Synthia Build Guide

The beginning

Welcome to CircuitMess Synthia build guide!

By following this build guide, you'll learn how to assemble your digital musical sampler. With Synthia, you'll learn how microcomputers and other electronic components are used for sound production; you will be able to create unique music by playing with the pre-loaded sounds samples or recording your own sound samples with the built-in microphone, and much more.
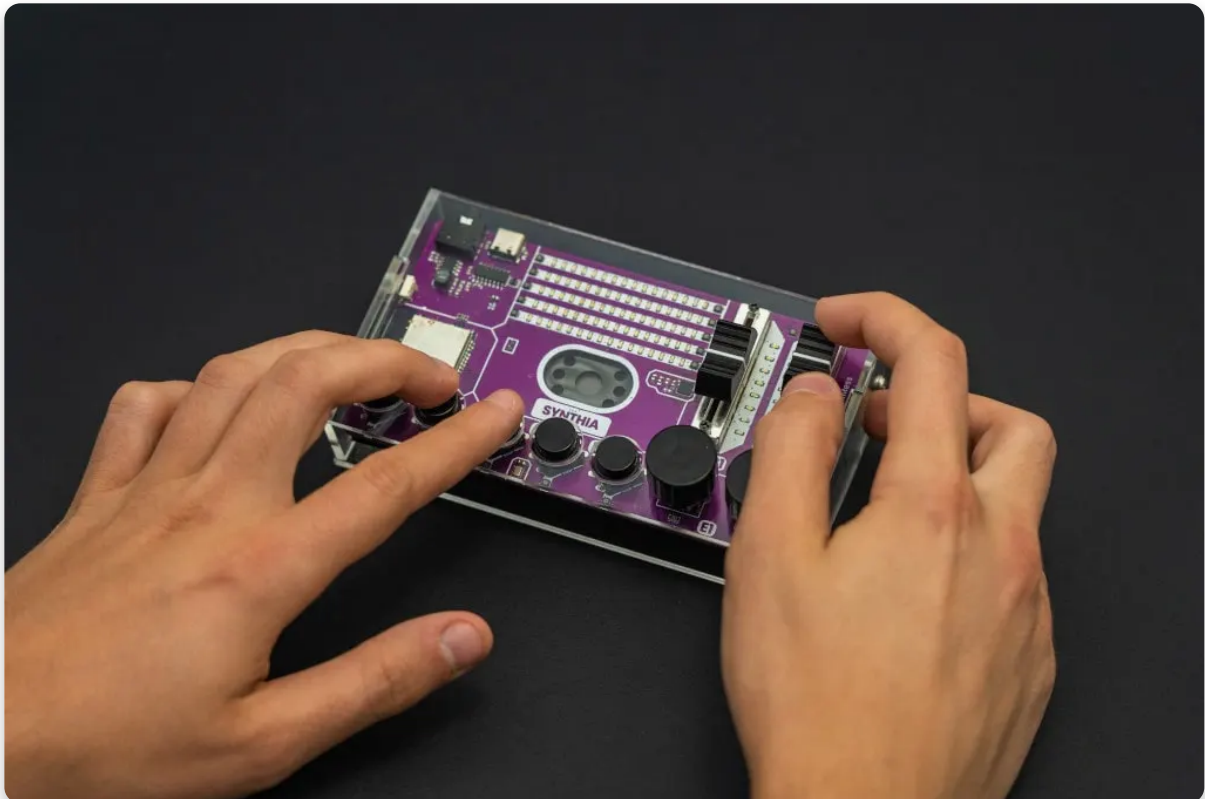
Age group

Like it says on the box, Synthia is designed for anyone who's at least **11 years old**.

You should approach some of the assembly steps carefully, so make sure to have an adult jump in if you need some help with soldering or tightening the bolts later

in the process. It's okay to ask for help.

Don't worry, though! We'll go through the assembly step by step and provide some useful tips along the way. We'll give you a heads-up if there's something important to keep in mind while assembling.

Assembly time

It should take you approximately **2 hours** to fully assemble your Synthia.

Of course, the assembly time depends on your previous knowledge and experience. If you don't have any experience yet, don't worry! It just might take you a little longer to get into the groove and overcome the challenges in the beginning.

Skills

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

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

So hold on tight, read all the instructions, and get ready to have fun! This is a great opportunity and your first step in your big engineering career.

Learning with Synthia

As previously mentioned, Synthia will teach you a few useful things in the following few hours.

Here's what you'll learn:

- **How to solder** and **assemble** your very own electronic device
- Which **electronic components** are needed for digital sound production
- About **Digital-to-Analog signal conversion**
- What **sound waves** are, and how to synthesize them with electronic circuitry
- How to **code custom light shows** for the built-in LED grid
- How **digital sound samplers work**
- How to **record** and edit sound recordings

What's in the box?

Let's meet all the components that arrived in the box!

Open your Synthia box and **check if you have all the components**. Make sure to lay it all on a clean surface where you'll inspect if everything is there according to the photo and the list below.

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. Acrylic casings

2. Circuit board

3. Plastic caps for sliders

4. Button caps

5. Encoder caps

6. Connector for the speaker

7. Speaker

8. Adhesive rubber feet

9. Screw roundhead M3x12mm

10. Brass standoffs

11. Screw roundhead M3x5mm

12. USB-C cable

13. Sliders

14. Rotary encoders

15. Pushbuttons

16. Headphone jack

<u>Mandatory tools</u>

In this chapter, we'll explain what tools you'll need to assemble your Synthia.

If you have your **CircuitMess Tools pack** in front of you, you should be all set!

In case you got the Synthia kit without the Tools pack, this is a good time to borrow some of the tools or purchase them.

The tools required are essential whenever you assemble, fix, or modify electronic devices and are the tools of the trade for every maker/hardware hacker/modder/electrician.
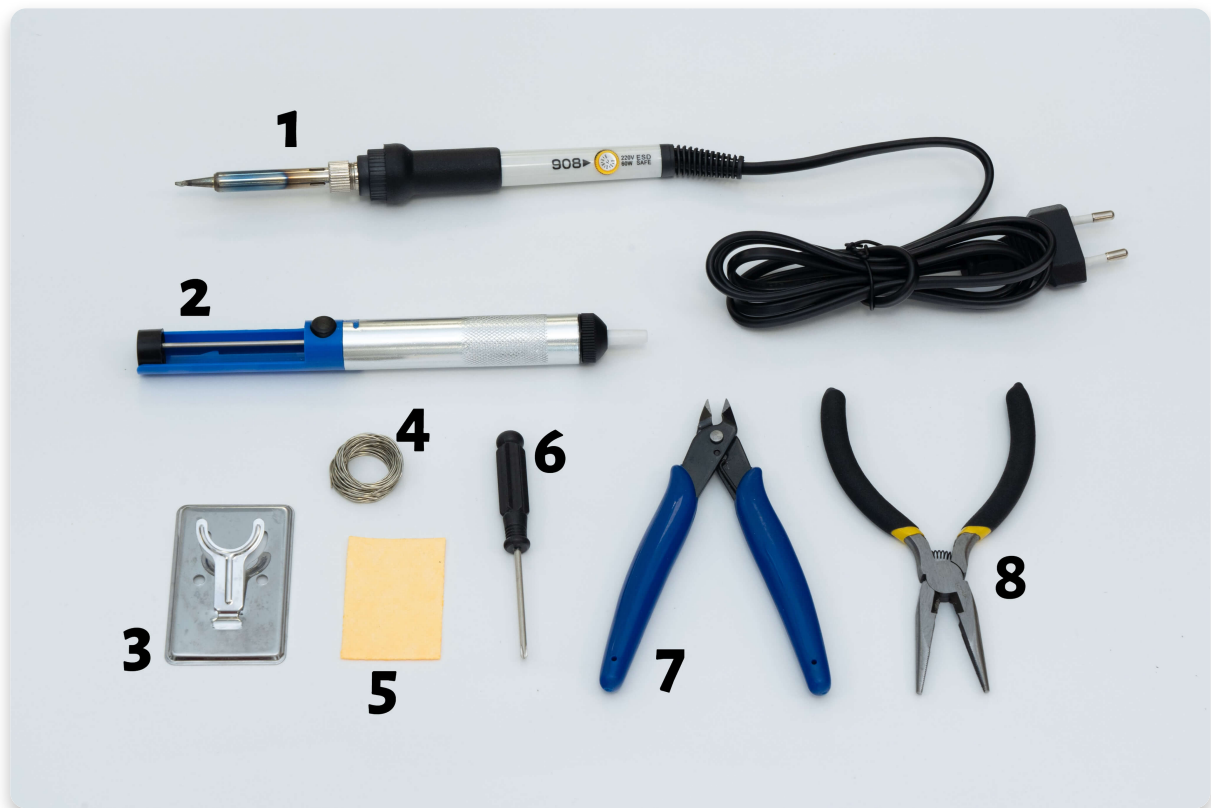
1. **Soldering iron**

