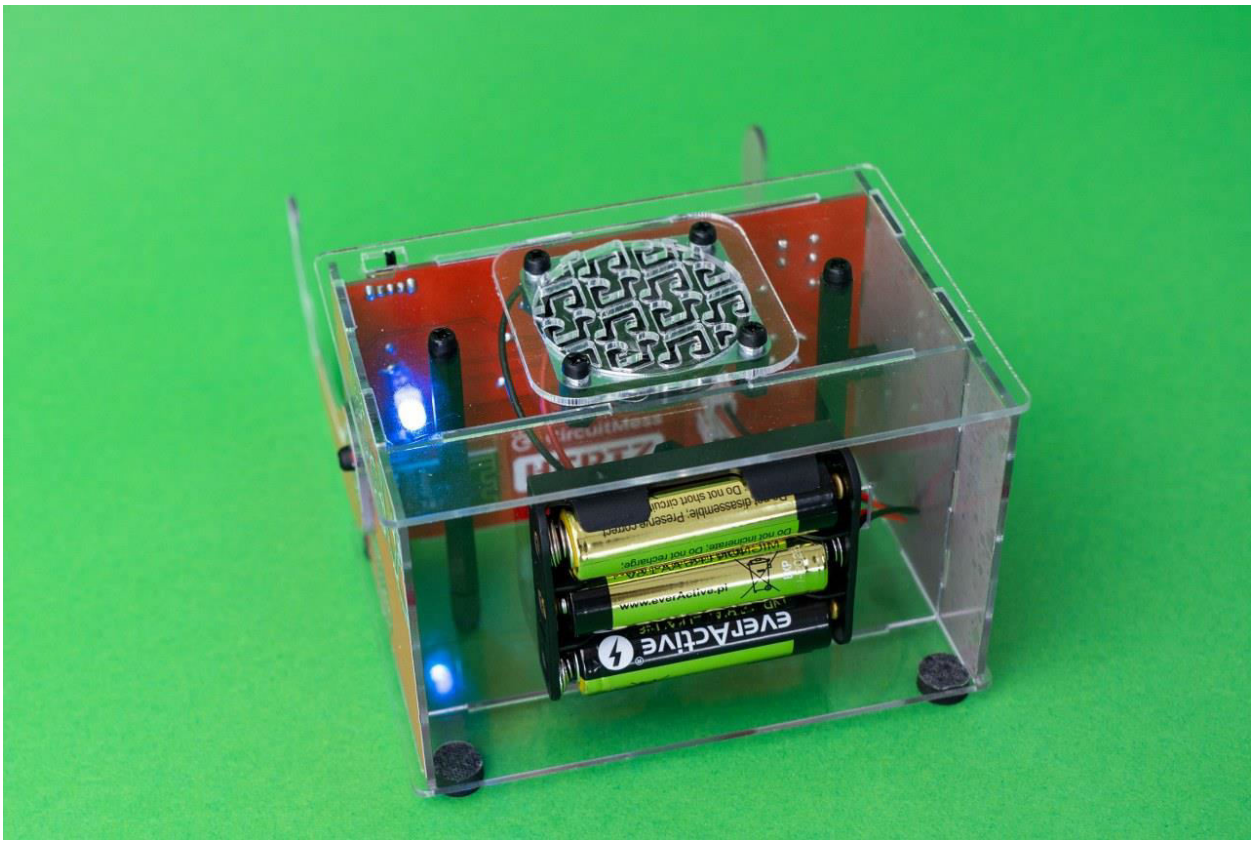
Play some music!

If you are here, that means you successfully assembled Hertz.