2. **Desoldering vacuum tool (solder sucker)**

3. **Soldering iron stand**

4. **A small reel of rosin-cored solder**

5. **Cleaning sponge**

6. **Phillps screwdriver**

7. **Needle-nose pliers**

Soldering iron

This is the most important tool in a maker's arsenal.
For Synthia's assembly, any entry-level soldering iron will suffice.

If you plan to dive into the world of DIY projects, you should consider getting a more expensive one with more features. Many soldering irons with interchangeable tips can be particularly useful when working with much smaller components.

In the next chapter, you'll find the instructions on how to properly solder and take care of your soldering iron.

Soldering sponge

This small piece doesn't seem like much until you soak it in some water. It then turns into a super solder-cleaning sponge! Use it after soldering a couple of joints to remove the excess solder from the tip of your iron. Make sure that the sponge isn't dripping wet or bone dry - it should be damp.

Diagonal cutter pliers

With pliers like these, you'll be able to trim the legs of soldered components and cut wires!

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

Needle-nose pliers

You're going to need pliers like these when assembling the casing or when plugging in some tricky connectors!

They're generally helpful when doing some fine mechanical work.

Standard cross screwdriver

You'll need this cross (Phillips) screwdriver to assemble the casing.

A standard 2.0mm cross screwdriver should do the trick.

Desoldering vacuum tool (solder sucker)

This tool is useful when cleaning up soldering mistakes, but it isn't necessary for assembly.

If you plan on doing some hacking, modding, or hardware repairs in the future, having this is always a good idea.

Additional useful tools

Helping third hand with magnifier

This could make your soldering experience a little more enjoyable, especially when doing some more complicated projects.

Multimeter

A multimeter can be used for many things: testing tricky connections, measuring battery voltage, testing resistors & capacitors, measuring the current consumption, and more.

It's a useful tool when you're trying to figure out what went wrong with any electronics kit.

Solder wick

You can use solder wick along with the desoldering vacuum tool to clean up any soldering mistakes. Just put it on the wrongly soldered joint and press on it with a hot soldering iron, then it will soak up the excess solder like a sponge!

Useful for fixing solder joints when they cannot be easily reached with a solder sucker.

Assembly

Soldering introduction

The first thing that you'll do as a part of the Synthia 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:

1. [Adafruit's video tutorial featuring Collin Cunningham](#) - A tutorial featuring Collin Cunningham, a super charismatic electronics guru.

2. [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.

3. [Sparkfun's video soldering tutorial](#) - Another well-made how-to-solder video tutorial.

4. [Sparkfun's standard soldering tutorial](#) - A detailed tutorial made by Sparkfun.
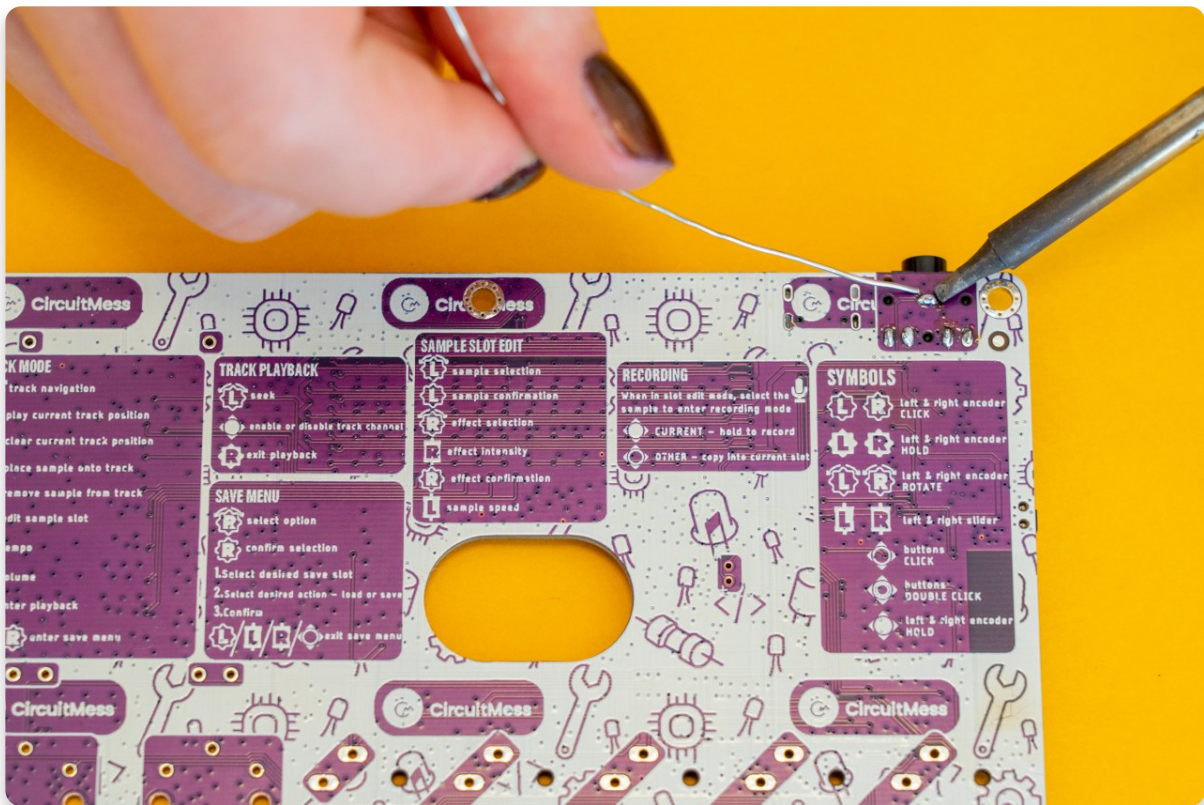
There are several rules of soldering that everybody, regardless of their skill level, should follow at all times.

- **Never inhale the dust and the fumes that can be produced by the soldering iron!** These can be hazardous, so please don't inhale them.

- **Never 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 it facing away from your hands. If you're finished with the soldering iron, unplug it from the power source and leave it to cool off for at least five minutes before putting it back in the box.

- **Clean the soldering iron!** The sponge is your best friend while soldering. Make sure to use it often and clean your soldering iron if you wish to have an easy and simple soldering experience. Carefully hold one part of the sponge with one hand and wipe the tip of the soldering iron on the other part of the sponge to remove the extra solder. Repeat the process until the tip of the iron is nice and clean from the old solder.

- **Check your solder joints twice (at least)!** Most of the malfunctions in the world of electronics are due to bad solder joints, so regardless if this is your first or 100th soldering project, always make sure to inspect your joints multiple times before proceeding to the next step.

- **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 the 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. Everything else should be clean. Little pieces of solder all over the board are a big no-no!

Now go over these rules a couple of times so you don't forget them!

Use this photo to get an idea about good and bad solder joints (Thank you Adafruit for this great photo!):
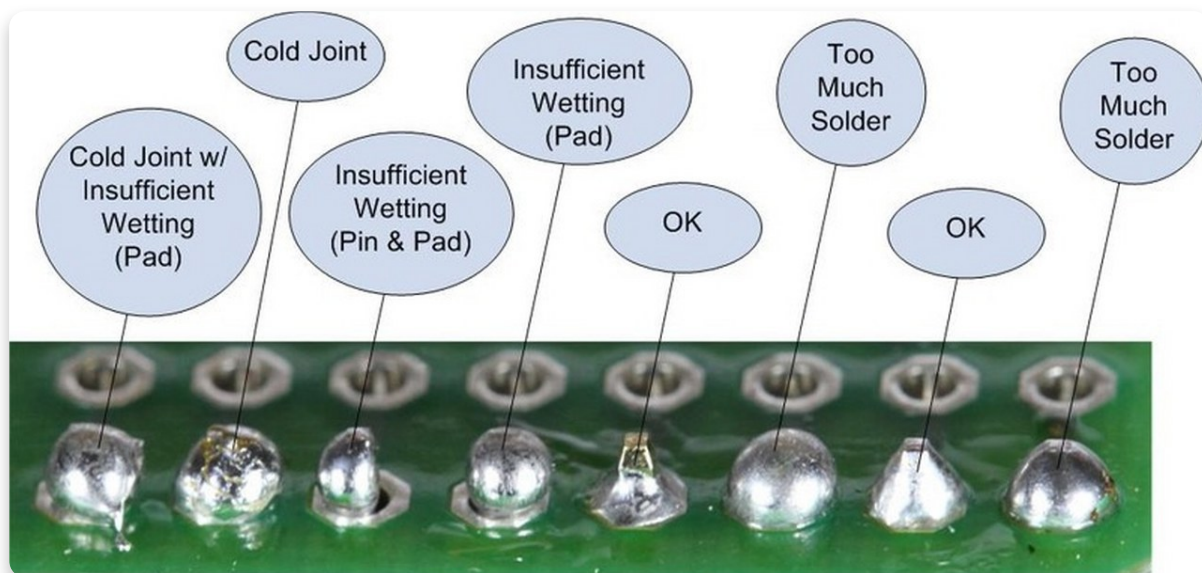
If you follow these rules, your soldering experience should be easy peasy.

Using the soldering iron

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

If you have purchased the CircuitMess tools pack with your Synthia kit, you have gotten a white soldering iron with a temperature regulator.

Remember the rules mentioned previously? Good! Let's go over the instructions on how to use the soldering iron now...
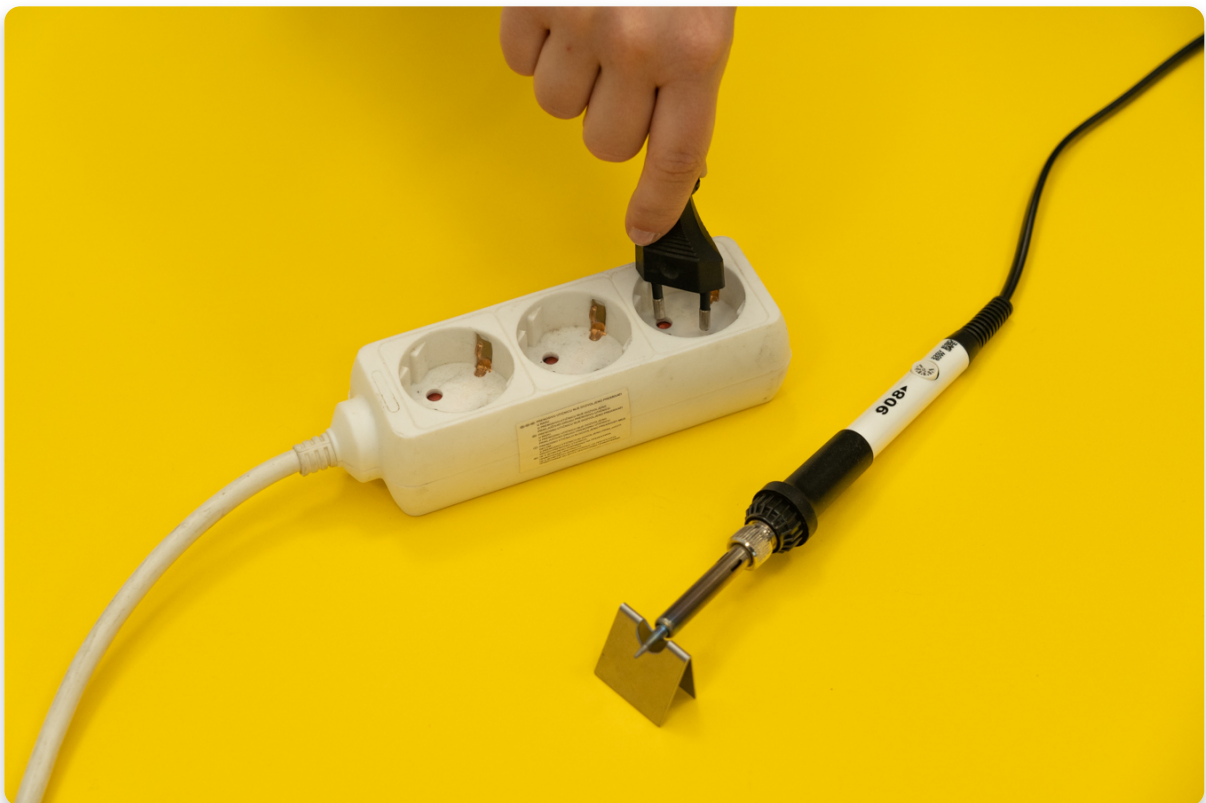
If you're using your soldering iron for the first time or need help with cleaning its tip, check our **video tutorial.**

Soldering iron instructions

Step 1

Set up your soldering iron so it stands on the stand - as shown in the photo. After that, plug it into a power outlet.

Step 2

Set the temperature to **350°** by turning the regulator. There is a small black arrow next to the regulator wheel, so make sure that it points to the right temperature, like in the photo.

Your soldering iron is now ready to use, but give it a minute or two, so it can heat up. The safest way to let it heat up is to leave it on the stand while you wait!

Step 3

Once you're done with soldering (don't worry, we'll let you know when that time comes), you'll unplug the iron from the power outlet to turn it off.

Please use the soldering iron 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.**

Chapter One - Soldering the components

Now you know how to solder, let's put it to the test. Ready?

Part one - The headphone jack

Before soldering, please check our **video tutorial** again to ensure you're doing everything right.