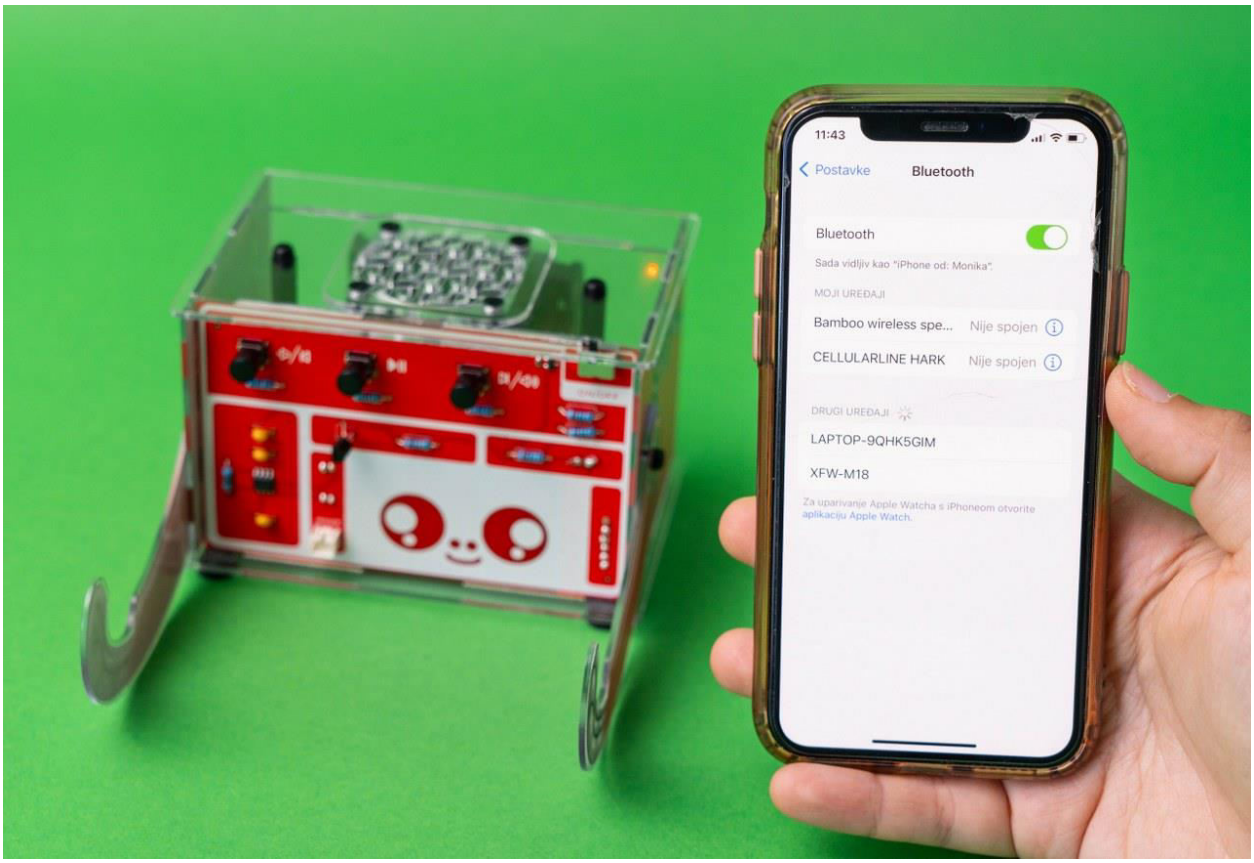
You can turn it on now:



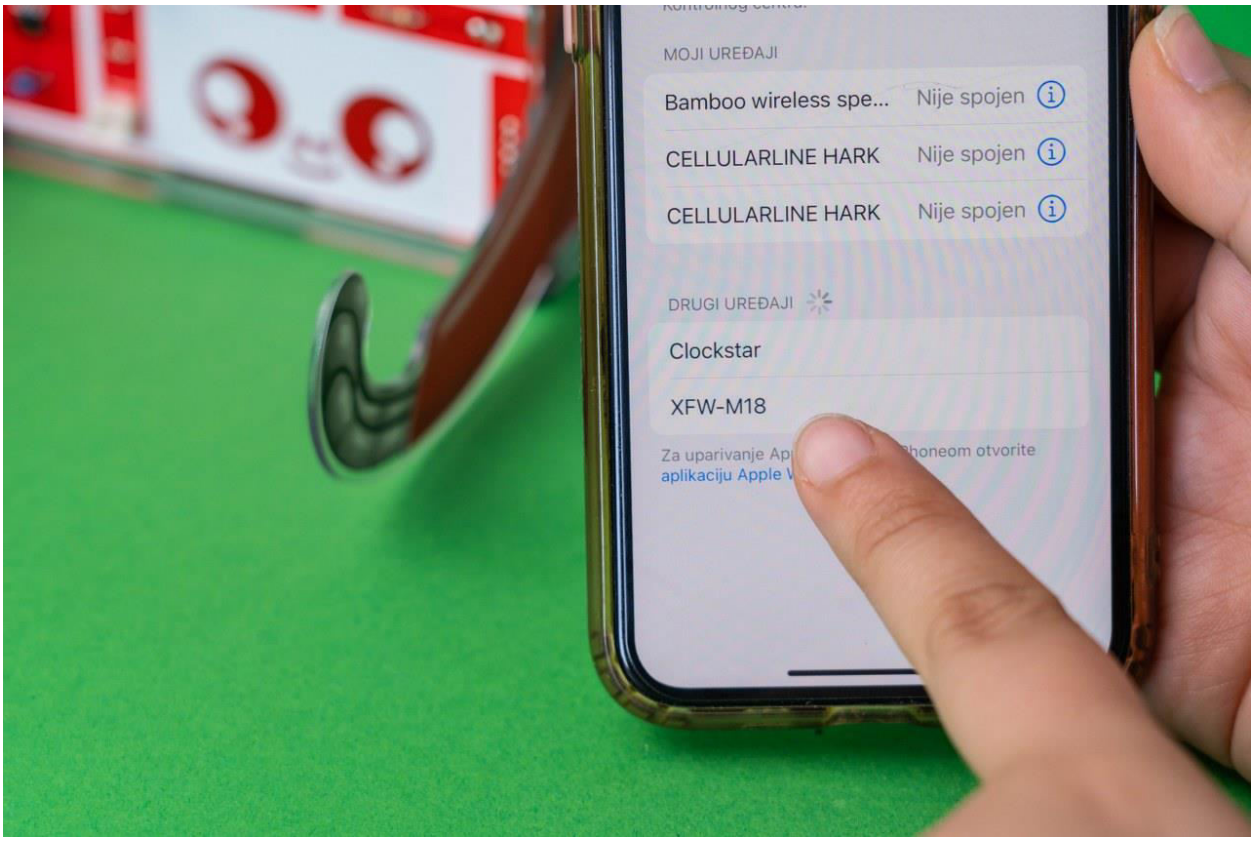
If everything is soldered properly and working, the LED should turn on, and you should hear the turning on sound.