The first components we'll use are **PCB** and **headphone jack**.
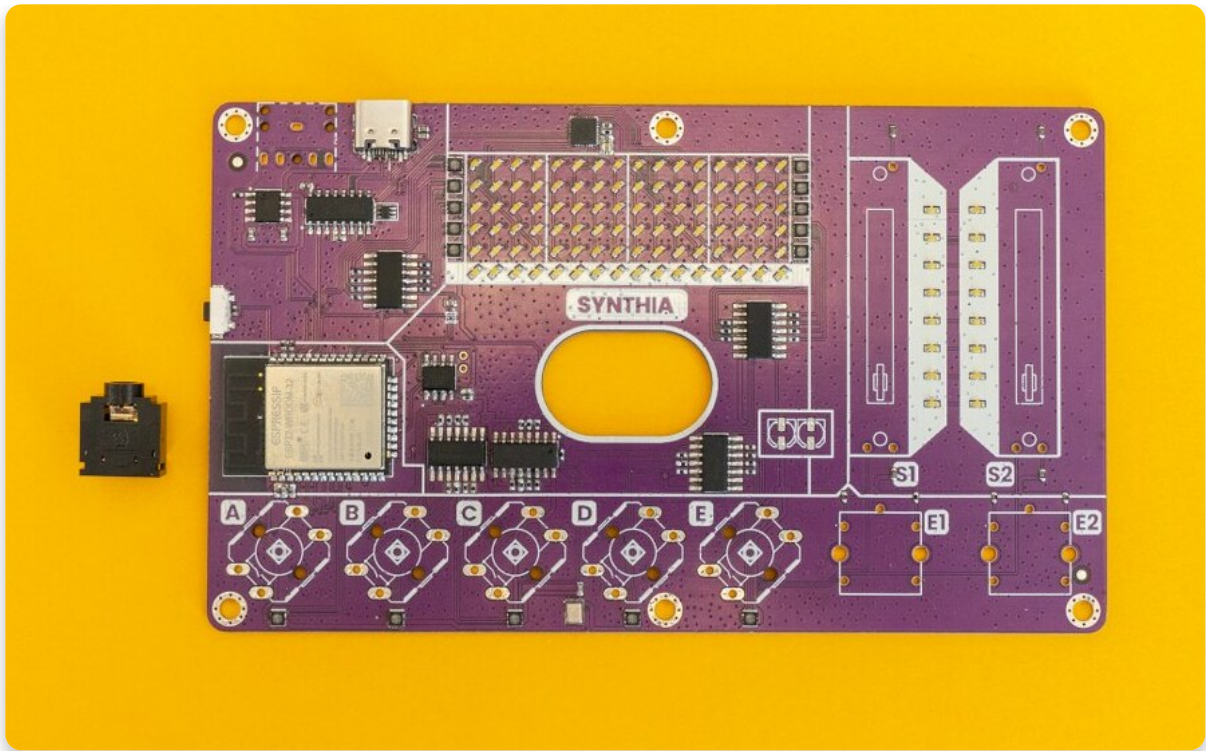
The headphone jack will be placed at the **upper left part** of the PCB. You can help yourself by finding the little square.

Or, you can simply check the photo below:

Make sure that the round part of the headphone jack is facing up. That way, you'll be able to connect your headphone jack to your headphones.

While placing it on the board, check if everything is well-adjusted before soldering.

Your Synthia should look like this by now:
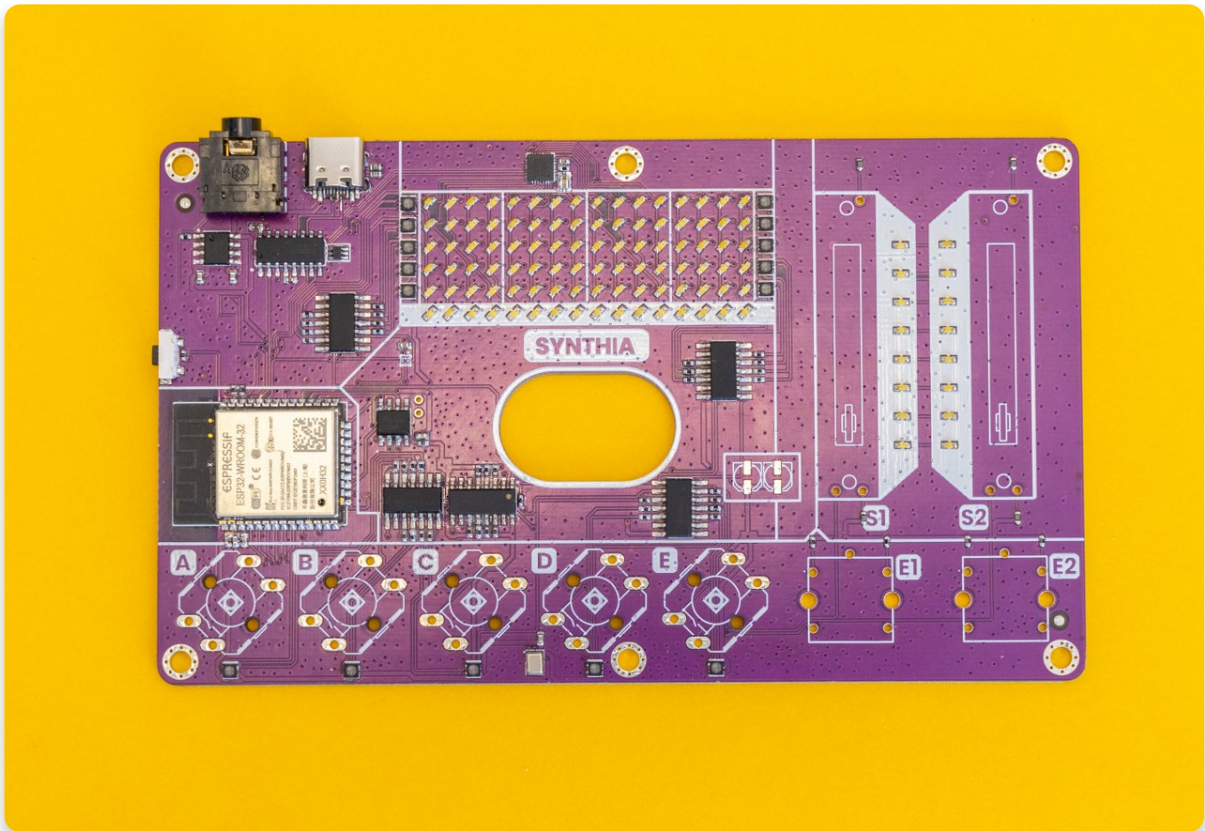
Now is the time to **take your soldering iron** and get down to business.
Turn the PCB around, find the pins that belong to the headphone jack, and solder them.
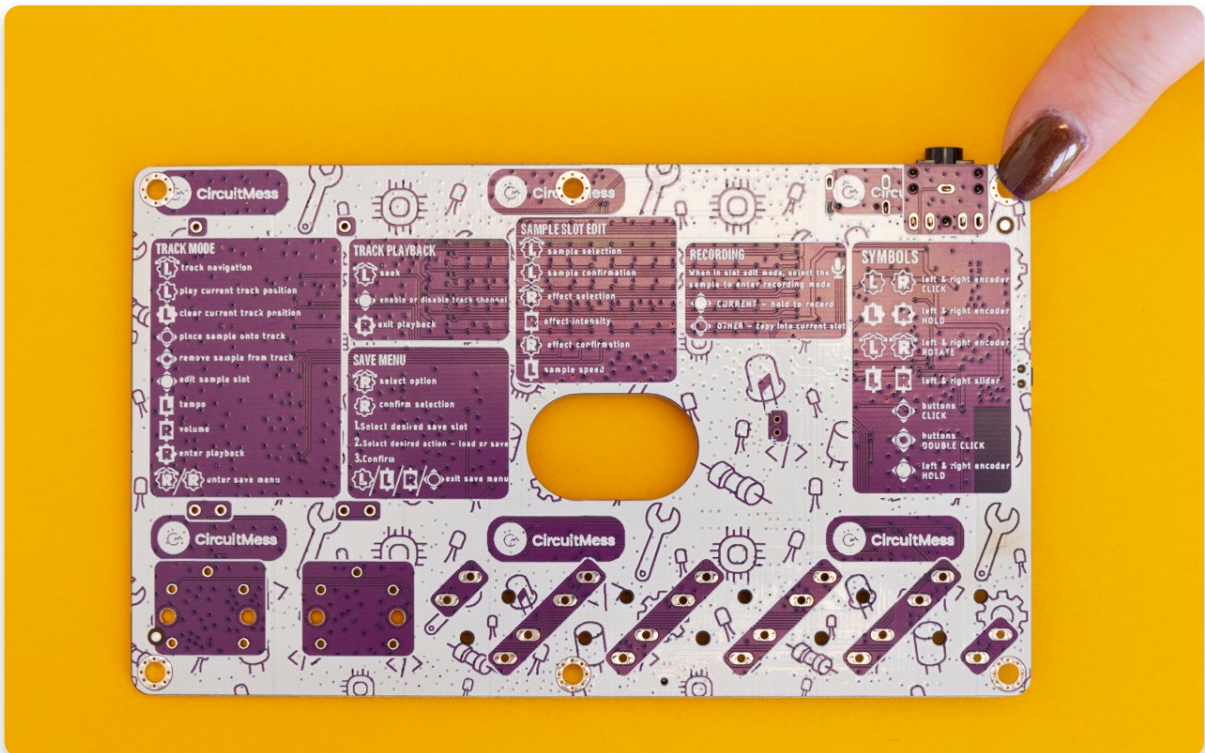
Solder all of the pins from the headphone jack and that this component is vertical to the board.
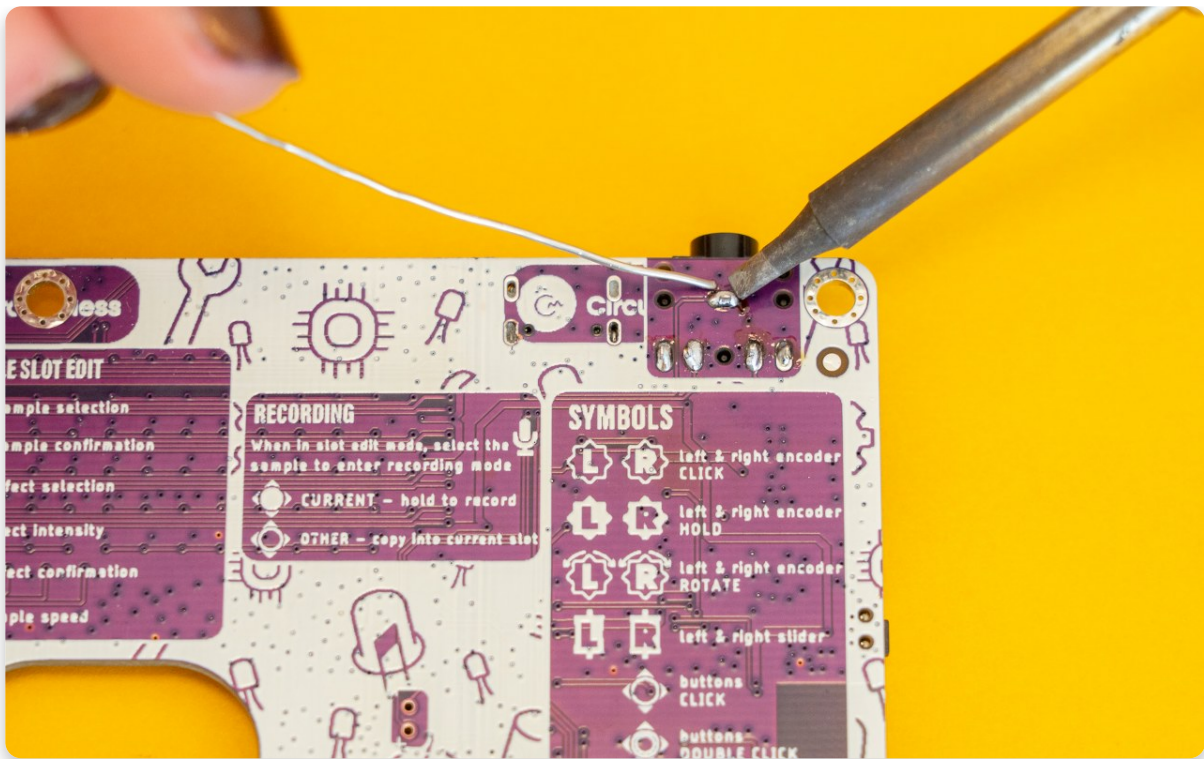
Great job! You successfully soldered your first component! We have many more things to solder ahead of us, so we better hop to the next component.

Part two - the speaker connector

The next thing we'll solder is the **speaker connector**. That is the little white thingy you got in one of the plastic bags.

You need to put the speaker connector here:

Take your soldering iron, turn over the PCB and start soldering.

**Beware not to solder the chip near the pins on the front side.**

Part three - pushbuttons

Now is the time to solder the **pushbuttons**!

Buttons are the most commonly used input, and there are a total of 5 of them.

The buttons consist of two parts - **the mechanical button parts and the button caps**. Buttons can work even without the caps, but pressing them with the caps on feels way nicer, and they look a lot cooler.

However, we'll leave the caps aside for now and focus on soldering the mechanical button parts.
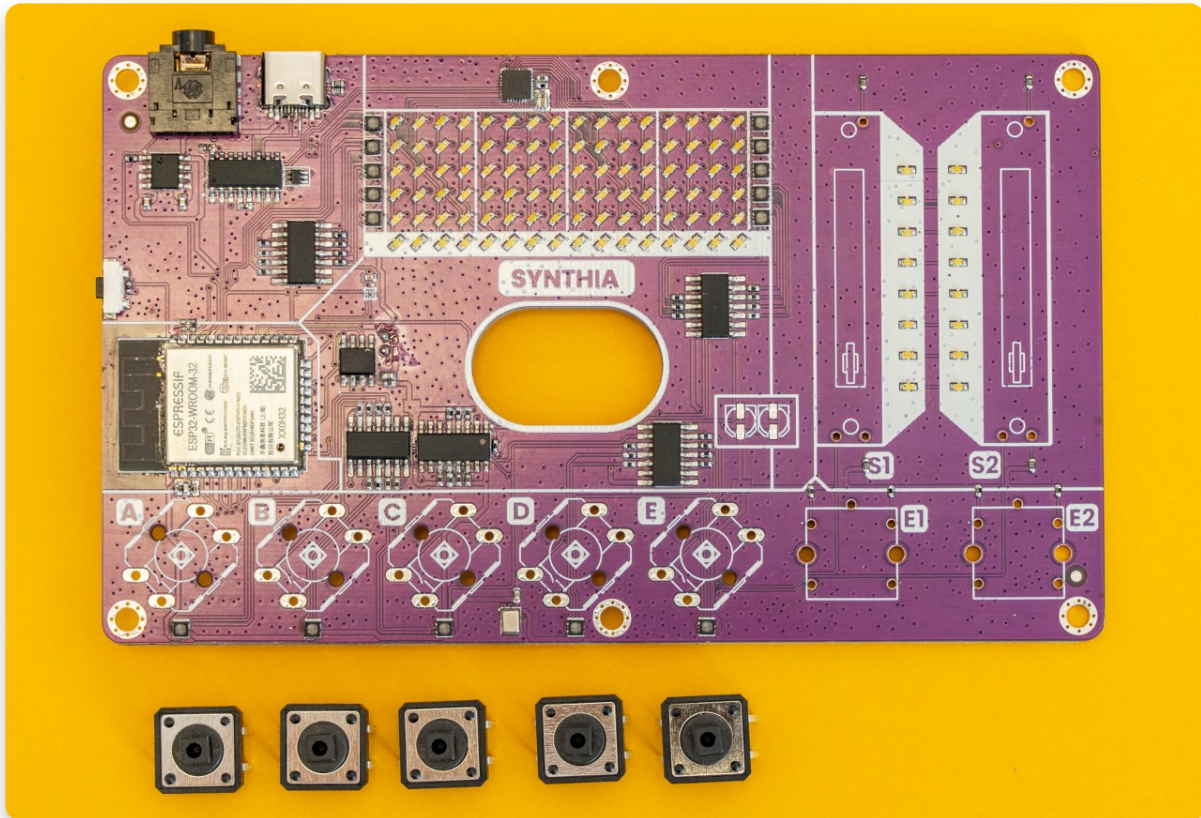
The five buttons will go on five white-marked squares at the bottom of the PCB.