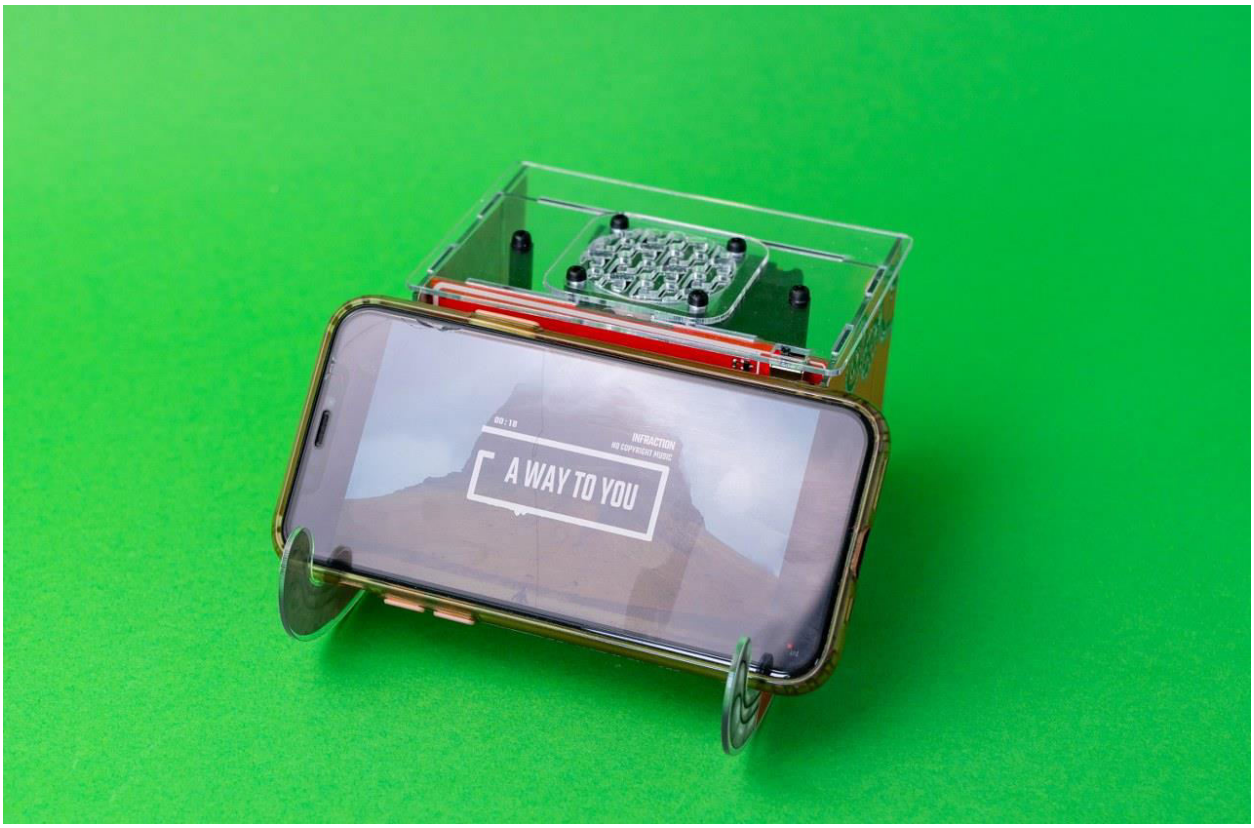
Take your phone, turn the Bluetooth on



and find this device to pair with.