You can check the exact place to put them on the photo below:
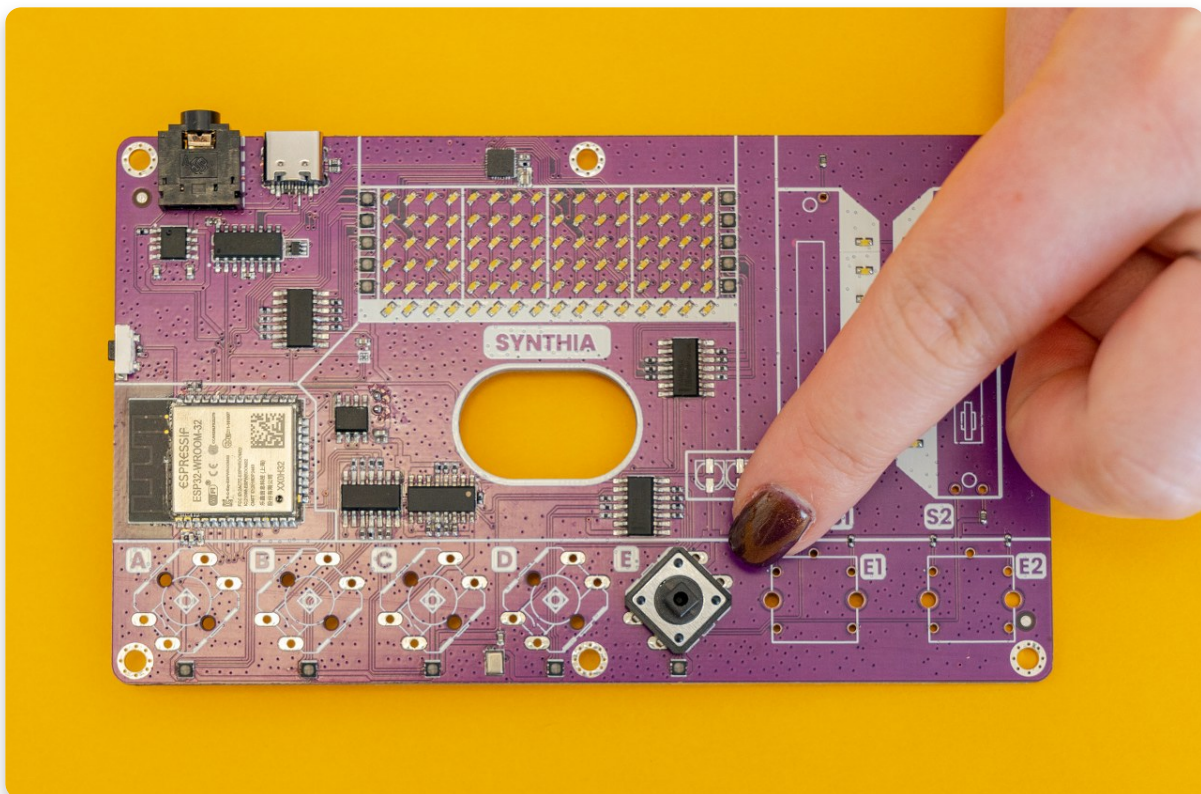
The first thing you'll have to do is place every single one of the pushbuttons onto the board. They should be placed vertically on the board.

Before soldering the pushbuttons, make sure they are perpendicular (vertical) to the board. This is very important as you'll have trouble putting the protective casing on the device if the buttons are tilted.

After placing the components in the right place (pins through the tiny holes), put the main board on the surface in front of you and pick up the soldering iron.

Solder all five pushbuttons, and make sure they are vertical to the board.

Also, now is a good time to check if there is any solder bridging.

After you finish soldering those five pushbuttons, this is what the back of the PCB should look like.

And the front:

Part four - encoders

The next thing we'll solder is **two encoders**.

Those are similar to pushbuttons, but they are round and a bit bigger.

Here are the components that you'll need for this step. Got everything? Cool, let's start!

Start with inserting the first encoder. As you can see in the photo, each rotary encoder goes where the white square is shown on the board - it's hard to miss it.

Also, keep in mind that all pins must be inserted into the holes to solder the encoder to the board later. In case any of the pins bend when inserting, simply straighten them out with your fingers and try again.

There are seven pins on each encoder arranged so that there is only one way to insert it. After inserting the first rotary encoder, repeat this step six more times.

Make sure encoders are vertical to the board before soldering.

If everything seems alright, start soldering!

Part five - sliders

It's time to solder the **sliding potentiometers**. They are crucial components that will later be used for playing with sounds.

There are two sliders, and each slider has three pins that need to be soldered to the board. One pin is on one end of the slider and two on the other, so you don't have to worry about aligning them the wrong way.

They should be located above the encoders.
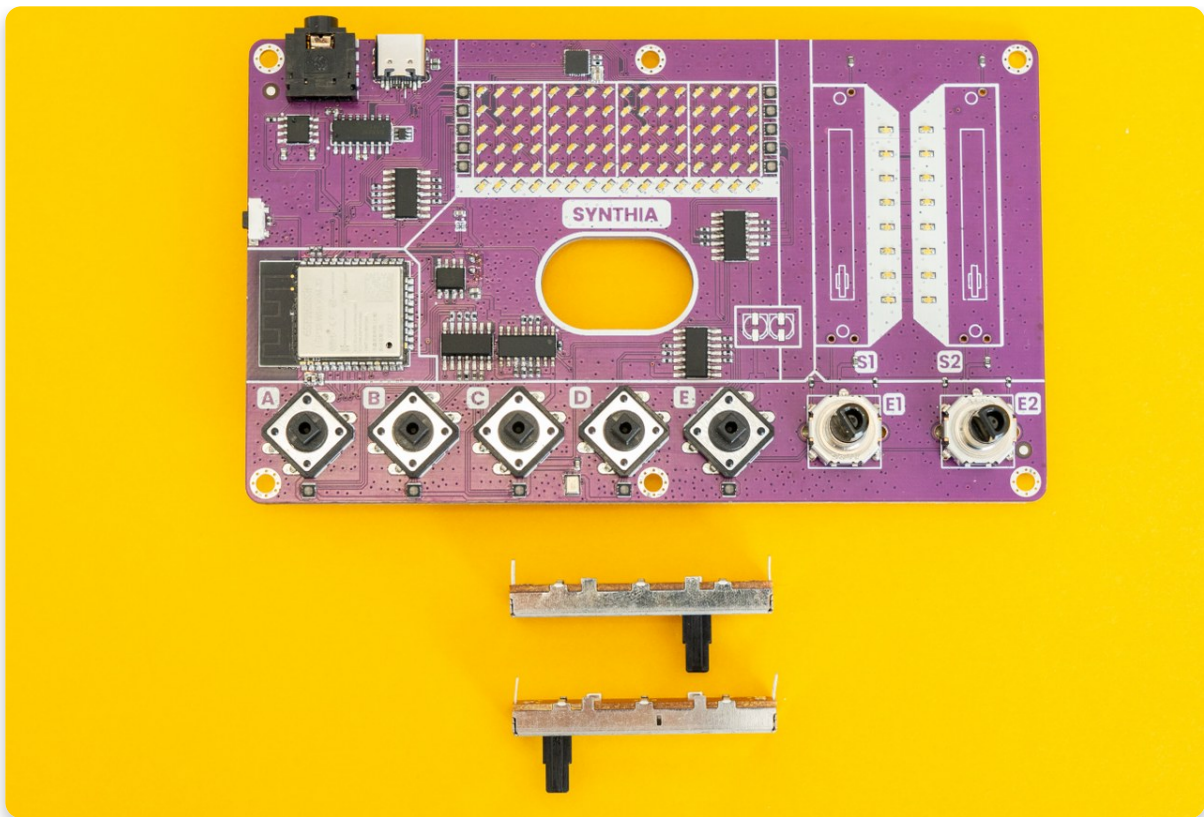
Place it on the right spot, and start soldering!
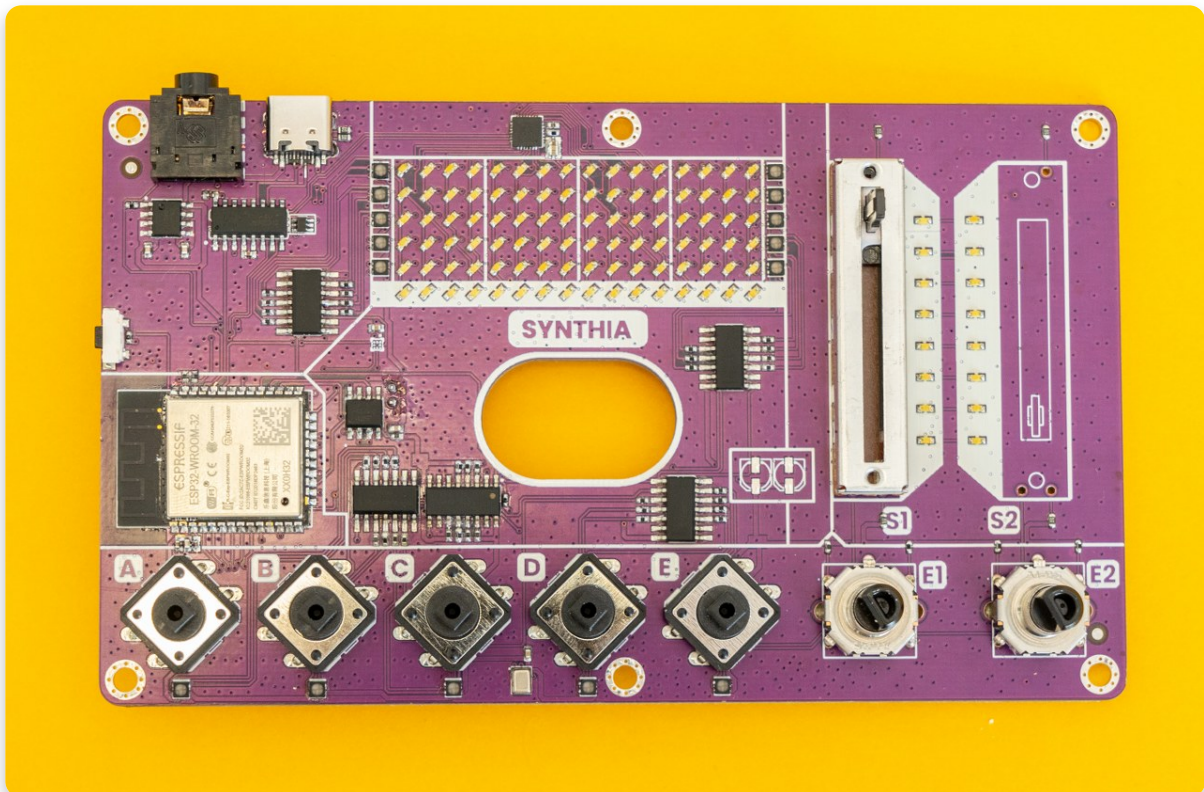
As previously mentioned, there are three pins on each slider. Fit the slider so that the two pins on one side go into the two holes on the PCB board, and one pin goes into the single hole on the other side of the PCB.

After inserting the first slider, turn the board upside down and solder the three pins.

This is what your PCB should look like after soldering the sliders.

And the back:

Congrats! You successfully soldered all of the components!

The hard part is done. The only thing left to do before connecting Synthia to the PC to check if everything is soldered properly is to connect the speaker!

We hope you had a great time soldering the components. Sadly, you'll have to **turn off your soldering iron now**, but there are fun steps ahead, and we're not quite done yet! Please turn off your soldering iron by unplugging it from the power outlet. **Leave it on the soldering iron stand for at least five minutes so it cools off before you put it away.**
Ready to continue?

Part six - connecting the speaker

We have to **connect the speaker** before doing the hardware test because, without it, we couldn't check the main feature on Synthia - the sound!

You probably already know what does the speaker look like, but if not, check the photo below:

One of the first components you soldered was the speaker connector. That is the small white thing at the back of the PCB.

Take the white part of the speaker and push it into the connector. If the speaker is connected properly, you should feel click!

This is what Synthia should look like right now:

In the next chapter, we'll guide you through the hardware test.

Chapter Two - First check

Welcome to one of the most exciting parts of the assembly - the hardware test!

With it, you'll be able to check if everything is soldered properly and if everything works as it should.

Only after doing that should we go on with assembling the casing! It would be a lot of work to disassemble the casing if we found out something wasn't working! That's why it is important to do this simple check. Let's start...
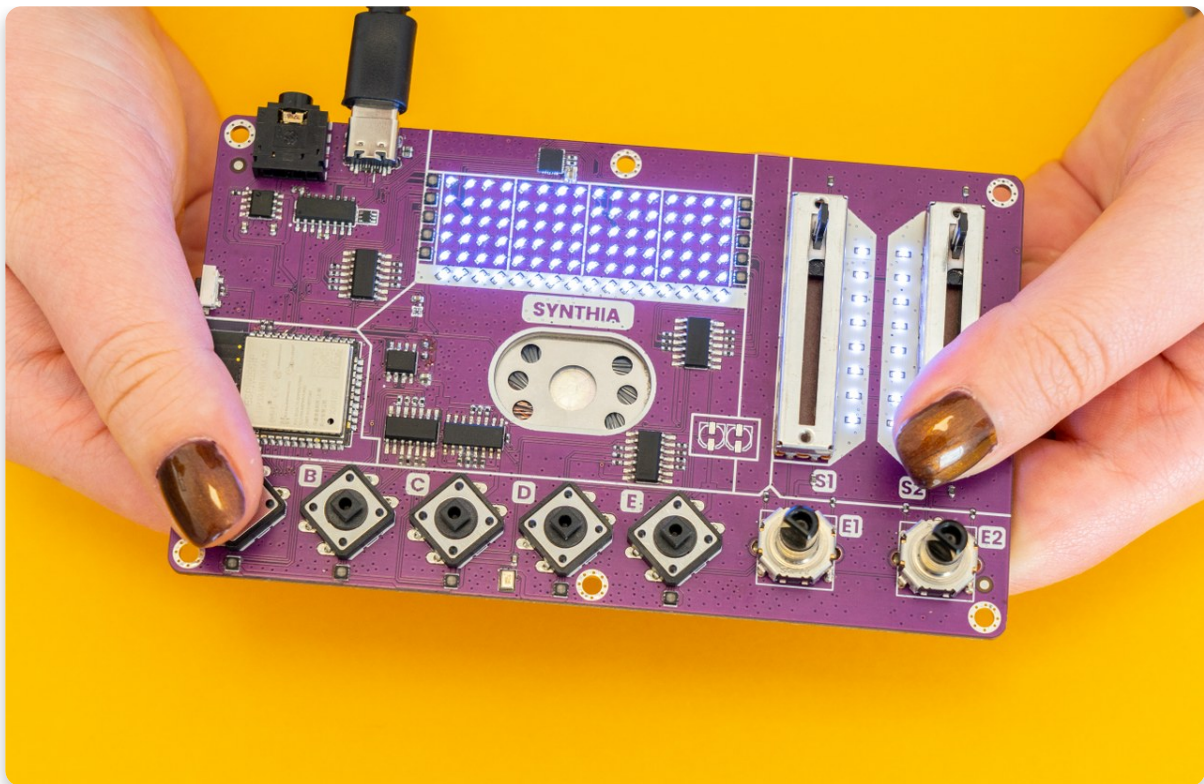
Step #1

Find the USB-C cable for charging and coding you got in the box.