Choose any song you want, put your phone on Hertz and enjoy the music.

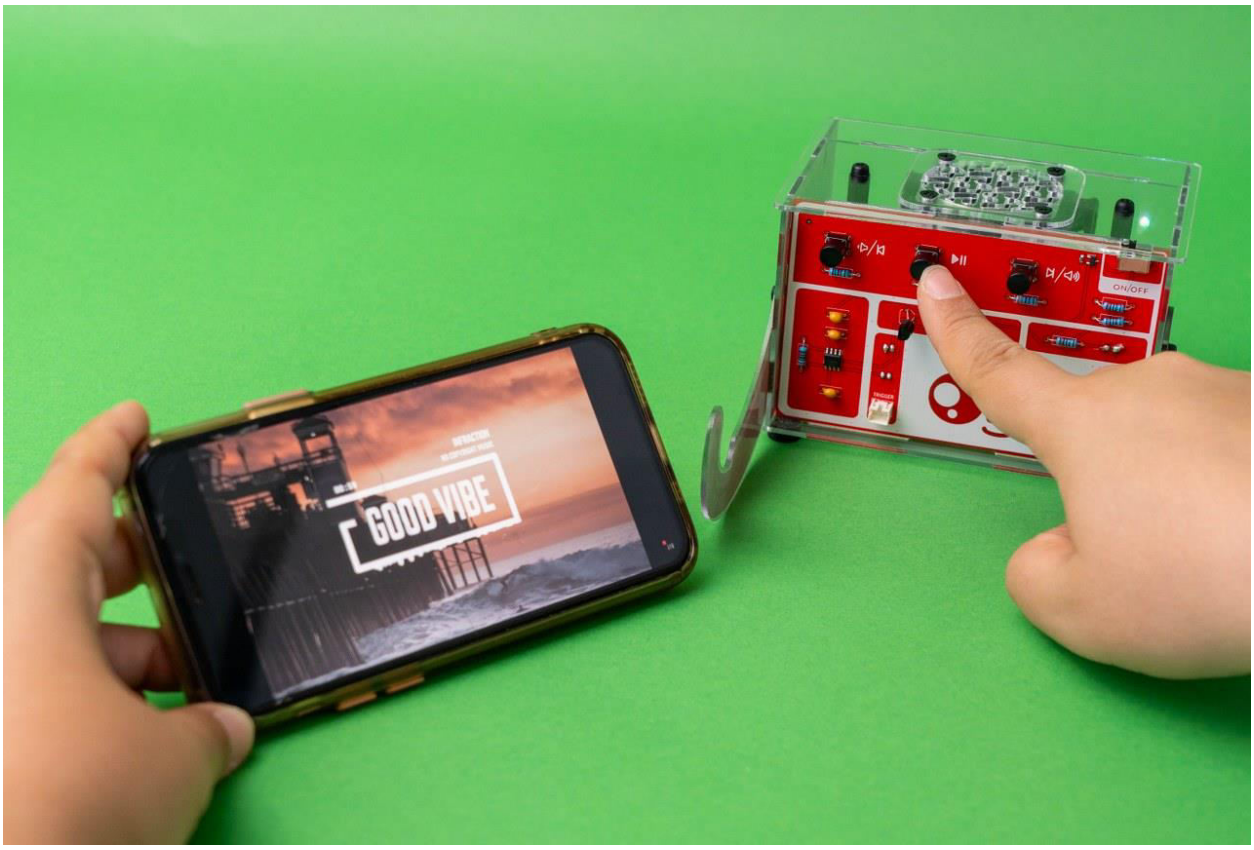


The same connecting process goes for IOS and for Android users.

With the first button from the left, you can turn down the volume or change the song.

The second button is for playing or stopping the song.

And the last one is to turn up the volume or to change the song.



Enjoy your music, and feel free to contact us at contact@circuitmess.com if you have any problems with Hertz.