If you don't have that one for any reason, any USB-C cable will do.

Use it to connect the device with your PC.

Synthia should turn on immediately!

As with any other CircuitMess device, the most important thing to check is if all buttons, encoders, and sliders are working properly. The other important thing to check is the LEDs.

Step #2

The first time you connect your Synthia to the PC, you'll hear Spencer's voice (if you are new here and don't know who Spencer is, that is our DIY voice assistant!).

Spencer will congrats you on your success and guide you through the first check so you won't be able to miss anything.

However, we wanted to make a written trail so you can follow this as well.

Step #3

The first thing you'll have to check are the pushbuttons. You'll have to **push each one of them**, and if they're working properly, **the green light should light up** under them.

Everything is working? Amazing!

Now you have to **click on encoders and rotate them a bit**. If the encoders are working, you should see **the LEDs lightning up on the LED matrix depending on where you are positioned on the matrix.**

And for the end, you have to **check the sliders.** You do that simply by **sliding them up and down**, and if everything is okay, **the LEDs on the side of them will turn on one by one.**

After you check everything, Spencer will let you know everything is alright! Click on the encoder and you can hear Spencer saying "**Spencer out!**".

Now you are sure everything is soldered properly, you are ready to assemble the Synthia's casing.

Chapter three - Casing up

If you came here, your device successfully passed the hardware test!

That means you are on track to becoming a professional maker!

Now, we need to use the two acrylic casings to protect the PCB and make your device look more professional.

For this part, these parts will be the main ones.

Each acrylic casing part has a protective layer on both sides that needs to be peeled off. They are not yet fully transparent, but they should be once you finish this step!

Remember to peel the protective layer from both sides of the casings!

After you peeled off everything, this is what the casings should look like:

We chose to put the upper casing first (that is the one with all the holes on it)!

For that, you'll need the bigger screws and the gold standoffs.

As you can see, there are six screws and six standoffs.

You'll place them in the six little holes at the edge of the acrylic casing and PCB.

We recommend you put one screw and one standoff, ensure that everything is secured, and then go to the next screw and standoff.
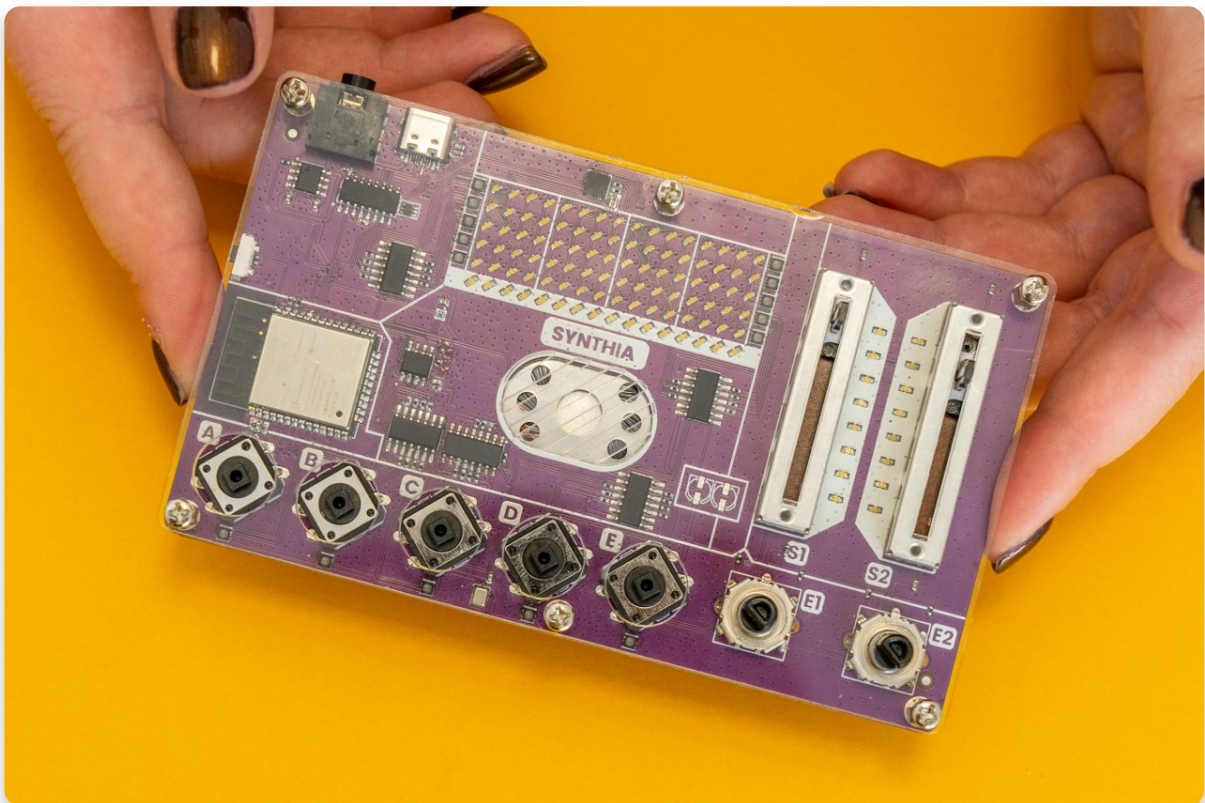
The important thing is to put the screw from the outside of the acrylic casing and the standoff from the inner side.

You'll have to fasten it with your fingers. No tools are needed yet!

Now, do the same thing for all six of them!

This is what you should have at the end!

Put this casing on the front side of the PCB.

Off to use the other acrylic casing!

This is what you'll be working with: the acrylic casing you have left, six standoffs, and six smaller screws.

The process is the same as for the front casing.

Take one screw and one standoff, and fasten it. The screws have to go to the outside of the casing and the standoffs to the inner side.

You'll recognize the sides by the six circles! On the outside, you'll be able to touch the edges of the circle!

Repeat this for all of the six screws and standoffs:

Now, take the PCB and this acrylic casing, and let's connect everything!

Now, take the screwdriver and fasten the screws!

Beware not to screw it too hard because that could lead to the breaking of the casing!

Everything is connected now! Amazing!

Now is the time to put buttons and encoder caps to make your experience smoother.

We'll start with the encoder caps. Those are the two biggest caps from the bag.

Put it right here:

Make sure to push the cap on the encoder until it clicks.

After putting them on the encoders, try to use them a bit to see if everything is put on correctly.

The next thing we'll need is the pushbutton caps.

As for the encoder caps, push them on the button until they click.

Make sure everything works smoothly before going to the next step.

This is what Synthia should look like right now:

The next thing to do is put caps on sliders.

After putting them on, slide them a bit to make sure everything works as it should!

Great job!

We came to the end of the assembly.

The only thing left to do is to put adhesive rubber feet at the bottom of the device to secure it.

These are the parts you'll need:

As you can see, there are white stickers under each of the rubber feet. You'll have to remove the sticker before putting them on the casing.

Stick the sticky side of the rubber feet to the bottom of the device.

This is what Synthia should look like after sticking the rubber feet!

What's next?

Congratulations! You successfully assembled a DIY digital music sampler, Synthia.

The **next thing** you'll have to check is how to use it, **what amazing features we prepared for your, and how to code it**!

We are currently in the process of creating both usage and coding guides, so we'll have to ask you for a bit more patience.

In the meantime, we invite you to join our **Discord channel** and **Facebook group** where you'll be able to share ideas, photos, and feedback with fellow makers and get exclusive news from CircuitMess.